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PROGRESS REPORT FROM BULGARIA TO THE INDC

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PROGRESS REPORT

Bulgaria 1971

All the activities are going on at The Institute of Physics with Nuclear Research Centre, Bulgarian Academy of Sciences, Sofia.

I. Neutron nuclear data

1. Three-group spatial and energy neutron distributions in the reactor on their passing through iron and lead neutron ducts. (T.Troshev, V.Hristov, T.Apostolov).

The carried out investigations are concerned with homogeneous and non-homogeneous neutron ducts with diameters of 100 mm, placed in water medium. Iron and lead neutron ducts, as well as ducts with periodical non-homogenities of paraffin or air included in these materials have been investigated. Miniature threshold corona counters containing B and ^{238}U have been used in carrying out the experiment.

Values of diffusion lengths in water-surrounded neutron ducts, avaraged along the neutron duct:

Neutron duct material	For neutron energy			
	>3 MeV	>1.3 MeV	0.4 eV - 10keV	Epithermal and thermal neutrons
iron	8.8	7.9	11.0	11.3
lead	10.9	8.4	6.7	6.8
iron+paraffin	-	6.4	7.5	7.6
iron+air	-	12.4	11.8	13.6
lead+paraffin	-	5.6	5.7	6.0
lead+air	-	9.8	8.0	9.5

2. Development of nondestructive methods for measuring the plutonium by means of neutron coincidence technique. (A. Trifonov, V. Hristov, T. Dragnev).

A handy portable device for measuring the quantity of plutonium in the waste fission materials from uranium industry and power reactors, as well as in the uranium containing water-water reactors has been worked out and its characteristics studied. A non-destructive method on the basis of neutron coincidence technique has been applied.

The device contains the following new elements: ordinary water as a moderator, which makes the container portable - weight 3 kg or 30 kg in working position; a possibility for measuring samples of big volume (up to 5 l); detectors of a new type - corona counters for neutrons with helium-3 or boron-10 with better characteristics compared to other detectors. The possibility for parallel coupling of a great number of corona counters by means of logic elements has been studied.

The estimates show that by means of this method quantities of plutonium-240 of the order of 100 mg can be determined. The work is carried out according to a contract with IAEA - Vienna.

3. Parameters of the intermediate structure of neutron induced fission in ^{239}Pu in the energy region 0 - 2000 eV (N. Ianeva)

Evaluation of data, obtained at the pulsed reactor IBR-30 in Dubna, is performed. This work is now in progress.

II. Non-neutron nuclear data

1. A group (J. Jelev, B. Amov, et al) has studied the radioactive decay of neutron deficient isotopes, obtained on the 660-MeV

proton accelerator of JINR - Dubna. The investigations are as follows: gamma-spectra - with Ge(Li) spectrometers; conversion electron spectra - with a low-background beta spectrometer with double twofold focusing at an $\pi/\sqrt{2}$ angle and a semiconductor Si(Li)-spectrometer; gamma-gamma coincidences - with two Ge(Li)-spectrometers.

a) ^{122}J , $T_{1/2} = 35$ min (B.Amov et al, Theses of reports - 12th Conference on nuclear spectroscopy and theory of deformed nuclei, Dubna, 22-25.6.1971, p.74).

The gamma-ray spectrum from the decay of ^{122}Xe ($T_{1/2} = 20\text{h}$) in equilibrium with ^{122}J , purified at a mass separator, has been investigated. The following gamma transitions: 953, 1037, 1357, 1793, 1940 and 2312 keV, earlier attributed to ^{122}J , have not been observed. Ten new gamma transitions have been found: 706(0.2); 721(0.1); 1131(0.1); 1181(0.15); 1235(0.06); 1640(0.09); 1682(0.11); 1788(0.07); 2205(0.04) and 2943(0.01) keV. The relative intensities of gamma transitions, the 564 keV transition assumed to be 100 units, are given in brackets.

b) ^{132}La , $T_{1/2} = 4.5\text{h}$ and $^{132\text{m}}\text{La}$, $T_{1/2} = 25$ min (B.Amov et al, Izvestia AN USSR, Ser.Fiz.35, 2266 (1971)).

Conversion electron intensities and internal conversion coefficients of 18 transitions at the decay of ^{132}La have been determined. According to this, quantum characteristics have been assigned to several states of ^{132}Ba : 1685 keV (2^+ , 3^+), 1728 (4^+), 2854 (2^- , 3^-), 3155 (1^- , 2^-), 3217(2^- , 3^-), 3423 (2^- , 3^-), 3492 (2^- , 3^-), 3562(1^- , 2^-), 3633 (1^- ; 2^-), 3662 (1^- , 2^-). On the basis of gamma-gamma coincidences 3 new excited levels are suggested: 1503 keV (0^+); 1511 keV (3^+); 2026 keV (4^- , 5^-). The earlier in-

troduced levels 1546, 1667 and 2077 keV have not been confirmed.

c) ^{133}La , $T_{1/2} = 4.0\text{h}$ (S. Avramov, B. Amov, et al, Program and theses of reports-21st annual conference on nuclear spectroscopy and nuclear structure, part I, Moscow 27.1. - 4.2.1971, p.77; Theses of reports-12th conference on nuclear spectroscopy and theory of deformed nuclei, Dubna; 22-25.6.1971, p.83).

The gamma-ray transition intensities for the decay of ^{133}La , purified at a mass separator, have been determined. On the basis of these data and others' data for the conversion electron intensities, the internal conversion coefficients for a number of transitions have been evaluated. From transition intensity balance the population of the levels and the values of the matrix elements have been calculated. Quantum characteristics have been assigned to the following levels in ^{133}Ba : 578.6 keV ($5/2^+$, $7/2^+$), 631.4 ($3/2^+$, $5/2^+$), 677.1 ($5/2^+$, $7/2^+$), 1114.4 ($5/2^+$, $7/2^+$). Most of the earlier introduced levels have been confirmed using gamma-gamma coincidences.

d) ^{194}Tl , $T_{1/2} = 33\text{ min}$ (B. Amov et al, Preprint JINR, Dubna, P6-6250 (1972)).

The gamma-ray and conversion electron intensities of a number of transitions in the decay of ^{194}Tl , purified at a mass separator have been determined. 19 new transitions have been observed. The internal conversion coefficients of some of them and the quantum characteristics of a number of levels have been determined. Eight new excited states of ^{194}Hg are suggested: 1292.5 keV (3^+), 1468.5 (3^+), 2165.8 (5^- , 6^-), 2180.0 (4^- , 5^-), 2260.0, 2264.7 (4^- , 5^-), 2374.8 (6^-), 2463.8 (6^-).

2. A group (E. Nadjakov et al) has studied the decay of nuclei obtained on the Dubna heavy ion accelerator U-300. New isotopes have been identified by means of radiochemical methods

and of excitation functions after measurement of the decay of their gamma spectra and of the gamma spectra of their daughter products on Ge (Li) spectrometers.

a) The new isotopes ^{181}Ir , $T_{1/2} = 10 \pm 2$ min; ^{180}Ir , $T_{1/2} = 6.5 \pm 1.5$ min; and ^{179}Ir , $T_{1/2} = 4 \pm 1$ min have been identified (E.Nadjakov, B.Bochev et al, Izvestia Akad.Nauk USSR, Ser.Fiz. 35, 2202 (1971)).

b) The new isotopes ^{171}W , $T_{1/2} = 9.0 \pm 1.5$ min and ^{170}W , $T_{1/2} = 4 \pm 1$ min have been identified. (E.Nadjakov, B.Bochev et al, Izvestia Akad.Nauk USSR, Ser.Fiz. 35, 2207 (1971)).

3. A group (E.Nadjakov et al.) has developed the recoil - distance Doppler-shift method for nuclear level lifetime measurements (picosecond range) on the Dubna heavy ion accelerators U-300 and U-300 + U-200. (B.Bochev et al, preprints JINR P6-6229, Dubna 1972; P7-6415, Dubna 1972).

The lifetimes $T_{1/2}$ of the ground-state rotational bands in ^{164}Yb and ^{162}Yb have been measured:

Transition	^{164}Yb		^{162}Yb	
	Energy keV	$T_{1/2}$ psec	Energy keV	$T_{1/2}$ psec
2 \rightarrow 0	123.5	882 \pm 88	166.5	387 \pm 53
4 \rightarrow 2	262.8	29.9 \pm 3.0	320.5	7.4 \pm 3.4
6 \rightarrow 4	375.0	5.2 \pm 0.7	436.0	5.9 \pm 2.6
8 \rightarrow 6	462.8	1.6 \pm 0.5	521.7	-
8 \rightarrow 6*		4.9 \pm 1.0		13.6 \pm 3.7

* Time interval from reaction to transition.

Measurements on other nuclei are in progress.

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