RDM Lifetime measurement in ^{167}Lu

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Introduction

The odd *Z* (~67) nuclei lying near the mid-closed shell gap shows the variation in their shapes which can be explained by studying the properties of the single particle orbits that have different shape driving effects in γ -soft nuclei [1, 2]**.** Odd Z and even N neutron deficient nuclei Lu and Hf isotopes around N = 96 predicts the stable triaxiality region where the local triaxial minima at large deformation (ε_2, γ) ≈ (0.4, ±20º) is given by cranking calculation in the total potential energy surfaces [4]. Wobbling mode of excitation was first of found in Lutetium isotopic family ^{163}Lu and then it was well established in neighbor of odd mass isotopes. The wobbling motion is an excitation mode unique to a triaxial body where the nucleus favors to rotate about an axis with the largest moment of inertia so it can transfer the angular momentum to other axes, resulting in a sequence of rotational bands. In odd-odd and odd-even Lu isotopes deformation driving effect of proton high-j low-k orbits play play an important role in the formation of the triaxial superdeformed states**.** The presence of N=94 shell gap and the position of the proton [660]1/2 orbit in the deformation driving single particle diagram provide the way for microscopic understanding of the observed triaxial superdeformed bands in this mass region [4]. The measurement of the quadrupole moments of the super-deformed band allows to investigate the interaction taking place at high spin with the normal deformed states in ^{167}*Lu* [5]. Lifetime measurements of the excited TSD bands provide a crucial test for the wobbling explanation. In this paper we are presenting the experiment performed for measuring lifetime in ^{167}*Lu*, which provides the measurement of the structural behavior of the nuclei due to single particle excitation. The enhanced γ-ray detection GDA setup present at IUAC was used and the data was acquired in the singles mode with the condition when any two of the BGO's element fire in coincidence with a Ge detector. The online data acquisition program CANDLE [6] was used for data acquire in conjunction with CAMAC [7] based data acquisition hardware.

Experimental Setup

The experiment was performed using the plunger device and the GDA setup present at the IUAC, New Delhi. The nucleus of interest was populated using the fusion evaporation reaction ^{12}C (^{159}Tb, 4n) ^{167}Lu at beam energy of 74 MeV provided by the 15UD Pelletron accelerator at IUAC, Delhi. The target was consisted of a self supporting foil of ^{159}Tb prepared using rolling technique. 1.2 mg/cm^2 thick target foil and gold foil of thickness ~ 8 mg/cm^2 as stopper was used. A minimum of ~10 μm distance was achieved between the target and stopper using the capacitance method [8] in which the minimum distance was found by the extrapolation of the plot between the distances vs. capacitance^{-1}**.** To detect emitted γ-rays from the excited nuclear states, in total 12 HPGe Compton- suppressed detectors with a 14 element BGO multiplicity filter were used in GDA setup [7]. Out of the twelve detectors, set of four Compton suppressed Ge detectors were mounted in backward ring at an angle of 144º, other four were mounted in the forward ring at 45º and remaining 4 were mounted at 90º in the middle ring. The 14-element BGO multiplicity filter was used to reduce the background obtained from the radioactivity and the coulex. The data were acquired for distances from 10-2000 μm.

Data Analysis

The heavy ion fusion reaction was used to populate the nuclei of interest. For each target-stopper distance, the data was sorted into singles. The spectrums acquired using detectors at backward angle were gain-matched and added together to increase the statistics. The lifetimes will be determined by the differential decay curve method for which the intensity of the peaks will have to be calculated at each target–stopper distance given. The un-shifted peaks of interest were normalized with respect to the total of the shifted and un-shifted peaks. The γ-transition up to spin $29/2^-$ were clearly identified for the $h_{9/2}$ band in ^{167}lu. The data analysis is still in progress. The $h_{9/2}$ band populated for the nuclei of interest ^{167}Lu is shown in the **fig.1** below

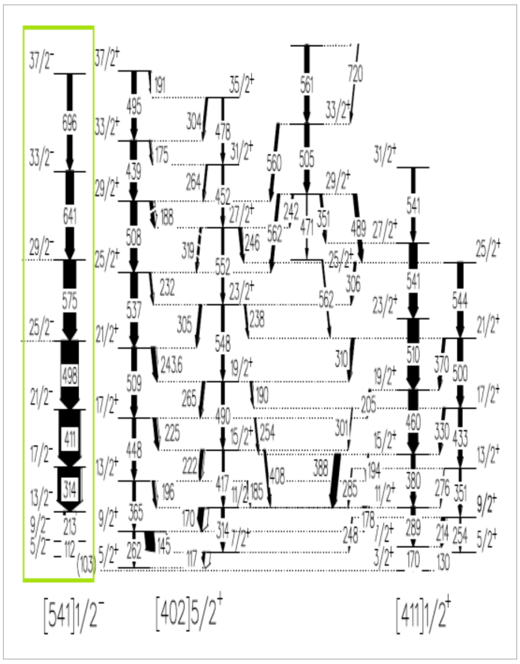

Fig.1 shows the partial level scheme for the ^{167}Lu nuclei with the band marked in rectangular block, obtained in the experiment.

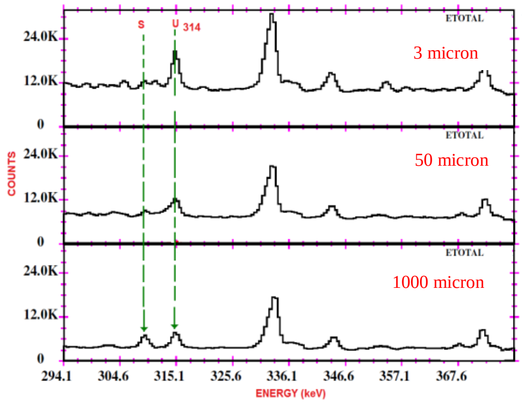

Fig.2. shows the shifted and unshifted peaks for the transition 314 KeV at varying psoitions in between the target and stopper

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References

[1] C.H. Yu *et al.*, Nucl. Phys. **A511**, 157 (1990)

[2] A. Görgen *et al.*, Phys. Rev. C , Vol. **69**, No. 3, 2004

[**3**]http://adsabs.harvard.edu/abs/2004APS..DNP.BD008A

[4] T. Ya *et al.*,Nuclear Physics A 848 (2010) 260–278.

[5] H. Amro *et al.* Physics Letters B 553 (2003) 197–203

[6] Ajith Kumar B.P., *et al.*, 2001 Proceedings of DAE BRNS Symp. on Nucl. Phys. 44, 390

[7] T. Subramaniam, *et al.*, 2008 Rev. of Sci. Instr. 79, 103503

[**8**] T.K. Alexander and A. Bell, Nucl. Instru. Meth. 81, 22 (1970).