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NUCLEAR PHYSICS RESEARCH IN THE USSR

COLLECTED ABSTRACTS

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Institute of Physics and Power Engineering

MEASUREMENTS OF INTEGRAL VALUES OF ALPHA FOR PLUTONIUM-239 AND URANIUM-235

V.G. Dvukhsherstnov, Yu.A. Kazansky, V.M. Furmanov

Integral values of alpha for ^{239}Pu and ^{235}U were measured in a neutron beam from the uranium-graphite reactor at the Obninsk Nuclear Power Station. The beam was filtered by two different thicknesses of ^{10}B. Values of alpha for the "difference" neutron spectrum were measured and compared with calculations taking account of the effects of the thickness of the samples used in the experiment. The results are presented in Table 1.

Table 1

Plutonium-239

Capture and fission cross-sections			Value of alpha
0.1-21.5 keV	< 0.1 keV	> 21.5 keV	
BNAB - 26	BNAB - 26		0.311
ORNL - RPI	BNAB - 26		0.439
HARWELL	BNAB - 26		0.360
Integral measurements			0.43 ± 0.03

Uranium-235

Capture and fission cross-sections			Value of alpha
0.1-100 keV	< 0.1 keV	> 100 keV	
BNAB - 26	BNAB - 26		0.397
ORELA	BNAB - 26		0.336
Integral measurements			0.37 ± 0.03

ANGULAR ANISOTROPY OF FRAGMENTS FROM THORIUM-232 AND PLUTONIUM-238 FISSION BY NEUTRONS WITH ENERGIES IN THE RANGE 13.40-14.80 MeV

D.L. Shpak, A.I. Blokhin, Yu.B. Ostapenko,
G.N. Smirenkin
(Communication published in Zh. eksp. teor. Fiz.)

Using multiangular track methods, the authors perform detailed measurements of the angular distributions of fragments from ^{232}Th and ^{238}Pu fission by neutrons with energies in the range 13.40-14.80 MeV. Their data on the angular anisotropy of the fission fragments are compared with results obtained by other authors.

Table 1

Angular anisotropy of fission fragments

E_n (MeV)	A(^{232}Th)	A(^{238}Pu) I series	A(^{238}Pu) II series
I3,46±0,06	0,55 ± 0,02	0,200±0,0I2	0,250±0,0I5
I3,60±0,06	0,6I ± 0,02	0,I72±0,0I2	-
I3,74±0,06	0,57 ± 0,02	0,I79±0,0I2	0,205±0,0I2
I3,87±0,06	0,60 ± 0,02	0,I93±0,0I2	0,I99±0,0I2
I4,03±0,06	0,68 ± 0,02	0,I72±0,0I2	0,I78±0,0I2
I4,I6±0,06	0,69 ± 0,02	0,I80±0,0I2	0,I87±0,0I2
I4,30±0,06	0,69 ± 0,02	0,I87±0,0I2	0,I80±0,0I2
I4,44±0,06	0,73 ± 0,02	0,208±0,0I2	0,2I2±0,0I2
I4,60±0,06	0,74 ± 0,02	0,I82±0,0I2	0,I90±0,0I2
I4,75±0,06	0,67 ± 0,02	0,232±0,0I2	0,226±0,0I2
I4,79±0,06	0,68 ± 0,02	0,226±0,0I2	0,240±0,0I2

Table 2

$\sigma_f(^{232}Th)/\sigma_f(^{238}Pu)$ in relation to neutron energy

E_n (MeV)	$\sigma_f(^{232}Th)/\sigma_f(^{238}Pu)$	E_n (MeV)	$\sigma_f(^{232}Th)/\sigma_f(^{238}Pu)$
I3,46±0,06	0,966±0,025	I4,I6±0,06	I,073±0,025
I3,60±0,06	0,9I6±0,025	I4,44±0,06	I,068±0,025
I3,74±0,06	0,994±0,025	I4,60±0,06	I,098±0,025
I3,87±0,06	I,I40±0,025	I4,75±0,06	I,I85±0,025
I4,03±0,06	I,056±0,025	I4,79±0,06	I,207±0,025

RELATIVE YIELDS OF DELAYED NEUTRONS IN URANIUM-238 FISSION BY NEUTRONS WITH ENERGIES IN THE RANGE 3.9-5.1 MeV

B.P. Maksyutenko, Yu.F. Balakshev, G.I. Volkova

(Article submitted to "Jadernye konstanty" ("Nuclear constants"), published by the Nuclear Data Centre of the USSR State Committee on the Utilization of Atomic Energy)

The following table contains the relative yields of groups of delayed neutrons together with the mean-square errors relating to the scatter of the results of two measurement series each consisting of 30 measurements. The decay curves were treated by the least-squares method. The measurements were performed with a titanium-deuterium target 1 mg/cm^2 thick and 45 mm in diameter.

Group number	$T_{\frac{1}{2}}$	Relative yields				
		E_n = 3.9 MeV	E_n = 4.2 MeV	E_n = 4.5 MeV	E_n = 4.8 MeV	E_n = 5.1 MeV
I	52,38	I,0	I,0	I,0	I,0	I,0
2	2I,58	9,24±0,I4	8,72±0,06	9,29±0,52	I0,48±0,06	8,0 ± 0,2
3	5,00	I4,37±0,7I	I2,23±0,23	I2,50±0,47	I4,5 ±0,I	II,4 ± 0,9
4	I,93	43,0 ±3,7	38,6 ±4,8	3I,6 ±4,6	44,53±0,05	37,4 ± 4,8

AUTOMATION OF EXPERIMENTS TO MEASURE THE RELATIVE YIELDS OF DELAYED NEUTRONS

G.I. Abakumov, Yu.F. Balakshev, A.P. Klimov, A.M. Kovalev, Yu.V. Larionov, B.P. Maksyutenko

(Preprint of the Institute of Physics and Power Engineering)

The authors explain a system which they have developed for the automatic control of the synchronous operation of an accelerator, a measurement complex and a recording device in the experimental measurement of relative yields of delayed neutrons.

A description is given of the recording device, which covers the ion beam in front of the magnetic analyser of the accelerator. The measurement complex operating as a time analyser and the control unit operating automatically and semi-automatically are also described.

NEUTRON CROSS-SECTIONS FOR RADIATIVE CAPTURE AND FISSION MEASURED FOR CERTAIN HEAVY NUCLEI BY THE SLOWING-DOWN TIME METHOD IN LEAD

V.B. Chelnokov, V.A. Tolstikov, Yu.Ya. Stavissky, A.A. Bergman, A.E. Samsonov

(Preprint of the Institute of Physics and Power Engineering)

The authors review measurements of the cross-sections for ^{235}U and ^{239}Pu fission, the neutron capture cross-sections for ^{107}Ag, ^{109}Ag, ^{197}Au, ^{232}Th and ^{238}U nuclei and the parameter $\alpha(E)$ for ^{239}Pu performed with a slowing-down time spectrometer in lead, taking into account the special features of the method (absolute normalization of the cross-sections, energy resolution, estimate of the effect of resonance self-shielding).

Experimental data from other papers are presented for purposes of comparison.

Table 1

Numerical fission cross-section values

E (keV)	$\sigma_f(E)$ for ^{235}U (barn)	$\sigma_f(E)$ for ^{239}Pu (barn)	$\frac{\sigma_f(^{239}Pu)}{\sigma_f(^{235}U)}$
34,6	I,97 ± 0,I4	I,44 ± 0,II	0,73 ± 0,07
24,2	2,I7 ± 0,I4	I,47 ± 0,II	0,68 ± 0,06
I7,3	2,42 ± 0,I4	I,62 ± 0,II	0,67 ± 0,06
I2,5	2,70 ± 0,I5	I,65 ± 0,I0	0,6I ± 0,05
9,5	2,90 ± 0,I6	I,74 ± 0,I0	0,60 ± 0,05
7,5	3,30 ± 0,I8	I,88 ± 0,II	0,57 ± 0,04
6,0	3,60 ± 0,20	2,06 ± 0,II	0,57 ± 0,04
5,0	3,90 ± 0,20	2,26 ± 0,I2	0,58 ± 0,04
4,0	4,40 ± 0,25	2,37 ± 0,I2	0,54 ± 0,04
3,2	4,90 ± 0,25	2,6I ± 0,I3	0,53 ± 0,04
2,6	5,40 ± 0,25	2,80 ± 0,I4	0,52 ± 0,04
2,I7	5,80 ± 0,30	3,I4 ± 0,I6	0,54 ± 0,04
I,77	6,40 ± 0,30	3,70 ± 0,20	0,58 ± 0,04
I,47	7,00 ± 0,35	4,30 ± 0,20	0,6I ± 0,04
I,23	7,70 ± 0,35	5,I0 ± 0,25	0,66 ± 0,04
I,05	8,30 ± 0,40	5,6 ± 0,3	0,67 ± 0,04
0,92	8,90 ± 0,40	5,7 ± 0,3	0,64 ± 0,04
0,80	9,90 ± 0,45	6,I ± 0,3	0,62 ± 0,04
0,70	I0,9 ± 0,5	6,7 ± 0,3	0,6I ± 0,04
0,60	II,7 ± 0,5	7,7 ± 0,4	0,66 ± 0,04
0,50	I2,3 ± 0,6	8,7 ± 0,4	0,7I ± 0,05
0,40	I3,4 ± 0,6	9,4 ± 0,5	0,70 ± 0,05
0,35	I4,7 ± 0,7	I0,5 ± 0,6	0,7I ± 0,05
0,30	I5,9 ± 0,7	I2,3 ± 0,6	0,77 ± 0,05
0,25	I7,9 ± 0,8	I5,0 ± 0,7	0,84 ± 0,05
0,20	I9,8 ± 0,9	I6,5 ± 0,8	0,83 ± 0,05

Table 2

Numerical values of the neutron capture cross-sections for ^{107}Ag, ^{109}Ag and ^{197}Au nuclei

E (keV)	$\sigma_\gamma(E)$ for ^{107}Ag and ^{109}Ag (barn)	$\sigma_\gamma(E)$ for ^{197}Au (barn)
34,6	0,84 ± 0,I0	0,59 ± 0,06
24,2	0,98 ± 0,09	0,73 ± 0,06
I7,3	I,I0 ± 0,09	0,89 ± 0,07
I2,5	I,23 ± 0,09	I,08 ± 0,07
9,5	I,33 ± 0,09	I,27 ± 0,08
7,5	I,40 ± 0,09	I,50 ± 0,09
6,0	I,47 ± 0,09	I,74 ± 0,I0
5,0	I,6I ± 0,I0	2,00 ± 0,I2
4,0	I,70 ± 0,I0	2,40 ± 0,I4
3,2	I,90 ± 0,II	2,90 ± 0,I7
2,6	2,II ± 0,I2	3,40 ± 0,20
2,I7	2,35 ± 0,I3	4,00 ± 0,23
I,77	2,73 ± 0,I6	4,90 ± 0,30
I,47	3,30 ± 0,I8	6,I0 ± 0,35
I,23	3,90 ± 0,22	7,30 ± 0,45
I,05	4,50 ± 0,25	8,40 ± 0,50
0,92	4,90 ± 0,28	9,40 ± 0,55
0,80	5,I ± 0,3	II,00 ± 0,65
0,70	5,6 ± 0,3	I2,80 ± 0,75
0,60	7,2 ± 0,4	I4,40 ± 0,85
0,50	8,6 ± 0,5	I5,I ± 0,9
0,40	8,8 ± 0,5	I6,8 ± I,0
0,35	8,9 ± 0,5	I8,I ± I,I
0,30	I0,0 ± 0,5	I9,8 ± I,2
0,25	9,4 ± 0,5	I9,5 ± I,I
0,20	I0,3 ± 0,5	I8,0 ± I,0

Table 3

Numerical values of the neutron capture cross-sections for ^{232}Th and ^{238}U nuclei

E (keV)	$\sigma_\gamma(E)$ for ^{232}Th (barn)	$\sigma_\gamma(E)$ for ^{238}U (barn)
34,6	0,39 ± 0,05	0,40 ± 0,05
24,2	0,46 ± 0,05	0,47 ± 0,05
I7,3	0,59 ± 0,05	0,55 ± 0,05
I2,5	0,67 ± 0,05	0,64 ± 0,05
9,5	0,75 ± 0,06	0,69 ± 0,06
7,5	0,84 ± 0,06	0,75 ± 0,06
6,0	0,96 ± 0,07	0,82 ± 0,06
5,0	I,07 ± 0,08	0,88 ± 0,07
4,0	I,24 ± 0,09	0,96 ± 0,07
3,2	I,42 ± 0,I0	I,II ± 0,08
2,6	I,77 ± 0,I3	I,3I ± 0,09
2,I7	2,I0 ± 0,I5	I,48 ± 0,I0
I,77	2,50 ± 0,I8	I,7I ± 0,I2
I,47	2,80 ± 0,20	I,99 ± 0,I4
I,23	3,I0 ± 0,20	2,40 ± 0,I6
I,05	3,40 ± 0,20	2,70 ± 0,I8
0,92	3,90 ± 0,25	3,00 ± 0,20
0,80	4,60 ± 0,30	3,20 ± 0,20
0,70	5,30 ± 0,35	3,40 ± 0,20
0,60	5,60 ± 0,35	3,90 ± 0,25
0,50	5,90 ± 0,40	4,20 ± 0,25
0,40	7,00 ± 0,45	4,5 ± 0,3
0,35	8,2 ± 0,5	5,0 ± 0,3
0,30	9,8 ± 0,6	6,0 ± 0,4
0,25	I0,7 ± 0,7	6,9 ± 0,5
0,20	I2,I ± 0,8	9,5 ± 0,6

Table 4

Cross-section ratios based on the results of measurements performed by the authors

E (keV)	$\frac{\sigma_\gamma(^{197}Au)}{\sigma_\gamma(^{235}U)}$	$\frac{\sigma_\gamma(^{232}Th)}{\sigma_\gamma(^{235}U)}$	$\frac{\sigma_\gamma(^{238}U)}{\sigma_\gamma(^{235}U)}$
34,6	0,30 ± 0,04	0,20 ± 0,03	0,20 ± 0,03
24,2	0,34 ± 0,04	0,2I ± 0,03	0,22 ± 0,03
I7,3	0,37 ± 0,04	0,24 ± 0,03	0,23 ± 0,03
I2,5	0,40 ± 0,04	0,25 ± 0,03	0,24 ± 0,02
9,5	0,44 ± 0,04	0,26 ± 0,03	0,24 ± 0,02
7,5	0,45 ± 0,04	0,25 ± 0,03	0,23 ± 0,02
6,0	0,48 ± 0,04	0,27 ± 0,03	0,23 ± 0,02
5,0	0,5I ± 0,04	0,27 ± 0,03	0,23 ± 0,02
4,0	0,54 ± 0,04	0,28 ± 0,03	0,22 ± 0,02
3,2	0,59 ± 0,05	0,29 ± 0,03	0,23 ± 0,02
2,6	0,63 ± 0,05	0,33 ± 0,03	0,24 ± 0,02
2,I7	0,69 ± 0,05	0,36 ± 0,03	0,25 ± 0,02
I,77	0,77 ± 0,06	0,39 ± 0,03	0,27 ± 0,02
I,47	0,87 ± 0,06	0,40 ± 0,03	0,28 ± 0,02
I,23	0,95 ± 0,07	0,40 ± 0,03	0,3I ± 0,03
I,05	I,0I ± 0,07	0,4I ± 0,03	0,32 ± 0,03
0,92	I,06 ± 0,08	0,44 ± 0,03	0,34 ± 0,03
0,80	I,II ± 0,08	0,46 ± 0,04	0,32 ± 0,03
0,70	I,I7 ± 0,08	0,49 ± 0,04	0,3I ± 0,03
0,60	I,23 ± 0,09	0,48 ± 0,04	0,33 ± 0,03
0,50	I,23 ± 0,09	0,48 ± 0,04	0,34 ± 0,03
0,40	I,25 ± 0,09	0,52 ± 0,04	0,34 ± 0,03
0,35	I,23 ± 0,09	0,56 ± 0,04	0,34 ± 0,03
0,30	I,24 ± 0,08	0,62 ± 0,05	0,38 ± 0,03
0,25	I,09 ± 0,07	0,60 ± 0,05	0,44 ± 0,04
0,20	0,9I ± 0,06	0,6I ± 0,05	0,48 ± 0,04

Table 5

Cross-section ratios based on the results of measurements performed by the authors

E (keV)	$\frac{\sigma_\gamma(^{197}Au)}{\sigma_f(^{239}Pu)}$	$\frac{\sigma_\gamma(^{232}Th)}{\sigma_f(^{239}Pu)}$	$\frac{\sigma_\gamma(^{238}U)}{\sigma_f(^{239}Pu)}$
34,6	0,4I ± 0,06	0,27 ± 0,04	0,38 ± 0,04
24,2	0,50 ± 0,06	0,3I ± 0,04	0,32 ± 0,04
I7,3	0,55 ± 0,06	0,36 ± 0,04	0,34 ± 0,04
I2,5	0,65 ± 0,06	0,4I ± 0,04	0,39 ± 0,04
9,5	0,73 ± 0,07	0,43 ± 0,04	0,40 ± 0,04
7,5	0,80 ± 0,07	0,45 ± 0,04	0,40 ± 0,04
6,0	0,84 ± 0,07	0,47 ± 0,04	0,40 ± 0,04
5,0	0,88 ± 0,07	0,47 ± 0,04	0,39 ± 0,04
4,0	I,0I ± 0,08	0,52 ± 0,05	0,40 ± 0,04
3,2	I,II ± 0,08	0,54 ± 0,05	0,43 ± 0,04
2,6	I,2I ± 0,09	0,63 ± 0,06	0,47 ± 0,04
2,I7	I,27 ± 0,I0	0,67 ± 0,06	0,47 ± 0,04
I,77	I,32 ± 0,I0	0,68 ± 0,06	0,46 ± 0,04
I,47	I,42 ± 0,I0	0,65 ± 0,06	0,46 ± 0,04
I,23	I,43 ± 0,II	0,6I ± 0,05	0,47 ± 0,04
I,05	I,50 ± 0,I2	0,6I ± 0,05	0,48 ± 0,04
0,92	I,65 ± 0,I3	0,68 ± 0,05	0,53 ± 0,04
0,80	I,80 ± 0,I4	0,75 ± 0,06	0,52 ± 0,04
0,70	I,9I ± 0,I3	0,79 ± 0,06	0,5I ± 0,04
0,60	I,87 ± 0,I4	0,73 ± 0,06	0,5I ± 0,04
0,50	I,74 ± 0,I3	0,69 ± 0,06	0,48 ± 0,04
0,40	I,79 ± 0,I4	0,75 ± 0,06	0,43 ± 0,04
0,35	I,72 ± 0,I4	0,78 ± 0,06	0,48 ± 0,04
0,30	I,6I ± 0,II	0,80 ± 0,06	0,49 ± 0,04
0,25	I,30 ± 0,09	0,7I ± 0,06	0,53 ± 0,04
0,20	I,09 ± 0,07	0,73 ± 0,06	0,57 ± 0,05

Table 6

Numerical values of α(E) and of the neutron capture cross-section for ^{239}Pu

E (keV)	α(E)	$\sigma_{\gamma}(E)$ (barn)
I2,5	0,65 ± 0,I3	I,I ± 0,2
9,5	0,79 ± 0,I3	I,4 ± 0,3
7,5	0,89 ± 0,I3	I,7 ± 0,3
6,0	0,87 ± 0,I6 *	I,8 ± 0,3
5,0	0,86 ± 0,I3	I,9 ± 0,4
4,0	0,88 ± 0,I3	2,I ± 0,4
3,2	0,95 ± 0,I2	2,5 ± 0,5
2,6	I,0I ± 0,I2	2,8 ± 0,5
2,I7	I,I2 ± 0,I2	3,5 ± 0,6
I,77	I,I6 ± 0,I2	4,3 ± 0,7
I,47	I,05 ± 0,I6 *	4,5 ± 0,7
I,23	I,03 ± 0,I2	5,2 ± 0,8
I,05	I,04 ± 0,II	5,8 ± 0,8
0,92	I,05 ± 0,II	6,0 ± 0,9
0,80	I,08 ± 0,II	6,6 ± I,0
0,70	I,I3 ±0,II	7,6 ± I,2
0,60	I,07 ± 0,I0	8,2 ± I,4
0,53	0,94 ± 0,I0	7,9 ± I,2
0,47	0,85 ± 0,I4 *	7,6 ± I,2
0,40	0,92 ± 0,09	8,6 ± I,5
0,35	I,05 ± 0,09	II,0 ± I,8
0,30	I,02 ± 0,09	I2,5 ± 2,0
0,27	0,90 ± 0,09	I2,4 ± 2,0
0,23	0,76 ± 0,09	I2,0 ± I,9
0,20	0.69 ± 0,09	II,4 ± I,8

COMMENT: In this table, an indication is given of the statistical error of the results of the α(E) measurements, but for the values marked with an asterisk the total error is given.

RADIATIVE CAPTURE BY URANIUM-238 OF NEUTRONS WITH ENERGIES IN THE RANGE 1.2-4 MeV

Yu.G. Panitkin, Yu.Ya. Stavissky, V.A. Tolstikov
(Article submitted to "Atomnaja energija")

The authors have measured the cross-section for the radiative capture by ^{238}U of neutrons with energies in the range 1.2-4 MeV. The measurements were performed by the activation method using an electrostatic accelerator. The induced activity was measured with a Ge(Li) detector on the basis of the gamma photons occurring in ^{239}U decay. An ionization chamber with a ^{235}U layer was used as neutron flux monitor.

Table 1

	E_n (MeV)	N^8/N^5	σ_5	σ_8
I	I,2 ± 0,043	0,6I ± 0,0I	I,23	94 ± 2
2	I,3 ± 0,045	0,529± 0,0I	I,24	82 ± I,7
3	I,5 ± 0,049	0,39I± 0,008	I,26	62 ± I,5
4	I,8 ± 0,054	0,3I5±0,007	I,287	48 ± I
5	2,0 ± 0,057	0,264± 0,05	I,306	40 ± I
6	2,2 ± 0,06I	0,2I9± 0,006	I,3I4	33 ± 8I
7	2,5 ± 0,067	0,I76± 0,005	I,287	27 ± 0,8
8	2,8 ± 0,073	0,I49± 0,005	I,257	22 ± 0,8
9	3,0 ± 0,078	0,I27± 0,004	I,230	I9 ± 0,8
I0	3,5 ± 0,094	0,II2± 0,009	I,I86	I6 ± I,5
II	4,0 ± 0,II0	0,0992± 0,007	I,I40	I3 ± I

CALCULATIONS OF CROSS-SECTIONS FOR THE DIRECT AND COLLECTIVE RADIATIVE CAPTURE OF NEUTRONS

A.G. Dovbenko, A.V. Ignatyuk
(Preprint of the Institute of Physics
and Power Engineering)

The authors describe neutron capture cross-sections and the spectra of the emitted gamma rays on the basis of direct and collective capture models. The results of calculations of the cross-sections for the reaction $^{208}Pb(n,\gamma)^{209}Pb$ and of the energy dependence of the intensity of local gamma transitions correspond fairly well to the existing experimental data for incident neutron energies exceeding 10 MeV. For lower energies, the calculated cross-section value is considerably lower than the experimental value.

DENSITY OF EXCITED PARTICLE-HOLE STATES

A.V. Ignatyuk, Yu.V. Sokolov
(Paper submitted to the 22nd Meeting
on Nuclear Spectroscopy and Structure,
held at Kiev in January 1972)

In recent years, for describing statistically the intermediate structure observed in the cross-sections for various reactions and for calculating the hard part of the spectrum of particles emitted in the decay of a compound nucleus, use has been made of models whose main characteristic is the density of the excited states of a nucleus with a given number of excited particles and holes. This parameter is usually calculated by means of simple relations derived in the continuous spectrum approximation. The authors calculated the density of particle-hole states for the single-particle level scheme of the shell model. It is shown that shell effects have a strong influence on the energy dependence of the thermodynamic characteristics of the particle-hole states. The shell effects are far more pronounced in this case than in that of the total nuclear level density. This leads to a considerable difference between the results of these calculations and the predictions of simpler models. The authors consider the dependence of the density of particle-hole states on the angular momentum of the system and calculate the moments of inertia determining this dependence.

CALIBRATION OF MAGNETIC ANALYSERS OF CHARGED PARTICLE ENERGY

A.I. Baryshnikov, A.I. Abramov
(Paper presented to the 1st All-Union Co-ordination Meeting on Neutron Radiation Metrology held in August 1971)

The authors describe a new method for calibrating magnetic analysers of the energy of charged particles based on the use of several nuclear reactions occurring simultaneously in the nuclei of a target at one incident particle energy. The proposed calibration method eliminates the disadvantages of the methods employed previously. It can be used, without the target being exchanged, for calibrating analysers in any primary particle energy range. Determination of the coefficient "a" in the frequency-energy dependence of the characteristics of the magnetic analyser

$$E = f^2/a^2$$

becomes simply a matter of determining the shift (ΔEb) of the peak of the magnetically analysed particle spectrum from the reaction A(ab)B recorded at an angle of 90° for two incident particle energies (frequencies). Whence

$$a = \sqrt{\frac{\alpha(f_1^2-f_2^2)}{\Delta Eb}} \quad , \text{ where } \alpha = \frac{M_B - m_a}{M_B - m_b} .$$

SPECTRA OF THE NEUTRONS OF THE "SCANDIUM" AND "IRON" BEAMS FROM THE URANIUM-GRAPHITE REACTOR AT THE OBNINSK NUCLEAR POWER STATION

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Using cylindrical proportional recoil-proton counters filled with hydrogen (1 atm and 3 atm) and methane (4 atm), the authors have measured the spectra of the neutrons of the "scandium" and "iron" beams from the uranium-graphite reactor at the Obninsk Nuclear Power Station. In the tables are presented the intensities of different neutron groups relative to the corresponding intensity of the base line (2 keV for the "scandium" beam and 24.5 keV for the "iron" beam).

Table 1

Spectrum of the neutrons of the "scandium" beam from the uranium-graphite reactor at the Obninsk Nuclear Power Station

Energy interval (keV)	Number of neutrons in the group relative to the number of neutrons with an energy of 2 keV
0,6 - 4,0	1,00
4,0 - 20	0,03
20 - 100	0,07
100 - 200	0,04
200 - 400	0,02
400 - 800	0,02
> 800	0,00

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Table 2

Spectra of the neutrons of the "iron" beams from the uranium-graphite reactor at the Obninsk Nuclear Power Station

Filter thickness (g/cm^2)	380 Fe	380 Fe + 19 Al + 5 S	380 Fe + 40.5 Al + 14 S	240 Fe + 19 Al + 5 S	240 Fe + 32.4 Al + 14 S
Energy interval (keV)	Number of neutrons in the group relative to the number of neutrons with an energy of 24.5 keV				
17 - 30	1.00	1.00	1.00	1.00	1.00
30 - 100	0.24	0.02	0.00	0.04	0.02
100 - 200	0.98	0.18	0.03	0.16	0.04
200 - 400	1.24	0.32	0.08	0.36	0.13
400 - 800	0.73	0.15	0.04	0.21	-
>800	0.37	0.08	0.01	0.20	-
>30	3.56	0.75	0.16	0.97	-
Relative intensity of neutrons with E = 24.5 keV	1.0	0.8	0.5	2.3	1.7

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CROSS-SECTION FOR CALIFORNIUM-249 FISSION BY NEUTRONS WITH ENERGIES IN THE RANGE 0.16-1.6 MeV

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Measurements were performed with an electrostatic accelerator using monoenergetic neutrons from the reactions $^7Li(p,n)^7Be$ and $^3H(p,n)^3He$. The fission fragments were recorded by glass track detectors.

Table 1

E_n (MeV)	σ_f (barn)	δ (%)
0,I6	3,37	5
0,25	3,62	I7,I
0,3I	2,68	4,5
0,40	2,4	4,6
0,5I	2,06	4,0
0,6I	I,98	4,8
0,7I	I,9I	5,5
0,8I	I,9I	4,9
0,9I	I,98	3,9
I,0I	2,I5	2,9
I,I0	2,32	3,4
I,20	2,3I	3,9
I,30	2,07	3,0
I,39	2,33	5,I
I,49	2,I8	3,5
I,58	I,98	6,3

The relative error δ includes only errors in the relative measurements of $\sigma_f = f(E_n)$.

The error in the absolute value of the cross-section also includes the error in the absolute value of the neutron flux from the reference source (7%) and the error in determining the amount of ^{249}Cf in the fissile layer (5%), which gives an error of about 10% for the absolute cross-section value.

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TOTAL NEUTRON CROSS SECTIONS OF VANADIUM-50 IN THE NEUTRON ENERGY RANGE 0.01-1.0 eV

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Using the WWR-M reactor of the Institute of Nuclear Research and the time-of-flight method, the authors measured (with a resolution of 3.5 μs/m) total neutron cross-sections of ^{50}V in the neutron energy range 0.01-1.0 eV. The sample was in the form of vanadium pentoxide (V_2O_5) enriched to 22.7% in the isotope under consideration. The sample thickness was 0.022 x 10^{24} nuclei/cm^2. The contribution of ^{51}V was subtracted by using data obtained for natural V_2O_5. In calculating the total cross-section of ^{50}V, the authors assumed the cross-section of oxygen to be constant over the entire measured energy range and to be equal to the cross-section for scattering by bound oxygen (4.2 barn). As the cross-section for scattering by oxygen varies with neutron energy, allowance for the oxygen contribution can lead to a systematic error not exceeding 1 barn. In addition, the authors measured total cross-sections using a sample consisting of metallic natural vanadium. The total cross-section of the natural vanadium determined from measurements on the V_2O_5 sample was several per cent higher than the total cross-section obtained from measurements on the metallic sample. It was not possible to find the precise reason for the differences. They may be due to impurities in the V_2O_5. Unfortunately, V_2O_5 should not be heated to high temperatures because of possible chemical transformations. There may therefore have been small amounts of water in the V_2O_5 sample. However, measurements of the total scattering cross-sections performed directly on $^{50}V_2O_5$ and V_2O_5 samples in 4π geometry showed that the scattering cross-section does not depend on energy in the energy range under consideration. This indicates that the presence of water in these samples does not have an appreciable influence on the cross-sections. Probably, the difference between the total cross-section value obtained by measurements on V_2O_5 and metallic vanadium samples is due to small-angle scattering in V_2O_5 microcrystals. It should be noted, however, that such differences may lead to a systematic error in the ^{50}V cross-section not exceeding 10%.

Direct measurements of the cross-section for scattering by ^{50}V using 4π geometry - performed in relation to natural vanadium, the scattering cross-section of which is assumed to be 4.8 barn - give a value of 7.1 ± 0.3 barn. The absorption cross-section obtained by subtracting the scattering cross-section from the total cross-section for v = 2200 m/s is 41 ± 4 barn.

The energy dependence of the total neutron cross-section of ^{50}V is presented in the following table, where the statistical error of the measurements is indicated. In the neutron energy range 0.02-1.0 eV, the total cross-section is described by the formula

$$\sigma_{tot} = (7.1 \pm 0.3) + \frac{6.6 \pm 0.5}{\sqrt{E}} ,$$

where E_n is the neutron energy measured in electron volts and σ_{tot} is the total cross-section in barns. Below 0.02 eV, the total cross-section deviates somewhat from the $\frac{1}{v}$ dependence, probably owing to the stronger effect of small-angle scattering by microcrystal grains. Generally, the effect of small-angle scattering in a V_2O_5 sample enriched in ^{50}V is found to be considerably less than the effect of small-angle scattering in a natural oxide sample, as the cross-section for absorption by ^{50}V is much greater than that for absorption by ^{51}V.

Energy dependence of the total neutron cross-section of ^{50}V

E_n (eV)	σ_{tot} (barn)	E_n (eV)	σ_{tot} (barn)
I,0	I2,0 ± I	0,055	35,9 ± 0,4
0,90	I2,0 ± I	0,050	37,I ± 0,4
0,80	I2,0 ± I	0,045	39,3 ± 0,4
0,70	I2,0 ± I	0,040	40,5 ± 0,5
0,60	I2,0 ± I	0,035	4I,4 ± 0,5
0,50	I5,0 ± I	0,030	45,3 ± 0,5
0,40	I7,0 ± I	0,0253	48,3 ± 0,5
0,30	I6,0 ± I	0,020	55,4 ± 0,8
0,25	I8,0 ± 0,8	0,0I9	56,7 ± 0,8
0,20	I8,4 ± 0,7	0,0I8	58,7 ± 0,8
0,I5	23,3 ± 0,5	0,0I7	57,4 ± I
0,I0	27,5 ± 0,5	0,0I6	60,7 ± I
0,090	29,5 ± 0,5	0,0I5	63,3 ± I
0,085	30,0 ± 0,5	0,0I4	68,7 ± I
0,080	30,6 ± 0,5	0,0I3	68,7 ± I
0,075	3I,6 ± 0,4	0,0I2	75,8 ± I,5
0,070	32,0 ± 0,4	0,0II	8I,4 ± I,5
0,065	33,I ± 0,4	0,0I0	85,8 ± 2,5
0,060	33,7 ± 0,4	0,009	94,2 ± 2,5

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EXCITATION FUNCTIONS OF THE REACTIONS $^{27}Al(n,p)^{27}Mg$ and $^{27}Al(n,\alpha)^{24}Na$

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Using the sample activation method, the authors measured the excitation functions of the reactions $^{27}Al(n,p)^{27}Mg$ and $^{27}Al(n,\alpha)^{24}Na$ in the neutron energy range 7.7-9.3 MeV. The reaction $d(d,n)^{3}He$ was used for obtaining monochromatic neutrons.