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Evolution of traceable Radon emanation sources from MBq to few Bq

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In the framework of the EMPIR project traceRadon[1] stable atmospheres with low-level, activity concentrations of radon have to be produced for calibration of radon detectors capable of measuring outdoor air activity concentrations. The traceable calibration of these detectors at very low activity concentrations is of special interest, for the radiation protection community, as well as the climate observation community.
Because radiation protection networks (like the EUropean Radiological Data Exchange Platform (EURDEP)) and climate observation networks (like the Integrated Carbon Observation System (ICOS)) need reliable, accurate radon activity concentration measurements, either for identification of Radon Priority Areas (RPA), for false alarm prevention or to apply the Radon Tracer method (RTM) for the estimate of greenhouse gas (GHG) emissions.
To achieve this goal, low activity sources of radium have been produced with different methods and different characteristics. Sources from MBq Ra-226 down to several Bq Ra-226 have been developed and characterized during this evolution and uncertainties below 2 % (k=1) have been reached through dedicated detection techniques, even for the lowest activity sources. The uncertainty of the lowest activity sources is improved by a new online technique, a combination of the source and the detector in the same device. This device named IRSD, reaches a counting efficiency approaching 50 % through detection under quasi 2π sr solid-angle. It is produced with Ra-226 activities between 2 Bq and 440 Bq, already.
To compare the performance of the sources in application, e.g., to establish a reference atmosphere, as well as to study the stability of the sources and to establish traceability to national standards an intercomparison exercise was carried out at the PTB facility.
The different source production techniques, the determination of the radium activity, as well as the radon activity (emanation) and assigned uncertainties are presented. The implementation details of the intercomparison set-up are shown and the results of the characterization of the sources are discussed.

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