SUPPORTING INFORMATION, Part 2

Synthesis of Phenolic Components of Grains of Paradise

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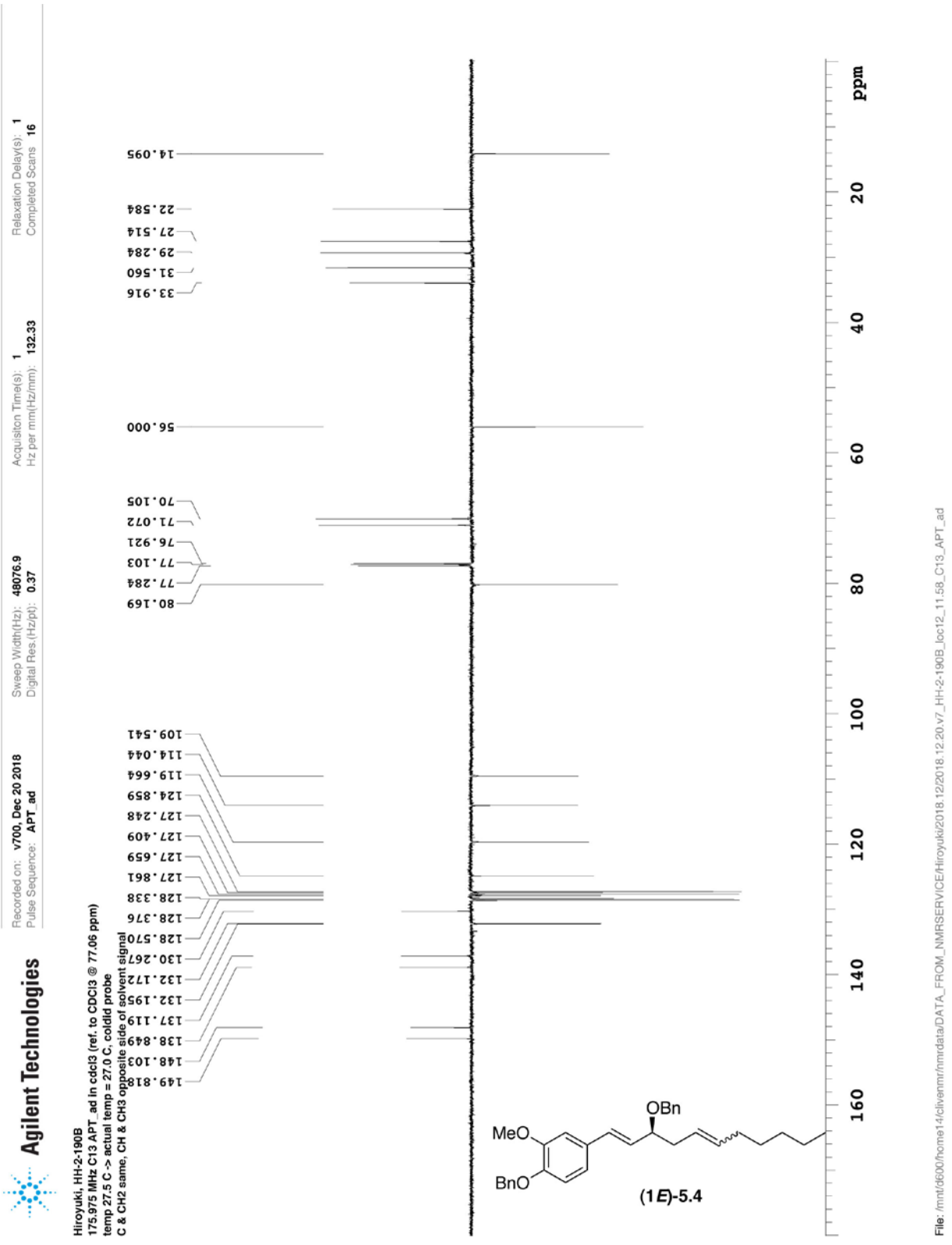
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Agilent Technologies
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Hz per mm(Hz/mm): 132.33
Relaxation Delay(s): 1
Completed Scans 16
Hiroyuki, HH-2-190B
175.975 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.095
22.584
27.514
29.284
31.560
33.916
56.000
70.105
71.072
76.921
77.103
77.284
80.169
109.541
114.044
119.664
124.859
127.248
127.409
127.659
127.861
128.338
128.376
128.570
130.267
132.172
132.195
137.119
138.849
148.103
149.818
MeO
BnO
OBn
(1E)-5.4
ppm
160
140
120
100
80
60
40
20
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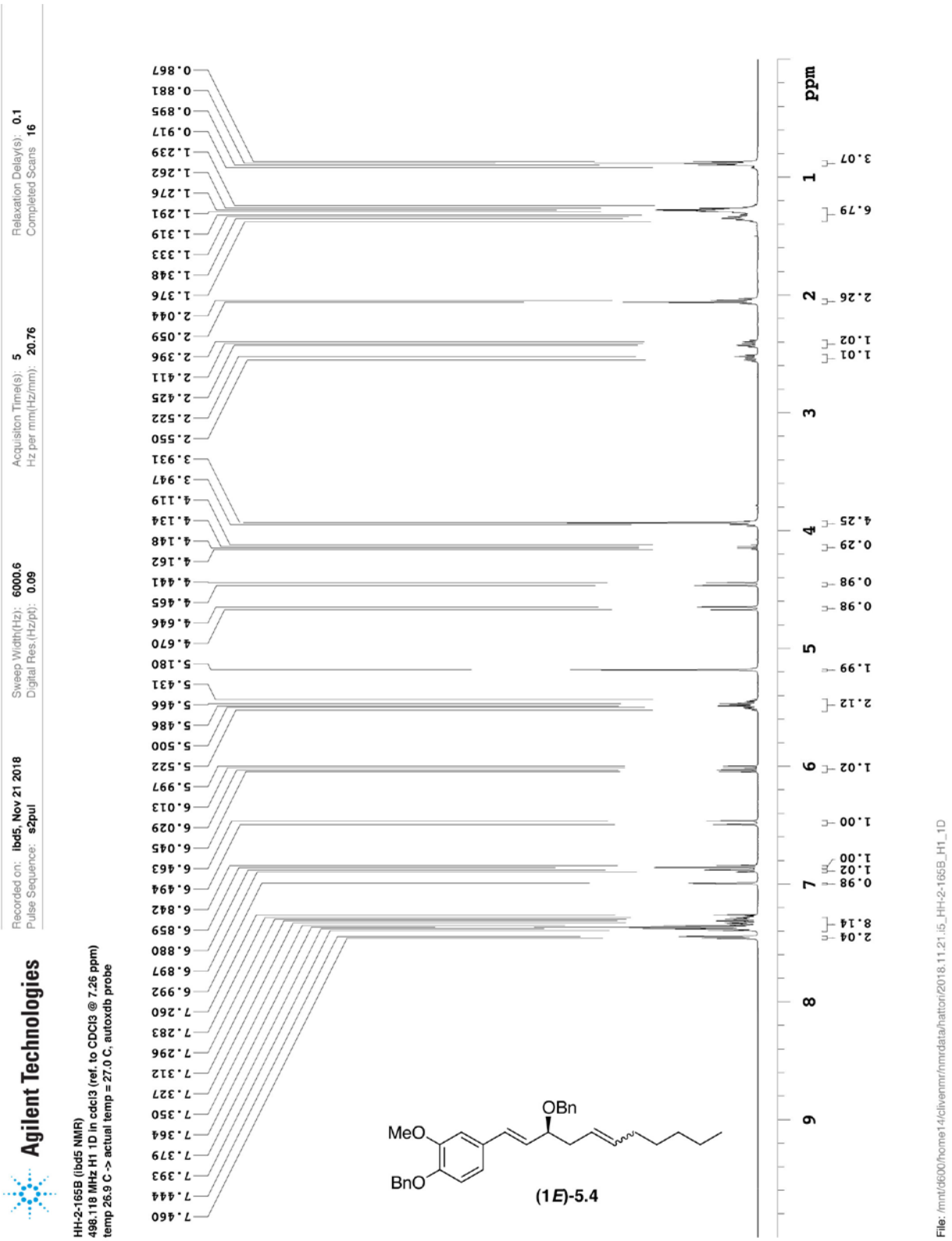
Department of Chemistry, University of Alberta
Agilent Technologies
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Digital Res.(Hz/pt): 0.09
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 20.76
Relaxation Delay(s): 0.1
Completed Scans 16
HH-2-165B (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
MeO
OBn
BnO
(1E)-5.4
ppm
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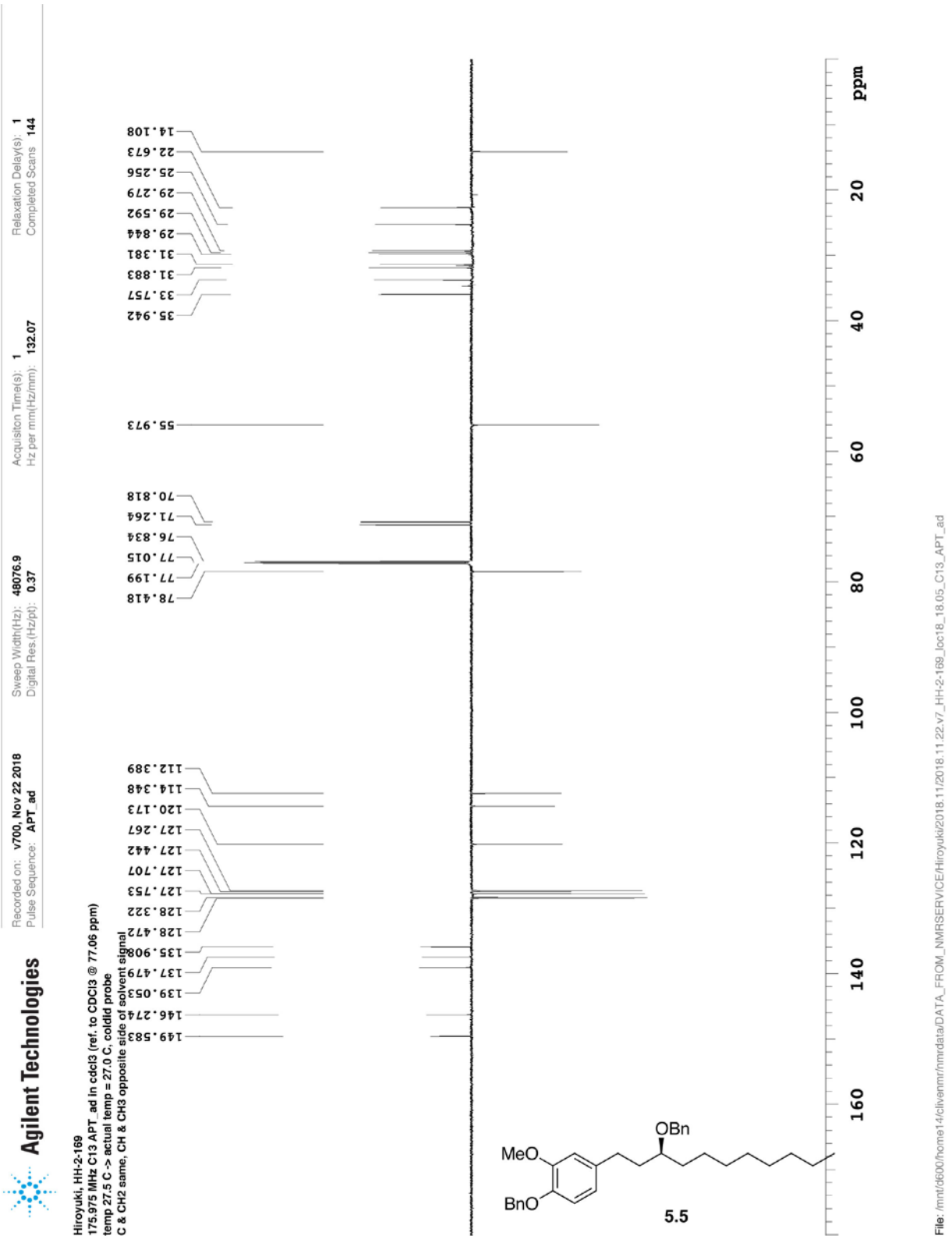
Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Nov 22 2018
Pulse Sequence: APT_ad
Sweep Width(Hz): 48076.9
Digital Res.(Hz/pt): 0.37
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 132.07
Relaxation Delay(s): 1
Completed Scans 144
Hiroyuki, HH-2-169
175.975 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, colddi probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.108
22.673
25.256
29.279
29.592
29.844
31.381
31.883
33.757
35.942
55.973
70.818
71.264
76.834
77.015
77.199
78.418
112.389
114.348
120.173
127.267
127.442
127.707
127.753
128.322
128.472
135.908
137.479
139.053
146.274
149.583
MeO
BnO
OBn
5.5
160
140
120
100
80
60
40
20
ppm
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Agilent Technologies

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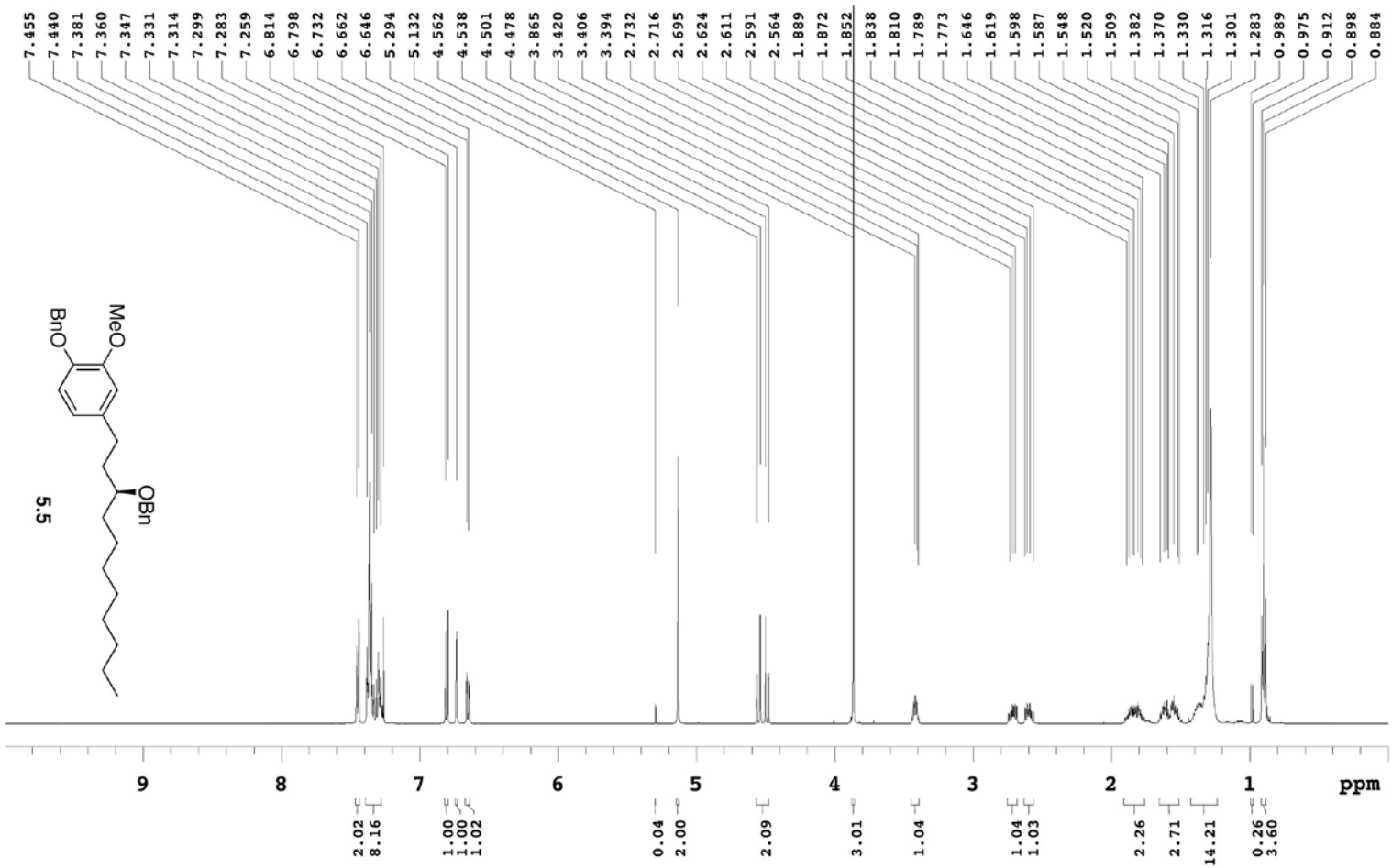
Recorded on:	ibd5, Nov 22 2018	Sweep Width(Hz):	6000.6	Acquisiton Time(s):	5	Relaxation Delay(s):	0.1
Pulse Sequence:	s2pul	Digital Res.(Hz/pt):	0.09	Hz per mm(Hz/mm):	20.76	Completed Scans	16

HH-2-169 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe



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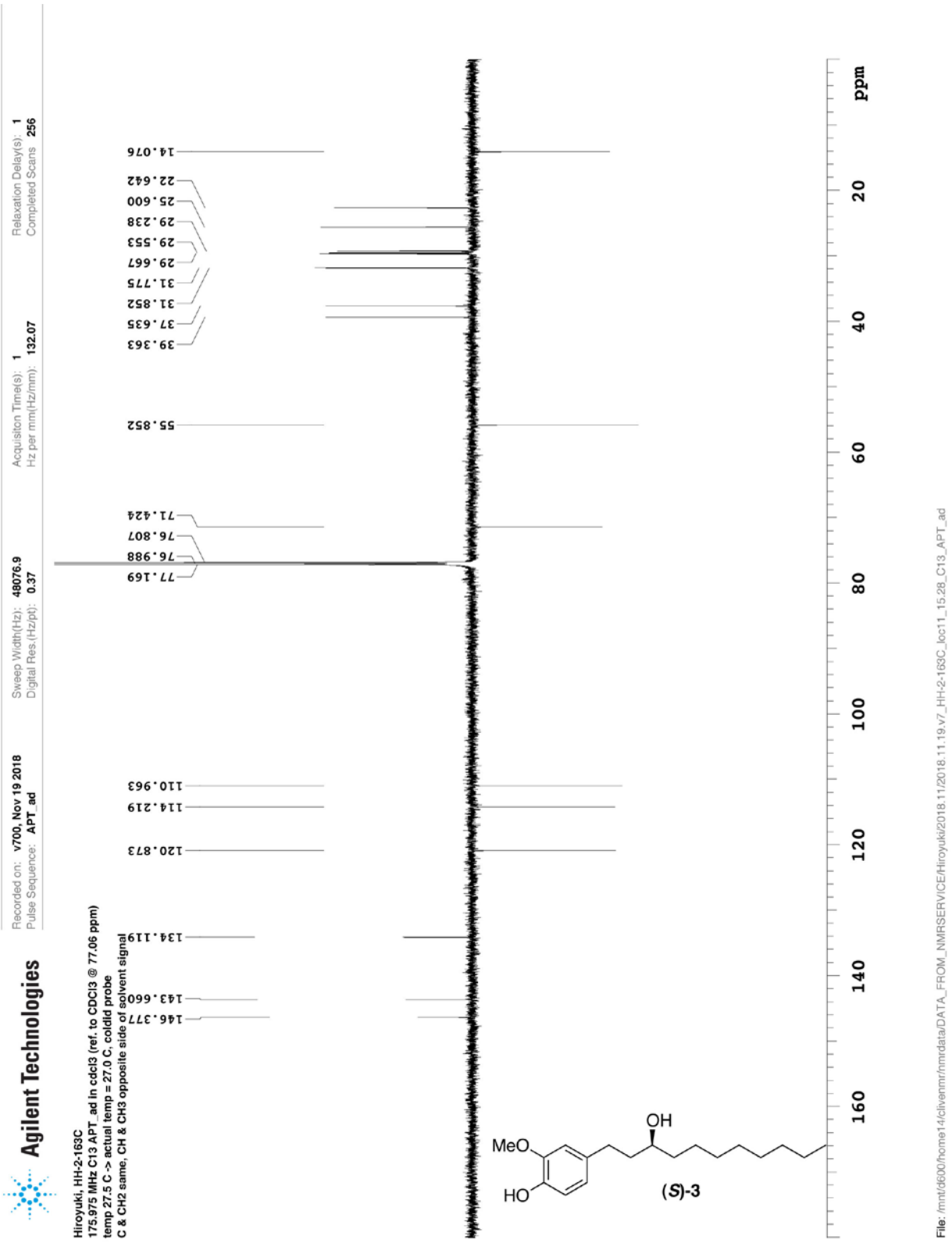
Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Nov 19 2018
Pulse Sequence: APT_ad
Sweep Width(Hz): 48076.9
Digital Res.(Hz/pt): 0.37
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 132.07
Relaxation Delay(s): 1
Completed Scans 256
Hiroyuki, HH-2-163C
175.975 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.076
22.642
25.600
29.238
29.553
29.667
31.775
31.852
37.635
39.363
55.852
71.424
76.807
76.988
77.169
110.963
114.219
120.873
134.119
143.660
146.377
MeO
HO
OH
(S)-3
ppm
160
140
120
100
80
60
40
20
File: /mnt/d600/home14/clivenmr/nmrdata/DATA_FROM_NMRSERVICE/Hiroyuki/2018.11/2018.11.19.v7_HH-2-163C_loc11_15.28_C13_APT_ad

Agilent Technologies

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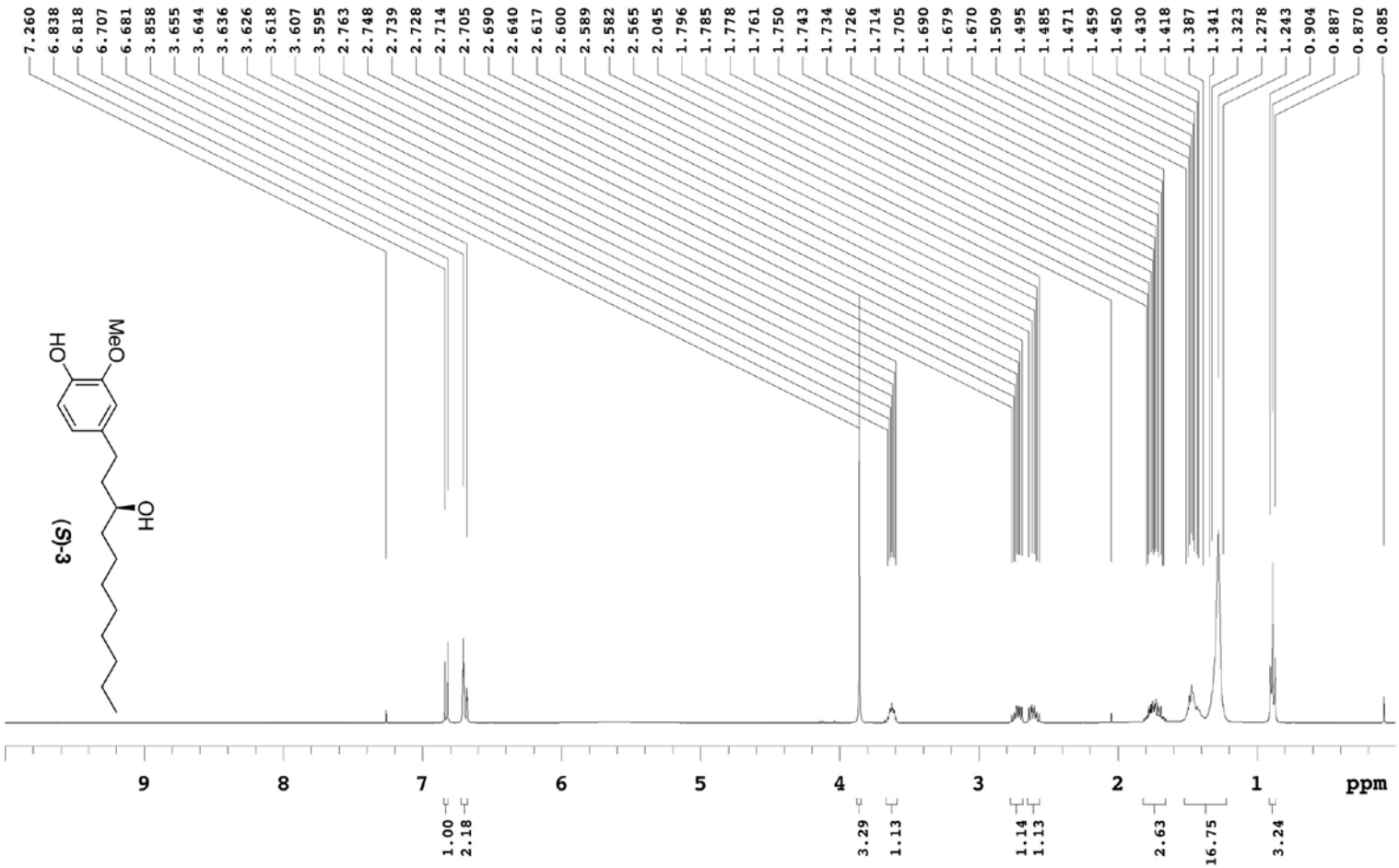
Recorded on:	mr400, Nov 23 2018	Sweep Width(Hz):	4807.69	Acquisiton Time(s):	5	Relaxation Delay(s):	0.1
Pulse Sequence:	s2pul	Digital Res.(Hz/pt):	0.07	Hz per mm(Hz/mm):	16.66	Completed Scans	16

HH-2-170 (mr400 NMR)
399.978 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 25.9 C -> actual temp = 27.0 C, onenmr probe



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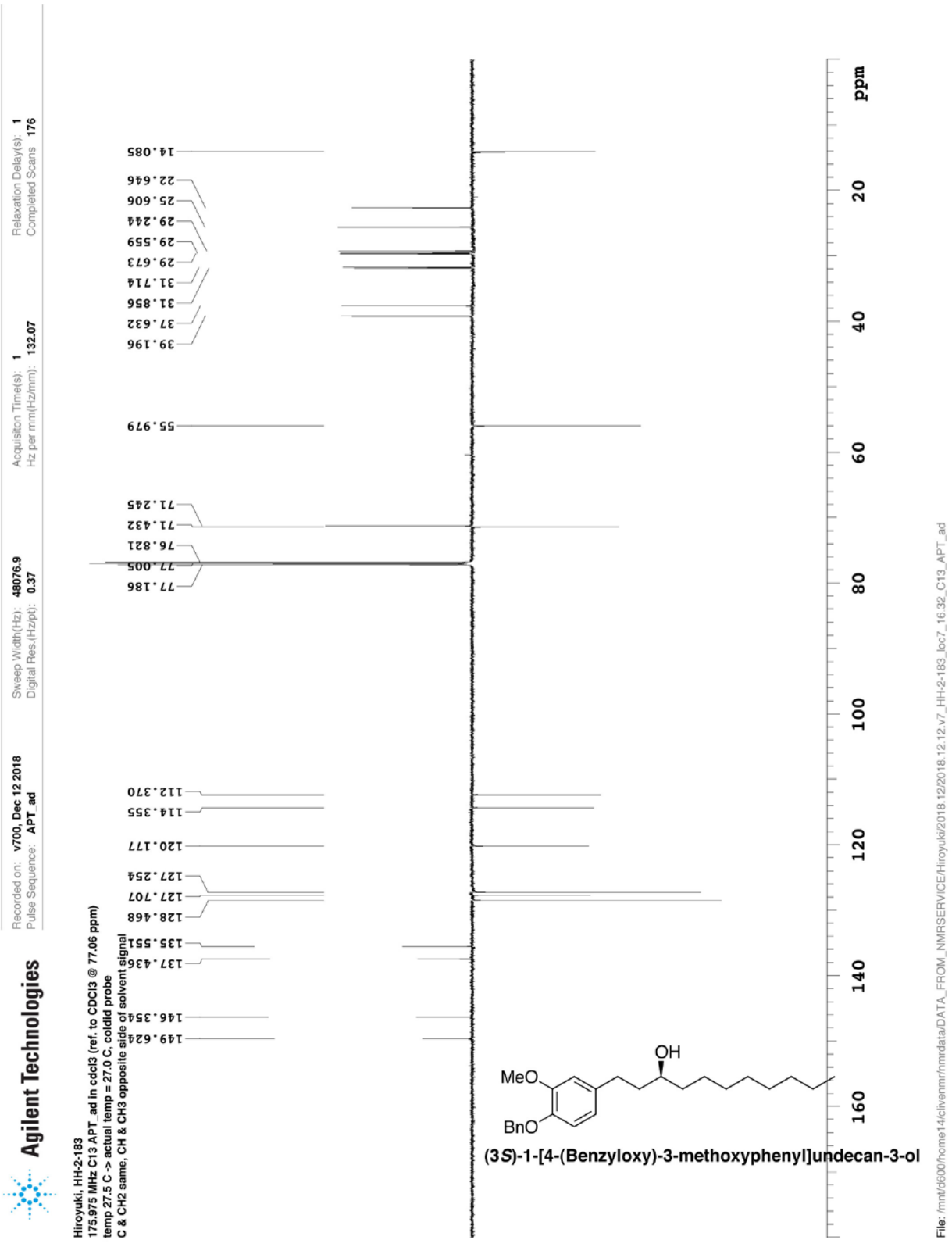
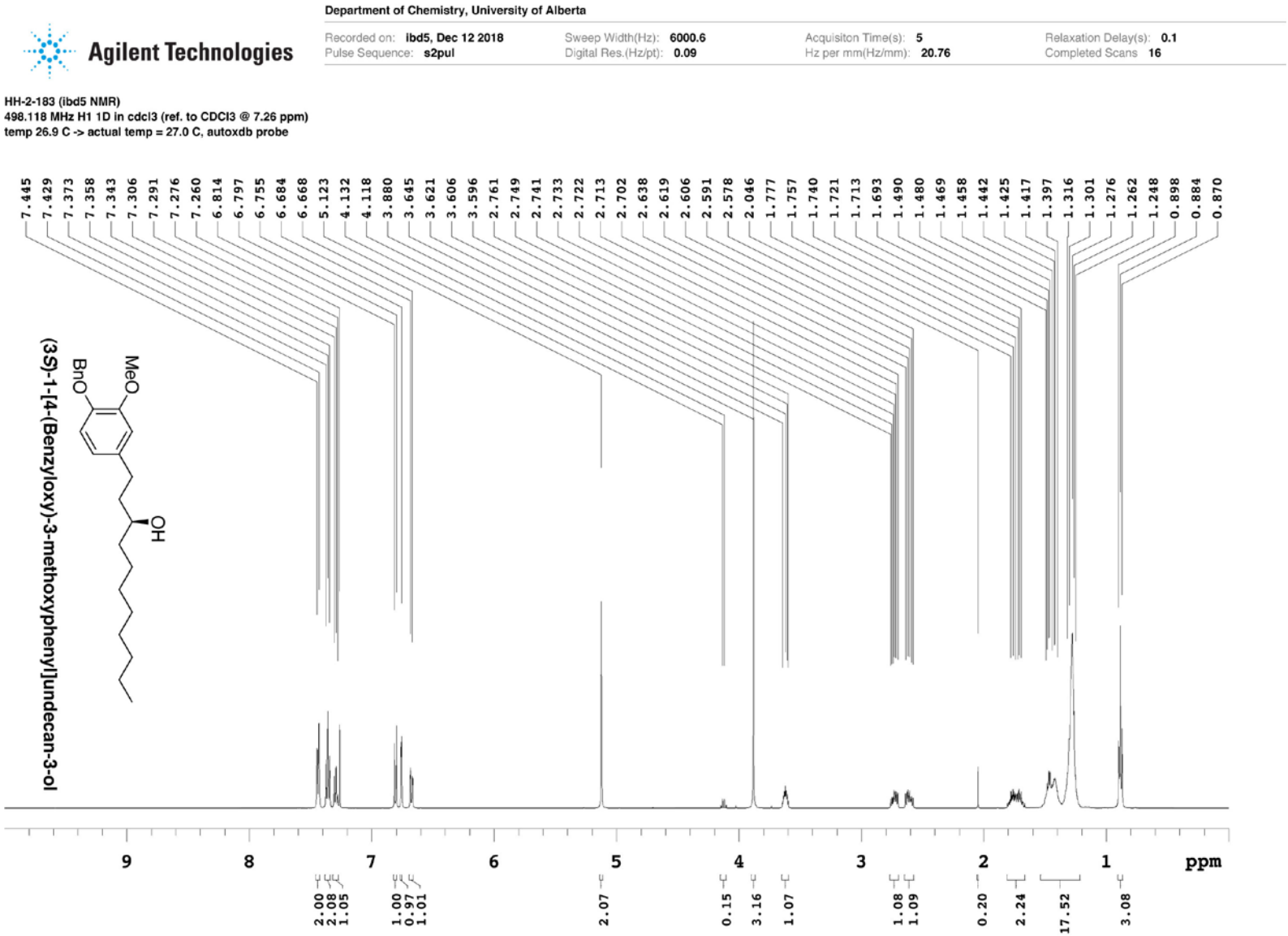

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Dec 12 2018
Pulse Sequence: APT_ad
Sweep Width(Hz): 48076.9
Digital Res.(Hz/pt): 0.37
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 132.07
Relaxation Delay(s): 1
Completed Scans 176
Hiroyuki, HH-2-183
175.975 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, colddi probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.085
22.646
25.606
29.244
29.559
29.673
31.714
31.856
37.632
39.196
55.979
71.245
71.432
76.821
77.005
77.186
112.370
114.355
120.177
127.254
127.707
128.468
135.551
137.436
146.354
149.624
MeO
BnO
OH
(3S)-1-[4-(Benzyloxy)-3-methoxyphenyl]undecan-3-ol
ppm
File: /mnt/dd00/home14/clivenmr/nmrdata/DATA_FROM_NMRSERVICE/Hiroyuki/2018.12/2018.12.12.v7_HH-2-183_loc7_16.32_C13_APT_ad


Agilent Technologies
Department of Chemistry, University of Alberta
Recorded on: ibd5, Dec 12 2018
Pulse Sequence: s2pul
Sweep Width(Hz): 6000.6
Digital Res.(Hz/pt): 0.09
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 20.76
Relaxation Delay(s): 0.1
Completed Scans 16
HH-2-183 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
7.445 7.429 7.373 7.358 7.343 7.306 7.291 7.276 7.260 6.814 6.797 6.755 6.684 6.668 5.123 4.132 4.118 3.880 3.645 3.621 3.606 3.596 2.761 2.749 2.741 2.733 2.722 2.713 2.702 2.638 2.619 2.606 2.591 2.578 2.046 1.777 1.757 1.740 1.721 1.713 1.693 1.490 1.480 1.469 1.458 1.442 1.425 1.417 1.397 1.316 1.301 1.276 1.262 1.248 0.898 0.884 0.870
(3S)-1-[4-(Benzyloxy)-3-methoxyphenyl]undecan-3-ol
BnO
MeO
OH
9 8 7 6 5 4 3 2 1 ppm
2.00 2.08 1.05
1.00 0.97 1.01
2.07
0.15 3.16 1.07
1.08 1.09
0.20 2.24 17.52 3.08
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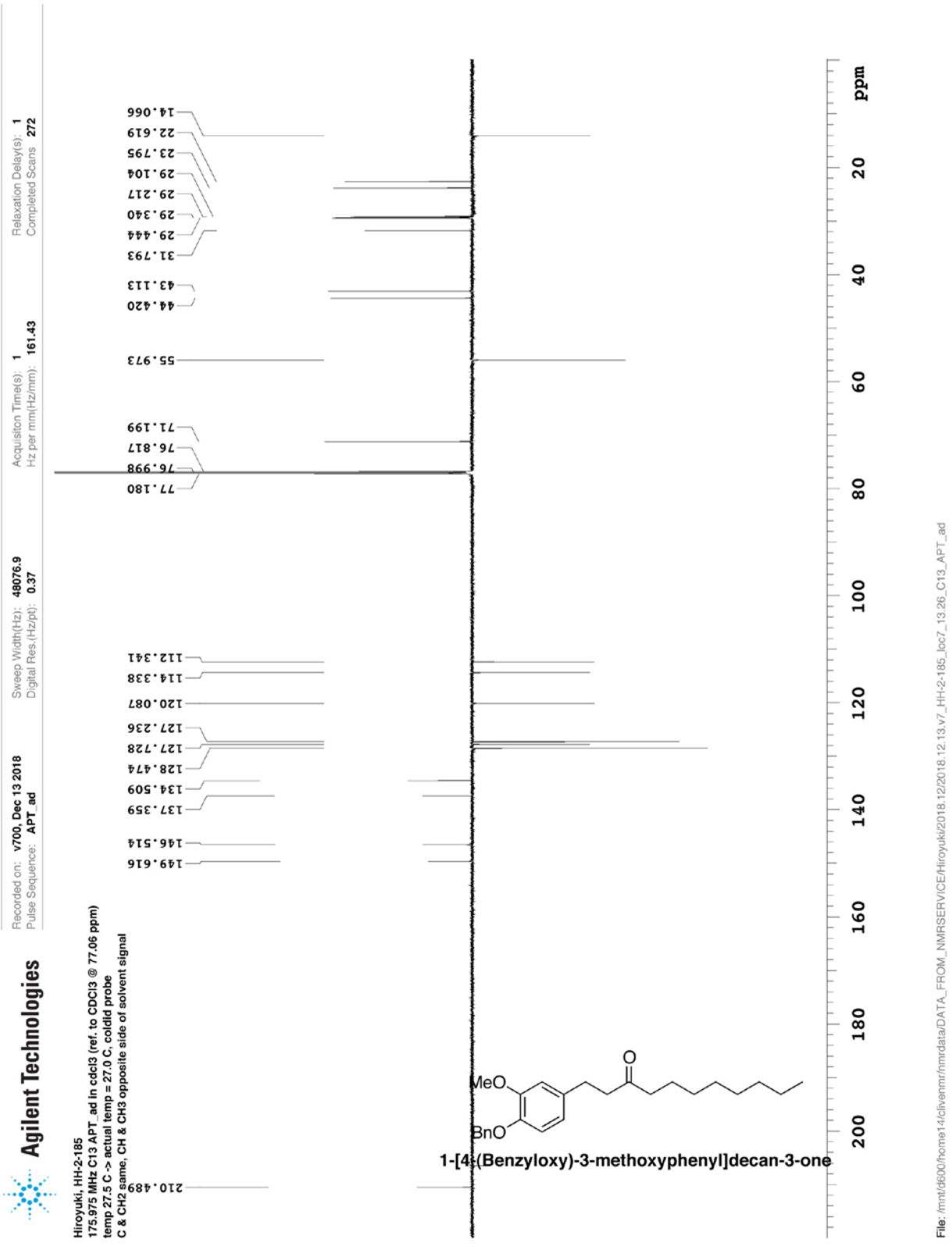
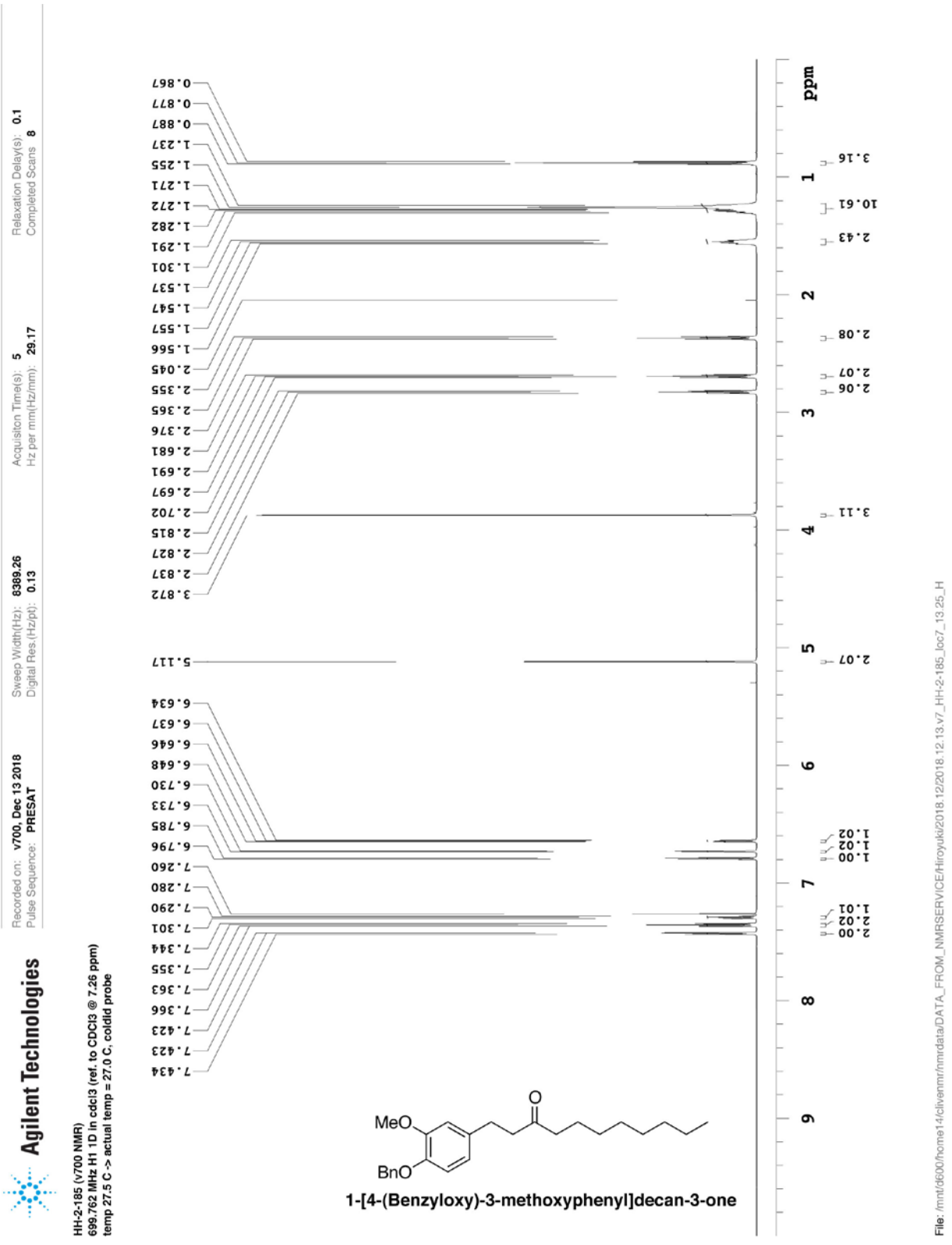
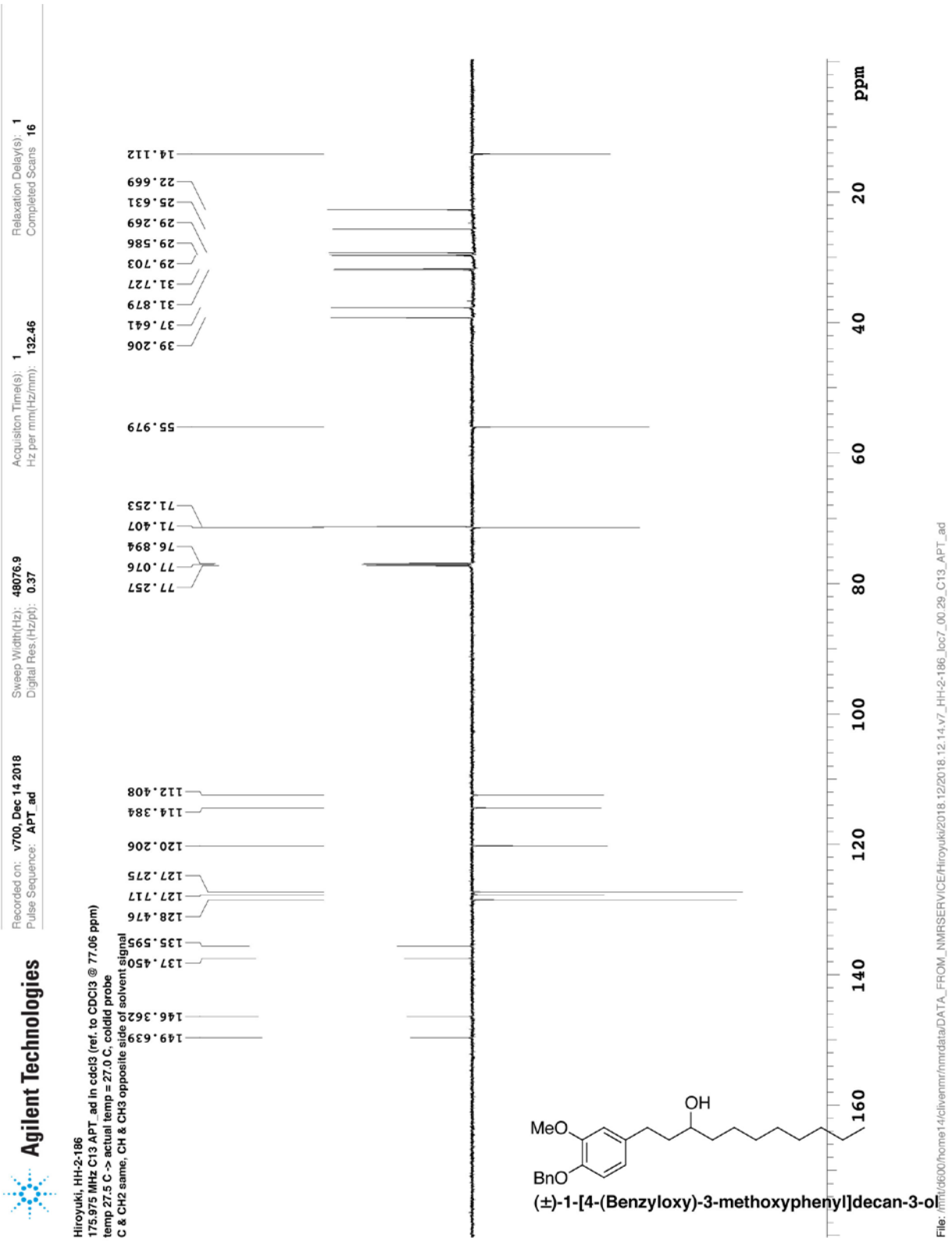

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Dec 13 2018
Pulse Sequence: APT_ad
Sweep Width(Hz): 48076.9
Digital Res.(Hz/pt): 0.37
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 161.43
Relaxation Delay(s): 1
Completed Scans 272
Hiroyuki, HH-2-185
175.975 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
C & CH2 same, CH & CH3 opposite side of solvent signal
210.489
149.616
146.514
137.359
134.509
128.474
127.728
127.236
120.087
114.338
112.341
77.180
76.998
76.817
71.199
55.973
44.420
43.113
31.793
29.444
29.340
29.217
29.104
23.795
22.619
14.066
MeO
BnO
O
1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-one
ppm
200
180
160
140
120
100
80
60
40
20
File: /mnt/dd00/home14/clivenmr/nmrdata/DATA_FROM_NMRSERVICE/Hiroyuki/2018.12/2018.12.13.v7_HH-2-185_loc7_13.26_C13_APT_ad


Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Dec 13 2018
Pulse Sequence: PRESAT
Sweep Width(Hz): 8389.26
Digital Res.(Hz/pt): 0.13
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 29.17
Relaxation Delay(s): 0.1
Completed Scans 8
HH-2-185 (v700 NMR)
699.762 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
MeO
BnO
O
1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-one
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/DATA_FROM_NMRSERVICE/Hiroyuki/2018.12/2018.12.13.v7_HH-2-185_loc7_13.25_H


Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Dec 14 2018
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Digital Res.(Hz/pt): 0.37
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 132.46
Relaxation Delay(s): 1
Completed Scans 16
Hiroyuki, HH-2-186
175.975 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.112
22.669
25.631
29.269
29.586
29.703
31.727
31.879
37.641
39.206
55.979
71.253
71.407
76.894
77.076
77.257
112.408
114.384
120.206
127.275
127.717
128.476
135.595
137.450
146.362
149.639
MeO
OH
BnO
(±)-1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-ol
ppm
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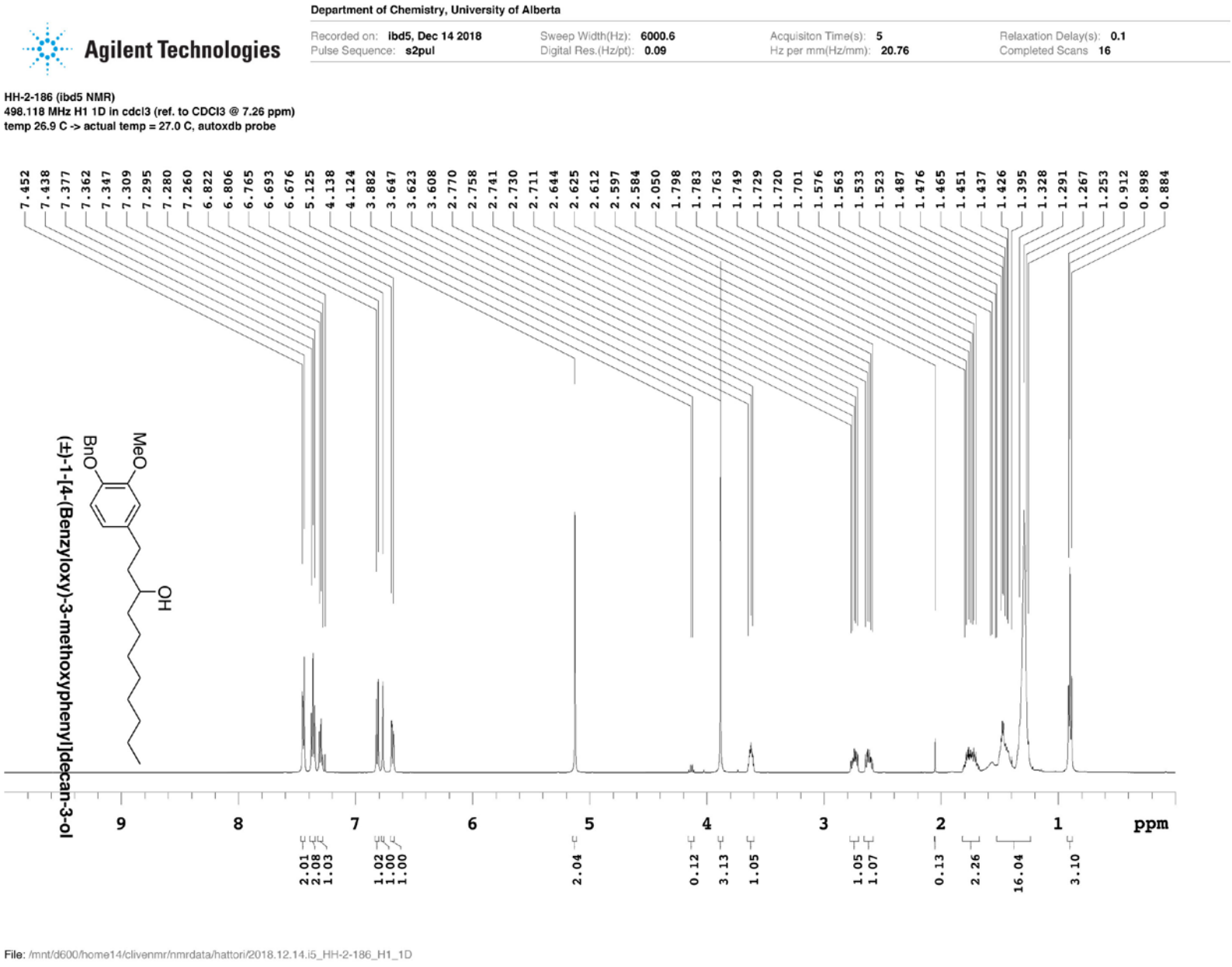
Agilent Technologies
Department of Chemistry, University of Alberta
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Sweep Width(Hz): 6000.6
Digital Res.(Hz/pt): 0.09
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 20.76
Relaxation Delay(s): 0.1
Completed Scans 16
HH-2-186 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
7.452 7.438 7.377 7.362 7.347 7.309 7.295 7.280 7.260 6.822 6.806 6.765 6.693 6.676 5.125 4.138 4.124 3.882 3.647 3.623 3.608 2.770 2.758 2.741 2.730 2.711 2.644 2.625 2.612 2.597 2.584 2.050 1.798 1.783 1.763 1.749 1.729 1.720 1.701 1.576 1.563 1.533 1.523 1.487 1.476 1.465 1.451 1.437 1.426 1.395 1.328 1.291 1.267 1.253 0.912 0.898 0.884
BnO
MeO
OH
(±)-1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-ol
9 8 7 6 5 4 3 2 1 ppm
2.01 2.08 1.03
1.02 1.00 1.00
2.04
0.12
3.13
1.05
1.05 1.07
0.13
2.26
16.04
3.10
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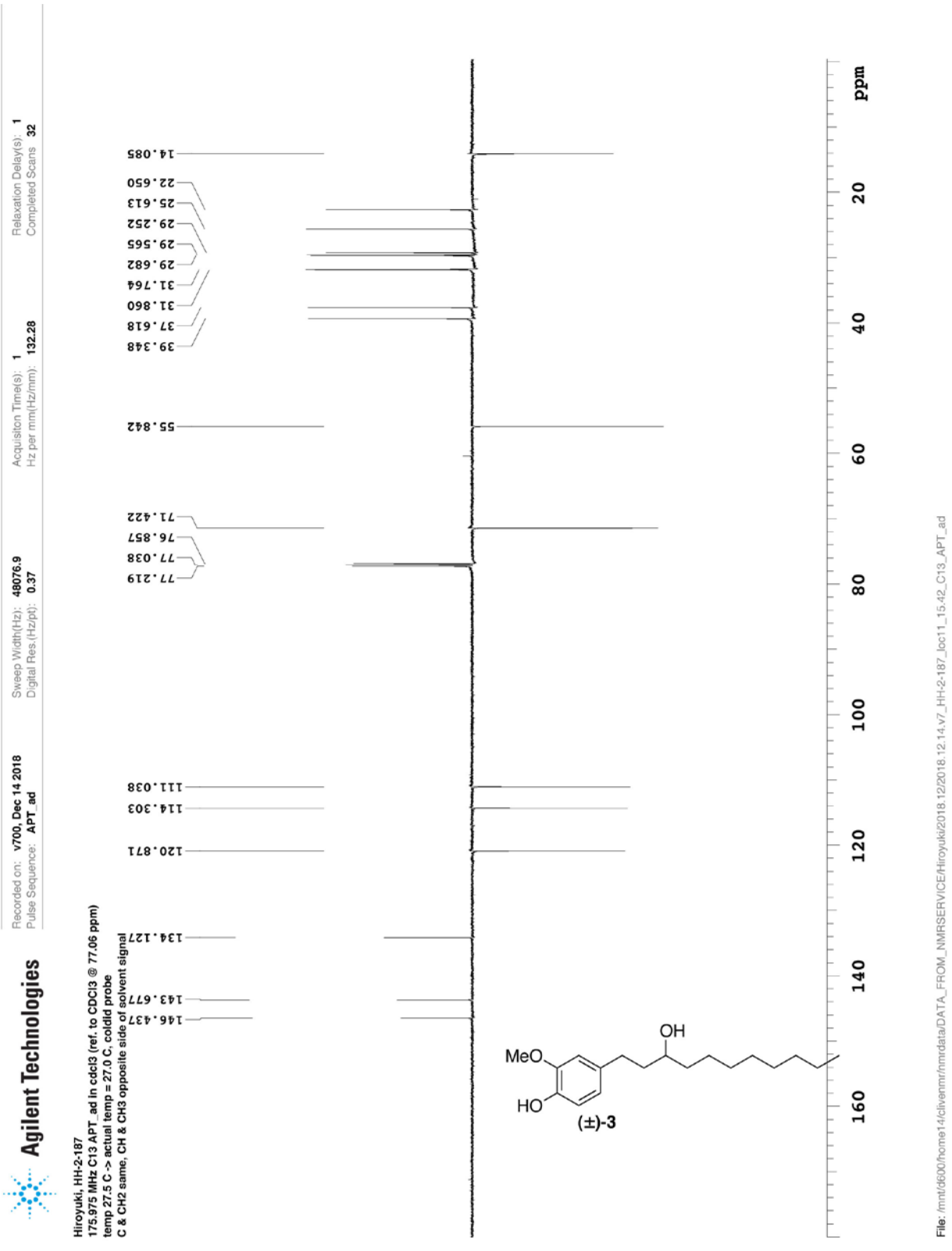
Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Dec 14 2018
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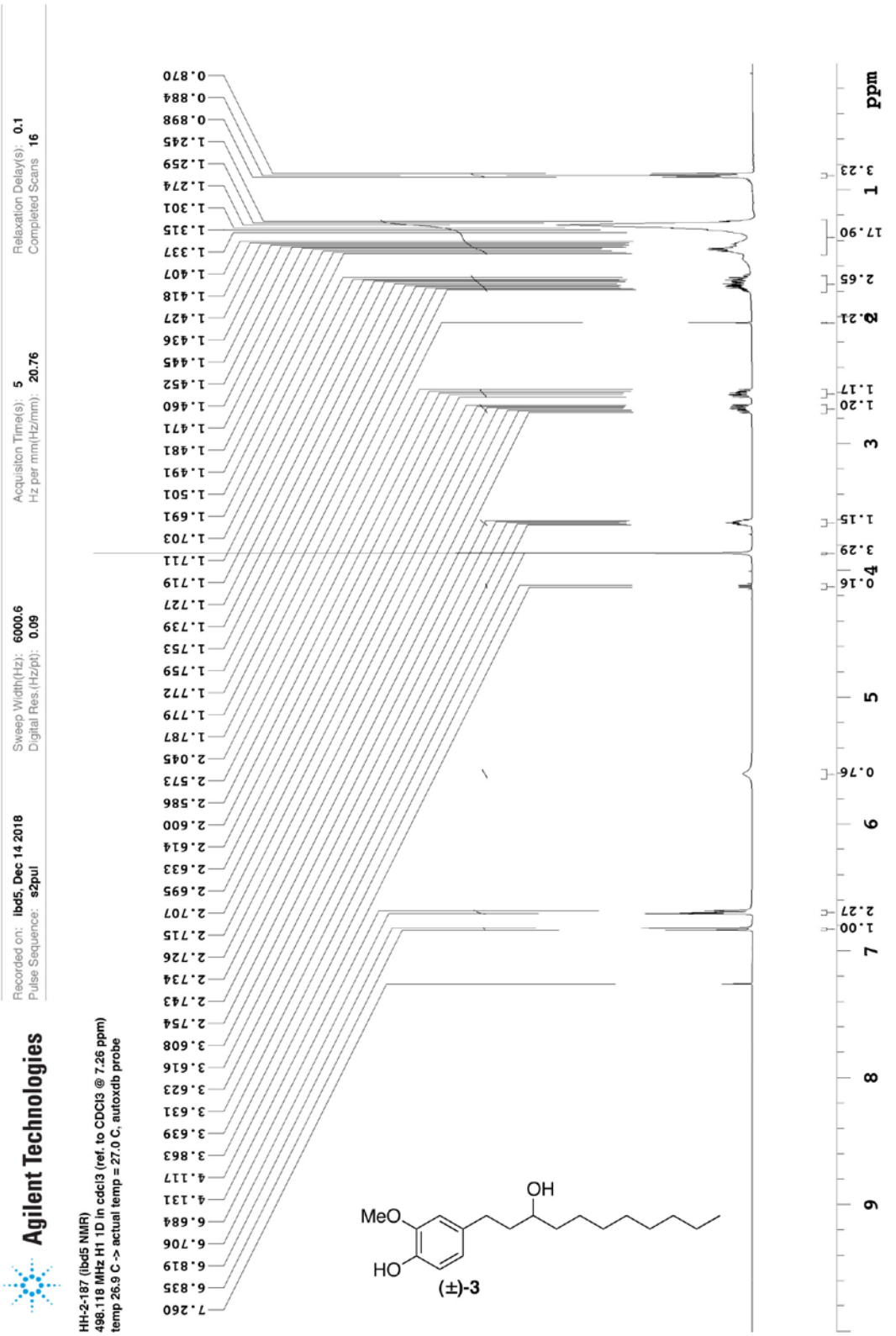
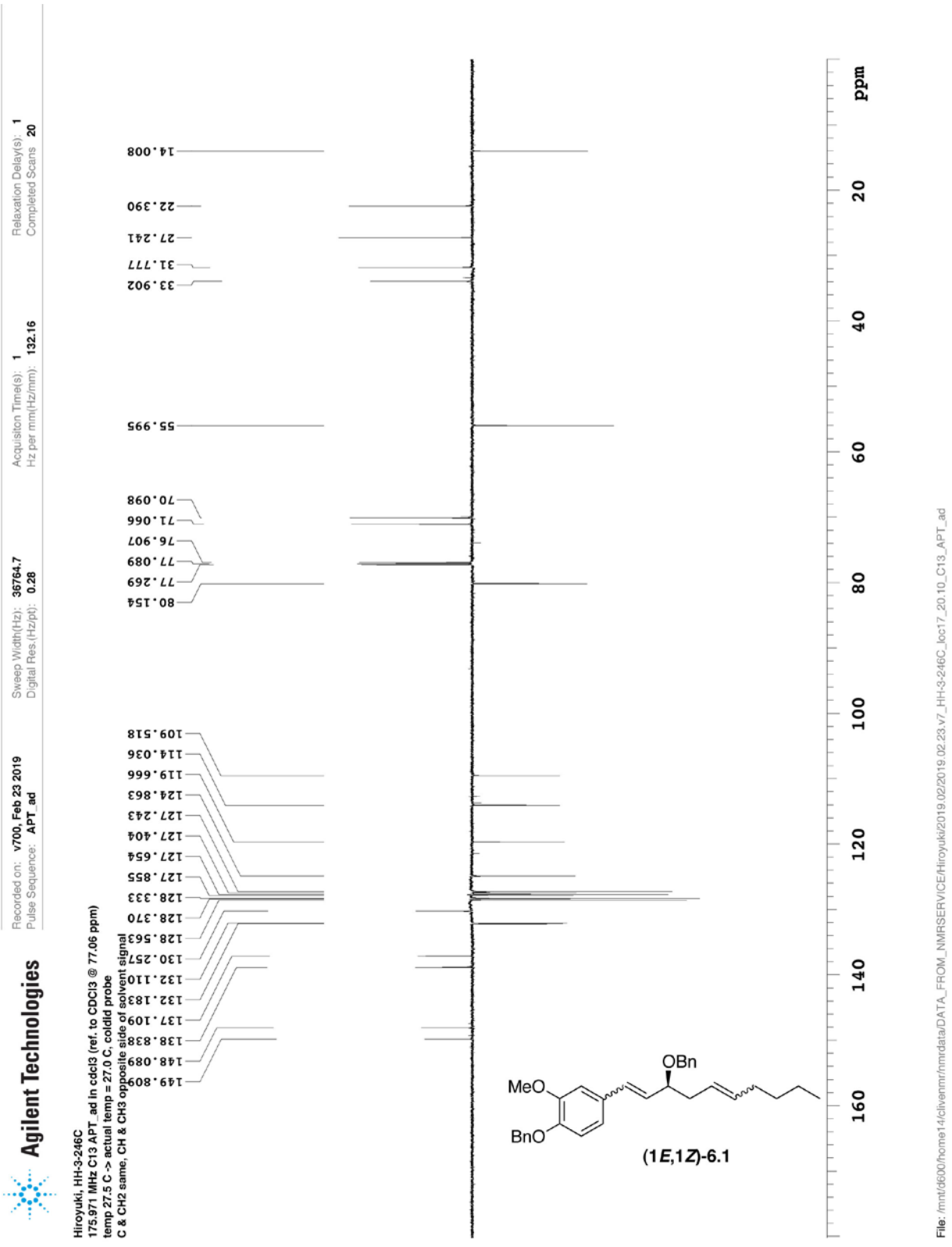
Sweep Width(Hz): 48076.9
Digital Res.(Hz/pt): 0.37
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 132.28
Relaxation Delay(s): 1
Completed Scans 32
Hiroyuki, HH-2-187
175.975 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.085
22.650
25.613
29.252
29.565
29.682
31.764
31.860
37.618
39.348
55.842
71.422
76.857
77.038
77.219
111.038
114.303
120.871
134.127
143.677
146.437
MeO
HO
OH
(±)-3
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/DATA_FROM_NMRSERVICE/Hiroyuki/2018.12/2018.12.14.v7_HH-2-187_loc11_15.42_C13_APT_ad


Agilent Technologies
Department of Chemistry, University of Alberta
Recorded on: lbd5, Dec 14 2018
Pulse Sequence: s2pul
Sweep Width(Hz): 6000.6
Digital Res.(Hz/pt): 0.09
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 20.76
Relaxation Delay(s): 0.1
Completed Scans 16
HH-2-187 (lbd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
MeO
HO
OH
(±)-3
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2018.12.14.i5_HH-2-187_H1_1D


Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Feb 23 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 36764.7
Digital Res.(Hz/pt): 0.28
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 132.16
Relaxation Delay(s): 1
Completed Scans 20
Hiroyuki, HH-3-246C
175.971 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.008
22.390
27.241
31.777
33.902
55.995
70.098
71.066
76.907
77.089
77.269
80.154
109.518
114.036
119.666
124.863
127.243
127.404
127.654
127.855
128.333
128.370
128.563
130.257
132.110
132.183
137.109
138.838
148.089
149.809
MeO
BnO
OBn
(1E,1Z)-6.1
ppm
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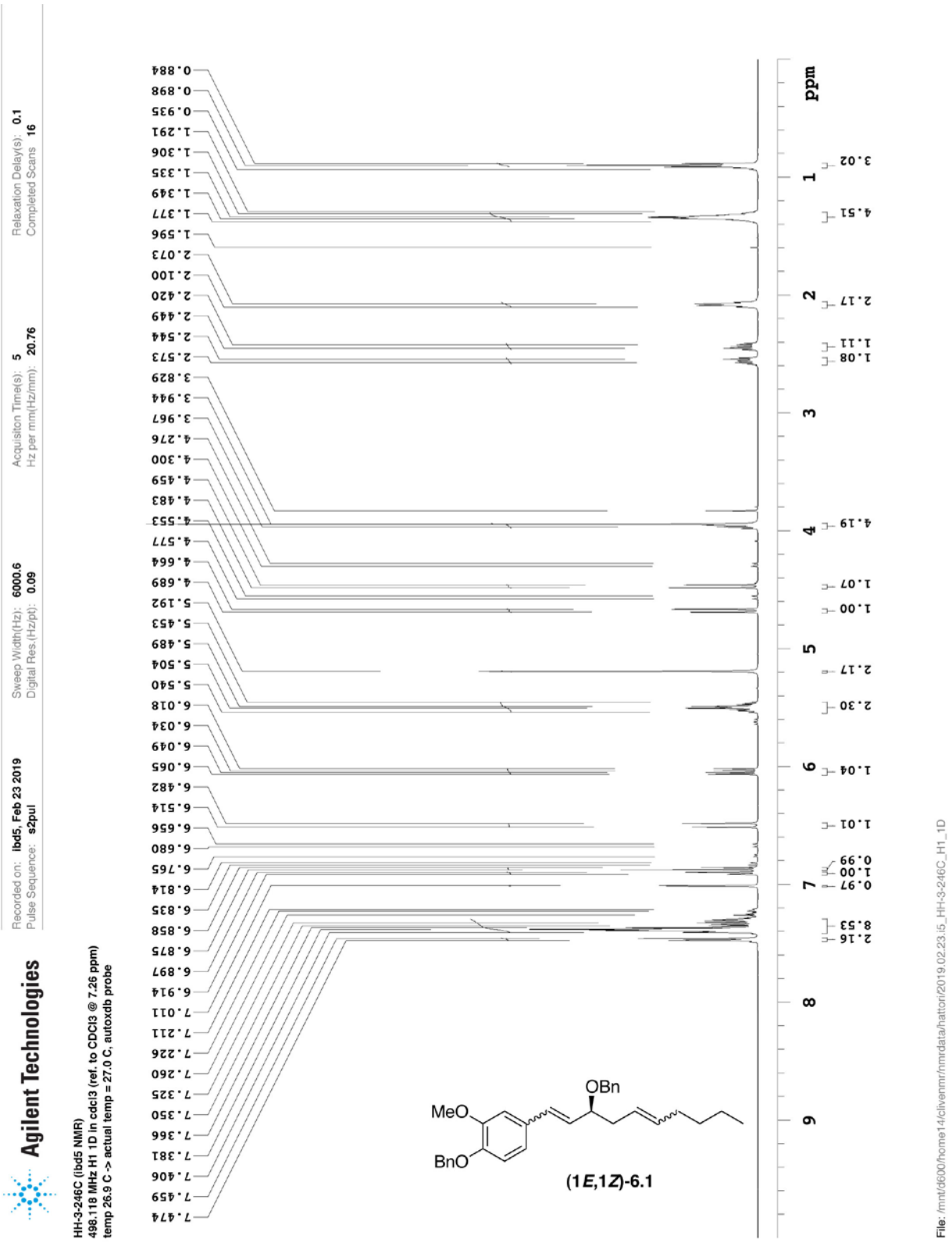
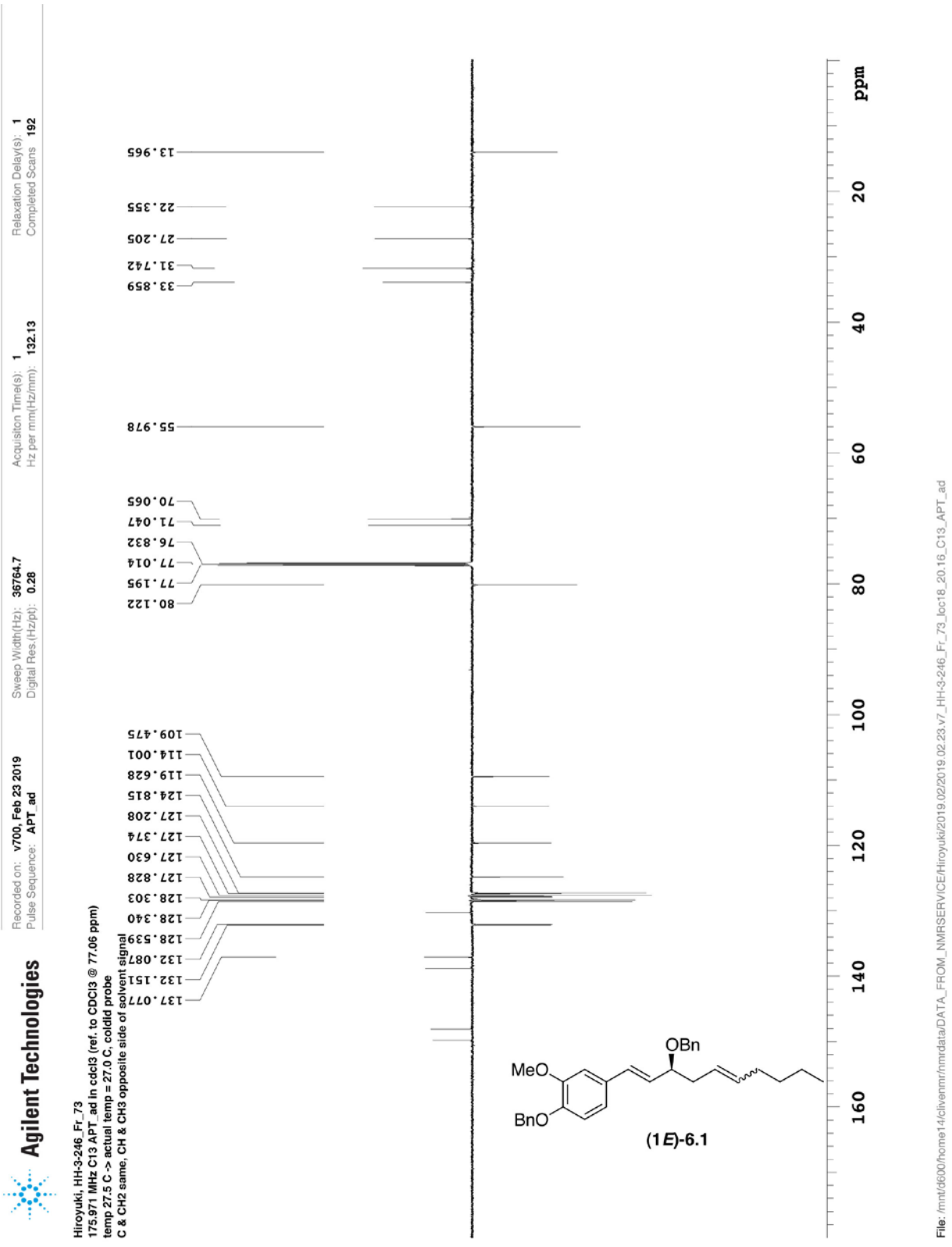

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 23 2019
Pulse Sequence: s2pul
Sweep Width(Hz): 6000.6
Digital Res.(Hz/pt): 0.09
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 20.76
Relaxation Delay(s): 0.1
Completed Scans 16
HH-3-246C (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
OBn
MeO
BnO
(1E,1Z)-6.1
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.23.i5_HH-3-246C_H1_1D

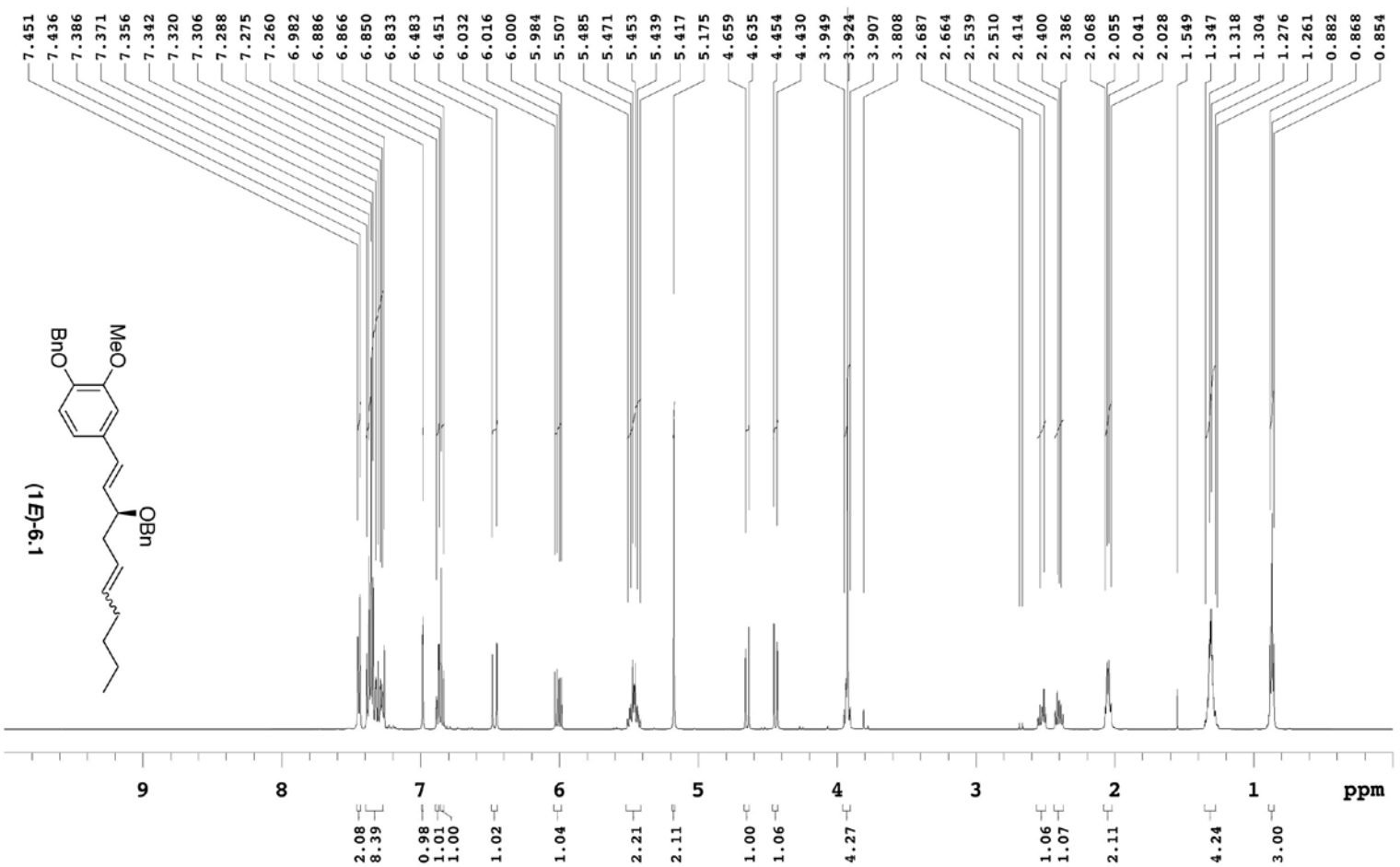

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: v700, Feb 23 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 36764.7
Digital Res.(Hz/pt): 0.28
Acquisiton Time(s): 1
Hz per mm(Hz/mm): 132.13
Relaxation Delay(s): 1
Completed Scans 192
Hiroyuki, HH-3-246_Fr_73
175.971 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 27.5 C -> actual temp = 27.0 C, coldid probe
C & CH2 same, CH & CH3 opposite side of solvent signal
137.077
132.151
132.087
128.539
128.340
128.303
127.828
127.630
127.374
127.208
124.815
119.628
114.001
109.475
80.122
77.195
77.014
76.832
71.047
70.065
55.978
33.859
31.742
27.205
22.355
13.965
ppm
MeO
BnO
OBn
(1E)-6.1
File: /mnt/d600/home14/clivenmr/nmrdata/DATA_FROM_NMRSERVICE/Hiroyuki/2019.02/2019.02.23.v7_HH-3-246_Fr_73_loc18_20.16_C13_APT_ad

Department of Chemistry, University of Alberta

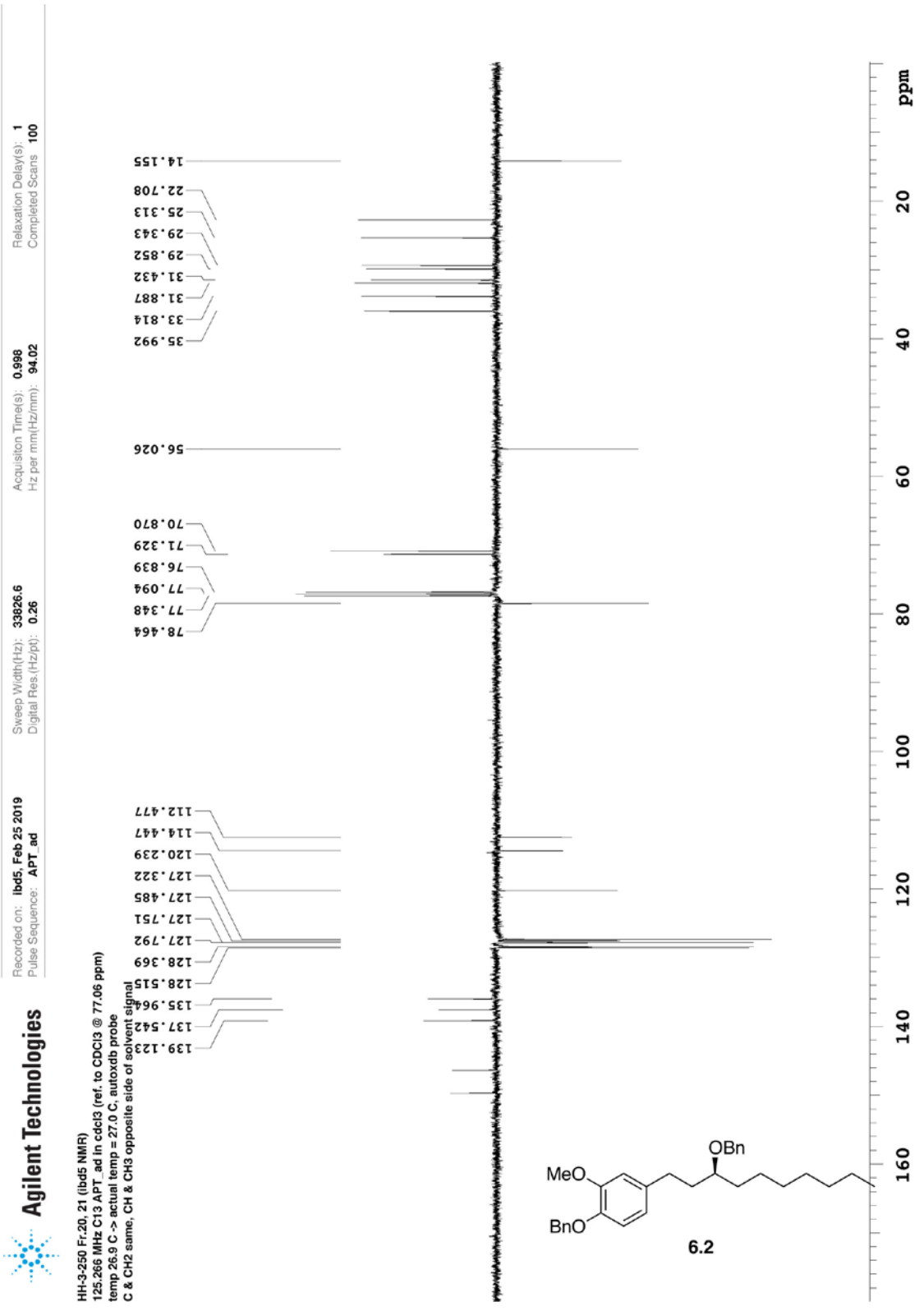
Agilent Technologies

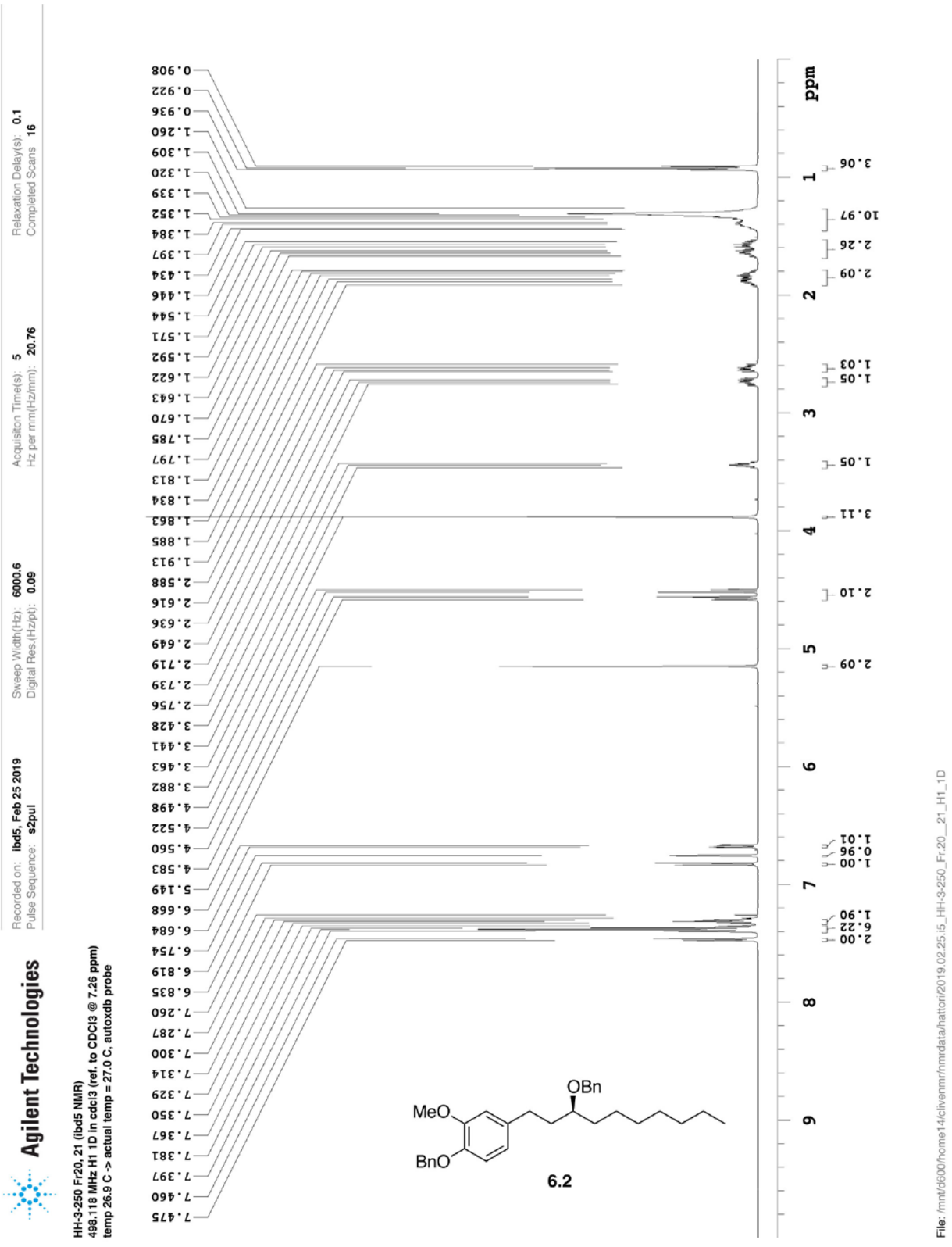
Recorded on: **ibd5, Feb 23 2019**	Sweep Width(Hz): **6000.6**	Acquisiton Time(s): **5**	Relaxation Delay(s): **0.1**
Pulse Sequence: **s2pul**	Digital Res.(Hz/pt): **0.09**	Hz per mm(Hz/mm): **20.76**	Completed Scans **16**

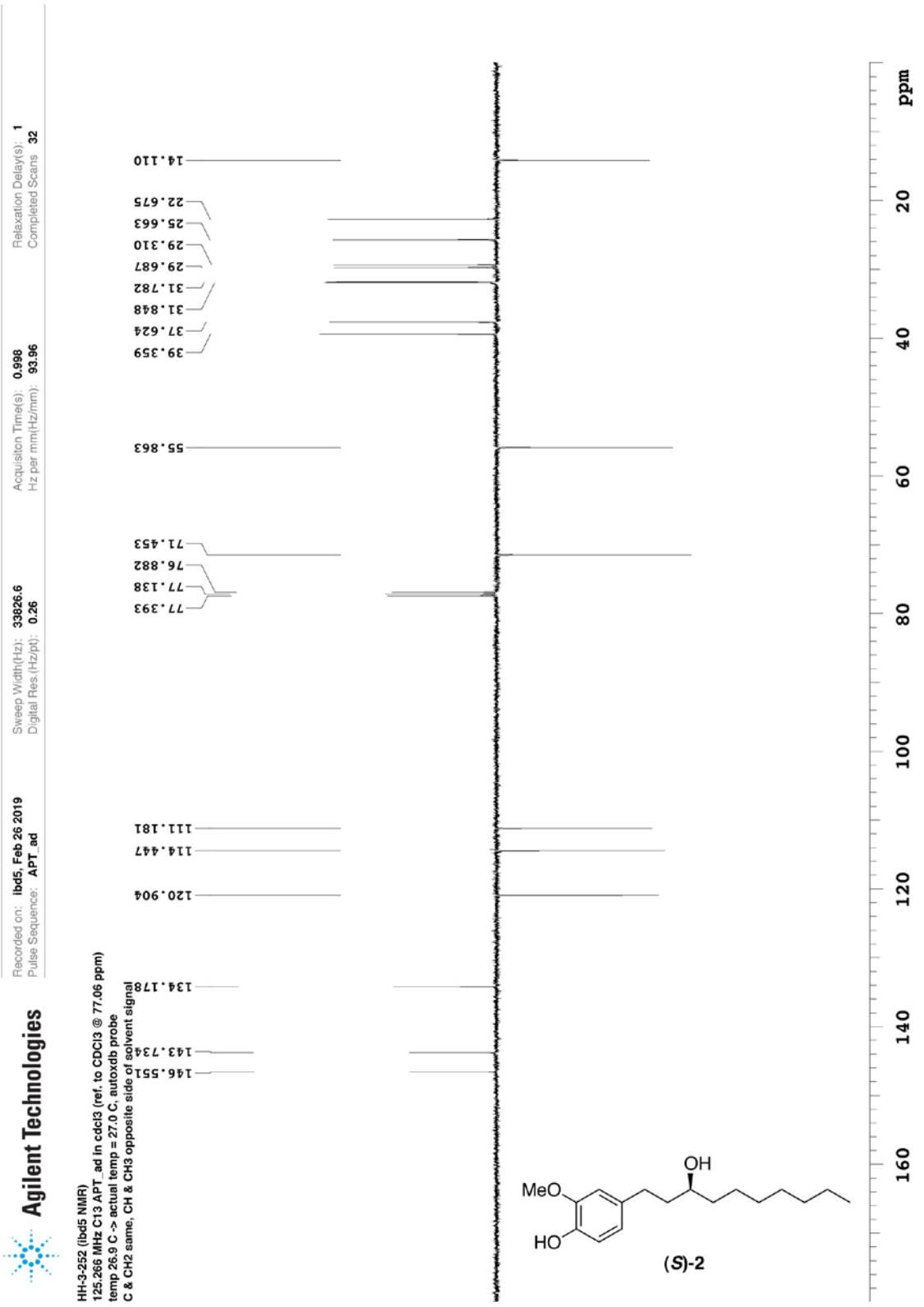
HH-3-246_Fr.73
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe



File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.23.i5_HH-3-246_Fr.73_H1_1D


Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 25 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 33826.6
Digital Res.(Hz/pt): 0.26
Acquisiton Time(s): 0.998
Hz per mm(Hz/mm): 94.02
Relaxation Delay(s): 1
Completed Scans 100
HH-3-250 Fr.20, 21 (ibd5 NMR)
125.266 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.155
22.708
25.313
29.343
29.852
31.432
31.887
33.814
35.992
56.026
70.870
71.329
76.839
77.094
77.348
78.464
112.477
114.447
120.239
127.322
127.485
127.751
127.792
128.369
128.515
135.964
137.542
139.123
MeO
BnO
OBn
6.2
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.25.i5_HH-3-250_Fr.20__21_C13_APT_ad


Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 25 2019
Pulse Sequence: s2pul
Sweep Width(Hz): 6000.6
Digital Res.(Hz/pt): 0.09
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 20.76
Relaxation Delay(s): 0.1
Completed Scans 16
HH-3-250 Fr20_21 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
OBn
MeO
BnO
6.2
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.25.i5_HH-3-250_Fr.20__21_H1_1D

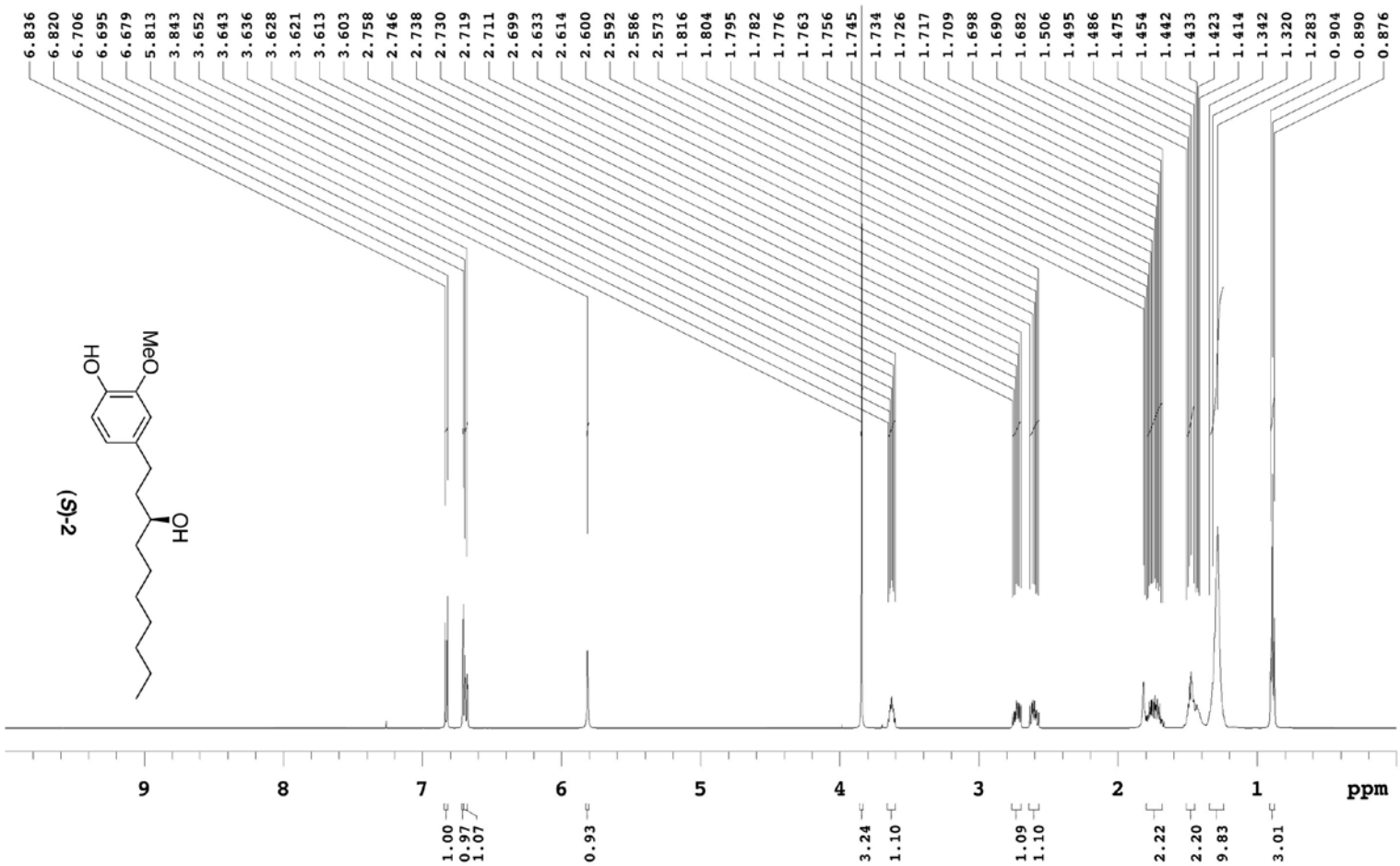

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 26 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 33826.6
Digital Res.(Hz/pt): 0.26
Acquisiton Time(s): 0.998
Hz per mm(Hz/mm): 93.96
Relaxation Delay(s): 1
Completed Scans 32
HH-3-252 (ibd5 NMR)
125.266 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.110
22.675
25.663
29.310
29.687
31.782
31.848
37.624
39.359
55.863
71.453
76.882
77.138
77.393
111.181
114.447
120.904
134.178
143.734
146.551
MeO
HO
OH
(S)-2
160
140
120
100
80
60
40
20
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.26.i5_HH-3-252_C13_APT_ad

Agilent Technologies

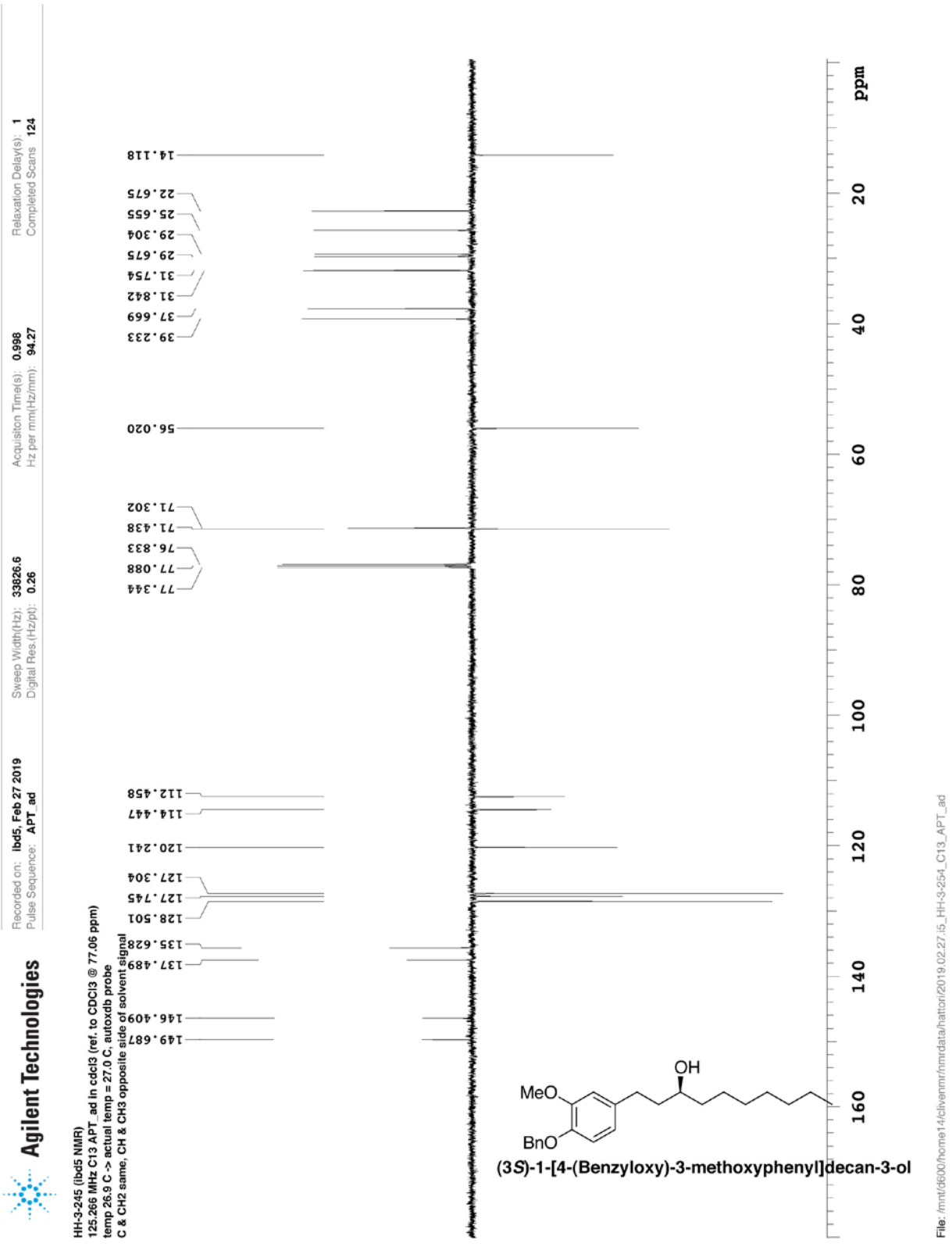
Department of Chemistry, University of Alberta

Recorded on:	ibd5, Feb 26 2019	Sweep Width(Hz):	6000.6	Acquisiton Time(s):	5	Relaxation Delay(s):	0.1
Pulse Sequence:	s2pul	Digital Res.(Hz/pt):	0.09	Hz per mm(Hz/mm):	20.76	Completed Scans	16

HH-3-252 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe



File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.26.i5_HH-3-252_H1_1D

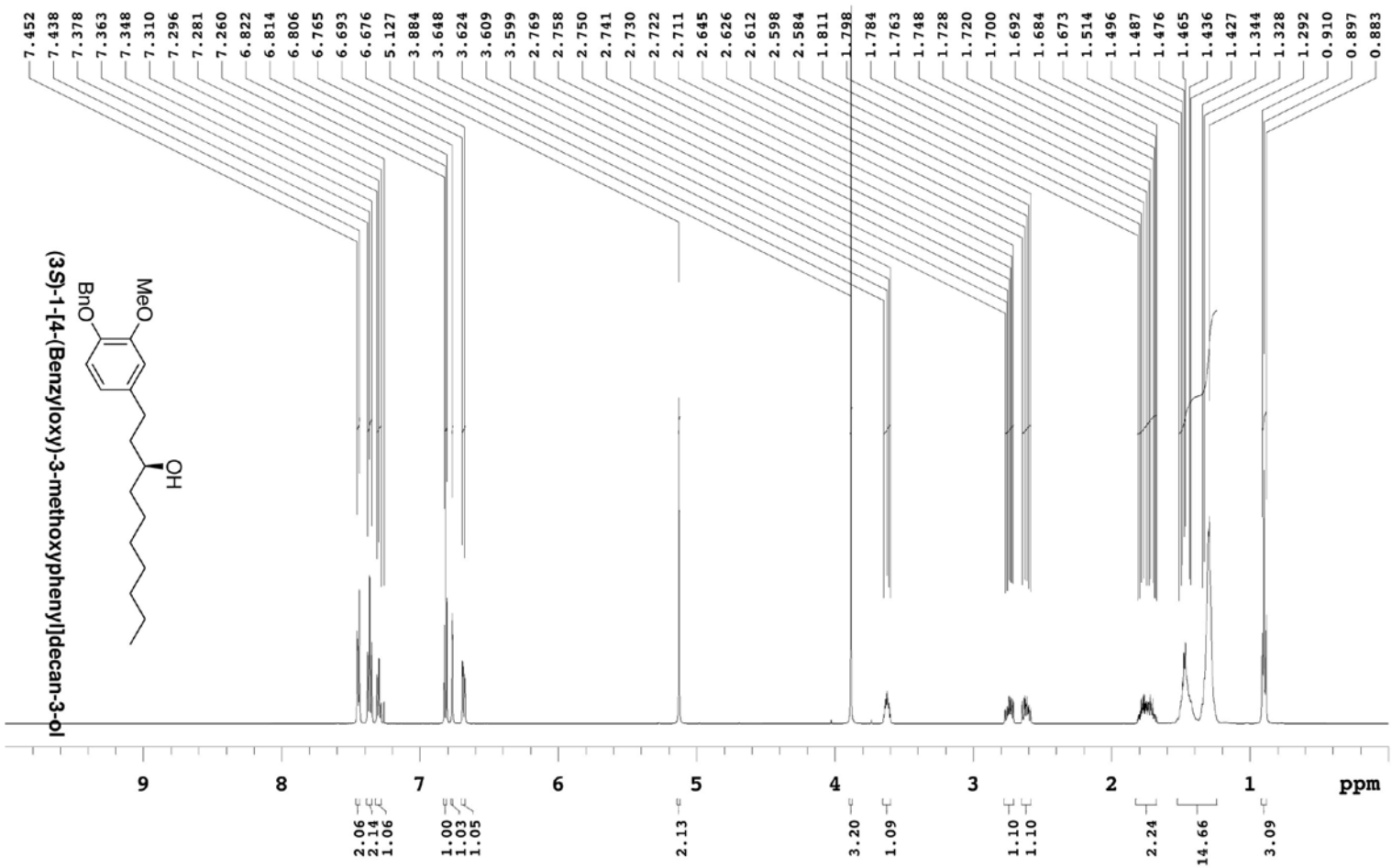

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 27 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 33826.6
Digital Res.(Hz/pt): 0.26
Acquisiton Time(s): 0.998
Hz per mm(Hz/mm): 94.27
Relaxation Delay(s): 1
Completed Scans 124
HH-3-245 (ibd5 NMR)
125.266 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.118
22.675
25.655
29.304
29.675
31.754
31.842
37.669
39.233
56.020
71.302
71.438
76.833
77.088
77.344
112.458
114.447
120.241
127.304
127.745
128.501
135.628
137.489
146.409
149.687
ppm
OH
MeO
BnO
(3S)-1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-ol
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.27.i5_HH-3-254_C13_APT_ad

Agilent Technologies

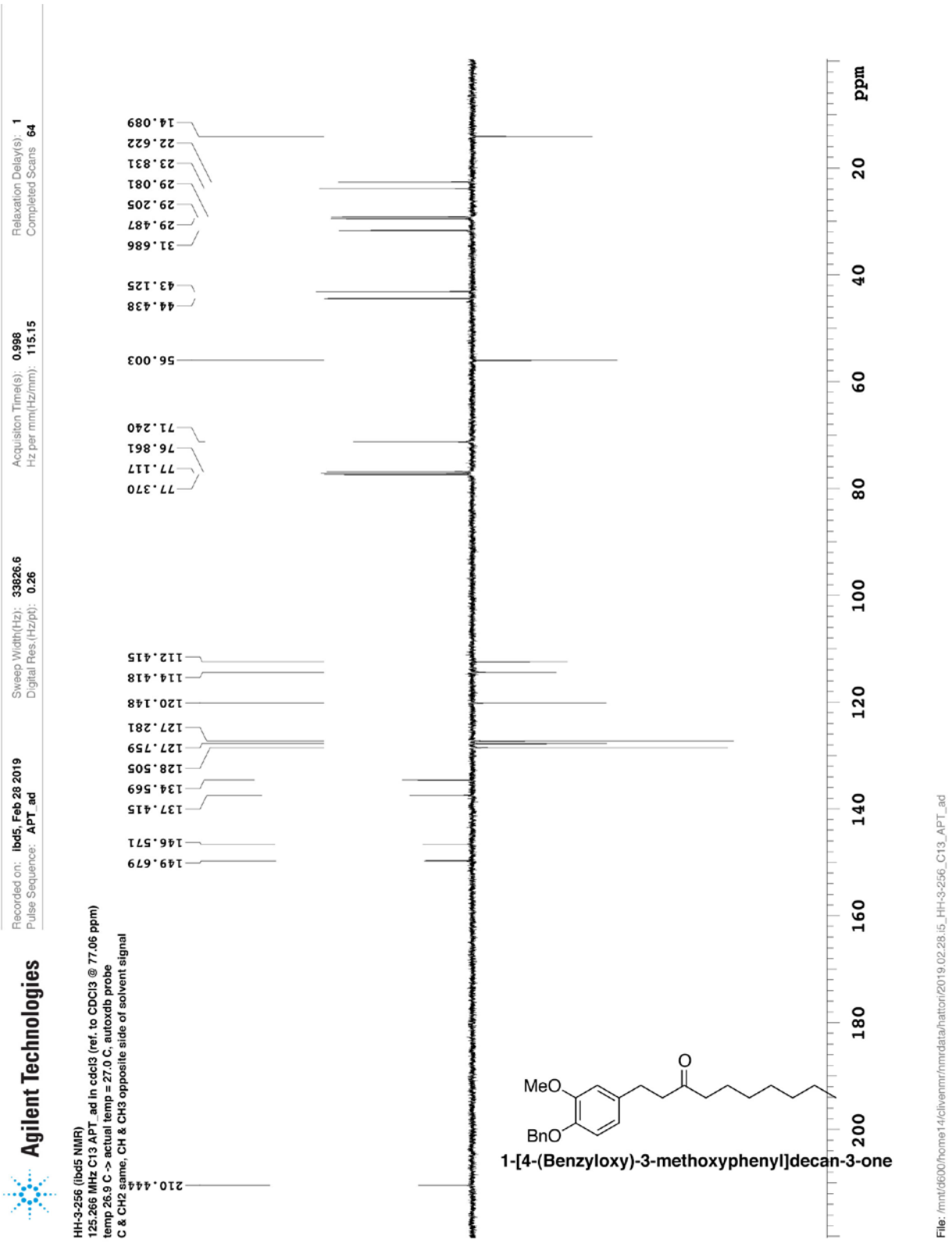
Department of Chemistry, University of Alberta

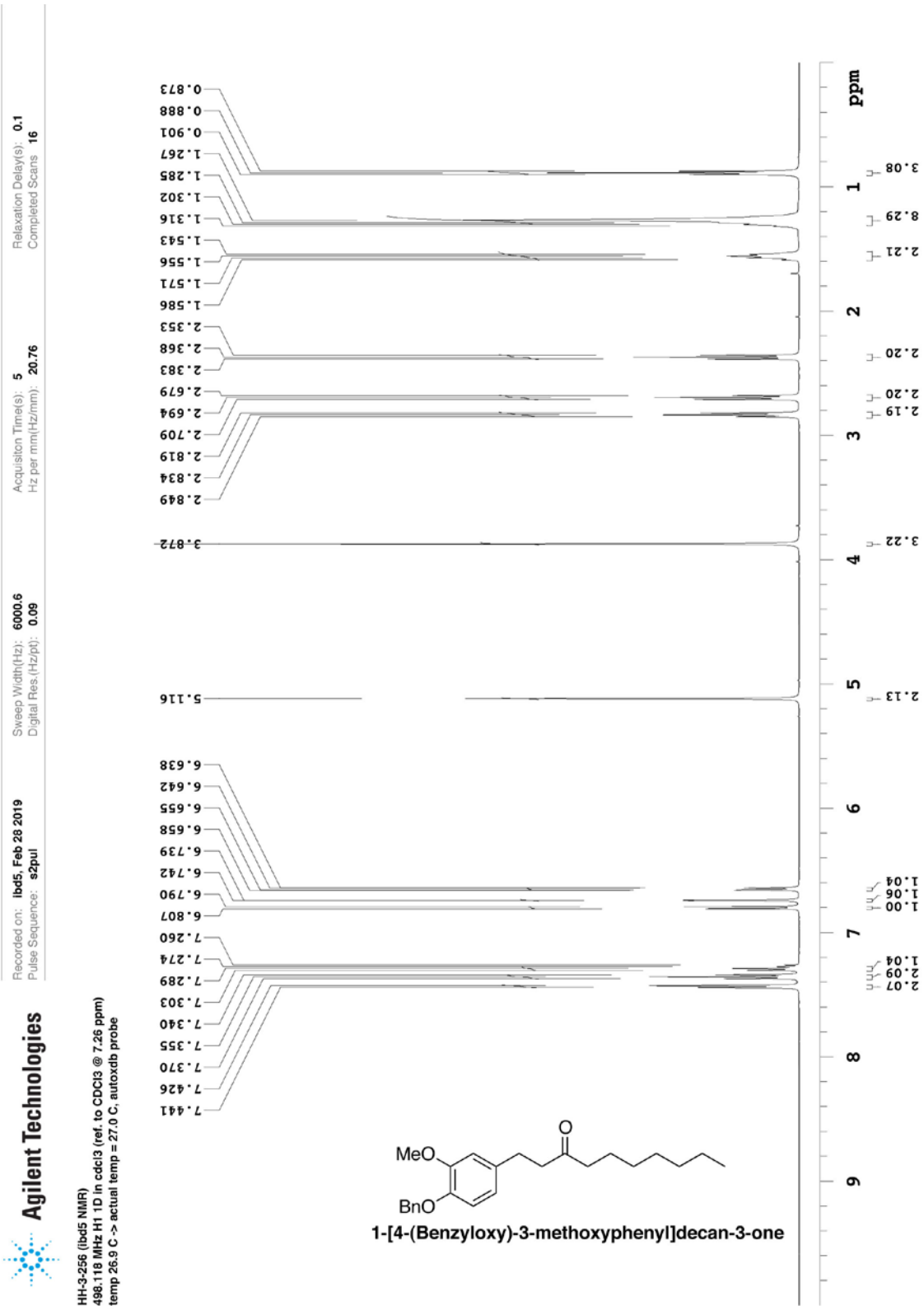
Recorded on:	ibd5, Feb 27 2019	Sweep Width(Hz):	6000.6	Acquisiton Time(s):	5	Relaxation Delay(s):	0.1
Pulse Sequence:	s2pul	Digital Res.(Hz/pt):	0.09	Hz per mm(Hz/mm):	20.76	Completed Scans	16

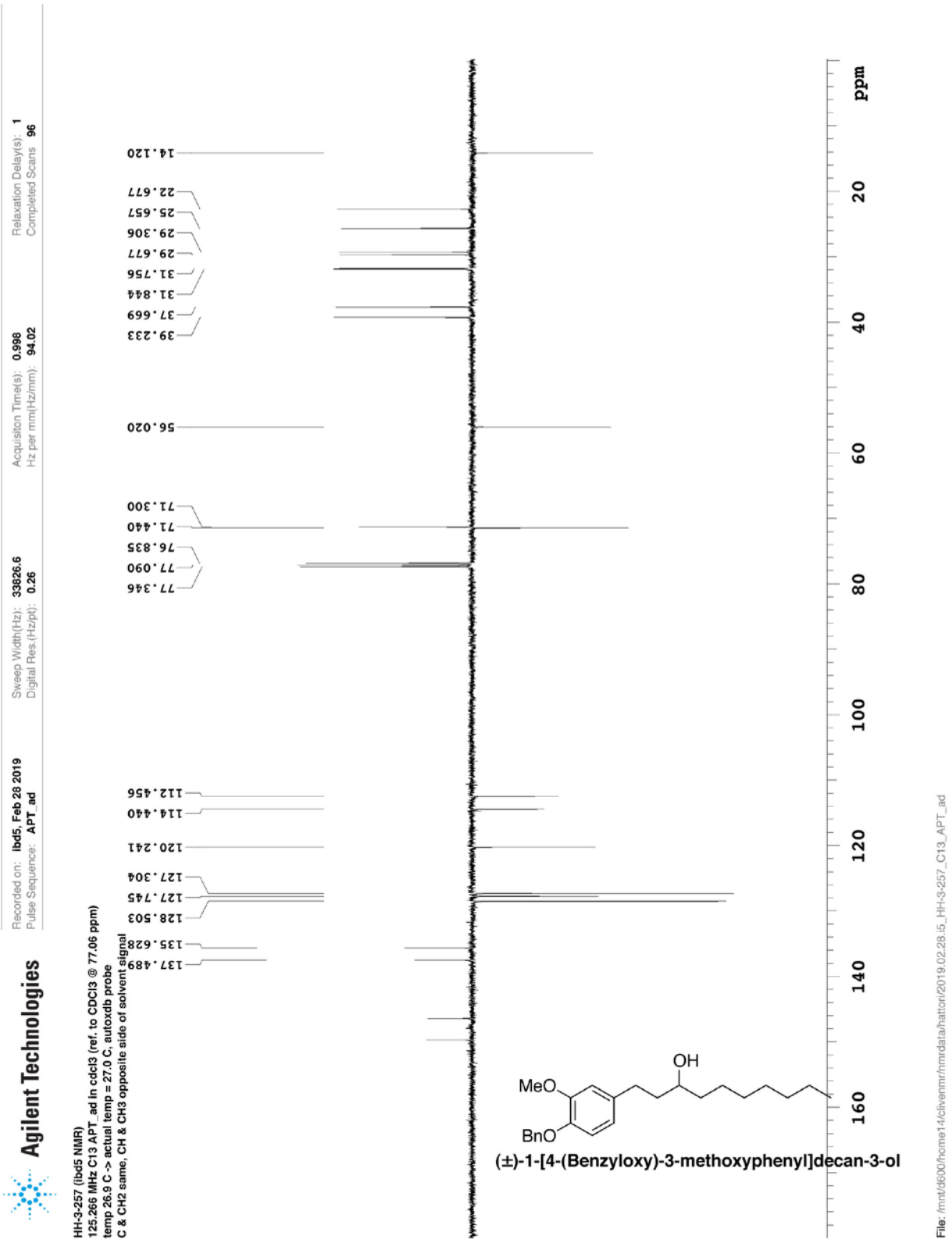
HH-3-254 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe



File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.27.i5_HH-3-254_H1_1D


Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 28 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 33826.6
Digital Res.(Hz/pt): 0.26
Acquisiton Time(s): 0.998
Hz per mm(Hz/mm): 115.15
Relaxation Delay(s): 1
Completed Scans 64
HH-3-256 (ibd5 NMR)
125.266 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
C & CH2 same, CH & CH3 opposite side of solvent signal
210.444
149.679
146.571
137.415
134.569
128.505
127.759
127.281
120.148
114.418
112.415
77.370
77.117
76.861
71.240
56.003
44.438
43.125
31.686
29.487
29.205
29.081
23.831
22.622
14.089
MeO
BnO
O
1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-one
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.28.i5_HH-3-256_C13_APT_ad


Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 28 2019
Pulse Sequence: s2pul
Sweep Width(Hz): 6000.6
Digital Res.(Hz/pt): 0.09
Acquisiton Time(s): 5
Hz per mm(Hz/mm): 20.76
Relaxation Delay(s): 0.1
Completed Scans 16
HH-3-256 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
MeO
BnO
O
1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-one
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.28.i5_HH-3-256_H1_1D

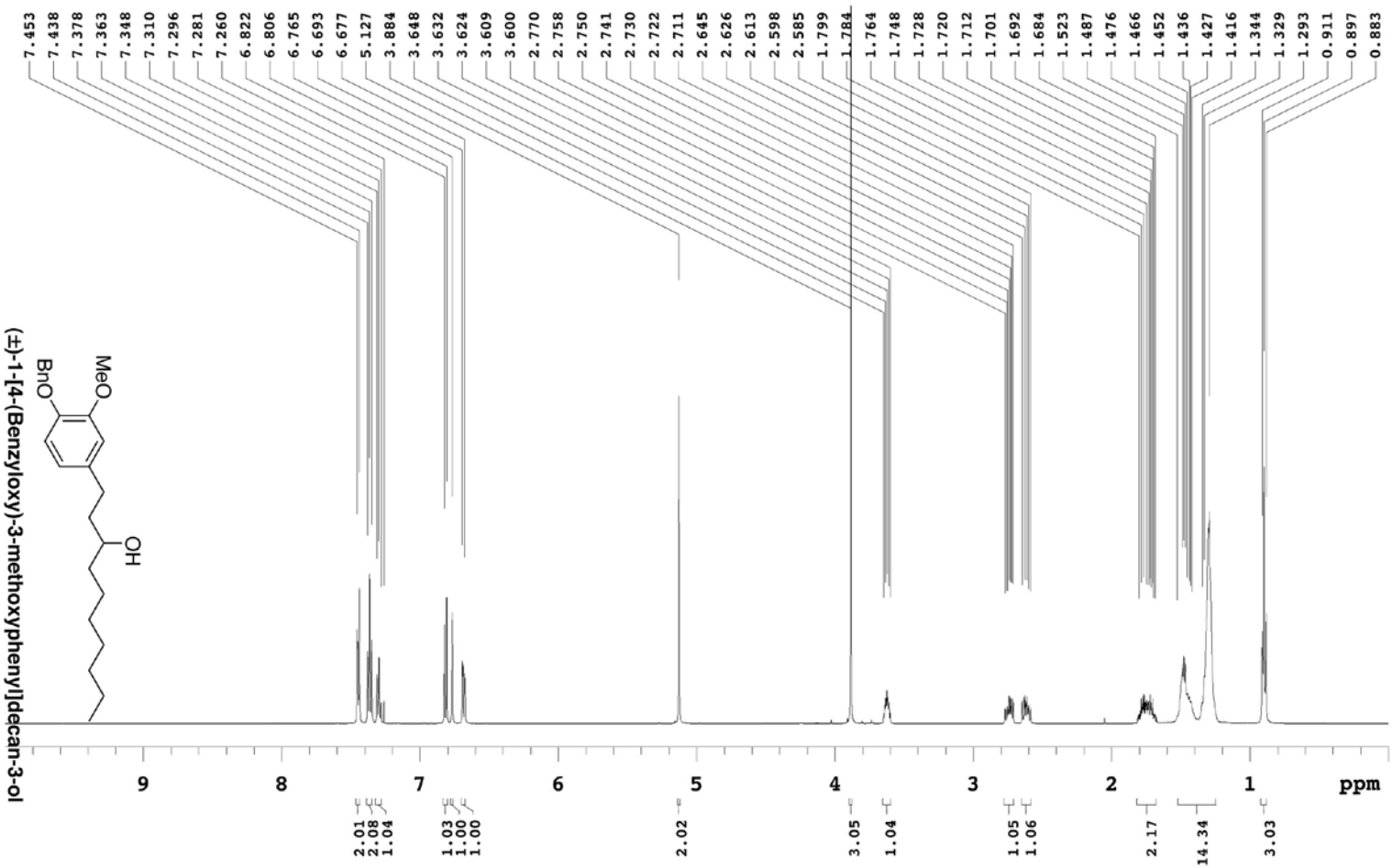

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Feb 28 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 33826.6
Digital Res.(Hz/pt): 0.26
Acquisiton Time(s): 0.998
Hz per mm(Hz/mm): 94.02
Relaxation Delay(s): 1
Completed Scans 96
HH-3-257 (ibd5 NMR)
125.266 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.120
22.677
25.657
29.306
29.677
31.756
31.844
37.669
39.233
56.020
71.300
71.440
76.835
77.090
77.346
112.456
114.440
120.241
127.304
127.745
128.503
135.628
137.489
ppm
MeO
BnO
OH
(±)-1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-ol
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.28.i5_HH-3-257_C13_APT_ad

Agilent Technologies

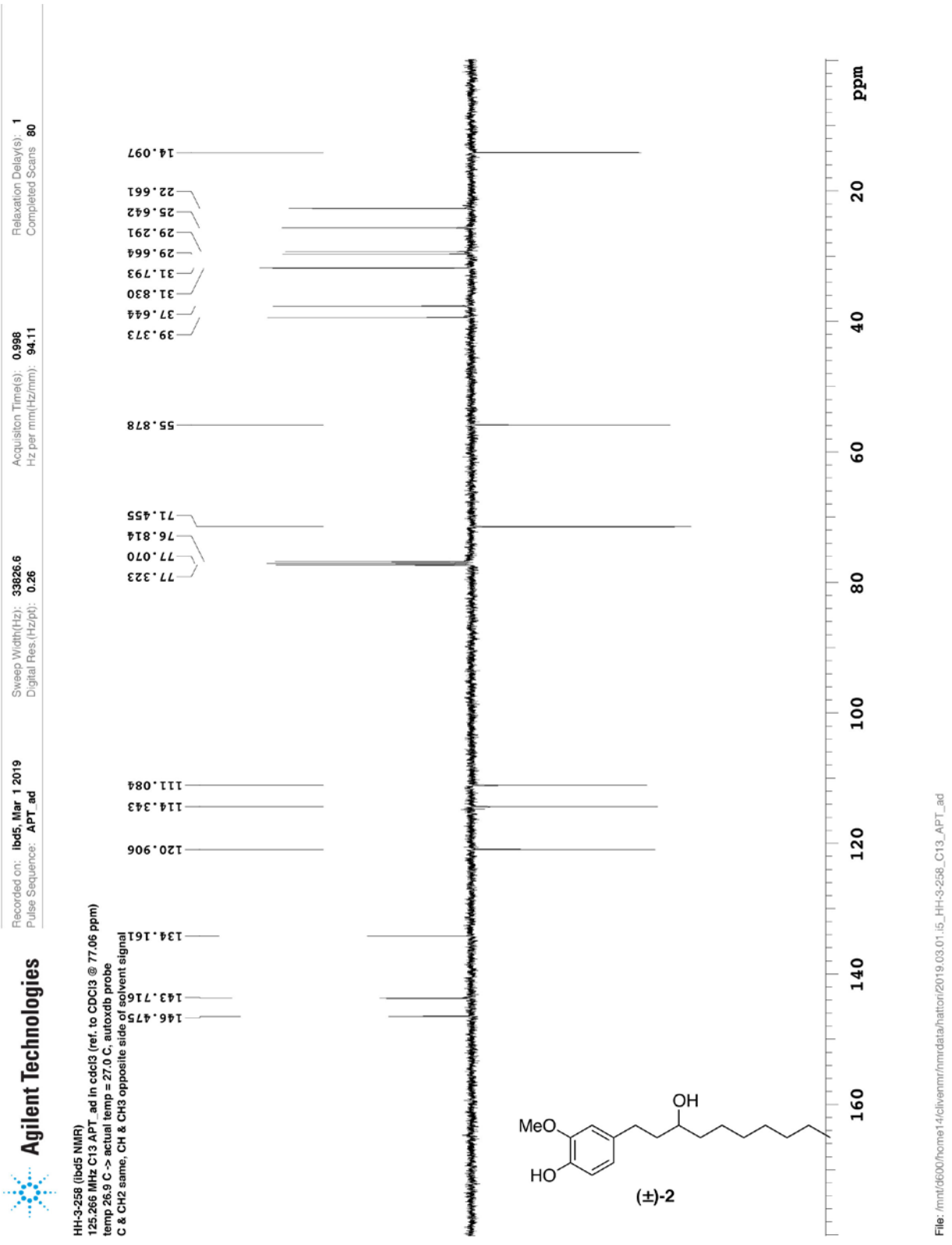
Department of Chemistry, University of Alberta

Recorded on:	ibd5, Feb 28 2019	Sweep Width(Hz):	6000.6	Acquisiton Time(s):	5	Relaxation Delay(s):	0.1
Pulse Sequence:	s2pul	Digital Res.(Hz/pt):	0.09	Hz per mm(Hz/mm):	20.76	Completed Scans	16

HH-3-257 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe



File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.02.28.i5_HH-3-257_H1_1D

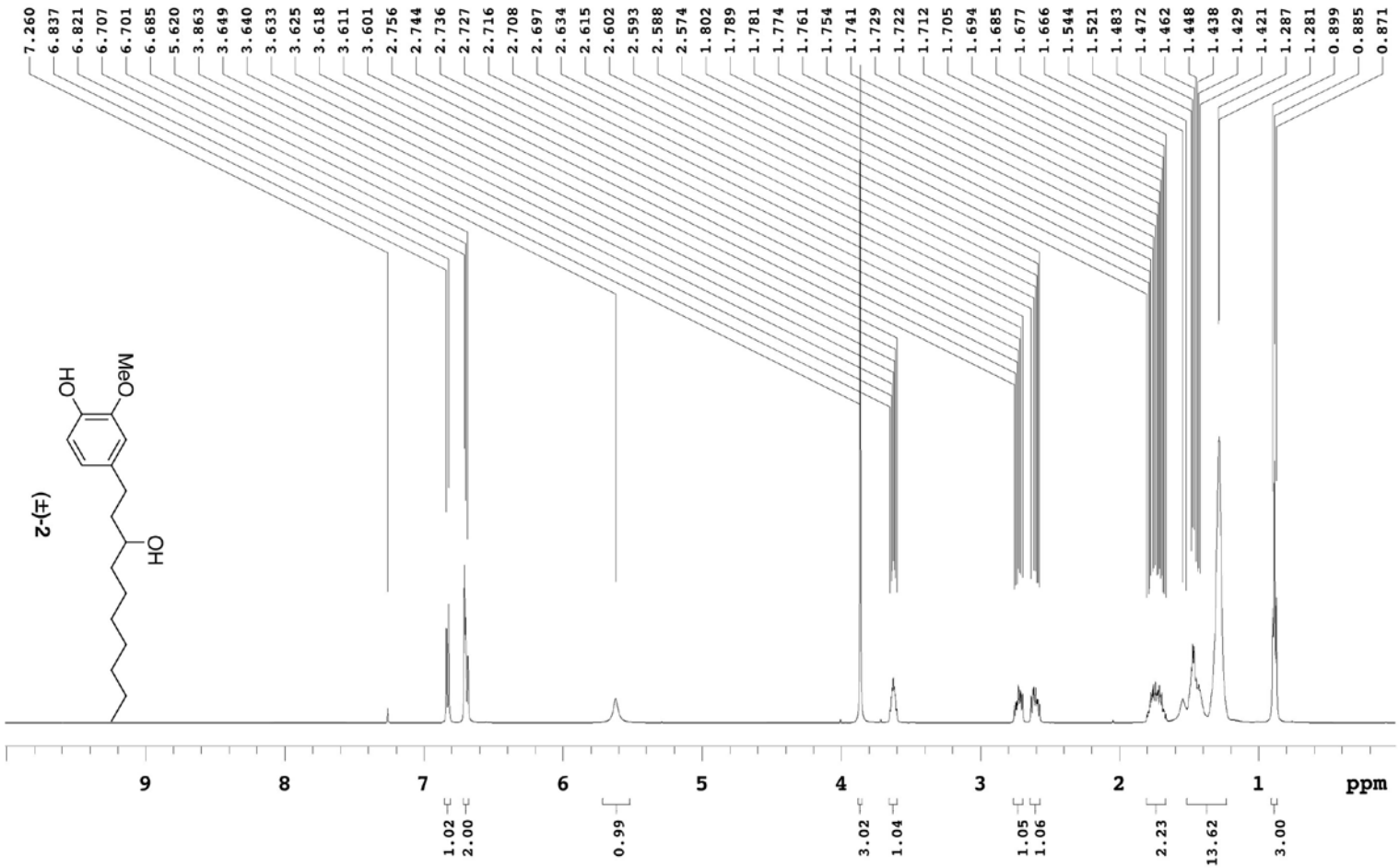

Department of Chemistry, University of Alberta
Agilent Technologies
Recorded on: ibd5, Mar 1 2019
Pulse Sequence: APT_ad
Sweep Width(Hz): 33826.6
Digital Res.(Hz/pt): 0.26
Acquisiton Time(s): 0.998
Hz per mm(Hz/mm): 94.11
Relaxation Delay(s): 1
Completed Scans 80
HH-3-258 (ibd5 NMR)
125.266 MHz C13 APT_ad in cdcl3 (ref. to CDCl3 @ 77.06 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe
C & CH2 same, CH & CH3 opposite side of solvent signal
14.097
22.661
25.642
29.291
29.664
31.793
31.830
37.644
39.373
55.878
71.455
76.814
77.070
77.323
111.084
114.343
120.906
134.161
143.716
146.475
MeO
HO
OH
(±)-2
ppm
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.03.01.i5_HH-3-258_C13_APT_ad

Agilent Technologies

Department of Chemistry, University of Alberta

Recorded on:	ibd5, Mar 1 2019	Sweep Width(Hz):	6000.6	Acquisiton Time(s):	5	Relaxation Delay(s):	0.1
Pulse Sequence:	s2pul	Digital Res.(Hz/pt):	0.09	Hz per mm(Hz/mm):	20.74	Completed Scans	16

HH-3-258 (ibd5 NMR)
498.118 MHz H1 1D in cdcl3 (ref. to CDCl3 @ 7.26 ppm)
temp 26.9 C -> actual temp = 27.0 C, autoxdb probe



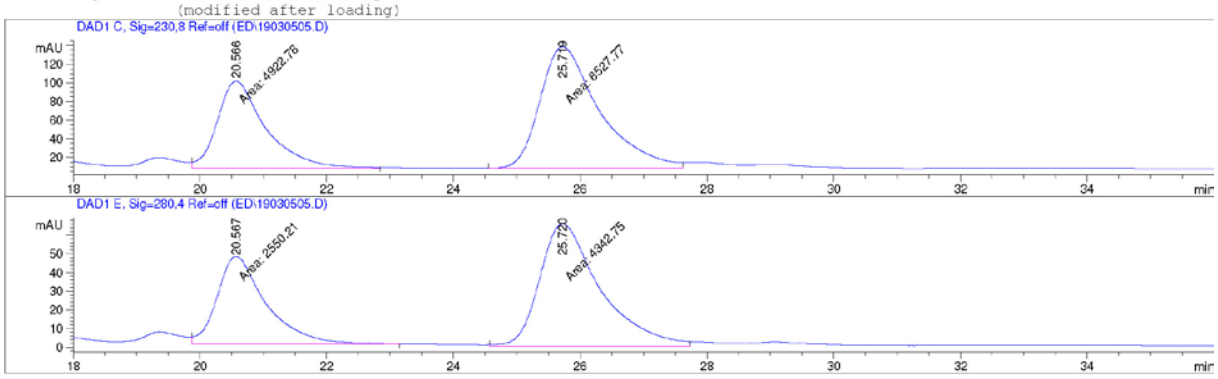
File: /mnt/d600/home14/clivenmr/nmrdata/hattori/2019.03.01.i5_HH-3-258_H1_1D

HPLC of natural compound 2

Data File C:\HPCHEM\1\DATA\ED\19030505.D Sample Name: CL NP

OD column, IPA:Hex=15:85 0.5 mL/min 20C

```
================================================================
Injection Date  : 3/5/2019 3:15:36 PM          Seq. Line :   5
Sample Name     : CL NP                        Location : Vial 28
Acq. Operator   : Ed                              Inj :   1
Acq. Instrument : Instrument 1                 Inj Volume : 1 µl
Different Inj Volume from Sequence !     Actual Inj Volume : 0.1 µl
Acq. Method     : C:\HPCHEM\1\METHODS\EDH85.M
Last changed    : 3/5/2019 11:26:00 AM by Ed
Analysis Method : C:\HPCHEM\1\METHODS\MEH98.M
Last changed    : 3/5/2019 2:19:28 PM by Ed
                  (modified after loading)
```




```
================================================================
                      Area Percent Report
================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 C, Sig=230,8 Ref=off
```

Data File C:\HPCHEM\1\DATA\ED\19030505.D Sample Name: CL NP

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.566	MM	0.8785	4922.77539	93.39045	36.5991
2	25.719	MF	1.0883	8527.76562	130.59981	63.4009
Totals :				1.34505e4	223.99026	

Signal 2: DAD1 E, Sig=280,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.567	MM	0.8990	2550.20557	47.28008	36.9973
2	25.720	MM	1.1036	4342.74561	65.58202	63.0027
Totals :				6892.95117	112.86211	

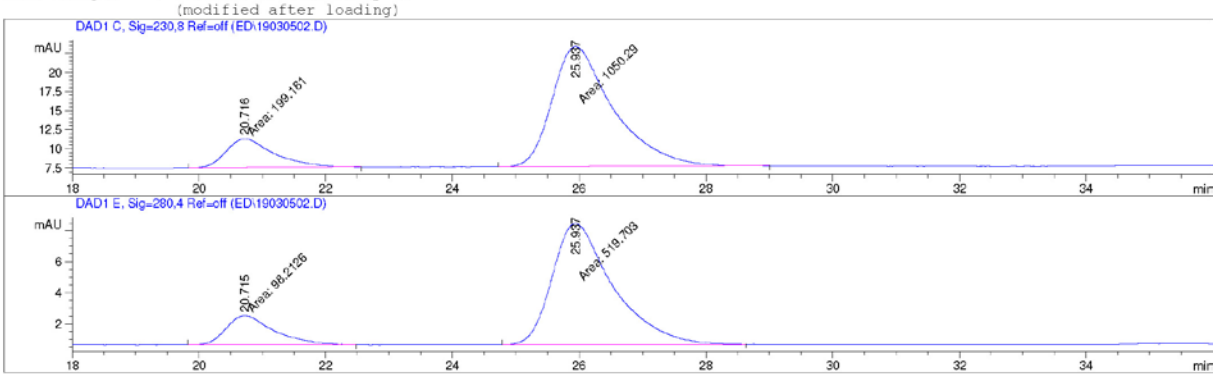
*** End of Report ***

HPLC of synthetic compound 2

Data File C:\HPCHEM\1\DATA\ED\19030502.D Sample Name: HH-3-252

OD column, IPA:Hex=15:85 0.5 mL/min 20C

```
==================================================================
Injection Date  : 3/5/2019 12:27:09 PM          Seq. Line :   2
Sample Name     : HH-3-252                      Location : Vial 29
Acq. Operator   : Ed                               Inj :   1
Acq. Instrument : Instrument 1                  Inj Volume : 1 µl
Different Inj Volume from Sequence !     Actual Inj Volume : 0.3 µl
Acq. Method     : C:\HPCHEM\1\METHODS\EDH85.M
Last changed    : 3/5/2019 11:26:00 AM by Ed
Analysis Method : C:\HPCHEM\1\METHODS\MEH98.M
Last changed    : 3/5/2019 2:19:28 PM by Ed
                  (modified after loading)
```




```
==================================================================
                        Area Percent Report
==================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 C, Sig=230,8 Ref=off
```

Data File C:\HPCHEM\1\DATA\ED\19030502.D Sample Name: HH-3-252

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.716	MM	0.8784	199.18086	3.77929	15.9413
2	25.937	MM	1.1152	1050.28552	15.69707	84.0587
Totals :				1249.46638	19.47636	

Signal 2: DAD1 E, Sig=280,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.715	MM	0.8710	98.21260	1.87927	15.8942
2	25.937	MM	1.1092	519.70337	7.80871	84.1058
Totals :				617.91597	9.68798	

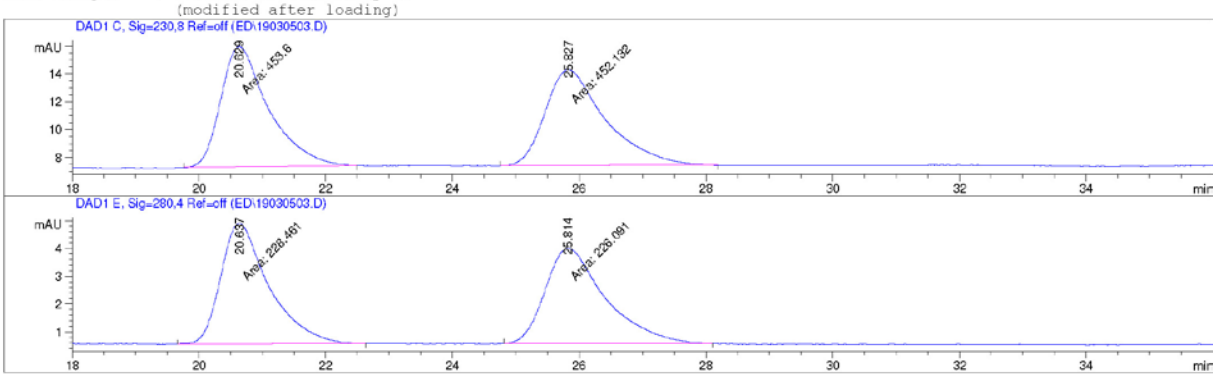
*** End of Report ***

HPLC of racemic compound 2

Data File C:\HPCHEM\1\DATA\ED\19030503.D Sample Name: HH-3-258

OD column, IPA:Hex=15:85 0.5 mL/min 20C

```
==================================================================
Injection Date  : 3/5/2019 1:23:17 PM          Seq. Line :   3
Sample Name     : HH-3-258                      Location : Vial 30
Acq. Operator   : Ed                               Inj :   1
Acq. Instrument : Instrument 1                 Inj Volume : 1 µl
Different Inj Volume from Sequence !     Actual Inj Volume : 0.3 µl
Acq. Method     : C:\HPCHEM\1\METHODS\EDH85.M
Last changed    : 3/5/2019 11:26:00 AM by Ed
Analysis Method : C:\HPCHEM\1\METHODS\MEH98.M
Last changed    : 3/5/2019 2:19:28 PM by Ed
                  (modified after loading)
```




```
==================================================================
                        Area Percent Report
==================================================================

Sorted By             :      Signal
Multiplier            :      1.0000
Dilution              :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: DAD1 C, Sig=230,8 Ref=off
```

Data File C:\HPCHEM\1\DATA\ED\19030503.D Sample Name: HH-3-258

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.629	MM	0.8748	453.60031	8.64238	50.0810
2	25.827	MM	1.0985	452.13226	6.86014	49.9190
Totals :				905.73257	15.50252	

Signal 2: DAD1 E, Sig=280,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.637	MM	0.8789	228.46127	4.33252	50.2608
2	25.814	MM	1.0990	226.09076	3.42874	49.7392
Totals :				454.55203	7.76126	

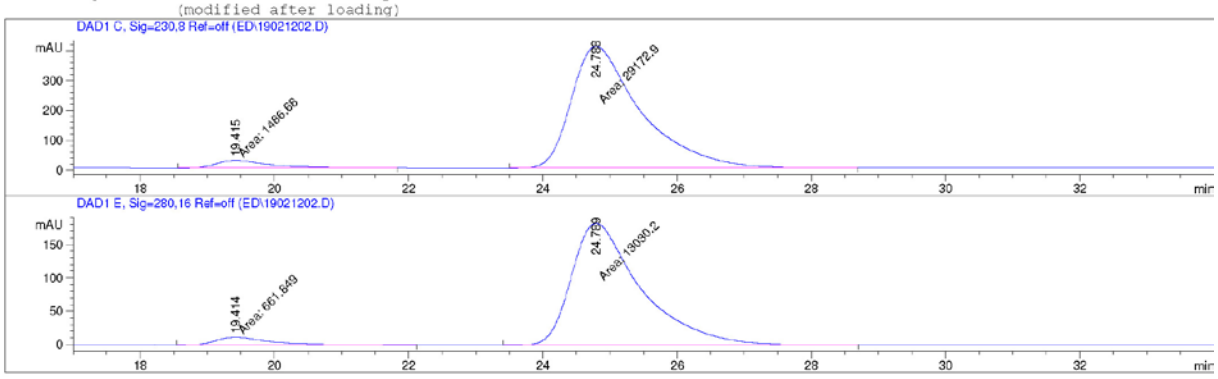
*** End of Report ***

HPLC of Synthetic compound 3

Data File C:\HPCHEM\1\DATA\ED\19021202.D Sample Name: CL S-isomer

OD column, IPA:Hex=15:85 0.5 mL/min 20C
Chiral from S-isomer

Injection Date	: 2/12/2019 9:35:39 AM	Seq. Line	: 2
Sample Name	: CL S-isomer	Location	: Vial 28
Acq. Operator	: Ed	Inj	: 1
Acq. Instrument	: Instrument 1	Inj Volume	: 1 µl
Acq. Method	: C:\HPCHEM\1\METHODS\EDH85.M		
Last changed	: 12/4/2018 10:37:52 AM by Carl		
Analysis Method	: C:\HPCHEM\1\METHODS\MEH98.M		
Last changed	: 2/12/2019 1:03:17 PM by ed (modified after loading)		



Area Percent Report

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 C, Sig=230,8 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.415	MM	0.9454	1486.67908	26.20981	4.8490
2	24.788	MM	1.1950	2.91729e4	406.86475	95.1510

Data File C:\HPCHEM\1\DATA\ED\19021202.D

Sample Name: CL S-isomer

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
Totals :				3.06596e4	433.07456	

Signal 2: DAD1 E, Sig=280,16 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.414	MM	0.9426	661.84857	11.70214	4.8338
2	24.789	MM	1.1909	1.30302e4	182.36313	95.1662
Totals :				1.36921e4	194.06526	

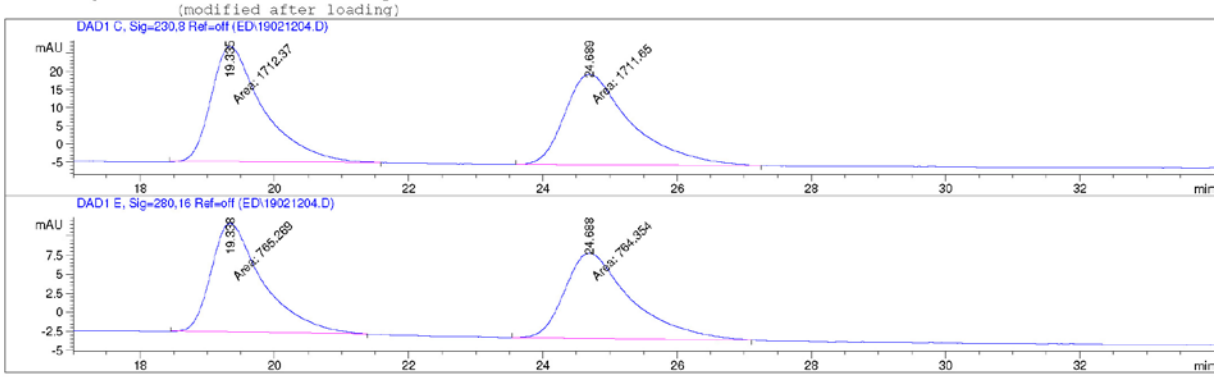
*** End of Report ***

HPLC of racemic compound 3

Data File C:\HPCHEM\1\DATA\ED\19021204.D Sample Name: CL Racemate

OD column, IPA:Hex=15:85 0.5 mL/min 20C
Racemate

Injection Date	: 2/12/2019 12:27:31 PM	Seq. Line	: 4
Sample Name	: CL Racemate	Location	: Vial 30
Acq. Operator	: Ed	Inj	: 1
Acq. Instrument	: Instrument 1	Inj Volume	: 1 µl
Acq. Method	: C:\HPCHEM\1\METHODS\EDH85.M		
Last changed	: 12/4/2018 10:37:52 AM by Carl		
Analysis Method	: C:\HPCHEM\1\METHODS\MEH98.M		
Last changed	: 2/12/2019 1:03:17 PM by ed		
	(modified after loading)		



Area Percent Report

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 C, Sig=230,8 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.335	MM	0.8978	1712.36523	31.78810	50.0105
2	24.689	MM	1.1423	1711.64526	24.97433	49.9895

Data File C:\HPCHEM\1\DATA\ED\19021204.D

Sample Name: CL Racemate

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
Totals :				3424.01050	56.76243	

Signal 2: DAD1 E, Sig=280,16 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.338	MM	0.8942	765.26886	14.26325	50.0299
2	24.688	MM	1.1380	764.35364	11.19423	49.9701
Totals :				1529.62250	25.45748	

*** End of Report ***

Experimental section

General procedures.

Solvents used for chromatography were distilled before use. Commercial thin layer chromatography plates (silica gel, Merck 60F-254) were used. Silica gel for flash chromatography was Merck type 60 (230−400 mesh). Dry solvents were prepared under an inert atmosphere (N_2) and transferred by syringe or cannula. Unless otherwise indicated, all reactions were done under an inert atmosphere (N_2). The symbols s, d, t, and q used for ^{13}C NMR spectra indicate zero, one, two, or three attached hydrogens, respectively, the assignments being made from APT spectra. Optical rotations were measured at 20 °C. Solutions were evaporated under water pump vacuum, and the residue was then kept under oil pump vacuum. High resolution electrospray mass spectrometric analyses were done with an orthogonal time-of-flight analyzer, and electron ionization mass spectra were measured with a double-focusing sector mass spectrometer. Gradient flash chromatography was done by stepwise small increases in the proportion of the more polar solvent, as described for the individual experiments.

*Synthesis of (**1**)*

*Ethyl (2E)-3-(4-hydroxy-3-methoxyphenyl)prop-2-enoate and Ethyl (2Z)-3-(4-hydroxy-3-methoxyphenyl)prop-2-enoate (**1.3**)*[18,30]

Dry PhH (150 mL) was added to a flask containing vanillin (8.0 g, 52.6 mmol) and the Wittig reagent **1.2**[31] (19.0 g, 54.6 mmol). The solution was stirred and heated at 80 °C for 4.5 h (oil bath) by which time the reaction was complete (tlc, silica, 1:1 EtOAc-hexane). Evaporation of the solvent and flash chromatography of the residue over silica gel (23 × 5 cm), using 1:1 EtOAc-hexane, gave **1.3** (11.638 g, 99%) as an oil which was a mixture of *Z* and *E* isomers (ca 3:1 *E*:*Z*).

In an earlier run we separated the *Z* and *E* isomers. The *Z* isomer had: FTIR ($CDCl_3$, cast) 3419, 2925, 1515, 1174 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 1.31 (t, *J* = 7.0 Hz, 3 H), 3.95 (s, 3 H), 4.21 (q, *J* = 7.0 Hz, 2 H), 5.83 (d, *J* = 13.0 Hz, 1 H), 5.83 (d, *J* = 13.0 Hz, 1 H), 6.81 (d, *J* = 13.0 Hz, 1 H), 6.90 (d, *J* = 8.0 Hz, 1 H), 7.13 (dd, *J* = 1.5, 8.5 Hz, 1 H), 7.79 (d, *J* = 2.0 Hz, 1 H); exact mass (electrospray) *m*/*z* calcd for $C_{12}H_{13}O_4$ $(M–H)^–$ 221.0819, found 221.0816.

The *E* isomer had: FTIR ($CDCl_3$, cast) 3392, 2927, 1514, 1176 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 1.35 (t, *J* = 7.0 Hz, 3 H), 3.94 (s, 3 H), 4.27 (q, *J* = 7.0 Hz, 2 H), 5.92 (s, OH), 6.31 (d, *J* = 15.9 Hz, 1 H), 6.93 (d, *J* = 8.0 Hz, 1 H), 7.05 (br s, 1 H), 7.09 (br d, *J* = 8.0 Hz, 1 H), 7.63 (d, *J* = 15.9 Hz, 1 H); exact mass (electrospray) *m*/*z* calcd for $C_{12}H_{13}O_4$ $(M–H)^–$ 221.0819, found 221.0817.

*Ethyl 3-(4-hydroxy-3-methoxyphenyl)propanoate (**1.4**)*[18,30]

10% Pd/C (1.2 g) was added to a solution of **1.3**[18,30] (*Z*,*E* isomer mixture, 11.8 g, 56.0 mmol) in EtOH (120 mL). The flask was flushed with hydrogen (balloon) several times, then kept under a slight pressure of H_2 (balloon), and the mixture was stirred overnight by which time the reaction was over (tlc, silica, 1:4 EtOAc-hexane). The mixture was diluted with EtOH and passed through a short pad of Celite. Evaporation of the filtrate gave **1.4** (10.2 g, 86%) as an oil which was pure enough for the next step. The material had: ^{1}H NMR ($CDCl_3$, 400 MHz) δ 1.24 (t, *J* = 7.2 Hz, 3 H), 2.59 (t, *J* = 7.2 Hz, 2 H), 2.88 (t, *J* = 7.6 Hz, 2 H), 3.87 (s, 3 H), 4.13 (q, *J* = 7.2 Hz, 2 H), 5.48 (s, OH), 6.69 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.71 (d, *J* = 2.0 Hz, 1 H), 6.83 (d, *J* = 8.0 Hz, 1 H).

*3-(4-Hydroxy-3-methoxyphenyl)propanal (**1.5**)*[18]

DIBAL-H (1.1 M in cyclohexane, 30 mL, 33 mmol) was added dropwise by syringe to a stirred and cooled (–78 °C) solution of **1.4** (4.23 g, 18.9 mmol) in dry CH_2Cl_2 (200 mL). After the addition, stirring at –78 °C was continued for 3.5 h, and then the mixture was quenched by addition of MeOH (15 mL). Saturated aqueous Rochelle salt (400 mL) was added, the cold bath was left in place but not recharged, and stirring was continued overnight. The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 200 mL). The combined organic extracts were washed with brine, dried ($MgSO_4$) and evaporated. Flash chromatography of the residue over silica gel (5 × 23 cm), using first 20% EtOAc-hexane, and then 50% EtOAc-hexane, gave **1.5** (2.5 g, 73%) as an oil: ^{1}H NMR ($CDCl_3$, 400 MHz) δ 2.75 (t, *J* = 7.2 Hz, 2 H), 2.90 (t, *J* = 7.2 Hz, 2 H), 3.88 (s, 3 H), 5.48 (s, OH), 6.67–6.70 (m, 2 H), 6.84 (d, *J* = 8.0 Hz, 1 H), 9.82 (s, 1 H); exact mass (EI) *m*/*z* calcd for $C_{10}H_{14}O_3$ $(M)^+$ 182.0943; found: 182.0943.

*(5E)-8-(4-Hydroxy-3-methoxyphenyl)oct-5-en-4-one (**1**)*

A solution of ylide **1.6**[19,32] (1.3 g, 3.68 mmol) in dry CH_2Cl_2 (24 mL) was added dropwise by syringe to a cooled (ice bath) flask containing **1.5** (552.3 mg, 3.07 mmol) and a magnetic stirring bar. The mixture was stirred and the ice bath was left in place but not recharged. Stirring was continued for 18 h by which time the reaction was over (tlc control, silica, 1:4 EtOAc-hexane). Evaporation of the solvent and flash chromatography of the residue over silica gel (20 × 2 cm), using 1:3 EtOAc-hexane, gave **1** (1.3 g, 77%) as a pale yellow solid which was a single *E* isomer, corresponding spectroscopically (^{1}H and ^{13}C NMR) to the natural product: mp 35–38 °C; FTIR ($CDCl_3$, cast) 3418, 2962, 1516, 1272 cm^{-1}; ^{1}H NMR ($CDCl_3$, 700 MHz) δ 0.92 (t, *J* = 7.7 Hz, 3 H), 1.62 (sextet, *J* = 7.7 Hz, 2 H), 2.48–2.52 (m, 4 H), 2.71 (t, *J* = 7.0 Hz, 2 H), 3.87 (s, 3 H), 5.54 (s, OH), 6.10 (dt, *J* = 1.4, 15.4 Hz, 1 H), 6.66–6.68 (m, 2 H), 6.81–6.85 (m, 2 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 13.8 (q), 17.7 (t), 34.2 (t), 34.4 (t), 42.1 (t),

55.9 (q), 110.9 (d), 114.3 (d), 120.9 (d), 130.8 (d), 132.7 (s), 144.0 (s), 145.9 (d), 146.4 (s), 200.7 (s); exact mass (electrospray) *m*/*z* calcd for $C_{15}H_{19}O_3$ $(M–H)^-$ 247.134, found 247.1339.

Synthesis of ***(3)***

(3S)-3-Hydroxy-4-methoxy-4-oxobutanoic acid ***(4.2)***[24,33]

The L-malic acid used in this experiment (99%) had $[\alpha]_D$ –3.22 (*c* = 30.036, MeOH); Lit.[34] $[\alpha]_D$ –2.92 (*c* = 30, MeOH).

$(CF_3CO)_2O$ (29.3 mL, 207.6 mmol) was added to a stirred sample of L-(–)-malic acid (**4.1**) (11.1 g, 83.0 mmol) and stirring was continued for 90 min (N_2 atmosphere). Residual $(CF_3CO)_2O$ was evaporated under water pump vacuum (protection from moisture). Dry MeOH (35 mL) was added and stirring was continued for 2 h. The MeOH was evaporated and the residue was crystalized from Et_2O to afford **4.2** (12.1 g, 98%): $[\alpha]_D$ –5.57 (*c* = 9.5 g/100 mL); FTIR (MeOH, cast) 3440, 3116, 1732, 1223 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 2.84 (dd, *J* = 6.5, 16.9 Hz, 1 H), 2.92 (dd, *J* = 4.5, 16.9 Hz, 1 H), 3.81 (s, 3 H), 4.52 (dd, *J* = 4.0, 6.5 Hz, 1 H); ^{13}C NMR (CD_3OD, 175 MHz) δ 39.8 (t), 52.7 (q), 68.6 (d), 173.9 (s), 175.2 (s); exact mass (electrospray) *m*/*z* calcd for $C_5H_8O_5$ $(M–H)^-$ 147.0299, found 147.0300.

Methyl (2S)-2,4-dihydroxybutanoate ***(4.3)***[24]

$BH_3.SMe_2$ (9.0 mL, 94.9 mmol) was added dropwise by syringe over ca 15 min to a stirred and cooled (0 °C) solution of **4.2** (3.5 g, 23.7 mmol) in THF (20 mL). The ice bath was left in place but not recharged, and stirring was continued overnight. The mixture was quenched by slow addition of MeOH and the solvents were evaporated at *room temperature* under water pump vacuum. The residual oil was diluted with MeOH and the solution was evaporated at room temperature. This procedure was repeated four more times to remove $B(OMe)_3$. The resulting crude diol (**4.3**) was used directly for the next step without purification. The material had: ^1H NMR ($CDCl_3$, 500 MHz) δ 1.88–1.95 (m, 1 H), 2.05–2.11 (m, 2 H), 3.80 (s, 3 H), 4.40 (dd, *J* = 3.5, 7.5 Hz, 1 H).

Methyl (2S)-4-[(tert-butyldimethylsilyl)oxy]-2-hydroxybutanoate ***(4.4)***[35]

Crude **4.3** (5.5 g, 41.2 mmol), was dissolved in dry CH_2Cl_2 (25 mL), and Et_3N (6.9 mL, 49.4 mmol) and DMAP (503.2 mg, 4.12 mmol) were then added (N_2 atmosphere). The stirred solution was cooled in an ice bath and solid *t*-$BuMe_2SiCl$ (6.8 g, 45.3 mmol) was added in several small portions by momentarily removing the septum used to close the reaction flask. The ice bath was left in place but not recharged, and stirring was continued for 30 h. Water (50 mL) was added and the mixture was extracted with EtOAc (3 × 50 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica

gel (25 × 4.5 cm), using 15:85 EtOAc-hexane, gave **4.4** (5.6 g, 60% over two steps) as an oil: which contained a small impurity (^{1}H NMR signals at δ 0.13 and 0.16 ppm); $[\alpha]_D$ –5.29 (*c* = 1.369, $CHCl_3$); Lit[35] –37.5 (*c* = 0.5, $CHCl_3$); FTIR ($CHCl_3$, cast) 3494, 2955, 1739, 1101 cm^{-1}; ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.05 (s, 6 H), 0.90 (s, 9 H), 1.83–1.90 (m, 1 H), 2.00–2.06 (m, 1 H), 3.77 (s, 3 H), 3.78–3.82 (m, 2 H), 4.35 (dd, *J* = 3.5, 7.0 Hz, 1 H); ^{13}C NMR (CD_3OD, 175 MHz) δ –5.59 (q), 18.2 (s), 25.8 (q), 36.2 (t), 52.3 (q), 59.8 (t), 68.9 (d), 175.3 (s); exact mass (electrospray) *m*/*z* calcd for $C_{11}H_{24}NaO_4Si$ $(M+Na)^+$ 271.1336, found 271.1333.

*Methyl (2S)-2-(benzyloxy)-4-[(tert-butyldimethylsilyl)oxy]butanoate (**4.5**)*[36]

(a) Use of Ag_2O[26]

Freshly-prepared Ag_2O[25] (7.4 g, 32.0 mmol) was tipped into a stirred solution of **4.4** (5.3 g, 21.3 mmol) and BnBr (3.8 mL, 32.0 mmol) in CH_2Cl_2 (60 mL). Stirring was then continued at 35 °C for 15 h with protection from light. The mixture was filtered through a pad of Celite, using CH_2Cl_2 as a rinse. Evaporation of the filtrate and flash chromatography of the residue over silica gel (20 × 6 cm), using 7:93 EtOAc-hexane, gave **4.5** (2.2 g, 30%) as an oil.

(b)Use of NaH[27]

Bu_4NI (939.5 mg, 2.54 mmol) was tipped into a stirred mixture of NaH (57–63% dispersion in oil, 1.29 g, 30.5 mmol) in dry DMF (30 mL). Dry DMF (15 mL) was injected into another flask containing **4.4** (6.3 g, 25.4 mmol), followed by BnBr (3.65 mL, 30.5 mmol). The resulting solution was taken up into a syringe and added at a fast dropwise rate to the stirred mixture in the first flask. Stirring was continued for 6 h. The mixture was quenched with ice-cold water and extracted with CH_2Cl_2 (3 × 60 mL). The combined organic extracts were washed with water and brine, dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (26 × 5.5 cm), using 5:95 EtOAc-hexane, gave **4.5** (6.9 g, 79%) as an oil: $[\alpha]_D$ –48.28 (*c* = 1.110, $CHCl_3$); FTIR ($CHCl_3$, cast) 2954, 1753, 1255, 1099 cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 0.04 (s, 6 H), 0.90 (s, 9 H), 1.90–2.04 (m, 2 H), 3.69–3.81 (m, 2 H), 3.75 (s, 3 H), 4.17 (dd, *J* = 4.4, 8.4 Hz, 1 H), 4.43 (d, *J* = 11.2 Hz, 1 H) , 4.71 (d, *J* = 11.2 Hz, 1 H) , 7.27–7.37 (m, 5 H); ^{13}C NMR (CD_3OD, 125 MHz) δ –5.4 (q), 18.3 (s), 25.9 (q), 36.1 (t), 51.8 (q), 58.6 (t), 72.6 (t), 75.0 (d), 127.8 (d), 128.0 (d), 128.4 (d), 137.6 (s), 173.5 (s); exact mass (electrospray) *m*/*z* calcd for $C_{18}H_{30}NaO_4Si$ $(M+Na)^+$ 361.1806, found 361.1802.

*(2S)-2-(Benzyloxy)-4-[(tert-butyldimethylsilyl)oxy]butanal (**4.6**)*

DIBAL-H (1 M in hexane, 8.12 mL, 8.12 mmol) was added by syringe at a slow dropwise rate to a stirred and cooled (–78 °C) solution of **4.5** (2.3 g, 6.76 mmol) in dry hexane (10 mL). Stirring at –78 °C was continued for 6 h and the mixture was quenched by dropwise

addition of MeOH (5 mL), followed by saturated aqueous Rochelle salt (40 mL). The cold bath was left in place but not recharged, and stirring was continued overnight. The mixture was extracted with EtOAc (3 × 50 mL) and the combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (22.5 × 4 cm), using 7:93 EtOAc-hexane, gave **4.6** (1.90 g, 91%) as an oil: $[\alpha]_D$ –20.64 (*c* = 1.149, $CHCl_3$); FTIR ($CDCl_3$, cast) 2929, 1732, 1255, 1099 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.05 (s, 6 H), 0.90 (s, 9 H), 1.88–1.98 (m, 2 H), 3.71–3.81 (m, 2 H), 3.97–3.99 (m, 1 H), 4.57 (d, *J* = 12.0 Hz, 1 H) , 4.69 (d, *J* = 11.5 Hz, 1 H) , 7.30–7.36 (m, 5 H), 9.69 (br s, 1 H); ^{13}C NMR (CD_3OD, 125 MHz) δ –5.47 (q), 18.2 (s), 25.9 (q), 33.9 (t), 58.1 (t), 72.6 (t), 80.8 (d), 127.9 (d), 128.0 (d), 128.5 (d), 137.5 (s), 203.4 (d); exact mass (electrospray) *m*/*z* calcd for $C_{17}H_{28}NaO_3Si$ $(M+Na)^+$ 331.17, found 331.1709.

*Diethyl {[4-(benzyloxy)-3-methoxyphenyl]methyl}phosphonate (**3.4**)*[23a]

4-(Benzyloxy)-3-methoxybenzaldehyde[37] was reduced ($NaBH_4$)[38] and the resulting alcohol was converted into the corresponding bromide (PBr_3)[38] to afford 1-(benzyloxy)-4-(bromomethyl)-2-methoxybenzene.

$(EtO)_3P$ (24.4 mL, 142.5 mmol) was added dropwise by syringe to a stirred solution of the bromide (8.8 g, 28.5 mmol) in PhH (50 mL) and the mixture was refluxed (oil bath at 100 °C) for 20 h. The mixture was cooled and evaporated. Flash chromatography of the residue over silica gel (11.5 × 5.5 cm), using 1:4 EtOAc-hexane, gave **3.4** (9.9 g, 95%) as an oil: ^1H NMR ($CDCl_3$, 500 MHz) δ 1.24 (t, *J* = 7.0 Hz, 3 H), 3.08 (d, *J* = 21.4 Hz, 2 H), 3.88 (s, 3 H), 3.96–4.04 (m, 4 H), 5.13 (s, 2 H), 6.73–6.76 (m, 1 H), 6.82 (d, *J* = 8.0 Hz, 1 H), 6.88 (t, *J* = 2.0 Hz, 1 H), 7.27–7.43 (m, 5 H).

*{[(3S,4E)-3-Benzyloxy)-5-[4-benzyloxy)-3-methoxyphenyl]pent-4-en-1-yl]oxy}(tert-butyl)dimethylsilane (E-**5.1**) and {[(3S,4Z)-3-Benzyloxy)-5-[4-benzyloxy)-3-methoxyphenyl]-pent-4-en-1-yl]oxy}(tert-butyl)dimethylsilane (Z-**5.1**)*

$(Me_3Si)_2NLi$ (1 M in THF, 5.37 mL, 5.37 mmol) was added dropwise by syringe to a stirred and cooled (–78 °C) solution of the phosphonate **3.4** (1.95 g, 5.37 mmol) in THF (12 mL) and HMPA (3 mL). Stirring at –78 °C was continued for 1 h and a solution of aldehyde **4.6** (1.4 g, 4.41 mmol) in THF (5 mL) was added dropwise. The cold bath was left in pace but not recharged, and stirring was continued for 23 h. The mixture was quenched with saturated aqueous $NaHCO_3$ and extracted with Et_2O (3 × 40 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (21.5 × 4.5 cm), using 1:19 EtOAc-hexane, gave *E*-**5.1** (1.6 g, 70%) and *Z*-**5.1** (140.5 mg, 6%) as colorless oils: *Z*-**5.1** had: $[\alpha]_D$ –30.42 (*c* = 1.208, $CHCl_3$); FTIR ($CDCl_3$, cast) 2928, 1513, 1255, 1089

cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ 0.05 (d, *J* = 1.6 Hz, 6 H), 0.90 (s, 9 H), 1.83–2.00 (m, 2 H), 3.72–3.77 (m, 1 H), 3.83–3.89 (m, 1 H), 3.88 (s, 3 H), 4.26 (d, *J* = 11.6 Hz, 1 H), 4.55 (d, *J* = 11.6 Hz, 1 H), 4.71 (dt, *J* = 4.0, 12.8 Hz, 1 H), 5.19 (s, 2 H), 5.61 (dd, *J* = 9.6, 12.0 Hz, 1 H), 6.61 (d, *J* = 11.6 Hz, 1 H), 6.82–6.84 (m, 3 H), 7.22–7.49 (m, 10 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ –5.4 (q), 18.3 (s), 25.9 (q), 38.6 (t), 56.0 (q), 59.4 (t), 70.2 (t), 71.1 (t), 112.9 (d), 113.8 (d), 121.5 (d), 127.2 (d), 127.3 (d), 127.81 (d), 127.83 (d), 128.2 (d), 128.6 (d), 130.2 (s), 131.6 (d), 132.6 (d), 137.2 (s), 138.7 (s) 147.4 (s), 149.3 (s); exact mass (electrospray) *m*/*z* calcd for $C_{32}H_{42}NaO_4Si$ $(M+Na)^+$ 541.2745, found 541.2745.

E-**5.1** had: $[\alpha]_D$ –33.95 (*c* = 1.121, $CHCl_3$); FTIR ($CDCl_3$, cast) 2928, 1512, 1258, 1091 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ 0.04 (s, 6 H), 0.89 (s, 9 H), 1.79 (sextet, *J* = 6.0 Hz, 1 H), 1.97 (sextet, *J* = 6.0 Hz, 1 H), 3.68–3.78 (m, 2 H), 3.92 (s, 3 H), 4.11 (dd, *J* = 8.0, 13.6 Hz, 1 H), 4.40 (d, *J* = 12.0 Hz, 1 H), 4.62 (d, *J* = 12.0 Hz, 1 H), 5.17 (s, 2 H), 5.99 (dd, *J* = 8.0, 16.0 Hz, 1 H), 6.48 (d, *J* = 16.0 Hz, 1 H), 6.83 (d, *J* = 8.0 Hz, 1 H), 6.87 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.98 (d, *J* = 1.6 Hz, 1 H), 7.28–7.45 (m, 10 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ –5.3 (q), 18.3 (s), 26.0 (q), 39.2 (t), 56.0 (q), 59.4 (t), 70.2 (t), 71.1 (t), 109.4 (d), 114.0 (d), 119.6 (d), 127.2 (d), 127.4 (d), 127.7 (d), 127.8 (d), 128.3 (d), 128.5 (d), 128.6 (s), 130.3 (d), 132.0 (d), 137.1 (s), 138.8 (s) 148.1 (s), 149.8 (s); exact mass (electrospray) *m*/*z* calcd for $C_{32}H_{42}NaO_4Si$ $(M+Na)^+$ 541.2745, found 541.274.

*Preparation of Z,E-**5.1** without separation*

$(Me_3Si)_2NLi$ (1 M in THF, 7.26 mL, 7.26 mmol) was added dropwise by syringe to a stirred and cooled (–78 °C) solution of the phosphonate **3.4** (2.65 g, 7.26 mmol) in THF (15 mL) and HMPA (5 mL). Stirring at –78 °C was continued for 1 h and a solution of aldehyde **4.6** (1.9 g, 6.1 mmol) in THF (5 mL) was added dropwise. The cold bath was left in pace but not recharged, and stirring was continued for 18 h. The mixture was quenched with saturated aqueous $NaHCO_3$ and extracted with Et_2O (3 × 50 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (20 × 4.5 cm), using 7:93 EtOAc-hexane, gave *E*,*Z*-**5.1** (2.3 g, 72%) as a colorless oil.

*(3S,4E)-3-(Benzyloxy)-5-[[4-(benzyloxy)-3-methoxyphenyl)pent-4-en-1-ol (**5.2**)*

Bu_4NF (1 M in THF, 10.6 mL, 10.6 mmol) was added by syringe at a fast dropwise rate to a stirred solution of *E*-**5.1** (1.567 g, 3.02 mmol, containing ca 3% of the *Z* isomer as judged by ^1H NMR) in THF (10 mL). Stirring was continued for 44 h, and the mixture was diluted with water and extracted with CH_2Cl_2 (3 × 40 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (23 × 4 cm), using 1:1 EtOAc-hexane, gave *E*-**5.2** (1.142 g, 93%) and *Z*-**5.2** (78 mg, 6%) as oils. *Z*-**5.2** had: $[\alpha]_D$ –

65.10 (*c* = 2.139, $CHCl_3$); FTIR ($CDCl_3$, cast) 3457, 2926, 1513, 1256, 1139 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 1.85–1.91 (m, 1 H), 1.97–2.04 (m, 1 H), 3.74–3.78 (m, 1 H), 3.82–3.86 (m, 1 H), 3.83 (s, 3 H), 4.23 (d, *J* = 12.0 Hz, 1 H), 4.52 (d, *J* = 11.5 Hz, 1 H), 4.69 (dt, *J* = 4.0, 13.4 Hz, 1 H), 5.18 (s, 2 H), 5.63 (dd, *J* = 9.5, 12.0 Hz, 1 H), 6.65 (d, *J* = 12.0 Hz, 1 H), 6.72 (dd, *J* = 2.0, 8.5 Hz, 1 H), 6.79 (d, *J* = 2.0 Hz, 1 H), 6.85 (d, *J* = 8.5 Hz, 1 H), 7.15–7.45 (m, 10 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 37.5 (t), 56.0 (q), 60.6 (t), 70.2 (t), 71.0 (t), 73.3 (d), 112.6 (d), 113.7 (d), 121.4 (d), 127.2 (d), 127.7 (d), 127.9 (d), 128.0 (d), 128.3 (d), 128.6 (d), 130.0 (s), 131.5 (d), 132.2 (d), 137.1 (s), 138.1 (s) 147.5 (s), 149.4 (s); exact mass (electrospray) *m*/*z* calcd for $C_{26}H_{28}NaO_4$ $(M+Na)^+$ 427.188, found 427.188.

E-**5.2** had: $[\alpha]_D$ –54.53.10 (*c* = 1.136, $CHCl_3$); FTIR ($CDCl_3$, cast) 3443, 2935, 1512, 1265, 1138 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 1.85–1.91 (m, 1 H), 1.97–2.04 (m, 1 H), 3.76–3.86 (m, 2 H), 3.94 (s, 3 H), 4.19 (dt, *J* = 4.5, 16.4 Hz, 1 H), 4.43 (d, *J* = 11.5 Hz, 1 H), 4.68 (d, *J* = 12.0 Hz, 1 H), 5.18 (s, 2 H), 6.04 (dd, *J* = 8.5, 15.9 Hz, 1 H), 6.52 (d, *J* = 15.9 Hz, 1 H), 6.86 (d, *J* = 8.5 Hz, 1 H), 6.90 (dd, *J* = 1.5, 8.5 Hz, 1 H), 7.00 (d, *J* = 1.5 Hz, 1 H), 7.29–7.46 (m, 10 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 38.3 (t), 56.1 (q), 60.6 (t), 70.3 (t), 71.1 (t), 79.7 (d), 109.5 (d), 114.0 (d), 119.8 (d), 127.3 (d), 127.6 (d), 127.7 (d), 127.8 (d), 127.9 (d), 128.5 (d), 128.6 (d), 129.9 (s), 132.5 (d), 137.0 (s), 138.3 (s), 148.3 (s), 149.8 (s); exact mass (electrospray) *m*/*z* calcd for $C_{26}H_{28}NaO_4$ $(M+Na)^+$ 427.188, found 427.1878.

*(3S,4E)-3-(Benzyloxy)-5-[[4-(benzyloxy)-3-methoxyphenyl)pent-4-enal (E-**5.3**)*

Dess-Martin reagent (1.30 g, 3.07 mmol) was added in portions to a stirred and cooled (0 °C) mixture of *E*-**5.2** (992.7 mg, 2.45 mmol), $NaHCO_3$ (1.44 g, 17.2 mmol)[39] and CH_2Cl_2 (10 mL). The ice bath was left in place and stirring was continued for 3 h, during which time all the ice melted. The mixture was cooled to 0 °C, quenched with saturated aqueous $Na_2S_2O_3$ and extracted with EtOAc (3 × 40 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (23.5 × 4 cm), using 1:2 EtOAc-hexane, gave *E*-**5.3** (943 mg, 95%) as a yellowish oil: $[\alpha]_D$ –51.26 (*c* = 2.233, $CHCl_3$); FTIR ($CDCl_3$, cast) 3031, 2863, 1724, 1512, 1265 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ 2.64 (qd, *J* = 1.6, 4.8, 16.0 Hz, 1 H), 2.85 (qd, *J* = 2.4, 8.0, 16.4 Hz, 1 H), 3.94 (s, 3 H), 4.46 (d, *J* = 12.0 Hz, 1 H), 4.48–4.52 (m, 1 H), 4.67 (d, *J* = 12.0 Hz, 1 H), 5.18 (s, 2 H), 6.03 (dd, *J* = 8.0, 15.6 Hz, 1 H), 6.58 (d, *J* = 16.0 Hz, 1 H), 6.87 (d, *J* = 8.4 Hz, 1 H), 6.90 (dd, *J* = 1.6, 8.4 Hz, 1 H), 6.99 (d, *J* = 1.6 Hz, 1 H), 7.29–7.47 (m, 10 H), 9.81 (t, *J* = 2.0 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 49.6 (t), 56.0 (q), 70.3 (t), 71.0 (t), 75.2 (d), 109.5 (d), 114.0 (d), 119.9 (d), 126.2 (d), 127.2 (d), 127.7 (d), 127.8 (d), 127.9 (d), 128.4 (d), 128.6 (d), 129.5 (s), 133.2 (d), 137.0 (s), 138.0 (s), 148.4 (s), 149.8 (s), 200.7 (d); exact mass (electrospray) *m*/*z* calcd for $C_{26}H_{26}NaO_4$ $(M+Na)^+$ 425.1723, found 425.1725.

*(3S,4E)-3-(Benzyloxy)-5-[[4-(benzyloxy)-3-methoxyphenyl)pent-4-enal and (3S,4Z)-3-(Benzyloxy)-5-[[4-(benzyloxy)-3-methoxyphenyl)pent-4-enal (E,Z-**5.3**)*

Dess-Martin reagent (1.95 g, 4.59 mmol) was added in portions to a stirred and cooled (0 °C) mixture of *E*,*Z*-**5.2** (1.55 g, 3.82 mmol), $NaHCO_3$ (2.25 g, 26.8 mmol)[39] and CH_2Cl_2 (10 mL). The ice bath was left in place and stirring was continued for 4 h, during which time all the ice melted. The mixture was cooled to 0 °C, quenched with saturated aqueous $Na_2S_2O_3$ and extracted with EtOAc (3 × 40 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (22 × 5 cm), using 1:2 EtOAc-hexane, gave *E*,*Z*-**5.3** (1.46 g, 94%) as a yellowish oil.

*1-(Benzyloxy)-4-[(1E,3S)-3-(benzyloxy)undeca-1,5-dien-1-yl]-2-methoxybenzene (1E-**5.4**) from E-**5.3***

$(Me_3Si)_2NLi$ (1 M in THF, 4.69 mL, 4.69 mmol) was added dropwise by syringe to a stirred and cooled (–78 °C) solution of hexyltriphenylphosphonium bromide[40] (2.00 g, 4.69 mmol) in a mixture of THF (40 mL) and HMPA (5 mL). Stirring at –78 °C was continued for 1 h and then a solution of *E*-**5.3** (926.0 mg, 2.30 mmol) in THF (5 mL) was added dropwise by syringe over ca 5 min. The cold bath was left in place but not recharged, and stirring was continued for 22 h. The mixture was quenched by addition of aqueous phosphate buffer [pH 7.2, prepared[41] by mixing aqueous 1 M Na_2HPO_4 (3.42 volumes) and 1 M NaH_2PO_4 (1.58 volumes)] and extracted with Et_2O (3 × 60 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (21.5 × 4.5 cm), using 7:93 EtOAc-hexane, gave **5.4** (827.1 mg, 76%) as a yellowish oil, which appeared to be a single isomer (^{1}H NMR, ^{13}C NMR) of unestablished C5–C6 geometry: $[\alpha]_D$ –57.70 (*c* = 1.003, $CHCl_3$); FTIR ($CDCl_3$, cast) 2926, 1265, 1160 cm^{-1}; ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.88 (t, *J* = 7.0 Hz, 3 H), 1.26–1.38 (m, 6 H), 2.05 (dd, *J* = 6.5, 13.9 Hz, 2 H), 2.38–2.44 (m, 1 H), 2.51–2.56 (m, 1 H), 3.92–3.96 (m, 1 H), 3.93 (s, 3 H), 4.45 (d, *J* = 12.0 Hz, 1 H), 4.66 (d, *J* = 12.0 Hz, 1 H), 5.18 (s, 2 H), 5.43–5.52 (m, 2 H), 6.02 (dd, *J* = 8.0, 15.9 Hz, 1 H), 6.48 (d, *J* = 15.4 Hz, 1 H), 6.85 (d, *J* = 8.5 Hz, 1 H), 6.89 (dd, *J* = 2.0, 8.5 Hz, 1 H), 6.99 (d, *J* = 2.0 Hz, 1 H), 7.27–7.46 (m, 10 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.1 (q), 22.6 (t), 27.5 (t), 29.3 (t), 31.6 (t), 33.9 (t), 56.0 (q), 70.1 (t), 71.1 (t), 80.2 (d), 109.6 (d), 114.1 (d), 119.6 (d), 124.8 (d), 127.2 (d), 127.4 (d), 127.7 (d), 127.9 (d), 128.3 (d), 128.4 (d), 128.6 (d), 130.3 (s), 132.2 (d), 137.1 (s), 138.8 (s), 148.1 (s), 149.8 (s); exact mass (electrospray) *m*/*z* calcd for $C_{32}H_{38}NaO_3$ $(M+Na)^+$ 493.2713, found 493.2716.

*1-(Benzyloxy)-4-[(3S)-3-(benzyloxy)undeca-1,5-dien-1-yl]-2-methoxybenzene (1E,1Z-**5.4**) from E,Z-**5.3***

$(Me_3Si)_2NLi$ (1 M in THF, 7.25 mL, 7.25 mmol) was added dropwise by syringe to a stirred and cooled (–78 °C) solution of hexyltriphenylphosphonium bromide[40] (3.1 g, 7.25 mmol) in a mixture of THF (55 mL) and HMPA (7.5 mL). Stirring at –78 °C was continued for 1.5 h and then a solution of *E,Z*-**5.3** (1.43 g, 3.55 mmol) in THF (5 mL) was added dropwise by syringe over ca 10 min. The cold bath was left in place but not recharged, and stirring was continued for 15 h. The mixture was quenched by addition of aqueous phosphate buffer [pH 7.2, prepared[41] by mixing aqueous 1 M Na_2HPO_4 (3.42 volumes) and 1 M NaH_2PO_4 (1.58 volumes)] and extracted with Et_2O (3 × 50 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (22 × 4.5 cm), using 5:95 EtOAc-hexane, gave 1*E*-**5.4** as a single isomer and 1*E*,1*Z*-**5.4** (1.5 g in total, 88%) as yellowish oils.

*1-(Benzyloxy)-4-[(3S)-3-(benzyloxy)undecyl]-2-methoxybenzene (**5.5**)*

5% Rh/Al_2O_3 (28.4 mg) was added to a solution of 1*E*-**5.4** (single compound of unestablished C5–C6 geometry, 567.8 mg, 1.21 mmol) in EtOH (4 mL) and the diene was hydrogenated at room temperature (H_2-filled balloon) for 3 h. The mixture was filtered through a pad of Celite, using CH_2Cl_2 as a rinse. Evaporation of the filtrate and flash chromatography of the residue over silica gel (22.5 × 2 cm), using 1:19 EtOAc-hexane, gave **5.5** (551.3 mg, 96%) as an oil: $[\alpha]_D$ 9.14 (*c* = 1.996, $CHCl_3$); FTIR ($CDCl_3$, cast) 2927, 1513, 1263, 1027 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.90 (t, *J* = 7.0 Hz, 3 H), 1.28–1.42 (m, 12 H), 1.51–1.66 (m, 2 H), 1.77–1.90 (m, 2 H), 2.56–2.62 (m, 1 H), 2.68–2.74 (m, 1 H), 3.42 (quint, *J* = 6.0 Hz, 1 H), 3.87 (s, 3 H), 4.49 (d, *J* = 11.5 Hz, 1 H), 4.55 (d, *J* = 12.0 Hz, 1 H), 5.13 (s, 2 H), 6.65 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.73 (d, *J* = 2.0 Hz, 1 H), 6.81 (d, *J* = 8.0 Hz, 1 H), 7.27–7.46 (m, 10 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.1 (q), 22.7 (t), 25.3 (t), 29.3 (t), 29.6 (t), 29.8 (t), 31.4 (t), 31.9 (t), 33.8 (t), 35.9 (t), 56.0 (q), 70.8 (t), 71.3 (t), 78.4 (d), 112.4 (d), 114.3 (d), 120.2 (d), 127.3 (d), 127.4 (d), 127.7 (d), 127.8 (d), 128.3 (d), 128.5 (d), 135.9 (s), 137.5 (s), 139.1 (s), 146.3 (s), 149.6 (s); exact mass (electrospray) *m*/*z* calcd for $C_{32}H_{42}NaO_3$ $(M+Na)^+$ 497.3026, found 497.3026.

*4-[(3S)-3-Hydroxyundecyl]-2-methoxyphenol [(S)-**3**]*

10% Pd/C (7.2 mg) was added to a solution of **5.5** (144.1 mg, 0.30 mmol) in EtOH (3 mL) and the compound was hydrogenated at room temperature (H_2-filled balloon) for 2.5 h. The mixture was filtered through a pad of Celite, using CH_2Cl_2 as a rinse. Evaporation of the filtrate and flash chromatography of the residue over silica gel (17 × 2 cm), using EtOAc, gave (*S*)-**3** (86.2 mg, 96%) as a white solid: mp 53–55 °C; $[\alpha]_D$ 8.35 (*c* = 1.233, $CHCl_3$); FTIR ($CDCl_3$,

cast) 3338, 3245, 1516, 1153 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ 0.89 (t, *J* = 6.8 Hz, 3 H), 1.28–1.51 (m, 14 H), 1.66–1.81 (m, 2 H), 2.57–2.64 (m, 1 H), 2.69–2.76 (m, 1 H), 3.60–3.66 (m, 1 H), 3.86 (s, 3 H), 6.68–6.71 (m, 2 H), 6.83 (d, *J* = 8.0 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.1 (q), 22.6 (t), 25.6 (t), 29.2 (t), 29.6 (t), 29.7 (t), 31.8 (t), 31.9 (t), 37.6 (t), 39.4 (t), 55.9 (q), 71.4 (d), 111.0 (d), 114.2 (d), 120.9 (d), 134.1 (s), 143.7 (s), 146.4 (s); exact mass (EI) *m*/*z* calcd for $C_{18}H_{30}O_3$ $(M)^+$ 294.2195, found 294.2191.

Chiral HPLC (CHIRALCEL OD column, 250 × 4.6 mm, 15:85 *i*-PrOH:hexane, 0.5 mL/min, wavelength 230 and 280 nm, 20 °C) showed the compound to have an ee of 90%.

*Preparation of (±)-3 for establishing enantiomeric purity of [(S)-**3**]*

*(±)-1-[4-(Benzyloxy)-3-methoxyphenyl]undecan-3-ol [(±)-**3**]*

(a) (3S)-1-[4-(Benzyloxy)-3-methoxyphenyl]undecan-3-ol

K_2CO_3 (218.8 mg, 1.59 mmol) was added to a stirred solution of (*S*)-**3** (155.4 mg, 0.53 mmol) in dry acetone (6 mL) and then BnBr (0.13 mL, 1.06 mmol) was added. The stirred mixture was heated at 60 °C for 10 h. The solvent was evaporated and water (20 mL) was added to the residue. The mixture was extracted with EtOAc (3 × 20 mL) and the combined organic extracts were washed with brine, dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (21.5 × 2 cm), using 1:4 EtOAc-hexane, gave (3*S*)-1-[4-(benzyloxy)-3-methoxyphenyl]undecan-3-ol (194.4 mg, 95%) as a white solid: mp 53–54 °C; $[\alpha]_D$ 6.78 (*c* = 1.15, $CHCl_3$); FTIR ($CDCl_3$, cast) 3328, 2924, 1514, 1223 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.88 (t, *J* = 7.0 Hz, 3 H), 1.25–1.49 (m, 14 H), 1.67–1.81 (m, 2 H), 2.58–2.64 (m, 1 H), 2.70–2.76 (m, 1 H), 3.60–3.65 (m, 1 H), 3.88 (s, 3 H), 5.12 (s, 2 H), 6.67 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.76 (d, *J* = 2.0 Hz, 1 H), 6.81 (d, *J* = 8.5 Hz, 1 H), 7.28–7.45 (m, 5 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.1 (q), 22.6 (t), 25.6 (t), 29.2 (t), 29.6 (t), 29.7 (t), 31.7 (t), 31.9 (t), 37.6 (t), 39.2 (t), 56.0 (q), 71.2 (t), 71.4 (d), 112.4 (d), 114.4 (d), 120.2 (d), 127.3 (d), 127.7 (d), 128.5 (d), 135.6 (s), 137.4 (s), 146.4 (s), 149.6 (s); exact mass (electrospray) *m*/*z* calcd for $C_{25}H_{36}NaO_3$ $(M+Na)^+$ 407.2557, found 407.2552.

(b) 1-[4-(Benzyloxy)-3-methoxyphenyl]undecan-3-one

$NaHCO_3$ (105.9 mg, 1.26 mmol) and Dess-Martin periodinane (213.9 mg, 0.50 mmol) were added sequentially to a stirred and cooled (0 °C) solution of (3*S*)-1-[4-(benzyloxy)-3-methoxyphenyl]undecan-3-ol (161.5 mg, 0.42 mmol) in dry CH_2Cl_2 (3 mL). Stirring at 0 °C was continued for 3.5 h. The reaction mixture was quenched by addition of saturated aqueous $Na_2S_2O_3$ (4 mL) and the mixture was extracted with CH_2Cl_2 (3 × 20 mL). The combined organic extracts were washed with brine, dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (24 × 2 cm), using 1:4 EtOAc-hexane, gave 1-[4-(benzyloxy)-3-

methoxyphenyl]undecan-3-one (125.6 mg 78%) as a white solid: mp 70–72 °C; FTIR ($CDCl_3$, cast) 2920, 1701, 1512, 1136 cm^{-1}; ^1H NMR ($CDCl_3$, 700 MHz) δ 0.88 (t, *J* = 7.0 Hz, 3 H), 1.24–1.30 (m, 10 H), 1.55 (quint, *J* = 7.0 Hz, 2 H), 2.37 (t, *J* = 7.0 Hz, 2 H), 2.69 (t, *J* = 7.0 Hz, 2 H), 2.83 (t, *J* = 7.0 Hz, 2 H), 3.87 (s, 3 H), 5.12 (s, 2 H), 6.64 (dd, *J* = 2.1, 7.7 Hz, 1 H), 6.73 (d, *J* = 2.1 Hz, 1 H), 6.79 (d, *J* = 7.7 Hz, 1 H), 7.28–7.43 (m, 5 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.1 (q), 22.6 (t), 23.8 (t), 29.1 (t), 29.2 (t), 29.3 (t), 29.4 (t), 31.8 (t), 43.1 (t), 44.4 (t), 56.0 (q), 71.2 (t), 112.3 (d), 114.3 (d), 120.1 (d), 127.2 (d), 127.7 (d), 128.5 (d), 134.5 (s), 137.4 (s), 146.5 (s), 149.6 (s), 210.5 (s); exact mass (electrospray) *m*/*z* calcd for $C_{25}H_{34}NaO_3$ $(M+Na)^+$ 405.24, found 405.2401.

(c) (±)-1-[4-(Benzyloxy)-3-methoxyphenyl]undecan-3-ol

$NaBH_4$ (10.4 mg, 0.27 mmol) was added in portions to a stirred solution of 1-[4-(benzyloxy)-3-methoxyphenyl]undecan-3-one (105 mg, 0.27 mmol) in dry MeOH (4 mL). Stirring was continued for 2 h, ice water (10 mL) was added and the mixture was extracted with EtOAc (3 × 20 mL). The combined organic extracts were washed with brine, dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (20 × 2 cm), using 7:93 EtOAc-hexane, gave (±)-1-[4-(benzyloxy)-3-methoxyphenyl]undecan-3-ol (101.3 mg 96%) as a white solid: mp 59–62 °C; FTIR ($CDCl_3$, cast) 3226, 2918, 1515, 1255 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.90 (t, *J* = 7.0 Hz, 3 H), 1.25–1.58 (m, 14 H), 1.67–1.81 (m, 2 H), 2.58–2.64 (m, 1 H), 2.71–2.77 (m, 1 H), 3.60–3.65 (m, 1 H), 3.88 (s, 3 H), 5.13 (s, 2 H), 6.68 (dd, *J* = 1.5, 8.0 Hz, 1 H), 6.77 (d, *J* = 1.5 Hz, 1 H), 6.81 (d, *J* = 8.0 Hz, 1 H), 7.28–7.45 (m, 5 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.1 (q), 22.7 (t), 25.6 (t), 29.3 (t), 29.6 (t), 29.7 (t), 31.7 (t), 31.9 (t), 37.6 (t), 39.2 (t), 56.0 (q), 71.3 (t), 71.4 (d), 112.4 (d), 114.4 (d), 120.2 (d), 127.3 (d), 127.7 (d), 128.5 (d), 135.6 (s), 137.5 (s), 146.4 (s), 149.6 (s); exact mass (electrospray) *m*/*z* calcd for $C_{25}H_{36}NaO_3$ $(M+Na)^+$ 407.2557, found 407.2555.

*(d) (±)-4-[(3-Hydroxyundecyl]-2-methoxyphenol [(±)-**3**]*

10% Pd/C (3.5 mg) was added to a solution of (±)-1-[4-(benzyloxy)-3-methoxyphenyl]undecan-3-ol (70.1 mg, 0.18 mmol) in EtOH (3 mL) and the mixture was stirred under H_2 (balloon) for 1.5 h. The mixture was filtered through a short pad of Celite which was rinsed with EtOAc. Evaporation of the filtrate gave (±)-**3** (52.8 mg, 98%) as a white solid that was pure (^1H NMR): 62–63 °C; FTIR ($CDCl_3$, cast) 3390, 2920, 1516, 1154 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.88 (t, *J* = 7.0 Hz, 3 H), 1.25–1.54 (m, 14 H), 1.66–1.80 (m, 2 H), 2.57–2.63 (m, 1 H), 2.70–2.75 (m, 1 H), 3.60–3.65 (m, 1 H), 3.86 (s, 3 H), 6.69 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.71 (d, *J* = 1.5 Hz, 1 H), 6.83 (d, *J* = 8.0 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.1 (q), 22.7 (t), 25.6 (t), 29.3 (t), 29.6 (t), 29.7 (t), 31.8 (t), 31.9 (t), 37.6 (t), 39.3 (t), 55.8 (q), 71.4 (d),

111.0 (d), 114.3 (d), 120.9 (d), 134.1 (s), 143.7 (s), 146.4 (s); exact mass (electrospray) *m*/*z* calcd for $C_{18}H_{29}O_3$ $(M–H)^-$ 293.2122, found 293.2122.

*Synthesis of (**2**)*

*1-(Benzyloxy)-4-[(1E,3S)-3-(benzyloxy)deca-1,5-dien-1-yl]-2-methoxybenzene (1E-**6.1**) and 1-(Benzyloxy)-4-[(1E,1Z,3S)-3-(benzyloxy)deca-1,5-dien-1-yl]-2-methoxybenzene (1E,1Z-**6.1**)*

$(Me_3Si)_2NLi$ (1 M in THF, 14.9 mL, 14.9 mmol) was added dropwise by syringe to a stirred and cooled (–78 °C) solution of pentyltriphenylphosphonium bromide[42] (6.16 g, 14.9 mmol) in a mixture of THF (70 mL) and HMPA (10 mL). Stirring at –78 °C was continued for 1.5 h and then a solution of *Z*,*E*-**5.3** (3.0 g, 7.5 mmol) in THF (5 mL) was added dropwise by syringe over ca 10 min. The cold bath was left in place but not recharged, and stirring was continued for 22 h. The mixture was quenched by addition of aqueous phosphate buffer [pH 7.2, prepared[41] by mixing aqueous 1 M Na_2HPO_4 (3.42 volumes) and 1 M NaH_2PO_4 (1.58 volumes)] and extracted with Et_2O (3 × 80 mL). The combined organic extracts were dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (27 × 5.5 cm), using 5:95 EtOAc-hexane, gave 1*Z*,1*E*-**6.1** (1.5 g, 44%) and 1*E*-**6.1** (178.2 mg, 5%), both as yellowish oils. The 1*Z*,1*E* mixture (mainly *E*) had: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.90 (t, *J* = 7.0 Hz, 3 H), 1.31–1.37 (m, 4 H), 2.08 (dd, *J* = 6.5, 13.4 Hz, 2 H), 2.41–2.46 (m, 1 H), 2.53–2.60 (m, 1 H), 3.94–3.98 (m, 1 H), 3.94 (s, 3 H), 4.47 (d, *J* = 12.0 Hz, 1 H), 4.68 (d, *J* = 12.5 Hz, 1 H), 5.19 (s, 2 H), 5.45–5.54 (m, 2 H), 6.04 (dd, *J* = 8.0, 15.4 Hz, 1 H), 6.50 (d, *J* = 15.9 Hz, 1 H), 6.87 (d, *J* = 8.5 Hz, 1 H), 6.90 (dd, *J* = 1.5, 8.5 Hz, 1 H), 7.01 (d, *J* = 1.5 Hz, 1 H), 7.28–7.49 (m, 10 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.0 (q), 22.4 (t), 27.2 (t), 31.8 (t), 33.9 (t), 56.0 (q), 70.1 (t), 71.1 (t), 80.2 (d), 109.5 (d), 114.0 (d), 119.7 (d), 124.9 (d), 127.2 (d), 127.4 (d), 127.7 (d), 127.9 (d), 128.3 (d), 128.4 (d), 128.6 (d), 130.3 (s), 132.1 (d), 132.2 (d), 137.1 (s), 138.8 (s), 148.1 (s), 149.8 (s).

The 1*E* isomer had: $[\alpha]_D$ –39.19 (*c* = 1.043, $CHCl_3$); FTIR ($CDCl_3$, cast) 2928, 1512, 1266, 1138 cm^{-1}; ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.87 (t, *J* = 7.0 Hz, 3 H), 1.26–1.35 (m, 4 H), 2.05 (dd, *J* = 6.5, 13.4 Hz, 2 H), 2.37–2.43 (m, 1 H), 2.50–2.55 (m, 1 H), 3.91–3.95 (m, 1 H), 3.92 (s, 3 H), 4.44 (d, *J* = 12.0 Hz, 1 H), 4.65 (d, *J* = 12.5 Hz, 1 H), 5.18 (s, 2 H), 5.42–5.51 (m, 2 H), 6.01 (dd, *J* = 8.0, 15.9 Hz, 1 H), 6.47 (d, *J* = 15.9 Hz, 1 H), 6.84 (d, *J* = 8.5 Hz, 1 H), 6.88 (dd, *J* = 2.0, 8.5 Hz, 1 H), 6.98 (d, *J* = 2.0 Hz, 1 H), 7.28–7.45 (m, 10 H); ^{13}C NMR ($CDCl_3$, 175 MHz) δ 14.0 (q), 22.4 (t), 27.2 (t), 31.7 (t), 33.9 (t), 56.0 (q), 70.1 (t), 71.0 (t), 80.1 (d), 109.5 (d), 114.0 (d), 119.6 (d), 124.8 (d), 127.2 (d), 127.4 (d), 127.6 (d), 127.8 (d), 128.30 (d), 128.34 (d), 128.5 (d), 130.2 (s), 132.1 (d), 132.2 (d), 137.1 (s), 138.8 (s), 148.0 (s), 149.8 (s); exact mass (electrospray) *m*/*z* calcd for $C_{31}H_{36}NaO_3$ $(M+Na)^+$ 479.2557, found 479.2558.

For both fractions the C5–C6 double bond geometry was not determined.

*1-(Benzyloxy)-4-[(3S)-3-(benzyloxy)decyl]-2-methoxybenzene (**6.2**)*

5% Rh/Al_2O_3 (32.5 mg) was added to a solution of 1*E*,1*Z*-**6.1** (unestablished C5–C6 geometry, 650.7 mg, 1.43 mmol) in EtOH (10 mL) and the diene was hydrogenated at room temperature (H_2-filled balloon) for 4 h. The mixture was filtered through a pad of Celite, using CH_2Cl_2 as a rinse. Evaporation of the filtrate and flash chromatography of the residue over silica gel (26.0 × 4 cm), using 1:19 EtOAc-hexane, gave **6.2** (407.2 mg, 62%) as an oil: $[\alpha]_D$ 6.53 (*c* = 1.041, $CHCl_3$); FTIR ($CDCl_3$, cast) 2928, 1513, 1262, 1027 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.92 (t, *J* = 7.0 Hz, 3 H), 1.26–1.53 (m, 10 H), 1.54–1.68 (m, 2 H), 1.79–1.92 (m, 2 H), 2.59–2.65 (m, 1 H), 2.71–2.77 (m, 1 H), 3.44 (quint, *J* = 5.5 Hz, 1 H), 3.88 (s, 3 H), 4.51 (d, *J* = 12.0 Hz, 1 H), 4.57 (d, *J* = 11.5 Hz, 1 H), 5.15 (s, 2 H), 6.67 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.76 (d, *J* = 2.0 Hz, 1 H), 6.83 (d, *J* = 8.0 Hz, 1 H), 7.28–7.48 (m, 10 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 14.2 (q), 22.7 (t), 25.3 (t), 29.3 (t), 29.9 (t), 31.4 (t), 31.9 (t), 33.8 (t), 36.0 (t), 56.0 (q), 70.9 (t), 71.3 (t), 78.5 (d), 112.5 (d), 114.4 (d), 120.2 (d), 127.3 (d), 127.5 (d), 127.75 (d), 127.79 (d), 128.4 (d), 128.5 (d), 136.0 (s), 137.5 (s), 139.1 (s), 146.3 (s), 149.7 (s); exact mass (electrospray) *m*/*z* calcd for $C_{31}H_{40}NaO_3$ $(M+Na)^+$ 483.287, found 483.2873.

Larger scale experiment

5% Rh/Al_2O_3 (65.0 mg) was added to a solution of 1*E*,1*Z*-**6.1** (unestablished C5–C6 geometry, 1.07 g, 2.35 mmol) in EtOH (10 mL) and the diene was hydrogenated at room temperature (H_2-filled balloon) for 4 h. The mixture was filtered through a pad of Celite, using CH_2Cl_2 as a rinse. Evaporation of the filtrate and flash chromatography of the residue over silica gel (25.5 × 4 cm), using 1:19 EtOAc-hexane, gave **6.2** (684 mg, 63%) as an oil.

*4-[(3S)-3-Hydroxydecyl]-2-methoxyphenol [(S)-**2**]*

10% Pd/C (20.1 mg) was added to a solution of **6.2** (402.5 mg, 0.87 mmol) in EtOH (10 mL) and the compound was hydrogenated at room temperature (H_2-filled balloon) for 2 h. The mixture was filtered through a pad of Celite, using CH_2Cl_2 as a rinse. Evaporation of the filtrate and flash chromatography of the residue over silica gel (22.5 × 2 cm), using first 1:4 EtOAc-hexane and then 1:1 EtOAc-hexane, gave (*S*)-**2** (211.4 mg, 86%) as a white solid: mp 48–49 °C; $[\alpha]_D$ 6.31 (*c* = 1.049, $CHCl_3$); FTIR ($CDCl_3$, cast) 3423, 2928, 1515, 1270 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.89 (t, *J* = 7.0 Hz, 3 H), 1.28–1.34 (m, 10 H), 1.41–1.51 (m, 2 H), 1.67–1.80 (m, 2 H), 1.82 (br s, OH), 2.57–2.63 (m, 1 H), 2.70–2.76 (m, 1 H), 3.60–3.65 (m, 1 H), 3.84 (s, 3 H), 5.81 (s, OH), 6.69 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.71 (d, *J* = 2.0 Hz, 1 H), 6.83 (d, *J* = 8.0 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 14.1 (q), 22.7 (t), 25.7 (t), 29.3 (t), 29.7 (t), 31.78 (t),

31.85 (t), 37.6 (t), 39.4 (t), 55.9 (q), 71.5 (d), 111.2 (d), 114.4 (d), 120.9 (d), 134.2 (s), 143.7 (s), 146.6 (s); exact mass (EI) *m*/*z* calcd for $C_{17}H_{28}NaO_3$ $(M+Na)^+$ 303.1931, found 301.1931.

Larger scale experiment

10% Pd/C (34.2 mg) was added to a solution of **6.2** (684 mg, 1.49 mmol) in EtOH (10 mL) and the compound was hydrogenated at room temperature (H_2-filled balloon) for 17 h. The mixture was filtered through a pad of Celite, using CH_2Cl_2 as a rinse. Evaporation of the filtrate and flash chromatography of the residue over silica gel (25 × 3 cm), using first 1:4 EtOAc-hexane and then 1:1 EtOAc-hexane, gave (*S*)-**2** (354 mg, 85%) as a white solid.

Chiral HPLC (CHIRALCEL OD column, 250 × 4.6 mm, 15:85 *i*-PrOH:hexane, 0.5 mL/min, wavelength 230 and 280 nm, 20 °C) showed the compound to have an ee of 68%.

The material isolated from natural sources had: $[\alpha]_D$ –0.46 (*c* = 0.29, $CHCl_3$). Chiral HPLC (CHIRALCEL OD column, 250 × 4.6 mm, 15:85 *i*-PrOH:hexane, 0.5 mL/min, wavelength 230 and 280 nm, 20 °C) showed the compound to be a 1:1.7 *R*:*S* mixture.

*Preparation of (±)-**2** for establishing enantiomeric purity of [(S)-**2**]*

(a) (3S)-1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-ol

K_2CO_3 (284.0 mg, 2.06 mmol) was added to a stirred solution of (*S*)-**2** (192.1 mg, 0.69 mmol) in dry acetone (10 mL) and BnBr (0.16 mL, 1.37 mmol) was added. The stirred mixture was then heated at 60 °C for 12 h. The solvent was evaporated, water (20 mL) was added to the residue and the mixture was extracted with EtOAc (3 × 30 mL). The combined organic extracts were washed with brine, dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (21 × 2 cm), using 1:4 EtOAc-hexane, gave (3*S*)-1-[4-(benzyloxy)-3-methoxyphenyl]decan-3-ol (247.0 mg, 97%) as a white solid: mp 63–65 °C; $[\alpha]_D$ 5.20 (*c* = 1.085, $CHCl_3$); FTIR ($CDCl_3$, cast) 3334, 2925, 1514, 1260 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.90 (t, *J* = 7.0 Hz, 3 H), 1.29–1.34 (m, 10 H), 1.43–1.51 (m, 2 H), 1.67–1.81 (m, 2 H), 2.58–2.65 (m, 1 H), 2.71–2.77 (m, 1 H), 3.60–3.65 (m, 1 H), 3.88 (s, 3 H), 5.13 (s, 2 H), 6.68 (dd, *J* = 1.5, 8.0 Hz, 1 H), 6.77 (d, *J* = 1.5 Hz, 1 H), 6.81 (d, *J* = 8.0 Hz, 1 H), 7.28–7.45 (m, 5 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 14.1 (q), 22.7 (t), 25.7 (t), 29.3 (t), 29.7 (t), 31.75 (t), 31.84 (t), 37.7 (t), 39.2 (t), 56.0 (q), 71.3 (t), 71.4 (d), 112.5 (d), 114.4 (d), 120.2 (d), 127.3 (d), 127.7 (d), 128.5 (d), 135.6 (s), 137.5 (s), 146.4 (s), 149.7 (s); exact mass (electrospray) *m*/*z* calcd for $C_{24}H_{34}NaO_3$ $(M+Na)^+$ 393.24, found 393.2395.

(b) 1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-one[43]

$NaHCO_3$ (153.2 mg, 1.82 mmol) and Dess-Martin periodinane (309.5 mg, 0.73 mmol) were added sequentially to a stirred and cooled (0 °C) solution of (3*S*)-1-[4-(benzyloxy)-3-

methoxyphenyl]decan-3-ol (225.0 mg, 0.61 mmol) in dry CH_2Cl_2 (4 mL). Stirring at 0 °C was continued for 14 h. The reaction was quenched by addition of saturated aqueous $Na_2S_2O_3$ (4 mL) and the mixture was extracted with CH_2Cl_2 (3 × 30 mL). The combined organic extracts were washed with brine, dried (Na_2SO_4) and evaporated. Flash chromatography of the residue over silica gel (22.5 × 2 cm), using 1:5 EtOAc-hexane, gave 1-[4-(benzyloxy)-3-methoxyphenyl]decan-3-one (203.1 mg, 90%) as a white solid: mp 53–55 °C; FTIR ($CDCl_3$, cast) 2928, 1712, 1514, 1262 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.89 (t, *J* = 7.5 Hz, 3 H), 1.24–1.32 (m, 8 H), 1.53–1.59 (m, 2 H), 2.37 (t, *J* = 7.5 Hz, 2 H), 2.69 (t, *J* = 7.5 Hz, 2 H), 2.83 (t, *J* = 7.5 Hz, 2 H), 3.87 (s, 3 H), 5.12 (s, 2 H), 6.65 (dd, *J* = 1.5, 8.5 Hz, 1 H), 6.74 (d, *J* = 1.5 Hz, 1 H), 6.80 (d, *J* = 8.5 Hz, 1 H), 7.27–7.44 (m, 5 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 14.1 (q), 22.6 (t), 23.8 (t), 29.1 (t), 29.2 (t), 29.5 (t), 31.7 (t), 43.1 (t), 44.4 (t), 56.0 (q), 71.2 (t), 112.4 (d), 114.4 (d), 120.1 (d), 127.3 (d), 127.8 (d), 128.5 (d), 134.6 (s), 137.4 (s), 146.6 (s), 149.7 (s), 210.4 (s); exact mass (electrospray) *m*/*z* calcd for $C_{24}H_{32}NaO_3$ $(M+Na)^+$ 391.2244, found 391.2240.

(c) (±)-1-[4-(Benzyloxy)-3-methoxyphenyl]decan-3-ol

$NaBH_4$ (20.2 mg, 0.53 mmol) was added in portions to a stirred solution of 1-[4-(benzyloxy)-3-methoxyphenyl]decan-3-one (196.3 mg, 0.53 mmol) in dry MeOH (5 mL). Stirring was continued for 3 h and then ice water (20 mL) was added. The mixture was extracted with EtOAc (3 × 30 mL). The combined organic extracts were washed with brine, dried (Na_2SO_4) and evaporated to give (±)-1-[4-(benzyloxy)-3-methoxyphenyl]decan-3-ol (193.7 mg 97%) as a white solid: mp 65–66 °C; FTIR ($CDCl_3$, cast) 3230, 2920, 1515, 1256 cm^{-1}; ^1H NMR ($CDCl_3$, 500 MHz) δ 0.90 (t, *J* = 7.0 Hz, 3 H), 1.26–1.34 (m, 10 H), 1.42–1.52 (m, 2 H), 1.67–1.81 (m, 2 H), 2.59–2.65 (m, 1 H), 2.71–2.77 (m, 1 H), 3.60–3.65 (m, 1 H), 3.88 (s, 3 H), 5.13 (s, 2 H), 6.68 (dd, *J* = 2.0, 8.0 Hz, 1 H), 6.77 (d, *J* = 2.0 Hz, 1 H), 6.81 (d, *J* = 8.0 Hz, 1 H), 7.28–7.45 (m, 5 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 14.1 (q), 22.7 (t), 25.7 (t), 29.3 (t), 29.7 (t), 31.76 (t), 31.84 (t), 37.7 (t), 39.2 (t), 56.0 (q), 71.3 (t), 71.4 (d), 112.5 (d), 114.4 (d), 120.2 (d), 127.3 (d), 127.7 (d), 128.5 (d), 135.6 (s), 137.5 (s), 146.4 (s), 149.7 (s); exact mass (electrospray) *m*/*z* calcd for $C_{24}H_{34}NaO_3$ $(M+Na)^+$ 393.2400, found 393.2401.

*(d) (±)-4-[(3-Hydroxydecyl]-2-methoxyphenol [(±)-**2**]*[15]

10% Pd/C (9.4 mg) was added to a solution of (±)-1-[4-(benzyloxy)-3-methoxyphenyl]decan-3-ol (190.0 mg, 0.51 mmol) in EtOH (6 mL) and the mixture was stirred under H_2 (balloon) for 1.5 h. The mixture was filtered through a short pad of Celite which was rinsed with EtOAc. Evaporation of the solvent gave (±)-**2** (143.5 mg, 99%) as a white solid that was pure (^1H NMR): 59–60 °C; FTIR ($CDCl_3$, cast) 3400, 2921, 1517, 1154 cm^{-1}; ^1H NMR

($CDCl_3$, 500 MHz) δ 0.89 (t, *J* = 7.0 Hz, 3 H), 1.25–1.34 (m, 10 H), 1.41–1.52 (m, 2 H), 1.54 (br s, OH), 1.67–1.80 (m, 2 H), 2.57–2.63 (m, 1 H), 2.70–2.76 (m, 1 H), 3.60–3.65 (m, 1 H), 3.86 (s, 3 H), 6.69–6.71 (m, 2 H), 6.83 (d, *J* = 8.0 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 14.1 (q), 22.7 (t), 25.6 (t), 29.3 (t), 29.7 (t), 31.79 (t), 31.83 (t), 37.6 (t), 39.4 (t), 55.9 (q), 71.5 (d), 111.1 (d), 114.3 (d), 120.9 (d), 134.2 (s), 143.7 (s), 146.5 (s); exact mass (electrospray) *m*/*z* calcd for $C_{17}H_{27}O_3$ $(M–H)^-$ 279.1966, found 279.1966.

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