# Novel technique for simultaneous detecting three naturally occurring radon isotopes ($^{222}$Rn, $^{220}$Rn and $^{219}$Rn)

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## Abstract

Radon inspection is becoming increasingly prevalent due to its negative effects on human health. After cigarette smoking, radon is the second leading cause of lung cancer due to its internal dosage through respiration. In this study, we employed a novel liquid scintillation technique to simultaneously detect three naturally occurring radon isotopes ($^{222}$Rn, $^{220}$Rn and $^{219}$Rn). The detection method utilises the delayed coincidence technique and the pulse shape discrimination implemented by digital charge comparison. Furthermore, a Monte Carlo simulation was performed to obtain the gamma response functions of the detector using standard $^{22}$Na, $^{60}$Co and $^{137}$Cs gamma sources. Additionally, the detector resolution and energy calibration parameters were determined by comparing the measured and simulated light output distributions. For the measurement, radon gas from the atmosphere was infused into 700 mL of Ultima Gold AB for 48 h. We determined that the minimum detectable activities of $^{222}$Rn ($^{238}$U decay chain), $^{220}$Rn ($^{232}$Th decay chain) and $^{219}$Rn ($^{235}$U decay chain) were 1.7, 1.0 and 1.2 mBq/l, respectively. The proposed novel technique offers a potential application for detecting all three naturally occurring radon isotopes in water samples.

**The full text can be found at the following link**:

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