KU LEUVEN

Update muX meeting 12/01

Marie Deseyn

Fit with proper lineshape

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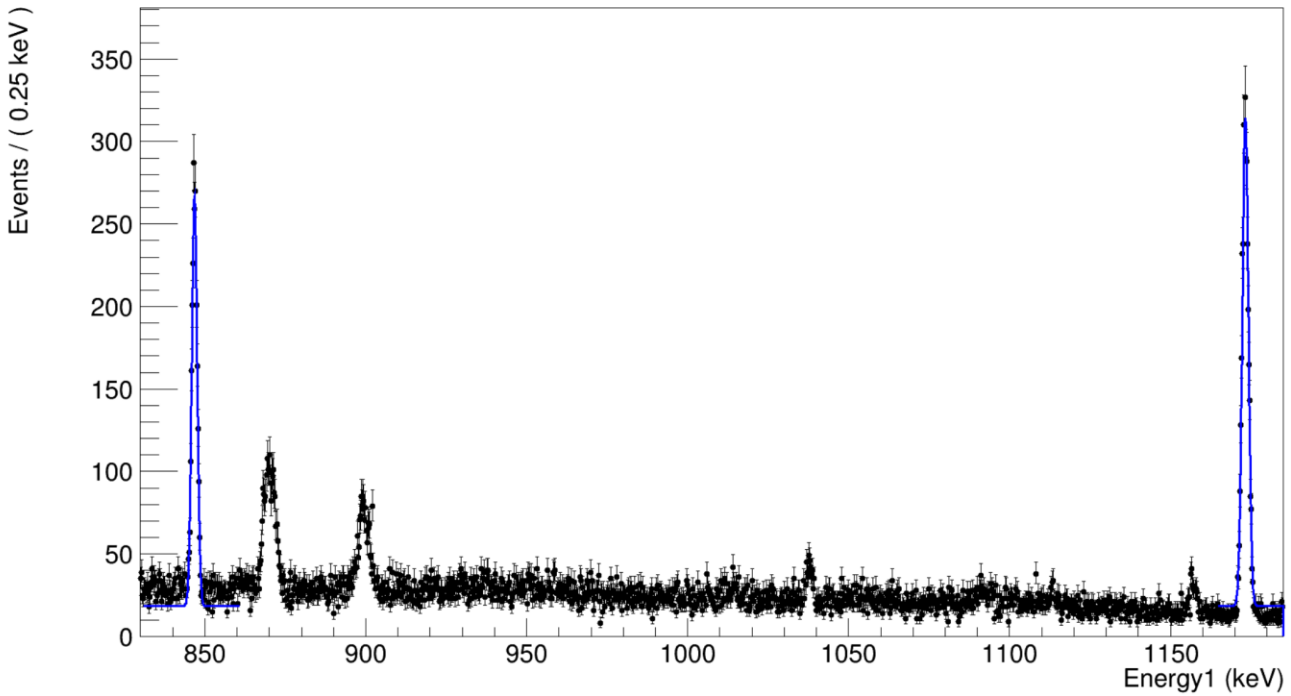
- Realized that Roofit somehow is extremely slow on (only) my laptop → do it now on the KU Leuven cluster

Fit with proper lineshape

- Fit two peaks in the silver spectrum with sigma = a*E+b where a and b are simultaneously fitted for the two peaks



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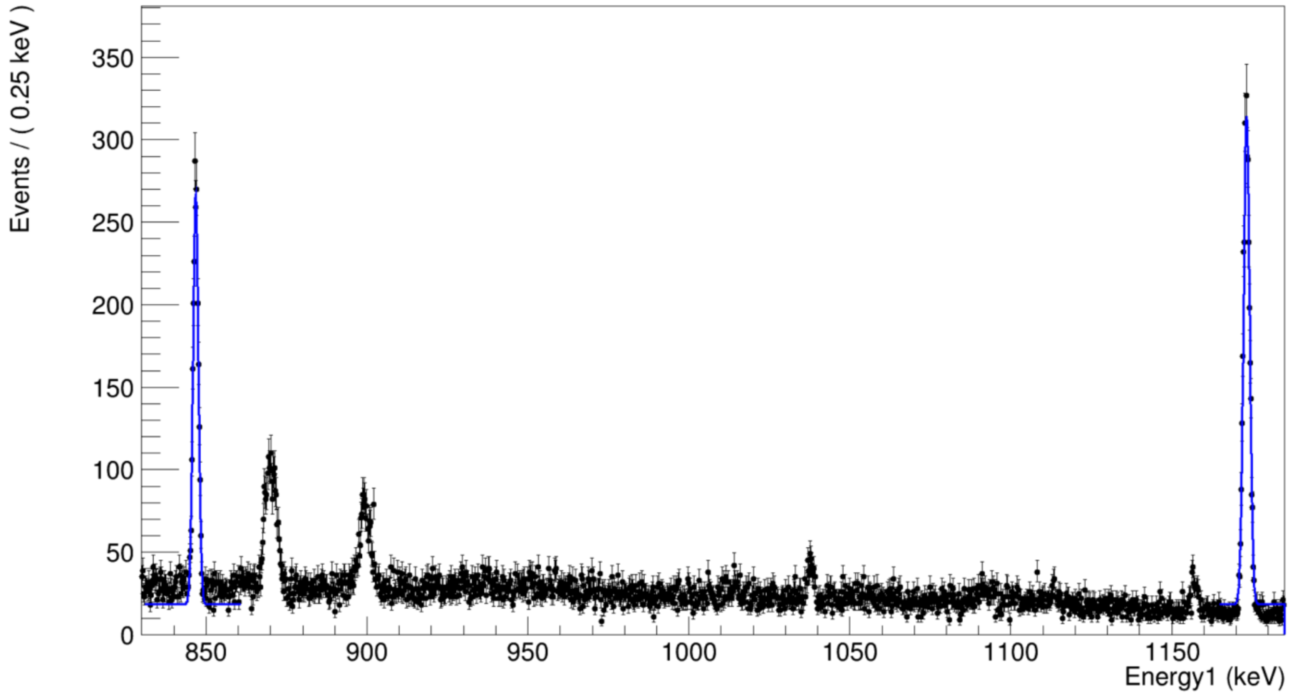
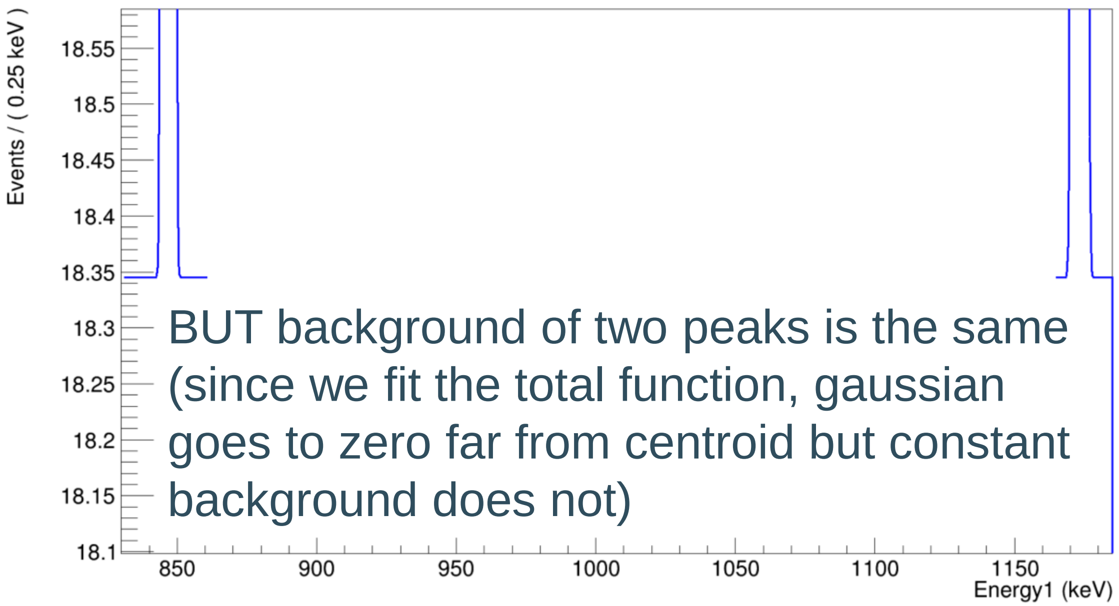
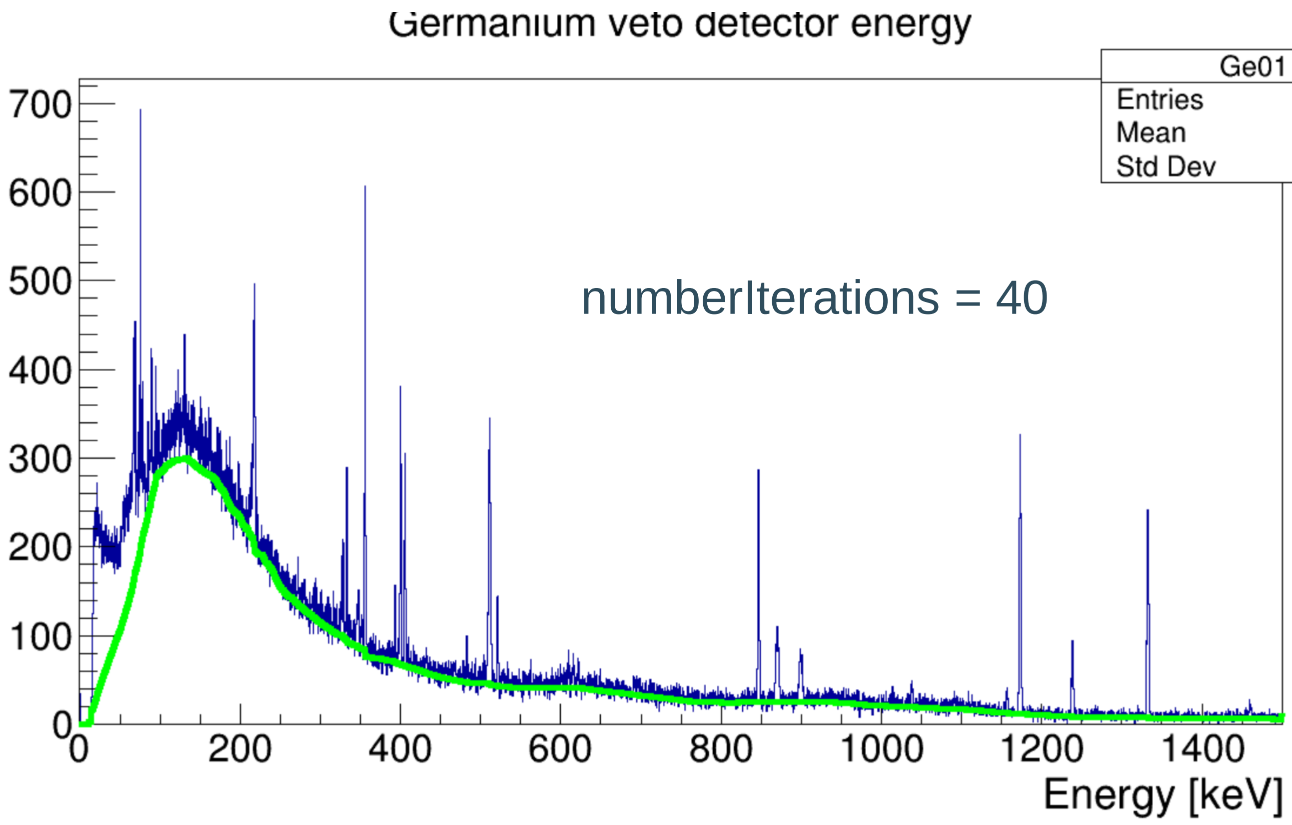


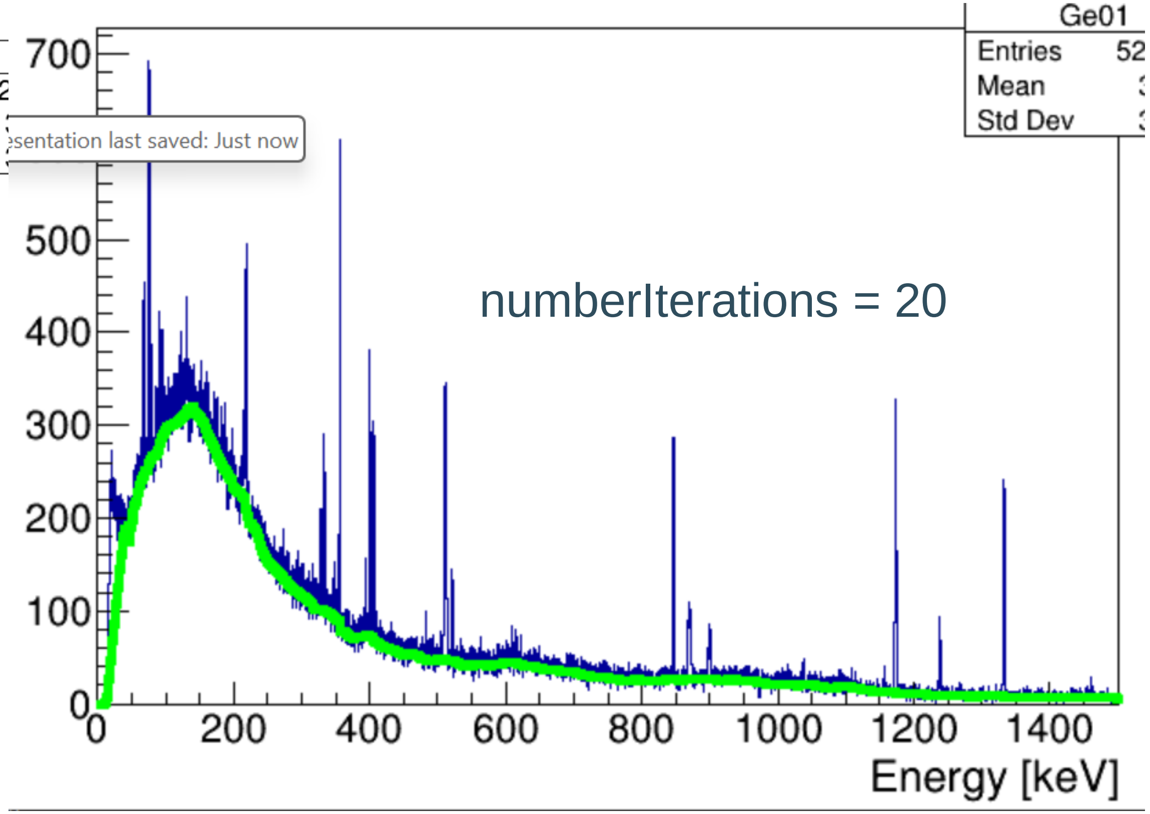


BUT background of two peaks is the same (since we fit the total function, gaussian goes to zero far from centroid but constant background does not)

Fit with proper lineshape

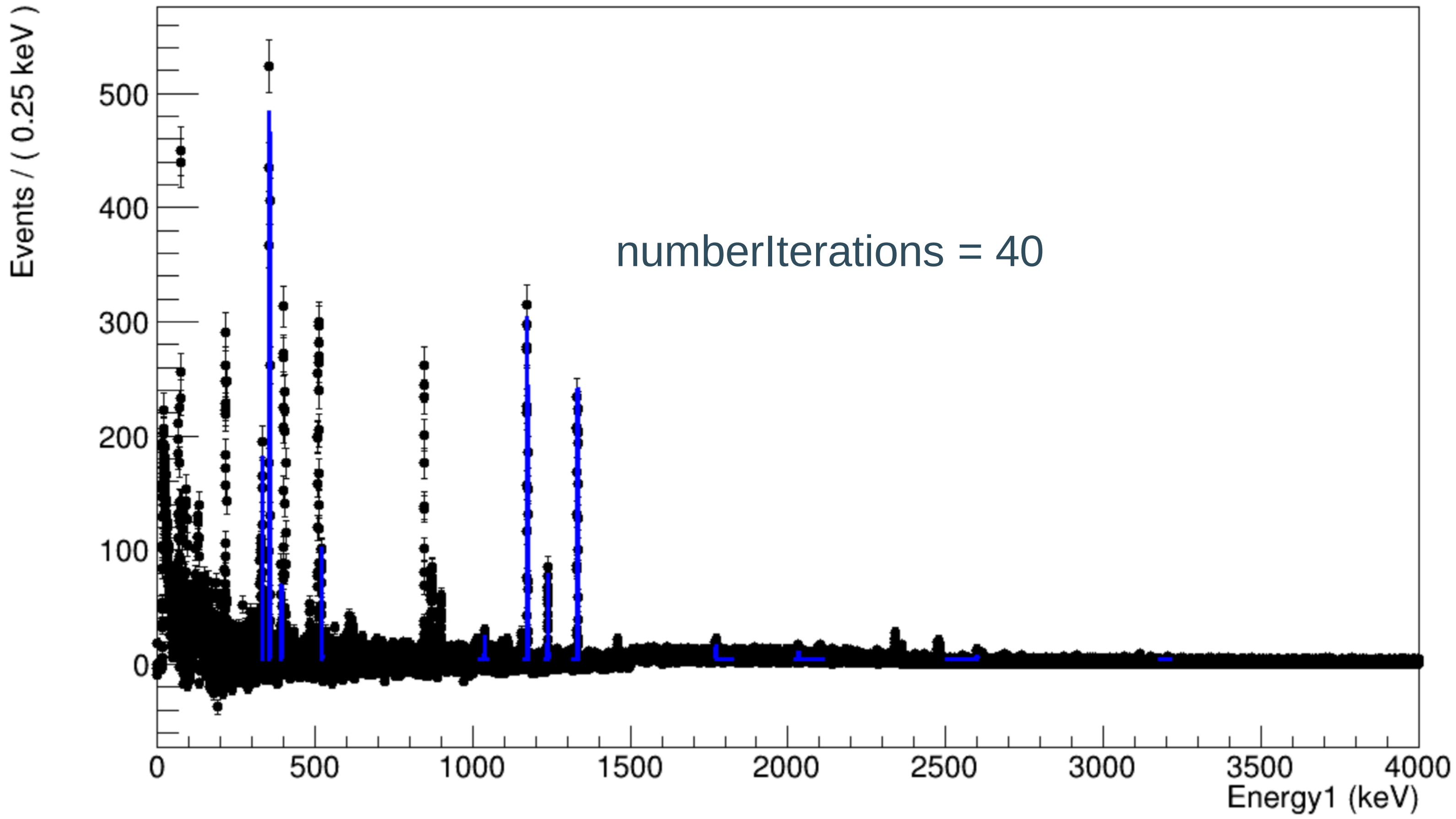
- Use TSpectrum to estimate full background: Background(spectrum, numberIterations,"Compton");

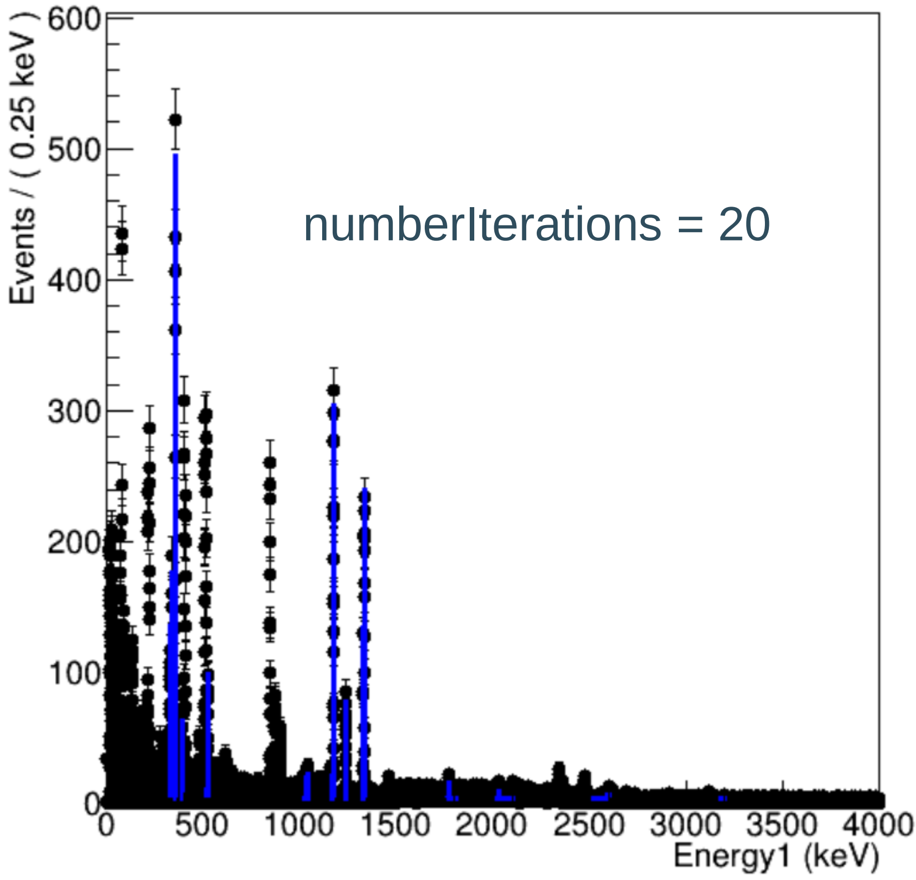




Fit with proper lineshape

- And fit background subtracted spectrum (only using 3 runs):





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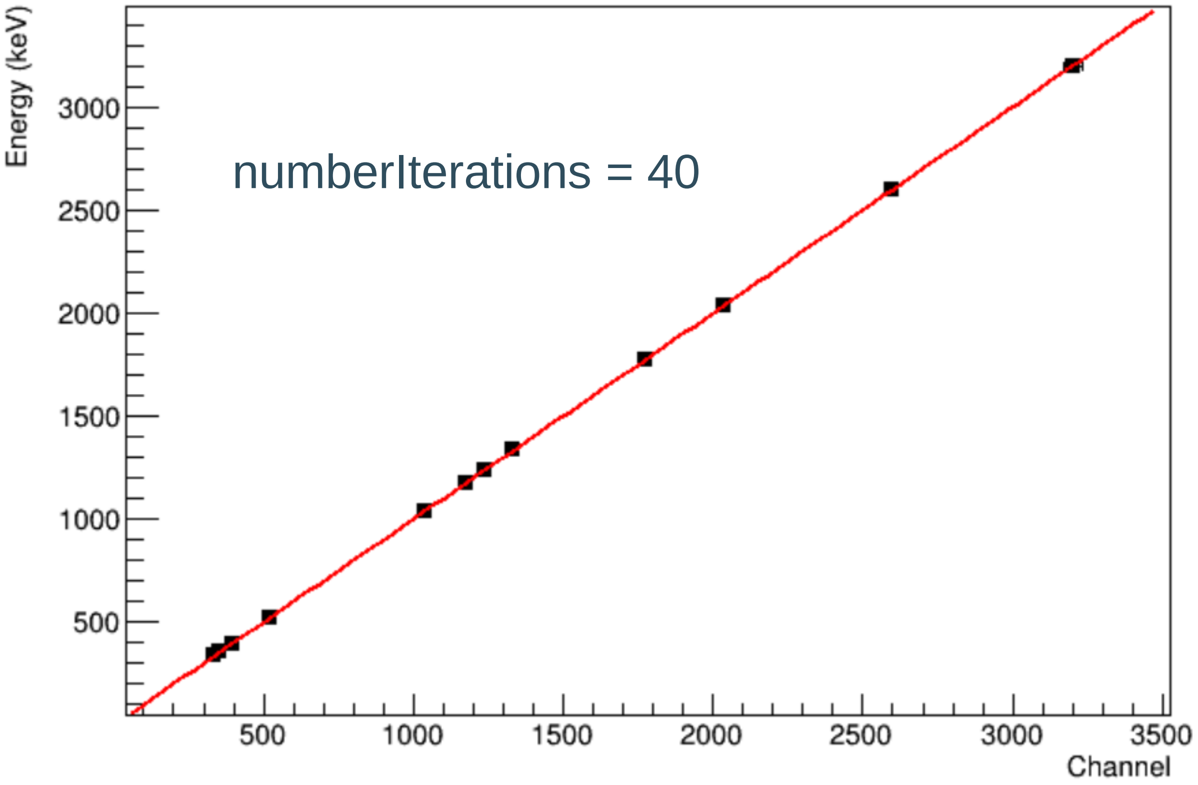

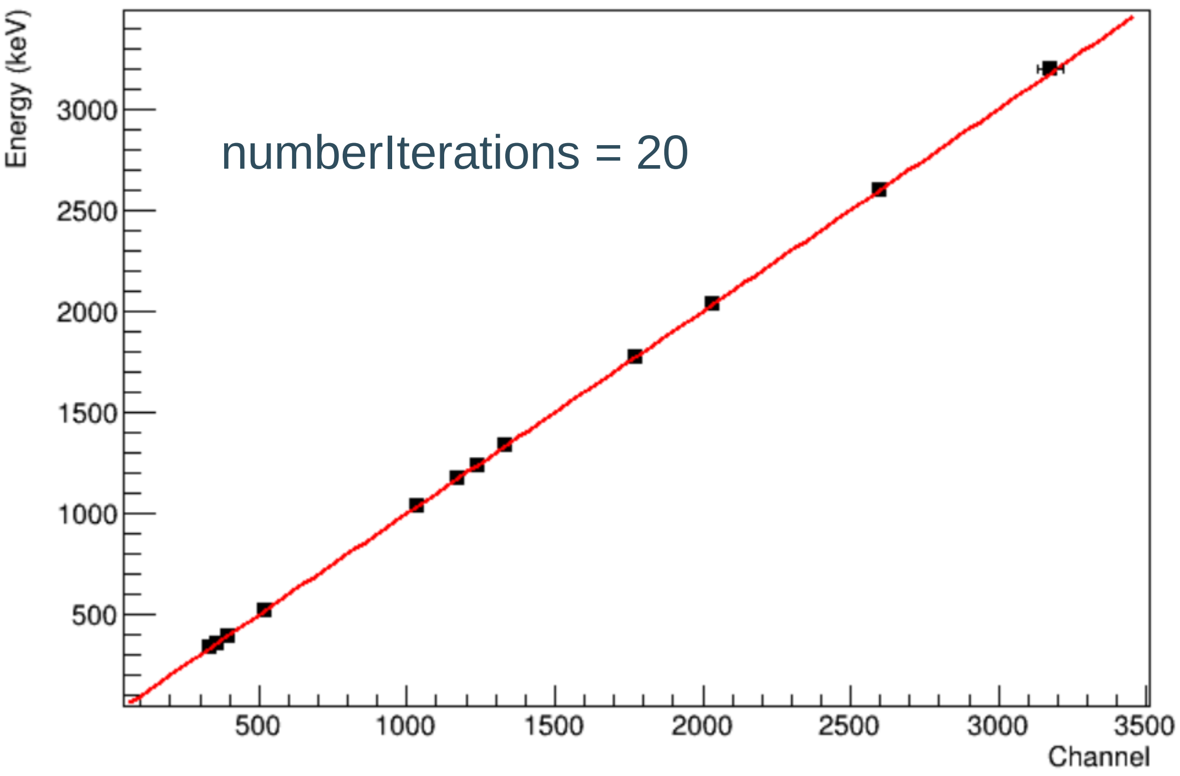

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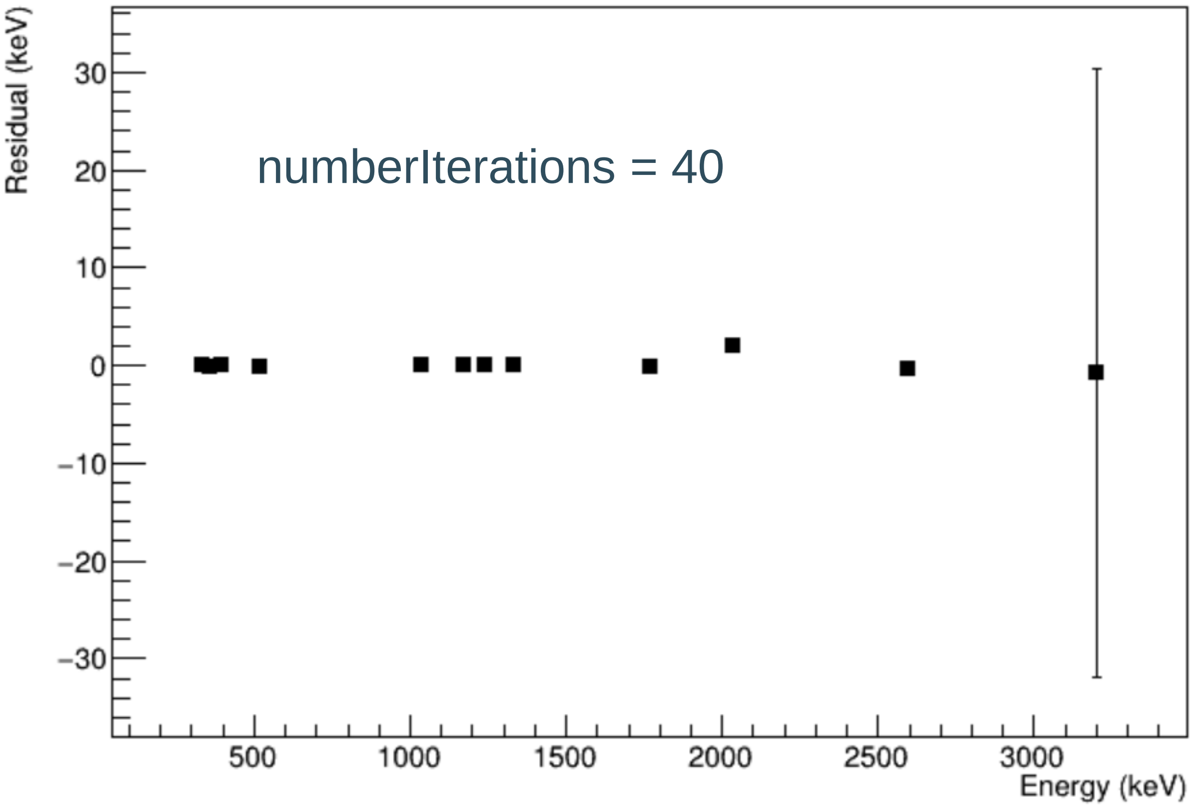

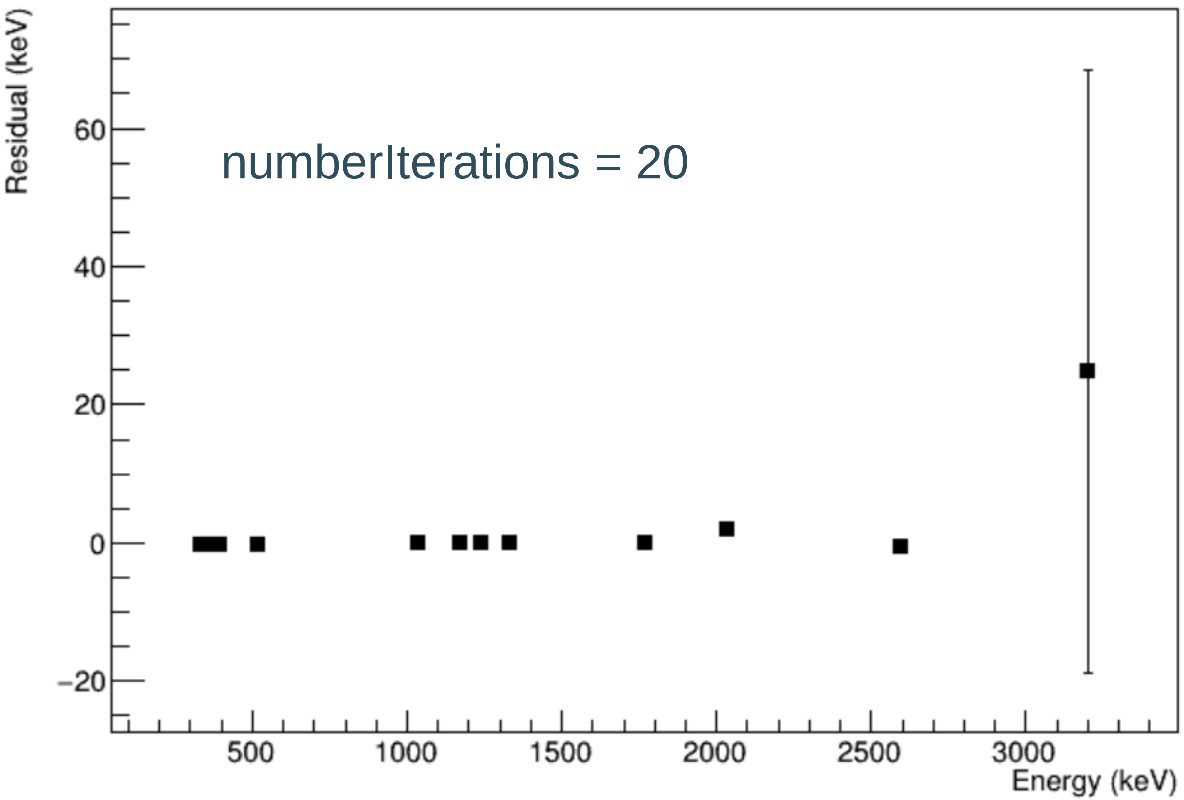

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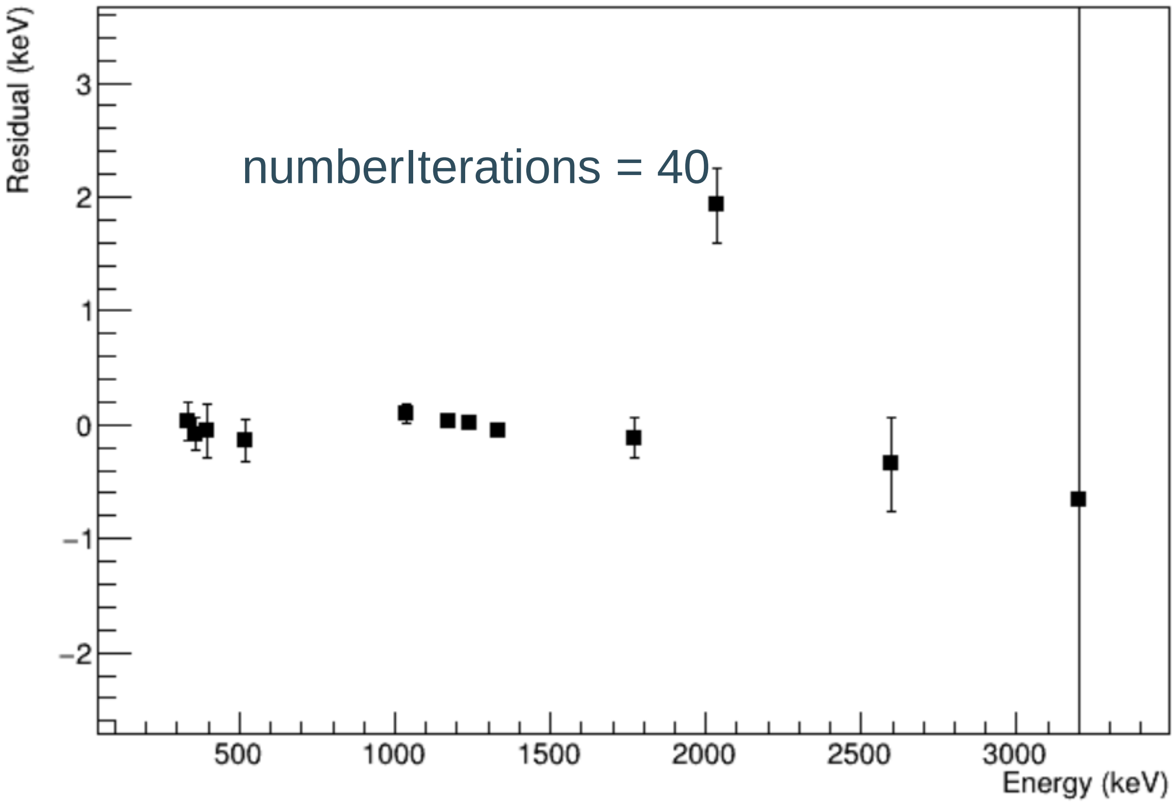
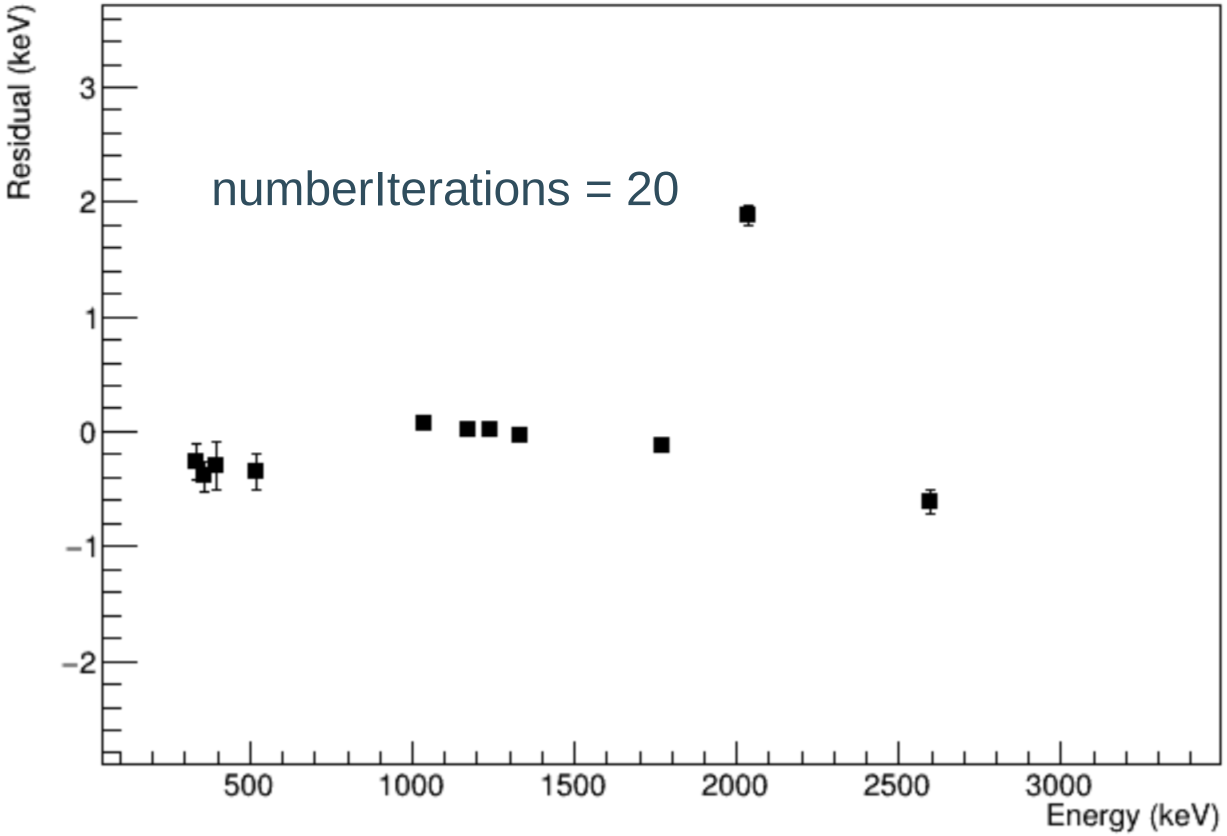




Effect of anti-coincidence window size

Saw some interesting things, but I first want to doublecheck my ELET optimization

Blocking the gammas from ^{108m}Ag with layer of lead??

Blocking the gammas from ^{108m}Ag with layer of lead??

- Gamma rays emitted from ^{108m}Ag

Gammas from ^{108m}Ag (418 y *21*)

Eγ (keV)	Iγ (%)	Decay mode
30.332 *8*		IT
79.138 *3*	6.63 *5*	IT
433.937 *4*	90	ε+β^+
614.276 *4*	89.8 *18*	ε+β^+
722.907 *10*	90.8 *18*	ε+β^+

- What if the rates become too large?
  → target with ~MBq of ^{108m}Ag

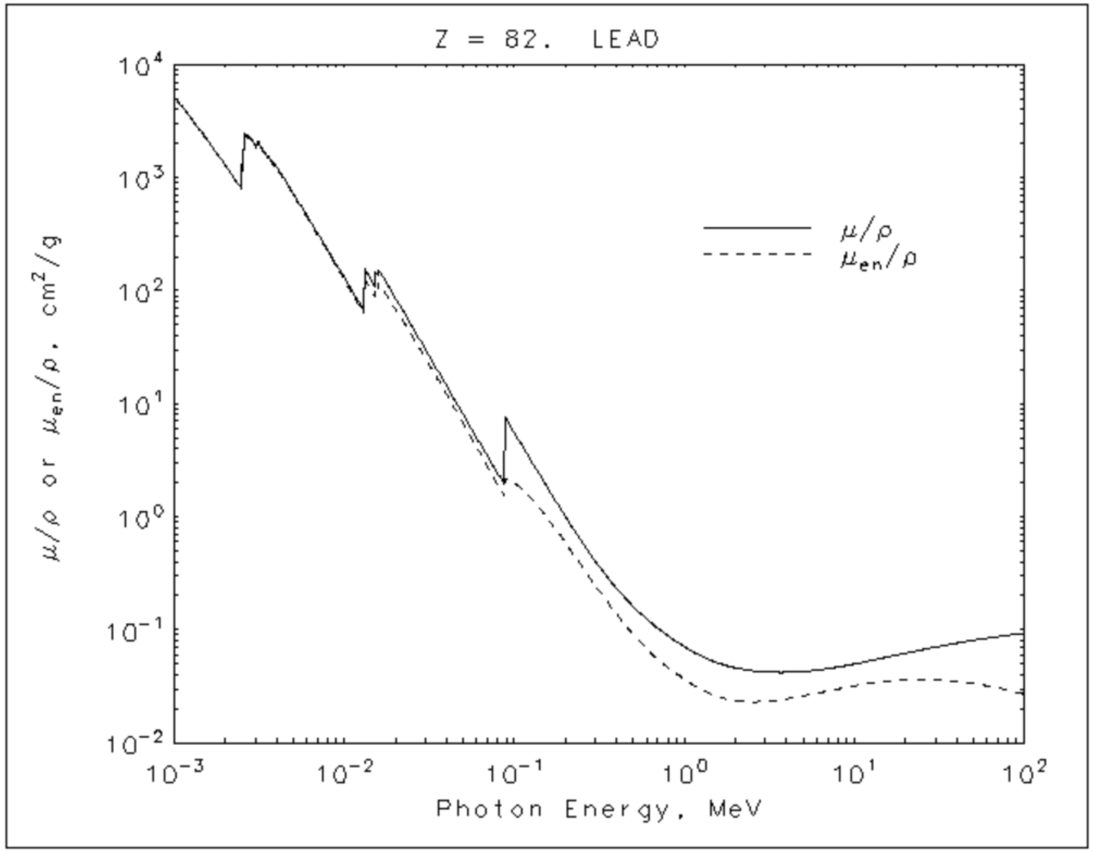
Z = 47, A = 108 amu, m = 206.768 au

	Line	DeltaE (eV)	W_12 (s^-1)
4p3/2 → 1s	K1-N3	4.35042e+06	3.7218e+16
4p1/2 → 1s	K1-N2	4.34612e+06	3.38644e+16
3p3/2 → 1s	K1-M3	4.04556e+06	9.62766e+16
3p1/2 → 1s	K1-M2	4.03515e+06	8.92878e+16
2p3/2 → 1s	K1-L3	3.17848e+06	4.27193e+17
2p1/2 → 1s	K1-L2	3.14145e+06	4.2036e+17
4s → 2p1/2	L2-N1	1.23389e+06	4.72807e+13
4d3/2 → 2p1/2	L2-N4	1.20779e+06	1.83237e+16
4s → 2p3/2	L3-N1	1.19686e+06	2.07425e+14
2p3/2 → 4d5/2	L3-N5	1.17272e+06	2.07965e+16
4d3/2 → 2p3/2	L3-N4	1.17077e+06	3.35196e+15
4p3/2 → 2s	L1-N3	982049	8.88926e+15
4p1/2 → 2s	L1-N2	977748	8.77682e+15
3s → 2s	L2-M1	962313	8.76388e+13
3s → 2p3/2	L3-M1	925287	4.2719e+14
3d3/2 → 2p1/2	L2-M4	901450	5.67102e+16
3d5/2 → 2p3/2	L3-M5	869064	6.52405e+16
3d3/2 → 2p3/2	L3-M4	864424	1.07666e+16
3p3/2 →2s	L1-M3	677192	2.42961e+16
3p1/2 → 3p1/2	L1-M2	666779	2.4965e+16
2s → 2p1/2	L2-L1	226918	1.06524e+15
2s → 2p3/2	L3-L1	189892	1.32262e+15

Blocking the gammas from ^{108m}Ag with layer of lead??

$$I = I_0 e^{-\frac{\mu}{\rho}\rho x}$$

$\frac{\mu}{\rho}$ depends on energy:



Department of Physics and Astronomy, IKS

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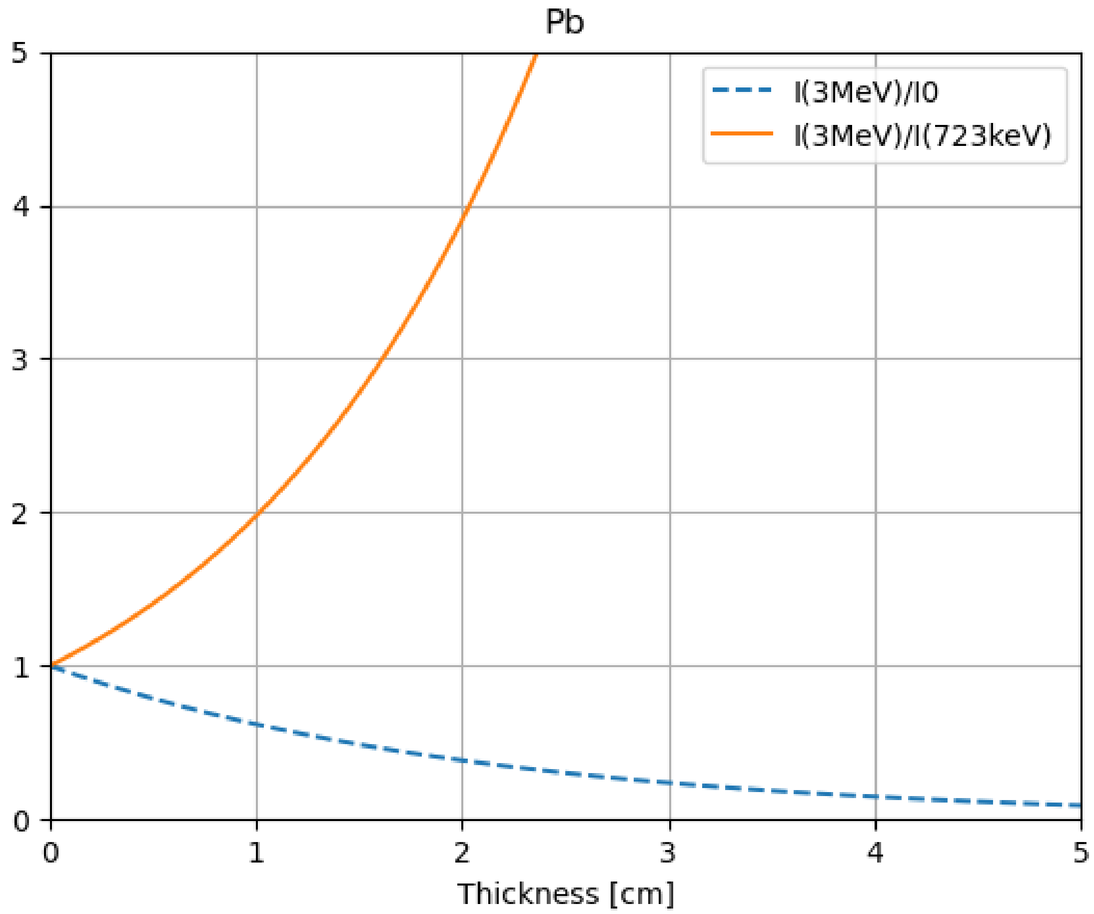

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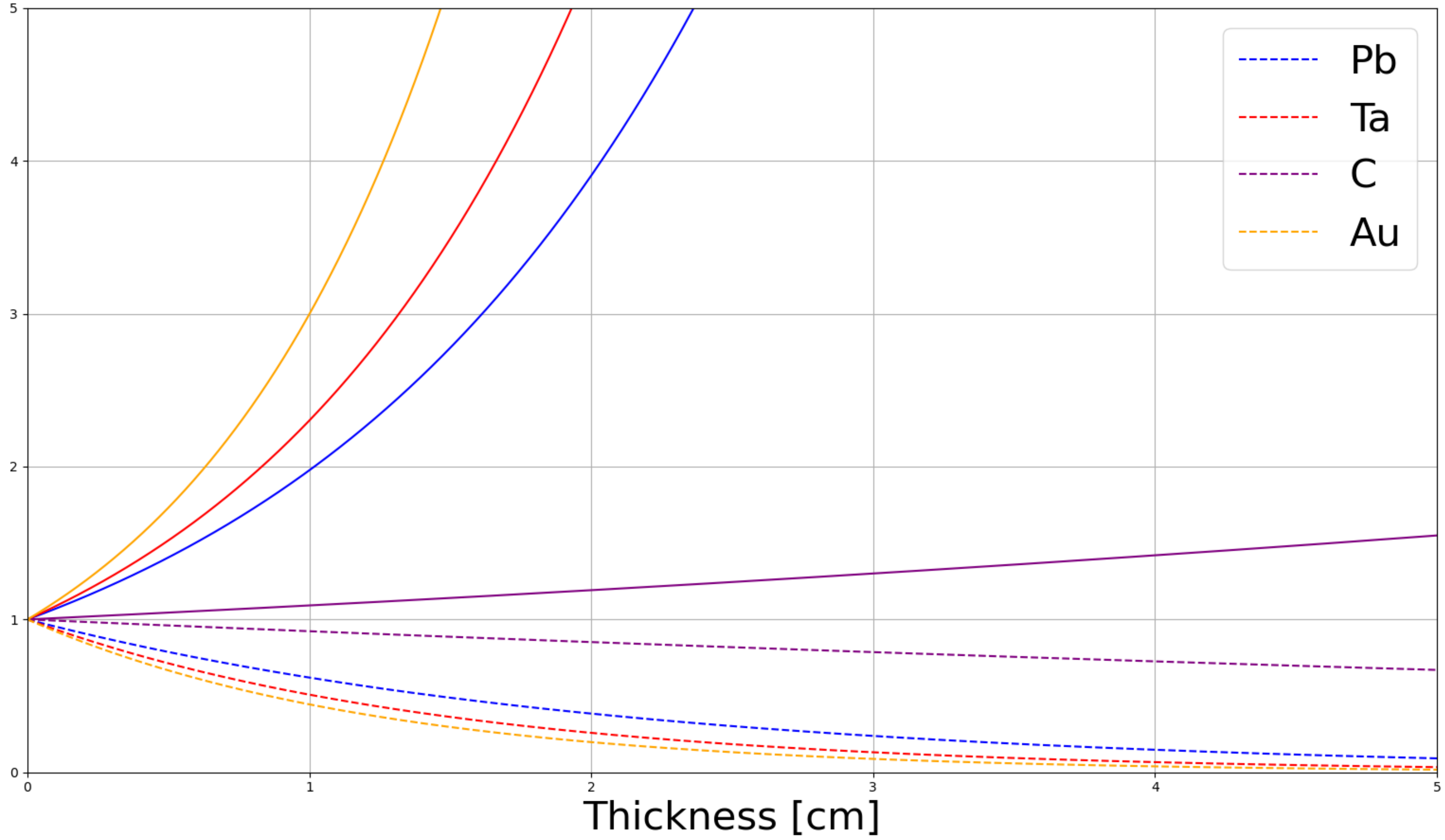

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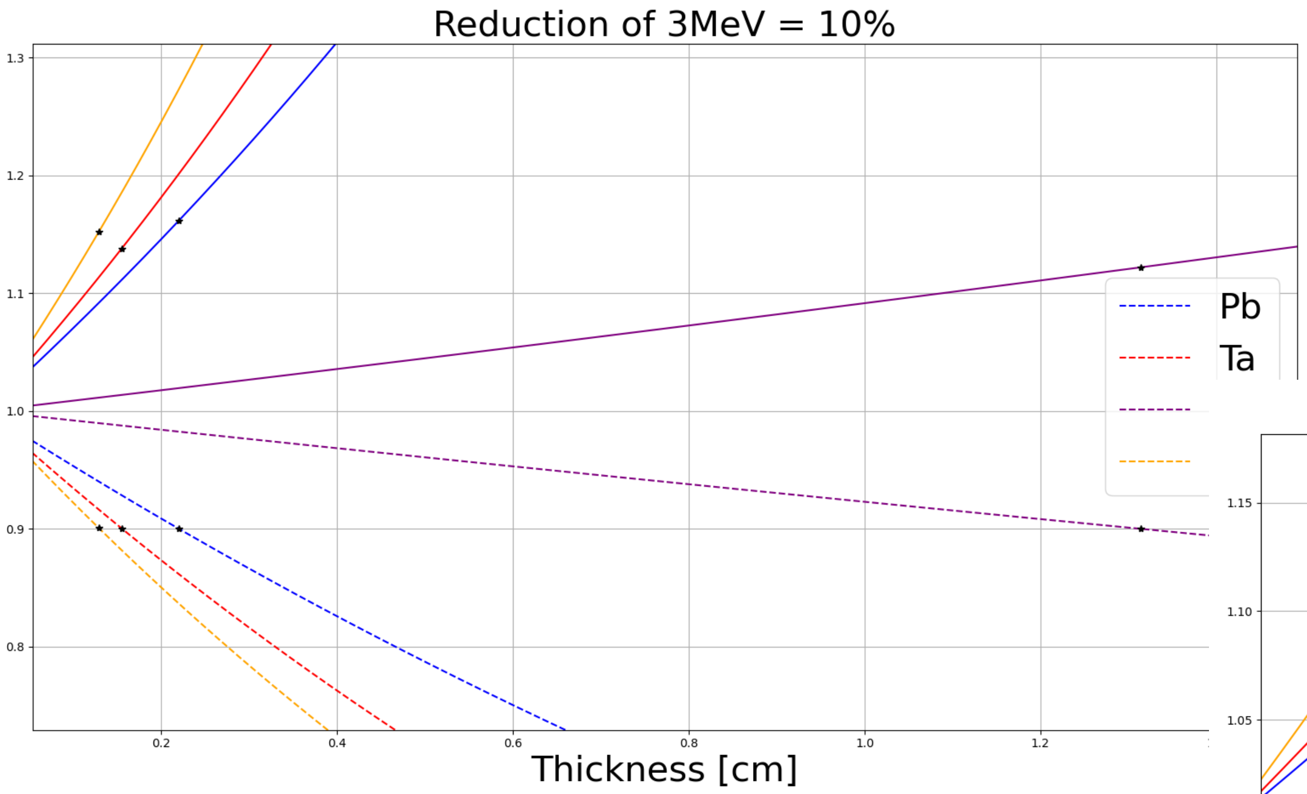
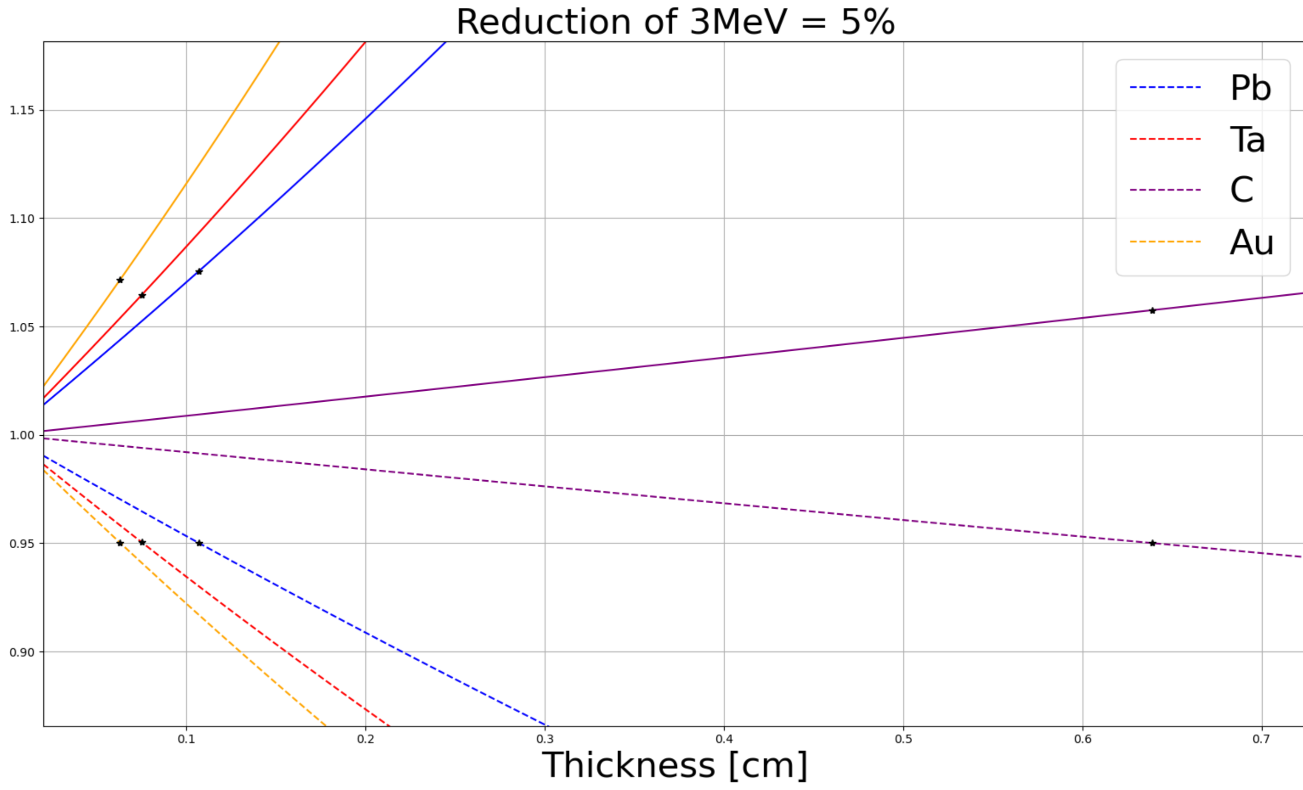
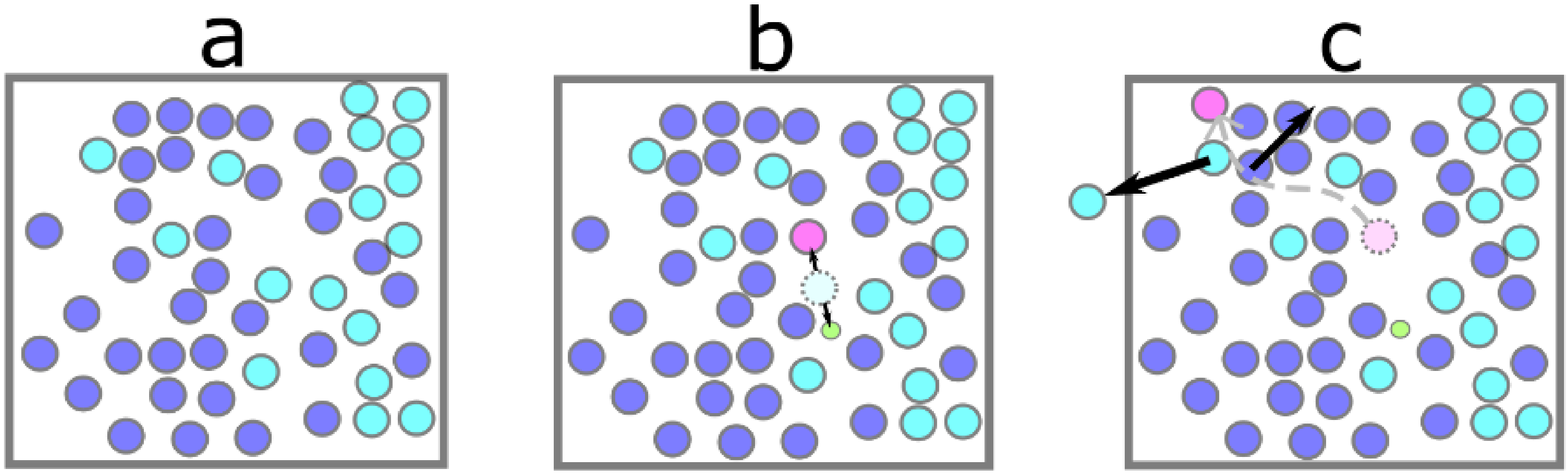




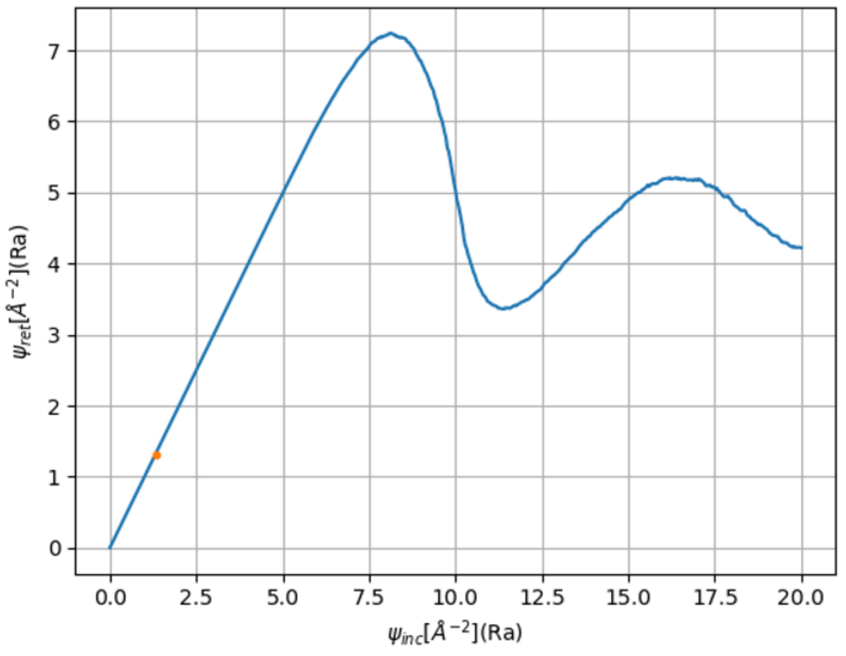
Recoil-sputtering for Ra implantation

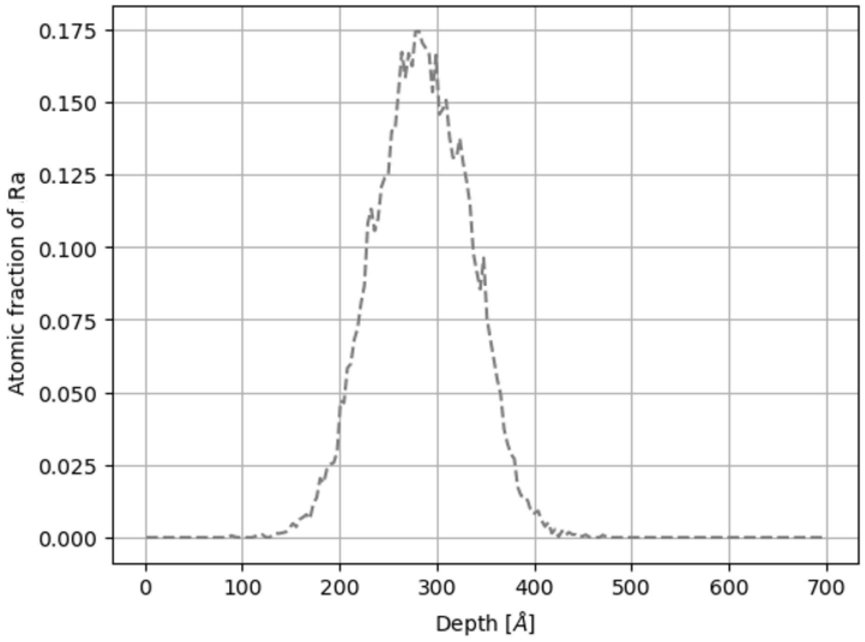
Recoil-sputtering: principle



Recoil-sputtering: 1) implantation

- TRIDYN simulation for 180kBq ($1.31*10^{16}$ particles) of ^{226}Ra at 30keV (1cmx1cm implantation spot)
- NOTE: surface binding energy of Ra is by default taken to be 0 in TRIDYN





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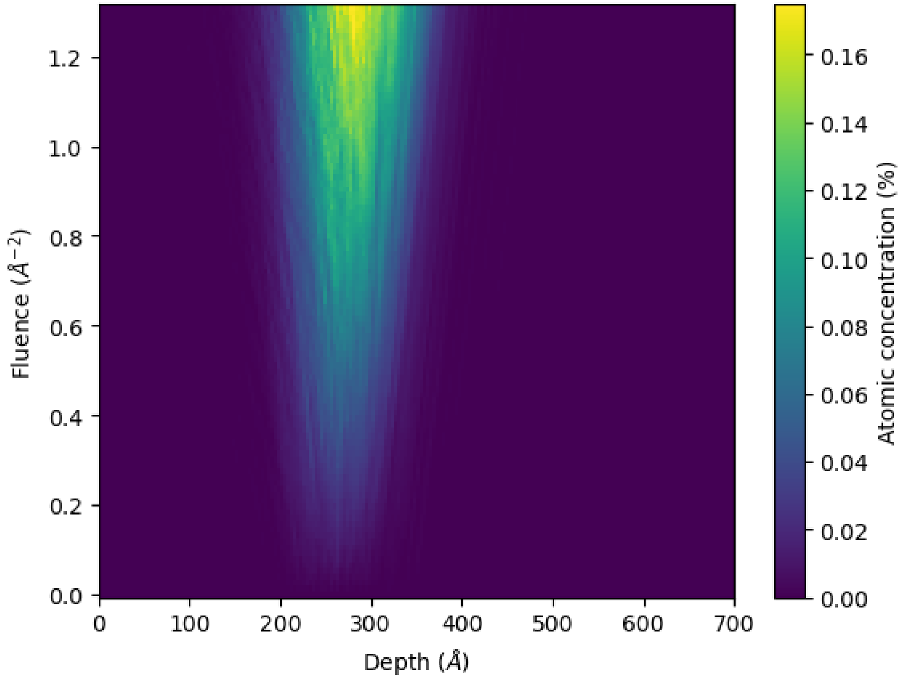
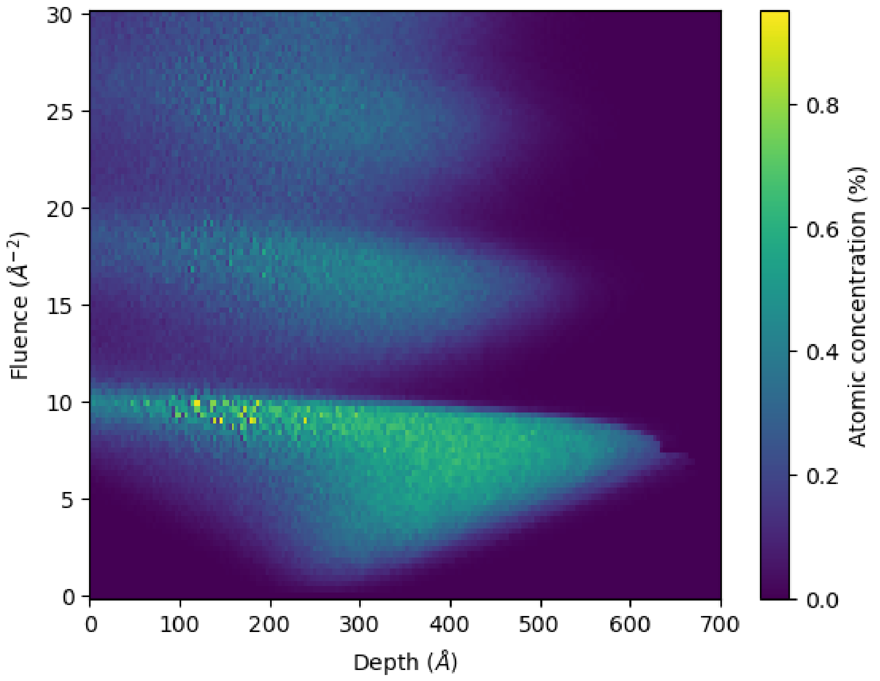
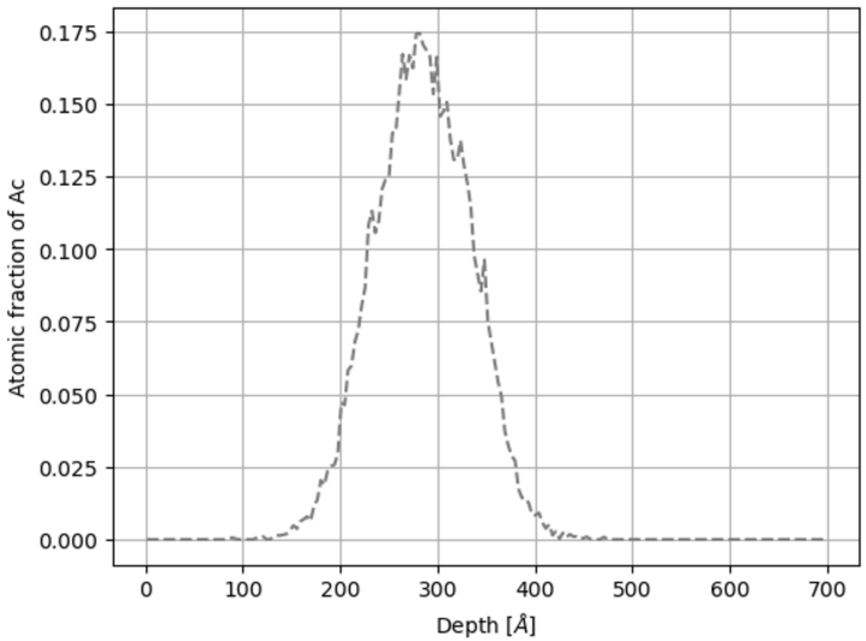




Recoil-sputtering: 2) Recoil-sputter simulation

- Generated target from depth profile (discrete: 23 layers of 21A (Ra+C), backing of 1500A (C))
- Generate recoiling ^{222}Rn particles based on the Q-value by simulating ~90000 recoiling particles with position according to the depth profile



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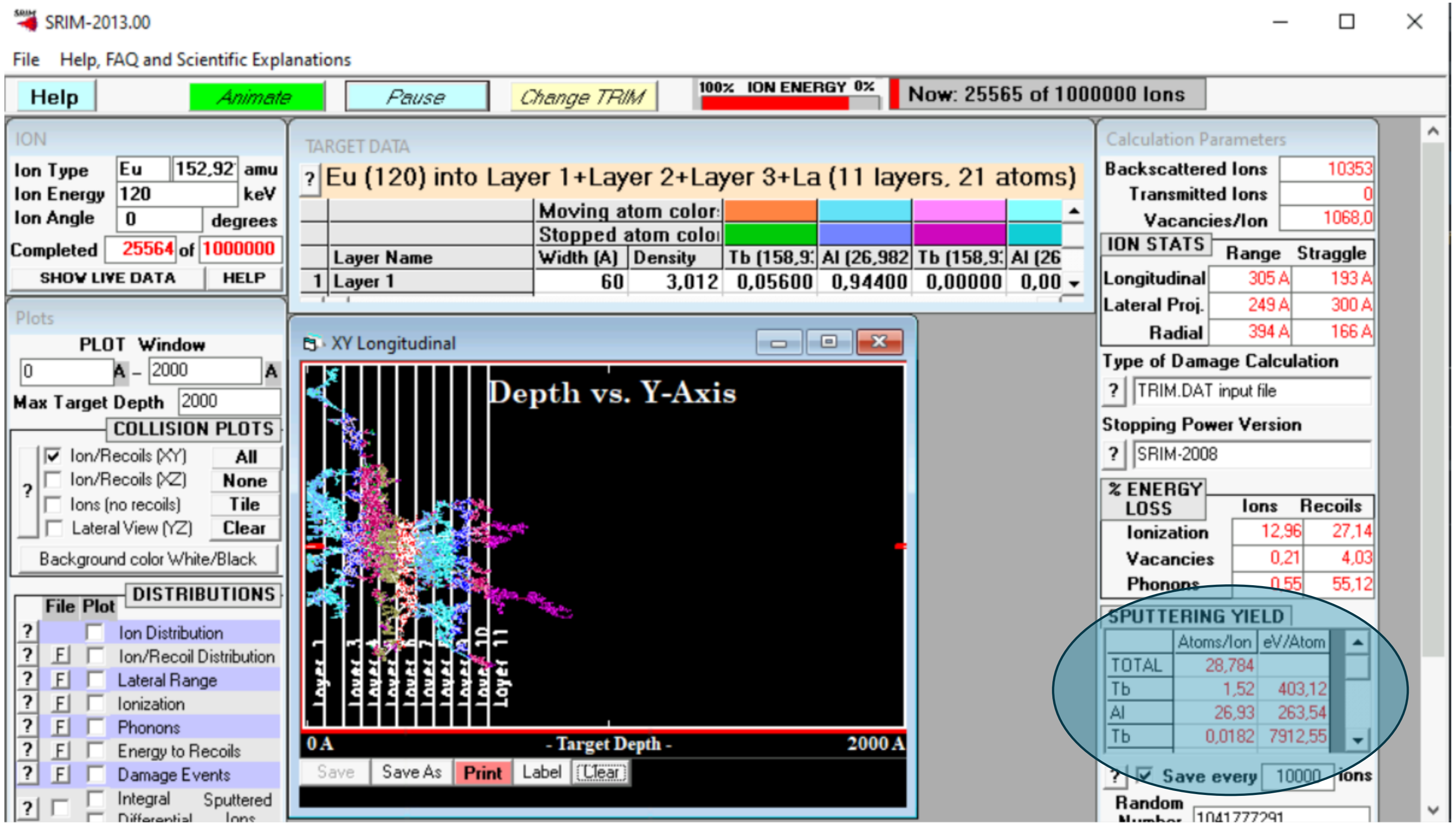

- Sputtering yield per simulation layer

Layer	Ra Sputtering yield	C - Sputtering yield
1	/	5.27
2	0.000011	0.0319
3	0.000011	0.0285
4	0	0.0254
5	0.000067	0.0247
6	0.000178	0.0216
7	0.000256	0.0176
8	0.000444	0.013
9	0.000311	0.0101
10	0.000411	0.007444
11	0.000344	0.005311
12	0.000222	0.0039
13	0.000089	0.002466
14	0.000067	0.001322
15	0	0.000633
16	0	0.000167
17	0	0.000078
18	0	0
19	0	0
20	0	0
21	/	0
SUM	0.002411	5.464121

Recoil-sputtering: 3) Activity lost after 1 year

Activity lost due to the decay:

$$N_{lost}(1y) = N(t_0) - N(1y) = 1,31 \cdot 10^{16} \cdot \left[1 - \exp\left(\frac{-\ln(2)}{1600\,y} \cdot 1y\right)\right]$$

$$= 5,67 \cdot 10^{12}$$

↳ Since BR = 100%, $5,67 \cdot 10^{12}$ recoil-events have to be taken into account.

Recoil-sputtering: 3) Activity lost after 1 year

Layer	Ra Sputtering yield	C - Sputtering yield
SUM	0.002411	5.464121

5.67*10^{12} particles lost due to decay

#part. lost due to recoil-sputt.

$$= Y_{sputt}(Ra) \cdot 5{,}67 \cdot 10^{12} = 1{,}14 \cdot 10^{9}$$

→ $1{,}14 \cdot 10^{9}$ particles lost due to recoil-sputtering after 1 year.

Or thus 0,1878 Bq lost after 1 year due to recoil-sputtering (first α-decay only)

- Note that this is only for the first alpha decay, there are 4 subsequent alpha decays → rough estimate: < 1Bq lost after one year

Recoil-sputtering: 3) Activity lost after 1 year

Thickness of C lost:

$$t_{lost} = Y_{sputt}(C) \cdot \frac{5{,}67 \cdot 10^{12}}{\underbrace{N(C)}_{0{,}176\,Å} \cdot \underbrace{\text{foil surface}}_{10^{16}\,Å^2}}$$

$$= 0{,}0175\ Å$$

Ag collection analysis

Plan for next collection

Irradiation of **100mg** enriched ^{107}Ag to a purity of **1%** (corresponding to $5.63 \cdot 10^{18}$ ^{108m}Ag particles) and collection at ISOLDE-GLM in **off-resonance laser** mode.
This would yield:

- Purity on collection foil = 99.96%
- $6.42 \cdot 10^{16}$ ^{108m}Ag particles incoming on the foil
- $\approx 3.15 \cdot 10^{16}$ ^{108m}Ag particles retained on the foil (at most $\approx 3.59 \cdot 10^{16}$, if collection is stopped at the maximum in the self-sputtering curve)
- A collection time at ISOLDE-GLM of ≈ 1.63 days

- Contacted Maria and BR2
- Contacted Lino and Andre to test the self-sputtering simulations for Ag