R.A. budget:
Neutron yield evaluation
for the reinforced PU foam and
Triplex with SaG4n

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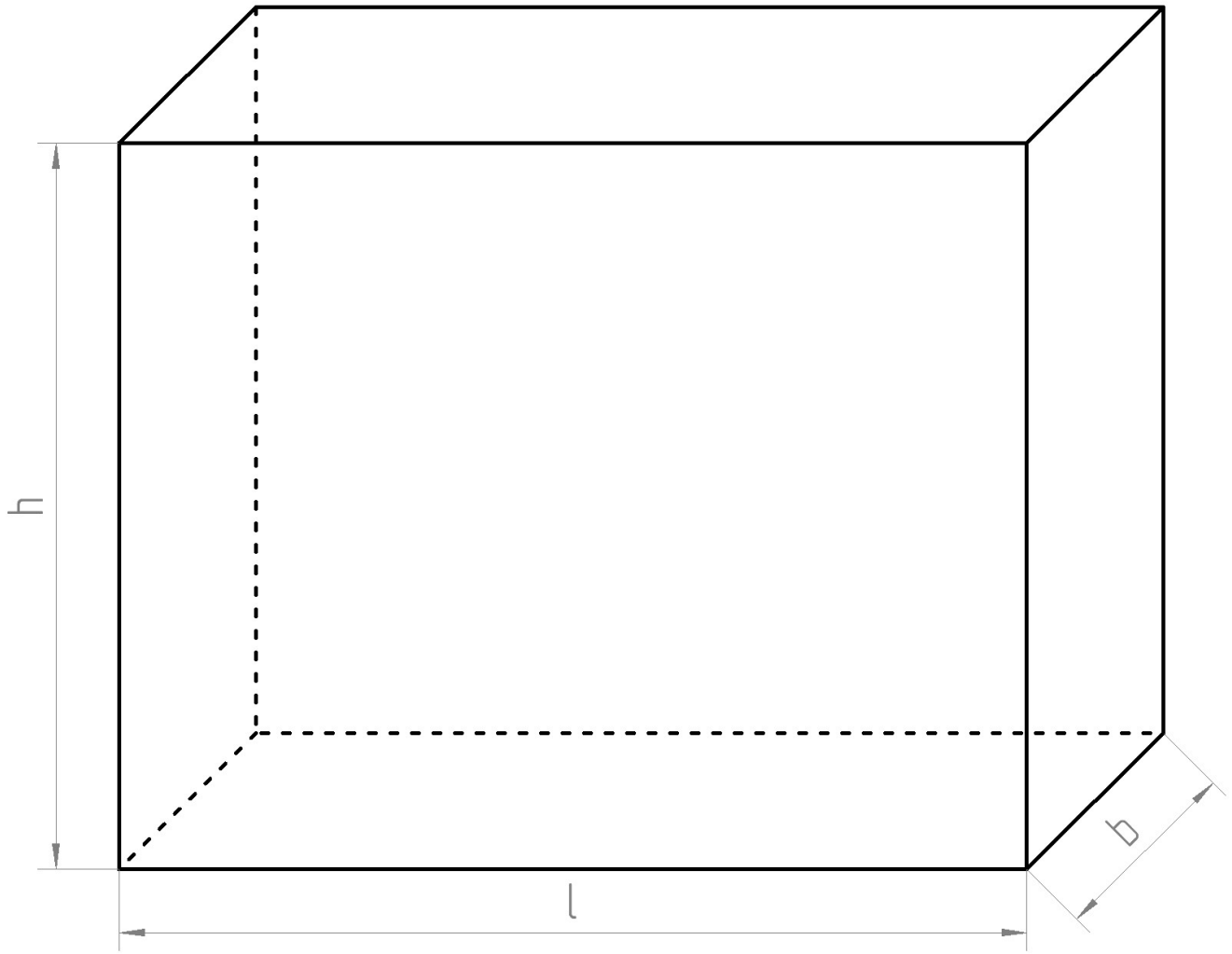
14.04.2020

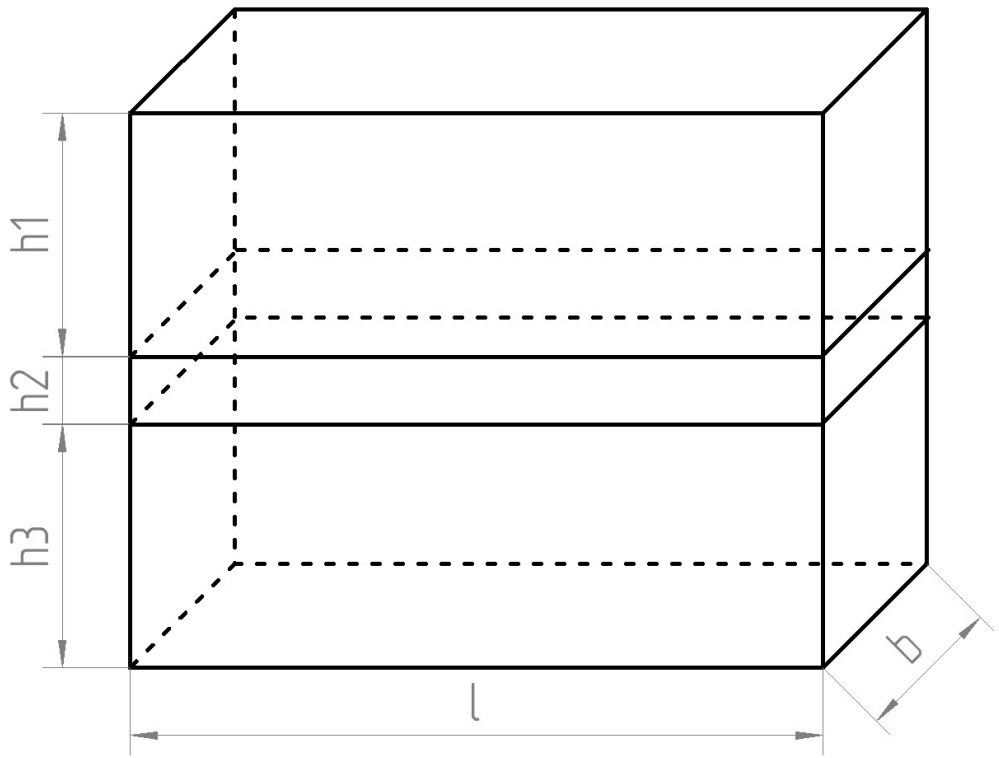
Sizes of the DS-20k cryostat part for the simulation with SaG4n



Reinforced PU foam

Cap as a test sample:
h = 770 mm, l = 10128 mm, b = 10128 mm

Sizes of the DS-20k cryostat part for the simulation with SaG4n



Triplex Cap as a test sample:

Upper layer: h1 = 265 um, l = 9358 mm, b = 9358 mm

Middle layer: h2 = 70 um, l = 9358 mm, b = 9358 mm

Lower layer: h3 = 265 um, l = 9358 mm, b = 9358 mm

Compositions
Reinforced PU foam

55% PU foam
$\rho = 0.100$ g/cm^3

Element	Mass fraction, %
H	32.5
C	3.6
N	2.8
O	37.6
Si	11.7
Ca	5.0
Al	5.0
B	1.4
Mg	0.3

90% PU foam
$\rho = 0.100$ g/cm^3

Element	Mass fraction, %
H	53.19
C	5.94
N	4.59
O	31.07
Si	2.60
Ca	1.12
Al	1.11
B	0.31
Mg	0.07

Compositions
Triplex

3 layers

Fiber glass foil (Triplex layer)
$\rho = 1.685\ g/cm^3$

Element	Mass fraction, %
H	0
C	0
N	0
O	47.89
Si	25.95
Ca	11.21
Al	11.15
B	3.07
Mg	0.71

Note: 2 outer layers are made of the fiber glass foil

Aluminium foil (Triplex layer)
$\rho = 2.7\ g/cm^3$

Element	Mass fraction, %
H	0
C	0
N	0
O	0
Si	0
Ca	0
Al	100
B	0
Mg	0

Note: and one inner layer is made of the aluminium foil

Triplex **homogeneous**
$\rho = 1.803\ g/cm^3$

Element	Mass fraction, %
H	0
C	0
N	0
O	39.52
Si	21.42
Ca	9.25
Al	26.67
B	2.56
Mg	0.58

α source characteristics

5 sets of the α particle energies and intensities: predefined Chain_Th232, Chain_U235 and

^{238}U upper

SOURCE 0 11
1.0 18
92238 4.198 79.0
92238 4.151 20.9
92238 4.038 0.078
92234 4.7746 71.38
92234 4.7224 28.42
92234 4.6035 0.2
92234 4.2773 4e-05
92234 4.1506 2.6e-05
92234 4.1086 7e-06
90230 4.687 76.3
90230 4.6205 23.4
90230 4.4798 0.12
90230 4.4384 0.03
90230 4.3718 0.00097
90230 4.2783 8e-06
90230 4.2485 1.03e-05
90230 3.8778 3.4e-06
90230 3.8294 1.4e-06
ENDSOURCE

^{238}U middle

SOURCE 0 1
1.0 24
88226 4.78434 93.84
88226 4.601 6.16
88226 4.34 0.0065
88226 4.191 0.001
88226 4.16 0.00027
86222 5.48948 99.92
86222 4.986 0.078
86222 4.826 0.0005
84218 6.00235 99.97890022
84218 5.181 0.00109978
85218 6.756 0.00071928
85218 6.693 0.017982
85218 6.653 0.00127872
86218 7.1292 1.9974e-05
86218 6.5311 2.54e-08
83214 5.516 0.009408
83214 5.452 0.012936
83214 5.273 0.001392
83214 5.184 0.0001464
83214 5.023 5.04e-05
83214 4.941 6e-05
84214 7.68682 99.96550252
84214 6.9022 0.010397504
84214 6.6098 5.99856e-05
ENDSOURCE

238U lower

SOURCE 0 1
1.0 5
82210 3.72 1.9e-06
83210 4.694 5.2e-05
83210 4.656 7.8e-05
84210 5.30433 99.99987
84210 4.51658 0.001039998648
ENDSOURCE

Other input parameters

Number of initial α particles $= 10^7$

Bias factor $= 10^4$

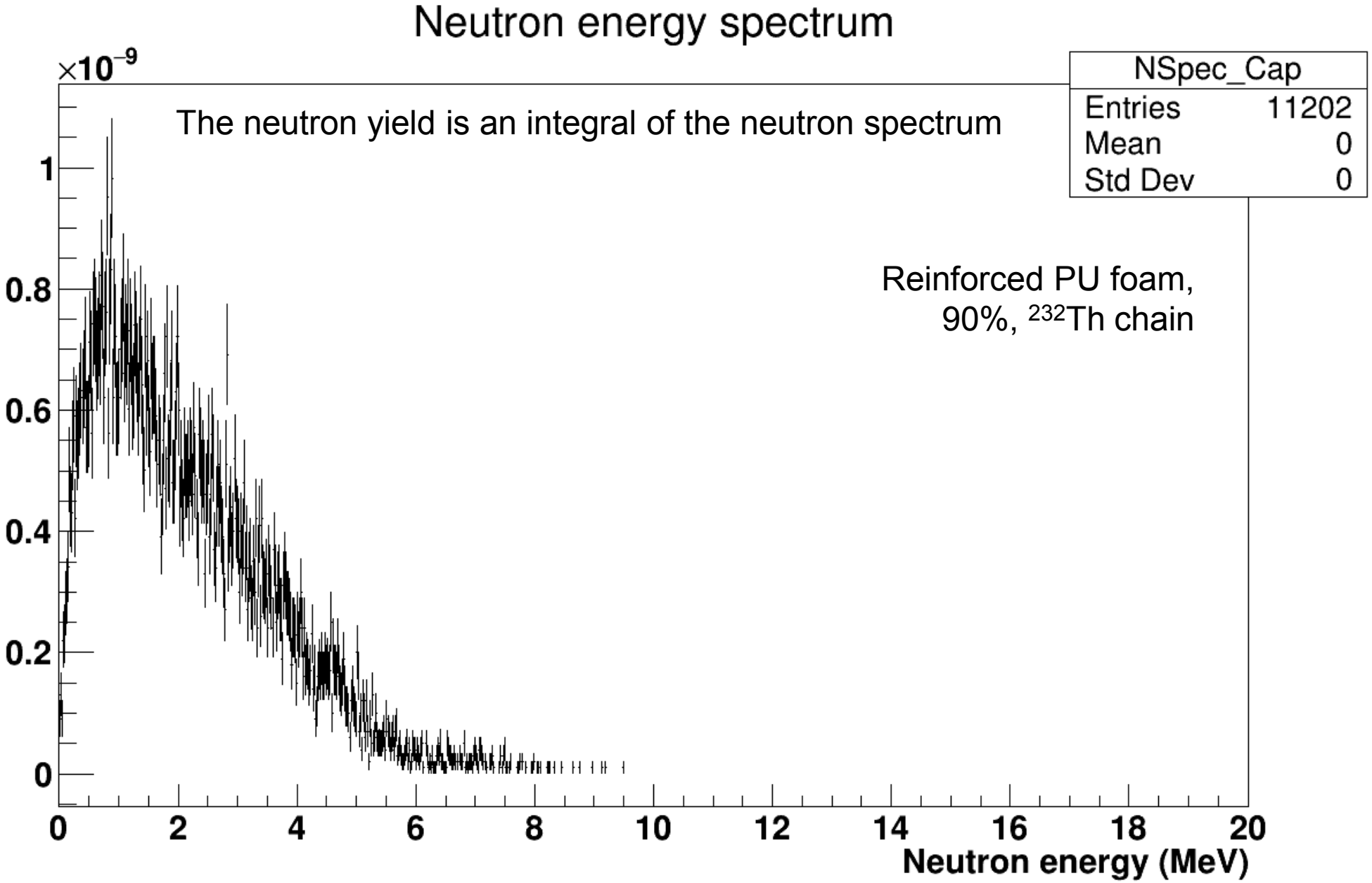
Maximum allowed step length: 0.001 cm

Uniform distribution of α particles in the source volume

Size of the world cube side: 2000 cm

Legend: Diff(T-J) ≡ difference between the results of SaG4n with TENDL-2017 and JENDLTENDL01;
Diff(N-T) ≡ difference between the results of NeuCBOT and the results of SaG4n with TENDL-2017;
Diff(N-J) ≡ difference between the results of NeuCBOT and the results of SaG4n with JENDLTENDL01.

$$\text{Diff(T}-\text{J)} \equiv \frac{Y_n\ (\text{TENDL}-2017\ )\ - Y_n\ (\text{JENDLTENDL01})}{Y_n\ (\text{JENDLTENDL01})} \times 100\%$$


Neutron energy spectrum
×10⁻⁹
The neutron yield is an integral of the neutron spectrum
NSpec_Cap
Entries 11202
Mean 0
Std Dev 0
Reinforced PU foam,
90%, ²³²Th chain
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20
Neutron energy (MeV)

Reinforced PU foam

	RA Chain	Data library / PU foam fraction	JENDLTENDL01	TENDL-2017	NeuCBOT	Diff(T-J), %	Diff(N-T), %	Diff(N-J), %
Neutron yield, 10^{-7} n/decay	^{232}Th	55%	3.91	5.45	---	39		
		90%	1.12	1.55	44	38	2739	3829
	^{235}U	55%	3.32	4.61	---	39		
		90%	0.86	1.20	44	40	3567	5016
	^{238}U upper	55%	1.02	1.56	---	53		
		90%	0.23	0.33	5.7	43	1627	2378
	^{238}U middle	55%	3.68	5.04	---	37		
		90%	1.03	1.42	28	38	1872	2618
	^{238}U lower	55%	1.92	2.64	---	38		
		90%	0.42	0.56	3.3	33	489	686

Triplex

	RA Chain	Data library / Element distribution	JENDLTENDL01	TENDL-2017	NeuCBOT	Diff(T-J), %	Diff(N-T), %	Diff(N-J), %
Neutron yield, 10^{-6} n/decay	^{232}Th	3 layers	1.629	2.130	21	31	886	1189
		Uniform distrib.	1.727	2.226	---	29	---	---
	^{235}U	3 layers	1.370	1.836	20	34	989	1360
		Uniform distrib.	1.446	1.901	---	31	---	---
	^{238}U upper	3 layers	0.374	0.548	2.1	47	283	461
		Uniform distrib.	0.370	0.536	---	45	---	---
	^{238}U middle	3 layers	1.508	1.982	13	31	556	762
		Uniform distrib.	1.603	2.051	---	28	---	---
	^{238}U lower	3 layers	0.725	0.975	1.4	34	44	93
		Uniform distrib.	0.738	0.974	---	32	---	---