JUNTA DE ENERGIA NUCLEAR

EANDC (OR) 57

INDC-171

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SPANISH PROGRESS REPORT TO THE EANDC

presented by

F. Verdaguer

Madrid - Spain

12 January 1967

Gamma spectrum of ^{233}U

R. Gaeta - J.L. Monleón

The gamma spectrum of ^{233}U has been studied with a Ge(Li) spectrometer 5mm thick in order to complete the data obtained through the α-spectrum measured with a solid state spectrometer. The following γ-rays were found; 42, 54, 66, 72, 95, 104, 118, 135, 146, 165, 189, 209, 218, 247, 261, 280, 292, 320, 338, 353, and 368 keV. The lines at 136, 218, 261, 338 and 353 keV have been observed for the first time in this work. The values of the other lines agree quite well with the results of Ruiz (1) and Tretyakov (2). The intensity of each levels will be determined by means of an IBM computer program which will be finished in a near future.

Total Cross Sections of Cr and As for 3.2 - 5.2 MeV neutrons

F. Manero

The total neutron cross sections of Cr and As have been measured by the transmission method for neutrons of energies between 3.2 and 5.2 MeV. Neutrons of about $\pm$30 keV energy spread were produced by bombarding a heavy ice target with deuterons.

For the chromium measurement we have used chromium in powder form with a purity better than 99,5% canned under presure in a thin walled brass cylinder and sealed air light in order to prevent the absorption of moisture.

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(1) Ruiz, C.F. UCRL-9511 (1961)

(2) Tretyakov E.F. and all. Soviet. Phys. JETP 37(10) 656 (1960)

For the arsenic measurements we have used also arsenic in powder with a purity of 99,999%.

The arsenic glass bottles were opened under argon and then the arsenic canned under pressure in a thin walled brass cylinder sealed air tight. The weights of the samples remained unchanged during the measurement showing that there was no absorption of moisture.

The total statistical errors of the measurements were less than 1,8% for both elements. The mean neutron energy accuracy is ±5 keV and the neutron energy spread ± 30 keV.

The results of the measurement are in listed in the table. They show broad resonances that suggest fluctuations in the level density of the compound nucleus.

Table

Total Neutron Cross Section of Cr and As (inborns)

Neutron Energy (MeV) ± 0,03 MeV	Chromium	Arsenic
3.19	3.68 ± 0,07	
3.26	3.75 ± 0,07	
3.30		3.73 ± 0,07
3.34	3.77 ± 0,07	3.83 ± 0,07
3.39	3.79 ± 0,07	
3.41	3.68 ± 0,07	3.74 ± 0,07
3.45		3.96 ± 0,07
3.48	3.91 ± 0,07	3.74 ± 0,07
3.53		3.63 ± 0,07
3.55	3.80 ± 0,07	3.66 ± 0,07
3.60	3.77 ± 0,07	3.60 ± 0,07
3.63	3.67 ± 0,07	
3.67	3.66 ± 0,07	3.80 ± 0,07
3.69	3.72 ± 0,07	3.74 ± 0,07
3.71		3.83 ± 0,07
3.74	3.70 ± 0,07	3.82 ± 0,07
3.78	3.68 ± 0,07	3.78 ± 0,07
3.86	3.67 ± 0,07	3.68 ± 0,07
3.90		3.75 ± 0,07

Table (continued)

Neutron Energy (MeV) ±0,03 MeV	Chromium	Arsenic
3,92		3.74 ± 0,07
3,94	3.66 ± 0,07	3.81 ± 0,07
3,99		3.70 ± 0,07
4,00	3.59 ± 0,07	3.75 ± 0,07
4,04		3.74 ± 0,07
4,06	3.86 ± 0,07	3.85 ± 0,07
4,08		3.90 ± 0,07
4,10	3.80 ± 0,07	4.01 ± 0,07
4,16	3.78 ± 0,07	3.88 ± 0,07
4,19		3.76 ± 0,07
4,22	3.82 ± 0,07	3.72 ± 0,07
4,24	3.73 ± 0,07	
4,26		3.88 ± 0,07
4,28	3.92 ± 0,07	3.85 ± 0,08
4,34	3.74 ± 0,07	3.85 ± 0,07
4,39	3.77 ± 0,07	3.89 ± 0,07
4,45	3.86 ± 0,07	3.87 ± 0,07
4,50	3.95 ± 0,07	3.89 ± 0,07
4,52	3.84 ± 0,07	
4,57	3.78 ± 0,07	3.81 ± 0,07
4,62	3.77 ± 0,07	3.94 ± 0,07
4,67	3.77 ± 0,07	3.92 ± 0,07
4,71	3.81 ± 0,07	
4,73	3.91 ± 0,07	3.95 ± 0,07
4,78	4.12 ± 0,07	3.80 ± 0,07
4,80	3.96 ± 0,07	
4,83	3.86 ± 0,07	
4,84	3.79 ± 0,07	4.04 ± 0,07
4,85	3.90 ± 0,07	
4,89	3.92 ± 0,07	4.05 ± 0,07
4,94	3.77 ± 0,07	3.99 ± 0,07
4,96	3.93 ± 0,07	
5,00	3.93 ± 0,07	3.90 ± 0,07
5,03	3.87 ± 0,07	
5,05	3.83 ± 0,07	3.95 ± 0,07
5,11	3.78 ± 0,07	3.98 ± 0,07
5,16	3.76 ± 0,07	3.92 ± 0,07
5,21	3.66 ± 0,07	4.14 ± 0,07

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Spanish Report to the members of the EANDC Regional Subcommittee on Nuclear Data

presented by

F. Verdaguer

Madrid - Spain
January 1967

Pulsed Neutron source techniques

1.- Dispersion law studies

T.F. Parkinson* and F.J. Olarte

In the last two months changes in the subcritical assembly have been made to use it for dispersion law studies. The organic coolant in the fuel element has been replaced by heavy water and a thermalizer been buildt around the accelerator target.

2.- Reactivity measurements with pulsed neutron techniques

F.J. Olarte

The reactivity of the subcritical system described in the previous report has been measured for a buckling of 17 m^{-2}. The results obtained with both Garelis and Gozani's data treatment methods are quite reasonable and show good internal consistency. The results show that the above mentioned computation techniques can be applied for system very far from criticality. The calculated reactivity is dependent on the detector position. This effect is more apparent in the radial traverse computed with Gozani's technique.

More detailed information will appear in (1).

The experiment has been continued including more detector positions. To eliminate the counter perturbation, measurements with 1, 2, and 3 detectors in the same axial and radial coordinates have been made.

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* On leave of absence from University of Florida. Gainesville, FLORIDA U.S.A.

(1) Olarte, F.J., "Medida de la reactividad de un sistema subcrítico". To be published in Anales de la Real Sociedad Española de Física y Química.

This experiment will attempt to further demostrate the spatial dependence of the measured reactivity. Higher armonics decay constants will be computed combining spatial and time-dependent measurements.

3.- Anisotropic migration of neutrons

S. Santiago

Final results were computed for the preliminary polyethylene-aluminium parallel slab experiment mentioned in the previous report.

$D_{\parallel}$, $D_{\perp}$, $C_{\parallel}$ and $C_{\perp}$ were jointly determined for two volume ratios. The anisotropy factor $D_{\parallel}/D_{\perp}$ obtained agrees quite well with recent theoretical predictions. The values for $D_{\parallel}$, $D_{\perp}$ show a systematic deviation from the predicted values. The experimental accuracy was not good enough to provide reliable values for the cooling parameters. (*).

Measurements are in progress in the alternating water-aluminium parallel slab system.

(*) To be published in "Anales de la Real Sociedad Española de Física y Química".

Absolute Measurements Laboratory

1.- Weighing of small drops.

C.E. Granados - E. Molina

In view of the discrepancy between the pycnometer and extrapolation methods, further investigation was made on the last one, which is used currently in this laboratory. A small quantity of water was weighted contained in an aluminium box which could be made air-tight or not, permitting then an evaporation equivalent to that obtained with a small drop in open air. A systematic error for the open condition has been found. The measurements are still going on in order to determine the dependence of this systematic error on room conditions.

2.- Dead time measurements

C.E. Granados - M.A. Vigón - F. Verdaguer

The dead time corrections for the coincidence method has been calculated in a very special case. The same pulse sequency was introduced into the two channels. The resulting formulae provided a very precise method to measure the dead times of both channels.

A paper will appear in Anales R. Soc. Esp. Fís y Quim.

Experimental Reactors

1.- Experimental Fast Reactor CORAL

F. Verdaguer - E. Rodriguez Mayquez - R. Gutierrez Bernal
Ag. Tanarro - J. De Carlos - An. Tanarro - F. Gonzalez
J. Agulló

The development of the project has reached the following state :

The civil engineering work has been concluded except for some minor points concerning the air tightness of the reactor hall.

The performance of the electromechanical system that drives the moving table has been tested and after some initial difficulties is now working as expected. The driven systems for safety plug, shim rods and control rods have also been tested and some modifications in the control rod system are now in course. The natural uranium reflector is already mechanized except for some special pieces that are under construction.

The different components of the electronic equipment are being tested and their installation on the control desk will begin next month.

The IAEA has sent to Madrid an Advisory Mission on Reactor Safety at the request of the government of Spain to review the safety aspects of the CORAL reactor. On the basis of the information supplied the Mission concluded that the reactor can be constructed and operated in its proposed location without endangering the public in the surrounding region. It is therefore expected that there will be no difficulties to conclude an agreement between the IAEA, U.S.A. and Spain for the supply of the enriched uranium for the fuel elements after the Board of Governors from the Agency have met next February in Vienna. NUKEM is prepared to supply the fuel elements 5 months after receipt of the order.

It is excepted to have all the mechanical, electromechanical and electronic system installed and in working conditions before next July and be able to achieve the criticality of the reactor during the second half of 1967.

2.- Experimental Reactor JEN-2

J. Montes - M. Fajardo - C. Martin Nuño

This Reactor has achieved criticality at May 31, 1966. The measurements carried out during the past months indicated that some changes on the mechanical structure of the reactor in order to increase the efficiency of the control blades were necessary.

After these changes the control blades can now be placed on the surface of the core, independently of its size if a rectangular geometry is mantained. Measurements on the reactivity controlled by the blades for different core structures are now in progress in order to decide if additional negative reactivity would be necessary for the normal operation of the reactor.

Solid State Physics

1.- γ-Radiation hardening in NaCl single crystals

F. Agulló-López

The study of effect of γ-rays on the plastic behaviour of NaCl has been continued during the present year. In particular, attention has been paid to the increase in yield stress of NaCl single crystals which had been previously strained in various amounts. The main results are: a/ Radiation considerably raises the yield stress with regard to the pre-irradiation flow stress level. However, the hardening decrease on increasing this previous stress level. b/ In irradiated samples an easy glide region appears after yielding.

Results of this work are expected to appear in J. Appl. Phys. December 1966.

2.- Effect of the radiation dose sequence on the F-centre coloration curve.

F. Agulló-López

It has been observed that the F-centre coloration curve depends markedly on the radiation dose sequence used to obtain the curve. The effect is intensity dependent and becomes negligible for low enough γ-ray intensities. A simple model to explain these results has been proposed.

Published in Solid State Comm. 4, 275 (1966)

3.- Effect of the γ-radiation intensity on the first stage of F-centre coloring

F. Agulló-López

The role of the γ-radiation intensity on the first stage of F-coloring has been investigated, in the range 250 - 30.000 R/m. Main results are: In all cases the first stage is made up of two components of very different growth rates. The total saturation level depends on intensity in the same way as that for the slow component. The fast component is intensity independent.

"Dinamic" studies of the effect of intensity have also been made. The dependence of the total saturation level with intensity is similar to that found through the direct method.

Part of this work has been presented to the International Conference on Luminescence. Budapest (1966)