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A feasible substitute of LaBr3 scintillator in the Ultra Fast Timing Technique for lifetime measurements of excited states.

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The measurement of absolute nuclear transition probabilities is a very sensitive tool to study the structure of atomic nuclei. Direct access to transition rates can be achieved via the lifetimes of the nuclear levels de-excited in radioactive decay. The Advanced Time-Delayed (ATD) method, or Fast Timing [1], is a well-established technique to measure lifetimes ranging from 5 ps to 50 ns. The development of the technique was originally based on the use of BaF2 inorganic crystals with excellent time response, and on the combination of these fast BaF2 scintillators with high-resolution HPGe detectors to provide a good energy selection [2]. Recently, a major breakthrough occurred with the introduction of the LaBr3(Ce) scintillator [3], which unites very good time response with energy resolution of the order of 3% at 662 keV, much better than 9% for BaF2 crystals.

A viable alternative to LaBr3 requires excellent time resolution and good energy resolution. The recently developed CeBr3 scintillator is a very promising candidate due to its fast rise time, high photon yield and his lower price [4, 5]. It is considered a feasible substitute of LaBr3 especially for large arrays of fast detectors for timing applications. The shape optimization of some of the fast detectors for the Fast Timing Technique has been performed at ISOLDE. In this work we report on the time response of a CeBr3 cylindrical crystal of 1-inch in height and 1-inch in diameter at 22Na and 60Co photon energies. The time response was measured against a fast reference BaF2 detector. Hamamatsu R9779 and Photonis XP20D0 fast photomultipliers were used. The full width at half maximum (FWHM) time resolution for an individual CeBr3 crystal coupled to Hamamatsu PMT is reported to be as low as 119 ps at 60Co energies, which is comparable to the resolution of 107 ps reported for LaBr3.

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