RADON IN WORPLACES – THE URGENT NEED OF NEW MEASUREMENT METHODS AND DEVICES

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Existing Rn-monitors , mission-oriented towards measurements in homes (20-25 °C and R.H. ≤ 50)

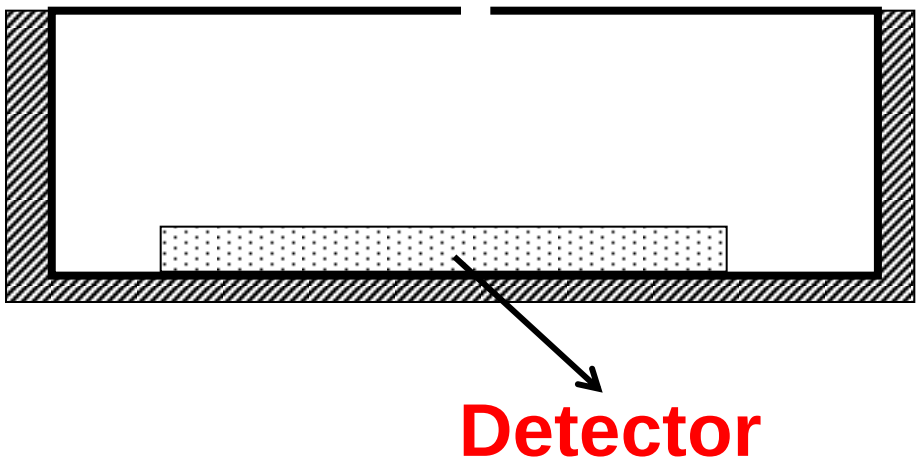
Calibrations and intercomparisons aimed at Rn-measurements in homes

Courtesy from J. Miles

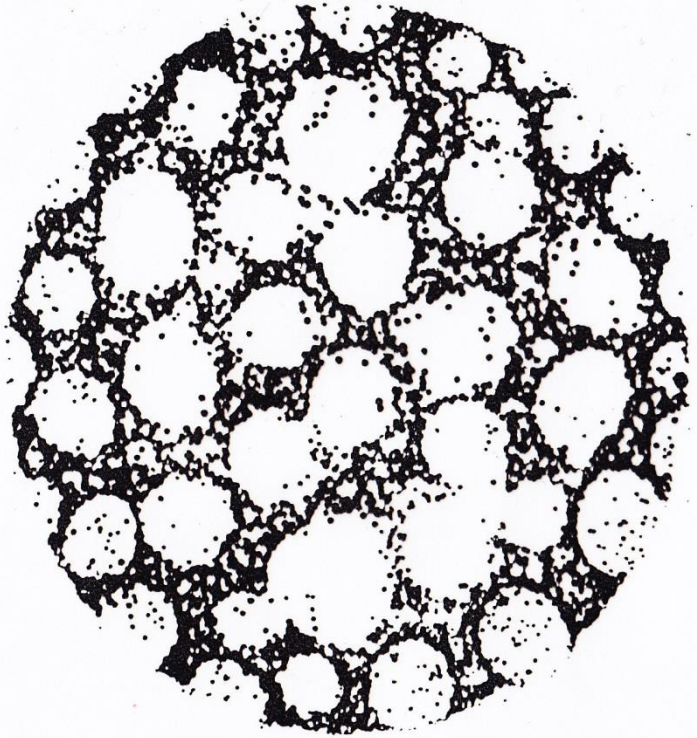
A variety of errors may occur if used in workplaces or any place with severe environmental conditions
(0÷40 °C, up to 100 R.H.)

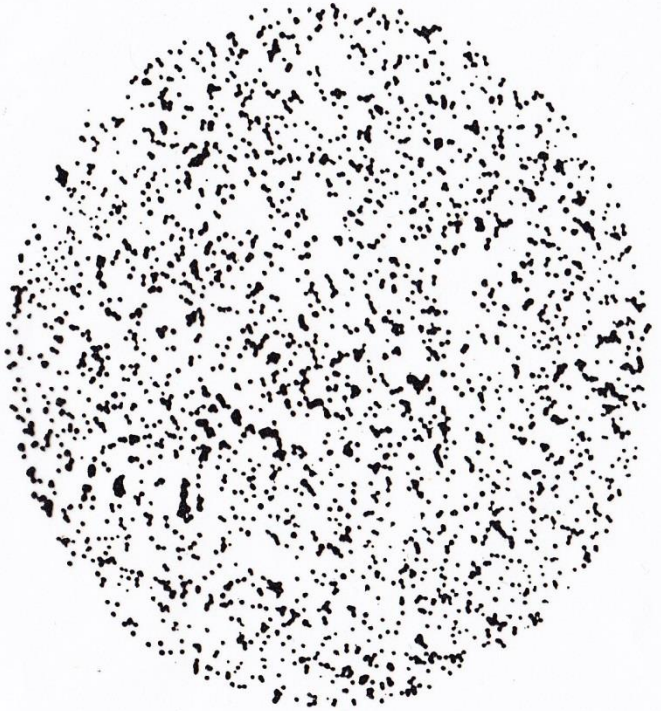
The field intercomparisons at Lurisia are timely needed

Rn-monitors for dwellings:
diffusive chambers with height ≤ 2.5 cm
(Frank and Benton,1981)



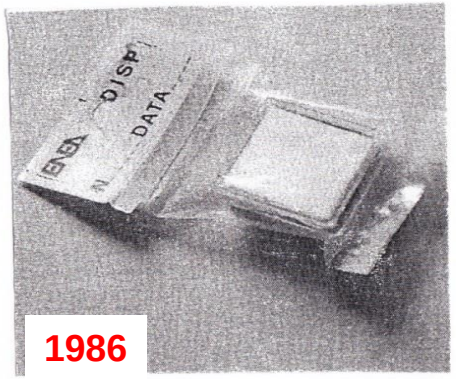
Problems of humidity and thoron when diffusive-chambers first used in soil





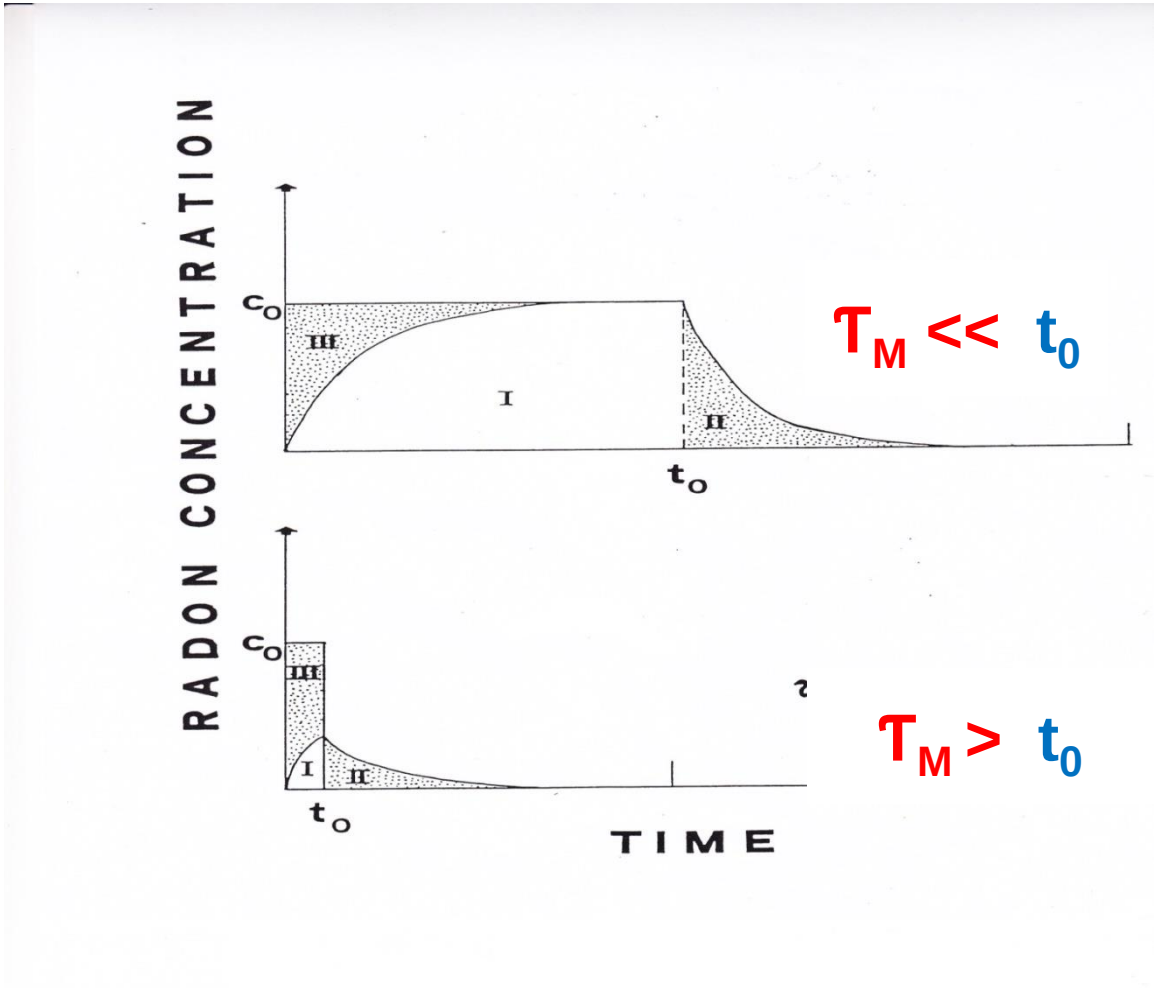
Permeation samples to stop water vapor, thoron, etc….but a long permeation time, τ_M

$$\tau_M = dV/PS$$



τ_M=34 hours τ_M= 6 hours τ_M=33 hours

$\tau_M = dV/PA$

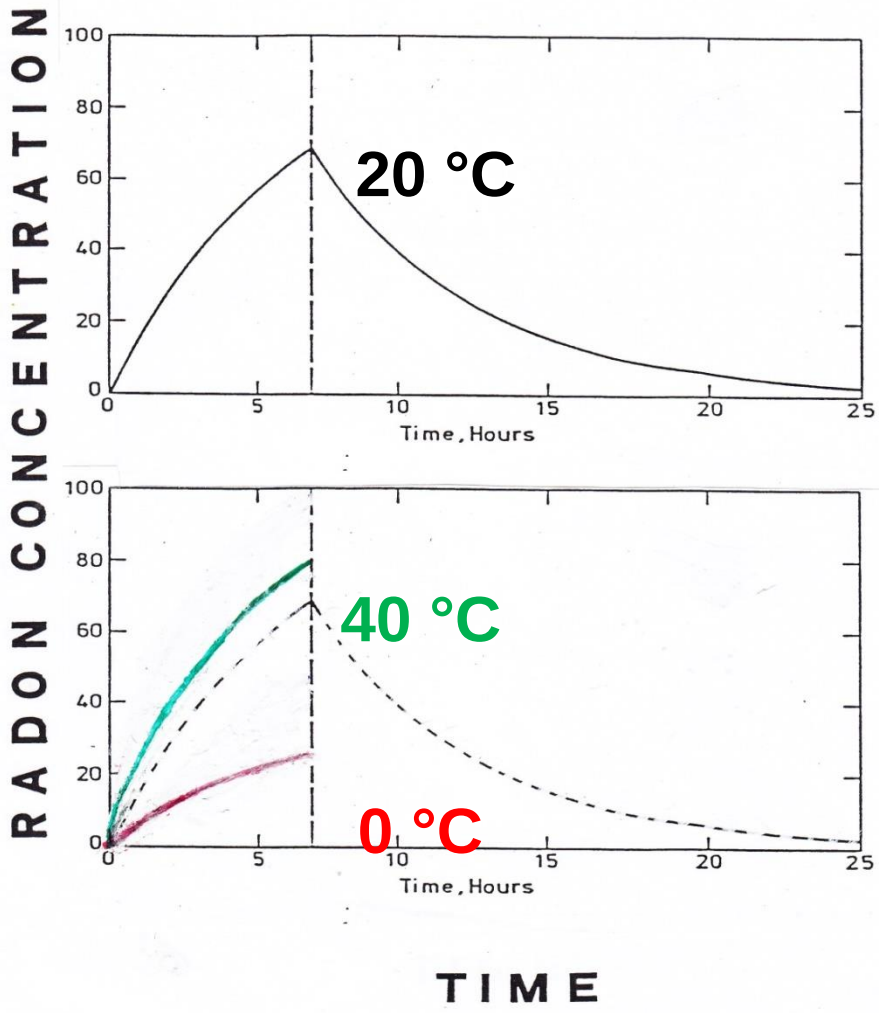


AREA II = AREA III, provided constant P

-Very wrong! P changes with temperature

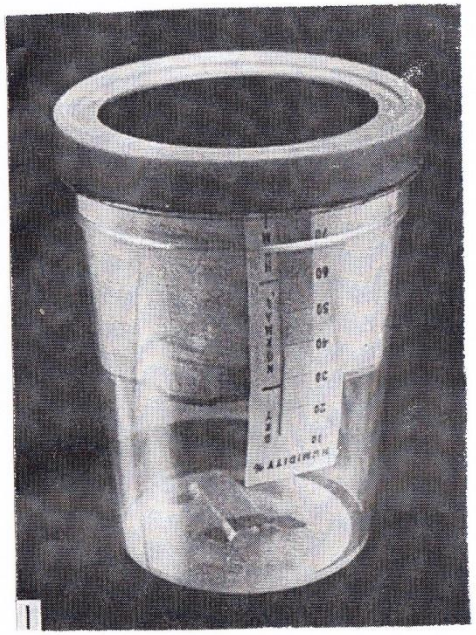
Temperature-T (°C)	PE-Permeability-P ($10^{-7} cm^2/s$)
0 °C	0.15 ± 0.04
20 °C	1.20 + 0.04
40 °C	3.60 + 0.50

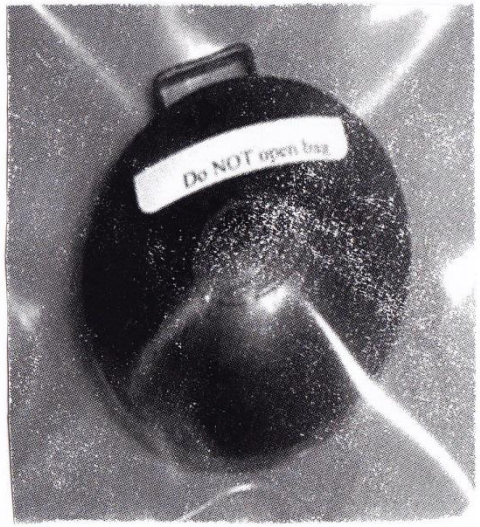
Permeation time, $\tau_M = dV/PA$



Different responses from 0°C to 40 °C

$T_M = dV/PA$

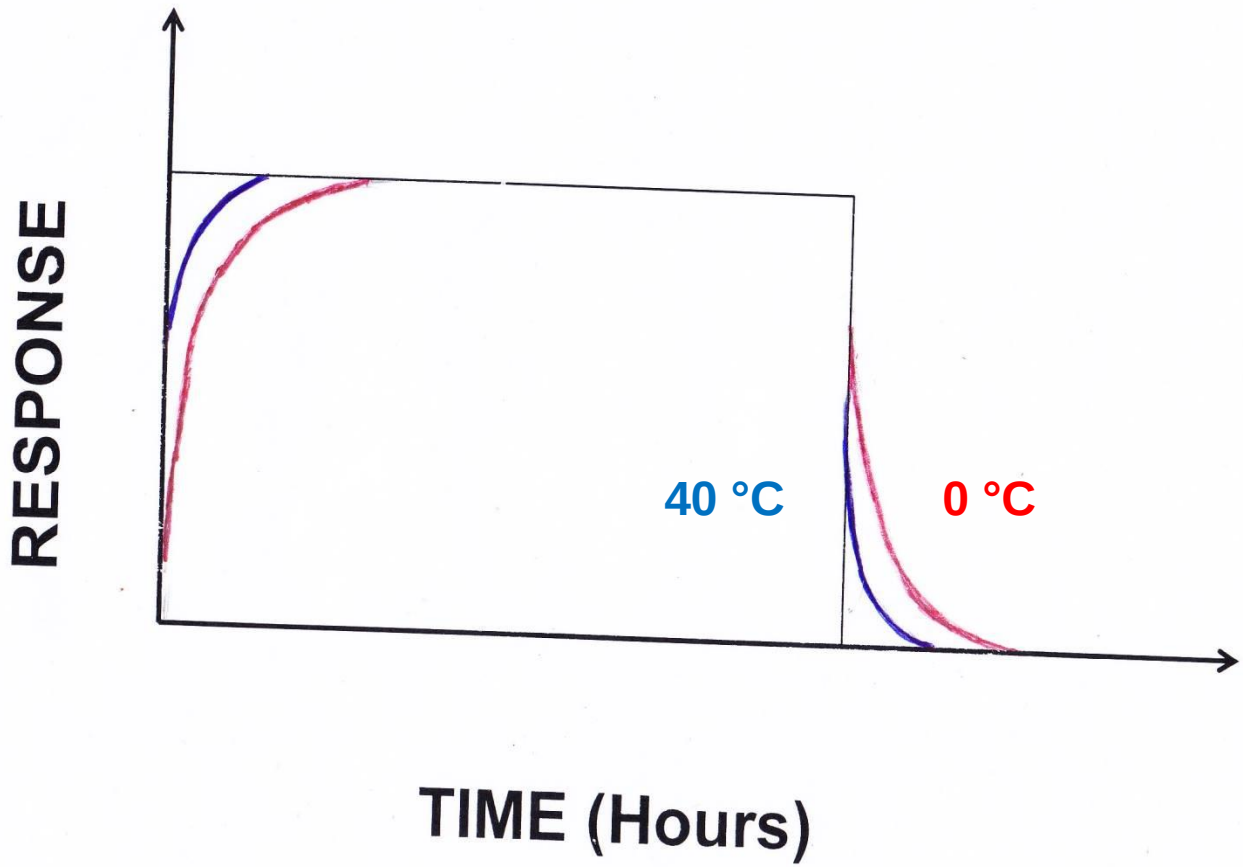




T_M=34 hours T_M= 6 hours 33 hours

Temp.	C_{in}/C_o	C_{in}/C_o	C_{in}/C_o
0°C	0.32	0.73	0.33
40°C	0.92	0.99	0.92

$\tau_M \leq 1$ hour $t_0 = 8$ hours



For an exposure of 8 working hours ,

$\tau_M \leq$ 1 hour as in diffusive chambers

For existing permeation monitors, τ_M (dV/PA) $\leq$1 hour only for small air volumes (but too small responses)

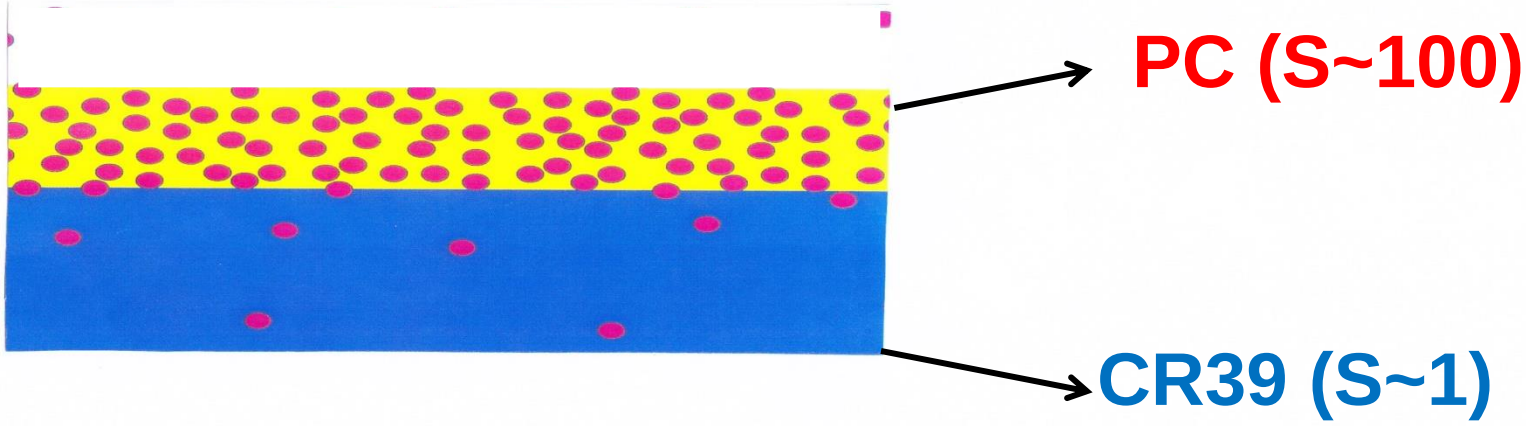
τ_M $\leq$1 hour and any desired response by Rn-sorption-based radiators

First Rn-film badge made of

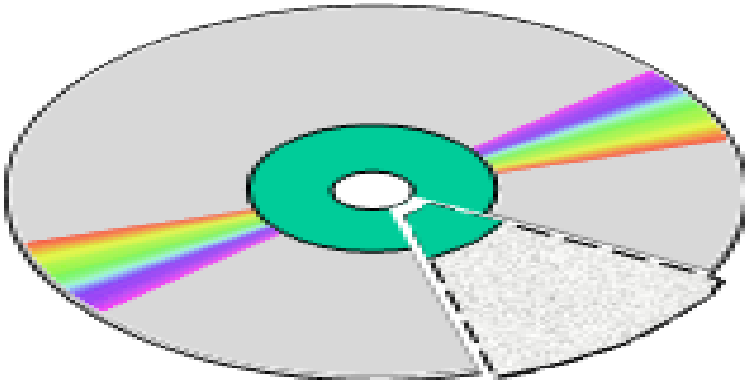
POLYCARBONATE (Radiator)

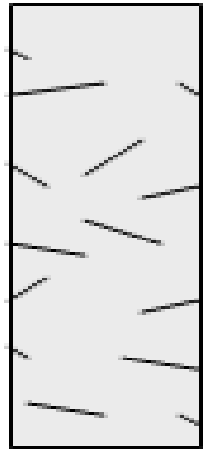
CR-39 (Detector)

PC Solubility ~ x10 larger than that of liquid scintillators



CD-ROM

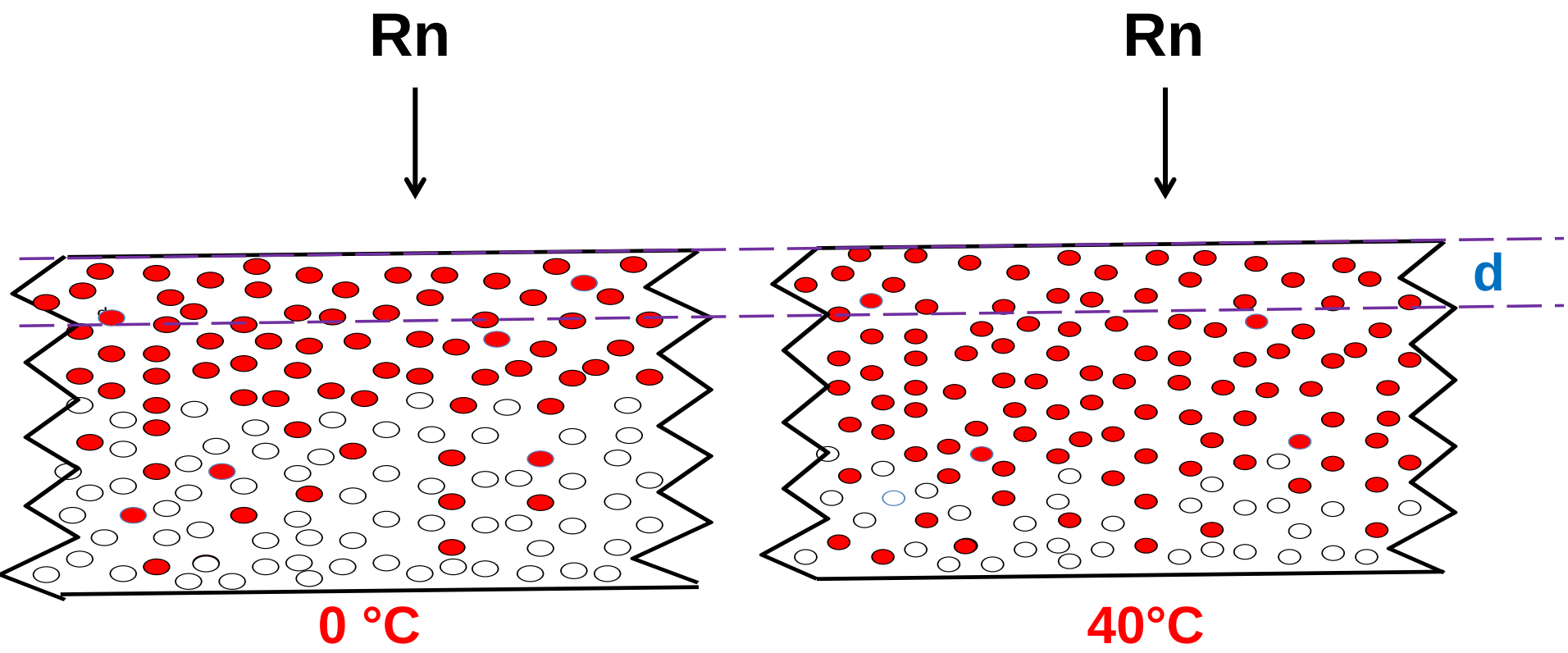




Retrospective radon-detector

$D_{air}=10^{-1}$ cm^2/s; $D_{PC}=10^{-10}$ cm^2/s

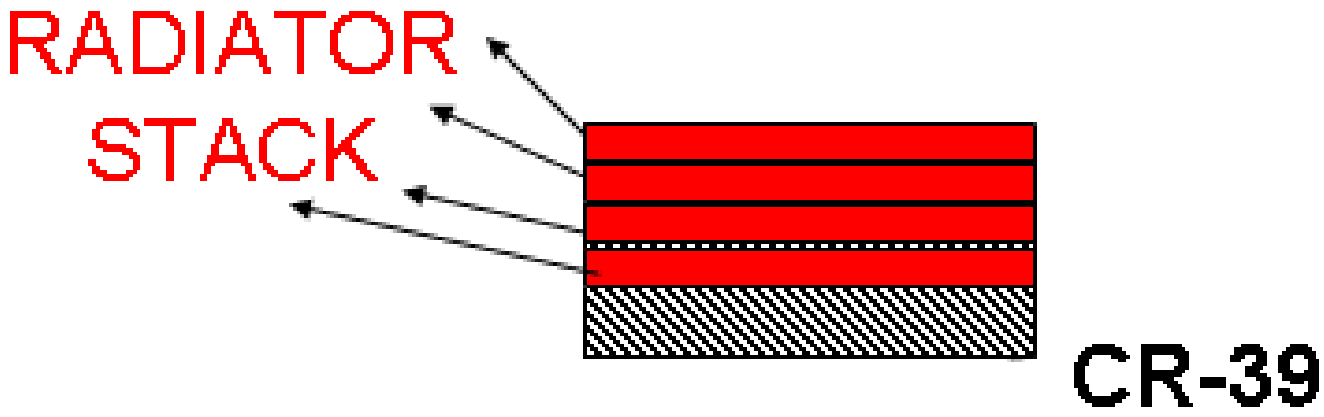
(From Pressianov and others)



$$T_{Abs} = (d^2/6D)$$

Small d: fast response, not affected by temperature

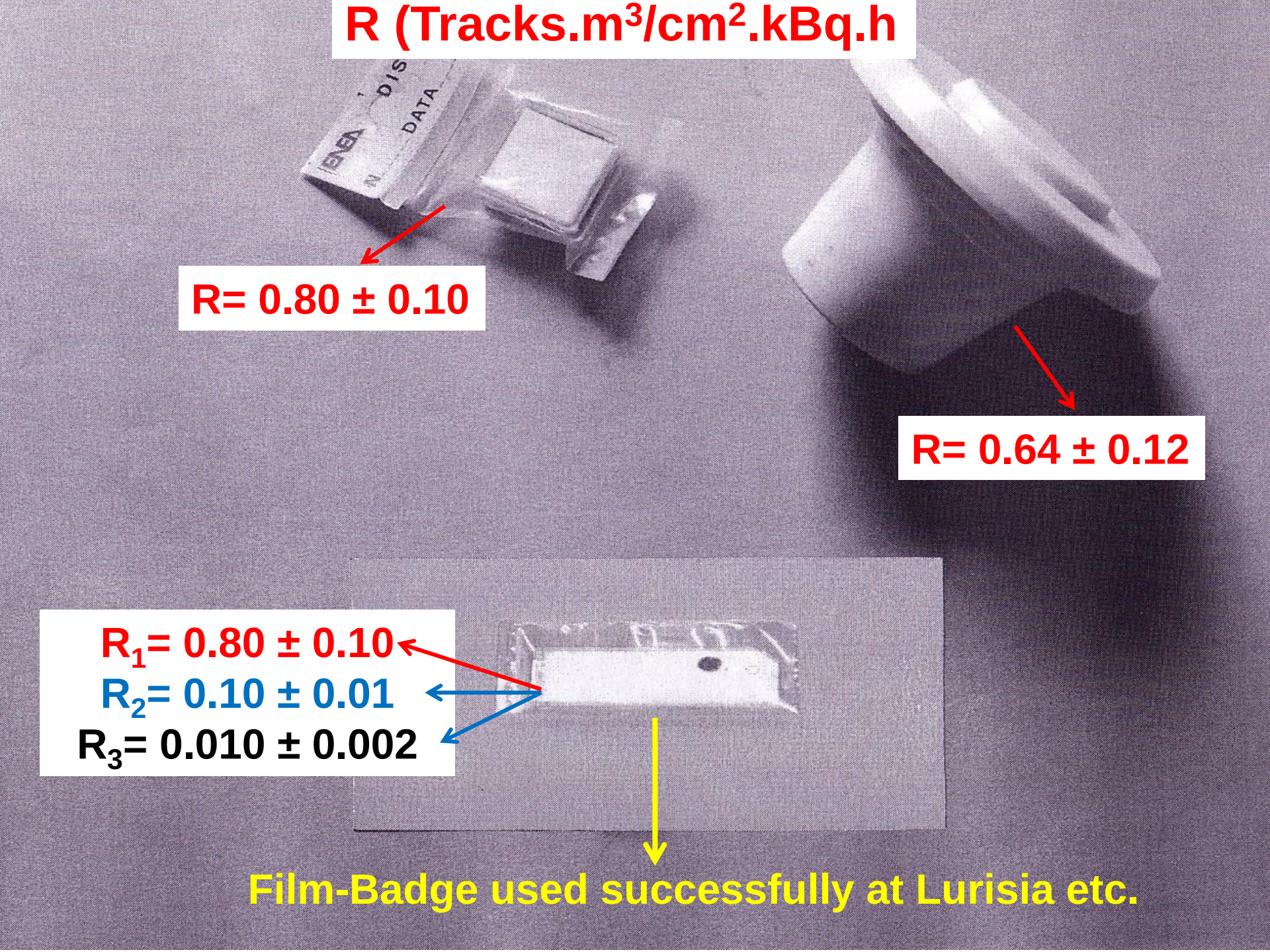
The stack absorption-time, T_{abs}, is that of a single film



$$€_{max} = KCSR_{max}$$

For $d \leq R_{max}$, different responses for different d

R (Tracks.m^3/cm^2.kBq.h



Film-Badge used successfully at Lurisia etc.

Response=k·C·**S**(Solubility)·**d**(Thickness)

Badges with any desired response:

-radiators with any thickness, **d** $\leq R_{max}$

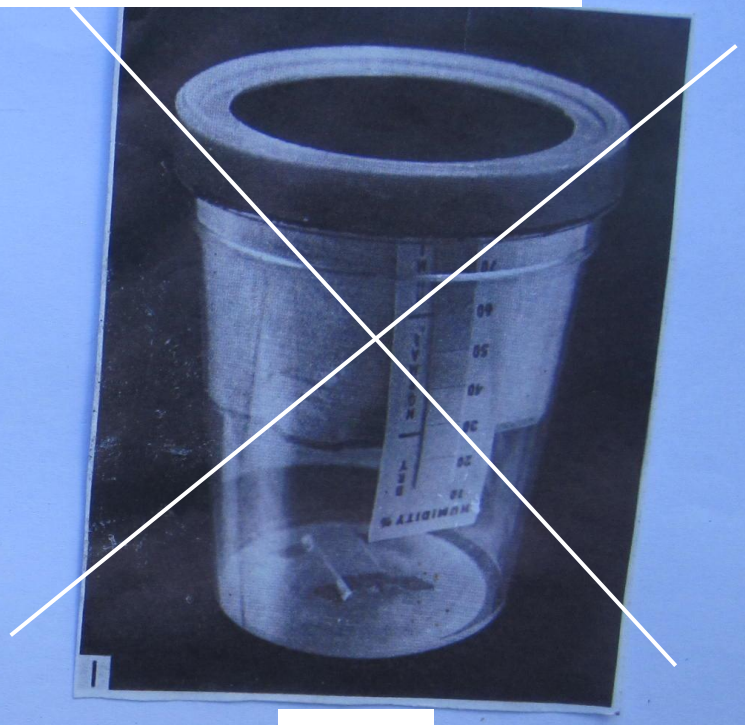
-radiators with different solubilities, **S**

Fast absorption by microfiber cloths, S=14

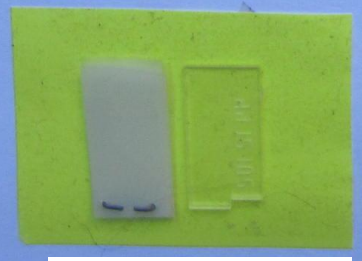
Fast absorption by activated carbon cloths, S=2000

CR-39 RESPONSE, R(Tracks.m^3/(cm^2.kBq.h)

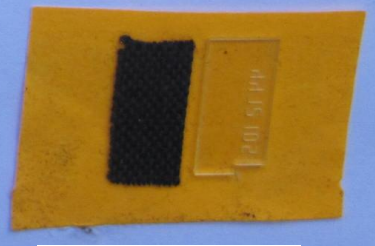
R ~ 3



R ~ 6



R ~ 0.01 ÷ 1

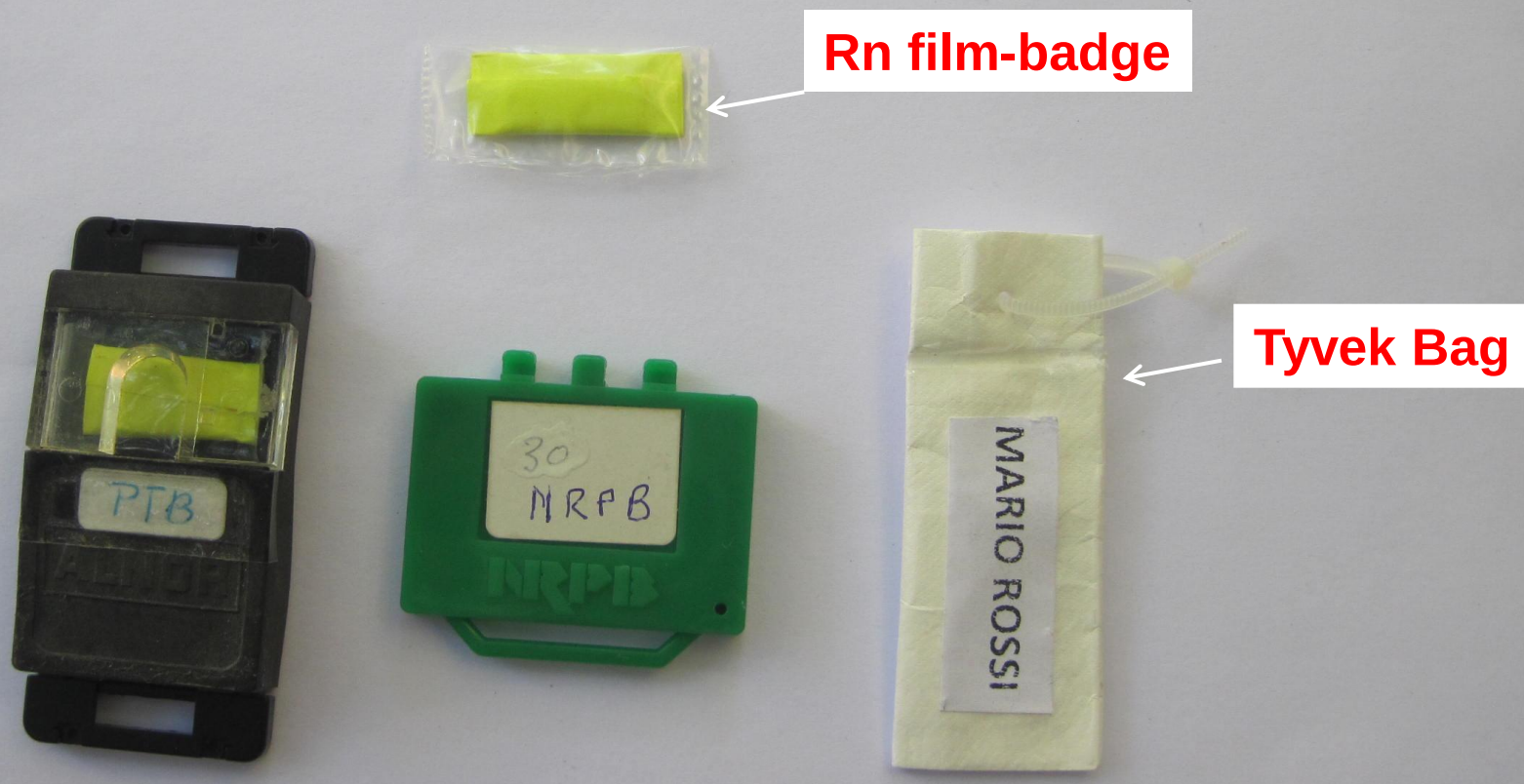


R ~ 6 ÷ 20

-Easily wearable and deliverable

-Enclosable in any (x-, *γ*-, *n-) personnel-dosimetry holder*

***-The holder of* choice: a heat sealed Tyvek Bag**



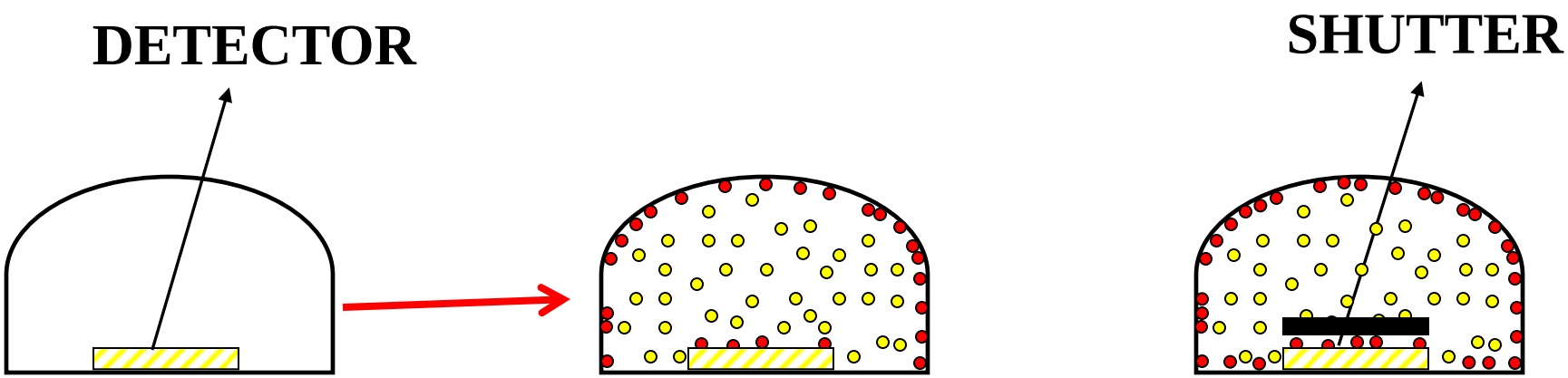
TURNING-OFF THE RADON MONITORS:

The two types of radon monitors (J. Miles)

- **SWITCHABLE Monitors**
- **ALWAYS-ON Monitors**

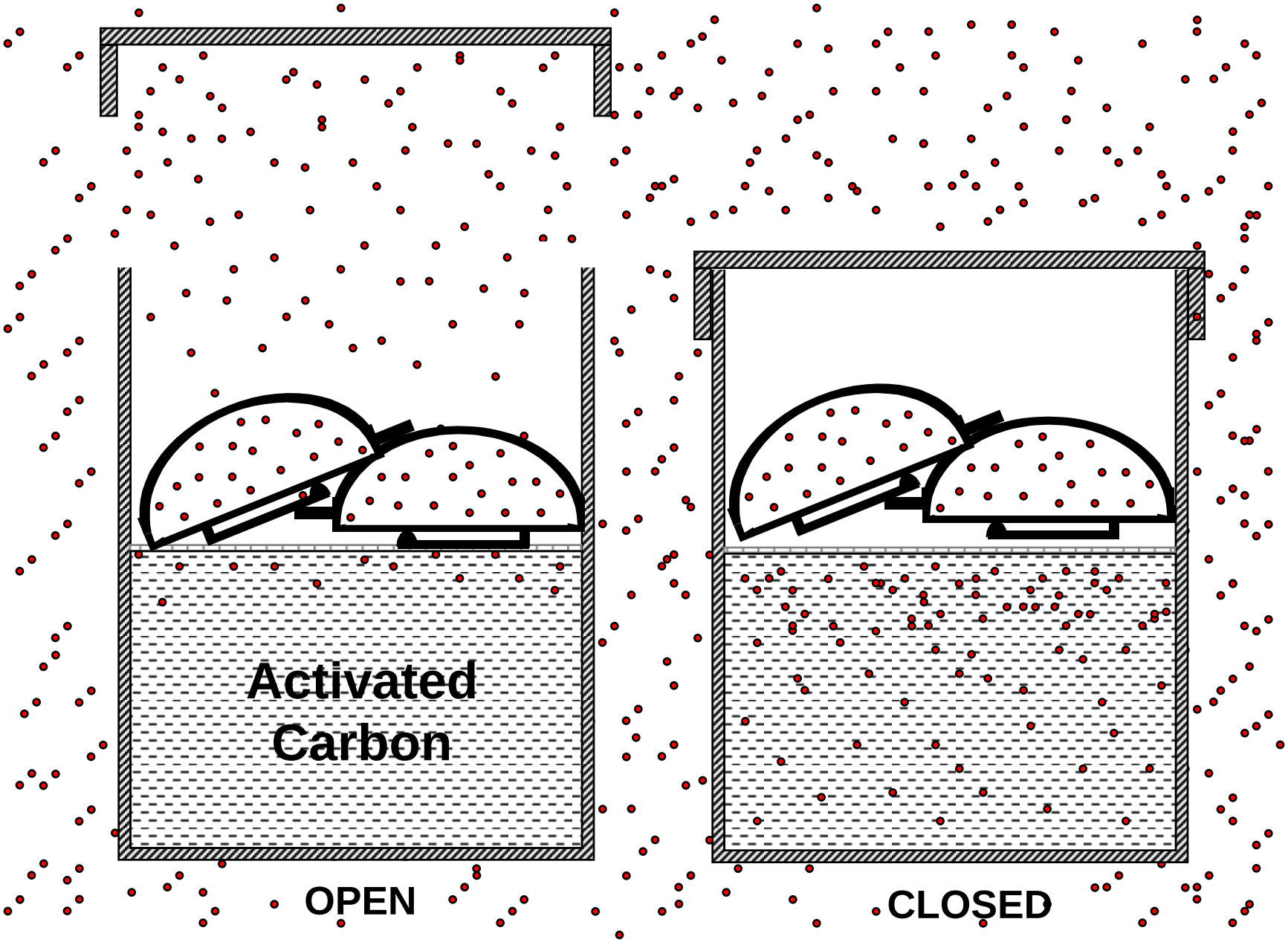
TURNING-OFF SWITCHABLE MONITORS

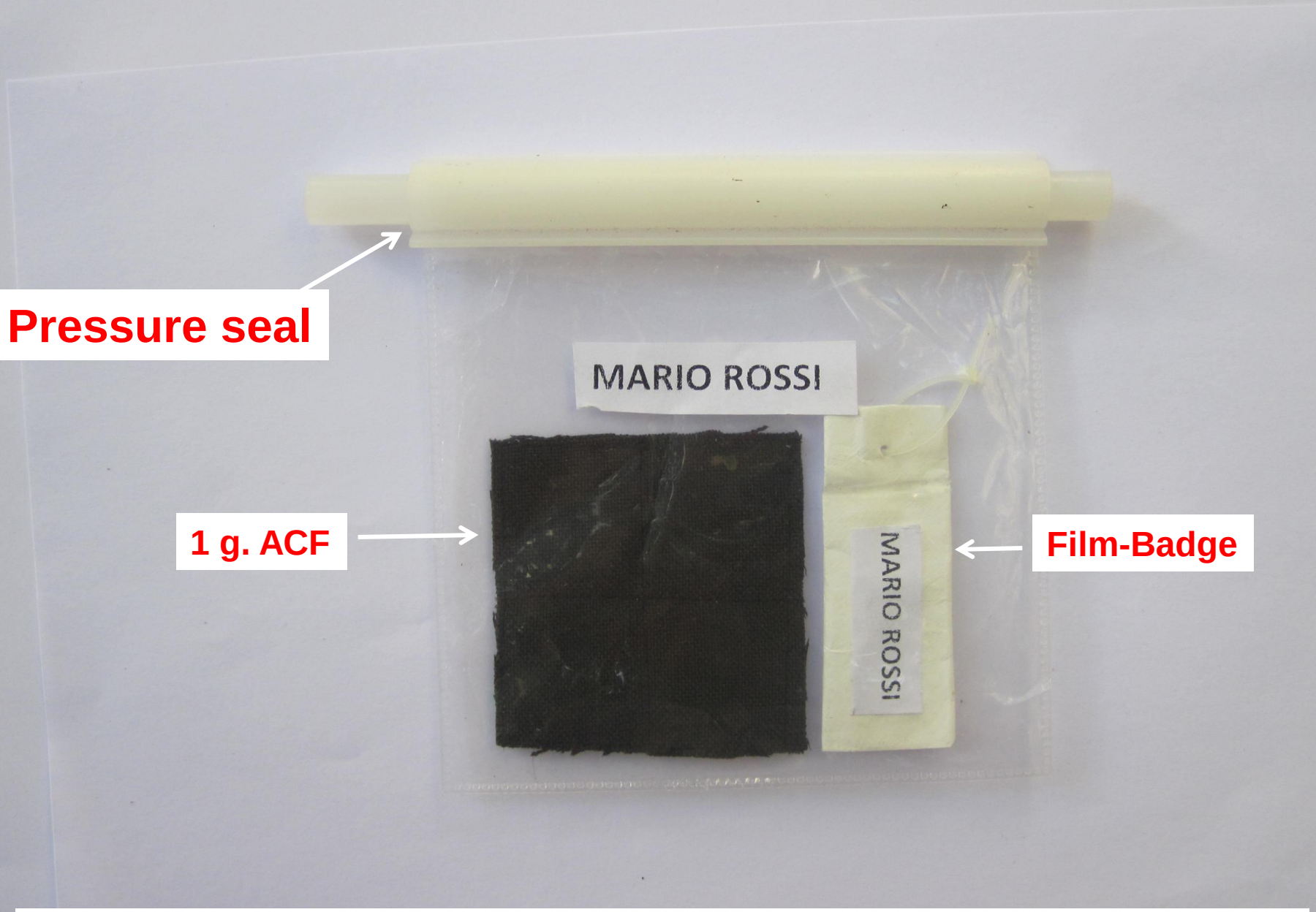
ON: Response signal with 3-hours ramp-up-time
OFF : response-signal with zero ramp-down-time



ON **After 3 hours** **OFF**

Turning off Rn-monitors by Activated Carbon





Rn permeation-time in the polyester bag: τ_M~100 years

Smartphone bag with pressure seal