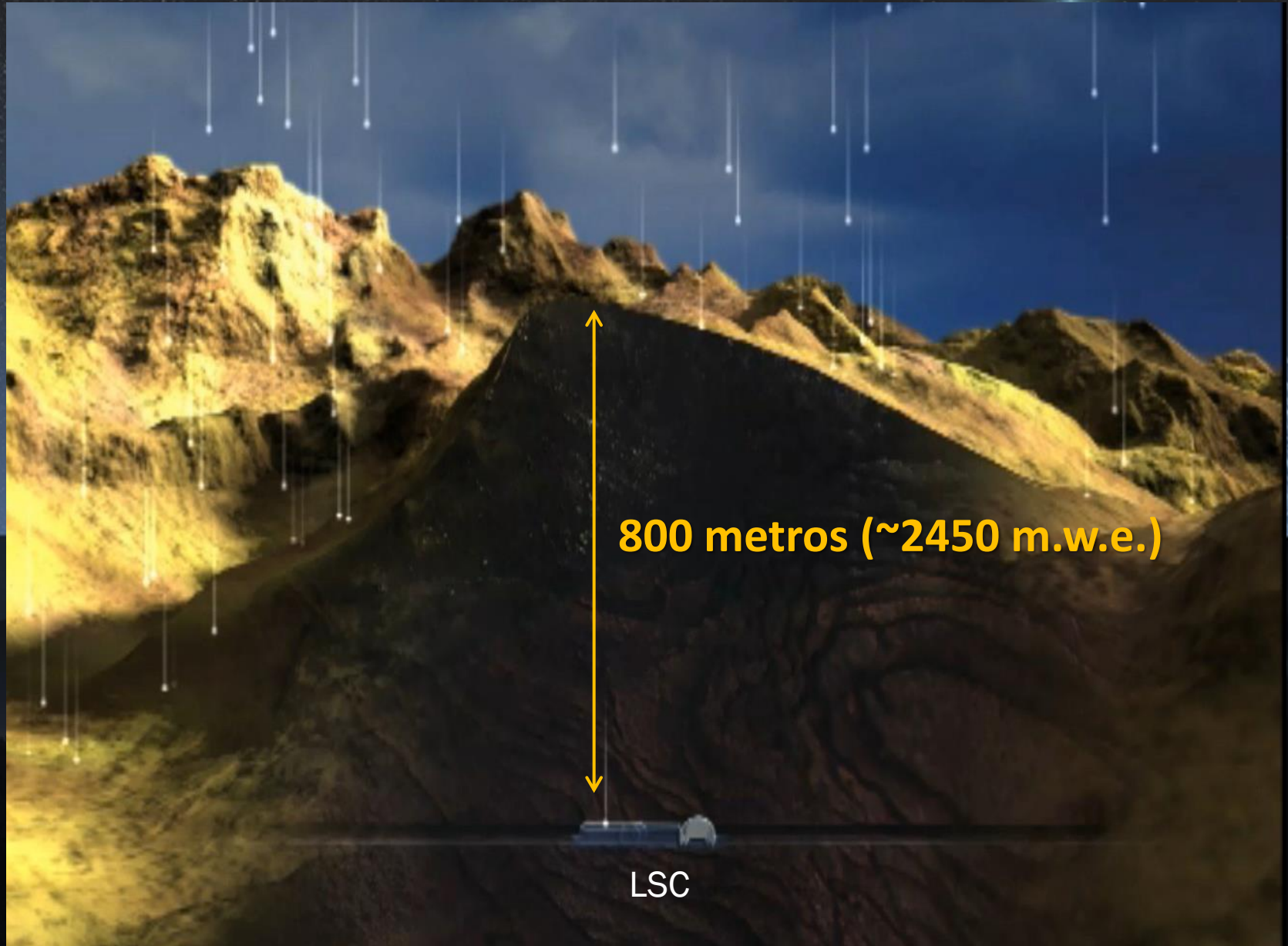


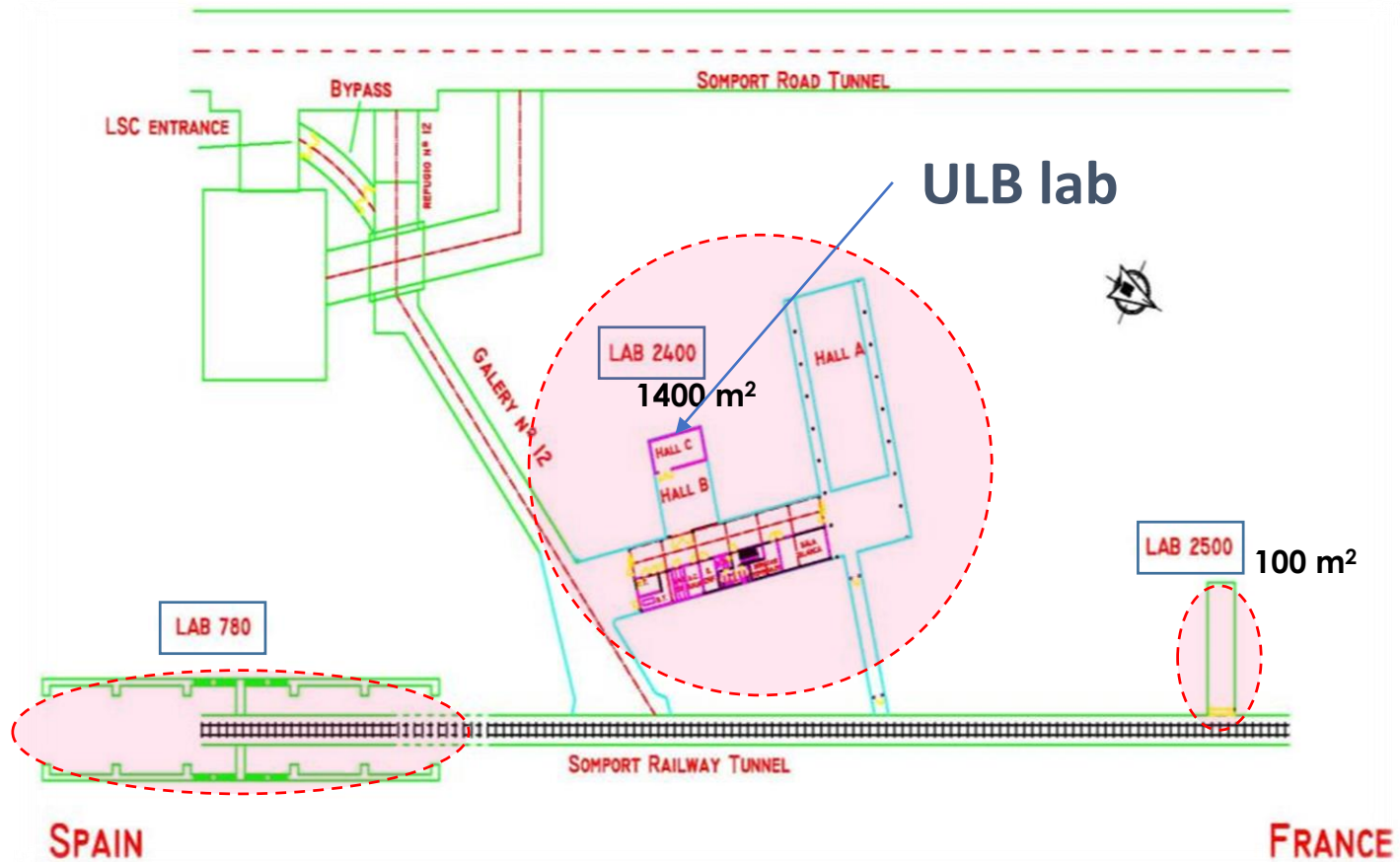


Ultra-Low Background Services in the LSC

Iulian Bandac



Ultra-Low Background Measurements Service



Ultra-Low Background Measurements Service



7 HPGe p-type coaxial (2 kg)
1 SAGe Well model GSW275L
(all made by Canberra)

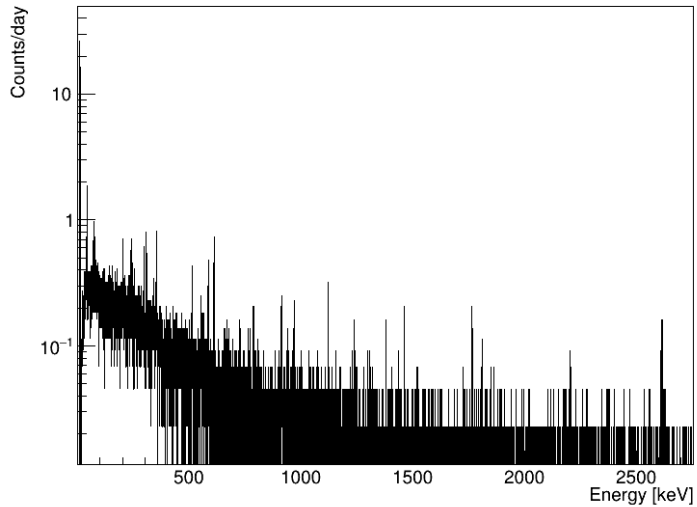
6 mounted and taking data: Asterix,
GeLatuca, GeOroel, GeTobazo,
GeAnayet, GeAspe.

Obelix in maintenance.

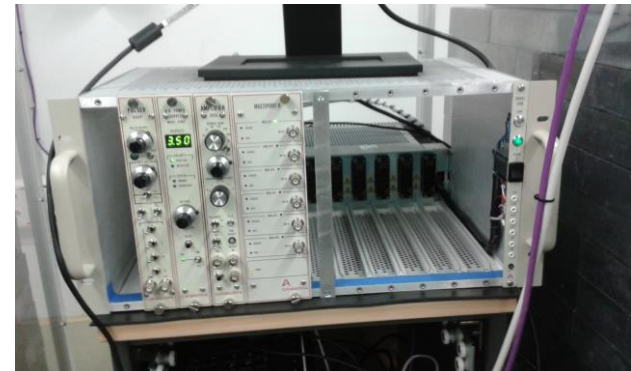
GeLaraca (SAGe) in testing.

Ultra-Low Background Measurements Service

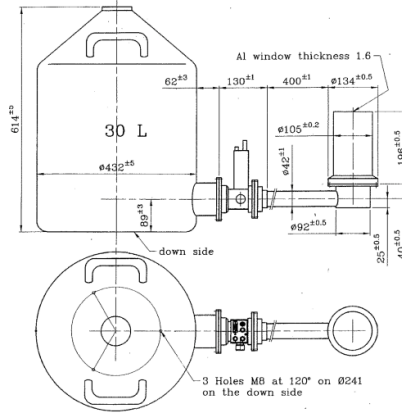
BKG Counts/Day



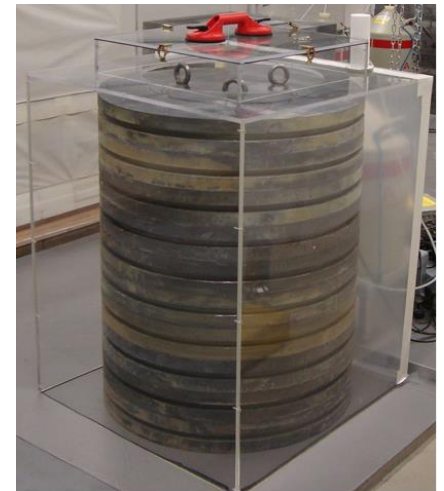
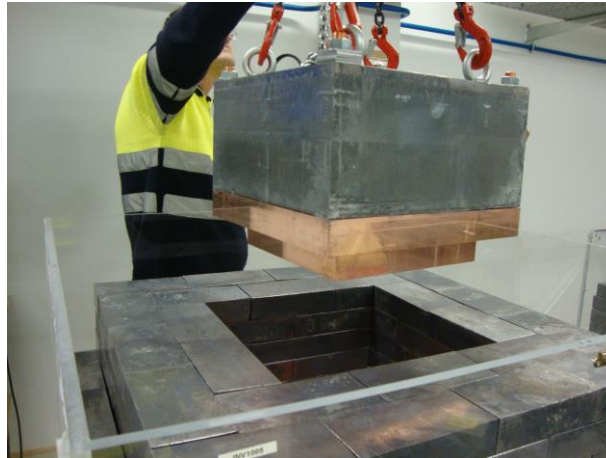
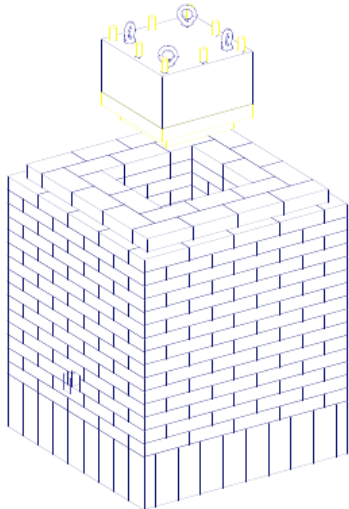
Detector Name	Diameter [mm]	Height [mm]	Weight [g]	Rel. Eff. [%]	FWHM @ 1332 keV [keV]	Cryostat Mat.	Preampl.	Electronics
GeOroel	81.4	81.7	2230	109.0	1.85	Al	PSC761	NIM
GeTobazo	81.2	81.2	2185	110.0	2.07	Al	PSC761	DSA1000
GeAnayet	81.0	81.1	2183	109.0	1.96	Al	PSC761	DSA1000
GeAspe	81.0	81.2	2187	108.0	1.94	Al	PSC761	DSA1000
GeLatuca	81.0	81.2	2187	108.0	1.86	Al	PSC761	DSA1000
Asterix	79.0	79.0	2031	95.1	2.08	Cu	Ge2002	DSA1000
Obelix	79.0	79.0	2031	92.8	2.00	Cu	Ge2002	DSA1000



Ultra-Low Background Measurements Service



10 cm Cu-OF
 20 cm Pb (~660 bricks)
 Methacrylate Rn box.
 Door



Ultra-Low Background Measurements Service

Name	V [cm ³]	M [kg]	FWHM @ 1332 keV [keV]	Integral (60-2700) keV [cts/kg/day]	Tl-208 2614.5 keV [cts/kg/day]	Bi-214 609.3 keV [cts/kg/day]	Co-60 1332.5 keV [cts/kg/day]	K-40 1460.8 keV [cts/kg/day]
GeOroel	420	2.31	1.85	165.3	0.4	2.9	0.1	0.4
Asterix	387	2.13	2.08	189.2	0.2	2.1	0.5	0.3
GeAnayet	410	2.26	1.96	473.3	3.2	1.9	0.1	0.6
GeLatuca	410	2.26	1.86	342.0	3.9	2.8	0.2	0.8
GeTobazo	410	2.26	2.07	491.7	3.8	2.8	0.4	0.7
GeAspe	409	2.25	1.94	477.9	3.8	2.2	0.3	0.9

Sensitivity, assuming secular equilibrium and 10% efficiency:

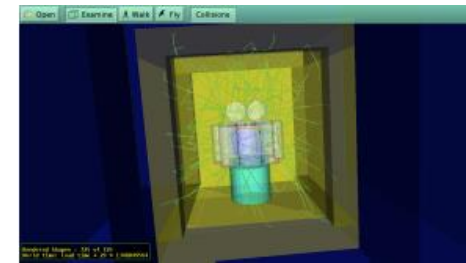
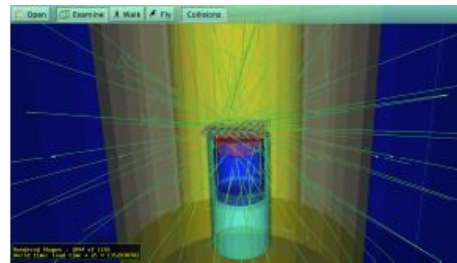
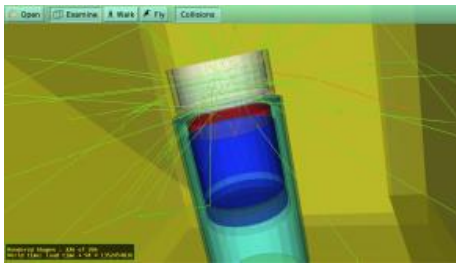
$^{238}\text{U} \sim 10 - 100$ ppt

$^{232}\text{Th} \sim 50 - 330$ ppt

$^{40}\text{K} \sim 10 - 100$ ppb

Ultra-Low Background Measurements Service

From 2011 performed measurements for: NEXT (>140), SuperKGD, ArDM, BiPo, ANAIS, CUNA, LABAC, KSTAR, TREXDM, DarkSide.

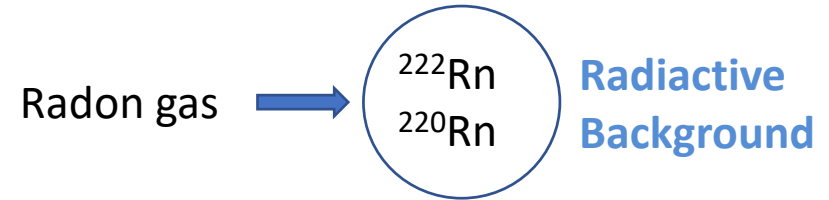
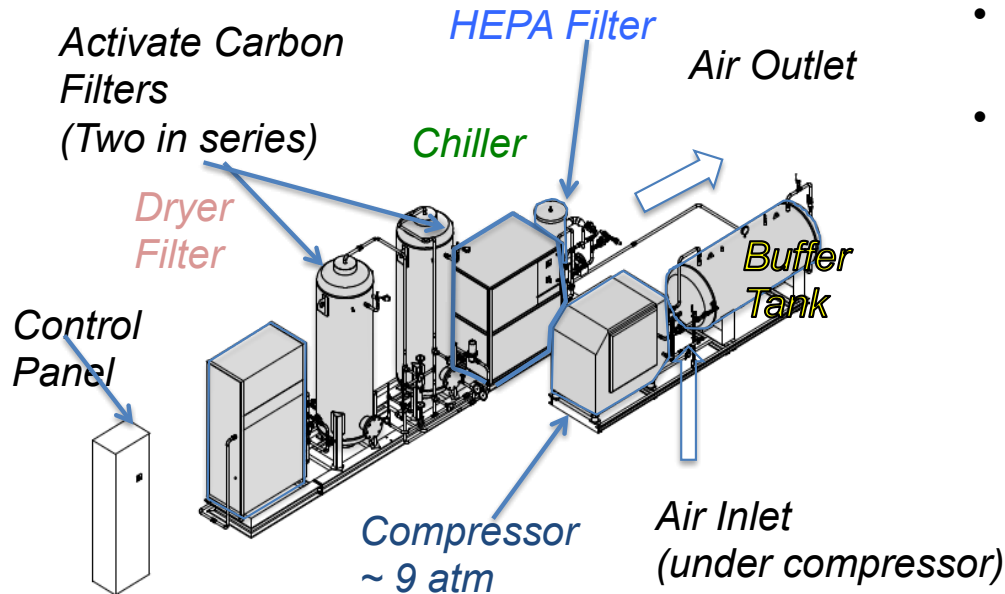


A MC simulation program, GEBIC, was developed using Geant4. GEBIC was improved and tested in collaboration with University of Zaragoza. GEBIC is used to calculate detector efficiency for each measured sample.

Code adapted to include specific characteristics of each detector.

Radon-free Air Facility at LSC

A) Radon Abatement System



- Output air flow 220 m³/h (ambient pressure, 20 °C).
- Rn level ~ 1 mBq/m³ (reduction factor of Rn >1000)
- System: absorption on charcoal and HEPA filter

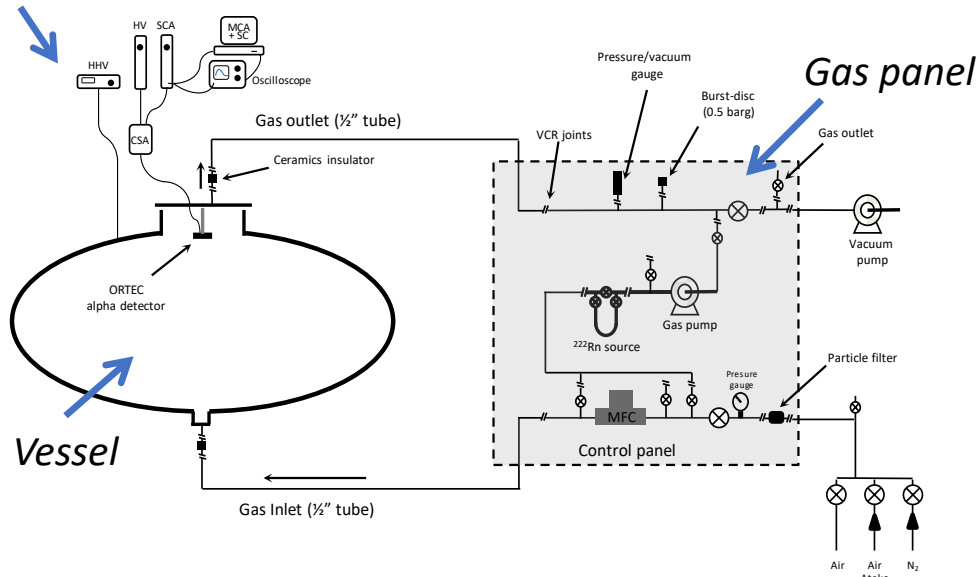


Chiller and charcoal filters, Hall A at LSC

Radon-free Air Facility at LSC

B) Radon Monitor

Counting electronics



Sensitivity 1 mBq/m³

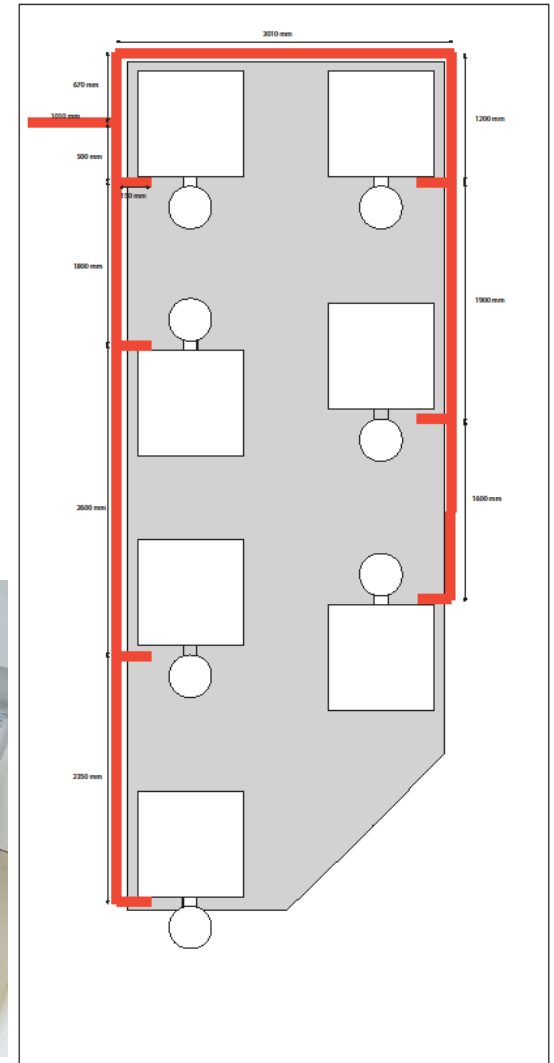
- Custom detector
- Analysis of the Rn level in the Rn-free air



Radon monitor, Hall A at LSC

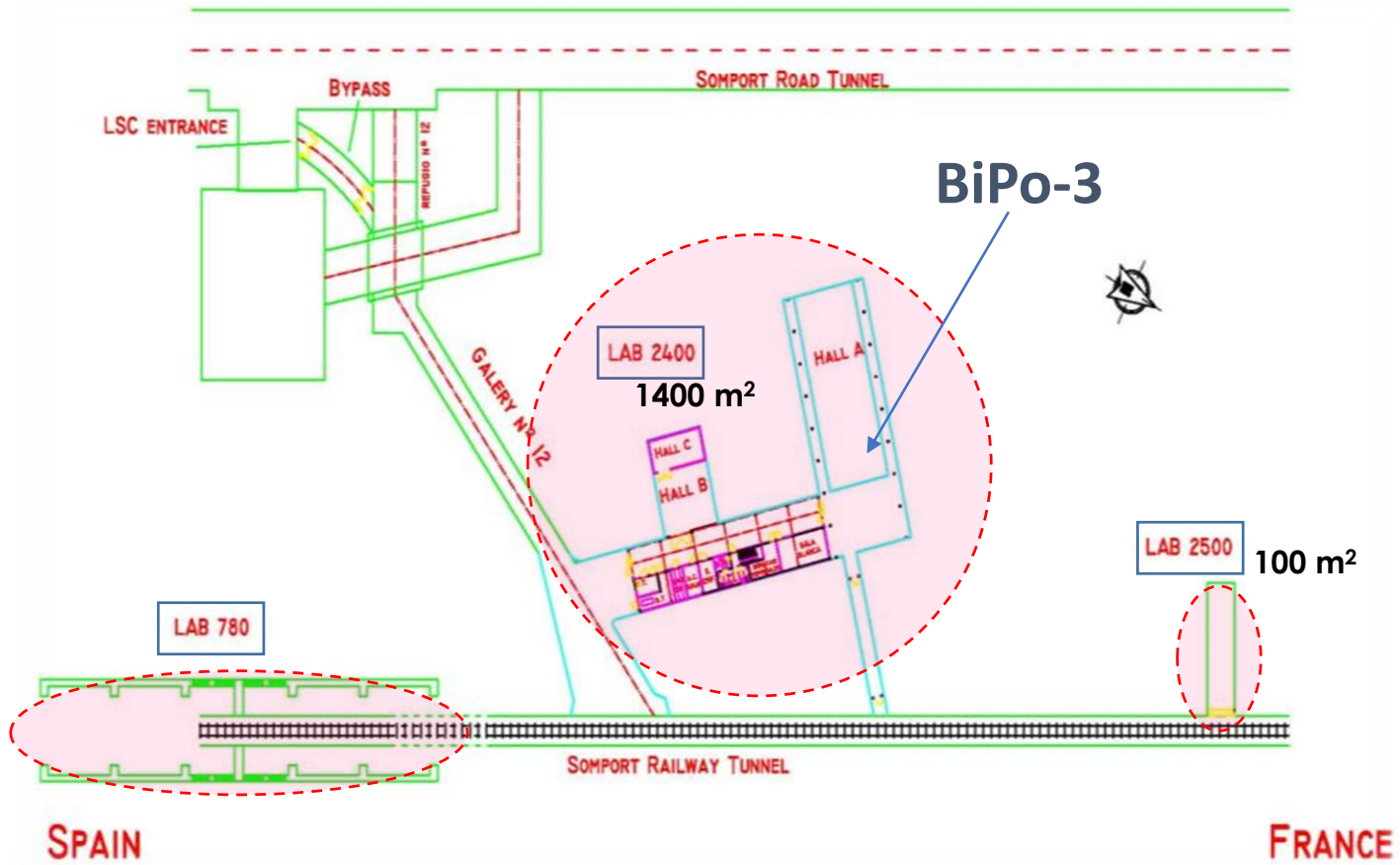
In collaboration with Jagiellonian University (Krakow, Poland)

Connection of Hall C to Radon-free Air Facility at LSC



Work in progress.

BiPo-3 detector



BiPo-3 detector

Goal: to measure the ^{212}Bi (^{232}Th chain) and ^{214}Bi (^{238}U chain) contaminations in thin foils with better sensitivity than a HPGe detector $\sim 1.0 \mu\text{Bq}/\text{m}^2$

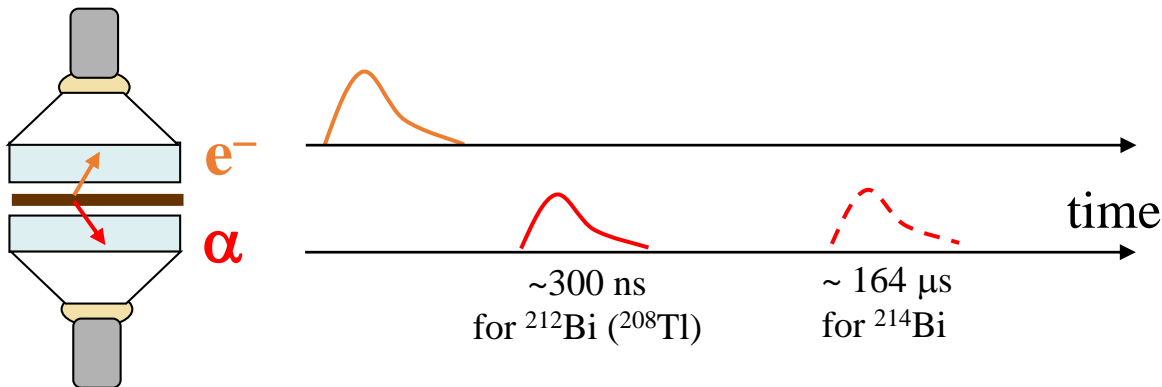
Method: tagging of fast coincidence β - α correlated decays.

Used for: SuperNEMO source foil screening ($40\text{mg}/\text{cm}^2$ ^{82}Se), TREXDM, and DarkSide-20k.



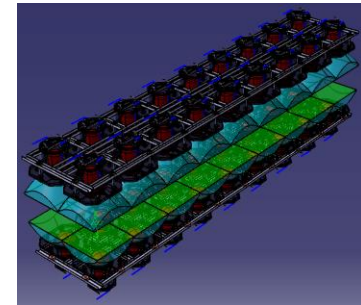
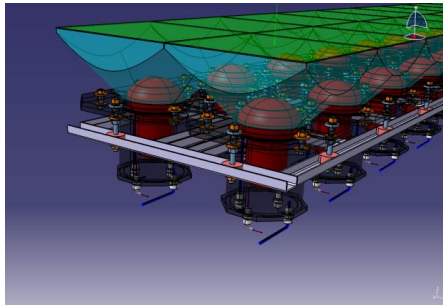
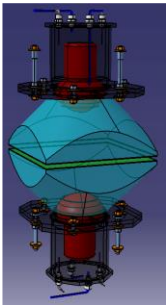
Sandwich of two low radioactive thin polystyrene plastic scintillators

Time topology signature: 1 hit + 1 delay hit (and no coincidence)

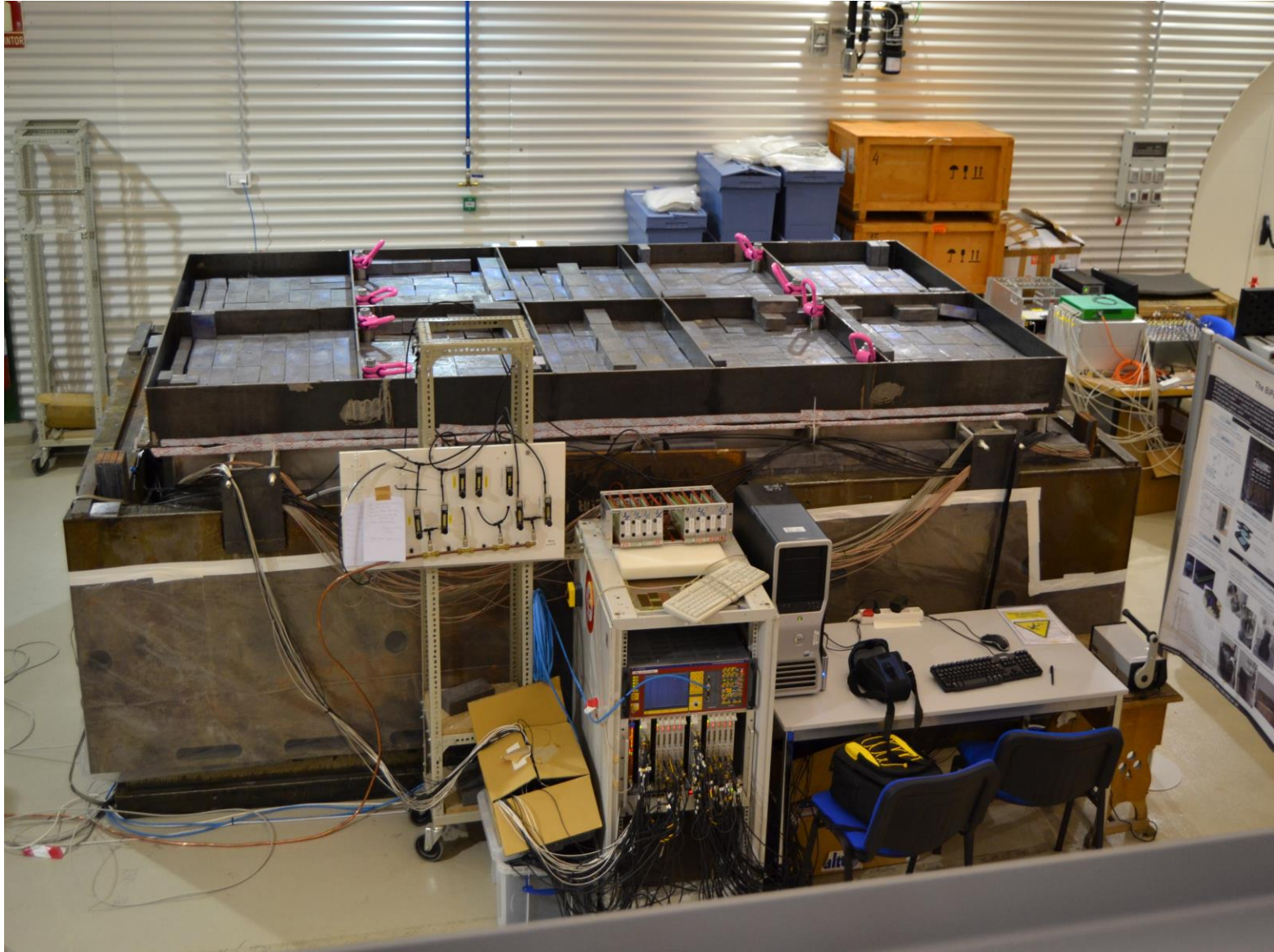


BiPo-3 detector

- ✓ **Total active area = 3.25 m²**
 - ✓ **Detector composed of 2 modules**
 - ✓ **Each module is an array of 18 optical sub-modules**
- Optical sub-modules consists of 2 thin scintillators face-to-face coupled via PMMA optical guides to 5" low radioactive PMT
- ⇒ **Total of 72 PMTs + Optical guide + scintillators**
- ✓ **Scintillators:**
 - ✓ **Polystyrene based, size: 300×300×2 mm³**
 - ✓ **entrance active face aluminized with 200nm of ultra pure Aluminum.**



BiPo-3 detector



LSC External Buildings

EDIFICIO SEDE (ES)

- Headquarters & Administration
- Safety and Quality Assurance
- 23 offices
- 4 specialized laboratories
- Mechanical workshop
- Storage room
- Meeting room
- Library
- Conference & exhibition rooms
- 2 apartments

CASA DE LOS ABETOS (CA)

- 2 Classroom
- 1 Conference room
- Exhibitions room

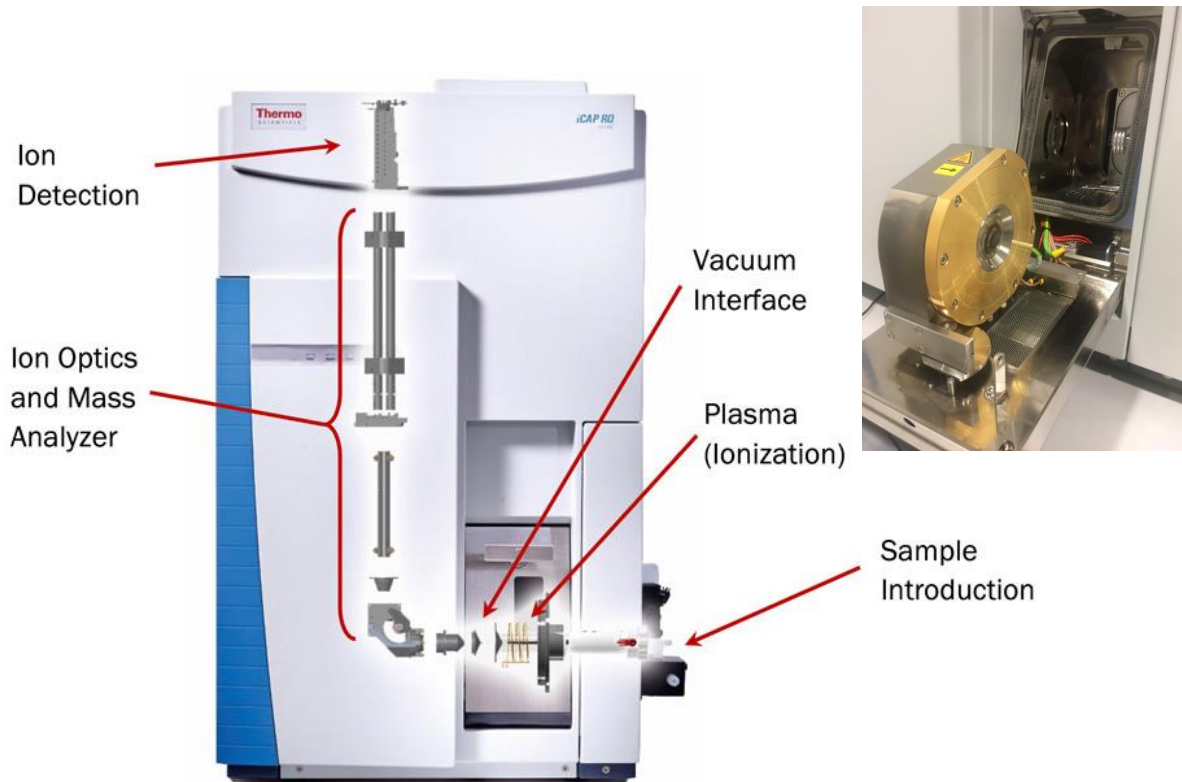


Surface: 1,821 m²
(2,115 m² built)



Surface: 400 m²
(460 m² built)

Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

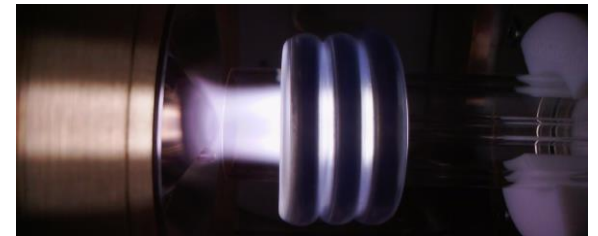
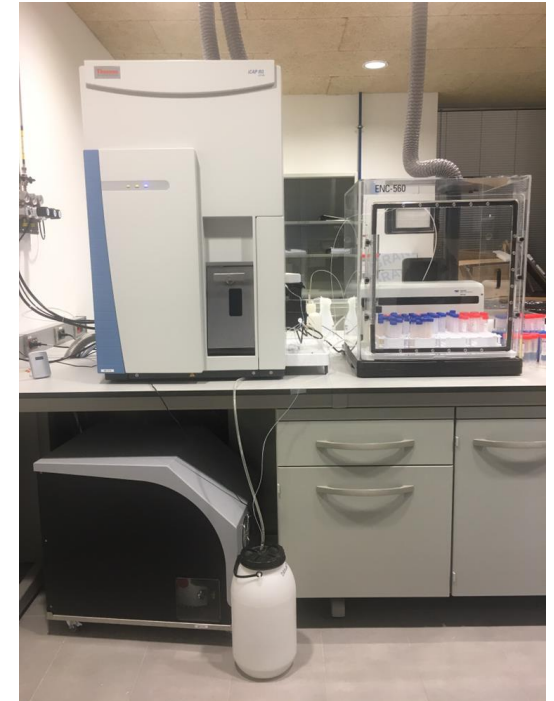
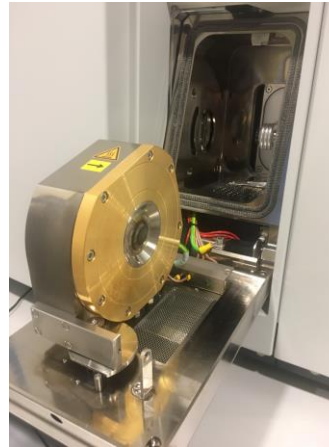


Thermo Fisher Scientific®

Mass range: 2-290 amu

Detection limits: ^{232}Th (1 ppt) ^{238}U (0.1 ppt)

We are in the process of finding another person to operate the ICP-MS.



Thank you!

