Contribution ID : **62** Type : **Poster**

Fast timing characteristics and lifetime measurement using $1.5'' \times 1.5''$ $CeBr_3$ detectors coupled with PMT Hamamatsu R13089-100

Tuesday, 18 July 2023 18:25 (15)

Measurement of lifetime of nuclear excited states and determination of electromagnetic transition strengths from that provides direct insight into nuclear structure. The measurement of lifetime in $\gamma - \gamma$ electronic coincidence method depends on the time resolution and energy resolution of the detector system. The ideal γ-ray spectroscopy requires a combination of excellent energy and time resolution along with the good photo-peak efficiency. With the availability of new generation scintillator detectors with reasonably good energy resolution, the precise measurement of lifetime in sub nanosecond ranges have been possible.
At Variable Energy Cyclotron Centre (VECC), Kolkata, $1.5'' \times 1.5''$ $CeBr_3$ detectors coupled with a new Photo-Multiplier tube Hamamatsu R13089-100 has been characterized [1]. The typical energy and time resolution obtained with $1.5'' \times 1.5''$ $CeBr_3$ detectors are 4.1% (at 662 keV of ^{137}Cs source) and 199(2) ps (for 1173-1332 keV cascade of ^{60}Co source). The systematic variation of the time-resolution for different PMT bias voltages and external CFD delays has also been studied. It has been observed that the time resolution improves with shorter CFD delays and higher PMT bias voltages.
With the knowledge of the basic characteristics of two detector set-up, time-walk response for this set-up was determined using Mirror Symmetric Centroid Difference (MSCD) method [2]. In order to calibrate the Prompt Response Function (PRF) of the experimental set-up for the energy range of interest, Prompt Response Difference (PRD) calibration curve [3] has been determined for two $1.5'' \times 1.5''$ $CeBr_3$ detectors with ^{152}Eu source. As this detector+PMT assembly was found to be linear upto PMT Bias voltage of -1400 V, hence the PRD calibration was first carried out at this bias voltage with 5 ns CFD external delay. Then the variation of the PRD curve has been studied at different PMT bias voltages and CFD external delays.

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 neighbouring 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 how the collectivity arises for the lower and the higher spin states. In this regard,the lifetime of $11/2^-$ state of ^{209}Po, has been measured with two $1.5'' \times 1.5''$ $CeBr_3$ detectors in MSCD method. The ^{209}Po was populated via electron capture decay of ^{209}At, which was produced using the reaction ^{209}Bi(α,4n)^{209}At with 52 MeV α beam from K-130 cyclotron at VECC, Kolkata. The lifetime of $11/2^-$ state at 1521.85 keV of ^{209}Po has been obtained as 98(6) ps using 239-195 keV cascade [5], which is found to be in good agreement with a recently reported value [6].

References :

Soumik Bhattacharya, et al., NIM A 1014, 165737(2021)

J.-M.Regis, et al., NIM A 622 (2010) 83-92

J.-M.Regis, et al., NIM A 684 (2012) 36-45

M. Stoyanova, et al., PRC 100, 064304 (2019)

Sneha Das, et al., JINST 17 (2022) P09012

V. Karayonchev, et al., PRC 103, 044309 (2021)

Primary author(s) : Ms. DAS, Sneha (Variable Energy Cyclotron Centre, Kolkata, India); BHATTACHARYYA, S (Variable Energy Cyclotron Centre, Kolkata, India); BHATTACHARYA, Soumik (Variable Energy Cyclotron Centre, Kolkata, India); CHAKRABORTY, S (Variable Energy Cyclotron Centre, Kolkata, India); DAR, Shabir (Variable Energy Cyclotron Centre, Kolkata, India)

Presenter(s) : Ms. DAS, Sneha (Variable Energy Cyclotron Centre, Kolkata, India)

Session Classification : Poster Session

Track Classification : Experimental Techniques