



LISE++ version 9.2.126

from 11/11/11

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- Yield Plot ("Distribution" method) gated on downstream block
- Spontaneous fission dialog & plots
- Corrections: potential energy at fission barrier
- Corrections: Electromagnetic Excitation plot
- New Options for nucleus identification in 2d-plot
- Modification of the "Utilities" menu
- Message (Gauge) how many blocks have remained at reading file



Yield Plot gated on downstream block (1)



Default Disper

Default Disper We

Xispace de

X2 space de Y space de

dE -de

dE2 - de

1st TKE de (Range - det

Plot Options • Only for "Distribution" method 1-D plots & Output in plots Charge states Reactions 2-D PseudoMC plots C One (set by user) One (set by user). All (separate) All (separate) For "Distribution" method just yield is gated, C All (summed) All (summed) not a shape! Outputs in plots just for one selected isotope • Use the MC transmission dialog to see <u>shape</u> changes due to gates on downstream blocks Yield gate from downstream block Use yields after the following dowstream block for "Distribution" plots of upstream blocks FP_PIN Ŧ Example File: gate.lpp Acquisition Start o Number of one-dimensional distributions 40 Start of TOF calc Threshold for two dimensional plate 1 - 10 With applied gate. No gates You should see a message in the top left corner Netd values D1-Xspace: output after slits D1-Xspace: output after slits correspondi ⁴⁷Ar (140.0 MeV/u) + Be (500 µm); Settings on ³²S. Config: DDSWMDDMMSMM #Ar (140.0 MeV/u) + Be (500 µm); Settings on ¹⁰S; Config: DDSWMDDMMSMM FP_PN" dp/p=1.00% ; Wedges: Al (1000 µm); Brho(Tm): 3.4601, 3.4601, 3.3166, 3.3166 block! dpip=1.00% ; Wedges: Al (1000 µm); Bitho(Tm): 3.4601, 3.4601, 3.3166, 3.3166 144 10+2 1041 14+3 (eld (pps/mm) 1e+0 Vield 18-18-3 14+2 18-3 80 40 X (mm) X (mm) Oleg B. Tarasov, 14-Nov-2011, East Lansing



Yield Plot gated on downstream block (2)



Default Disper

Default Disper We

Xispace de

X2 space de Y space de

dE - de

dE2 - de

1st TKE de (Range - det





Spontaneous Fission

249

Z^2/A= 38.6

A Element Z

Alpha decay

Q_symmetr =

Fission barrier =

T1/2, sec 2.3e+09

Result being used in the code

Model = 1

Final result in the code for Spontaneous fission

cf 98

Value

[MeV] 231.09

2.89

lg(T1/2/ yr)

1.86

Spontaneous fission dialog & plots (1)

? X

Properties from Database / Mass formula

Masses from

** Z.Ren & C.Xu, Nuclear Physics A 759 (2005) 64-78

1.1e+10 sec <-- experimental half-life value --> lg (T1/2 / yr) 2.55

🗶 Quit

Decays: Alpha

AME2003 (AW) + LDM#2

(equation 3 in ** [NPA759])

(equation 4 in ** [NPA759])

(equation 5 in ** [NPA759])

(equation 6 in ** [NPA759])

Plot -



• Take care! These parameterizations might be applied for the limited region (see the next slides)

Table of

(= Z

(= N

Nuclides

2.3e+09

2.4e+15

8.7e+14

1.8e+15

Make it default

Spontaneous Fission half-life, sec

Formula 1

O Formula 2

C Formula 3-1

C Formula 3-2

🧹 Ok



ſ	Choose a Plot Type	AND DO NOT THE				
	Select a data set to plot iplot one data set difference between data sets formula 3-2 (NPA759(05)6	Include "unbound" isotopes				
>	Dimension of the plot C ONE-dimensional TWD-dimensional	Plot type C Isotopes, Z=const C Isobars, A=const Isotones, N=const	function of C (protons) C A (nucleons) C N (neutrons)			
	Nmax = 200	C Isospin, N-Z =const C Isospin, N-2Z=const	O N-Z (isospin)			
	D: Color scale board base Internal database valu or calcualtions External source (iso & isolist files)	database)				
	Decay mode filter All modes NZ chart	C All O Odd C Even	OK Cancel			

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Spontaneous fission plots : 4 formulas from NPA759

150











-0-200





10+20

10+27 18+26

1e+25

18+24

1e+23

10+22 10+21

18+20

18+15

10+17 10+16 14+15

10+14 18+13 18+12 10+11 10+10

18+5

18+8 18+7 18+6 1e+5

10+4 1e+3 1e+2

18+1

1e+0

136

on half-life 10+18 Spontaneous fission half-life

dormula 3-2 (NPA759(05)64)>

Z+94-98 even

140

144

Spontaneous fission dialog & plots (3)

- 2-90 Z+08





Z. Ren, C. Xu / Nuclear Physics A 759 (2005) 64-78



Fig. 4. Comparison of experimental half-lives and theoretical ones of spontaneous fission for nuclear ground state of Pu, Cm, and Cf isotopic chains. The even-odd effect of half-lives for an isotopic chain is clearly seen although some experimental points of odd-A nuclei are not available now

Cluster Radioactivity Paren Masses from AME 2003 (A/w/) + LDM#2 Element Z 249 cf 90 PHYSICAL REVIE 79,064616 (2009) ¢ Alpha decas 4 N => Expt. Parent Chu 1. proton_f Half-lives Cluster (Lighter product) in LISE++ 107Zr Choose @ 0-turnel f $\log_{10} T_{1/2}$ Abres # C 1 - proton_f 222 Ra HC 1.0475 11.01 Residue (Heavier product) ŕΤh ¹⁸O 1.075 >15.3 142Ce 228 T 20O mission 1.025 20.87 cha 231 Pa 23F 1.00 >24.61 Log10[T1/2[sec]] VAL 250 U No 1.04 >18.2 [MeV] 17.96 232 U ^{24}N 0.99 Excitation 21.05 n energi 234U ²⁶Ne 1.01 25.06 Q cluster 269.45 Make it default 236Pu 28 Mg 0,981 21.67 238 Pu 30 Mg 0.986 25.70 ³⁴Si 🖌 Ok X Qut 242Cm 0.981 23.24

148 N

152

155

The cluster radioactivity dialog cannot be used to estimate spontaneous fission half-lives. Fission barrier penetration* should be used (instead using CB).

Under construction

* For example N.R.Dagdeviren and H.Aweidenmuller, PLB 186 (1987) 267 S.Levit et al., PRC 22 (1980) 1979 R.Smolanczuk et al., PRC 52 (1995) 1871

Corrections: potential energy at fission barrier (1)





Oleg B. Tarasov, 14-Nov-2011, East Lansing

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Coulomb fission of ¹⁸⁰Hg : fission properties (2)



File: 180Hg_Coulex.lpp

Fission properties	
Cross sections ✓ Use Odd-Even corrections for fragments ✓ Include post-scission (n,p,a) evaporation Parameters for shell structures ** Shell position Strength Curvature (N sh.i) (dUi) (MeV) (2C sh.i) (MeV) 1 83 - 2.65 0.7 2 62 - 4.5 0.15 1 83 - 2.65 0.7 2 62 - 4.5 0.15 1 9 Potential energy plot €+€ Put original values *1* €+€ Put vi2005'' values *2* *1* J.Benlikire et al., NPA628(1998)458 *2" see LISE++ v.7.5 documentation Cross section suppression values ↓ OK ↓ Cancel ♀ Help	Fragment excitation (TXE) depends on Image: Dissipated energy [NPA 628(1998)458] TXE = E* - Bf + Edis Reaction Q-value [EPhys.lA14(2002)459] TXE = (a1 + a2) (f Q)^2 + E* f = 0.005 default f. Do not use Image: Use for all Angular Distributions (default) Angular distribution shape Isotropic Isotropic Make default

- The "shell" position N=62 has been chosen in order to correspond Z=48, because
- C. Böckstiegel et al., Nuclear Physics A 802 (2008) 12-25 :

"The most salient feature is that the positions of the heavy components of the asymmetric fission channels do not vary in atomic number, while they move strongly in mass as well as in neutron number."

LISE⁺⁺ perspective:

create an option to set Z-shell positions for potential energy





Fig. 4. (Coloor online.) Mean positions of the standard fission channels in atomic number (upper part) and neutror number (lower part) deduced from the data in Fig. 3. Values were converted from measured atomic numbers or mass numbers using the unchanged-charge-density assumption and neglecting neutron evaporation. The shape of the symbol denotes the element as given in the legend of the figure. Data from the present experiment are marked by solid symbols. The values of standard I (standard II) for the isotopes of a given element are connected by dashed (full) lines and marked by red (blue) symbols.



Coulomb fission of ¹⁸⁰Hg (3)

LISE ---

Correction were done with connection to the work of A.N.Andreev et al., PRL 105, 252502 (2010)

File: 180Hg_Coulex.lpp

1D-F	Plot	2D-Plot	Databases	Help		_	
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	Ver	tical (Y) sp	ace distribut	tions		۶.	Sot in LISI
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	Tot	al Kinetic I	Energy distrik	outions		۲.	Should be
	Deb	oug distrib	utions			۶.	Deformatio
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According to the authors $Z_H = 44(2)$ and $Z_L = 36(2)$. Set in LISE++ the "shell" position at N=56?

Should be explained why this position... Deformation should be taken into account according to the work of P.Moller et al., PHYSICAL REVIEW C 79, 064304 (2009)



FIG. 4 (color online). The derived fission-fragment distribution of ¹⁸⁰Hg as a function of the fragment mass and the total kinetic energy.



Neutrons (N)

Cross sections (Coulomb fission)





Coulomb fission of ¹⁸⁰Hg (4)



Correction were done with connection to the work of A.N.Andreev et al., PRL 105, 252502 (2010)

File: <u>180Hg_Coulex.lpp</u>

1D-Plot 2D-Plot Databases Help		
Block selection distributions		
Angular distributions		
Horizontal (X) space distributions	*	
Vertical (V) space distributions		
Momentum distributions		
Energy distribution		
Total Kinetic Energy distributions	•	
Debug distributions	•	
Debug information		
Brho selection plot		
Wedge selection plot		
Isomeric Gamma spectrum	•	
Transmission characteristics		
Range distributions		
Charge distributions		
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Cross Section distributions		
Q-gg distributions		
Q-g distributions	· · · · · ·	
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Electromagnetic & EM Fission cross sections







See more for PID plots at : <u>http://groups.nscl.msu.edu/lise/9_2/9_2_57.pdf (page 7)</u>

- 1) white color is available
- 2) "+4,+5,+6" sizes are available
- 3) option using "s" or "sec" is available.





Modification of the "Utilities" menu & Message (Gauge) : how many blocks have remained at reading file





If the number of blocks in a file is more than 30



