

Rovibrational excitation of HD molecules by He atoms

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Abstract. Rate coefficients for rovibrational transitions induced in HD by collisions with He are presented. Full quantum mechanical treatment has been used with the interaction potential surface calculated by Muchnick & Russek (1994). The vibrational $v = 1 \rightarrow 0$ quenching rates of HD due to various perturbers are compared up to temperatures of 1500 K. The influence of vibrationally excited channels on the pure rotational excitation cross sections is shown to be negligible.

Key words: atomic data — atomic processes

1. Introduction

Pure rotational transitions of HD have been detected recently. In the dense photon dominated region of the Orion bar the R(0) line at $112\text{ m}\mu$ has been detected with the long wavelength spectrometer (LWS) of ISO (Wright et al. 1999) and Bertoldi et al. (1999) report the detection of the R(5) line at $19.43\text{ }\mu\text{m}$ with the short wavelength spectrometer (SWS) of ISO in the Orion molecular outflow. On the other hand, infrared rovibrational transitions in HD have been predicted by Sternberg (1990) and Timmermann (1996) as possible occurrences in dense photon dominated regions (PDR). The interpretation of such observations require the knowledge of the different microscopic processes involved and in particular the rovibrational excitation rate coefficients due to the various perturbers, i.e. atomic and molecular hydrogen as well as helium. In a previous paper, Roueff & Zeippen (1999) have calculated the rotational excitation of HD due to collisions with helium. In the present work, these calculations are extended to the rovibrational excitation of HD by helium. Note that rovibrational excitation of HD by hydrogen atoms and molecules has already been calculated by Flower & Roueff (1999) in a complete close-coupling quantal approach. The same method is used

in this study. Section 2 of the present paper summarizes the formalisms selected for the calculations. Results are given in Sect. 3 and a discussion plus a conclusion can be found in Sect. 4.

2. Numerical methods

The computer code MOLSCAT developed by Hutson & Green (1995) has been used in this work. Close-coupling quantal collision equations are solved for a rotating harmonic oscillator perturbed by a structureless atom, in this case helium. Different numerical methods are implemented in the code to solve the coupled, second-order differential equations. Among the various possibilities, the hybrid modified LOG-DERIVATIVE/AIRY propagator (Alexander & Manolopoulos 1987) and the R-MATRIX propagator (Stechel et al. 1978) have been tried, with mutually consistent results. The potential surface of Muchnick & Russek (1994), relative to the $\text{H}_2\text{-He}$ system, is expressed as a function of the distances between the three atoms in the system including a range of H_2 internuclear distances adequate to probe the vibrationally excited wave functions, as shown in Flower et al. (1998). The potential surfaces of the $\text{H}_2\text{-He}$ and HD-He systems are identical from the adiabatic point of view where nuclei are fixed. As in the previous related studies (Flower et al. 1998; Flower & Roueff 1999; Roueff & Zeippen 1999), the facility provided by the MOLSCAT program to expand the potential in terms of Legendre polynomials was used. Now, contrary to the $\text{H}_2\text{-He}$ case, the Legendre expansion for the HD-He interaction contains odd as well as even contributions of λ since the system is not symmetric anymore with respect to the exchange of nuclei within the molecule. In the present collision calculations, terms up to $\lambda = 15$ have been retained in the potential expansion and vibrational levels up to $v = 3$ have been included.

The integral cross-sections are obtained by summing the partial cross-sections σ_J until convergence is reached. A step of 1 is taken for collision energies smaller than 5000 cm^{-1} . Larger step values may be used for higher

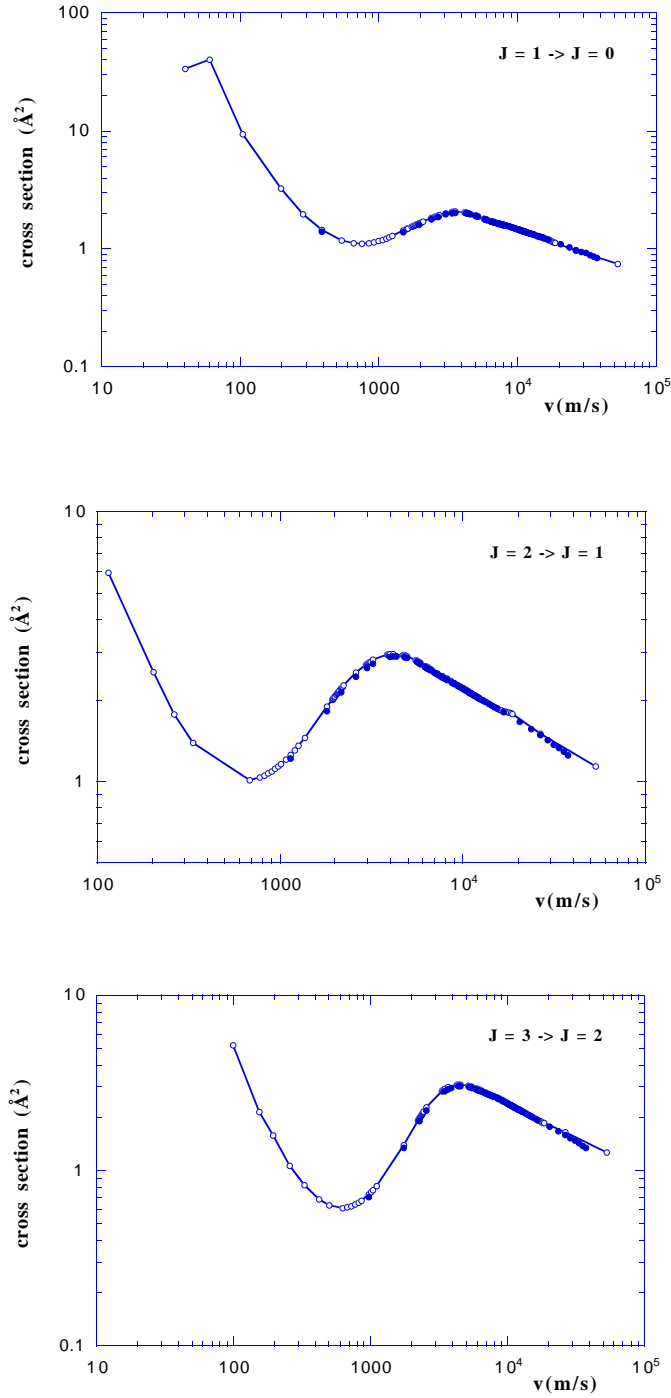


Fig. 1. Comparison between present (filled points) and rigid rotor results (Roueff & Zeppen 1999) (open points) for the de-excitation collisional cross-sections as a function of the relative center-of-mass velocity: **a)** de-excitation from the $J = 1$ level, **b)** de-excitation from the $J = 2$ level, **c)** de-excitation from the $J = 3$ level

Table 1. Labels and energies of HD rovibrational levels used in the present expansion basis

J	v	$E(\text{cm}^{-1})$	$E(\text{K})$
0	0	0.00	0.00
1	0	89.23	128.4
2	0	267.12	384.3
3	0	532.32	765.9
4	0	883.30	1270.7
5	0	1317.45	1895.4
6	0	1832.55	2635.8
7	0	2424.14	3487.5
8	0	3089.46	4445.3
0	1	3632.568	5226.7
1	1	3717.938	5349.6
9	0	3824.924	5503.5
2	1	3888.082	5594.4
3	1	4141.820	5959.5
4	1	4477.420	6442.3
10	0	4626.133	6656.3
5	1	4892.634	7039.8
6	1	5384.750	7747.8
11	0	5488.828	7897.6
7	1	5950.651	8562.1
12	0	6408.644	9221.1
8	1	6586.873	9477.5
0	2	7087.660	10198.1
1	2	7169.249	10315.5
9	1	7289.669	10488.7
2	2	7331.849	10549.4
13	0	7381.163	10620.4
3	2	7574.313	10898.3
4	2	7894.961	11359.7
10	1	8055.076	11590.0
5	2	8291.609	11930.4
14	0	8401.964	12089.2
6	2	8761.628	12606.7
11	1	8878.973	12775.5
7	2	9301.995	13384.2
15	0	9466.661	13621.1
12	1	9757.136	14039.0
8	2	9909.350	14258.1
0	3	10368.877	14919.3
1	3	10446.746	15031.3
16	0	10570.939	15210.0
9	2	10580.064	15223.1
2	3	10601.922	15254.6
13	1	10685.293	15374.5
3	3	10833.290	15587.5

energies since the partial cross-sections vary smoothly with J . This is fortunate because, as expected, the number of partial cross-sections becomes very large as collision energy increases. The expansion basis is made of the first 45 rovibrational levels in HD whose energies, displayed in Table 1, are taken from Dabrowski & Herzberg (1976) and Abgrall et al. (1982). Cross-sections for rovibrational transitions were calculated on a grid of barycentric collision energies extending from the threshold of the first rotational level at 89.23 cm^{-1} up to $100\,000 \text{ cm}^{-1}$.

3. Results

The collision rates $q(T)$ are taken to be the Maxwellian average of the cross-sections:

$$q(T) = \left(\frac{8kT}{\pi\mu}\right)^{1/2} \left(\frac{1}{kT}\right)^2 \int_0^\infty \sigma(E) E dE e^{-E/kT} \quad (1)$$

where σ is the cross-section and μ the reduced mass of the system. The present excitation and de-excitation rates are given in Tables 2-5 for 4 temperatures: 300 K, 500 K, 1000 K and 1500 K. Collision rate coefficients for other temperatures are available on request from one of us (Evelyne.Roueff@obspm.fr).

To the best of our knowledge, there is no previous calculation or experiment to which the present results could be compared. It is all the more important to stress the excellent agreement between the new data and those obtained in our previous pure rotational excitation study based on the rigid rotor approximation (Roueff & Zeppen 1999). This shows that the coupling between rotation and vibration is negligible for the ground state. A typical example is displayed in Fig. 1 for the rotational de-excitation of the first three rotational levels as a function of the relative velocity between HD and He.

Table 6. Vibrational quenching rate of the $v = 1$ state in HD due to collisions with He, H and para H₂. Numbers in parentheses are powers of 10

$T(K)$	He	H	H ₂
300	1.0(-16)	5.7(-15)	5.8(-17)
500	9.8(-16)	2.6(-14)	3.4(-16)
1000	2.1(-14)	3.4(-13)	8.1(-15)
1500	1.2(-13)	3.5(-12)	

4. Discussion and conclusion

Similar calculations have been performed on the HD–H and HD–H₂ systems by Flower & Roueff (1999). Table 6 gives a comparison between the quenching rate of the $v = 1$ state of HD due to collisions with He (present work), H and H₂ at different temperatures.

The magnitude of the quenching rate coefficients vary significantly with the perturber. At all temperatures considered, quenching by hydrogen atoms is more efficient by about one order of magnitude. However, collisions with helium predominate over those with molecular hydrogen.

Helium is sometimes taken as a prototype of the H₂ molecule in its ground state $J = 0$ in view of rotationally inelastic dynamics. The rate coefficients are then evaluated by scaling the values with the square root of the ratio of the reduced masses of the two systems:

$$\left(\frac{\mu_{\text{HD-He}}}{\mu_{\text{HD-H}_2}}\right)^{1/2} = 1.1934. \quad (2)$$

However, the results displayed in Table 6 show that this approximation is inadequate. In this work, we have extended the previous calculations of Flower & Roueff (1999) devoted to HD rovibrational excitation in H and H₂ collisions to the case of Helium. This should allow future infrared observations of HD in various environments to be interpreted without uncertainties related to basic molecular physics.

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Table 2. continued

v_f, j_f	1, 0	1.94D-26	2.98D-26	4.16D-26	1.54D-25	6.84D-25	5.49D-24	6.57D-23	1.07D-21
		1.37D-20		3.24D-11	7.55D-20	5.62D-12	1.57D-12	3.16D-13	1.34D-19
		9.56D-14	1.53D-14	8.20D-20	3.60D-15	3.67D-20	6.23D-16	2.11D-18	1.99D-18
		1.10D-16	3.81D-18	1.50D-20	4.12D-18	4.52D-18	2.22D-17	3.11D-18	4.96D-21
		2.22D-18	4.61D-18	1.28D-18	1.13D-21	9.78D-19	7.13D-19	0.00D+00	0.00D+00
		0.00D+00	3.77D-19	0.00D+00	2.02D-19	3.69D-19			
1, 1	1, 1	3.51D-26	6.82D-26	1.26D-25	3.80D-25	3.03D-24	1.62D-23	1.34D-22	1.85D-21
		3.46D-20	6.46D-11		2.62D-19	4.18D-11	5.97D-12	1.54D-12	5.36D-19
		4.19D-13	6.49D-14	3.50D-19	1.59D-14	1.60D-19	2.68D-15	7.17D-18	7.78D-18
		4.75D-16	8.49D-18	6.62D-20	1.39D-17	1.39D-17	9.57D-17	9.97D-18	2.20D-20
		7.32D-18	1.99D-17	4.18D-18	4.97D-21	4.24D-18	2.39D-18	0.00D+00	3.83D-19
		0.00D+00	1.27D-18	0.00D+00	8.72D-19	1.16D-18			
0, 9	0, 9	1.49D-23	3.33D-23	1.45D-22	1.11D-21	1.44D-20	3.22D-19	1.24D-17	9.60D-16
		1.87D-13	5.70D-19	9.95D-19		3.95D-18	5.77D-17	2.68D-16	4.69D-12
		6.99D-16	6.57D-16	3.16D-13	4.22D-16	3.22D-14	2.92D-16	7.33D-21	8.55D-21
		1.84D-16	2.14D-20	3.88D-15	8.76D-20	7.50D-20	8.93D-17	1.36D-19	6.08D-16
		1.64D-19	3.64D-17	1.89D-19	1.03D-16	1.47D-17	3.54D-19	0.00D+00	0.00D+00
		1.66D-17	5.94D-19	0.00D+00	5.45D-18	0.00D+00			
1, 2	1, 2	5.06D-26	5.89D-26	1.59D-25	4.89D-25	2.50D-24	3.01D-23	2.29D-22	2.74D-21
		5.16D-20	8.25D-12	3.08D-11	7.68D-19		3.75D-11	4.64D-12	1.49D-18
		1.38D-12	2.09D-13	1.04D-18	4.88D-14	4.85D-19	8.25D-15	7.19D-18	1.06D-17
		1.44D-15	1.70D-17	2.06D-19	2.16D-17	2.59D-17	2.88D-16	1.88D-17	6.87D-20
		1.42D-17	6.00D-17	8.38D-18	1.53D-20	1.28D-17	4.87D-18	6.31D-19	7.65D-19
		0.00D+00	2.64D-18	4.42D-19	2.61D-18	2.16D-18			
1, 3	1, 3	2.25D-26	3.80D-26	8.35D-26	3.53D-25	1.70D-24	1.42D-23	2.82D-22	3.83D-21
		9.67D-20	9.57D-13	1.82D-12	4.65D-18	1.55D-11		2.95D-11	4.70D-18
		4.35D-12	6.72D-13	3.18D-18	1.57D-13	1.46D-18	2.45D-14	1.12D-17	1.32D-17
		4.24D-15	2.08D-17	6.23D-19	3.64D-17	3.79D-17	8.32D-16	3.14D-17	2.06D-19
		2.48D-17	1.72D-16	1.49D-17	4.46D-20	3.68D-17	9.23D-18	9.53D-19	1.38D-18
		0.00D+00	5.08D-18	7.80D-19	7.33D-18	3.49D-18			
1, 4	1, 4	6.70D-27	1.08D-26	2.93D-26	1.14D-25	7.74D-25	6.13D-24	8.60D-23	3.02D-21
		8.54D-20	4.95D-14	1.21D-13	5.54D-18	4.95D-13	7.59D-12		3.92D-17
		2.47D-11	2.52D-12	1.17D-17	5.24D-13	4.72D-18	7.88D-14	1.22D-17	2.54D-17
		1.28D-14	2.66D-17	1.96D-18	4.31D-17	5.83D-17	2.44D-15	4.67D-17	6.31D-19
		4.17D-17	4.97D-16	2.64D-17	1.31D-19	1.05D-16	1.72D-17	1.40D-18	2.27D-18
		2.13D-20	9.87D-18	1.33D-18	2.04D-17	5.52D-18			
0,10	0,10	8.50D-26	1.92D-25	8.39D-25	6.39D-24	8.09D-23	1.70D-21	5.98D-20	3.56D-18
		4.11D-16	2.39D-20	4.82D-20	1.11D-13	1.81D-19	1.38D-18	4.49D-17	
		1.14D-15	2.52D-15	3.27D-12	2.07D-15	2.11D-13	7.56D-16	6.10D-21	5.86D-21
		4.95D-16	1.52D-20	1.96D-14	8.97D-20	1.26D-19	2.74D-16	2.71D-19	2.65D-15
		3.76D-19	1.13D-16	3.33D-19	4.12D-16	4.52D-17	8.12D-19	0.00D+00	9.01D-20
		6.07D-17	1.46D-18	5.07D-20	1.59D-17	2.80D-19			
1, 5	1, 5	9.26D-28	1.57D-27	4.44D-27	2.05D-26	1.42D-25	1.65D-24	2.32D-23	5.65D-22
		3.64D-20	2.49D-15	5.50D-15	2.42D-18	2.46D-14	1.86D-13	4.12D-12	1.66D-16
			1.72D-11	6.79D-17	2.18D-12	1.87D-17	2.73D-13	1.45D-17	2.14D-17
		4.26D-14	4.75D-17	6.88D-18	5.26D-17	6.60D-17	7.54D-15	7.45D-17	2.05D-18
		6.80D-17	1.49D-15	4.63D-17	4.00D-19	3.09D-16	3.32D-17	1.95D-18	3.50D-18
		6.16D-20	1.98D-17	2.07D-18	5.77D-17	8.89D-18			
1, 6	1, 6	5.32D-29	9.26D-29	2.68D-28	1.30D-27	1.01D-26	1.19D-25	2.27D-24	5.30D-23
		2.16D-21	4.44D-17	9.50D-17	2.53D-19	4.14D-16	3.21D-15	4.70D-14	4.09D-17
		1.92D-12		8.85D-16	1.48D-11	9.06D-17	1.23D-12	1.56D-17	1.72D-17
		1.58D-13	3.69D-17	2.79D-17	1.08D-16	9.23D-17	2.59D-14	9.41D-17	7.39D-18
		1.19D-16	4.81D-15	8.23D-17	1.30D-18	9.54D-16	6.61D-17	2.91D-18	5.66D-18
		1.96D-19	4.28D-17	3.09D-18	1.71D-16	1.48D-17			
0,11	0,11	2.24D-28	5.07D-28	2.22D-27	1.68D-26	2.09D-25	4.25D-24	1.41D-22	7.79D-21
		7.26D-19	2.57D-22	5.50D-22	1.31D-16	2.22D-21	1.63D-20	2.35D-19	5.71D-14
		8.14D-18	9.50D-16		1.15D-14	2.48D-12	3.88D-15	3.23D-21	3.31D-21
		1.56D-15	9.21D-21	1.40D-13	6.48D-20	2.29D-19	8.65D-16	5.23D-19	1.41D-14
		9.09D-19	3.91D-16	5.88D-19	1.89D-15	1.54D-16	1.65D-18	3.12D-20	8.38D-20
		2.50D-16	3.76D-18	5.10D-20	5.10D-17	2.83D-19			

Table 2. continued

v_f, j_f	1, 7	2.22D-30	3.86D-30	1.18D-29	5.97D-29	5.04D-28	6.68D-27	1.36D-25	4.36D-24
		1.77D-22	8.02D-19	1.77D-18	1.24D-20	7.40D-18	5.73D-17	7.45D-16	2.57D-18
		1.86D-14	1.13D-12	8.19D-16		6.24D-16	9.37D-12	1.58D-17	1.33D-17
		7.87D-13	3.03D-17	1.34D-16	9.56D-17	1.92D-16	1.01D-13	1.50D-16	2.95D-17
		1.76D-16	1.74D-14	1.58D-16	4.64D-18	3.21D-15	1.37D-16	4.02D-18	8.12D-18
		7.24D-19	9.88D-17	4.77D-18	5.38D-16	2.56D-17			
	0,12	4.65D-31	1.06D-30	4.65D-30	3.51D-29	4.34D-28	8.68D-27	2.78D-25	1.44D-23
		1.23D-21	1.51D-24	3.30D-24	1.76D-19	1.36D-23	9.87D-23	1.25D-21	4.86D-17
		2.95D-20	1.28D-18	3.27D-14	1.16D-16		2.31D-14	7.98D-22	1.07D-21
		9.49D-15	3.69D-21	1.85D-12	3.98D-20	2.69D-19	3.23D-15	9.70D-19	1.06D-13
		2.08D-18	1.43D-15	1.45D-18	1.06D-14	5.92D-16	3.54D-18	2.14D-20	6.33D-20
		1.20D-15	1.04D-17	4.42D-20	1.89D-16	2.44D-19			
	1, 8	5.04D-32	8.95D-32	2.76D-31	1.47D-30	1.27D-29	1.80D-28	3.94D-27	1.32D-25
		6.84D-24	7.44D-21	1.61D-20	4.62D-22	6.71D-20	4.80D-19	6.01D-18	5.05D-20
		1.25D-16	5.06D-15	1.48D-17	5.02D-13	6.68D-15		9.07D-18	1.06D-17
		6.73D-12	2.52D-17	9.01D-16	1.10D-16	2.70D-16	5.45D-13	4.73D-16	1.40D-16
		3.44D-16	7.37D-14	2.65D-16	1.84D-17	1.23D-14	3.20D-16	4.98D-18	1.15D-17
		3.23D-18	2.59D-16	6.09D-18	1.89D-15	4.12D-17			
	2, 0	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	4.54D-32
		1.63D-30	1.34D-25	2.29D-25	6.17D-29	3.11D-25	1.17D-24	4.98D-24	2.17D-27
		3.53D-23	3.41D-22	6.56D-26	4.51D-21	1.23D-24	4.83D-20		3.18D-11
		2.16D-19	5.94D-12	1.15D-23	1.78D-12	3.60D-13	2.86D-19	8.43D-14	2.28D-23
		2.16D-14	2.02D-19	4.69D-15	1.10D-23	1.04D-19	1.27D-15	2.11D-17	2.66D-17
		2.34D-22	2.74D-16	1.31D-17	3.17D-19	8.77D-17			
	2, 1	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	1.20D-32	2.42D-31
		5.53D-30	2.57D-25	5.04D-25	1.46D-28	9.35D-25	2.80D-24	2.09D-23	4.22D-27
		1.06D-22	7.63D-22	1.37D-25	7.72D-21	3.33D-24	1.15D-19	6.45D-11	
		7.18D-19	4.34D-11	3.36D-23	6.52D-12	1.76D-12	1.11D-18	3.65D-13	8.47D-23
		9.06D-14	8.42D-19	2.01D-14	4.68D-23	4.59D-19	5.39D-15	6.45D-17	7.79D-17
		1.19D-21	1.15D-15	4.07D-17	1.44D-18	2.91D-16			
	1, 9	0.00D+00	0.00D+00	4.23D-33	2.28D-32	2.06D-31	3.00D-30	6.94D-29	2.46D-27
		1.34D-25	5.06D-23	1.09D-22	1.12D-23	4.50D-22	3.20D-21	3.75D-20	1.27D-21
		7.48D-19	2.48D-17	2.29D-19	1.62D-15	1.05D-16	2.59D-13	1.56D-18	2.55D-18
			1.09D-17	1.73D-14	1.54D-16	7.11D-16	5.07D-12	1.16D-15	8.61D-16
		1.49D-15	4.34D-13	5.43D-16	8.63D-17	5.57D-14	6.90D-16	5.19D-18	1.40D-17
		1.75D-17	7.99D-16	7.62D-18	7.64D-15	6.26D-17			
	2, 2	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	1.67D-32	3.09D-31
		8.82D-30	3.75D-25	4.20D-25	2.79D-28	1.14D-24	3.37D-24	1.67D-23	8.38D-27
		1.79D-22	1.25D-21	2.90D-25	1.34D-20	8.82D-24	2.08D-19	9.21D-12	3.32D-11
		2.35D-18		9.53D-23	3.96D-11	5.22D-12	3.14D-18	1.22D-12	2.27D-22
		2.85D-13	2.54D-18	5.89D-14	1.57D-22	1.42D-18	1.63D-14	1.18D-16	1.77D-16
		4.33D-21	3.35D-15	6.91D-17	4.67D-18	5.71D-16			
	0,13	0.00D+00	0.00D+00	7.76D-33	5.85D-32	7.17D-31	1.41D-29	4.38D-28	2.16D-26
		1.70D-24	6.29D-27	1.40D-26	2.16D-22	5.89D-26	4.30D-25	5.26D-24	4.61D-20
		1.11D-22	4.02D-21	1.88D-17	2.52D-19	1.89D-14	3.17D-17	7.63D-23	1.09D-22
		1.58D-14	4.06D-22		8.68D-21	8.41D-20	2.63D-14	8.84D-19	1.49D-12
		4.10D-18	6.16D-15	4.98D-18	8.47D-14	2.44D-15	9.77D-18	1.27D-20	3.69D-20
		7.33D-15	3.68D-17	3.42D-20	8.27D-16	2.24D-19			
	2, 3	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	2.10D-32	4.90D-31
		1.29D-29	1.78D-25	3.01D-25	5.00D-28	6.33D-25	2.58D-24	1.19D-23	2.16D-26
		8.70D-23	1.61D-21	8.94D-25	1.85D-20	4.16D-23	3.98D-19	1.21D-12	2.18D-12
		1.45D-17	1.73D-11	8.91D-22		3.25D-11	1.07D-17	3.95D-12	7.93D-22
		9.00D-13	7.83D-18	1.81D-13	4.90D-22	4.48D-18	4.74D-14	1.68D-16	1.96D-16
		1.52D-20	9.52D-15	1.47D-16	1.47D-17	1.16D-15			
	2, 4	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	4.67D-33	8.55D-32
		2.73D-30	5.39D-26	8.34D-26	1.18D-28	2.10D-25	7.42D-25	4.43D-24	8.37D-27
		3.01D-23	3.77D-22	8.71D-25	1.03D-20	7.77D-23	2.70D-19	6.74D-14	1.63D-13
		1.85D-17	6.31D-13	2.39D-21	8.97D-12		9.21D-17	2.57D-11	5.57D-21
		3.24D-12	3.19D-17	5.80D-13	1.85D-21	1.55D-17	1.51D-13	1.78D-16	3.83D-16
		5.24D-20	2.77D-14	1.75D-16	4.77D-17	2.45D-15			

Table 2. continued

v_f, j_f	1,10	0.00D+00	0.00D+00	0.00D+00	0.00D+00	2.47D-33	3.69D-32	8.67D-31	3.19D-29
		1.78D-27	2.87D-25	6.20D-25	1.53D-25	2.53D-24	1.76D-23	2.01D-22	1.98D-23
		3.72D-21	1.15D-19	3.57D-21	5.88D-18	1.01D-18	5.88D-16	5.79D-20	1.11D-19
		1.43D-13	4.11D-19	8.06D-16	3.20D-18	9.98D-17		3.12D-15	1.06D-14
		6.50D-15	4.44D-12	3.50D-15	5.34D-16	3.49D-13	2.11D-15	5.33D-18	1.53D-17
		1.17D-16	2.95D-15	9.53D-18	3.76D-14	1.07D-16			
	2, 5	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	1.98D-32
		6.26D-31	6.76D-27	1.09D-26	3.91D-29	2.78D-26	1.12D-25	6.48D-25	3.29D-27
		6.20D-24	7.02D-23	3.63D-25	1.46D-21	5.10D-23	8.61D-20	2.88D-15	6.15D-15
		5.50D-18	2.68D-14	4.57D-21	1.99D-13	4.68D-12	5.26D-16		3.70D-20
		2.00D-11	1.78D-16	2.23D-12	8.01D-21	6.32D-17	4.91D-13	2.83D-16	8.48D-16
		1.82D-19	8.56D-14	4.72D-16	1.58D-16	5.88D-15			
	0,14	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	2.18D-32	6.63D-31	3.15D-29
		2.34D-27	1.67D-29	3.72D-29	2.72D-25	1.58D-28	1.14D-27	1.36D-26	5.00D-23
		2.65D-25	8.56D-24	1.52D-20	4.47D-22	8.67D-18	3.96D-20	1.21D-24	2.22D-24
		6.34D-18	7.78D-24	1.20D-14	6.20D-23	1.58D-21	2.76D-15	5.74D-20	
		9.10D-19	6.90D-14	1.23D-17	1.28D-12	1.19D-14	3.89D-17	7.27D-21	2.02D-20
		6.70D-14	1.55D-16	2.63D-20	4.53D-15	3.09D-19			
	2, 6	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	3.02D-33
		1.11D-31	5.98D-28	9.90D-28	5.85D-30	2.60D-27	1.10D-26	7.18D-26	5.66D-28
		7.01D-25	1.10D-23	7.83D-26	2.13D-22	1.36D-23	7.76D-21	9.15D-17	1.89D-16
		8.76D-19	7.79D-16	2.63D-21	5.63D-15	7.34D-14	1.36D-16	2.49D-12	7.27D-20
			1.92D-15	1.47D-11	4.44D-20	2.95D-16	2.01D-12	7.63D-16	1.82D-15
		6.51D-19	2.80D-13	1.29D-15	5.65D-16	1.35D-14			
	1,11	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	7.11D-33	2.65D-31
		1.52D-29	1.25D-27	2.71D-27	1.31D-27	1.11D-26	7.67D-26	8.63D-25	1.72D-25
		1.55D-23	4.48D-22	3.39D-23	2.12D-20	9.39D-21	1.68D-18	8.61D-22	1.77D-21
		2.57D-16	6.99D-21	3.98D-18	4.93D-20	7.28D-19	9.35D-14	2.22D-17	5.55D-15
		1.93D-15		2.51D-14	4.61D-15	3.57D-12	1.49D-14	3.79D-18	1.07D-17
		8.54D-16	1.45D-14	9.31D-18	2.55D-13	1.41D-16			
	2, 7	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		9.66D-33	2.98D-29	4.89D-29	5.84D-31	1.33D-28	5.71D-28	3.92D-27	4.33D-29
		4.13D-26	6.58D-25	4.38D-27	1.65D-23	8.16D-25	5.17D-22	1.72D-18	3.62D-18
		2.76D-20	1.39D-17	2.76D-22	9.76D-17	1.13D-15	6.31D-18	2.39D-14	8.46D-20
		1.27D-12	2.15D-15		2.55D-19	2.20D-15	1.30D-11	1.31D-15	3.25D-15
		2.96D-18	1.25D-12	2.09D-15	2.43D-15	2.58D-14			
	0,15	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	3.83D-32
		2.73D-30	2.47D-32	5.44D-32	2.98D-28	2.27D-31	1.60D-30	1.83D-29	5.03D-26
		3.35D-28	9.78D-27	1.32D-23	4.55D-25	5.63D-21	3.38D-23	3.77D-27	7.93D-27
		4.11D-21	3.47D-26	4.40D-18	2.48D-25	3.40D-24	9.04D-19	8.05D-23	8.26D-15
		3.60D-21	3.71D-16	2.40D-19		1.54D-13	4.84D-17	2.67D-21	7.29D-21
		1.10D-12	3.36D-16	1.45D-20	3.33D-14	2.26D-19			
	1,12	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		9.73D-32	4.28D-30	9.32D-30	8.50D-30	3.82D-29	2.64D-28	2.93D-27	1.10D-27
		5.17D-26	1.43D-24	2.15D-25	6.31D-23	6.27D-23	4.49D-21	7.18D-24	1.56D-23
		5.31D-19	6.29D-23	2.54D-20	4.54D-22	5.70D-21	1.18D-16	1.27D-19	1.54D-17
		4.78D-18	5.76D-14	4.14D-16	3.08D-14		7.51D-14	1.55D-18	4.19D-18
		6.44D-15	1.15D-13	5.96D-18	2.81D-12	1.10D-16			
	2, 8	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		0.00D+00	1.02D-30	1.72D-30	6.72D-32	4.76D-30	2.17D-29	1.57D-28	6.51D-30
		1.82D-27	3.25D-26	7.58D-28	8.84D-25	1.23D-25	3.84D-23	2.87D-20	5.99D-20
		2.16D-21	2.37D-19	3.33D-23	1.57D-18	1.81D-17	2.35D-19	3.24D-16	1.65D-20
		1.07D-14	7.86D-17	8.02D-13	3.18D-18	2.46D-14		8.82D-16	2.13D-15
		1.13D-17	8.89D-12	2.29D-15	1.02D-14	3.37D-14			
	3, 0	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		0.00D+00	0.00D+00	0.00D+00	0.00D+00	4.00D-33	1.46D-32	8.34D-32	0.00D+00
		6.96D-31	9.31D-30	9.27D-32	1.68D-28	4.83D-30	3.88D-27	3.10D-24	4.66D-24
		1.05D-25	1.11D-23	2.82D-28	3.63D-23	1.39D-22	3.85D-24	1.21D-21	2.01D-26
		2.63D-20	1.30D-22	5.23D-19	1.14D-24	3.29D-21	5.73D-18		3.37D-11
		4.25D-23	3.34D-17	6.07D-12	4.25D-20	2.47D-12			

Table 2. continued

v_f, j_f	3, 1	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		0.00D+00	0.00D+00	3.70D-33	0.00D+00	1.00D-32	4.35D-32	2.78D-31	9.67D-33
		2.58D-30	3.74D-29	5.15D-31	7.01D-28	2.95D-29	1.85D-26	8.04D-24	1.16D-23
		5.86D-25	3.46D-23	1.69D-27	8.74D-23	6.17D-22	2.28D-23	7.50D-21	1.15D-25
		1.30D-19	7.58D-22	2.68D-18	6.41D-24	1.84D-20	2.86D-17	6.95D-11	
		2.31D-22	1.64D-16	4.28D-11	2.19D-19	8.57D-12			
	0,16	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		2.51D-33	0.00D+00	0.00D+00	2.57D-31	0.00D+00	0.00D+00	1.58D-32	3.95D-29
		2.75D-31	7.85D-30	9.30D-27	3.79D-28	3.39D-24	3.16D-26	4.29D-28	1.08D-27
		4.44D-24	5.12D-27	2.03D-21	4.11D-26	5.13D-25	1.05D-21	9.78D-24	2.31D-18
		2.82D-22	3.66D-19	1.48D-20	5.87D-15	1.72D-16	9.17D-19	5.32D-22	1.40D-21
			1.87D-16	3.95D-21	3.49D-13	6.10D-20			
	2, 9	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		0.00D+00	2.42D-32	4.08D-32	5.05D-33	1.15D-31	5.36D-31	4.05D-30	5.24D-31
		4.87D-29	9.43D-28	7.72D-29	2.85D-26	1.62D-26	1.39D-24	2.77D-22	5.71D-22
		1.12D-22	2.18D-21	5.63D-24	1.42D-20	1.49D-19	1.47D-20	2.53D-18	2.95D-21
		6.68D-17	3.43D-18	3.45D-15	9.88D-19	1.69D-15	3.98D-13	2.31D-16	5.49D-16
		1.03D-16		1.19D-15	1.24D-13	1.89D-14			
	3, 2	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		0.00D+00	0.00D+00	0.00D+00	0.00D+00	4.57D-33	1.95D-32	1.29D-31	4.31D-33
		1.21D-30	1.61D-29	2.48D-31	3.26D-28	1.63D-29	7.76D-27	3.13D-24	4.80D-24
		2.53D-25	1.07D-23	1.24D-27	5.18D-23	2.23D-22	1.12D-23	3.31D-21	1.19D-25
		7.30D-20	5.22D-22	1.36D-18	1.01D-23	2.07D-20	2.43D-17	9.92D-12	3.39D-11
		5.16D-22	2.82D-16		4.36D-19	4.59D-11			
	1,13	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		0.00D+00	1.11D-32	2.41D-32	3.97D-32	9.78D-32	6.64D-31	7.18D-30	4.90D-30
		1.22D-28	3.23D-27	8.97D-28	1.33D-25	2.52D-25	8.73D-24	2.75D-25	6.17D-25
		9.17D-22	2.61D-24	1.08D-22	1.88D-23	2.21D-22	1.61D-19	4.00D-21	7.40D-20
		1.16D-19	5.17D-17	5.75D-18	8.41D-17	3.54D-14	3.93D-16	2.52D-19	6.27D-19
		1.65D-13	1.06D-13	1.58D-18		2.48D-17			
	3, 3	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00	0.00D+00
		0.00D+00	2.59D-33	4.10D-33	0.00D+00	1.03D-32	4.03D-32	2.48D-31	1.10D-32
		2.39D-30	3.57D-29	6.36D-31	8.09D-28	4.16D-29	2.42D-26	9.68D-24	1.58D-23
		9.59D-25	4.07D-23	3.74D-27	1.89D-22	1.44D-21	5.85D-23	1.90D-20	6.43D-25
		3.51D-19	3.65D-21	7.78D-18	7.26D-23	1.76D-19	1.65D-16	1.86D-12	3.13D-12
		3.68D-21	2.06D-15	2.12D-11	3.16D-18				

Table 3. Collision rate coefficients in cubic centimeters per second for a temperature $T = 500$ K. xDy denotes $x \times 10^y$

v_i, j_i	0, 0	0, 1	0, 2	0, 3	0, 4	0, 5	0, 6	0, 7
	0, 8	1, 0	1, 1	0, 9	1, 2	1, 3	1, 4	0,10
	1, 5	1, 6	0,11	1, 7	0,12	1, 8	2, 0	2, 1
	1, 9	2, 2	0,13	2, 3	2, 4	1,10	2, 5	0,14
	2, 6	1,11	2, 7	0,15	1,12	2, 8	3, 0	3, 1
	0,16	2, 9	3, 2	1,13	3, 3			
v_f, j_f	0, 0	4.47D-11	8.33D-12	2.90D-12	7.11D-13	1.85D-13	4.80D-14	1.09D-14
	2.57D-15	2.69D-18	3.07D-18	6.16D-16	7.56D-18	8.70D-18	9.87D-18	1.40D-16
	8.50D-18	5.97D-18	2.88D-17	3.67D-18	5.89D-18	1.94D-18	4.94D-21	3.83D-21
	9.48D-19	5.88D-21	1.24D-18	2.11D-20	2.24D-20	4.22D-19	1.44D-20	2.65D-19
	1.61D-20	1.73D-19	1.10D-20	6.80D-20	8.57D-20	1.10D-20	5.27D-20	1.48D-20
	1.67D-20	1.54D-20	0.00D+00	4.08D-20	3.96D-20			
	0, 1	1.04D-10	5.97D-11	1.01D-11	3.24D-12	7.79D-13	1.96D-13	4.55D-14
	1.06D-14	8.49D-18	1.36D-17	2.56D-15	1.60D-17	2.80D-17	3.04D-17	5.87D-16
	2.71D-17	1.99D-17	1.22D-16	1.21D-17	2.51D-17	6.57D-18	8.69D-21	1.27D-20
	3.23D-18	1.91D-20	5.33D-18	6.23D-20	6.90D-20	1.45D-18	4.44D-20	1.15D-18
	4.96D-20	5.98D-19	3.41D-20	2.93D-19	2.98D-19	3.45D-20	1.57D-19	4.95D-20
	7.25D-20	5.02D-20	0.00D+00	1.44D-19	1.26D-19			
	0, 2	1.93D-11	5.97D-11	5.60D-11	8.94D-12	2.37D-12	5.90D-13	1.29D-13
	3.06D-14	1.45D-17	1.53D-17	7.32D-15	3.16D-17	4.10D-17	5.57D-17	1.70D-15
	5.16D-17	3.88D-17	3.54D-16	2.50D-17	7.37D-17	1.37D-17	1.69D-20	1.89D-20
	6.89D-18	3.02D-20	1.58D-17	1.13D-19	1.17D-19	3.15D-18	7.88D-20	3.43D-18
	8.79D-20	1.31D-18	6.05D-20	8.72D-19	6.57D-19	6.37D-20	2.61D-19	1.01D-19
	2.17D-19	9.83D-20	4.86D-20	3.24D-19	2.33D-19			
	0, 3	4.40D-12	6.58D-12	3.65D-11	4.88D-11	7.06D-12	1.74D-12	3.77D-13
	8.39D-14	1.34D-17	2.35D-17	2.00D-14	3.50D-17	6.64D-17	7.92D-17	4.67D-15
	8.54D-17	6.90D-17	9.73D-16	4.60D-17	2.03D-16	2.66D-17	1.74D-20	2.85D-20
	1.37D-17	4.55D-20	4.37D-17	1.59D-19	1.73D-19	6.43D-18	1.18D-19	9.57D-18
	1.35D-19	2.71D-18	9.43D-20	2.41D-18	1.36D-18	1.05D-19	3.68D-19	1.81D-19
	6.04D-19	1.76D-19	9.14D-20	6.81D-19	3.78D-19			
	0, 4	5.04D-13	9.91D-13	2.73D-12	2.29D-11	3.92D-11	5.79D-12	1.12D-12
	2.47D-13	2.10D-17	3.66D-17	5.51D-14	5.05D-17	7.12D-17	1.21D-16	1.29D-14
	1.27D-16	1.16D-16	2.66D-15	8.45D-17	5.53D-16	5.05D-17	2.83D-20	3.47D-20
	2.73D-17	6.06D-20	1.19D-16	2.21D-19	2.20D-19	1.32D-17	1.70D-19	2.61D-17
	1.95D-19	5.63D-18	1.42D-19	6.48D-18	2.81D-18	1.71D-19	4.86D-19	3.04D-19
	1.62D-18	3.12D-19	1.60D-19	1.43D-18	5.84D-19			
	0, 5	4.59D-14	8.34D-14	2.54D-13	1.16D-12	1.37D-11	3.23D-11	4.12D-12
	7.64D-13	3.28D-17	4.15D-17	1.64D-13	7.77D-17	9.60D-17	1.33D-16	3.68D-14
	2.03D-16	1.88D-16	7.44D-15	1.52D-16	1.53D-15	9.88D-17	2.09D-20	5.44D-20
	5.50D-17	8.14D-20	3.25D-16	2.89D-19	2.88D-19	2.75D-17	2.28D-19	7.12D-17
	2.81D-19	1.20D-17	2.15D-19	1.74D-17	5.95D-18	2.88D-19	6.31D-19	4.87D-19
	4.29D-18	5.68D-19	2.63D-19	3.03D-18	8.81D-19			
	0, 6	3.20D-15	5.63D-15	1.70D-14	7.66D-14	5.45D-13	8.69D-12	2.45D-11
	3.03D-12	4.08D-17	4.34D-17	5.29D-13	6.77D-17	1.60D-16	1.87D-16	1.15D-13
	2.46D-16	3.22D-16	2.20D-14	2.73D-16	4.38D-15	1.92D-16	2.93D-20	6.32D-20
	1.15D-16	1.24D-19	9.17D-16	3.64D-19	3.39D-19	5.89D-17	3.19D-19	1.98D-16
	3.93D-19	2.63D-17	3.42D-19	4.71D-17	1.30D-17	5.05D-19	8.09D-19	7.38D-19
	1.14D-17	1.06D-18	4.14D-19	6.54D-18	1.32D-18			
	0, 7	1.52D-16	2.75D-16	7.82D-16	3.50D-15	2.22D-14	2.32D-13	5.15D-12
	1.91D-11	4.13D-17	4.13D-17	2.21D-12	5.89D-17	1.36D-16	3.79D-16	3.96D-13
	3.81D-16	4.38D-16	7.13D-14	5.13D-16	1.35D-14	3.82D-16	4.91D-20	9.87D-20
	2.42D-16	1.64D-19	2.70D-15	5.62D-19	4.20D-19	1.31D-16	4.31D-19	5.74D-16
	5.81D-19	5.94D-17	5.55D-19	1.32D-16	2.91D-17	9.45D-19	1.04D-18	1.07D-18
	3.10D-17	2.05D-18	6.00D-19	1.45D-17	1.94D-18			
	0, 8	6.02D-18	1.07D-17	3.09D-17	1.30D-16	8.15D-16	7.20D-15	1.06D-13
	2.75D-17	2.75D-17	3.20D-17	1.47D-11	4.75D-17	1.37D-16	4.08D-16	1.78D-12
	9.72D-16	7.47D-16	2.61D-13	8.07D-16	4.55D-14	7.96D-16	9.70D-20	1.36D-19
	5.32D-16	2.32D-19	8.60D-15	6.19D-19	5.38D-19	3.00D-16	5.68D-19	1.75D-15
	8.62D-19	1.41D-16	9.57D-19	3.85D-16	6.80D-17	1.81D-18	1.28D-18	1.43D-18
	8.63D-17	4.07D-18	8.15D-19	3.29D-17	2.78D-18			

Table 3. continued

v_f, j_f	1, 0	7.75D-23	1.06D-22	1.81D-22	2.55D-22	8.54D-22	3.81D-21	1.77D-20	8.49D-20
		3.39D-19		4.53D-11	8.28D-19	8.72D-12	3.16D-12	8.03D-13	1.05D-18
		2.43D-13	6.05D-14	7.73D-19	1.54D-14	4.26D-19	3.73D-15	6.99D-18	8.41D-18
		8.90D-16	2.08D-17	1.91D-19	2.53D-17	3.22D-17	2.15D-16	2.43D-17	6.92D-20
		1.90D-17	5.14D-17	1.25D-17	2.06D-20	1.34D-17	7.90D-18	5.08D-18	1.66D-18
		8.20D-21	5.88D-18	8.09D-19	3.47D-18	5.07D-18			
1, 1	2.08D-22	3.97D-22	4.46D-22	1.05D-21	3.49D-21	1.13D-20	4.40D-20	1.99D-19	
	9.25D-19	1.06D-10		2.69D-18	6.13D-11	1.07D-11	3.58D-12	3.85D-18	
	1.01D-12	2.40D-13	3.01D-18	6.33D-14	1.72D-18	1.51D-14	2.63D-17	3.83D-17	
	3.63D-15	4.31D-17	7.88D-19	8.41D-17	9.70D-17	8.81D-16	7.54D-17	2.88D-19	
	6.14D-17	2.11D-16	3.99D-17	8.45D-20	5.53D-17	2.57D-17	1.54D-17	5.91D-18	
	3.35D-20	1.92D-17	2.89D-18	1.43D-17	1.58D-17				
0, 9	1.94D-19	3.48D-19	9.95D-19	4.17D-18	2.45D-17	2.08D-16	2.50D-15	4.97D-14	
	1.98D-12	9.05D-18	1.25D-17		2.38D-17	1.12D-16	5.77D-16	1.23D-11	
	1.61D-15	2.34D-15	1.25D-12	1.55D-15	1.77D-13	1.46D-15	1.40D-19	1.62D-19	
	1.23D-15	2.61D-19	3.02D-14	7.67D-19	6.31D-19	7.23D-16	1.02D-18	5.79D-15	
	1.31D-18	3.45D-16	1.68D-18	1.20D-15	1.67D-16	3.57D-18	1.44D-18	1.73D-18	
	2.52D-16	8.16D-18	9.71D-19	7.71D-17	3.65D-18				
1, 2	5.23D-22	4.78D-22	9.42D-22	1.60D-21	4.92D-21	2.16D-20	7.01D-20	2.90D-19	
	1.40D-18	2.09D-11	6.26D-11	5.23D-18		5.85D-11	9.30D-12	9.11D-18	
	3.01D-12	6.96D-13	7.83D-18	1.75D-13	4.69D-18	4.25D-14	4.19D-17	4.65D-17	
	1.01D-14	9.07D-17	2.21D-18	1.22D-16	1.72D-16	2.46D-15	1.37D-16	8.21D-19	
	1.13D-16	5.94D-16	7.65D-17	2.35D-19	1.55D-16	4.96D-17	2.40D-17	1.19D-17	
	9.26D-20	3.76D-17	6.76D-18	4.02D-17	2.83D-17				
1, 3	4.06D-22	5.62D-22	8.24D-22	2.05D-21	4.69D-21	1.80D-20	1.12D-19	4.51D-19	
	2.73D-18	5.11D-12	7.38D-12	1.65D-17	3.95D-11		5.00D-11	2.17D-17	
	8.51D-12	1.96D-12	1.97D-17	4.99D-13	1.23D-17	1.13D-13	4.36D-17	7.47D-17	
	2.69D-14	1.05D-16	5.95D-18	2.04D-16	2.35D-16	6.52D-15	2.13D-16	2.21D-18	
	1.85D-16	1.57D-15	1.27D-16	6.13D-19	4.06D-16	8.68D-17	3.33D-17	2.17D-17	
	2.39D-19	6.65D-17	1.26D-17	1.04D-16	4.35D-17				
1, 4	2.25D-22	2.99D-22	5.48D-22	1.19D-21	3.91D-21	1.22D-20	6.40D-20	6.17D-19	
	3.98D-18	6.35D-13	1.21D-12	4.18D-17	3.07D-12	2.45D-11		9.16D-17	
	4.39D-11	6.19D-12	5.73D-17	1.45D-12	3.43D-17	3.24D-13	6.95D-17	1.18D-16	
	7.23D-14	1.65D-16	1.64D-17	2.25D-16	3.41D-16	1.73D-14	2.90D-16	6.02D-18	
	2.81D-16	4.13D-15	2.06D-16	1.59D-18	1.05D-15	1.45D-16	4.24D-17	3.50D-17	
	6.09D-19	1.16D-16	2.24D-17	2.64D-16	6.43D-17				
0,10	4.85D-21	8.78D-21	2.54D-20	1.07D-19	6.30D-19	5.14D-18	5.97D-17	9.81D-16	
	2.64D-14	1.26D-18	1.97D-18	1.36D-12	4.58D-18	1.61D-17	1.39D-16		
	1.85D-15	5.76D-15	9.45D-12	5.80D-15	9.06D-13	3.09D-15	1.30D-19	1.36D-19	
	2.65D-15	2.19D-19	1.23D-13	6.69D-19	8.27D-19	1.85D-15	1.67D-18	2.12D-14	
	2.66D-18	9.02D-16	2.53D-18	4.06D-15	4.28D-16	7.22D-18	1.38D-18	1.78D-18	
	7.75D-16	1.68D-17	9.91D-19	1.89D-16	4.09D-18				
1, 5	7.18D-23	9.86D-23	1.88D-22	4.77D-22	1.51D-21	6.90D-21	3.11D-20	2.30D-19	
	3.51D-18	7.12D-14	1.25D-13	4.32D-17	3.68D-13	1.54D-12	1.62D-11	4.49D-16	
		3.41D-11	2.23D-16	5.08D-12	1.10D-16	9.68D-13	1.10D-16	1.41D-16	
	2.10D-13	2.44D-16	4.88D-17	2.89D-16	3.51D-16	4.74D-14	4.22D-16	1.71D-17	
	4.07D-16	1.11D-14	3.25D-16	4.25D-18	2.75D-15	2.49D-16	5.40D-17	5.35D-17	
	1.60D-18	2.04D-16	3.57D-17	6.66D-16	9.51D-17				
1, 6	1.45D-23	2.08D-23	4.05D-23	1.11D-22	3.97D-22	1.83D-21	1.17D-20	7.56D-20	
	7.74D-19	5.08D-15	8.58D-15	1.80D-17	2.44D-14	1.02D-13	6.57D-13	4.02D-16	
	9.79D-12		1.50D-15	2.89D-11	4.08D-16	3.65D-12	1.36D-16	1.46D-16	
	6.57D-13	2.27D-16	1.62D-16	5.06D-16	4.94D-16	1.41D-13	4.72D-16	5.23D-17	
	6.33D-16	3.13D-14	5.12D-16	1.19D-17	7.45D-15	4.33D-16	7.14D-17	8.03D-17	
	4.51D-18	3.82D-16	5.37D-17	1.73D-15	1.47D-16				
0,11	9.14D-23	1.66D-22	4.86D-22	2.04D-21	1.19D-20	9.52D-20	1.05D-18	1.61D-17	
	3.54D-16	8.52D-20	1.41D-19	1.26D-14	3.60D-19	1.34D-18	7.97D-18	8.64D-13	
	8.39D-17	1.96D-15		1.99D-14	7.51D-12	1.21D-14	7.15D-20	7.42D-20	
	6.38D-15	1.22D-19	6.69D-13	3.95D-19	1.06D-18	4.56D-15	2.77D-18	9.14D-14	
	5.27D-18	2.52D-15	3.80D-18	1.54D-14	1.18D-15	1.23D-17	1.10D-18	1.48D-18	
	2.62D-15	3.50D-17	8.93D-19	4.85D-16	3.53D-18				

Table 3. continued

v_f, j_f	1, 7	2.01D-24	2.87D-24	5.92D-24	1.67D-23	6.54D-23	3.36D-22	2.24D-21	2.01D-20
		1.89D-19	2.92D-16	5.13D-16	2.70D-18	1.39D-15	5.87D-15	3.47D-14	9.16D-17
		3.30D-13	6.55D-12	3.44D-15		1.99D-15	2.17D-11	1.25D-16	1.23D-16
		2.65D-12	1.92D-16	6.10D-16	3.98D-16	8.14D-16	4.63D-13	7.01D-16	1.72D-16
		8.02D-16	9.69D-14	8.74D-16	3.57D-17	2.16D-14	7.69D-16	9.38D-17	1.09D-16
		1.42D-17	7.48D-16	8.10D-17	4.65D-15	2.31D-16			
0,12	1.44D-24	2.65D-24	7.78D-24	3.29D-23	1.91D-22	1.51D-21	1.61D-20	2.35D-19	
	4.76D-18	3.62D-21	6.20D-21	1.37D-16	1.66D-20	6.47D-20	3.67D-19	6.39D-15	
	3.17D-18	4.12D-17	5.78D-13	8.88D-16		3.69D-14	2.28D-20	2.54D-20	
	2.73D-14	4.45D-20	6.00D-12	1.65D-19	8.57D-19	1.24D-14	3.79D-18	5.23D-13	
	9.60D-18	6.97D-15	7.74D-18	6.94D-14	3.57D-15	2.08D-17	7.75D-19	1.06D-18	
	9.91D-15	7.59D-17	7.87D-19	1.39D-15	2.33D-18				
1, 8	1.93D-25	2.82D-25	5.88D-25	1.75D-24	7.10D-24	3.96D-23	2.87D-22	2.72D-21	
	3.39D-20	1.29D-17	2.22D-17	4.62D-19	6.13D-17	2.42D-16	1.42D-15	8.88D-18	
	1.14D-14	1.50D-13	3.79D-16	3.95D-12	1.50D-14		7.49D-17	8.24D-17	
	1.69D-11	1.34D-16	2.91D-15	3.78D-16	8.91D-16	1.98D-12	1.80D-15	6.47D-16	
	1.37D-15	3.37D-13	1.27D-15	1.18D-16	6.96D-14	1.53D-15	1.11D-16	1.45D-16	
	5.18D-17	1.66D-15	9.89D-17	1.37D-14	3.29D-16				
2, 0	6.85D-30	5.20D-30	1.01D-29	1.59D-29	5.53D-29	1.17D-28	6.10D-28	4.86D-27	
	5.75D-26	3.36D-22	5.39D-22	6.16D-25	8.41D-22	1.30D-21	4.22D-21	5.20D-24	
	1.80D-20	7.78D-20	3.12D-23	3.16D-19	1.29D-22	1.04D-18		4.51D-11	
	2.15D-18	9.07D-12	3.62D-22	3.49D-12	8.87D-13	2.33D-18	2.60D-13	6.20D-22	
	7.80D-14	1.40D-18	2.22D-14	1.42D-21	1.15D-18	6.47D-15	3.48D-16	2.33D-16	
	1.13D-20	1.95D-15	9.06D-17	5.49D-18	5.46D-16				
2, 1	1.26D-29	1.80D-29	2.68D-29	6.19D-29	1.61D-28	7.20D-28	3.12D-27	2.32D-26	
	1.92D-25	9.59D-22	1.86D-21	1.70D-24	2.21D-21	5.27D-21	1.71D-20	1.29D-23	
	5.50D-20	1.99D-19	7.68D-23	7.39D-19	3.42D-22	2.72D-18	1.07D-10		
	6.62D-18	6.29D-11	1.10D-21	1.15D-11	3.97D-12	8.13D-18	1.05D-12	2.23D-21	
	3.04D-13	5.26D-18	8.93D-14	6.77D-21	4.65D-18	2.57D-14	9.11D-16	7.39D-16	
	5.47D-20	7.63D-15	3.48D-16	2.33D-17	1.68D-15				
1, 9	1.40D-26	2.05D-26	4.38D-26	1.33D-25	5.68D-25	3.26D-24	2.54D-23	2.55D-22	
	3.35D-21	4.55D-19	7.89D-19	5.77D-20	2.15D-18	8.51D-18	4.67D-17	1.13D-18	
	3.67D-16	4.00D-15	2.96D-17	7.13D-14	1.64D-15	2.51D-12	2.28D-17	2.96D-17	
		5.88D-17	2.75D-14	2.74D-16	1.43D-15	1.34D-11	3.15D-15	2.82D-15	
	4.69D-15	1.56D-12	2.11D-15	4.45D-16	2.58D-13	2.67D-15	1.15D-16	1.62D-16	
	2.22D-16	4.26D-15	1.18D-16	4.50D-14	4.18D-16				
2, 2	2.02D-29	2.82D-29	4.47D-29	1.03D-28	2.93D-28	1.13D-27	6.40D-27	4.03D-26	
	3.40D-25	2.47D-21	2.19D-21	2.85D-24	4.51D-21	7.74D-21	2.48D-20	2.17D-23	
	9.91D-20	3.22D-19	1.32D-22	1.20D-18	6.25D-22	4.64D-18	2.24D-11	6.57D-11	
	1.37D-17		2.36D-21	6.09D-11	1.01D-11	1.93D-17	3.09D-12	5.92D-21	
	8.64D-13	1.37D-17	2.38D-13	2.23D-20	1.26D-17	7.04D-14	1.88D-15	1.55D-15	
	1.86D-19	2.01D-14	6.98D-16	6.79D-17	2.96D-15				
0,13	2.00D-26	3.70D-26	1.10D-25	4.65D-25	2.70D-24	2.11D-23	2.21D-22	3.10D-21	
	5.91D-20	1.07D-22	1.87D-22	1.54D-18	5.15D-22	2.05D-21	1.15D-20	5.72D-17	
	9.30D-20	1.07D-18	3.39D-15	1.79D-17	3.95D-13	4.70D-16	4.20D-21	5.37D-21	
	3.00D-14	1.11D-20		3.97D-20	2.75D-19	6.33D-14	2.41D-18	4.99D-12	
	1.26D-17	2.06D-14	1.84D-17	4.21D-13	1.09D-14	4.55D-17	5.45D-19	7.54D-19	
	4.63D-14	2.14D-16	8.05D-19	4.59D-15	1.90D-18				
2, 3	5.04D-29	6.43D-29	1.16D-28	2.52D-28	7.45D-28	2.78D-27	1.31D-26	9.58D-26	
	6.33D-25	2.10D-21	2.97D-21	5.83D-24	4.23D-21	1.05D-20	2.36D-20	4.61D-23	
	8.18D-20	5.00D-19	2.98D-22	1.74D-18	1.61D-21	9.07D-18	6.02D-12	8.33D-12	
	4.45D-17	4.25D-11	5.90D-21		5.40D-11	4.55D-17	8.50D-12	1.37D-20	
	2.41D-12	3.44D-17	6.56D-13	6.71D-20	3.44D-17	1.83D-13	1.95D-15	1.79D-15	
	6.07D-19	5.11D-14	1.72D-15	1.90D-16	5.47D-15				
2, 4	2.74D-29	3.64D-29	6.15D-29	1.39D-28	3.80D-28	1.42D-27	6.22D-27	3.66D-26	
	2.81D-25	1.36D-21	1.75D-21	2.45D-24	3.03D-21	6.17D-21	1.82D-20	2.91D-23	
	5.08D-20	2.49D-19	4.07D-22	1.82D-18	4.28D-21	1.09D-17	7.82D-13	1.48D-12	
	1.19D-16	3.61D-12	2.09D-20	2.76D-11		2.14D-16	4.63D-11	4.43D-20	
	7.45D-12	1.18D-16	1.84D-12	1.83D-19	1.00D-16	5.14D-13	2.54D-15	3.83D-15	
	1.92D-18	1.32D-13	2.44D-15	5.38D-16	1.08D-14				

Table 3. continued

v_f, j_f	1,10	7.59D-28	1.13D-27	2.45D-27	7.65D-27	3.34D-26	2.00D-25	1.59D-24	1.69D-23
		2.30D-22	1.34D-20	2.34D-20	4.13D-21	6.40D-20	2.51D-19	1.36D-18	9.57D-20
		1.01D-17	1.05D-16	2.58D-18	1.52D-15	9.09D-17	3.58D-14	3.02D-18	4.45D-18
		1.64D-12	1.01D-17	7.07D-15	3.42D-17	3.15D-16		4.50D-15	1.98D-14
		1.34D-14	1.16D-11	1.04D-14	2.12D-15	1.28D-12	6.02D-15	1.24D-16	1.91D-16
		1.12D-15	1.32D-14	1.59D-16	1.78D-13	6.24D-16			
2, 5	6.88D-30	9.13D-30	1.62D-29	3.71D-29	1.14D-28	4.38D-28	2.28D-27	1.47D-26	
	1.16D-25	4.01D-22	5.31D-22	1.54D-24	9.43D-22	2.18D-21	6.06D-21	2.29D-23	
	2.38D-20	9.29D-20	4.16D-22	6.10D-19	7.39D-21	8.63D-18	8.96D-14	1.52D-13	
	1.02D-16	4.29D-13	7.15D-20	1.70D-12	1.81D-11	1.19D-15		1.57D-19	
	3.87D-11	4.61D-16	5.89D-12	4.74D-19	3.15D-16	1.44D-12	3.48D-15	5.99D-15	
	5.89D-18	3.58D-13	5.35D-15	1.49D-15	2.57D-14				
0,14	2.43D-28	4.53D-28	1.35D-27	5.79D-27	3.37D-26	2.63D-25	2.72D-24	3.75D-23	
	6.85D-22	2.20D-24	3.90D-24	1.68D-20	1.09D-23	4.35D-23	2.42D-22	5.60D-19	
	1.85D-21	1.98D-20	2.63D-17	2.87D-19	1.96D-15	5.95D-18	4.09D-22	6.21D-22	
	1.76D-16	1.58D-21	2.84D-13	5.25D-21	3.32D-20	1.01D-14	3.01D-19		
	3.11D-18	1.37D-13	2.73D-17	4.33D-12	3.77D-14	1.08D-16	4.23D-19	6.87D-19	
	3.12D-13	7.39D-16	9.20D-19	1.91D-14	3.74D-18				
2, 6	2.34D-30	3.12D-30	5.53D-30	1.30D-29	4.02D-29	1.65D-28	8.58D-28	6.05D-27	
	5.37D-26	9.61D-23	1.32D-22	6.07D-25	2.38D-22	5.78D-22	1.80D-21	1.12D-23	
	7.03D-21	3.81D-20	2.42D-22	2.13D-19	5.72D-21	2.00D-18	8.21D-15	1.35D-14	
	4.64D-17	3.67D-14	1.14D-19	1.47D-13	8.88D-13	1.09D-15	1.18D-11	4.96D-19	
		3.11D-15	3.09D-11	1.23D-18	1.13D-15	4.95D-12	8.41D-15	1.29D-14	
	1.79D-17	1.01D-12	1.26D-14	4.34D-15	5.30D-14				
1,11	3.18D-29	4.75D-29	1.04D-28	3.30D-28	1.46D-27	8.88D-27	7.24D-26	7.80D-25	
	1.11D-23	3.28D-22	5.75D-22	2.01D-22	1.58D-21	6.19D-21	3.33D-20	4.78D-21	
	2.41D-19	2.38D-18	1.46D-19	3.25D-17	5.24D-18	6.24D-16	1.85D-19	2.94D-19	
	1.95D-14	7.34D-19	2.36D-16	2.64D-18	1.78D-17	1.18D-12	1.78D-16	2.75D-14	
	3.93D-15		4.13D-14	1.31D-14	9.70D-12	3.41D-14	1.10D-16	1.80D-16	
	6.04D-15	5.41D-14	1.94D-16	9.49D-13	9.12D-16				
2, 7	3.91D-31	5.22D-31	9.27D-31	2.22D-30	7.13D-30	3.08D-29	1.82D-28	1.41D-27	
	1.45D-26	1.54D-23	2.10D-23	1.89D-25	3.93D-23	9.67D-23	3.20D-22	2.59D-24	
	1.37D-21	7.52D-21	4.25D-23	5.66D-20	1.12D-21	4.52D-19	5.69D-16	9.65D-16	
	5.10D-18	2.46D-15	4.06D-20	9.74D-15	5.33D-14	2.06D-16	4.39D-13	1.06D-18	
	7.54D-12	7.97D-15		3.23D-18	6.53D-15	2.65D-11	1.36D-14	2.26D-14	
	6.07D-17	3.77D-12	1.80D-14	1.43D-14	9.16D-14				
0,15	3.11D-30	5.78D-30	1.72D-29	7.29D-29	4.18D-28	3.20D-27	3.23D-26	4.30D-25	
	7.53D-24	3.27D-26	5.71D-26	1.74D-22	1.55D-25	6.01D-25	3.19D-24	5.34D-21	
	2.30D-23	2.25D-22	2.22D-19	2.98D-21	1.30D-17	5.41D-20	4.70D-23	9.41D-23	
	1.38D-18	2.97D-22	1.20D-15	1.28D-21	6.85D-21	5.38D-17	4.54D-20	2.16D-13	
	3.84D-19	3.25D-15	4.16D-18	2.86D-13	1.18D-16	2.13D-19	4.04D-19		
	3.55D-12	1.74D-15	6.61D-19	1.10D-13	4.02D-18				
1,12	1.37D-30	2.05D-30	4.53D-30	1.43D-29	6.35D-29	3.83D-28	3.10D-27	3.32D-26	
	4.65D-25	7.45D-24	1.31D-23	8.46D-24	3.58D-23	1.39D-22	7.33D-22	1.97D-22	
	5.20D-21	4.92D-20	5.95D-21	6.31D-19	2.33D-19	1.12D-17	1.33D-20	2.26D-20	
	2.80D-16	5.89D-20	1.08D-17	2.30D-19	1.31D-18	1.14D-14	1.06D-17	6.58D-16	
	1.24D-16	8.42D-13	2.94D-15	9.98D-14		1.20D-13	5.80D-17	1.02D-16	
	3.39D-14	3.18D-13	1.40D-16	7.75D-12	8.23D-16				
2, 8	7.72D-32	1.04D-31	1.93D-31	4.87D-31	1.70D-30	8.15D-30	5.31D-29	4.73D-28	
	5.41D-27	1.92D-24	2.67D-24	7.94D-26	5.03D-24	1.31D-23	4.46D-23	1.46D-24	
	2.07D-22	1.25D-21	2.72D-23	9.84D-21	5.97D-22	1.08D-19	3.27D-17	5.48D-17	
	1.27D-18	1.44D-16	1.98D-20	5.36D-16	2.95D-15	2.35D-17	2.12D-14	8.30D-19	
	2.38D-13	1.30D-15	5.24D-12	1.82D-17	5.26D-14		1.03D-14	1.70D-14	
	1.67D-16	2.08D-11	1.82D-14	4.63D-14	1.07D-13				
3, 0	5.79D-33	7.44D-33	1.24D-32	2.68D-32	7.54D-32	2.79D-31	1.33D-30	8.19D-30	
	6.00D-29	1.94D-26	2.50D-26	5.02D-28	3.82D-26	7.85D-26	2.04D-25	4.38D-27	
	7.03D-25	3.24D-24	3.82D-26	1.88D-23	3.48D-25	1.23D-22	2.76D-20	3.05D-20	
	8.55D-22	6.03D-20	3.73D-24	8.98D-20	2.29D-19	7.60D-21	8.02D-19	5.08D-23	
	6.34D-18	6.59D-20	4.21D-17	5.11D-22	3.99D-19	1.61D-16		4.64D-11	
	2.80D-21	4.36D-16	8.85D-12	1.41D-18	4.95D-12				

Table 3. continued

v_f, j_f	3, 1	3.91D-33	5.63D-33	1.15D-32	3.16D-32	1.13D-31	5.17D-31	2.92D-30	2.02D-29
		1.61D-28	1.52D-26	2.30D-26	1.45D-27	4.54D-26	1.23D-25	4.04D-25	1.36D-26
		1.67D-24	8.74D-24	1.23D-25	5.25D-23	1.14D-24	3.83D-22	4.43D-20	5.92D-20
		2.90D-21	1.19D-19	1.24D-23	1.97D-19	8.26D-19	2.79D-20	3.31D-18	1.98D-22
		2.33D-17	2.58D-19	1.67D-16	2.33D-21	1.69D-18	6.38D-16	1.11D-10	
		1.42D-20	1.77D-15	6.04D-11	6.34D-18	1.63D-11			
	0,16	3.38D-32	6.34D-32	1.90D-31	8.09D-31	4.64D-30	3.51D-29	3.47D-28	4.48D-27
		7.49D-26	5.77D-28	1.01D-27	1.62D-24	2.72D-27	1.04D-26	5.41D-26	4.53D-23
		3.85D-25	3.78D-24	1.67D-21	5.27D-23	8.22D-20	1.05D-21	1.65D-23	3.37D-23
		3.06D-20	1.10D-22	5.84D-18	5.15D-22	3.19D-21	1.27D-18	2.50D-20	6.92D-16
		2.49D-19	6.66D-17	3.46D-18	1.57D-13	4.31D-15	4.82D-17	5.16D-20	1.09D-19
			1.55D-15	2.18D-19	8.06D-13	1.66D-18			
	2, 9	1.75D-32	2.46D-32	4.82D-32	1.32D-31	5.01D-31	2.60D-30	1.81D-29	1.66D-28
		1.98D-27	2.32D-25	3.22D-25	2.95D-26	6.19D-25	1.62D-24	5.77D-24	5.52D-25
		2.75D-23	1.80D-22	1.25D-23	1.55D-21	3.53D-22	1.89D-20	1.60D-18	2.64D-18
		3.29D-19	6.67D-18	1.52D-20	2.43D-17	1.23D-16	8.34D-18	8.52D-16	9.18D-19
		7.85D-15	3.35D-16	1.21D-13	4.32D-17	2.26D-14	3.37D-12	4.51D-15	7.66D-15
		8.67D-16		1.22D-14	3.25D-13	7.44D-14			
	3, 2	0.00D+00	0.00D+00	5.90D-33	1.70D-32	6.35D-32	2.98D-31	1.74D-30	1.20D-29
		9.80D-29	7.88D-27	1.20D-26	8.66D-28	2.75D-26	7.60D-26	2.76D-25	8.03D-27
		1.19D-24	6.24D-24	7.90D-26	4.15D-23	9.04D-25	2.79D-22	1.84D-20	2.98D-20
		2.25D-21	5.72D-20	1.41D-23	2.02D-19	5.61D-19	2.48D-20	3.15D-18	2.83D-22
		2.43D-17	2.96D-19	1.42D-16	4.06D-21	2.46D-18	7.28D-16	2.26D-11	6.44D-11
		3.03D-20	3.02D-15		1.20D-17	7.57D-11			
	1,13	4.87D-32	7.40D-32	1.67D-31	5.38D-31	2.40D-30	1.46D-29	1.17D-28	1.23D-27
		1.68D-26	1.44D-25	2.53D-25	2.92D-25	6.94D-25	2.67D-24	1.38D-23	6.49D-24
		9.42D-23	8.51D-22	1.82D-22	1.01D-20	6.80D-21	1.64D-19	4.73D-21	8.46D-21
		3.65D-18	2.36D-20	3.40D-19	9.50D-20	5.25D-19	1.18D-16	3.72D-18	2.50D-17
		3.56D-17	6.16D-15	4.80D-16	2.86D-15	5.79D-13	7.89D-15	1.53D-17	2.87D-17
		4.75D-13	3.41D-13	5.12D-17		3.24D-16			
	3, 3	8.01D-33	1.10D-32	2.03D-32	5.05D-32	1.67D-31	7.17D-31	3.99D-30	2.79D-29
		2.40D-28	3.56D-26	4.71D-26	2.34D-27	8.29D-26	1.88D-25	5.70D-25	2.38D-26
		2.28D-24	1.22D-23	2.25D-25	8.53D-23	1.93D-24	6.67D-22	7.97D-20	1.04D-19
		5.73D-21	1.74D-19	2.38D-23	4.62D-19	1.79D-18	7.02D-20	1.09D-17	8.25D-22
		7.35D-17	1.00D-18	5.21D-16	1.78D-20	1.04D-17	3.09D-15	9.10D-12	1.25D-11
		1.66D-19	1.32D-14	5.44D-11	5.49D-17				

Table 4. Collision rate coefficients in cubic centimeters per second for a temperature $T = 1000$ K. xDy denotes $x \times 10^y$

v_i, j_i	0, 0	0, 1	0, 2	0, 3	0, 4	0, 5	0, 6	0, 7
	0, 8	1, 0	1, 1	0, 9	1, 2	1, 3	1, 4	0,10
	1, 5	1, 6	0,11	1, 7	0,12	1, 8	2, 0	2, 1
	1, 9	2, 2	0,13	2, 3	2, 4	1,10	2, 5	0,14
	2, 6	1,11	2, 7	0,15	1,12	2, 8	3, 0	3, 1
	0,16	2, 9	3, 2	1,13	3, 3			
v_f, j_f	0, 0	6.55D-11	1.34D-11	6.51D-12	2.14D-12	7.62D-13	2.74D-13	9.13D-14
	3.05D-14	1.88D-17	2.57D-17	9.79D-15	6.93D-17	8.73D-17	1.15D-16	3.00D-15
	1.30D-16	1.15D-16	8.93D-16	9.22D-17	2.61D-16	6.32D-17	1.09D-19	6.21D-20
	4.00D-17	1.11D-19	7.63D-17	5.11D-19	7.98D-19	2.32D-17	5.35D-19	2.24D-17
	8.32D-19	1.24D-17	6.56D-19	6.61D-18	6.45D-18	5.49D-19	5.32D-18	8.76D-19
	1.34D-18	9.74D-19	4.20D-19	2.82D-18	1.80D-18			
	0, 1	1.73D-10	9.28D-11	1.97D-11	8.53D-12	2.91D-12	9.87D-13	3.42D-13
	1.13D-13	8.52D-17	1.30D-16	3.68D-14	1.40D-16	2.71D-16	3.53D-16	1.14D-14
	3.84D-16	3.70D-16	3.43D-15	2.91D-16	1.02D-15	2.05D-16	1.94D-19	2.17D-19
	1.30D-16	3.76D-19	3.00D-16	1.44D-18	2.40D-18	7.62D-17	1.65D-18	8.89D-17
	2.53D-18	4.11D-17	2.01D-18	2.68D-17	2.16D-17	1.68D-18	1.56D-17	2.91D-18
	5.42D-18	3.08D-18	1.46D-18	9.51D-18	5.67D-18			
	0, 2	4.57D-11	1.20D-10	9.32D-11	1.93D-11	7.38D-12	2.52D-12	8.19D-13
	2.79D-13	2.18D-16	1.59D-16	9.10D-14	2.89D-16	3.86D-16	5.91D-16	2.85D-14
	6.87D-16	6.52D-16	8.71D-15	5.49D-16	2.61D-15	3.89D-16	3.33D-19	2.93D-19
	2.55D-16	6.67D-19	7.83D-16	2.63D-18	4.01D-18	1.52D-16	2.83D-18	2.36D-16
	4.41D-18	8.31D-17	3.45D-18	7.26D-17	4.46D-17	2.99D-18	2.54D-17	5.91D-18
	1.48D-17	5.73D-18	3.04D-18	1.98D-17	1.03D-17			
	0, 3	2.12D-11	2.43D-11	8.91D-11	8.77D-11	1.76D-11	6.00D-12	1.99D-12
	6.36D-13	1.42D-16	2.90D-16	2.11D-13	3.53D-16	6.19D-16	7.91D-16	6.66D-14
	1.01D-15	1.04D-15	2.05D-14	8.83D-16	6.21D-15	6.68D-16	4.40D-19	4.89D-19
	4.47D-16	1.09D-18	1.88D-15	3.46D-18	5.78D-18	2.74D-16	4.11D-18	5.74D-16
	6.43D-18	1.53D-16	5.12D-18	1.81D-16	8.46D-17	4.62D-18	3.42D-17	1.05D-17
	3.70D-17	9.51D-18	5.62D-18	3.80D-17	1.62D-17			
	0, 4	5.40D-12	8.17D-12	1.44D-11	6.81D-11	7.86D-11	1.58D-11	4.74D-12
	1.54D-12	2.09D-16	3.41D-16	4.85D-13	5.86D-16	7.26D-16	1.14D-15	1.53D-13
	1.33D-15	1.49D-15	4.73D-14	1.40D-15	1.44D-14	1.08D-15	7.97D-19	7.70D-19
	7.69D-16	1.71D-18	4.40D-15	4.88D-18	7.42D-18	4.84D-16	5.64D-18	1.35D-15
	8.82D-18	2.78D-16	7.09D-18	4.35D-16	1.59D-16	6.97D-18	4.25D-17	1.72D-17
	8.92D-17	1.54D-17	9.58D-18	7.15D-17	2.39D-17			
	0, 5	1.26D-12	1.82D-12	3.58D-12	8.95D-12	5.15D-11	7.00D-11	1.34D-11
	3.75D-12	3.84D-16	5.00D-16	1.19D-12	7.70D-16	1.07D-15	1.25D-15	3.60D-13
	1.86D-15	2.06D-15	1.10D-13	2.09D-15	3.34D-14	1.78D-15	6.96D-19	1.40D-18
	1.30D-15	2.92D-18	1.02D-14	6.07D-18	9.70D-18	8.57D-16	7.27D-18	3.13D-15
	1.16D-17	5.06D-16	9.61D-18	1.02D-15	2.99D-16	1.07D-17	5.06D-17	2.68D-17
	2.11D-16	2.51D-17	1.53D-17	1.35D-16	3.40D-17			
	0, 6	2.55D-13	3.48D-13	6.89D-13	1.72D-12	5.82D-12	3.94D-11	6.00D-11
	1.13D-11	6.56D-16	6.78D-16	3.00D-12	8.73D-16	1.40D-15	1.77D-15	9.01D-13
	2.05D-15	2.99D-15	2.64D-13	3.11D-15	7.87D-14	2.84D-15	1.44D-18	2.49D-18
	2.26D-15	4.32D-18	2.39D-14	8.46D-18	1.15D-17	1.52D-15	9.48D-18	7.28D-15
	1.52D-17	9.28D-16	1.32D-17	2.41D-15	5.69D-16	1.67D-17	5.90D-17	3.88D-17
	4.97D-16	4.16D-17	2.31D-17	2.57D-16	4.75D-17			
	0, 7	4.19D-14	5.95D-14	1.10D-13	2.80D-13	8.60D-13	3.72D-12	2.95D-11
	5.14D-11	7.64D-16	8.04D-16	9.46D-12	9.16D-16	1.37D-15	2.59D-15	2.39D-12
	2.99D-15	3.49D-15	6.76D-13	4.82D-15	1.94D-13	4.61D-15	3.05D-18	4.08D-18
	3.87D-15	7.17D-18	5.74D-14	1.23D-17	1.49D-17	2.78D-15	1.21D-17	1.73D-14
	2.04D-17	1.72D-15	1.80D-17	5.71D-15	1.10D-15	2.80D-17	6.90D-17	5.33D-17
	1.18D-15	7.06D-17	3.18D-17	4.97D-16	6.50D-17			
	0, 8	6.08D-15	8.58D-15	1.63D-14	3.90D-14	1.21D-13	4.53D-13	2.42D-12
		6.70D-16	7.01D-16	4.39D-11	8.39D-16	1.29D-15	2.56D-15	7.97D-12
	5.28D-15	5.33D-15	1.87D-12	6.16D-15	5.12D-13	7.72D-15	5.16D-18	6.44D-18
	6.83D-15	9.41D-18	1.45D-13	1.36D-17	1.66D-17	5.07D-15	1.53D-17	4.23D-14
	2.74D-17	3.28D-15	2.56D-17	1.38D-14	2.14D-15	4.66D-17	7.66D-17	6.57D-17
	2.86D-15	1.21D-16	4.02D-17	9.71D-16	8.64D-17			

Table 4. continued

v_f, j_f	1, 0	1.01D-19	1.74D-19	3.43D-19	2.35D-19	4.44D-19	1.25D-18	3.78D-18	8.94D-18
		1.80D-17		6.56D-11	2.67D-17	1.36D-11	6.87D-12	2.33D-12	2.90D-17
		8.75D-13	3.26D-13	2.39D-17	1.14D-13	1.60D-17	3.94D-14	4.63D-17	7.45D-17
		1.34D-14	1.79D-16	9.49D-18	2.34D-16	3.65D-16	4.41D-15	3.34D-16	4.71D-18
		3.19D-16	1.47D-15	2.73D-16	1.51D-18	4.98D-16	1.87D-16	2.63D-16	5.46D-17
		9.11D-19	1.72D-16	2.60D-17	1.21D-16	1.18D-16			
1, 1	1, 1	3.66D-19	7.04D-19	6.67D-19	1.27D-18	1.93D-18	4.31D-18	1.04D-17	2.50D-17
		5.01D-17	1.74D-10		8.05D-17	9.39D-11	2.03D-11	9.22D-12	9.31D-17
		3.29D-12	1.15D-12	8.07D-17	4.21D-13	5.61D-17	1.44D-13	2.79D-16	3.44D-16
		4.93D-14	3.53D-16	3.42D-17	7.86D-16	1.10D-15	1.64D-14	9.79D-16	1.73D-17
		1.00D-15	5.51D-15	8.36D-16	5.61D-18	1.90D-15	5.91D-16	7.91D-16	1.89D-16
		3.45D-18	5.44D-16	9.19D-17	4.68D-16	3.61D-16			
0, 9	0, 9	7.58D-16	1.08D-15	2.07D-15	5.02D-15	1.49D-14	5.55D-14	2.49D-13	1.60D-12
		1.70D-11	3.85D-16	4.37D-16		5.64D-16	9.61D-16	2.42D-15	3.83D-11
		6.10D-15	1.13D-14	6.52D-12	9.80D-15	1.48D-12	1.10D-14	8.38D-18	8.98D-18
		1.24D-14	1.17D-17	3.94D-13	1.65D-17	1.95D-17	9.61D-15	2.22D-17	1.09D-13
		4.04D-17	6.29D-15	3.68D-17	3.46D-14	4.27D-15	7.88D-17	7.86D-17	7.28D-17
		7.12D-15	2.08D-16	4.30D-17	1.93D-15	1.05D-16			
1, 2	1, 2	1.29D-18	9.85D-19	1.58D-18	2.02D-18	4.32D-18	8.66D-18	1.74D-17	3.71D-17
		7.82D-17	4.72D-11	1.22D-10	1.35D-16		9.52D-11	2.00D-11	1.77D-16
		8.26D-12	2.87D-12	1.67D-16	9.82D-13	1.24D-16	3.47D-13	6.11D-16	4.88D-16
		1.18D-13	7.82D-16	7.85D-17	1.08D-15	1.83D-15	3.97D-14	1.71D-15	4.09D-17
		1.70D-15	1.34D-14	1.50D-15	1.34D-17	4.73D-15	1.07D-15	1.18D-15	3.74D-16
		8.52D-18	1.01D-15	2.15D-16	1.19D-15	6.34D-16			
1, 3	1, 3	1.58D-18	1.86D-18	2.05D-18	3.44D-18	5.20D-18	1.17D-17	2.72D-17	5.38D-17
		1.17D-16	2.31D-11	2.57D-11	2.24D-16	9.25D-11		8.92D-11	3.12D-16
		1.90D-11	6.67D-12	3.23D-16	2.33D-12	2.53D-16	7.72D-13	4.58D-16	8.65D-16
		2.67D-13	1.09D-15	1.67D-16	1.86D-15	2.44D-15	8.96D-14	2.46D-15	8.91D-17
		2.58D-15	3.02D-14	2.22D-15	2.95D-17	1.09D-14	1.70D-15	1.53D-15	6.66D-16
		1.93D-17	1.64D-15	3.93D-16	2.78D-15	9.29D-16			
1, 4	1, 4	1.65D-18	1.92D-18	2.49D-18	3.48D-18	6.46D-18	1.09D-17	2.72D-17	8.08D-17
		1.84D-16	6.21D-12	9.27D-12	4.49D-16	1.54D-11	7.07D-11		6.41D-16
		8.31D-11	1.67D-11	6.52D-16	5.42D-12	5.27D-16	1.83D-12	6.76D-16	1.10D-15
		5.96D-13	1.92D-15	3.54D-16	2.19D-15	3.40D-15	1.99D-13	3.11D-15	1.91D-16
		3.46D-15	6.68D-14	3.16D-15	6.33D-17	2.41D-14	2.47D-15	1.74D-15	1.03D-15
		4.27D-17	2.54D-15	6.96D-16	6.26D-15	1.29D-15			
0,10	0,10	8.10D-17	1.17D-16	2.26D-16	5.53D-16	1.64D-15	5.88D-15	2.61D-14	1.41D-13
		1.08D-12	1.46D-16	1.76D-16	1.34D-11	2.58D-16	4.66D-16	1.21D-15	
		4.89D-15	1.59D-14	3.27D-11	2.39D-14	5.36D-12	1.82D-14	9.58D-18	9.45D-18
		1.98D-14	1.19D-17	1.19D-12	1.50D-17	2.34D-17	1.87D-14	3.27D-17	3.05D-13
		6.05D-17	1.26D-14	4.72D-17	9.10D-14	8.52D-15	1.40D-16	6.91D-17	6.66D-17
		1.83D-14	3.60D-16	3.81D-17	3.91D-15	1.07D-16			
1, 5	1, 5	1.25D-18	1.40D-18	1.94D-18	2.98D-18	5.09D-18	1.09D-17	2.12D-17	6.28D-17
		2.55D-16	1.57D-12	2.23D-12	7.59D-16	4.28D-12	1.01D-11	5.59D-11	1.75D-15
			7.29D-11	1.52D-15	1.48D-11	1.17D-15	4.34D-12	1.28D-15	1.69D-15
		1.42D-12	2.45D-15	7.77D-16	3.07D-15	3.62D-15	4.51D-13	4.10D-15	4.14D-16
		4.40D-15	1.48D-13	4.21D-15	1.36D-16	5.34D-14	3.64D-15	2.04D-15	1.53D-15
		9.55D-17	3.92D-15	1.08D-15	1.39D-14	1.75D-15			
1, 6	1, 6	6.48D-19	7.87D-19	1.07D-18	1.80D-18	3.32D-18	7.00D-18	1.80D-17	4.27D-17
		1.50D-16	3.40D-13	4.55D-13	8.23D-16	8.67D-13	2.07D-12	6.55D-12	3.31D-15
		4.24D-11		4.60D-15	6.49D-11	2.94D-15	1.26D-11	2.30D-15	2.33D-15
		3.48D-12	3.00D-15	1.82D-15	4.27D-15	5.15D-15	1.09D-12	4.45D-15	9.30D-16
		5.89D-15	3.40D-13	5.55D-15	2.97D-16	1.19D-13	5.32D-15	2.40D-15	2.07D-15
		2.22D-16	6.25D-15	1.59D-15	3.12D-14	2.53D-15			
0,11	0,11	7.63D-18	1.11D-17	2.19D-17	5.37D-17	1.60D-16	5.67D-16	2.42D-15	1.26D-14
		8.03D-14	3.81D-17	4.84D-17	7.20D-13	7.70D-17	1.53D-16	3.89D-16	1.03D-11
		1.34D-15	7.00D-15		3.85D-14	2.81D-11	4.71D-14	8.48D-18	8.27D-18
		3.41D-14	1.05D-17	4.46D-12	1.23D-17	2.84D-17	3.31D-14	4.72D-17	9.51D-13
		9.05D-17	2.59D-14	6.80D-17	2.57D-13	1.76D-14	1.94D-16	5.24D-17	4.92D-17
		5.03D-14	5.99D-16	2.93D-17	8.04D-15	8.15D-17			

Table 4. continued

v_f, j_f	1, 7	2.64D-19	3.16D-19	4.63D-19	7.78D-19	1.59D-18	3.62D-18	9.58D-18	3.01D-17
		8.85D-17	6.07D-14	8.47D-14	3.63D-16	1.52D-13	3.70D-13	1.09D-12	2.54D-15
		4.41D-12	3.32D-11	1.29D-14		8.60D-15	5.58D-11	2.46D-15	2.51D-15
		1.06D-11	2.94D-15	4.63D-15	3.64D-15	6.00D-15	2.77D-12	5.95D-15	2.18D-15
		7.00D-15	8.39D-13	7.95D-15	6.66D-16	2.77D-13	7.76D-15	2.95D-15	2.66D-15
		5.67D-16	1.01D-14	2.24D-15	7.10D-14	3.67D-15			
0,12	6.46D-19	9.52D-19	1.90D-18	4.72D-18	1.41D-17	5.00D-17	2.09D-16	1.05D-15	
	6.34D-15	7.38D-18	9.74D-18	4.72D-14	1.65D-17	3.46D-17	9.09D-17	4.91D-13	
	3.01D-16	1.29D-15	8.14D-12	7.42D-15		6.41D-14	6.71D-18	7.15D-18	
	9.26D-14	9.92D-18	2.44D-11	1.30D-17	3.26D-17	6.02D-14	6.07D-17	3.72D-12	
	1.39D-16	4.94D-14	9.67D-17	8.14D-13	3.74D-14	2.63D-16	3.91D-17	3.43D-17	
	1.47D-13	9.99D-16	2.55D-17	1.77D-14	4.33D-17				
1, 8	8.23D-20	1.01D-19	1.49D-19	2.67D-19	5.57D-19	1.40D-18	3.97D-18	1.31D-17	
	5.04D-17	9.54D-15	1.32D-14	1.85D-16	2.43D-14	5.56D-14	1.66D-13	8.79D-16	
	5.86D-13	2.92D-12	7.17D-15	2.53D-11	3.37D-14		1.80D-15	1.79D-15	
	4.81D-11	2.21D-15	1.32D-14	2.95D-15	5.91D-15	8.84D-12	1.04D-14	5.55D-15	
	1.02D-14	2.23D-12	9.95D-15	1.59D-15	6.93D-13	1.31D-14	3.28D-15	3.18D-15	
	1.63D-15	1.82D-14	2.50D-15	1.72D-13	4.72D-15				
2, 0	4.05D-24	2.73D-24	3.64D-24	5.03D-24	1.18D-23	1.57D-23	5.76D-23	2.47D-22	
	9.63D-22	3.21D-19	7.30D-19	4.03D-21	1.22D-18	9.44D-19	1.76D-18	1.32D-20	
	4.93D-18	1.53D-17	3.70D-20	3.19D-17	1.01D-19	5.16D-17		6.54D-11	
	6.75D-17	1.39D-11	2.16D-19	7.31D-12	2.48D-12	5.86D-17	9.57D-13	2.27D-19	
	3.86D-13	1.60D-17	1.49D-13	4.09D-19	4.57D-17	5.69D-14	9.19D-15	3.64D-15	
	1.22D-18	2.52D-14	1.51D-15	1.79D-16	5.82D-15				
2, 1	6.17D-24	8.17D-24	8.56D-24	1.49D-23	3.03D-23	8.42D-23	2.66D-22	8.84D-22	
	3.21D-21	1.38D-18	2.40D-18	1.15D-20	2.61D-18	4.75D-18	7.60D-18	3.48D-20	
	1.74D-17	4.13D-17	9.62D-20	8.69D-17	2.87D-19	1.37D-16	1.75D-10		
	1.94D-16	9.50D-11	6.83D-19	2.10D-11	9.86D-12	1.81D-16	3.54D-12	8.36D-19	
	1.34D-12	5.28D-17	5.45D-13	1.78D-18	1.68D-16	2.05D-13	2.22D-14	1.25D-14	
	5.25D-18	8.97D-14	6.27D-15	6.94D-16	1.67D-14				
1, 9	2.12D-20	2.61D-20	3.96D-20	7.27D-20	1.61D-19	4.17D-19	1.29D-18	4.46D-18	
	1.81D-17	1.32D-15	1.83D-15	8.49D-17	3.37D-15	7.82D-15	2.20D-14	3.88D-16	
	7.80D-14	3.28D-13	2.11D-15	1.96D-12	1.98D-14	1.95D-11	9.58D-16	1.03D-15	
		1.33D-15	5.20D-14	2.00D-15	5.75D-15	4.12D-11	1.24D-14	1.48D-14	
	2.15D-14	7.51D-12	1.38D-14	4.11D-15	1.90D-12	1.96D-14	3.28D-15	3.22D-15	
	5.49D-15	3.70D-14	2.72D-15	4.44D-13	5.00D-15				
2, 2	1.45D-23	1.87D-23	2.57D-23	4.39D-23	8.86D-23	2.32D-22	6.08D-22	2.05D-21	
	6.18D-21	4.36D-18	3.24D-18	1.97D-20	5.51D-18	7.87D-18	1.76D-17	5.78D-20	
	3.33D-17	7.02D-17	1.62D-19	1.35D-16	5.26D-19	2.22D-16	4.88D-11	1.25D-10	
	3.28D-16		1.41D-18	9.73D-11	2.08D-11	3.43D-16	8.76D-12	2.06D-18	
	3.28D-12	1.11D-16	1.24D-12	5.16D-18	3.87D-16	4.83D-13	4.38D-14	2.36D-14	
	1.55D-17	2.06D-13	1.32D-14	1.79D-15	2.61D-14				
0,13	5.03D-20	7.50D-20	1.52D-19	3.81D-19	1.15D-18	4.06D-18	1.69D-17	8.25D-17	
	4.80D-16	1.17D-18	1.58D-18	3.36D-15	2.78D-18	6.09D-18	1.63D-17	2.89D-14	
	5.31D-17	2.13D-16	3.44D-13	1.06D-15	6.51D-12	6.71D-15	3.82D-18	4.53D-18	
	6.48D-14	7.08D-18		1.13D-17	2.61D-17	1.74D-13	5.44D-17	2.13D-11	
	1.49D-16	9.17D-14	1.46D-16	3.24D-12	7.34D-14	5.74D-16	3.59D-17	3.32D-17	
	5.00D-13	2.10D-15	3.39D-17	4.20D-14	3.35D-17				
2, 3	6.62D-23	7.05D-23	1.00D-22	1.37D-22	2.50D-22	4.75D-22	1.18D-21	3.48D-21	
	8.81D-21	5.65D-18	7.14D-18	2.75D-20	7.54D-18	1.33D-17	1.98D-17	7.20D-20	
	4.12D-17	9.85D-17	1.87D-19	1.64D-16	6.82D-19	2.93D-16	2.54D-11	2.73D-11	
	4.89D-16	9.61D-11	2.22D-18		9.28D-11	5.62D-16	1.94D-11	4.29D-18	
	7.55D-12	2.29D-16	2.88D-12	1.39D-17	8.95D-16	1.05D-12	3.56D-14	2.94D-14	
	4.38D-17	4.42D-13	3.13D-14	4.40D-15	4.26D-14				
2, 4	8.38D-23	9.53D-23	1.24D-22	1.86D-22	3.08D-22	6.16D-22	1.30D-21	3.40D-21	
	8.74D-21	7.12D-18	8.10D-18	2.64D-20	1.03D-17	1.42D-17	2.49D-17	9.09D-20	
	3.94D-17	9.62D-17	3.49D-19	2.19D-16	1.38D-18	4.76D-16	6.99D-12	1.04D-11	
	1.14D-15	1.67D-11	4.16D-18	7.52D-11		1.39D-15	8.69D-11	8.44D-18	
	1.86D-11	6.41D-16	6.62D-12	3.37D-17	2.05D-15	2.49D-12	4.76D-14	6.05D-14	
	1.20D-16	9.61D-13	4.53D-14	1.08D-14	7.99D-14				

Table 4. continued

v_f, j_f	1,10	4.51D-21	5.62D-21	8.67D-21	1.64D-20	3.72D-20	1.01D-19	3.18D-19	1.18D-18
		4.94D-18	1.60D-16	2.24D-16	2.42D-17	4.15D-16	9.64D-16	2.70D-15	1.35D-16
		9.09D-15	3.77D-14	7.52D-16	1.88D-13	4.74D-15	1.32D-12	3.06D-16	3.54D-16
		1.51D-11	5.08D-16	5.12D-14	8.44D-16	2.58D-15		9.80D-15	5.25D-14
		3.14D-14	3.72D-11	4.12D-14	1.31D-14	6.69D-12	2.78D-14	3.88D-15	4.14D-15
		2.11D-14	9.17D-14	3.80D-15	1.33D-12	6.58D-15			
2, 5	3.88D-23	4.52D-23	6.01D-23	9.15D-23	1.62D-22	3.19D-22	7.37D-22	1.92D-21	
	5.56D-21	4.51D-18	4.98D-18	2.08D-20	6.67D-18	9.86D-18	1.57D-17	8.78D-20	
	3.08D-17	5.74D-17	4.00D-19	1.50D-16	1.78D-18	5.81D-16	1.86D-12	2.58D-12	
	1.70D-15	4.84D-12	5.98D-18	1.09D-11	6.00D-11	3.65D-15		1.52D-17	
	7.86D-11	1.76D-15	1.69D-11	7.78D-17	4.66D-15	5.61D-12	5.77D-14	6.75D-14	
	3.12D-16	2.12D-12	8.94D-14	2.53D-14	1.91D-13				
0,14	3.64D-21	5.49D-21	1.13D-20	2.87D-20	8.71D-20	3.09D-19	1.27D-18	6.14D-18	
	3.45D-17	1.43D-19	1.98D-19	2.31D-16	3.58D-19	8.04D-19	2.17D-18	1.84D-15	
	7.00D-18	2.70D-17	1.81D-14	1.24D-16	2.45D-13	6.95D-16	9.96D-19	1.37D-18	
	4.57D-15	2.56D-18	5.27D-12	5.40D-18	1.31D-17	4.40D-14	3.42D-17		
	1.10D-16	2.98D-13	2.33D-16	1.94D-11	1.52D-13	1.03D-15	4.23D-17	4.90D-17	
	2.24D-12	5.71D-15	5.63D-17	1.27D-13	9.72D-17				
2, 6	3.62D-23	4.17D-23	5.64D-23	8.60D-23	1.52D-22	3.06D-22	7.10D-22	1.94D-21	
	5.98D-21	2.58D-18	3.07D-18	2.27D-20	3.99D-18	6.21D-18	1.05D-17	9.75D-20	
	1.99D-17	4.57D-17	4.61D-19	1.06D-16	2.44D-18	3.42D-16	4.51D-13	5.89D-13	
	1.77D-15	1.09D-12	9.85D-18	2.54D-12	7.74D-12	7.04D-15	4.73D-11	2.93D-17	
		7.13D-15	6.93D-11	1.74D-16	1.15D-14	1.50D-11	1.23D-13	1.39D-13	
	7.89D-16	4.73D-12	1.71D-13	6.02D-14	3.52D-13				
1,11	8.07D-22	1.01D-21	1.59D-21	3.07D-21	7.16D-21	1.99D-20	6.48D-20	2.44D-19	
	1.07D-18	1.79D-17	2.51D-17	5.29D-18	4.70D-17	1.09D-16	3.03D-16	3.03D-17	
	1.00D-15	3.95D-15	1.98D-16	1.90D-14	1.30D-15	1.11D-13	2.80D-17	3.46D-17	
	9.24D-13	5.52D-17	9.05D-15	1.15D-16	3.98D-16	1.24D-11	1.58D-15	1.19D-13	
	1.07D-14		6.87D-14	5.32D-14	3.30D-11	1.06D-13	4.57D-15	5.42D-15	
	8.30D-14	2.89D-13	5.71D-15	5.01D-12	1.15D-14				
2, 7	1.51D-23	1.76D-23	2.34D-23	3.63D-23	6.48D-23	1.34D-22	3.27D-22	9.04D-22	
	2.97D-21	1.17D-18	1.35D-18	1.10D-20	1.86D-18	2.84D-18	5.10D-18	4.04D-20	
	1.01D-17	2.28D-17	1.84D-19	6.40D-17	9.03D-19	1.77D-16	9.25D-14	1.27D-13	
	6.03D-16	2.18D-13	5.12D-18	5.14D-13	1.46D-12	4.90D-15	5.38D-12	3.30D-17	
	3.67D-11	2.44D-14		3.44D-16	3.46D-14	6.19D-11	1.89D-13	2.24D-13	
	2.07D-15	1.37D-11	2.19D-13	1.49D-13	5.21D-13				
0,15	2.49D-22	3.82D-22	8.02D-22	2.09D-21	6.48D-21	2.33D-20	9.74D-20	4.69D-19	
	2.61D-18	1.06D-20	1.48D-20	1.68D-17	2.71D-20	6.14D-20	1.66D-19	1.27D-16	
	5.30D-19	1.99D-18	1.13D-15	8.74D-18	1.24D-14	4.61D-17	4.14D-19	6.75D-19	
	2.92D-16	1.48D-18	1.85D-13	4.04D-18	1.21D-17	2.54D-15	4.04D-17	4.47D-12	
	1.51D-16	3.08D-14	5.62D-16		5.42D-13	2.32D-15	3.87D-17	5.18D-17	
	1.51D-11	1.63D-14	6.52D-17	5.42D-13	1.64D-16				
1,12	1.29D-22	1.64D-22	2.62D-22	5.20D-22	1.26D-21	3.61D-21	1.22D-20	4.78D-20	
	2.14D-19	1.85D-18	2.66D-18	1.10D-18	5.08D-18	1.20D-17	3.36D-17	6.31D-18	
	1.11D-16	4.25D-16	4.11D-17	1.93D-15	3.02D-16	1.06D-14	2.45D-17	3.37D-17	
	7.18D-14	5.90D-17	2.22D-15	1.38D-16	3.92D-16	6.88D-13	1.29D-15	1.86D-14	
	5.27D-15	1.01D-11	2.99D-14	2.88D-13		2.41D-13	3.12D-15	4.13D-15	
	3.21D-13	1.10D-12	4.80D-15	2.66D-11	1.21D-14				
2, 8	5.99D-24	6.97D-24	9.58D-24	1.55D-23	3.01D-23	7.06D-23	1.96D-22	6.66D-22	
	2.55D-21	3.80D-19	4.53D-19	1.11D-20	6.26D-19	1.02D-18	1.89D-18	5.65D-20	
	4.13D-18	1.04D-17	2.47D-19	2.96D-17	1.16D-18	1.10D-16	1.67D-14	2.25D-14	
	4.05D-16	4.03D-14	9.51D-18	8.89D-14	2.59D-13	1.56D-15	8.46D-13	6.93D-17	
	3.77D-12	1.79D-14	2.93D-11	6.72D-16	1.32D-13		1.63D-13	1.95D-13	
	4.44D-15	5.51D-11	2.14D-13	3.54D-13	5.13D-13				
3, 0	1.76D-24	1.96D-24	2.47D-24	3.48D-24	5.58D-24	1.02D-23	2.10D-23	4.99D-23	
	1.27D-22	1.62D-20	1.84D-20	3.37D-22	2.10D-20	2.81D-20	4.04D-20	8.49D-22	
	7.03D-20	1.42D-19	2.03D-21	3.41D-19	5.24D-21	8.37D-19	8.19D-17	7.41D-17	
	2.06D-18	1.11D-16	1.81D-20	9.13D-17	1.50D-16	6.62D-18	2.64D-16	8.61D-20	
	9.40D-16	2.33D-17	2.71D-15	3.41D-19	5.17D-17	4.94D-15		6.76D-11	
	8.63D-19	9.13D-15	1.28D-11	9.25D-17	1.09D-11				

Table 4. continued

v_f, j_f	3, 1	7.79D-25	9.82D-25	1.54D-24	2.86D-24	6.07D-24	1.44D-23	3.71D-23	1.03D-22
		2.93D-22	9.04D-21	1.18D-20	8.37D-22	1.79D-20	3.28D-20	6.40D-20	2.19D-21
		1.41D-19	3.29D-19	5.12D-21	8.24D-19	1.23D-20	2.17D-18	8.70D-17	1.12D-16
		5.41D-18	1.60D-16	4.48D-20	2.02D-16	5.13D-16	1.90D-17	8.29D-16	2.68D-19
		2.85D-15	7.41D-17	8.63D-15	1.22D-18	1.84D-16	1.59D-14	1.81D-10	
		3.33D-18	3.17D-14	8.80D-11	3.49D-16	3.41D-11			
0,16	1.09D-23	1.68D-23	3.55D-23	9.30D-23	2.89D-22	1.04D-21	4.37D-21	2.11D-20	
	1.17D-19	1.39D-21	1.98D-21	7.53D-19	3.75D-21	8.76D-21	2.44D-20	5.56D-18	
	8.10D-20	3.24D-19	4.81D-17	1.62D-18	4.87D-16	1.03D-17	2.67D-19	4.33D-19	
	8.50D-17	9.68D-19	6.21D-15	2.77D-18	9.40D-18	8.88D-16	3.52D-17	1.12D-13	
	1.48D-16	1.04D-14	7.35D-16	3.28D-12	1.32D-13	3.33D-15	2.13D-17	3.06D-17	
		2.44D-14	4.21D-17	2.70D-12	1.24D-16				
2, 9	4.53D-24	5.43D-24	7.82D-24	1.36D-23	2.83D-23	7.07D-23	2.08D-22	7.15D-22	
	2.83D-21	1.49D-19	1.78D-19	1.25D-20	2.52D-19	4.21D-19	8.25D-19	6.20D-20	
	1.89D-18	5.18D-18	3.26D-19	1.64D-17	1.88D-18	6.51D-17	3.14D-15	4.20D-15	
	3.26D-16	7.31D-15	1.48D-17	1.59D-14	4.26D-14	2.19D-15	1.36D-13	1.63D-16	
	5.06D-13	2.06D-14	2.77D-12	2.01D-15	2.55D-13	2.35D-11	1.28D-13	1.66D-13	
	1.39D-14		2.09D-13	1.27D-12	5.34D-13				
3, 2	4.98D-25	6.55D-25	1.06D-24	2.05D-24	4.50D-24	1.10D-23	2.93D-23	8.22D-23	
	2.39D-22	5.75D-21	7.65D-21	6.59D-22	1.37D-20	2.58D-20	5.76D-20	1.67D-21	
	1.32D-19	3.35D-19	4.07D-21	9.27D-19	1.22D-20	2.28D-18	4.80D-17	7.49D-17	
	6.09D-18	1.20D-16	6.10D-20	2.87D-16	5.12D-16	2.32D-17	1.46D-15	4.09D-19	
	4.65D-15	1.04D-16	1.13D-14	2.05D-18	2.84D-16	2.33D-14	4.59D-11	1.17D-10	
	6.10D-18	5.33D-14		6.15D-16	1.34D-10				
1,13	1.60D-23	2.05D-23	3.31D-23	6.63D-23	1.61D-22	4.64D-22	1.57D-21	6.15D-21	
	2.76D-20	1.28D-19	1.86D-19	1.42D-19	3.63D-19	8.72D-19	2.48D-18	8.23D-19	
	8.19D-18	3.16D-17	5.34D-18	1.41D-16	4.06D-17	7.49D-16	2.72D-17	3.97D-17	
	4.77D-15	7.75D-17	3.62D-16	1.93D-16	5.85D-16	3.87D-14	1.98D-15	4.43D-15	
	7.85D-15	4.37D-13	3.65D-14	8.17D-14	7.56D-12	1.84D-13	1.58D-15	2.23D-15	
	1.88D-12	1.55D-12	2.95D-15		8.44D-15				
3, 3	2.14D-24	2.56D-24	3.60D-24	5.94D-24	1.13D-23	2.45D-23	6.06D-23	1.69D-22	
	5.15D-22	2.60D-20	3.02D-20	1.61D-21	4.06D-20	6.12D-20	1.07D-19	4.73D-21	
	2.16D-19	5.36D-19	1.13D-20	1.52D-18	2.08D-20	4.32D-18	1.86D-16	2.00D-16	
	1.12D-17	2.37D-16	6.04D-20	3.92D-16	9.06D-16	4.03D-17	3.13D-15	7.10D-19	
	9.62D-15	2.10D-16	2.68D-14	5.18D-18	7.22D-16	5.59D-14	3.92D-11	4.56D-11	
	1.81D-17	1.37D-13	1.34D-10	1.77D-15					

Table 5. Collision rate coefficients in cubic centimeters per second for a temperature $T = 1500$ K. xDy denotes $x \times 10^y$

v_i, j_i	0, 0	0, 1	0, 2	0, 3	0, 4	0, 5	0, 6	0, 7
	0, 8	1, 0	1, 1	0, 9	1, 2	1, 3	1, 4	0,10
	1, 5	1, 6	0,11	1, 7	0,12	1, 8	2, 0	2, 1
	1, 9	2, 2	0,13	2, 3	2, 4	1,10	2, 5	0,14
	2, 6	1,11	2, 7	0,15	1,12	2, 8	3, 0	3, 1
	0,16	2, 9	3, 2	1,13	3, 3			
v_f, j_f	0, 0	7.85D-11	1.63D-11	9.28D-12	3.55D-12	1.47D-12	6.38D-13	2.58D-13
	1.04D-13	7.18D-17	1.11D-16	4.03D-14	2.56D-16	2.86D-16	3.97D-16	1.51D-14
	5.15D-16	5.17D-16	5.50D-15	4.76D-16	1.96D-15	3.78D-16	1.07D-18	5.67D-19
	2.76D-16	7.96D-19	6.90D-16	2.50D-18	5.00D-18	1.83D-16	3.46D-18	2.37D-16
	6.52D-18	1.13D-16	5.58D-18	8.50D-17	6.40D-17	4.12D-18	7.13D-17	1.25D-17
	2.62D-17	1.20D-17	6.69D-18	4.22D-17	1.98D-17			
	0, 1	2.16D-10	1.14D-10	2.65D-11	1.33D-11	5.39D-12	2.16D-12	9.10D-13
	3.64D-13	4.27D-16	5.43D-16	1.42D-13	4.86D-16	9.10D-16	1.25D-15	5.39D-14
	1.47D-15	1.63D-15	1.98D-14	1.46D-15	7.16D-15	1.19D-15	2.74D-18	1.98D-18
	8.78D-16	2.64D-18	2.55D-15	6.81D-18	1.47D-17	5.86D-16	1.07D-17	8.86D-16
	1.97D-17	3.66D-16	1.71D-17	3.21D-16	2.08D-16	1.25D-17	2.08D-16	3.98D-17
	9.59D-17	3.72D-17	2.21D-17	1.36D-16	6.16D-17			
	0, 2	6.31D-11	1.60D-10	1.18D-10	2.75D-11	1.24D-11	5.05D-12	1.98D-12
	8.14D-13	1.16D-15	7.27D-16	3.20D-13	1.02D-15	1.32D-15	2.05D-15	1.22D-13
	2.60D-15	2.73D-15	4.58D-14	2.64D-15	1.68D-14	2.15D-15	3.66D-18	2.82D-18
	1.63D-15	5.54D-18	6.08D-15	1.28D-17	2.49D-17	1.11D-15	1.85D-17	2.15D-15
	3.45D-17	7.02D-16	2.90D-17	7.91D-16	4.08D-16	2.20D-17	3.35D-16	7.48D-17
	2.26D-16	6.62D-17	4.26D-17	2.62D-16	1.10D-16			
	0, 3	3.90D-11	4.04D-11	1.28D-10	1.14D-10	2.64D-11	1.08D-11	4.32D-12
	1.67D-12	7.12D-16	1.32D-15	6.67D-13	1.45D-15	2.12D-15	2.76D-15	2.57D-13
	3.68D-15	4.18D-15	9.68D-14	3.96D-15	3.60D-14	3.43D-15	6.09D-18	4.45D-18
	2.66D-15	7.99D-18	1.33D-14	1.71D-17	3.59D-17	1.86D-15	2.78D-17	4.76D-15
	5.02D-17	1.21D-15	4.25D-17	1.78D-15	7.19D-16	3.34D-17	4.37D-16	1.23D-16
	4.90D-16	1.03D-16	7.31D-17	4.52D-16	1.67D-16			
	0, 4	1.37D-11	1.86D-11	2.74D-11	1.05D-10	1.07D-10	2.48D-11	9.13D-12
	3.61D-12	7.68D-16	1.36D-15	1.37D-12	2.37D-15	2.85D-15	3.97D-15	5.29D-13
	4.77D-15	5.64D-15	2.01D-13	5.85D-15	7.49D-14	5.08D-15	8.58D-18	7.32D-18
	4.16D-15	1.42D-17	2.79D-14	2.47D-17	4.84D-17	3.01D-15	3.96D-17	1.01D-14
	7.00D-17	2.00D-15	5.74D-17	3.88D-15	1.24D-15	4.92D-17	5.21D-16	1.87D-16
	1.03D-15	1.54D-16	1.16D-16	7.57D-16	2.35D-16			
	0, 5	4.58D-12	6.08D-12	9.97D-12	1.95D-11	8.63D-11	9.90D-11	2.26D-11
	7.76D-12	1.44D-15	1.85D-15	2.99D-12	2.93D-15	4.21D-15	4.88D-15	1.10D-12
	6.46D-15	7.33D-15	4.15D-13	7.97D-15	1.56D-13	7.62D-15	9.35D-18	1.31D-17
	6.34D-15	2.26D-17	5.80D-14	3.24D-17	6.48D-17	4.82D-15	5.38D-17	2.13D-14
	9.27D-17	3.31D-15	7.60D-17	8.26D-15	2.13D-15	7.34D-17	5.77D-16	2.71D-16
	2.13D-15	2.29D-16	1.75D-16	1.27D-15	3.15D-16			
	0, 6	1.43D-12	1.76D-12	2.93D-12	5.74D-12	1.44D-11	7.14D-11	8.93D-11
	2.03D-11	2.67D-15	2.77D-15	6.62D-12	3.50D-15	5.22D-15	6.67D-15	2.44D-12
	7.55D-15	9.97D-15	8.83D-13	1.09D-14	3.25D-13	1.09D-14	1.57D-17	2.09D-17
	9.89D-15	3.58D-17	1.21D-13	4.95D-17	8.11D-17	7.68D-15	7.23D-17	4.44D-14
	1.27D-16	5.47D-15	1.00D-16	1.75D-14	3.69D-15	1.10D-16	6.19D-16	3.70D-16
	4.40D-15	3.40D-16	2.50D-16	2.12D-15	4.08D-16			
	0, 7	3.78D-13	4.85D-13	7.49D-13	1.51D-12	3.47D-12	1.07D-11	5.84D-11
	8.01D-11	3.51D-15	3.77D-15	1.81D-11	4.12D-15	5.41D-15	8.57D-15	5.62D-12
	1.02D-14	1.17D-14	1.99D-12	1.55D-14	7.06D-13	1.59D-14	3.00D-17	3.42D-17
	1.50D-14	5.75D-17	2.57D-13	7.09D-17	1.09D-16	1.25D-14	9.99D-17	9.40D-14
	1.69D-16	9.09D-15	1.30D-16	3.73D-14	6.42D-15	1.74D-16	6.53D-16	4.73D-16
	9.17D-15	5.13D-16	3.29D-16	3.61D-15	5.19D-16			
	0, 8	9.10D-14	1.16D-13	1.85D-13	3.48D-13	8.21D-13	2.19D-12	7.94D-12
		3.75D-15	3.82D-15	7.17D-11	4.30D-15	5.39D-15	8.50D-15	1.60D-11
	1.48D-14	1.64D-14	4.73D-12	1.90D-14	1.62D-12	2.41D-14	4.35D-17	5.15D-17
	2.35D-14	7.19D-17	5.71D-13	8.70D-17	1.28D-16	2.00D-14	1.30D-16	2.03D-13
	2.35D-16	1.54D-14	1.75D-16	8.10D-14	1.13D-14	2.68D-16	6.59D-16	5.43D-16
	1.94D-14	7.77D-16	3.92D-16	6.15D-15	6.39D-16			

Table 5. continued

v_f, j_f	1, 0	2.20D-18	4.76D-18	9.20D-18	5.20D-18	6.11D-18	1.42D-17	3.64D-17	7.34D-17
		1.31D-16		7.83D-11	1.80D-16	1.63D-11	9.65D-12	3.76D-12	1.96D-16
		1.62D-12	7.26D-13	1.74D-16	3.02D-13	1.31D-16	1.26D-13	1.87D-16	3.52D-16
		5.16D-14	6.65D-16	9.23D-17	7.23D-16	1.18D-15	2.05D-14	1.22D-15	5.72D-17
		1.27D-15	8.19D-15	1.28D-15	2.00D-17	3.11D-15	8.55D-16	1.87D-15	3.91D-16
		2.25D-17	1.03D-15	2.03D-16	9.40D-16	6.47D-16			
1, 1	9.43D-18	1.67D-17	1.59D-17	2.66D-17	3.00D-17	5.04D-17	1.05D-16	2.18D-16	
	3.69D-16	2.17D-10		5.29D-16	1.15D-10	2.68D-11	1.41D-11	5.98D-16	
	5.86D-12	2.42D-12	5.50D-16	1.06D-12	4.27D-16	4.37D-13	1.39D-15	1.46D-15	
	1.79D-13	1.24D-15	3.10D-16	2.57D-15	3.66D-15	7.20D-14	3.47D-15	1.96D-16	
	3.99D-15	2.89D-14	3.84D-15	6.85D-17	1.13D-14	2.67D-15	5.59D-15	1.29D-15	
	7.65D-17	3.21D-15	6.75D-16	3.41D-15	1.99D-15				
0, 9	1.95D-14	2.50D-14	4.01D-14	7.69D-14	1.72D-13	4.66D-13	1.43D-12	5.97D-12	
	3.96D-11	2.85D-15	3.02D-15		3.45D-15	4.64D-15	7.73D-15	6.47D-11	
	1.54D-14	2.75D-14	1.40D-11	2.73D-14	4.00D-12	3.18D-14	6.96D-17	7.34D-17	
	3.80D-14	9.30D-17	1.34D-12	1.10D-16	1.66D-16	3.35D-14	1.98D-16	4.58D-13	
	3.39D-16	2.58D-14	2.33D-16	1.79D-13	2.01D-14	4.08D-16	6.16D-16	5.55D-16	
	4.21D-14	1.18D-15	3.87D-16	1.07D-14	7.22D-16				
1, 2	3.07D-17	2.12D-17	3.16D-17	4.13D-17	7.36D-17	1.13D-16	1.87D-16	3.37D-16	
	5.88D-16	6.39D-11	1.62D-10	8.56D-16		1.19D-10	2.80D-11	1.04D-15	
	1.34D-11	5.57D-12	1.02D-15	2.25D-12	8.36D-16	9.59D-13	3.39D-15	2.26D-15	
	3.95D-13	2.70D-15	6.34D-16	3.47D-15	6.04D-15	1.59D-13	6.11D-15	4.14D-16	
	6.56D-15	6.47D-14	6.73D-15	1.45D-16	2.60D-14	4.70D-15	8.13D-15	2.41D-15	
	1.60D-16	5.71D-15	1.47D-15	7.88D-15	3.45D-15				
1, 3	3.76D-17	4.35D-17	4.49D-17	6.66D-17	9.74D-17	1.78D-16	3.07D-16	4.85D-16	
	8.08D-16	4.15D-11	4.16D-11	1.26D-15	1.31D-10		1.16D-10	1.61D-15	
	2.75D-11	1.17D-11	1.70D-15	4.85D-12	1.48D-15	1.92D-12	2.25D-15	3.92D-15	
	8.03D-13	4.40D-15	1.18D-15	6.07D-15	8.26D-15	3.24D-13	8.70D-15	7.95D-16	
	9.77D-15	1.32D-13	9.53D-15	2.80D-16	5.47D-14	7.26D-15	1.02D-14	4.02D-15	
	3.06D-16	8.82D-15	2.50D-15	1.66D-14	4.96D-15				
1, 4	4.87D-17	5.55D-17	6.51D-17	8.08D-17	1.26D-16	1.93D-16	3.65D-16	7.17D-16	
	1.19D-15	1.51D-11	2.04D-11	1.96D-15	2.86D-11	1.08D-10		2.63D-15	
	1.11D-10	2.58D-11	2.85D-15	1.00D-11	2.60D-15	4.09D-12	2.59D-15	4.33D-15	
	1.61D-12	7.46D-15	2.14D-15	8.11D-15	1.16D-14	6.47D-13	1.10D-14	1.48D-15	
	1.28D-14	2.63D-13	1.30D-14	5.23D-16	1.11D-13	1.01D-14	1.08D-14	5.90D-15	
	5.72D-16	1.27D-14	4.29D-15	3.37D-14	6.60D-15				
0,10	3.74D-15	4.86D-15	7.85D-15	1.52D-14	3.41D-14	8.82D-14	2.71D-13	9.51D-13	
	4.53D-12	1.59D-15	1.75D-15	3.31D-11	2.15D-15	3.03D-15	5.31D-15		
	1.21D-14	3.10D-14	5.78D-11	5.17D-14	1.22D-11	4.71D-14	9.75D-17	9.78D-17	
	5.38D-14	1.18D-16	3.41D-12	1.30D-16	2.33D-16	5.69D-14	2.87D-16	1.10D-12	
	4.36D-16	4.50D-14	2.98D-16	4.15D-13	3.54D-14	6.71D-16	4.99D-16	4.61D-16	
	9.42D-14	1.79D-15	3.11D-16	1.86D-14	6.91D-16				
1, 5	5.19D-17	5.38D-17	6.77D-17	8.82D-17	1.25D-16	2.09D-16	3.39D-16	7.02D-16	
	1.70D-15	5.31D-12	6.97D-12	3.21D-15	1.12D-11	2.10D-11	9.10D-11	4.92D-15	
		1.02D-10	5.19D-15	2.40D-11	4.74D-15	8.60D-12	4.81D-15	6.14D-15	
	3.43D-12	9.17D-15	3.92D-15	1.14D-14	1.38D-14	1.31D-12	1.45D-14	2.75D-15	
	1.60D-14	5.22D-13	1.62D-14	9.69D-16	2.24D-13	1.41D-14	1.18D-14	8.44D-15	
	1.07D-15	1.80D-14	6.35D-15	6.73D-14	8.45D-15				
1, 6	3.84D-17	4.39D-17	5.25D-17	7.40D-17	1.09D-16	1.75D-16	3.30D-16	5.93D-16	
	1.39D-15	1.76D-12	2.12D-12	4.22D-15	3.45D-12	6.57D-12	1.56D-11	9.26D-15	
	7.52D-11		1.09D-14	9.40D-11	9.34D-15	2.18D-11	9.14D-15	9.22D-15	
	7.39D-12	1.16D-14	7.50D-15	1.50D-14	1.94D-14	2.82D-12	1.70D-14	5.16D-15	
	2.06D-14	1.06D-12	2.01D-14	1.81D-15	4.53D-13	1.94D-14	1.25D-14	1.04D-14	
	2.07D-15	2.59D-14	9.13D-15	1.35D-13	1.17D-14				
0,11	6.54D-16	8.56D-16	1.41D-15	2.74D-15	6.19D-15	1.59D-14	4.68D-14	1.61D-13	
	6.41D-13	6.76D-16	7.72D-16	3.43D-12	1.01D-15	1.53D-15	2.76D-15	2.77D-11	
	6.13D-15	1.75D-14		6.04D-14	5.18D-11	9.44D-14	1.30D-16	1.29D-16	
	8.00D-14	1.51D-16	1.07D-11	1.57D-16	3.11D-16	8.70D-14	3.92D-16	2.88D-12	
	5.94D-16	7.96D-14	4.22D-16	1.01D-12	6.33D-14	8.28D-16	3.69D-16	3.19D-16	
	2.23D-13	2.59D-15	2.16D-16	3.27D-14	5.00D-16				

Table 5. continued

v_f, j_f	1, 7	2.37D-17	2.65D-17	3.40D-17	4.70D-17	7.55D-17	1.28D-16	2.41D-16	5.25D-16
		1.08D-15	4.91D-13	6.22D-13	2.81D-15	9.35D-13	1.83D-12	4.08D-12	1.04D-14
		1.19D-11	6.30D-11	2.53D-14		2.03D-14	8.48D-11	1.11D-14	1.15D-14
		1.96D-11	1.26D-14	1.51D-14	1.38D-14	2.02D-14	6.25D-12	2.13D-14	9.92D-15
		2.67D-14	2.31D-12	2.67D-14	3.41D-15	9.42D-13	2.60D-14	1.44D-14	1.28D-14
		4.32D-15	3.76D-14	1.21D-14	2.74D-13	1.62D-14			
0,12	1.05D-16	1.39D-16	2.32D-16	4.58D-16	1.04D-15	2.68D-15	7.76D-15	2.58D-14	
	9.89D-14	2.28D-16	2.70D-16	4.42D-13	3.73D-16	6.02D-16	1.13D-15	2.63D-12	
	2.52D-15	6.73D-15	2.33D-11	2.18D-14		9.50D-14	1.57D-16	1.63D-16	
	1.69D-13	1.97D-16	4.68D-11	2.23D-16	3.97D-16	1.34D-13	5.12D-16	9.31D-12	
	8.11D-16	1.28D-13	4.95D-16	2.69D-12	1.14D-13	1.03D-15	3.03D-16	2.32D-16	
	5.57D-13	3.76D-15	1.88D-16	6.16D-14	2.74D-16				
1, 8	1.16D-17	1.32D-17	1.70D-17	2.50D-17	4.04D-17	7.51D-17	1.48D-16	3.32D-16	
	8.40D-16	1.26D-13	1.58D-13	2.01D-15	2.45D-13	4.47D-13	1.02D-12	5.81D-15	
	2.62D-12	8.99D-12	2.43D-14	5.22D-11	5.45D-14		9.84D-15	9.65D-15	
	7.66D-11	1.11D-14	3.26D-14	1.20D-14	2.02D-14	1.72D-11	3.16D-14	1.99D-14	
	3.46D-14	5.31D-12	3.30D-14	6.71D-15	2.08D-12	4.19D-14	1.51D-14	1.39D-14	
	1.02D-14	6.08D-14	1.25D-14	5.90D-13	1.97D-14				
2, 0	1.20D-21	1.11D-21	1.05D-21	1.62D-21	2.48D-21	3.36D-21	7.78D-21	2.28D-20	
	5.52D-20	6.78D-18	1.83D-17	1.60D-19	3.15D-17	1.91D-17	2.35D-17	4.38D-19	
	5.32D-17	1.37D-16	1.22D-18	2.48D-16	3.27D-18	3.58D-16		7.79D-11	
	4.84D-16	1.64D-11	5.66D-18	1.01D-11	3.93D-12	4.29D-16	1.72D-12	5.16D-18	
	8.13D-13	7.35D-17	3.73D-13	7.04D-18	2.90D-16	1.61D-13	4.04D-14	1.42D-14	
	1.84D-17	8.77D-14	6.73D-15	1.20D-15	1.89D-14				
2, 1	1.76D-21	2.22D-21	2.25D-21	3.28D-21	5.87D-21	1.30D-20	2.89D-20	7.21D-20	
	1.82D-19	3.55D-17	5.35D-17	4.68D-19	5.82D-17	9.20D-17	1.09D-16	1.22D-18	
	1.88D-16	3.84D-16	3.35D-18	7.12D-16	9.41D-18	9.74D-16	2.16D-10		
	1.37D-15	1.15D-10	1.74D-17	2.72D-11	1.48D-11	1.29D-15	6.17D-12	1.77D-17	
	2.68D-12	2.26D-16	1.30D-12	2.80D-17	1.02D-15	5.53D-13	9.55D-14	4.82D-14	
	7.36D-17	2.98D-13	2.66D-14	4.32D-15	5.39D-14				
1, 9	4.83D-18	5.57D-18	7.34D-18	1.10D-17	1.88D-17	3.56D-17	7.70D-17	1.78D-16	
	4.68D-16	2.94D-14	3.70D-14	1.37D-15	5.74D-14	1.06D-13	2.28D-13	3.78D-15	
	5.94D-13	1.74D-12	1.17D-14	6.85D-12	5.51D-14	4.36D-11	7.57D-15	7.75D-15	
		8.68D-15	8.39D-14	1.01D-14	1.92D-14	6.83D-11	3.24D-14	4.07D-14	
	5.33D-14	1.53D-11	4.50D-14	1.36D-14	4.89D-12	6.27D-14	1.48D-14	1.33D-14	
	2.83D-14	1.11D-13	1.25D-14	1.34D-12	1.89D-14				
2, 2	3.51D-21	4.23D-21	6.31D-21	8.39D-21	1.62D-20	3.20D-20	7.04D-20	1.73D-19	
	3.61D-19	9.57D-17	6.44D-17	8.47D-19	9.94D-17	1.47D-16	2.68D-16	2.10D-18	
	4.01D-16	6.89D-16	5.62D-18	1.12D-15	1.63D-17	1.59D-15	6.48D-11	1.64D-10	
	2.19D-15		3.25D-17	1.21D-10	2.86D-11	2.25D-15	1.40D-11	3.86D-17	
	6.09D-12	4.20D-16	2.68D-12	7.25D-17	2.16D-15	1.21D-12	1.76D-13	8.67D-14	
	1.94D-16	6.37D-13	5.37D-14	1.00D-14	8.20D-14				
0,13	1.57D-17	2.11D-17	3.57D-17	7.17D-17	1.65D-16	4.24D-16	1.23D-15	3.99D-15	
	1.48D-14	6.84D-17	8.30D-17	6.29D-14	1.20D-16	2.03D-16	3.96D-16	3.12D-13	
	8.84D-16	2.29D-15	2.05D-12	6.88D-15	1.99D-11	2.42D-14	1.15D-16	1.28D-16	
	1.09D-13	1.68D-16		2.20D-16	3.67D-16	2.86D-13	5.38D-16	4.20D-11	
	9.42D-16	1.97D-13	7.66D-16	8.70D-12	1.81D-13	2.43D-15	3.49D-16	2.84D-16	
	1.60D-12	6.71D-15	2.90D-16	1.26D-13	2.44D-16				
2, 3	1.22D-20	1.21D-20	1.62D-20	1.99D-20	3.13D-20	5.10D-20	1.08D-19	2.37D-19	
	4.85D-19	1.15D-16	1.48D-16	1.11D-18	1.42D-16	2.26D-16	3.23D-16	2.55D-18	
	5.54D-16	9.89D-16	6.44D-18	1.35D-15	2.04D-17	1.92D-15	4.43D-11	4.31D-11	
	2.82D-15	1.34D-10	4.74D-17		1.18D-10	3.24D-15	2.78D-11	7.17D-17	
	1.27D-11	7.53D-16	5.71D-12	1.76D-16	4.63D-15	2.39D-12	1.35D-13	1.12D-13	
	4.91D-16	1.25D-12	1.18D-13	2.21D-14	1.27D-13				
2, 4	2.32D-20	2.46D-20	2.98D-20	3.95D-20	5.80D-20	9.64D-20	1.67D-19	3.43D-19	
	6.77D-19	1.78D-16	2.00D-16	1.58D-18	2.33D-16	2.90D-16	4.37D-16	4.35D-18	
	6.33D-16	1.21D-15	1.21D-17	1.88D-15	3.44D-17	3.05D-15	1.63D-11	2.21D-11	
	5.10D-15	3.00D-11	7.47D-17	1.12D-10		6.23D-15	1.15D-10	1.23D-16	
	2.78D-11	1.81D-15	1.18D-11	3.85D-16	9.76D-15	5.19D-12	1.71D-13	2.13D-13	
	1.21D-15	2.49D-12	1.74D-13	4.91D-14	2.33D-13				

Table 5. continued

v_f, j_f	1,10	1.70D-18	1.97D-18	2.66D-18	4.10D-18	7.23D-18	1.44D-17	3.17D-17	7.89D-17
		2.11D-16	6.18D-15	7.87D-15	6.40D-16	1.23D-14	2.28D-14	4.88D-14	2.12D-15
		1.20D-13	3.51D-13	6.77D-15	1.16D-12	2.33D-14	5.20D-12	3.57D-15	3.85D-15
		3.62D-11	4.73D-15	1.16D-13	6.14D-15	1.25D-14		2.42D-14	1.03D-13
		5.80D-14	6.35D-11	9.48D-14	3.39D-14	1.45D-11	7.52D-14	1.92D-14	1.86D-14
		9.18D-14	2.51D-13	1.82D-14	3.49D-12	2.41D-14			
2, 5	1.34D-20	1.51D-20	1.85D-20	2.55D-20	3.97D-20	6.69D-20	1.25D-19	2.63D-19	
	5.71D-19	1.54D-16	1.58D-16	1.58D-18	1.97D-16	2.55D-16	3.48D-16	4.47D-18	
	5.56D-16	8.84D-16	1.27D-17	1.65D-15	3.70D-17	3.99D-15	5.95D-12	7.71D-12	
	7.17D-15	1.23D-11	9.15D-17	2.19D-11	9.59D-11	1.01D-14		2.01D-16	
	1.08D-10	4.25D-15	2.65D-11	8.11D-16	2.04D-14	1.05D-11	1.98D-13	2.21D-13	
	2.75D-15	4.95D-12	3.21D-13	1.04D-13	5.43D-13				
0,14	2.17D-18	2.95D-18	5.09D-18	1.04D-17	2.41D-17	6.27D-17	1.82D-16	5.88D-16	
	2.12D-15	1.71D-17	2.12D-17	8.67D-15	3.16D-17	5.53D-17	1.10D-16	4.05D-14	
	2.50D-16	6.37D-16	2.22D-13	1.83D-15	1.60D-12	5.96D-15	4.24D-17	5.23D-17	
	2.13D-14	8.01D-17	1.70D-11	1.34D-16	2.44D-16	1.02D-13	4.78D-16		
	1.06D-15	4.37D-13	1.71D-15	3.97D-11	2.92D-13	5.16D-15	5.44D-16	5.55D-16	
	5.89D-12	1.70D-14	6.10D-16	3.41D-13	7.39D-16				
2, 6	1.90D-20	2.09D-20	2.60D-20	3.48D-20	5.28D-20	8.68D-20	1.65D-19	3.36D-19	
	7.79D-19	1.21D-16	1.37D-16	2.04D-18	1.59D-16	2.16D-16	3.03D-16	5.11D-18	
	4.62D-16	8.06D-16	1.45D-17	1.56D-15	4.41D-17	3.28D-15	2.12D-12	2.52D-12	
	8.88D-15	4.02D-12	1.21D-16	7.55D-12	1.75D-11	1.82D-14	8.10D-11	3.36D-16	
		1.36D-14	9.85D-11	1.64D-15	4.47D-14	2.47D-11	3.94D-13	4.21D-13	
	6.06D-15	9.93D-12	5.52D-13	2.21D-13	9.72D-13				
1,11	5.22D-19	6.12D-19	8.34D-19	1.32D-18	2.39D-18	4.90D-18	1.12D-17	2.85D-17	
	8.06D-17	1.23D-15	1.57D-15	2.45D-16	2.48D-15	4.60D-15	9.86D-15	8.34D-16	
	2.39D-14	6.60D-14	3.08D-15	2.14D-13	1.10D-14	7.97D-13	3.03D-16	3.36D-16	
	4.04D-12	4.38D-16	4.00D-14	7.08D-16	1.80D-15	3.16D-11	5.05D-15	2.19D-13	
	2.16D-14		1.01D-13	1.07D-13	5.87D-11	2.26D-13	2.75D-14	2.94D-14	
	3.07D-13	6.95D-13	3.10D-14	1.12D-11	4.63D-14				
2, 7	1.12D-20	1.24D-20	1.50D-20	2.02D-20	2.97D-20	4.89D-20	8.93D-20	1.77D-19	
	3.98D-19	8.34D-17	9.07D-17	9.63D-19	1.12D-16	1.45D-16	2.12D-16	2.40D-18	
	3.22D-16	5.42D-16	7.09D-18	1.07D-15	1.85D-17	2.16D-15	6.69D-13	8.37D-13	
	5.16D-15	1.22D-12	6.74D-17	2.33D-12	5.08D-12	2.05D-14	1.37D-11	3.73D-16	
	6.77D-11	4.39D-14		2.95D-15	1.04D-13	9.14D-11	5.89D-13	6.34D-13	
	1.33D-14	2.53D-11	6.78D-13	4.76D-13	1.32D-12				
0,15	3.00D-19	4.12D-19	7.21D-19	1.50D-18	3.55D-18	9.38D-18	2.76D-17	8.98D-17	
	3.25D-16	2.30D-18	2.85D-18	1.31D-15	4.27D-18	7.50D-18	1.50D-17	5.90D-15	
	3.40D-17	8.61D-17	3.01D-14	2.42D-16	1.78D-13	7.73D-16	2.23D-17	3.20D-17	
	2.75D-15	5.80D-17	1.35D-12	1.27D-16	2.94D-16	1.29D-14	7.41D-16	1.53D-11	
	1.99D-15	8.18D-14	5.21D-15		7.20D-13	1.44D-14	7.09D-16	8.35D-16	
	3.12D-11	5.35D-14	9.74D-16	1.29D-12	1.59D-15				
1,12	1.38D-19	1.63D-19	2.27D-19	3.69D-19	6.92D-19	1.47D-18	3.54D-18	9.43D-18	
	2.76D-17	2.19D-16	2.86D-16	8.93D-17	4.66D-16	8.95D-16	1.95D-15	3.07D-16	
	4.80D-15	1.31D-14	1.15D-15	4.08D-14	4.61D-15	1.46D-13	5.60D-16	7.07D-16	
	6.04D-13	1.05D-15	1.72D-14	2.04D-15	4.54D-15	3.38D-12	1.14D-14	6.87D-14	
	3.30D-14	2.75D-11	1.12D-13	4.40D-13		4.89D-13	2.25D-14	2.64D-14	
	9.90D-13	2.09D-12	2.92D-14	4.89D-11	5.16D-14				
2, 8	5.21D-21	5.76D-21	7.20D-21	1.01D-20	1.61D-20	2.99D-20	6.18D-20	1.50D-19	
	3.87D-19	3.53D-17	3.99D-17	1.07D-18	4.96D-17	6.98D-17	1.04D-16	3.42D-18	
	1.77D-16	3.30D-16	8.81D-18	6.60D-16	2.44D-17	1.73D-15	1.83D-13	2.26D-13	
	4.55D-15	3.47D-13	1.35D-16	6.19D-13	1.42D-12	1.03D-14	3.42D-12	7.12D-16	
	1.07D-11	6.22D-14	5.79D-11	5.18D-15	2.87D-13		5.42D-13	5.95D-13	
	2.46D-14	8.75D-11	6.65D-13	9.92D-13	1.21D-12				
3, 0	3.42D-21	3.62D-21	4.14D-21	4.98D-21	6.47D-21	8.90D-21	1.32D-20	2.13D-20	
	3.60D-20	2.92D-18	3.16D-18	6.09D-20	3.25D-18	3.71D-18	4.20D-18	9.63D-20	
	5.61D-18	8.07D-18	1.49D-19	1.38D-17	2.72D-19	2.37D-17	1.74D-15	1.48D-15	
	4.06D-17	1.92D-15	7.36D-19	1.32D-15	1.77D-15	9.93D-17	2.45D-15	2.84D-18	
	6.49D-15	2.87D-16	1.41D-14	9.63D-18	5.01D-16	2.05D-14		8.20D-11	
	2.47D-17	3.82D-14	1.51D-11	9.08D-16	1.56D-11				

Table 5. continued

v_f, j_f	3, 1	1.66D-21	1.93D-21	2.58D-21	3.89D-21	6.48D-21	1.16D-20	2.20D-20	4.30D-20
		8.26D-20	1.70D-18	2.02D-18	1.53D-19	2.68D-18	4.07D-18	6.41D-18	2.47D-19
		1.12D-17	1.88D-17	3.58D-19	3.42D-17	5.79D-19	6.07D-17	1.69D-15	2.08D-15
		1.02D-16	2.62D-15	1.67D-18	3.06D-15	6.14D-15	2.67D-16	7.63D-15	8.08D-18
		1.93D-14	8.51D-16	4.23D-14	3.16D-17	1.64D-15	6.27D-14	2.28D-10	
		8.58D-17	1.25D-13	1.06D-10	3.13D-15	4.78D-11			
	0,16	3.41D-20	4.54D-20	7.61D-20	1.52D-19	3.47D-19	8.92D-19	2.56D-18	8.15D-18
		2.88D-17	9.58D-19	1.17D-18	1.13D-16	1.74D-18	3.03D-18	6.07D-18	4.94D-16
		1.39D-17	3.64D-17	2.44D-15	1.13D-16	1.36D-14	4.32D-16	2.15D-17	3.10D-17
		2.11D-15	5.73D-17	9.16D-14	1.31D-16	3.40D-16	1.29D-14	9.26D-16	8.37D-13
		2.71D-15	8.70D-14	8.68D-15	1.15D-11	5.99D-13	2.53D-14	6.71D-16	8.38D-16
			1.03D-13	1.03D-15	5.34D-12	1.86D-15			
	2, 9	8.95D-21	1.00D-20	1.27D-20	1.82D-20	2.97D-20	5.47D-20	1.13D-19	2.60D-19
		6.58D-19	2.50D-17	2.82D-17	1.81D-18	3.54D-17	4.98D-17	7.71D-17	5.37D-18
		1.33D-16	2.60D-16	1.62D-17	5.62D-16	5.22D-17	1.48D-15	5.84D-14	7.16D-14
		4.72D-15	1.07D-13	2.19D-16	1.89D-13	3.99D-13	2.01D-14	9.53D-13	1.38D-15
		2.54D-12	1.12D-13	9.41D-12	1.13D-14	7.20D-13	5.14D-11	5.93D-13	6.98D-13
		5.89D-14		8.27D-13	2.66D-12	1.55D-12			
	3, 2	1.28D-21	1.54D-21	2.11D-21	3.33D-21	5.75D-21	1.08D-20	2.14D-20	4.30D-20
		8.57D-20	1.27D-18	1.53D-18	1.53D-19	2.35D-18	3.64D-18	6.70D-18	2.40D-19
		1.21D-17	2.35D-17	3.49D-19	4.66D-17	6.73D-19	7.80D-17	1.16D-15	1.64D-15
		1.37D-16	2.33D-15	2.44D-18	4.61D-15	7.21D-15	3.76D-16	1.59D-14	1.28D-17
		3.64D-14	1.29D-15	6.50D-14	5.28D-17	2.60D-15	1.01D-13	6.03D-11	1.53D-10
		1.51D-16	2.13D-13		5.34D-15	1.75D-10			
	1,13	4.03D-20	4.72D-20	6.47D-20	1.03D-19	1.87D-19	3.89D-19	9.04D-19	2.35D-18
		6.69D-18	2.93D-17	3.84D-17	2.10D-17	6.27D-17	1.20D-16	2.62D-16	7.14D-17
		6.38D-16	1.74D-15	2.63D-16	5.26D-15	1.10D-15	1.84D-14	1.02D-15	1.33D-15
		7.33D-14	2.16D-15	5.28D-15	4.31D-15	1.01D-14	3.60D-13	2.56D-14	3.55D-14
		7.24D-14	2.33D-12	2.27D-13	3.50D-13	2.17D-11	7.49D-13	1.81D-14	2.24D-14
		3.91D-12	3.42D-12	2.66D-14		5.18D-14			
	3, 3	4.26D-21	4.81D-21	6.08D-21	8.53D-21	1.31D-20	2.18D-20	3.91D-20	7.59D-20
		1.56D-19	4.54D-18	5.05D-18	3.20D-19	6.17D-18	8.08D-18	1.15D-17	5.98D-19
		1.80D-17	3.38D-17	9.04D-19	6.97D-17	1.10D-18	1.38D-16	3.65D-15	3.74D-15
		2.32D-16	3.99D-15	2.31D-18	5.58D-15	1.08D-14	5.59D-16	3.02D-14	1.73D-17
		7.18D-14	2.16D-15	1.42D-13	9.66D-17	5.15D-15	2.05D-13	7.00D-11	7.71D-11
		3.07D-16	4.47D-13	1.96D-10	1.17D-14				