TDCR with Background

TDCR is affected by background because background TDCR can be different from isotope TDCR. This should be taken into account with low activities.

TDCR obeys linear mathematics. In the following, subscripts A, B and Tot refer to isotope, background and total (= isotope + bkg), respectively. $TDCR_A$, $TDCR_B$ and $TDCR_{Tot}$ are their TDCRs. C_A, C_B and C_{Tot} are all the accepted coincidences (3-coincidences + 2-coincidences). T_A, T_B and T_{Tot} are the 3-coincidences or triples. The general formula for TDCR is

(1) $$TDCR = \frac{T}{C}$$

From which $T = C\ x\ TDCR$. Obviously $T_{Tot} = T_A + T_B$. This leads to

(2) $$C_{Tot}\,TDCR_{Tot} = C_A TDCR_A + C_B TDCR_B$$

From which one can solve, noting that $C_A = C_{Tot} - C_B$:

(3) $$TDCR_A = (C_{Tot}TDCR_{Tot} - C_B TDCR_B) / (C_T - C_B)$$

With common pure beta emitters TDCR approximates counting efficiency. If this principle is used for DPM counting, one gets:

(4) $$DPM_A = C_A / TDCR_A = (C_{Tot} - C_B) / TDCR_A$$

By inserting $TDCR_A$ from (3), this can be written:

(5) $$DPM_A = (C_{Tot} - C_B)^2 / (C_{Tot}TDCR_{Tot} - C_B TDCR_B)$$

It is required that bkg values C_B and $TDCR_B$ are carefully measured. Note that $TDCR_A$ needs not be known beforehand.

In a special case that $TDCR_A$ is known, e.g. obtained with a proper standard, one can simply use eq (4) for DPM. $TDCR_B$ needs not be known then. This is analogous to the well-known relation $DPM = (C_{Tot} - C_B)/Eff_A$ where EffA is efficiency of the isotope, determined with a standard. Because TDCRA or EffA are fixed, DPM obtained in this way has better precision (less fluctuation) than from eq (5).

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