

Rotational Analysis of the $A^1\Sigma^+ - X^1\Sigma^+$ Transition of SrS

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The previously unobserved $A^1\Sigma^+ - X^1\Sigma^+$ transition of gas phase SrS was studied by dye laser spectroscopy. The 0-0, 0-1, 1-1, 2-1, 3-0, 3-2, 4-1, 5-1, and 5-2 bands were rotationally analyzed at high resolution. The $A^1\Sigma^+$ state is extensively perturbed. Spectroscopic constants of individual vibrational levels and equilibrium molecular constants were determined. Ground state ($X^1\Sigma^+$) constants derived from the analysis include: $\omega_e = 388.2643(11) \text{ cm}^{-1}$, $B_e = 0.1208034(33) \text{ cm}^{-1}$, and $r_e = 2.43969 \text{ \AA}$. Excited state ($A^1\Sigma^+$) constants determined include: $T_e = 13932.7068(10) \text{ cm}^{-1}$, $\omega_e = 339.1454(20) \text{ cm}^{-1}$, $B_e = 0.1139895(38) \text{ cm}^{-1}$, and $r_e = 2.51155 \text{ \AA}$. © 1988 Academic Press, Inc.

INTRODUCTION

In the course of our work on SrSH, we discovered the previously unobserved $A^1\Sigma^+ - X^1\Sigma^+$ transition of SrS. The only previous high-resolution work on the SrS molecule is the absorption study of Marcano and Barrow (1). In this work the $B^1\Sigma^+ - X^1\Sigma^+$ absorption spectrum in the 3600- to 3900-Å region was rotationally analyzed, and extensive perturbations were observed in the $B^1\Sigma^+$ state. We present here a rotational analysis of the $A^1\Sigma^+ - X^1\Sigma^+$ transition by dye laser excitation spectroscopy.

Partridge *et al.* (2) used ab initio calculations to determine spectroscopic constants (ω_e , D_e , and r_e) for the $X^1\Sigma^+$, $a^3\Pi$, and $A'^1\Pi$ states of the alkaline earth sulfides, including SrS. The transition energies, T_e , for the $a^3\Pi - X^1\Sigma^+$ and $A'^1\Pi - X^1\Sigma^+$ transitions were calculated to be 6870 and 7179 cm^{-1} , respectively.

The dissociation energy of 80 kcal/mole (3-5) is known from high-temperature mass spectrometry. Martin and Schaber (6) have recorded the infrared spectrum of matrix-isolated SrS and related metal sulfides.

Electronic transitions for BeS (7-9), MgS (10), CaS (11), and BaS (12-15) have been previously analyzed. The corresponding oxide spectra, including the SrO $A^1\Sigma^+ - X^1\Sigma^+$ transition (16-18), are also known.

EXPERIMENTAL DETAILS

The strontium sulfide molecule was produced in a Broida oven (19) by the reaction of strontium with carbon disulfide. The strontium metal was vaporized in a resistively heated crucible, carried to the reaction region by argon, and mixed with the oxidant (CS_2). A dye laser, tuned to the $^3P_1 - ^1S$ strontium atomic transition at 6892.6 Å, was required to promote the reaction. The pressures were approximately 1 Torr argon and a few mTorr carbon disulfide.

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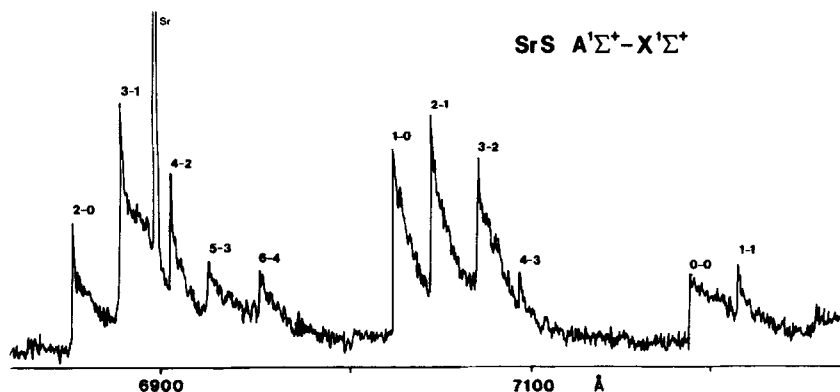


FIG. 1. Low resolution spectrum of SrS $A^1\Sigma^+ - X^1\Sigma^+$. The low resolution SrS laser excitation spectrum consists of a progression of vibrational band sequences. The $\Delta v = 2$, $\Delta v = 1$, and $\Delta v = 0$ sequences are shown, in order of increasing wavelength. The relative intensities of the bands have not been corrected for the variation in laser power.

Two types of spectra were recorded. Low-resolution laser excitation spectra were obtained by scanning a broadband (1 cm^{-1}) continuous wave dye laser and detecting the total fluorescence through a red pass filter with a photomultiplier tube. High-resolution (0.003 cm^{-1}) laser excitation spectra were obtained by scanning a computer-controlled ring dye laser (Coherent Autoscan 699-29) while detecting fluorescence through a 0.64-m monochromator. The monochromator was used as a narrow band-pass filter to select the rotational lines of interest.

The wavemeter of the computer-controlled dye laser is calibrated with an iodine cell, and the absolute accuracy of the line positions was approximately $\pm 0.003 \text{ cm}^{-1}$.

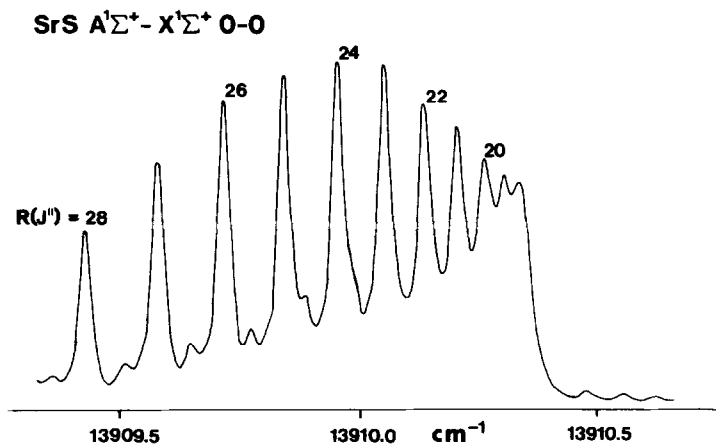


FIG. 2. High resolution spectrum of SrS $A^1\Sigma^+ - X^1\Sigma^+$. The high resolution spectrum near the R-branch bandhead of the 0-0 band is shown. Rotational lines of high J values coming out of the bandhead are labeled. Low J , R-branch lines going into the bandhead are the smaller features. A monochromator was used as a narrow band-pass filter, and its wavelength setting determined the relative intensities of the rotational lines.

TABLE I
Observed Line Positions for SrS $A^1\Sigma^+ - X^1\Sigma^+$ (in cm^{-1})

a					b				
0-0 Band					0-1 Band				
J^*	P(J^*)	$\Delta\nu^a$	R(J^*)	$\Delta\nu$	J^*	P(J^*)	$\Delta\nu^a$	R(J^*)	$\Delta\nu$
0			13908.5562	0.0003	4	13521.5876	0.0015		
1	13908.0868	-0.0004	13908.7713	0.0014	5	13521.2991	0.0005		
2	13907.8333	0.0008	13908.9698	-0.0006	6	13520.9989	0.0034		
3	13907.5648	0.0005	13909.1599	0.0025	7	13520.6803	0.0005		
4	13907.2832	0.0007	13909.3334	0.0026	8	13520.3518	0.0002		
5	13906.9878	0.0005	13909.4918	0.0011	9	13520.0099	-0.0009		
6	13906.6742	-0.0042	13909.6369	-0.0001	10	13519.6581	0.0008		
7	13906.3547	-0.0013	13909.7703	0.0006	11	13519.2931	0.0018		
8	13906.0244	0.0042	13909.8888	-0.0001	12	13518.9120	-0.0008		
9	13905.6691	-0.0016	13909.9955	0.0009	13	13518.5222	0.0006		
10	13905.3055	-0.0023	13910.0889	0.0022	14	13518.1200	0.0021		
11	13904.9324	0.0011	13910.1656	0.0004	15	13517.7013	-0.0003		
12	13904.5427	0.0014			16	13517.2715	-0.0012		
13	13904.1382	0.0005			17	13516.8326	0.0014		
14	13903.7215	0.0009			18	13516.3763	-0.0009		
15	13903.2923	0.0024			19	13515.9106	0.0000		
16	13902.8477	0.0019			20	13515.4307	-0.0006		
17	13902.3903	0.0022			21	13514.9455	0.0009	13524.7183	-0.0033
18	13901.9189	0.0021			22	13514.4336	-0.0016	13524.6683	-0.0035
19	13901.4343	0.0023			23	13513.9201	0.0019	13524.6097	0.0004
20	13900.9344	0.0007			24	13513.3886	-0.0001	13524.5346	0.0004
21	13900.4222	0.0004			25	13512.8471	0.0005	13524.4444	-0.0021
22	13899.8987	0.0022			26	13512.2929	0.0011	13524.3450	-0.0010
23	13899.3597	0.0022	13910.0472	-0.0014	27	13511.7234	-0.0011	13524.2336	0.0006
24	13898.8040	-0.0010	13909.9505	-0.0001	28	13511.1424	-0.0022	13524.1069	-0.0004
25	13898.2359	-0.0031	13909.8387	-0.0002	29	13510.5507	-0.0014	13523.9695	0.0006
26	13897.6585	-0.0009	13909.7120	-0.0017	30	13509.9461	-0.0009	13523.8177	-0.0001
27	13897.0655	-0.0008	13909.5719	-0.0029	31	13509.3291	-0.0002	13523.6521	-0.0019
28	13896.4594	-0.0002	13909.4218	-0.0005	32			13523.4748	-0.0028
29	13895.8377	-0.0017	13909.2550	-0.0012	33	13508.0524	-0.0038	13523.2864	-0.0021
30	13895.2034	-0.0022	13909.0765	0.0001	34	13507.3971	-0.0036	13523.0826	-0.0041
31	13894.5596	0.0013	13908.8797	-0.0033	35	13506.7291	-0.0035	13522.8680	-0.0042
32	13893.8952	-0.0022	13908.6729	-0.0031	36	13506.0473	-0.0046	13522.6436	-0.0014
33	13893.2201	-0.0029	13908.4523	-0.0030	37	13505.3572	-0.0014	13522.3989	-0.0062
34	13892.5304	-0.0046	13908.2173	-0.0037	38	13504.6463	-0.0063	13522.1373b	-0.0152
35	13891.8311	-0.0023	13907.9678	-0.0053	39	13503.9251	-0.0090	13521.8408b	-0.0464
36	13891.1139	-0.0044	13907.7030	-0.0084	40	13503.1864b	-0.0166	13521.6298b	0.0206
37	13890.3847	-0.0049	13907.4279	-0.0082	41	13502.3337b	-0.1255	13521.3252	0.0068
38	13889.6404	-0.0069	13907.1312b	-0.0160	42	13501.7186b	0.0158	13521.0203	0.0054
39	13888.8874	-0.0041	13906.7231b	-0.1215	43	13500.9425	0.0088	13520.7011	0.0024
40	13888.1085b	-0.0135	13906.5442b	0.0159	44	13500.1594	0.0073	13520.3718	0.0021
41	13887.2176b	-0.1214	13906.2067	0.0084	45	13499.3631	0.0053	13520.0310	0.0030
42	13886.5603b	0.0179	13905.8587	0.0041	46	13498.5501	-0.0008	13519.6760	0.0024
43	13885.7410	0.0087	13905.5004	0.0032	47	13497.7350	0.0037	13519.3068	0.0005
44	13884.9136	0.0051	13905.1280	0.0019	48	13496.9000	0.0009		
45	13884.0738	0.0027	13904.7421	0.0008	49	13496.0549	0.0007		
46	13883.2241	0.0039	13904.3373	-0.0055	50	13495.1979	0.0012		
47	13882.3575	0.0019	13903.9266	-0.0040	51	13494.3271	0.0006		
48	13881.4784	0.0010	13903.5056	0.0009	52	13493.4448	0.0011		
49	13880.5861	0.0005	13903.0650	0.0000	53	13492.5469	-0.0013		
50	13879.6805	0.0002	13902.6108	-0.0007	54	13491.6387	-0.0014		
51	13878.7607	-0.0005	13902.1460	0.0016	55	13490.7191	-0.0001		
52	13877.8294	0.0008	13901.6638	0.0004	56	13489.7871	0.0014		
53	13876.8853	0.0030	13901.1693	0.0006	57	13488.8392	-0.0003		
54	13875.9246	0.0022	13900.6607	0.0004	58	13487.8788	-0.0018		
55	13874.9511	0.0022	13900.1392	0.0012	59	13486.9081	-0.0010		
56	13873.9625	0.0008	13899.6015	-0.0005	60	13485.9232	-0.0016		
57	13872.9614	0.0005	13899.0528	0.0006	61	13484.9248	-0.0030		
58	13871.9458	-0.0006	13898.4874	-0.0012	62	13483.9156	-0.0026		
59	13870.9198	0.0015	13897.9118	0.0007	63				
60	13869.8779	0.0014	13897.3212	0.0013	64	13481.8641	0.0034		
61	13868.8214	0.0003	13896.7147	-0.0001	65	13480.8154	0.0025		
62	13867.7501	-0.0018	13896.0983	0.0024	66	13479.7535	0.0012		
63	13866.6687	-0.0004	13895.4635	0.0003	67	13478.6777	-0.0013		
64	13865.5755	0.0029	13894.8170	0.0004	68	13477.5926	-0.0004		
65	13864.4614	-0.0010	13894.1528	-0.0034	69	13476.4929	-0.0013		
66	13863.3360	-0.0026	13893.4821	0.0002	70	13475.3828	0.0001		
67			13892.7948	0.0011					
68			13892.0904	-0.0013					
69			13891.3731	-0.0026					
70			13890.6454	-0.0005					

^a Observed-Calculated line positions using the constants of Table IV.
^b Perturbed.

RESULTS AND DISCUSSION

A portion of the low-resolution laser excitation spectrum of the SrS $A^1\Sigma^+ - X^1\Sigma^+$ transition is shown in Fig. 1. The spectrum consists of a progression of band sequences.

TABLE I—Continued

f 3-2 Band					h 5-1 Band				
J^*	$P(J^*)$	Δv^a	$R(J^*)$	Δv	J^*	$P(J^*)$	Δv^a	$R(J^*)$	Δv
20			14152.3372	-0.0039	14	15198.5310	0.0001		
21	14142.5897	-0.0011	14152.2730	-0.0003	15	15198.0341	-0.0049	15204.9188	-0.0088
22	14142.0565	-0.0025	14152.1896	-0.0022	16	15197.5243	-0.0056	15204.8583	-0.0062
23	14141.5120	-0.0014	14152.0930	-0.0034	17	15196.9967	-0.0069	15204.7773	-0.0072
24			14151.9836	-0.0036	18	15196.4537	-0.0068	15204.6903	-0.0024
25	14140.3825	0.0016	14151.8631	-0.0011	19	15195.8970	-0.0035	15204.5685	-0.0062
26	14139.7952	0.0011	14151.7307	0.0033	20	15195.3196	-0.0044	15204.4405	-0.0046
27	14139.1940	0.0005	14151.5778	0.0009	21	15194.7254	-0.0055	15204.2956	-0.0036
28	14138.5789	-0.0002	14151.4098	-0.0029	22	15194.1163	-0.0052	15204.1367	-0.0006
29	14137.9533	0.0022	14151.2331	-0.0016	23	15193.4938	-0.0020	15203.9593	-0.0000
30	14137.3161	0.0067	14151.0434	0.0004	24	15192.8556	0.0015	15203.7685	0.0030
31	14136.6571	0.0030	14150.8356	-0.0021	25	15192.1962	-0.0003	15203.5576	0.0016
32	14135.9870	0.0018	14150.6202	0.0015	26	15191.5249	0.0018	15203.3327	0.0019
33	14135.3049	0.0023	14150.3858	-0.0003	27	15190.8382	0.0042	15203.0917	0.0017
34	14134.6095	0.0030	14150.1413	0.0014	28	15190.1344	0.0051	15202.8348	0.0010
35	14133.8964	-0.0004	14149.8814	0.0012	29	15189.4141	0.0049	15202.5584	-0.0039
36	14133.1697	-0.0040	14149.6093	0.0025	30	15188.6764	0.0028	15202.1936b	-0.0017
37	14132.4360	-0.0010			31	15187.9232	0.0004	15201.9975b	0.0244
38	14131.6819	-0.0049			32	15187.0718b	-0.0785	15201.6677b	0.0122
					33	15186.3940b	0.0188	15201.3321b	0.0095
					34	15185.5925b	0.0139	15200.9808	0.0065
					35	15184.7798b	0.0131	15200.6158	0.0053
					36	15183.9473	0.0078	15200.2337	0.0025
					37	15183.1028	0.0059	15199.8369	0.0008
					38	15182.2450	0.0062	15199.4231	-0.0021
					39	15181.3659	0.0008		
					40	15180.4753	-0.0004	15198.5477	-0.0071
					41	15179.5715	0.0013	15198.0890	-0.0058
					42	15178.6452	-0.0032	15197.6149	-0.0029
					43	15177.7059	-0.0042	15197.1177	-0.0056
					44	15176.7519	-0.0030	15196.6074b	-0.0036
					45	15175.7795	-0.0029		
					46	15174.7887b	-0.0035		
					47	15173.7846	0.0009		
					48	15172.7640	0.0076		
					49	15171.7194	0.0100		
					50	15170.6539	0.0112		
g 4-1 Band					i 5-2 Band				
J^*	$P(J^*)$	Δv^a	$R(J^*)$	Δv	J^*	$P(J^*)$	Δv^a	$R(J^*)$	Δv
1	14868.0878	0.0012	14868.7603	0.0002	9	14817.6340	0.0066		
2	14867.8299	-0.0008	14868.9567	0.0035	10	14817.2376	0.0045		
3	14867.5590	-0.0002	14869.1283	-0.0024	11	14816.8247	0.0027		
4	14867.2682	-0.0038	14869.2904	-0.0021	12	14816.3978	0.0036		
5	14866.9644	-0.0048	14869.4404	0.0018	13	14815.9478	-0.0019		
6	14866.6474	-0.0032	14869.5683	-0.0008	14	14815.4866	-0.0021		
7	14866.3190	0.0025			15	14815.0050	-0.0062	14821.8983	-0.0016
8	14865.9719	0.0053	14869.7823	-0.0007	16	14814.5131	-0.0045	14821.8466	-0.0056
9	14865.6027	0.0016	14869.8623	-0.0041	17	14813.9992	-0.0086	14821.7846	-0.0041
10	14865.2184	-0.0016			18	14813.4750	-0.0071	14821.7039	-0.0056
11	14864.8220	-0.0012			19	14812.9334	-0.0071	14821.6089	-0.0058
12	14864.4144	0.0036			20	14812.3776	-0.0057	14821.4992	-0.0052
13	14863.9827	0.0000			21	14811.8041	-0.0064	14821.3779	-0.0010
14	14863.5404	0.0015			22	14811.2197	-0.0027	14821.2381	-0.0001
15	14863.0801	0.0005			23	14810.6224	0.0034		
16	14862.6045	-0.0000			24	14810.0014	0.0009	14820.9129	0.0010
17	14862.1121	-0.0017			25	14809.3681	0.0010	14820.7295	0.0030
18	14861.6077	0.0002			26	14808.7204	0.0016	14820.5301	0.0036
19	14861.0862	0.0008	14869.8390	0.0010	27	14808.0601	0.0043	14820.3138	0.0020
20	14860.5488	0.0012	14869.7490	0.0005	28	14807.3848	0.0066	14820.0869	0.0042
21	14859.9962	0.0020			29	14806.6920	0.0059	14819.8404	0.0012
22	14859.4252	0.0003	14869.5234	0.0013	30	14805.9858	0.0063	14819.5034b	-0.0778
23	14858.8414	0.0015	14869.3852	0.0002	31	14805.2634	0.0048	14819.3243b	0.0154
24	14858.2364	-0.0026	14869.2329	0.0010	32	14804.4478b	-0.0756	14819.0381b	0.0158
25	14857.6250	0.0028	14869.0619	-0.0008	33	14803.7902b	0.0164	14818.7287b	0.0075
26	14856.9864	-0.0031	14868.8788	0.0014	34	14803.0243b	0.0143	14818.4076	0.0019
27	14856.3351	-0.0057	14868.6759	0.0000	35	14802.2448b	0.0129		
28	14855.6751	-0.0009	14868.4589	0.0009	36	14801.4501b	0.0106	14817.7283	-0.0029
29	14854.9919	-0.0031	14868.2230	-0.0006	37	14800.6397	0.0071	14817.3730	0.0011
30	14854.2954	-0.0023	14867.9749	0.0022	38	14799.8148	0.0036	14816.9940	-0.0036
31			14867.7061	0.0010	39	14799.9740	-0.0011	14816.6049	-0.0033
32			14867.4213	0.0008	40	14798.1213	-0.0030	14816.2002	-0.0032
33			14867.1200	0.0010	41	14797.2609	0.0026	14815.7772	-0.0058
34			14866.8001	-0.0001	42	14796.3753	-0.0018	14815.3401	-0.0063
35			14866.4630	-0.0009	43	14795.4790	-0.0012	14814.8860	-0.0074
36			14866.1136	0.0036	44	14794.5695	0.0021	14814.4214b	-0.0022
37			14865.3480	-0.0002	45	14793.6366	-0.0017	14813.9350b	-0.0013
38			14864.9378	-0.0019	46	14792.6908b	-0.0016	14813.4349	0.0039
					47	14791.7322	0.0030		
h 5-1 Band									
J^*	$P(J^*)$	Δv^a	$R(J^*)$	Δv					
2			15204.1716	0.0137					
3			15204.3349	0.0102					
4			15204.4830	0.0096					
5			15204.6119	0.0081					
6	15201.8427	0.0112	15204.7186	0.0025					
7	15201.4918	0.0102	15204.8152	0.0048					
8	15201.1209	0.0072	15204.8887	0.0019					
9	15200.7335	0.0058							
10	15200.3254	0.0016							
11	15199.9027	0.0007							
12	15199.4618	-0.0008							

Each individual band exhibits a bandhead degraded to the red, implying a larger bond length in the excited state than in the ground state. Since the $A^1\Sigma^+$ and $X^1\Sigma^+$ vibrational frequencies differ by 50 cm^{-1} , the vibrational assignment of the bands was straightforward.

Following the vibrational assignment, the 0-0, 0-1, 1-1, 2-1, 3-0, 3-2, 4-1, 5-1, and 5-2 bands were recorded at high resolution. The bandhead in the R -branch of the 0-0 band is shown in Fig. 2. To select out this bandhead, the monochromator filter was set to detect fluorescence from the connecting 0-1 band. Low J lines can be seen as the small features going into the bandhead.

The frequencies of 682 rotational lines from the nine bands are presented in Table I, and the bandhead frequencies from both low- and high-resolution spectra are presented in Table II.

Perturbations were observed in most of the vibrational levels in the excited $A^1\Sigma^+$ state. The local perturbations observed are evident in the line positions in Table I. The exact assignment of the perturbing states was not possible, since both homogeneous ($\Delta\Lambda = 0$) and heterogeneous ($\Delta\Lambda = \pm 1$) interactions fit the perturbations equally well. In all cases, the perturbations appeared to be sharp, suggesting that the perturbing states have rotational constants quite different from that of the perturbed $A^1\Sigma^+$ excited state. By analogy with other alkaline earth oxides and sulfides, perturbations from the unknown $A'^1\Pi$, $a^3\Pi$ states and, perhaps, the $b^3\Sigma^+$ state are possible.

A perturbation in the P branch of the 5-1 band is shown in Fig. 3. The perturbed $P(32)$ line is shifted a small amount lower in frequency while the perturbing line is shifted to higher frequency. A similar pattern was observed in the R branch of the 5-1 band and in the P and R branches of the 5-2 band. These observations show that $v' = 5$, $J' = 31$ of the $A^1\Sigma^+$ state is perturbed. A list of the observed local perturbations is provided in Table III.

The 682 lines from the nine bands (Table I) were simultaneously fit using the customary $^1\Sigma^+$ energy level expression,

$$T_v(J) = T_v + BJ(J+1) - D[J(J+1)]^2 + H[J(J+1)]^3.$$

TABLE II
Vibrational Bandhead Positions for SrS $A^1\Sigma^+ - X^1\Sigma^+$ (in cm^{-1})

v, v''	0	1	2	3
0	13910.3435(50) ^a	13524.7884(50)		
1	14244(5) ^b	13862.7019(50)		
2	14594(5) ^b	14199.5340(50)		
3	14921.0962(50)	14541(5) ^b	14152.4687(50)	
4		14870.0406(50)	14487(5) ^b	14103(5) ^b
5		15205.0073(50)	14821.9450(50)	14446(5) ^b

^a The numbers in parentheses represent one standard deviation uncertainty.

^b The positions of these bandheads were determined from a low-resolution laser excitation spectrum.

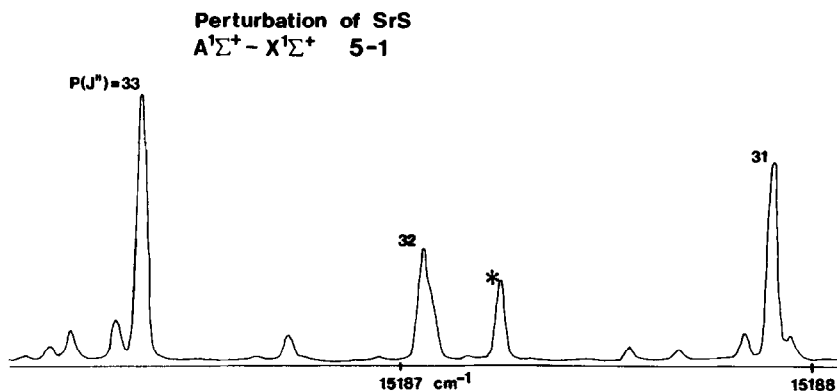


FIG. 3. Perturbation of the SrS $A^1\Sigma^+ - X^1\Sigma^+$ spectrum. The perturbation shown here is in the P branch of the 5-1 band. The perturbation occurred at the rotational level $J = 31$ of the vibrational level $v = 5$ in the $A^1\Sigma^+$ state. In this case, the perturbed line, $P(32)$, is shifted by a small amount (around 0.1 cm^{-1}) lower in frequency from its expected position as a result of the perturbation. The perturbing line, marked by the asterisk, is shifted to higher frequency.

The molecular constants resulting from the fit for vibrational levels in both the ground and excited states are presented in Table IV. The ground state constants agree reasonably well but are more accurate than those from the work of Marcano and Barrow (1). The excited state centrifugal distortion constants D_v and H_v (especially for $v = 3, 4$, and 5) are not physically reasonable molecular rotational constants but only effective constants because of the severe perturbations observed in these levels.

Lines from the 0-0, 0-1, 1-1, 2-1 bands and ground state vibrational combination differences between the 3-0 and 3-2 bands and between the 5-1 and 5-2 bands were also fit with a Dunham-type energy level expression (20) to determine equilibrium molecular constants (Table V),

$$E_{vJ} = \sum Y_{kl}(v + 1/2)^k [J(J + 1)]^l.$$

Due to the perturbed nature of the upper vibrational levels in the excited state, the 4-1 band was not included. The use of ground state combination differences essentially

v'	J'
0	40
1	0
3	43
3	59
5	31
5	45

TABLE IV
Molecular Constants for the $A^1\Sigma^+ - X^1\Sigma^+$ Transition of SrS (in cm^{-1})

Level	T_v	B_v	$D_v \times 10^8$	$H_v \times 10^{10}$
$X^1\Sigma^+$				
$v = 0$	0.0	0.1205652(29) ^a	4.894(64)	-
$v = 1$	385.70299(55)	0.1200876(29)	4.919(58)	-
$v = 2$	768.84690(69)	0.1196035(35)	4.86(13)	-
$A^1\Sigma^+$				
$v = 0$	13908.3283(3)	0.1137945(30)	5.355(60)	-
$v = 1$	14246.3691(8)	0.1134215(31)	4.779(74)	-
$v = 2$	14583.3051(8)	0.1130825(33)	6.29(11)	-
$v = 3$	14919.3935(4)	0.1126042(34)	1.81(14)	-
$v = 4$	15254.0297(8)	0.1122499(55)	2.44(75)	-0.440(32)
$v = 5$	15589.2504(14)	0.1109100(65)	-44.38(60)	-0.948(17)

^a The numbers in parentheses represent one standard deviation uncertainty.

TABLE V
Equilibrium Molecular Constants for the $A^1\Sigma^+ - X^1\Sigma^+$ Transition of SrS (in cm^{-1})

Constant ^a	$X^1\Sigma^+$	$A^1\Sigma^+$
Y_{00} (T_e)	0.0	13932.7068(10) ^b
Y_{10} (ω_e)	388.2643(11)	339.1454(20)
$-Y_{20}$ ($\omega_e x_e$)	1.28032(38)	0.55237(67)
Y_{01} (B_e)	0.1208034(33)	0.1139895(38)
$-Y_{11}$ (α_e)	0.00047463(70)	0.0004048(38)
Y_{21} (γ_e) $\times 10^6$	-2.07(28)	16.6(14)
$-Y_{02}$ (D_e) $\times 10^8$	4.870(63)	6.16(11)
$-Y_{12}$ (β_e) $\times 10^8$	---	-2.56(16)
$-Y_{22}$ $\times 10^8$	---	1.024(61)
Y_{03} (H_e) $\times 10^{13}$	---	-2.71(58)
r_e (Å)	2.439687(14)	2.511548(17)

^a As defined in Ref. 21, pg. 92, 107 and 108.

^b The numbers in parentheses represent one standard deviation uncertainty.

resulted in the removal of the most badly perturbed vibrational levels of the excited state ($v' = 3, 5$) from the fit, while allowing the $v'' = 2$ level of the ground state to be included. Again, the higher order excited state rotational constants (particularly the D 's and the H) are not actual molecular constants, but only effective constants.

Transitions involving the ^{86}Sr and ^{87}Sr isotopes of SrS were also observed in natural abundance (9.86, 7.00%). The positions of the isotopic transitions were accurately predicted from the constants of Table V. Only a few of the isotopic lines were measured and they were not included in the fits.

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