Probing nuclear structure of ^{69}Ge through heavy-ion induced gamma-ray spectroscopy

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Introduction

The proximity of the intruder orbitals with high angular momenta near the Fermi surface tends to drive the nucleus toward deformation. In A$\sim$70 mass region, $\nu g_{9/2}$ and $\pi g_{9/2}$ orbitals play significant roles in nuclear structure.The structure of Ge isotopes in this mass region cannot be addressed by bosonic approaches due to the influence of single-particle states, nor are they sufficiently collective to be accurately described by collective models.The structure of ^{69}Ge was explained by the particle-core coupling model [1].The first complete multiplet $\left|2^+ \otimes 5/2^-, J>\right.$ was observed by Eberth et al. in the late seventies[2]. Paradellis et al. added another complete multiplet $\left|12^+ \otimes 9/2^+, J>\right.$ structure in 1978[3].We want to further explore the complex nuclear structure of lower and higher spin states in the ^{69}Ge through a heavy-ion-induced fusion evaporation reaction.

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Expermimental Details

High-spin states of ^{69}Ge were populated using the fusion-evaporation reaction^{48}Ti(^{28}Si,nα2p)^{69}Ge.A beam of ^{28}Si at 100 MeV energy was delivered by the 15 UD Pelletron accelerator at the IUAC,New Delhi. The target used in this experiment was an isotopically enriched ^{48}Ti with thickness of 1.0 mg/cm^2 on a 8 mg/cm^2-thick Au backing.The de-excitation cascades of γ-rays from residual nuclei were detected using Indian National Gamma Array (INGA) which consisted of 16 Compton-suppressed n-type HPGe detectors.Eight detectors were placed at 90°and the remaining 8 detectors arranged in four groups,with each group consisting of two detectors,at angles of 148°, 123°, 57°, and 32° with respect to the beam direction. Analysis of the data is in progress with the help of the standard analysis packages RADWARE[4], INGASORT[5] etc.

Discussion

We aim to conduct a systematic study of the odd mass Ge nuclei having interplay between valence particles and ^{56}Ni core. Fig. 1(top) demonstrates the prompt existence of ^{69}Ge in the produced yield nuclei.The strong E1 transitions and the well-defined rotational sequence above the $15/2^-$ octupole state of ^{71}Ge offer the first experimental evidence of an octupole rotational band in the Ge isotopes and indicates enhanced octupole correlation

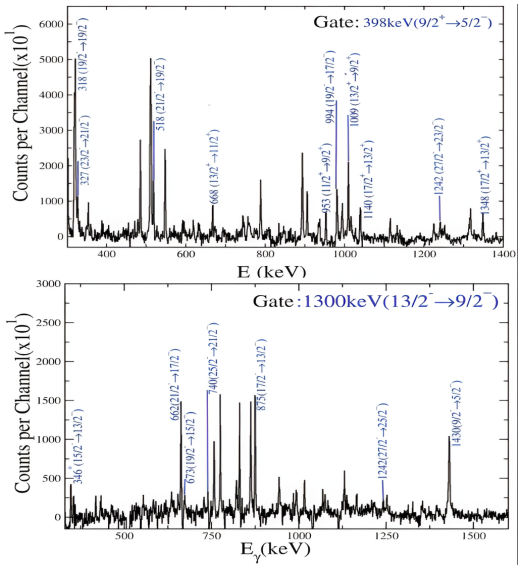

FIG. 1: Typical γ-γ coincidence spectra gated by 398 keV (top figure) and 1300 keV (bottom figure) γ-ray transitions of ^{69}Ge. Newly observed transition is marked by asterisk(*).

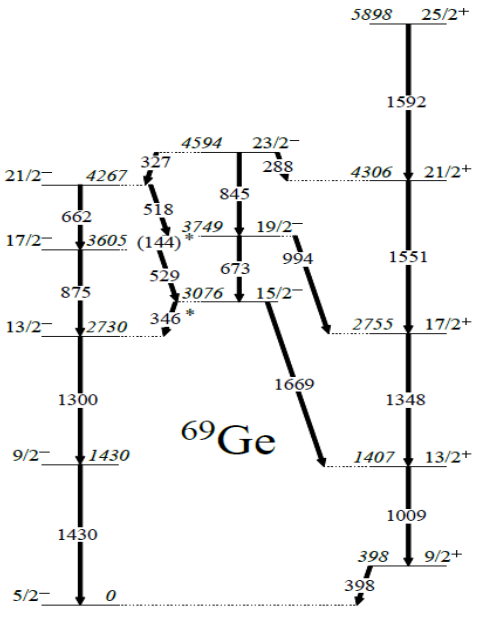

FIG. 2: Partial level scheme of ^{69}Ge (obtained from the present work) where the asterisks denote newly observed transitions.

around N=40 in the A $\sim$70 region[6].Strong E1 transitions above the $15/2^-$ state have been found in ^{69}Ge in previous work[7].We have studied the systematic behaviour of excitation energy of $15/2^-$ state(relative to yrast $9/2^+$state)of odd-A Ge isotopes with 2^+ and 3^-staes of even-A Ge isotopes. Rapid decrement of 3^-state in even-A Ge isotopes with increasing neutron number reflects increasing octupole correlation. Systematic of excitation energy with neutron numbers along with other investigations will be presented in symposium. A new gamma transition with an energy of 346 keV ($15/2^- \rightarrow 13/2^-$)(Fig.1, bottom)has already been observed by our group. Spins and parities of tentatively assigned 6592.9keV energy state[8],as well as,other relevant states, will be determined based DCO analysis.The electric or magnetic nature of the γ-ray transitions will be established from linear polarization measurements using data recorded by the 90° detectors.

Acknowledgments

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