

# CYGNO simulation updates

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23/09/25

# Radioactivity measurements

New results from ICP-MS measurement of PMMA and FC samples

- ICP-MS measures the **concentration** (g/g) of atomic species (U, Th, K), not the radioactivity (unlike HPGe screening)
  - destructive, but only small samples needed
  - can measure parent nuclides of a radioactive decay chain (U, Th) up to ~1-10 ppt
  - can measure K up to ~few ppb
- ICP-MS results can be converted in Bq/kg using standard tables  
FC plastic (top) and metal (bottom)

## PMMA

Sample	Th content	U content	K content
	Unit (ppt)	Unit (ppt)	Unit (ppb)
PMMA	136 ± 41	56 ± 17	143 ± 43

### Conversion factors:

- 1 Bq 238U/kg = 81 ppb U ( $81 \times 10^{-9}$  gU/g)
- 1 Bq 232Th/kg = 246 ppb Th ( $246 \times 10^{-9}$  gTh/g)
- 1 Bq 235U/kg = 1.76 ppm U ( $1.76 \times 10^{-6}$  gU/g)
- 1 Bq 40K/kg = 32300 ppb K ( $32300 \times 10^{-6}$  gK/g)

Sample	Th content	U content	K content
	Unit (ppt)	Unit (ppt)	Unit (ppb)
Cu Kapton	320 ± 96	875 ± 263	3735 ± 1120
Cu Pet	995 ± 300	320 ± 96	1240 ± 372

Sample	Th content	U content	K content
	Unit (ppt)	Unit (ppt)	Unit (ppb)
Cu Kapton	1250 ± 375	145 ± 44	755 ± 227
Cu Pet	2000 ± 600	30 ± 9	1310 ± 393

# Radioactivity measurements

- Added new measurements in the [CYGNO-db for radioactivity](#) after conversion in Bq/kg
  - in case of filed cage needed a scaling by mass-fractions of metal and plastic parts taking into account the geometrical details (1 cm strips, 1 cm pitch, thickness)

materiali di base	Kapton/PET		
Spessore	50 µm kapton ~35 µm rame/75 µm PET ~35 µm rame		
<b>Field cage kapton_Cu ICP-MS</b>			<b>meas (Bq/kg)</b>
U	LNGS chemistry lab	M	4.58E-03
Th	LNGS chemistry lab	M	3.91E-03
K	LNGS chemistry lab	M	5.20E-02
<b>Field cage PET_Cu ICP-MS</b>			<b>meas (Bq/kg)</b>
U	LNGS chemistry lab	M	1.73E-03
Th	LNGS chemistry lab	M	6.58E-03
K	LNGS chemistry lab	M	3.97E-02
<b>Acrylic ICP-MS</b>			<b>meas (Bq/kg)</b>
U	LNGS chemistry lab	M	6.91E-04
Th	LNGS chemistry lab	M	5.53E-04
K	LNGS chemistry lab	M	4.43E-03

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Th	LNGS chemistry lab	M	3.91E-03
K	LNGS chemistry lab	M	5.20E-02
Field cage kapton_Cu HPGe			limit (k=1.645)/r error (1 sigma)
238U (234Th)	Donatella <a href="https://agen">https://agen</a>	L (<)	7.24E-01
238U (Ra226)		M	6.83E-03 3.99E-03
232Th (Ra228)		L (<)	2.27E-02
232Th (Th228)		M	2.18E-02 1.11E-02
235U		L (<)	1.14E-02
40K		L (<)	8.67E-02
137Cs		L (<)	3.73E-03

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Acrylic ICP-MS			meas (Bq/kg)
U	LNGS chemistry lab	M	6.91E-04
Th	LNGS chemistry lab	M	5.53E-04
K	LNGS chemistry lab	M	4.43E-03
PMMA - Acrylic	Reference	Limit/Meas	Activity (Bq/kg)
238U (226Ra)	(Laubenstein?) @LNGS	M (=)	5.00E-05
238U (234mPa)	(Laubenstein?) @LNGS	L (<)	1.80E-03
U235	(Laubenstein?) @LNGS	L (<)	7.00E-05
Th232 (Ac228)	(Laubenstein?) @LNGS	L (<)	1.40E-04
Th232 (Th228)	(Laubenstein?) @LNGS	L (<)	8.00E-05
40K	(Laubenstein?) @LNGS	L (<)	4.10E-04
137Cs	(Laubenstein?) @LNGS	L (<)	2.50E-05
Acrylic	Reference	Limit/Meas	Activity (Bq/kg)
U	SNO: <a href="https://www.radiopurity.org">https://www.radiopurity.org</a>	L	2.96E-04
Th	SNO: <a href="https://www.radiopurity.org">https://www.radiopurity.org</a>	L	5.69E-05
K	SNO: <a href="https://www.radiopurity.org">https://www.radiopurity.org</a>	L	7.12E-05
U235	SNO: <a href="https://www.radiopurity.org">https://www.radiopurity.org</a>	L	9.54E-08

Donchamp vendor

SNO

# NR samples

- NR samples at defined energy correspond to a lower ionization energy wrt ER (keVee)
- Available on cloud in the cygno-sim area ER samples of energies in keV:  
1-3-5-10-15-20-25-30-35-40-45-50 (1000 events each)
- Direct comparison with NR of same energy is not useful due to QF: we need samples of higher NR energy, so that the equivalent keVee is the same of ER → **in preparation**

