RADIATIVE TRANSFER IN SILYLIDENE MOLECULE

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SUMMARY: In order to search for silylidene (H_2CSi) in the interstellar medium, Izuha et al. (1996) recorded microwave spectrum of H_2CSi in laboratory and made an unsuccessful attempt of its identification in IRC +10216, Ori KL, Sgr B2, through its $7_{17}-6_{16}$ transition at 222.055 GHz. For finding out if there are other transitions of H_2CSi which may help in its identification in the interstellar medium, we have considered 25 rotational levels of ortho-H_2CSi connected by collisional transitions and 35 radiative transitions, and solved radiative transfer problem using the LVG approximation. We have found that the brightness temperatures of $9_{19}-8_{18}$, $9_{18}-8_{17}$, $10_{1,10}-9_{19}$, $10_{19}-9_{18}$, $11_{1,11}-10_{1,10}$, $11_{1,10}-10_{19}$ and $12_{1,12}-11_{1,11}$ transitions are larger than that of $7_{17}-6_{16}$ transition. Thus, these transitions may help in detection of H_2CSi in the interstellar medium.

Key words. ISM: lines and bands – molecular data – radiative transfer

1. INTRODUCTION

Out of a large number of molecules identified in the interstellar medium, some molecules have been found bearing the Si atom. The Si-bearing molecules identified in the interstellar medium are SiN (Turner 1992), SiC (Cernicharo et al. 1989), SiO (Snyder and Buhl 1974), SiS (Turner 1987), *c*-SiC$_2$ (Thaddeus et al. 1984), SiCN (Guélin et al. 2000), SiNC (Guélin et al. 2004), *c*-SiC$_3$ (Apponi et al. 1999), C$_4$Si (Ohishi et al. 1989), SiH$_4$ (Goldhaber and Betz 1984). These molecules have been detected in an envelope around a red supergiant star IRC +10216. SiO and SiS are also detected in the massive-star forming regions such as Ori KL and Sgr B2. Herbst et al. (1989) carried out detailed chemical model calculations for Si-bearing molecules in the dense molecular clouds and predicted relative abun-

dances of 23 Si-bearing molecules, and Si and Si$^+$. Two molecules, SiS and SiCN, which have not been part of the tables of Herbst et al. (1989), have been identified in the IRC +10216. The results of Herbst et al. (1989) showed that the H_2CSi could be one of the Si-bearing molecules existing in the interstellar medium. In their model 1 (gas kinetic temperature 10 K, molecular hydrogen number density 10^4 cm^{-3}, and silicon fractional abundance 4×10^{-8}) with respect to H_2 at early time, the relative abundance of H_2CSi has been reported to be 1.6 $\times 10^{-10}$, which reduced to 5.8 $\times 10^{-14}$ in the steady state. Some molecules which have been identified in the interstellar medium have abundances larger than that of H_2CSi and some have smaller. This supports the opinion that H_2CSi may be identified in the interstellar medium.

In the H_2CSi molecule, the nuclear spin of each of the C and Si atoms is zero. The nuclear spin of the H atom is 1/2 and because of two hydrogen atoms in H_2CSi, there are two species, called, ortho ($I = 1$, parallel spins) and para ($I = 0$, antiparallel spins). The ortho and para species of H_2CSi behave as two independent molecules, as there are no transitions between the two species. With the intention of detection of H_2CSi in the interstellar medium, Izuha et al. (1996) recorded a microwave spectrum of H_2CSi and made an unsuccessful attempt of its identification in the IRC +10216, Ori KL, Sgr B2 through its transition $7_{17} - 6_{16}$ at 222.055 GHz. For IRC+10216, the rms noise level in the antenna temperature was 3 mK for resolution of 2 MHz, and the 3σ upper limit to the column density toward IRC+10216 was derived to be 5.8×10^{13} cm^{-2}.

Since the structure of H_2CSi is similar to that of H_2CO and H_2CS, which have been identified in the interstellar medium, we have decided to investigate the H_2CSi molecule in more detail. We have considered the ortho-H_2CSi in the present investigation in order to complete the previous study of Izuha et al. (1996). Sharma et al. (2014a) have discussed the the rotational lines of H_2CSi which may help for identification of H_2CSi in the interstellar medium. In order to understand the transfer of radiation in the ortho-H_2CSi, we have considered 25 rotational levels connected by collisional transitions, and 35 radiative transitions. The radiative transfer is treated by means of the Large Velocity Gradient (LVG) approximation.

In Section 2, we have discussed the ortho-H_2CSi and details used in the investigation. Section 3 is devoted to obtained results and discussion. Finally, we summarize the investigation in Section 4.

2. THEORY

For investigation of a molecule, one requires information about the spectroscopy of the molecule. As the kinetic temperature in a region where H_2CSi may be identified is very low (few tens of Kelvin), we are concerned with rotational levels in the ground vibrational state and ground electron state. Using the rotational and distortional constants of Izuha et al. (1996), Sharma et al. (2014a) calculated energies for rotational levels of ortho and para species of H_2CSi. The rotational levels in an asymmetric top molecule are expressed as J_{k_a,k_c}, where J denotes the rotational quantum number, k_a and k_c are the projections of J on the axis of symmetry in case of prolate and oblate symmetric tops, respectively. Since the collisional rate coefficients are available for transitions among 25 rotational levels, we have accounted for 25 rotational levels whose energies are given in Table 1. The energy level diagram for the levels is shown in Fig. 1.
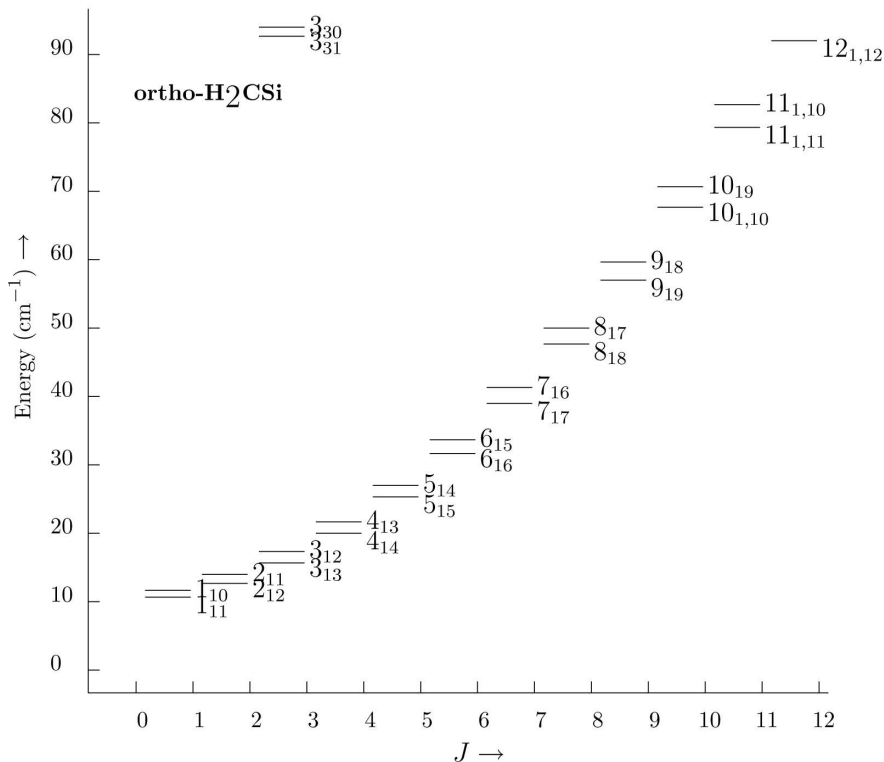

Fig. 1. *Rotational levels of ortho-H_2CSi. For the sake of clarity, upper level of a doublet is shifted a bit in the upper direction.*

Table 1. Energies of levels in ortho-H_2CSi.

No.	Level	$E(\text{cm}^{-1})$	$E(\text{GHz})$	No.	Level	$E(\text{cm}^{-1})$	$E(\text{GHz})$
1	1_{11}	10.679	320.382	14	7_{16}	40.122	1203.663
2	1_{10}	10.711	321.336	15	8_{18}	47.691	1430.726
3	2_{12}	12.795	383.841	16	8_{17}	48.835	1465.042
4	2_{11}	12.890	386.703	17	9_{19}	57.206	1716.179
5	3_{13}	15.968	479.027	18	9_{18}	58.635	1759.064
6	3_{12}	16.158	484.750	19	$10_{1,10}$	67.777	2033.317
7	4_{14}	20.198	605.937	20	10_{19}	69.524	2085.721
8	4_{13}	20.516	615.475	21	$11_{1,11}$	79.404	2382.132
9	5_{15}	25.486	764.568	22	$11_{1,10}$	81.500	2445.000
10	5_{14}	25.962	778.872	23	$12_{1,12}$	92.087	2762.613
11	6_{16}	31.830	954.914	24	3_{31}	92.932	2787.952
12	6_{15}	32.498	974.937	25	3_{30}	92.932	2787.952
13	7_{17}	39.232	1176.969				

These 25 levels are coupled through radiative as well as collisional transitions. The radiative transitions are governed by the selection rules:

$$J: \quad \Delta J = 0, \pm 1$$
$$k_a, k_c: \quad \text{odd, even} \longleftrightarrow \text{odd, odd} \quad \text{(ortho-transition)}$$
$$\text{even, even} \longleftrightarrow \text{even, odd} \quad \text{(para-transition)}$$

Among these 25 levels there are 35 radiative transitions. We have solved a set of statistical equilibrium equations coupled with equations of radiative transfer. Namely, in the large-velocity gradient (LVG) approximation (Sobolev 1957) that we use, the knowledge of the probability of photon escape β is sufficient to determine the level populations by solving the equations:

$$n_i \sum_{\substack{j=1 \\ j \neq i}}^{25} P_{ij} = \sum_{\substack{j=1 \\ j \neq i}}^{25} n_j\, P_{ji} \quad i = 1, 2, \ldots, 25 \quad (1)$$

where n's are the level populations and P's are as follows:

(i) For radiatively allowed transitions:

$$P_{ij} = \begin{cases} (A_{ij} + B_{ij}\, I_{\nu,bg})\beta_{ij} + n_{H_2}\, C_{ij} & i > j \\[2mm] B_{ij}\, I_{\nu,bg}\beta_{ij} + n_{H_2}\, C_{ij} & i < j \end{cases} \quad (2)$$

(ii) For radiatively forbidden transitions:

$$P_{ij} = n_{H_2}\, C_{ij} \quad (3)$$

where $I_{\nu,bg}$ is the intensity of cosmic background radiation, A's and B's are Einstein coefficients, and C's the collisional rate coefficients. The n_{H_2} is the number density of molecular hydrogen, and the escape probability β for the transition between the upper level u and lower level l is:

$$\beta_{lu} = \beta_{ul} = \frac{1 - \exp(-\tau_\nu)}{\tau_\nu} \quad (4)$$

where the optical thickness τ_ν is:

$$\tau_\nu = \frac{hc}{4\pi(\mathrm{d}v_r/\mathrm{d}r)} \left[B_{lu}n_l - B_{ul}n_u \right] \quad (5)$$

where $(\mathrm{d}v_r/\mathrm{d}r)$ is the velocity gradient in the region. Here, the external radiation field, impinging on a volume element generating the lines, is the cosmic microwave background (CMB) only with the background temperature $T_{\text{bg}} = 2.7$ K. Twenty-four linearly independent statistical equilibrium equations (1) are closed by the equation.

$$\sum_{i=1}^{25} n_i = n_{\text{total}}$$

where n_{total} is the total number density of silylidene molecules. This system is non-linear because the optical depths $\tau_\nu^{ul} = \tau_\nu^{lu}$ depend upon the solution. Thus, it is necessary to solve the system iteratively. For the initial values to start the iterative procedure we have used the equilibrium (LTE) values of the level populations at a given kinetic temperature. The input parameters for solving the above set of equations are the radiative transition probabilities and the collisional rate coefficients for the transitions between the levels.

2.1. Radiative transition probabilities

The electric dipole moment of H_2CSi is $\mu = 0.3$ Debye (Izuha et al. 1996). Using the rotational and distortional constants, and the electric dipole moment, we have calculated Einstein A-coefficients for transitions between the levels using the computer code ASROT (Kisiel 2001) and the values for ortho-H_2CSi are given in Table 2.

Table 2. Einstein A-coefficients for radiative transitions.

Transition			Freq (GHz)	A (s^{-1})	Transition			Freq (GHz)	A (s^{-1})
$1_{1,0}$	$\rightarrow$	$1_{1,1}$	0.954	4.546E-13	$2_{1,2}$	$\rightarrow$	$1_{1,1}$	63.459	8.031E-08
$2_{1,1}$	$\rightarrow$	$1_{1,0}$	65.367	8.778E-08	$2_{1,1}$	$\rightarrow$	$2_{1,2}$	2.862	4.091E-12
$3_{1,3}$	$\rightarrow$	$2_{1,2}$	95.186	3.442E-07	$3_{3,1}$	$\rightarrow$	$2_{1,2}$	2404.111	4.159E-09
$3_{1,2}$	$\rightarrow$	$2_{1,1}$	98.047	3.761E-07	$3_{3,0}$	$\rightarrow$	$2_{1,1}$	2401.249	4.144E-09
$3_{1,2}$	$\rightarrow$	$3_{1,3}$	5.723	1.636E-11	$3_{3,0}$	$\rightarrow$	$3_{1,3}$	2308.925	1.842E-09
$4_{1,4}$	$\rightarrow$	$3_{1,3}$	126.910	8.922E-07	$4_{1,3}$	$\rightarrow$	$3_{1,2}$	130.725	9.751E-07
$4_{1,3}$	$\rightarrow$	$4_{1,4}$	9.537	4.544E-11	$5_{1,5}$	$\rightarrow$	$4_{1,4}$	158.630	1.825E-06
$5_{1,4}$	$\rightarrow$	$4_{1,3}$	163.398	1.994E-06	$5_{1,4}$	$\rightarrow$	$5_{1,5}$	14.305	1.022E-10
$6_{1,6}$	$\rightarrow$	$5_{1,5}$	190.346	3.242E-06	$6_{1,5}$	$\rightarrow$	$5_{1,4}$	196.065	3.543E-06
$6_{1,5}$	$\rightarrow$	$6_{1,6}$	20.024	2.003E-10	$7_{1,7}$	$\rightarrow$	$6_{1,6}$	222.055	5.243E-06
$7_{1,6}$	$\rightarrow$	$6_{1,5}$	228.726	5.730E-06	$7_{1,6}$	$\rightarrow$	$7_{1,7}$	26.694	3.559E-10
$8_{1,8}$	$\rightarrow$	$7_{1,7}$	253.758	7.929E-06	$8_{1,7}$	$\rightarrow$	$7_{1,6}$	261.379	8.665E-06
$8_{1,7}$	$\rightarrow$	$8_{1,8}$	34.315	5.880E-10	$9_{1,9}$	$\rightarrow$	$8_{1,8}$	285.452	1.140E-05
$9_{1,8}$	$\rightarrow$	$8_{1,7}$	294.023	1.246E-05	$9_{1,8}$	$\rightarrow$	$9_{1,9}$	42.885	9.183E-10
$10_{1,10}$	$\rightarrow$	$9_{1,9}$	317.139	1.575E-05	$10_{1,9}$	$\rightarrow$	$9_{1,8}$	326.656	1.721E-05
$10_{1,9}$	$\rightarrow$	$10_{1,10}$	52.403	1.371E-09	$11_{1,11}$	$\rightarrow$	$10_{1,10}$	348.815	2.109E-05
$11_{1,10}$	$\rightarrow$	$10_{1,9}$	359.279	2.304E-05	$11_{1,10}$	$\rightarrow$	$11_{1,11}$	62.867	1.973E-09
$12_{1,12}$	$\rightarrow$	$11_{1,11}$	380.481	2.750E-05					

2.2. Collisional rate coefficients

The collisional transitions do not follow any restrictions, but their computation is a tedious job. Using the method discussed by Sharma et al. (2014b), Sharma et al. (2014c) have calculated collisional rate coefficients among 25 levels of each of the ortho and para species of H_2CSi colliding with the He atom (see below). They have given the collisional deexcitation rate coefficients which have been used in the present investigation. The excitation rate coefficients for the transitions have been calculated by means of the detailed equilibrium equation (Chandra and Kegel 2000).

For calculations of collisional rate coefficients, the interaction potential between the molecule and the colliding partner is required. For calculation of the interaction potential, the molecule H_2CSi is first optimized with the help of GAUSSIAN 2003 (Frisch et al. 2004) and the coordinates of its constituent atoms are obtained. In interstellar molecular clouds, the most abundant element hydrogen is predominantly in the form of H_2 molecules and therefore one has to account for the collisions between H_2CSi and H_2 molecules. For convenience, H_2 is considered as structureless and is replaced by the He atom (Machin and Roueff 2007, Rabli and Flower 2010, Gotoum et al. 2011, Spielfiedel et al. 2012, Sharma et al. 2014b, 2014c) as both the He and H_2 have two protons and two electrons, and the interaction potential depends on charges of the colliding particles.

The values of collisional deexcitation rate coefficients for $7_{1,7} \rightarrow 6_{1,5}$, $9_{1,9} \rightarrow 8_{1,8}$, $9_{1,8} \rightarrow 8_{1,7}$, $10_{1,10} \rightarrow 9_{1,9}$, $10_{1,9} \rightarrow 9_{1,8}$, $11_{1,11} \rightarrow 10_{1,10}$, $11_{1,10} \rightarrow 10_{1,9}$, $12_{1,12} \rightarrow 11_{1,11}$ transitions for kinetic temperatures 10, 20, 30, 40, and 50 K are given in Table 3. It is interesting to note that the collisional rate coefficients increase with the increase of kinetic temperature.

Table 3. Collisional rate coefficients in cm^3 s^{-1} for ortho H_2CSi.

Transition	10 K	20 K	30 K	40 K	50 K	u	l
$7_{1,7} \rightarrow 6_{1,5}$	6.93E-12	1.03E-11	1.30E-11	1.51E-11	1.65E-11	13	12
$9_{1,9} \rightarrow 8_{1,8}$	3.92E-11	4.85E-11	5.48E-11	5.93E-11	6.20E-11	17	15
$9_{1,8} \rightarrow 8_{1,7}$	4.36E-11	5.24E-11	5.81E-11	6.20E-11	6.42E-11	18	16
$10_{1,10} \rightarrow 9_{1,9}$	7.36E-11	9.14E-11	1.03E-10	1.11E-10	1.16E-10	19	17
$10_{1,9} \rightarrow 9_{1,8}$	7.62E-11	9.37E-11	1.05E-10	1.12E-10	1.17E-10	20	18
$11_{1,11} \rightarrow 10_{1,10}$	4.90E-10	6.02E-10	6.77E-10	7.30E-10	7.63E-10	21	19
$11_{1,10} \rightarrow 10_{1,9}$	5.28E-10	6.49E-10	7.29E-10	7.86E-10	8.21E-10	22	20
$12_{1,12} \rightarrow 11_{1,11}$	3.08E-09	3.78E-09	4.25E-09	4.58E-09	4.79E-09	23	21

3. RESULTS AND DISCUSSION

The collisional rate coefficients are computed by Sharma et al. (2014c) for the transitions among 25 rotational levels and kinetic temperatures 10 - 50 K. Though in some molecular clouds the kinetic temperature may be above 50 K, keeping in mind the availability of collisional rate coefficients, we considered kinetic temperature up to 50 K. We have calculated relative percentage populations (under Local Thermodynamic Equilibrium (LTE)) for the energy levels as:

$$Q_i = \frac{(2J_i + 1)\,\exp(-E_i/kT)}{Z}\,100 \qquad (6)$$

where:

$$Z = \sum_{i=1}^{25}(2J_i + 1)\,\exp(-E_i/kT). \qquad (7)$$

Here, J_i and E_i are, respectively, the rotational quantum number and energy of the i-th level. We have found $Q_{25} = 0.54$ for $T = 50$K. It shows that for the considered temperatures, the accounted number of levels is sufficient. The values of Q_i for the upper level of transitions given in Table 3 are given in Table 4 for kinetic temperatures 10, 20, 30, 40, and 50 K.

Table 4. The values of Q_i for the level i for various temperatures.

Level	10 K	20 K	30 K	40 K	50 K
13	0.86	3.53	4.82	5.28	5.43
17	0.08	1.23	2.58	3.50	4.10
18	0.07	1.11	2.40	3.33	3.93
19	0.02	0.63	1.71	2.65	3.34
20	0.02	0.56	1.58	2.49	3.18
21	0.00	0.30	1.07	1.91	2.62
22	0.00	0.26	0.97	1.77	2.47
23	0.00	0.13	0.64	1.31	1.98

We have solved the set of coupled equations through the iterative procedure for given values of molecular hydrogen number density n_{H_2} and the parameter $\gamma \equiv n_{mol}/(dv_r/dr)$, where n_{mol} is the density of the molecule H_2CSi and (dv_r/dr) is the velocity-gradient. In order to cover a large number of molecular clouds where H_2CSi may be found, we have taken wide ranges for the physical parameters; the n_{H_2} is varied from 10^2 cm^{-3} to 10^6 cm^{-3}, and γ is taken as 10^{-6} cm^{-3}(km/s)$^{-1}$pc, 5×10^{-6} cm^{-3}(km/s)$^{-1}$pc and 10^{-5} cm^{-3}(km/s)$^{-1}$pc. The kinetic temperatures are taken to be $T = 10, 20, 30, 40,$ and 50 K. The parameter γ is the ratio of column density and velocity difference and covers a wide range of physically available column densities and velocity differences.

Once the level populations are known, the intensity of the lines can be calculated. Intensity I_ν of a line generated in an interstellar cloud, with homogeneous excitation conditions, is:

$$I_\nu - I_{\nu,bg} = (S_\nu - I_{\nu,bg})(1 - e^{-\tau_\nu}) \qquad (8)$$

where S_ν is the source function, $I_{\nu,bg}$ is the background intensity against which the line is observed, and τ_ν is the optical depth of the line. Eq. (8) can also be expressed as:

$$B_\nu(T_B) - B_\nu(T_{bg}) =$$
$$= [B_\nu(T_{ex}) - B_\nu(T_{bg})]\,(1 - e^{-\tau_\nu}) \qquad (9)$$

where B_ν is Planck's function corresponding to various temperatures, T_{bg} is the background temperature, T_B is the brightness temperature, and T_{ex} is the excitation temperature of the line. In the Rayleigh-Jeans limit $[\nu(\text{GHz}) << 21T(\text{K})]$, $(h\nu << kT)$, Eq. (9) can be written as:

$$T_B = T_{ex} + (T_{bg} - T_{ex})e^{-\tau_\nu}\,. \qquad (10)$$

This obviously shows that for the optically thin case $\tau_\nu \approx 0$, we have $T_B = T_{bg}$. Whether a given line appears in absorption or in emission, depends in general on the physical conditions within the cloud where it is formed, and on the background against which it is observed.

Using the level populations, we have calculated brightness temperatures for transitions $7_{17} - 6_{16}$, $9_{19} - 8_{18}$, $9_{18} - 8_{17}$, $10_{1,10} - 9_{19}$, $10_{19} - 9_{18}$, $11_{1,11} - 10_{1,10}$, $11_{1,10} - 10_{19}$ and $12_{1,12} - 11_{1,11}$. The results for the first four transitions are shown in Fig. 2 whereas for the last four transitions are shown in Fig. 3. Figs. 2 and 3 for 10 K temperature show that the brightness temperature of all these lines is almost the background temperature, and levels being above 30 cm^{-1} are not substantially populated. At 20 K, the populations of 7_{17} and 6_{16} become substantial and, therefore, the brightness temperature of the $7_{17} - 6_{16}$ line is larger than those of the other seven transitions. With a further increase of temperature, all the levels are populated. The brightness temperatures of other seven transitions are larger than that of $7_{17} - 6_{16}$. It shows that the probability of detection of the other seven transitions is larger than that of the $7_{17} - 6_{16}$ transition. Thus, the other seven transitions may help for the search of H_2CSi in the interstellar medium.

Figs. 2 and 3 show that, with the increase of density, the brightness temperature of all the lines increases. The other seven transitions become stronger than the $7_{17} - 6_{16}$ transition in the high density region. Thus, in the dense molecular clouds, where density is 10^4 cm^{-3} or more, the probability of detection of H_2CSi is large as compared to that in the low density regions.

We note that all predictions in our study have been made based on the gas-phase abundances of H_2CSi. As shown for SiO and SiS by Tercero et al. (2011), the grain-based abundances of H_2CSi are likely to be higher, possibly resulting in even higher expected brightness temperature of H_2CSi spectral lines.

4. CONCLUSION

We have calculated radiative transition probabilities among 25 rotational levels of ortho-H_2CSi by using the parameters derived from very accurate laboratory measurements. With these values as well as with the collisional rate coefficients obtained by Sharma et al. (2014c) we have solved the radiative transfer problem using the LVG approximation. We have found that there are seven line transitions which may help in identification of H_2CSi in the interstellar medium. They can be searched for in clouds at densities greater than 10^4 cm^{-3}, temperatures higher than 20 K, and for γ higher than 5×10^{-6} cm^{-3}(km/s)$^{-1}$pc.
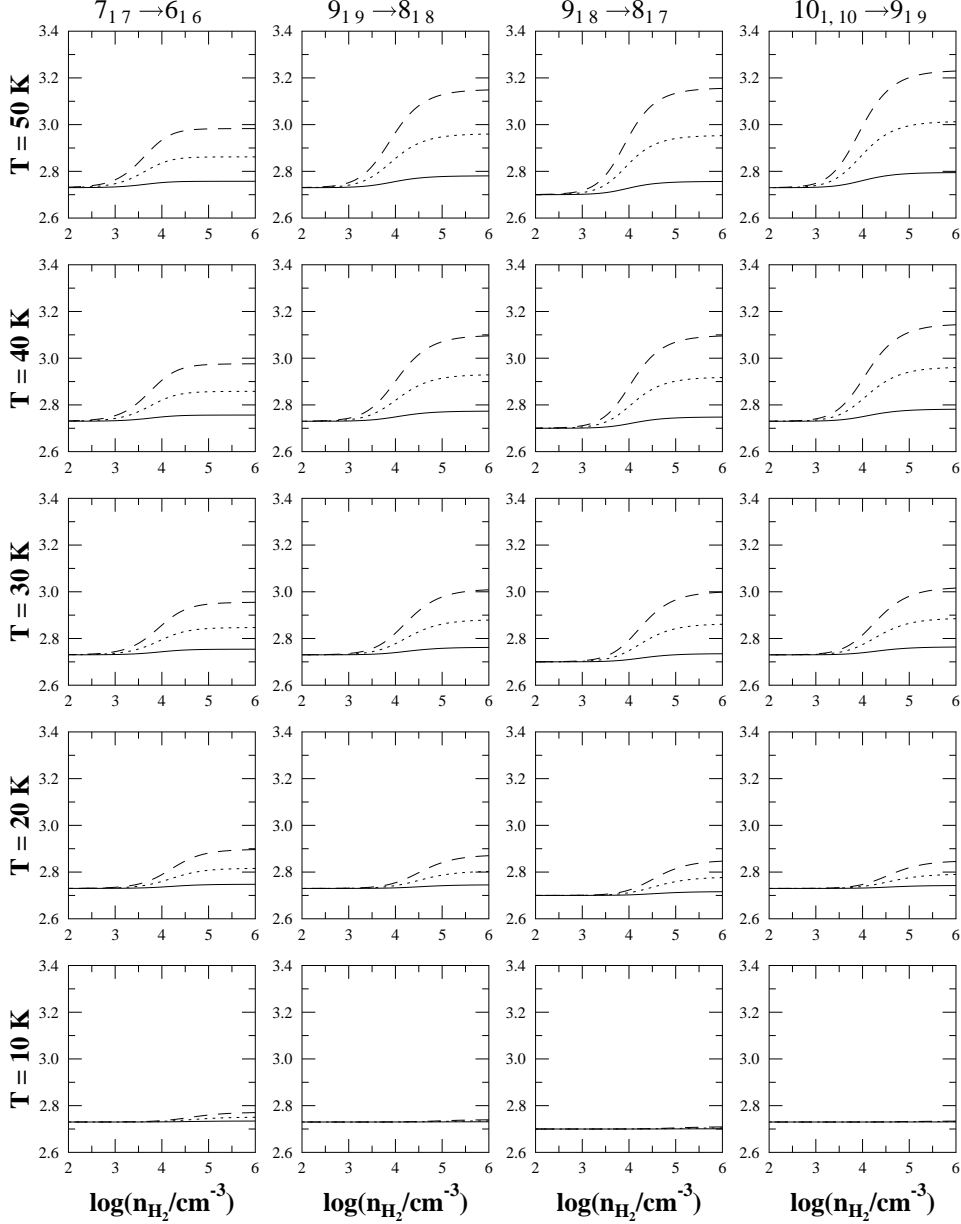
Fig. 2. *Brightness temperature in Kelvin for the $7_{17} - 6_{16}$ transition (column 1), $9_{19} - 8_{18}$ transition (column 2), $9_{18} - 8_{17}$ transition (column 3), and $10_{1,10} - 9_{19}$ transition (column 4) for H_2CSi for kinetic temperatures $T = 10, 20, 30, 40,$ and 50 K. Solid line is for $\gamma = 10^{-6}$ cm^{-3}(km/s)$^{-1}$pc, dotted line for $\gamma = 5 \times 10^{-6}$ cm^{-3}(km/s)$^{-1}$pc, and dashed line for $\gamma = 10^{-5}$ cm^{-3}(km/s)$^{-1}$pc.*
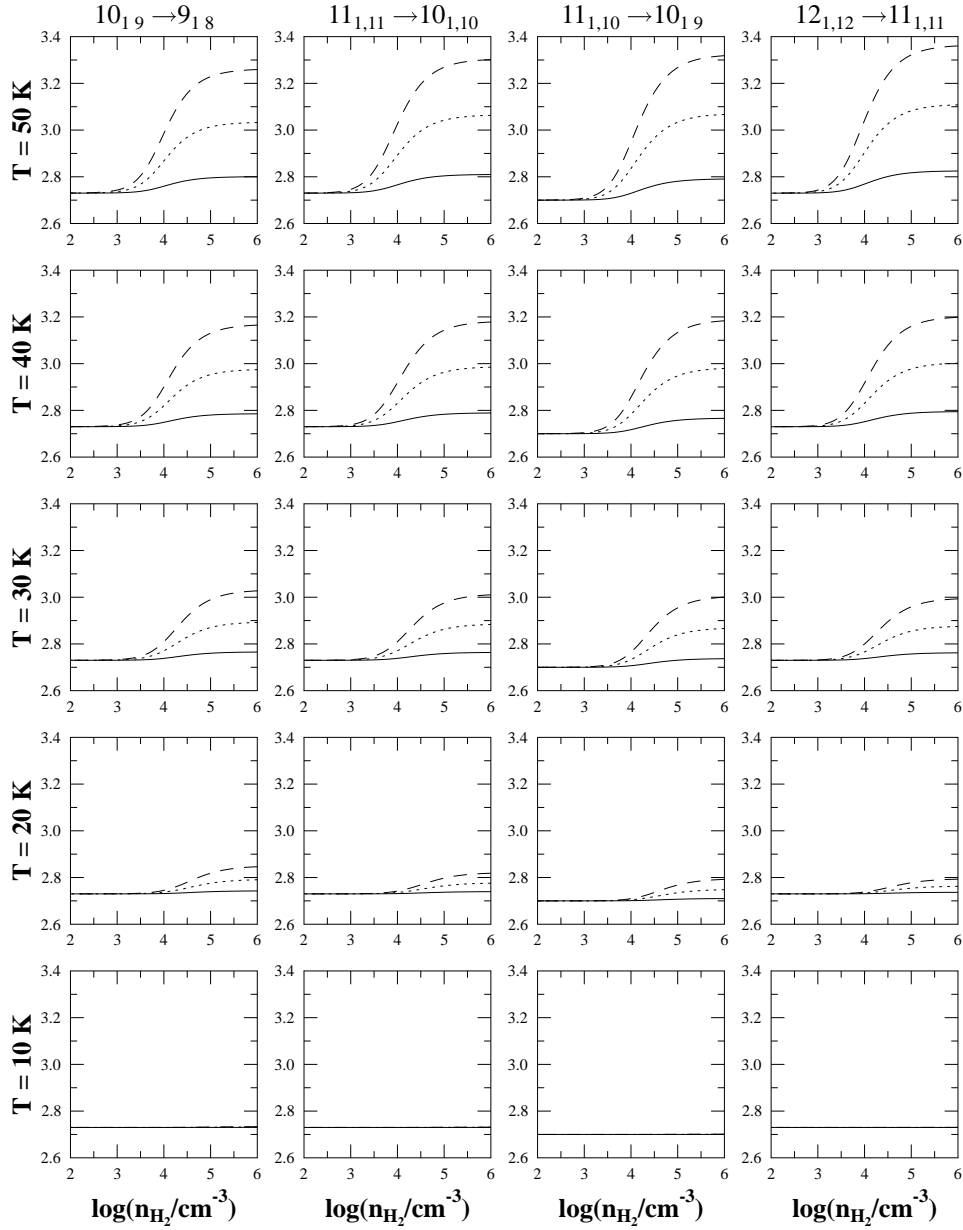
Fig. 3. *Brightness temperature in Kelvin for the $10_{19} - 9_{18}$ transition (column 1), $11_{1,11} - 10_{1,10}$ transition (column 2), $11_{1,10} - 10_{19}$ transition (column 3), and $12_{1,12} - 11_{1,11}$ transition (column 4) for H_2CSi for kinetic temperatures $T = 10$, 20, 30, 40, and 50 K. Solid line is for $\gamma = 10^{-6}$ $cm^{-3}(km/s)^{-1}pc$, dotted line for $\gamma = 5 \times 10^{-6}$ $cm^{-3}(km/s)^{-1}pc$, and dashed line for $\gamma = 10^{-5}$ $cm^{-3}(km/s)^{-1}pc$.*

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ПРЕНОС ЗРАЧЕЊА КОД МОЛЕКУЛА СИЛИЛИДЕНА

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У циљу потраге за молекулом силилидена (H_2CSi) у међузвезданој средини, Изуха и сарадници (1996) снимили су лабораторијски спектар H_2CSi у микроталасном подручју и покушали су да изврше његову идентификацију помоћу прелаза $7_{17} - 6_{16}$ на 222.055 GHz у објектима IRC+10216, Ori KL, Sgr B2, али без успеха. Ради утврђивања да ли постоје још неки прелази у молекулу H_2CSi који би могли да помогну његовој идентификацији у међузвезданој средини, размотрили смо 25 ротационих нивоа ortho-H_2CSi повезаних сударним прелазима и 35 радијативних прелаза, и решили смо проблем преноса зрачења користећи LVG апроксимацију. Утврдили смо да су температуре по сјају прелаза: $9_{19}-8_{18}$, $9_{18}-8_{17}$, $10_{1,10} - 9_{19}$, $10_{19} - 9_{18}$, $11_{1,11} - 10_{1,10}$, $11_{1,10} - 10_{19}$ и $12_{1,12}-11_{1,11}$ веће него за прелаз $7_{17}-6_{16}$. Ти прелази би, дакле, могли послужити за детекцију H_2CSi у међузвезданој средини.