Band Structures in ^{96}Ru

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Introduction

Nuclei in the A ≈ 100 mass region exhibit a wide variety of nuclear shapes ranging from spherical to highly deformed. High spin states in deformed odd-odd nuclei in the rare-earth are of utmost important during the recent past because of observation of a number of interesting phenomena. Investigations have revealed diversity in band structures resulting from coupling of $g_{9/2}$, $d_{5/2}$, $g_{7/2}$, and $h_{11/2}$ valence nucleons and the core-excited configurations. The proton particle-hole excitations across the major shell gap are energetically possible due to strong proton pair correlations and proton neutron interaction between the spin –orbit partner orbitals. For the nuclei approaching Z=50 from below, the proton Fermi surface lies near the oblate-driving high-Ω orbitals of the intruder $\pi g_{9/2}$ subshell. Strongly prolate-driving low-Ω $\nu h_{11/2}$ subshell orbitals are accessible at low excitation energies for the nuclei receding the N=50 Shell closure. The delicate interplay of strongly shape-driving $\pi g_{9/2}$ and $\nu h_{11/2}$ orbitals can influence the overall shape of the nucleus and result in γ-soft (triaxial) shapes with the modest deformation (ε_2)~0.15. The relevant intriguing triaxiality based phenomena such as magnetic rotation and degenerate twin bands have been reported in this mass region [1].

The present work reports in-beam γ-ray spectroscopic measurements to study level structures in ^{96}Ru nucleus. In the earlier study the level structures of ^{96}Ru have been investigated through ^{65}Cu (^{36}S, p4n) by Kharraja *et al* [2] by performing 36 Compton-suppressed Ge Detectors of the Gammasphere array. The level scheme in the earlier study have been extended to J = 20ħ.

Experimental Details

Excited states in ^{96}Ru nucleus were populated in the ^{75}As (^{28}Si, 3p4n) fusion-evaporation reaction at E_{lab}=120 MeV. The de-excitations have been investigated through in-beam γ-ray spectroscopic techniques. The ^{28}Si beam was delivered by the 15UD Pelletron accelerator at Inter University Accelerator Center (IUAC), New Delhi. The ^{75}As target of thickness 3 mg/cm^2 was prepared onto a 10 mg/cm^2 thick Pb backing by vacuum evaporation followed by rolling. The recoiling nuclei in the excited states were stopped within target and the deexciting γ-rays were detected using the Indian National Gamma Array (INGA) equipped with 18 clover [3]. A total of about 300 x 10^6 triple coincidence events were recorded in the detectors mounted in five- rings configuration experiment. The data were sorted offline using INGASORT program [3] to produce symmetrised E_γ-E_γ matrices and E_γ-E_γ-E_γ cubes. The clover detectors were calibrated for γ-ray energies and efficiencies using the ^{133}Ba and ^{152}Eu radioactive sources. The data analysis was performed using RADWARE analysis package [4] to establish coincidence relationships for various gamma transitions.

Results and Discussion

The present level scheme of ^{96}Ru shown in Fig. 1 is built on the $I^\pi=0^+$ ground state. The level scheme has been extended substantially with addition of about thirty new transitions. Three bands labeled B1-B4 could be identified in the present level scheme, which is established up to ~10 MeV excitation energy and J = 22ħ. The level scheme is a significant extension to those reported in the earlier work [2]. The present level scheme preserves major features of the previously observed bands B1 and B2.

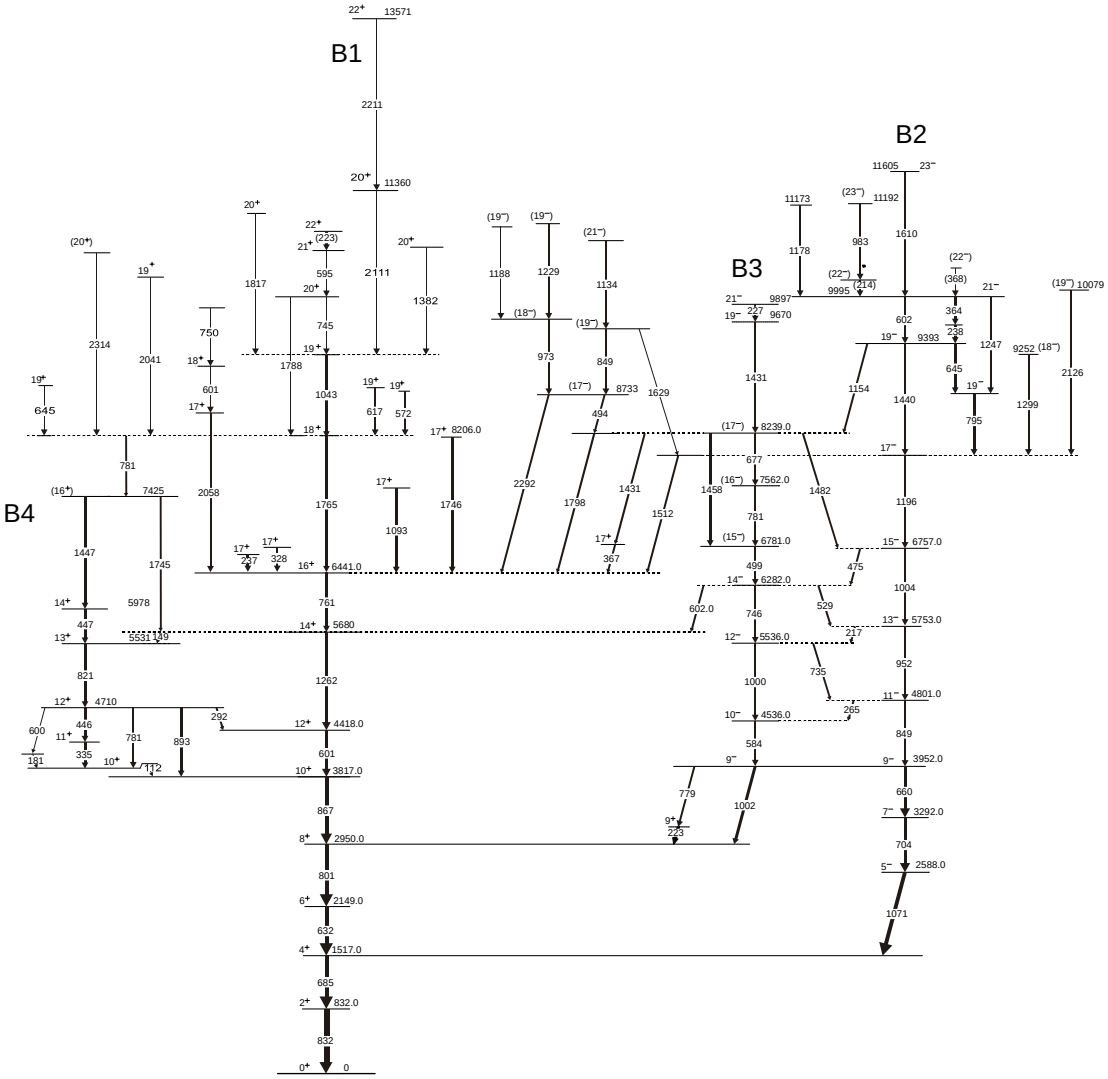

Fig.1. Partial level scheme of ^{96}Ru obtained in the present work.

Several new interband transitions have been added in bands B1, B2, and B3. Multifragmentations at the positive parity and negative parity bands at spins around 20$\hbar$ is observed, which are likely to be maximally spin aligned states. Major changes in the level scheme of ^{96}Ru and its interpretation will be discussed.

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