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ELECTRON-IMPACT-EXCITATION COLLISION STRENGTHS FOR BE-LIKE IONS

II. Intermediate-Energy Region and Collision Rates

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Intermediate-energy collision strengths calculated using the R-matrix method are presented for four Be-sequence ions, C III (2.6–8.0 Ry), O V (4.4–12.0 Ry), Ne VII (8.4–20.0 Ry), and Si XI (11.0–34.0 Ry). The six ionic states $(2s^2)\ ^1S$, $(2s2p)\ ^3P^0$, $^1P^0$ and $(2p^2)\ ^3P^e$, $^1D^e$, $^1S^e$, corresponding to ten fine-structure levels, are included, leading to 29 independent transitions per ion. High-energy analytical expressions have also been calculated for the collision strengths. These results have been combined with previously published low-energy collision strengths to deduce effective collision strengths (that is, collision rates) for ranges of electron temperature appropriate to the four ions.

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CONTENTS

INTRODUCTION

In a previous paper (Berrington et al.[1]; hereafter Paper I), electron-impact collision strengths were presented for four beryllium sequence ions, C III, O V, Ne VII, and Si XI. For each ion, the six lowest LS target states were included, resulting in ten levels due to the fine-structure splitting of the two triplet states. Although 45 inelastic transitions are possible, for some groups the collision strengths are proportional to the level degeneracies. Therefore the tabulations were limited to the 29 independent transitions.

These results should be of high accuracy but unfortunately they were limited to low electron-impact energies (C III, $E < 2.4$ Ry; O V, $E < 4.25$ Ry; Ne VII, $E < 8$ Ry; Si XI, $E < 10$ Ry). This was due to (a) the limited number of terms in the continuum expansion, and (b) the presence at higher energy of pseudoresonances in the collision strengths resulting from the inclusion of correlation orbitals in the target wave functions (see Berrington et al.[2] for further details). Recently, we have undertaken further calculations for these Be-like ions to provide reliable collision strengths at higher energies. These are again based on the R-matrix method (Burke and Robb[3]) and the same target wave functions, but they have more terms in the continuum expansion. Additionally, the problem of the pseudoresonances has been eliminated by using the T-matrix averaging technique developed by Burke et al.[4] From these collision strengths we have been able to derive high-energy analytical fits. Combining these with our numerical data at lower energies, we have calculated collision rates and hence effective collision strengths for a wide range of electron temperatures.

Goett et al.[5] have published analogous results for Be-like ions (with $12 \leqslant Z \leqslant 74$) calculated using a Coulomb–Born–exchange method. Such a method is unable to predict the resonance structure in the collision strengths (which will be important for low-Z ions) but these authors allowed for intermediate coupling effects (which will become more important for high-Z ions). Hence these two calculations should prove complementary.

Target Wave Functions and Continuum Expansion

For each ion, we have included the six ionic states with the two outer electrons in the $n = 2$ shells, namely the $(2s^2)\ ^1S^e$, $(2s2p)\ ^3P^0$, $^1P^0$, and $(2p^2)\ ^3P^e$, $^1D^e$, $^1S^e$. The adopted wave functions are the same as those discussed in Paper I, where further details can be found.

The wave functions for the ion plus electron system were expanded as discussed by, for example, Burke and Robb.[3] The number of continuum terms (n) and the radius (r_a) at which a zero logarithmic derivative is imposed on the expansion are summarized in Table A. These differ from those adopted in the previous calculations in order to accommodate the higher electron-impact energies. Otherwise the calculations were similar to those described in Paper I.

Elimination of Pseudoresonances

For all four ions, it was possible to extend the calculations to electron-impact energies both above and below the region where the pseudoresonances are present and they could now be eliminated using the procedure of Burke et al.[4] Briefly, T matrices were calculated over energy ranges covering the pseudoresonance regions at a relatively fine mesh. Both the real and imaginary parts of the T matrices were then energy averaged for each partial wave and then combined to yield collision strengths. Further details can be found in Burke et al.[4]

In Table A we summarize the energy ranges and mesh sizes used in the smoothing. The energies given are relative to the $2s^2\ ^1S^e$ level, and the mesh refers to the energy interval at which T matrices were derived prior to the energy averaging.

Higher Partial Waves and Fine-Structure Transitions

The R-matrix calculations were carried out for total angular momenta from 0 to 6, for both odd and even parities and doublet and quartet spin states. As in Paper I these were supplemented with K matrices calculated in the Coulomb–Born approximation for angular momenta between 7 and 20. These results were transformed to a jJ-coupling scheme to provide collision strengths for transitions between the fine-structure levels. The program of Saraph,[6] adapted to accept the energy-averaged T matrices and Coulomb–Born K matrices, was used with term coupling and relativistic effects again being neglected (see Paper I).

In jJ coupling the partial wave expansion was therefore from $J = 0.5$ to 18.5. This was sufficient to ensure convergence in the collision strengths for optically forbidden transitions. However, for some allowed transitions, particularly at the highest energies, it was necessary to allow for higher partial waves. This was achieved by taking the individual partial collision strengths for J values from 14.5 to 18.5. These were found to form geometric series which could then be used to calculate the contribution from $J = 19.5$ to infinity. The geometric series approximation to the partial collision strength should be valid provided $J > E/(E - E')$, where E and E' are the initial and final energies of the scattering electron, respectively (Burgess and Sheorey[7]). Although this condition may not hold for some transitions at the highest electron energies examined, it should be emphasized that in all cases these high partial wave contributions were small. For example, the largest contributions were for the $(2s2p)\ ^1P^0$–$(2p^2)\ ^1D^e$ transition at the highest electron-impact energies, where they corresponded to 20%–30% of the total collision strength, while for other transitions such as the $(2s^2)\ ^1S^e$–$(2s2p)\ ^1P^0$ the maximum contributions were approximately 10%. Hence these estimates of the contributions of high partial waves should not be a significant source of error.

For transitions between a singlet lower level and triplet upper levels (or vice versa), the collision strengths are in the ratios of the triplet level degeneracies. Therefore, as in Paper I, results for these transitions are given in the form of multiplet collision strengths. Collision strengths for individual transitions can then be found

TABLE A
Parameters for the Collision Calculations

	C III	O V	Ne VII	Si XI
r_a	8.0	6.0	5.0	4.0
n	20	20	20	20
Energy range for R-matrix calculations (Ry)	2.6–12.0	4.4–23.8	8.4–37.8	11.0–54.0
Energy mesh (Ry)	0.1	0.2	0.2	0.5
Energy range for high-energy fits (Ry)	8.0–12.0	12.0–23.8	20.0–37.8	34.0–54.0

by scaling the multiplet values by the ratio of the triplet state degeneracy to the multiplet degeneracy (9 for the states considered here). However, it should be noted that for five transitions, inappropriate scaling factors were used in Paper I. Hence to obtain multiplet collision strengths, the results in Paper I should be multiplied by the following factors:

1. $(2s2p)\ ^3P^0 \rightarrow (2s2p)\ ^1P^0$ factor of 1.8,
2. $(2s2p)\ ^3P^0 \rightarrow (2p^2)\ ^1D^e$ and $(2p^2)\ ^1S^e$ factor of 9,
3. $(2p^2)\ ^3P^e \rightarrow (2p^2)\ ^1D^e$ and $(2p^2)\ ^1S^e$ factor of 9.

The appropriate scaling factors can be checked by comparing the results in Paper I (containing the errors) with the present results (correct) at the match-up points.

High-Energy Fits

The upper limits for the electron-impact energies used in the R-matrix calculations (see Table A) followed from the number of terms in the continuum expansion. We have therefore fitted analytical expressions to the collision strengths in order to extrapolate to higher energies. Two types of expression were used, viz.,

Type 1: Optically forbidden transitions

$$\Omega = \sum_{n=0}^{4} a_n E^{-n} \tag{1}$$

Type 2: Optically allowed transitions

$$\Omega = a_0 \log E + \sum_{n=1}^{4} a_n E^{-(n-1)}, \tag{2}$$

where Ω is the collision strength and E is the total energy (in rydbergs) of the five-electron system relative to the ground-state energy of the target ion. The ranges of energies used to derive the coefficients a_0 to a_4 are summarized in Table A. In general, the accuracy of the analytical fits was 2% or better over this energy range.

Results and Accuracy

Intermediate-Energy Collision Strengths

For the four Be-like ions, we have tabulated collision strengths for the 29 independent transitions (Tables II–V). The electron-impact energies range from just above the highest considered in Paper I to those where the high-energy fits become applicable (see Table A). The energy spacing is such as to allow accurate interpolation for other energies.

These collision strengths have been compared with those published in Paper I (because the present results do not overlap the energy range considered in Paper I, it is necessary to extrapolate them. However, this extrapolation was over a small energy interval and should be reliable). For the 116 transitions (four ions each with 29 transitions) the difference between the two sets of calculations was less than 5% for 100, between 5 and 10% for 12, and between 10 and 20% for 4 transitions. Ten of the transitions, with discrepancies greater than 5%, including all four with discrepancies greater than 10%, were for C III, possibly indicating the presence of pseudoresonances even at the lowest energy considered (2.6 Ry). Additionally, for three of the C III transitions with large discrepancies ($(2s^2)\ ^1S^e$–$(2p^2)\ ^1D^e$, $(2s^2)\ ^1S^e$–$(2p^2)\ ^1S^e$, $(2s2p)\ ^3P^0$–$(2p^2)\ ^1D^e$) the energy dependence of the collision strength was also peculiar. Therefore for these transitions we resmoothed the individual partial waves by hand and then recalculated the total collision strengths. These results are unlikely to be as accurate as for the other transitions and are quoted to fewer significant figures. However, the agreement at the match-up point is improved (to better than 5%) and for all three transitions strong pseudoresonances were present near the ends of the energy range which could have affected the T-matrix smoothing. The other six discordant transitions were in O V and Ne VII. Only for the $(2s2p)\ ^1P^0$–$(2p^2)\ ^1D^e$ collision strengths in C III and Ne VII were there differences greater than 5% for the same transition in two ions (although the signs of the discrepancies are different). Generally, apart from the three C III transitions discussed above, these discrepancies can be ascribed to differences in the two R-matrix calculations together with small errors in the smoothing procedure and the extrapolation to a common energy. However, we note that for over 80% of the transitions, the agreement is considerably better than 5%.

High-Energy Fits

The high-energy fits have been tabulated for all four ions (Tables VI–IX). For the three anomalous C III transitions discussed above the resmoothed collision strengths were used. In general the type and order of the fit for any transition were the same for all four ions. These expressions essentially reproduced exactly the collision strength data over the ranges for which they were fitted (see Table A). When extrapolating to higher energies, the results for the optically allowed transitions should be reliable as they have the correct asymptotic form, that is $\Omega \propto \log E$ (see for example Dufton and Kingston[8]). For the other transitions, they may be less reliable, particularly at very high energies, and we return to this point in the next section.

Collision Rates

Using the collision strength from Paper I for low energies together with the intermediate-energy data and

high-energy fits tabulated here, we have derived collision rates assuming a Maxwellian distribution of electron-impact energies. For each ion, nine electron temperatures (T_e) were considered, centered on that for the maximum fractional population of the ion under conditions of ionization equilibrium (Jordan[9]). The interval between successive temperatures corresponded to $\Delta \log T_e = 0.2$, giving a temperature range of nearly two orders of magnitude. This should be sufficient for the analyses of both astronomical (see for example Dufton and Kingston[8]) and laboratory (see for example Kingston et al.[10]) plasmas. As the collision rates (C) are relatively rapidly varying functions of temperature, we have instead tabulated (Tables X–XIII) the effective collision strength ($\bar{\Omega}$) given by

$$C = \frac{8.631 \times 10^{-6}}{g_1 T_e^{1/2}} N_e \bar{\Omega} \exp(-\Delta E/kT_e), \qquad (3)$$

where N_e is the electron density (in cm^{-3}), g_1 is the degeneracy of the lower level of the transition, ΔE is the energy difference of the two levels, k is Boltzmann's constant, and T_e is the electron temperature in K.

We have also given the temperature (T_H) at which the high-energy analytical expressions contribute 10% of the total collision rate. As these expressions should be reliable over the energy range to which they were fitted, they could be a significant source of error only for temperatures considerably greater than T_H. For the optically forbidden transitions, T_H is generally large because the collision strengths decrease with energy, and hence the high-energy regions are not an important contributor to the collision rate. For the allowed transitions T_H is lower but as discussed previously, the analytical expressions should in these cases be reliable. Hence for the temperature range considered here the use of high-energy extrapolations should not be a significant source of error.

The overall accuracy of these rates is quite difficult to assess. At the highest temperatures the most serious error is due to the omission of higher channels in the expansion. A calculation by Berrington et al.[11] for O V that includes some of these channels indicates that for the forbidden $(2s^2)\ ^1S^e$–$(2s2p)\ ^3P^0$ transition, which is one of the most strongly affected, this may give an error of up to 20% at the highest temperature. On the other hand, those rates and others calculated by similar methods have been used to analyze solar observations (see Dufton and Kingston[3]) and in general excellent agreement has been found between the observations and the theoretical predictions. Similar good agreement between laboratory measurements and theory has been found for Ne VII by Lang.[12] Thus in general we believe that it is not unreasonable to state that the data have a typical accuracy of 10%.

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EXPLANATION OF TABLES

TABLE I. Theoretical Energy Levels (Ry)

Energies in rydbergs of levels relative to the $2s^2\ ^1S^e$ level

TABLES II–V. Collision Strengths (Dimensionless) for C III, O V, Ne VII, and Si XI

For three anomalous C III transitions (in Table II), the results are quoted to only three significant figures.

ENERGY	The energy in rydbergs of the incident electron plus target ion relative to the $(2s^2)^1S^e$ ground state of the ion. The ion energy levels are given in Table I.
TRANSITIONS	The electron-excitation transitions for which the collision strengths have been calculated
FROM:	The lower level of the transition
TO:	The upper level of the transition
3PO J = 0	$(2s2p)\ ^3P$ level with odd parity and J quantum number of zero
3PE	$(2p^2)\ ^3P$ level with even parity. The collision strength in this case includes transitions to and from all the levels with different J values. Transitions between individual levels are proportional to the level degeneracies.

TABLES VI–IX. Fit Parameters for High-Energy Analytical Expressions for C III, O V, Ne VII, and Si XI Collision Strengths

For ranges of applicability of these fits see text and Table A.

TRANSITION	The electron-excitation transition for which the analytical expression has been calculated
TYPE	The type of analytical expression Type 1: Eq. (1) in text Type 2: Eq. (2) in text
a_0, a_1, a_2, a_3, a_4	Coefficients of the analytical expression

TABLES X–XIII. Effective Collision Strengths (Dimensionless) for C III, O V, Ne VII, Si XI

See Eq. (3).

TRANSITION	The electron-excitation transition for which the effective collision strength is calculated
2S2P 3P0 J = 0	$(2s2p)\ ^3P$ level with odd parity and J quantum number of zero
2P2P 3PE	$(2p^2)\ ^3P$ level with even parity. The effective collision strength in this case includes transitions to and from all levels with different J values. Transitions between individual levels are proportional to the level degeneracies.
LOG (ELECTRON TEMPERATURE)	The logarithm to base 10 of the electron temperature (in K)
LOG T_H	The logarithm to base 10 of the electron temperature (in K) at which the high-energy analytical expressions contribute 10% of the effective collision strength

EXAMPLES OF USE OF TABLES

The use of each of the three types of table is considered below.

1. Tables II to V list the collision strengths for the different ions. We consider Table III (for the ion O V) and find that, for an energy of 8 Ry, the collision strengths for $2s^2\ ^1S^e \rightarrow 2s2p\ ^3P^0$ and $2s2p\ ^1P^0 \rightarrow 2p^2\ ^1D^e$ transitions are 0.1232 and 11.98, respectively. The energy is for the ion plus colliding electron and is relative to the ground-state energy of the ion. Hence the kinetic energy (E_v) of the colliding electron will be this energy minus the excitation energy (listed in Table I) of the lower level of the transition. For the $2s^2\ ^1S^e \rightarrow\ ^3P^0$ transition $E_v = 8.0 - 0.0 = 8.0$ Ry while for the $2s2p\ ^1P^0 \rightarrow 2p^2\ ^1D^e$ transitions $E_v = 8.0 - 1.4567 = 6.5433$ Ry. Note also that the $2s^2\ ^1S^e \rightarrow 2s2p\ ^3P^0$ collision strength is the multiplet value. Collision strengths for the individual transitions are found by scaling this value by the ratio of the relevant triplet level degeneracy divided by the sum of the triplet level degeneracies. Hence for the energy of 8.0 Ry the collision strengths for the $1s^2\ ^1S \rightarrow 2s2p\ ^3P^0_J$ transitions are $1/9 \times 0.1232 = 0.0137$ for $J = 0$, $1/3 \times 0.1232 = 0.0411$ for $J = 1$, and $5/9 \times 0.1232 = 0.0684$ for $J = 2$.

2. Tables VI to IX give the high-energy fits for the different ions. We consider Table VII (for the ion O V) and note that the energy E again refers to the energy of the ion plus colliding electron relative to the ground-state energy of the ion. For an electron kinetic energy, E_v, of 20 Ry, we can calculate the collision strength for the two transitions given above as follows:

(a) $2s^2\ ^1S^e \rightarrow 2s2p\ ^1P^0$.

For this transition, because the lower level is the ground state, the energy of the system is the same as the electron kinetic energy, that is 20 Ry. As the fit type is 1, we use Eq. (1) to find

$$\Omega = 33.36/(20 \times 20) - 236.7/(20 \times 20 \times 20) = 0.0538.$$

Note that as discussed above, this is the multiplet collision strength.

(b) $2s2p\ ^1P^0 \rightarrow 2p^2\ ^1D^e$.

In this case, the energy, E, will be the sum of the kinetic energy of the colliding electron plus the excitation energy of the $2s2p\ ^1P^0$ state (1.4567 Ry in Table I), that is 21.4567. The fit type is now 2, corresponding to Eq. (2), and we now find

$$\Omega = 6.690 \log 21.4567 + 5.800 = 14.71.$$

3. Tables X to XIII list the effective collision strength for the different ions. We consider Table XI (for the ion O V) and find for the $2s2p\ ^1P^0 \rightarrow 2p^2\ ^1D^e$ transition at an electron temperature, T_e of $\log T_e = 5.5$ (that is $T_e = 3.16 \times 10^5$ K) an effective collision strength $\bar{\Omega} = 9.33$. Hence for an electron density of 10^{14} cm^{-3}, the collision rate will be given by Eq. (3), viz.,

$$C = \frac{8.629 \times 10^{-6}}{3 \times (3.16 \times 10^5)^{1/2}} \times 10^{14} \times 9.33 \times \exp(-0.6584/(3.16 \times 10^5 \times 6.33 \times 10^{-6}))$$

$$= 3.44 \times 10^6\ \text{s}^{-1},$$

where the factors 0.6584 and 6.33×10^{-6} inside the exponential are the energy difference of the two levels (see Table I) in Ry and Boltzmann's constant in Ry K^{-1}.

TABLE I. Theoretical Energy Levels
See page 200 for Explanation of Tables

Level	C III	O V	Ne VII	Si XI
$2s^2\ {}^1S^e$	0.0	0.0	0.0	0.0
$2s2p\ {}^3P^o$	0.4778	0.7470	1.0125	1.5355
$2s2p\ {}^1P^o$	0.9409	1.4567	1.9624	2.9597
$2p^2\ {}^3P^e$	1.2598	1.9504	2.6320	3.9788
$2p^2\ {}^1D^e$	1.3343	2.1151	2.8843	4.4037
$2p^2\ {}^1S^e$	1.6867	2.6491	3.5946	5.4643

TABLE II. Collision Strengths for C III

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 3PO AND 1PO LEVELS

	FROM	1SE	3PO J=0	3PO J=0	3PO J=1	1SE	3PO
	TO	3PO	3PO J=1	3PO J=2	3PO J=2	1PO	1PO
ENERGY							
2.60		3.881E-01	3.668E-01	3.546E-01	1.258E+00	6.196E+00	8.190E-01
2.80		3.744E-01	3.559E-01	3.483E-01	1.226E+00	6.371E+00	7.740E-01
3.00		3.614E-01	3.454E-01	3.434E-01	1.199E+00	6.551E+00	7.318E-01
3.25		3.460E-01	3.328E-01	3.381E-01	1.168E+00	6.779E+00	6.830E-01
3.50		3.316E-01	3.209E-01	3.336E-01	1.140E+00	7.006E+00	6.383E-01
3.75		3.180E-01	3.097E-01	3.298E-01	1.114E+00	7.232E+00	5.975E-01
4.00		3.051E-01	2.990E-01	3.268E-01	1.092E+00	7.451E+00	5.603E-01
4.30		2.907E-01	2.869E-01	3.239E-01	1.068E+00	7.705E+00	5.201E-01
4.60		2.773E-01	2.756E-01	3.218E-01	1.047E+00	7.952E+00	4.842E-01
5.00		2.607E-01	2.614E-01	3.200E-01	1.023E+00	8.261E+00	4.424E-01
5.50		2.419E-01	2.452E-01	3.193E-01	9.996E-01	8.624E+00	3.984E-01
6.00		2.248E-01	2.302E-01	3.198E-01	9.806E-01	8.962E+00	3.617E-01
7.00		1.947E-01	2.027E-01	3.234E-01	9.527E-01	9.568E+00	3.034E-01
8.00		1.685E-01	1.768E-01	3.287E-01	9.318E-01	1.010E+01	2.560E-01

TRANSITIONS UP TO THE 3PE LEVELS

	FROM	1SE	3PO J=0	3PO J=1	3PO J=2	3PO J=0	3PO J=1	3PO J=2
	TO	3PE	3PE J=0	3PE J=0	3PE J=0	3PE J=1	3PE J=1	3PE J=1
ENERGY								
2.60		1.078E-02	3.735E-02	2.954E+00	6.102E-02	2.956E+00	2.382E+00	3.959E+00
2.80		1.038E-02	3.563E-02	3.046E+00	5.714E-02	3.050E+00	2.443E+00	3.964E+00
3.00		9.997E-03	3.414E-02	3.124E+00	5.520E-02	3.131E+00	2.497E+00	4.057E+00
3.25		9.546E-03	3.240E-02	3.226E+00	5.293E-02	3.236E+00	2.569E+00	4.181E+00
3.50		9.125E-03	3.079E-02	3.332E+00	5.081E-02	3.344E+00	2.643E+00	4.309E+00
3.75		8.730E-03	2.929E-02	3.437E+00	4.879E-02	3.453E+00	2.718E+00	4.439E+00
4.00		8.359E-03	2.790E-02	3.541E+00	4.687E-02	3.559E+00	2.792E+00	4.567E+00
4.30		7.939E-03	2.636E-02	3.663E+00	4.469E-02	3.684E+00	2.880E+00	4.719E+00
4.60		7.545E-03	2.495E-02	3.780E+00	4.263E-02	3.806E+00	2.965E+00	4.867E+00
5.00		7.052E-03	2.323E-02	3.929E+00	4.009E-02	3.961E+00	3.075E+00	5.056E+00
5.50		6.475E-03	2.132E-02	4.105E+00	3.723E-02	4.146E+00	3.206E+00	5.283E+00
6.00		5.929E-03	1.961E-02	4.265E+00	3.465E-02	4.318E+00	3.328E+00	5.494E+00
7.00		4.889E-03	1.667E-02	4.550E+00	3.019E-02	4.635E+00	3.554E+00	5.881E+00
8.00		3.885E-03	1.414E-02	4.787E+00	2.633E-02	4.917E+00	3.755E+00	6.224E+00

TRANSITIONS UP TO THE 3PE LEVELS

	FROM	3PO J=0	3PO J=1	3PO J=2	1PO	3PE J=0	3PE J=0	3PE J=1
	TO	3PE J=2	3PE J=2	3PE J=2	3PE	3PE J=1	3PE J=2	3PE J=2
ENERGY								
2.60		6.102E-02	3.851E+00	1.139E+01	5.259E-01	4.838E-01	3.546E-01	1.414E+00
2.80		5.714E-02	3.960E+00	1.173E+01	4.989E-01	4.630E-01	3.477E-01	1.368E+00
3.00		5.520E-02	4.057E+00	1.202E+01	4.734E-01	4.433E-01	3.411E-01	1.324E+00
3.25		5.293E-02	4.183E+00	1.240E+01	4.437E-01	4.200E-01	3.337E-01	1.273E+00
3.50		5.081E-02	4.313E+00	1.279E+01	4.162E-01	3.982E-01	3.274E-01	1.228E+00
3.75		4.879E-02	4.443E+00	1.319E+01	3.908E-01	3.778E-01	3.219E-01	1.186E+00
4.00		4.687E-02	4.571E+00	1.358E+01	3.673E-01	3.588E-01	3.173E-01	1.149E+00
4.30		4.469E-02	4.721E+00	1.404E+01	3.417E-01	3.376E-01	3.127E-01	1.109E+00
4.60		4.263E-02	4.867E+00	1.448E+01	3.184E-01	3.181E-01	3.091E-01	1.074E+00
5.00		4.009E-02	5.053E+00	1.505E+01	2.909E-01	2.945E-01	3.056E-01	1.034E+00
5.50		3.723E-02	5.275E+00	1.573E+01	2.614E-01	2.684E-01	3.030E-01	9.926E-01
6.00		3.465E-02	5.482E+00	1.637E+01	2.365E-01	2.456E-01	3.019E-01	9.594E-01
7.00		3.019E-02	5.865E+00	1.754E+01	1.971E-01	2.075E-01	3.027E-01	9.110E-01
8.00		2.633E-02	6.207E+00	1.858E+01	1.671E-01	1.765E-01	3.053E-01	8.773E-01

TABLE II. Collision Strengths for C III

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 1DE LEVEL

ENERGY	FROM / TO	1SE / 1DE	3PO / 1DE	1PO / 1DE	3PE / 1DE
2.60		3.34E-01	8.81E-01	1.563E+01	2.363E+00
2.80		3.31E-01	8.06E-01	1.669E+01	2.248E+00
3.00		3.30E-01	7.40E-01	1.747E+01	2.139E+00
3.25		3.28E-01	6.90E-01	1.833E+01	2.014E+00
3.50		3.26E-01	6.44E-01	1.906E+01	1.899E+00
3.75		3.24E-01	5.96E-01	1.970E+01	1.794E+00
4.00		3.23E-01	5.59E-01	2.026E+01	1.698E+00
4.30		3.21E-01	5.29E-01	2.083E+01	1.593E+00
4.60		3.19E-01	5.00E-01	2.135E+01	1.499E+00
5.00		3.17E-01	4.68E-01	2.193E+01	1.386E+00
5.50		3.16E-01	4.15E-01	2.256E+01	1.264E+00
6.00		3.15E-01	3.78E-01	2.311E+01	1.158E+00
7.00		3.13E-01	3.31E-01	2.401E+01	9.735E-01
8.00		3.12E-01	2.84E-01	2.477E+01	8.067E-01

TRANSITIONS UP TO THE 1SE LEVEL

ENERGY	FROM / TO	1SE / 1SE	3PO / 1SE	1PO / 1SE	3PE / 1SE	1DE / 1SE
2.60		4.81E-02	9.293E-02	4.784E+00	2.604E-01	7.066E-01
2.80		5.08E-02	8.795E-02	4.867E+00	2.422E-01	7.071E-01
3.00		5.32E-02	8.326E-02	4.979E+00	2.252E-01	7.086E-01
3.25		5.43E-02	7.780E-02	5.147E+00	2.054E-01	7.118E-01
3.50		5.55E-02	7.277E-02	5.336E+00	1.872E-01	7.163E-01
3.75		5.66E-02	6.816E-02	5.537E+00	1.705E-01	7.223E-01
4.00		5.77E-02	6.395E-02	5.744E+00	1.553E-01	7.295E-01
4.30		5.84E-02	5.939E-02	5.993E+00	1.387E-01	7.396E-01
4.60		5.86E-02	5.532E-02	6.237E+00	1.239E-01	7.511E-01
5.00		5.86E-02	5.060E-02	6.556E+00	1.067E-01	7.682E-01
5.50		5.72E-02	4.567E-02	6.937E+00	8.869E-02	7.915E-01
6.00		5.55E-02	4.162E-02	7.294E+00	7.400E-02	8.162E-01
7.00		5.36E-02	3.536E-02	7.952E+00	5.247E-02	8.660E-01
8.00		5.27E-02	3.041E-02	8.538E+00	3.833E-02	9.124E-01

TABLE III. Collision Strengths for O V

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 3PO AND 1PO LEVELS

FROM	1SE	3PO J=0	3PO J=0	3PO J=1	1SE	3PO
TO	3PO	3PO J=1	3PO J=2	3PO J=2	1PO	1PO
ENERGY						
4.40	1.599E-01	1.651E-01	1.434E-01	5.479E-01	3.509E+00	3.659E-01
4.80	1.552E-01	1.598E-01	1.420E-01	5.362E-01	3.578E+00	3.516E-01
5.20	1.506E-01	1.545E-01	1.405E-01	5.252E-01	3.691E+00	3.391E-01
5.60	1.461E-01	1.494E-01	1.393E-01	5.151E-01	3.800E+00	3.271E-01
6.20	1.398E-01	1.420E-01	1.378E-01	5.013E-01	3.951E+00	3.100E-01
6.80	1.339E-01	1.350E-01	1.366E-01	4.890E-01	4.090E+00	2.939E-01
7.40	1.284E-01	1.283E-01	1.357E-01	4.782E-01	4.218E+00	2.787E-01
8.00	1.232E-01	1.221E-01	1.351E-01	4.686E-01	4.335E+00	2.644E-01
9.00	1.151E-01	1.124E-01	1.347E-01	4.551E-01	4.508E+00	2.423E-01
10.00	1.077E-01	1.036E-01	1.346E-01	4.442E-01	4.660E+00	2.222E-01
11.00	1.009E-01	9.564E-02	1.353E-01	4.353E-01	4.795E+00	2.036E-01
12.00	9.458E-02	8.834E-02	1.361E-01	4.279E-01	4.914E+00	1.863E-01

TRANSITIONS UP TO THE 3PE LEVELS

FROM	1SE	3PO J=0	3PO J=1	3PO J=2	3PO J=0	3PO J=1	3PO J=2
TO	3PE	3PE J=0	3PE J=0	3PE J=0	3PE J=1	3PE J=1	3PE J=1
ENERGY							
4.40	4.778E-03	1.391E-02	1.772E+00	2.158E-02	1.768E+00	1.363E+00	2.224E+00
4.80	4.528E-03	1.325E-02	1.834E+00	2.053E-02	1.830E+00	1.410E+00	2.301E+00
5.20	4.295E-03	1.267E-02	1.891E+00	1.957E-02	1.889E+00	1.449E+00	2.368E+00
5.60	4.074E-03	1.211E-02	1.945E+00	1.867E-02	1.943E+00	1.486E+00	2.431E+00
6.20	3.763E-03	1.134E-02	2.019E+00	1.741E-02	2.017E+00	1.536E+00	2.519E+00
6.80	3.475E-03	1.062E-02	2.084E+00	1.626E-02	2.084E+00	1.582E+00	2.597E+00
7.40	3.209E-03	9.976E-03	2.144E+00	1.522E-02	2.143E+00	1.622E+00	2.668E+00
8.00	2.965E-03	9.379E-03	2.197E+00	1.428E-02	2.196E+00	1.658E+00	2.731E+00
9.00	2.601E-03	8.492E-03	2.275E+00	1.292E-02	2.273E+00	1.711E+00	2.824E+00
10.00	2.287E-03	7.725E-03	2.343E+00	1.178E-02	2.341E+00	1.757E+00	2.905E+00
11.00	2.018E-03	7.057E-03	2.403E+00	1.084E-02	2.400E+00	1.798E+00	2.977E+00
12.00	1.788E-03	6.471E-03	2.459E+00	1.005E-02	2.456E+00	1.836E+00	3.044E+00

TRANSITIONS UP TO THE 3PE LEVELS

FROM	3PO J=0	3PO J=1	3PO J=2	1PO	3PE J=0	3PE J=0	3PE J=1
TO	3PE J=2	3PE J=2	3PE J=2	3PE	3PE J=1	3PE J=2	3PE J=2
ENERGY							
4.40	2.156E-02	2.218E+00	6.613E+00	2.025E-01	2.131E-01	1.528E-01	6.096E-01
4.80	2.051E-02	2.294E+00	6.844E+00	1.924E-01	2.044E-01	1.503E-01	5.937E-01
5.20	1.956E-02	2.364E+00	7.051E+00	1.831E-01	1.965E-01	1.480E-01	5.785E-01
5.60	1.866E-02	2.429E+00	7.245E+00	1.744E-01	1.890E-01	1.459E-01	5.644E-01
6.20	1.740E-02	2.518E+00	7.512E+00	1.623E-01	1.783E-01	1.432E-01	5.449E-01
6.80	1.625E-02	2.597E+00	7.750E+00	1.512E-01	1.684E-01	1.409E-01	5.275E-01
7.40	1.522E-02	2.667E+00	7.965E+00	1.411E-01	1.591E-01	1.391E-01	5.119E-01
8.00	1.427E-02	2.729E+00	8.154E+00	1.319E-01	1.505E-01	1.376E-01	4.979E-01
9.00	1.291E-02	2.820E+00	8.434E+00	1.183E-01	1.375E-01	1.358E-01	4.778E-01
10.00	1.178E-02	2.900E+00	8.677E+00	1.067E-01	1.259E-01	1.347E-01	4.609E-01
11.00	1.084E-02	2.970E+00	8.893E+00	9.677E-02	1.155E-01	1.340E-01	4.465E-01
12.00	1.005E-02	3.037E+00	9.097E+00	8.814E-02	1.061E-01	1.337E-01	4.340E-01

TABLE III. Collision Strengths for O V

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 1DE LEVEL

FROM	1SE	3PO	1PO	3PE
TO	1DE	1DE	1DE	1DE
ENERGY				
4.40	9.332E-02	3.157E-01	9.803E+00	1.045E+00
4.80	9.150E-02	2.999E-01	1.013E+01	9.969E-01
5.20	8.973E-02	2.860E-01	1.049E+01	9.555E-01
5.60	8.808E-02	2.734E-01	1.080E+01	9.160E-01
6.20	8.583E-02	2.566E-01	1.119E+01	8.601E-01
6.80	8.386E-02	2.419E-01	1.150E+01	8.080E-01
7.40	8.218E-02	2.291E-01	1.176E+01	7.594E-01
8.00	8.076E-02	2.177E-01	1.198E+01	7.141E-01
9.00	7.898E-02	2.013E-01	1.230E+01	6.453E-01
10.00	7.788E-02	1.869E-01	1.258E+01	5.839E-01
11.00	7.738E-02	1.736E-01	1.283E+01	5.298E-01
12.00	7.743E-02	1.608E-01	1.306E+01	4.791E-01

TRANSITIONS UP TO THE 1SE LEVEL

FROM	1SE	3PO	1PO	3PE	1DE
TO	1SE	1SE	1SE	1SE	1SE
ENERGY					
4.40	2.015E-02	3.726E-02	2.848E+00	1.210E-01	3.219E-01
4.80	1.971E-02	3.507E-02	2.931E+00	1.139E-01	3.241E-01
5.20	1.924E-02	3.309E-02	3.025E+00	1.078E-01	3.278E-01
5.60	1.882E-02	3.123E-02	3.118E+00	1.020E-01	3.315E-01
6.20	1.826E-02	2.865E-02	3.252E+00	9.385E-02	3.372E-01
6.80	1.778E-02	2.632E-02	3.375E+00	8.637E-02	3.430E-01
7.40	1.737E-02	2.420E-02	3.487E+00	7.951E-02	3.488E-01
8.00	1.702E-02	2.229E-02	3.590E+00	7.324E-02	3.547E-01
9.00	1.656E-02	1.949E-02	3.741E+00	6.397E-02	3.646E-01
10.00	1.622E-02	1.712E-02	3.872E+00	5.601E-02	3.743E-01
11.00	1.596E-02	1.510E-02	3.992E+00	4.917E-02	3.837E-01
12.00	1.577E-02	1.336E-02	4.103E+00	4.326E-02	3.925E-01

TABLE IV. Collision Strengths for Ne VII

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 3PO AND 1PO LEVELS

FROM		1SE	3PO J=0	3PO J=0	3PO J=1	1SE	3PO
TO		3PO	3PO J=1	3PO J=2	3PO J=2	1PO	1PO
ENERGY							
8.40		7.744E-02	7.811E-02	7.619E-02	2.688E-01	2.433E+00	1.733E-01
8.80		7.593E-02	7.662E-02	7.613E-02	2.673E-01	2.473E+00	1.692E-01
9.40		7.375E-02	7.445E-02	7.608E-02	2.651E-01	2.528E+00	1.634E-01
10.00		7.168E-02	7.236E-02	7.606E-02	2.630E-01	2.579E+00	1.577E-01
11.00		6.844E-02	6.905E-02	7.607E-02	2.598E-01	2.656E+00	1.489E-01
12.00		6.545E-02	6.593E-02	7.616E-02	2.568E-01	2.722E+00	1.407E-01
13.50		6.136E-02	6.161E-02	7.637E-02	2.529E-01	2.809E+00	1.294E-01
15.00		5.770E-02	5.765E-02	7.667E-02	2.493E-01	2.884E+00	1.193E-01
16.50		5.438E-02	5.401E-02	7.702E-02	2.460E-01	2.949E+00	1.102E-01
18.00		5.135E-02	5.064E-02	7.739E-02	2.429E-01	3.008E+00	1.019E-01
20.00		4.765E-02	4.651E-02	7.787E-02	2.388E-01	3.081E+00	9.198E-02

TRANSITIONS UP TO THE 3PE LEVELS

FROM	1SE	3PO J=0	3PO J=1	3PO J=2	3PO J=0	3PO J=1	3PO J=2
TO	3PE	3PE J=0	3PE J=0	3PE J=0	3PE J=1	3PE J=1	3PE J=1
ENERGY							
8.40	2.376E-03	6.286E-03	1.103E+00	8.905E-03	1.105E+00	9.427E-01	1.668E+00
8.80	2.324E-03	6.112E-03	1.124E+00	8.649E-03	1.125E+00	9.571E-01	1.692E+00
9.40	2.247E-03	5.863E-03	1.152E+00	8.283E-03	1.152E+00	9.766E-01	1.726E+00
10.00	2.173E-03	5.627E-03	1.177E+00	7.939E-03	1.178E+00	9.942E-01	1.756E+00
11.00	2.057E-03	5.261E-03	1.215E+00	7.409E-03	1.215E+00	1.020E+00	1.801E+00
12.00	1.947E-03	4.927E-03	1.247E+00	6.930E-03	1.246E+00	1.041E+00	1.838E+00
13.50	1.796E-03	4.481E-03	1.288E+00	6.294E-03	1.286E+00	1.069E+00	1.885E+00
15.00	1.659E-03	4.093E-03	1.322E+00	5.745E-03	1.319E+00	1.092E+00	1.924E+00
16.50	1.533E-03	3.755E-03	1.351E+00	5.270E-03	1.349E+00	1.111E+00	1.958E+00
18.00	1.416E-03	3.460E-03	1.378E+00	4.856E-03	1.376E+00	1.130E+00	1.989E+00
20.00	1.273E-03	3.120E-03	1.412E+00	4.381E-03	1.409E+00	1.153E+00	2.029E+00

TRANSITIONS UP TO THE 3PE LEVELS

FROM	3PO J=0	3PO J=1	3PO J=2	1PO	3PE J=0	3PE J=0	3PE J=1
TO	3PE J=2	3PE J=2	3PE J=2	3PE	3PE J=1	3PE J=2	3PE J=2
ENERGY							
8.40	8.815E-03	1.670E+00	4.396E+00	8.720E-02	9.944E-02	7.980E-02	3.038E-01
8.80	8.561E-03	1.695E+00	4.471E+00	8.493E-02	9.755E-02	7.937E-02	3.009E-01
9.40	8.198E-03	1.727E+00	4.574E+00	8.168E-02	9.484E-02	7.879E-02	2.968E-01
10.00	7.856E-03	1.757E+00	4.667E+00	7.860E-02	9.225E-02	7.826E-02	2.929E-01
11.00	7.330E-03	1.799E+00	4.803E+00	7.380E-02	8.820E-02	7.751E-02	2.869E-01
12.00	6.954E-03	1.835E+00	4.919E+00	6.941E-02	8.445E-02	7.689E-02	2.815E-01
13.50	6.225E-03	1.880E+00	5.066E+00	6.350E-02	7.932E-02	7.619E-02	2.743E-01
15.00	5.683E-03	1.918E+00	5.190E+00	5.831E-02	7.468E-02	7.570E-02	2.679E-01
16.50	5.214E-03	1.950E+00	5.297E+00	5.373E-02	7.044E-02	7.537E-02	2.622E-01
18.00	4.804E-03	1.981E+00	5.396E+00	4.969E-02	6.650E-02	7.515E-02	2.570E-01
20.00	4.332E-03	2.020E+00	5.519E+00	4.498E-02	6.160E-02	7.496E-02	2.503E-01

TABLE IV. Collision Strengths for Ne VII

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 1DE LEVEL

FROM	1SE	3PO	1PO	3PE
TO	1DE	1DE	1DE	1DE
ENERGY				
8.40	3.418E-02	1.362E-01	6.859E+00	4.842E-01
8.80	3.393E-02	1.323E-01	6.971E+00	4.719E-01
9.40	3.355E-02	1.268E-01	7.117E+00	4.543E-01
10.00	3.320E-02	1.217E-01	7.246E+00	4.374E-01
11.00	3.266E-02	1.136E-01	7.430E+00	4.110E-01
12.00	3.219E-02	1.063E-01	7.579E+00	3.865E-01
13.50	3.161E-02	9.672E-02	7.763E+00	3.532E-01
15.00	3.119E-02	8.836E-02	7.902E+00	3.235E-01
16.50	3.094E-02	8.114E-02	8.015E+00	2.969E-01
18.00	3.084E-02	7.489E-02	8.106E+00	2.730E-01
20.00	3.094E-02	6.778E-02	8.198E+00	2.447E-01

TRANSITIONS UP TO THE 1SE LEVEL

FROM	1SE	3PO	1PO	3PE	1DE
TO	1SE	1SE	1SE	1SE	1SE
ENERGY					
8.40	1.033E-02	1.656E-02	2.049E+00	5.455E-02	1.874E-01
8.80	1.024E-02	1.610E-02	2.090E+00	5.303E-02	1.882E-01
9.40	1.012E-02	1.545E-02	2.146E+00	5.082E-02	1.893E-01
10.00	1.001E-02	1.484E-02	2.197E+00	4.872E-02	1.905E-01
11.00	9.843E-03	1.390E-02	2.271E+00	4.541E-02	1.926E-01
12.00	9.688E-03	1.305E-02	2.334E+00	4.235E-02	1.947E-01
13.50	9.482E-03	1.193E-02	2.413E+00	3.817E-02	1.980E-01
15.00	9.301E-03	1.096E-02	2.478E+00	3.443E-02	2.015E-01
16.50	9.141E-03	1.011E-02	2.535E+00	3.108E-02	2.050E-01
18.00	8.996E-03	9.366E-03	2.586E+00	2.807E-02	2.086E-01
20.00	8.815E-03	8.484E-03	2.653E+00	2.450E-02	2.133E-01

TABLE V. Collision Strengths for Si XI

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 3PO AND 1PO LEVELS

ENERGY	FROM / TO	1SE 3PO	3PO J=0 3PO J=1	3PO J=0 3PO J=2	3PO J=1 3PO J=2	1SE 1PO	3PO 1PO
11.00		4.242E-02	5.210E-02	3.677E-02	1.479E-01	1.151E+00	9.863E-02
12.00		4.114E-02	5.048E-02	3.640E-02	1.451E-01	1.182E+00	9.486E-02
14.00		3.873E-02	4.746E-02	3.576E-02	1.399E-01	1.234E+00	8.806E-02
16.00		3.650E-02	4.472E-02	3.522E-02	1.353E-01	1.277E+00	8.214E-02
18.00		3.441E-02	4.222E-02	3.477E-02	1.311E-01	1.313E+00	7.695E-02
21.00		3.154E-02	3.886E-02	3.425E-02	1.257E-01	1.358E+00	7.031E-02
24.00		2.893E-02	3.589E-02	3.387E-02	1.211E-01	1.394E+00	6.471E-02
28.00		2.579E-02	3.241E-02	3.353E-02	1.160E-01	1.436E+00	5.840E-02
34.00		2.164E-02	2.795E-02	3.326E-02	1.097E-01	1.490E+00	5.046E-02

TRANSITIONS UP TO THE 3PE LEVELS

ENERGY	FROM / TO	1SE 3PE	3PO J=0 3PE J=0	3PO J=1 3PE J=0	3PO J=2 3PE J=0	3PO J=0 3PE J=1	3PO J=1 3PE J=1	3PO J=2 3PE J=1
11.00		1.362E-03	3.256E-03	5.798E-01	4.313E-03	5.813E-01	4.489E-01	7.415E-01
12.00		1.308E-03	3.130E-03	5.968E-01	4.167E-03	5.981E-01	4.609E-01	7.609E-01
14.00		1.207E-03	2.898E-03	6.252E-01	3.895E-03	6.261E-01	4.810E-01	7.935E-01
16.00		1.116E-03	2.688E-03	6.475E-01	3.648E-03	6.479E-01	4.966E-01	8.189E-01
18.00		1.035E-03	2.498E-03	6.655E-01	3.426E-03	6.654E-01	5.091E-01	8.395E-01
21.00		9.269E-04	2.247E-03	6.866E-01	3.133E-03	6.861E-01	5.237E-01	8.638E-01
24.00		8.378E-04	2.030E-03	7.030E-01	2.881E-03	7.021E-01	5.350E-01	8.830E-01
28.00		7.362E-04	1.783E-03	7.214E-01	2.594E-03	7.203E-01	5.478E-01	9.055E-01
34.00		6.155E-04	1.482E-03	7.455E-01	2.234E-03	7.443E-01	5.647E-01	9.374E-01

TRANSITIONS UP TO THE 3PE LEVELS

ENERGY	FROM / TO	3PO J=0 3PE J=2	3PO J=1 3PE J=2	3PO J=2 3PE J=2	1PO 3PE	3PE J=0 3PE J=1	3PE J=0 3PE J=2	3PE J=1 3PE J=2
11.00		4.313E-03	7.371E-01	2.196E+00	4.341E-02	5.320E-02	3.771E-02	1.513E-01
12.00		4.167E-03	7.576E-01	2.259E+00	4.151E-02	5.130E-02	3.731E-02	1.480E-01
14.00		3.895E-03	7.917E-01	2.364E+00	3.807E-02	4.783E-02	3.664E-02	1.422E-01
16.00		3.648E-03	8.181E-01	2.446E+00	3.504E-02	4.475E-02	3.613E-02	1.372E-01
18.00		3.426E-03	8.393E-01	2.512E+00	3.238E-02	4.202E-02	3.574E-02	1.329E-01
21.00		3.133E-03	8.644E-01	2.589E+00	2.897E-02	3.847E-02	3.532E-02	1.275E-01
24.00		2.881E-03	8.840E-01	2.650E+00	2.613E-02	3.542E-02	3.501E-02	1.230E-01
28.00		2.594E-03	9.064E-01	2.718E+00	2.299E-02	3.198E-02	3.469E-02	1.180E-01
34.00		2.234E-03	9.359E-01	2.808E+00	1.920E-02	2.770E-02	3.419E-02	1.146E-01

TABLE V. Collision Strengths for Si XI

See page 200 for Explanation of Tables

TRANSITIONS UP TO THE 1DE LEVEL

ENERGY	FROM / TO	1SE / 1DE	3PO / 1DE	1PO / 1DE	3PE / 1DE
11.00		9.751E-03	7.000E-02	3.207E+00	2.679E-01
12.00		9.676E-03	6.718E-02	3.301E+00	2.585E-01
14.00		9.539E-03	6.202E-02	3.449E+00	2.416E-01
16.00		9.429E-03	5.741E-02	3.564E+00	2.267E-01
18.00		9.347E-03	5.331E-02	3.655E+00	2.135E-01
21.00		9.269E-03	4.796E-02	3.757E+00	1.963E-01
24.00		9.224E-03	4.342E-02	3.837E+00	1.815E-01
28.00		9.180E-03	3.836E-02	3.913E+00	1.645E-01
34.00		9.136E-03	3.228E-02	3.989E+00	1.427E-01

TRANSITIONS UP TO THE 1SE LEVEL

ENERGY	FROM / TO	1SE / 1SE	3PO / 1SE	1PO / 1SE	3PE / 1SE	1DE / 1SE
11.00		3.726E-03	9.092E-03	9.653E-01	3.164E-02	8.080E-02
12.00		3.687E-03	8.738E-03	9.986E-01	2.994E-02	8.077E-02
14.00		3.615E-03	8.114E-03	1.054E+00	2.687E-02	8.089E-02
16.00		3.551E-03	7.586E-03	1.098E+00	2.420E-02	8.124E-02
18.00		3.495E-03	7.136E-03	1.133E+00	2.188E-02	8.178E-02
21.00		3.425E-03	6.573E-03	1.174E+00	1.897E-02	8.287E-02
24.00		3.369E-03	6.110E-03	1.206E+00	1.660E-02	8.420E-02
28.00		3.314E-03	5.587E-03	1.241E+00	1.410E-02	8.618E-02
34.00		3.259E-03	4.896E-03	1.289E+00	1.133E-02	8.918E-02

TABLE VI. Fit Parameters for High-Energy Analytical Expressions for C III Collision Strengths

See page 200 for Explanation of Tables

Transition		Type	a_0	a_1	a_2	a_3	a_4
$(2s^2)\ ^1S^e$	$(2s2p)\ ^3P^o$	1	-	-	+1.862 + 1	-6.345 + 0	-
	$(2s2p)\ ^1P^o$	2	+7.798 + 0	+3.280 + 0	-2.180 + 0	-	-
	$(2p^2)\ ^3P^e$	1	-	-	+3.714 - 1	-1.002 + 0	-
	$(2p^2)\ ^1D^e$	1	+2.650 - 1	+7.840 - 1	+3.160 - 2	-	-
	$(2p^2)\ ^1S^e$	1	+1.330 - 2	+6.820 - 1	-3.014 + 0	-	-
$(2s2p)\ ^3P^o_0$	$(2s2p)\ ^3P^o_1$	1	-	-	+2.008 + 1	-6.981 + 1	-
	$(2s2p)\ ^3P^o_2$	1	+3.787 - 1	-3.868 - 1	-	-	-
$(2s2p)\ ^3P^o_1$	$(2s2p)\ ^3P^o_2$	1	+7.473 - 1	+1.446	-	-	-
$(2s2p)\ ^3P^o_0$	$(2p^2)\ ^3P^e_0$	1	-	+1.262 - 1	-9.988 - 2	-	-
	$(2p^2)\ ^3P^e_1$	2	+3.423	+2.263	-3.364	-	-
	$(2p^2)\ ^3P^e_2$	1	-	+2.408 - 1	-2.354 - 1	-	-
$(2s2p)\ ^3P^o_1$	$(2p^2)\ ^3P^e_0$	2	+3.423	+1.985	-2.321	-	-
	$(2p^2)\ ^3P^e_1$	2	+2.567	+1.736	-2.338	-	-
	$(2p^2)\ ^3P^e_2$	2	+4.278	+2.977	-5.020	-	-
$(2s2p)\ ^3P^o_2$	$(2p^2)\ ^3P^e_0$	1	-	+2.408 - 1	-2.354 - 1	-	-
	$(2p^2)\ ^3P^e_1$	2	+4.278 + 0	+2.938 + 0	-4.625 + 0	-	-
	$(2p^2)\ ^3P^e_2$	2	+1.284 + 1	+8.890 + 0	-1.507 + 1	-	-
$(2s2p)\ ^1P^o$	$(2s2p)\ ^1P^o$	1	-	-	+2.536 + 2	-7.302 + 2	-
	$(2p^2)\ ^1D^e$	1	-	+2.040 + 0	+1.680 + 0	-	-
	$(2p^2)\ ^1S^e$	1	-	-	+3.056 + 0	-8.974 + 0	-
$(2s2p)\ ^1P^o$	$(2p^2)\ ^3P^e$	1	-	-	+1.748 + 1	-5.334 + 1	-
	$(2p^2)\ ^1D^e$	2	+1.287 + 1	+1.457 + 1	-1.060 + 1	-	-
	$(2p^2)\ ^1S^e$	2	+6.310 + 0	+4.483 + 0	+1.291 + 1	-	-
$(2p^2)\ ^3P^e_0$	$(2p^2)\ ^3P^e_1$	1	-	-	+1.854 + 1	-5.766 + 1	-
	$(2p^2)\ ^3P^e_2$	1	+3.209 - 1	-1.138 - 1	-	-	-
$(2p^2)\ ^3P^e_1$	$(2p^2)\ ^3P^e_2$	1	+6.160 - 1	+2.151 + 0	-	-	-
$(2p^2)\ ^3P^e$	$(2p^2)\ ^1D^e$	1	-	-	+7.949 + 1	-2.228 + 2	-
	$(2p^2)\ ^1S^e$	1	-	-	+2.959 + 0	-4.012 + 0	-
$(2p^2)\ ^1D^e$	$(2p^2)\ ^1S^e$	1	+1.238 + 0	-2.609 + 0	-	-	-

TABLE VII. Fit Parameters for High-Energy Analytical Expressions for O V Collision Strengths

See page 200 for Explanation of Tables

Transition	Type	a_0	a_1	a_2	a_3	a_4
$(2s^2)\ ^1S^e$ - $(2s2p)\ ^3P^o$	1	-	-	+3.336 + 1	-2.367 + 2	-
$(2s2p)\ ^1P^o$	2	+3.346 + 0	+1.283	-	-	-
$(2p^2)\ ^3P^e$	1	-	-	+3.979 - 1	-1.684 + 0	-
$(2p^2)\ ^1D^e$	1	+7.789 - 2	+9.359 - 4	-	-	-
$(2p^2)\ ^1S^e$	1	+1.306 - 2	+3.220 - 2	-	-	-
$(2s2p)\ ^3P^o_1$ - $(2s2p)\ ^3P^o_1$	1	-	-	+3.355 + 1	-2.515 + 2	-
$(2s2p)\ ^3P^o_2$	1	+1.501 - 1	-1.524 - 1	-	-	-
$(2s2p)\ ^3P^o_1$ - $(2s2p)\ ^3P^o_2$	1	+3.515 - 1	+9.504 - 1	-	-	-
$(2s2p)\ ^3P^o_0$ - $(2p^2)\ ^3P^e_0$	1	-	+8.239 - 2	-5.876 - 2	-	-
$(2p^2)\ ^3P^e_1$	2	+1.572 + 0	+7.500 - 1	-	-	-
$(2p^2)\ ^3P^e_2$	1	-	+1.392 - 1	-2.305 - 1	-	-
$(2s2p)\ ^3P^o_1$ - $(2p^2)\ ^3P^e_0$	2	+1.572 + 0	+7.500 - 1	-	-	-
$(2p^2)\ ^3P^e_1$	2	+1.156 + 0	+5.863 - 1	-	-	-
$(2p^2)\ ^3P^e_2$	2	+1.926 + 0	+9.586 - 1	-	-	-
$(2s2p)\ ^3P^o_2$ - $(2p^2)\ ^3P^e_0$	1	-	+1.421 - 1	-2.570 - 1	-	-
$(2p^2)\ ^3P^e_1$	2	+1.926 + 0	+9.533 - 1	-	-	-
$(2p^2)\ ^3P^e_2$	2	+5.778 + 0	+2.817 + 0	-	-	-
$(2s2p)\ ^3P^o$ - $(2s2p)\ ^1P^o$	1	-	-	+5.002 + 1	-2.715 + 2	-
$(2p^2)\ ^1D^e$	1	-	+2.225 + 0	-3.575 + 0	-	-
$(2p^2)\ ^1S^e$	1	-	-	+2.849 + 0	-1.103 + 1	-
$(2s2p)\ ^1P^o$ - $(2p^2)\ ^3P^e$	1	-	-	+3.195 + 0	-2.142 + 1	-
$(2p^2)\ ^1D^e$	2	+6.690 + 0	+5.800 + 0	-	-	-
$(2p^2)\ ^1S^e$	2	+2.799 + 0	+1.217 + 0	-1.576 + 0	-	-
$(2p^2)\ ^3P^e_0$ - $(2p^2)\ ^3P^e_1$	1	-	-	+3.462 + 1	-2.321 + 2	-
$(2p^2)\ ^3P^e_2$	1	+1.270 - 1	+8.063 - 2	-	-	-
$(2p^2)\ ^3P^e_1$ - $(2p^2)\ ^3P^e_2$	1	+3.014 - 1	+1.541 + 0	-	-	-
$(2p^2)\ ^3P^e$ - $(2p^2)\ ^1D^e$	1	-	-	+1.200 + 2	-6.080 + 2	-
$(2p^2)\ ^1S^e$	1	-	-	+8.868 + 0	-3.166 + 1	-
$(2p^2)\ ^1D^e$ - $(2p^2)\ ^1S^e$	1	+4.682 - 1	-9.073 -1	-	-	-

TABLE VIII. Fit Parameters for High-Energy Analytical Expressions for Ne VII Collision Strengths

See page 200 for Explanation of Tables

Transition	Type	a_0	a_1	a_2	a_3	a_4
$(2s^2)\ ^1S^e$ - $(2s2p)\ ^3P^o$	1	-	-	+5.064 + 1	-6.854 + 2	+1.082 + 3
$(2s2p)\ ^1P^o$	2	+1.826 + 0	+7.732 - 1	-1.132 + 0	-	-
$(2p^2)\ ^3P^e$	1	-	-	+9.487 - 1	-8.785 + 0	-
$(2p^2)\ ^1D^e$	1	+3.100 - 2	-	-	-	-
$(2p^2)\ ^1S^e$	1	+7.069 - 3	+3.495 - 2	-	-	-
$(2s2p)\ ^3P^o_0$ - $(2s2p)\ ^3P^o_1$	1	-	-	+4.502 + 1	-5.283 + 2	-
$(2s2p)\ ^3P^o_2$	1	+8.205 - 2	-8.353 - 2	-	-	-
$(2s2p)\ ^3P^o_1$ - $(2s2p)\ ^3P^o_2$	1	+2.112 - 1	+5.619 - 1	-	-	-
$(2s2p)\ ^3P^o_0$ - $(2p^2)\ ^3P^e_0$	1	-	+7.071 - 2	-1.613 - 1	-	-
$(2p^2)\ ^3P^e_1$	2	+8.655 - 1	+3.649 - 1	-9.198 - 1	-	-
$(2p^2)\ ^3P^e_2$	1	-	+9.720 - 2	-1.897 - 1	-	-
$(2s2p)\ ^3P^o_1$ - $(2p^2)\ ^3P^e_0$	2	+8.655 - 1	+3.662 - 1	-9.402 - 1	-	-
$(2p^2)\ ^3P^e_1$	2	+6.433 - 1	+3.642 - 1	-5.621 - 1	-	-
$(2p^2)\ ^3P^e$	2	+1.074 + 0	+7.092 - 1	-1.053 + 0	-	-
$(2s2p)\ ^3P^o_2$ - $(2p^2)\ ^3P^e_0$	1	-	+9.721 - 2	-1.898 - 1	-	-
$(2p^2)\ ^3P^e_1$	2	+1.069 + 0	+7.151 - 1	-1.155 + 0	-	-
$(2p^2)\ ^3P^e_2$	2	+3.208 + 0	+1.565 + 0	-3.201 + 0	-	-
$(2s2p)\ ^3P^o$ - $(2s2p)\ ^1P^o$	1	-	-	+7.254 + 1	-7.010 + 2	-
$(2p^2)\ ^1D^e$	1	-	+1.467 + 0	-2.016 + 0	-	-
$(2p^2)\ ^1S^e$	1	-	-	+6.712 + 0	-6.616 + 1	-
$(2s2p)\ ^1P^o$ - $(2p^2)\ ^3P^e$	1	-	-	+4.139 + 1	-4.681 + 2	-
$(2p^2)\ ^1D^e$	2	+3.905 + 0	+3.887 + 0	-6.802 + 0	-	-
$(2p^2)\ ^1S^e$	2	+1.551 + 0	+7.639 - 1	-2.593 + 0	-	-
$(2p^2)\ ^3P^e_0$ - $(2p^2)\ ^3P^e_1$	1	-	-	+5.880 + 1	-6.832 + 2	-
$(2p^2)\ ^3P^e_2$	1	+7.009 - 2	+8.174 - 2	-	-	-
$(2p^2)\ ^3P^e_1$ - $(2p^2)\ ^3P^e_2$	1	+2.073 - 1	+8.583 - 1	-	-	-
$(2p^2)\ ^3P^e$ - $(2p^2)\ ^1D^e$	1	-	-	+1.867 + 2	-1.768 + 3	-
$(2p^2)\ ^1S^e$	1	-	-	+1.583 + 1	-1.212 + 2	-
$(2p^2)\ ^1D^e$ - $(2p^2)\ ^1S^e$	1	+2.758 - 1	-1.255 + 0	-	-	-

TABLE IX. Fit Parameters for High-Energy Analytical Expressions for Si XI Collision Strengths

See page 200 for Explanation of Tables

Transition	Type	a_0	a_1	a_2	a_3	a_4
$(2s^2)\ {}^1S^e$ - $(2s2p)\ {}^3P^o$	1	-	-	+4.923 + 1	-8.264 + 2	-
$(2s2p)\ {}^1P^o$	2	+8.085 - 1	+2.554 - 1	+5.496 - 1	-	-
$(2p^2)\ {}^3P^e$	1	-	-	+1.222 + 0	-1.740 + 1	-
$(2p^2)\ {}^1D^e$	1	+9.022 - 3	+3.900 - 3	-	-	-
$(2p^2)\ {}^1S^e$	1	+2.523 - 3	+2.442 - 2	-	-	-
$(2s2p)\ {}^3P^o_1$ - $(2s2p)\ {}^3P^o_1$	1	-	-	+7.067 + 1	-1.300 + 3	-
$(2s2p)\ {}^3P^o_2$	1	+3.220 - 2	+3.399 - 2	-	-	-
$(2s2p)\ {}^3P^o_1$ - $(2s2p)\ {}^3P^o_2$	1	+7.541 - 2	+1.132 + 0	-	-	-
$(2s2p)\ {}^3P^o_0$ - $(2p^2)\ {}^3P^e_0$	1	-	+5.801 - 2	-2.489 - 1	-	-
$(2p^2)\ {}^3P^e_1$	2	+3.785 - 1	+1.846 - 1	-2.917 - 1	-	-
$(2p^2)\ {}^3P^e_2$	1	-	+8.990 - 2	-4.858 - 1	-	-
$(2s2p)\ {}^3P^o_1$ - $(2p^2)\ {}^3P^e_0$	2	+3.785 - 1	+1.882 - 1	-3.542 - 1	-	-
$(2p^2)\ {}^3P^e_1$	2	+2.839 - 1	+1.426 - 1	-1.128 - 1	-	-
$(2p^2)\ {}^3P^e_2$	2	+4.731 - 1	+2.330 - 1	-2.665 - 1	-	-
$(2s2p)\ {}^3P^o_2$ - $(2p^2)\ {}^3P^e_0$	1	-	+9.170 - 2	-5.303 - 1	-	-
$(2p^2)\ {}^3P^e_1$	2	+4.731 - 1	+2.274 - 1	-1.566 - 1	-	-
$(2p^2)\ {}^3P^e_2$	2	+1.419 + 0	+7.097 - 1	-1.099 + 0	-	-
$(2s2p)\ {}^3P^o$ - $(2s2p)\ {}^1P^o$	1	-	-	+1.281 + 2	-2.366 + 3	-
$(2p^2)\ {}^1D^e$	1	-	+1.241 + 0	-5.261 + 0	-	-
$(2p^2)\ {}^1S^e$	1	-	-	+1.171 + 1	-2.056 + 2	-
$(2s2p)\ {}^1P^o$ - $(2p^2)\ {}^3P^e$	1	-	-	+4.973 + 1	-9.427 + 2	-
$(2p^2)\ {}^1D^e$	2	+1.747 + 0	+1.336 + 0	-6.668 - 1	-	-
$(2p^2)\ {}^1S^e$	2	+6.854 - 1	+2.927 - 1	-1.161 + 0	-	-
$(2p^2)\ {}^3P^e_0$ - $(2p^2)\ {}^3P^e_1$	1	-	-	+7.422 + 1	-1.435 + 3	-
$(2p^2)\ {}^3P^e_2$	1	+3.514 - 2	-2.276 - 2	-	-	-
$(2p^2)\ {}^3P^e_1$ - $(2p^2)\ {}^3P^e_2$	1	+1.017 - 1	+4.531 - 1	-	-	-
$(2p^2)\ {}^3P^e$ - $(2p^2)\ {}^1D^e$	1	-	-	+3.503 + 2	-6.233 + 3	-
$(2p^2)\ {}^1S^e$	1	+1.794 + 1	-2.120 + 2	-	-	-
$(2p^2)\ {}^1D^e$ - $(2p^2)\ {}^1S^e$	1	+1.113 - 1	-7.220 -1	-	-	-

TABLE X. Effective Collision Strengths for C III

See page 200 for Explanation of Tables

TRANSITION	LOG(ELECTRON TEMPERATURE)									LOG T H
	4.10	4.30	4.50	4.70	4.90	5.10	5.30	5.50	5.70	
2S2S 1SE TO 2S2P 3PO	1.04E+00	1.03E+00	1.03E+00	9.96E-01	9.16E-01	8.08E-01	6.92E-01	5.79E-01	4.73E-01	5.70
2S2S 1SE TO 2S2P 1PO	4.00E+00	4.11E+00	4.24E+00	4.42E+00	4.65E+00	5.00E+00	5.50E+00	6.17E+00	7.01E+00	5.56
2S2S 1SE TO 2P2P 3PE	1.66E-02	1.57E-02	1.47E-02	1.38E-02	1.30E-02	1.22E-02	1.12E-02	1.01E-02	8.70E-03	5.70
2S2S 1SE TO 2P2P 1DE	4.01E-01	3.98E-01	3.94E-01	3.88E-01	3.79E-01	3.69E-01	3.57E-01	3.47E-01	3.34E-01	5.57
2S2S 1SE TO 2P2P 1SE	5.77E-02	3.82E-02	3.89E-02	3.98E-02	4.10E-02	4.25E-02	4.42E-02	4.59E-02	4.71E-02	5.59
2S2P 3PO J=0 TO 2S2P 3PO J=1	9.62E-01	1.03E+00	1.09E+00	1.11E+00	1.06E+00	9.53E-01	8.15E-01	6.73E-01	5.41E-01	5.70
2S2P 3PO J=0 TO 2S2P 3PO J=2	7.18E-01	8.57E-01	1.01E+00	1.11E+00	1.09E+00	9.88E-01	8.43E-01	7.03E-01	5.88E-01	5.70
2S2P 3PO J=1 TO 2S2P 3PO J=2	2.78E+00	3.17E+00	3.60E+00	3.83E+00	3.74E+00	3.37E+00	2.88E+00	2.39E+00	1.97E+00	5.70
2S2P 3PO TO 2S2P 1PO	3.70E+00	3.54E+00	3.29E+00	2.93E+00	2.50E+00	2.07E+00	1.68E+00	1.38E+00	1.20E+00	5.58
2S2P 3PO J=0 TO 2P2P 3PE J=0	4.61E-02	4.51E-02	4.40E-02	4.27E-02	4.11E-02	3.92E-02	3.66E-02	3.32E-02	2.91E-02	5.70
2S2P 3PO J=0 TO 2P2P 3PE J=1	1.87E+00	1.92E+00	2.01E+00	2.12E+00	2.27E+00	2.47E+00	2.73E+00	3.07E+00	3.49E+00	5.54
2S2P 3PO J=0 TO 2P2P 3PE J=2	1.01E-01	9.71E-02	9.24E-02	8.73E-02	8.18E-02	7.57E-02	6.87E-02	6.10E-02	5.27E-02	5.70
2S2P 3PO J=1 TO 2P2P 3PE J=0	1.88E+00	1.93E+00	2.01E+00	2.12E+00	2.27E+00	2.47E+00	2.72E+00	3.05E+00	3.45E+00	5.55
2S2P 3PO J=1 TO 2P2P 3PE J=1	1.61E+00	1.65E+00	1.71E+00	1.78E+00	1.89E+00	2.03E+00	2.21E+00	2.45E+00	2.75E+00	5.55
2S2P 3PO J=1 TO 2P2P 3PE J=2	2.57E+00	2.63E+00	2.72E+00	2.85E+00	3.02E+00	3.26E+00	3.57E+00	3.98E+00	4.49E+00	5.55
2S2P 3PO J=2 TO 2P2P 3PE J=0	1.01E-01	9.71E-02	9.24E-02	8.74E-02	8.19E-02	7.57E-02	6.87E-02	6.10E-02	5.28E-02	5.70
2S2P 3PO J=2 TO 2P2P 3PE J=1	2.58E+00	2.64E+00	2.72E+00	2.85E+00	3.03E+00	3.26E+00	3.57E+00	3.98E+00	4.49E+00	5.55
2S2P 3PO J=2 TO 2P2P 3PE J=2	7.45E+00	7.65E+00	7.94E+00	8.33E+00	8.87E+00	9.60E+00	1.06E+01	1.18E+01	1.33E+01	5.54
2S2P 3PO TO 2P2P 1DE	1.39E+00	1.36E+00	1.33E+00	1.27E+00	1.20E+00	1.10E+00	9.74E-01	8.36E-01	6.84E-01	5.54
2S2P 3PO TO 2P2P 1SE	1.34E-01	1.34E-01	1.31E-01	1.26E-01	1.18E-01	1.08E-01	9.63E-02	8.33E-02	6.97E-02	5.70
2S2P 1PO TO 2P2P 3PE	1.60E+00	1.44E+00	1.28E+00	1.13E+00	9.80E-01	8.44E-01	7.18E-01	5.98E-01	4.86E-01	5.70
2S2P 1PO TO 2P2P 1DE	1.14E+01	1.16E+01	1.20E+01	1.25E+01	1.32E+01	1.42E+01	1.55E+01	1.72E+01	1.90E+01	5.56
2S2P 1PO TO 2P2P 1SE	5.57E+00	5.62E+00	5.70E+00	5.83E+00	4.04E+00	4.34E+00	4.79E+00	5.46E+00	6.45E+00	5.49
2P2P 3PE J=0 TO 2P2P 3PE J=1	8.44E-01	8.09E-01	7.71E-01	7.30E-01	6.83E-01	6.27E-01	5.63E-01	4.92E-01	4.16E-01	5.70
2P2P 3PE J=0 TO 2P2P 3PE J=2	4.97E-01	4.76E-01	4.54E-01	4.35E-01	4.16E-01	3.97E-01	3.79E-01	3.61E-01	3.45E-01	5.65
2P2P 3PE J=1 TO 2P2P 3PE J=2	2.16E+00	2.07E+00	1.98E+00	1.89E+00	1.79E+00	1.68E+00	1.55E+00	1.42E+00	1.28E+00	5.70
2P2P 3PE TO 2P2P 1DE	3.84E+00	3.79E+00	3.70E+00	3.56E+00	3.35E+00	3.08E+00	2.76E+00	2.40E+00	2.02E+00	5.70
2P2P 3PE TO 2P2P 1SE	3.64E-01	3.65E-01	3.58E-01	3.45E-01	3.32E-01	2.93E-01	2.57E-01	2.16E-01	1.73E-01	5.70
2P2P 1DE TO 2P2P 1SE	6.50E-01	6.57E-01	6.62E-01	6.67E-01	6.74E-01	6.85E-01	7.02E-01	7.29E-01	7.69E-01	5.55

TABLE XI. Effective Collision Strengths for O V

See page 200 for Explanation of Tables

TRANSITION	LOG(ELECTRON TEMPERATURE)									LOG T H
	4.50	4.70	4.90	5.10	5.30	5.50	5.70	5.90	6.10	
2S2S 1SE TO 2S2P 3PO	5.98E-01	5.55E-01	5.02E-01	4.40E-01	3.76E-01	3.16E-01	2.63E-01	2.16E-01	1.74E-01	6.10
2S2S 1SE TO 2S2P 1PO	2.73E+00	2.79E+00	2.85E+00	2.94E+00	3.06E+00	3.24E+00	3.49E+00	3.82E+00	4.21E+00	5.76
2S2S 1SE TO 2P2P 3PE	1.26E-02	1.06E-02	9.07E-03	7.85E-03	6.86E-03	5.98E-03	5.13E-03	4.28E-03	3.44E-03	6.10
2S2S 1SE TO 2P2P 1DE	1.17E-01	1.15E-01	1.12E-01	1.09E-01	1.05E-01	1.00E-01	9.54E-02	9.08E-02	8.70E-02	5.83
2S2S 1SE TO 2P2P 1SE	1.76E-02	1.77E-02	1.78E-02	1.80E-02	1.81E-02	1.81E-02	1.79E-02	1.74E-02	1.68E-02	5.80
2S2P 3PO J=0 TO 2S2P 3PO J=1	8.70E-01	8.42E-01	7.76E-01	6.80E-01	5.71E-01	4.63E-01	3.68E-01	2.88E-01	2.22E-01	6.10
2S2P 3PO J=0 TO 2S2P 3PO J=2	1.05E+00	1.02E+00	9.38E-01	8.11E-01	6.63E-01	5.23E-01	4.07E-01	3.20E-01	2.58E-01	6.00
2S2P 3PO J=1 TO 2S2P 3PO J=2	3.32E+00	3.24E+00	2.98E+00	2.59E+00	2.14E+00	1.71E+00	1.35E+00	1.06E+00	8.52E-01	6.03
2S2P 3PO TO 2S2P 1PO	1.58E+00	1.51E+00	1.36E+00	1.15E+00	9.54E-01	7.77E-01	6.26E-01	4.98E-01	3.89E-01	6.10
2S2P 3PO J=0 TO 2P2P 3PE J=0	1.97E-02	1.94E-02	1.88E-02	1.81E-02	1.70E-02	1.57E-02	1.41E-02	1.23E-02	1.03E-02	6.01
2S2P 3PO J=0 TO 2P2P 3PE J=1	1.41E+00	1.44E+00	1.46E+00	1.51E+00	1.57E+00	1.67E+00	1.79E+00	1.95E+00	2.13E+00	5.74
2S2P 3PO J=0 TO 2P2P 3PE J=2	3.31E-02	3.19E-02	3.05E-02	2.89E-02	2.70E-02	2.47E-02	2.21E-02	1.91E-02	1.61E-02	6.00
2S2P 3PO J=1 TO 2P2P 3PE J=0	1.41E+00	1.43E+00	1.46E+00	1.51E+00	1.58E+00	1.67E+00	1.79E+00	1.95E+00	2.13E+00	5.74
2S2P 3PO J=1 TO 2P2P 3PE J=1	1.14E+00	1.16E+00	1.18E+00	1.21E+00	1.25E+00	1.32E+00	1.40E+00	1.51E+00	1.64E+00	5.75
2S2P 3PO J=1 TO 2P2P 3PE J=2	1.84E+00	1.87E+00	1.90E+00	1.95E+00	2.03E+00	2.14E+00	2.29E+00	2.47E+00	2.69E+00	5.75
2S2P 3PO J=2 TO 2P2P 3PE J=0	3.31E-02	3.19E-02	3.05E-02	2.90E-02	2.70E-02	2.48E-02	2.21E-02	1.91E-02	1.61E-02	6.00
2S2P 3PO J=2 TO 2P2P 3PE J=1	1.84E+00	1.87E+00	1.90E+00	1.95E+00	2.03E+00	2.14E+00	2.29E+00	2.47E+00	2.69E+00	5.75
2S2P 3PO J=2 TO 2P2P 3PE J=2	5.45E+00	5.53E+00	5.64E+00	5.80E+00	6.04E+00	6.37E+00	6.82E+00	7.37E+00	8.03E+00	5.75
2S2P 3PO TO 2P2P 1DE	4.59E-01	4.49E-01	4.34E-01	4.14E-01	3.88E-01	3.56E-01	3.20E-01	2.80E-01	2.38E-01	5.97
2S2P 3PO TO 2P2P 1SE	4.61E-02	4.58E-02	4.51E-02	4.35E-02	4.10E-02	3.76E-02	3.32E-02	2.83E-02	2.30E-02	6.07
2S2P 1PO TO 2P2P 3PE	8.17E-01	6.74E-01	5.53E-01	4.55E-01	3.78E-01	3.13E-01	2.57E-01	2.04E-01	1.55E-01	6.10
2S2P 1PO TO 2P2P 1DE	7.92E+00	8.02E+00	8.17E+00	8.42E+00	8.80E+00	9.33E+00	1.00E+01	1.08E+01	1.16E+01	5.74
2S2P 1PO TO 2P2P 1SE	2.49E+00	2.51E+00	2.55E+00	2.61E+00	2.72E+00	2.87E+00	3.08E+00	3.34E+00	3.67E+00	5.72
2P2P 3PE J=0 TO 2P2P 3PE J=1	3.72E-01	3.54E-01	3.34E-01	3.13E-01	2.89E-01	2.62E-01	2.32E-01	2.00E-01	1.66E-01	6.02
2P2P 3PE J=0 TO 2P2P 3PE J=2	2.11E-01	2.02E-01	1.94E-01	1.85E-01	1.77E-01	1.68E-01	1.60E-01	1.53E-01	1.47E-01	5.83
2P2P 3PE J=1 TO 2P2P 3PE J=2	9.38E-01	8.96E-01	8.53E-01	8.07E-01	7.58E-01	7.05E-01	6.50E-01	5.94E-01	5.40E-01	5.90
2P2P 3PE TO 2P2P 1DE	1.69E+00	1.65E+00	1.58E+00	1.49E+00	1.39E+00	1.25E+00	1.11E+00	9.45E-01	7.78E-01	6.06
2P2P 3PE TO 2P2P 1SE	1.70E-01	1.69E-01	1.66E-01	1.58E-01	1.47E-01	1.32E-01	1.15E-01	9.63E-02	7.77E-02	6.09
2P2P 1DE TO 2P2P 1SE	3.02E-01	3.03E-01	3.05E-01	3.08E-01	3.13E-01	3.20E-01	3.31E-01	3.45E-01	3.62E-01	5.74

TABLE XII. Effective Collision Strengths for Ne VII

See page 200 for Explanation of Tables

TRANSITION	LOG(ELECTRON TEMPERATURE)									LOG T H
	5.00	5.20	5.40	5.60	5.80	6.00	6.20	6.40	6.60	
2S2S 1SE TO 2S2P 3PO	2.48E-01	2.22E-01	1.93E-01	1.66E-01	1.41E-01	1.18E-01	9.78E-02	7.90E-02	6.18E-02	6.32
2S2S 1SE TO 2S2P 1PO	1.91E+00	1.95E+00	2.01E+00	2.09E+00	2.21E+00	2.37E+00	2.56E+00	2.80E+00	3.07E+00	6.01
2S2S 1SE TO 2P2P 3PE	5.05E-03	4.68E-03	4.25E-03	3.80E-03	3.34E-03	2.88E-03	2.41E-03	1.95E-03	1.52E-03	6.30
2S2S 1SE TO 2P2P 1DE	4.24E-02	4.12E-02	3.99E-02	3.84E-02	3.70E-02	3.55E-02	3.43E-02	3.32E-02	3.25E-02	6.06
2S2S 1SE TO 2P2P 1SE	9.66E-03	9.69E-03	9.74E-03	9.78E-03	9.76E-03	9.64E-03	9.41E-03	9.11E-03	8.77E-03	6.04
2S2P 3PO J=0 TO 2S2P 3PO J=1	5.20E-01	4.57E-01	3.82E-01	3.08E-01	2.42E-01	1.88E-01	1.44E-01	1.09E-01	8.07E-02	6.66
2S2P 3PO J=0 TO 2S2P 3PO J=2	6.06E-01	5.15E-01	4.16E-01	3.24E-01	2.49E-01	1.93E-01	1.53E-01	1.27E-01	1.10E-01	6.22
2S2P 3PO J=1 TO 2S2P 3PO J=2	2.00E+00	1.72E+00	1.40E+00	1.11E+00	8.58E-01	6.66E-01	5.26E-01	4.26E-01	3.57E-01	6.25
2S2P 3PO TO 2S2P 1PO	5.63E-01	4.98E-01	4.31E-01	3.68E-01	3.11E-01	2.57E-01	2.09E-01	1.66E-01	1.26E-01	6.36
2S2P 3PO J=0 TO 2P2P 3PE J=0	1.02E-02	9.79E-03	9.29E-03	8.65E-03	7.86E-03	6.93E-03	5.92E-03	4.90E-03	3.93E-03	6.25
2S2P 3PO J=0 TO 2P2P 3PE J=1	9.86E-01	1.00E+00	1.03E+00	1.06E+00	1.10E+00	1.16E+00	1.24E+00	1.34E+00	1.46E+00	6.01
2S2P 3PO J=0 TO 2P2P 3PE J=2	1.50E-02	1.43E-02	1.35E-02	1.25E-02	1.13E-02	9.89E-03	8.41E-03	6.93E-03	5.55E-03	6.26
2S2P 3PO J=1 TO 2P2P 3PE J=0	9.86E-01	1.00E+00	1.03E+00	1.06E+00	1.10E+00	1.16E+00	1.24E+00	1.34E+00	1.46E+00	6.01
2S2P 3PO J=1 TO 2P2P 3PE J=1	7.82E-01	7.93E-01	8.12E-01	8.40E-01	8.80E-01	9.33E-01	1.00E+00	1.08E+00	1.18E+00	6.01
2S2P 3PO J=1 TO 2P2P 3PE J=2	1.27E+00	1.29E+00	1.32E+00	1.38E+00	1.47E+00	1.58E+00	1.71E+00	1.86E+00	2.03E+00	6.00
2S2P 3PO J=2 TO 2P2P 3PE J=0	1.50E-02	1.43E-02	1.35E-02	1.25E-02	1.13E-02	9.92E-03	8.44E-03	6.96E-03	5.57E-03	6.26
2S2P 3PO J=2 TO 2P2P 3PE J=1	1.27E+00	1.29E+00	1.32E+00	1.38E+00	1.47E+00	1.58E+00	1.71E+00	1.86E+00	2.03E+00	6.00
2S2P 3PO J=2 TO 2P2P 3PE J=2	3.78E+00	3.84E+00	3.93E+00	4.07E+00	4.24E+00	4.48E+00	4.79E+00	5.18E+00	5.63E+00	6.01
2S2P 3PO TO 2P2P 1DE	2.16E-01	2.08E-01	1.97E-01	1.84E-01	1.67E-01	1.48E-01	1.26E-01	1.04E-01	8.37E-02	6.25
2S2P 3PO TO 2P2P 1SE	2.22E-02	2.20E-02	2.12E-02	2.01E-02	1.85E-02	1.65E-02	1.41E-02	1.17E-02	9.12E-03	6.24
2S2P 1PO TO 2P2P 3PE	2.85E-01	2.39E-01	2.01E-01	1.69E-01	1.42E-01	1.18E-01	9.61E-02	7.64E-02	5.89E-02	6.31
2S2P 1PO TO 2P2P 1DE	5.55E+00	5.60E+00	5.71E+00	5.93E+00	6.25E+00	6.67E+00	7.19E+00	7.80E+00	8.48E+00	6.00
2S2P 1PO TO 2P2P 1SE	1.75E+00	1.77E+00	1.80E+00	1.87E+00	1.97E+00	2.11E+00	2.27E+00	2.47E+00	2.70E+00	5.97
2P2P 3PE J=0 TO 2P2P 3PE J=1	2.16E-01	1.98E-01	1.79E-01	1.60E-01	1.41E-01	1.23E-01	1.04E-01	8.61E-02	6.83E-02	6.25
2P2P 3PE J=0 TO 2P2P 3PE J=2	1.29E-01	1.19E-01	1.10E-01	1.02E-01	9.51E-02	8.94E-02	8.47E-02	8.10E-02	7.81E-02	6.07
2P2P 3PE J=1 TO 2P2P 3PE J=2	5.60E-01	5.15E-01	4.71E-01	4.29E-01	3.91E-01	3.56E-01	3.26E-01	2.99E-01	2.77E-01	6.11
2P2P 3PE TO 2P2P 1DE	8.60E-01	8.21E-01	7.70E-01	7.09E-01	6.36E-01	5.54E-01	4.67E-01	3.78E-01	2.94E-01	6.29
2P2P 3PE TO 2P2P 1SE	8.82E-02	8.64E-02	8.24E-02	7.64E-02	6.95E-02	6.93E-02	4.94E-02	3.95E-02	3.02E-02	6.31
2P2P 1DE TO 2P2P 1SE	1.74E-01	1.75E-01	1.76E-01	1.79E-01	1.83E-01	1.88E-01	1.96E-01	2.06E-01	2.17E-01	6.00

TABLE XIII. Effective Collision Strengths for Si XI

See page 200 for Explanation of Tables

TRANSITION	LOG(ELECTRON TEMPERATURE)									LOG T H
	5.40	5.60	5.80	6.00	6.20	6.40	6.60	6.80	7.00	
2S2S 1SE TO 2S2P 3PO	8.91E-02	7.88E-02	6.91E-02	6.02E-02	5.19E-02	4.39E-02	3.58E-02	2.81E-02	2.13E-02	6.58
2S2S 1SE TO 2S2P 1PO	1.03E+00	1.06E+00	1.09E+00	1.13E+00	1.19E+00	1.27E+00	1.36E+00	1.47E+00	1.59E+00	6.25
2S2S 1SE TO 2P2P 3PE	2.01E-03	1.87E-03	1.72E-03	1.55E-03	1.37E-03	1.17E-03	9.56E-04	7.50E-04	5.65E-04	6.54
2S2S 1SE TO 2P2P 1DE	1.06E-02	1.04E-02	1.02E-02	1.00E-02	9.81E-03	9.62E-03	9.45E-03	9.33E-03	9.23E-03	6.28
2S2S 1SE TO 2P2P 1SE	3.86E-03	3.84E-03	3.80E-03	3.73E-03	3.63E-03	3.51E-03	3.38E-03	3.24E-03	3.10E-03	6.28
2S2P 3PO J=0 TO 2S2P 3PO J=1	2.18E-01	1.84E-01	1.50E-01	1.20E-01	9.54E-02	7.49E-02	5.81E-02	4.40E-02	3.24E-02	6.64
2S2P 3PO J=0 TO 2S2P 3PO J=2	2.00E-01	1.64E-01	1.30E-01	1.01E-01	7.97E-02	6.41E-02	5.34E-02	4.61E-02	4.13E-02	6.44
2S2P 3PO J=1 TO 2S2P 3PO J=2	6.95E-01	5.80E-01	4.67E-01	3.70E-01	2.93E-01	2.35E-01	1.91E-01	1.59E-01	1.35E-01	6.48
2S2P 3PO TO 2S2P 1PO	2.40E-01	2.03E-01	1.72E-01	1.45E-01	1.21E-01	9.73E-02	7.46E-02	5.45E-02	3.82E-02	7.00
2S2P 3PO J=0 TO 2P2P 3PE J=0	4.05E-03	3.92E-03	3.73E-03	3.46E-03	3.12E-03	2.72E-03	2.29E-03	1.87E-03	1.48E-03	6.47
2S2P 3PO J=0 TO 2P2P 3PE J=1	5.29E-01	5.41E-01	5.57E-01	5.80E-01	6.09E-01	6.47E-01	6.92E-01	7.46E-01	8.05E-01	6.24
2S2P 3PO J=0 TO 2P2P 3PE J=2	5.44E-03	5.26E-03	4.99E-03	4.65E-03	4.21E-03	3.71E-03	3.16E-03	2.61E-03	2.09E-03	6.45
2S2P 3PO J=1 TO 2P2P 3PE J=0	5.20E-01	5.32E-01	5.50E-01	5.74E-01	6.05E-01	6.44E-01	6.91E-01	7.46E-01	8.06E-01	6.23
2S2P 3PO J=1 TO 2P2P 3PE J=1	4.12E-01	4.21E-01	4.32E-01	4.49E-01	4.70E-01	4.96E-01	5.29E-01	5.68E-01	6.12E-01	6.24
2S2P 3PO J=1 TO 2P2P 3PE J=2	6.73E-01	6.87E-01	7.07E-01	7.35E-01	7.71E-01	8.17E-01	8.73E-01	9.38E-01	1.01E+00	6.24
2S2P 3PO J=2 TO 2P2P 3PE J=0	5.42E-03	5.23E-03	4.98E-03	4.63E-03	4.20E-03	3.70E-03	3.16E-03	2.61E-03	2.10E-03	6.45
2S2P 3PO J=2 TO 2P2P 3PE J=1	6.73E-01	6.88E-01	7.08E-01	7.36E-01	7.72E-01	8.17E-01	8.72E-01	9.37E-01	1.01E+00	6.24
2S2P 3PO J=2 TO 2P2P 3PE J=2	2.01E+00	2.06E+00	2.12E+00	2.20E+00	2.31E+00	2.45E+00	2.62E+00	2.82E+00	3.04E+00	6.24
2S2P 3PO TO 2P2P 1DE	8.57E-02	8.29E-02	7.88E-02	7.30E-02	6.47E-02	5.41E-02	4.24E-02	3.15E-02	2.23E-02	7.00
2S2P 3PO TO 2P2P 1SE	1.06E-02	1.04E-02	9.92E-03	9.20E-03	8.20E-03	6.89E-03	5.42E-03	4.02E-03	2.84E-03	7.00
2S2P 1PO TO 2P2P 3PE	7.46E-02	6.66E-02	5.94E-02	5.24E-02	4.55E-02	3.84E-02	3.13E-02	2.46E-02	1.86E-02	6.53
2S2P 1PO TO 2P2P 1DE	2.84E+00	2.90E+00	3.00E+00	3.13E+00	3.30E+00	3.49E+00	3.71E+00	3.96E+00	4.23E+00	6.24
2S2P 1PO TO 2P2P 1SE	9.21E-01	9.39E-01	9.66E-01	1.01E+00	1.06E+00	1.12E+00	1.21E+00	1.30E+00	1.41E+00	6.22
2P2P 3PE J=0 TO 2P2P 3PE J=1	6.87E-02	6.60E-02	6.24E-02	5.78E-02	5.22E-02	4.57E-02	3.85E-02	3.11E-02	2.40E-02	6.47
2P2P 3PE J=0 TO 2P2P 3PE J=2	4.24E-02	4.15E-02	4.05E-02	3.94E-02	3.82E-02	3.72E-02	3.64E-02	3.59E-02	3.55E-02	6.29
2P2P 3PE J=1 TO 2P2P 3PE J=2	1.81E-01	1.76E-01	1.69E-01	1.61E-01	1.52E-01	1.42E-01	1.34E-01	1.26E-01	1.20E-01	6.33
2P2P 3PE TO 2P2P 1DE	3.42E-01	3.29E-01	3.11E-01	2.87E-01	2.55E-01	2.15E-01	1.69E-01	1.25E-01	8.89E-02	7.00
2P2P 3PE TO 2P2P 1SE	4.01E-02	3.83E-02	3.57E-02	3.23E-02	2.79E-02	2.27E-02	1.74E-02	1.27E-02	8.81E-03	7.00
2P2P 1DE TO 2P2P 1SE	7.87E-02	7.92E-02	7.98E-02	8.05E-02	8.18E-02	8.39E-02	8.69E-02	9.05E-02	9.43E-02	6.23