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OSCILLATOR STRENGTHS FOR DIPOLE-ALLOWED FINE-STRUCTURE TRANSITIONS IN Si II

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An extensive dataset of oscillator strengths, line strengths, and Einstein *A* -coefficients has been calculated for a large number of dipole-allowed (ΔS=0) fine-structure transitions in Si II. The line strengths in *LS* coupling are obtained in an *ab initio* manner in the close-coupling approximation employing the R-matrix method. The fine-structure components are obtained through algebraic transformations of the *LS* multiplets. Observed spectroscopic energies are employed whenever available. A 12-state eigenfunction expansion of the core ion, Si III, is employed for the present calculations. This work presents the oscillator strengths of 1122 fine-structure transitions in Si II corresponding to 390 *LS* multiplets and provides a reasonably complete set of radiative transitions for this astrophysically important ion for the first time. Present results are of comparable accuracy to previous detailed calculations obtained for a small number of transitions and are in reasonably good agreement with the measured oscillator strengths and lifetimes.

INTRODUCTION

Si II is one of the most common ions observed in absorption and emission spectra from astrophysical sources, such as the interstellar medium, quasars, hot stars, and the sun. The oscillator strengths for transitions in Si II are used in the determination of abundances, temperatures, densities, and column densities (see, e.g., Ref. [1]). Si II has been investigated both experimentally [2–9] and theoretically [10–17] by many workers. However, all these studies have remained confined to a limited number of transitions until the work of the Opacity Project (OP) [10]. One of the aims of the OP [18] has been to obtain accurate atomic radiative data in an *ab initio* manner in the close-coupling (CC) approximation using the R-matrix method. The radiative work of the OP was carried out in *LS* coupling; however, the laboratory plasma experiments and the various astrophysical models usually consider the fine-structure transitions (see, e.g., [2–5]). The extended non-LTE (low temperature equilibrium) models which consider a number of transitions, such as ones observed in hot stars, require both radiative and collisional data for a large number of energy levels. Collisional data are now available for Si II [19] obtained in the close-coupling approximation using the R-matrix method. The aim of this work is to present an extensive set of radiative data of reliable accuracy for fine-structure transitions in Si II to be used in collisional-radiative models employed in astrophysical applications. Similar sets of data for fine-structure transitions in other ions employing the present method have been reported earlier [20].

Summary of the Theoretical Work and Computations

The calculations of the oscillator strengths (*f*-values), line strengths (*S*-values), and Einstein coefficients or transition probabilities (*A*-values) have been described in previous works [20] and are not discussed in detail here. We present only the computational details pertaining to the Si II calculations.

In terms of accuracy, the strength of the present method lies in the fact that accurate bound-state wave-functions may be obtained for an atom or ion using the close-coupling approximation where the core ion, termed the ‘‘target,’’ represents the *N*-electron system. The wave-function expansion, $\Psi(E)$, for any symmetry, $SL\pi$, of the bound $(N + 1)$ electron system is represented in terms of the target states as

$$\Psi(E) = \mathbf{A} \sum_i \chi_i \theta_i + \sum_i c_j \Phi_j, \qquad (1)$$

where X_i is the target ion wavefunction in a specific state $S_i\, L_i\, \pi_i$ and θ_i is the wave function for the $(N + 1)$th electron in a channel labeled as $S_i\, L_i\, \pi_i\, k_i^2 l_i\, (SL\pi)$; k_i^2 is the electron energy, which for $k_i^2 < 0$ may represent bound states of the e + ion system; and **A** is the antisymmetrization operator. The Φ_j’s are correlation functions of the $(N + 1)$ electron system that compensate for the orthogonality condition on the total wavefunction, as well as account for short-range correlation effects, and c_j ’s are the variational coefficients. The CC expansions imply extensive configuration interactions in the coupled wave functions for each $SL\pi$ at negative energies corresponding to the bound states of the system.

The present work corresponds to CC calculations employing a 12-state expansion of the target ion Si III. The target states are: $3s^2$ ($^1S^e$), $3s3p$($^3P^o$, $^1P^o$), $3p^2$ ($^1D^e$, $^3P^e$, $^1S^e$), $3s3d$($^3D^e$, $^1D^e$), $3s4s$($^3S^e$, $^1S^e$), $3s4p$($^3P^o$, $^1P^o$). These states are optimized through atomic structure calculations

with spectroscopic configurations, $3s^2$, $3s3p$, $3p^2$, $3s3d$, $3s4s$, $3s4p$, and correlation configurations, $3d^2$, $3p3d$, $3p4s$, $3p4p$, $3d4s$, $3d4p$.

Computations for the line strengths are carried out employing the R-matrix codes developed for the OP [21]. We obtain 65 calculated bound *LS* states of Si II below the first ionization threshold and 390 corresponding oscillator strengths for transitions among these states. The number of observed energy terms [22] is 45. The calculated energies agree within 3% with the measured ones for most of the states, as can be seen in Table I.

The fine-structure components of the transitions are obtained through algebraic transformations of the *LS* multiplet in the two ways as described in Ref. [20] and employing the code JJTOLS [20]. The *f*, *S*, and *A* are related as

$$E_{fi} = 3g_i(f_{if}/S), \quad A_{fi}(\text{a.u.}) = \frac{1}{2}\alpha^3 \frac{g_i}{g_f} E_{fi}^2 f_{if},$$

$$A_{fi}(\text{s}^{-1}) = \frac{A_{fi}(\text{a.u.})}{\tau_0}, \quad (2)$$

where E_{fi} is the transition energy in rydbergs; *S* is the line strength in atomic units (a.u.), α is the fine structure constant; g_i , g_f are the statistical weight factors of the initial and final states [$g = (2S + 1)(2L + 1)$ in *LS* coupling and $= (2J + 1)$ in *JJ* coupling]; and $\tau_0 = 2.4191 \times 10^{-17}$ *s* is the atomic unit of time. Spectroscopic observed energies [22] are employed whenever available as these are measured with higher accuracy than the calculated values. As the present calculated energies agree quite well with the observed energies for most of the terms, implementation of the observed energies improves the accuracies of the total *f*- and *A*-values only slightly. Table I lists all the bound *LS* terms among which the dipole allowed fine-structure transitions are considered, resulting in 1122 transitions. In Table I, each *LS* term is prefixed by a degeneracy symbol for convenience of identification, in accordance with the National Institute of Standards and Technology convention. An alphabetically ascending order of letters is chosen for the even parity states and a descending order for the odd parity states of the same symmetry.

The target expansion in this work is the same as that which Mendoza et al. [10] used for the OP radiative data. The R-matrix computations are carried out independently in both works. Although the level of accuracy in both the works is about the same, the extent of the present computations is not exactly the same as that of theirs. (The details of the OP work are yet to be published.) The differences between the two works come from the choice of number of terms in the R-matrix basis set, number of partial waves, and number of bound channels in the second sum of the CC expansion [Eq. (1)], all of which affect the accuracy of the calculations. The R-matrix basis set of 12 terms in the present work was checked for convergence through unitarity of collision strengths for excitation and dielectronic recombination as in Ref. [23]. All possible configurations of the ion were included in the bound channel second term of the CC expansion to complete the electron correlation effects. A larger number of partial waves is included, *l* going up to 9 in the present work as compared to 5 in the OP work, and this has resulted in a larger data set.

Results and Discussion

The *f*-, *S*-, and *A*-values for the 1122 dipole-allowed fine-structure transitions in Si II, corresponding to 390 *LS* multiplets, have been calculated. The complete set of *f*-values is presented in Table II; a computer-readable listing including *S*- and *A*-values is available

electronically from the author at the address given at the end of the Conclusion.

To evaluate the uncertainties, comparison of the present weighted oscillator strengths *gf* is made for astrophysically important transitions with a number of other available theoretical and experimental values in Table A. Although the multiplet transitions have been studied more extensively for a number of transitions, much less data are available for the fine-structure transitions. Among the calculations, Mendoza et al. [10] and the present work correspond to *ab initio* R-matrix calculations which can be used for large-scale computations of the *f*-values. Most other works correspond to various atomic structure calculations requiring optimization and can be applied for a limited number of transitions. Differences in optimization may lead to differences in results as we discuss below, where comparison of the present results is made with some of the best results available at this time.

For the transition $3s^2 3p(z\ ^2P^o) \rightarrow 3s3p^2\ (a\ ^2P^e)$, the only other calculated *gf*-values available for the fine-structure components are by Luo et al. [15]. As can be seen in Table A, the present *gf*-values show good agreement with those of Luo et al. [15], while the measured values are about 17% lower. For the multiplet transition the present *gf*-value agrees consistently well with all other calculated numbers, but the measured values are again somewhat lower than the calculated values. The transition $3s^2 3p(z\ ^2P^o) \rightarrow 3s3p^2\ (a\ ^2D^e)$ has been studied by a number of investigators, but both the measured and the calculated values show a large spread. This is a rather sensitive transition because the upper $a\ ^2D^e$ state is a mixture of $3s3p^2$ and $3s^2 3d$ which causes cancellations in the relevant matrix elements. The latest measurement for both the *LS* and the fine-structure transitions of $3s^2 3p(z\ ^2P^o) \rightarrow 3s3p^2\ (a\ ^2D^e)$ was carried out by Berjeson and Lawler [2]. The agreement of their

TABLE A
Comparison of the Present gf-values with Experiments and Other Calculations

Transition	LS multiplet			g_i	g_f	Fine structure		
	Present	Expt	Theo			Present	Expt	Theo
$3s^23p(z\ ^2P^o) \rightarrow 3s3p^2(a\ ^2P^e)$	5.233	4.5 [5]	5.226 [13]	4	4	2.906		2.943 [15]
		4.32 [4]	5.32 [14]	4	2	0.580		0.607 [15]
		4.44 [7]	5.28 [15]	2	4	0.583	0.489 [4]	0.587 [15]
			5.32 [10]	2	2	1.164	0.964 [4]	1.159 [15]
			5.46 [17]					
$3s^23p(z\ ^2P^o) \rightarrow 3s3p^2\ (a\ ^2D^e)$	0.0148	0.0112 [2]	0.0149 [10]	2	4	0.0049	0.00417 [2]	0.00631 [12]
		0.0312 [4]	0.0099 [11]				0.0103 [4]	0.00626 [15]
		0.033 [5]	0.0112 [13]				0.0110 [5]	
			0.0208 [15]				0.00631 [8]	
			0.0060 [16]	4	6	0.00880	0.00661 [2]	0.00646 [12]
							0.0198 [5]	0.0108 [15]
				4	4	0.00098	0.000513 [2]	0.000398 [12]
							0.00220 [5]	0.00116 [15]
$3s^23p(z\ ^2P^o) \rightarrow 3s^23d(b\ ^2D^e)$	7.104	6.84 [7]	7.07 [10]	4	4	0.473		0.46 [15]
		5.76 [5]	6.98 [13]	4	6	4.26		4.18 [15]
		5.1 [4]	7.17 [11]	2	4	2.374	1.70 [4]	2.32 [15]
			6.97 [15]					
			6.83 [16]					
$3s^23p(z\ ^2P^o) \rightarrow 3s^24d(c\ ^2D^e)$	0.971	0.96 [4]	1.02 [10]	4	4	0.065	0.053 [5]	
		0.798 [5]	1.44 [11]	4	6	0.582	0.477 [5]	
			1.05 [13]	2	4	0.324	0.320 [4]	0.403 [15]
			1.62 [15]				0.266 [5]	
			1.10 [16]					
$3s^23p(z\ ^2P^o) \rightarrow 3s^24s(a\ ^2S^e)$	0.802	1.38 [5]	0.786 [10]	4	2	0.534	0.916 [5]	0.467 [15]
		1.23 [4]	0.773 [11]	2	2	0.268	0.460 [5]	0.233 [15]
			0.780 [13]				0.414 [4]	
			0.78 [17]					
$3s^23p(z\ ^2P^o) \rightarrow 3s3p^2(b\ ^2S^e)$	0.504	0.882 [5]	0.531 [10]	4	2	0.336	0.587 [5]	0.353 [15]
		0.822 [4]	0.633 [11]	2	2	0.168	0.294 [5]	0.203 [15]
			0.529 [13]				0.272 [4]	
			0.548 [15]					
			0.54 [17]					
$3s^23p(^2P^o) \rightarrow 3s^25s(c\ ^2S^e)$	0.087	0.169 [5]	0.090 [10]	4	2	0.058	0.113 [5]	
			0.119 [13]	2	2	0.029	0.56 [5]	

measured *LS* multiplet value with the present *f*-value is fair, while the agreement is good with the present J = 1/2–3/2 fine-structure component. Their results also agree well with the atomic structure calculations of Hibbert et al. [13] for the *LS* multiplet and reasonably well with those of Dufton et al. [12] for the fine-structure transitions. The present *gf* value agrees quite well with that given by Mendoza et al. [10] for this transition and for other transitions. For the second transition of this symmetry, $z\ ^2P^o \rightarrow b\ ^2D^e$, good agreement is found between the present value with the measured value of Livingston et al. [7] and with all other theoretical calculations. The fine-structure components agree well with Luo et al. [15], while the measured value [4] is lower. For the third transition, $z\ ^2P^o \rightarrow c\ ^2D^e$, the present *gf* value agrees very well with the measured value of Van Buren [4] and with a few of the other theoretical values [10, 13, 16]. For the three transitions $z\ ^2P^o \rightarrow (a, b, c)\ ^2S^e$, all the calculated values agree with each other in general, but the measured values show poor agreement with the calculations.

Comparison is also made of the present lifetimes with other measured and calculated values in Table B. The lifetimes can be measured in general with less uncertainty

TABLE B
Comparison of the Present Lifetimes (τ) with Experiments
and Other Calculations

State	τ (ns) Present	Experiment	Theory
$z\ ^4S^o$	0.270	0.35 (.1) [8]	0.258 [10]
			0.27 [14]
$a\ ^2D^e$	335.7	439 (44) [2]	342 [10]
		200–400 [9]	442 [13]
			210.5 [14]
			850 [16]
			128 [17]
$b\ ^2D^e$	0.337	0.35 (.04) [7]	0.339 [10]
		0.7 (.2) [9]	0.343 [13]
		0.45 (.05) [8]	0.35 [16]
			0.37 [14]
			0.33 [17]
$a\ ^2P^e$	0.245	0.29 (.04) [7]	0.235 [10]
		<0.4 [9]	0.246 [13]
			0.23 [14]
			0.26 [17]
$a\ ^2S^e$	0.876	0.89 (.05) [3]	0.901 [10]
		0.91 (.04) [3]	0.904 [13]
		0.9 (.2) [9]	0.83 [14]
			0.90 [17]
$b\ ^2S^e$	1.017	0.58 [5]	0.929 [10]
			0.968 [13]
			1.08 [14]
			0.94 [17]
$c\ ^2S^e$	2.552	1.99 (.2) [3]	2.36 [10]
			2.501 [13]
$y\ ^2P^o$	9.478	8.3 (.8) [8]	9.31 [10]
		9.1 (5) [6]	9.51 [13]
			9.7 [16]
			8.29 [14]
$z\ ^2F^o$	3.355	3.2 (.4) [9]	3.26 [10]
		3.4 (3) [6]	3.1 [16]

Note. Numbers in parentheses give the experimental errors.

than the *gf* values. The lifetime value is obtained easily once the *A*-values are known since

$$\tau_f = \frac{1}{A_f}, \qquad (3)$$

where A_f is the total radiative transition probability for the state *f*, i.e.,

$$A_f = \sum_i A_{fi}. \qquad (4)$$

The present lifetime of the state $z\ ^4S^o$ agrees with the calculations by Mendoza et al. [10] and Hjorth-Jensen and Aashmar [14], but is lower than the measured value by Berry et al. [8]. The lifetime of the $a\ ^2D^e$ state of the present work is within the spread of various measured values and agrees closely only with the value calculated by Mendoza et al. [10]. However, the measured lifetime of the $a\ ^2D^e$ state by Berjeson and Lawler [2] agrees very well with the atomic structure calculations of Hibbert et al. [13], which is expected since both groups agree well with each other for the relevant *gf* values. As in the case of the *gf* value, the present lifetime for the $b\ ^2D^e$

state agrees well with the value measured by Livingston et al. [7] and with all calculated values. The present lifetime for $a\ ^2P^e$ is consistent with all other calculated values and with the measured values of Livingston et al. [7] and of Savage and Lawrence [9]. Good agreement is obtained among the calculated and measured lifetimes for $a\ ^2S^e$. The measured lifetime of $b\ ^2S^e$ is much lower than all the calculated values. The present lifetime for the $c\ ^2S^e$ state is about 28% larger than the recent value measured by Schectman and Povolny [3], but agrees very well with the value calculated by Hibbert et al. [13]. Good agreement is achieved among calculated and measured lifetime values for the states $y\ ^2P^o$ and $z\ ^2F^o$.

An estimate of the accuracy for the present *f*-, *S*-, and *A*-values is approximately 10–30% for most of the transitions, based on the general uncertainty estimate in the close-coupling method, the low uncertainty in the calculated energy values, and the comparison of the *gf* and lifetime values with those given in other works. For weak transitions, the uncertainties can be larger. A few points should be noted as follows. The present method obtains the fine-structure components through a purely algebraic transformation and does not include any relativistic mixing of *LS* terms explicitly in the wave functions. Hence, for the transitions between highly excited states, the uncertainty may be higher if *LSJ*-mixing becomes significant. Intercombination transitions between levels of different spin multiplicity could then redistribute the line strengths somewhat differently among the allowed fine-structure components.

Conclusion

A reasonably complete set of *f*-, *S*-, and *A*-values for 1122 dipole-allowed fine-structure transitions in Si II is obtained for the first time. The values should be accurate to within 10–30%. The uncertainty due to neglect of relativistic effects is expected to be low for this singly charged ion. However, the uncertainty for transitions among highly excited levels may be higher owing to intermediate-coupling effects. Present results should be applicable to detailed analysis of the absorption and emission spectra of Si II from a variety of astrophysical sources.

The full table of transition probabilities and energies is available in electronic form from the author at nahar@astronomy.ohio-state.edu. A FORTRAN77 code is also attached to the table to read the *A*-values and calculate the lifetimes for any *LS* term or fine-structure level.

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EXPLANATION OF TABLES

TABLE I. Bound States of Si II

This table presents the bound states of Si II among which the dipole allowed transitions are considered.

Term — Electronic configuration and *LS* term. Each *LS* term is prefixed by a degeneracy symbol in alphabetically ascending order for successive even parity and descending order for successive odd parity states of the same symmetry

$E_{expt}(Ry)$ — Experimental term binding energies of Si II (in rydbergs), derived from statistically averaging over the measured levels of Si II from Ref. [22]

$E_{cal}(Ry)$ — Term binding energies (in rydbergs) obtained in the present calculations

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II

In Table II, data are given in subsets, with the first line corresponding to the *LS* transition and subsequent lines to its fine-structure components. The subsets are ordered by observed states up to $a\ ^4P^e \rightarrow z\ ^4D^o$ followed by the calculated states starting with transition $h\ ^2S^e \rightarrow q\ ^2P^o$. The calculated transition energy is used for a transition where one or both states are unobserved.

Transition — The transition $i \rightarrow f$, with states i and f in the notation of Table I

E_i, E_f — Term *binding energies* of the initial and final *LS* terms given in rydberg on the first line and the *excitation energies* of the initial and final fine structure levels given in cm^{-1} in subsequent lines. Negative signs for *LS* term binding energies are omitted for convenience. For transitions between observed levels, experimental energies are listed. For transitions where one or both states are unobserved, theoretical binding energies are listed and no calculated fine-structure energies are given. The energy for these latter transitions can be obtained as $E_{fi} = 3g_i(f_{if}/S)$ from the *f*- and *S*-values given in the electronic version of the table.

g_i, g_f — The statistical weight factors of the initial and final states

f_{if} — Oscillator strength

TABLE I. Bound States of Si II
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Term		$E_{expt}(Ry)$	$E_{cal}(Ry)$	Term		$E_{expt}(Ry)$	$E_{cal}(Ry)$
$3s^2 4s$	$a\ ^2S^e$	-0.604586	-0.6019	$3s^2 6f$	$x\ ^2F^o$	-0.114226	-0.1141
$3s3p^2$	$b\ ^2S^e$	-0.502844	-0.4892	$3s^2 7f$	$w\ ^2F^o$	-0.083752	-0.0836
$3s^2 5s$	$c\ ^2S^e$	-0.308682	-0.3072	$3s^2 8f$	$v\ ^2F^o$	-0.064007	-0.0639
$3s^2 6s$	$d\ ^2S^e$	-0.188283	-0.1870	$3s^2 9f$	$u\ ^2F^o$	-0.050496	-0.0504
$3s^2 7s$	$e\ ^2S^e$	-0.126951	-0.1262	$3s^2 10f$	$t\ ^2F^o$	-0.040848	-0.0408
$3s^2 8s$	$f\ ^2S^e$	-0.091416	-0.0909	$3s^2 5g$	$a\ ^2G^e$	-0.161012	-0.1608
$3s^2 9s$	$g\ ^2S^e$	-0.068977	-0.0687	$3s^2 6g$	$b\ ^2G^e$	-0.111793	-0.1117
$3s^2 10s$	$h\ ^2S^e$		-0.0537	$3s^2 7g$	$c\ ^2G^e$	-0.082114	-0.0820
$3s^2 11s$	$i\ ^2S^e$		-0.0431	$3s^2 8g$	$d\ ^2G^e$	-0.062856	-0.0628
$3s3p^2$	$a\ ^2P^e$	-0.436581	-0.4270	$3s^2 9g$	$e\ ^2G^e$	-0.049660	-0.0496
$3s3p(^3P^o)4p$	$b\ ^2P^e$		-0.0064	$3s^2 10g$	$f\ ^2G^e$	-0.040224	-0.0402
$3s^2 3p$	$z\ ^2P^o$	-1.199725	-1.2014	$3s^2 6h$	$z\ ^2H^o$		-0.1112
$3s^2 4p$	$y\ ^2P^o$	-0.461236	-0.4637	$3s^2 7h$	$y\ ^2H^o$		-0.0817
$3s^2 5p$	$x\ ^2P^o$	-0.254872	-0.2564	$3s^2 8h$	$x\ ^2H^o$		-0.0626
$3s^2 6p$	$w\ ^2P^o$	-0.162882	-0.1625	$3s^2 9h$	$w\ ^2H^o$		-0.0494
$3s^2 7p$	$v\ ^2P^o$	-0.114654	-0.1165	$3s^2 10h$	$v\ ^2H^o$		-0.0400
$3s3p(^3P^o)4s$	$u\ ^2P^o$	-0.093902	-0.1011	$3s^2 7i$	$a\ ^2I^e$		-0.0816
$3s^2 8p$	$t\ ^2P^o$	-0.079472	-0.0802	$3s^2 8i$	$b\ ^2I^e$		-0.0625
$3s^2 9p$	$s\ ^2P^o$	-0.062106	-0.0622	$3s^2 9i$	$c\ ^2I^e$		-0.0494
$3s3p(^3P^o)3d$	$r\ ^2P^o$	-0.050990	-0.0525	$3s^2 10i$	$d\ ^2I^e$		-0.0400
$3s^2 10p$	$q\ ^2P^o$	-0.048422	-0.0481	$3s^2 8k$	$z\ ^2K^o$		-0.0625
$3s3p^2$	$a\ ^2D^e$	-0.697367	-0.7091	$3s^2 9k$	$y\ ^2K^o$		-0.0494
$3s^2 3d$	$b\ ^2D^e$	-0.478394	-0.4787	$3s^2 10k$	$x\ ^2K^o$		-0.0400
$3s^2 4d$	$c\ ^2D^e$	-0.280873	-0.2796	$3s^2 9l$	$a\ ^2L^e$		-0.0494
$3s^2 5d$	$d\ ^2D^e$	-0.177254	-0.1763	$3s^2 10l$	$b\ ^2L^e$		-0.0400
$3s^2 6d$	$e\ ^2D^e$	-0.121410	-0.1209	$3s^2 10m$	$z\ ^2M^o$		-0.0400
$3s^2 7d$	$f\ ^2D^e$	-0.088234	-0.0879	$3p^3$	$z\ ^4S^o$	-0.080306	-0.0868
$3s^2 8d$	$g\ ^2D^e$	-0.066982	-0.0668	$3s3p^2$	$a\ ^4P^e$	-0.809605	-0.8284
$3s^2 9d$	$h\ ^2D^e$		-0.0524	$3s3p(^3P^o)4s$	$z\ ^4P^o$	-0.134751	-0.1497
$3s^2 10d$	$i\ ^2D^e$		-0.0422	$3s3p(^3P^o)3d$	$y\ ^4P^o$	-0.066073	-0.0769
$3s3p(^3P^o)3d$	$z\ ^2D^o$	-0.209976	-0.2302	$3s3p(^3P^o)3d$	$z\ ^4D^o$	-0.068094	-0.0801
$3s^2 4f$	$z\ ^2F^o$	-0.257797	-0.2477	$3s3p(^3P^o)3d$	$z\ ^4F^o$	-0.158839	-0.1765
$3s^2 5f$	$y\ ^2F^o$	-0.164810	-0.1646				

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$a^2S^e \rightarrow y^2P^o$	0.6046	0.4612	2	6	1.136E+00
	65500.47	81251.32	2	4	7.582E-01
	65500.47	81191.34	2	2	3.776E-01
$a^2S^e \rightarrow x^2P^o$	0.6046	0.2549	2	6	4.059E-03
	65500.47	103885.25	2	4	2.707E-03
	65500.47	103860.74	2	2	1.352E-03
$a^2S^e \rightarrow w^2P^o$	0.6046	0.1629	2	6	8.796E-03
	65500.47	113976.72	2	4	5.865E-03
	65500.47	113962.08	2	2	2.931E-03
$a^2S^e \rightarrow v^2P^o$	0.6046	0.1147	2	6	2.089E-02
	65500.47	119273.81	2	4	1.393E-02
	65500.47	119245.22	2	2	6.962E-03
$a^2S^e \rightarrow u^2P^o$	0.6046	0.0939	2	6	1.239E-02
	65500.47	121590.19	2	4	8.267E-03
	65500.47	121444.12	2	2	4.123E-03
$a^2S^e \rightarrow t^2P^o$	0.6046	0.0795	2	6	8.304E-05
	65500.47	123138.67	2	4	5.537E-05
	65500.47	123097.63	2	2	2.767E-05
$a^2S^e \rightarrow s^2P^o$	0.6046	0.0621	2	6	1.086E-03
	65500.47	125033.70	2	4	7.237E-04
	65500.47	125024.90	2	2	3.618E-04
$a^2S^e \rightarrow r^2P^o$	0.6046	0.0510	2	6	3.330E-03
	65500.47	126236.40	2	4	2.220E-03
	65500.47	126279.00	2	2	1.111E-03
$a^2S^e \rightarrow q^2P^o$	0.6046	0.0484	2	6	8.135E-06
	65500.47	126525.80	2	4	5.422E-06
	65500.47	126545.40	2	2	2.712E-06
$b^2S^e \rightarrow y^2P^o$	0.5028	0.4612	2	6	5.262E-03
	76665.35	81251.32	2	4	3.524E-03
	76665.35	81191.34	2	2	1.739E-03
$b^2S^e \rightarrow x^2P^o$	0.5028	0.2549	2	6	3.899E-04
	76665.35	103885.25	2	4	2.600E-04
	76665.35	103860.74	2	2	1.299E-04
$b^2S^e \rightarrow w^2P^o$	0.5028	0.1629	2	6	5.775E-04
	76665.35	113976.72	2	4	3.851E-04
	76665.35	113962.08	2	2	1.925E-04
$b^2S^e \rightarrow v^2P^o$	0.5028	0.1147	2	6	2.036E-02
	76665.35	119273.81	2	4	1.358E-02
	76665.35	119245.22	2	2	6.784E-03
$b^2S^e \rightarrow u^2P^o$	0.5028	0.0939	2	6	5.427E-02
	76665.35	121590.19	2	4	3.622E-02
	76665.35	121444.12	2	2	1.805E-02
$b^2S^e \rightarrow t^2P^o$	0.5028	0.0795	2	6	1.035E-02
	76665.35	123138.67	2	4	6.903E-03
	76665.35	123097.63	2	2	3.448E-03
$b^2S^e \rightarrow s^2P^o$	0.5028	0.0621	2	6	9.083E-03
	76665.35	125033.70	2	4	6.056E-03
	76665.35	125024.90	2	2	3.027E-03
$b^2S^e \rightarrow r^2P^o$	0.5028	0.0510	2	6	6.208E-02
	76665.35	126236.40	2	4	4.138E-02
	76665.35	126279.00	2	2	2.071E-02
$b^2S^e \rightarrow q^2P^o$	0.5028	0.0484	2	6	8.602E-03
	76665.35	126525.80	2	4	5.734E-03
	76665.35	126545.40	2	2	2.868E-03
$c^2S^e \rightarrow x^2P^o$	0.3087	0.2549	2	6	1.705E+00
	97972.09	103885.25	2	4	1.139E+00
	97972.09	103860.74	2	2	5.669E-01
$c^2S^e \rightarrow w^2P^o$	0.3087	0.1629	2	6	2.977E-04
	97972.09	113976.72	2	4	1.986E-04
	97972.09	113962.08	2	2	9.919E-05
$c^2S^e \rightarrow v^2P^o$	0.3087	0.1147	2	6	1.770E-02
	97972.09	119273.81	2	4	1.181E-02
	97972.09	119245.22	2	2	5.896E-03
$c^2S^e \rightarrow u^2P^o$	0.3087	0.0939	2	6	2.022E-02
	97972.09	121590.19	2	4	1.351E-02
	97972.09	121444.12	2	2	6.711E-03
$c^2S^e \rightarrow t^2P^o$	0.3087	0.0795	2	6	2.201E-04
	97972.09	123138.67	2	4	1.468E-04
	97972.09	123097.63	2	2	7.329E-05
$c^2S^e \rightarrow s^2P^o$	0.3087	0.0621	2	6	3.427E-04
	97972.09	125033.70	2	4	2.285E-04
	97972.09	125024.90	2	2	1.142E-04
$c^2S^e \rightarrow r^2P^o$	0.3087	0.0510	2	6	5.615E-03
	97972.09	126236.40	2	4	3.742E-03
	97972.09	126279.00	2	2	1.874E-03

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$c^2S^e \rightarrow q^2P^o$	0.3087	0.0484	2	6	7.885E-04
	97972.09	126525.80	2	4	5.256E-04
	97972.09	126545.40	2	2	2.630E-04
$d^2S^e \rightarrow w^2P^o$	0.1883	0.1629	2	6	2.027E+00
	111184.46	113976.72	2	4	1.354E+00
	111184.46	113962.08	2	2	6.733E-01
$d^2S^e \rightarrow v^2P^o$	0.1883	0.1147	2	6	3.164E-02
	111184.46	119273.81	2	4	2.112E-02
	111184.46	119245.22	2	2	1.052E-02
$d^2S^e \rightarrow u^2P^o$	0.1883	0.0939	2	6	9.998E-02
	111184.46	121590.19	2	4	6.697E-02
	111184.46	121444.12	2	2	3.301E-02
$d^2S^e \rightarrow t^2P^o$	0.1883	0.0795	2	6	5.807E-03
	111184.46	123138.67	2	4	3.876E-03
	111184.46	123097.63	2	2	1.931E-03
$d^2S^e \rightarrow s^2P^o$	0.1883	0.0621	2	6	6.167E-05
	111184.46	125033.70	2	4	4.112E-05
	111184.46	125024.90	2	2	2.055E-05
$d^2S^e \rightarrow r^2P^o$	0.1883	0.0510	2	6	7.656E-03
	111184.46	126236.40	2	4	5.099E-03
	111184.46	126279.00	2	2	2.557E-03
$d^2S^e \rightarrow q^2P^o$	0.1883	0.0484	2	6	2.910E-03
	111184.46	126525.80	2	4	1.939E-03
	111184.46	126545.40	2	2	9.708E-04
$e^2S^e \rightarrow v^2P^o$	0.1270	0.1147	2	6	1.610E+00
	117914.80	119273.81	2	4	1.081E+00
	117914.80	119245.22	2	2	5.291E-01
$e^2S^e \rightarrow u^2P^o$	0.1270	0.0939	2	6	1.396E+00
	117914.80	121590.19	2	4	9.430E-01
	117914.80	121444.12	2	2	4.527E-01
$e^2S^e \rightarrow t^2P^o$	0.1270	0.0795	2	6	5.068E-02
	117914.80	123138.67	2	4	3.387E-02
	117914.80	123097.63	2	2	1.680E-02
$e^2S^e \rightarrow s^2P^o$	0.1270	0.0621	2	6	2.042E-03
	117914.80	125033.70	2	4	1.362E-03
	117914.80	125024.90	2	2	6.800E-04
$e^2S^e \rightarrow r^2P^o$	0.1270	0.0510	2	6	1.309E-02
	117914.80	126236.40	2	4	8.712E-03
	117914.80	126279.00	2	2	4.378E-03
$e^2S^e \rightarrow q^2P^o$	0.1270	0.0484	2	6	7.692E-03
	117914.80	126525.80	2	4	5.124E-03
	117914.80	126545.40	2	2	2.568E-03
$f^2S^e \rightarrow t^2P^o$	0.0914	0.0795	2	6	3.248E+00
	121814.38	123138.67	2	4	2.188E+00
	121814.38	123097.63	2	2	1.060E+00
$f^2S^e \rightarrow s^2P^o$	0.0914	0.0621	2	6	2.762E-02
	121814.38	125033.70	2	4	1.843E-02
	121814.38	125024.90	2	2	9.191E-03
$f^2S^e \rightarrow r^2P^o$	0.0914	0.0510	2	6	2.874E-02
	121814.38	126236.40	2	4	1.910E-02
	121814.38	126279.00	2	2	9.641E-03
$f^2S^e \rightarrow q^2P^o$	0.0914	0.0484	2	6	2.346E-02
	121814.38	126525.80	2	4	1.562E-02
	121814.38	126545.40	2	2	7.840E-03
$g^2S^e \rightarrow s^2P^o$	0.0690	0.0621	2	6	3.463E+00
	124276.70	125033.70	2	4	2.317E+00
	124276.70	125024.90	2	2	1.145E+00
$g^2S^e \rightarrow r^2P^o$	0.0690	0.0510	2	6	1.017E-01
	124276.70	126236.40	2	4	6.729E-02
	124276.70	126279.00	2	2	3.438E-02
$g^2S^e \rightarrow q^2P^o$	0.0690	0.0484	2	6	1.128E-01
	124276.70	126525.80	2	4	7.498E-02
	124276.70	126545.40	2	2	3.782E-02
$a^2P^e \rightarrow x^2P^o$	0.4366	0.2549	6	6	2.610E-04
	84004.26	103885.25	4	4	2.168E-04
	84004.26	103860.74	4	2	4.331E-05
	83801.95	103885.25	2	4	8.761E-05
	83801.95	103860.74	2	2	1.750E-04
$a^2P^e \rightarrow w^2P^o$	0.4366	0.1629	6	6	1.828E-03
	84004.26	113976.72	4	4	1.520E-03
	84004.26	113962.08	4	2	3.039E-04
	83801.95	113976.72	2	4	6.122E-04
	83801.95	113962.08	2	2	1.224E-03
$a^2P^e \rightarrow v^2P^o$	0.4366	0.1147	6	6	2.402E-02
	84004.26	119273.81	4	4	1.998E-02

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
	84004.26	119245.22	4	2	3.993E-03
	83801.95	119273.81	2	4	8.039E-03
	83801.95	119245.22	2	2	1.607E-02
$a^2P^e \rightarrow u^2P^o$	0.4366	0.0939	6	6	5.030E-02
	84004.26	121590.19	4	4	4.189E-02
	84004.26	121444.12	4	2	8.346E-03
	83801.95	121590.19	2	4	1.685E-02
	83801.95	121444.12	2	2	3.356E-02
$a^2P^e \rightarrow t^2P^o$	0.4366	0.0795	6	6	5.818E-03
	84004.26	123138.67	4	4	4.842E-03
	84004.26	123097.63	4	2	9.673E-04
	83801.95	123138.67	2	4	1.947E-03
	83801.95	123097.63	2	2	3.889E-03
$a^2P^e \rightarrow s^2P^o$	0.4366	0.0621	6	6	1.451E-03
	84004.26	125033.70	4	4	1.207E-03
	84004.26	125024.90	4	2	2.414E-04
	83801.95	125033.70	2	4	4.852E-04
	83801.95	125024.90	2	2	9.702E-04
$a^2P^e \rightarrow r^2P^o$	0.4366	0.0510	6	6	1.241E-05
	84004.26	126236.40	4	4	1.032E-05
	84004.26	126279.00	4	2	2.066E-06
	83801.95	126236.40	2	4	4.147E-06
	83801.95	126279.00	2	2	8.303E-06
$a^2P^e \rightarrow q^2P^o$	0.4366	0.0484	6	6	9.544E-04
	84004.26	126525.80	4	4	7.940E-04
	84004.26	126545.40	4	2	1.589E-04
	83801.95	126525.80	2	4	3.191E-04
	83801.95	126545.40	2	2	6.385E-04
$a^2P^e \rightarrow z^2D^o$	0.4366	0.2100	6	10	6.256E-06
	84004.26	108820.60	4	6	5.619E-06
	84004.26	108778.70	4	4	6.233E-07
	83801.95	108778.70	2	4	6.284E-06
$a^2D^e \rightarrow y^2P^o$	0.6974	0.4612	10	6	5.745E-02
	55325.18	81251.32	6	4	5.748E-02
	55309.35	81251.32	4	4	9.585E-03
	55309.35	81191.34	4	2	4.781E-02
$a^2D^e \rightarrow x^2P^o$	0.6974	0.2549	10	6	1.007E-02
	55325.18	103885.25	6	4	1.007E-02
	55309.35	103885.25	4	4	1.679E-03
	55309.35	103860.74	4	2	8.389E-03
$a^2D^e \rightarrow w^2P^o$	0.6974	0.1629	10	6	9.974E-03
	55325.18	113976.72	6	4	9.974E-03
	55309.35	113976.72	4	4	1.663E-03
	55309.35	113962.08	4	2	8.312E-03
$a^2D^e \rightarrow v^2P^o$	0.6974	0.1147	10	6	4.209E-02
	55325.18	119273.81	6	4	4.209E-02
	55309.35	119273.81	4	4	7.016E-03
	55309.35	119245.22	4	2	3.507E-02
$a^2D^e \rightarrow u^2P^o$	0.6974	0.0939	10	6	6.193E-02
	55325.18	121590.19	6	4	6.197E-02
	55309.35	121590.19	4	4	1.033E-02
	55309.35	121444.12	4	2	5.154E-02
$a^2D^e \rightarrow t^2P^o$	0.6974	0.0795	10	6	6.514E-03
	55325.18	123138.67	6	4	6.515E-03
	55309.35	123138.67	4	4	1.086E-03
	55309.35	123097.63	4	2	5.427E-03
$a^2D^e \rightarrow s^2P^o$	0.6974	0.0621	10	6	6.727E-03
	55325.18	125033.70	6	4	6.726E-03
	55309.35	125033.70	4	4	1.121E-03
	55309.35	125024.90	4	2	5.606E-03
$a^2D^e \rightarrow r^2P^o$	0.6974	0.0510	10	6	8.624E-02
	55325.18	126236.40	6	4	8.621E-02
	55309.35	126236.40	4	4	1.437E-02
	55309.35	126279.00	4	2	7.190E-02
$a^2D^e \rightarrow q^2P^o$	0.6974	0.0484	10	6	1.885E-02
	55325.18	126525.80	6	4	1.885E-02
	55309.35	126525.80	4	4	3.142E-03
	55309.35	126545.40	4	2	1.571E-02
$a^2D^e \rightarrow z^2D^o$	0.6974	0.2100	10	10	2.565E-03
	55325.18	108820.60	6	6	2.394E-03
	55325.18	108778.70	6	4	1.709E-04
	55309.35	108820.60	4	6	2.566E-04
	55309.35	108778.70	4	4	2.308E-03
$a^2D^e \rightarrow z^2F^o$	0.6974	0.2578	10	14	1.276E-01
	55325.18	103556.03	6	8	1.215E-01
	55325.18	103556.16	6	6	6.074E-03
	55309.35	103556.16	4	6	1.276E-01
$a^2D^e \rightarrow y^2F^o$	0.6974	0.1648	10	14	5.438E-02
	55325.18	113760.15	6	8	5.179E-02
	55325.18	113760.32	6	6	2.589E-03
	55309.35	113760.32	4	6	5.439E-02
$a^2D^e \rightarrow x^2F^o$	0.6974	0.1142	10	14	2.793E-02
	55325.18	119311.19	6	8	2.660E-02
	55325.18	119311.34	6	6	1.330E-03
	55309.35	119311.34	4	6	2.794E-02
$a^2D^e \rightarrow w^2F^o$	0.6974	0.0838	10	14	1.638E-02
	55325.18	122655.25	6	8	1.560E-02
	55325.18	122655.37	6	6	7.801E-04
	55309.35	122655.37	4	6	1.639E-02
$a^2D^e \rightarrow v^2F^o$	0.6974	0.0640	10	14	1.041E-02
	55325.18	124822.08	6	8	9.909E-03
	55325.18	124822.14	6	6	4.955E-04
	55309.35	124822.14	4	6	1.041E-02
$a^2D^e \rightarrow u^2F^o$	0.6974	0.0505	10	14	7.071E-03
	55325.18	126304.82	6	8	6.733E-03
	55325.18	126304.82	6	6	3.367E-04
	55309.35	126304.82	4	6	7.072E-03
$a^2D^e \rightarrow t^2F^o$	0.6974	0.0408	10	14	5.020E-03
	55325.18	127363.50	6	8	4.780E-03
	55325.18	127363.50	6	6	2.390E-04
	55309.35	127363.50	4	6	5.021E-03
$b^2D^e \rightarrow y^2P^o$	0.4784	0.4612	10	6	2.848E-02
	79355.02	81251.32	6	4	2.869E-02
	79338.50	81251.32	4	4	4.823E-03
	79338.50	81191.34	4	2	2.336E-02
$b^2D^e \rightarrow x^2P^o$	0.4784	0.2549	10	6	9.653E-03
	79355.02	103885.25	6	4	9.653E-03
	79338.50	103885.25	4	4	1.610E-03
	79338.50	103860.74	4	2	8.042E-03
$b^2D^e \rightarrow w^2P^o$	0.4784	0.1629	10	6	5.737E-03
	79355.02	113976.72	6	4	5.737E-03
	79338.50	113976.72	4	4	9.567E-04
	79338.50	113962.08	4	2	4.781E-03
$b^2D^e \rightarrow v^2P^o$	0.4784	0.1147	10	6	2.290E-02
	79355.02	119273.81	6	4	2.290E-02
	79338.50	119273.81	4	4	3.818E-03
	79338.50	119245.22	4	2	1.908E-02
$b^2D^e \rightarrow u^2P^o$	0.4784	0.0939	10	6	3.187E-02
	79355.02	121590.19	6	4	3.190E-02
	79338.50	121590.19	4	4	5.319E-03
	79338.50	121444.12	4	2	2.650E-02
$b^2D^e \rightarrow t^2P^o$	0.4784	0.0795	10	6	2.202E-03
	79355.02	123138.67	6	4	2.203E-03
	79338.50	123138.67	4	4	3.673E-04
	79338.50	123097.63	4	2	1.835E-03
$b^2D^e \rightarrow s^2P^o$	0.4784	0.0621	10	6	5.267E-04
	79355.02	125033.70	6	4	5.267E-04
	79338.50	125033.70	4	4	8.781E-05
	79338.50	125024.90	4	2	4.390E-04
$b^2D^e \rightarrow r^2P^o$	0.4784	0.0510	10	6	8.725E-04
	79355.02	126236.40	6	4	8.721E-04
	79338.50	126236.40	4	4	1.454E-04
	79338.50	126279.00	4	2	7.276E-04
$b^2D^e \rightarrow q^2P^o$	0.4784	0.0484	10	6	2.876E-05
	79355.02	126525.80	6	4	2.875E-05
	79338.50	126525.80	4	4	4.793E-06
	79338.50	126545.40	4	2	2.398E-05
$b^2D^e \rightarrow z^2D^o$	0.4784	0.2100	10	10	1.231E-05
	79355.02	108820.60	6	6	1.150E-05
	79355.02	108778.70	6	4	8.200E-07
	79338.50	108820.60	4	6	1.232E-06
	79338.50	108778.70	4	4	1.108E-05
$b^2D^e \rightarrow z^2F^o$	0.4784	0.2578	10	14	5.580E-01
	79355.02	103556.03	6	8	5.313E-01
	79355.02	103556.16	6	6	2.656E-02
	79338.50	103556.16	4	6	5.582E-01
$b^2D^e \rightarrow y^2F^o$	0.4784	0.1648	10	14	6.988E-02
	79355.02	113760.15	6	8	6.654E-02
	79355.02	113760.32	6	6	3.327E-03
	79338.50	113760.32	4	6	6.991E-02

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$b^2D^e \rightarrow x^2F^o$	0.4784	0.1142	10	14	1.698E-02
	79355.02	119311.19	6	8	1.617E-02
	79355.02	119311.34	6	6	8.084E-04
	79338.50	119311.34	4	6	1.698E-02
$b^2D^e \rightarrow w^2F^o$	0.4784	0.0838	10	14	5.574E-03
	79355.02	122655.25	6	8	5.307E-03
	79355.02	122655.37	6	6	2.654E-04
	79338.50	122655.37	4	6	5.575E-03
$b^2D^e \rightarrow v^2F^o$	0.4784	0.0640	10	14	2.188E-03
	79355.02	124822.08	6	8	2.083E-03
	79355.02	124822.14	6	6	1.042E-04
	79338.50	124822.14	4	6	2.188E-03
$b^2D^e \rightarrow u^2F^o$	0.4784	0.0505	10	14	9.701E-04
	79355.02	126304.82	6	8	9.238E-04
	79355.02	126304.82	6	6	4.619E-05
	79338.50	126304.82	4	6	9.703E-04
$b^2D^e \rightarrow t^2F^o$	0.4784	0.0408	10	14	4.726E-04
	79355.02	127363.50	6	8	4.500E-04
	79355.02	127363.50	6	6	2.250E-05
	79338.50	127363.50	4	6	4.727E-04
$c^2D^e \rightarrow x^2P^o$	0.2809	0.2549	10	6	2.432E-01
	101024.35	103885.25	6	4	2.438E-01
	101023.05	103885.25	4	4	4.066E-02
	101023.05	103860.74	4	2	2.016E-01
$c^2D^e \rightarrow w^2P^o$	0.2809	0.1629	10	6	8.736E-04
	101024.35	113976.72	6	4	8.739E-04
	101023.05	113976.72	4	4	1.457E-04
	101023.05	113962.08	4	2	7.275E-04
$c^2D^e \rightarrow v^2P^o$	0.2809	0.1147	10	6	7.266E-03
	101024.35	119273.81	6	4	7.270E-03
	101023.05	119273.81	4	4	1.212E-03
	101023.05	119245.22	4	2	6.049E-03
$c^2D^e \rightarrow u^2P^o$	0.2809	0.0939	10	6	1.278E-02
	101024.35	121590.19	6	4	1.281E-02
	101023.05	121590.19	4	4	2.135E-03
	101023.05	121444.12	4	2	1.060E-02
$c^2D^e \rightarrow t^2P^o$	0.2809	0.0795	10	6	1.081E-03
	101024.35	123138.67	6	4	1.081E-03
	101023.05	123138.67	4	4	1.802E-04
	101023.05	123097.63	4	2	8.995E-04
$c^2D^e \rightarrow s^2P^o$	0.2809	0.0621	10	6	1.540E-04
	101024.35	125033.70	6	4	1.540E-04
	101023.05	125033.70	4	4	2.566E-05
	101023.05	125024.90	4	2	1.283E-04
$c^2D^e \rightarrow r^2P^o$	0.2809	0.0510	10	6	1.893E-04
	101024.35	126236.40	6	4	1.892E-04
	101023.05	126236.40	4	4	3.153E-05
	101023.05	126279.00	4	2	1.579E-04
$c^2D^e \rightarrow q^2P^o$	0.2809	0.0484	10	6	2.982E-04
	101024.35	126525.80	6	4	2.981E-04
	101023.05	126525.80	4	4	4.969E-05
	101023.05	126545.40	4	2	2.487E-04
$c^2D^e \rightarrow z^2D^o$	0.2809	0.2100	10	10	9.745E-06
	101024.35	108820.60	6	6	9.114E-06
	101024.35	108778.70	6	4	6.475E-07
	101023.05	108820.60	4	6	9.767E-07
	101023.05	108778.70	4	4	8.743E-06
$c^2D^e \rightarrow z^2F^o$	0.2809	0.2578	10	14	2.782E-01
	101024.35	103556.03	6	8	2.649E-01
	101024.35	103556.16	6	6	1.324E-02
	101023.05	103556.16	4	6	2.783E-01
$c^2D^e \rightarrow y^2F^o$	0.2809	0.1648	10	14	5.026E-01
	101024.35	113760.15	6	8	4.786E-01
	101024.35	113760.32	6	6	2.393E-02
	101023.05	113760.32	4	6	5.026E-01
$c^2D^e \rightarrow x^2F^o$	0.2809	0.1142	10	14	1.460E-01
	101024.35	119311.19	6	8	1.390E-01
	101024.35	119311.34	6	6	6.952E-03
	101023.05	119311.34	4	6	1.460E-01
$c^2D^e \rightarrow w^2F^o$	0.2809	0.0838	10	14	6.215E-02
	101024.35	122655.25	6	8	5.919E-02
	101024.35	122655.37	6	6	2.960E-03
	101023.05	122655.37	4	6	6.216E-02
$c^2D^e \rightarrow v^2F^o$	0.2809	0.0640	10	14	3.258E-02
	101024.35	124822.08	6	8	3.102E-02
	101024.35	124822.14	6	6	1.551E-03
	101023.05	124822.14	4	6	3.258E-02
$c^2D^e \rightarrow u^2F^o$	0.2809	0.0505	10	14	1.930E-02
	101024.35	126304.82	6	8	1.838E-02
	101024.35	126304.82	6	6	9.190E-04
	101023.05	126304.82	4	6	1.930E-02
$c^2D^e \rightarrow t^2F^o$	0.2809	0.0408	10	14	1.246E-02
	101024.35	127363.50	6	8	1.187E-02
	101024.35	127363.50	6	6	5.935E-04
	101023.05	127363.50	4	6	1.246E-02
$d^2D^e \rightarrow w^2P^o$	0.1773	0.1629	10	6	3.760E-01
	112394.72	113976.72	6	4	3.771E-01
	112394.56	113976.72	4	4	6.286E-02
	112394.56	113962.08	4	2	3.114E-01
$d^2D^e \rightarrow v^2P^o$	0.1773	0.1147	10	6	1.193E-02
	112394.72	119273.81	6	4	1.195E-02
	112394.56	119273.81	4	4	1.992E-03
	112394.56	119245.22	4	2	9.917E-03
$d^2D^e \rightarrow u^2P^o$	0.1773	0.0939	10	6	2.727E-02
	112394.72	121590.19	6	4	2.741E-02
	112394.56	121590.19	4	4	4.569E-03
	112394.56	121444.12	4	2	2.248E-02
$d^2D^e \rightarrow t^2P^o$	0.1773	0.0795	10	6	2.615E-03
	112394.72	123138.67	6	4	2.618E-03
	112394.56	123138.67	4	4	4.364E-04
	112394.56	123097.63	4	2	2.174E-03
$d^2D^e \rightarrow s^2P^o$	0.1773	0.0621	10	6	4.158E-04
	112394.72	125033.70	6	4	4.159E-04
	112394.56	125033.70	4	4	6.931E-05
	112394.56	125024.90	4	2	3.463E-04
$d^2D^e \rightarrow r^2P^o$	0.1773	0.0510	10	6	6.854E-04
	112394.72	126236.40	6	4	6.847E-04
	112394.56	126236.40	4	4	1.141E-04
	112394.56	126279.00	4	2	5.723E-04
$d^2D^e \rightarrow q^2P^o$	0.1773	0.0484	10	6	1.005E-03
	112394.72	126525.80	6	4	1.004E-03
	112394.56	126525.80	4	4	1.674E-04
	112394.56	126545.40	4	2	8.382E-04
$d^2D^e \rightarrow y^2F^o$	0.1773	0.1648	10	14	5.414E-01
	112394.72	113760.15	6	8	5.155E-01
	112394.72	113760.32	6	6	2.578E-02
	112394.56	113760.32	4	6	5.414E-01
$d^2D^e \rightarrow x^2F^o$	0.1773	0.1142	10	14	3.840E-01
	112394.72	119311.19	6	8	3.658E-01
	112394.72	119311.34	6	6	1.829E-02
	112394.56	119311.34	4	6	3.841E-01
$d^2D^e \rightarrow w^2F^o$	0.1773	0.0838	10	14	1.331E-01
	112394.72	122655.25	6	8	1.268E-01
	112394.72	122655.37	6	6	6.340E-03
	112394.56	122655.37	4	6	1.331E-01
$d^2D^e \rightarrow v^2F^o$	0.1773	0.0640	10	14	6.327E-02
	112394.72	124822.08	6	8	6.026E-02
	112394.72	124822.14	6	6	3.013E-03
	112394.56	124822.14	4	6	6.327E-02
$d^2D^e \rightarrow u^2F^o$	0.1773	0.0505	10	14	3.574E-02
	112394.72	126304.82	6	8	3.404E-02
	112394.72	126304.82	6	6	1.702E-03
	112394.56	126304.82	4	6	3.574E-02
$d^2D^e \rightarrow t^2F^o$	0.1773	0.0408	10	14	2.255E-02
	112394.72	127363.50	6	8	2.148E-02
	112394.72	127363.50	6	6	1.074E-03
	112394.56	127363.50	4	6	2.255E-02
$e^2D^e \rightarrow v^2P^o$	0.1214	0.1147	10	6	3.102E-01
	118522.93	119273.81	6	4	3.141E-01
	118522.86	119273.81	4	4	5.236E-02
	118522.86	119245.22	4	2	2.518E-01
$e^2D^e \rightarrow u^2P^o$	0.1214	0.0939	10	6	3.987E-01
	118522.93	121590.19	6	4	4.051E-01
	118522.86	121590.19	4	4	6.753E-02
	118522.86	121444.12	4	2	3.216E-01
$e^2D^e \rightarrow t^2P^o$	0.1214	0.0795	10	6	1.008E-02
	118522.93	123138.67	6	4	1.011E-02
	118522.86	123138.67	4	4	1.685E-03
	118522.86	123097.63	4	2	8.348E-03
$e^2D^e \rightarrow s^2P^o$	0.1214	0.0621	10	6	9.194E-04

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
	118522.93	125033.70	6	4	9.198E-04
	118522.86	125033.70	4	4	1.533E-04
	118522.86	125024.90	4	2	7.655E-04
$e^2D^e \rightarrow r^2P^o$	0.1214	0.0510	10	6	1.822E-03
	118522.93	126236.40	6	4	1.819E-03
	118522.86	126236.40	4	4	3.032E-04
	118522.86	126279.00	4	2	1.524E-03
$e^2D^e \rightarrow q^2P^o$	0.1214	0.0484	10	6	2.166E-03
	118522.93	126525.80	6	4	2.164E-03
	118522.86	126525.80	4	4	3.606E-04
	118522.86	126545.40	4	2	1.808E-03
$e^2D^e \rightarrow x^2F^o$	0.1214	0.1142	10	14	7.512E-01
	118522.93	119311.19	6	8	7.153E-01
	118522.93	119311.34	6	6	3.577E-02
	118522.86	119311.34	4	6	7.513E-01
$e^2D^e \rightarrow w^2F^o$	0.1214	0.0838	10	14	3.200E-01
	118522.93	122655.25	6	8	3.048E-01
	118522.93	122655.37	6	6	1.524E-02
	118522.86	122655.37	4	6	3.200E-01
$e^2D^e \rightarrow v^2F^o$	0.1214	0.0640	10	14	1.188E-01
	118522.93	124822.08	6	8	1.132E-01
	118522.93	124822.14	6	6	5.659E-03
	118522.86	124822.14	4	6	1.188E-01
$e^2D^e \rightarrow u^2F^o$	0.1214	0.0505	10	14	5.925E-02
	118522.93	126304.82	6	8	5.642E-02
	118522.93	126304.82	6	6	2.821E-03
	118522.86	126304.82	4	6	5.925E-02
$e^2D^e \rightarrow t^2F^o$	0.1214	0.0408	10	14	3.470E-02
	118522.93	127363.50	6	8	3.305E-02
	118522.93	127363.50	6	6	1.652E-03
	118522.86	127363.50	4	6	3.470E-02
$f^2D^e \rightarrow t^2P^o$	0.0882	0.0795	10	6	8.625E-01
	122163.54	123138.67	6	4	8.748E-01
	122163.48	123138.67	4	4	1.458E-01
	122163.48	123097.63	4	2	6.983E-01
$f^2D^e \rightarrow s^2P^o$	0.0882	0.0621	10	6	4.128E-03
	122163.54	125033.70	6	4	4.132E-03
	122163.48	125033.70	4	4	6.887E-04
	122163.48	125024.90	4	2	3.433E-03
$f^2D^e \rightarrow r^2P^o$	0.0882	0.0510	10	6	5.986E-03
	122163.54	126236.40	6	4	5.966E-03
	122163.48	126236.40	4	4	9.943E-04
	122163.48	126279.00	4	2	5.023E-03
$f^2D^e \rightarrow q^2P^o$	0.0882	0.0484	10	6	5.492E-03
	122163.54	126525.80	6	4	5.483E-03
	122163.48	126525.80	4	4	9.139E-04
	122163.48	126545.40	4	2	4.590E-03
$f^2D^e \rightarrow w^2F^o$	0.0882	0.0838	10	14	9.338E-01
	122163.54	122655.25	6	8	8.892E-01
	122163.54	122655.37	6	6	4.447E-02
	122163.48	122655.37	4	6	9.340E-01
$f^2D^e \rightarrow v^2F^o$	0.0882	0.0640	10	14	2.816E-01
	122163.54	124822.08	6	8	2.682E-01
	122163.54	124822.14	6	6	1.341E-02
	122163.48	124822.14	4	6	2.816E-01
$f^2D^e \rightarrow u^2F^o$	0.0882	0.0505	10	14	1.087E-01
	122163.54	126304.82	6	8	1.035E-01
	122163.54	126304.82	6	6	5.176E-03
	122163.48	126304.82	4	6	1.087E-01
$f^2D^e \rightarrow t^2F^o$	0.0882	0.0408	10	14	5.553E-02
	122163.54	127363.50	6	8	5.289E-02
	122163.54	127363.50	6	6	2.645E-03
	122163.48	127363.50	4	6	5.554E-02
$g^2D^e \rightarrow s^2P^o$	0.0670	0.0621	10	6	9.095E-01
	124495.70	125033.70	6	4	9.144E-01
	124495.70	125033.70	4	4	1.524E-01
	124495.70	125024.90	4	2	7.496E-01
$g^2D^e \rightarrow r^2P^o$	0.0670	0.0510	10	6	3.556E-02
	124495.70	126236.40	6	4	3.527E-02
	124495.70	126236.40	4	4	5.879E-03
	124495.70	126279.00	4	2	3.011E-02
$g^2D^e \rightarrow q^2P^o$	0.0670	0.0484	10	6	2.293E-02
	124495.70	126525.80	6	4	2.285E-02
	124495.70	126525.80	4	4	3.809E-03
	124495.70	126545.40	4	2	1.923E-02

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$g^2D^e \rightarrow v^2F^o$	0.0670	0.0640	10	14	1.097E+00
	124495.70	124822.08	6	8	1.045E+00
	124495.70	124822.14	6	6	5.227E-02
	124495.70	124822.14	4	6	1.098E+00
$g^2D^e \rightarrow u^2F^o$	0.0670	0.0505	10	14	2.563E-01
	124495.70	126304.82	6	8	2.441E-01
	124495.70	126304.82	6	6	1.221E-02
	124495.70	126304.82	4	6	2.563E-01
$g^2D^e \rightarrow t^2F^o$	0.0670	0.0408	10	14	1.015E-01
	124495.70	127363.50	6	8	9.668E-02
	124495.70	127363.50	6	6	4.834E-03
	124495.70	127363.50	4	6	1.015E-01
$a^2G^e \rightarrow x^2F^o$	0.1610	0.1142	18	14	1.581E-02
	114177.10	119311.19	10	8	1.581E-02
	114177.10	119311.19	8	8	5.645E-04
	114177.10	119311.34	8	6	1.524E-02
$a^2G^e \rightarrow w^2F^o$	0.1610	0.0838	18	14	2.491E-03
	114177.10	122655.25	10	8	2.491E-03
	114177.10	122655.25	8	8	8.896E-05
	114177.10	122655.37	8	6	2.402E-03
$a^2G^e \rightarrow v^2F^o$	0.1610	0.0640	18	14	8.620E-04
	114177.10	124822.08	10	8	8.620E-04
	114177.10	124822.08	8	8	3.079E-05
	114177.10	124822.14	8	6	8.313E-04
$a^2G^e \rightarrow u^2F^o$	0.1610	0.0505	18	14	4.110E-04
	114177.10	126304.82	10	8	4.110E-04
	114177.10	126304.82	8	8	1.468E-05
	114177.10	126304.82	8	6	3.963E-04
$a^2G^e \rightarrow t^2F^o$	0.1610	0.0408	18	14	2.342E-04
	114177.10	127363.50	10	8	2.342E-04
	114177.10	127363.50	8	8	8.365E-06
	114177.10	127363.50	8	6	2.258E-04
$b^2G^e \rightarrow w^2F^o$	0.1118	0.0838	18	14	4.169E-02
	119578.23	122655.25	10	8	4.169E-02
	119578.23	122655.25	8	8	1.489E-03
	119578.23	122655.37	8	6	4.020E-02
$b^2G^e \rightarrow v^2F^o$	0.1118	0.0640	18	14	6.998E-03
	119578.23	124822.08	10	8	6.998E-03
	119578.23	124822.08	8	8	2.499E-04
	119578.23	124822.14	8	6	6.748E-03
$b^2G^e \rightarrow u^2F^o$	0.1118	0.0505	18	14	2.450E-03
	119578.23	126304.82	10	8	2.450E-03
	119578.23	126304.82	8	8	8.750E-05
	119578.23	126304.82	8	6	2.362E-03
$b^2G^e \rightarrow t^2F^o$	0.1118	0.0408	18	14	1.173E-03
	119578.23	127363.50	10	8	1.173E-03
	119578.23	127363.50	8	8	4.189E-05
	119578.23	127363.50	8	6	1.131E-03
$c^2G^e \rightarrow v^2F^o$	0.0821	0.0640	18	14	7.503E-02
	122835.13	124822.08	10	8	7.503E-02
	122835.13	124822.08	8	8	2.680E-03
	122835.13	124822.14	8	6	7.235E-02
$c^2G^e \rightarrow u^2F^o$	0.0821	0.0505	18	14	1.295E-02
	122835.13	126304.82	10	8	1.295E-02
	122835.13	126304.82	8	8	4.626E-04
	122835.13	126304.82	8	6	1.249E-02
$c^2G^e \rightarrow t^2F^o$	0.0821	0.0408	18	14	4.641E-03
	122835.13	127363.50	10	8	4.641E-03
	122835.13	127363.50	8	8	1.657E-04
	122835.13	127363.50	8	6	4.475E-03
$d^2G^e \rightarrow u^2F^o$	0.0629	0.0505	18	14	1.124E-01
	124948.40	126304.82	10	8	1.124E-01
	124948.40	126304.82	8	8	4.015E-03
	124948.40	126304.82	8	6	1.084E-01
$d^2G^e \rightarrow t^2F^o$	0.0629	0.0408	18	14	2.006E-02
	124948.40	127363.50	10	8	2.006E-02
	124948.40	127363.50	8	8	7.165E-04
	124948.40	127363.50	8	6	1.935E-02
$e^2G^e \rightarrow t^2F^o$	0.0497	0.0408	18	14	1.547E-01
	126396.47	127363.50	10	8	1.547E-01
	126396.47	127363.50	8	8	5.523E-03
	126396.47	127363.50	8	6	1.491E-01
$z^2P^o \rightarrow a^2S^e$	1.1997	0.6046	6	2	1.337E-01
	287.24	65500.47	4	2	1.335E-01
	0.00	65500.47	2	2	1.341E-01

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
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Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$z^2P^o \rightarrow b^2S^e$	1.1997	0.5028	6	2	8.399E-02
	287.24	76665.35	4	2	8.388E-02
	0.00	76665.35	2	2	8.420E-02
$z^2P^o \rightarrow c^2S^e$	1.1997	0.3087	6	2	1.453E-02
	287.24	97972.09	4	2	1.452E-02
	0.00	97972.09	2	2	1.456E-02
$z^2P^o \rightarrow d^2S^e$	1.1997	0.1883	6	2	5.584E-03
	287.24	111184.46	4	2	5.579E-03
	0.00	111184.46	2	2	5.593E-03
$z^2P^o \rightarrow e^2S^e$	1.1997	0.1270	6	2	2.794E-03
	287.24	117914.80	4	2	2.791E-03
	0.00	117914.80	2	2	2.798E-03
$z^2P^o \rightarrow f^2S^e$	1.1997	0.0914	6	2	1.609E-03
	287.24	121814.38	4	2	1.607E-03
	0.00	121814.38	2	2	1.611E-03
$z^2P^o \rightarrow g^2S^e$	1.1997	0.0690	6	2	1.016E-03
	287.24	124276.70	4	2	1.016E-03
	0.00	124276.70	2	2	1.018E-03
$z^2P^o \rightarrow a^2P^e$	1.1997	0.4366	6	6	8.721E-01
	287.24	84004.26	4	4	7.265E-01
	287.24	83801.95	4	2	1.450E-01
	0.00	84004.26	2	4	2.916E-01
	0.00	83801.95	2	2	5.818E-01
$z^2P^o \rightarrow a^2D^e$	1.1997	0.6974	6	10	2.449E-03
	287.24	55325.18	4	6	2.201E-03
	287.24	55309.35	4	4	2.444E-04
	0.00	55309.35	2	4	2.457E-03
$z^2P^o \rightarrow b^2D^e$	1.1997	0.4784	6	10	1.184E+00
	287.24	79355.02	4	6	1.065E+00
	287.24	79338.50	4	4	1.183E-01
	0.00	79338.50	2	4	1.187E+00
$z^2P^o \rightarrow c^2D^e$	1.1997	0.2809	6	10	1.618E-01
	287.24	101024.35	4	6	1.455E-01
	287.24	101023.05	4	4	1.617E-02
	0.00	101023.05	2	4	1.621E-01
$z^2P^o \rightarrow d^2D^e$	1.1997	0.1773	6	10	4.073E-02
	287.24	112394.72	4	6	3.662E-02
	287.24	112394.56	4	4	4.069E-03
	0.00	112394.56	2	4	4.080E-02
$z^2P^o \rightarrow e^2D^e$	1.1997	0.1214	6	10	1.593E-02
	287.24	118522.93	4	6	1.433E-02
	287.24	118522.86	4	4	1.592E-03
	0.00	118522.86	2	4	1.596E-02
$z^2P^o \rightarrow f^2D^e$	1.1997	0.0882	6	10	7.836E-03
	287.24	122163.54	4	6	7.047E-03
	287.24	122163.48	4	4	7.830E-04
	0.00	122163.48	2	4	7.848E-03
$z^2P^o \rightarrow g^2D^e$	1.1997	0.0670	6	10	4.426E-03
	287.24	124495.70	4	6	3.980E-03
	287.24	124495.70	4	4	4.423E-04
	0.00	124495.70	2	4	4.433E-03
$y^2P^o \rightarrow c^2S^e$	0.4612	0.3087	6	2	2.031E-01
	81251.32	97972.09	4	2	2.028E-01
	81191.34	97972.09	2	2	2.036E-01
$y^2P^o \rightarrow d^2S^e$	0.4612	0.1883	6	2	4.160E-02
	81251.32	111184.46	4	2	4.157E-02
	81191.34	111184.46	2	2	4.165E-02
$y^2P^o \rightarrow e^2S^e$	0.4612	0.1270	6	2	1.606E-02
	81251.32	117914.80	4	2	1.605E-02
	81191.34	117914.80	2	2	1.608E-02
$y^2P^o \rightarrow f^2S^e$	0.4612	0.0914	6	2	7.886E-03
	81251.32	121814.38	4	2	7.883E-03
	81191.34	121814.38	2	2	7.894E-03
$y^2P^o \rightarrow g^2S^e$	0.4612	0.0690	6	2	4.468E-03
	81251.32	124276.70	4	2	4.466E-03
	81191.34	124276.70	2	2	4.472E-03
$y^2P^o \rightarrow a^2P^e$	0.4612	0.4366	6	6	1.153E-05
	81251.32	84004.26	4	4	9.779E-06
	81251.32	83801.95	4	2	1.812E-06
	81191.34	84004.26	2	4	3.997E-06
	81191.34	83801.95	2	2	7.419E-06
$y^2P^o \rightarrow c^2D^e$	0.4612	0.2809	6	10	8.393E-01
	81251.32	101024.35	4	6	7.546E-01
	81251.32	101023.05	4	4	8.384E-02
	81191.34	101023.05	2	4	8.409E-01

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$y^2P^o \rightarrow d^2D^e$	0.4612	0.1773	6	10	1.495E-01
	81251.32	112394.72	4	6	1.345E-01
	81251.32	112394.56	4	4	1.494E-02
	81191.34	112394.56	2	4	1.497E-01
$y^2P^o \rightarrow e^2D^e$	0.4612	0.1214	6	10	4.511E-02
	81251.32	118522.93	4	6	4.057E-02
	81251.32	118522.86	4	4	4.508E-03
	81191.34	118522.86	2	4	4.515E-02
$y^2P^o \rightarrow f^2D^e$	0.4612	0.0882	6	10	1.803E-02
	81251.32	122163.54	4	6	1.622E-02
	81251.32	122163.48	4	4	1.802E-03
	81191.34	122163.48	2	4	1.805E-02
$y^2P^o \rightarrow g^2D^e$	0.4612	0.0670	6	10	8.708E-03
	81251.32	124495.70	4	6	7.834E-03
	81251.32	124495.70	4	4	8.704E-04
	81191.34	124495.70	2	4	8.716E-03
$x^2P^o \rightarrow d^2S^e$	0.2549	0.1883	6	2	3.278E-01
	103885.25	111184.46	4	2	3.275E-01
	103860.74	111184.46	2	2	3.286E-01
$x^2P^o \rightarrow e^2S^e$	0.2549	0.1270	6	2	4.372E-02
	103885.25	117914.80	4	2	4.370E-02
	103860.74	117914.80	2	2	4.377E-02
$x^2P^o \rightarrow f^2S^e$	0.2549	0.0914	6	2	1.560E-02
	103885.25	121814.38	4	2	1.560E-02
	103860.74	121814.38	2	2	1.562E-02
$x^2P^o \rightarrow g^2S^e$	0.2549	0.0690	6	2	7.671E-03
	103885.25	124276.70	4	2	7.668E-03
	103860.74	124276.70	2	2	7.678E-03
$x^2P^o \rightarrow d^2D^e$	0.2549	0.1773	6	10	1.137E+00
	103885.25	112394.72	4	6	1.022E+00
	103885.25	112394.56	4	4	1.136E-01
	103860.74	112394.56	2	4	1.139E+00
$x^2P^o \rightarrow e^2D^e$	0.2549	0.1214	6	10	1.612E-01
	103885.25	118522.93	4	6	1.450E-01
	103885.25	118522.86	4	4	1.611E-02
	103860.74	118522.86	2	4	1.614E-01
$x^2P^o \rightarrow f^2D^e$	0.2549	0.0882	6	10	5.258E-02
	103885.25	122163.54	4	6	4.730E-02
	103885.25	122163.48	4	4	5.256E-03
	103860.74	122163.48	2	4	5.263E-02
$x^2P^o \rightarrow g^2D^e$	0.2549	0.0670	6	10	2.378E-02
	103885.25	124495.70	4	6	2.140E-02
	103885.25	124495.70	4	4	2.377E-03
	103860.74	124495.70	2	4	2.380E-02
$w^2P^o \rightarrow e^2S^e$	0.1629	0.1270	6	2	4.157E-01
	113976.72	117914.80	4	2	4.152E-01
	113962.08	117914.80	2	2	4.168E-01
$w^2P^o \rightarrow f^2S^e$	0.1629	0.0914	6	2	5.157E-02
	113976.72	121814.38	4	2	5.154E-02
	113962.08	121814.38	2	2	5.163E-02
$w^2P^o \rightarrow g^2S^e$	0.1629	0.0690	6	2	1.817E-02
	113976.72	124276.70	4	2	1.816E-02
	113962.08	124276.70	2	2	1.819E-02
$w^2P^o \rightarrow e^2D^e$	0.1629	0.1214	6	10	1.291E+00
	113976.72	118522.93	4	6	1.161E+00
	113976.72	118522.86	4	4	1.290E-01
	113962.08	118522.86	2	4	1.294E+00
$w^2P^o \rightarrow f^2D^e$	0.1629	0.0882	6	10	1.868E-01
	113976.72	122163.54	4	6	1.680E-01
	113976.72	122163.48	4	4	1.867E-02
	113962.08	122163.48	2	4	1.870E-01
$w^2P^o \rightarrow g^2D^e$	0.1629	0.0670	6	10	6.464E-02
	113976.72	124495.70	4	6	5.814E-02
	113976.72	124495.70	4	4	6.461E-03
	113962.08	124495.70	2	4	6.470E-02
$v^2P^o \rightarrow f^2S^e$	0.1147	0.0914	6	2	2.360E-01
	119273.81	121814.38	4	2	2.351E-01
	119245.22	121814.38	2	2	2.378E-01
$v^2P^o \rightarrow g^2S^e$	0.1147	0.0690	6	2	3.878E-02
	119273.81	124276.70	4	2	3.871E-02
	119245.22	124276.70	2	2	3.893E-02
$v^2P^o \rightarrow f^2D^e$	0.1147	0.0882	6	10	7.175E-01
	119273.81	122163.54	4	6	6.436E-01
	119273.81	122163.48	4	4	7.151E-02
	119245.22	122163.48	2	4	7.222E-01

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$v^2P^o \rightarrow g^2D^e$	0.1147	0.0670	6	10	1.533E-01
	119273.81	124495.70	4	6	1.377E-01
	119273.81	124495.70	4	4	1.530E-02
	119245.22	124495.70	2	4	1.539E-01
$u^2P^o \rightarrow f^2S^e$	0.0939	0.0914	6	2	8.248E-02
	121590.19	121814.38	4	2	6.776E-02
	121444.12	121814.38	2	2	1.119E-01
$u^2P^o \rightarrow g^2S^e$	0.0939	0.0690	6	2	3.924E-03
	121590.19	124276.70	4	2	3.854E-03
	121444.12	124276.70	2	2	4.064E-03
$u^2P^o \rightarrow f^2D^e$	0.0939	0.0882	6	10	3.965E-01
	121590.19	122163.54	4	6	3.289E-01
	121590.19	122163.48	4	4	3.654E-02
	121444.12	122163.48	2	4	4.585E-01
$u^2P^o \rightarrow g^2D^e$	0.0939	0.0670	6	10	6.697E-03
	121590.19	124495.70	4	6	5.928E-03
	121590.19	124495.70	4	4	6.587E-04
	121444.12	124495.70	2	4	6.918E-03
$t^2P^o \rightarrow g^2S^e$	0.0795	0.0690	6	2	6.756E-01
	123138.67	124276.70	4	2	6.675E-01
	123097.63	124276.70	2	2	6.916E-01
$t^2P^o \rightarrow g^2D^e$	0.0795	0.0670	6	10	1.802E+00
	123138.67	124495.70	4	6	1.606E+00
	123138.67	124495.70	4	4	1.784E-01
	123097.63	124495.70	2	4	1.838E+00
$z^2D^o \rightarrow d^2D^e$	0.2100	0.1773	10	10	7.467E-06
	108820.60	112394.72	6	6	6.937E-06
	108820.60	112394.56	6	4	4.955E-07
	108778.70	112394.72	4	6	7.520E-07
	108778.70	112394.56	4	4	6.767E-06
$z^2D^o \rightarrow e^2D^e$	0.2100	0.1214	10	10	2.382E-05
	108820.60	118522.93	6	6	2.220E-05
	108820.60	118522.86	6	4	1.585E-06
	108778.70	118522.93	4	6	2.388E-06
	108778.70	118522.86	4	4	2.150E-05
$z^2D^o \rightarrow f^2D^e$	0.2100	0.0882	10	10	3.456E-05
	108820.60	122163.54	6	6	3.222E-05
	108820.60	122163.48	6	4	2.301E-06
	108778.70	122163.54	4	6	3.463E-06
	108778.70	122163.48	4	4	3.117E-05
$z^2D^o \rightarrow g^2D^e$	0.2100	0.0670	10	10	4.043E-05
	108820.60	124495.70	6	6	3.769E-05
	108820.60	124495.70	6	4	2.692E-06
	108778.70	124495.70	4	6	4.050E-06
	108778.70	124495.70	4	4	3.645E-05
$z^2F^o \rightarrow d^2D^e$	0.2578	0.1773	14	10	4.262E-02
	103556.03	112394.72	8	6	4.262E-02
	103556.16	112394.72	6	6	2.841E-03
	103556.16	112394.56	6	4	3.978E-02
$z^2F^o \rightarrow e^2D^e$	0.2578	0.1214	14	10	6.594E-03
	103556.03	118522.93	8	6	6.594E-03
	103556.16	118522.93	6	6	4.396E-04
	103556.16	118522.86	6	4	6.155E-03
$z^2F^o \rightarrow f^2D^e$	0.2578	0.0882	14	10	2.304E-03
	103556.03	122163.54	8	6	2.304E-03
	103556.16	122163.54	6	6	1.536E-04
	103556.16	122163.48	6	4	2.150E-03
$z^2F^o \rightarrow g^2D^e$	0.2578	0.0670	14	10	1.107E-03
	103556.03	124495.70	8	6	1.107E-03
	103556.16	124495.70	6	6	7.377E-05
	103556.16	124495.70	6	4	1.033E-03
$z^2F^o \rightarrow a^2G^e$	0.2578	0.1610	14	18	1.234E+00
	103556.03	114177.10	8	10	1.200E+00
	103556.03	114177.10	8	8	3.428E-02
	103556.16	114177.10	6	8	1.234E+00
$z^2F^o \rightarrow b^2G^e$	0.2578	0.1118	14	18	1.893E-01
	103556.03	119578.23	8	10	1.840E-01
	103556.03	119578.23	8	8	5.258E-03
	103556.16	119578.23	6	8	1.893E-01
$z^2F^o \rightarrow c^2G^e$	0.2578	0.0821	14	18	6.249E-02
	103556.03	122835.13	8	10	6.076E-02
	103556.03	122835.13	8	8	1.736E-03
	103556.16	122835.13	6	8	6.249E-02
$z^2F^o \rightarrow d^2G^e$	0.2578	0.0629	14	18	2.879E-02
	103556.03	124948.40	8	10	2.799E-02
	103556.03	124948.40	8	8	7.998E-04
	103556.16	124948.40	6	8	2.879E-02
$z^2F^o \rightarrow e^2G^e$	0.2578	0.0497	14	18	1.586E-02
	103556.03	126396.47	8	10	1.542E-02
	103556.03	126396.47	8	8	4.406E-04
	103556.16	126396.47	6	8	1.586E-02
$z^2F^o \rightarrow f^2G^e$	0.2578	0.0402	14	18	9.785E-03
	103556.03	127432.02	8	10	9.513E-03
	103556.03	127432.02	8	8	2.718E-04
	103556.16	127432.02	6	8	9.784E-03
$y^2F^o \rightarrow e^2D^e$	0.1648	0.1214	14	10	1.000E-01
	113760.15	118522.93	8	6	1.000E-01
	113760.32	118522.93	6	6	6.668E-03
	113760.32	118522.86	6	4	9.335E-02
$y^2F^o \rightarrow f^2D^e$	0.1648	0.0882	14	10	1.562E-02
	113760.15	122163.54	8	6	1.562E-02
	113760.32	122163.54	6	6	1.041E-03
	113760.32	122163.48	6	4	1.458E-02
$y^2F^o \rightarrow g^2D^e$	0.1648	0.0670	14	10	5.552E-03
	113760.15	124495.70	8	6	5.552E-03
	113760.32	124495.70	6	6	3.701E-04
	113760.32	124495.70	6	4	5.181E-03
$y^2F^o \rightarrow a^2G^e$	0.1648	0.1610	14	18	9.497E-02
	113760.15	114177.10	8	10	9.235E-02
	113760.15	114177.10	8	8	2.639E-03
	113760.32	114177.10	6	8	9.495E-02
$y^2F^o \rightarrow b^2G^e$	0.1648	0.1118	14	18	1.017E+00
	113760.15	119578.23	8	10	9.883E-01
	113760.15	119578.23	8	8	2.824E-02
	113760.32	119578.23	6	8	1.017E+00
$y^2F^o \rightarrow c^2G^e$	0.1648	0.0821	14	18	2.274E-01
	113760.15	122835.13	8	10	2.211E-01
	113760.15	122835.13	8	8	6.317E-03
	113760.32	122835.13	6	8	2.274E-01
$y^2F^o \rightarrow d^2G^e$	0.1648	0.0629	14	18	8.942E-02
	113760.15	124948.40	8	10	8.694E-02
	113760.15	124948.40	8	8	2.484E-03
	113760.32	124948.40	6	8	8.942E-02
$y^2F^o \rightarrow e^2G^e$	0.1648	0.0497	14	18	4.527E-02
	113760.15	126396.47	8	10	4.402E-02
	113760.15	126396.47	8	8	1.258E-03
	113760.32	126396.47	6	8	4.527E-02
$y^2F^o \rightarrow f^2G^e$	0.1648	0.0402	14	18	2.659E-02
	113760.15	127432.02	8	10	2.585E-02
	113760.15	127432.02	8	8	7.386E-04
	113760.32	127432.02	6	8	2.659E-02
$x^2F^o \rightarrow f^2D^e$	0.1142	0.0882	14	10	1.658E-01
	119311.19	122163.54	8	6	1.658E-01
	119311.34	122163.54	6	6	1.105E-02
	119311.34	122163.48	6	4	1.548E-01
$x^2F^o \rightarrow g^2D^e$	0.1142	0.0670	14	10	2.647E-02
	119311.19	124495.70	8	6	2.647E-02
	119311.34	124495.70	6	6	1.765E-03
	119311.34	124495.70	6	4	2.470E-02
$x^2F^o \rightarrow b^2G^e$	0.1142	0.1118	14	18	1.919E-01
	119311.19	119578.23	8	10	1.866E-01
	119311.19	119578.23	8	8	5.331E-03
	119311.34	119578.23	6	8	1.918E-01
$x^2F^o \rightarrow c^2G^e$	0.1142	0.0821	14	18	8.789E-01
	119311.19	122835.13	8	10	8.545E-01
	119311.19	122835.13	8	8	2.441E-02
	119311.34	122835.13	6	8	8.789E-01
$x^2F^o \rightarrow d^2G^e$	0.1142	0.0629	14	18	2.303E-01
	119311.19	124948.40	8	10	2.239E-01
	119311.19	124948.40	8	8	6.398E-03
	119311.34	124948.40	6	8	2.303E-01
$x^2F^o \rightarrow e^2G^e$	0.1142	0.0497	14	18	9.796E-02
	119311.19	126396.47	8	10	9.524E-02
	119311.19	126396.47	8	8	2.721E-03
	119311.34	126396.47	6	8	9.795E-02
$x^2F^o \rightarrow f^2G^e$	0.1142	0.0402	14	18	5.200E-02
	119311.19	127432.02	8	10	5.056E-02
	119311.19	127432.02	8	8	1.444E-03
	119311.34	127432.02	6	8	5.200E-02
$w^2F^o \rightarrow g^2D^e$	0.0838	0.0670	14	10	2.374E-01

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
	122655.25	124495.70	8	6	2.375E-01
	122655.37	124495.70	6	6	1.583E-02
	122655.37	124495.70	6	4	2.216E-01
$w^2F^o \rightarrow c^2G^e$	0.0838	0.0821	14	18	2.912E-01
	122655.25	122835.13	8	10	2.832E-01
	122655.25	122835.13	8	8	8.090E-03
	122655.37	122835.13	6	8	2.911E-01
$w^2F^o \rightarrow d^2G^e$	0.0838	0.0629	14	18	8.037E-01
	122655.25	124948.40	8	10	7.814E-01
	122655.25	124948.40	8	8	2.233E-02
	122655.37	124948.40	6	8	8.037E-01
$w^2F^o \rightarrow e^2G^e$	0.0838	0.0497	14	18	2.256E-01
	122655.25	126396.47	8	10	2.193E-01
	122655.25	126396.47	8	8	6.267E-03
	122655.37	126396.47	6	8	2.256E-01
$w^2F^o \rightarrow f^2G^e$	0.0838	0.0402	14	18	1.001E-01
	122655.25	127432.02	8	10	9.729E-02
	122655.25	127432.02	8	8	2.780E-03
	122655.37	127432.02	6	8	1.001E-01
$v^2F^o \rightarrow d^2G^e$	0.0640	0.0629	14	18	3.953E-01
	124822.08	124948.40	8	10	3.844E-01
	124822.08	124948.40	8	8	1.098E-02
	124822.14	124948.40	6	8	3.952E-01
$v^2F^o \rightarrow e^2G^e$	0.0640	0.0497	14	18	7.524E-01
	124822.08	126396.47	8	10	7.316E-01
	124822.08	126396.47	8	8	2.090E-02
	124822.14	126396.47	6	8	7.524E-01
$v^2F^o \rightarrow f^2G^e$	0.0640	0.0402	14	18	2.198E-01
	124822.08	127432.02	8	10	2.137E-01
	124822.08	127432.02	8	8	6.107E-03
	124822.14	127432.02	6	8	2.198E-01
$u^2F^o \rightarrow e^2G^e$	0.0505	0.0497	14	18	4.892E-01
	126304.82	126396.47	8	10	4.756E-01
	126304.82	126396.47	8	8	1.359E-02
	126304.82	126396.47	6	8	4.892E-01
$u^2F^o \rightarrow f^2G^e$	0.0505	0.0402	14	18	7.195E-01
	126304.82	127432.02	8	10	6.995E-01
	126304.82	127432.02	8	8	1.998E-02
	126304.82	127432.02	6	8	7.195E-01
$t^2F^o \rightarrow f^2G^e$	0.0408	0.0402	14	18	4.970E-01
	127363.50	127432.02	8	10	4.832E-01
	127363.50	127432.02	8	8	1.380E-02
	127363.50	127432.02	6	8	4.970E-01
$a^4P^e \rightarrow z^4S^o$	0.8096	0.0803	12	4	2.893E-01
	43107.91	123033.50	6	4	2.889E-01
	42932.62	123033.50	4	4	2.895E-01
	42824.29	123033.50	2	4	2.899E-01
$a^4P^e \rightarrow z^4P^o$	0.8096	0.1348	12	12	3.364E-01
	43107.91	117178.06	6	6	2.355E-01
	43107.91	116978.38	6	4	1.007E-01
	42932.62	117178.06	4	6	1.518E-01
	42932.62	116978.38	4	4	4.485E-02
	42932.62	116862.38	4	2	1.399E-01
	42824.29	116978.38	2	4	2.807E-01
	42824.29	116862.38	2	2	5.605E-02
$a^4P^e \rightarrow y^4P^o$	0.8096	0.0661	12	12	3.240E-01
	43107.91	124567.40	6	6	2.264E-01
	43107.91	124615.60	6	4	9.711E-02
	42932.62	124567.40	4	6	1.459E-01
	42932.62	124615.60	4	4	4.325E-02
	42932.62	124638.90	4	2	1.352E-01
	42824.29	124615.60	2	4	2.707E-01
	42824.29	124638.90	2	2	5.415E-02
$a^4P^e \rightarrow z^4D^o$	0.8096	0.0681	12	20	1.255E+00
	43107.91	124449.50	6	8	1.004E+00
	43107.91	124316.90	6	6	2.255E-01
	43107.91	124325.30	6	4	2.506E-02
	42932.62	124316.90	4	6	7.909E-01
	42932.62	124325.30	4	4	4.018E-01
	42932.62	124337.30	4	2	6.279E-02
	42824.29	124325.30	2	4	6.286E-01
	42824.29	124337.30	2	2	6.287E-01
$h^2S^e \rightarrow r^2P^o$	0.0537	0.0525	2	6	3.185E-01
	*		2	4	2.123E-01
	*		2	2	1.062E-01

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$h^2S^e \rightarrow q^2P^o$	0.0537	0.0481	2	6	3.270E+00
	*		2	4	2.180E+00
	*		2	2	1.090E+00
$h^2D^e \rightarrow q^2P^o$	0.0524	0.0481	10	6	9.680E-01
	*		6	4	9.680E-01
	*		4	4	1.613E-01
	*		4	2	8.067E-01
$h^2D^e \rightarrow u^2F^o$	0.0524	0.0504	10	14	1.240E+00
	*		6	8	1.181E+00
	*		6	6	5.905E-02
	*		4	6	1.240E+00
$h^2D^e \rightarrow t^2F^o$	0.0524	0.0408	10	14	2.390E-01
	*		6	8	2.276E-01
	*		6	6	1.138E-02
	*		4	6	2.390E-01
$i^2D^e \rightarrow t^2F^o$	0.0422	0.0408	10	14	1.410E+00
	*		6	8	1.343E+00
	*		6	6	6.714E-02
	*		4	6	1.410E+00
$a^2G^e \rightarrow z^2H^o$	0.1608	0.1112	18	22	1.650E+00
	*		10	12	1.620E+00
	*		10	10	3.000E-02
	*		8	10	1.650E+00
$a^2G^e \rightarrow y^2H^o$	0.1608	0.0817	18	22	2.061E-01
	*		10	12	2.024E-01
	*		10	10	3.747E-03
	*		8	10	2.061E-01
$a^2G^e \rightarrow x^2H^o$	0.1608	0.0626	18	22	6.167E-02
	*		10	12	6.055E-02
	*		10	10	1.121E-03
	*		8	10	6.167E-02
$a^2G^e \rightarrow w^2H^o$	0.1608	0.0494	18	22	2.683E-02
	*		10	12	2.635E-02
	*		10	10	4.879E-04
	*		8	10	2.683E-02
$a^2G^e \rightarrow v^2H^o$	0.1608	0.0400	18	22	1.422E-02
	*		10	12	1.396E-02
	*		10	10	2.586E-04
	*		8	10	1.422E-02
$b^2G^e \rightarrow z^2H^o$	0.1117	0.1112	18	22	2.106E-02
	*		10	12	2.067E-02
	*		10	10	3.828E-04
	*		8	10	2.106E-02
$b^2G^e \rightarrow y^2H^o$	0.1117	0.0817	18	22	1.450E+00
	*		10	12	1.424E+00
	*		10	10	2.636E-02
	*		8	10	1.450E+00
$b^2G^e \rightarrow x^2H^o$	0.1117	0.0626	18	22	2.683E-01
	*		10	12	2.635E-01
	*		10	10	4.879E-03
	*		8	10	2.683E-01
$b^2G^e \rightarrow w^2H^o$	0.1117	0.0494	18	22	9.500E-02
	*		10	12	9.327E-02
	*		10	10	1.727E-03
	*		8	10	9.500E-02
$b^2G^e \rightarrow v^2H^o$	0.1117	0.0400	18	22	4.539E-02
	*		10	12	4.456E-02
	*		10	10	8.253E-04
	*		8	10	4.539E-02
$c^2G^e \rightarrow y^2H^o$	0.0820	0.0817	18	22	3.989E-02
	*		10	12	3.916E-02
	*		10	10	7.253E-04
	*		8	10	3.989E-02
$c^2G^e \rightarrow x^2H^o$	0.0820	0.0626	18	22	1.339E+00
	*		10	12	1.315E+00
	*		10	10	2.434E-02
	*		8	10	1.339E+00
$c^2G^e \rightarrow w^2H^o$	0.0820	0.0494	18	22	2.906E-01
	*		10	12	2.853E-01
	*		10	10	5.283E-03
	*		8	10	2.906E-01

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$c^2G^e \rightarrow v^2H^o$	0.0820	0.0400	18	22	1.122E-01
	*		10	12	1.102E-01
	*		10	10	2.040E-03
	*		8	10	1.122E-01
$d^2G^e \rightarrow x^2H^o$	0.0628	0.0626	18	22	5.667E-02
	*		10	12	5.564E-02
	*		10	10	1.030E-03
	*		8	10	5.667E-02
$d^2G^e \rightarrow w^2H^o$	0.0628	0.0494	18	22	1.272E+00
	*		10	12	1.249E+00
	*		10	10	2.313E-02
	*		8	10	1.272E+00
$d^2G^e \rightarrow v^2H^o$	0.0628	0.0400	18	22	3.000E-01
	*		10	12	2.945E-01
	*		10	10	5.455E-03
	*		8	10	3.000E-01
$e^2G^e \rightarrow w^2H^o$	0.0496	0.0494	18	22	7.278E-02
	*		10	12	7.145E-02
	*		10	10	1.323E-03
	*		8	10	7.278E-02
$e^2G^e \rightarrow v^2H^o$	0.0496	0.0400	18	22	1.239E+00
	*		10	12	1.216E+00
	*		10	10	2.253E-02
	*		8	10	1.239E+00
$f^2G^e \rightarrow v^2H^o$	0.0401	0.0400	18	22	8.722E-02
	*		10	12	8.564E-02
	*		10	10	1.586E-03
	*		8	10	8.722E-02
$a^2I^e \rightarrow x^2H^o$	0.0816	0.0626	26	22	5.769E-03
	*		14	12	5.769E-03
	*		12	12	8.741E-05
	*		12	10	5.682E-03
$a^2I^e \rightarrow w^2H^o$	0.0816	0.0494	26	22	7.539E-04
	*		14	12	7.539E-04
	*		12	12	1.142E-05
	*		12	10	7.424E-04
$a^2I^e \rightarrow v^2H^o$	0.0816	0.0400	26	22	2.173E-04
	*		14	12	2.173E-04
	*		12	12	3.293E-06
	*		12	10	2.140E-04
$a^2I^e \rightarrow z^2K^o$	0.0816	0.0625	26	30	2.338E+00
	*		14	16	2.316E+00
	*		14	14	2.227E-02
	*		12	14	2.339E+00
$a^2I^e \rightarrow y^2K^o$	0.0816	0.0494	26	30	2.289E-01
	*		14	16	2.267E-01
	*		14	14	2.180E-03
	*		12	14	2.289E-01
$a^2I^e \rightarrow x^2K^o$	0.0816	0.0400	26	30	5.885E-02
	*		14	16	5.829E-02
	*		14	14	5.604E-04
	*		12	14	5.885E-02
$b^2I^e \rightarrow w^2H^o$	0.0625	0.0494	26	22	1.600E-02
	*		14	12	1.600E-02
	*		12	12	2.424E-04
	*		12	10	1.576E-02
$b^2I^e \rightarrow v^2H^o$	0.0625	0.0400	26	22	2.346E-03
	*		14	12	2.346E-03
	*		12	12	3.555E-05
	*		12	10	2.311E-03
$b^2I^e \rightarrow z^2K^o$	0.0625	0.0625	26	30	4.654E-04
	*		14	16	4.609E-04
	*		14	14	4.432E-06
	*		12	14	4.654E-04
$b^2I^e \rightarrow y^2K^o$	0.0625	0.0494	26	30	2.123E+00
	*		14	16	2.103E+00
	*		14	14	2.022E-02
	*		12	14	2.123E+00
$b^2I^e \rightarrow x^2K^o$	0.0625	0.0400	26	30	3.254E-01
	*		14	16	3.223E-01
	*		14	14	3.099E-03

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
	*		12	14	3.254E-01
$c^2I^e \rightarrow v^2H^o$	0.0494	0.0400	26	22	2.969E-02
	*		14	12	2.969E-02
	*		12	12	4.499E-04
	*		12	10	2.924E-02
$c^2I^e \rightarrow y^2K^o$	0.0494	0.0494	26	30	1.261E-03
	*		14	16	1.249E-03
	*		14	14	1.201E-05
	*		12	14	1.262E-03
$c^2I^e \rightarrow x^2K^o$	0.0494	0.0400	26	30	1.985E+00
	*		14	16	1.966E+00
	*		14	14	1.890E-02
	*		12	14	1.985E+00
$d^2I^e \rightarrow x^2K^o$	0.0400	0.0400	26	30	2.242E-03
	*		14	16	2.221E-03
	*		14	14	2.136E-05
	*		12	14	2.242E-03
$a^2L^e \rightarrow x^2K^o$	0.0494	0.0400	34	30	4.353E-03
	*		18	16	4.353E-03
	*		16	16	3.627E-05
	*		16	14	4.317E-03
$a^2L^e \rightarrow z^2M^o$	0.0494	0.0400	34	38	3.000E+00
	*		18	20	2.982E+00
	*		18	18	1.754E-02
	*		16	18	3.000E+00
$b^2L^e \rightarrow z^2M^o$	0.0400	0.0400	34	38	6.147E-07
	*		18	20	6.111E-07
	*		18	18	3.595E-09
	*		16	18	6.147E-07
$z^2P^o \rightarrow h^2S^e$	1.2014	0.0537	6	2	6.867E-04
	*		4	2	6.867E-04
	*		2	2	6.867E-04
$z^2P^o \rightarrow i^2S^e$	1.2014	0.0431	6	2	4.850E-04
	*		4	2	4.850E-04
	*		2	2	4.850E-04
$z^2P^o \rightarrow b^2P^e$	1.2014	0.0064	6	6	2.417E-03
	*		4	4	2.014E-03
	*		4	2	4.028E-04
	*		2	4	8.056E-04
	*		2	2	1.611E-03
$z^2P^o \rightarrow h^2D^e$	1.2014	0.0524	6	10	2.750E-03
	*		4	6	2.475E-03
	*		4	4	2.750E-04
	*		2	4	2.750E-03
$z^2P^o \rightarrow i^2D^e$	1.2014	0.0422	6	10	1.817E-03
	*		4	6	1.635E-03
	*		4	4	1.817E-04
	*		2	4	1.817E-03
$y^2P^o \rightarrow h^2S^e$	0.4637	0.0537	6	2	2.817E-03
	*		4	2	2.817E-03
	*		2	2	2.817E-03
$y^2P^o \rightarrow i^2S^e$	0.4637	0.0431	6	2	1.883E-03
	*		4	2	1.883E-03
	*		2	2	1.883E-03
$y^2P^o \rightarrow b^2P^e$	0.4637	0.0064	6	6	1.348E-02
	*		4	4	1.124E-02
	*		4	2	2.247E-03
	*		2	4	4.494E-03
	*		2	2	8.989E-03
$y^2P^o \rightarrow h^2D^e$	0.4637	0.0524	6	10	4.833E-03
	*		4	6	4.350E-03
	*		4	4	4.833E-04
	*		2	4	4.833E-03
$y^2P^o \rightarrow i^2D^e$	0.4637	0.0422	6	10	2.933E-03
	*		4	6	2.640E-03
	*		4	4	2.933E-04
	*		2	4	2.933E-03
$x^2P^o \rightarrow h^2S^e$	0.2564	0.0537	6	2	4.467E-03
	*		4	2	4.467E-03
	*		2	2	4.467E-03
$x^2P^o \rightarrow i^2S^e$	0.2564	0.0431	6	2	2.850E-03

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II

See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}		E_f Ry/cm^{-1}	g_i	g_f	f_{if}
		*		4	2	2.850E-03
		*		2	2	2.850E-03
$x^2P^o \rightarrow b^2P^e$	0.2564		0.0064	6	6	7.917E-03
		*		4	4	6.597E-03
		*		4	2	1.319E-03
		*		2	4	2.639E-03
		*		2	2	5.278E-03
$x^2P^o \rightarrow h^2D^e$	0.2564		0.0524	6	10	1.305E-02
		*		4	6	1.175E-02
		*		4	4	1.305E-03
		*		2	4	1.305E-02
$x^2P^o \rightarrow i^2D^e$	0.2564		0.0422	6	10	7.933E-03
		*		4	6	7.140E-03
		*		4	4	7.933E-04
		*		2	4	7.933E-03
$w^2P^o \rightarrow h^2S^e$	0.1625		0.0537	6	2	8.900E-03
		*		4	2	8.900E-03
		*		2	2	8.900E-03
$w^2P^o \rightarrow i^2S^e$	0.1625		0.0431	6	2	5.167E-03
		*		4	2	5.167E-03
		*		2	2	5.167E-03
$w^2P^o \rightarrow b^2P^e$	0.1625		0.0064	6	6	1.578E-02
		*		4	4	1.315E-02
		*		4	2	2.631E-03
		*		2	4	5.261E-03
		*		2	2	1.052E-02
$w^2P^o \rightarrow h^2D^e$	0.1625		0.0524	6	10	3.100E-02
		*		4	6	2.790E-02
		*		4	4	3.100E-03
		*		2	4	3.100E-02
$w^2P^o \rightarrow i^2D^e$	0.1625		0.0422	6	10	1.767E-02
		*		4	6	1.590E-02
		*		4	4	1.767E-03
		*		2	4	1.767E-02
$v^2P^o \rightarrow h^2S^e$	0.1166		0.0537	6	2	1.505E-02
		*		4	2	1.505E-02
		*		2	2	1.505E-02
$v^2P^o \rightarrow i^2S^e$	0.1166		0.0431	6	2	7.567E-03
		*		4	2	7.567E-03
		*		2	2	7.567E-03
$v^2P^o \rightarrow b^2P^e$	0.1166		0.0064	6	6	9.867E-02
		*		4	4	8.222E-02
		*		4	2	1.644E-02
		*		2	4	3.289E-02
		*		2	2	6.578E-02
$v^2P^o \rightarrow h^2D^e$	0.1166		0.0524	6	10	6.600E-02
		*		4	6	5.940E-02
		*		4	4	6.600E-03
		*		2	4	6.600E-02
$v^2P^o \rightarrow i^2D^e$	0.1166		0.0422	6	10	3.567E-02
		*		4	6	3.210E-02
		*		4	4	3.567E-03
		*		2	4	3.567E-02
$u^2P^o \rightarrow h^2S^e$	0.1011		0.0537	6	2	1.225E-03
		*		4	2	1.225E-03
		*		2	2	1.225E-03
$u^2P^o \rightarrow i^2S^e$	0.1011		0.0431	6	2	5.300E-04
		*		4	2	5.300E-04
		*		2	2	5.300E-04
$u^2P^o \rightarrow b^2P^e$	0.1011		0.0064	6	6	1.483E-01
		*		4	4	1.236E-01
		*		4	2	2.472E-02
		*		2	4	4.944E-02
		*		2	2	9.889E-02
$u^2P^o \rightarrow h^2D^e$	0.1011		0.0524	6	10	1.242E-04
		*		4	6	1.118E-04
		*		4	4	1.242E-05
		*		2	4	1.242E-04
$u^2P^o \rightarrow i^2D^e$	0.1011		0.0422	6	10	1.307E-04
		*		4	6	1.176E-04
		*		4	4	1.307E-05
		*		2	4	1.307E-04
$t^2P^o \rightarrow h^2S^e$	0.0802		0.0537	6	2	6.400E-02
		*		4	2	6.400E-02
		*		2	2	6.400E-02
$t^2P^o \rightarrow i^2S^e$	0.0802		0.0431	6	2	2.067E-02
		*		4	2	2.067E-02
		*		2	2	2.067E-02
$t^2P^o \rightarrow b^2P^e$	0.0802		0.0064	6	6	9.683E-03
		*		4	4	8.069E-03
		*		4	2	1.614E-03
		*		2	4	3.228E-03
		*		2	2	6.456E-03
$t^2P^o \rightarrow h^2D^e$	0.0802		0.0524	6	10	1.883E-01
		*		4	6	1.695E-01
		*		4	4	1.883E-02
		*		2	4	1.883E-01
$t^2P^o \rightarrow i^2D^e$	0.0802		0.0422	6	10	5.633E-02
		*		4	6	5.070E-02
		*		4	4	5.633E-03
		*		2	4	5.633E-02
$s^2P^o \rightarrow h^2S^e$	0.0622		0.0537	6	2	8.050E-01
		*		4	2	8.050E-01
		*		2	2	8.050E-01
$s^2P^o \rightarrow i^2S^e$	0.0622		0.0431	6	2	8.067E-02
		*		4	2	8.067E-02
		*		2	2	8.067E-02
$s^2P^o \rightarrow b^2P^e$	0.0622		0.0064	6	6	4.417E-04
		*		4	4	3.681E-04
		*		4	2	7.361E-05
		*		2	4	1.472E-04
		*		2	2	2.944E-04
$s^2P^o \rightarrow h^2D^e$	0.0622		0.0524	6	10	2.000E+00
		*		4	6	1.800E+00
		*		4	4	2.000E-01
		*		2	4	2.000E+00
$s^2P^o \rightarrow i^2D^e$	0.0622		0.0422	6	10	2.367E-01
		*		4	6	2.130E-01
		*		4	4	2.367E-02
		*		2	4	2.367E-01
$r^2P^o \rightarrow i^2S^e$	0.0525		0.0431	6	2	8.233E-02
		*		4	2	8.233E-02
		*		2	2	8.233E-02
$r^2P^o \rightarrow b^2P^e$	0.0525		0.0064	6	6	9.983E-03
		*		4	4	8.319E-03
		*		4	2	1.664E-03
		*		2	4	3.328E-03
		*		2	2	6.656E-03
$r^2P^o \rightarrow h^2D^e$	0.0525		0.0524	6	10	1.308E-02
		*		4	6	1.177E-02
		*		4	4	1.308E-03
		*		2	4	1.308E-02
$r^2P^o \rightarrow i^2D^e$	0.0525		0.0422	6	10	1.900E-01
		*		4	6	1.710E-01
		*		4	4	1.900E-02
		*		2	4	1.900E-01
$q^2P^o \rightarrow i^2S^e$	0.0481		0.0431	6	2	9.250E-01
		*		4	2	9.250E-01
		*		2	2	9.250E-01
$q^2P^o \rightarrow b^2P^e$	0.0481		0.0064	6	6	5.600E-03
		*		4	4	4.667E-03
		*		4	2	9.333E-04
		*		2	4	1.867E-03
		*		2	2	3.733E-03
$q^2P^o \rightarrow i^2D^e$	0.0481		0.0422	6	10	2.250E+00
		*		4	6	2.025E+00
		*		4	4	2.250E-01
		*		2	4	2.250E+00
$z^2D^o \rightarrow b^2P^e$	0.2302		0.0064	10	6	9.000E-02
		*		6	4	9.000E-02
		*		4	4	1.500E-02
		*		4	2	7.500E-02

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II

See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}	E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$z^2D^o \rightarrow h^2D^e$	0.2302	0.0524	10	10	4.830E-05
	*		6	6	4.508E-05
	*		6	4	3.220E-06
	*		4	6	4.830E-06
	*		4	4	4.347E-05
$z^2D^o \rightarrow i^2D^e$	0.2302	0.0422	10	10	4.790E-05
	*		6	6	4.471E-05
	*		6	4	3.193E-06
	*		4	6	4.790E-06
	*		4	4	4.311E-05
$z^2F^o \rightarrow h^2D^e$	0.2576	0.0524	14	10	6.271E-04
	*		8	6	6.271E-04
	*		6	6	4.181E-05
	*		6	4	5.853E-04
$z^2F^o \rightarrow i^2D^e$	0.2576	0.0422	14	10	3.957E-04
	*		8	6	3.957E-04
	*		6	6	2.638E-05
	*		6	4	3.693E-04
$y^2F^o \rightarrow h^2D^e$	0.1646	0.0524	14	10	2.707E-03
	*		8	6	2.707E-03
	*		6	6	1.805E-04
	*		6	4	2.527E-03
$y^2F^o \rightarrow i^2D^e$	0.1646	0.0422	14	10	1.557E-03
	*		8	6	1.557E-03
	*		6	6	1.038E-04
	*		6	4	1.453E-03
$x^2F^o \rightarrow h^2D^e$	0.1141	0.0524	14	10	9.500E-03
	*		8	6	9.500E-03
	*		6	6	6.333E-04
	*		6	4	8.867E-03
$x^2F^o \rightarrow i^2D^e$	0.1141	0.0422	14	10	4.657E-03
	*		8	6	4.657E-03
	*		6	6	3.105E-04
	*		6	4	4.347E-03
$w^2F^o \rightarrow h^2D^e$	0.0836	0.0524	14	10	3.829E-02
	*		8	6	3.829E-02
	*		6	6	2.552E-03
	*		6	4	3.573E-02
$w^2F^o \rightarrow i^2D^e$	0.0836	0.0422	14	10	1.386E-02
	*		8	6	1.386E-02
	*		6	6	9.238E-04
	*		6	4	1.293E-02
$v^2F^o \rightarrow h^2D^e$	0.0639	0.0524	14	10	3.121E-01
	*		8	6	3.121E-01
	*		6	6	2.081E-02
	*		6	4	2.913E-01
$v^2F^o \rightarrow i^2D^e$	0.0639	0.0422	14	10	5.071E-02
	*		8	6	5.071E-02
	*		6	6	3.381E-03
	*		6	4	4.733E-02
$u^2F^o \rightarrow i^2D^e$	0.0504	0.0422	14	10	3.893E-01
	*		8	6	3.893E-01
	*		6	6	2.595E-02
	*		6	4	3.633E-01
$z^2H^o \rightarrow c^2G^e$	0.1112	0.0820	22	18	7.636E-03
	*		12	10	7.636E-03
	*		10	10	1.697E-04
	*		10	8	7.467E-03
$z^2H^o \rightarrow d^2G^e$	0.1112	0.0628	22	18	1.077E-03
	*		12	10	1.077E-03
	*		10	10	2.394E-05
	*		10	8	1.053E-03
$z^2H^o \rightarrow e^2G^e$	0.1112	0.0496	22	18	3.286E-04
	*		12	10	3.286E-04
	*		10	10	7.303E-06
	*		10	8	3.213E-04
$z^2H^o \rightarrow f^2G^e$	0.1112	0.0401	22	18	1.418E-04
	*		12	10	1.418E-04
	*		10	10	3.152E-06
	*		10	8	1.387E-04
$z^2H^o \rightarrow a^2I^e$	0.1112	0.0816	22	26	2.004E+00
	*		12	14	1.979E+00
	*		12	12	2.570E-02
	*		10	12	2.005E+00
$z^2H^o \rightarrow b^2I^e$	0.1112	0.0625	22	26	2.182E-01
	*		12	14	2.154E-01
	*		12	12	2.797E-03
	*		10	12	2.182E-01
$z^2H^o \rightarrow c^2I^e$	0.1112	0.0494	22	26	6.045E-02
	*		12	14	5.968E-02
	*		12	12	7.751E-04
	*		10	12	6.046E-02
$z^2H^o \rightarrow d^2I^e$	0.1112	0.0400	22	26	2.482E-02
	*		12	14	2.450E-02
	*		12	12	3.182E-04
	*		10	12	2.482E-02
$y^2H^o \rightarrow d^2G^e$	0.0817	0.0628	22	18	2.068E-02
	*		12	10	2.068E-02
	*		10	10	4.596E-04
	*		10	8	2.022E-02
$y^2H^o \rightarrow e^2G^e$	0.0817	0.0496	22	18	3.241E-03
	*		12	10	3.241E-03
	*		10	10	7.202E-05
	*		10	8	3.169E-03
$y^2H^o \rightarrow f^2G^e$	0.0817	0.0401	22	18	1.054E-03
	*		12	10	1.054E-03
	*		10	10	2.343E-05
	*		10	8	1.031E-03
$y^2H^o \rightarrow a^2I^e$	0.0817	0.0816	22	26	4.477E-03
	*		12	14	4.420E-03
	*		12	12	5.740E-05
	*		10	12	4.477E-03
$y^2H^o \rightarrow b^2I^e$	0.0817	0.0625	22	26	1.795E+00
	*		12	14	1.772E+00
	*		12	12	2.302E-02
	*		10	12	1.796E+00
$y^2H^o \rightarrow c^2I^e$	0.0817	0.0494	22	26	2.991E-01
	*		12	14	2.953E-01
	*		12	12	3.834E-03
	*		10	12	2.991E-01
$y^2H^o \rightarrow d^2I^e$	0.0817	0.0400	22	26	9.954E-02
	*		12	14	9.827E-02
	*		12	12	1.276E-03
	*		10	12	9.955E-02
$x^2H^o \rightarrow e^2G^e$	0.0626	0.0496	22	18	3.754E-02
	*		12	10	3.755E-02
	*		10	10	8.343E-04
	*		10	8	3.671E-02
$x^2H^o \rightarrow f^2G^e$	0.0626	0.0401	22	18	6.318E-03
	*		12	10	6.318E-03
	*		10	10	1.404E-04
	*		10	8	6.178E-03
$x^2H^o \rightarrow b^2I^e$	0.0626	0.0625	22	26	1.023E-02
	*		12	14	1.010E-02
	*		12	12	1.311E-04
	*		10	12	1.023E-02
$x^2H^o \rightarrow c^2I^e$	0.0626	0.0494	22	26	1.668E+00
	*		12	14	1.647E+00
	*		12	12	2.139E-02
	*		10	12	1.668E+00
$x^2H^o \rightarrow d^2I^e$	0.0626	0.0400	22	26	3.332E-01
	*		12	14	3.289E-01
	*		12	12	4.272E-03
	*		10	12	3.332E-01
$w^2H^o \rightarrow f^2G^e$	0.0494	0.0401	22	18	5.727E-02
	*		12	10	5.727E-02
	*		10	10	1.273E-03
	*		10	8	5.600E-02
$w^2H^o \rightarrow c^2I^e$	0.0494	0.0494	22	26	1.618E-02
	*		12	14	1.597E-02
	*		12	12	2.075E-04
	*		10	12	1.618E-02

TABLE II. Energies and Oscillator Strengths for Allowed Transitions in Si II
See page 189 for Explanation of Tables

Transition	E_i Ry/cm^{-1}		E_f Ry/cm^{-1}	g_i	g_f	f_{if}
$w^2H^o \rightarrow d^2I^e$	0.0494		0.0400	22	26	1.591E+00
		*		12	14	1.571E+00
		*		12	12	2.040E-02
		*		10	12	1.591E+00
$v^2H^o \rightarrow d^2I^e$	0.0400		0.0400	22	26	2.204E-02
		*		12	14	2.176E-02
		*		12	12	2.826E-04
		*		10	12	2.205E-02
$z^2K^o \rightarrow c^2I^e$	0.0625		0.0494	30	26	4.900E-03
		*		16	14	4.900E-03
		*		14	14	5.385E-05
		*		14	12	4.846E-03
$z^2K^o \rightarrow d^2I^e$	0.0625		0.0400	30	26	5.800E-04
		*		16	14	5.800E-04
		*		14	14	6.374E-06
		*		14	12	5.736E-04
$z^2K^o \rightarrow a^2L^e$	0.0625		0.0494	30	34	2.673E+00
		*		16	18	2.654E+00
		*		16	16	1.966E-02
		*		14	16	2.673E+00
$z^2K^o \rightarrow b^2L^e$	0.0625		0.0400	30	34	2.387E-01
		*		16	18	2.369E-01
		*		16	16	1.755E-03
		*		14	16	2.387E-01
$y^2K^o \rightarrow d^2I^e$	0.0494		0.0400	30	26	1.363E-02
		*		16	14	1.363E-02
		*		14	14	1.498E-04
		*		14	12	1.348E-02
$y^2K^o \rightarrow a^2L^e$	0.0494		0.0494	30	34	2.323E-05
		*		16	18	2.306E-05
		*		16	16	1.708E-07
		*		14	16	2.323E-05
$y^2K^o \rightarrow b^2L^e$	0.0494		0.0400	30	34	2.443E+00
		*		16	18	2.425E+00
		*		16	16	1.797E-02
		*		14	16	2.443E+00
$x^2K^o \rightarrow b^2L^e$	0.0400		0.0400	30	34	7.167E-05
		*		16	18	7.114E-05
		*		16	16	5.270E-07
		*		14	16	7.167E-05