

v.16.16.13
07/24/23

- Update of the Isomer database based on the Atlas of Nuclear Isomers-Second Edition and NNDC

Project by
D.Kaloyanov and F.Krause

More than 1500 isomers states have been added

[link](#)

- Migration of all LISE databases to sqlite format

Project by D.Kaloyanov

Scalability, Security, Usability, Speed, Flexibility

[link](#)

- LISE package optimization with profilers

Project by S.Tarasova

- Transmission calculation speed was improved 27%
- Compilation with MSVC2019:
 - Two bugs have been fixed
 - Thousands warning were analyzed and corrected

[link](#)

- New Abrasion-Ablation excitation energy model :

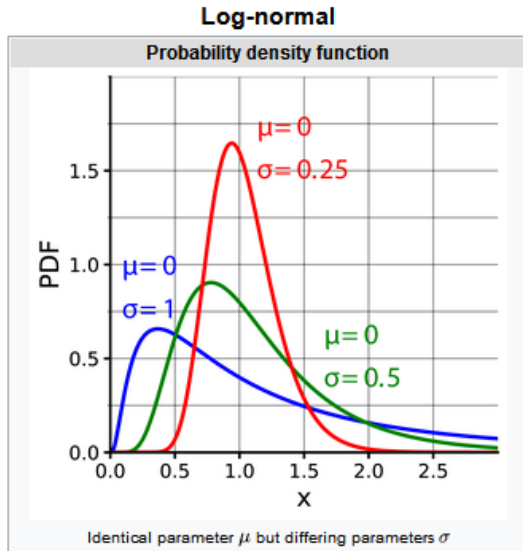
Log-Normal

- Update of the AA vs. user CS minimization utility

- 2D-plot X vs.A/q

[link](#)

https://en.wikipedia.org/wiki/Log-normal_distribution



Notation	$\text{Lognormal}(\mu, \sigma^2)$
Parameters	$\mu \in (-\infty, +\infty)$, $\sigma > 0$
Support	$x \in (0, +\infty)$
PDF	$\frac{1}{x\sigma\sqrt{2\pi}} \exp\left(-\frac{(\ln x - \mu)^2}{2\sigma^2}\right)$
CDF	$\frac{1}{2} \left[1 + \text{erf}\left(\frac{\ln x - \mu}{\sigma\sqrt{2}}\right) \right]$
Quantile	$\exp\left(\mu + \sqrt{2\sigma^2} \text{erf}^{-1}(2p - 1)\right)$
Mean	$\exp\left(\mu + \frac{\sigma^2}{2}\right)$
Median	$\exp(\mu)$
Mode	$\exp(\mu - \sigma^2)$
Variance	$[\exp(\sigma^2) - 1] \exp(2\mu + \sigma^2)$

This model is recommended for neutron-rich side

Excitation Energy of prefragment

A: 54, Element: Zn, Z: 30

Reaction: $^{76}\text{Kr} (140.0 \text{ MeV/u}) + \text{Be}$

Excitation Energy in the code = 366.73 MeV

Abrasion model:

- Geometrical: J.Gosset et al., PRC 16 (1977) 629
- Exponential (Y ~ exp(-k*d_abr)) k = 0.54
- 5. Log-normal distribution

Use LISE++ corrections for Geometric A-A model

Global Abrasion Cross-Section Factor = 0.507 (default 1)

1. J.W.Wilson, L.W.Towsend, F.F.Badavi, NIM B18 (1986) 225-231 -- geometrical model

Excitation Energy = 205.68 MeV
Standard deviation = 47.03 MeV

$E^* = (\gamma \cdot f \cdot \Delta S)_{geom} + E_{friction}$

Excitation Energy Transfer (friction)
 $E_{friction} = \text{coef}_1 * C_p + \text{coef}_2 * C_p * C_i$
C_p is the length of the longest chord in the projectile surface interface, C_i is the chord of intersection

coef₁ = 6.5, C_p = 9.79 fm
coef₂ = 0.5, C_i = 4.57 fm

Correction factor of Surface distortion excitation
 $f = 1 + c_1 * d_{abr} / A_p + c_2 * (d_{abr} / A_p)^2$
c₁ = 1.5, c₂ = 2.5, f = 1.7

2. J.-J.Gaimard and K.-H.Schmidt, NPA531 (1991) 709 -- convolution of triangle distributions

Hole depth (MeV) = 40
Mean Excitation Energy = 320.58 MeV
Standard deviation = 45.93 MeV

3. Parametrized Gaussian distribution -- simplified combination from NPA710 (2002) 157

Mean Excitation Energy = 329.9 MeV
Standard deviation = 24.77 MeV

4. Exponential excitation-energy distribution -- L.Audriac et al., PRC88, 041602(R) (2013)

Mean Temperature (MeV) = 13
Mean Excitation Energy = 312 MeV
Standard deviation = 63.69 MeV

5. Log-normal distribution -- O.T. private communication

1st order: Median(E) / dA = 15.25 MeV, Sqr(Var) / Sqr(dA) = 4.66 MeV
2nd order: 0, 0
Mean Excitation Energy = 366.73 MeV
Standard deviation = 22.79 MeV

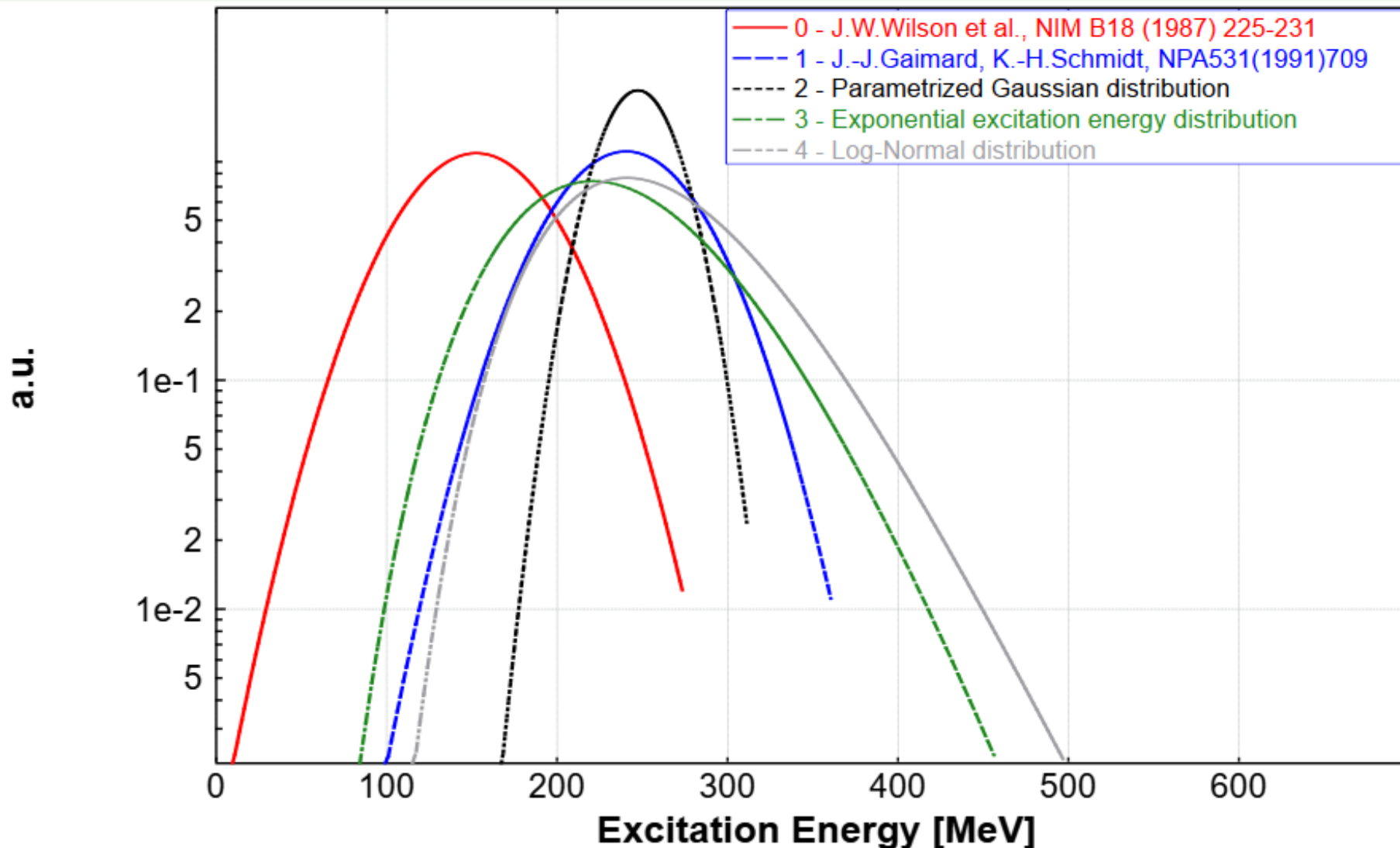
Plot as f (A_pf), Plot as f (Z_pf), Make default, OK, Cancel, Help

Excitation energy for $^{78}\text{Kr} + \text{Be} \rightarrow ^{60}\text{Zn}$: Ex.Energy distribution

Abrasion: "Geom"; $E^*_{\text{method: <0>}}$: $g=0.95$; $\sigma=9.6$; $c_{1,2}=(1.5,2.5)$ Friction:"Off"; $E^*_{\text{method: <1>}}$: Hole Depth: 40.0 MeV

$E^*_{\text{method: <2>}}$: $\langle E^* \rangle: (0.0e+00 \ 13.7 \ 0.0)$; $\sigma(E): (0.0e+00 \ 5.4 \ -0.1)$; $E^*_{\text{method: <3>}}$: $\langle T \rangle: 13.0 \text{ MeV}$

$E^*_{\text{method: <4>}}$: Mediane: 15.2(0) MeV; Sqr(Var): 4.7(0) MeV; No Intrin.Thermalztn; LimitTemp: No; DB₁=hfb22



Update of the AA vs. user CS minimization utility

Excitation energy models #3 (Gaussian), #4 (Temperature), #5 (Log-normal) can be used in minimization.
Model #3 was selected for current page

The screenshot shows the 'User Cross-Section analysis using the Abrasion-Ablation model' utility. The 'Break-up channel parameters' section, highlighted with a red box, includes the following data:

Limiting temperature		
T_{lim} @ A=050	T_{lim} @ A=150	T_{lim} @ A=250
8.275	6.581	4.7
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	2	1
15	10	5

Other sections include:

- Excitation energy model #3 (gaussian parametrization):** E^* : quadratic polynomial. Parameters for $\langle E^* \rangle$ and $\sigma(E^*)$ are shown with coefficients and bounds.
- Common parameters:** AA X-section (Amplitude factor: 0.507), Thermiztn (Time Coefficient: 1.65), dR correction (Effective Coulomb B.: 4.789).
- Local line to analyze:** Z = 30.
- Fitting:** N iterations = 100, Plot Product values from the chi2-table checked.
- Operations:** Make items 1-3, Prefragment excitation energy selected.
- Cascade Info & Dialog operations:** mass model (User's ME file [hfb22] + LDM#1), decay channels (Np=32; Modes=1011 1000 010), E^* model (2 - Parametrized Gaussian distribution).

New varied parameters

Update of the AA vs. user CS minimization utility

Excitation energy models #3 (Gaussian), #4 (Temperature), #5 (Log-normal) can be used in minimization.
Model #5 was selected for current page

ExE model #5

Log-Normal

Median (MeV)	sqr(Var) (MeV)
15.25	4.66
* d_abr	* d_abr ^(1/2)
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	5
30	30

Log-Normal: 2nd order

Median ² (MeV)	Var (MeV)
0	0
* d_abr ²	* d_abr
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
-2	-2
2	2

Common parameters

AA X-sections

Amplitude factor: 0.507

Thermlztn

Time Coefficient: 1.65

dR correction

Effective Coulomb B.: 4.789

Break-up channel parameters

Limiting temperature

T _{lim} @ A=050	T _{lim} @ A=150	T _{lim} @ A=250
8.275	6.581	4.7
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	2	1
15	10	5

Local line to analyze

Change Z = 30

Calculate down to Z = 30

Universal analysis value

Weights

Analysis value	x ²	LoD
Local	3	2
Global	0.5	1

Use experimental CS errors in analysis

Use Reduced chi-square (divide by "n-p")

if exp.error is absent, then error=coef*CS, where coef is 1

Fitting

N iterations = 100

Fit options Show initial conditions

Restore previous values Generate chi2-table

Plot Product values from the chi2-table

Target value = --

Number of user CSs = --

Show intermediate results

Operations

This utility can be used if

Make items 1-3

- "Projectile Fragmentation" reaction mode is selected
- Abrasion-Ablation is the selected CS method
- "File" cross section option is set to "on"
- There are more than 2 user CS in memory

Load Settings Save Settings

Evaporation Settings

Prefragment excitation energy

Analysis Log-file

Browse View

p2_hfb22_#2_hfb22

Cascade Info & Dialog operations

Press "Escape" to interrupt the analysis.

"d_abr" is the number of abraded nucleons

mass model: User's ME file [hfb22] + LDM#1

decay channels: Np=32; Modes=1011 1000 010

E* model: 4 - Log-Normal distribution

Clear AA Make default

OK Cancel Help

New varied parameters

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