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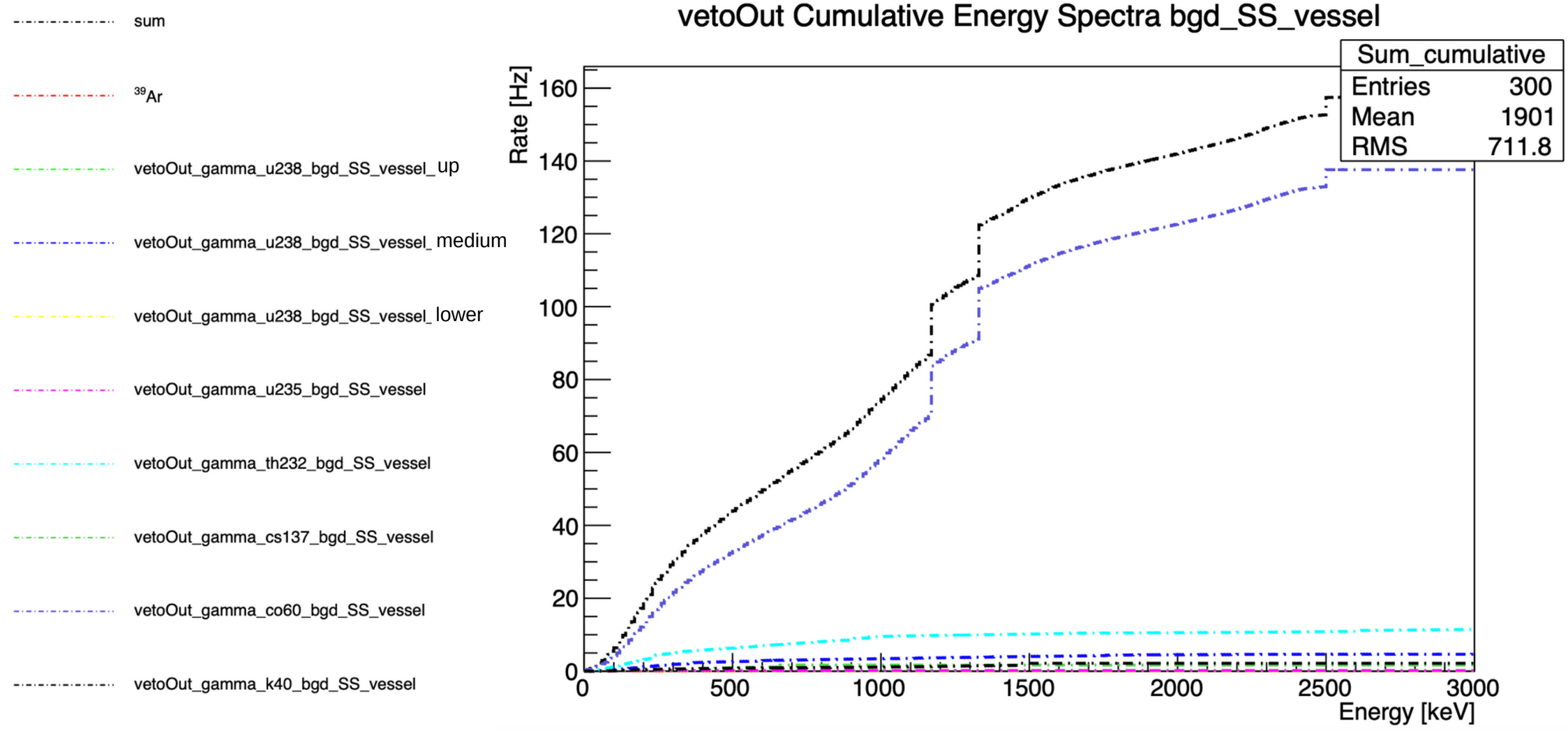
Gamma Rate from Vessel New Results

Stainless Steel Activities

[mBq/kg]	U238 up	U238 mid	U238 low	Th232	U235	Cs137	Co60	K40
DS50	4.0E-1	4.0E-1	4.0E-1	8.0E-1	1.8E-2	2.9E-1	1.3E+1	2.5E+0
GERDA[1]	0.7E+0	0.7E+0	0.7E+0	1.1E+0	1.7E+0	3.4E-1	2.1E+1	1.2E+0
TISCO[2]	1.9E+0	1.9E+0	1.9E+0	3.0E+0	2.7E+0	1.4E+0	0.7E+0	1.6E+1

DS50 SS

Data used simulations in the TDR (316L)



GERDA SS

Data obtained using an average of radio purity data in GERDA Survey (G1,G2,G3,G5,G6,G7)

sum

^{39}Ar

vetoOut_gamma_u238_bgd_SS_vessel_ up

vetoOut_gamma_u238_bgd_SS_vessel_ medium

vetoOut_gamma_u238_bgd_SS_vessel_ lower

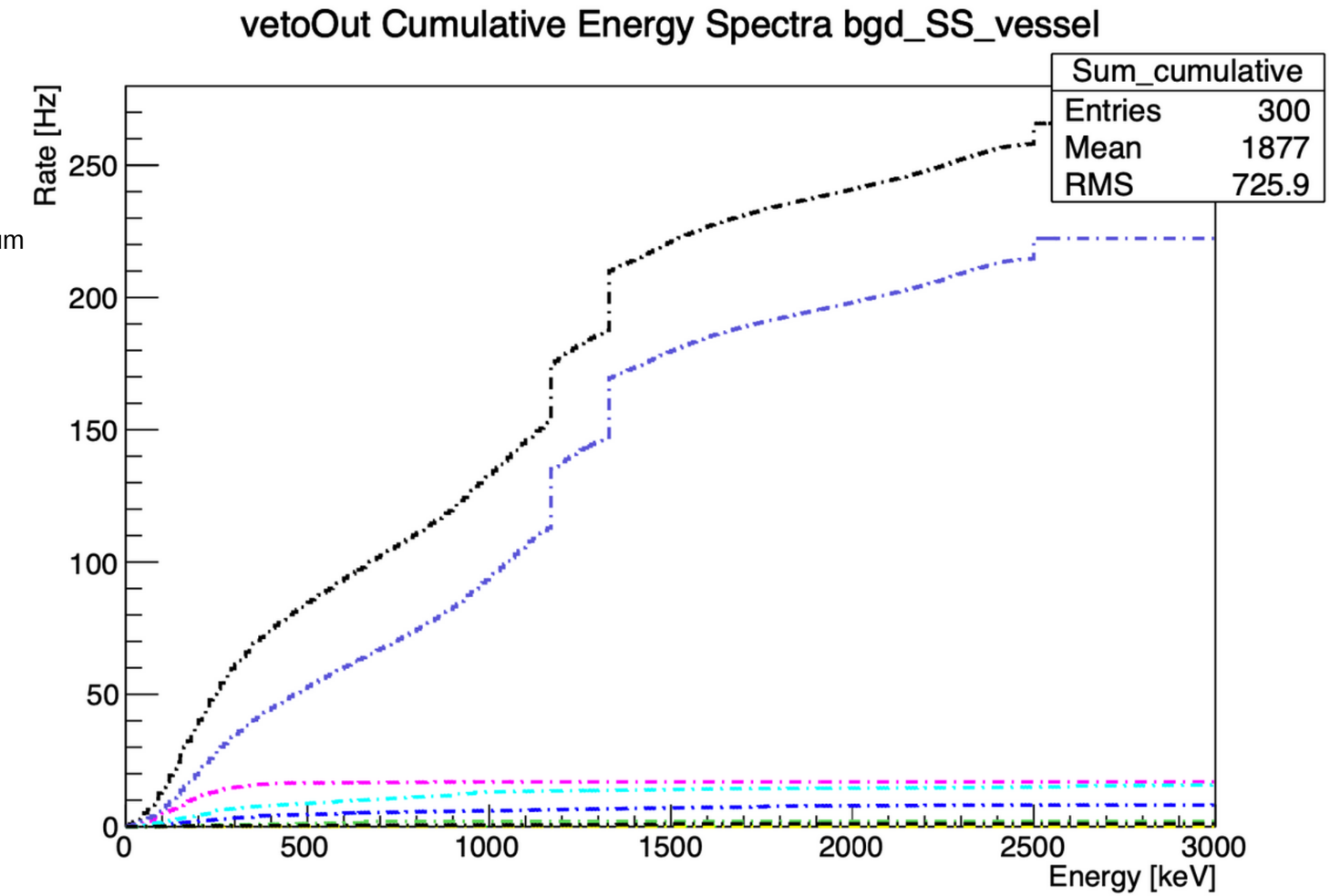
vetoOut_gamma_u235_bgd_SS_vessel

vetoOut_gamma_th232_bgd_SS_vessel

vetoOut_gamma_cs137_bgd_SS_vessel

vetoOut_gamma_co60_bgd_SS_vessel

vetoOut_gamma_k40_bgd_SS_vessel



Nuclear grades Steel

Additional requirments for 304L and 316L

01 Homogeneity of structure and properties

02 Cleanliness and low inclusion content

03 Low cobalt and residual content

04 Strength, intergranular corrosion resistance and weldability

Industrial NG SS

TISCO nuclear grade SS304L plates donated PANDAX Collaboration

sum

^{39}Ar

vetoOut_gamma_u238_bgd_SS_vessel_ up

vetoOut_gamma_u238_bgd_SS_vessel_ medium

vetoOut_gamma_u238_bgd_SS_vessel_ lower

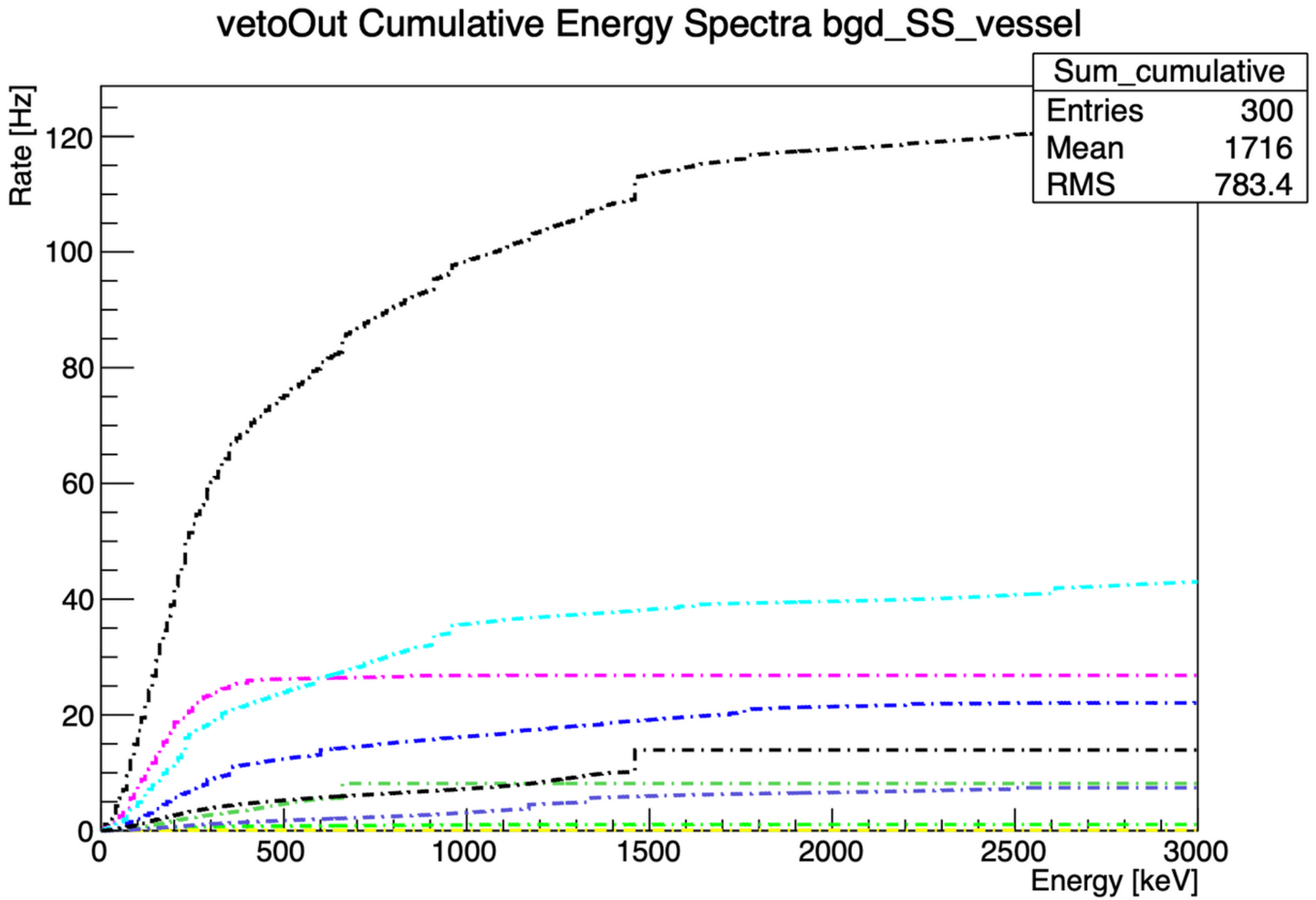
vetoOut_gamma_u235_bgd_SS_vessel

vetoOut_gamma_th232_bgd_SS_vessel

vetoOut_gamma_cs137_bgd_SS_vessel

vetoOut_gamma_co60_bgd_SS_vessel

vetoOut_gamma_k40_bgd_SS_vessel



LZ Titanium samples

Name	Type	^{238}U (mBq/kg)			^{232}Th (mBq/kg)		^{40}K (mBq/kg)
		early	late	^{210}Pb	early	late	
~~TIMET Sheet (1)~~	~~ASTM Grade 1 Sheet~~	~~11~~	~~*<0.62*~~	~~-~~	~~*<0.8*~~	~~*<0.6*~~	~~*<2.5*~~
TIMET Sheet (2)	ASTM Grade 1 Sheet	5	3.3	-	2.8	0.8	*<1.5*
TIMET Sheet (3)	ASTM Grade 1 Sheet	8.5	0.37	-	0.45	0.61	*<0.5*
TIMET Sheet (4)	ASTM Grade 1 Sheet	8.0	*<0.12*	-	*<0.12*	*<0.1*	*<0.6*
~~TIMET HN3469-T~~	~~ASTM Grade 1 Slab~~	~~*<1.6*~~	~~*<0.09*~~	~~-~~	~~0.28~~	~~0.23~~	~~*<0.5*~~
TIMET HN3469-M	ASTM Grade 1 Slab	2.8	*<0.10*	-	*<0.20*	0.25	*<0.7*

From the LZ paper they were taken for this analysis just TIMET Grade 1 samples because they presented the best and more stable radiopurities

Before averaging the values of radio purity, they were rejected the best and the worst samples respect to 238U early in order not to depend on the characteristics of specific samples

LZ Titanium activity

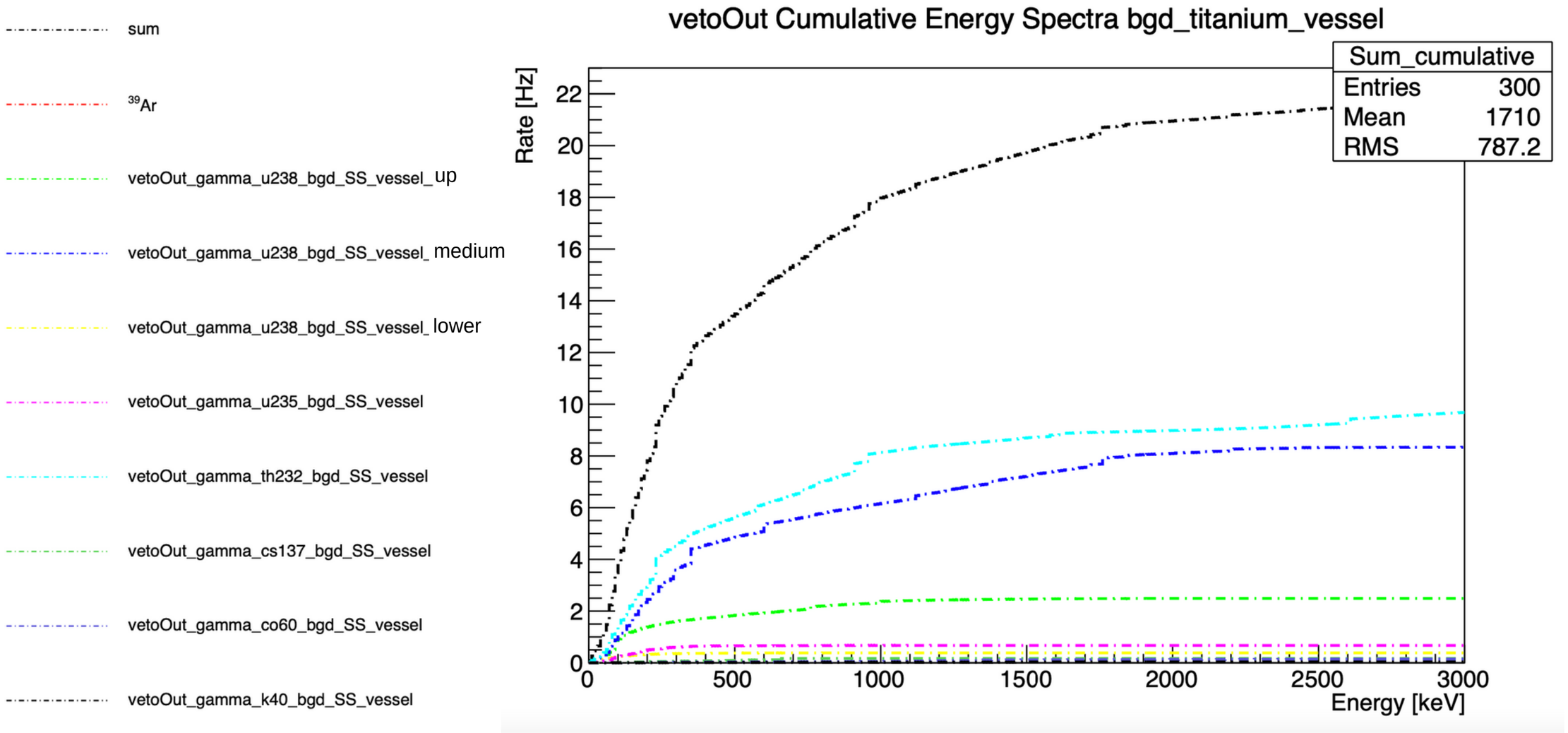
[mBq/kg]	U238 up	U238 mid	U238 low	Th232	U235	Cs137	Co60	K40
LZ MEAN [3]	6.0E+0	9.7E-1	6.0E+0	9.0E-1	7.4E-2	4.0E-2	2.0E-2	8.2E-1

LZ Collaboration didn't measured the lower part of 238U chain, so the upper part value was taken as reference

The radiopurity for 60Co, 137Cs and 235U is the one of the titanium chosen for the LZ Vessel because it was not measured for every single sample

Industrial Ti

Data obtained using an average of radio purity data in LZ Survey



Industrial Ti

Data obtained using an average of radio purity data in LZ Survey

sum

^{39}Ar

vetoOut_gamma_u238_bgd_SS_vessel_up

vetoOut_gamma_u238_bgd_SS_vessel_medium

vetoOut_gamma_u238_bgd_SS_vessel_lower

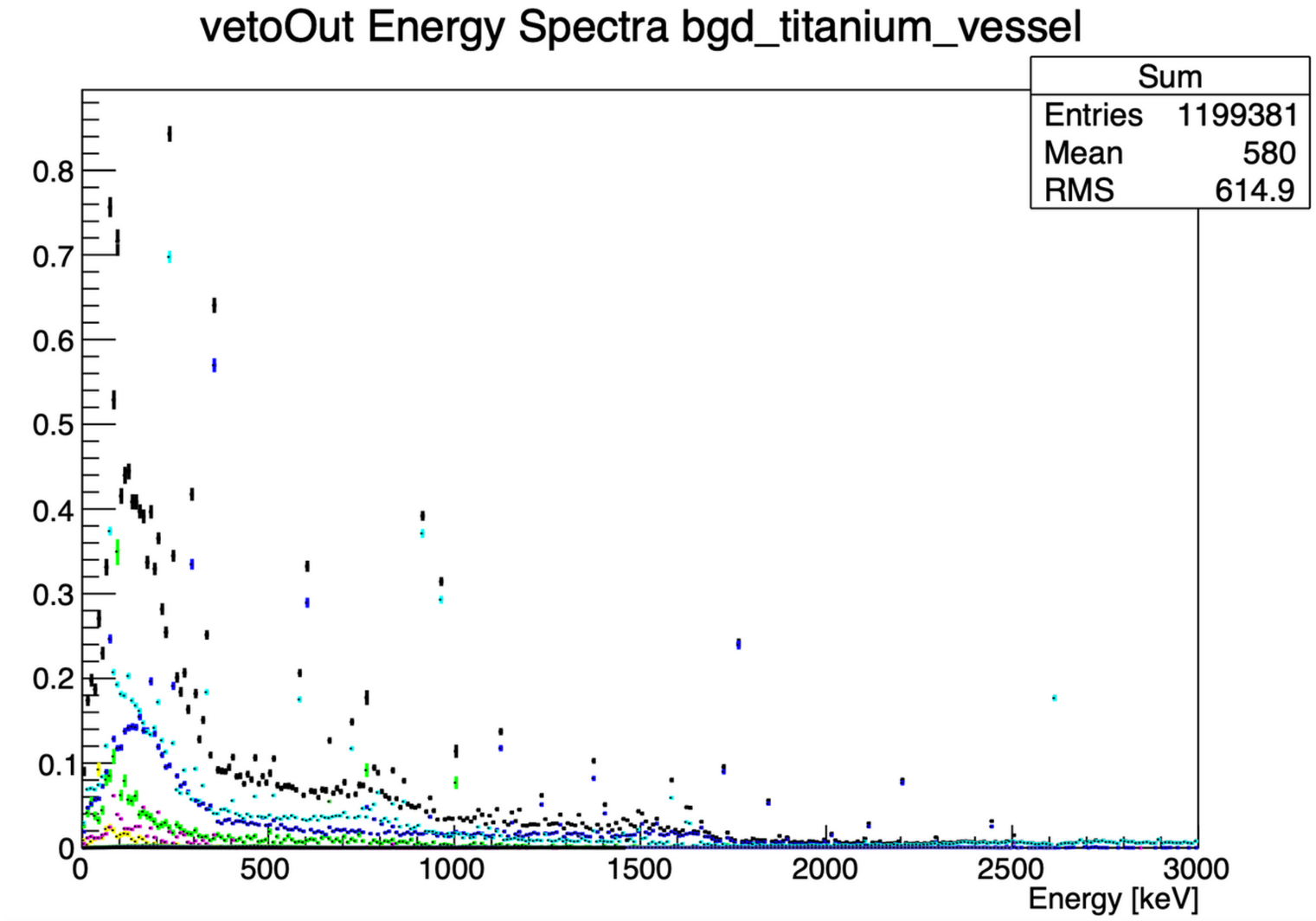
vetoOut_gamma_u235_bgd_SS_vessel

vetoOut_gamma_th232_bgd_SS_vessel

vetoOut_gamma_cs137_bgd_SS_vessel

vetoOut_gamma_co60_bgd_SS_vessel

vetoOut_gamma_k40_bgd_SS_vessel



Conclusions

- ss

  Even with nuclear grade stainless steel where cobalt contempt is lowered, it remains to keep under control uranium and thorium contamination

- **Titanium**

  The cobalt contempt is naturally under control but not all titanium samples are just as good as TIMET ones

- **Next Step**

  Repeat this kind of analysis taking into account an energy cut

References

1 W. Maneschg et al, **Measurements of extremely low radioactivity levels in stainless steel for GERDA**, Nuclear Instruments and Methods in Physics Research A 593 (2008) 448– 453

2 T. Zang et al, **Low Background Stainless Steel for the Pressure Vessel in the PandaX-II Dark Matter Experiment**, [arXiv:1609.07515]

3 D.S. Akerib et al, **Identification of Radiopure Titanium for the LZ Dark Matter Experiment and Future Rare Event Searches** [arXiv:1702.02646v5]