Nuclear g-factor measurement of $31/2^+$ isomer in ^{153}Ho

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Introduction

A great deal of experimental and theoretical work have been carried out for the structure of nuclei around the shell gaps at $Z = 66$ and $N = 86$ ($A \approx 150$). Both the structural changes and shape co-existence effects are observed in this region. ^{152}Dy nucleus is a good example of it and found to have near-spherical oblate shape at low spin and exhibit coexisting collective prolate shape at higher spin. ^{153}Ho is a neighboring isotone of ^{152}Dy with additional odd proton. Single and SD structures are observed along the yrast line [1]. The ground state shape changes from spherical to deformed between $N = 86$ and 88 in the odd Ho ($Z = 67$) isotopic chain. At high spin range, $< j > \approx 44 - 49\hbar$, onset of a collective $E2$ component has been observed. The occurrence of yrast isomeric state reflect the few-particle alignment character of the considered excitation regime. In ^{153}Ho, high-spin yrast (isomeric) states are established to be single-particle character and the continuum state exhibit the onset of collective motion [2].

The structure of the high-spin yrast states can be be confirmed by measurements of g-factors since it depend on the coupling scheme for the individual particles particularly the relative contributions of protons and neutrons to the total angular momentum. The isomeric level at energy $E_x = 2773$ keV ($j^\pi = 31/2^+$ and $T_{1/2} = 229ns$) is observed in ^{153}Ho [2]. The half life of $31/2^+$ isomeric state in ^{153}Ho is well suited for the g-factor measurements by time differential perturbed angular distribution (TDPAD) technique.

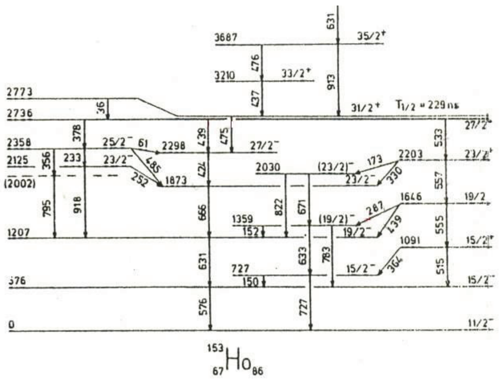

FIG. 1: Partial level diagram of $31/2^+$ isomeric state in ^{153}Ho.

Experimental Details and Results

The experiment was performed at 15UD pelletron accelerator facility of the Inter University Accelerator Centre at New Delhi. The $31/2^+$ isomeric level of ^{153}Ho (Fig. 1) has been populated through the reaction ^{141}Pr($^{16}O, 4n\gamma$)^{153}Ho using $88MeV$ pulsed ^{16}O ion beam having a pulse width of $2ns$ and repetition period of $1\mu s$. The static external magnetic field $B_{ext} = 8.660(50)kG$ (measured by Hall probe) perpendicular to the beam-detector plane was provided by C-type electromagnet. Details of the set-up can be found in different communications [3]. The target consisted of $800g/cm^2$ natural ^{141}Pr sandwiched between gold backing ($20mg/cm^2$) and $150g/cm^2$ of gold. The spin rotation of the implanted ions due to magnetic hyperfine interactions in the host modifies the angular distribution of the de-exciting γ-rays and is normally observed in the time evolution of the

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ratio of counts at ±45° to the beam. The data were collected in *LIST* mode with four parameters: the energy and time signals for both NaI(Tl) detectors. The acquired data, following proper gain matching for energy and time, were sorted off-line into $E_\gamma - t$ matrices corresponding to the two different detectors.

From the measured intensities, the normalized ratio function was formed,

$$R(t) = \frac{N(45°, t) - N(-45°, t)}{N(45°, t) + N(-45°, t)}. \qquad (1)$$

The value of the Larmor frequency (ω_L) is then obtained by LSQ fitting of the two site function of the form,

$$R(t) = B_2 Sin(2\omega_L + \Phi) + \Psi, \qquad (2)$$

where Φ is the phase shift, Ψ is the background correction, $B_2 = 0.75A_2/(1 + 0.25A_2)$. Spin rotation spectrum of $31/2^+$ isomer is shown in Fig. 2. The value of Larmor frequency so obtained is $22.91(22) Mrad/s$. The effective magnetic field B_{eff} is equal to the sum of the external and the internal magnetic field at temperature (T),

$$B_{eff}(T) = B_{ext} + B_{int}(T) = \beta(T)B_{ext}, \quad (3)$$

where B_{int} + B_{ext} is the effective magnetic field at the nucleus. $\beta(T)$ for Ho at room temperature is 7.24 [4]. From the measured value of the Larmor precession frequency (ω_L) we have extracted the g-factor using the relation,

$$g = \frac{\omega_L.\hbar}{\mu_N.B_{eff}}, \qquad (4)$$

where B_{eff} is the effective magnetic field.

$$g(31/2^+) = 0.076(1) \qquad (5)$$

The yrast isomeric $31/2^+$ state is equivalent of 11^- state of ^{152}Dy with additional proton in the $\pi h_{11/2}$ state. The 11^- state is considered to be of the configuration $[\nu(f_{7/2}h_{9/2})_{8^+} \otimes 3^-]_{11^-}$ and $\nu(h_{9/2}h_{13/2})_{11^-}$. Further analysis is in progress.

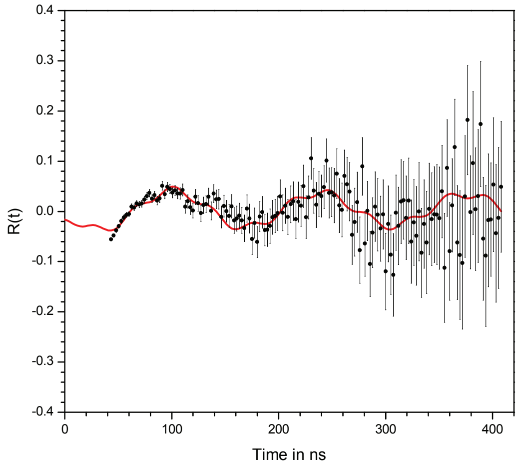

FIG. 2: Spin rotation spectrum of $31/2^+$ isomer in ^{153}Ho.

Acknowledgments

The authors wish to thank the accelerator staff, particularly Dr. S. Chopra and Mr. R. Joshi for the stable beam at the Inter University Accelerator Centre during the experiment.

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