Band structures in ^{99}Rh

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Introduction

It is always interesting to go beyond the shell model description in near spherical nuclei and investigate the coherent development of single-particle motion into the collective effects. The transitional nuclei with Z < 50 and A ≈100 are characterized by a small quadrupole deformation and a gamma-soft potential at low and moderate angular momenta. The level structure of these nuclei provides an opportunity to investigate, how single-particle motion coherently develops into collective effects, as nucleons are added to closed shell. In recent studies devoted to study nuclei having only ten or eleven active nucleons outside the vicinity of doubly magic ^{100}Sn core, the maximally spin aligned states have been observed in $^{98, 99}$Ag [1], ^{98,99,103}Pd [2]. Recently, terminating high spin bands were reported in the nucleus ^{101}Rh [3]. The present study is part of an ongoing effort to study neutron deficient isotopes at or close to the N=Z=50 shell gap.

Experimental Details

Excited states in ^{99}Rh nucleus were populated in the ^{75}As(^{28}Si,2p2n) 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 [4]. A total of about 300 x 10^6 triple or higher-fold coincidence events were recorded in the detectors mounted in five-rings configuration experiment. The data were sorted offline using INGASORT program [4] 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 [5] to establish coincidence relationships for various gamma transitions. From the γ- γ coincidence data, the intensity, directional correlation of oriented states (DCO) ratio, and polarization asymmetry of different transitions were extracted and used for establishing the level scheme of ^{99}Rh. The level scheme of ^{99}Rh in the present work is shown in Fig. 1.

Results and Discussion

The present level scheme of ^{99}Rh shown in Fig. 1 is built on the $I^\pi = 9/2^+$ ground state. The level scheme of ^{99}Rh has been extended substantially with addition of about new sixty transitions. Five bands labeled B1-B5 could be identified in the present level scheme, which is established up to ~16 MeV excitation energy and 63/2$\hbar$ spin. The level scheme is a significant extension to those reported in the earlier work by Singh et al. [6] from the ^{66}Zn (^{37}Cl, 2p2n) reaction using 8 Ge detector array. The present level scheme preserves major features of the previously observed band to be based on $\pi g_{9/2} \otimes (\nu h_{11/2})^2$. The previously observed single quasiparticle bands based on $h_{11/2}$, $g_{7/2}$, and $d_{5/2}$ neutron orbitals have been substantially extended. Multifragmentations at the positive parity and negative parity bands at spins around 20h is observed, which are likely to be maximally spin aligned states similar to the ones observed in ^{101}Rh [3]. Detailed analysis and interpretation of the level scheme based on Projected Hartree-Fock calculations is under progress.

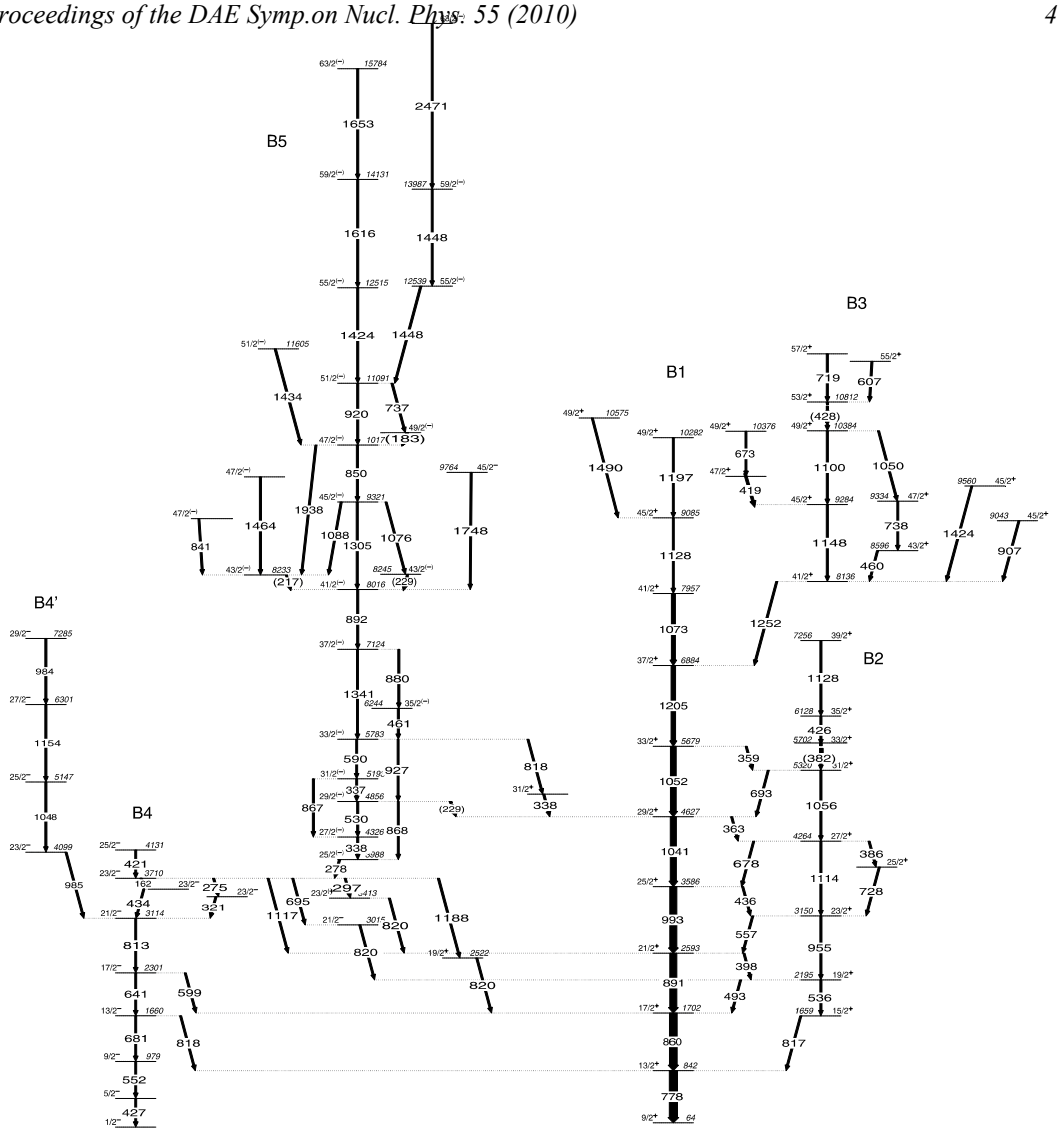

Fig.1. The level scheme of ^{99}Rh obtained in the present work.

The authors would like to thank the collaboration of IUAC, New Delhi, TIFR, Mumbai, IUC-DAEF and SINP, Kolkata., for establishing the INGA clover detector array. Financial support from UGC, New Delhi is duly acknowledged.

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