



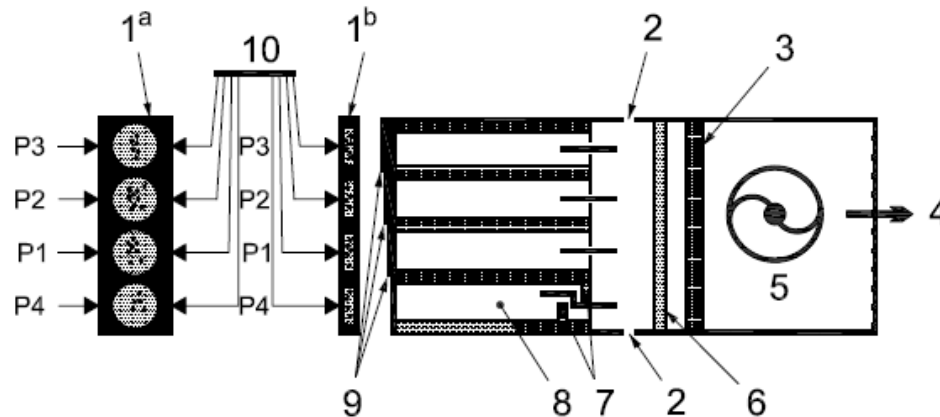
# Measurements of radon daughters

Tuukka Turtiainen (STUK)

# Measuring PAEC

- PAEC is interesting since the result is “closer” to the dose than radon concentration
- If generic equilibrium factor ( $F=0.4$ ) is not expected, PAEC / WL measurements can be carried out
- The concentration is PAEC or WL from which the exposure unit WLM and corresponding dose is calculated
- At present, the reference levels are set for radon concentration so these measurements are “academic”
- It must be remembered that the diameter of the aerosol greatly affects the dose, the unattached fraction being the most harmful
  - The unattached fraction follows radon concentration better than the unattached fraction

# Integrated measurement



## Key

- 1 solid state nuclear track detector (SSNTD)
- 2 air inlet
- 3 mass flow-meter
- 4 air outlet
- 5 vacuum pump
- 6 high-efficiency filter
- 7 baffles (diffusion barrier)
- 8 collimator
- 9 boPET (biaxially oriented polyethylene terephthalate) screen
- 10 scanning range

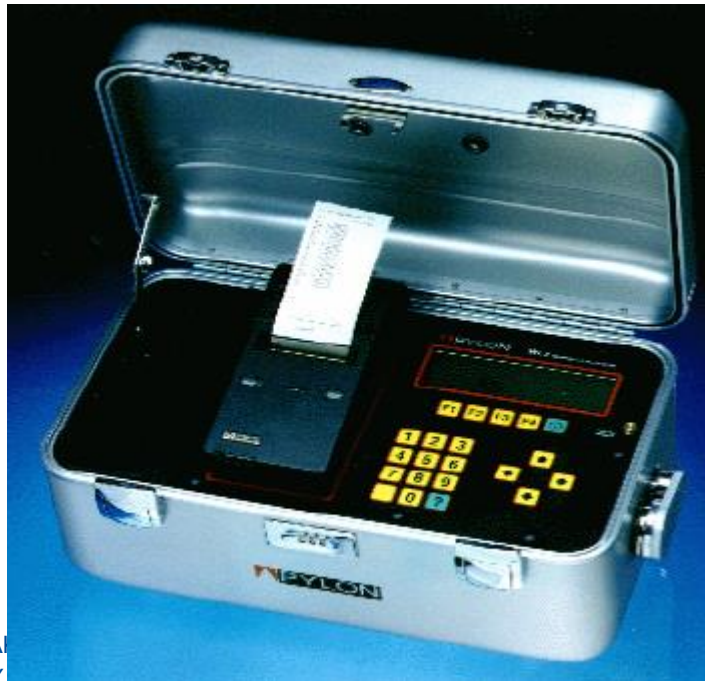
- Integrating measurements are carried out with SSNTDs
  - Generally 4 four films that have collimators/screens in front in order to attain energy discrimination

If thoron present, several alpha active nuclides

Rn-222: 5.5 Mev, Bi-212 and Po-218: 6.0 MeV, Rn-220: 6.2 MeV, Po-216: 6.8 MeV, Po-214: 7.7 MeV, Po-212: 8.8 Mev

# Continuous measurements

- WL-monitors
- Generally a sample is taken on a filter (precise pump)
- Filter is measured immediately several times with a semiconductor (different measurement length)
- An algorithm based on the different half-life of these daughter nuclides is computed

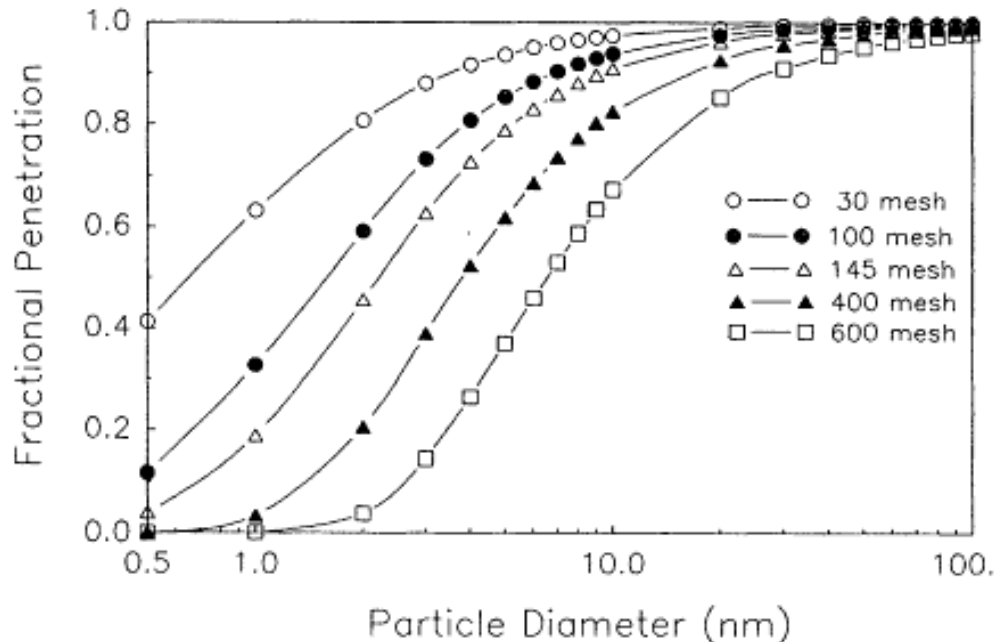


## Even more detailed investigations

- If the measurer knows how to operate lung models, daughters in different size particles can be measured
- The average concentration of each nuclide in different size groups can be estimated and the resulting dose calculated
- The ICRP 65 dose is based on conversion convention and has little to do with dosimetric models and hence these results are not comparable with doses calculated based on ICRP 65

# Attached / Unattached daughters

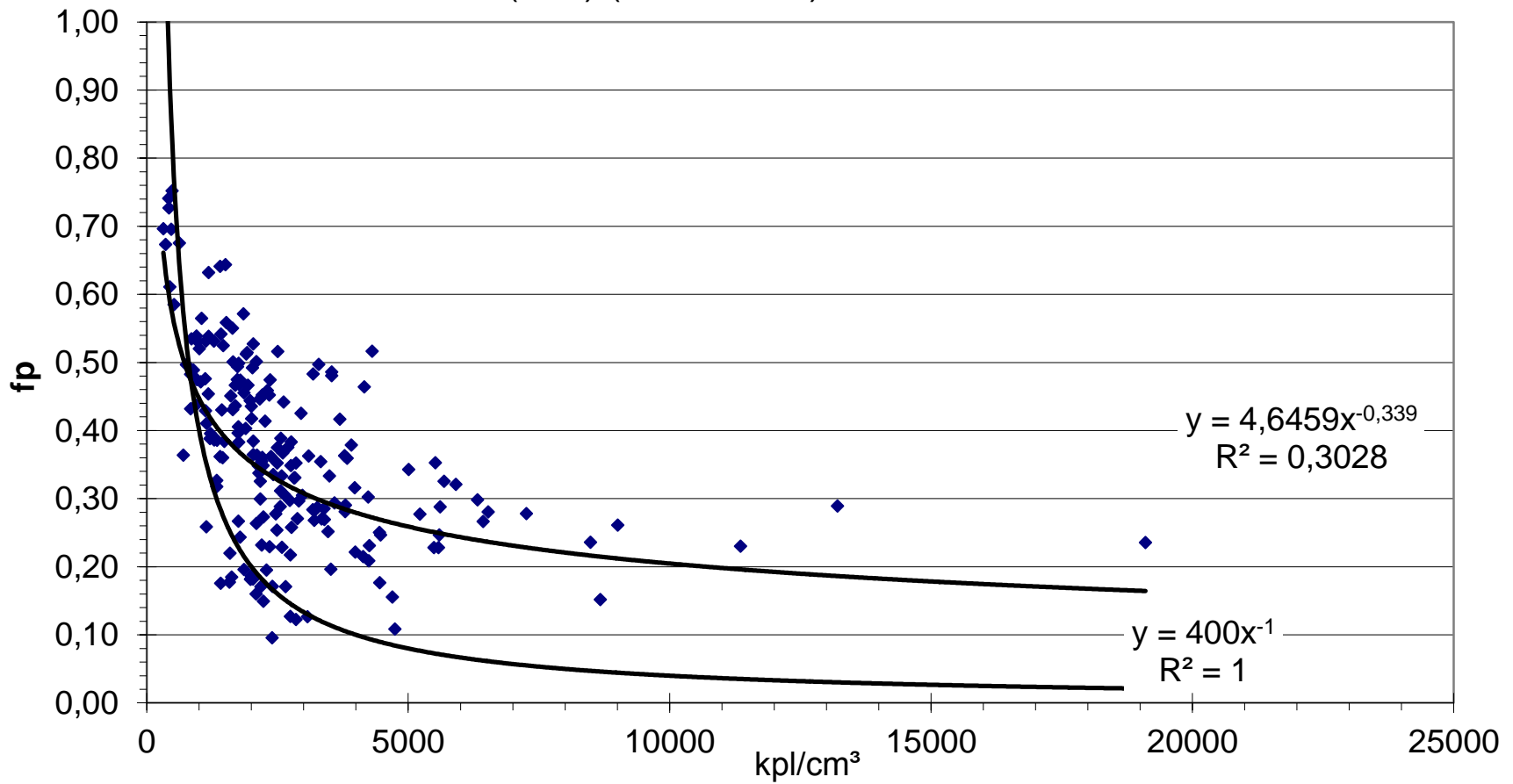
- The unattached fraction can be “filtered” with metal wire screens
- Deposition of smallest particles (unattached fraction) on wire screens while larger particles will go through and can be collected on a subsequent filter



Source: NRC: Comparative Dosimetry of Radon in Mines and Homes , 1991

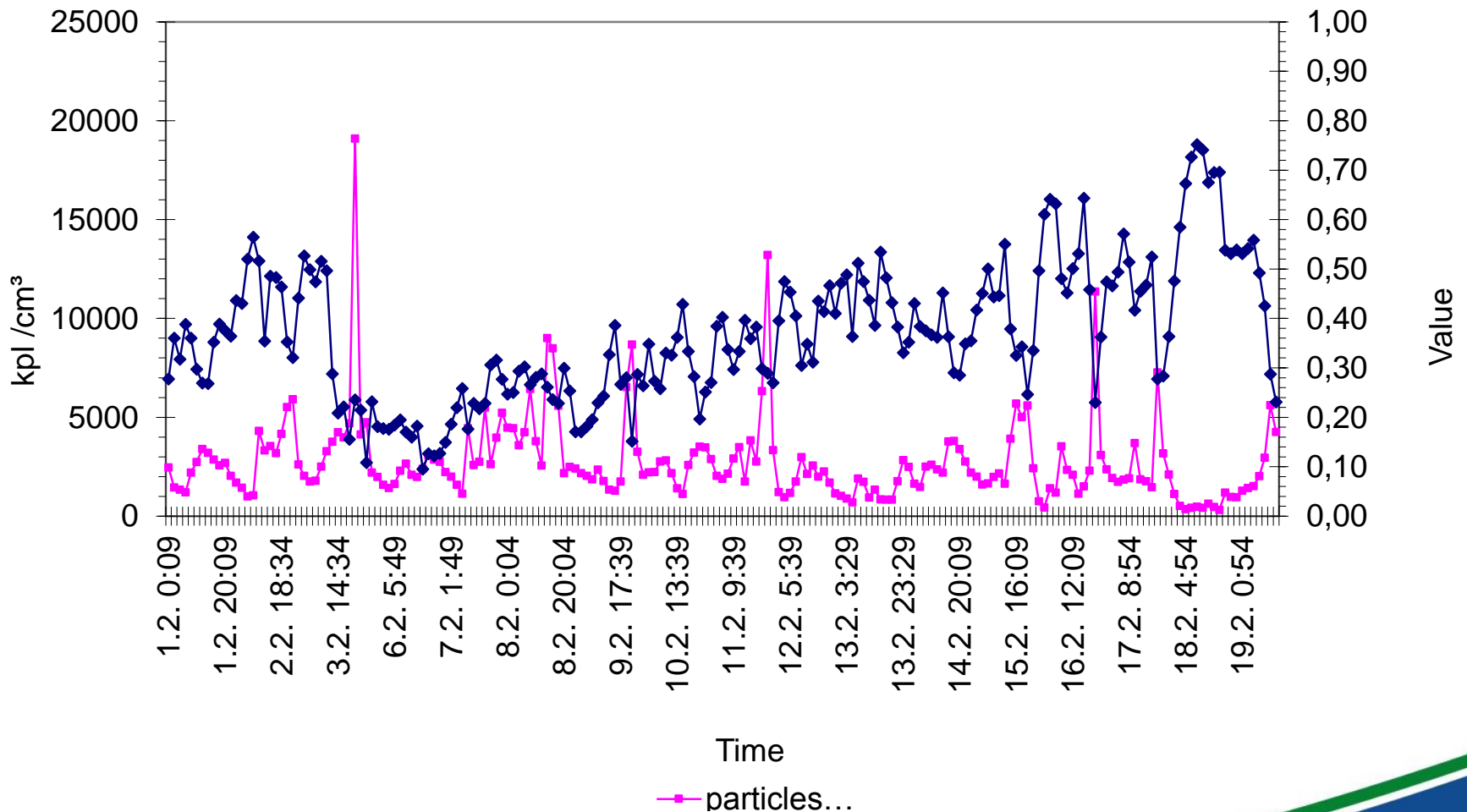
# Unattached vs. particle concentration

Unattached fraction (fp) vs aerosol total particle concentration Z (cm<sup>3</sup>) (3 - 400 nm): Huet fit and data



# Unattached vs. particle concentration

### Particle concentration and unattached fraction





# Radon, attached and unattached

