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## On-site measurement of $^{11}\text{C}$ and $^{18}\text{F}$ half-life by TDCR counting

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**Title:** On-site measurement of  $^{11}\text{C}$  and  $^{18}\text{F}$  half-life by TDCR counting

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**Text:**

The triple to double coincidence ratio (TDCR) liquid scintillation measurement technique is commonly used in national metrology institutes (NMIs) to perform standardization of pure beta emitters. LNE-LNHB has developed two new portable TDCR devices. Such portable instrumentation gives end-users access to a reference measurement method that can be used for a large number of radionuclides. It addresses a wide range of industrial and medical applications for radionuclide metrology such as calibrating solutions with short-lived radionuclides, preventing radioactive source transportation, and performing on-site comparisons to promote radionuclide metrology harmonization.

The standardization of  $^{11}\text{C}$  and  $^{18}\text{F}$  measurement devices, such as a dose calibrator, is necessary in radiopharmaceutical production sites. Due to their short half-life, a primary on-site calibration is more interesting for the laboratory. However, impurities in the radiopharmaceutical solution must be checked in such a context. While this is easily done in the case of gamma emitters, it is much more complicated for pure beta emitters, for example. One solution is then to follow the radioactive decay of the solution in order to quantify possible impurities. In this work, we present new half-life measurements of  $^{11}\text{C}$  and  $^{18}\text{F}$  decays performed at the Orsay Hospital in the CEA/SHFJ laboratory (France). These measurements were carried out by liquid scintillation using two custom portable micro-TDCR and mini-TDCR devices. The measured data were analysed to evaluate the half-life of these two radionuclides as accurately as possible, and those for count rates above  $400,000\text{ s}^{-1}$  until almost complete decay of the radionuclide. The measured half-lives were determined to be 20,333 (7) min for  $^{11}\text{C}$  and 1,8287 (2) h for  $^{18}\text{F}$ . The former result is more precise by a factor of three compared to DDEP recommendation of 20,361 (23) min. The latter falls in the most precise available measurements as the DDEP recommended value is 1,82890 (23) h. In this paper, the results and corresponding uncertainty budgets will be described precisely. Accidental coincidence correction and background influence will be discussed in detail. Indeed, these two parameters were identified as the major contribution for such on-site measurements. A review of the half-life data and the impact of its measures will also be discussed.

Finally, an evaluation of the sensitivity to impurities will be carried out in order to define the detection capabilities of such an on-site measurement technique.

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**Proposed session:** Nuclear decay data

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