



THE AUSTRALIAN NATIONAL UNIVERSITY

ENSDF analysis and utility codes I

T. Kibèdi (ANU)

Heavy Ion Accelerator Facility, ANU Canberra



NEC 14UD tandem electrostatic accelerator commissioned 1975

HV: up to 15.85 MV

Max beam on target: $\sim 1 \mu\text{A}$

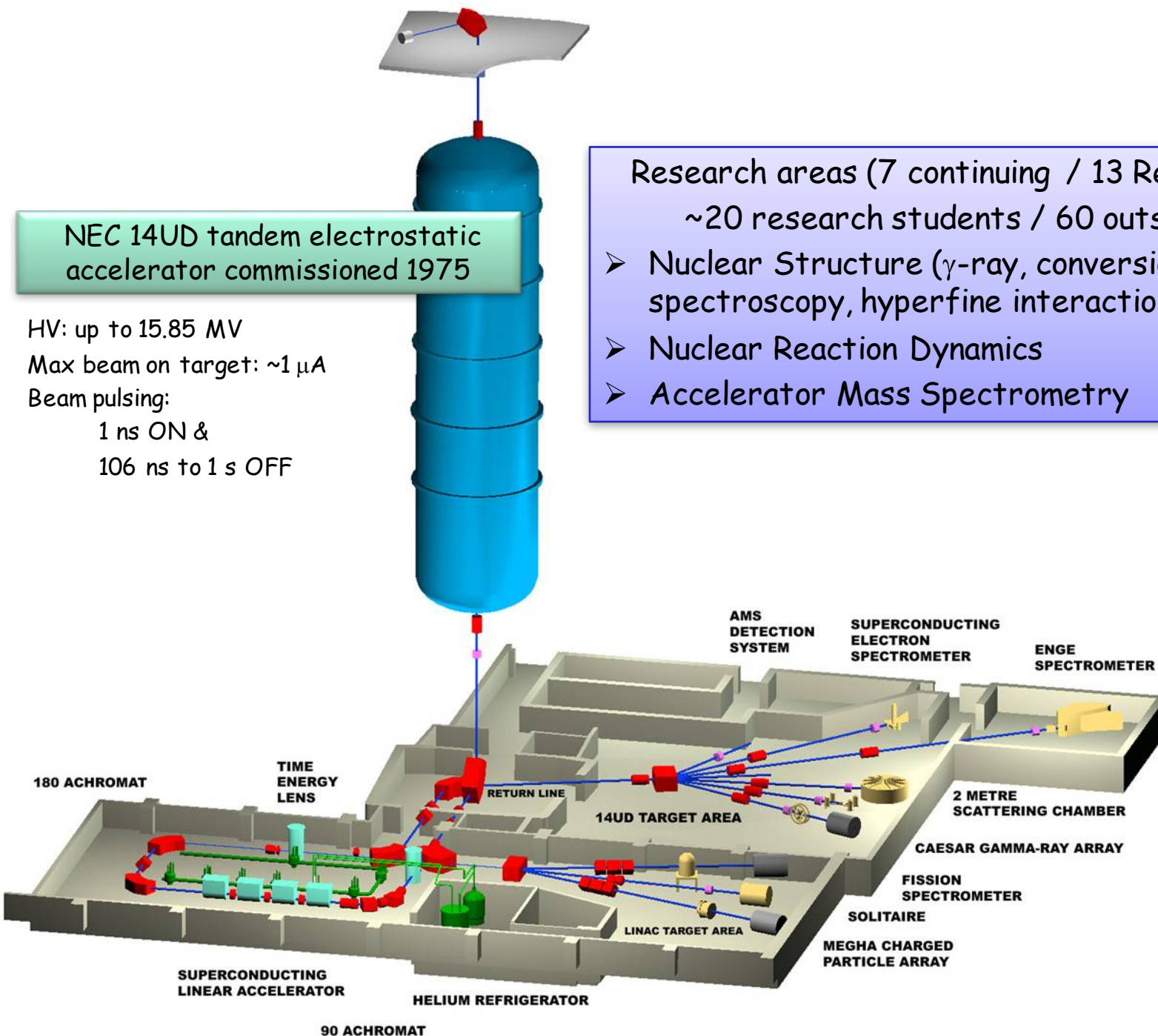
Beam pulsing:

1 ns ON &

106 ns to 1 s OFF

Research areas (7 continuing / 13 Researchers /
~20 research students / 60 outside users)

- Nuclear Structure (γ -ray, conversion electron spectroscopy, hyperfine interactions)
- Nuclear Reaction Dynamics
- Accelerator Mass Spectrometry



ENSDF files & editors

- ❑ ENSDF: 80 character/line (record or card) ASCII (American Standard Code for Information Interchange) file (Jag Tuli's talk on ENSD format)
- ❑ 17 record types: Identification, Normalization, Parent, Q-value, Level, Alpha, Beta, EC+beta+, Gamma, Reference, Cross reference, Delayed Particle, Product normalisation, Special record, History, Atomic Relaxation, End records
- ❑ Fixed length fields: **VALUE** **UNIT** **UNC**
- ❑ Value is given as ASCII string to preserve accuracy reported in the original paper
- ❑ Uncertainty: symmetric, asymmetric, limits, data came from systematics (More on Friday)
- ❑ No ENSDF editor available yet for all platforms

See talks next Tuesday by

-- Elisabeth McCutchan on EVP (Windows)

-- Viktor Zerkhin on web based ENSDF editor

Redit (Windows)
Sergey Lisin (PNPI)

174TM	174ER	B-	DECAY	1991BE04,1989CH05	99NDS	199908
174TM	M	TYP=UPD\$AUT=Tibor Kibedi\$CUT=1-Sep-2015\$				
174TM	M	TYP=FUL\$AUT=E. BROWNE, HUO JUNDE\$CIT=NDS 87, 15 (1999)\$CUT=1-Nov-1998				
174TM	c	Activity produced by bombarding natural tungsten target with [+176]Yb				
174TM2c		(E=1.5 GeV) projectiles (1989Ch05) and [+186]W target with [+136]Xe				
174TM3c		(E=1.577 GeV) projectiles (1991Be04). Mass separated [+174]Er.				
174TM4c		Measured [b(+)], [g-ray energies and intensities, coincidences, Tm				
174TM5c		K-x rays (1991Be04,1989Ch05).				
174TM	c	[+174]Er decay scheme is based on 1991Be04. Direct [b(+)] population				
174TM2c		to levels at 767 and 773 from [+174]Er (Jp=0+) is inconsistent with				
174TM3c		[g-ray decay from these levels to [+174]Tm (Jp=4-) g.s., which				
174TM4c		suggests the existence of a very low-energy level with J<2				
174TM5c		(1991Be04). But 2006Ch10 exclude this conclusion.				
174TM	c	Measured E[b]-1.3 MeV (1989Ch05).				
174TM	cG	E,RI\$From 1991Be04.				
174TM	cG	MS\$From adopted gammas				
174TM	cL	TS\$From adopted levels. Other: 3.3 M 2 (1989Ch05), 3.1 M 3 (1991Be04)				
174TM	cL	US\$From adopted levels				
174TM	DG	CC\$FROM BrIcc v2.3b (16-Dec-2014) 2008Ki07, "Frozen Orbitals" appr.				
174TM	CG	MR\$IF NO VALUE GIVEN IT WAS ASSUMED MR=1.00 FOR E2/M1,				
174TM2CG		MR=1.00 FOR E3/M2 AND MR=0.10 FOR THE OTHER MULTIPOLARITIES				
174ER	P	0.0	0+	3.2 M	2	1.92E3 30
174TM	N	0.114	7	1.0		
174TM	cN	NR\$Assuming no [b(+)] population to levels at 58.5 keV and below, and				
174TM2cN		using I[g(71.7)]g + 100.4]g + 130.4]g + 708.6]g + 714.4 + 766.5]g				
174TM3cN		+ 773.4]g)=100%.				
174TM	PN					
174TM	L	0.0	4-	5.4 M	1	
174TM	L	58.53	17 (2-)			
174TM	G	58.5	2 45	E2 (E2)		25.6 6
174TM3G		LC=19.6 5\$MC=4.81 11				
174TM3G		NC=1.091 24\$OC=0.124 3\$PC=0.0001396 22				
174TM	cG	\$OBSERVED only in a coincidence experiment (1989Ch05). Not observed				
174TM2cG		by 1991Be04 ([I]g<45, estimated from K1 x ray intensities).				
174TM	L	100.40	20 3-			
174TM	G	100.4	2 100	M1		3.07
174TM3G		KC=2.57 4\$LC=0.389 6\$MC=0.0867 14				
174TM3G		NC=0.0203 3\$OC=0.00291 5\$PC=0.0001577 24				
174TM	cG	\$EKC=1.7 (I3) (1991Be04) suggests M1+E2 with MR=1.1 (I+7-4), which				
174TM2cG		disagrees with 2005Ch67 and 2006Ch10				
174TM	cG	\$Other: E[g=100.4 (I2), I[g=100 (I1) (1989Ch05)				

ENSDF codes - typical workflow

Input: ENSDF file



ENSDF code

- Calculation of level energies, level feeding, conversion coefficients, normalization factors,...
- Format and physics checking

New ENSDF file



Most codes running from terminal/command

- Interactive : `fmtchk<cr>`
- Command line: `fmtchk [ENSDF-file]<cr>`

```
MacBook-Pro-2:174Er tibors$ fmtchk
FMTCCHK version 10.4b [30-Jun-2013]

INPUT file (DEF: fmtchk.inp): 174Er.ens
OUTPUT file (DEF: fmtchk.rpt):

Errors only or full report (E, F):
Check continuation cards (Y, N):
Report only fatal errors (N, Y):
Suppress warning messages (N, Y):
Suppress XREF/DSID check (N, Y):

174ER ADOPTED LEVELS, GAMMAS 99NDS 199908
2 error(s) reported
4 warning(s) reported

174ER 9BE(208PB,XG) 2005CA02 200502
1 warning(s) reported

174ER 176VB(136XE,XG) 2006DR04,2009DR06 200907
2 warning(s) reported

Program completed successfully
MacBook-Pro-2:174Er tibors$
```

Calculation report file

```
Program Bricc v2.3 (28-Oct-2011)

Theoretical Dirac-Fock conversion coefficients based on the "Frozen Orbital"
Approximation
ICC data file: C:\Program Files\Bricc\BriccF022.icc
ICC index file: C:\Program Files\Bricc\BriccF022.idx
Average difference between experimental and theoretical ICC: -1.01(12)%
Average difference between interpolated and theoretical ICC: +0.03(3)%
Adopted theoretical uncertainty: 1.4% of the ICC
Minimum CC value to put on G-record: 1.00E-04
Assumed MR value for E2/M1: MR= 1.00
for M3/E2, E4/M3, M5/E4, M2/E1, M4/E3, E5/M4: MR= 0.10
for E3/M2: MR= 1.00

Input ENSDF file: br-ec-decay_20040914.ens
Processed on: 18:33:44 28-Oct-2011
Operating system: MacOS

1: 7LI 7BE EC DECAY 2002T110 02NP 200302
58: 7LI G 477.6035 20.10 4.4 H1(-E2) 0.20 20 7.3E-7 11
59: 7LI G E from evaluation of 2000H014.
60: 7LI G MR from measured [a value (1964K84)]
61: 7LI G CC measured value (1964K84). Theoretical value interpolated
62: 7LI2G from tables of 1976B063 are 7.73x10(-7) for M1 and 2.96x10(-6)
63: 7LI2G for E2.
```

NOTE: Some codes use special input files

Running ENSDF codes on the web

- ☐ ENSDF file uploaded to IAEA server
- ☐ No local program installation is required
- ☐ See Viktor Zerkin's talk on next Tuesday

Running ENSDF Codes on Web

by V.Zerkin, IAEA-NDS, 2011-2016 (ver.2016-06-28)

[News, updates, versions, history](#)

Request #16

User: Tibor Access level=1

Project: tmp15

Uploading... Remote file: <https://localhost/exfor/x4guide/ensdf/radlst.inp>

Your input: 56Kb (56587 bytes)

...Ensdf file... Total: 697 lines (extended to L=80: 2 lines)

...Nuclide: **205Tl**

...See: your file: 205Tl.ens-00, working file: 205Tl.ens. ENSDF: [text](#), [ensdf+](#), [ensdf±](#), [edit](#)

...End of work: remove files and close this project → [clean](#)

☐ [Run utilities](#)

Programs, parameters, run, results	Timeout: 600 sec	Your Files [refresh]	Sort by: [name] [extension]
		[length] [time]	
Checking and utility codes			
(1) FMTCHK Checking ENSDF format /10.3e+, 15-Dec-2015/		✗ 205Tl.ens-00	56,587 2016/
(2) chk_ENSDF Total ENSDF checker /v-0.4.7, 10-Apr-2014/		✗ 205Tl.ens	56,457 2016/
PNPI checking codes (see [page])			
(3) chk_PARENT Checking PARENT-records in DECAY datasets /24-Jan-2009/		✗ 205Tl.ens.radlst.ENSDF.RPT	18,084 2016/
(4) chk_brackets Pair brackets checker from ENSDF-format files /20-Apr-2012/		✗ 205Tl.ens.radlst.err	0 2016/
		✗ 205Tl.ens.radlst.inp	19 2016/
		✗ 205Tl.ens.radlst.RADLST.INP	56,457 2016/
		✗ 205Tl.ens.radlst.RADLST.RPT	99,608 2016/
		✗ 205Tl.ens.radlst.tt	2,741 2016/
Total files: 8, length: 289953 bytes			
Analysis codes			
(7) ALPHAD Alpha Hinderance Factor Program (AHF, AHFYE, ALPHAD) /v-2.0a, 06-Nov-2006/			
(8) BrIcc calculates conversion coefficients and E0 electronic factors /v2.3b, 16-Dec-2014/			
(9) BrIccMixing calculates Mixing Ratio (MR) and Normalization Factor (R) /v2.3b, 16-Dec-2014/			
(10) GABS Gamma-ray absolute intensity and normalization calculation /v-11.0, 02-Apr-2015/			
(11) GTOL Determines level energies from a least-squares fit to E _γ 's & feedings /v-7.2h, 24-May-2013/			
(12) LOGFT Calculates log ft for beta decay /v-7.2, 7-Feb-2001/			
(13) PANDORA Checks physics of ENSDF files /v-7.0b, 01-May-2007/			
(14) RADLST calculates the nuclear and atomic radiations associated with the radioactive decay /v-5.5, 05-Oct-1988/			
The program RADLST (Radiation Listing) is designed to calculate the nuclear and atomic radiations associated with the radioactive decay of nucleus. It uses as its primary input nuclear decay data in the ENSDF format. By T.W.Burrows Brookhaven National Laboratory. See [manual]			
Input File: 205Tl.ens			
<input checked="" type="checkbox"/> Output Radiation Listing			
<input type="checkbox"/> Output ENDF-like File			
<input type="checkbox"/> Output File For Nudat			
<input type="checkbox"/> Output Mird Listing			
<input type="checkbox"/> Calculate Continua			

Platforms, programming languages & compilers

- ❑ Supported platforms: Windows, Linux and MacOS
- ❑ Programming languages: FORTRAN 77, FORTRAN 95, Java, Python
- ❑ FORTRAN compilers
 - GFORTRAN: freely available at <https://gcc.gnu.org/wiki/GFortran>
 - Windows users download the "MinGW native windows" binary packages using the MinGW installation manager; add "C:\MinGW\bin" to the path
 - Linux and MacOS users follow the instructions on the <https://gcc.gnu.org/wiki/GFortranBinaries>
 - Intel FORTRAN: not free; USD ~400 (academic) at <https://software.intel.com/en-us/fortran-compilers>
 - Free student licenses at: <https://software.intel.com/en-us/qualify-for-free-software/student>
 - Windows: integrated with MS Visual Studio
 - Linux & MacOS: use makefiles
- 👉 Optional exercise: compile FMTCHK using GFORTRAN

Obtaining ENSDF codes

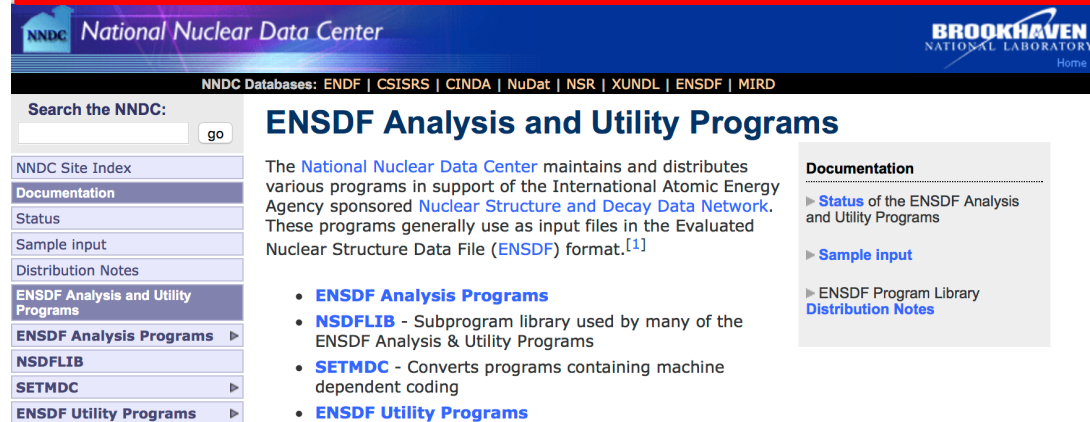
❑ Source codes

Looking the source code could be helpful to resolve problems!

Error messages not always sufficiently clear

- ❑ Executables for Windows/Linux/MacOS
- ❑ ReadMe files / pdf manuals
- ❑ Sample input & output files

http://www.nndc.bnl.gov/nndcscr/ensdf_pgm/



National Nuclear Data Center

NNDC Databases: ENSDF | CSISRS | CINDA | NuDat | NSR | XUNDL | ENSDF | MIRD

Search the NNDC: go

ENSDF Analysis and Utility Programs

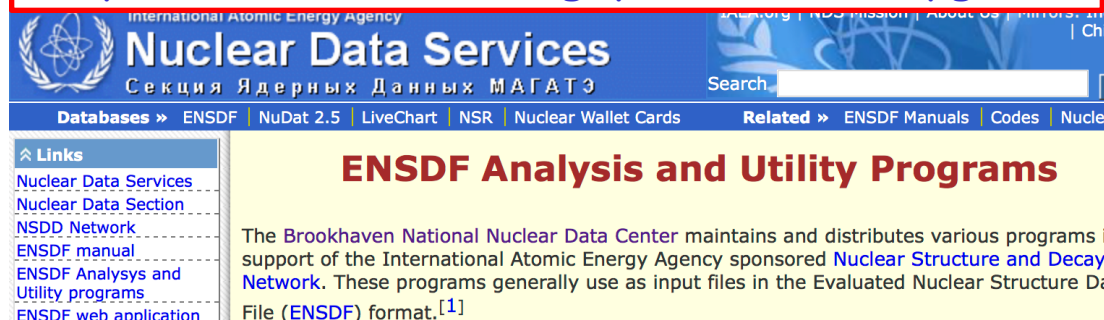
The National Nuclear Data Center maintains and distributes various programs in support of the International Atomic Energy Agency sponsored Nuclear Structure and Decay Data Network. These programs generally use as input files in the Evaluated Nuclear Structure Data File (ENSDF) format.^[1]

- **ENSDF Analysis Programs**
- **NSDFLIB** - Subprogram library used by many of the ENSDF Analysis & Utility Programs
- **SETMDC** - Converts programs containing machine dependent coding
- **ENSDF Utility Programs**

Documentation

- **Status** of the ENSDF Analysis and Utility Programs
- **Sample input**
- ENSDF Program Library
- **Distribution Notes**

https://www-nds.iaea.org/public/ensdf_pgm/



International Atomic Energy Agency

Nuclear Data Services

Секция Ядерных Данных МАГАТЭ

Databases » ENSDF | NuDat 2.5 | LiveChart | NSR | Nuclear Wallet Cards | Related » ENSDF Manuals | Codes | Nuclear Data

ENSDF Analysis and Utility Programs

The Brookhaven National Nuclear Data Center maintains and distributes various programs in support of the International Atomic Energy Agency sponsored Nuclear Structure and Decay Network. These programs generally use as input files in the Evaluated Nuclear Structure Data File (ENSDF) format.^[1]

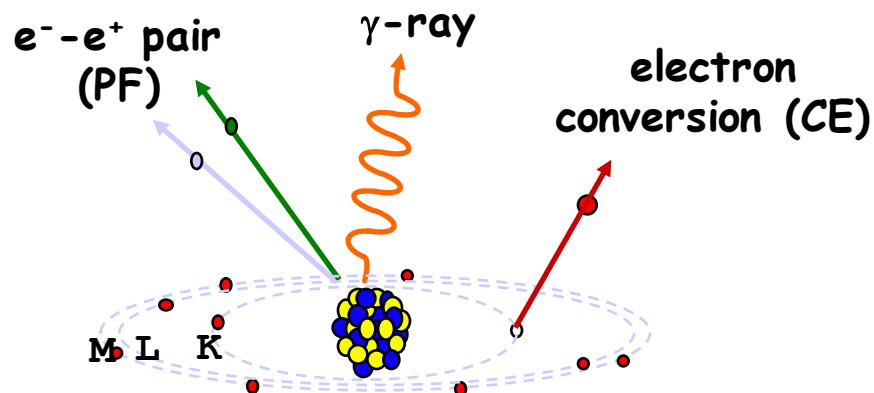
Links

- Nuclear Data Services
- Nuclear Data Section
- NSDD Network
- ENSDF manual
- ENSDF Analysis and Utility programs
- ENSDF web application

For alpha decay calculates the theoretical $T_{1/2}(\alpha)$'s and R_0 's to deduce the hindrance factor.

- Hindrance factor: $T_{1/2}(\text{exp})/T_{1/2}(\text{calc})$; typically between 1 and $3E4$
- Theoretical α -decay half life derived from a simple model. Alpha particle contained inside the nucleus by a potential barrier at $r=R_0$
- R_0 can be specified in the ENSDF input file; use the **radD** code to calculate R_0 for odd-odd and odd-mass nuclei
- Language: FORTRAN77, updated to FORTRAN90
- Documentation: [readme-alphad.pdf](#)
- Input ENSDF file: [alphad.inp](#)
- Calculation report: [alphad.rpt](#)
- Output ENSDF file: [alphad.new](#)
- [alphad_new](#): combines alphad and radD; need to be tested

Electromagnetic Decay Processes



EM decay: energy and momentum carried away

Energetics

Gamma $E_\gamma = E_i - E_f + T_r$

CE $E_{CE,i} = E_i - E_f - E_{BE,i} + T_r$

PF $E^+ + E^- = E_i - E_f - 2m_0c^2 + T_r$

Selection rules (πL)

$$|L-j_i| \lesssim j_f \lesssim L+j_i$$

$$\pi = (-1)^L \quad \text{for EL}$$

$$\pi = (-1)^{L+1} \quad \text{for ML}$$

Transition probability

$$\lambda_T = \lambda_\gamma + \lambda_K + \lambda_L + \lambda_M + \dots + \lambda_{PF}$$

Conversion coefficient

$$\alpha_{CE,PF} = \lambda_{CE,PF} / \lambda_\gamma$$

$$\lambda_{CE,PF} = \lambda_\gamma \times \alpha_{CE,PF}$$

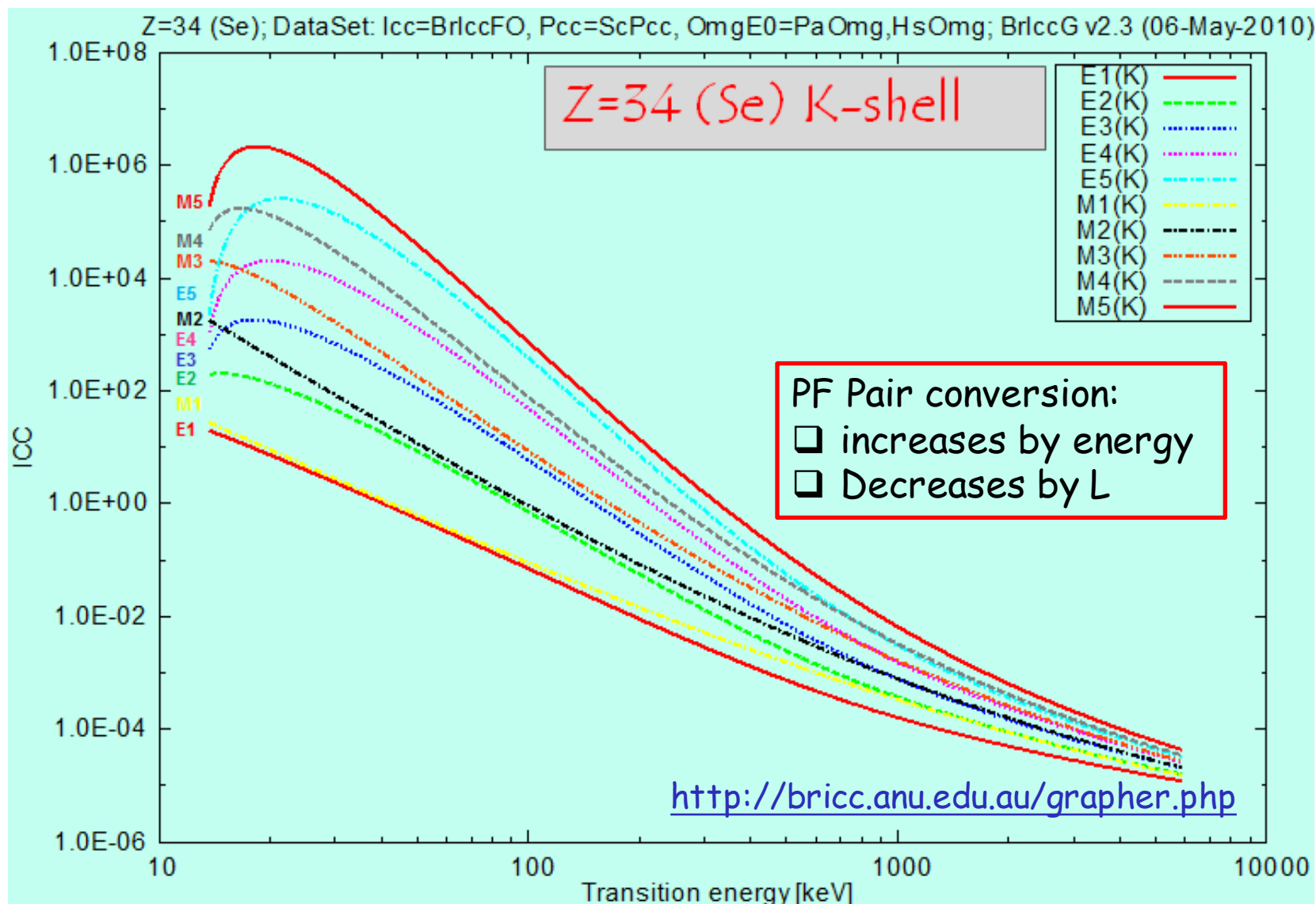
E0 transitions:

$$j_i = j_f$$

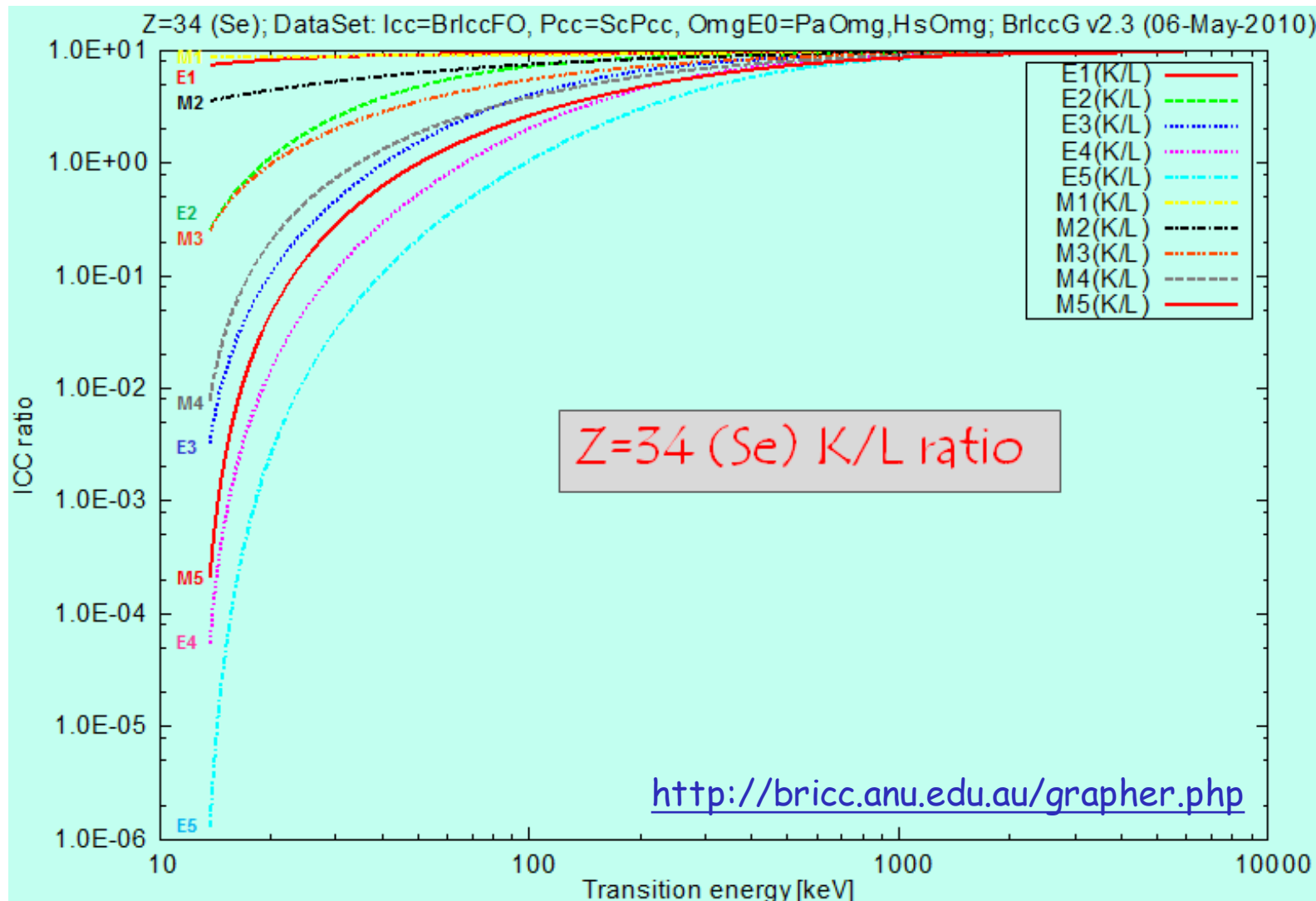
No single photon emission is allowed!

Conversion coefficient is not defined

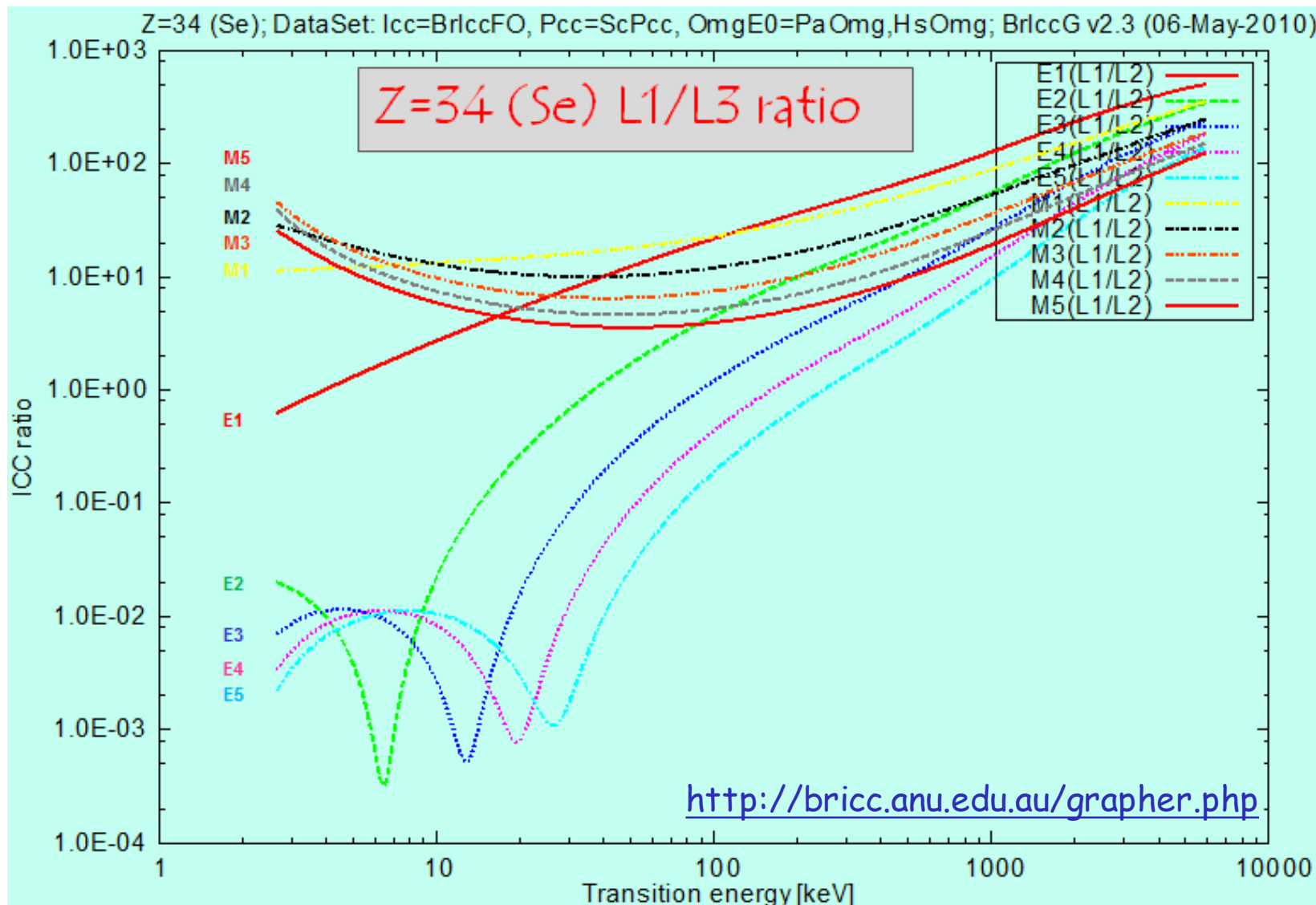
$$\lambda_{CE,PF} = \rho^2(E0) \times \Omega_{CE,PF}$$



ICC - shell dependence



ICC - shell dependence



Mixed Transitions

	$\Delta\pi=+1$		$\Delta\pi=-1$	
πL	M1	M3	E1	E3
$\pi' L'$	E2	E4	M2	M4

Mixing ratio (MR)

$$\delta^2(\pi' L' / \pi L) = \frac{\lambda_\gamma(\pi' L')}{\lambda_\gamma(\pi L)}$$

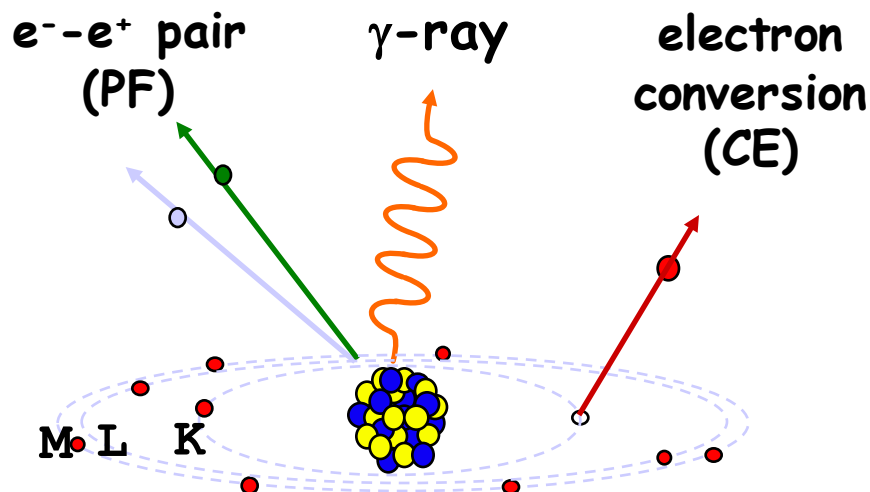
Conversion coefficient for CE and PF

$$\alpha(\pi' L' / \pi L) = \frac{\alpha(\pi L) + \delta^2 \alpha(\pi' L')}{1 + \delta^2}$$

Special cases of mixed transitions with 3 multipolarities

- ❑ 184W 536.674(15) keV E1+M2+E3, ME(M2/E1)=+0.070(6), MR(E3/M2)=-0.025(4), $\lambda=-2.1(2)$; very few known cases; none of the codes can handle two MR
- ❑ M1+E2+E0: more common, not discussed here

Theoretical conversion coefficients



α_{CE} : 2002Ba85 Band et al.
2008Ki07 Kibedi et al.
2012Ki04 Kibedi et al.

α_{PF} : 1979Sc31 Schluter et al.
1996Ho21 Hofman et al.

Ω_{CE} : 1969Ha61 Hager-Seltzer
1970Be87 Bell et al.
1986PaZM Passoja et al.

Use BrIcc to obtain values by interpolation

Energetics of CE-decay

$$E_i - E_f = E_{CE,i} + E_{BE,i} + T_r$$

Transition probability

$$\lambda_T = \lambda_\gamma + \lambda_K + \lambda_L + \lambda_M + \dots + \lambda_{PF}$$

Conversion coefficient

$$\alpha_{CE,PF} = \lambda_{CE,PF} / \lambda_\gamma$$

$$\lambda_{CE,PF} = \lambda_\gamma \times \alpha_{CE,PF}$$

E0 transitions:

$$j_i = j_f$$

No single photon emission is allowed!
Conversion coefficient is not defined

$$\lambda_{CE,PF} = \rho(E0) \times \Omega_{CE,PF}$$

Calculates Band-Raman Internal Coefficients for gamma-rays based on atomic number, gamma-ray energy, multipolarity, mixing ratio and atomic shell

- Language: FORTRAN90
- Documentation: [BrIcc.pdf](#)
- Data files: [BrIccFO.idx](#), [BrIccFO.icc](#), [BrIccNH.idx](#), [BrIccNH.icc](#)
- Installation: Compressed archive (Linux&MacOS); installer package (Windows)
- "[BrIccHome](#)" environment variable to find data files
- HsIcc (Hager and Seltzer Internal ICC) used for older (pre ~2009) datasets
- Step_1: generates new cards
- Input ENSDF file: [myFile.ens](#)
- Calculation report: [BrIcc.lst](#)
- New ENSDF records: [Card.new](#)
- Old/new card comparison report: [Compar.lst](#)
- Step_2: merge (delete/replace/insert) new cards to ENSDF file
- Output ENSDF file: [cards.new](#)

More on today afternoon practice session

BrIccMixing — Calculates multipole mixing ratios from internal conversion coefficients, ratios of internal conversion coefficients and multipole mixing ratios

- Language: FORTRAN90; uses GnuPlot for plotting
- Documentation: **BrIccMixing.pdf**; sign convention: 1970Kr14
- Data files: BrIcc & Gnuplot (<http://www.gnuplot.info>) need to be installed
- Installation: Compressed archive (Linux&MacOS); installer package (Windows)
- Input ASCII file: **myFile.in**
- Calculation report: **BrIccMixing.lst**
- GnuPlot script and data file for each data set

More on today afternoon practice session

Conversion coefficient for CE and PF

$$\alpha(\pi' L' / \pi L) = \frac{\alpha(\pi L) + \delta^2 \alpha(\pi' L')}{1 + \delta^2}$$

ENSDF Analysis - DELTA

Analyses angular correlation and conversion coefficient data, and calculates the best values of mixing ratios

Language: FORTRAN77

- Documentation: [readdelt.me](#)
- Installation: executable
- Input ASCII file: [delta.dat](#)
- Calculation report: [delta.rpt](#)

Replaced by BrIccMixing

Calculates absolute gamma-transition intensities and decay scheme normalization factors NR for converting relative decay intensities to absolute intensities per 100 decays

Language: FORTRAN77 updated using FORTRAN90

- Documentation: [Gabs-Manual.pdf](#);
1986Br21 E. Browne, Calculated Uncertainties of Absolute gamma-ray Intensities and Decay Branching Ratios Derived from Decay Schemes, Nucl. Instr. Meth. A249 (1986) 462
- Installation: executable
- Input ENSDF file: [myEnsdf.in](#) (a minimum of one transition going to g.s. need to be marked)
- Calculation report: [myEnsdf.rpt](#)
- Output ENSDF file: [myENSDF.new](#)

More on today afternoon practice session

ENSDF Analysis - JGAMUT

Tool to create ADOPTED dataset by combining gamma-ray energies and intensities from different input data sets. Two ways of taking input gamma-ray energy and intensity measurements and producing adopted values.

Language: java

- Documentation: [jgamutManual.pdf](#)
- Installation: executable
- Input ENSDF file: [myEnsdf.in](#) (a minimum of one transition going to g.s. need to be marked)
- Calculation report: [myEnsdf.rpt](#)
- Output ENSDF file: [myENSDF.new](#)

More on today afternoon practice session (ask Balraj)

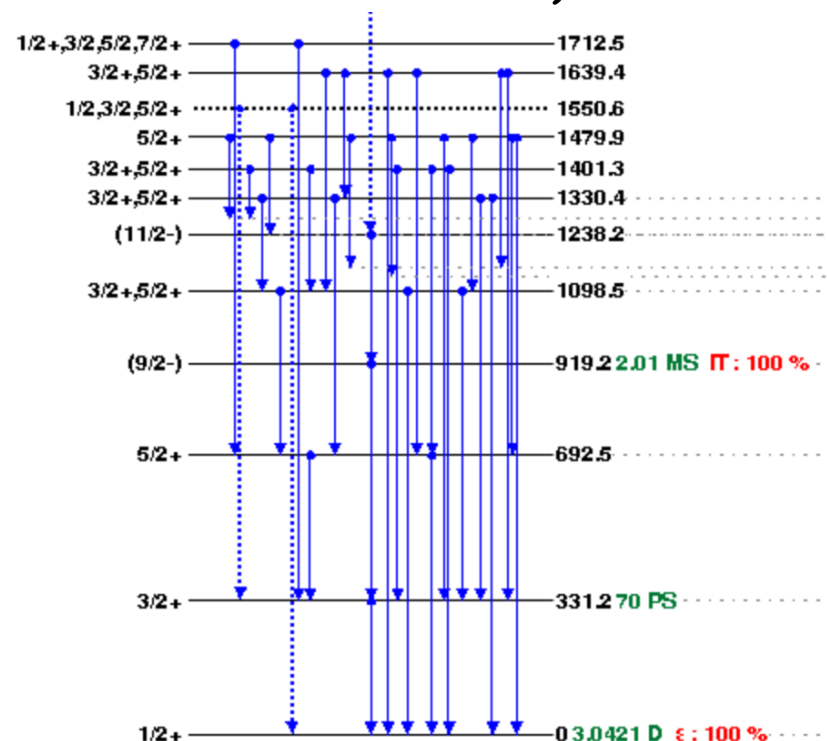
ENSDF Analysis - GTOL

Tool to perform a least-squares fit to the gamma-energies to obtain level energies and to calculate the net feedings to levels.

Language: FORTRAN77 converted to FORTRAN90

- Documentation: [readme-gtol-2.pdf](#)
- Installation: executable
- Input ENSDF file: [gtol.inp](#) (special commands to control execution)
- Calculation report: [gtol.rpt](#)
- Output ENSDF file: [gtol.out](#)

More on today afternoon practice session



Tool to calculate

- logft for beta decay
- partial capture fractions for electron capture decay
- electron capture to positron ratio for positron decay
- Average β -ray energies

Language: FORTRAN77 converted to FORTRAN90

- Documentation: readmelogft.me
- Installation: executable; radial wave function data: [LOGFT.DAT](#)
- Input ENSDF file: [data.tst](#)
- Calculation report: [logft.rpt](#)
- Output ENSDF file: [logft.new](#)

More on today afternoon practice session

Tool to carry out physics checking on ENSDF datasets

- Decay data sets, other than IT and SF decays have a P-card and vice versa
- An L-record with $T_{1/2} > 0.1$ sec should have MS FLAG
- Consistency of spin/parity of levels with multipolarity connecting transitions
- For a transfer reaction with even-even target $J=L\pm 1/2$
- β -decay: log ft, J_i , J_f , parity change
- α -decay: HF, J_i , J_f parity change
- Levels out of order

Language: FORTRAN77 converted to FORTRAN90

- Documentation: [readmepandora.pdf](#)
- Installation: executable
- Input ENSDF file: [pandora.inp](#)
- Several output files: [pandora.err](#), [pandora.gam](#), [pandora.gle](#), [pandora.lev](#),
[pandora.rad](#), [pandora.rep](#), [pandora.xrf](#)
- Output ENSDF file: [pandora.out](#)

More on today afternoon practice session

ENSDF Analysis - RADLIST

Calculates the nuclear and atomic radiations associated with the radioactive decay of nuclei:

- β^+ , β^- , ε decay
- α decay
- γ -rays, conversion electrons, electron-positron pairs
- X-rays and Auger electrons

Language: FORTRAN77

- Documentation: [readme-pandora.pdf](#); [radlistdoc.pdf](#) (description of physics)
- Installation: executable; atomic mass data [RADMAS.DAT](#); atomic data [MEDNEW.DAT](#)
- Input ENSDF file: [radlist.inp](#)
- Several output files: [radlist1.out](#), [radlist2.out](#), [radlist3.out](#), [radlist4.out](#), [radlist5.out](#)

Code is not maintained, replacement (BrIccEmis) under development (Friday)

Use myEnsdf at <https://www-nds.iaea.org/exfor/myensdf.htm>

Calculates

- reduced electromagnetic transition strengths and compares these to the Recommended Upper Limits (RUL)
- $BE\lambda$ and $BM\lambda$
 - Language: FORTRAN77
 - Documentation: [ruler.pdf](#), [readme-ruler.pdf](#); [Ruler-NewFeatures.pdf](#)
 - Installation: executable
 - Input ENSDF file: [ruler.inp](#)
 - Output files: (a) [ruler1.rpt](#), (b) [ruler2.rpt](#)

More on today afternoon practice session

Code is not maintained, replacement
under development

Recommended Upper Limits RUL

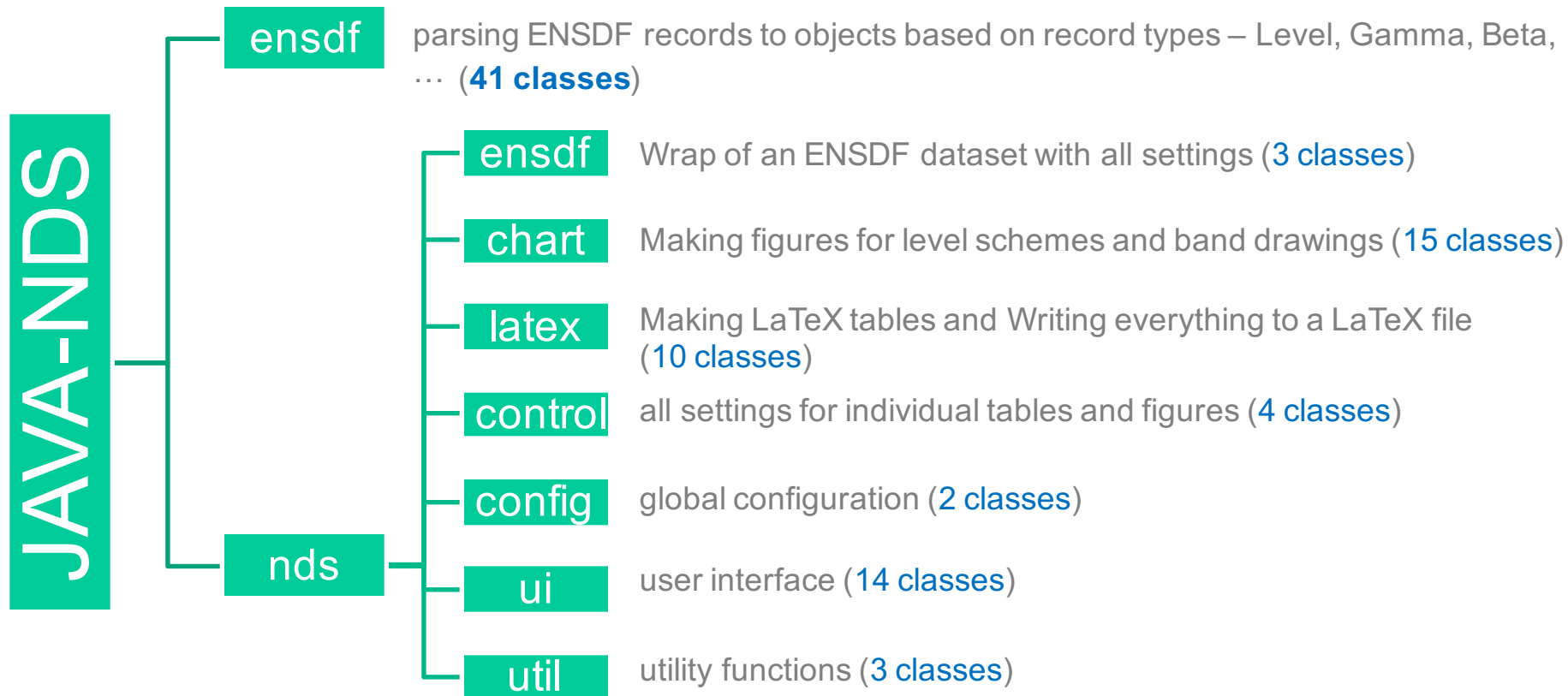
Character*	Γ_γ/Γ_w (Upper Limit)		
	A=6-44 ^{a,s}	A=45-150 ^{b,c}	A>150 ^d
E1 (IV)	0.3 [#]	0.01	0.01
E2 (IS) ^e	100	300	1000
E3	100	100	100
E4	100	100 [†]	
M1 (IV)	10	3	2
M2 (IV)	3	1	1
M3 (IV)	10	10	10
M4		30	10

Adds gamma transitions to the adopted dataset when all gamma's come from one data set

- Language: FORTRAN 77
- Documentation: readaddg.me
- Installation: executable
- Input1: ADOPTED data set; sample: **ADDGAML.DAT**
- Input2: A decay/reaction data set with gammas to be added;
Sample: **ADDGAMG.DAT**
- Output: Merged dataset; sample: **ADDGAM.NEW**
- The relative intensities (RI) will be scaled, so the strongest gamma will be 100
- If only one gamma coming from the level, no uncertainty in RI given; DRI=0
- If gammas come from more than one data set but are non-overlapping, the program may be run successively with different gamma data sets as input; care should be taken to merge intensities correctly!
- Use jGAMUT

Calculates the average value and uncertainty of a set of experimental data using 5 different statistical methods

- Language: FORTRAN90
- Documentation: [AveTools.pdf](#)
- Installation: Compressed archive (Linux&MacOS); installer package (Windows)
- Input ASCII file: [AveTools.in](#)
- Output: [Avetools.rpt](#)
- V.AveLib - alternative code in java; next talk by Balraj Singh` s on Averaging methods



Nuclear Data Sheets for A=209*

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Nuclear Data Sheets for A = 209* NDS-PUB

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Cutoff Date: Literature available in NSR database up to September 30, 2013 has been included.

General Policies and Organization of Material: see <http://www.nndc.bnl.gov/nds/NDSPolicies.pdf>.

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Courtesy of Jun Chen, NSCL/MSU

Code to generate ENSDF file from data stored in Excel

- Language: Python 2.7.6 ONLY!
- Installation: compressed archive of Python script, documentation and sample input; requires xldr Python module

- ❑ Codes are for you to do your work, but you need to understand how they work and how to drive. Knowledge in programming is useful, but not essential
- ❑ ENSDF codes written by evaluators and tested by evaluators. Give feedback if you notice problems, unexpected behaviors
- ❑ Always run FMTCHK to verify that the input ENSDF file has no errors
- ❑ Observe the messages on the terminal console and in the report files
- ❑ Error messages may not be sufficient to solve problems. Look into the source code if available
- ❑ Some codes create new ENSDF files under different name. Check the new ones before overwriting the old ones
- ❑ IAEA action to replace old codes with new ones: jGamut, java_NDS, v.AveLib are already out