

ELECTRON IMPACT EXCITATION OF FINE-STRUCTURE LEVELS IN SULFUR-LIKE Fe XI

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ABSTRACT

Collision strengths for electron impact excitation of fine-structure levels in sulfur-like Fe XI are calculated in a semirelativistic R -matrix approach. The 38 fine-structure levels arising from the 20 LS states $3s^23p^4\ ^3P, ^1D, ^1S; 3s3p^5\ ^3P^o, ^1P^o; 3s^23p^3(^4S^o)3d\ ^3D^o, 3s^23p^3(^2P^o)3d\ ^{1,3}P^o, ^{1,3}D^o, ^{1,3}F^o, 3s^23p^3(^2D^o)3d\ ^{1,3}S^o, ^{1,3}P^o, ^{1,3}D^o, ^{1,3}F^o$ are included in our calculation. The target levels are represented by configuration interaction wave functions. The relativistic effects are considered in the Breit-Pauli approximation by including one-body mass correction, Darwin term, and spin-orbit terms in the scattering equations. Collision strengths for transitions from the $3s^23p^4\ ^3P_{2,1,0}$ levels to the fine-structure levels of the $3s^23p^33d$ configuration are compared with the distorted-wave results of Bhatia & Doschek at 8.0, 16.0, 24.0 ryd. There are some significant discrepancies between the two calculations, mostly caused by the difference in target wave functions. The collision strengths are integrated over a Maxwellian distribution of electron energies to obtain effective collision strengths over the temperature range from 5×10^5 to 5×10^6 K.

Subject headings: atomic data — atomic processes

1. INTRODUCTION

Several emission lines arising from transitions among the fine-structure levels of the $3s^23p^4$, $3s3p^5$, and $3s^23p^33d$ configurations of Fe XI have been observed in the ultraviolet (UV) and extreme-ultraviolet (EUV) solar spectra obtained by the solar EUV Rocket Telescope and Spectrograph (Thomas & Neupert 1994) and by the *Skylab* experiments (Feldman 1981; Dere 1982). Fe XI lines have also been observed extensively in the spectra of late-type stars (Drake, Laming, & Widing 1995a, 1995b) obtained by the *Extreme Ultraviolet Explorer (EUVE)* in the spectral range from 170 to 400 Å. The resonance and forbidden transitions of Fe XI are detected in the EUV coronal spectra of χ^1 Orionis (Haisch, Drake, & Schmitt 1994). These include Fe XI lines at 178.10, 179.76, 180.40, 181.10, 182.20, 184.70, 188.22, 189.10, 189.70, 192.02, 201.74, and 204.60 Å, which arise from $3s^23p^4$ – $3s^23p^33d$ transitions. These lines have great diagnostic potential to determine temperatures, densities, and abundances in the solar flare and active region as well in late-type stars.

Electron impact excitation collision strengths and spontaneous radiative rates among the 48 levels of the configurations $3s^23p^4$, $3s3p^5$, $3s^23p^33d$, and $3p^6$ in Fe XI were recently reported by Bhatia & Doschek (1996). They reported collision strengths above the highest excitation threshold at 8.0, 16.0, and 24.0 ryd and did not include resonance effects in their distorted wave calculation. Mason (1975) calculated collision strengths at 8.0 ryd using a distorted wave approach. Fawcett (1986) presented a systematic study of the energy levels of a number of S-like ions including Fe XI. Sugar & Corliss (1985) compiled the measured energy levels of iron ions. Wang, Marotta, & Raju (1984a) measured relative values of the electron collisional excitation rate coefficients of Fe XI using a theta pinch device, and Wang, Raju, & Griem (1984b) deduced absolute excitation rate coefficients of Fe XI from the relative excitation rates using the absolute excitation rate coefficients of Fe X as a standard.

Recently, Gupta & Tayal (1999) carried out fairly extensive semirelativistic R -matrix calculation for electron impact excitation of Fe XI by including electron correlation, relativistic, and resonance effects. The relativistic effects were included in the Breit-Pauli approximation via the one-body mass correction, Darwin, and spin-orbit interaction terms in the scattering equations (Scott & Burke 1980). In that work, 20 LS $3s^23p^4\ ^3P, ^1D, ^1S; 3s3p^5\ ^3P^o, ^1P^o; 3s^23p^3(^4S^o)3d\ ^3D^o, 3s^23p^3(^2P^o)3d\ ^{1,3}P^o, ^{1,3}D^o, ^{1,3}F^o, 3s^23p^3(^2D^o)3d\ ^{1,3}S^o, ^{1,3}P^o, ^{1,3}D^o, ^{1,3}F^o$ states of Fe XI were considered which were represented by configuration interaction (CI) wave functions. These 20 LS states give rise to 38 fine-structure levels in the intermediate coupling scheme comprised of five even-parity states and 33 odd-parity states of different values of the total quantum number J . The total collision strengths and effective collision strengths for transitions between the levels of $3s^23p^4$ configuration and from the $3s^23p^4\ ^3P_{2,1,0}, ^1D_2, ^1S_0$ levels to the levels of the excited $3s3p^5$ configuration of Fe XI are reported in our earlier work (Gupta & Tayal 1999). The present study extends our earlier work to the transitions involving all the higher levels belonging to the $3s^23p^33d$ configuration. The contributions from higher partial waves are calculated using the Bethe approximation (Burgess & Sheorey 1974). The effective collision strengths are presented for all transitions among the 38 fine-structure levels excluding those already reported in our earlier work (Gupta & Tayal 1999).

2. COLLISION CALCULATION

We chose the 1s, 2s, 2p, 3s, and 3p radial functions as the Hartree-Fock functions given by Clementi & Roetti (1974) for the ground $3s^23p^4\ ^3P$ state. The radial functions $3d$ and $4f$ are chosen to give the best over all representation of the energies of the states. The details of the J -dependent CI wave functions for 38 fine-structure levels are given in Gupta & Tayal (1999). The optimized parameters of the orbitals and the details of the calculated excitation energies and the oscillator strengths using these orbitals can be found in Deb & Tayal (1998). We have presented our calculated excitation energies for 38 fine-structure levels in Table 1, which are compared with the experimental energies compiled by Sugar & Corliss (1985).

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TABLE 1

COMPARISON OF CALCULATED AND EXPERIMENTAL ENERGY LEVELS
(IN AU) OF Fe XI

Key	Level	J	Present Calculation	Experiment
1	$3s^23p^4\ ^3P$	2	0.0	0.0
2		1	0.0534	0.0577
3		0	0.0616	0.0652
4	$3s^23p^4\ ^1D$	2	0.1754	0.1720
5	$3s^23p^4\ ^1S$	0	0.3649	0.3682
6	$3s3p^5\ ^3P^o$	2	1.2765	1.2920
7		1	1.3183	1.3357
8		0	1.3435	1.3631
9	$3s3p^5\ ^1P^o$	1	1.6728	1.6487
10	$3s^23p^3(^2D)3d\ ^3D^o$	2	1.9202	
11		3	1.9272	
12		1	1.9334	
13	$3s^23p^3(^2D)3d\ ^1S^o$	0	1.9607	
14	$3s^23p^3(^2D)3d\ ^3F^o$	2	2.0356	
15		3	2.0564	
16		4	2.0810	
17	$3s^23p^3(^2P)3d\ ^1D^o$	2	2.1714	
18	$3s^23p^3(^2P)3d\ ^3P^o$	0	2.2391	
19	$3s^23p^3(^2P)3d\ ^3D^o$	1	2.2414	
20	$3s^23p^3(^2P)3d\ ^3P^o$	1	2.2520	
21	$3s^23p^3(^2P)3d\ ^3D^o$	2	2.2716	
22	$3s^23p^3(^2P)3d\ ^3P^o$	2	2.2911	2.2603
23	$3s^23p^3(^2P)3d\ ^3F^o$	4	2.3065	
24	$3s^23p^3(^2P)3d\ ^3D^o$	3	2.3081	
25	$3s^23p^3(^2P)3d\ ^3F^o$	3	2.3210	
26		2	2.3335	
27	$3s^23p^3(^2D)3d\ ^3S^o$	1	2.4324	2.3988
28	$3s^23p^3(^2D)3d\ ^3P^o$	2	2.4715	2.4207
29	$3s^23p^3(^2D)3d\ ^1P^o$	1	2.4720	2.4306
30	$3s^23p^3(^2P)3d\ ^1F^o$	3	2.5032	
31	$3s^23p^3(^2D)3d\ ^3P^o$	1	2.5117	2.4668
32		0	2.5130	2.4683
33	$3s^23p^3(^4S)3d\ ^3D^o$	3	2.6042	2.5256
34		2	2.6366	2.5589
35		1	2.6555	2.5806
36	$3s^23p^3(^2D)3d\ ^1D^o$	2	2.7459	2.6375
37	$3s^23p^3(^2D)3d\ ^1F^o$	3	2.8790	2.7066
38	$3s^23p^3(^2P)3d\ ^1P^o$	1	2.9117	2.8390

The scattering wave function for each total angular momentum J and parity π combination is expanded in the inner region ($r \leq a$) in the R -matrix basis as (Scott & Taylor 1982; Berrington et al. 1987)

$$\Psi_k(J\pi) = A \sum_{ij} c_{ijk} \Phi_i^J(x_1, x_2, \dots, x_N; r_{N+1}, \sigma_{N+1}) \times u_{ij}(r_{N+1}) + \sum_j d_{jk} \phi_j^J(x_1, x_2, \dots, x_{N+1}), \quad (1)$$

where A is the antisymmetrization operator, Φ_i^J are channel functions representing the 38 fine-structure atomic levels coupled with the angular and spin functions of the scattered electron to form channel functions of J and π , the ϕ_j^J are $(N+1)$ -electron bound configurations formed from the atomic orbitals and are included to ensure completeness of the total wave function expansion and to allow for short range electron correlations, and the u_{ij} are the orthogonal set of continuum basis. The coefficients c_{ijk} and d_{jk} are obtained by diagonalizing the $(N+1)$ -electron Breit-Pauli Hamiltonian in the inner region. We have chosen a boundary radius $a = 3.4$ au and included 19 continuum orbitals for each angular momentum to obtain convergence in the

energy range up to 40 ryd. The maximum number of channels retained in the first expansion in equation (1) is 147. The coupled equations are solved in the asymptotic region using a perturbation method to yield K -matrices and then the collision strengths. The R -matrix method is used to calculate partial collision strengths from $J = 0.5$ to $J = 17.5$. The contribution from the higher partial waves, needed for the dipole-allowed transitions, are calculated using the Bethe approximation (Burgess & Sheorey 1974).

Finally, the effective collision strengths are calculated by integrating the total collision strengths over a Maxwellian distribution of electron energies,

$$\gamma(i \rightarrow f) = \int_0^\infty \Omega(i \rightarrow f) \exp(-\epsilon_f/kT) d(\epsilon_f/kT). \quad (2)$$

Here $\Omega(i \rightarrow f)$ is the total collision strength for transition between levels i and f , ϵ_f is the energy of the incident electron with respect to upper level f , T is the electron temperature, and k is the Boltzmann constant.

3. DISCUSSION OF RESULTS

We present in Table 2 our collision strengths for transitions between the $3s^23p^4\ ^3P_{2,1,0}$ levels and from these levels to the remaining 35 fine-structure levels at incident electron energies 8.0, 16.0, and 24.0 ryd. The collision strengths for low-lying excitation levels were reported by Gupta & Tayal (1999) and are included here in Table 2 for the sake of completeness. These energies are above highest excitation threshold where resonances do not occur. Our results are compared with the distorted-wave calculation of Bhatia & Doschek (1996). The key of lower and upper levels involved in a transition are given in Table 1. It is clear from Table 2 that there are large differences between the two calculations for many transitions. These differences are perhaps caused by electron correlation effects in both target and scattering wave functions considered in the two calculations. For example, the present collision strengths for the $3s^23p^4\ ^3P_2-3s^23p^3(^2D)3d\ ^3P_2^o$, $3s^23p^4\ ^3P_2-3s^23p^3(^4S)3d\ ^3D_3^o$, $3s^23p^4\ ^3P_1-3s^23p^3(^2D)3d\ ^1P_1^o$, $3s^23p^4\ ^3P_1-3s^23p^3(^4S)3d\ ^3D_2^o$, and $3s^23p^4\ ^3P_0-3s^23p^3(^2D)3d\ ^1P_0^o$ transitions are smaller by a factor of 1.6, 1.4, 3, 1.3, and 2.3, respectively, than the results of Bhatia & Doschek (1996). There are similar differences between the oscillator strengths for these transitions obtained from wave functions used in the present work (Deb & Tayal 1998) and that reported by Bhatia & Doschek (1996). It is also worth mentioning that the lower level of the $3s^23p^4\ ^3P_1-3s^23p^3(^2D)3d\ ^1P_1^o$ and $3s^23p^4\ ^3P_0-3s^23p^3(^2D)3d\ ^1P_0^o$ transitions mixes very strongly with the levels $3s3p^5\ ^1P_1^o$ and $3s^23p^3(^2D)3d\ ^3S_0^o$ and may be the cause of difference between the two calculations for these transitions.

For many transitions we found complicated resonance structure in the collision strengths in the threshold energy region. To account for these important resonance effects, the collision strengths are integrated over a Maxwellian distribution of electron energies in the threshold region to give the effective collision strengths (eq. [2]). In Table 3, we have tabulated our results of effective collision strengths for eight electron temperature from 5×10^5 to 5×10^6 K, which covers the temperature of formation of Fe XI ions in solar corona under the conditions of ionization equilibrium. The keys of lower and upper levels of a transition are given in Table 1.

TABLE 2
COLLISION STRENGTHS FOR ELECTRON EXCITATION OF FINE-STRUCTURE LEVELS IN Fe XI

Transition	Present (8.0 ryd)	BD	Present (16.0 ryd)	BD	Present (24.0 ryd)	BD
1-2	2.33(-1)	2.90(-1)	2.08(-1)	2.61(-1)	1.95(-1)	2.48(-1)
1-3	9.35(-2)	1.21(-1)	9.04(-2)	1.16(-1)	8.82(-2)	1.14(-1)
1-4	1.40(-1)	1.26(-1)	1.12(-1)	9.61(-2)	9.64(-2)	8.15(-2)
1-5	7.61(-3)	7.49(-3)	5.20(-3)	4.51(-3)	4.17(-3)	3.27(-3)
1-6	1.15	1.36	1.21	1.49	1.25	1.58
1-7	3.88(-1)	4.67(-1)	4.14(-1)	5.07(-1)	4.30(-1)	5.37(-1)
1-8	5.09(-3)	4.13(-3)	3.16(-3)	2.74(-3)	2.21(-3)	1.88(-3)
1-9	8.19(-2)	6.77(-2)	5.92(-2)	5.77(-2)	5.18(-2)	5.16(-2)
1-10	5.99(-2)	1.75(-2)	4.80(-2)	1.22(-2)	4.21(-2)	9.51(-3)
1-11	6.87(-2)	3.13(-2)	4.78(-2)	2.55(-2)	3.70(-2)	2.30(-2)
1-12	1.85(-2)	1.81(-2)	1.70(-2)	1.69(-2)	1.67(-2)	1.67(-2)
1-13	9.49(-3)	8.57(-3)	6.49(-3)	5.53(-3)	4.49(-3)	3.74(-3)
1-14	2.28(-2)	5.67(-2)	1.86(-2)	4.69(-2)	1.58(-2)	4.21(-2)
1-15	3.34(-2)	6.12(-2)	3.05(-2)	4.61(-2)	2.87(-2)	3.78(-2)
1-16	3.87(-2)	4.74(-2)	3.47(-2)	4.18(-2)	3.26(-2)	3.99(-2)
1-17	2.62(-2)	3.50(-2)	2.07(-2)	2.72(-2)	1.70(-2)	2.28(-2)
1-18	2.96(-3)	2.42(-3)	1.52(-3)	1.38(-3)	9.38(-4)	8.40(-4)
1-19	5.58(-2)	2.50(-2)	6.19(-2)	2.54(-2)	6.53(-2)	2.64(-2)
1-20	1.31(-1)	9.78(-2)	1.51(-1)	1.12(-1)	1.61(-1)	1.23(-1)
1-21	6.25(-2)	2.66(-2)	6.74(-2)	2.67(-2)	6.99(-2)	2.76(-2)
1-22	3.75(-1)	2.15(-1)	4.39(-1)	2.52(-1)	4.76(-1)	2.80(-1)
1-23	3.20(-2)	1.78(-2)	2.02(-2)	1.17(-2)	1.53(-2)	8.62(-3)
1-24	1.78(-2)	8.07(-2)	1.34(-2)	8.87(-2)	1.32(-2)	9.53(-2)
1-25	7.78(-2)	2.09(-2)	8.42(-2)	2.03(-2)	8.75(-2)	2.08(-2)
1-26	1.20(-2)	5.54(-3)	1.28(-2)	3.62(-3)	1.34(-2)	2.59(-3)
1-27	1.72	1.78	2.09	2.11	2.31	2.35
1-28	3.91	6.29	4.69	7.51	5.19	8.40
1-29	5.66(-1)	1.66	6.64(-1)	1.98	7.33(-1)	2.21
1-30	7.94(-2)	3.65(-2)	8.78(-2)	3.78(-2)	9.21(-2)	4.00(-2)
1-31	3.45(-1)	6.52(-2)	4.11(-1)	7.65(-2)	4.53(-1)	8.51(-2)
1-32	3.54(-3)	1.30(-3)	2.07(-3)	7.95(-4)	1.44(-3)	5.20(-4)
1-33	6.64	9.16	8.01	11.01	8.83	12.36
1-34	9.86(-1)	1.05	1.19	1.25	1.33	1.40
1-35	6.81(-2)	6.63(-2)	7.86(-2)	7.63(-2)	8.58(-2)	8.41(-2)
1-36	2.66(-2)	2.82(-2)	2.30(-2)	2.84(-2)	2.18(-2)	2.92(-2)
1-37	7.21(-2)	4.22(-2)	7.19(-2)	3.87(-2)	7.33(-2)	3.79(-2)
1-38	5.81(-3)	4.86(-3)	3.52(-3)	3.15(-3)	2.46(-3)	2.28(-3)
2-3	3.68(-2)	3.60(-2)	2.25(-2)	2.19(-2)	1.58(-2)	1.49(-2)
2-4	5.94(-2)	6.19(-2)	4.17(-2)	4.05(-2)	3.11(-2)	2.98(-2)
2-5	6.17(-3)	7.50(-3)	3.51(-3)	4.01(-3)	2.26(-3)	2.50(-3)
2-6	4.20(-1)	4.83(-1)	4.35(-1)	5.35(-1)	4.47(-1)	5.75(-1)
2-7	2.53(-1)	2.91(-1)	2.61(-1)	3.14(-1)	2.66(-1)	3.32(-1)
2-8	2.95(-1)	3.57(-1)	3.20(-1)	3.93(-1)	3.33(-1)	4.21(-1)
2-9	3.73(-2)	2.99(-2)	1.99(-2)	2.08(-2)	1.42(-2)	1.51(-2)
2-10	1.14(-2)	2.20(-2)	8.59(-3)	2.15(-2)	7.37(-3)	2.19(-2)
2-11	3.26(-2)	1.58(-2)	2.55(-2)	1.22(-2)	2.22(-2)	1.05(-2)
2-12	2.36(-2)	1.97(-2)	1.54(-2)	1.30(-2)	1.12(-2)	9.23(-3)
2-13	7.10(-3)	6.35(-3)	5.57(-3)	4.66(-3)	4.42(-3)	3.70(-3)
2-14	1.76(-2)	7.61(-3)	1.77(-2)	5.44(-3)	1.81(-2)	4.20(-3)
2-15	1.21(-2)	3.35(-2)	8.53(-3)	2.52(-2)	6.27(-3)	2.07(-3)
2-16	1.85(-2)	1.43(-2)	1.83(-2)	1.16(-2)	1.82(-2)	1.04(-2)
2-17	2.62(-2)	2.79(-2)	1.96(-2)	1.94(-2)	1.52(-2)	1.46(-2)
2-18	1.75(-2)	6.24(-3)	2.00(-2)	6.77(-3)	2.14(-2)	7.14(-3)
2-19	5.85(-3)	1.21(-2)	4.58(-3)	1.20(-2)	4.21(-3)	1.22(-2)
2-20	8.11(-3)	2.77(-3)	7.16(-3)	1.63(-3)	7.12(-3)	1.01(-3)
2-21	1.06(-1)	9.14(-2)	1.20(-1)	1.04(-1)	1.31(-1)	1.15(-1)
2-22	1.08(-1)	6.69(-2)	1.21(-1)	7.54(-2)	1.28(-1)	8.23(-2)
2-23	7.84(-3)	1.85(-2)	6.33(-3)	1.58(-2)	5.62(-3)	1.47(-2)
2-24	2.23(-2)	2.62(-2)	2.21(-2)	2.63(-2)	2.22(-2)	2.70(-2)
2-25	1.12(-2)	1.19(-2)	7.89(-3)	7.31(-3)	7.01(-3)	4.87(-3)
2-26	1.72(-2)	1.57(-2)	1.48(-2)	1.46(-2)	1.38(-2)	1.43(-2)
2-27	5.02(-1)	6.46(-1)	6.06(-1)	7.64(-1)	6.64(-1)	8.51(-1)
2-28	9.61(-1)	1.28	1.14	1.53	1.25	1.71
2-29	4.39(-1)	1.32	5.25(-1)	1.58	5.85(-1)	1.76

TABLE 2—Continued

Transition	Present (8.0 ryd)	BD	Present (16.0 ryd)	BD	Present (24.0 ryd)	BD
2-30	8.76(-3)	9.15(-3)	5.26(-3)	5.45(-3)	3.37(-3)	3.50(-3)
2-31	7.48(-1)	2.10(-1)	8.94(-1)	2.48(-1)	9.85(-1)	2.75(-1)
2-32	1.08	1.59	1.30	1.90	1.44	2.13
2-33	2.02(-2)	1.81(-2)	1.58(-2)	1.47(-2)	1.35(-2)	1.31(-2)
2-34	3.78	5.11	4.57	6.14	5.07	6.90
2-35	1.15	1.56	1.40	1.87	1.56	2.10
2-36	9.75(-2)	4.12(-1)	1.12(-1)	4.90(-1)	1.24(-1)	5.47(-1)
2-37	1.69(-2)	1.69(-2)	1.03(-2)	1.03(-2)	6.87(-3)	6.83(-3)
2-38	1.13(-2)	7.87(-3)	1.10(-2)	7.15(-3)	1.10(-2)	6.95(-3)
3-4	2.31(-2)	2.61(-2)	1.79(-2)	1.91(-2)	1.45(-2)	1.56(-2)
3-5	2.54(-2)	1.79(-3)	2.47(-2)	9.02(-4)	2.41(-2)	5.35(-4)
3-6	1.47(-2)	1.23(-2)	9.00(-3)	8.19(-3)	6.27(-3)	5.62(-3)
3-7	2.96(-1)	3.44(-1)	3.18(-1)	3.84(-1)	3.30(-1)	4.14(-1)
3-8	3.95(-3)	2.98(-3)	2.46(-3)	1.98(-3)	1.71(-3)	1.36(-3)
3-9	1.17(-2)	1.07(-2)	5.96(-3)	8.02(-3)	4.09(-3)	6.33(-3)
3-10	1.15(-2)	5.11(-3)	6.96(-3)	3.25(-3)	4.63(-3)	2.20(-3)
3-11	5.19(-3)	7.23(-3)	5.20(-3)	7.91(-3)	5.42(-3)	8.62(-3)
3-12	4.02(-3)	3.65(-3)	2.56(-3)	2.38(-3)	1.84(-3)	1.62(-3)
3-13	1.94(-3)	1.68(-3)	1.35(-3)	1.09(-3)	9.35(-4)	7.38(-4)
3-14	4.72(-3)	1.09(-2)	3.12(-3)	6.85(-3)	2.11(-3)	4.54(-3)
3-15	8.55(-3)	4.30(-3)	9.65(-3)	4.16(-3)	1.05(-2)	4.18(-3)
3-16	1.63(-3)	1.15(-3)	1.11(-3)	7.20(-4)	7.59(-4)	4.87(-4)
3-17	1.03(-2)	1.10(-2)	6.95(-3)	7.04(-3)	4.76(-3)	4.75(-3)
3-18	9.87(-5)	4.60(-5)	6.96(-5)	2.90(-5)	4.53(-5)	1.90(-5)
3-19	5.16(-2)	3.80(-2)	5.86(-2)	4.42(-2)	6.34(-2)	4.93(-2)
3-20	4.84(-3)	4.53(-3)	4.32(-3)	4.47(-3)	4.21(-3)	4.45(-3)
3-21	2.33(-3)	1.92(-3)	1.50(-3)	1.20(-3)	1.02(-3)	7.87(-4)
3-22	4.59(-3)	3.06(-3)	2.67(-3)	1.79(-3)	1.72(-3)	1.11(-3)
3-23	3.93(-5)	2.27(-3)	1.74(-5)	1.42(-3)	9.72(-6)	9.59(-4)
3-24	1.32(-2)	1.07(-2)	1.46(-2)	1.15(-2)	1.56(-2)	1.23(-2)
3-25	2.47(-3)	8.37(-3)	1.87(-3)	8.15(-3)	1.58(-3)	8.33(-3)
3-26	5.26(-3)	7.14(-3)	2.73(-3)	4.36(-3)	1.73(-3)	2.84(-3)
3-27	1.17(-1)	1.77(-1)	1.41(-1)	2.10(-1)	1.54(-1)	2.34(-1)
3-28	4.25(-3)	1.75(-3)	2.41(-3)	1.03(-3)	1.68(-3)	6.58(-4)
3-29	4.95(-1)	1.15	5.89(-1)	1.38	6.53(-1)	1.54
3-30	3.24(-3)	2.97(-3)	2.35(-3)	1.85(-3)	1.90(-3)	1.28(-3)
3-31	6.52(-1)	4.19(-1)	7.84(-1)	5.01(-1)	8.67(-1)	5.60(-1)
3-32	1.46(-3)	9.13(-4)	7.71(-4)	5.59(-4)	4.78(-4)	3.69(-4)
3-33	7.00(-3)	6.52(-3)	5.88(-3)	5.77(-3)	5.30(-3)	5.49(-3)
3-34	4.23(-3)	2.82(-3)	2.56(-3)	1.73(-3)	1.67(-3)	1.13(-3)
3-35	1.65	2.25	2.01	2.71	2.24	3.04
3-36	3.80(-3)	3.43(-3)	2.28(-3)	2.10(-3)	1.49(-3)	1.37(-3)
3-37	5.97(-3)	6.03(-3)	3.86(-3)	3.79(-3)	2.75(-3)	2.61(-3)
3-38	8.47(-3)	2.22(-2)	9.16(-3)	2.66(-2)	9.73(-3)	3.00(-2)

NOTE.—Present: relativistic R-matrix calculation. BD: Bhatia & Doschek 1996.

In Table 4 we compare our average excitation rates for four transitions with the measured absolute average rate coefficients of Wang et al. (1984b) and the distorted wave calculation of Mason (1975). For transitions $3p^4-3p^33d\ ^3D_1$ and $3p^4-3p^33d\ ^1D_2$ there is a good agreement between the two calculations, whereas for $3p^4-3p^33d\ ^1F_3$ and $3p^4-3p^33d\ ^3P_2$ transitions our results are lower by 22% and 17%, respectively, with the results of Mason (1975). The calculated and measured values are within the estimated compounded errors of 1.5 to 2.0 factors in the measurements (Wang et al. 1984b).

In conclusion, we reported total collision strengths for transitions from the $3s^23p^4\ ^3P_{2,1,0}$ levels to the fine-

structure levels of $3s^23p^33d$ configuration. For several transitions significant differences are noted with the calculation of Bhatia & Doschek (1996). The effective collision strengths are presented among the fine-structure levels over a wide range of electron temperature suitable for use in plasma modeling. The important electron correlation, relativistic, and resonance effects are included in our calculation. We believe our results to be most extensive and definitive to date and should be useful in plasma modeling.

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TABLE 3
EFFECTIVE COLLISION STRENGTHS FOR TRANSITIONS IN Fe XI

TRANSITION	ELECTRON TEMPERATURE (10^5 K)							
	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
1-10.....	2.37(-1)	1.84(-1)	1.62(-1)	1.28(-1)	1.07(-1)	8.29(-2)	6.81(-2)	5.79(-2)
1-11.....	3.45(-1)	2.62(-1)	2.28(-1)	1.75(-1)	1.44(-1)	1.07(-1)	8.64(-2)	7.24(-2)
1-12.....	1.17(-1)	8.77(-2)	7.60(-2)	5.84(-2)	4.84(-2)	3.67(-2)	2.99(-2)	2.52(-2)
1-13.....	2.78(-2)	2.23(-2)	1.99(-2)	1.59(-2)	1.34(-2)	1.03(-2)	8.37(-3)	7.08(-3)
1-14.....	1.26(-1)	1.01(-1)	8.89(-2)	6.97(-2)	5.79(-2)	4.38(-2)	3.53(-2)	2.97(-2)
1-15.....	2.00(-1)	1.60(-1)	1.42(-1)	1.12(-1)	9.37(-2)	7.14(-2)	5.80(-2)	4.90(-2)
1-16.....	2.96(-1)	2.38(-1)	2.11(-1)	1.65(-1)	1.36(-1)	1.02(-1)	8.25(-2)	6.92(-2)
1-17.....	9.74(-2)	7.82(-2)	6.97(-2)	5.57(-2)	4.69(-2)	3.61(-2)	2.95(-2)	2.50(-2)
1-18.....	1.42(-2)	1.08(-2)	9.35(-3)	7.08(-3)	5.74(-3)	4.20(-3)	3.32(-3)	2.75(-3)
1-19.....	9.45(-2)	8.46(-2)	8.07(-2)	7.43(-2)	6.93(-2)	6.06(-2)	5.33(-2)	4.74(-2)
1-20.....	1.74(-1)	1.66(-1)	1.63(-1)	1.57(-1)	1.50(-1)	1.35(-1)	1.20(-1)	1.08(-1)
1-21.....	1.41(-1)	1.21(-1)	1.13(-1)	9.92(-2)	8.98(-2)	7.59(-2)	6.56(-2)	5.76(-2)
1-22.....	4.44(-1)	4.37(-1)	4.35(-1)	4.29(-1)	4.16(-1)	3.78(-1)	3.39(-1)	3.05(-1)
1-23.....	1.94(-1)	1.54(-1)	1.35(-1)	1.04(-1)	8.53(-2)	6.30(-2)	5.01(-2)	4.17(-2)
1-24.....	1.38(-1)	1.08(-1)	9.41(-2)	7.24(-2)	5.95(-2)	4.45(-2)	3.58(-2)	3.00(-2)
1-25.....	1.82(-1)	1.56(-1)	1.45(-1)	1.27(-1)	1.15(-1)	9.64(-2)	8.30(-2)	7.28(-2)
1-26.....	8.32(-2)	6.65(-2)	5.89(-2)	4.64(-2)	3.89(-2)	2.97(-2)	2.42(-2)	2.05(-2)
1-27.....	1.87	1.91	1.93	1.95	1.92	1.77	1.60	1.44
1-28.....	4.18	4.27	4.33	4.37	4.30	3.97	3.58	3.23
1-29.....	6.09(-1)	6.17(-1)	6.23(-1)	6.27(-1)	6.14(-1)	5.65(-1)	5.10(-1)	4.59(-1)
1-30.....	1.19(-1)	1.10(-1)	1.07(-1)	9.98(-2)	9.37(-2)	8.24(-2)	7.25(-2)	6.44(-2)
1-31.....	3.81(-1)	3.85(-1)	3.88(-1)	3.89(-1)	3.81(-1)	3.49(-1)	3.14(-1)	2.83(-1)
1-32.....	1.09(-2)	8.49(-3)	7.48(-3)	5.85(-3)	4.86(-3)	3.67(-3)	2.97(-3)	2.49(-3)
1-33.....	7.22	7.36	7.44	7.50	7.35	6.75	6.09	5.48
1-34.....	1.10	1.11	1.12	1.13	1.11	1.02	9.16(-1)	8.24(-1)
1-35.....	8.60(-2)	8.33(-2)	8.24(-2)	8.03(-2)	7.74(-2)	6.98(-2)	6.24(-2)	5.58(-2)
1-36.....	4.58(-2)	3.96(-2)	3.69(-2)	3.23(-2)	2.90(-2)	2.43(-2)	2.08(-2)	1.82(-2)
1-37.....	9.62(-2)	8.92(-2)	8.62(-2)	8.05(-2)	7.54(-2)	6.59(-2)	5.78(-2)	5.12(-2)
1-38.....	4.77(-3)	4.51(-3)	4.33(-3)	3.91(-3)	3.54(-3)	2.95(-3)	2.51(-3)	2.18(-3)
2-10.....	1.21(-1)	8.93(-2)	7.64(-2)	5.66(-2)	4.54(-2)	3.29(-2)	2.60(-2)	2.15(-2)
2-11.....	1.61(-1)	1.24(-1)	1.08(-1)	8.40(-2)	6.97(-2)	5.29(-2)	4.29(-2)	3.62(-2)
2-12.....	1.03(-1)	7.93(-2)	6.93(-2)	5.35(-2)	4.40(-2)	3.30(-2)	2.65(-2)	2.22(-2)
2-13.....	2.03(-2)	1.63(-2)	1.46(-2)	1.18(-2)	1.01(-2)	7.91(-3)	6.54(-3)	5.59(-3)
2-14.....	1.00(-1)	8.12(-2)	7.24(-2)	5.79(-2)	4.88(-2)	3.78(-2)	3.10(-2)	2.64(-2)
2-15.....	1.19(-1)	9.49(-2)	8.32(-2)	6.36(-2)	5.16(-2)	3.77(-2)	2.97(-2)	2.46(-2)
2-16.....	1.53(-1)	1.25(-1)	1.11(-1)	8.74(-2)	7.26(-2)	5.48(-2)	4.42(-2)	3.72(-2)
2-17.....	7.54(-2)	6.11(-2)	5.48(-2)	4.44(-2)	3.77(-2)	2.94(-2)	2.41(-2)	2.05(-2)
2-18.....	2.50(-2)	2.31(-2)	2.24(-2)	2.13(-2)	2.03(-2)	1.81(-2)	1.61(-2)	1.44(-2)
2-19.....	3.21(-2)	2.45(-2)	2.13(-2)	1.65(-2)	1.37(-2)	1.04(-2)	8.41(-3)	7.10(-3)
2-20.....	3.35(-2)	2.66(-2)	2.36(-2)	1.89(-2)	1.61(-2)	1.26(-2)	1.04(-2)	8.87(-3)
2-21.....	1.56(-1)	1.45(-1)	1.41(-1)	1.34(-1)	1.27(-1)	1.13(-1)	1.00(-1)	8.96(-2)
2-22.....	1.53(-1)	1.44(-1)	1.40(-1)	1.33(-1)	1.26(-1)	1.12(-1)	9.89(-2)	8.82(-2)
2-23.....	8.56(-2)	6.75(-2)	5.90(-2)	4.50(-2)	3.66(-2)	2.68(-2)	2.12(-2)	1.76(-2)
2-24.....	8.00(-2)	6.53(-2)	5.89(-2)	4.85(-2)	4.19(-2)	3.35(-2)	2.81(-2)	2.42(-2)
2-25.....	6.94(-2)	5.41(-2)	4.74(-2)	3.65(-2)	3.00(-2)	2.23(-2)	1.79(-2)	1.50(-2)
2-26.....	5.95(-2)	4.76(-2)	4.25(-2)	3.44(-2)	2.94(-2)	2.32(-2)	1.92(-2)	1.65(-2)
2-27.....	5.52(-1)	5.59(-1)	5.64(-1)	5.67(-1)	5.55(-1)	5.10(-1)	4.60(-1)	4.14(-1)
2-28.....	1.03	1.05	1.06	1.07	1.05	9.62(-1)	8.68(-1)	7.81(-1)
2-29.....	4.76(-1)	4.84(-1)	4.89(-1)	4.94(-1)	4.86(-1)	4.49(-1)	4.06(-1)	3.66(-1)
2-30.....	2.98(-2)	2.34(-2)	2.06(-2)	1.61(-2)	1.33(-2)	9.94(-3)	7.98(-3)	6.68(-3)
2-31.....	7.96(-1)	8.14(-1)	8.24(-1)	8.32(-1)	8.17(-1)	7.52(-1)	6.78(-1)	6.11(-1)
2-32.....	1.14	1.17	1.19	1.21	1.19	1.10	9.90(-1)	8.93(-1)
2-33.....	3.85(-2)	3.22(-2)	2.95(-2)	2.50(-2)	2.20(-2)	1.79(-2)	1.51(-2)	1.31(-2)
2-34.....	4.09	4.17	4.23	4.27	4.19	3.86	3.48	3.13
2-35.....	1.25	1.28	1.29	1.31	1.28	1.18	1.07	9.61(-1)
2-36.....	1.13(-1)	1.12(-1)	1.12(-1)	1.11(-1)	1.08(-1)	9.88(-2)	8.88(-2)	7.97(-2)
2-37.....	2.84(-2)	2.36(-2)	2.14(-2)	1.76(-2)	1.51(-2)	1.18(-2)	9.75(-3)	8.30(-3)
2-38.....	1.11(-2)	1.11(-2)	1.10(-2)	1.08(-2)	1.03(-2)	9.23(-3)	8.18(-3)	7.29(-3)
3-10.....	4.90(-2)	3.76(-2)	3.28(-2)	2.52(-2)	2.06(-2)	1.53(-2)	1.22(-2)	1.02(-2)
3-11.....	3.85(-2)	2.92(-2)	2.54(-2)	1.96(-2)	1.62(-2)	1.23(-2)	1.00(-2)	8.46(-3)
3-12.....	3.30(-2)	2.45(-2)	2.10(-2)	1.56(-2)	1.25(-2)	9.06(-3)	7.14(-3)	5.90(-3)
3-13.....	5.19(-3)	4.28(-3)	3.86(-3)	3.13(-3)	2.65(-3)	2.05(-3)	1.68(-3)	1.42(-3)
3-14.....	3.07(-2)	2.41(-2)	2.11(-2)	1.62(-2)	1.32(-2)	9.68(-3)	7.68(-3)	6.37(-3)
3-15.....	5.49(-2)	4.57(-2)	4.10(-2)	3.31(-2)	2.81(-2)	2.18(-2)	1.80(-2)	1.53(-2)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
3-16.....	3.82(-2)	3.04(-2)	2.65(-2)	2.01(-2)	1.61(-2)	1.16(-2)	9.02(-3)	7.39(-3)
3-17.....	3.00(-2)	2.42(-2)	2.16(-2)	1.73(-2)	1.45(-2)	1.11(-2)	9.06(-3)	7.65(-3)
3-18.....	1.59(-3)	1.16(-3)	9.82(-4)	7.15(-4)	5.65(-4)	4.00(-4)	3.11(-4)	2.54(-4)
3-19.....	6.01(-2)	5.87(-2)	5.84(-2)	5.75(-2)	5.57(-2)	5.07(-2)	4.55(-2)	4.09(-2)
3-20.....	1.14(-2)	9.22(-3)	8.37(-3)	7.08(-3)	6.26(-3)	5.17(-3)	4.41(-3)	3.84(-3)
3-21.....	1.49(-2)	1.15(-2)	1.00(-2)	7.62(-3)	6.19(-3)	4.53(-3)	3.58(-3)	2.97(-3)
3-22.....	1.94(-2)	1.54(-2)	1.36(-2)	1.06(-2)	8.68(-3)	6.44(-3)	5.14(-3)	4.28(-3)
3-23.....	1.86(-2)	1.44(-2)	1.25(-2)	9.25(-3)	7.32(-3)	5.16(-3)	3.98(-3)	3.24(-3)
3-24.....	3.30(-2)	2.83(-2)	2.63(-2)	2.29(-2)	2.07(-2)	1.74(-2)	1.50(-2)	1.32(-2)
3-25.....	1.98(-2)	1.55(-2)	1.35(-2)	1.04(-2)	8.47(-3)	6.25(-3)	4.97(-3)	4.14(-3)
3-26.....	2.15(-2)	1.69(-2)	1.48(-2)	1.14(-2)	9.32(-3)	6.88(-3)	5.47(-3)	4.55(-3)
3-27.....	1.33(-1)	1.33(-1)	1.34(-1)	1.34(-1)	1.30(-1)	1.19(-1)	1.07(-1)	9.65(-2)
3-28.....	9.28(-3)	7.30(-3)	6.48(-3)	5.18(-3)	4.37(-3)	3.37(-3)	2.76(-3)	2.33(-3)
3-29.....	5.19(-1)	5.33(-1)	5.40(-1)	5.47(-1)	5.39(-1)	4.98(-1)	4.50(-1)	4.05(-1)
3-30.....	9.45(-3)	7.62(-3)	6.82(-3)	5.49(-3)	4.66(-3)	3.62(-3)	2.98(-3)	2.53(-3)
3-31.....	6.92(-1)	7.09(-1)	7.19(-1)	7.27(-1)	7.15(-1)	6.59(-1)	5.95(-1)	5.36(-1)
3-32.....	2.45(-3)	1.99(-3)	1.79(-3)	1.45(-3)	1.23(-3)	9.59(-4)	7.86(-4)	6.66(-4)
3-33.....	1.22(-2)	1.05(-2)	9.76(-3)	8.48(-3)	7.59(-3)	6.29(-3)	5.37(-3)	4.68(-3)
3-34.....	1.07(-2)	8.39(-3)	7.42(-3)	5.86(-3)	4.91(-3)	3.74(-3)	3.03(-03)	2.56(-3)
3-35.....	1.80	1.84	1.86	1.88	1.85	1.70	1.53	1.38
3-36.....	7.95(-3)	6.45(-3)	5.78(-3)	4.65(-3)	3.93(-3)	3.03(-3)	2.47(-3)	2.09(-3)
3-37.....	1.09(-2)	8.96(-3)	8.11(-3)	6.68(-3)	5.74(-3)	4.52(-3)	3.74(-3)	3.19(-3)
3-38.....	8.82(-3)	8.89(-3)	8.92(-3)	8.84(-3)	8.55(-3)	7.73(-3)	6.90(-3)	6.17(-3)
4-10.....	1.22(-1)	9.78(-2)	8.64(-2)	6.73(-2)	5.53(-2)	4.11(-2)	3.28(-2)	2.74(-2)
4-11.....	1.83(-1)	1.49(-1)	1.32(-1)	1.03(-1)	8.49(-2)	6.30(-2)	5.02(-2)	4.18(-2)
4-12.....	7.76(-2)	6.37(-2)	5.67(-2)	4.46(-2)	3.69(-2)	2.76(-2)	2.21(-2)	1.85(-2)
4-13.....	4.45(-2)	3.67(-2)	3.24(-3)	2.50(-2)	2.02(-2)	1.46(-2)	1.15(-2)	9.43(-3)
4-14.....	2.29(-1)	1.94(-1)	1.75(-1)	1.40(-1)	1.16(-1)	8.75(-2)	7.03(-2)	5.88(-2)
4-15.....	3.40(-1)	2.88(-1)	2.59(-1)	2.07(-1)	1.73(-1)	1.30(-1)	1.05(-1)	8.80(-2)
4-16.....	4.64(-1)	3.91(-1)	3.51(-1)	2.79(-1)	2.32(-1)	1.75(-1)	1.40(-1)	1.17(-1)
4-17.....	4.71(-1)	4.03(-1)	3.65(-1)	2.98(-1)	2.54(-1)	1.99(-1)	1.65(-1)	1.41(-1)
4-18.....	2.04(-2)	1.67(-2)	1.48(-2)	1.15(-2)	9.41(-3)	6.94(-3)	5.51(-3)	4.57(-3)
4-19.....	9.41(-2)	8.23(-2)	7.63(-2)	6.54(-2)	5.79(-2)	4.75(-2)	4.03(-2)	3.50(-2)
4-20.....	6.43(-2)	5.33(-2)	4.78(-2)	3.82(-2)	3.21(-2)	2.46(-2)	2.00(-2)	1.69(-2)
4-21.....	1.30(-1)	1.06(-1)	9.40(-2)	7.34(-2)	6.04(-2)	4.49(-2)	3.58(-2)	2.99(-2)
4-22.....	1.81(-1)	1.50(-1)	1.33(-1)	1.05(-1)	8.72(-2)	6.55(-2)	5.27(-2)	4.41(-2)
4-23.....	2.51(-1)	2.03(-1)	1.79(-1)	1.37(-1)	1.12(-1)	8.13(-2)	6.41(-2)	5.29(-2)
4-24.....	2.08(-1)	1.68(-1)	1.48(-1)	1.14(-1)	9.33(-2)	6.86(-2)	5.44(-2)	4.51(-2)
4-25.....	2.25(-1)	1.83(-1)	1.62(-1)	1.26(-1)	1.04(-1)	7.75(-2)	6.20(-2)	5.17(-2)
4-26.....	1.64(-1)	1.35(-1)	1.20(-1)	9.54(-2)	7.97(-2)	6.06(-2)	4.92(-2)	4.14(-2)
4-27.....	1.02(-1)	8.87(-2)	8.32(-2)	7.40(-2)	6.75(-2)	5.74(-2)	4.98(-2)	4.38(-2)
4-28.....	2.16(-1)	1.93(-1)	1.82(-1)	1.64(-1)	1.50(-1)	1.28(-1)	1.11(-1)	9.83(-2)
4-29.....	1.95	1.98	2.00	2.02	1.98	1.82	1.64	1.48
4-30.....	2.66(-1)	2.15(-1)	1.92(-1)	1.56(-1)	1.33(-1)	1.05(-1)	8.78(-2)	7.53(-2)
4-31.....	1.56	1.58	1.59	1.60	1.57	1.45	1.31	1.18
4-32.....	2.62(-2)	2.05(-2)	1.78(-2)	1.36(-2)	1.10(-2)	7.99(-3)	6.30(-3)	5.20(-3)
4-33.....	1.32(-1)	1.14(-1)	1.06(-1)	9.35(-2)	8.45(-2)	7.11(-2)	6.13(-2)	5.37(-2)
4-34.....	1.23(-1)	1.03(-1)	9.51(-2)	8.12(-2)	7.20(-2)	5.93(-2)	5.05(-2)	4.40(-2)
4-35.....	5.33(-2)	4.18(-2)	3.68(-2)	2.86(-2)	2.36(-2)	1.78(-2)	1.43(-2)	1.20(-2)
4-36.....	4.30	4.36	4.40	4.42	4.33	3.97	3.58	3.22
4-37.....	7.46	7.56	7.63	7.66	7.49	6.86	6.17	5.54
4-38.....	9.28(-2)	9.47(-2)	9.57(-2)	9.61(-2)	9.38(-2)	8.57(-2)	7.69(-2)	6.90(-2)
5-10.....	1.37(-2)	1.01(-2)	8.61(-3)	6.29(-3)	4.96(-3)	3.49(-3)	2.70(-3)	2.20(-3)
5-11.....	1.68(-2)	1.26(-2)	1.08(-2)	7.97(-3)	6.32(-3)	4.47(-3)	3.47(-3)	2.83(-3)
5-12.....	9.26(-3)	6.76(-3)	5.74(-3)	4.18(-3)	3.31(-3)	2.34(-3)	1.82(-3)	1.48(-3)
5-13.....	2.21(-3)	1.57(-3)	1.32(-3)	9.43(-4)	7.34(-4)	5.09(-4)	3.90(-4)	3.16(-4)
5-14.....	1.91(-2)	1.56(-2)	1.39(-2)	1.08(-2)	8.82(-3)	6.50(-3)	5.15(-3)	4.27(-3)
5-15.....	2.68(-2)	2.18(-2)	1.94(-2)	1.52(-2)	1.25(-2)	9.35(-3)	7.48(-3)	6.24(-3)
5-16.....	3.39(-2)	2.81(-2)	2.52(-2)	1.99(-2)	1.66(-2)	1.25(-2)	1.00(-2)	8.38(-3)
5-17.....	3.69(-2)	2.98(-2)	2.62(-2)	2.02(-2)	1.64(-2)	1.19(-2)	9.40(-3)	7.77(-3)
5-18.....	1.62(-2)	1.39(-2)	1.26(-2)	1.02(-2)	8.57(-3)	6.55(-3)	5.31(-3)	4.47(-3)
5-19.....	2.93(-2)	2.50(-2)	2.26(-2)	1.84(-2)	1.56(-2)	1.21(-2)	9.88(-3)	8.38(-3)
5-20.....	5.43(-2)	4.60(-2)	4.14(-2)	3.31(-2)	2.76(-2)	2.09(-2)	1.69(-2)	1.41(-2)
5-21.....	4.78(-2)	3.93(-2)	3.48(-2)	2.69(-2)	2.19(-2)	1.60(-2)	1.26(-2)	1.04(-2)
5-22.....	9.27(-2)	7.84(-2)	7.05(-2)	5.63(-2)	4.70(-2)	3.55(-2)	2.86(-2)	2.40(-2)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
5-23.....	5.55(-2)	4.64(-2)	4.20(-2)	3.41(-2)	2.90(-2)	2.24(-2)	1.83(-2)	1.55(-2)
5-24.....	6.42(-2)	5.26(-2)	4.65(-2)	3.60(-2)	2.94(-2)	2.15(-2)	1.70(-2)	1.41(-2)
5-25.....	6.06(-2)	5.00(-2)	4.45(-2)	3.50(-2)	2.89(-2)	2.16(-2)	1.73(-2)	1.44(-2)
5-26.....	2.88(-2)	2.37(-2)	2.12(-2)	1.70(-2)	1.42(-2)	1.08(-2)	8.79(-3)	7.40(-3)
5-27.....	7.56(-3)	6.56(-3)	6.12(-3)	5.37(-3)	4.85(-3)	4.08(-3)	3.51(-3)	3.08(-3)
5-28.....	3.16(-2)	2.47(-2)	2.14(-2)	1.59(-2)	1.26(-2)	8.88(-3)	6.86(-3)	5.58(-3)
5-29.....	2.08(-1)	2.05(-1)	2.04(-1)	2.00(-1)	1.93(-1)	1.74(-1)	1.56(-1)	1.39(-1)
5-30.....	2.46(-1)	1.98(-1)	1.75(-1)	1.36(-1)	1.13(-1)	8.49(-3)	6.86(-2)	5.76(-2)
5-31.....	2.57(-1)	2.57(-1)	2.57(-1)	2.54(-1)	2.47(-1)	2.25(-1)	2.02(-1)	1.81(-1)
5-32.....	3.18(-2)	2.50(-2)	2.17(-2)	1.62(-2)	1.29(-2)	9.13(-3)	7.07(-3)	5.77(-3)
5-33.....	8.61(-2)	6.61(-2)	5.69(-2)	4.21(-2)	3.34(-2)	2.36(-2)	1.83(-2)	1.49(-2)
5-34.....	1.27(-1)	9.69(-2)	8.32(-2)	6.12(-2)	4.83(-2)	3.40(-2)	2.62(-2)	2.13(-2)
5-35.....	1.20(-1)	9.16(-2)	7.87(-2)	5.81(-2)	4.61(-2)	3.27(-2)	2.54(-2)	2.07(-2)
5-36.....	3.39(-1)	2.52(-1)	2.15(-1)	1.56(-1)	1.23(-1)	8.63(-2)	6.65(-2)	5.41(-2)
5-37.....	3.08(-1)	2.27(-1)	1.94(-1)	1.43(-1)	1.14(-1)	8.26(-2)	6.51(-2)	5.38(-2)
5-38.....	2.67	2.74	2.79	2.82	2.77	2.55	2.30	2.07
6-7.....	4.22(-1)	4.04(-1)	3.87(-1)	3.47(-1)	3.13(-1)	2.62(-1)	2.25(-1)	1.96(-1)
6-8.....	1.77(-1)	1.53(-1)	1.42(-1)	1.24(-1)	1.11(-1)	9.31(-2)	8.01(-2)	7.01(-2)
6-9.....	2.56(-1)	2.39(-1)	2.21(-1)	1.80(-1)	1.51(-1)	1.13(-1)	9.00(-2)	7.48(-2)
6-10.....	1.58(-1)	1.26(-1)	1.11(-1)	8.35(-2)	6.69(-2)	4.78(-2)	3.72(-2)	3.04(-2)
6-11.....	2.76(-1)	2.24(-1)	1.97(-1)	1.50(-1)	1.20(-1)	8.66(-2)	6.76(-2)	5.55(-2)
6-12.....	7.26(-2)	5.73(-2)	4.98(-2)	3.72(-2)	2.96(-2)	2.10(-2)	1.63(-2)	1.33(-2)
6-13.....	1.76(-2)	1.48(-2)	1.32(-2)	1.02(-2)	8.26(-3)	5.97(-3)	4.67(-3)	3.84(-3)
6-14.....	1.41(-1)	1.19(-1)	1.05(-1)	8.13(-2)	6.58(-2)	4.75(-2)	3.71(-2)	3.05(-2)
6-15.....	2.35(-1)	1.99(-1)	1.77(-1)	1.37(-1)	1.12(-1)	8.14(-2)	6.41(-2)	5.29(-2)
6-16.....	4.47(-1)	3.80(-1)	3.40(-1)	2.66(-1)	2.18(-1)	1.61(-1)	1.28(-1)	1.06(-1)
6-17.....	2.60(-1)	2.19(-1)	1.94(-1)	1.48(-1)	1.19(-1)	8.56(-2)	6.66(-2)	5.45(-2)
6-18.....	1.49(-2)	1.26(-2)	1.14(-2)	9.41(-3)	8.12(-3)	6.45(-3)	5.38(-3)	4.62(-3)
6-19.....	5.10(-2)	4.08(-2)	3.59(-2)	2.78(-2)	2.28(-2)	1.69(-2)	1.35(-2)	1.13(-2)
6-20.....	5.84(-2)	4.72(-2)	4.18(-2)	3.25(-2)	2.68(-2)	2.00(-2)	1.61(-2)	1.35(-2)
6-21.....	1.26(-1)	1.01(-1)	8.91(-2)	6.83(-2)	5.55(-2)	4.06(-2)	3.21(-2)	2.66(-2)
6-22.....	1.93(-1)	1.57(-1)	1.38(-1)	1.05(-1)	8.46(-2)	6.11(-2)	4.79(-2)	3.94(-2)
6-23.....	2.31(-1)	1.81(-1)	1.58(-1)	1.20(-1)	9.80(-2)	7.20(-2)	5.73(-2)	4.76(-2)
6-24.....	1.89(-1)	1.49(-1)	1.29(-1)	9.65(-2)	7.70(-2)	5.47(-2)	4.25(-2)	3.47(-2)
6-25.....	2.41(-1)	1.91(-1)	1.67(-1)	1.26(-1)	1.01(-1)	7.27(-2)	5.69(-2)	4.68(-2)
6-26.....	1.20(-1)	9.43(-2)	8.17(-2)	6.09(-2)	4.84(-2)	3.43(-2)	2.65(-2)	2.16(-2)
6-27.....	8.27(-2)	6.50(-2)	5.66(-2)	4.26(-2)	3.42(-2)	2.46(-2)	1.93(-2)	1.59(-2)
6-28.....	3.06(-1)	2.38(-1)	2.06(-1)	1.54(-1)	1.24(-1)	8.87(-2)	6.94(-2)	5.70(-2)
6-29.....	4.35(-2)	3.37(-2)	2.93(-2)	2.22(-2)	1.79(-2)	1.30(-2)	1.02(-2)	8.42(-3)
6-30.....	5.81(-2)	4.48(-2)	3.87(-2)	2.89(-2)	2.31(-2)	1.65(-2)	1.29(-2)	1.06(-2)
6-31.....	7.63(-2)	5.92(-2)	5.14(-2)	3.88(-2)	3.13(-2)	2.27(-2)	1.78(-2)	1.47(-2)
6-32.....	1.20(-2)	9.49(-3)	8.41(-3)	6.68(-3)	5.62(-3)	4.33(-3)	3.55(-3)	3.01(-3)
6-33.....	1.26(-1)	9.99(-2)	8.84(-2)	6.98(-2)	5.83(-2)	4.45(-2)	3.62(-2)	3.06(-2)
6-34.....	9.73(-2)	7.58(-2)	6.65(-2)	5.18(-2)	4.30(-2)	3.25(-2)	2.63(-2)	2.22(-2)
6-35.....	4.14(-2)	3.19(-2)	2.78(-2)	2.12(-2)	1.74(-2)	1.29(-2)	1.03(-2)	8.58(-3)
6-36.....	3.61(-2)	2.72(-2)	2.35(-2)	1.77(-2)	1.44(-2)	1.06(-2)	8.43(-3)	7.01(-3)
6-37.....	3.14(-2)	2.44(-2)	2.14(-2)	1.66(-2)	1.37(-2)	1.02(-2)	8.18(-3)	6.83(-3)
6-38.....	4.76(-3)	4.43(-3)	4.21(-3)	3.73(-3)	3.33(-3)	2.72(-3)	2.29(-3)	1.97(-3)
7-8.....	1.84(-1)	1.60(-1)	1.45(-1)	1.18(-1)	9.94(-2)	7.56(-2)	6.10(-2)	5.12(-2)
7-9.....	1.22(-1)	1.14(-1)	1.06(-1)	9.03(-2)	7.83(-2)	6.19(-2)	5.13(-2)	4.38(-2)
7-10.....	1.03(-1)	8.20(-2)	7.15(-2)	5.38(-2)	4.32(-2)	3.10(-2)	2.42(-2)	1.98(-2)
7-11.....	9.89(-2)	7.78(-2)	6.75(-2)	5.04(-2)	4.01(-2)	2.84(-2)	2.20(-2)	1.80(-2)
7-12.....	7.25(-2)	5.79(-2)	5.06(-2)	3.83(-2)	3.08(-2)	2.21(-2)	1.73(-2)	1.42(-2)
7-13.....	2.50(-2)	2.14(-2)	1.91(-2)	1.48(-2)	1.19(-2)	8.61(-3)	6.72(-3)	5.51(-3)
7-14.....	1.09(-1)	9.28(-2)	8.30(-2)	6.51(-2)	5.35(-2)	3.95(-2)	3.14(-2)	2.60(-2)
7-15.....	1.33(-1)	1.13(-1)	1.01(-1)	8.00(-2)	6.63(-2)	4.97(-2)	3.99(-2)	3.34(-2)
7-16.....	1.16(-1)	9.49(-2)	8.33(-2)	6.32(-2)	5.07(-2)	3.63(-2)	2.82(-2)	2.31(-2)
7-17.....	1.11(-1)	9.21(-2)	8.13(-2)	6.21(-2)	4.99(-2)	3.58(-2)	2.78(-2)	2.28(-2)
7-18.....	8.81(-3)	6.44(-3)	5.45(-3)	3.93(-3)	3.08(-3)	2.15(-3)	1.66(-3)	1.35(-3)
7-19.....	3.48(-2)	2.72(-2)	2.36(-2)	1.78(-2)	1.43(-2)	1.04(-2)	8.15(-3)	6.72(-3)
7-20.....	5.83(-2)	4.72(-2)	4.17(-2)	3.23(-2)	2.65(-2)	1.96(-2)	1.56(-2)	1.30(-2)
7-21.....	6.23(-2)	4.79(-2)	4.12(-2)	3.05(-2)	2.41(-2)	1.70(-2)	1.32(-2)	1.07(-2)
7-22.....	9.95(-2)	8.11(-2)	7.17(-2)	5.56(-2)	4.56(-2)	3.38(-2)	2.70(-2)	2.25(-2)
7-23.....	1.18(-1)	9.21(-2)	7.98(-2)	5.94(-2)	4.73(-2)	3.35(-2)	2.60(-2)	2.12(-2)
7-24.....	1.11(-1)	8.80(-2)	7.73(-2)	5.98(-2)	4.93(-2)	3.68(-2)	2.96(-2)	2.48(-2)

TABLE 3—Continued

TRANSITION	ELECTRON TEMPERATURE (10^5 K)							
	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
7-25.....	7.20(-2)	5.57(-2)	4.83(-2)	3.61(-2)	2.89(-2)	2.08(-2)	1.62(-2)	1.33(-2)
7-26.....	1.35(-1)	1.07(-1)	9.35(-2)	7.06(-2)	5.67(-2)	4.08(-2)	3.20(-2)	2.63(-2)
7-27.....	4.09(-2)	3.25(-2)	2.86(-2)	2.22(-2)	1.83(-2)	1.37(-2)	1.10(-2)	9.21(-3)
7-28.....	6.27(-2)	4.77(-2)	4.12(-2)	3.09(-2)	2.48(-2)	1.79(-2)	1.41(-2)	1.16(-2)
7-29.....	5.67(-2)	4.40(-2)	3.82(-2)	2.88(-2)	2.32(-2)	1.68(-2)	1.32(-2)	1.09(-2)
7-30.....	4.31(-2)	3.31(-2)	2.86(-2)	2.14(-2)	1.71(-2)	1.22(-2)	9.56(-3)	7.85(-3)
7-31.....	9.29(-2)	7.24(-2)	6.30(-2)	4.78(-2)	3.86(-2)	2.81(-2)	2.22(-2)	1.83(-2)
7-32.....	2.04(-2)	1.53(-2)	1.31(-2)	9.65(-3)	7.65(-3)	5.44(-3)	4.23(-3)	3.46(-3)
7-33.....	3.81(-2)	3.04(-2)	2.70(-2)	2.16(-2)	1.83(-2)	1.42(-2)	1.16(-2)	9.87(-3)
7-34.....	5.91(-2)	4.52(-2)	3.92(-2)	2.96(-2)	2.40(-2)	1.75(-2)	1.39(-2)	1.15(-2)
7-35.....	7.01(-2)	5.49(-2)	4.82(-2)	3.74(-2)	3.10(-2)	2.33(-2)	1.88(-2)	1.58(-2)
7-36.....	2.92(-2)	2.17(-2)	1.85(-2)	1.37(-2)	1.09(-2)	7.73(-3)	6.02(-3)	4.93(-3)
7-37.....	2.70(-2)	2.07(-2)	1.80(-2)	1.37(-2)	1.12(-2)	8.24(-3)	6.55(-3)	5.44(-3)
7-38.....	5.52(-3)	5.26(-3)	5.08(-3)	4.65(-3)	4.26(-3)	3.60(-3)	3.10(-3)	2.71(-3)
8-9.....	2.04(-2)	1.84(-2)	1.70(-2)	1.41(-2)	1.19(-2)	9.19(-3)	7.47(-3)	6.29(-3)
8-10.....	3.08(-2)	2.42(-2)	2.09(-2)	1.56(-2)	1.25(-2)	8.88(-3)	6.91(-3)	5.65(-3)
8-11.....	3.54(-2)	2.86(-2)	2.51(-2)	1.89(-2)	1.52(-2)	1.08(-2)	8.41(-3)	6.87(-3)
8-12.....	3.13(-2)	2.51(-2)	2.19(-2)	1.64(-2)	1.31(-2)	9.33(-3)	7.23(-3)	5.90(-3)
8-13.....	7.58(-3)	6.34(-3)	5.62(-3)	4.31(-3)	3.48(-3)	2.50(-3)	1.94(-3)	1.59(-3)
8-14.....	5.51(-2)	4.76(-2)	4.30(-2)	3.45(-2)	2.88(-2)	2.19(-2)	1.77(-2)	1.49(-2)
8-15.....	2.57(-2)	2.09(-2)	1.84(-2)	1.40(-2)	1.12(-2)	8.04(-3)	6.26(-3)	5.13(-3)
8-16.....	4.36(-2)	3.57(-2)	3.14(-2)	2.38(-2)	1.91(-2)	1.37(-2)	1.07(-2)	8.72(-3)
8-17.....	3.25(-2)	2.69(-2)	2.38(-2)	1.82(-2)	1.46(-2)	1.05(-2)	8.14(-3)	6.66(-3)
8-18.....	6.84(-3)	5.35(-3)	4.64(-3)	3.46(-3)	2.75(-3)	1.95(-3)	1.51(-3)	1.23(-3)
8-19.....	1.46(-2)	1.14(-2)	9.88(-3)	7.34(-3)	5.82(-3)	4.11(-3)	3.17(-3)	2.58(-3)
8-20.....	1.55(-2)	1.20(-2)	1.03(-2)	7.67(-3)	6.08(-3)	4.29(-3)	3.31(-3)	2.70(-3)
8-21.....	1.62(-2)	1.26(-2)	1.10(-2)	8.52(-3)	7.04(-3)	5.30(-3)	4.28(-3)	3.60(-3)
8-22.....	4.66(-2)	3.88(-2)	3.46(-2)	2.74(-2)	2.29(-2)	1.73(-2)	1.40(-2)	1.18(-2)
8-23.....	3.81(-2)	3.00(-2)	2.61(-2)	1.94(-2)	1.55(-2)	1.09(-2)	8.47(-3)	6.91(-3)
8-24.....	4.46(-2)	3.46(-2)	2.99(-2)	2.22(-2)	1.76(-2)	1.24(-2)	9.62(-3)	7.84(-3)
8-25.....	2.58(-2)	1.99(-2)	1.71(-2)	1.27(-2)	1.01(-2)	7.12(-3)	5.51(-3)	4.49(-3)
8-26.....	2.99(-2)	2.35(-2)	2.06(-2)	1.58(-2)	1.29(-2)	9.57(-3)	7.65(-3)	6.38(-3)
8-27.....	1.50(-2)	1.17(-2)	1.01(-2)	7.59(-3)	6.07(-3)	4.34(-3)	3.38(-3)	2.77(-3)
8-28.....	1.21(-2)	9.31(-3)	8.09(-3)	6.16(-3)	5.02(-3)	3.69(-3)	2.94(-3)	2.44(-3)
8-29.....	8.86(-3)	6.64(-3)	5.70(-3)	4.22(-3)	3.37(-3)	2.41(-3)	1.88(-3)	1.54(-3)
8-30.....	1.95(-2)	1.51(-2)	1.30(-2)	9.69(-3)	7.72(-3)	5.49(-3)	4.26(-3)	3.48(-3)
8-31.....	1.47(-2)	1.10(-2)	9.46(-3)	7.02(-3)	5.60(-3)	4.02(-3)	3.14(-3)	2.59(-3)
8-32.....	4.19(-2)	3.29(-2)	2.86(-2)	2.16(-2)	1.74(-2)	1.26(-2)	9.89(-3)	8.14(-3)
8-33.....	6.99(-3)	5.15(-3)	4.40(-3)	3.25(-3)	2.60(-3)	1.86(-3)	1.46(-3)	1.20(-3)
8-34.....	2.14(-2)	1.77(-2)	1.60(-2)	1.31(-2)	1.13(-2)	8.97(-3)	7.45(-3)	6.38(-3)
8-35.....	3.52(-2)	2.65(-2)	2.27(-2)	1.68(-2)	1.33(-2)	9.41(-3)	7.30(-3)	5.97(-3)
8-36.....	1.36(-2)	1.02(-2)	8.71(-3)	6.43(-3)	5.11(-3)	3.64(-3)	2.84(-3)	2.32(-3)
8-37.....	9.95(-3)	7.62(-3)	6.62(-3)	5.05(-3)	4.11(-3)	3.03(-3)	2.40(-3)	2.00(-3)
8-38.....	1.76(-3)	1.63(-3)	1.55(-3)	1.36(-3)	1.21(-3)	9.88(-4)	8.30(-4)	7.14(-4)
9-10.....	5.89(-2)	4.82(-2)	4.27(-2)	3.33(-2)	2.73(-2)	2.03(-2)	1.61(-2)	1.34(-2)
9-11.....	6.66(-2)	5.60(-2)	5.00(-2)	3.90(-2)	3.18(-2)	2.33(-2)	1.84(-2)	1.52(-2)
9-12.....	3.78(-2)	3.16(-2)	2.82(-2)	2.20(-2)	1.80(-2)	1.33(-2)	1.05(-2)	8.72(-3)
9-13.....	3.58(-2)	2.84(-2)	2.47(-2)	1.86(-2)	1.48(-2)	1.05(-2)	8.18(-3)	6.68(-3)
9-14.....	8.43(-2)	7.10(-2)	6.34(-2)	4.97(-2)	4.09(-2)	3.02(-2)	2.40(-2)	1.99(-2)
9-15.....	9.46(-2)	7.86(-2)	6.99(-2)	5.44(-2)	4.46(-2)	3.27(-2)	2.59(-2)	2.15(-2)
9-16.....	1.21(-1)	1.01(-1)	8.97(-2)	7.00(-2)	5.74(-2)	4.22(-2)	3.35(-2)	2.77(-2)
9-17.....	3.65(-1)	3.13(-1)	2.85(-1)	2.34(-1)	2.01(-1)	1.59(-1)	1.31(-1)	1.12(-1)
9-18.....	9.45(-3)	7.54(-3)	6.66(-3)	5.19(-3)	4.28(-3)	3.20(-3)	2.56(-3)	2.14(-3)
9-19.....	3.66(-2)	3.11(-2)	2.84(-2)	2.35(-2)	2.03(-2)	1.61(-2)	1.34(-2)	1.14(-2)
9-20.....	2.60(-2)	2.08(-2)	1.84(-2)	1.44(-2)	1.20(-2)	9.02(-3)	7.27(-3)	6.10(-3)
9-21.....	5.62(-2)	4.54(-2)	3.99(-2)	3.06(-2)	2.49(-2)	1.82(-2)	1.44(-2)	1.19(-2)
9-22.....	7.26(-2)	5.90(-2)	5.20(-2)	4.00(-2)	3.26(-2)	2.38(-2)	1.88(-2)	1.56(-2)
9-23.....	5.64(-2)	4.52(-2)	3.96(-2)	3.01(-2)	2.42(-2)	1.75(-2)	1.37(-2)	1.13(-2)
9-24.....	1.01(-1)	8.13(-2)	7.12(-2)	5.40(-2)	4.34(-2)	3.11(-2)	2.43(-2)	1.99(-2)
9-25.....	6.31(-2)	5.08(-2)	4.46(-2)	3.41(-2)	2.77(-2)	2.02(-2)	1.59(-2)	1.32(-2)
9-26.....	6.30(-2)	5.02(-2)	4.38(-2)	3.31(-2)	2.65(-2)	1.90(-2)	1.49(-2)	1.22(-2)
9-27.....	1.85(-2)	1.47(-2)	1.29(-2)	9.92(-3)	8.09(-3)	5.94(-3)	4.71(-3)	3.91(-3)
9-28.....	7.83(-2)	6.16(-2)	5.36(-2)	4.03(-2)	3.23(-2)	2.32(-2)	1.81(-2)	1.48(-2)
9-29.....	6.08(-2)	5.14(-2)	4.71(-2)	3.99(-2)	3.51(-2)	2.85(-2)	2.41(-2)	2.08(-2)
9-30.....	1.50(-1)	1.26(-1)	1.14(-1)	9.49(-2)	8.24(-2)	6.61(-2)	5.54(-2)	4.78(-2)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
9–31.....	7.03(–2)	5.61(–2)	4.96(–2)	3.90(–2)	3.24(–2)	2.46(–2)	1.99(–2)	1.68(–2)
9–32.....	2.29(–2)	1.77(–2)	1.53(–2)	1.14(–2)	9.03(–3)	6.39(–3)	4.95(–3)	4.04(–3)
9–33.....	2.84(–2)	2.20(–2)	1.92(–2)	1.47(–2)	1.20(–2)	8.88(–3)	7.07(–3)	5.88(–3)
9–34.....	3.66(–2)	2.82(–2)	2.45(–2)	1.85(–2)	1.50(–2)	1.09(–2)	8.62(–3)	7.13(–3)
9–35.....	1.77(–2)	1.37(–2)	1.20(–2)	9.27(–3)	7.63(–3)	5.70(–3)	4.57(–3)	3.82(–3)
9–36.....	6.60(–2)	5.45(–2)	4.95(–2)	4.13(–2)	3.60(–2)	2.90(–2)	2.43(–2)	2.10(–2)
9–37.....	6.34(–2)	5.38(–2)	4.93(–2)	4.16(–2)	3.63(–2)	2.93(–2)	2.45(–2)	2.11(–2)
9–38.....	3.13(–3)	2.87(–3)	2.72(–3)	2.40(–3)	2.14(–3)	1.76(–3)	1.49(–3)	1.29(–3)
10–11.....	4.53(–1)	3.61(–1)	3.22(–1)	2.57(–1)	2.18(–1)	1.69(–1)	1.38(–1)	1.18(–1)
10–12.....	3.16(–1)	2.52(–1)	2.24(–1)	1.80(–1)	1.52(–1)	1.18(–1)	9.75(–2)	8.29(–2)
10–13.....	6.38(–2)	5.52(–2)	5.08(–2)	4.29(–2)	3.73(–2)	2.98(–2)	2.48(–2)	2.13(–2)
10–14.....	2.45(–1)	1.99(–1)	1.78(–1)	1.44(–1)	1.23(–1)	9.66(–2)	7.98(–2)	6.81(–2)
10–15.....	3.57(–1)	2.99(–1)	2.71(–1)	2.24(–1)	1.94(–1)	1.54(–1)	1.28(–1)	1.10(–1)
10–16.....	3.12(–1)	2.60(–1)	2.34(–1)	1.90(–1)	1.62(–1)	1.27(–1)	1.05(–1)	8.92(–2)
10–17.....	1.58(–1)	1.34(–1)	1.23(–1)	1.03(–1)	9.05(–2)	7.32(–2)	6.16(–2)	5.32(–2)
10–18.....	3.20(–2)	2.83(–2)	2.68(–2)	2.42(–2)	2.22(–2)	1.91(–2)	1.66(–2)	1.46(–2)
10–19.....	9.08(–2)	7.73(–2)	7.18(–2)	6.29(–2)	5.68(–2)	4.79(–2)	4.13(–2)	3.62(–2)
10–20.....	1.21(–1)	1.07(–1)	1.01(–1)	9.02(–2)	8.26(–2)	7.05(–2)	6.12(–2)	5.39(–2)
10–21.....	1.28(–1)	1.06(–1)	9.69(–2)	8.20(–2)	7.23(–2)	5.92(–2)	5.03(–2)	4.37(–2)
10–22.....	1.37(–1)	1.16(–1)	1.07(–1)	9.22(–2)	8.20(–2)	6.78(–2)	5.79(–2)	5.04(–2)
10–23.....	1.34(–1)	1.08(–1)	9.56(–2)	7.52(–2)	6.25(–2)	4.71(–2)	3.79(–2)	3.18(–2)
10–24.....	1.55(–1)	1.31(–1)	1.20(–1)	1.03(–1)	9.13(–2)	7.54(–2)	6.44(–2)	5.61(–2)
10–25.....	1.09(–1)	8.38(–2)	7.27(–2)	5.48(–2)	4.41(–2)	3.19(–2)	2.51(–2)	2.07(–2)
10–26.....	1.10(–1)	9.03(–2)	8.10(–2)	6.55(–2)	5.57(–2)	4.34(–2)	3.58(–2)	3.05(–2)
10–27.....	6.60(–2)	5.76(–2)	5.41(–2)	4.81(–2)	4.38(–2)	3.72(–2)	3.22(–2)	2.84(–2)
10–28.....	5.58(–2)	4.38(–2)	3.87(–2)	3.06(–2)	2.56(–2)	1.96(–2)	1.59(–2)	1.34(–2)
10–29.....	2.82(–2)	2.23(–2)	1.99(–2)	1.60(–2)	1.36(–2)	1.06(–2)	8.78(–3)	7.48(–3)
10–30.....	7.03(–2)	5.62(–2)	4.98(–2)	3.92(–2)	3.26(–2)	2.46(–2)	1.98(–2)	1.66(–2)
10–31.....	3.21(–2)	2.48(–2)	2.17(–2)	1.67(–2)	1.37(–2)	1.02(–2)	8.16(–3)	6.82(–3)
10–32.....	8.92(–3)	6.98(–3)	6.20(–3)	4.99(–3)	4.25(–3)	3.33(–3)	2.76(–3)	2.36(–3)
10–33.....	6.59(–2)	5.05(–2)	4.42(–2)	3.42(–2)	2.82(–2)	2.11(–2)	1.69(–2)	1.42(–2)
10–34.....	6.45(–2)	4.75(–2)	4.06(–2)	3.00(–2)	2.40(–2)	1.73(–2)	1.36(–2)	1.12(–2)
10–35.....	4.01(–2)	2.99(–2)	2.57(–2)	1.91(–2)	1.54(–2)	1.11(–2)	8.71(–3)	7.18(–3)
10–36.....	2.48(–2)	1.91(–2)	1.67(–2)	1.30(–2)	1.08(–2)	8.17(–3)	6.61(–3)	5.56(–3)
10–37.....	2.56(–2)	2.10(–2)	1.90(–2)	1.54(–2)	1.31(–2)	1.02(–2)	8.35(–3)	7.08(–3)
10–38.....	1.77(–3)	1.65(–3)	1.57(–3)	1.39(–3)	1.25(–3)	1.03(–3)	8.67(–4)	7.49(–4)
11–12.....	1.39(–1)	1.03(–1)	8.80(–2)	6.48(–2)	5.16(–2)	3.70(–2)	2.89(–2)	2.38(–2)
11–13.....	8.17(–2)	6.90(–2)	6.30(–2)	5.22(–2)	4.50(–2)	3.54(–2)	2.92(–2)	2.49(–2)
11–14.....	1.71(–1)	1.39(–1)	1.23(–1)	9.52(–2)	7.80(–2)	5.76(–2)	4.58(–2)	3.80(–2)
11–15.....	3.51(–1)	2.84(–1)	2.52(–1)	1.99(–1)	1.66(–1)	1.26(–1)	1.02(–1)	8.55(–2)
11–16.....	9.13(–1)	7.72(–1)	7.01(–1)	5.76(–1)	4.94(–1)	3.88(–1)	3.22(–1)	2.75(–1)
11–17.....	1.50(–1)	1.20(–1)	1.05(–1)	8.22(–2)	6.77(–2)	5.05(–2)	4.04(–2)	3.38(–2)
11–18.....	1.65(–2)	1.21(–2)	1.03(–2)	7.59(–3)	6.02(–3)	4.28(–3)	3.32(–3)	2.72(–3)
11–19.....	4.99(–2)	3.90(–2)	3.43(–2)	2.65(–2)	2.19(–2)	1.63(–2)	1.31(–2)	1.10(–2)
11–20.....	7.19(–2)	5.85(–2)	5.30(–2)	4.41(–2)	3.85(–2)	3.11(–2)	2.63(–2)	2.27(–2)
11–21.....	1.50(–1)	1.25(–1)	1.13(–1)	9.36(–2)	8.12(–2)	6.50(–2)	5.45(–2)	4.69(–2)
11–22.....	3.08(–1)	2.62(–1)	2.42(–1)	2.08(–1)	1.85(–1)	1.53(–1)	1.31(–1)	1.14(–1)
11–23.....	2.77(–1)	2.23(–1)	1.99(–1)	1.58(–1)	1.33(–1)	1.03(–1)	8.39(–2)	7.11(–2)
11–24.....	2.04(–1)	1.63(–1)	1.45(–1)	1.18(–1)	1.01(–1)	8.00(–2)	6.66(–2)	5.71(–2)
11–25.....	2.90(–1)	2.44(–1)	2.23(–1)	1.89(–1)	1.66(–1)	1.35(–1)	1.14(–1)	9.86(–2)
11–26.....	7.43(–2)	5.82(–2)	5.11(–2)	3.97(–2)	3.28(–2)	2.47(–2)	1.99(–2)	1.67(–2)
11–27.....	1.26(–1)	1.10(–1)	1.03(–1)	9.07(–2)	8.20(–2)	6.91(–2)	5.96(–2)	5.22(–2)
11–28.....	1.10(–1)	8.61(–2)	7.58(–2)	5.92(–2)	4.90(–2)	3.70(–2)	2.99(–2)	2.51(–2)
11–29.....	4.05(–2)	3.18(–2)	2.81(–2)	2.22(–2)	1.86(–2)	1.42(–2)	1.16(–2)	9.78(–3)
11–30.....	1.13(–1)	9.34(–2)	8.47(–2)	7.00(–2)	6.04(–2)	4.80(–2)	3.99(–2)	3.42(–2)
11–31.....	4.42(–2)	3.56(–2)	3.19(–2)	2.58(–2)	2.21(–2)	1.73(–2)	1.43(–2)	1.22(–2)
11–32.....	1.08(–2)	8.34(–3)	7.28(–3)	5.57(–3)	4.55(–3)	3.35(–3)	2.66(–3)	2.21(–3)
11–33.....	1.50(–1)	1.12(–1)	9.65(–2)	7.21(–2)	5.79(–2)	4.19(–2)	3.30(–2)	2.72(–2)
11–34.....	5.75(–2)	4.33(–2)	3.75(–2)	2.86(–2)	2.33(–2)	1.73(–2)	1.38(–2)	1.15(–2)
11–35.....	2.71(–2)	2.07(–2)	1.79(–2)	1.36(–2)	1.11(–2)	8.22(–3)	6.55(–3)	5.46(–3)
11–36.....	3.30(–2)	2.55(–2)	2.23(–2)	1.73(–2)	1.42(–2)	1.06(–2)	8.51(–3)	7.11(–3)
11–37.....	4.19(–2)	3.43(–2)	3.08(–2)	2.49(–2)	2.11(–2)	1.63(–2)	1.33(–2)	1.13(–2)
11–38.....	2.39(–3)	2.21(–3)	2.10(–3)	1.85(–3)	1.64(–3)	1.33(–3)	1.12(–3)	9.60(–4)
12–13.....	3.43(–2)	2.91(–2)	2.65(–2)	2.21(–2)	1.90(–2)	1.50(–2)	1.24(–2)	1.05(–2)
12–14.....	2.18(–1)	1.85(–1)	1.69(–1)	1.41(–1)	1.22(–1)	9.76(–2)	8.16(–2)	7.01(–2)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
12-15	1.81(-1)	1.53(-1)	1.40(-1)	1.18(-1)	1.03(-1)	8.29(-2)	6.97(-2)	6.01(-2)
12-16	1.23(-1)	9.82(-2)	8.61(-2)	6.60(-2)	5.36(-2)	3.92(-2)	3.09(-2)	2.56(-2)
12-17	8.14(-2)	6.60(-2)	5.87(-2)	4.64(-2)	3.87(-2)	2.93(-2)	2.36(-2)	1.98(-2)
12-18	1.25(-2)	9.25(-3)	7.90(-3)	5.83(-3)	4.64(-3)	3.31(-3)	2.58(-3)	2.12(-3)
12-19	1.24(-1)	1.10(-1)	1.05(-1)	9.63(-2)	8.94(-2)	7.78(-2)	6.83(-2)	6.05(-2)
12-20	6.65(-2)	5.67(-2)	5.24(-2)	4.51(-2)	4.02(-2)	3.33(-2)	2.85(-2)	2.48(-2)
12-21	1.11(-1)	9.91(-2)	9.41(-2)	8.56(-2)	7.91(-2)	6.84(-2)	5.98(-2)	5.29(-2)
12-22	5.41(-2)	4.20(-2)	3.65(-2)	2.77(-2)	2.25(-2)	1.64(-2)	1.30(-2)	1.07(-2)
12-23	5.33(-2)	4.13(-2)	3.57(-2)	2.65(-2)	2.11(-2)	1.50(-2)	1.17(-2)	9.53(-3)
12-24	6.56(-2)	5.19(-2)	4.60(-2)	3.64(-2)	3.06(-2)	2.35(-2)	1.91(-2)	1.62(-2)
12-25	4.59(-2)	3.54(-2)	3.08(-2)	2.34(-2)	1.90(-2)	1.39(-2)	1.10(-2)	9.14(-3)
12-26	7.79(-2)	6.31(-2)	5.66(-2)	4.58(-2)	3.90(-2)	3.04(-2)	2.51(-2)	2.14(-2)
12-27	3.89(-2)	3.33(-2)	3.09(-2)	2.70(-2)	2.42(-2)	2.03(-2)	1.74(-2)	1.53(-2)
12-28	2.52(-2)	1.92(-2)	1.67(-2)	1.27(-2)	1.04(-2)	7.67(-3)	6.11(-3)	5.08(-3)
12-29	1.71(-2)	1.31(-2)	1.15(-2)	8.95(-3)	7.42(-3)	5.61(-3)	4.53(-3)	3.81(-3)
12-30	5.71(-2)	4.61(-2)	4.11(-2)	3.26(-2)	2.72(-2)	2.05(-2)	1.66(-2)	1.39(-2)
12-31	1.97(-2)	1.56(-2)	1.39(-2)	1.12(-2)	9.55(-3)	7.46(-3)	6.15(-3)	5.25(-3)
12-32	1.21(-2)	9.45(-3)	8.26(-3)	6.32(-3)	5.15(-3)	3.78(-3)	3.00(-3)	2.49(-3)
12-33	2.65(-2)	2.04(-2)	1.78(-2)	1.38(-2)	1.14(-2)	8.61(-3)	6.95(-3)	5.84(-3)
12-34	3.43(-2)	2.59(-2)	2.24(-2)	1.70(-2)	1.38(-2)	1.01(-2)	8.05(-3)	6.69(-3)
12-35	3.84(-2)	2.80(-2)	2.38(-2)	1.74(-2)	1.37(-2)	9.74(-3)	7.56(-3)	6.19(-3)
12-36	1.32(-2)	1.01(-2)	8.88(-3)	6.87(-3)	5.66(-3)	4.23(-3)	3.39(-3)	2.84(-3)
12-37	1.64(-2)	1.34(-2)	1.21(-2)	9.87(-3)	8.39(-3)	6.50(-3)	5.32(-3)	4.51(-3)
12-38	1.24(-3)	1.17(-3)	1.13(-3)	1.02(-3)	9.32(-4)	7.83(-4)	6.70(-4)	5.84(-4)
13-14	5.07(-2)	4.50(-2)	4.16(-2)	3.52(-2)	3.08(-2)	2.48(-2)	2.08(-2)	1.79(-2)
13-15	4.44(-2)	3.73(-2)	3.32(-2)	2.57(-2)	2.09(-2)	1.52(-2)	1.19(-2)	9.79(-3)
13-16	6.40(-2)	5.40(-2)	4.80(-2)	3.71(-2)	3.00(-2)	2.17(-2)	1.70(-2)	1.39(-2)
13-17	2.95(-1)	2.76(-1)	2.65(-1)	2.43(-1)	2.25(-1)	1.95(-1)	1.70(-1)	1.50(-1)
13-18	1.78(-2)	1.66(-2)	1.60(-2)	1.49(-2)	1.39(-2)	1.21(-2)	1.06(-2)	9.39(-3)
13-19	2.03(-2)	1.67(-2)	1.48(-2)	1.16(-2)	9.59(-3)	7.14(-3)	5.70(-3)	4.75(-3)
13-20	2.02(-2)	1.65(-2)	1.47(-2)	1.15(-2)	9.52(-3)	7.10(-3)	5.68(-3)	4.74(-3)
13-21	1.68(-2)	1.35(-2)	1.20(-2)	9.52(-3)	7.95(-3)	6.03(-3)	4.87(-3)	4.10(-3)
13-22	4.50(-2)	3.71(-2)	3.29(-2)	2.56(-2)	2.10(-2)	1.55(-2)	1.23(-2)	1.03(-2)
13-23	3.30(-2)	2.66(-2)	2.33(-2)	1.77(-2)	1.42(-2)	1.01(-2)	7.88(-3)	6.45(-3)
13-24	2.25(-2)	1.80(-2)	1.59(-2)	1.23(-2)	1.01(-2)	7.44(-3)	5.92(-3)	4.92(-3)
13-25	2.01(-2)	1.59(-2)	1.40(-2)	1.07(-2)	8.67(-3)	6.32(-3)	4.99(-3)	4.13(-3)
13-26	2.25(-2)	1.77(-2)	1.54(-2)	1.16(-2)	9.35(-3)	6.73(-3)	5.27(-3)	4.33(-3)
13-27	1.20(-2)	9.32(-3)	8.10(-3)	6.10(-3)	4.91(-3)	3.54(-3)	2.78(-3)	2.29(-3)
13-28	1.20(-2)	9.69(-3)	8.60(-3)	6.76(-3)	5.61(-3)	4.20(-3)	3.37(-3)	2.82(-3)
13-29	8.55(-3)	6.35(-3)	5.45(-3)	4.07(-3)	3.27(-3)	2.36(-3)	1.86(-3)	1.53(-3)
13-30	1.13(-2)	8.64(-3)	7.46(-3)	5.56(-3)	4.44(-3)	3.17(-3)	2.47(-3)	2.03(-3)
13-31	9.65(-3)	7.24(-3)	6.22(-3)	4.63(-3)	3.70(-3)	2.66(-3)	2.08(-3)	1.71(-3)
13-32	3.88(-3)	3.14(-3)	2.81(-3)	2.27(-3)	1.93(-3)	1.51(-3)	1.24(-3)	1.06(-3)
13-33	1.01(-2)	7.32(-3)	6.26(-3)	4.70(-3)	3.80(-3)	2.79(-3)	2.22(-3)	1.84(-3)
13-34	8.88(-3)	6.59(-3)	5.66(-3)	4.23(-3)	3.41(-3)	2.48(-3)	1.96(-3)	1.62(-3)
13-35	5.48(-3)	4.01(-3)	3.42(-3)	2.52(-3)	2.01(-3)	1.44(-3)	1.12(-3)	9.24(-4)
13-36	3.92(-3)	2.96(-3)	2.57(-3)	1.95(-3)	1.59(-3)	1.17(-3)	9.30(-4)	7.73(-4)
13-37	5.90(-3)	4.71(-3)	4.18(-3)	3.30(-3)	2.74(-3)	2.07(-3)	1.66(-3)	1.39(-3)
13-38	1.20(-4)	1.06(-4)	9.83(-5)	8.21(-5)	7.03(-5)	5.46(-5)	4.46(-5)	3.77(-5)
14-15	7.27(-1)	6.04(-1)	5.42(-1)	4.34(-1)	3.64(-1)	2.78(-1)	2.25(-1)	1.90(-1)
14-16	6.27(-1)	5.29(-1)	4.70(-1)	3.62(-1)	2.93(-1)	2.11(-1)	1.65(-1)	1.35(-1)
14-17	2.03(-1)	1.69(-1)	1.51(-1)	1.21(-1)	1.02(-1)	7.77(-2)	6.31(-2)	5.33(-2)
14-18	1.66(-1)	1.64(-1)	1.63(-1)	1.59(-1)	1.53(-1)	1.37(-1)	1.22(-1)	1.10(-1)
14-19	1.68(-1)	1.30(-1)	1.14(-1)	8.69(-2)	7.08(-2)	5.21(-2)	4.15(-2)	3.45(-2)
14-20	2.63(-1)	2.39(-1)	2.27(-1)	2.03(-1)	1.85(-1)	1.57(-1)	1.36(-1)	1.19(-1)
14-21	2.23(-1)	1.88(-1)	1.73(-1)	1.46(-1)	1.29(-1)	1.05(-1)	8.84(-2)	7.65(-2)
14-22	1.40(-1)	1.14(-1)	1.01(-1)	7.82(-2)	6.41(-2)	4.75(-2)	3.79(-2)	3.15(-2)
14-23	1.67(-1)	1.36(-1)	1.20(-1)	9.20(-2)	7.47(-2)	5.44(-2)	4.29(-2)	3.54(-2)
14-24	2.08(-1)	1.65(-1)	1.45(-1)	1.10(-1)	8.87(-2)	6.41(-2)	5.03(-2)	4.14(-2)
14-25	1.11(-1)	8.96(-2)	7.93(-2)	6.23(-2)	5.18(-2)	3.92(-2)	3.17(-2)	2.67(-2)
14-26	2.52(-1)	2.10(-1)	1.89(-1)	1.54(-1)	1.32(-1)	1.03(-1)	8.55(-2)	7.30(-2)
14-27	7.62(-2)	6.06(-2)	5.29(-2)	4.00(-2)	3.22(-2)	2.31(-2)	1.81(-2)	1.49(-2)
14-28	5.45(-2)	4.33(-2)	3.83(-2)	3.00(-2)	2.49(-2)	1.88(-2)	1.52(-2)	1.28(-2)
14-29	5.11(-2)	4.29(-2)	3.91(-2)	3.26(-2)	2.83(-2)	2.27(-2)	1.89(-2)	1.63(-2)
14-30	7.03(-2)	5.52(-2)	4.83(-2)	3.70(-2)	3.01(-2)	2.21(-2)	1.75(-2)	1.45(-2)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
14-31	4.10(-2)	3.26(-2)	2.88(-2)	2.27(-2)	1.90(-2)	1.45(-2)	1.18(-2)	9.93(-3)
14-32	3.28(-2)	2.71(-2)	2.46(-2)	2.02(-2)	1.75(-2)	1.39(-2)	1.16(-2)	9.96(-3)
14-33	5.76(-2)	4.51(-2)	3.97(-2)	3.09(-2)	2.56(-2)	1.92(-2)	1.55(-2)	1.30(-2)
14-34	4.37(-2)	3.50(-2)	3.14(-2)	2.56(-2)	2.20(-2)	1.75(-2)	1.46(-2)	1.25(-2)
14-35	3.65(-2)	2.97(-2)	2.68(-2)	2.22(-2)	1.92(-2)	1.54(-2)	1.29(-2)	1.11(-2)
14-36	3.82(-2)	2.95(-2)	2.59(-2)	2.01(-2)	1.66(-2)	1.25(-2)	1.01(-2)	8.47(-3)
14-37	5.84(-2)	4.52(-2)	3.96(-2)	3.06(-2)	2.51(-2)	1.87(-2)	1.50(-2)	1.25(-2)
14-38	3.70(-3)	3.42(-3)	3.24(-3)	2.84(-3)	2.52(-3)	2.04(-3)	1.71(-3)	1.47(-3)
15-16	1.21	1.01	9.02(-1)	7.09(-1)	5.86(-1)	4.36(-1)	3.48(-1)	2.90(-1)
15-17	2.12(-1)	1.75(-1)	1.55(-1)	1.22(-1)	1.01(-1)	7.54(-2)	6.04(-2)	5.04(-2)
15-18	2.84(-2)	2.30(-2)	2.03(-2)	1.57(-2)	1.28(-2)	9.42(-3)	7.46(-3)	6.18(-3)
15-19	2.47(-1)	2.22(-1)	2.11(-1)	1.91(-1)	1.76(-1)	1.52(-1)	1.32(-1)	1.17(-1)
15-20	3.16(-1)	2.93(-1)	2.81(-1)	2.57(-1)	2.37(-1)	2.05(-1)	1.79(-1)	1.58(-1)
15-21	3.06(-1)	2.46(-1)	2.19(-1)	1.74(-1)	1.46(-1)	1.12(-1)	9.19(-2)	7.79(-2)
15-22	3.71(-1)	3.24(-1)	2.99(-1)	2.55(-1)	2.25(-1)	1.83(-1)	1.55(-1)	1.35(-1)
15-23	3.62(-1)	2.91(-1)	2.55(-1)	1.95(-1)	1.58(-1)	1.15(-1)	9.07(-2)	7.49(-2)
15-24	3.96(-1)	3.17(-1)	2.79(-1)	2.14(-1)	1.75(-1)	1.29(-1)	1.02(-1)	8.49(-2)
15-25	4.63(-1)	3.95(-1)	3.61(-1)	3.02(-1)	2.63(-1)	2.11(-1)	1.77(-1)	1.52(-1)
15-26	2.24(-1)	1.77(-1)	1.55(-1)	1.18(-1)	9.49(-2)	6.87(-2)	5.39(-2)	4.45(-2)
15-27	9.84(-2)	7.86(-2)	6.89(-2)	5.27(-2)	4.27(-2)	3.12(-2)	2.46(-2)	2.04(-2)
15-28	1.03(-1)	8.18(-2)	7.22(-2)	5.65(-2)	4.68(-2)	3.53(-2)	2.85(-2)	2.39(-2)
15-29	5.93(-2)	4.72(-2)	4.18(-2)	3.29(-2)	2.74(-2)	2.07(-2)	1.67(-2)	1.40(-2)
15-30	9.38(-2)	7.46(-2)	6.59(-2)	5.15(-2)	4.27(-2)	3.21(-2)	2.58(-2)	2.17(-2)
15-31	7.46(-2)	6.14(-2)	5.53(-2)	4.53(-2)	3.89(-2)	3.07(-2)	2.54(-2)	2.17(-2)
15-32	1.67(-2)	1.28(-2)	1.11(-2)	8.38(-3)	6.76(-3)	4.91(-3)	3.87(-3)	3.20(-3)
15-33	9.33(-2)	7.26(-2)	6.40(-2)	5.03(-2)	4.21(-2)	3.22(-2)	2.63(-2)	2.22(-2)
15-34	6.27(-2)	4.98(-2)	4.44(-2)	3.59(-2)	3.06(-2)	2.39(-2)	1.98(-2)	1.69(-2)
15-35	5.32(-2)	4.12(-2)	3.61(-2)	2.80(-2)	2.31(-2)	1.75(-2)	1.41(-2)	1.19(-2)
15-36	6.37(-2)	4.87(-2)	4.25(-2)	3.26(-2)	2.68(-2)	1.99(-2)	1.59(-2)	1.33(-2)
15-37	8.89(-2)	6.94(-2)	6.09(-2)	4.73(-2)	3.90(-2)	2.92(-2)	2.34(-2)	1.95(-2)
15-38	6.13(-3)	5.70(-3)	5.42(-3)	4.79(-3)	4.27(-3)	3.49(-3)	2.93(-3)	2.53(-3)
16-17	3.03(-1)	2.53(-1)	2.27(-1)	1.81(-1)	1.51(-1)	1.15(-1)	9.28(-2)	7.80(-2)
16-18	2.50(-2)	2.01(-2)	1.76(-2)	1.34(-2)	1.08(-2)	7.84(-3)	6.15(-3)	5.06(-3)
16-19	1.22(-1)	9.73(-2)	8.49(-2)	6.39(-2)	5.12(-2)	3.65(-2)	2.84(-2)	2.32(-2)
16-20	1.21(-1)	9.73(-2)	8.51(-2)	6.44(-2)	5.16(-2)	3.69(-2)	2.87(-2)	2.35(-2)
16-21	4.69(-1)	3.99(-1)	3.64(-1)	3.04(-1)	2.64(-1)	2.11(-1)	1.77(-1)	1.52(-1)
16-22	8.61(-1)	7.72(-1)	7.25(-1)	6.39(-1)	5.76(-1)	4.82(-1)	4.14(-1)	3.62(-1)
16-23	8.20(-1)	6.72(-1)	6.01(-1)	4.81(-1)	4.06(-1)	3.12(-1)	2.56(-1)	2.17(-1)
16-24	7.44(-1)	6.27(-1)	5.71(-1)	4.76(-1)	4.13(-1)	3.31(-1)	2.77(-1)	2.39(-1)
16-25	5.68(-1)	4.52(-1)	3.96(-1)	3.04(-1)	2.48(-1)	1.82(-1)	1.45(-1)	1.20(-1)
16-26	2.23(-1)	1.79(-1)	1.57(-1)	1.19(-1)	9.67(-2)	7.02(-2)	5.52(-2)	4.55(-2)
16-27	1.71(-1)	1.36(-1)	1.18(-1)	8.94(-2)	7.17(-2)	5.14(-2)	4.01(-2)	3.29(-2)
16-28	1.77(-1)	1.38(-1)	1.20(-1)	9.09(-2)	7.32(-2)	5.28(-2)	4.14(-2)	3.41(-2)
16-29	8.31(-2)	6.65(-2)	5.88(-2)	4.59(-2)	3.79(-2)	2.83(-2)	2.27(-2)	1.90(-2)
16-30	1.38(-1)	1.08(-1)	9.51(-2)	7.30(-2)	5.96(-2)	4.39(-2)	3.49(-2)	2.90(-2)
16-31	1.04(-1)	8.21(-2)	7.21(-2)	5.58(-2)	4.57(-2)	3.39(-2)	2.71(-2)	2.25(-2)
16-32	2.09(-2)	1.63(-2)	1.43(-2)	1.09(-2)	8.91(-3)	6.56(-3)	5.21(-3)	4.33(-3)
16-33	1.80(-1)	1.43(-1)	1.27(-1)	1.01(-1)	8.60(-2)	6.70(-2)	5.53(-2)	4.71(-2)
16-34	9.14(-2)	7.05(-2)	6.16(-2)	4.78(-2)	3.96(-2)	2.99(-2)	2.42(-2)	2.04(-2)
16-35	4.32(-2)	3.27(-2)	2.82(-2)	2.11(-2)	1.70(-2)	1.23(-2)	9.64(-3)	7.95(-3)
16-36	1.03(-1)	7.75(-2)	6.72(-2)	5.09(-2)	4.13(-2)	3.03(-2)	2.40(-2)	1.99(-2)
16-37	1.36(-1)	1.06(-1)	9.26(-2)	7.16(-2)	5.89(-2)	4.39(-2)	3.51(-2)	2.93(-2)
16-38	8.80(-3)	8.16(-3)	7.74(-3)	6.81(-3)	6.05(-3)	4.91(-3)	4.12(-3)	3.54(-3)
17-18	1.87(-2)	1.50(-2)	1.32(-2)	1.01(-2)	8.16(-3)	5.92(-3)	4.66(-3)	3.84(-3)
17-19	9.89(-2)	8.51(-2)	7.81(-2)	6.53(-2)	5.66(-2)	4.51(-2)	3.75(-2)	3.22(-2)
17-20	8.00(-2)	6.84(-2)	6.28(-2)	5.31(-2)	4.65(-2)	3.77(-2)	3.17(-2)	2.74(-2)
17-21	1.62(-1)	1.39(-1)	1.28(-1)	1.07(-1)	9.36(-2)	7.50(-2)	6.26(-2)	5.38(-2)
17-22	1.93(-1)	1.61(-1)	1.45(-1)	1.16(-1)	9.79(-2)	7.49(-2)	6.09(-2)	5.14(-2)
17-23	1.85(-1)	1.53(-1)	1.37(-1)	1.08(-1)	8.94(-2)	6.70(-2)	5.37(-2)	4.49(-2)
17-24	2.06(-1)	1.74(-1)	1.58(-1)	1.29(-1)	1.10(-1)	8.50(-2)	6.95(-2)	5.88(-2)
17-25	1.57(-1)	1.31(-1)	1.18(-1)	9.55(-2)	8.07(-2)	6.20(-2)	5.06(-2)	4.28(-2)
17-26	1.92(-1)	1.64(-1)	1.50(-1)	1.25(-1)	1.08(-1)	8.51(-2)	7.05(-2)	6.02(-2)
17-27	4.89(-2)	3.98(-2)	3.54(-2)	2.80(-2)	2.32(-2)	1.74(-2)	1.40(-2)	1.17(-2)
17-28	6.01(-2)	4.68(-2)	4.05(-2)	3.03(-2)	2.41(-2)	1.72(-2)	1.34(-2)	1.09(-2)
17-29	1.16(-1)	1.02(-1)	9.55(-2)	8.48(-2)	7.71(-2)	6.53(-2)	5.65(-2)	4.96(-2)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
17-30	1.30(-1)	1.04(-1)	9.23(-2)	7.20(-2)	5.96(-2)	4.48(-2)	3.61(-2)	3.03(-2)
17-31	8.71(-2)	7.59(-2)	7.10(-2)	6.27(-2)	5.68(-2)	4.79(-2)	4.13(-2)	3.62(-2)
17-32	1.54(-2)	1.23(-2)	1.09(-2)	8.58(-3)	7.15(-3)	5.44(-3)	4.41(-3)	3.72(-3)
17-33	4.39(-2)	3.39(-2)	2.95(-2)	2.26(-2)	1.85(-2)	1.37(-2)	1.09(-2)	9.06(-3)
17-34	5.61(-2)	4.39(-2)	3.84(-2)	2.96(-2)	2.42(-2)	1.79(-2)	1.43(-2)	1.19(-2)
17-35	3.43(-2)	2.74(-2)	2.43(-2)	1.92(-2)	1.59(-2)	1.20(-2)	9.67(-3)	8.11(-3)
17-36	8.74(-2)	7.08(-2)	6.43(-2)	5.40(-2)	4.75(-2)	3.88(-2)	3.28(-2)	2.85(-2)
17-37	6.77(-2)	5.33(-2)	4.73(-2)	3.79(-2)	3.22(-2)	2.52(-2)	2.08(-2)	1.78(-2)
17-38	2.01(-2)	1.94(-2)	1.90(-2)	1.79(-2)	1.68(-2)	1.46(-2)	1.28(-2)	1.13(-2)
18-19	3.90(-2)	3.15(-2)	2.82(-2)	2.25(-2)	1.90(-2)	1.45(-2)	1.18(-2)	9.98(-3)
18-20	8.84(-2)	7.40(-2)	6.70(-2)	5.47(-2)	4.65(-2)	3.61(-2)	2.96(-2)	2.51(-2)
18-21	2.38(-1)	2.30(-1)	2.25(-1)	2.14(-1)	2.03(-1)	1.80(-1)	1.59(-1)	1.41(-1)
18-22	3.34(-2)	2.63(-2)	2.31(-2)	1.78(-2)	1.46(-2)	1.08(-2)	8.63(-3)	7.19(-3)
18-23	3.39(-2)	2.80(-2)	2.50(-2)	2.00(-2)	1.67(-2)	1.27(-2)	1.03(-2)	8.70(-3)
18-24	1.89(-2)	1.52(-2)	1.34(-2)	1.03(-2)	8.47(-3)	6.24(-3)	4.96(-3)	4.12(-3)
18-25	5.91(-2)	4.89(-2)	4.40(-2)	3.54(-2)	2.98(-2)	2.28(-2)	1.86(-2)	1.57(-2)
18-26	6.97(-2)	6.24(-2)	5.92(-2)	5.35(-2)	4.92(-2)	4.22(-2)	3.68(-2)	3.24(-2)
18-27	9.93(-3)	7.78(-3)	6.79(-3)	5.15(-3)	4.17(-3)	3.03(-3)	2.38(-3)	1.97(-3)
18-28	2.01(-2)	1.75(-2)	1.63(-2)	1.42(-2)	1.27(-2)	1.05(-2)	8.98(-3)	7.82(-3)
18-29	4.82(-3)	3.81(-3)	3.37(-3)	2.64(-3)	2.19(-3)	1.64(-3)	1.32(-3)	1.10(-3)
18-30	1.72(-2)	1.42(-2)	1.27(-2)	1.02(-2)	8.57(-3)	6.55(-3)	5.31(-3)	4.47(-3)
18-31	6.65(-3)	4.93(-3)	4.20(-3)	3.07(-3)	2.42(-3)	1.71(-3)	1.32(-3)	1.08(-3)
18-32	4.68(-3)	3.87(-3)	3.50(-3)	2.89(-3)	2.50(-3)	1.99(-3)	1.66(-3)	1.43(-3)
18-33	6.54(-3)	5.32(-3)	4.77(-3)	3.84(-3)	3.24(-3)	2.48(-3)	2.02(-3)	1.70(-3)
18-34	8.67(-3)	6.89(-3)	6.13(-3)	4.93(-3)	4.19(-3)	3.28(-3)	2.71(-3)	2.31(-3)
18-35	6.87(-3)	4.97(-3)	4.21(-3)	3.06(-3)	2.42(-3)	1.71(-3)	1.33(-3)	1.09(-3)
18-36	4.68(-3)	3.55(-3)	3.08(-3)	2.36(-3)	1.93(-3)	1.44(-3)	1.15(-3)	9.66(-4)
18-37	7.31(-3)	5.81(-3)	5.15(-3)	4.06(-3)	3.38(-3)	2.55(-3)	2.05(-3)	1.72(-3)
18-38	2.31(-3)	2.14(-3)	2.03(-3)	1.78(-3)	1.58(-3)	1.28(-3)	1.08(-3)	9.26(-4)
19-20	1.94(-1)	1.81(-1)	1.74(-1)	1.61(-1)	1.50(-1)	1.29(-1)	1.13(-1)	9.99(-2)
19-21	2.19(-1)	1.86(-1)	1.71(-1)	1.43(-1)	1.24(-1)	9.89(-2)	8.22(-2)	7.04(-2)
19-22	7.05(-2)	5.83(-2)	5.23(-2)	4.20(-2)	3.55(-2)	2.73(-2)	2.23(-2)	1.89(-2)
19-23	9.58(-2)	7.87(-2)	7.00(-2)	5.50(-2)	4.55(-2)	3.40(-2)	2.72(-2)	2.28(-2)
19-24	6.14(-2)	4.91(-2)	4.35(-2)	3.44(-2)	2.87(-2)	2.19(-2)	1.77(-2)	1.50(-2)
19-25	9.20(-2)	7.68(-2)	6.95(-2)	5.68(-2)	4.85(-2)	3.79(-2)	3.13(-2)	2.67(-2)
19-26	2.11(-1)	1.83(-1)	1.70(-1)	1.47(-1)	1.31(-1)	1.09(-1)	9.31(-2)	8.12(-2)
19-27	7.74(-2)	7.11(-2)	6.80(-2)	6.24(-2)	5.77(-2)	4.99(-2)	4.36(-2)	3.85(-2)
19-28	3.04(-2)	2.53(-2)	2.30(-2)	1.90(-2)	1.65(-2)	1.32(-2)	1.10(-2)	9.47(-3)
19-29	3.18(-2)	2.85(-2)	2.69(-2)	2.42(-2)	2.21(-2)	1.89(-2)	1.64(-2)	1.44(-2)
19-30	6.75(-2)	5.65(-2)	5.13(-2)	4.21(-2)	3.60(-2)	2.80(-2)	2.30(-2)	1.95(-2)
19-31	3.08(-2)	2.83(-2)	2.73(-2)	2.53(-2)	2.36(-2)	2.06(-2)	1.80(-2)	1.60(-2)
19-32	4.75(-3)	3.61(-3)	3.12(-3)	2.34(-3)	1.89(-3)	1.37(-3)	1.08(-3)	8.89(-4)
19-33	1.95(-2)	1.60(-2)	1.45(-2)	1.20(-2)	1.03(-2)	8.19(-3)	6.81(-3)	5.84(-3)
19-34	3.41(-2)	2.54(-2)	2.17(-2)	1.61(-2)	1.29(-2)	9.24(-3)	7.23(-3)	5.95(-3)
19-35	4.58(-2)	3.35(-2)	2.85(-2)	2.08(-2)	1.64(-2)	1.16(-2)	9.04(-3)	7.39(-3)
19-36	1.72(-2)	1.27(-2)	1.09(-2)	8.18(-3)	6.58(-3)	4.78(-3)	3.77(-3)	3.11(-3)
19-37	2.19(-2)	1.70(-2)	1.49(-2)	1.15(-2)	9.46(-3)	7.05(-3)	5.64(-3)	4.71(-3)
19-38	6.79(-3)	6.43(-3)	6.19(-3)	5.63(-3)	5.14(-3)	4.33(-3)	3.71(-3)	3.24(-3)
20-21	2.00(-1)	1.80(-1)	1.71(-1)	1.53(-1)	1.40(-1)	1.19(-1)	1.03(-1)	9.07(-2)
20-22	2.88(-1)	2.49(-1)	2.29(-1)	1.95(-1)	1.71(-1)	1.39(-1)	1.17(-1)	1.01(-1)
20-23	1.44(-1)	1.19(-1)	1.06(-1)	8.32(-2)	6.90(-2)	5.18(-2)	4.16(-2)	3.48(-2)
20-24	4.55(-1)	4.34(-1)	4.23(-1)	3.99(-1)	3.76(-1)	3.31(-1)	2.92(-1)	2.59(-1)
20-25	1.11(-1)	8.82(-2)	7.76(-2)	6.00(-2)	4.93(-2)	3.66(-2)	2.93(-2)	2.44(-2)
20-26	1.45(-1)	1.20(-1)	1.08(-1)	8.74(-2)	7.41(-2)	5.74(-2)	4.71(-2)	4.00(-2)
20-27	3.73(-2)	2.97(-2)	2.62(-2)	2.05(-2)	1.69(-2)	1.28(-2)	1.03(-2)	8.65(-3)
20-28	6.00(-2)	5.38(-2)	5.08(-2)	4.54(-2)	4.14(-2)	3.51(-2)	3.03(-2)	2.66(-2)
20-29	2.01(-2)	1.58(-2)	1.38(-2)	1.06(-2)	8.69(-3)	6.42(-3)	5.11(-3)	4.25(-3)
20-30	4.83(-2)	4.03(-2)	3.65(-2)	2.98(-2)	2.54(-2)	1.98(-2)	1.62(-2)	1.37(-2)
20-31	2.27(-2)	1.79(-2)	1.58(-2)	1.24(-2)	1.03(-2)	7.87(-3)	6.39(-3)	5.40(-3)
20-32	7.79(-3)	5.93(-3)	5.10(-3)	3.78(-3)	3.01(-3)	2.14(-3)	1.67(-3)	1.36(-3)
20-33	3.73(-2)	3.03(-2)	2.72(-2)	2.22(-2)	1.90(-2)	1.49(-2)	1.23(-2)	1.05(-2)
20-34	3.72(-2)	2.78(-2)	2.39(-2)	1.79(-2)	1.43(-2)	1.04(-2)	8.13(-3)	6.71(-3)
20-35	1.99(-2)	1.50(-2)	1.30(-2)	9.76(-3)	7.87(-3)	5.71(-3)	4.50(-3)	3.72(-3)
20-36	1.84(-2)	1.37(-2)	1.18(-2)	8.85(-3)	7.13(-3)	5.18(-3)	4.09(-3)	3.38(-3)
20-37	2.67(-2)	2.09(-2)	1.84(-2)	1.43(-2)	1.18(-2)	8.84(-3)	7.09(-3)	5.92(-3)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
20–38	7.59(–3)	6.99(–3)	6.61(–3)	5.78(–3)	5.11(–3)	4.14(–3)	3.46(–3)	2.97(–3)
21–22	3.00(–1)	2.77(–1)	2.65(–1)	2.42(–1)	2.24(–1)	1.92(–1)	1.68(–1)	1.48(–1)
21–23	2.03(–1)	1.67(–1)	1.50(–1)	1.19(–1)	1.00(–1)	7.62(–2)	6.18(–2)	5.21(–2)
21–24	3.17(–1)	2.63(–1)	2.38(–1)	1.95(–1)	1.66(–1)	1.30(–1)	1.07(–1)	9.09(–2)
21–25	2.52(–1)	2.10(–1)	1.90(–1)	1.56(–1)	1.34(–1)	1.05(–1)	8.74(–2)	7.47(–2)
21–26	1.89(–1)	1.61(–1)	1.48(–1)	1.27(–1)	1.13(–1)	9.30(–2)	7.92(–2)	6.89(–2)
21–27	9.58(–2)	8.54(–2)	8.04(–2)	7.14(–2)	6.48(–2)	5.47(–2)	4.72(–2)	4.14(–2)
21–28	1.11(–1)	9.90(–2)	9.33(–2)	8.32(–2)	7.58(–2)	6.43(–2)	5.56(–2)	4.88(–2)
21–29	2.26(–2)	1.76(–2)	1.53(–2)	1.17(–2)	9.45(–3)	6.89(–3)	5.44(–3)	4.50(–3)
21–30	1.46(–1)	1.22(–1)	1.11(–1)	9.07(–2)	7.75(–2)	6.05(–2)	4.97(–2)	4.23(–2)
21–31	3.46(–2)	2.81(–2)	2.52(–2)	2.04(–2)	1.74(–2)	1.36(–2)	1.12(–2)	9.59(–3)
21–32	4.18(–2)	4.01(–2)	3.93(–2)	3.74(–2)	3.54(–2)	3.13(–2)	2.76(–2)	2.46(–2)
21–33	6.57(–2)	5.05(–2)	4.40(–2)	3.36(–2)	2.75(–2)	2.03(–2)	1.62(–2)	1.35(–2)
21–34	8.11(–2)	6.06(–2)	5.21(–2)	3.91(–2)	3.16(–2)	2.30(–2)	1.83(–2)	1.51(–2)
21–35	2.92(–2)	2.17(–2)	1.86(–2)	1.39(–2)	1.12(–2)	8.16(–3)	6.44(–3)	5.32(–3)
21–36	3.61(–2)	2.69(–2)	2.31(–2)	1.73(–2)	1.40(–2)	1.02(–2)	8.06(–3)	6.67(–3)
21–37	4.35(–2)	3.34(–2)	2.91(–2)	2.23(–2)	1.82(–2)	1.34(–2)	1.06(–2)	8.83(–3)
21–38	1.01(–2)	9.31(–3)	8.82(–3)	7.76(–3)	6.90(–3)	5.61(–3)	4.71(–3)	4.05(–3)
22–23	5.57(–1)	4.77(–1)	4.38(–1)	3.69(–1)	3.22(–1)	2.60(–1)	2.19(–1)	1.89(–1)
22–24	5.29(–1)	4.76(–1)	4.50(–1)	4.03(–1)	3.67(–1)	3.10(–1)	2.68(–1)	2.35(–1)
22–25	5.45(–1)	4.95(–1)	4.71(–1)	4.24(–1)	3.88(–1)	3.31(–1)	2.87(–1)	2.53(–1)
22–26	1.27(–1)	1.04(–1)	9.35(–2)	7.48(–2)	6.28(–2)	4.81(–2)	3.91(–2)	3.30(–2)
22–27	6.88(–2)	5.41(–2)	4.71(–2)	3.54(–2)	2.84(–2)	2.04(–2)	1.59(–2)	1.31(–2)
22–28	9.58(–2)	8.19(–2)	7.55(–2)	6.45(–2)	5.71(–2)	4.68(–2)	3.97(–2)	3.45(–2)
22–29	2.93(–2)	2.30(–2)	2.02(–2)	1.56(–2)	1.28(–2)	9.56(–3)	7.66(–3)	6.40(–3)
22–30	1.31(–1)	1.14(–1)	1.06(–1)	9.03(–2)	7.95(–2)	6.45(–2)	5.43(–2)	4.68(–2)
22–31	5.75(–2)	4.77(–2)	4.32(–2)	3.57(–2)	3.08(–2)	2.45(–2)	2.04(–2)	1.75(–2)
22–32	1.28(–2)	1.01(–2)	8.91(–3)	6.92(–3)	5.71(–3)	4.27(–3)	3.43(–3)	2.87(–3)
22–33	8.24(–2)	6.27(–2)	5.45(–2)	4.16(–2)	3.40(–2)	2.52(–2)	2.02(–2)	1.68(–2)
22–34	5.06(–2)	3.92(–2)	3.43(–2)	2.64(–2)	2.17(–2)	1.62(–2)	1.29(–2)	1.08(–2)
22–35	3.73(–2)	2.96(–2)	2.61(–2)	2.03(–2)	1.67(–2)	1.24(–2)	9.96(–3)	8.31(–3)
22–36	5.06(–2)	3.70(–2)	3.15(–2)	2.33(–2)	1.86(–2)	1.34(–2)	1.05(–2)	8.66(–3)
22–37	6.23(–2)	4.83(–2)	4.22(–2)	3.25(–2)	2.66(–2)	1.97(–2)	1.57(–2)	1.31(–2)
22–38	1.64(–2)	1.51(–2)	1.43(–2)	1.25(–2)	1.10(–2)	8.91(–3)	7.45(–3)	6.39(–3)
23–24	5.41(–1)	4.40(–1)	3.89(–1)	3.03(–1)	2.48(–1)	1.83(–1)	1.46(–1)	1.21(–1)
23–25	1.10	9.88(–1)	9.30(–1)	8.25(–1)	7.47(–1)	6.28(–1)	5.40(–1)	4.73(–1)
23–26	3.23(–1)	2.65(–1)	2.36(–1)	1.85(–1)	1.53(–1)	1.15(–1)	9.27(–2)	7.77(–2)
23–27	5.28(–2)	4.14(–2)	3.60(–2)	2.70(–2)	2.16(–2)	1.54(–2)	1.20(–2)	9.86(–3)
23–28	1.25(–1)	1.15(–1)	1.10(–1)	1.02(–1)	9.46(–2)	8.21(–2)	7.18(–2)	6.35(–2)
23–29	3.79(–2)	2.96(–2)	2.58(–2)	1.95(–2)	1.58(–2)	1.14(–2)	9.00(–3)	7.42(–3)
23–30	2.06(–1)	1.71(–1)	1.54(–1)	1.26(–1)	1.07(–1)	8.36(–2)	6.87(–2)	5.84(–2)
23–31	4.38(–2)	3.35(–2)	2.88(–2)	2.13(–2)	1.70(–2)	1.20(–2)	9.35(–3)	7.64(–3)
23–32	1.84(–2)	1.43(–2)	1.24(–2)	9.31(–3)	7.45(–3)	5.33(–3)	4.15(–3)	3.41(–3)
23–33	1.95(–1)	1.45(–1)	1.25(–1)	9.27(–2)	7.42(–2)	5.33(–2)	4.18(–2)	3.44(–2)
23–34	6.62(–2)	5.05(–2)	4.37(–2)	3.28(–2)	2.65(–2)	1.92(–2)	1.51(–2)	1.25(–2)
23–35	2.80(–2)	2.12(–2)	1.83(–2)	1.36(–2)	1.09(–2)	7.85(–3)	6.15(–3)	5.07(–3)
23–36	1.06(–1)	8.18(–2)	7.16(–2)	5.53(–2)	4.55(–2)	3.39(–2)	2.72(–2)	2.27(–2)
23–37	1.08(–1)	8.30(–2)	7.22(–2)	5.51(–2)	4.49(–2)	3.30(–2)	2.62(–2)	2.18(–2)
23–38	4.10(–2)	3.82(–2)	3.64(–2)	3.22(–2)	2.87(–2)	2.35(–2)	1.98(–2)	1.70(–2)
24–25	6.30(–1)	5.62(–1)	5.30(–1)	4.71(–1)	4.28(–1)	3.62(–1)	3.12(–1)	2.74(–1)
24–26	4.11(–1)	3.67(–1)	3.46(–1)	3.07(–1)	2.78(–1)	2.34(–1)	2.01(–1)	1.76(–1)
24–27	4.77(–2)	3.83(–2)	3.38(–2)	2.64(–2)	2.18(–2)	1.64(–2)	1.32(–2)	1.11(–2)
24–28	9.33(–2)	8.20(–2)	7.70(–2)	6.83(–2)	6.20(–2)	5.23(–2)	4.52(–2)	3.96(–2)
24–29	6.42(–2)	5.81(–2)	5.53(–2)	5.01(–2)	4.61(–2)	3.95(–2)	3.44(–2)	3.03(–2)
24–30	1.94(–1)	1.65(–1)	1.51(–1)	1.26(–1)	1.09(–1)	8.69(–2)	7.23(–2)	6.19(–2)
24–31	8.61(–2)	7.70(–2)	7.27(–2)	6.52(–2)	5.95(–2)	5.06(–2)	4.38(–2)	3.85(–2)
24–32	1.31(–2)	1.02(–2)	8.84(–3)	6.68(–3)	5.38(–3)	3.90(–3)	3.06(–3)	2.52(–3)
24–33	1.63(–1)	1.22(–1)	1.04(–1)	7.71(–2)	6.14(–2)	4.37(–2)	3.41(–2)	2.79(–2)
24–34	5.99(–2)	4.59(–2)	4.00(–2)	3.07(–2)	2.52(–2)	1.87(–2)	1.50(–2)	1.25(–2)
24–35	3.25(–2)	2.57(–2)	2.28(–2)	1.80(–2)	1.51(–2)	1.16(–2)	9.44(–3)	7.98(–3)
24–36	5.50(–2)	4.17(–2)	3.62(–2)	2.76(–2)	2.25(–2)	1.66(–2)	1.33(–2)	1.10(–2)
24–37	6.68(–2)	5.20(–2)	4.56(–2)	3.52(–2)	2.89(–2)	2.15(–2)	1.72(–2)	1.43(–2)
24–38	1.84(–2)	1.71(–2)	1.62(–2)	1.42(–2)	1.26(–2)	1.03(–2)	8.61(–3)	7.41(–3)
25–26	5.45(–1)	4.79(–1)	4.45(–1)	3.83(–1)	3.40(–1)	2.78(–1)	2.35(–1)	2.04(–1)
25–27	5.62(–2)	4.57(–2)	4.06(–2)	3.22(–2)	2.69(–2)	2.05(–2)	1.67(–2)	1.41(–2)

TABLE 3—Continued

ELECTRON TEMPERATURE (10^5 K)								
TRANSITION	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
25-28	1.49(-1)	1.38(-1)	1.33(-1)	1.23(-1)	1.15(-1)	1.00(-1)	8.76(-2)	7.75(-2)
25-29	3.00(-2)	2.37(-2)	2.09(-2)	1.64(-2)	1.36(-2)	1.02(-2)	8.25(-3)	6.92(-3)
25-30	2.87(-1)	2.55(-1)	2.40(-1)	2.12(-1)	1.91(-1)	1.60(-1)	1.37(-1)	1.19(-1)
25-31	4.59(-2)	3.59(-2)	3.13(-2)	2.37(-2)	1.91(-2)	1.38(-2)	1.08(-2)	8.94(-3)
25-32	1.28(-2)	9.96(-3)	8.69(-3)	6.63(-3)	5.38(-3)	3.93(-3)	3.11(-3)	2.57(-3)
25-33	1.17(-1)	8.59(-2)	7.33(-2)	5.42(-2)	4.33(-2)	3.12(-2)	2.45(-2)	2.02(-2)
25-34	6.45(-2)	4.86(-2)	4.19(-2)	3.15(-2)	2.54(-2)	1.85(-2)	1.46(-2)	1.21(-2)
25-35	2.89(-2)	2.22(-2)	1.92(-2)	1.46(-2)	1.18(-2)	8.64(-3)	6.84(-3)	5.67(-3)
25-36	8.42(-2)	6.63(-2)	5.87(-2)	4.66(-2)	3.92(-2)	3.01(-2)	2.46(-2)	2.08(-2)
25-37	8.49(-2)	6.53(-2)	5.69(-2)	4.36(-2)	3.56(-2)	2.63(-2)	2.09(-2)	1.74(-2)
25-38	3.14(-2)	2.96(-2)	2.84(-2)	2.56(-2)	2.32(-2)	1.93(-2)	1.65(-2)	1.43(-2)
26-27	2.81(-2)	2.24(-2)	1.97(-2)	1.53(-2)	1.26(-2)	9.40(-3)	7.53(-3)	6.30(-3)
26-28	3.98(-2)	3.32(-2)	3.01(-2)	2.51(-2)	2.18(-2)	1.75(-2)	1.46(-2)	1.26(-2)
26-29	3.50(-2)	2.97(-2)	2.74(-2)	2.35(-2)	2.09(-2)	1.72(-2)	1.47(-2)	1.28(-2)
26-30	1.59(-1)	1.30(-1)	1.16(-1)	9.29(-2)	7.79(-2)	5.93(-2)	4.80(-2)	4.04(-2)
26-31	3.65(-2)	2.97(-2)	2.66(-2)	2.13(-2)	1.80(-2)	1.39(-2)	1.14(-2)	9.64(-3)
26-32	2.21(-2)	1.94(-2)	1.81(-2)	1.59(-2)	1.43(-2)	1.19(-2)	1.02(-2)	8.93(-3)
26-33	3.87(-2)	2.92(-2)	2.51(-2)	1.87(-2)	1.50(-2)	1.08(-2)	8.43(-3)	6.93(-3)
26-34	6.45(-2)	4.92(-2)	4.25(-2)	3.19(-2)	2.57(-2)	1.86(-2)	1.46(-2)	1.21(-2)
26-35	7.13(-2)	5.40(-2)	4.65(-2)	3.46(-2)	2.76(-2)	1.98(-2)	1.55(-2)	1.27(-2)
26-36	5.51(-2)	4.39(-2)	3.91(-2)	3.12(-2)	2.62(-2)	2.01(-2)	1.65(-2)	1.39(-2)
26-37	6.20(-2)	4.83(-2)	4.24(-2)	3.29(-2)	2.71(-2)	2.02(-2)	1.62(-2)	1.36(-2)
26-38	2.05(-2)	1.91(-2)	1.82(-2)	1.61(-2)	1.44(-2)	1.18(-2)	9.90(-3)	8.53(-3)
27-28	8.52(-2)	7.09(-2)	6.41(-2)	5.25(-2)	4.48(-2)	3.51(-2)	2.89(-2)	2.46(-2)
27-29	3.37(-2)	2.89(-2)	2.67(-2)	2.27(-2)	2.00(-2)	1.62(-2)	1.37(-2)	1.18(-2)
27-30	2.66(-2)	2.18(-2)	1.96(-2)	1.59(-2)	1.35(-2)	1.04(-2)	8.58(-3)	7.29(-3)
27-31	3.45(-2)	2.87(-2)	2.60(-2)	2.14(-2)	1.84(-2)	1.45(-2)	1.20(-2)	1.02(-2)
27-32	1.52(-2)	1.25(-2)	1.12(-2)	9.01(-3)	7.59(-3)	5.82(-3)	4.74(-3)	4.00(-3)
27-33	2.01(-1)	1.98(-1)	1.96(-1)	1.89(-1)	1.80(-1)	1.60(-1)	1.41(-1)	1.26(-1)
27-34	1.64(-1)	1.60(-1)	1.58(-1)	1.52(-2)	1.44(-1)	1.28(-1)	1.13(-1)	1.00(-1)
27-35	1.24(-1)	1.20(-1)	1.19(-1)	1.14(-1)	1.08(-1)	9.63(-2)	8.51(-2)	7.58(-2)
27-36	9.11(-2)	8.24(-2)	7.78(-2)	6.85(-2)	6.12(-2)	5.03(-2)	4.26(-2)	3.69(-2)
27-37	3.81(-2)	2.92(-2)	2.54(-2)	1.93(-2)	1.57(-2)	1.16(-2)	9.18(-3)	7.63(-3)
27-38	1.28(-2)	1.22(-2)	1.18(-2)	1.09(-2)	9.97(-3)	8.47(-3)	7.30(-3)	6.39(-3)
28-29	1.13(-1)	1.04(-1)	9.87(-2)	8.85(-2)	8.02(-2)	6.72(-2)	5.75(-2)	5.02(-2)
28-30	4.40(-2)	3.68(-2)	3.34(-2)	2.76(-2)	2.38(-2)	1.88(-2)	1.56(-2)	1.33(-2)
28-31	1.51(-1)	1.40(-1)	1.35(-1)	1.23(-1)	1.14(-1)	9.70(-2)	8.40(-2)	7.38(-2)
28-32	5.11(-2)	5.08(-2)	5.04(-2)	4.89(-2)	4.67(-2)	4.17(-2)	3.69(-2)	3.29(-2)
28-33	1.49(-1)	1.28(-1)	1.18(-1)	1.01(-1)	8.90(-2)	7.27(-2)	6.14(-2)	5.32(-2)
28-34	1.00(-1)	8.81(-2)	8.28(-2)	7.35(-2)	6.66(-2)	5.62(-2)	4.84(-2)	4.24(-2)
28-35	3.67(-2)	3.21(-2)	3.00(-2)	2.63(-2)	2.36(-2)	1.97(-2)	1.68(-2)	1.47(-2)
28-36	4.38(-2)	3.74(-2)	3.44(-2)	2.93(-2)	2.58(-2)	2.09(-2)	1.76(-2)	1.52(-2)
28-37	7.19(-2)	6.22(-2)	5.74(-2)	4.87(-2)	4.26(-2)	3.41(-2)	2.84(-2)	2.44(-2)
28-38	6.39(-3)	5.89(-3)	5.57(-3)	4.87(-3)	4.30(-3)	3.47(-3)	2.90(-3)	2.49(-3)
29-30	8.55(-2)	5.33(-2)	5.10(-2)	4.67(-2)	4.32(-2)	3.73(-2)	3.26(-2)	2.88(-2)
29-31	1.20(-1)	1.10(-1)	1.06(-1)	9.67(-2)	8.91(-2)	7.64(-2)	6.64(-2)	5.84(-2)
29-32	3.29(-2)	2.83(-2)	2.61(-2)	2.19(-2)	1.90(-2)	1.51(-2)	1.25(-2)	1.07(-2)
29-33	3.97(-2)	3.43(-2)	3.19(-2)	2.77(-2)	2.47(-2)	2.04(-2)	1.74(-2)	1.51(-2)
29-34	3.11(-2)	2.69(-2)	2.50(-2)	2.16(-2)	1.92(-2)	1.58(-2)	1.34(-2)	1.16(-2)
29-35	2.12(-2)	1.76(-2)	1.60(-2)	1.34(-2)	1.17(-2)	9.49(-3)	7.99(-3)	6.90(-3)
29-36	6.45(-2)	5.70(-2)	5.38(-2)	4.82(-2)	4.40(-2)	3.75(-2)	3.25(-2)	2.85(-2)
29-37	5.14(-2)	4.22(-2)	3.81(-2)	3.10(-2)	2.64(-2)	2.05(-2)	1.68(-2)	1.42(-2)
29-38	2.40(-2)	2.43(-2)	2.44(-2)	2.41(-2)	2.33(-2)	2.11(-2)	1.88(-2)	1.68(-2)
30-31	4.20(-2)	3.65(-2)	3.39(-2)	2.93(-2)	2.61(-2)	2.15(-2)	1.83(-2)	1.59(-2)
30-32	1.45(-2)	1.17(-2)	1.03(-2)	8.06(-3)	6.64(-3)	4.93(-3)	3.94(-3)	3.28(-3)
30-33	5.64(-2)	4.63(-2)	4.17(-2)	3.41(-2)	2.92(-2)	2.29(-2)	1.89(-2)	1.61(-2)
30-34	5.48(-2)	4.60(-2)	4.20(-2)	3.52(-2)	3.06(-2)	2.46(-2)	2.07(-2)	1.78(-2)
30-35	3.72(-2)	2.91(-2)	2.55(-2)	1.96(-2)	1.60(-2)	1.18(-2)	9.42(-3)	7.84(-3)
30-36	1.90(-1)	1.68(-1)	1.59(-1)	1.43(-1)	1.31(-1)	1.12(-1)	9.71(-2)	8.55(-2)
30-37	9.44(-2)	7.34(-2)	6.46(-2)	5.07(-2)	4.23(-2)	3.23(-2)	2.63(-2)	2.23(-2)
30-38	1.37(-1)	1.37(-1)	1.37(-1)	1.34(-1)	1.29(-1)	1.15(-1)	1.03(-1)	9.15(-2)
31-32	5.09(-2)	4.48(-2)	4.17(-2)	3.58(-2)	3.14(-2)	2.53(-2)	2.12(-2)	1.82(-2)
31-33	5.84(-2)	5.11(-2)	4.79(-2)	4.23(-2)	3.83(-2)	3.23(-2)	2.79(-2)	2.44(-2)
31-34	3.60(-2)	3.04(-2)	2.78(-2)	2.33(-2)	2.02(-2)	1.61(-2)	1.34(-2)	1.14(-2)
31-35	2.67(-2)	2.22(-2)	2.02(-2)	1.69(-2)	1.46(-2)	1.17(-2)	9.73(-3)	8.35(-3)

TABLE 3—Continued

TRANSITION	ELECTRON TEMPERATURE (10^5 K)							
	5.0	8.0	10.0	15.0	20.0	30.0	40.0	50.0
31–36	6.06(–2)	5.40(–2)	5.10(–2)	4.57(–2)	4.17(–2)	3.53(–2)	3.05(–2)	2.68(–2)
31–37	6.24(–2)	5.18(–2)	4.70(–2)	3.86(–2)	3.31(–2)	2.59(–2)	2.13(–2)	1.81(–2)
31–38	3.70(–2)	3.63(–2)	3.58(–2)	3.42(–2)	3.23(–2)	2.84(–2)	2.50(–2)	2.21(–2)
32–33	7.02(–3)	5.85(–3)	5.31(–3)	4.38(–3)	3.76(–3)	2.95(–3)	2.43(–3)	2.08(–3)
32–34	2.59(–2)	2.16(–2)	1.98(–2)	1.67(–2)	1.46(–2)	1.19(–2)	1.01(–2)	8.73(–3)
32–35	1.70(–2)	1.43(–2)	1.30(–2)	1.09(–2)	9.44(–3)	7.52(–3)	6.26(–3)	5.36(–3)
32–36	9.61(–3)	8.00(–3)	7.26(–3)	5.97(–3)	5.12(–3)	4.01(–3)	3.30(–3)	2.81(–3)
32–37	2.76(–2)	2.22(–2)	1.99(–2)	1.59(–2)	1.34(–2)	1.03(–2)	8.42(–3)	7.12(–3)
32–38	4.49(–3)	4.11(–3)	3.87(–3)	3.36(–3)	2.95(–3)	2.37(–3)	1.97(–3)	1.69(–3)
33–34	3.36(–1)	3.09(–1)	2.96(–1)	2.69(–1)	2.46(–1)	2.10(–1)	1.81(–1)	1.59(–1)
33–35	4.30(–2)	3.84(–2)	3.62(–2)	3.22(–2)	2.92(–2)	2.45(–2)	2.10(–2)	1.84(–2)
33–36	8.70(–2)	7.30(–2)	6.66(–2)	5.53(–2)	4.77(–2)	3.76(–2)	3.11(–2)	2.65(–2)
33–37	1.50(–1)	1.36(–1)	1.29(–1)	1.15(–1)	1.04(–1)	8.68(–2)	7.42(–2)	6.46(–2)
33–38	1.86(–2)	1.75(–2)	1.67(–2)	1.51(–2)	1.36(–2)	1.14(–2)	9.70(–3)	8.43(–3)
34–35	2.83(–1)	2.62(–1)	2.51(–1)	2.29(–1)	2.10(–1)	1.79(–1)	1.55(–1)	1.36(–1)
34–36	9.37(–2)	8.26(–2)	7.74(–2)	6.77(–2)	6.06(–2)	5.01(–2)	4.27(–2)	3.70(–2)
34–37	9.00(–2)	7.95(–2)	7.41(–2)	6.41(–2)	5.67(–2)	4.60(–2)	3.87(–2)	3.33(–2)
34–38	2.28(–2)	2.14(–2)	2.06(–2)	1.86(–2)	1.69(–2)	1.42(–2)	1.21(–2)	1.06(–2)
35–36	5.26(–2)	4.44(–2)	4.06(–2)	3.38(–2)	2.92(–2)	2.31(–2)	1.91(–2)	1.63(–2)
35–37	5.79(–2)	5.13(–2)	4.80(–2)	4.17(–2)	3.70(–2)	3.02(–2)	2.54(–2)	2.19(–2)
35–38	4.51(–2)	4.40(–2)	4.32(–2)	4.09(–2)	3.84(–2)	3.35(–2)	2.94(–2)	2.60(–2)
36–37	5.79(–1)	5.54(–1)	5.41(–1)	5.13(–1)	4.83(–1)	4.25(–1)	3.749(–1)	3.31(–1)
36–38	4.27(–1)	4.27(–1)	4.26(–1)	4.17(–1)	4.01(–1)	3.59(–1)	3.19(–1)	2.85(–1)
37–38	3.56(–1)	3.57(–1)	3.56(–1)	3.48(–1)	3.34(–1)	2.99(–1)	2.66(–1)	2.37(–1)

TABLE 4

COMPARISON OF CALCULATED AND EXPERIMENTAL EXCITATION RATES (IN $10^{-9} \text{ cm}^3 \text{ s}^{-1}$) AT ELECTRON TEMPERATURE 160 eV

Excitation	Present		Other Calculation ^b
	Calculation	Experiment ^a	
$3p^4-3p^33d \ ^1F_3$	2.2	3.7	2.8
$3p^4-3p^33d \ ^3D_1$	1.0	1.6	1.1
$3p^4-3p^33d \ ^1D_2$	1.4	2.4	1.4
$3p^4-3p^33d \ ^3P_2$	1.7	3.1	2.1

^a Result of Wang et al. 1984b.^b Distorted-wave calculation of Mason 1975.

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