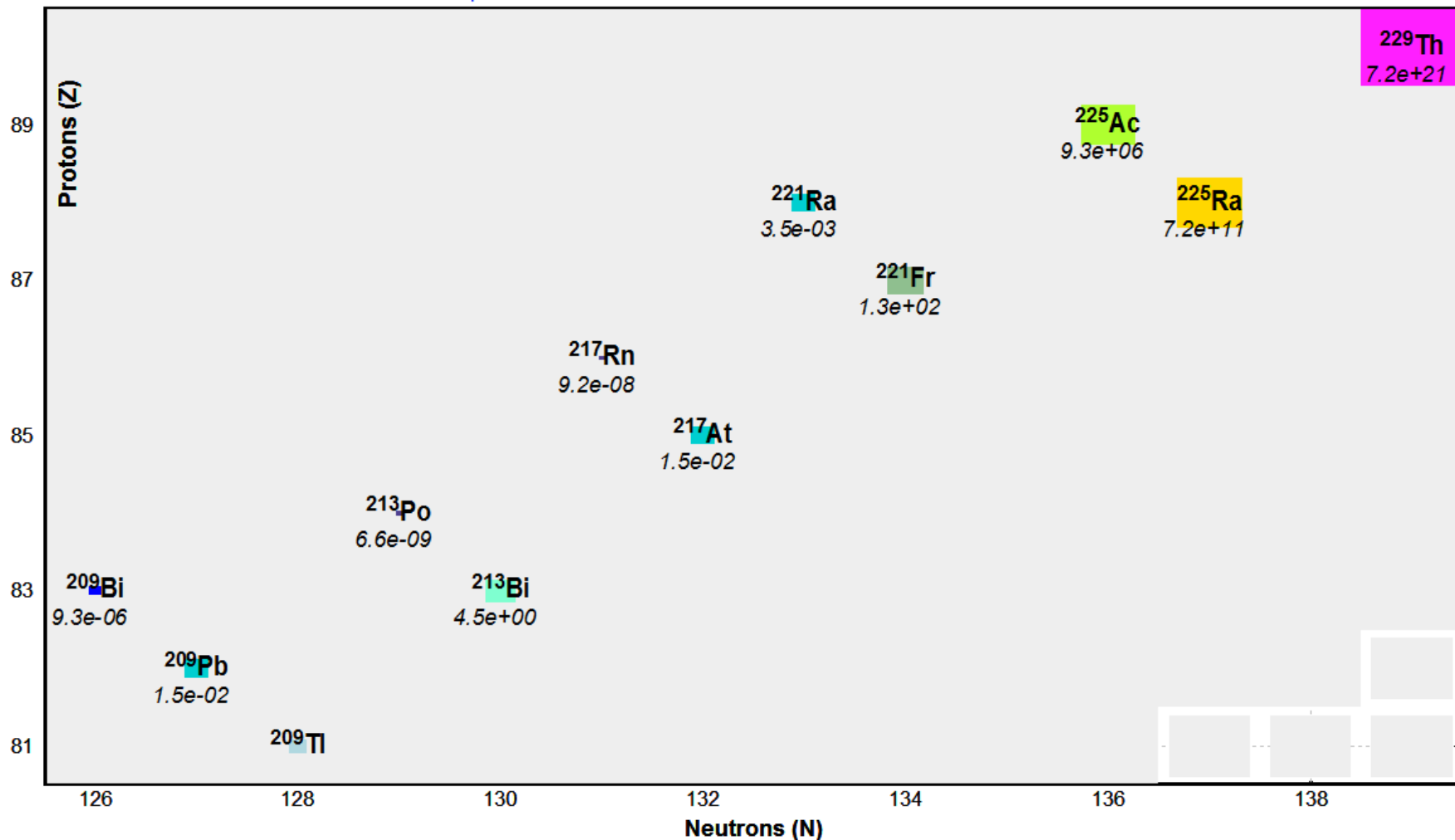


Decay time $1\text{e-}7$ sec, 12 isotopes, no stiffness

Radioactive decay residues

Initial isotope: ^{229}Th

Irradiation Time (IT) = $1.00\text{e}+02$ sec; Decay Time (DT) = $1.00\text{e-}07$ sec; Irr.Rate = $1.00\text{e}+20$ pps; Plot All isotopes
 Model="ODE", $N_{\text{Implant}}=10$, $N_{\text{Resid}}=100$, Abs.Err= $1.0\text{e-}10$, Rel.Err= $1.0\text{e-}05$, Threshold= $1.0\text{e-}40$, $T_{1/2}^{\text{bounds}} = 1.0\text{e-}20, 1.0\text{e}+20$



^{229}Th case : $1\text{e}13$ years decay time

Radiation residue calculator

Mode to implant:

- ☒ 1. One nucleus to implant. Chose manually here
- ☐ 2. List of isotopes to implant from file
- ☐ 3. Select detector to obtain the list of isotopes stopped in

designations:

Yield = Number of atoms; N of DI = Number of Different Isotopes;
Final Time (FT) = Irradiation Time (IT) + Decay Time (DT)

no file N of isotopes = 0

FP_PPACO Refresh N of isotopes = 0

1. Chose fragment to implant

A	Element	Z
229	th	90

Alpha decay

$T_{1/2} = 2.50\text{e}+11$ sec

Implantation Rate = $1\text{e}+20$ pps

Yield of this nucleus @ Irradiation time (IT) = $1\text{e}+20$

Yield of this nucleus @ Final time (FT) = $1\text{e}+20$

Irradiation (Implantation)

IT : Irradiation Time [sec] = 1

N of DI @ time (IT) = 12

Radiation Residues: Stiffness starts @ 255 step

DT : Decay Time after irradiation (sec) = $1\text{e}+13$

N of DI @ time (FT) = 11

Total Yield @ time (FT) = $1\text{e}+20$

Calculate

Options

1D : Residues as function of time

1D : Activity as function of time

2D : Final Residues (@ TF)

CAUTION RADIATION AREA

View Results (Text)

Quit

Link

Elapsed time is 00:03:27.25 or 207.25 sec

Radiation residue calculator settings

Integration model:

- ☒ ODE (ordinary differential equation solver) ISBN: 0716704617
- ☐ RK45 (Runge-Kutta-Fehlberg ODE solver)
- ☐ Numerical Recipes: ODEINT
- ☐ Numerical Recipes: STIFF
- ☐ Numerical Recipes: STIFBS

Isotopes to plot:

- ☒ ALL (Stable & Radioactive)
- ☐ only Radioactive
- ☐ only Stable

2D-plot:

- ☒ Z vs. N
- ☐ Z vs. N-Z
- ☐ Z vs. N-ZZ

Half-life boundaries (sec)

$T_{1/2_min} = 1.0\text{e}-04$ "unbound" below this value

$T_{1/2_max} = 1.0\text{e}+20$ "stable" above this value

$1\text{e}-19 < T_{min} < T_{max} < 1\text{e}+20$

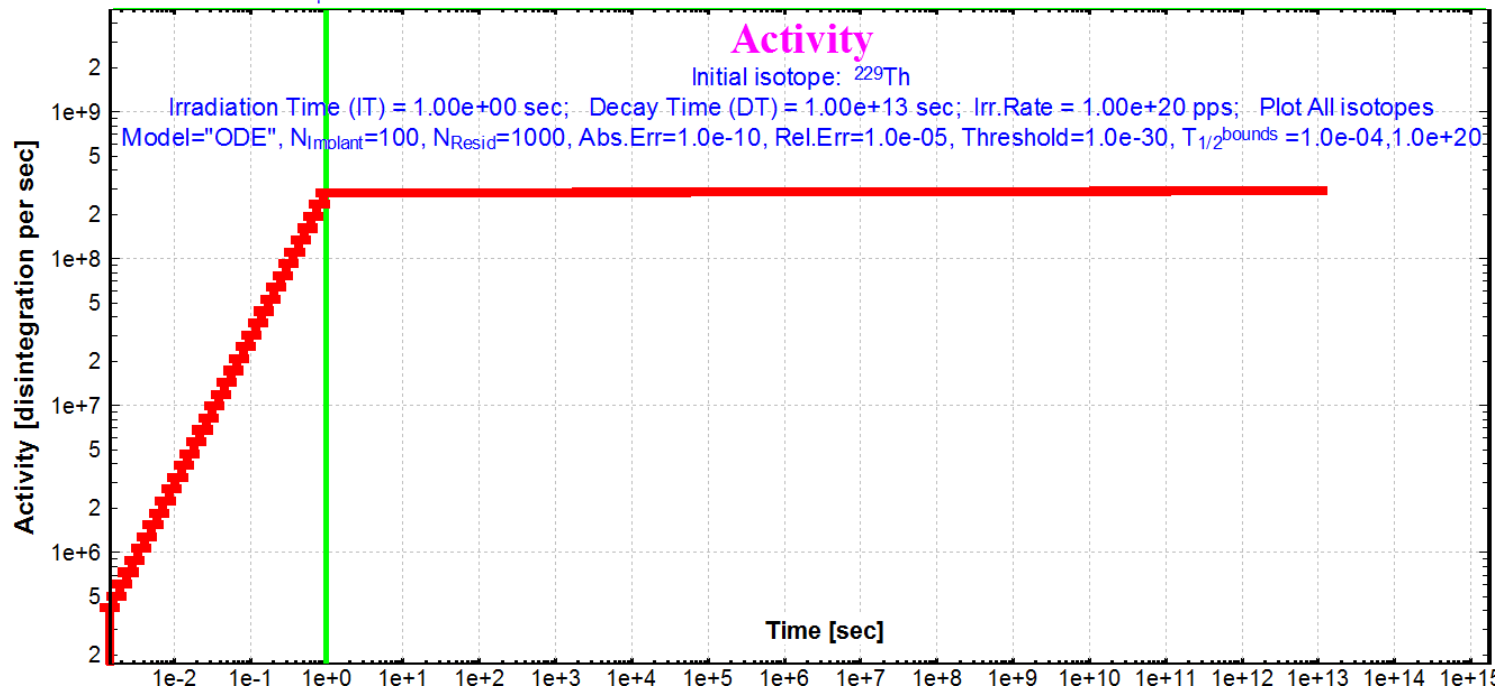
☒ "Isotope conservation law" (apply primary irradiation rates of eliminated nuclei to their daughters)

Number of non-dimensional distributions: 100

Make default ☒ Ok ☐ Cancel

Option	Value	Description	Default value
N_Implant	100	number of points : Irradiation	100
N_Decay	1000	number of points : DECAY	100
AbsError	$1.000\text{e}-10$	absolute error tolerance	$1\text{e}-11$
RelError	$1.000\text{e}-05$	relative error tolerance	$1\text{e}-03$
Y_thrsld	$1.000\text{e}-30$	Minimum yield value	$1\text{e}-10$

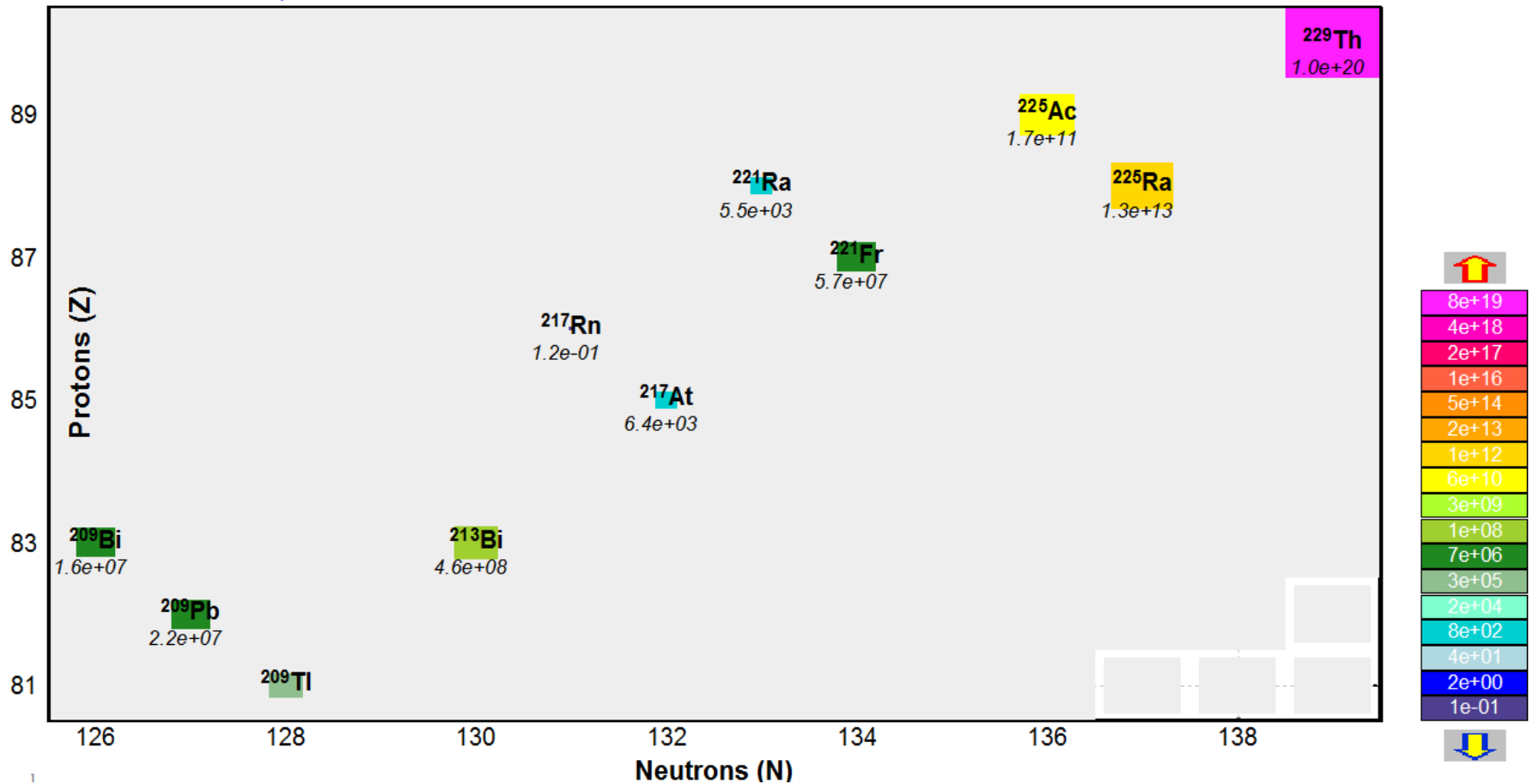
At each step for first two models, the code requires
absl local error $l \leq \text{abs}(Y) * \text{RelErr} + \text{AbsErr}$



Radioactive decay residues

Initial isotope: ^{229}Th

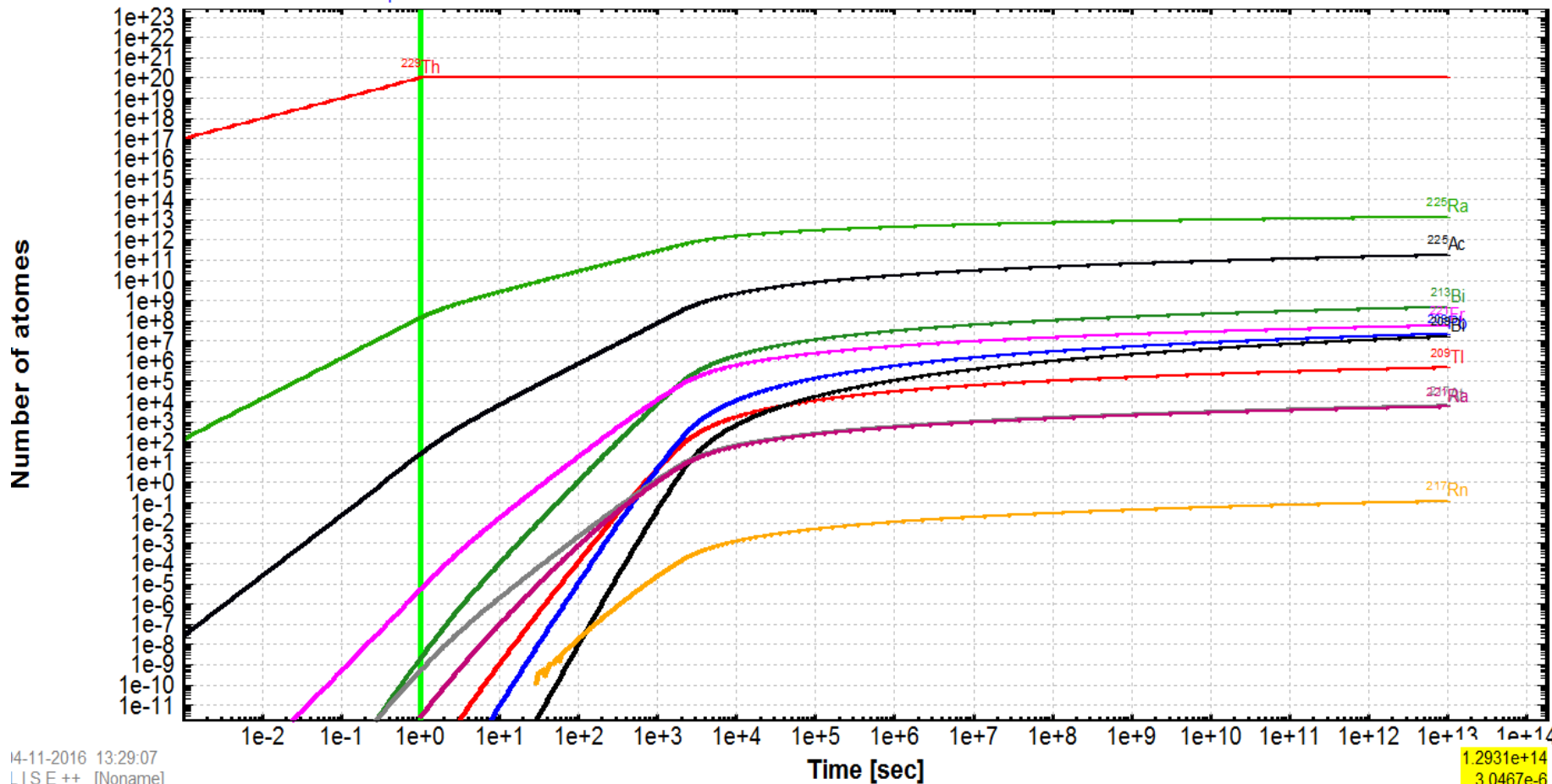
Irradiation Time (IT) = $1.00\text{e}+00$ sec; Decay Time (DT) = $1.00\text{e}+13$ sec; Irr.Rate = $1.00\text{e}+20$ pps; Plot All isotopes
Model="ODE", $N_{\text{Implant}}=100$, $N_{\text{Resid}}=1000$, Abs.Err= $1.0\text{e}-10$, Rel.Err= $1.0\text{e}-05$, Threshold= $1.0\text{e}-30$, $T_{1/2}^{\text{bounds}}=1.0\text{e}-04, 1.0\text{e}+20$



Evolution of Radiation Residue Yield

Initial isotope: ^{229}Th

Irradiation Time (IT) = $1.00\text{e}+00$ sec; Decay Time (DT) = $1.00\text{e}+13$ sec; Irr.Rate = $1.00\text{e}+20$ pps; Plot All isotopes
Model="ODE", $N_{\text{Implant}}=100$, $N_{\text{Resid}}=1000$, Abs.Err= $1.0\text{e}-10$, Rel.Err= $1.0\text{e}-05$, Threshold= $1.0\text{e}-30$, $T_{1/2}^{\text{bounds}}=1.0\text{e}-04, 1.0\text{e}+20$



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