

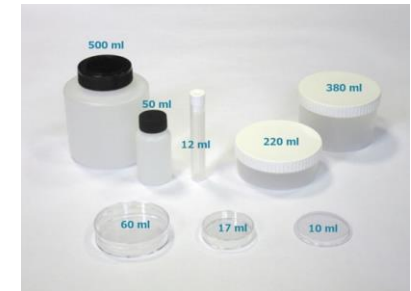
MEASUREMENTS AT LSM

Anne Meyer, Sébastien Aubry, Sina Bonnot, Anne de Vismes Ott, Eric Cale

IRSN/PSE-ENV/SAME/LMRE – Orsay

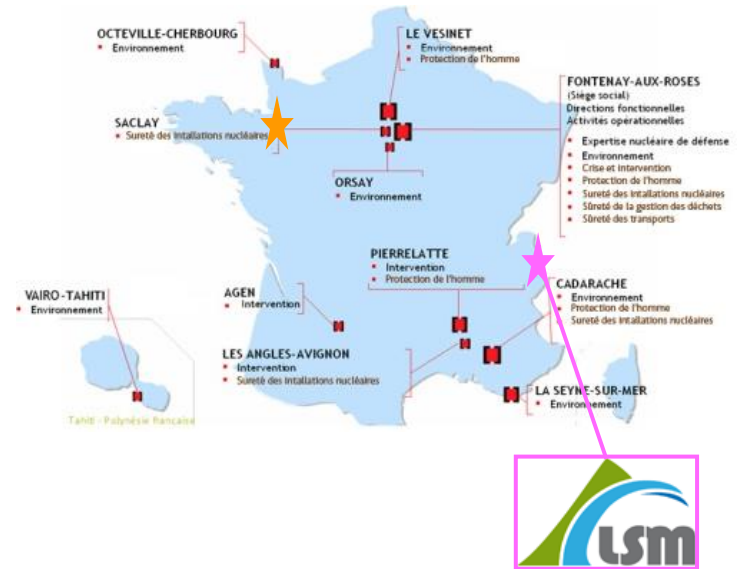
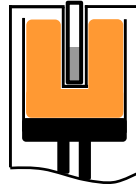
Germanium meeting, 18th March 2024

- | Institute for Radiation Protection and Nuclear Safety
- | Laboratory of Environmental Radioactivity Metrology
 - Activity determination in **environmental samples**
 - Environment **surveillance**
 - **Radioecology** studies
 - **Emergency** preparedness
 - Research and development: materials and methods improvements
- | **Gamma ray spectrometry**
 - Accreditation since 1999
 - **23 HPGe** detectors (4 in the deep underground lab in Modane)
 - ~ 1500 measurements/year
 - Specificities:
 - **wide range** of measurements:
matrix, counting geometry, radionuclides
 - **low level** radioactivity

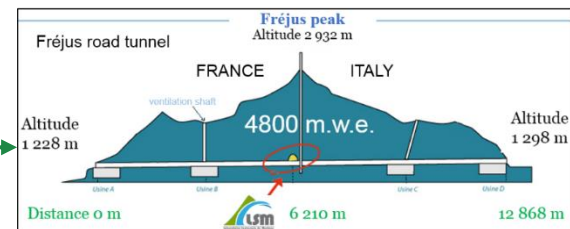
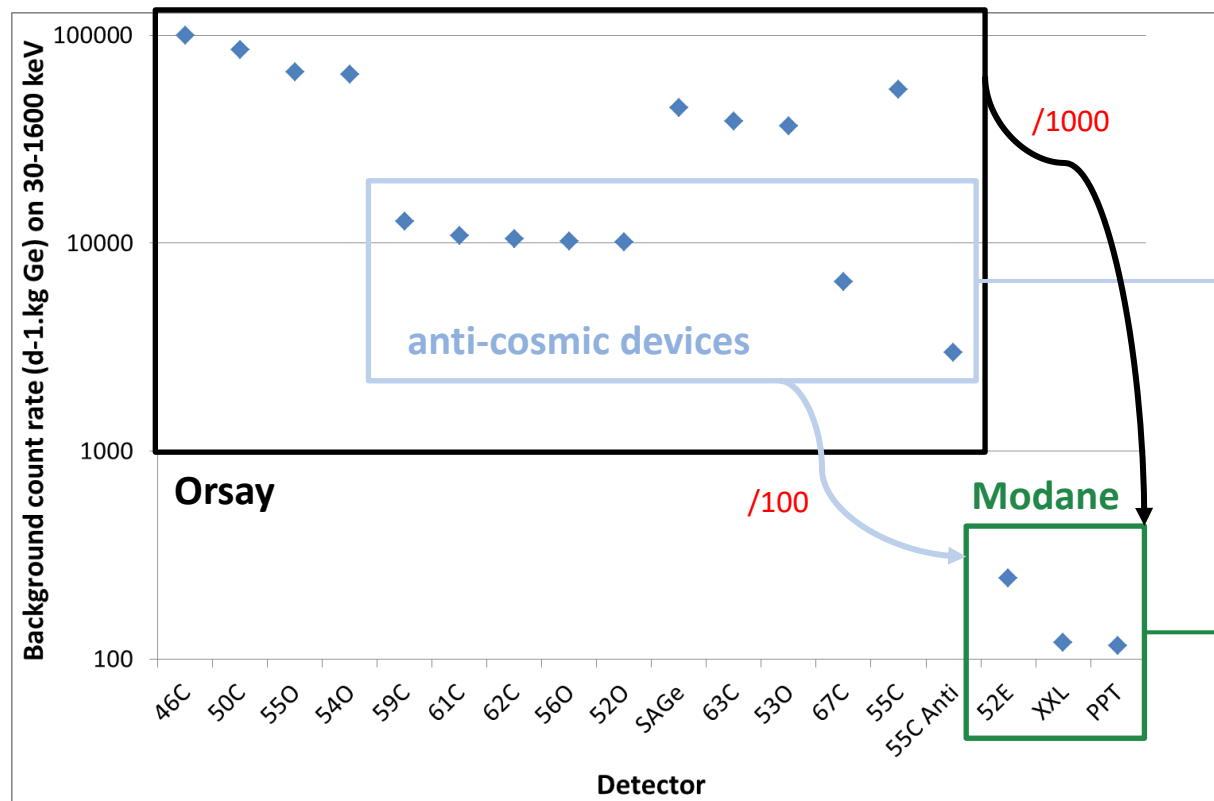


Gamma-ray spectrometry in Modane

- 4 **ultra low background HPGe** detectors
 - 1 **type N coaxial** detector: 52E (52 % relative efficiency)
 - 1 **type P planar** detector: LYS (66 % relative efficiency)
 - 2 **well-type** detectors of large volume : PPT (450 cm³) and XXL (844 cm³)



Background comparison



Example of measurements: aerosol filters

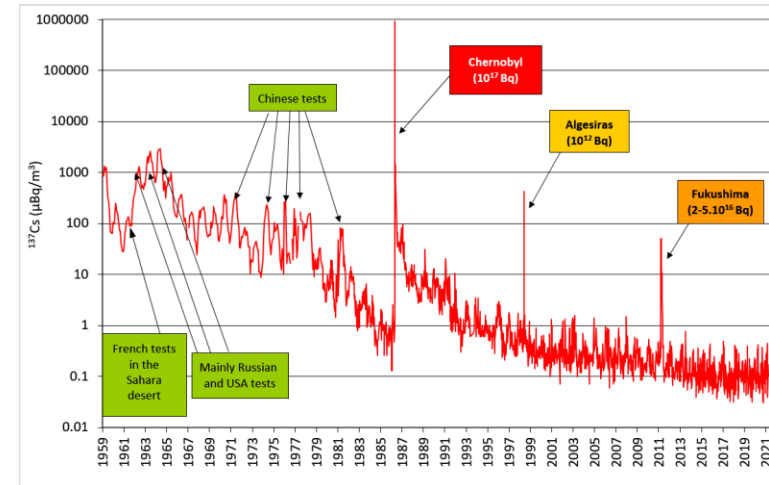
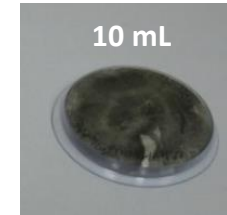
Measurements on **coaxial detector** for 2-4 days

OPERA-Air network

- **High-flow** air samplers ($\sim 800 \text{ m}^3/\text{h}$)
- Weekly sampling (volume $\sim 100\,000 \text{ m}^3$)
- ~ 80 measurements / year
- ^{137}Cs activity: $\sim 0.5 - 100 \text{ mBq/sample}$
- ^{137}Cs activity concentration in the air $\sim 0.1 \text{ }\mu\text{Bq}\cdot\text{m}^{-3}$
- Detection limits $^{137}\text{Cs} \sim 20 \text{ nBq}\cdot\text{m}^{-3}$

Multiple purposes

- **Baseline of the ^{137}Cs activity concentration** in the atmosphere
- **Detection of anomalies** at low-level



Example of measurements: fallout

Measurements on **well-type detectors**

Cloud water samples

- 1 sampler (Puy de Dôme), monthly sampling
 - Liquide $< 1 \text{ L}$ \rightarrow dry residue mass $\sim 1\text{-}100 \text{ mg}$
 - ^{137}Cs activity $< 1 \text{ mBq /sample}$
 - ^{137}Cs activity concentration in the cloud waters: $1\text{-}5 \text{ mBq.L}^{-1}$
- => **cloud activity** level yielding from **rainout process**

Rain water samples

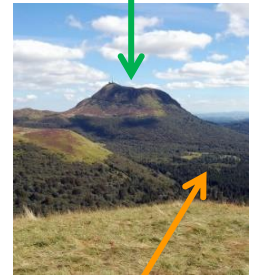
- 3 samplers, monthly sampling, **volume** $20 - 300 \text{ L}$
 - ^{137}Cs activity $\sim 1 \text{ mBq /sample}$
 - ^{137}Cs activity concentration in the rain waters: $10 - 150 \mu\text{Bq.L}^{-1}$
- => **rain activity** level resulting from **rainout** and **washout processes**

Purposes

- Study of the **scavenging efficiency of precipitation**
- Improved capability in **modeling radionuclide deposition** in case of nuclear accident (in foggy / cloudy conditions at lowland / high altitude location)



Puy de Dôme
(1465 m)



Clermont-Ferrand
(645 m)



Example of measurements: marine samples

Measurements on **well-type detectors**

Samples

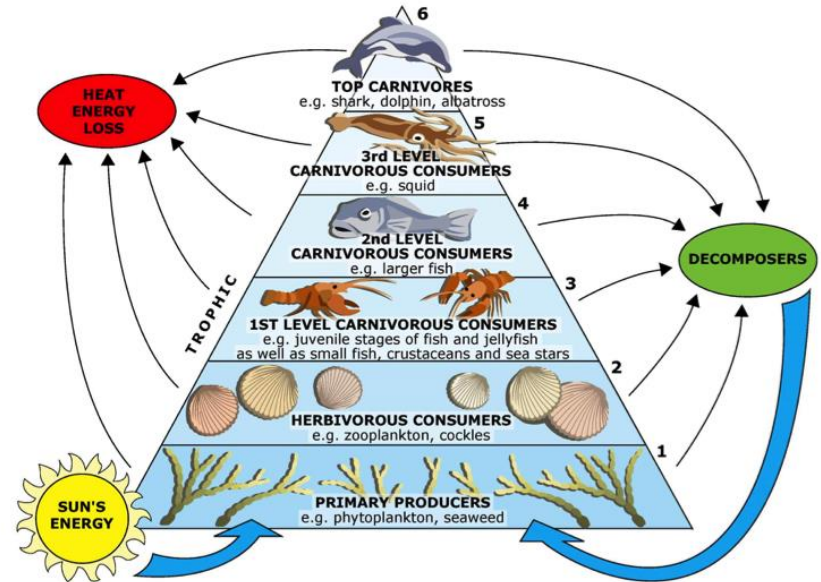
- Shellfish, sea cucumber
- ~ **6 – 8 g ashes**
- Counting time: ~ 2 – 4 days
- **^{137}Cs activity ~ 0.5 - 4 mBq /sample**

Purpose

- Study of **radionuclide transfer in Mediterranean food webs**



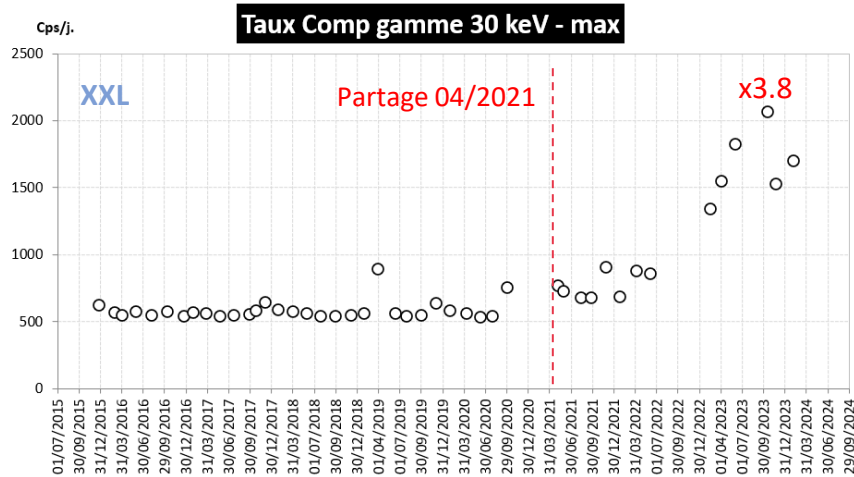
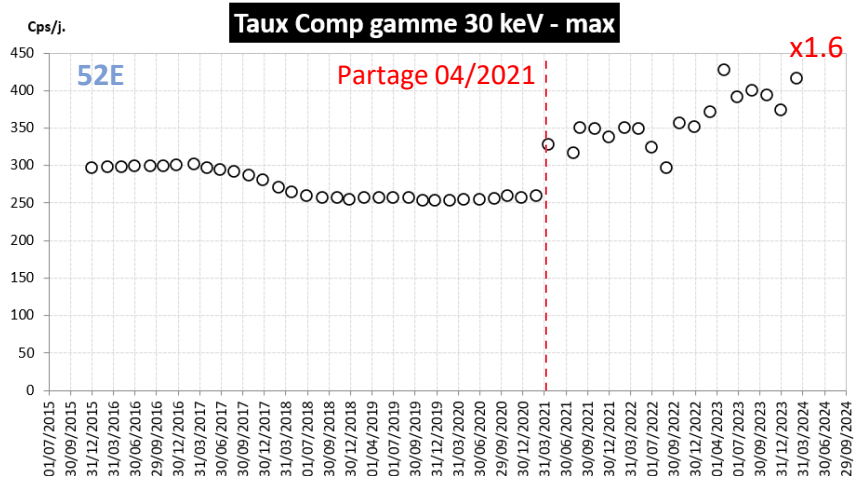
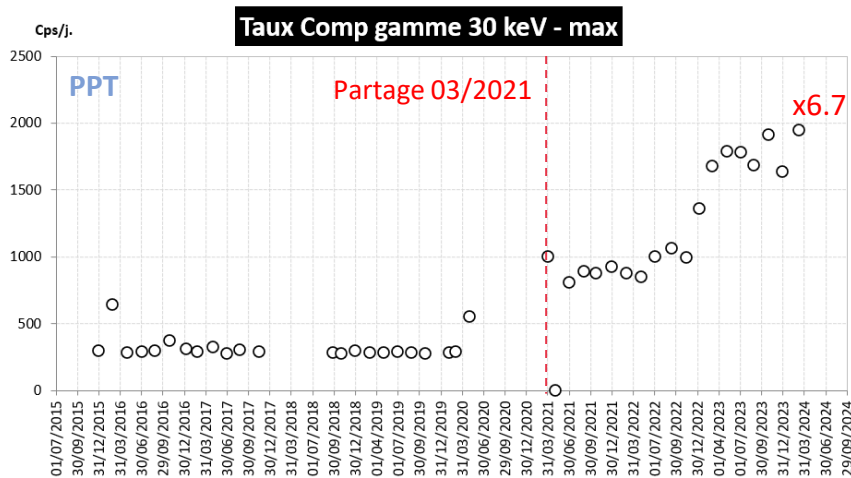
© 2007-2009 The University of Waikato | www.sciencelearn.org.nz



<https://oap.ospar.org/fr/>

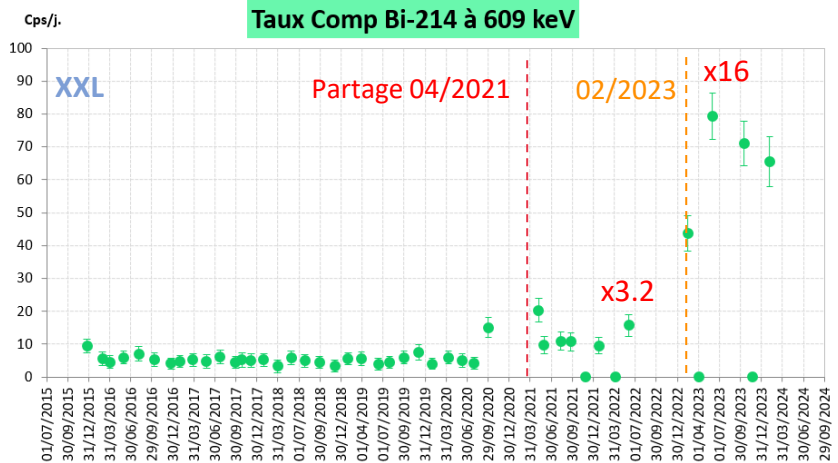
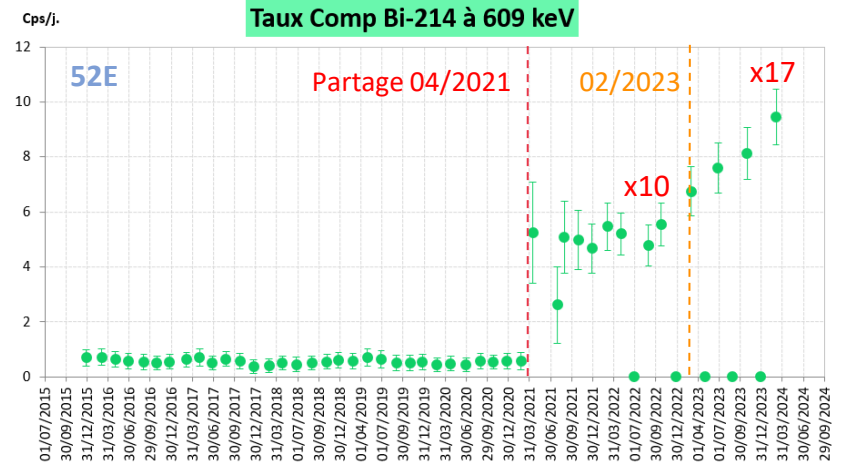
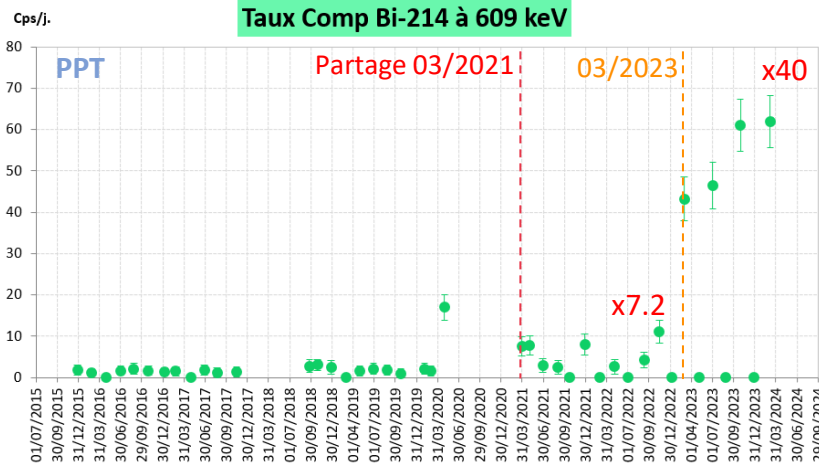
Background monitoring: total rate

Increase in background since the move in PARTAGe.



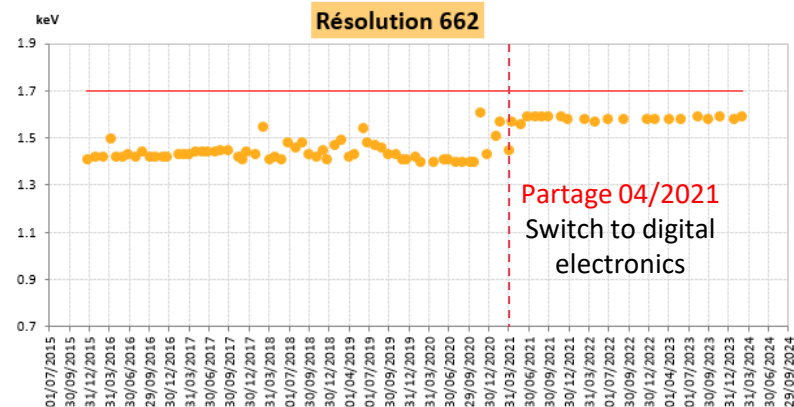
Background monitoring: 609 keV (^{214}Bi)

- Significant increase for all detectors
- Further net increase after the beginning of 2023 (including LYS).

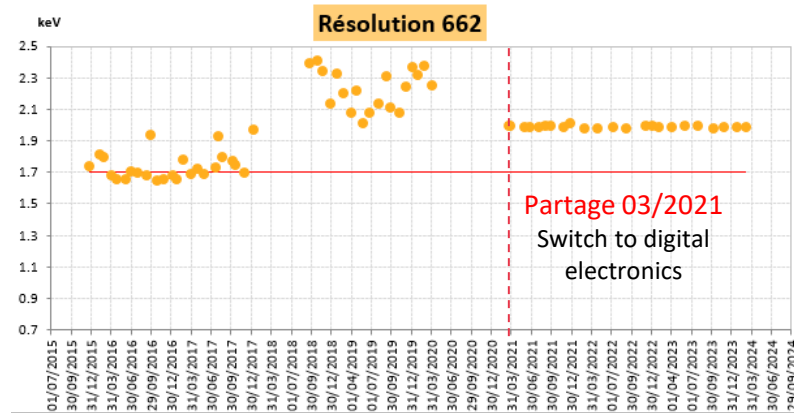


Resolution monitoring: 52E and PPT

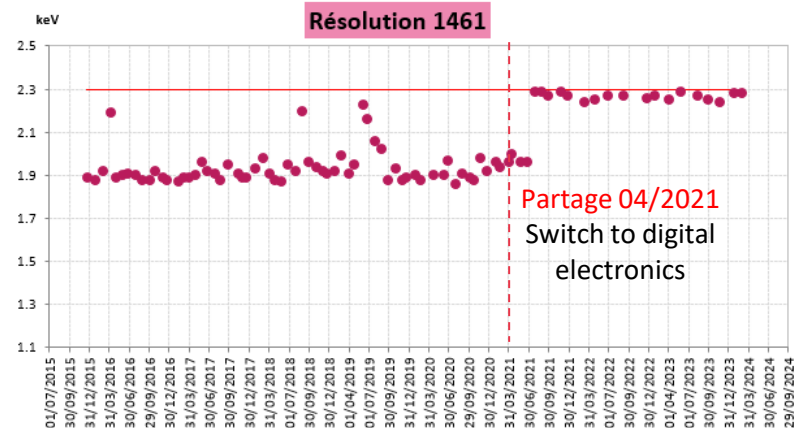
52E



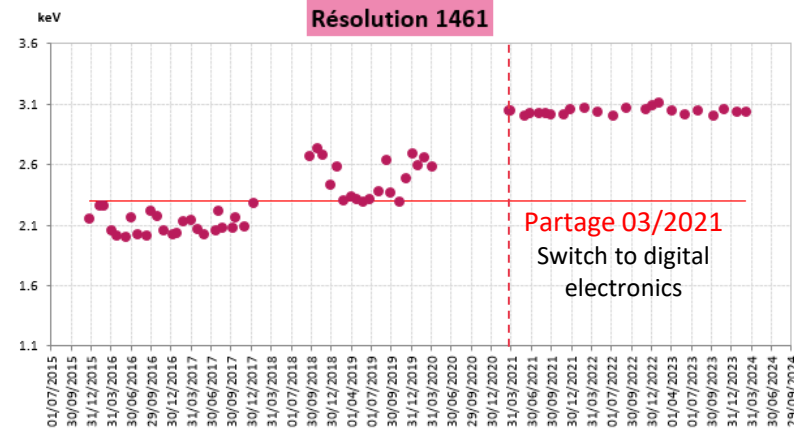
PPT



52E

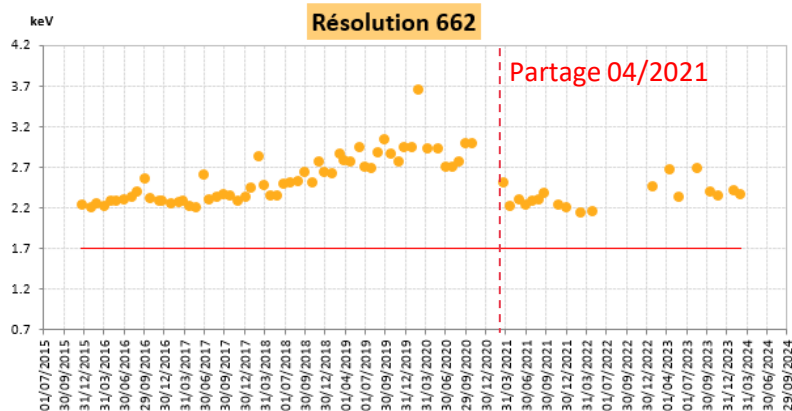


PPT

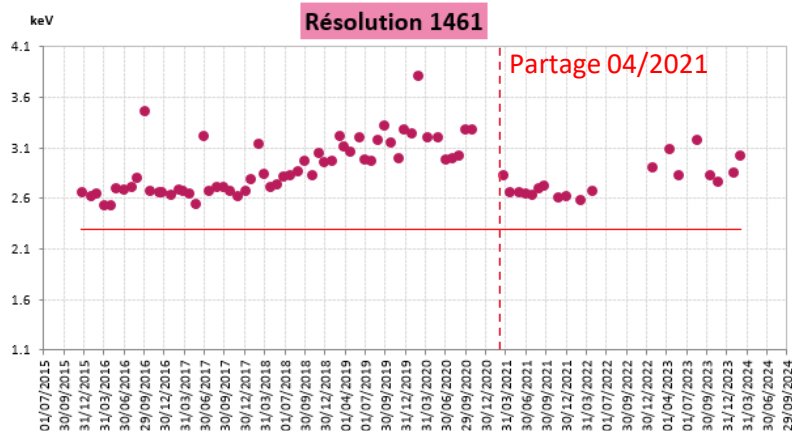


Resolution monitoring: XXL and LYS

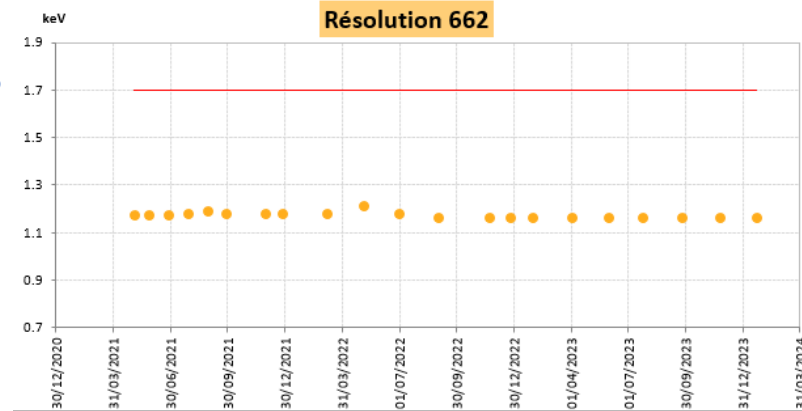
XXL



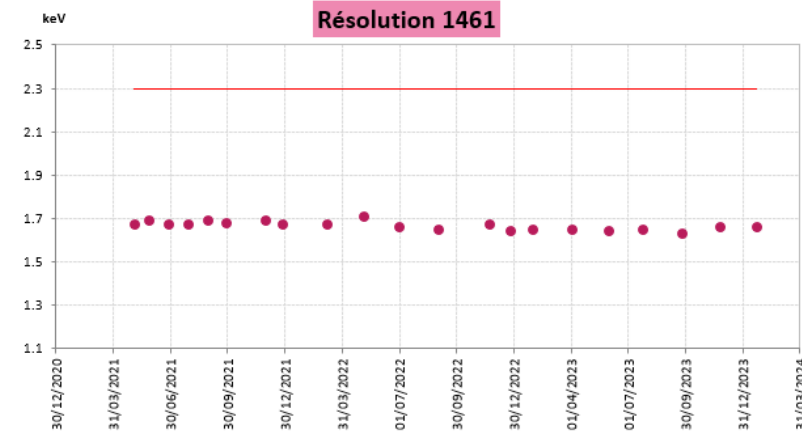
XXL



LYS



LYS



Standard sources

Detector calibration

- **52E, XXL and PPT**: last calibrations 10 years ago or more
- **LYS**: installed since 2021, not calibrated yet

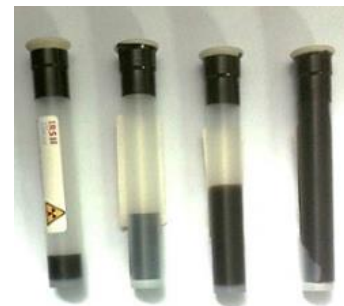


Quality control

- **Efficiency** and **resolution** monitoring (monthly)
- Reference materials (AIEA milk) – low activities (\Rightarrow long counting times)
 - 662 keV (^{137}Cs), 1460 keV (^{40}K) (\Rightarrow no low energy value)

Fabrication of **sealed multi-gamma standard sources** (Orano/LEA)

- ^{51}Cr , ^{54}Mn , ^{57}Co , ^{60}Co , ^{65}Zn , ^{85}Sr , ^{88}Y , ^{109}Cd , ^{113}Sn , ^{137}Cs , ^{139}Ce , ^{241}Am
- **Low activities**: < exemption level
- **June 2024: 17 mL and 60 mL**
 - 52E and LYS **calibration**: as soon as possible in **June**
 - **quality controls**: **storage at Modane**
- Later: other geometries



Organisation

Traceability issues

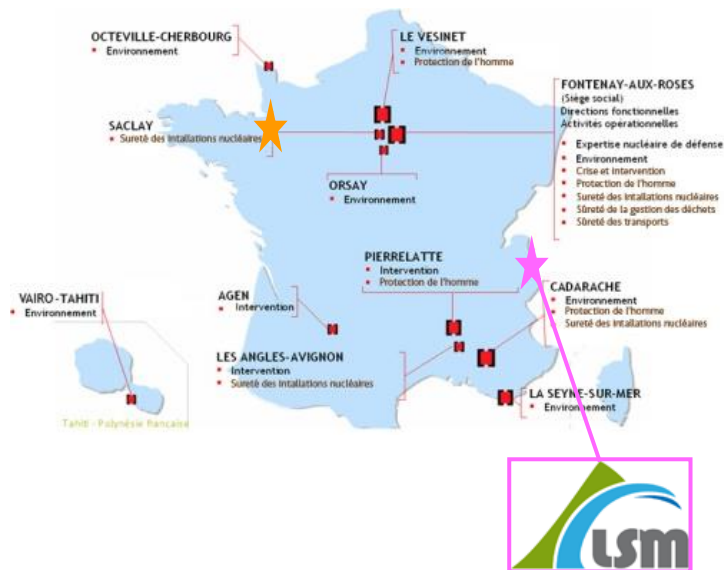
- Association between sample number – spectrum
- Counting times shorter than planned
- Spectra recorded in the wrong directory or not recorded

Communication

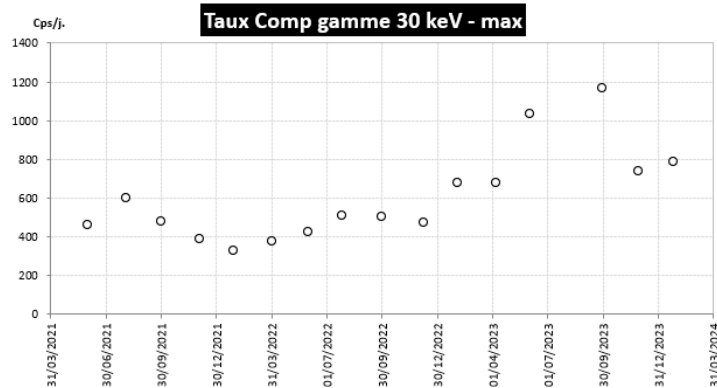
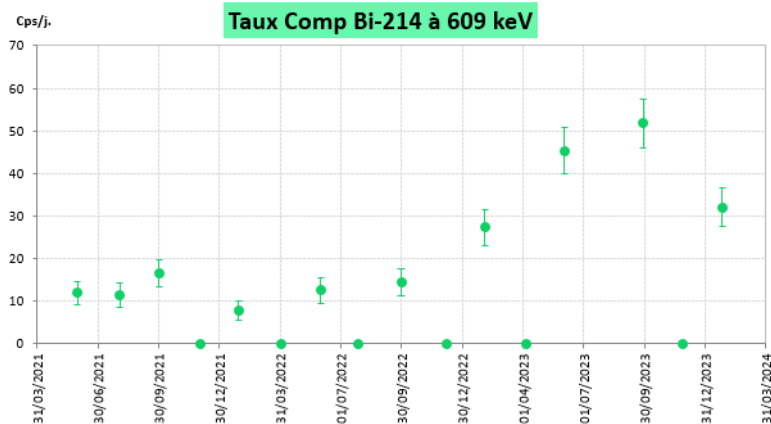
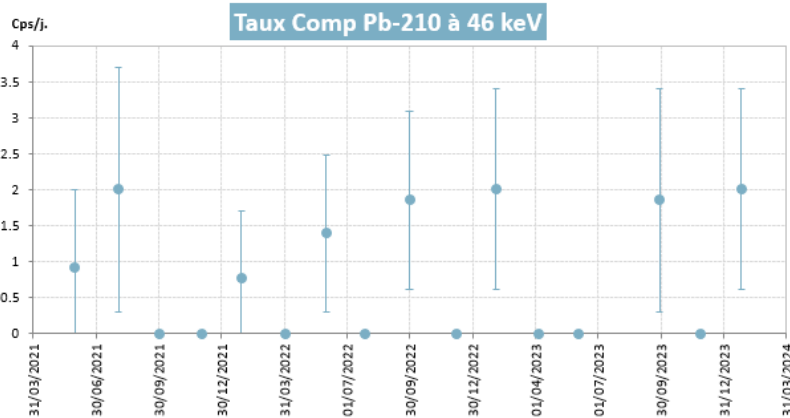
- Notification of any changes / problems
- Possibility to have a single contact person?

Thanks to LSM staff for their
technical support.

Thanks for your attention.



Background monitoring: LYS



Background monitoring: 46.5 keV (^{210}Pb)

