Istituto Nazionale di Fisica Nucleare
Sezione di Napoli - Sezione Siciliana

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P. Cuzzocrea, E. Perillo and S. Notarrigo: BEST-FITS FOR SOME STANDARD NEUTRON-INDUCED REACTION CROSS SECTIONS AROUND 14 MeV.

The attempts made[72, 76] to analyse the behaviour of the (n, p), (n, α) and (n, 2n) cross sections at $\sim$14 MeV neutron energy have shown that the various experimental data scatter much more than the stated errors should allow. Therefore systematic errors must be present.

A very important source of these systematic errors is in the different neutron flux calibrations. In the activation measurements the rate of the neutron flux is generally obtained by normalizing the results to standard reaction cross sections but the assumed values are still considerably scattered.

It is advisable to have at one's disposal reliable normalization values, at least for the most common standard reactions.

We have calculated the best-fits in the range 12.8 - 15.5 MeV of neutron energy with the data available up to March, 1967 for the standard reactions ^{65}Cu(n, 2n), ^{63}Cu(n, 2n), ^{107}Ag(n, 2n), ^{109}Ag(n, 2n), ^{56}Fe(n, p), ^{27}Al(n, α) and ^{27}Al(n, p).

The data used are listed in tables 1-7 with the references for the original sources.

The weights used were the squares of the reciprocals of the erros reported by the various authors.

The calculated best-fits were linear. When a large set of data was available the energy range was also divided into partially overlapping bands and the straight line sections were adjusted to give, by successive approximations, a best-fit curve.

The results are shown together with the original data in figs. 1-7 for the range 13.5-15.0 MeV; the dashed curves represent the best-fits. In the following table 8 are reported the results for some values of the neutron energy.

Table 8

Reaction	$\sigma \pm \Delta\sigma$	E_n	Reaction	$\sigma \pm \Delta\sigma$	E_n
^{65}Cu(n,2n)	840 ± 13.9	13.5	^{56}Fe(n,p)	113.5 ± 3.4	13.5
	896 ± 12.5	14.0		112.5 ± 2.6	14.0
	950 ± 16.5	14.5		107.2 ± 2.9	14.5
	990 ± 20.5	15.0		100.0 ± 3.6	15.0
^{63}Cu(n,2n)	385 ± 26.7	13.5	^{27}Al(n,α)	122.5 ± 2.9	13.5
	457 ± 21.5	14.0		120.9 ± 1.9	14.0
	524 ± 20.5	14.5		116.1 ± 2.2	14.5
	585 ± 25.5	15.0		112.0 ± 2.9	15.0
^{107}Ag(n,2n)	597 ± 141	13.5	^{27}Al(n,p)	85.2 ± 7.9	13.5
	596 ± 102	14.0		79.5 ± 6.1	14.0
	594 ± 130	14.5		68.2 ± 6.7	14.5
	592 ± 169	15.0		62.1 ± 8.3	15.0
^{109}Ag(n,2n)	588 ± 323	13.5			
	651 ± 262	14.0			
	714 ± 251	14.5			
	777 ± 285	15.0			

The errors shown[(x)] were obtained from the whole sets of data.

The studied reactions cover a wide range of decay half-lives and therefore the obtained values can be used for the normalization in a large number of cross section measurements.

More care must be taken for fine resolution experiments as measurements of the excitation functions for these reactions have shown the presence of fluctuations from the mean[(77)].

Thanks are due to Dr. G. Spadaccini for his assistance in carrying out the calculations with the Olivetti Programma 101 computer of the Istituto di Fisica Superiore dell'Università di Napoli.

(x) - See: H. D. Young, Statistical treatment of experimental data (McGraw Hill, New York, 1962), p. 122.

TABLE 1

$^{65}Cu(n, 2n)^{64}Cu$

σ	Δσ	E_n	Ref.	σ	Δσ	E_n	Ref.
970	78	14.1	(1)	893	63	14.05	(15)
1085	174	14.5	(2)	964	68	14.42	(15)
954	130	14.8	(3)	988	69	14.61	(15)
869	104	15.0	(4)	986	71	14.99	(15)
1030	95	14.5	(5)	1007	70	15.18	(15)
778	31	13.33	(6)	874	26	13.58	(13,70)
771	31	13.40	(6)	909	27	13.89	(13,70)
814	33	13.52	(6)	943	28	14.25	(13,70)
830	33	13.69	(6)	973	30	14.50	(13,70)
879	35	13.88	(6)	981	30	14.68	(13,70)
879	35	14.01	(6)	1002	30	14.74	(13,70)
906	36	14.09	(6)	857	50	13.55	(69)
892	36	14.31	(6)	867	50	13.60	(69)
937	37	14.50	(6)	878	50	13.65	(69)
953	38	14.68	(6)	888	50	13.70	(69)
968	39	14.81	(6)	878	50	13.75	(69)
975	39	14.93	(6)	931	50	13.80	(69)
940	85	14.1	(7)	941	50	13.85	(69)
959	80	14.4	(8, 16)	941	50	13.90	(69)
860	43	13.86	(9)	952	50	13.95	(69)
892	45	14.11	(9)	984	50	14.00	(69)
909	45	14.37	(9)	994	50	14.05	(69)
930	46	14.59	(9)	941	50	14.10	(69)
962	48	14.77	(9)	962	50	14.15	(69)
770	75	13.2	(11)	931	50	14.20	(69)
930	84	14.1	(11)	920	50	14.25	(69)
952	86	14.6	(11)	899	50	14.30	(69)
940	86	15.2	(11)	899	50	14.35	(69)
1000	25	14.7	(12)	941	50	14.40	(69)
937	85	14.2	(14)	962	50	14.45	(69)
878	70	14.6	(14)	994	50	14.50	(69)
758	53	13.10	(15)	1026	50	14.55	(69)
827	58	13.38	(15)	1026	50	14.60	(69)
855	60	13.54	(15)	1015	50	14.65	(69)
909	64	13.88	(15)	1015	50	14.70	(69)

TABLE 2

$^{63}Cu(n, 2n)^{62}Cu$

σ	Δσ	E_n	Ref.	σ	Δσ	E_n	Ref.
330	66	14	(17)	350	50	13.16	(10)
270	50	13.2	(18)	500	50	14.1	(10)
640	70	14.5	(18)	680	30	15.2	(10)
510	36	14.1	(1)	424	22	13.86	(9)
482	72	14.5	(2)	455	23	14.11	(9)
350	60	13.0	(19)	488	25	14.37	(9)
460	70	13.16	(19)	519	26	14.59	(9)
430	70	13.85	(19)	550	27	14.77	(9)
450	70	14.0	(19)	248	22	13.00	(26)
450	70	14.45	(19)	314	28	13.47	(26)
550	80	14.9	(19)	422	38	14.05	(26)
450	70	15.0	(19)	525	47	15.24	(26)
520	80	15.3	(19)	548	10	14.8	(27)
360	80	13.0	(20)	340	22	13.0	(28)
568	30	14.1	(21)	450	30	13.54	(28)
233	21	12.81	(22)	479	32	13.70	(28)
378	34	13.77	(22)	554	38	14.05	(28)
507	45	14.74	(22)	575	39	14.24	(28)
649	58	15.78	(22)	598	41	14.42	(28)
530	26	14.6	(23)	619	42	14.80	(28)
490	44	14.1	(7)	660	44	14.99	(28)
458	10	14.1	(24)	715	48	15.18	(28)
409	25	14.13	(25)				

TABLE 3

$^{107}Ag(n, 2n)^{106}Ag$

σ	Δσ	E_n	Ref.	σ	Δσ	E_n	Ref.
560	56	14.1	(1)	734	44	14.13	(25)
519	60	14.5	(2)	855	77	13.00	(26)
458	50	14.1	(21)	927	83	13.47	(26)
1340	220	14	(29)	852	76	14.05	(26)
662	66	14.8	(30)	966	87	15.24	(26)
537	15	14.1	(24)	889	66	14.4	(8)
657	100	14.8	(31)				

TABLE 4

$^{109}Ag(n,2n)^{108}Ag$

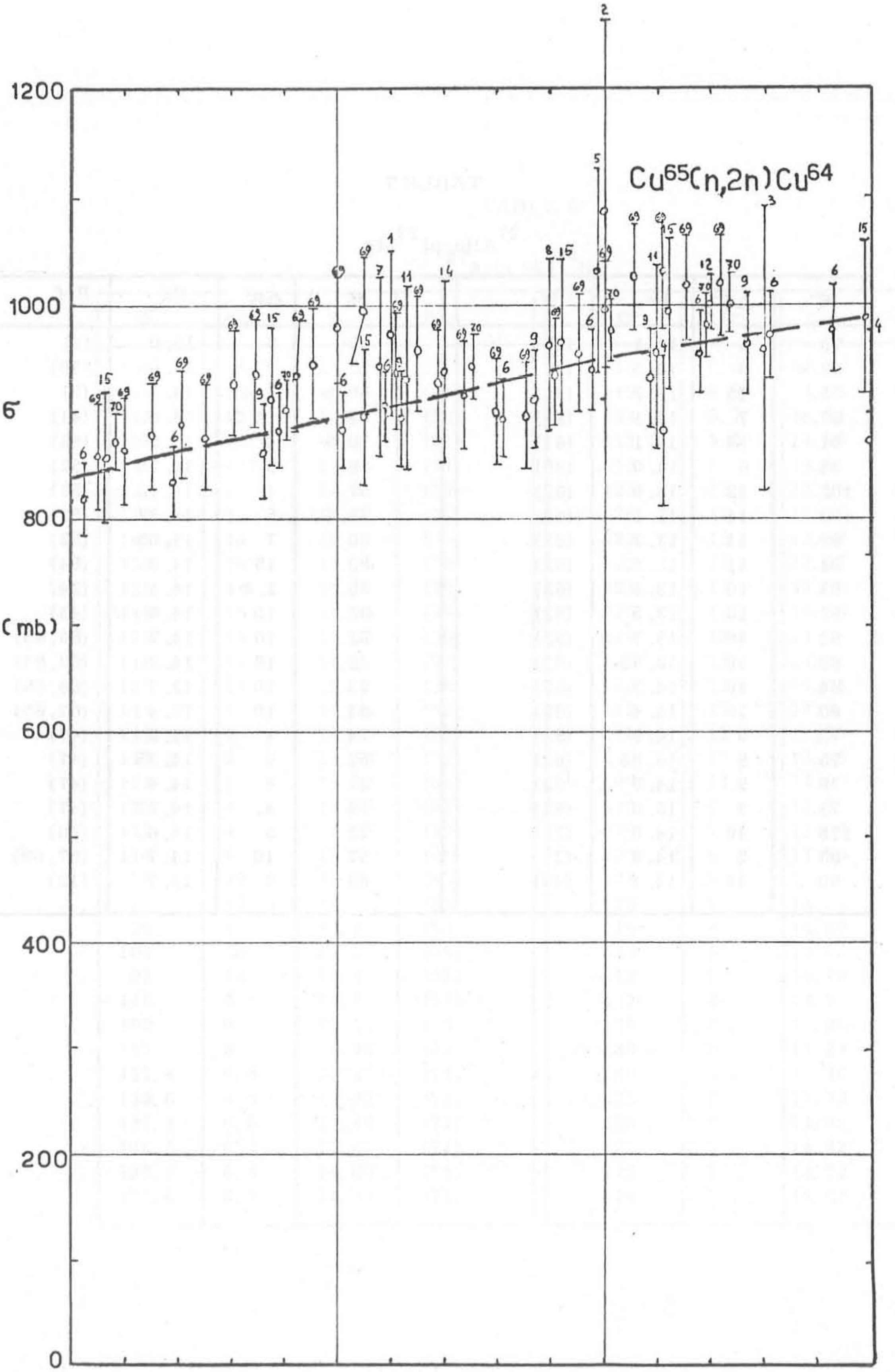
σ	Δσ	E_n	Ref.	σ	Δσ	E_n	Ref.
1000	100	14.1	(1)	710	110	14.8	(31)
311	156	14.5	(2)	833	83	14.8	(30)
604	66	14.1	(21)	840	150	14	(29)
619	40	14.0	(32)				

TABLE 5

$^{56}Fe(n,p)^{56}Mn$

σ	Δσ	E_n	Ref.	σ	Δσ	E_n	Ref.
124	12.4	14.1	(1)	117	5	13.2	(10)
96.7	12	14.5	(2)	113	5	14.1	(10)
72	7	14.0	(33)	88	3	15.2	(10)
120	30	13.2	(35)	108	10	14.4	(47)
114	19	14.1	(21)	105	5	14.7	(12)
90	15	14.0	(36)	113	3	12.59	(48)
95	20	13.5	(37)	114	4	13.08	(48)
96	2	15.48	(38)	115	4	13.58	(48)
105	2	14.71	(38)	118	4	13.89	(48)
110	10	14.3	(38)	110	4	14.24	(48)
114	2	13.99	(38)	110	4	14.50	(48)
116	3	13.35	(38)	108	4	14.68	(48)
131	15	15.27	(39)	107	4	14.76	(48)
90	18	14.1	(40)	121	7	14.1	(49)
128	13	15.0	(4)	112	7	13.10	(28)
112.5	5.6	14.1	(7)	114	7	13.54	(28)
86	8	14.0	(34, 41)	108	7	13.70	(28)
128	13	14.8	(42)	106	7	14.05	(28)
102	10	14.0	(43)	103	7	14.24	(28)
117	29	14.5	(44)	100	6	14.42	(28)
106	11	13.58	(45, 46)	95.7	5.9	14.80	(28)
108	11	14.07	(45, 46)	94.2	5.9	14.99	(28)
100	10	14.73	(45, 46)	87.4	5.5	15.18	(28)

8.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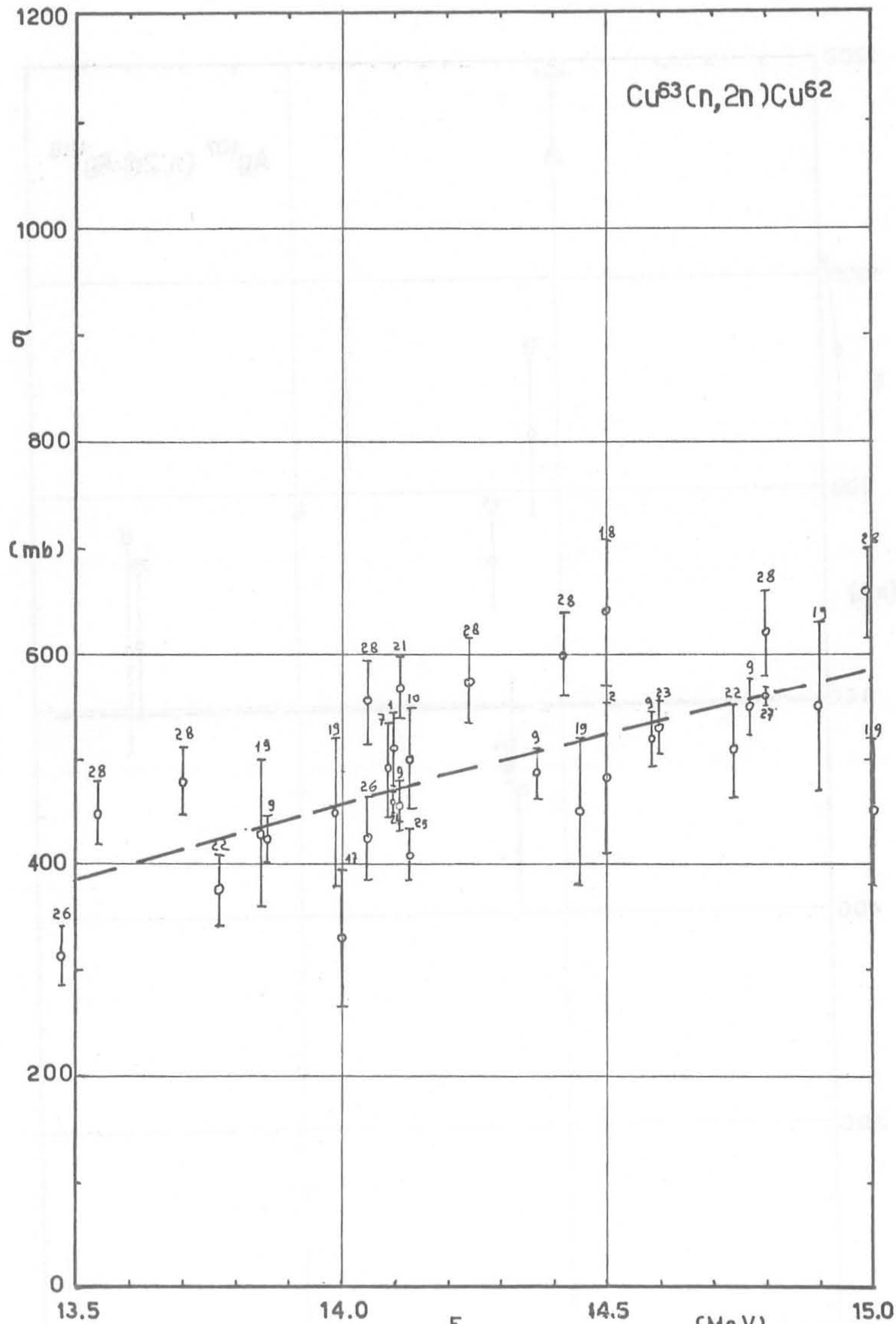
σ
(mb)
1200
1000
800
600
400
200
0
13.5
14.0
14.5
15.0
En
(MeV)

Fig. 1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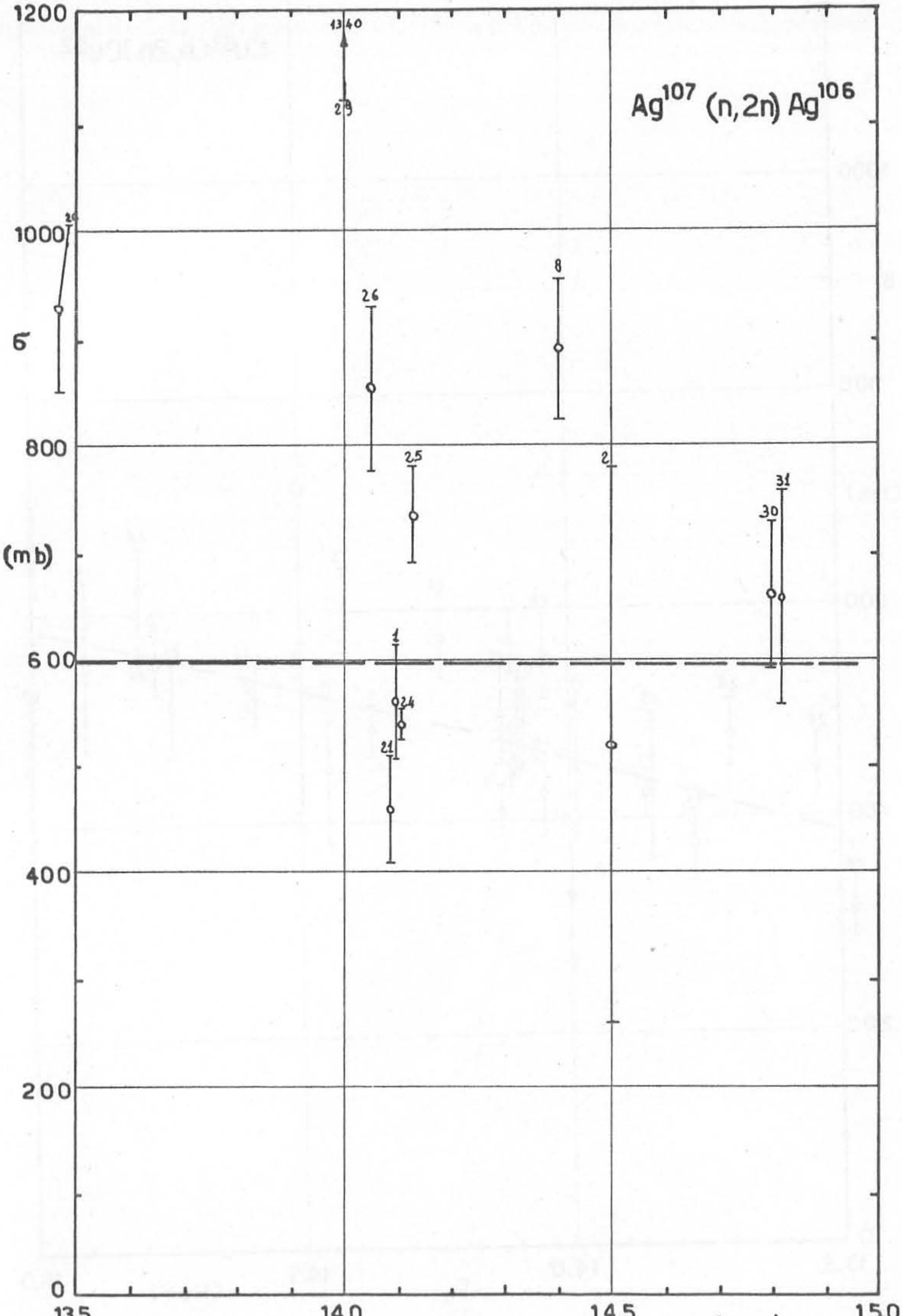
1000
800
600
400
200
0
σ
(mb)
13.5
14.0
14.5
15.0
En
(MeV)

Fig. 2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1000
800
600
400
200
0
σ
(mb)
13.5
14.0
14.5
15.0
En
(Me V)
1340
29
26
8
25
2
31
30
1
24
21

Fig. 3

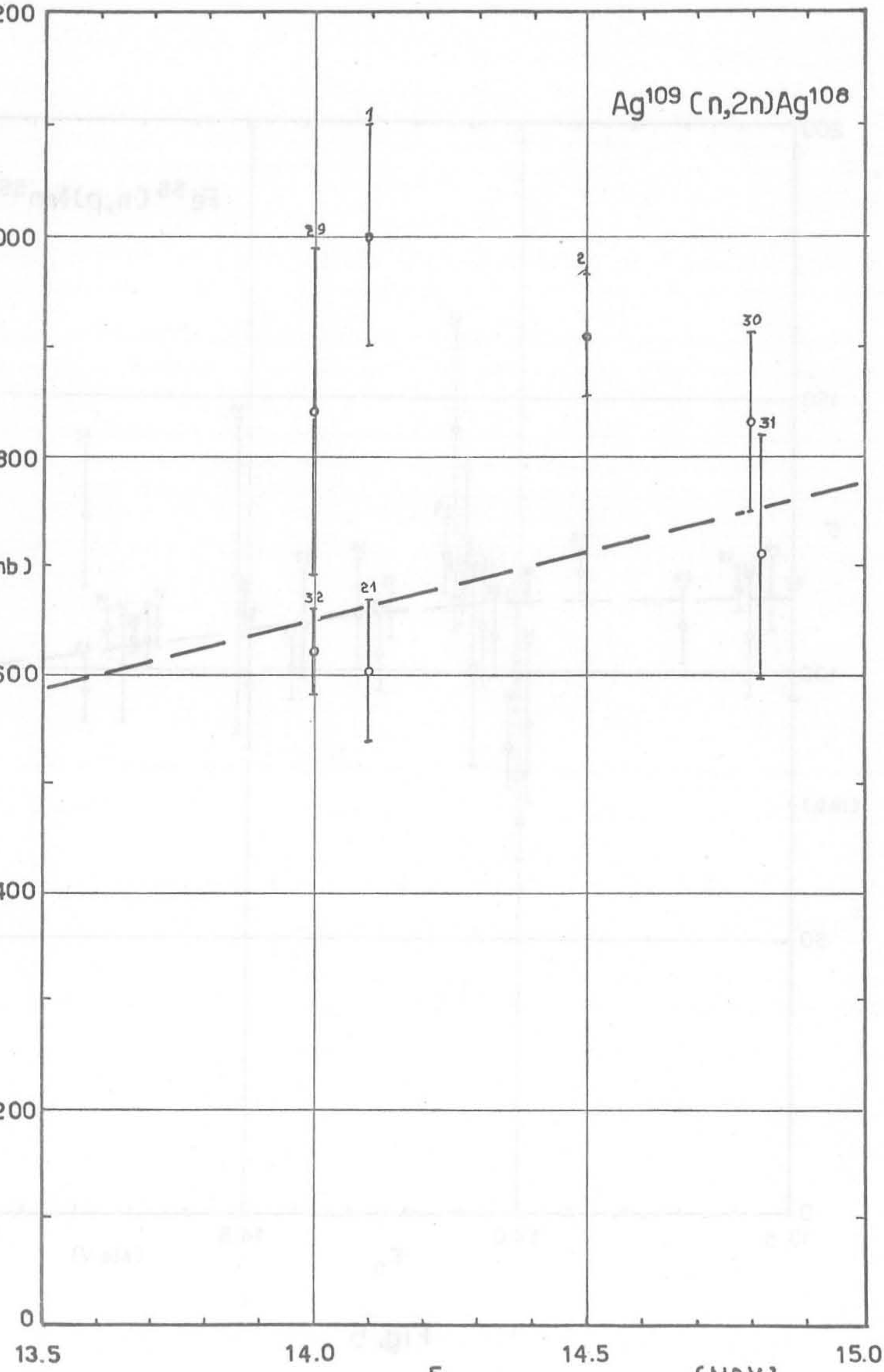
1200
1000
800
600
400
200
0
σ
(mb)
Ag109 (n,2n)Ag108
1
29
2
30
31
32
21
13.5
14.0
14.5
15.0
En
(MeV)

Fig. 4

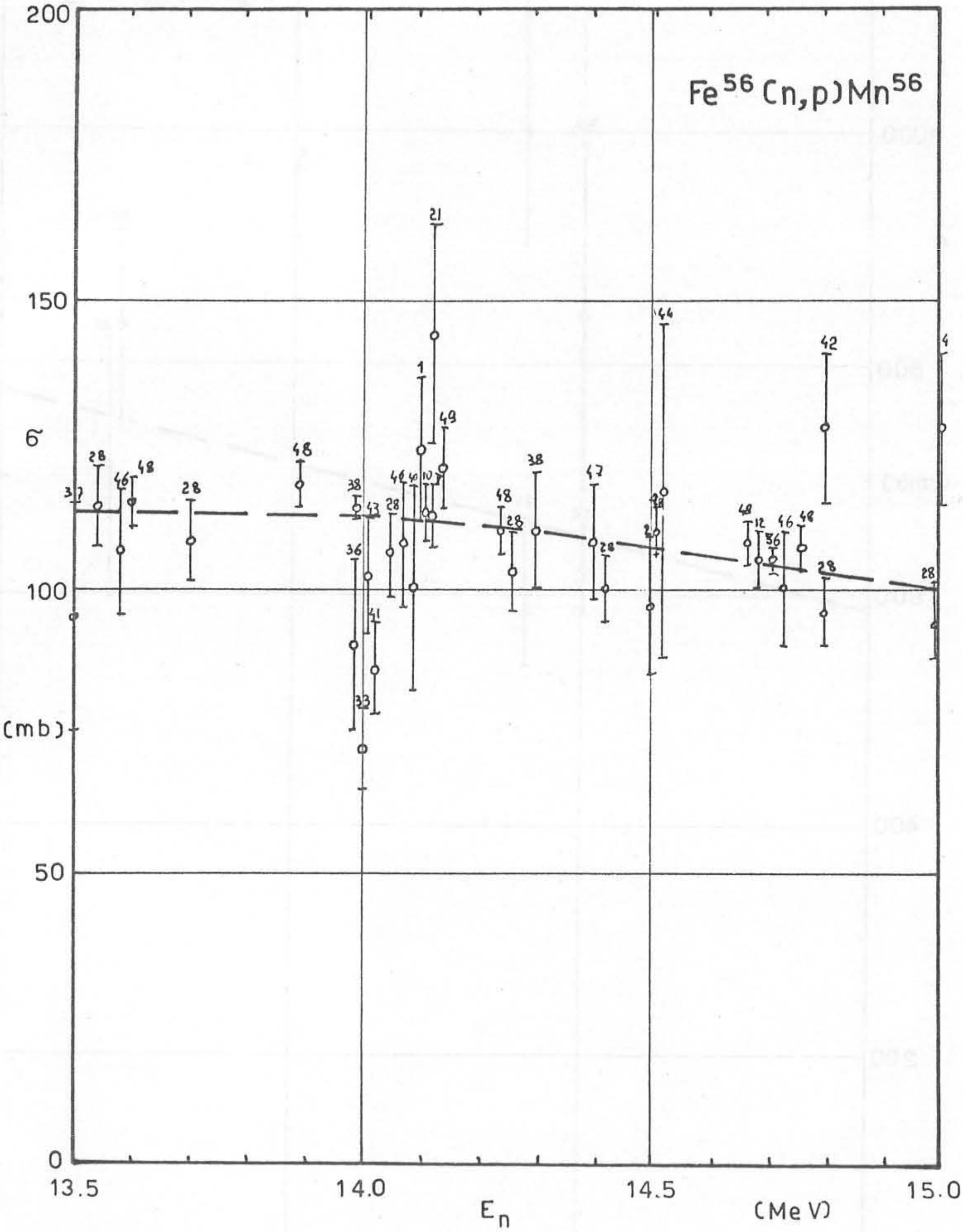

Fig. 5

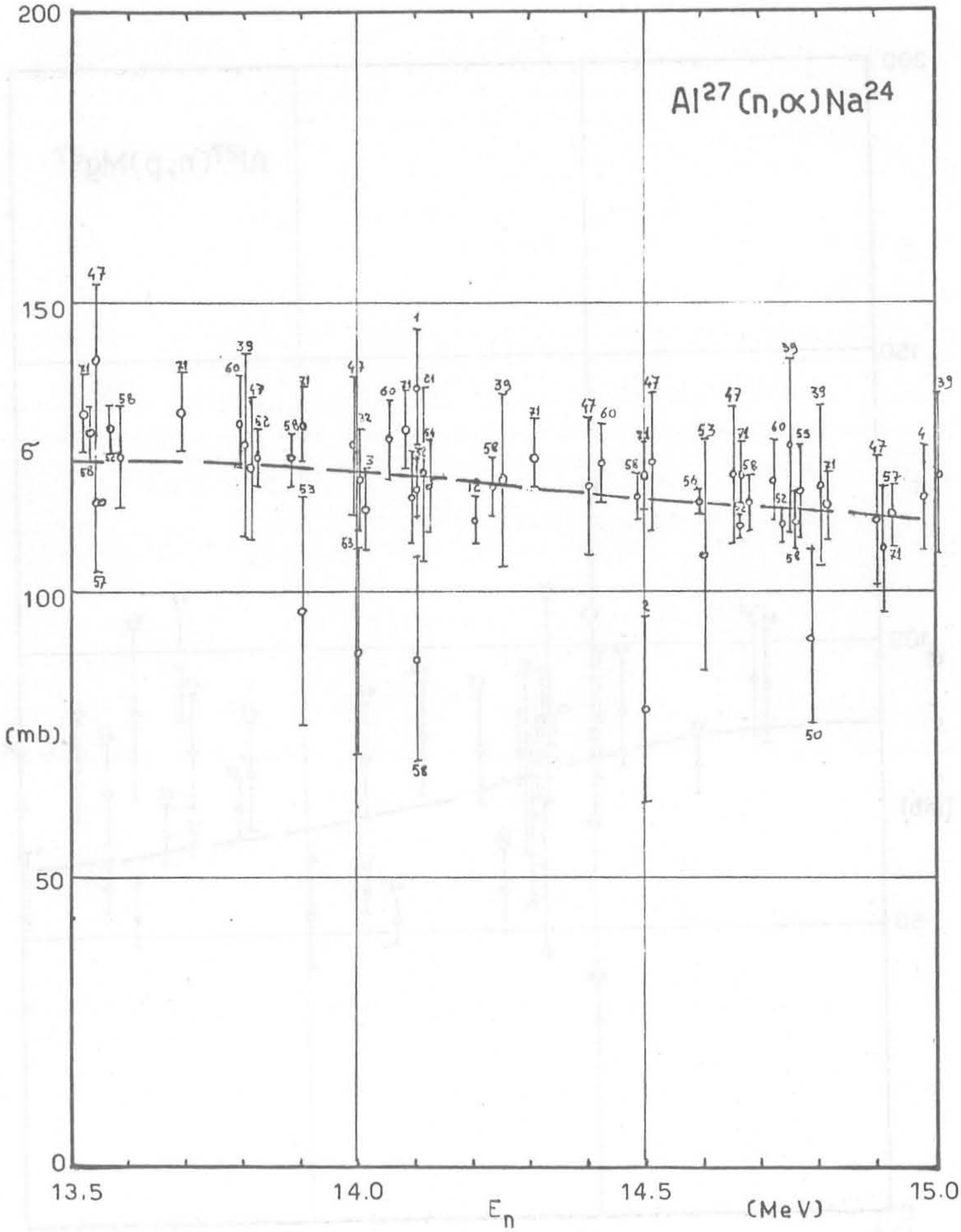

Fig. 6

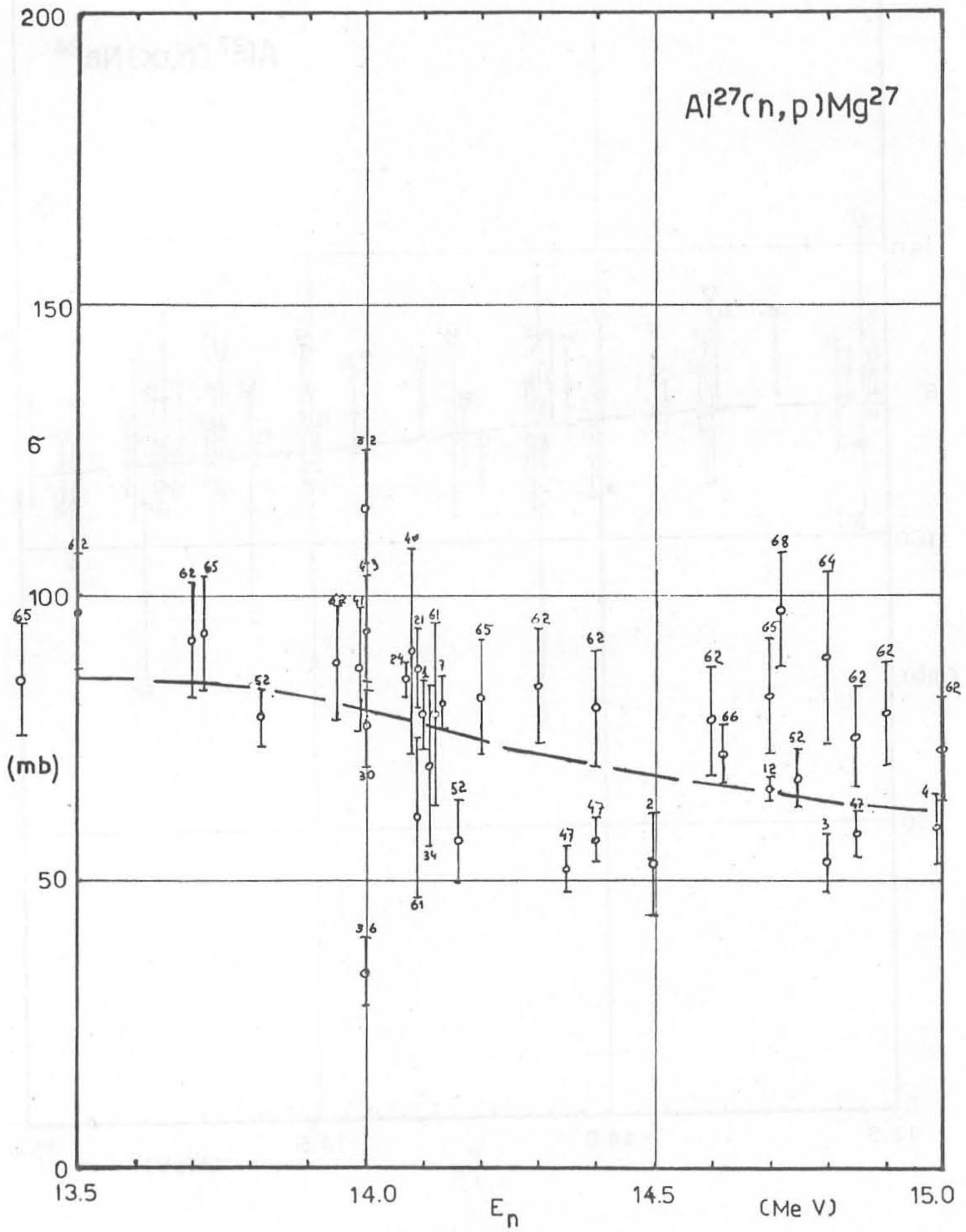

Fig. 7

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