Radon Calibration Facilities at HPA

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The Radon Problem

There is no international radon concentration standard

Therefore we rely on

National standards eg NPL, PTB, NIST

Laboratory intercomparisons of radon chambers (BIPM 2004)

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Radon chambers

Provide a controlled and monitored atmosphere

May be:

Steady state

Flow through

Or use individual radon sources

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Radon chambers

Parameters typically monitored and / or controlled:

Radon concentration

Decay product concentrations (equilibrium factor)

Temperature/pressure/humidity

Aerosol concentration/size distribution

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Radon chambers

Aim is to reproduce where possible conditions in which instruments or detectors are used.

For homes and above ground workplaces

Ambient temperature/pressure/humidity

Equilibrium factor ~ 0.4

Aerosol size approx. 200 nm (median thermodynamic diameter)

Radon concentration variable

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HPA Radon Chamber

Steady state (constant emanation) type

Volume 43 m^3

Radon concentration 400 – 8000 Bq m^{-3}

Equilibrium factor (F) 0.1 – 1.0 (approx)

Unattached fraction (fp) up to 0.3

Aerosol concentration 2000 – 70 000 particles cm^{-3}, MTD 90 -120 nm

Temperature/pressure/humidity monitored but not controlled

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HPA radon chamber

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Radon chamber aerosol

Carnauba wax

Used to help control equilibrium factor and unattached fraction

Produced using evaporation/condensation technique

Measured using TSI diffusion battery and condensation nucleus counter

Checked against 2 x TSI SMPS systems plus TEM – broad agreement

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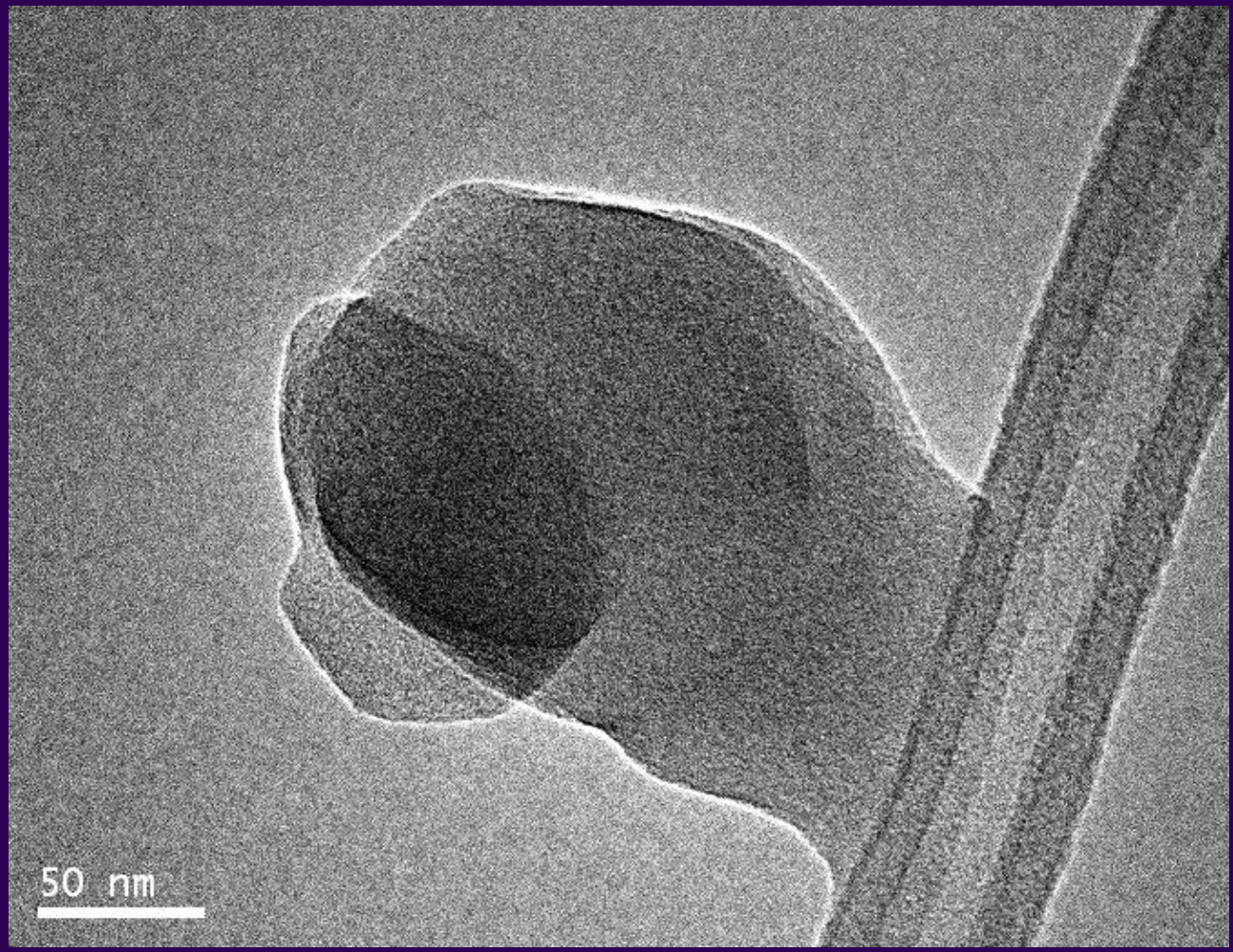
TEM of radon chamber aerosol



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Radon gas monitoring

Primary instrument is Atmos 12 DPX

Calibrated every six months using sources supplied by PTB

- Source released into sealed known volume
- Concentration range 1000 - 40 000 Bq m^{-3}
- Used to calibrate Alphaguard secondary instruments

Alphaguard has battery life of nine days – used as backup in chamber

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Instrument background

Background increases with time for all instruments

Caused by Pb - 210 implanted into material of detecting volume – decays to Po - 210

Assessed by operating instrument in radon – free atmosphere (Nitrogen) for minimum 48 hours.

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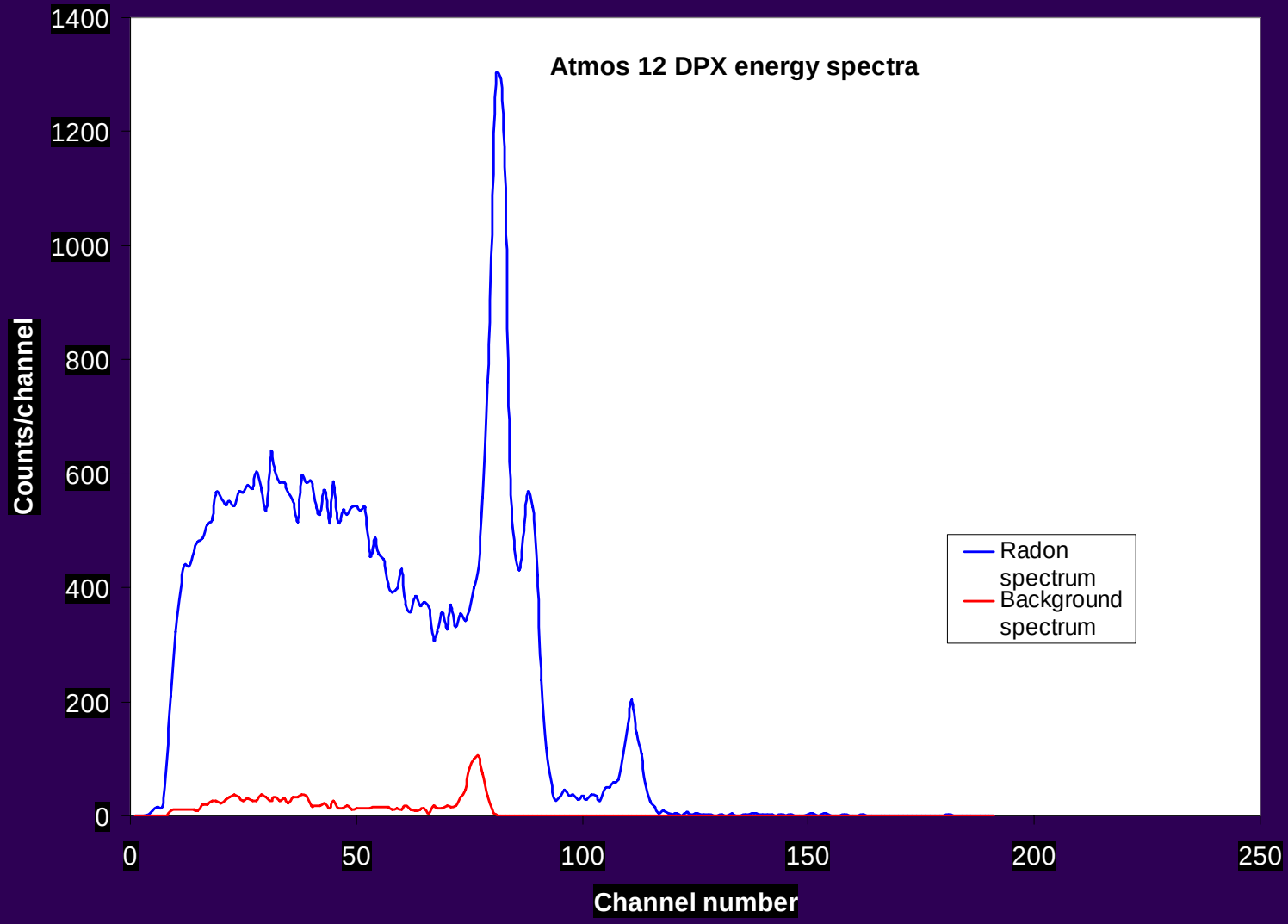
Instrument background Po - 210



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Decay product monitoring

Measured using alpha spectrometry

Sampled at 30 cm from wall of chamber onto Millipore AA filter

Counted using Ortec Soloist under partial vacuum

Analysed using Nazaroff (1982) method to determine individual radionuclide concentrations and EER

Calibration traceable to NPL and PTB

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Equilibrium Factor

Calculated by dividing EER by actual radon concentration

Obtained by use of aerosol generator, electrostatic precipitator and mixing fan in various combinations

Decay product concentrations are homogenous within chamber

F can be set and held stable for several days if necessary in range 0.1 to ~1.0

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Unattached Fraction

Measured by sampling onto wire mesh backed by filter

Sampled for five minutes – constant flowrate critical

Filter and screen counted simultaneously using drawer counters

Analysed using method outlined by Thomas (1972)

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FRED

Fast Radon Exposure Device

Smaller volume - 0.28m^3

Radon concentration 60 – 80 kBq m^{-3}

Monitored using Alphaguard

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Data management

All monitoring data stored electronically using Microsoft Access

Data is written to local database on monitoring PC then uploaded to network

No data loss if network fails

Alphaguards operate independently if power fails – battery life nine days

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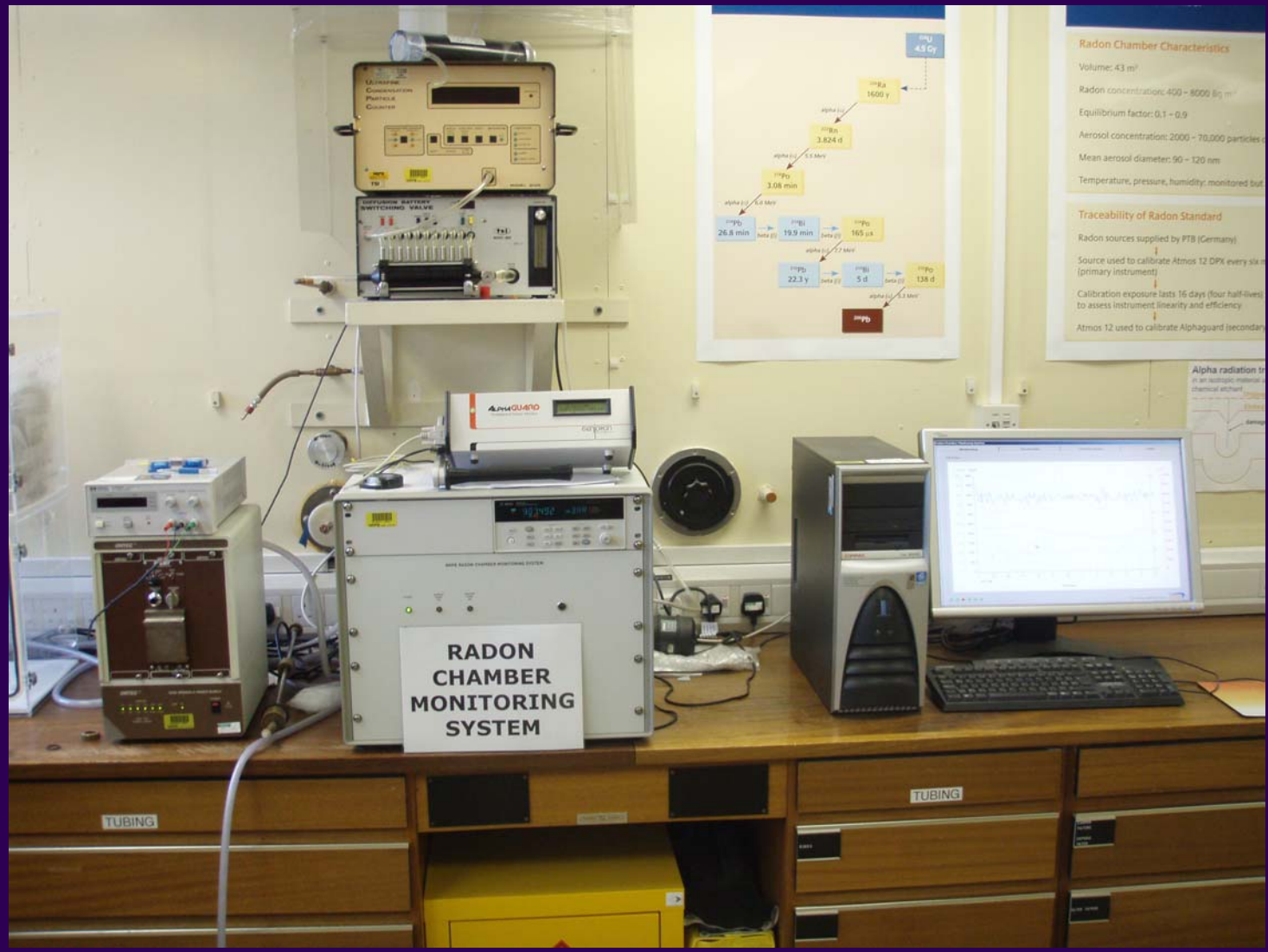
Monitoring equipment



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The End

Any Questions?

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