

Nanoporous scintillators for radioactive gas detection

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The measurement of pure beta emitting radioactive elements such as ^3H and ^{85}Kr , is a major and a mandatory measurement for nuclear safety authorities issue for the monitoring of the territory, in particular for the monitoring of the expending nuclear activities for the carbon-free production of electricity. The short penetration length of these electrons in the air makes their detection very difficult. It requires mixing the radioactive gas with the sensitive element which is done with ionization chamber (gas-gas mixture) or liquid scintillation (gas-liquid mixture for ^3H only). However, these two methods do not meet all the needs since neither of them combines sensitivity to both gases, real-time analysis, and ease of wide deployment on the territory. Here we demonstrate that the new approach, based on the gas-solid mixture, allows to combine all the criteria allowing the efficient and real time detection of tritium and ^{85}Kr , and more generally of pure beta radioactive elements. We show that by synthesizing a transparent and scintillating nanoporous material, here a highly porous aerogel based on doped inorganic scintillators, we detect in real time with an efficiency of 95% and 20% the ^{85}Kr and the ^3H (illustrative results are presented Figure 1). We achieve sub-Bq.cm⁻³ in 100 s of accumulation, which is the best performance obtained so-far in real time. In this contribution, the latest results in terms of new materials characteristics including time-resolved luminescence, and detection performances will be presented.

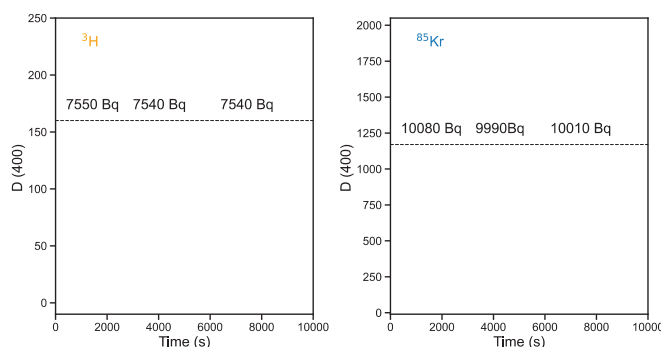


Figure 1: Typical measurements and their reproducibility for ^3H and ^{85}Kr detection. D(400) corresponds to the number of double coincidences measured in 400ns.

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