Microscopic study of g factors of first 2^+ states of neutron-rich Xe and Ba isotopes

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Nuclear g factors give insight into the collective and single-particle structure of nuclear states. Sometime back Wolf et al. [1] and Smith et al. [2] measured the g-factors of neutron-rich Barium isotopes. Recently, Goodin et al. [3] have measured the g factors of first 2^+ states of neutron-rich Xenon and Barium isotopes by using new techniques developed for measuring angular correlations with large detector arrays. The g factors of 2^+ states in ^{140,142}Xe are measured for the first time by the method of correlation attenuation in randomly oriented magnetic fields. The measurement of g factors in ^{140,142}Xe has extended the knowledge of systematics for Xe isotopes above ^{132}Sn. The new experimental data on magnetic moments near the shell closure pose a challenge for microscopic models. The IBM-2 model predictions compare well with the experimental data.

In the present paper an attempt has been made to carry out a microscopic study of the yrast states, B(E2) transition probabilities and g factors in the neutron-rich $^{140-144}$Xe and $^{142-148}$Ba by employing Projected Shell Model (PSM) [4].

The Hamiltonian [4] employed in the present work is

$$H = H_0 - \tfrac{1}{2}\chi\sum_{\mu} Q_{\mu}^{+}Q_{\mu} - G_M P^{+}P - G_Q\sum_{\mu} P_{\mu}^{+}P_{\mu}$$

where Ho is spherical single particle Hamiltonian. The second term in the Hamiltonian is the quadrupole-quadrupole interaction and the last two terms the monopole and quadrupole pairing interaction, respectively.

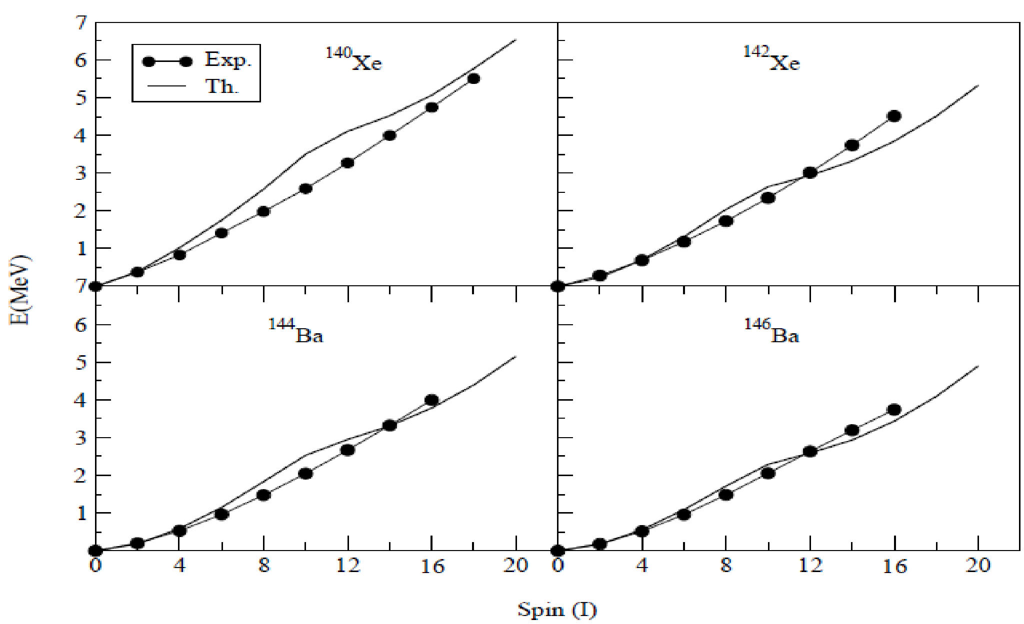

Fig. 1 Comparison of the calculated energy spectra with experimental data for ^{140,142}Xe and ^{144,146}Ba isotopes.

The monopole pairing strength G_M is taken as

$$G_M = \left[19.60 \mp 15.70 \frac{N-Z}{A}\right] A^{-1} .$$

The g-factors have been calculated by

$$g(I) = \frac{\mu(I)}{\mu_N I} = \frac{1}{\mu_N I}\left[\mu_\pi(I) + \mu_\nu(I)\right],$$

with $\mu_\tau(I)$ being the magnetic moment of a state $|\psi^I>$, expressed as

$$\begin{aligned}\mu_z(I) &= <\psi_I^I | \hat{\mu}^\tau | \psi_I^I> \\ &= \frac{I}{\sqrt{I(I+1)}} <\psi^I \| \hat{\mu}^\tau \| \psi^I> \\ &= \frac{I}{\sqrt{I(I+1)}} [g_l^\tau <\psi^I \| \hat{j}^\tau \| \psi^I> \\ &+ (g_s^\tau - g_l^\tau) <\psi^I \| \hat{s}^\tau \| \psi^I>],\end{aligned}$$

where $\tau = \pi$ and ν for protons and neutrons, respectively.

In Fig.1, the comparison of experimental and calculated yrast spectra is presented for ^{140,142}Xe and ^{144,146}Ba. It is evident from the graphs of these figures that the agreement between the experimental and theoretical low-lying yrast states is reasonably good. In Table 1, the electromagnetic properties such as B(E2) transition probabilities and g-factors are presented. The values of the B(E2) transition probabilities obtained for ^{144,146}Ba are in good agreement with the experiments. The calculated B(E2) values for ^{140,142}Xe are slightly higher than the observed values. The calculated values of g factors for neutron-rich Xe and Ba isotopes are in reasonable agreement with the measured values.

Table 1. Comparison of experimental (Exp) and calculated (Th.) B(E2) transition probabilities (in units of e^2b^2), g factors in $^{140-144}$Xe and $^{142-148}$Ba.

	$B(E2; 2_1^+ \rightarrow 0_1^+)$		g-factor $g(2_1^+)$	
	Exp.	Th.	Exp.	Th.
^{140}Xe	0.065(3)	0.192	0.35(12)	0.171
^{142}Xe	0.085(19)	0.231	0.25(10)	0.145
^{144}Xe		0.275		0.129
^{142}Ba	0.134(7)	0.245	0.425(50)	0.230
^{144}Ba	0.216(9)	0.294	0.34(5)	0.190
^{146}Ba	0.274(10)	0.338	0.27(10)	0.173
^{148}Ba		0.451		0.170

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