

IBD & Radioactivity simulation from Fifteen

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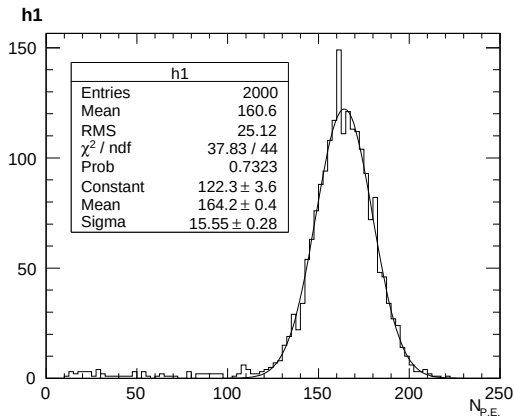
Dayabay Collaboration

Radioactivity decay rates

	gds	Iso	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

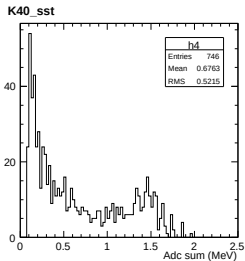
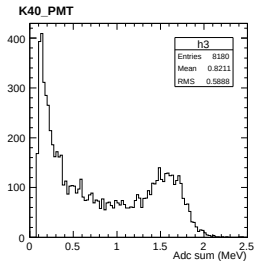
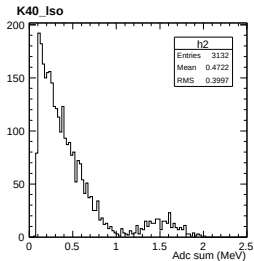
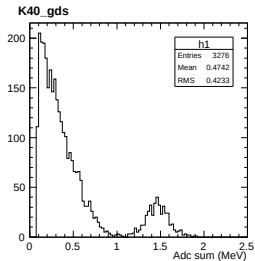
- Taken from DYB-doc-1408 & DYB-doc-3454-v5.
- 20 tons gds, 20 tons Iso, 19 tons sst, 192 PMTs.
- Because of the cascade decays of ^{238}U and ^{232}Th , multipliers of 9 and 4 are applied to the above rates to get the final rates for ^{238}U and ^{232}Th , respectively.
- Intended for study of IBD & Radioactivity decays together, but IBD events are buried by large amount of Radioactivity events, less than 100 IBD events generated for about 80000 readouts. Here is just a cross check of the Radioactivity background rates.

Energy calibration



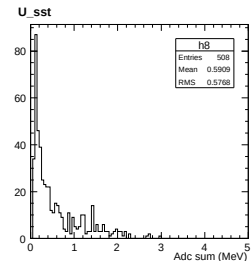
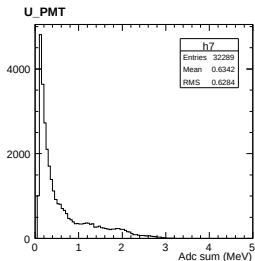
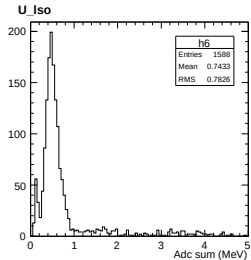
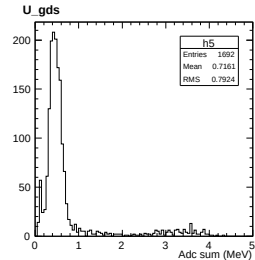
- Only generate 1.461 MeV γ for K40.

K40 spectrum

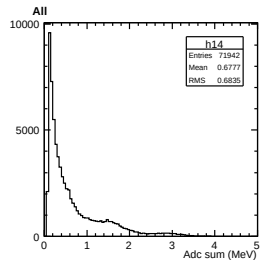
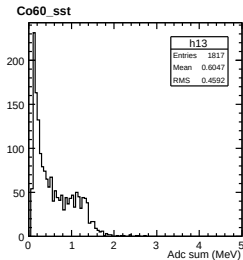
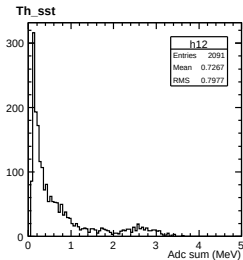
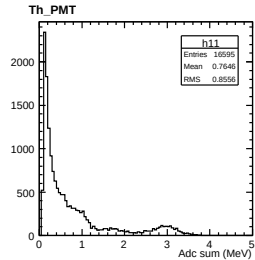
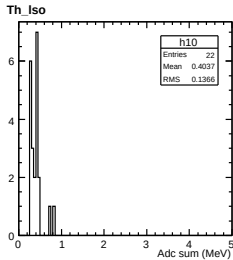
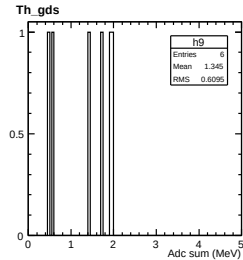


- Found a mistake in K40 generator. The beta spectrum is not correct. Resulted less backgrounds. The correction has been committed in.

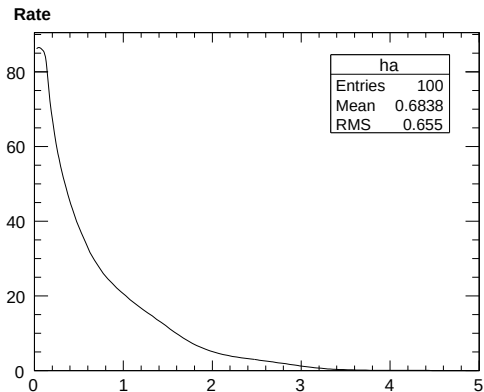
Uranium spectrum



Thorium & Co60 spectrum



Total Radioactivity rate



Radioactivity rates

> 1 MeV	gds	Iso	PMT	sst	Sum(Hz)
K40	0.52	0.38	3.86	0.27	5.03
U	0.24	0.25	8.70	0.13	9.32
Th	0.00	0.00	4.62	0.55	5.17
Co60				0.51	0.51
Sum	0.76	0.63	17.18	0.95	20.03

> 0.5 MeV	gds	Iso	PMT	sst	Sum(Hz)
K40	1.13	1.18	5.72	0.45	8.47
U	0.92	1.00	15.40	0.24	17.56
Th	0.01	0.00	8.80	1.07	9.87
Co60				1.04	1.04
Sum	2.05	2.18	29.92	1.76	36.95

Comparing with TDR

- In TDR, the largest amount of Radioactivity come from stainless steel (17.6 Hz) and PMT (12 Hz).
- This study has comparable PMT contributions, less stainless steel contributions due to lower concentration.

> 1 MeV	PMT concen.	PMT rate	sst concen.	sst rate
U	132/150 ppb	3.86/2.7	1.2/24.8 mBq/kg	0.13/7
Th	256/150 ppb	8.70/5.5	6/12.3 mBq/kg	0.55/4.6
K40	0.0115%/15 ppb	4.62/3.8	13/53 mBq/kg	0.27/1.5
Co60			2/15 mBq/kg	0.51/4.5