Vol. 29 (1998) ACTA PHYSICA POLONICA B No 1–2

LEVELS OF ^{100,101}Ru EXCITED IN THE REACTION ^{100}Mo(αxn) *

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(Received November 25, 1997)

Excited states of ^{100}Ru and ^{101}Ru were studied by in-beam gamma-ray spectroscopy methods in reaction ^{100}Mo(α, xn). Angular distributions, excitation functions and coincidences γ–γ were measured. Lifetimes were deduced by DSA method. Particular changes to level schemes were proposed. Alignment was studied and comparison with IBA-1 calculation is discussed.

PACS numbers: 27.60. +j, 23.20. Lv

1. Introduction

A new region of deformation was observed in the early seventies around mass $A \sim 100$. Further research revealed that different types of deformations are possible. Moreover it has been determined that shape coexistence may occur [1]. Abrupt transition from spherical to deformed shape was observed for nuclei with $Z \sim 40$. The presence of parent $(g_{9/2})_\pi$ and $(g_{7/2})_\nu$ shells accentuate the importance of np interaction [2].

2. Experimental results and discussion

The reaction ^{100}Mo$(\alpha, \mathrm{xn})^{100,101}$Ru was studied with a 40 MeV α-particle beam of the U120M cyclotron in Řež near Prague. Isotopically enriched target 6 mg/cm^2 thick was used. Angular distributions were measured at five angles between $\theta = 30^\circ$ and 150° with respect to the beam axis using HPGe

* Presented at the XXV Mazurian Lakes School of Physics, Piaski, Poland, August 27–September 6, 1997.

detector (efficiency 20 %, FWHM=1.85 keV at 1.3 MeV). The γ–γ coincidence spectra were taken up to $1.85 \cdot 10^8$ events with two Ge(Li) detectors. Coincidence matrix 2048 $\times$ 2048 was created. Excitation functions were measured at six different energies between $E_\alpha = 22$ MeV and 40 MeV.

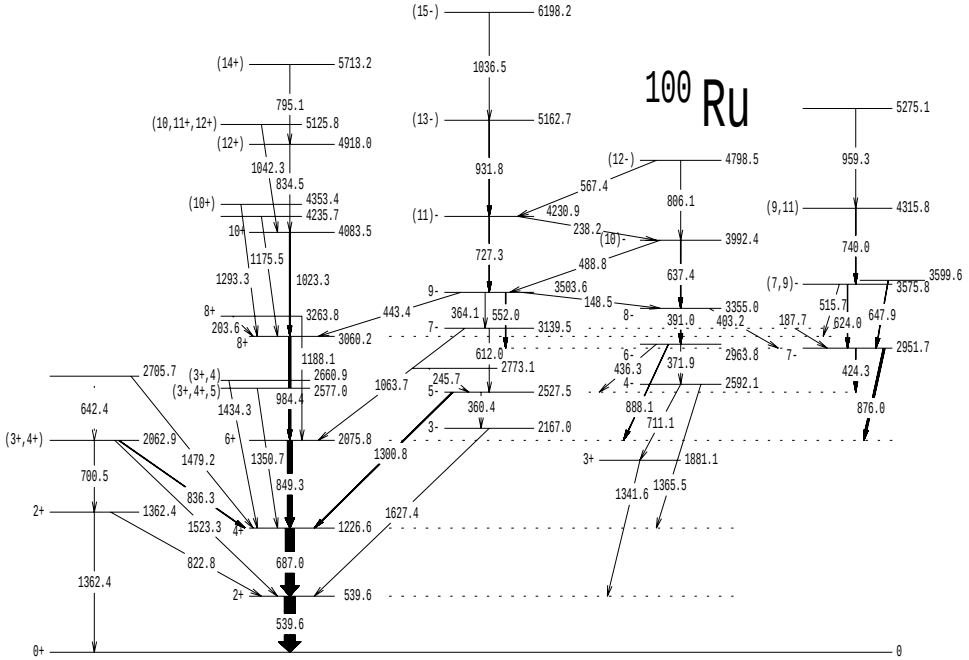

Fig. 1. Level scheme of ^{100}Ru from the present work.

Improved level scheme for ^{100}Ru was proposed (Fig. 1). Five new levels were found, the 3^-_1 state was observed for the first time in (α, xn) reaction, spin and parity 3^+ was assigned to the state at 1881.1 keV in accordance with [3]. Spin and parity 4^- was suggested for the level at 2592.1 keV instead of older $(2^+, 3^-)$ assignment.

Level scheme of ^{101}Ru was improved as well (Fig. 2). Five new levels were found, the level order was changed in g.s. band and new transitions between different bands were found.

Coefficients of angular distributions were determined for the most of the observed transitions, mixing ratios δ for transitions of M1+E2 multipolarity were also determined in many cases.

Lifetimes in higher spin regions were obtained by DSA method, where data from measurement of angular distributions were used. Our DSA method was sensitive in region of *ps*. Determined lifetimes and B(E2) values are presented in Table I and Table II for ^{100}Ru and ^{101}Ru, respectively.

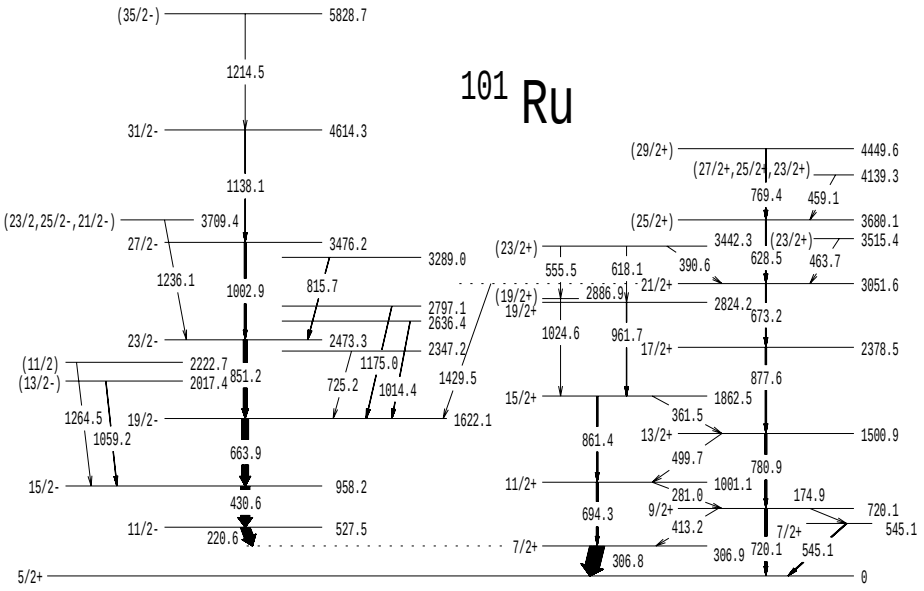

Fig. 2. Partial level scheme of ^{101}Ru from the present work.

TABLE I

Level lifetimes and B(E2) values in ^{100}Ru

Level [keV]	Lifetime [ps]	Transition [keV]	B(E2) [w.u.]
5713.2	≥ 1	795.1	≤ 93
5125.8	≥ 1	1042.3 [a]	≤ 4.8
4353.4	≥ 0.6	1293.3 [a]	≤ 13.5
4083.5	$1.5^{+0.6}_{-0.4}$	1023.3	17^{+6}_{-5}
3060.2	$0.6^{+0.8}_{-0.3}$	984.4	53^{+53}_{-30}
6198.2	≥ 0.2	1036.5	≤ 120
5162.7	$0.6^{+0.5}_{-0.2}$	931.8	70^{+35}_{-30}
4798.5	≥ 0.5	806.1	≤ 125
4230.9	2^{+6}_{-1}	727.3	50^{+50}_{-35}
3503.6	≥ 3	364.1	≤ 355
		552.0	≤ 80

[a] E2 multipolarity assumed

TABLE II

Level lifetimes and B(E2) values in ^{101}Ru

Level [keV]	Lifetime [ps]	Transition [keV]	B(E2) [w.u.]
5828.7	$0.3^{+0.2}_{-0.1}$	1214.5	35^{+20}_{-15}
4614.3	$0.48^{+0.1}_{-0.1}$	1138.1	30^{+10}_{-5}
3709.4	$0.45^{+0.2}_{-0.1}$	1236.1 [a]	20^{+8}_{-5}
3476.2	$0.7^{+0.15}_{-0.1}$	1002.9	40^{+10}_{-7}
3289.0	≥ 1	815.7	≤ 80
2473.3	$0.5^{+0.7}_{-0.2}$	851.2	130^{+90}_{-80}
1622.1	≥ 1	663.9	≤ 230

[a] E2 multipolarity assumed

The IBA-1 model calculation was compared with the lower part of the ^{100}Ru level scheme. We used the six parameter formula [4]. These parameters were fitted to nine levels up to 8^+_1. Results are presented in Fig. 3.

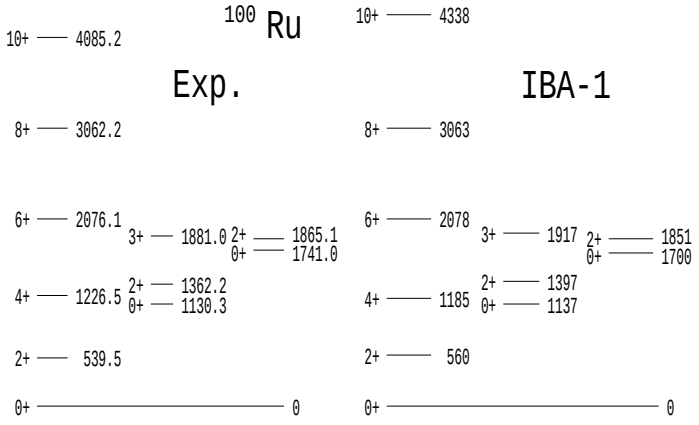

Fig. 3. The comparison of the experimental excitation energies and IBA-1 model predictions for ^{100}Ru.

New data obtained for the ^{101}Ru bands allow us to construct alignment plots (Fig. 4), which confirm probable $h_{11/2}$ neutron origin of bandcrossing in positive parity band, as was suggested for isotopes in this mass region [5,6]. The negative-parity band of ^{101}Ru exhibits the beginning of an up-bend at frequency above 0.5 MeV similar to the increase of alignment in ^{103}Rh [5] and ^{100}Ru [6].

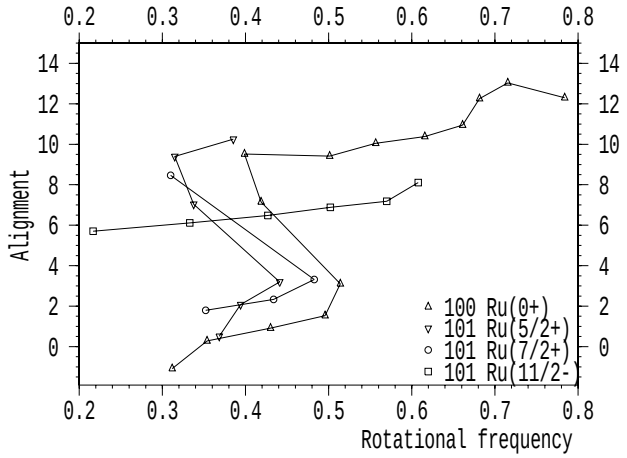

Fig. 4. Aligned angular momenta of ^{100,101}Ru. Rotational frequency $\hbar\omega$ is in [MeV], alignment i_x in [$\hbar$]. The Harris parameters of the references are $J_0 = 9.6\ \hbar^2\mathrm{MeV}^{-1}$ and $J_1 = 18\ \hbar^4\mathrm{MeV}^{-3}$. High spin data for ^{100}Ru were taken from [6].

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