



# Decay Data Library for ENDF/B-VII

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# ENDF/B-VII Decay

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Why do we need a decay data library in ENDF?

- ❑ ENSDF is not 100% numerical, for instance using GE, LE, AP and uncertainty convention
- ❑ ENSDF can has one dataset per decay type, very confusing to the unsuspecting user
- ❑ As is, ENSDF can not be used to solve some decay problems as function of time. The information is implicit in ENSDF, but one has to work to get it

## ENDF contents:

- A single dataset per ground state / isomer
- Energy level, isomer count (0 for GS, 1 for first isomer,...)
- Branching ratios to daughter nuclide/s isomer counts
- Half-life, spin and parity, mass
- Average radiation energies
- Discreet radiation energies and intensities
- Sometimes we need to add ENSDF datasets, ex  $^{112}\text{In}$ , EC=56% and B- =44%
- Sometimes we need to subtract, ex  $^{137}\text{Cs}$  –  $^{137}\text{Ba}$ , 661g belongs to  $^{137}\text{Ba}$  IT decay

# Example of dataset

```

1.000000+0 1.000000+0      -1      0      0      1      0 0 0 0
0.000000+0 1.000000+0      0      0      0      6      1 1451 1
0.000000+0 0.000000+0      0      0      4      7      1 1451 2
0.000000+0 0.000000+0      0      0      33     2      1 1451 3
0-nn- 1 BNL      EVAL-NOV05 A.A. Sonzogni (from ENSDF)      1 1451 4
/ENSDF/      1 1451 5
----ENDF/B-VII      Material      1      1 1451 6
-----RADIOACTIVE DECAY DATA      1 1451 7
-----ENDF-6 FORMAT      1 1451 8
***** Begin Description *****      1 1451 9
**      ENDF/B-VII RADIOACTIVE DECAY DATA FILE      **      1 1451 10
**      Produced at the BNL from the ENSDF database      **      1 1451 11
**      Authors: NSDD      **      1 1451 12
** Translated into ENDF format by A.A. Sonzogni, November 2005 **      1 1451 13
*****      1 1451 14
Parent Excitation Energy: 0.0      1 1451 15
Parent Spin & Parity: 1/2+      1 1451 16
Parent half-life: 613.9 s 6      1 1451 17
Decay Mode: %B--100      1 1451 18
ENSDF Author: BALRAJ SINGH      1 1451 19
Publication: NDS 106, 601 (2005)      1 1451 20
***** Energy Balance *****      1 1451 21
Mean Gamma Energy: 0.0 keV      1 1451 22
Mean X-Ray+511 Energy: 0.0 keV      1 1451 23
Mean CE+Auger Energy: 0.0 keV      1 1451 24
Mean B- Energy: 301.37 keV      1 1451 25
Mean B+ Energy: 0.0 keV      1 1451 26
Mean Neutrino Energy: 480.977 keV      1 1451 27
Mean Neutron Energy: 0.0 keV      1 1451 28
Mean Proton Energy: 0.0 keV      1 1451 29
Mean Alpha Energy: 0.0 keV      1 1451 30
Mean Recoil Energy: 0.0 keV      1 1451 31
Sum Mean Energies: 782.347 keV      1 1451 32
Q effective: 782.347 keV      1 1451 33
Missing Energy: 0.0 keV      1 1451 34
Deviation: 0.0 %      1 1451 35
***** End Description *****      1 1451 36

```

# Example of dataset

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Unless you have eagle eyes,  
file can't really be read without  
the help of an application

1.000000+0	1.000000+0	0	0	0	1	1 8457	1
6.139000+2	6.000000-1	0	0	6	0	1 8457	2
3.013699+5	0.000000+0	0.000000+0	0.000000+0	0.000000+0	0.000000+0	1 8457	3
5.000000-1	1.000000+0	0	0	6	1	1 8457	4
1.000000+0	0.000000+0	7.823469+5	1.000000+0	1.000000+0	0.000000+0	1 8457	5
0.000000+0	1.000000+0	0	0	6	1	1 8457	6
1.000000+0	0.000000+0	3.013699+5	0.000000+0	0.000000+0	0.000000+0	1 8457	7
7.823469+5	1.000000+0	0	0	6	0	1 8457	8
1.000000+0	1.000000+0	1.000000+0	0.000000+0	0.000000+0	0.000000+0	1 8457	9
0.000000+0	0.000000+0	0	0	0	0	1 8 099999	0

# Example of Possibilities, delayed neutrons

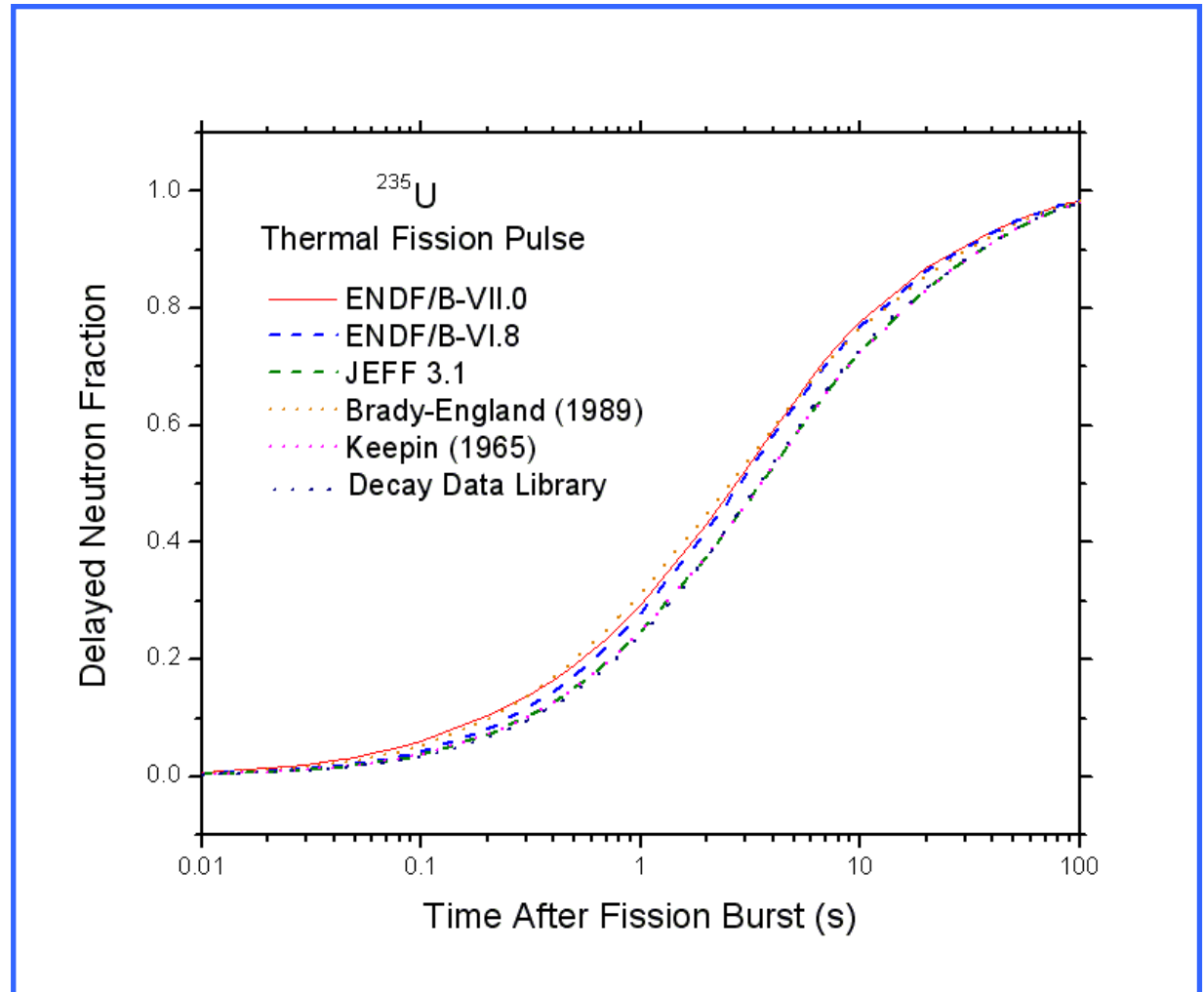
$$V_d = 0.0159/\text{fission}$$

(using ENDF/B-VII.0 decay data library and JEFF-3.1 fission yields)

Very close to Keepin and JEFF-3.1 time dependence

ENDF/B-VII.0:

$$V_d = 0.01585/\text{fission}$$



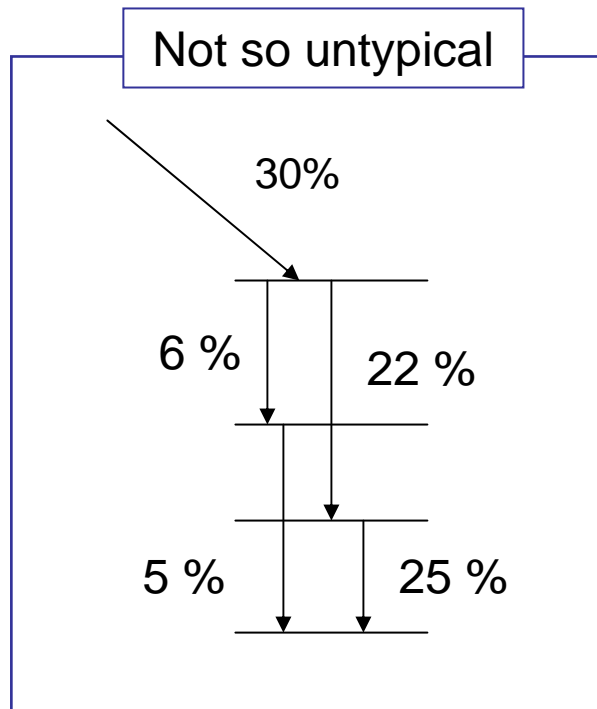
## Problems encountered

- ❑ Different parents energies, example  $E=140.0$  in Adopted Levels but  $E=139.8$  in parent record. Very common, can cause a lot of problems.
  
- ❑ BR values not consistent with Decay mode continuation record. For instance  $\%A=9.0$  2 in Adopted Levels but  $BR=0.087$  3 in corresponding A DECAY dataset.
  
- ❑ Some important nuclei deserve we produce an “Adopted decay dataset”, for instance  $^{137}\text{Cs}$ .

Energy balance:

$$Q \times BR + E(\text{parent}) = \text{effective Q-value} = Q_{\text{eff}}$$

$Q_{\text{eff}}$  should be equal to  $\Sigma E_{\gamma} I_{\gamma} + \Sigma E_{\alpha} I_{\alpha} + \Sigma E_{\nu} I_{\nu} + \dots$



Experimental intensities are often not 100% consistent

Causes problems with energy balance

We should perhaps fix this problems for important cases