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INDC

INTERNATIONAL NUCLEAR DATA COMMITTEE

Brief Progress Report to INDC from Belgium on

NUCLEAR DATA RESEARCH

for the year 1970.

Compiled by

M. NEVE de MEVERGNIES

April 1970

IAEA NUCLEAR DATA SECTION, KÄRNTNER RING 11, A-1010 VIENNA

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C.E.N./S.C.K.
2400 MOL

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CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE (C.E.N.-S.C.K.) Mol, Belgium

1. NEUTRON SPECTROMETRY

Low Energy Scattering Cross-Section of ^{235}U .

H. CEULEMANS, F. POORTMANS (Contract I.A.E.A. n° 726/RB)

The scattering cross-section of a rolled metal sample of ^{235}U has been determined in the energy region between 0.8 eV and 0.025 eV using the BR2-R3 crystal spectrometer. In this energy region the scattering cross-section increases slowly from approximately 13 barn to 14.5 barn.

The results have been presented at the Helsinki Conference on Nuclear Data for Reactors [1].

Total Cross-Section of ^{226}Ra and ^{227}Ac .

H. CHRISTIAEN⁺, H. CEULEMANS, G. GOEDEME[✕]

The preparation of this experiment has been very time-consuming because of the special mechanical parts which had to be constructed, especially the sample cavity which will contain the RaCO_3 in powdered form. After filling and sealing, the sample holder will be mounted in the BR2 crystal spectrometer arm inside a heavy container. Measurements should start around mid-1971.

Total, Absorption and Activation Cross-Sections for ^{151}Eu below 1 eV.

F. POORTMANS, I. GIRLEA^{✕✕}, A. FABRY

This work has now been completed and a report on these results has been prepared for publication.

+ I.W.O.N.L. Bursar, Univ. of Leuven
 ✕ Laboratorium voor Radiologie, EtABC, Vilvoorde
 ✕✕ On leave from Institute of Atomic Physics, Bucarest

Resonance Scattering Cross-Section of ^{235}U .

F. POORTMANS, H. CEULEMANS, J. THEOBALD [⊗], E. MIGNECO [⊗]

The measurements were performed below 100 eV at a 30 meter flight path of the linear electron accelerator of CBNM, Euratom, Geel. In the whole energy range, the scattering cross-section is consistent with a potential scattering of 11.7 barn. The total cross-section was measured with the same samples and the same time-of-flight resolution. The spin of 14 resonances below 60 eV could be determined.

A paper describing these measurements has been presented at the Helsinki Conference on Nuclear Data for Reactors [2].

Scattering and Total Cross-Section Measurements on ^{237}Np .

F. POORTMANS, H. CEULEMANS, J. THEOBALD [⊗], E. MIGNECO [⊗]

A first series of measurements below 70 eV has been analyzed. The results have been presented at the "Third Conference on Neutron Cross-Sections and Technology", Knoxville, March, 1971. The resonance parameters, including spin, have been obtained for about 15 resonances.

Scattering and total cross-section measurements will be repeated and extended to higher neutron energy, using faster detectors and a thicker Neptunium oxide sample.

Scattering and Total Cross-Section of ^{238}U .

L. MEWISSEN, F. POORTMANS, H. CEULEMANS

A first series of measurements with different samples thicknesses was started at a 30 m time-of-flight station of the Linac of C.B.N.M., Euratom, Geel.

[⊗] C.B.N.M., Euratom, Geel

The very low background in the scattering measurements allowed us to use very thin samples so that the corrections for multiple interaction effects are very small.

The analysis of these measurements is in progress and a second series of experiments with better resolution scheduled around mid-1971.

Neutron Capture Cross-Section of ^{238}U .

G. VANPRAET [≠], H. CEULEMANS, F. POORTMANS, L. MEWISSEN

The development of a gamma ray detector system for neutron capture cross section measurements has been started.

The response function of a liquid hydrogen-free scintillator (C_6F_6 , 4 inch diameter, 3 inch thick) has been investigated by numerical calculations on the IBM 1130 at the RUCA, using a code provided by R.L. Macklin. A symmetric pair of such detectors which have very low neutron sensitivity will be used and their installation, together with the related electronic equipment, should be ready around mid-1971. Capture cross-section measurements on ^{238}U are planned to start before the end of 1971 at the Linac of C.B.N.M. (Euratom).

2. FISSION PHYSICS AND CHEMISTRY

Reassessment of some neutron yields from the longer-lived halogen delayed
P. del MARMOL, P. FETTWEIS and D.C. PERRICOS [≠] neutron emitters.

Halogen (Br and I) isotopes contribute to about 75 per-cent of all delayed neutron precursors (d.n.p.) in thermal neutron fission of ^{235}U and their respective neutron activities are usually related to

[≠] R.U.C. Antwerpen

[≠] I.A.E.A., fellow from Nuclear Research Centre Democritos, Athens, Greece

^{88}Br and ^{137}I , so it is important to know the relative neutron yields of these isotopes.

The results were reported at the "Conference on the Properties of Nuclei far from the Region of Beta-Stability" (Leysin), and a detailed paper is in print in *Radiochimica Acta*.

New Germanium Fission Isotopes.

P. del MARMOL, P. FETTWEIS, H. VAN TIGCHELT

A simple and rapid (separation times of 5 to 15 seconds) radiochemical procedure to separate Ge from fission products has been developed for the purpose of studying new neutron-rich isotopes of this element. Measurements were started on $^{79-83}\text{Ge}$, using the As daughters for identification.

Decay schemes of ^{78}Ge .

N.K. ARAS [≠], P. del MARMOL, P. FETTWEIS

^{78}Ge has been obtained by chemical separation from fission products. The γ -spectrum of its daughter ^{78}As has been studied with the help of a 20 cm³ Ge(Li) detector and a 4096-channel analyzer. A report on the results has been prepared for publication.

Joint S.C.K./C.E.N. - C.B.N.M. (Euratom) Studies on Fission.

A. DERUYTTER ^{≠≠}, C. WAGEMANS ^{≠≠≠}, G. WEGENER-PENNING ⁺
(Contract EUR/C/4146/67 f)

These studies have included the following items :

- ratio of the binary-to-ternary fission cross-sections of ^{235}U and ^{239}Pu ;

≠ Visitor from Middle East Technical University, Ankara, Turkey

≠≠ C.B.N.M., Euratom, Geel

≠≠≠ NFWO bursar, University of Gent and S.C.K./C.E.N.

+ IWONL bursar, University of Gent and S.C.K./C.E.N.

- normalization of the ^{235}U and ^{239}Pu fission cross-sections in the resonance region;
- comparison of the spontaneous fission of ^{240}Pu and thermal neutron induced fission of ^{239}Pu ;
- branching ratio of ^{235}U .

The results have been partly published [3] [4] [5].

3. STANDARD SPECTRA

A. FABRY, M. DE COSTER, G. and S. DE LEEUW, J-C. SCHEPERS, P. VANDENPLAS

The generation of standard neutron spectra implies first a significant improvement and/or development of reaction rate and neutron spectrometry techniques, including thorough international comparisons and calibrations via the standards. Application of the improved techniques in the standard clean assemblies then allows meaningful integral checks and subsequent improvements of multigroup cross-section sets.

The intermediate-energy secondary-standard neutron-spectrum facility $\Sigma\Sigma$.

This facility, simple in geometry and composition, has been extensively described [8] and is believed to be computable to an accuracy depending most essentially on uranium-238 data over the major part of the useful energy range.

$\Sigma\Sigma$ has been put successfully into operation during May 1970. The total central fast neutron flux has been measured as $6.10^8 \text{ cm}^{-2} \text{ sec}^{-1}$ at a 1 MW power level of the driving reactor BR1; the corresponding gamma ray dose rate is 375 rad/hr.

Fundamental reaction rates are currently being measured by the track recorder and the activation techniques both within the natural

uranium source shell and at the center of the assembly. Fast neutron spectrum measurements have been performed until now by means of the ${}^6\text{Li} (n, \alpha)$ [9] and proton recoil [10][11] techniques in the energy range 5 keV - 1.5 MeV, and it has been found that a reasonable simulation of the central neutron spectra in large dilute fast reactors is effectively achieved.

The study of the clean system with a view to check the uncertainties in the uranium-238 nuclear data will continue up to late 1971.

The polythene-boron 10 intermediate-energy primary-standard spectrum facility $\pi \Sigma$.

The conceptual design study of the primary standard facility (A. FABRY, P. VANDENPLAS - Fast Reactor Physics, Vol. I, p. 389-411, IAEA, Vienna 1968) has been continued.

A number of experiments are performed in the secondary standard as a support to these calculations. The detailed technical design has started at the end of 1970.

The main conclusions of this study, for the energy range 100 keV - 10 MeV, have been presented in ref. [12].

PUBLICATIONS FROM C.E.N./S.C.K. in the field of Nuclear Data (1970)

- [1] The scattering cross-section of ${}^{235}\text{U}$ between 0.025 eV and 1 eV
H. CEULEMANS, F. POORTMANS
Nuclear Data for Reactors, Vol. I, p. 461, IAEA, Vienna (1970)
- [2] Scattering cross-section of ${}^{235}\text{U}$ below 100 eV. Determination of Γ_n and J of resonances
F. POORTMANS, H. CEULEMANS, E. MIGNECO, J. THEOBALD
Nuclear Data for Reactors, Vol. I, p. 449, IAEA, Vienna (1970)
- [3] Variation of the binary-to-ternary fission ratio for ${}^{235}\text{U}$ in the resonance region
A.J. DERUYTTER, C. WAGEMANS
Report EANDC(E) 123-"AL" (1970)

- [4] Measurement of the ^{235}U fission cross-section in the resonance region and discussion of the normalization differences
A.J. DERUYTTER, C. WAGEMANS
Report EANDC(E) 129"AL" (1970)
- [5] Measurement and normalization of ^{239}Pu fission cross-sections in the low resonance region
A.J. DERUYTTER, C. WAGEMANS, G. PENNING
Report EANDC(E) 131"AL" (1970)
- [6] Identification of ^{88}Se and search for delayed neutron emission from ^{87}Se and ^{88}Se
P. del MARMOL
J. Inorg. Nucl. Chem. 32, 705 (1970)
- [7] Determination of fission density in ^{235}U and implications for its mass distribution
P. POPA, M. DE COSTER, P. VAN ASSCHE
Nuclear Science and Engineering, 39, 50 (1970)
- [8] Conceptual design and major aims of the C.E.N./S.C.K. secondary standard neutron spectrum facility
A. FABRY, P. VANDEPLAS
IAEA Panel on Fast Reactor Spectrum Measurements and their Interpretation, Argonne, 10-13 November (1970)
- [9] Improvements in the use of the $^6\text{Li} (n,\alpha)^t$ reaction for in-core neutron spectrum measurements
G. DE LEEUW-GIERTS, S. DE LEEUW
C.E.N./S.C.K., Report Blg 450
- [10] Application of the methane filled spherical proton recoil proportional counter in the C.E.N./S.C.K. secondary standard neutron spectrum facility
I. GIRLEA, A. FABRY, G. and S. DE LEEUW
IAEA Panel on Fast Reactor Spectrum Measurements and their Interpretation, Argonne, November 1970
- [11] New spectrometer for in-core neutron spectrum measurements or low α activity detection
G. DE LEEUW-GIERTS, S. DE LEEUW
Nucl. Instr. Meth. 91, n° 4, 585-587 (1971)
- [12] Implications of fundamental integral measurements on high-energy nuclear data for fast reactor physics
A. FABRY, M. DE COSTER, G. MINSART, J.-C. SCHEPERS, P. VANDEPLAS
Nuclear Data for Reactors, Vol. II, p. 535-569, IAEA, Vienna, 1970.

CENTRE DE PHYSIQUE NUCLEAIRE DE L'UNIVERSITE DE LOUVAIN (Belgium)Time-energy spectra of fast neutrons in a pulsed graphite sphere.

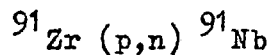
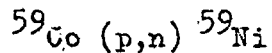
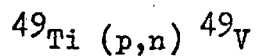
Ph. MONSEU, G. DECONNINCK and R. GREGOIRE

The time behavior of the neutron population at the surface of a graphite sphere was measured with a stilbene scintillator (G. DECONNINCK et Ph. MONSEU, Nucl. Ins. and Meth., 88 (1970) 309). The birth and the decay of three energy groups, ranging from 1 to 1.7 MeV, was observed and compared with a Monte-Carlo calculation. Fairly good agreement with the measurement was obtained taking into account the finite time resolution of the experimental device.

Study of (p,n) Reactions.

G. DECONNINCK, J.M. DAS, R. GREGOIRE, P. MINNE, J. ROYEN

The following (p,n) reactions were recently studied in detail in the incident proton energy range of 2.2 MeV upto 4.3 MeV :



Special attention was paid to the isobaric analogue resonances found for which detailed neutron and gamma angular distributions measurements were performed.