MICHIGAN STATE UNIVERSITY

From 12/09/2011

LISE++ version 9.2.159

- ❑ **Update of isotope discovery history**

- ❑ **Update of Statistics window**

- ❑ **Extended version of the Isotope dialog : Decay analysis**

- ❑ **Decay mode revision**

- ❑ **Color editing of the table of nuclides**

- ❑ **Update of LISE for Excel**

- ❑ **Miscellaneous**

The code operates under MS Windows environment and provides a highly user-friendly interface.
It can be freely downloaded from the following internet addresses:
http://www.nscl.msu/edu/lise

9.2.127 28/11/11   Implemented: Isotope Discoveries of elements Ca,In,Sn,Pt

www.nscl.msu.edu/~thoennes/isotopes/abstracts/20-calcium/20-Ca-39.pdf
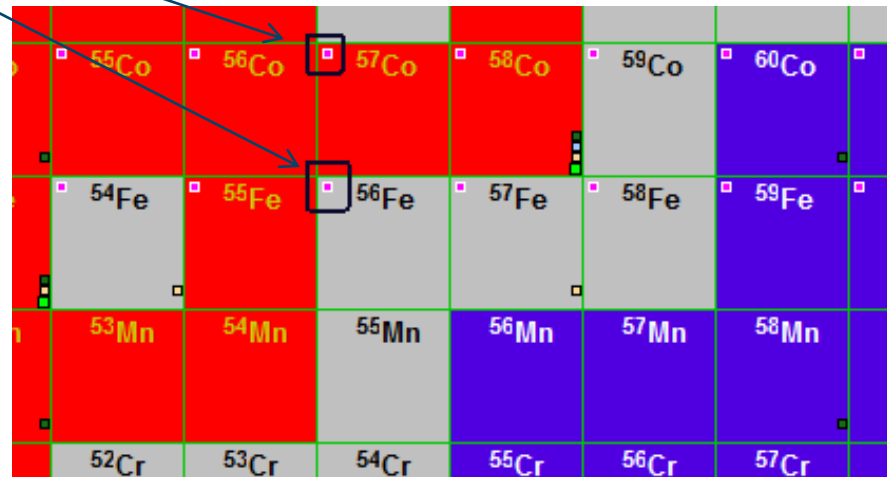
^{39}Ca

^{39}Ca was first observed in 1943 by Huber et al.: "Der Kernphotoeffekt mit der Lithium-Gammastrahlung: I. Die leichten Elemente bis zum Calcium" [?]. ^{39}Ca was populated in a radiative capture reaction with 17 MeV γ-rays. 500 keV protons bombarded lithium to produced the γ-rays from the reaction $^{7}Li(p,\gamma)$. Subsequent to the irradiations the decay curves of the emitted β-rays were measured. "Als Resultat von 600 durchgeführten Bestrahlungen erhielten wir die in Fig. 13 aufgezeichnete Zerfall-skurve mit einer Halbwertszeit von T = 1.06 ± 0.03 sec." (As a result of 600 irradiations we achieved the decay curve shown in Figure 13 with a halflife of T = 1.06 ± 0.03 sec.).

[1] O. Huber, O. Lienhard, P. Scherrer, H. Wäffler, Helv. Phys. Acta 16 (1943) 33.

Adapted from
A. Amos, J.L. Gross, and M. Thoennessen
At. Data Nucl. Data Tables **97**, 383 (2011)

9.2.131 28/11/11

Show discovery history availability in the chart of nuclides

9.2.129 28/11/11
Call the LISE++ database dialog
from the Isotope statistics window

9.2.152 07/12/11
Call the "Decay analysis" dialog
from the Isotope statistics window

9.2.128 28/11/11
Update of JAEA (Japan Atomic Nuclear Agency Chart) Nuclear Chart - 2010

9.2.136 01/12/11
Double click by left mouse button on an isotope in the chart of nuclides -> show only database information on this isotope

9.2.130 28/11/11
Beta+ & Beta- values results are shown in the Isotope statistic window

9.2.135 01/12/11   Extended version of the isotope dialog
9.2.137 02/12/11   Analysis of "conflict" decay branches

Access from

"Isotope" dialog
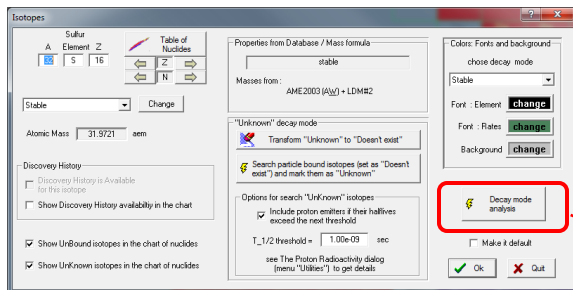
Statistics window

"Utility" menu

2nd step

If after 1st step the mode was set as "decay" then

Accept as "unbound" If half-life of this mode smaller than "does not exist" threshold

Accept as "stable" If half-life of this mode greater than "stable" threshold
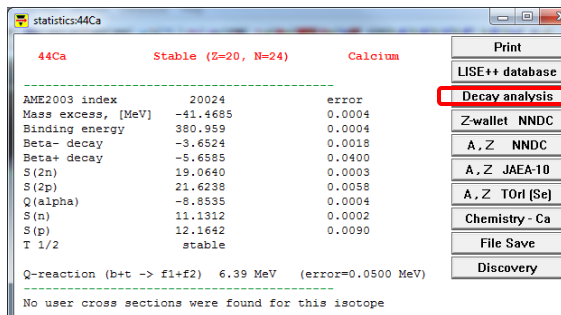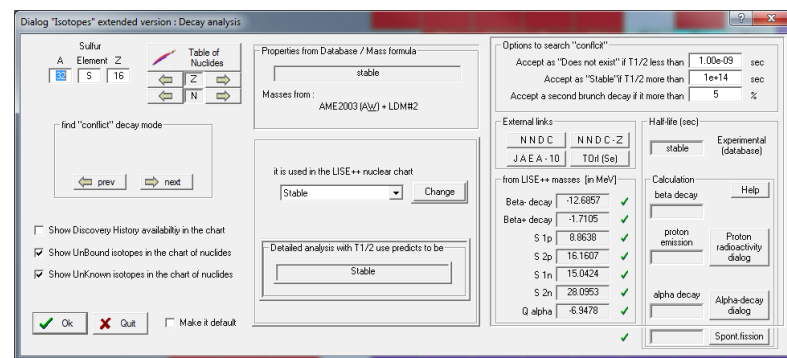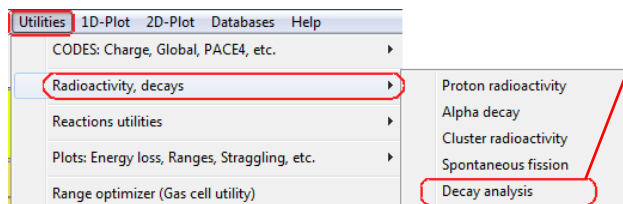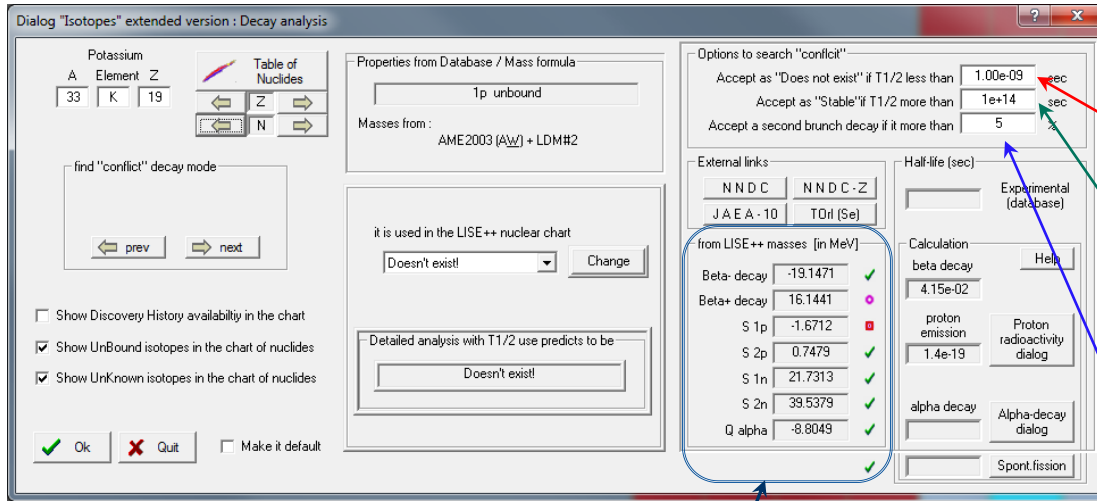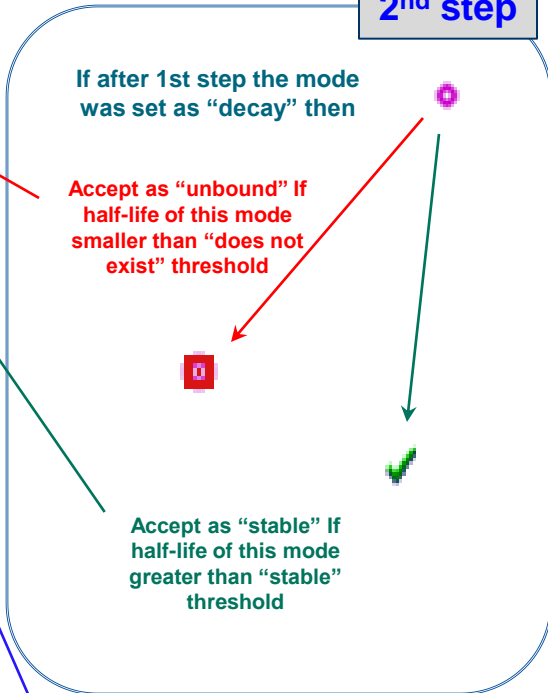
1st step

According chosen mass model or database

Stable. No decay. Qa, b-, b+ <0, and S1n,S2n,S1p,S2p > 0

Decay. Qa , b-, b+ > 0, and S1p,S2p < 0

Unbound. Qa-CB>0, and S1p+CB,S2p+CB,S1n,S2n < 0, where CB – Coulomb Barrier

3rd step

• If more than 2 decay modes are present, than only two will be chosen based on short half-life

• if there are two bunches are present, then LISE++ accepts the second mode if its half-life no greater than 1st mode half-life value divided on "2nd branch value" or

$$[T1/2]_2 * coef < [T1/2]_1$$

"conflict" decay mode happens then

**Decay mode set in LISE++ chart of nuclides
is not the same as
the "Decay analysis" dialog predicts**
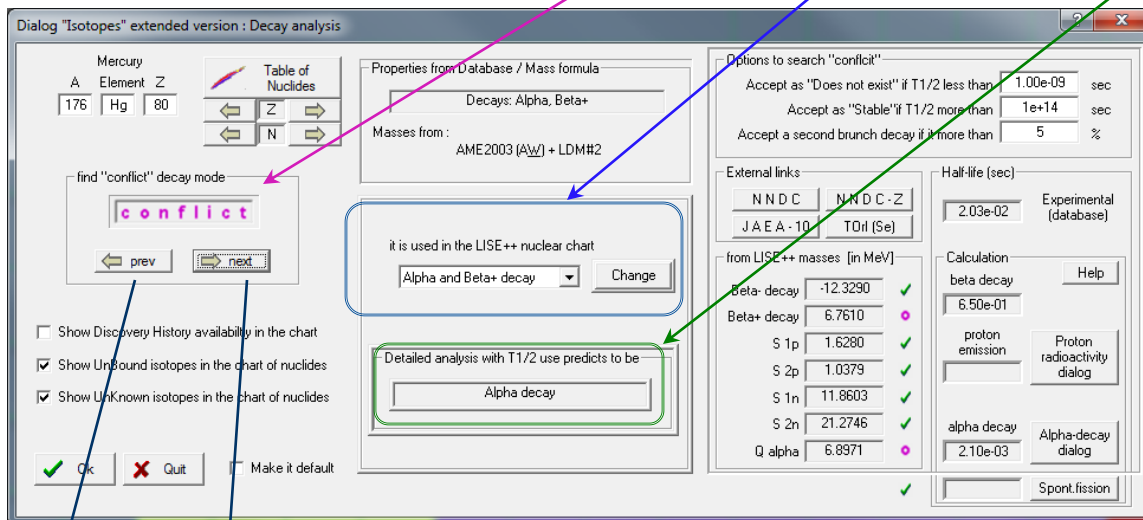
**Find
Previous Conflict
(n--)**

**Find
Next conflict
(n++)**

**Pay attention, that
the Decay analysis is evidently very sensitive to mass model being used.
So A&W2003 is good to determinate decay modes for nuclei close to the stability line,
but is not good tools to define possible particle-bound isotopes (so called "unknown" mode).**

The "ktuy.lme" file gives plenty conflicts even for nuclei close to the stability line ☹

9.2.141 05/12/11   New decays : p & β+, p & α

9.2.144 06/12/11   New decay : β- & α

9.2.147 06/12/11   New decay : SF & β+

9.2.149 06/12/11   New decay : SF & β-

9.2.153 07/12/11   New order of decay modes

   => New iso-file : "table2012.iso"

   (instead previous "table.iso")

9.2.154 08/12/11   Total Revision of Decay modes

   in the LISE++ chart of nuclides,

   and revision of half-lives of heavy elements

Doesn't exist!
Stable
Beta+ decay
Beta- decay
Beta+ and Beta- decay
Alpha decay
Alpha and Beta+ decay
Alpha and Beta- decay
Proton decay
Proton and Beta+ decay
Proton and Alpha decay
Spontaneous fission
SF and Beta+ decay
SF and Beta- decay
SF and Alpha decay
Unbound
Unknown
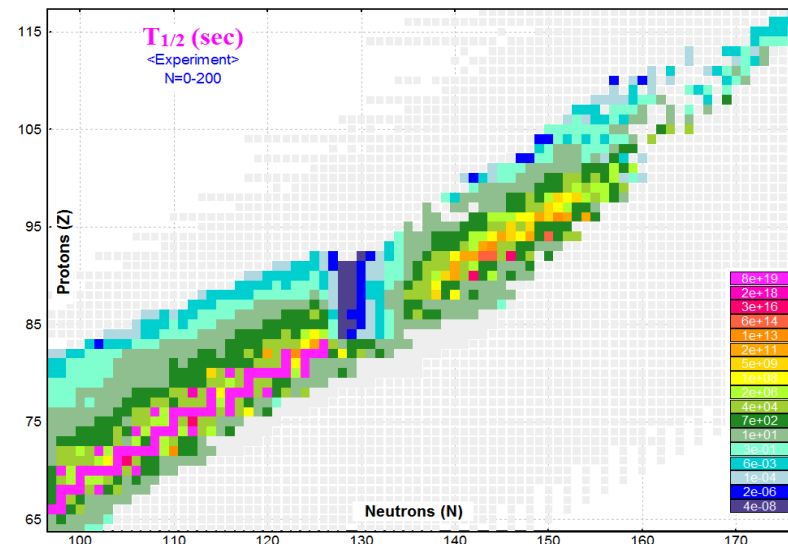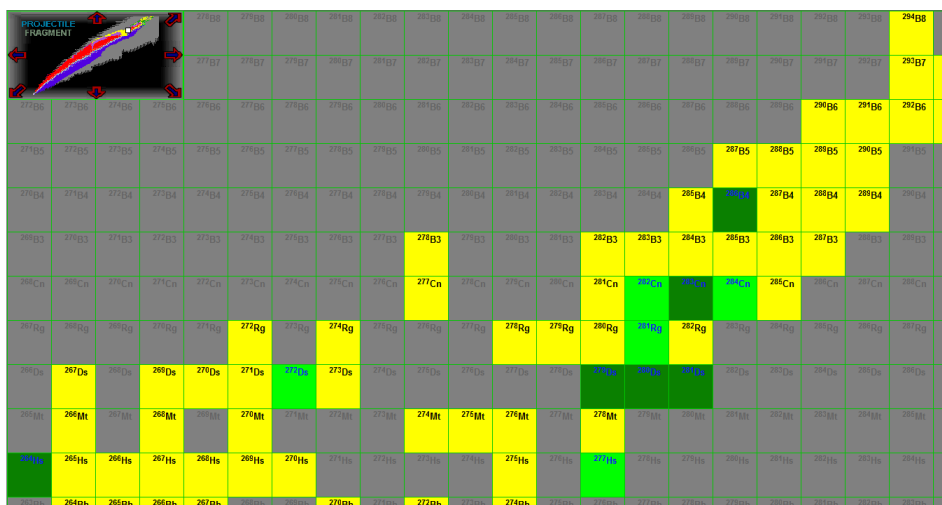
9.2.154 07/12/11   Color editing of the table of nuclides
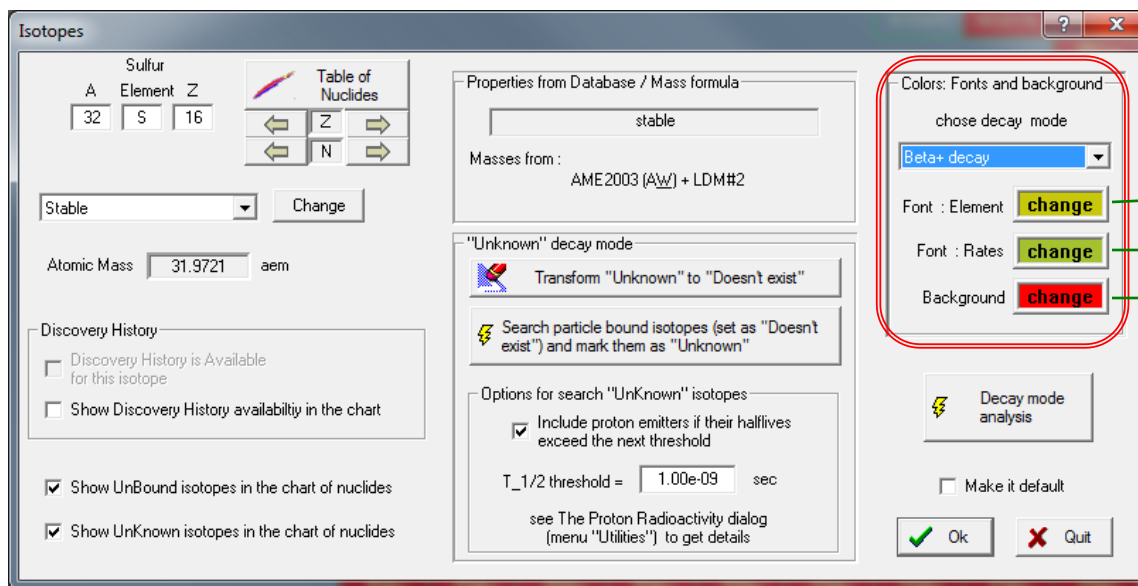
Example of user modifications
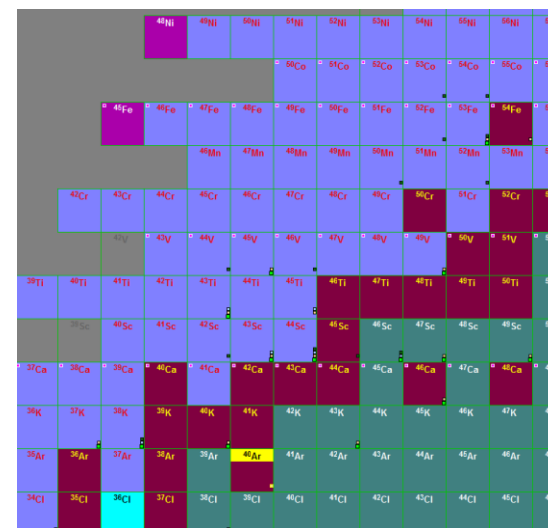
- **Color modifications will be saved in the "lisepp.ini" file (if you have checked "make it default" in the "Isotopes" dialog)**

- **If you want to restore default LISE++ colors, then erase blocks [Decay_Font], [Decay_Background], [Decay_Label] in the "lisepp.ini" file**

9.2.150 06/12/11   Default text font and background colors for the nuclear chart have been changed

Version 9.1

Version 9.2.159

New functions:

- public **find_line** (x1,y1,x2,y2, **x**)

- public **find_parabola** (x1,y1,x2,y2,x3,y3, **x**)

- public **interpolate2** (Xarray, Yarray, **x**)

- private **interpolate3L** (Xarray, Yarray, **x**) **:** based on *find_parabola*. X is between 1st and 2nd parabola points

- private **interpolate3R** (Xarray, Yarray, **x**) **:** based on *find_parabola*. X is between 2nd and 3rd parabola points

- public **interpolate3** (Xarray, Yarray, **x**) **:** combination of interpolate3L and interpolate3R. **Recommended**

Xarray should be sorted!

-778 :   count(Xarray) != count(Yarray)
-777 :   at least one cell in Xarray is not value
-776 :   Xarray order is wrong. Non-sorted
-775:   count(Xarray) < 3
-774:   x < min(Xarray)
-773:   x > max(Xarray)
-771:   at least one cell in Yarray is not value

See example "test_for_lise_excel.xlsx",
Sheet "interpolation"

New functions:

Function **MatrixElement** (ByRef M As Object, ByVal row As Integer, ByVal col As Integer) As Double

Function **GetSquareMatrixOrder** (ByRef M As Object) As Integer

Function **MatricesMult** (ByRef M1 As Object, ByRef M2 As Object, ByVal row As Integer, ByVal col As Integer) As Double

Function **MatrixVectorMult** (ByRef Matrix As Object, ByRef Vector As Object, ByVal row As Integer) As Double

Function **MatrixVectorSumSquare** (ByRef Matrix As Object, ByRef Vector As Object, ByVal row) As Double

See example "**test_for_lise_excel.xlsx**"
 Sheet "matrices"

	1	2	3	4	5	6		1	2	3	4	5	6	
1	0.433	-0.751	0	0		0.852	OI - local	1.32	1.52	1.49	1.00	0	0.070	INIT
2	1.316	0.026	0	0		-17.06		X	A	Y	B	L	D	
3	0	0	1.188	-0.054		0.00								
4	0	0	4.445	0.641		0.00								
5					1									
6						1		SIGMAs						
								1	2	3	4	5	6	
1	0.495	-0.159				-0.683	IF- local	1.28	2.11	1.78	6.68	0	0.070	sigma-I CALC
2	1.658	1.487				24.07								
3			0.937	0.103		0.00								
4			0.146	1.083		0.00								
5					1									
6						1								
	1	2	3	4	5	6		1	2	3	4	5	6	
1	0.005	-0.376				2.454	OF- global	0.60	3.98	2.35	7.49	0	0.070	sigma-G CALC
2	2.674	-1.208				0.12								
3			1.572	0.016		0.00								
4			4.988	0.686		0.00								
5					1									
6						1								

OF_global = IF_local x OI_local

New functions:

- public **A1900_R_Dipole** (N,B), where N – dipole number, B – magnetic field (T); return R in m

- public **A1900_Br_Dipole** (N,B), where N – dipole number, B – magnetic field (T); return Brho in Tm

- private **A1900_R_DipoleX** (B), where X – dipole number, B – magnetic field (T); return R in m

- private **A1900_Br_DipoleX** (B), where X – dipole number, B – magnetic field (T); return Brho in Tm m

A1900 Dipole D1

Hall Probe (Tesla)	Current (amps)	1/2 Effective Length (cm)	R eff (m) @ 45 deg
0.000			
0.653	40	121.511	3.0942
0.975	60	121.400	3.0914
1.211	75	121.297	3.0888
1.716	120	120.064	3.0574
1.822	135	119.708	3.0483
2.020	170	118.440	3.0160
2.057	180	118.258	3.0114
2.100	190	117.790	2.9995

D1 => R_eff(B)

$y = -0.042371x^3 + 0.107587x^2 - 0.097616x + 3.123894$
$R^2 = 0.998957$

A1900 Dipole D2

Hall Probe (Tesla)	Current (amps)	1/2 Effective Length (cm)	R eff (m) @ 45 deg
0.000			
0.954	60	121.302	3.0889
1.259	80	120.816	3.0766
1.513	100	120.352	3.0647
1.697	120	119.669	3.0473
1.837	140	119.147	3.0341
1.948	160	118.495	3.0175
1.994	170	118.176	3.0093

D2 => R_eff(B)

$y = -0.057268x^3 + 0.190835x^2 - 0.249934x + 3.203346$
$R^2 = 0.999154$

A1900 Dipole D2

Legend: 170 A, 160 A, 140 A, 120 A, 100 A, 80 A, 60 A

X-axis: Position along arc length (cm)
Y-axis: Field (kG)

See example "test_for_lise_excel.xlsx"
Sheet "A1900_dipoles"

9.2.132 29/11/11   "inter" modification for Distribution class

9.2.133 30/11/11   "inter2" modification for Distribution2 class

changed from interpolation3L to interpolation3 (universal) : see presentation page

9.2.138 02/12/11   Correction for half-life calculation in the database and isotope dialogs

9.2.142 05/12/11   Revision of mass constants

9.2.143 05/12/11   Corrections for 1D plot legends

9.2.145 06/12/11   New decay spontaneous fission formula : maximum of four other formulas

9.2.157 08/12/11   Mass excess extrapolation is based now on 4 points instead 3 points from previous version