# A systematical study of E2 transition probabilities and g-factors of neutron-rich $^{70,72,74,76}$Ge

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The advent of new experimental tools has made it possible to study the high spin spectroscopy of neutron-deficient nuclei in the A ≈ 70-80 region. Earlier, Leske et al. [1,2] have measured the g-factors and lifetimes of $^{68,70}$Ge by the α-transfer technique. The electromagnetic properties of low lying states in $^{70,72}$Ge nuclei have been studied through multiple Coulomb excitation techniques. Recently, Gurdal et al. [3] have measured the g-factors of $4_1^+$ states in $^{72,74,76}$Ge for the first time and re-measured the g-factors of $2_1^+$ states in $^{70\text{-}76}$Ge. The measurement of the g-factors have been made by using the transient field technique in inverse kinematics with a variety of targets, following Coulomb excitation of the relevant states. They have analysed the data within the framework of the IBA- II model. They have also performed large scale shell model calculations by using three different interactions and found no evidence for neutron shell closures at N=38 or 40. They concluded that a wider theoretical framework is needed for the nuclei spinning between Zn and Sr.

In the present work, projected shell model [PSM] [4] is employed to calculate the B(E2) transition probabilities and g-factors of $2_1^+$ and $4_1^+$ states in neutron-rich $^{70\text{-}76}$Ge. Earlier, the microscopic study of yrast band structures have been performed in neutron-deficient Ge nuclei by using the PSM approach [5]. The same parameters and calculational framework is employed here. The valence space of the model consists of three harmonic oscillator shells N=2,3,4 for neutrons as well as protons.The calculations have been performed by taking prolate deformation for all the four nuclei. The choice of the deformation parameters has been made from the calculation of potential energy surfaces (PES) for the $0_1^+$ states. The deformation parameters chosen correspond to the minima of the PES on the prolate side. The minimum on the prolate side of PES is found to be of lower energy than the oblate minimum, hinting thereby the possibility of the occurrence of prolate shape for the low lying observed yrast states in $^{70\text{-}76}$Ge. In Fig. 1, the theoretical results obtained for g-factors of $2_1^+$ and $4_1^+$ states have been compared with the collective model and three shell model calculations. A careful examination of Fig. 1, reveals that the calculated g-factors by using the PSM approach for $^{70,72}$Ge reproduced the experimental data qualitatively. However, for $^{74,76}$Ge the calculated values are under estimated. The calculated B(E2) transition probabilities of $2_1^+$ and $4_1^+$ states reproduce the experimental data by taking one value of effective charge as 0.5. For example, the experimental values of B(E2)'s for $2_1^+$ states for $^{74,76}$Ge are 0.060(3) and 0.046(3) $e^2b^2$ that are reproduced as 0.056 and 0.047, respectively. The experimental data is taken from Ref. [6]. The experimental value of B(E2)'s for $4_1^+$ states for $^{74,76}$Ge are 0.085(5) and 0.0722(133) and theoretical values are 0.090 and 0.0702 $e^2b^2$ respectively. Thus, the B(E2) transition probabilities of $2_1^+$ and $4_1^+$ states are reproduced by the PSM calculations but the g-factors are under estimated for $^{74,76}$Ge.

The results of the shell model calculations [3] under estimate the g-factors of the $2_1^+$ and $4_1^+$ states in $^{70\text{-}76}$Ge. However, the simple collective estimate of Z/A is in better agreement with the data. In conclusion, the fine tuning of the Nilsson parameters for the neutron-rich nuclei in the mass A ~ 70-80 may improve the theoretical results.

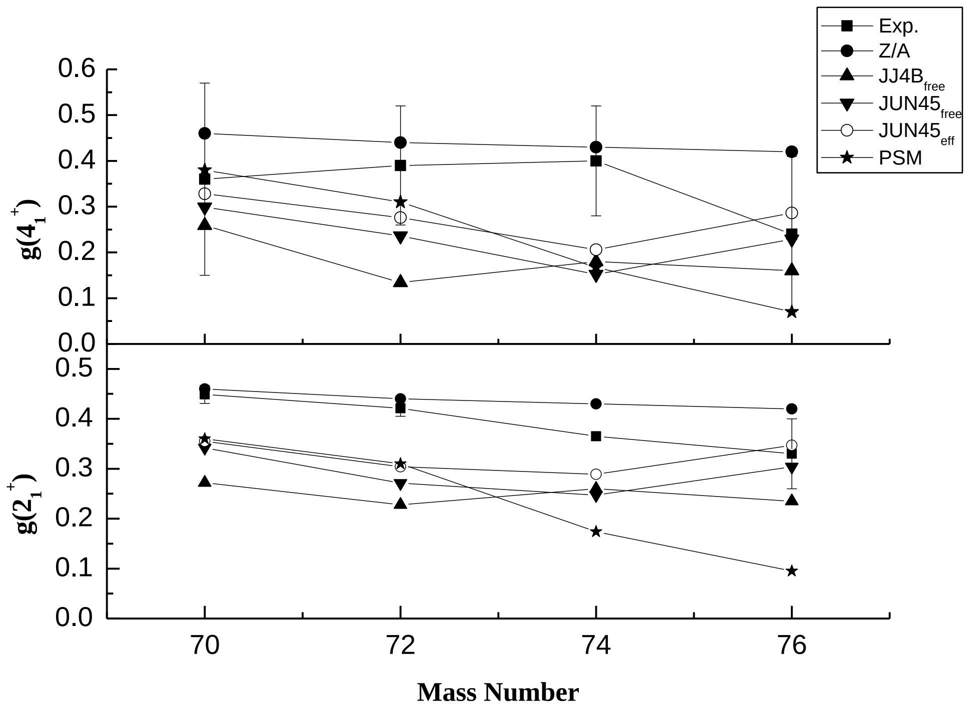


**Fig. 1** Comparison of experimental and theoretical results. The experimental data [3] are compared with theoretical predictions of the collective model (Z/A), shell model of Ref. [3] and PSM calculations.

## References


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