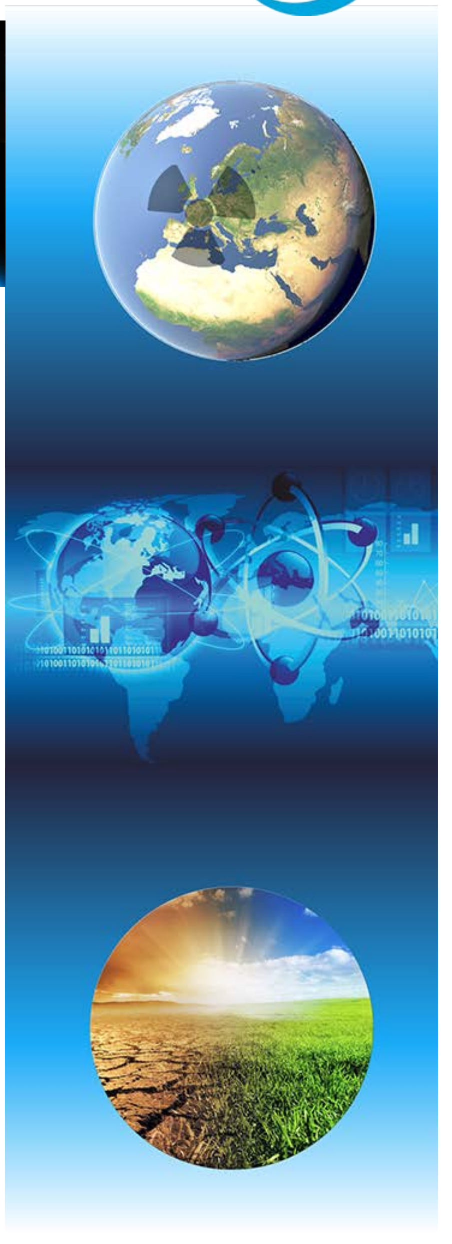
The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States



Calibration of novel transfer standards with new ^{222}Rn emanation sources

EMPIR 19ENV01 traceRadon

This project 19ENV01 traceRadon has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.
***19ENV01 traceRadon** denotes the EMPIR project reference.*

T.J. Ballé, S. Röttger, F. Mertes, P. P. S. Otáhal, P. Kovar, A. Röttger ICRM 2023

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

Introduction

The traceRadon project

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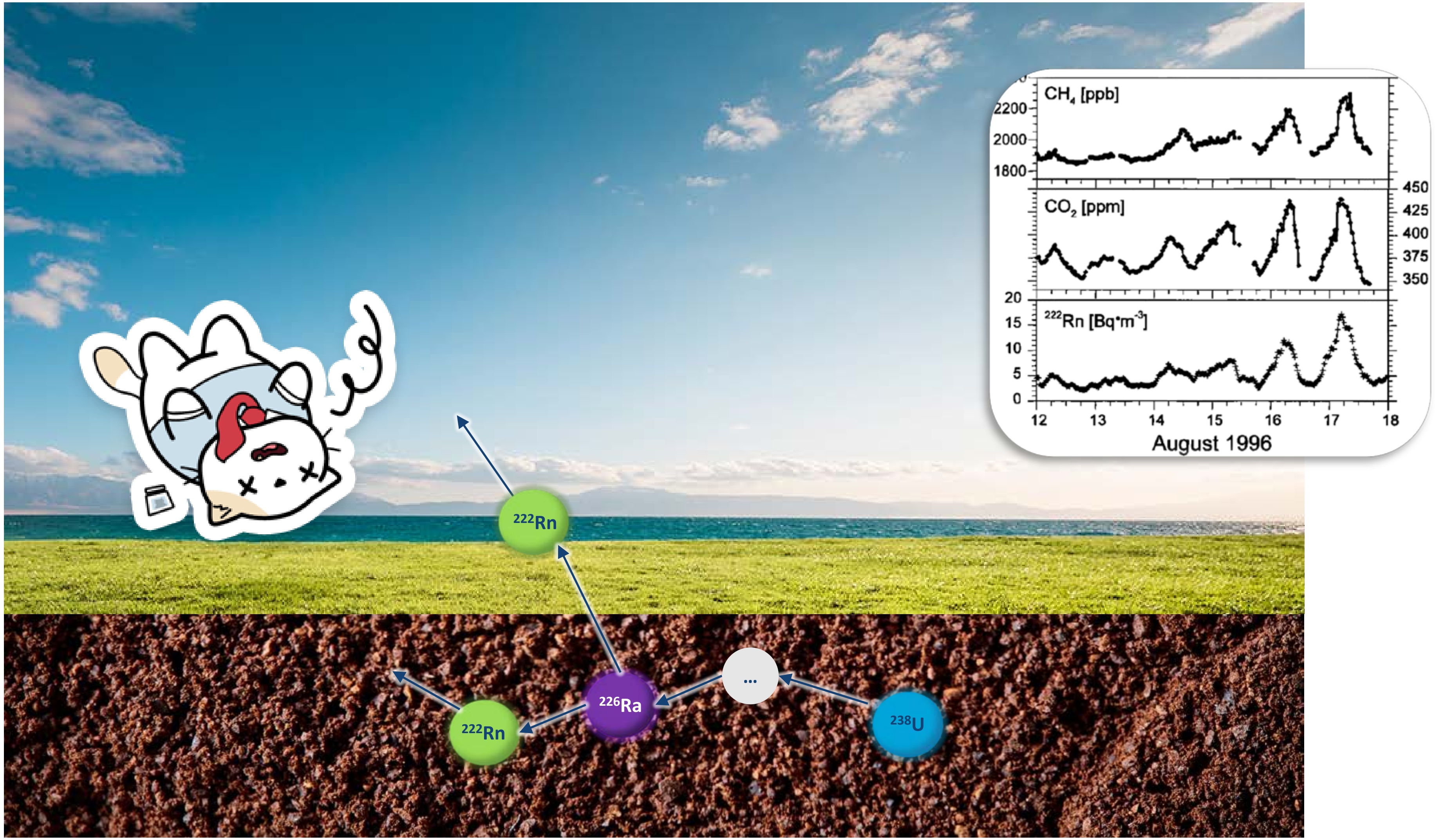
Radon (^{222}Rn)



Journal of Geophysical Research: Atmospheres **104** (1999) 1998JD100064

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Physikalisch-Technische Bundesanstalt
National Metrology Institute

The traceRadon project

Provide traceability to the SI system in the range of 1 Bq/m^3 – 100 Bq/m^3

☺ Measurement range

☹ Traceability to the SI system

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EMPIR
EURAMET
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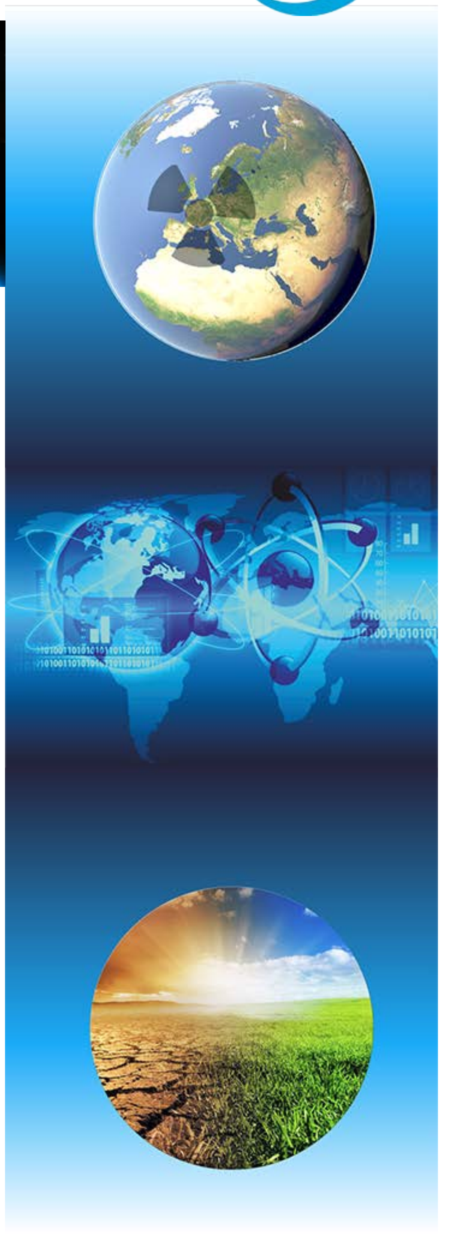
traceRadon

EURAMET



Transfer Standards and calibration source

ARMON, ANSTO and IRSD

PTB Physikalisch-Technische Bundesanstalt Braunschweig und Berlin
Budapest Főváros Kormányhivatala
CMI Czech Metrology Institute
ENEA Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile
IFIN-HH
NPL National Physical Laboratory
AGES
ICOS Atmosphere Thematic Centre
ICOS Carbon Portal
INESCTEC
European Commission Joint Research Centre
University of Bristol
UC Universidad de Cantabria
UPC
ideas

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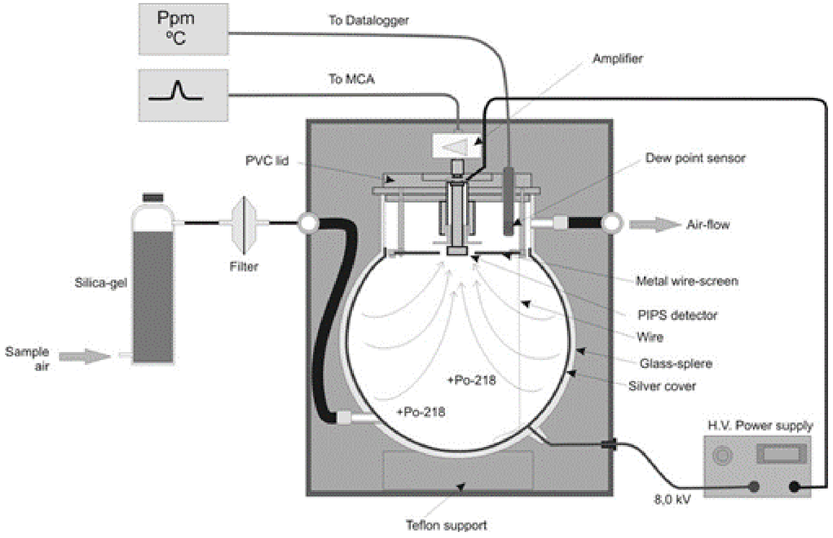
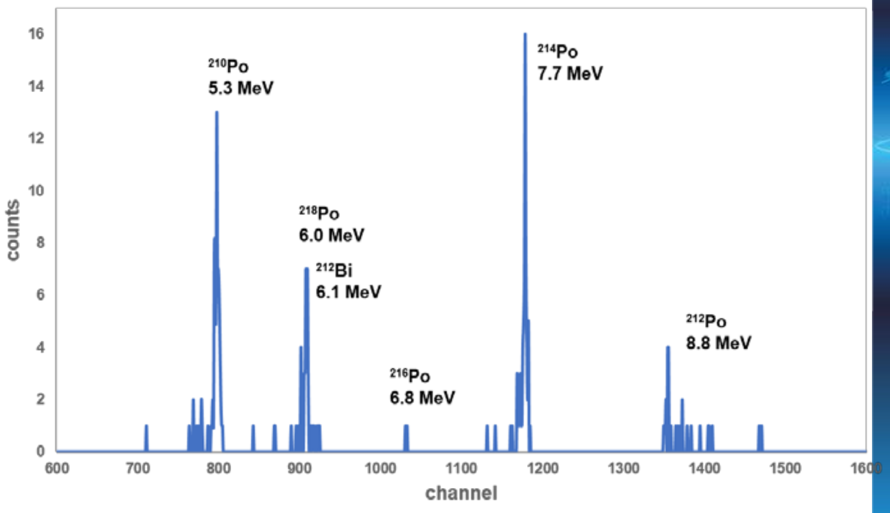
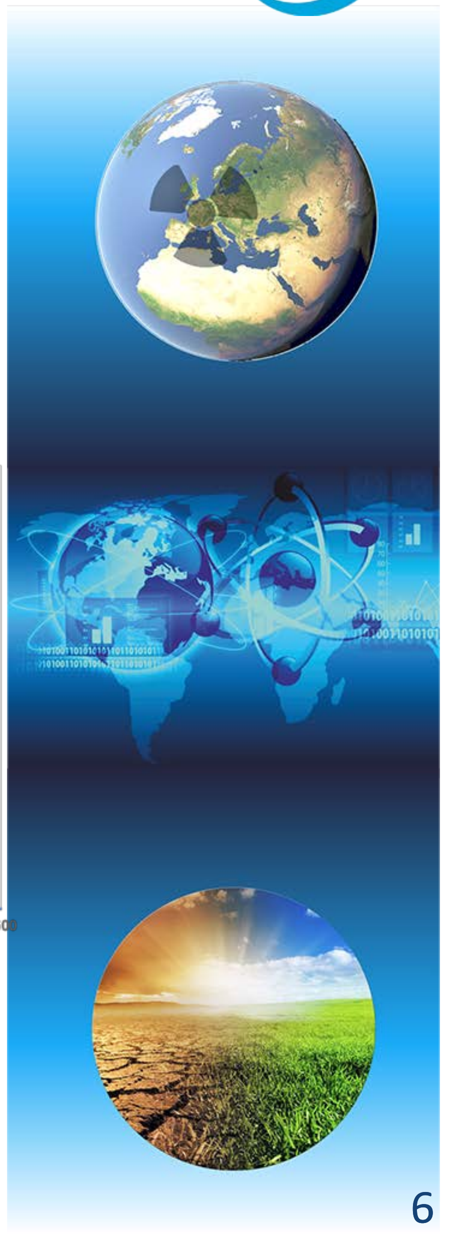
The Atmospheric Radon MONitor (ARMON)

- Operation principle: Electrostatic collection of ^{218}Po and ^{216}Po from ^{222}Rn and ^{220}Rn respectively on an alpha detector
- Designed, built and calibrated at the INTE-UPC (radon chamber)







ARMON v1.0 Grossi et al. (2012) Vargas et al. (2025)

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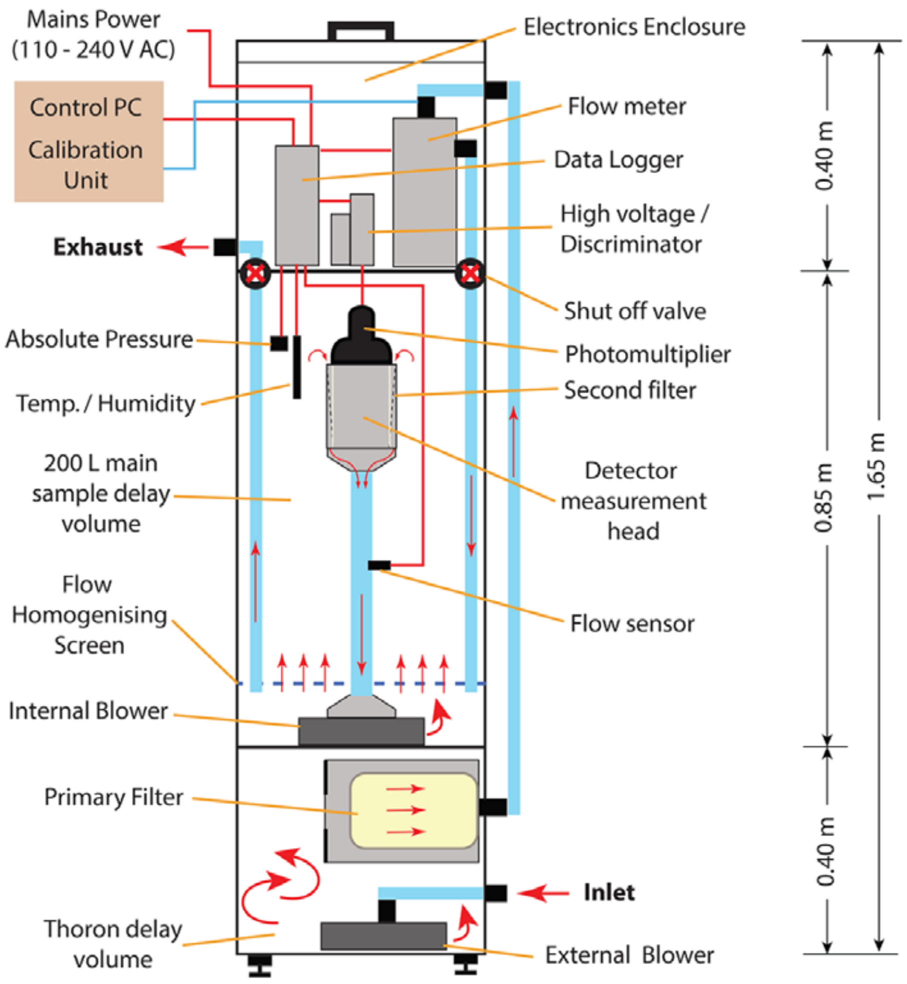
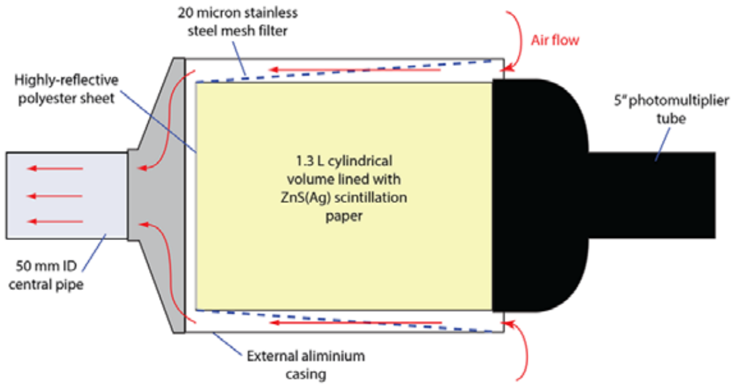
Australian Nuclear Science and Technology Organization (ANSTO)





*Advances in Geosciences **57** (2022) 63 - 80*

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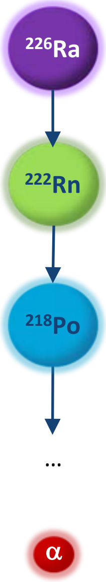
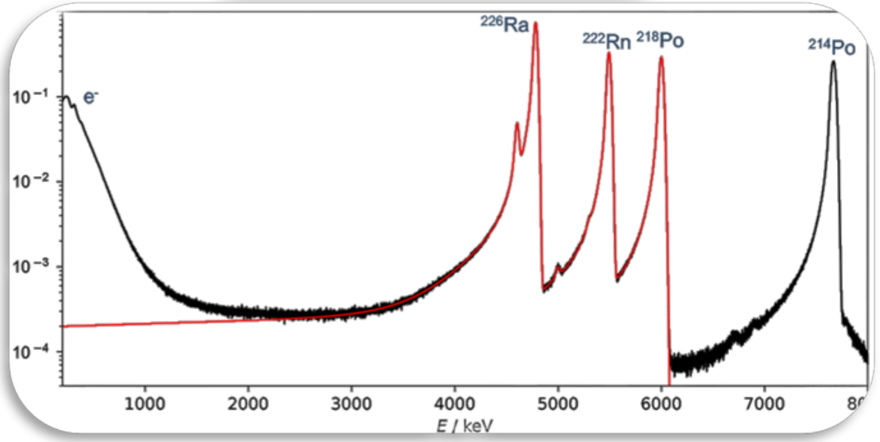
Integrated Radon Source Detector system (IRSD)

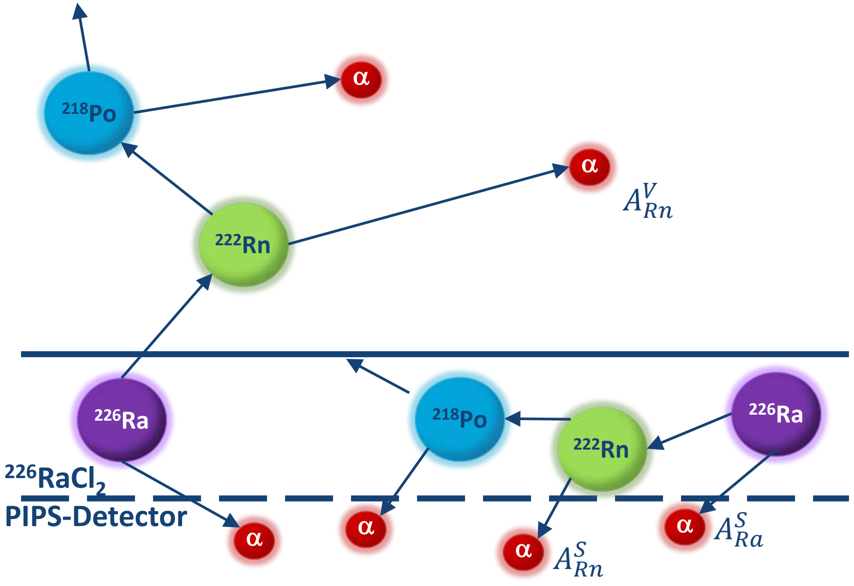




$$A_{Ra}^{S} = A_{Rn}^{S} + A_{Rn}^{V}$$

Change of A_{Rn}^{S} :

$$\frac{dA_{Rn}^{S}}{dt} = \lambda_{Rn}A_{Ra}^{S} - \lambda_{Rn}A_{Rn}^{S} - \lambda_{Rn}\eta(t)$$



Meas. Sci. Technol. ***32*** *(2021) 124008*

Further details: Int. J. Environ. Res. Public Health ***19*** *(2022) 840*

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Summary

- Goal: Improve ^{222}Rn activity concentration measurements in the range 1 – 100 Bq/m³
- Method: Develop new calibration standards
- Result: New transfer standards and new primary standards



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Further information on traceRadon

FRIDAY 31 March 2023

9:00	**Low Level Radioactivity Measurement Techniques (LL) – Chairs: B. Quintana Arnés**	
9:00	**Paul Malfrait,** IRSN, France Online analysis of gamma-ray spectrum by spectral unmixing	O-89
9:20	**Begoña Quintana,** Univ. of Salamanca, Spain Low-level activity determination of ^{14}C from marine shells by the CIEMAT/NIST method	O-108
9:40	**Iolanda Osvath,** IAEA, Marine Env. Laboratories, Monaco Improvements in the detection capability for monitoring low levels of radionuclides in atmospheric aerosols at IAEA Marine Environment Laboratories in Monaco	O-106
10:00	**Posters Overview: LL – Chairs: B. Quintana Arnés**	
	Stefan Röttger, PTB, Germany Radon metrology for use in climate change observation and radiation protection at the environmental level	P-23
	Dirk Arnold, PTB, Germany Metrology for the harmonisation of measurements of environmental pollutants in Europe	P-25
	Mirela Vasile, SCK CEN, Belgium A comparison of different approaches for the analysis of ^{36}Cl in graphite samples	P-45
	Ivelina Dimitrova, Sofia Univ., Bulgaria Estimation of Correction Factors for RadonEye Continuous Radon Monitors	P-73
	Tomislav Ilievski, RBI, Croatia Upgrade of HPGe spectrometry system for low level activity determination with cosmic veto	P-85
	Charles Philippe Mano, CEA, France Algorithms development for low level radioxenon spectrum analysis	P-104
10:10	**Best Poster Award – Chair: Brian Zimmerman**	
10:25	Coffee Break	
11:00	**WG Meeting: Low Level Radioactivity Measurement Techniques (80 min.)**	
12:20	**Closing the ICRM 2023 – Chairs: Brian Zimmerman, Aurelian Luca**	
12:30	Lunch	
14:00	**The General Meeting of ICRM (ICRM GM): Part 1**	
16:00	Coffee Break	
16:20	**ICRM GM: Part 2 & Meeting Close**	
17:00	Break	
17:30	**ICRM Executive Board Meeting**	
19:30		

Poster

Oral

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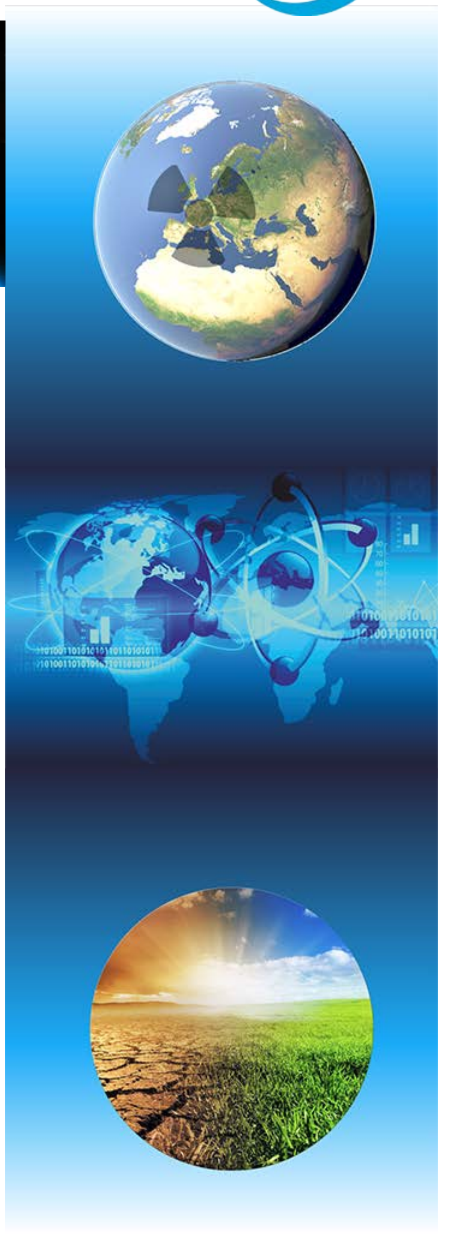

Thank you for your attention!

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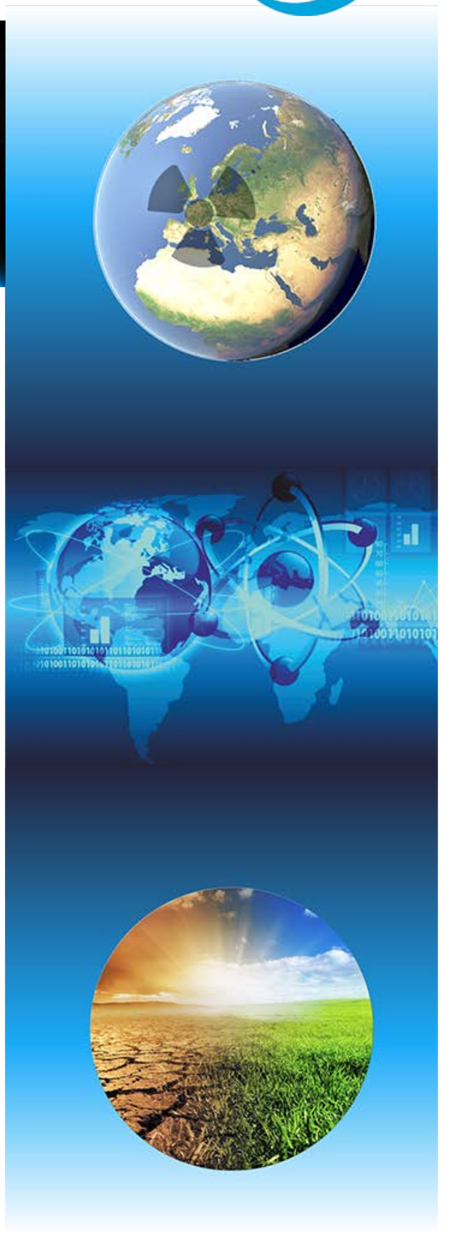
- traceRadon-project stakeholder committee, stakeholders, MSU, EURAMET

Acknowledgements

- traceRadon-project collaborators:

- traceRadon-project partners:



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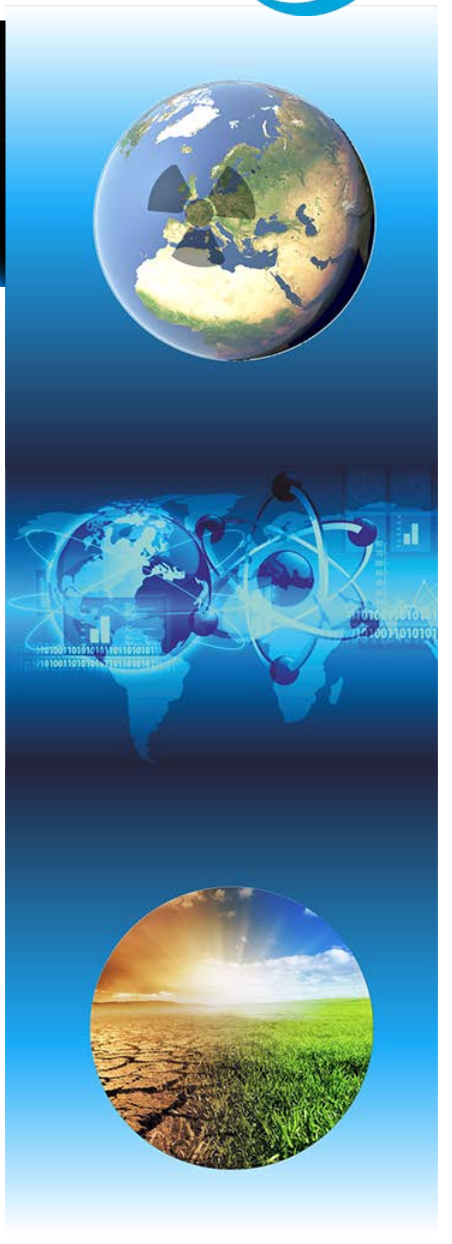

Backup

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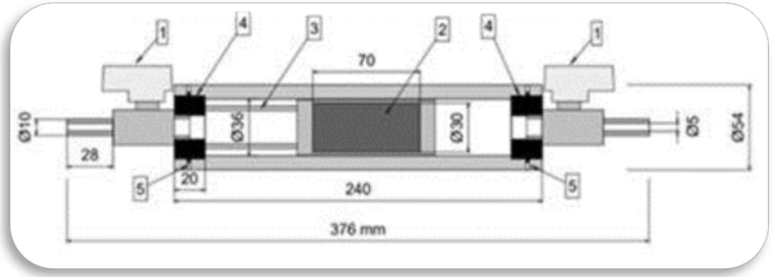
CMI-source



Int. J. Environ. Res. Public Health ***2020***, *17, 1904*

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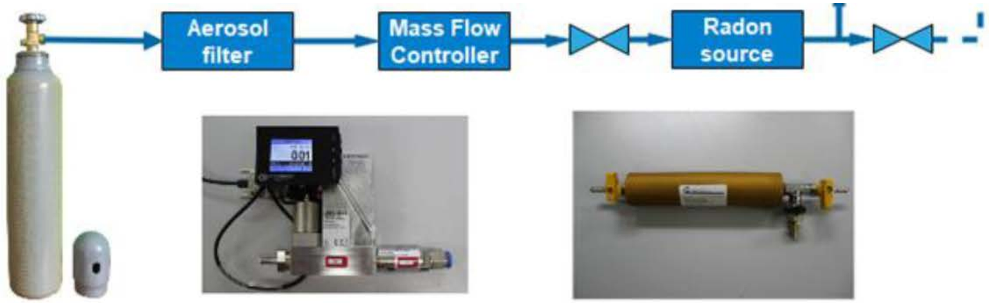
CMI-source

Steady state:

$$C = \frac{\eta_{Rn}}{Q \cdot \frac{M \cdot p_{cali} \cdot R \cdot T_{con}}{M \cdot p_{con} \cdot R \cdot T_{cali}} + \lambda_{Rn} \cdot V}$$

C: Radon activity concentration
η_{Rn}: Radon emanation power
Q: flow rate
M: molar mass
R: molar gas constant
p_{con}: air pressure
p_{Cali}: 1013.25 hPa
T_{con}: temperature
T_{cali}: 273.16 K
λ_{Rn}: Rn decay constant
V: Volume of the Rn chamber



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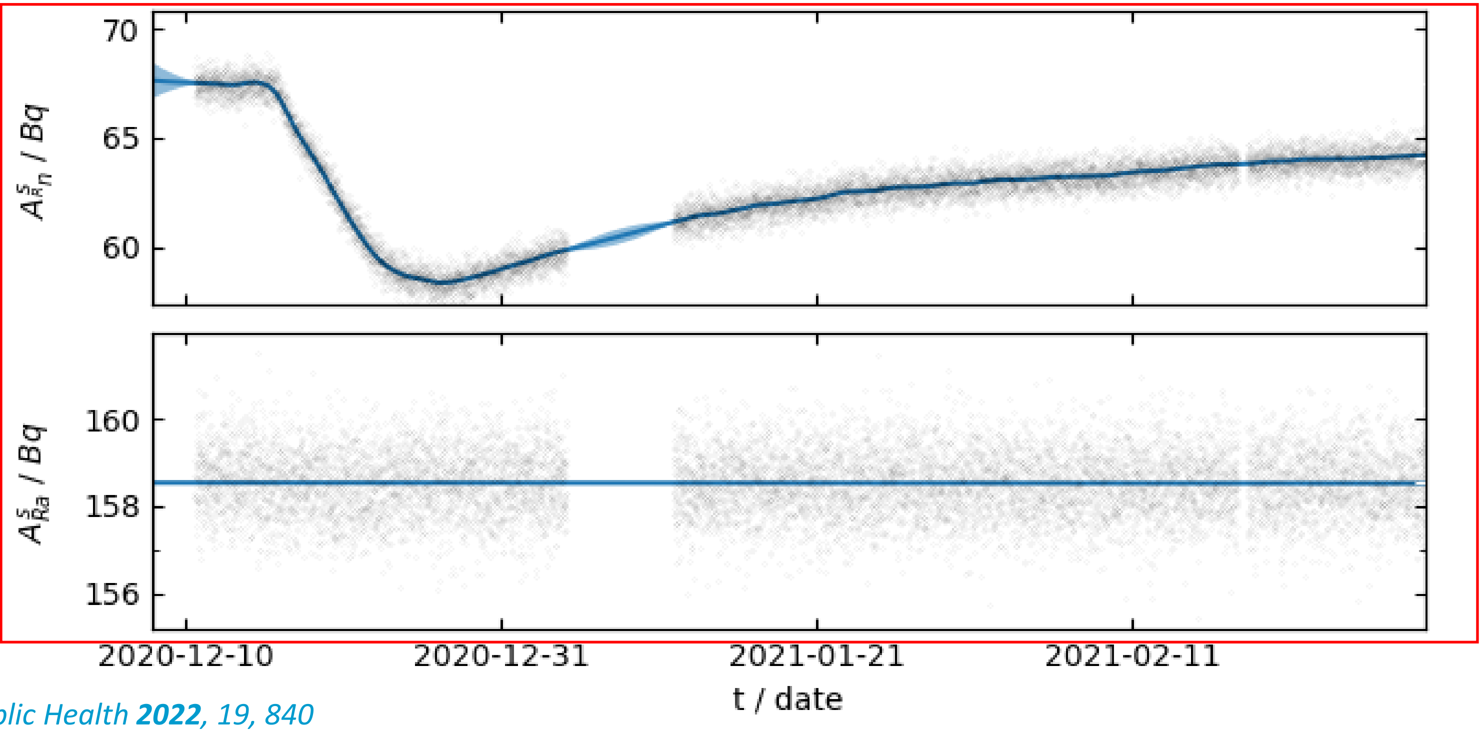
Integrated Radon Source Detector system (IRSD)

Blue: calculated

Gray: measured

Measured by IRSD



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Results

	CMI source		PTB IRSD system		
	k_{CMI}	C (Bq·m^{-3})	k_{IRSD}	C (Bq·m^{-3})	$k_{\mathrm{IRSD}}/k_{\mathrm{CMI}}$
RRI #1	1.056 ± 0.019	21547	1.019 ± 0.015	1925	0.965
RRI #2	1.022 ± 0.017	1605	0.981 ± 0.015	56.3	0.960

RRI: Radon Reference Instrument

*Int. J. Environ. Res. Public Health **2020**, 17, 1904, Meas. Sci. Technol. **32** (2021) 124008*

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