Evidence for prolate-oblate shape coexistence in the odd-A $^{73}_{35}Br_{38}$ nucleus

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The excited states in ^{73}Br nucleus have been investigated through the fusion evaporation reaction ^{50}Cr(^{28}Si, αp)^{73}Br at a beam energy of 90 MeV using the Indian National Gamma Array. The γ-γ coincidence technique has been used to add eight new γ-ray transitions in the level scheme. The mixing ratio of $\Delta I = 0$ (mixed with $E2$ and $M1$) transitions have been determined using angular distribution and $R_{\rm DCO}$-polarization measurement. The half-life of the $9/2^+$ isomeric state has been measured to be $\tau_{1/2} = 52(2)$ ns from the variation in the intensity of delayed γ-ray transition as a function of coincidence time window. The two state mixing model calculations were performed to obtain the mixing amplitude, and mixing interaction of two different configurations of ^{73}Br. The calculated mixing amplitudes along with the deformations of two different configurations provide the monopole transition strength $\rho^2(E0)$ for Se, Br, and Kr isotopes in a semiempirical approach. These results support a prolate-oblate shape coexistence in the odd-A ^{73}Br nucleus. The observed structural properties have been discussed in terms of projected shell model calculations.

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I. INTRODUCTION

Shape coexistence is widely spread over the nuclear chart, owing to the presence of competing "shell gaps" in the nuclear potential [1,2]. A strong interaction between the nucleons in the nuclear potential enhances the correlation energy of the system. Such interactions contribute to the origin of deformation resulting in different shapes for individual states at low excitation energy. The minima of these deformations can be vividly observed near the single particle shell gaps of the Nilsson diagram, where the minimum of the deformation energy moves towards a deformed shape in the region lying away from the shell closure. Specifically, in the $A \approx 70$ mass region, the shape driving behavior of the $g_{9/2}$ orbital results in the formation of low lying isomeric states, leading to a prolate-oblate shape coexistence [3].

In recent years, relatively light mass nuclei in the mid-shell region have attracted considerable attention due to the presence of shape coexistence in several even-even Ge, Se, and Kr isotopes [3–8]. In the ^{72}Ge nucleus, a shape isomer has been identified at the excited 0^+ state with a half-life of 444.2(8) ns [9]. Later, the multistep Coulomb excitation measurements confirm the asymmetric shape coexistence phenomena in which the prolate shaped 0^+_2 state coexists with an oblate-deformed ground state. The theoretical two state mixing model calculation also supports the presence of the prolate 0^+_2 state. In the light ^{72}Se nucleus, a shape isomer at excited 0^+_2 state having a half-life of 22.8 (14) ns was reported by Hamilton *et al.* [10]. It was suggested that the low-lying 0^+_2 state having a deformed rotational character coexists with the vibrational states associated with the spherical ground state. Afterward, the monopole transition strength around

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