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Fast timing characteristics of 1.5′′ x 1.5′′ $CeBr_3$ detector

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Measurement of lifetime of nuclear excited states and extraction of electromagnetic transition strengths from that provides direct insight into nuclear structure. Gamma ray coincidence spectroscopy with new-age fast scintillator detectors, such as, $LaBr_3$(Ce) and $CeBr_3$ serves as a useful tool for lifetime measurements in sub-nanosecond ranges. Although the energy resolution of $CeBr_3$ is slightly poorer than that of $LaBr_3$(Ce), but with comparable time resolution and without any internal activity, $CeBr_3$ scintillator detectors emerge as a potential alternative to $LaBr_3$(Ce).
At Variable Energy Cyclotron Centre (VECC), Kolkata, 1.5′′ x 1.5′′ $CeBr_3$detectors coupled with a new Photo-Multiplier tube Hamamatsu R13089-100 has been characterized. An energy resolution of 4.1% has been obtained at 662 keV of ^{137}Cs source. Absolute photo-peak efficiencies at different source-to-detector distances have been measured [1]. GEANT4 simulation has been carried out which reproduces pulse height spectra and absolute efficiencies reasonably well. The best time resolution (TAC FWHM) of 199(2) ps between two $CeBr_3$detectors for 1173-1332 energy cascade of ^{60}Co source and 327(3) ps for 511-511 keV of ^{22}Na source have been obtained after optimizing various parameters. With the knowledge of basic characteristics of two detector set-up, time-walk response for this set-up was determined using Mirror Symmetric Centroid Difference (MSCD) method [2]. ^{152}Eu source has been used to calibrate Prompt Response Difference[PRD(E_γ)] curve for different high voltages at various CFD delays [3]. For each set-up, known lifetimes of two states of ^{133}Cs - $(3/2)^+$state at 384 keV and $(5/2)^+$state at 161 keV, populated via electron capture decay of ^{133}Ba, have been reproduced.
Nuclei near ^{208}Pb region are expected to have spherical structure at lower spin and collective structure at higher spin and excitation energies. For even-even Po (Z=84) isotopes in this region, the variation of $R_{4/2}$ ratio approaches towards vibrational limit as neutron holes increase whereas, E2 transition strength increase from ^{210}Po to ^{206}Po [4]. The low-lying states of neighboring odd-A nuclei in this region are mainly described by the coupling of one neutron hole with the nearest even-even core. The lifetime measurement of low-lying states of Po isotopes will be of great importance to understand the interplay between single particle and collective structure. Lifetime of $(11/2)^-$state at 1521.85 keV of ^{209}Po has been determined. The excited states of ^{209}Po were populated via electron capture decay of ^{209}At which was produced using the reaction ^{209}Bi (α, 4n) ^{209}At at 52 MeV beam energy at VECC, kolkata. The value obtained has been found to be in good agreement with the previously reported value [5].

References:

[1] S.Das, et al., Proc. of DAE-BRNS Symp. on Nucl. Phys.70 (2019) 986
[2] J.-M.Regis, et al., NIM A 622 (2010) 83-92
[3] J.-M.Regis, et al., NIM A 684 (2012) 36-45
[4] M. Stoyanova, et al., PRC 100, 064304 (2019)
[5] V. Karayonchev, et al., PRC 103, 044309 (2021)

Primary author: DAS, Sneha

Co-authors: BHATTACHARYA, Soumik; BHATTACHARYYA, S; BANIK, R; DAR, Shabir; PANDIT, Deepak; CHOUDHURI, A; BANERJEE, K; MONDAL, Debasish; MUKHOPADHYAY, S

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