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Progress Report to INDC from Austria

April 1984

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Institut fuer Radiumforschung und Kernphysik der
Oesterr. Akademie der Wissenschaften und der Universitaet Wien,
Vienna, Austria

July 1984

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

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PROGRESS REPORT TO INDC FROM AUSTRIA

April 1984

E.M. W i l d
Editor

Institut für Radiumforschung und Kernphysik der Österr.
Akademie der Wissenschaften und der Universität Wien,
Boltzmanng. 3, A-1090 Wien, Austria

This report contains abstracts about work performed at

Institut für Radiumforschung und Kernphysik der Österr.
Akademie der Wissenschaften und der Universität Wien

Atominstitut der Österreichischen Universitäten, Wien.

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Boltzmanngasse 3, A-1090 Wien, Austria.

REVISED NUCLEAR MODEL CALCULATIONS OF NEUTRON INDUCED CROSS SECTIONS FOR ^{93}NB

B. Strohmaier

Starting from two former cross section evaluations for neutron induced reactions on ^{93}Nb /1,2/, new calculations were performed regarding new experimental data, particularly for proton emission /3,4/. These calculations are based on the same nuclear reaction models as the previous ones, but employ slightly different options with respect to energy and angular momentum dependence of preequilibrium emission. In this way the new experimental data could be reproduced (fig. 1) while maintaining the description of the data on which the former evaluations were based /5/.

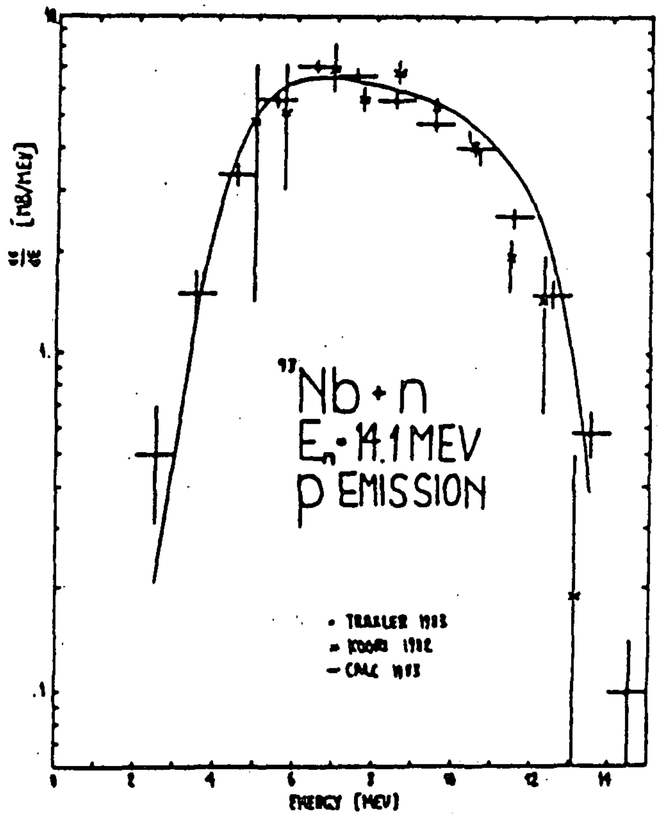

Fig. 1. Proton production (C.M. system) from ^{93}Nb+n at 14.1 MeV incident neutron energy. The calculation comprises the contributions of (n,p) and (n,np).

/1/ B. Strohmaier, S. Tagesen, H. Vonach, Physics Data 13-2 (1980)
/2/ B. Strohmaier, Ann. Nucl. Energy 9 (1982) 397
/3/ N. Koori, to be published
Data displayed in M. Hanita et al., NEANDC(J)-83/U, p. 59, JAERI Progr. Rept. July 81-June 82
/4/ G. Traxler, Thesis Univ. Vienna (1983)
/5/ B. Strohmaier, Proc. IAEA Consultants' Meeting on Nuclear Data for Structural Materials, Nov. 2-4, 1983, Vienna, in press

NEUTRON OPTICAL POTENTIALS IN THE A ~ 50 MASS REGION

B. Strohmaier

The corresponding investigations in 1982 /1/ have been continued. At present, the interest concentrates on the low energy region. There, the experimental data base on which the parameter studies are based has been extended and also further optical potentials have been included in these studies.

/1/ B. Strohmaier, Progress Rept. 1982

APPLICATION OF THE DIRECT REACTION THEORY FOR CONTINUUM PARTICLE EMISSION SPECTRA TO NEUTRON INDUCED REACTIONS

M. Uhl

Recently Tamura et al. /1/ developed an approach which extends direct reaction theories, usually applied in the region of low lying "discrete" levels of the residual nucleus, to the transitions of high excited states in the "continuum". In this way precompound processes, which formerly were mainly treated by simple phenomenological models, can be described in the frame of quantum mechanical reaction theory.
So far the theory of Tamura et al. /1/ was mainly applied to the analysis of double differential cross sections for proton induced reactions at incident energies between 45 and 65 MeV. Therefore we started to investigate the applicability of this approach to neutron induced reactions of the type (n,n'), (n,p) and (n,α) at incident energies of 14 and 25 MeV. The calculations were performed by means of the code ORION-TRISTAR 1, kindly made available to us by Prof. Tamura; in this program the treatment of the direct reactions is restricted to the one-step DWBA. In general the calculated cross sections reproduced experimental data quite satisfactorily. As a typical example fig. 1 shows a comparison of the ^{56}Fe(n,n') data of Marcinkowski et al. /2/ to the prediction of the theory. However, the model parameters employed often differed substantially from those reported for the corresponding proton induced reactions; this was true in particular for the ^{93}Nb(n,α) reaction. Furthermore in the case of ^{93}Nb(n,n') it turned out to be difficult to reproduce experimental data at incident energies of 14.4 and 25.7 MeV with the same set of model parameters; while the shape of the angular distributions of the emitted neutrons was reasonably reproduced at both incident energies, discrepancies up to a factor of two showed up in the absolute cross sections.
These investigations will be continued as the approach of Tamura et al. /1/ represents an important improvement compared to the phenomenological preequilibrium models. It is planned to include the code ORION TRISTAR 1 in our general nuclear reaction cross section program MAURINA under development.

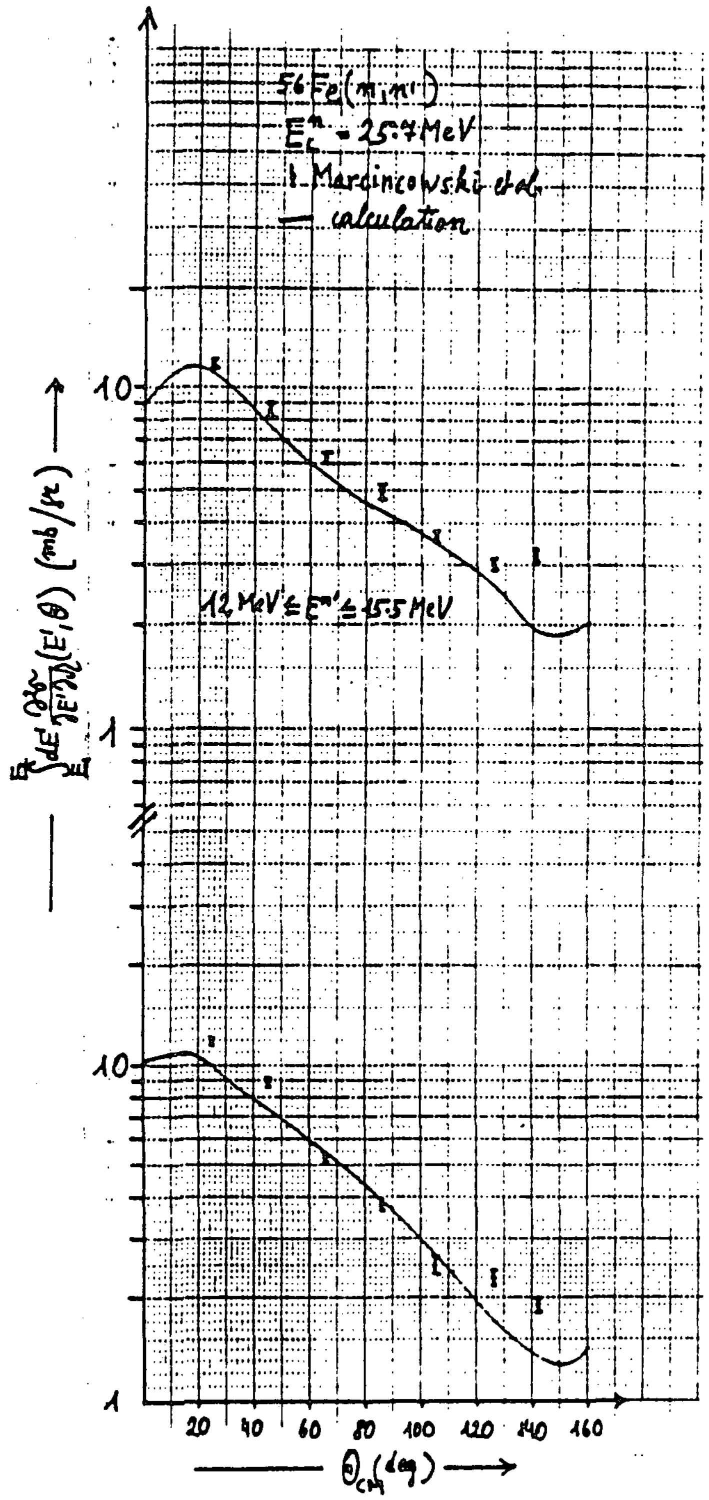

Fig. 1. Comparison of experimental /2/ and theoretical cross sections for ^{56}Fe(n,n') at 25.7 MeV

/1/ T. Tamura et al., Phys. Rev. C26 (1982) 379 and other references therein
/2/ A. Marcinkowski et al., Nucl. Sci. Eng. 83 (1983) 13

DEVELOPMENT OF A GENERAL NUCLEAR REACTION CROSS SECTION COMPUTER CODE

M. Uhl

Work on the new cross section code MAURINA which accounts for compound nucleus-, direct- and preequilibrium reactions is in progress. The program section supplying the optical model transmission coefficients has been completed and tested. It comprises optical model routines which generate the transmission coefficients on a suitably chosen grid of channel energies and routines which by means of a cubic spline calculate these quantities at the meshpoints of the numerical integrations required for the compound nucleus model.
The routines which handle first chance compound nucleus reactions under consideration of width fluctuation, fission, isospin mixing and angular distribution have been debugged. As a first application of this program section the experimental α-particle angular distributions resulting from $^{56}Fe(n,\alpha)$ and $^{60}Ni(n,\alpha)$ by Fischer et al. /1/ were analized. The direct reaction mechanisms which will be considered are inelastic scattering with macroscopic form factors and stripping- and pickup reactions with cluster form factors in case of transfer of more than one nucleon. The calculation will be performed by means of the DWBA code DWUCK /2/. The required interface routines are being developed. In a later stage a suitable coupled channel program will be included so that also inelastic scattering on deformed nuclei can be treated adequately.

A program section which deals with precompound reactions in the frame of the exciton model, has been completed. In addition to the well known formulation of this model the routines account also for isospin mixing, the spin distribution in the residual nuclei under the assumption of an exciton number dependent spin-cutoff factor and angular distributions employing the systematics of Kalbach and Mann /3/. Further a simple statistical treatment of direct transfer, knockout and inelastic scattering reactions following the approach of Kalbach /4/ has been included; in this way also cross sections for (n,d), (n,t) and $(n,{}^3He)$ reactions, which are important for fusion related technological applications, can be predicted. The exciton model is intended to be used for routine applications where many cross sections are to be calculated at a large number of incident energies. For the analysis of specific experiments the theory of Tamura et al. /5/ will be used for the precompound portion of the emission spectra.

/1/ R. Fischer et al., IRK Progr. Report 1982, p. 12
/2/ P.D. Kunz, unpublished
/3/ C. Kalbach et al., Phys. Rev. C23 (1981) 112
/4/ C. Kalbach, Z. Phys. A283 (1977) 401 and "PRECO-D", informal TUNL report, 1980
/5/ T. Tamura et al., Phys. Rec. C26 (1982) 379

MEASUREMENT OF DIFFERENTIAL (N,CHARGED PARTICLE) CROSS-SECTIONS BY MEANS OF THE VIENNA MULTITELESCOPE SYSTEM *)

A. Chalupka, R. Fischer, P. Maier-Komor [1], B. Strohmaier, G. Traxler, M. Uhl and H. Vonach

A) $^{56}Fe(n,\alpha)$ and $^{60}Ni(n,\alpha)$

The analysis of the $^{56}Fe(n,\alpha)$ and $^{60}Ni(n,\alpha)$ measurements described in the last annual report was completed. The results obtained from this analysis can be summarized as follows:

1) Angle integrated α-emission cross-sections:

Table 1 gives the results for the angle-integrated α-emission cross-sections for 1 MeV energy bins which corresponds roughly to the experimental energy resolution. The errors give effective 1σ errors obtained by summing the statistical errors and estimates of all identified sources of systematic error quadratically. In Figs. 1 and 2 these results are compared with the existing measurements of Grimes et al. /3/, which for this purpose have been transformed into the c.m. system. There is good overall agreement between the two measurements but in detail there exist two areas of disagreement.

At low energy ($E_{\alpha ch}$ < 6 MeV) the α-emission cross-section of ref. 2 is much smaller than ours, which cannot be explained by the slightly different incident neutron energies. In this energy range our measurements are complicated by rather a large background and also the Livermore data /3/ indicate experimental problems as there are considerable discrepancies between the emission cross-sections for the different angles.

Considering the different incident neutron energies the high-energy parts of the α-spectra in the $^{60}Ni(n,\alpha)$ reaction definitely disagree beyond experimental errors. No obvious reason for this discrepancy could be found.

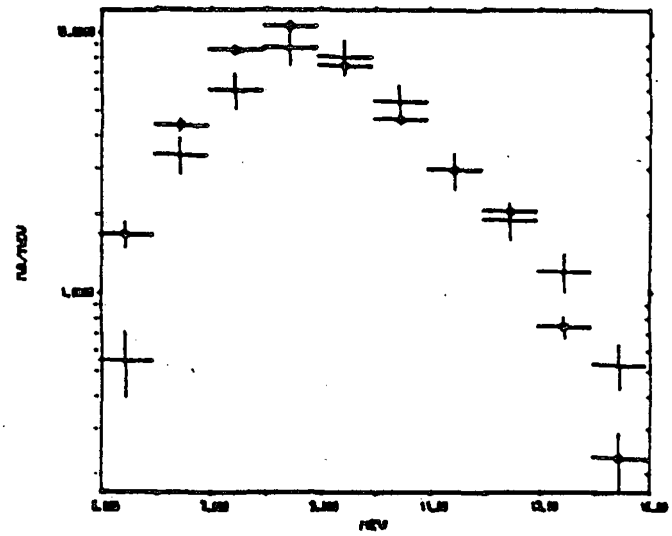

Fig. 1. The angle integrated α-emission cross-section for the $^{56}Fe(n,\alpha)$ reaction
• present results (E_n = 14.1 MeV),
+ results of ref. 3 (E_n = 15 MeV)

Table 1: Angle-integrated α-particle emission cross-sections for the $^{56}Fe(n,x\alpha)$ and $^{60}Ni(n,x\alpha)$ reactions at E_n=14.1 MeV

E_α(chann.E_n)	$\frac{d\sigma}{dE_\alpha}$ (^{56}Fe+n)	$\frac{d\sigma}{dE_\alpha}$ (^{60}Ni+n)
5 - 6	1.69 ± .20 ::	2.98 ± .25 ::
6 - 7	4.39 ± .28	5.59 ± .26
7 - 8	8.60 ± .43	10.91 ± .55
8 - 9	10.63 ± .51	15.23 ± .73
9 - 10	7.45 ± .37	13.54 ± .65
10 - 11	4.63 ± .25	8.96 ± .44
11 - 12	2.98 ± .18	4.87 ± .26
12 - 13	2.06 ± .13	3.35 ± .18
13 - 14	.75 ± .08	1.46 ± .11
14 - 15	.23 ± .06	1.04 ± .09
15 - 16		.28 ± .06

:: the fully correlated part of the erorrs amounts to 4.4% of the cross-section values

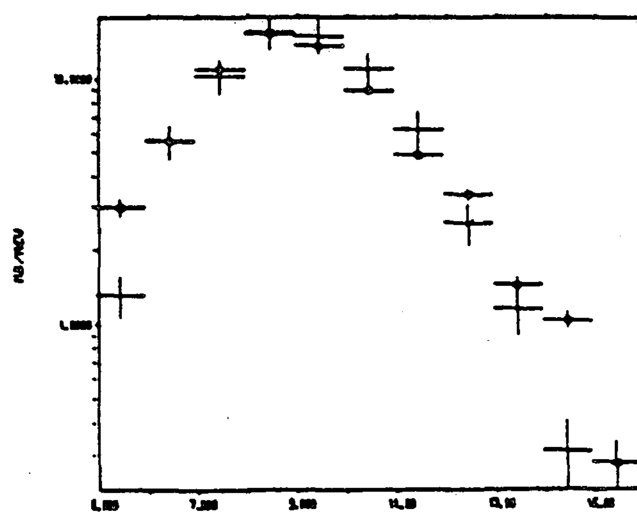

Fig. 2. The angle integrated α-emission cross-section for the reaction $^{60}Ni(n,\alpha)$
• present results (E_n = 14.1 MeV),
+ results of ref. 3 (E_n = 15 MeV)

* supported by Fonds zur Förderung der wissenschaftlichen Forschung in Österreich

[1] Physikdepartment, TU München, FRG

2) Total α-emission cross-sections:

The total α-emission cross-sections obtained by numerical integration of the $d\sigma/dE_\alpha$ values are given in table 2. As the table shows there is good agreement both with the results of ref. /3/ and the results of helium accumulation measurements /4/; in this comparison it has to be considered that at the higher incident neutron energies of ref. 3 and 4 the α-emission cross-sections should be about 5-10% higher than at our energy of 14.1 MeV.

Table 2: Total α-emission cross-sections in the $^{56}Fe(n,x\alpha)$ and $^{60}Ni(n,x\alpha)$ reactions

E_n (MeV)	$\sigma(^{56}Fe(n,x\alpha))$	$\sigma(^{60}Ni(n,x\alpha))$	Ref.
14.1	44 ± 2.	69.6 ± 3.1	this work
15	41 ± 7.	76 ± 12	2
15	48 ± 3.	79 ± 6.	4

3) Angular distribution of α-emission:

The gross-features of the angular distributions have already been presented in the last progress report (p. 13, figure 2). As shown in this figure there are considerable contributions from non-compound reactions at the highest α-particle energies probably due to collective excitation of low-lying levels as already found in the study of the $^{50}Cr(n,\alpha)$ reaction /5/. In the region of the evaporation peak (Progress Rep. 1982, p. 13, fig. 2b) the angular distributions are approximately symmetrix around 90° and show a small minimum at 90° as expected according to Hauser-Feshbach theory. The size of this minimum is about the same as in our $^{50}Cr(n,\alpha)$ measurements /5/ and much smaller than in some of the early work on (n,α) reactions /6,7/ which probably suffered from some unidentified systematic errors.

/1/ C. Derndorfer et al., Nucl. Instr. & Meth. 187 (1981) 423
/2/ G. Traxler, R. Fischer and H. Vonach, Nucl. Instr. & Meth. 217 (1983) 121
/3/ S.M. Grimes et al., Phys. Rev. C19 (1979) 2127
/4/ D.W. Kneff et al., Symp. on Neutron Cross-Section from 10-50 MeV, BNL-NCS-51245, p. 289
/5/ C. Derndorfer et al., Z. Physik A301 (1981) 327
/6/ W. Patzak and H. Vonach, Nucl. Phys. 39 (1962) 263
/7/ M. Bormann, Habilitationsschrift Hamburg 1965

MEASUREMENT OF THE ENERGY- AND ANGULAR DISTRIBUTION OF THE HIGH-ENERGY PART OF INELASTICALLY SCATTERED 14 MEV NEUTRONS *)

G. Staffel, G. Winkler, A. Pavlik and H. Vonach

The construction work on the new time-of-flight equipment described in the last year's report has been completed so far that first test measurements could be performed. The main features of the new system are: the scattering sample and the $^{3}T(d,n)^{4}He$ neutron source are located inside a tube system which can be evacuated; the incident neutron energy can be kept constant when changing the scattering angle by moving the sample along the access channel axis of the detector. Background measurements showed that using polyethylene for the extension collimator (extending into the 80-cm diameter tube containing source and sample) and also for its throat was a good choice. Fig. 1 demonstrates the reduction of background achieved by evacuating the flight-tube system using a rotary vacuum pump. The effect is most pronounced in the time-of-flight region of the elastic and the low-cross-section high-energy inelastic portion of the scattered neutrons.

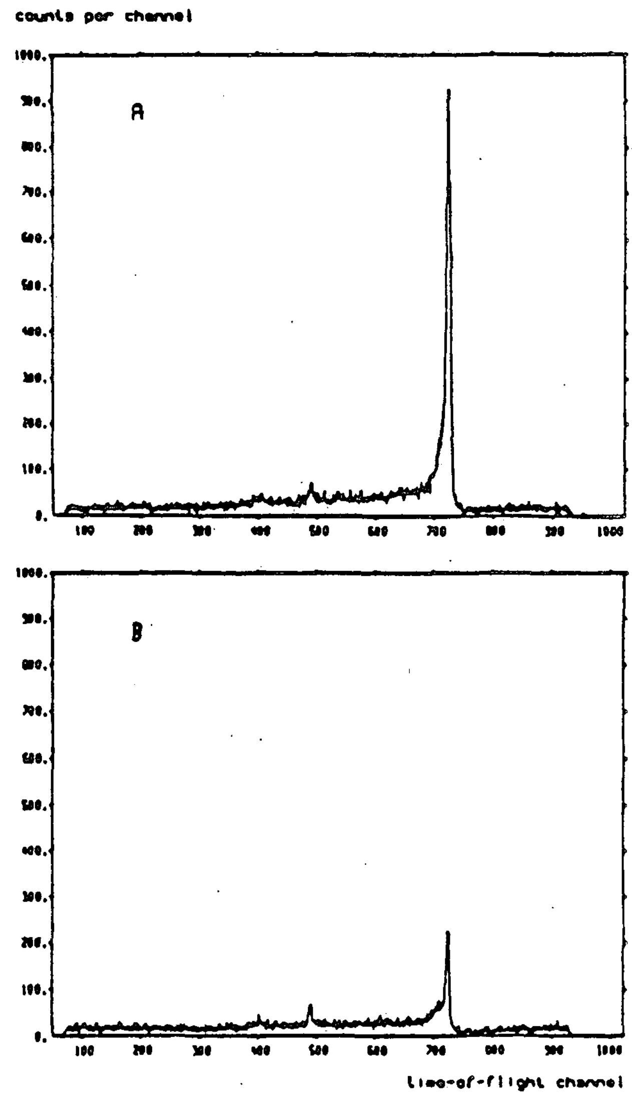

Fig. 1. Background distributions with flight-tube system under normal pressure (A) and after evacuating to < 10 Pa (B), both in the same scale. The flight path from the point of 90° scattering angle to the centroid of the 12.7-cm-diameter 5.1-cm thick detector scintillator (NE 213) was 4.52 m, the calibration of the time-of-flight coordinate was 0.426 ns per channel. The total neutron yield was 2×10^{12} neutrons into the full solid angle. The detector threshold was set at 1/2 Compton edge from a ^{137}Cs source.

* supported by the Jubiläumsfonds der Österreichischen Nationalbank

PRECISE MEASUREMENT OF CROSS SECTIONS FOR THE REACTION ^{65}CU(N,2N)^{64}CU IN THE 14 MEV REGION AND SIMULTANEOUS REEVALUATION OF SOME IMPORTANT CROSS SECTIONS AT 14.70 MEV

G. Winkler and B. Ryves [1]

The activation measurements concerning the ^{65}Cu(n,2n)^{64}Cu dosimetry reaction, already described in the last year's report, were finally evaluated at 13.692, 14.473 and 14.822 MeV neutron energy achieving an accuracy of 1.4 - 1.5% (equivalent standard deviation, systematic errors included) relative to well-known cross sections for the reference reaction ^{27}Al(n,α)^{24}Na. The new measured precision value for the β^{+}-branching ratio of ^{64}Cu (Christmas et al., see RADIONUCLIDE METROLOGY, this report) was employed. The new cross section values were incorporated in a reevaluation of the ^{65}Cu(n,2n)^{64}Cu cross section simultaneously with some other important cross sections at 14.70 MeV by the weighted least-squares method yielding a consistent set with uncertainties (1σ) of 0.6 - 2.0%. The uncertainty for the evaluated ^{65}Cu(n,2n)^{64}Cu cross section could be reduced to 1.2%; the cross section value is 4.1% above the value from the ENDF/B-V (1981) evaluation, which assumes the same cross section shape in the 14 MeV region. A renormalization of the ENDF/B-V data in the 14 MeV region may be recommended. The work above has been published in detail in Ann. Nucl. Energy 10, No. 11 (1983) 601.

[1] National Physical Laboratory, Teddington, England

RESULTS FROM THE PARTICIPATION IN THE INTERNATIONAL COMPARISON OF D+T NEUTRON FLUENCE AND ENERGY USING NIOBIUM AND ZIRCONIUM ACTIVATION

G. Winkler

The results of the Nb/Zr intercomparison in the 14 MeV neutron energy range, which took place during the two years before, were distributed to the participants by the organizer, V.E. Lewis /1/. The IRK result for the niobium specific activity/unit fluence was within < 0.1% of the weighted mean of the results from the participating laboratories. The fluence measurement at IRK was based on the simultaneous irradiation of aluminium samples and employing a high-accuracy ^{27}Al(n,α)^{24}Na cross section evaluated earlier at IRK /2/. The induced ^{24}Na activity was measured by means of the 12.7 x 12.7 cm NaI(Tl) well-type detector installed at IRK (see section RADIONUCLIDE METROLOGY, this report). The results for the energy scale based on the Nb/Zr activity ratio according to the calibration at NPL were also in very good agreement with the values calculated at IRK on the basis of the effective incident deuteron energy, Q-value of the T(d,n) reaction, dE/dx (E_d) values, and the angular position of the sample /3/. An energy loss of 10 ± 10 keV in a tritium-depleted zone of the neutron target and a tritium-to-titanium ratio of 1.5 ± 0.5 was assumed.

/1/ V.E. Lewis, Division of radiation science and acoustics, National Physical Laboratory, Teddington, England; report presented at the meeting of Section III of CCEMRI at BIPM in Sèvres, May 1983; to be published in Metrologia
/2/ S. Tagesen and H. Vonach, Physics Data 13-3 (1981), Fachinformationszentrum Karlsruhe
/3/ A. Pavlik, G. Winkler, H. Vonach, A. Paulsen and H. Liskien, J. Phys. G: Nucl. Phys. 8 (1982) 1283

CALIBRATION OF NEUTRON DETECTORS IN A 'KNOWN' NEUTRON FIELD

P. Doll [1], B. Haesner [1], H.O. Klages [1] and A. Chalupka

With the availability of a ^{252}Cf neutron-source embedded in a small low-mass highly efficient ionisation chamber /1/ it is challencing to calibrate neutron detectors in the energy range of "say" 1-8 MeV. This device gives a start signal when a neutron is emitted at spontaneous fission of ^{252}Cf, thus allowing a time-of-flight measurement for the fission neutron between the chamber and the neutron detector. The recommended value for the total neutron emission multiplicity for spontaneous fission of ^{252}Cf is 3.745 ± 0.010 /2/ per fission. The so-called "Golden Californium-chamber" /3/ with improved characteristics, concerning the neutron flux modifications due to the steel backing and the housing of the intense fission activity, was exploited to calibrate a liquid He-scintillator /4/ and a large (14 cm Ø, 20 cm high) NE 213 scintillator. Very recently also other groups /5/ exploited this fission-chamber and investigated the neutron flux distribution. Despite a considerable number of different measurements, the characteristics of the spectrum is not entirely settled but a temperature of T = 1.42 ± 0.018 MeV is mostly accepted in the energy range from 0.8 and 8 MeV (fig. 3 in ref. 6) where uncertainties of 3% as maximum are quoted. As a goal in practical application, therefore, an accuracy of ≤ 3% should be obtained. We combined these efforts with the operation of a non-standard liquid-^3He scintillator /4/ which offers the capability to detect without any threshold neutrons with a well determined efficiency once the scintillator dimensions, the density of the liquid ^3He and the $n+^3He \rightarrow p+t$ cross section as function of neutron energy are known. Detailed publication of experimental conditions, data reduction and results is forthcoming.

/1/ A. Chalupka, Nucl. Instr. & Meth. 164 (1979) 105
/2/ J.W. Boldeman, Neutron Standards and Applications, National Bureau of Standards 493 (1977) 182
/3/ A. Chalupka, B. Strohmaier, IRK Progress Report 1982, p. 24
/4/ R. van Staa, J. Reher, B. Zeitnitz, Nucl. Instr. & Meth. 136 (1976) 241
/5/ H. Klein, Contribution to the XII. Int. Symp. on Nuclear Physics, 22.-26.Nov. 1982, Gaußig/Dresden and R. Böttger, H. Klein, A. Chalupka, B. Strohmaier, PTB-Braunschweig, progress report 1982, p. 7 and p. 25
/6/ J.A. Grundl and C.M. Eisenhauer, Symp. on Neutron Standards and Applications, Gaithersburg 28-31, 1977, National Bureau of Standards, 493

[1] Inst. f. Kernphysik, Kernforschungszentrum Karlsruhe, FRG

EVALUATION OF THE ^{58}NI(N,2N)^{57}NI CROSS-SECTIONS

A. Pavlik and G. Winkler

The cross sections for the $^{58}Ni(n,2n)^{57}Ni$ dosimetry reaction were reevaluated in the energy range from threshold to 20 MeV including the new precise experimental data (see the last year's report). The results have been published as a IAEA Nuclear Data Section report, INDC(AUS)-9/L, June 1983.

THE DECAY SCHEME OF ^{64}Cu

P. Christmas [1], S.M. Judge [1], T.B. Ryves [1], D. Smith [1] and G. Winkler

The evaluation of the measurements to clarify longstanding discrepancies concerning the branching ratios (β^+, β^-, EC) in the decay of ^{64}Cu, already mentioned in the last year's report, has been completed and the results published /1/. Six distinct but partially correlated measurements were used to determine all branching ratios. From this data, best estimates, including covariances, were obtained. The β^+/β^--ratio was determined by magnetic β-spectrometry and separately by $4\pi\beta$-γ coincidence-counting using a gas proportional counter. $4\pi\beta$-γ liquid scintillation counting using a multidimensional computer discrimination technique with different γ-channel settings /2/ was employed to determine the total β-ray-branching ratio and the total disintegration rate of the ^{64}Cu sources. The positron branching ratio was measured by means of a Ge(Li) detector, comparing the emission rates of annihilation γ-rays from sources of ^{64}Cu and ^{22}Na of known activity, and independently by counting the total γ-rays from a copper foil, with the activity known from an irradiation in a standard thermal-neutron field, by means of a calibrated NaI(Tl) well-type detector. The yield of the low-intensity 1.34 MeV γ-ray was determined with a calibrated Ge detector. Magnetic β-ray spectrometry also provided highly accurate β^- and β^+ end-point energies. The new more reliable branching ratios were used for a precise measurement and reevaluation of the ^{65}Cu(n,2n)^{64}Cu cross section in the 14 MeV region (see section EXPERIMENTAL NUCLEAR PHYSICS, NEUTRON INDUCED REACTIONS).

[1] National Physical Laboratory, Teddington, England

/1/ P. Christmal et al., Nucl. Instr. and Meth. 215 (1983) 397
/2/ D. Smith and L.E.H. Stuart, Metrologia 11 (1975) 67

SURVEY OF STANDARDIZATION POSSIBILITIES WITH A NAI(TL) WELL-TYPE DETECTOR

A. Pavlik and G. Winkler

The standardization capabilities of the 12.7 cm x 12.7 cm NaI(Tl) well-type detector installed at IRK were investigated for a series of 27 radionuclides of practical interest with different complexity of the decay schemes. Total detection efficiencies and their uncertainties were calculated for low-mass point-like sources, for 1-cm^3 aqueous solutions, and also for the nuclides being homogeneously incorporated in a 1-g solid sample with 20-mm diameter. The physical consistency of the chosen decay schemes was tested within their limits of uncertainty which enabled tightening the efficiency-uncertainty limits taking a choice among different versions of the decay-scheme data. The work was presented at the 7th meeting of the "Comite Consultatif pour les Etalons de Mesure des Rayonnements Ionisants (Section II)" at BIPM in May 1983, and at the ICRM ("Internat. Committee for Radionuclide Metrology") Seminar in Geel in May 1983. The results, the underlying procedures and concepts of the used computer code have been published as Refs. 1-3, respectively.

/1/ A. Pavlik and G. Winkler, Int. J. Appl. Radiat. Isot. 34, No. 8 (1983) 1167
/2/ G. Winkler and A. Pavlik, Int. J. Appl. Radiat. Isot. 34, No. 2 (1983) 547
/3/ A. Pavlik, Sitzungsber. Österr. Akad. Wiss., mathem.-naturw. Kl., Abt. II, 191, Heft 8-9 (1982) 253

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1. NEUTRON INTERFEROMETRIC MEASUREMENT OF COHERENT SCATTERING LENGTHS OF HIGHLY ABSORBING ELEMENTS

H. Rauch and D. Tuppinger

Liquid solutions of $Sm(NO_3)_3$, $Gd(NO_3)_3$ and $Dy(NO_3)_3$ have been used as phase shifting materials inside the neutron interferometer. Although the elements Sm, Gd and Dy have very high absorption cross sections it was possible to extract the coherent scattering length to an accuracy of about 9 per cent. A preliminary value for Sm can be given as 2.7 fm for a neutron wave length of 1.96 Å.

2. OPTICAL MODEL ANALYSIS OF $\alpha - {}^{40}Ca$ SCATTERING DATA BY POTENTIAL INVERSION FOR FIXED ENERGY

G. Ratel, H. Leeb, H. Fiedeldey[x)] and R. Lipperheide[xx)]

Elastic scattering data of $\alpha - {}^{40}Ca$ in the energy range between 20 MeV and 105 MeV are analysed in the framework of the optical model using the method of potential inversion of Lipperheide and Fiedeldey. Starting from the cross section data we apply a combination of rational and non rational Bargmann inversion schemes. The energy dependence of the potential is investigated and is compared with the results of already known optical model analysis works.

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x) Department of Physics, University of South Africa
xx) Hahn-Meitner-Institut für Kernforschung, Berlin

3. MICROSCOPIC MODEL CALCULATIONS OF THE OPTICAL POTENTIAL OF α-^{40}Ca

H.Leeb and F.Osterfeld x)

The optical potential for α-^{40}Ca is calculated taking into account all open inelastic channels with the formalism of Feshbach in the energy range between 26 and 36 MeV. For the single channel term we use a folding potential deduced from the M3Y interaction and normalized by a fit to the rotational bands of the α-^{40}Ca-system in the framework of the fish bone model. For the imaginary part the contributions of open inelastic channels, calculated with RPA, are taken into account. The results of the theoretical calculations are compared with the experimental cross section data.

4. ABSOLUTE CROSS SECTIONS OF MULTI-NUCLEON TRANSFER REACTIONS

H.Oberhummer, H.Jasicek, H.Leeb, W.Leitner, W.Pfeiffer, K.Preisinger, P.Riehs

Recently, high discrepancies between theory and experiment were observed for the absolute cross sections of multi-nucleon transfer reactions. So far, the main effort was spent to explain the shapes of angular distributions and the relative intensities and no systematic study was carried out to understand the reactions in terms of absolute intensities. Therefore an investigation program has been started to study the discrepancies by means of model calculations and some new measurements. For the calculations we will use a programm code which has been developed in our institute on the basis of microscopic models applying distorted wave Born approximation. The new measurements are planned in cooperations with institutions of the universities of Tübingen and Zürich.

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x) Institut für Kernphysik, KFA Karlsruhe, BRD

5. NEUTRON ACTIVATION AND MEASUREMENT FACILITY AT THE TRIGA MarkII REACTOR

F.Grass, P.Schindler, J.O.Schmidt[x)], G.P.Westphal

In the past years, the fast neutron irradiation facility of the TRIGA MARKII reactor was in continuous operation. A number of improvements of the equipment were made. However, the main effort has been spent to increase the capability of measuring very short lived nuclides. The pneumatic system allows a lowest possible transport time between irradiation and measurement position of 20 ms. In case of gamma spectrometry we are using a 70 cm^3 Ge-Li detector which has a resolution of 2.8 keV up to a countrate of 500 kc/s. The digital information is transfered to a PDP 11/34 computer by direct memory access. Gamma spectra are evaluated by the versatile computer code ALCHEM. Recently a new computer program RINAA has been developed taking into account decay curve fitting up to four decaying components[1)].

1) J.O.Schmidt, Internal Report AIAU 83510(1983)

6. MEASUREMENTS OF THE EMISSION OF PROMPT FISSION NEUTRONS

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The work on this subject has been continued. For the reactions $^{205}Tl(\alpha,xnf)$ and $^{238}U(\alpha,xnf)$ at E_α=118 MeV we obtained for σ_f the values of 0,11 b and 1,85 b. The average number of neutrons in coincidence to the fragments is determined to be about 6.4 and 7.4 per fragment of the ^{205}Tl and ^{238}U reaction.

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