Numerical Differential Cross Sections of the (p, α) Reactions on Al^27, Mn^55 and Co^59

AUTHOR(S):

Ogata, Hiroshi; Itoh, Hidehiko; Masuda, Yoshiko; Takamatsu, Kunio; Kawashima, Maumi; Masaike, Akira; Kumabe, Isao

CITATION:

Ogata, Hiroshi ...[et al]. Numerical Differential Cross Sections of the (p, α) Reactions on Al^27, Mn^55 and Co^59. Memoirs of the College of Science, University of Kyoto. Series A 1961, 29(3): 267-281

ISSUE DATE:

1961-09

URL:

http://hdl.handle.net/2433/257436

Memoirs of the College of Science, University of Kyoto, Series A,
Vol. XXIX, No. 3, Article 2, 1961.

NUMERICAL DIFFERENTIAL CROSS SECTIONS OF THE (p, α) REACTIONS ON Al^{27}, Mn^{55} AND Co^{59}

BY

Hiroshi OGATA, Hidehiko ITOH, Yoshiko MASUDA, Kunio TAKAMATSU, Maumi KAWASHIMA, Akira MASAIKE and **Isao KUMABE**

(Received September 15, 1960)

We have measured the angular distributions of the reactions $Al^{27}(p, \alpha)Mg^{24}$, $Mn^{55}(p, \alpha)Cr^{52}$ and $Co^{59}(p, \alpha)Fe^{56}$ resulting in the ground and first excited states of the residual nuclei at 10.5~14.5 Mev, 7.6~12.9 Mev and 7.7~14.1 Mev, respectively. The results have been published in the Journal of the Physical Society of Japan (**1, 2**). The results were represented graphically but the numerical data were not. The numerical dada are, however, necessary for exact comparison with theoretical calculations and with experimental results at other laboratories.

Since some people required us the numerical data, and since the data obtained are rather numerous, we decided to submit these numerical data to this Memoirs.

The details of experimental procedures and discussions have been given in the original articles (**1, 2**).

REFERENCES

1. H. OGATA, H. ITOH, Y. MASUDA, K. TAKAMATSU, M. KAWASHIMA, A. MASAIKE and I. KUMABE: J. Phys. Soc. Japan, **15** (1960), 1719.
2. H. OGATA, H. ITOH, Y. MASUDA, K. TAKAMATSU, M. KAWASHIMA, A. MASAIKE and I. KUMABE: J. Phys. Soc. Japan, **15** (1960), 1726.

Table I (i). Differential cross sections of the reaction $Al^{27}(p, \alpha_0)Mg^{24}$ resulting in the ground state of Mg^{24}.

$\left(\frac{d\sigma}{d\Omega}\right)_{c.m.}$ (μb/sterad)

E_p (Mev) / $\theta_{c.m.}$ (deg)	10.65	10.83	10.99	11.11
21.4	298.6 (12.1)	546.4 (10.5)	613.6 (24.7)	433.5 (14.3)
32.1	198.3 (7.0)	525.5 (9.4)	536.2 (23.2)	317.6 (8.7)
42.7	171.6 (6.5)	439.0 (10.2)	392.7 (20.0)	214.8 (7.2)
53.2	137.7 (5.9)	396.3 (8.1)	388.1 (14.2)	274.7 (8.1)
63.6	152.4 (8.1)	306.5 (7.4)	470.2 (22.3)	348.6 (12.0)
73.9	200.6 (6.6)	214.9 (5.8)	492.5 (23.0)	346.9 (8.6)
84.1	236.9 (7.3)	160.7 (5.9)	476.1 (23.0)	255.1 (7.5)
94.2	197.7 (7.1)	125.8 (4.4)	458.1 (16.1)	352.3 (8.8)
104.1	277.7 (8.1)	180.0 (5.3)	389.5 (21.3)	434.6 (10.0)
113.9	279.9 (8.2)	158.8 (5.5)	404.0 (22.0)	454.4 (10.3)
123.6	303.1 (8.6)	159.4 (5.5)	332.6 (20.2)	375.7 (13.3)
133.2	324.9 (9.1)	197.6 (5.7)	294.4 (17.2)	231.8 (7.6)
142.7	322.7 (10.0)	260.7 (7.3)	329.4 (20.5)	206.2 (7.9)
152.1	294.8 (9.6)	352.7 (9.3)	268.2 (18.7)	159.4 (7.0)
161.4	244.9 (8.9)	498.7 (11.2)	207.0 (16.5)	206.8 (10.1)
170.7	274.3 (9.4)	652.7 (11.6)	125.6 (11.5)	227.3 (8.4)

E_p=mean incident proton energy at the center of target, in laboratory system.
In bracket, the probable error is given.

Table I (ii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	11.22	11.25	11.41	11.45
21.4	669.1 (14.5)	694.2 (13.4)	607.0 (13.5)	602.6 (13.7)
32.1	323.0 (9.0)	335.1 (8.7)	369.4 (9.2)	354.2 (9.1)
42.7	251.0 (7.6)	227.0 (5.7)	228.1 (5.3)	171.5 (6.4)
53.2	269.7 (8.0)	270.8 (8.0)	283.4 (8.2)	156.5 (6.2)
63.6	277.9 (9.7)	283.1 (8.8)	276.6 (9.3)	299.9 (10.0)
74.0	207.5 (7.5)	231.6 (7.6)	268.4 (8.1)	399.6 (10.1)
84.1	273.0 (8.3)	270.2 (6.5)	310.7 (8.8)	443.6 (10.8)
94.2	416.5 (10.4)	442.2 (10.7)	353.6 (9.5)	374.5 (10.0)
104.1	578.7 (12.4)	652.9 (13.2)	398.5 (10.2)	347.9 (10.0)
114.0	631.2 (13.1)	666.6 (13.5)	503.2 (11.7)	356.3 (10.0)
123.6	517.4 (12.0)	562.0 (12.3)	544.2 (12.2)	372.2 (10.3)
133.2	391.6 (10.5)	395.9 (10.6)	586.1 (12.7)	346.4 (10.1)
142.7	277.3 (9.0)	336.8 (9.9)	530.5 (12.4)	288.1 (9.3)
152.1	231.0 (8.2)	304.8 (9.5)	420.9 (11.1)	192.9 (7.7)
161.4	256.5 (8.7)	262.7 (8.8)	282.8 (9.1)	108.0 (5.8)
170.7	284.5 (9.2)	262.7 (8.9)	154.9 (6.7)	71.2 (4.7)

Table I (iii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	11.53	11.70	11.80	11.91
21.4	562.0 (10.6)	618.4 (14.6)	543.1 (13.7)	748.8 (15.8)
32.1	485.0 (10.7)	671.2 (15.5)	486.6 (13.0)	429.6 (10.7)
42.7	350.4 (9.5)	563.9 (14.3)	383.4 (11.7)	196.8 (8.5)
53.2	244.1 (8.0)	371.8 (11.7)	259.7 (9.5)	104.9 (6.3)
63.6	247.7 (7.3)	232.3 (8.4)	185.3 (7.6)	84.4 (5.0)
74.0	299.9 (8.7)	203.8 (7.9)	156.6 (7.0)	149.9 (7.0)
84.2	369.7 (10.0)	208.9 (8.3)	128.0 (6.4)	156.9 (7.2)
94.2	425.9 (11.0)	153.1 (7.2)	102.3 (5.7)	80.7 (5.3)
104.1	440.8 (11.4)	148.5 (6.6)	87.7 (5.5)	59.0 (4.6)
114.0	392.8 (10.7)	193.8 (8.3)	132.6 (6.7)	191.1 (8.3)
123.7	358.7 (10.5)	208.9 (8.5)	208.7 (8.6)	358.9 (11.6)
133.2	275.4 (9.2)	190.6 (8.4)	293.0 (10.2)	369.7 (11.9)
142.7	245.0 (8.9)	251.5 (9.9)	285.9 (11.3)	265.5 (11.1)
152.1	228.8 (8.5)	377.6 (13.1)	305.4 (11.7)	251.0 (10.9)
161.4	189.9 (7.9)	538.0 (22.4)	480.4 (14.8)	292.0 (11.8)
170.7	124.4 (6.3)	701.9 (18.2)	687.9 (17.7)	422.6 (14.3)

Table I (iv)

E_p (Mev) / $\theta_{c.m.}$ (deg)	12.08	12.17	12.25	12.37
21.4	517.9 (13.5)	392.9 (11.8)	454.4 (10.0)	370.1 (12.0)
32.1	482.7 (13.0)	352.2 (11.3)	261.5 (5.8)	286.9 (10.0)
42.7	410.9 (12.3)	324.5 (10.7)	155.3 (5.9)	203.1 (8.4)
53.2	318.1 (10.8)	297.3 (10.4)	107.3 (6.1)	145.4 (7.2)
63.7	237.6 (8.6)	250.6 (8.8)	106.4 (4.6)	158.2 (6.9)
74.0	274.4 (9.3)	186.2 (7.6)	122.8 (3.9)	133.4 (6.4)
84.2	260.4 (9.1)	166.7 (7.3)	72.4 (4.7)	100.0 (5.6)
94.2	202.7 (8.3)	136.9 (6.7)	60.4 (4.3)	78.0 (5.1)
104.2	146.4 (5.9)	143.3 (7.0)	69.2 (4.6)	89.4 (5.5)
114.0	171.2 (7.7)	151.9 (7.3)	101.7 (5.8)	112.6 (6.2)
123.7	194.9 (8.0)	179.1 (8.1)	133.4 (6.4)	127.7 (6.7)
133.2	183.8 (6.6)	183.1 (8.2)	122.4 (6.5)	105.7 (6.2)
142.7	139.6 (6.6)	206.2 (9.7)	113.1 (6.7)	58.4 (5.1)
152.1	147.9 (8.3)	240.6 (10.3)	125.1 (7.4)	110.7 (7.0)
161.4	202.9 (9.1)	256.6 (10.8)	178.3 (8.6)	216.4 (9.9)
170.7	272.7 (9.3)	282.1 (11.6)	173.1 (8.7)	366.8 (12.9)

Table I (v)

E_p (Mev) / $\theta_{c.m.}$ (deg)	12.50	12.58	12.67	12.78
21.4	534.4 (13.4)	330.0 (10.3)	308.0 (10.3)	512.3 (13.3)
32.1	387.9 (11.4)	166.8 (7.5)	124.3 (6.3)	201.3 (8.4)
42.7	270.1 (9.7)	106.7 (6.0)	123.4 (6.5)	185.5 (8.1)
53.2	163.4 (7.6)	99.0 (5.8)	186.8 (8.2)	215.2 (8.6)
63.7	96.4 (3.8)	112.9 (4.8)	192.6 (7.6)	196.8 (7.8)
74.0	67.2 (4.5)	82.6 (5.0)	160.1 (7.1)	211.7 (8.1)
84.2	66.5 (4.6)	59.9 (4.3)	93.5 (5.4)	211.2 (11.6)
94.2	95.3 (5.6)	69.4 (4.7)	65.7 (4.6)	176.8 (7.4)
104.2	128.5 (5.3)	108.8 (5.9)	80.5 (5.2)	115.4 (5.9)
114.0	161.0 (7.4)	144.1 (6.9)	147.7 (7.1)	109.5 (8.7)
123.7	159.9 (7.9)	162.5 (7.4)	189.1 (8.2)	139.7 (7.0)
133.2	188.9 (11.6)	229.0 (12.5)	187.0 (11.6)	150.8 (8.9)
142.7	210.9 (7.9)	215.3 (9.6)	141.8 (7.9)	110.2 (6.6)
152.1	196.6 (8.8)	288.2 (11.2)	161.3 (8.5)	66.1 (5.1)
161.4	161.0 (12.0)	300.9 (11.5)	273.2 (11.1)	95.1 (6.6)
170.7	86.4 (6.2)	241.9 (10.1)	466.3 (20.6)	133.6 (7.8)

Table I (vi)

E_p (Mev) / $\theta_{c.m.}$ (deg)	12.85	12.94	13.05	13.16
21.4	523.8 (16.1)	543.6 (14.0)	653.0 (12.0)	447.8 (11.4)
32.1	340.2 (11.0)	315.0 (10.8)	232.8 (8.8)	172.1 (7.1)
42.7	229.8 (9.1)	168.7 (7.9)	81.3 (4.2)	98.0 (5.4)
53.2	174.7 (8.0)	122.9 (6.8)	87.2 (5.5)	116.6 (5.9)
63.7	151.5 (6.9)	112.4 (6.0)	128.0 (5.0)	122.2 (5.6)
74.0	136.1 (6.6)	105.7 (5.9)	150.1 (6.6)	140.0 (6.0)
84.2	159.0 (7.2)	105.4 (6.0)	128.2 (5.1)	142.2 (6.2)
94.2	175.9 (7.7)	98.4 (5.8)	86.5 (5.2)	144.0 (6.3)
104.2	156.6 (7.3)	78.0 (5.3)	55.8 (4.2)	111.4 (5.5)
114.0	115.4 (6.4)	64.8 (4.9)	48.6 (4.0)	81.9 (4.0)
123.7	129.1 (6.8)	79.8 (5.5)	127.5 (6.5)	151.5 (6.6)
133.3	125.8 (6.8)	110.4 (6.5)	210.9 (8.5)	263.1 (8.9)
142.7	100.9 (6.7)	111.9 (7.2)	238.0 (9.9)	346.0 (15.7)
152.1	101.4 (6.8)	117.9 (7.5)	229.0 (9.9)	288.1 (10.4)
161.4	107.7 (7.1)	73.8 (5.9)	180.6 (8.8)	168.0 (8.0)
170.7	91.8 (6.5)	62.3 (5.5)	108.5 (6.9)	71.0 (5.2)

Table I (vii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	13.31	13.39	13.46	13.61
21.5	399.1 (10.9)	176.3 (7.2)	266.4 (8.8)	258.6 (8.7)
32.1	143.8 (6.6)	92.7 (5.2)	119.7 (5.9)	114.6 (5.9)
42.7	122.1 (6.1)	82.0 (4.7)	104.5 (5.6)	121.7 (6.1)
53.3	146.6 (6.7)	120.8 (6.0)	109.9 (5.7)	134.9 (6.4)
63.7	137.5 (4.2)	169.7 (6.6)	113.8 (5.4)	84.0 (4.7)
74.0	129.2 (5.9)	187.5 (7.0)	101.8 (7.3)	83.6 (4.7)
84.2	122.3 (5.8)	149.6 (6.0)	100.8 (5.2)	90.3 (5.0)
94.3	114.8 (5.7)	128.4 (6.0)	93.3 (5.0)	105.7 (5.4)
104.2	116.4 (5.6)	151.8 (6.6)	82.2 (4.7)	75.9 (4.7)
114.0	127.8 (6.1)	168.0 (7.0)	74.5 (4.6)	60.1 (4.2)
123.7	184.8 (7.5)	170.7 (7.1)	85.0 (5.0)	62.0 (4.3)
133.3	231.0 (8.5)	149.1 (6.7)	102.0 (5.5)	91.9 (5.3)
142.7	181.7 (7.9)	104.9 (6.3)	95.0 (5.8)	92.9 (5.9)
152.1	153.9 (7.6)	103.9 (6.3)	107.3 (6.4)	97.4 (6.1)
161.5	100.6 (6.3)	97.9 (6.1)	95.8 (6.0)	97.4 (6.1)
170.7	101.0 (6.3)	115.6 (6.7)	109.7 (5.2)	155.3 (7.8)

Table I (viii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	13.71	13.83	13.96	14.06
21.5	237.2 (8.3)	215.9 (7.8)	158.8 (5.8)	141.8 (6.9)
32.1	147.5 (6.5)	128.6 (6.1)	146.1 (6.4)	180.3 (7.8)
42.7	140.9 (6.4)	148.7 (6.6)	178.4 (7.2)	214.3 (7.9)
53.3	126.9 (6.1)	144.2 (6.3)	182.5 (7.3)	229.8 (9.8)
63.7	80.4 (4.5)	100.4 (5.0)	119.1 (4.8)	102.4 (5.5)
74.0	58.5 (3.9)	78.5 (4.5)	82.9 (4.6)	60.7 (4.3)
84.2	49.9 (3.6)	73.9 (4.4)	86.3 (4.7)	69.5 (4.3)
94.3	73.1 (4.4)	86.9 (4.7)	118.1 (5.5)	130.6 (6.3)
104.2	74.4 (4.5)	108.9 (5.5)	121.8 (5.7)	140.2 (6.8)
114.0	87.2 (5.0)	97.3 (5.3)	97.9 (4.3)	118.6 (6.4)
123.7	97.7 (5.3)	103.1 (5.5)	80.5 (4.8)	148.3 (7.2)
133.3	117.0 (5.9)	151.0 (6.7)	133.0 (6.3)	165.4 (7.7)
142.7	113.3 (6.4)	182.0 (8.1)	203.3 (8.5)	252.8 (10.5)
152.1	127.5 (6.9)	223.9 (9.1)	262.3 (8.0)	223.6 (10.0)
161.5	232.6 (9.4)	262.5 (9.9)	267.5 (10.0)	143.7 (8.0)
170.7	400.1 (12.3)	359.0 (11.6)	220.1 (9.1)	70.4 (5.6)

Table I (ix)

E_p (Mev) / $\theta_{c.m.}$ (deg)	14.16	14.28	14.45
21.5	136.8 (6.5)	77.4 (4.8)	132.1 (5.0)
32.1	122.9 (6.2)	58.5 (4.3)	65.0 (4.7)
42.7	174.9 (6.1)	95.2 (5.7)	159.6 (10.5)
53.3	156.2 (6.8)	135.6 (7.3)	186.2 (8.0)
63.7	103.0 (5.3)	98.2 (5.1)	167.0 (5.3)
74.0	37.9 (3.3)	54.3 (3.9)	51.1 (3.2)
84.2	60.4 (3.4)	66.3 (4.5)	30.8 (2.8)
94.3	89.1 (5.1)	99.3 (6.0)	41.1 (3.6)
104.2	141.7 (6.6)	144.1 (6.6)	67.3 (4.7)
114.0	147.7 (6.8)	185.6 (7.6)	119.6 (6.3)
123.7	189.7 (7.8)	216.0 (8.4)	158.9 (7.4)
133.3	238.1 (8.8)	229.5 (7.6)	137.9 (7.0)
142.7	268.1 (10.4)	232.5 (5.5)	171.2 (8.6)
152.1	249.6 (10.1)	163.2 (8.1)	114.0 (7.0)
161.5	153.3 (8.0)	114.3 (6.9)	80.5 (6.0)
170.7	48.2 (4.5)	71.3 (7.7)	23.8 (3.3)

Table I (x)

E_p (Mev) / $\theta_{c.m.}$ (deg)	14.50	14.55
21.5	120.7 (6.5)	141.1 (8.5)
32.1	123.1 (6.6)	123.1 (6.7)
42.7	202.6 (8.5)	193.1 (8.3)
53.3	235.9 (9.1)	245.0 (9.5)
63.7	184.5 (7.6)	194.5 (6.0)
74.0	97.4 (5.6)	117.8 (6.2)
84.2	57.2 (4.3)	83.7 (5.2)
94.3	64.5 (4.5)	80.1 (5.2)
104.2	66.7 (4.8)	58.2 (4.5)
114.0	79.0 (5.3)	49.5 (4.2)
123.7	106.4 (6.2)	64.4 (4.8)
133.3	127.5 (6.9)	79.8 (4.9)
142.7	132.8 (7.8)	111.1 (7.1)
152.1	114.4 (7.3)	85.6 (6.0)
161.5	65.9 (5.5)	50.0 (4.8)
170.7	38.1 (4.2)	19.6 (3.0)

Table II (i) Differential cross sections of the reaction $Al^{27}(p, \alpha_1)Mg^{24*}$ resulting in the first excited state of Mg^{24}.

$\left(\frac{d\sigma}{d\Omega}\right)_{c.m.}$ (μb/sterad)

E_p (Mev) / $\theta_{c.m.}$ (deg)	10.65	10.83	10.99	11.11
21.5	2881 (37)	3588 (37)	2716 (53)	2403 (34)
32.2	2914 (27)	2247 (20)	2223 (47)	2152 (23)
42.9	3045 (33)	1529 (19)	1841 (43)	1976 (22)
53.4	2788 (34)	1360 (15)	1581 (29)	1927 (21)
63.9	2458 (32)	1522 (16)	1467 (39)	1257 (22)
74.2	2103 (22)	1575 (16)	1721 (43)	1317 (17)
84.4	1916 (21)	1632 (19)	1996 (47)	1138 (16)
94.5	1729 (20)	1646 (16)	2171 (35)	1249 (17)
104.4	1592 (20)	1287 (14)	1840 (45)	1362 (18)
114.2	1572 (20)	1237 (15)	1604 (45)	1372 (18)
123.9	1560 (20)	1300 (16)	1463 (42)	1357 (18)
133.4	1542 (20)	1374 (15)	1717 (48)	1399 (19)
142.9	1667 (23)	1444 (17)	1848 (49)	1680 (23)
152.2	1579 (23)	1341 (18)	2422 (57)	2011 (25)
161.5	1482 (22)	1219 (18)	2257 (55)	2227 (27)
170.8	1377 (21)	1211 (16)	2062 (47)	2203 (27)

Table II (ii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	11.22	11.25	11.41	11.45
21.5	2514 (28)	2405 (25)	3137 (30)	2350 (27)
32.2	2595 (26)	2415 (23)	3060 (26)	2253 (22)
42.9	2245 (23)	2160 (18)	2615 (24)	2162 (23)
53.4	2077 (22)	2041 (21)	2130 (22)	1810 (20)
63.9	1462 (22)	1603 (21)	1625 (23)	1412 (22)
74.2	1242 (18)	1307 (18)	1505 (19)	1183 (16)
84.4	1286 (18)	1242 (14)	1606 (20)	1189 (18)
94.5	1409 (19)	1437 (19)	1808 (22)	1403 (19)
104.4	1552 (20)	1533 (20)	1701 (21)	1657 (21)
114.2	1541 (21)	1614 (21)	1558 (21)	1965 (24)
123.9	1691 (22)	1624 (21)	1580 (21)	2071 (25)
133.4	1900 (23)	1997 (22)	1895 (23)	2097 (25)
142.9	2206 (25)	2469 (27)	2444 (27)	2103 (25)
152.2	2442 (27)	2610 (28)	2944 (29)	2282 (27)
161.5	2416 (27)	2375 (26)	3238 (31)	2667 (29)
170.8	2322 (27)	2100 (25)	3326 (31)	3072 (31)

Table II (iii)

$\theta_{c.m.}$ (deg) \ E_p (Mev)	11.53	11.70	11.80	11.91
21.5	3203 (25)	2398 (31)	1683 (24)	1856 (25)
32.2	2906 (26)	2032 (30)	1633 (24)	1467 (23)
42.9	2089 (23)	1429 (23)	1447 (23)	1188 (21)
53.4	1607 (20)	1007 (19)	1269 (21)	1029 (20)
63.9	1409 (18)	955 (17)	943 (17)	920 (17)
74.2	1422 (19)	986 (18)	822 (16)	928 (18)
84.4	1546 (21)	1040 (18)	873 (17)	924 (18)
94.5	1638 (22)	902 (17)	920 (17)	864 (17)
104.4	1749 (24)	869 (16)	894 (17)	785 (17)
114.2	1778 (23)	1046 (19)	976 (18)	856 (18)
123.9	1854 (24)	1241 (21)	1062 (20)	951 (19)
133.4	1688 (23)	1396 (23)	1106 (20)	989 (20)
142.9	2016 (26)	1654 (27)	1234 (24)	1003 (22)
152.2	1867 (26)	1802 (29)	1292 (24)	1100 (22)
161.5	1536 (23)	2098 (44)	1623 (28)	1241 (25)
170.8	1262 (20)	2405 (34)	1732 (28)	1514 (27)

Table II (iv)

$\theta_{c.m.}$ (deg) \ E_p (Mev)	12.08	12.17	12.25	12.37
21.5	1435 (23)	1479 (23)	2168 (22)	1610 (24)
32.2	1084 (22)	1215 (20)	1082 (11)	1166 (20)
42.9	959 (19)	1162 (20)	784 (13)	818 (17)
53.4	985 (19)	1143 (20)	683 (15)	780 (17)
63.9	1082 (20)	1134 (19)	747 (12)	928 (17)
74.2	1133 (19)	1032 (18)	857 (10)	976 (18)
84.4	1026 (20)	994 (18)	722 (15)	942 (17)
94.5	952 (18)	940 (18)	874 (17)	906 (17)
104.4	870 (14)	915 (18)	961 (17)	1065 (21)
114.2	799 (17)	933 (18)	1134 (19)	1123 (20)
123.9	803 (16)	965 (19)	1110 (19)	1101 (20)
133.4	800 (14)	898 (19)	1017 (21)	1002 (20)
142.9	981 (17)	990 (21)	1015 (20)	1012 (21)
152.2	1114 (23)	1065 (22)	1133 (22)	1074 (22)
161.5	1226 (23)	1249 (24)	1106 (21)	1101 (22)
170.8	1126 (19)	1386 (26)	861 (20)	1066 (22)

Table II (v)

E_p (Mev) / $\theta_{c.m.}$ (deg)	12.50	12.58	12.67	12.78
21.5	1895 (25)	1766 (24)	1543 (23)	1300 (21)
32.2	1339 (21)	1335 (21)	1085 (20)	852 (17)
42.9	896 (18)	932 (18)	852 (17)	673 (16)
53.4	760 (16)	748 (17)	641 (15)	760 (17)
63.9	790 (11)	694 (15)	620 (14)	837 (16)
74.2	598 (14)	576 (13)	585 (14)	628 (14)
84.4	530 (13)	489 (12)	524 (13)	443 (11)
94.5	724 (15)	608 (14)	549 (13)	511 (13)
104.4	1009 (15)	848 (17)	653 (15)	719 (15)
114.2	1273 (21)	1158 (20)	926 (19)	887 (25)
123.9	1285 (21)	1247 (21)	1265 (21)	1038 (19)
133.4	1207 (29)	1207 (28)	1482 (33)	1097 (19)
142.9	1133 (18)	1337 (24)	1654 (27)	1264 (23)
152.2	1220 (23)	1454 (25)	1657 (27)	1451 (26)
161.5	1398 (36)	1613 (27)	1692 (28)	1691 (28)
170.8	1819 (29)	1802 (28)	1555 (38)	2001 (31)

Table II (vi)

E_p (Mev) / $\theta_{c.m.}$ (deg)	12.85	12.94	13.05	13.16
21.5	1675 (24)	1692 (25)	1953 (20)	1682 (22)
32.2	1048 (19)	1142 (20)	1576 (22)	1346 (20)
42.9	835 (17)	926 (19)	1138 (16)	1112 (20)
53.4	932 (18)	940 (19)	856 (17)	728 (15)
63.9	920 (17)	837 (16)	749 (12)	757 (14)
74.2	721 (15)	673 (15)	678 (14)	719 (14)
84.4	476 (12)	534 (13)	655 (11)	664 (13)
94.5	447 (10)	599 (14)	615 (14)	694 (13)
104.4	616 (14)	700 (16)	775 (16)	808 (15)
114.2	775 (17)	745 (17)	913 (17)	914 (16)
123.9	981 (19)	820 (18)	963 (18)	892 (16)
133.4	1102 (20)	869 (18)	882 (17)	959 (17)
142.9	1199 (23)	982 (22)	933 (19)	1052 (22)
152.2	1322 (25)	1073 (23)	1175 (23)	1056 (20)
161.5	1396 (26)	1207 (24)	1431 (25)	963 (19)
170.8	1460 (26)	1305 (25)	1567 (26)	742 (17)

Table II (vii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	13.31	13.39	13.46	14.61
21.5	1826 (23)	1229 (19)	691 (14)	695 (14)
32.2	1330 (20)	1129 (18)	614 (13)	612 (14)
42.9	940 (17)	1058 (17)	734 (15)	651 (14)
53.4	777 (16)	954 (18)	800 (15)	784 (16)
63.9	732 (10)	695 (13)	703 (14)	682 (13)
74.2	671 (13)	495 (11)	487 (16)	534 (12)
84.4	623 (13)	492 (11)	437 (11)	483 (12)
94.5	585 (13)	553 (12)	461 (11)	515 (12)
104.4	634 (13)	535 (12)	471 (11)	504 (12)
114.2	746 (15)	661 (14)	538 (13)	525 (12)
123.9	850 (16)	828 (16)	622 (14)	548 (13)
133.4	973 (17)	1059 (18)	724 (15)	655 (14)
142.9	1091 (20)	1133 (21)	775 (16)	693 (16)
152.2	1212 (22)	1059 (20)	830 (18)	811 (18)
161.5	1072 (21)	1027 (20)	917 (19)	1046 (20)
170.8	898 (19)	980 (20)	1072 (20)	1317 (23)

Table II (viii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	13.71	13.83	13.96	14.06
21.5	708 (14)	823 (15)	860 (13)	857 (17)
32.2	747 (15)	730 (15)	743 (15)	678 (15)
42.9	766 (15)	773 (15)	839 (16)	650 (14)
53.4	786 (15)	791 (15)	798 (15)	760 (16)
63.9	668 (14)	655 (13)	578 (10)	564 (13)
74.2	541 (12)	526 (12)	397 (10)	336 (10)
84.4	482 (11)	483 (11)	417 (10)	326 (9)
94.5	550 (12)	511 (11)	453 (11)	391 (11)
104.4	506 (12)	515 (12)	436 (11)	374 (11)
114.2	499 (12)	503 (12)	469 (9)	362 (11)
123.9	512 (12)	503 (12)	478 (12)	409 (12)
133.4	527 (13)	556 (13)	484 (12)	444 (13)
142.9	647 (15)	622 (15)	508 (14)	515 (15)
152.2	819 (18)	810 (17)	598 (12)	541 (16)
161.5	1024 (21)	1061 (20)	755 (17)	680 (18)
170.8	1239 (22)	1241 (22)	899 (18)	887 (20)

Table II (ix)

E_p (Mev) / $\theta_{c.m.}$ (deg)	14.16	14.28	14.45
21.5	829 (17)	760 (15)	692 (11)
32.2	494 (12)	641 (14)	607 (14)
42.9	534 (11)	684 (14)	667 (22)
53.4	640 (15)	657 (16)	808 (17)
63.9	518 (12)	561 (12)	554 (10)
74.2	299 (9)	422 (11)	403 (9)
84.4	297 (8)	353 (10)	283 (8)
94.5	336 (10)	350 (12)	324 (10)
104.4	381 (11)	387 (11)	345 (11)
114.2	365 (11)	459 (12)	336 (11)
123.9	361 (11)	427 (12)	346 (11)
133.4	348 (11)	451 (11)	338 (11)
142.9	316 (11)	358 (12)	427 (14)
152.2	358 (13)	318 (11)	359 (13)
161.5	422 (13)	345 (12)	329 (12)
170.8	516 (15)	451 (20)	299 (12)

Table II (x)

E_p (Mev) / $\theta_{c.m.}$ (deg)	14.50	14.55
21.5	695 (16)	604 (18)
32.2	544 (14)	524 (14)
42.9	554 (14)	582 (14)
53.4	601 (14)	597 (15)
63.9	529 (13)	461 (9)
74.2	330 (10)	319 (10)
84.4	251 (9)	278 (10)
94.5	314 (10)	319 (10)
104.4	324 (11)	313 (10)
114.2	369 (11)	350 (11)
123.9	334 (11)	340 (11)
133.4	360 (12)	306 (11)
142.9	379 (13)	435 (14)
152.2	424 (14)	596 (17)
161.5	365 (13)	657 (18)
170.8	322 (12)	673 (18)

Table III (i). Differential cross sections of the reaction $Mn^{55}(p, \alpha_0)Cr^{52}$ resulting in the ground state of Cr^{52}.

$\left(\frac{d\sigma}{d\Omega}\right)_{c.m.}$ (μb/sterad)

E_p (Mev) / $\theta_{c.m.}$ (deg)	7.65	8.85	9.65
20.6	147.8 (7.4)	72.2 (5.7)	58.7 (3.8)*
30.9	121.1 (5.2)	62.6 (4.0)	53.2 (3.1)*
41.2	112.1 (5.3)	70.4 (3.2)	45.6 (2.9)
51.4	114.3 (5.3)	53.1 (3.8)*	35.4 (2.3)*
61.6	114.4 (4.7)	53.1 (4.5)	24.5 (1.6)*
71.7	106.5 (4.5)	57.9 (3.5)*	23.8 (1.9)*
81.8	103.8 (4.6)	54.2 (2.5)	23.8 (1.9)*
91.9	102.7 (4.6)	56.6 (3.5)	25.5 (1.8)
101.8	113.8 (4.1)	55.4 (3.4)	29.8 (1.7)*
111.7	114.3 (4.4)	53.8 (3.4)*	29.0 (1.6)*
121.6	109.6 (4.1)	59.4 (3.7)	30.4 (1.9)*
131.4	129.9 (3.4)	62.8 (3.6)*	31.9 (1.9)*
141.2	140.6 (5.0)	79.1 (4.4)	32.8 (2.0)
150.9	178.1 (6.6)	76.9 (4.5)	36.2 (2.0)*
160.6	180.6 (5.8)	69.5 (4.4)	46.6 (2.6)*
170.3	205.4 (5.1)	53.1 (3.7)	51.5 (2.7)

* Corresponding $\theta_{c.m.}$ should be added by 0.1° to the tabulated angle $\theta_{c.m.}$.

Table III (ii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	10.7	11.8	12.9
20.7	28.4 (2.2)	27.1 (2.8)	15.3 (1.5)
31.0	23.4 (1.6)	21.5 (2.2)	9.17 (0.93)
41.2	35.7 (1.8)	13.5 (1.4)	5.69 (0.67)*
51.5	33.0 (1.5)	9.53 (1.09)	6.08 (0.75)
61.7	21.0 (1.2)	8.91 (1.01)	5.49 (0.54)
71.8	16.8 (1.2)	6.05 (0.94)	6.26 (0.64)
81.9	14.6 (1.1)	8.53 (0.97)	5.10 (0.58)
91.9	17.3 (1.0)	7.21 (0.88)	4.58 (0.59)*
101.9	20.1 (1.1)	7.88 (0.91)	3.94 (0.50)
111.8	22.1 (1.2)	9.29 (0.84)	2.87 (0.39)
121.7	23.4 (1.2)	8.72 (1.13)	3.44 (0.43)
131.5	18.6 (1.1)	9.29 (0.73)	2.82 (0.38)
141.2	20.7 (1.2)	9.55 (1.11)	4.15 (0.56)*
151.0	18.1 (1.2)	11.8 (0.93)	5.99 (0.62)
160.7	17.5 (1.2)	14.1 (1.3)	8.46 (0.74)
170.3	18.1 (1.2)	18.1 (1.4)	6.13 (0.63)

Table IV (i). Differential cross sections of the reaction $Mn^{55}(p,\alpha_1)Cr^{52*}$ resulting in the first excited state of Cr^{52}.

$\left(\frac{d\sigma}{d\Omega}\right)_{c.m.}$ (μb/sterad)

E_p (Mev) / $\theta_{c.m.}$ (deg)	7.65	8.85	9.65
20.7	459.6 (13.0)	349.9 (12.6)	274.2 (8.3)
31.0	419.0 (9.7)	296.5 (8.6)	271.5 (7.0)
41.3	390.8 (9.9)	300.5 (6.6)	226.6 (6.4)
51.5	364.0 (9.5)	297.9 (8.3)	165.0 (5.0)*
61.7	299.2 (7.6)	255.4 (9.7)	149.9 (4.0)*
71.9	276.6 (7.2)	205.1 (6.6)	137.0 (4.5)
82.0	275.0 (7.6)	192.0 (4.8)	128.7 (4.4)
92.0	277.8 (7.5)	169.0 (5.7)	143.2 (4.2)
102.0	280.2 (6.4)	167.1 (5.9)	132.7 (3.7)
111.9	285.8 (6.8)	166.7 (6.0)	148.0 (3.7)
121.7	294.6 (6.7)	182.8 (6.4)	158.4 (4.4)*
131.5	294.6 (5.2)	197.4 (6.5)	159.5 (4.3)*
141.3	335.2 (7.8)	237.0 (7.6)	169.1 (4.5)
151.0	380.6 (8.8)	246.3 (7.9)	191.6 (4.6)
160.7	418.1 (8.8)	261.7 (8.4)	198.4 (5.4)
170.3	585.3 (8.3)	259.8 (8.1)	208.1 (5.4)

Table IV (ii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	10.7	11.8	12.9
20.7	203.7 (5.9)	153.2 (6.6)	128.5 (4.4)
31.0	169.0 (4.2)	130.1 (4.8)	109.9 (3.2)
41.3	142.7 (3.7)	105.8 (3.8)	73.1 (2.4)
51.6	117.0 (2.8)	81.4 (3.4)	47.2 (2.1)
61.8	94.4 (2.6)	51.2 (2.4)	34.5 (1.4)
71.9	83.4 (2.8)	50.1 (2.7)	28.4 (1.4)
82.0	79.6 (2.5)	45.8 (2.2)	26.2 (1.3)
92.0	76.7 (2.1)	41.0 (2.1)	22.6 (1.3)
102.0	74.4 (2.2)	42.1 (2.1)	23.9 (1.2)
111.9	70.9 (2.2)	44.6 (1.8)	20.5 (1.1)
121.8	75.5 (2.2)	47.9 (2.1)	23.6 (1.1)
131.6	90.3 (2.4)	46.3 (1.6)	26.2 (1.2)
141.3	109.9 (2.8)	53.0 (2.6)	29.8 (1.5)
151.0	116.3 (3.0)	52.9 (2.0)	29.4 (1.4)
160.7	107.2 (2.9)	62.2 (2.6)	32.9 (1.5)
170.4	102.9 (2.9)	63.3 (2.6)	36.1 (1.5)

Table V (i). Differential cross sections of the reaction $Co^{59}(p, \alpha_0)Fe^{56}$ resulting in the ground state of Fe^{56}.

$\left(\frac{d\sigma}{d\Omega}\right)_{c.m.}$ (μb/sterad)

E_p (Mev) / $\theta_{c.m.}$ (deg)	7.7	8.7	9.8	10.85
20.6	156.6 (7.9)	76.6 (5.7)	52.8 (2.6)	42.9 (5.0)
30.8	127.5 (4.9)	85.9 (5.5)	47.0 (2.9)*	33.5 (2.3)*
41.1	115.8 (4.5)	71.2 (2.9)	42.3 (2.0)	32.8 (1.9)
51.3	101.2 (4.3)	63.0 (2.7)	37.9 (1.8)	21.4 (1.2)
61.5	78.3 (4.0)	51.2 (2.9)	32.5 (1.5)	20.5 (1.2)
71.6	70.7 (3.7)	50.7 (2.8)	35.7 (1.7)	17.4 (1.2)
81.7	71.7 (3.7)	46.5 (2.4)	26.3 (1.6)	13.2 (1.0)
91.7	77.8 (3.8)	41.0 (2.3)	24.2 (1.5)	14.9 (1.0)
101.7	71.2 (3.7)	36.8 (2.2)	23.5 (1.6)	15.3 (1.1)
111.6	84.6 (3.8)	37.1 (2.1)	23.1 (1.7)	17.2 (1.2)
121.5	84.9 (4.1)	45.6 (2.4)	28.4 (1.7)	17.1 (1.2)
131.3	107.5 (4.6)	54.3 (2.7)	37.7 (1.9)	17.4 (1.2)
141.1	88.0 (4.2)	61.8 (2.8)	39.7 (2.1)	21.2 (1.3)
150.8	89.7 (4.0)	66.6 (2.8)	45.5 (2.5)*	19.9 (1.3)*
160.6	89.8 (3.5)	66.6 (3.0)	41.9 (2.1)	18.1 (1.2)
170.3	102.2 (4.5)	66.6 (3.0)	45.5 (2.1)	22.6 (2.4)

Table V (ii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	11.9	13.1	14.1
20.6	50.9 (4.6)	42.0 (3.2)	74.0 (5.9)
30.9	30.0 (2.0)	27.9 (2.0)	39.5 (3.4)
41.1	19.0 (1.1)	18.9 (1.1)	19.2 (1.3)*
51.4	10.4 (0.65)	8.94 (0.72)	9.45 (0.82)
61.5	9.81 (0.88)	4.50 (0.54)	6.76 (0.65)*
71.7	7.60 (0.80)	6.98 (0.67)	4.55 (0.55)
81.7	7.82 (0.70)	7.84 (0.69)	5.27 (0.69)*
91.8	5.61 (0.51)	3.75 (0.48)	4.52 (0.58)
101.7	5.77 (0.65)	3.81 (0.41)	4.01 (0.59)*
111.7	5.28 (0.63)	4.56 (0.58)	3.71 (0.57)
121.5	7.82 (0.60)	4.44 (0.54)	4.34 (0.53)*
131.4	9.43 (0.87)	6.34 (0.62)	3.02 (0.47)
141.1	8.68 (0.82)	8.19 (0.62)	3.62 (0.57)*
150.9	7.98 (0.78)	5.65 (0.66)	5.19 (0.69)
160.6	6.31 (1.21)	7.09 (0.69)	4.47 (0.60)
170.3	8.14 (0.81)	14.3 (2.4)	6.80 (1.12)

Table VI (i). Differential cross sections of the reaction $Co^{59}(p, \alpha_1)Fe^{56*}$ resulting in the first excited state of Fe^{56}.

$\left(\frac{d\sigma}{d\Omega}\right)_{c.m.}$ (μb/sterad)

E_p (Mev) / $\theta_{c.m.}$ (deg)	7.7	8.7	9.8	10.85
20.6	400.2 (12.7)	196.8 (9.0)	171.8 (4.7)	118.1 (8.3)
30.9	368.2 (8.1)	234.2 (9.1)	163.2 (5.4)	143.3 (4.9)
41.2	339.7 (7.8)	221.7 (5.1)	165.1 (4.0)	113.7 (2.8)
51.4	328.3 (7.7)	224.0 (5.2)	141.4 (3.5)	80.6 (2.4)
61.6	304.8 (7.9)	199.7 (5.8)	131.7 (2.9)	69.7 (2.3)
71.7	260.0 (7.0)	203.7 (5.7)	122.5 (3.1)	68.4 (2.3)
81.8	265.8 (7.0)	199.7 (5.0)	135.9 (3.7)	72.4 (2.4)
91.8	297.1 (7.4)	184.9 (4.8)	131.0 (3.5)	63.3 (2.2)
101.8	317.5 (7.8)	201.8 (5.1)	125.9 (3.8)	57.3 (2.1)
111.7	308.2 (7.3)	188.9 (4.7)	112.8 (3.9)	55.9 (2.1)
121.6	326.3 (7.9)	203.0 (5.1)	120.5 (3.6)	58.4 (2.2)
131.4	338.5 (8.2)	205.7 (5.1)	113.8 (3.3)	73.0 (2.4)
141.2	350.4 (8.3)	217.7 (5.3)	123.8 (3.8)	84.2 (2.6)
150.9	340.5 (7.8)	217.6 (5.2)	133.3 (4.2)	81.6 (2.6)
160.6	317.8 (8.0)	229.7 (5.5)	155.4 (4.2)	91.2 (2.7)
170.3	314.4 (8.0)	233.5 (5.6)	150.2 (3.8)	79.6 (4.5)

Table VI (ii)

E_p (Mev) / $\theta_{c.m.}$ (deg)	11.9	13.1	14.1
20.6	98.0 (6.3)	110.7 (5.2)	109.6 (7.2)
30.9	110.7 (3.9)	110.7 (4.0)	112.5 (5.8)
41.2	81.1 (2.2)	69.4 (2.0)	63.0 (2.4)
51.4	46.0 (1.4)	41.4 (1.6)	29.7 (1.5)
61.6	36.2 (1.7)	26.1 (1.3)	22.9 (1.2)
71.7	36.0 (1.7)	28.6 (1.4)	27.7 (1.4)*
81.8	29.1 (1.3)	27.5 (1.3)	26.0 (1.5)
91.9	30.6 (1.2)	25.0 (1.2)	17.3 (1.1)
101.8	38.6 (1.9)	20.8 (1.0)	13.1 (1.1)
111.7	35.0 (1.6)	21.5 (1.3)	18.3 (1.3)*
121.6	39.9 (1.4)	25.7 (1.3)	18.4 (1.1)
131.4	51.0 (2.2)	26.9 (1.3)	21.3 (1.2)
141.2	45.3 (1.9)	25.8 (1.1)	25.2 (1.5)
150.9	41.2 (1.7)	25.8 (1.4)	25.1 (1.5)
160.6	47.9 (3.4)	24.3 (1.0)	25.7 (1.5)
170.3	48.9 (2.0)	38.5 (4.0)	24.4 (2.1)