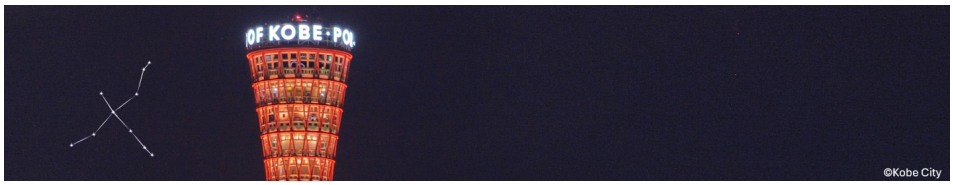


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# Direct in-chamber radon-220 (thoron) emanation measurements for directional dark matter experiments

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Measuring radon emanation from detector materials is a key method for controlling radon contamination, a significant source of background in rare event physics experiments. Methods for measuring radon emanation are well established but have predominantly focused on the 222Rn isotope, the dominant radon isotope for these backgrounds. However, measurements of 220Rn (thoron), the second most abundant radon isotope, remain relatively unexplored. 220Rn emanation measurements are challenging because the 220Rn emanating from the material of interest must be transferred from the emanation chamber to the active detector chamber within its short 55 s half life. In comparison, 222Rn, with its 3.8 d half life, has ample time to be transferred to the detector. In this study, a direct in chamber approach for measuring 220Rn emanation is presented, in which the sample is placed directly within the active detector chamber, thereby minimising losses during transfer. The method was demonstrated with a DURRIDGE RAD8 electrostatic radon detector, which measured 220Rn emanation from low activity thoriated rods with an activity of 76 ± 20 mBq. Compared with a conventional 220Rn emanation set up, the in chamber method increased sensitivity by a factor of 3. Using helium as the carrier gas provided a further increase by a factor of 1.7, giving an overall sensitivity gain of about 5. These results indicate that in chamber 220Rn emanation measurements provide an effective tool for low background experiments and have the potential to accelerate radon studies by exploiting the shorter half life of 220Rn.

**Presenter:** Dr MARCELO GREGORIO, Robert Renz (Australian National University)

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