Table 1. Measured energies, observed hyperfine splittings, and calculated Fermi contact constants for mutually perturbing pairs of ro-vibrational levels of the NaK molecule, $1(b)^3\Pi_0(v_b, J) \sim 2(A)^1\Sigma^+(v_A, J)$, studied in this work.

perturbed level pair $1(b)^3\Pi_0 \sim 2(A)^1\Sigma^+$			$E_{upper} \equiv U$	$E_{lower} \equiv L$	ΔE_U^{obs}	ΔE_L^{obs}	$\left[1+(\omega_{probe}/\omega_{pump})\right]_U$	$\left[1+(\omega_{probe}/\omega_{pump})\right]_L$	ΔU	ΔL	$\Delta E_{hfs}^0 \equiv \Delta U + \Delta L$	b_F
v_A	v_b	J	(cm^{-1})[a]	(cm^{-1})[a]	(cm^{-1})[b]	(cm^{-1})[b]			(cm^{-1})[b]	(cm^{-1})[b]	(cm^{-1})	(cm^{-1})
18	17	18	13586.61	13577.97	0.0006	0.0038	1.997	1.998	0.0003	0.0019	0.0022	0.0105 ± 0.0020
18	17	19	13588.99	13581.20	0.0006	0.0036	1.997	1.998	0.0003	0.0018	0.0021	0.0096 ± 0.0019
18	17	20	13591.54	13584.58	0.0006	0.0036	1.997	1.998	0.0003	0.0018	0.0021	0.0091 ± 0.0018
18	17	21	13594.25	13588.07	0.0006	0.0034	1.997	1.998	0.0003	0.0017	0.0020	0.0083 ± 0.0018
18	17	22	13597.15	13591.69	0.0016	0.0032	1.997	1.998	0.0008	0.0016	0.0024	0.0095 ± 0.0017
18	17	23	13600.28	13595.34	0.0018	0.0026	1.997	1.998	0.0009	0.0013	0.0022	0.0084 ± 0.0016
18	17	24	13603.71	13598.98	0.0020	0.0028	1.921	1.922	0.0010	0.0015	0.0025	0.0092 ± 0.0016
18	17	25	13607.46	13602.62	0.0042	0.0024	1.918	1.918	0.0022	0.0013	0.0035	0.0124 ± 0.0015
18	17	26	13611.56	13606.19	0.0044	0.0014	1.921	1.922	0.0023	0.0007	0.0030	0.0102 ± 0.0014
18	17	27	13615.97	13609.77	0.0050	0.0013	1.920	1.921	0.0026	0.0007	0.0033	0.0109 ± 0.0014
18	17	28	13620.65	13613.37	0.0058	0.0006	1.997	1.998	0.0029	0.0003	0.0032	0.0102 ± 0.0014
18	17	29	13625.59	13617.01	0.0060	0.0006	1.997	1.998	0.0030	0.0003	0.0033	0.0102 ± 0.0013
11	12	37	13128.93	13123.22	0.0026	0.0058	2.033	2.034	0.0013	0.0029	0.0042	0.0104 ± 0.0011
11	12	38	13134.18	13129.44	0.0036	0.0048	2.033	2.033	0.0018	0.0024	0.0042	0.0102 ± 0.0010
11	12	39	13139.99	13135.41	0.0050	0.0032	2.033	2.033	0.0025	0.0016	0.0041	0.0097 ± 0.0010
11	12	40	13146.40	13141.08	0.0068	0.0012	2.032	2.033	0.0033	0.0006	0.0039	0.0091 ± 0.0010
20	18	43	13825.89	13820.08	0.0020	0.0066	1.912	1.913	0.0010	0.0035	0.0045	0.0101 ± 0.0009
20	18	44	13831.70	13827.10	0.0034	0.0050	1.912	1.913	0.0018	0.0026	0.0044	0.0097 ± 0.0009
20	18	45	13838.21	13833.71	0.0060	0.0028	1.912	1.913	0.0031	0.0015	0.0046	0.0099 ± 0.0009
20	18	46	13845.48	13839.85	0.0074	0.0014	1.912	1.913	0.0039	0.0007	0.0046	0.0097 ± 0.0009

a) The estimated absolute error in measured energies (U and L) is 0.01 cm^{-1}.

b) The estimated error in measured hyperfine splittings (ΔE_U^{obs} and ΔE_L^{obs}) is 0.0006 cm^{-1}. The error in ΔU and ΔL is 0.0003 cm^{-1}.

Table 2. Mixing probabilites, unperturbed level energies, and spin-orbit matrix elements for mutually perturbing pairs of ro-vibrational levels of the NaK molecule, $1(b)^3\Pi_0(v_b, J) \sim 2(A)^1\Sigma^+(v_A, J)$, studied in this work.

perturbed level pair $1(b)^3\Pi_0 \sim 2(A)^1\Sigma^+$			U	L	$U-L$	ΔU	ΔL	$\cos^2\theta$	$\sin^2\theta$	E^0_Σ	E^0_Π	$\lvert H_{SO}\rvert$
v_A	v_b	J	(cm^{-1})[a]	(cm^{-1})[a]	(cm^{-1})	(cm^{-1})[b]	(cm^{-1})[b]	(Eq. 14)	(Eq. 15)	(cm^{-1}) (Eq. 11)	(cm^{-1}) (Eq. 12)	(cm^{-1}) (Eq. 10)
18	17	18	13586.61	13577.97	8.64	0.0003	0.0019	0.136	0.864	13585.4	13579.1	2.96 ± 1.09
18	17	19	13588.99	13581.20	7.79	0.0003	0.0018	0.143	0.857	13587.9	13582.3	2.73 ± 0.99
18	17	20	13591.54	13584.58	6.96	0.0003	0.0018	0.143	0.857	13590.6	13585.6	2.44 ± 0.88
18	17	21	13594.25	13588.07	6.18	0.0003	0.0017	0.150	0.850	13593.3	13589.0	2.21 ± 0.78
18	17	22	13597.15	13591.69	5.46	0.0008	0.0016	0.333	0.667	13595.3	13593.5	2.57 ± 0.18
18	17	23	13600.28	13595.34	4.94	0.0009	0.0013	0.409	0.591	13598.3	13597.4	2.43 ± 0.09
18	17	24	13603.71	13598.98	4.73	0.0010	0.0015	0.400	0.600	13601.8	13600.9	2.32 ± 0.08
18	17	25	13607.46	13602.62	4.84	0.0022	0.0013	0.629	0.371	13604.4	13605.7	2.34 ± 0.08
18	17	26	13611.56	13606.19	5.37	0.0023	0.0007	0.767	0.233	13607.4	13610.3	2.27 ± 0.27
18	17	27	13615.97	13609.77	6.20	0.0026	0.0007	0.788	0.212	13611.1	13614.7	2.54 ± 0.32
18	17	28	13620.65	13613.37	7.28	0.0029	0.0003	0.906	0.094	13614.1	13620.0	2.12 ± 0.87
18	17	29	13625.59	13617.01	8.58	0.0030	0.0003	0.909	0.091	13617.8	13624.8	2.47 ± 1.01
11	12	37	13128.93	13123.22	5.71	0.0013	0.0029	0.310	0.690	13127.2	13125.0	2.64 ± 0.13
11	12	38	13134.18	13129.44	4.74	0.0018	0.0024	0.429	0.571	13132.1	13131.5	2.35 ± 0.04
11	12	39	13139.99	13135.41	4.58	0.0025	0.0016	0.610	0.390	13137.2	13138.2	2.23 ± 0.06
11	12	40	13146.40	13141.08	5.32	0.0033	0.0006	0.846	0.154	13141.9	13145.6	1.92 ± 0.34
20	18	43	13825.89	13820.08	5.81	0.0010	0.0035	0.222	0.778	13824.6	13821.4	2.41 ± 0.21
20	18	44	13831.70	13827.10	4.60	0.0018	0.0026	0.409	0.591	13829.8	13829.0	2.26 ± 0.04
20	18	45	13838.21	13833.71	4.50	0.0031	0.0015	0.674	0.326	13835.2	13836.7	2.11 ± 0.08
20	18	46	13845.48	13839.85	5.63	0.0039	0.0007	0.848	0.152	13840.7	13844.6	2.02 ± 0.31

a) The estimated absolute error in measured energies (U and L) is 0.01 cm^{-1}.

b) The estimated error in the hyperfine splittings (ΔU and ΔL) is 0.0003 cm^{-1}.

Table 3. Rotational mixing coefficients for the "unperturbed" NaK $1(b)^3\Pi_0$ levels $a'\left|1(b)^3\Pi_0(v_b, J)\right\rangle + b'\left|1(b)^3\Pi_1(v_b, J)\right\rangle + c'\left|1(b)^3\Pi_2(v_b, J)\right\rangle$ studied in this work, vibrational overlap integrals, and values for the magnitude of the electronic part of the NaK $1(b)^3\Pi_0(v_b, J) \sim 2(A)^1\Sigma^+(v_A, J)$ spin-orbit interaction, $|H_{el}|$.

$1(b)^3\Pi_0(v_b, J)$ level		mixing coefficients			$\left\|\langle v_b \mid v_A \rangle\right\|$	$\|H_{el}\|$ (cm^{-1})
v_b	J	$\|a'\|$	$\|b'\|$	$\|c'\|$		
17	18	0.9890	0.1473	0.0100	0.1509	19.87 ± 7.31
17	19	0.9878	0.1549	0.0141	0.1509	18.30 ± 6.63
17	20	0.9866	0.1625	0.0141	0.1508	16.37 ± 5.93
17	21	0.9853	0.1700	0.0141	0.1508	14.85 ± 5.28
17	22	0.9840	0.1772	0.0173	0.1508	17.34 ± 1.21
17	23	0.9826	0.1847	0.0173	0.1507	16.39 ± 0.61
17	24	0.9813	0.1918	0.0200	0.1508	15.65 ± 0.57
17	25	0.9798	0.1990	0.0200	0.1507	15.84 ± 0.55
17	26	0.9783	0.2059	0.0224	0.1507	15.39 ± 1.84
17	27	0.9768	0.2131	0.0245	0.1507	17.23 ± 2.20
17	28	0.9752	0.2200	0.0245	0.1507	14.43 ± 5.89
17	29	0.9736	0.2267	0.0265	0.1507	16.82 ± 6.92
12	37	0.9581	0.2834	0.0424	0.1470	18.75 ± 0.91
12	38	0.9561	0.2895	0.0447	0.1468	16.73 ± 0.26
12	39	0.9542	0.2956	0.0458	0.1467	15.94 ± 0.40
12	40	0.9522	0.3017	0.0480	0.1465	13.78 ± 2.42
18	43	0.9483	0.3130	0.0520	0.1464	17.39 ± 1.51
18	44	0.9464	0.3186	0.0539	0.1464	16.33 ± 0.31
18	45	0.9444	0.3240	0.0566	0.1463	15.27 ± 0.60
18	46	0.9424	0.3294	0.0583	0.1463	14.65 ± 2.22