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ABSTRACT

A brief description is given of the activities involved in preparing evaluated photonuclear data for 27 important elements. The "BOFOD" photonuclear reaction data library uses the ENDF-6 format. It includes (γ,n), (γ,2n), (γ,fiss), (γ,abs) and (γ,tot) cross-sections up to 20 MeV. A group-constant system is created on the basis of the BOFOD library. The role of photoneutron processes in accumulation of the ^{232}U isotope is shown by way of an example.

INTRODUCTION

Analysis of the neutron-physics characteristics and of techno-economic feasibility of nuclear power reactors requires a reliable nuclear database. Besides constants for the neutron-nucleus interaction processes, it is necessary to have a system of group constants reflecting the photon-nucleus interaction processes. Processes of the (γ,Xn) and (γ,fiss) type can, in certain energy ranges, lead to appreciable deviations from the initial fission neutron spectrum. It is, therefore, important to take processes of this type into account in the physical calculation of reactors. Firstly, we need constants for the photon-nucleus interaction for the following materials and actinides:

(a) Steel and its components: Fe, Cr, Ni, Mn, Co, F;

(b) Emergency shielding materials and their additives: Zr, Mo, Sn, Gd, W, Pb, Bi;

(c) Coolant: Na, Pb, Bi;

(d) Light elements: H, D, Li, Be, O;

(e) Fuel materials and associated actinides: ^{232}Th, ^{231}Pa, ^{232}Pa, ^{233}Pa, ^{232}U, ^{233}U, ^{234}U, ^{235}U, ^{238}U, ^{237}Np, ^{241}Am, ^{243}Am.

For materials (a)-(d) above we need to investigate processes of the (γ,n) and (γ,2n) type, and for materials (e) we should also include (γ,fiss) processes in the photon energy region up to 20 MeV. The present work describes the BOFOD-90 evaluated photonuclear reaction library created at the Nuclear Data Centre on the basis of which the group constants for photoneutron processes have been prepared. Treatment of the problem of ^{232}U accumulation, as a result of photoneutron reactions, in irradiated thorium for the uranium-thorium cycle has been used as an example to demonstrate the importance of taking photoneutron processes into account.

PREPARATION OF THE BOFOD-90 EVALUATED PHOTONEUTRON DATA LIBRARY

An analysis was made at the Nuclear Data Centre of the Institute of Physics and Power Engineering (FEhI) of the status of work to meet the need for photonuclear data. Under the quadripartite nuclear data exchange arrangement between the Nuclear Data Centres of Russia, USA, France and the IAEA purely experimental photonuclear data are currently being collected and compiled, mainly by the Centre for Photonuclear Data and Experiments at the Scientific Research Institute for Nuclear Physics of the Moscow State University. There are, at present, no freely accessible libraries for evaluated photonuclear data which could be used as the basis for obtaining sets of group constants. Therefore, for the next stage of work on the preparation of evaluated photonuclear data files the following activities were carried out by the FEhI Nuclear Data Centre:

1. A review was made of the status of published experimental work on the (γ,Xn) and (γ,fiss) processes on the basis of the CINDA system [1];
2. The Nuclear Data Centre requested and received the EXFOR library [2] of experimental photonuclear data from the Scientific Research Institute for Nuclear Physics, Moscow State University;
3. Compilations of experimental work in Ref. [3] were analysed;
4. Numerical data sets were compiled from various experimental investigations with the aim of further analysis during the preparation of evaluated data;
5. A program was developed to describe (γ,n), (γ,2n) and (γ,fiss) type processes on the basis of a generalized statistical model.

The preparatory work carried out at the FEhI Nuclear Data Centre to analyse the status of photonuclear investigations formed the basis for the evaluated photonuclear data files. The preliminary results of this work were published in Ref. [4].

The first version of the BOFOD evaluated photonuclear data library was prepared in 1989-90 and contained the following 27 elements: ^{9}Be, ^{23}Na, ^{55}Mn, ^{52}Cr, ^{nat}Ni, ^{nat}Zr, ^{92}Mo, ^{94}Mo, ^{96}Mo, ^{98}Mo, ^{100}Mo, ^{182}W, ^{184}W, ^{186}W, ^{nat}Pb, ^{209}Bi, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{241}Pu, ^{241}Am, ^{243}Am. The BOFOD library contains (γ,n), (γ,2n), (γ,fiss) and (γ,tot) type processes in the photon energy region up to 20 MeV.

Table 1 lists accessible experimental information on measurements of the various photonuclear processes which were used as the basis for theoretical analysis and for the preparation of evaluated data files. It contains the following information:

Yr: Year of publication of experimental studies;

Lab: Code of institute at which measurements were carried out. The institute codes correspond to those in the CINDA system [1];

Author: Surname of first author of publication;

Reference: Publication source;

Process: Process code;

Entry/Sub: Numerical code of experimental work in the EXFOR library.

Tables 2 and 3 give the threshold energies for (γ,n) and (γ,2n) reactions, taken from the systematics contained in Ref. [5]. The photofission threshold values in Table 3 were determined in accordance with Ref. [6]. The data are presented in the ENDF/B-5 format [7], which is used widely for evaluated neutron data. We intend subsequently to convert the data into the new ENDF-6 format [8]. As in the case of the neutron data, we used the following scheme to present the photonuclear data:

MF = 1: General purpose file;

MF = 3: File for excitation functions of the various photonuclear processes presented with the help of MT identifiers;

MF = 4, 5: Data files for angular and energy distributions of photoneutrons. The following MT numbers are used to code the photon-nucleus interaction processes:

MT = 516: (γ,2n)

MT = 518: (γ,fiss)

MT = 532: (γ,n)

MT = 533: $(\gamma,tot) = (\gamma,n) + (\gamma,2n) + (\gamma,fiss)$

Table 4 gives the contents of the BOFOD-90 library. The following notations are used:

CS: Integral cross-sections (MF = 3);

DA: Angular distribution of photoneutrons (MF = 4);

DE: Energy distribution of photoneutrons (MF = 5);

NUP: Energy dependence of the number of photofission prompt neutrons (MF = 1).

Table 5 presents, by way of an example, the evaluated data file for the element ^{209}Bi. Figures 1-49 show the energy dependence of photoneutron reaction cross-sections from the BOFOD-90 library as compared with experiment. In the present paper it was not our purpose to make a detailed study of the reasons for discrepancy between the different measurements and evaluated data; this is a separate work, which will entail a full description of the evaluation procedure and experiment analysis. We simply note that there are a number of uncertainties in the experimental data presented in the library which do not always result in incorrect determination of the (γ,n) and $(\gamma,1n)$, and other, processes. There are also a number of instances where neutron emission type processes are presented as purely (γ,n) processes, as can be seen in the case of ^{98}Mo and ^{100}Mo, and so on. On the whole, Figs 1-49 present the latest status with regard to the photoneutron processes for the elements under consideration.

PREPARATION OF GROUP CROSS-SECTIONS FOR PHOTONUCLEAR PROCESSES

The various integral characteristics of photoneutron reactions and the group constants were calculated using the <RECENT> code package [9]. The following group boundaries were selected for the group constants: each 1 MeV interval was divided into four 250 keV groups. This was perfectly satisfactory for taking account of the photoneutron processes, as will be shown below. Tables 6 and 7 present the following data:

<CS>:	Single-group cross-section weighted for constant function;
<CS/E>:	Single-group cross-section weighted for 1/E spectrum;
CS-max:	Maximum value of the cross-section in the interval up to 20 MeV;
E_γ-max:	Photon energy value for CS-max.

The integral data in Tables 6-7 give the orders of magnitude of photoneutron reactions as compared with neutron data. Tables 8-21 give group-averaged cross-sections for the elements in the BOFOD-90 Library, which can be used to make allowance for photonuclear data in reactor neutron-physics calculations.

ACCURACY OF THE CALCULATED EVALUATION OF URANIUM-232 ACCUMULATION IN IRRADIATED THORIUM ON ACCOUNT OF PHOTONEUTRON REACTIONS

A promising method of obtaining uranium-233 with a low uranium-232 content is to produce uranium-233 in the thorium blanket of a fast reactor. The first practical step in this direction is irradiation of thorium bundles in the BN-350 reactor blanket. Irradiation of thorium samples in capillary ampoules placed in the BN-350 uranium blanket at various distances from the core boundary has now been completed. We shall soon have data on the isotopic composition of the uranium produced in these samples and thus be able to verify the calculated data. Before doing so, however, we should make sure that the approximations used in the calculations do not introduce substantial errors into the results.

Uranium-232 undergoes transmutation in irradiated material either through (n,2n) and (n,γ) reactions

$$^{232}Th\ (n,2n)\ ^{231}Th \xrightarrow[\beta^-]{1.06\ d} {}^{231}Pa\ (n,\gamma)\ ^{232}Pa \xrightarrow[\beta^-]{1.31d} {}^{232}U$$

$$^{232}Th\ (n,\gamma)\ ^{233}Th \xrightarrow[\beta^-]{22.3\,min} {}^{233}Pa \begin{cases} (n,2n)\ ^{232}Pa \xrightarrow[\beta^-]{1.31d} {}^{232}U \\ \xrightarrow[\beta^-]{27.0\ d} {}^{233}U(n,2n)^{232}U \end{cases}$$

or through photonuclear reactions, which give the same results as the (n,2n) reactions shown in the above schemes. In fast reactor calculations the ABBN 26- or 28-group structure is generally used to describe the dependences on neutron energy and the ABBN 15-group structure to describe the dependences on photon energy. The actual neutron spectrum in the reactor and, in particular, in the blanket at energies above the (n,2n) reaction threshold is close to the well-known fission spectrum over which the cross-sections in the ABBN group system are averaged [10]. There are therefore no major doubts about the methodological correctness of calculating (n,2n) reaction rates in the approximation used. Should doubts arise, they can be resolved by performing calculations in a 300-group structure. This option is available, for example, in the SOKRATOR system. As regards (γ,n), there are grounds for doubt about the correctness of the 15-group calculation methodology. It was to find out how far these doubts are valid that the present work was undertaken.

First of all, we note that the role of photoneutron reactions in uranium-232 formation increases as the distance from the core boundary into the blanket increases - from ~ 5% in the inner row of the blanket fuel assembly to ~ 20% in the outer (fourth) row. Thus, the photoneutron channel for uranium-232 formation is very important during irradiation in the blanket. Hence the need to resolve doubts about the correctness of its calculated evaluation.

What gives rise to these doubts? First of all, it is the rough photon energy group structure. Almost all the photoneutron reactions in the blanket occur within a single photon group covering the region from 7 to 9 MeV. Within this range the photoneutron reaction cross-sections change strongly, and there is doubt that they can be correctly described by a single group-averaged characteristic. Moreover, the spectrum of photons generated during neutron radiative capture in steel (these are the photons which are capable of photonuclear reactions with heavy isotopes) is a line spectrum; if we assume that all these photons have the same group-averaged energy (as we are assuming now), this can lead to appreciable errors in the reaction rate.

A further source of doubt is that the majority of contemporary data sources for the capture photon spectrum do not make allowance for the dependence of the spectrum of these photons on the captured neutron energy.

It is these doubts that we tried to resolve.

In the present work we did not calculate the distribution of photons in the medium. Since we are only concerned with evaluating the accuracy of the different approximations, we assumed that the flux of photons with a given energy was proportional to the source of these photons.

INFLUENCE OF PHOTON ENERGY GROUP STRUCTURE

In order to find the scale of error caused by the rough 15-group structure, we adopted a more detailed energy structure: the 6.5-10 MeV region was divided into 14 groups, each with a width of 0.25 MeV. For this group structure we calculated the (γ,n) reaction cross-sections and the spectra of neutron radiative capture in iron, nickel, chromium and molybdenum. We note that during neutron capture in sodium and in fuel materials, no photons capable of photoneutron reactions are formed. In stainless steel, the captures in Fe, Ni, Cr and Mo in the BN-350 blanket are 50%, 20%, 20% and 10%, respectively. The spectrum of photons formed during neutron capture in molybdenum, however, is soft and only iron, nickel and chromium can provide photons capable of the (γ,n) reaction. Figure 50a shows the spectrum of radiative capture photons in steel and the contributions of iron, nickel and chromium to it. Figure 50b gives the energy behaviour of the (γ,n) reaction cross-section. Figure 50c shows the energy dependence of the (γ,n) reaction. It is clear that the decisive contribution to this reaction is made by photons with an energy of 7-9 MeV, i.e. those lying in the ABBN second photon group. It is also evident that while 8.5-9 MeV photons formed during neutron capture in nickel and chromium numerically constitute about one-third of all photons capable of reaction, half of them contribute to the reaction because of the high capture cross-section. The role of the hardest radiative capture photons with an energy of 9.5 MeV becomes still stronger. At the same time the role of the main photon line of iron at 7.7 MeV in the reaction rate drops because of the comparatively low cross-section of the (γ,n) reaction. On average, in the 7-9 MeV group we find that the errors of the 15-group approximation are compensated for (solid and dotted lines in the middle which indicate the group-averaged reaction rate in the second group calculated using the detailed and the rough energy structure). There is of course no such compensation in the first and third groups but the role of these groups is not large. Thus, we come to the conclusion that although the 15-group structure is unjustifiably rough for calculation of the (γ,n) reaction rates for the fast reactor blanket of interest to us, where the structural material is steel Cr18Ni10, the errors of the 15-group structure are compensated for and as a result the error does not exceed 10-15%.

INFLUENCE OF THE DEPENDENCE OF PHOTON SPECTRUM ON ABSORBED NEUTRON ENERGY

In most evaluated nuclear data libraries the capture photon spectra are considered to be independent of the absorbed neutron energy and agree with the well-known spectra which are formed during thermal neutron capture. That the photon spectrum depends on the absorbed neutron energy does not, however, give rise to doubts. The reasons for this dependence are as follows:

1. As the neutron energy increases ever higher levels of the compound nucleus are excited, and this offers greater possibilities for radiative transitions in comparison with the lower-lying levels. However, since the probability of radiative transition is proportional to the cube of transition energy, the above difference in possibilities should have appeared only at energies comparable with the neutron binding energy, i.e. at energies of the order of MeV, at which radiative capture has a low probability;
2. As the energy increases the resonances excited by p- and d-neutrons makes an ever-greater contribution to capture. Spins and parities of the corresponding states of the compound nucleus differ from those for s-resonances, which determine thermal neutron capture in particular, and therefore the decay schemes of these states should also differ. Available experimental data confirm this difference although for the nuclei of structural materials such data are too meager for accurate evaluation;
3. As the neutron energy changes so does the ratio of the contributions to capture of the various isotopes of the natural mixture. This factor cannot but affect

the total photon spectrum since the photon spectra of thermal neutron capture for different isotopes vary considerably, particularly in the hard part.

In order to take into account the dependence of the photon spectrum on absorbed photon energy, we used data from the handbook [11], which contains results based on experimental data.

Figure 51 shows how the yield of photons with energies in the ranges of 7.5-8 MeV and 9.0-9.5 MeV depends on the absorbed neutron energy. The very strong dependence seen on this figure results from the third of the causes mentioned above in the 12th ABBN group the main contribution to capture in iron is made by ^{54}Fe and ^{57}Fe). We calculated the changes that occur in the (γ,n) reaction rate in the BN-350 blanket when we go over from the photon spectrum of thermal capture to the photon spectrum averaged over all absorbed neutron energies. The influence was found to be insignificant: in the first row of the blanket the (γ,n) reaction rate with allowance for hardening of the photon spectrum increased by only 5%. In deeper layers of the blanket the difference was even smaller.

Thus, in resolving the specific problem considered we found that all doubts about the correctness of the broad group calculation method used were basically groundless. However, we cannot of course rule out the effect of variation in the photon spectrum with changes in absorbed neutron energy on calculation results in other situations. Therefore, it is of topical interest to make a correct evaluation of data on photon formation in neutron reactions and to evaluate the photoneutron reactions for a broad range of reactor materials.

CONCLUSION

In this paper we have given the basic results for preparation of the BOFOD-90 evaluated photonuclear data library, prepared a system of group constants, generated an atlas of photoneutron reactions and demonstrated the role of photonuclear processes in neutron-physics calculations for the uranium-thorium cycle. The results obtained can be used as the basis for generating a system of group constants for photonuclear data.

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[10] ABAGYAN, L.P., et al., Group Constants for Reactor and Shielding Calculations, Ehnergoizdat, Moscow (1981) (in Russian).

[11] MASHKOVICH, V.P., Ionizing Radiation Shielding Handbook, Ehnergoatomizdat, Moscow (1982) (in Russian).

Table 1

List of experimental work on the nuclei considered

Yr Lab Author	Reference	Process	Entry/Sub
11-NA-23			
71 LRL ALVAREZ R.A.+	J,PR/C,4,1673,7111	(G,N)	C7022003
71LRLALVAREZR.A.+	J,PR/C,4,1673,7111	(G,2N)	C7022004
24-CR-52			
69 MOS GORYACHEV B.I.+	J,IZV,33,(10),1736,69	(G,N)	M0093003
25-MN-55			
73 LRL ALVAREZ R.A.+	C,73PACIFI,1,545,7303	(G,N)	C7028003
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,N)	C7999010
73 LRL ALVAREZ R.A.+	C,73PACIFI,1,545,7303	(G,2N)	C7028004
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,2N)	C7999011
42-MO-92			
74 SAC BEIL H.+	J,NP/A,227,427,74	(G,N)	L0032002
74 SAC CARLOS P.+	J,NP/A,219,61,7402	(G,2N)	C7032004
42-MO-94			
74 SAC BEIL H.+	J,NP/A,227,427,74	(G,N)	L0032005
74 SAC CARLOS P.+	J,NP/A,219,61,7402	(G,2N)	C7032007
42-MO-96			
74 SAC CARLOS P.+	J,NP/A,219,61,7402	(G,N)	C7032009
74 SAC BEIL H.+	J,NP/A,227,427,74	(G,N)	L0032008
74 SAC CARLOS P.+	J,NP/A,219,61,7402	(G,2N)	C7032010
42-MO-98			
74 SAC BEIL H.+	J,NP/A,227,427,74	(G,N)	L0032012
74 SAC BEIL H.+	J,NP/A,227,427,74	(G,2N)	L0032014
42-MO-100			
74 SAC BEIL H.+	J,NP/A,227,427,74	(G,N)	L0032016
74 SAC BEIL H.+	J,NP/A,227,427,74	(G,2N)	L0032018
74-W-182			
78 SAR GORJACHEV A.M.+	J,IZK,6,8,78	(G,N)	M0025002
81 JIA GUREVICH G.M.	J,NP,257,81	(G,TOT)	M0073010
74-W-184			
78 SAR GORJACHEV A.M.+	J,IZK,6,8,78	(G,N)	M0025003
81 JIA GUREVICH G.M.	J,NP,257,81	(G,TOT)	M0073011
74-W-186			
78 SAR GORJACHEV A.M.+	J,IZK,6,8,78	(G,N)	M0025004
81 JIA GUREVICH G.M.	J,NP,257,81	(G,TOT)	M0073012
83-BI-209			
64 LRL HARVEY R.R.+	J,PR/B,136,126,6410	(G,N)	C7007012
84 SGU BELJAEV S.N.+	J,IZV,48,(10),1940,84	(G,N)	M0127004
85 SGU BELJAEV S.N.+	J,YF,42,1050,85	(G,N)	M0146006
64 LRL HARVEY R.R.+	J,PR/B,136,126,6410	(G,2N)	C7007013
76 JIA GUREVICH G.M.+	J,ZEP,23,411,76	(G,TOT)	M0056008
90-TH-232			
73 SAC VEYSSIERE A.+	J,NP/A,199,45,7301	(G,N)	C7031003
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,N)	C7999037
73 SAC VEYSSIERE A.+	J,NP/A,199,45,7301	(G,2N)	C7031004
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,2N)	C7999038
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,F)	C7999039
92-U-233			
78 IFP OSTAPENKO JU.B.+	P,YK-3(30),3,78	(G,F)	M0004005
92-U-234			
80 IFP LINDGREN L.J.+	J,YF,32,335,80	(G,F)	M0037003
92-U-235			
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,N)	C7999041
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,2N)	C7999042

Table 1 (continued)

Yr Lab Author	Reference	Process	Entry/Sub
78 IFP ZHUCHKO V.E.+	J,YF,28,1170,78	(G,F)	C7999042
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,F)	C7999043
76 JIA GUREVICH G.M.+	J,NP/A,275,326,76	(G,TOT)	M0090003
92-U-236			
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,N)	C7999045
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,2N)	C7999046
78 IFP ZHUCHKO V.E.+	J,YF,28,1185,78	(G,F)	M0079007
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,F)	C7999047
92-U-238			
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,N)	C7999049
73 SAC VEYSSIERE A.+	J,NP/A,199,45,7301	(G,2N)	C7031012
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,2N)	C7999050
79 LRL BERMAN B.L.	P,UCRL-78482,(SUPPL.),7906	(G,F)	C7999051
79 JIA KORECKAJA I.S.+	J,YF,30,910,79	(G,F)	M0017007
76 JIA GUREVICH G.M.+	J,NP/A,275,326,76	(G,TOT)	M0090004
93-NP-237			
73 SAC VEYSSIERE A.+	J,NP/A,199,45,7301	(G,N)	L0031006
83 IPE CESAR M.T.F.+	W,CESAR KHOURI,830524	(G,N)	G0002004
73 SAC VEYSSIERE A.+	J,NP/A,199,45,7301	(G,2N)	C7031008
73 SAC VEYSSIERE A.+	J,NP/A,199,45,7301	(G,F)	C7031009
78 IFP ZHUCHKO V.E.	J,YF,28,1170,78	(G,F)	M0078022
83 IPE CESAR M.T.F.+	W,CESAR KHOURI,830524	(G,F)	G0002003
94-PU-239			
78 IFP ZHUCHKO V.E.+	J,YF,28,1170,78	(G,F)	M0078024
76 JIA GUREVICH G.M.+	J,NP/A,275,326,76	(G,TOT)	M0090005
94-PU-241			
78 IFP ZHUCHKO V.E.+	J,YF,28,1170,78	(G,F)	M0078026
95-AM-241			
78 IFP OSTAPENKO JU.B.+	P,YK-3(30),3,78	(G,F)	M0004019
79 JIA KORETSKAYA I.S.+	J,YF,30,910,79	(G,F)	01135005
95-AM-243			
79 JIA KORETSKAYA I.S.+	J,YF,30,910,79	(G,F)	M0017006

Table 2

Threshold energies for (G,N) and (G,2N) reactions

Target nucleus	Abundance, %	(G,N) (MeV)	(G,2N) (MeV)
4-Be-9	100%	1.6651	20.5653
11-Na-23	100%	12.4178	23.489
24-Cr	-	7.9405	17.6607
24-Cr-50	4.345%	12.940	23.583
24-Cr-52	83.789%	12.0407	21.3026
24-Cr-53	9.501%	7.9405	19.9812
24-Cr-54	2.365%	9.7202	17.6607
25-Mn-55	100%	10.224	19.1670
26-Fe	-	7.6462	17.6891
26-Fe-54	5.8%	13.3820	24.062
26-Fe-56	91.72%	11.2027	20.5011
26-Fe-57	2.2%	7.6462	18.8489
26-Fe-58	0.28%	10.0430	17.6891
28-Ni	-	7.8195	16.5008
28-Ni-58	68.27%	12.203	22.470
28-Ni-60	26.10%	11.3883	20.3876
28-Ni-61	1.13%	7.8195	19.2078
28-Ni-62	3.59%	10.5966	18.4161
28-Ni-64	0.91%	9.6596	16.5008
40-Zr	-	7.2026	14.3065
40-Zr-90	51.45%	11.983	21.290
40-Zr-91	11.22%	7.2026	19.185
40-Zr-92	17.15%	8.6351	15.8377
40-Zr-94	17.38%	8.191	14.9495
40-Zr-96	2.80%	7.832	14.3065
42-Mo	-	6.8161	14.2175
42-Mo-92	14.84%	12.692	22.787
42-Mo-94	9.25%	9.6722	17.7449
42-Mo-95	15.92%	7.3751	17.047
42-Mo-96	16.68%	9.1542	16.5293
42-Mo-97	9.55%	6.8161	15.9703
42-Mo-98	24.13%	8.6424	15.4584
42-Mo-100	9.63%	8.301	14.2175
74-W	-	6.1914	12.9518
74-W-182	26.3%	8.054	14.700
74-W-183	14.3%	6.1914	14.246
74-W-184	30.67%	7.4111	13.6025
74-W-186	28.6%	7.2020	12.9518
82-Pb	-	6.7409	14.1091
82-Pb-204	1.4%	8.401	15.189
82-Pb-206	24.1%	8.081	14.8152
82-Pb-207	22.1%	6.7409	14.822
82-Pb-208	52.4%	7.3682	14.1091
83-Bi-209	100%	7.453	14.359

Table 3

Threshold energies for (G,N), (G,2N) and (G,F) reactions

Target nucleus	Abundance, %	(G,N) (MэВ)	(G,2N) (MeV)	(G,F) (MeV)
90-Th-232	100%	6.434	11.563	5.40
92-U-233	1.592E+5 Y	5.743	13.010	5.18
92-U-234	2.45E+5 Y	6.8408	12.583	5.06
92-U-235	0.7200%	5.306	12.1471	5.31
92-U-238	99.2745%	6.1436	11.2682	5.08
93-Np-237	2.14E+6 Y	6.619	12.3106	5.70
94-Pu-239	24119 Y	5.656	12.654	5.31
94-Pu-241	14.35 Y	5.2406	11.7740	5.34
95-Am-241	432.2 Y	6.660	12.598	6.00
95-Am-243	7380 Y	6.377	11.9053	6.03

Table 4

Content of evaluated photonuclear data files for elements included in BOFOD-90

Element	MAT	Content of data file
Be-9	409	CS: (g,n) DA: (g,n)
Na-23	1123	--------//--------
CR-52	2452	CS: (g,n) DA: (g,n)
Mn-55	2555	CS,DA,DE: (g,n),(g,2n)
Ni-nat	2800	CS,DA: (g,n)
Zr-nat	4000	--------//--------
Mo-92	4492	-------//-------
Mo-94	4494	CS:(g,n),(g,2n) DA:(g,n),(g,2n)
Mo-96	4496	-------//-------
Mo-98	4498	-------//-------
Mo-100	4410	-------//-------
W -182	7682	-------//-------
W -184	7684	-------//-------
W -186	7686	-------//-------
Pb-nat	8200	-------//-------
Bi-209	8309	CS: (g,n),(g,2n),(g,tot) DA:(g,n)
U -233	9233	NUP
U -234	9234	NUP
Th-232	9032	NUP
U -235	9235	CS: (g,fiss),NUP,DE: (g,fiss)
U -238	9238	----------//-------------
U -236	9236	CS:(g,n),(g,2n),(g,fiss),(g,tot) DA:(g,n),(g,2n),NUP
Np-237	9337	-------//-------------
Pu-239	9439	-------//-------------
Pu-241	9441	-------//-------------
Am-241	9541	CS:(g,fiss),NUP,DE: (g,fiss)
Am-243	9543	----------//----------

Table 5

Evaluated photonuclear data file for ^{209}Bi

```
8.32090+04 2.07185+02        -1          0          42          18309 1451
0.00000+00 0.00000+00         0          0          00          08309 1451
0.00000+00 0.00000+00         0          0          14          68309 1451
 83-BI-209  CJD       EVAL-OCT90 BLOKHIN A.I. ET AL.               8309 1451
J.,YK,1992,V.3       DIST-FEB92                                    8309 1451
----BOFOD-90          MATERIAL 8309                                8309 1451
-----PHOTO-NUCLEAR DATA                                            8309 1451
------CONTENT: NEUTRON TRANSPORT                                   8309 1451
-------ENDF/B-5 FORMAT                                             8309 1451
--------REFERENCE: J.,YK,1992,V.3 (IN RUSSIAN)                     8309 1451
MATERIAL CONVERTED TO ENDF/B-5 FORMAT BY CJD (30-10-90)            8309 1451
AUTHOR OF EVALUATION:BLOKHIN,BULEEVA
N.,NASYROVA S.,PAKHOMOVA O.                                        8309 1451
 *     *     *     *     *     *   *      *                        8309 1451
    MT=516 - (G,2N) REACTION                                       8309 1451
    MT=532 - (G,N) REACTION                                        8309 1451
    MT=533 - (G,TOT) REACTION                                      8309 1451
                                                                   8309 1451
                              1        451          21          08309 1451
                              3        516           8          08309 1451
                              3        532          12          08309 1451
                              3        533          13          08309 1451
                              4        516           2          08309 1451
                              4        532           2          08309 1451
                                                                   8309 1  0
                                                                   8309 0  0
8.32090+04 2.07185+02         0          0           0          08309 3516
0.00000+00-1.33200+07         0          0           1         158309 3516
        15          2                                              8309 3516
1.33200+07 0.00000+00 1.35000+07 1.00000-03 1.40000+07 2.00000-038309 3516
1.45000+07 1.00000-02 1.50000+07 5.00000-02 1.55000+07 7.70000-028309 3516
1.60000+07 1.00000-01 1.65000+07 1.02000-01 1.70000+07 9.80000-028309 3516
1.75000+07 9.20000-02 1.80000+07 8.20000-02 1.85000+07 7.50000-028309 3516
1.90000+07 7.00000-02 1.95000+07 6.50000-02 2.00000+07 6.00000-028309 3516
                                                                   8309 3  0
8.32090+04 2.07185+02         0          0           0          08309 3532
0.00000+00-7.45300+06         0          0           1         268309 3532
        26          2                                              8309 3532
7.45300+06 0.00000+00 8.00000+06 4.00000-02 8.50000+06 5.00000-028309 3532
9.00000+06 7.00000-02 9.50000+06 9.00000-02 1.00000+07 1.10000-018309 3532
1.05000+07 1.40000-01 1.10000+07 1.90000-01 1.15000+07 2.50000-018309 3532
1.20000+07 3.00000-01 1.25000+07 3.90000-01 1.30000+07 4.80000-018309 3532
1.35000+07 5.40000-01 1.40000+07 5.20000-01 1.45000+07 4.60000-018309 3532
1.50000+07 3.20000-01 1.55000+07 1.80000-01 1.60000+07 1.00000-018309 3532
```

Table 5 (continued)

1.65000+07	6.50000-02	1.70000+07	5.00000-02	1.75000+07	4.00000-028309 3532
1.80000+07	3.50000-02	1.85000+07	3.00000-02	1.90000+07	2.00000-028309 3532
					8309 3 0
8.32090+ 4	2.07185+ 2	0	0	0	08309 3533
0.0 + 0	-7.41720+ 6	0	0	1	288309 3533
28	2				8309 3533
7.45300+ 6	0.0 + 0	8.00000+ 6	4.00000- 2	8.50000+ 6	5.00000-28309 3533
9.00000+ 6	7.00000- 2	9.50000+ 6	9.00000- 2	1.00000+ 7	1.10000-18309 3533
1.05000+ 7	1.40000- 1	1.10000+ 7	1.90000- 1	1.15000+ 7	2.50000-18309 3533
1.20000+ 7	3.00000- 1	1.25000+ 7	3.90000- 1	1.30000+ 7	4.80000-18309 3533
1.33200+ 7	5.18400- 1	1.33200+ 7	5.18400- 1	1.35000+ 7	5.41000-18309 3533
1.40000+ 7	5.22000- 1	1.45000+ 7	4.70000- 1	1.50000+ 7	3.70000-18309 3533
1.55000+ 7	2.57000- 1	1.60000+ 7	2.00000- 1	1.65000+ 7	1.67000-18309 3533
1.70000+ 7	1.48000- 1	1.75000+ 7	1.32000- 1	1.80000+ 7	1.17000-18309 3533
1.85000+ 7	1.05000- 1	1.90000+ 7	9.00000- 2	1.95000+ 7	8.00000-28309 3533
2.00000+ 7	7.00000- 2				8309 3533
					8309 3 0
					8309 0 0
8.32090+04	2.07185+02	0	0	0	08309 4516
0.00000+00	2.07185+02	1	2	0	08309 4516
					8309 4 0
8.32090+04	2.07185+02	0	0	0	08309 4532
0.00000+00	2.07185+02	1	2	0	08309 4532
					8309 4 0
					8309 0 0
					0 0 0

Table 6

Integral characteristics of (G,N), (G,2N) and (G,Fiss) reactions

Target nucleus	(G,N) EG-max MeV	CS-max mB	<CS> mB	<CS/E> mB	(G,2N) EG-max MeV	CS-max mB	<CS> mB	<CS/E> mB	(G,Fiss) EG-max MeV	CS-max mB	<CS> mB	<CS/E> mB
Th-232	11.5	445.0	86.9	50.5	14.3	375.0	90.2	38.1	14.3	56.0	19.2	9.53
U-233	11.3	139.0	30.9	16.1	-	-	-	-	13.8	425.0	139.0	66.8
U-234	8.0	125.0	56.2	30.8	-	-	-	-	14.3	385.0	130.0	62.4
U-235	-	-	-	-	-	-	-	-	13.9	331.0	108.0	51.9
U-236	11.3	290.0	69.8	37.9	14.3	121.0	24.6	10.4	14.5	253.0	81.4	38.8
U-238	-	-	-	-	-	-	-	-	14.4	165.0	59.5	28.0
Np-237	12.3	204.0	60.5	31.2	6.8	42.0	12.1	12.1	4.5	282.0	104.0	49.5
Pu-239	17.5	5.78E-3	5.2E-2	2.6E-2	17.4	6.0E-3	1.1E-3	3.7E-4	-	-	-	-
Pu-241	10.3	0.2	4.6E-2	2.7E-2	-	-	-	-	-	-	-	-
Am-241	-	-	-	-	-	-	-	-	14.0	336.0	123.0	59.0
Am-243	-	-	-	-	-	-	-	13.8	350.0	119.0	59.6	

Table 7

Integral characteristics of (G,N) and (G,2N) reactions

Target nucleus	(G,N) EG-max MeV	CS-max mB	<CS> mB	<CS/E> mB	(G,2N) EG-max MeV	CS-max mB	<CS> mB	<CS/E> mB
Be-9	20.0	9.3	2.7	1.35	-	-	-	-
Na-23	20.0	9.6	2.0	0.74	-	-	-	-
Cr-52	18.3	106.0	20.8	7.6	-	-	-	-
Mn-55	19.0	67.5	18.1	6.95	-	-	-	-
Ni	16.6	46.0	11.0	4.24	-	-	-	-
Zr	14.6	161.0	43.4	18.0	17.5	27.5	4.66	1.65
Mo-92	16.5	160.0	35.9	13.5	-	-	-	-
Mo-94	16.0	187.0	48.3	19.5	20.0	48.0	3.5	1.16
Mo-96	16.0	192.0	48.2	20.0	20.0	67.5	8.0	2.72
Mo-98	15.5	189.0	44.6	19.5	18.8	83.0	14.1	4.91
Mo-100	14.5	152.0	36.7	16.7	17.5	102.0	22.9	8.29
W-182	13.5	416.0	108.0	50.5	-	-	-	-
W-184	12.8	411.0	100.0	48.0	-	-	-	-
W-186	12.8	417.0	96.2	46.7	15.5	253.0	53.5	21.0
b	13.5	608.0	151.0	75.7	20.0	133.0	28.1	10.1
Bi-209	13.5	540	118	58.1	16.5	102.0	22.5	8.3

Table 8

Group cross-sections for ^{9}Be, ^{23}Na, ^{52}Cr, ^{55}Mn and ^{00}Ni nuclei

NO.	GROUP-EV	BE-9(G,N) AVERAGE	CR-52(G,N) AVERAGE	MN-55(G,N) AVERAGE	NA-23(G,N) AVERAGE	NI-00(G,N) AVERAGE
3	1.5000+ 6	2.9922- 5	-	-		
4	1.7500+ 6	2.5762- 4	-	-		
5	2.0000+ 6	2.3750- 4	-	-		
6	2.2500+ 6	2.1250- 4	-	-		
7	2.5000+ 6	2.0500- 4	-	-		
8	2.7500+ 6	2.1500- 4	-	-		
9	3.0000+ 6	2.2750- 4	-	-		
10	3.2500+ 6	2.4250- 4	-	-		
11	3.5000+ 6	3.1250- 4	-	-		
12	3.7500+ 6	4.3750- 4	-	-		
13	4.0000+ 6	5.2500- 4	-	-		
14	4.2500+ 6	5.7500- 4	-	-		
15	4.5000+ 6	5.4833- 4	-	-		
16	4.7500+ 6	3.9167- 4	-	-		
17	5.0000+ 6	4.2833- 4	-	-		
18	5.2500+ 6	7.9167- 4	-	-		
19	5.5000+ 6	1.2500- 3	-	-		
20	5.7500+ 6	1.6700- 3	-	-		
21	6.0000+ 6	1.6640- 3	-	-		
22	7.2500+ 6	1.1000- 3	-	-		
23	7.5000+ 6	8.6667- 4	-	-		
24	7.7500+ 6	6.1333- 4	-	-		1.0871- 6
25	8.0000+ 6	5.9000- 4	-	-		5.1569- 6
26	8.2500+ 6	8.5000- 4	-	-		9.3978- 6
27	8.5000+ 6	1.1000- 3	-	-		1.3639- 5
28	8.7500+ 6	1.3000- 3	-	-		1.7880- 5
29	9.0000+ 6	1.7333- 3	-	-		8.0000- 5
30	9.2500+ 6	2.2667- 3	-	-		2.0000- 4
31	9.5000+ 6	2.3742- 3	-	-		3.2000- 4
32	9.7500+ 6	2.2958- 3	-	-		4.4000- 4
33	1.0000+ 7	2.2125- 3	-	1.6667- 6		6.2500- 4
34	1.0250+ 7	2.1375- 3	-	2.5333- 4		8.7500- 4
35	1.0500+ 7	2.1957- 3	-	1.7417- 3		1.1250- 3
36	1.0750+ 7	3.1523- 3	-	3.9583- 3		1.3750- 3
37	1.1000+ 7	3.5250- 3	-	5.2500- 3		1.8750- 3
38	1.1250+ 7	3.5750- 3	-	5.7500- 3		2.6250- 3
39	1.1500+ 7	3.6375- 3	-	6.5000- 3		3.6250- 3
40	1.1750+ 7	3.7125- 3	-	7.5000- 3		4.8750- 3
41	1.2000+ 7	3.5875- 3	5.3360- 4	8.5375- 3		5.8750- 3
42	1.2250+ 7	3.2625- 3	2.2500- 3	9.6125- 3	4.9800- 6	6.6250- 3
43	1.2500+ 7	2.8667- 3	4.0000- 3	1.1363- 2	7.9500- 5	7.5000- 3
44	1.2750+ 7	2.4533- 3	6.2500- 3	1.3788- 2	3.4250- 4	8.5000- 3
45	1.3000+ 7	2.4975- 3	8.7500- 3	1.5875- 2	6.2500- 4	9.6250- 3
46	1.3250+ 7	3.1625- 3	1.1000- 2	1.7625- 2	8.7500- 4	1.0875- 2
47	1.3500+ 7	3.2300- 3	1.3250- 2	1.9625- 2	1.1750- 3	1.2125- 2
48	1.3750+ 7	2.7700- 3	1.5250- 2	2.1875- 2	1.5250- 3	1.3375- 2
49	1.4000+ 7	2.6770- 3	1.7250- 2	2.4500- 2	1.8500- 3	1.5000- 2
50	1.4250+ 7	2.9070- 3	1.9750- 2	2.7500- 2	2.1500- 3	1.7000- 2
51	1.4500+ 7	2.7531- 3	2.2000- 2	3.1000- 2	2.4750- 3	1.9000- 2
52	1.4750+ 7	1.6469- 3	2.5000- 2	3.5000- 2	2.8250- 3	2.1000- 2
53	1.5000+ 7	9.4500- 4	2.8500- 2	3.9000- 2	3.2125- 3	2.3250- 2
54	1.5250+ 7	2.0362- 3	4.2100- 2	5.0800- 2	4.8475- 3	3.3250- 2
55	1.6500+ 7	5.6000- 3	6.0000- 2	6.0750- 2	6.9625- 3	4.5350- 2
56	1.6750+ 7	6.4000- 3	6.6250- 2	6.2250- 2	7.3875- 3	4.2850- 2
57	1.7000+ 7	6.8375- 3	7.3500- 2	6.1000- 2	7.6250- 3	4.0000- 2
58	1.7250+ 7	6.9125- 3	8.3250- 2	5.7000- 2	7.6750- 3	3.8000- 2
59	1.7500+ 7	6.9875- 3	9.2750- 2	5.3750- 2	7.7250- 3	3.6250- 2
60	1.7750+ 7	7.0625- 3	1.0000- 1	5.1250- 2	7.7750- 3	3.4750- 2
61	1.8000+ 7	7.2125- 3	1.0475- 1	5.3125- 2	7.8500- 3	3.3500- 2
62	1.8250+ 7	7.4375- 3	1.0525- 1	5.9375- 2	7.9500- 3	3.2500- 2
63	1.8500+ 7	7.6625- 3	1.0225- 1	6.3750- 2	8.0375- 3	3.1425- 2
64	1.8750+ 7	7.8875- 3	9.6500- 2	6.6250- 2	8.1125- 3	3.0275- 2
65	1.9000+ 7	8.1625- 3	8.9000- 2	6.4375- 2	8.2375- 3	2.9400- 2
66	1.9250+ 7	8.4875- 3	8.1250- 2	5.8125- 2	8.4125- 3	2.8800- 2
67	1.9500+ 7	8.8125- 3	7.5000- 2	5.3750- 2	8.7750- 3	2.8250- 2
68	1.9750+ 7	9.1375- 3	7.0000- 2	5.1250- 2	9.3250- 3	2.7750- 2

Table 9

Group cross-sections for ^{000}Zr

40-ZR-000 NO.	GROUP-EV	(G,TOT) AVERAGE	(G,N) AVERAGE	(G,2N) AVERAGE
21	6.0000+ 6	8.1987- 6	8.1987- 6	-
22	7.2500+ 6	1.1830- 3	1.1830- 3	-
23	7.5000+ 6	2.5000- 3	2.5000- 3	-
24	7.7500+ 6	3.5000- 3	3.5000- 3	-
25	8.0000+ 6	4.5000- 3	4.5000- 3	-
26	8.2500+ 6	5.5000- 3	5.5000- 3	-
27	8.5000+ 6	7.0000- 3	7.0000- 3	-
28	8.7500+ 6	9.0000- 3	9.0000- 3	-
29	9.0000+ 6	1.1000- 2	1.1000- 2	-
30	9.2500+ 6	1.3000- 2	1.3000- 2	-
31	9.5000+ 6	1.4750- 2	1.4750- 2	-
32	9.7500+ 6	1.6250- 2	1.6250- 2	-
33	1.0000+ 7	1.8000- 2	1.8000- 2	-
34	1.0250+ 7	2.0000- 2	2.0000- 2	-
35	1.0500+ 7	2.2250- 2	2.2250- 2	-
36	1.0750+ 7	2.4750- 2	2.4750- 2	-
37	1.1000+ 7	2.7250- 2	2.7250- 2	-
38	1.1250+ 7	2.9750- 2	2.9750- 2	-
39	1.1500+ 7	3.2500- 2	3.2500- 2	-
40	1.1750+ 7	3.5500- 2	3.5500- 2	-
41	1.2000+ 7	3.8750- 2	3.8750- 2	-
42	1.2250+ 7	4.2250- 2	4.2250- 2	-
43	1.2500+ 7	4.6500- 2	4.6500- 2	-
44	1.2750+ 7	5.1500- 2	5.1500- 2	-
45	1.3000+ 7	5.5750- 2	5.5750- 2	-
46	1.3250+ 7	5.9250- 2	5.9250- 2	-
47	1.3500+ 7	6.3750- 2	6.3750- 2	-
48	1.3750+ 7	6.9250- 2	6.9250- 2	-
49	1.4000+ 7	7.6000- 2	7.6000- 2	-
50	1.4250+ 7	8.4078- 2	8.4000- 2	7.8000- 5
51	1.4500+ 7	9.3325- 2	9.3000- 2	3.2500- 4
52	1.4750+ 7	1.0369- 1	1.0300- 1	6.9500- 4
53	1.5000+ 7	1.1738- 1	1.1550- 1	1.8750- 3
54	1.5250+ 7	1.5791- 1	1.4949- 1	8.4250- 3
55	1.6500+ 7	1.7344- 1	1.5605- 1	1.7500- 2
56	1.6750+ 7	1.7030- 1	1.4983- 1	2.0500- 2
57	1.7000+ 7	1.6027- 1	1.3695- 1	2.3375- 2
58	1.7250+ 7	1.4905- 1	1.2293- 1	2.6125- 2
59	1.7500+ 7	1.3997- 1	1.1335- 1	2.6625- 2
60	1.7750+ 7	1.2966- 1	1.0478- 1	2.4875- 2
61	1.8000+ 7	1.1894- 1	9.5563- 2	2.3375- 2
62	1.8250+ 7	1.0891- 1	8.6788- 2	2.2125- 2
63	1.8500+ 7	1.0013- 1	7.9250- 2	2.0875- 2
64	1.8750+ 7	9.2335- 2	7.2710- 2	1.9625- 2
65	1.9000+ 7	8.7400- 2	6.8150- 2	1.9250- 2
66	1.9250+ 7	8.2173- 2	6.2423- 2	1.9750- 2
67	1.9500+ 7	7.5417- 2	5.4167- 2	2.1250- 2
68	1.9750+ 7	7.1250- 2	4.7500- 2	2.3750- 2

Table 10

Group cross-sections for ^{92}Mo, ^{94}Mo and ^{100}Mo nuclei

NO.	GROUP-EV	42-MO-100(G,N) AVERAGE	MO-100(G,2N) AVERAGE	MO-92(G,N) AVERAGE	MO-94(G,N) AVERAGE	MO-94(G,2N) AVERAGE
26	8.2500+ 6	7.5920- 4				
27	8.5000+ 6	3.5000- 3				
28	8.7500+ 6	6.5000- 3				
29	9.0000+ 6	1.0000- 2				
30	9.2500+ 6	1.4000- 2				
31	9.5000+ 6	1.7500- 2			3.1200- 5	
32	9.7500+ 6	2.0500- 2			1.6000- 3	
33	1.0000+ 7	2.3500- 2			4.5000- 3	
34	1.0250+ 7	2.7000- 2			8.0000- 3	
35	1.0500+ 7	3.1000- 2			1.1500- 2	
36	1.0750+ 7	3.5000- 2			1.4000- 2	
37	1.1000+ 7	3.9500- 2			1.7000- 2	
38	1.1250+ 7	4.5500- 2			2.0500- 2	
39	1.1500+ 7	5.3500- 2			2.4000- 2	
40	1.1750+ 7	6.3500- 2			2.8500- 2	
41	1.2000+ 7	7.2500- 2			3.3000- 2	
42	1.2250+ 7	8.1000- 2			3.9000- 2	
43	1.2500+ 7	9.0500- 2		4.6400- 5	4.6000- 2	
44	1.2750+ 7	9.9500- 2		2.7000- 3	5.2000- 2	
45	1.3000+ 7	1.0850- 1		8.0000- 3	5.8500- 2	
46	1.3250+ 7	1.1700- 1		1.5000- 2	6.5000- 2	
47	1.3500+ 7	1.2550- 1		2.2000- 2	7.3500- 2	
48	1.3750+ 7	1.3450- 1		2.9500- 2	8.5500- 2	
49	1.4000+ 7	1.4300- 1	3.2000- 5	3.9000- 2	9.9500- 2	
50	1.4250+ 7	1.4950- 1	2.2500- 3	5.0500- 2	1.1400- 1	
51	1.4500+ 7	1.5000- 1	8.5000- 3	6.3500- 2	1.2750- 1	
52	1.4750+ 7	1.4300- 1	1.9000- 2	7.6000- 2	1.3950- 1	
53	1.5000+ 7	1.3150- 1	3.2500- 2	9.0500- 2	1.5150- 1	
54	1.5250+ 7	9.1600- 2	7.0850- 2	1.3470- 1	1.7980- 1	
55	1.6500+ 7	5.9500- 2	9.5500- 2	1.5900- 1	1.7700- 1	
56	1.6750+ 7	5.2500- 2	9.8500- 2	1.5700- 1	1.7000- 1	
57	1.7000+ 7	4.6000- 2	1.0025- 1	1.5300- 1	1.6200- 1	
58	1.7250+ 7	4.0000- 2	1.0150- 1	1.4500- 1	1.5200- 1	
59	1.7500+ 7	3.4500- 2	1.0150- 1	1.3500- 1	1.4150- 1	1.3725- 6
60	1.7750+ 7	3.0000- 2	1.0050- 1	1.2650- 1	1.3250- 1	3.5686- 3
61	1.8000+ 7	2.6000- 2	9.9250- 2	1.1900- 1	1.2100- 1	1.1000- 2
62	1.8250+ 7	2.2500- 2	9.7500- 2	1.1250- 1	1.0700- 1	1.9000- 2
63	1.8500+ 7	1.9500- 2	9.5250- 2	1.0600- 1	9.4000- 2	2.7000- 2
64	1.8750+ 7	1.7000- 2	9.2500- 2	9.9500- 2	8.1500- 2	3.3500- 2
65	1.9000+ 7	1.5000- 2	9.0000- 2	9.4500- 2	7.0000- 2	3.8000- 2
66	1.9250+ 7	1.3500- 2	8.7500- 2	8.9500- 2	6.0500- 2	4.2000- 2
67	1.9500+ 7	1.1000- 2	8.4000- 2	8.4000- 2	5.1000- 2	4.5000- 2
68	1.9750+ 7	8.5000- 3	8.0000- 2	7.8500- 2	4.1500- 2	4.7000- 2

Table 11

Group cross-sections for ^{96}Mo and ^{98}Mo nuclei

NO.	GROUP-EV	MO-98(G,N) AVERAGE	MO-96(G,N) AVERAGE	MO-98(G,2N) AVERAGE	MO-96(G,2N) AVERAGE
27	8.5000+ 6	3.2581- 4	-		
28	8.7500+ 6	3.2542- 3	-		
29	9.0000+ 6	6.0000- 3	1.0840- 4		
30	9.2500+ 6	9.5000- 3	2.8500- 3		
31	9.5000+ 6	1.3500- 2	6.0000- 3		
32	9.7500+ 6	1.7000- 2	9.0000- 3		
33	1.0000+ 7	2.1000- 2	1.3000- 2		
34	1.0250+ 7	2.5000- 2	1.6500- 2		
35	1.0500+ 7	2.9000- 2	2.0000- 2		
36	1.0750+ 7	3.3000- 2	2.3500- 2		
37	1.1000+ 7	3.7500- 2	2.7000- 2		
38	1.1250+ 7	4.2000- 2	3.0500- 2		
39	1.1500+ 7	4.7000- 2	3.4000- 2		
40	1.1750+ 7	5.4500- 2	3.8000- 2		
41	1.2000+ 7	6.2000- 2	4.3000- 2		
42	1.2250+ 7	6.9000- 2	4.9500- 2		
43	1.2500+ 7	7.6500- 2	5.8000- 2		
44	1.2750+ 7	8.4500- 2	6.7000- 2		
45	1.3000+ 7	9.4000- 2	7.5500- 2		
46	1.3250+ 7	1.0450- 1	8.3500- 2		
47	1.3500+ 7	1.1450- 1	9.2000- 2		
48	1.3750+ 7	1.2400- 1	1.0250- 1		
49	1.4000+ 7	1.3500- 1	1.1400- 1		
50	1.4250+ 7	1.4600- 1	1.2550- 1		
51	1.4500+ 7	1.5550- 1	1.3850- 1		
52	1.4750+ 7	1.6600- 1	1.5150- 1		
53	1.5000+ 7	1.7850- 1	1.6300- 1		
54	1.5250+ 7	1.7410- 1	1.8500- 1	1.3954- 2	
55	1.6500+ 7	1.2900- 1	1.7650- 1	4.2250- 2	1.0326- 3
56	1.6750+ 7	1.1050- 1	1.6450- 1	5.2250- 2	7.0000- 3
57	1.7000+ 7	9.1500- 2	1.4950- 1	6.0000- 2	1.5500- 2
58	1.7250+ 7	7.5000- 2	1.3050- 1	6.6250- 2	2.4000- 2
59	1.7500+ 7	6.0000- 2	1.1350- 1	7.2000- 2	3.2750- 2
60	1.7750+ 7	4.7500- 2	9.8000- 2	7.6750- 2	4.2000- 2
61	1.8000+ 7	3.8500- 2	8.3500- 2	8.0000- 2	4.9250- 2
62	1.8250+ 7	3.0500- 2	7.2500- 2	8.1750- 2	5.3500- 2
63	1.8500+ 7	2.4000- 2	6.4000- 2	8.2750- 2	5.8000- 2
64	1.8750+ 7	1.9500- 2	5.5500- 2	8.2750- 2	6.2500- 2
65	1.9000+ 7	1.6000- 2	4.7500- 2	8.1750- 2	6.5000- 2
66	1.9250+ 7	1.3000- 2	4.0500- 2	7.8250- 2	6.6250- 2
67	1.9500+ 7	1.0000- 2	3.3500- 2	7.3750- 2	6.6750- 2
68	1.9750+ 7	6.5000- 3	2.7500- 2	6.9000- 2	6.7250- 2

Table 12

Group cross-sections for ^{182}W, ^{184}W and ^{186}W nuclei

NO.	GROUP-EV	W-186(G,N) AVERAGE	W-186(G,2N) AVERAGE	W-184(G,N) AVERAGE	W-182(G,N) AVERAGE
21	6.0000+ 6	1.6667- 5	-	-	-
22	7.2500+ 6	2.9167- 3	-	4.0000- 4	-
23	7.5000+ 6	8.0000- 3	-	5.0000- 3	-
24	7.7500+ 6	1.4000- 2	-	1.1000- 2	-
25	8.0000+ 6	2.0500- 2	-	1.8000- 2	2.7440- 3
26	8.2500+ 6	2.9000- 2	-	2.6000- 2	1.3500- 2
27	8.5000+ 6	3.8000- 2	-	3.4000- 2	2.5500- 2
28	8.7500+ 6	4.6500- 2	-	4.2500- 2	3.7000- 2
29	9.0000+ 6	5.6000- 2	-	5.1000- 2	4.8500- 2
30	9.2500+ 6	6.8000- 2	-	6.1000- 2	5.8500- 2
31	9.5000+ 6	8.1000- 2	-	7.2500- 2	6.7500- 2
32	9.7500+ 6	9.3000- 2	-	8.4000- 2	7.8500- 2
33	1.0000+ 7	1.0450- 1	-	9.6500- 2	9.0500- 2
34	1.0250+ 7	1.1800- 1	-	1.1050- 1	1.0150- 1
35	1.0500+ 7	1.3300- 1	-	1.2450- 1	1.1750- 1
36	1.0750+ 7	1.4800- 1	-	1.3950- 1	1.3950- 1
37	1.1000+ 7	1.6750- 1	-	1.6000- 1	1.7000- 1
38	1.1250+ 7	2.0000- 1	-	2.0800- 1	2.0950- 1
39	1.1500+ 7	2.4500- 1	-	2.6950- 1	2.4850- 1
40	1.1750+ 7	2.9800- 1	-	3.2050- 1	2.8350- 1
41	1.2000+ 7	3.4150- 1	-	3.6000- 1	3.1450- 1
42	1.2250+ 7	3.7500- 1	-	3.8400- 1	3.4200- 1
43	1.2500+ 7	4.0550- 1	-	4.0250- 1	3.6500- 1
44	1.2750+ 7	4.1600- 1	8.6400- 5	4.0700- 1	3.8450- 1
45	1.3000+ 7	3.9250- 1	6.9000- 3	3.8000- 1	4.0150- 1
46	1.3250+ 7	3.5250- 1	2.6000- 2	3.3650- 1	4.1250- 1
47	1.3500+ 7	3.1650- 1	5.9500- 2	3.0050- 1	4.0850- 1
48	1.3750+ 7	2.7900- 1	1.0350- 1	2.6750- 1	3.8200- 1
49	1.4000+ 7	2.4700- 1	1.3850- 1	2.4250- 1	3.3400- 1
50	1.4250+ 7	2.1850- 1	1.6550- 1	2.2250- 1	2.7750- 1
51	1.4500+ 7	1.9250- 1	1.9600- 1	2.0200- 1	2.3800- 1
52	1.4750+ 7	1.7000- 1	2.2300- 1	1.8800- 1	2.1650- 1
53	1.5000+ 7	1.4850- 1	2.4150- 1	1.7600- 1	2.0000- 1
54	15250+ 7	1.1850- 1	2.4250- 1	1.4590- 1	1.6720- 1
55	1.6500+ 7	9.9500- 2	2.0050- 1	1.2150- 1	1.4150- 1
56	1.6750+ 7	9.4000- 2	1.8250- 1	1.1450- 1	1.3350- 1
57	1.7000+ 7	8.9000- 2	1.6750- 1	1.0800- 1	1.2500- 1
58	1.7250+ 7	8.4500- 2	1.5650- 1	1.0250- 1	1.1750- 1
59	1.7500+ 7	8.0000- 2	1.4500- 1	9.7000- 2	1.1050- 1
60	1.7750+ 7	7.6000- 2	1.3200- 1	9.1500- 2	1.0400- 1
61	1.8000+ 7	7.2000- 2	1.2000- 1	8.6000- 2	9.8000- 2
62	1.8250+ 7	6.8000- 2	1.1050- 1	8.1000- 2	9.2500- 2
63	1.8500+ 7	6.3500- 2	1.0100- 1	7.7000- 2	8.8000- 2
64	1.8750+ 7	5.9500- 2	9.2000- 2	7.2500- 2	8.3500- 2
65	1.9000+ 7	5.6500- 2	8.4000- 2	6.8500- 2	7.8500- 2
66	1.9250+ 7	5.3500- 2	7.6000- 2	6.5000- 2	7.3500- 2
67	1.9500+ 7	5.0500- 2	6.8000- 2	6.1000- 2	6.9000- 2
68	1.9750+ 7	4.7500- 2	5.9500- 2	5.7500- 2	6.4500- 2

Table 13

Group cross-sections for ^{000}Pb nucleus

82-PB-000 NO.	GROUP-EV	(G,TOT) AVERAGE	(G,N) AVERAGE	(G,2N) AVERAGE
21	6.0000+ 6	1.5256- 3	1.5256- 3	
22	7.2500+ 6	8.5000- 3	8.5000- 3	
23	7.5000+ 6	1.7500- 2	1.7500- 2	
24	7.7500+ 6	3.2500- 2	3.2500- 2	
25	8.0000+ 6	4.7000- 2	4.7000- 2	
26	8.2500+ 6	6.1000- 2	6.1000- 2	
27	8.5000+ 6	7.8500- 2	7.8500- 2	
28	8.7500+ 6	9.9500- 2	9.9500- 2	
29	9.0000+ 6	1.2250- 1	1.2250- 1	
30	9.2500+ 6	1.4750- 1	1.4750- 1	
31	9.5000+ 6	1.7250- 1	1.7250- 1	
32	9.7500+ 6	1.9750- 1	1.9750- 1	
33	1.0000+ 7	2.2375- 1	2.2375- 1	
34	1.0250+ 7	2.5125- 1	2.5125- 1	
35	1.0500+ 7	2.7875- 1	2.7875- 1	
36	1.0750+ 7	3.0625- 1	3.0625- 1	
37	1.1000+ 7	3.3250- 1	3.3250- 1	
38	1.1250+ 7	3.5750- 1	3.5750- 1	
39	1.1500+ 7	3.8275- 1	3.8275- 1	
40	1.1750+ 7	4.0825- 1	4.0825- 1	
42	1.2250+ 7	4.5400- 1	4.5400- 1	
43	1.2500+ 7	4.8125- 1	4.8125- 1	
44	1.2750+ 7	5.1375- 1	5.1375- 1	
45	1.3000+ 7	5.4950- 1	5.4950- 1	
46	1.3250+ 7	5.8850- 1	5.8850- 1	
47	1.3500+ 7	6.0225- 1	6.0225- 1	
48	1.3750+ 7	5.9075- 1	5.9075- 1	
49	1.4000+ 7	5.6844- 1	5.6781- 1	4.8200- 4
50	1.4250+ 7	5.3671- 1	5.3079- 1	5.9000- 3
51	1.4500+ 7	4.8588- 1	4.6925- 1	1.6625- 2
52	1.4750+ 7	4.3242- 1	4.0255- 1	2.9875- 2
53	1.5000+ 7	3.8563- 1	3.4325- 1	4.2375- 2
54	1.5250+ 7	2.6354- 1	1.9153- 1	7.3325- 2
55	1.6500+ 7	1.7918- 1	8.7050- 2	9.7375- 2
56	1.6750+ 7	1.7220- 1	6.9230- 2	1.0312- 1
57	1.7000+ 7	1.6700- 1	5.9000- 2	1.0800- 1
58	1.7250+ 7	1.6100- 1	4.9000- 2	1.1200- 1
59	1.7500+ 7	1.5600- 1	4.0500- 2	1.1550- 1
60	1.7750+ 7	1.5200- 1	3.3500- 2	1.1850- 1
61	1.8000+ 7	1.4875- 1	2.7500- 2	1.2125- 1
62	1.8250+ 7	1.4625- 1	2.2500- 2	1.2375- 1
63	1.8500+ 7	1.4375- 1	1.8000- 2	1.2575- 1
64	1.8750+ 7	1.4125- 1	1.4000- 2	1.2725- 1
65	1.9000+ 7	1.4000- 1	1.1000- 2	1.2900- 1
66	1.9250+ 7	1.4000- 1	9.0000- 3	1.3100- 1
67	1.9500+ 7	1.3875- 1	6.5000- 3	1.3225- 1
68	1.9750+ 7	1.3625- 1	3.5000- 3	1.3275- 1

Table 14

Group cross-sections for ^{209}Bi nucleus

BI-209 NO.	GROUP-EV	(G,TOT) AVERAGE	(G,2N) AVERAGE	(G,N) AVERAGE
22	7.2500+ 6	3.2307- 4	-	3.2307- 4
23	7.5000+ 6	1.2578- 2	-	1.2578- 2
24	7.7500+ 6	3.0859- 2	-	3.0859- 2
25	8.0000+ 6	4.2500- 2	-	4.2500- 2
26	8.2500+ 6	4.7500- 2	-	4.7500- 2
27	8.5000+ 6	5.5000- 2	-	5.5000- 2
28	8.7500+ 6	6.5000- 2	-	6.5000- 2
29	9.0000+ 6	7.5000- 2	-	7.5000- 2
30	9.2500+ 6	8.5000- 2	-	8.5000- 2
31	9.5000+ 6	9.5000- 2	-	9.5000- 2
32	9.7500+ 6	1.0500- 1	-	1.0500- 1
33	1.0000+ 7	1.1750- 1	-	1.1750- 1
34	1.0250+ 7	1.3250- 1	-	1.3250- 1
35	1.0500+ 7	1.5250- 1	-	1.5250- 1
36	1.0750+ 7	1.7750- 1	-	1.7750- 1
37	1.1000+ 7	2.0500- 1	-	2.0500- 1
38	1.1250+ 7	2.3500- 1	-	2.3500- 1
39	1.1500+ 7	2.6250- 1	-	2.6250- 1
40	1.1750+ 7	2.8750- 1	-	2.8750- 1
41	1.2000+ 7	3.2250- 1	-	3.2250- 1
42	1.2250+ 7	3.6750- 1	-	3.6750- 1
43	1.2500+ 7	4.1250- 1	-	4.1250- 1
44	1.2750+ 7	4.5750- 1	-	4.5750- 1
45	1.3000+ 7	4.9500- 1	-	4.9500- 1
46	1.3250+ 7	5.2536- 1	3.6000- 4	5.2500- 1
47	1.3500+ 7	5.3625- 1	1.2500- 3	5.3500- 1
48	1.3750+ 7	5.2675- 1	1.7500- 3	5.2500- 1
49	1.4000+ 7	5.0900- 1	4.0000- 3	5.0500- 1
50	1.4250+ 7	4.8300- 1	8.0000- 3	4.7500- 1
51	1.4500+ 7	4.4500- 1	2.0000- 2	4.2500- 1
52	1.4750+ 7	3.9500- 1	4.0000- 2	3.5500- 1
53	1.5000+ 7	3.4175- 1	5.6750- 2	2.8500- 1
54	1.5250+ 7	2.2185- 1	8.9850- 2	1.3200- 1
55	1.6500+ 7	1.6225- 1	1.0100- 1	6.1250- 2
56	1.6750+ 7	1.5275- 1	9.9000- 2	5.3750- 2
57	1.7000+ 7	1.4400- 1	9.6500- 2	4.7500- 2
58	1.7250+ 7	1.3600- 1	9.3500- 2	4.2500- 2
59	1.7500+ 7	1.2825- 1	8.9500- 2	3.8750- 2
60	1.7750+ 7	1.2075- 1	8.4500- 2	3.6250- 2
61	1.8000+ 7	1.1400- 1	8.0250- 2	3.3750- 2
62	1.8250+ 7	1.0800- 1	7.6750- 2	3.1250- 2
63	1.8500+ 7	1.0125- 1	7.3750- 2	2.7500- 2
64	1.8750+ 7	9.3750- 2	7.1250- 2	2.2500- 2
65	1.9000+ 7	8.7500- 2	6.8750- 2	1.8750- 2
66	1.9250+ 7	8.2500- 2	6.6250- 2	1.6250- 2
67	1.9500+ 7	7.7500- 2	6.3750- 2	1.3750- 2
68	1.9750+ 7	7.2500- 2	6.1250- 2	1.1250- 2

Table 15

Group cross-sections for ^{232}Th nucleus

90-TH-232 NO.	GROUP-EV	(G,TOT) AVERAGE	(G,F) AVERAGE	(G,N) AVERAGE	(G,2N) AVERAGE
16	4.7500+ 6	5.8001- 9	5.8001- 9	-	-
17	5.0000+ 6	2.7571- 7	2.7571- 7	-	-
18	5.2500+ 6	2.4328- 5	2.4328- 5	-	-
19	5.5000+ 6	2.3214- 4	2.3214- 4	-	-
20	5.7500+ 6	9.2054- 4	9.2054- 4	-	-
21	6.0000+ 6	2.1794- 2	1.0864- 2	1.0858- 2	-
22	7.2500+ 6	4.5722- 2	9.6412- 3	3.6051- 2	-
23	7.5000+ 6	5.5989- 2	9.8150- 3	4.6167- 2	-
25	8.0000+ 6	8.2742- 2	1.0820- 2	7.1915- 2	-
26	8.2500+ 6	9.5497- 2	1.1967- 2	8.3528- 2	-
27	8.5000+ 6	1.1138- 1	1.4017- 2	9.7416- 2	-
28	8.7500+ 6	1.2709- 1	1.5355- 2	1.1173- 1	-
29	9.0000+ 6	1.5381- 1	1.6568- 2	1.3709- 1	-
30	9.2500+ 6	1.9739- 1	1.7938- 2	1.7938- 1	-
31	9.5000+ 6	2.4174- 1	2.0070- 2	2.2162- 1	-
32	9.7500+ 6	2.9214- 1	2.2630- 2	2.6948- 1	-
33	1.0000+ 7	3.4496- 1	2.4313- 2	3.2048- 1	-
34	1.0250+ 7	4.0055- 1	2.4921- 2	3.7557- 1	-
35	1.0500+ 7	4.3036- 1	2.5375- 2	4.0497- 1	-
36	1.0750+ 7	4.5396- 1	2.5792- 2	4.2816- 1	-
37	1.1000+ 7	4.6756- 1	2.6312- 2	4.4125- 1	-
38	1.1250+ 7	4.7070- 1	2.6937- 2	4.4375- 1	1.9600- 5
39	1.1500+ 7	4.7010- 1	2.7563- 2	4.3562- 1	6.6491- 3
40	1.1750+ 7	4.9153- 1	2.8121- 2	4.1448- 1	4.6923- 2
41	1.2000+ 7	4.9590- 1	2.8542- 2	3.7225- 1	8.6443- 2
42	1.2250+ 7	4.9748- 1	2.9119- 2	3.2597- 1	1.4025- 1
43	1.2500+ 7	4.9041- 1	3.1206- 2	2.5844- 1	1.9135- 1
44	1.2750+ 7	4.8658- 1	3.4538- 2	2.0116- 1	2.4668- 1
45	1.3000+ 7	4.9375- 1	3.9841- 2	1.5932- 1	2.8810- 1
46	1.3250+ 7	5.0061- 1	4.5387- 2	1.2652- 1	3.2678- 1
47	1.3500+ 7	5.0615- 1	5.0307- 2	1.0097- 1	3.5190- 1
48	1.3750+ 7	5.0605- 1	5.4212- 2	8.0631- 2	3.7028- 1
49	1.4000+ 7	4.9440- 1	5.5300- 2	6.4480- 2	3.7325- 1
50	1.4250+ 7	4.8080- 1	5.5340- 2	5.2591- 2	3.7255- 1
51	1.4500+ 7	4.6390- 1	5.3400- 2	4.4789- 2	3.6525- 1
52	1.4750+ 7	4.4064- 1	5.0707- 2	3.7461- 2	3.5237- 1
53	1.5000+ 7	4.0586- 1	4.6690- 2	2.9957- 2	3.2891- 1
54	1.5250+ 7	3.0267- 1	3.7735- 2	1.3610- 2	2.5293- 1
55	1.6500+ 7	2.1738- 1	2.7638- 2	6.7509- 3	1.8459- 1
56	1.6750+ 7	1.9869- 1	2.4978- 2	5.8805- 3	1.6780- 1
57	1.7000+ 7	1.8270- 1	2.3182- 2	5.1793- 3	1.5406- 1
58	1.7250+ 7	1.6971- 1	2.1710- 2	4.5761- 3	1.4333- 1
59	1.7500+ 7	1.5897- 1	2.0685- 2	4.1544- 3	1.3416- 1
60	1.7750+ 7	1.4929- 1	1.9681- 2	3.7866- 3	1.2575- 1
61	1.8000+ 7	1.4060- 1	1.8691- 2	3.4321- 3	1.1827- 1
62	1.8250+ 7	1.3446- 1	1.7788- 2	3.1199- 3	1.1356- 1
63	1.8500+ 7	1.3000- 1	1.7058- 2	2.8552- 3	1.1008- 1
64	1.8750+ 7	1.2561- 1	1.6343- 2	2.6143- 3	1.0666- 1
65	1.9000+ 7	1.2132- 1	1.5875- 2	2.4171- 3	1.0305- 1
66	1.9250+ 7	1.1704- 1	1.5625- 2	2.2577- 3	9.9158- 2
67	1.9500+ 7	1.1290- 1	1.5375- 2	2.1074- 3	9.5408- 2
68	1.9750+ 7	1.0890- 1	1.5125- 2	1.9672- 3	9.1803- 2

Table 16

Group cross-sections for ^{233}U nucleus

92-U-233 NO.	GROUP-EV	(G,TOT) AVERAGE	(G,F) AVERAGE	(G,N) AVERAGE
16	4.7500+ 6	1.1423- 6	8.6073- 7	-
17	5.0000+ 6	9.9190- 5	7.4626- 5	-
18	5.2500+ 6	1.6486- 3	1.5822- 3	-
19	5.5000+ 6	4.8448- 3	4.8094- 3	-
20	5.7500+ 6	6.4824- 3	6.4713- 3	1.2100- 5
21	6.0000+ 6	1.1640- 2	1.1047- 2	4.7000- 4
22	7.2500+ 6	2.9226- 2	2.3642- 2	5.3000- 3
23	7.5000+ 6	3.6701- 2	2.7160- 2	9.5000- 3
24	7.7500+ 6	4.4317- 2	3.0024- 2	1.4200- 2
25	8.0000+ 6	5.2591- 2	3.6089- 2	1.6125- 2
26	8.2500+ 6	6.2246- 2	4.4102- 2	1.8042- 2
27	8.5000+ 6	7.4771- 2	5.3000- 2	2.1333- 2
28	8.7500+ 6	8.9237- 2	6.4153- 2	2.4900- 2
29	9.0000+ 6	1.1087- 1	7.9321- 2	3.0625- 2
30	9.2500+ 6	1.3664- 1	9.8461- 2	3.7732- 2
31	9.5000+ 6	1.7473- 1	1.2602- 1	4.6607- 2
32	9.7500+ 6	2.1150- 1	1.5578- 1	5.5536- 2
33	1.0000+ 7	2.5485- 1	1.7787- 1	7.6667- 2
34	1.0250+ 7	3.0541- 1	2.0141- 1	1.0400- 1
35	1.0500+ 7	3.3560- 1	2.1637- 1	1.1896- 1
36	1.0750+ 7	3.6227- 1	2.2972- 1	1.3258- 1
37	1.1000+ 7	3.8107- 1	2.4375- 1	1.3725- 1
38	1.1250+ 7	3.9410- 1	2.5903- 1	1.3508- 1
39	1.1500+ 7	4.0298- 1	2.7931- 1	1.2329- 1
40	1.1750+ 7	4.1036- 1	2.9971- 1	1.1068- 1
41	1.2000+ 7	4.0944- 1	3.1617- 1	9.3125- 2
42	1.2250+ 7	4.1078- 1	3.3363- 1	7.7175- 2
43	1.2500+ 7	4.2169- 1	3.5446- 1	6.7000- 2
44	1.2750+ 7	4.3313- 1	3.7481- 1	5.8280- 2
45	1.3000+ 7	4.4368- 1	3.9139- 1	5.2200- 2
46	1.3250+ 7	4.5496- 1	4.0763- 1	4.7320- 2
47	1.3500+ 7	4.6319- 1	4.1844- 1	4.4750- 2
48	1.3750+ 7	4.6386- 1	4.2161- 1	4.2250- 2
49	1.4000+ 7	4.5175- 1	4.1200- 1	3.9750- 2
50	1.4250+ 7	4.3477- 1	3.9694- 1	3.7570- 2
51	1.4500+ 7	4.0855- 1	3.7196- 1	3.6050- 2
52	1.4750+ 7	3.8109- 1	3.4631- 1	3.4390- 2
53	1.5000+ 7	3.5165- 1	3.1849- 1	3.2400- 2
54	1.5250+ 7	2.8713- 1	2.5731- 1	2.9464- 2
55	1.6500+ 7	2.2245- 1	1.9485- 1	2.6700- 2
56	1.6750+ 7	2.0311- 1	1.7717- 1	2.5860- 2
57	1.7000+ 7	1.9235- 1	1.6684- 1	2.5350- 2
58	1.7250+ 7	1.8185- 1	1.5688- 1	2.4850- 2
59	1.7500+ 7	1.7135- 1	1.4678- 1	2.4350- 2
60	1.7750+ 7	1.6140- 1	1.3672- 1	2.3610- 2
61	1.8000+ 7	1.5122- 1	1.2633- 1	2.2750- 2
62	1.8250+ 7	1.3973- 1	1.1665- 1	2.2250- 2
63	1.8500+ 7	1.2824- 1	1.0614- 1	2.1750- 2
64	1.8750+ 7	1.1675- 1	9.5155- 2	2.1250- 2
65	1.9000+ 7	1.0762- 1	8.6484- 2	2.0750- 2
66	1.9250+ 7	1.0087- 1	7.9731- 2	2.0250- 2
67	1.9500+ 7	9.4125- 2	7.3511- 2	1.9750- 2
68	1.9750+ 7	8.7375- 2	6.7742- 2	1.9250- 2

Table 17

Group cross-sections for ^{234}U nucleus

92-U-234 NO.	GROUP-EV	(G,TOT) AVERAGE	(G,F) AVERAGE	(G,N) AVERAGE
14	4.2500+ 6	8.6605- 8	8.6605- 8	-
15	4.5000+ 6	2.6807- 6	2.6807- 6	-
16	4.7500+ 6	7.3441- 5	7.3441- 5	-
17	5.0000+ 6	1.1033- 3	1.1033- 3	-
18	5.2500+ 6	4.6586- 3	4.6586- 3	-
19	5.5000+ 6	7.4700- 3	7.4700- 3	-
20	5.7500+ 6	8.7692- 3	8.7692- 3	-
21	6.0000+ 6	4.6026- 2	3.2153- 2	1.3353- 2
22	7.2500+ 6	6.5217- 2	2.7164- 2	3.7814- 2
23	7.5000+ 6	7.9545- 2	3.1202- 2	4.7730- 2
24	7.7500+ 6	1.3433- 1	3.3702- 2	1.0036- 1
25	8.0000+ 6	1.4415- 1	3.8342- 2	1.0541- 1
26	8.2500+ 6	1.2590- 1	4.5811- 2	7.9385- 2
27	8.5000+ 6	1.2533- 1	5.1235- 2	7.4072- 2
28	8.7500+ 6	1.3754- 1	5.3720- 2	8.3783- 2
29	9.0000+ 6	1.2927- 1	6.4133- 2	6.4001- 2
30	9.2500+ 6	1.2343- 1	8.6481- 2	3.6346- 2
31	9.5000+ 6	1.4296- 1	1.1092- 1	3.2029- 2
32	9.7500+ 6	1.7273- 1	1.3582- 1	3.6880- 2
33	1.0000+ 7	2.1593- 1	1.5713- 1	5.7968- 2
34	1.0250+ 7	2.9358- 1	1.7209- 1	1.1797- 1
35	1.0500+ 7	3.7451- 1	1.9161- 1	1.8286- 1
36	1.0750+ 7	4.3756- 1	2.1658- 1	2.2098- 1
37	1.1000+ 7	4.6748- 1	2.3375- 1	2.3375- 1
38	1.1250+ 7	4.6444- 1	2.4125- 1	2.2325- 1
39	1.1500+ 7	4.7336- 1	2.4000- 1	2.3350- 1
40	1.1750+ 7	4.7264- 1	2.3000- 1	2.4282- 1
41	1.2000+ 7	4.5059- 1	2.2708- 1	2.2343- 1
42	1.2250+ 7	4.3716- 1	2.3606- 1	2.0065- 1
43	1.2500+ 7	4.2799- 1	2.5547- 1	1.7229- 1
44	1.2750+ 7	4.2643- 1	2.7958- 1	1.4661- 1
45	1.3000+ 7	4.3430- 1	3.0736- 1	1.2644- 1
46	1.3250+ 7	4.4423- 1	3.3301- 1	1.1129- 1
47	1.3500+ 7	4.5994- 1	3.6004- 1	9.9683- 2
48	1.3750+ 7	4.6994- 1	3.8023- 1	8.9697- 2
49	1.4000+ 7	4.6497- 1	3.8325- 1	8.1724- 2
50	1.4250+ 7	4.5281- 1	3.8175- 1	7.0679- 2
51	1.4500+ 7	4.3157- 1	3.7200- 1	5.9067- 2
52	1.4750+ 7	4.0332- 1	3.5604- 1	4.6675- 2
53	1.5000+ 7	3.6209- 1	3.2851- 1	3.2502- 2
54	1.5250+ 7	2.6750- 1	2.5730- 1	7.4771- 3
55	1.6500+ 7	2.0712- 1	1.7769- 1	2.8016- 2
56	1.6750+ 7	1.9310- 1	1.5694- 1	3.5493- 2
57	1.7000+ 7	1.8909- 1	1.4578- 1	4.1299- 2
58	1.7250+ 7	1.8541- 1	1.3572- 1	4.8059- 2
59	1.7500+ 7	1.7923- 1	1.2629- 1	5.2741- 2
60	1.7750+ 7	1.6515- 1	1.2018- 1	4.4886- 2
61	1.8000+ 7	1.5848- 1	1.2003- 1	3.8455- 2
62	1.8250+ 7	1.5674- 1	1.2109- 1	3.5486- 2
63	1.8500+ 7	1.5564- 1	1.2266- 1	3.2749- 2
64	1.8750+ 7	1.5455- 1	1.2422- 1	3.0209- 2
65	1.9000+ 7	1.5412- 1	1.2563- 1	2.8481- 2
66	1.9250+ 7	1.5437- 1	1.2687- 1	2.7444- 2
67	1.9500+ 7	1.5462- 1	1.2812- 1	2.6444- 2
68	1.9750+ 7	1.5487- 1	1.2937- 1	2.5481- 2

Table 18

Group cross-sections for ^{236}U nucleus

92-U-236 NO.	GROUP-EV	(G,F) AVERAGE	(G,2N) AVERAGE	(G,N) AVERAGE
10	3.2500+ 6	9.5147-11	-	-
11	3.500 + 6	2.6563-10	-	-
12	3.7500+ 6	1.3738- 9	-	-
13	4.0000+ 6	1.1320- 8	-	-
14	4.2500+ 6	5.6246- 8	-	-
15	4.5000+ 6	3.8979- 7	-	-
16	4.7500+ 6	2.4866- 6	-	-
17	5.0000+ 6	6.6467- 5	-	-
18	5.2500+ 6	4.5159- 4	-	-
19	5.5000+ 6	1.2749- 3	-	-
20	5.7500+ 6	4.6785- 3	-	-
21	6.0000+ 6	1.1910- 2	-	4.1460- 3
22	7.2500+ 6	1.7250- 2	-	1.8500- 2
23	7.5000+ 6	1.8750- 2	-	2.5000- 2
24	7.7500+ 6	2.0250- 2	-	3.2000- 2
25	8.0000+ 6	2.2750- 2	-	4.1500- 2
26	8.2500+ 6	2.6250- 2	-	5.0500- 2
27	8.5000+ 6	3.1000- 2	-	6.0000- 2
28	8.7500+ 6	3.7000- 2	-	7.4500- 2
29	9.0000+ 6	4.6000- 2	-	8.9500- 2
30	9.2500+ 6	5.8000- 2	-	1.0500- 1
31	9.5000+ 6	7.0000- 2	-	1.2500- 1
32	9.7500+ 6	8.2000- 2	-	1.5500- 1
33	1.0000+ 7	9.6500- 2	-	1.9500- 1
34	1.0250+ 7	1.1350- 1	-	2.3250- 1
35	1.0500+ 7	1.2600- 1	-	2.5750- 1
36	1.0750+ 7	1.3400- 1	-	2.7400- 1
37	1.1000+ 7	1.3975- 1	-	2.8550- 1
38	1.1250+ 7	1.4325- 1	-	2.9000- 1
39	1.1500+ 7	1.4675- 1	-	2.8650- 1
40	1.1750+ 7	1.5025- 1	1.4900- 4	2.7750- 1
41	1.2000+ 7	1.5425- 1	8.2500- 3	2.6700- 1
42	1.2250+ 7	1.5875- 1	2.3000- 2	2.5550- 1
43	1.2500+ 7	1.6900- 1	3.7500- 2	2.3900- 1
44	1.2750+ 7	1.8500- 1	5.4500- 2	2.1450- 1
45	1.3000+ 7	1.9725- 1	7.7000- 2	1.8400- 1
46	1.3250+ 7	2.0575- 1	9.8500- 2	1.5200- 1
47	1.3500+ 7	2.1700- 1	1.1100- 1	1.2300- 1
48	1.3750+ 7	2.3100- 1	1.1700- 1	1.0250- 1
49	1.4000+ 7	2.4175- 1	1.2000- 1	8.9500- 2
50	1.4250+ 7	2.4925- 1	1.2050- 1	7.8500- 2
51	1.4500+ 7	2.4475- 1	1.1800- 1	6.9500- 2
52	1.4750+ 7	2.2825- 1	1.1350- 1	6.2000- 2
53	1.5000+ 7	2.1175- 1	1.0800- 1	5.4500- 2
54	1.5250+ 7	1.6845- 1	7.9400- 2	4.2300- 2
55	1.6500+ 7	1.2925- 1	5.3500- 2	3.3000- 2
56	1.6750+ 7	1.1975- 1	4.7500- 2	3.0500- 2
57	1.7000+ 7	1.1125- 1	4.2500- 2	2.8000- 2
58	1.7250+ 7	1.0375- 1	3.8000- 2	2.6000- 2
59	1.7500+ 7	9.5750- 2	3.4500- 2	2.4500- 2
60	1.7750+ 7	8.7250- 2	3.1000- 2	2.3500- 2
61	1.8000+ 7	7.8500- 2	2.6500- 2	2.1500- 2
62	1.8250+ 7	6.9500- 2	2.2000- 2	1.9500- 2
63	1.8500+ 7	6.2500- 2	1.8500- 2	1.8750- 2
64	1.8750+ 7	5.7500- 2	1.5000- 2	1.8250- 2
65	1.9000+ 7	5.2750- 2	1.1500- 2	1.7500- 2
66	1.9250+ 7	4.8250- 2	9.0000- 3	1.6500- 2
67	1.9500+ 7	4.4500- 2	7.5000- 3	1.5750- 2
68	1.9750+ 7	4.1500- 2	6.5000- 3	1.5250- 2

Table 19

Group cross-sections for ^{237}Np nucleus

NP-237 NO.	GROUP-EV	(G,F) AVERAGE	(G,N) AVERAGE	(G,2N) AVERAGE
11	3.5000+ 6	2.4597-11		
12	3.7500+ 6	4.7609-10		
13	4.0000+ 6	6.0494- 9		
14	4.2500+ 6	5.3500- 8		
15	4.5000+ 6	5.5527- 7		
16	4.7500+ 6	1.3931- 5		
17	5.0000+ 6	2.0602- 4		
18	5.2500+ 6	1.6716- 3		
19	5.5000+ 6	5.4042- 3		
20	5.7500+ 6	8.5477- 3		
21	6.0000+ 6	1.8706- 2	2.7048- 3	
22	7.2500+ 6	3.0000- 2	1.5000- 2	
23	7.5000+ 6	3.2500- 2	2.0500- 2	
24	7.7500+ 6	3.5500- 2	2.6500- 2	
25	8.0000+ 6	3.8500- 2	3.4000- 2	
26	8.2500+ 6	4.1500- 2	3.9500- 2	
27	8.5000+ 6	4.5250- 2	4.7000- 2	
28	8.7500+ 6	4.9750- 2	5.7000- 2	
29	9.0000+ 6	5.5250- 2	6.5500- 2	
30	9.2500+ 6	6.1750- 2	7.6000- 2	
31	9.5000+ 6	6.9750- 2	8.8000- 2	
32	9.7500+ 6	7.9250- 2	1.0200- 1	
33	1.0000+ 7	1.0050- 1	1.1550- 1	
34	1.0250+ 7	1.3350- 1	1.2800- 1	
35	1.0500+ 7	1.6625- 1	1.4300- 1	
36	1.0750+ 7	1.9875- 1	1.5650- 1	
37	1.1000+ 7	2.1525- 1	1.6700- 1	
38	1.1250+ 7	2.1575- 1	1.7700- 1	
39	1.1500+ 7	2.1025- 1	1.8750- 1	
40	1.1750+ 7	1.9875- 1	1.9650- 1	
41	1.2000+ 7	1.9475- 1	2.0200- 1	
42	1.2250+ 7	1.9825- 1	2.0350- 1	1.3390- 4
43	1.2500+ 7	2.0725- 1	2.0050- 1	2.5000- 3
44	1.2750+ 7	2.2175- 1	1.9450- 1	5.5000- 3
45	1.3000+ 7	2.3675- 1	1.8550- 1	8.5000- 3
46	1.3250+ 7	2.5225- 1	1.7450- 1	1.1000- 2
47	1.3500+ 7	2.6700- 1	1.6200- 1	1.4000- 2
48	1.3750+ 7	2.8100- 1	1.4600- 1	1.8000- 2
49	1.4000+ 7	2.8650- 1	1.2950- 1	2.1500- 2
50	1.4250+ 7	2.8350- 1	1.1600- 1	2.4000- 2
51	1.4500+ 7	2.7775- 1	1.0400- 1	2.6500- 2
52	1.4750+ 7	2.6925- 1	9.2500- 2	2.9500- 2
53	1.5000+ 7	2.5400- 1	8.2500- 2	3.2000- 2
54	1.5250+ 7	1.9500- 1	6.2400- 2	3.8000- 2
55	1.6500+ 7	1.4425- 1	4.8000- 2	4.1500- 2
56	1.6750+ 7	1.3675- 1	4.4500- 2	4.1750- 2
57	1.7000+ 7	1.3075- 1	4.1000- 2	4.1250- 2
58	1.7250+ 7	1.2625- 1	3.8000- 2	4.0750- 2
59	1.7500+ 7	1.2175- 1	3.5500- 2	4.0250- 2
60	1.7750+ 7	1.1725- 1	3.2500- 2	3.9750- 2
61	1.8000+ 7	1.1300- 1	3.0000- 2	3.9250- 2
62	1.8250+ 7	1.0900- 1	2.8500- 2	3.8500- 2
63	1.8500+ 7	1.0525- 1	2.7000- 2	3.7500- 2
64	1.8750+ 7	1.0175- 1	2.5000- 2	3.6500- 2
65	1.9000+ 7	9.8750- 2	2.3500- 2	3.5500- 2
66	1.9250+ 7	9.6250- 2	2.2000- 2	3.4500- 2
67	1.9500+ 7	9.3750- 2	2.0000- 2	3.3500- 2
68	1.9750+ 7	9.1250- 2	1.8500- 2	3.2500- 2

Table 20

Group cross-sections for ^{239}Pu and ^{241}Pu nuclei

NO.	GROUP-EV	PU-241(G,N) AVERAGE	PU-239(G,N) AVERAGE	PU-239(G,2N) AVERAGE
17	5.0000+ 6	3.6000-10	-	
18	5.2500+ 6	1.0100- 6	-	
19	5.5000+ 6	4.5000- 6	2.2440- 9	
20	5.7500+ 6	9.0000- 6	1.0100- 6	
21	6.0000+ 6	2.1400- 5	7.8000- 6	
22	7.2500+ 6	3.6000- 5	1.5500- 5	
23	7.5000+ 6	4.2500- 5	1.8500- 5	
24	7.7500+ 6	5.0000- 5	2.1500- 5	
25	8.0000+ 6	5.8000- 5	2.5500- 5	
26	8.2500+ 6	6.6500- 5	3.0000- 5	
27	8.5000+ 6	7.6000- 5	3.4000- 5	
28	8.7500+ 6	8.7500- 5	3.8000- 5	
29	9.0000+ 6	1.0100- 4	4.3000- 5	
30	9.2500+ 6	1.2150- 4	4.8650- 5	
31	9.5000+ 6	1.5400- 4	5.5000- 5	
32	9.7500+ 6	1.8400- 4	6.1350- 5	
33	1.0000+ 7	1.9800- 4	6.8500- 5	
34	1.0250+ 7	1.9750- 4	7.9000- 5	
35	1.0500+ 7	1.8600- 4	9.8500- 5	
36	1.0750+ 7	1.6750- 4	1.2350- 4	
37	1.1000+ 7	1.4850- 4	1.4700- 4	
38	1.1250+ 7	1.2750- 4	1.7050- 4	
39	1.1500+ 7	1.0250- 4	1.8700- 4	
40	1.1750+ 7	8.2500- 5	1.9000- 4	
41	1.2000+ 7	7.2000- 5	1.8500- 4	
42	1.2250+ 7	6.6500- 5	1.7850- 4	
43	1.2500+ 7	6.2000- 5	1.7050- 4	9.6000-11
44	1.2750+ 7	5.8000- 5	1.6150- 4	6.5000-10
45	1.3000+ 7	5.4500- 5	1.5100- 4	9.0000-10
46	1.3250+ 7	5.1500- 5	1.4000- 4	2.0000- 9
47	1.3500+ 7	4.8500- 5	1.2950- 4	4.0000- 9
48	1.3750+ 7	4.6000- 5	1.1900- 4	5.5000- 9
49	1.4000+ 7	4.4000- 5	1.0800- 4	7.0000- 9
50	1.4250+ 7	4.2500- 5	9.7000- 5	9.0000- 9
51	1.4500+ 7	4.1500- 5	8.9000- 5	1.5000- 8
52	1.4750+ 7	4.0000- 5	8.3000- 5	2.5000- 8
53	1.5000+ 7	3.8000- 5	7.7500- 5	7.5000- 8
54	1.5250+ 7	3.4000- 5	6.3600- 5	1.9660- 6
55	1.6500+ 7	3.0500- 5	5.0500- 5	4.5400- 6
56	1.6750+ 7	2.9500- 5	4.6500- 5	5.1500- 6
57	1.7000+ 7	2.8500- 5	4.3500- 5	5.5100- 6
58	1.7250+ 7	2.7000- 5	4.0000- 5	5.7000- 6
59	1.7500+ 7	2.5500- 5	3.6500- 5	5.7150- 6
60	1.7750+ 7	2.4750- 5	3.3500- 5	5.5950- 6
61	1.8000+ 7	2.4250- 5	3.0500- 5	5.4650- 6
62	1.8250+ 7	2.3750- 5	2.7500- 5	5.3050- 6
63	1.8500+ 7	2.3250- 5	2.4500- 5	5.1000- 6
64	1.8750+ 7	2.2500- 5	2.2000- 5	4.8400- 6
65	1.9000+ 7	2.1500- 5	1.9500- 5	4.5900- 6
66	1.9250+ 7	2.0750- 5	1.7000- 5	4.3500- 6
67	1.9500+ 7	2.0250- 5	1.5000- 5	4.1100- 6
68	1.9750+ 7	1.9500- 5	1.3500- 5	3.8950- 6

Table 21

Group cross-sections for ^{235}U, ^{238}U, ^{241}Am and ^{243}Am nuclei

NO.	GROUP-EV	AM-241(G,F) AVERAGE	AM-243(G,F) AVERAGE	U-238(G,F) AVERAGE	U-235(G,F) AVERAGE
10	3.2500+ 6	-	-	2.7498-11	1.6909-10
11	3.5000+ 6	2.4597-11	2.4597-11	3.2261-10	8.4545-10
12	3.7500+ 6	4.7609-10	4.7609-10	2.5164-10	7.9631-10
13	4.0000+ 6	6.0494- 9	6.0494- 9	1.7212- 9	1.3629-10
14	4.2500+ 6	5.3500- 8	5.3500- 8	1.9155- 8	4.7740-10
15	4.5000+ 6	5.5527- 7	5.5527- 7	8.5812- 7	1.7118- 8
16	4.7500+ 6	1.3931- 5	1.3931- 5	6.9585- 6	3.3910- 7
17	5.0000+ 6	2.0602- 4	2.0602- 4	5.9726- 5	9.0270- 6
18	5.2500+ 6	1.6716- 3	1.6716- 3	4.5254- 4	1.1615- 4
19	5.5000+ 6	5.4042- 3	5.4042- 3	2.1467- 3	3.8551- 4
20	5.7500+ 6	8.5477- 3	8.5477- 3	3.2810- 3	2.2289- 3
21	6.0000+ 6	1.9344- 2	2.0490- 2	6.4070- 3	8.5019- 3
22	7.2500+ 6	3.6250- 2	4.0250- 2	9.8098- 3	1.8379- 2
23	7.5000+ 6	4.2250- 2	4.8000- 2	1.2653- 2	2.0770- 2
24	7.7500+ 6	4.8750- 2	5.8000- 2	1.5446- 2	2.0600- 2
25	8.0000+ 6	5.7000- 2	6.8500- 2	1.5933- 2	2.3695- 2
26	8.2500+ 6	6.7000- 2	7.9500- 2	1.8922- 2	3.2815- 2
27	8.5000+ 6	7.6750- 2	9.1750- 2	2.4399- 2	3.9544- 2
28	8.7500+ 6	8.6250- 2	1.0525- 1	2.8044- 2	4.6146- 2
29	9.0000+ 6	1.0225- 1	1.2275- 1	3.3017- 2	5.6131- 2
30	9.2500+ 6	1.2475- 1	1.4425- 1	4.0959- 2	6.8275- 2
31	9.5000+ 6	1.4400- 1	1.6450- 1	5.0066- 2	8.5268- 2
32	9.7500+ 6	1.6000- 1	1.8350- 1	6.0578- 2	1.0586- 1
33	1.0000+ 7	1.7100- 1	1.9850- 1	7.2274- 2	1.2647- 1
34	1.0250+ 7	1.7700- 1	2.0950- 1	8.4815- 2	1.4628- 1
35	1.0500+ 7	1.8300- 1	2.1850- 1	9.2420- 2	1.6568- 1
36	1.0750+ 7	1.8900- 1	2.2550- 1	9.9609- 2	1.8511- 1
37	1.1000+ 7	1.9400- 1	2.3100- 1	9.9437- 2	2.0132- 1
38	1.1250+ 7	1.9800- 1	2.3500- 1	9.9683- 2	2.1519- 1
39	1.1500+ 7	2.0250- 1	2.3875- 1	9.4169- 2	2.2652- 1
40	1.1750+ 7	2.0750- 1	2.4225- 1	9.6061- 2	2.3619- 1
41	1.2000+ 7	2.1375- 1	2.4550- 1	9.5776- 2	2.4732- 1
42	1.2250+ 7	2.2125- 1	2.4850- 1	1.0291- 1	2.5916- 1
43	1.2500+ 7	2.2025- 1	2.6000- 1	1.1252- 1	2.7302- 1
44	1.2750+ 7	2.1075- 1	2.8000- 1	1.2422- 1	2.8916- 1
45	1.3000+ 7	2.3025- 1	3.0000- 1	1.4193- 1	3.0769- 1
46	1.3250+ 7	2.7875- 1	3.2000- 1	1.4783- 1	3.2337- 1
47	1.3500+ 7	3.1125- 1	3.3500- 1	1.5242- 1	3.2965- 1
48	1.3750+ 7	3.2775- 1	3.4500- 1	1.5942- 1	3.3079- 1
49	1.4000+ 7	3.3200- 1	3.3750- 1	1.6347- 1	3.2901- 1
50	1.4250+ 7	3.2400- 1	3.1250- 1	1.6424- 1	3.2426- 1
51	1.4500+ 7	3.1275- 1	2.8025- 1	1.6272- 1	3.0782- 1
52	1.4750+ 7	2.9825- 1	2.4075- 1	1.5937- 1	2.8374- 1
53	1.5000+ 7	2.8200- 1	2.0825- 1	1.5187- 1	2.6280- 1
54	1.5250+ 7	2.2740- 1	1.4455- 1	1.2036- 1	2.0366- 1
55	1.6500+ 7	1.7675- 1	1.0475- 1	9.2674- 2	1.5819- 1
56	1.6750+ 7	1.6225- 1	9.8250- 2	8.8203- 2	1.4251- 1
57	1.7000+ 7	1.4750- 1	1.0275- 1	8.4361- 2	1.2996- 1
58	1.7250+ 7	1.3250- 1	1.1825- 1	8.0616- 2	1.2437- 1
59	1.7500+ 7	1.2075- 1	1.3325- 1	7.5779- 2	1.1836- 1
60	1.7750+ 7	1.1225- 1	1.4775- 1	7.3743- 2	1.1166- 1
61	1.8000+ 7	1.1675- 1	1.5250- 1	7.5638- 2	1.0504- 1
62	1.8250+ 7	1.3425- 1	1.4750- 1	7.3602- 2	8.9216- 2
63	1.8500+ 7	1.4975- 1	1.4125- 1	6.8982- 2	7.5735- 2
64	1.8750+ 7	1.6325- 1	1.3375- 1	6.4587- 2	6.4387- 2
65	1.9000+ 7	1.6875- 1	1.2150- 1	6.0475- 2	5.4758- 2
66	1.9250+ 7	1.6625- 1	1.0450- 1	5.6626- 2	4.6569- 2
67	1.9500+ 7	1.6075- 1	7.6000- 2	5.3015- 2	3.9592- 2
68	1.9750+ 7	1.5225- 1	3.6000- 2	4.9638- 2	3.3670- 2

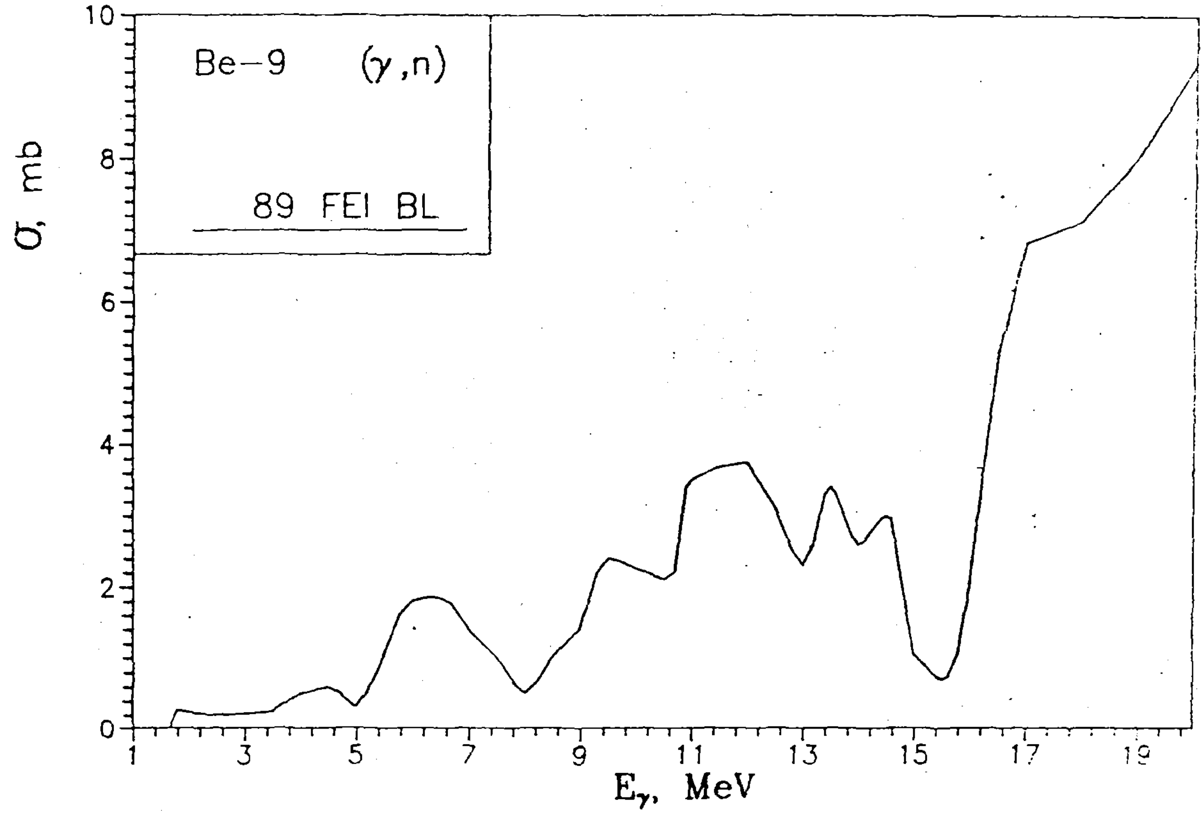

Fig. 1. Cross-section of (γ,n) reaction with ^{9}Be

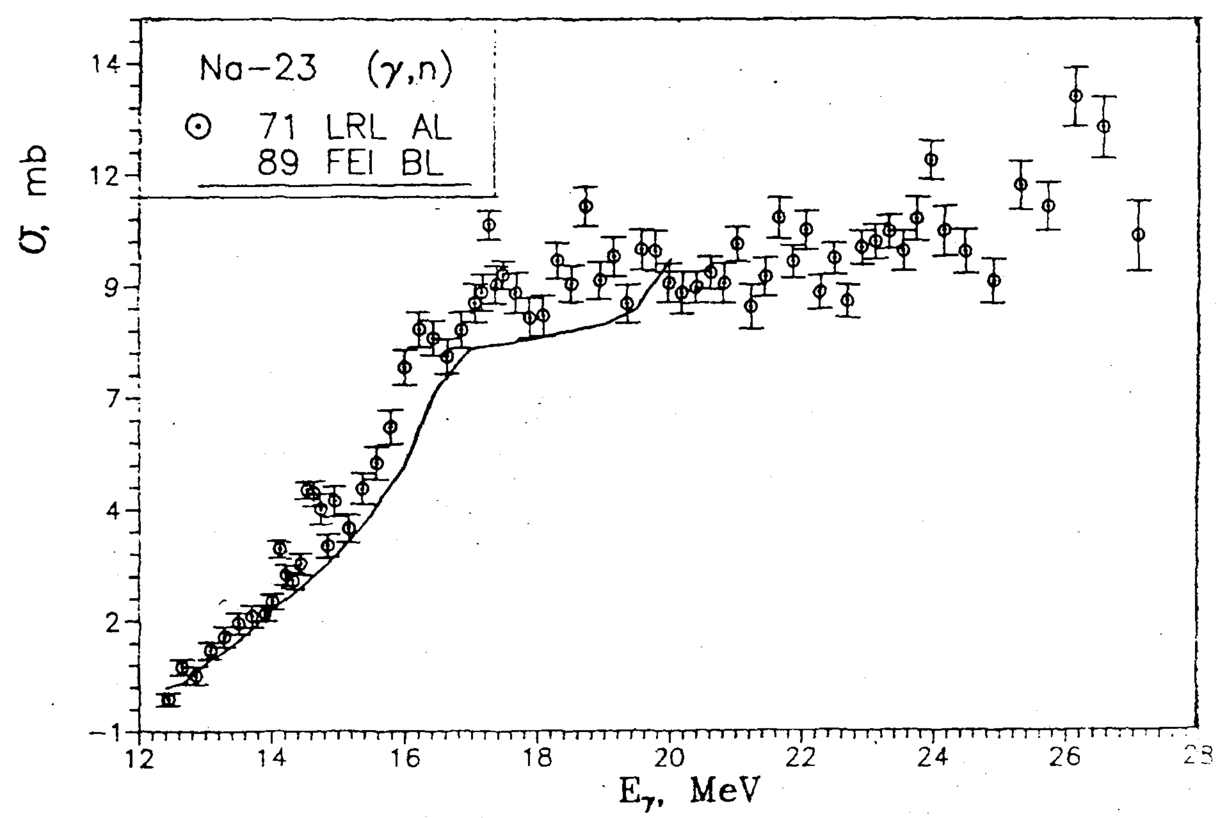

Fig. 2. Cross-section of (γ,n) reaction with ^{23}Na

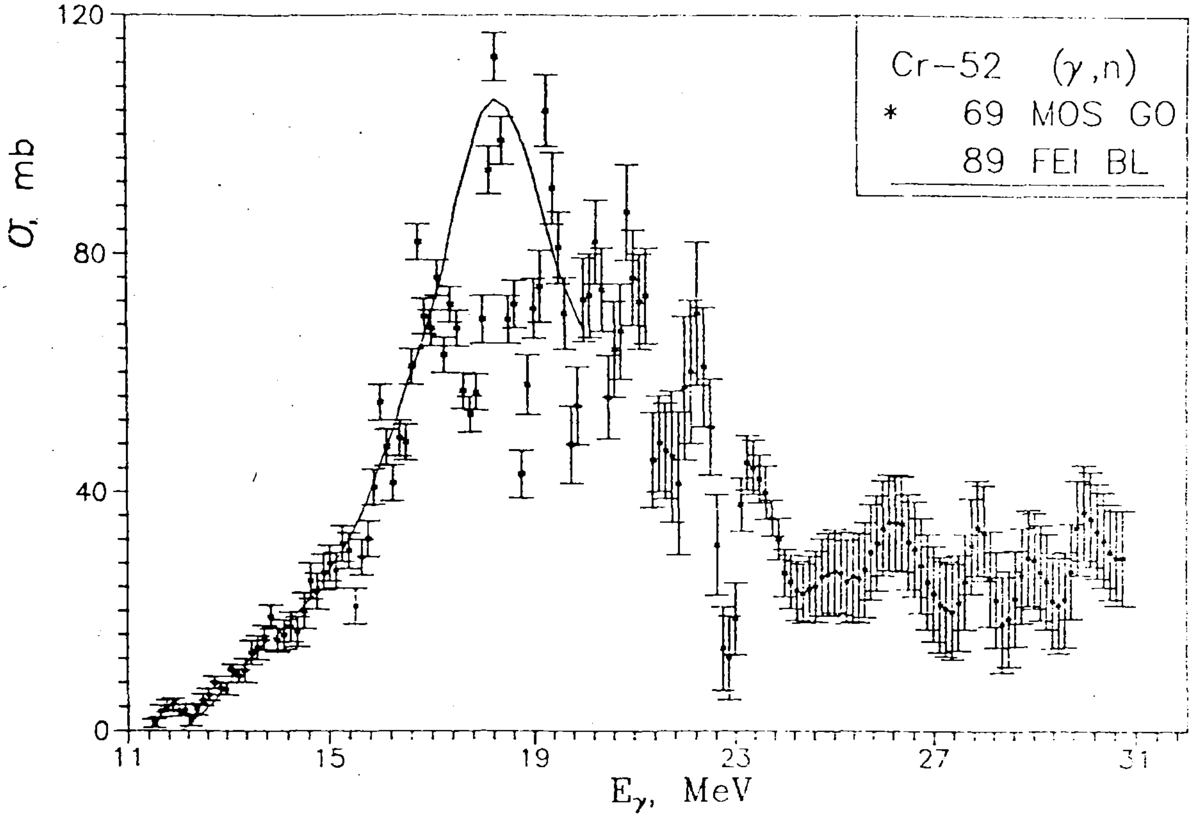

Fig. 3. Cross-section of (γ,n) reaction with ^{52}Cr

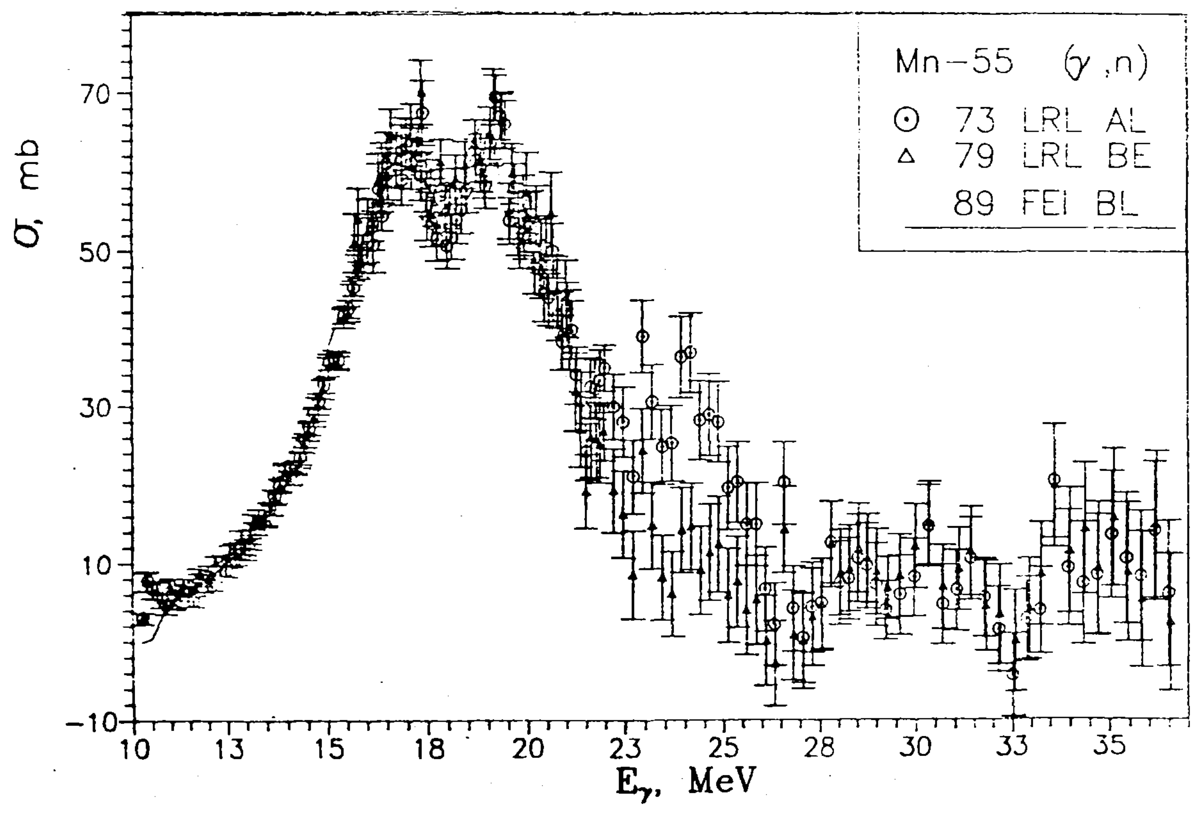

Fig. 4. Cross-section of (γ,n) reaction with ^{55}Mn

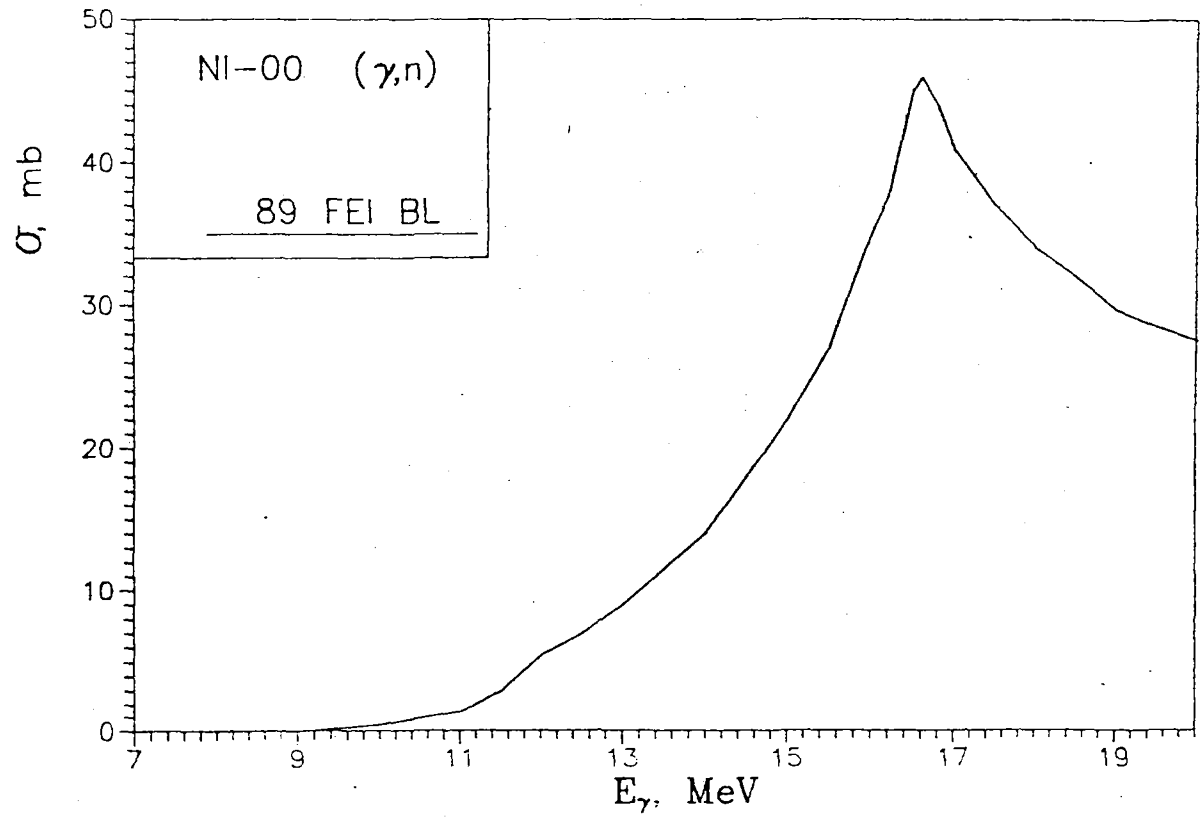

Fig. 5. Cross-section of (γ,n) reaction with ^{000}Ni

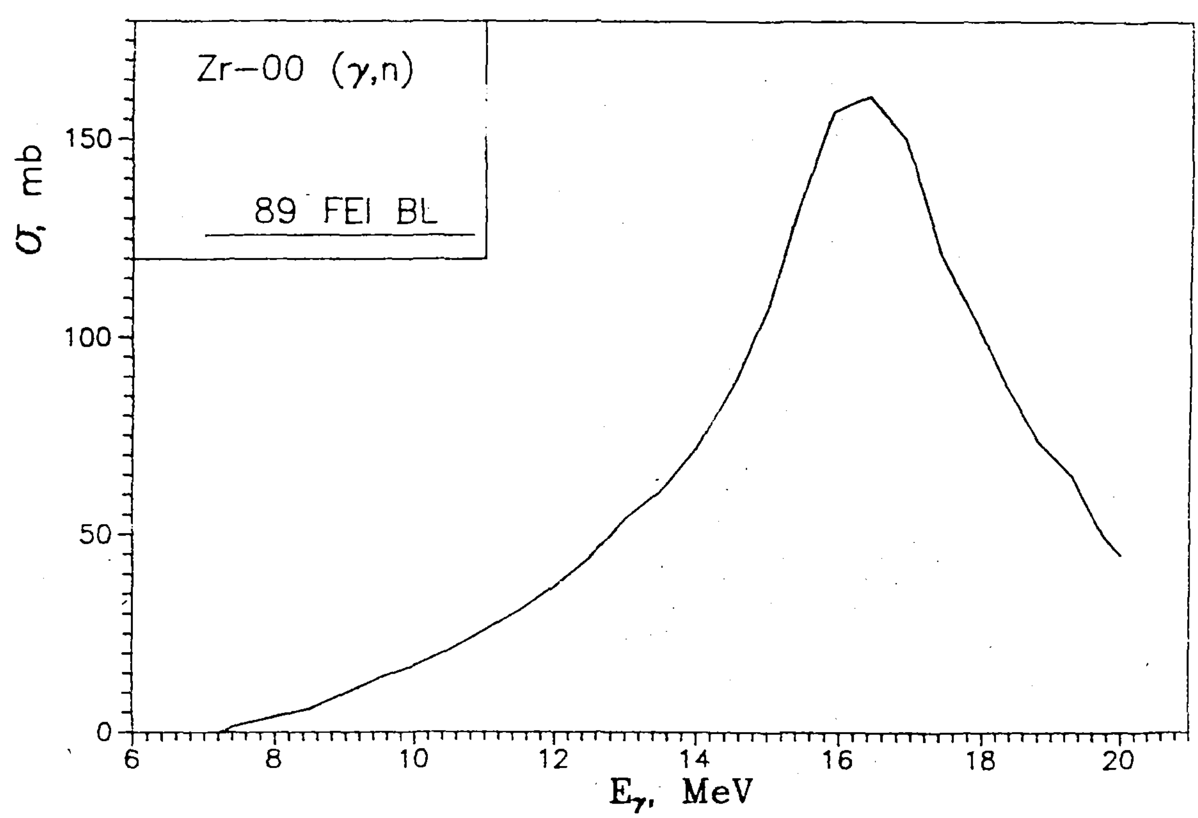

Fig. 6. Cross-section of (γ,n) reaction with ^{000}Zr

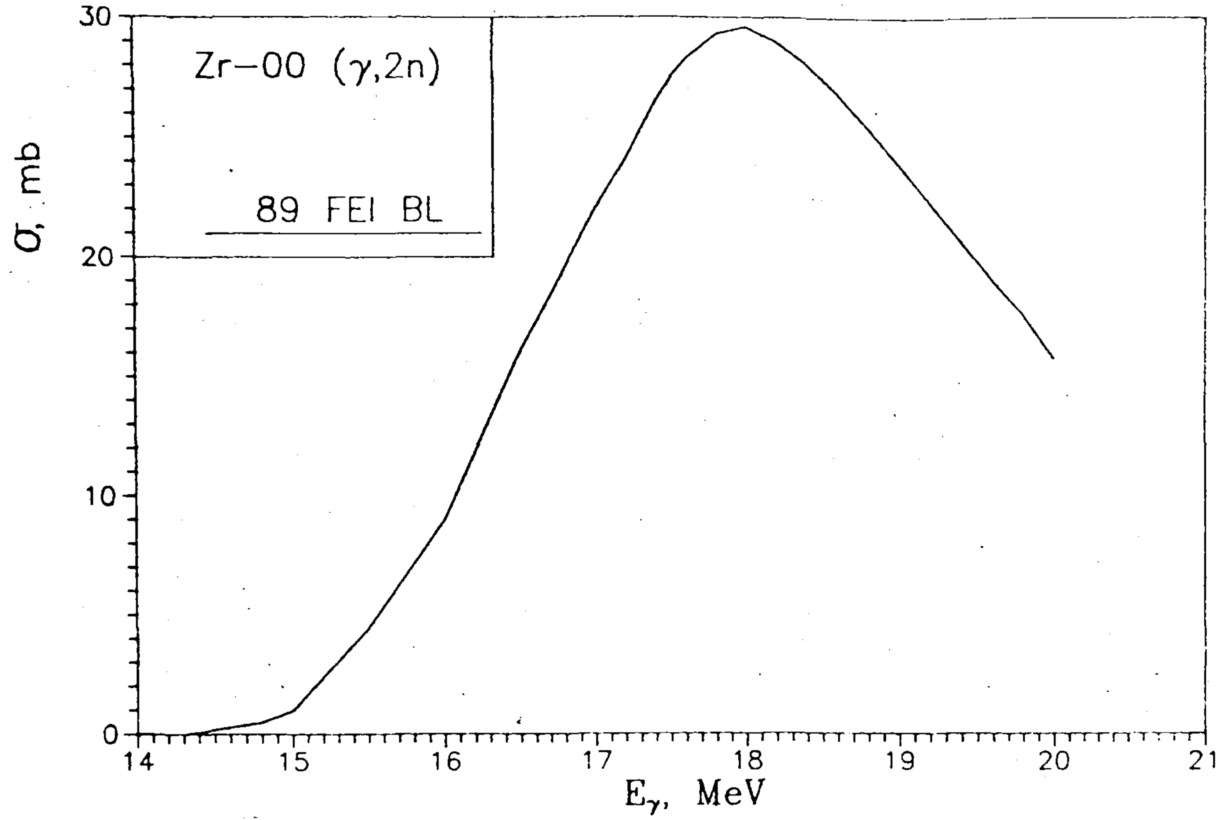

Fig. 7. Cross-section of (γ,2n) reaction with ^{000}Zr

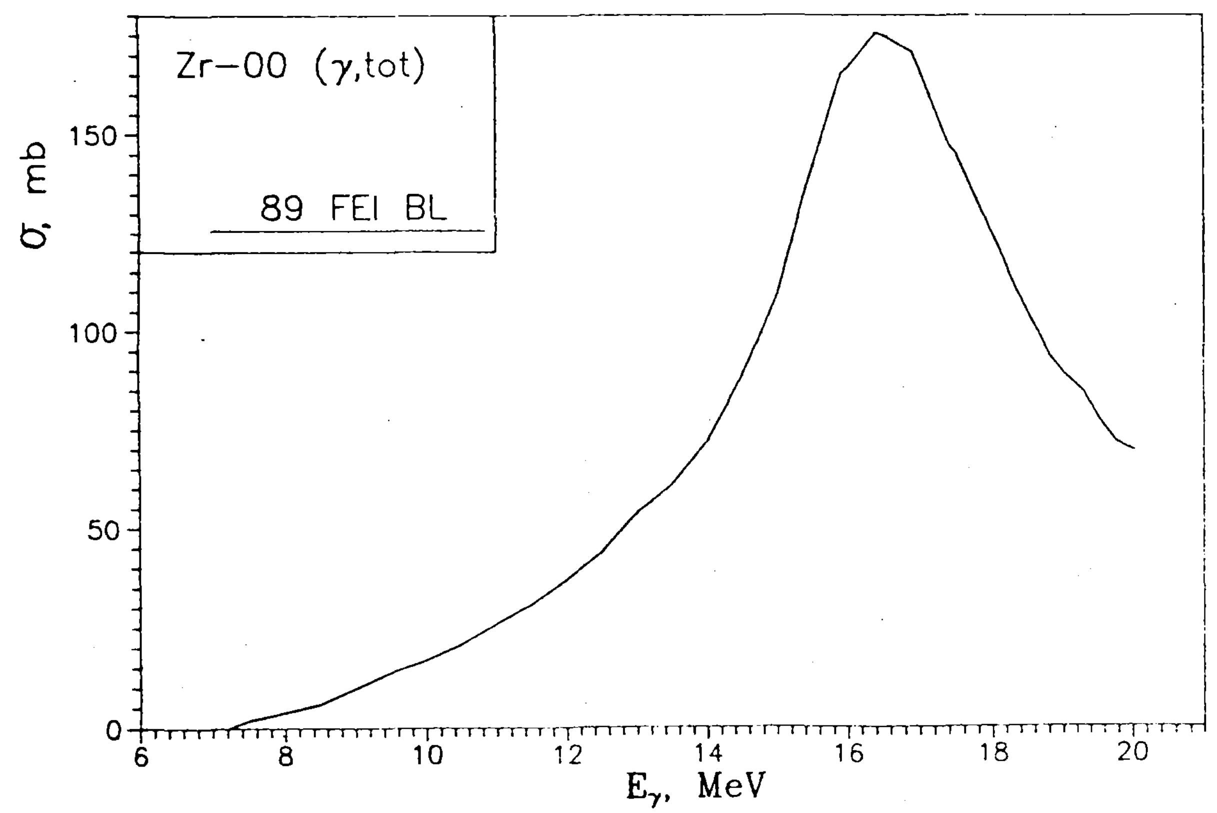

Fig. 8. Cross-section of (γ,tot) reaction with ^{000}Zr

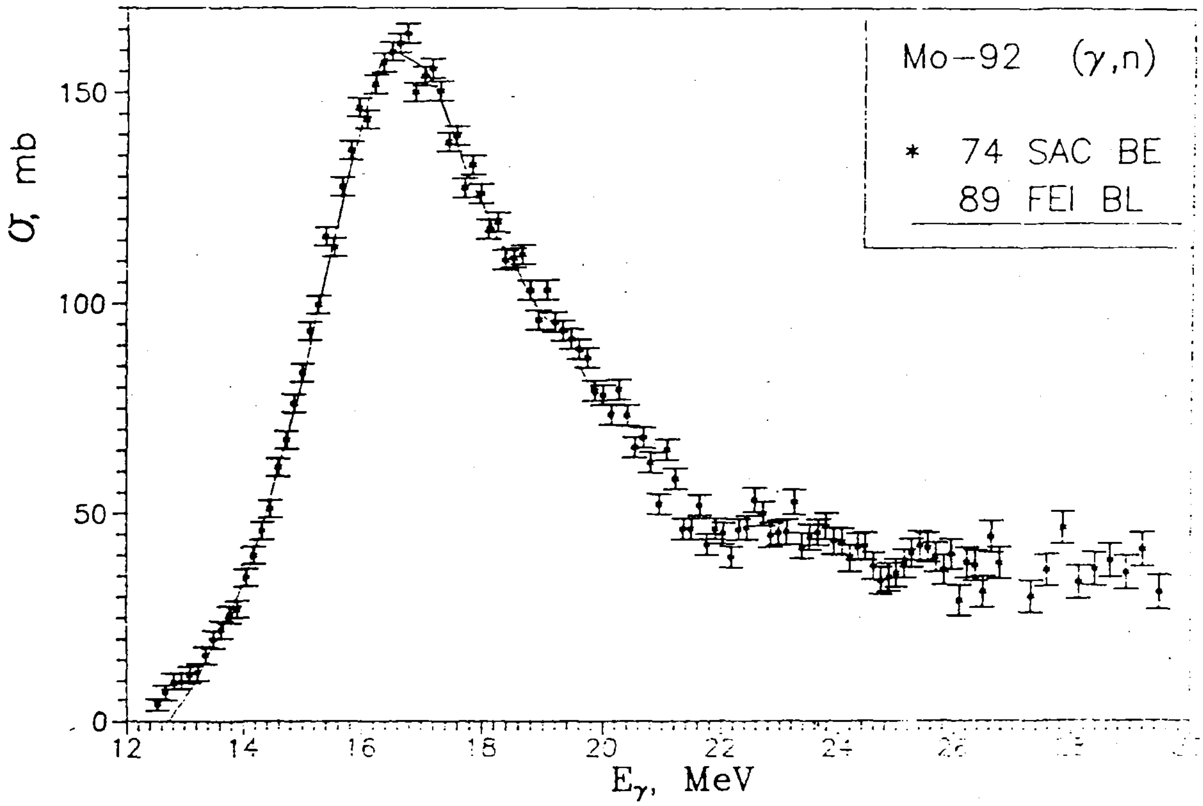

Fig. 9. Cross-section of (γ,n) reaction with ^{92}Mo

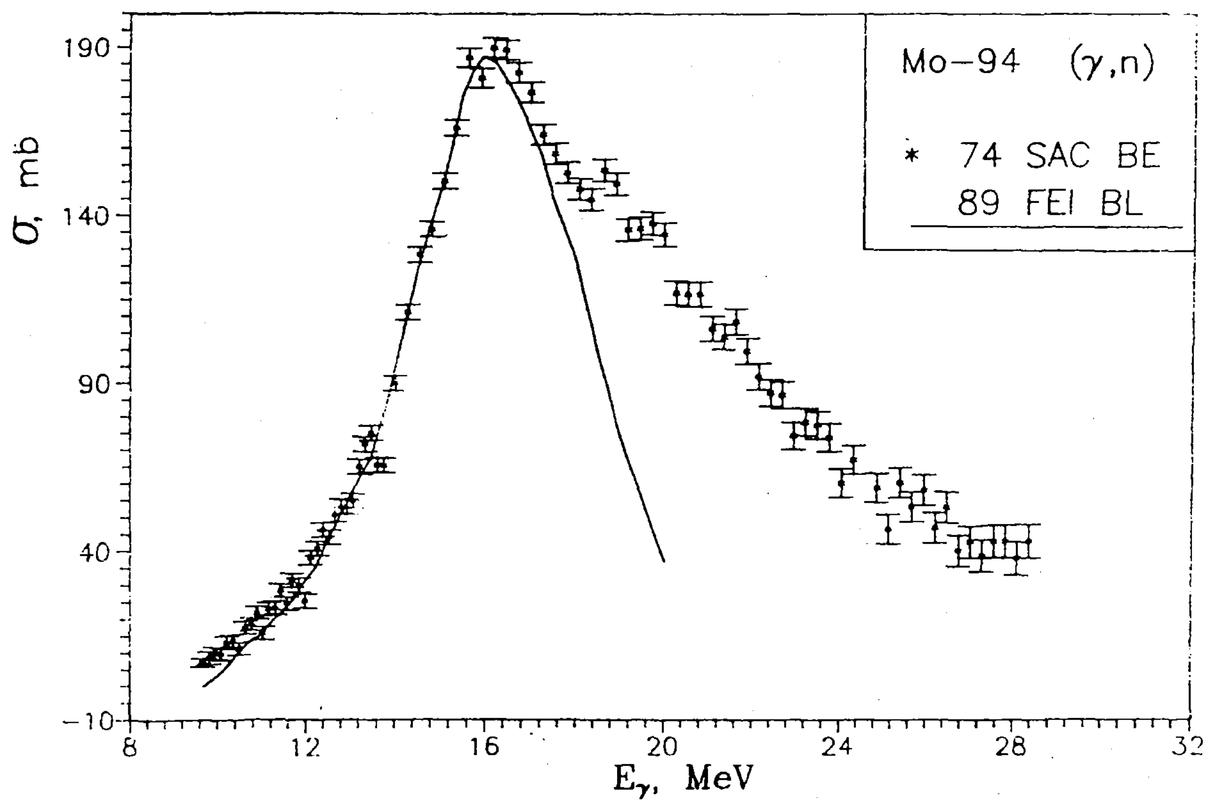

Fig. 10. Cross-section of (γ,n) reaction with ^{94}Mo

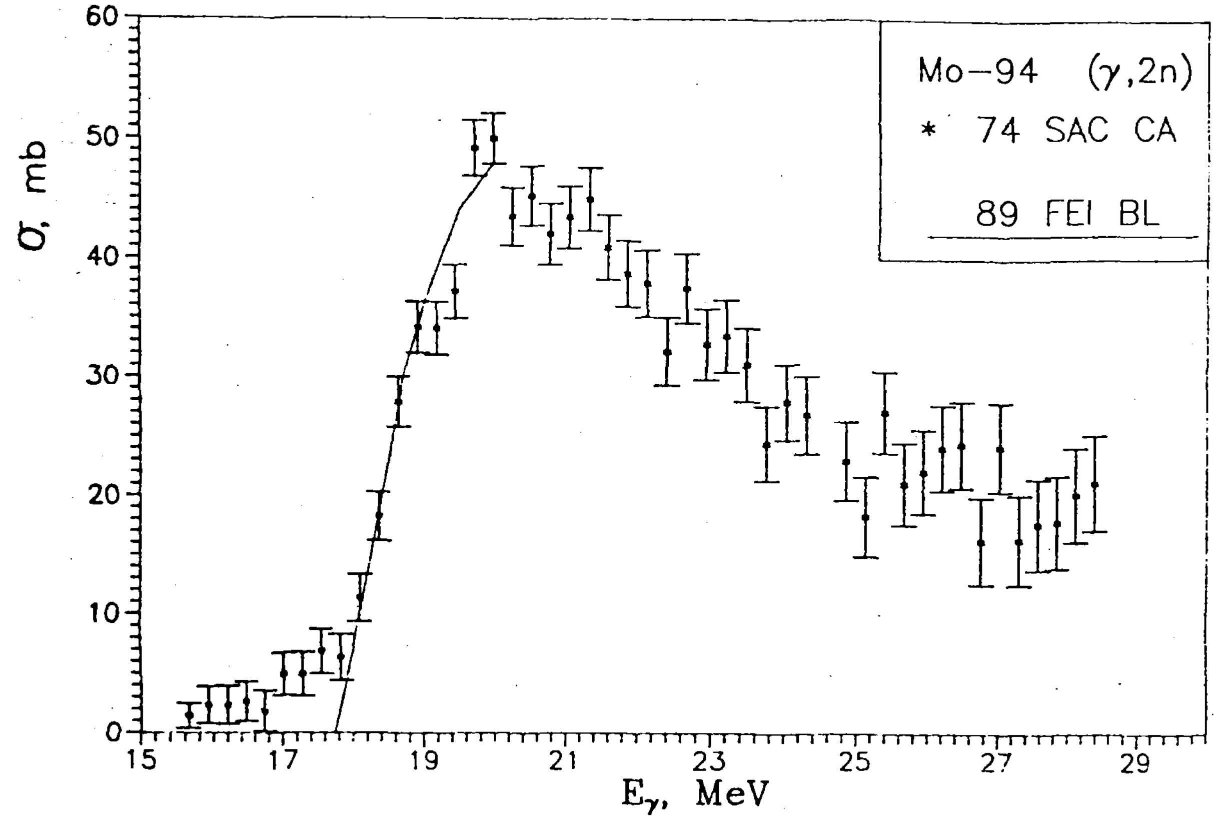

Fig. 11. Cross-section of (γ,2n) reaction with ^{94}Mo

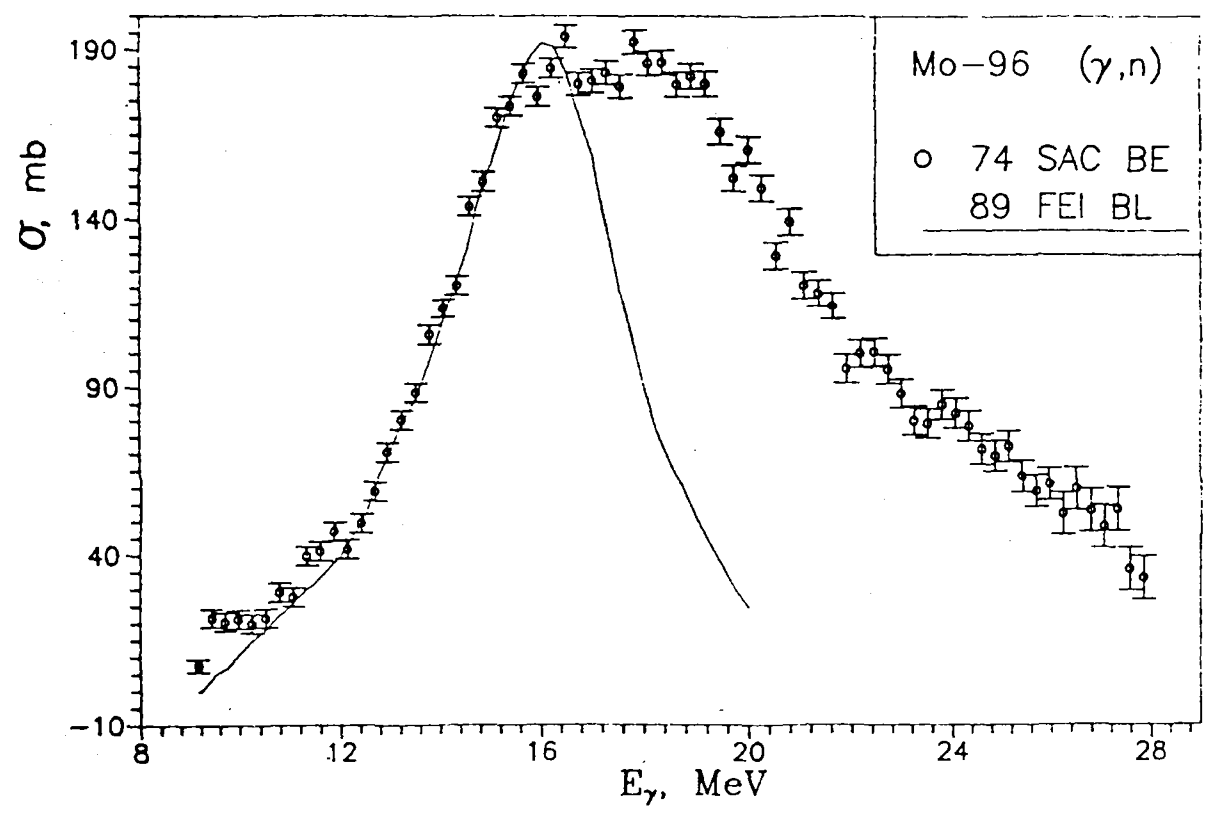

Fig. 12. Cross-section of (γ,n) reaction with ^{96}Mo

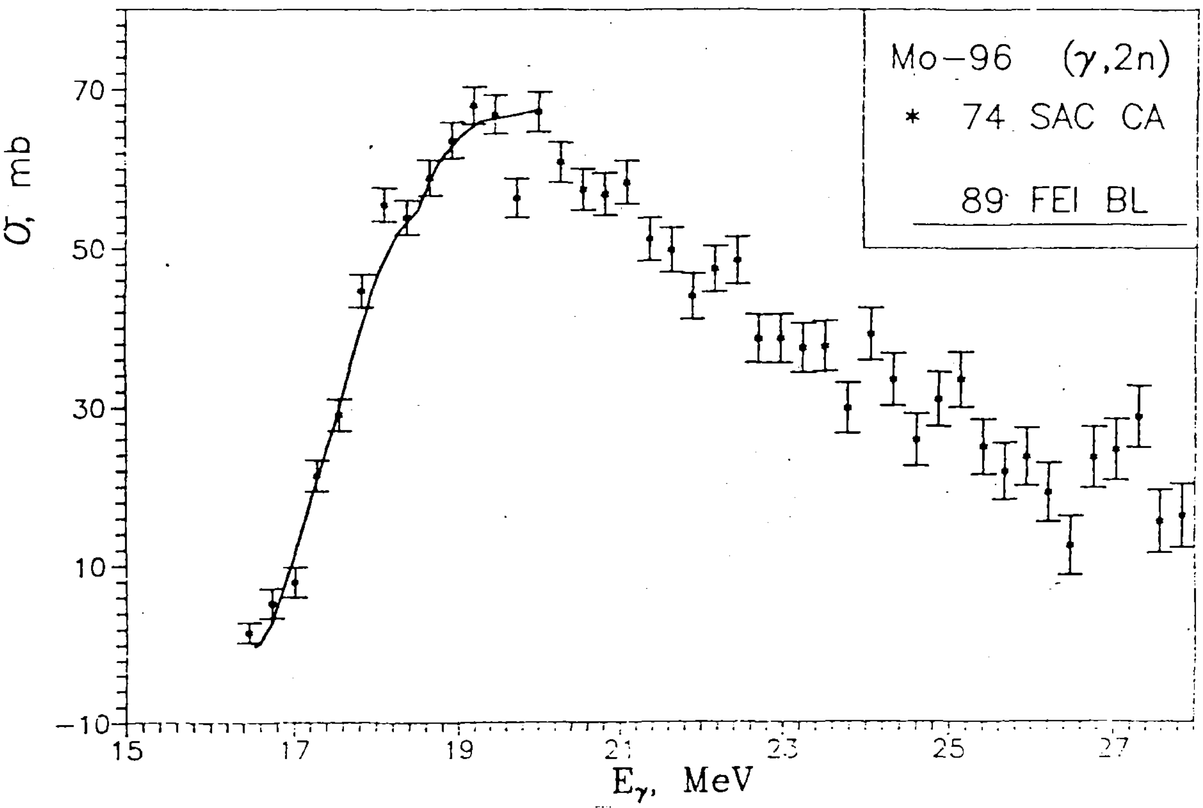

Fig. 13. Cross-section of (γ,2n) reaction with ^{96}Mo

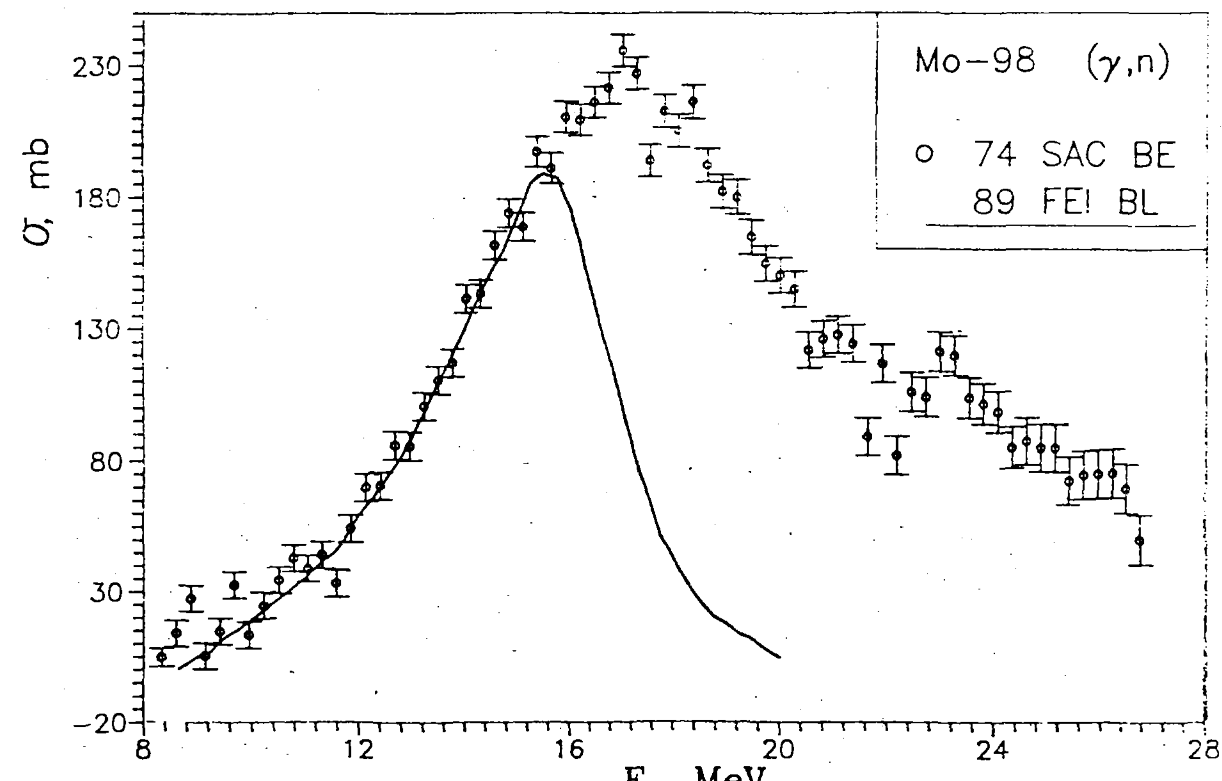

Fig. 14. Cross-section of (γ,n) reaction with ^{98}Mo

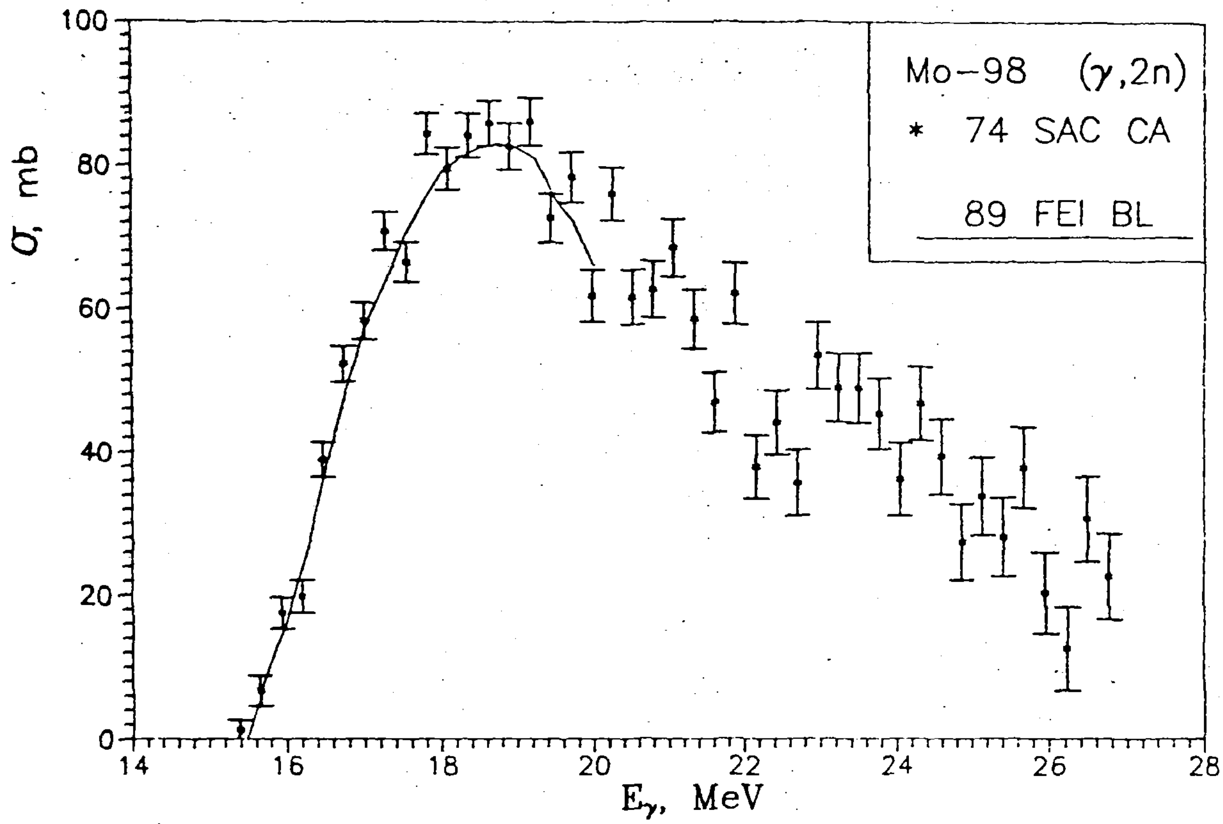

Fig. 15. Cross-section of (γ,2n) reaction with ^{98}Mo

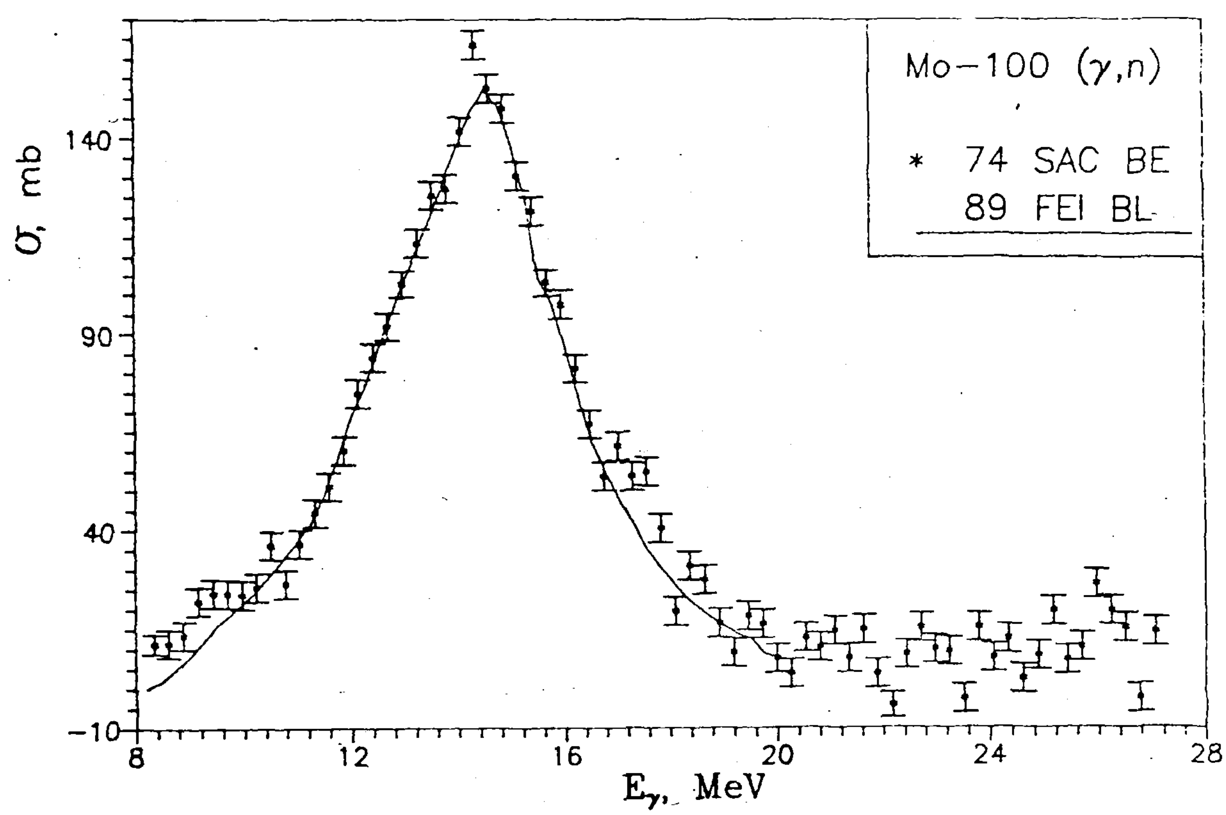

Fig. 16. Cross-section of (γ,n) reaction with ^{100}Mo

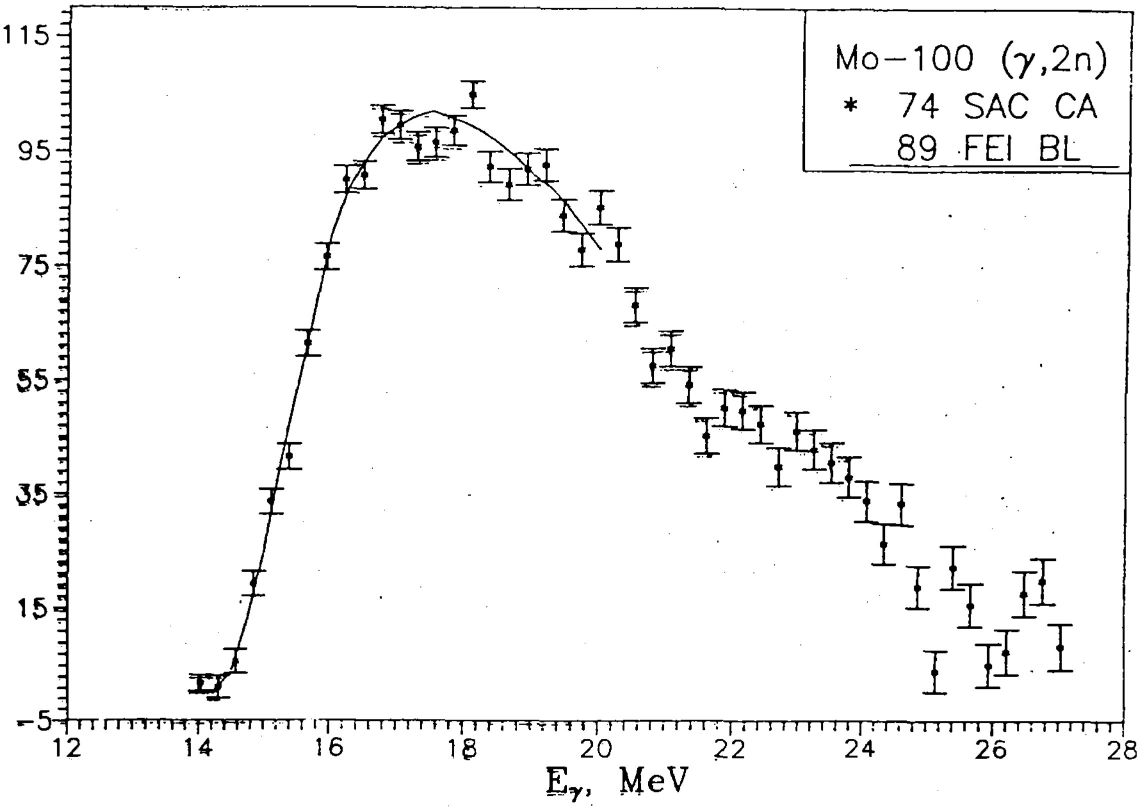

Fig. 17. Cross-section of (γ,2n) reaction with ^{100}Mo

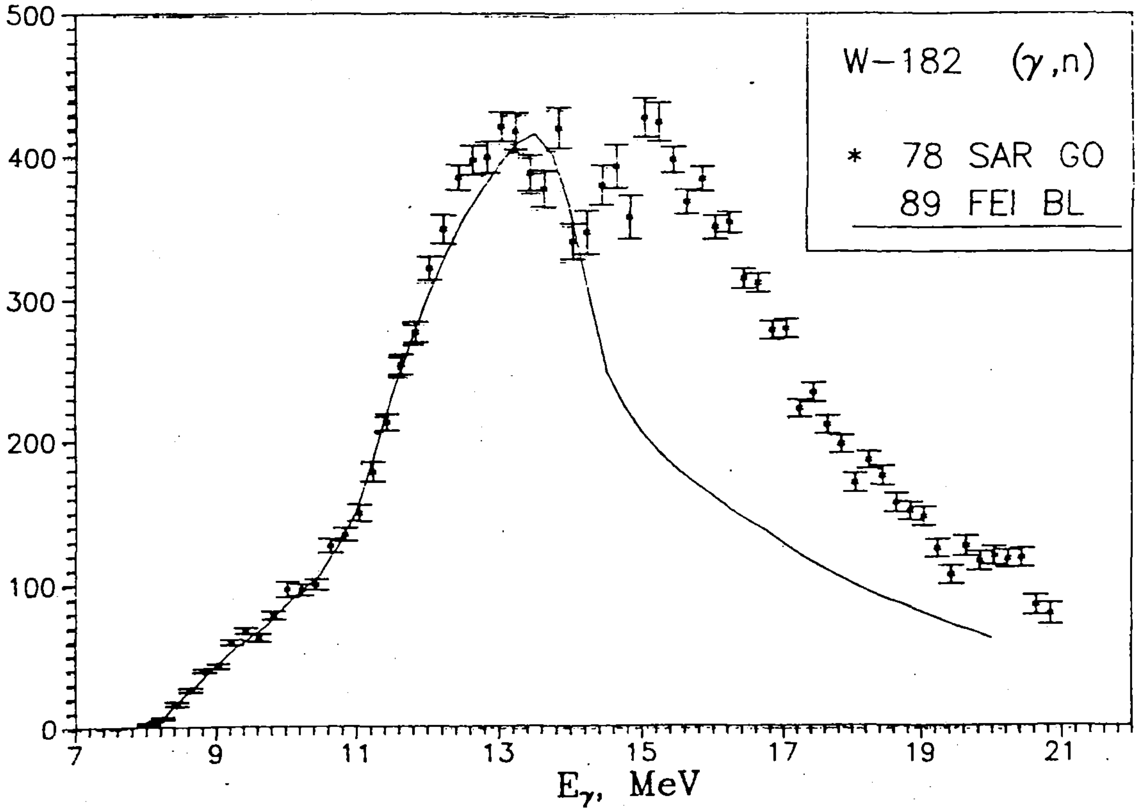

Fig. 18. Cross-section of (γ,n) reaction with ^{182}W

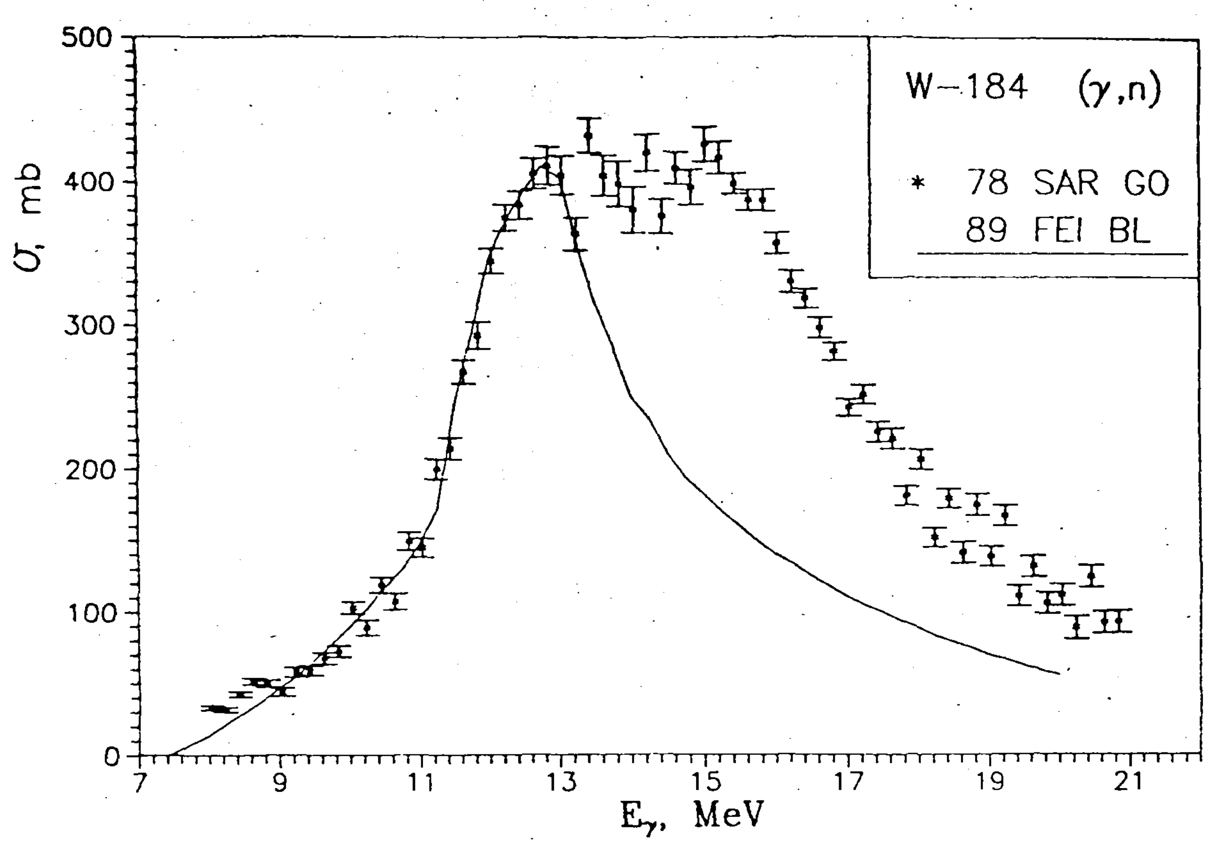

Fig. 19. Cross-section of (γ,n) reaction with ^{184}W

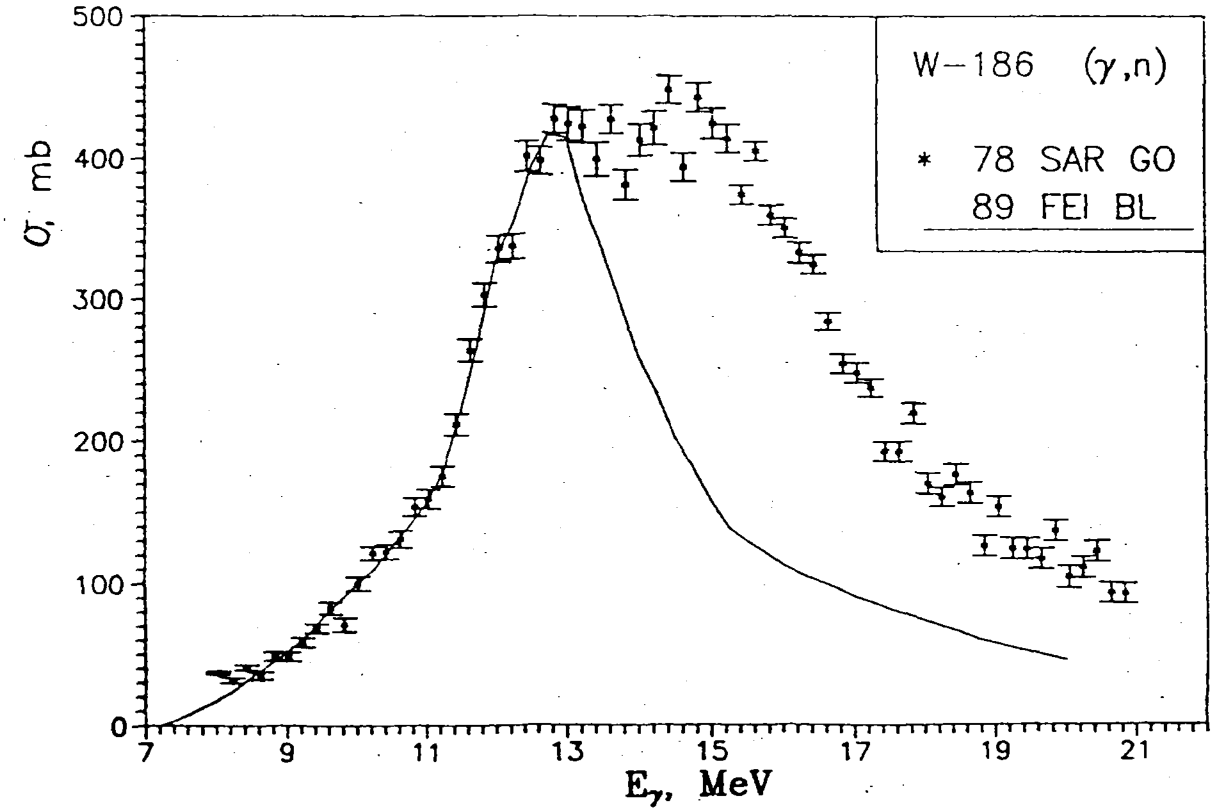

Fig. 20. Cross-section of (γ,n) reaction with ^{186}W

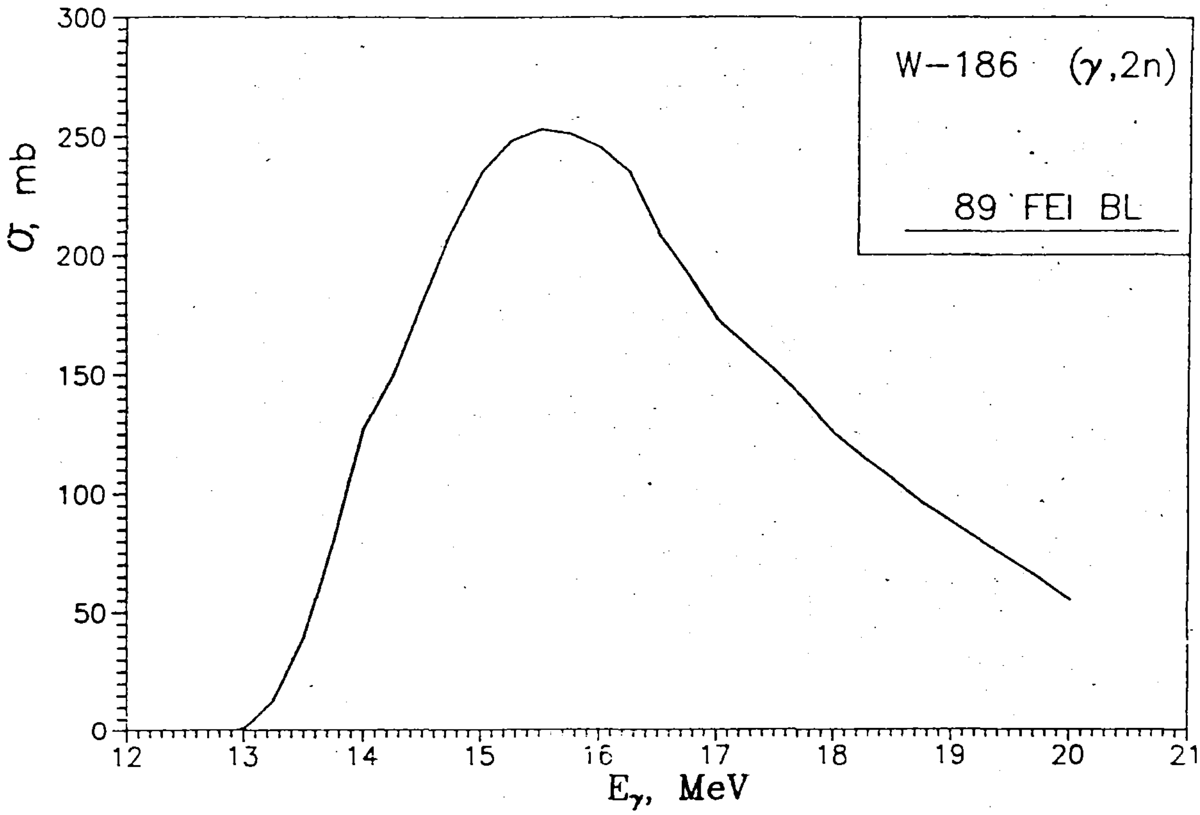

Fig. 21. Cross-section of $(\gamma,2n)$ reaction with ^{186}W

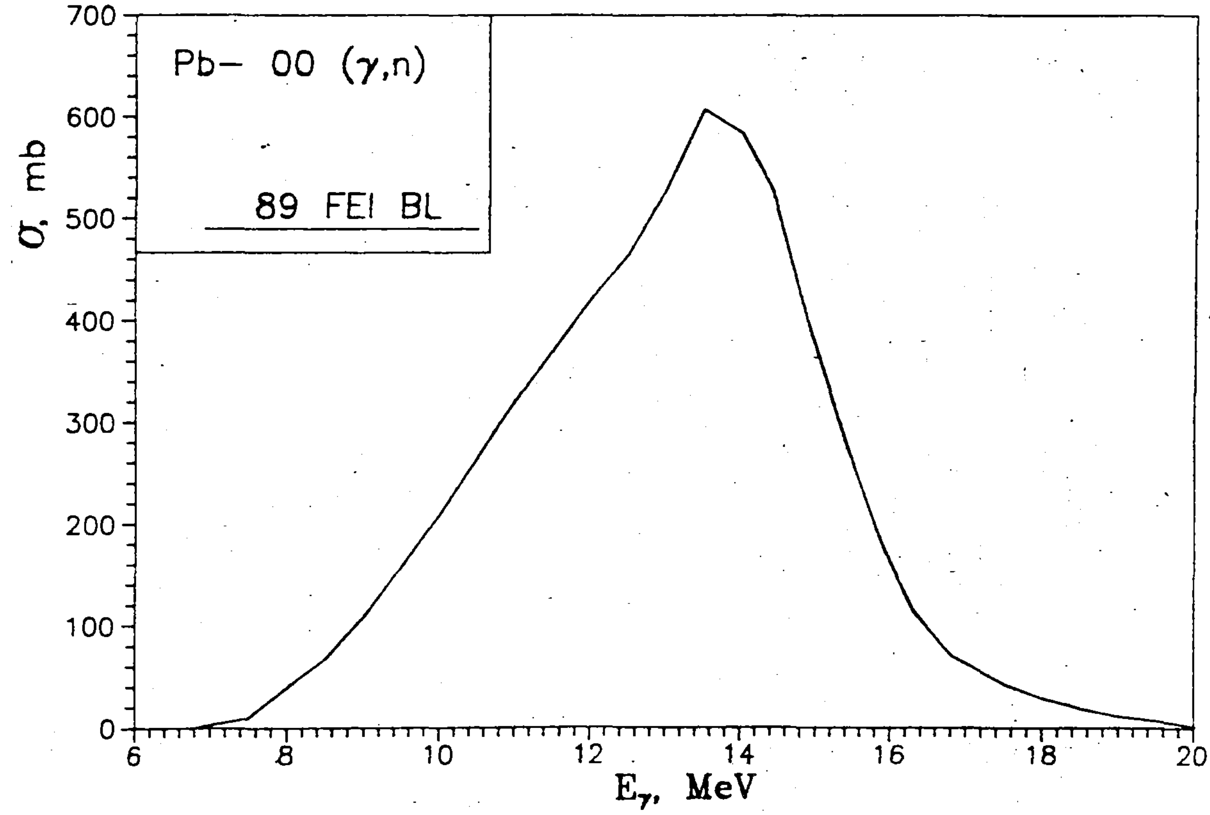

Fig. 22. Cross-section of (γ,n) reaction with ^{000}Pb

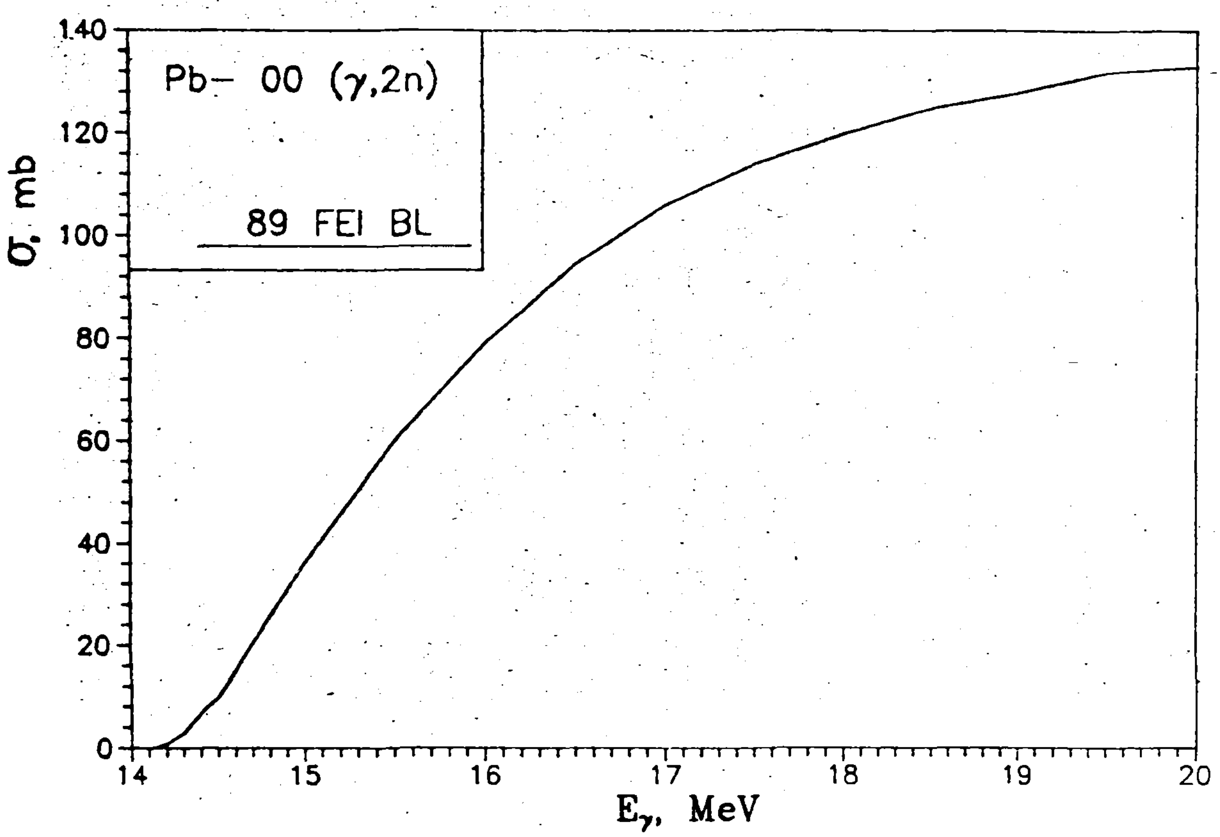

Fig. 23. Cross-section of (γ,2n) reaction with ^{000}Pb

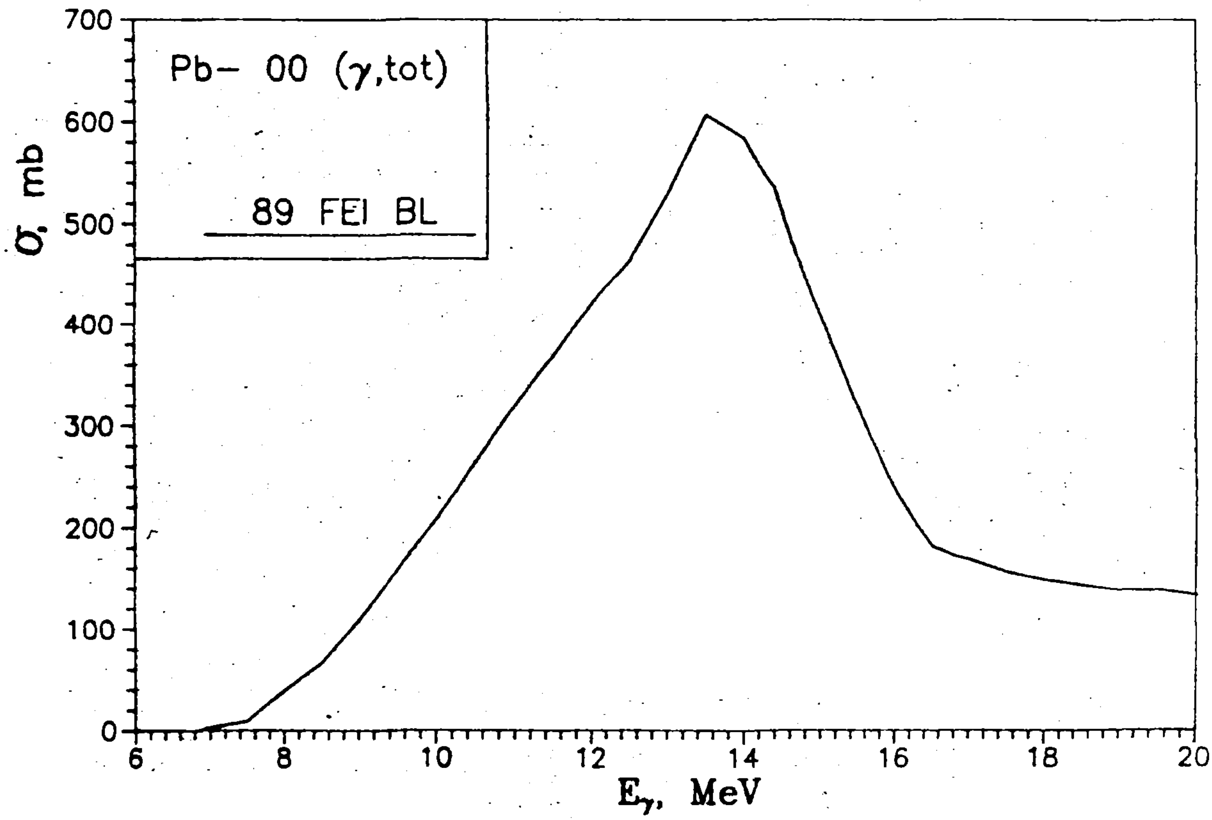

Fig. 24. Cross-section of (γ,tot) reaction with ^{000}Pb

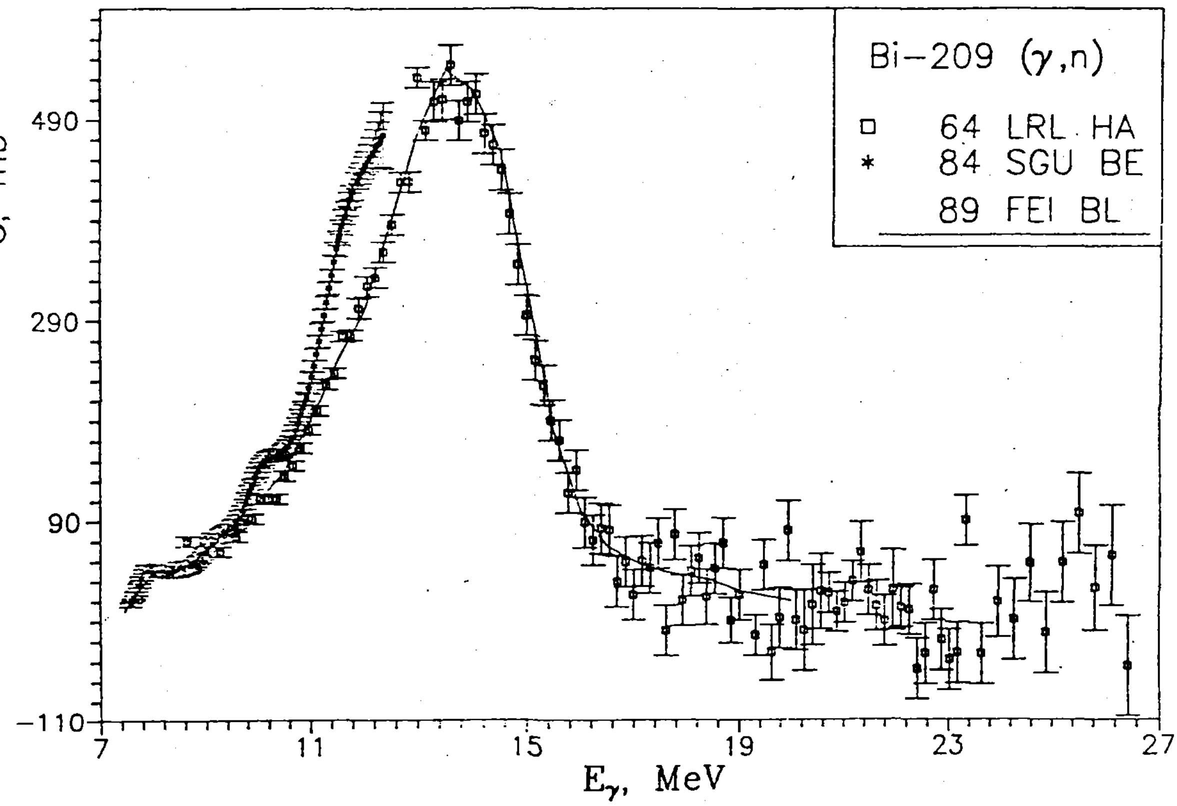

Fig. 25. Cross-section of (γ,n) reaction with ^{209}Bi

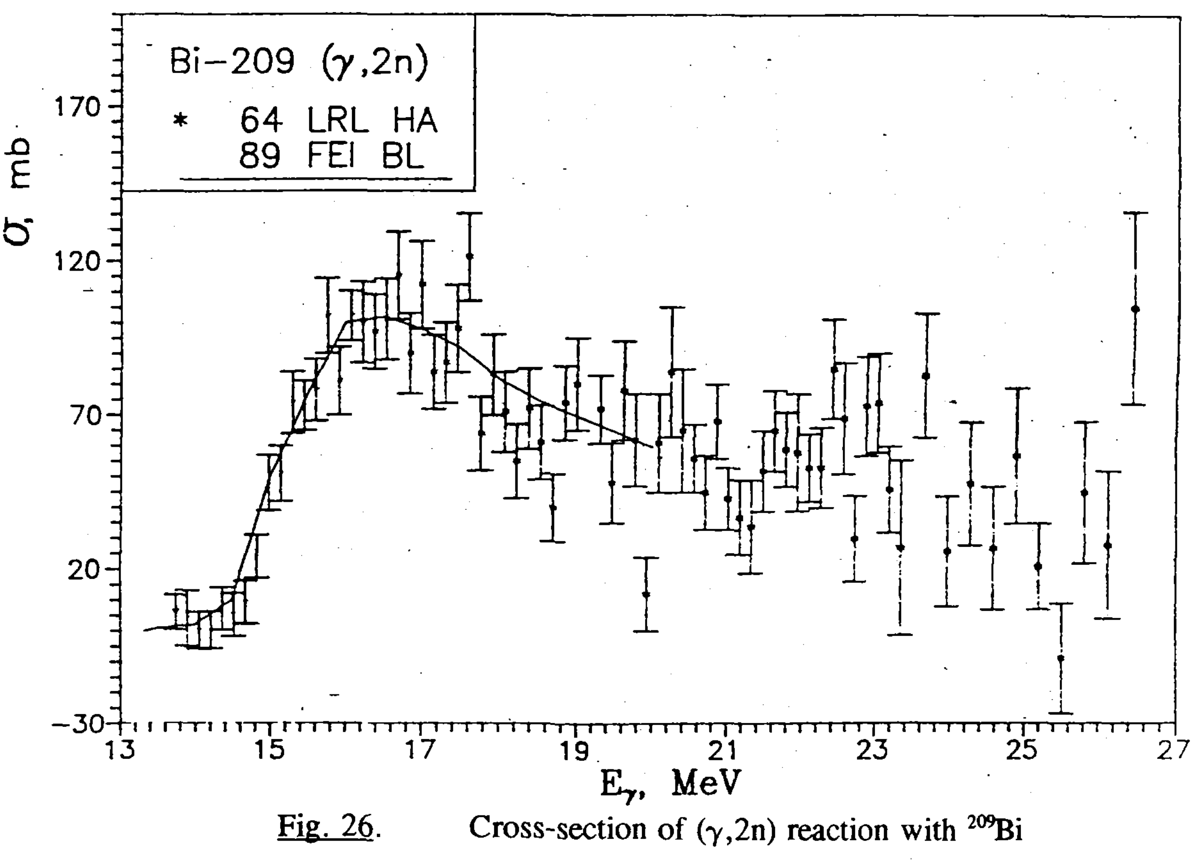

Fig. 26. Cross-section of (γ,2n) reaction with ^{209}Bi

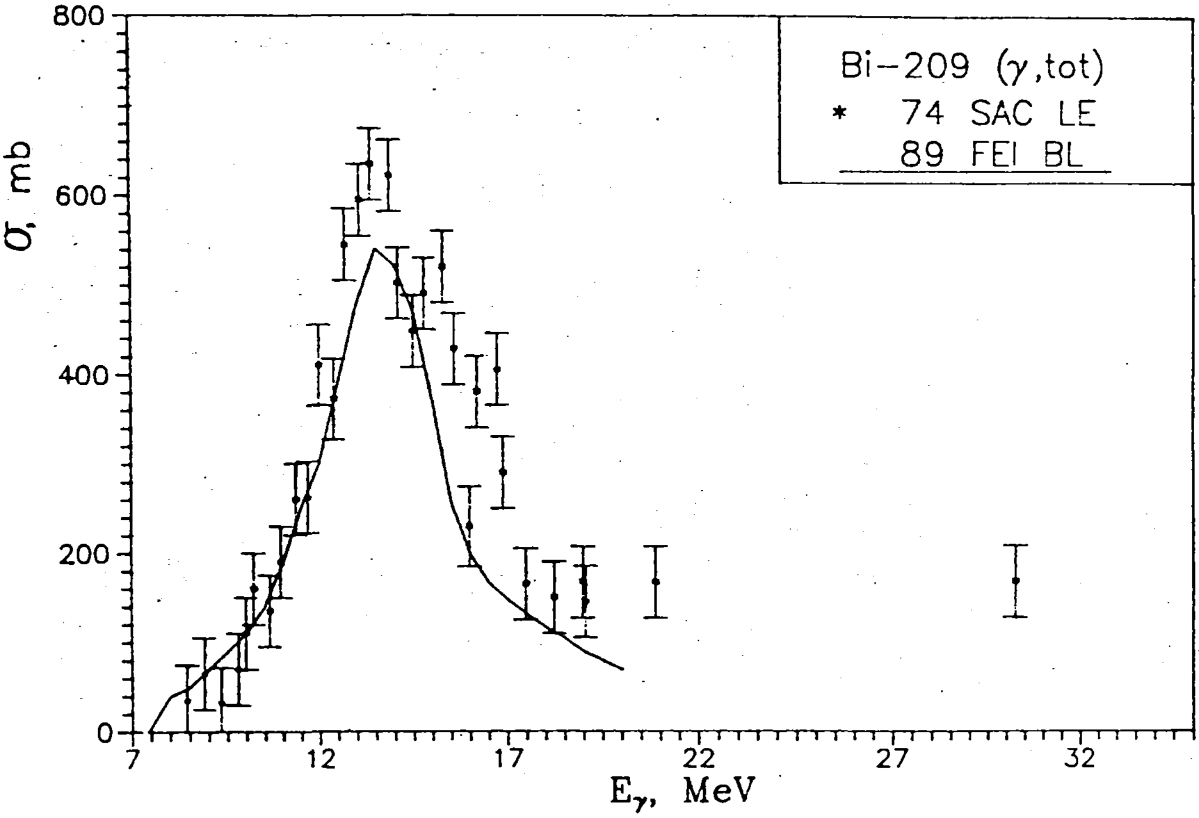

Fig. 27. Cross-section of (γ,tot) reaction with ^{209}Bi

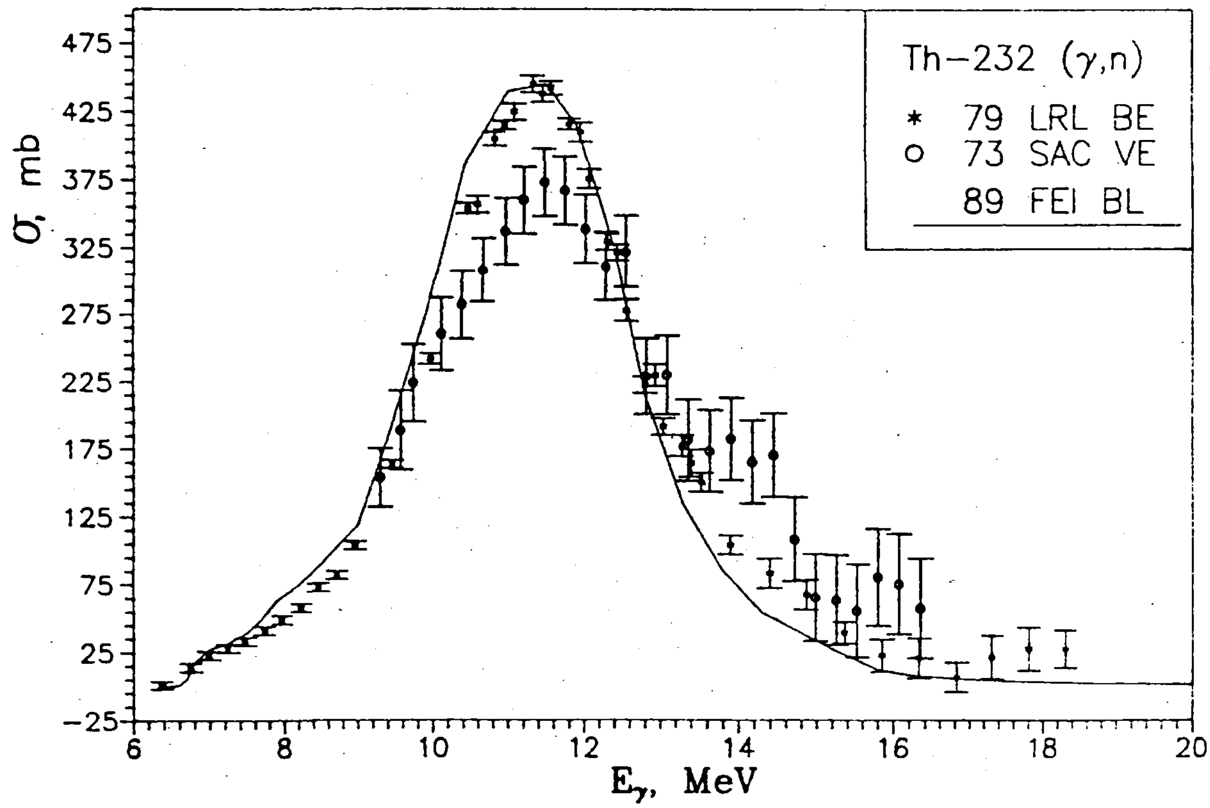

Fig. 28. Cross-section of (γ,n) reaction with ^{232}Th

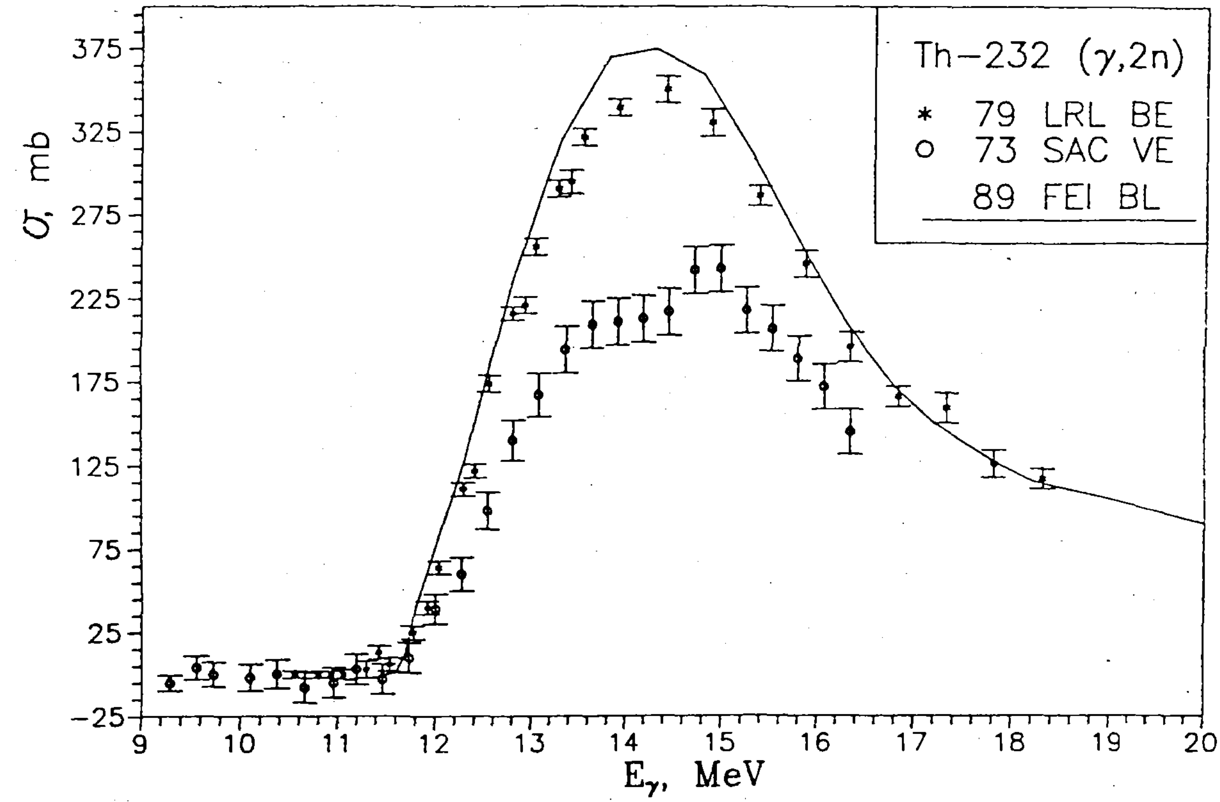

Fig. 29. Cross-section of (γ,2n) reaction with ^{232}Th

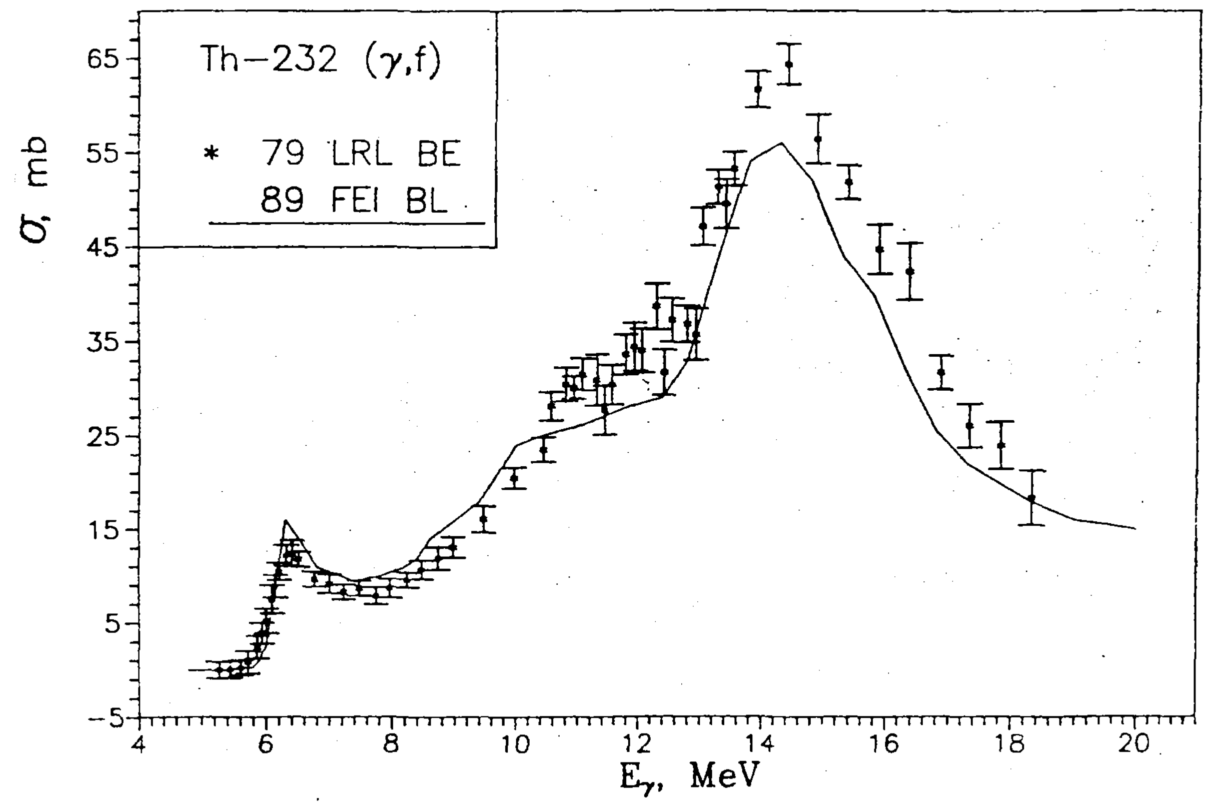

Fig. 30. Cross-section of (γ,fiss) reaction with ^{232}Th

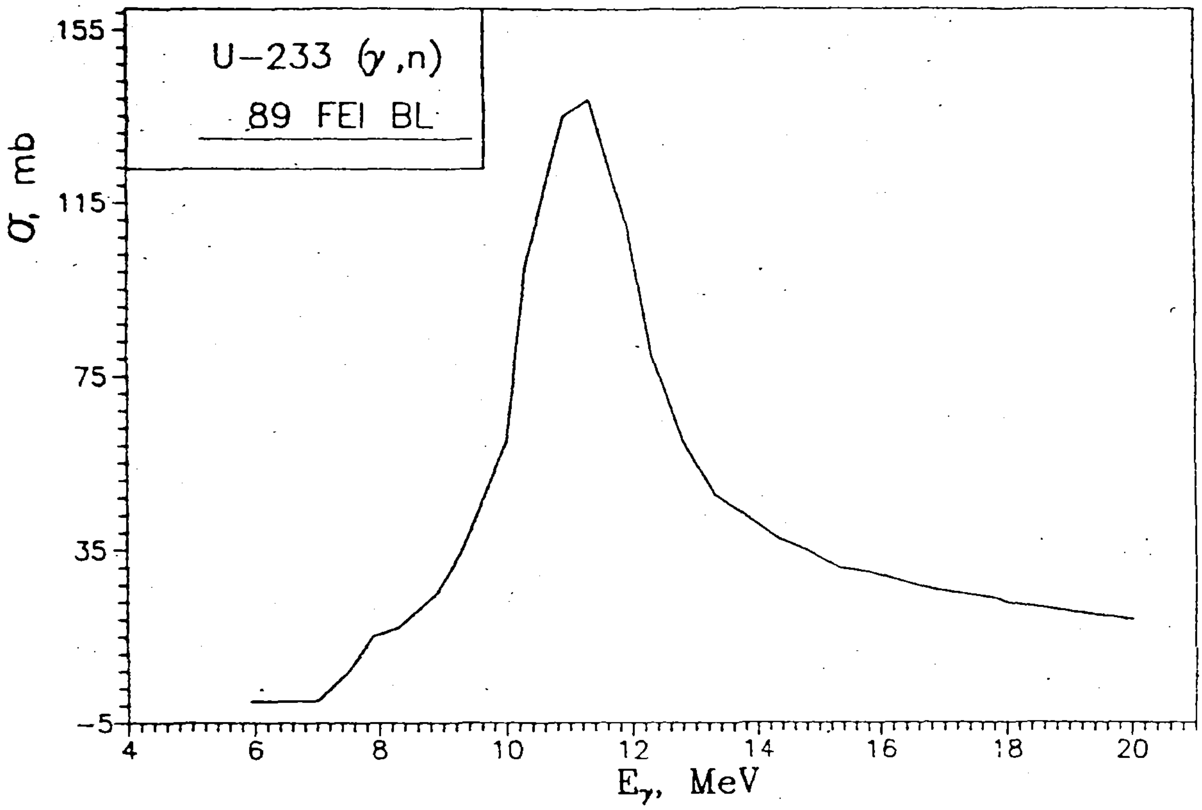

Fig. 31. Cross-section of (γ,n) reaction with ^{233}U

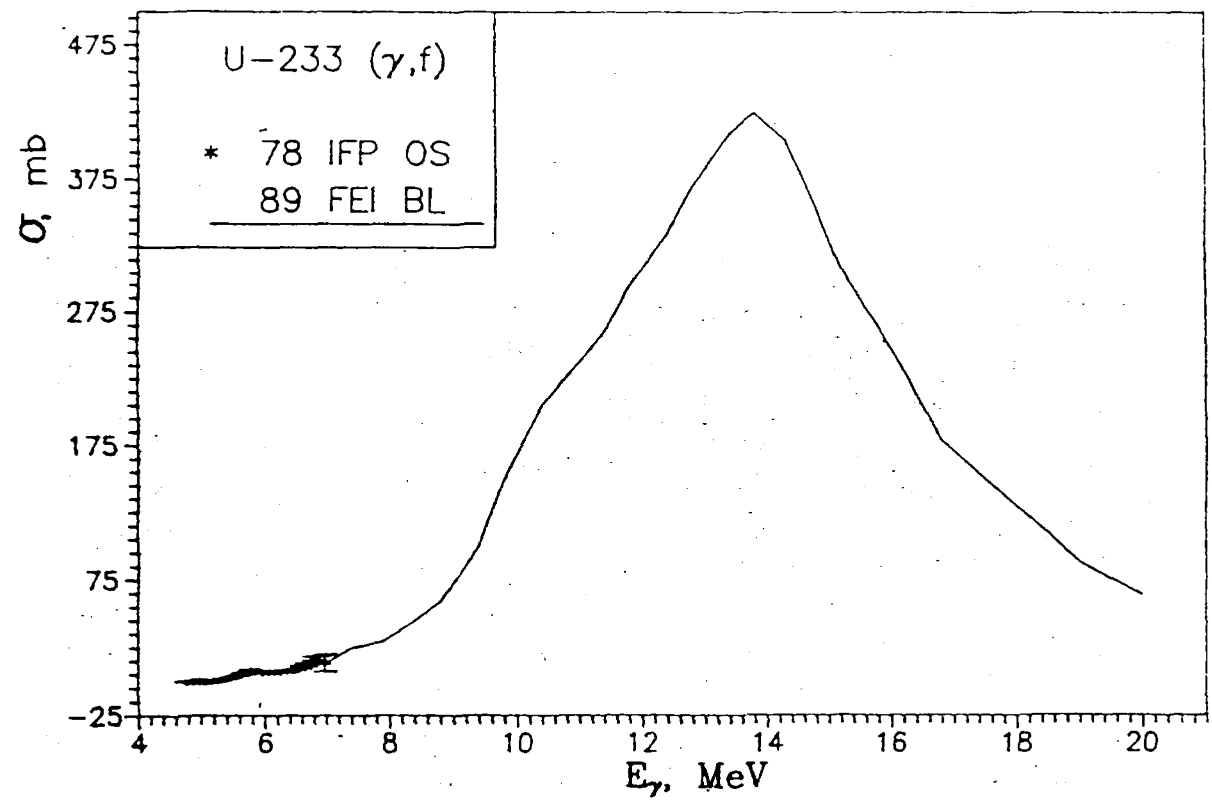

Fig. 32. Cross-section of (γ,fiss) reaction with ^{233}U

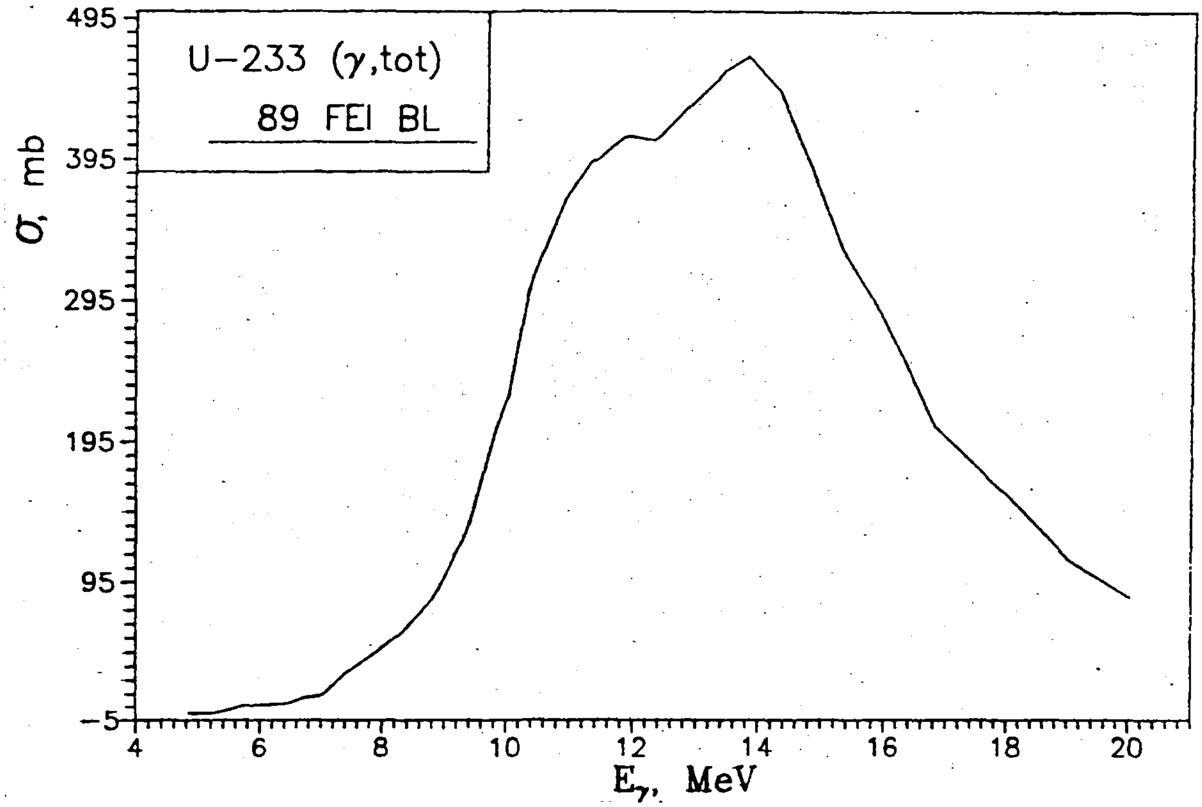

Fig. 33. Cross-section of (γ,tot) reaction with ^{233}U

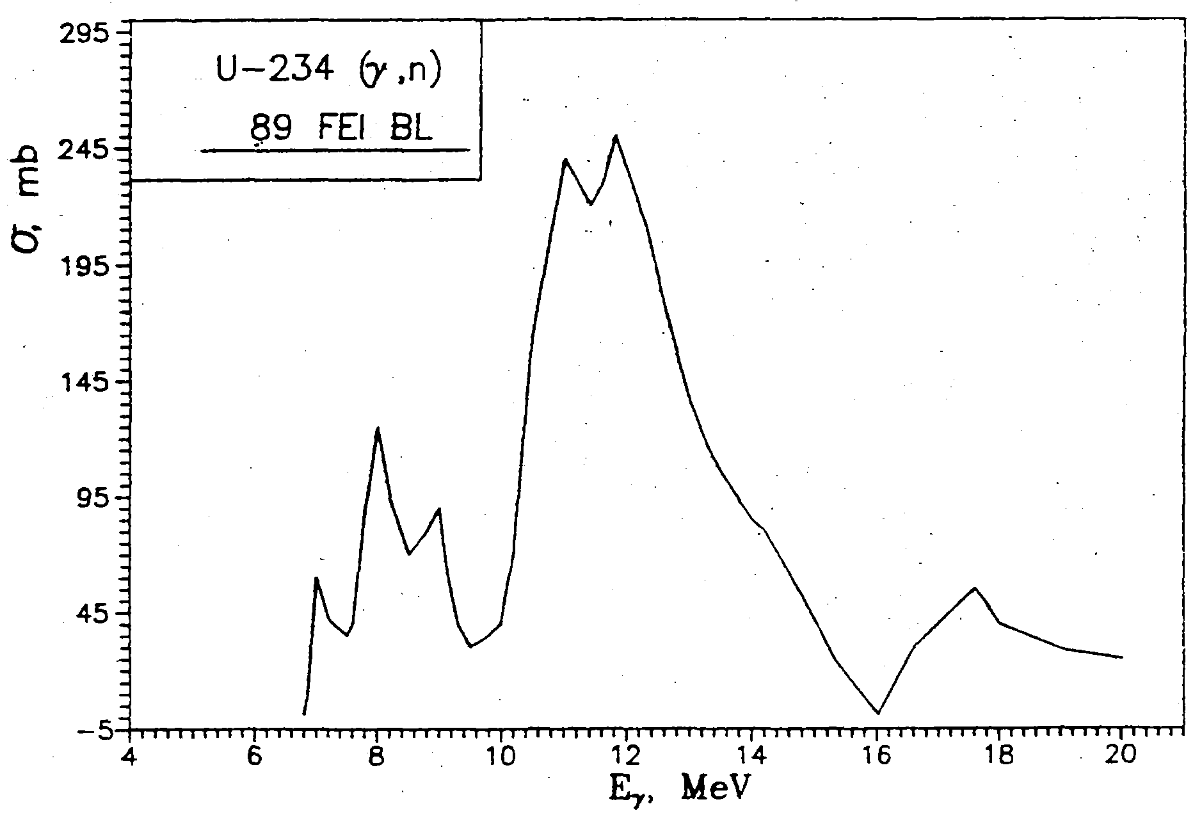

Fig. 34. Cross-section of (γ,n) reaction with ^{234}U

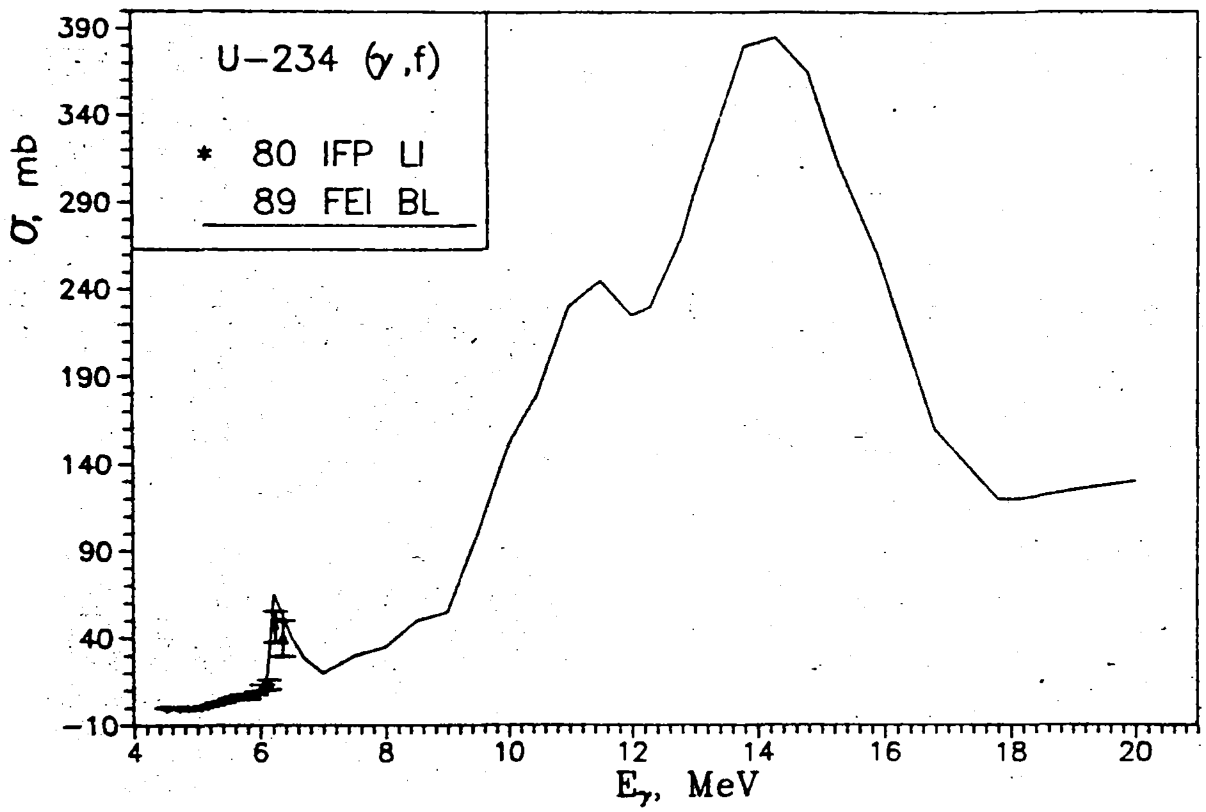

Fig. 35. Cross-section of (γ,fiss) reaction with ^{234}U

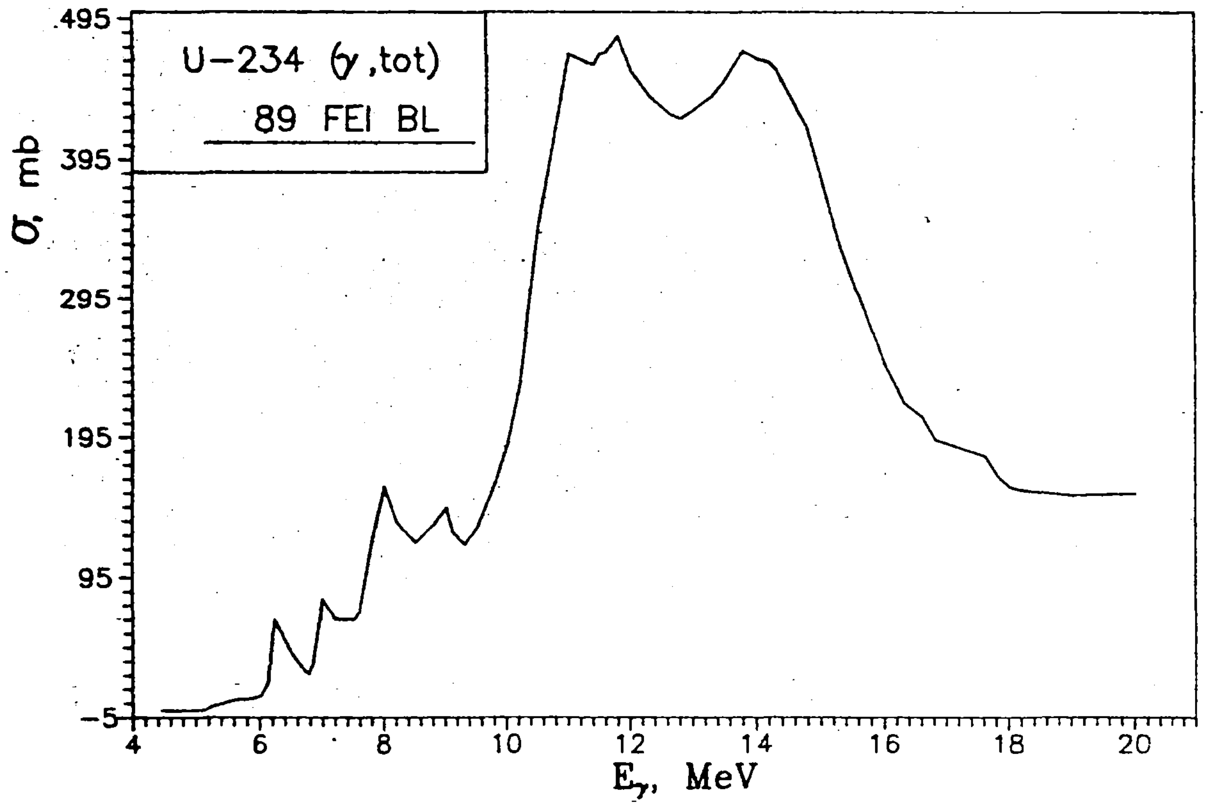

Fig. 36. Cross-section of (γ,tot) reaction with ^{234}U

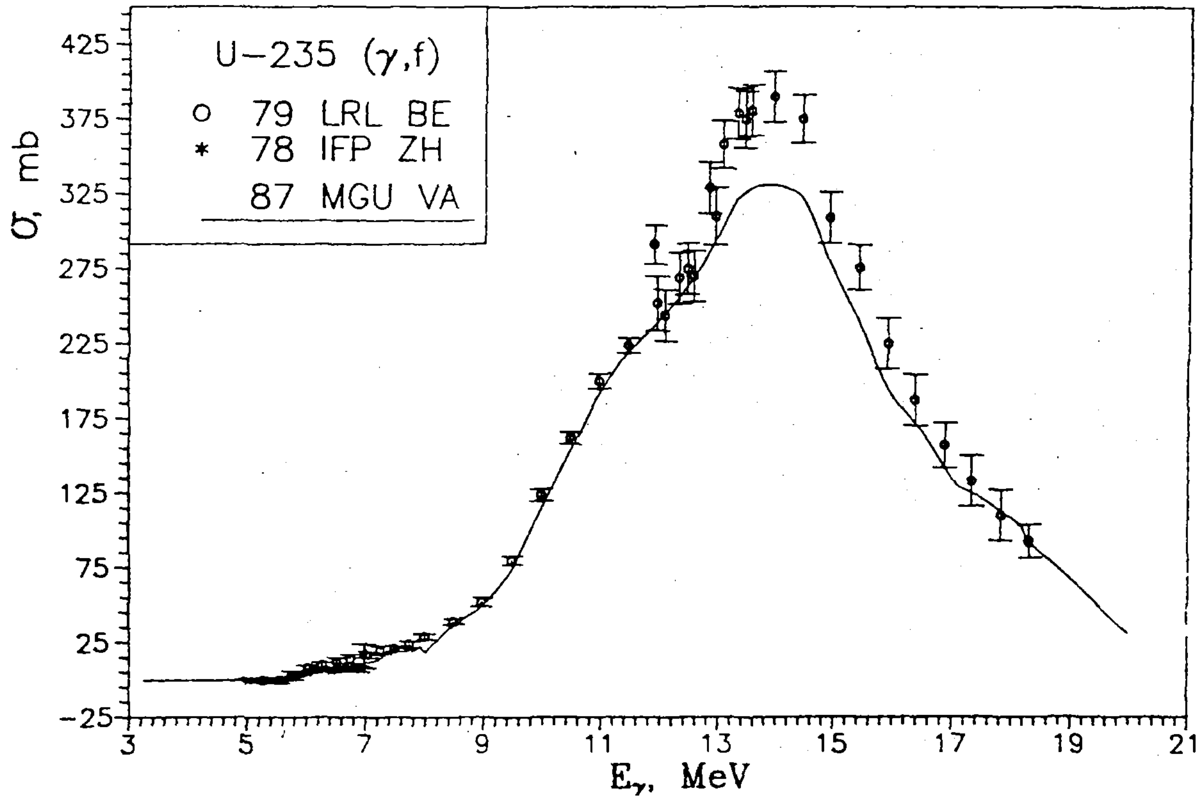

Fig. 37. Cross-section of (γ,fiss) reaction with ^{235}U

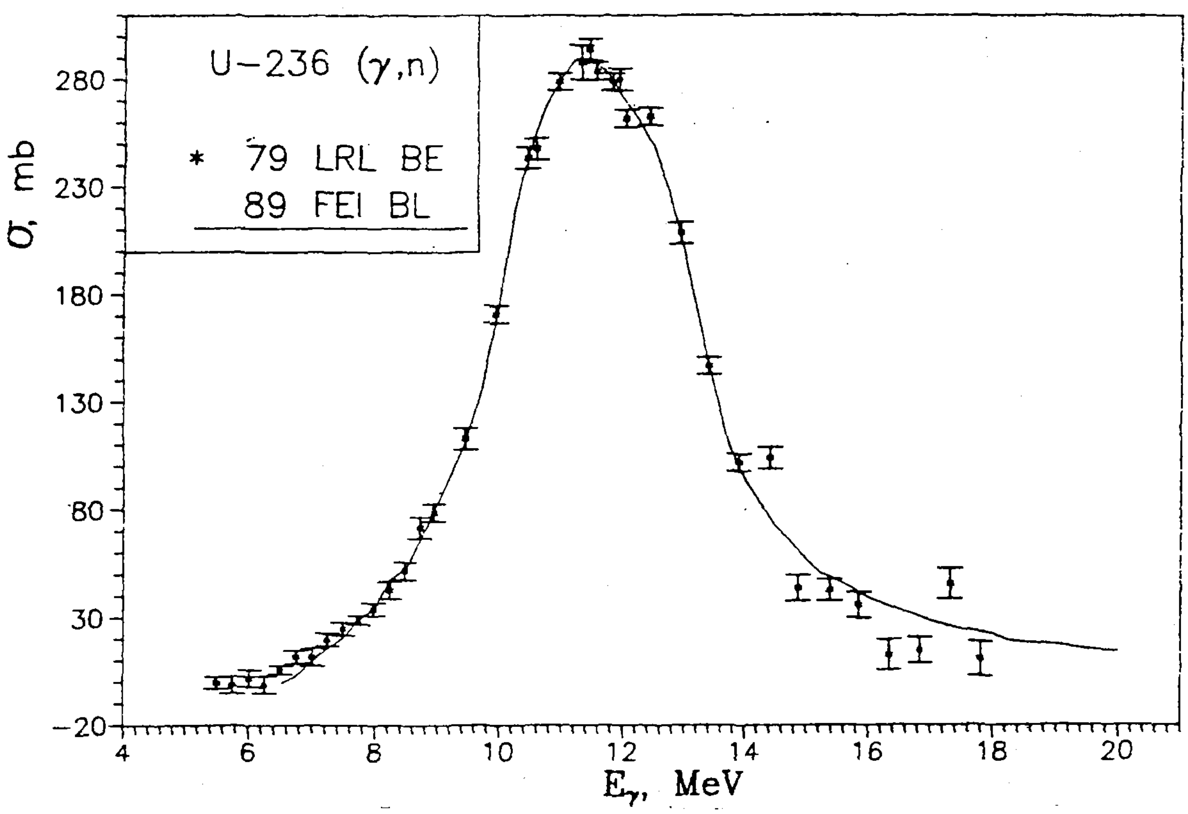

Fig. 38. Cross-section of (γ,n) reaction with ^{236}U

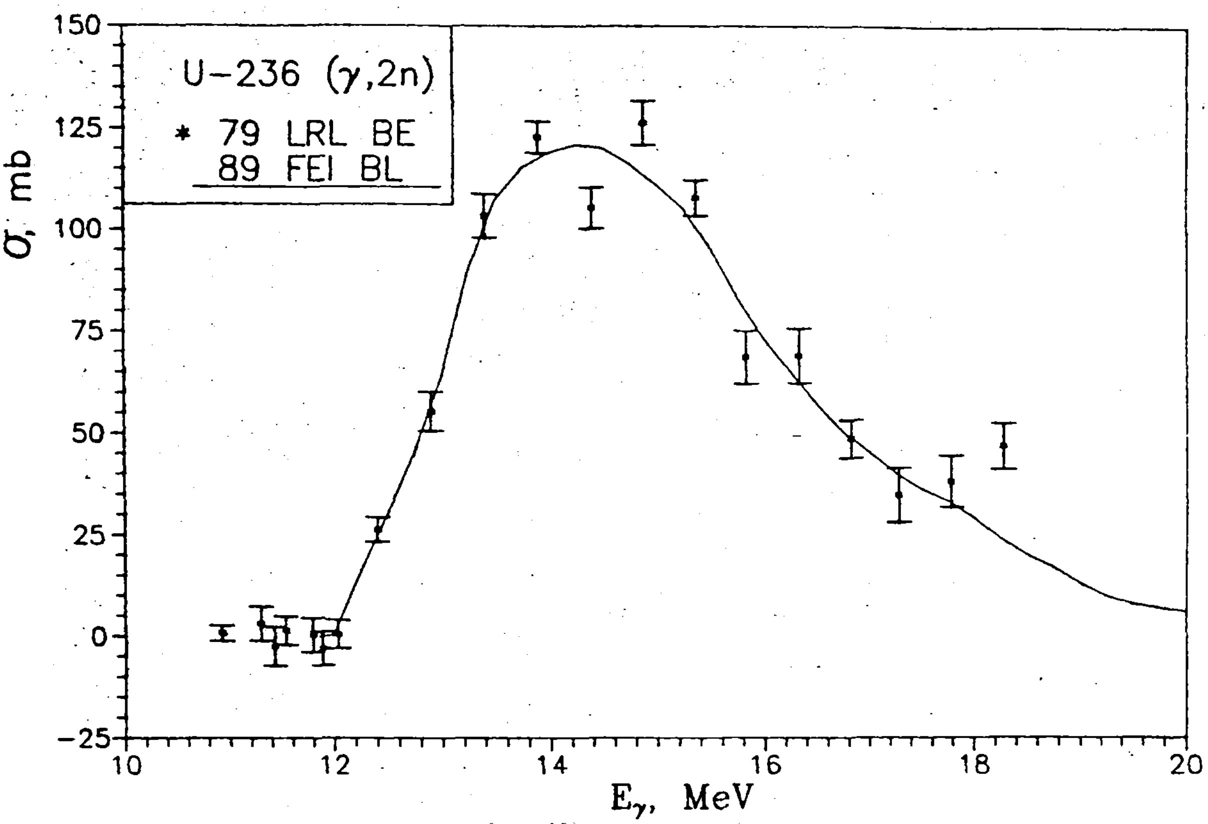

Fig. 39. Cross-section of $(\gamma,2n)$ reaction with ^{236}U

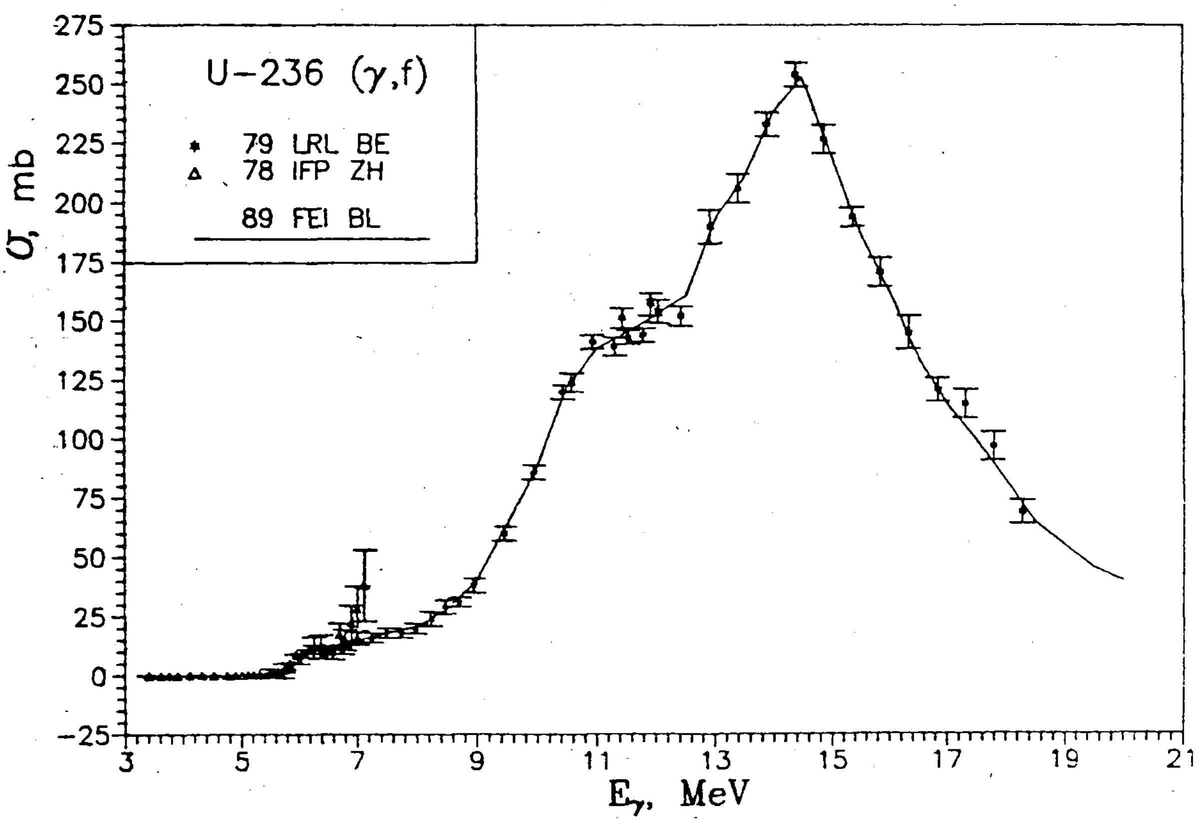

Fig. 40. Cross-section of $(\gamma,fiss)$ reaction with ^{236}U

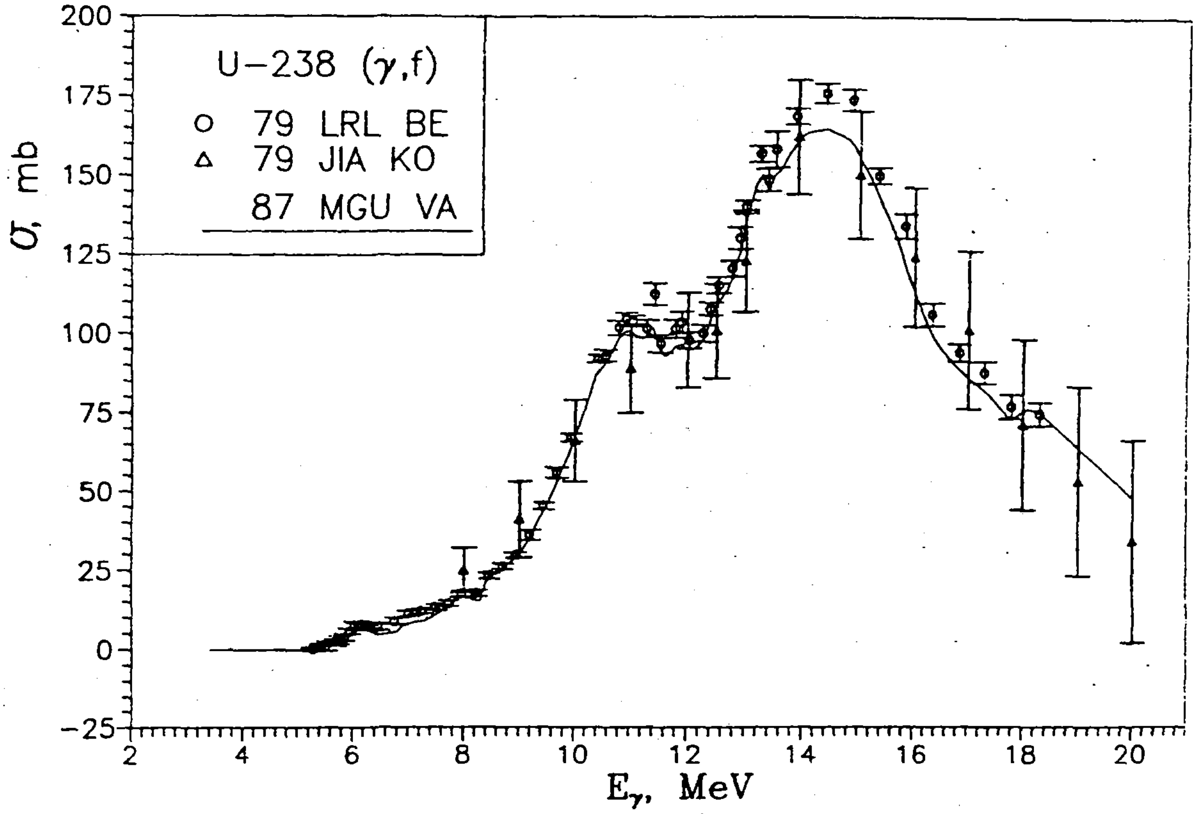

Fig. 41. Cross-section of (γ,fiss) reaction with ^{238}U

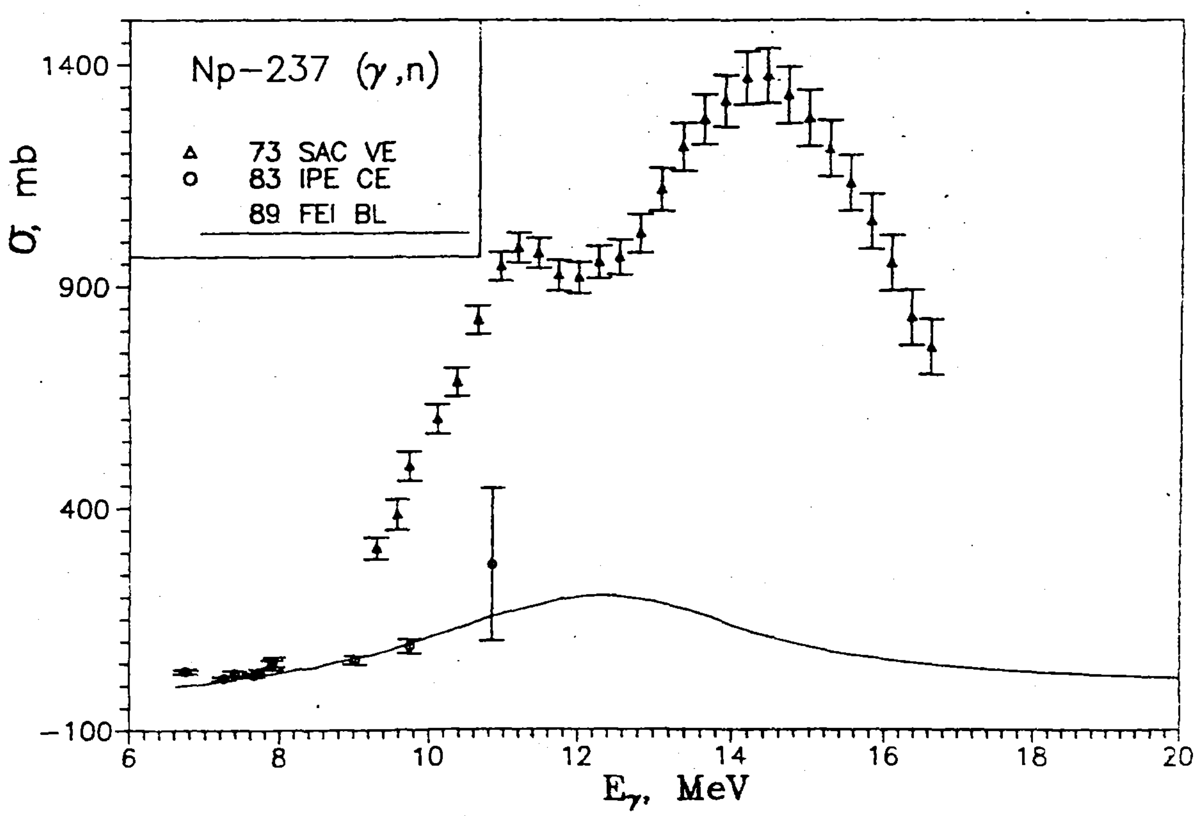

Fig. 42. Cross-section of (γ,n) reaction with ^{237}Np

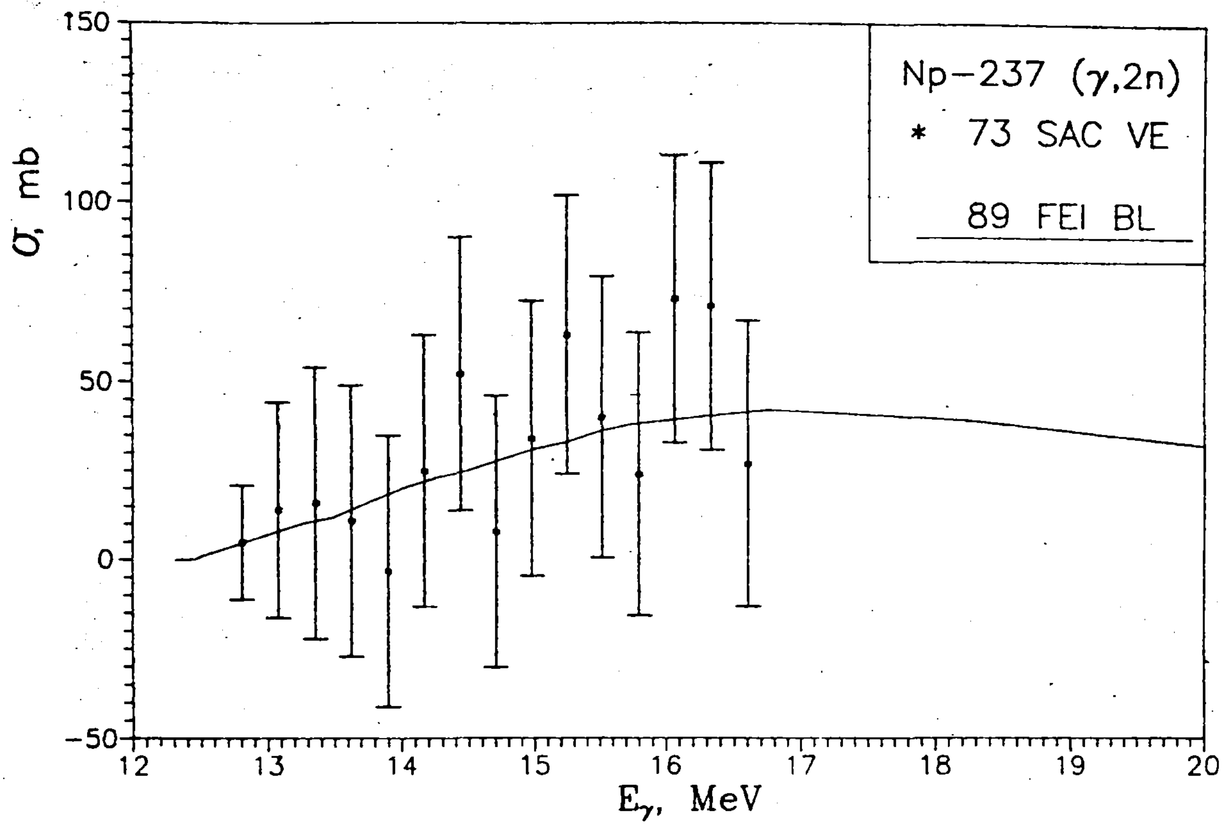

Fig. 43. Cross-section of (γ,2n) reaction with ^{237}Np

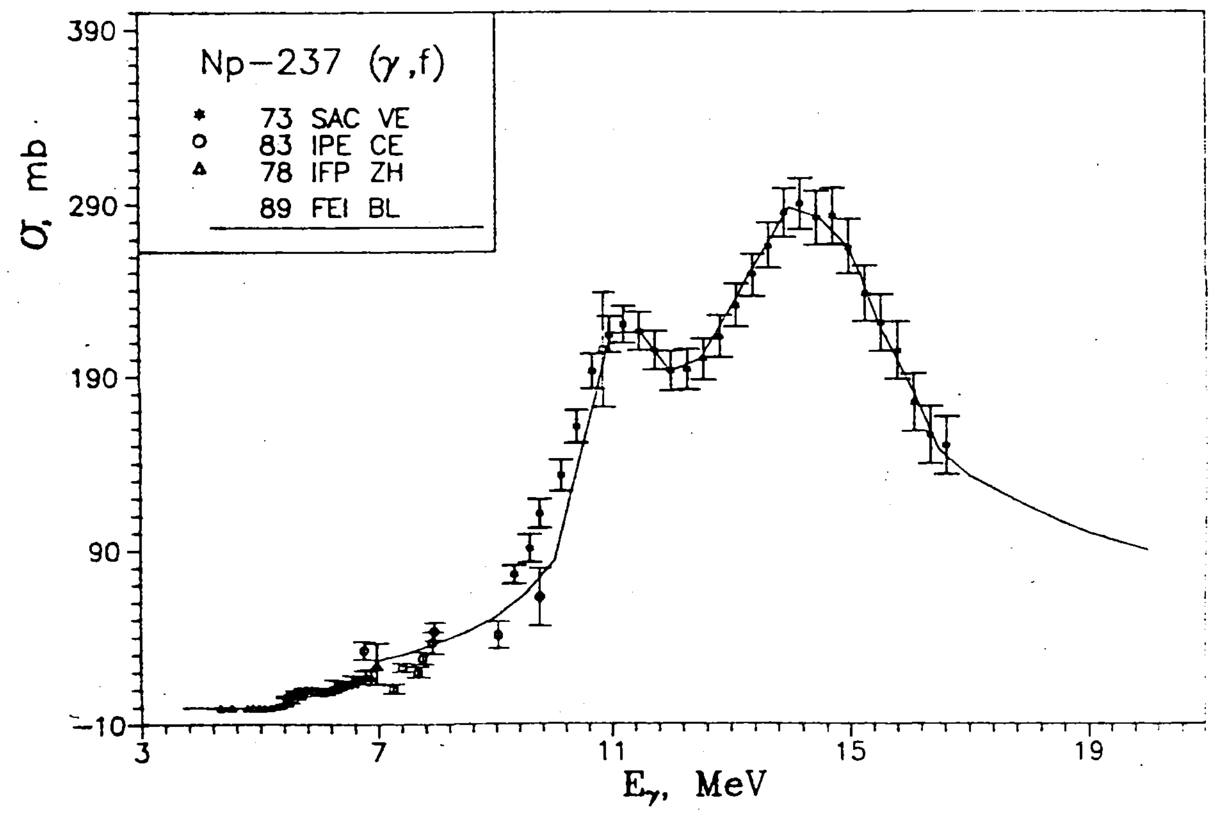

Fig. 44. Cross-section of (γ,fiss) reaction with ^{237}Np

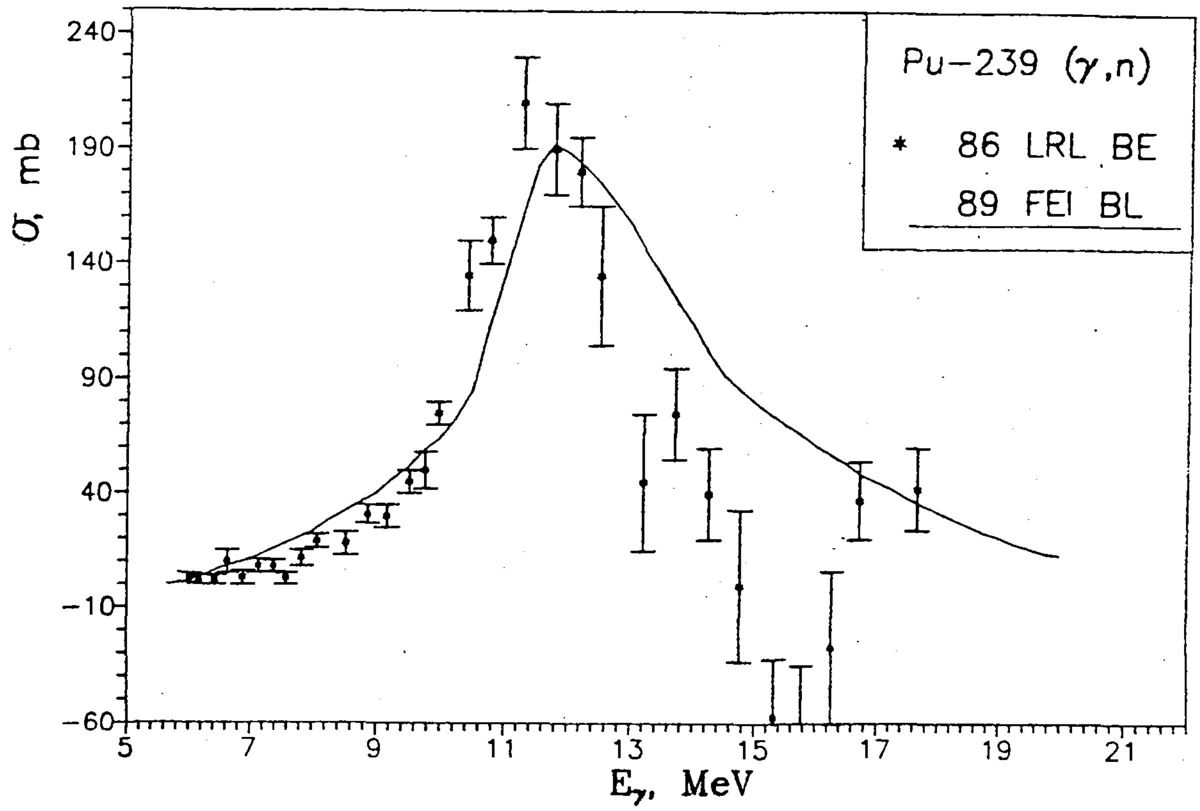

Fig. 45. Cross-section of (γ,n) reaction with ^{239}Pu

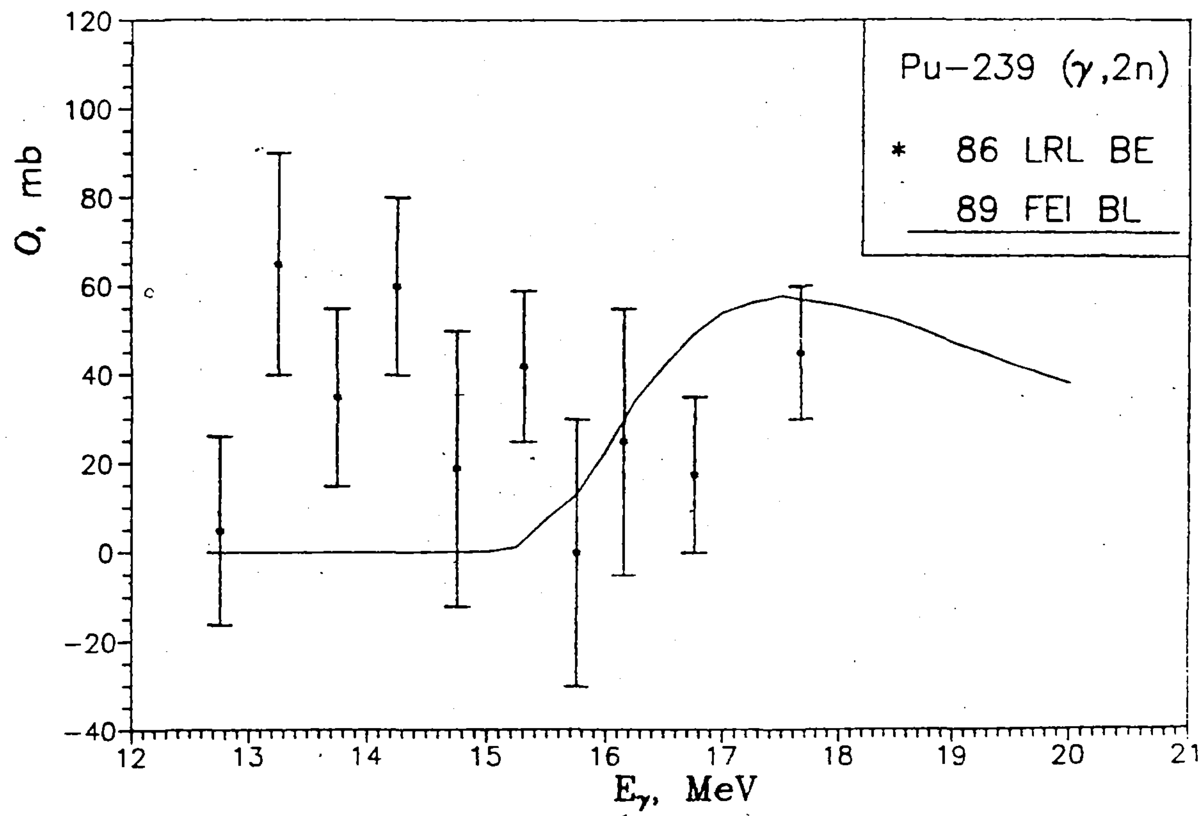

Fig. 46. Cross-section of (γ,2n) reaction with ^{239}Pu

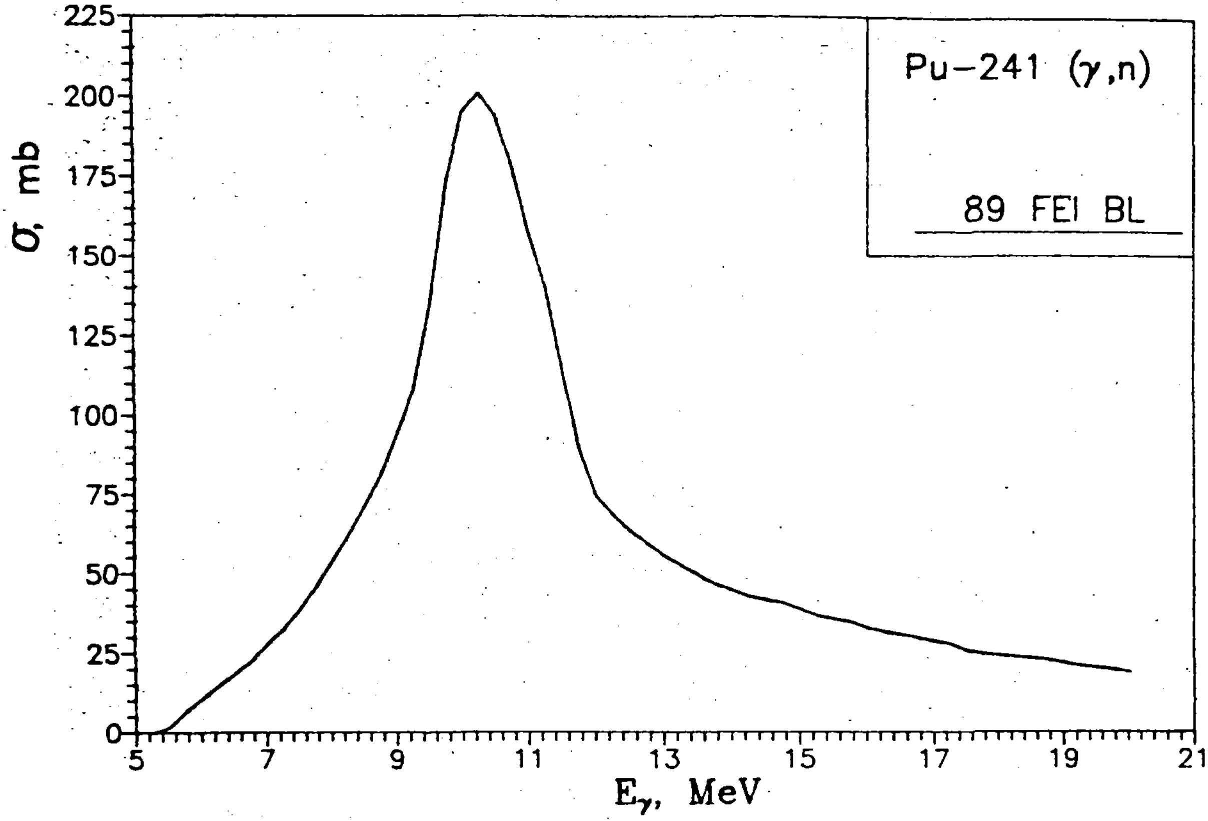

Fig. 47. Cross-section of (γ,n) reaction with ^{241}Pu

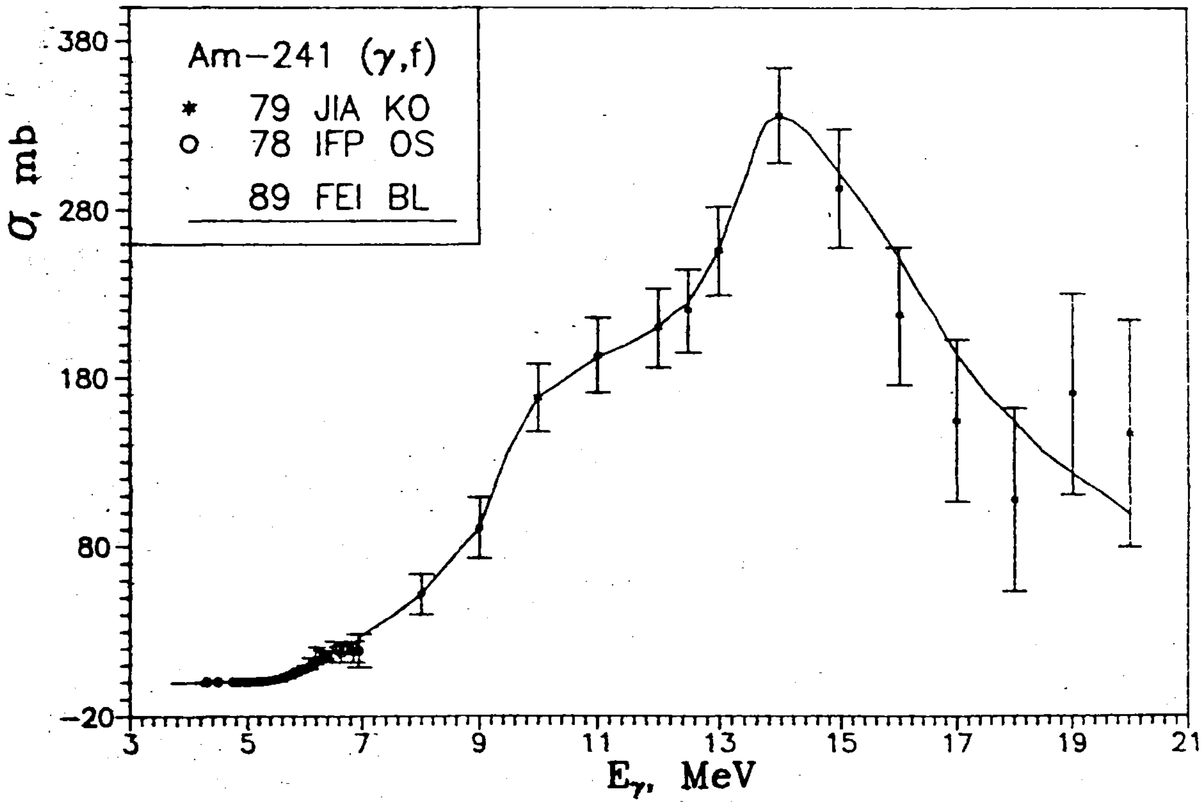

Fig. 48. Cross-section of (γ,fiss) reaction with ^{241}Am

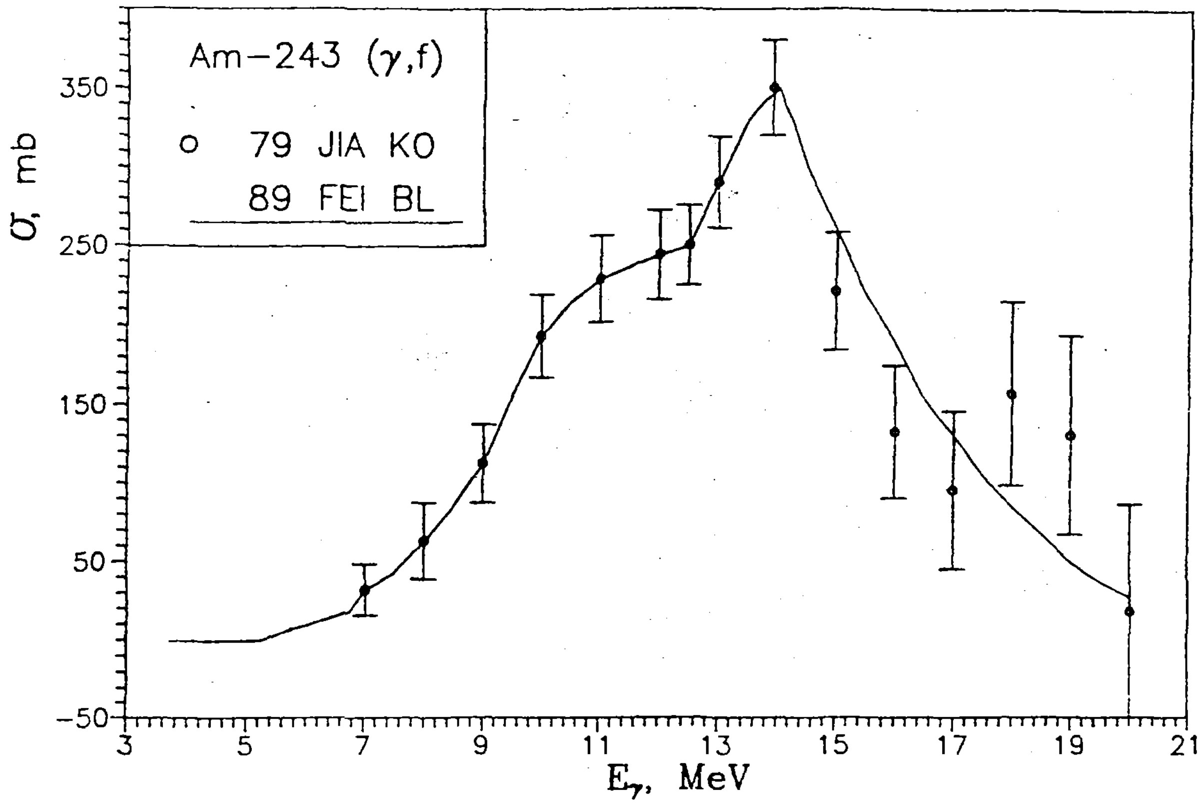

Fig. 49. Cross-section of (γ,fiss) reaction with ^{243}Am

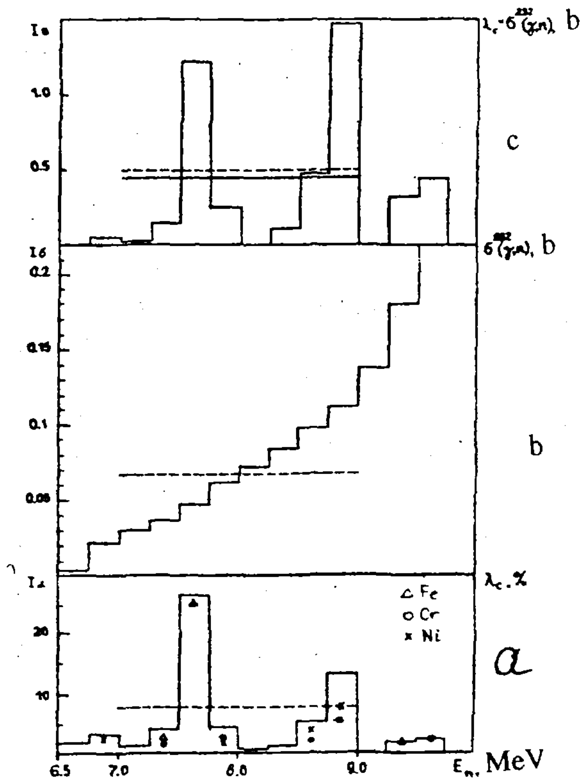

Fig. 50(a) Photon yield per 100 neutron captures in steel;

(b) Cross-section of the (γ,n) photoneutron reaction with ^{232}Th;

(c) Energy dependence of the contribution to the (γ,n) reaction.

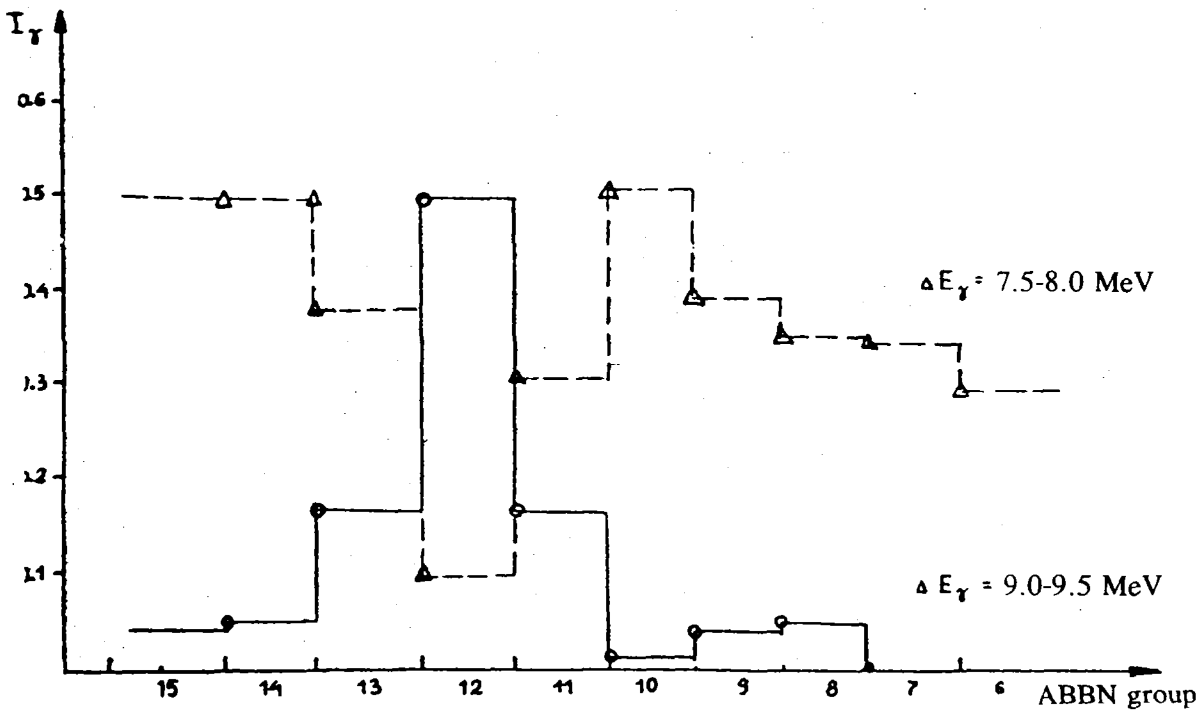

Fig. 51. Dependence of the yield of photons I_γ with energies ΔE_γ = 7.5-8.0 MeV (- - -) and ΔE_γ = 9.0-9.5 MeV (——) on absorbed neutron energy E_n in ABBN energy groups.