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Calculation of the $\text{NFb}^1\Sigma - \text{X}^3\Sigma^-$ Stimulated Emission Cross Section

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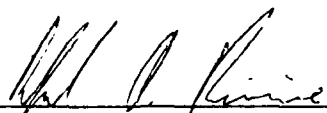
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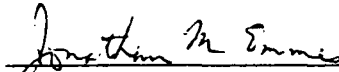
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The stimulated emission cross section for the $NFb^1 \Sigma-X^3 \Sigma^-$ transition has been derived under conditions of the Born-Oppenheimer approximation where coordinates involving nuclear and electronic motion are separable. Exact and Hund's coupling case B Honl-London factors are presented. Sample calculations for the five rotational branches of the $NFb^1 \Sigma-X^3 \Sigma^- (0,0)$ band at several temperatures are given.					
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The stimulated emission cross section for a transition between an initial state $\langle I|$ and a final state $|F\rangle$ is given by:

$$\sigma_{em}(\nu) = (8\pi^3/3ch) |\langle I|\mu|F\rangle|^2 \nu g(\nu), \quad (1)$$

where $|\langle I|\mu|F\rangle|$ is the electric dipole matrix element connecting the two levels, ν is the frequency of the transition, and $g(\nu)$ is the normalized lineshape function.

For the NF $b^1\Sigma^- - X^3\Sigma^-$ transition, we can write

$$|\langle I|\mu|F\rangle|^2 = |\langle NF b^1\Sigma, v', N' | \mu | NF X^3\Sigma, v'', N'' \rangle|^2, \quad (2)$$

where v is the vibrational quantum number and N is the rotational quantum number. Under the Born–Oppenheimer approximation where coordinates involving nuclear and electronic motion are separable, Eq. (1) can be written as

$$|\langle I|\mu|F\rangle|^2 = |R_e|^2 q_{v'v''} s(N')/(2N' + 1), \quad (3)$$

where $|R_e|^2$ is the electronic transition moment, $q_{v'v''}$ is the Franck–Condon factor, and $s(N')$ are Hönl–London factors which depend upon the rotational quantum number N' .

The NF $b^1\Sigma^- - X^3\Sigma^-$ spectrum consists of the rotational branches depicted in Fig. 1. Although five branches are present, it should be noted that the much stronger Q_P and Q_R branches comprise most of the intensity for a particular set of transitions from a specific NF $b^1\Sigma, v', N'$ level. Following the notation given by Vervloet and Watson (Ref. 2), Eq. (3) becomes

$$|\langle I|\mu|F\rangle|^2 = q_{v'v''} \mu_0^2 s(N, \rho)/(2N' + 1), \quad (4)$$

where μ_0^2 is the parallel electronic transition moment. The Hönl–London factors appearing in Eq (4) are given in Table 1. Two sets of Hönl–London factors are listed in Table 1. One set is valid for any $^3\Sigma^- - ^1\Sigma^-$ transition and the other is valid for Hund's coupling case b. It should be noted that the simpler Hund's case b factors may be used to a good level of approximation for the case of NF, since the spin–spin interaction constant for the NF $^3\Sigma^-$ state is small compared to the rotational energy level spacing (Refs. 2 and 3) even at relatively low N'' . This trend is illustrated in Fig. 2, where relative Hönl–London factors for the Q_P branch are plotted as a function of N' . For a particular NF $(b^1\Sigma, v', N') \rightarrow NF (X^3\Sigma^- v'', N'')$ transition, the stimulated emission cross section is

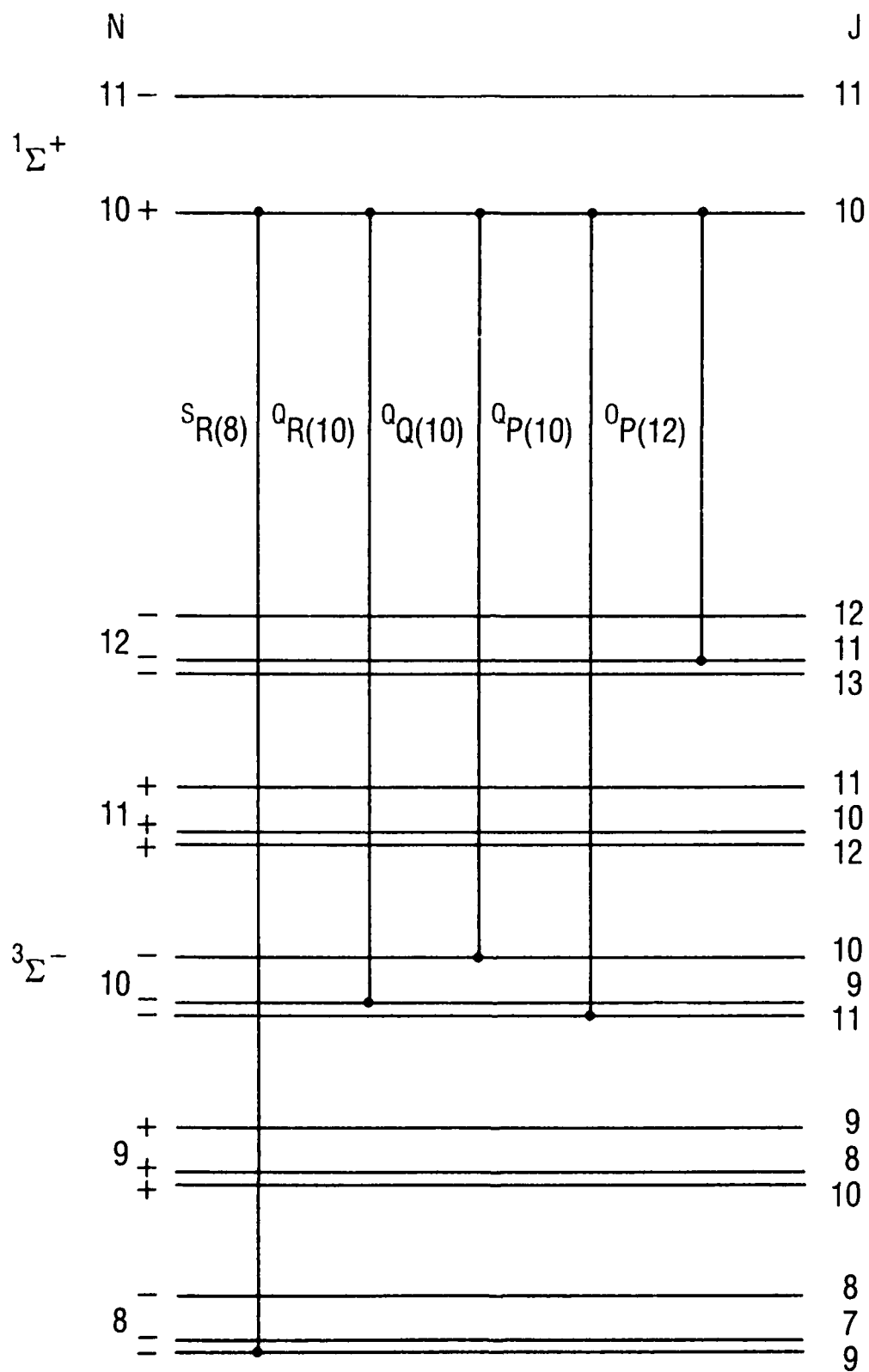


Fig. 1. Rotational Branches in a $1\Sigma - 3\Sigma^-$ Transition

Table 1. NF $b^1\Sigma^- - X^3\Sigma^-$ Hönl-London Factors

N	$^O P$ Branch	$^O P$ Branch	$^O Q$ Branch	$^O R$ Branch	$^S R$ Branch
$^O P$	N-1	$[s_j J^{1/2} - c_j(J+1)^{1/2}\rho]^2$		$\mu_0^2 [(1-\rho)^2 (N+1) (N+2)]/(2N+3)$	
$^O P$	N+1	$[c_j J^{1/2} + s_j(J+1)^{1/2}\rho]^2$		$\mu_0^2 [(N + (N-1)\rho)^2/(2N-1)]$	
$^O Q$	N	$(2J+1)\rho^2$		$\mu_0^2 (2N+1)\rho^2$	
$^O R$	N-1	$[s_j(J+1)^{1/2} + c_j J^{1/2}\rho]^2$		$\mu_0^2 [(N+1) + (N+2)\rho]^2/(2N+3)$	
$^S R$	N+1	$[c_j(J+1)^{1/2} - s_j J^{1/2}\rho]^2$		$\mu_0^2 (1-\rho)^2 (N-1) N/(2N+3)$	

$^a N$ is the NF $b^1\Sigma$ rotational quantum number.

$$^b \rho = \mu_1/\mu_0$$

$$^c s_j = \{[(F_2(J)-F_1(J))/[F_3(J)-F_1(J)]]\}^{1/2}$$

$$c_j = \{[(F_3(J)-F_2(J))/[F_3(J)-F_1(J)]]\}^{1/2}$$

$$F_1(J) = B J(J+1) + (B - \lambda - \gamma/2) - [(B - \lambda - \gamma/2)^2 + 4J(J+1)(B - \gamma/2)^2]^{1/2}$$

$$F_2(J) = B J(J+1)$$

$$F_3(J) = B J(J+1) + (B - \lambda - \gamma/2) + [(B - \lambda - \gamma/2)^2 + 4J(J+1)(B - \gamma/2)^2]^{1/2}$$

$$\sigma_{em}(\nu) = (8\pi^3/3ch) q_{\nu'\nu''} \mu_0^2 s(N',\rho)/(2N' + 1) g(\nu). \quad (5)$$

Sample Calculations

Tables 2-4 contain calculated stimulated emission cross sections for the five branches of the NF $b^1\Sigma^- - X^3\Sigma^-$ (0,0) band at several temperatures using Eq. (5). The full Hönl-London factors rather than the Hund's case b limit were used in the calculations. The values represent cross sections at the peak of Doppler-broadened lines whose normalized lineshape function is

$$g(\nu) = (2(\ln 2/\pi)^{1/2})/\Delta\nu_D \exp[(-4\ln 2 (\nu-\nu_0)^2)/\Delta\nu_D^2], \quad (6)$$

where $\Delta\nu_D$ is the FWHM Doppler width and ν_0 is the frequency at line center. The Doppler width is given by

$$\Delta\nu_D = 2\nu_0 (2kT\ln 2/Mc^2)^{1/2}, \quad (7)$$

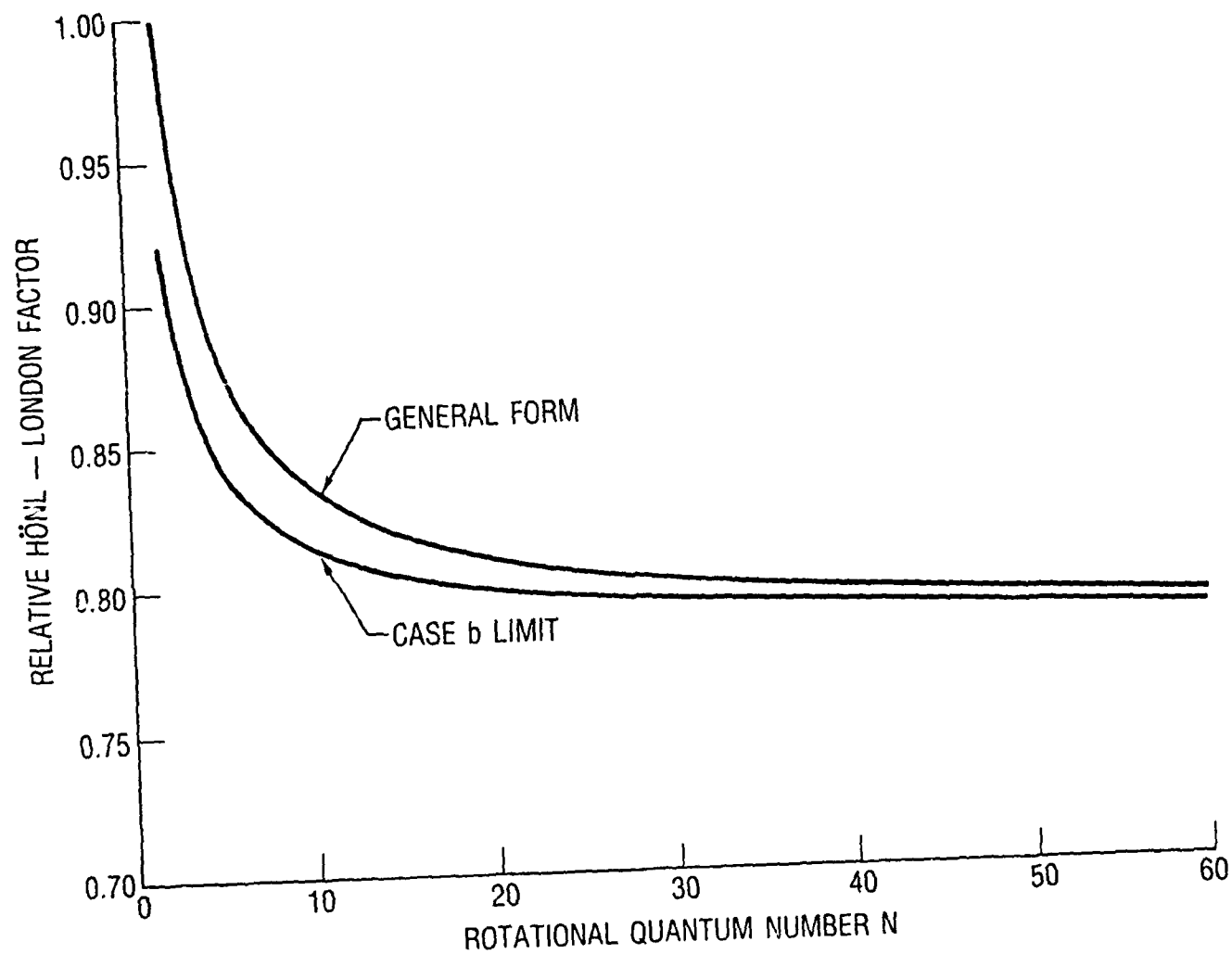


Fig.2 $^1\Sigma - ^3\Sigma^-$ Hönl-London Factors Plotted vs N

where M is the mass of the species. Values of $\mu_0 = 2.72 \times 10^6 (ea_0)^2$ and $\mu_1/\mu_0 = 0.2611$ used in the calculations as well as the NF $X^3\Sigma^-$ state spectroscopic constants were taken from Ref. 2. Note that the values in Tables 2-4 represent stimulated emission cross sections per NF molecule in a particular $b^1\Sigma^-$ rotational level in $v'=0$. The small signal gain for a unit length of gain medium is given by

$$\text{gain} = \sigma([NF\ b^1\Sigma, v'=0, N'] - (1/3)[NF\ X^3\Sigma^-, v''=0, J'']). \quad (8)$$

The factor of 1/3 appearing in Eq. (8) comes from the fact that the degeneracy of the NF $X^3\Sigma^-$ state is three while the NF $b^1\Sigma$ has a degeneracy of one.

Table 2. Calculated NF b-X (0,0) Band Stimulated Emission Cross Section at 300 K

N	⁰ P Branch	⁰ P Branch	⁰ Q Branch	⁰ R Branch	^S R Branch
2	1.202×10^{-19}	1.519×10^{-18}	2.040×10^{-19}	8.426×10^{-19}	7.148×10^{-19}
3	1.988×10^{-19}	1.426×10^{-18}	2.040×10^{-19}	9.454×10^{-19}	6.264×10^{-19}
4	2.442×10^{-19}	1.374×10^{-18}	2.040×10^{-19}	1.001×10^{-18}	5.776×10^{-19}
5	2.735×10^{-19}	1.341×10^{-18}	2.040×10^{-19}	1.036×10^{-18}	5.466×10^{-19}
6	2.940×10^{-19}	1.318×10^{-18}	2.040×10^{-19}	1.060×10^{-18}	5.252×10^{-19}
7	3.091×10^{-19}	1.301×10^{-18}	2.040×10^{-19}	1.077×10^{-18}	5.095×10^{-19}
8	3.207×10^{-19}	1.288×10^{-18}	2.040×10^{-19}	1.091×10^{-18}	4.976×10^{-19}
9	3.298×10^{-19}	1.277×10^{-18}	2.040×10^{-19}	1.101×10^{-18}	4.882×10^{-19}
10	3.373×10^{-19}	1.269×10^{-18}	2.040×10^{-19}	1.110×10^{-18}	4.805×10^{-19}
11	3.434×10^{-19}	1.262×10^{-18}	2.040×10^{-19}	1.117×10^{-18}	4.742×10^{-19}
12	3.486×10^{-19}	1.257×10^{-18}	2.040×10^{-19}	1.123×10^{-18}	4.690×10^{-19}
13	3.530×10^{-19}	1.252×10^{-18}	2.040×10^{-19}	1.128×10^{-18}	4.645×10^{-19}
14	3.568×10^{-19}	1.247×10^{-18}	2.040×10^{-19}	1.132×10^{-18}	4.606×10^{-19}
15	3.601×10^{-19}	1.244×10^{-18}	2.040×10^{-19}	1.136×10^{-18}	4.572×10^{-19}
16	3.630×10^{-19}	1.240×10^{-18}	2.040×10^{-19}	1.139×10^{-18}	4.542×10^{-19}
17	3.656×10^{-19}	1.238×10^{-18}	2.040×10^{-19}	1.142×10^{-18}	4.516×10^{-19}
18	3.679×10^{-19}	1.235×10^{-18}	2.040×10^{-19}	1.144×10^{-18}	4.493×10^{-19}
19	3.700×10^{-19}	1.233×10^{-18}	2.040×10^{-19}	1.147×10^{-18}	4.472×10^{-19}
20	3.719×10^{-19}	1.231×10^{-18}	2.040×10^{-19}	1.149×10^{-18}	4.453×10^{-19}
21	3.736×10^{-19}	1.229×10^{-18}	2.040×10^{-19}	1.151×10^{-18}	4.436×10^{-19}
22	3.751×10^{-19}	1.227×10^{-18}	2.040×10^{-19}	1.153×10^{-18}	4.420×10^{-19}
23	3.765×10^{-19}	1.225×10^{-18}	2.040×10^{-19}	1.154×10^{-18}	4.406×10^{-19}
24	3.778×10^{-19}	1.224×10^{-18}	2.040×10^{-19}	1.156×10^{-18}	4.393×10^{-19}
25	3.790×10^{-19}	1.223×10^{-18}	2.040×10^{-19}	1.157×10^{-18}	4.381×10^{-19}
26	3.801×10^{-19}	1.221×10^{-18}	2.040×10^{-19}	1.158×10^{-18}	4.369×10^{-19}
27	3.812×10^{-19}	1.220×10^{-18}	2.040×10^{-19}	1.159×10^{-18}	4.359×10^{-19}
28	3.821×10^{-19}	1.219×10^{-18}	2.040×10^{-19}	1.160×10^{-18}	4.349×10^{-19}
29	3.830×10^{-19}	1.218×10^{-18}	2.040×10^{-19}	1.161×10^{-18}	4.340×10^{-19}
30	3.839×10^{-19}	1.217×10^{-18}	2.040×10^{-19}	1.162×10^{-18}	4.332×10^{-19}

Table 2. Calculated NF b-X (0,0) Band Stimulated Emission Cross Section at 300 K
(continued)

N	⁰ P Branch	⁰ P Branch	⁰ Q Branch	⁰ R Branch	^S R Branch
31	3.846×10^{-19}	1.216×10^{-18}	2.040×10^{-19}	1.163×10^{-18}	4.324×10^{-19}
32	3.854×10^{-19}	1.216×10^{-18}	2.040×10^{-19}	1.164×10^{-18}	4.317×10^{-19}
33	3.861×10^{-19}	1.215×10^{-18}	2.040×10^{-19}	1.165×10^{-18}	4.310×10^{-19}
34	3.867×10^{-19}	1.214×10^{-18}	2.040×10^{-19}	1.166×10^{-18}	4.303×10^{-19}
35	3.873×10^{-19}	1.213×10^{-18}	2.040×10^{-19}	1.166×10^{-18}	4.297×10^{-19}
36	3.879×10^{-19}	1.213×10^{-18}	2.040×10^{-19}	1.167×10^{-18}	4.291×10^{-19}
37	3.884×10^{-19}	1.212×10^{-18}	2.040×10^{-19}	1.168×10^{-18}	4.286×10^{-19}
38	3.890×10^{-19}	1.212×10^{-18}	2.040×10^{-19}	1.168×10^{-18}	4.281×10^{-19}
39	3.895×10^{-19}	1.211×10^{-18}	2.040×10^{-19}	1.169×10^{-18}	4.276×10^{-19}
40	3.899×10^{-19}	1.210×10^{-18}	2.040×10^{-19}	1.169×10^{-18}	4.271×10^{-19}

Cross section in units of cm³/molecule

Table 3. Calculated NF b-X (0,0) Band Stimulated Emission Cross Section at 600 K

N	^O P Branch	^Q P Branch	^Q Q Branch	^Q R Branch	^S R Branch
2	8.502×10^{-20}	1.074×10^{-18}	1.443×10^{-19}	5.958×10^{-19}	5.054×10^{-19}
3	1.406×10^{-19}	1.008×10^{-18}	1.443×10^{-19}	6.685×10^{-19}	4.430×10^{-19}
4	1.727×10^{-19}	9.715×10^{-19}	1.443×10^{-19}	7.078×10^{-19}	4.084×10^{-19}
5	1.934×10^{-19}	9.480×10^{-19}	1.443×10^{-19}	7.324×10^{-19}	3.865×10^{-19}
6	2.079×10^{-19}	9.317×10^{-19}	1.443×10^{-19}	7.494×10^{-19}	3.714×10^{-19}
7	2.186×10^{-19}	9.197×10^{-19}	1.443×10^{-19}	7.618×10^{-19}	3.603×10^{-19}
8	2.267×10^{-19}	9.106×10^{-19}	1.443×10^{-19}	7.712×10^{-19}	3.518×10^{-19}
9	2.332×10^{-19}	9.033×10^{-19}	1.443×10^{-19}	7.787×10^{-19}	3.452×10^{-19}
10	2.385×10^{-19}	8.974×10^{-19}	1.443×10^{-19}	7.847×10^{-19}	3.398×10^{-19}
11	2.428×10^{-19}	8.926×10^{-19}	1.443×10^{-19}	7.896×10^{-19}	3.353×10^{-19}
12	2.465×10^{-19}	8.885×10^{-19}	1.443×10^{-19}	7.938×10^{-19}	3.316×10^{-19}
13	2.496×10^{-19}	8.850×10^{-19}	1.443×10^{-19}	7.973×10^{-19}	3.284×10^{-19}
14	2.523×10^{-19}	8.820×10^{-19}	1.443×10^{-19}	8.004×10^{-19}	3.257×10^{-19}
15	2.546×10^{-19}	8.794×10^{-19}	1.443×10^{-19}	8.030×10^{-19}	3.233×10^{-19}
16	2.567×10^{-19}	8.771×10^{-19}	1.443×10^{-19}	8.054×10^{-19}	3.212×10^{-19}
17	2.585×10^{-19}	8.751×10^{-19}	1.443×10^{-19}	8.074×10^{-19}	3.193×10^{-19}
18	2.602×10^{-19}	8.732×10^{-19}	1.443×10^{-19}	8.093×10^{-19}	3.177×10^{-19}
19	2.616×10^{-19}	8.716×10^{-19}	1.443×10^{-19}	8.109×10^{-19}	3.162×10^{-19}
20	2.630×10^{-19}	8.701×10^{-19}	1.443×10^{-19}	8.124×10^{-19}	3.149×10^{-19}
21	2.642×10^{-19}	8.688×10^{-19}	1.443×10^{-19}	8.138×10^{-19}	3.137×10^{-19}
22	2.653×10^{-19}	8.676×10^{-19}	1.443×10^{-19}	8.150×10^{-19}	3.126×10^{-19}
23	2.663×10^{-19}	8.665×10^{-19}	1.443×10^{-19}	8.161×10^{-19}	3.115×10^{-19}
24	2.672×10^{-19}	8.655×10^{-19}	1.443×10^{-19}	8.171×10^{-19}	3.106×10^{-19}
25	2.680×10^{-19}	8.645×10^{-19}	1.443×10^{-19}	8.181×10^{-19}	3.098×10^{-19}
26	2.688×10^{-19}	8.636×10^{-19}	1.443×10^{-19}	8.190×10^{-19}	3.090×10^{-19}
27	2.695×10^{-19}	8.628×10^{-19}	1.443×10^{-19}	8.198×10^{-19}	3.082×10^{-19}
28	2.702×10^{-19}	8.621×10^{-19}	1.443×10^{-19}	8.206×10^{-19}	3.075×10^{-19}
29	2.708×10^{-19}	8.614×10^{-19}	1.443×10^{-19}	8.213×10^{-19}	3.069×10^{-19}
30	2.714×10^{-19}	8.607×10^{-19}	1.443×10^{-19}	8.219×10^{-19}	3.063×10^{-19}

Table 3. Calculated NF b-X (0,0) Band Stimulated Emission Cross Section at 600 K
(continued)

N	⁰ P Branch	⁰ P Branch	⁰ Q Branch	⁰ R Branch	^S R Branch
31	2.720×10^{-19}	8.601×10^{-19}	1.443×10^{-19}	8.225×10^{-19}	3.058×10^{-19}
32	2.725×10^{-19}	8.595×10^{-19}	1.443×10^{-19}	8.231×10^{-19}	3.052×10^{-19}
33	2.730×10^{-19}	8.590×10^{-19}	1.443×10^{-19}	8.237×10^{-19}	3.048×10^{-19}
34	2.734×10^{-19}	8.585×10^{-19}	1.443×10^{-19}	8.242×10^{-19}	3.043×10^{-19}
35	2.739×10^{-19}	8.580×10^{-19}	1.443×10^{-19}	8.247×10^{-19}	3.039×10^{-19}
36	2.743×10^{-19}	8.575×10^{-19}	1.443×10^{-19}	8.251×10^{-19}	3.034×10^{-19}
37	2.747×10^{-19}	8.571×10^{-19}	1.443×10^{-19}	8.256×10^{-19}	3.031×10^{-19}
38	2.750×10^{-19}	8.567×10^{-19}	1.443×10^{-19}	8.260×10^{-19}	3.027×10^{-19}
39	2.754×10^{-19}	8.563×10^{-19}	1.443×10^{-19}	8.264×10^{-19}	3.023×10^{-19}
40	2.757×10^{-19}	8.559×10^{-19}	1.443×10^{-19}	8.267×10^{-19}	3.020×10^{-19}

Cross section in units of cm³/molecule

Table 4. Calculated NF b-X (0,0) Band Stimulated Emission Cross Section at 900 K

N	⁰ P Branch	⁰ P Branch	⁰ Q Branch	⁰ R Branch	^S R Branch
2	6.942×10^{-20}	8.771×10^{-19}	1.178×10^{-19}	4.864×10^{-19}	4.127×10^{-19}
3	1.148×10^{-19}	8.233×10^{-19}	1.178×10^{-19}	5.459×10^{-19}	3.617×10^{-19}
4	1.410×10^{-19}	7.932×10^{-19}	1.178×10^{-19}	5.779×10^{-19}	3.335×10^{-19}
5	1.579×10^{-19}	7.741×10^{-19}	1.178×10^{-19}	5.980×10^{-19}	3.156×10^{-19}
6	1.697×10^{-19}	7.607×10^{-19}	1.178×10^{-19}	6.119×10^{-19}	3.032×10^{-19}
7	1.784×10^{-19}	7.510×10^{-19}	1.178×10^{-19}	6.220×10^{-19}	2.942×10^{-19}
8	1.851×10^{-19}	7.435×10^{-19}	1.178×10^{-19}	6.297×10^{-19}	2.873×10^{-19}
9	1.904×10^{-19}	7.376×10^{-19}	1.178×10^{-19}	6.358×10^{-19}	2.818×10^{-19}
10	1.947×10^{-19}	7.328×10^{-19}	1.178×10^{-19}	6.407×10^{-19}	2.774×10^{-19}
11	1.983×10^{-19}	7.288×10^{-19}	1.178×10^{-19}	6.447×10^{-19}	2.738×10^{-19}
12	2.013×10^{-19}	7.255×10^{-19}	1.178×10^{-19}	6.481×10^{-19}	2.708×10^{-19}
13	2.038×10^{-19}	7.226×10^{-19}	1.178×10^{-19}	6.510×10^{-19}	2.682×10^{-19}
14	2.060×10^{-19}	7.202×10^{-19}	1.178×10^{-19}	6.535×10^{-19}	2.659×10^{-19}
15	2.079×10^{-19}	7.180×10^{-19}	1.178×10^{-19}	6.557×10^{-19}	2.640×10^{-19}
16	2.096×10^{-19}	7.162×10^{-19}	1.178×10^{-19}	6.576×10^{-19}	2.623×10^{-19}
17	2.111×10^{-19}	7.145×10^{-19}	1.178×10^{-19}	6.593×10^{-19}	2.607×10^{-19}
18	2.124×10^{-19}	7.130×10^{-19}	1.178×10^{-19}	6.608×10^{-19}	2.594×10^{-19}
19	2.136×10^{-19}	7.117×10^{-19}	1.178×10^{-19}	6.621×10^{-19}	2.582×10^{-19}
20	2.147×10^{-19}	7.105×10^{-19}	1.178×10^{-19}	6.633×10^{-19}	2.571×10^{-19}
21	2.157×10^{-19}	7.094×10^{-19}	1.178×10^{-19}	6.644×10^{-19}	2.561×10^{-19}
22	2.166×10^{-19}	7.084×10^{-19}	1.178×10^{-19}	6.654×10^{-19}	2.552×10^{-19}
23	2.174×10^{-19}	7.075×10^{-19}	1.178×10^{-19}	6.664×10^{-19}	2.544×10^{-19}
24	2.181×10^{-19}	7.066×10^{-19}	1.178×10^{-19}	6.672×10^{-19}	2.536×10^{-19}
25	2.188×10^{-19}	7.059×10^{-19}	1.178×10^{-19}	6.680×10^{-19}	2.529×10^{-19}
26	2.195×10^{-19}	7.052×10^{-19}	1.178×10^{-19}	6.687×10^{-19}	2.523×10^{-19}
27	2.201×10^{-19}	7.045×10^{-19}	1.178×10^{-19}	6.694×10^{-19}	2.517×10^{-19}
28	2.206×10^{-19}	7.039×10^{-19}	1.178×10^{-19}	6.700×10^{-19}	2.511×10^{-19}
29	2.211×10^{-19}	7.033×10^{-19}	1.178×10^{-19}	6.706×10^{-19}	2.506×10^{-19}
30	2.216×10^{-19}	7.028×10^{-19}	1.178×10^{-19}	6.711×10^{-19}	2.501×10^{-19}

Table 4. Calculated NF b-X (0,0) Band Stimulated Emission Cross Section at 900 K
(continued)

N	^O P Branch	^Q P Branch	^Q Q Branch	^Q R Branch	^S R Branch
31	2.221×10^{-19}	7.023×10^{-19}	1.178×10^{-19}	6.716×10^{-19}	2.497×10^{-19}
32	2.225×10^{-19}	7.018×10^{-19}	1.178×10^{-19}	6.721×10^{-19}	2.492×10^{-19}
33	2.229×10^{-19}	7.014×10^{-19}	1.178×10^{-19}	6.725×10^{-19}	2.488×10^{-19}
34	2.233×10^{-19}	7.009×10^{-19}	1.178×10^{-19}	6.729×10^{-19}	2.485×10^{-19}
35	2.236×10^{-19}	7.006×10^{-19}	1.178×10^{-19}	6.733×10^{-19}	2.481×10^{-19}
36	2.240×10^{-19}	7.002×10^{-19}	1.178×10^{-19}	6.737×10^{-19}	2.478×10^{-19}
37	2.243×10^{-19}	6.998×10^{-19}	1.178×10^{-19}	6.741×10^{-19}	2.474×10^{-19}
38	2.246×10^{-19}	6.995×10^{-19}	1.178×10^{-19}	6.744×10^{-19}	2.471×10^{-19}
39	2.249×10^{-19}	6.992×10^{-19}	1.178×10^{-19}	6.747×10^{-19}	2.469×10^{-19}
40	2.251×10^{-19}	6.989×10^{-19}	1.178×10^{-19}	6.750×10^{-19}	2.466×10^{-19}

Cross section in units of cm³/molecule

LABORATORY OPERATIONS

The Aerospace Corporation functions as an "architect-engineer" for national security projects, specializing in advanced military space systems. Providing research support, the corporation's Laboratory Operations conducts experimental and theoretical investigations that focus on the application of scientific and technical advances to such systems. Vital to the success of these investigations is the technical staff's wide-ranging expertise and its ability to stay current with new developments. This expertise is enhanced by a research program aimed at dealing with the many problems associated with rapidly evolving space systems. Contributing their capabilities to the research effort are these individual laboratories:

Aerophysics Laboratory: Launch vehicle and reentry fluid mechanics, heat transfer and flight dynamics; chemical and electric propulsion, propellant chemistry, chemical dynamics, environmental chemistry, trace detection; spacecraft structural mechanics, contamination, thermal and structural control; high temperature thermomechanics, gas kinetics and radiation; cw and pulsed chemical and excimer laser development, including chemical kinetics, spectroscopy, optical resonators, beam control, atmospheric propagation, laser effects and countermeasures.

Chemistry and Physics Laboratory: Atmospheric chemical reactions, atmospheric optics, light scattering, state-specific chemical reactions and radiative signatures of missile plumes, sensor out-of-field-of-view rejection, applied laser spectroscopy, laser chemistry, laser optoelectronics, solar cell physics, battery electrochemistry, space vacuum and radiation effects on materials, lubrication and surface phenomena, thermionic emission, photosensitive materials and detectors, atomic frequency standards, and environmental chemistry.

Electronics Research Laboratory: Microelectronics, solid-state device physics, compound semiconductors, radiation hardening; electro-optics, quantum electronics, solid-state lasers, optical propagation and communications; microwave semiconductor devices, microwave/millimeter wave measurements, diagnostics and radiometry, microwave/millimeter wave thermionic devices; atomic time and frequency standards; antennas, rf systems, electromagnetic propagation phenomena, space communication systems.

Materials Sciences Laboratory: Development of new materials: metals, alloys, ceramics, polymers and their composites, and new forms of carbon; nondestructive evaluation, component failure analysis and reliability; fracture mechanics and stress corrosion; analysis and evaluation of materials at cryogenic and elevated temperatures as well as in space and enemy-induced environments.

Space Sciences Laboratory: Magnetospheric, auroral and cosmic ray physics, wave-particle interactions, magnetospheric plasma waves; atmospheric and ionospheric physics, density and composition of the upper atmosphere, remote sensing using atmospheric radiation; solar physics, infrared astronomy, infrared signature analysis; effects of solar activity, magnetic storms and nuclear explosions on the earth's atmosphere, ionosphere and magnetosphere; effects of electromagnetic and particulate radiations on space systems; space instrumentation.