Comparison of Triple-to-Double Coincidence Ratio Liquid Scintillation Counting Activity Determinations of ^{60}Co Using Field Programmable Gate Array and List-Mode Acquired Data

- Triple-to-Double Coincidence Ratio Liquid Scintillation Counting (TDCR LSC) = A primary method for the measurement of activity using ratio of triple-coincidence and double-coincidence count rates

$$TDCR = \frac{R_{Triples}}{R_{Doubles}} = \frac{\varepsilon_{Triples}}{\varepsilon_{Doubles}}$$

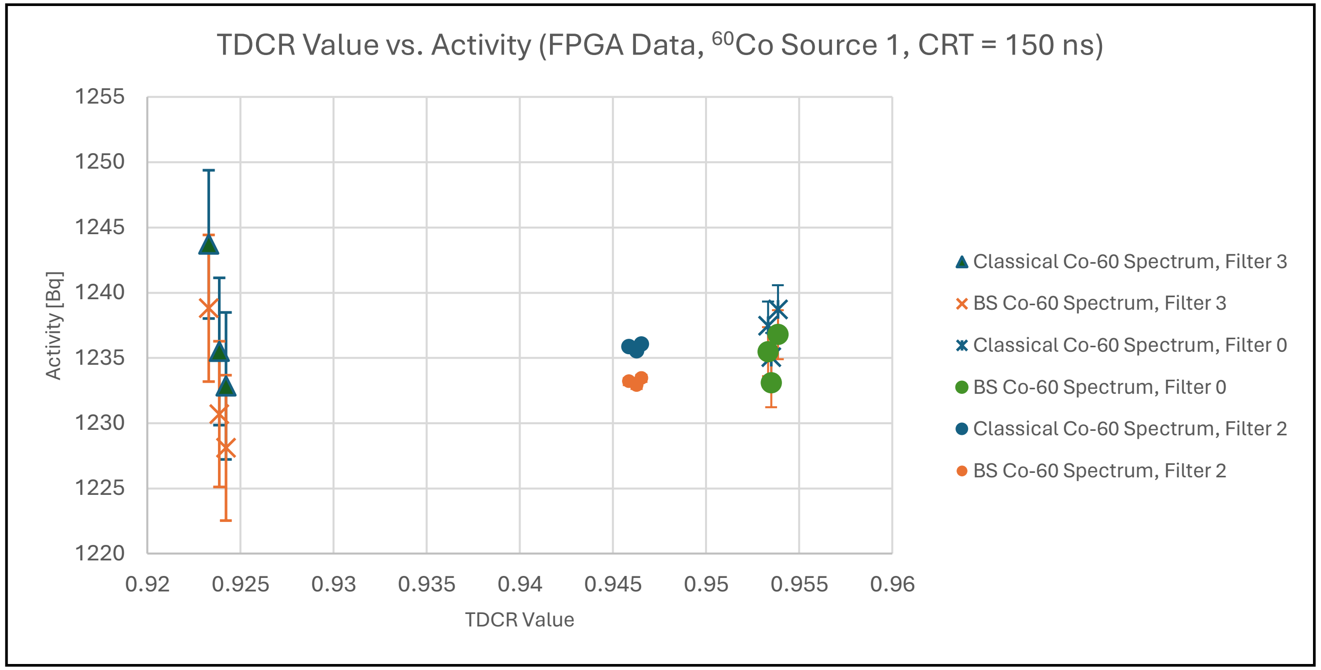
$$A = \frac{R_{Doubles}}{\varepsilon_{Doubles}}$$

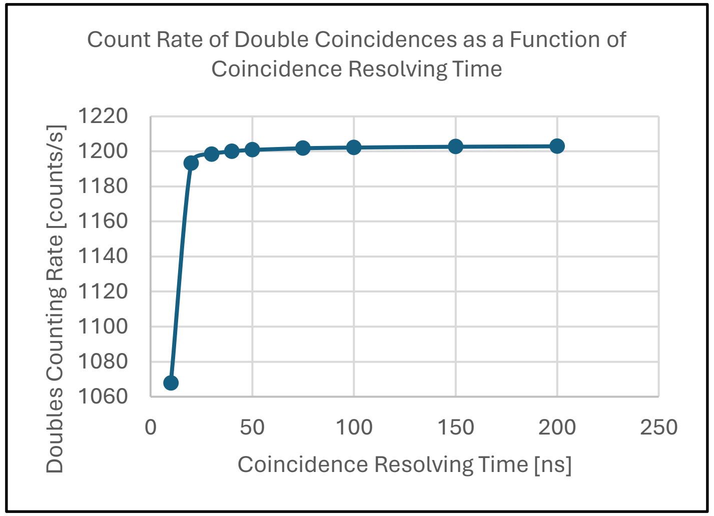
- Counting efficiencies for triple and logical sum of double coincidences:

$$\varepsilon_T = \int_0^{E_{max}} S(E)\left(1 - e^{\frac{-E\cdot Q(E)}{3\cdot M}}\right)^3 dE$$

$$\varepsilon_D = \int_0^{E_{max}} S(E)\left(3\left(1 - e^{\frac{-E\cdot Q(E)}{3\cdot M}}\right)^2 - 2\left(1 - e^{\frac{-E\cdot Q(E)}{3\cdot M}}\right)^3\right) dE$$

- $S(E)$ is the beta spectrum expected to affect the efficiency, $Q(E)$ is energy dependent quench function, and M is the free parameter
- This work: Three studies on the effects of changing parameters on activity determination using TDCR method:
  1. Classical vs. BetaShape ^{60}Co Beta Spectra Study
  2. FPGA vs. List-Mode Data Acquisition Study
  3. Coincidence Resolving Time Study





Activity [Bq]				
	List-Mode Data	Unc.	FPGA Data	Unc.
Classical Beta Spectrum	1266.5	3.1	1268.5	2.4
BetaShape Spectrum	1264.5	3.1	1266.5	2.4