Radioactivity background survey

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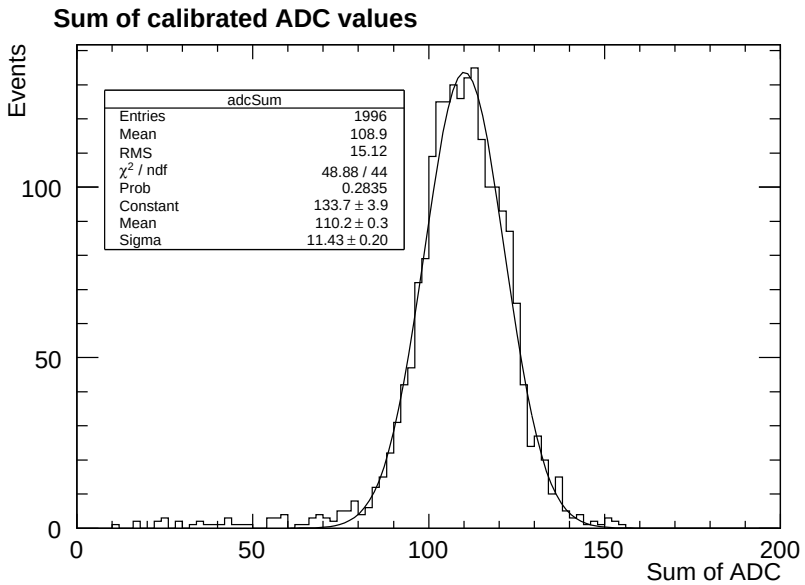
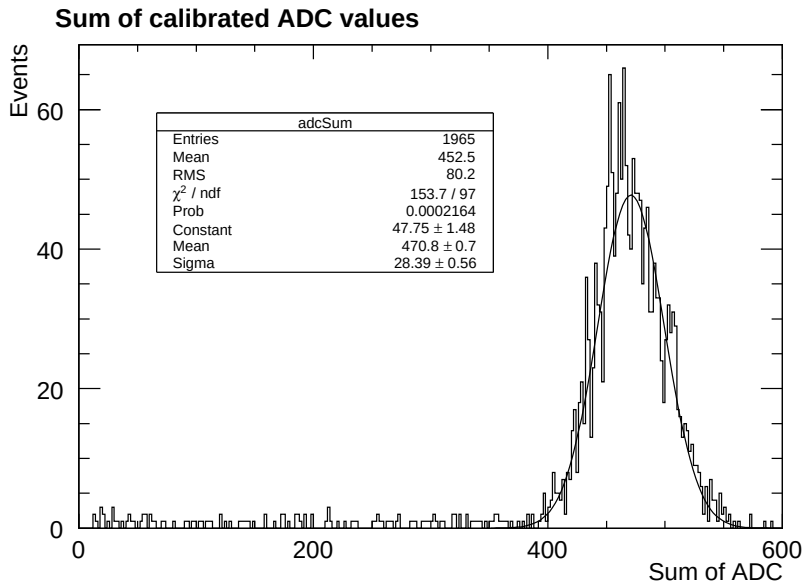
Radioactivity decay rates

	gds	lso	PMT	sst
U	10^{-3} ppb	10^{-3} ppb	132 ppb	0.0012 Bq/kg
Th	10^{-3} ppb	10^{-3} ppb	256 ppb	0.006 Bq/kg
K40	10^{-3} ppb	10^{-3} ppb	0.0115%	0.013 Bq/kg
Co60				0.002 Bq/kg

- Taken from DYB-doc-1408 & DYB-doc-3454-v5.
- 20 tons gds, 20 tons lso, 19 tons sst, 192 PMTs.
- Because of the cascade decays of ^{238}U and ^{232}Th, multipliers of 9 and 4 are applied to the above rates to get the final rates for ^{238}U and ^{232}Th, respectively.
- Generated 50000 K40 in gds, lso, PMT, sst each. 20000 Uranium/Thorium gds, lso each, 50000 Uranium/Thorium in PMT, sst each. 50000 Co60 in sst.

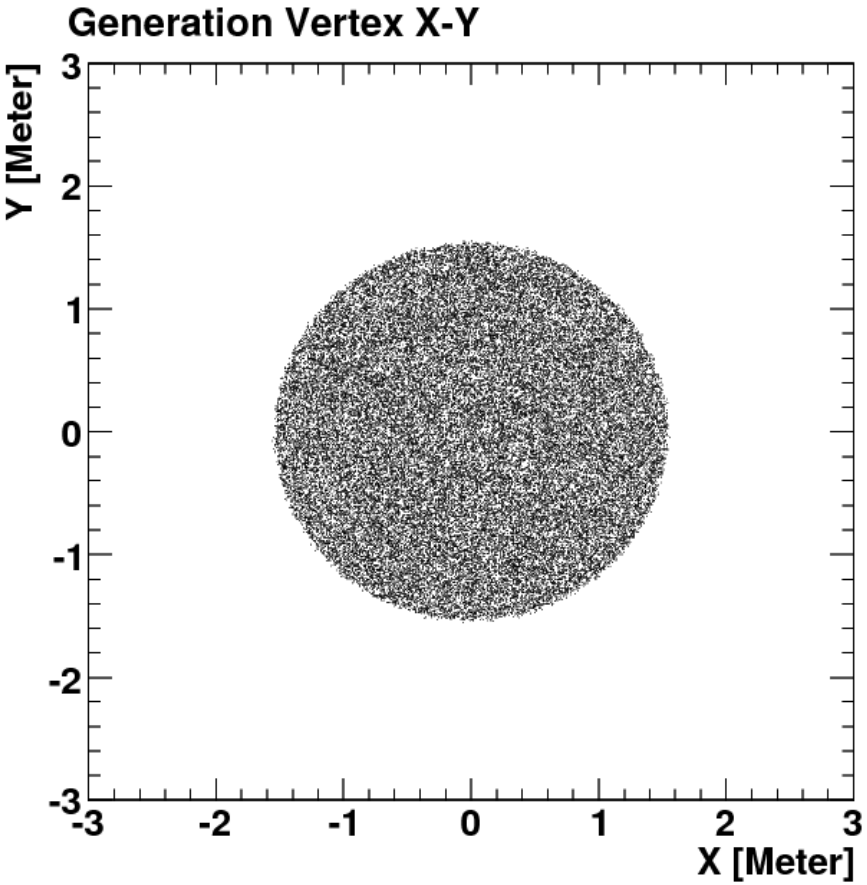
Energy calibration

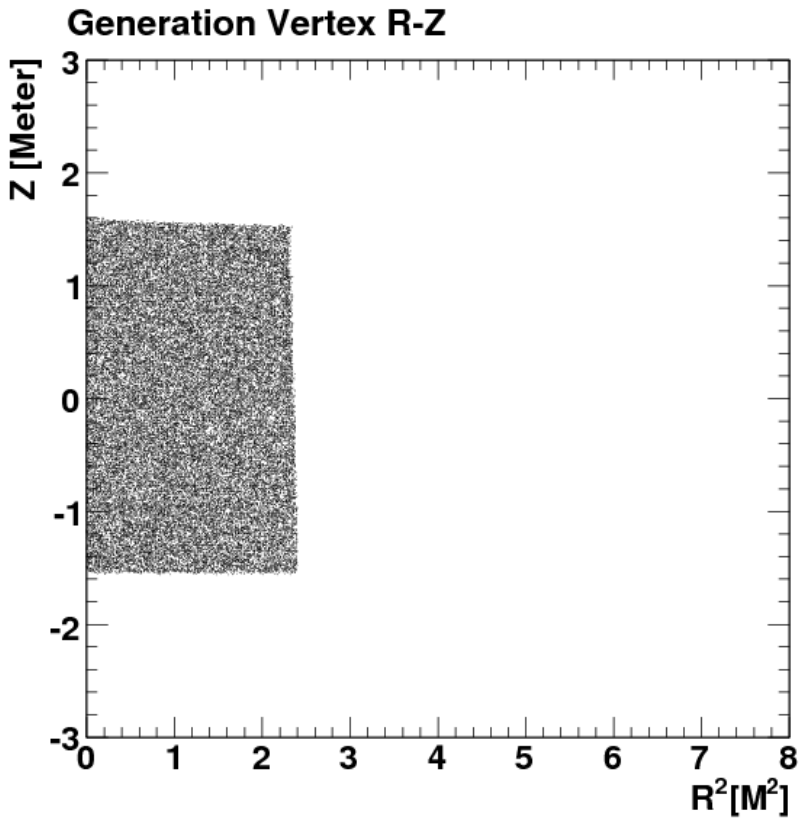




- 1 MeV $\gamma \sim$ 110.2 ADC sum (choosen in this study)
- 4 MeV $\gamma \sim$ 470.8 ADC sum

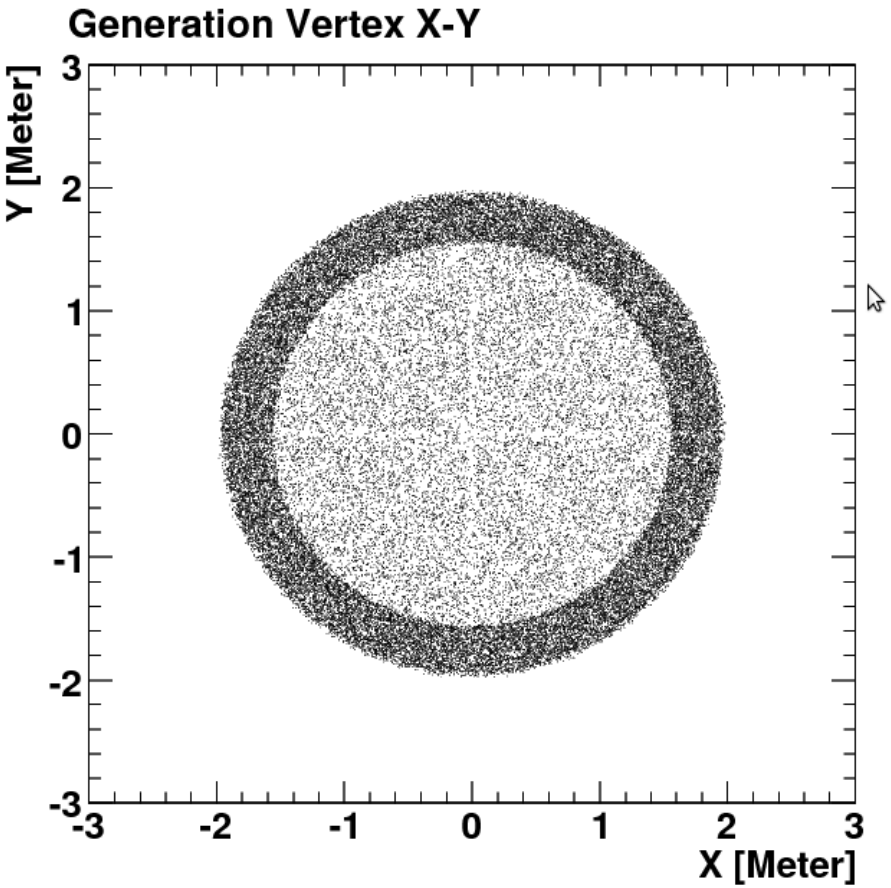
gds generation position

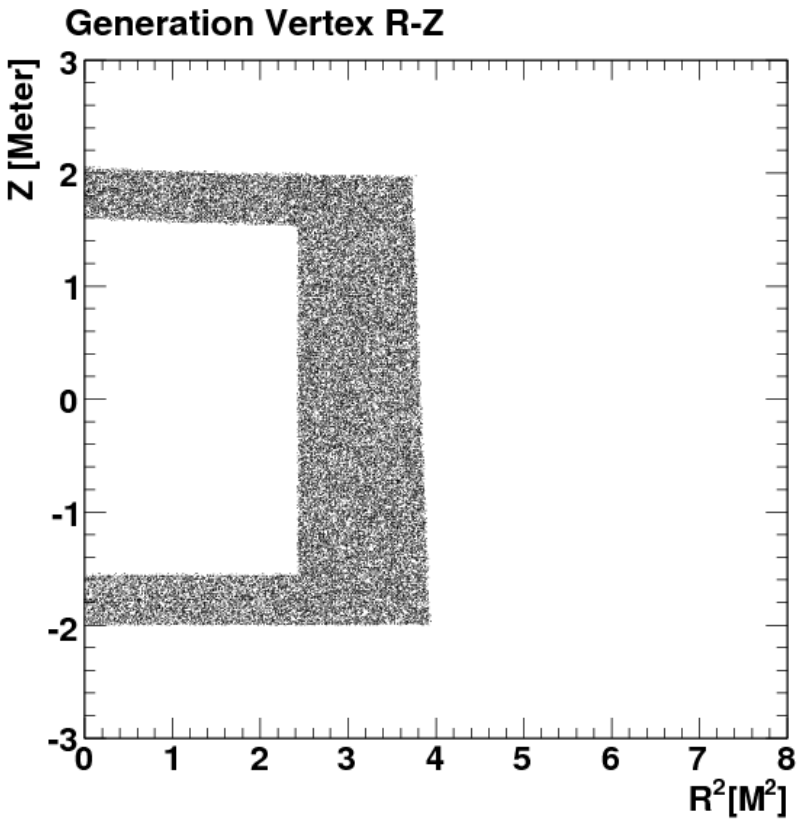




- volume = "/dd/Structure/AD/db-gds1"
- positioner.Strategy = "FullVolume"
- positioner.Mode = "Uniform"

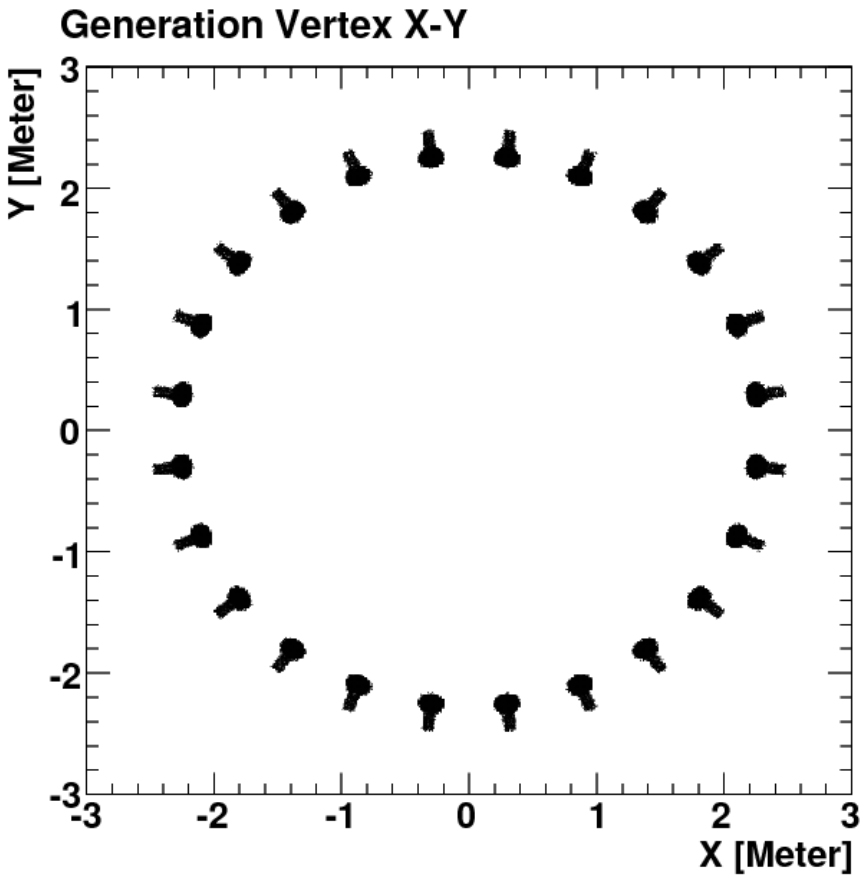
Iso generation position

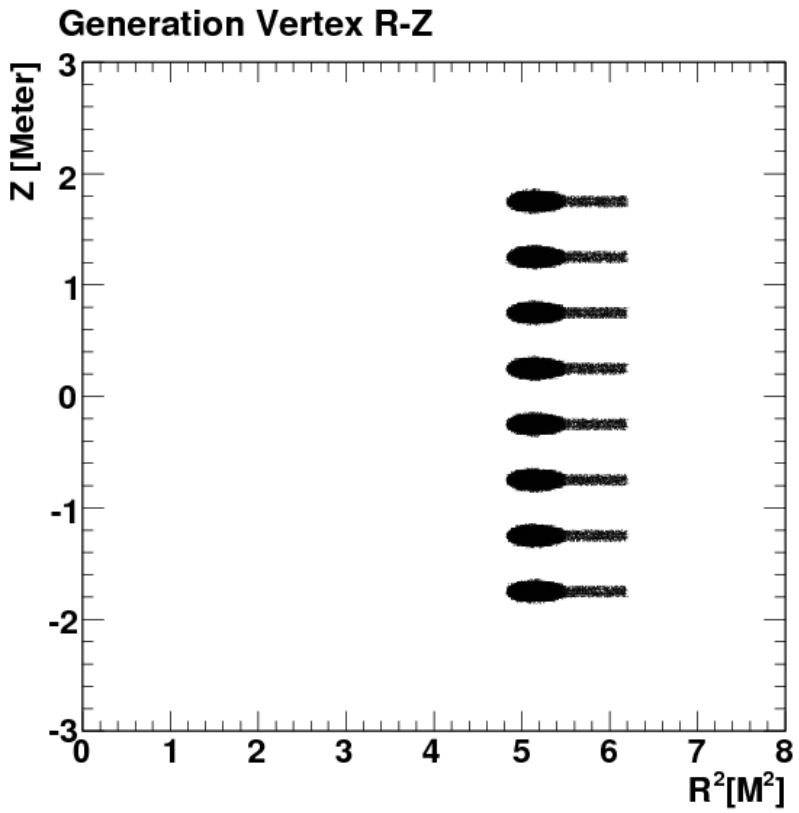




- volume = "/dd/Structure/AD/db-Iso1"
- positioner.Strategy = "AvoidDaughters"
- positioner.Mode = "Uniform"

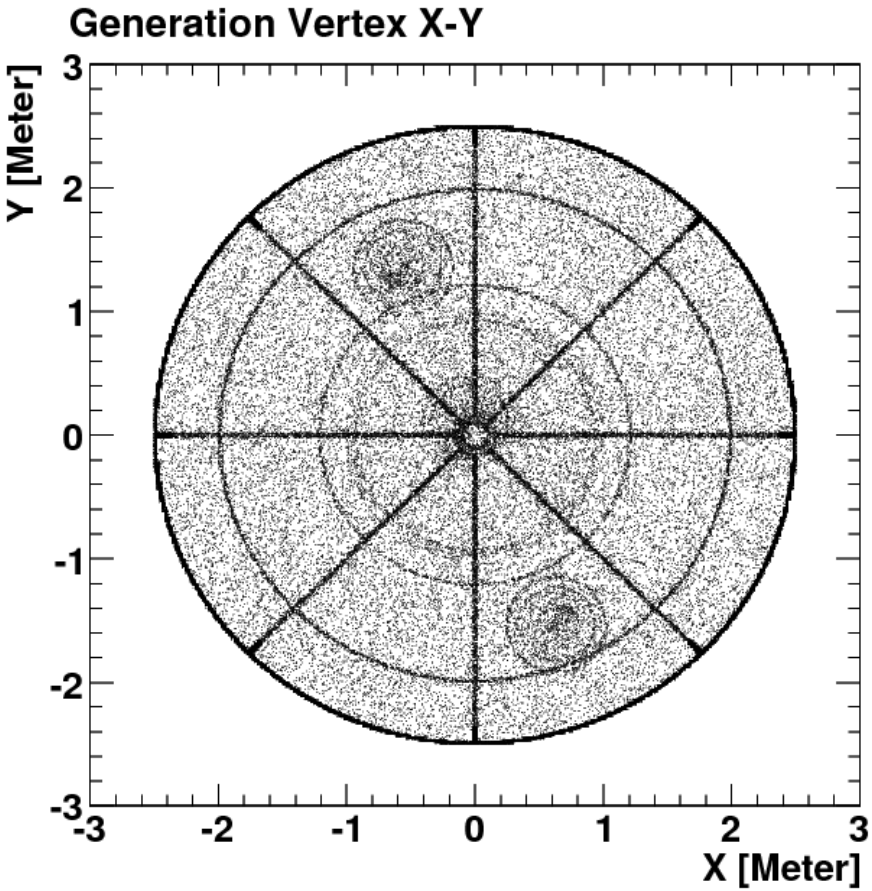
PMT generation position

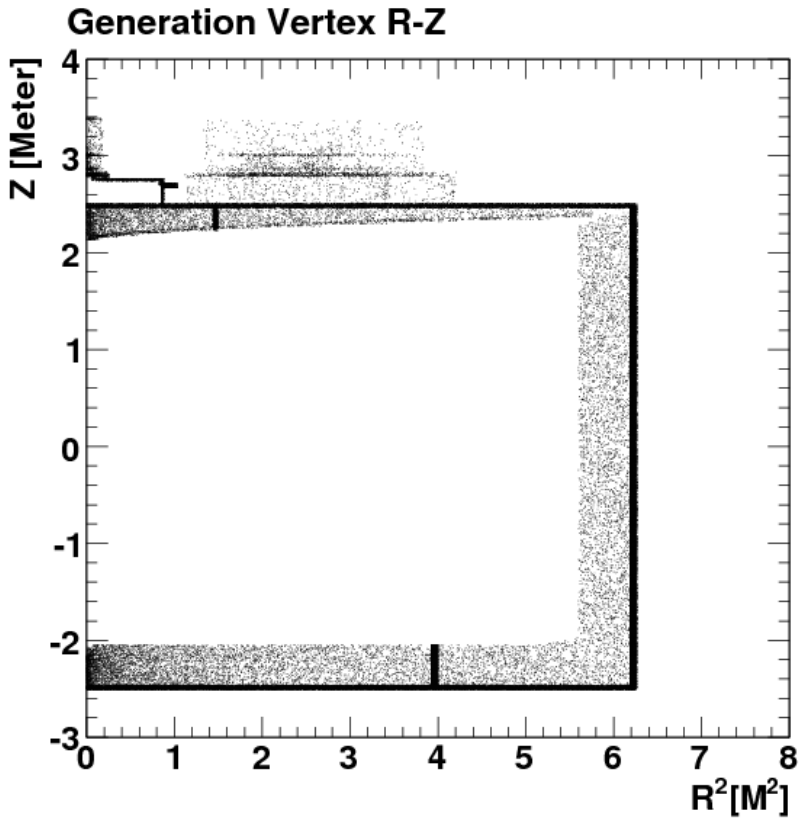




- volume = "/dd/Structure/AD/db-oil1"
- positioner.Strategy = "VolumeType"
- positioner.FillVolumes = ["lvPmtHemiVacuum"]
- positioner.Mode = "Uniform"

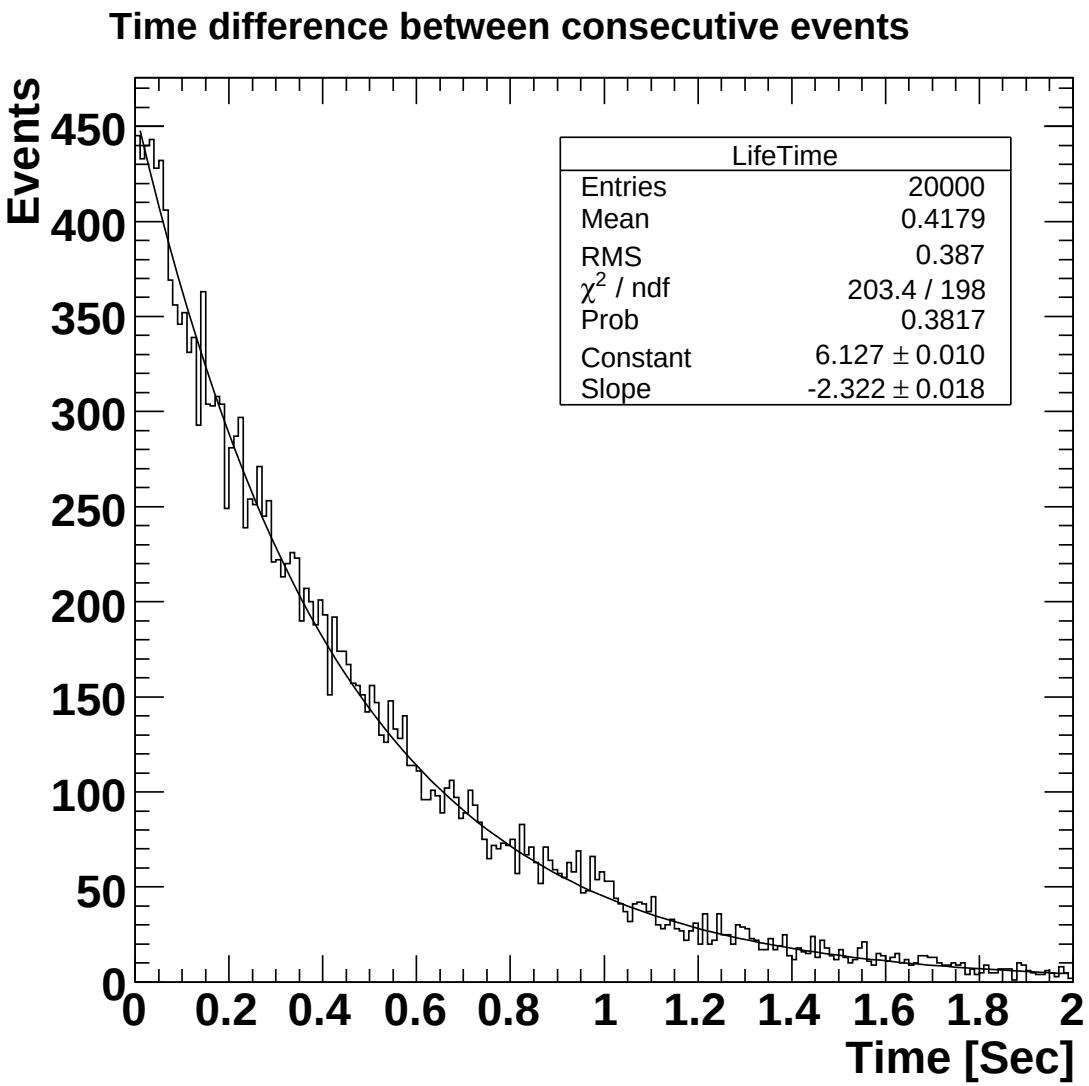
sst generation position





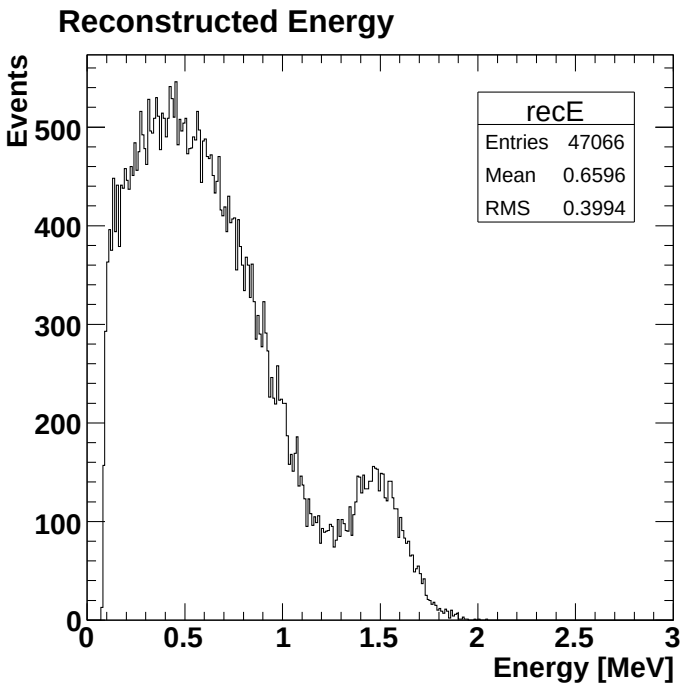
- volume = "/dd/Structure/AD/db-ade1"
- positioner.Strategy = "Material"
- positioner.FillVolumes = ["StainlessSteel"]
- positioner.Mode = "Uniform"

Life time

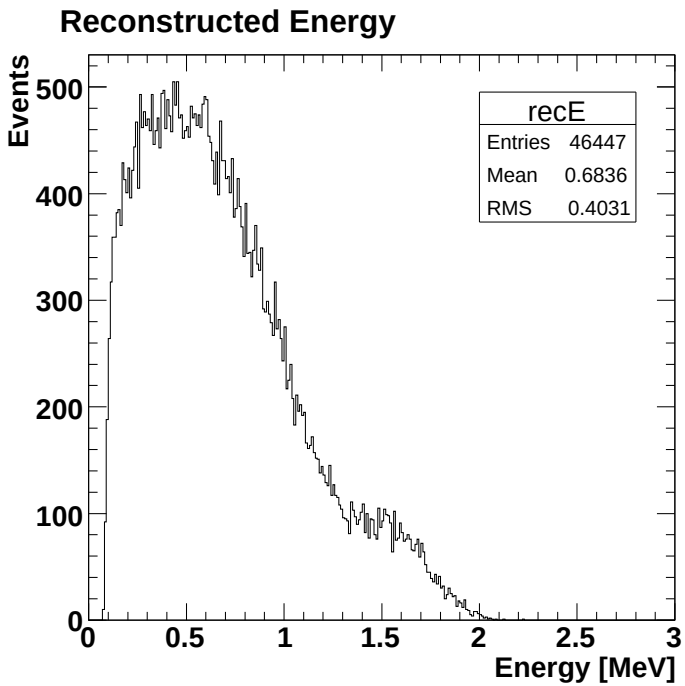


- Imput rate: 0.44 Hz
- Fit with $e^{-t/\tau}$, $\tau = 1/2.322 \approx 0.43$

K40 spectrum in gds and lso

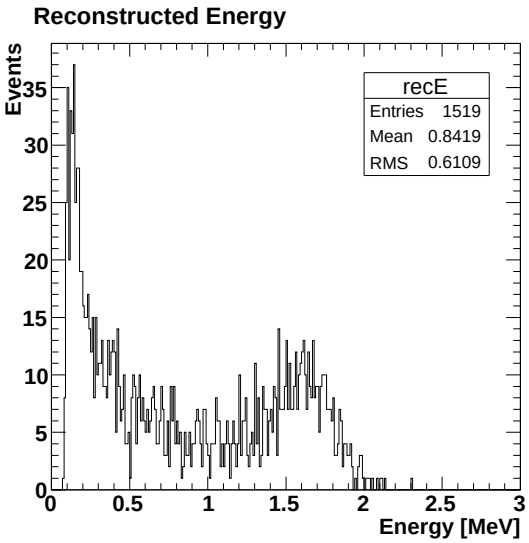


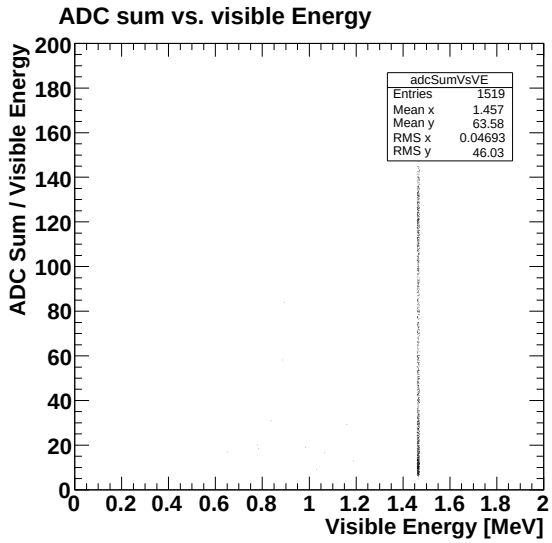
K40 spectrum in gds

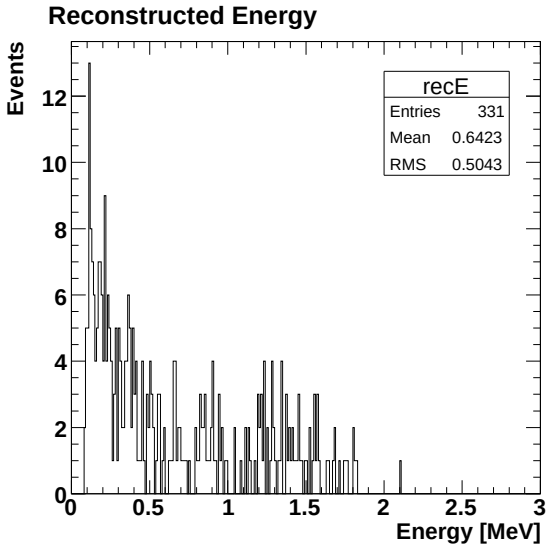


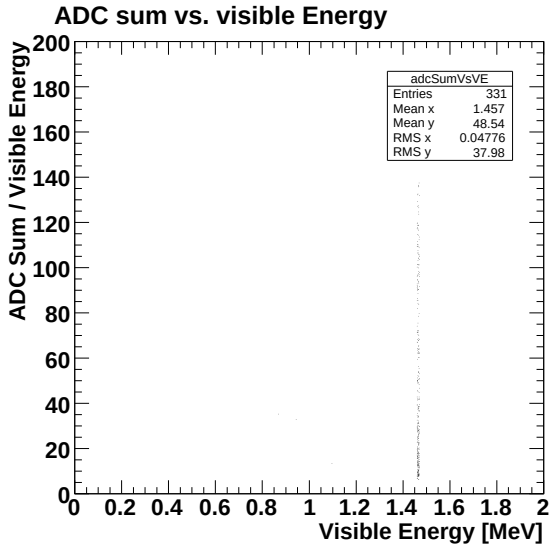
K40 spectrum in lso

K40 spectrum in PMT and sst





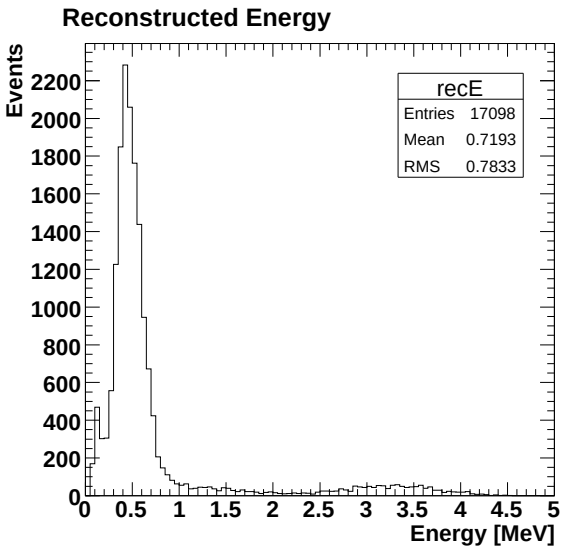


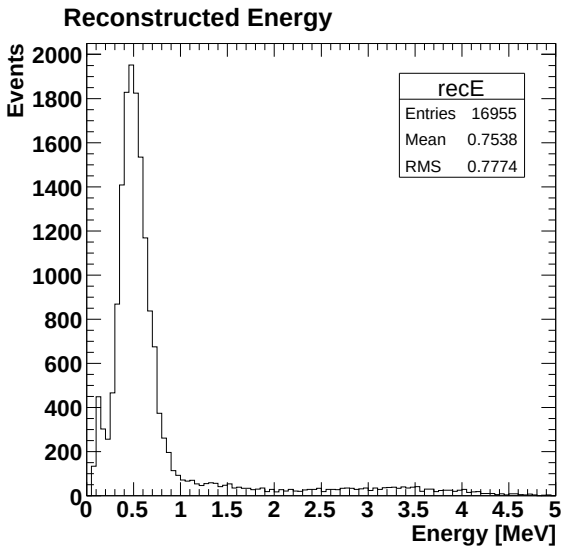


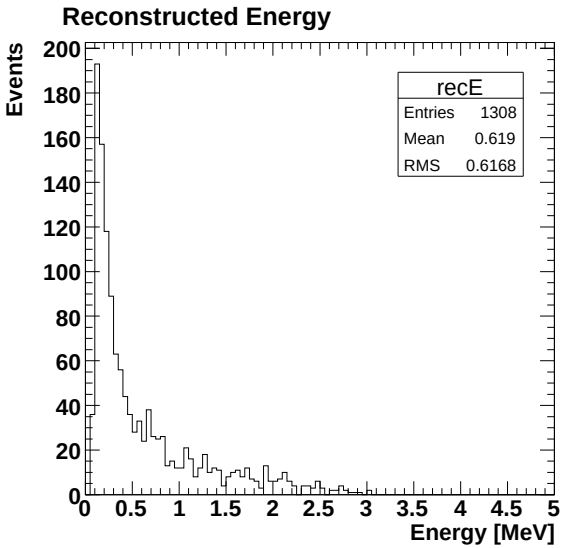
- K40 spectrum in PMT
- Almost all the readouts come from γ decay

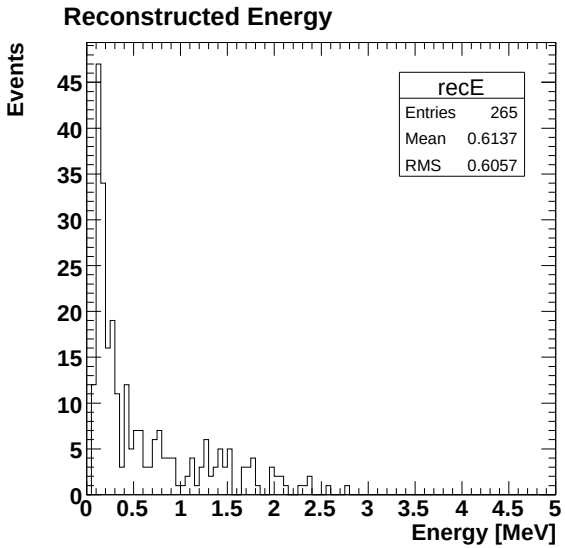
- K40 spectrum in sst

Uranium spectrum



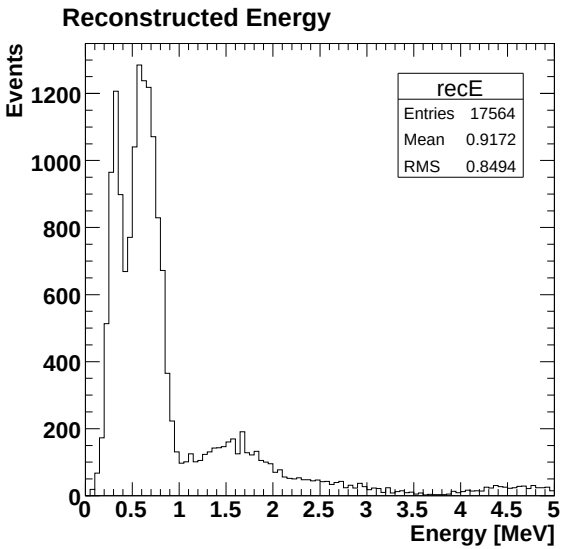


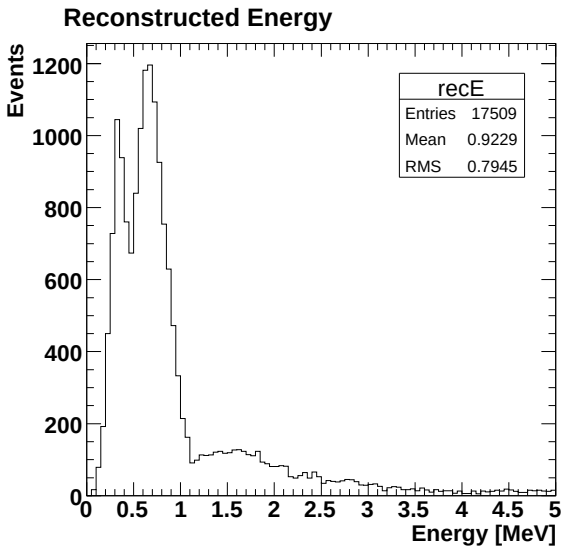


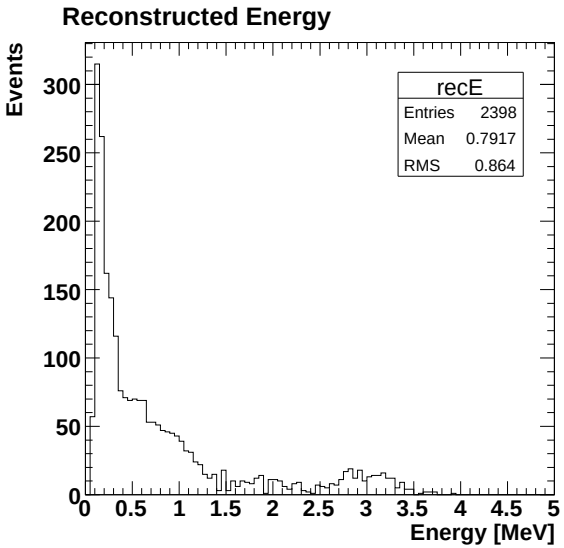


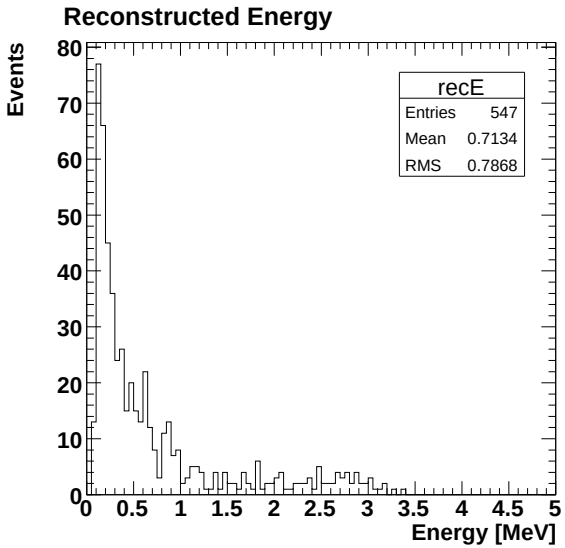
- Up left: in gds
- Up right: in lso
- Down left: in PMT
- Down right: in sst

Thorium spectrum



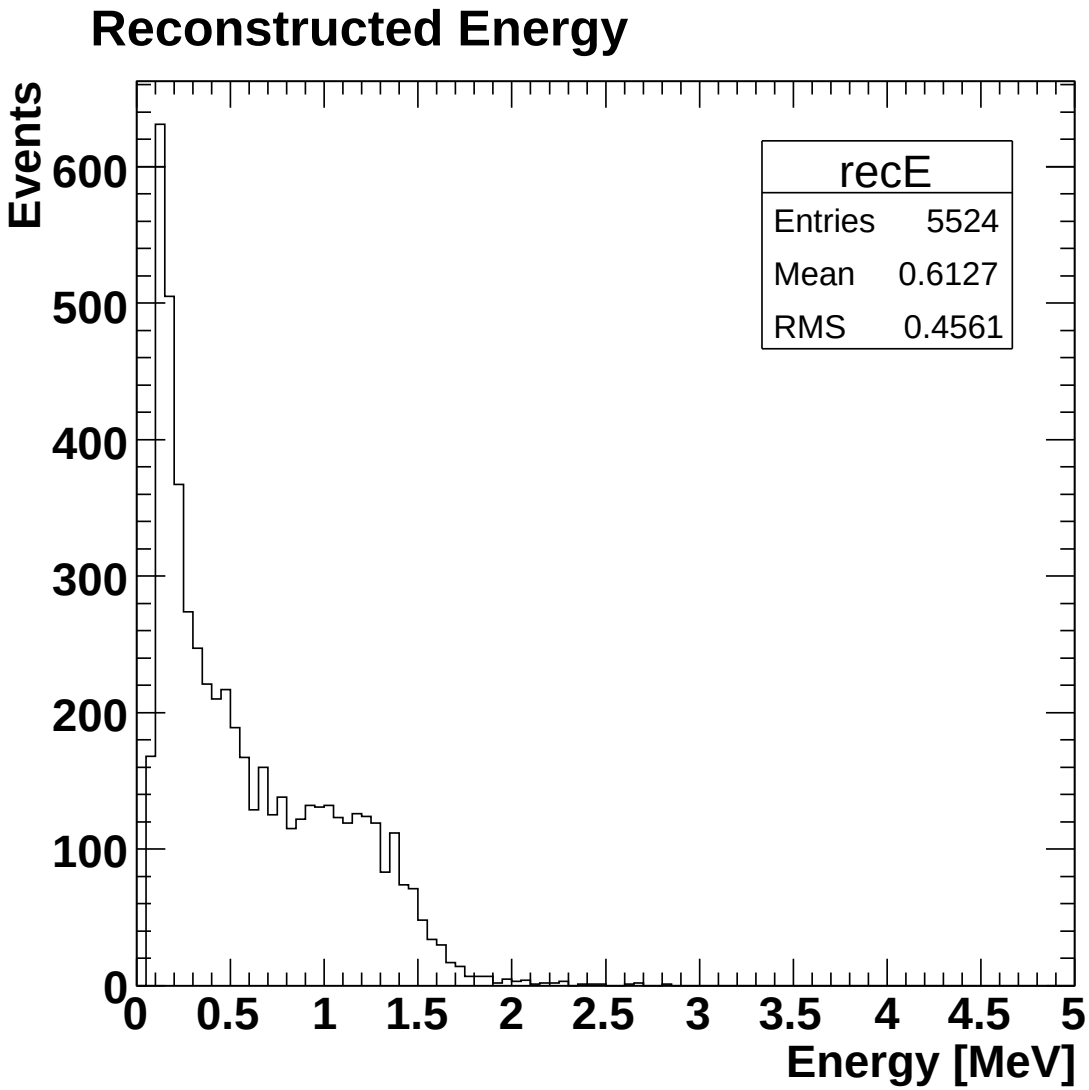




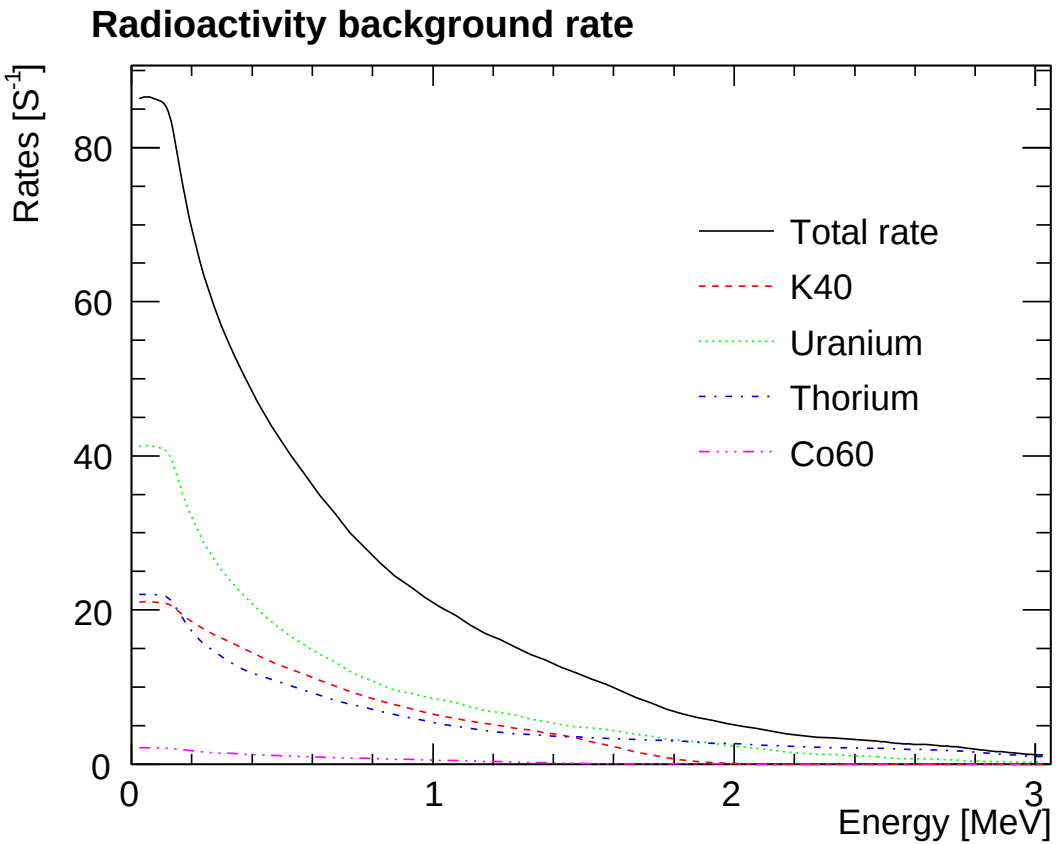


- Up left: in gds
- Up right: in lso
- Down left: in PMT
- Down right: in sst

Co60 spectrum in sst



Radioactivity rates



Radioactivity rates

>0.5 MeV	gds	Iso	PMT	sst	Sum(Hz)
K40	2.90	2.98	6.09	0.39	12.36
U	0.89	1.05	14.52	0.21	16.67
Th	0.02	0.02	9.13	1.02	10.19
Co60					1.03
Sum	3.81	4.05	29.75	1.62	40.26

>1 MeV	gds	Iso	PMT	sst	Sum(Hz)
K40	0.90	0.97	4.20	0.20	6.27
U	0.23	0.25	7.77	0.12	8.37
Th	0.01	0.01	4.70	0.51	5.23
Co60					0.49
Sum	1.13	1.23	16.67	0.84	20.36

- Basically agree with Doc3540. K40 rates increase a little bit after correcting the β decay sepctrum.