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UNIVERSITÀ DEGLI STUDI DELLA CAMPANIA
LUIGI VANVITELLI

SCUOLA POLITECNICA E DELLE SCIENZE DI BASE

DIPARTIMENTO DI MATEMATICA E FISICA

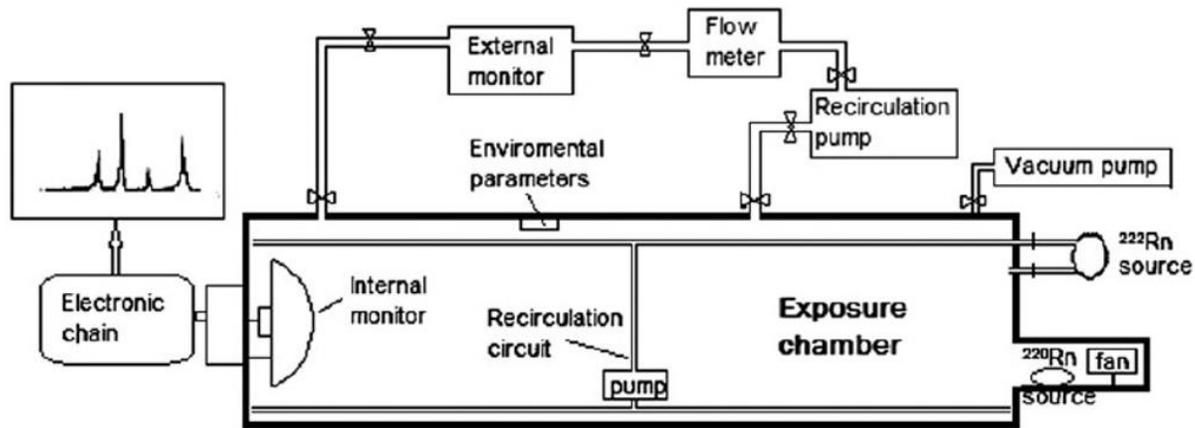
Radon-Thoron mixed atmosphere: realization, characterization, monitoring and use for detector calibration.

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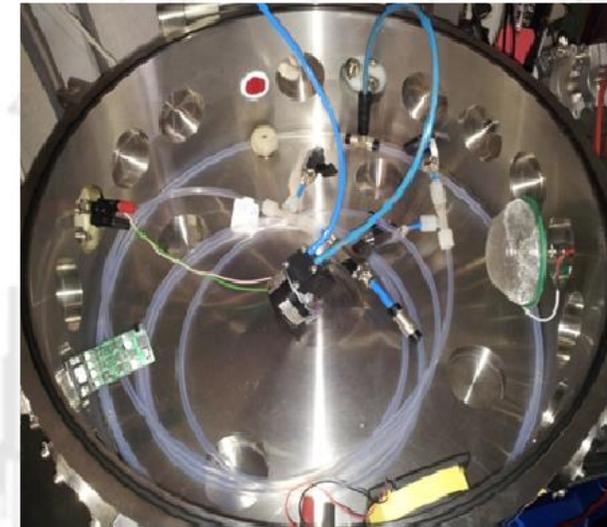
The second radon-in-field international intercomparison for passive measurement
devices: dwellings and workplaces.
21-22 September 2017

Radon/thoron exposure chamber



Chamber volume	32.7 ± 0.7 L
Total volume	34.5 ± 0.8 L
Activity range	8-560 Bq/L
Flux	0.9 lpm
^{222}Rn Homogeneity	>90%
^{220}Rn Homogeneity	> 80%

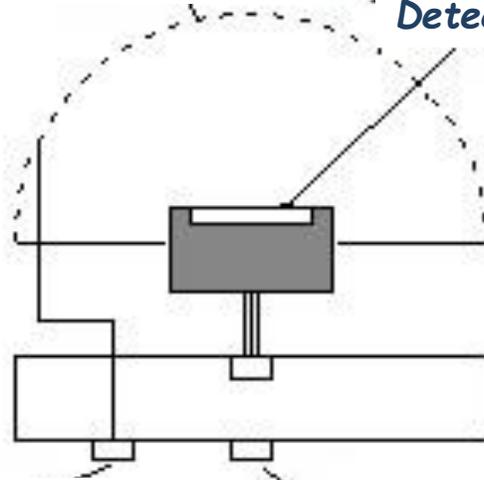
Layout of the radon/thoron exposure chamber. The chamber is actually able to generate and control the radon, thoron and radon + thoron atmospheres.



Electrostatic collection - internal monitor

Metallic Grid

Silicon Detector

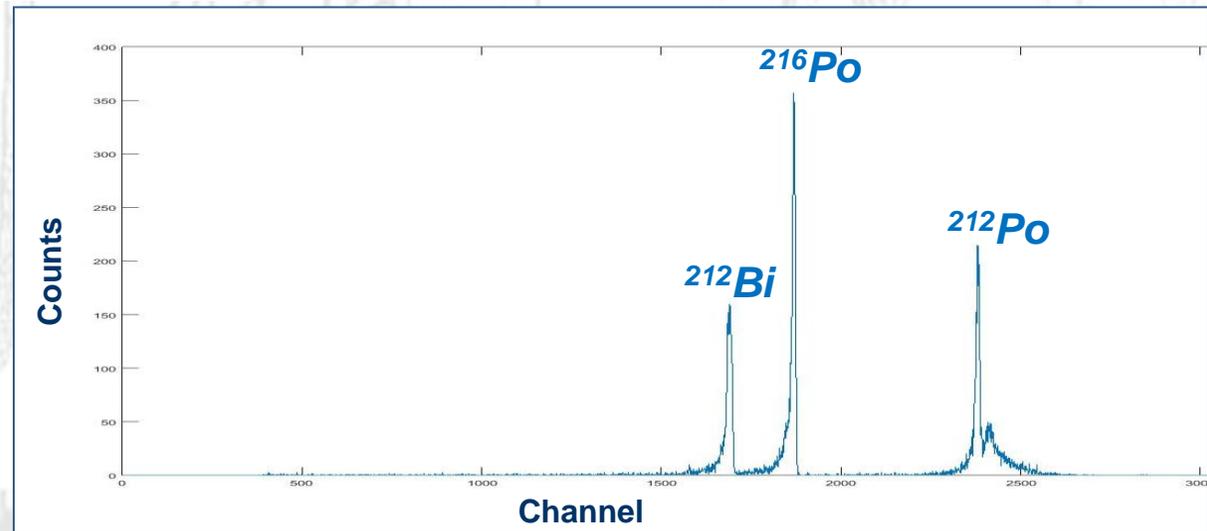
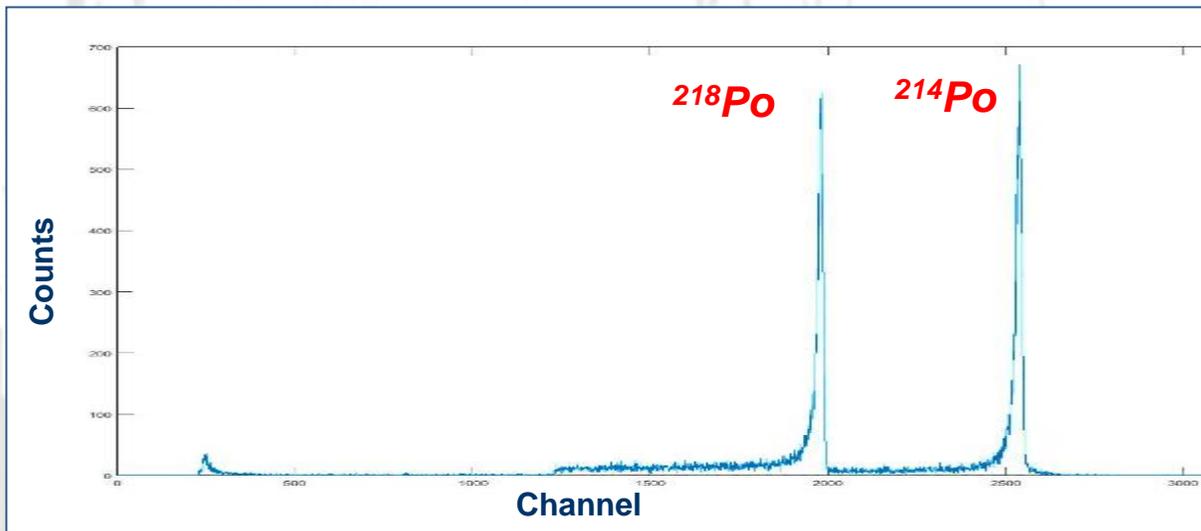


^{222}Rn (radon)

HV Connector

Signal Connector

^{220}Rn (thoron)



216-Po Traceability radon chain

The reference source is obtained from a glass bulb of 33 cl containing radon gas.



The gas diffused inside the bulb from a ^{226}Ra Pylon source with nominal activity of 106.3 kBq

The bulb is measured with the HPGe detector



Radon Source



INMRI-ENEA reference



216-Po Traceability radon chain

The reference source is obtained from a glass bulb of 33 cl containing radon gas.



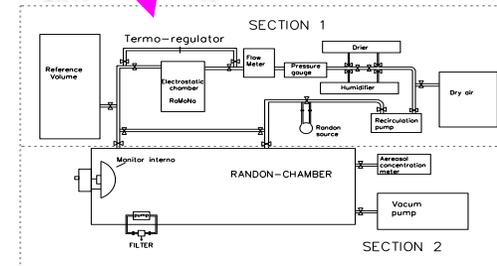
The bulb is measured with the HPGe detector



Radon Source



The gas diffused inside the bulb from a ^{226}Ra Pylon source with nominal activity of 106.3 kBq



216-Po Traceability radon chain

The reference source is obtained from a glass bulb of 33 cl containing radon gas.



Applied Radiation and Isotopes

Volume 67, Issue 5, May 2009, Pages 863-866



A radon facility at Naples University: Features and first tests

G. Venoso ^{a, b, 1}, M. Pugliese ^{a, b}, V. Roca ^{a, b} ✉, C. Sabbarese ^{b, c}

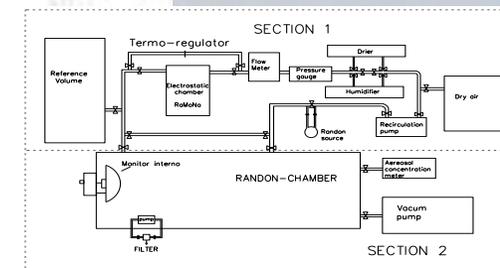
^a Dipartimento di Scienze Fisiche, Università degli Studi di Napoli Federico II, Italy

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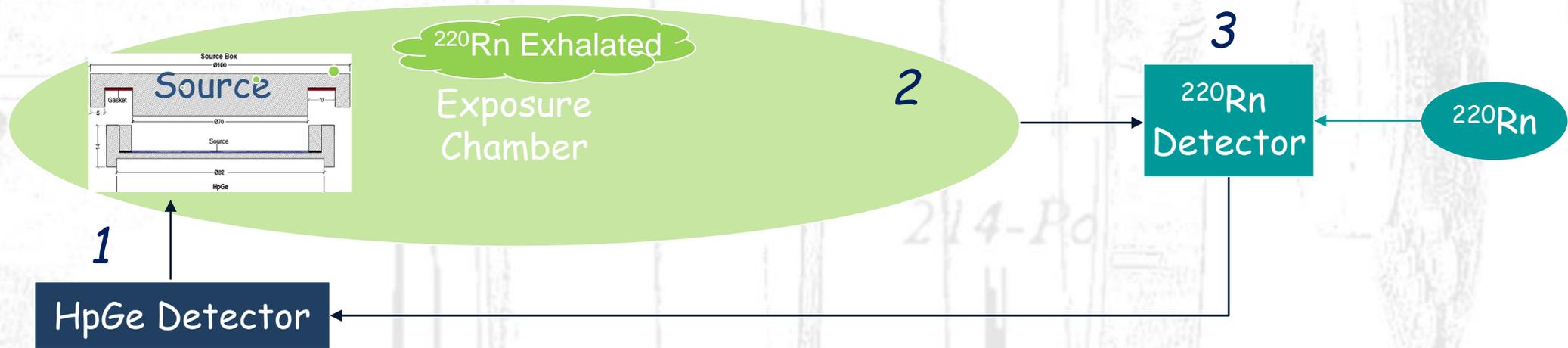
Available online 1 February 2009.

The gas attused inside the bulb from a ^{226}Ra Pylon source with nominal activity of 106.3 kBq



Traceability thoron chain

For the measurements of thoron is essentially to have calibrated system of detection. The methodology used for the development of a reference sample and a calibration chamber can be divided into three main phases.



Therefore, the activity measurement of ^{220}Rn can be associated to a reference standard.

Measurement of exhaled thoron from the source

- Measure, with germanium HpGe, the sealed source after 4 days.

This measure is used to check the balance in the series of ^{232}Th and to estimate the activity of ^{212}Pb e ^{212}Bi

ENDF/B-VI.8 Th232 decay path

Applied Radiation and Isotopes 81 (2013) 221–225

Sealed source



Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Applied Radiation and Isotopes

journal homepage: www.elsevier.com/locate/apradiso




Realization and characterization of a ^{220}Rn source for calibration purposes



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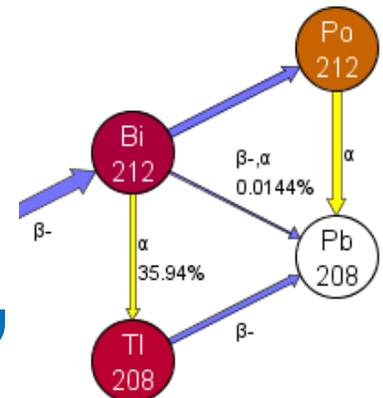
^b Dipartimento di Fisica, Università degli Studi di Napoli "Federico II", Napoli, Italy

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HIGHLIGHTS

- A thoron source realized by well characterized samples containing thorium.
- Methodology for measuring exhaled thoron activity by gamma ray spectrometry.
- Stable on time thoron specific activity concentration in air.
- Radon isotopes spectroscopy by electrostatic collection.

^{220}Rn Exhaled

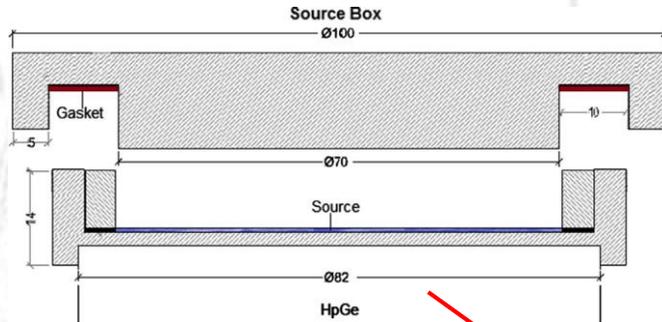


Source



Radon and thoron mixed atmosphere

Thoron Source



The chamber, is characterized for both radon and thoron, we produce standard mixed atmospheres, monitoring the specific activity of both isotopes at same time using the internal monitor.

Radon Source

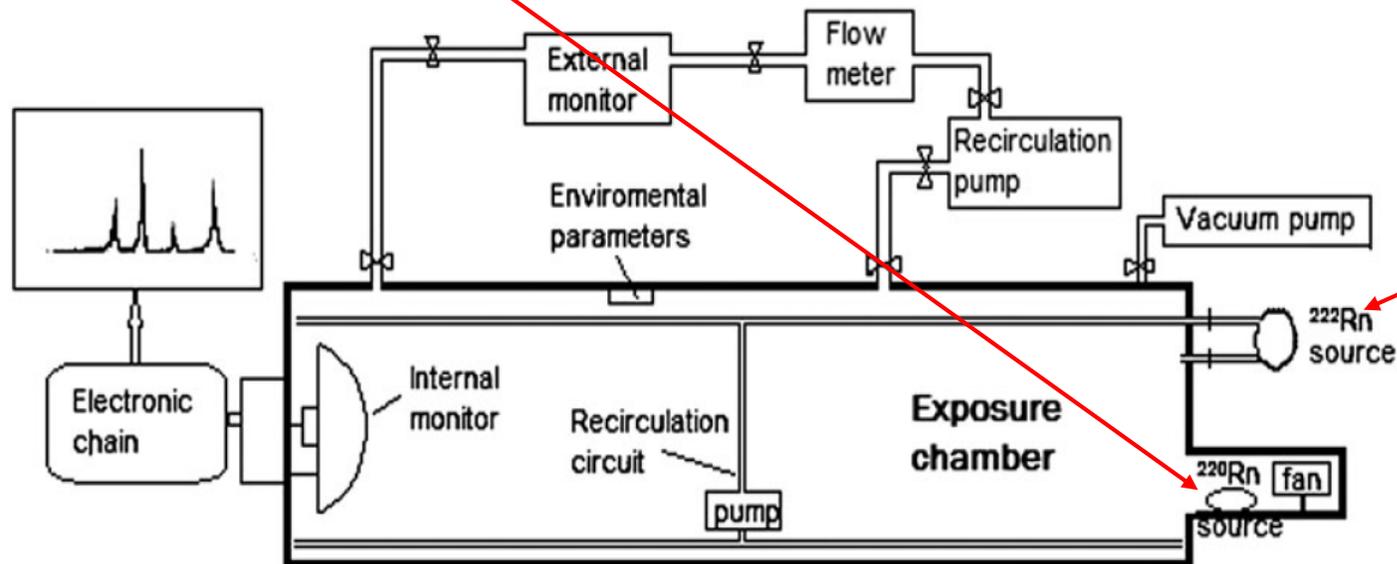
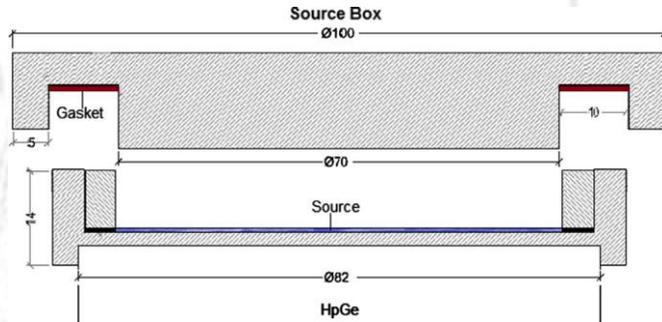


Figure 1. A schematic outline of the facility.

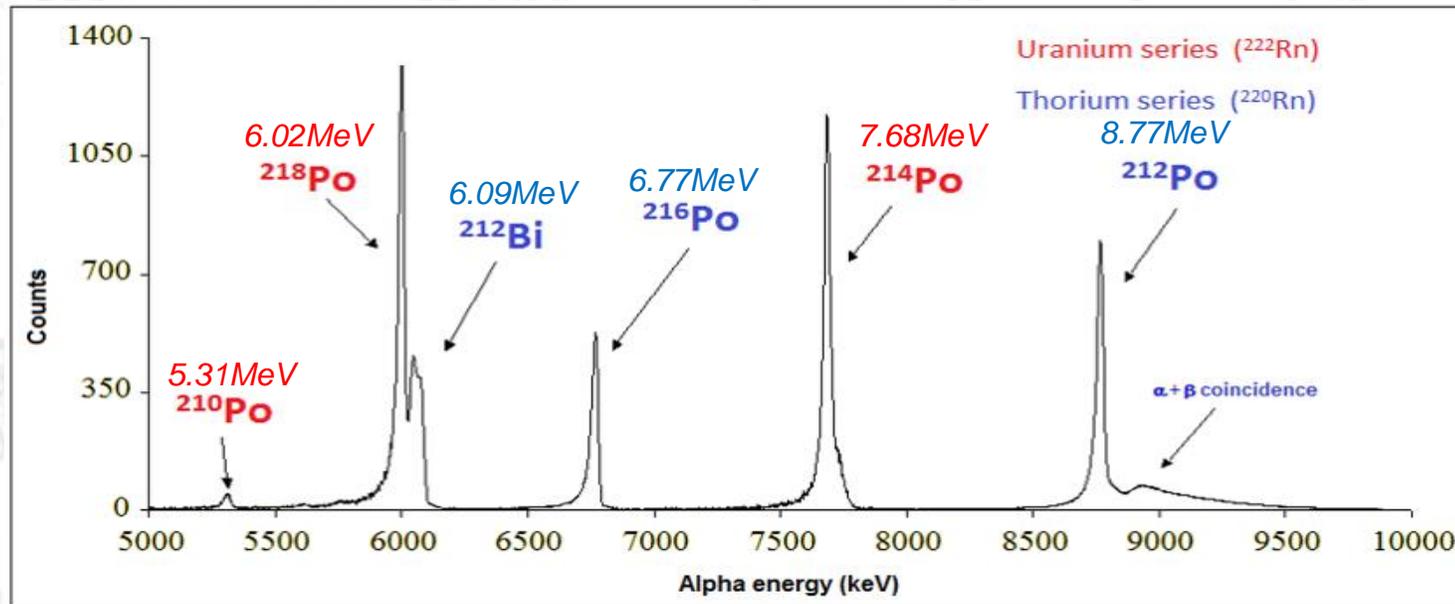
Radon and thoron mixed atmosphere

Thoron Source

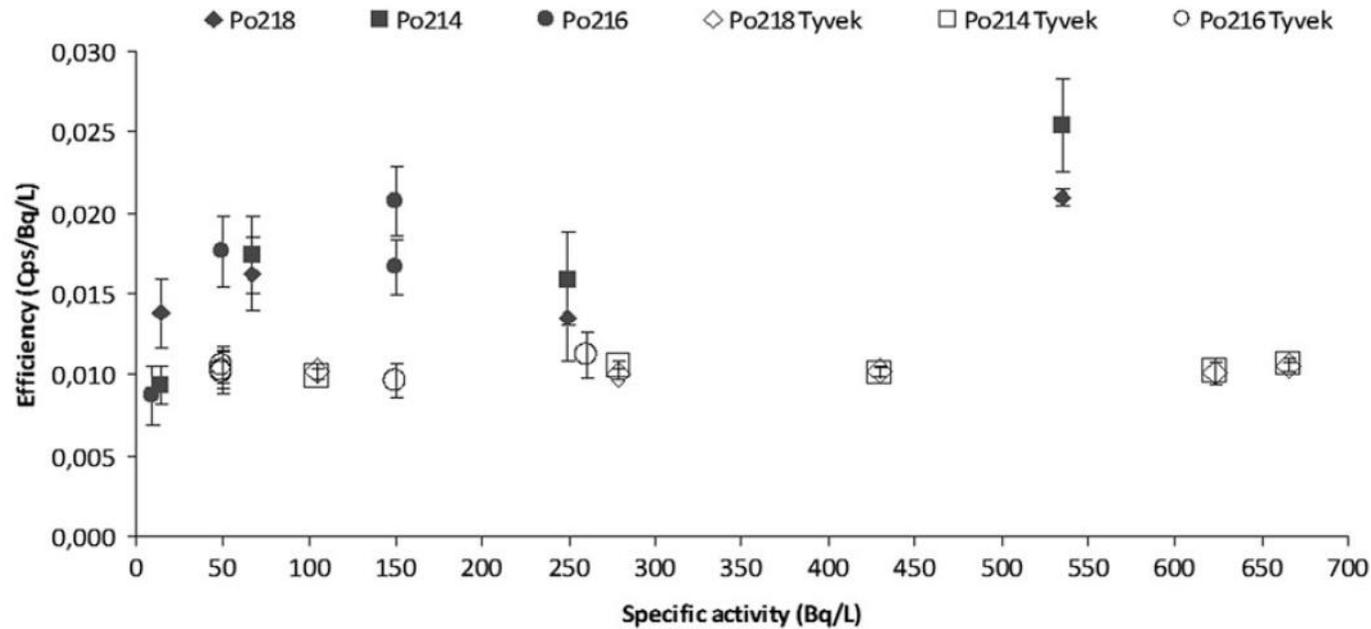


The chamber, is characterized for both radon and thoron, we produce standard mixed atmospheres, monitoring the specific activity of both isotopes at same time using the internal monitor.

Radon Source



Radon and thoron mixed atmosphere



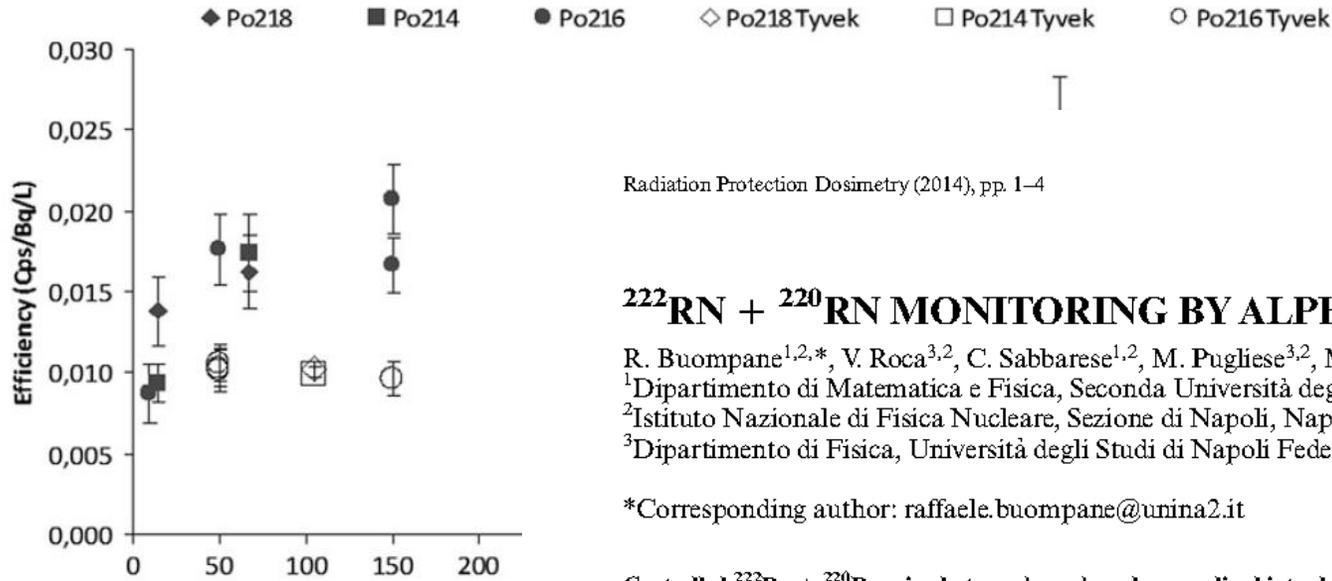
Efficiency values of the internal monitor for the considered polonium isotopes with (full labels) and without (empty labels) Tyvek[®] filter.

Efficiency values of the internal monitor for the considered polonium isotopes with Tyvek[®] filter.

Table 2. Mean values of the monitor (with Tyvek[®]) efficiency of radon from the respective polonium isotopes.

Isotopes	Efficiency	Standard deviation	% Error
²¹⁸ Po	0.0103	0.0002	2
²¹⁴ Po	0.0104	0.0002	2
²¹⁶ Po	0.0103	0.0005	5

Radon and thoron mixed atmosphere



Radiation Protection Dosimetry (2014), pp. 1-4

doi:10.1093/rpd/ncu071

$^{222}\text{Rn} + ^{220}\text{Rn}$ MONITORING BY ALPHA SPECTROMETRY

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Controlled $^{222}\text{Rn} + ^{220}\text{Rn}$ mixed atmospheres have been realised introducing calibrated sources in a stainless steel chamber. An electrostatic alpha monitor internal to the chamber has been used for an accurate discrimination of alpha peaks due to the products of the two isotopes. In the chamber, different specific activities are achieved in order to test the response of the internal reference instrument and to evaluate the possible interferences due to contemporary presence of both radon isotopes. Results show that: (i) the atmospheres are very stable, (ii) the monitor is adequate for their control because the various alpha lines are well evaluated and (iii) using Tyvek[®] filter, the efficiency of monitor is stable and constant vs. activity.

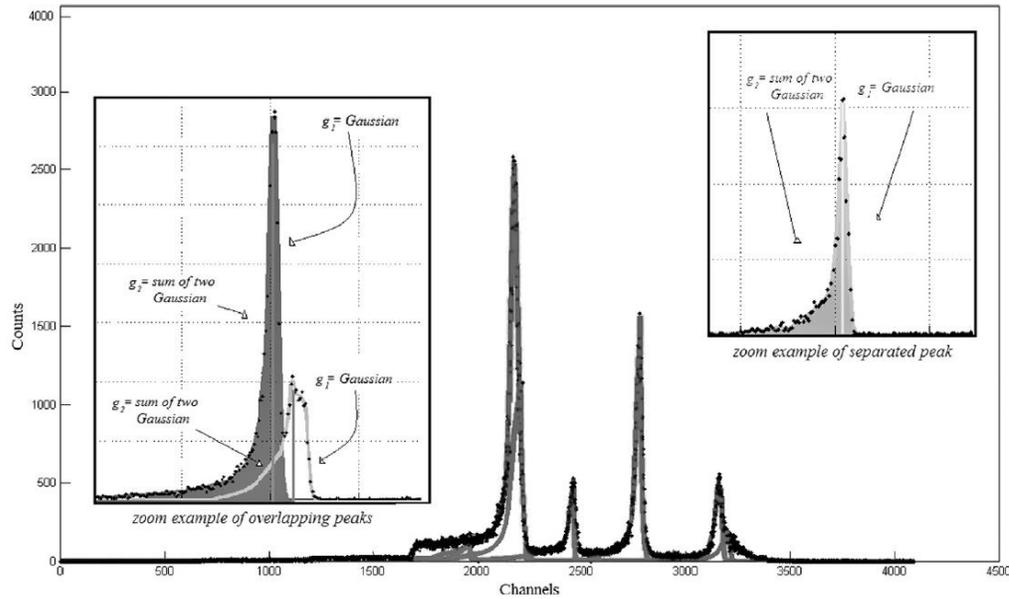
Efficiency value considered polonium isotopes with (full labels) and without (empty labels) Tyvek[®] filter.

of the internal idered polonium yvek[®] filter.

tor (with Tyvek[®]) efficiency of radon from the respective polonium isotopes.

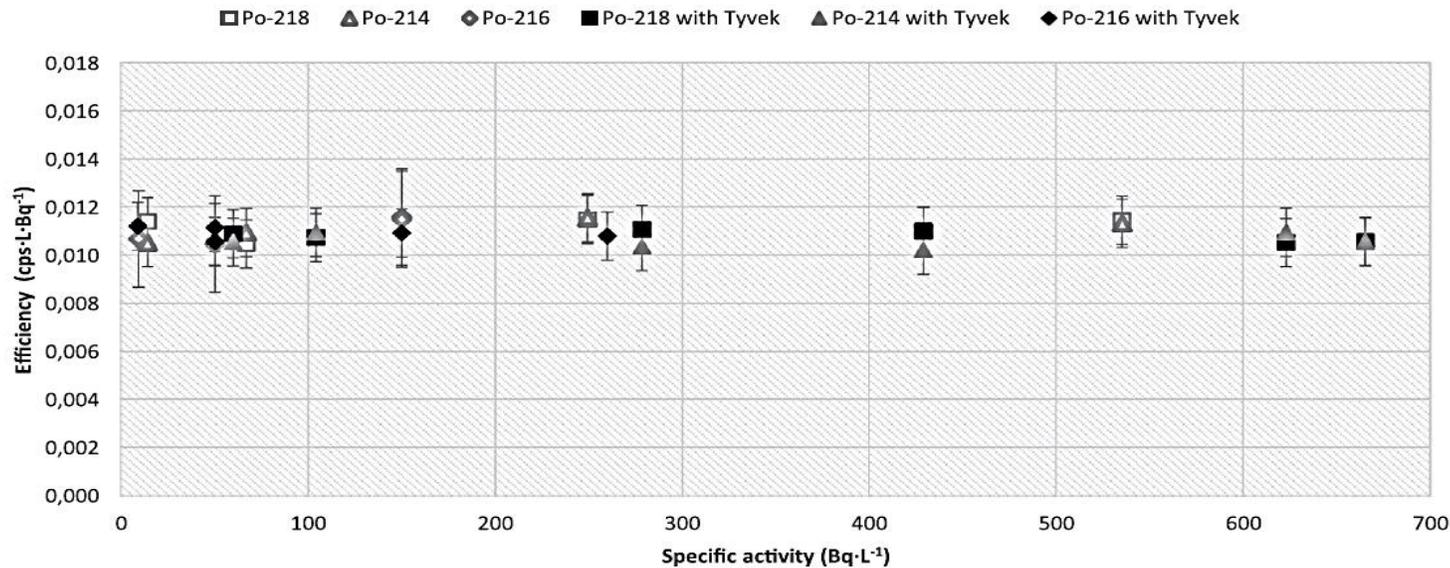
Isotopes	Efficiency	Standard deviation	% Error
^{218}Po	0.0103	0.0002	2
^{214}Po	0.0104	0.0002	2
^{216}Po	0.0103	0.0005	5

Radon and thoron mixed atmosphere



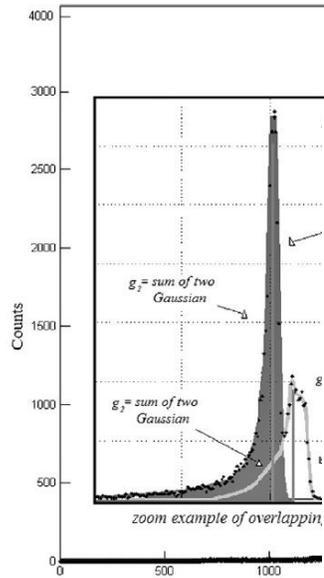
Efficiency values of the internal monitor for the considered polonium isotopes with and without Tyvek® filter.

Isotopes	Efficiency	Standard deviation	% Error
^{218}Po	0.0109	0.0004	4
^{214}Po	0.0107	0.0004	4
^{216}Po	0.0109	0.0004	4



Efficiency values of the internal monitor for the considered polonium isotopes with and without Tyvek® filter.

Radon and thoron mixed atmosphere



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journal homepage: www.elsevier.com/locate/apradiso



% Error

4
4
4

Analysis of alpha particles spectra of the Radon and Thoron progenies generated by an electrostatic collection detector using new software



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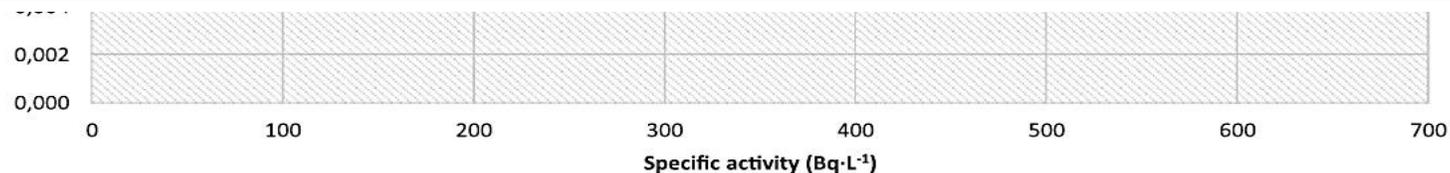
ARTICLE INFO

Keywords:

Alpha-particle spectrometry
Peaks deconvolution
Radon-Thoron activity measurement
RaMonA collection efficiency

ABSTRACT

A complete and detailed analysis of alpha spectra from the ^{222}Rn and ^{220}Rn progenies was performed by newly developed software. The software identifies the alpha peaks, performs appropriate fits and calculates the net area and its uncertainty, considering the entire background. The deconvolution of the overlapped peaks of ^{218}Po and ^{212}Bi allows us also to evaluate their minimum detectable area. The efficiency of the electrostatic detection method was recalculated and new useful considerations on the collected alpha emitters were made.



Mixed atmosphere for calibration purpose

Detector in the chamber before an exposition

The chamber is used for the calibration of active and passive detector in the mixed atmosphere.



The detectors can be exposed directly inside the chamber or connected externally by a dedicated circuit.

External circuit

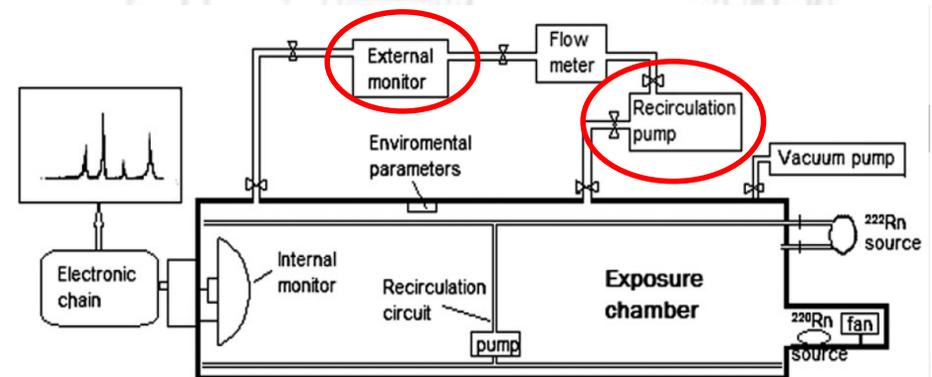


Figure 1. A schematic outline of the facility.

216-Po *Conclusions*

- ✓ *The methodology for the production of traceable standard radon has been implemented.*
- ✓ *The standard atmospheres of radon has been realized and monitored by internal monitor based on the electrostatic collection method.*
- ✓ *The methodology for the characterization of thoron source has been implemented, and different source has been realized.*
- ✓ *The standard atmospheres of thoron and of radon + thoron has been realized and monitored by internal monitor based on the electrostatic collection method.*
- ✓ *The exposure chamber can be used for the detector calibration in mixed atmosphere, in order to investigate interferences radon/thoron and dependency from other parameters.*
- ✓ *The characterization of the thoron sources and of the exposure chamber in function of environmental parameter are in program.*

216-Po

Thank you for your attention.

214-Po

212