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PROGRESS REPORT TO EANDC FROM DANISH AEC RESEARCH ESTABLISHMENT RISO FOR THE PERIOD UNTIL JUNE 1964

H. Bjerrum Moller, Editor

OECD ENEA

JUNE 1964

EUROPEAN-AMERICAN NUCLEAR DATA COMMITTEE

I SPECIAL BEAM FACILITIES

Continued work on angled Soller collimators.

K. Abrahams, F. Stecher-Rasmussen and E. Warming.

The overall polarization from the two versions of the polarizing collimators has been found with different methods (Bragg reflection from a Co Fe single crystal and total reflection from a Co Fe mirror) to be lower than the 80-90% theoretically to be expected. Values of 30-50% overall polarization have been found. For the second version we could prove that the reflecting plates are close to magnetic saturation. Other investigators also found polarizations lower than expected theoretically.

A first explanation of the discrepancy between the measured polarization and the polarization calculated from the simple theory of total reflection of neutrons from magnetized materials might be that the theory is not quite correct. Effects as for example depolarization of the neutrons in the inhomogeneous magnetic fields near the boundaries of the magnetic domains might play a role.

Another explanation might be that, because it is never possible to polish the surface of a reflecting plate flat within a few times the projected coherence length of the neutrons (given by $\lambda/2\,\theta^2$ of the order of a few microns for the angle θ and the wavelengths λ we are working with), a part of the neutrons will be reflected under an angle bigger than calculated and a part of the neutrons will be reflected under an angle smaller than calculated. The result will be that the total polarization of the beam will drop, just as the total reflected intensity. This is because the polarization near the angle we are working at (the optimum angle with respect to polarization and intensity) will drop strongly for decreasing angle, but will only slightly increase for increasing angle while the intensity will drop strongly for increasing angle. Fig. 1 is illustrating this point, it represents a computation of the polarization and intensity of a neutron

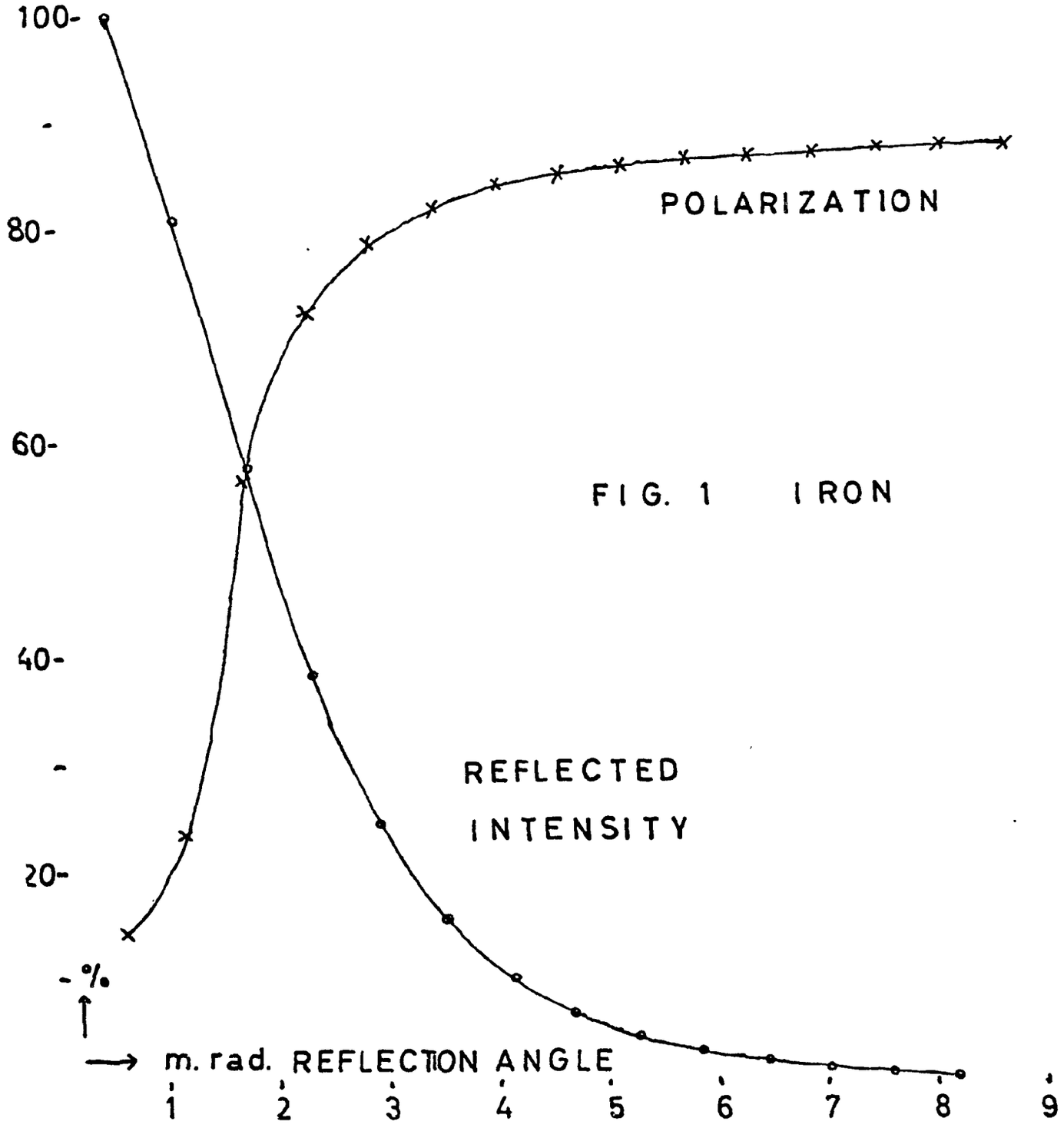
100-
80-
60-
40-
20-
- %
POLARIZATION
REFLECTED
INTENSITY
m. rad. REFLECTION ANGLE
1
2
3
4
5
6
7
8
9

FIG. 1 IRON

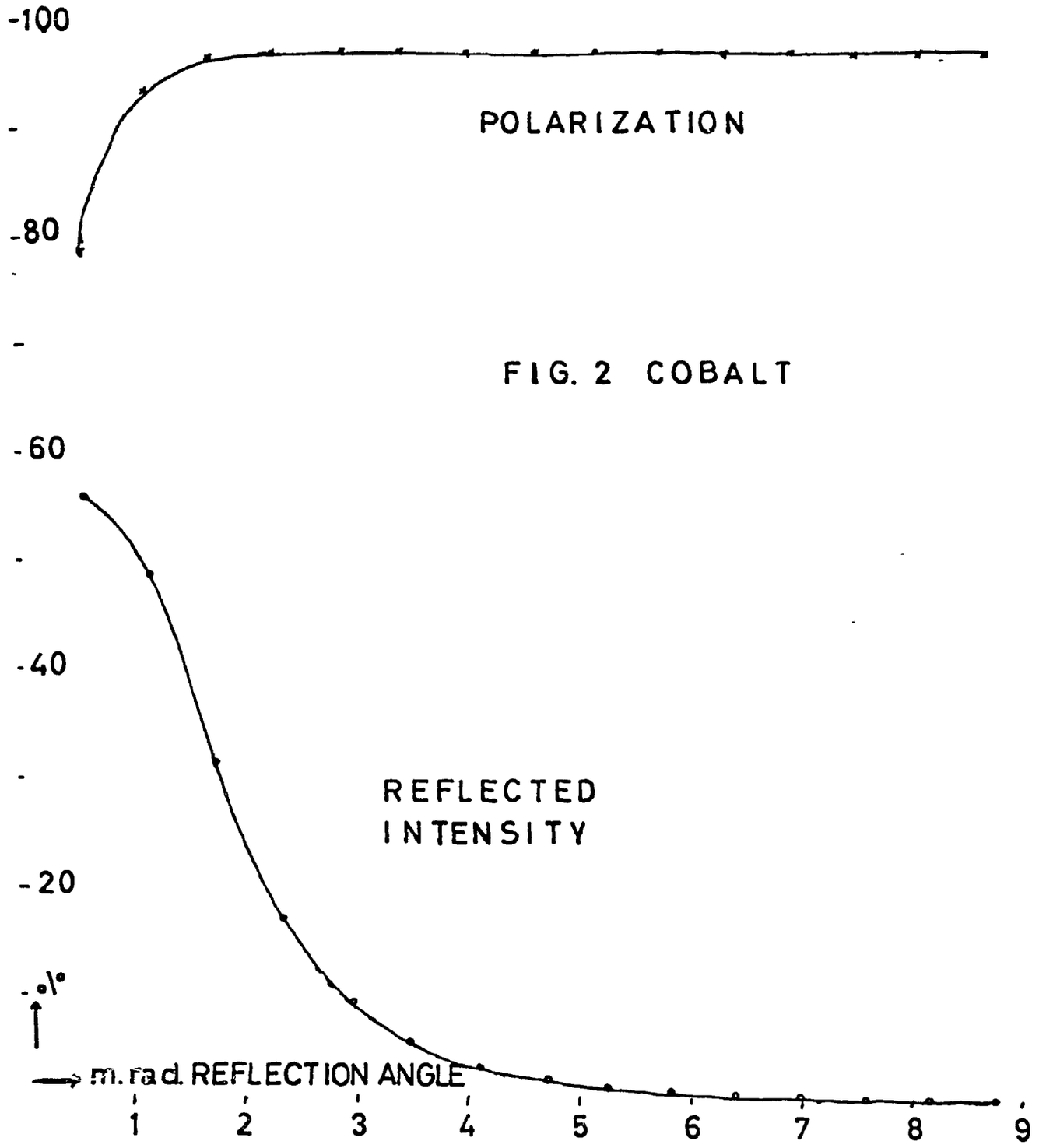
-100
-80
POLARIZATION
-60
-40
-20
REFLECTED
INTENSITY
m.rad. REFLECTION ANGLE
1
2
3
4
5
6
7
8
9

FIG. 2 COBALT

beam reflected from an iron plate, with as incoming energy distribution a Maxwellian one. This effect is much less pronounced for a cobalt mirror, because of the fact that the magnetic scattering amplitude will be bigger than the nuclear scattering amplitude for cobalt. Fig. 2 gives the result of the calculations of polarization and intensity for a cobalt mirror.

We are in the process of building a third version of the polarizing collimators, provided with tapered channels, by means of which we will focus the incoming 11 cm broad beam down to about 3 cm. For this collimator the plates will be made by depositing electrolytically a layer of cobalt on copper plates. We hope to acheive an increase in the polarization of about a factor two and an increase in the total reflected intensity of a factor three.

II INVESTIGATIONS OF CAPTURE GAMMA RAYS

1. (n, γ) Polarization Experiment

K. Abrahams, W. Ratynski, F. Stecher-Rasmussen, E, Warming.

Measurements of the circular polarization of capture gamma radiation after capture of polarized neutrons have been started. This circular polarization is related to the spins of the nuclear energy levels between which an experimentally selected gamma transition is taking place. The purpose of the measurements is the determination of these spins.

The measurement of the circular polarization is performed by determining the difference of the number of gamma quanta transmitted through a cylinder of material successively with magnetization parallel and antiparallel to the polarization direction. If the photon spin is parallel to the electronspins the transmission probability is highest (for energy of the photon bigger than 0.65 Mev).

The gamma transitions of interest are selected by analysing the energy spectrum of the capture gamma radiation, transmitted through the magnetized material, taken with a 3" x 3" Na I (Tl) scintillation spectrometer [x]. The gamma spectrometer is facing the target through a cylinder of magnetized permendur (a 50% Co 50% Fe alloy with a high saturation magnetization and easy to magnetize).

Because it is not easy to change the direction of the analysing magnet without disturbing the scintillation spectrometer and the magnetic guide field keeping the neutron beam polarized, the polarization of the gamma radiation has changed sign rather than the magnetization of the permendur. The inversion of the sign of the gamma polarization takes place every two minutes, by changing the configuration of the magnetic guide field along the beam, thus inverting the sign of the neutron polarization p_n related to the gamma polarization p by $p = p_n R \cos\vartheta$; ϑ is the angle between the neutron polarization and the emission direction of the gamma ray (in our case $\cos\vartheta$ is almost one) and R is the nuclear constant related to the multipolarity of the gamma transition and the spins of the levels involved in this gamma transition.

This extra precaution is especially important because very small effects have to be measured (around 0.5% of the counting rate). A sketch of the set up is given in Fig. 1.

In Fig. 2 test measurements on the 5.42 Mev line in S^{33} are shown; these measurements are in agreement with the circular polarization theoretically to be expected for dipole transition of a spin 1/2 to a spin 3/2 level. In Fig. 3 the difference spectrum for the 7.38 Mev transition in Pb^{208} from the capturing state to the 0^+ ground state is shown; this difference spectrum indicates that the predominant contribution to the capturing state of Pb^{208} is from resonances with spin 1, as to be expected

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x) The transmitted gamma spectra are accumulated in different parts of the memory of a multichannel analyser.

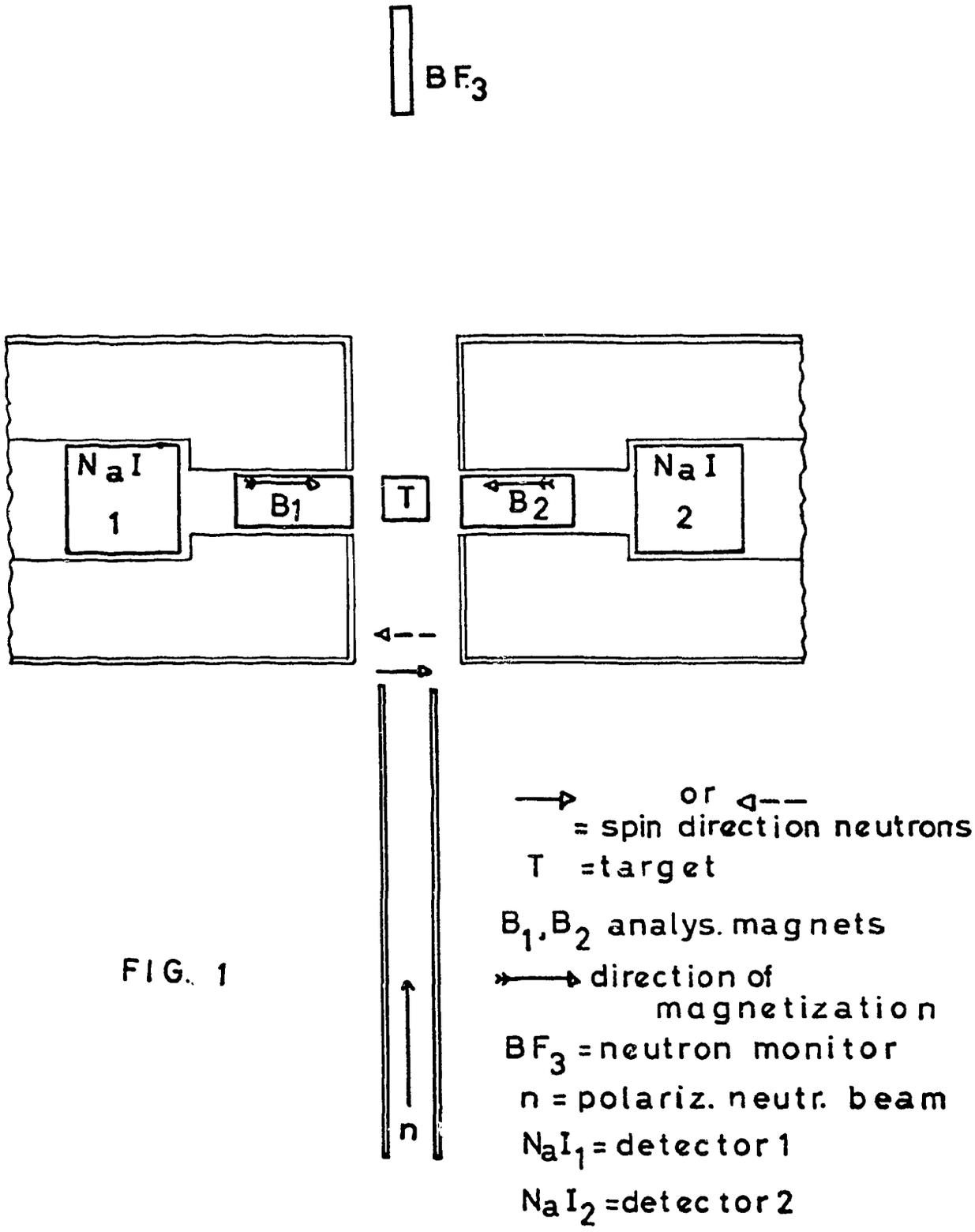
BF3
NaI
1
B1
T
B2
NaI
2
n
or
= spin direction neutrons
T =target
B1,B2 analys. magnets
direction of
magnetization
BF3 =neutron monitor
n = polariz. neutr. beam
NaI1 = detector 1
NaI2 =detector 2

FIG. 1

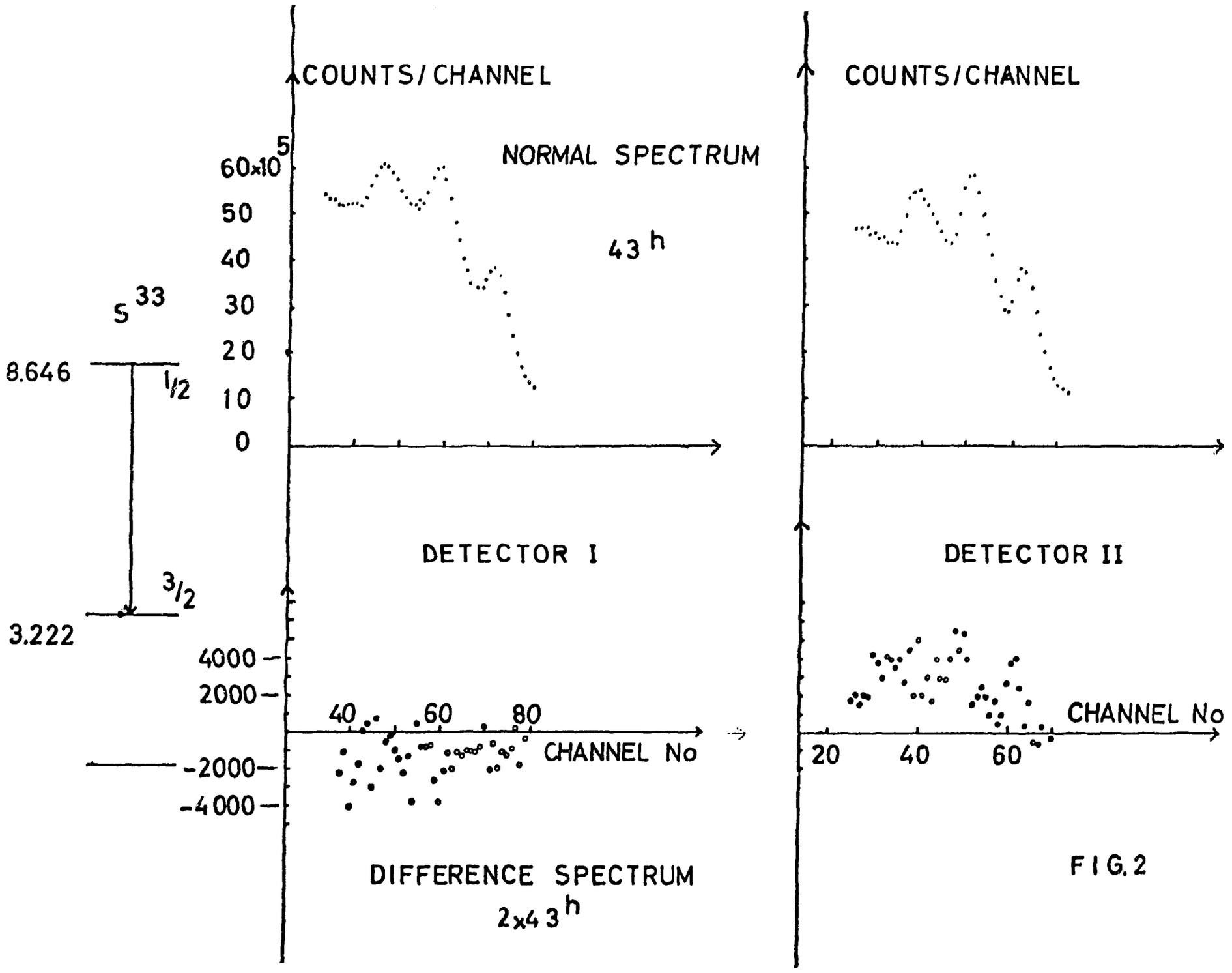
COUNTS/CHANNEL
NORMAL SPECTRUM
43 h
60x10^5
50
40
30
20
10
0
S 33
8.646
1/2
3/2
3.222
DETECTOR I
DETECTOR II
4000
2000
-2000
-4000
40
60
80
CHANNEL No
20
40
60
CHANNEL No
DIFFERENCE SPECTRUM
2x43 h

FIG. 2

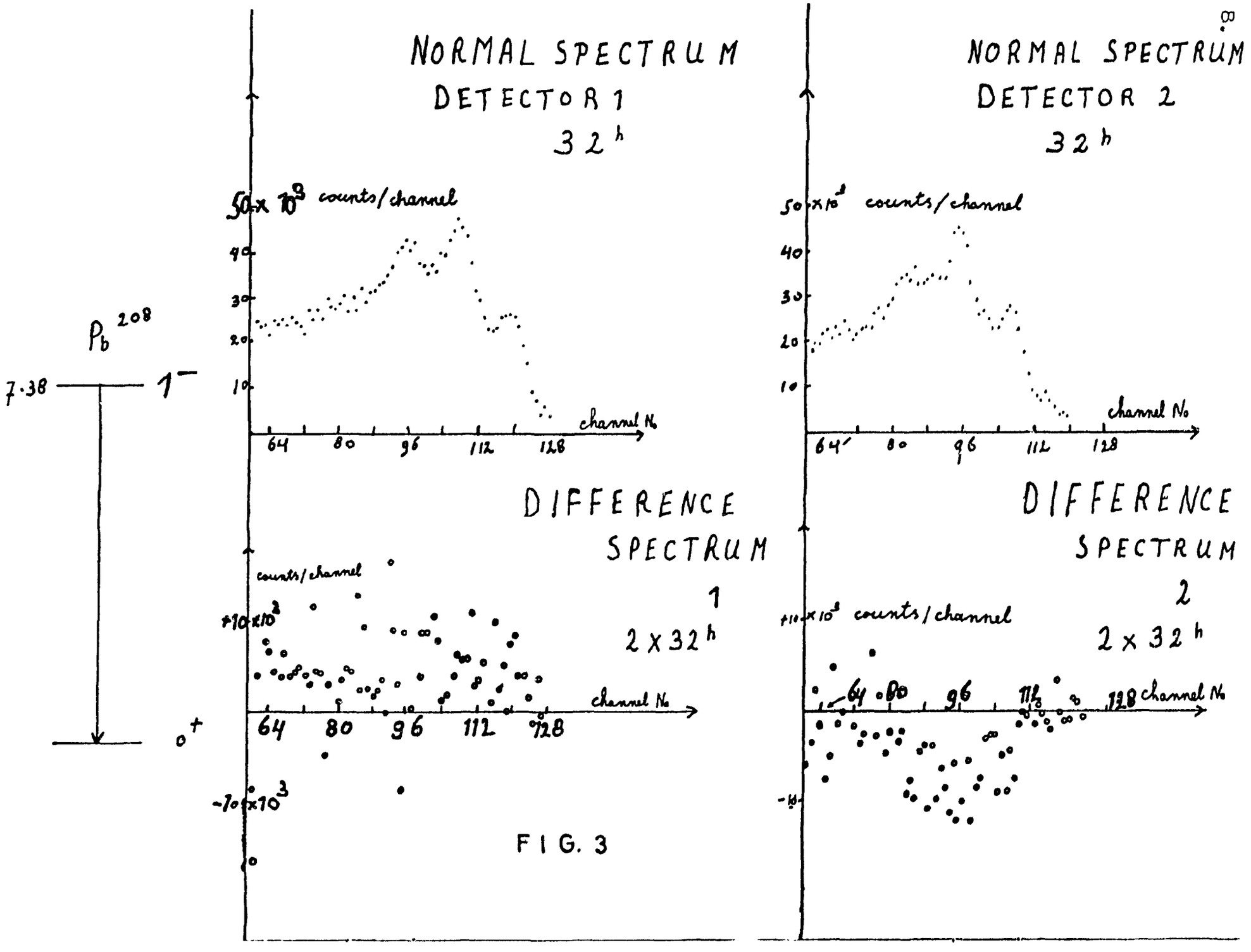
NORMAL SPECTRUM
DETECTOR 1
32 h
50 x 10³ counts/channel
40
30
20
10
channel No
64
80
96
112
128
Pb 208
7·38
1⁻
0⁺
DIFFERENCE
SPECTRUM
1
2 X 32 h
counts/channel
+10 x10³
-10 x10³
NORMAL SPECTRUM
DETECTOR 2
32 h
50 x10³ counts/channel
DIFFERENCE
SPECTRUM
2
2 x 32 h
+10 x10³ counts/channel
-10

FIG. 3

from the high probability of this ground state transition. In the same way the spin of the 4.76 Mev 3.62 Mev and 1.95 Mev levels of Ca^{41} have been determined to be 3/2 and the spin of the 3.95 Mev level of Ca^{41} is determined to be 1/2, as in agreement with angular correlation measurements done by one of the authors together with A. Tveter in Kjeller.

When the big polarizing collimator system, allowing of the order of ten times shorter measuring times and smaller samples is placed, we hope to start measurements on enriched isotopes of Ce and Zr. (Now our sample is a cylinder with diameter 2.5 cm, 3 cm high).

2. Decay $Ta^{182} \rightarrow W^{182}$ x)

O. W. B. Schult and U. Gruber, Labor f. Techn. Physik,
T. H. München and Research Establishment Risø, Denmark.

The earlier measured intensities of γ-rays by the curved crystal spectrometer and the investigation of the decay of $Ta^{182} \rightarrow W^{182}$ by H. Daniel et al. using a double focusing β-ray spectrometer made it possible to complete the level scheme of W^{182}. The evaluated conversion coefficients agree well with theoretical values of Sliv and Band. The multipolarity of several transitions could be fixed.

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x) To be published in Nuclear Physics by H. Daniel, I. Hüfner, Th. Lorenz, O. W. B. Schult and U. Gruber.

5. Level Scheme of Lu^{177}.[x)]

B.P. Maier, U. Gruber, O.W.B. Schult and R. Koch, Labor f. Techn. Physik, T.H. München and Research Establishment Risø, Denmark.

The neutron capture gamma spectrum of Lu^{177} revealed 250 gamma transitions. 3 rotational bands were found. The groudstate band has the Nilsson assignment 404 $7/2^+$ and the energies 121.62 keV, 268.79 keV, 440.66 keV, 636.22 keV, 854.34 keV. The level sequence of the [514] $9/2^-$ band is 150.39 keV, 288.99 keV, 451.49 keV, 637.05 keV and 844.88 keV, the [402] $5/2^+$ band has the energies 457.92 keV, 552.05 keV, 671.89 keV, 816.63 keV, 985.23 keV, 1176.73 keV and perhaps 1389.5 keV. The energies of these levels agree well with the formula $E = A(I + 1)I - B(I + 1)^2I^2$. The branching ratios of the rotational bands were compared with the theoretical values. The differences are smaller than two times the statistical error. For the [514] band we found $g_k = 1.16$ and for [402] band $g_k = 1.33$.

6. Level Scheme of Dy^{162}.

O.W.B. Schult, U. Gruber and B.P. Maier, Labor f. Techn. Physik, T.H. München and Research Establishment Risø, Denmark.

The strongest lines found during the irradiation of Dy^{161} with thermal neutrons belong to the groundstate rotational band and a vibrational band. We found the 0.0^+, 0.2^+, 0.4^+ and 0.6^+ levels of the rotational band between 0 and 548 keV and levels with the assignments 2.2^+, 2.3^+, 2.4^+ and 2.5^+ of the vibrational band between 888 keV and 1297 keV. The energy of the 2.2^+ level agrees very well with the value found by Yoshizawa[xx)].

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x) To be published in Zeitschrift für Physik.

xx) Y. Yoshizawa et al., private communication.

7. Level Scheme of Dy^{164} x).

O. W. B. Schult, B. P. Maier, U. Gruber, F. Stanek, Labor f. Techn. Physik, T. H. München and Research Establishment Risø, Denmark.

The neutron capture Gamma ray spectrum of Dy^{164} was measured with the curved crystal spectrometer at the DR 3 reactor at Risø. A level scheme was constructed from the energies (30 keV - 1 MeV) and the intensities of the detected lines. The states obtained are: the groundstate rotational band with the levels at 73.392 $(0,2^+)$, 242.230 $(0,4^+)$, and 501.32 keV $(0,6^+)$, the Gamma vibrational levels 761.80 $(2,2^+)$, 828.19 $(2,3^+)$, 915.98 $(2,4^+)$, and 1024.63 keV $(2,5^+)$ and a band with $K = 2^-$ having the energies 976.88 $(2,2^-)$, 1039.30 $(2,3^-)$, 1122.76 $(2,4^-)$ and 1225.15 keV $(2,5^-)$. The precisely determined energies are compared with the collective model. The intensities of the transitions agree with the branching ratios expected from this model.

8. Level Scheme of Dy^{165} x).

O. W. B. Schult, U. Gruber, B. P. Maier, Labor f. Techn. Physik, T. H. München and Research Establishment Risø, Denmark.

220 neutron capture Gamma rays of Dy^{165} were measured with the Risø curved crystal spectrometer. The intense transitions permitted the construction of a level scheme for this odd N nucleus. The rotational bands $K = 7/2^+[633]$, $K = 1/2^-[521]$ and $K = 5/2^-[512]$ were precisely localized, including the spin 11/2 states. Gammavibrational bands built on these Nilsson orbits were observed with their band heads at 538.6, 573.5 and 570.2 keV. The I = 5/2 term at 533 keV can be considered as the $5/2^-$ [523] Nilsson state. The branching ratios allowed for the determination of $(g_K - g_R)^2$- factors for the [633], [521] and [512] bands and yielded El-hindrance factors.

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x) To be published in Zeitschrift für Physik.

9. Neutron Capture Gamma Rays from Re^{185} and Re^{187}.

U. Gruber, R.H. Koch, B.P. Maier, O.W.B. Schult, Labor f. Techn. Physik, T.H. München and Research Establishment Risø, Denmark.

After the measurement of neutron capture gamma rays from an enriched Re^{185} source, where we observed about 140 gamma transitions we investigated the spectrum of an enriched Re^{187} sample and found some 120 lines. By these two experiments we could clearly attribute the lines to the isotopes. After the neutron irradiation we measured the intensities of the 1o5 keV, 92 keV and 63 keV transitions. They can be attributed to levels below the isomeric state. Takahashi et al.[x] found the isomeric level at 171.5 keV in accordance with our measurements.

10. Neutron Capture Gamma Rays from Tm^{170}, Tb^{160}, Hg^{200}, Sm^{150} and Pr^{142}.

B.P. Maier, O.W.B. Schult, R.H. Koch, U. Gruber, Labor f. Techn. Physik, T.H. München and Research Establishment Risø, Denmark.

About 130 lines were found in the low energy part of the Tm^{169} $(n\ \gamma)Tm^{170}$ spectrum. Roughly 200 transitions were observed during the irradiation of Tb^{159}. The spectrum of Hg^{200} revealed 103 gamma lines. Some of these transitions fit into Groshev's level scheme. The irradiation of Sm^{149} yields a spectrum of some 200 low energy lines, in Pr^{142} we observed 30 transitions.

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x) K. Takahashi, M. McKeown, G. Scharf-Goldhaber Bull. Amer. Phy. Soc. vol. 8 No. 8 (1963)

3. Low Energy Neutron Capture Gamma Rays from Rh^{104}.

U. Gruber, O. W. B. Schult, B. P. Maier and R. Koch, Labor f. Techn. Physik, T. H. München and Research Establishment Risø, Denmark.

After the first rough scanning of the neutron-capture-gamma spectrum of Rh^{104} this measurement was repeated. The Rh source was much larger, the resolution and the accuracy were improved. Approximately 240 lines were measured. The higher accuracy reduced the probability for accidental Ritz-combinations. The earlier proposed levels[x)] at 52.42, 97.11, 128.9, 180.85, 186.04, 197.91, 213.06, 220.81, 224.44, 266.79, 269.30, 358.66, 420.8 keV could be confirmed.

4. Level Scheme of U^{239}.

B. P. Maier, O. W. B. Schult, U. Gruber, Labor f. Techn. Physik, T. H. München and Research Establishment Risø, Denmark.

It is likely that the 133-keV line of the neutron capture gamma spectrum of U^{239} is an E2-transition from the $[631]\,1/2^+$ state to the $[622]\,5/2^+$ ground state. The high intensity of this transition is explained by the $I = 1/2^+$ of the compound state. From the intensity of the 133 keV line it could be concluded that the 74 keV transition emitted in the decay of U^{239} to Np^{239} is not a 100% transition. Our presumption was checked by measurements of Blinowska et al.[xx)], who found a new β-branch to the ground state of Np^{239} and a 43 keV - 31 keV γ-cascade from the 74 keV level in Np^{239}.

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x) U. Gruber, Zeitschrift für Physik 178, 472 (1964)

xx) Submitted for Nuclear Physics by K. J. Blinowska, P. G. Hansen, H. L. Nielsen, O. W. B. Schult and K. Wien.

III SOLID STATE INVESTIGATIONS WITH NEUTRONS

1. Critical Magnetic Scattering of Neutrons in Iron for Temperatures above the Curie-point

L. Passell[x)], K. Blinowski[xx)], P. Nielsen and T. Brun

Critical Magnetic scattering of neutrons on iron has been studied in order to determine the spin-correlation-ranges and relaxation-time constants. The results have been published in Journ. of Appl. Physics, March 1964. A detailed report is in preparation about the experiment.

2. Magnetic Scattering of Neutrons in Chromium

H. Bjerrum Møller, K. Blinowski, A. R. Mackintosh, T. Brun and P. Nielsen

The magnetic scattering of neutrons from chromium metal has been studied near the Neel temperature. From the angular and temperature dependence of the critical magnetic scattering, information about the period and polarization of the short-range magnetic fluctuations has been determined, together with the range of order, which decreases anomalously slowly with temperature in chromium. Studies of the magnetic Bragg reflections have revealed that, under some circumstances, the symetry of the magnetic order can be lower than cubic. This provides an explanation for recent results on the bulk magnetization of chromium.

This work has be published in Solid State Communications 2 109 (1964).

Further work on the detailed analysis of the experimental data is being carried out at the moment, and an experimental energy analysis of the critically scattered neutrons is planned for the near future.

This and a more detailed description of the whole experiment will be published later.

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x) Present Address: Brookhaven Nat. Lab., Upton, L.I., N.Y. (U.S.A.).

xx) Present Address: Laboratory II Institute for Nuclear Research Swierk k/otwocka, Poland.

3. Crystal Structure Investigation by a Neutron Diffraction Time-of-Flight Method

K. Mikke and B. Lebech

A study of the influence of strong electric fields on the crystal structure of ferroelectrics, such as $BaTiO_3$, will be started shortly.

The experimental arrangement at the DR 3 is shown in Fig. 1. The time-of-flight method for neutron diffraction structure investigation is based on the ordinary first order Bragg equation.

$$\lambda = 2 d \sin \theta$$

where

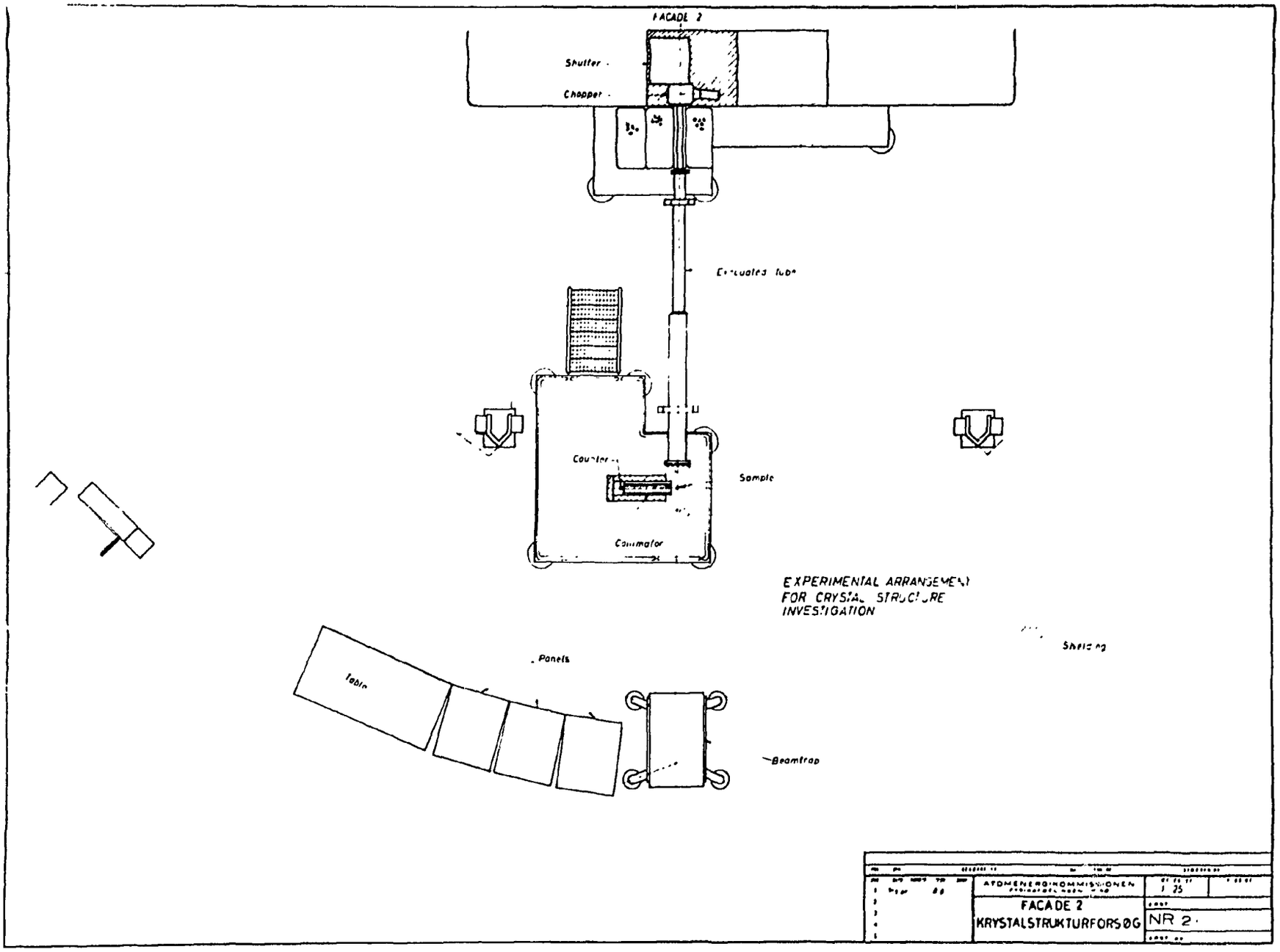
λ is the neutron wavelength,

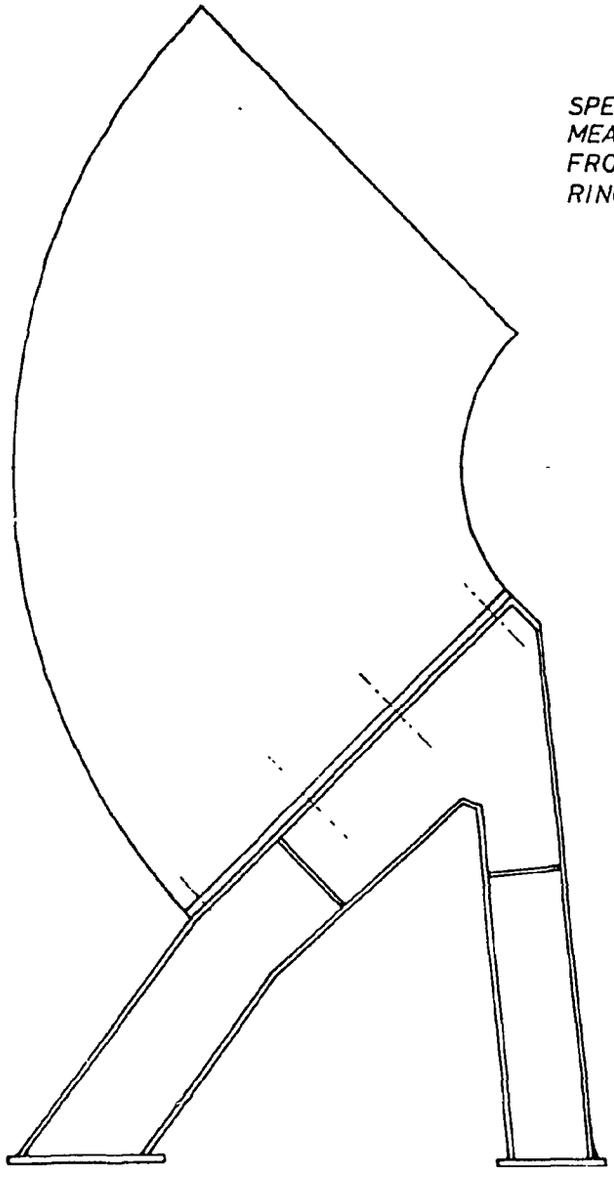
d is the interplanar spacing,

θ is the scattering angle.

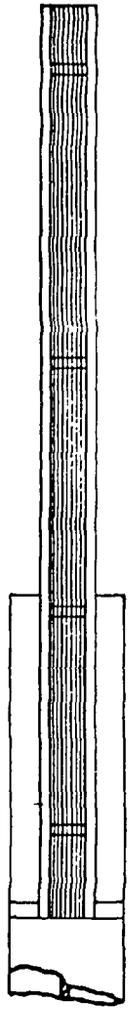
Buras and Leciejewicz have shown (phys. stat. sol. 4 349 (1964), that for neutrons it is possible to obtain a well resolved diffraction pattern by measuring the intensity of a diffracted beam as a function of λ at a fixed angle 2θ . The polychromatic neutron pulses are obtained by chopping the neutron beam from a nuclear reactor. The chopped beam is scattered on a powdered sample, and the time distribution of the neutron intensity is measured by a neutron counter connected to a multi-channel time analyser.

The method can reduce the exposure time appreciably, as the intensity from a whole Debye - Scherrer ring can be collected. We have chosen $2\theta = \frac{\pi}{2}$ and are using a special collimator (Fig. 2), which enables recording of the intensity from 1/4 of the Debye - Scherrer ring. The chopper and the collimator have been constructed at Institute for Nuclear Research, Swierk, Poland and are installed at the DR 3.


FACADE 2
Shutter
Chopper
Evacuated tube
Counter
Sample
Collimator
EXPERIMENTAL ARRANGEMENT
FOR CRYSTAL STRUCTURE
INVESTIGATION
Shielding
Panels
Cabin
Beamtrap
ATOMENERGIKOMMISSIONEN
FACADE 2
KRYSTALSTRUKTURFORSØG
NR 2.



SPECIAL COLLIMATOR FOR MEASURING THE INTENSITY FROM 1/4 DEBYE-SCHERRER RING



POS	STK	BENEVNELSE	MAT. EL. TEGN. NR	BEMÆRKNING
VOG	DATO	KONSTR.	TEGN.	GODK.
1				
2				
3				
4				
5				

ATOMENERGIKOMMISSIONEN
FYSIKAFDELINGEN · RISØ

KOLLIMATOR

MÅLESTOK 1:5

SLAG OG

ERST

NR. 3 -

ERST AF

The method is expected to provide the possibility of studies of some transient effects in crystals, e.g. the temporary structural changes produced by strong external electric field pulses in ferroelectrics or by external magnetic pulses in magnetic materials. It is proposed to start this kind of investigations in ferroelectric crystals by measuring the intensities and positions of some selected diffraction peaks with changing time interval between the applied external field pulse and the neutron pulse responsible for the formation of a given diffraction peak.

4. Temperature dependence of the Debye temperature for Al

O. B. Rasmussen, O. Dietrich and J. Als-Nielsen

Method

The intensity I of elastic, coherent-scattered neutrons from an extinction-free crystal is assumed to be proportional to the Debye-Waller factor e^{-2W} :

$$I \sim e^{-2W}$$

$$2W = \frac{3h^2}{m k_B d^2 \theta} \left(\frac{\phi(\theta/T)}{\theta/T} + 1/4 \right) \simeq \frac{3h^2}{m k_B d_o^2 (1+2\alpha(T-T_o))} (T/\theta^2 + 1/36T)$$

$$2W \simeq \frac{A_o}{\gamma(T)} (T/\theta^2 + 1/36T) \text{ with } A_o = \frac{3h^2}{m k_B d_o^2} = 313.7^o \text{ K and}$$

$$\gamma(T) = 1 + 2\alpha(T-T_o)$$

h, k_B	resp. the Planck and Bolzmann constants
m	mass of Al atom
T	absolute temperature
θ	Debye temperature
d_o	Distance between reflecting planes at T_o. For the reflection considered (2, 2, 4) $d_o = 0.826$ Å

α linear expansion coefficient.

Defining $y = 1/A_o \log_e I_T/I_o = T_o/\theta_o^2 + 1/36T_o - T/\gamma\theta^2 - 1/36\gamma T$

θ is expressed by

$$\theta = T\left\{T\gamma(T_o/\theta_o^2 + 1/36\,T_o - y) - 1/36\right\}^{-1/2} \qquad (1)$$

The temperature dependence of θ can thus be determined by knowing the value θ_o at a reference temperature and by measuring y - essentially the ratio between intensities at different crystal temperatures.

Experimental procedure

A single crystal of Al (2 1/2" diam., 4" high) was placed in the direct polyenergetic reactor beam and the intensity around the (2, 2, 4) Bragg reflection recorded as function of the missetting angle (angular scan of the spectrometer with fixed crystal). This was done at several temperatures of the crystal and correction (small) was made for the shift in wave length due to the thermal expansion of d_{224}.

Any segment of the Bragg peak should be proportional to e^{-2W}, if extinction is negligible, because the shape of the Bragg peak is independent of temperature, the shape being only determined by the collimators and mosaic structure, and the latter is assumed to be temperature-independent.

The area over a fixed angle was therefore chosen as I, assuming that all counts in the area are entirely due to Bragg scattered neutrons. The scattering angle was chosen as low as 18° to avoid extinction, and data taken at 6° and 14° also showed that extinction at these low angles was negligible. On the other hand, data taken around 120° showed a serious extinction effect, which in this geometry was difficult to correct for.

Results and conclusion

The measured values of $y = 1/A_o \log_e I_T/I_o$ are shown in Fig. 1. They are compared to the results obtained by Chipmann[1] using x-ray technique. Chipmann uses a monochromatic incoming x-ray beam on a powder sample and another procedure for the background subtraction. This may possibly be the explanation of the slight systematic difference between the results.

The Debye temperature Θ can now be deduced from Fig. 1. and (1), if Θ_o is known. The result can then be compared to the theoretical estimate[2]

$$\frac{d}{dT} \log_e \Theta = 1/2 \frac{d}{dT} \log_e c_{44} + \alpha/2$$

using Sutton's[3] data for the elastic constant $C_{44}(T)$ and the linear thermal expansion coefficient α.

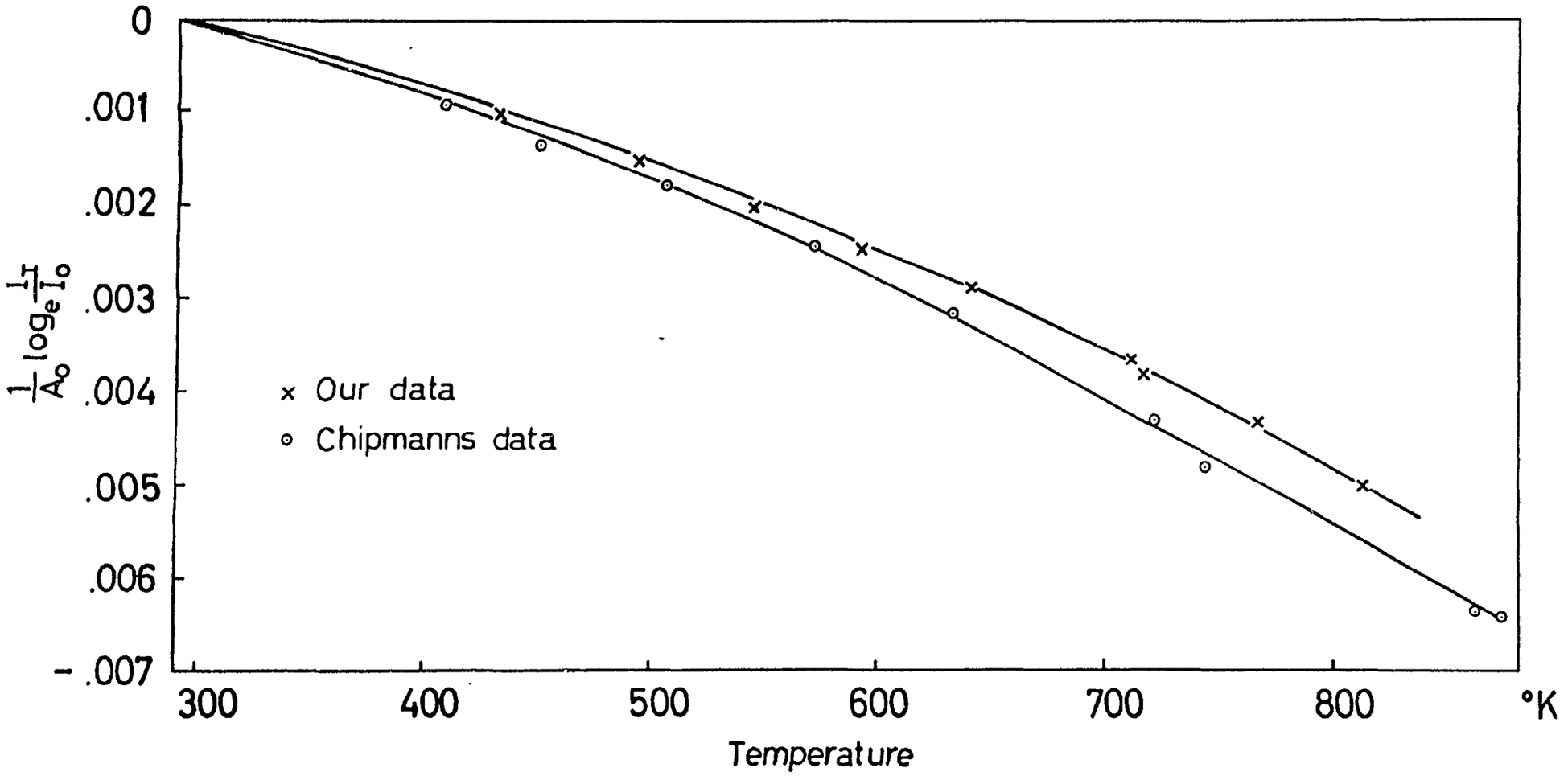
Unfortunately $\Theta(T)$ is very sensitive to the choice of Θ_o, and a statement concerning the accuracy of (2) is therefore impossible until an independent measurement of Θ_o has been made within $\pm 5^oK$. Fig. 2 shows the comparison with (2) for two different choices of Θ_o (385^oK and 395^oK), the first yielding fine agreement between (2) and Chipmann's data, the latter between (2) and our data.

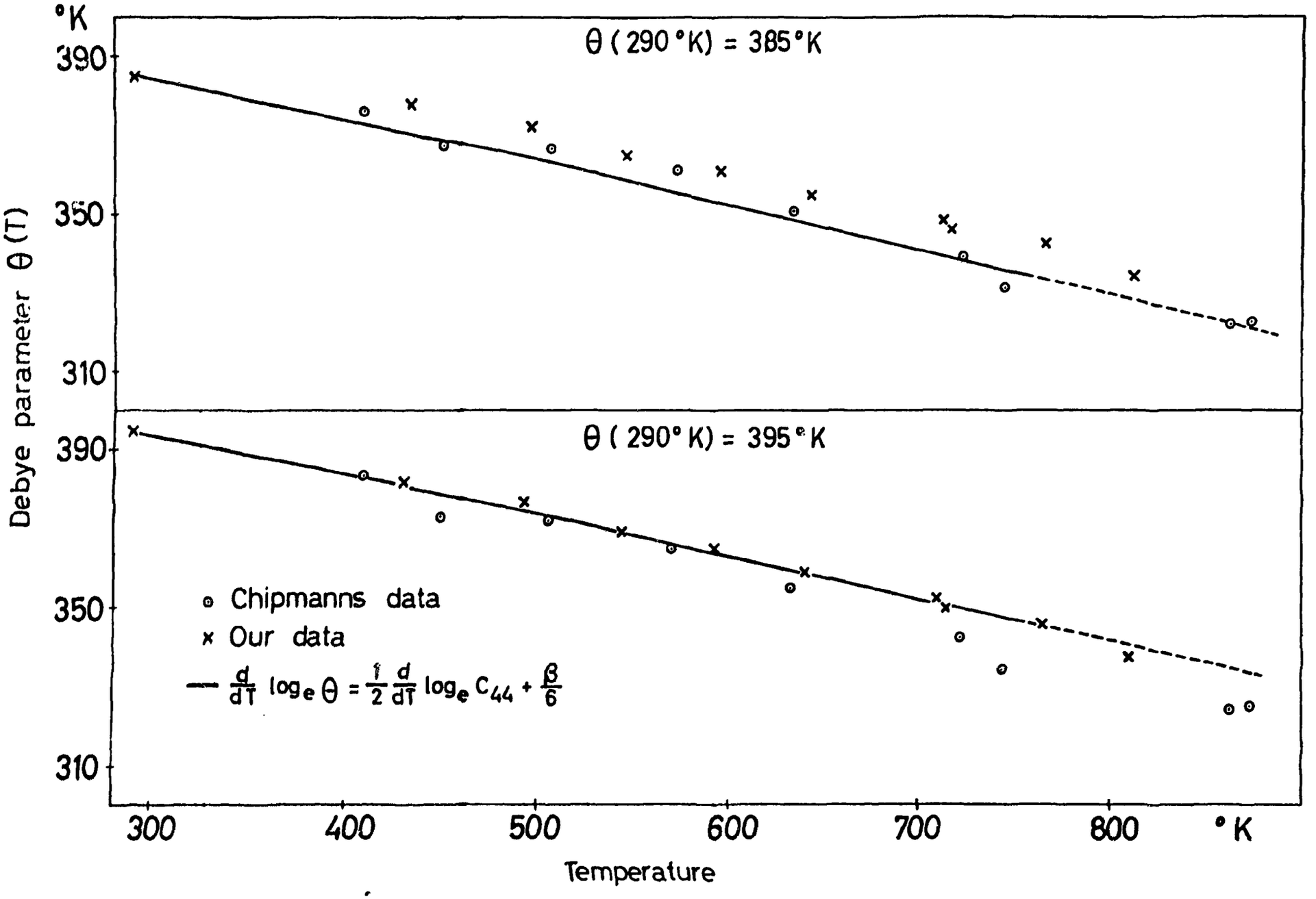
List of references

1) Journ. of Appl. Phys. Vol. 31, No. 11, 2012-2015, 1960.

2) Proceedings of the Symposium on Inelastic Scattering of Neutrons in Solids and Liquids, IAEA, Oct. 1960, page 75-85.

3) Phys. Rev. 91 No. 4, 816-821, 1953.


0
.001
.002
.003
.004
.005
.006
- .007
$\frac{1}{A_0}\log_e\frac{I_T}{I_0}$
× Our data
○ Chipmanns data
300
400
500
600
700
800
°K
Temperature


°K
390
350
310
θ (290 °K) = 385 °K
390
350
310
θ (290° K) = 395 °K
Chipmanns data
Our data
$\frac{d}{dT} \log_e \theta = \frac{1}{2} \frac{d}{dT} \log_e C_{44} + \frac{\beta}{6}$
Debye parameter θ (T)
300
400
500
600
700
800
°K
Temperature

5. The Effect of Experimental Resolution on Crystal Reflectivity and Secondary Extinction in Neutron Diffraction[x)]

O. W. Dietrich and J. Als-Nielsen

A detailed calculation of the reflectivity for neutrons of a plane slab crystal in the transmission case has been carried out. The calculations take account of the experimental resolution from two Soller collimators placed in front of and behind the crystal. The secondary extinction in the crystal depends, as expected, on the collimation. Curves are given for this dependence.

Some inconsistencies in previously published works[xx)] on this subject have been pointed out.

6. Higher Order Contamination in Crystal Monochromatization of Neutrons[xxx)]

O. W. Dietrich and I. Als-Nielsen

The problem of calculation and measurement of the higher order contamination in crystal monochromatization of neutrons has been investigated. Calculations were carried out in a semiempirical manner using the reflectivity calculation reported above and measurement of the spectral distribution of the reflected neutrons. Direct measurements were made using a multi-foil technique. It was concluded that the calculational method gives the best results for small contamination, whereas direct measurements are preferable for larger contamination.

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x) A detailed account of this work is given in Risø Report No. 72 (1963) and will appear in Acta Crystallographica at a later date.

xx) Bacon, G.E. and Lowde, R.D. (1948). Acta Cryst. 1, 303. Holm, M.W. (1955): The Reflectivity of NaCe and Be Crystals for Slow Neutrons, IDO-16115, 1. Rev.

xxx) A detailed account of this work is given in Risø Report No. 73 (1964).

IV THE NEUTRON HALF LIFE

A. Bahnsen[x], W.K. Brown, C.J. Christensen, A. Nielsen, B.M. Rustad[xx])

An overall description of the experiment was given in the last progress report. Our progress since then is here divided into three categories:

1. Decay counter. Efficiency
2. Background
3. Neutron density measurement

1. In order to improve the resolution of the counter and also the signal to background a new counter system has been made and is still under construction. In this system a sort of gross fiber optics is used for the light guides [1]. The light is taken from the 0.3x10 cm side of the

1) Paul Gorenstein and David Luckey, Rev. Sci. Instr. 34, 196 (1963)

5x10x0,3 cm plastic scintillators by means of a lucite plate of cross sectional area 0,3x10 cm. This plate is cut into strips of 0,3x2,5 cm area each. These strips are bent and twisted so that the 8 strips from the two scintillators can be joined to an almost square area 2,3x2,5 cm which fits one 2" photomultiplier well. In this way background is cut down a bit because the total light guide area near the phototube is six times smaller than in the old system and we need only one photo tube instead of four thus decreasing the noise.

This technique seems promising and we hope by improving the craftsmanship to improve the resolution quite a bit. Furthermore, the response of the old system depended very much on where the scintillator was hit. This is also avoided in the new construction.

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The obtained spectrum is still not quite satisfactory, but improving.

2. The capture γ's from our beam is now the main source of error, of the order of 10%. Therefore we are working on improving the collimator system.

3. There has been trouble with the accuracy of filling the He^3-counter with the low He^3-content and also with the homogeneity of the counter over the big beam area. An improved version of the counter is under construction with the solution of these problems in mind.

V. NEUTRON DOSIMETRY

Cadmium Corrections for Manganese, Cobalt, Indium and Gold

J. Olsen and B. Fastrup (The Institute of Physics, University of Aarhus).

A report with the above title has been presented at the EAES symposium on Fast and Epithermal Neutron Spectra in Reactors (Harwell 11th to 13th December, 1963).

Reference:

AERE - R 4500, Proceedings of the Symposium.

VI NEUTRON CROSS SECTIONS

P. Skjerk Christensen

A number of measurements of pure elements have been performed with the Pile Oscillator installed in the center of DR 1.

The results are in agreement with the cross-sections found in current literature within the accuracy attained.