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Unexpected Daily Peaks in a Laboratory Simulation Experiment of Radon Signals

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Radon is a noble radioactive gas of special interest in earth sciences due to both its unique chemical and physical properties and its natural abundance. The most stable isotope of radon, ^{222}Rn, has a half-life of 3.823 days and is the only gas-phase atom in the ^{238}U decay series.

Radon could be considered as a possible tracer for tectonic and volcanic processes, yet the physical mechanisms that influence radon emanation from rock and transport are unclear. Our team strives to observe and analyse radon signals in monitored environments.

Simulation of radon signals and investigation of their characteristics in laboratory experiments are conducted using radon in an enclosed chamber, termed “Enhanced Confined Mode” (ECM).

An ECM experiment will be described; its arrangement comprises of two ^{222}Rn sources of activity $\sim 10^5$Bq each. The sources are connected in parallel via tube to a horizontal stainless steel cylinder ($\sim$570cm^3) that contains air at atmospheric pressure. Direct count rate measurements were performed using a NaI (2x2”) gamma-ray scintillation detector aligned along the cylinder’s axis, at one minute resolution, for over 60 days.

Radon is supplied into the ECM chamber by diffusion and it disintegrates as it undergoes radioactive decay. A priori, a steady state of diffusion and radioactive decay rates is expected. However, our results show evident deviations from this expected steady state, namely fluctuations that are significant relative to the uncertainty in measurements. Predominant daily peaks characterise the data. Signal processing and analysis of these daily peaks will be presented.