ОБЪЕДИНЕННЫЙ
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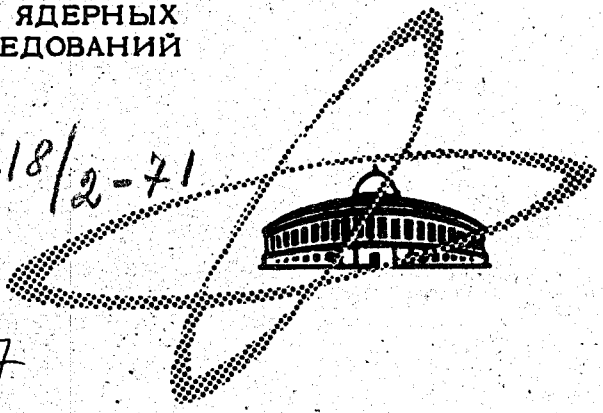
Дубна



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A NEW NEUTRON-DEFICIENT ISOTOPE ^{92}Ru

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Introduction

Neutron-deficient isotopes are under investigation at JINR, Dubna with the JASNAPP facility making use of spallation reactions induced in high-energy proton bombardment [1,2]. Our search for a new isotope ^{92}Ru, further in the line of the known short-lived neutron-deficient isotopes ^{95}Ru, ^{94}Ru and ^{93}Ru [3,4] and [5] resp., proved successful [6] via observing the growth and decay of the daughter isotope ^{92}Tc [7]. This paper is intended to provide some additional information on this isotope.

Apparatus and Source Preparation

A substantial part of the JASNAPP facility was used in this experiment including the external beam irradiation chamber, a pneumatic transfer system, a chemical box and gamma-spectrometric devices. A thermochromatographic method was used for separating the ruthenium activities from $AgCl$ targets irradiated by 660 MeV protons at the JINR synchrocyclotron in Dubna. Time-dependent gamma-ray spectra analyzed by a 4096 channel analyzer (AI-4096, USSR) were taken with several $Ge(Li)$ spectrometers: $38\,cc$ (ÚJV, Řež, Czechoslovakia) and 42 cc (KFKI Budapest, Hungary) having the

resolution 3.6 keV and 4.2 keV, respectively, at 661 keV and an additional 1.8 cc *Ge(Li)*-spectrometer (ÚJV,Řež, 2.0 keV resolution) was calibrated using a set of absolutely calibrated sources for the relative intensity measurement.

Experimental Procedure

At first, ^{92}Tc was identified in the ruthenium fraction and at second, three weak lines at 134 keV, 202 keV and 259 keV were observed. A definite growth of ^{92}Tc lines gave us a clear evidence for the ^{92}Ru existence (viz.[6]).

Having set the irradiation time 3.0 min and that of chemistry separation 2.5 min fifteen experiments were performed under the same conditions (the time sequence of irradiation, transfer, chemistry and delivery time being the same within a couple of seconds). The gamma-ray spectra measurements lasted 41 seconds and each spectrum was run over 16-24 times with no time interval between the consequent measurements. Interpreting the ^{92}Tc lines as the daughter of ^{92}Ru was based on a firm ground for any eventual interfere of the technetium impurity could be easily recognized when observing the ^{96}Tc lines in the gamma-ray spectra of ruthenium taken well after the short-lived isotopes had decayed.

In order to obtain better statistics, the relevant spectra from these experiments were summed up before the evaluation being carried out at the MINSK-2 computer using a program KATOK[8].

Results

The decay of so far unidentified lines at 134 keV and 259 keV is shown on Fig. 1. The 202 keV line mentioned in our previous paper[6] was not observed any more (it already becomes clear that it belongs to ^{87}Nb) and the line at 216 keV, formerly assigned solely to ^{97}Ru was found complex containing a short-lived component. The decay pattern of 216 keV line and its decomposition into two components is shown on Fig. 2. The values of the decay period of all these three lines are in good agreement with the half-life $T_{1/2}$ = (3.65± 0.43) min. derived from the growth and decay of ^{92}Tc lines (Fig. 1). Moreover, having in view that neither technetium nor any other impurity was observed in both short- and long-lived fractions (Figs. 3,4), we have assigned all these three lines to ^{92}Ru. Their accurate energies and relative intensities are given in Tab. 1. The mean value of the ^{92}Ru half-life was determined $T_{1/2}$= (3.16 ± 0.33) min. A typical Ru spectrum is given on Fig. 5.

Discussion

It may be assumed by analogy to the decay $^{90}_{42}Mo_{48} \rightarrow {}^{90}_{41}Nb_{49}$ that $^{92}_{44}Ru_{48}(0^+)$ would most likely feed the 1^+ level in $^{92}_{43}Tc_{49}$ having the dominant configuration $\pi(p_{3/2})^{-1}\nu(p_{1/2})^{-1}$. Emitting three gamma-quanta in cascade, the ^{92}Tc nucleus would undergo successive transformations following the chain of $4^-[\pi(g_{9/2})^3\nu(p_{1/2})^{-1}]$, $6^+[\pi(g_{9/2})\nu(g_{9/2})^{-1}]_{6^+}$ and $8^+[\pi(g_{9/2})^3\nu(g_{9/2})]_{8^+}$ (ground state) levels (Fig. 6).

It is likely that the found three gamma transitions in ^{92}Ru are relevant to the above-mentioned transitions. Unfortunately, on the basis of our experiments it is not possible to determine their proper order.

Acknowledgement

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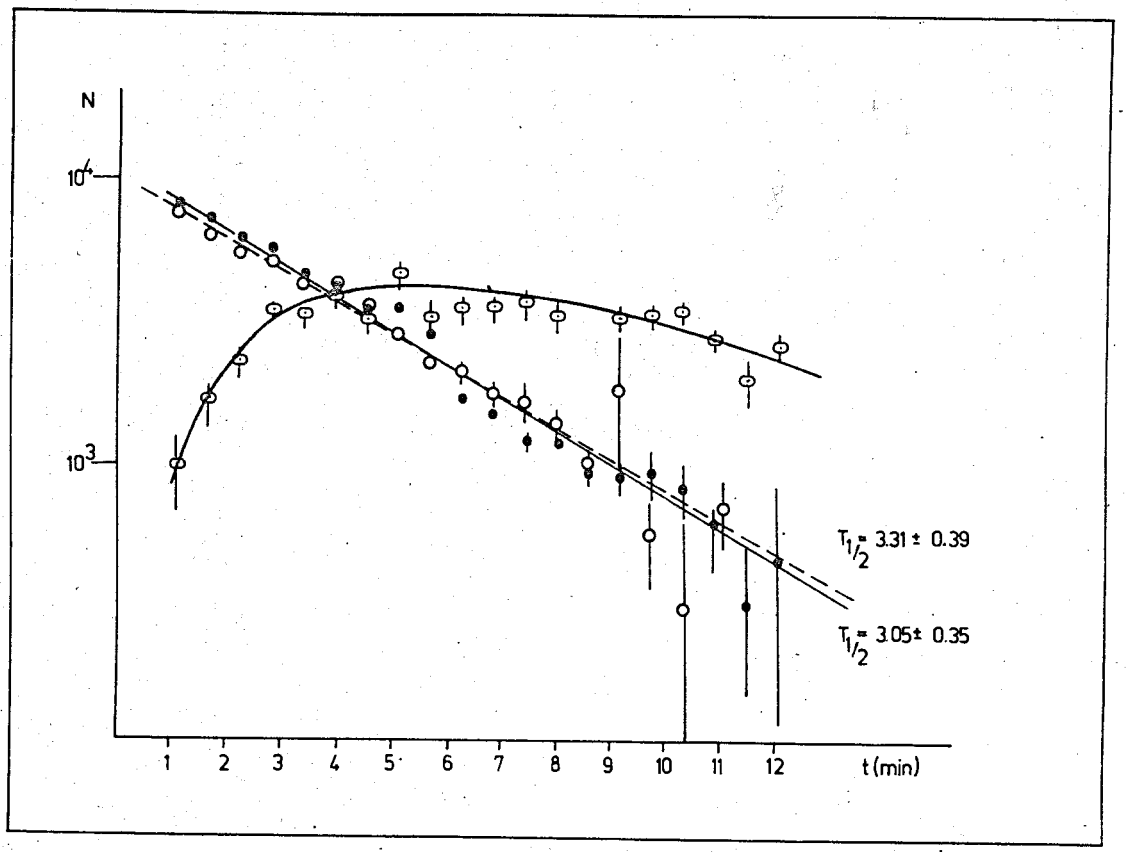

Fig. 1. The decay of 134 keV (black dots), 259 keV (white balls) lines of ^{92}Ru together with the growth and decay of 148 keV ^{92}Tc line.

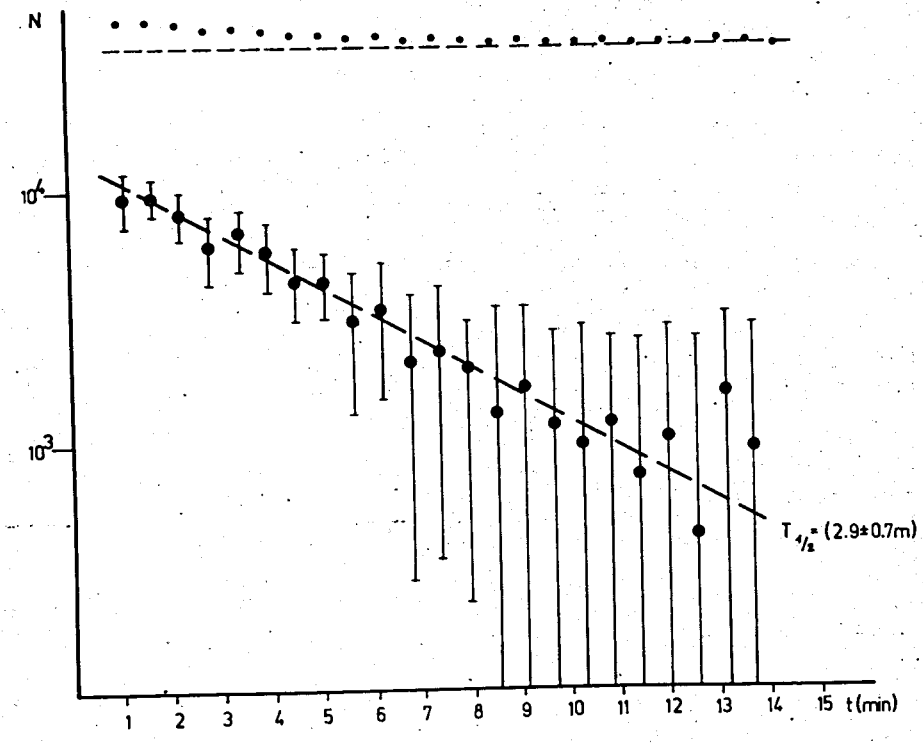

Fig. 2. The decay of the complex 216 keV line (black dots) and the 214 keV line of ^{92}Ru (black balls).

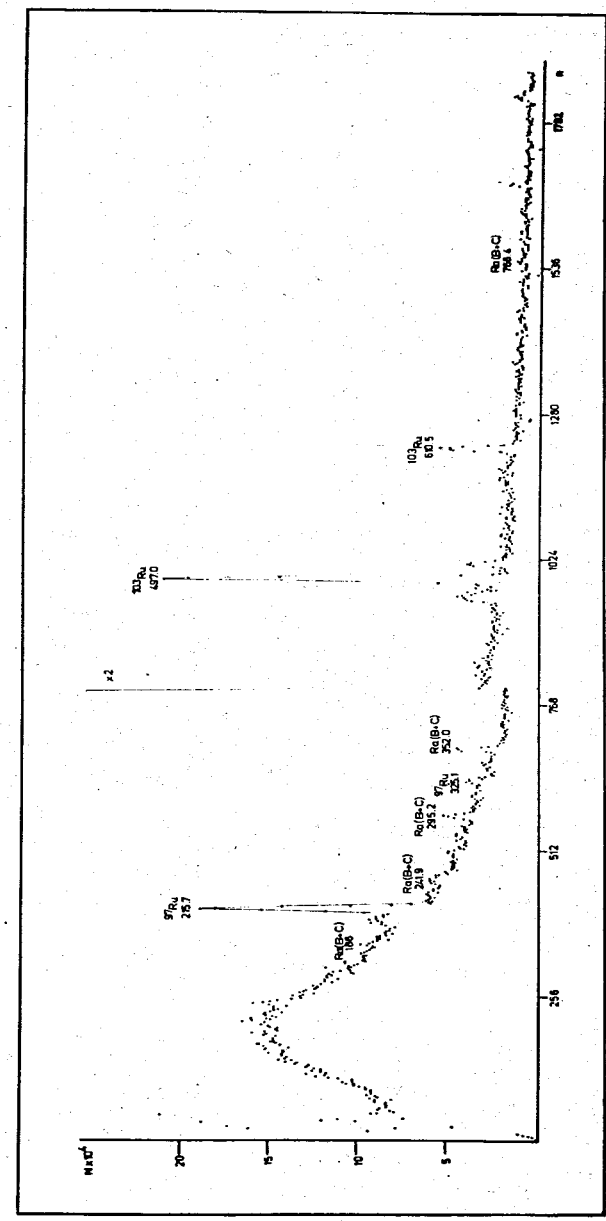

Fig. 3. *Ru* fraction gamma-ray spectrum after 10 days (together with *Ra(B+ C)*.

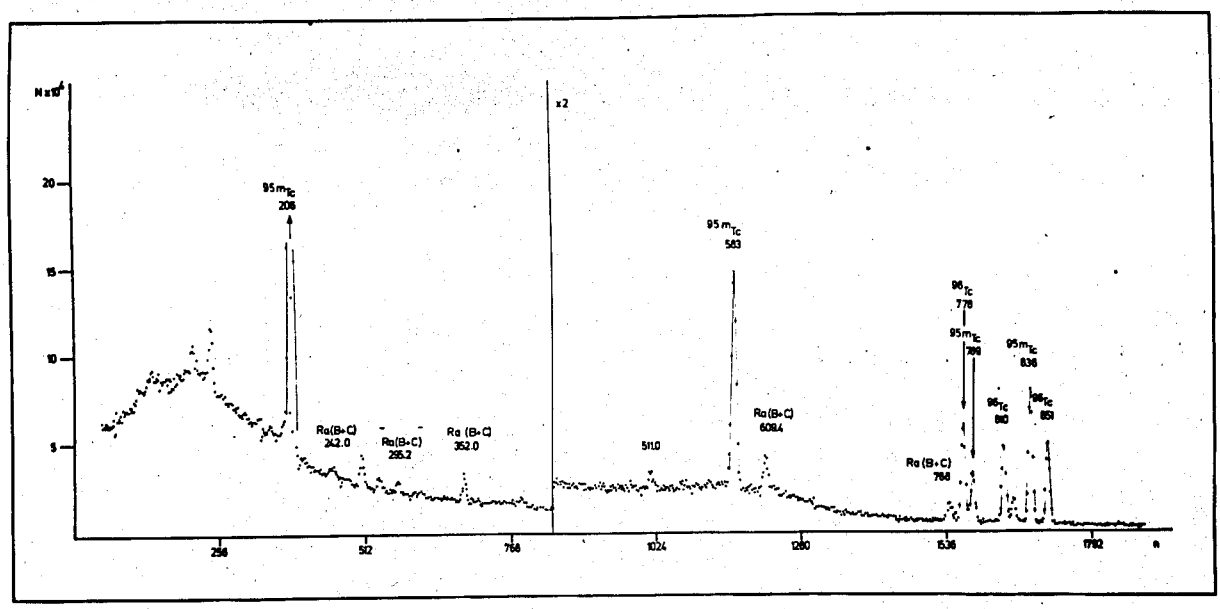

Fig. 4. *Tc* fraction gamma ray spectrum after 10 days (together with *Ra(B+C))*.

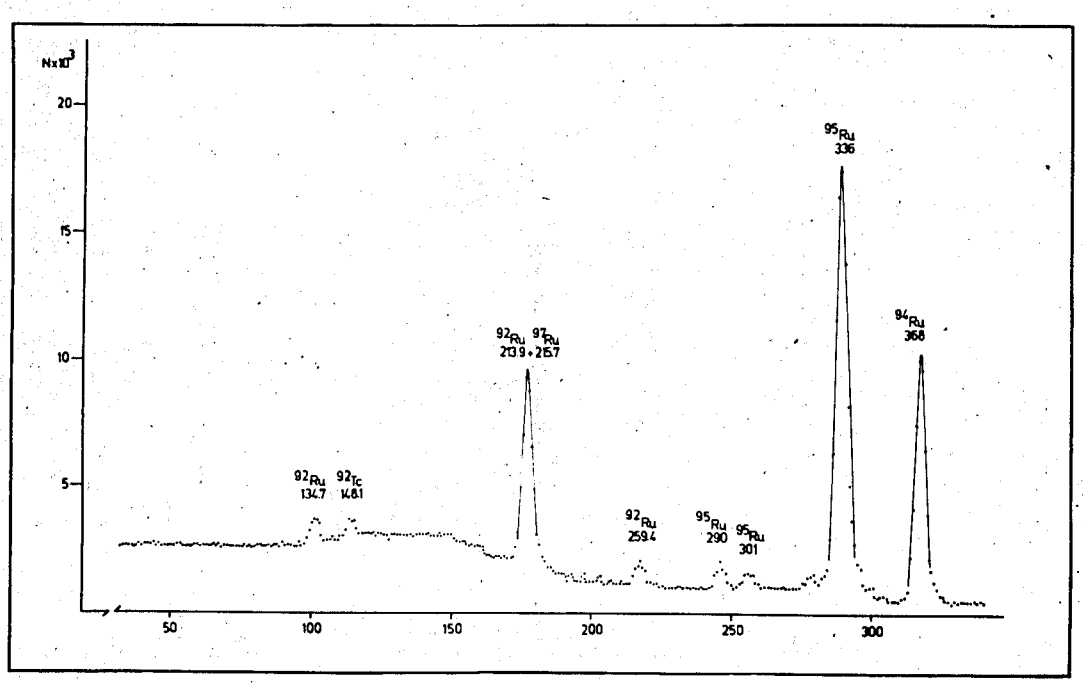

Fig. 5. The ^{92}Ru spectrum taken for 41 sec. app. 6 min. after the end of chemical separation.

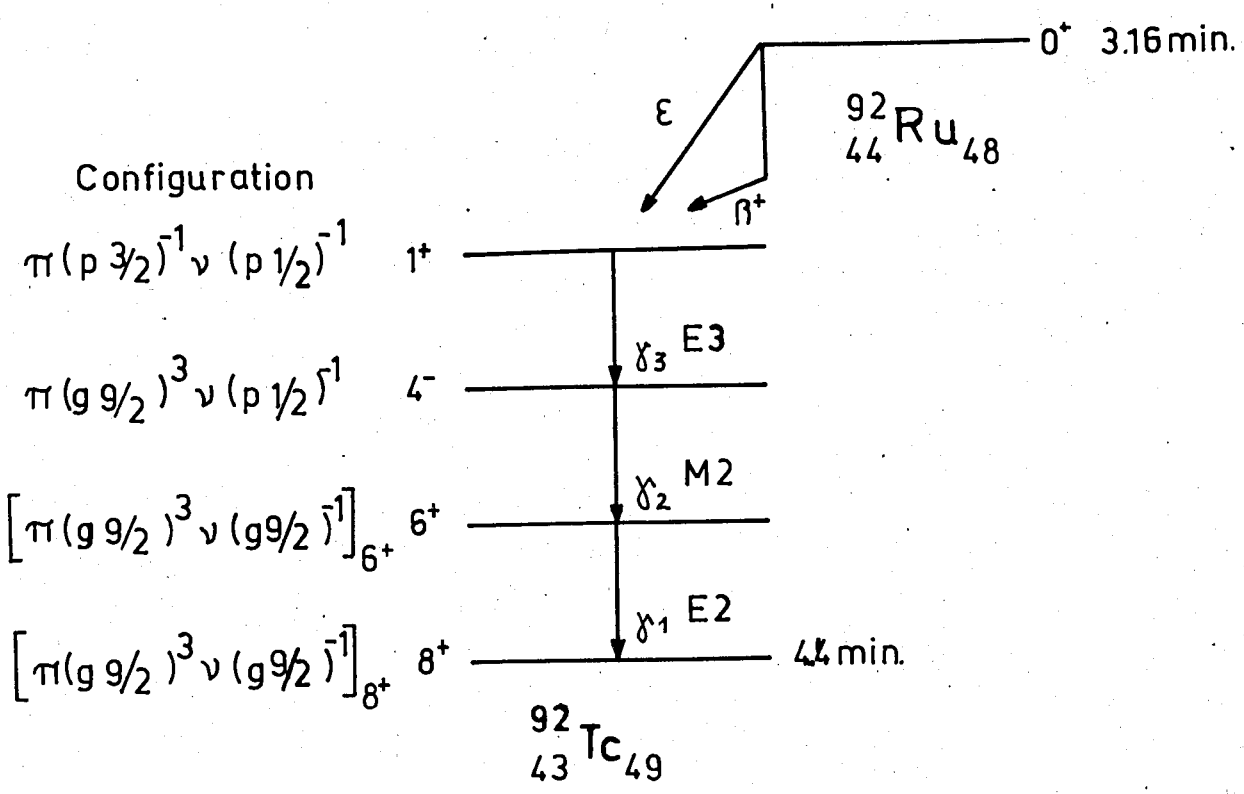

Fig. 6. A proposed decay scheme of ^{92}Ru