INDC(HUN)-3/G-403

Progress Report

HUNGARY 1971

Készült az MTA Központi Fizikai Kutató Intézet Könyvtár Kiadói Osztályán O.v.: Dr. Farkas Istvánné Példányszám: 50 Munkaszám: 5551 Budapest, 1971, április 22. Progress Report

April 1971

Hungarian Academy of Sciences Central Research Institute for Physics, Budapest

> Department of Atomic Physics Roland Eötvös University, Budapest

Institute of Experimental Physics Kossuth University, Debrecen

Hungary

THE 7-DECAY OF 99/2 ANALOGUE RESONANCES IN THE 59,61,63,65_{Cu} NUCLEI

I. Szentpétery and Judith Szücs Central Research Institute for Physics, Budapest

The excitation function of 58,60,62,64 Ni $(p, \gamma)^{59,61,63,65}$ Cu reactions was measured in the $E_p = 3.2 - 4.2$ MeV energy region with the 5 MeV Van de Graaff generator of the Central Research Institute for Physics. The excitation functions were measured with a 7.5 x 7.5 cm NaI crystal; the γ -spectra of the investigated resonances were taken with a 30 cm³ Ge(Li) detector.

In the case of $5^{8}, 6^{0}, 6^{2}$ Ni the g_{94} analogue resonances were found near to the predicted bombarding energy on investigation of the γ decay of these resonances, strong Ml transitions were found to the anti-analogue states. This phenomenon has already been observed with s-d shell muclei, but it has not been found previously in the case of f - p nuclei. Measurements of the angular distributions for the primary γ - transitions were carried out as well. The T_{γ} and A_{2} values are given for these transitions. From the position of the analogue and anti-analogue states an estimate can be given for the avarage strength of the $V_{1}(r)$ symmetry potential. GAMMA-GAMMA ANGULAR CORRELATION MEASUREMENTS IN THE

59 co/n, 7/60 co REACTION

Ъу

B. Kardon, D. Kiss, Z. Seres Central Research Institute for Physics, Budapest, Hungary

Published in the Proceedings of the International Conference on Angular Correlation in Nuclear Disintegration. Delft, 1970.

Angular correlation measurements of gamma radiation following thermal neutron capture in 59 Co have been performed with a combination of a 10 ccm Ge/Li/ diode and a $\oint 12.7 \ge 12.7$ cm NaI/T1/ detector. In the decay of 60 Co cascades of 6876.6 - 555.7 keV and 6984.6 -- 447.2 keV were observed. The spins and parities of the 505 keV and 613 keV levels were found to be 3⁺. SMALL-ANGLE SCATTERING OF NEUTRONS BY DEFORMED NUCLEI

G. Pálla

Central Research Institute for Physics, Budapest. To be published

It has recently been suggested that long-range interactions may be responsible for the "anomalous" small-angle elastic scattering on 232 Th and 238 U.It is shown that the existence of an anomaly must be considered as a misinterpretation of the effect of deformation of the nuclei on the values of the differential cross-section.

PHENOMENOLOGICAL FORMULA FOR /n,2n/, /p,2n/ AND /p,3n/ REACTION CROSS-SECTIONS

L. Jéki

Central Research Institute for Physics, Budapest

Report KFKI-71-8 /1971/

A phenomenological formula is suggested to calculate /n,2n/, /p,2n/ and /p,3n/ reaction cross-sections which gives good agreement between the calculated and measured values.

252 Cf FISSION NEUTRON SPECTRUM FROM 0,01 TO 1,0 MeV

P.P. Dyachenko, B.D. Kuzminov Institute of Physics and Power Engineering, Obninsk, USSR L. Jéki, Gy. Kluge, Gy. Kozma, A. Lajtai Central Research Institute for Physics, Budapest To be published

The results of measuremets by time-of-flight technique on fission neutron spectrum of 252 Cf from 0,01 to 1,0 MeV are reported.

A ⁶Li loaded glass scintillator and a gas scintillation detector (80 % Ar + 20 % Ni) are used for the detection of fission neutrons and fragments, respectively.

The results are discussed in terms of the evaporation model.

SURVEY OF MEASUREMENTS OF THE FISSION NEUTRON SPECTRUM OF²⁵²Cf. L. Jéki, Gy. Kluge, A. Lajtai Central Research Institute for Physics, Budapest Report KFKI-71-9 /1971/

The background sources arising in different techniques for measuring fission neutron energies were studied in detail and the background due to the detection of delayed gamma rays was calculated. The proposed value of the Maxwellian temperature for the energy distribution of neutrons from the spontaneous fission of 252 Cf is about T=1.57 MeV.

PRODUCTION OF SPONTANEOUSLY FISSIONING ISOMERS OF URANIUM, PLUTONIUM AND AMERICIUM IN THE NEUTRON REACTIONS

Yu.P. Gangrsky

Joint Institute for Nuclear Research, Dubna, USSR

T. Nagy., I. Vinnay., I. Kovacs Central Research Institute for Physics, Budapest

The cross-sections of production of spontaneously fissioning isomers 238 U, 242 Pu, 243 Am in the reaction (n, n⁶) and 242 Am in the reaction (n,2n) were measured. The upper limits of the production of fissioning isomers 231 Th, 234 U, 237 U, 238 Pu in the reaction (n, 2n) were obtained. The time-of--flight method and neutrons from the reactions 3 H + d and 9 Be + d were used. UNFOLDING NEUTRON SPECTRA FROM ACTIVATION DATA BY CODES RFOL AND RF07

L. Turi., A. Fischer. Central Research Institute for Physics, Budapest

Two methods for unfolding neutron spectrum from activation data described. Program RFO1 can be used only for the case of threshold detectors, while program RFO7 has no such restrictions and by using proper foils can determine simultaneously the spectrum in the whole energy range of reactors. The algorithm of the methods and input/output specifications of the codes are given.

UNFOLDING NEUTRON SPECTRA FROM ACTIVATION DATA BY CODE RFSP

A. Fischer., L. Turi. Central Reseach Institute for Physics. Budapest

A method for unfolding neutron spectra from activation data is described. The code RFSP is an advanced version of the well-known SPECTRA code /1/. The program determine the spectrum which satisfies the activation equations and minimizes quantity characterizing the deviation from the reference spectrum. A typical run by RFSP requires much less time than one by SPECTRA. The algorithm of the method and input/output specifications of the code are given. /1/. Greer et al. SC-RR-67-746 PRODGROUP - A PROGRAM FOR THE PRODUCTION OF MULTIGROUP REACTOR CONSTANTS FROM THE EVALUATED NUCLEAR DATA AVAILABLE AT IAEA

P. Vértes

Central Research Institute for Physics, Budapest

The evaluated data files available at IAEA are used for generating multigroup constant sets for P_1 equations. The method of data handling and calculation and the corresonding computer program have been elaborated and 26-group constant sets for 15 elements from KEDAK data have been obtained.

A MUFT-TYPE FORTY GROUP CONSTANT LIBRARY

P. Vértes Central Research Institute for Physics, Budapest

A MUFT type library making use of the evaluated nuclear data files distributed by IAEA has been produced by means of a computer program. Sets for 15 elements from KEDAK data and for 3 elements from UKAEA data have been obtained. SPECTRUM CALCULATION OF NEUTRONS TRANSMITTED THROUGH AND REFLECTED FROM SLABS OF DIFFERENT MATERIAL AND THICKNESS

S. Makra, P. Vértes, L. Koblinger Central Research Institute for Physics, Budapest To be published. Partly supported by IAEA Agreement No. 889/CF

An albedo code is used for the calculation of neutron spectra. Discrete energy, fission or reactor input spectra are used, and the spectra of the neutrons reflected from, or transmitted through, slabs of 5 - 200 cm thickness are calculated. Neutrons from thermal energies up to 10.5 MeV are considered. Calculations were performed for the following materials: H_2O , $/CH_2/_{h}$, C, Al, Be, Fe, Fb, concrete, concrete + Fe, concrete + B, $/CH_2/_{h}$ + B, and some selected sandwiches of H_2O , Al, and Be up to a maximum number of six layers. CALCULATIONS OF DOSE FRACTIONS OF SLOW, INTERMEDIATE, AND FAST NEUTRONS BEHIND SHIELDS OF DIFFERENT COMPOSITION AND THICKNESS AS WELL AS READINGS OF SELECTED DOSIMETERS

S. Makra and E. Békés Central Research Institute for Physics Budapest, Hungary

New Developments in Physical and Biological Radiation Detectors Symposium, IAEA, Vienna 1970.

The percentage doses of slow, intermediate, and fast neutrons were determined for a fission source shielded by materials of different composition and thicknesses. Water, polythene, iron, concrete, concrete+iron, and concrete+boron materials, and thicknesses ranging from 5 cm to 200 cm were considered.

Making use of these results one can estimate the percentage dose measured by different dosimeters and hence the correction factors to be applied.

A more sophisticated method of evaluating the reading is to multiply the response function by the spectra values and to integrate over the energy range in question. On the basis of these calculations, readings are presented for several dosimeters and the results compared. The results show the great importance of intermediate energy neutrons.

NEUTRON AVERAGE ENERGIES:

CALCULATIONS AND THEORY OF MEASUREMENTS

S. Makra Central Research Institute for Physics, Budapest Report KFKI-70-6-HP (1970)

Basic features of neutron average energy $/\tilde{E}/$ reasuring techniques are dealt with and calculated \tilde{E} values are presented.

An average energy measuring device determines the following quantity:

$$\widetilde{E}_{eff} = \frac{\int_{E_1}^{E_2} E k(E) \overline{\Phi}(E) dE}{\int_{E_1}^{E_2} k(E) \overline{\Phi}(E) dE}$$

where $\oint /E/$ is the neutron spectrum, and k/E/ is a weight factor. Generally k/E/ \neq 1, resulting in a difference between \widetilde{E} /when k/E/ \equiv 1/ and \widetilde{E}_{eff} .

In this paper the Block & Shon technique /based on the energy dependence of the spatial distribution of thermalized neutrons in a moderator/, as well the double sphere method based on the energy dependence of the counting ratio of two Bonner spheres of different diameters are investigated. The energy dependence of the sensitivity, the k/E/ factors, the accuracy, and the optimum sphere diameters are calculated. The values of \tilde{E} and \tilde{E}_{eff} after the neutrons have penetrated different shields /water, polyethilene, iron, concrete and some of their mixtures/ are determined for some reactor sources using the spectra calculated by albedo method, and is some cases are comparted with values measured at different reactors.

The E values for reactor spectra which have penetrated through different shields vary by a factor of 25, while the ratio $\widetilde{E}_{eff}/\widetilde{E}$ is 1,0 \pm 0,3 for both techniques, if $\widetilde{E} > 0,5$ MeV, but may reach 2-3 if \widetilde{E} is low. SPIN CUT-OFF FACTORS FROM /n,2n/ REACTIONS FOR N < 50 NUCLEI

D. Horváth and A. Kiss Department of Atomic Physics Roland Eötvös University, Budapest To be published in Act.Phys.Hung.

The experimental data on isomeric ratios measured in /n,2n/ reactions are re-evaluated using a method based on the Huizenga-Vandenbosch assumptions. So far only the experimental values of isomeric /n,2n/ cross-section ratios reported for N<50 nuclei at 14 MeV have been re--analysed. The dependence of the extracted spin cut-off factors on the parameters used is discussed, and their values are compared with those predicted by the Fermi gas model; their ratios are found to be about 0,5.

NUCLEAR DATA PROGRAM AT THE INSTITUTE FOR EXPERIMENTAL PHYSICS, UNIVERSITY OF DEBRECEN

The general activities and experimental facilities are the same as described in our previous report sent to NDS on 27 March 1970.

Results in the past year and plans for the future.

Measurements on the angular distributions of fission fragments from 232 Th and 238 U at 14 MeV have been completed, and the results that were sent to NDS are being published.

The /n,2n/ cross-section for ²³⁸U was determined. The analysis of gamma spectra from fission fragments is in progress for the determination of independent and cumulative yield for some fragments.

By detailed investigation of the fine structure in the mass distributions of fission fragments from ^{235}U and ^{238}U at 14 MeV, the enrichment of these isotopes in fuel elements can be determined. This method would be suitable for the determination of the enrichment of ^{235}U in unused canned fuel elements in a safeguard system.

Measurements on prompt gamma-ray spectra from inelastic scattering of 14 MeV neutrons for U and Fe have been performed.

In the near future we shall begin systematic investigation of /n,t/ cross-sections for d+t and d+d neutrons using a low background proportional counter.

Present data are rather scanty, though they are important from the pure scientific-point of view, but also in connection with tritium regeneration as regard controlled thermonuclear devices. It is planned to make measurements of $/n, \alpha / and /n, \gamma / cross-sections$ below 1 MeV using photoneutron sources.