n-budget status

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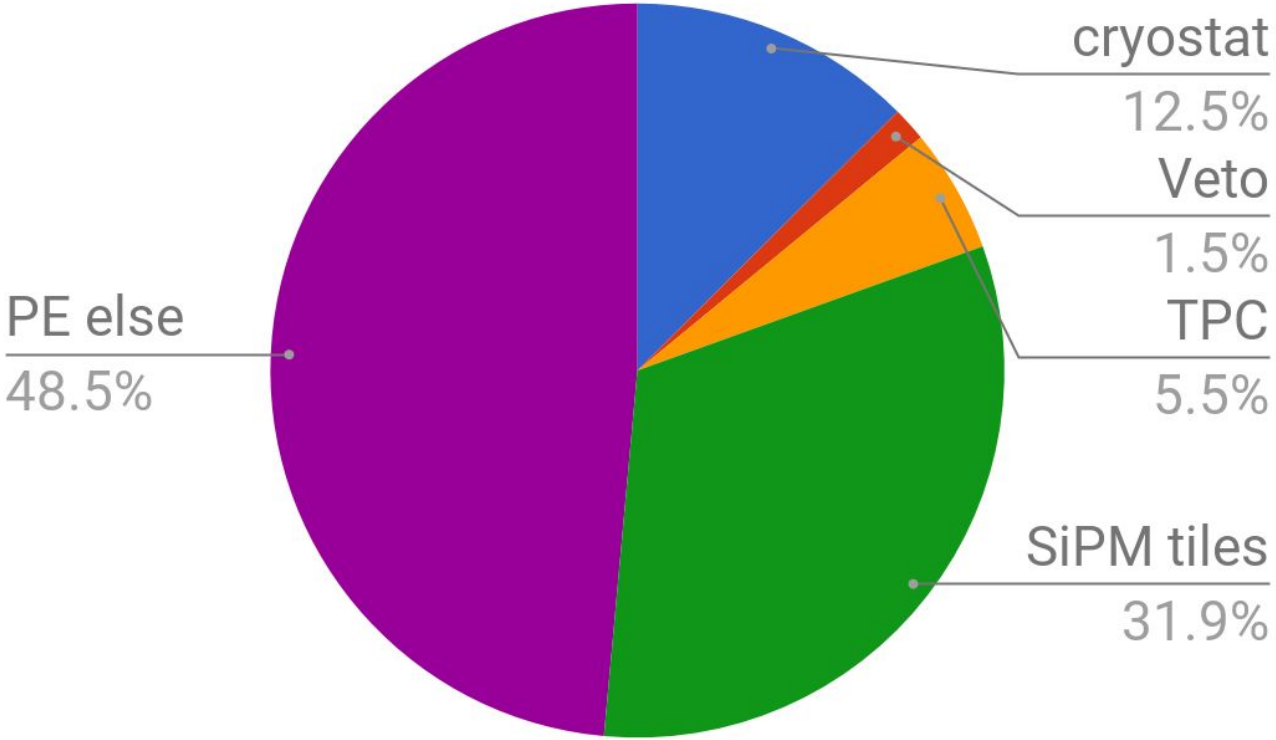
Quick numbers: total number of expected neutrons with current status after cuts:
0.3 n in 100 t y after cuts

cryostat	3.7E-2
Veto	4.4E-3
TPC	1.6E-2
SiPM tiles	9.4E-2
PE else	1.4E-1



Cryostat

Limiting factor is the PU foam.

Inefficiency of neutrons from the cryostat is an upper limit ($6.5 \ 10^{-10}$).

High statistics simulations ongoing.

Assay request of new material attended (to be sent to Temple) but no response from CERN group so far.

Component	position	material	[kg]	n / 100 t yr	n bg/(100 t yr)
Cryostat					
Stainless steel	cryostat	Stainless steel	27104	112549	7.3E-5
PU foam	cryostat	RPUF ins. foam	25344	55442961	3.6E-2
plywood	cryostat	Plywood	2185.92	980393	6.4E-4

Conclusions

Dominance (urgent stuff?) Not a priority at the moment.

Everything assayed? yes

Needed more assays (complete chain or enhance sensitivity)? more assays requested by CERN people. We don’t know why.

MC status: MC input needed to validate inefficiency (critical for PU results).

Veto

Everything based on databases, no assay of veto material performed by ourselves so far.

Acrylic in the order of 10 ppts (JUNO) can be provided by the company and is not an issue in terms of n production.

Gd doping candidates must be evaluated the sooner the better.

It would be good to understand the differences between DEAPs production and this one and try to go down to ppt level

VETO					
Gd sulfide	Veto PS	Gd2(SO4)3	458.64	186	4.3E-4
Acrylic bulk shell	Veto PS	Acrylic 10 ppt	11700	379	8.7E-4
Acrylic bulk panels	Veto PS	Acrylic 10 ppt	1120	36	8.3E-5
Acrylic bulk	Veto PS	Gd2(SO4)3 on Acrylic	458.64	631	1.5E-3
Reflector	Veto PS	Vikuiti	100	56	1.3E-4
Veto support structure	Veto PS	SS DS50	1071	358	8.2E-4

Conclusions

Dominance (urgent stuff?) Not a priority at the moment.

Everything assayed? Nope. Nothing, actually.

Needed more assays (complete chain or enhance sensitivity)? Yes. Gd is the most important source (ignoring surface)

MC status: Geometry still under discussion, not massive changes expected but needs to be properly simulation.

TPC

Component	position	material	[kg]	n / 100 t yr	n bg/(100 t yr)
TPC					
TPC support structure	Steel structure	SS DS50	1071	358	1.2E-2
Sh. rings resistors	Reflector	SMD resistor	0.1	30.31	1.0E-3
Sh. rings resis solder	Reflector	Solder Indalloy 1E	0.2	1.95	6.4E-5
Acrylic panels	Reflector	Acrylic 1 ppt	700	2.27	7.5E-5
Acrylic plates	TPC Top/Bottom	Acrylic 1 ppt	2000	6.48	2.1E-4
Vikuiti reflector	Reflector	Vikuiti	1.6	0.90	3.0E-5
Vikuiti reflector	Vessel	Vikuiti	8	4.51	1.5E-4
Conductive polymer	Vessel	clevios	1	1.70	5.6E-5

Conclusions

Dominance (urgent stuff?) SMD resistors. Proper estimation of mass and assay.

Everything assayed? Only clevios (and structure for proto).

Needed more assays (complete chain or enhance sensitivity)? this solder same as PE? Reflector.

MC status: I think simulations include Cu shaping rings. Have to cross-check if the MC numbers are with the final TPC thickness.

fibers

Estimation: 230 um thick fiber (fused silica) + 900 um Peek jacket.

They have not been assayed. Numbers based on; 8 mBq/kg U, 2 mBq/kg Th, 1 Bq/kg ^{210}Pb.

Peek jacket only ICPMS results. Strong dependence on mid and lower chain.

Component	position		material		n in 100 t yr	n bg / (100 t yr)		
CABLES+FIBERS		103500 m		mass				
		g/m		[kg]			mid chain 70m	Pb 1 Bq
Opt. Fiber top	TPC top/b	1.1E-1	fused silica dirtier	2.2E+0	2.8E+1	9.4E-4	9.4E-4	9.4E-4
O. Fib. jacket top	TPC top/b	3.2E-1	peek fiber	6.4E+0	1.1E+1	3.7E-4	3.0E-3	7.6E-3
Opt. Fiber bottom	TPC top/b	1.1E-1	fused silica dirtier	2.2E+0	2.8E+1	9.4E-4	9.4E-4	9.4E-4
O. Fib. jacket bottom	TPC top/b	3.2E-1	peek fiber	6.4E+0	1.1E+1	3.7E-4	3.0E-3	7.6E-3
Opt. Fiber side (bottom	TPC side	1.1E-1	fused silica dirtier	3.0E+0	3.8E+1	1.2E-3	1.2E-3	1.2E-3
O. Fib. jacket side	TPC side	3.2E-1	peek fiber	8.6E+0	1.5E+1	4.9E-4	4.0E-3	1.0E-2
Opt. Fiber to flange	Veto PS (5	1.1E-1	fused silica dirtier	2.0E+0	2.5E+1	5.8E-5	5.8E-5	5.8E-5
O. Fib. jacket to flange	Veto PS (5	3.2E-1	peek fiber	5.7E+0	9.8E+0	2.3E-5	1.8E-4	4.7E-4
							1.00E-02	2.60E-02

Conclusions

Dominance (urgent stuff?) Yes. We need an assay of everything.

Everything assayed? No

Needed more assays (complete chain or enhance sensitivity)? mid and low chain missing.

MC status: MC input from SiPMs position, reflector and veto. Needs to be improved.

cables

FEP composition needs to be known: used [C 21.7; F 68.7; O 9.6].
This lays extremely high n/yield (more than one order of magnitude above other plastics.

Thicknesses to be defined soon as we get some cables.

[0.3 mm; 1 mm; 2 mm]

Component	position		material		n in 100 t yr	n bg / (100 t y		
Cathode HV	TPC side	7.1E+2	Cu	4.2E+0	1.8E-2	5.9E-7		
LV, HV, control cable top	TPC top/b	1.8E+0	SAMI cable Cu	3.6E+1	1.5E-2	5.0E-7	5.0E-7	5.0E-7
LV, HV, control cable ins	TPC top/b	7.3E-2	SAMI cable FEP	1.5E+0	1.6E+2	5.4E-3	4.0E-2	2.0E-1
LV, HV, control cable bot	TPC top/b	1.8E+0	SAMI cable Cu	3.6E+1	1.5E-2	5.0E-7	5.0E-7	5.0E-7
LV, HV, control cable ins	TPC top/b	7.3E-2	SAMI cable FEP	1.5E+0	1.6E+2	5.4E-3	4.0E-2	2.0E-1
LV, HV, control cable bot	TPC side	1.8E+0	SAMI cable Cu	4.8E+1	2.0E-2	6.7E-7	6.7E-7	6.7E-7
LV, HV, control cable ins	TPC side	7.3E-2	SAMI cable FEP	2.0E+0	2.2E+2	7.3E-3	5.3E-2	2.7E-1
						1.8E-2	1.3E-1	6.6E-1

Conclusions

Dominance (urgent stuff?) Quite high. Numbers need to be carefully checked.

Everything assayed? Nope. Finished cable sample to be assayed soon.

Needed more assays (complete chain or enhance sensitivity)? more sensitivity needed. Composition critical.

MC status: MC input from SiPMs position, reflector and veto. Needs to be improved.

SiPMs

SiPM tiles						
SiPMs	24		Si SiPM	2000	3.3E-1	6.4E-6
SiPM "glue"	1				0.0E+0	0.0E+0
Dielectric PCB	1		pyralux	3800	2.1E+2	4.1E-3
Cu Luvata	1		Cu Luvata	1600	7.4E-2	1.4E-6
Invar against contractior	1		invar	10125	2.4E+1	4.5E-4
PCB adhesive	1		Acrylic adhesive	250	3.3E+1	6.3E-4
Connector	2		connector	175	4.2E+0	8.1E-5
Res. 50 MOhm 588-HVC	48	2	Res. 50 MOhm 588-HV	96	3.2E+3	6.1E-2
Res. 10.7 kOhm CPF040	11	0.65	resistor	7.15	1.0E+2	2.0E-3
Res. 10 Ohm CPF0402B1	12	0.65	resistor	7.8	1.1E+2	2.1E-3
Res. 50 Ohm CPFA0402E	12	0.65	resistor	7.8	1.1E+2	2.1E-3
Res. 1 kOhm CPFA0402B	3	0.65	resistor	1.95	2.8E+1	5.4E-4
Res. 250 Ohm CPF0402E	6	0.65	resistor	3.9	5.6E+1	1.1E-3
Res. 750 Ohm CPFA0402	1	0.65	resistor	0.65	9.3E+0	1.8E-4
Res. 0 Ohm CRG0402ZR	5	0.65	resistor	3.25	4.6E+1	8.9E-4
Res. 5.11 Ohm 716-8153	18	0.65	resistor	11.7	1.7E+2	3.2E-3
PEN Capacitor 100 nF EC	4	10	PEN cap 100 nF ECW-U	40	3.8E+2	7.2E-3
Solder	240	0.5	Solder sphere	120	2.1E+1	4.1E-4
Clips for housing	4	45.5	Harwin clip	182	3.7E+2	7.2E-3
Glass	0.2		Borosilicate glass	0	0.0E+0	0.0E+0

FEBs

Front end board						
Dielectric PCB	1		pyralux	0	0.0E+0	0.0E+0
Cu Luvata	1		Cu Luvata	1700	7.9E-2	1.5E-6
Finished PCB	1		PCB CCL	3825	1.4E+3	2.7E-2
PCB adhesive	1		Acrylic adhesive	250	3.3E+1	6.3E-4
connectors tile	2		Conn. harwin short	120	1.4E+0	2.6E-5
connector to fingers	1		Conn. harwin short	80	9.1E-1	1.7E-5
Op. amplifiers LMH6629	4	19.5	Chip LMH6629	78	3.8E+2	7.3E-3
summing amplifier THS4	1	22.7	Chip THS4521	22.7	7.8E+1	1.5E-3
diff. amplifier OPA838	1	15.2	Chip OPA838	15.2	5.1E+1	9.8E-4
Res. 10 Ohm CPF0402B1	4	0.65	resistor	2.6	3.7E+1	7.1E-4
Res. 50 Ohm CPFA0402E	3	0.65	resistor	1.95	2.8E+1	5.4E-4
PEN Capacitor 100 nF EC	2	10	PEN cap 100 nF ECW-U	20	1.9E+2	3.6E-3
Panasonic PPS caps (1 u	3	24	PPS cap 1 uF ECP-U1C1	72	2.3E+2	4.5E-3
Panasonic PPS caps (10(	20	7	PPS cap 100 nF ECP-U1	140	4.5E+2	8.7E-3
Tantalum caps (47 uF) 6	3	10	Ta capacitor 47 uF 6TPH	30	3.9E+1	7.4E-4
Solder	1		Solder Indalloy 1E	1000	8.1E+1	1.5E-3
diode	1	11.8	Zenner diode MMSZ523	11.8	4.1E+1	7.9E-4
AVR microcontroller	1		chip	500	1.2E+3	2.4E-2
Acrylic housing	1		Acrylic housing	18000	1.7E+2	3.2E-3
mushrooms	2		Cu	7000	2.5E-1	4.7E-6
Circlip (seeger)	4		SS DS50	500	1.4E+0	2.7E-5

PE rest 1

Optical Module	(1/25 PDM					
Dielectric PCB	1		pyralux	270	1.5E+1	2.9E-4
Cu Luvata	1		Cu Luvata	380	1.8E-2	3.4E-7
PCB adhesive	1		Acrylic adhesive	250	3.3E+1	6.3E-4
Connector	1		connector	100	2.4E+0	4.6E-5
Amplifier	1		chip	33	8.2E+1	1.6E-3
Resistor			resistor	33	4.7E+2	9.1E-3
Capacitor			PEN cap 100 nF ECW-U	33	3.1E+2	6.0E-3
LED	25		LED (op. driver)	264	6.4E+1	1.2E-3

PE rest 2

Mother board	(1/25 PDM					
Cu plate	0.04		Cu	8.1E+4	2.8E+0	5.4E-5
Finger board	(2/25 PDM					
Dielectric PCB	1		pyralux	460	2.6E+1	5.0E-4
Cu Luvata	1		Cu Luvata	384	1.8E-2	3.4E-7
PCB adhesive	1		Acrylic adhesive	250	3.3E+1	6.3E-4
Connector to PDM	12.5		Conn. Harwin long	146	3.0E+0	5.7E-5
Connector to Steering	1		Conn. Harwin long	200	4.1E+0	7.9E-5
Solder	1		Solder Indalloy 1E	10	8.1E-1	1.5E-5
Steering module	(1/25 PDM					
	0.04					
Dielectric PCB	1		pyralux	90	5.1E+0	9.8E-5
Cu Luvata	1		Cu Luvata	790	3.7E-2	7.0E-7
PCB adhesive	1		Acrylic adhesive	250	3.3E+1	6.3E-4
Resistor (number?)	25		resistor	100	1.4E+3	2.7E-2
Capacitor (number?)	25		PPS capacitor	100	1.1E+1	2.2E-4
Solder	1		Solder Indalloy 1E	500	4.0E+1	7.7E-4
Chip HV5523	2		chip	500	1.2E+3	2.4E-2
Chip HV3418	1		chip	1000	2.5E+3	4.8E-2
Connector to fingers	1		connector	500	1.2E+1	2.3E-4
Connector to Opt. Mod	1		connector	500	1.2E+1	2.3E-4
Connector to HV	1		connector	500	1.2E+1	2.3E-4
Connector to LV?	1		connector	500	1.2E+1	2.3E-4
LV, HV, control cable	0.04		SAMI cable Cu	2640	9.3E-3	1.8E-7
LV, HV, control cable ins	0.04		SAMI cable FEP	300	2.8E+2	5.4E-3

Conclusions

Dominance (urgent stuff?) Resistors, chips and capacitors are absolutely urgent.

Everything assayed? Nope.

Needed more assays (complete chain or enhance sensitivity)? Yes, a lot. PCBs to be reassayed.

MC status: MC input OK.