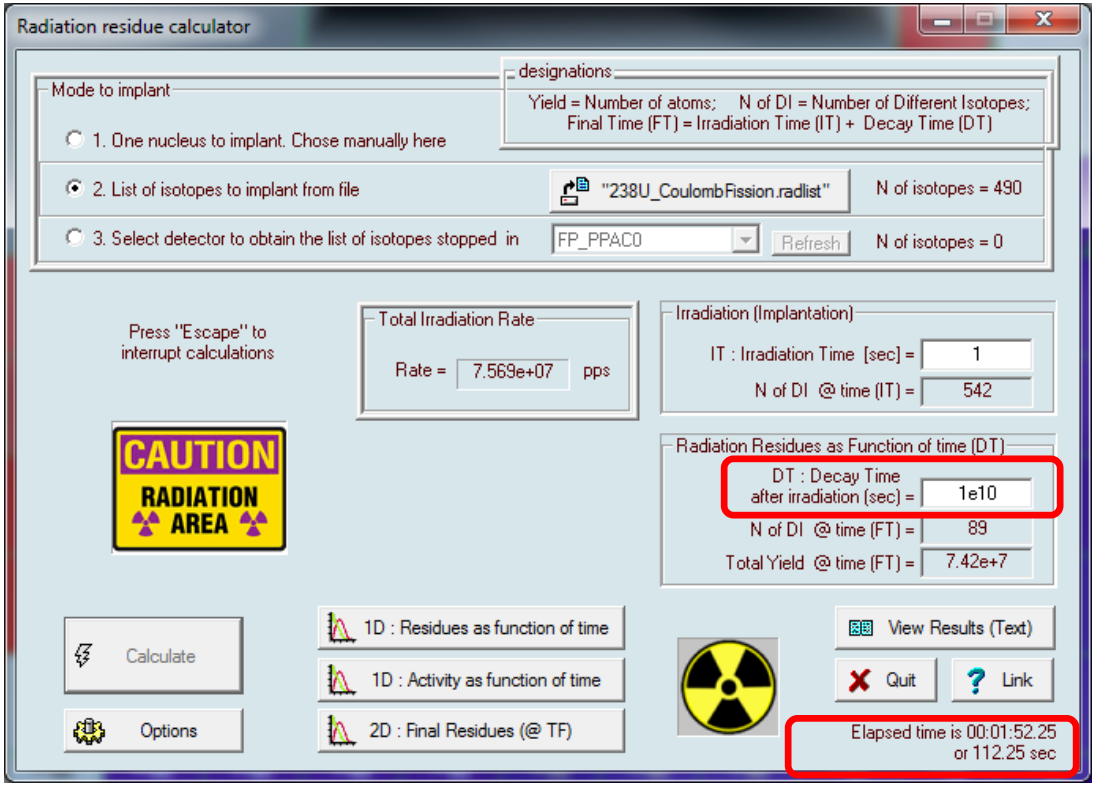
^{238}U fission case calculation : version from 11/03/16

File: http://lise.nscl.msu.edu/9_10/radiation/238U_CoulombFission.radlist

This file has been produced by LISE^{++} with next settings and Coulomb Fission mechanism



→ **Decay time 317 years**

→ **Takes 2 minutes**

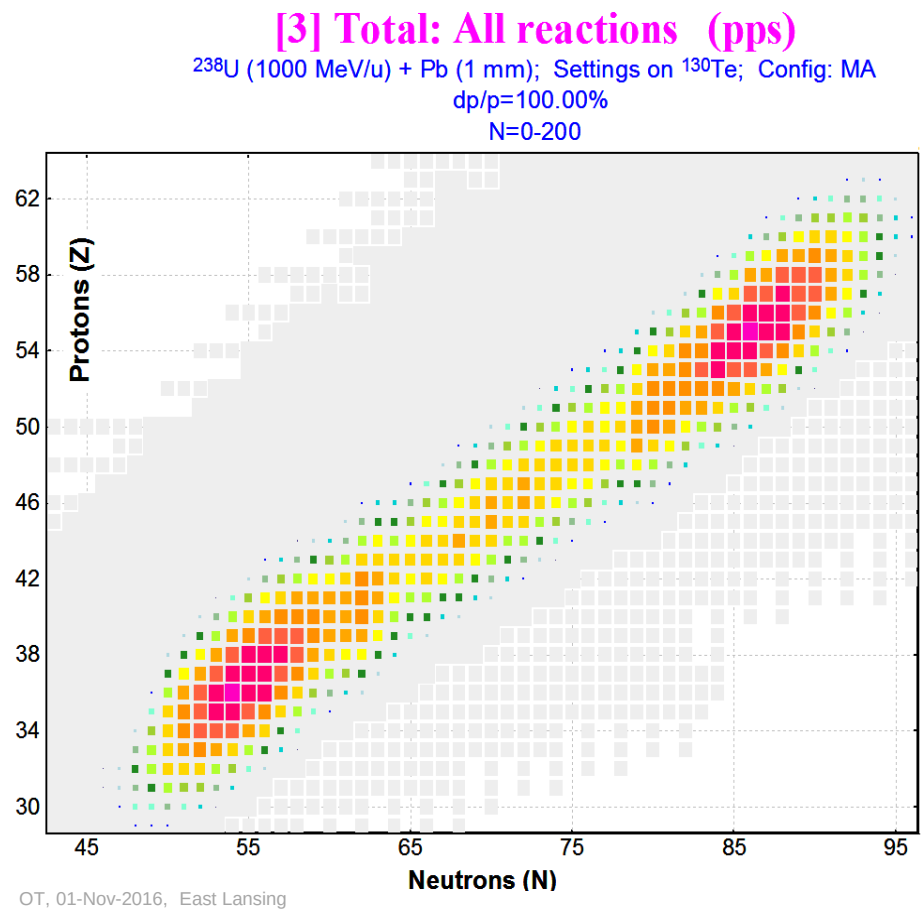
^{238}U fission case calculation

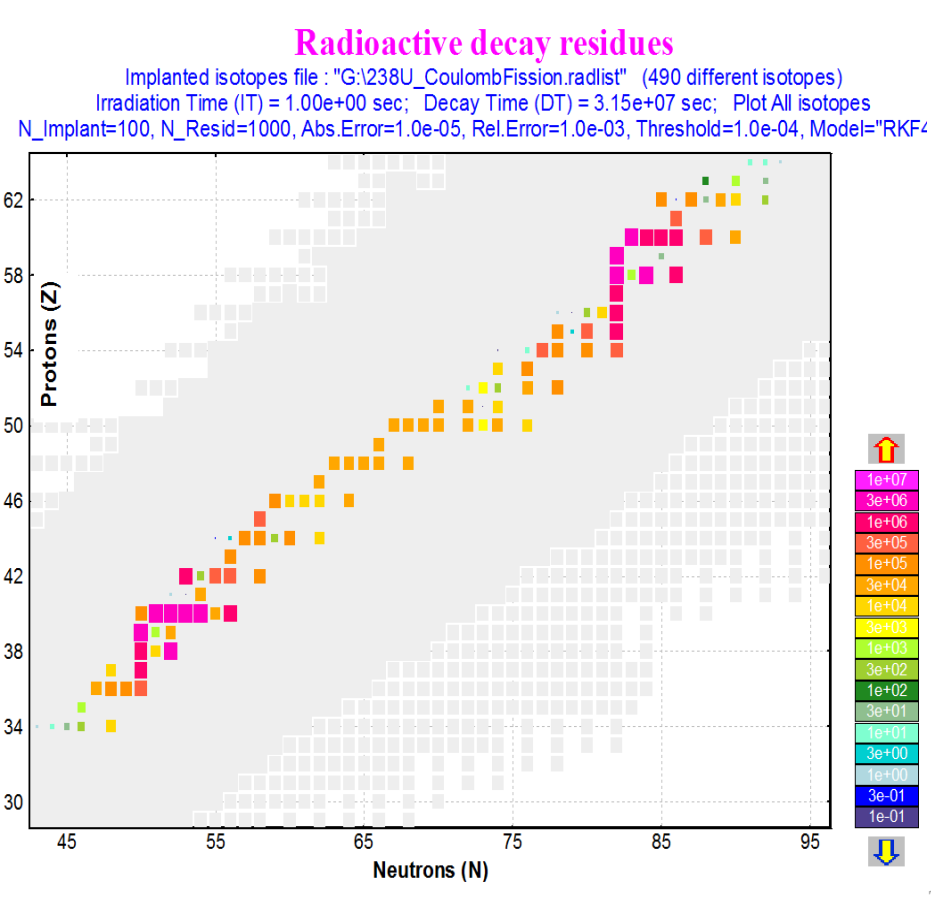
Implanted isotopes

(number of different isotopes is 490)

Radiation Residues after 1000 year decay time

(number of different isotopes is 122)





Wiki : Long-lived fission product

https://en.wikipedia.org/wiki/Long-lived_fission_product

Actinides and fission products by half-life V·T·E

Actinides[3] by decay chain				Half-life range (y)	Fission products of ^{235}U by yield[4]		
4n	4n+1	4n+2	4n+3		4.5–7%	0.04–1.25%	<0.001%
$^{228}Ra^{№}$				4–6 †		$^{155}Eu^{þ}$	
$^{244}Cm^{f}$	$^{241}Pu^{f}$	^{250}Cf	$^{227}Ac^{№}$	10–29	^{90}Sr	^{85}Kr	$^{113m}Cd^{þ}$
$^{232}U^{f}$		$^{238}Pu^{f№}$	$^{243}Cm^{f}$	29–97	^{137}Cs	$^{151}Sm^{þ}$	^{121m}Sn
$^{248}Bk^{[5]}$	$^{249}Cf^{f}$	$^{242m}Am^{f}$		141–351	No fission products have a half-life in the range of 100–210 k years ...		
	$^{241}Am^{f}$		$^{251}Cf^{f}[6]$	430–900			
		$^{226}Ra^{№}$	^{247}Bk	1.3 k – 1.6 k			
$^{240}Pu^{f№}$	$^{229}Th^{№}$	$^{246}Cm^{f}$	$^{243}Am^{f}$	4.7 k – 7.4 k			
	$^{245}Cm^{f}$	^{250}Cm		8.3 k – 8.5 k			
			$^{239}Pu^{f№}$	24.1 k			
		$^{230}Th^{№}$	$^{231}Pa^{№}$	32 k – 76 k			
$^{236}Np^{f}$	$^{233}U^{f№}$	$^{234}U^{№}$		150 k – 250 k ‡	$^{99}Tc^{₡}$	^{126}Sn	
^{248}Cm		$^{242}Pu^{f}$		327 k – 375 k		$^{79}Se^{₡}$	
				1.53 M	^{93}Zr		
	$^{237}Np^{f№}$			2.1 M – 6.5 M	$^{135}Cs^{₡}$	^{107}Pd	
$^{238}U^{№}$			$^{247}Cm^{f}$	15 M – 24 M		$^{129}I^{₡}$	
$^{244}Pu^{№}$				80 M	... nor beyond 15.7 M years[7]		
$^{232}Th^{№}$		$^{238}U^{№}$	$^{235}U^{f№}$	0.7 G – 14.1 G			

Legend for superscript symbols
₡ has thermal neutron capture cross section in the range of 8–50 barns
f fissile
m metastable isomer
№ naturally occurring radioactive material (NORM)
þ neutron poison (thermal neutron capture cross section greater than 3k barns)
† range 4–97 y: Medium-lived fission product
‡ over 200,000 y: **Long-lived fission product**

https://en.wikipedia.org/wiki/Long-lived_fission_product

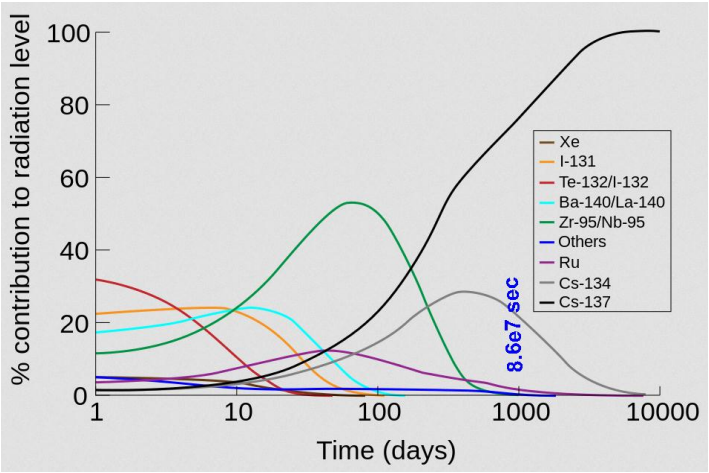
Medium-lived fission products

Prop:	$t_{½}$	Yield	Q *	βγ *
Unit:	(a)	(%)	(keV)	
^{155}Eu	4.76	0.0803	252	βγ
^{85}Kr	10.76	0.2180	687	βγ
^{113m}Cd	14.1	0.0008	316	β
^{90}Sr	28.9	4.505	2826	β
^{137}Cs	30.23	6.337	1176	βγ
^{121m}Sn	43.9	0.00005	390	βγ
^{151}Sm	96.6	0.5314	77	β

Long-lived fission products

Prop:	$t_{½}$	Yield	Q *	βγ
Unit:	(Ma)	(%)	(keV)	*
^{99}Tc	0.211	6.1385	294	β
^{126}Sn	0.230	0.1084	4050	βγ
^{79}Se	0.327	0.0447	151	β
^{93}Zr	1.53	5.4575	91	βγ
^{135}Cs	2.3	6.9110	269	β
^{107}Pd	6.5	1.2499	33	β
^{129}I	15.7	0.8410	194	βγ

Hover underlined: more info



Summary of runs

RKF45

ODE method

step	decay time , s	N of Isotopes	atoms	**elapsed time, s**	Implantation Steps	Decay steps	AbsErr	RelErr	Threshold	T1/2 MIN	T1/2 MAX		*decay time , years*
1	1E+10	82	7.42E+07	**201.8**	100	1000	1E-01	1E-04	1E-01	1E-01	1E+15	STIFFNESS622	*3.2E+02*
2	1E+10	89	7.42E+07	**112.3**	100	1000	1E-01	1E-04	1E-01	1E-01	1E+15		*3.2E+02*
3	1E+10	89	7.44E+07	**676.1**	100	1000	1E-02	1E-04	1E-02	1E-01	1E+15		*3.2E+02*
4	1E+11	91	7.44E+07	**946.2**	100	10000	1E-04	1E-04	1E-05	1E-01	1E+15	STIFFNESS 812	*3.2E+03*
5	1E+11	85	7.42E+07	**115.5**	100	1000	1E-01	1E-04	1E-01	1E+00	1E+15		*3.2E+03*
6	1E+11	87	7.44E+07	**1193.5**	100	3000	1E-03	1E-04	1E-03	1E+00	1E+15		*3.2E+03*
7	1E+11	94	7.46E+07	**1468.6**	100	10000	1E-04	1E-04	1E-05	1E-01	1E+15		*3.2E+03*
8	1E+11	91	7.46E+07	**1328.6**	100	10000	1E-04	1E-04	1E-05	1E-01	1E+15		*3.2E+03*
9	1E+12	97	7.48E+07	**2406.4**	100	10000	1E-05	1E-04	1E-06	1E-01	1E+15		*3.2E+04*
10	1E+08	118	7.52E+07	**433.9**	100	10000	1E-05	1E-04	1E-06	1E-01	1E+15		*3.2E+00*

^{238}U fission case calculation : 3.2 years decay time

step	decay time , s	N of Isotopes	atoms	elapsed time, s	Implantation Steps	Decay steps	AbsErr	RelErr	Threshold	T1/2 MIN	T1/2 MAX		decay time , years
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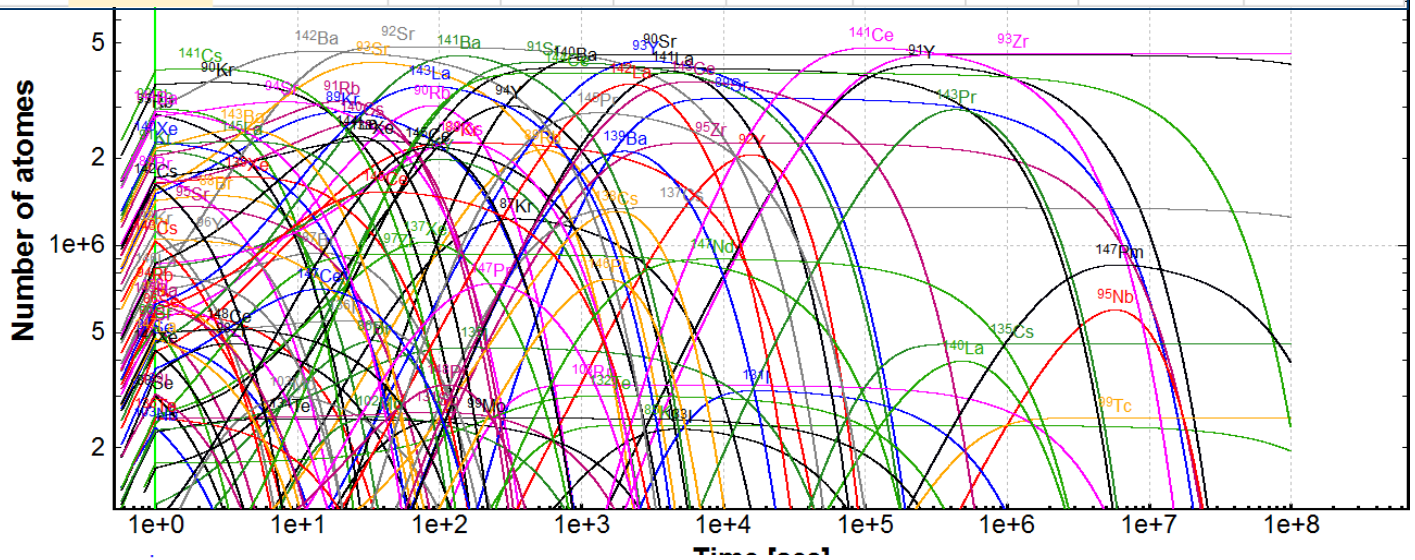
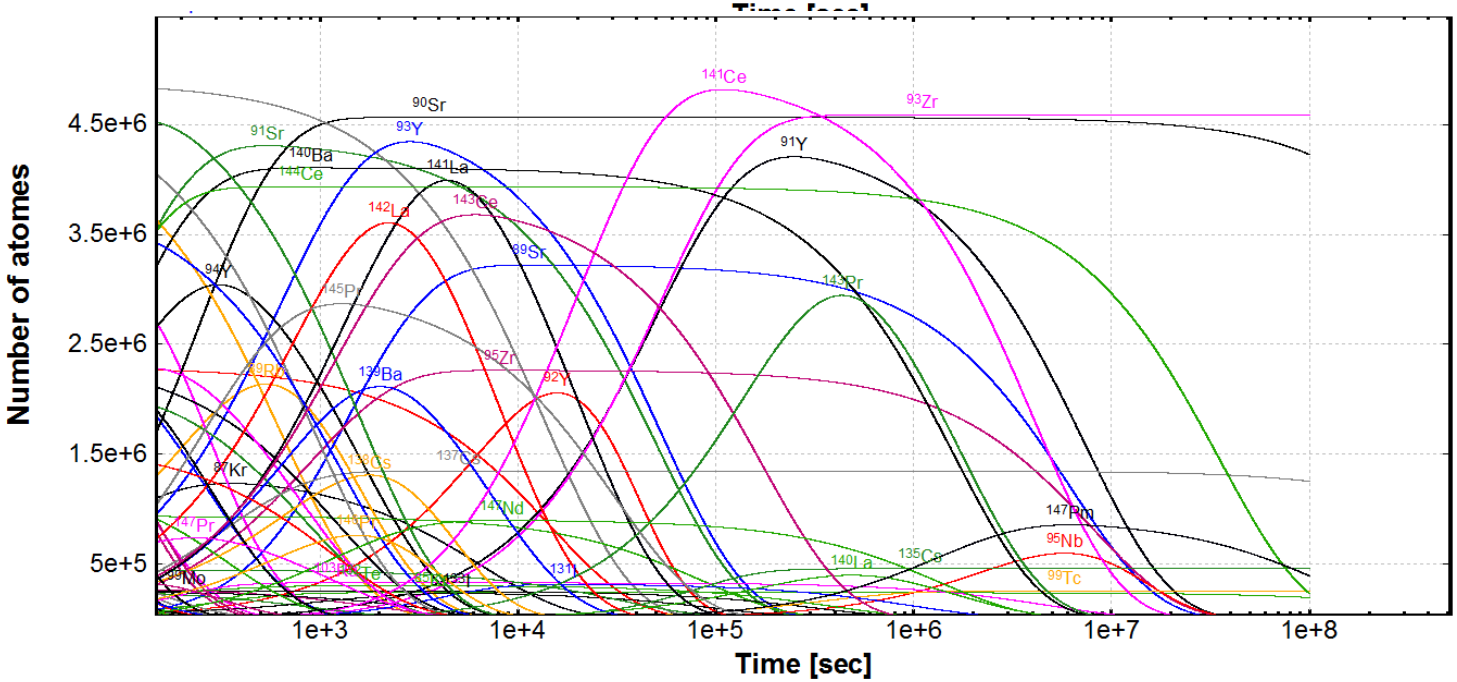
Only radioactive residues





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Zoom Z=40 region

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Medium-lived fission products

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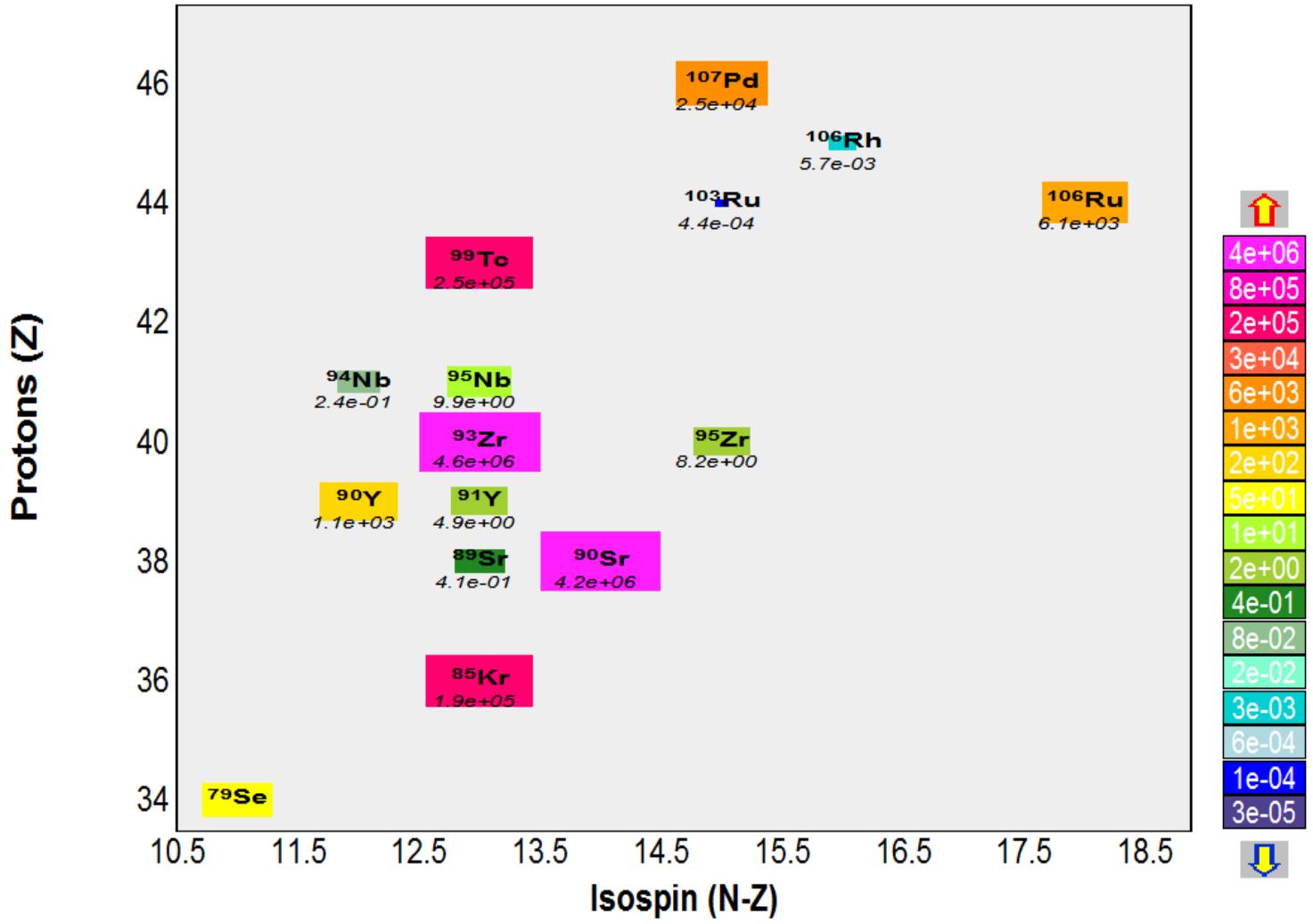
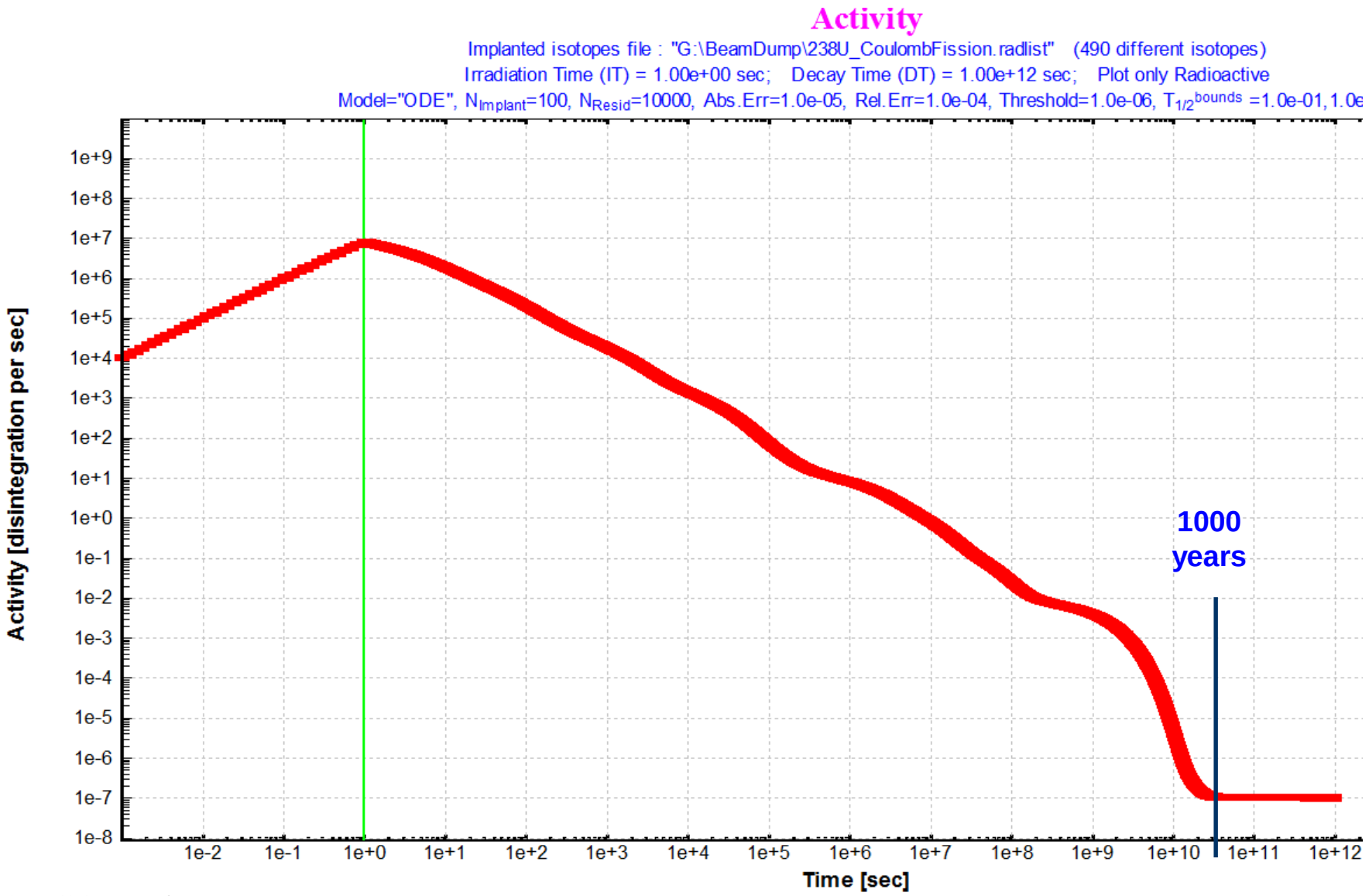


^{238}U fission case calculation : 3.2e4 years decay time

step	decay time , s	N of Isotopes	atoms	elapsed time, s	Implantation Steps	Decay steps	AbsErr	RelErr	Threshold	T1/2 MIN	T1/2 MAX		decay time , years
9	1E+12	97	7.48E+07	2406.4	100	10000	1E-05	1E-04	1E-06	1E-01	1E+15		3.2E+04



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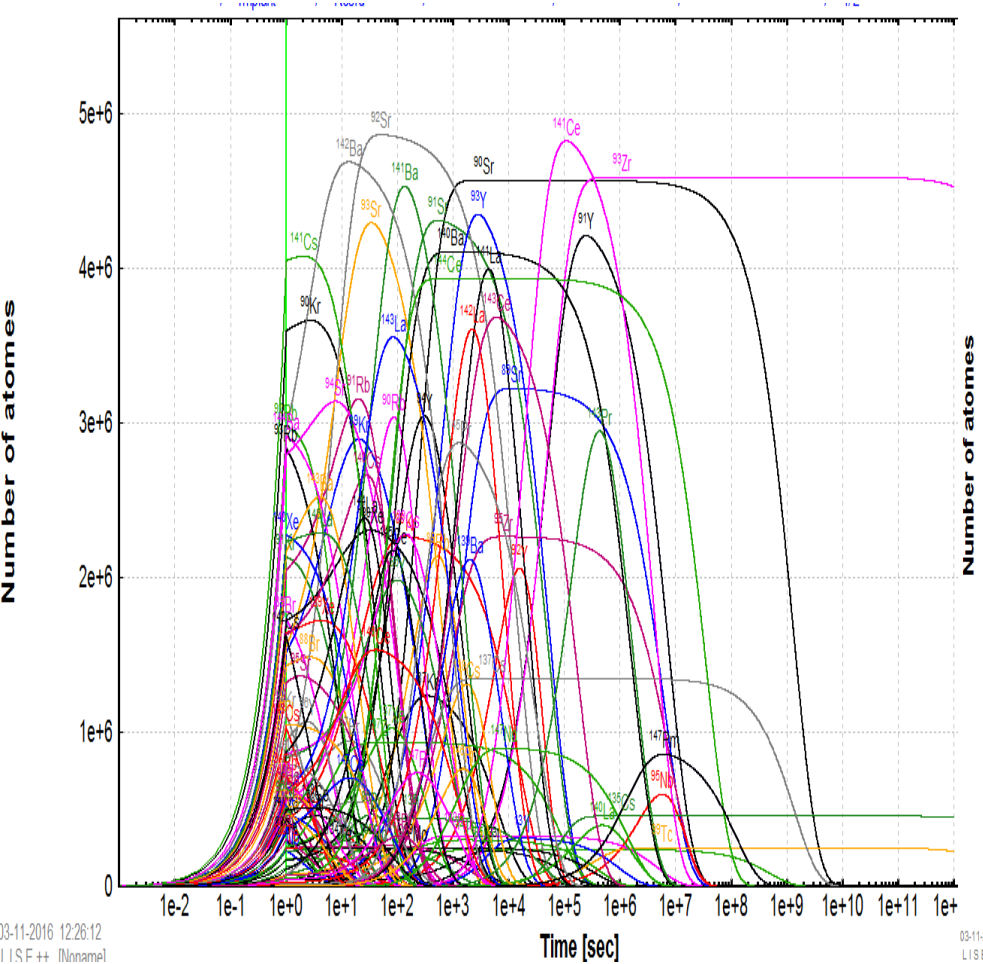

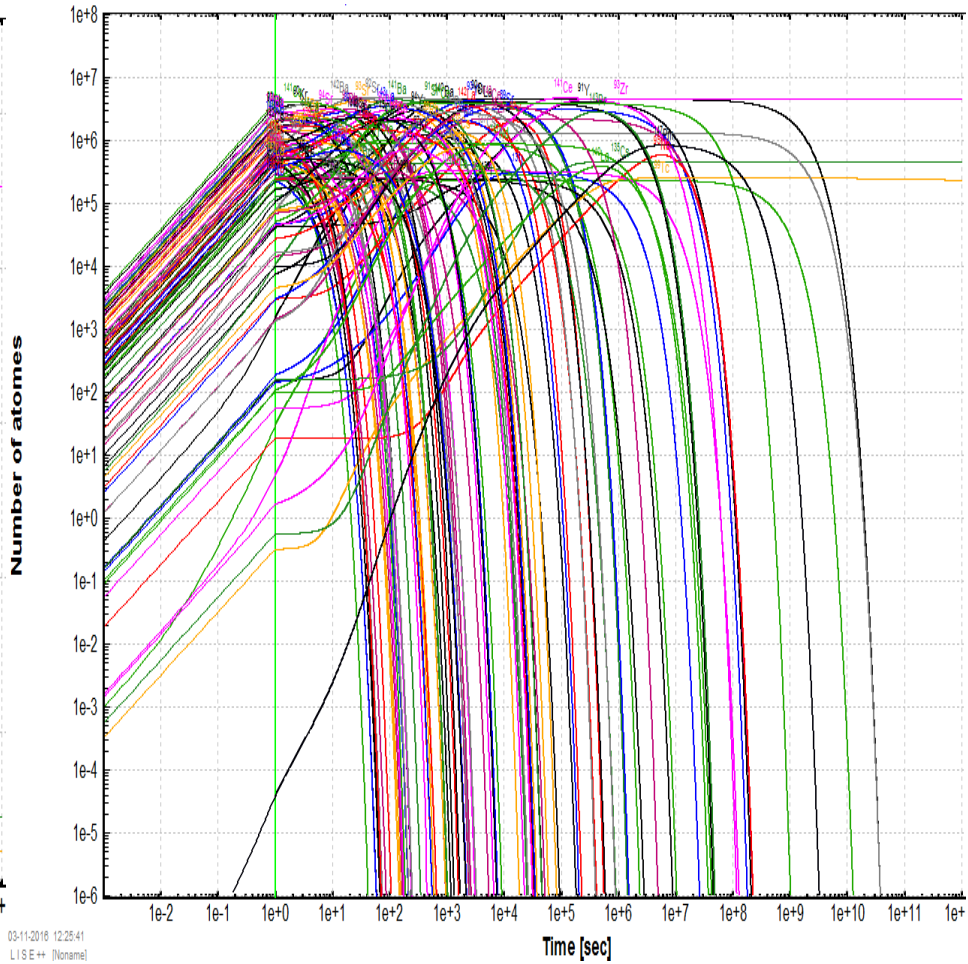

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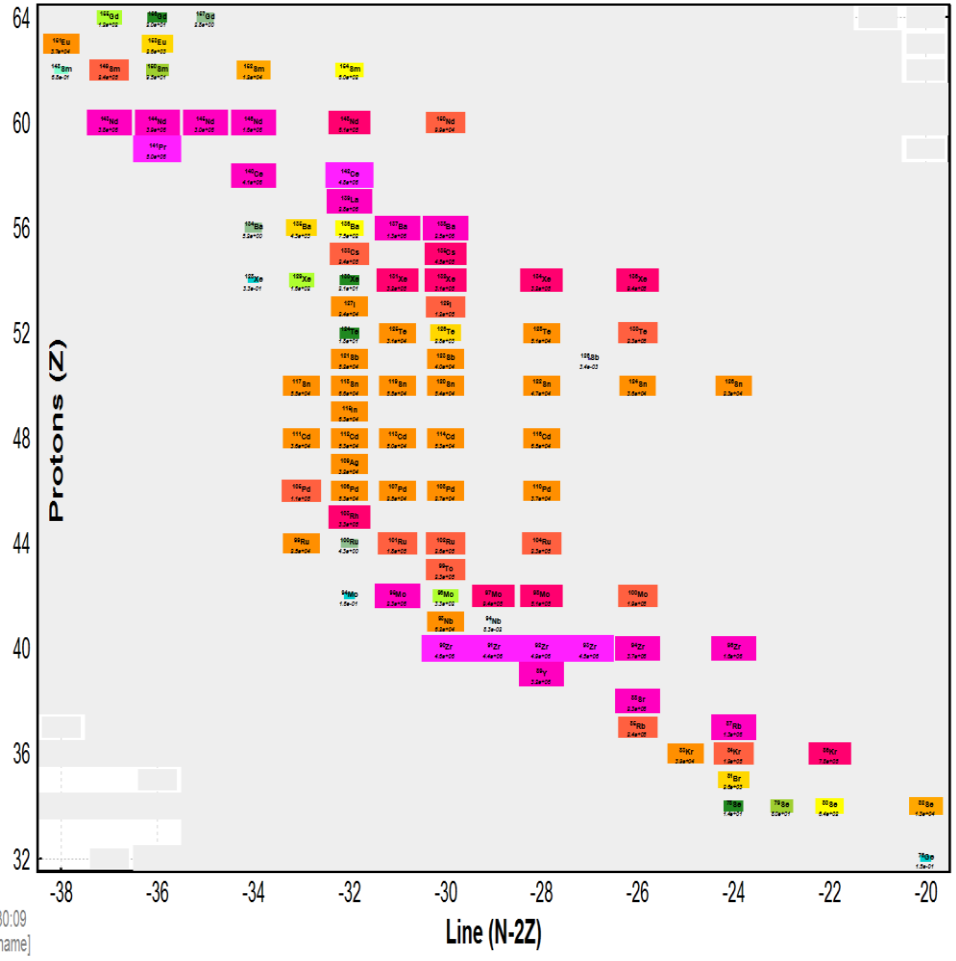
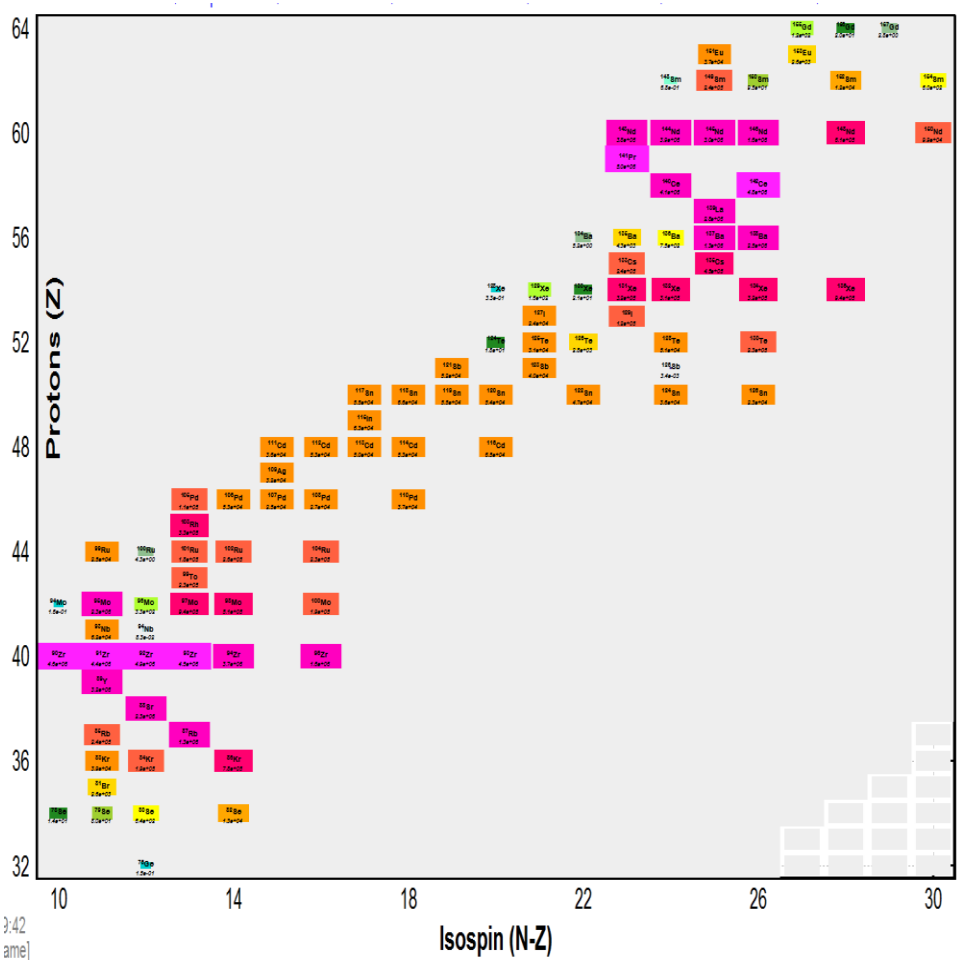
All residues





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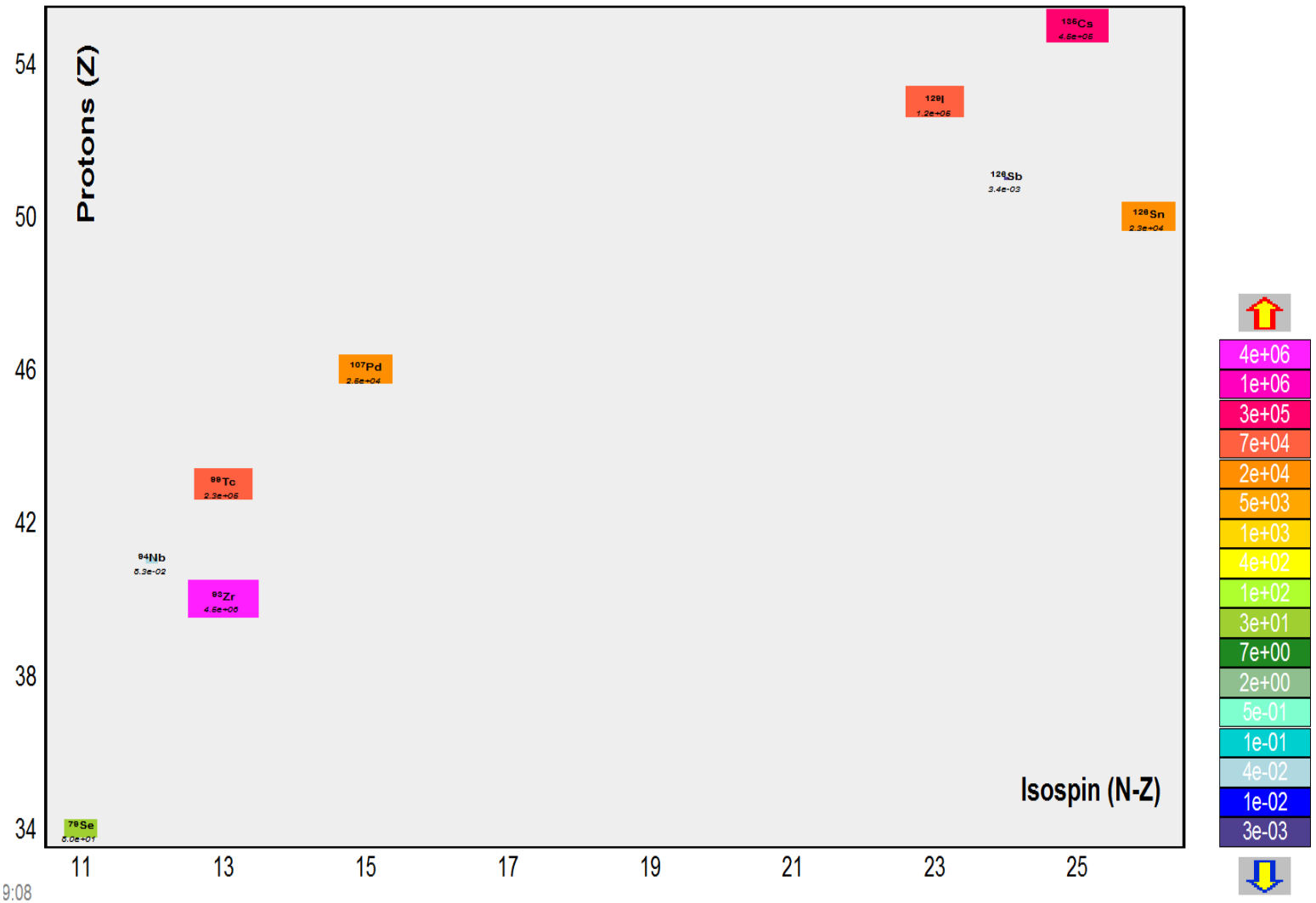

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