High Spin Spectroscopy of ^{70}Ge

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Introduction

Structure of nuclei in mass 70 region is of interest due to presence of a variety of complex phenomenon. In these nuclei rapid change of nuclear shape with proton and neutron numbers, spin and excitation energy. Valance nucleons in f-p-g shell configuration will drive the nuclei towards high deformations. Relatively large values of quadrupole deformation are evident in the even-even nuclei in this region.

Nuclear structure in this region of nuclear chart has been extensively studied and identified a variety of nuclear structure information on these nuclei. Simultaneous presence of different nuclear shapes have been identified in several even-even nuclei in this region. Both positive parity and negative parity structures were identified in these nuclei. The positive parity bands are generated by $g_{9/2}$ orbitals. The negative parity structures are strongly coupled bands generated by $f_{5/2}$ and $p_{3/2}$ orbitals. In even-A Ge nuclei, with A= 68, 70 ,72, both positive parity and negative parity structures were identified up to moderate spins in earlier studies.

Present study is aimed to explore the high spin structure of the ^{70}Ge nucleus. A negative parity structure was reported in an earlier study[2]. In a recent study of ^{70}Ge [1], ground state band and 0_2^+ band were extended up to 12^+ and 8^+ respectively and they slightly modified the negative parity structure earlier reported.

Experimental Details

In the present experiment, ^{70}Ge nuclei are produced in the fusion-evaporation reaction ^{64}Ni(^{12}C, 2p4n)^{70}Ge using 55 MeV energy ^{12}C ion beam of about 1pnA provided by the 15UD Pelletron accelerator of Inter University Accelerator Center, New Delhi. In this experiment, ^{64}Ni target foil of 1.5mg/cm^2 thickness with 7mg/cm^2 gold backing was used. Gamma ray cascades from the de-excitation of evaporation residues, populated at high angular momenta and excitation energy in the fusion evaporation reaction, are detected using a moderate array of 12 Compton suppressed HPGe detectors placed around the target position. These twelve detectors are separated in to three groups. Each group consists of four detectors corresponding to angles 45°, 99°, and 153° respectively with the beam direction and are tilted ±23° with respective to the horizontal plan

CAMAC based online data acquisition system CANDLE [3] was used to record two fold gamma coincidence events in list mode. During the experiment a total of about 130 million events of two or higher fold coincidences were recorded.

Data Analysis

From the event-mode data, a gamma energy matrix of 4k × 4k size was generated using INGASORT [4] program. This $E_\gamma \times E_\gamma$ matrix contains gamma energies up to above 2MeV with an energy dispersion 0.5 keV/channel. This primary data set was used for establishing coincidence conditions and to construct the level scheme. This matrix was analysed using escl8r[5] program of RADWARE.

In the present work level structure of ^{70}Ge is revised. The negative parity structure is extended from 15^- to 19^- and the positive parity structure is extended by identifying a new side band built on the 6^+ state of the ground state band up to 19^+. Figure 1 shows the

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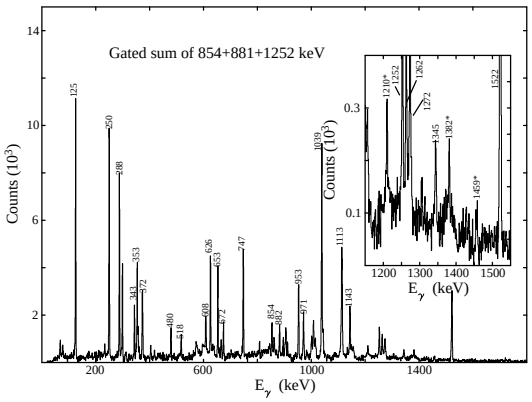

FIG. 1: Sum of energy gated coincidence spectra on the transitions with energies 881, 854, 1252 keV which are members of negative parity band of ^{70}Ge. (New transitions are labeled with $*$.)

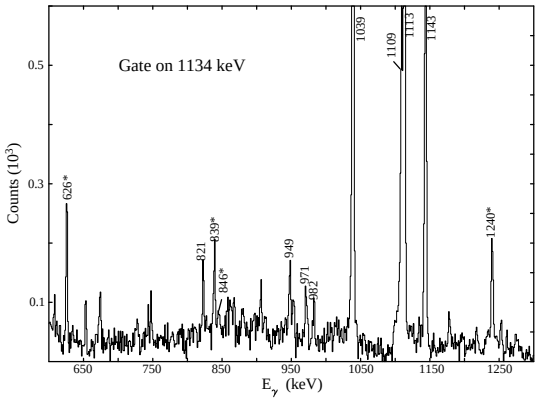

FIG. 2: Energy gate on 1134 keV transition connecting the positive parity side band to the ground state band of ^{70}Ge. (New transitions are labeled with $*$.)

sum spectrum of the gates on gamma transitions 854, 881, 1252 keV corresponding to the negative parity band and energy spectrum with gate on 1134 keV transition which connects the side band to the ground state band is shown in Figure 2.

Conclusions

In summary high spin level structure of ^{70}Ge was studied in this experimental investi-

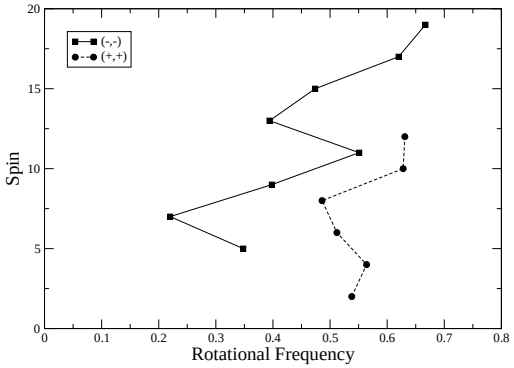

FIG. 3: I -$\hbar\omega$ plot for the positive parity and negative parity sequences.

gation. A total of about 20 new gamma transitions belonging to this nucleus were identified and placed in the level scheme based on the coincidence logic and intensity flow arguments. A new weakly populated side band built on the 6^+ state of the ground state is identified in this study. Variation of spin with rotational frequency for both positive parity and negative parity sequences were shown in Figure 3. Preliminary results will be presented and further analysis is in progress.

Acknowledgments

Authors would like to acknowledge support of Pelletron crew for providing good beam and Target lab for the help in preparation of ^{64}Ni target. One of the author MKR would like to acknowledge the fellowship provided by IUAC under UFUP scheme and Council of Scientific and Industrial Research(CSIR),India.

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