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Regione Toscana



CAEN SyS
Systems and Spectroscopy Solutions

ENEA
Agenzia nazionale per le nuove tecnologie,
l'energia e lo sviluppo economico sostenibile



A. Serafini, D. Abbado, M. Alberi, P. Carconi, E. Chiarelli, P. De Felice, A. Deserventi, M. Donati, E. Fanchini, L. Fanucci, A. Fazio, F. Giordano, P. Grignani, G. Guiducci, A. Iovene, L. Luciani, G. Manessi, F. Mantovani, M. Marini, A. Masuelli, S. Mohsen, M. Morichi, G. Merlini, A. Pepperosa, K. G. C. Raptis, F. Rogo, V. Strati, G. Tona

08 May 2020 – EGU General Assembly 2020

CORSAIR

Making radioactivity measurements on
building materials accessible to everyone



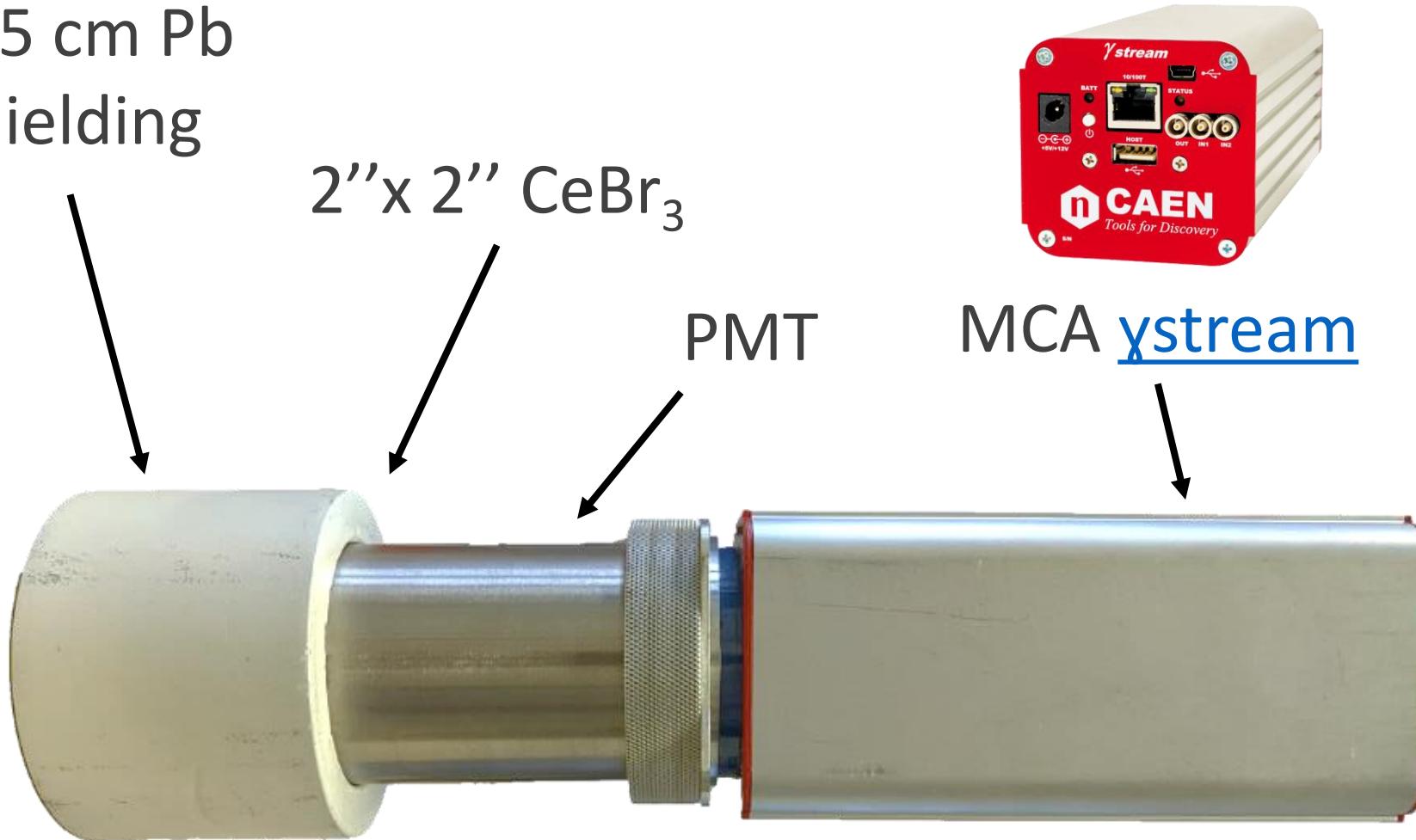
Our detector: a full γ -spectroscopic laboratory packed in 4 kg

1.25 cm Pb
shielding

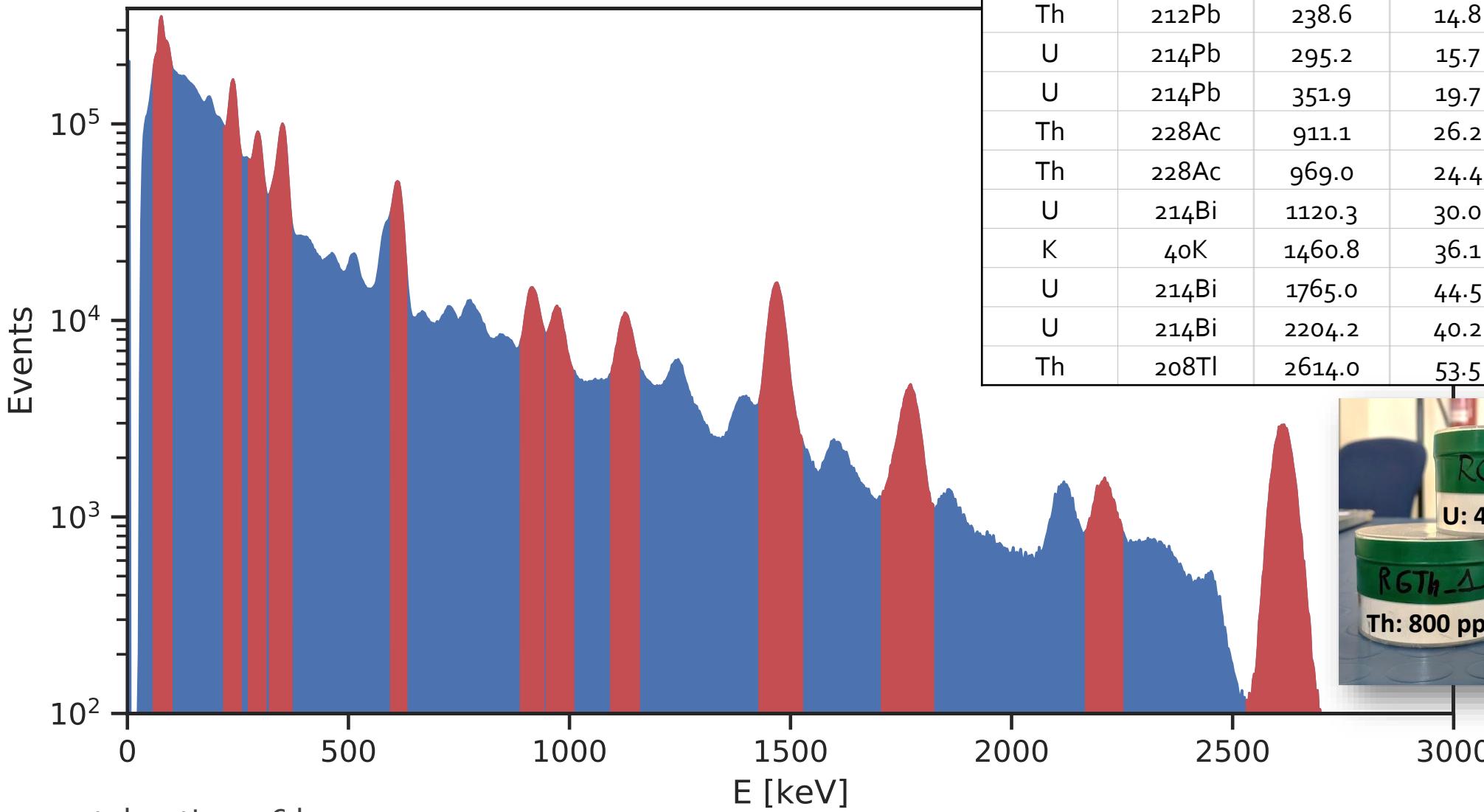
2" x 2" CeBr₃

PMT

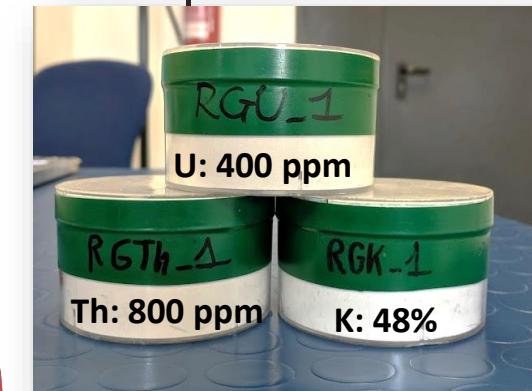
MCA ystream



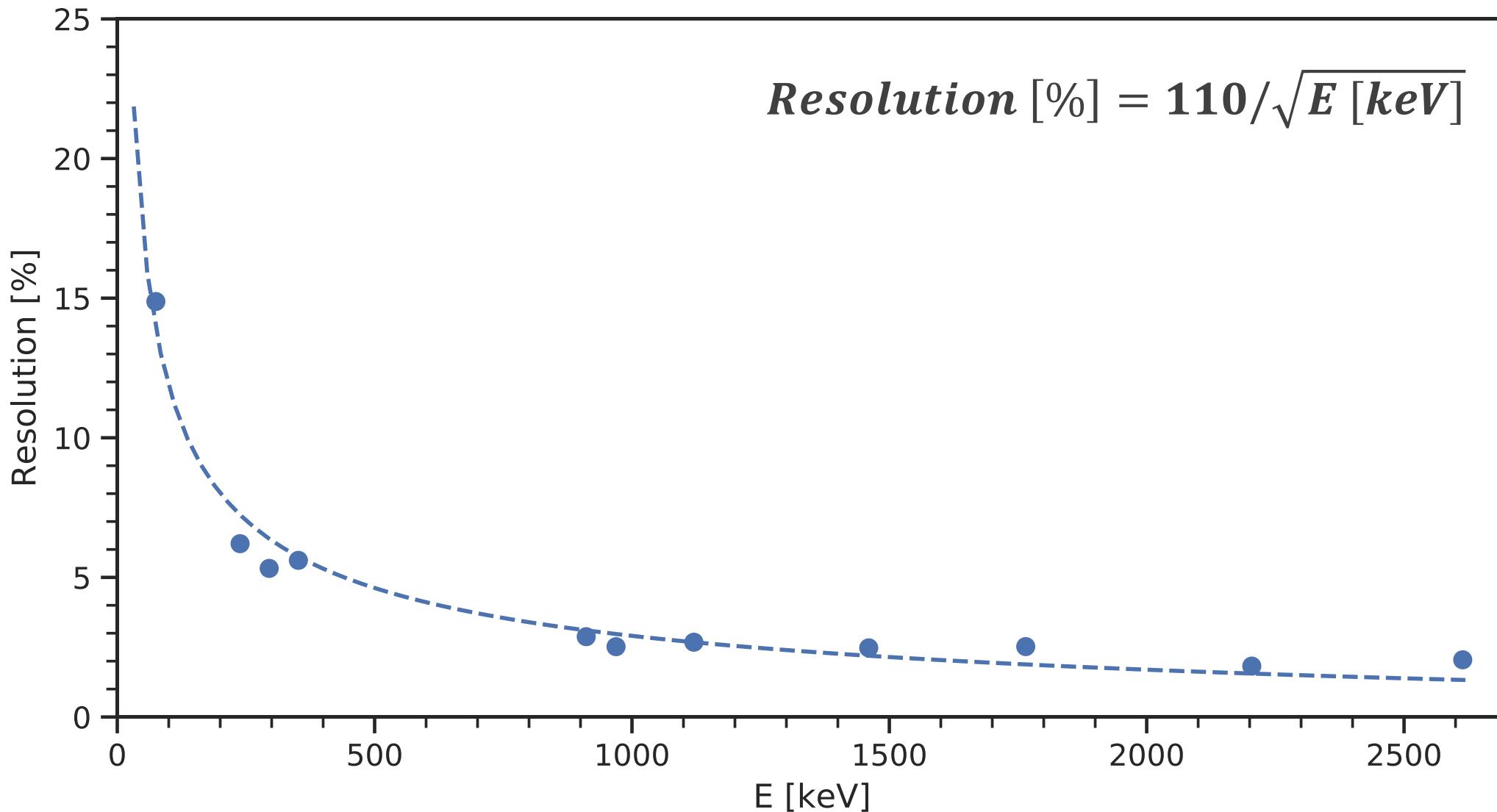
Characterization of the detector resolution



Element		Energy [keV]	FWHM [keV]	Resolution [%]
Pb	KX-ray	75.0	11.2	14.9
Th	^{212}Pb	238.6	14.8	6.2
U	^{214}Pb	295.2	15.7	5.3
U	^{214}Pb	351.9	19.7	5.6
Th	^{228}Ac	911.1	26.2	2.9
Th	^{228}Ac	969.0	24.4	2.5
U	^{214}Bi	1120.3	30.0	2.7
K	^{40}K	1460.8	36.1	2.5
U	^{214}Bi	1765.0	44.5	2.5
U	^{214}Bi	2204.2	40.2	1.8
Th	^{208}Tl	2614.0	53.5	2.0



Characterization of the detector resolution

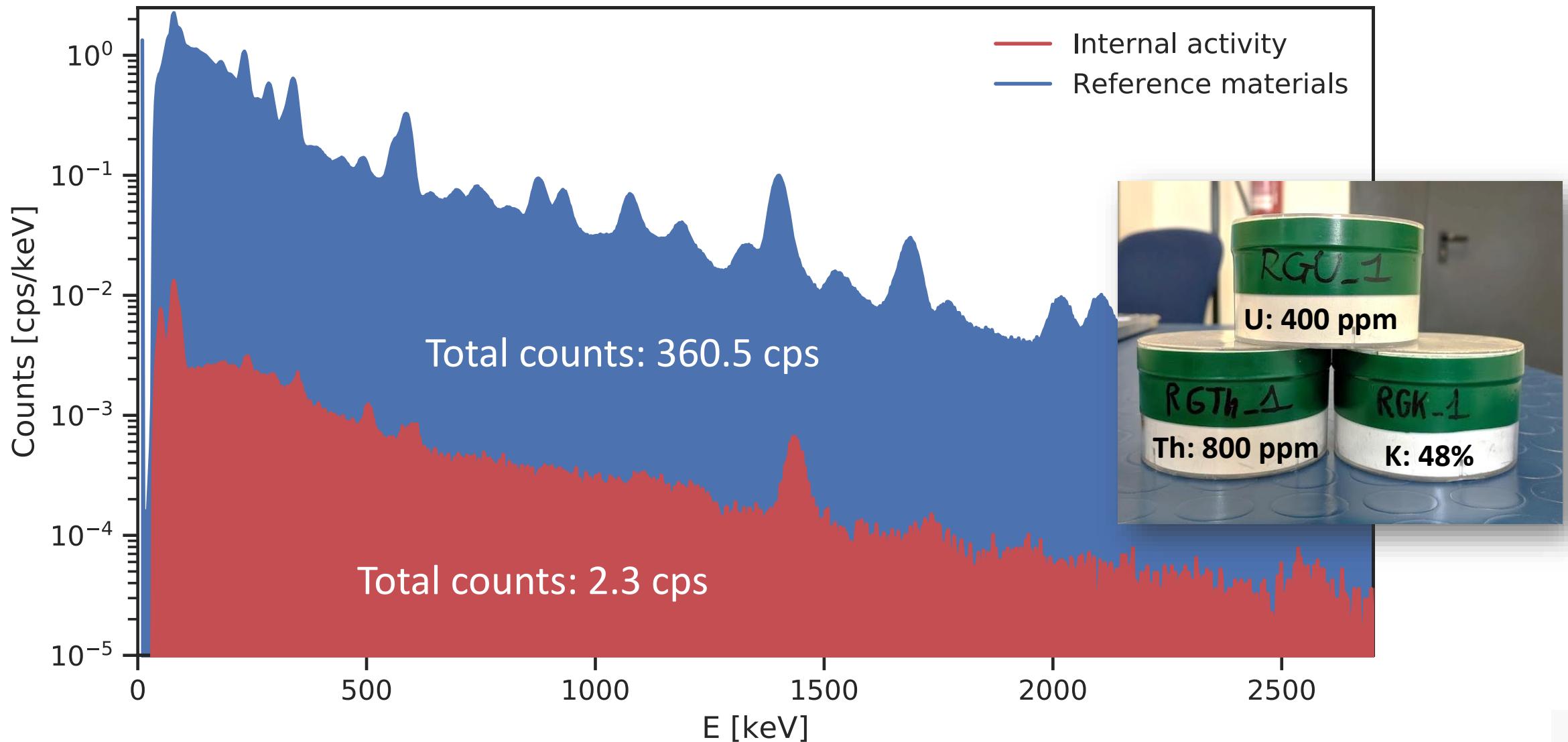


Characterization of the internal activity

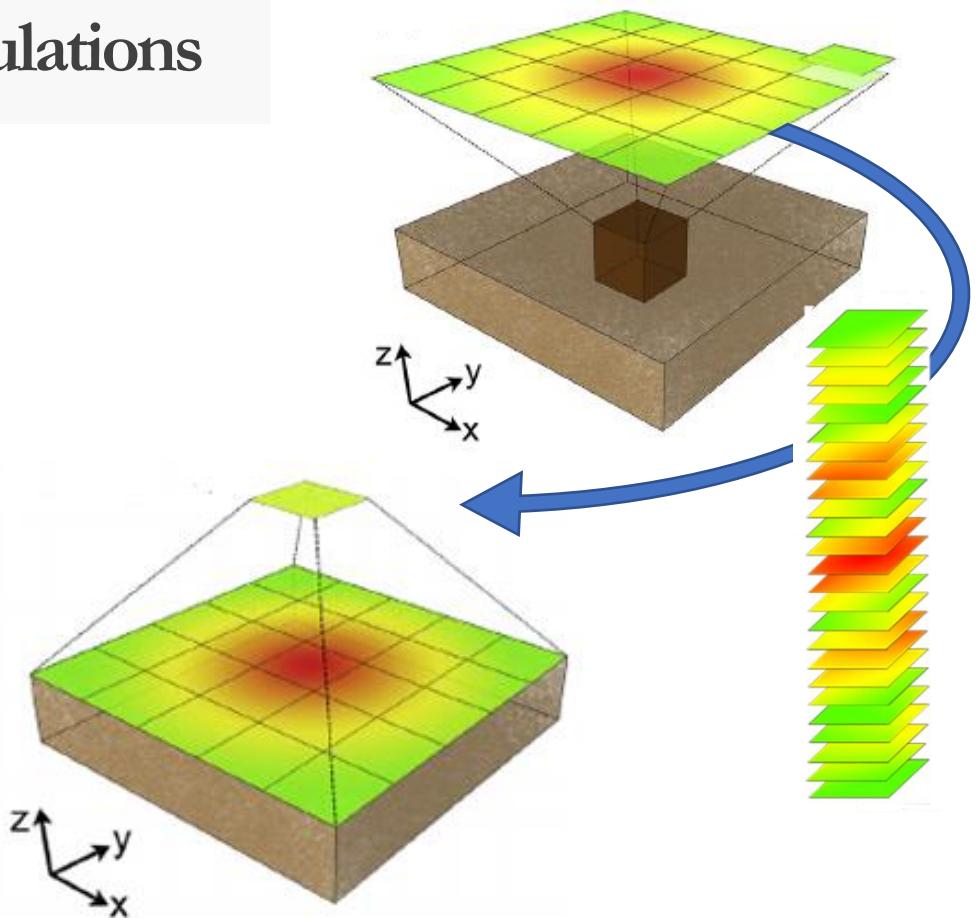
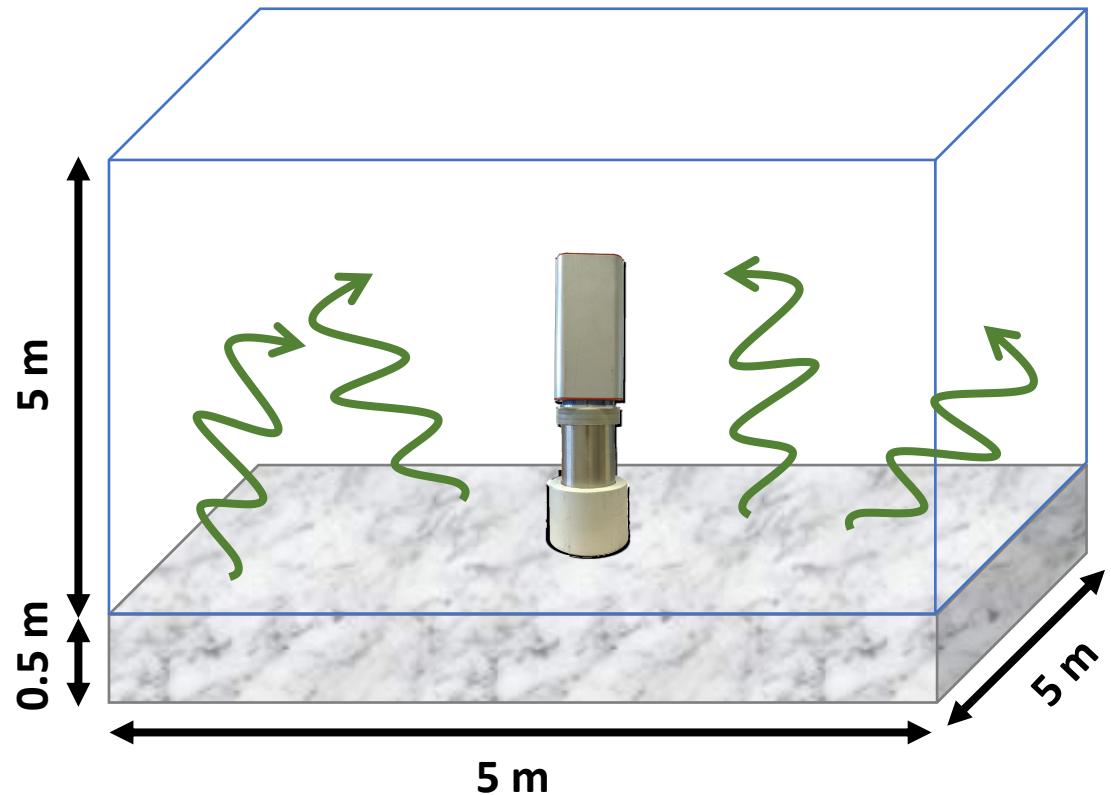
- » Initial 10 min measurement with reference materials used for energy calibration.
- » 32 h measurement with detector shielded by > 10 cm of lead on each side.
- » Final 10 min measurement with reference materials for confirming initial energy calibration.



Characterization of the internal activity



Shielding characterization via Monte Carlo simulations

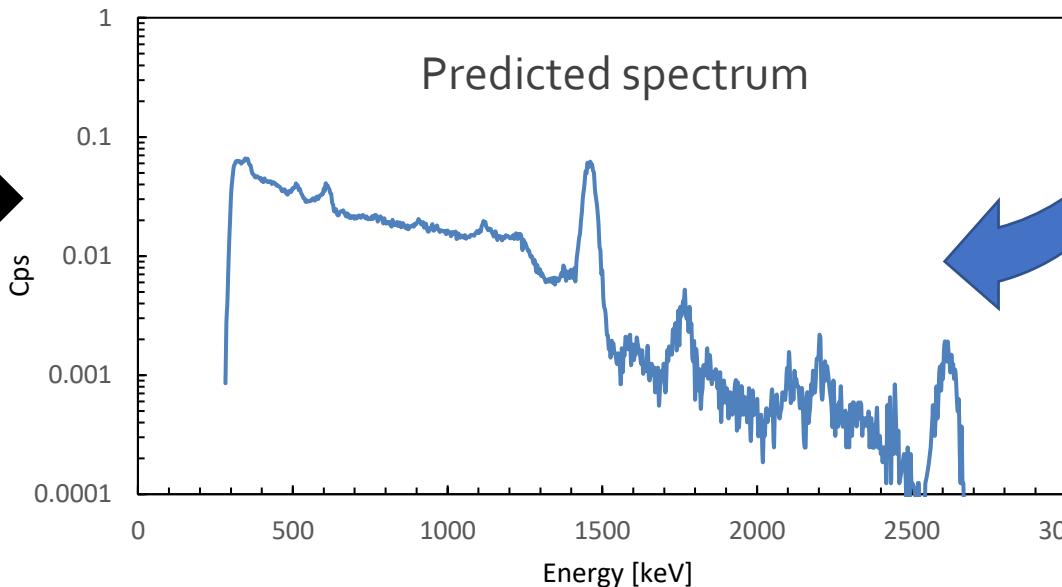
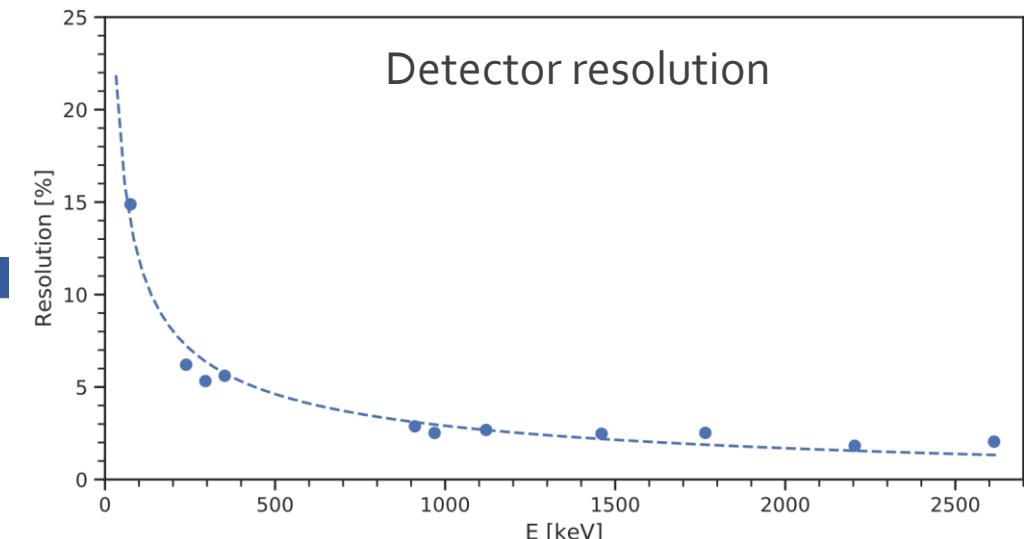
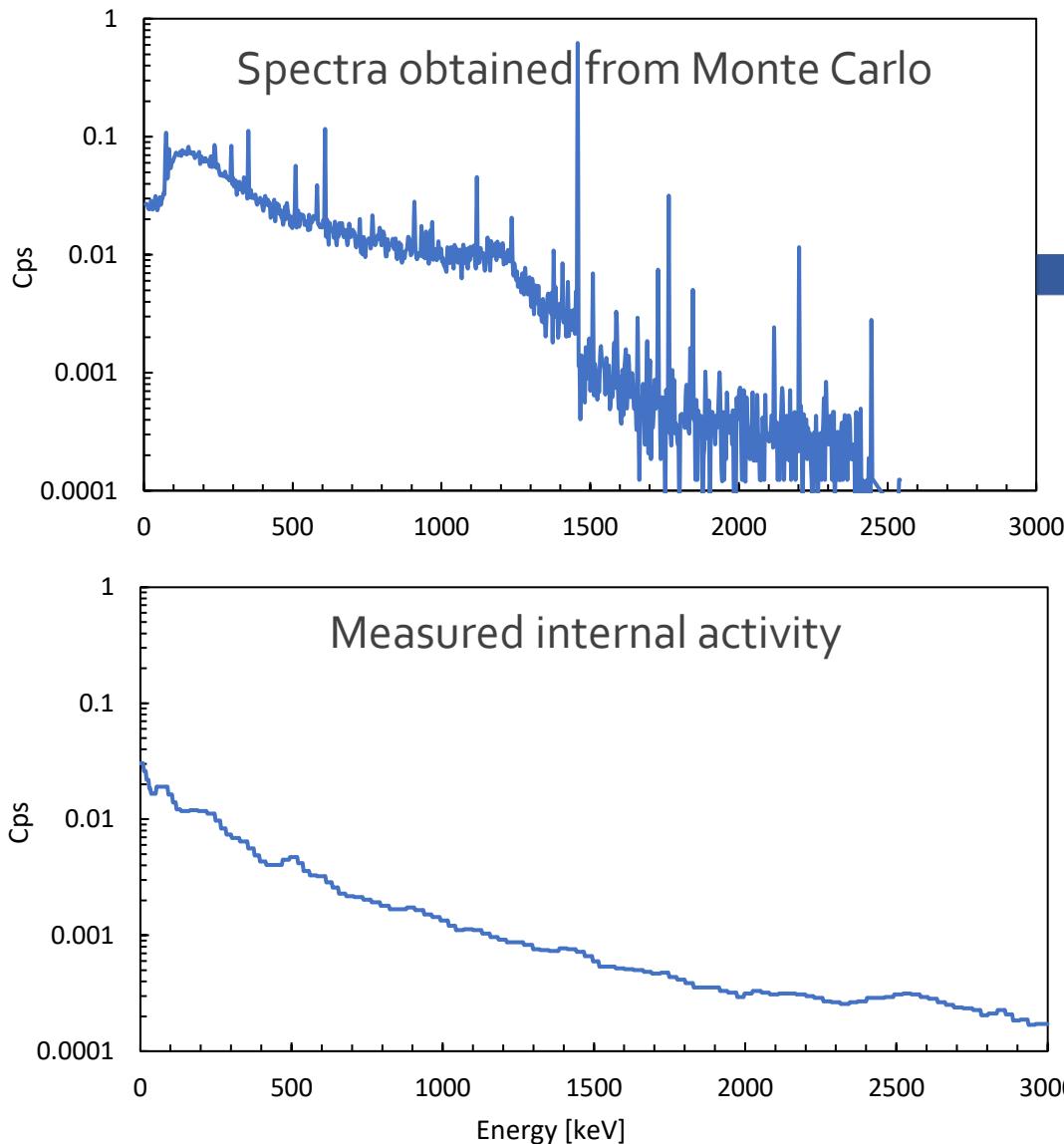


Investigating the potentialities of Monte Carlo simulation for assessing
soil water content via proximal gamma-ray spectroscopy

Baldoncini, M., M. Albéri, C. Bottardi, E. Chiarelli, K. G. C. Raptis, V. Strati, and F. Mantovani

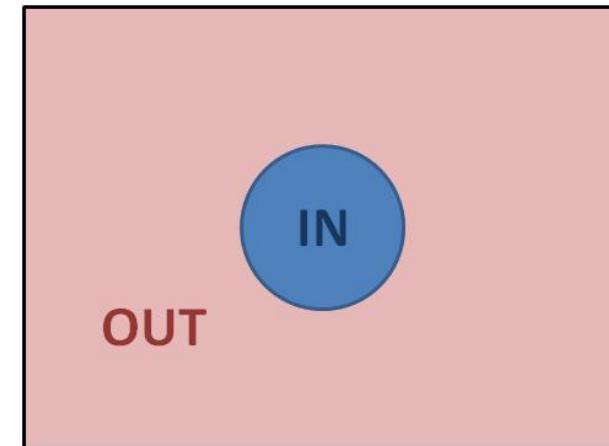
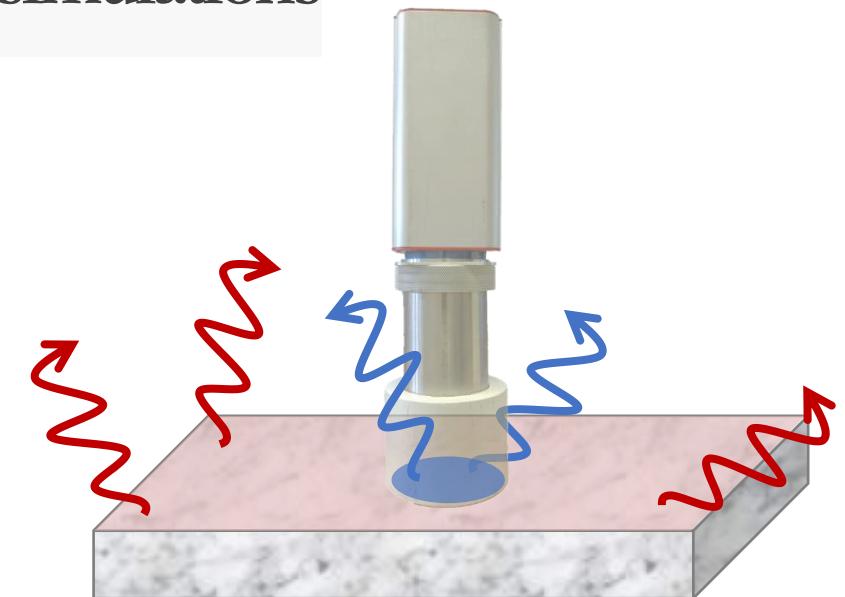
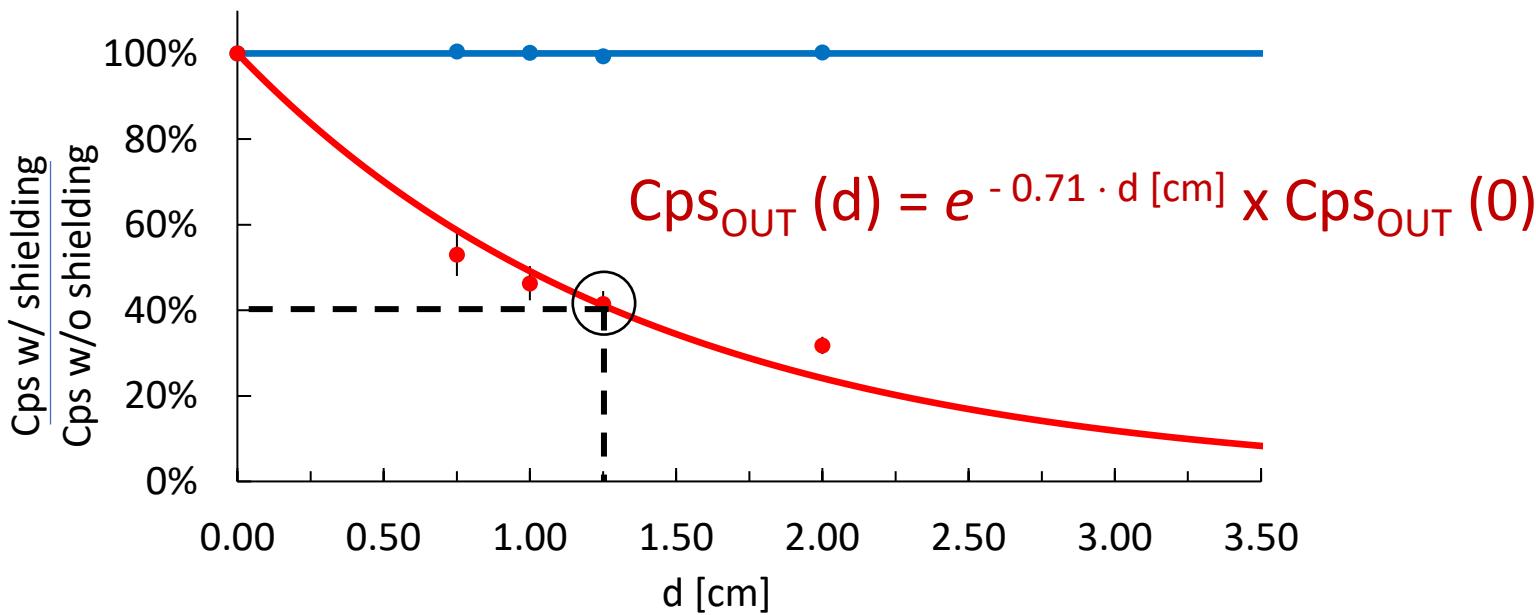
Journal of Environmental Radioactivity, 192, 105-116 (2018)

From Monte Carlo simulations to reality

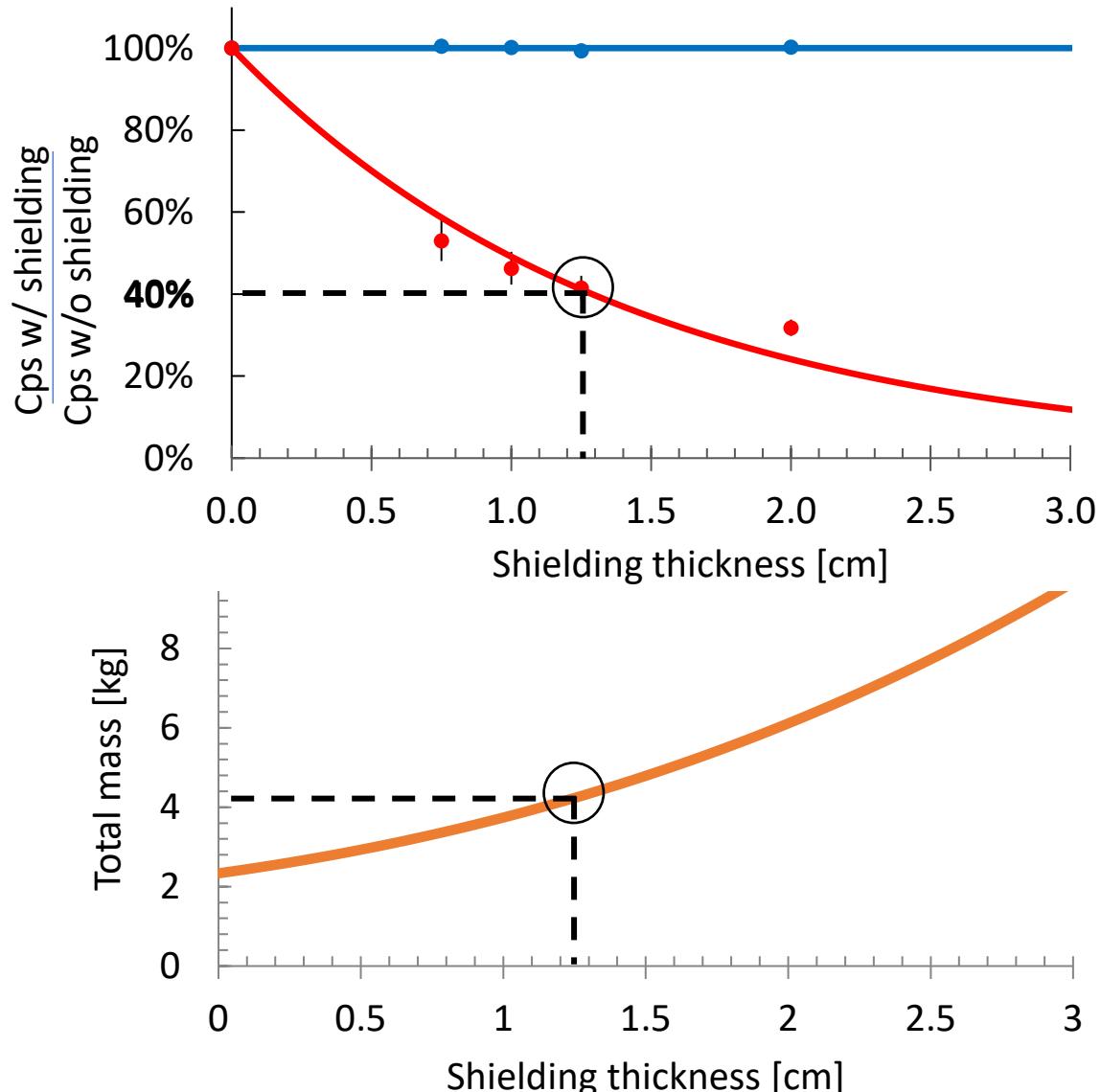


Understanding the shielding effect via Monte Carlo simulations

Shielding thickness d	Total counts between 0.3 MeV and 3.0 MeV		
	IN [cps]	OUT [cps]	TOT [cps]
0.00 cm	16	32	48
0.75 cm	16	17	33
1.00 cm	16	15	31
1.25 cm	16	13	29
2.00 cm	16	10	26



Optimizing shielding thickness for detector portability



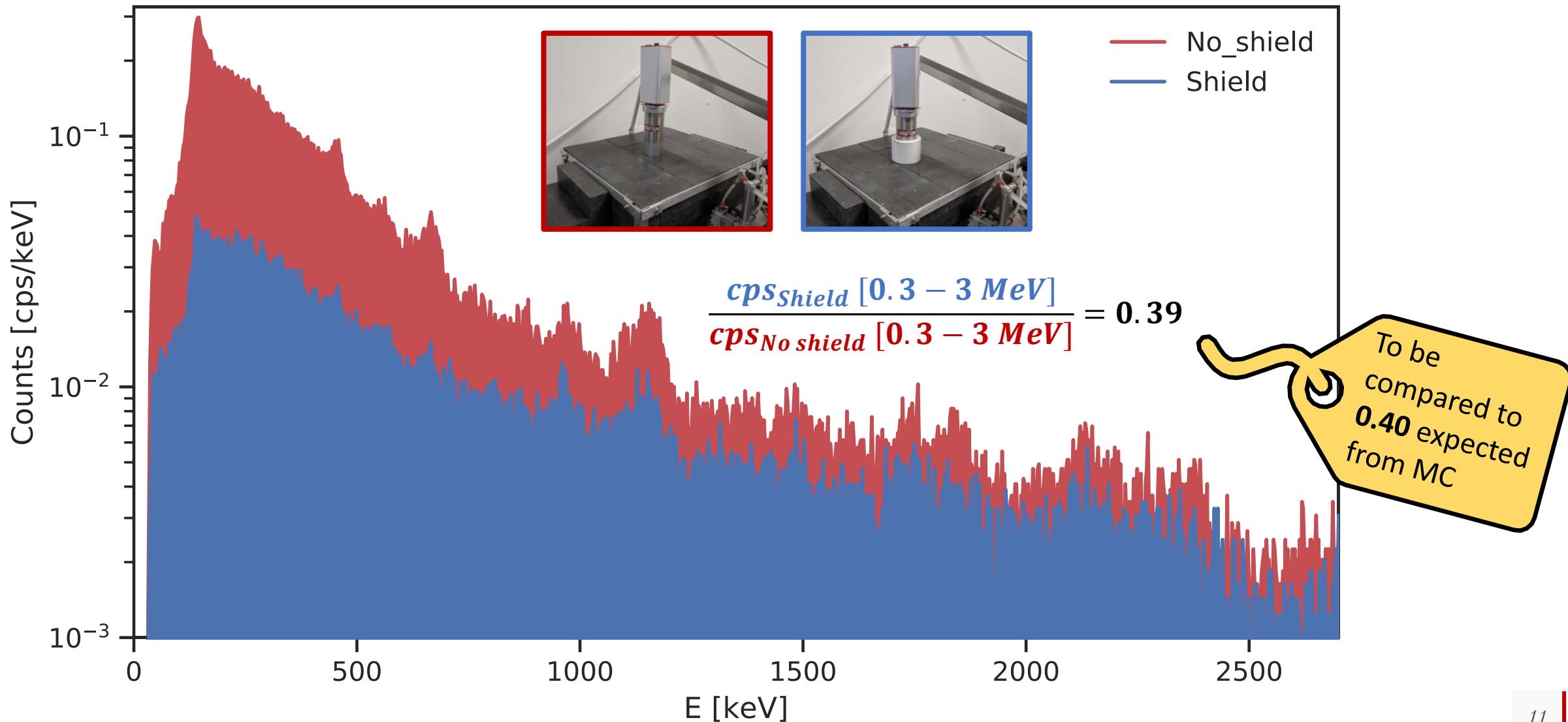
Shielded thickness has been chosen to be **1.25 cm**:

- » Expected to enable a **60% reduction of background signal** (gamma rays coming from the sides and the top of the detector);
- » Allows to maintain the detector lightweight and portable with a total mass of **4.2 kg**.



Components	Mass
$2'' \times 2'' \text{ CeBr}_3$ crystal	0.53 kg
PMT	1.05 kg
1.25 cm Pb shielding	1.90 kg
MCA γ stream	0.70 kg
Total mass	4.18 kg

Experimental validation of Monte Carlo simulation



CORSAIR system measuring stone materials at quarries

