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EQUILIBRIUM CHARGE STATE DISTRIBUTIONS OF IONS ($Z_1 \geq 4$) AFTER PASSAGE THROUGH FOILS — COMPILATION OF DATA AFTER 1972 —

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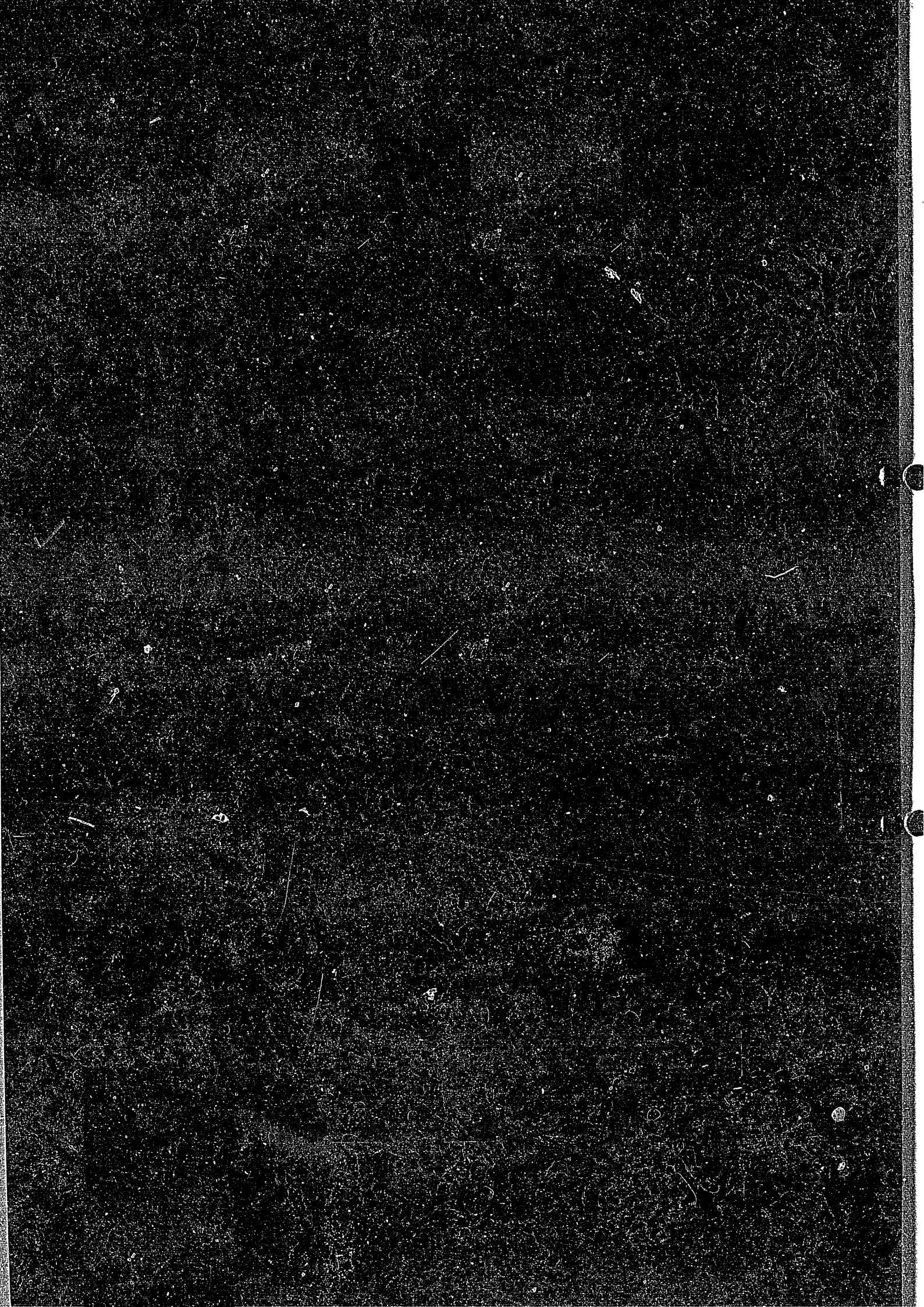

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EQUILIBRIUM CHARGE STATE DISTRIBUTIONS OF IONS ($Z_1 \geqq 4$) AFTER PASSAGE THROUGH FOILS – COMPILATION OF DATA AFTER 1972 –

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abstract

Tables are presented for equilibrium charge distributions, mean charges, and distribution widths of energetic heavy ions ($Z_1 \geq 4$) passing through thin foils reported after May 1972. Data reported before May 1972 have been already compiled in ATOMIC DATA 5, 113 (1973) by Wittkower and Betz.

CONTENTS

INTRODUCTION

All the equilibrium charge distribution data of ions reported before May 1972 were tabulated in At. Data 5, 113 (1973) by Wittkower and Betz (referred to WB in this text) for ions with the atomic number Z_1 greater than 3 after passage through gaseous and solid targets. A comprehensive review article on heavy ion charge distributions in media was given by Betz[1] in 1972. Since then, many charge distribution data particularly for high energy and heavy ions as well as several review articles[2-6] have been reported in connection with the investigation of basic collision processes and their application of to other fields. Consequently, the necessity arises in compiling more recent charge distribution data. In the present tables, equilibrium charge distribution data reported after May 1972 are compiled for ions $Z_1 \geq 4$ passing through solid targets. The format of the present tables only slightly differs from that of WB in the definition of the ion energy but the skewness parameter is omitted in the present work.

In view of the foil materials through which ions pass, the most abundant data are accumulated for ions observed behind carbon foils. In Fig.1, the data compiled in the present tables as well as the data in WB are displayed for various ions in carbon foils as a function of ion energy in units of MeV/u (the data outside the scale of Fig.1 is limited).

In the following, a brief explanation is given for quantities appearing in the tables such as ion energy, mean charge, distribution width and distribution function.

Charge Equilibration and Ion Energy

When energetic ions penetrate through a medium, their charge states vary as a function of the penetration depth and, at a certain depth, the charge equilibration is attained where charge distributions become independent of initial charge state of ions. The foil thickness where the charge equilibration is attained is closely related to the magnitude of charge exchange cross sections, and Betz[6], Baron[7], and Zaikov et al.[8] have tried to find some trend of the charge equilibrium thickness of foils with respect to Z_1 and ion energy.

Once the charge equilibration is attained, the charge distribution, however, varies as a function of penetration depth. A typical example of the variation of the charge distriburion as a function of foil thickness is shown in Fig.2 for the incidence of 65 MeV Cu^{9+} ions in carbon foil[9], where the charge fraction $F(q)$ for charge state q and mean charge $\bar{q}$ are plotted as a function of carbon foil thickness. At the bottom of the figure is indicated the ion energy after passage through foil which was estimated from the foil thickness and the stopping power. The mean charge state $\bar{q}$ is defined by

$$\bar{q} = \sum_q qF(q) \quad . \qquad (1)$$

Fig.2 shows that the charge equilibration is attained at around 30 $\mu g/cm^2$ thick carbon foils. For thicker foils, the equilibrium charge fractions $F(q)$ for $q > \bar{q}$ (in this case $\bar{q} \simeq 18$) are seen to decrease, meanwhile those for $q < \bar{q}$ increase, and then $\bar{q}$ values decrease. The variation of $F(q)$ and $\bar{q}$ in charge equilibration over the foil thickness is attributed to the variation of the ion energy E at the emergence from foil due to the energy loss in the

foils. In fact, apart from disagreement in the absolute values, the observed variation of equilibrium $\bar{q}$ vs foil thickness in Fig.2 can be reproduced quite well with an empirical relation of q vs E, for instance, given by Nikolaev and Dmitriev[10] (as drawn with a dotted line in Fig.2),

$$\bar{q} = Z_1(1 + X^{-1/0.6})^{-0.6} , \qquad (2)$$

$$X = 3.86\sqrt{E/M_1}/Z_1^{0.45} , \qquad (3)$$

where E is in units of MeV, and M_1 is the atomic mass of ions. Whatever foil thickness or incident ion energy one may adopt, the equilibrium charge distribution data of heavy ions can be reproduced when they are classified according to the projectile energy E emergent from foil. Hence, in the present tables, the equilibrium charge distribution data for each ion are listed as a function of the emergent energy from foils.

Mean Charge

The mean charge $\bar{q}$ is defined by eq.(1). $\bar{q}/Z_1$ values of ions either in solid media or in gaseous media are known to focus around a single curve when they are plotted against some appropriate function of E anf Z_1. In Fig.3, all the equilibrium $\bar{q}/Z_1$ values of ions in carbon foils contained in the present tables are plotted as a function of reduced velocity X (eq.(3)) which was introduced by Nikolaev and Dmitriev[10] in the scaling procedure of $\bar{q}$ in solid targets. Empirical or semiempirical formulas of $\bar{q}$ of ions in solids have been reported by Nikolaev and Dmitriev[10], Betz[6], To and Drouin[11], Baron[12], Sayer[13], and Shima et al[14].

Z_1 oscillation of $\bar{q}$ for fixed ion velocity and foil material

has been reported by Lennard et al.[15,16], and Z_2 oscillation of $\bar{q}$ in solid for fixed Z_1 and E has been reported by Shima et al.[17,18] In Fig.4, the latter case is shown for the ions of Cu, Cl, Si and F as a function of Z_2 of foils. Generally, higher $\bar{q}$ values are seen for the passage through foils with lower Z_2, and the oscillatory behavior becomes remarkable with decreasing ion energy.

Distribution Width

Distribution width d is defined as

$$d = \{ \sum_q (q - \bar{q})^2 F(q) \}^{0.5} . \qquad (4)$$

In case when the charge distribution is of Gaussian, 68 % of ions are expected to be observed within the width 2d in units of charge around the maximum of the distribution. In Fig.5, $d/Z_1^{0.27}$ values of various ions observed behind carbon foils are plotted as a function of reduced velocity X (eq.(3)). Data are taken from the tables of the present work and of WB. Solid line, drawn to guide the eye, represents the d values of Cl ions, which exhibits a typical trend of d vs ion velocity. As is apparent from Fig.5, it is rather difficult to find systematics of d in terms of Z_1 or E. This is because the shell effect[19] of charge distribution is involved in d. Hence, existing empirical relations of d in solid targets reported by Nikolaev and Dmitriev[10], Betz[6], Baudinet-Robinet[20,21], and To and Drouin[11] provide rather crude values of d, or in some of them, their application is limited to a certain range of Z_1 and E. As an example of d in carbon targets, the formula by Nikolaev and Dmitriev[10] is introduced.

$$d = 0.5\ Z_1^{0.5}(1 + X^{-1/0.6})^{-0.8}\ X^{-1/1.2} . \qquad (5)$$

Lennard et al.[22] report on the Z_1 oscillation of d for fixed

ion velocity of various ions in carbon, and Shima et al.[23] demonstrate the presence of the shell effect in d.

Distribution Function

In a crude approximation, charge distributions of ions are expressed with a Gaussian distribution.

$$F(q) = \frac{1}{\sqrt{2\pi}\, d} \exp\{-(q-\bar{q})^2 / 2d^2\} \quad . \qquad (6)$$

If empirical formulas for $\bar{q}$ and d are used in eq.(6), approximate values of F(q) can be estimated at least for charge states around the most probable charge state in the range where $\bar{q}/Z_1$ is not far from 0 or 1. On the other hand, for low velocity-, and high velocity-ions, observed charge distributions deviate from a symmetric function. Through the analysis of many existing data of ions in carbon foils, the deduction of empirical formulas of F(q) for asymmetric distributions has been performed by Sayer[13] and Baudinet-Robinet[20,21,24,25]. According to Baudinet-Robinet, equilibrium charge distribution functions of ions observed behind carbon foils are approximated with χ^2-, Gaussian-, and reduced χ^2-distribution for low-charge ions, intermediate-charge ions and high-charge ions, respectively. Here, χ^2- and reduced χ^2-distributions have the common expression as

$$F(q) = c\,[\,2^{\frac{\nu}{2}}\,\Gamma(\tfrac{\nu}{2})\,]^{-1}\, t^{\frac{\nu}{2}-1} \exp(-\tfrac{t}{2}) \quad , \qquad (7)$$

where Γ is the gamma function, and $c=2(\bar{q}+2)/d^2$, $\nu=2(\bar{q}+2)^2/d^2$, $t=c(q+2)$ for χ^2-distribution, and $c=2(Z_1-\bar{q}+2)/d^2$, $\nu=2(Z_1-\bar{q}+2)^2/d^2$, $t=c(Z_1-q+2)$ for reduced χ^2-distribution. The comparison between these empirical relations of F(q) and observed F(q)[26-28] are shown

in Fig.6 for low-, intermediate- and high-charge Ar ions in carbon foils.[25]

In more detailed analysis of distribution functions, the influence of the shell effect, which was not considered explicitly in the formulas of Sayer and of Baudinet-Robinet, becomes important. Using a parameter "negative-charge-state", Nir et al.[29] present a clear illustration of the shell effect of F(q). Based on the concept of the shell effect, Shima et al.[9] separate the observed charge distribution into two Gaussian distributions. Systematic analysis of equilibrium charge distribution functions in carbon foils has also been done by Betz.[6]

Theoretical approaches for the equilibrium charge distribution functions of ions in solids are done by Garcia[30], Veje[31], Wietschorke et al.[32], Kaneko[33], Goscinski et al.[34], and Aberg et al.[35] The density effect[1] is discussed in detail by Betz[36], Moak[3], Sofield[37], and Cowern[38].

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Captions of Figures in the Introduction

Fig.1. Charge distribution data compiled in the present tables (●) and in the tables by Wittkower and Betz (▮) are shown for various ions passing through carbon foils as a function of ion energy in units of MeV/u.

Fig.2. Charge fraction F(q) (upper) and mean charge $\bar{q}$ (lower) emergent from carbon foils with the thickness between 3.1 and 183 $\mu g/cm^2$ for incident ions of 65 MeV Cu^{9+}. The ion energy E at the emergence from foil is indicated at the bottom of the figure. Solid lines are drawn to guide the eye. Dotted line in the lower figure indicates the $\bar{q}$ values estimated from the empirical formula (eq.(2) in the text) by Nikolaev and Dmitriev[10].

Fig.3. Equilibrium mean charge $\bar{q}$ of various ions in carbon foils taken from the tables in this work. The abscissa indicates the reduced velocity of ions defined by eq.(3) in the text.

Fig.4. Equilibrium mean charges $\bar{q}$ of 117 MeV Cu, 23.5-108.5 MeV Cl, 29-109 Si and 29 and 59 MeV F ions as a function of Z_2 of solid targets through which ions pass. Data are taken from the tables of this work.

Fig.5. Equilibrium charge distribution widths d divided by $Z_1^{0.27}$ are plotted as a function of the reduced velocity X (eq.(3) in the text) for various ions observed behind carbon foils. Data are taken from the tables in this article and of Wittkower and Betz. Solid line is drawn to guide the eye to show the ion velocity dependence of d of Cl ions.

Fig.6. Observed and calculated equilibrium charge fractions F(q)

of 0.181, 19.5 and 240 MeV Ar ions in carbon foils. Data are taken from Refs.26-28. Dotted-lines indicate χ^2-, Gaussian-, and reduced χ^2-distributions, respectively, calculated by Baudinet-Robinet.[20,21,24,25] (from Ref.25)

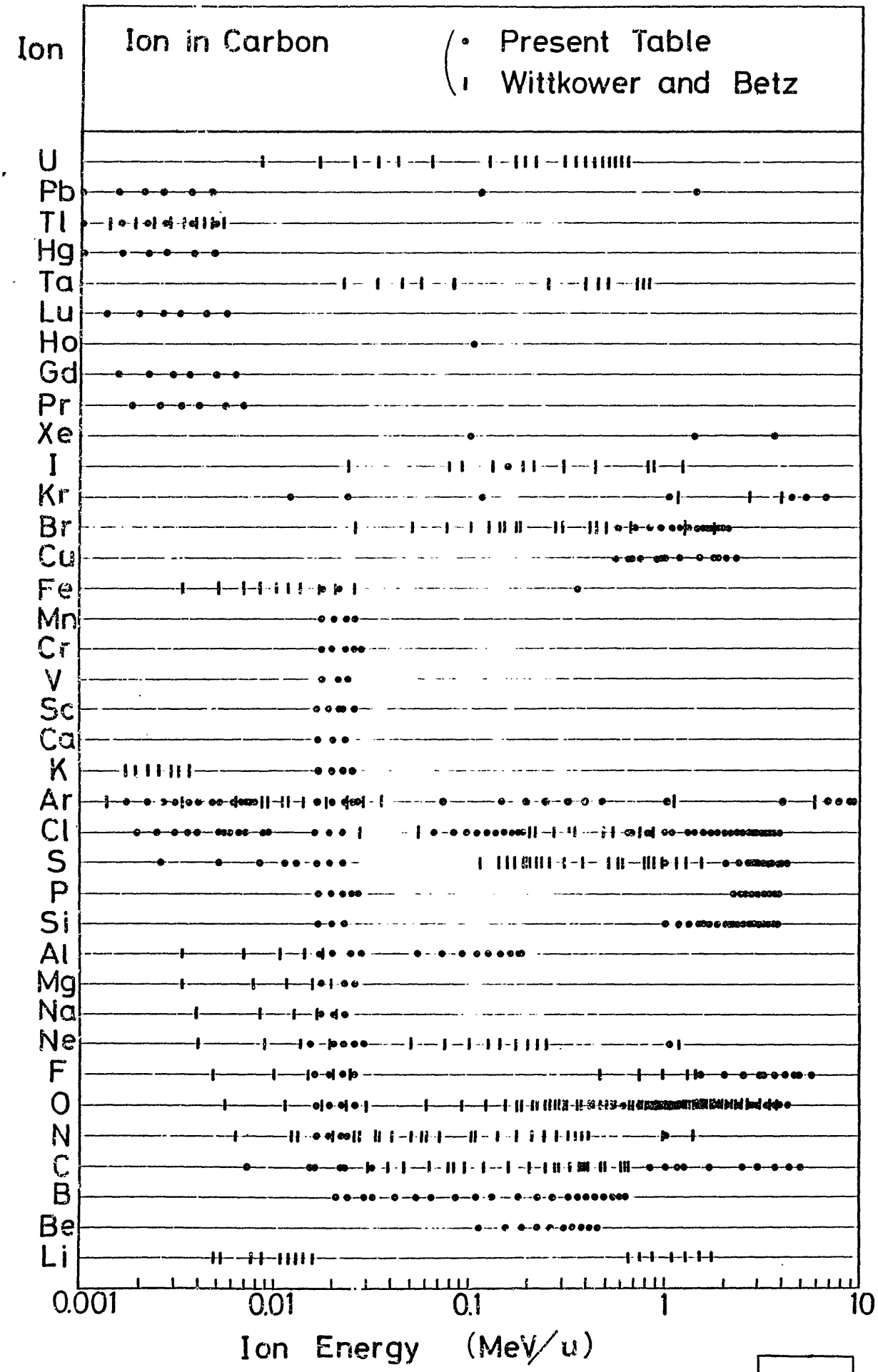
Ion
Ion in Carbon
Present Table
Wittkower and Betz
U
Pb
Tl
Hg
Ta
Lu
Ho
Gd
Pr
Xe
I
Kr
Br
Cu
Fe
Mn
Cr
V
Sc
Ca
K
Ar
Cl
S
P
Si
Al
Mg
Na
Ne
F
O
N
C
B
Be
Li
0.001
0.01
0.1
1
10
Ion Energy (MeV/u)

FIG. 1

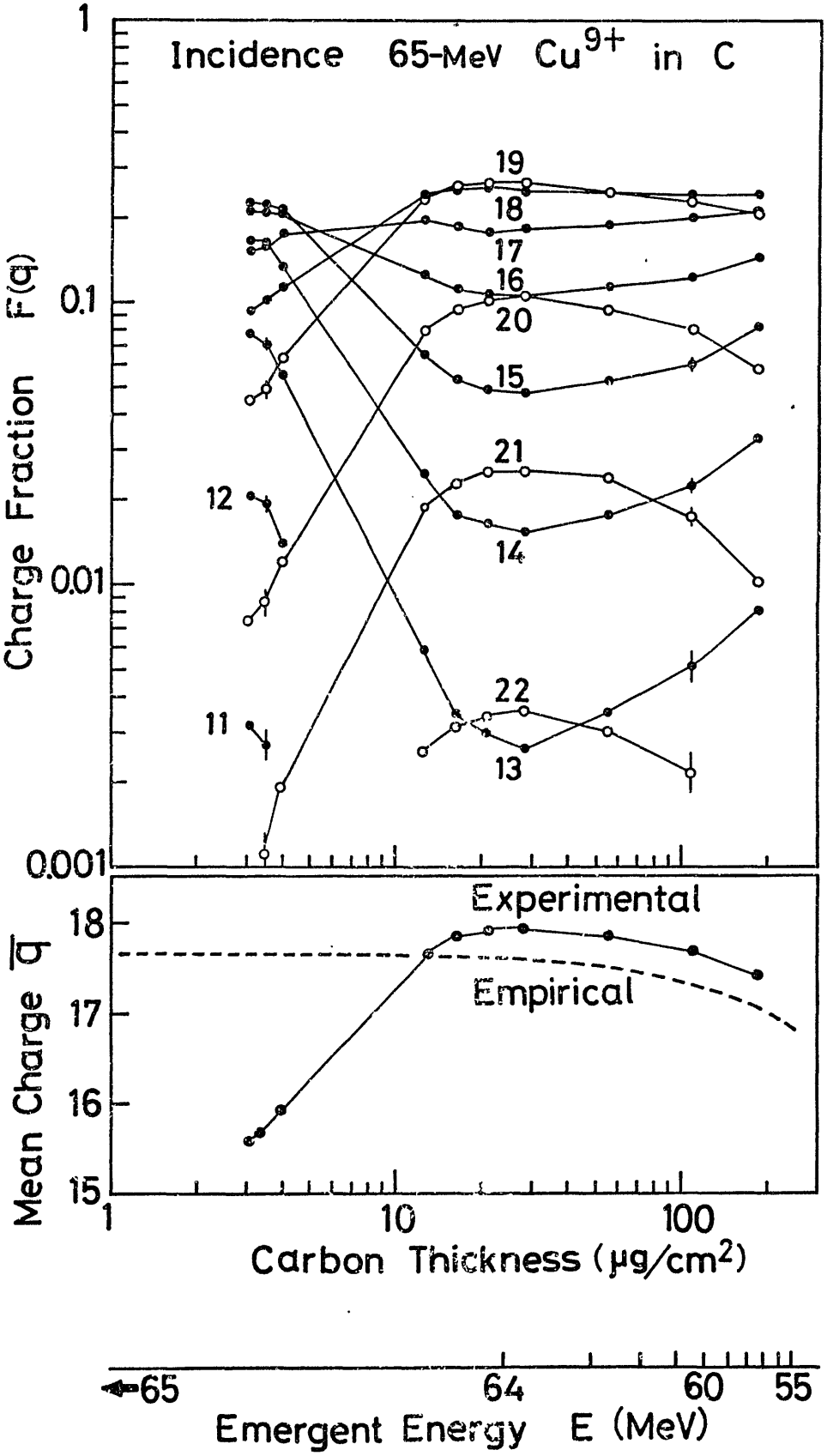
Incidence 65-MeV Cu^{9+} in C
Charge Fraction F(q)
1
0.1
0.01
0.001
19
18
17
16
20
15
21
12
14
22
11
13
Mean Charge $\bar{q}$
18
17
16
15
Experimental
Empirical
1
10
100
Carbon Thickness (μg/cm²)
65
64
60
55
Emergent Energy E (MeV)

FIG. 2

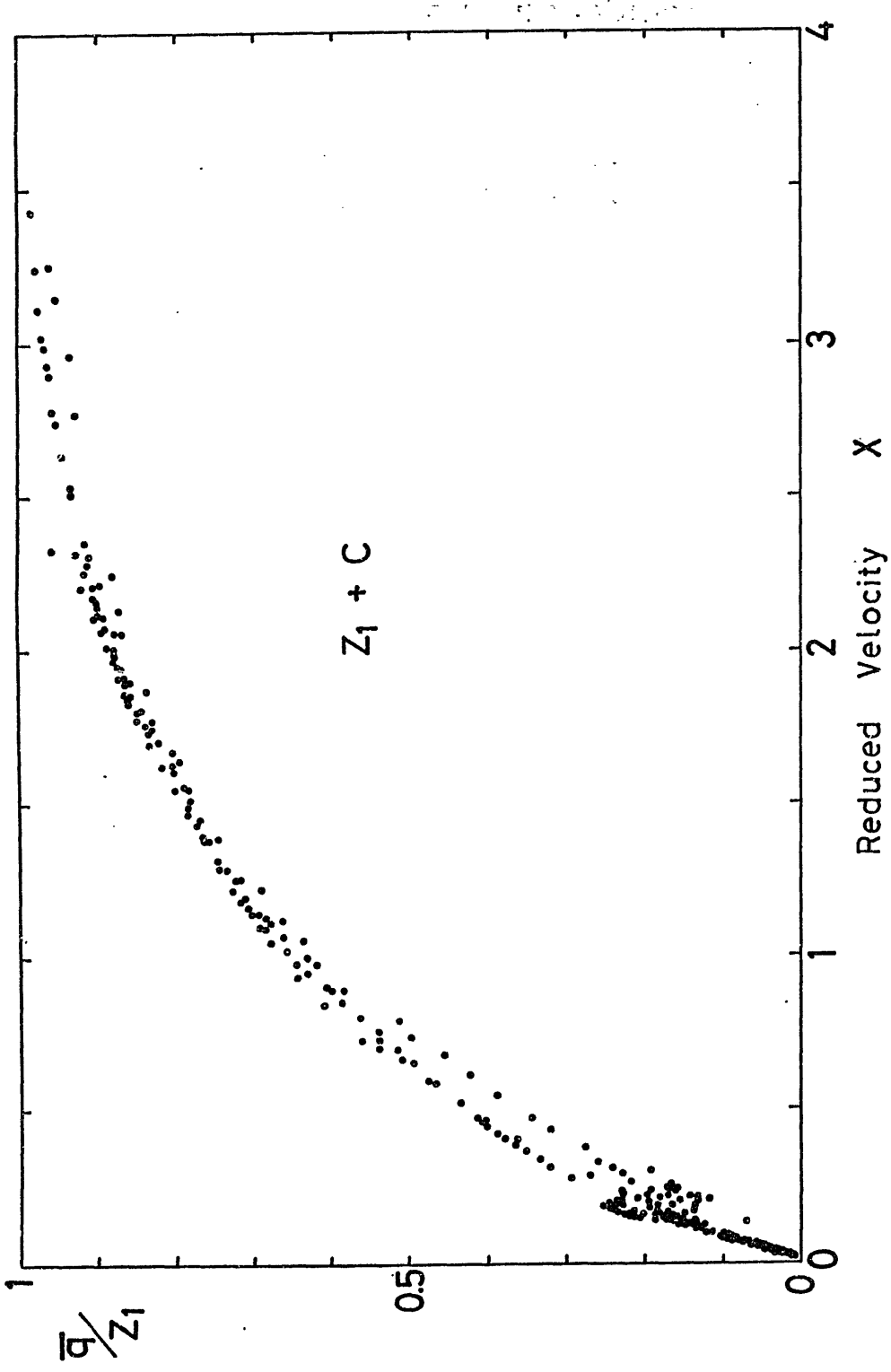

FIG. 3

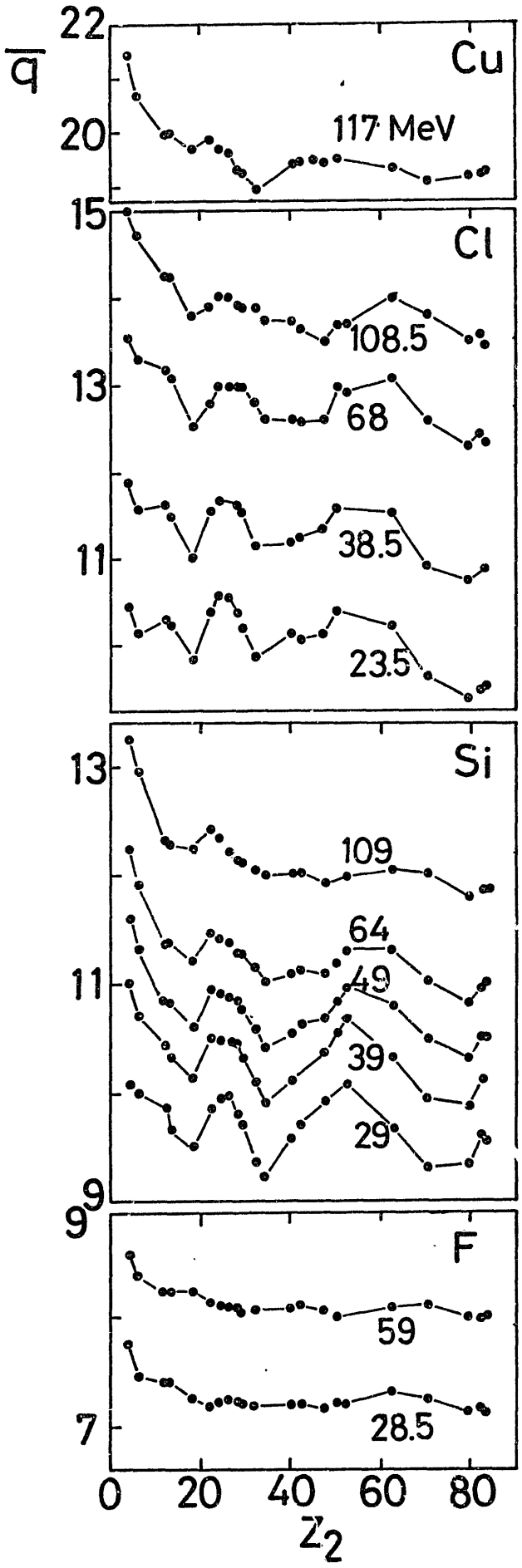
$\overline{q}$
22
20
15
13
11
13
11
9
9
7
Cu
117 MeV
Cl
108.5
68
38.5
23.5
Si
109
64
49
39
29
F
59
28.5
0
20
40
60
80
Z_2

FIG. 4

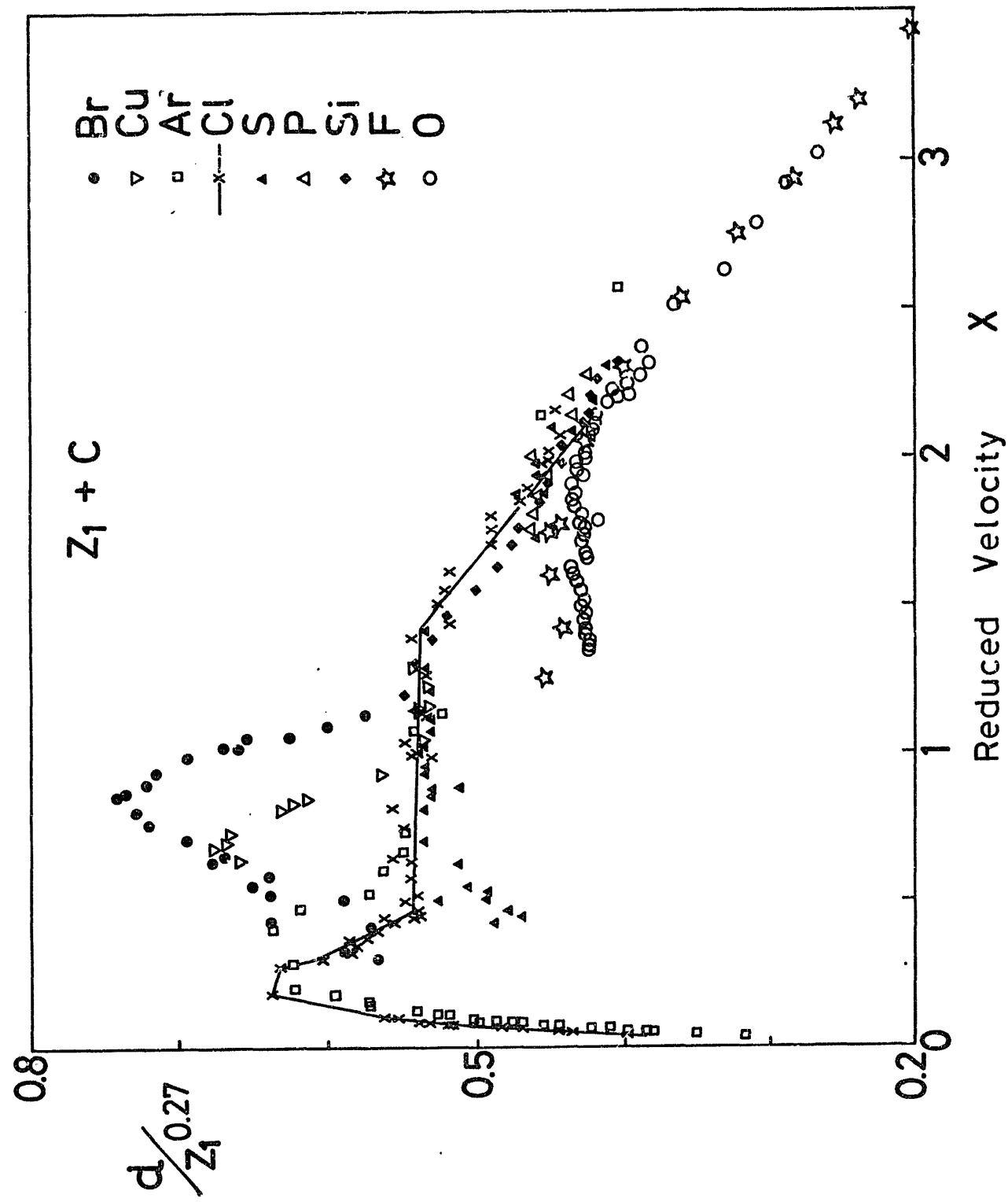

FIG. 5

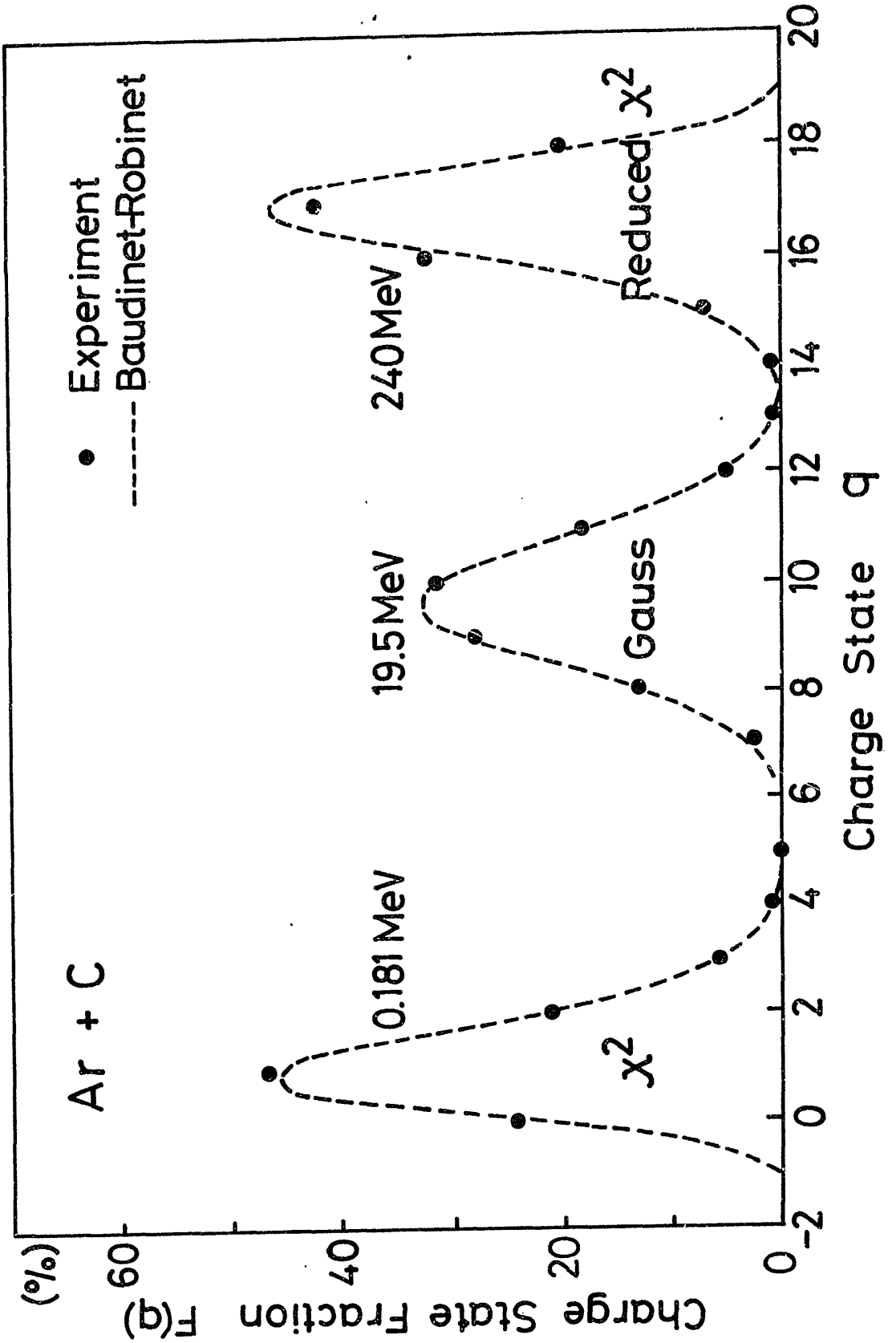
Ar + C
Experiment
Baudinet-Robinet
0.181 MeV
19.5 MeV
240 MeV
Gauss
χ^2
Reduced χ^2
Charge State Fraction F(q) (%)
Charge State q
0
20
40
60
-2
0
2
4
6
8
10
12
14
16
18
20

FIG. 6

POLICIES OF COMPILATION

1. Data in the present tables are extracted mostly from tables listed in the original published papers. For papers in which only figures of charge distribution are presented, the references are indicated in the footnote of each table, and no effort is made to extract the numerical values from the figures. except for the cases when the reading of numerical values is accompanied by less errors, and the cases when the authors of the original papers kindly provided the numerical values upon our request.
2. Some papers have presented only values of the mean charge $\bar{q}$. In such cases, $\bar{q}$ values are listed in the table leaving the F(q) column blank.
3. Some papers have presented nonequilibrium charge fraction data which are closely related to the equilibrium charge fraction data. Such references are indicated in the footnote of each table.
4. Data are tabulated first by increasing the atomic number of ions Z_1, then by increasing the atomic number of target foils Z_2 and finally by increasing the ion energy E in units of MeV at the emergence from foil. If only the incident energies are given, they are denoted in the column of ion energy with an asterisk *, and comments regarding to the adopted foil thickness are described in the footnote of each table when the foil thickness is explicitly described in the original paper. Some of the ion energies in the present tables are indicated in units of MeV/u, which are the cases when the ion energies are

given in units of MeV/u in the original paper, but no specific description is given on the atomic mass number of ions.

5. Skewness parameter s, defined by $s = \sum_q (q - \bar{q})^3 \; F(q) / \sigma^3$ is not listed in the present tables.
6. Errors of the data are not described in the present tables. Magnitude of errors differs according to the individual experimental procedure.

EXPLANATION OF TABLES

TABLES I-XXXV. Equilibrium Charge Fractions in Solid Targets for Ions : B, Be, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca, Sc, V, Cr, Mn, Fe, Cu, Br, Kr, I, Xe, Pr, Gd, Ho, Lu, Hg, Tl, Pb and U

E — Ion energy at the emergence from foil in units of MeV. In some limited cases, E is listed in units of MeV/u using the symbol E/u. When the emergent energy is not indicated in the original paper, only the incident energy is given in the column of E with an asterisk *, together with a comment in the footnote of each table.

QB — Mean charge defined by QB = $\bar{q} = \sum_q qF(q)$.

d — Distribution width defined by $d = \{\sum_q (q - \bar{q})^2 F(q)\}^{0.5}$.

Fraction — Charge fraction F(q) in units of per cent for each charge state q. 1-, 0+, 1+, and 2+ mean the charge state q = 1-, 0, 1+, and 2+, respectively.

Footnote — In the footnote of each table are given comments if the references presented only a graph of the equilibrium charge fractions or a graph of the nonequilibrium charge fractions.

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TABLE I. ^{9}Be ions in C

Ref	E	QB	d	1+	2+	3+	4+
1	1.03*	1.99	0.59	17.0	67.0	15.0	0.70
1	1.41*	2.24	0.65	10.0	58.0	30.0	2.00
1	1.70*	2.41	0.67	6.00	51.0	39.0	4.00
1	2.06*	2.59	0.67	3.50	41.0	48.5	7.00
1	2.39*	2.71	0.68	2.30	35.0	52.0	10.5
1	2.73*	2.84	0.67	1.50	27.4	56.5	14.7
1	3.06*	2.94	0.67	0.90	23.0	58.0	18.0
1	3.42*	3.03	0.67	0.60	19.0	57.0	23.4
1	3.77*	3.09	0.67	0.40	17.0	55.6	27.0
1	4.10*	3.17	0.66	0.30	14.0	54.7	31.0

*incident energy, foil thickness 10-25 $\mu g/cm^2$

TABLE IIa. ^{11}B ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
2	.226	1.07	0.67	17.0	59.0	21.0	2.00		
3	.266	1.15	0.71	16.0	55.9	25.4	2.66		
3	.304	1.23	0.74	13.9	53.1	28.6	4.38		
3	.357	1.30	0.76	12.3	51.4	30.4	6.00		
2	.467	1.38	0.72	8.00	50.0	35.0	6.00		
3	.600	1.60	0.77	5.50	40.6	42.1	11.8		
2	.711	1.73	0.75	3.00	38.0	45.0	15.0		
2	.954	1.94	0.72	1.00	27.0	52.0	21.0		
2	1.20	2.12	0.71		17.0	53.0	27.0	2.00	
2	1.45	2.29	0.71		12.0	50.0	35.0	3.00	
2	1.70	2.49	0.70		7.00	42.0	46.0	5.00	
4	2.0*	2.56	0.61		4.80	35.7	58.6	0.80	0.10
4	2.5*	2.91	0.68		2.40	20.4	61.9	14.9	0.40
4	3.0*	3.09	0.70		1.80	13.5	59.6	23.9	1.20
4	3.5*	3.18	0.66		0.30	8.30	54.3	31.7	2.30
4	4.0*	3.42	0.67		0.10	5.50	51.2	38.9	4.30
4	4.5*	3.56	0.67		0.10	3.70	43.1	46.7	6.50
4	5.0*	3.61	0.68			2.80	39.0	49.1	8.50
4	5.5*	3.74	0.69			2.20	33.4	52.5	11.9
4	6.0*	3.80	0.69			1.80	30.4	53.3	14.5
4	6.5*	3.87	0.69			1.40	26.9	54.4	17.2
4	7.0*	3.93	0.70			1.10	23.3	53.9	21.1

*incident energy, foil thickness 10 $\mu g/cm^2$

TABLE IIb. ^{11}B ions in Al

Ref	E	QB	d	0+	1+	2+	3+
5	.253	1.03	0.65	18.5	61.3	19.2	1.02
5	.281	1.06	0.66	17.5	60.6	20.6	1.32
5	.294	1.10	0.67	16.3	59.3	22.7	1.63

TABLE IIIa. ^{12}C ions in C

Ref	E	QB	d	1-	0+	1+	2+	3+	4+	5+	6+
6	.088	0.40	0.63	4.40	58.0	34.0	3.80				
6	.185	0.70	0.71	2.00	38.0	47.0	12.0	0.20			
3	.198	0.78	0.73	2.70	32.2	50.5	14.3	0.38			
3	.267	0.95	0.74	0.90	25.8	52.4	19.3	1.65			
6	.280	0.99	0.75	0.90	24.0	51.0	22.0	1.60			
6	.380	1.14	0.76	0.60	18.0	50.0	28.0	2.70			
43	9.95	4.69	0.69				0.03	2.73	35.6	51.3	10.3
43	11.9	4.89	0.71					1.56	26.9	52.8	18.8
43	13.9	5.05	0.71					0.98	19.9	52.0	27.1
43	14.9	5.13	0.70					0.75	16.7	51.8	30.8
43	19.9	5.41	0.64					0.08	8.12	42.7	49.1
43	29.9	5.72	0.49					0.01	1.66	25.1	73.2
7	36*	5.81	0.41						0.80	16.6	82.5
43	44.4	5.90	0.30						0.06	9.68	90.3
43	52.9	5.94	0.24						0.05	5.91	94.0
43	59.9	5.96	0.20						0.02	3.87	96.1

*incident energy

Graph is presented in Ref. 1 for equilibrium charge fractions of 1.5-7.0 MeV ^{12}C and ^{13}C ions in C.

Graph is presented in Ref. 7 and 50 for nonequilibrium to equilibrium charge fractions of 36 MeV C ions in C.

TABLE IIIb. ^{12}C ions in Al

Ref	E	QB	d	1-	0+	1+	2+	3+
5	.270	0.99	0.73	0.81	23.4	53.2	21.4	1.26
5	.293	0.99	0.74	0.86	23.8	52.1	21.8	1.39
5	.321	1.06	0.74	0.68	20.8	52.1	24.6	1.84

TABLE IVa. ^{14}N ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
3	.232	0.91	0.75	31.3	49.1	17.5	2.19				
3	.271	0.99	0.75	27.2	48.8	22.1	1.89				
3	.313	1.12	0.80	22.7	46.8	26.5	3.91				
3	.338	1.18	0.80	19.6	47.1	28.6	4.66				
8	14.6*	5.58	0.73				0.22	4 81	41.2	44.5	9.28

*incident energy

Graph is presented in Ref. 40 for equilibrium charge fractions of 3.0 MeV N ions in C.

Graph is presented in Ref. 42 for equilibrium charge fractions of 0.25 - 0.75 MeV N ions in C.

TABLE IVb. ^{14}N ions in Al

Ref	E	QB	d	0+	1+	2+	3+
5	.318	1.17	0.79	19.7	48.1	28.0	4.16
5	.348	1.20	0.83	20.8	44.1	29.6	5.56
5	.374	1.20	0.80	19.0	46.5	29.9	4.62

TABLE IVc. ^{14}N ions in Ag

Ref	E	QB	d	1+	2+	3+	4+	5+
32	.590	1.88	0.70	29.7	52.5	17.8		
32	.690	1.99	0.70	24.9	51.0	24.0	0.10	
32	.780	2.16	0.69	16.5	51.9	30.8	0.80	
32	.870	2.22	0.77	17.6	46.5	32.2	3.70	
32	.970	2.35	0.80	15.3	40.1	39.0	5.60	
32	1.06	2.43	0.83	13.7	37.6	40.3	8.30	
32	1.16	2.52	0.81	10.0	39.0	40.5	10.5	
32	1.25	2.60	0.83	9.20	33.9	44.1	12.5	0.20
32	1.34	2.74	0.83	6.10	30.4	47.3	14.9	1.20
32	1.44	2.81	0.82	4.90	29.6	47.2	17.2	1.20

TABLE IVd. ^{14}N ions in Ta

Ref	E	QB	d	1+	2+	3+	4+	5+
32	.690	1.94	0.69	27.1	51.5	21.4		
32	.780	2.00	0.72	26.0	48.1	25.9		
32	.870	2.08	0.75	23.4	45.8	30.1	0.70	
32	.970	2.20	0.77	18.5	45.6	33.1	2.80	
32	1.16	2.46	0.81	12.5	37.4	42.2	7.90	
32	1.25	2.55	0.83	10.9	34.3	43.8	11.0	
32	1.34	2.60	0.79	8.20	34.5	46.4	11.0	
32	1.44	2.74	0.78	5.40	33.0	47.4	15.0	
32	1.53	2.80	0.80	5.50	27.1	49.8	17.0	0.60
32	1.62	2.95	0.80	2.60	24.5	49.9	20.8	2.10

TABLE IVe. ^{14}N ions in Au

Ref	E	QB	d	1+	2+	3+	4+
32	.690	1.93	0.72	29.9	47.7	22.4	
32	.780	2.04	0.73	24.6	46.5	28.8	
32	.870	2.15	0.73	19.6	46.2	33.7	0.50
32	.970	2.29	0.76	14.9	44.3	36.9	3.80
32	1.06	2.41	0.80	12.5	41.5	38.9	7.20
32	1.16	2.51	0.81	11.4	35.3	44.4	8.90
32	1.25	2.65	0.81	8.80	30.1	48.6	12.5
32	1.34	2.76	0.78	6.20	26.5	52.5	14.8
32	1.44	2.86	0.73	2.90	25.9	53.3	17.8
32	1.53	2.96	0.74	3.00	20.6	53.7	22.7
32	1.62	3.01	0.74	2.20	20.1	51.9	25.7
32	1.72	3.14	0.82	2.50	20.6	37.7	39.2

TABLE IVf. ^{14}N ions in Pb

Ref	E	QB	d	1+	2+	3+	4+	5+
32	.690	1.93	0.63	23.8	60.2	16.1		
32	.780	2.04	0.65	18.9	57.8	23.3		
32	.870	2.17	0.70	17.0	49.5	33.3	0.20	
32	.970	2.24	0.74	15.8	46.8	35.1	2.30	
32	1.06	2.35	0.76	12.9	44.3	38.0	4.90	
32	1.16	2.46	0.78	11.0	38.7	43.2	7.00	
32	1.25	2.57	0.79	8.70	35.5	45.6	10.2	
32	1.34	2.64	0.80	8.10	31.6	48.1	12.1	
32	1.44	2.71	0.81	6.90	30.5	47.9	14.6	0.20
32	1.53	2.81	0.80	5.20	26.6	50.8	16.7	0.70
32	1.62	2.91	0.80	4.10	23.8	49.6	21.6	0.90
32	1.72	3.08	0.88	3.80	20.4	42.7	30.1	3.00

TABLE Va. ^{16}O ions in C

Ref	E	QB	d	1-	0+	1+	2+	3+	4+	5+	6+	7+	8+
3	.267	1.07	0.82	2.30	20.3	49.4	24.5	3.49					
3	.312	1.22	0.84	1.60	16.0	47.4	28.8	6.23					
3	.361	1.34	0.87	1.20	13.3	44.3	31.7	8.97	0.14				
3	.420	1.50	0.88	0.50	10.9	39.5	36.8	11.8	0.51				
43	9.77	5.70	0.75					0.35	4.90	30.1	54.0	10.2	0.48
43	11.8	5.91	0.73					0.07	2.11	24.3	55.0	17.7	0.91
43	14.3	6.07	0.75					0.03	1.65	17.5	55.4	23.2	2.22
43	14.9	6.12	0.76					0.03	1.51	16.5	53.4	25.8	2.78
43	16.7	6.27	0.76					0.02	0.93	11.4	51.7	31.4	4.52
8	16.6*	6.26	0.76					0.04	1.06	11.6	51.6	31.6	4.08
9	19.6	6.44	0.75							8.40	46.4	38.0	7.20
43	20.0	6.37	0.79						0.68	11.2	44.1	37.6	6.43
9	24.5	6.72	0.76							4.10	34.1	47.1	14.7
43	24.8	6.75	0.76						0.10	3.71	32.3	48.6	15.3
9	29.4	6.95	0.74							1.80	24.2	49.9	24.0
43	29.6	6.95	0.78						0.07	2.46	25.3	46.4	25.8
9	34.3	7.16	0.71							0.90	16.1	49.1	33.9
43	35.7	7.22	0.71						0.01	0.78	14.3	47.1	37.8
9	39.1	7.33	0.68							0.50	10.6	44.7	44.2
9	44.0	7.47	0.64							0.30	7.30	40.0	52.7
43	44.8	7.47	0.63							0.20	6.70	39.4	53.7
9	48.0	7.56	0.58								4.50	34.7	60.7
43	49.8	7.57	0.58							0.09	4.40	33.6	62.0
9	53.8	7.64	0.54								3.10	30.0	66.9

(Table Va continued)

Ref	E	QB	d	1-	0+	1+	2+	3+	4+	5+	6+	7+	8+
43	54.8	7.62	0.55							0.04	3.18	31.4	65.4
9	58.7	7.69	0.51								2.30	26.1	71.5
9	63.6	7.75	0.47								1.50	22.2	76.3
43	69.8	7.78	0.43							0.01	0.85	19.9	79.2

*incident energy
Graph is presented in Ref. 36 for nonequilibrium charge fractions of 40 MeV O ions in C.
Graph is presented in Ref. 45 for equilibrium charge fractions of 1.0 MeV O ions in C.

TABLE Vb. ^{16}O ions in Al

Ref	E	QB	d	1-	0+	1+	2+	3+	4+
5	.365	1.38	0.86	0.93	12.5	43.5	34.0	8.87	0.32
5	.396	1.45	0.85	0.76	10.3	42.7	35.4	10.8	
5	.429	1.53	0.88	0.72	9.76	39.0	37.7	12.3	0.59

Graph is presented in Ref. 36 for nonequilibrium charge fractions of 40 MeV O ions in Al.

TABLE Vc. ^{16}O ions in Si

Ref	E	QB
39	40.0	6.90

TABLE VIa. ^{19}F ions in Be

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.6	7.77	0.83	0.35	5.30	31.7	43.8	18.9
10	59.0	8.63	0.57		0.11	4.02	29.0	66.9

TABLE VIb. ^{19}F ions in C

Ref	E	QB	d	1-	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+
3	.303	1.21	0.88	1.30	19.6	42.7	29.5	6.91						
3	.365	1.44	0.93	0.70	14.5	37.3	36.0	10.4	1.11					
3	.433	1.61	0.89	0.40	10.1	33.6	41.2	13.7	0.98					
3	.490	1.76	0.92	0.40	7.90	29.4	41.3	19.3	1.63					
10	28.7	7.47	0.80							0.55	8.83	42.9	38.9	8.86
10	38.9	7.88	0.77							0.11	2.89	27.1	48.3	21.6
10	49.0	8.20	0.72								0.94	15.1	47.4	36.6
10	59.1	8.42	0.65								0.28	8.23	40.9	50.6
10	60.3	8.45	0.64								0.25	7.37	39.3	53.1
10	69.2	8.57	0.58								0.09	4.26	33.8	61.9
10	79.2	8.70	0.51									2.26	25.6	72.1
10	89.3	8.76	0.46									1.37	21.0	77.6
10	94.3	8.80	0.43									0.95	18.4	80.6
10	108.3	8.86	0.36									0.42	13.0	86.6

Graph is presented in Ref. 10 for nonequilibrium charge fractions of 61.3 and 109 MeV F ions in C.
Graph is presented in Ref. 11 for nonequilibrium charge fractions of 26.5 MeV F ions in C.

TABLE VIc. ^{19}F ions in Mg

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.5	7.39	0.79	0.69	9.87	45.6	37.2	6.69
10	58.9	8.25	0.70		0.58	13.5	46.6	39.4

TABLE VId. ^{19}F ions in Al

Ref	E	QB	d	1-	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+
5	.426	1.60	0.93	0.45	11.5	33.2	38.9	14.6	1.33					
5	.468	1.72	0.91	0.39	8.28	30.8	41.2	18.0	1.34					
5	.515	1.82	0.92	0.28	6.86	29.1	40.7	20.9	2.21					
10	28.8	7.43	0.80							0.73	9.65	43.7	38.1	7.36
10	59.1	8.25	0.70								0.64	13.3	46.5	39.5
12	94.5	8.65	0.54									2.99	29.2	67.8

TABLE VIe. ^{19}F ions in KCL

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.6	7.28	0.78	1.02	12.4	49.4	31.9	5.20
10	58.9	8.24	0.71		0.62	14.3	45.2	39.8

TABLE VIf. ^{19}F ions in Ti

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.5	7.20	0.73	0.93	12.7	55.6	27.2	3.51
10	58.8	8.14	0.73		1.08	17.1	48.9	32.9

TABLE VIg. ^{19}F ions in Cr

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.9	7.24	0.72	0.77	11.1	54.6	30.3	3.22
10	59.0	8.11	0.72		1.09	17.9	49.6	31.4

TABLE VIh. ^{19}F ions in Fe

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.4	7.24	0.74	0.89	11.8	53.3	30.4	3.61
10	58.7	8.10	0.72		0.97	18.5	50.0	30.5

TABLE VIi. ^{19}F ions in Ni

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.8	7.25	0.75	0.86	12.1	52.1	30.9	3.95
10	59.0	8.09	0.72		0.99	18.7	50.3	30.0
12	94.7	8.55	0.60		0.10	5.02	35.1	59.8

TABLE VIj. ^{19}F ions in Cu

Ref	E	QB	d	5+	6+	7+	8+	9+
10	29.3	7.23	0.78	1.20	13.9	49.7	31.3	3.93
10	59.4	8.06	0.73		1.28	20.2	49.8	28.7

TABLE VIk. ^{19}F ions in Ge

Ref	E	QB	d	5+	6+	7+	8+	9+
10	29.1	7.22	0.80	1.42	14.4	49.1	30.7	4.34
10	59.3	8.08	0.73		1.28	19.2	49.5	30.0

TABLE VIl. ^{19}F ions in Zr

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.3	7.21	0.77	1.23	13.6	51.9	29.4	3.89
10	58.6	8.10	0.73		1.30	18.4	49.5	30.8

TABLE VIm. ^{19}F ions in Mo

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.2	7.21	0.77	1.27	13.9	51.1	29.8	3.83
10	58.5	8.12	0.73		1.18	17.8	48.7	32.3
12	94.8	8.52	0.61		0.16	5.60	36.4	57.9

TABLE VIn. ^{19}F ions in Ag

Ref	E	QB	d	5+	6+	7+	8+	9+
10	29.2	7.20	0.72	0.96	12.3	56.1	27.4	3.17
10	59.4	8.02	0.74		1.69	21.5	50.1	26.8
12	94.8	8.52	0.61		0.16	5.60	36.4	57.9

TABLE VIo. ^{19}F ions in Sn

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.8	7.27	0.72	0.85	10.7	55.7	29.5	3.30
10	59.1	8.00	0.74		1.66	22.3	50.2	25.9

TABLE VIp. ^{19}F ions in Sm

Ref	E	QB	d	5+	6+	7+	8+	9+
10	29.2	7.35	0.80	0.97	11.1	46.2	35.4	6.28
10	59.1	8.12	0.72		0.98	17.9	49.1	32.0

TABLE VIq. ^{19}F ions in Yb

Ref	E	QB	d	5+	6+	7+	8+	9+
10	29.2	7.27	0.81	1.38	13.5	47.1	32.6	5.43
10	59.4	8.13	0.74		1.24	17.7	47.7	33.4

TABLE VIr. ^{19}F ions in Au

Ref	E	QB	d	5+	6+	7+	8+	9+
10	29.5	7.18	0.80	1.60	15.1	51.1	27.9	4.24
10	59.6	8.03	0.75		1.92	21.4	49.0	27.7
12	94.8	8.50	0.62		0.19	6.12	37.1	56.6

TABLE VIs. ^{19}F ions in Pb

Ref	E	QB	d	5+	6+	7+	8+	9+
10	29.5	7.20	0.78	1.77	13.3	51.9	29.3	3.79
10	59.6	8.01	0.76		2.34	21.3	49.9	27.2

TABLE VIt. ^{19}F ions in Bi

Ref	E	QB	d	5+	6+	7+	8+	9+
10	28.8	7.14	0.73	0.84	15.0	56.4	24.7	2.99
10	59.0	8.01	0.74		1.78	21.2	50.3	26.2

TABLE VIIa. ^{20}Ne ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
3	.307	1.47	0.86	11.9	41.8	33.7	12.5							
3	.399	1.80	0.92	6.90	32.2	37.7	21.0	2.21						
3	.451	1.92	0.92	4.90	28.7	39.4	23.9	3.07						
3	.514	2.08	0.95	4.30	23.1	37.7	29.8	5.18						
3	.571	2.24	0.92	2.10	19.1	38.6	32.8	7.10	0.23					
8	20.8*	7.62	0.87					0.07	0.88	8.35	31.8	45.7	12.4	0.78

*incident energy

TABLE VIIb. ^{20}Ne ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+
5	.460	1.90	0.93	6.10	27.6	39.7	23.6	2.92
5	.497	1.98	0.93	4.95	25.4	40.1	25.9	3.63
5	.525	2.07	0.92	3.78	23.4	39.1	29.4	4.36

TABLE VIIc. ^{20}Ne ions in Mo

Ref	E	QB	d	1+	2+	3+	4+	5+	6+	7+
32	1.34	3.43	0.87	1.60	10.1	41.9	36.8	9.00	0.60	
32	1.54	3.62	0.90	1.00	7.60	36.2	39.8	14.1	1.20	
32	1.74	3.86	0.88	0.60	5.40	25.2	47.7	18.8	2.30	
32	1.95	3.99	0.91	0.30	3.90	25.7	41.9	24.5	3.70	
32	2.15	4.17	0.91	0.10	2.70	19.4	41.0	31.1	5.60	0.10
32	2.35	4.31	0.91		1.80	16.1	41.0	32.3	8.40	0.40
32	2.55	4.41	0.93		2.00	12.4	39.5	35.2	10.2	0.70
32	2.76	4.60	0.90		0.50	10.6	32.3	43.1	12.2	1.30
32	2.96	4.72	0.90		0.60	7.40	31.2	43.7	15.3	1.90

TABLE VIId. ^{20}Ne ions in Au

Ref	E	QB	d	1+	2+	3+	4+	5+	6+	7+
32	1.34	3.44	0.89	1.60	11.1	38.9	38.1	9.80	0.40	
32	1.54	3.63	0.89	0.90	8.00	34.5	41.4	14.2	1.00	
32	1.74	3.81	0.86	0.80	5.20	26.6	49.3	16.2	1.90	
32	1.95	3.96	0.97	0.60	4.70	27.1	37.2	26.2	3.90	0.20
32	2.15	4.12	0.95	0.20	3.40	22.3	39.1	29.3	5.40	0.40
32	2.35	4.25	0.93	0.20	2.60	16.5	41.2	32.1	7.10	0.30
32	2.55	4.40	0.91	0.10	1.70	13.4	37.7	37.9	8.60	0.60
32	2.76	4.54	0.89		1.00	10.6	31.4	45.1	10.9	0.90
32	2.96	4.68	0.92		1.00	8.50	30.1	44.1	14.4	1.90
32	3.16	4.75	0.98		0.90	7.10	34.7	33.4	21.4	2.50
32	3.37	4.85	0.99		0.60	7.60	28.4	36.5	24.1	2.90
32	3.57	4.92	0.93		0.20	5.40	25.6	43.3	21.6	3.90
32	3.77	5.02	0.96		0.10	4.90	24.7	38.9	25.9	5.20
32	3.97	5.17	0.95			3.50	20.7	39.6	28.5	7.50

TABLE VIIIa. ^{23}Na ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
3	.394	1.95	0.87	2.30	29.8	42.3	22.1	3.50	
3	.461	2.12	0.89	1.80	23.1	42.8	26.5	5.86	
3	.528	2.30	0.91	1.10	17.7	40.3	32.1	8.49	0.31

TABLE VIIIb. ^{23}Na ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+
5	.530	2.12	0.88	1.61	22.7	42.9	27.2	5.57
5	.574	2.20	0.89	1.29	20.6	41.8	29.0	7.29
5	.617	2.30	0.88	0.93	17.4	40.5	32.9	8.26

TABLE IXa. ^{24}Mg ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
3	.411	2.39	0.90	0.60	14.4	41.7	32.8	9.42	1.00
3	.551	2.68	0.91	0.30	8.24	34.4	39.3	15.8	1.94
3	.616	2.74	0.91	0.40	6.75	32.7	40.3	17.7	2.13

TABLE IXb. ^{24}Mg ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
5	.574	2.30	0.86	0.76	15.6	45.4	29.8	8.42	
5	.593	2.41	0.89	0.63	12.6	44.0	31.8	10.2	0.82
5	.649	2.49	0.89	0 34	11.1	41.5	34.5	11.5	1.11

TABLE Xa. ^{27}Al ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+
3	.463	2.69	0.96	0.40	10.4	30.4	40.1	16.3	2.43				
3	.541	2.83	0.94	0.30	7.55	27.2	41.6	20.5	2.83				
3	.673	3.03	0.98	0.40	5.32	22.3	40.1	26.6	5.25				
3	.761	3.17	0.97	0.30	3.95	18.5	39.8	30.1	7.33				
49	1.5*	3.69	0.97			10.6	32.1	37.2	17.3	2.70			
49	2.0*	4.22	1.04			4.40	19.6	36.9	29.0	9.00	1.10		
49	2.5*	4.66	0.97				11.6	32.9	36.4	16.4	2.70		
49	3.0*	4.98	0.99				5.50	27.4	36.5	25.1	5.00	0.50	
49	3.5*	5.23	1.01				3.90	19.2	37.5	30.1	8.60	0.90	
49	4.0*	5.27	0.95				2.70	17.0	33.0	34.7	5.10	1.40	0.07
49	4.5*	5.63	1.02				1.70	10.9	31.8	36.8	16.1	2.60	0.13
49	5.0*	5.79	1.01				0.90	8.40	26.9	39.1	18.6	3.90	0.21
49	5.14*	5.86	1.02				1.10	7.40	26.8	39.2	21.0	4.30	0.26

*incident energy

TABLE Xb. ^{27}Al ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
5	.608	2.37	0.94	0.93	16.6	38.5	33.2	9.84	0.97
5	.650	2.45	0.94	0.76	14.3	38.0	34.5	11.4	1.13
5	.692	2.50	0.92	0.57	12.7	37.3	36.3	11.8	1.34
5	.734	2.56	0.92	0.49	10.9	36.9	37.5	12.5	1.78

TABLE XIa. ^{28}Si ions in Be

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	26.8	9.86	1.12	1.60	9.23	26.3	34.7	21.2	6.80	0.26	
14	37.0	10.8	1.10	0.16	1.99	9.85	25.1	34.4	25.1	3.23	0.13
14	47.2	11.5	1.02		0.27	2.98	12.6	30.1	40.6	12.2	1.24
14	62.4	12.2	0.94			0.41	3.80	16.5	43.4	29.2	6.77
14	77.7	12.7	0.88				1.03	6.84	32.3	41.4	18.5
14	92.8	13.0	0.82				0.20	3.13	20.9	43.7	32.1
14	108.0	13.2	0.76					1.76	15.0	42.5	40.7

TABLE XIb ^{28}Si ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+
3	.476	2.84	1.06	0.90	9.49	26.4	35.9	22.5	4.84									
3	.558	3.06	1.06	0.60	6.75	21.0	37.1	27.2	6.66	0.64								
3	.646	3.30	1.07	0.40	4.64	16.5	34.5	32.3	10.7	1.09								
13	28.7	9.89	1.12								1.42	8.72	25.8	34.6	22.1	7.05	0.27	
13	33.7	10.3	1.11								0.54	4.38	17.1	31.9	30.9	14.3	0.96	
13	38.8	10.7	1.08								0.16	2.25	11.8	27.8	35.0	20.7	2.26	0.08
13	43.1	11.0	1.06								0.07	1.15	7.50	22.8	35.4	28.4	4.43	0.21
13	43.8	11.0	1.05								0.05	1.07	7.30	22.9	35.2	28.8	4.49	0.22
13	48.2	11.2	1.02									0.49	4.52	17.5	34.5	35.2	7.35	0.50
13	53.3	11.5	0.99									0.22	2.84	12.9	31.0	41.1	10.9	1.02
13	58.3	11.7	0.97									0.08	1.51	9.39	28.2	42.7	16.2	1.96
13	62.4	11.8	0.96									0.02	1.07	7.40	24.4	44.7	19.8	2.65
13	63.5	11.8	0.95										0.99	7.19	23.8	45.2	19.9	2.97
13	68.4	12.0	0.93										0.49	4.68	20.6	44.5	25.2	4.45
13	73.5	12.2	0.92										0.26	3.34	16.8	43.1	30.1	6.41
13	78.5	12.3	0.90										0.12	2.34	13.5	41.3	34.1	8.66
13	83.5	12.4	0.90										0.04	1.71	11.3	38.9	36.9	11.1
13	88.6	12.5	0.87											1.13	8.76	38.5	38.2	13.4
13	92.9	12.7	0.86											0.79	6.88	32.5	43.3	16.5
13	97.9	12.7	0.86											0.54	6.32	30.2	43.5	19.4
13	103.0	12.9	0.85												4.27	26.0	45.4	24.4
13	108.1	13.0	0.82												3.60	23.8	43.9	28.7

Graph is presented in Ref. 35 for nonequilibrium charge fractions of 40 and 56.2 MeV Si ions in C.

TABLE XIc. ^{28}Si ions in Mg

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	26.4	9.67	1.06	1.70	11.3	30.1	35.7	17.6	3.63		
14	36.4	10.3	1.03		3.66	16.8	34.7	32.1	12.0	0.74	
14	47.1	10.8	0.95		0.87	7.38	27.2	41.9	20.4	2.24	
14	62.3	11.3	0.92			1.79	18.1	35.3	37.1	7.22	0.39
14	107.4	12.2	0.82				1.38	13.1	47.1	32.3	6.18

TABLE XId. ^{28}Si ions in Al

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	28.4	9.63	1.03	2.08	11.4	30.7	35.9	16.9	2.98		
14	38.5	10.3	1.01	0.30	3.32	16.8	36.2	32.7	10.2	0.50	
14	48.5	10.8	0.94		0.71	6.92	26.6	41.6	22.1	2.03	0.05
14	62.2	11.3	0.89			2.21	14.4	38.7	38.1	6.33	0.29
14	78.7	11.8	0.85			0.53	6.19	28.5	48.5	15.1	1.19
14	93.8	12.0	0.82			0.09	2.87	19.8	51.0	23.4	2.80
14	107.8	12.3	0.81				1.29	12.6	47.6	32.8	5.71

TABLE XIe. ^{28}Si ions in KCl

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	27.6	9.39	1.10	3.62	16.4	34.0	30.8	12.6	2.31		
14	37.5	10.1	1.07	0.80	6.48	20.9	37.8	25.8	7.92	0.31	
14	47.4	10.5	1.02		2.36	13.0	32.9	34.2	16.4	1.14	
14	62.8	11.1	0.96		0.36	4.18	19.0	38.9	32.3	5.11	0.24
14	108.2	12.2	0.85				2.40	15.3	46.2	30.8	5.35

TABLE XIf. ^{28}Si ions in Ti

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	27.5	9.75	1.09	1.78	10.3	28.7	34.7	19.5	5.09		
14	37.5	10.4	1.05		3.23	15.1	33.6	32.5	14.6	1.06	
14	47.6	10.9	1.00		0.93	7.37	24.4	38.6	25.4	3.31	
14	62.7	11.4	0.95		0.12	2.30	13.3	35.0	39.0	9.49	0.69
14	108.0	12.4	0.85				1.31	11.2	42.0	36.3	9.24

TABLE XIg. ^{28}Si ions in Cr

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	27.9	9.90	1.08	1.12	8.52	25.3	35.8	22.7	6.61		
14	48.1	10.9	0.99		0.88	7.08	24.8	38.9	25.4	2.99	
14	63.2	11.4	0.92			2.42	14.1	36.5	38.4	8.02	0.47
14	108.5	12.3	0.83				1.30	12.1	54.5	33.9	7.16

TABLE XIh. ^{28}Si ions in Fe

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	26.9	9.85	1.06	1.29	8.36	26.3	37.2	21.5	5.35		
14	47.1	10.8	0.99		1.01	7.66	26.0	38.9	23.8	2.66	
14	62.3	11.3	0.92			2.84	15.3	37.7	37.1	6.71	0.34
14	107.7	12.2	0.85				2.39	16.2	46.8	29.7	5.00

TABLE XIi. ^{28}Si ions in Ni

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	28.0	9.75	1.08	1.82	10.1	28.4	35.5	19.6	4.46	0.11	
14	38.0	10.4	1.03	0.31	3.12	15.1	34.5	33.3	12.8	0.78	
14	48.0	10.8	0.98		1.04	7.73	26.4	39.8	22.7	2.31	
14	63.1	11.2	0.92		0.20	3.10	16.3	38.8	35.5	5.81	0.26
14	78.2	11.6	0.88			1.26	9.17	32.2	45.1	11.5	0.79
14	93.3	11.9	0.86			0.43	5.16	24.7	49.1	18.7	1.90
14	108.4	12.1	0.85				2.73	17.9	47.5	27.7	4.22

TABLE XIj. ^{28}Si ions in Cu

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	27.7	9.63	1.08	2.32	11.8	30.4	34.9	17.2	3.36	0.07	
14	37.7	10.3	1.04	0.38	3.80	17.4	35.3	31.6	10.9	0.59	
14	47.8	10.7	0.98		1.21	8.92	28.3	29.5	20.2	1.84	
14	62.9	11.2	0.93		0.25	3.27	17.1	38.1	35.7	5.36	0.22
14	108.2	12.1	0.85			0.32	2.86	17.7	49.4	26.9	3.76

TABLE XIk. ^{28}Si ions in Ge

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	28.5	9.34	1.07	4.26	16.9	34.4	31.4	11.5	1.59		
14	38.5	10.1	1.00		5.54	22.9	38.1	26.5	7.00		
14	48.5	10.6	0.98		1.93	11.6	32.8	37.1	15.5	1.03	
14	63.6	11.1	0.90			4.06	19.3	41.6	31.1	3.79	0.10
14	108.8	12.0	0.81				3.02	19.6	51.0	23.8	2.69

TABLE XIl. ^{28}Si ions in Se

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	26.1	8.98	1.01	7.17	24.0	38.4	24.2	6.29			
14	36.1	9.74	1.04	1.48	9.66	28.8	37.0	19.3	3.78		
14	47.5	10.3	0.99		2.98	16.0	36.6	32.9	10.9	0.58	
14	62.5	11.0	0.93		0.53	5.41	23.4	41.5	26.5	2.70	
14	107.9	12.0	0.82				3.61	21.4	51.0	21.7	2.22

TABLE XIm. ^{28}Si ions in Zr

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	26.8	9.46	1.06	3.09	14.5	33.7	32.7	13.9	2.10		
14	36.9	10.0	1.04	0.72	6.07	23.3	37.5	25.6	6.65	0.23	
14	47.0	10.5	1.00		2.40	13.6	34.0	35.0	14.2	0.86	
14	62.1	11.0	0.92			5.37	22.4	40.7	28.3	3.32	
14	107.5	12.0	0.82				3.48	21.4	50.7	22.0	2.36

TABLE XIn. ^{28}Si ions in Mo

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	26.6	9.59	1.04	2.08	12.0	31.8	35.6	16.0	2.54		
14	46.8	10.5	1.02		2.14	13.0	32.9	34.1	16.7	1.08	
14	61.9	11.1	0.93			4.89	21.5	39.9	29.7	3.87	0.14
14	107.3	12.0	0.83				3.74	21.2	49.4	22.6	2.57

TABLE XIo. ^{28}Si ions in Ag

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	29.2	9.94	1.05	1.03	7.03	24.6	37.8	23.6	5.78	0.17	
14	39.2	10.4	1.05	0.27	3.28	15.5	34.8	31.7	13.6	0.79	
14	49.2	10.7	1.00		1.48	9.74	28.7	38.0	20.3	1.79	0.04
14	64.2	11.1	0.96		0.45	4.81	20.4	39.3	30.8	4.09	0.15
14	79.3	11.4	0.92		0.11	2.23	13.5	36.1	39.4	8.18	0.46
14	94.3	11.7	0.88			0.92	8.14	29.9	46.2	13.7	1.14
14	109.3	11.9	0.87			0.33	4.66	23.3	48.0	21.2	2.45

TABLE XIq. ^{28}Si ions in Te

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	28.3	10.0	1.01	0.78	6.38	23.3	39.0	25.1	5.44		
14	38.3	10.6	0.99		1.79	10.5	30.3	38.3	17.7	1.38	
14	48.3	11.0	0.97		0.71	6.11	22.8	39.2	28.0	3.21	
14	63.4	11.3	0.92			3.03	15.5	38.3	36.2	6.65	0.30
14	108.7	12.0	0.85				4.20	21.7	48.8	22.6	2.78

TABLE XIr. ^{28}Si ions in Sm

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	28.7	9.62	1.06	2.15	11.8	30.9	35.6	16.5	3.04		
14	38.7	10.3	1.01		3.38	17.1	36.7	31.0	11.2	0.61	
14	48.7	10.8	0.96		0.86	7.75	27.6	40.0	21.7	2.10	
14	63.7	11.3	0.90		0.11	2.46	15.0	39.2	37.0	5.94	0.28
14	108.9	12.2	0.79				2.31	16.6	52.5	25.5	3.05

TABLE XIs. ^{28}Si ions in Yb

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	28.7	9.29	1.07	4.47	18.1	35.5	29.9	10.9	1.53		
14	38.7	9.89	1.06	1.08	7.80	25.7	37.3	22.5	5.53	0.17	
14	48.8	10.5	1.00		2.27	13.8	34.1	34.7	14.3	0.98	
14	63.8	11.0	0.95		0.46	4.90	22.5	40.7	27.8	3.50	0.16
14	108.9	12.0	0.74				0.37	23.0	52.8	21.7	2.22

TABLE XIp. ^{28}Si ions in Sn

Ref	E	QB	d	9+	10+	11+	12+	13+	14+
14	49.2	11.0	0.89	5.41	20.8	44.5	26.6	2.74	
14	62.5	11.3	0.92	3.01	15.0	36.7	38.5	6.57	0.26
14	109.3	12.0	0.84		4.20	20.4	50.9	21.8	2.67

TABLE XIt. ^{28}Si ions in Au

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
13	29.1	9.34	1.07	3.92	17.2	35.1	30.6	11.4	1.83		
13	39.2	9.86	1.06	1.16	8.29	26.9	36.9	21.5	5.42	0.17	
13	49.2	10.3	1.03	0.42	2.97	17.1	36.2	31.3	11.4	0.66	
13	64.1	10.8	0.99		0.98	7.97	26.7	38.9	22.8	2.54	0.09
13	79.1	11.2	0.95		0.23	3.48	17.8	38.3	34.0	5.93	0.31
13	89.3	11.4	0.92		0.12	1.99	13.4	36.4	38.9	8.61	0.54
13	94.2	11.5	0.91			1.37	11.3	34.7	41.0	10.7	0.83
13	99.2	11.6	0.89		0.02	1.05	9.00	31.1	43.9	12.9	1.01
13	109.2	11.8	0.88			0.58	6.30	27.7	46.7	17.1	1.64

TABLE XIu. ^{28}Si ions in Pb

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	29.0	9.63	1.04	1.60	12.0	31.3	35.3	16.7	3.07		
14	39.0	10.1	1.05		6.43	20.5	36.4	27.5	8.85	0.39	
14	49.0	10.5	1.02		2.49	13.3	32.0	35.4	15.7	1.15	
14	64.0	11.0	0.95			6.76	24.0	39.4	26.6	3.21	
14	109.2	11.9	0.86			0.37	5.30	25.1	48.1	19.2	1.96

TABLE XIv. ^{28}Si ions in Bi

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+
14	28.0	9.48	1.04	2.59	14.1	33.4	34.5	13.6	1.96		
14	47.8	10.5	1.01		2.33	14.2	33.0	35.2	14.1	1.19	
14	62.8	11.0	0.96			6.43	24.1	38.9	27.0	3.38	
14	108.0	11.9	0.86				5.71	25.6	47.7	19.0	2.03

TABLE XIIa. ^{31}P ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+
3	.529	3.09	1.23	1.40	9.42	19.8	30.7	26.7	10.5	1.45									
3	.619	3.31	1.23	1.10	6.83	16.5	29.4	29.8	14.3	2.03									
3	.710	3.51	1.19	0.70	4.92	13.7	27.2	32.8	17.9	2.75									
3	.796	3.61	1.20	0.60	4.18	12.9	25.6	33.1	19.9	3.57	0.10								
3	.854	3.78	1.18	0.30	3.14	10.3	24.5	33.6	23.1	4.96	0.14								
15	72.6*	12.5	0.96										0.20	2.20	12.0	30.5	41.5	13.5	
15	77.4*	12.7	0.95											1.50	9.50	26.9	44.2	16.6	1.30
15	82.3*	12.8	0.95											1.00	7.10	24.6	43.7	21.5	2.20
15	87.1*	13.0	0.94											0.60	4.80	21.6	43.0	26.0	4.00
15	94.4*	13.2	0.96												4.40	16.9	43.7	26.8	8.30
15	101.6*	13.4	0.87												2.90	7.90	41.1	39.1	8.90
15	108.9*	13.5	0.90												2.60	6.10	38.2	39.0	14.0
15	116.1*	13.6	0.90												1.30	8.10	30.7	38.3	21.2
15	123.4*	13.7	0.88												0.90	6.50	32.0	41.3	19.2

*incident energy, foil thickness 100 $\mu g/cm^2$
Graph is presented in Ref. 15 for nonequilibrium charge fractions of 87.1 and 123.4 MeV P ions in C.
Graph is presented in Ref. 37 for nonequilibrium charge fractions of 0.85 MeV P ions in C.

TABLE XIIb. ^{31}P ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+
5	.716	2.54	1.21	0.29	17.7	30.6	26.7	16.0	6.10	
5	.729	2.53	1.20	0.29	17.2	31.6	27.3	15.0	5.82	0.23
5	.773	2.57	1.19	0.28	15.9	31.2	28.0	15.9	6.18	
5	.776	2.64	1.21	0.28	14.4	30.3	29.0	16.3	6.88	0.38
5	.830	2.72	1.21	0.15	14.6	29.2	28.8	18.0	7.17	0.73

Graph is presented in Ref. 37 for equilibrium mean charge of 0.85 MeV P ions in Al.

TABLE XIIIa. ^{32}S ions in Be

Ref	E	QB	d	12+	13+	14+	15+	16+
16	116.0*	14.7	0.88	0.80	7.40	31.8	42.3	17.7
16	129.4*	14.9	0.82		4.50	26.1	45.0	24.4
16	141.8*	15.1	0.78		2.50	20.4	46.1	31.1

*incident energy, foil thickness 160 μg/cm^2
Graph and table are presented in Ref.16 for nonequilibrium charge fractions of 116.0-141.8 MeV S ions in Be.

TABLE XIIIb. ^{32}S ions in C

Ref	E	QB	d	1-	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
6	.085	0.73	0.84	3.60	38.0	42.0	13.0	3.00													
6	.180	1.35	1.00	1.10	18.0	41.0	27.0	11.0	2.00												
6	.275	1.82	1.09	0.40	9.60	32.0	31.0	20.0	7.20												
6	.375	2.18	1.10	0.20	5.10	23.0	31.0	27.0	13.0												
6	.425	2.20	1.35	0.10	3.70	19.0	26.0	27.0	17.0	6.00	1.00										
3	.544	3.02	1.32		1.30	12.4	22.2	27.5	23.4	10.7	2.38	0.28									
3	.634	3.23	1.30		0.80	9.16	19.9	26.9	26.1	13.8	3.34										
3	.757	3.45	1.29		0.70	6.76	16.6	25.8	27.9	18.2	4.08										
8	33.3*	10.6	1.14									0.43	2.29	12.8	29.8	33.1	17.3	3.83	0.43		
16	69.5*	12.8	1.07												1.80	9.20	25.1	35.2	25.1	3.60	
16	79.4*	13.2	0.97													3.90	16.4	34.8	35.9	8.70	
16	89.2*	13.7	0.91													0.70	9.90	29.2	44.0	15.3	1.00
41	92.0*	13.6	0.89													1.00	9.00	35.0	42.0	12.0	1.00
16	94.2*	13.7	1.00													1.60	9.50	27.1	41.3	18.2	2.40
16	99.2*	13.9	0.97													1.00	6.40	22.2	44.1	22.4	3.90
16	105.8*	14.0	0.97													0.80	4.50	20.5	42.8	25.7	5.60
16	116.0*	14.4	0.92														2.30	13.8	39.6	34.7	9.20
16	117.2*	14.3	0.95														3.20	15.1	39.2	33.1	9.40
16	127.3*	14.6	0.89														1.20	9.60	35.5	39.2	14.6
8	131.8*	14.2	0.87													0.24	2.73	17.3	46.0	28.9	4.89
16	141.8*	14.8	0.87														0.70	5.70	28.6	43.3	21.7

*incident energy. Foil thicknesses are 103 μg/cm^2 for 69.5 and 79.4 MeV, 113 μg/cm^2 for 89.2 MeV, 165 μg/cm^2 for 94.2 MeV, 113 μg/cm^2 for 99.2 MeV, 165 μg/cm^2 for 105.8, 116, 117.2 and 127.3 MeV, and 188 μg/cm^2 for 141.8 MeV.
Graph is presented in Ref.17 for nonequilibrium charge fractions of 54 MeV S ions in C.
Graph and table are presented in Ref.16 for nonequilibrium charge fractions of 69.5-141.8 MeV S ions in C.

TABLE XIIIc. ^{32}S ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	11+	12+	13+	14+	15+	16+
5	.728	2.62	1.24	1.29	17.1	32.6	25.9	15.2	6.29	1.58						
5	.791	2.74	1.26	1.29	15.0	30.4	26.8	16.7	8.29	1.58						
5	.859	2.82	1.26	0.95	13.2	29.8	27.5	17.9	8.73	1.98						
16	116.0*	13.6	0.82								0.96	8.82	34.4	46.8	8.70	0.34
16	129.4*	13.7	0.81								0.58	6.65	30.3	50.1	11.6	0.75
16	141.8*	13.8	0.80								0.26	5.15	28.2	51.0	14.3	1.00

*incident energy, foil thickness 100 μg/cm^2
Graph is presented in Ref.17 for equilibrium charge fractions of 54 MeV S ions in Al.

TABLE XIIId. ^{32}S ions in Ti

Graph is presented in Ref.17 for equilibrium charge fractions of 54 MeV S ions in Ti.

TABLE XIIIe. ^{32}S ions in Ni

Ref	E	QB	d	11+	12+	13+	14+	15+	16+
16	116.0*	13.5	0.91	1.71	12.7	34.9	40.3	10.2	0.24
16	129.4*	13.7	0.96	1.90	9.15	29.5	43.2	14.7	1.63
16	141.8*	13.9	0.93		7.44	26.8	41.8	21.4	2.65

*incident energy, foil thickness 100 μg/cm^2
Graph is presented in Ref.17 for equilibrium charge fractions of 54 MeV S ions in Ni.

TABLE XIIIf. ^{32}S ions in Au

Ref	E	QB	d	11+	12+	13+	14+	15+
16	116.0*	13.1	0.90	4.40	22.3	41.9	28.7	2.80
16	129.4*	13.3	0.91	2.73	17.2	39.4	34.7	5.90
16	141.8*	13.4	0.88	1.35	12.8	34.0	43.0	8.70

*incident energy, foil thickness 100 μg/cm^2

TABLE XIVa. ^{35}Cl ions in Be

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	24.1	10.5	1.16	0.41	3.53	14.7	29.5	32.1	16.2	3.31	0.23			
12	26.0	10.6	1.17		3.03	14.5	27.9	32.3	17.5	4.31	0.49			
12	31.0	11.0	1.18		1.54	8.44	23.3	34.5	22.5	8.43	1.27	0.07		
18	36.0	11.5	1.17		0.46	3.89	14.4	30.3	32.1	15.4	3.16	0.29		
12	38.9	11.8	1.15		0.16	2.01	9.77	25.5	34.6	21.6	5.74	0.58		
12	46.2	12.2	1.18			1.06	6.41	19.8	33.3	27.1	10.1	2.14		
12	66.5	13.5	1.15				0.51	4.14	15.4	30.0	31.4	16.6	1.91	0.07
12	76.7	14.0	1.09					1.30	7.26	22.2	34.0	28.9	6.07	0.26
43	89.0	14.2	1.05				0.01	0.42	4.15	19.2	35.3	32.2	8.07	0.60
12	91.9	14.6	1.01					0.16	2.29	10.9	29.9	39.5	15.8	1.50
12	107.1	15.0	0.97						0.73	5.66	20.3	42.8	25.6	4.89
12	117.2	15.2	0.91						0.31	3.28	15.1	46.5	27.6	7.18

TABLE XIVb. ^{35}Cl ions in C

Ref	E	QB	d	1-	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
19	.070	0.57	0.85	3.72	51.5	32.9	8.62	2.51	0.73													
19	.089	0.77	0.94	2.87	41.7	37.0	13.4	3.92	0.84	0.20												
19	.109	0.90	0.96	1.54	37.3	39.0	16.0	5.00	1.06	0.21												
19	.130	1.04	1.01	1.84	31.1	39.7	19.6	6.42	1.49	0.29												
19	.143	1.19	1.07	1.10	26.1	39.5	22.6	8.28	2.05	0.39												
19	.185	1.43	1.11	0.67	20.3	36.1	26.9	11.6	3.54	0.73	0.09											
19	.198	1.46	1.12	0.74	18.3	37.2	27.1	12.2	3.56	0.86	0.12											
19	.211	1.56	1.17	0.85	16.8	34.8	28.1	13.3	5.01	0.98	0.20											
19	.240	1.68	1.16		14.9	32.9	30.0	15.0	5.59	1.34	0.19											
19	.255	1.71		0.50	33.7	30.7	30.7	15.1	5.53	1.55	0.17											
19	.316	2.02	1.21		8.54	28.1	31.8	19.8	8.89	2.48	0.39	0.02										
19	.331	2.08	1.19		7.00	27.1	32.1	22.7	8.04	2.60	0.44	0.05										
3	.581	2.84	1.21		0.90	12.6	28.1	28.7	20.6	7.97	1.19											
3	.698	3.04	1.31		1.30	10.0	25.3	28.1	20.7	11.7	2.56	0.39										
3	.812	3.27	1.36		0.90	7.72	22.1	27.1	23.2	13.2	5.36	0.42										
48	2.4*	4.99	1.30				2.86	10.6	21.5	28.2	24.5	10.6	1.42									
48	3.0*	5.42	1.25				1.06	5.78	16.4	26.6	30.8	16.1	3.02	0.14								
48	3.5*	5.66	1.25				0.48	4.21	13.6	24.3	31.5	20.5	5.17	0.29								
48	4.0*	5.94	1.24				0.20	2.73	9.94	20.9	31.7	25.8	7.81	1.01								
48	4.5*	6.21	1.22					1.93	6.85	17.3	31.0	29.9	11.3	1.75								
48	5.0*	6.43	1.19					0.96	5.00	14.2	29.6	33.0	14.3	2.74	0.15							
48	5.5*	6.61	1.18					0.66	3.43	12.1	27.5	34.7	17.3	4.00	0.29							
48	6.0*	6.83	1.15					0.24	2.07	9.53	24.9	35.8	21.3	5.59	0.58							
48	6.4*	6.96	1.15					0.12	1.79	7.82	23.0	35.5	23.8	7.06	0.95							
48	6.8*	7.05	1.15						1.41	7.53	21.5	34.4	26.3	7.53	1.41							
13	23.4	10.1	1.17								0.05	0.96	6.88	21.6	32.7	26.4	9.79	1.51	0.08			
13	24.1	10.2	1.17									0.72	6.34	21.2	34.1	24.8	11.2	1.74				
13	29.3	10.7	1.14										2.79	9.23	29.4	33.4	19.8	4.89	0.47			
13	30.1	10.7	1.16										2.43	12.0	28.0	32.9	18.9	5.18	0.56			
43	34.6	11.1	1.16									0.04	1.16	7.22	22.1	32.7	26.9	8.69	1.15	0.02		
13	37.9	11.5	1.15										0.45	3.82	14.7	30.9	32.2	14.7	3.07	0.23		
13	48.0	12.1	1.15											1.02	6.25	20.5	34.2	26.9	9.52	1.67		
43	49.6	12.1	1.16									.001	0.04	1.24	6.96	23.0	33.2	25.6	8.73	1.28	.008	
13	57.9	12.6	1.17											0.28	2.86	12.8	28.7	32.5	17.8	4.82	0.19	
13	62.4	12.9	1.16											0.16	1.64	8.88	24.5	33.2	23.4	7.97	0.46	
13	68.2	13.3	1.13												0.69	5.11	18.0	32.8	29.2	13.0	1.09	0.03
43	69.5	13.1	1.13										.002	0.04	1.21	7.16	21.6	34.9	25.6	8.93	0.54	.004
13	72.6	13.4	1.13												0.45	3.96	15.1	31.3	31.1	16.3	1.68	0.06
13	78.3	13.6	1.11												0.23	2.26	12.3	28.2	34.3	19.6	2.61	0.12
13	87.7	14.0	1.05													0.94	6.45	21.9	35.0	29.2	5.81	0.38
43	89.5	13.7	1.00											.003	0.18	2.04	10.5	27.6	36.8	20.0	2.76	0.12
13	92.7	14.3	1.05													0.57	4.51	17.5	34.1	34.2	8.43	0.74
13	97.8	14.4	1.05													0.35	3.60	15.1	30.9	37.6	11.5	1.07
13	103.2	14.6	1.01													0.19	2.26	11.9	29.8	40.3	13.9	1.60
13	107.9	14.7	1.00													0.13	1.76	10.2	29.1	40.8	15.9	2.08
13	112.9	14.8	0.98														1.22	8.10	25.1	43.2	19.5	2.90
13	118.1	14.9	0.98														0.90	6.29	23.9	42.5	23.3	4.36
13	123.0	15.0	0.97														0.63	5.39	21.5	42.1	25.2	5.12
13	130.0	15.2	0.95														0.37	3.96	17.7	41.7	29.6	6.70
13	141.1	15.3	0.92														0.15	2.37	14.5	39.4	34.8	8.69

*incident energy, foil thickness 10 μg/cm^2

Graph is presented in Ref.7 for nonequilibrium charge fractions of 445 MeV Cl ions in C.
Graph is presented in Ref.13 for nonequilibrium charge fractions of 95 MeV Cl ions in C.
Graph is presented in Ref.20 for nonequilibrium charge fractions of 130 MeV Cl ions in C.
Graph is presented in Ref.33 for equilibrium mean charge of 50 MeV Cl ions in C.

TABLE XIVc. ^{35}Cl ions in Mg

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	23.1	10.2	1.15	0.76	5.56	19.1	32.7	28.9	11.2	1.72	0.10			
18	38.1	11.6	1.14		0.29	2.98	13.3	29.0	33.7	16.9	3.48	0.25		
14	65.9	13.1	1.09				0.94	6.39	21.2	35.7	26.8	8.46	0.46	
14	106.3	14.2	0.96					0.23	3.89	17.5	38.2	33.8	5.98	0.38

TABLE XIVd. ^{35}Cl ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
5	.781	2.68	1.20	1.44	13.1	33.8	29.0	15.0	5.84	1.89											
5	.867	2.83	1.23	0.98	10.8	31.7	30.1	17.0	6.96	2.12	0.38										
5	.953	2.99	1.27	0.67	8.67	29.3	30.4	18.3	9.32	2.49	0.78										
18	23.4	10.2	1.14								0.79	5.55	19.3	33.7	28.1	10.9	1.70				
18	38.2	11.5	1.16								0.03	0.52	4.07	14.9	30.1	32.6	14.6	2.91	0.20		
14	66.3	13.0	1.09											1.04	6.89	22.1	35.1	27.4	7.21	0.36	
43	89.2	13.7	1.03										.005	0.05	1.77	10.1	27.8	37.2	20.9	2.19	0.02
12	93.4	13.9	1.00										0.01	0.09	1.14	7.56	25.1	40.1	23.3	2.75	0.12
14	106.7	14.2	0.97												0.36	4.12	18.5	38.6	32.4	5.75	0.28
12	118.5	14.5	0.88												0.07	1.76	10.4	38.3	40.2	8.75	0.54

Graph is presented in Ref. 33 for equilibrium mean charge of 50 MeV Cl ions in Al.

TABLE XIVe. ^{35}Cl ions in KCl

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
18	23.2	9.79	1.17	0.14	1.89	10.7	27.6	33.1	19.9	5.87	0.80	0.05		
18	38.1	11.0	1.17			1.53	8.56	23.8	33.8	23.1	7.96	1.20		
14	67.2	12.5	1.12				0.33	3.29	13.8	30.8	33.5	15.4	2.87	
14	107.4	13.8	0.99						1.14	8.20	27.1	39.0	22.5	2.13

Graph is presented in Ref. 33 for equilibrium mean charge of 50 MeV Cl ions in KCl.

TABLE XIVf. ^{35}Cl ions in Ti

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	21.8	10.2	1.12	0.70	5.81	20.4	34.6	27.7	9.42	1.31	0.08			
18	36.5	11.4	1.15		0.50	4.28	16.2	32.2	31.1	13.0	2.52	0.21		
14	67.4	12.8	1.12				1.77	9.64	26.2	34.8	21.5	5.60	0.27	
14	107.7	13.9	1.02					0.99	6.99	24.4	38.1	25.5	3.91	0.17

TABLE XIVg. ^{35}Cl ions in Cr

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	22.5	10.4	1.12	0.42	4.54	15.1	34.2	31.0	12.7	2.00	0.12			
18	37.3	11.5	1.14		0.30	3.17	13.6	30.7	32.6	15.8	3.47	0.31		
14	67.5	13.0	1.11				1.27	8.22	24.2	35.3	23.5	7.14	0.38	
14	107.8	14.0	1.01					0.70	6.32	22.2	38.5	27.4	4.68	0.19

TABLE XIVh. ^{35}Cl ions in Fe

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	21.6	10.3	1.14	0.51	5.37	19.4	30.7	30.8	11.5	1.64	0.07			
18	36.3	11.5	1.16		0.39	3.60	14.6	29.0	33.5	15.3	3.34	0.28		
14	66.4	12.9	1.13				1.43	8.51	24.6	34.0	23.7	7.59	0.25	
14	106.7	13.9	1.04					1.09	7.48	24.1	36.9	26.2	4.06	0.21

TABLE XIVi. ^{35}Cl ions in Ni

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	22.8	10.3	1.13	0.57	4.75	17.9	33.3	29.8	11.7	1.78	0.09			
18	37.7	11.6	1.16											
14	67.4	13.0	1.14			0.10	1.51	8.03	23.2	34.5	24.4	7.73	0.43	
14	107.7	13.9	1.03					1.15	7.40	24.0	37.5	25.8	3.95	0.16

Graph is presented in Ref. 33 for equilibrium mean charge of 50 MeV Cl ions in Ni.

TABLE XIVj. ^{35}Cl ions in Cu

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	23.8	10.3	1.14	0.64	5.18	18.6	33.3	28.9	11.5	1.77	0.09			
18	38.7	11.6	1.16		0.43	3.44	13.1	29.6	33.0	16.6	3.55	0.28		
14	67.2	13.0	1.14			0.13	1.58	8.34	23.7	34.8	23.8	7.31	0.39	
43	89.3	13.5	1.08			0.01	0.33	3.08	14.6	31.1	33.5	16.0	1.41	0.01
12	93.7	13.6	1.06				0.29	2.43	11.5	29.1	36.8	18.0	1.83	0.03
14	107.4	13.9	1.02					1.07	7.22	24.1	37.9	25.9	3.81	
12	118.8	14.1	1.01					0.67	5.38	20.[illegible]	37.6	30.0	5.47	0.25

TABLE XIVk. ^{35}Cl ions in Ge

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
12	23.3	9.87	1.16	0.15	1.67	9.60	25.5	33.6	22.3	6.53	0.75	0.03		
18	38.6	11.2	1.16		0.07	1.01	6.37	20.2	33.5	27.6	9.69	1.46	0.08	
14	68.2	12.8	1.11					1.97	9.78	26.0	35.6	21.0	5.47	0.22
14	108.3	13.9	1.01						1.29	7.91	25.8	37.9	24.2	2.94

TABLE XIVl. ^{35}Cl ions in Se

Ref	E	QB	d	10+	11+	12+	13+	14+	15+	16+
14	65.2	12.5	1.10	3.20	14.0	30.8	33.3	15.7	3.01	
14	105.5	13.7	1.02		1.73	9.89	28.0	38.3	20.1	2.05

TABLE XIVm. ^{35}Cl ions in Zr

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
18	21.1	9.75	1.15	2.08	11.6	27.3	33.8	19.3	5.27	0.63			
18	35.7	11.0	1.17	0.09	1.38	8.70	23.0	33.9	24.3	7.52	1.01	0.05	
14	66.1	12.5	1.11			0.36	3.49	15.0	32.0	32.4	14.3	2.60	
14	106.4	13.7	1.00					1.77	10.7	29.4	38.5	18.1	1.51

TABLE XIVn. ^{35}Cl ions in Mo

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
18	20.7	9.68	1.15	0.14	2.24	12.2	28.9	33.5	17.7	4.72	0.57	0.04		
18	35.3	11.0	1.16			1.35	8.37	23.6	34.3	23.4	7.63	1.24	0.09	
14	65.8	12.5	1.12				0.42	3.82	13.3	32.6	32.2	14.7	2.86	
14	106.2	13.5	1.02						2.01	11.3	30.0	36.4	18.8	1.40

TABLE XIVo. ^{35}Cl ions in Ag

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	24.1	10.2	1.12	0.54	5.13	19.1	34.3	28.6	10.7	1.56	0.10			
18	39.0	11.4	1.13		0.47	4.22	16.3	32.0	31.9	12.7	2.29	0.15		
14	69.0	12.6	1.11			0.25	2.62	13.1	30.7	33.4	16.5	3.37	0.04	
12	94.1	13.2	1.08			0.06	0.76	5.26	19.2	35.9	29.1	9.28	0.46	0.01
14	109.1	13.5	1.03				0.19	2.43	12.6	31.3	36.1	16.2	1.24	
12	119.2	13.7	1.01				0.09	1.63	10.1	29.2	37.9	19.5	1.63	0.04

Graph is presented in Ref. 33 for equilibrium mean charge of 50 MeV Cl ions in Ag.

TABLE XIVp. ^{35}Cl ions in Sn

Ref	E	QB	d	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
18	24.3	10.5	1.08	0.23	3.19	12.0	32.4	35.0	14.6	2.49	0.16		
18	39.3	11.7	1.10		0.15	2.22	11.6	29.0	35.1	18.1	3.56	0.25	
14	68.4	13.0	1.14				1.53	8.45	21.4	34.3	25.2	8.42	0.22
14	108.5	13.7	1.04				0.35	1.81	9.96	27.9	37.2	20.9	1.83

TABLE XIVq. ^{35}Cl ions in Te

Ref	E	QB	d	10+	11+	12+	13+	14+	15+	16+
14	67.8	12.9	1.13	1.43	8.82	25.8	31.6	25.5	6.70	0.21
14	107.9	13.7	1.03		1.97	10.7	28.5	36.7	20.3	1.82

TABLE XIVr. ^{35}Cl ions in Sm

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	23.8	10.3	1.16	0.05	0.70	5.44	18.4	32.7	29.0	11.6	1.92	0.12			
18	38.7	11.5	1.12			0.29	3.12	13.6	30.3	33.8	15.6	3.00	0.20		
14	68.2	13.1	1.07					0.84	6.00	21.6	35.9	27.1	8.23	0.29	
14	108.3	14.0	0.99						0.68	5.93	22.1	38.2	28.9	4.09	0.14

TABLE XIVs. ^{35}Cl ions in Yb

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
18	24.0	9.66	1.18	0.25	2.74	12.8	28.7	32.2	17.8	4.87	0.59	0.03		
18	38.9	10.9	1.16		0.12	1.58	8.66	23.9	34.3	23.2	7.24	0.88	0.07	
14	68.4	12.6	1.09					2.45	12.6	30.5	34.1	17.1	3.32	
14	108.5	13.8	0.99						1.29	8.82	28.1	38.8	20.8	2.19

TABLE XIVt. ^{35}Cl ions in Au

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
18	24.2	9.50	1.17	0.30	3.35	15.5	31.5	30.8	14.6	3.57	0.42	0.03			
18	39.1	10.8	1.17		0.14	1.85	10.1	26.4	33.7	20.7	6.16	0.85	0.05		
14	68.8	12.3	1.09					4.33	17.6	33.7	30.5	11.9	1.95		
43	89.6	12.8	1.11			.002	0.05	1.71	9.10	27.0	33.6	22.9	5.46	0.19	.002
12	94.3	13.0	1.08					0.86	7.72	24.1	35.8	24.5	6.70	0.30	0.01
14	108.8	13.5	1.02						2.76	14.2	33.7	34.3	14.0	1.06	
12	119.4	13.6	1.01					0.12	2.02	11.7	31.5	36.7	16.5	1.32	0.03

Graph is presented in Ref. 33 for equilibrium mean charge of 50 MeV Cl ions in Au.

TABLE XIVu. ^{35}Cl ions in Pb

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
18	24.1	9.57	1.13	0.21	2.52	13.7	31.6	32.1	16.0	3.56	0.35			
14	68.7	12.5	1.12					3.58	15.1	31.6	31.7	15.1	2.97	
14	108.8	13.6	1.02						1.02	14.0	34.5	33.1	14.7	2.77

TABLE XIVv. ^{35}Cl ions in Bi

Ref	E	QB	d	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+
18	22.5	9.40	1.13	0.34	3.58	16.7	33.7	30.0	13.0	2.57	0.20			
18	37.1	10.8	1.14		0.14	1.79	10.1	26.8	34.6	20.3	5.45	0.68	0.03	
14	67.1	12.3	1.12				0.43	4.60	17.8	33.6	29.9	11.7	2.04	
14	107.2	13.4	1.06					0.26	3.56	16.0	33.7	32.5	13.0	0.95

TABLE XVa. ^{40}Ar ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+	18+
19	.071	0.51	0.66	57.9	34.8	6.22	1.11															
19	.070	0.53	0.71	57.9	33.7	6.52	1.97															
19	.089	0.67	0.77	48.3	40.0	9.02	2.22	0.46														
19	.110	0.85	0.83	37.8	44.4	13.7	3.44	0.68														
19	.127	0.90	0.84	34.8	45.6	15.2	3.71	0.74														
19	.143	1.03	0.92	30.5	44.2	18.1	5.97	1.10	0.13													
19	.165	1.05	0.92	29.5	45.8	18.0	5.67	1.39	0.21													
19	.202	1.28	0.97	21.5	42.1	25.9	8.34	1.82	0.27	0.03												
19	.212	1.35	1.00	19.1	42.3	26.3	9.59	2.36	0.31	0.06												
19	.256	1.54	1.04	14.2	39.2	30.0	12.4	3.41	0.72	0.10												
19	.277	1.62	1.04	11.9	37.8	32.4	13.2	3.78	0.77	0.13												
19	.293	1.65	1.06	11.4	38.0	31.0	14.4	4.28	0.86	0.12												
19	.311	1.72	1.10	11.9	33.6	32.4	16.1	4.74	1.05	0.17												
19	.320	1.79	1.07	7.90	36.4	32.6	16.3	5.40	1.13	0.20	0.02											
19	.325	1.83	1.10	7.84	35.5	31.6	17.8	5.78	1.26	0.25	0.03											
3	.686	2.62	1.18	1.20	15.7	32.1	29.1	15.2	5.56	1.09												
3	.833	2.89	1.21	0.50	11.1	28.0	31.8	18.8	7.54	2.07	0.20											
3	.942	3.09	1.24	0.50	8.16	24.8	32.0	21.1	10.0	3.46												
3	1.02	3.22	1.26	0.50	7.24	21.7	31.4	23.5	11.5	4.35												
3	1.10	3.34	1.31	0.50	5.83	20.5	30.8	24.0	12.4	4.73	1.22											

(TABLE XVa continued)

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+	18+
20	3.0*	4.82	1.36			2.80	14.4	25.9	25.4	20.6	8.40	2.40	0.20									
20	6.0*	6.53	1.39				1.30	6.40	15.7	24.7	25.8	19.9	5.50	0.80	0.10							
20	8.0*	7.23	1.35				0.20	2.10	8.50	17.5	26.4	29.5	12.2	3.10	0.40							
20	10.0*	7.81	1.25					0.60	3.20	10.4	23.4	33.8	21.4	6.10	1.00	0.10						
20	13.0*	8.58	1.23						0.80	4.20	11.8	30.6	30.2	17.3	4.40	0.70						
20	16.0*	9.17	1.20							1.50	5.70	21.0	33.2	25.6	10.6	2.10	0.20					
20	19.5*	9.67	1.20							0.30	2.60	13.3	28.2	31.5	18.4	5.00	0.80					
8	41.6*	11.9	1.19									0.27	2.15	9.80	25.5	32.9	22.2	6.41	0.76			
8	165*	15.6	1.00													0.19	1.93	10.3	28.9	41.0	15.7	1.94
8	280*	16.6	0.84																6.59	45.2	30.8	17.4
8	320*	16.7	0.86																5.31	40.4	32.6	21.7
8	360*	17.0	0.84																3.61	25.3	39.5	31.6
8	384*	17.2	0.74																1.58	14.9	46.4	37.1

*incident energy. Foil thicknesses are 20 μg/cm^2 for 3.0-16.0 MeV, and 5 μg/cm^2 for 19.5 MeV.

TABLE XVb. ^{40}Ar ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+
5	.918	2.73	1.15	0.82	11.7	32.2	33.3	14.8	5.48	1.79
5	.995	2.87	1.14	0.34	9.64	29.1	34.6	18.5	5.65	2.21
5	1.07	2.97	1.18	0.53	8.26	27.2	35.1	18.8	6.98	3.10

TABLE XVc. ^{40}Ar ions in Si

Ref	E	QB
39	86.0	14.8

TABLE XVIa. ^{39}K ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
3	.666	2.63	1.07	0.40	12.4	35.9	31.6	14.9	3.77	0.96	
3	.777	2.86	1.11	0.30	8.80	30.6	34.2	18.5	6.11	1.57	
3	.897	3.09	1.16	0.30	6.03	26.2	33.8	22.5	8.69	2.14	0.46
3	1.00	3.22	1.20	0.40	5.11	23.0	33.7	23.8	9.85	4.23	

TABLE XVIb. ^{39}K ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
5	.902	2.93	1.09	0.34	7.24	28.1	37.6	18.8	6.19	1.74	
5	.974	3.03	1.11	0.40	6.03	27.2	34.6	22.1	7.97	1.70	
5	1.05	3.19	1.13	0.31	4.27	23.0	35.6	25.7	8.26	2.00	0.78

TABLE XVII. ^{40}Ca ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
3	.685	2.89	1.03	0.30	5.65	31.7	38.0	17.8	5.22	1.33	
3	.813	3.13	1.09	0.20	3.83	24.7	37.8	23.1	8.08	1.95	0.34
3	.953	3.34	1.10	0.10	2.47	19.9	36.7	26.6	10.9	2.87	0.44

TABLE XVIII. ^{45}Sc ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
3	.783	3.05	1.08	0.80	7.95	16.9	43.2	23.6	6.34	1.33	
3	.862	3.22	1.09	0.70	6.07	14.2	41.6	26.5	9.02	1.89	
3	1.00	3.41	1.10	0.70	4.24	11.0	38.8	30.7	19.9	2.77	
3	1.06	3.55	1.14	0.40	3.46	9.74	37.1	30.6	13.8	4.10	0.72
3	1.21	3.82	1.17	0.50	2.06	7.03	32.0	31.4	18.8	7.05	1.26

TABLE XIX. ^{51}V ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
3	.896	3.17	1.38	1.60	10.8	19.9	26.4	23.2	14.2	3.90	
3	1.08	3.59	1.38	1.00	6.75	14.1	24.4	25.5	21.9	5.69	0.69
3	1.21	3.86	1.37	0.60	4.57	11.5	21.9	25.7	26.2	8.22	1.38

TABLE XXa. ^{52}Cr ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
3	.896	3.14	1.44	1.40	13.0	20.5	24.5	22.3	13.1	4.90	0.28
3	1.01	3.41	1.46	1.00	9.77	17.1	24.1	23.8	16.3	7.38	0.62
3	1.20	3.83	1.49	0.80	5.64	12.9	21.2	25.2	20.8	11.1	2.43
3	1.34	4.09	1.48	0.80	4.01	10.0	18.4	25.5	24.1	13.3	3.96
3	1.44	4.22	1.49	0.60	3.65	8.82	17.4	25.0	24.0	15.2	5.45

TABLE XXb. ^{52}Cr ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+
5	1.20	3.80	1.49	0.80	6.03	13.0	21.6	25.9	19.0	11.2	2.39
5	1.25	3.91	1.46	0.80	4.84	11.6	20.6	26.8	21.1	11.6	2.69
5	1.30	3.98	1.52	0.75	5.07	11.2	19.6	25.6	20.8	13.0	4.00
5	1.35	4.11	1.51	0.65	4.10	10.0	18.7	25.4	22.2	14.2	4.73
5	1.40	4.22	1.49	0.55	3.65	8.82	17.4	25.0	24.0	15.1	5.45

TABLE XXIa. ^{55}Mn ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+
3	.949	3.32	1.49	0.60	11.3	19.6	23.4	23.4	14.6	5.31	1.60	0.30
3	1.11	3.74	1.50	0.50	7.03	14.2	21.0	25.5	19.7	9.29	2.78	
3	1.30	3.99	1.51	0.50	4.83	11.6	19.5	26.1	21.3	11.6	4.05	0.42
3	1.41	4.24	1.53	0.70	3.47	8.84	17.0	25.4	24.5	14.0	5.13	1.07

TABLE XXIb. ^{55}Mn ions in Al

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+
5	1.16	3.64	1.52	0.85	7.59	15.7	21.6	25.1	17.8	8.17	3.08	
5	1.27	3.77	1.51	0.76	6.32	13.9	21.1	25.9	19.5	9.22	2.86	0.41
5	1.37	3.96	1.54	0.73	5.09	12.0	19.8	25.6	20.8	11.5	4.02	0.55

TABLE XXII. ^{56}Fe ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+
3	.987	3.43	1.52	1.30	9.40	17.7	23.7	24.1	14.8	6.50	2.56	
3	1.21	4.00	1.51	0.50	4.92	11.4	18.9	26.4	22.6	10.7	3.79	0.71

Graph is presented in Ref. 46 for charge fractions of 20 MeV Fe ions in 3 $\mu g/cm^2$ C.

TABLE XXIIIa. ^{63}Cu ions in Be

Ref	E	QB	d	18+	19+	20+	21+	22+	23+	24+
18	116.9	21.5	1.32	0.81	5.88	16.3	27.5	27.3	16.4	5.11

TABLE XXIIIb. ^{63}Cu ions in C

Ref	E	QB	d	11+	12+	13+	14+	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+	25+
21	35.5	15.1	1.64	0.92	4.22	11.6	19.5	23.2	20.1	13.0	5.76	1.67						
21	40.7	15.8	1.68	0.35	2.15	6.48	14.1	19.8	22.4	18.6	11.2	4.49	0.46					
21	42.4	15.9	1.66		1.69	5.80	12.8	19.7	22.2	19.5	12.4	5.38	0.63					
21	46.9	16.5	1.65		0.71	3.28	8.51	15.7	21.5	21.9	17.2	9.55	1.50	0.16				
21	57.3	17.4	1.57			0.82	3.31	8.24	14.6	21.1	24.4	20.7	5.76	1.02				
21	60.4	17.7	1.55			0.52	2.21	6.05	12.2	20.1	24.9	24.0	8.07	1.73	0.22			
21	62.7	17.9	1.53			0.35	1.78	5.26	11.3	18.9	24.9	25.7	9.32	2.39	0.30			
21	75.5	18.8	1.40					1.57	4.78	11.1	21.0	32.6	19.9	7.43	1.63	0.18		
21	95.6	19.8	1.33						0.93	3.48	10.1	27.0	29.6	19.5	7.46	1.68	0.19	
21	112.9	20.5	1.34						0.20	1.15	4.65	17.5	27.9	27.2	15.3	5.23	0.91	
21	115.8	20.6	1.34							0.82	3.81	15.5	26.7	28.0	17.4	6.45	1.24	0.09
21	117.1	20.7	1.32							0.75	3.30	14.9	25.7	28.7	18.3	6.90	1.40	
21	130.9	21.2	1.32								1.60	8.82	20.5	29.1	24.4	12.1	3.19	0.34
21	146.4	21.7	1.35								0.68	4.77	14.6	24.7	27.9	19.1	7.09	1.04

Graph is presented in Ref. 21 for nonequilibrium charge fractions of 65 MeV Cu ions in C.

TABLE XXIIIc. ^{63}Cu ions in Mg

Ref	E	QB	d	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	116.7	19.9	1.29	0.44	2.63	9.03	26.1	30.2	21.6	8.01	1.85	0.22

TABLE XXIIId. ^{63}Cu ions in Al

Ref	E	QB	d	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	116.8	20.0	1.30	0.60	2.52	8.30	24.5	30.9	21.9	8.97	2.07	0.24
12	146.8	20.9	1.29			2.31	11.7	24.3	30.1	20.7	8.97	1.97

TABLE XXIIIe. ^{63}Cu ions in KCl

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	113.8	19.5	1.31	0.12	1.32	4.87	13.0	30.6	28.4	15.7	4.98	0.91	0.09

TABLE XXIIIf. ^{63}Cu ions in Ti

Ref	E	QB	d	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	113.7	19.7	1.32	0.86	3.75	10.9	28.1	29.1	18.6	7.03	1.48	0.17

TABLE XXIIIg. ^{63}Cu ions in Cr

Ref	E	QB	d	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	115.4	19.6	1.31	1.02	4.29	12.4	29.5	29.0	16.3	6.10	1.21	0.12

TABLE XXIIIh. ^{63}Cu ions in Fe

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+
1°	113.3	19.5	1.30	0.15	1.30	5.03	14.2	31.5	27.8	14.5	4.61	0.77	0.08

TABLE XXIIIi. ^{63}Cu ions in Ni

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+
18	115.7	19.3	1.31	0.30	1.96	6.46	16.2	33.0	25.9	12.1	3.46	0.64

TABLE XXIIIj. ^{63}Cu ions in Cu

Ref	E	QB	d	12+	13+	14+	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+
12	48.4	15.3	1.65	3.79	10.6	18.7	22.4	20.2	14.1	7.47	2.73					
12	63.3	16.5	1.65	0.59	2.73	8.03	15.7	21.4	22.1	17.4	10.0	1.84	0.23			
12	76.5	17.4	1.55		0.60	2.91	8.49	15.2	22.1	24.0	20.1	5.57	1.00	0.11		
12	98.2	18.5	1.39			0.29	1.83	6.27	13.9	23.6	32.3	15.9	4.91	0.88	0.10	
18	117.9	19.3	1.32				0.31	2.06	6.63	16.3	32.9	26.0	11.9	3.31	0.53	0.05
12	133.1	19.7	1.29					0.69	3.57	11.1	29.2	29.3	18.2	6.45	1.33	0.15
12	147.5	20.3	1.33						1.32	5.72	19.8	27.8	25.9	14.2	4.43	0.73

TABLE XXIIIk. ^{63}Cu ions in Ge

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+
18	117.4	19.0	1.31	0.70	3.19	9.03	19.3	34.5	22.5	8.63	1.83	0.22

TABLE XXIIIl. ^{63}Cu ions in Zr

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+
18	112.1	19.2	1.33	0.39	2.19	6.82	16.3	32.7	25.8	11.8	3.42	0.50

TABLE XXIIIm. ^{63}Cu ions in Mo

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	111.3	19.3	1.33	0.37	1.94	6.52	15.7	32.0	26.5	12.7	3.67	0.58	0.03

TABLE XXIIIn. ^{63}Cu ions in Ag

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	118.3	19.5	1.36	0.39	1.60	4.90	13.4	29.0	28.5	15.9	5.30	1.00	
12	148.3	20.3	1.31			1.68	5.98	21.3	29.4	25.6	11.9	3.48	0.72

TABLE XXIIIo. ^{63}Cu ions in Sn

Ref	E	QB	d	16+	17+	18+	19+	20+	21+	22+	23+
18	118.6	19.6	1.29	0.96	4.34	12.3	29.9	28.9	17.2	5.37	1.03

TABLE XXIIIp. ^{63}Cu ions in Sm

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	117.6	19.4	1.31	0.16	1.63	5.66	14.9	32.2	27.1	13.5	3.95	0.69	0.10

TABLE XXIIIq. ^{63}Cu ions in Yb

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+
18	118.0	19.1	1.32	0.50	2.49	7.70	17.5	33.4	24.9	10.6	2.63	0.36

TABLE XXIIIr. ^{63}Cu ions in Au

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+
18	118.7	19.3	1.35	0.75	2.72	7.20	18.0	32.0	25.4	11.7	2.56	0.30
12	148.7	20.0	1.29		0.52	2.25	8.24	24.5	30.8	22.1	9.34	2.24

TABLE XXIIIs. ^{63}Cu ions in Pb

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+
18	118.1	19.3	1.33	0.39	2.07	6.59	15.8	32.4	26.2	12.5	3.54	0.52	0.04

TABLE XXIIIt. ^{63}Cu ions in Bi

Ref	E	QB	d	15+	16+	17+	18+	19+	20+	21+	22+	23+
18	114.6	19.2	1.32	0.46	2.32	7.15	16.9	32.8	25.5	11.5	3.00	0.42

TABLE XXIV. ^{79}Br ions in C

Ref	E	QB	d	11+	12+	13+	14+	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+	25+	26+	27+	28+	29+
22	45.3	16.3	1.67	0.14	0.86	3.26	9.45	18.7	23.4	22.0	13.4	5.90	2.16	0.56	0.12							
22	55.2	17.2	1.75		0.23	1.08	4.21	11.2	17.9	24.2	19.3	12.5	6.15	2.38	0.74	0.16						
22	65.1	18.0	1.82			0.34	1.78	5.31	12.1	19.8	22.2	17.5	11.9	6.00	2.27	0.75	0.13					
22	75.1	18.9	1.88				0.65	2.48	6.74	14.3	20.0	20.3	16.5	10.4	5.63	2.19	0.59	0.12				
22	85.1	19.6	1.90				0.20	0.94	3.21	8.64	15.0	19.8	20.3	15.0	10.2	4.59	1.75	0.44				
22	95.1	20.5	1.94					0.33	1.44	4.26	9.59	15.8	20.1	18.4	14.7	9.24	4.42	1.51	0.14			
22	105.2	21.2	1.92						0.64	2.18	5.62	11.1	16.7	19.7	18.8	13.6	7.87	3.44	0.43	0.04		
22	115.2	22.0	1.87						0.15	0.76	2.56	5.99	12.2	16.7	19.8	18.9	13.9	7.61	1.27	0.16		
22	125.3	22.5	1.81							0.24	1.34	3.96	8.50	14.1	19.8	20.4	17.3	11.6	2.44	0.41	0.04	
22	132.8	23.1	1.71								0.51	2.12	5.34	10.4	16.6	22.5	20.9	16.5	4.33	0.85		
22	135.3	23.1	1.72								0.47	2.02	5.18	10.4	17.2	22.1	20.1	16.6	4.80	0.95	0.14	
22	145.3	23.7	1.64									0.89	2.86	6.96	12.8	18.3	24.0	24.0	7.78	2.03	0.30	0.03
22	155.0	24.1	1.56									0.35	1.60	4.52	9.58	16.5	23.7	28.6	11.6	3.18	0.60	
22	166.1	24.5	1.50										0.78	2.54	6.74	14.1	21.4	30.9	16.3	5.68	1.31	0.20

Graph is presented in Ref. 24 for nonequilibrium charge fractions and mean charges for 130 MeV Br ions in C.

TABLE XXVa. ^{84}Kr ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
25	1.00*	3.14	1.63	4.40	13.4	18.2	22.0	21.3	12.7	5.90	2.00			
25	2.00*	5.58	1.80		1.40	3.60	8.10	13.8	19.2	23.5	16.5	9.40	3.50	1.10

Ref	14+	15+	16+	17+	18+	19+	20+	21+	22+	23+	24+	25+	26+	27+
8,47	0.37	1.53	3.86	10.1	17.8	21.1	18.9	13.8	7.40	3.14	1.41	0.42	0.18	
34		0.01	0.19	0.98	3.27	7.53	13.4	17.9	19.6	17.4	11.3	6.04	21.8	2.47

Ref	E	QB	d
26	373*	28.9	1.34
26	444*	30.2	1.30
26	552*	31.1	1.24

*incident energy. Foil thicknesses are 6.5 $\mu g/cm^2$ for 1.00 and 2.00 MeV and 40 $\mu g/cm^2$ for 1.39 MeV/u.
Graph is presented in Ref. 26 for nonequilibrium charge fractions of 373, 444 and 552 MeV Kr ions in C.
Graph is presented in Ref. 38 for equilibrium charge fractions of 9.89 MeV ^{86}Kr ions in C.

TABLE XXVb. ^{84}Kr ions in Cu

Ref	E	QB
26	373*	26.9
26	444*	27.8
26	552*	28.2

*incident energy

TABLE XXVc. ^{84}Xe ions in Ag

Ref	E	QB
26	373*	26.3
26	444*	27.2
26	552*	28.2

*incident energy

TABLE XXVd. ^{84}Kr ions in Au

Ref	E	QB
26	373*	26.1
26	444*	27.0
26	552*	27.9

*incident energy

TABLE XXVI. ^{127}I ions in C

Graph is presented in Ref. 44 for equilibrium charge fractions of 20 MeV I ions in C.

TABLE XXVIIa. Xe ions in C

Ref	E	QB	d	23+	24+	25+	26+	27+	28+	29+	30+	31+	32+	33+	34+	35+	36+
34	1.39/u*	29.5	1.78	0.03	0.16	0.81	3.27	8.91	16.1	21.5	21.4	14.9	8.25	3.36	1.01	0.21	0.02
28	3.6/u*	37.0															

*incident energy. Foil thickness is 40 μg/cm^2 for 1.39 MeV/u.
Graph is presented in Ref. 38 for equilibrium charge fractions of 13.6 MeV ^{136}Xe ions in C.

TABLE XXVIIb. Xe ions in Al

Ref	E	QB	d	23+	24+	25+	26+	27+	28+	29+	30+	31+	32+	33+	34+	35+	36+
34	1.39/u*	29.4	1.85	0.10	0.32	1.17	3.94	9.89	17.1	21.4	19.8	14.1	7.56	3.30	1.03	0.24	0.05

*incident energy, foil thickness 31 μg/cm^2

TABLE XXVIIc. Xe ions in Ag

Ref	E	QB	d	21+	22+	23+	24+	25+	26+	27+	28+	29+	30+	31+	32+	33+	34+	35+	36+
34	1.39/u*	28.7	1.84	0.01	0.02	0.14	0.71	2.53	7.57	15.1	21.6	20.9	15.8	9.20	4.14	1.55	0.55	0.15	0.02

*incident energy, foil thickness 65 μg/cm^2

TABLE XXVIId. Xe ions in Au

Ref	E	QB	d	21+	22+	23+	24+	25+	26+	27+	28+	29+	30+	31+	32+	33+	34+	35+	36+
34	1.39/u*	28.2	1.85	0.03	0.09	0.39	1.60	4.33	11.4	18.7	22.4	18.6	12.9	5.84	2.47	0.72	0.40	0.10	0.05

*incident energy, foil thickness 65 μg/cm^2

TABLE XXVIII. ^{141}Pr ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+
27	.256	1.41	0.92	13.0	48.0	26.0	11.0	2.00		
27	.363	1.77	1.10	9.00	37.0	31.0	16.0	5.00	2.00	
27	.467	2.12	1.12	6.00	25.0	33.0	25.0	9.00	2.00	
27	.570	2.34	1.14	4.00	20.0	33.0	27.0	13.0	3.00	
27	.772	2.73	1.21	2.00	14.0	27.0	31.0	19.0	6.00	1.00
27	.973	3.07	1.21	1.00	9.00	22.0	31.0	26.0	9.00	2.00

TABLE XXIX. Gd ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+	6+
27	.245	1.56	0.93	10.0	44.0	32.0	12.0	3.00		
27	.355	1.75	0.92	6.00	36.0	39.0	15.0	4.00		
27	.461	1.91	0.94	4.00	31.0	40.0	21.0	3.00	1.00	
27	.564	2.10	1.12	5.00	24.0	38.0	22.0	6.00	4.00	
27	.768	2.38	1.09	3.00	17.0	37.0	29.0	10.0	4.00	
27	.970	2.72	1.29	3.00	12.0	31.0	31.0	13.0	7.00	3.00

Projectile mass number is not indicated in Ref. 27.

TABLE XXX. ^{165}Ho ions in C

Graph is presented in Ref. 38 for equilibrium charge fractions of 17.2 MeV Ho ions in C.

TABLE XXXI. ^{175}Lu ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
27	.238	1.50	0.70	4.00	50.0	38.0	8.00		
27	.350	1.75	0.77	2.00	37.0	47.0	12.0	2.00	
27	.457	2.01	0.89	2.00	27.0	45.0	20.0	6.00	
27	.561	2.17	0.84	1.00	21.0	46.0	28.0	5.00	
27	.766	2.46	0.92	1.00	12.0	40.0	36.0	9.00	2.00
27	.968	2.73	0.97		8.00	35.0	38.0	14.0	5.00

TABLE XXXII. Hg ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
27	.208	0.67	0.65	43.0	47.0	10.0			
27	.327	0.83	0.67	33.0	53.0	15.0			
27	.439	1.05	0.76	24.0	52.0	22.0	3.00		
27	.546	1.27	0.78	15.0	51.0	29.0	6.00		
27	.755	1.52	0.88	10.0	44.0	35.0	10.0	2.00	
27	.959	1.75	0.95	6.00	35.0	39.0	15.0	3.00	1.00

Projectile mass number is not indicated in Ref. 27.

TABLE XXXIII. ^{205}Tl ions in C

Ref	E	QB	d	0+	1+	2+	3+	4+	5+
27	.208	0.71	0.65	39.0	52.0	8.00	1.00		
27	.327	0.97	0.78	28.0	51.0	17.0	4.00		
27	.439	1.16	0.84	21.0	51.0	23.0	5.00	1.00	
27	.546	1.28	0.86	17.0	47.0	28.0	7.00	1.00	
27	.755	1.71	0.99	8.00	39.0	35.0	15.0	3.00	1.00
27	.959	1.95	1.04	6.00	30.0	35.0	22.0	6.00	1.00

TABLE XXXIVa. Pb ions in C

Ref.	E	QB	d	0+	1+	2+	3+	4+	5+
27	.208	0.67	0.65	43.0	47.0	10.0			
27	.327	0.89	0.72	32.0	47.0	21.0			
27	.439	1.17	0.84	22.0	45.0	27.0	6.00		
27	.546	1.40	0.93	16.0	41.0	32.0	9.00	2.00	
27	.755	1.78	1.05	10.0	32.0	38.0	15.0	5.00	1.00
27	.959	2.07	1.11	7.00	24.0	39.0	21.0	8.00	2.00

Ref.	E	QB	d	24+	25+	26+	27+	28+	29+	30+	31+	32+	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+
34	.581/u*	31.1	2.13	0.11	0.31	1.20	2.89	6.15	11.8	15.7	19.5	16.6	13.1	7.50	3.45	1.34	0.39	0.09				
34	1.00/u*	35.0	2.18					0.09	0.52	1.15	3.05	7.30	12.1	17.1	17.9	16.6	11.9	6.51	3.54	1.61	0.58	0.04

Ref.	E	QB	d	30+	31+	32+	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+	43+	44+	45+	46+	47+
34	1.39/u*	37.8	2.31	0.03	0.14	0.59	1.86	4.45	8.18	13.4	17.3	16.6	14.4	11.0	6.33	3.29	1.44	0.64	0.27	0.09	.004

*incident energy. Foil thicknesses are 30 μg/cm^2 for 0.581 MeV/u and 40 μg/cm^2 for 1.00 MeV/u and 1.39 MeV/u.
Projectile mass number is not indicated in Ref. 27.
Graph is presented in Ref. 38 for equilibrium charge fractions of 23.3 MeV ^{208}Pb ions in C.

TABLE XXXIVb. Pb ions in Al

Ref	E	QB	d	31+	32+	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+	43+	44+	45+	46+	47+	48+	49+
34	1.39/u*	39.3	2.65	0.10	0.24	0.70	1.83	3.88	7.38	11.4	14.1	14.7	14.1	12.1	8.28	5.29	2.99	1.58	0.80	0.38	0.15	0.05

*incident energy, foil thickness 31 μg/cm^2

TABLE XXXIVc. Pb ions in Ag

Ref	E	QB	d	30+	31+	32+	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+	43+	44+	45+	46+	47+	48+	49+
34	1.39/u*	38.2	3.05	0.10	0.38	1.22	2.86	5.63	9.14	11.7	13.9	13.2	11.9	8.42	7.67	4.78	3.57	2.32	1.56	0.85	0.52	0.16	0.04

*incident energy, foil thickness 65 μg/cm^2

TABLE XXXVa. U ions in Mylar

Ref	E	QB	d	88+	89+	90+	91+	92+
30	200/u *	89.9	0.69	3.00	20.0	61.0	16.0	
31	437/u *	91.0	0.77		2.29	23.5	47.8	26.4
31	962/u *	91.6	0.56			3.74	30.6	65.7

*incident energy

TABLE XXXVb. U ions in C

Ref	E	QB	d	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+	43+	44+	45+	46+	47+	48+	49+
34	1.39/u*	40.9	2.27	0.05	0.18	0.55	1.61	3.84	8.08	13.1	16.7	17.5	15.3	11.1	6.40	3.09	1.60	0.57	0.18	0.06
				55+	56+	57+	58+	59+	60+	61+	62+	63+	64+	65+	66+	67+	68+	69+	70+	
29	5.9/u*	63.1	2.23	0.15	0.30	0.64	1.52	3.41	5.67	9.16	15.1	19.4	17.9	14.0	7.21	3.67	1.32	0.46	0.15	
				71+	72+	73+	74+	75+	76+	77+	78+	79+	80+	81+	82+	83+				
51	16.3/u*	77.9	1.64	0.02	0.15	1.00	1.90	5.00	11.0	20.0	25.0	21.5	11.0	3.00	0.40	0.05				

*incident energy. Foil thicknesses are 40 μg/cm^2 for 1.39 MeV/u, 170 μg/cm^2 for 5.9 MeV/u, and 500 μg/cm^2 for 16.3 MeV/u.

TABLE XXXVc. U ions in Al

Ref	E	QB	d	32+	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+	43+	44+	45+	46+	47+	48+	49+	50+	51+
34	1.39/u*	41.7	2.55	0.01	0.05	0.17	0.40	1.06	2.49	5.29	8.96	12.9	15.4	16.2	13.3	9.75	6.50	3.98	2.01	0.85	0.35	0.14	0.06
				89+	90+	91+	92+																
30	200/u*	90.2	0.71	14.0	59.0	23.0	4.00																

*incident energy. Foil thickness is 31 μg/cm^2 for 1.39 MeV/u.

TABLE XXXVd. U ions in Cu

Ref	E	QB	d	88+	89+	90+	91+	92+
30	200/u*	89.9	0.87	6.00	24.0	50.0	17.0	3.00
31	437/u*	91.3	0.70		0.19	12.7	40.7	46.3
31	962/u*	91.9	0.38		0.04	0.77	12.8	86.4

*incident energy
Graph is presented in Ref. 31 for nonequilibrium charge fractions of 962 MeV/u U ions in Cu.

TABLE XXXVe. U ions in Ag

Ref	E	QB	d	32+	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+	43+	44+	45+	46+	47+	48+	49+	50+	51+
34	1.39/u*	41.4	2.85	0.02	0.08	0.27	0.76	1.87	4.20	7.38	11.4	13.4	15.3	12.9	11.0	7.98	4.94	3.56	2.32	1.29	0.75	0.38	0.19
29	10/u*	63.0	0.87																				
				88+	89+	90+	91+	92+															
30	200/u*	90.5	0.87	2.00	10.0	35.0	44.0	9.00															

*incident energy. Foil thickness is 65 μg/cm^2 for 1.39 MeV/u.

TABLE XXXVf. U ions in Ta

Ref	E	QB	d	90+	91+	92+
31	437/u*	91.0	0.72	23.7	48.1	28.2
31	962/u*	91.9	0.34	0.37	11.3	88.3

*incident energy

TABLE XXXVg. U ions in Au

Ref	E	QB	d	31+	32+	33+	34+	35+	36+	37+	38+	39+	40+	41+	42+	43+	44+	45+	46+	47+	48+	49+	50+
34	1.39/u*	40.2	2.95	0.05	0.15	0.48	1.13	2.48	4.57	7.99	11.3	14.4	14.5	13.3	10.1	7.11	4.39	2.87	2.13	1.53	0.84	0.36	0.20
				51+																			
				0.02																			

*incident energy, foil thickness 82 μg/cm^2

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