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ASSAYING RETROSPECTIVE RADON CONCENTRATIONS INDOOR BY MEASURING THE ^{210}PO DEPOSITED IN GLASSES

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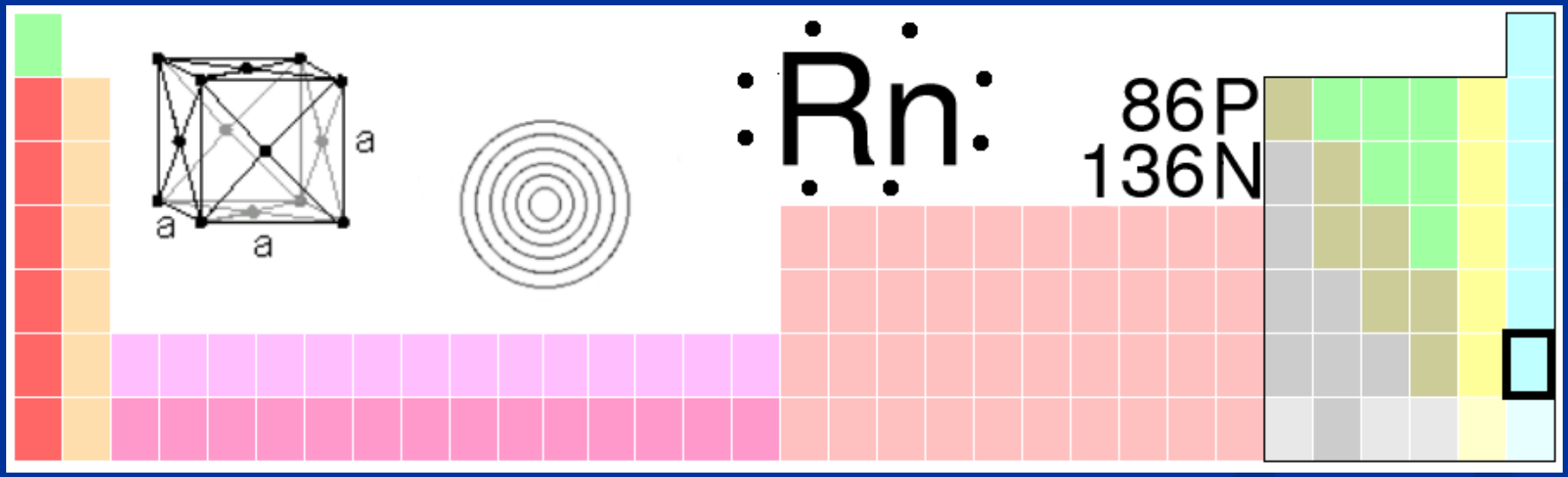
1. Introduction

1. Introduction
2. Theoretical considerations
3. Building the experimental device
4. Determining the activity concentration of ^{210}Po on indoor surfaces
5. Measurements and results
6. Summary and conclusions

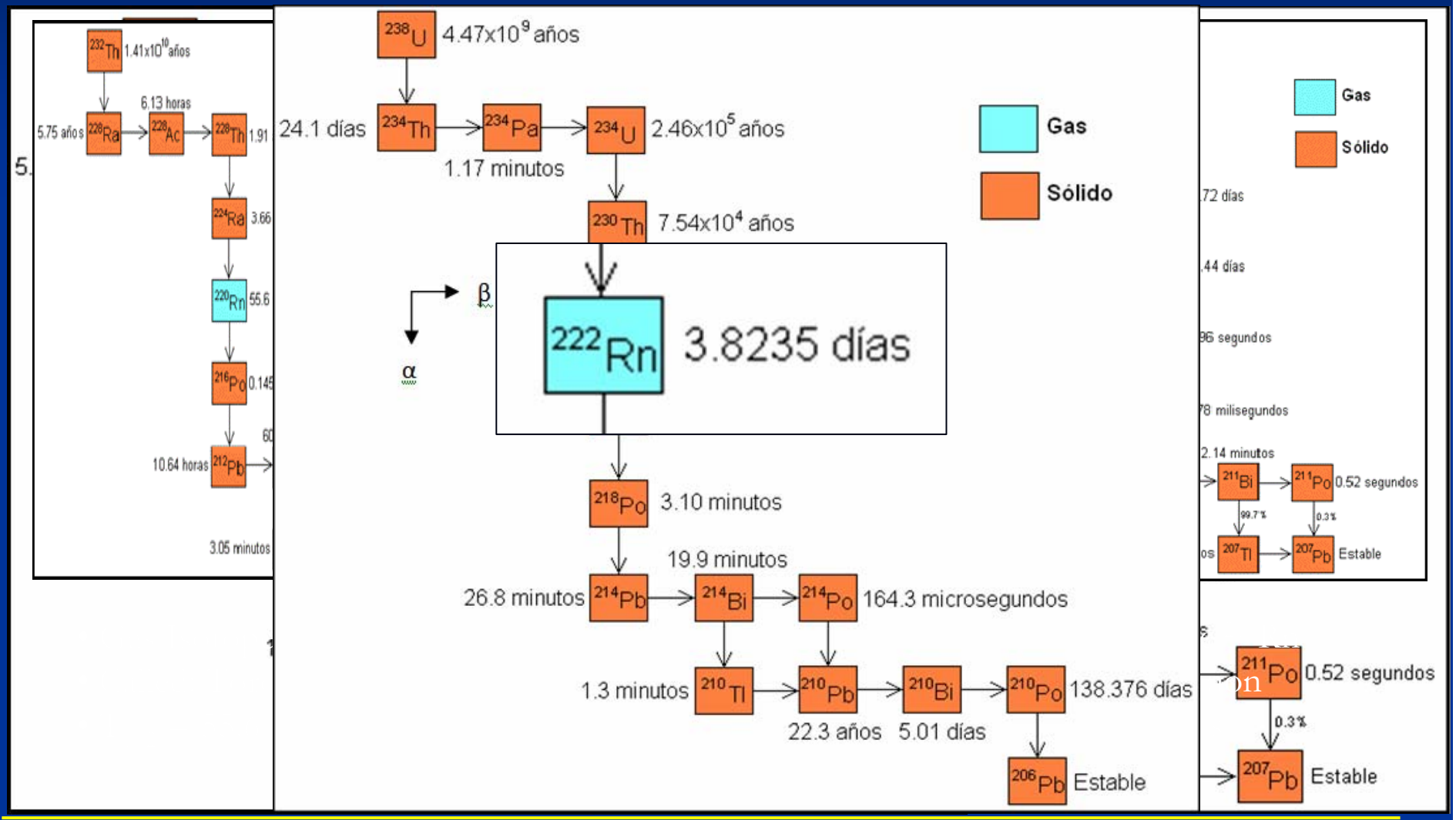
1. Introduction

"ASSAYING RETROSPECTIVE RADON CONCENTRATIONS INDOOR BY MEASURING THE ^{210}Po DEPOSITED IN GLASSES"

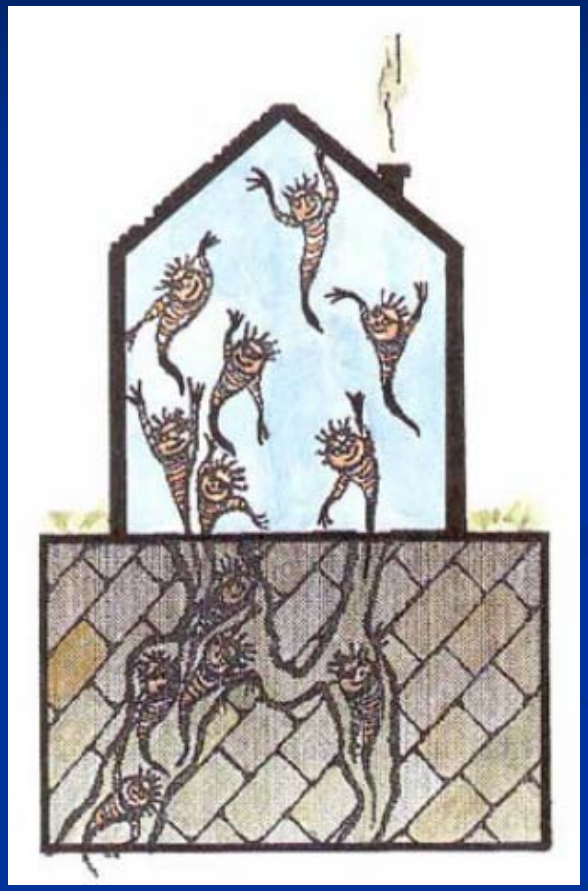


1. Introduction

(4n) ^{232}Th series (4n + 2) ^{238}U series (4n + 3) ^{235}U series



1. Introduction



Radon is classified as carcinogenic to human beings in 1988 by the IARC (WHO)

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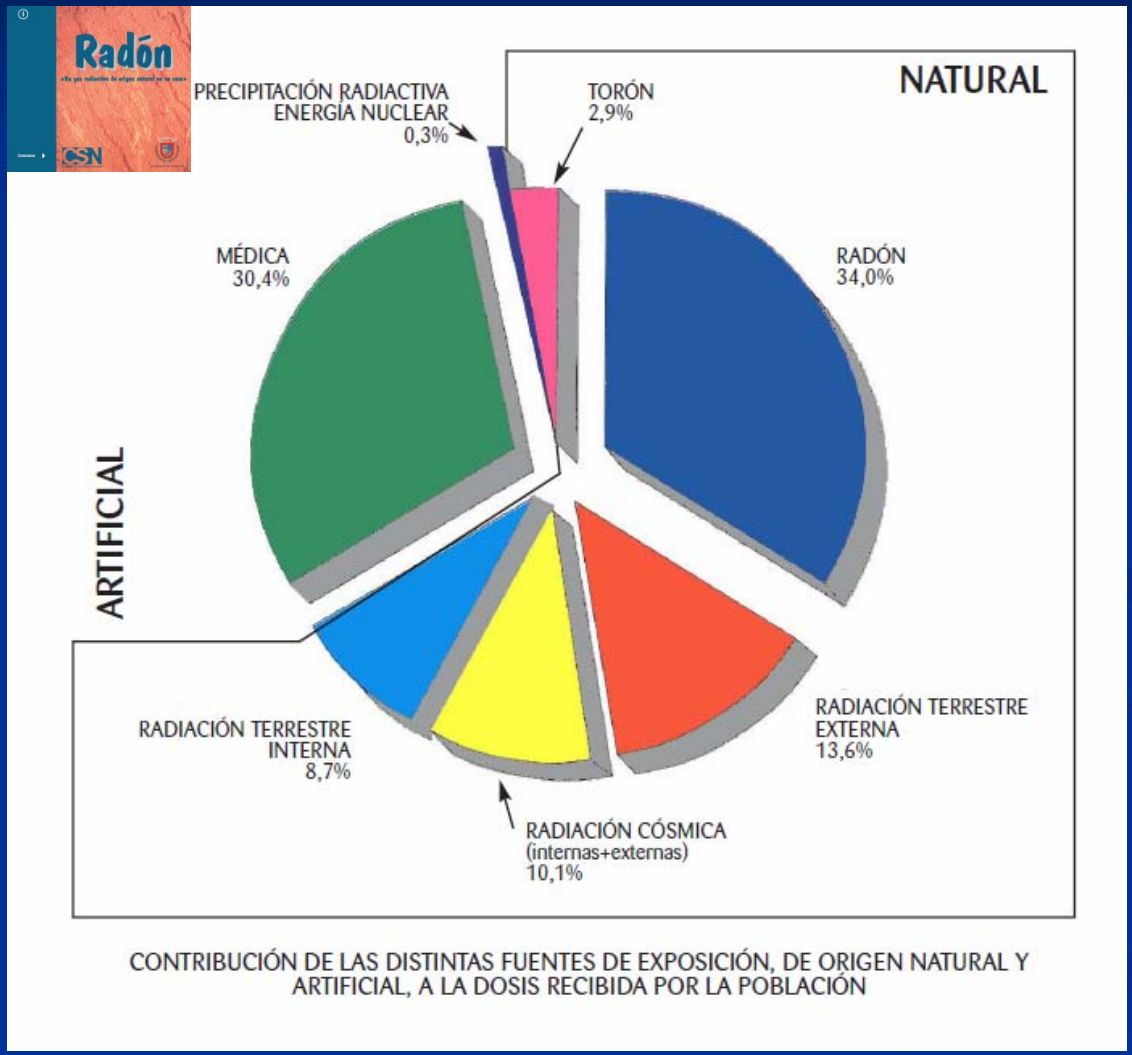

CONTRIBUCIÓN DE LAS DISTINTAS FUENTES DE EXPOSICIÓN, DE ORIGEN NATURAL Y ARTIFICIAL, A LA DOSIS RECIBIDA POR LA POBLACIÓN

- Epidemiological Studies:
20 years latency period

- Travelling in time is very difficult.
Retrospective estimations

- Design and construction of the device to estimate retrospective radon concentration

2. Theoretical considerations

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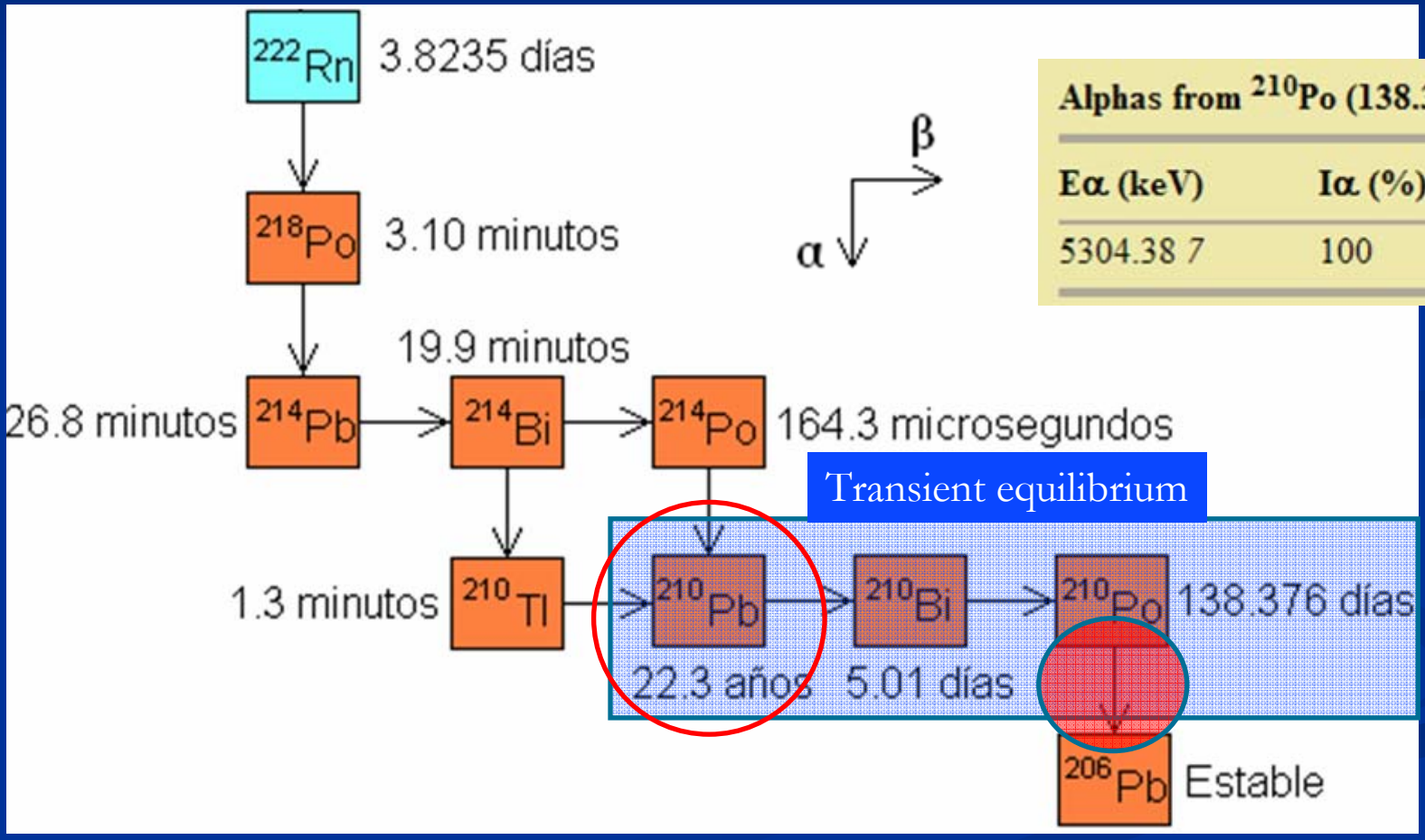
2. Theoretical considerations

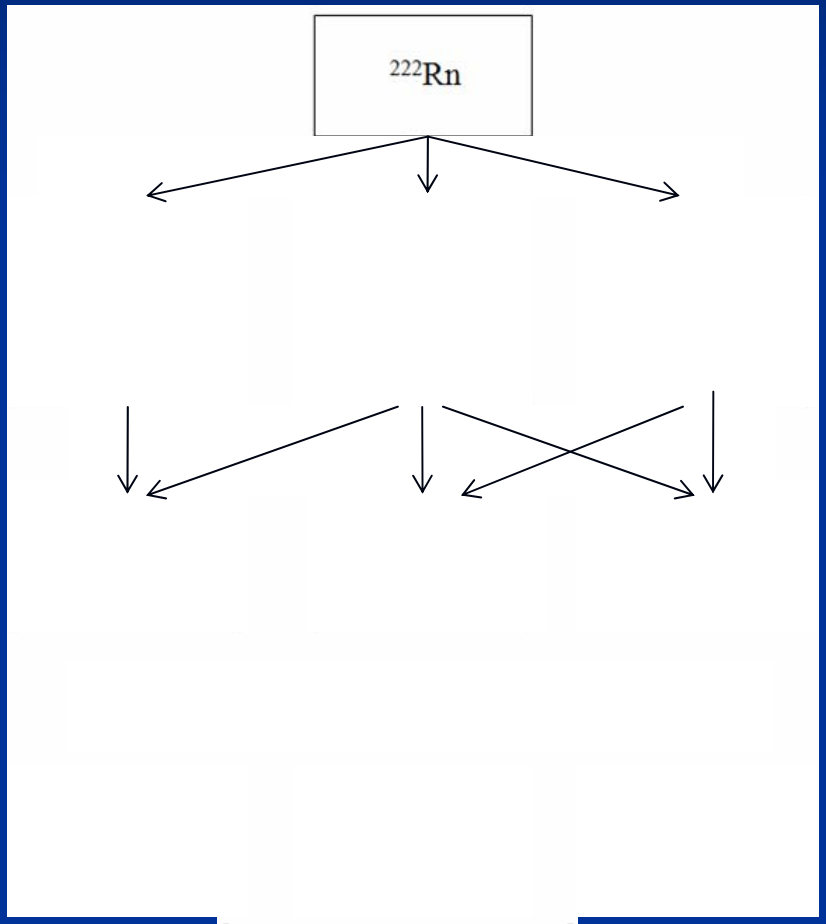
Retrospective estimations



Alphas from ^{210}Po (138.376 d *2*)	
Eα (keV)	Iα (%)
5304.38 *7*	100

2. Theoretical considerations

Radon decay and behaviour

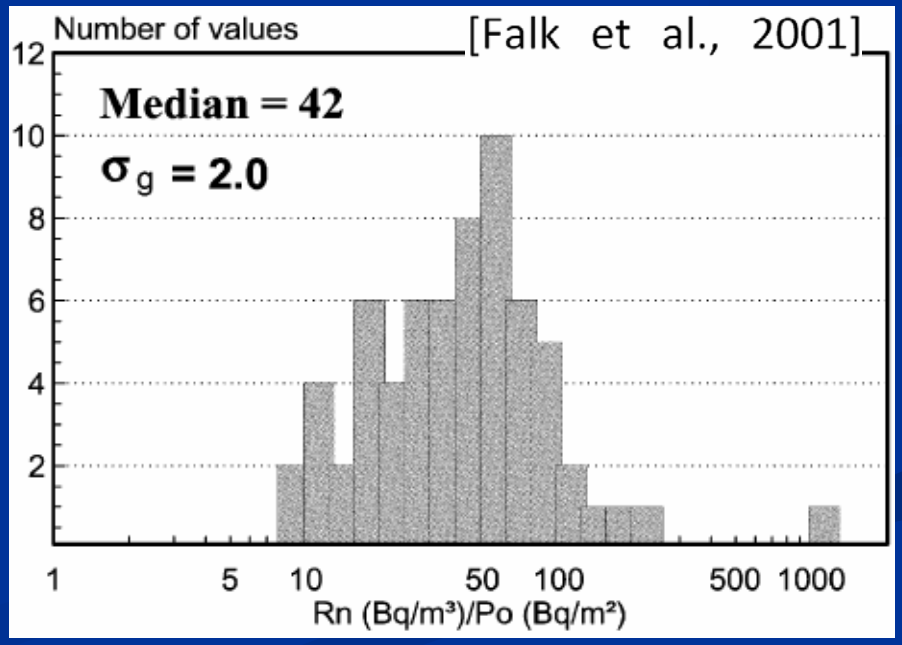


[Aceña y Crespo, 1989]

^{210}Pb usually implanted in surfaces

Relationship between
^{222}Rn (air) and ^{210}Po (surfaces)

$^{222}Rn\ (Bq/m^3) = k\ (m^{-1}) * {}^{210}Po\ (Bq/m^2)$



$k = 42\ m^{-1}$

3. Building the experimental device

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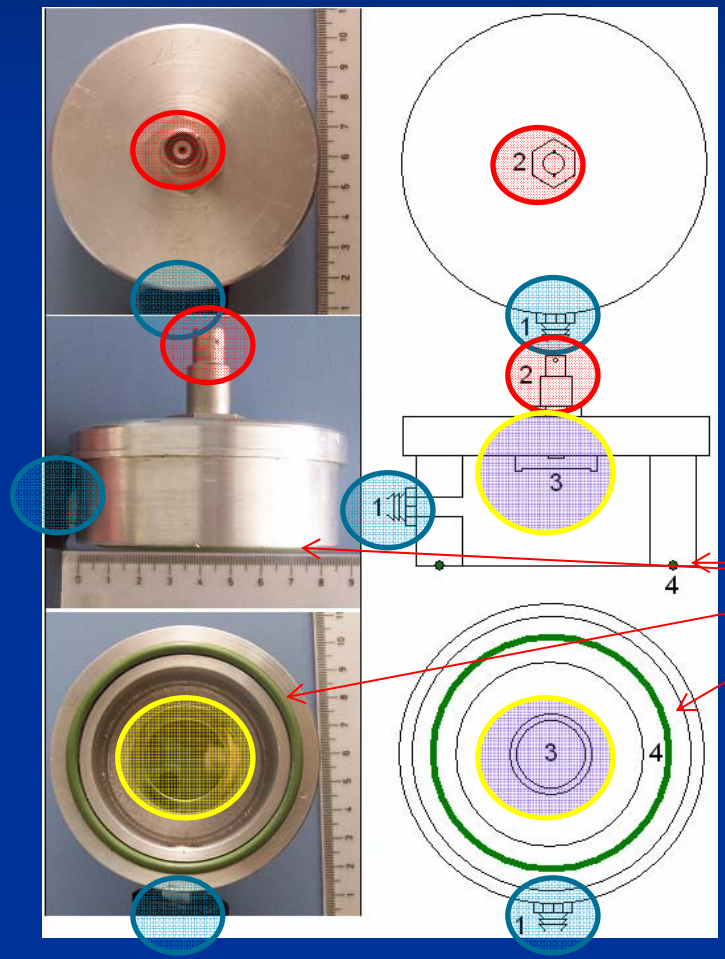
3. Building the experimental device

a. Aluminum canister.

a. Aluminum canister.
b. Silicon detector.
c. Portable “Bin Power Module”.
d. NIM A576 APAD. Ortec.
e. MCA. Amp Tek.

3. Building the experimental device

a. Aluminum canister.



1. To vacuum pump.
2. Bulkhead mounted jack.
3. PIPS Detector (450 mm^2).
4. O-ring.

3. Building the experimental device

b) Silicon Detector.

c) "Bin Power Module".

a. Aluminum canister.

b. Silicon Detector.

c. "Bin Power Module".

d) NIM A576 APAD. Ortec.

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3. Building the experimental device

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4. Activity concentration of ^{210}Po

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4. Activity concentration of ^{210}Po

A. Calibration.

1. Energy calibration.

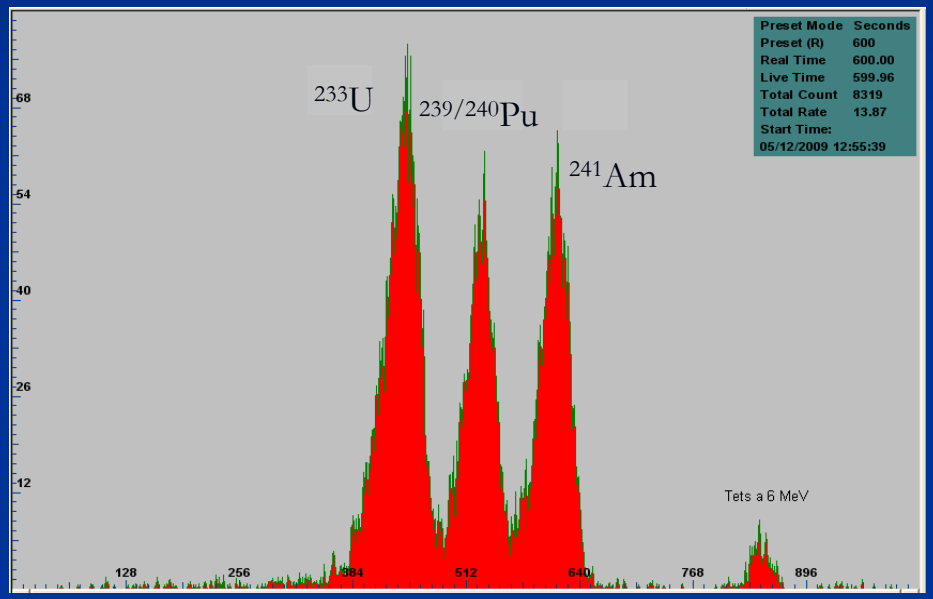
2. Efficiency calibration.

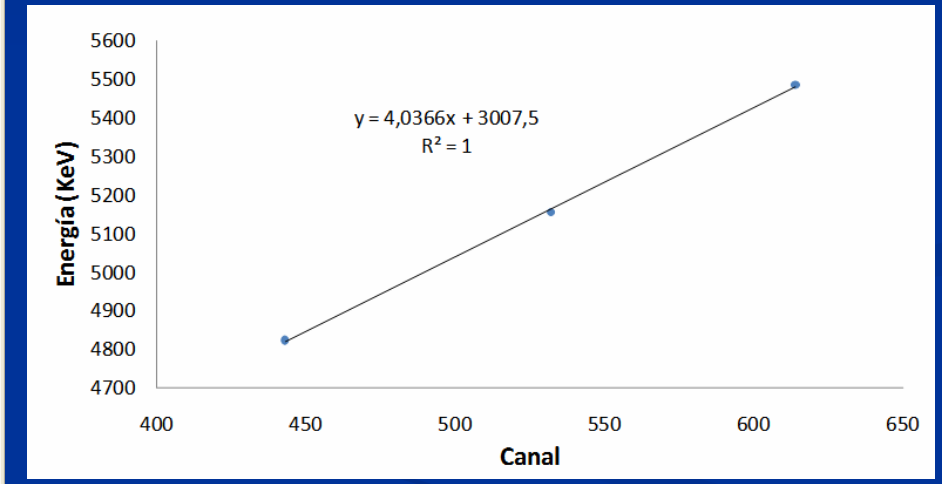
   i. Geometrical factor (source – detector).
   ii. Intrinsic efficiency.

B. Method.

4. Activity concentration of ^{210}Po

1. Energy calibration.





Nucleído	Energía (KeV)	Canales
^{233}U	4824,12	443
$^{239/240}$Pu	5155	532
^{241}Am	5486	614

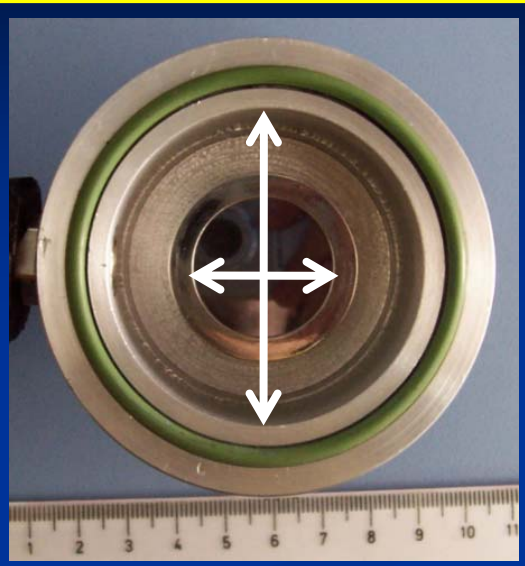
E (^{210}Po) = 5304.387 keV

4. Activity concentration of ^{210}Po

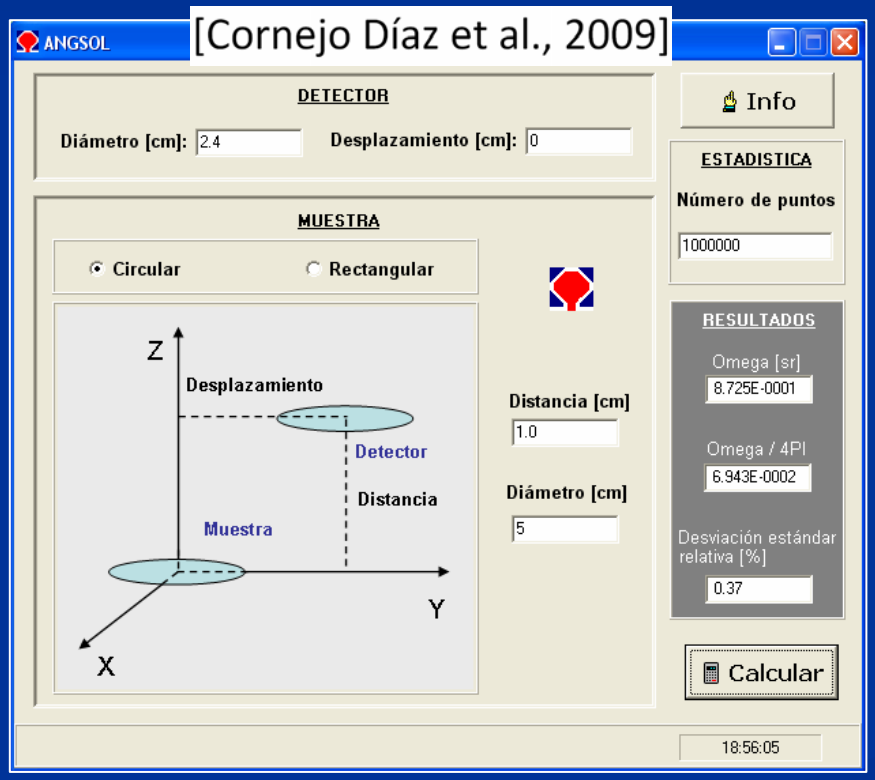
2. Efficiency calibration.

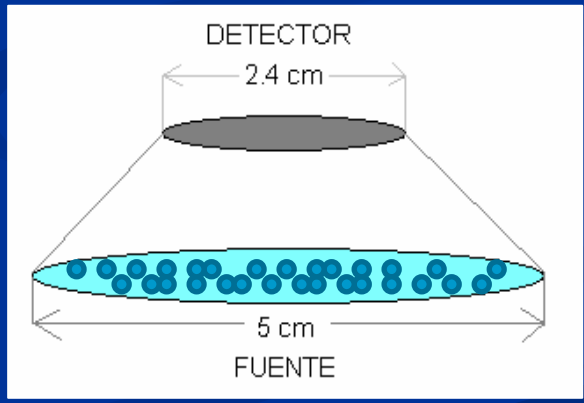
ii. Geometrical factor ("Efce" – detector).

Intrinsic efficiency (ε_{int})



[Cornejo Díaz et al., 2009]





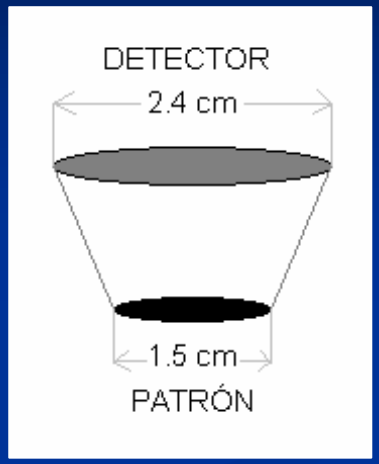
$$Fg_m = \Omega/4\pi = 0.06943 \pm 0.003$$

4. Activity concentration of ^{210}Po

2. Efficiency calibration.

ii. Intrinsic Efficiency "Ef_{int}"

$$Ef_{int} = \frac{cps_p - cps_f}{A_p * Fg_p}$$



$Fg_p = \Omega/4\pi = 0.1636 \pm 0.0004$

A_p (Bq)	Área total	t medida patrón (s)	Área del fondo	t medida fondo (s)	Fg_p
80.2 ± 0.4	7935	600	25	161086,47	0.1636 ± 0.0004

$Ef_{int} = 1.01 \pm 0.01$

4. Activity concentration of ^{210}Po

B. Method.

$$A = \frac{\left(\frac{N_m}{t_m} - \frac{N_f}{t_f}\right)}{S * Ef_{int} * Fg_m} \quad [Bq/m^2]$$

A = Concentración de actividad de ^{210}Po (Bq/m^2).

N_m = Área total de la emisión del ^{210}Po obtenida en el espectro.

t_m = Tiempo de medida de la muestra (en segundos).

N_f = Área total del fondo en el rango de la emisión del ^{210}Po.

t_f = Tiempo de medida del fondo (en segundos).

S = Superficie de captación de la cámara (m^2).

Fg_m = Factor geométrico fuente – detector (tanto por uno).

Ef_{int} = Eficiencia intrínseca del detector (tanto por uno).

$$AMD = \frac{LID}{t_m * S * Ef_{int} * Fg_m}$$

$$LID = 2.71 + 4.65\sqrt{\mu_b}$$

$$\mu_b = C_f \cdot t_m$$

5. Measurements and results

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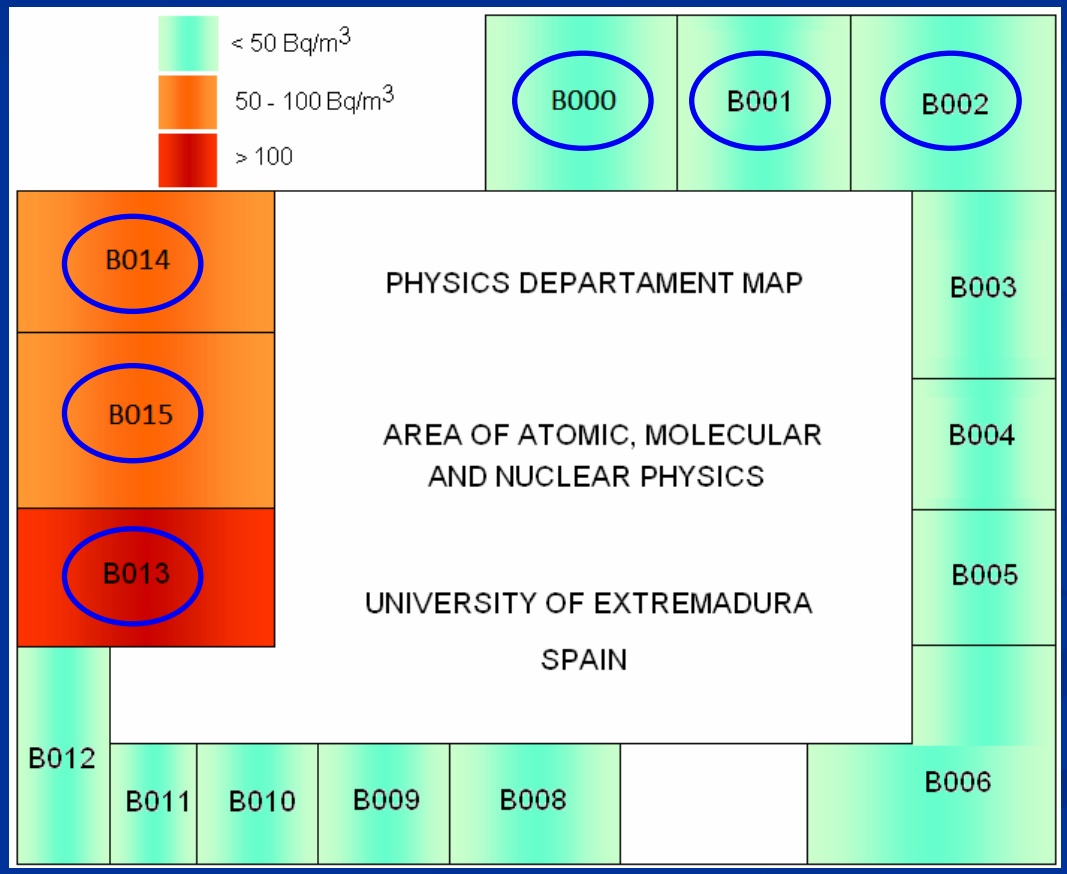
5. Measurements and results

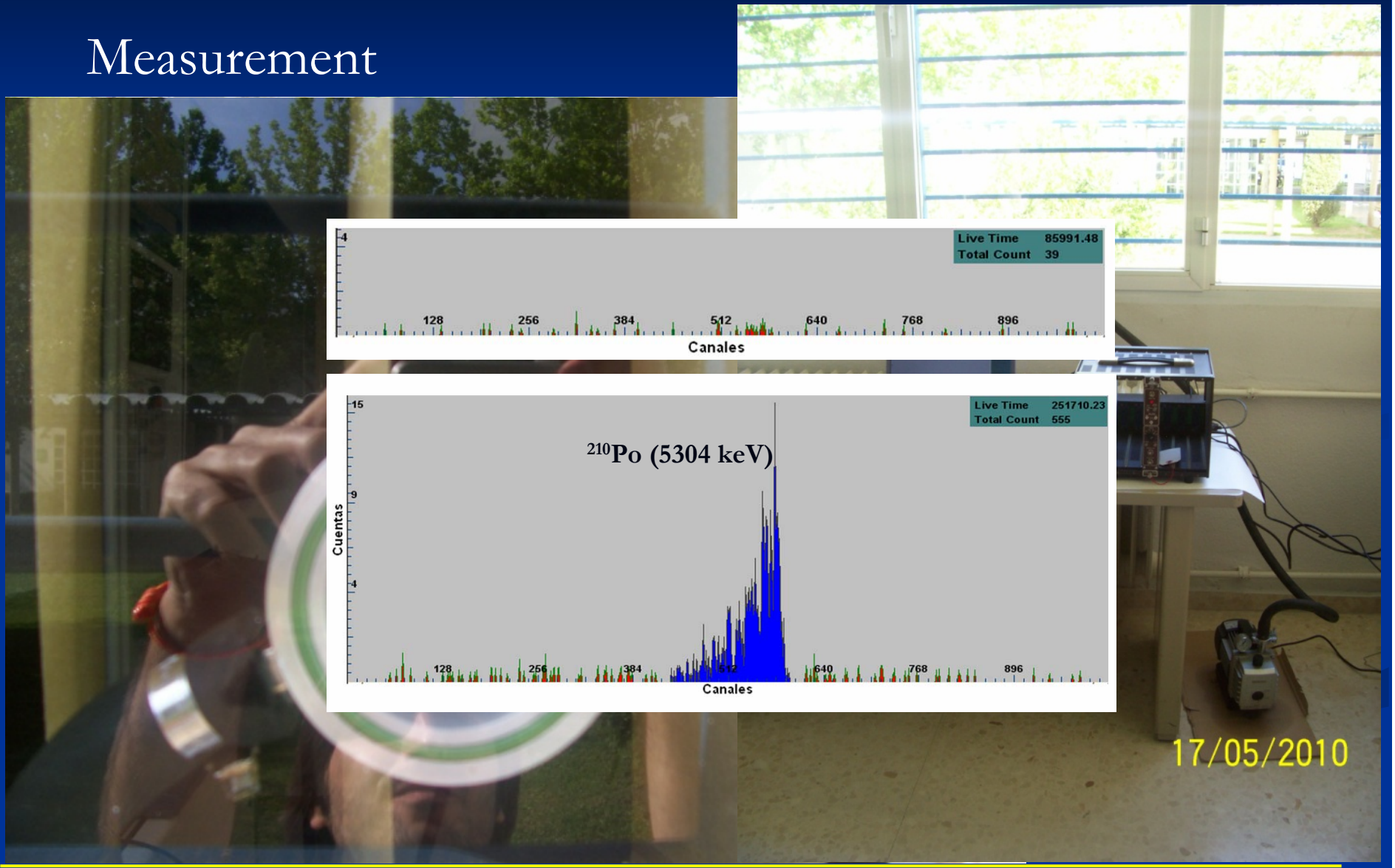
Selection of sampling points.

Measuring the concentration of radon (Charcoal canisters).



5. Measurements and results

Measurement



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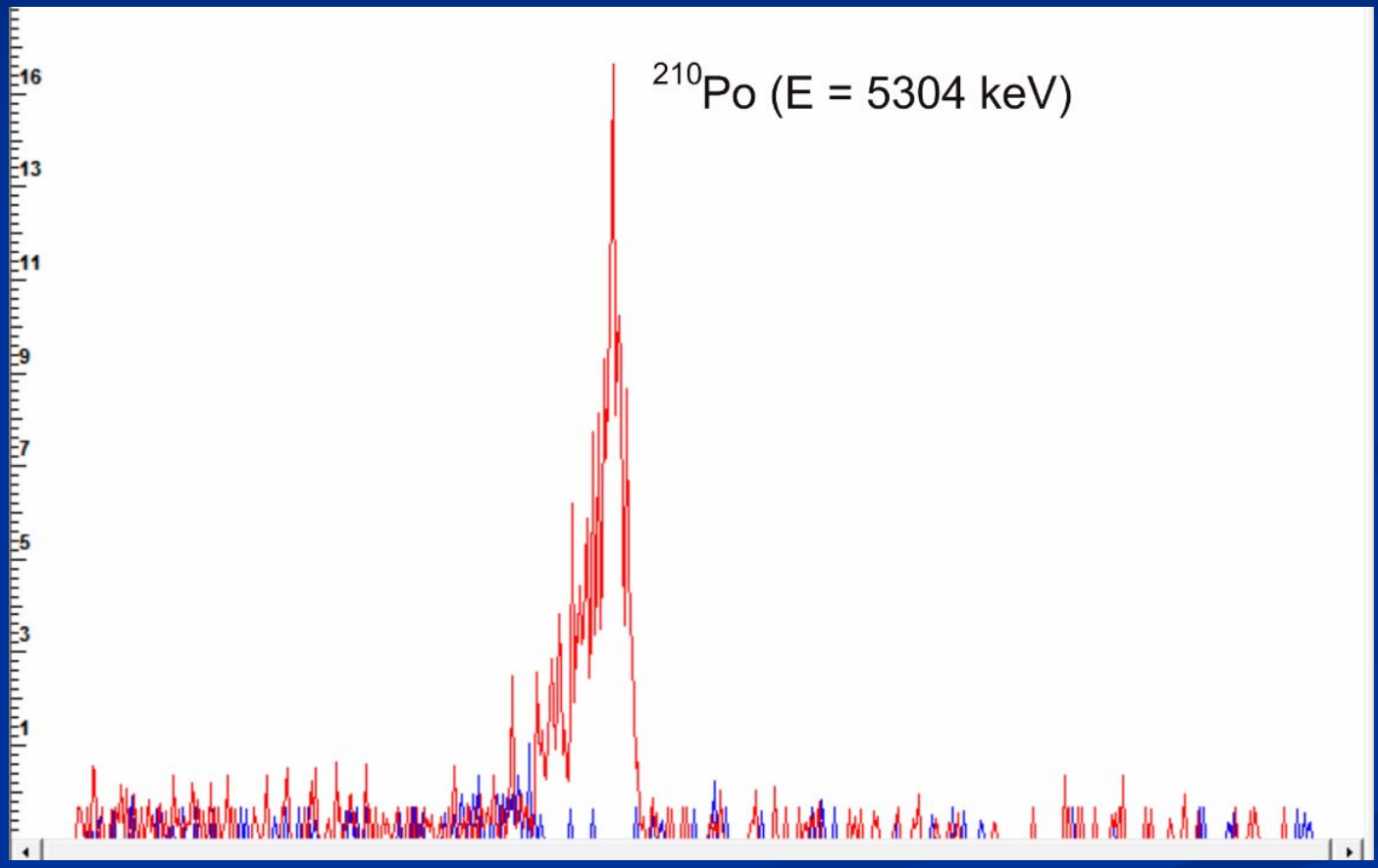
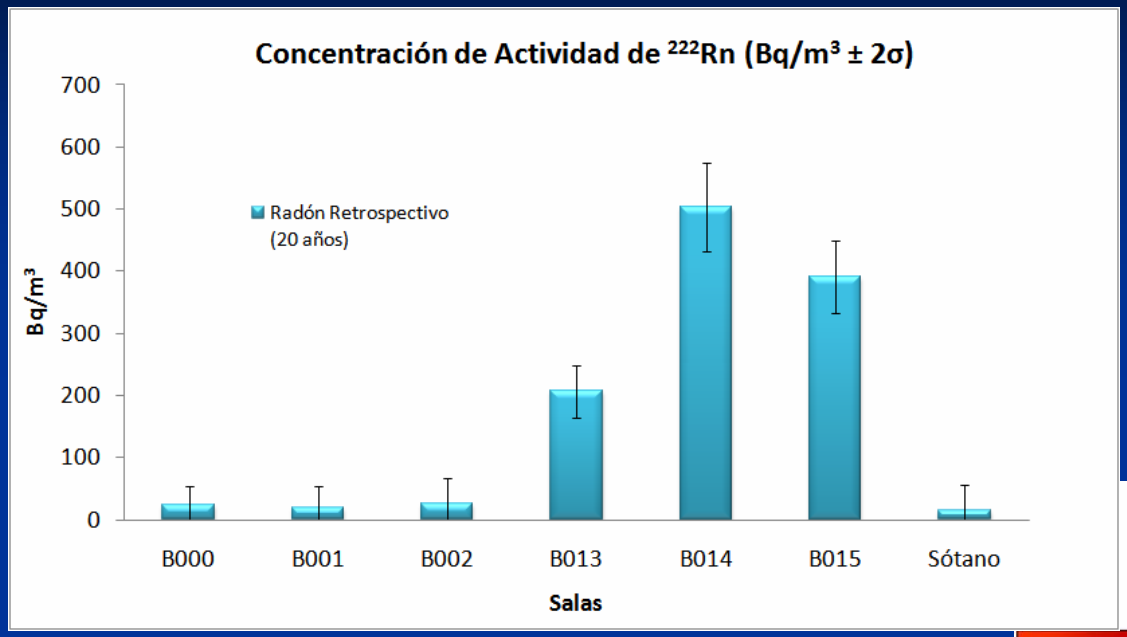
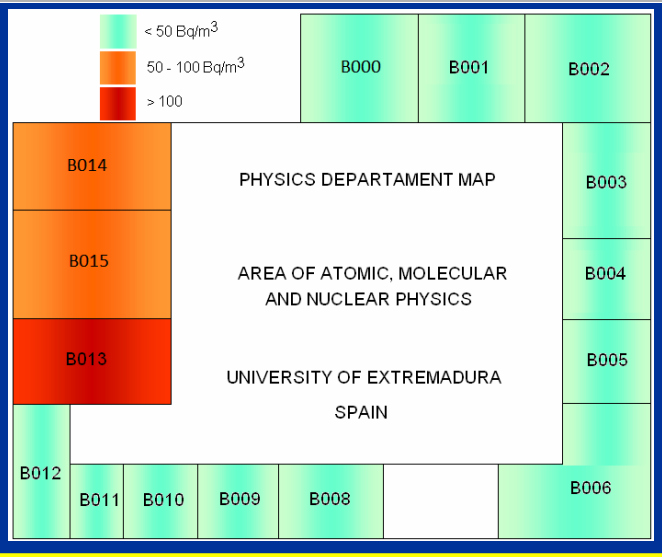


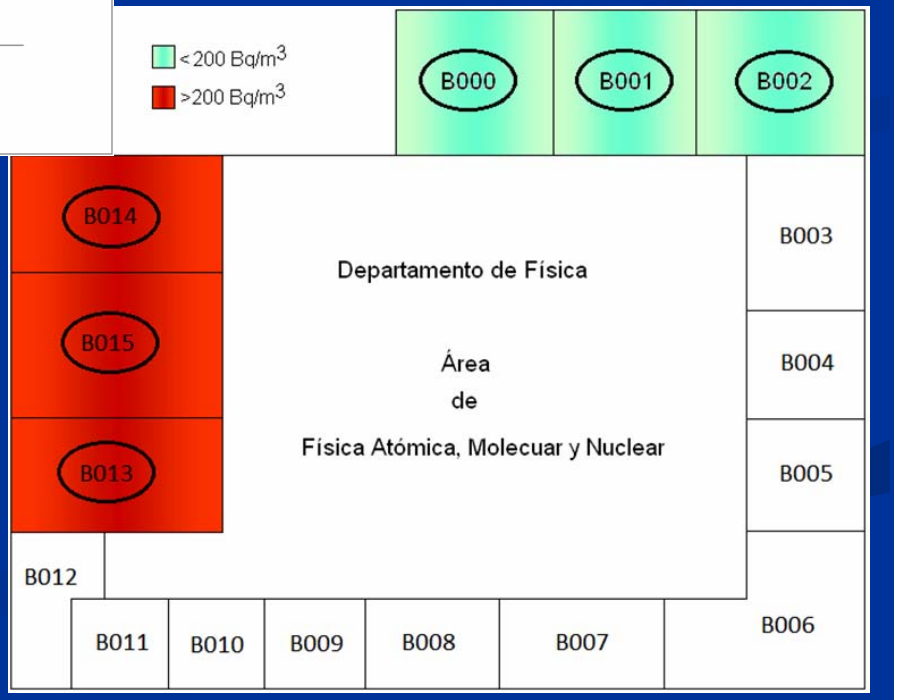
5. Measurements and results

Sala	Tiempo de medida (s)	Cuentas totales pico de ^{210}Po	Actividad de ^{210}Po ± 1 σ (Bq/m^2)	Concentración retrospectiva ^{222}Rn ± 1 σ (Bq/m^3)
B000	88912	14	< 1.2	< 48
B001 (1)	70357	13	< 1.7	< 67
B001 (2)	106244	23	< 1.5	< 59
B002	90272	24	< 1.7	< 69
B013 (1)	264105	217	5.34 ± 0.51	213 ± 21
B013 (2)	252720	205	5.03 ± 0.52	201 ± 21
B014	251710	467	12.6 ± 0.9	503 ± 36
B015	313369	446	9.8 ± 0.7	391 ± 29
Sótano	91732	21	< 1.7	< 68

5. Measurements and results

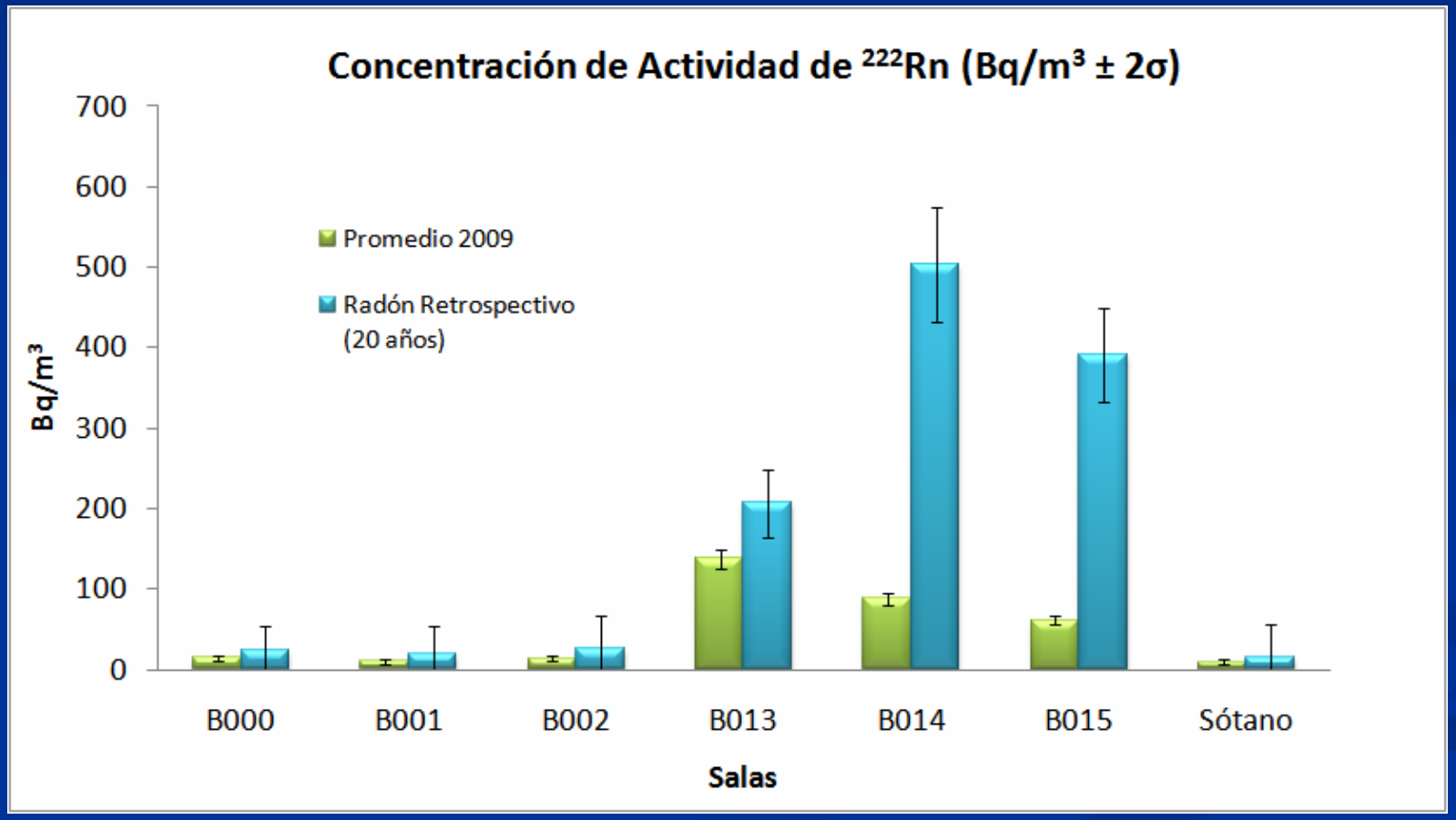






5. Measurements and results

Results



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SUMMARY AND CONCLUSIONS

- Measurements of ^{222}Rn are very important.
- Retrospective estimations are possible.
- Design and construction of the measuring device.
- Calibrations.
- Comparisons with other procedures.

6. Summary and conclusions

CONCLUSIONS

- The device designed and constructed to estimate the retrospective concentration of ^{222}Rn works well.

- The results are qualitatively in agreement with values obtained by other procedures.

Thank you !!!