

Electronic Supplementary Information for:

High-resolution FTIR spectroscopy of benzaldehyde in the far infrared region: probing the rotational barrier

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The following content is included as the Electronic Supplementary Information of this publication:

Table S1: Anharmonic (VPT2) vibrational energy levels and vibrationally-averaged rotational constants with excitations in the out-of-plane and torsional modes of benzaldehyde in  $\text{cm}^{-1}$ .

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Table S2: The torsional energy levels (in  $\text{cm}^{-1}$ ) and symmetry of benzaldehyde from the ground state quasiadiabatic channel calculation.

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Table S3: The summary of assigned transitions of benzaldehyde.

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Table S4: Reproduced barrier heights with different values of wavenumber shifts due to the possible Fermi resonance between the second torsional overtone and the in-plane bending mode (in  $\text{cm}^{-1}$ ).

... 3

Table S5: The observed, calculated frequencies and (obs.-cal.) error (in  $\text{cm}^{-1}$ ) of our reported transitions in the ground state and  $\nu_t = 1$  torsional state of benzaldehyde (the table is lined in the order of the observed frequency, lower states ", upper states ').

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**Table S1** Anharmonic (VPT2) vibrational energy levels and vibrationally-averaged rotational constants with excitations in the out-of-plane and torsional modes of benzaldehyde in  $\text{cm}^{-1}$ .

$V_{\text{oop}}$	$V_{\text{tor}}$	$E / (hc \text{ cm}^{-1})$	$A / \text{cm}^{-1}$	$B / \text{cm}^{-1}$	$C / \text{cm}^{-1}$
0	0	0	0.173908	0.052006	0.040040
0	1	109.13	0.173667	0.051993	0.040106
1	0	226.34	0.174651	0.052000	0.040058
0	2	217.55	0.173426	0.051981	0.040172
1	1	334.57	0.174410	0.051987	0.040124
2	0	451.38	0.175394	0.051994	0.040076
0	3	325.25	0.173185	0.051968	0.040238
1	2	442.09	0.174169	0.051975	0.040190
2	1	558.70	0.175153	0.051981	0.040142
3	0	675.11	0.176137	0.051988	0.040093
0	4	432.24	0.172944	0.051955	0.040304
1	3	548.88	0.173928	0.051962	0.040256
2	2	665.32	0.174912	0.051969	0.040207
3	1	781.53	0.175896	0.051976	0.040159
4	0	897.53	0.176880	0.051982	0.040111
0	5	538.51	0.172703	0.051943	0.040370
1	4	654.97	0.173687	0.051949	0.040321
2	3	771.21	0.174671	0.051956	0.040273
3	2	887.24	0.175655	0.051963	0.040225
4	1	1003.05	0.176639	0.051970	0.040177
5	0	1118.65	0.177623	0.051977	0.040129

**Table S2** The torsional energy levels (in  $\text{cm}^{-1}$ ) and symmetry of benzaldehyde from the ground-state quasiadiabatic channel calculation.

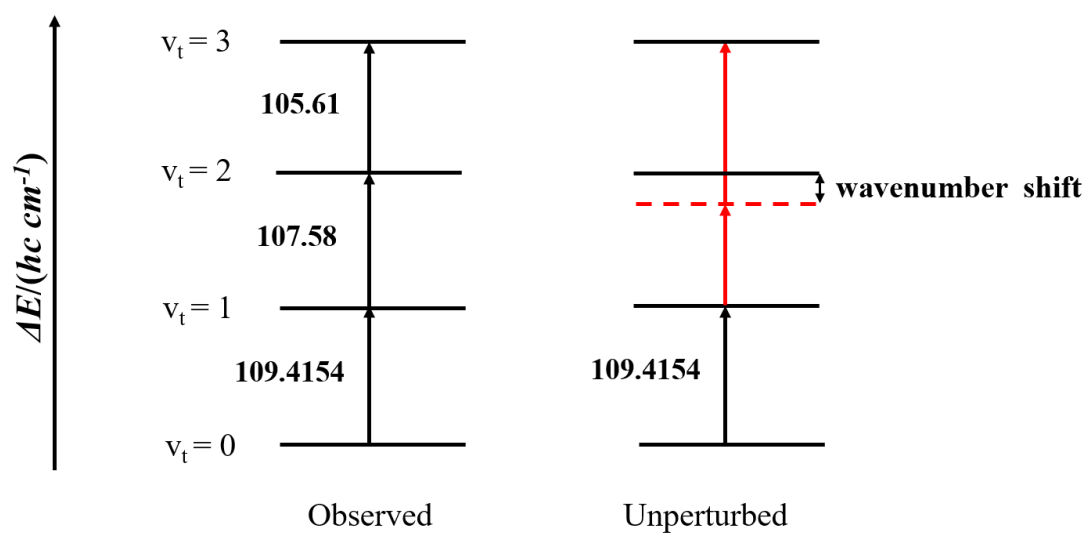
$v_{\text{tors}}$	Symmetry	$E / (hc \text{ cm}^{-1})$
0	+	0
0	-	0
1	+	146.84
1	-	146.84
2	+	283.75
2	-	283.75
3	+	425.72
3	-	425.72
4	+	561.36
4	-	561.36
5	+	698.57
5	-	698.57

**Table S3** The summary of assigned transitions of benzaldehyde.

	$N_{\text{lines}}$	$J$	$K_a$	$K_c$
GSCD	74	18-43	12-38	0-27
Q branch	143	23-99	0-1	23-99
R branch	232	11-64	7-45	0-36
P branch	82	20-63	13-38	0-35
Total	457	11-99	0-45	0-99

**Table S4** Reproduced barrier heights with different values of wavenumber shifts due to the possible Fermi resonance between the second torsional overtone and the in-plane bending mode (in  $\text{cm}^{-1}$ ). This reproduction is based on the assumption that only the  $\nu_t = 2$  state is perturbed so that  $\nu_t = 2 \leftarrow \nu_t = 1 + \nu_t = 3 \leftarrow \nu_t = 2 = 213.19 \text{ cm}^{-1}$  as illustrated in the figure attached below.

Shifted value	$\nu_t = 2 \leftarrow \nu_t = 1$	$\nu_t = 3 \leftarrow \nu_t = 2$	$V_2$	$V_4$	$V_6$	Barrier
0	107.58	105.61	1530.6	21.7	3.0	1533.6
0.1	107.48	105.71	1840	-120	30	1870
0.2	107.38	105.81	2220	-290	70	2290
0.3	107.28	105.91	2550	-450	100	2650
0.4	107.18	106.01	2910	-610	140	3050



**Table S5** The observed, calculated frequencies and (obs.-cal.) error (in  $\text{cm}^{-1}$ ) of our reported transitions in the ground state and  $v_t = 1$  torsional state of benzaldehyde (the table is lined in the order of the observed frequency, lower states ", upper states ').

$J'$	$K_a'$	$K_c'$	$v$	$J''$	$K_a''$	$K_c''$	$v$	$\nu_{\text{obs.}}$	$\nu_{\text{cal.}}$	$\nu_{\text{obs.}} - \nu_{\text{cal.}}$
62	32	31	1	63	33	31	0	94.65165	94.65184	-0.00019
62	32	30	1	63	33	30	0	94.65165	94.65184	-0.00019
42	37	6	1	43	38	6	0	94.87419	94.87431	-0.00013
42	37	5	1	43	38	5	0	94.87419	94.87431	-0.00013
41	37	5	1	42	38	5	0	94.96340	94.96339	0.00001
41	37	4	1	42	38	4	0	94.96340	94.96339	0.00001
39	37	2	1	40	38	2	0	95.14176	95.14181	-0.00005
39	37	3	1	40	38	3	0	95.14176	95.14181	-0.00005
42	36	6	1	43	37	6	0	95.18455	95.18444	0.00011
42	36	7	1	43	37	7	0	95.18455	95.18444	0.00011
38	36	3	1	39	37	3	0	95.54121	95.54128	-0.00007
38	36	2	1	39	37	2	0	95.54121	95.54128	-0.00007
38	31	8	1	39	32	8	0	97.07062	97.07049	0.00013
38	31	7	1	39	32	7	0	97.07062	97.07049	0.00013
35	31	4	1	36	32	4	0	97.33898	97.33901	-0.00003
35	31	5	1	36	32	5	0	97.33898	97.33901	-0.00003
36	30	6	1	37	31	6	0	97.55088	97.55095	-0.00007
36	30	7	1	37	31	7	0	97.55088	97.55095	-0.00007
57	23	35	1	58	24	35	0	97.77649	97.77652	-0.00003
57	23	34	1	58	24	34	0	97.77649	97.77652	-0.00003
28	28	0	1	29	29	0	0	98.86900	98.86888	0.00011
28	28	1	1	29	29	1	0	98.86900	98.86888	0.00011
34	26	8	1	35	27	8	0	98.92173	98.92193	-0.00020
34	26	9	1	35	27	9	0	98.92173	98.92193	-0.00020
27	27	0	1	28	28	0	0	99.25632	99.25636	-0.00004
27	27	1	1	28	28	1	0	99.25632	99.25636	-0.00004
27	26	2	1	28	27	2	0	99.55219	99.55209	0.00009
27	26	1	1	28	27	1	0	99.55219	99.55209	0.00009
32	23	10	1	33	24	10	0	99.98022	99.98013	0.00009
32	23	9	1	33	24	9	0	99.98022	99.98013	0.00009
31	23	9	1	32	24	9	0	100.07013	100.07002	0.00011
31	23	8	1	32	24	8	0	100.07013	100.07002	0.00011
38	19	20	1	39	20	20	0	100.59683	100.59667	0.00017
38	19	19	1	39	20	19	0	100.59683	100.59667	0.00017
42	16	26	1	43	17	26	0	101.10089	101.10094	-0.00006
42	16	27	1	43	17	27	0	101.10089	101.10094	-0.00006
25	21	4	1	26	22	4	0	101.18967	101.18974	-0.00006
25	21	5	1	26	22	5	0	101.18967	101.18974	-0.00006

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28	20	9	1	29	21	9	0	101.20599	101.20575	0.00024
28	20	8	1	29	21	8	0	101.20599	101.20575	0.00024
29	19	11	1	30	20	11	0	101.40127	101.40131	-0.00004
29	19	10	1	30	20	10	0	101.40127	101.40131	-0.00004
23	20	4	1	24	21	4	0	101.65790	101.65788	0.00002
23	20	3	1	24	21	3	0	101.65790	101.65788	0.00002
35	16	19	1	36	17	19	0	101.71515	101.71498	0.00017
35	16	20	1	36	17	20	0	101.71515	101.71498	0.00017
39	14	25	1	40	15	25	0	101.93016	101.93020	-0.00004
39	14	26	1	40	15	26	0	101.93016	101.93020	-0.00004
20	20	0	1	21	21	0	0	101.93016	101.93029	-0.00013
20	20	1	1	21	21	1	0	101.93016	101.93029	-0.00013
26	18	8	1	27	19	8	0	101.95610	101.95601	0.00009
26	18	9	1	27	19	9	0	101.95610	101.95601	0.00009
21	19	3	1	22	20	3	0	102.12481	102.12490	-0.00009
21	19	2	1	22	20	2	0	102.12481	102.12490	-0.00009
37	13	24	1	38	14	24	0	102.38673	102.38668	0.00004
37	13	25	1	38	14	25	0	102.38673	102.38668	0.00004
24	17	7	1	25	18	7	0	102.41959	102.41952	0.00006
24	17	8	1	25	18	8	0	102.41959	102.41952	0.00006
36	13	23	1	37	14	23	0	102.47310	102.47309	0.00001
36	13	24	1	37	14	24	0	102.47310	102.47309	0.00001
19	18	2	1	20	19	2	0	102.59072	102.59079	-0.00007
19	18	1	1	20	19	1	0	102.59072	102.59079	-0.00007
25	16	10	1	26	17	10	0	102.61016	102.61037	-0.00022
25	16	9	1	26	17	9	0	102.61016	102.61037	-0.00022
33	13	20	1	34	14	20	0	102.73493	102.73477	0.00015
33	13	21	1	34	14	21	0	102.73493	102.73477	0.00015
36	12	24	1	37	13	24	0	102.75642	102.75659	-0.00017
36	12	25	1	37	13	25	0	102.75642	102.75657	-0.00015
20	17	3	1	21	18	3	0	102.78251	102.78239	0.00012
20	17	4	1	21	18	4	0	102.78251	102.78239	0.00012
29	14	15	1	30	15	15	0	102.81011	102.80999	0.00011
29	14	16	1	30	15	16	0	102.81011	102.80999	0.00011
32	13	19	1	33	14	19	0	102.82261	102.82273	-0.00012
32	13	20	1	33	14	20	0	102.82261	102.82273	-0.00012
35	12	23	1	36	13	23	0	102.84244	102.84231	0.00013
35	12	24	1	36	13	24	0	102.84244	102.84231	0.00013
30	13	17	1	31	14	17	0	102.99962	102.99960	0.00002
30	13	18	1	31	14	18	0	102.99962	102.99960	0.00002
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24	14	11	1	25	15	11	0	103.25933	103.25915	0.00018
20	14	6	1	21	15	6	0	103.62128	103.62140	-0.00012
20	14	7	1	21	15	7	0	103.62128	103.62140	-0.00012

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59	0	59	1	59	1	59	0	109.61833	109.61848	-0.00016
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69	0	69	1	69	1	69	0	109.69417	109.69434	-0.00016
69	1	69	1	69	0	69	0	109.69417	109.69434	-0.00016
70	1	70	1	70	0	70	0	109.70272	109.70258	0.00014
70	0	70	1	70	1	70	0	109.70272	109.70258	0.00014
71	0	71	1	71	1	71	0	109.71110	109.71094	0.00016
71	1	71	1	71	0	71	0	109.71110	109.71094	0.00016



72	0	72	1	72	1	72	0	109.71947	109.71942	0.00005
72	1	72	1	72	0	72	0	109.71947	109.71942	0.00005
73	1	73	1	73	0	73	0	109.72807	109.72802	0.00005
73	0	73	1	73	1	73	0	109.72807	109.72802	0.00005
74	0	74	1	74	1	74	0	109.73678	109.73674	0.00004
74	1	74	1	74	0	74	0	109.73678	109.73674	0.00004
75	1	75	1	75	0	75	0	109.74555	109.74558	-0.00003
75	0	75	1	75	1	75	0	109.74555	109.74558	-0.00003
76	1	76	1	76	0	76	0	109.75466	109.75454	0.00013
76	0	76	1	76	1	76	0	109.75466	109.75454	0.00013
77	1	77	1	77	0	77	0	109.76366	109.76361	0.00004
77	0	77	1	77	1	77	0	109.76366	109.76361	0.00004
78	0	78	1	78	1	78	0	109.77278	109.77281	-0.00003
78	1	78	1	78	0	78	0	109.77278	109.77281	-0.00003
79	1	79	1	79	0	79	0	109.78225	109.78212	0.00013
79	0	79	1	79	1	79	0	109.78225	109.78212	0.00013
80	1	80	1	80	0	80	0	109.79163	109.79155	0.00007
80	0	80	1	80	1	80	0	109.79163	109.79155	0.00007
81	1	81	1	81	0	81	0	109.80105	109.80110	-0.00005
81	0	81	1	81	1	81	0	109.80105	109.80110	-0.00005
82	0	82	1	82	1	82	0	109.81081	109.81078	0.00004
82	1	82	1	82	0	82	0	109.81081	109.81078	0.00004
83	0	83	1	83	1	83	0	109.82049	109.82056	-0.00007
83	1	83	1	83	0	83	0	109.82049	109.82056	-0.00007
84	1	84	1	84	0	84	0	109.83029	109.83047	-0.00018
84	0	84	1	84	1	84	0	109.83029	109.83047	-0.00018
85	1	85	1	85	0	85	0	109.84040	109.84050	-0.00010
85	0	85	1	85	1	85	0	109.84040	109.84050	-0.00010
86	1	86	1	86	0	86	0	109.85047	109.85064	-0.00017
86	0	86	1	86	1	86	0	109.85047	109.85064	-0.00017
87	0	87	1	87	1	87	0	109.86093	109.86091	0.00002
87	1	87	1	87	0	87	0	109.86093	109.86091	0.00002
88	1	88	1	88	0	88	0	109.87120	109.87129	-0.00008
88	0	88	1	88	1	88	0	109.87120	109.87129	-0.00008
89	0	89	1	89	1	89	0	109.88172	109.88179	-0.00007
89	1	89	1	89	0	89	0	109.88172	109.88179	-0.00007
90	0	90	1	90	1	90	0	109.89235	109.89241	-0.00006
90	1	90	1	90	0	90	0	109.89235	109.89241	-0.00006
92	0	92	1	92	1	92	0	109.91393	109.91400	-0.00007
92	1	92	1	92	0	92	0	109.91393	109.91400	-0.00007
94	1	94	1	94	0	94	0	109.93622	109.93606	0.00016
94	0	94	1	94	1	94	0	109.93622	109.93606	0.00016
95	1	95	1	95	0	95	0	109.94726	109.94727	-0.00001
95	0	95	1	95	1	95	0	109.94726	109.94727	-0.00001

96	1	96	1	96	0	96	0	109.95874	109.95860	0.00014
96	0	96	1	96	1	96	0	109.95874	109.95860	0.00014
97	0	97	1	97	1	97	0	109.96995	109.97004	-0.00010
97	1	97	1	97	0	97	0	109.96995	109.97004	-0.00010
98	1	98	1	98	0	98	0	109.98171	109.98160	0.00011
98	0	98	1	98	1	98	0	109.98171	109.98160	0.00011
99	0	99	1	99	1	99	0	109.99324	109.99328	-0.00005
99	1	99	1	99	0	99	0	109.99324	109.99328	-0.00005
12	9	3	1	11	8	3	0	112.65355	112.65351	0.00005
12	9	4	1	11	8	4	0	112.65355	112.65351	0.00005
14	9	5	1	13	8	5	0	112.84080	112.84063	0.00017
14	9	6	1	13	8	6	0	112.84080	112.84063	0.00017
44	16	29	1	44	15	29	0	113.20525	113.20525	0.00000
42	16	27	1	42	15	27	0	113.21147	113.21148	-0.00001
41	16	26	1	41	15	26	0	113.21402	113.21400	0.00002
18	12	6	1	17	11	6	0	113.93908	113.93914	-0.00006
18	12	7	1	17	11	7	0	113.93908	113.93914	-0.00006
21	11	10	1	20	10	10	0	113.98063	113.98064	-0.00002
21	11	11	1	20	10	11	0	113.98063	113.98064	-0.00002
24	10	14	1	23	9	14	0	114.01671	114.01664	0.00007
24	10	15	1	23	9	15	0	114.01671	114.01665	0.00006
23	11	12	1	22	10	12	0	114.16779	114.16770	0.00008
23	11	13	1	22	10	13	0	114.16779	114.16770	0.00008
24	11	13	1	23	10	13	0	114.26123	114.26103	0.00020
24	11	14	1	23	10	14	0	114.26123	114.26103	0.00020
19	13	6	1	18	12	6	0	114.27134	114.27123	0.00011
19	13	7	1	18	12	7	0	114.27134	114.27123	0.00011
26	11	15	1	25	10	15	0	114.44711	114.44711	0.00001
26	11	16	1	25	10	16	0	114.44711	114.44711	0.00000
19	14	6	1	18	13	6	0	114.50779	114.50774	0.00005
19	14	5	1	18	13	5	0	114.50779	114.50774	0.00005
22	13	9	1	21	12	9	0	114.55340	114.55347	-0.00007
22	13	10	1	21	12	10	0	114.55340	114.55347	-0.00007
26	12	14	1	25	11	14	0	114.68976	114.68967	0.00009
26	12	15	1	25	11	15	0	114.68976	114.68967	0.00009
16	16	0	1	15	15	0	0	114.69367	114.69380	-0.00013
16	16	1	1	15	15	1	0	114.69367	114.69380	-0.00013
21	14	7	1	20	13	7	0	114.69595	114.69607	-0.00012
21	14	8	1	20	13	8	0	114.69595	114.69607	-0.00012
27	12	15	1	26	11	15	0	114.78315	114.78307	0.00008
27	12	16	1	26	11	16	0	114.78315	114.78307	0.00008
25	13	12	1	24	12	12	0	114.83552	114.83558	-0.00006
25	13	13	1	24	12	13	0	114.83552	114.83558	-0.00006
20	15	5	1	19	14	5	0	114.83685	114.83687	-0.00002

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20	15	6	1	19	14	6	0	114.83685	114.83687	-0.00002
29	12	17	1	28	11	17	0	114.96923	114.96931	-0.00008
29	12	18	1	28	11	18	0	114.96923	114.96931	-0.00008
24	14	10	1	23	13	10	0	114.97888	114.97872	0.00016
24	14	11	1	23	13	11	0	114.97888	114.97872	0.00016
31	12	19	1	30	11	19	0	115.15448	115.15459	-0.00011
31	12	20	1	30	11	20	0	115.15448	115.15460	-0.00011
21	16	6	1	20	15	6	0	115.16460	115.16458	0.00002
21	16	5	1	20	15	5	0	115.16460	115.16458	0.00002
45	9	36	1	44	8	36	0	115.22727	115.22714	0.00014
44	8	36	1	43	7	36	0	115.22727	115.22728	0.00000
27	14	13	1	26	13	13	0	115.26135	115.26128	0.00008
27	14	14	1	26	13	14	0	115.26135	115.26128	0.00008
23	16	8	1	22	15	8	0	115.35331	115.35330	0.00001
23	16	7	1	22	15	7	0	115.35331	115.35330	0.00001
19	18	2	1	18	17	2	0	115.43830	115.43830	-0.00001
19	18	1	1	18	17	1	0	115.43830	115.43830	-0.00001
29	14	15	1	28	13	15	0	115.44951	115.44941	0.00010
29	14	16	1	28	13	16	0	115.44951	115.44941	0.00010
25	16	10	1	24	15	10	0	115.54213	115.54218	-0.00005
25	16	9	1	24	15	9	0	115.54213	115.54218	-0.00005
30	14	16	1	29	13	16	0	115.54331	115.54336	-0.00005
30	14	17	1	29	13	17	0	115.54331	115.54336	-0.00005
33	13	20	1	32	12	20	0	115.58368	115.58355	0.00014
33	13	21	1	32	12	21	0	115.58368	115.58355	0.00013
19	19	0	1	18	18	0	0	115.66705	115.66717	-0.00012
19	19	1	1	18	18	1	0	115.66705	115.66717	-0.00012
20	19	1	1	19	18	1	0	115.76153	115.76142	0.00010
20	19	2	1	19	18	2	0	115.76153	115.76142	0.00010
33	14	19	1	32	13	19	0	115.82441	115.82451	-0.00010
33	14	20	1	32	13	20	0	115.82441	115.82451	-0.00010
21	19	3	1	20	18	3	0	115.85555	115.85576	-0.00021
21	19	2	1	20	18	2	0	115.85555	115.85576	-0.00021
36	13	23	1	35	12	23	0	115.86035	115.86056	-0.00021
36	13	24	1	35	12	24	0	115.86035	115.86057	-0.00021
22	19	4	1	21	18	4	0	115.95018	115.95016	0.00001
22	19	3	1	21	18	3	0	115.95018	115.95016	0.00001
20	20	0	1	19	19	0	0	115.98884	115.98879	0.00005
20	20	1	1	19	19	1	0	115.98884	115.98879	0.00005
32	16	16	1	31	15	16	0	116.20352	116.20355	-0.00003
32	16	17	1	31	15	17	0	116.20352	116.20355	-0.00003
23	20	3	1	22	19	3	0	116.27217	116.27203	0.00014
23	20	4	1	22	19	4	0	116.27217	116.27203	0.00014
22	21	2	1	21	20	2	0	116.40336	116.40342	-0.00006

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22	21	1	1	21	20	1	0	116.40336	116.40342	-0.00006
35	16	19	1	34	15	19	0	116.48660	116.48652	0.00008
35	16	20	1	34	15	20	0	116.48660	116.48652	0.00008
23	21	2	1	22	20	2	0	116.49811	116.49791	0.00020
23	21	3	1	22	20	3	0	116.49811	116.49791	0.00020
33	17	16	1	32	16	16	0	116.53117	116.53127	-0.00010
33	17	17	1	32	16	17	0	116.53117	116.53127	-0.00010
28	20	8	1	27	19	8	0	116.74536	116.74546	-0.00010
28	20	9	1	27	19	9	0	116.74536	116.74546	-0.00010
23	23	0	1	22	22	0	0	116.94506	116.94519	-0.00012
23	23	1	1	22	22	1	0	116.94506	116.94519	-0.00012
36	18	18	1	35	17	18	0	117.04705	117.04700	0.00005
36	18	19	1	35	17	19	0	117.04705	117.04700	0.00005
29	21	9	1	28	20	9	0	117.06640	117.06633	0.00007
29	21	8	1	28	20	8	0	117.06640	117.06633	0.00007
26	23	3	1	25	22	3	0	117.22918	117.22914	0.00004
26	23	4	1	25	22	4	0	117.22918	117.22914	0.00004
26	24	2	1	25	23	2	0	117.45060	117.45054	0.00006
26	24	3	1	25	23	3	0	117.45060	117.45054	0.00006
38	19	19	1	37	18	19	0	117.46685	117.46695	-0.00010
38	19	20	1	37	18	20	0	117.46685	117.46695	-0.00010
25	25	0	1	24	24	0	0	117.57566	117.57572	-0.00006
25	25	1	1	24	24	1	0	117.57566	117.57572	-0.00006
26	25	2	1	25	24	2	0	117.67062	117.67045	0.00017
26	25	1	1	25	24	1	0	117.67062	117.67045	0.00017
31	23	8	1	30	22	8	0	117.70400	117.70382	0.00018
31	23	9	1	30	22	9	0	117.70400	117.70382	0.00018
29	24	5	1	28	23	5	0	117.73523	117.73518	0.00005
29	24	6	1	28	23	6	0	117.73523	117.73518	0.00005
44	18	26	1	43	17	26	0	117.80286	117.80305	-0.00018
44	18	27	1	43	17	27	0	117.80286	117.80305	-0.00018
26	26	1	1	25	25	1	0	117.88888	117.88887	0.00001
26	26	0	1	25	25	0	0	117.88888	117.88887	0.00001
27	26	1	1	26	25	1	0	117.98360	117.98368	-0.00008
27	26	2	1	26	25	2	0	117.98360	117.98368	-0.00008
31	25	6	1	30	24	6	0	118.14518	118.14525	-0.00007
31	25	7	1	30	24	7	0	118.14518	118.14525	-0.00007
46	19	27	1	45	18	27	0	118.22459	118.22461	-0.00003
46	19	28	1	45	18	28	0	118.22459	118.22461	-0.00003
28	27	2	1	27	26	2	0	118.29553	118.29550	0.00003
28	27	1	1	27	26	1	0	118.29553	118.29550	0.00003
29	27	2	1	28	26	2	0	118.39048	118.39047	0.00002
29	27	3	1	28	26	3	0	118.39048	118.39047	0.00002
31	27	4	1	30	26	4	0	118.58077	118.58063	0.00014

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31	27	5	1	30	26	5	0	118.58077	118.58063	0.00014
31	30	1	1	30	29	1	0	119.22262	119.22251	0.00011
31	30	2	1	30	29	2	0	119.22262	119.22251	0.00011
40	26	15	1	39	25	15	0	119.22262	119.22262	0.00000
40	26	14	1	39	25	14	0	119.22262	119.22262	0.00000
47	23	24	1	46	22	24	0	119.23045	119.23045	-0.00001
47	23	25	1	46	22	25	0	119.23045	119.23045	-0.00001
42	27	15	1	41	26	15	0	119.63143	119.63133	0.00010
42	27	16	1	41	26	16	0	119.63143	119.63133	0.00010
56	21	35	1	55	20	35	0	119.63143	119.63149	-0.00005
56	21	36	1	55	20	36	0	119.63143	119.63149	-0.00005
48	25	23	1	47	24	23	0	119.77006	119.77005	0.00000
48	25	24	1	47	24	24	0	119.77006	119.77005	0.00000
39	29	11	1	38	28	11	0	119.77361	119.77368	-0.00007
39	29	10	1	38	28	10	0	119.77361	119.77368	-0.00007
37	30	7	1	36	29	7	0	119.79488	119.79486	0.00002
37	30	8	1	36	29	8	0	119.79488	119.79486	0.00002
35	31	4	1	34	30	4	0	119.81480	119.81478	0.00002
35	31	5	1	34	30	5	0	119.81480	119.81478	0.00002
33	32	2	1	32	31	2	0	119.83348	119.83348	0.00000
33	32	1	1	32	31	1	0	119.83348	119.83348	0.00000
40	29	12	1	39	28	12	0	119.86950	119.86944	0.00006
40	29	11	1	39	28	11	0	119.86950	119.86944	0.00006
38	31	7	1	37	30	7	0	120.10155	120.10153	0.00003
38	31	8	1	37	30	8	0	120.10155	120.10153	0.00003
41	30	11	1	40	29	11	0	120.17767	120.17784	-0.00017
41	30	12	1	40	29	12	0	120.17767	120.17784	-0.00017
37	32	6	1	36	31	6	0	120.21523	120.21539	-0.00016
37	32	5	1	36	31	5	0	120.21523	120.21539	-0.00016
42	30	12	1	41	29	12	0	120.27383	120.27375	0.00008
42	30	13	1	41	29	13	0	120.27383	120.27375	0.00008
45	29	17	1	44	28	17	0	120.34912	120.34912	0.00000
45	29	16	1	44	28	16	0	120.34912	120.34912	0.00000
38	34	4	1	37	33	4	0	120.72564	120.72564	0.00001
38	34	5	1	37	33	5	0	120.72564	120.72564	0.00001
36	36	1	1	35	35	1	0	120.94292	120.94303	-0.00011
36	36	0	1	35	35	0	0	120.94292	120.94303	-0.00011
48	31	17	1	47	30	17	0	121.06169	121.06167	0.00002
48	31	18	1	47	30	18	0	121.06169	121.06167	0.00002
49	31	18	1	48	30	18	0	121.15815	121.15800	0.00014
49	31	19	1	48	30	19	0	121.15815	121.15800	0.00014
39	36	4	1	38	35	4	0	121.23016	121.23005	0.00011
39	36	3	1	38	35	3	0	121.23016	121.23005	0.00011
37	37	1	1	36	36	1	0	121.24065	121.24074	-0.00009

37	37	0	1	36	36	0	0	121.24065	121.24074	-0.00009
38	37	1	1	37	36	1	0	121.33641	121.33641	0.00000
38	37	2	1	37	36	2	0	121.33641	121.33641	0.00000
45	34	12	1	44	33	12	0	121.39748	121.39737	0.00011
45	34	11	1	44	33	11	0	121.39748	121.39737	0.00011
38	38	1	1	37	37	1	0	121.53700	121.53706	-0.00005
38	38	0	1	37	37	0	0	121.53700	121.53706	-0.00005
41	37	5	1	40	36	5	0	121.62383	121.62390	-0.00007
41	37	4	1	40	36	4	0	121.62383	121.62390	-0.00007
42	37	5	1	41	36	5	0	121.71981	121.71988	-0.00007
42	37	6	1	41	36	6	0	121.71981	121.71988	-0.00007
40	38	3	1	39	37	3	0	121.72847	121.72864	-0.00017
40	38	2	1	39	37	2	0	121.72847	121.72864	-0.00017
41	38	3	1	40	37	3	0	121.82448	121.82455	-0.00007
41	38	4	1	40	37	4	0	121.82448	121.82455	-0.00007
39	39	0	1	38	38	0	0	121.83202	121.83198	0.00003
39	39	1	1	38	38	1	0	121.83202	121.83198	0.00003
42	39	4	1	41	38	4	0	122.11972	122.11971	0.00001
42	39	3	1	41	38	3	0	122.11972	122.11971	0.00001
45	38	8	1	44	37	8	0	122.20888	122.20893	-0.00005
45	38	7	1	44	37	7	0	122.20888	122.20893	-0.00005
42	41	2	1	41	40	2	0	122.51353	122.51365	-0.00012
42	41	1	1	41	40	1	0	122.51353	122.51365	-0.00012
51	37	14	1	50	36	14	0	122.58683	122.58693	-0.00010
51	37	15	1	50	36	15	0	122.58683	122.58693	-0.00010
49	38	11	1	48	37	11	0	122.59455	122.59447	0.00008
49	38	12	1	48	37	12	0	122.59455	122.59447	0.00008
42	42	1	1	41	41	1	0	122.70832	122.70843	-0.00011
42	42	0	1	41	41	0	0	122.70832	122.70843	-0.00011
48	40	9	1	47	39	9	0	122.89499	122.89491	0.00008
48	40	8	1	47	39	8	0	122.89499	122.89491	0.00008
47	41	7	1	46	40	7	0	122.99492	122.99472	0.00020
47	41	6	1	46	40	6	0	122.99492	122.99472	0.00020
48	42	6	1	47	41	6	0	123.28599	123.28595	0.00004
48	42	7	1	47	41	7	0	123.28599	123.28595	0.00004
49	42	7	1	48	41	7	0	123.38246	123.38247	-0.00001
49	42	8	1	48	41	8	0	123.38246	123.38247	-0.00001
48	43	5	1	47	42	5	0	123.47931	123.47927	0.00004
48	43	6	1	47	42	6	0	123.47931	123.47927	0.00004
49	43	6	1	48	42	6	0	123.57579	123.57579	0.00000
49	43	7	1	48	42	7	0	123.57579	123.57579	0.00000
51	42	9	1	50	41	9	0	123.57579	123.57572	0.00007
51	42	10	1	50	41	10	0	123.57579	123.57572	0.00007
46	45	2	1	45	44	2	0	123.66879	123.66871	0.00008

46	45	1	1	45	44	1	0	123.66879	123.66871	0.00008
52	42	10	1	51	41	10	0	123.67248	123.67245	0.00003
52	42	11	1	51	41	11	0	123.67248	123.67245	0.00003
51	43	9	1	50	42	9	0	123.76909	123.76905	0.00004
51	43	8	1	50	42	8	0	123.76909	123.76905	0.00004
53	43	11	1	52	42	11	0	123.96260	123.96260	-0.00001
53	43	10	1	52	42	10	0	123.96260	123.96260	-0.00001
54	43	12	1	53	42	12	0	124.05951	124.05949	0.00002
54	43	11	1	53	42	11	0	124.05951	124.05949	0.00002
51	45	6	1	50	44	6	0	124.15127	124.15132	-0.00005
51	45	7	1	50	44	7	0	124.15127	124.15132	-0.00005
63	41	23	1	62	40	23	0	124.54590	124.54605	-0.00015
63	41	22	1	62	40	22	0	124.54590	124.54605	-0.00015
62	42	20	1	61	41	20	0	124.64359	124.64356	0.00003
62	42	21	1	61	41	21	0	124.64359	124.64356	0.00003
65	41	25	1	64	40	25	0	124.74112	124.74110	0.00002
65	41	24	1	64	40	24	0	124.74112	124.74110	0.00002
58	45	13	1	57	44	13	0	124.83005	124.83009	-0.00004
58	45	14	1	57	44	14	0	124.83005	124.83009	-0.00004
59	45	14	1	58	44	14	0	124.92750	124.92734	0.00016
59	45	15	1	58	44	15	0	124.92750	124.92734	0.00016
58	46	13	1	57	45	13	0	125.01907	125.01907	0.00001
58	46	12	1	57	45	12	0	125.01907	125.01907	0.00001