Radiopurity issues for NEXT100

- **Request for Ge detectors time to LSC**
- **Status of measurements**
- **Topics for discussion**

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NEXT100 *Skype Meeting*

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Request for Ge detectors time to LSC

(see complete document at
http://dl.dropbox.com/u/10977880/NEXT/NEXT100/Screening/RequestLSC2.pdf)

- **Required sensitivity** (see TDR):

Material	NEXT system	Reference	^{238}U (mBq/kg)	^{232}Th (mBq/kg)
Pb	Shield	Cometa (supplier)	0.37	0.07
Cu	ICS	Luvata (supplier)	<0.012	< 0.004
Steel (316Ti)	PV	XENON	< 1.9	< 1
Inconel 718	PV	LSC	<5.6	< 13.8
Inconel 625	PV	LSC	<2.4	<6.0
Peek	FC/EP/TP	Unizar	36	11.7
Capacitors (Tantalum)	FC/EP/TP	Unizar	320	1.23×10^3
SMD Resistors, Finechem (per pc)	FC	Unizar	0.022	0.048
Polyethylene	FC	XENON	0.23	<0.14
TTX	LT	ArDM	12.4	1.6
TPB	LT/EP/TP	A. Chemicals	1.63	0.47
PTFE (Teflon)	EP/TP/DB	GERDA	0.025	0.031
PMT (R11410-MOD per pc)	EP	XENON	< 2.5	< 2.5
PMT (R11410-MOD per pc)	EP	LUX	< 0.4	< 0.3
Sapphire window	EP	EXO	0.31	0.12
CUFLON	TP	ICPMS	0.36	0.28
Kapton cable	TP/EP	KAPPA	14	39

Table 1: List of the most important materials used in NEXT. The quoted activities have been measured by other experiment and are the target to be reached by our screening campaign.

- To keep up with the **project plan**:

1. Fabrication of Cuflon Dice Boards (starts April, 2012).
2. Fabrication of Pressure Vessel (starts May, 2012).
3. Fabrication of Field Cage (starts May, 2012).

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➢ Screening "shopping list"

Pressure vessel (PV)

1. Stainless steel 316Ti, of thickeness 10, 15 and 50 mm, used for construction of the PV body, end-caps and flanges.
2. Inconel bolts, used to bolt the end-caps to the main body (already measured).
3. Welding rods, needed for the welding of the flanges.

Inner Copper Shield (ICS)

1. Ultra low background copper (probably supplied by Luvata).

Field Cage (FC)

Notice that the field cage is built in the USA by Texas A&M (TAMU). The TAMU group is procuring radiopure materials from American suppliers. Samples of these materials will be sent to LSC for screening.

1. Field cage rings (ultra low background copper, American supplier)
2. EL and cathode grids and frames, HV penetrator (steel, American supplier).
3. High density Polyethylene (HDP).

Tracking plane (TP)

1. Cuflon boards.
2. Resistors and Tantalum capacitors.
3. Board-to-cable connector.
4. Kapton connector.
5. Silver epoxy for glueing the MPPCs
6. Soldering paste for the MPPCs (alternative to Silver epoxy).

Energy plane (EP)

1. PMT R11410MOD.
2. Can (ultra low background copper, same American supplier than FC, no need of an additional measurement).
3. Sapphire windows.
4. PMT bases.

Front end electronics for MPPCs (FEE)

1. Boards (Cuflon)
2. Resistors and capacitors, connectors
3. Kapton cables.

Request for Ge detectors time to LSC

- **Screening program**

Detector 1:

up to August, 2012

Material	Subsystem	Required sensitivity	weeks	Tentative starting date
SS 316Ti — 10 mm	PV	<1 mBq/kg	4	23/01/2012 (running)
SS 316Ti — 15 mm thick	PV	<1 mBq/kg	4	7/03/2012
SS 316Ti — 50 mm thick	PV	<1 mBq/kg	4	7/04/2012
Welding rods	PV	<10 mBq/kg	1	7/05/2012
SS A. Supplier	FC	<1 mBq/kg	5	15/05/2012
Copper	FC	<50 μBq/kg	8	23/06/2012

Detector 2:

up to July-August, 2012

Material	Subsystem	Required sensitivity	weeks	Tentative starting date
Cuflon	Tracking Plane	<0.2 mBq/kg	2	15/03/2012
HDP	FC	<0.2 mBq/kg	8	1/04/2012
PMT R11410MOD	Energy plane	<0.25 mBq/kg	8	1/06/2012

Detector 3:

from April-June, 2012

Material	Subsystem	Required sensitivity	weeks	Tentative starting date
Connectors	DB	<10 mBq/kg	1	1/04/2012
Capacitors	DB	<500 mBq/kg	1	7/04/2012
Resistors	DB	<500 mBq/kg	1	15/04/2012
Silver epoxy	DB	<10 mBq/kg	1	23/04/2012
Solder paste	FEE	<100 mBq/kg	1	1/05/2012
Cables— Kapton	Tracking plane	<50 mBq/kg	1	7/05/2012
Sapphire windows	Energy plane	<5 mBq/kg	2	23/05/2012
PMT bases	Energy plane	<5 mBq/kg	3	7/06/2012

A very positive answer from LSC has been obtained: two detectors can be used from now onward and a third one as it is ready.

Status of measurements

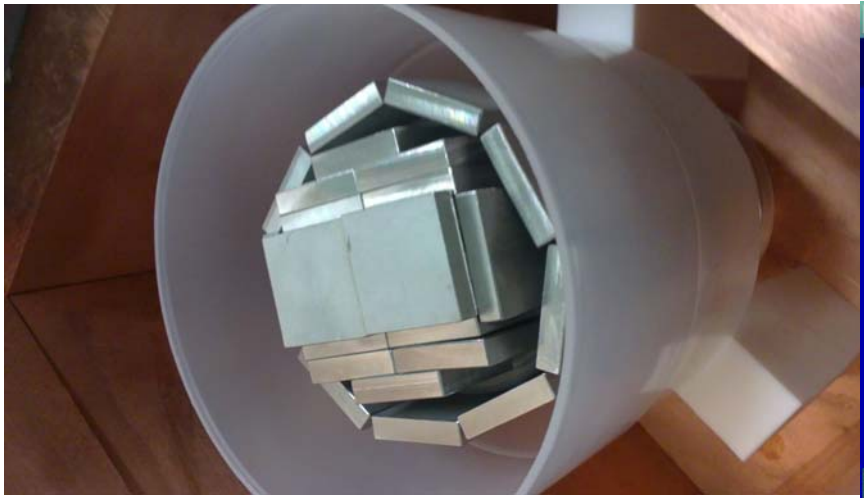
- **First stainless steel measurement**

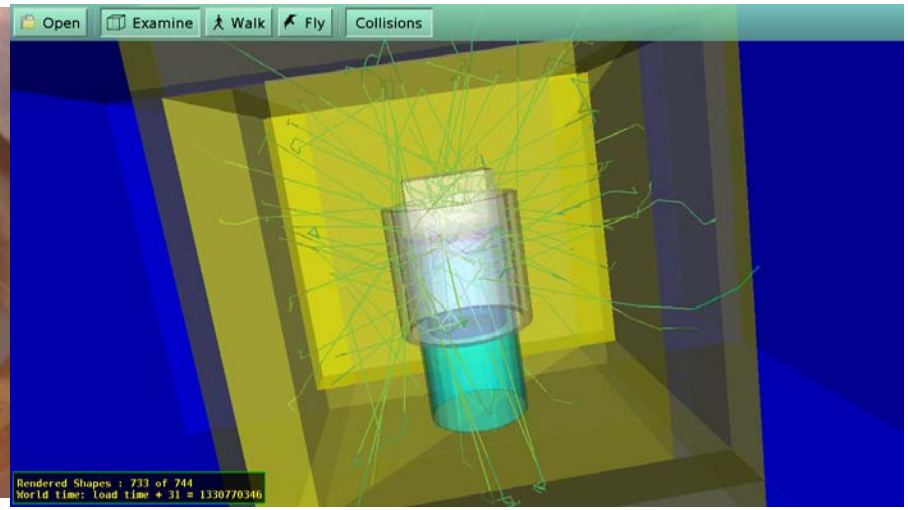
Sample: Nironit 316Ti stainless steel, 49 pieces ~45x45x11 mm^3, ~7.6 kg

Detector: GeTobazo

Measurement: running since 23rd January 2012

Simulated efficiency: from 0.025 @ 500 keV to 0.01 @ 3MeV

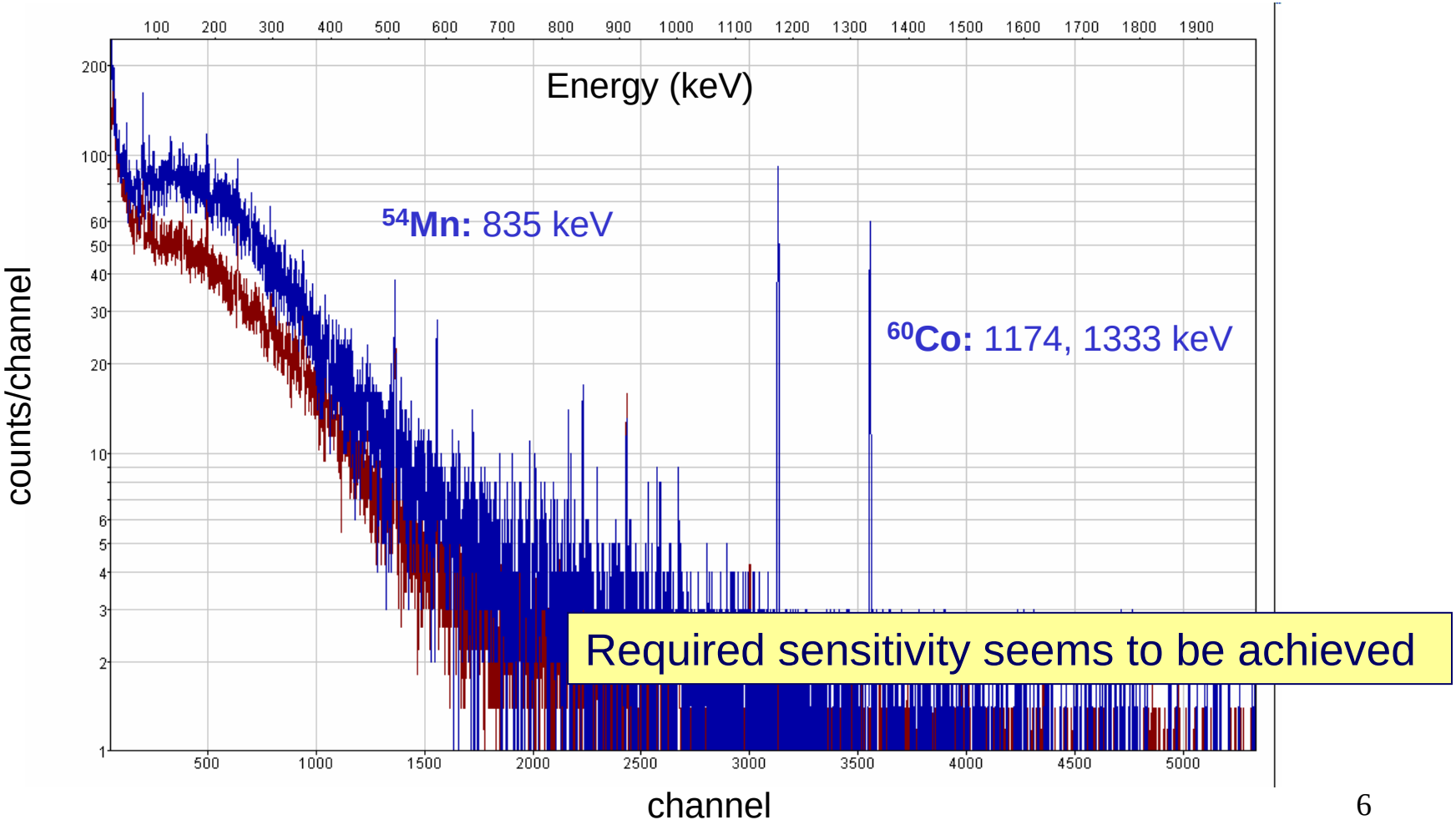




Status of measurements

- **First stainless steel measurement**

Preliminary data: 27 days for sample and (normalized) background



Status of measurements

- **This week:**

  • Start of new measurements using GeTobazo and GeAnayet detectors with the other **two stainless steel 316Ti samples**

    • 43 pieces, ~4.8x4.8x1.5 cm^3, ~11 kg

    • 7 pieces, ~5x5x5 cm3, ~6.7 kg

  • **Efficiency calibrations** using ^{152}Eu reference source: to validate Monte Carlo simulations for detection efficiency for each sample.

Topics for discussion

- **Procurement of next samples**
  - **High density polyethylne:** best radiopurity measured by XENON (from in2plastic company)
  - **Copper:** american supplier for field cage and cans and Luvata supplier for ICS?
  - **Cuflon:** more material being purchased?
  - **Silver epoxy:** more material provided?
  - **PMT:** ready at Valencia?
  - **…**
- News about **Ge detectors at Berkeley**?
- Development of **special radiopure soldering wire** in USA: start measuring normal material
- Some important **material missed** at the list of screening materials?

(complete summary of radiopurity information at http://next.ific.uv.es/cgi-bin/DocDB/public/ShowDocument?docid=76)

Results of Nironit stainless steel from XENON

Table 1
Screening results, see text for discussion.

	Material	Supplier	Use	Detector	Time [d]	Amount	Unit	^{228}Ra	^{228}Th	^{238}U	^{226}Ra	^{235}U	^{40}K	^{137}Cs	^{60}Co
	Metal														
1.	Lead	Plombum	Outer Pb shield	Gator	18.4	2.27 kg	mBq/kg	<6.9	<0.52	<260	<4.2	<12	14(3)	<0.81	<0.11
2.	Lead	Plombum	Outer Pb shield	LNGS	14.5	44 kg	mBq/kg	<6.6	<1.6	<130	<5.7	<51	14(6)	<2.1	<1.1
3.	Lead	Foundaries de Gentilly	Inner Pb shield	Gator	17.8	2.27 kg	mBq/kg	<0.66	<0.42	<24	<0.71	<1.8	<1.46	0.63(6)	<0.11
4.	Lead	Foundaries de Gentilly	Inner Pb Shield	LNGS	18.7	44 kg	mBq/kg	<3.9	<4.3	<33	<6.8	<20	<28	<0.85	<0.19
5.	Copper	Norddeutsche Affinerie	Shield	Gator	51.4	512 kg	μBq/kg	21(7)	21(7)	70(20)	70(20)	3.4	23(6)		2(1)
6.	Copper	Norddeutsche Affinerie	TPC	Gator	20.3	18.1 kg	mBq/kg	<0.37	<0.33	<11	<0.37	<0.47	<1.3	<0.14	0.24(6)
7.	Stainless steel 316Ti (1.5 mm)	NIRONIT	Cryostat wall	LNGS	6.87	1.2 kg	mBq/kg	<2.4	<1.0	<130	<1.9	<2.0	10(4)	<0.9	8.5(9)
8.	Stainless steel 316Ti (2.5 mm)	NIRONIT	Cryostat bottom	LNGS	20.6	1.97 kg	mBq/kg	<3.1	<1.5	<42	<2.7	<1.4	<12	<0.88	13(1)
9.	Stainless steel 316Ti (3.0 mm)	NIRONIT	Grid frame	Gator	6.76	6.6 kg	mBq/kg	<4.1	<1.8	<130	3.6(8)	<5.8	<5.7	<1.1	7(1)
10.	Stainless steel 316Ti (25 mm)	NIRONIT	Top flange/support bars	LNGS	5.58	1.52 kg	mBq/kg	<0.92	2.9(7)	<20	<1.3	<1.3	<7.1	<0.82	1.4(3)
11.	Screws 2–56 7/16"	McMaster	Standard screw	Gator	12.1	0.27 kg	mBq/kg	24(5)	<21	<550	<13	<25	< 47	<5.1	6(2)

Results of Nironit stainless steel from GERDA

Table 3
Part1: concentrations of primordial, anthropogenic and cosmogenic radionuclides given in (mBq/kg) for the 1.4571 stainless steel measured with the detectors DARIO (D) at MPI-K (Heidelberg, Germany) and GeMPI (G) at LNGS (Gran Sasso, Italy)

Sample	D1	D2	D3	D4	D5	D6	D7
Exposure	158.5	243.2	384.8	443.6	241.8	521.3	217.56
Vendor	IS	IB	IB	IB	IB	IB	IB
^{228}Ra	<3.0	<3.5	<3.6	<3.8	<1.8	<1.4	<4.2
^{228}Th	3.4 ± 1.0	<1.7	<1.9	<1.8	<1.1	<0.8	<1.0
^{226}Ra	<2.6	<2.0	<0.9	<1.6	<1.5	<0.6	<1.4
^{234m}Pa	<155	<100	<84	<53	<76	<38	<152
^{40}K	<4.0	<4.7	<3.4	<3.3	<3.2	<1.8	<7.2
^{60}Co	6.6 ± 1.1	14.4 ± 2.1	15.4 ± 2.2	14.8 ± 2.1	16.8 ± 2.5	16.8 ± 2.4	17.5 ± 2.6
^{7}Be		34.6 ± 5.3					
Sample	G1	G2	G3	G4	G5	G6	G7
Exposure	174.9	1072.4	178.9	195.6	510.1	294.1	331.3
Vendor	IB	IB	U	A	A	IB	A
^{228}Ra	<2.6	<0.86	<1.0	<3.0	1.0 ± 0.5	<1.1	1.9 ± 1.0
^{228}Th	<0.20	<0.11	<0.41	5.1 ± 0.5	1.5 ± 0.2	<0.27	5.2 ± 0.5
^{226}Ra	<1.3	<0.24	<0.74	<1.3	1.0 ± 0.6	<0.35	3.9 ± 1.6
^{234m}Pa	<94	<12	<45	<41	54 ± 16	<38	<56
^{235}U	<2.6	<0.63	<1.5	<1.9	2.5 ± 1.5	<1.5	<3.9
^{40}K	<2.8	<0.93	<1.1	<1.7	<0.81	<1.1	<1.7
^{60}Co	45.5 ± 2.1	14.0 ± 0.1	13.8 ± 0.7	20 ± 1	18.3 ± 0.7	13 ± 0.6	42.1 ± 1.9
^{137}Cs	0.77 ± 0.43	<0.16	<0.26	<0.36	<0.1	<0.39	<0.6
^{7}Be	<3.9	<3.0	<5.7	9.6 ± 2.9	4.8 ± 1.7	13.6 ± 2.5	<5.9
^{54}Mn	1.3 ± 0.4	1.5 ± 0.1	0.92 ± 0.24	2.0 ± 0.3	1.7 ± 0.2	1.4 ± 0.2	1.6 ± 0.3
^{58}Co	0.67 ± 0.34	0.99 ± 0.12	0.56 ± 0.23	0.71 ± 0.26	0.69 ± 0.16	0.59 ± 0.20	0.54 ± 0.27
^{56}Co	<0.32	0.17 ± 0.06	<0.62	<0.71	0.28 ± 0.10	<0.42	<0.6
^{46}Sc	<0.35	0.24 ± 0.06	<0.54	<0.67	0.47 ± 0.14	<0.31	0.61 ± 0.26
^{48}V	0.30 ± 0.11	0.36 ± 0.07	0.27 ± 0.11	0.31 ± 0.13	0.22 ± 0.09	0.40 ± 0.12	0.39 ± 0.13