In-beam γ-ray spectroscopy of ^{66}Zn

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Introduction

High spin studies of nuclei in mass region A $\sim$ 60-70 have revealed plethora of interesting nuclear structural phenomena. Lying above the double magic spherical N=Z=28, ^{56}Ni and semi-magic N=40, nuclei in this mass region are known to display various shape features such as prolate, oblate, and triaxial. Microscopically, the orbitals that play a major role in the structure of these nuclei are the negative parity $2p_{\frac{3}{2}}$, $1f_{\frac{5}{2}}$ and $2p_{\frac{1}{2}}$, and the unique parity $1g_{\frac{9}{2}}$ orbitals. The shell gaps at N=Z=34,36 for oblate deformation and N=Z=38 for prolate deformation in the Nilsson energy diagram have been attributed to various collective features observed. Alignment of nucleons at higher frequency and the corresponding band-crossing phenomenon have been observed in several nuclei. Normal and superdeformed bands built on particle-hole excitation from $1f_{\frac{7}{2}}$ orbital to $1g_{\frac{9}{2}}$ have been found in several Ni, Zn, and Ge isotopes. In this contribution, we present preliminary results from high spin study of ^{66}Zn (Z=30, N=36) following its population in a heavy ion induced fusion evaporation reaction. It is to be noted that most of the previous studies have been performed long back using modest experimental setups and light ion induced reactions [1–3]. Detail results of the present investigation will be presented during the symposium.

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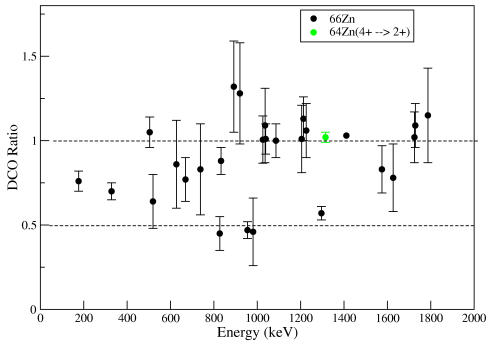

FIG. 1: DCO ratios of γ-ray transitions obtained by gating on quadrupole 1039 keV ($2^+ \rightarrow 0^+$) of ^{66}Zn

Experimental Details

Excited states in ^{66}Zn were populated via fusion-evaporation reaction ^{52}Cr(^{18}O,2p2n) at a beam energy of 72.5 MeV. The ^{18}O beam was delivered by the 15-UD Pelletron accelerator at Inter University Accelerator Center, New Delhi (IUAC) [4]. Isotopic ^{52}Cr target of thickness $\sim$ 1 mgcm^{-2} was evaporated on a 8 mgcm^{-2} ^{197}Au backing [5]. Fourteen Compton Suppressed Clover detectors of Indian National Gamma Array (IUAC) at IUAC were used to detect the γ-rays emitted by the deexciting nucleus. A total of around 2.1 billion coincidence events of two or higher folds were recorded during the entire in-beam experiment using a CAMAC based analog data acquisition software CANDLE [7]. The coincidence data were then sorted into several symmetric all vs all and asymmetric angle

dependent matrices. Similarly, matrices for extracting linear polarization of γ-ray transitions were also constructed. The offline analysis of the data were performed using Radware [8] and INGAsort [9] suites of programs. More details about the experiment can be found in Rai *et al.* [10].

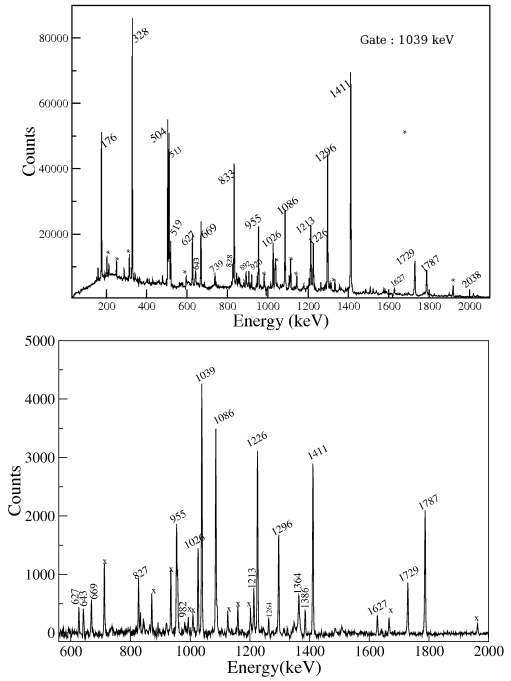

FIG. 2: Background subtracted coincidence spectrum gated by (a)1039 keV, and (b)519 keV of ^{66}Zn

Results

Preliminary investigation of the data reveals many new unreported γ-ray transitions belonging to ^{66}Zn. The positive parity yrast band and the negative parity side bands have been extended significantly. Multipolarity of the newly observed and previously reported γ-ray transitions have been done through angular correlation measurement via Directional Correlation of Oriented States (DCO). Linear polarization measurements for parity assignments have been performed using Clover detector as a Compton polarimeter. Fig. 2 illustrates the background subtracted coincidence spectra gated by 1039 keV ($2^+ \rightarrow 0^+$) and the newly observed 519 keV of ^{66}Zn respectively, where many new transitions can be seen. Total Routhian Surface (TRS) calculations have been performed to study the shape evolution of the nucleus along the yrast band, details of which will be presented in the symposium.

Acknowledgement

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