Workflow of ENSDF evaluation with ENSDF Java codes

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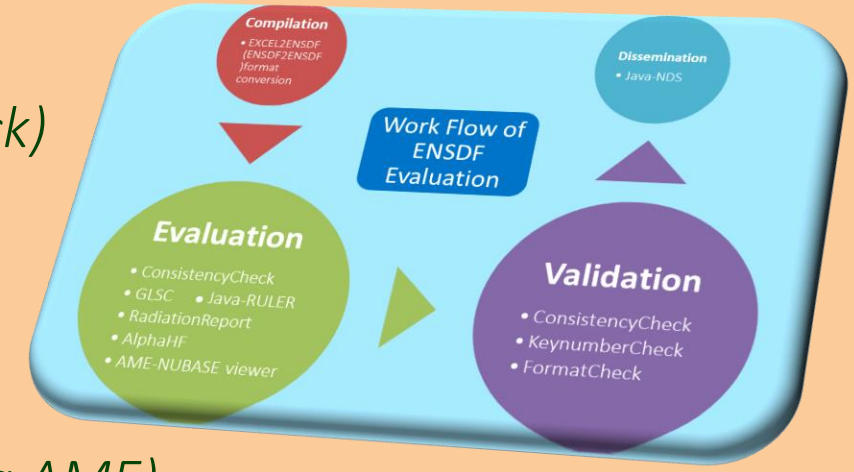
ENSDF code development and modernization at FRIB

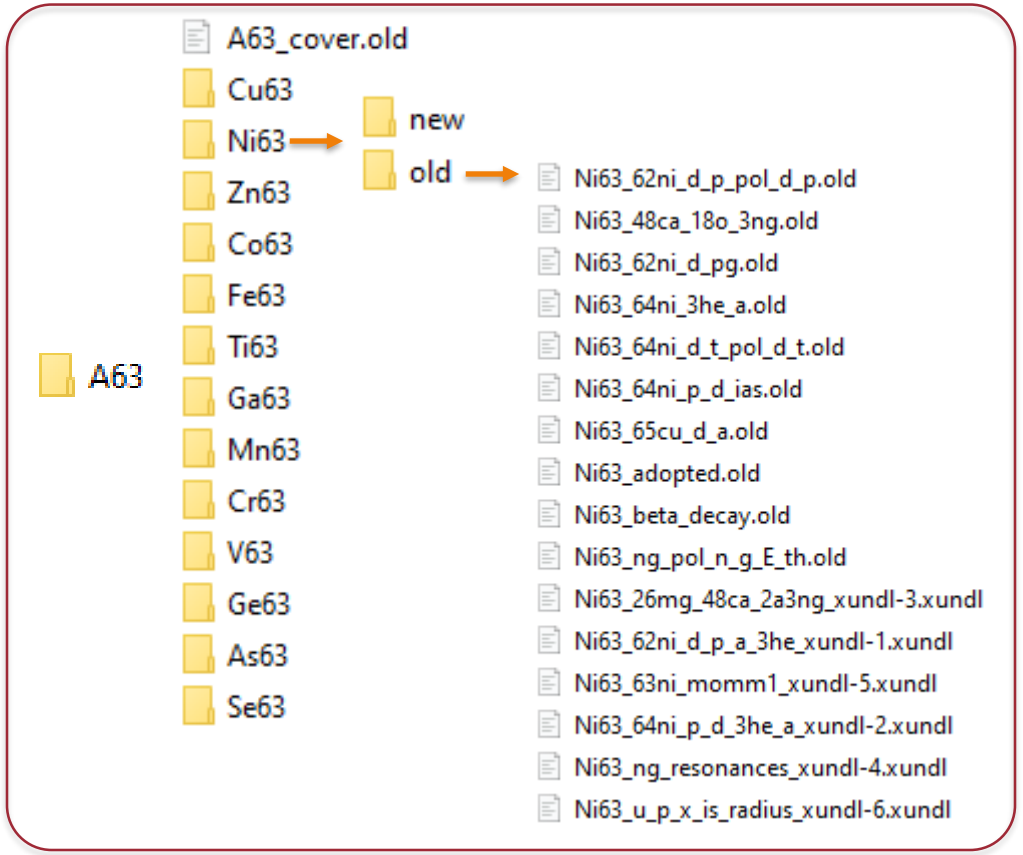
To streamline and automate evaluation process, ensure evaluation quality and improve evaluation efficiency

- *McMaster-MSU Java-NDS (constantly improved)*
- *ConsistencyCheck* NEW feature *(add format and keynumber check)*
- *KeynumberCheck (included in ConsistencyCheck)*
- *Java-RULER* NEW improvement *(improved B(XL) calculator tool)*
- *Excel2ENSDF* NEW improvement *(improved operations on records)*
- *AME-NUBASE viewer* NEW improvement *(improved calculator tool using AME)*
- *GLSC (Gamma to Level Scheme Computation: GTOL+GABS)* NEW improvement *(output with new E(level), %IB, %IG for decay)*
- *RadiationReport (LOGFT+RADLIST)* NEW feature *(added calculators for logft from feeding or vice-versa)*
- *AlphaHF (ALPHAD+RadD)*
- *FormatCheck* NEW *(same checking function is also included in ConsistencyCheck)*



Setup of an ENSDF mass-chain evaluation

Setup | Compilation | Evaluation | Validation | Dissemination



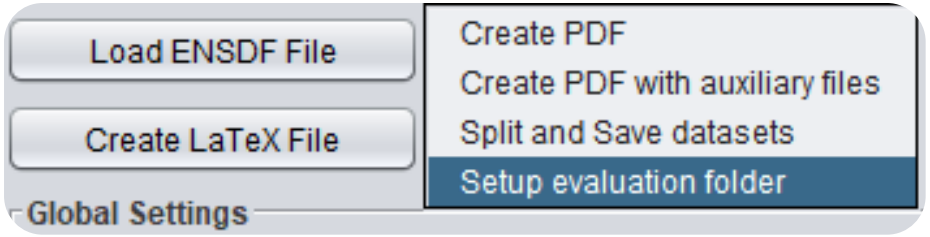
Automatic setup of evaluation folders and datasets

Step 1: download all A=63 datasets from ENSDF database as A63.old

Step 2: load A63.old into ***Java-NDS***

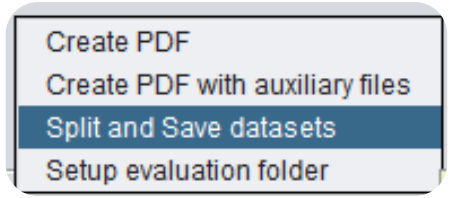
Step 3: choose a directory for A63 evaluation folder

Step 4: right-click on a blank area and click “setup evaluation folder” in the popup



Repeat for XUNDL datasets

Or, simply split the whole mass chain to files of individual datasets in one folder



Compilation: converting tabulated data to ENSDF

Setup | **Compilation** | Evaluation | Validation | Dissemination

Step 1: scan data tables in a paper using
a commercial OCR like ABBYY FineReader or a free OCR like Tabula
Save data into a Excel file

E_i[#] (keV)	E_γ (keV)	$I_i \rightarrow I_f$	I_γ[†]	R_{DCO}	Δ_{asym}	$\delta_{E2/M1}$	$E\lambda/M\lambda$
708.7 (1)	708.7 (1)	$2^+ \rightarrow 0^+$	100.0 (5.2)	1.02 (10)[a]	0.12 (1)	-	$E2$
1391.4 (2)	682.4 (3)	$2^+ \rightarrow 2^+$	9.28 (47)	0.96 (11)[b]	-0.07 (3)	2.5	$M1+E2$
	1391.2[⊕] (5)	$2^+ \rightarrow 0^+$	0.12 (3)	-	-	-	-
1483.5 (2)	774.8 (1)	$4^+ \rightarrow 2^+$	84.7 (86)	0.98 (9)[b]	0.14 (1)	-	$E2$
1794.6 (2)	310.9 (3)	$3^+ \rightarrow 4^+$	0.91 (13)	0.63 (8)[b]	0.09 (5)	3.0	$M1+E2$

Data table in the pdf of a paper

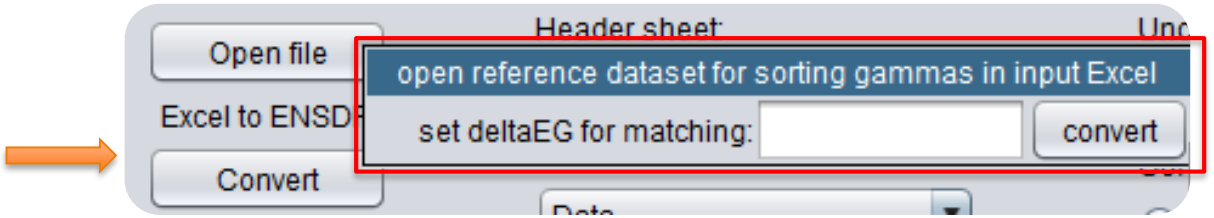
OCR & reformat

Excel table ready for conversion

	A	B	C	D	E	F	G	H	I	J	K	L
1	EL	EG	*JPI*	*JF*	RI	DCO	*POL*	MR	*MUL*	GFLAG	LFLAG	BAND
2	708.7 (1)	708.7 (1)	2+	0+	100.0 (52)	1.02 (10)	0.12 (1)		*E2*	A		M
3	1391.4 (2)	682.4 (3)	2+	2+	9.28 (47)	0.96 (11)	-0.07 (3)	2.5	*M1+E2*	B		R
4		1391.2(5)	2+	0+	0.12 (3)					I		R
5	1483.5 (2)	774.8 (1)	4+	2+	84.7 (86)	0.98 (9)	0.14 (1)		*E2*	B		M
6	1794.6 (2)	310.9 (3)	3+	4+	0.91 (13)	0.63 (8)	0.09 (5)	3.0	*M1+E2*	B		U
7		403.1 (3)	3+	2+	0.78 (8)	0.56 (8)	0.16 (9)		*M1+E2*	B		U
8		1086.1 (2)	3+	2+	4.11 (42)	0.82 (10)	0.04 (2)	0.29	*M1+E2*	B		U

Step 2: edit and format the Excel table (rename column) for ***Excel2ENSDF*** to read

Step 3: load the Excel table into the ***Excel2ENSDF***



Step 4: if E(level) are not given, load a reference dataset (e.g., adopted from ENSDF) for level matching

Right-click on "Open"

Open a reference dataset for matching and placing gammas in input Excel file with no levels being given

Step 5: convert it to an ENSDF-format dataset file
default output: ***output.ens***

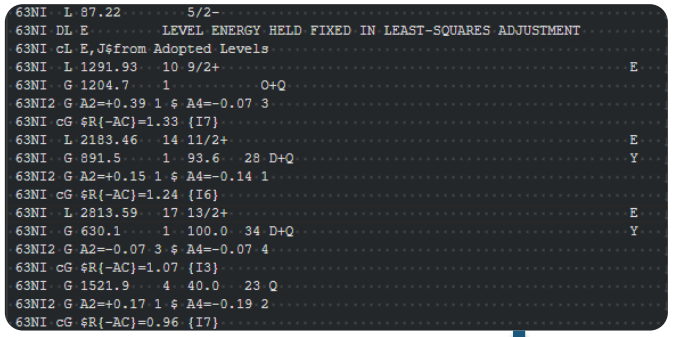
Compilation: editing/merging ENSDF data with Excel

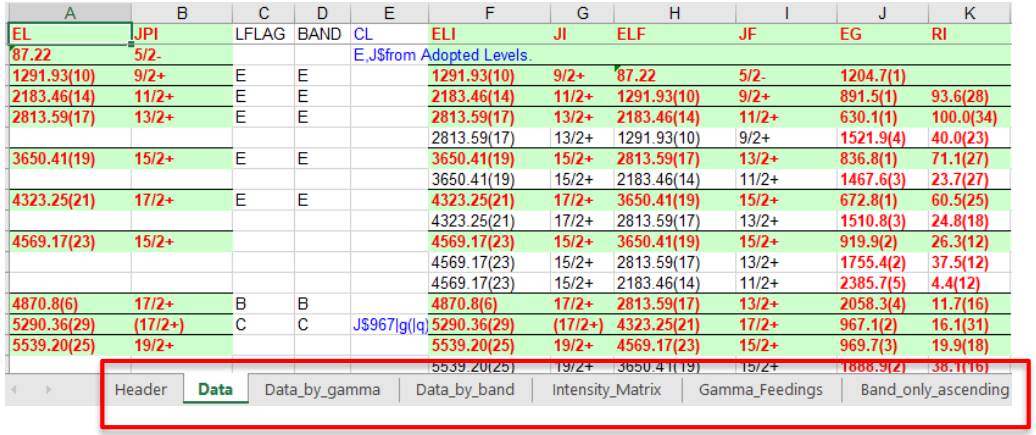
Setup | **Compilation** | Evaluation | Validation | Dissemination

Excel2ENSDF also reads an ENSDF dataset and converts it to an Excel table

ENSDF to Excel

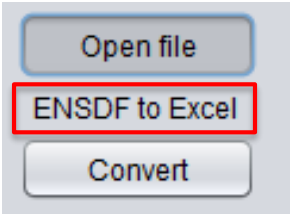
Just load the ENSDF dataset and it will automatically recognize it.





A	B	C	D	E	F	G	H	I	J	K
EL	JPI	LFLAG	BAND	CL	ELI	JI	ELF	JF	EG	RI
87.22	5/2-			E,J$from Adopted Levels.						
1291.93(10)	9/2+	E	E		1291.93(10)	9/2+	87.22	5/2-	1204.7(1)	
2183.46(14)	11/2+	E	E		2183.46(14)	11/2+	1291.93(10)	9/2+	891.5(1)	93.6(28)
2813.59(17)	13/2+	E	E		2813.59(17)	13/2+	2183.46(14)	11/2+	630.1(1)	100.0(34)
					2813.59(17)	13/2+	1291.93(10)	9/2+	1521.9(4)	40.0(23)
3650.41(19)	15/2+	E	E		3650.41(19)	15/2+	2813.59(17)	13/2+	836.8(1)	71.1(27)
					3650.41(19)	15/2+	2183.46(14)	11/2+	1467.6(3)	23.7(27)
4323.25(21)	17/2+	E	E		4323.25(21)	17/2+	3650.41(19)	15/2+	672.8(1)	60.5(25)
					4323.25(21)	17/2+	2813.59(17)	13/2+	1510.8(3)	24.8(18)
4569.17(23)	15/2+				4569.17(23)	15/2+	3650.41(19)	15/2+	919.9(2)	26.3(12)
					4569.17(23)	15/2+	2813.59(17)	13/2+	1755.4(2)	37.5(12)
					4569.17(23)	15/2+	2183.46(14)	11/2+	2385.7(5)	4.4(12)
4870.8(6)	17/2+	B	B		4870.8(6)	17/2+	2813.59(17)	13/2+	2058.3(4)	11.7(16)
5290.36(29)	(17/2+)	C	C	J$967|g(|q)	5290.36(29)	(17/2+)	4323.25(21)	17/2+	967.1(2)	16.1(31)
5539.20(25)	19/2+				5539.20(25)	19/2+	4569.17(23)	15/2+	969.7(3)	19.9(18)
					5539.20(25)	19/2+	3650.41(19)	15/2+	1888.9(2)	38.1(16)

Header | Data | Data_by_gamma | Data_by_band | Intensity_Matrix | Gamma_Feedings | Band_only_ascending



label after an ENSDF is loaded

Default output: ***output.xls***

- Includes everything from the dataset: data values and comments
- Can be converted back (~100%) to the original ENSDF dataset

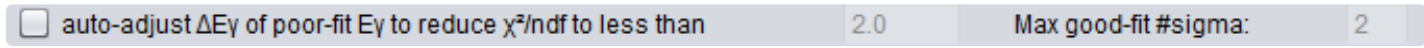
- ❑ Extracts ENSDF data into tabulated data for different uses
- ❑ Enables side-by-side (column) comparison and check for values of different datasets, e.g., gamma-ray energies, intensities
- ❑ Enables flexible and fast data editing with Excel,
  e.g., to remove (add) values of a record, simply delete (insert) its column in Excel then convert the table back to ENSDF

Evaluation: a least-squares fit to Eγ values

Setup | Compilation | **Evaluation** | Validation | Dissemination

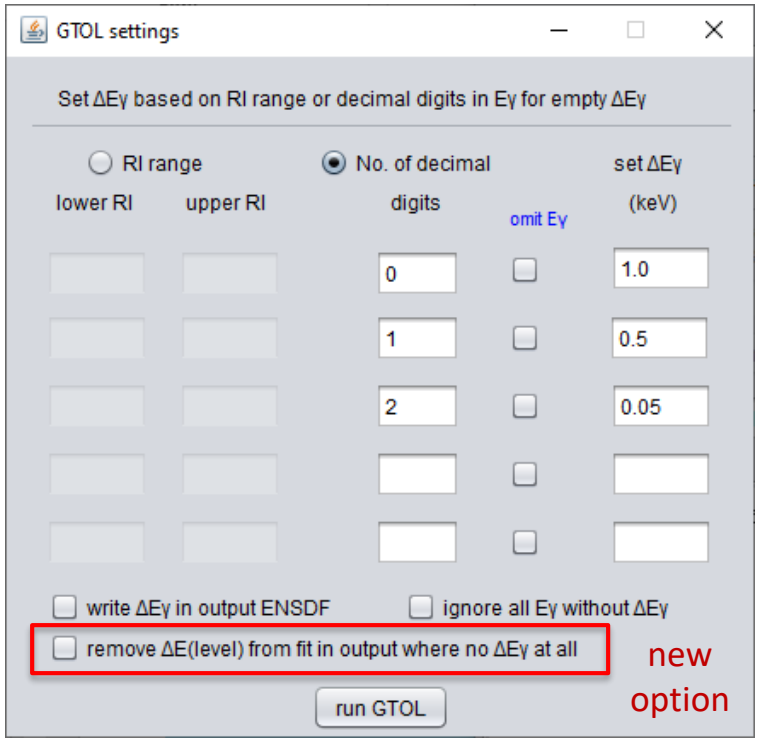
GLSC *(Gamma To Level Scheme Computation)* computes E(level) based on input Eγ values and uncertainties and it uses assumed uncertainties if not given.

Provides an option for auto-adjustment of ΔEγ of poor-fitted (Eγ, ΔEγ) pairs



In GLSC main window

In GLSC main window



- Customized settings of ΔEγ if not explicitly given
- New option for removing ΔE(level) in the output, if there is not any full path of (Eγ, ΔEγ) pairs connected to a fixed level (e.g., ground state)
  (this is determined by the code)

  A simple case: all decaying and feeding gammas has no ΔEγ

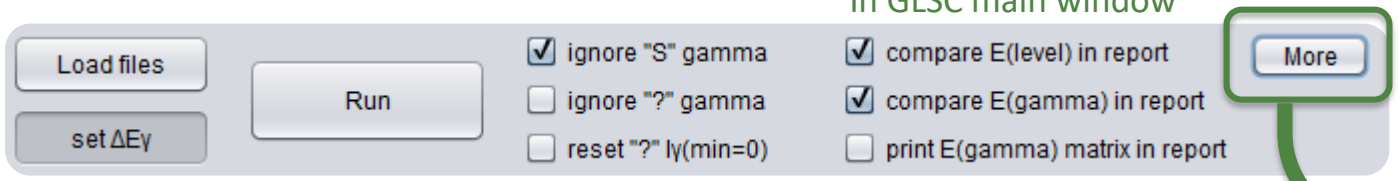
Evaluation: new E(level), %Iβ, %Iγ in one output

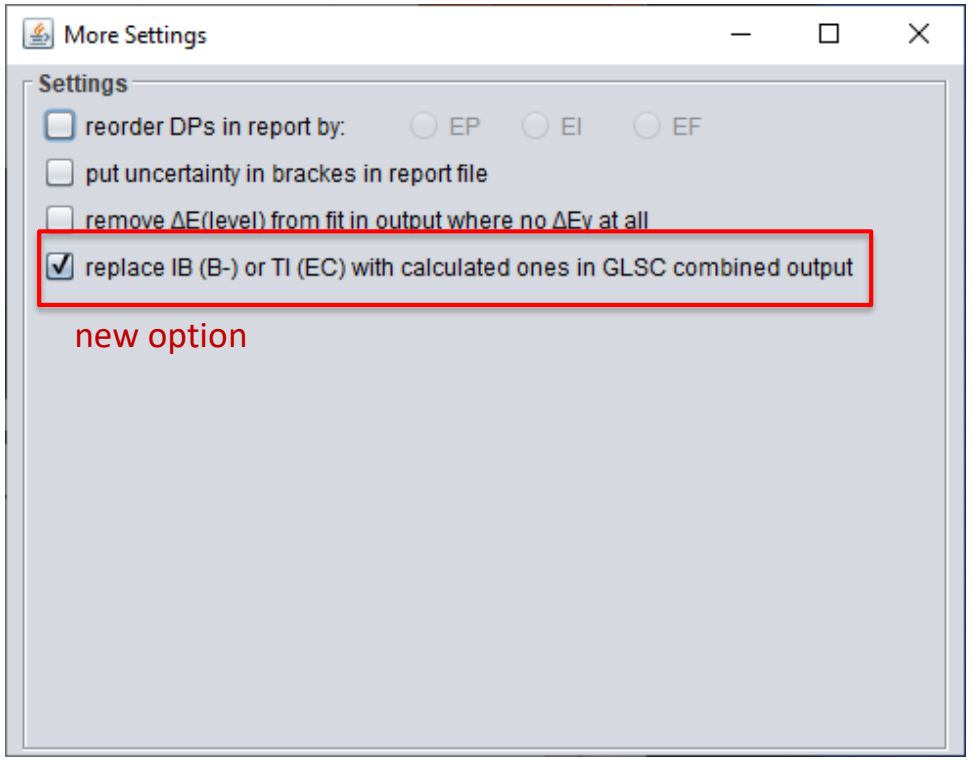
Setup | Compilation | **Evaluation** | Validation | Dissemination

GLSC also computes Iγ normalization, level feedings (%Iβ) based on I(γ+ce) intensity balances, and %Iγ for decay datasets.

Provides an option for making an output combining E(level) from fitting, computed %Iβ (in IB record or TI for EC) and %Iγ (in %IG continuation record) in one run

In GLSC main window





- One run gets and combines GTOL+GABS results in one output output file: ***GLSC_combined.out***
- Computed %Iβ is simply from I(γ+ce) intensity balance and will overwrite the existing value and uncertainty. It must be checked and verified the new value and uncertainty are not unexpected (e.g., numbers, uncertainty format) before adopting them.

  Particularly, g.s. feeding, which might be expected to be obtained differently.

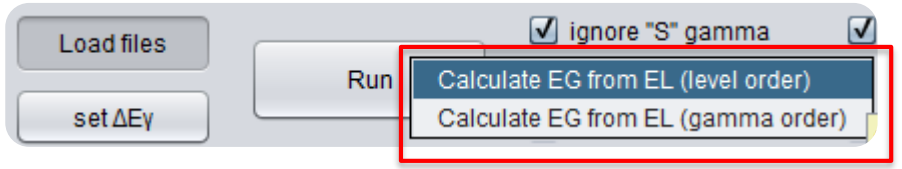
Evaluation: a tool to get Eγ from level-energy difference

Setup | Compilation | **Evaluation** | Validation | Dissemination

Scenarios when Eγ needs to be calculated from level-energy difference:

- ❑ All E(level) values are precise with uncertainties but Eγ values are rounded numbers. All Eγ should be re-calculated from level-energy difference
- ❑ Some Eγ values are precise with uncertainties and some are rounded numbers. E(level) can be obtained from a fit to those precise Eγ values. Those rounded Eγ values should be re-calculated from level-energy difference

GLSC has a tool to calculate Eγ with no uncertainty from level-energy difference between its initial and final level energies if they have uncertainties.



In ***GLSC*** main window, right click "Run" button to get the popup

Output files:

calcEG.rpt: contains all details about each gamma

Gamma energies calculated from level-energy differences (ordered by EL)

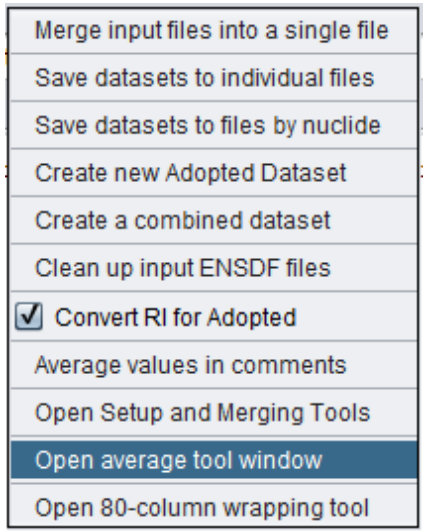
##Gamma	EG(calc)	EG(input)	diff.	RI	EI	EF	JI	JF	MULT	FLAGS
#1	29.656 8	29.66 1	-0.00	420 36	29.656 8	0.0	5/2+	5/2−	E1	d
#2	4.260 11	4.251	0.01		33.916 8	29.656 8	7/2+	5/2+		
#3	33.916 8	33.91 1	0.01	81 8	33.916 8	0.0	7/2+	5/2−	E1	d
#4	24.623 12	24.63 1	-0.01		58.539 9	33.916 8	9/2+	7/2+	M1+E2	bd
#5	28.883 12	28.88 1	0.00		58.539 9	29.656 8	9/2+	5/2+	E2	bd
#6	20.140 14	20.19 3	-0.05		78.679 10	58.539 9	7/2−	9/2+	E1	bX
#7	44.763 13	44.77 2	-0.01	29 7	78.679 10	33.916 8	7/2−	7/2+	E1	d
#8	49.023 13	49.02 2	0.00		78.679 10	29.656 8	7/2−	5/2+	E1	bd
#9	78.679 10	78.67 2	0.01	35 4	78.679 10	0.0	7/2−	5/2−	E2(+M1)	d
#10	67.379 23	67.37 2	0.01	11.9 14	125.918 21	58.539 9	11/2+	9/2+	M1+E2	d
#11	92.002 23	92.05 7	-0.05	5.0 15	125.918 21	33.916 8	11/2+	7/2+	[E2]	x

calcEG.out: a new dataset with new Eγ from level-energy difference (**only those Eγ values with no uncertainties are overwritten**).

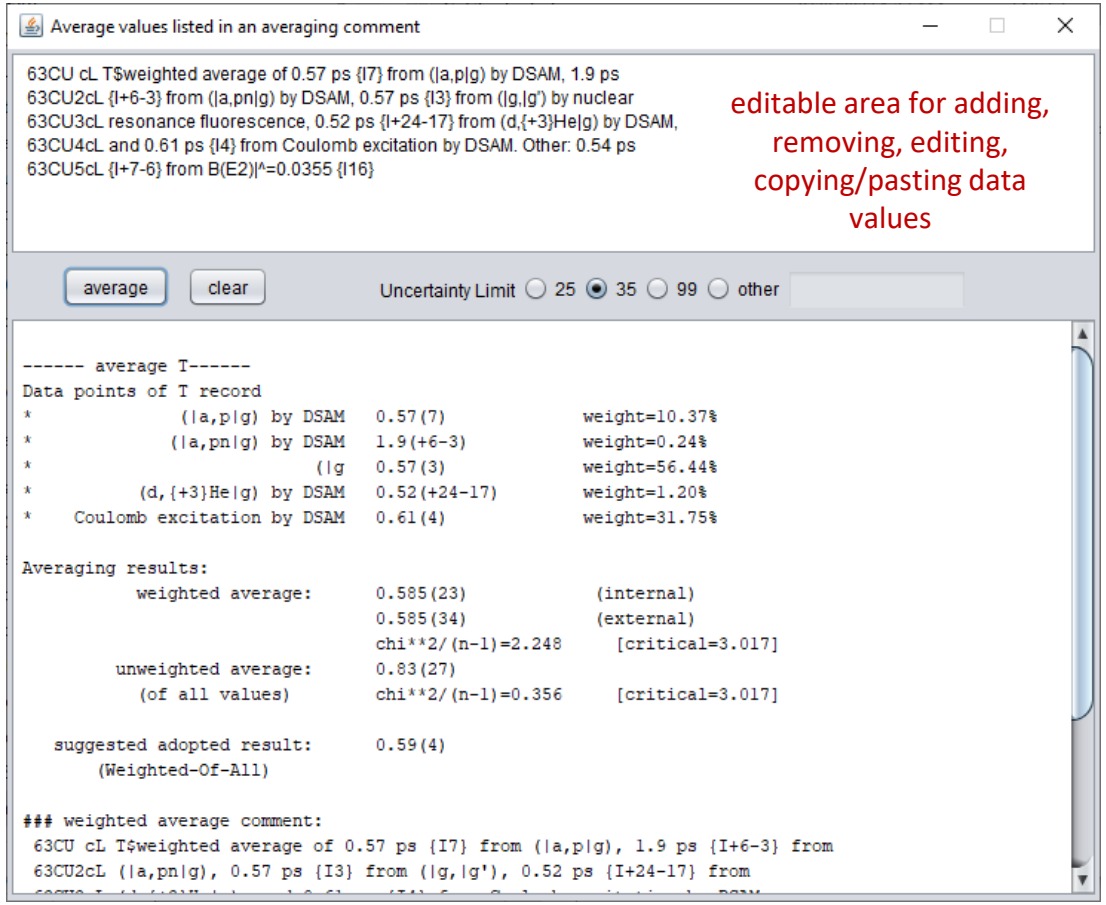
Evaluation: a tool to average values in comments

Setup | Compilation | **Evaluation** | Validation | Dissemination

ConsistencyCheck has a handy tool for extracting data values in an ENSDF comment (or ***any free-format text***) and calculating their average



In ConsistencyCheck main window, right click a blank area to get the popup



- Takes any list of data points separated by “**,**”, “**;**”, or “**and**”, or combination. Each data point is like,
  1.9 ps {I+6-3} or 1.9 ps +6-3

(please let me know if you find a kind of format that can’t be processed)

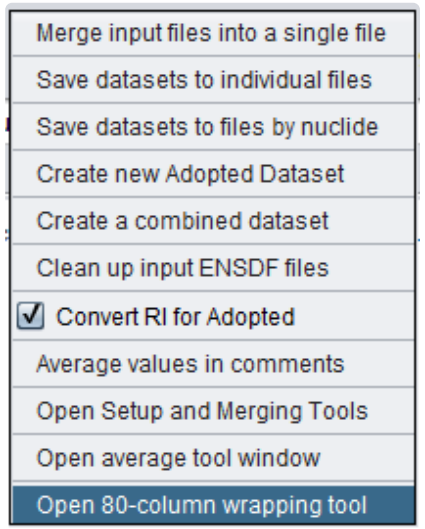
- New option to run V.AveLib and display its results (not default)

  Just right click “average” to get all results

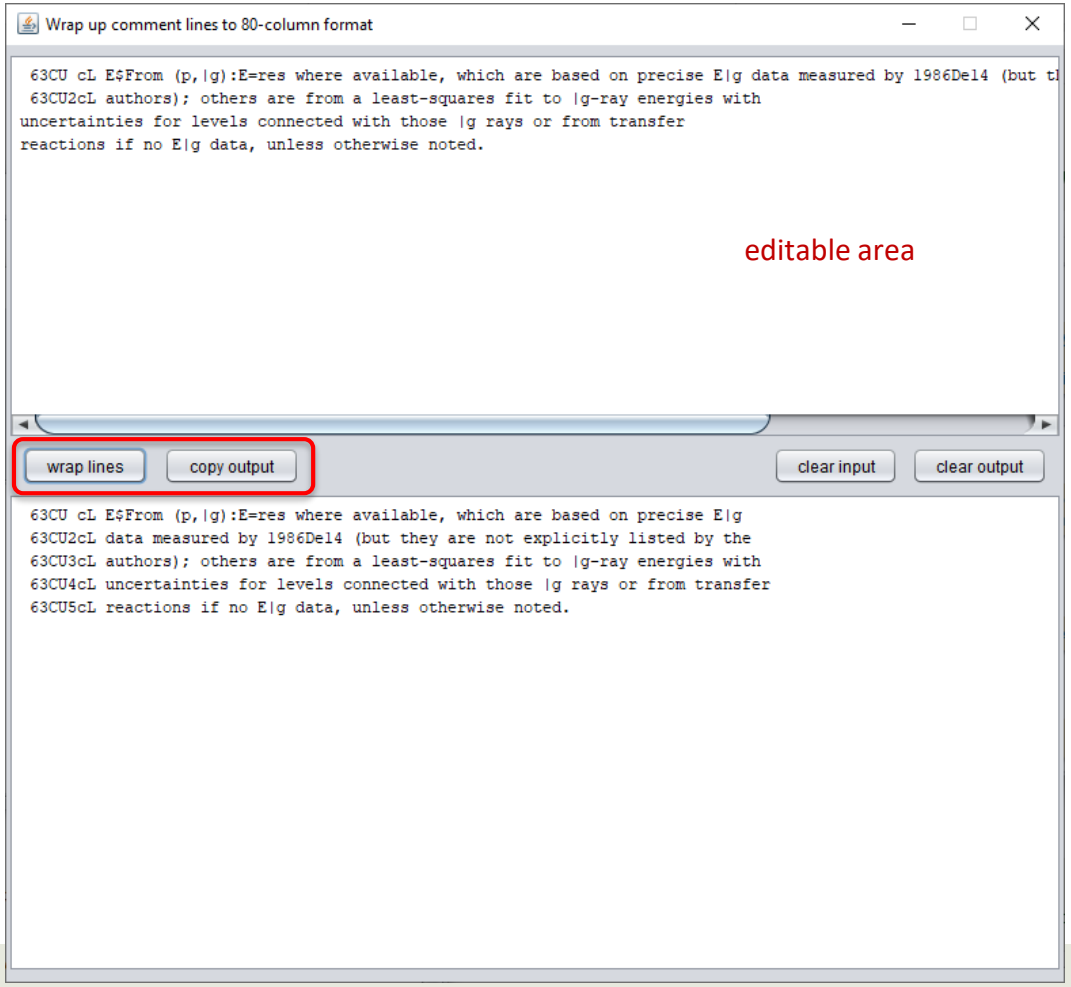
Evaluation: a tool to edit and wrap an ENSDF comment

Setup | Compilation | **Evaluation** | Validation | Dissemination

ConsistencyCheck has a handy tool for editing and wrapping a long ENSDF comment to 80-column format with ease



In ConsistencyCheck main window, right click a blank area to get the popup

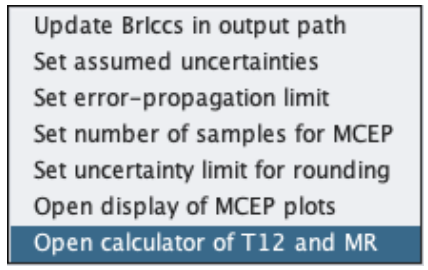


- Useful for editing a long ENSDF comment without worrying about the 80-column limit (when using a text editor)
- New 80-column formatted comment is ready to be copied and pasted back into an ENSDF dataset

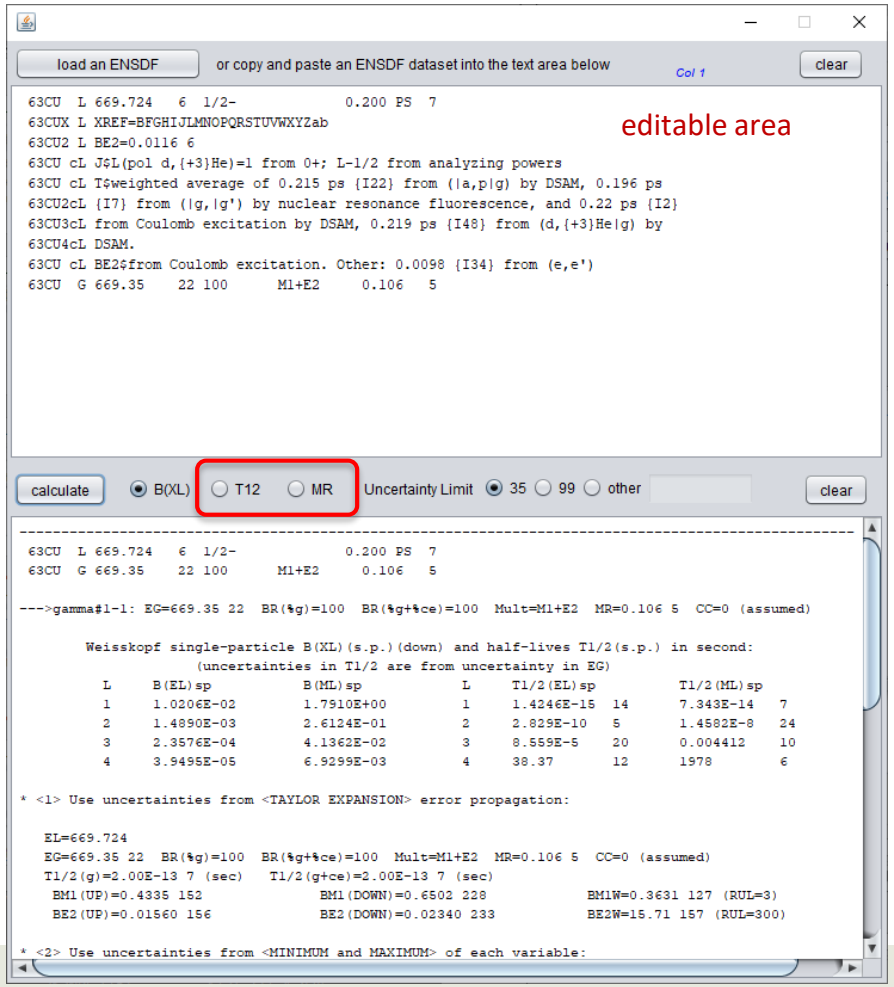
Evaluation: a tool to calculate a single B(XL)

Setup | Compilation | **Evaluation** | Validation | Dissemination

Java-RULER has a handy tool for calculating a single B(XL) based on a part of ENSDF record lines



In Java-RULER main window, right click a blank area to get the popup



- Copy & paste ENSDF lines of a level and its gammas to be calculated for
- It also has options to calculates T1/2 or MR from measured B(XL)
- For calculations based on a B(XL)up value, the record line of its final level is also needed
- New improvement for extracting B(XL) values in comments

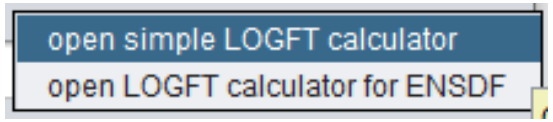
Java-RULER works on an ENSDF dataset to calculate B(XL)(W.u.) values and insert them into the output dataset. This is needed only for the "Adopted Levels, Gammas" dataset

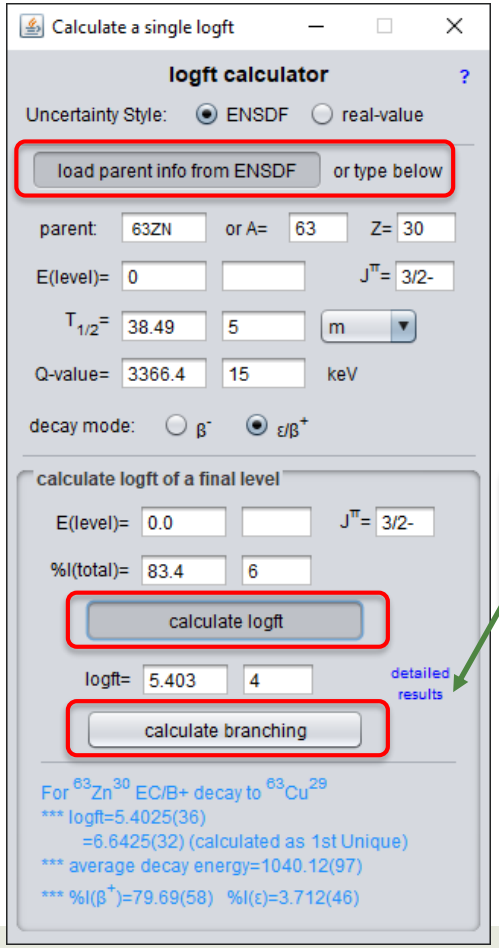
Evaluation: a tool to calculate a single logft (1)

Setup | Compilation | **Evaluation** | Validation | Dissemination

RadiationReport has a new handy tool for calculating a single B(XL) based on a part of ENSDF record lines

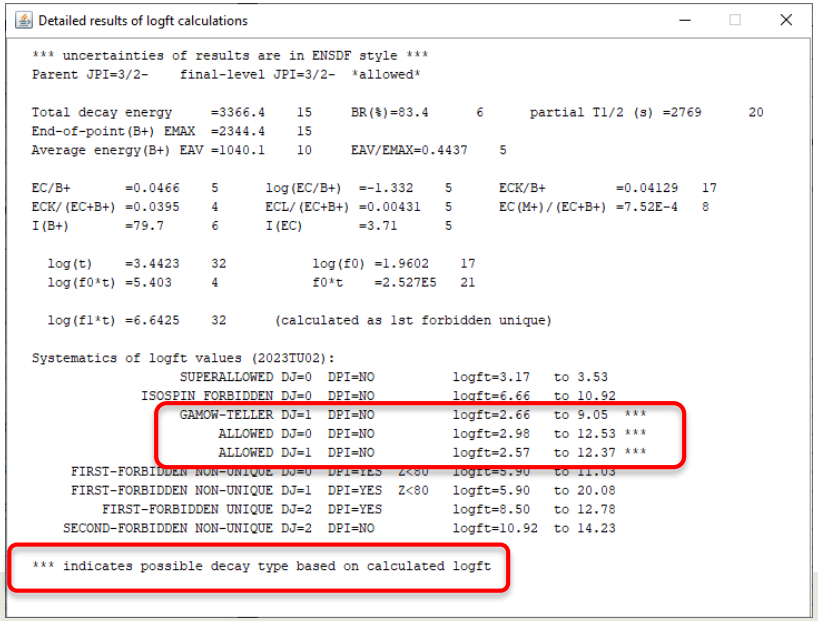
In RadiationReport main window, right click a blank area to get the popup





click here for detailed results

- A simple logft calculator for calculating a single logft based on parent and daughter level data entered manually or loaded from an input dataset
- It can also calculate a beta feeding for a given logft value
- It compares calculated logft with systematics and indicates possible decay types



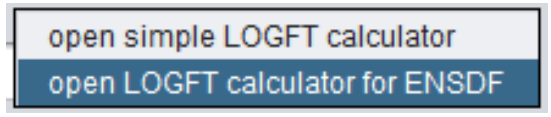
RadiationReport works on an ENSDF decay dataset to calculate all radiations as well as logft values. Note that the recommended program for adopted logft is BetaShape.

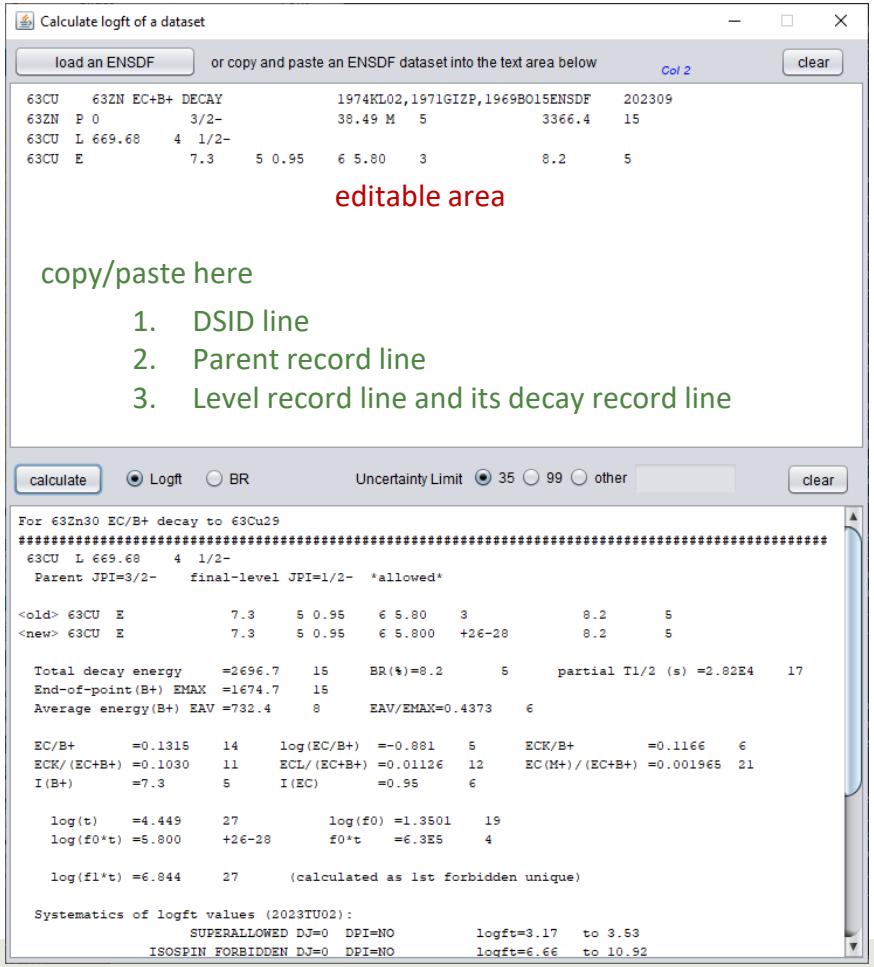
Evaluation: a tool to calculate a single logft (2)

Setup | Compilation | **Evaluation** | Validation | Dissemination

RadiationReport has a new handy tool for calculating a single B(XL) based on a part of ENSDF record lines

In RadiationReport main window, right click a blank area to get the popup





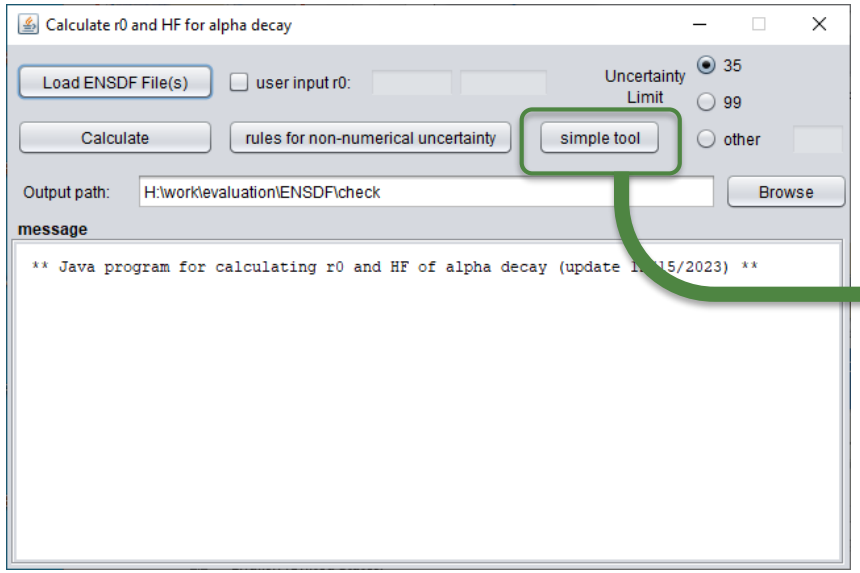
- ❑ Similar to Simple Calculator
- ❑ Easier usage by copy/paste

RadiationReport works on an ENSDF decay dataset to calculate all radiations as well as logft values. Note that the recommended program for adopted logft is BetaShape.

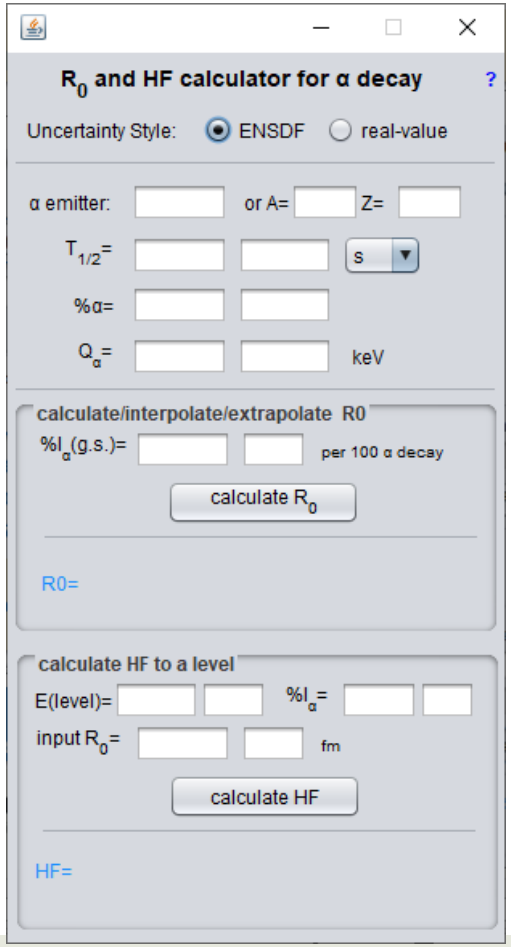
Evaluation: a tool to calculate a single Hindrance Factor

Setup | Compilation | **Evaluation** | Validation | Dissemination

AlphaHF has a handy tool for calculating nuclear radius parameter r_0 or HF for a single alpha-decay branch



AlphaHF works on an ENSDF alpha-decay dataset to calculate nuclear radius parameter r_0 or Hindrance factors for all decay branches



AlphaHF

- ❑ Alternative to ALPHAD for calculating HF
- ❑ Alternative to RadD for calculating or interpolating/extrapolating r_0

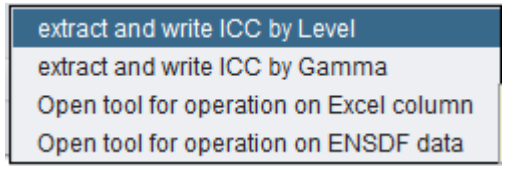
Evaluation: a tool to extract ce data for BriccMixing

Setup | Compilation | **Evaluation** | Validation | Dissemination

Lots of ce data (conversion coefficients, subshell ratios, etc) are given in comments and evaluators are required to run BriccMixing with those data to get mixing ratio

Excel2ENSDF has a tool to extract ce data listed in each individual ***gamma comment and continuation record*** and write them into an output file in the format of input file for the BriccMixing program.

The output file can be read by the BriccMixing to calculate mixing ratio for each gamma listed in the file.



In ***Excel2ENSDF*** main window, right click a blank area to get the popup

```
167YB  G 213.19    4  86      5M1                    0.399   6          d
167YB2 G %IG=3.7 4
167YB  cG $E|g=213.19 {I4}, I|g=86 {I5} (1975VyZY)
167YB  cG $E|g=213.20 {I4}, I|g=39 {I2} (1976Me06)
167YB2 G EKC=0.36 7
167YB  cG $K:L1:L2:L3=31 {I6}:4.13:0.41:|<0.1 (1975VyZY)
167YB  cG $K:L1:L2:L3=1.23:0.16:|?0.02:<0.01 (1971Ab04)
```

ce data in the continuation record and comment of 213-keV gamma in the input ENSDF dataset

extracted ce data entries that can be read by BriccMixing

```
*NEW-------------------------------------------------------------
167YB  G 213.19    4  86      5  M1                     0.399
167YB      213.19     4
   E1+M2   0     1
# NsrKey              Shell     IccVal      Unc     Type
Entry*                K         0.36        7       A
Entry*                L1/L3     41.0        82      R
1975VyZY*             L1/L2     10.0        20      R
1971Ab04*             L1/L2     8.0         16      R
Entry*                L2/L3     4.10        82      R
1975VyZY*             K/L2      76          15      R
1971Ab04*             K/L2      62          13      R
Entry*                K/L3      310         62      R
1975VyZY*             K/L1      7.5         15      R
1971Ab04*             K/L1      7.7         16      R
```

ICC_summary.rpt

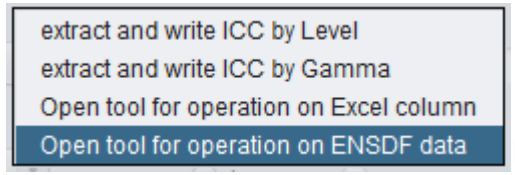
Evaluation: batch operations on ENSDF records

Setup | Compilation | **Evaluation** | Validation | Dissemination

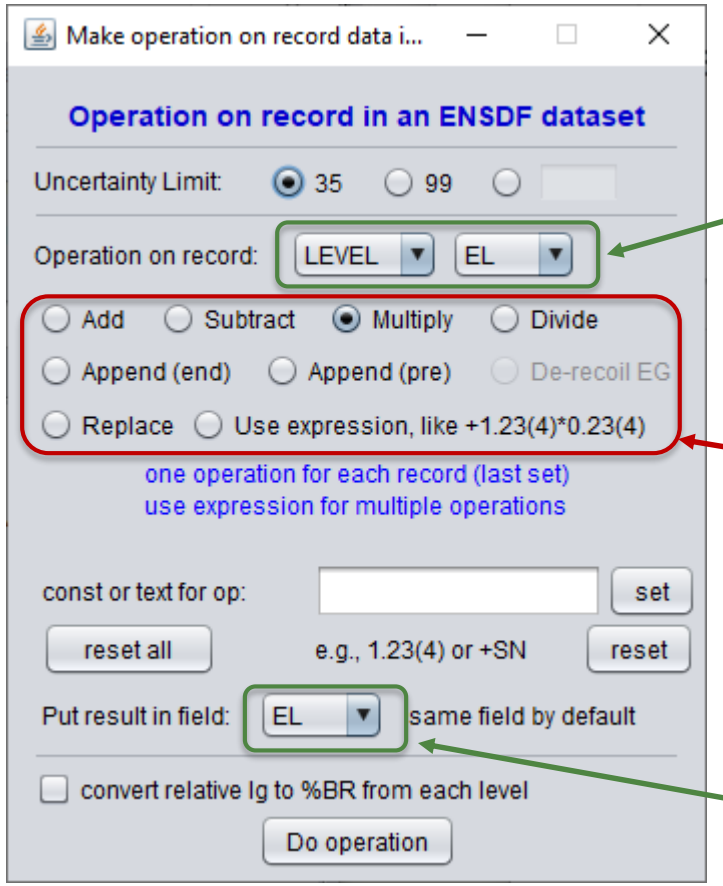
Evaluators occasionally encounter situations like:

- ❑ All intensities need to multiply a factor
- ❑ All energies need to add a constant or append a text like "+SN"
- ❑ All values in A record need to move to B record
- ❑ All E(gamma) values need to be de-corrected for recoil energy
- ❑ Or, more complicated like: all "E(p)" placed in "S" record need to be converted to E(level)=E(p)*factor+S(p) and then re-placed in level record

Excel2ENSDF has a tool to make batch operations on ENSDF records



In ***Excel2ENSDF*** main window, right click a blank area to get the popup



Record that need operation

Available operations

Set a new place for value after operation

Evaluation: auto-grouping data of various reactions&decays

Setup | Compilation | **Evaluation** | Validation | Dissemination

Ni63 / new

- Ni63_ng_pol_n_g_E_th.ens
- Ni63_adopted.ens
- Ni63_beta_decay.ens
- Ni63_64ni_3he_a.ens
- Ni63_48ca_18o_3ng.ens
- Ni63_26mg_48ca_2a3ng.ens
- Ni63_62ni_d_pg.ens
- Ni63_64ni_p_d.ens
- Ni63_62ni_a_3he.ens
- Ni63_ng_resonances.ens
- Ni63_62ni_d_p_pol_d_p.ens
- Ni63_64ni_d_t_pol_d_t.ens
- Ni63_65cu_d_a.ens

63.mrg

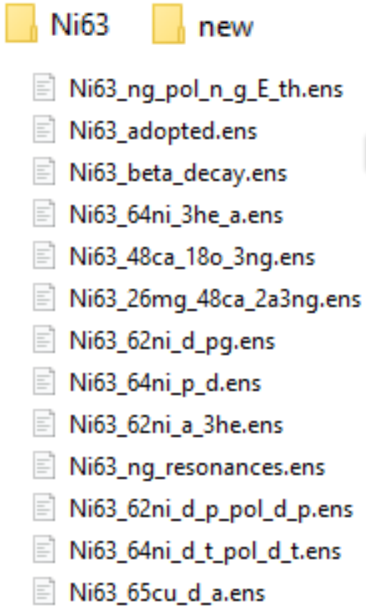
```
LEVEL********************************** 63NI  L 517.897    30 3/2-                                                    ---
                  *new XREF new tags      63NIX L XREF=AEFHIJKL
                  *new XREF old tags      63NIX L XREF=AEFHIJKL
                  #old XREF in Adopted    63NIX L XREF=AEFHIJKL
              63CO B- DECAY--->A  A       63NI  L 517.8      6  3/2-
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI  L 517.899    30 3/2-
         62NI(D,P),(POL D,P)--->F  F      63NI  L 515        5 3/2-                          1        0.32          *** possible JPI=1/2-,3/2-
              62NI(A,3HE)--->H  H         63NI  L 518                                                0.028         *** possible JPI=1/2,3/2,5/2,7/2,9/2,11/2,13/2+
              64NI(P,D)--->I  I           63NI  L 518                                                4.90          *** possible JPI=1/2,3/2,5/2,7/2,9/2,11/2,13/2+
         64NI(D,T),(POL D,T)--->J  J      63NI  L 518          3/2-                          1        0.82          *** possible JPI=1/2-,3/2-
              64NI(3HE,A)--->K  K         63NI  L 518          3/2-                          1        0.64          *** possible JPI=1/2-,3/2-
              65CU(D,A)--->L  L           63NI  L 523        15                                                  A   *** possible JPI=1/2,3/2,5/2,7/2,9/2,11/2,13/2,15/2,17/2-
              63CO B- DECAY--->A  A       63NI  B            0.11              8.9                             ?
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI cL J$spin=3/2 also from |g|g(|g) in 1964Co13.
         62NI(D,P),(POL D,P)--->F  F      63NI cL E$others: 518 (1970Li03,1970Tu02,1977St07), 526 (1963Fu04).
         62NI(D,P),(POL D,P)--->F  F      63NI cL S$others: 0.34 (2013Sc06), 0.306 (1963Fu04), 0.276 (1977St07), 0.32
         62NI(D,P),(POL D,P)--->F  F      63NI2cL (1970Tu02).
              64NI(P,D)--->I  I           63NI cL S$other: 0.51 at 25|'.
         64NI(D,T),(POL D,T)--->J  J      63NI cL S$other: 0.58 (1981Bi04).
              64NI(3HE,A)--->K  K         63NI cL E$other: 520 {I40} (1968Ru02).
              64NI(3HE,A)--->K  K         63NI cL S$other: 0.64 (1968Ru02).
GAMMA------------------------------------ 63NI  G 362.40     8 100                                                  --- EG=362.40     FL=155.510    JF=3/2-
              63CO B- DECAY--->A  A       63NI  G 362.3      5 100                                                C *** EG=362.3      FL=155.55     JF=3/2-
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI  G 362.40     8 100                                                *** EG=362.40     FL=155.512    JF=3/2-
              63CO B- DECAY--->A  A       63NI2 G %IG=0.107 22
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI cG E$weighted average of 362.1 {I2} (1970GaZQ) and 362.42 {I5} (1992Ha21).
GAMMA------------------------------------ 63NI  G 430.71     5 2.4                                                  --- EG=430.71     FL=87.220     JF=5/2-
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI  G 430.71     5 2.4                                                *** EG=430.71     FL=87.225     JF=
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI cG E$other: 430.7 {I3} (1970GaZQ).
GAMMA------------------------------------ 63NI  G 517.61     31 30      6                                          --- EG=517.61     FL=0.0        JF=1/2-
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI  G 517.61     31 30      6                                        *** EG=517.61     FL=0          JF=1/2-
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI cG E$unweighted average of 517.3 {I3} (1970GaZQ) and 517.91 {I4}
     62NI(N,G),(POL N,G) E=TH--->E  E     63NI2cG (1992Ha21).
```

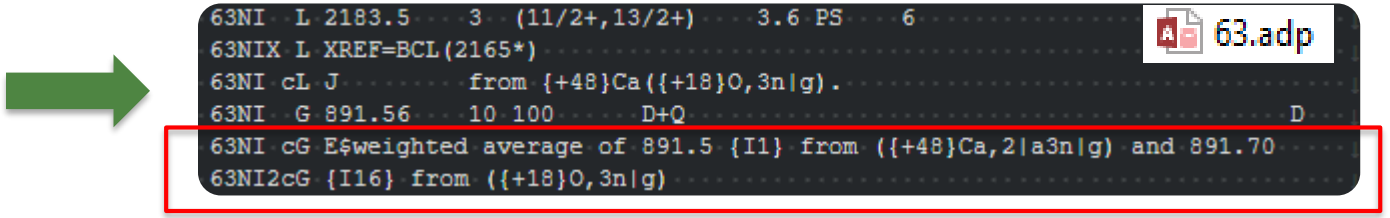
ConsistencyCheck
matches & groups levels and gammas from input datasets of various reactions and decays

All data and comments from various reactions and decays for a level (and its gammas) are gathered and seen in one screen.
No need to jump across individual datasets back and forth.

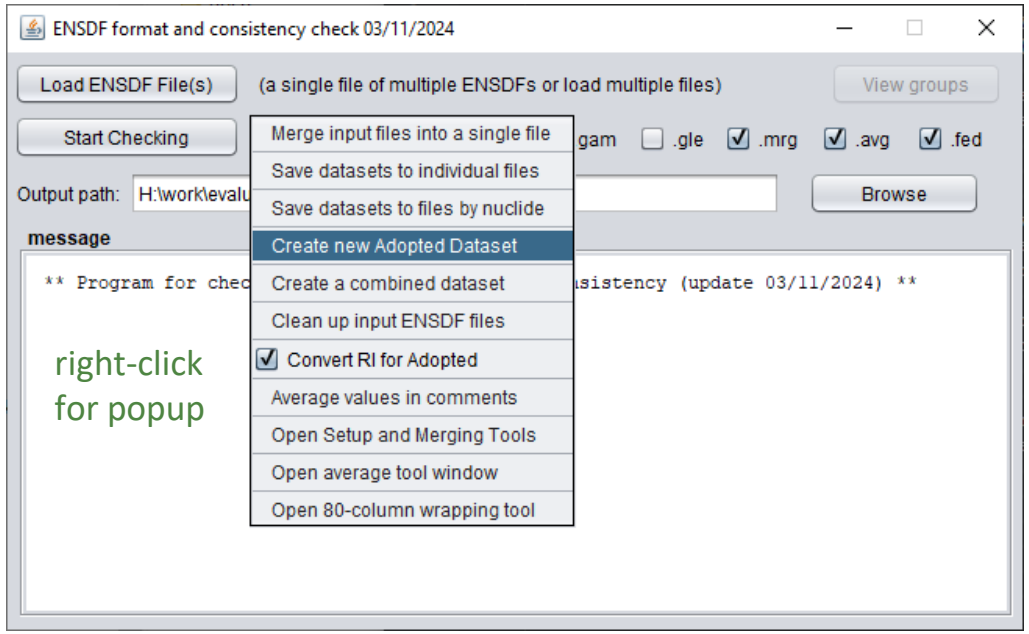
Evaluation: auto-making a preliminary Adopted dataset

Setup | Compilation | **Evaluation** | Validation | Dissemination





NOTE: this is only a very preliminary Adopted dataset with only an **initial assessment by the code**, which need to be checked and verified by the evaluator.



ConsistencyCheck

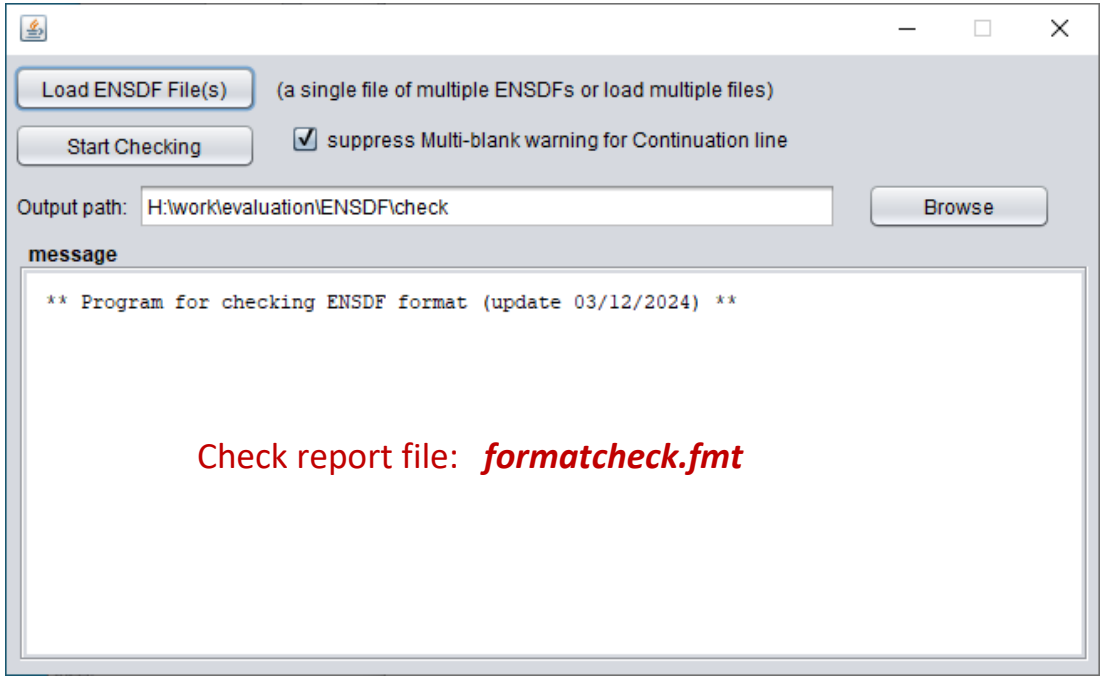
generates a preliminary new Adopted dataset combining all input data of various reactions and decays and selecting the best values from an initial **automatic** assessment for JPI, T1/2, EG, RI, MUL, MR

like automatically averaging of all available values (T1/2, EG, RI), generating needed comments, and placing them into the new dataset

Validation: ENSDF format check

Setup | Compilation | Evaluation | **Validation** | Dissemination

FormatCheck: a new ENSDF Java code to replace the legacy FMTCHK Fortran code that lacks of maintenance



This is the stand-alone program for checking ENSDF format

- Includes all checking items (exceptions below) covered in FMTCHK (please let me know if some items are missing)
- Remove unneeded check items in FMTCHK due to file I/O restrictions, like end-of-file check
- Remove no-longer-correct error messages for outdated format requirements, like, in "XREF=L(3034*)", * is marked as in error since it is expected to be like "(*3034)". Either is good now.
- Remove check for inconsistency, like unmatched DSIDs. Those are items checked by ConsistencyCheck but not format issues.
- Add lots of new check items (still growing), like unbalanced brackets (anywhere).

The same code is also integrated into ConsistencyCheck with its report file named like "63.fmt" for A=63 nuclides (for all checkings at one time)

Validation: NSR keynumber check for format and relevance

Setup | Compilation | Evaluation | **Validation** | Dissemination

KeynumberCheck: scan and check all **NSR keynumbers** or **keynumber-like** strings against format errors and irrelevance

- **Format error** in keynumber is easy to be made but is also easy to be found (by the code)
- **Irrelevance check** is done through searching for close mass numbers in the NSR abstract retrieved on-the-fly from the NSR database for each valid keynumber.
  - It generates a list of "irrelevant" keynumbers but it is preliminary based on the current searching method
  - Evaluator must check and filter out those incorrectly selected as "irrelevant" by looking into the papers
- Normally, a few to tens of irrelevant keynumbers can be found in a mass chain evaluation. Those are mostly due to misprint of one letter or one digit.
- A stand-alone version is available, and it has also been integrated into ***ConsistencyCheck*** with its report file named like "***63_keynumber.rpt***" for A=63 nuclides (for all checkings at one time)

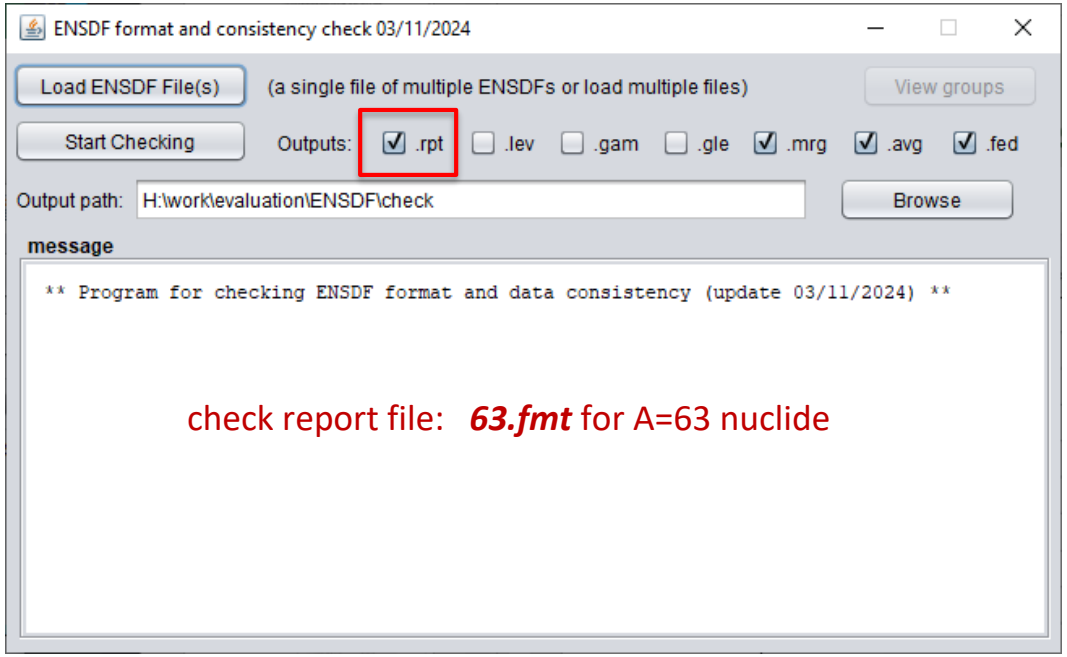
example

```
--- Line 712: ---------------------------- line#=49    in 156SM: 252CF SF DECAY
    1970Jo20   : <W> probably irrelevant. Check if typo.
                     #title=Four-Parameter Measurements of Isomeric Transitions in
                           {+252}Cf Fission Fragments
```

Validation: in- and cross-dataset inconsistency check

Setup | Compilation | Evaluation | **Validation** | Dissemination

ConsistencyCheck: initially developed to check in- and cross-dataset inconsistencies, but has become a toolkit of many other checking and utility functions

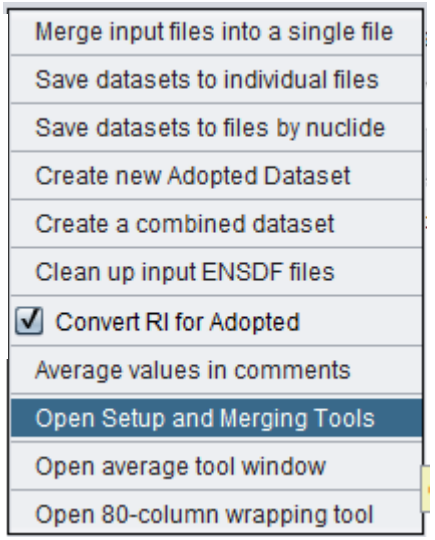


- Mostly found inconsistencies are those between JPI values in Adopted Levels and JPIs in individual datasets with comments saying those JPIs from Adopted Levels
- Similar inconsistencies are also easily made for adopted E(level), $T_{1/2}$, gamma branching ratios, etc., and are checked by this code.
- Inconsistencies in physics are also checked, for example like Mult=M1+E2 for a transition from 3+ to 2-. Many such possible physics inconsistencies are considered in the code and will be checked.
- Other possible inconsistencies: unmatched DSIDs in XREF list and source dataset, unmatched XREF tag in Adopted Levels, unmatched parent data with Adopted, etc.
- This code also digs into comments to search for inconsistently quoted values.

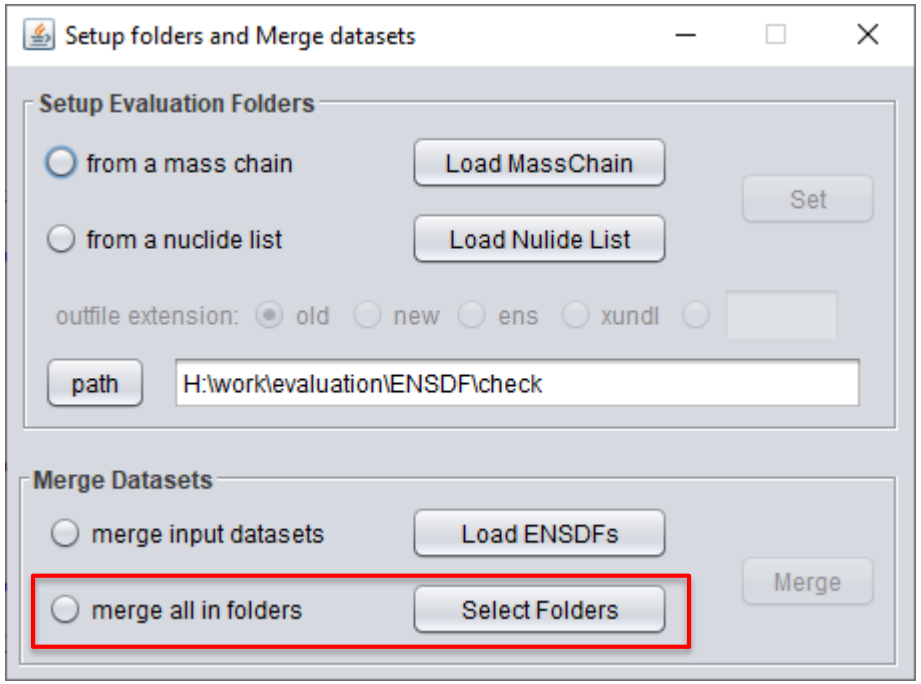
Dissemination: merge all individual datasets

Setup | Compilation | Evaluation | Validation | Dissemination

ConsistencyCheck: has a tool to merge all updated individual datasets in an evaluation folder into a single ENSDF file in order (the same order in the XREF list in Adopted Levels)



In ***ConsistencyCheck*** main window, right click a blank area to get the popup



Select the evaluation folder, e.g., A=63

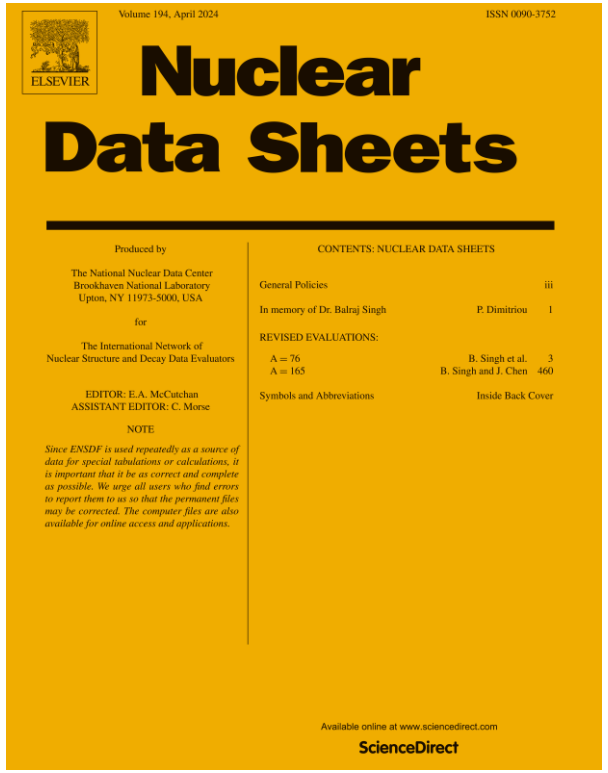
Output: “merged.ens”

Dissemination: generate print-ready pdf from an ENSDF file

Setup | Compilation | Evaluation | Validation | Dissemination

McMaster-MSU Java-NDS:

- It is first officially released in 2017 for generating print-ready pdf from ENSDF datasets for the journal of Nuclear Data Sheets and online web display.
- It has been constantly maintained and improved based on evaluators' feedbacks.
- There is no major change since last release (v2.1 in December 2021), but it has been constantly updated with minor changes and bug fixes. The updated version is always uploaded to the NSDD GitHub in time (most recent version: ***12March2024***).
- A test version of Java-NDS for the new JSON format is also available for testing. Please let me know if you are interested to get a copy to try.



All ENSDF Java codes can be found and downloaded at the NSDD GitHub for ENSDF Analysis and Utility Programs

https://github.com/IAEA-NSDDNetwork