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Erratum

Erratum to: The LUX-ZEPLIN (LZ) radioactivity and cleanliness control programs

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Table 1

The relative efficiency and face area values quoted in Table 1 are incorrect and the volume and mass of Roseberry are slightly larger than originally quoted. The table should read as follows:

Location	Detector	Type	V [cm^3]	M [kg]	Relative Efficiency (%)	Face Area [cm^2]
BUGS	Belmont	p-type	600	3.2	160	–
	Merrybent	p-type	375	2.0	100	–
	Lunehead	p-type	375	2.0	100	–
	Roseberry	BEGe	195	1.0	–	65
	Chaloner	BEGe	150	0.8	–	50
	Lumpsey	SAGe well	263	1.4	–	–
LBNL	MERLIN	n-type	430	2.2	115	–
BHUC	MAEVE	p-type	375	2.0	85	–
	MORGAN	p-type	375	2.0	85	–
	MORDRED	n-type	253	1.3	60	–
	SOLO	p-type	113	0.6	30	–
Alabama	Ge-II	p-type	260	1.4	60	–
	Ge-III	p-type	406	2.2	105	–

Table 3

The uncertainties quoted in Table 3 are incorrect. The table should read as follows:

Detector	$^{238}U_e$ (ppm)	$^{238}U_l$ (ppm)	$^{232}Th_e$ (ppm)	$^{232}Th_l$ (ppm)	K (%)
Reference	8.5(1)	8.87(4)	12.1(1)	12.1(1)	2.82(1)
MERLIN	–	8.92(9)	12.4(1)	12.4(1)	2.81(3)
MAEVE	8.6(1)	8.6(1)	11.9(1)	11.9(1)	2.74(3)
MORDRED	10.2(1)	7.92(5)	11.3(1)	11.3(2)	2.66(6)
SOLO	–	6.16(1)	9.94(1)	12.5(7)	2.91(1)
Chaloner	7.9(2)	8.73(5)	11.1(1)	11.1(1)	2.81(1)
Lunehead	–	8.5(1)	11.8(1)	11.8(1)	2.85(1)
Ge-II	11.4(15)	9.6(13)	12.2(17)	12(16)	3.4(4)
Ge-III	10.3(10)	9.2(9)	12.8(13)	12.1(12)	3.3(3)
Average	9.2(2)	7.61(3)	10.54(5)	11.9(1)	2.84(2)
Std. Dev.	1.26	0.98	0.84	0.46	0.25

Items needing correction

Main body of the text

In Section 2.2.2 the Merrybent detector is referred to as having a relative efficiency of 110% – this should read 100%.

Correcting values in the appendices

In the following tables, the items that have been updated or corrected are listed. The values that have been changed are highlighted in bold.

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Table 10 HPGe screening results

Sample	Supplier	Detector	Mass [kg]	Units	$^{238}U_e$	$^{238}U_l$	$^{232}Th_e$	$^{232}Th_l$	^{40}K	^{210}Pb	^{60}Co
Tungsten Alloy	Midwest Tungsten	MERLIN	0.98	**Bq/kg**	–	1.7(10)	**0.15(1)**	**0.14(1)**	77(5)	–	–
Titanium Sponge	VSMPO	MAEVE	**1.0**	mBq/kg	17(9)	12(1)	< 4.1	< 4.1	< 6.2	–	–
Stainless Steel Sheet	Nironit	Ge-II	10	mBq/kg	< **14**	4.9(10)	**6.8(12)**	**4.9(10)**	1.7(36)	–	15(2)
Stainless Steel Sheet	Nironit	Ge-III	10	mBq/kg	< **9.5**	2.5(5)	< **0.9**	**0.52(37)**	0.69(183)	–	14(2)
Stainless Steel Sheet	Nironit	Ge-II	**8.5**	mBq/kg	< **3.8**	2.2(8)	< **5.0**	< **1.0**	< **2.7**	–	9.7(13)
Stainless Steel Sheet	Nironit	MAEVE	10	mBq/kg	7.3(25)	0.35(5)	1.1(2)	4.0(3)	< 0.80	–	**14.5(3)**
Stainless Steel Sheet	Nironit	MERLIN	10	mBq/kg	–	< 0.60	–	< 1.3	< 3.0	–	1.7(3)
Helicoflex Nimonic Spring	Helicoflex	Chaloner	0.37	mBq/kg	850(78)	16(5)	27(6)	2.0(17)	**84(59)**	226(82)	32(3)
Stainless Steel Plate	Coulter	MERLIN	13	mBq/kg	< 6.2	< 2.5	< 2.0	< 2.0	< 31	–	**12.1(4)**
3.2 mm Titanium Welding Wire	Loterios	MORDRED	**1.0**	mBq/kg	< 6.2	85(16)	< 6.9	< 4.1	< 9.3	–	–
Cable Ties	Mouser Electronics	SOLO	**0.06**	mBq/kg	< 182	< 13	< 20	< 16	< 84	–	–
Copper Block	**Silicon Valley MFG**	MERLIN	0.35	mBq/kg	< 24	< 8.6	< 9.3	< 8.5	< 28	–	–
Stainless Steel Mount	McMaster Carr	MORGAN	0.32	mBq/kg	< 19	< 3.6	< 6.0	< 4.1	< 20	–	24(7)
CHV Cables	Quadrant From Boedeker Stock	MERLIN	0.46	mBq/kg	< 34	56(15)	< 21	16(17)	< 34	–	–
Environmental Dust From 4850L SURF Clean-room (vented)	N/A	MERLIN	0.39	Bq/kg	**17.53(6)**	**15.09(2)**	**9.63(2)**	**9.63(2)**	251(3)	–	–
Environmental Dust From 4850L SURF Clean-room (un-vented)	N/A	MERLIN	0.39	Bq/kg	**12.59(4)**	**12.10(1)**	**7.68(1)**	**7.68(1)**	197(1)	–	–
HEPA Dust (unvented)	N/A	Ge-III	0.86	Bq/kg	< 30	< 4.8	**7.4(23)**	11(2)	187(30)	–	–
A4 Coarse Dust	Powder Technology	Ge-II	0.12	Bq/kg	**-**	**29.1(4)**	–	–	–	–	–
A1 Ultrafine Dust	Powder Technology	Ge-II	0.10	Bq/kg	**–**	**47(1)**	–	–	–	–	–
AFRL-02 Dust	Powder Technology	Ge-II	0.30	Bq/kg	**–**	**4.9(1)**	–	–	–	–	–
AFRL-03 Dust	Powder Technology	Ge-II	0.32	Bq/kg	**–**	**6.6(1)**	–	–	–	–	–
DAWN Ultra Washing Up Liquid	**P&G**	MERLIN	0.63	mBq/kg	**3.0(21)**	< **0.5**	< **0.9**	< **0.5**	2080(91)	< 25	–
Adhesive Epoxy	Reynolds Polymer Technology	Ge-III	0.08	mBq/kg	< **640**	123(41)	< **35**	< **35**	99(158)	–	< **9.0**

Table 10 continued

Sample	Supplier	Detector	Mass [kg]	Units	$^{238}U_e$	$^{238}U_l$	$^{232}Th_e$	$^{232}Th_l$	^{40}K	^{210}Pb	^{60}Co
Polishing Compound (Finesse-It)	3M	Ge-II	0.59	mBq/kg	< **329**	< **39**	< 29	< 1.9	< **198**	–	–
Sandpaper 7-inch	Reynolds	Ge-II	0.13	mBq/kg	4.5(7)	4.3(5)	8.7(8)	**8.1(7)**	**9.9(15)**	–	–
Microgrit Aluminum Oxide	Microgrit	Ge-II	0.68	mBq/kg	**11(2)**	5.0(5)	7.6(7)	7.0(6)	5.6(9)	–	**–**
Fiberoptic Cable Mounts	University of Liverpool Fabrication	Lumpsey	–	mBq/Unit	< 75	12(3)	< 9.0	< 5.0	< 20	–	< 1.0
FEP Tube 5/8 ID &3/4 OD	McMaster Carr	MERLIN	**0.77**	mBq/kg	< 31	< 9.0	< 11	< 10	167(50)	–	**–**
Cross-Linked Polyethylene Sheet	**Foam Factory**	MERLIN	0.09	mBq/kg	< 177	< 72	< 107	< 77	< 302	–	–
Cross-Linked Polyethylene Sheet	**Foam Factory**	MORGAN	0.09	mBq/kg	< 132	< 23	< 33	< 19	< 147	–	–
R11410-20 Aluminum Ring (2013)	Hamamatsu	SOLO	0.24	mBq/kg	< 150	< 1.5	< 8.3	< 8.3	**13(3)**	–	–
Receptacles 0.8 mm	Harwin	Chaloner	0.07	mBq/kg	1178(177)	< 6.9	22(11)	15(5)	110(87)	22393(741)	–
Receptacles 1.0 mm	Harwin	Chaloner	0.14	mBq/kg	389(86)	24(5)	12(4)	9.1(27)	**63(49)**	23677(661)	–
R11410-20 Faceplate Flange (2015)	Hamamatsu	SOLO	0.53	mBq/kg	< 162	< 2.8	< 3.8	< 4.2	< 14	–	**13(3)**
Resistors 0805 100k	VISHAY	Chaloner	**0.003**	mBq/kg	3460(317)	1036(107)	510(209)	144(70)	6118(1724)	97516(2157)	< 169
Resistors 0805 2M49	VISHAY	Chaloner	**0.004**	mBq/kg	1787(282)	571(73)	645(168)	150(53)	7069(1344)	52702(1292)	< 65
Resistors 0805 49.9R	VISHAY	Chaloner	**0.004**	mBq/kg	3430(475)	670(98)	314(184)	264(77)	5425(1672)	61140(1914)	< 29
General Routing Material	**Various Suppliers**	Lunehead	0.10	mBq/kg	2008(535)	99(10)	23(16)	20(9)	< 153	–	–
3-inch PMT Bases	LZ Fabrication	Lunehead	–	mBq/Unit	1.9(7)	0.39(5)	0.20(5)	0.17(2)	0.26(20)	–	< **0.005**
Stainless Steel Rods	McMaster Carr	MERLIN	1.0	mBq/kg	< 37	25(5)	< 8.1	12(4)	< 124	–	**9.7(8)**
Stainless Steel Rods	McMaster Carr	MORGAN	1.1	mBq/kg	< 25	< 22	6.0(20)	4.0(10)	< 5.0	–	**–**
1-inch PMT Bases	Imperial College London Fabrication	Lunehead	–	mBq/Unit	**1.9(7)**	**0.39(5)**	**0.20(5)**	**0.17(2)**	< 2.5	–	–
Trifoil Washers	McMaster Carr	MERLIN	–	mBq/Unit	**0.003(2)**	< **0.003**	**0.0004(6)**	**0.0005(4)**	< **0.002**	–	–
PTFE Nuts, Bolts &Washers	**McMaster Carr**	MERLIN	**0.09**	mBq/kg	< 99	< 31	< 37	< 33	< 236	–	**–**
PTFE Nuts, Bolts &Washers	**McMaster Carr**	MAEVE	**0.09**	mBq/kg	< 46	< 21	< 23	< 8.0	< 52	–	**–**
PEEK Key Handle Nuts #10-32 Narrow Nuts	McMaster Carr	MERLIN	**0.004**	mBq/kg	16223(8277)	6354(1553)	16612(7832)	14210(1805)	< 9460	–	–
R11410-20 – Ceramic Stem Body (2018)	Hamamatsu	MORGAN	1.6	mBq/kg	77(30)	**15(1)**	12(1)	5.0(13)	55(8)	–	–
Loop Antennae	**University of Oxford Fabrication**	MORGAN	–	mBq/Unit	< 6.2	< 0.30	0.80(30)	0.60(30)	< 2.3	–	–
1-inch PMT Batch 6	Hamamatsu	Roseberry	–	mBq/Unit	0.33(12)	< 0.16	< 0.15	0.08(2)	7.2(6)	1.9(4)	0.33(3)
Semi-Rigid Cabling	**University of Oxford Fabrication**	Chaloner	–	mBq/Unit	< 6.0	< 8.1	< 16	< 4.8	58(104)	161(42)	< 4.8
LZ PMT Cable Offcuts (1)	Axon	Chaloner	–	**mBq/m**	< 0.15	< 0.15	< 0.10	< 0.03	< 1.2	< 0.25	< 0.06

Table 10 continued

Sample	Supplier	Detector	Mass [kg]	Units	$^{238}U_e$	$^{238}U_l$	$^{232}Th_e$	$^{232}Th_l$	^{40}K	^{210}Pb	^{60}Co
LZ PMT Cable Offcuts (2)	Axon	Chaloner	–	**mBq/m**	< 0.21	< 0.20	< 0.15	< 0.04	< 0.98	< 0.58	< 0.06
LZ PMT Cable Offcuts (3)	Axon	Chaloner	–	**mBq/m**	< 0.22	< 0.20	< 0.12	< 0.04	< 0.91	< 0.45	< 0.04
LZ PMT Cable Offcuts (4)	Axon	Chaloner	–	**mBq/m**	< 0.12	< 0.10	< 0.10	< 0.05	< 0.59	< 0.36	**0.03(1)**
Resistor - MOX93021007GTE	Ohmite	MERLIN	0.08	mBq/kg	8642(1235)	2099(1235)	970(40)	3943(163)	**396.3(3)**	–	–
PT100	Omega	Lunehead	**0.002**	mBq/kg	**4038(1095)**	3433(307)	1439(387)	1042(240)	156416(5925)	–	< 196
PT100	IST	Chaloner	**0.002**	mBq/kg	–	5325(426)	5006(459)	5065(339)	15449(3633)	707129(7862)	–
Stainless Steel Fasteners	**J&M**	MERLIN	3.3	mBq/kg	–	21(5)	12(4)	**10.5(4)**	–	–	**21(1)**
PEEK Virgin Natural Sheet 1.000	Boedeker Plastics Inc	MERLIN	2.4	mBq/kg	< 10	**16(3)**	18(6)	13(3)	39(6)	274(37)	–
Silver Plated Stainless Steel Pan Head Screw #4-40 x .3125	**UC Components**	MERLIN	0.10	mBq/kg	< 123	< 35	< 57	< 31	< 135	–	–
Long Level Sensor 300mm	**University of Oxford Fabrication**	Merrybent	–	mBq/Unit	< 20	< 1.5	< 0.70	< 0.40	< 4.1	–	< 0.30
Position Sensor	**University of Oxford Fabrication**	Lunehead	–	mBq/Unit	< 24	< 1.2	1.4(10)	< 1.0	< 6.5	–	< 0.30
Cu Coupon	**University of Oxford Fabrication**	Chaloner	1.9	mBq/kg	< 23	< 1.8	< 2.3	< 1.9	< 16	480(180)	< 0.60
PEEK Coupon	**University of Oxford Fabrication**	Lunehead	0.31	mBq/kg	< 270	< 17	13(10)	< 10	< 90	–	< 4.0
Heat Shrink For LZ Gate/Anode	**TE Connectivity**	MERLIN	0.18	mBq/kg	< **78**	< 23	< 37	< 30	< 98	–	–
Heater Block Plate	**Silicon Valley MFG**	MERLIN	–	mBq/Unit	< 1.9	< 0.70	< 0.80	< 0.70	< 2.6	–	–
Position Sensors	**University of Oxford Fabrication**	MAEVE	–	mBq/Unit	< 3.1	5.3(3)	< 1.0	< 0.64	< 1.9	–	–
Position Sensors	**University of Oxford Fabrication**	MAEVE	–	mBq/Unit	< 3.1	5.3(3)	< 1.0	< 0.64	< 1.9	–	–
Weir Precision Sensors (WPS)	**University of Oxford Fabrication**	MAEVE	–	mBq/Unit	< 1.9	3.7(5)	2.3(4)	2.9(3)	19(2)	–	–
Extruded PTFE Tubing	ZEUS	MERLIN	0.42	mBq/kg	< 62	< 13	< 12	< 16	< 61	–	–
PEEK Screws #4-40 x 0.25 Pan Head	McMaster Carr	MERLIN	–	mBq/Unit	< **0.12**	**0.21(4)**	**0.30(8)**	**0.37(5)**	< **0.16**	–	–
Valves For Xe Supply &Return	Technifab	**MORGAN**	3.2	mBq/kg	< 8.6	< 1.1	2.2(13)	2.2(13)	< 13	–	3.5(6)

Table 11 ICP-MS screening results

Sample	Supplier	Detector	Units	^{238}U	^{232}Th
Adhesive	Reynolds	University of Alabama	mBq/kg	< **0.10**	< **0.13**

Table 12 GDMS screening results

Sample	Supplier	Detector	Mass [g]	Units	$^{238}U_e$	$^{232}Th_e$	^{40}K
NEXT100 50 mm SS Flange Material	Nironit	NRC	1.0	mBq/kg	∼ **12**	< 0.20	< 0.60
NEXT100 SS 15 mm Cryostat Cover Material	Nironit	NRC	1.0	mBq/kg	∼ **12**	< 0.20	< 0.60
NEXT100 SS 10 mm For Shell	Nironit	NRC	1.0	mBq/kg	∼ **7.4**	< 0.20	< 0.60
Titanium - Timet Japanese Mill	Timet	NRC	1.0	mBq/kg	$\mathbf{7.4^{+7.4}_{-3.7}}$	< 0.80	< 0.10
Stainless Steel Plate - Gerda G2	Ilsenburg	NRC	1.0	mBq/kg	∼ **5.0**	< 0.40	< **0.30**
Stainless Steel Plate - Gerda G1	Ilsenburg	NRC	1.0	mBq/kg	∼ **5.0**	< 0.40	∼ **3.0**
Stainless Steel Plate - Gerda D6	Ilsenburg	NRC	1.0	mBq/kg	∼ **5.0**	< 0.40	< **2.0**
LUX Ti sample	Supra Alloy	NRC	0.30	mBq/kg	$\mathbf{11^{+11}_{-5}}$	< 0.40	< 0.10
Ti Sheet Stock	Timet	NRC	0.40	mBq/kg	$\mathbf{11^{+11}_{-5}}$	< 0.80	< 0.15
0.3125 Ti Sheet Stock Grade CP-2	PTG	NRC	0.40	mBq/kg	$\mathbf{12^{+12}_{-6}}$	$\mathbf{4.0^{+4.0}_{-2.0}}$	< 7.0
0.375 Ti Sheet Stock Grade CP-1	Supra Alloy	NRC	0.40	mBq/kg	$\mathbf{36^{+36}_{-18}}$	$\mathbf{3.2^{+3.2}_{-1.6}}$	< 7.0

Table 13 NAA screening results

Sample	Supplier	Detector	Mass [g]	Units	$^{238}U_e$	$^{232}Th_e$	^{40}K
Raw FEP Pellets	Axon	University of Alabama	3.1	mBq/kg	< 0.017	**0.036(2)**	**0.168(4)**
Raw FEP Pellets	Axon	University of Alabama	3.1	mBq/kg	< **0.005**	**0.037(2)**	**0.175(4)**
FEP Inner Cable Jacket	Axon	University of Alabama	**2.6**	mBq/kg	< **0.057**	**0.083(8)**	**5.053(78)**
FEP Outer Cable Jacket	Axon	University of Alabama	2.6	mBq/kg	< 0.024	**0.096(6)**	**10.7(20)**
PTFE 8764 For Skin Region	Boedeker Plastics	University of Alabama	**8.0**	mBq/kg	**0.018(40)**	**0.029(1)**	**0.076(1)**
PTFE FLON008	Flontech	University of Alabama	2.8	mBq/kg	< 0.027	**0.051(3)**	0.33(2)
Teflon NXT85	DuPont	University of Alabama	2.9	mBq/kg	< 0.021	**0.028(2)**	**0.122(10)**
Teflon 807NX	DuPont	University of Alabama	2.8	mBq/kg	0.038(10)	**0.029(2)**	0.096(5)

Table 14 Radon emanation results

Sample	Supplier	Detector	Quantity screened	Units	^{222}Rn
HV Umbilical Epoxy	Stycast	University of Alabama	0.11 m^2	µBq/m^2	**7106 ± 2007**
PMT HV Feedthrough	Accuglass	University of Alabama	5 unit	µBq/unit	< **174**
PMT Capacitors (After Cooling, In Jar)	KEMET	University of Alabama	0.5 kg	µBq/kg	729 ± 486
PMT Capacitors (After Cooling)	KEMET	University of Alabama	0.5 kg	µBq/kg	1080 ± 544
PMT Capacitors (Before Cooling)	KEMET	University of Alabama	0.5 kg	µBq/kg	3510 ± 961

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