Background simulation status

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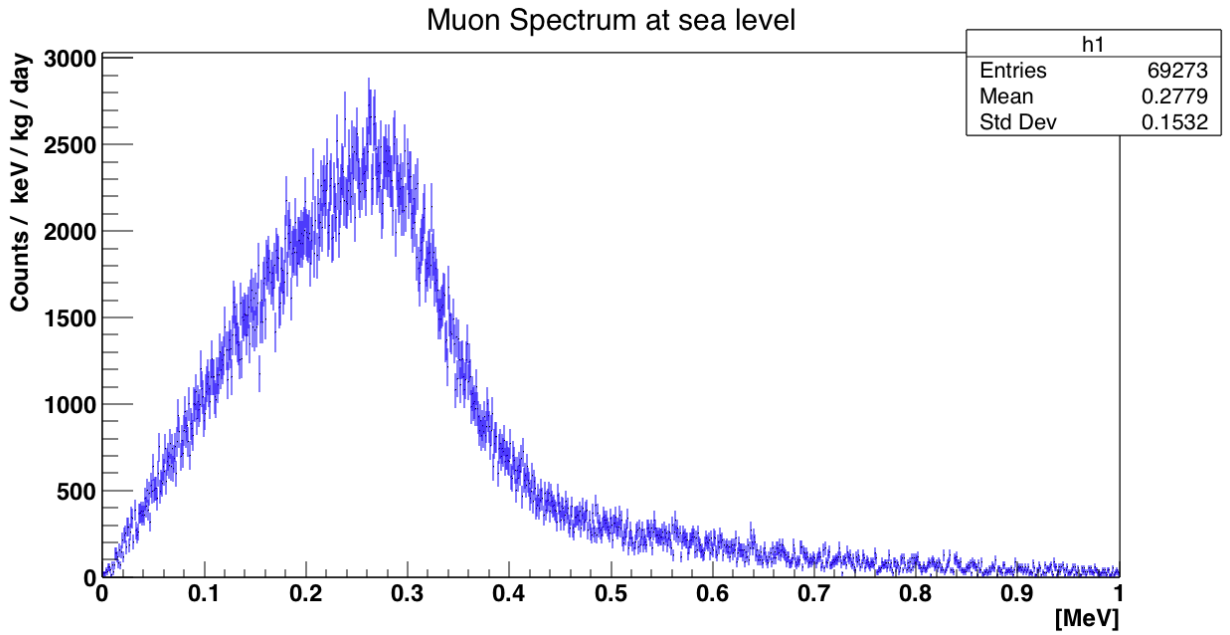
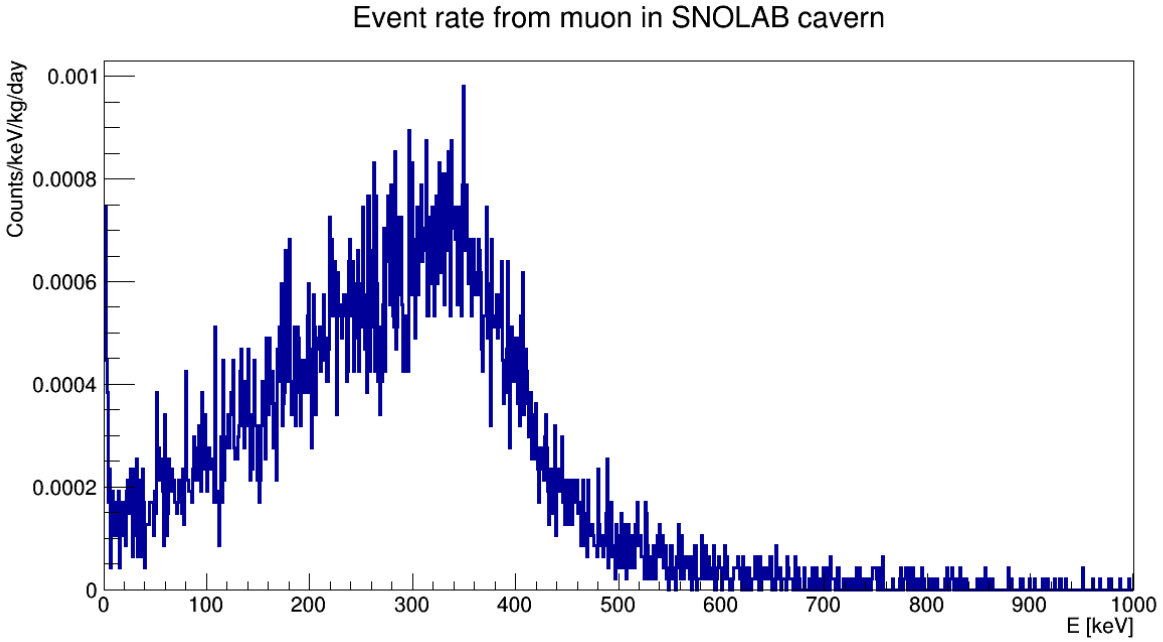
6th News-G collaboration meeting

Reducing the background: First step, going deep underground





Sea level muon flux:

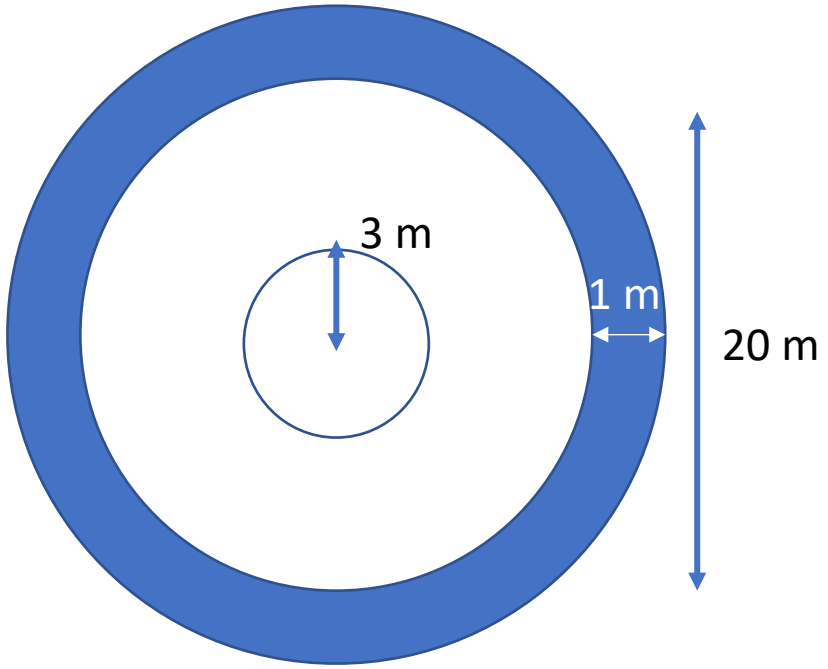
~8.64×10^6 μ/m2/s

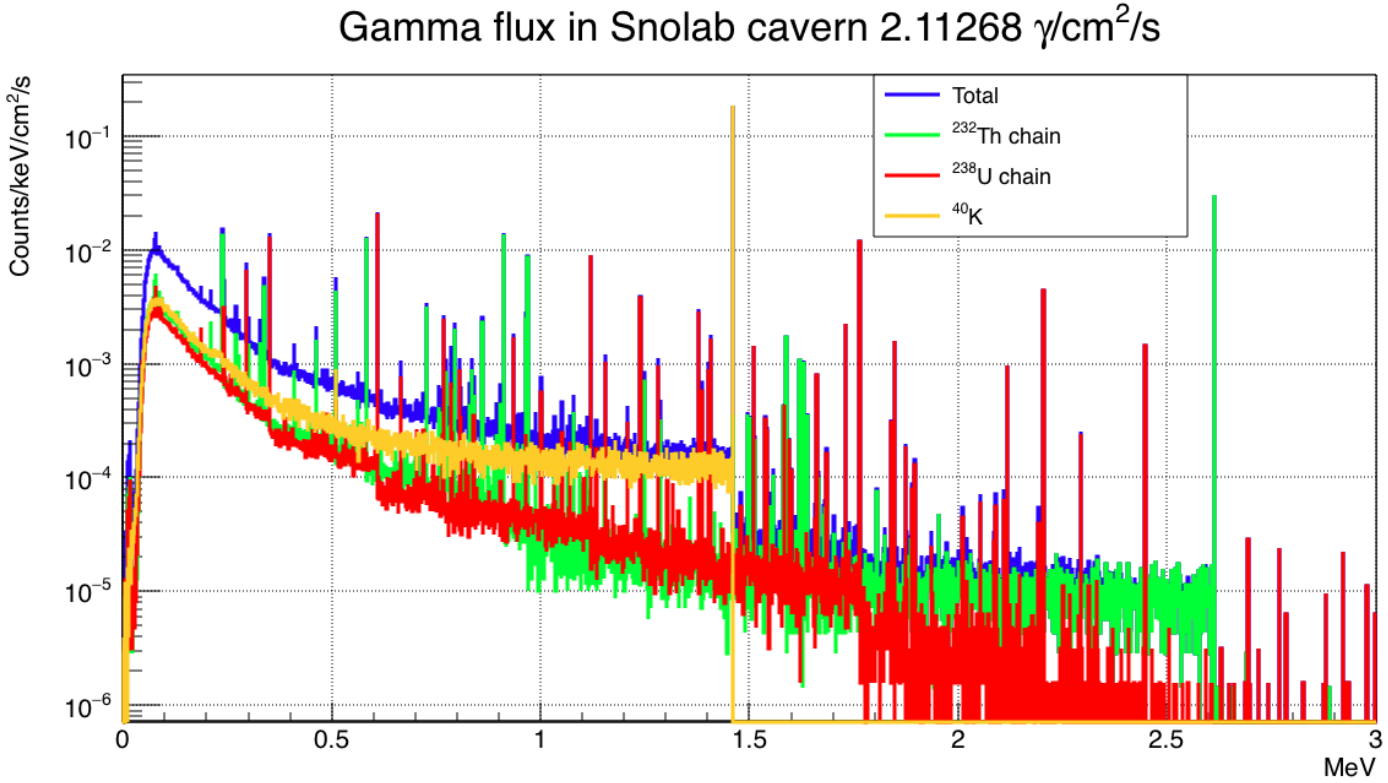
SNOLAB:

~0.27 μ/m2/day

Sub-keV events:
~20 dru -> 0.0008 dru

Estimation of the gamma flux:





Contamination of Norite Rock:

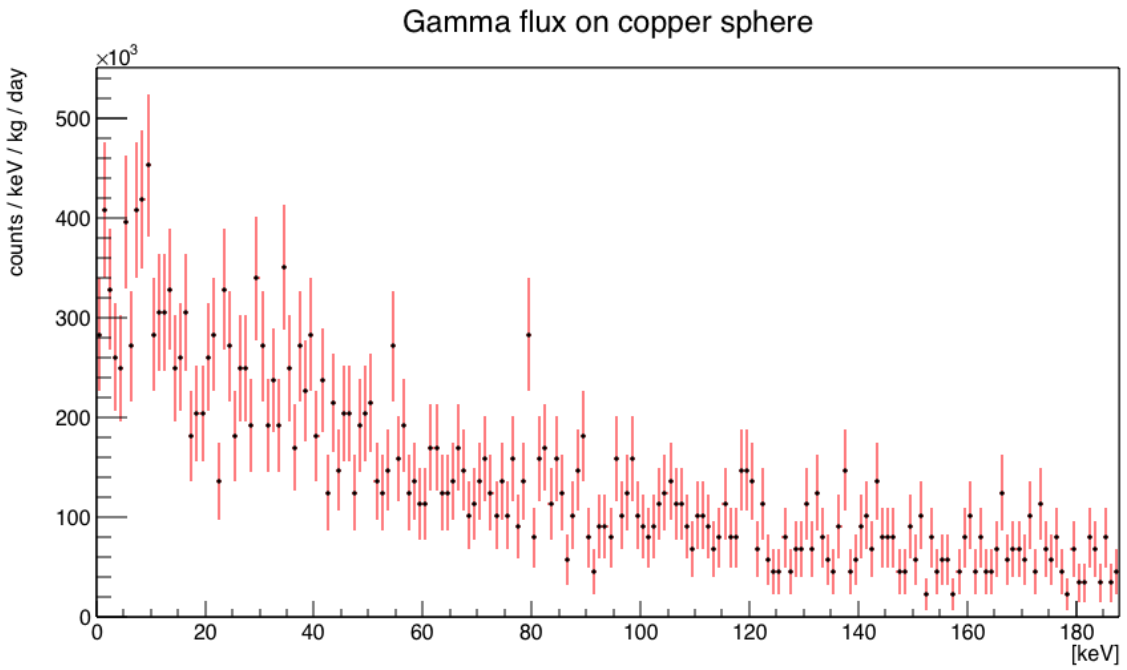
13 Bq/kg ^{238}U
15 Bq/kg ^{232}Th
364 Bq/kg ^{40}K

	40K	214Pb	214Bi	212Pb	208Tl	208Tl	137Cs	60Co	60Co
Energie	1460	352	609	239	583	2614	661	1173	1332
XXL(blindage)	76±2	25.5±0.4	40.5±0.5	8.2±0.3	8.5±0.3	26±1	1.4±0.2		
NEMO(blindage)	85±3	21±1	35±3	6.3±0.6	5.7±0.7	27±2	7±1		
Radon	125±4	43±2	67±2	14±1	14±1	42±7			
Jasmin	127±5	36±2	64±6	12±1	13±1	41±3	2.2±0.9	13±2	13±2
TGV	141±3	25±1	41±1	7.4±0.6	9±1	29±2	5.6±0.6		
Edelweiss	207±3	47±1	72.2±0.6	17.3±0.3	18±1	51±2	1.1±0.2		
Polset (bureaux)	434±7	52±1	82±1	51±3	51±1	126±4	3.7±0.4		

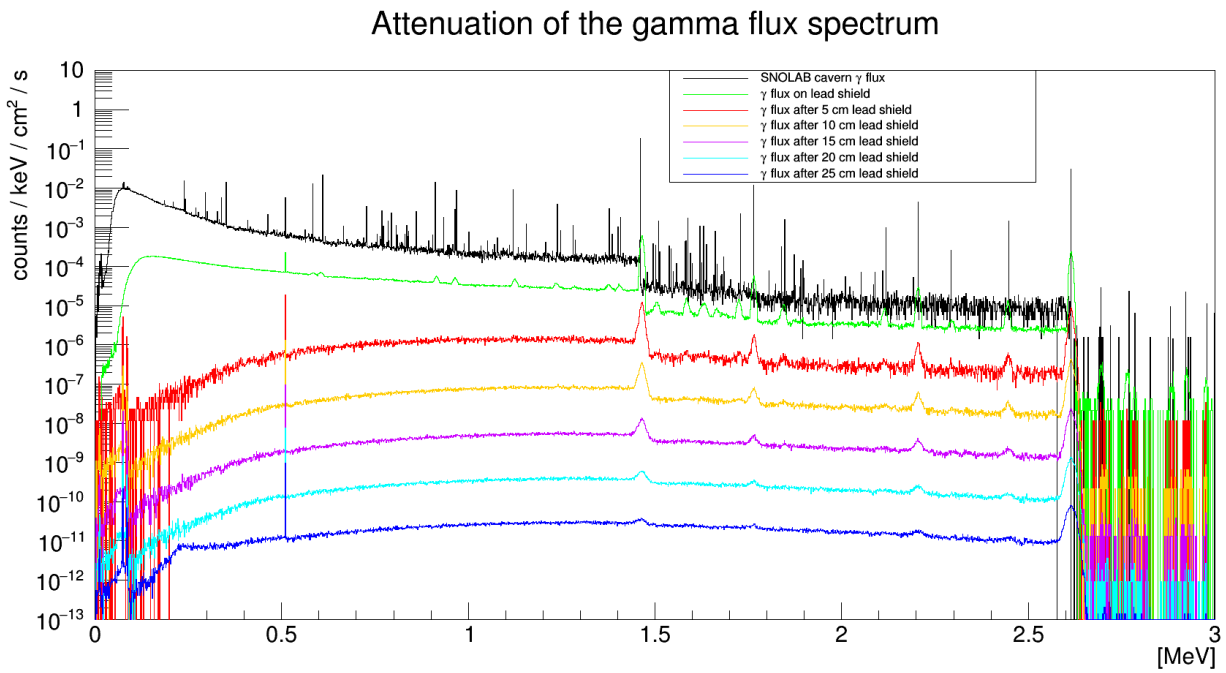
Flux mesurés : $\gamma.s^{-1}.cm^{-2}(.10^{-3})$

Attenuation of the gamma flux:

Without shield



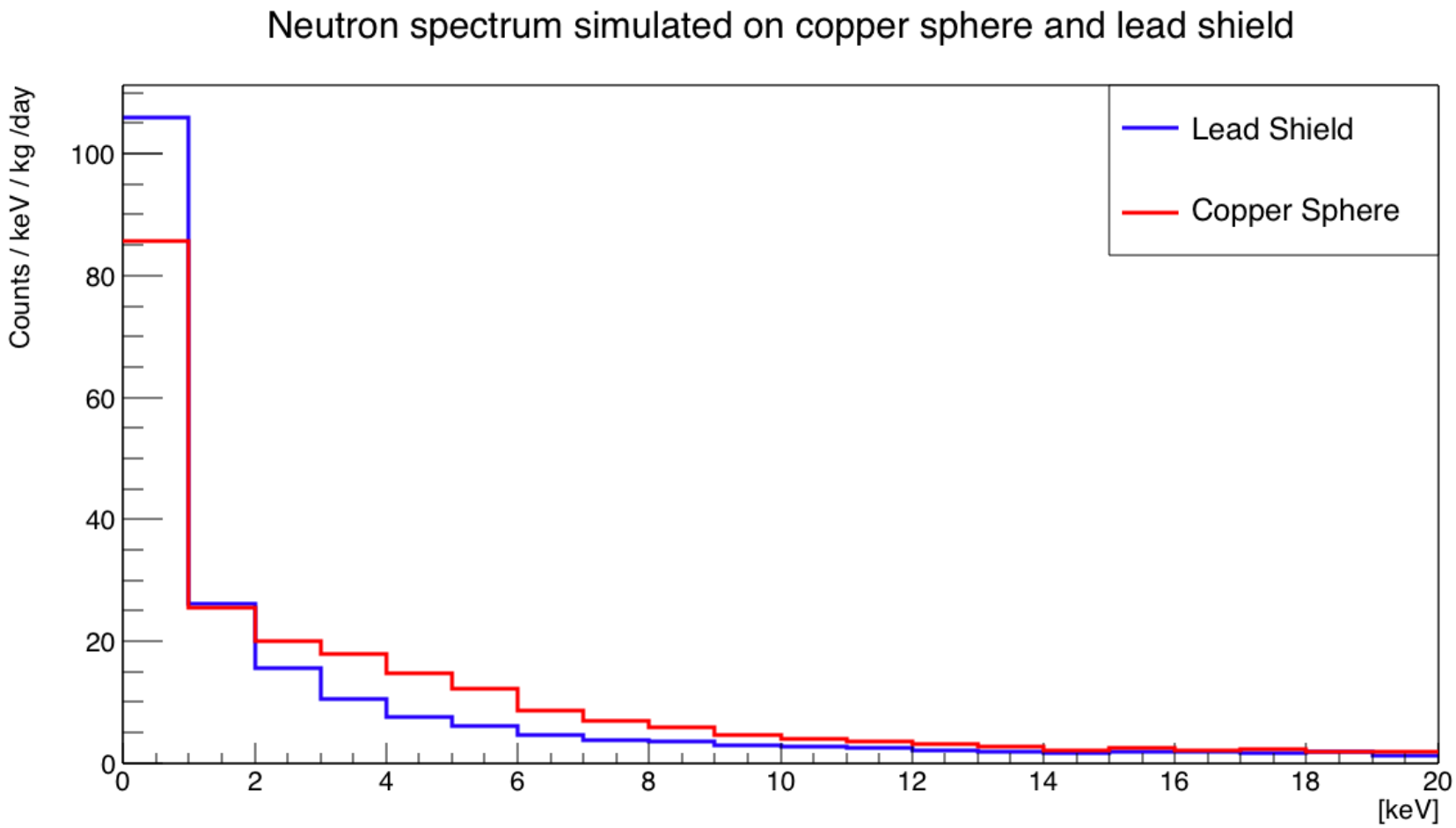
Total rate in [14, 10^6] eV = 848 Hz



With shield:
4.6 x10^{-3} mHz in [14, 10^6] eV
And 9 x10^{-3} dru < 1 keV

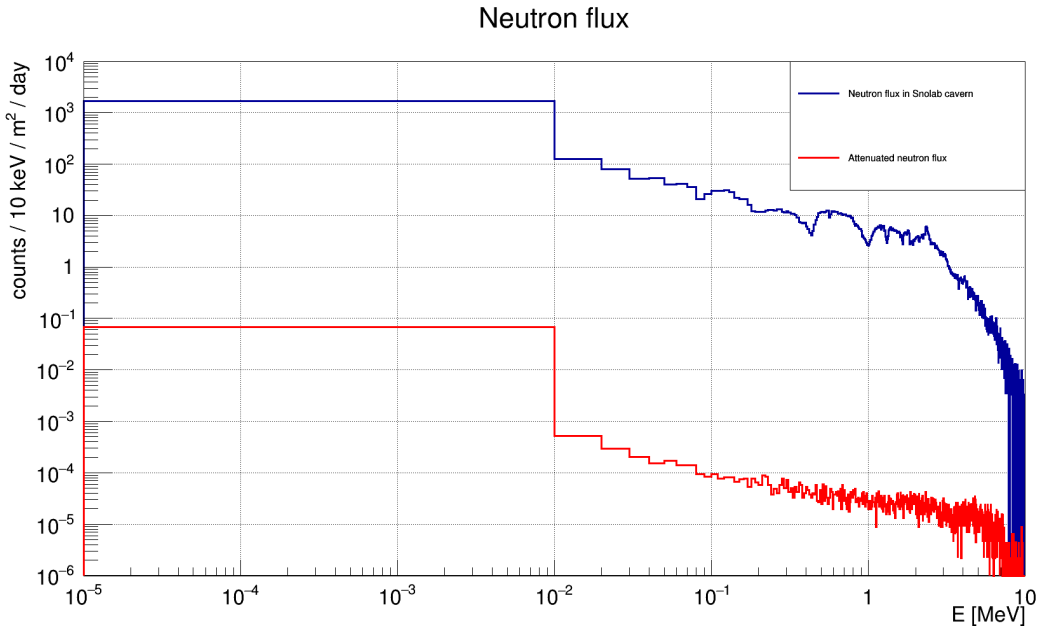
Effect of the PL shield is very limited, with only the lead shield, the results will be similar

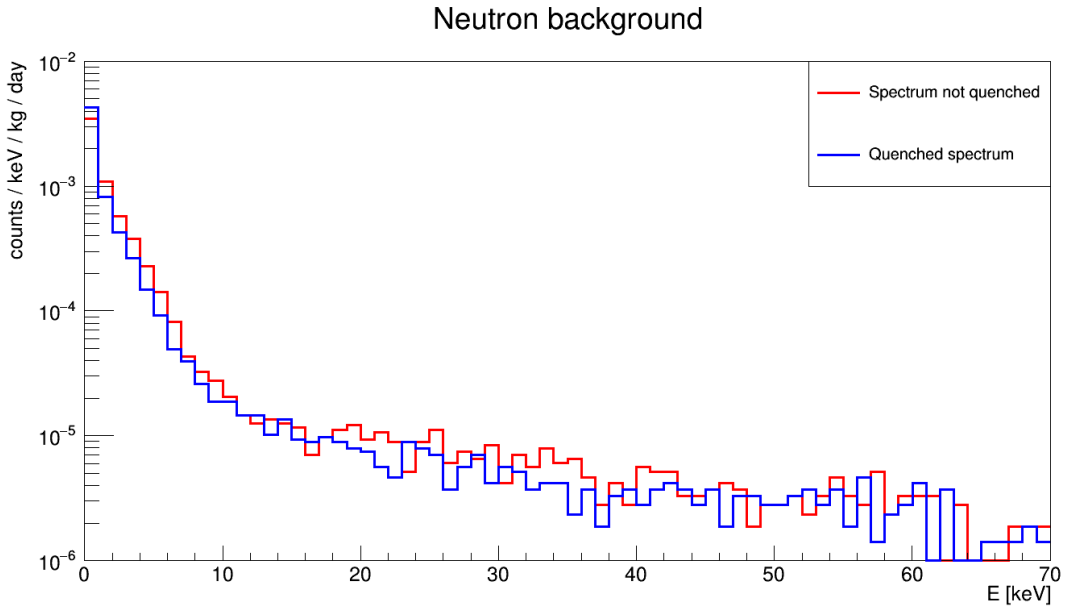
Background from the neutron flux:

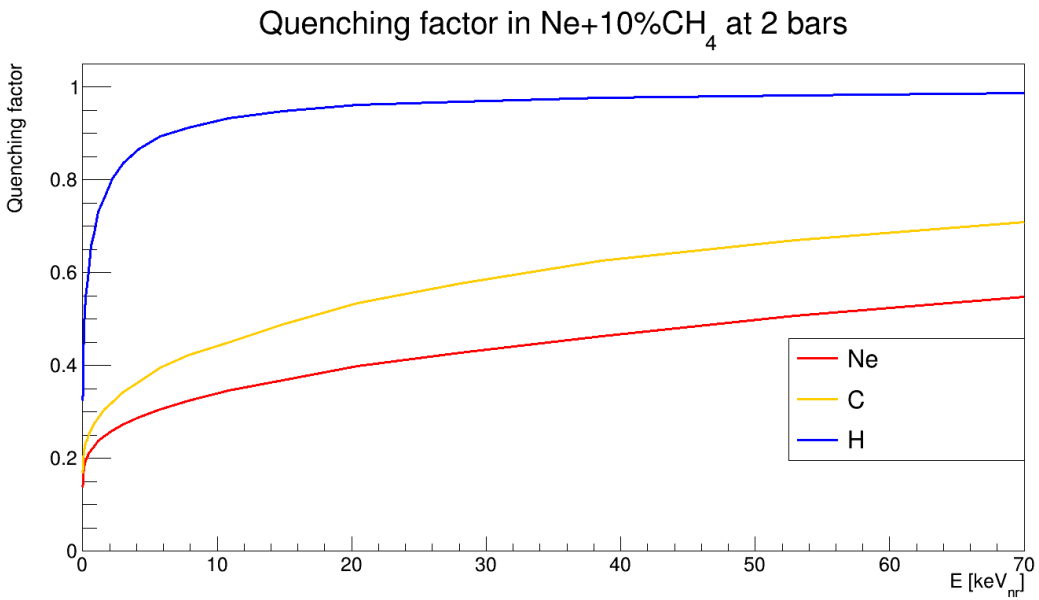


Background higher with the lead shield.

Attenaution of the neutron flux:







With polyethylene and lead shield:

4.38 x 10^{-3} dru < keV

3.5 x 10^{-11} mHz

Background from the lead shield

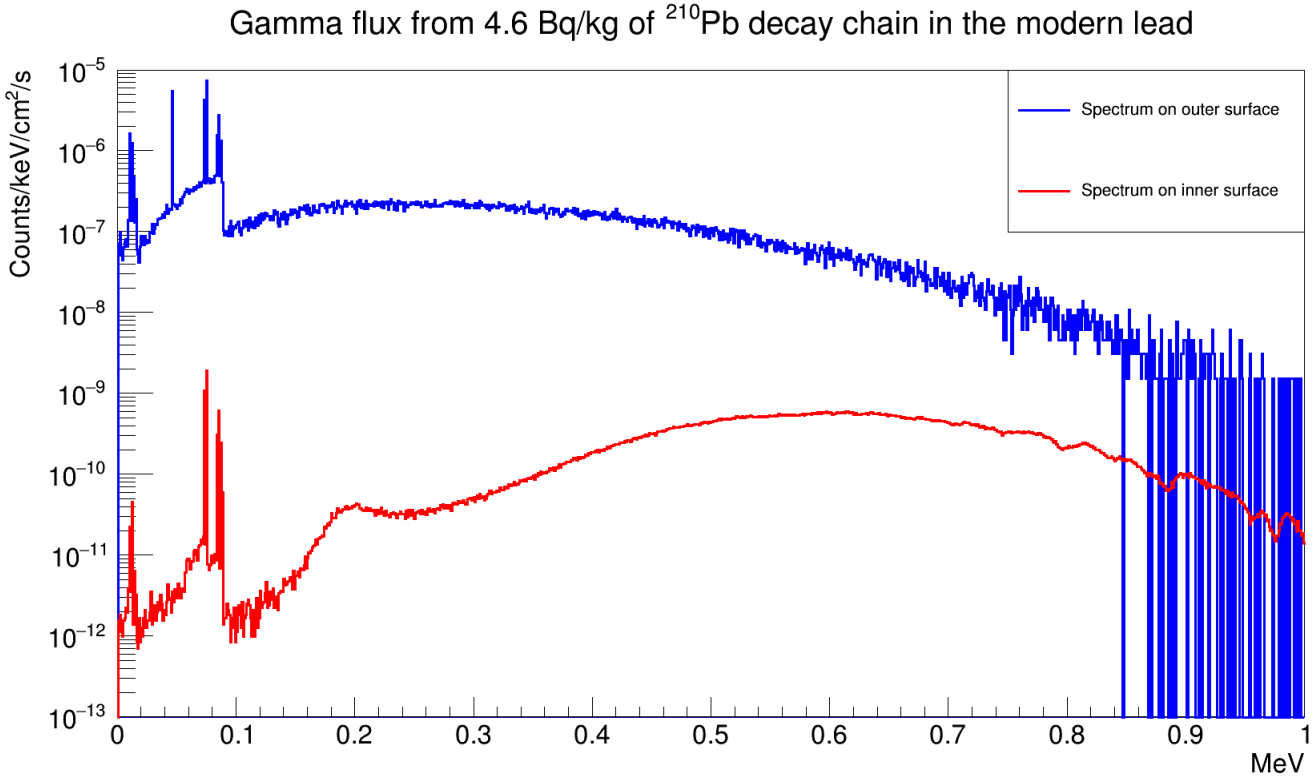
With a negligible background form gamma and neutron, the dominant will be the one coming form lead shield:

9 µBq/kg of ^{232}Th => 0.42 dru < 1 keV
70 µBq/kg of ^{238}U => 0.050 dru < 1keV
4.6 mBq/kg of ^{210}Pb => 25.9 dru < 1 keV

With only modern lead the background would be dominated by ^{210}Pb.

3 cm of roman lead have a huge attenuation.

With roman lead:
9.1 µBq/kg of ^{232}Th
44.5 µBq/kg of ^{238}U



	Source	Contamintaion / flux			Counts / keV / kg / day <1 keV		Counts / keV / kg / day in [1;5] keV		Rate [mHz]	
Archeological Lead	210Pb	<25		mBq/kg	0.14		0.12		0.057	
	238U	44.5	±7.7	µBq/kg	0.142	0.049	0.094	0.0026	0.277	0.053
	232Th	9.1	±1.8	µBq/kg	0.0256	0.0098	0.0161	0.0041	0.0557	0.0118
	40K	<1.3		mBq/kg	0.28		0.23		0.65	
Modern Lead	210Pb	4.6	±0.016	mBq/kg	0.053	0.003	0.055	0.001	0.17	
	238U	79	±14	µBq/kg	0.17	0.042	0.132	0.028	0.5	0.09
	232Th	9	±2	µBq/kg	0.0251	0.002	0.0201	0.0011	0.075	0.002
	40K	<1.46		mBq/kg	0.35		0.26		0.67	
Total (without upper limit)					0.5027	0.1028	0.3822	0.0358	0.9647	0.1568

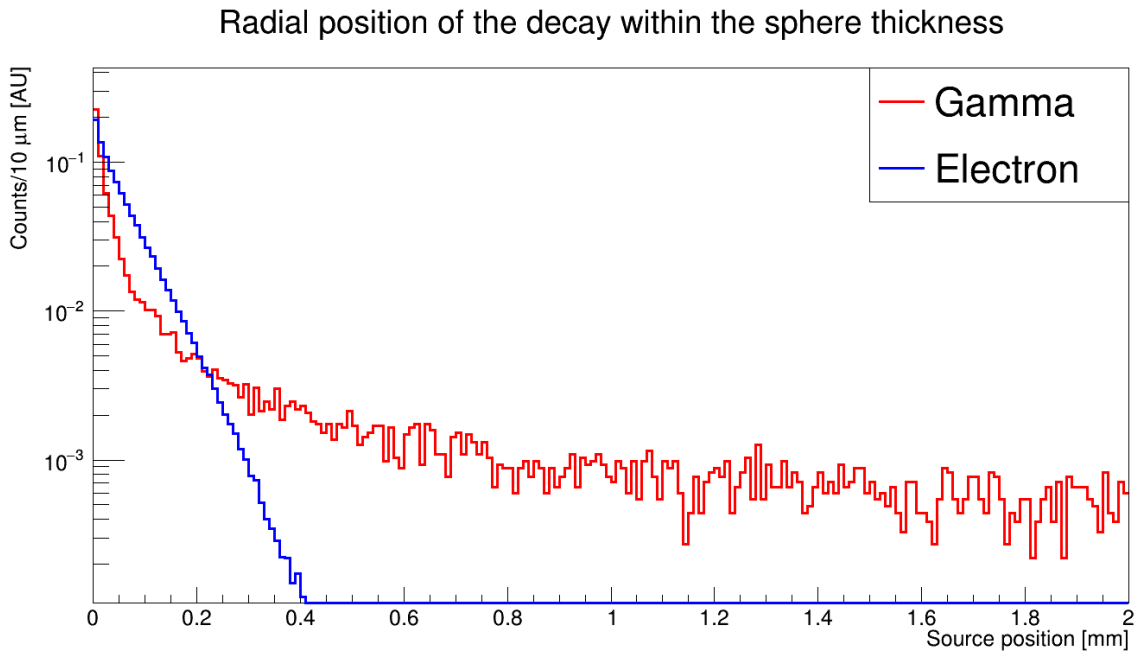
Background from the copper sphere

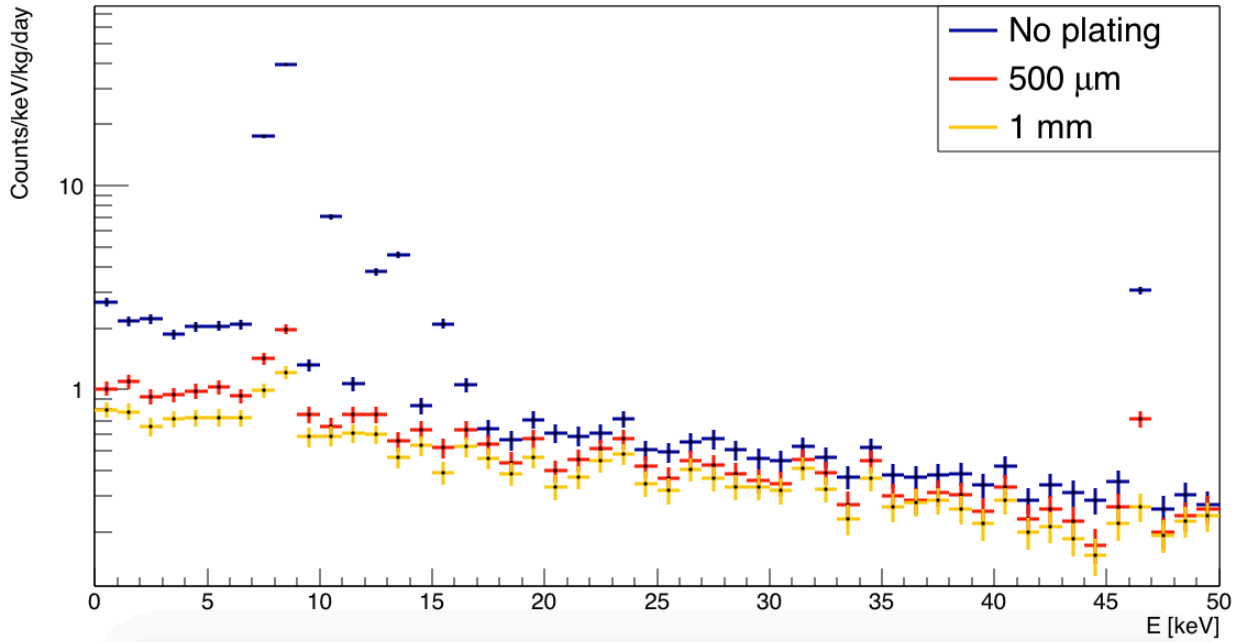
With 0.5 dru from the lead shield, the dominant background the ^{210}Pb chain come from the copper sphere:

28.5 mBq/kg of ^{210}Pb => 2.7 dru < 1 keV from gamma

With 500 µm of electrolyte, reduction of 62 %

=> 1.04 dru < 1 keV





Summary of the main background

	Source	Contamintaion / flux			Counts / keV / kg / day <1 keV		Counts / keV / kg / day in [1;5] keV		Rate [mHz]	
Copper Sphere	210Pb	28.5	±8.1	mBq/kg	1.04	0.38	1.01	0.33	0.86	0.25
	238U	3	±0.1	µBq/kg	0.0117	0.0013	0.0115	0.0008	0.028	0.001
	232Th	13	±0.2	µBq/kg	0.0754	0.0059	0.0692	0.0033	0.163	0.003
500 µm electrolyte inside	40K	0.1		mBq/kg	0.0157	0.003	0.0186	0.006	0.0622	0.0018
	60Co	38		µBq/kg	0.105	0.009	0.107	0.004	0.385	0.002
Archeological Lead	210Pb	<25		mBq/kg	0.14		0.12		0.057	
	238U	44.5	±7.7	µBq/kg	0.142	0.049	0.094	0.0026	0.277	0.053
	232Th	9.1	±1.8	µBq/kg	0.0256	0.0098	0.0161	0.0041	0.0557	0.0118
	40K	<1.3		mBq/kg	0.28		0.23		0.65	
Modern Lead	210Pb	4.6	±0.016	mBq/kg	0.053	0.003	0.055	0.001	0.17	
	238U	79	±14	µBq/kg	0.17	0.042	0.132	0.028	0.5	0.09
	232Th	9	±2	µBq/kg	0.0251	0.002	0.0201	0.0011	0.075	0.002
	40K	<1.46		mBq/kg	0.35		0.26		0.67	
Cavern	Gamma	2.11E+00		γ/cm2/s	0.00837	0.0001	0.00951	0.000044	0.00464	0.000037
	Neutron	4000		n/m2/day	0.00438	0.00036	0.000415	0.000132	3.54E-11	2.60E-12
	Muon	0.27		µ/m2/day	6.20E-04	1.10E-04	4.40E-04	4.20E-04	5.04E-08	5.10E-10
Total without upper limit					1.677	0.506	1.544	0.381	2.581	0.415

^{210}Pb measured by X-mass

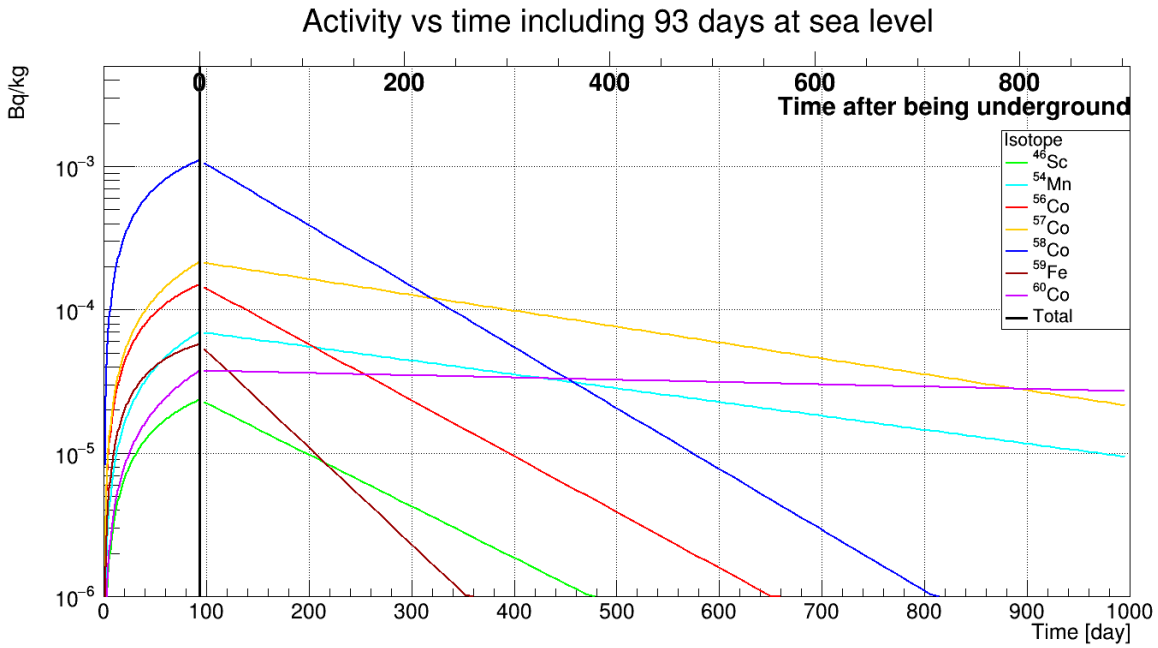
^{238}U and ^{232}Th measured at PNNL

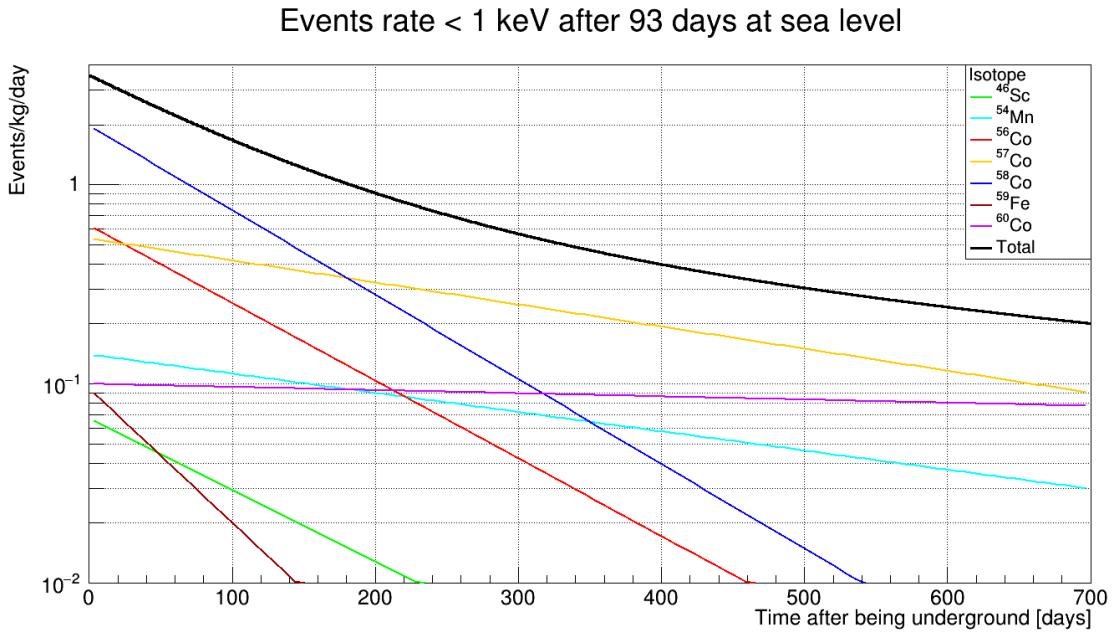
^{60}Co estimated from 3 months of exposure at sea level

^{40}K activity in C10100 copper measured by NEXT-100

The upper limits in the lead are not counted in the total

Cosmogenic activation of copper

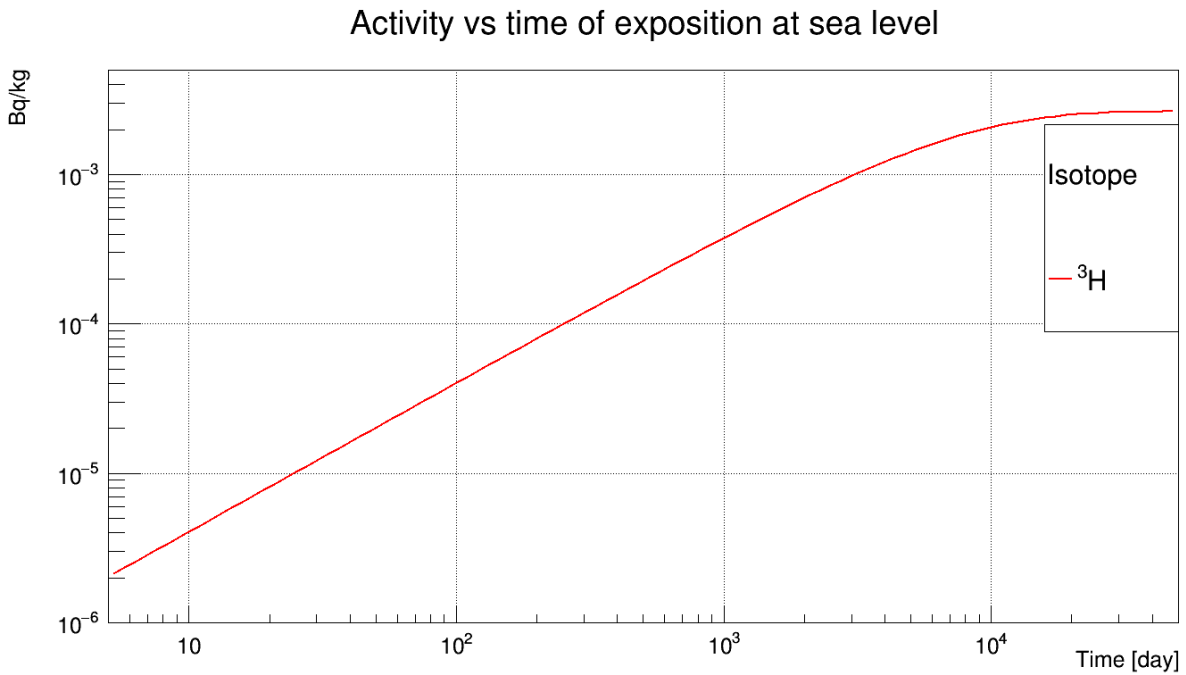


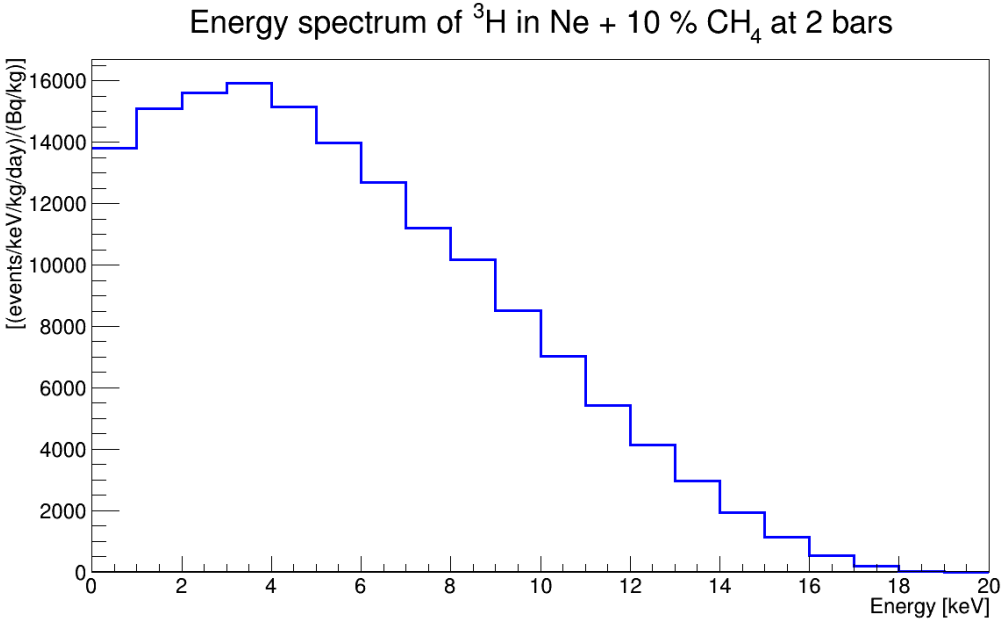


	half life [days]	Production rate [days^{-1}]	
		Ziegler	Gordon et al
^{56}Co	77.2	22.9	20.0
^{57}Co	271.7	88.3	74.1
^{58}Co	70.9	159.6	123
^{60}Co	1898	97.4	55.4
^{54}Mn	312	32.5	27.7
^{59}Fe	44.6	6.5	4.9
^{46}Sc	83.79	3.8	2.7

April 1 => 3.5 dru < 1kev
June 1 => 2.2 dru < 1 keV
July 1 => 1.7 dru < 1 keV
August 1 => 1.4 dru < 1 keV
Septembre 1 => 1.2 dru < 1 keV

Cosmogenic activation of neon tritium production



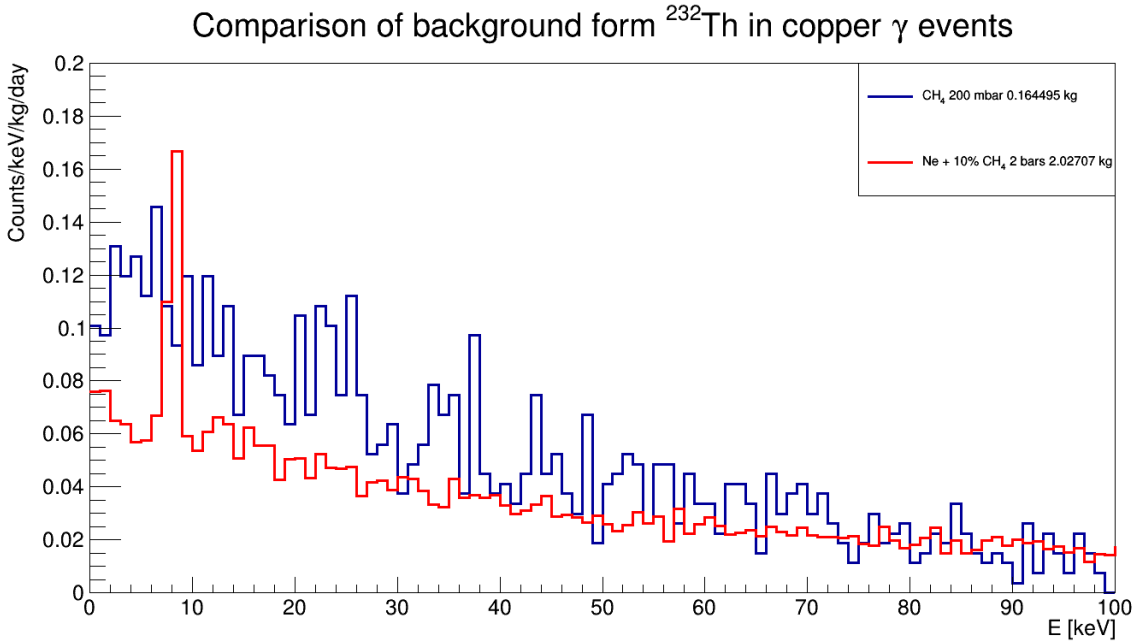


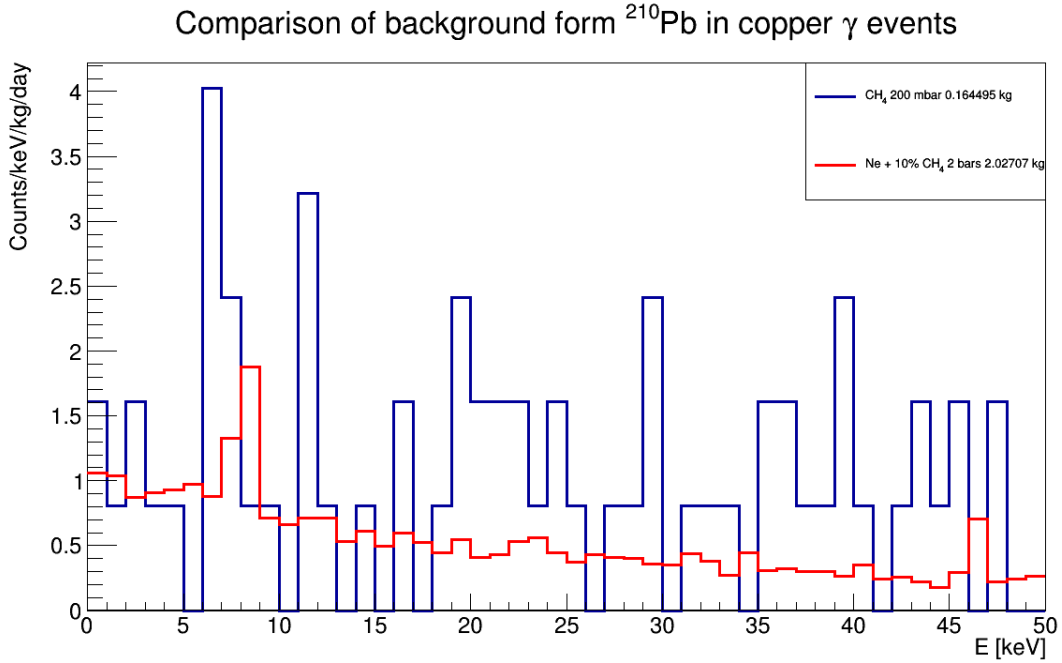
13804 events / keV / kg / day < 1kev for 1 Bq/kg
To keep the rate below 0.1 dru, we need less than 7.2 µBq/kg. This activity is reached after ~20 days.

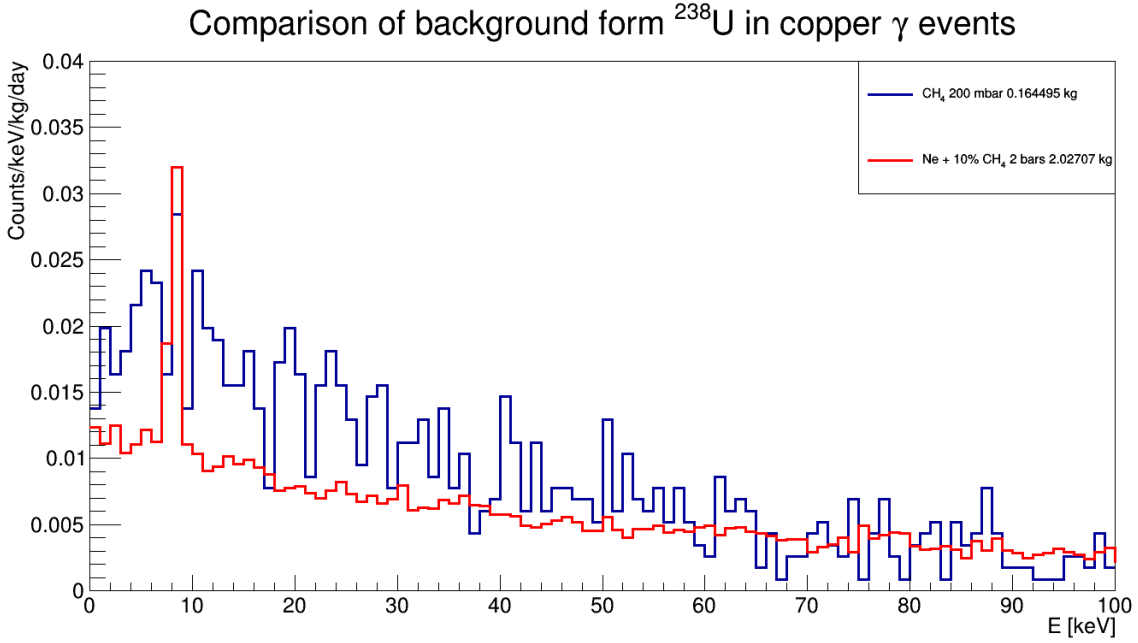
SNOLAB:
Praxair: Neon produced in US, send in Paris Ontario. 3 to 5 weeks between production and delivery => 0.1 to 0.2 dru

LSM:
Messer: Neon produced in China, send to Austria, then in France.
Air Liquide: No information yet.

First simulation on pure 200 mbar pure CH4







Comparison between 200 mbar pure CH_4 and 2 bars of Ne+10% CH_4 (same quantity of CH_4)

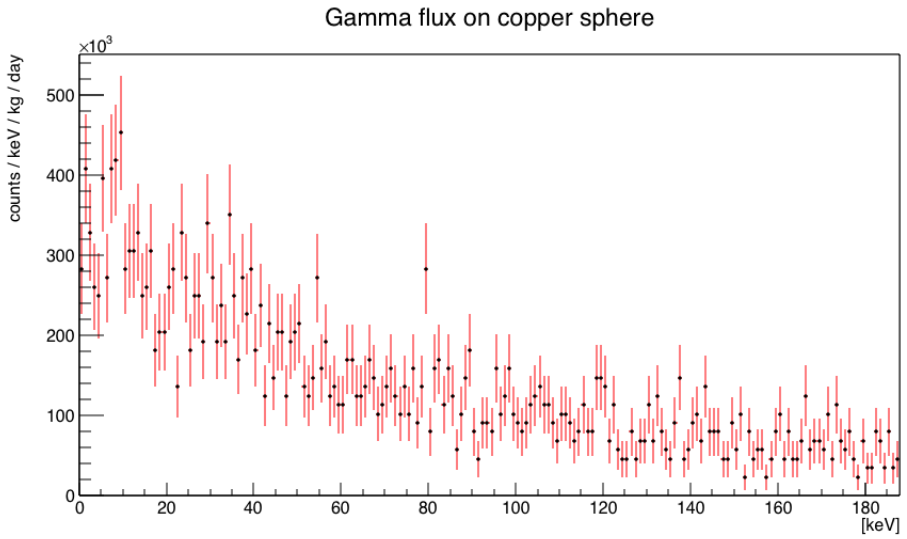
Events rate estimated assuming 3 µBq/kg of ^{238}U and 12 µBq/kg of ^{232}Th, 28 mBq/kg of ^{210}Pb 500 µm of pure copper on the inner surface.

Similar events rate

Conclusion on dominant background Ne+CH_4 at 2 bars:

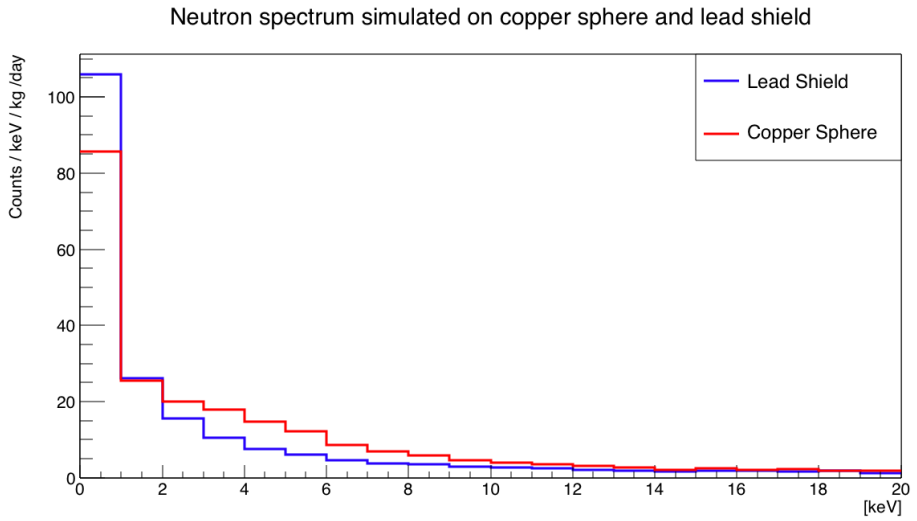
Copper sphere only

Dominated by gamma



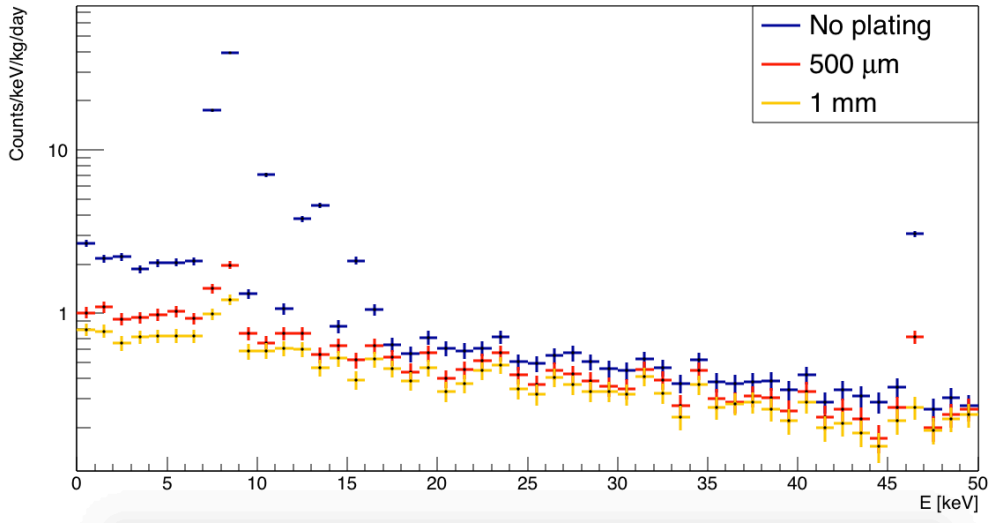
+ lead shield

Dominated by neutron



+ polyethylene shield

Dominated by ^{210}Pb



THANK YOU