In-beam γ ray spectroscopy of ^{63,64}Cu

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Introduction

Generation of high angular momentum in a nucleus having restricted valence space outside a magic core forms an interesting physics problem. In case of nuclei in mass region A$\sim$60 outside the ^{56}Ni core, generation of higher spin requires either breaking of ^{56}Ni core and/or excitation of particles into the high j positive parity orbital $1g_{9/2}$. Identification of these two mechanismS is one of the motivation for studying high spin states of nuclei in this mass region. The active orbitals responsible for the structure of nuclei in this mass region are the negative parity orbitals $2p_{3/2}$, $1f_{5/2}$, $2p_{1/2}$ and the positive parity $1g_{9/2}$ orbital. Experimental evidences of super-deformed bands and prompt-proton decaying states in nearby isotopes[1, 2] make it important to identify high spin states in these nuclei to which the superdeformed or proton decaying states decay.

In this contribution, we report on preliminary results of our recent investigation for studying high spin states in ^{63,64}Cu produced in a heavy ion induced fusion-evaporation reaction. Earlier investigations of nuclear structure in these two nuclei have mostly employed alpha-induced reaction with few Ge(Li) detectors[3, 4]. The only heavy ion induced study that we found in literature exists for ^{63}Cu[5], in which ^{52}Cr(^{16}O,αp) reaction was used with 12 HPGe Compton suppressed detectors coupled to a charged particle array. However, due to low cross section and low statistics, information on high spin states above $23/2^+$ could not be extracted.

Experimental Details

High-spin states in ^{63,64}Cu were populated via fusion-evaporation reaction ^{52}Cr(^{18}O,αpxn) at 72.5 MeV beam energy provided by 15UD Pelletron at Inter University Accelerator Centre(IUAC), New Delhi [6]. A 1 mg-cm^{-2} isotopic(99.8%) ^{52}Cr was evaporated onto a 11.4 mg-cm^{-2} ^{197}Au backing using ultra high vacuum deposition technique. Prompt gamma rays were detected using fourteen Compton suppressed clover detectors of Indian National Gamma Array(INGA) facility at IUAC[7]. Detectors were placed at a distance of 24 cm from the target position. Out of fourteen clovers, four each were kept at backward angles of 123° and 148°, remaining six clovers were kept at 90° with respect to the beam direction. Coincidence events of two or higher fold were collected during beam time of five days using CANDLE[8], a CAMAC based analog data acquisition software, which was then sorted into all vs all and angle dependent $\gamma - \gamma$ matrices for g-g coincidence relation, DCO analysis and polarisation measurement. Further data analysis is being done using standard analysis packages such as RADWARE[9] and INGASORT[10].

Results and Discussion

Preliminary analysis of the data shows that all the previously reported gamma lines[3–5]

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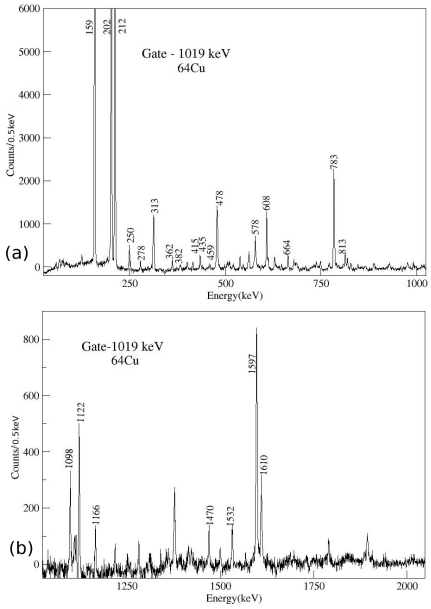

FIG. 1: Spectra gated by 1019 keV transition ($6_1^- \rightarrow 4_1^+$) of ^{64}Cu, divided into two parts (a) and (b)

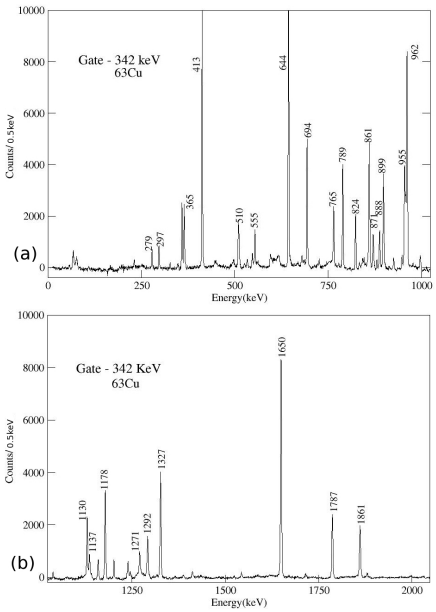

FIG. 2: Spectra gated by 342 keV transition ($17/2_1^+ \rightarrow 13/2_2^+$) of ^{63}Cu, divided into two parts (a) and (b).

are well observed in our experiment. Many new transitions in ^{63,64}Cu have been observed as seen from multiple gates on known and uncontaminated transitions belonging to these nuclei. We expect to find near yrast levels up to very high spin in both of these nuclei which is preferentially populated in heavy ion induced reactions as we have used in this work. Fig.1 and Fig.2 show known transitions and new transitions(unmarked) by putting gate on 1019 keV ($6_1^- \rightarrow 4_1^+$) and 342 keV ($17/2_1^+ \rightarrow 13/2_2^+$) transitions of ^{64}Cu and ^{63}Cu respectively. Detailed analysis is in progress and the results will be presented in the symposium.

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