Contribution ID : **93** Type : **Poster**

Calculation of true coincidence summing correction factor for Broad Energy Germanium (BEGe) and Clover detector

Tuesday, 18 July 2023 19:10 (15)

In nuclear astrophysics, the nuclear reactions of the stellar evolution occur within the Gamow window which lies much below the Coulomb barrier. The cross-sections of these reactions are very less around nb-pb order, thereby making these measurements very difficult [1]. In such measurements, the low yields of measured ϒ-ray lead to insufficient statistics and hence increase uncertainty in the measurement of reaction cross-sections. A better statistics in the measurements may be achieved by increasing the yield, which is directly proportional to beam current, target thickness and efficiency of the detector. Beam current and target thickness cannot be increased beyond certain limits due to practical limitations. The detector efficiency can be increased by reducing the source to detector distance. In such close geometry measurements, the summing effect comes into the picture which needs to be accounted for. When two or more ϒ-rays emitted in the cascade from the excited nucleus are detected within the resolving time of the detector then this phenomenon is referred as true coincidence summing effect [2,3]. In close geometry measurements, it is necessary to perform summing correction for each ϒ-ray photopeak of interest. The factor for this correction is called true coincidence summing correction factor (kTCS).

The kTCS for an electrically cooled Falcon 5000 BEGe detector [4] has been calculated in close and distant geometry measurement using multi-energetic ϒ-ray sources (60Co, 133Ba, 152Eu). The correction factors were calculated using experimental method as well as analytical methods. Photopeak and total efficiency required here were obtained using Geant4 Monte Carlo simulation toolkit. A few mono-energetic radioactive sources were also fabricated using proton beams obtained from K-130 cyclotron at VECC, Kolkata. These fabricated (51Cr, 65Zn, 109Cd) and available (137Cs, 241Am) mono-energetic radioactive sources were used to validate the Geant4 simulation in close geometry measurements. Both experimental and analytical correction factors were found in good agreement with each other. From this work, it was found that significant coincidence summing is present in the BEGe detector if the detector is at 8 cm or bellow from the source. A similar study is also performed for CANBERRA clover detector as well, in which a desktop digitizer (Caen DT5725S) was used for data acquisition. The summing correction factors for this detector were also calculated in close geometry measurements. This study has been found to be crucial to make the right choice of gamma ray detection system for experimental measurement of reaction cross-section in the stellar energy region.

References:

C. G. Bruno e, Journal of Physics: Conf. Series 1078 (2018) 012007

C. Agarwal et al., J Radional Nucl Chem 289 (2011) 773-780

G. J. Mccallum et al., NIM 130 (1975) 189-197

S. Sharma et al., NIM in Phys Res A 964 (2020) 163810

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Session Classification : Poster Session