

Table 1.1: Activities of ^{238}U , ^{232}Th and ^{40}K measured in relevant materials and following different techniques.

#	Material	Technique	Unit	^{238}U	^{232}Th	^{40}K	Ref.
Shielding							
1	Pb, Cometa	GDMs	mBq/kg	0.37	0.073	<0.31	NEXT
2	Pb, Cometa		mBq/kg	<0.5	<0.5	<1	Cometa
3	Pb, Mifer	GDMs	mBq/kg	1.24	0.32		NEXT
4	Pb, Mifer, new provider	GDMs	mBq/kg	0.33	0.10	1.21	NEXT
5	Pb, Tecnibusa	GDMs	mBq/kg	0.73	0.14	0.91	NEXT
6	Pb, Tecnibusa	Ge (by LSC)	mBq/kg	<1.3 (e)	<0.9 (f)	<1.8	NEXT (+)
7	Cu, Luvata C10100	Ge (by UZ)	mBq/kg	<11.0*	<9.7*	<17.7*	NEXT
8	Cu, Luvata C10100 hot rolled	GDMs	mBq/kg	<0.012	<0.004	0.061	NEXT
9	Cu, Luvata C10100 cold rolled	GDMs	mBq/kg	<0.012	<0.004	0.091	NEXT
10	Cu, Electroformed	GDMs	mBq/kg	<0.062	<0.020		NEXT
11	Cu, ETP Sanmetal	GDMs	mBq/kg	<0.062	<0.020		NEXT
Vessel							
12	Ti, Nironit, XENON	Ge	mBq/kg	0.93±0.24 (b)	0.22±0.10	0.90±0.30	[7]
13	Ti, LUX	Ge	mBq/kg	6.2±1.2, <0.19	<0.25	<0.9	[8]
14	Ti, LUX	GDMs	mBq/kg	52	2.5	<1.5	NEXT
15	Ti, LUX	Ge (by UZ)	mBq/kg	238±28	417±54	49±11	NEXT
16	Ti, LUX, after polishing	Ge (by UZ)	mBq/kg	<15*	4.2±1.4	<22*	NEXT
17	Ti, SMP	Ge (by LSC, GeOroel)	mBq/kg	<9.4 (e)	<9.4 (f)	<19	NEXT (+)
18	Ti, SMP	Ge (by LSC, GeTobazo)	mBq/kg	<6.3 (e)	<7.7 (f)	<9.3	NEXT (+)
19	Ti, Ti Metal Supply	Ge (by LSC)	mBq/kg	<0.30 (e)	3.2±0.3 (f)	<0.52	NEXT (+)
20	Stainless Steel, Pfeiffer 304L	Ge by UZ	mBq/kg	14.8±2.8 (a)	10.4±2.0 (a)	<16.6	NEXT
21	Stainless steel 316L, Elantec, UK, DRIFT	GDMs	mBq/kg	17.4±1.2	3.3±0.4	<9.3	[16]
22	Stainless steel 316L, block, Italy, DRIFT	GDMs	mBq/kg	<6.2	8.2±0.8	<9.9	[16]
23	Stainless steel 316L, SNOlab	Ge	mBq/kg	0.63±0.15 (b)	0.62±0.15	<0.97	[6]
24	Stainless steel 316Ti, Nironit, XENON	Ge	mBq/kg	<1.9 (b)	<1.0 (d)	10±4	[4]
25	Stainless steel Austenitic 1.4571, GERDA	Ge	mBq/kg	<0.24 (b)	<0.11 (d)	<0.93	[5]
26	Stainless steel TIG, SNOlab	Ge	mBq/kg	1.01±0.71 (b)	2.8±0.8	<1.45	[6]
27	Inconel 718	Ge (by LSC)	mBq/kg	<5.6 (e)	<4.6 (f)	<11	NEXT (+)
28	Inconel 625 (Follows at next page)	Ge (by LSC)	mBq/kg	<1.8 (e)	<2.0 (f)	<2.6	NEXT (+)

(Continuation)

#	Material	Technique	Unit	^{238}U	^{232}Th	^{40}K	Ref.
29	PCTFE, Daikin Neoflon, EXO	Ge	mBq/kg	5.6±1.2	<2.3	<30	[9]
30	Viton, O-ring seal, Johannsen AG, EXO	Ge	mBq/kg	868±87	130	2170±226	[9]
HV and EL components							
31	Peek, Sammetal	Ge (by UZ)	mBq/kg	36.3±4.3	11.7±2.2	8.3±3.0	NEXT
32	Peek	Ge	mBq/kg	<70 (b)	<50 (d)	<260	[10]
33	SM5D, 700MΩ resistors, Finechem, XENON	Ge	mBq/pc	0.027±0.003 (b)	0.014±0.003 (d)	0.19±0.03	[4]
34	SMD resistors, Finechem	Ge (by UZ)	mBq/pc	0.022±0.007 (e)	<0.016* (f)	0.17±0.07	NEXT
35	SMD resistors, Farnell	Ge (by UZ)	mBq/pc	0.15±0.04 (e)	0.28±0.06 (f)	0.19±0.08	NEXT
36	Polyethylene, EDELWEISS	Ge	mBq/kg	16±10 (e)	<6 (f)	70±50	[16]
37	Polyethylene, XENON	Ge	mBq/kg	0.23±0.05 (b)	<0.14 (d)	0.7±0.4	[4]
38	Polyethylene insulator, EXO	NAA	mBq/kg	<2.9	<0.57	1.46±0.22	[9]
39	Tetratex, ArDM	ICPMS	mBq/kg	12.4±3.7	<1.6	<16	[11]
40	TPB, Sigma-Aldrich, SNOlab	Ge	mBq/kg	1.63±1.01 (b)	0.47±1.11	8.22±12.03	[6]
41	TPB, American Chemicals, SNOlab	Ge	mBq/kg	<4.33 (b)	<1.69	<36.29	[6]
42	Teflon, Du Pont TE-6472, EXO	NAA	mBq/kg	<0.0096	<0.0011	0.0558±0.0062	[9]
43	PTFE, Dyneon TF 1620, GERDA	Ge	mBq/kg	0.025±0.009 (b)	0.031±0.014 (d)	0.60±0.11	[12]
Detector components: energy plane							
44	PMT, Hamamatsu R8520, XENON	Ge	mBq/PMT	0.19±0.01 (b)	0.20±0.02 (d)	9.9±0.4	[4]
45	PMT base, Hamamatsu R8520, XENON	Ge	mBq/base	0.16±0.02 (b)	0.07±0.02 (d)	<0.16	[4]
46	PMT, Hamamatsu R11410MOD, XENON	Ge	mBq/PMT	<2.4 (b)	<2.6 (d)	13±4	[4]
47	PMT, Hamamatsu R11410MOD, LUX		mBq/PMT	<0.4	<0.3	<8.3	[15]
48	PMT, Hamamatsu R11410MOD		mBq/PMT	3.3	2.3	5.7	Hamamatsu
49	Sapphire, Czochralsky Type, ROSEBUD	Ge	mBq/kg	<5 (e)	<5(f)	<30	[16]
50	Sapphire, Verneuil Type, ROSEBUD	Ge	mBq/kg	<3 (e)	<3(f)	<12	[16]
51	Sapphire window, EXO	NAA	mBq/kg	<0.31	0.123±0.029	<0.20	[9]
52	Quartz, Heraeus 2, EXO	NAA	mBq/kg	0.068±0.027	0.027±0.005	0.062±0.016	[9]
Detector components: tracking plane							
53	Cuflon, circuit board, EDELWEISS	Ge	mBq/kg	<23 (e)	<30 (f)	400±200	[16]
54	Cuflon, Crane Polyflon, GERDA	Ge	mBq/kg	<0.85 (b)	<1.9 (d)	±15	[12]
55	Cuflon	Ge	mBq/kg	<0.84 (b)	<1.9	48±15	[18]
56	Cuflon	ICPMS	mBq/kg	0.36 ^{+0.07} _{-0.04}	0.28 ^{+0.04} _{-0.03}	6 ⁺⁹ ₋₂	[18]
57	ARJOPROX, ARLON	Ge	Bq/kg	<0.044 (e)	<0.065 (f)	0.3±0.2	[16]
58	ARAMID paper, CIMULEC	Ge	Bq/kg	<0.06 (e)	0.04±0.03 (f)	0.15±0.14	[16]
59	Kapton, AXON	Ge	Bq/kg	0.07±0.03 (e)		0.3±0.2	[16]
60	Kapton+Cu, KAPPA Industrie	Ge	Bq/kg	0.014±0.012 (e)	0.013±0.012 (f)	<0.09	[16]

(Follows at next page)

(Continuation)

#	Material	Technique	Unit	^{238}U	^{232}Th	^{40}K	Ref.
61	Kapton+Cu, SOGEG (g)	Ge	Bq/kg	<0.08 (e)	0.05±0.04 (f)	<0.9	[16]
62	Kapton+Cu, CIRE (g)	Ge	Bq/kg	0.09±0.05 (e)	<0.08 (f)	0.7±0.4	[16]
63	Kapton+Cu, CIRE (g)	Ge	Bq/kg	0.28±0.26 (e)	0.3±0.2 (f)	<2.1	[16]
64	Kapton+Cu ATLANTEK (g)	Ge	Bq/kg	<0.06 (e)	<0.02 (f)	0.4±0.2	[16]
65	Polyamide+Cu VISHAY	Ge	Bq/kg	9.1±0.2 (e)	3.3±0.2 (f)	7.0±0.7	[16]
66	FR4 PCB	Ge (by UZ)	Bq/kg	0.4	0.24	1.5	
67	Kapton-copper foil	Ge (by UZ)	mBq/cm ²	<0.011	<0.0046*	<0.0077*	[19]
68	Kapton-copper PCB, LabCircuits	Ge (by UZ)	mBq/cm ²	<0.014* (e)	<0.003* (f)	<0.040*	
69	EPO-TEK 301-2FL, Epoxy Tech.	Ge	mBq/kg	9±3 (b)	<60 (d)	<25	[20]
70	EPO-TEK H20E, silver, Epoxy Tech.	Ge	mBq/kg	<25 (e)	<40 (f)	600±400	[16]
71	EPO-TEK 417F, silver, Epoxy Tech.	Ge	mBq/kg	68±11 (b)	<131 (d)	<65	[20]
72	Tra-Con Tra-Duct 2902 silver epoxy, Ellsworth	ICPMS	mBq/kg	0.98±0.05	0.045±0.004		[21]
73	FFC/FCP connector, Molex	Ge	mBq/unit	3.0±0.2 (e)	1.8±0.1 (f)	3.5±0.5	[16]
74	Tantalum capacitor, AVX	Ge	Bq/kg	0.32±0.05 (e)	0.41±0.05 (f)	0.3±0.2	[16]

(a) Average on different isotopes

(b) Activity of ^{226}Ra

(c) Two values for early/late part of chain

(d) Activity of ^{228}Th (e) Activity from ^{214}Bi (f) Activity from ^{208}Tl

(g) Special fabrication

(*) Level obtained from the minimum de-

tectable activity of the detector (MDA)

(+) Preliminary result.

Bibliography

- [1] G. Luzón et al., "Characterization of the Canfranc Underground Laboratory: Status and future plans", proceedings of the 6th International Workshop on Identification of Dark Matter, World Scientific, 514.
- [2] <http://gifna.unizar.es/nextrp>
- [3] C. Arpesella et al, "Measurements of extremely low radioactivity levels in BOREXINO", *Astroparticle Physics* 18 (2002) 1-25.
- [4] E. Aprile et al, "Material screening and selection for XENON100", *Astropart. Phys.* 35 (2011) 43-49.
- [5] W. Maneschg et al, "Measurements of extremely low radioactivity levels in stainless steel for GERDA", *NIMA* 593 (2008) 448.
- [6] I. Lawson and B. Cleveland, "Low Background Counting At SNOLAB", Topical Workshop on Low Radioactivity Techniques LRT 2010, AIP Conf. Proc. 1338 (2011) 68-77.
- [7] Communication from L. Baudis.
- [8] D. S. Akerib et al, "Radio-assay of Titanium samples for the LUX Experiment", [arXiv:1112.1376](https://arxiv.org/abs/1112.1376) [physics.ins-det].
- [9] S. Leonard et al, "Systematic study of trace radioactive impurities in candidate construction materials for EXO-200", *NIMA* 591 (2008) 490.
- [10] P. Finnerty et al, "Low-background gamma counting at the Kimballton Underground Research Facility", *Nucl. Instrum. Meth. A* 642 (2011) 65-69.
- [11] V. Boccone et al, "Development of wavelength shifter coated reflectors for the ArDM argon dark matter detector", *JINST* 4 (2009) P06001, [[arXiv:0904.0246](https://arxiv.org/abs/0904.0246)].
- [12] D. Budjas et al, "Gamma-ray spectrometry of ultra low levels of radioactivity within the material screening program for the GERDA experiment", *Applied Radiation and Isotopes* 67 (2009) 755.
- [13] D. Budjas et al, "Highly sensitive gamma-spectrometers of GERDA for material screening: Part I", Proceedings of the XIV International Baksan School Particles and Cosmology Baksan Valley, Kabardino-Balkaria, Russia, April 16-21, 2007, [[arxiv:0812.0723](https://arxiv.org/abs/0812.0723)].
- [14] NEXT Collaboration, Conceptual Design Report, "The NEXT-100 experiment for $\beta\beta 0\nu$ searches at LSC", [arXiv:1106.3630](https://arxiv.org/abs/1106.3630) [physics.ins-det].
- [15] C. Faham, Presentation "Performance and Radioactivity Measurements of the PMTs for the LUX and LZ Dark Matter Experiments" at TIPP2011, <http://conferences.fnal.gov/tipp11/>.

- [16] ILIAS Database, <http://radiopurity.in2p3.fr>.
- [17] G. Heusser, "Low-radioactivity background techniques", *Annu. Rev. Part. Sci.* 45 (1995) 543-590.
- [18] S. Nisi et al, "Comparison of inductively coupled mass spectrimetry and ultra low-level gamma-ray spectroscopy for ultra low background material selection", *Applied Radiation and Isotopes* 67 (2009) 828.
- [19] S. Cebrian et al, "Radiopurity of micromegas readout planes", *Astropart. Phys.* 34 (2011) 354-359.
- [20] J. Busto et al, "Radioactivity measurements of a large number of adhesives", *NIMA* 492 (2002) 35-42.
- [21] Communication from A. Goldschmidt.
- [22] R. Luescher et al, "Search for bb decay in ^{136}Xe : new results from the Gotthard experiment", *Physics Letters B* 434 (1998) 407-414.
- [23] A. Dobi et al, "Xenon purity analysis for EXO-200 via mass spectrometry", *arXiv:1109.1046v1* [physics.ins-det].
- [24] V. S. Uras et al, "Radon(Rn222) emanation results", *SNO-STR-94-024* (1994)
- [25] M. Liu et al (SNO), "Rn222 emanation into vacuum", *Nuclear Instruments and Methods in Physics Research A* 329 (1993) 291.
- [26] G. Zuzel, H. Simgen (GERDA), "High Sensitivity radon Emanation Measurements", *Applied radiation and isotopes* 67 (2009)889.
- [27] F.J. Iguaz "Development of a Time projection Chamber with MicroMegs technology for the search of the Double Beta Decay of ^{136}Xe , THesis work, Zaragoza 2010.