



Update on ENSDF Tools

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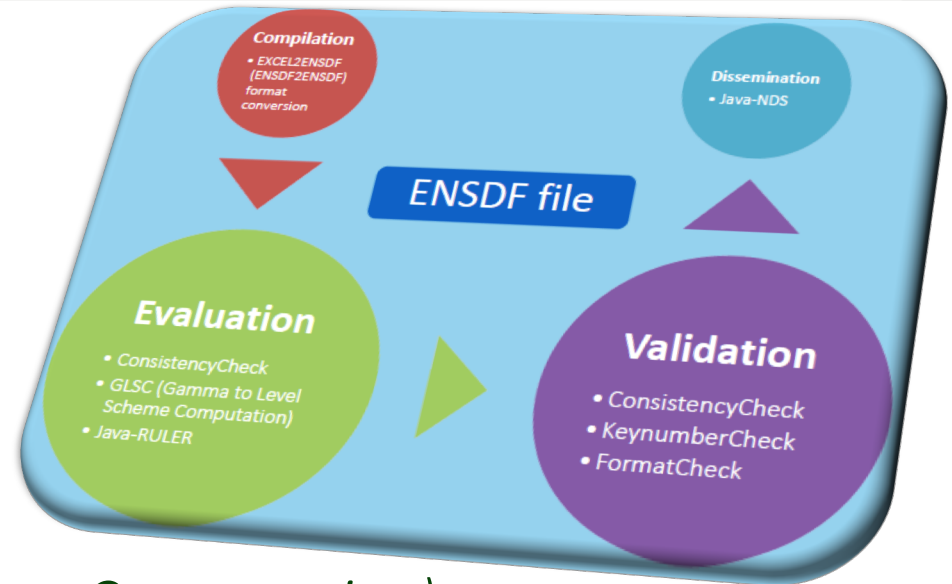
U.S. DEPARTMENT OF
ENERGY

Office of
Science

Code developments for ENSDF

ENSDF evaluation tools:

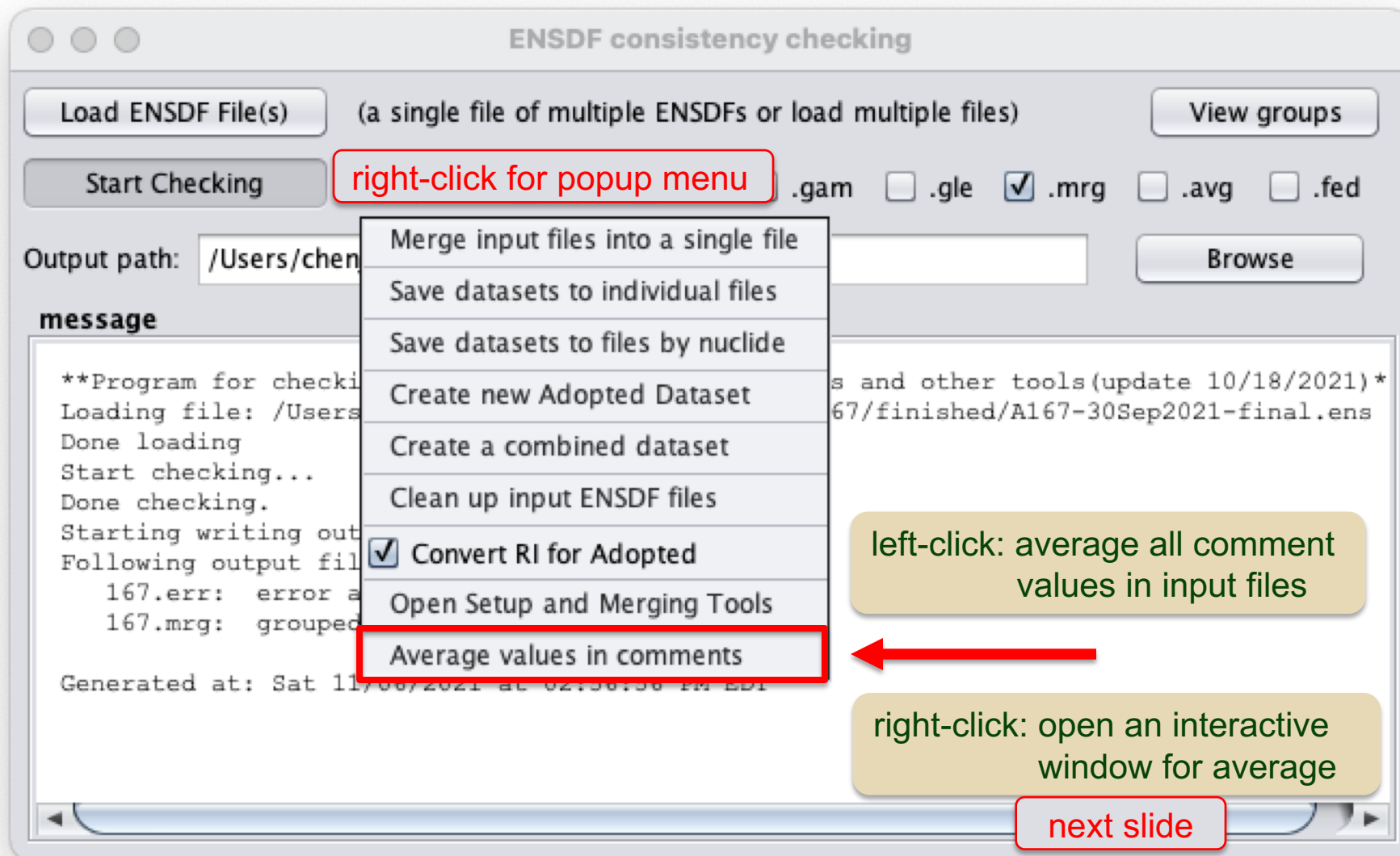
- *McMaster-MSU Java-NDS*
- *ConsistencyCheck*
- *KeynumberCheck*
- *Java-RULER*
- *Excel2ENSDF*
- *GLSC (Gamma to Level Scheme Computation)*
an alternative to the combination of legacy GTOL, GABS and more
- *AME-NUBASE retrieval tool*
has a function to update all Q records in datasets with a few clicks
- *ENSDFSearch (a standalone tool; under development)*
search anything in ENSDF and XUNDL with customized-search capability



Codes are available in Google Drive for downloading:

https://drive.google.com/drive/folders/1dCkFVZVIUeDUdmuJ8ts6P5UC_TUDICKZ?usp=sharing

ConsistencyCheck: average values in ENSDF comments



ConsistencyCheck: average values in ENSDF comments

Average values listed in the comments

31NA cL T\$weighted average of following measured T{-1/2} values in ms:
31NA2cL 16.6 {I4} (2017Ha23), 18 {I2} (2001Pe14, earlier values from the same
31NA3cL group: 16.9 {I18} (1999Dl01), 18 {I2} (1997Ta22)), 19 {I4} (1998NoZW,
31NA4cL 1999YoZW), 17.0 {I4} (1984La03), 17.7 {I5} (1981ThZV), 16.9 {I7}
31NA5cL (1974Ro31, average of 21 {I3} from |b counting, 20 {I5} from neutron
31NA6cL counting and 16.6 {I7} from ion counting).

average clear Uncertainty Limit ☒ 25 ☐ 35 ☐ 99 ☐ other

----- average T-----
Data points of T record

*	2017Ha23	16.6(4)	weight=33.15%
*	(2001Pe14	18(2)	weight=1.33%
*	(1998NoZW, 1999YoZW)	19(4)	weight=0.33%
*	1984La03	17.0(4)	weight=33.15%
*	1981ThZV	17.7(5)	weight=21.22%
*	(1974Ro31	16.9(7)	weight=10.82%

Averaging results:

weighted average:	17.03(23)	(internal)
	17.03(19)	(external)
	chi*2/(n-1)=0.694	[critical=2.802]
unweighted average:	17.5(4)	
(of all values)	chi*2/(n-1)=0.791	[critical=2.802]
suggested adopted result:	17.0(4)	
(Weighted-Of-All)		

weighted average comment:
31NA cL T\$weighted average of 16.6 {I4} (2017Ha23), 18 {I2} ((2001Pe14, earlier
31NA2cL values from the same group: 16.9 {I18} (1999Dl01)), 19 {I4} from
31NA3cL (1998NoZW, 1999YoZW), 17.0 {I4} (1984La03), 17.7 {I5} (1981ThZV), and
31NA4cL 16.9 {I7} ((1974Ro31, average of 21 {I3} from |b counting, 20 {I5} from
31NA5cL neutron counting and 16.6 {I7} from ion counting)).

- Inputs are directly copied and pasted from ENSDF comments
- Inputs can be edited freely

ConsistencyCheck:

average values in ENSDF comments

Average values listed in the comments

16.6 4, 18 2, 17.5 +6-8

- Inputs can be also from typing, separated by “,”
- uncertainty in ENSDF format

averageclear

Uncertainty Limit ☒ 25 ☐ 35 ☐ 99 ☐ other

```
----- average X-----
Data points of X record
*           16.6(4)           weight=73.31%
*           18(2)            weight=2.93%
*           17.5(+6-8)       weight=23.76%

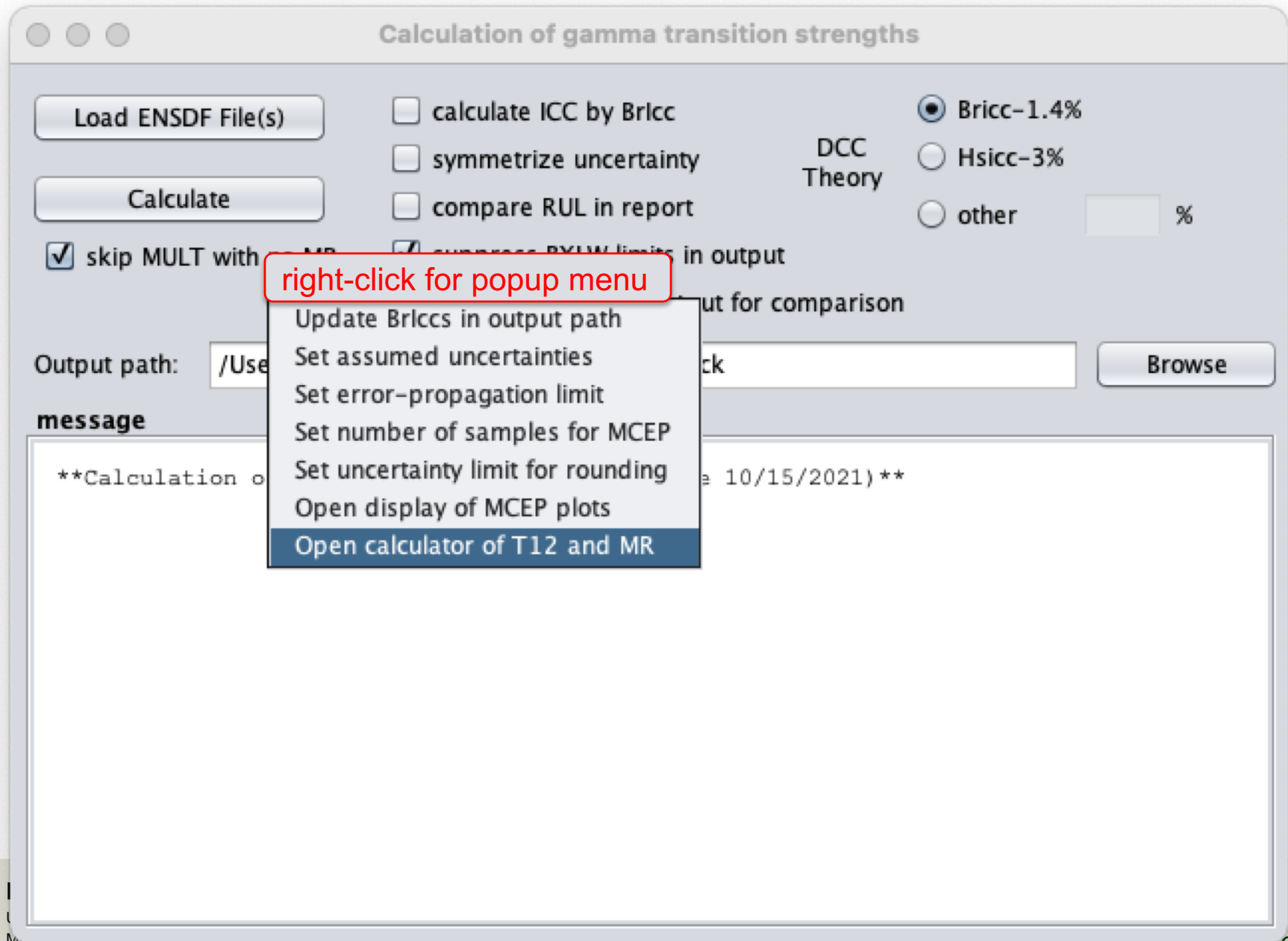
Averaging results:
  weighted average: 16.9(+3-4) (internal)
                   16.9(3)    (external)
                   chi*2/(n-1)=0.788 [critical=3.780]
  unweighted average: 17.4(4)
  (of all values)     chi*2/(n-1)=0.503 [critical=3.780]

  suggested adopted result: 16.9(4)
  (Weighted-Of-All)

### weighted average comment:
xxxxx cX X$weighted average of 16.6 {I4}, 18 {I2}, and 17.5 {I+6-8}

### unweighted average comment (all values):
xxxxx cX X$unweighted average of 16.6 {I4}, 18 {I2}, and 17.5 {I+6-8}
```

Java-RULER: calculator for B(XL), T1/2 and MR



Java-RULER:

calculator for B(XL), T1/2 and MR

load an ENSDF

or copy and paste an ENSDF dataset into the text area below

clear

64NI L 0.0 0+ STABLE
64NIX L XREF=ABCDZFGHIJKLMNOPQRSTUVWXYZ
64NI cL \$Evaluated rms charge radius <r{+2}>{+1/2}=3.8572 fm {I23} (2013An02)
64NI cL \$Evaluated |d<r{+2}>({+60}Ni,{+64}Ni)=+0.338 fm{+2} {I10} (2013An02)
64NI cL \$Measured |d<r{+2}>({+60}Ni,{+64}Ni)=+0.368 fm{+2} {I9}; deduced
64NI2cL total charge radius R{-c}({+64}Ni)=3.854 fm {I2} (2020Ka22).
64NI cL \$Measured isotope shift |d|n({+60}Ni,{+64}Ni)=+1027.2 MHz {I25}(stat)
64NI2cL {I77}(syst) (2020Ka22).
64NI L 1345.777 23 2+ 1.086 PS 35
64NIX L XREF=ABCDZFGHIJKLMNOP(1320)OPQRSTUVWXYZ
64NI2 L MOMM1=+0.37 6 (2001Ke02,2001Ke08,2014StZZ)
64NI2 L MOME2=+0.35 20 (1971ChZT,2016St14)
64NI2 L BE2=0.0705 29
64NI2 L B2=0.206 21 (1989Va02)
64NI cL J\$ L(t,p)=L(|a,|a')=L(d,d')=L(p,p')=2 from 0+
64NI cL T\$ weighted average of 1.065 ps {I116} from RDDS in
64NI2cL {+238}U({+64}Ni,{+64}Ni'|g) (2017Kl01) and 1.088 ps {I35} from DSAM in
64NI3cL Coul. Ex. (2001Ke08,2001Ke02). Others: 0.017 ps {I8} from DSAM in
64NI4cL (n,n'|g) (1983El03, 1989Ge09); 0.28 ps {I10} from DSAM in (|a,|a'|g)
64NI5cL (1974Iv01); 0.91 ps {I4} from adopted B(E2)|^=0.0705 {I29}
64NI dL \$2001Ke02-27 evaluation gives B(E2)|^=0.076 {I0}

calculate

☐ B(XL)

☒ T12

☐ MR

Uncertainty Limit

☒ 25

☐ 35

☐ 99

☐ other

clear

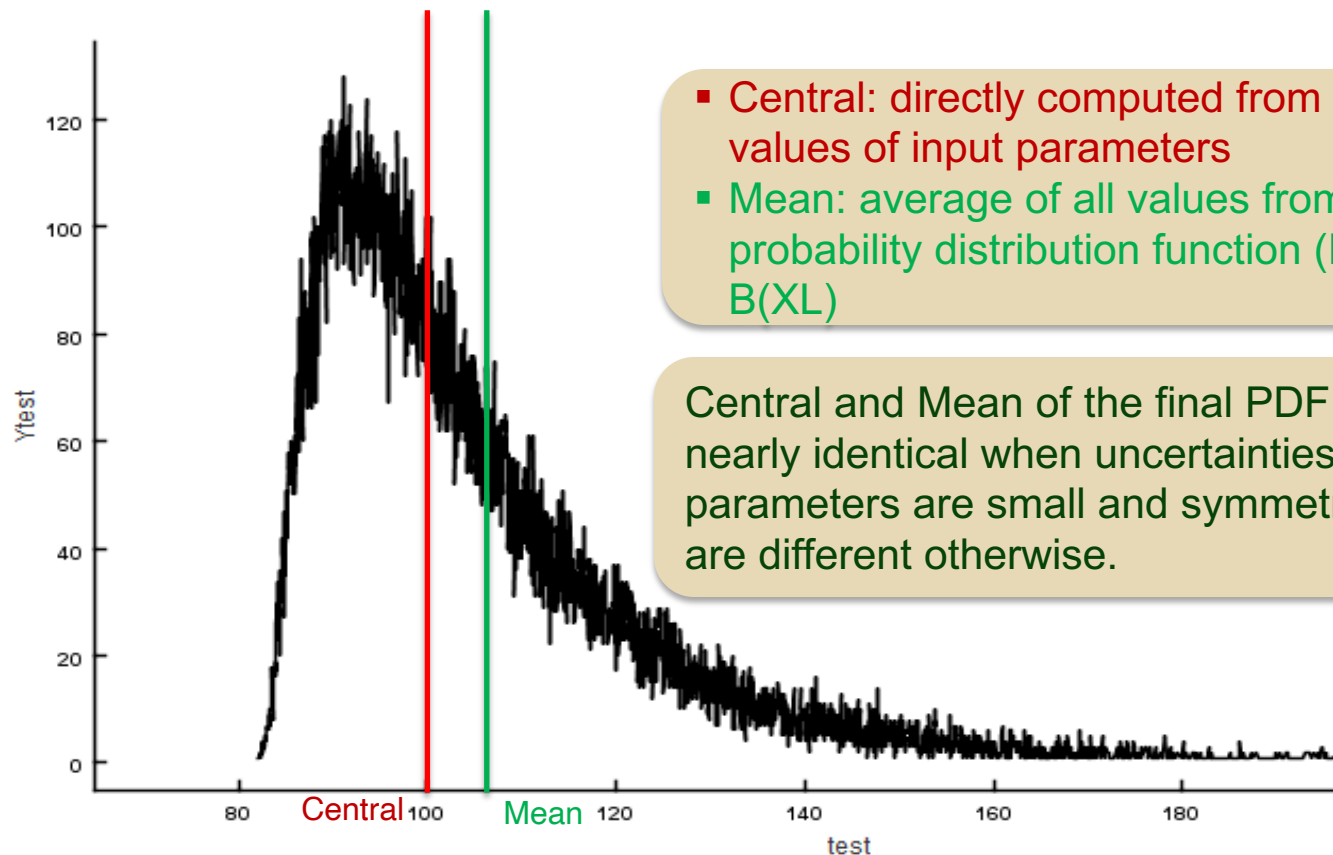
```
****T12 result at level=1345.777
inputs: BE2UP=0.0705 29 EG=1345.83 Mult=E2 JI=2+ JF=0+

METHOD      T1/2      %BR
-----
normal: 0.91 ps 4  99.98370 23
extreme: 0.91 ps 4  99.98370 23
Monte-Carlo: 0.91 ps 4  99.98370 23

canUseNormalError=true
```

Java-RULER: decision needed

Java-RULER has been compared with **UncTools** by Tibor and tested by Filip for the Monte-Carlo approach for error-propagation; two codes give consistent results but decision is needed on the final value to be adopted: **Central** or **Mean** of the probability distribution function (PDF) of B(XL)



GLSC (Gamma to Level Scheme Computation): γ normalization tool

Java program for fitting gammas (update 09/27/2021)

Load files Run ☒ ignore "S" gamma ☒ compare E(level) in report
☐ ignore "?" gamma ☒ compare E(gamma) in report
set ΔE_γ ☒ also run GABS ☐ reset "?" I_γ (min=0) ☐ print E(gamma) matrix in report

☐ auto-adjust ΔE_γ of poor-fit E_γ to reduce χ^2/ndf to less than 2.0 Max acceptable #sigma: 2

GABS: $\Sigma I(g+ce \text{ to } g.s.)$ for normalization gammas in ENSDF format (value & uncer.)
100

other normalization options

Output path: /Users/chenj/work/evaluation/ENSDF/check Browse

message

```
** Java program for fitting gammas (update 09/27/2021) **  
Loading ENSDF file: /Users/chenj/work/evaluation/ENSDF/check/check.ens  
Done loading
```

default normalization uses sum of $\gamma+ce$ intensities to ground state

Open a window for other normalization options

next slide

GLSC (Gamma to Level Scheme Computation): % γ normalization tool

Gamma intensity normalization

EI	J π	EF	J π	EG	RI	CC	TI	Select
49.93	3/2+	0.0	1/2+	49.9	21(3)	0.01325		<input type="checkbox"/>
220.80	(3/2)-	49.93	3/2+	170.9	5.2(9)	1.04E-3		<input type="checkbox"/>
220.80	(3/2)-	0.0	1/2+	220.8	2.0(3)	4.66E-4		<input type="checkbox"/>
460.72	(7/2-)	220.80	(3/2)-	239.9	0.25(5)			<input type="checkbox"/>
673.08	3/2+	220.80	(3/2)-	452.4	0.38(7)			<input type="checkbox"/>
673.08	3/2+	49.93	3/2+	623.1	3.5(6)			<input type="checkbox"/>
673.08	3/2+	0.0	1/2+	673.1	1.8(3)			<input type="checkbox"/>
941.92	(1/2-,3...)	49.93	3/2+	892.0	0.15(3)			<input type="checkbox"/>
941.92	(1/2-,3...)	0.0	1/2+	941.8	0.13(4)			<input type="checkbox"/>
944.00	5/2+	220.80	(3/2)-	723.1	0.11(2)			<input type="checkbox"/>
944.00	5/2+	49.93	3/2+	894.1	0.7(1)			<input type="checkbox"/>
1028.61	(1/2-,3...)	220.80	(3/2)-	807.8	1.3(2)			<input type="checkbox"/>
1435.93	(1/2-,3...)	49.93	3/2+	1385.9	0.19(4)			<input type="checkbox"/>
1435.93	(1/2-,3...)	0.0	1/2+	1435.8	0.07(2)			<input type="checkbox"/>
2015.08	5/2+	944.00	5/2+	1070.9	0.13(3)			<input type="checkbox"/>
2015.08	5/2+	460.72	(7/2-)	1554.3	0.15(3)			<input type="checkbox"/>
2015.08	5/2+	220.80	(3/2)-	1794.3	0.7(1)			<input type="checkbox"/>
2015.08	5/2+	49.93	3/2+	1965.0	0.06(2)			<input type="checkbox"/>
2243.64	1/2+	1435.93	(1/2-,3...)	807.6	0.4(2)			<input type="checkbox"/>
2243.64	1/2+	1028.61	(1/2-,3...)	1215.0	1.5(3)			<input type="checkbox"/>
2243.64	1/2+	941.92	(1/2-,3...)	1301.7	0.08(2)			<input type="checkbox"/>
2243.64	1/2+	673.08	3/2+	1570.6	0.23(5)			<input type="checkbox"/>
2243.64	1/2+	220.80	(3/2)-	2022.8	4.1(7)			<input type="checkbox"/>
2243.64	1/2+	49.93	3/2+	2193.6	3.3(5)			<input type="checkbox"/>
2243.64	1/2+	0.0	1/2+	2243.6	12.2(20)			<input type="checkbox"/>
3759.6	(1/2+,3...)	220.80	(3/2)-	3537.7	1.1(3)			<input type="checkbox"/>
3759.6	(1/2+,3...)	49.93	3/2+	3710.0	0.6(4)			<input type="checkbox"/>
3759.6	(1/2+,3...)	0.0	1/2+	3761.1	0.9(4)			<input type="checkbox"/>

set $\Sigma(\text{Intensity}) =$ % ☐ I_γ

per 100 parent decays via ☒ Current branch ☒ $I(\gamma+ce)$

☐ All branches

☐ cascade gamma

☐ use input NR to calculate % γ

run

Select normalization gammas

Other options

Set total absolute intensities of selected gammas

AME-NUBASE retrieval tool

Table of Atomic Mass Evaluation

Atomic Mass Table

+NUBASE

instruction

References

AME2020 AME2016 AME2012

Nuclide? Get ☒ rounded

28Si14 (AME+NUBASE2020) --- rounded

Q(b-) = -14344.9 +/- 1.1
Q(ec) = -4642.08 +/- 0.05
**Q(b+) = -5664.08 +/- 0.05 (see note)
S(n) = 17179.61 +/- 0.11
S(p) = 11584.90 +/- 0.05
Q(a) = -9984.135 +/- 0.013
S(2n) = 30494.43 +/- 0.11
S(2p) = 19856.196 +/- 0.029
Q(ep) = -14195.17 +/- 0.05
Q(b-n) = -28905 +/- 9
Q(2b) = -25570 +/- 160
mass = 27976926.5344 +/- 0.0006(check)
(micro-u)
B.E./A = 8447.7445 +/- 0.0002
M Excess = -21492.7971 +/- 0.0005
Q(4b) = *
Q(d,a) = 1428.15 +/- 0.07
Q(p,a) = -7712.77 +/- 0.06
Q(n,a) = -2653.61 +/- 0.05
Energy = 0.0
JPI = 0+
T1/2 = stbl
DecayMode = IS=92.2545 37

prev=28Al Q(b-)=4642.08 +/- 0.05
Q(ec)=-1830.77 +/- 0.27
next=28P Q(b-)=11220 +/- 160
Q(ec)=14344.9 +/- 1.1

** : here Q(b+)=Q(ec)-2*510.999 keV
Q(b+)=Q(ec) defined in AME and ENSDF

- ☐ AME2020 & NUBASE2020
- ☐ main usage: automatically update Q record in an input ENSDF file

- ☐ to get all AME entries for a single nuclide type nuclide name, like, **28Si**
- ☐ to list all isotopes of an element type element symbol or Z=##, like **Si** or **Z=14**
- ☐ to list all isotones of the same mass type A=## or ##, like **A=28** or **28**
- ☐ to get specific data entries of a nuclide or nuclides, type any of inputs above followed by the entry names, separated by :, like **A=28:QB:E:J:T:ME:SN**

AME-NUBASE retrieval tool

Table of Atomic Mass Evaluation

Atomic Mass Table +NUBASE

[References](#) ☒ AME2020 ☐ AME2016 ☐ AME2012

Nuclide ? ☐ rounded

AME+NUBASE2020

*** default mass number=28 for Si ***

##	Nuclide
1	22Si14
2	23Si14
3	24Si14
4	25Si14
5	26Si14
6	27Si14
7	28Si14
8	29Si14
9	30Si14
10	31Si14
11	32Si14
12	33Si14
13	34Si14
14	35Si14
15	36Si14
16	37Si14
17	38Si14
18	39Si14
19	40Si14
20	41Si14
21	42Si14
22	43Si14
23	44Si14
24	45Si14

Table of Atomic Mass Evaluation

Atomic Mass Table +NUBASE

[References](#) ☒ AME2020 ☐ AME2016 ☐ AME2012

Nuclide ? ☐ rounded

AME+NUBASE2020

##	Nuclide
1	28O 8
2	28F 9
3	28Ne10
4	28Na11
5	28Mg12
6	28Al13
7	28Si14
8	28P 15
9	28S 16
10	28Cl17

AME-NUBASE retrieval tool

Table of Atomic Mass Evaluation

Atomic Mass Table +NUBASE

[References](#) ☒ AME2020 ☐ AME2016 ☐ AME2012

Nuclide ☐ rounded

AME+NUBASE2020

##	Nuclide	Q(b)	Energy	JPI	T1/2	M Excess	S(n)
1	28O 8	B- 18676# +/- 709#	0.0	0+	<100ns	52080# +/- 699#	661# +/- 859#
2	28F 9	B- 22104.0579 +/- 174.2886	0.0	(4-)	46 zs	33403.796 +/- 120.347	-199.0000 +/- 6.0000
3	28Ne10	B- 12288.0534 +/- 126.4833	0.0	0+	18.8 ms 0.2	11299.738 +/- 126.068	3822.4899 +/- 155.3457
4	28Na11	B- 14031.6303 +/- 10.2498	0.0	1+*	33.1 ms 1.3	-988.315 +/- 10.246	3541.8428 +/- 10.9030
5	28Mg12	B- 1830.7740 +/- 0.2653	0.0	0+	20.915 h 0.009	-15019.946 +/- 0.261	8504.6694 +/- 0.2651
6	28Al13	B- 4642.0776 +/- 0.0486	0.0	3+*	2.245 m 0.005	-16850.719 +/- 0.049	7725.1740 +/- 0.0110
6i	28Al13	B- 4642.0776 +/- 0.0486	5992.58 +/- 0.10	0+	T=2	-10858.14 +/- 0.11	7725.1740 +/- 0.0110
7	28Si14	B- -14344.9407 +/- 1.1473	0.0	0+	stbl	-21492.79711 +/- 0.00051	17179.6099 +/- 0.1074
7i	28Si14	B- -14344.9407 +/- 1.1473	12541.04 +/- 0.05	(3+)		-8951.75 +/- 0.05	17179.6099 +/- 0.1074
7i	28Si14	B- -14344.9407 +/- 1.1473	9315.92 +/- 0.10	3+	T=1 1.5 fs 0.6	-12176.88 +/- 0.10	17179.6099 +/- 0.1074
7i	28Si14	B- -14344.9407 +/- 1.1473	15227 +/- 1	(0+)	T=2	-6265.8 +/- 1.0	17179.6099 +/- 0.1074
8	28P 15	B- -11221.0593 +/- 160.0041	0.0	3+	270.3 ms 0.5	-7147.856 +/- 1.147	14560.1422 +/- 9.0735
8i	28P 15	B- -11221.0593 +/- 160.0041	5887 +/- 20	0+	T=2	-1261 +/- 20	14560.1422 +/- 9.0735
9	28S 16	B- -24197# +/- 525#	0.0	0+	125 ms 10	4073.203 +/- 160.000	21489# +/- 431#
10	28Cl17	B- *	0.0	1+*	>100ns	28270# +/- 500#	*

example input: **A=28:QB:E:J:T:ME:SN**

to get data entries of Q(beta), Energy, JPI, T1/2, mass excess, S(n) for all A=28 nuclides from AME&NUBASE