Excited states in ^{98}Rh

Surender Kumar[1], S. Sihotra[1], K. Singh[1], J. Goswamy[1], N. Singh[1], R. Palit[2], S. Muralithar[3], R. Kumar[3], R. P. Singh[3], R.K. Bhowmik[3], and D. Mehta[1]*
[1]*Physics Department, Panjab University, Chandigarh-160 014, India.*
[2]*Department of Atomic and Nuclear Physics, Tata Institute of Fundamental Research, Mumbai, India*
[3]Inter University Accelerator Centre, Aruna Asaf Ali Marg, New Delhi - 110067, India
* *email:dmehta@pu.ac.in*

Introduction

Transitional nuclei with A≈100 and proton number in lower vicinity of the *Z*=50 shell closure are characterized by gamma–soft potential with small quadrupole deformation at low and moderate angular momenta. The doubly-odd nuclei have configurations which are dominated by the odd proton in the $g_{9/2}$ and $p_{1/2}$ orbitals situated below the *Z*=50 gap. This induces complex level structures for which the proton and the neutron occupy high-Ω and/or low-Ω orbitals. The coexistence of spherical and deformed shapes further increases the complexity of the level structures. Strongly prolate driving low- unique parity $h_{11/2}$ neutron orbital is accessible at low excitation energies for the nuclei with neutron number receding the N=50 shell closure.

In the present work, high spin data obtained for doubly–odd nucleus ^{98}Rh (*Z*=45, N=53) are presented. Gasior et al [1] assigned spin and parities for the low lying levels in ^{98}Rh from the decay of ^{98}Pd and $J^{\pi} = 2^{+}$ was assigned to the ground state. This assignment was attributed to the $[\pi(g_{9/2})^5] \otimes \nu[(d_{5/2})^{(3-n)},(s_{1/2})^n]$ configurations, where n=0,1,2. The high spin states in ^{98}Rh were populated previously through the ^{70}Ge(^{32}S,3pn) at 128 MeV by Chattopadhyay et al. [2]. Ghugre et al. [3] studied the same through ^{65}Cu (^{36}S, xn) reaction at 142 MeV. The two level schemes differ considerably especially in terms of spin-parity assignments to the states at high excitation energies. In general, the spin assignments to various levels are uncertain.

Experimental details and data analysis

Excited states in ^{98}Rh nucleus were populated in fusion-evaporation reaction ^{75}As(^{28}Si, 2p3n) 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 Centre (IUAC), New Delhi. The ^{75}As target of thickness 3 mg/cm^2 onto a 10 mg/cm^2 thick Pb backing was prepared by vacuum evaporation followed by rolling. The recoiling nuclei are stopped within target and the de-exciting γ-rays were detected using the Indian National Gamma Array (INGA)-IUAC equipped with 18 clover detectors mounted in five rings configuration **[4]**. A total of about 300×10^6 triple or higher-fold coincidence events were recorded in the 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. RADWARE analysis package **[5]** was used to establish coincidence and intensity relationships for various gamma transitions. The photopeak efficiency of fully equipped INGA-IUAC array is around 5% at the 1.3 MeV gamma ray energy. The clover detectors were calibrated for γ-ray energies and efficiencies using the ^{133}Ba and ^{152}Eu radioactive sources. The analysis was performed to establish energy, intensity and coincidence relationships for various gamma transitions. The angular correlation and polarization analyses were performed to deduce multipolarity of the gamma transitions.

Results and discussion

The present level scheme of ^{98}Rh (Fig. 1) has been established up to E ~ 10 MeV and J = 21$\hbar$. The identified bands have been labeled as B1-B6. The level scheme has been extended substantially at the low excitation energies (bands B2 and B3) with addition of about forty new transitions.

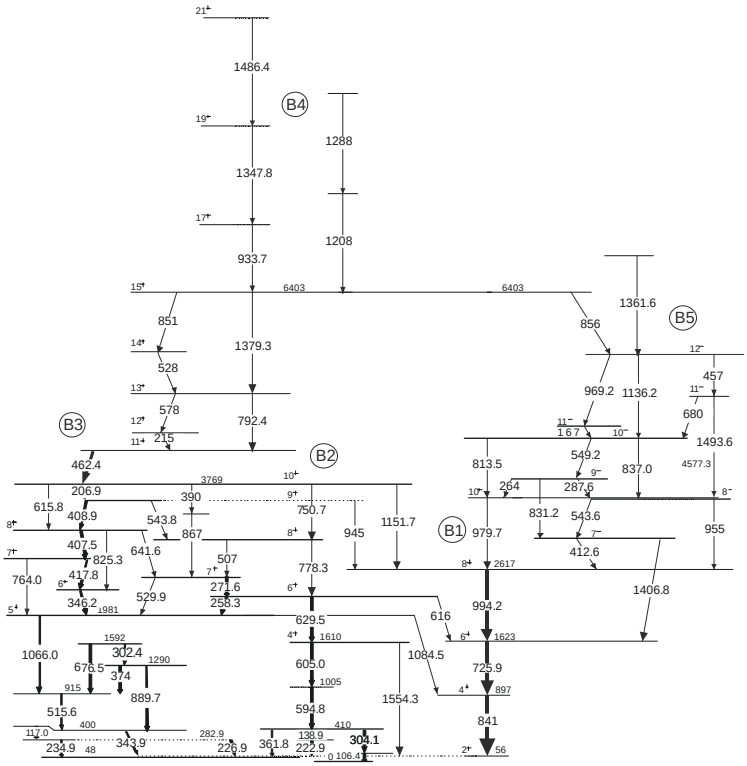

Fig.1 The level scheme of ^{98}Rh developed in the present work. The level energies are relative to the lowest observed level instead of the previously assigned 2^+ ground state. The spin-parity assignments are tentative

A few low-lying states likely to be isomers are observed in the present level scheme with excitation energy lower than the previously assigned 2^+ ground state. It suggests that the earlier proposed 2^+ ground state needs to reassigned. Major changes in the level scheme of ^{98}Rh and its interpretation is expected in the present investigations. The low excitation states are expected to be based on $\pi g_{9/2} \otimes \nu d_{5/2}$ and $\pi p_{1/2} \otimes \nu d_{5/2}$, $\pi g_{9/2} \otimes \nu g_{7/2}$, and $\pi g_{9/2} \otimes \nu g_{9/2}$ configurations. The previously observed high spin part of the earlier reported level scheme (bands B4 and B5) is also modified. These bands are assigned opposite parities in the previous level schemes by Chattopadhyay et al [2] and Ghugre et al. [3]. The parity assignments in the previous level schemes are also contrary. The chiral bands based on $\pi g_{9/2} \otimes \nu h_{11/2}$ configuration are also expected to be observed. Further analysis is expected to yield new results.

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