International Atomic Energy Agency

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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Progress Report to the INDC from the German Democratic Republic

Compiled by D. Seeliger

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June 1980

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

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Readers are requested not to quote results contained herein without first consulting the appropriate authors.

Compiled by
D. Seeliger

The present report contents abstracts of original investigations which are performed or in progress, as well as short reports on the activities of the nuclear data libraries in the GDR.

A more detailed information on all nuclear research activities is given in the annual report "Gemeinsamer Jahresbericht 1978" (ZfK - 385, June 1979), which recently was distributed to the INDC members.

During the period between the X-th and XI-th INDC-Meeting the coordinating group for nuclear data research "Arbeitsgemeinschaft Kerndaten" continued succesful activities. Basing on the two big nuclear data libraries at the Technical University Dresden for neutron data and at the Central Institute of Isotope Techniques for nuclear structure and decay data the increasing number of requests from the nuclear data users could be covered. The continual support from the Nuclear Data Section of the IAEA is acknowledged.

Experimental an Theoretical Investigations of the Reaction $^{11}B(p,n)$ +)

J. Höhn, J. Kayser, W. Pilz, D. Schmidt and D. Seeliger

Technical University Dresden

With the multi-angle time-of-flight facility at the tandem generator EGP-10 differential cross sections of the neutron production reactions $^{11}B(p,n_0)$ and $^{11}B(p,n_1)$ have been measured between E_p = 5,4 MeV and 7,5 MeV at 5 angles between 20° and 160°. Simultaneously, the charged particle reaction channels $^{11}B(p,p_0)$, $^{11}B(p,p_1)$, $^{11}B(p,\alpha)$ and $^{10}B(p,p_0)$ are investigated. The experimental results are compared with theoretical calculations in the framework of the continuum shell model of nuclear reactions.

This work has been published in:

Report TU Dresden, 05-24-1978

Neutron Elastic and Inelastic Scattering Cross Sections for ^{28}Si, ^{32}S and ^{24}Mg at Incident Energies between 7 MeV and 11 MeV[+)]

M. Adel-Fawzy, H. Förtsch, D. Schmidt, D. Seeliger, T. Streil
Technical University Dresden
and
G.N. Lovchikova, A.M. Trufanov
Physical-Energetic Institute Obninsk (USSR)

For the light nuclei ^{28}Si, ^{32}S and ^{24}Mg, using natural samples, the elastic and inelastic differential scattering cross sections within the incident energy range between 7 MeV and 11 MeV at the tandem time-of-flight facility have been determined.
Experimental data are compared with coupled channels calculations with the programme CHUCK.
This work is in progress.

+) This work is partially published in:
a) Proc. II-nd Intern. Neutron Symposium, Smolenice, June 1979
Phys. and Appl. Vol. 6, 1980, p. 127
b) ZfK - 368, p. 15, 1979
c) Proc. IX-th Intern. Neutron Symposium, Gaußig, Nov. 1979
in print.

Neutron Elastic Scattering Cross Sections for ^{93}Nb and In at incident Energies between 6,8 MeV and 12,0 MeV +)

M. Adel-Fawzy, H. Förtsch, S. Mittag, W. Pilz, D. Schmidt,
D. Seeliger, T. Streil
Technical University Dresden
and
G.N. Lovchikova, A.M. Trufanov
Physical-Energetic Institute, Obninsk (USSR)

Absolute differential elastic scattering cross sections for ^{93}Nb and In at incident energies 6,8; 8,0; 9,0; 10,0; 11,0 and 12,0 MeV are determined with the time-of-flight spectrometer at the tandem accelerator EGP-10.
Experimental results are compared with optical model calculations.

+) This work has been published in:
a) Kernenergie, 22 (1979) 235
b) Gemeinsamer Jahresbericht 1978
ZfK-385, June 1979, p. 17

The Isomer Shift of Neutron Resonances. 1. Measurements on Various compounds of ^{238}U

G.G. Akopyan, V.A. Vagov, K. Seidel[+], A. Meister[+], D. Pabst, L.B. Pikelner and S. Szalaj

Joint Institute for Nuclear Research Dubna
and
Technical University Dresden[+]

Employing the time-of flight method, the recently predicted isomer shift of neutron resonances has been searched for in various compounds of ^{238}U by precisely measuring their transmission spectra at the IBR-30 pulsed reactor. The present paper, to be regarded as the first of a series of articles, describes the physical problems involved, the pertinent techniques of measuring and data analyzing, as well as first results on the resonance shifts experimentally determined.

The work has been published in:
Communications of the JINR P3 - 11740

The Isomer Shift of Neutron Resonances. 2. Correcting for Crystal Lattice Vibration Effects

K. Seidel[+], A. Meister[+], D. Pabst, L.B. Pikelner

Joint Institute for Nuclear Research Dubna
and
Technical University Dresden[+]

The Einstein model, generalized to comprise two types of atoms, is employed to describe the shape of neutron resonance lines of nuclei in different chemical compounds. The results of calculations for the 6.67 eV resonance of ^{238}U are compared with experimental data yielding a satisfactory agreement.

The work has been published in:
Communications of the JINR P3 - 11741

The Isomer Shift of Neutron Resonances. IV. The Change of the Nuclear Mean-Square Charge Radius of ^{238}U on Neutron Resonance Capture

K. Seidel[+], A. Meister[+], D. Pabst and L.B. Pikelner
Joint Institute for Nuclear Research Dubna
and
Technical University Dresden[+]

Final results are presented as to the isomer shift of the 6.67 eV resonance in ^{238}U. The change of the nuclear mean-square charge radius caused by the neutron capture at this resonance level is deduced and found to be $\langle r_p^2 \rangle = -(1.7 \pm^{1.2}_{0.8})$ fm^2.

The work has been published in:
Communications of the JINR P3-80-135

The Isomer Shift of Neutron Resonances. 3. Determination of Electron Density Differences at the Nucleus between Uranium Metal and Various Uranium Compounds.

K. Seidel[+], A. Meister[+] and D. Pabst
Joint Institute for Nuclear Research Dubna
and
Technical University Dresden[+]

Electron density differences at the nucleus between uranium metal, trivalent, tetravalent, and hexavalent uranium compounds have been determined. The calculations are based upon experimental values known for the chemical shift of the $L_{\alpha 1}$ x-ray line of uranium and for chemically induced changes in the radioactivity constant of ^{235}U.

The work has been published in:
Communications of the JINR P3 - 11742

Absolute Fission Cross Section Measurements
at a Neutron Energy of 14.7 MeV +)

R. Arlt, W. Meiling, G. Musiol, H.-G. Ortlepp,
R. Teichner, W. Wagner
Technical University of Dresden
I. D. Alkhazov, O. I. Kostochkin, S. S. Kovalenko,
K. A. Petrshak, V. I. Spakov
V. G. Khlopin - Radium Institut, Leningrad

The fission cross sections of the $^{235,238}U$, ^{239}Pu and ^{237}Np isotopes have been measured by employing the time-correlated associated particle method (TCAPM). Technical details of the measuring system used have been published earlier /1,2,3/. The fission foils were produced and assayed at the Radium Institute of Leningrad and the fission cross section measurements were carried out at the Technical University of Dresden. An overall accuracy of 1-2 % was obtained. In Table 1 the results of our measurements are compared with the results of other groups having used the TCAPM. The fission cross sections of all isotopes investigated in this work are about 5-10 % lower than the values given by most of the earlier fission cross section evaluations. From table 1 it is evident that the values obtained by the different groups agree well for the $^{235,238}U$ and ^{237}Np isotopes. Our value for ^{239}Pu lies between the values obtained in Leningrad and in Bruyères-le-Châtel with a difference of about 9 %.

+) Preprint TU Dresden, Sektion Physik,
05-36-79 to be published in "Kernenergie"

Table 1 Measurement result of this work compared with the results of other groups employing the TCAPM (all values are given in barn)

Isotope	Bryères le Châtel /4/	RI Leningrad /5/	TU Dresden first work /6/	TU Dresden final result /this work/
E_n/MeV	14,6	14,7	14,7	14,7
^{235}U	2.063 ± 0.039	2.096 ± 0.034	2.073 ± 0.023	2.085 ± 0.023
^{238}U	1.149 ± 0.025	1.178 ± 0.024	1.194 ± 0.022	1.166 ± 0.021
^{237}Np	-	2.92 ± 0.044	-	2.226 ± 0.024
^{239}Pu	2.290 ± 0.052	2.505 ± 0.045	-	2.394 ± 0.024

References

/1/ R. Arlt, W. Wagner, G. Musiol, H.-G. Ortlepp, A. M. Sokolov, R. Teichner
Preprint TU Dresden, Sektion Physik, 05-3-78, 1978

/2/ R. Arlt, G. Pausch, R. Teichner, W. Wagner
Preprint TU Dresden, Sektion Physik, 05-5-79, 1979

/3/ R. Arlt, W. Grimm, W. Meiling, R. Krause, W. Wagner, F. Weidhase,
Nucl. Instr. and Methods 169 (1980) 301

/4/ M. Cance, G. Grenier
Nucl. Sci. and Eng. 68 (1968) 197

/5/ V. M. Adamov, I. D. Alkhazov, S. E. Gusev, L. V. Drapchinsky et al.
Conf. on Fission Cross Sections and Technology, Knoxville 1979

/6/ I. D. Alkhazov, V. N. Dushin, S. S. Kovalenko et al.
Atomnaya Energya 47 (1979) 416

Cross Sections for (n,α) and (n,p) Reactions at 3 MeV incident Energy +)

H. Helfer, S. Sassonov, U. Jahn
Technical University Dresden
and
M. Florek, J. Oravec, I. Svarka, S. Usacev, R. Antalik
Nuclear Physics Department of the Komenius University,
Bratislava (CSSR)

By means of the activation techniques at the DD-neutron generator of the Technical University Dresden measurements of the extremly small (n,α) and (n,p) cross sections at 3 MeV for several medium nuclei are carried out. Preliminary results are abtained for the reaction $^{69}Ga(n,\alpha)$, for which the cross section was found equal to $15 \pm_{/u}$ barn.

+) Preliminary results are reported in:
Proc. II-nd Intern. Neutron Symposium, Smolenice, June 1979
Phys. and Appl., Vol. G, 1980, p. 103

Measurement of the High Energy Part of the Fission Neutron Emission Spectra at 14.7 MeV Incident Energy[+)]

H. Märten, D. Seeliger

Technical University Dresden

By means of a time-of-flight Spectrometer at the DT-Generator two-dimensional measurements of the neutron emission spectra from $^{238}U+n$ at a flight path of 5 m are carried out. The aim of this experiments is the determination of the highest part of the neutron fission spectra. Experiments and data processing are in progress.

+)
Preliminary information was presented in:
Proc. IX-th Intern. Neutron Symposium, Gaußig, Nov. 1979 in print.

Description of γ-Production Spectra and Cross Sections in the Frame of the Statistical Model of Nuclear Reactions [+)]

B. Bassaragtscha, D. Hermsdorf, D. Seeliger

Technical University Dresden

The application of the statistical model for the description of γ-deexcitation of highly excited nuclei is investigated. Calculations of γ-production spectra and production cross sections for the reactions $^{56}Fe(n,x\gamma)$ and $^{93}Nb(n,x\gamma)$ have been performed by use of the code STAPRE and the results are compared with most recent experiments.

+) This work is published in:

a) Proc. II-nd Intern. Neutron Symposium Smolenice, June 1979 Phys. and Appl., Vol. 6, 1980, p. 381

b) ZfK - 368, p. 21, 1979

Evaluation of Neutron Nuclear Data for Si

D. Hermsdorf, L. Neumann, E. Paffrath
Technical University Dresden

Basing on an intercomparison of different data files available from the libraries UKNDL, ENDL, ENDF/B and JENDL important discrepancies have been obtained /1/ confirming the need for an independent evaluation.
All experimental informations from EXFOR and the most recent publications have been analyzed in terms of the methods commonly applied for data evaluation, i.e. methods of the statistical mathematics in such cases where enough data points are available, resonance analysis and methods of the theoretical nuclear physics including optical model, statistical models, DWBA and coupled channel formalisms by use of different computer codes (ELIESE, STAPRE, CHUCK and other ones).
At present the evaluation of γ-ray spectra and production cross-sections will be finished.
All methods yield a consistent interpretation of the data base obtained experimentally. The results will be prepared for the SOKRATOR library (file 2015) in the format of the ENDF/B-library.

/1/ Hermsdorf, D., Neumann, L.
Proceedings of the 9 th International Symposium on the Interaction of Fast Neutrons with Nuclei,
Gaußig, 1979, in press

Re-Evaluation of Neutron Nuclear Data for Fe for the SOKRATOR Library

D. Hermsdorf, P. Reichelt

Technical University Dresden

Starting from an intensive and systematical intercomparison of data files available from different libraries (KEDAK, ENDL, SOKRATOR) inconsistencies of recommended data could be discovered /1/.
To overcome these deficiencies a re-evaluation of the SOKRATOR file 2012 for Fe has been carried out including most recent experimental results and theoretical methods for calculation of unknown cross sections /2, 3/.
The results have been summarized and coded using the SOKRATOR library format.
The 2 nd version of file 2012 is extended relative to

i an energy range up to 20 MeV
ii the inclusion of resonance parameters in the resolved resonance region
iii the representation of angular distributions in terms of Legendre - Polynomials as well as point-wise
iv the inclusion of neutron emission spectra from (n,n'), (n,2n) and (n,3n) reactions
v the inclusion of a detailled comment for description of the methods used for evaluation at the head of the file

The file 2012 now contains 4182 records and is available on request.

/1/ Hermsdorf, D., Smoll, F., Annual Report ZfK-350, 8, 1978
/2/ Hermsdorf, D., Rösner, P., Annual Report ZfK-385, 23, 1979
/3/ Bychkov, V.N. et al., Jad. Konstanti 36, in press, 1980

On the Work with Nuclear Data libraries in 1979

D. Hermsdorf, D. Seeliger
Technical University Dresden
and
K. Friedrich, L. Jankowski, B. Letz
Central Institut for Isotopes and Radiation Research,
Information and Computer Centre, Leipzig

In 1979 further progress could be achieved in the establishment of two national nuclear data centres situated in Dresden and Leipzig, which are responsible for Neutron Nuclear Data and Nuclear Structure Data respectively. Both, the data supply and the managment of different libraries could be improved and extended by receiving the most recent libraries (KEDAK-3, ENDL-78, ENDF/B-IV, ENDF/B-V (partly), ENSDF (version 79), GAMADAT (version 78) and NSRD files).

By the CIIRR special activities has been devoted to the development of programms to retrieve the ENSDF, GAMDAT and NSRD files for making them available for an internal use.

On this basis, 18 requests für NND and 16 for NSDD arising from different users in the GDR could be fulfilled. To participate in the world-wide cooperation in nuclear data exchange close contacts are realized with the NDS of the IAEA Vienna and the soviet national centres CJD Obninsk, IAE Moscow and LIJAF Leningrad.

On the determination of the efficiency
of a pulse fission chamber +)

R. Arlt, G. Pausch, R. Teichner, W. Wagner
Technical University of Dresden, Section of Physics

Different sources of errors have to be analysed in order to obtain a high accuracy in absolute fission cross section measurements /1/. One of the factors of influence is the ineffeciency of the parallel plate fission chamber used in our experiments. There are two reasons which cause counting losses of the fission products (f. p.). The first one is the energy dependent absorption of the f. p. inside the fissile target layer. The second one is the low energy cut off of the timing system. The f. p. losses due to absorption have been calculated in dependence of the target thickness, the neutron energy, the f. p. anisotropy and the fission chamber geometry. For a typical fission foil with a thickness of 300 $\mu g/cm^2$ the losses amount to about 1 % for E_n = 2.6 MeV and about 0.5 % for E_n = 14.7 MeV. The dependence of the losses from the f. p. angular distribution turned out to be weak. Experiments are in progress to determine the fission chamber ineffeciency employing a method described by V. Doolin et. al. /2/.

+) published as Report of the Technical University of Dresden, Section of Physics, 05-5-79. 1979

References

/1/ R. Arlt, Proc. VIII Int. Symp. on the Int. of Fast Neutrons with Nuclei, Gaussig GDR, 1978, Report ZfK - 382, 1979

/2/ V. Doolin, Mozhaev V., NIaM 105 (1972) 277

A Multi-Angle Time-of-Flight Neutron Spectrometer at the Tandem Accelerator EGP-10 +)

P. Eckstein, H. Helfer, J. Kayser, R. Krause, W. Meiling, W. Pilz, D. Schmidt, D. Seeliger and T. Streil

Technical University Dresden

At the tandem accelerator EGP-10 a time-of-flight spectrometer was constructed with eight detectors, which are located in heavy shieldings at angles between 20° and 160° corresponding to the beam direction. Flight paths can be changed within the interval from 2 m to 5 m. This spectrometer is used for investigations of (n,n) and (n,n') reactions as well as (p,n) reactions.

This work has been published in:
a) Nucl. Instr. a. Meth. 169 (1980) 533
b) Report TU Dresden, part I, II, III
05-19-78, 05-20-78, 05-21-78

Neutron Production in the Energy Range 7 to 12 MeV using a Gas-Target [+)]

S. Mittag, W. Pilz, D. Schmidt, D. Seeliger and T. Streil

Technical University Dresden

A gas-target for monoenergetic neutron production at the tandem accelerator EGP-10 has been developed. With the DD-reaction an energy range of the neutrons between 7 and 12 MeV can be covered. Construction and operation of the target are described in detail. For neutron energies below 9 MeV the neutrons produced are almost monoenergetic; above this energy the deuteron break-up essentially contributes to the neutron production.

+) This work has been published in:

a) IAEA Consultants' Meeting on Neutron Source Properties, Debrecen, March 1980, INDC(GDR)-11/L

b) Kernenergie 22 (1979) 237

Determination of the Differential Neutron Source Strength for the Reaction $D(d,n)^3He$ at incident Deuteron Energy up to 500 keV [+)]

A. Meister, T. Schweitzer, D. Seeliger, K. Seidel and S. Unholzer

Technical University Dresden

The neutron intensity of a DD-neutron-generator is determined by means of three different types of monitors:
- a semiconductor detector for registration of the charged particles from the target as an absolute monitor;
- an organic scintillator;
- a BF_3 - proportional counter surroundet with paraffin.

Counting rates of this monitors over several years during neutron scattering experiments are compared between each other.
The accuracy of the determination of the differential neutron source strength as well as the average neutron energy and the neutron energy spread are estimated theoretically, taking into account:
- uncertainties of the cross sections;
- depth distributions of the deuterium within the Ti-D-target;
- geometrical uncertainties arising from the finite surface areas of the target and the semiconductor detector;
- changes of the direction of incident deuterons;
- and multiple-scattering of the deuterons within the target.

These investigations have been performed for thin as well as for thick target layers.

+) This work has been published in:
Report TU Dresden, 05- -1980, in print

A CAMAC Experiment for the Precise Measurement of the Cross Section in Fast Neutron Induced Fission +)

R. Arlt, W. Grimm, W. Meiling, R. Krause, H.-G. Ortlepp, R. Teichner, W. Wagner, F. Weidhase
Technical University of Dresden, Section of Physics

In 1975 the joint fission cross section measurement program of the Technical University of Dresden and the V. G. Khlopin - Radium Institute of Leningrad was started. The aim of this program is to carry out absolute fission cross section measurements at several spot points of neutron energies employing the time correlated associated particle method (TCAPM) /1,2/.
For this purpose a computer coupled measuring system has been developed at the TU Dresden. The system consists of two parts. The analogue electronics of the fission chamber and the associated particle counting system (APCS) is built up from classical moduls. The second part consists of two CAMAC crates coupled to the KRS 4200 minicomputer via branch highway. Three different APCS's have been developed in order to carry out absolute fission cross section measurements at 14.7 MeV (TD reaction), 2.6 MeV and 8.2 MeV (DD reaction) /3/.
By counting the coincident associated charged particles instead of the neutrons and using the control and processing possibilities of a CAMAC system including a minicomputer, the relative error of the fission cross section measurements could be reduced to a value of 1-2 % /4/.

+) published in NIaM 169 (1980) 381

References

/1/ I. D. Alkhazov, V. P. Kasatkin, O. I. Kostochkin et al.,
Proc. of 2-nd Conf. on Neutron Physics,
Kiev, USSR, vol. 4 p. 13, 1973

/2/ M. C ance, G. Grenier,
ibid /1/ p. 237

/3/ R. Arlt, W. Grimm, M. Josch, G. Musiol et al.,
to be published in the Proceedings of the International Conference on Neutron Cross Sections and Technology, Knoxville U.S.A. 1979

/4/ see e.g. R. Arlt, W. Meiling, G. Musiol,
H.-G. Ortlepp et al. Preprint TU Dresden,
Sektion Physik, 05-36-79, 1979

A Method for the Absolute Measurement of Fission Cross Sections at Neutron Energies of about 8.5 MeV +)

R. Arlt, M. Josch, G. Musiol, H.-G. Ortlepp,
R. Teichner, W. Wagner
Technical University of Dresden, Section of Physics, GDR
I. D. Alkhazov, L. V. Drapchinsky, O. I. Kostochkin,
S. S. Kovalenko, V. I. Shpakov
V. I. Khlopin - Radium Institute of Leningrad, USSR

The use of the time correlated associated particle method (TCAPM) for absolute fission cross section measurements has been extended to neutron energies of about 8.5 MeV. Absolute fission cross section in this energy region are difficult to perform since the efficiency of the normally used black neutron detector drops down in this region and the corrections become large.
An associated particle counting system similar to that of Bartle et al. /1/ has been built up at the 5 MV Tandem Generator of the CINR Rossendorf (Fig. 1).
Special efforts were made to obtain a high neutron production rate, a well defined neutron cone and a low background /2/.
As it was shown in a first measurement it seems to be possible to determine fission cross sections absolutely in the region of the first fission plateau with an accuracy better than 2 %. In a first run the fission cross section of ^{235}U has been determined. A preliminary value of 1.74 $\pm$ 0.11 barns was obtained /3/. Further experiments are in progress to reduce the statistical error.

+) to be published in the Proceedings of the IX. International Symp. on the Interact. of Fast Neutr. with Nuclei, Gaussig 1979, GDR

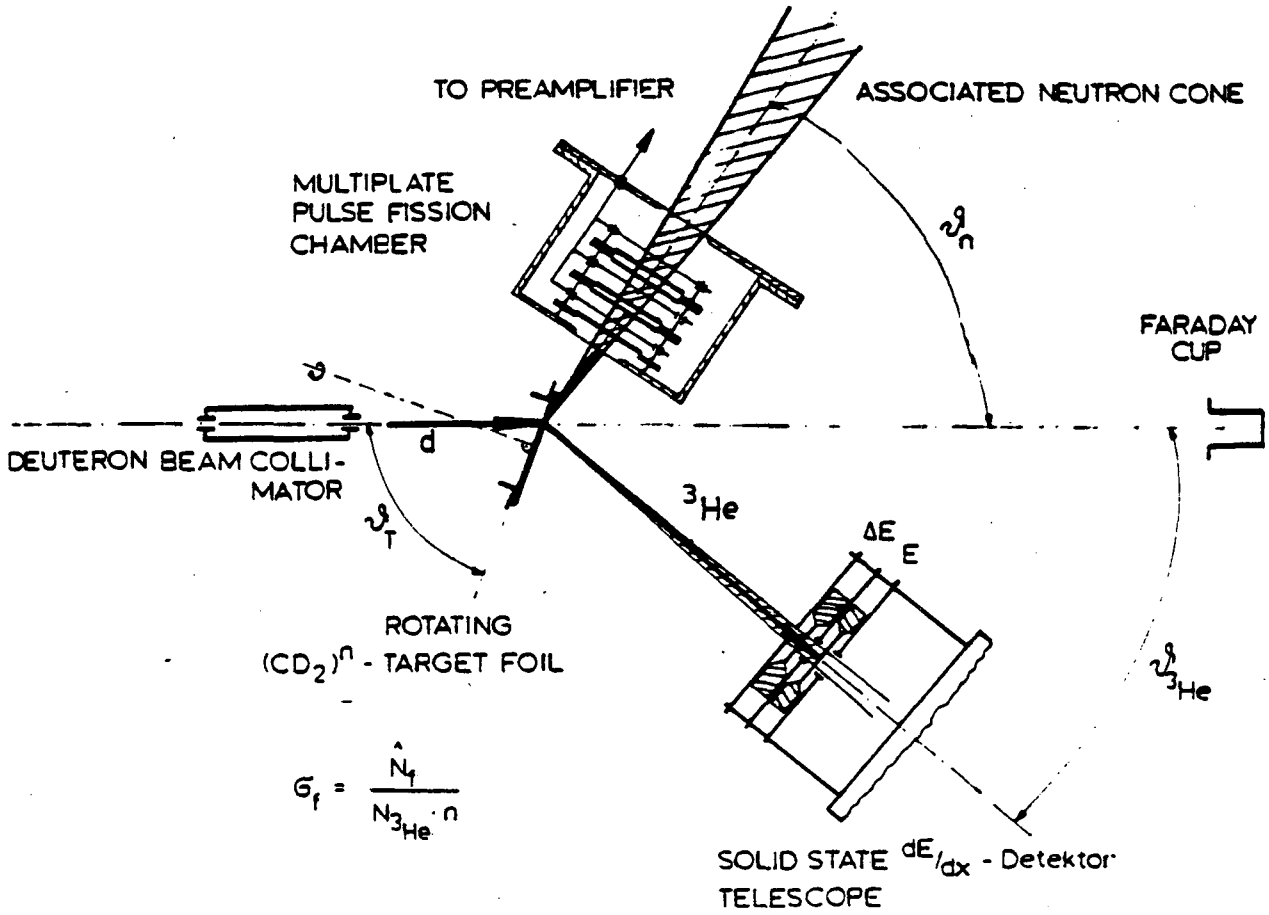

Fig. 1 Set up for fission cross section measurements in the region of the second fission plateau. The system is placed inside a 40 cm scattering chamber

References

/1/ C. M. Bartle et al. NIaM 144 (1977) 437

/2/ R. Arlt, G. Musiol, H.-G. Ortlepp et al. Report ZfK - 350, 1978, p. 209

/3/ R. Arlt, W. Grimm, M. Josch et al. Proceeding of the International Conference on Neutron Cross Sections and Technology, Knoxville U.S.A., 1979