Supplementary Material Table I

Table of NaCs $4^3\Pi$ level energies. v and J denote the vibrational and rotational quantum numbers for a given state with unprimed, single primed, and double primed quantum numbers corresponding to the upper state [43Π], intermediate state [2(A)1Σ+], and ground state [1(X)1Σ+], respectively.

Some level were observed as a result of collsions which transferred population from the intermediate state rotational level J' to J'_{coll}. Ground state energies are calculated with Dunham coefficients from Docenko et al. [Eur. Phys. J. D 31, 205–211 (2004).]

Upper Level		Intermediate Level			Ground State Level		Ground State Energy (cm^{-1})	Pump Laser Energy (cm^{-1})	Transferred Collisional Energy (cm^{-1})	Probe Laser Energy (cm^{-1})	Total Upper State Energy (cm^{-1})
v	J	v'	J'	J'_{coll}	v''	J''					
1	30	29	31	-	2	32	305.71	11976.64	-	11593.33	23875.68
1	32	29	31	-	2	32	305.71	11976.64	-	11597.86	23880.21
2	30	29	31	-	2	32	305.71	11976.64	-	11651.84	23934.19
2	32	29	31	-	2	32	305.71	11976.64	-	11656.31	23938.66
3	30	29	31	-	2	32	305.71	11976.64	-	11707.19	23989.54
3	32	29	31	-	2	32	305.71	11976.64	-	11711.57	23993.92
4	30	29	31	-	2	32	305.71	11976.64	-	11762.13	24044.48
4	32	29	31	-	2	32	305.71	11976.64	-	11765.57	24047.92
5	30	29	31	-	2	32	305.71	11976.64	-	11819.11	24101.46
5	32	29	31	-	2	32	305.71	11976.64	-	11823.57	24105.92
6	30	29	31	-	2	32	305.71	11976.64	-	11870.34	24152.69
6	32	29	31	-	2	32	305.71	11976.64	-	11873.83	24156.18
7	30	29	31	-	2	32	305.71	11976.64	-	11910.68	24193.03
7	32	29	31	-	2	32	305.71	11976.64	-	11916.08	24198.43
8	30	29	31	-	2	32	305.71	11976.64	-	11963.46	24245.81
8	32	29	31	-	2	32	305.71	11976.64	-	11967.96	24250.30
9	30	29	31	-	2	32	305.71	11976.64	-	11989.34	24271.69
9	32	29	31	-	2	32	305.71	11976.64	-	11991.63	24273.98
13	16	9	17	-	0	18	69.15	11017.22	-	13239.60	24325.97
13	17	9	17	18	0	18	69.15	11017.22	1.64	13239.60	24327.61
13	18	9	17	19	0	18	69.15	11017.22	3.38	13238.32	24328.06
13	19	9	17	20	0	18	69.15	11017.22	5.21	13237.63	24329.21
14	24	9	27	25	0	26	89.96	11017.22	-4.96	13235.58	24337.79
14	25	9	27	26	0	26	89.96	11017.22	-2.53	13234.59	24339.23
14	25	9	27	24	0	26	89.96	11017.22	-7.28	13239.34	24339.23
14	26	9	27	-	0	26	89.96	11017.22	-	13233.64	24340.81
14	26	9	27	25	0	26	89.96	11017.22	-4.96	13238.60	24340.82
14	27	9	27	28	0	26	89.96	11017.22	2.63	13232.66	24342.47
14	27	9	27	26	0	26	89.96	11017.22	-2.53	13237.83	24342.47
14	28	9	27	-	0	26	89.96	11017.22	-	13237.03	24344.21
14	28	9	27	29	0	26	89.96	11017.22	5.37	13231.66	24344.21
14	29	9	27	28	0	26	89.96	11017.22	2.63	13236.18	24345.99
14	30	9	27	29	0	26	89.96	11017.22	5.37	13235.24	24347.79
14	31	9	27	30	0	26	89.96	11017.22	8.21	13234.30	24349.69

19	30	29	31	-	2	32	305.71	11976.64	-	12118.44	24400.79
19	32	29	31	-	2	32	305.71	11976.64	-	12120.77	24403.12
20	30	29	31	-	2	32	305.71	11976.64	-	12143.75	24426.10
20	32	29	31	-	2	32	305.71	11976.64	-	12145.65	24428.00
21	30	29	31	-	2	32	305.71	11976.64	-	12155.09	24437.44
21	32	29	31	-	2	32	305.71	11976.64	-	12156.36	24438.71
23	30	29	31	-	2	32	305.71	11976.64	-	12163.61	24445.96
23	32	29	31	-	2	32	305.71	11976.64	-	12165.45	24447.80
24	30	29	31	-	2	32	305.71	11976.64	-	12179.70	24462.05
24	32	29	31	-	2	32	305.71	11976.64	-	12181.34	24463.69
25	30	29	31	-	2	32	305.71	11976.64	-	12188.33	24470.68
25	32	29	31	-	2	32	305.71	11976.64	-	12189.75	24472.10
27	30	29	31	-	2	32	305.71	11976.64	-	12200.52	24482.87
27	32	29	31	-	2	32	305.71	11976.64	-	12202.10	24484.45
28	30	29	31	-	2	32	305.71	11976.64	-	12211.15	24493.50
28	32	29	31	-	2	32	305.71	11976.64	-	12213.73	24496.08
33	33	12	34	-	0	35	122.18	11155.49	-	13261.01	24538.68
33	35	12	34	-	0	35	122.18	11155.49	-	13263.62	24541.29
36	30	29	31	-	2	32	305.71	11976.64	-	12276.32	24558.67
36	32	29	31	-	2	32	305.71	11976.64	-	12278.66	24561.01
38	33	12	34	-	0	35	122.18	11155.49	-	13300.85	24578.52
38	35	12	34	-	0	35	122.18	11155.49	-	13303.29	24580.96
39	30	29	31	-	2	32	305.71	11976.64	-	12303.75	24586.09
39	32	29	31	-	2	32	305.71	11976.64	-	12305.37	24587.72
39	33	12	34	-	0	33	114.22	11163.45	-	13310.64	24588.31
39	35	12	34	-	0	33	114.22	11163.45	-	13312.65	24590.32
40	33	12	34	-	0	33	114.22	11163.45	-	13320.80	24598.47
40	35	12	34	-	0	33	114.22	11163.45	-	13322.81	24600.47
41	33	12	34	-	0	33	114.22	11163.45	-	13331.01	24608.68
41	35	12	34	-	0	33	114.22	11163.45	-	13333.02	24610.69
42	33	12	34	-	0	33	114.22	11163.45	-	13341.06	24618.73
42	35	12	34	-	0	33	114.22	11163.45	-	13343.12	24620.79
43	33	12	34	-	0	33	114.22	11163.45	-	13351.73	24629.40
43	35	12	34	-	0	33	114.22	11163.45	-	13353.85	24631.52
43	43	12	44	-	0	43	158.61	11151.40	-	13330.01	24640.02
43	45	12	44	-	0	43	158.61	11151.40	-	13332.71	24642.72
44	30	29	31	-	2	32	305.71	11976.64	-	12354.74	24637.09
44	32	29	31	-	2	32	305.71	11976.64	-	12356.37	24638.72
44	33	12	34	-	0	33	114.22	11163.45	-	13361.60	24639.27
44	35	12	34	-	0	33	114.22	11163.45	-	13363.67	24641.33
47	30	29	31	-	2	32	305.71	11976.64	-	12385.31	24667.66
47	32	29	31	-	2	32	305.71	11976.64	-	12387.00	24669.35
48	30	29	31	-	2	32	305.71	11976.64	-	12398.11	24680.45
48	32	29	31	-	2	32	305.71	11976.64	-	12400.33	24682.68

49	30	29	31	-	2	32	305.71	11976.64	-	12406.44	24688.79
49	32	29	31	-	2	32	305.71	11976.64	-	12408.14	24690.49
50	30	29	31	-	2	32	305.71	11976.64	-	12415.95	24698.30
50	32	29	31	-	2	32	305.71	11976.64	-	12417.05	24699.40
52	30	29	31	-	2	32	305.71	11976.64	-	12437.61	24719.96
52	32	29	31	-	2	32	305.71	11976.64	-	12439.26	24721.61
53	30	29	31	-	2	32	305.71	11976.64	-	12450.66	24733.01
53	32	29	31	-	2	32	305.71	11976.64	-	12453.05	24735.40
54	30	29	31	-	2	32	305.71	11976.64	-	12459.27	24741.62
54	32	29	31	-	2	32	305.71	11976.64	-	12460.90	24743.25
57	30	29	31	-	2	32	305.71	11976.64	-	12491.73	24774.08
57	32	29	31	-	2	32	305.71	11976.64	-	12493.29	24775.64
58	30	29	31	-	2	32	305.71	11976.64	-	12501.61	24783.96
58	32	29	31	-	2	32	305.71	11976.64	-	12503.31	24785.66
59	30	29	31	-	2	32	305.71	11976.64	-	12513.82	24796.17
59	32	29	31	-	2	32	305.71	11976.64	-	12515.36	24797.71
61	30	29	31	-	2	32	305.71	11976.64	-	12531.44	24813.78
61	32	29	31	-	2	32	305.71	11976.64	-	12533.15	24815.50
62	30	29	31	-	2	32	305.71	11976.64	-	12547.18	24829.53
62	32	29	31	-	2	32	305.71	11976.64	-	12548.71	24831.06
63	30	29	31	-	2	32	305.71	11976.64	-	12558.43	24840.78
63	32	29	31	-	2	32	305.71	11976.64	-	12559.97	24842.31
64	30	29	31	-	2	32	305.71	11976.64	-	12569.64	24851.99
64	32	29	31	-	2	32	305.71	11976.64	-	12571.15	24853.50
65	45	18	44	-	0	43	158.61	11494.24	-	13232.63	24885.48
67	43	18	44	-	0	43	158.61	11494.24	-	13246.59	24899.44
67	45	18	44	-	0	43	158.61	11494.24	-	13249.07	24901.92
68	43	18	44	-	0	43	158.61	11494.24	-	13254.56	24907.41
68	45	18	44	-	0	43	158.61	11494.24	-	13258.88	24911.73

Supplementary Material Table II

NaCs $4^3\Pi$ pointwise potential energy curve resulting from the IPA fitting.
Note that the inconsistency in the R grid spacing is a result
of how sections were joined together after RKR fitting.

R (Å)	Energy (cm^{-1})
3.47	25147.18
3.48	25131.89
3.49	25116.57
3.50	25101.23
3.51	25085.87
3.52	25070.50
3.53	25055.10
3.54	25039.70
3.55	25024.29
3.56	25008.87
3.57	24993.44
3.58	24978.01
3.59	24962.59
3.60	24947.16
3.61	24931.75
3.62	24916.34
3.63	24900.94
3.64	24885.56
3.65	24870.19
3.66	24854.84
3.67	24839.52
3.68	24824.22
3.69	24808.94
3.70	24793.70
3.71	24778.49
3.72	24763.31
3.73	24748.17
3.74	24733.07
3.75	24718.01
3.76	24703.00
3.77	24688.04
3.78	24673.11
3.79	24658.23
3.80	24643.39
3.81	24628.59
3.82	24613.83
3.83	24599.10
3.84	24584.41

3.85	24569.76
3.86	24555.13
3.87	24540.54
3.88	24525.99
3.89	24511.46
3.90	24496.96
3.91	24482.49
3.92	24468.04
3.93	24453.62
3.94	24439.22
3.95	24424.85
3.97	24392.03
4.02	24331.05
4.06	24268.55
4.10	24204.33
4.15	24138.24
4.20	24070.57
4.21	24056.89
4.22	24043.16
4.23	24029.41
4.24	24015.62
4.26	24001.82
4.27	23988.01
4.28	23974.19
4.29	23960.37
4.30	23946.57
4.32	23932.80
4.33	23919.08
4.34	23905.41
4.36	23891.83
4.37	23878.35
4.38	23865.01
4.40	23851.84
4.42	23838.88
4.43	23826.20
4.45	23813.86
4.47	23801.95
4.49	23790.54
4.51	23779.71
4.53	23769.57
4.56	23760.31
4.59	23752.22
4.63	23745.93
4.68	23743.52

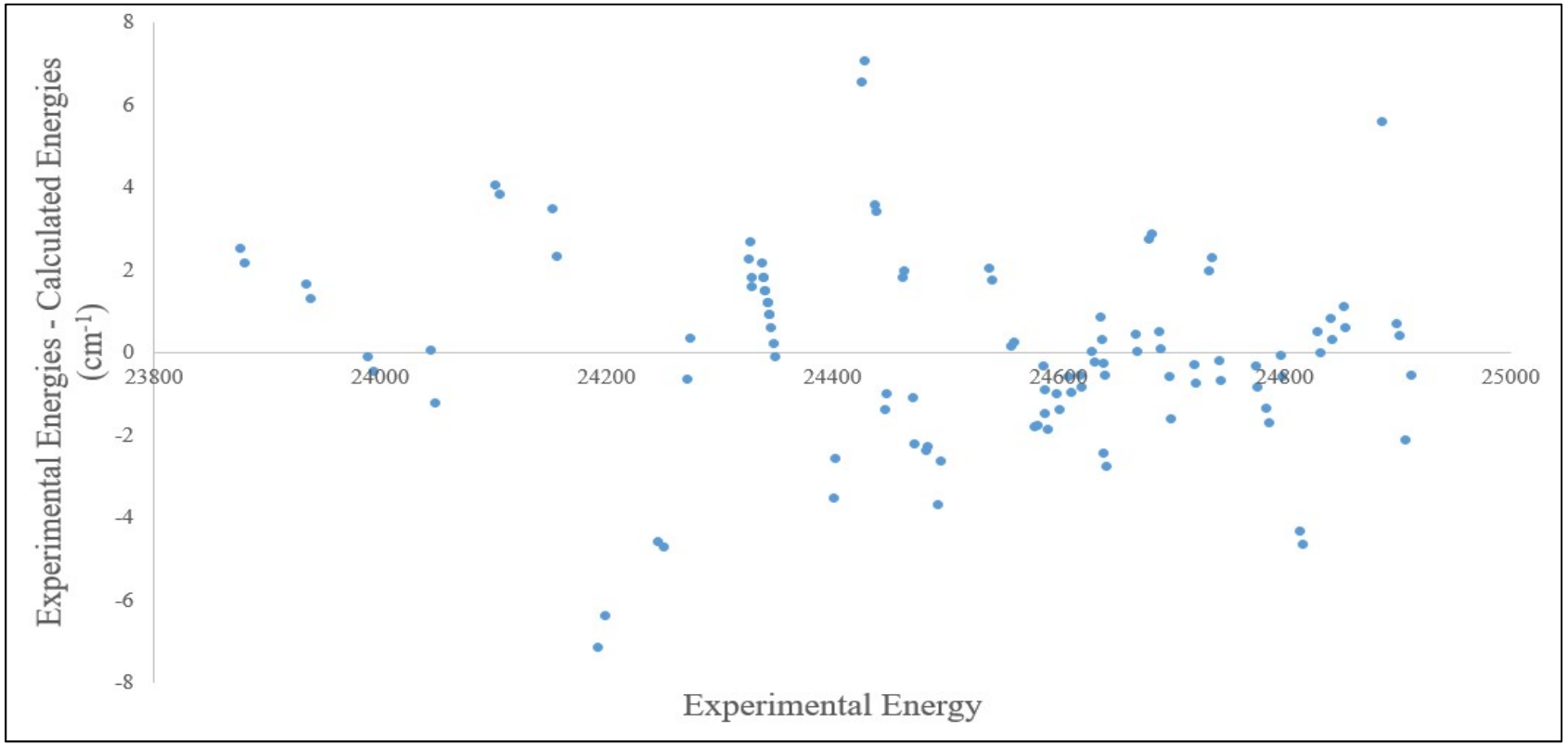
4.76	23751.65
4.83	23770.81
4.89	23790.74
4.93	23807.11
4.96	23821.88
4.99	23835.65
5.02	23848.67
5.04	23861.09
5.07	23873.02
5.09	23884.51
5.11	23895.62
5.13	23906.37
5.14	23916.79
5.16	23926.90
5.18	23936.74
5.20	23946.36
5.21	23955.78
5.23	23965.04
5.24	23974.15
5.26	23983.15
5.28	23992.05
5.29	24000.87
5.30	24009.63
5.32	24018.33
5.33	24026.99
5.35	24035.62
5.36	24044.23
5.37	24052.84
5.39	24061.44
5.45	24104.78
5.52	24149.31
5.58	24195.35
5.64	24242.22
5.70	24289.28
5.80	24346.54
5.90	24395.23
6.00	24432.95
6.10	24461.19
6.20	24481.44
6.30	24495.07
6.40	24503.00
6.50	24506.04
6.60	24504.92
6.70	24500.43

6.80	24493.41
6.90	24484.73
7.00	24475.10
7.10	24464.93
7.20	24454.50
7.30	24444.05
7.40	24431.81
7.51	24422.87
7.62	24413.20
7.73	24402.74
7.83	24391.56
7.93	24379.73
8.02	24367.30
8.12	24354.30
8.22	24340.76
8.32	24326.71
8.42	24312.22
8.53	24297.37
8.65	24282.35
8.80	24267.56
8.87	24261.94
8.91	24259.27
8.95	24256.75
9.00	24254.46
9.06	24252.61
9.15	24251.82
9.27	24254.49
9.40	24261.53
9.49	24269.45
9.56	24276.25
9.61	24282.58
9.66	24288.62
9.70	24294.45
9.78	24305.68
9.94	24332.02
10.08	24356.68
10.21	24380.11
10.34	24402.50
10.47	24424.02
10.59	24444.84
10.72	24465.15
10.85	24485.08
10.99	24504.73
11.57	24614.56

11.66	24630.31
11.74	24646.06
11.82	24661.76
11.90	24677.34
11.98	24692.78
12.06	24708.04
12.14	24723.11
12.21	24737.95
12.29	24752.58
12.36	24766.96
12.44	24781.10
12.51	24794.98
12.58	24808.58
12.65	24821.91
12.72	24834.95
12.79	24847.69
12.86	24860.14
12.92	24872.32
12.99	24884.26
13.06	24895.99
13.12	24907.52
13.19	24918.89
13.25	24930.12
13.32	24941.23
13.38	24952.23
13.44	24963.13
13.50	24973.96
13.57	24984.72
13.63	24995.42
13.69	25006.08
13.75	25016.71
13.81	25027.30
13.87	25037.89
13.93	25048.47

Supplementary Figure I

Differences between experimental energies and calculated energies from the final IPA potential. The RMS difference is 2.33 cm^{-1}.



Supplementary Material Table III

The following are the final parameters associated
with the EMO functional form described in Eqs. 2, 3, 4.
Note that T_e must be added to the overall potential
of Eq. 2 to raise the potential to the appropriate absolute energy.

T_e	23753.63
D_e	3113.55
q	7
R_e	5.0
R_{ref}	9.0
N_β	6
β_0	0.13206
β_1	-0.037
β_2	0.083
β_3	-0.3132
β_4	0.2539
β_5	0.10
β_6	-0.10

Supplementary Figure II

Differences between experimental energies and calculated energies from the final EMO potential. The RMS difference is 2.53 cm^{-1}.