g-factor of $21/2^-$ isomeric state in ^{131}La

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Introduction

The neutron deficient *La* nuclei belonging to the transitional region, N = 66 to N = 82, are important benchmark for investigating the phenomenon of shape coexistence in nuclei. These nuclei have deformation between spherical and strongly deformed nuclei and there is a strong competition between collective and particle excitation at high spins. The different deformation-driving properties of neutrons and protons occupying the unique parity subshell $h_{11/2}$ in the high-Ω and low-Ω orbitals, respectively, lead to the occurrence of shape coexistence and thus to triaxial shape [1.2] . The γ-degrees of freedom was found to play an important role in the description of these nuclei . A large triaxiality with in the range $20^0 - 30^0$ [3] has been established for the even-even *Xe, Ba* and *Ce* nuclei from the analysis of the low-lying state properties within the rigid-triaxial rotor model and the interacting boson model. A sensitive test of the model is the measurement of electromagnetic moments of nuclei. The knowledge of the static magnetic dipole moments is very important for elucidating the structure of coexisting shapes, as they are providing independent information on the underlying configurations. The present work concerns on $21/2^-$ isomeric state in ^{131}La which is a part of the magnetic moment measurements in mass region A ~ 130.

Experimental Details

The isomeric state in ^{131}La was populated and aligned using ^{19}F pulsed beam at 75 MeV in the ^{116}Cd (^{19}F, 4n)^{131}La nuclear reaction at 15UD Pelletron accelerator facility, IUAC, New Delhi. The time differential perturbed angular distribution (TDPAD) technique was used to observe the precession of the angular distribution pattern of the delayed γ–rays. The excited ^{131}La nuclei were recoil implanted into the lead host. The target was placed between the pole tips of an electromagnet. The magnetic field B = 5 kG was applied perpendicular to the beam-detector plane. The magnetic field was calibrated through the known g-factor (g = 1.442 (8)) of $5/2^+$ isomeric state in ^{19}F. The γ-rays were detected by two NaI(Tl) detectors placed at $\pm 45^0$ to the beam direction.

Data Analysis and Results

In the off-line analysis of list-mode data, two dimensional matrices of energy versus time were formed for each detector. From these matrices time-gated energy spectra and energy-gated time spectra were formed. The partial level scheme of ^{131}La [4] showing the decay of the presently investigated isomer is shown in Fig. 1.

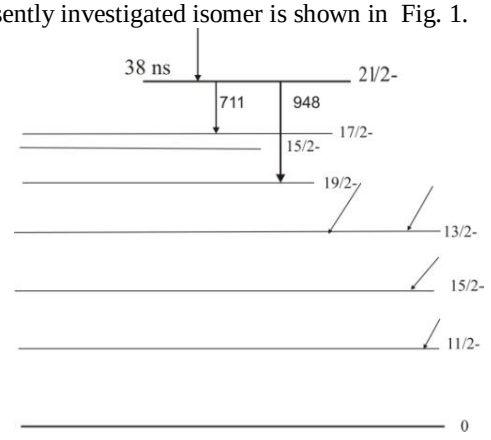

Fig. 1 Partial level scheme showing the decay of $21/2^-$ isomeric stae in ^{131}La.

After proper normalization, the time spectra corresponding to isomeric state were used to form the experimental modulation ratios $R_{exp}(t)$

$$R_{\exp}(t) = \frac{N_1(t) - N_2(t)}{N_1(t) + N_2(t)},$$

which were least squares fitted to the theoretical function,

$$R_{theo} = \frac{3}{4} A_2 \cos 2(\phi - \omega_L t),$$

where A_2, ω_L and ϕ are the angular distribution coefficient, Larmor frequency and the phase angle, respectively. The modulation function for 198 keV (Fig.2) and 948 keV (Fig.3) transitions corresponding to ^{19}F and ^{131}La respectively, detected by NaI detectors are shown below. From the present analysis, the g-factor of $21/2^-$ state can be extracted w.r.t. the g-factor of $5/2^+$ state in ^{19}F, for the precision measurement independent of any error in magnetic field. The configuration assigned from the spectroscopic studies [4] of the nuclei is $\pi g_{7/2} \otimes \nu g_{7/2} \otimes \nu h_{11/2}$ The alaysis is in progress.

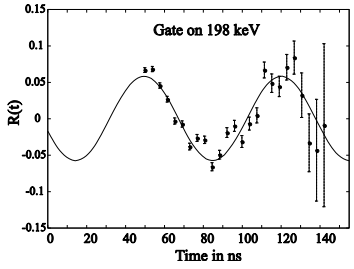

Fig. 2 Spin rotation spectra of $5/2^+$ state in ^{19}F.

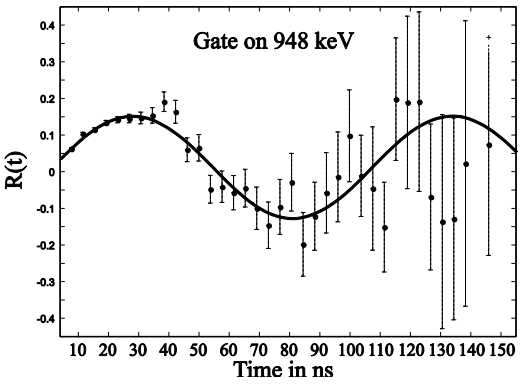

Fig. 3 Spin rotation spectra of $21/2^-$ isomeric state in ^{131}La.

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