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Coincidence Resolution Time Measurements of LaBr3 (Ce) Detectors with a Fully Digital Acquisition System.

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Fully digital acquisition systems are being increasingly used because of their high sampling rate, their more compact size and their ever-decreasing prize. The possibility of obtaining sampling rates on the order of 5 Gs/s at an affordable price make them a great choice for the study of ultrafast inorganic scintillators such as LaBr3(Ce), a key detector in various nuclear physics experiments, like for example the construction of the high-performance FAst-TIMing Array (FATIMA) for DESPEC. For this purpose relatively large (1"x1.5"x1") truncated cone LaBr3(Ce) crystals coupled to ultrafast photomultipliers (PMTs) were tested using traditional electronics, based upon constant fraction discriminators (CFD), time to digital converters (TDC) and multi-channel analyzers, showing excellent results both in time and energy [1]. We compared these measurements with a fully digital acquisition chain (DDAQ), where coincidence measurements with Co-60 and Na-22 sources were acquired. Pulses from PMTs optimized for timing measurements were digitized to a switched capacitor array with a speed sampling of 5 Gs/s and a resolution of 16 bits. Different algorithms were applied to the raw data set obtained. Among them an in-silico version of the analog CFD was used. With this strategy we obtained coincidence resolving times below 150 ps FWHM for Co-60, outperforming the standard acquisition system. This result proves that the DDAQ can be a great substitute for analog processing signals in read out systems.

[1] V. Vedia, M. Carmona-Gallardo, L.M. Fraile, H. Mach, J. M. Udías. Performance evaluation of novel LaBr3(Ce) scintillator geometries for fast-timing applications, Nucl. Instrum. Meth. A , accepted http://dx.doi.org/10.1016/j.nima.2017.03.030.

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