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Daily and half-daily periodicities of radon in an enclosed 120cm pipe

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Radon is an inert gas that is wide-spread in nature. Radon is readily detected due to its radioactivity; the most stable isotope, ^{222}Rn, has a half-life of 3.823 days. Geophysicists monitor radon gas in order to trace temporally and spatially varying processes, yet still some physical mechanisms that govern radiation patterns from radon (and progeny) in various environments are not well understood.

Experiments aimed to observe radon signals in closed chambers are termed “Enhanced Confined Mode” (ECM). A Laboratory ECM experiment is performed in a horizontal 120cm stainless steel pipe. A ^{222}Rn source of activity $\sim 10^5$Bq is connected via tube to one end of the pipe, which contains air at atmospheric pressure. Count rate measurements are performed at several positions along the pipe using five NaI (36x76 mm) gamma-ray scintillation detectors; two detectors are positioned parallel along the pipe’s axis and three detectors perpendicular to the pipe’s axis. Measurements are made at one minute resolution, for over 120 days.

Radon gas diffuses into the ECM chamber; there it (and its equilibrium gamma emitting daughters) disintegrates due to radioactive decay. A model for radon concentration along the pipe as the function of time was calculated. The model predicts a steady state of diffusion and radioactive decay rates over time. However, Power Spectral Analysis of the measurements reveals statistically significant peaks at 1 cycles/day and sometimes 2 cycles/day, for three of the five time series gathered. The peaks are observed for detectors that are farthest away from the source. Time and frequency domain analysis will be presented and discussed.