

Selective Electrophilic Cyclization of ortho-Carbonylarylacetylenols for the Synthesis of Cyclopenta[a]naphthalenol and 2-phenylnaphthalen-1-ol Analogs

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^aProgram on Chemical Sciences, Chulabhorn Graduate Institute, Center of Excellence on Environmental Health and Toxicology (EHT), OPS, MHESI, 54 Kamphaeng Phet 6, Laksi, Bangkok 10210, Thailand

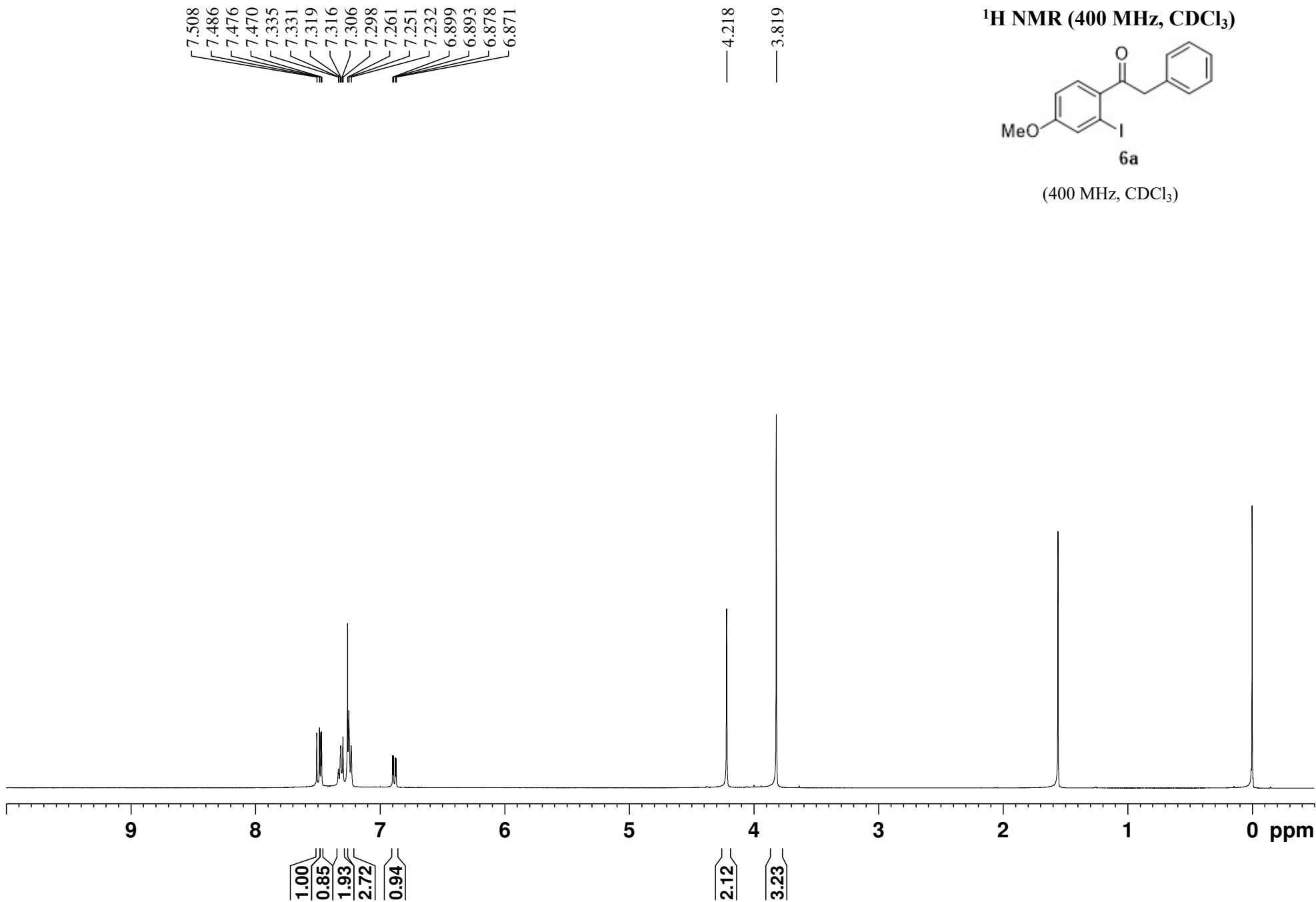
^bLaboratory of Medicinal Chemistry, Chulabhorn Research Institute, 54 Kamphaeng Phet 6, Laksi, Bangkok 10210, Thailand

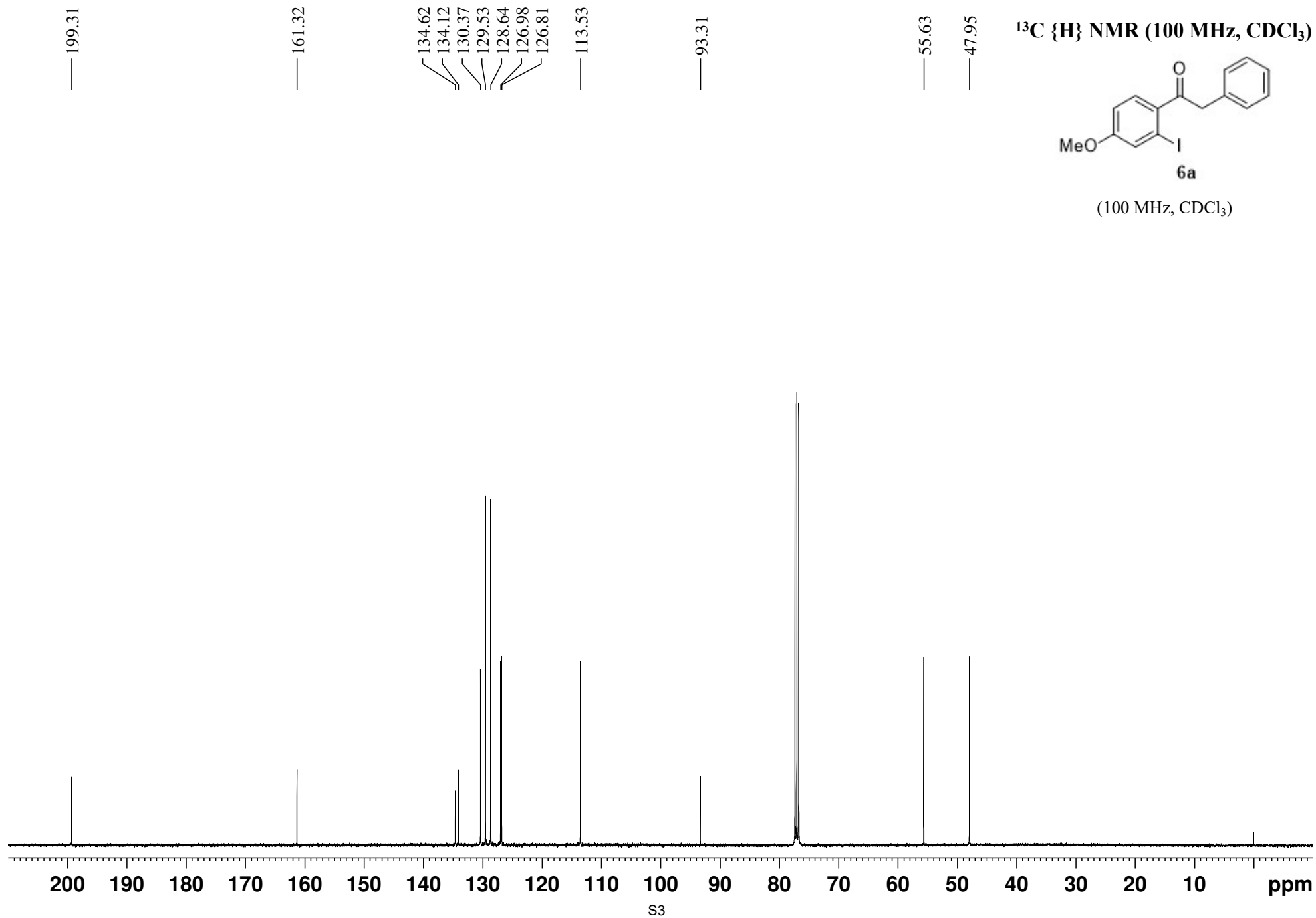
^cThammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand

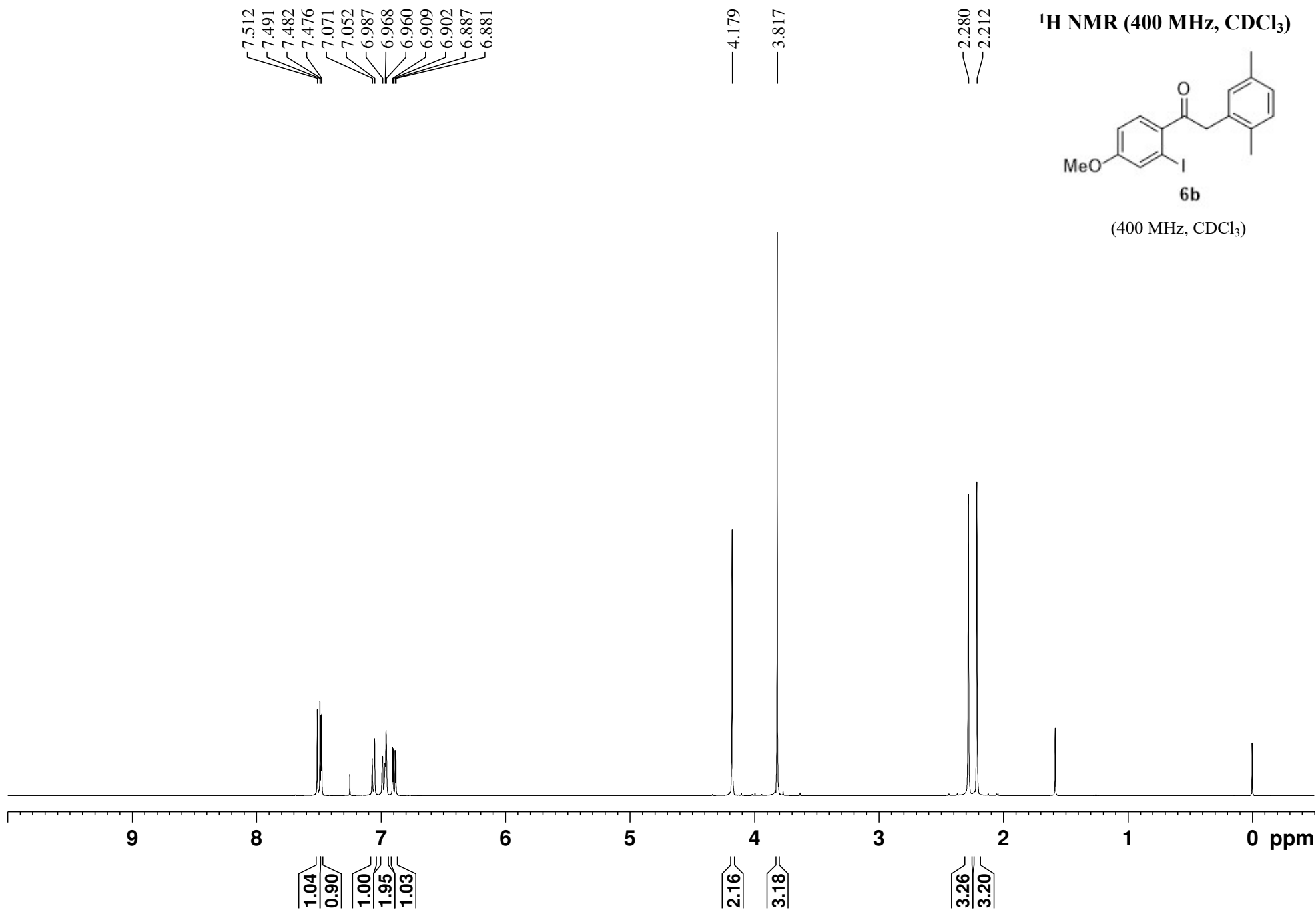
† These authors contributed equally.

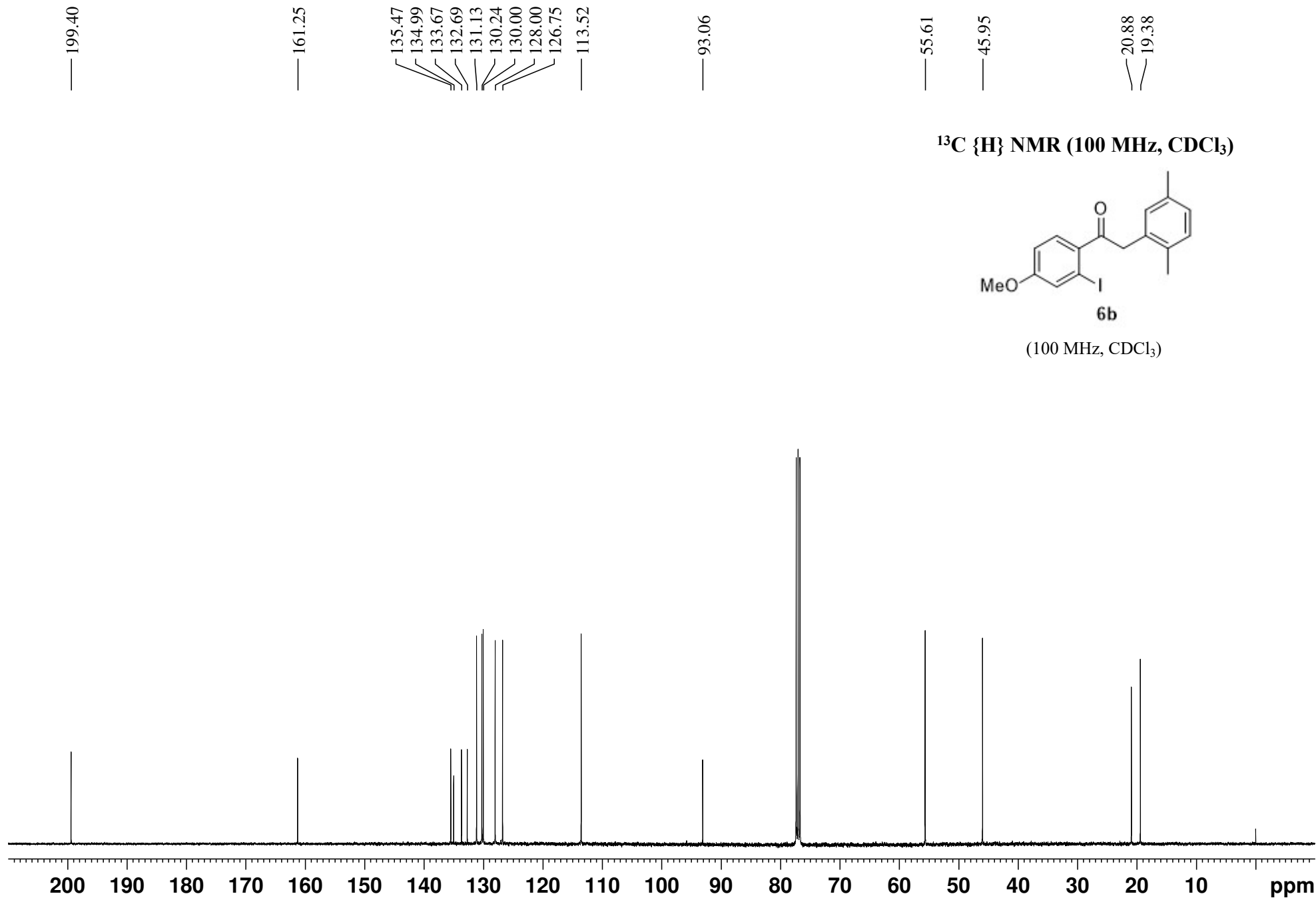
Email: jumreang@cri.or.th

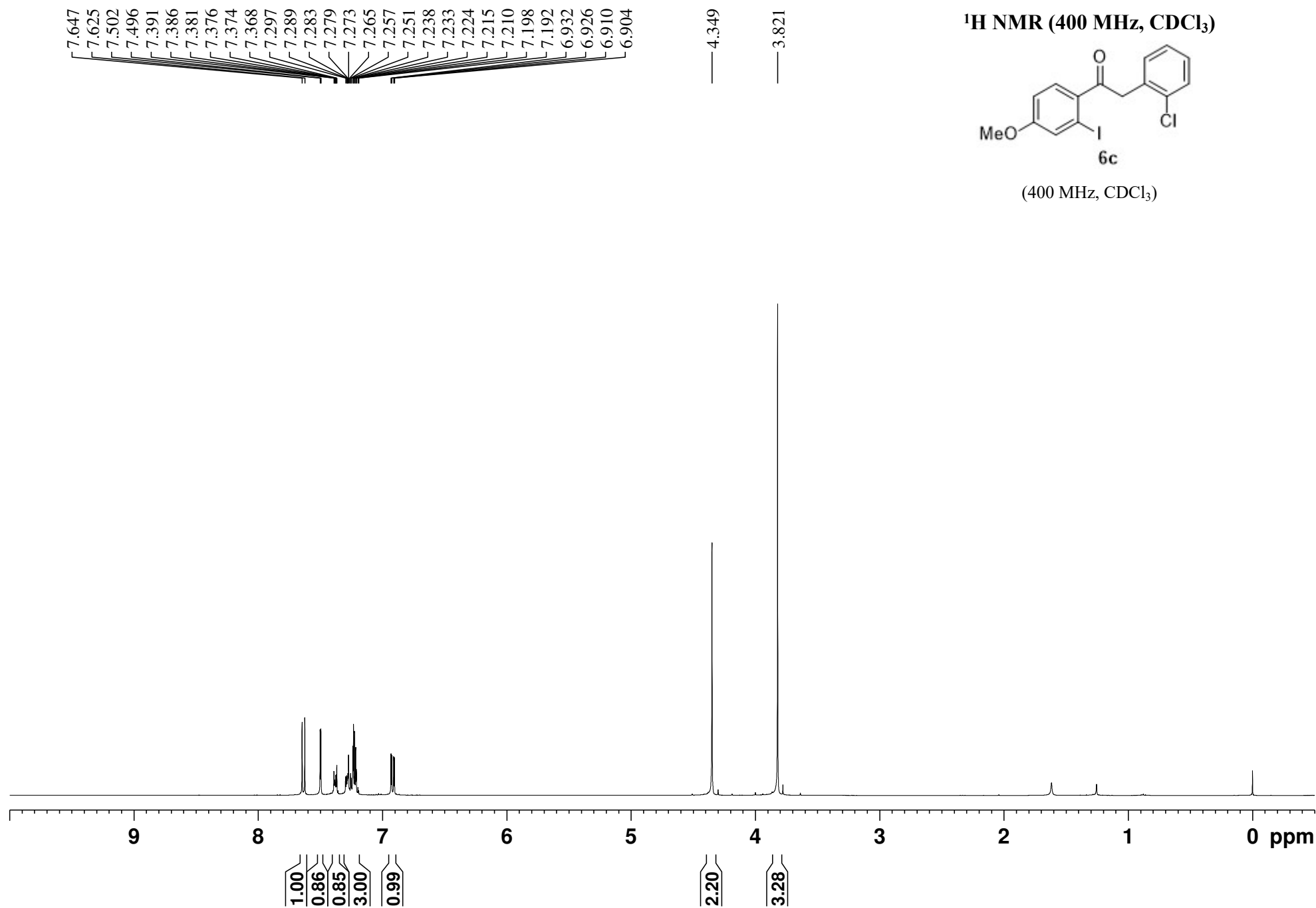
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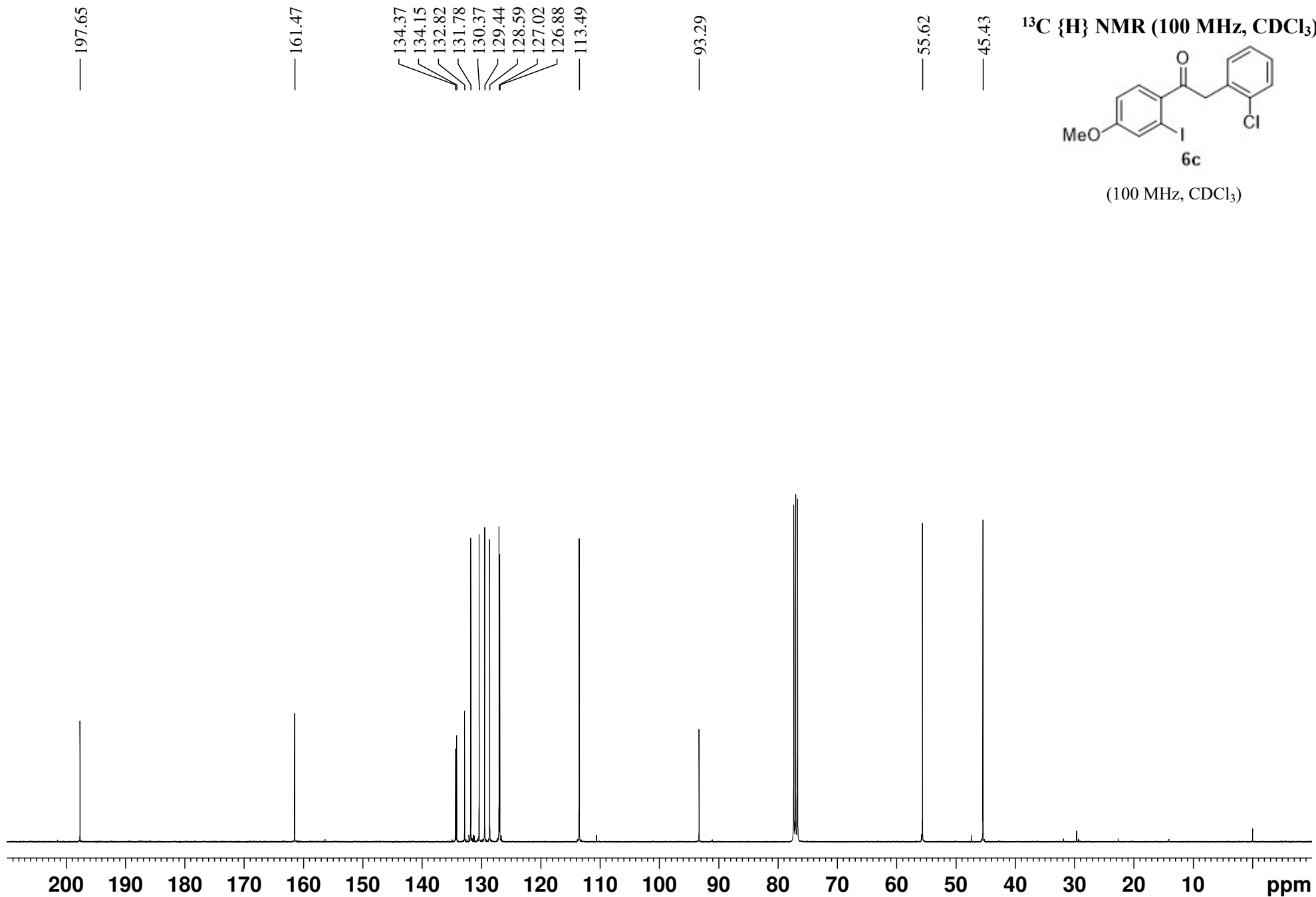


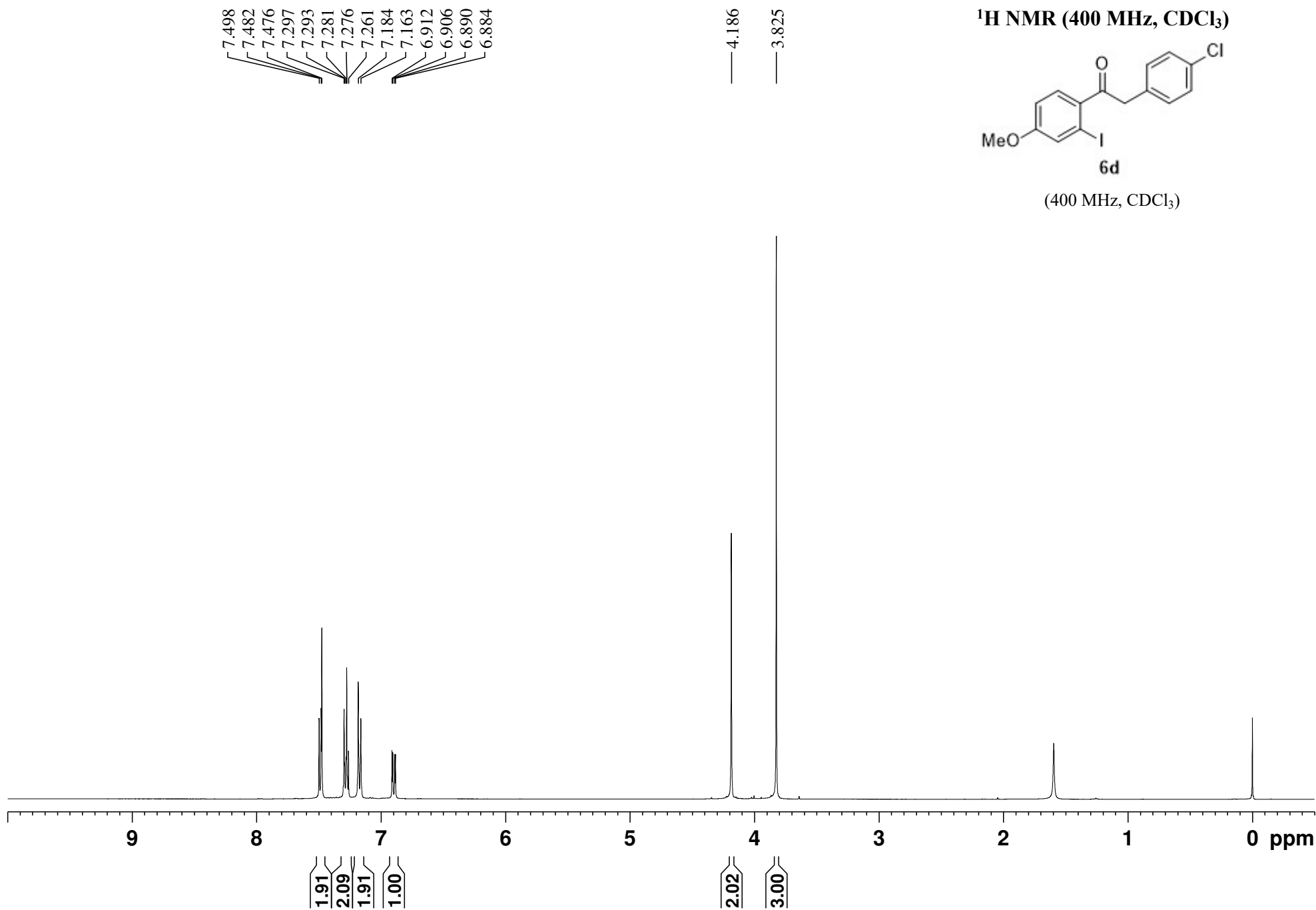


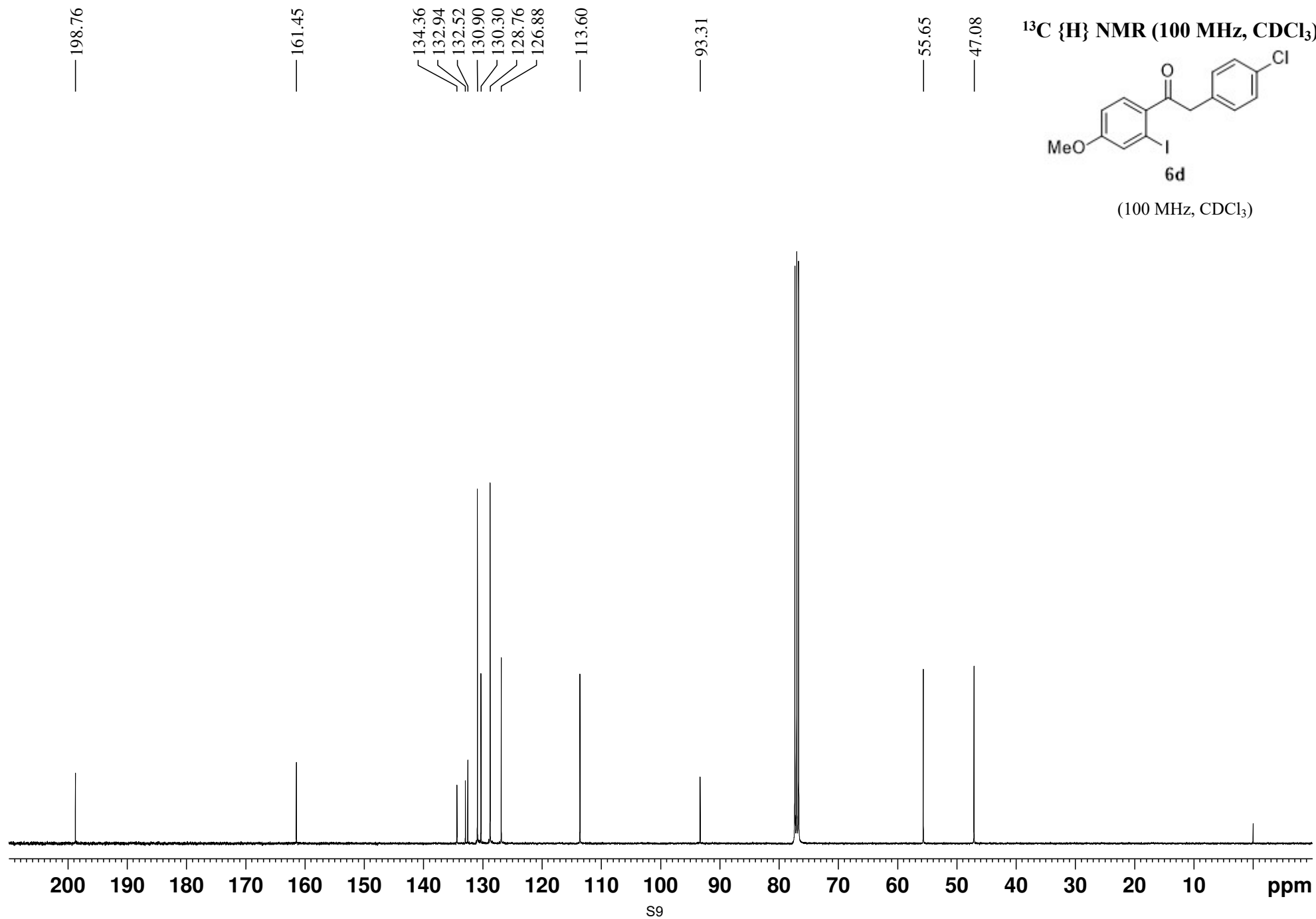


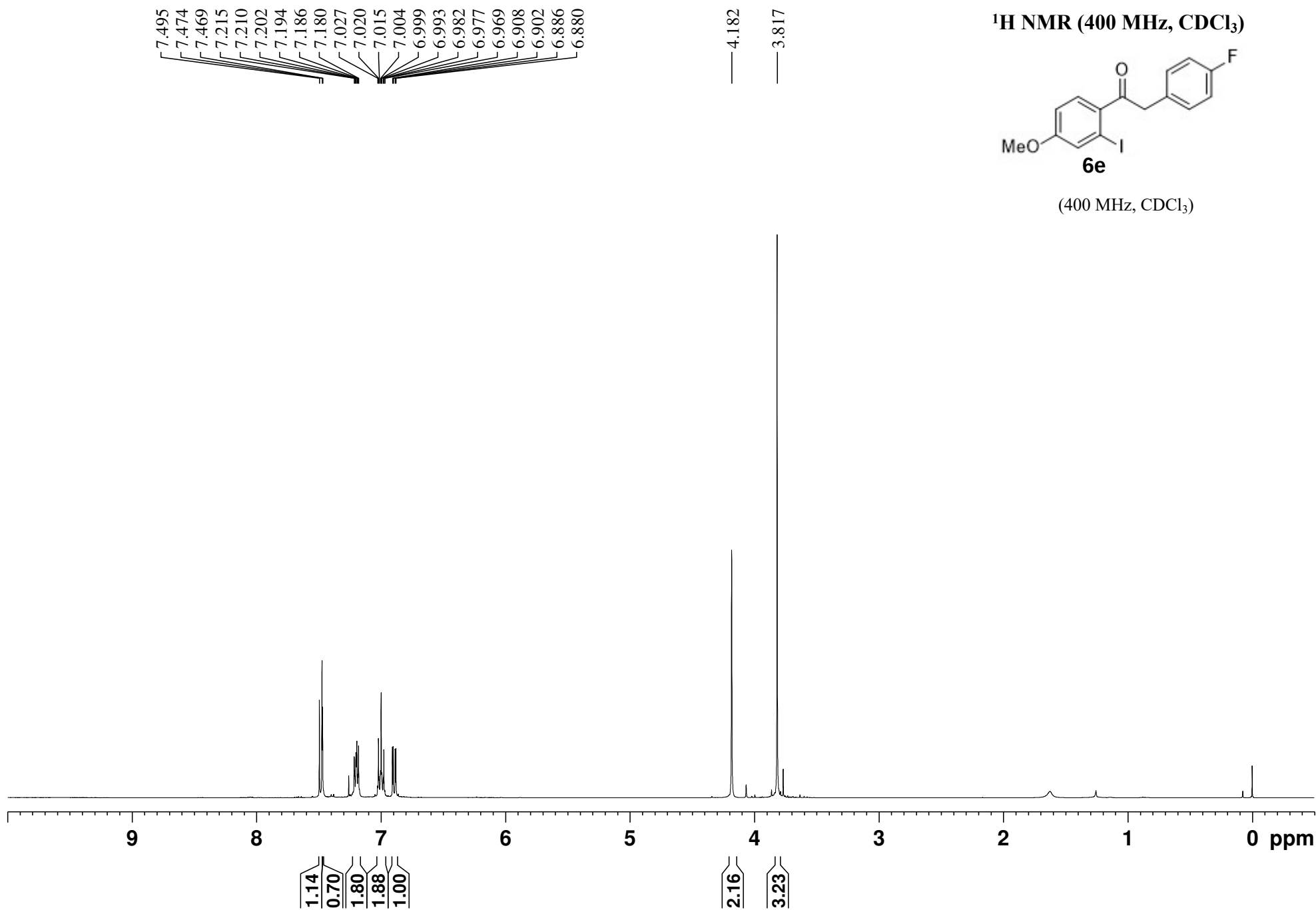


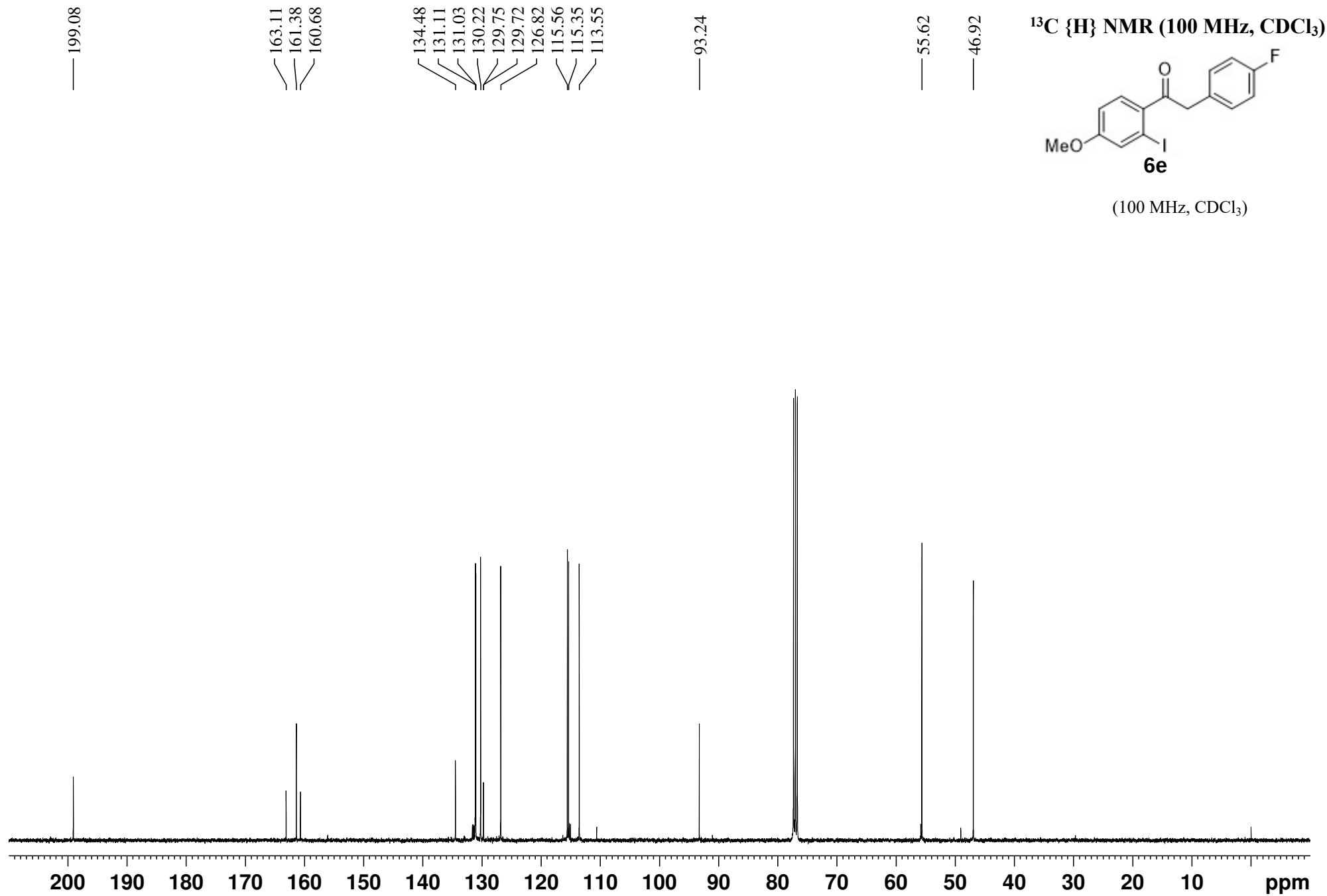




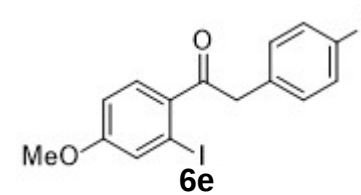






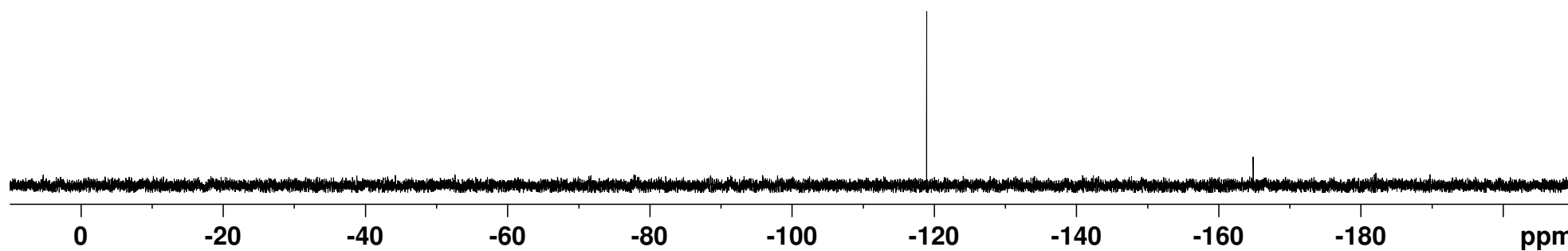


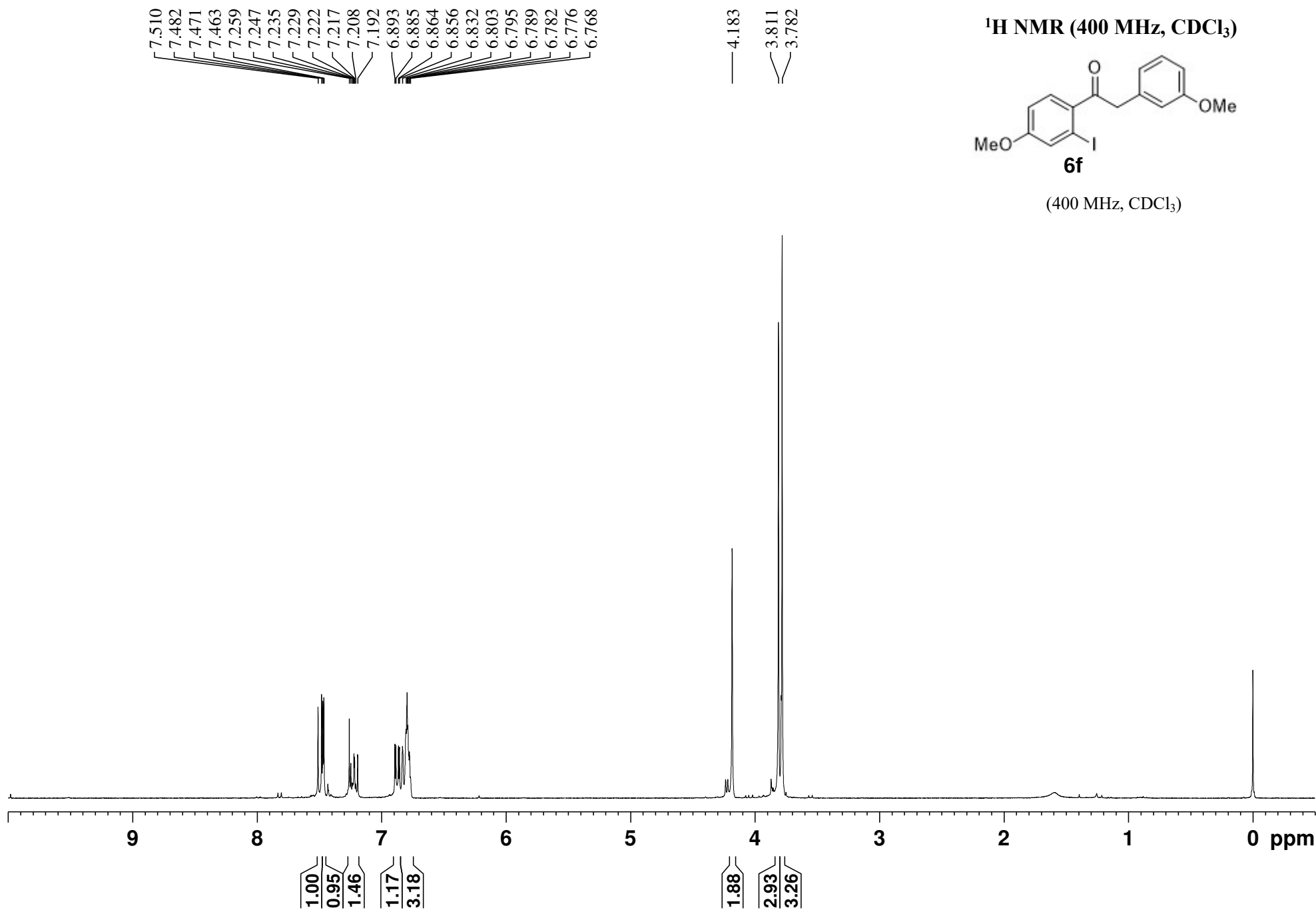
^{19}F NMR (376MHz, CDCl_3)

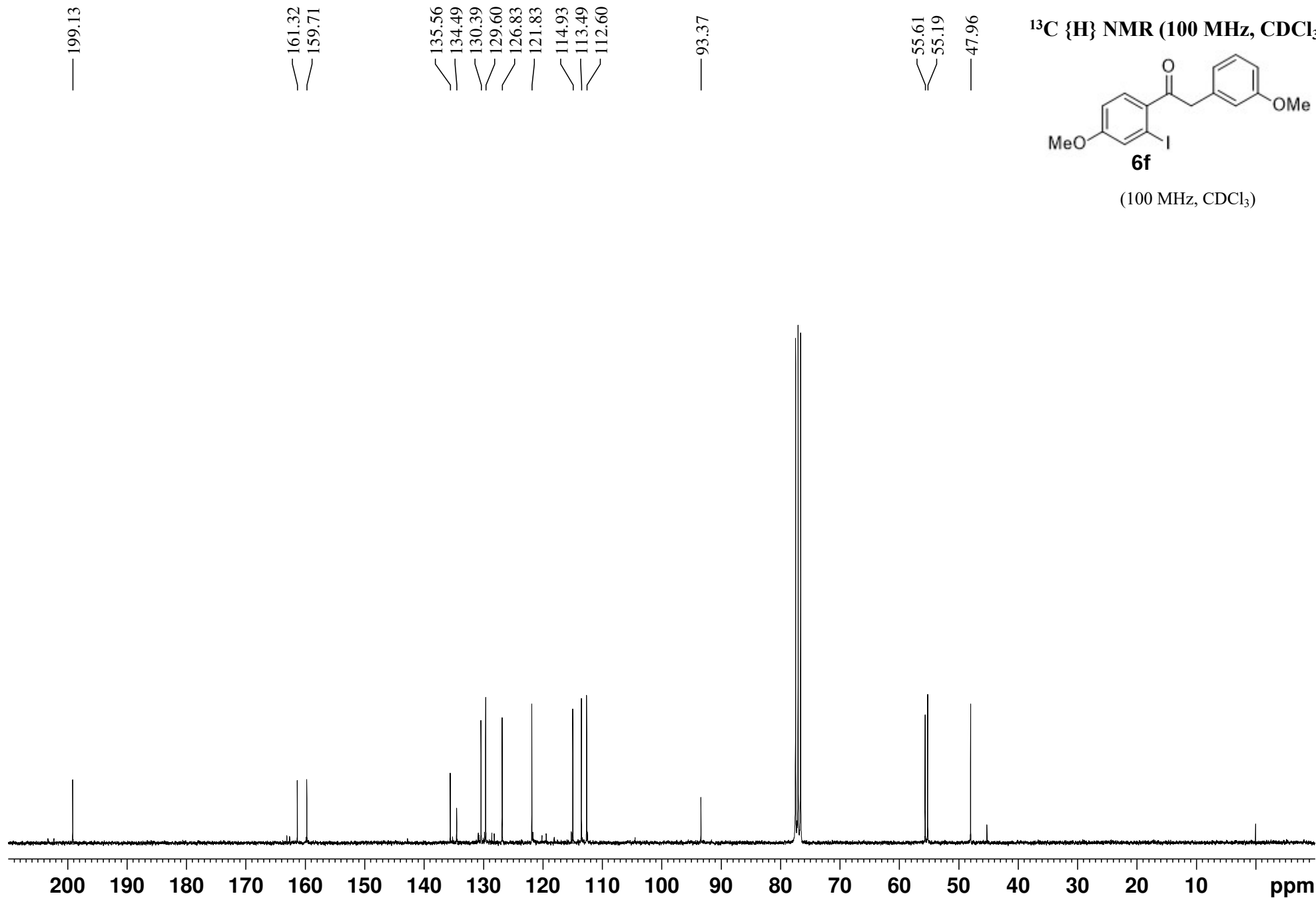


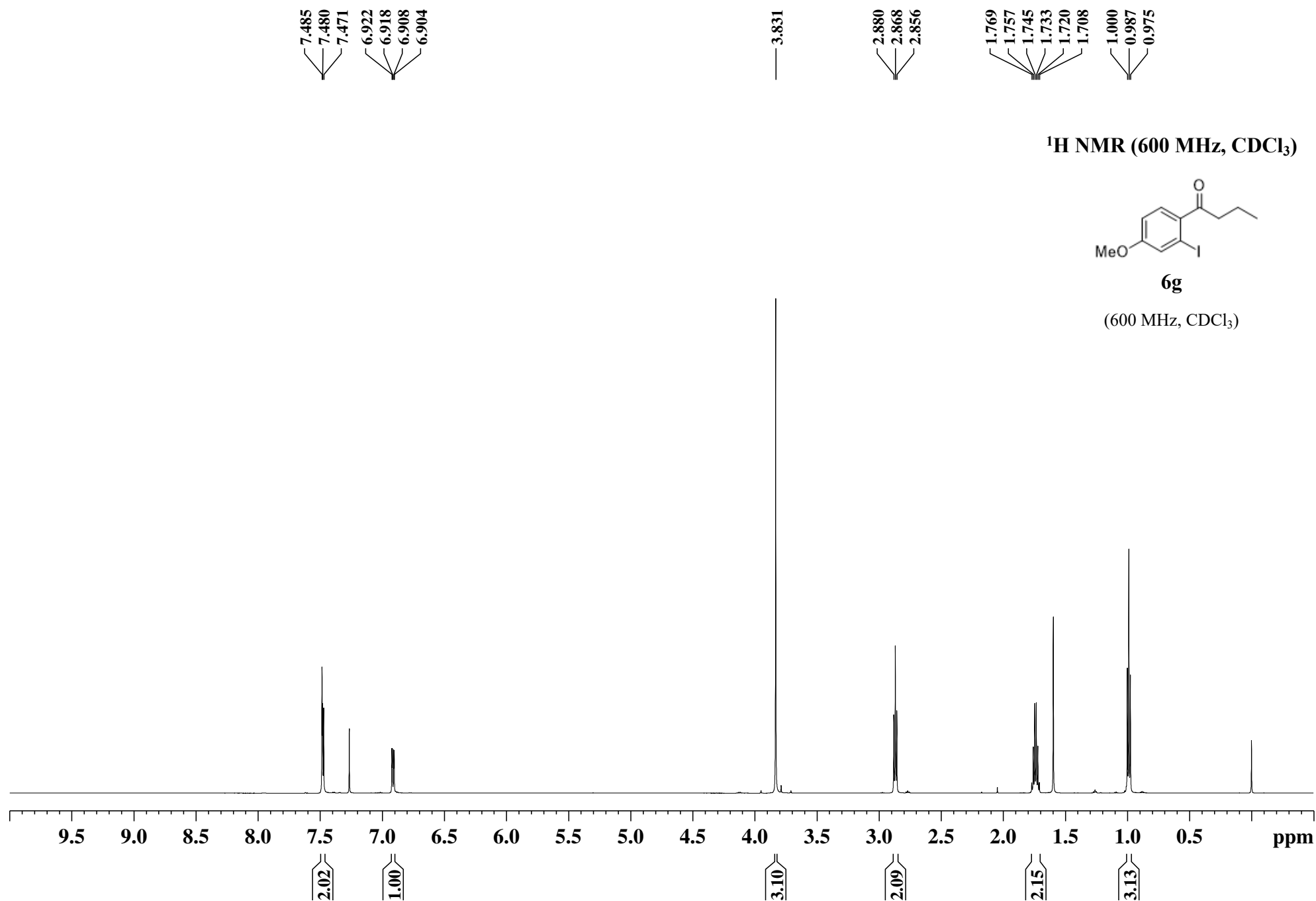
(376 MHz, CDCl_3)

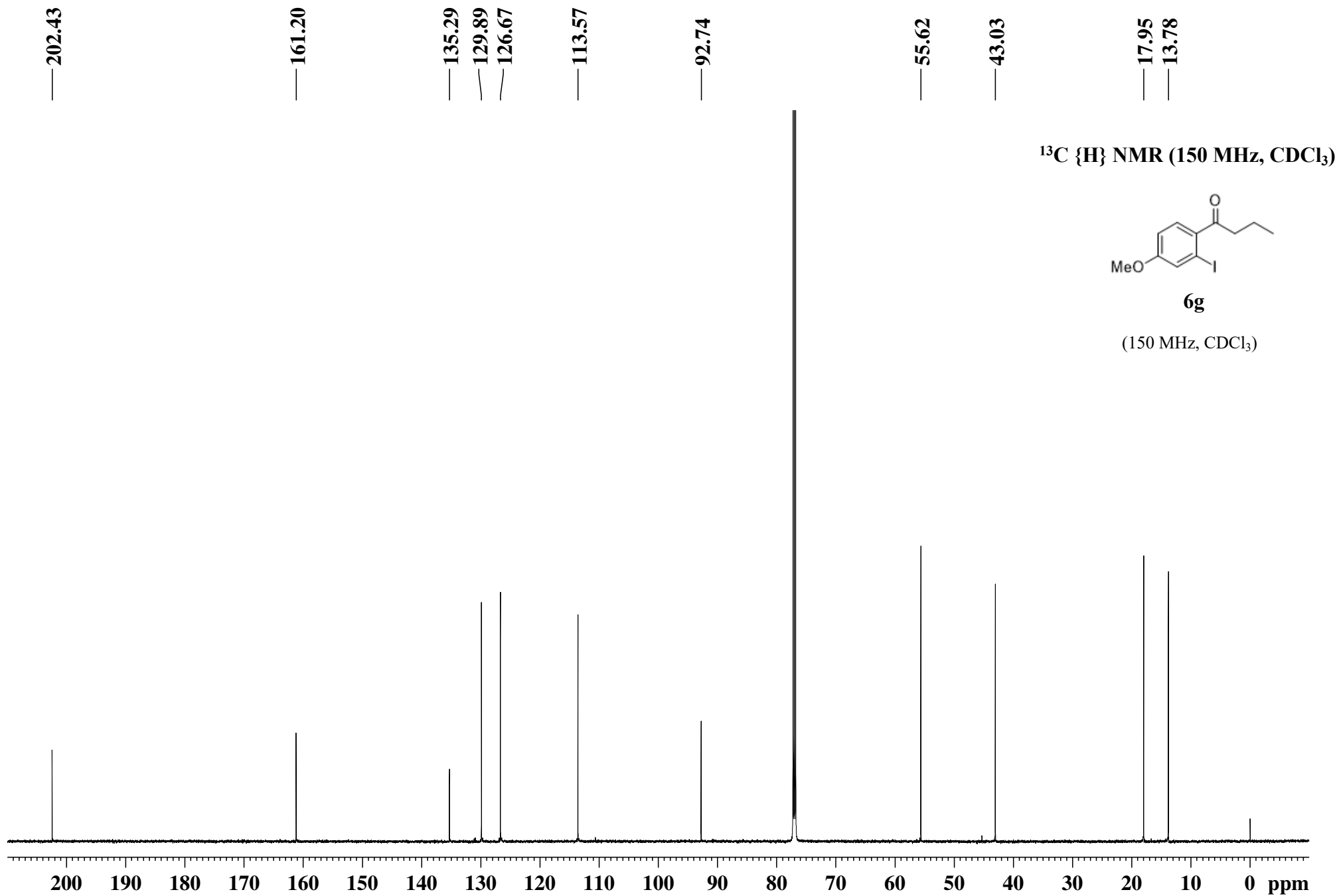
— -118.97







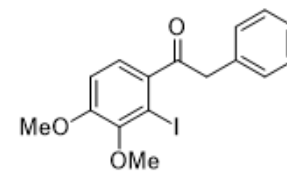




7.327
7.315
7.302
7.261
7.259
7.250
7.245
7.169
7.155
6.870
6.856

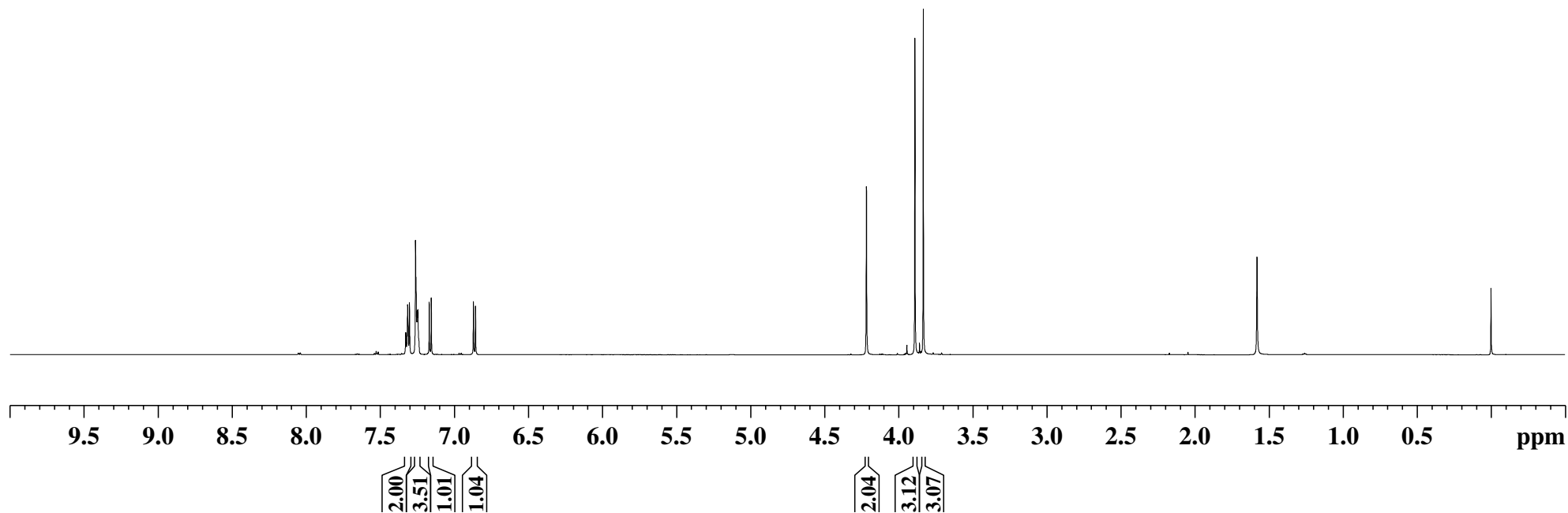
4.217
3.890
3.833

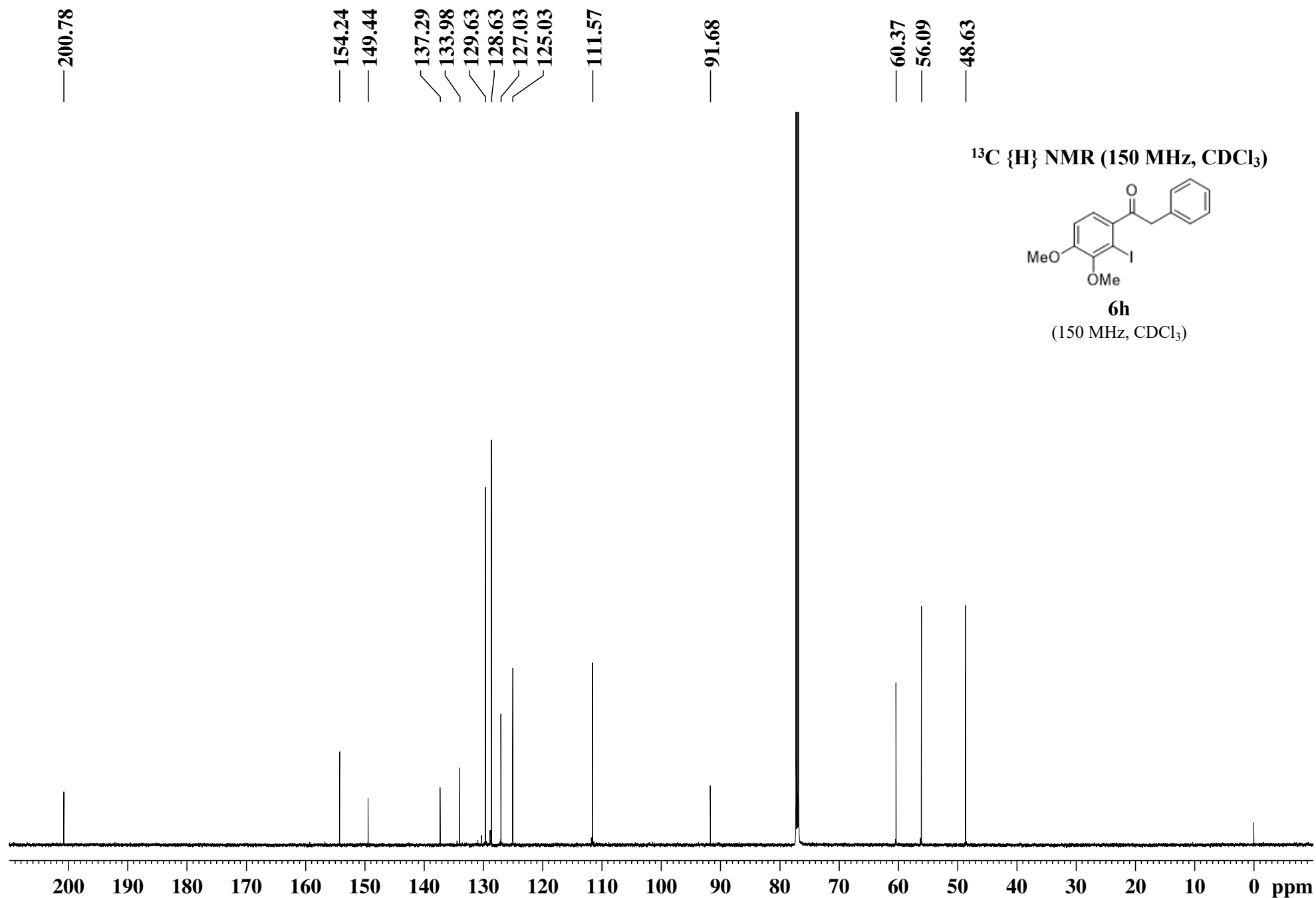
¹H NMR (600 MHz, CDCl₃)



6h

(600 MHz, CDCl₃)



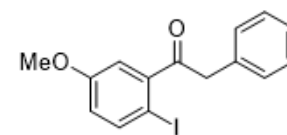


7.739
7.725
7.342
7.329
7.317
7.281
7.268
7.266
7.254
6.807
6.802
6.701
6.696
6.686
6.681

4.201

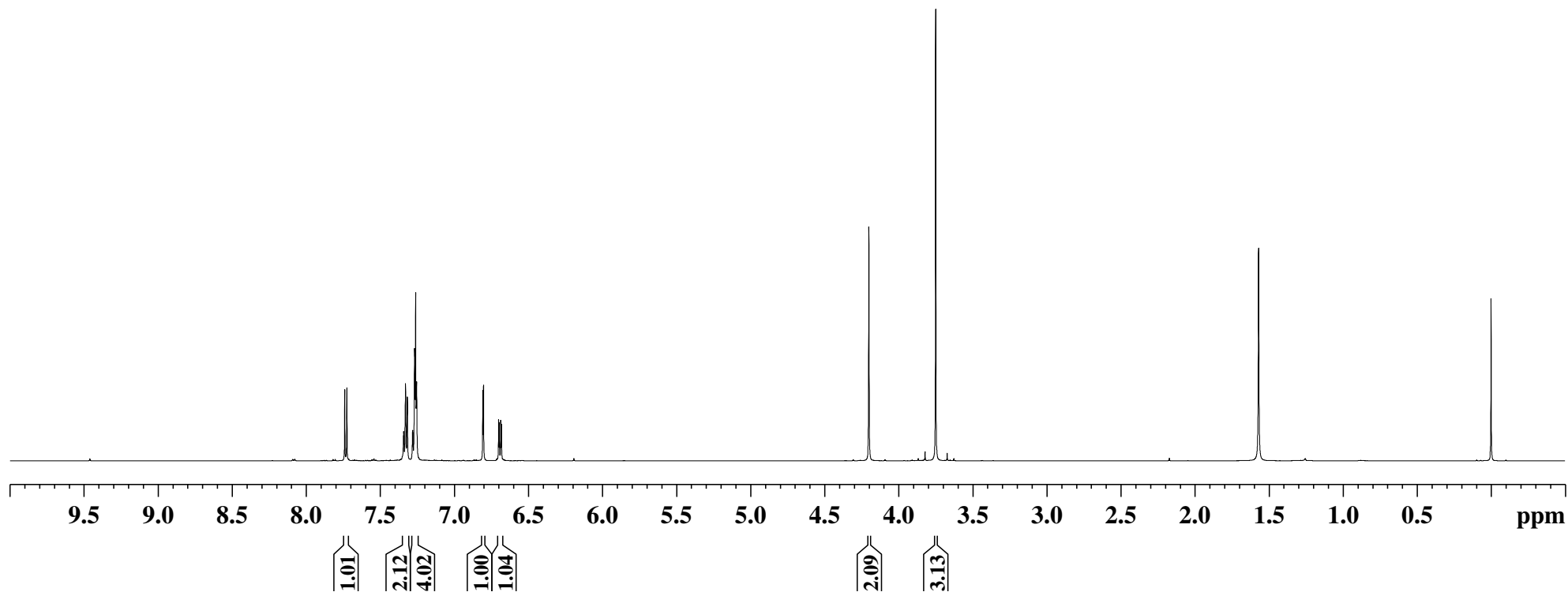
3.749

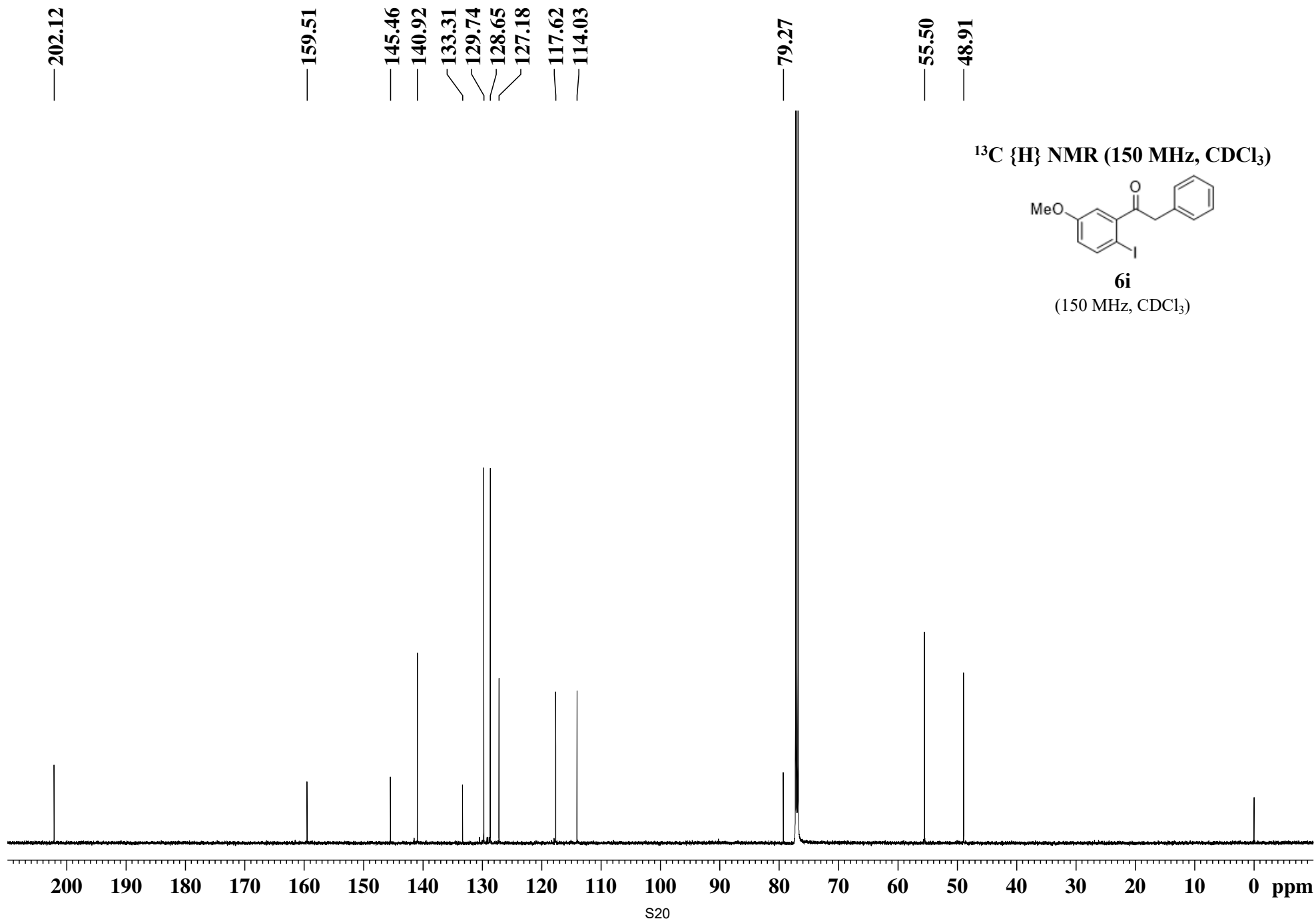
¹H NMR (600 MHz, CDCl₃)

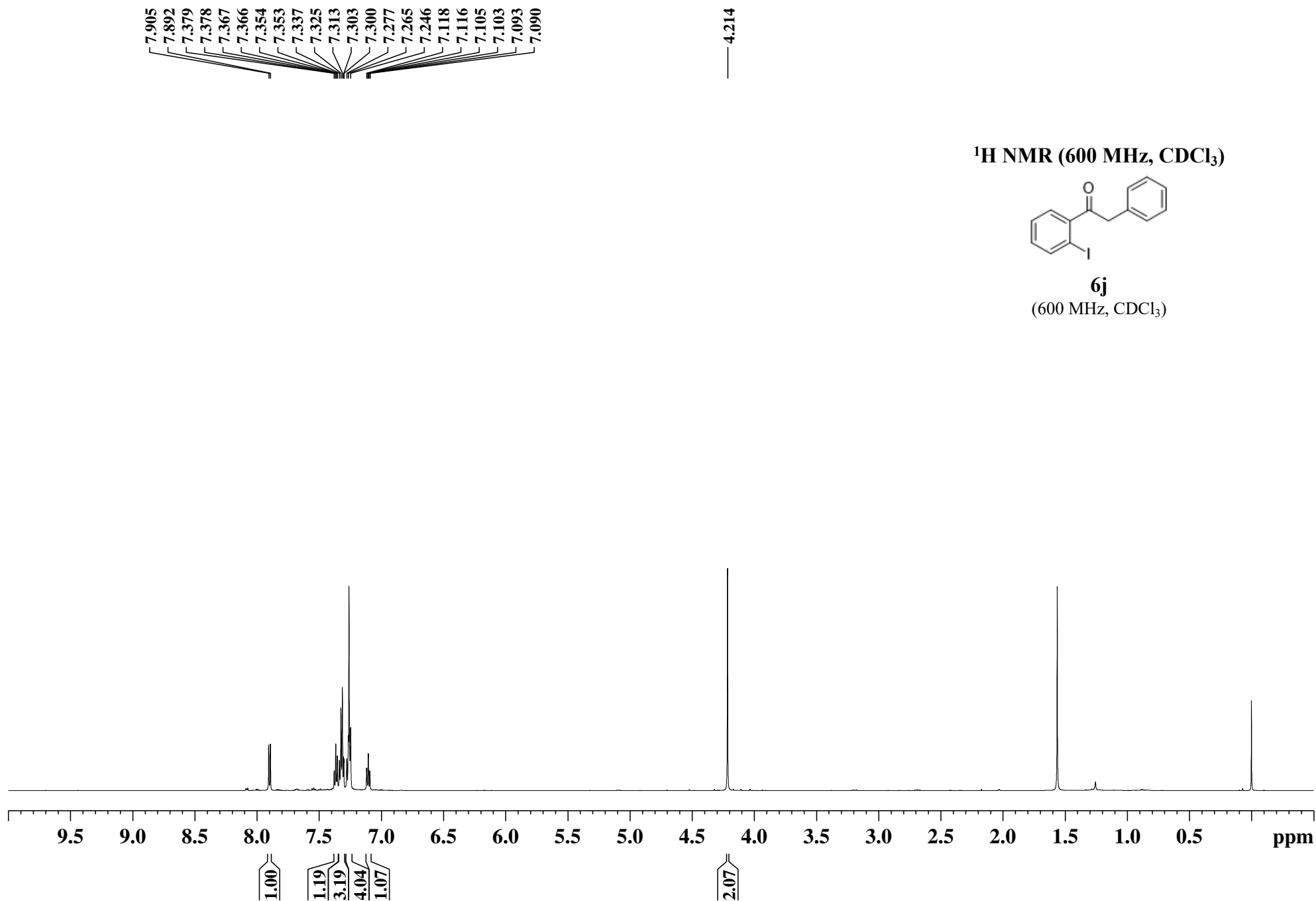


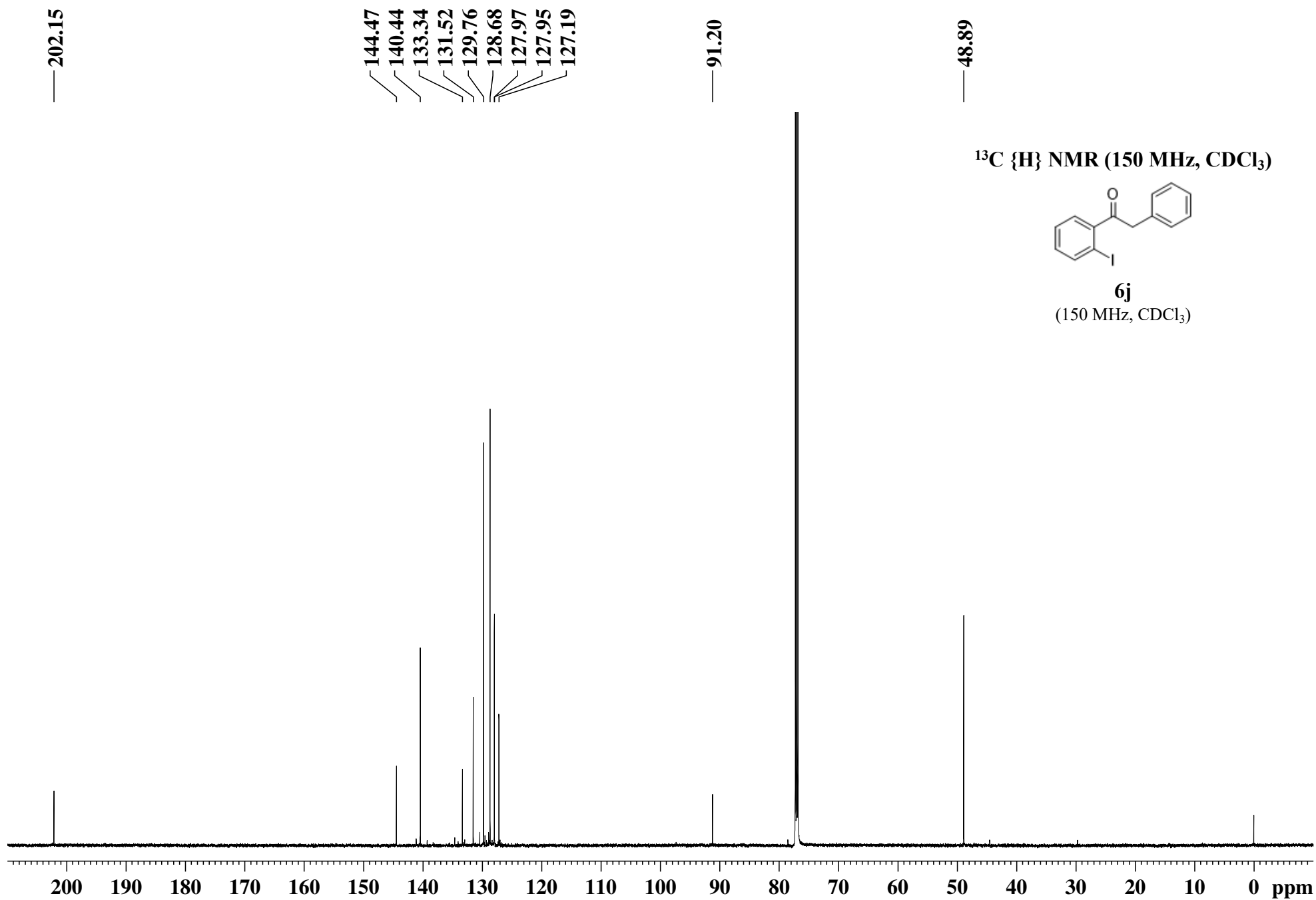
6i

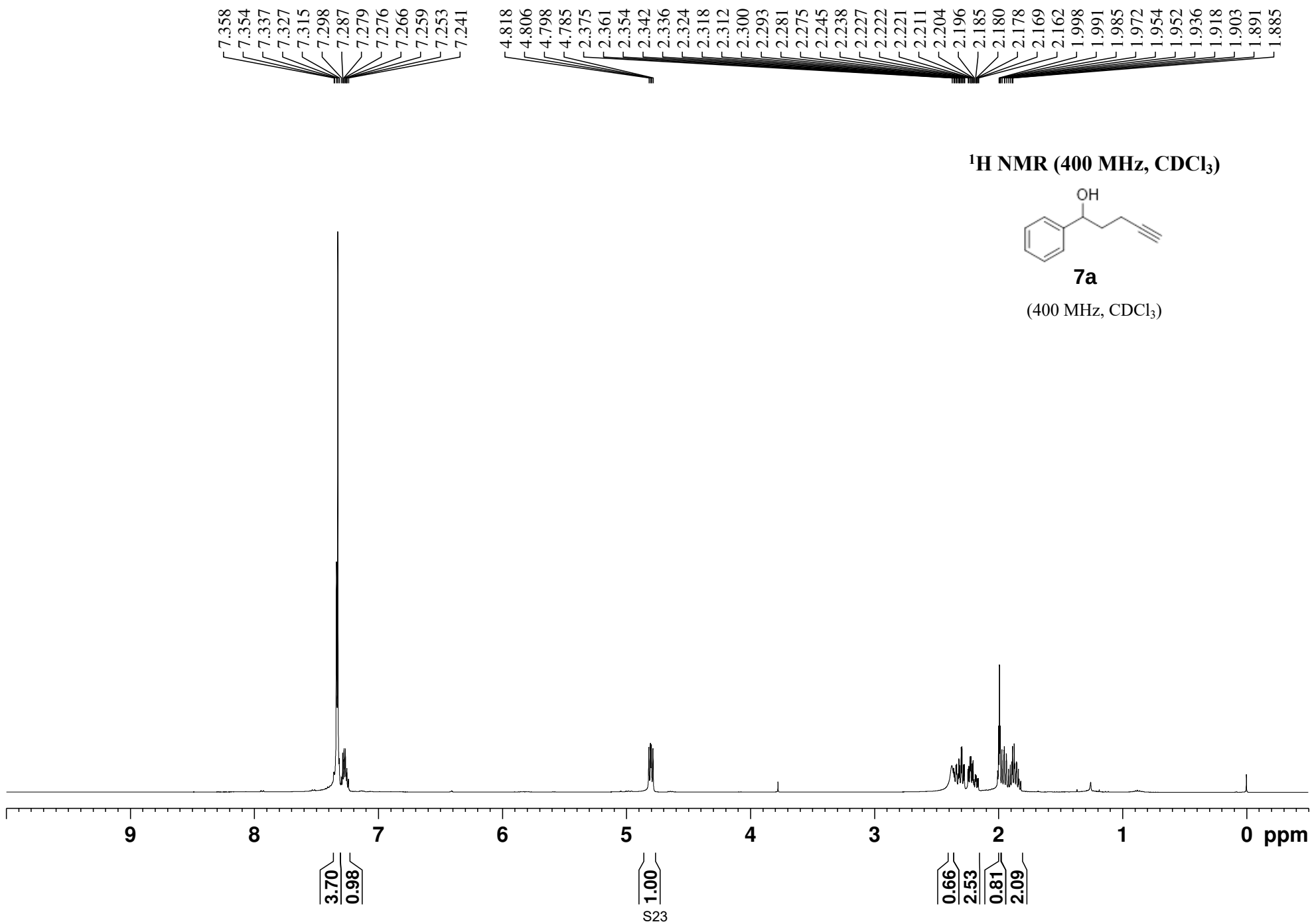
(600 MHz, CDCl₃)











— 144.89

— 129.41
— 128.59
— 126.71

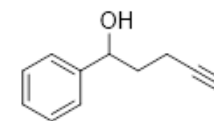
— 84.82

— 73.92
— 69.88

— 38.26

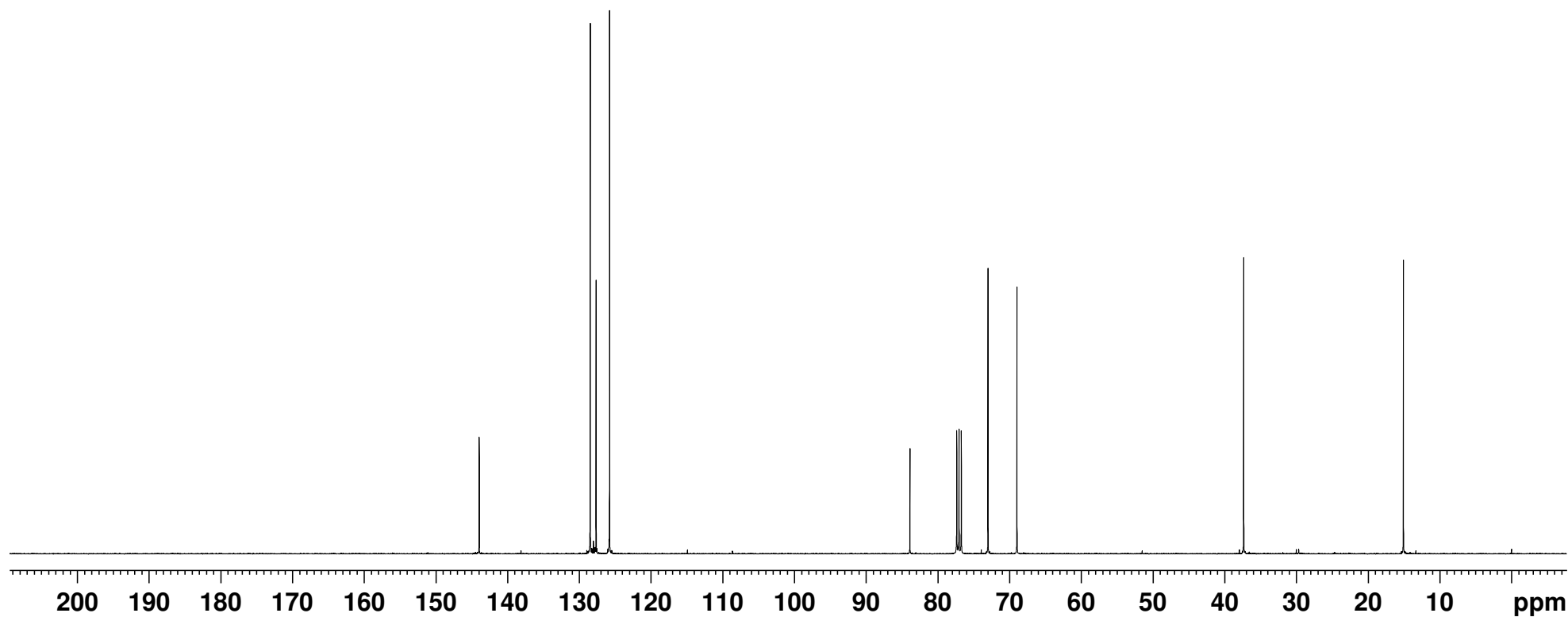
— 15.98

^{13}C {H} NMR (100 MHz, CDCl_3)



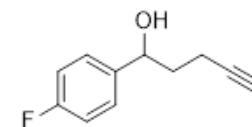
7a

(100 MHz, CDCl_3)



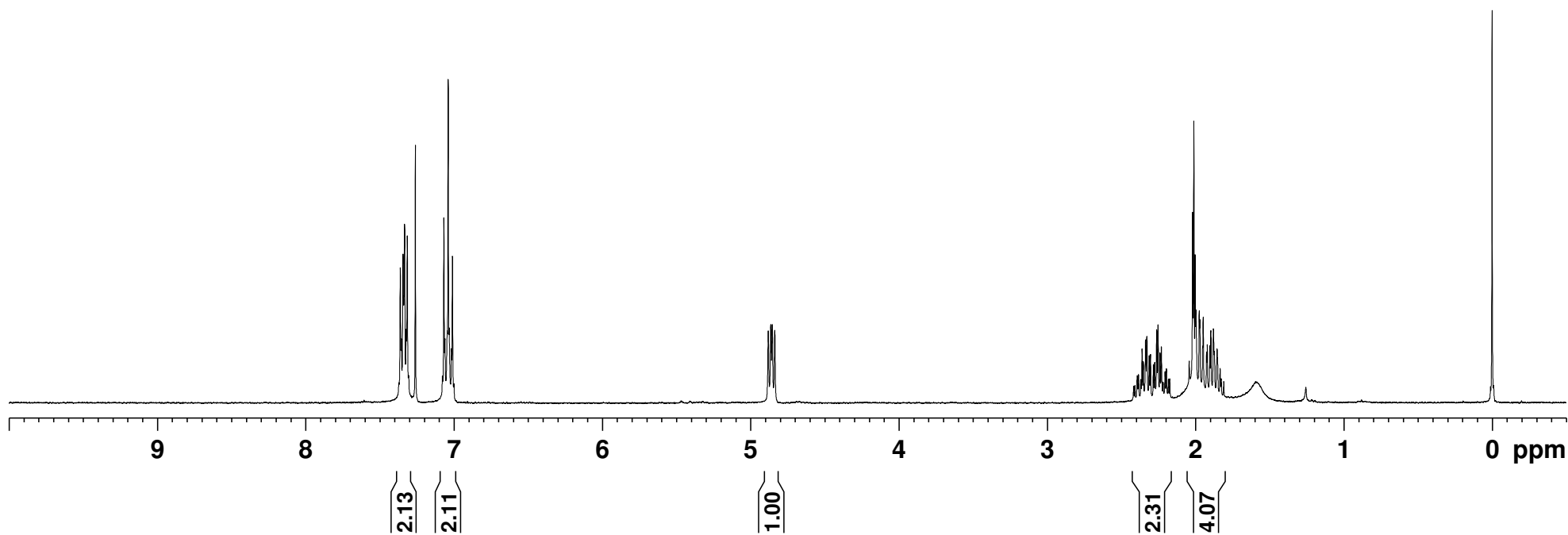
7.371
7.362
7.355
7.344
7.333
7.322
7.315
7.305
7.078
7.068
7.061
7.045
7.039
7.032
7.017
7.010
7.000
4.880
4.863
4.854
4.836
2.416
2.408
2.392
2.384
2.368
2.360
2.351
2.336
2.327
2.311
2.302
2.283
2.274
2.261
2.252
2.238
2.229
2.218
2.204
2.195
2.182
2.173
2.041
2.019
2.010
2.001
1.996
1.974
1.970
1.951
1.947
1.924
1.920
1.903
1.896

¹H NMR (300 MHz, CDCl₃)



7b

(300 MHz, CDCl₃)



— 163.82
— 160.57

— 139.72
— 139.68

— 127.47
— 127.37

— 115.44
— 115.15

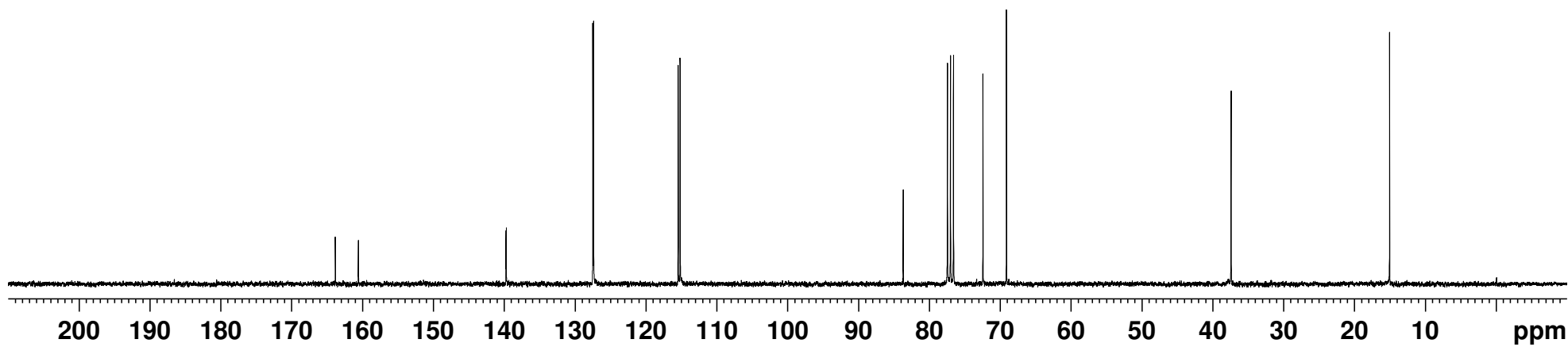
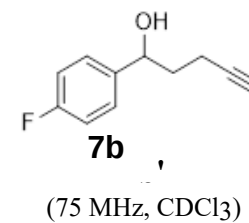
— 83.66

— 72.42
— 69.10

— 37.39

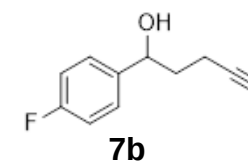
— 15.02

^{13}C {H} NMR (75 MHz, CDCl_3)

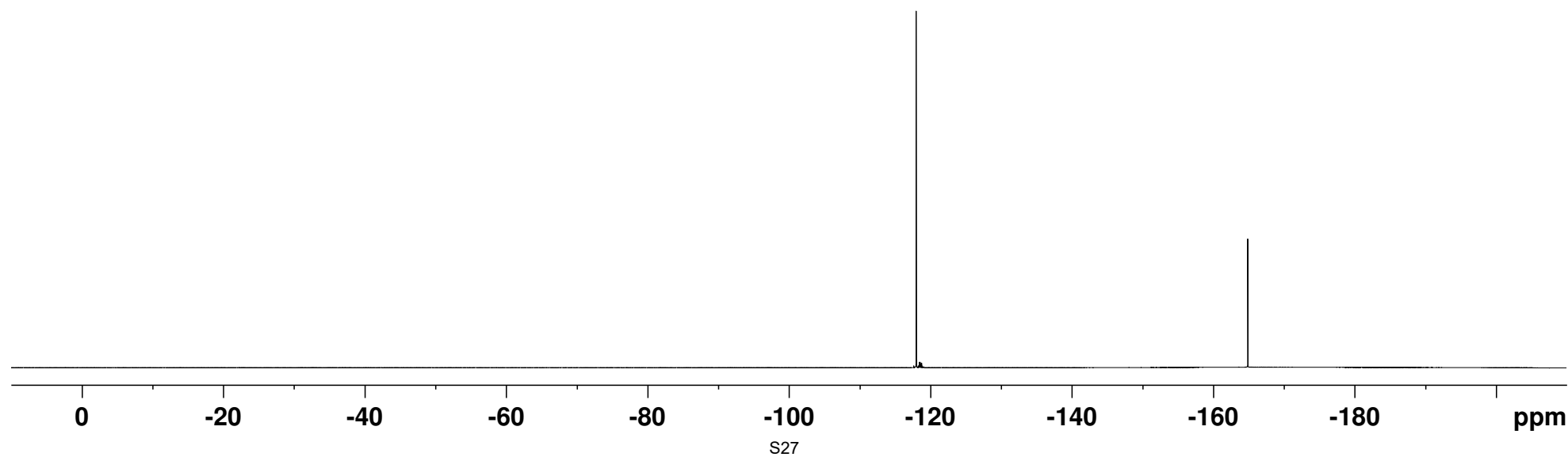


— -118.01 —

^{19}F NMR (282 MHz, CDCl_3)



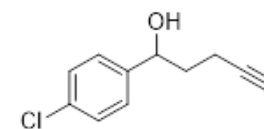
(282 MHz, CDCl_3)



7.340
7.337
7.330
7.319
7.310
7.301
7.292
7.280
7.271
7.262

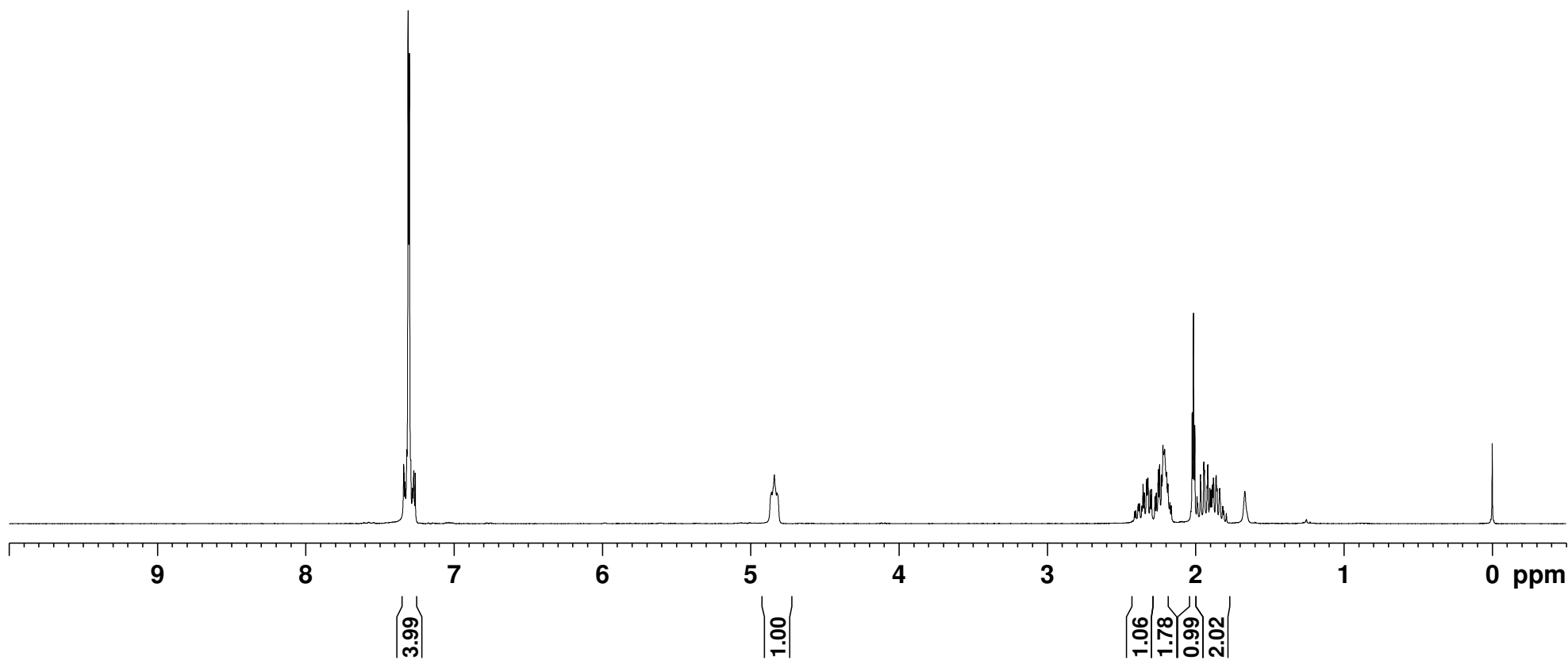
4.859
4.841
4.822
2.411
2.403
2.386
2.379
2.377
2.363
2.354
2.346
2.329
2.323
2.321
2.306
2.297
2.274
2.265
2.251
2.243
2.229
2.220
2.209
2.196
2.186
2.023
2.014
2.005
1.990
1.985
1.967
1.944
1.940
1.922
1.918
1.904
1.896
1.887
1.880
1.861

¹H NMR (400 MHz, CDCl₃)



7c

(400 MHz, CDCl₃)



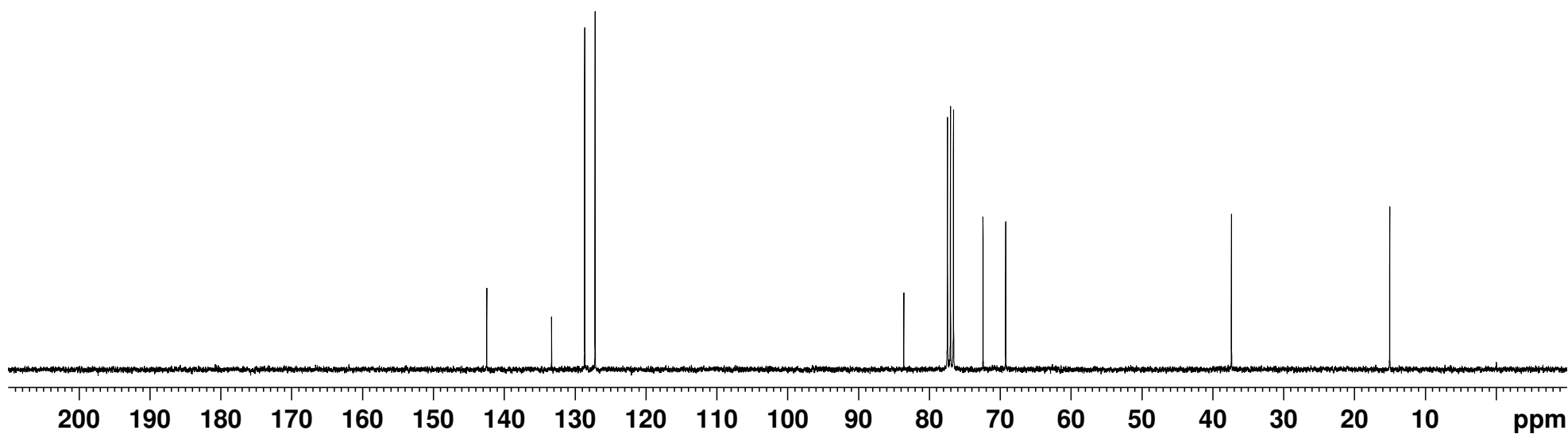
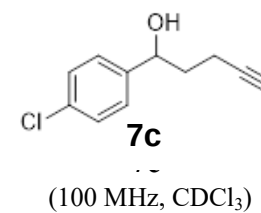
— 142.45
— 133.30
— 128.63
— 127.16

— 83.58
— 72.40
— 69.20

— 37.34

— 15.01

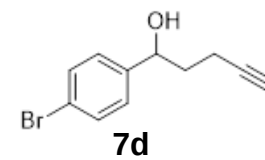
^{13}C {H} NMR (100 MHz, CDCl_3)



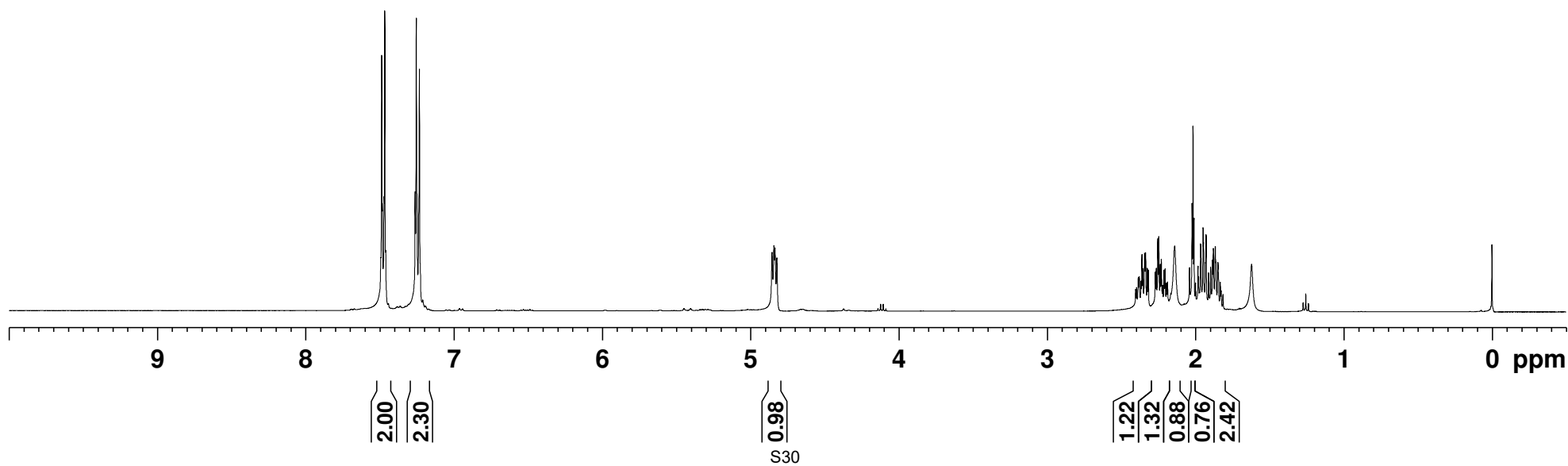
7.493
7.487
7.483
7.471
7.466
7.461
7.262
7.254
7.249
7.237
7.233
7.227

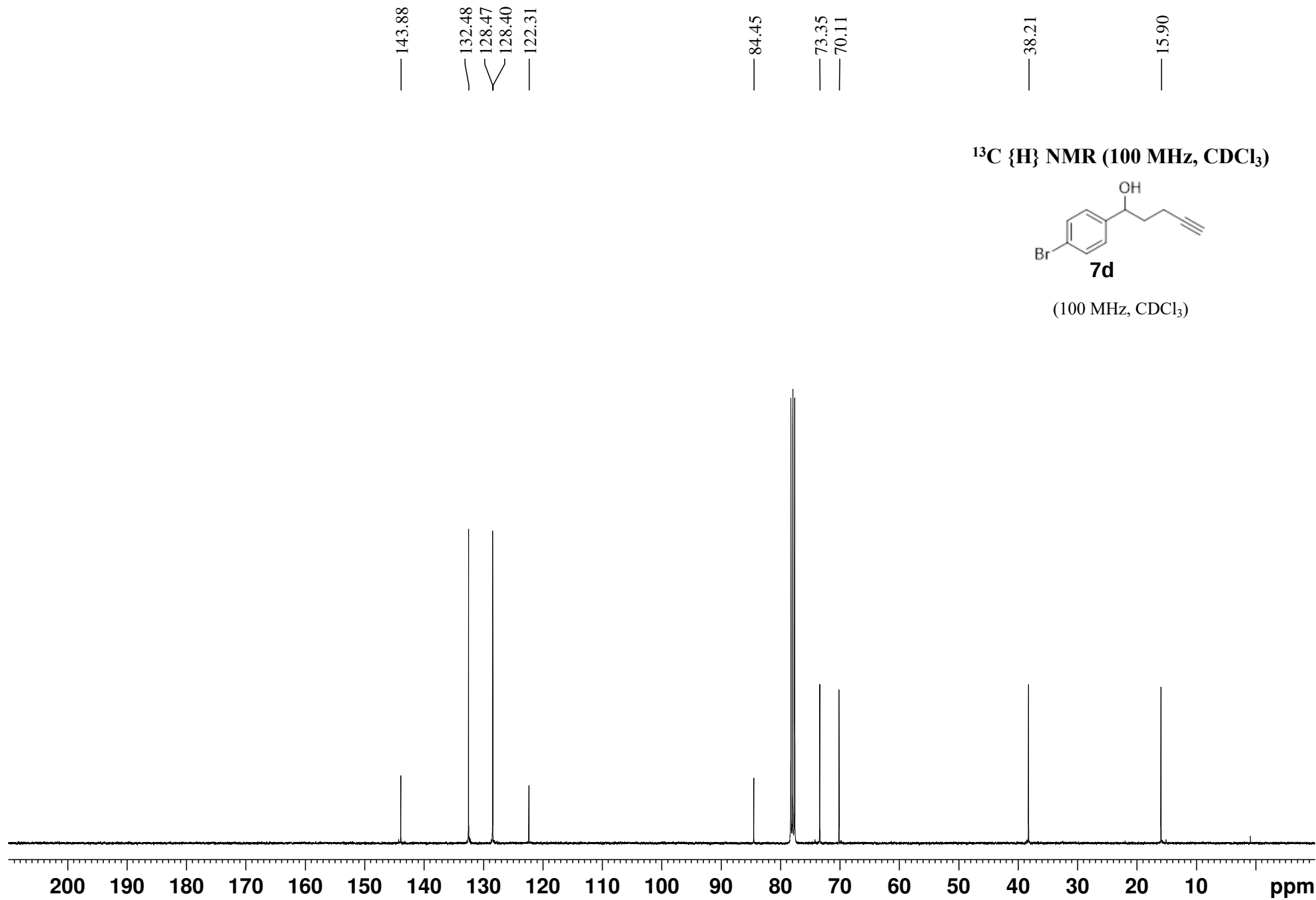
4.855
4.842
4.835
4.822
2.403
2.396
2.384
2.379
2.366
2.360
2.354
2.342
2.336
2.324
2.317
2.270
2.263
2.253
2.247
2.237
2.230
2.221
2.211
2.204
2.194
2.187
2.140
2.022
2.016
2.009
1.999
1.982
1.978
1.973
1.965
1.948
1.944
1.931
1.927
1.911
1.897

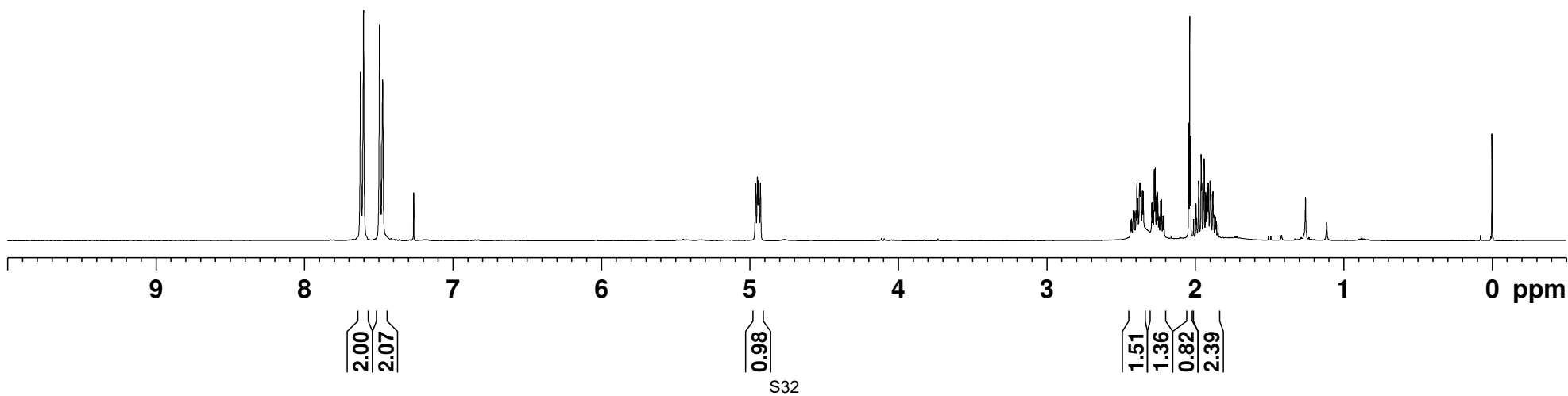
¹H NMR (400 MHz, CDCl₃)



(400 MHz, CDCl₃)



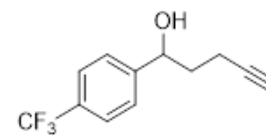




7.622
7.601
7.493
7.473

4.960
4.948
4.940
4.928
2.434
2.427
2.417
2.414
2.410
2.407
2.397
2.391
2.385
2.374
2.371
2.368
2.365
2.355
2.348
2.291
2.284
2.274
2.267
2.258
2.251
2.241
2.232
2.225
2.215
2.209
2.042
2.036
2.029
1.993
1.989
1.975
1.959
1.954
1.942
1.938
1.928
1.922
1.916
1.911

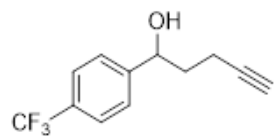
¹H NMR (400 MHz, CDCl₃)



7e

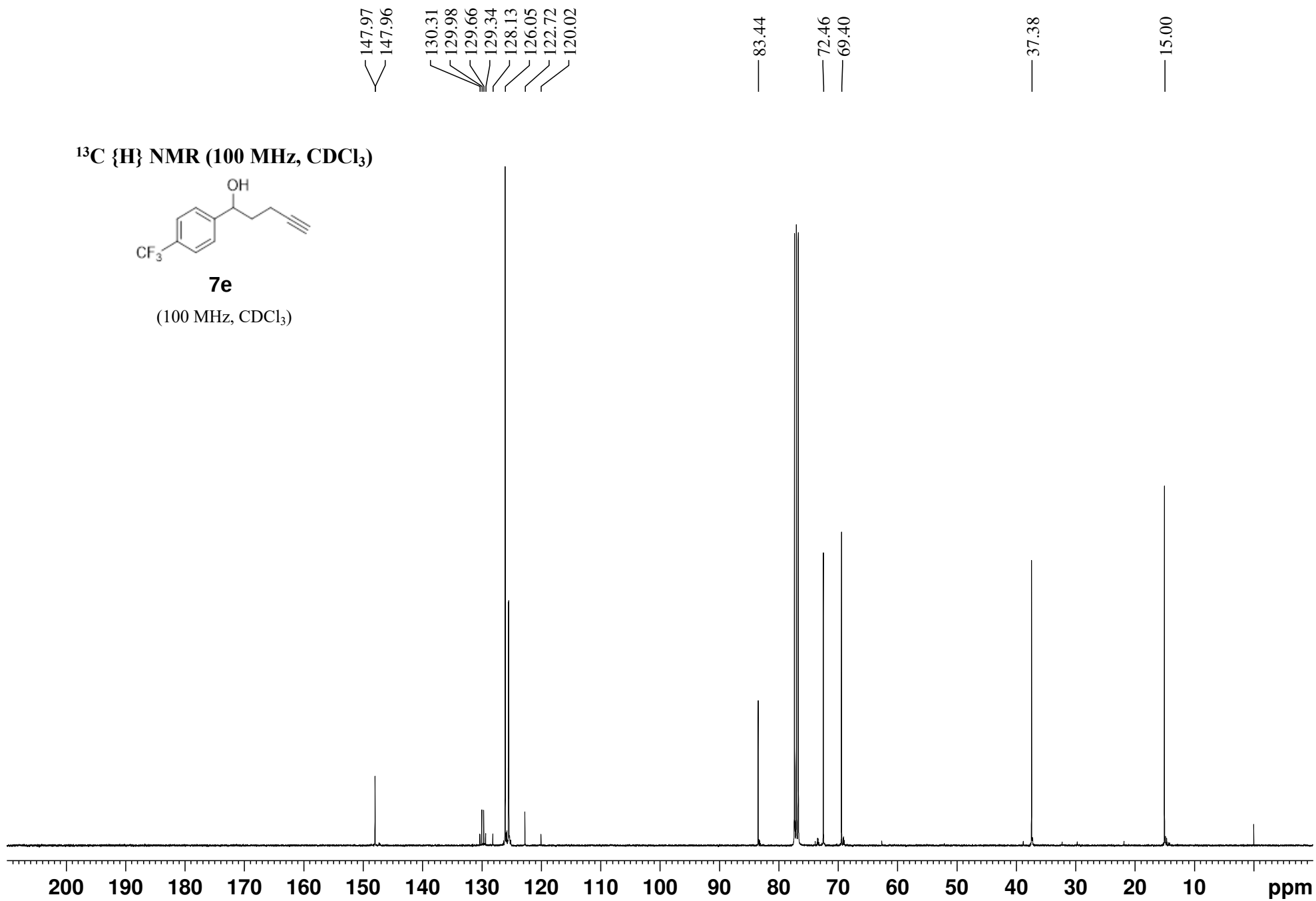
(400 MHz, CDCl₃)

^{13}C {H} NMR (100 MHz, CDCl_3)

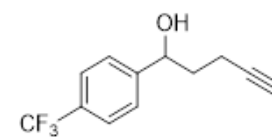


7e

(100 MHz, CDCl_3)



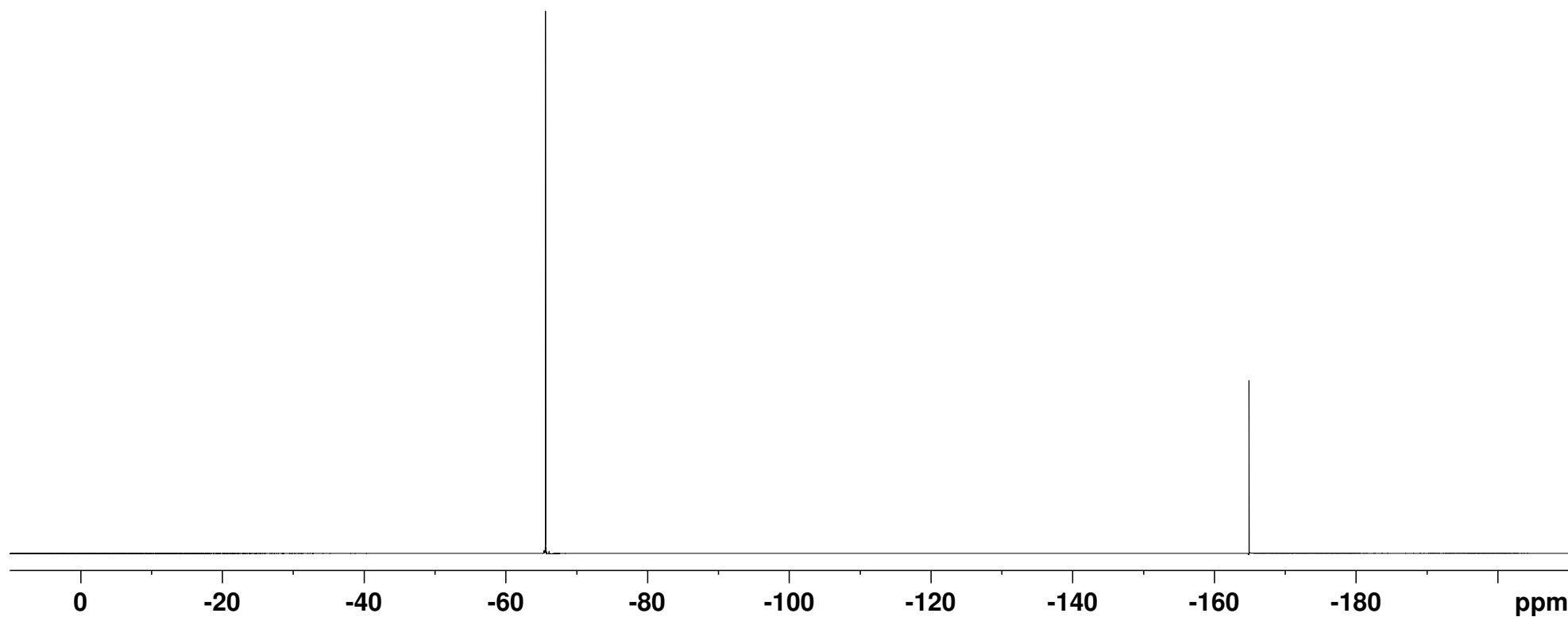
^{19}F NMR (376MHz, CDCl_3)

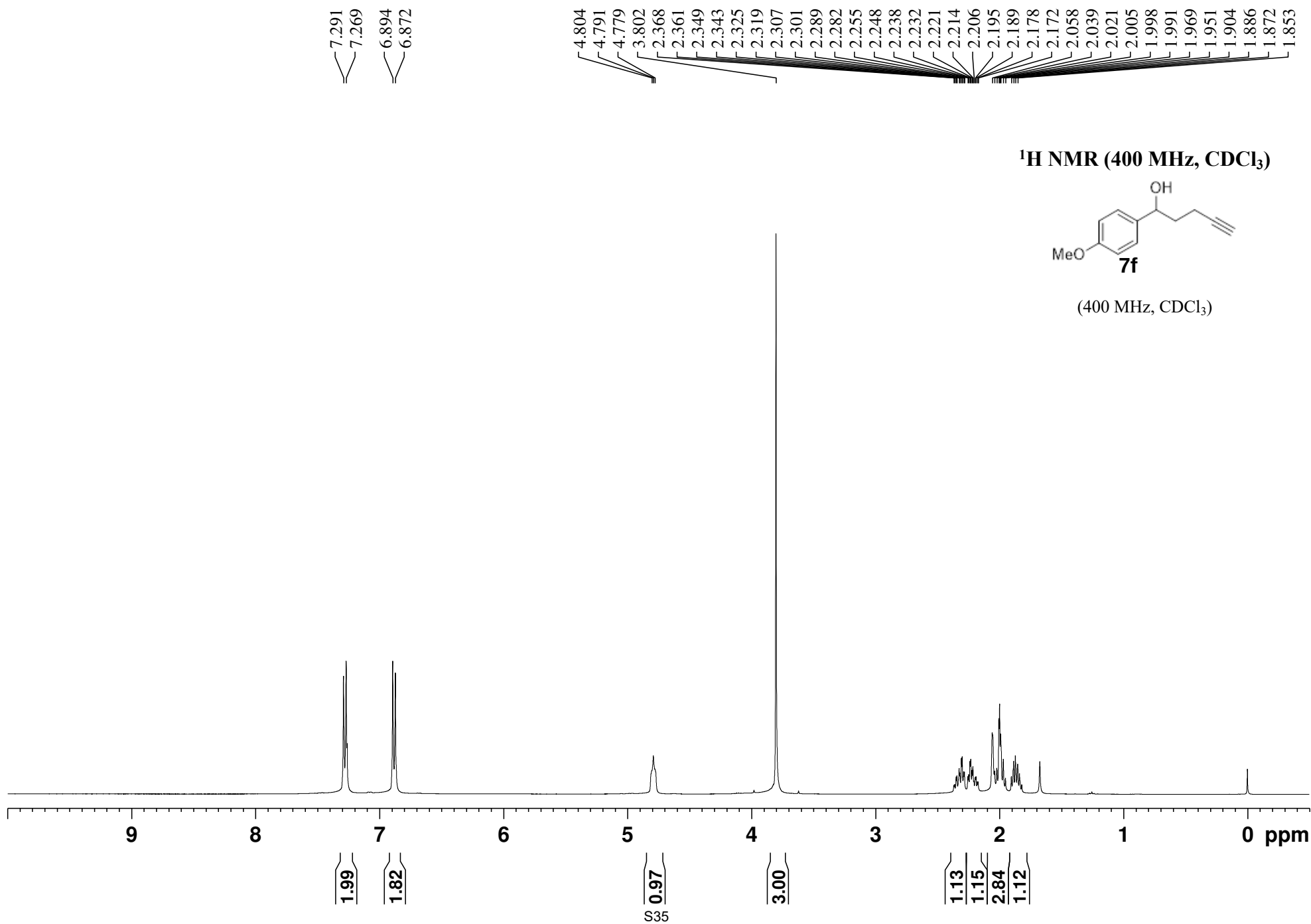


7e

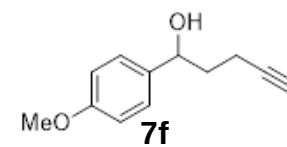
(376 MHz, CDCl_3)

— -65.64

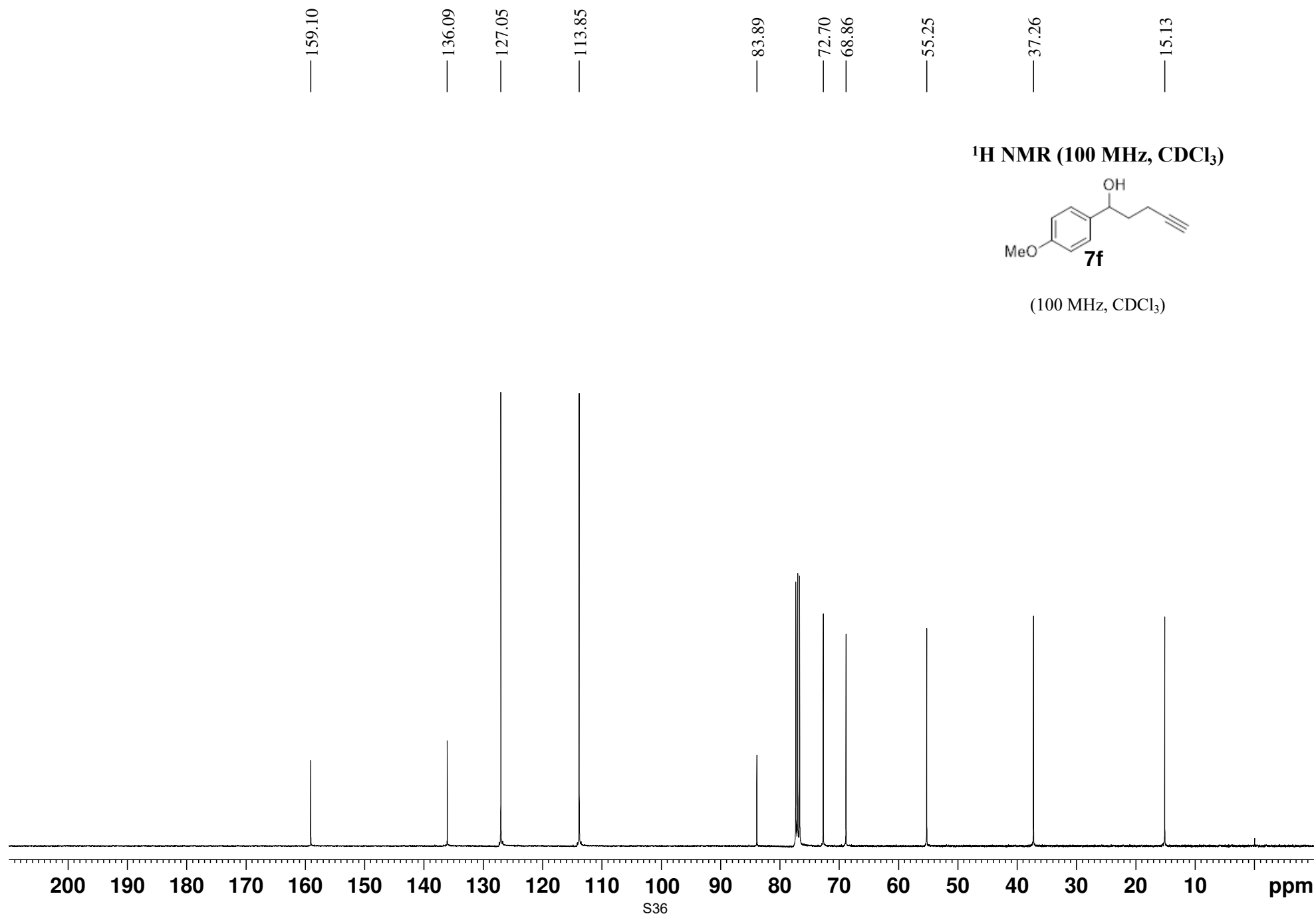


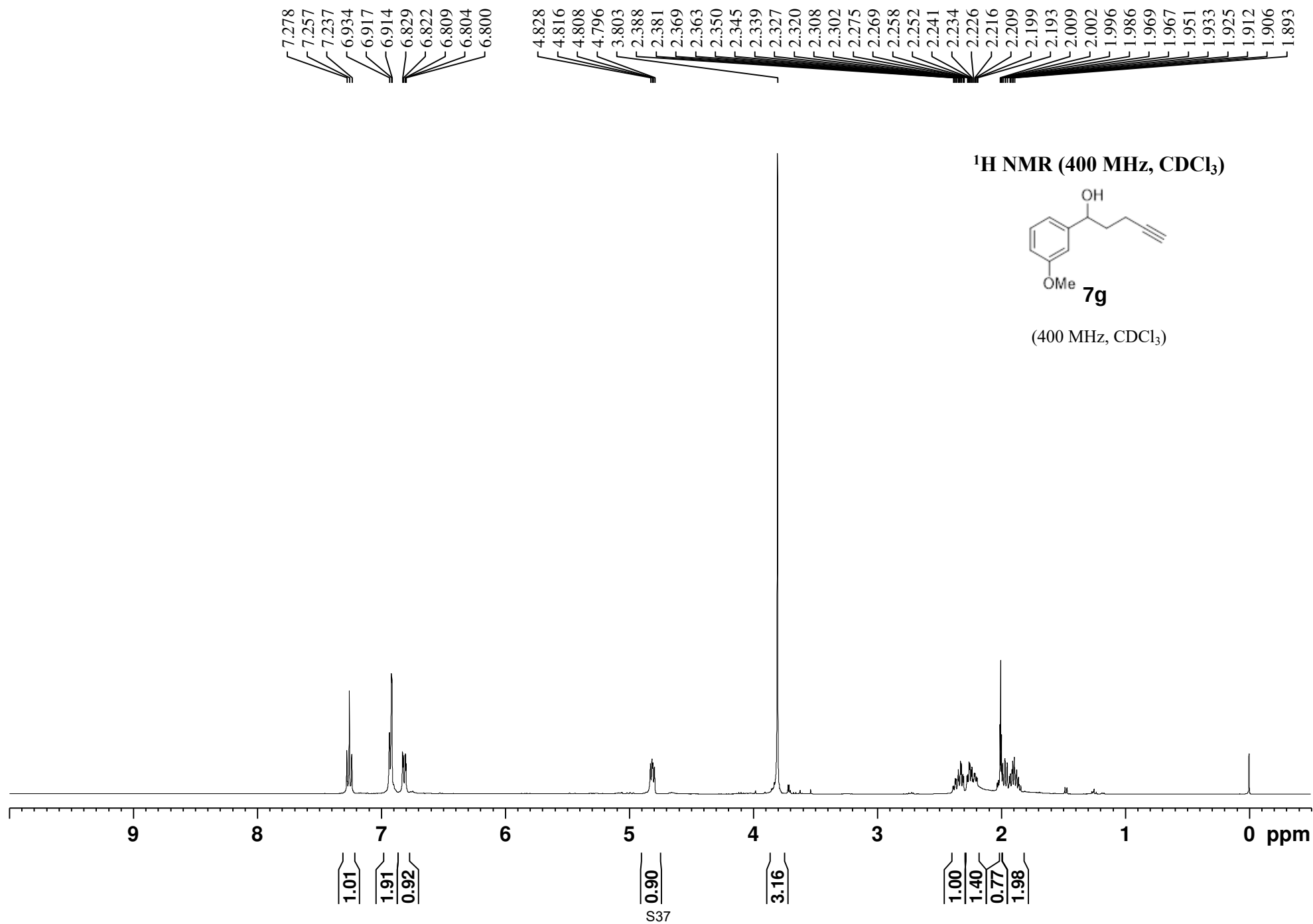


¹H NMR (100 MHz, CDCl₃)



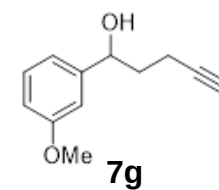
(100 MHz, CDCl₃)



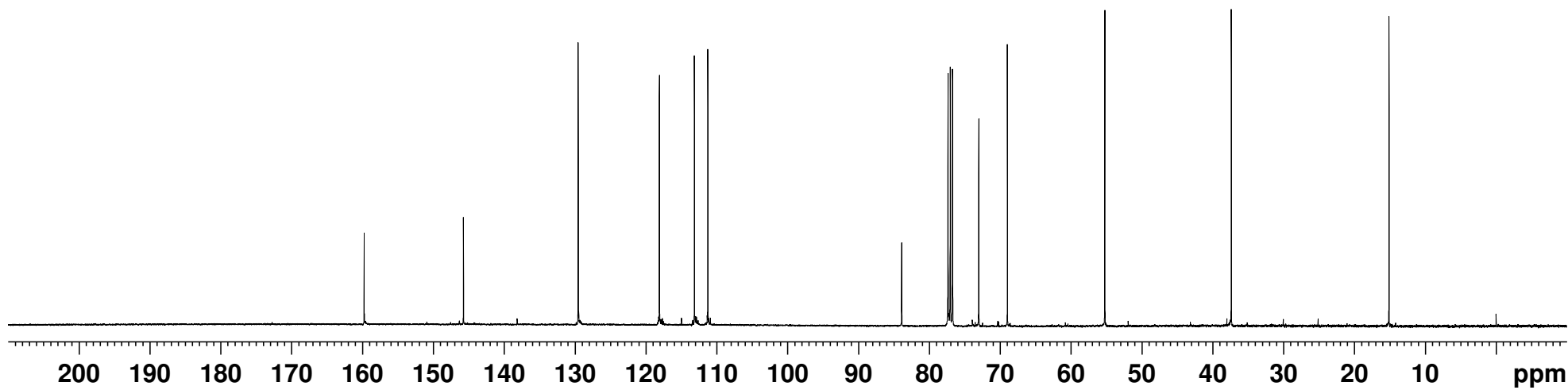


— 159.73 — 145.72 — 129.52 — 118.06
 — 113.11 — 111.22 — 83.86 — 72.97
 — 68.93 — 55.18 — 37.32 — 15.06

^{13}C {H} NMR (100 MHz, CDCl_3)



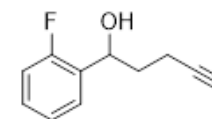
(100 MHz, CDCl_3)



7.518
7.513
7.493
7.488
7.469
7.463
7.319
7.313
7.301
7.295
7.285
7.277
7.268
7.262
7.250
7.244
7.200
7.197
7.175
7.172
7.151
7.147
7.080
7.076
7.053
7.048
7.045
7.041
7.017
7.014
5.194
5.173
5.152

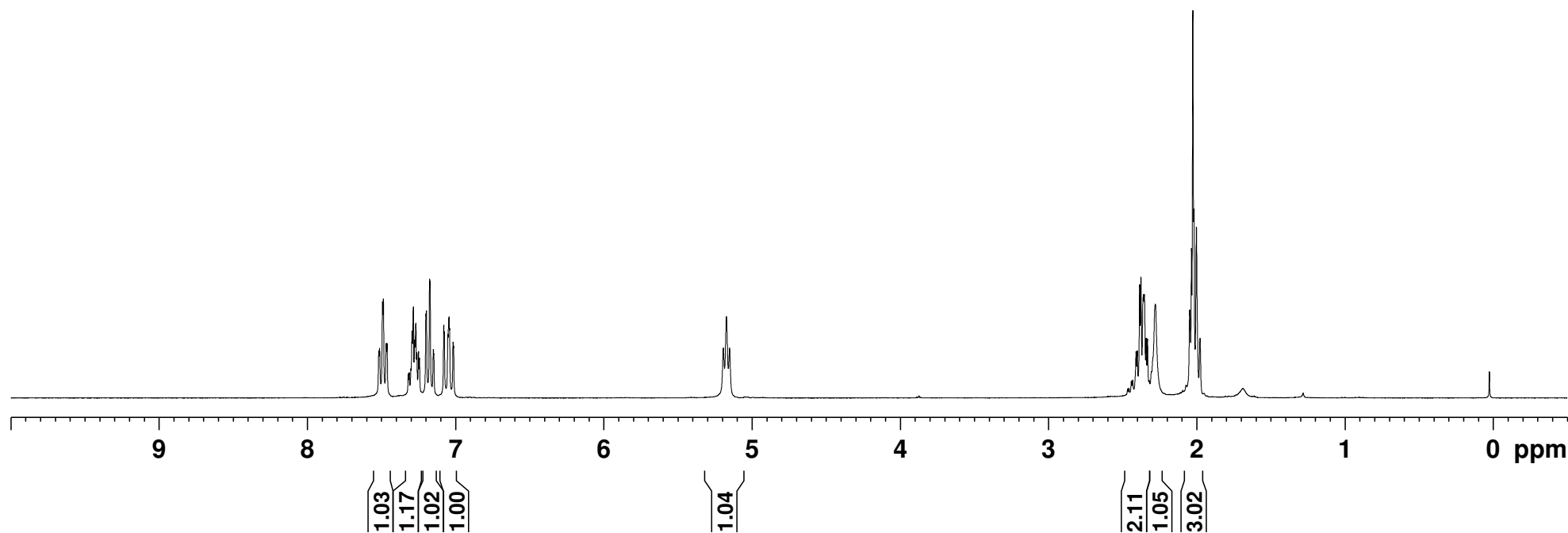
2.467
2.458
2.441
2.433
2.410
2.402
2.386
2.377
2.361
2.355
2.342
2.333
2.321
2.306
2.280
2.048
2.036
2.027
2.019
2.003
1.978

¹H NMR (300 MHz, CDCl₃)



7h

(300 MHz, CDCl₃)



— 161.36
— 158.10

130.95
130.77
129.06
128.95
127.29
127.23
124.32
124.27
115.49
115.20

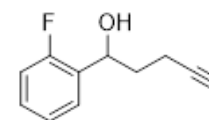
— 83.68

68.98
67.47
67.44

— 36.20

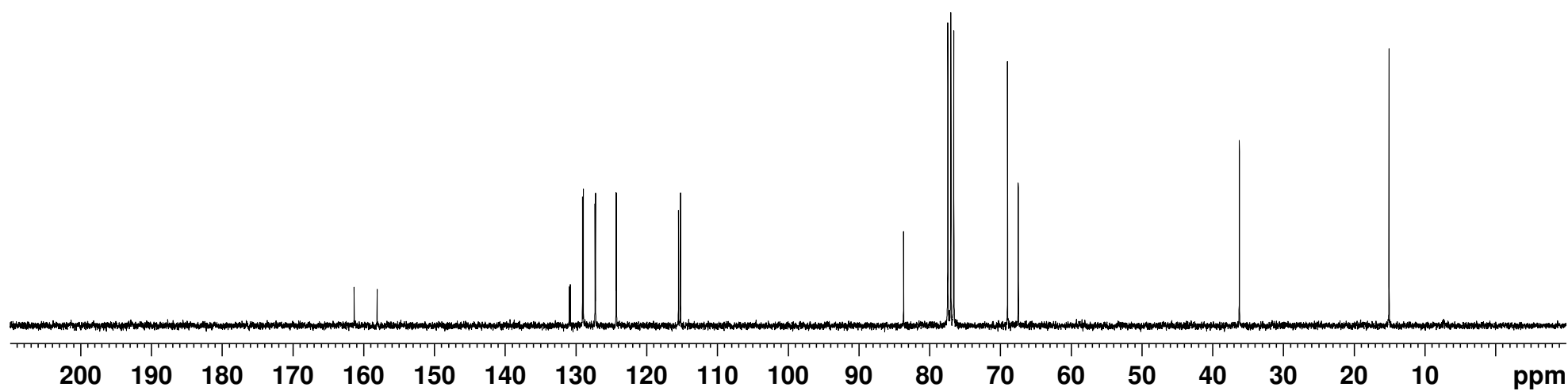
— 15.04

^{13}C {H} NMR (75 MHz, CDCl_3)



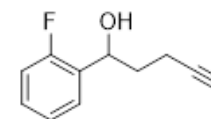
7h

(75 MHz, CDCl_3)



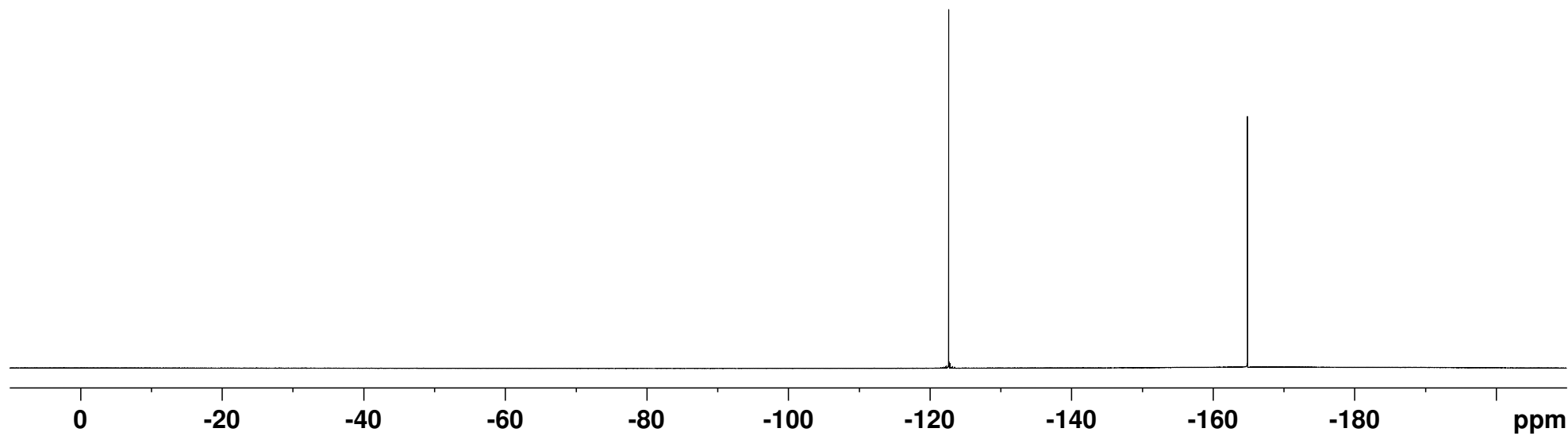
— -122.69

^{19}F NMR (282 MHz, CDCl_3)

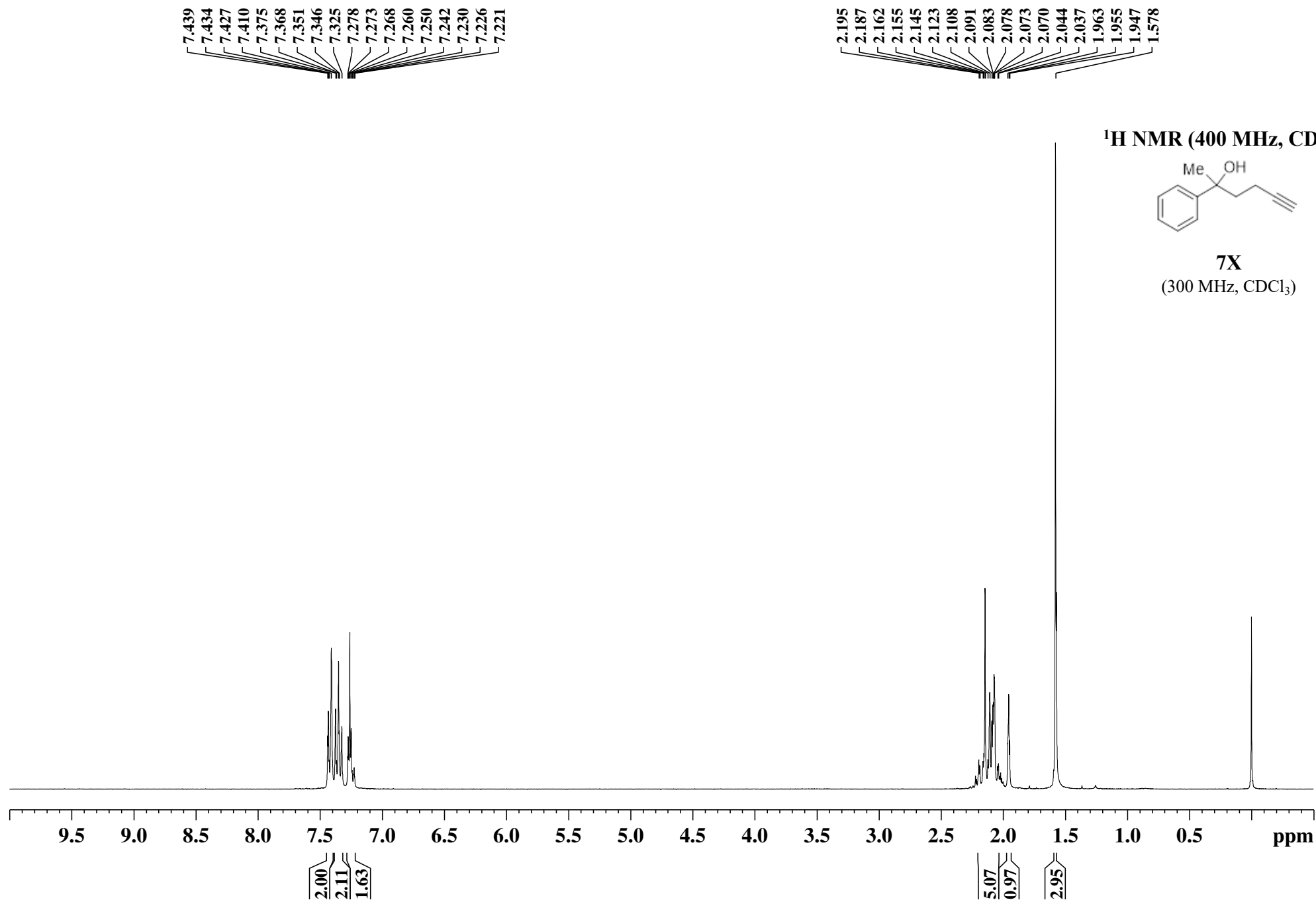


7h

(282 MHz, CDCl_3)



PY-2-084 1H NMR 300 MHz CDCl3



PY-2-084 ¹³C NMR 150 MHz CDCl₃

— 146.74

— 128.28

— 126.76

— 124.68

— 84.56

— 74.57

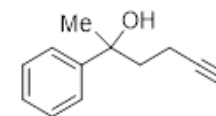
— 68.78

— 42.32

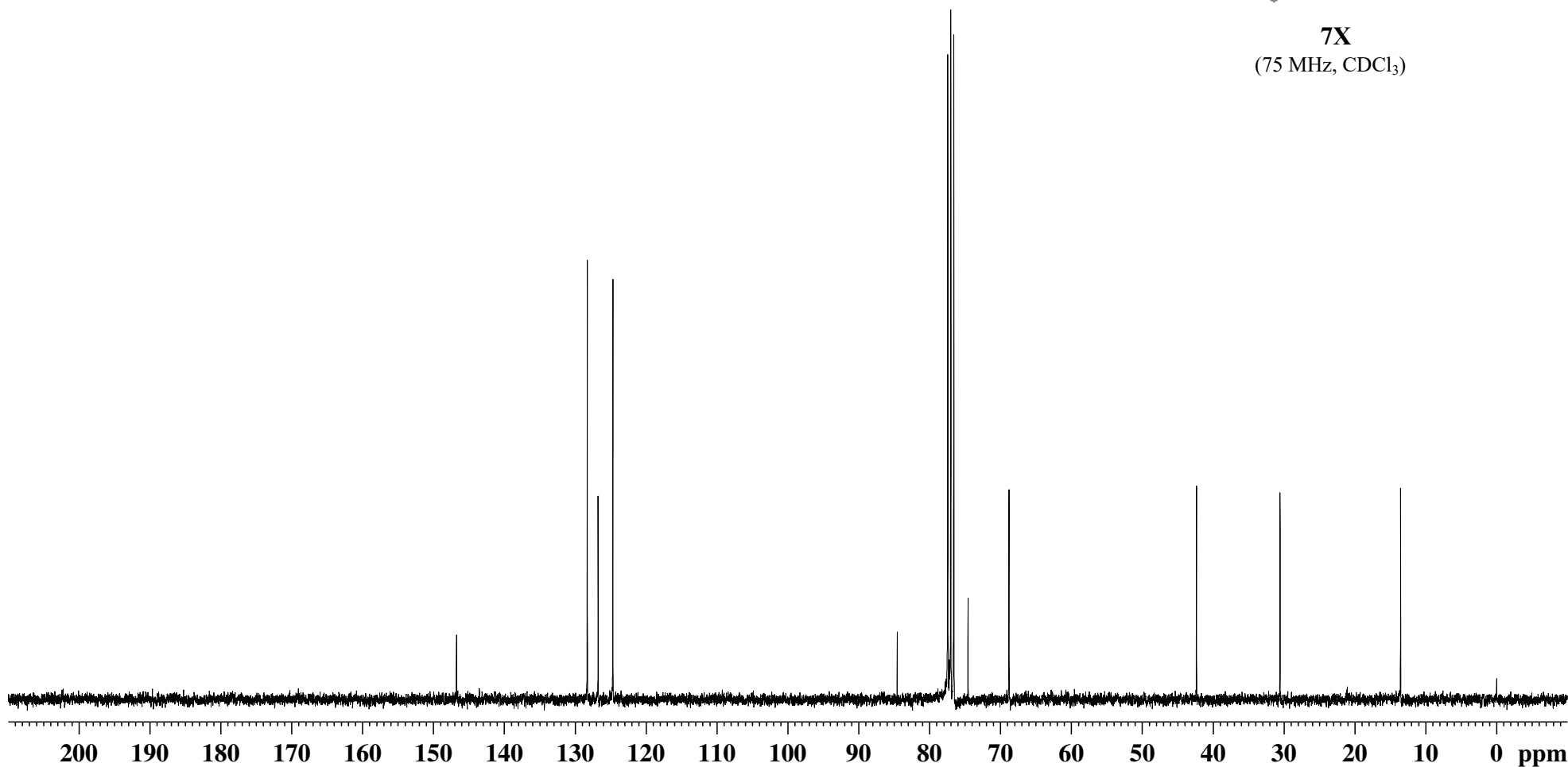
— 30.54

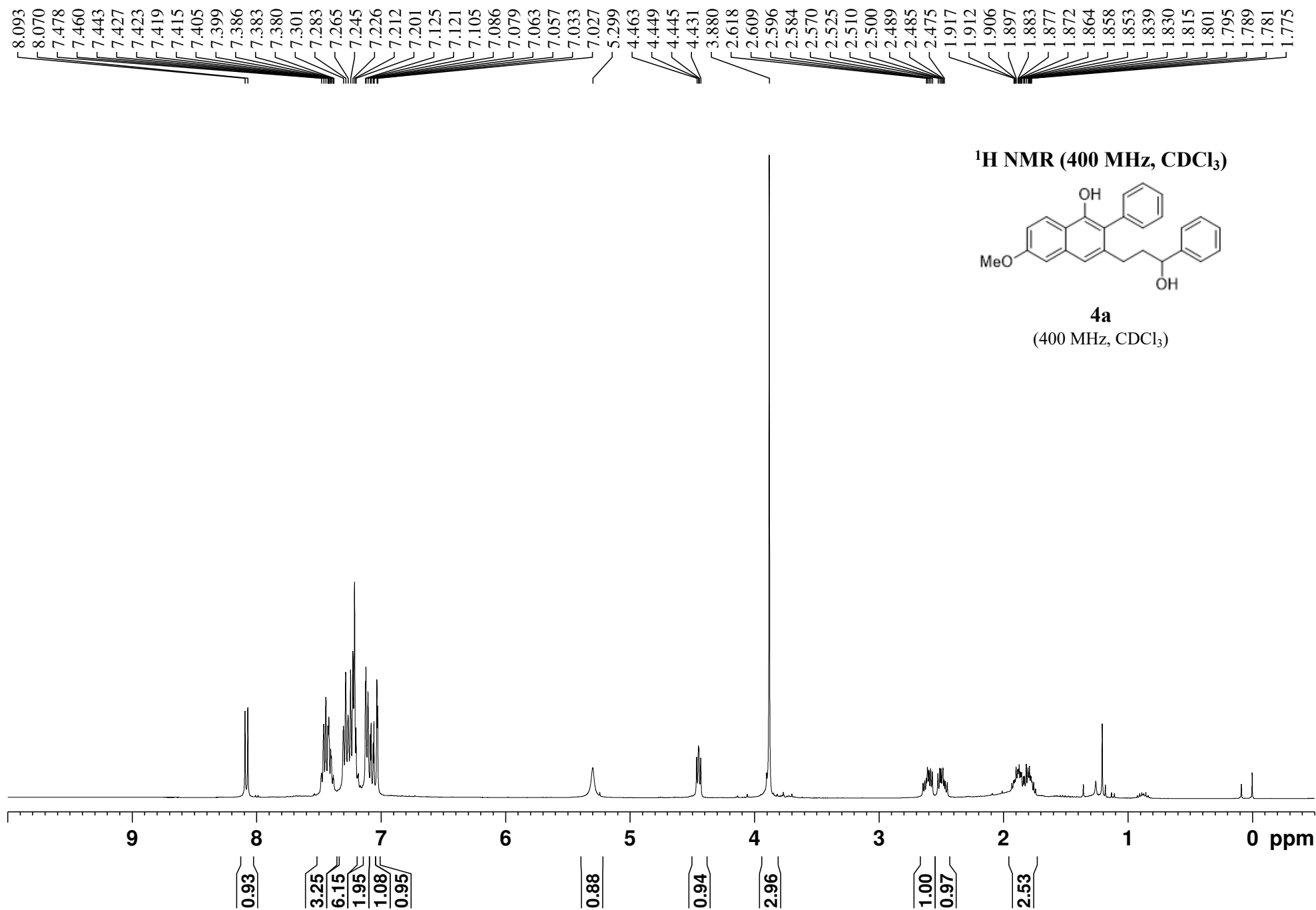
— 13.54

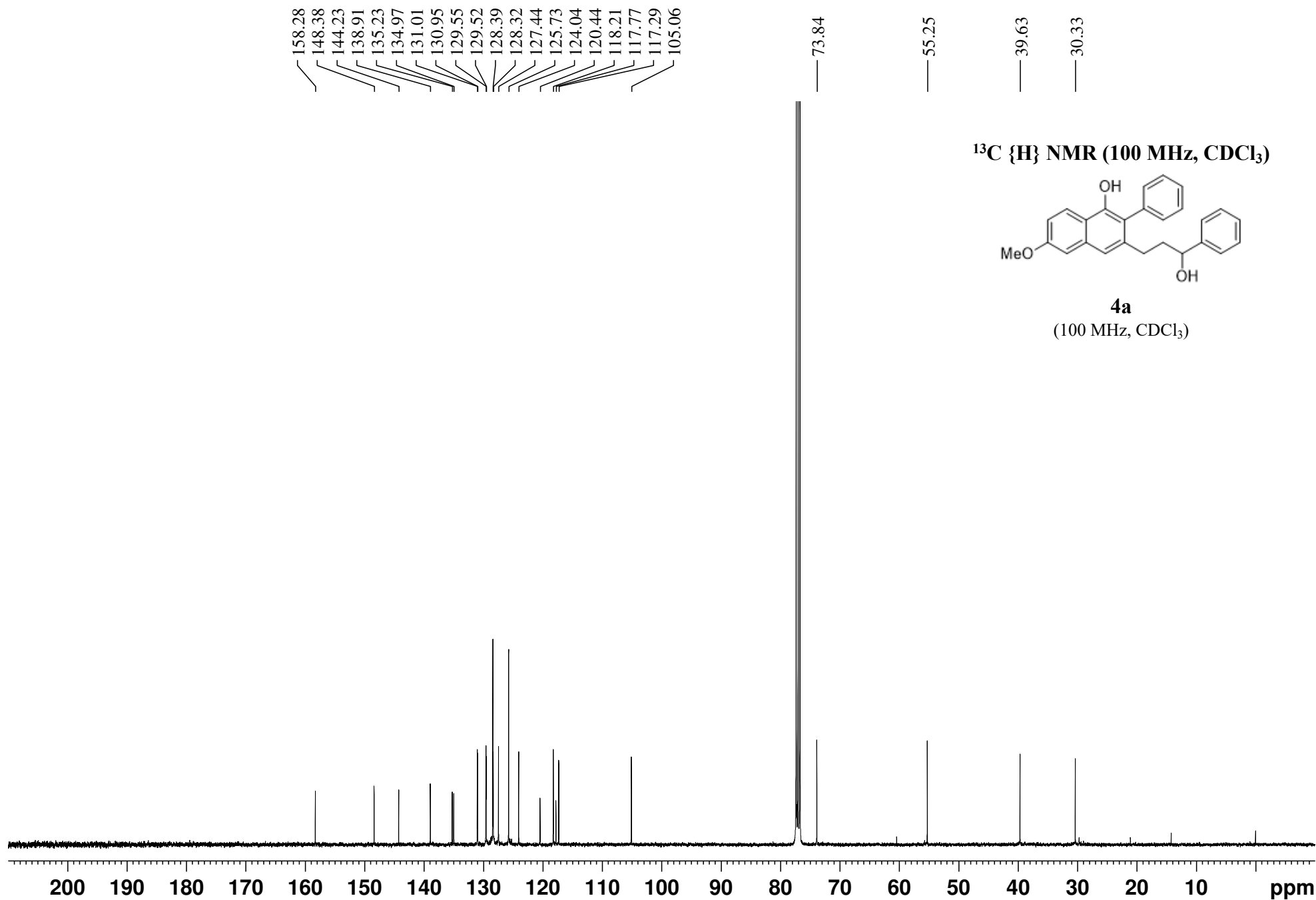
¹³C {¹H} NMR (75 MHz, CDCl₃)

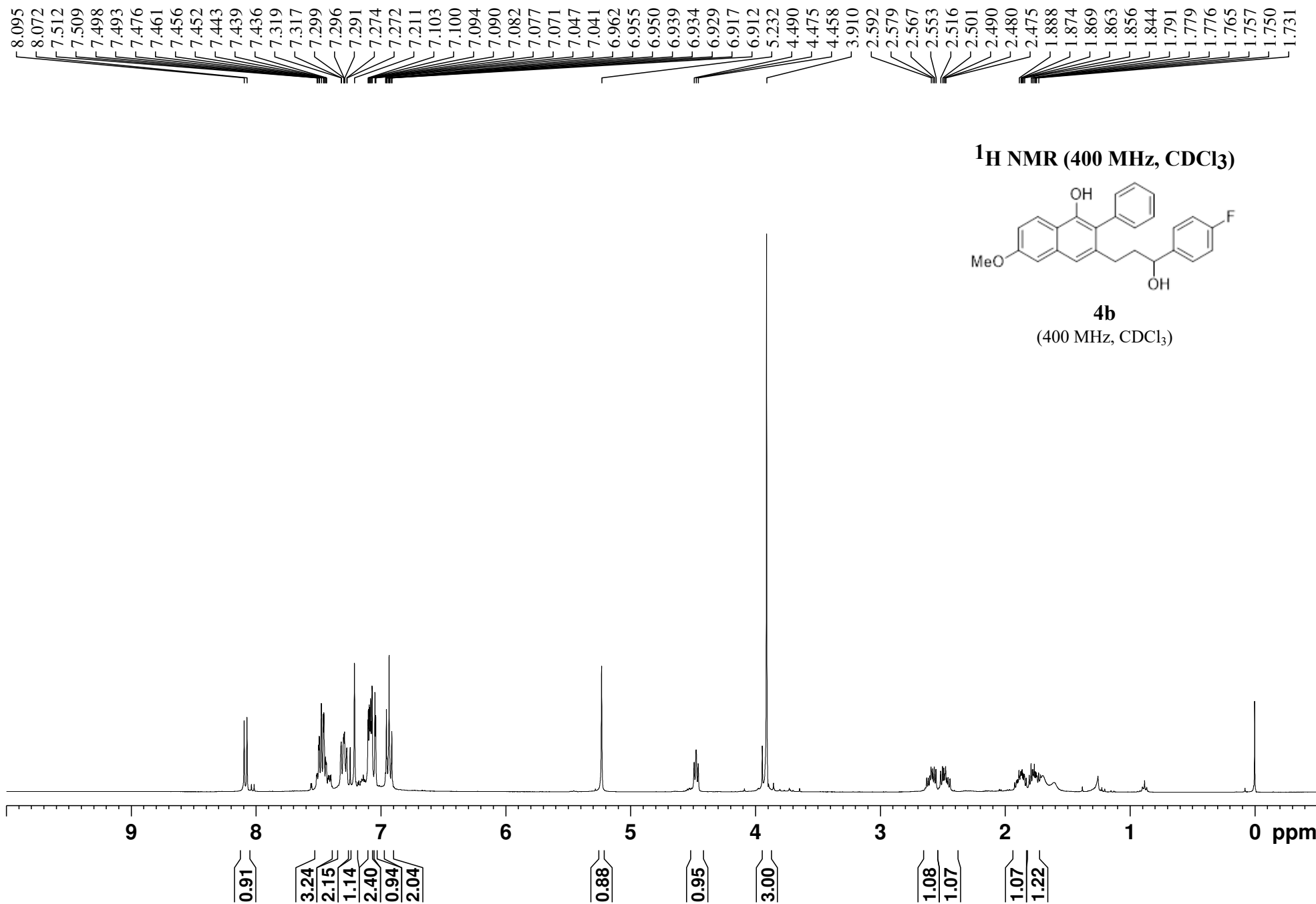


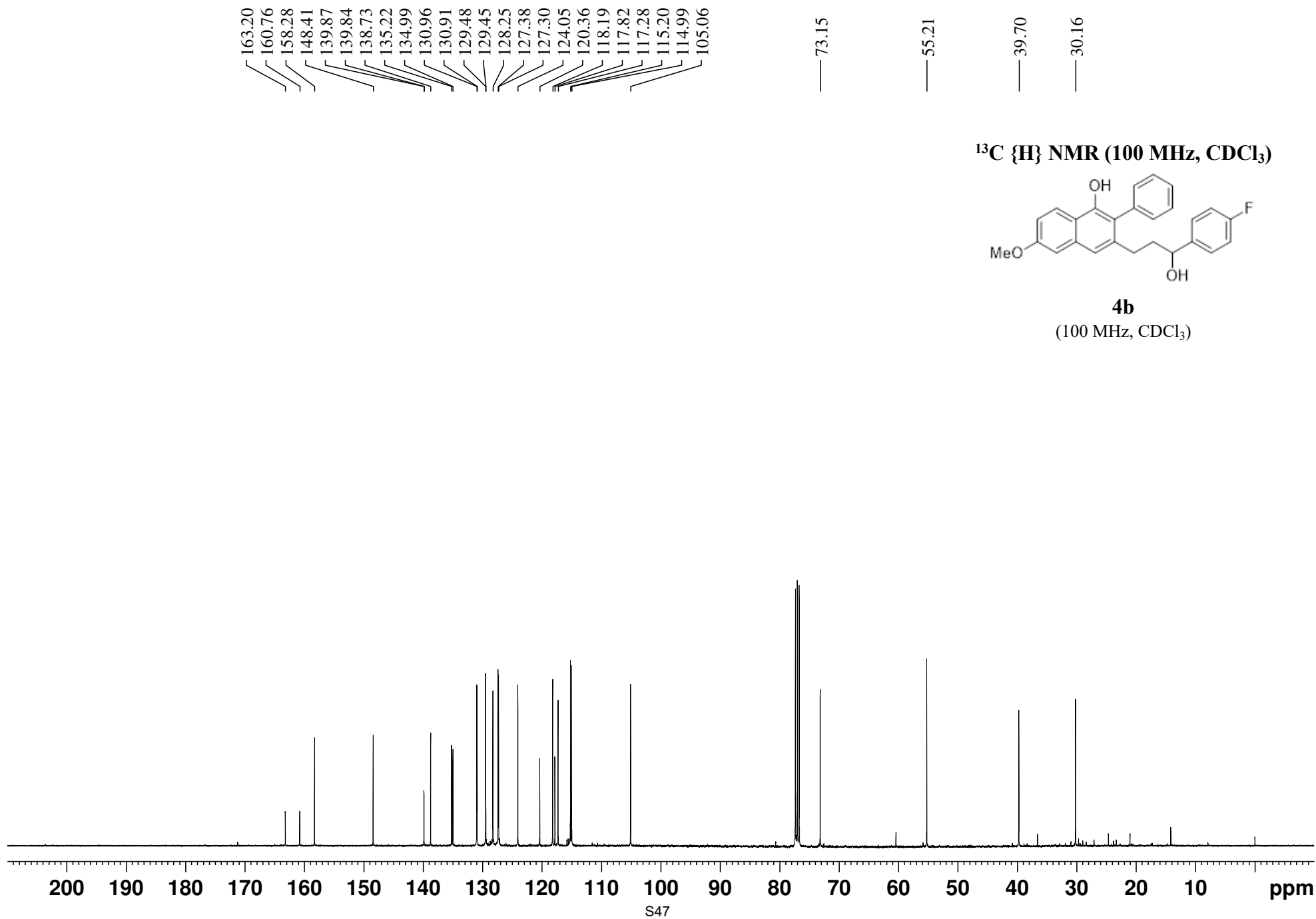
7X
(75 MHz, CDCl₃)





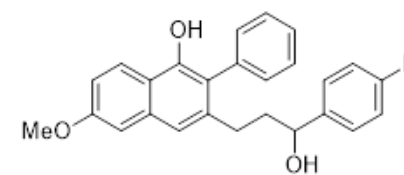






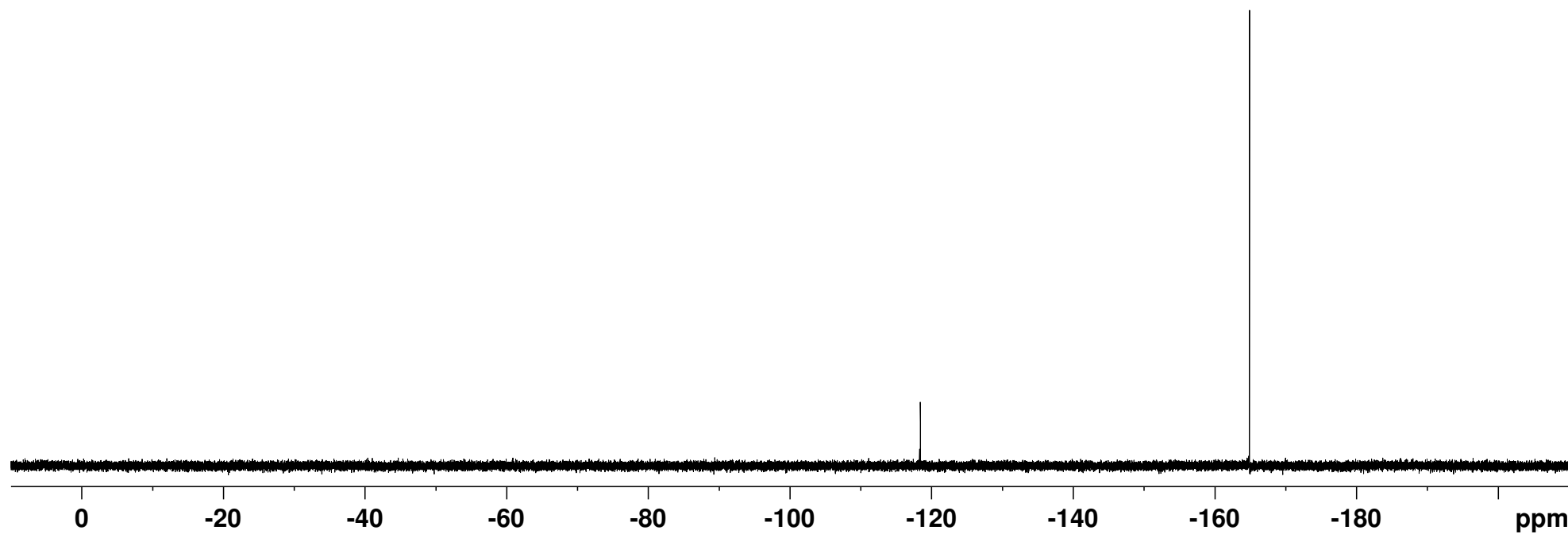
— -118.43

^{19}F NMR (376 MHz, CDCl_3)



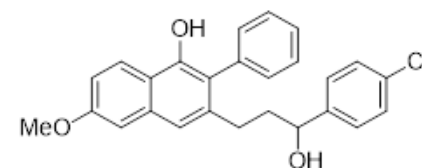
4b

(376 MHz, CDCl_3)



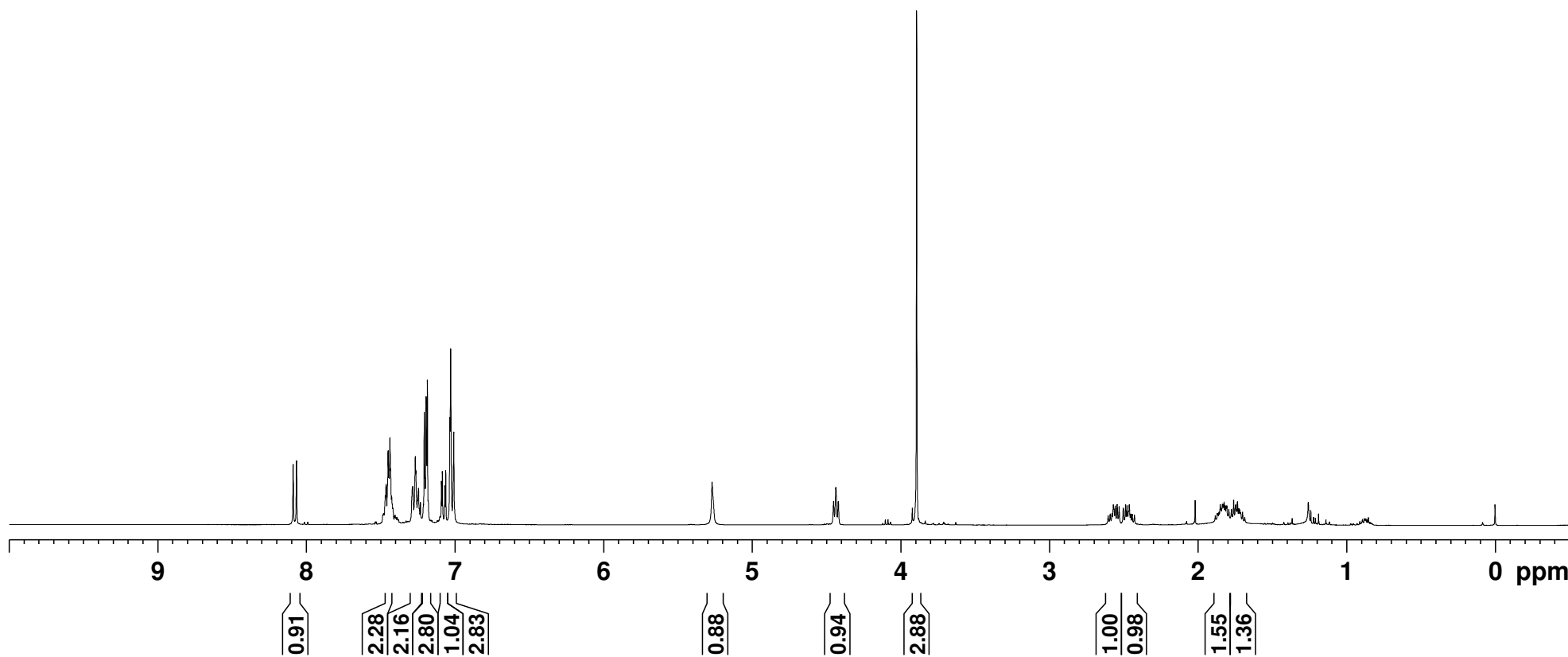
8.088
8.066
7.468
7.463
7.449
7.444
7.442
7.437
7.432
7.425
7.286
7.283
7.266
7.262
7.252
7.248
7.245
7.239
7.232
7.206
7.201
7.193
7.185
7.090
7.084
7.068
7.061
7.034
7.028
7.007
5.269
4.451
4.436
4.419
3.892
2.568
2.555
2.543
2.529
2.501
2.486
2.476
2.466
2.461
1.857
1.848
1.843
1.838
1.834
1.830
1.823
1.816
1.809
1.805
1.791
1.773
1.759
1.747
1.744
1.739
1.733
1.724
1.718
1.713
1.699

¹H NMR (400 MHz, CDCl₃)



4c

(400 MHz, CDCl₃)



158.28
148.42
142.58
138.65
135.22
134.95
132.91
130.93
130.89
129.47
129.45
128.41
128.26
127.07
124.05
120.34
118.22
117.83
117.29
105.08

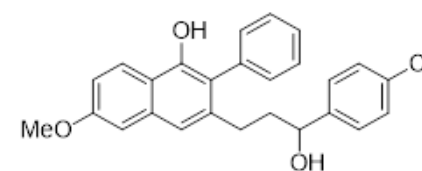
73.07

55.21

39.67

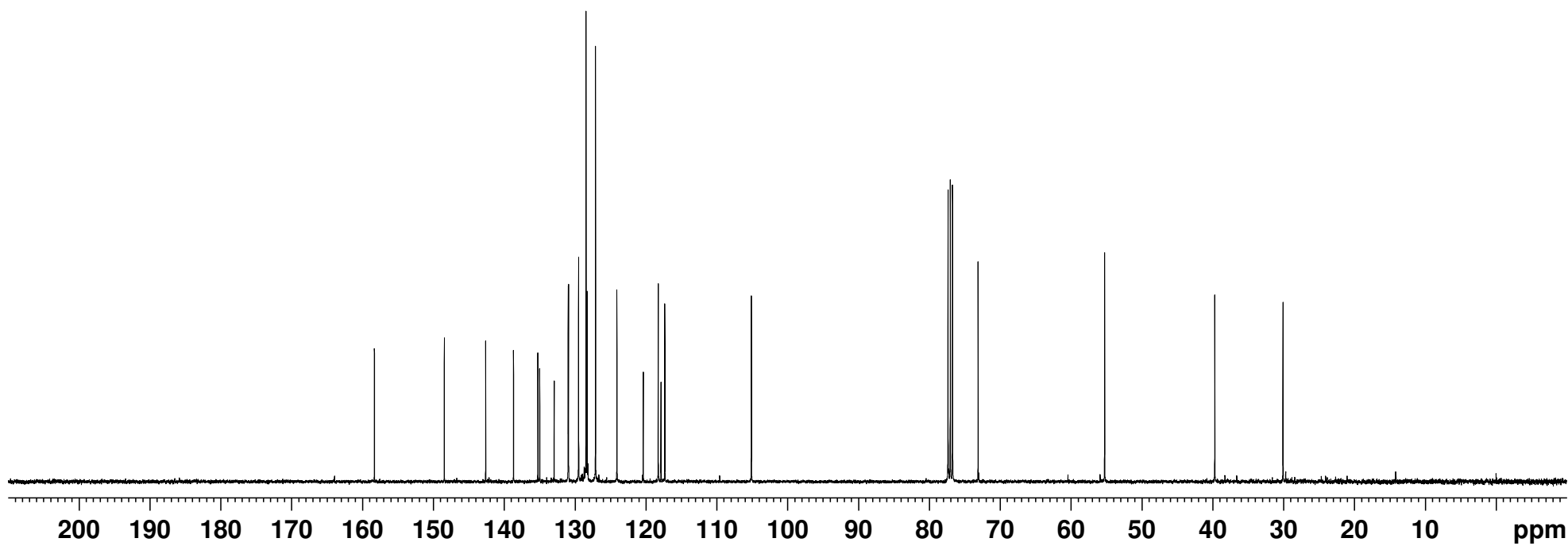
30.04

^{13}C {H} NMR (100 MHz, CDCl_3)

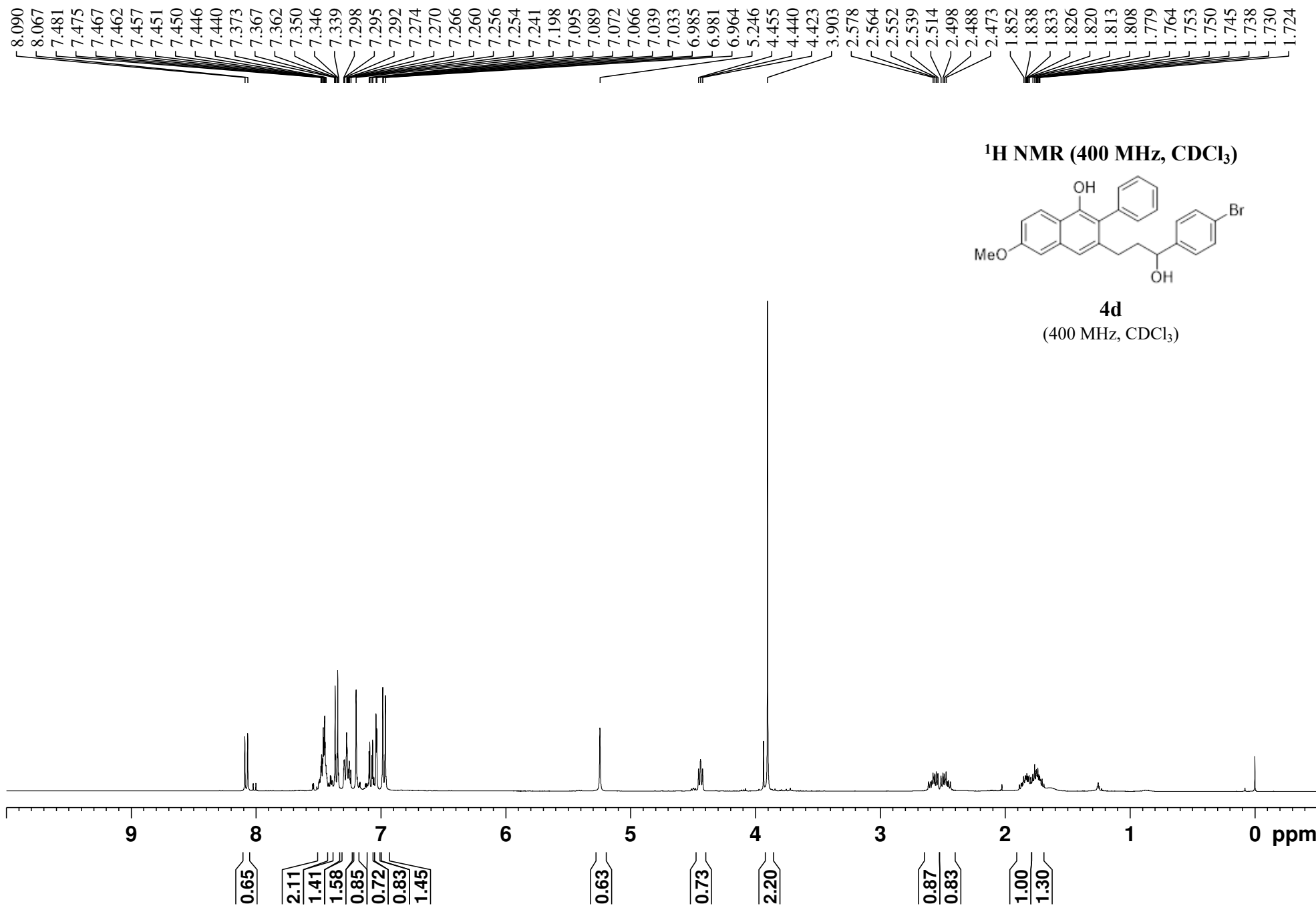


4c

(100 MHz, CDCl_3)



S50



158.30
148.43
143.12
138.63
135.22
134.93
131.37
130.94
130.89
129.50
129.48
128.29
127.43
124.06
121.07
120.33
118.24
117.83
117.31
105.07

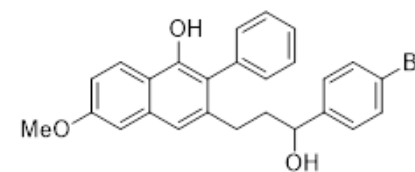
73.11

55.23

39.66

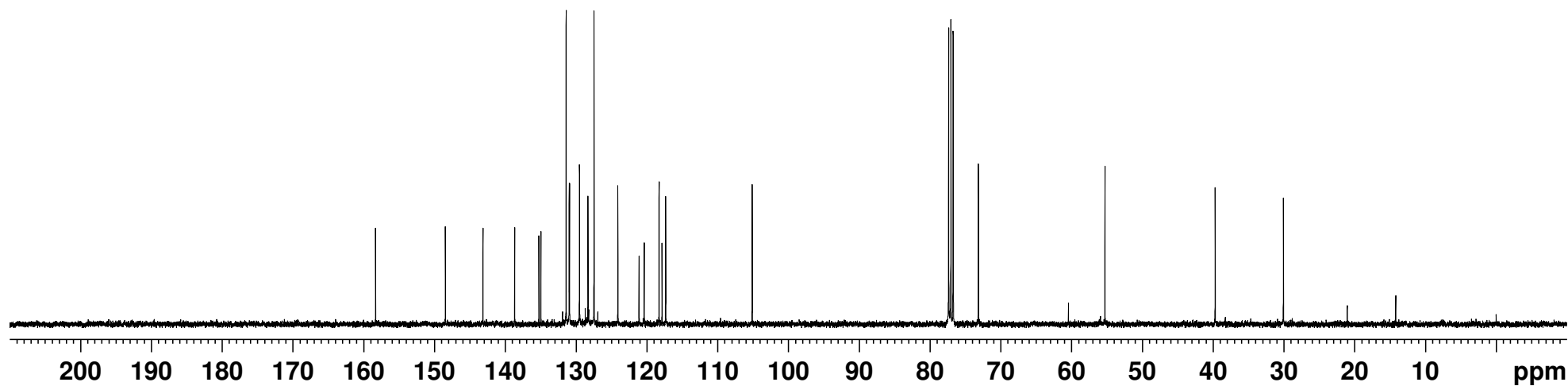
30.02

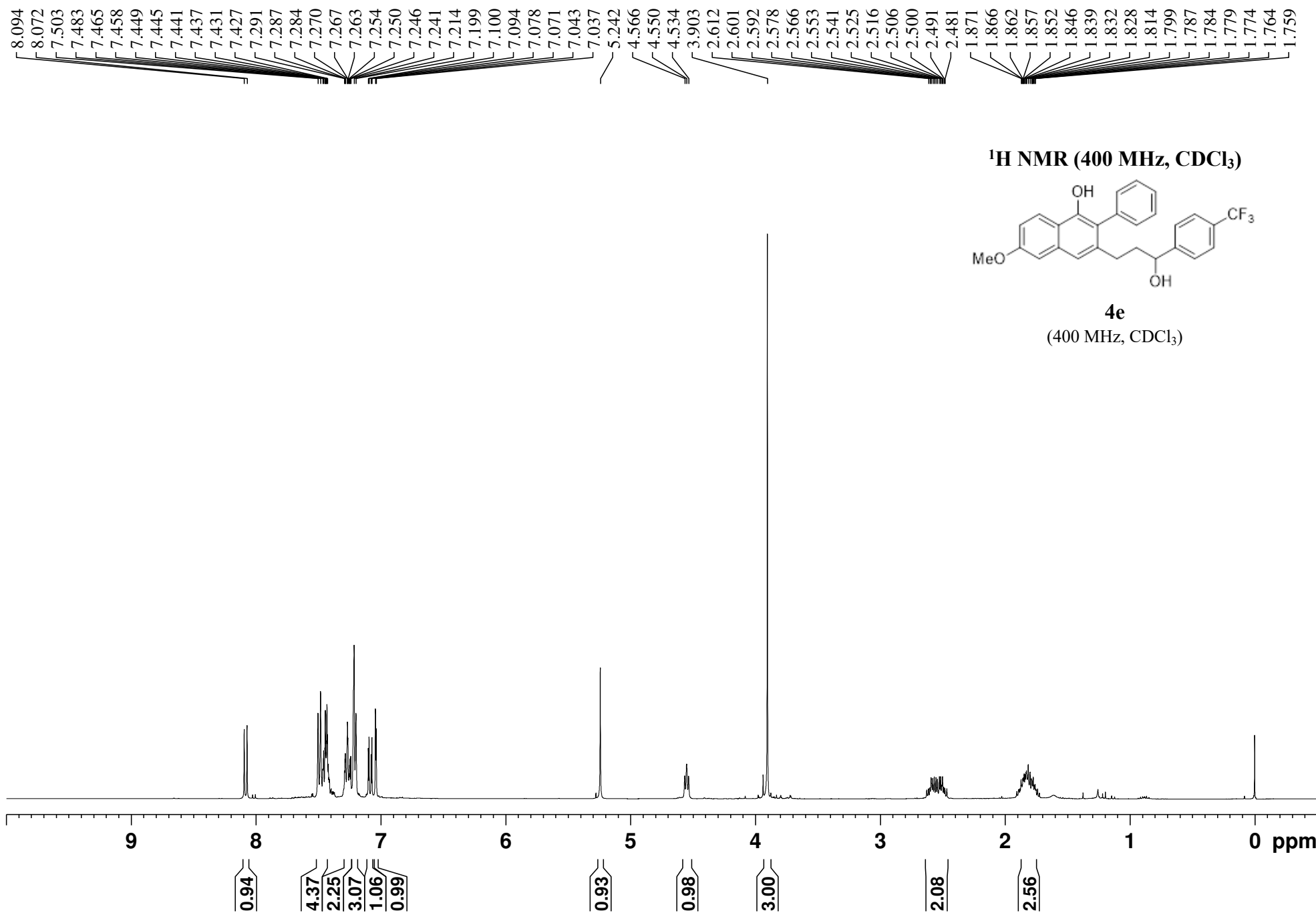
^{13}C {H} NMR (100 MHz, CDCl_3)

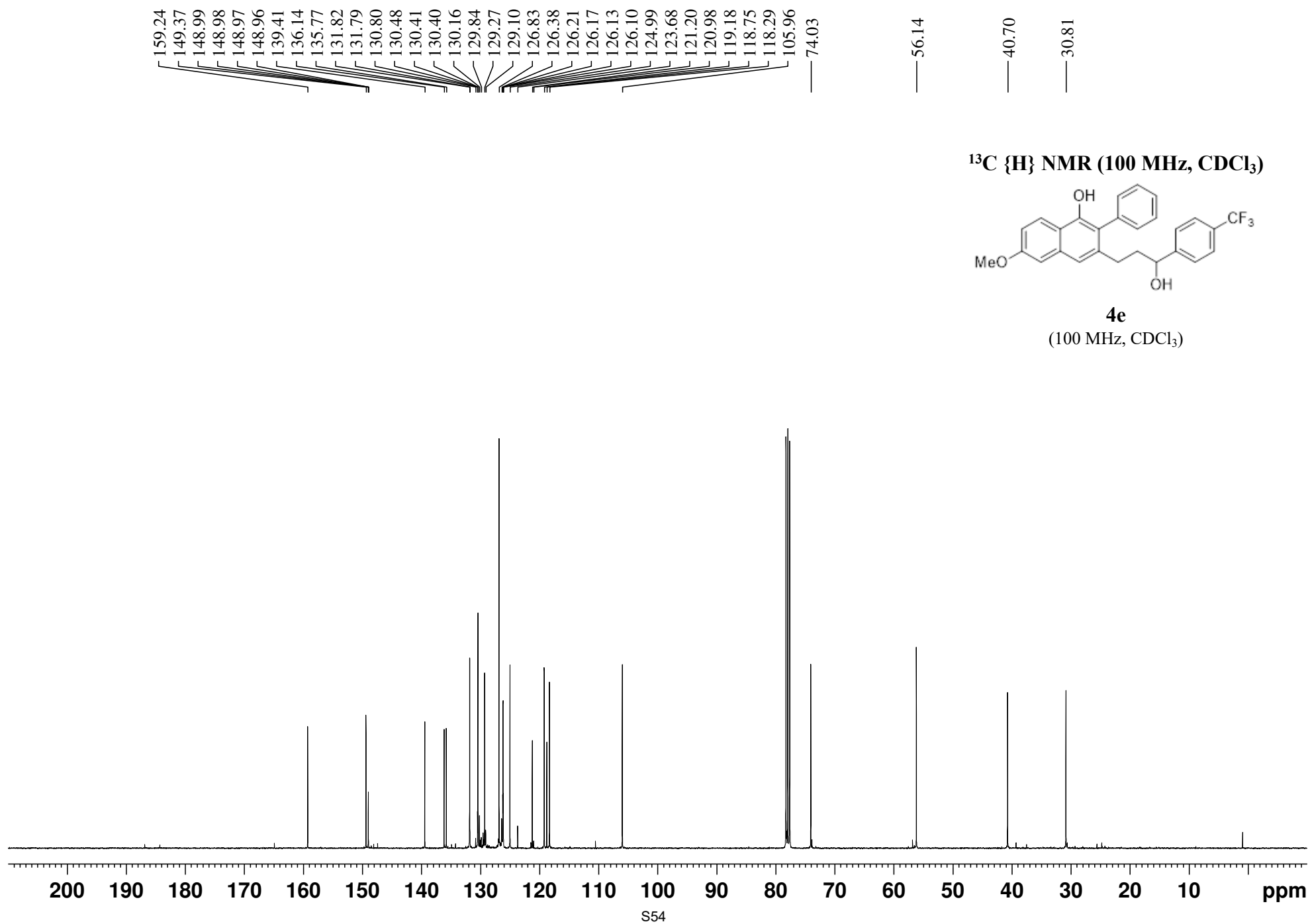


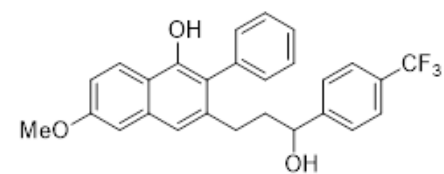
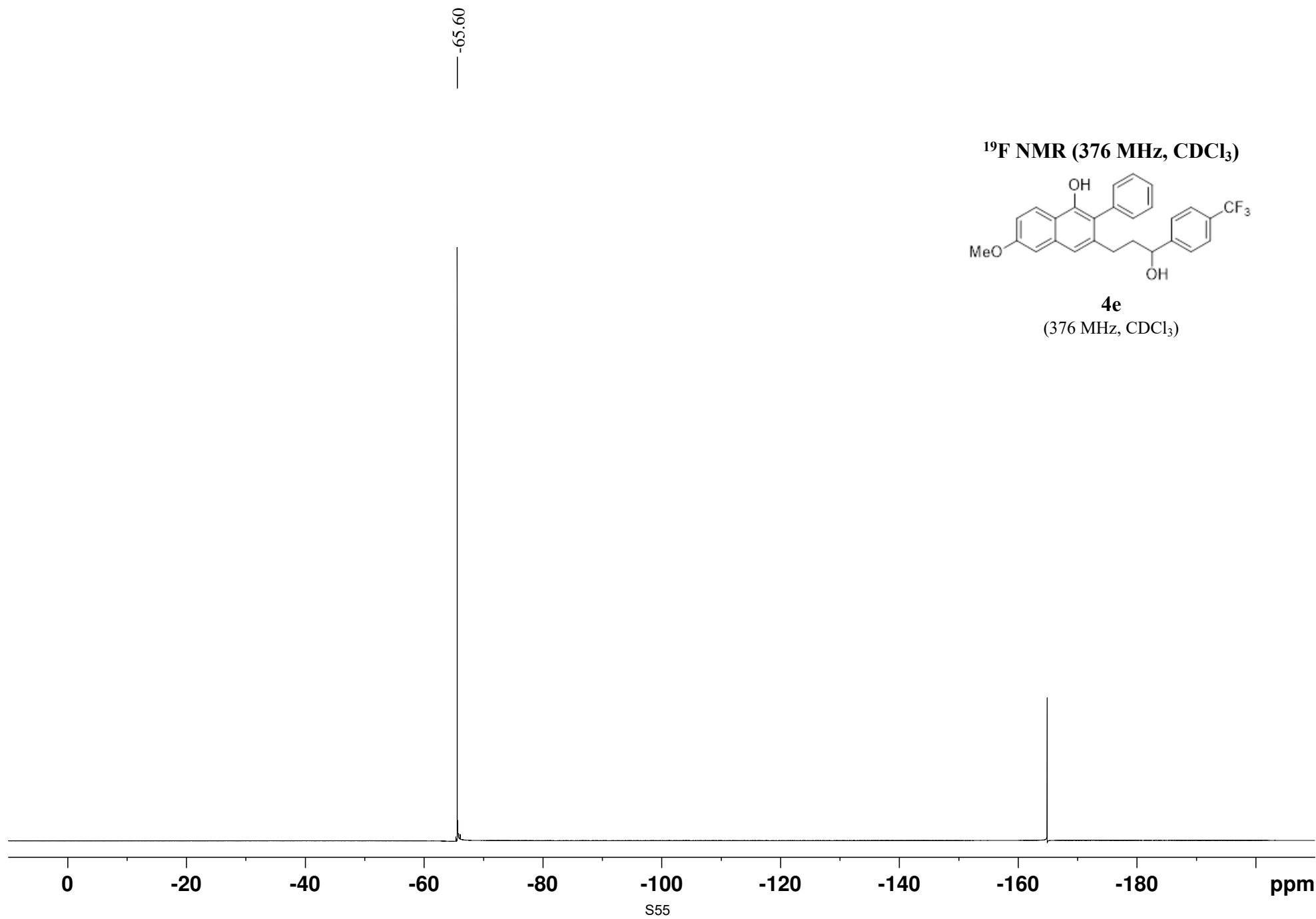
4d

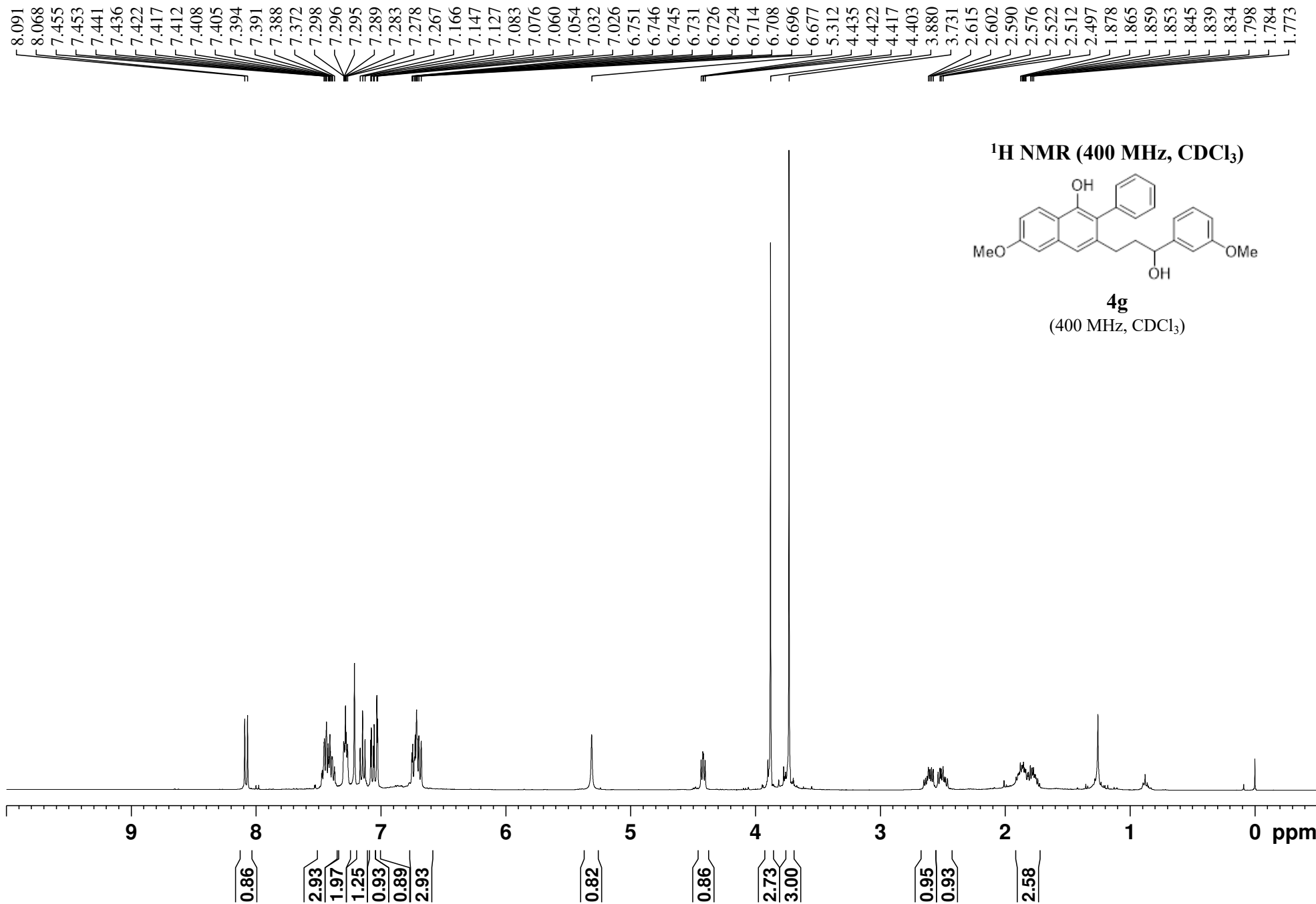
(100 MHz, CDCl_3)

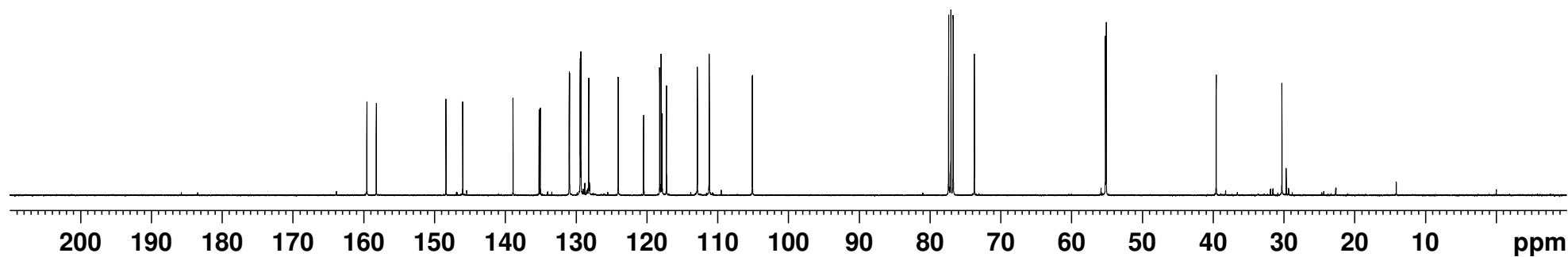






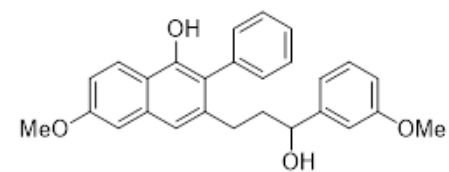




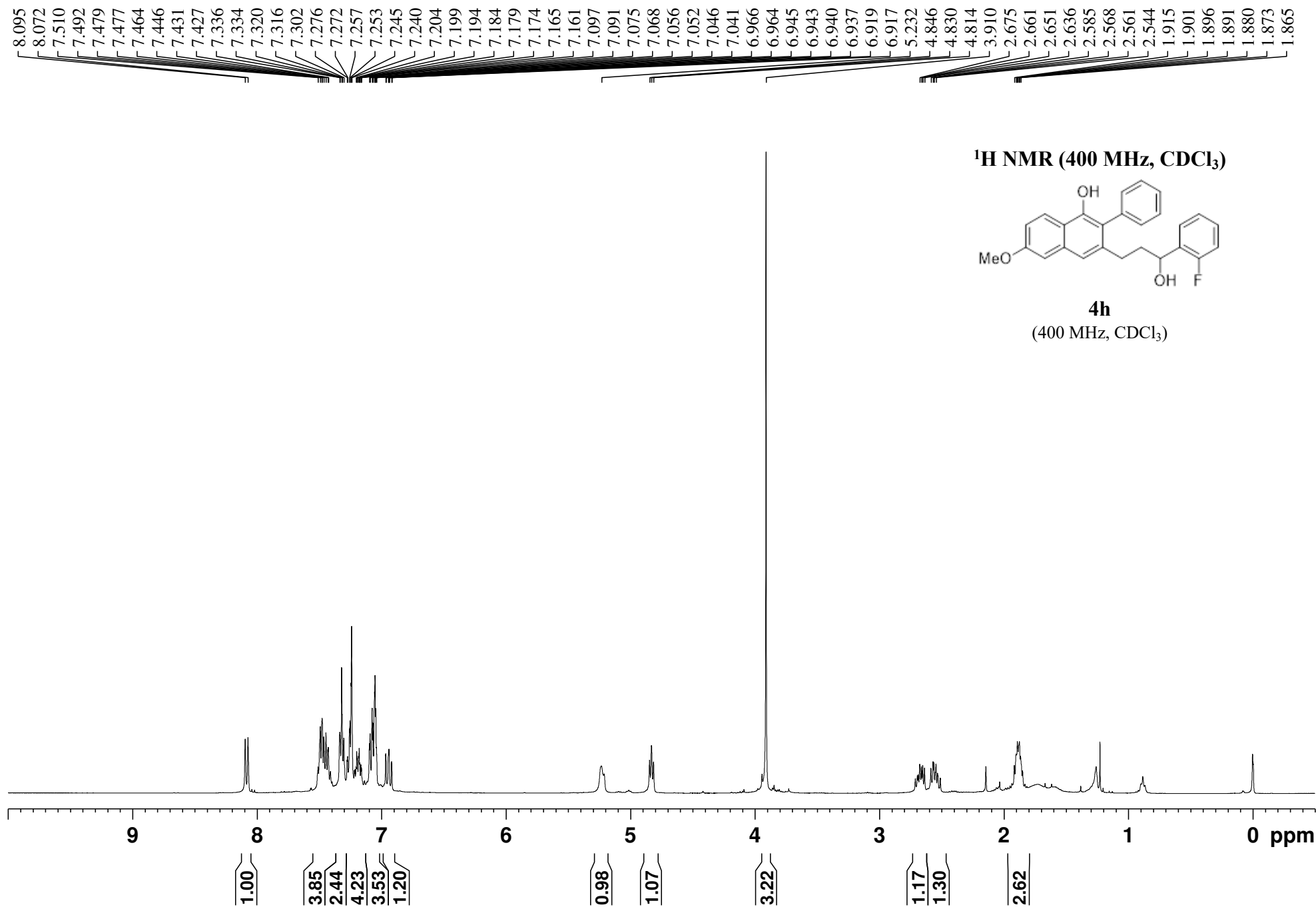


S57

^{13}C {H} NMR (100 MHz, CDCl_3)



4g
(100 MHz, CDCl_3)



160.88
158.44
158.27
148.39
138.74
135.24
134.94
131.23
131.10
130.98
130.93
129.48
128.71
128.63
128.29
127.09
127.04
124.18
124.14
124.04
120.45
118.21
117.81
117.28
115.30
115.09
105.09

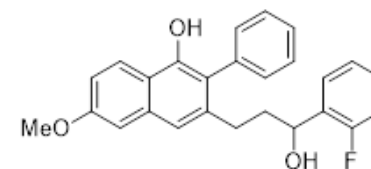
67.89
67.87

55.23

38.62

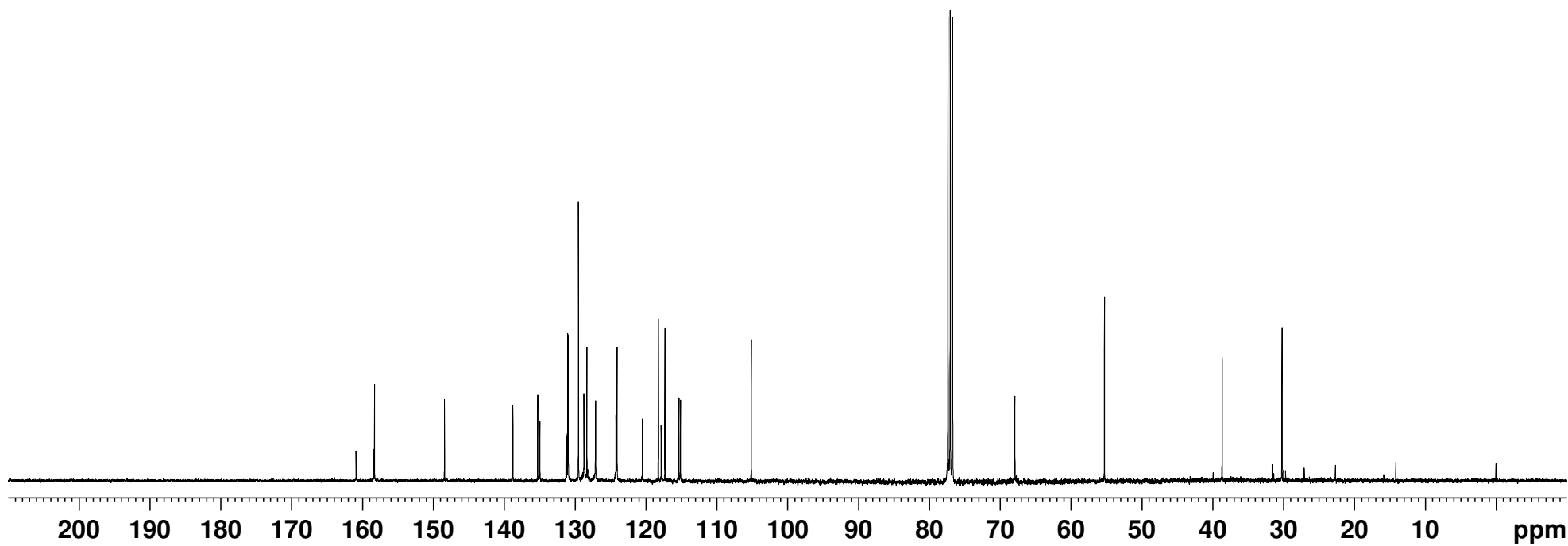
30.17

^{13}C {H} NMR (100 MHz, CDCl_3)

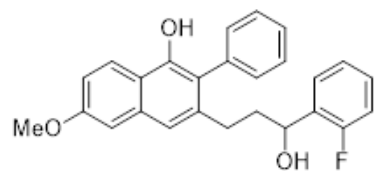


4h

(100 MHz, CDCl_3)



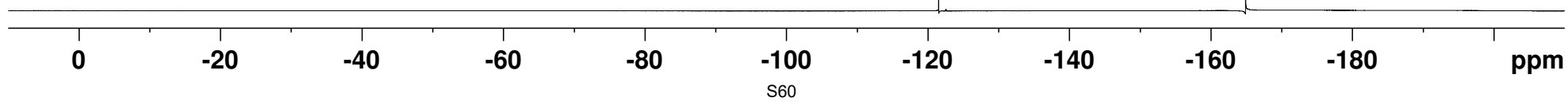
^{19}F NMR (376 MHz, CDCl_3)

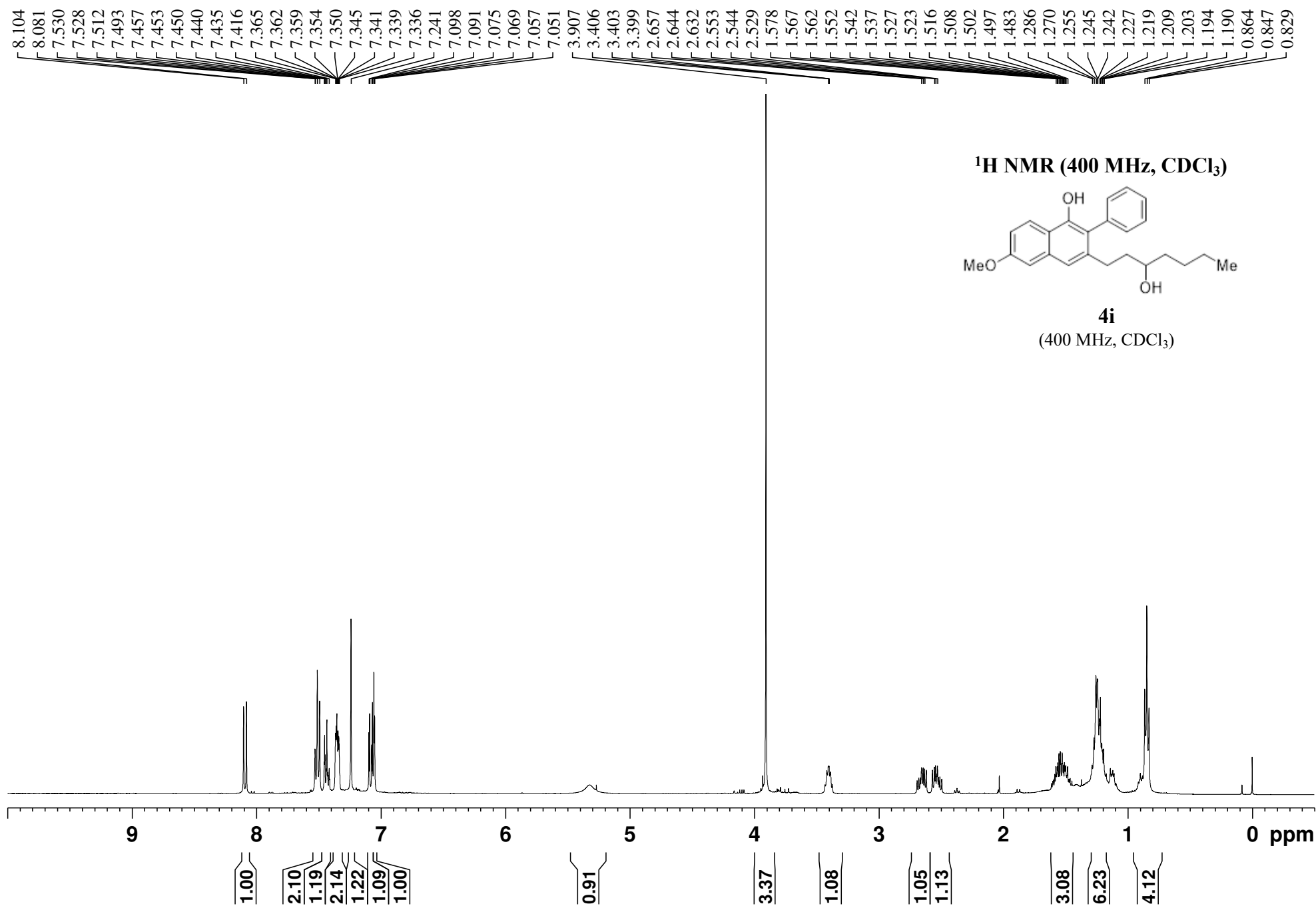


4h

(376 MHz, CDCl_3)

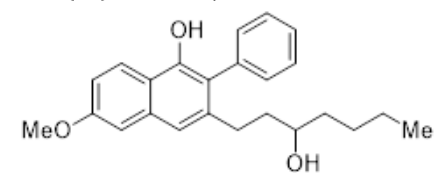
— -121.56





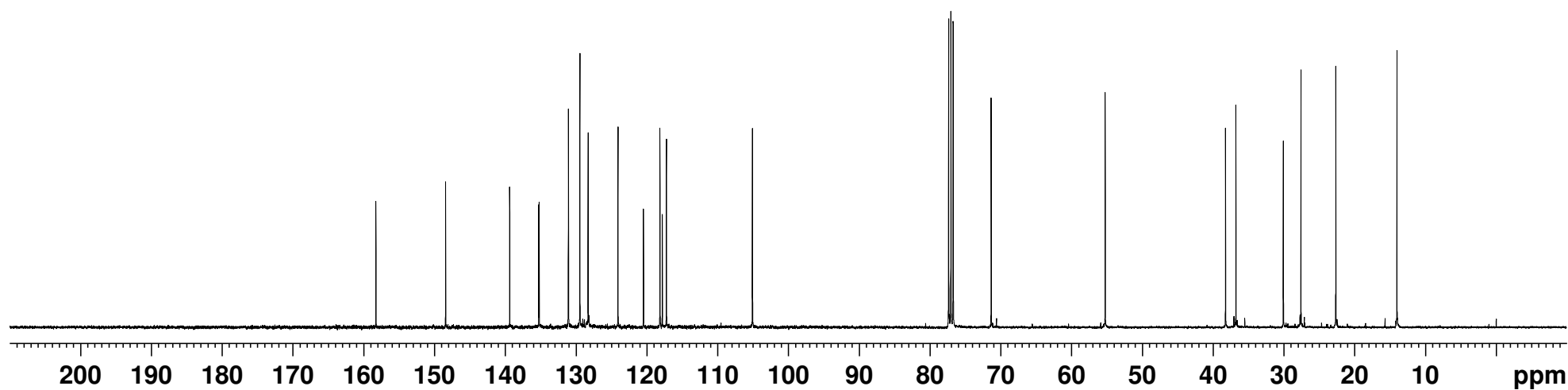


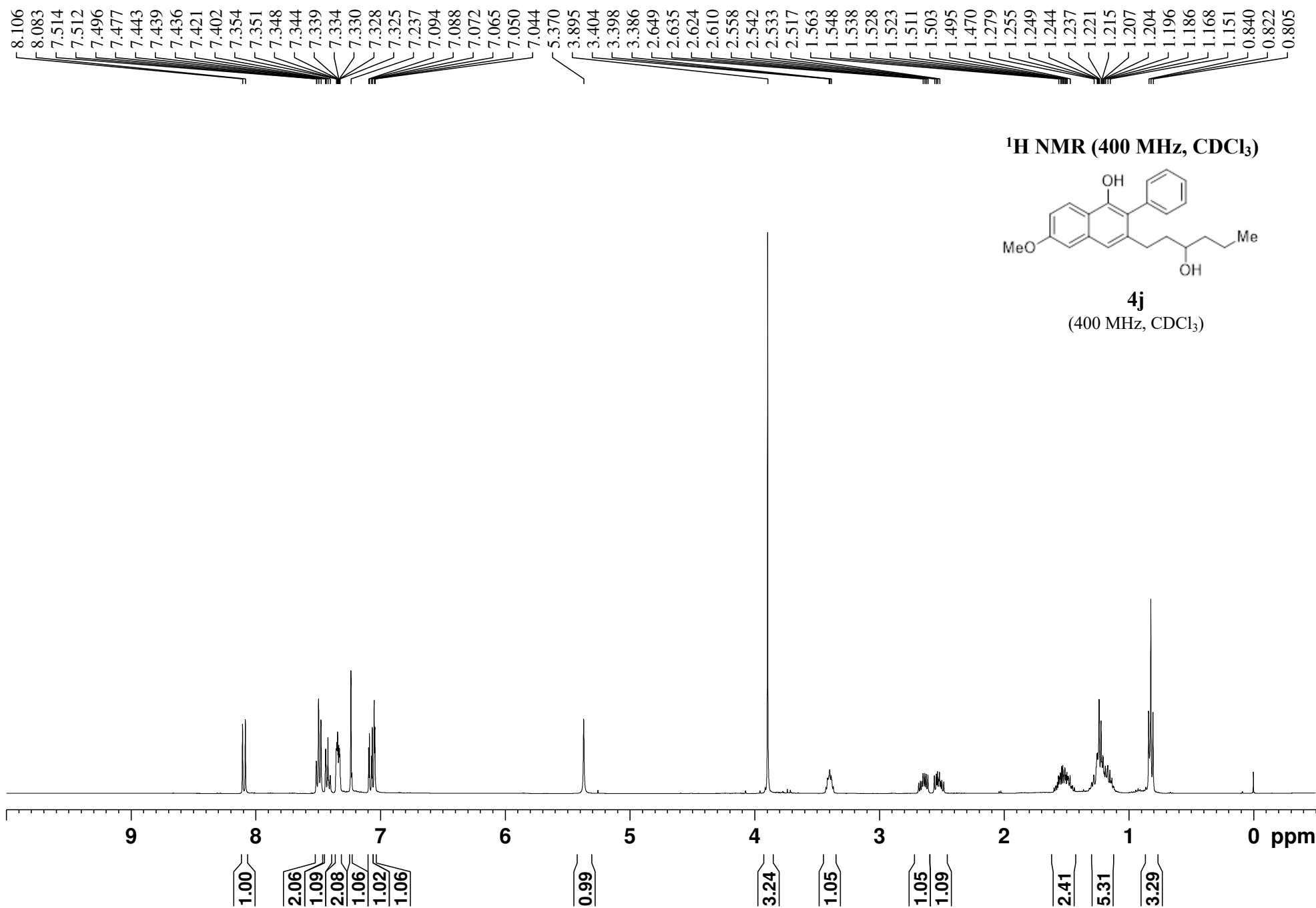
¹³C {¹H} NMR (100 MHz, CDCl₃)



4i

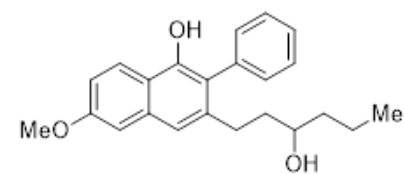
(100 MHz, CDCl₃)



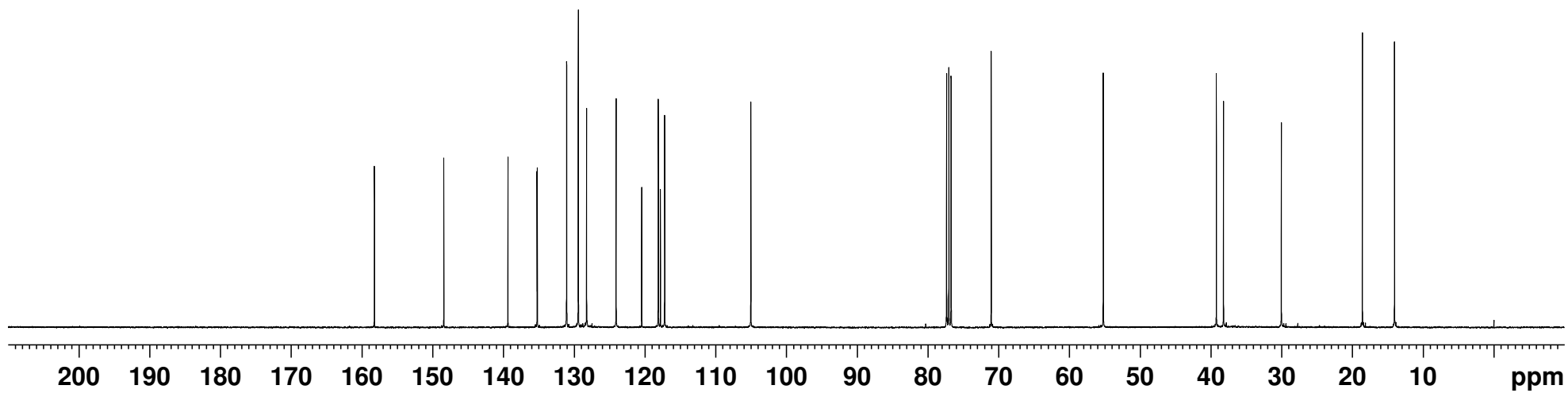




^{13}C {H} NMR (100 MHz, CDCl_3)

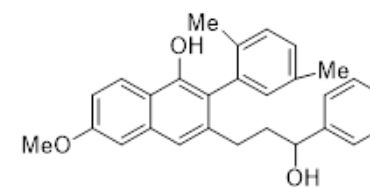


4j
(100 MHz, CDCl_3)



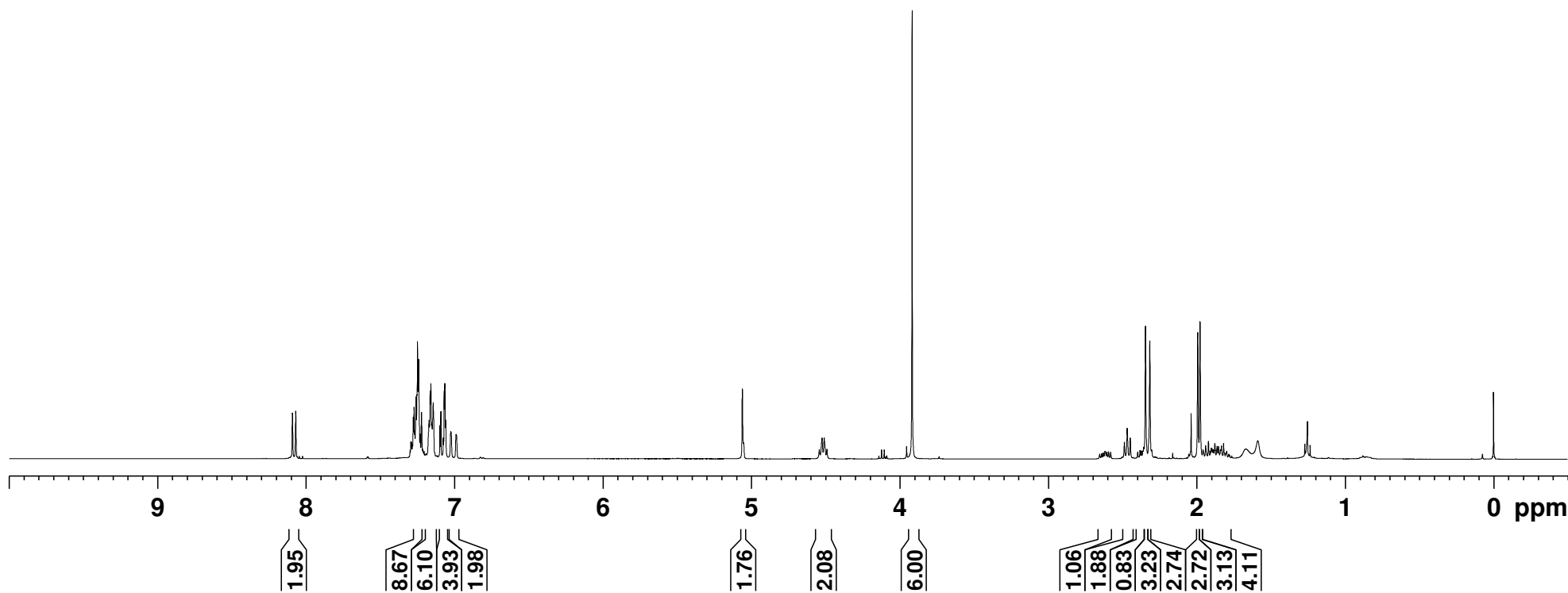


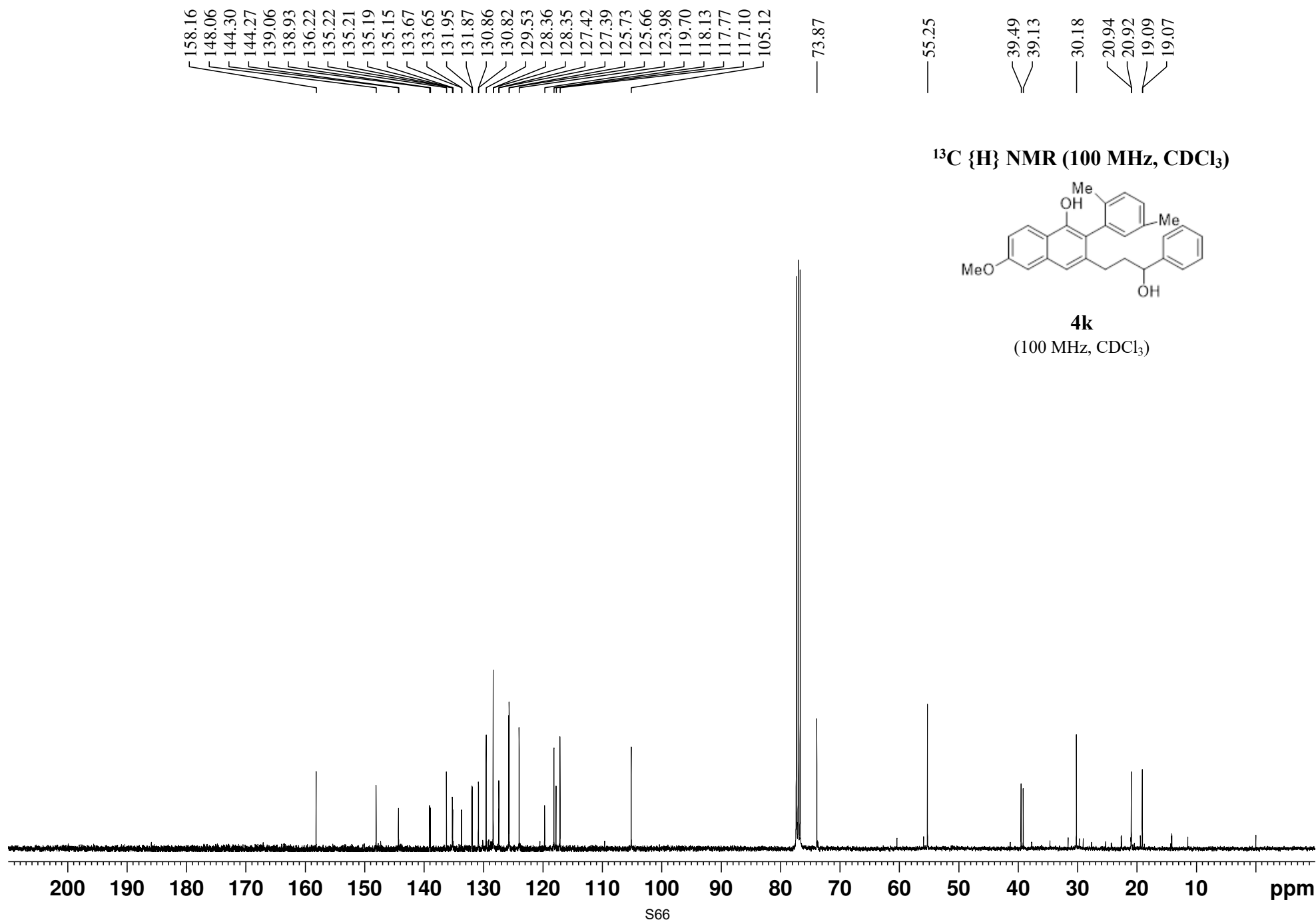
¹H NMR (400 MHz, CDCl₃)



4k

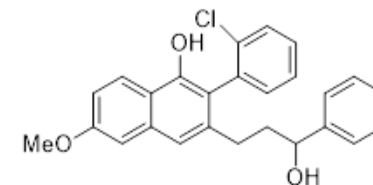
(400 MHz, CDCl₃)





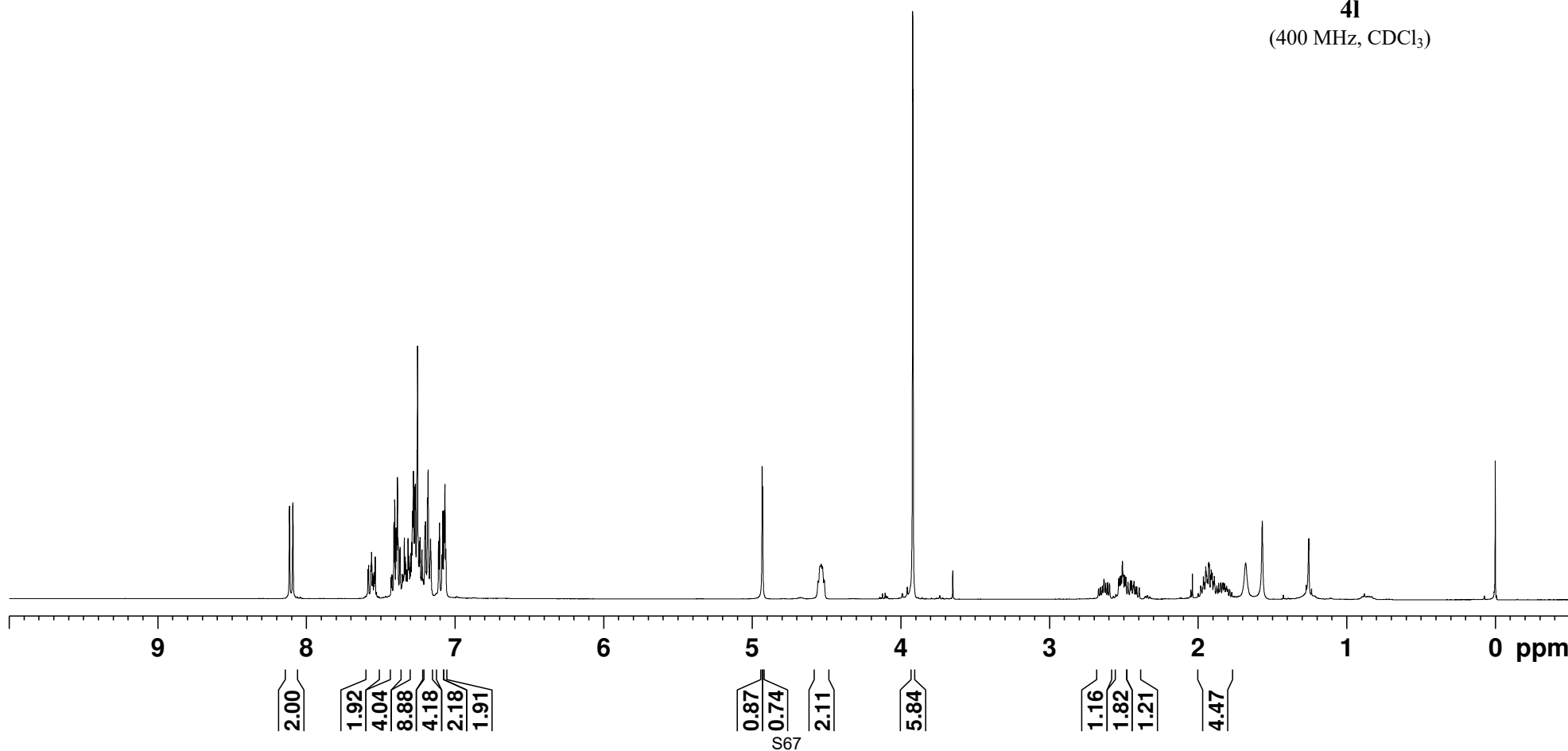
8.113
8.091
7.585
7.581
7.565
7.562
7.554
7.541
7.537
7.425
7.411
7.406
7.397
7.392
7.391
7.387
7.383
7.372
7.369
7.316
7.311
7.309
7.297
7.292
7.286
7.280
7.271
7.267
7.255
7.252
7.247
7.243
7.239
7.234
7.222
7.202
7.198
7.185
7.181
7.164
7.110
7.104
7.087
7.082
7.073
7.067
7.061
4.933
4.929
4.543
4.536
4.527
3.920
3.918
2.509
2.503
2.494
1.948
1.945
1.942
1.928
1.923
1.914
1.910
1.904

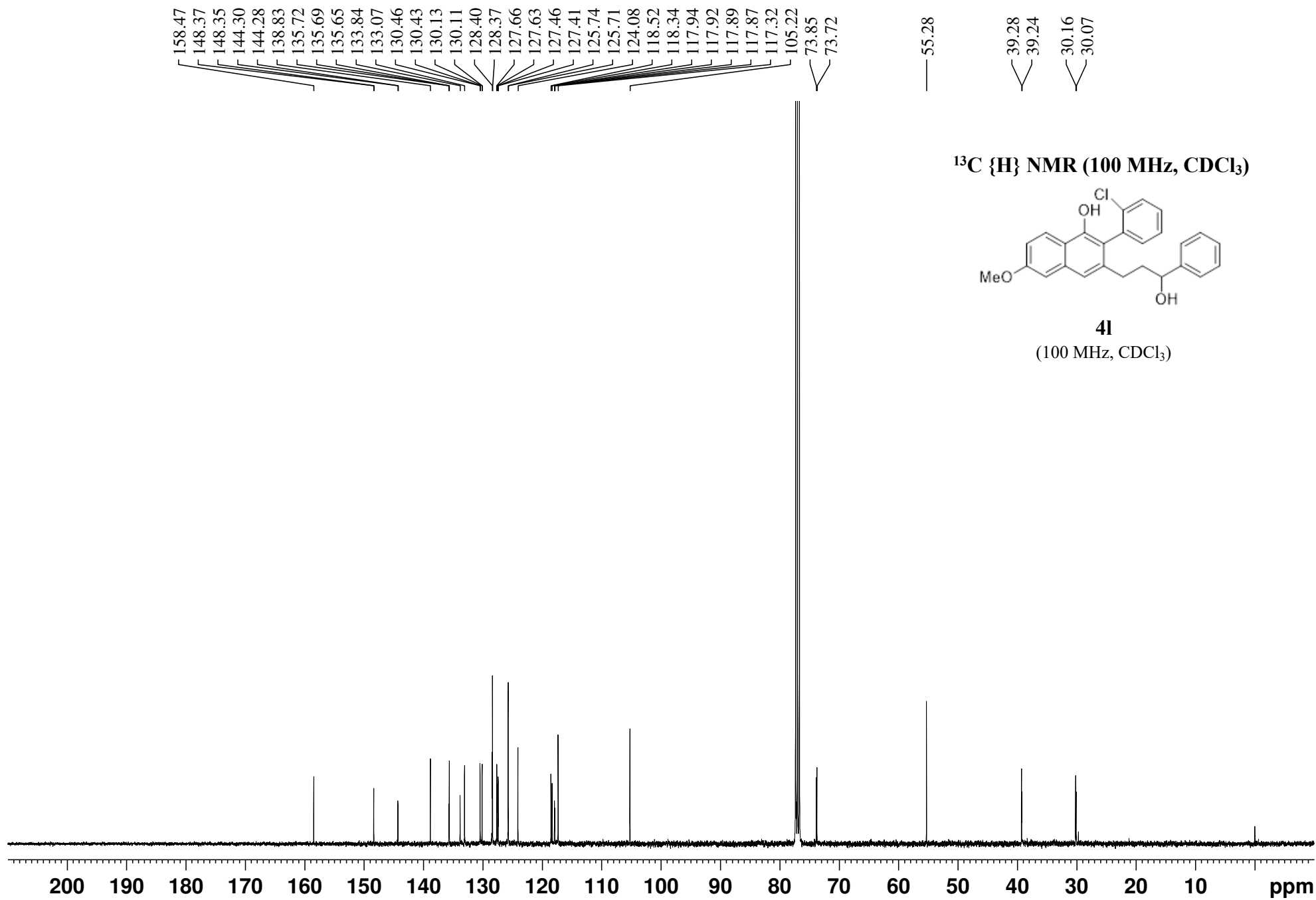
¹H NMR (400 MHz, CDCl₃)



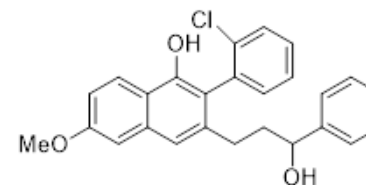
41

(400 MHz, CDCl₃)





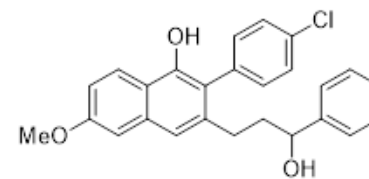
$^{13}\text{C} \{^1\text{H}\}$ NMR (100 MHz, CDCl_3)



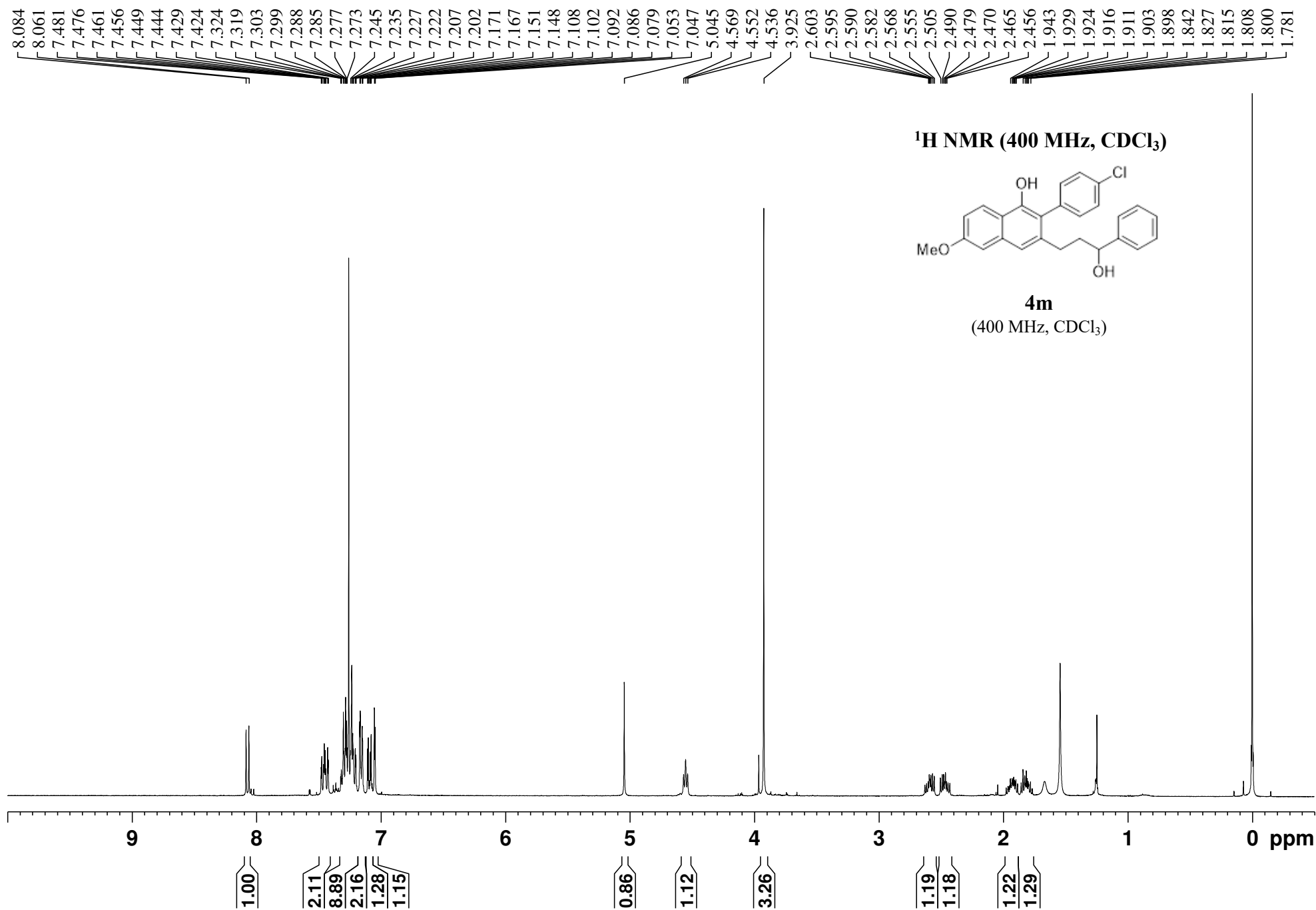
4l

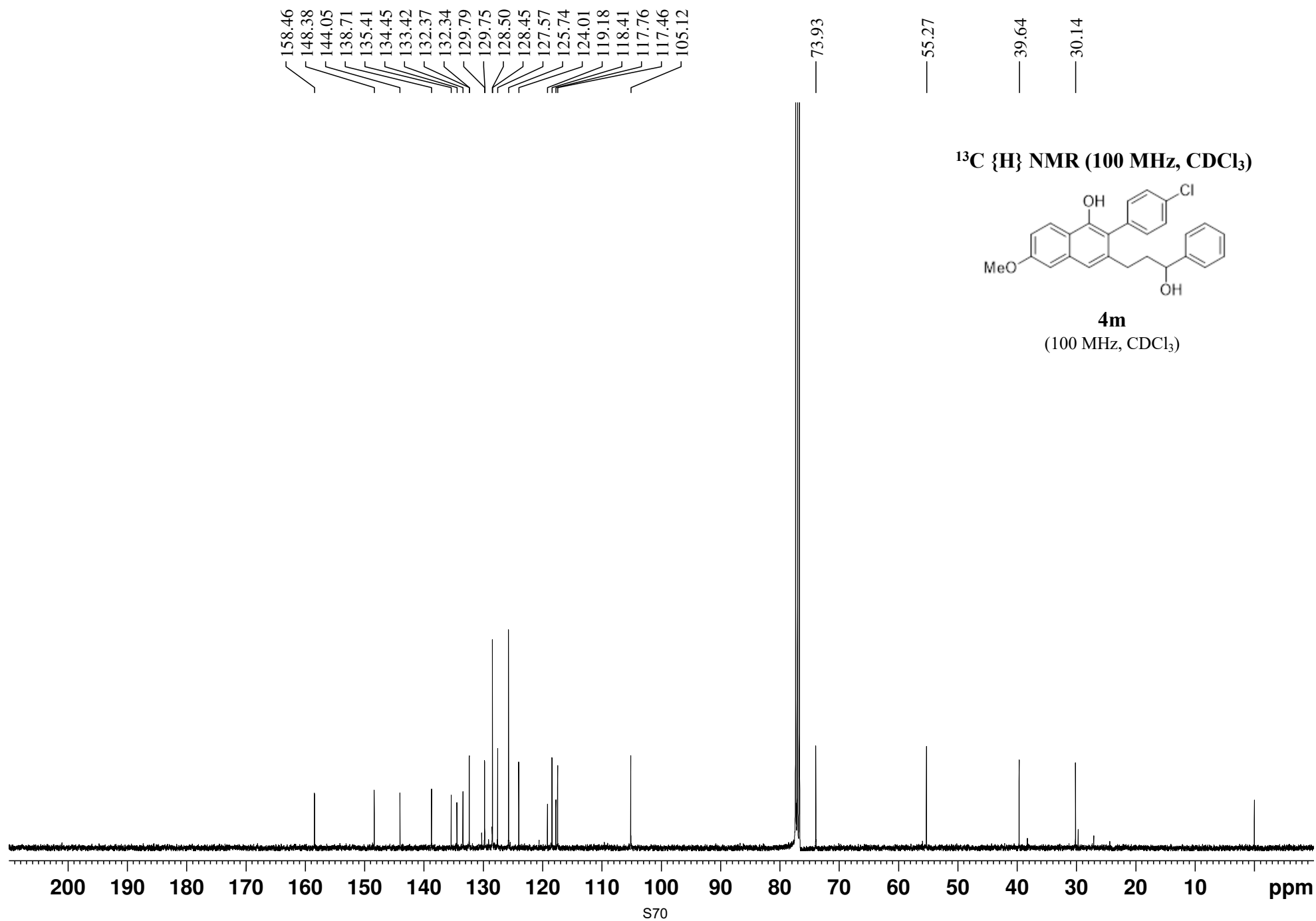
(100 MHz, CDCl_3)

¹H NMR (400 MHz, CDCl₃)



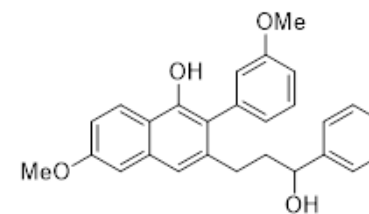
4m
(400 MHz, CDCl₃)



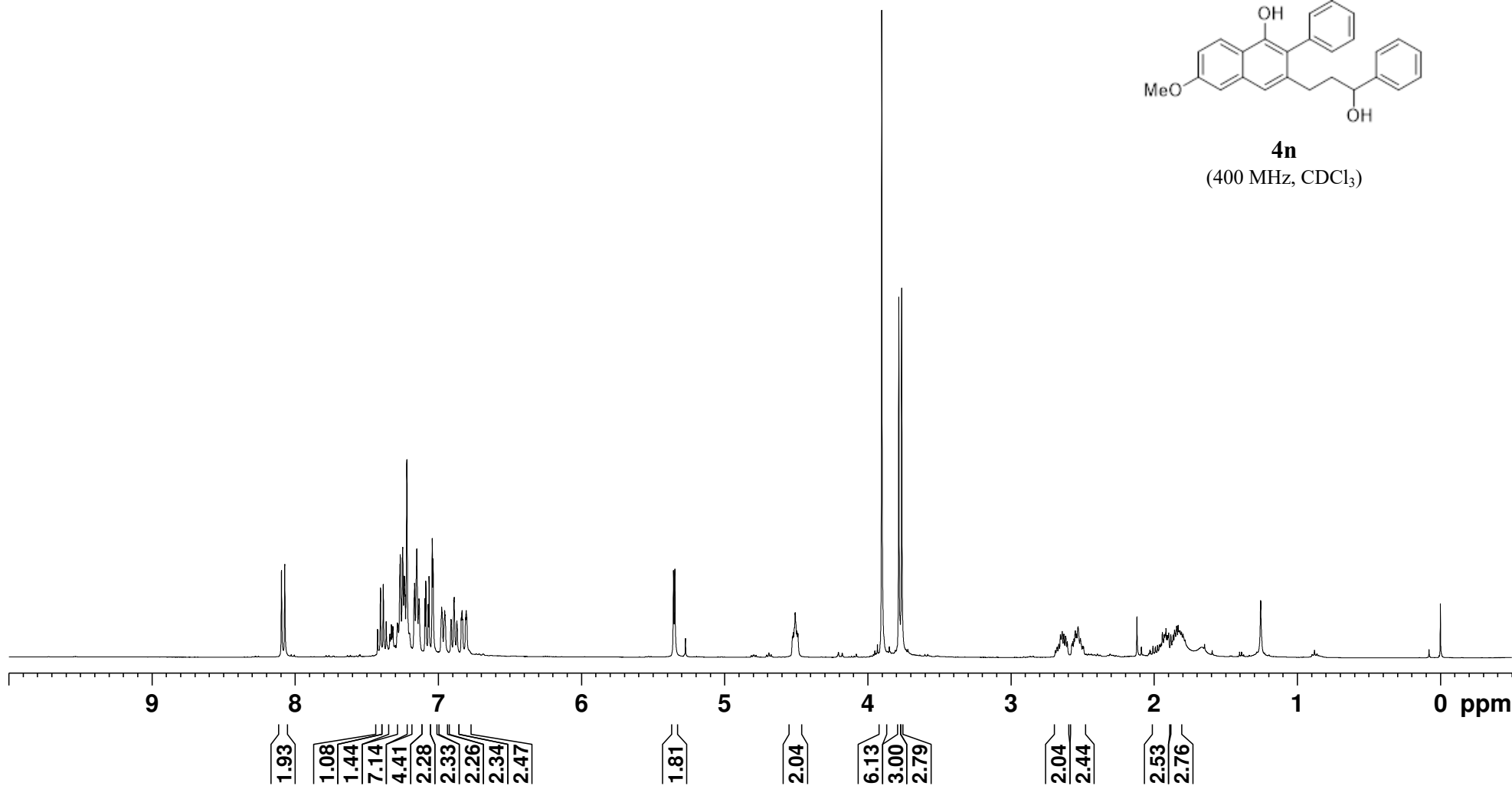


8.095
8.072
7.424
7.403
7.384
7.364
7.265
7.250
7.248
7.239
7.236
7.232
7.219
7.169
7.165
7.150
7.135
7.093
7.087
7.070
7.064
7.042
7.036
6.976
6.974
6.955
6.953
6.910
6.891
6.889
6.869
6.839
6.835
6.833
6.830
6.810
6.806
6.804
6.800
5.357
5.347
4.520
4.513
4.507
4.494
4.488
3.902
3.783
3.763
2.641
2.550
2.542
2.531
1.942
1.917
1.898
1.857
1.852
1.842
1.832
1.826
1.824
1.817
1.808
1.798

¹H NMR (400 MHz, CDCl₃)



4n
(400 MHz, CDCl₃)



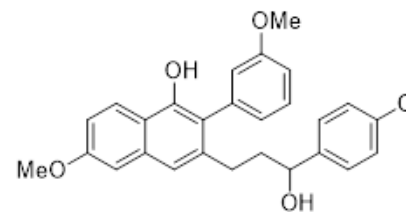
COc1ccc2c(c1)c3cc(OC)ccc3c(O)c2CC(CO)c4ccccc4

4n
(100 MHz, CDCl₃)



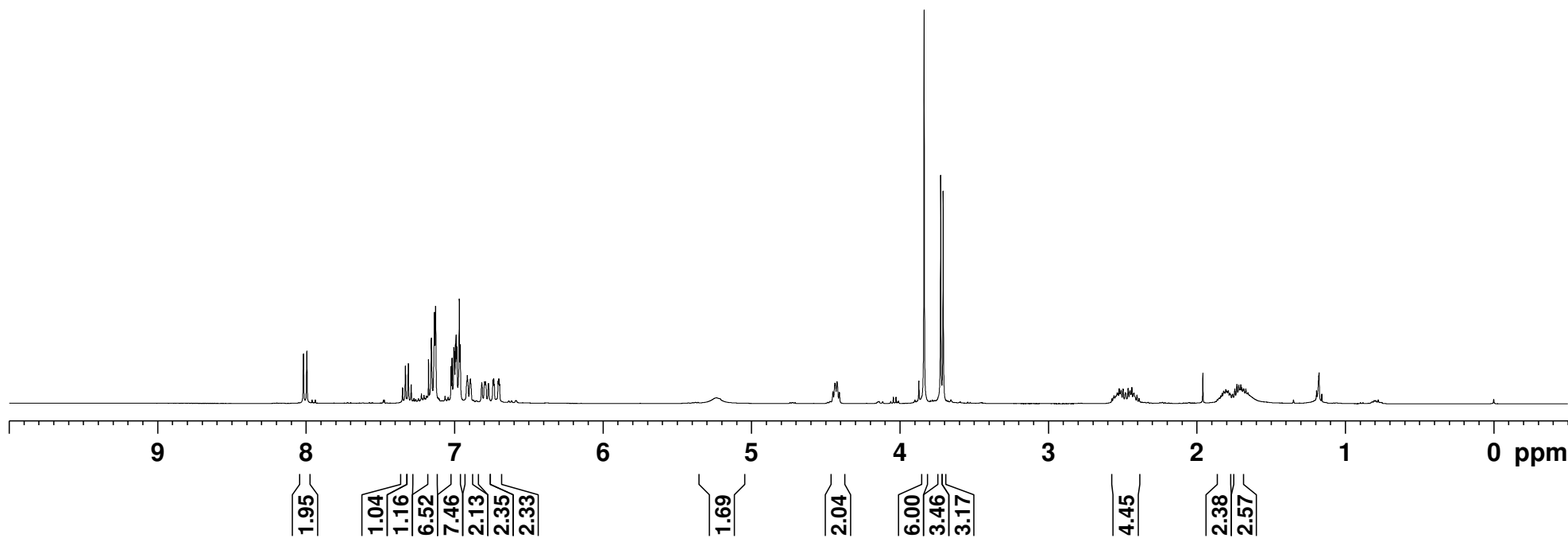
8.017
7.995
7.350
7.331
7.310
7.292
7.175
7.156
7.134
7.128
7.023
7.017
7.004
7.000
6.994
6.989
6.984
6.967
6.961
6.914
6.911
6.895
6.893
6.890
6.816
6.797
6.794
6.790
6.771
6.742
6.738
6.736
6.732
6.706
6.702
6.700
6.696
4.451
4.438
4.423
4.408
3.837
3.725
3.708
2.537
2.523
2.510
2.496
2.481
2.463
2.449
2.437
2.423
1.819
1.815
1.811
1.804
1.797
1.787
1.744
1.730
1.718
1.710
1.703
1.696

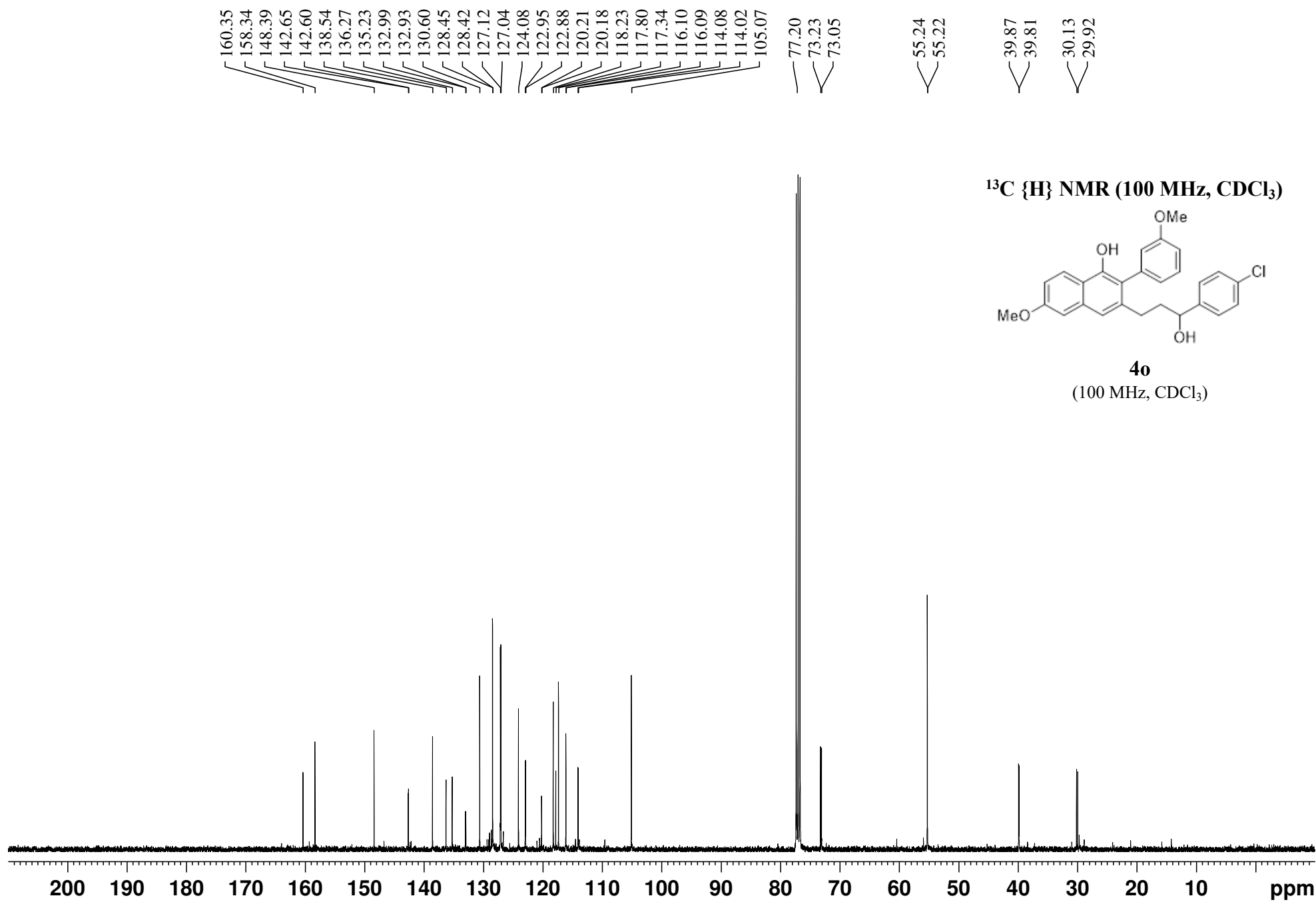
¹H NMR (400 MHz, CDCl₃)

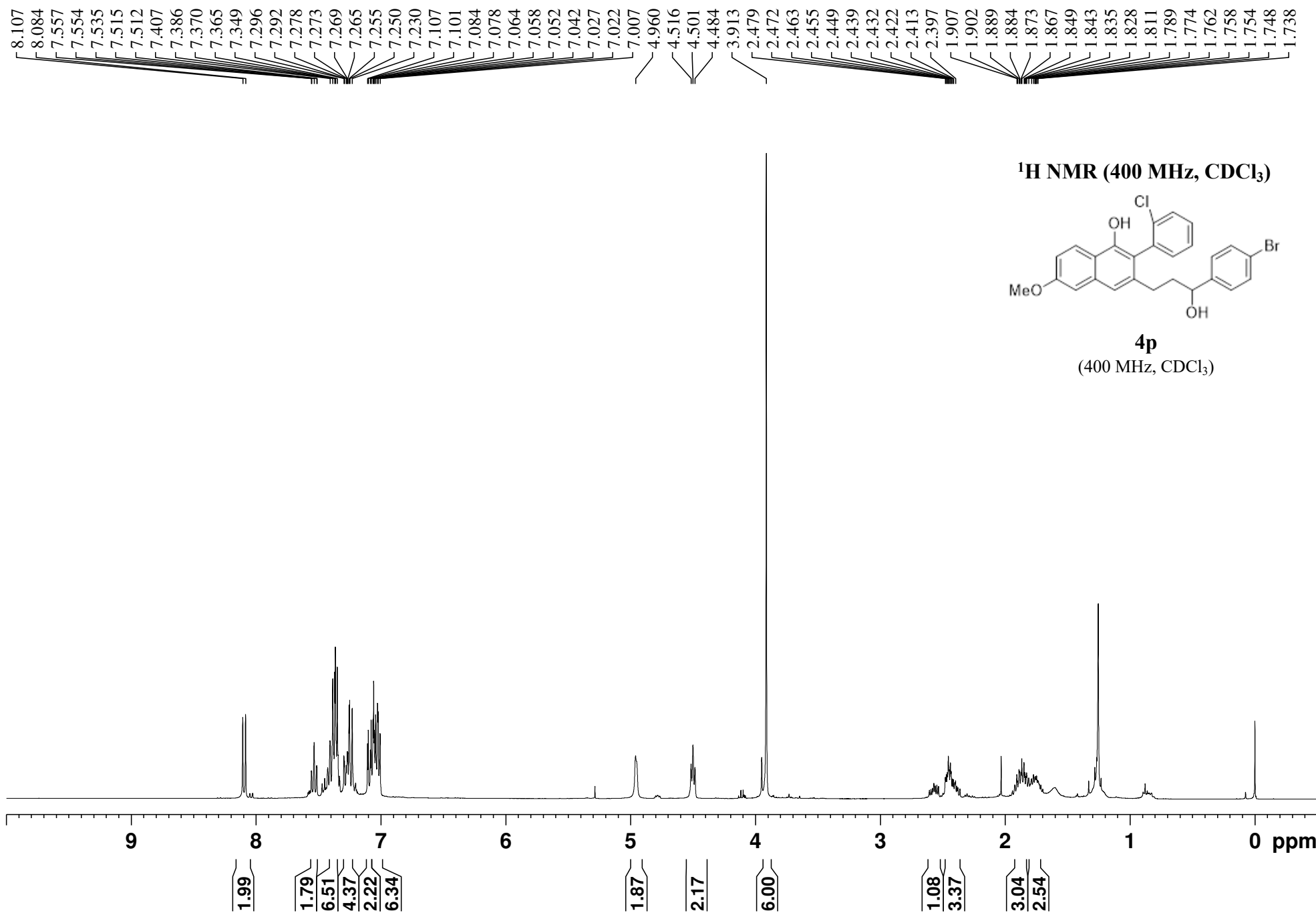


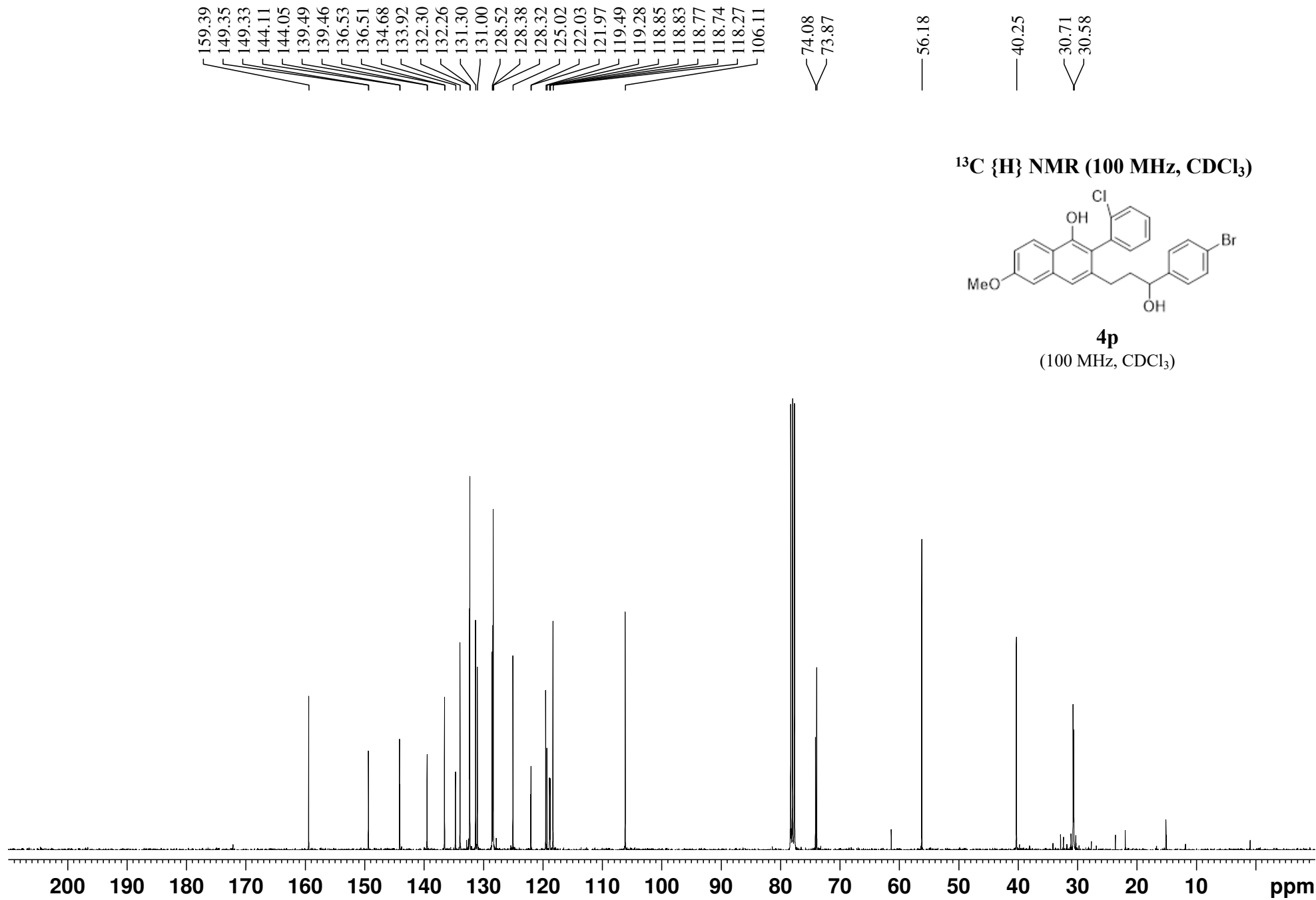
4o

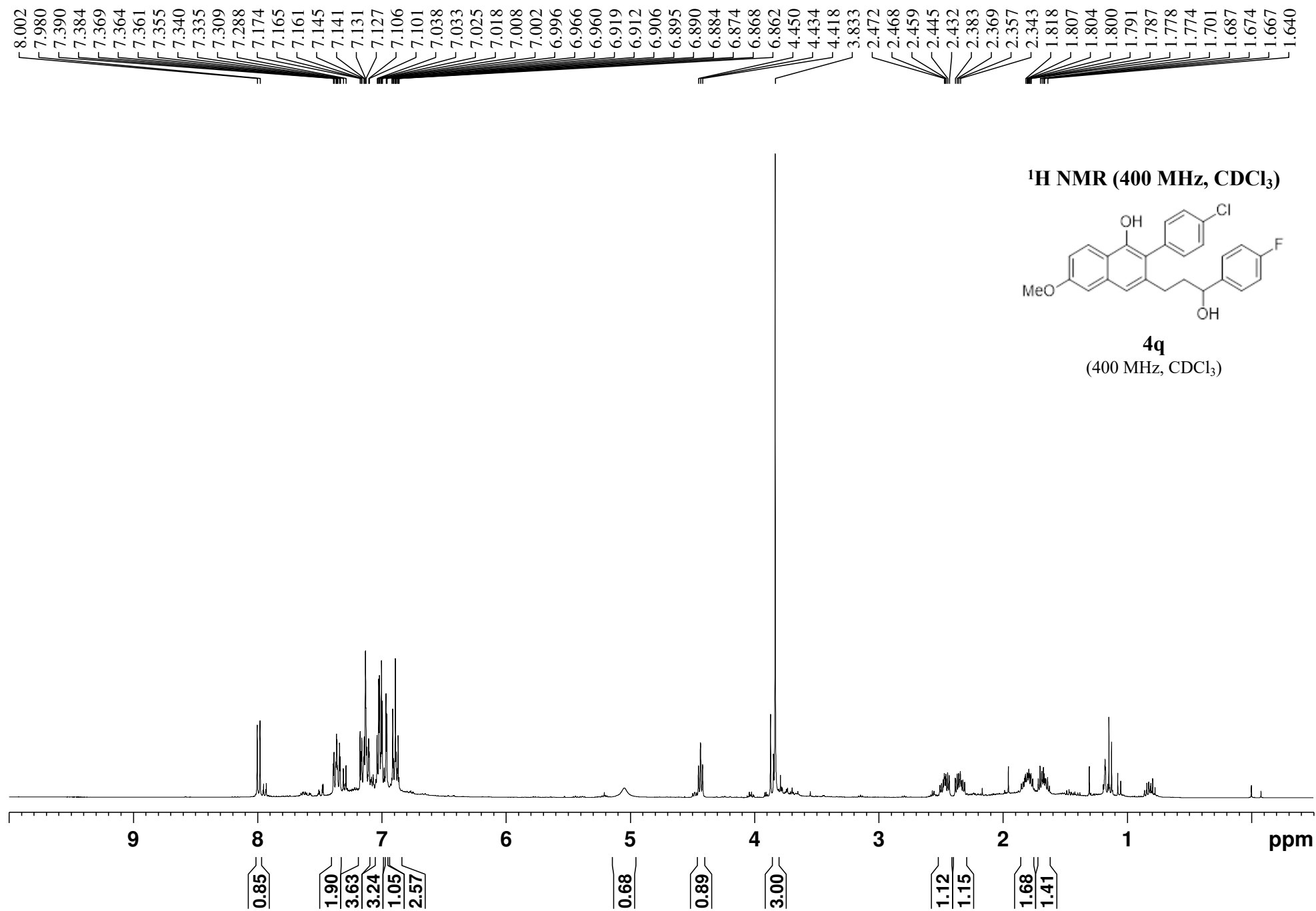
(400 MHz, CDCl₃)

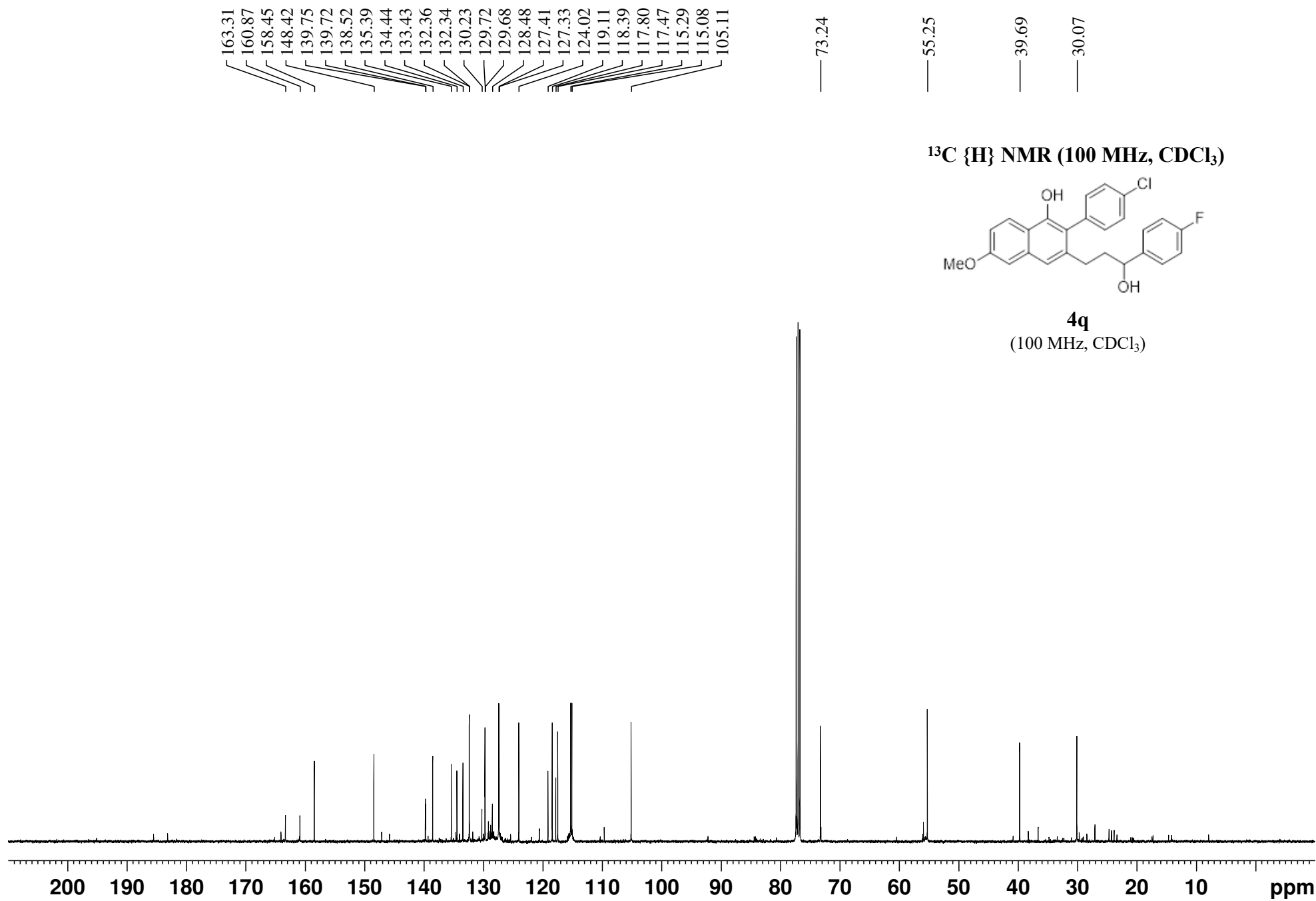




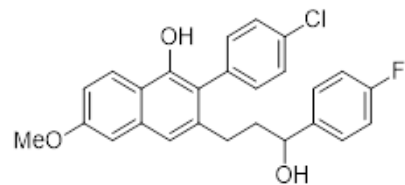






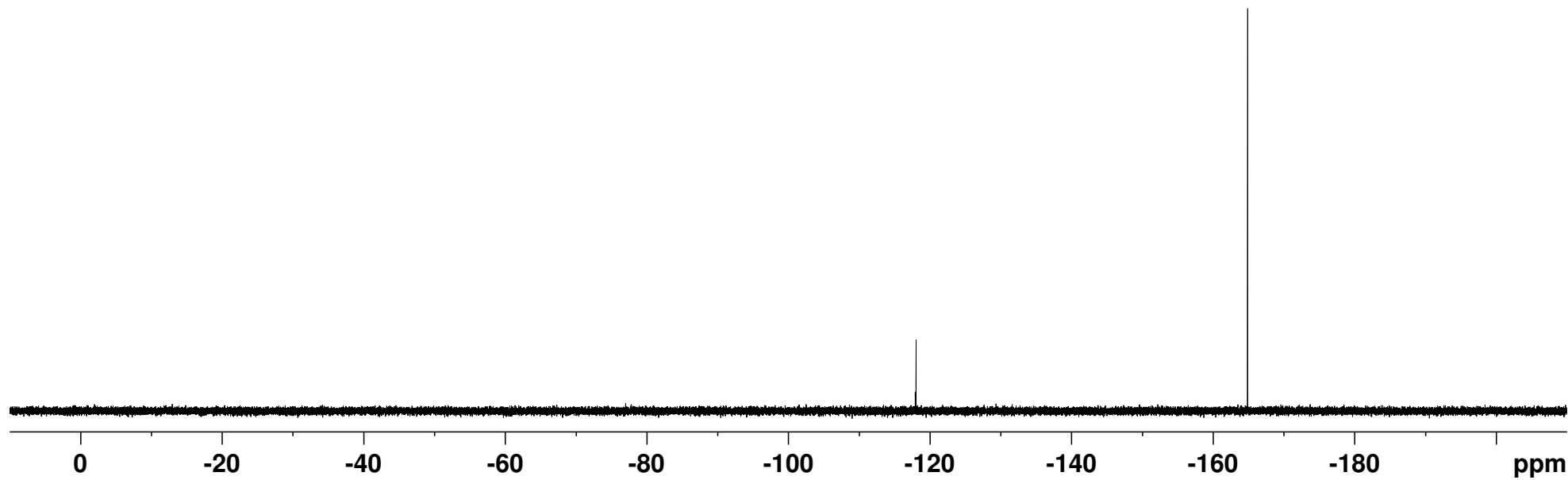


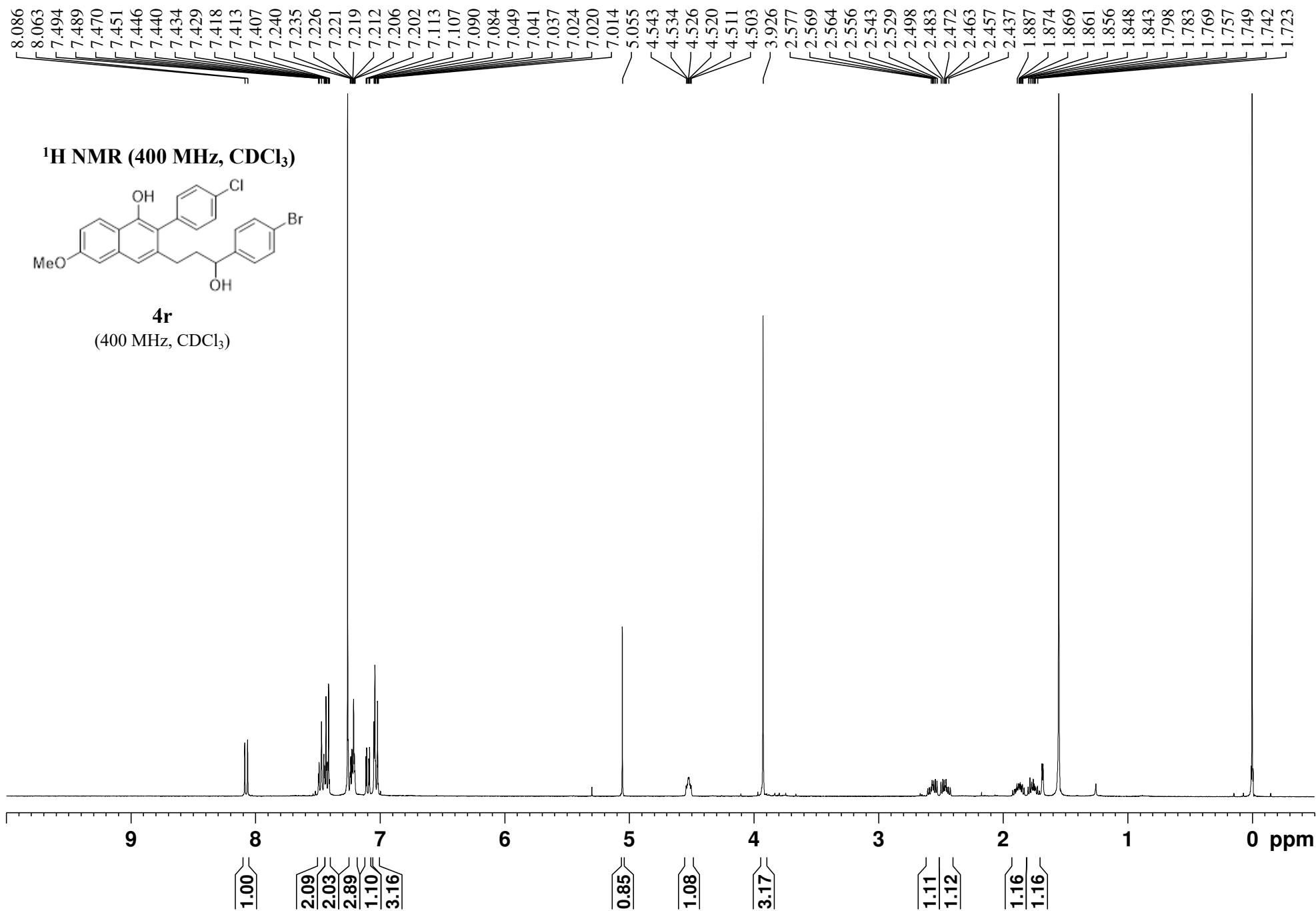
^{19}F NMR (376 MHz, CDCl_3)

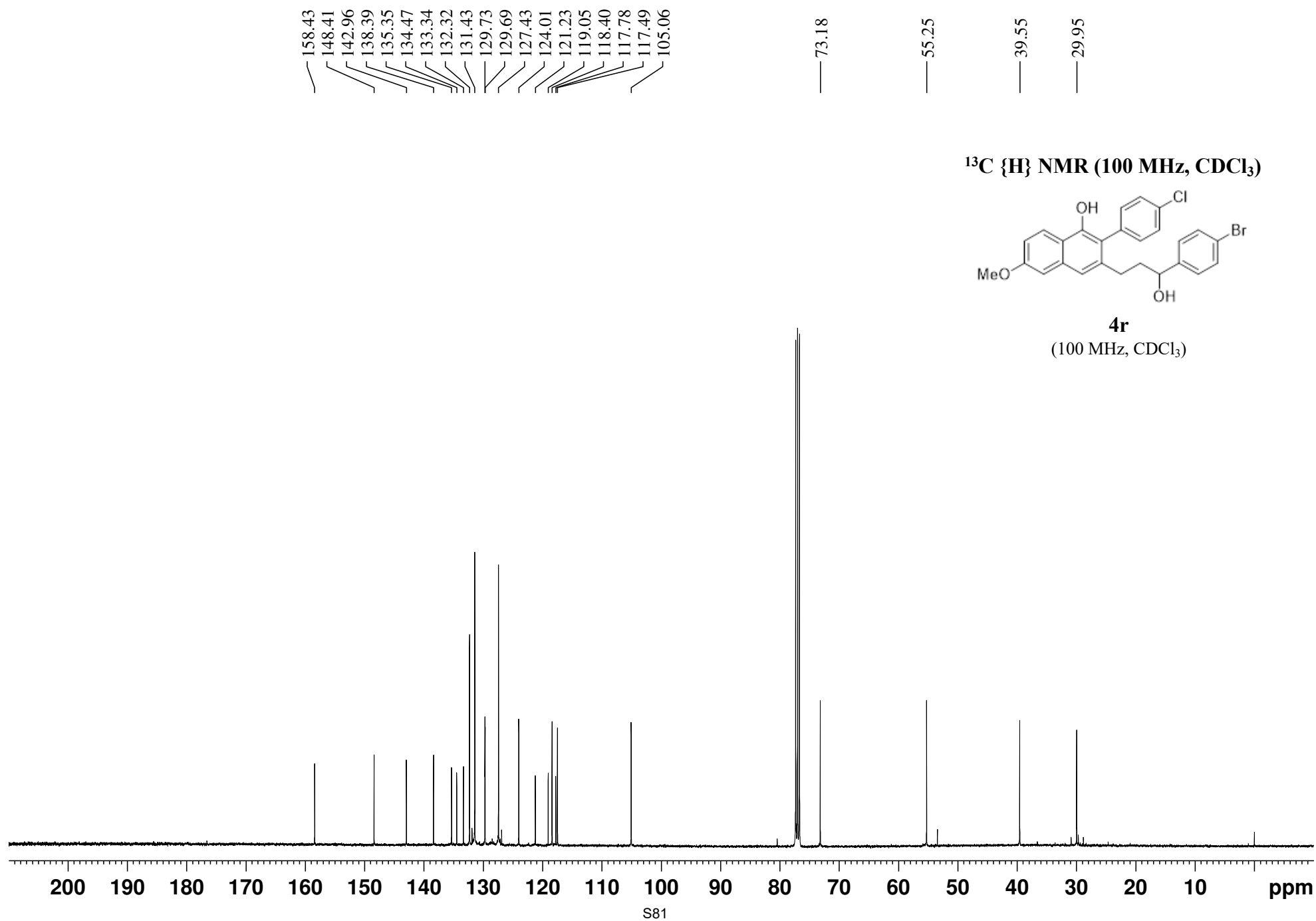


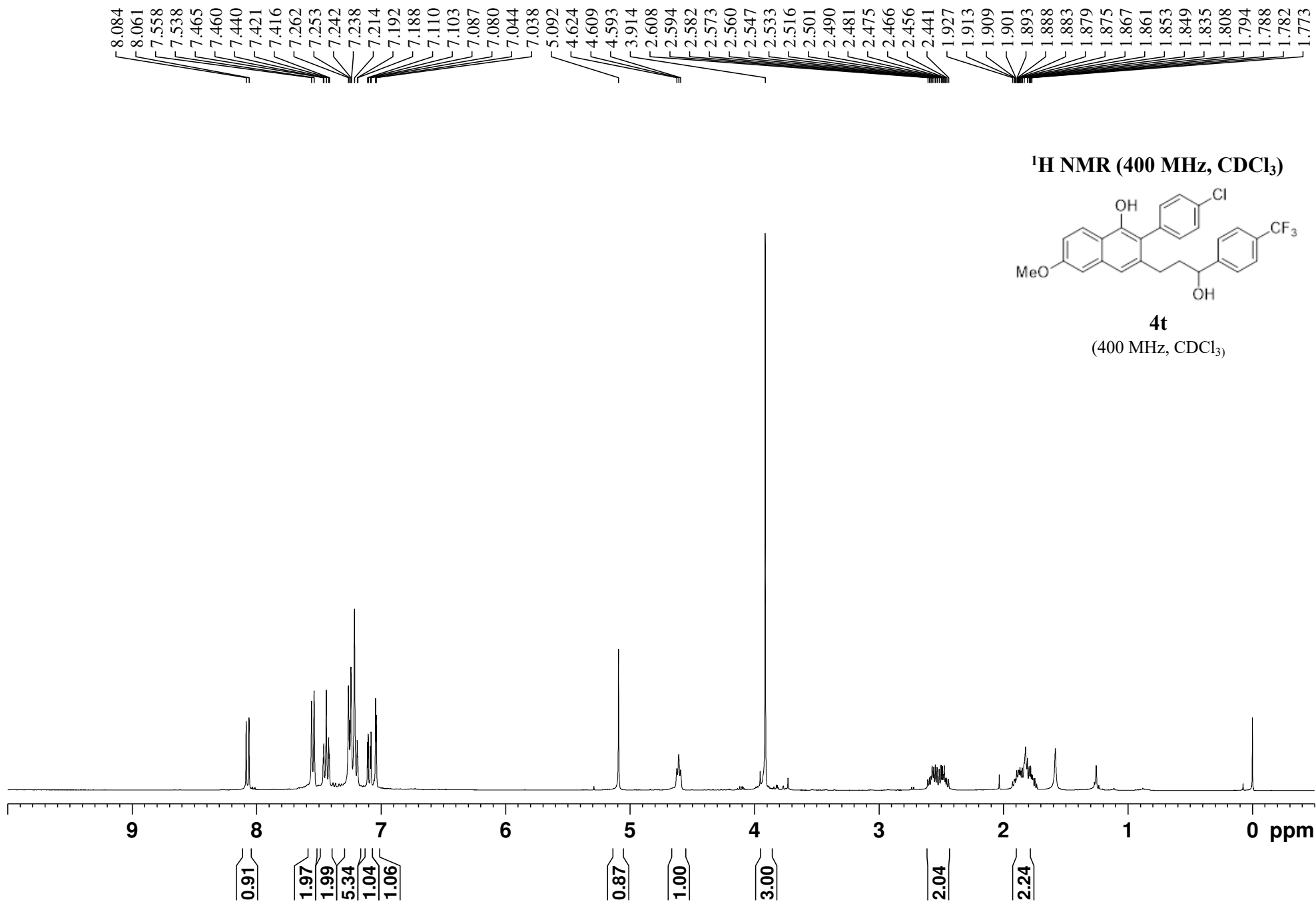
4q
(376 MHz, CDCl_3)

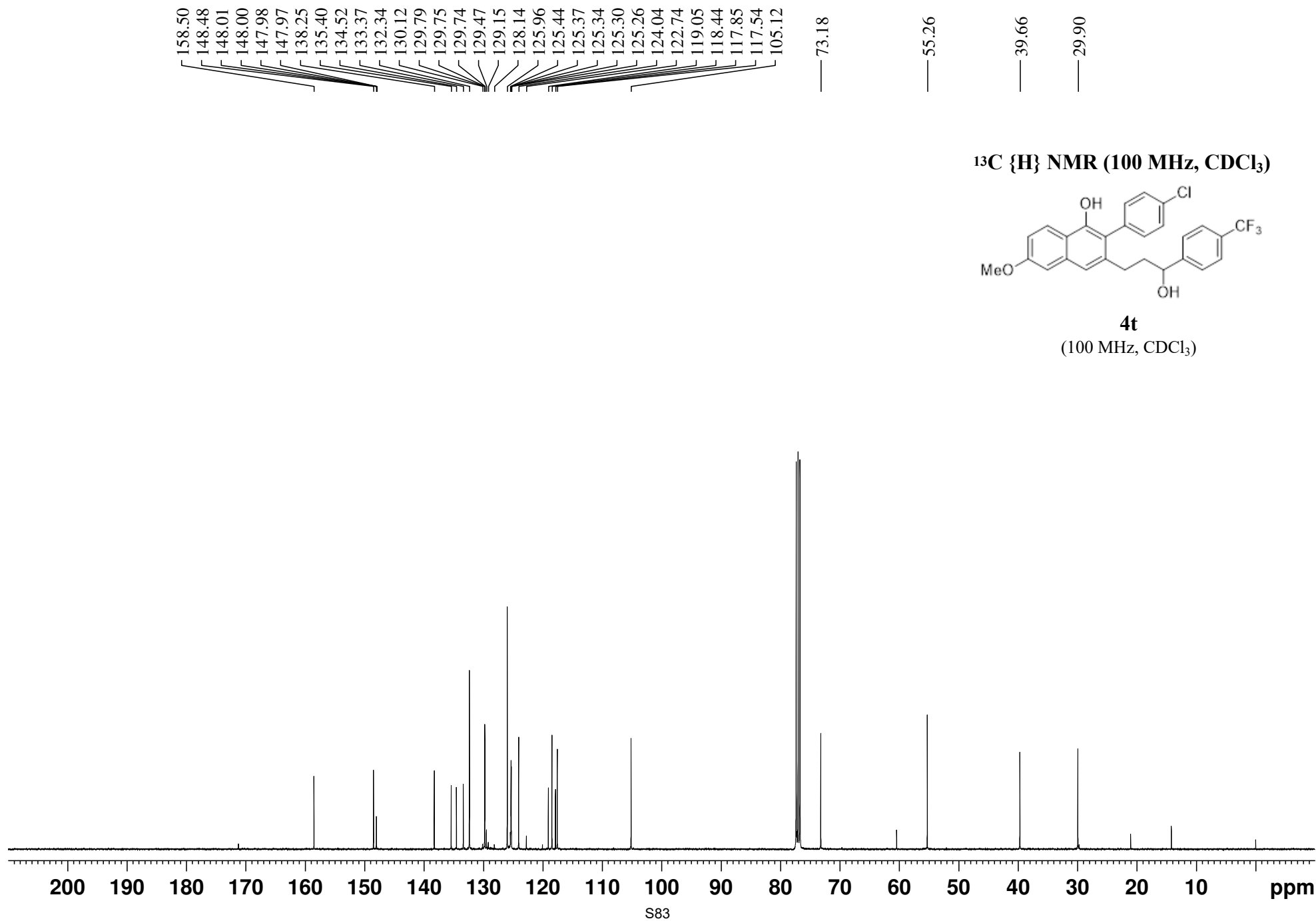
— -118.05



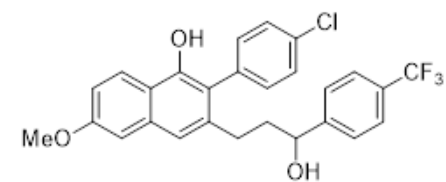








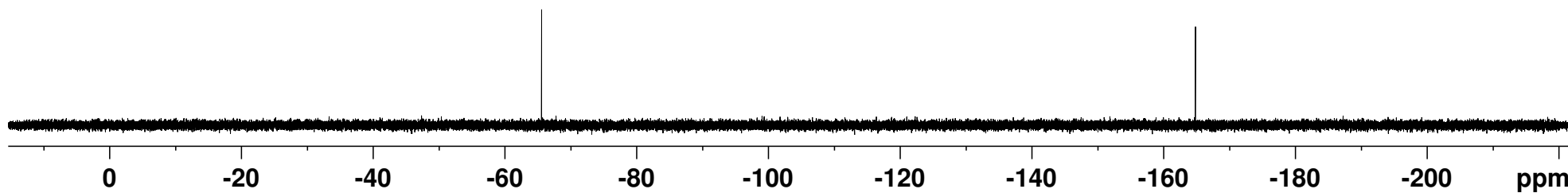
^{19}F NMR (376 MHz, CDCl_3)

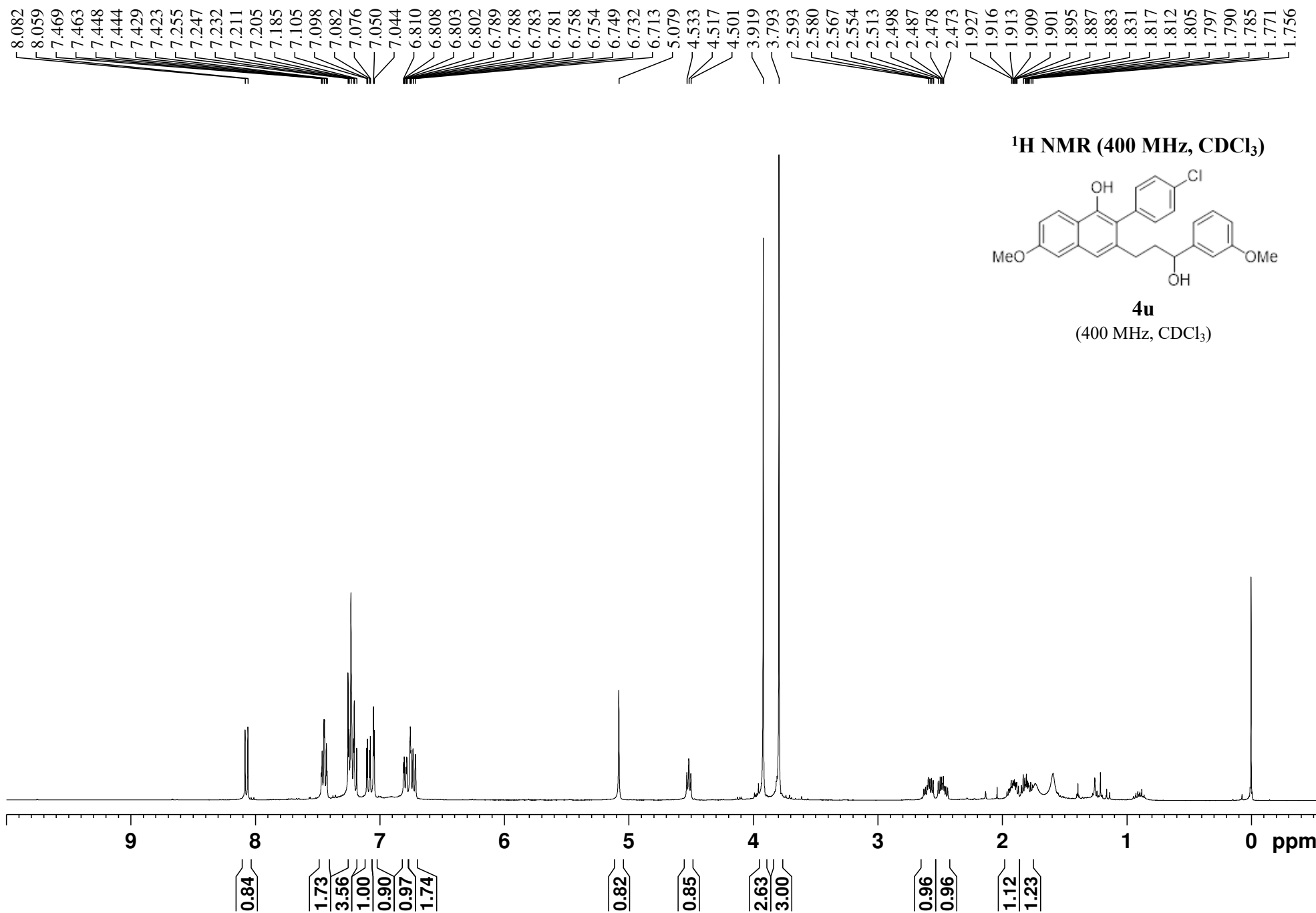


4t

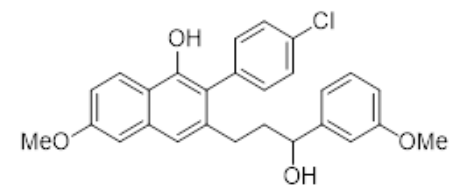
(376 MHz, CDCl_3)

— -65.61

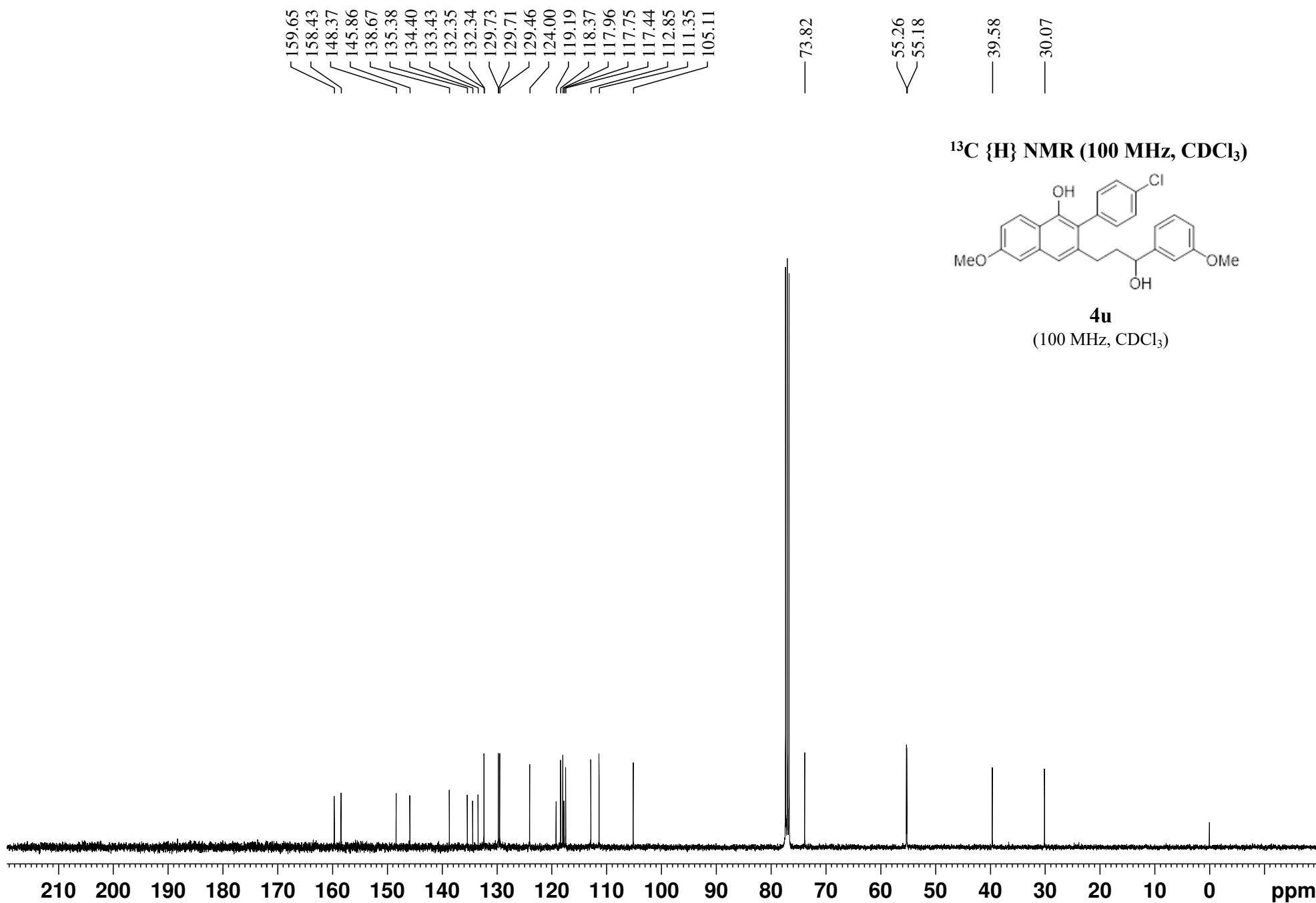


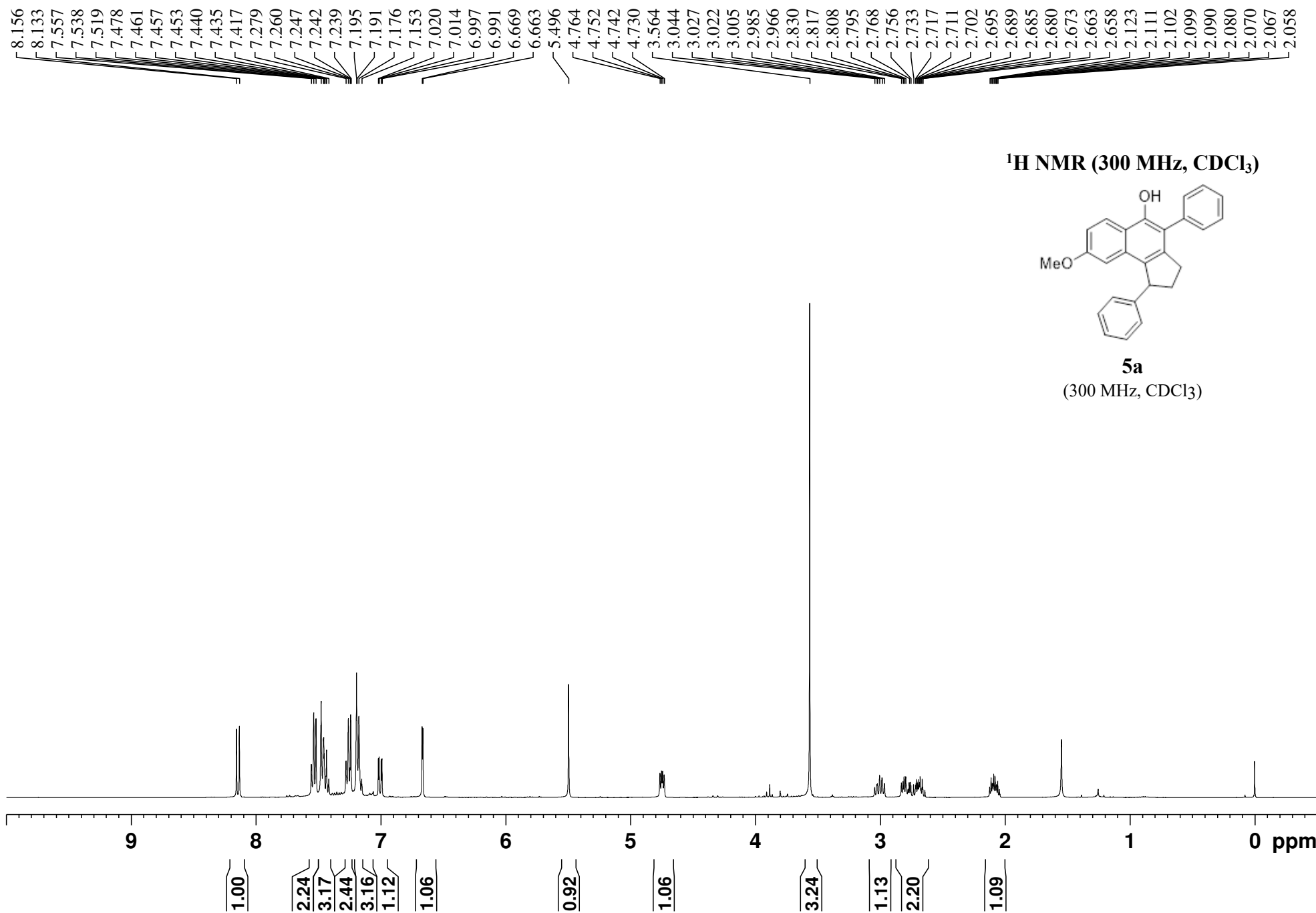


^{13}C {H} NMR (100 MHz, CDCl_3)



4u
(100 MHz, CDCl_3)



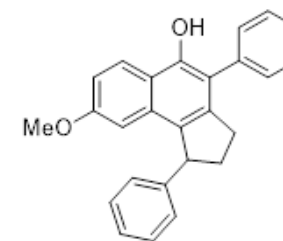


157.86
147.87
146.62
141.98
135.59
131.68
131.32
130.21
129.46
128.50
128.00
127.57
126.00
124.77
118.86
117.15
116.37
103.31

54.87
50.85

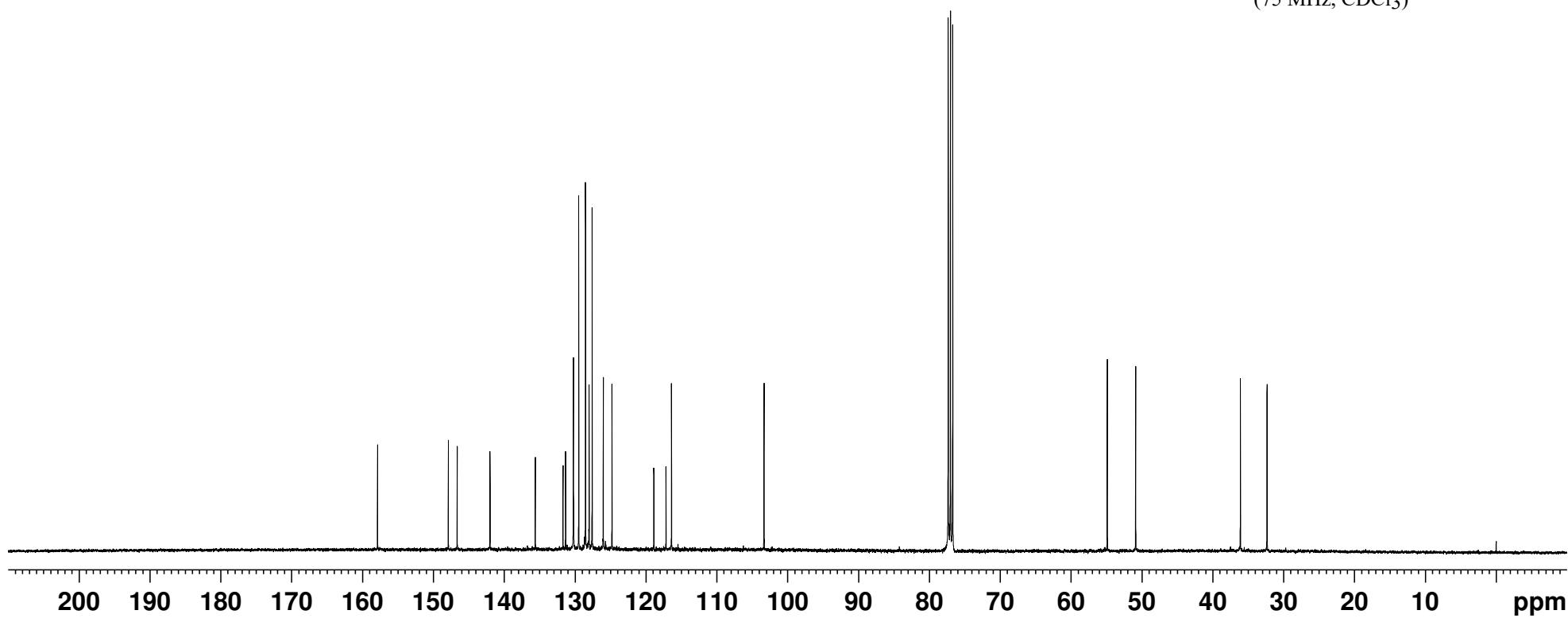
36.08
32.32

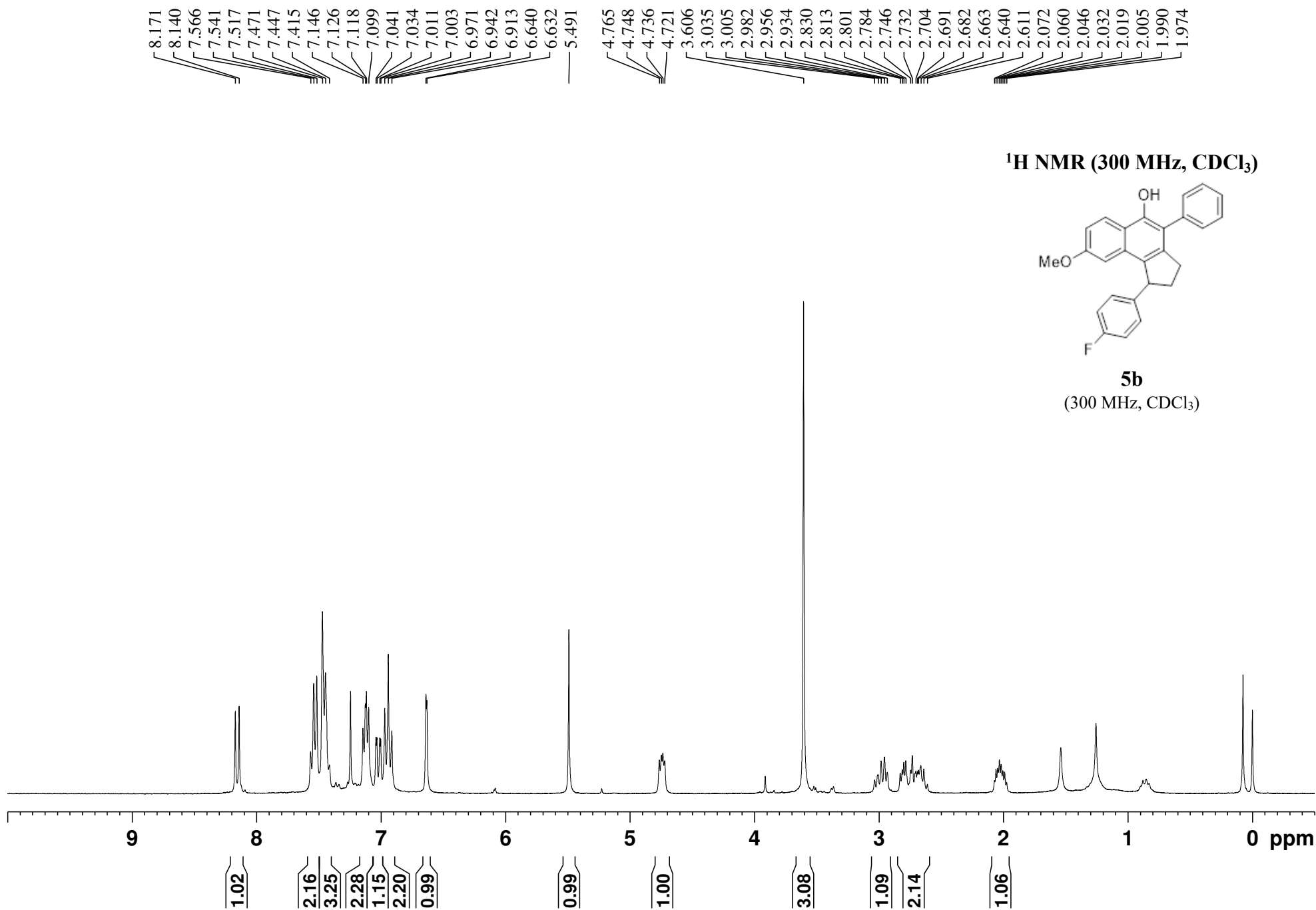
^{13}C {H} NMR (75 MHz, CDCl_3)



5a

(75 MHz, CDCl_3)



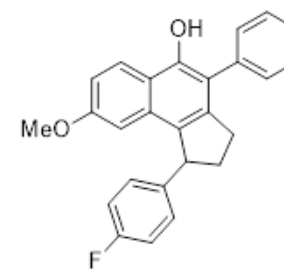


162.88
159.66
157.99
148.01
142.25
142.21
141.99
135.51
131.62
130.97
130.19
129.49
128.92
128.82
128.06
124.90
118.93
117.17
116.37
115.36
115.08
103.27

— 54.91
— 49.98

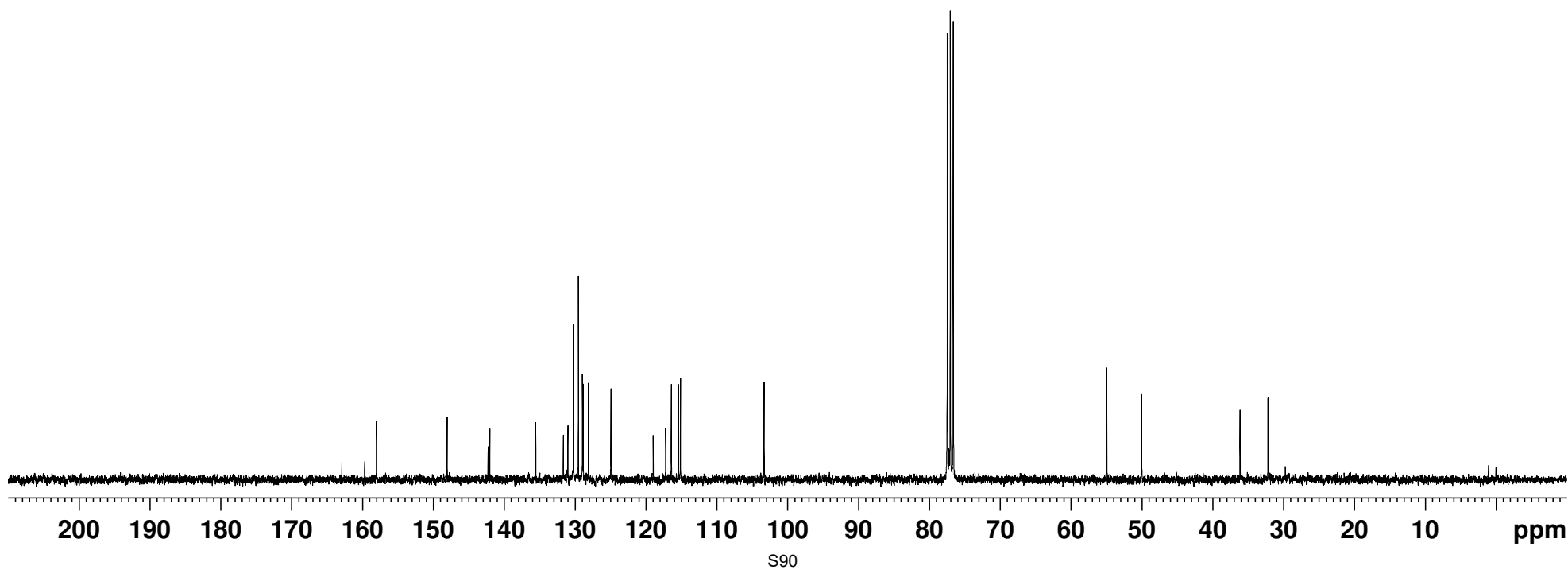
— 36.09
— 32.16

^{13}C {H} NMR (75 MHz, CDCl_3)



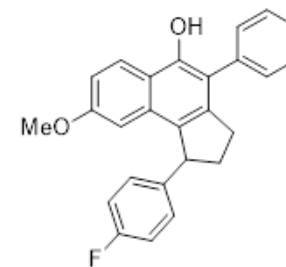
5b

(75 MHz, CDCl_3)



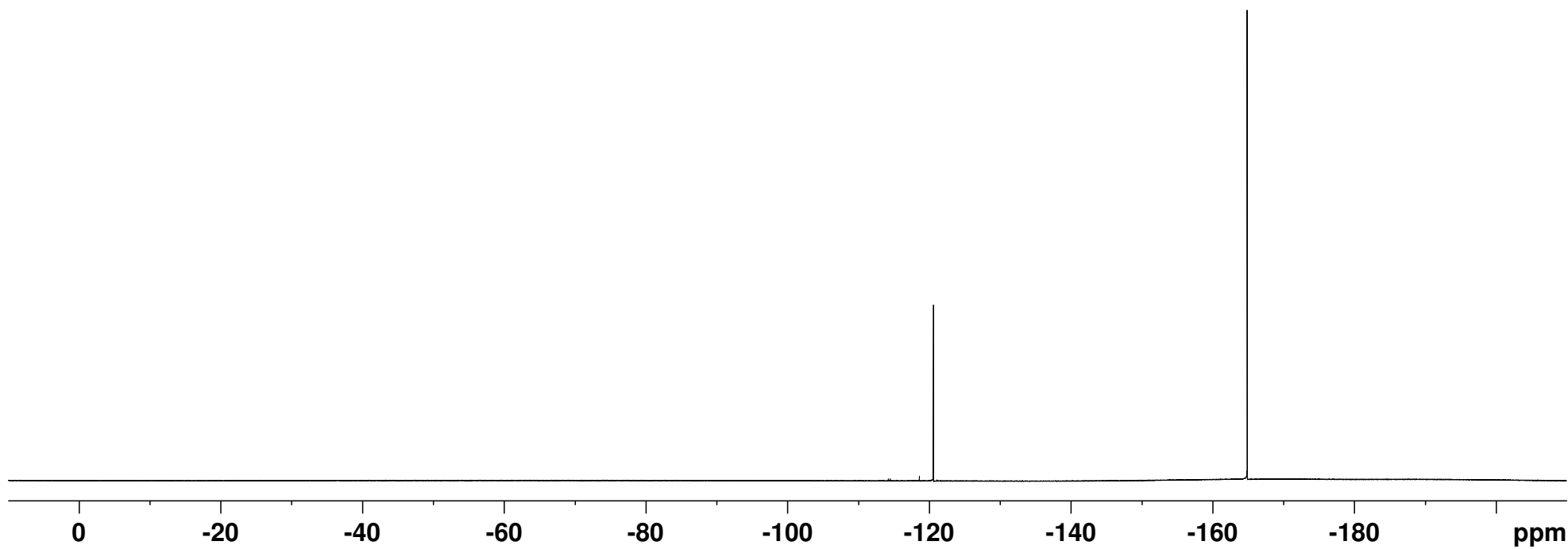
— -120.62

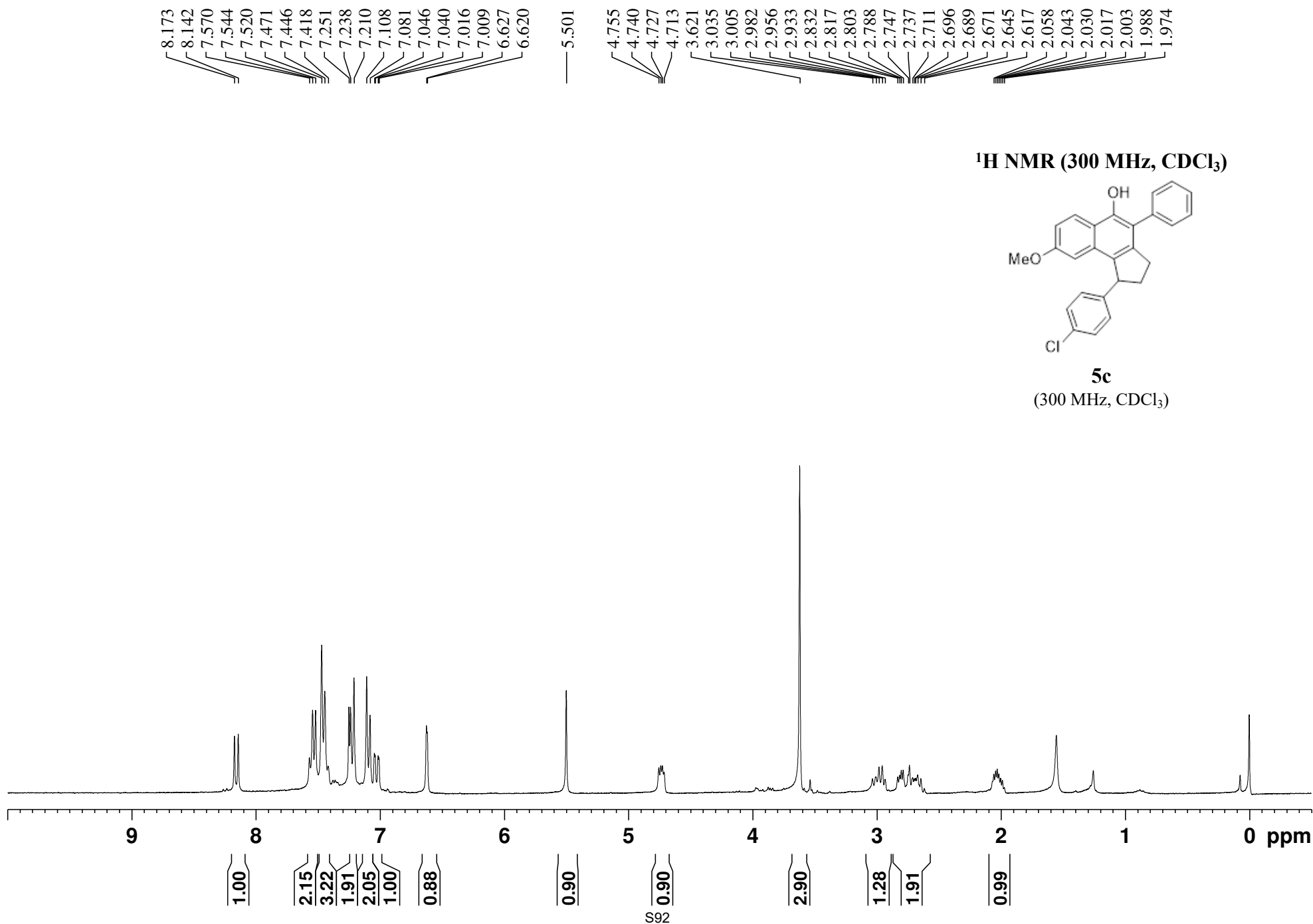
^{19}F NMR (282 MHz, CDCl_3)

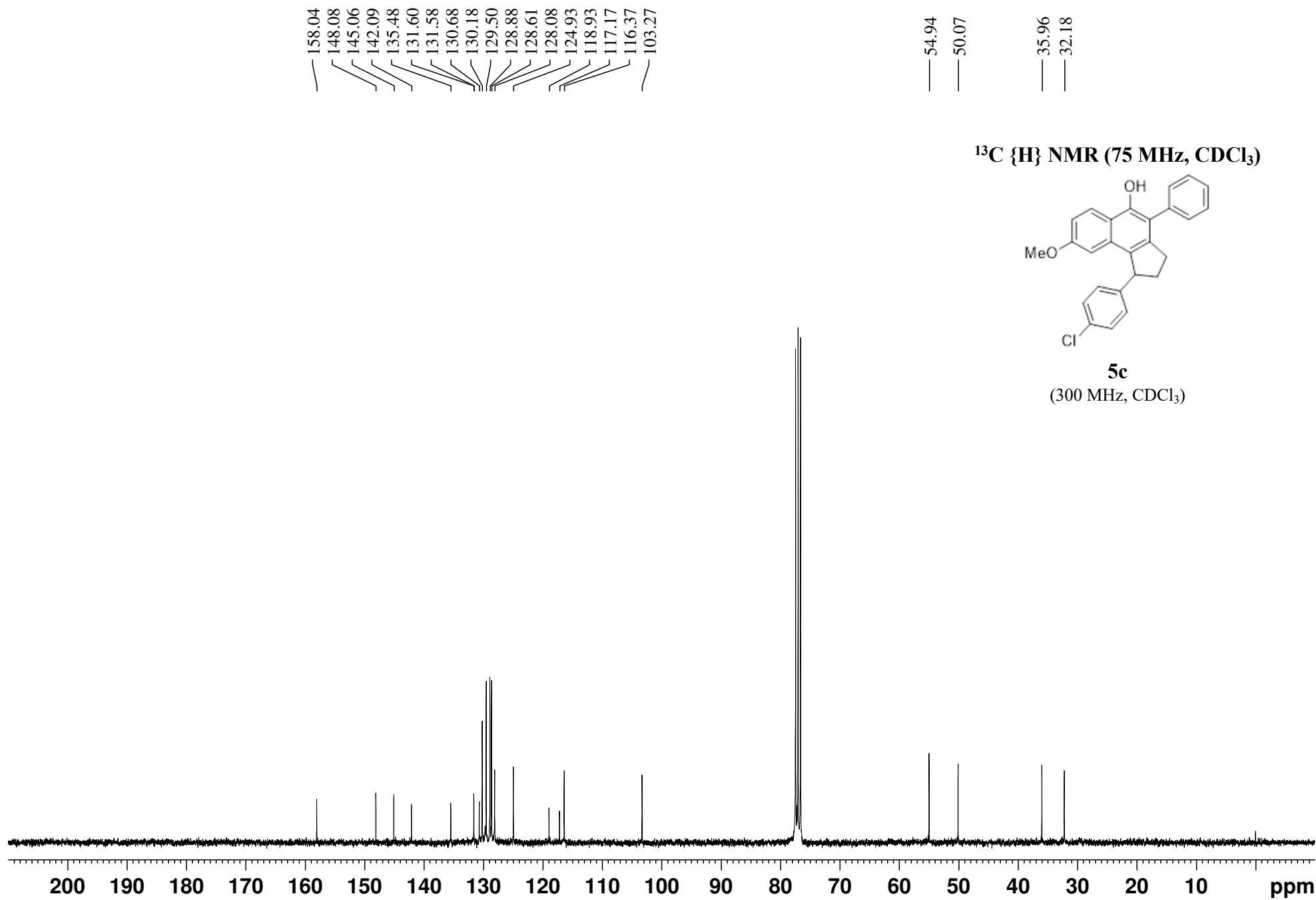


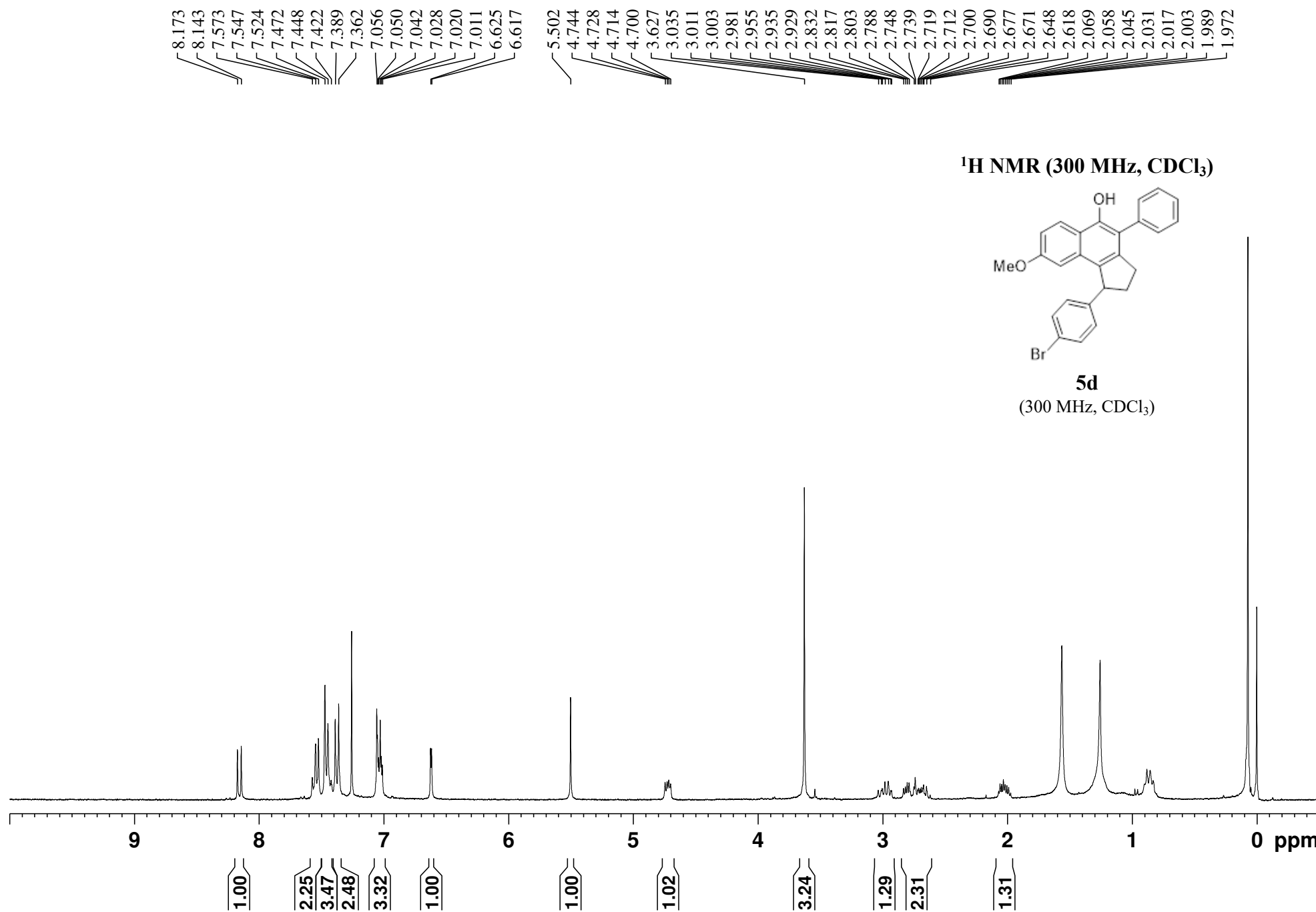
5b

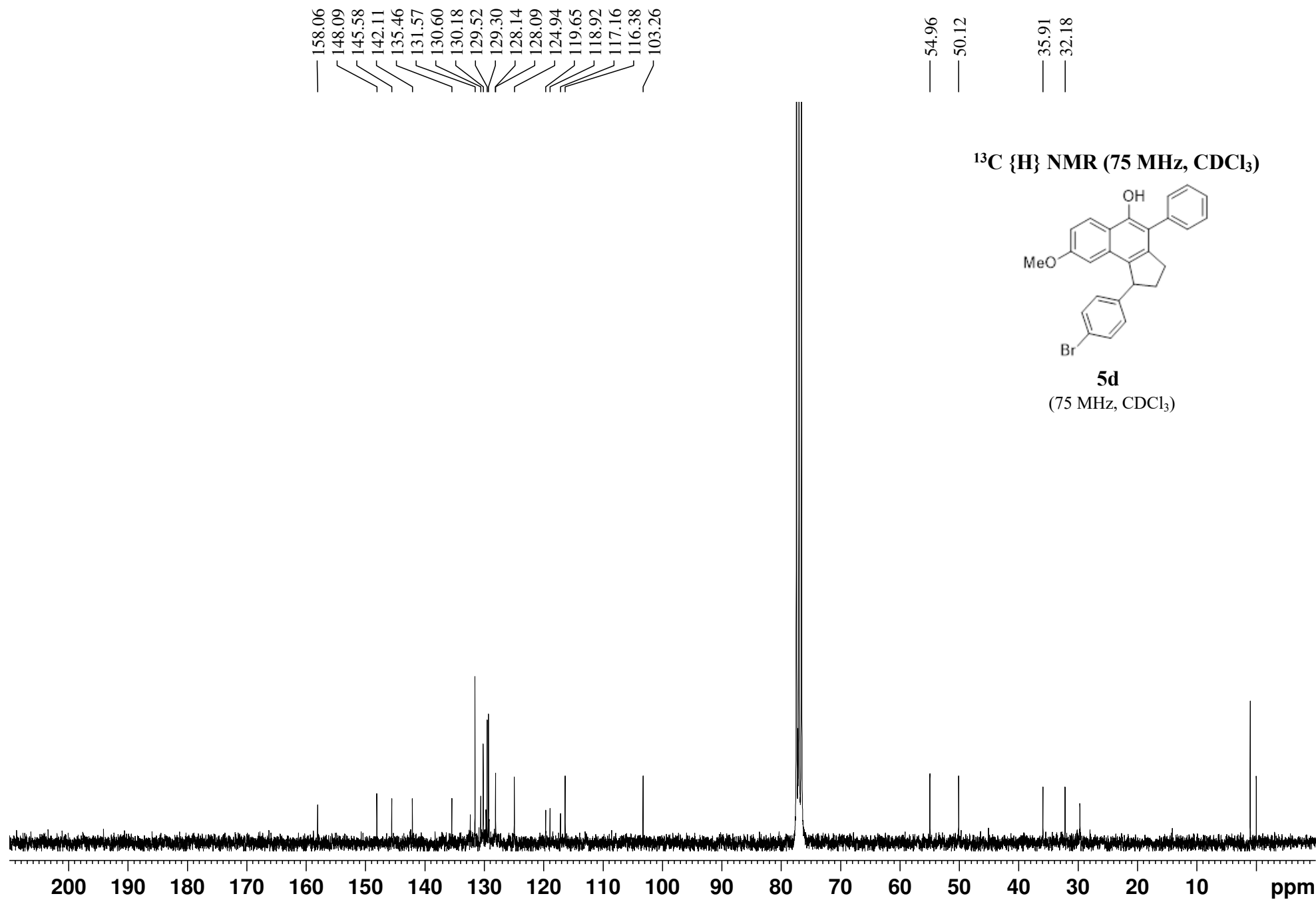
(282 MHz, CDCl_3)

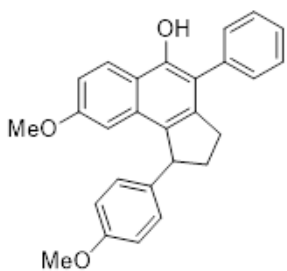




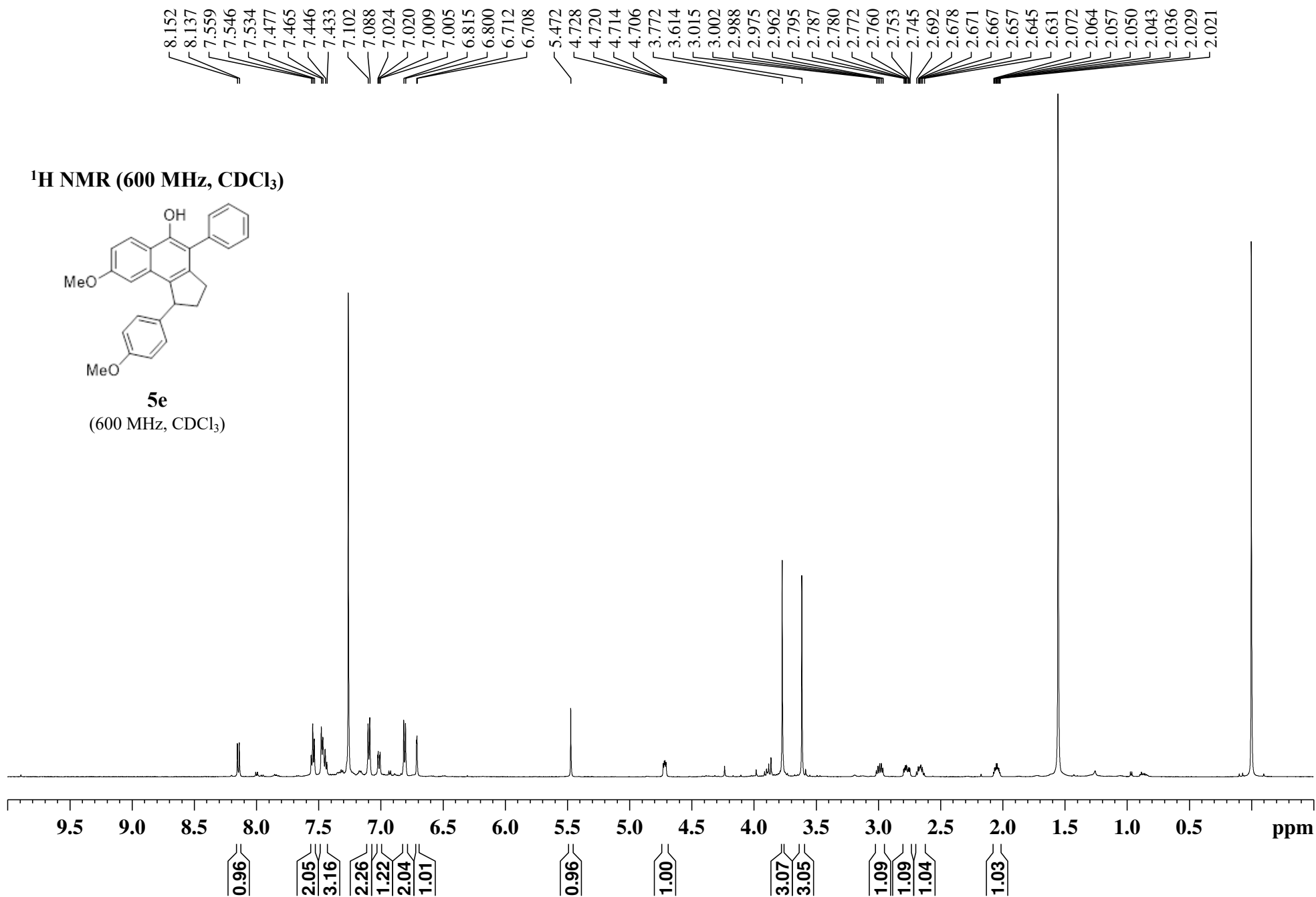


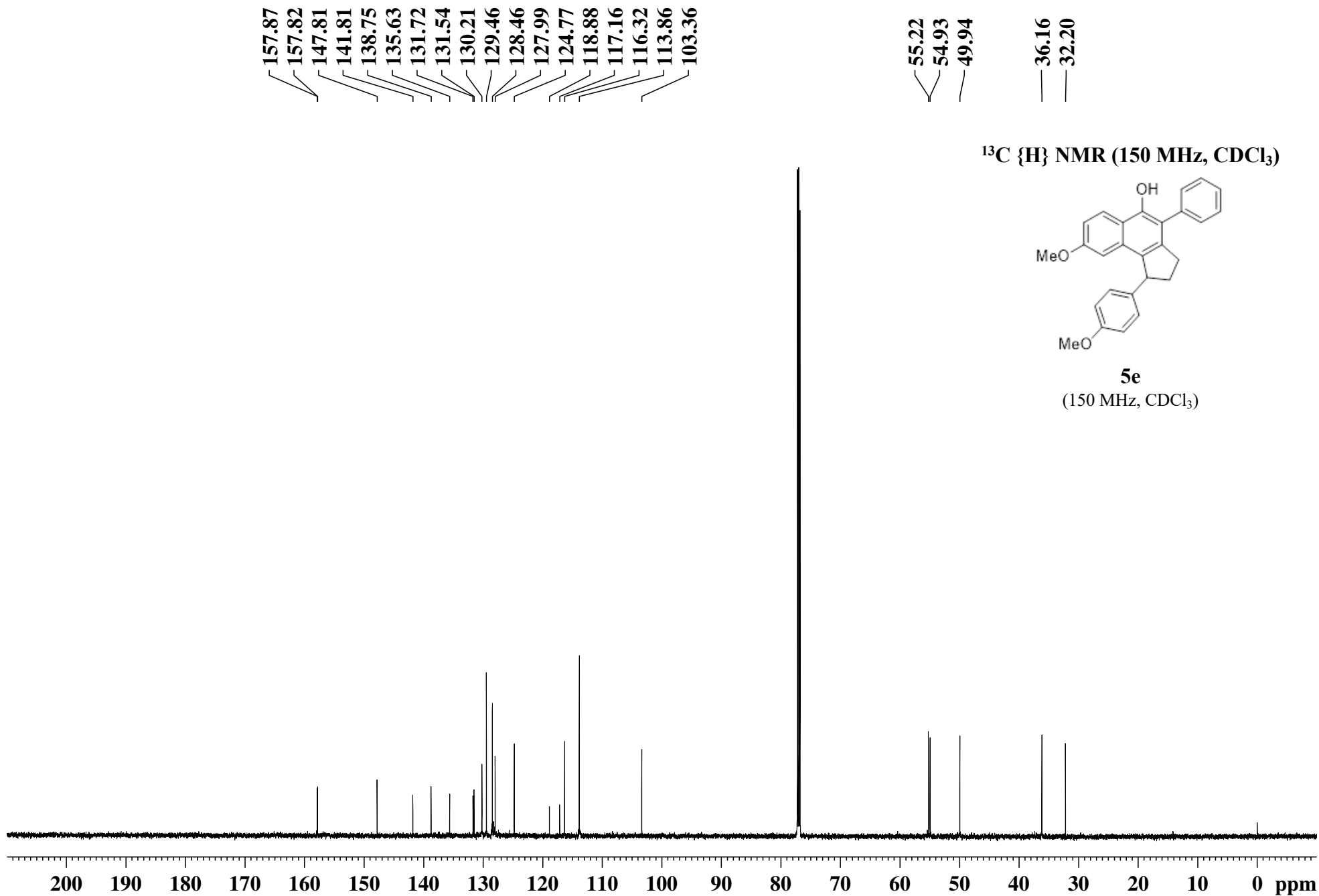




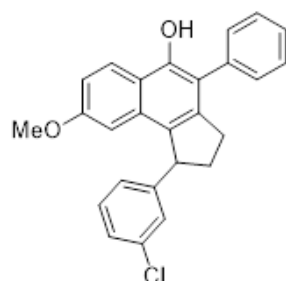


5e
(600 MHz, CDCl₃)



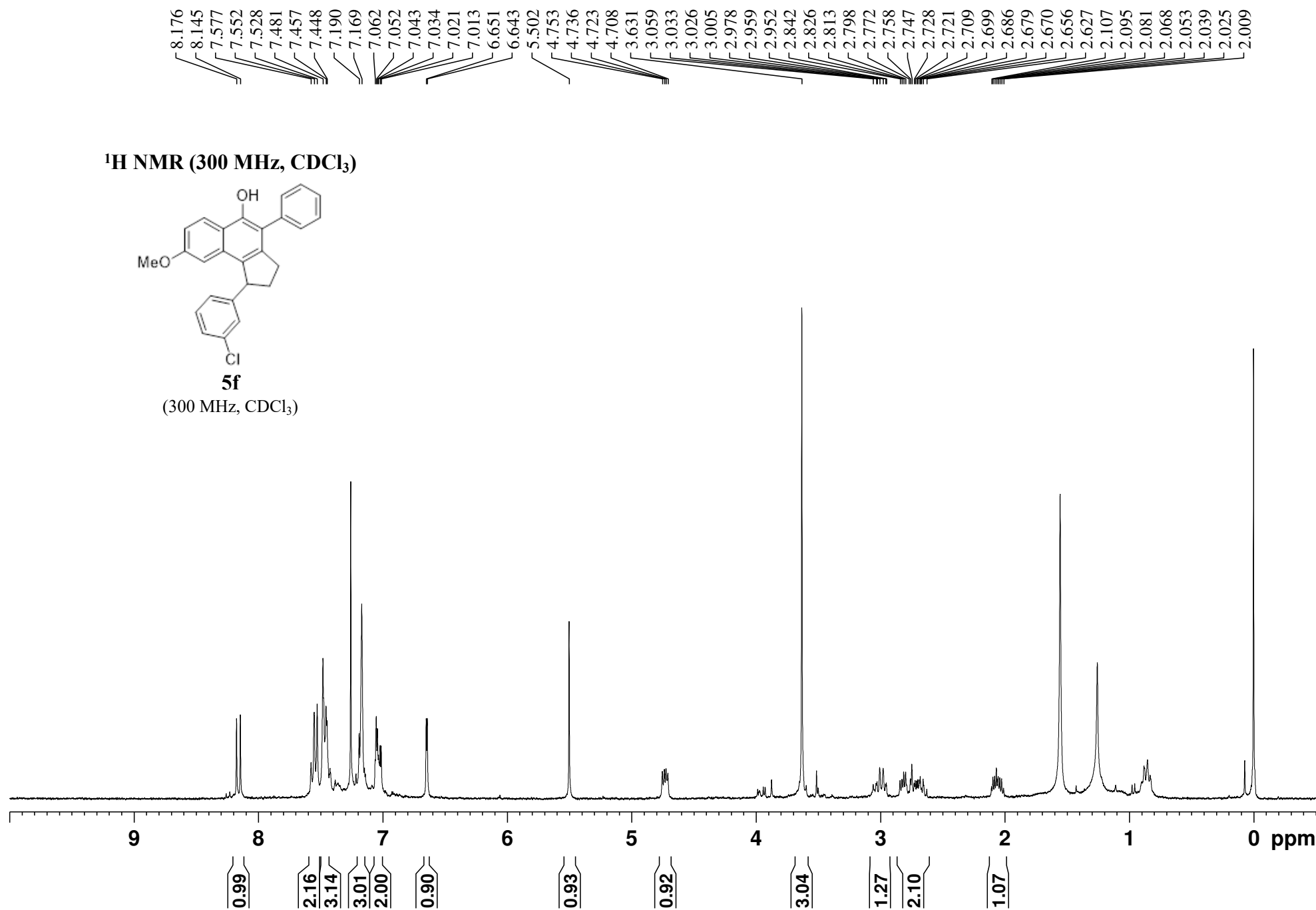


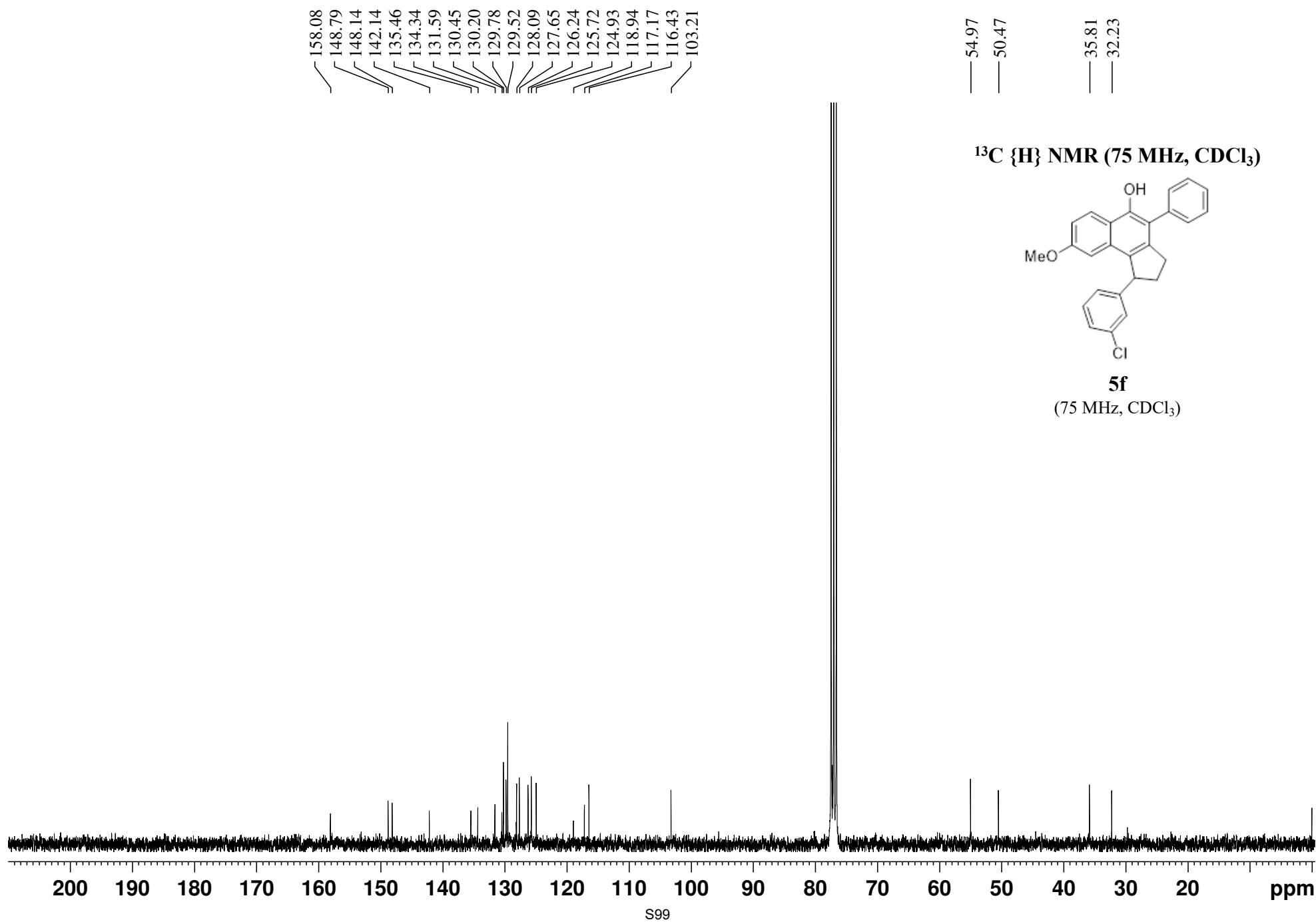
¹H NMR (300 MHz, CDCl₃)

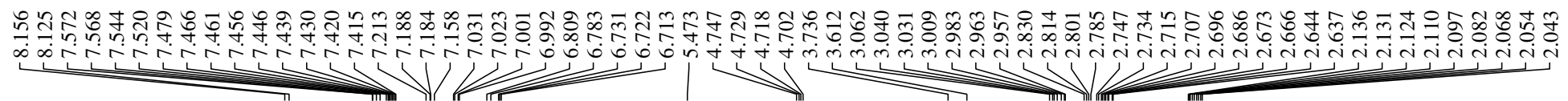


5f

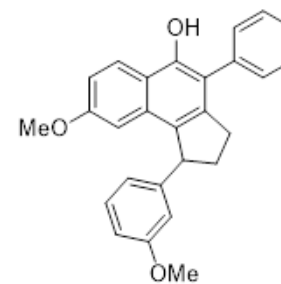
(300 MHz, CDCl₃)



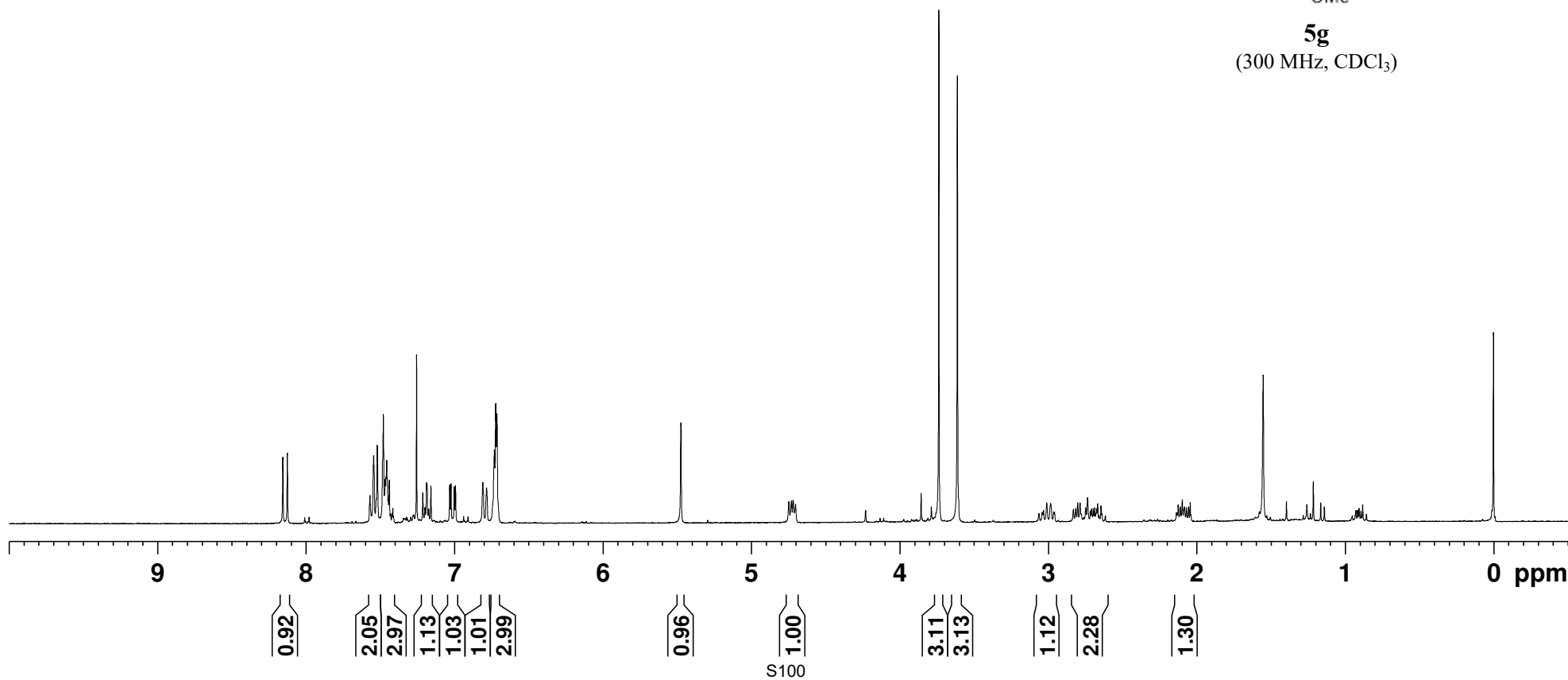


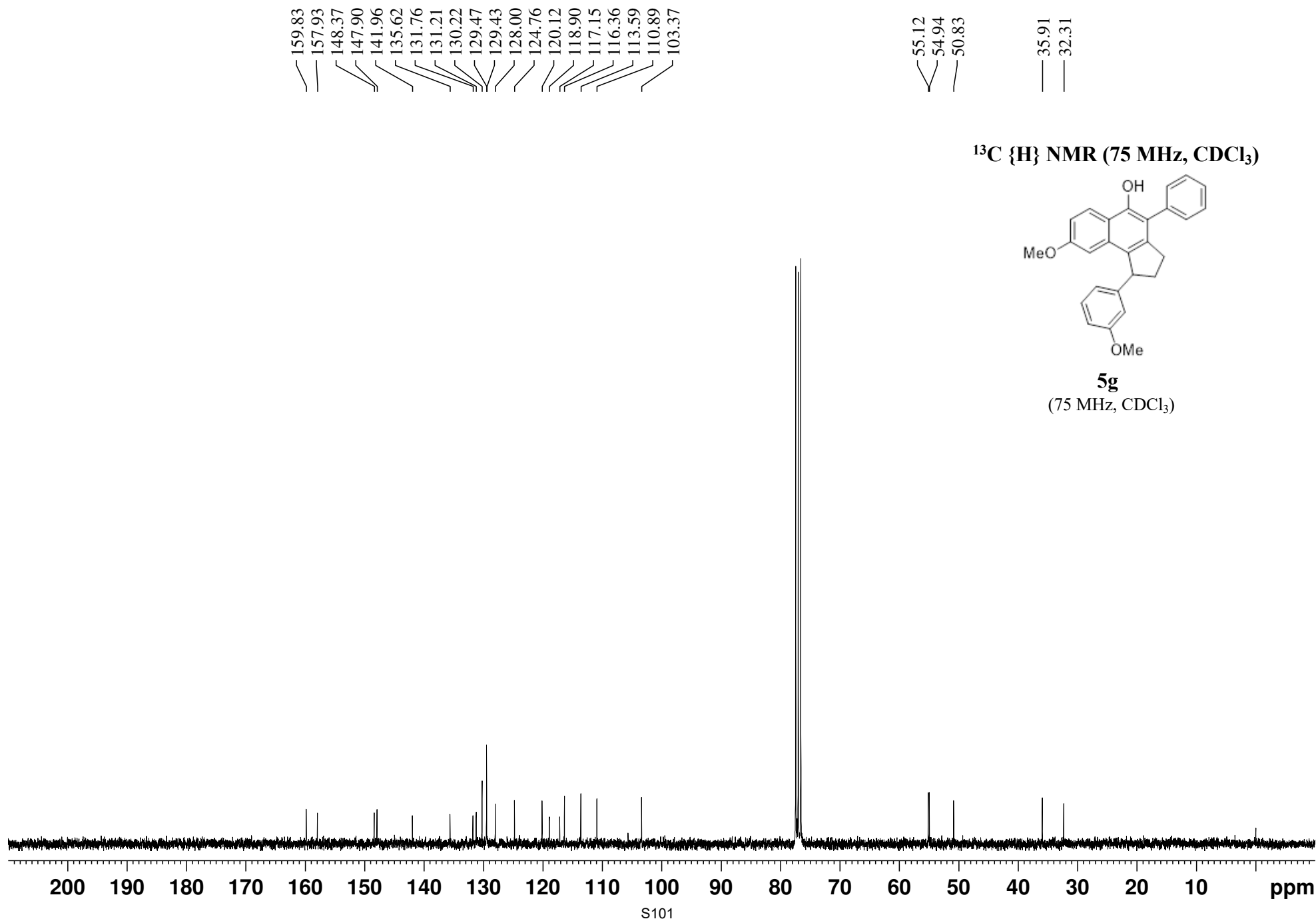


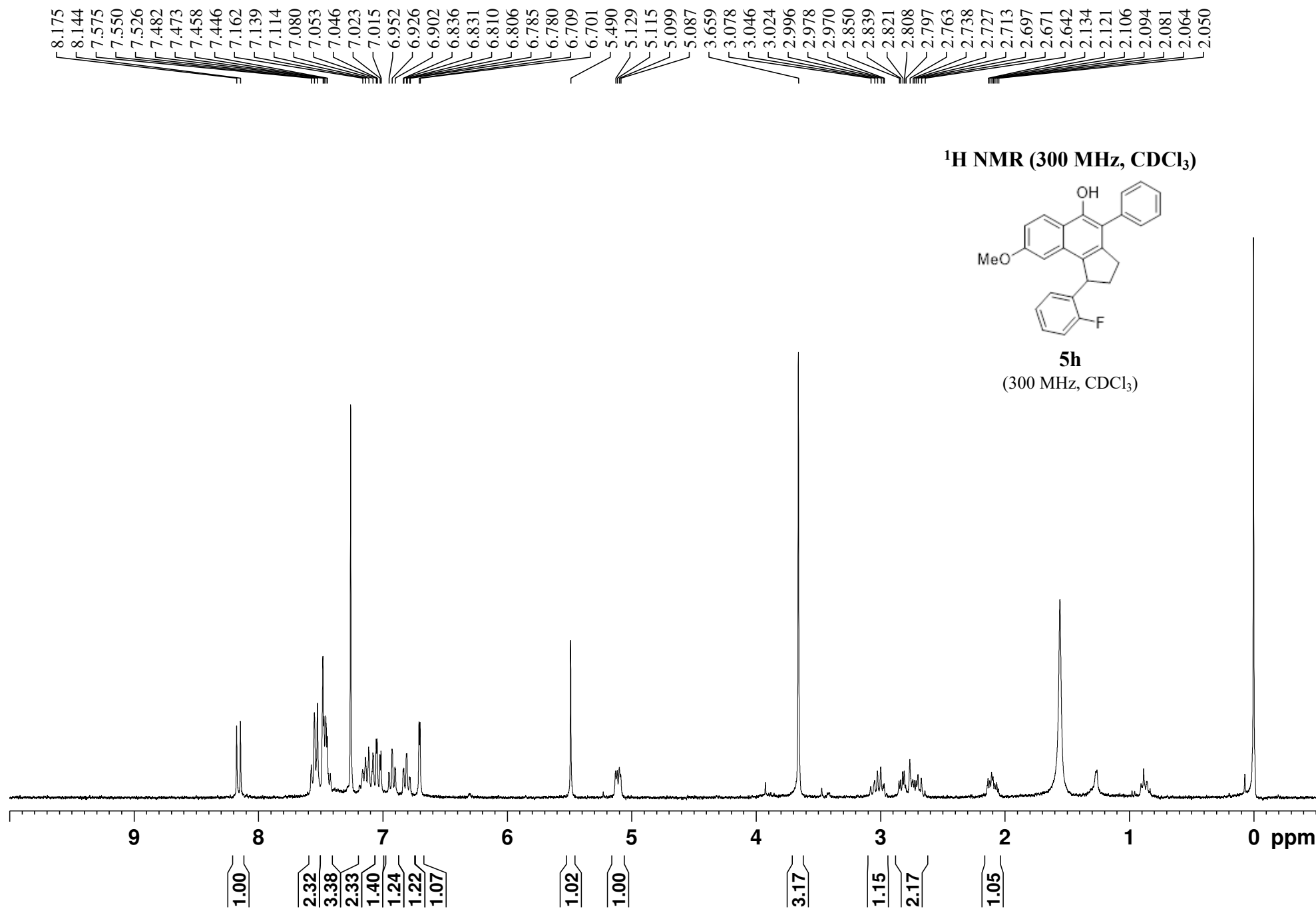
¹H NMR (300 MHz, CDCl₃)

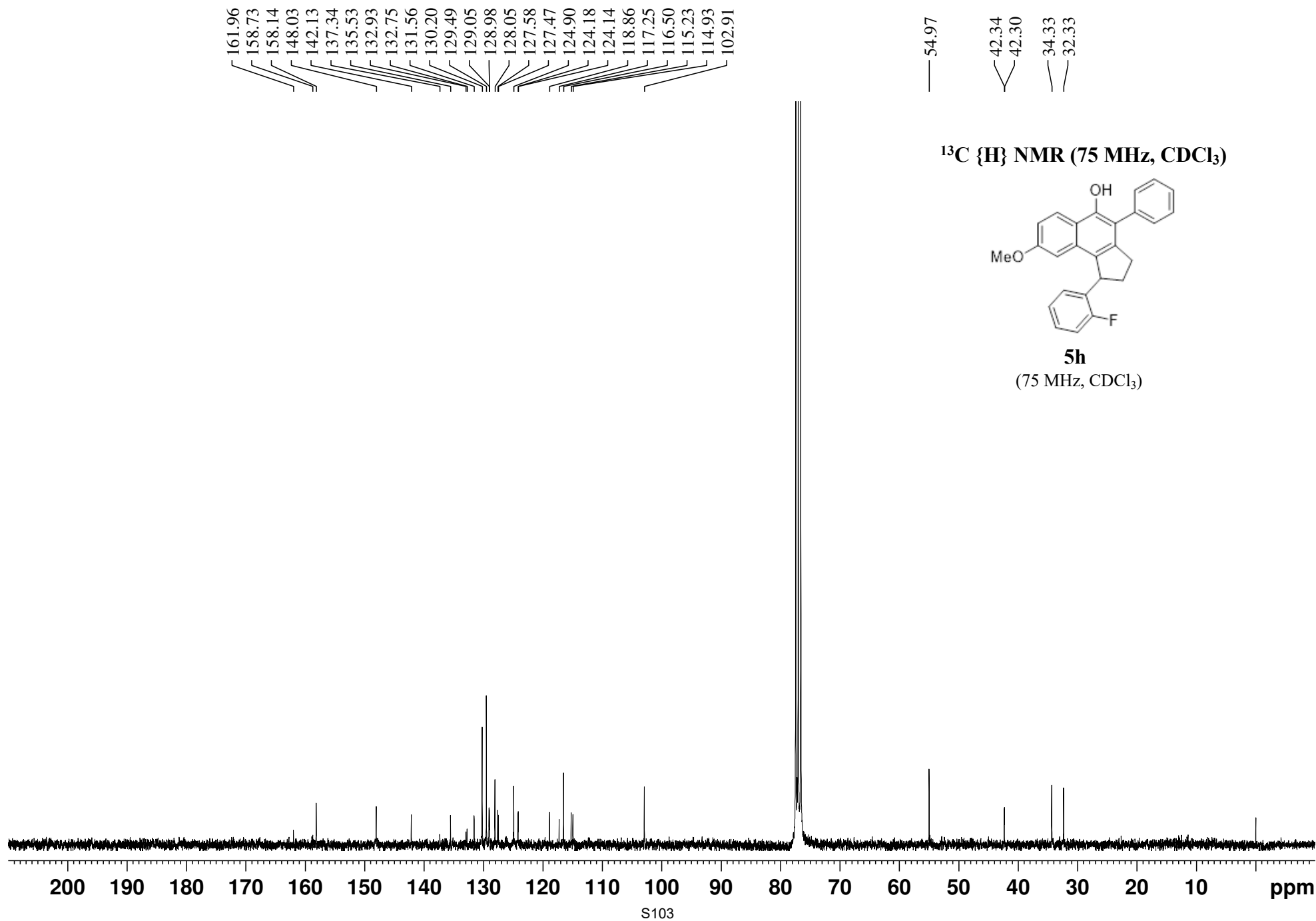


5g
(300 MHz, CDCl₃)

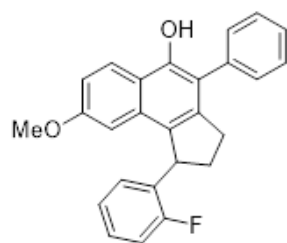






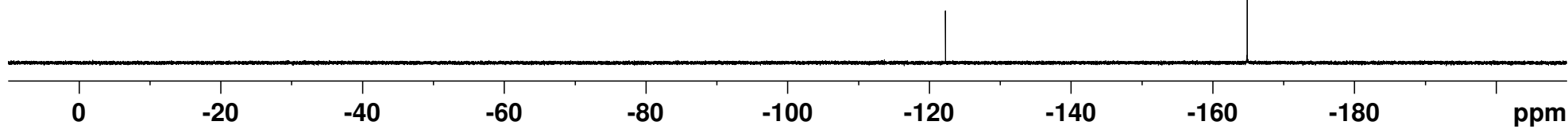


^{19}F NMR (282 MHz, CDCl_3)

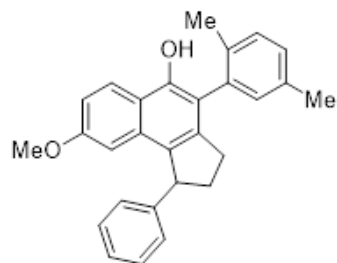


5h
(282 MHz, CDCl_3)

— -122.31

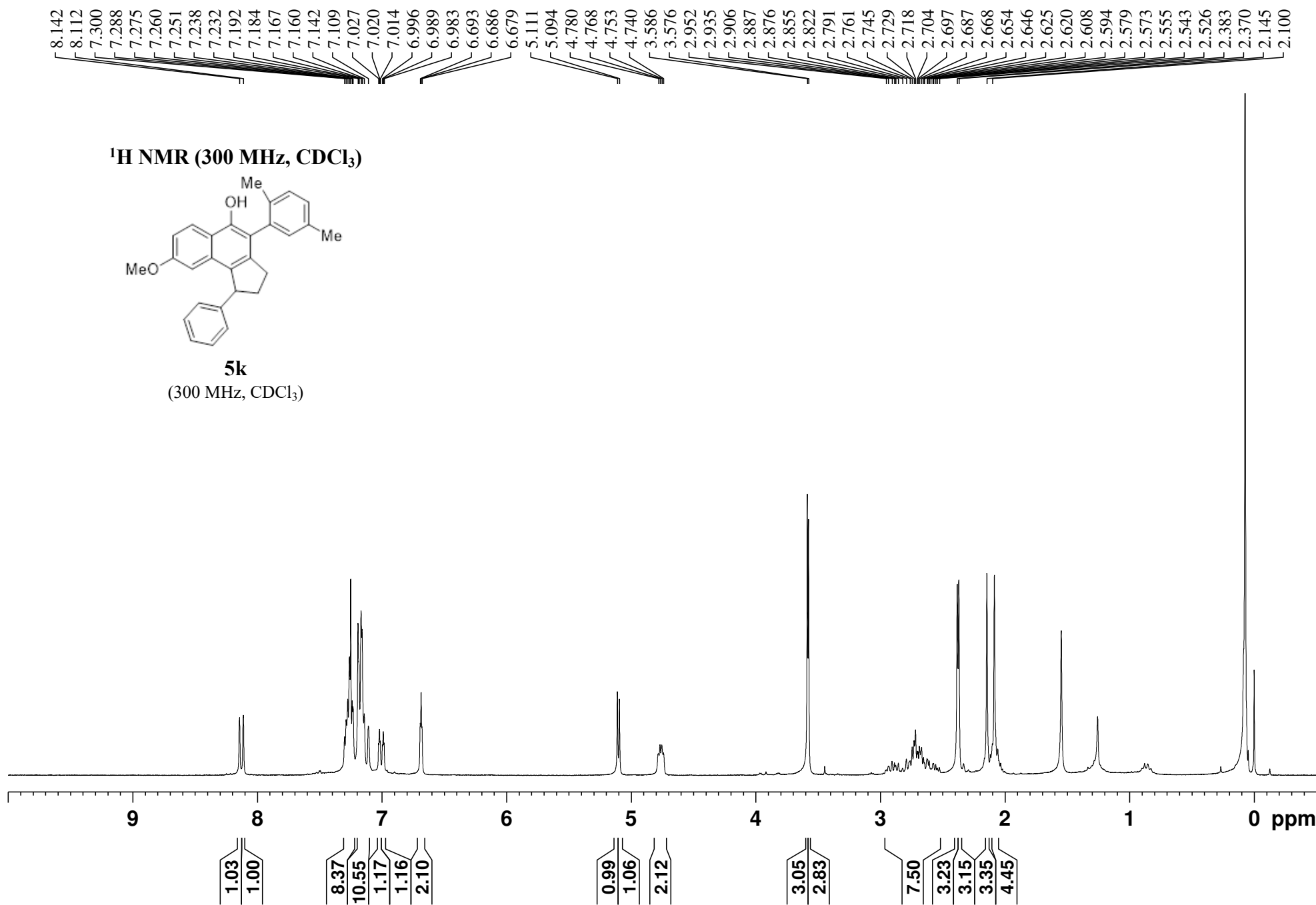


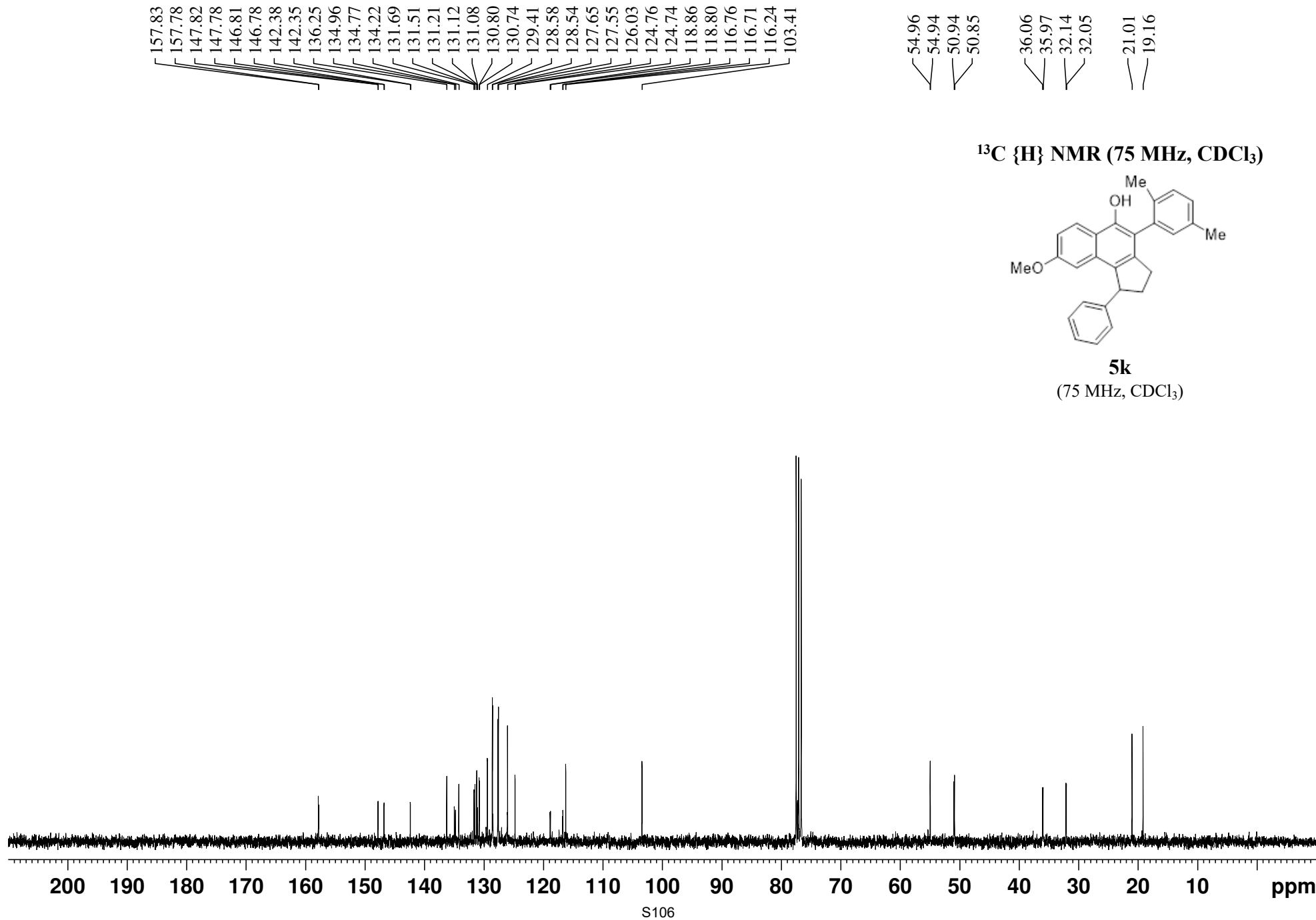
¹H NMR (300 MHz, CDCl₃)

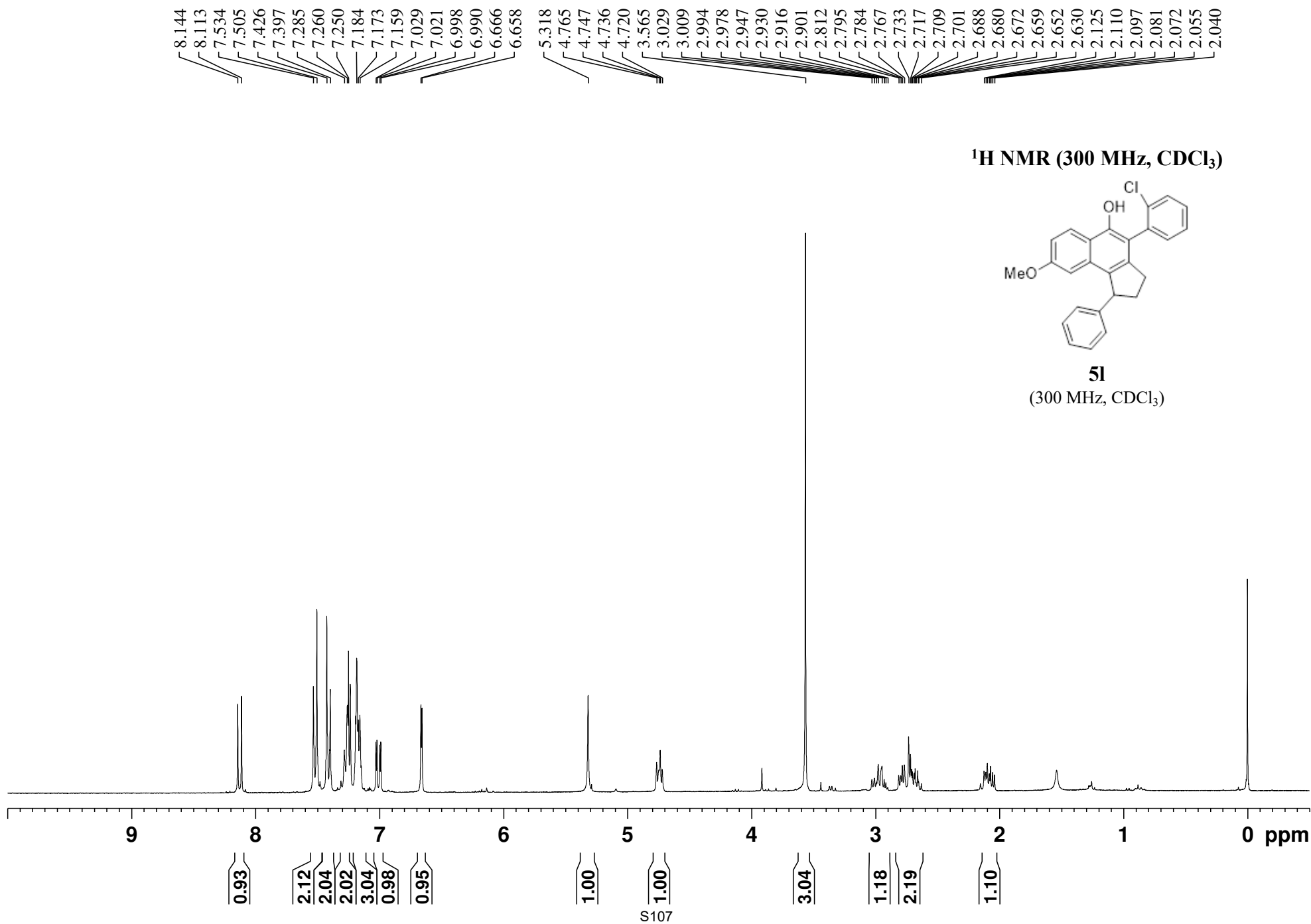


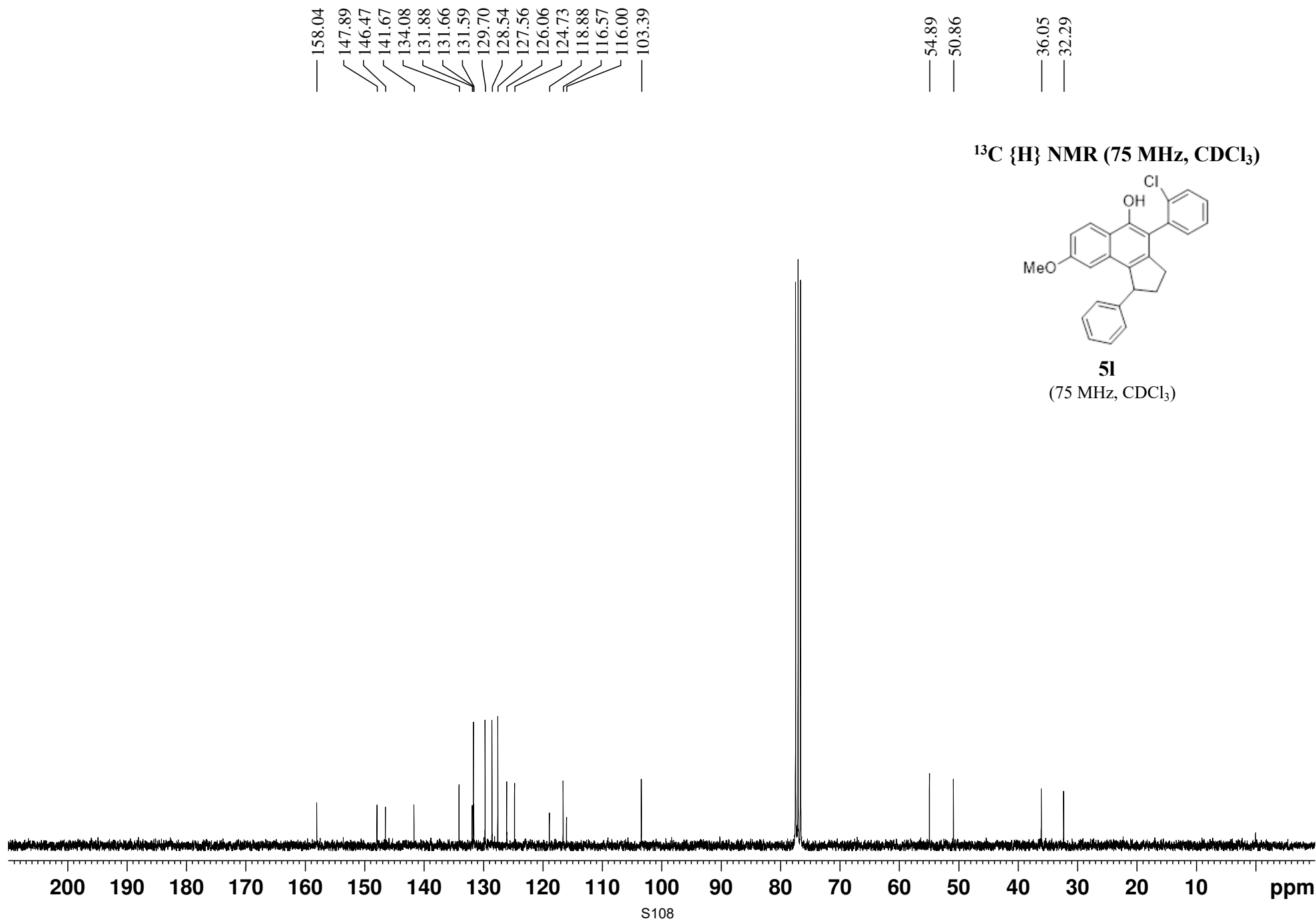
5k

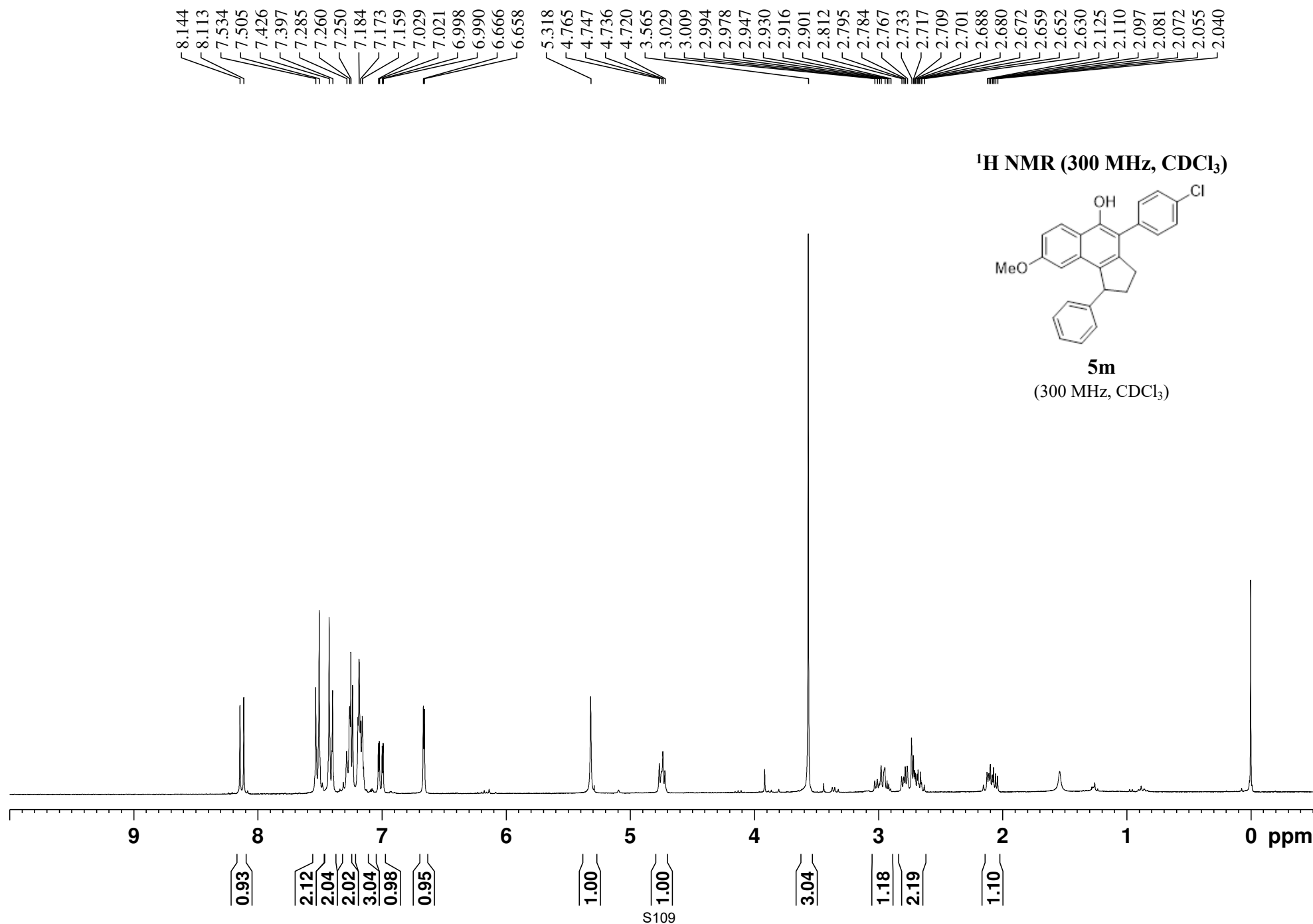
(300 MHz, CDCl₃)









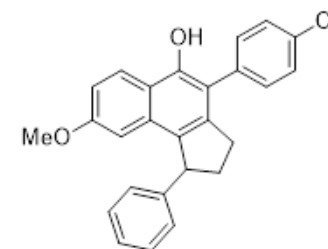


— 158.04
 / 147.89
 / 146.47
 / 141.67
 / 134.08
 / 131.88
 / 131.66
 / 131.59
 / 129.70
 / 128.54
 / 127.56
 / 126.06
 / 124.73
 / 118.88
 / 116.57
 / 116.00
 — 103.39

— 54.89
 — 50.86

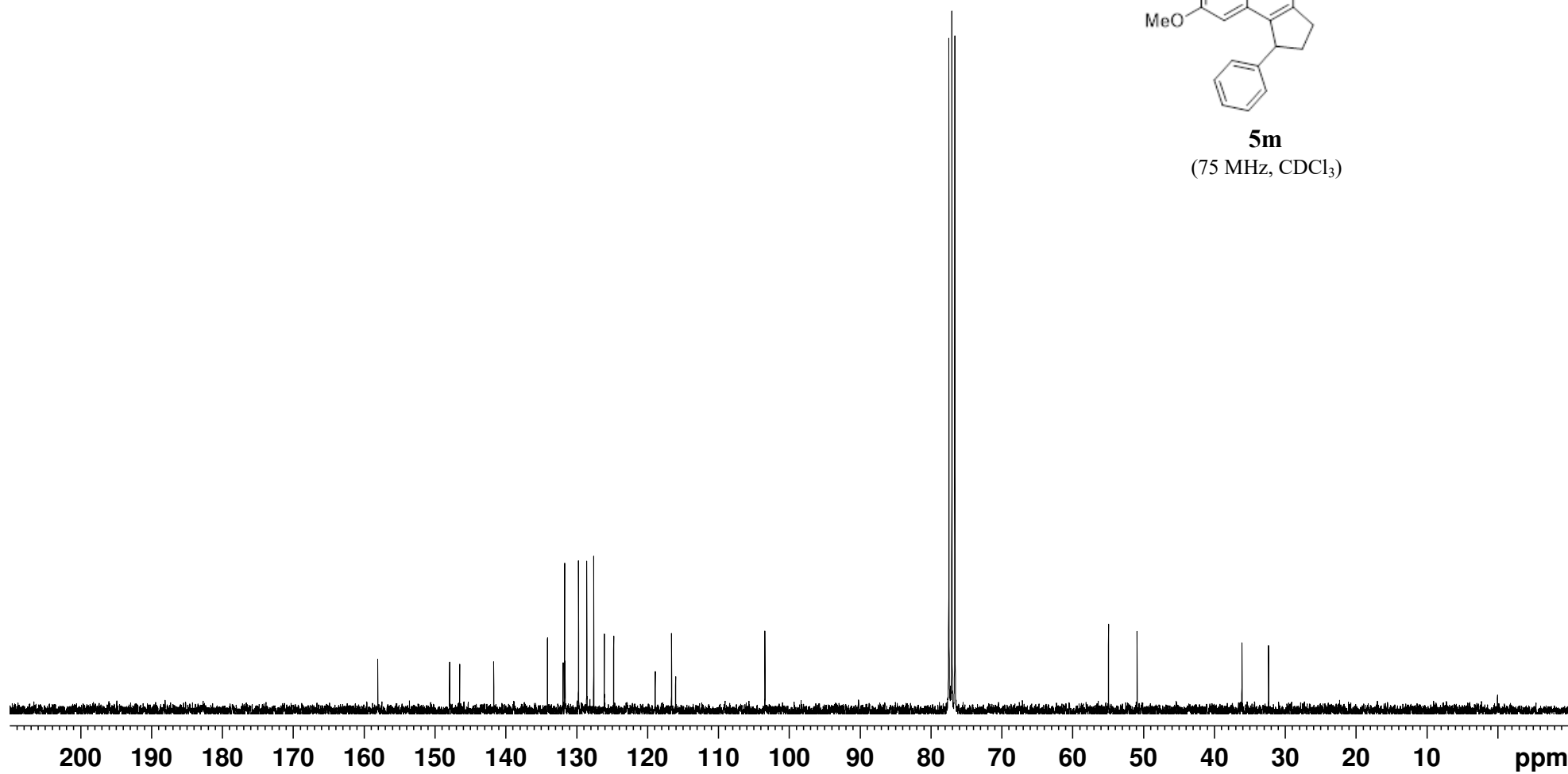
— 36.05
 — 32.29

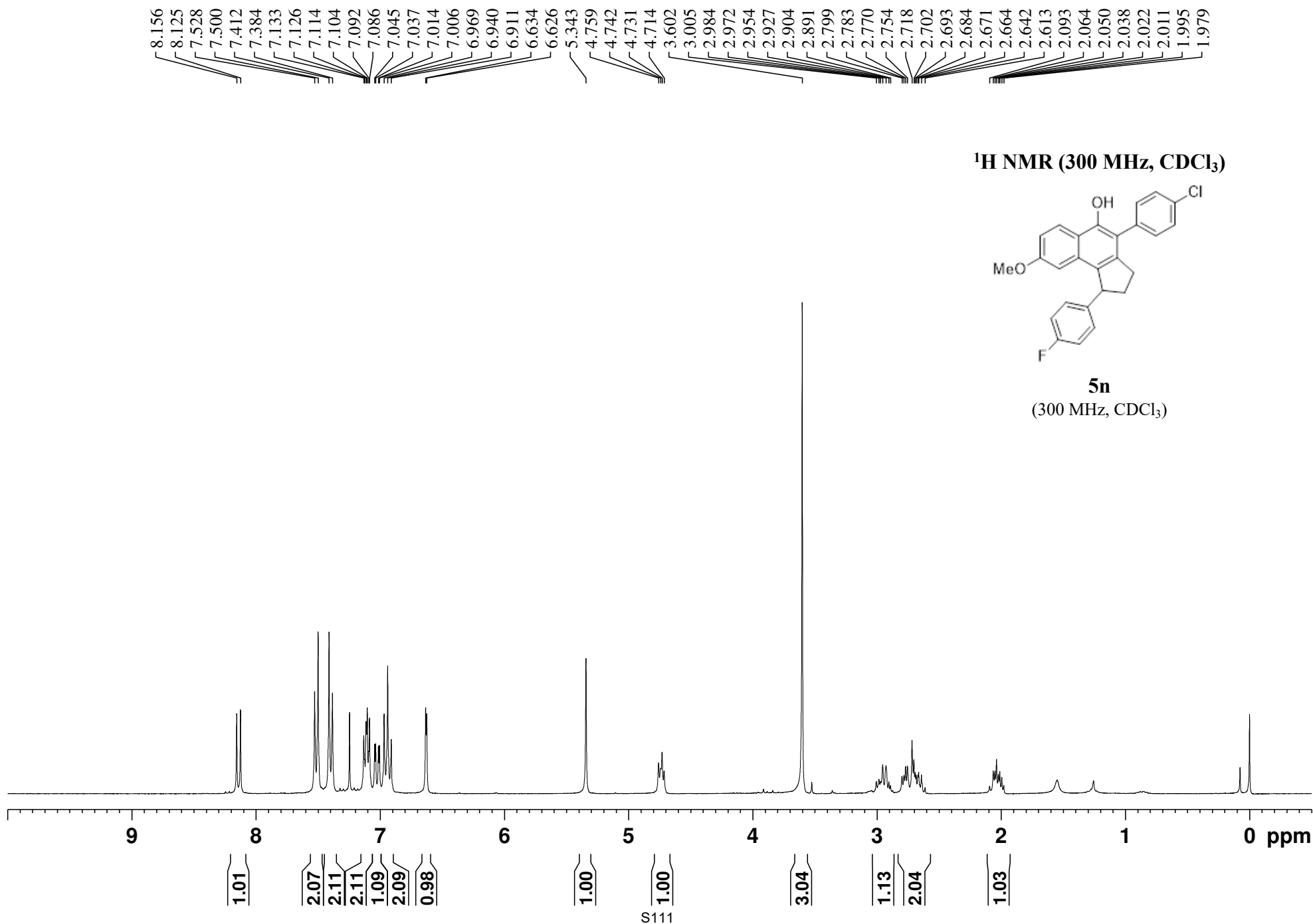
^{13}C {H} NMR (75 MHz, CDCl_3)

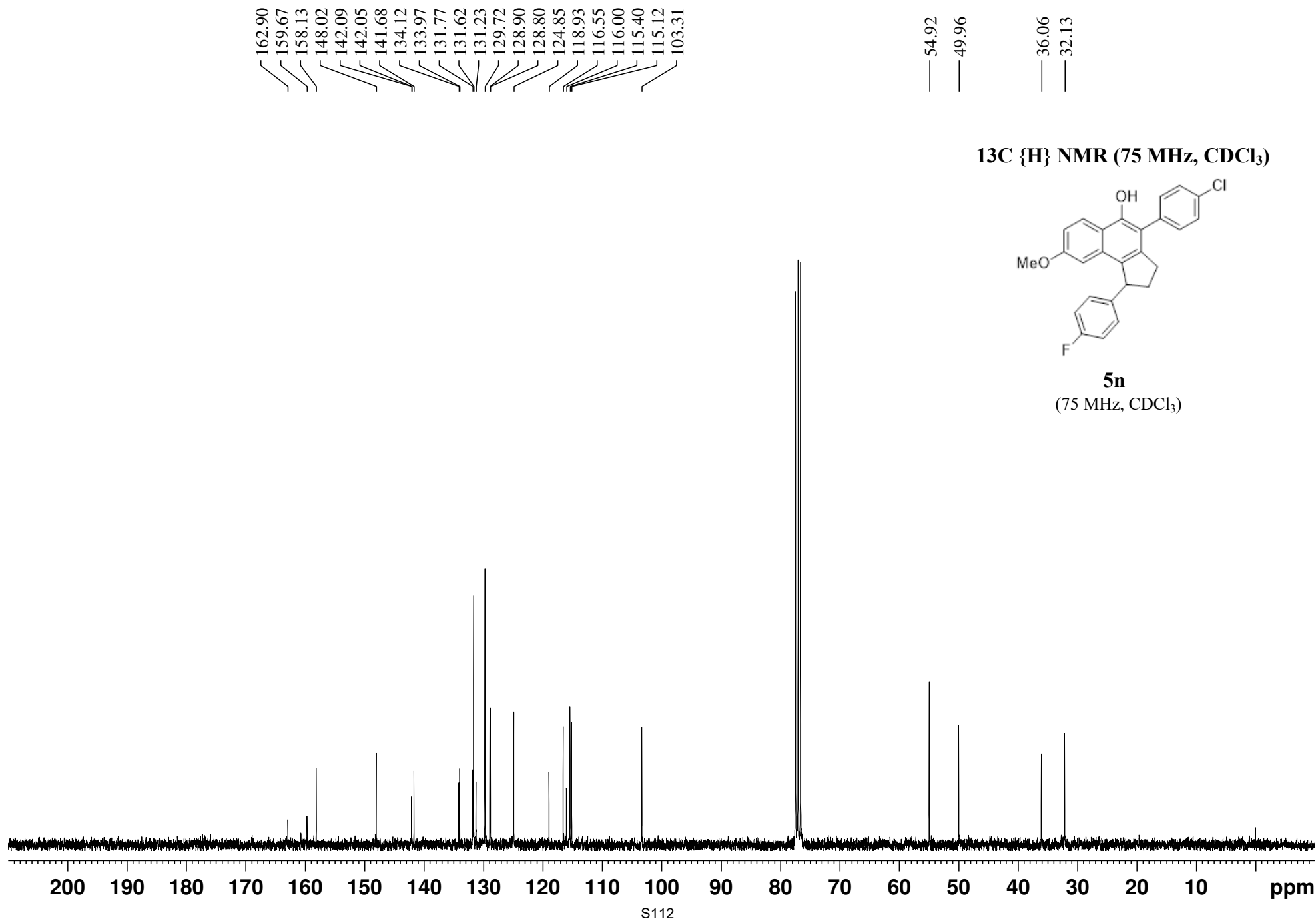


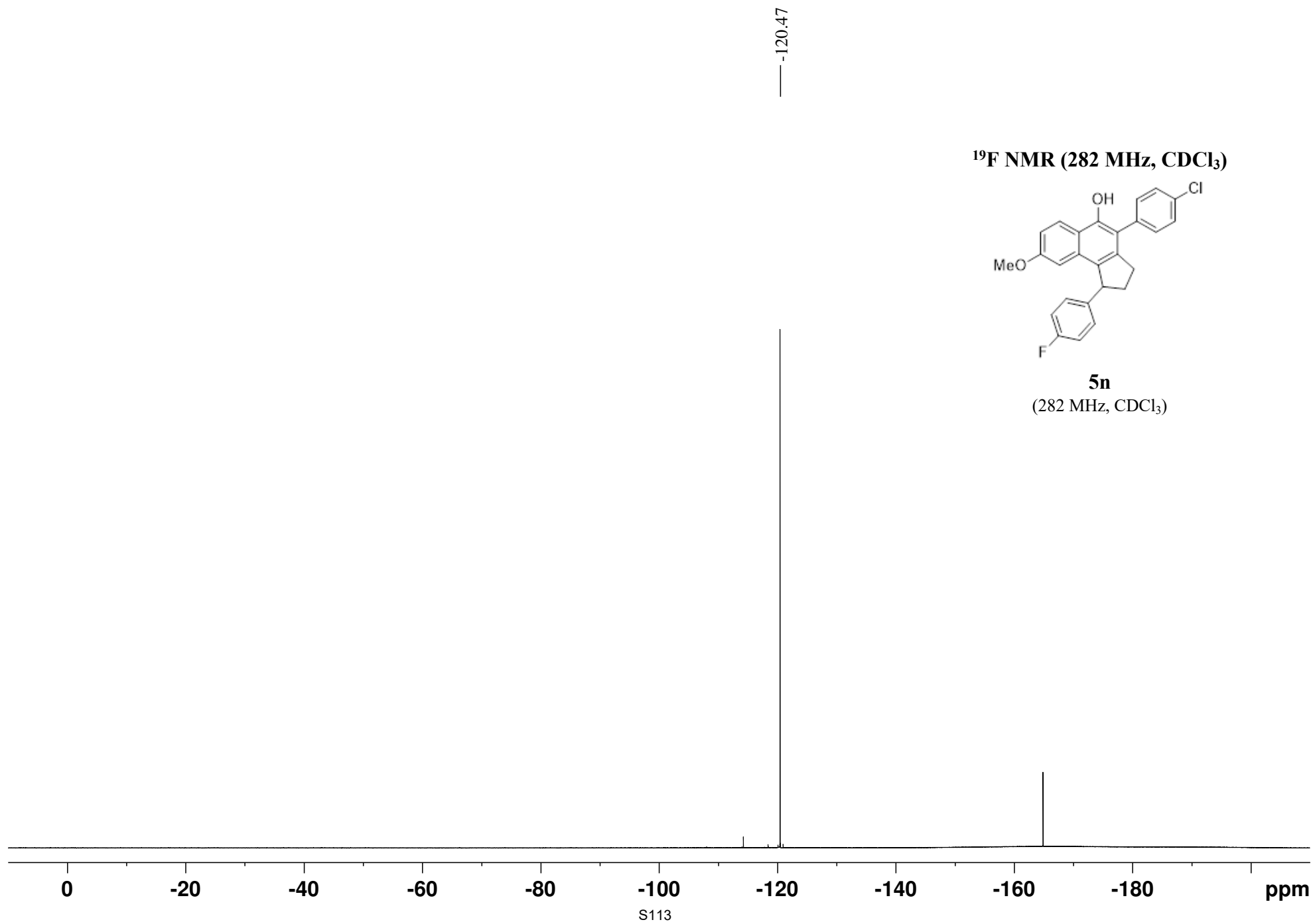
5m

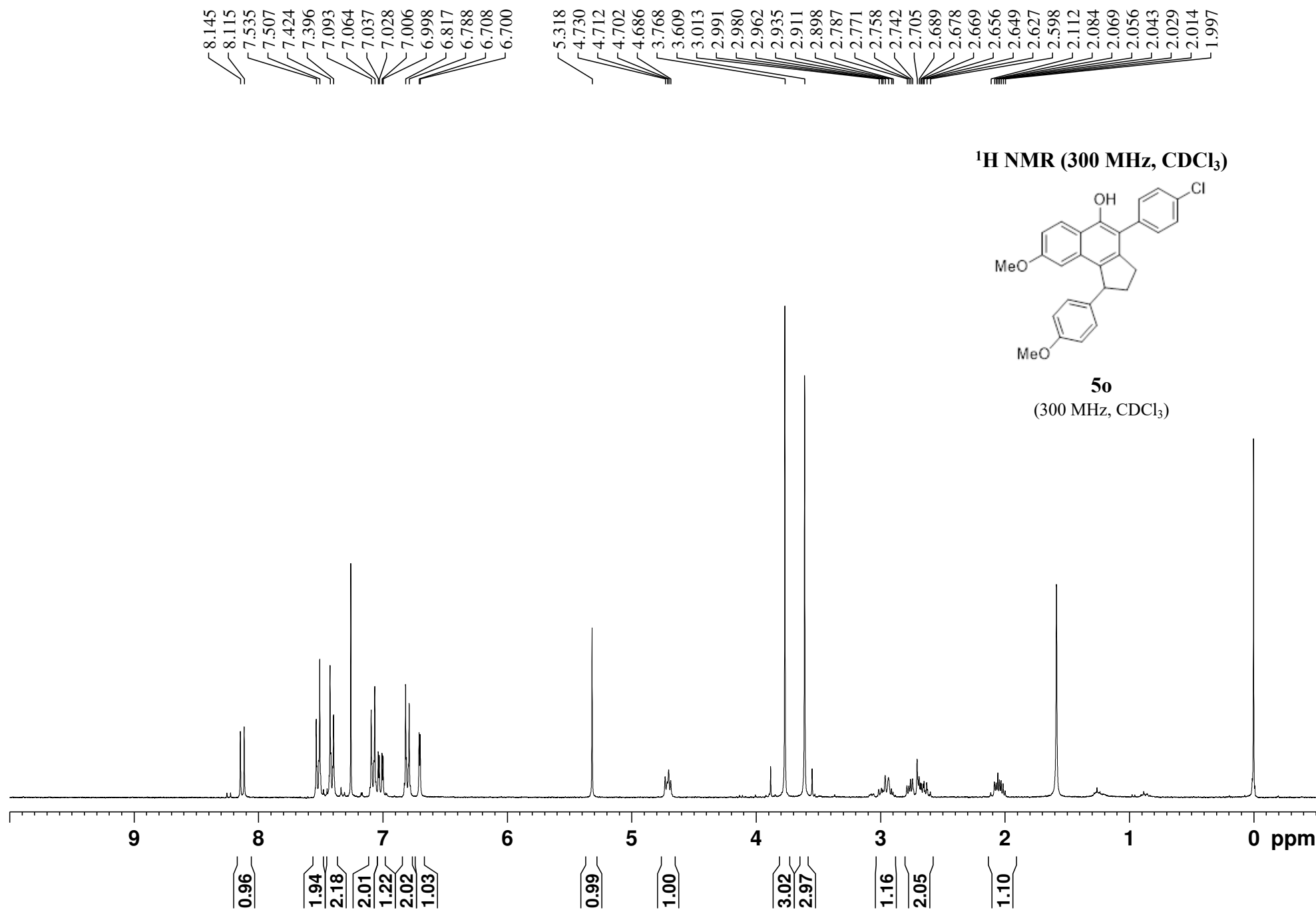
(75 MHz, CDCl_3)

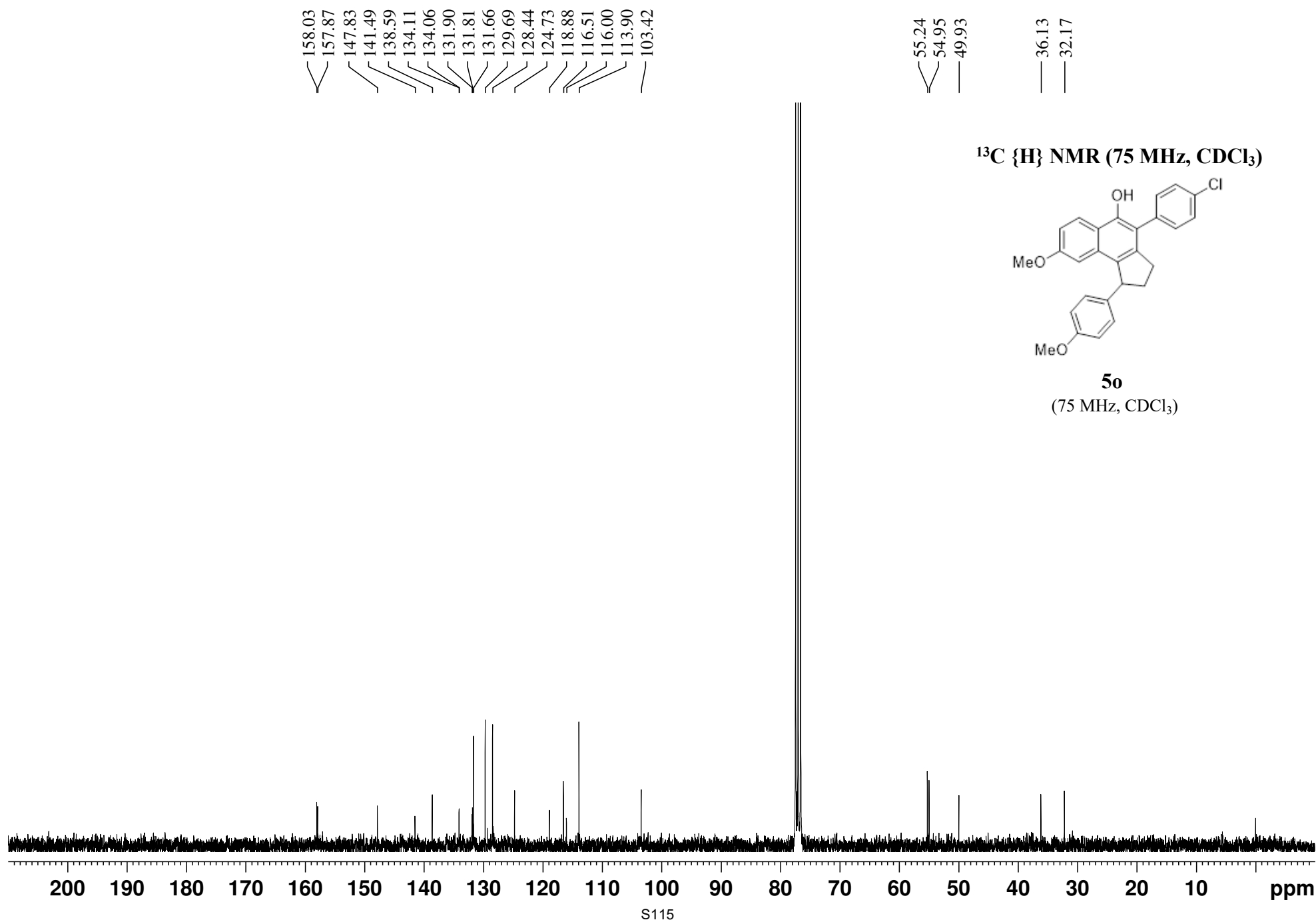


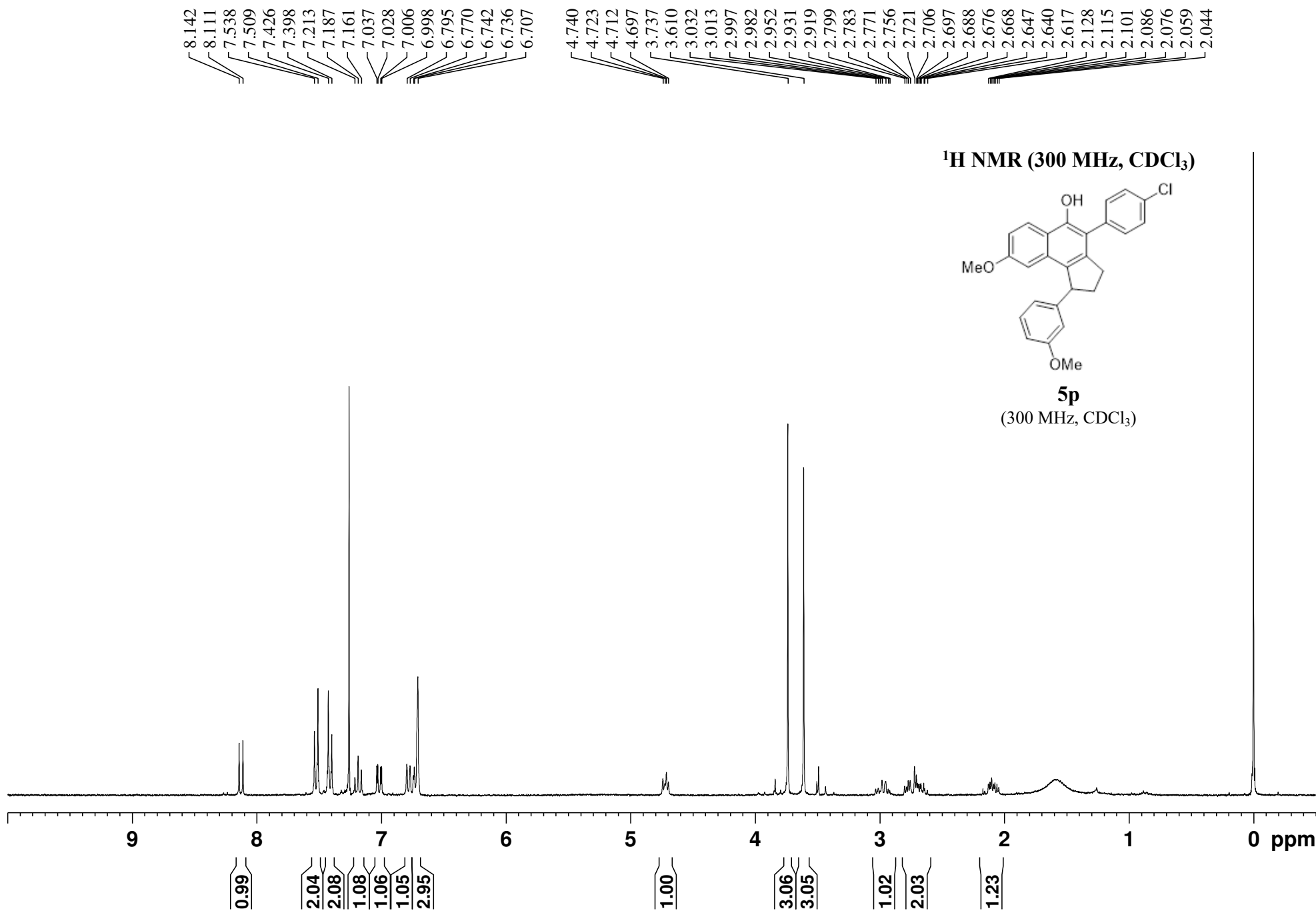


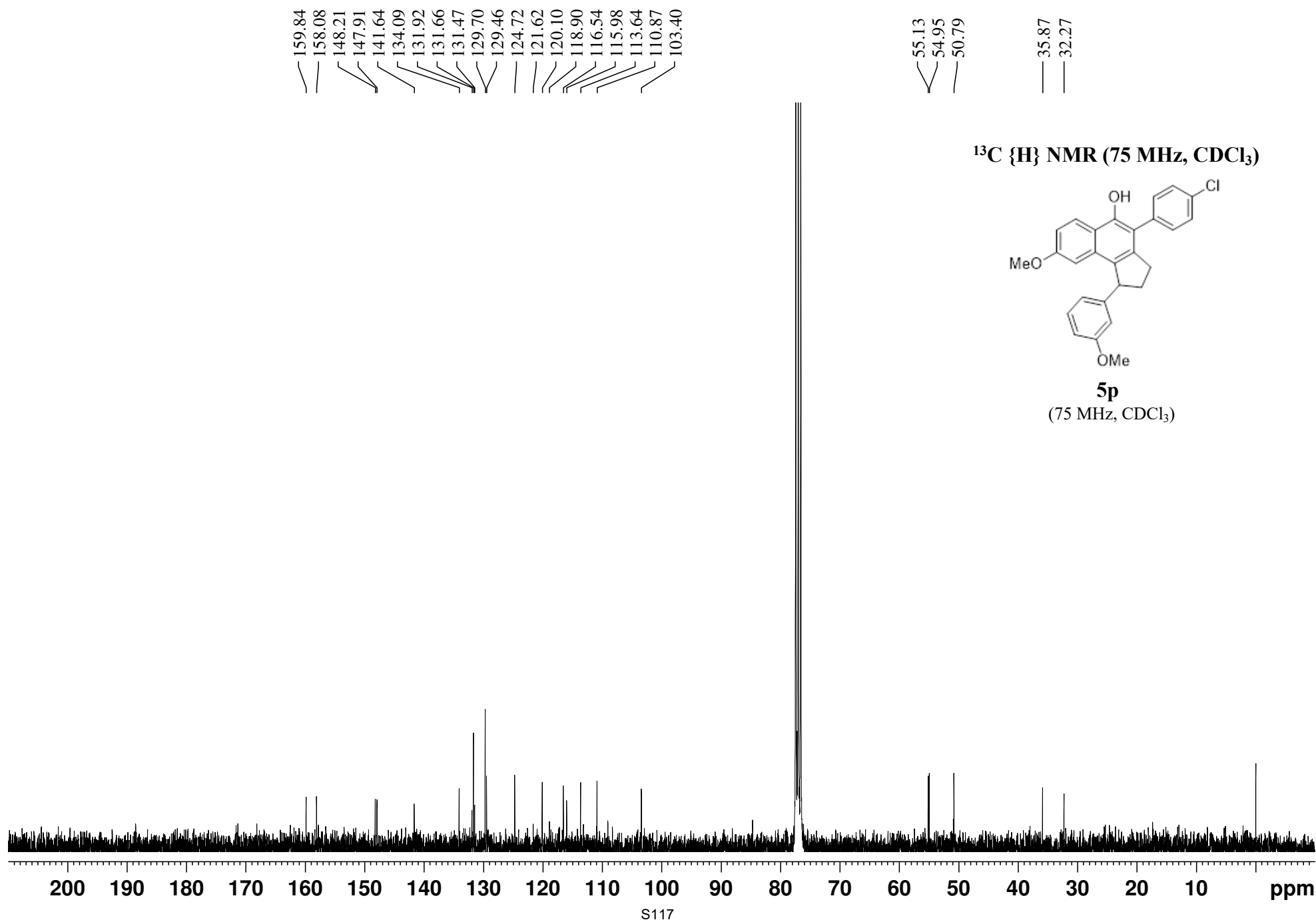






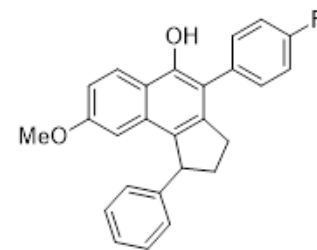




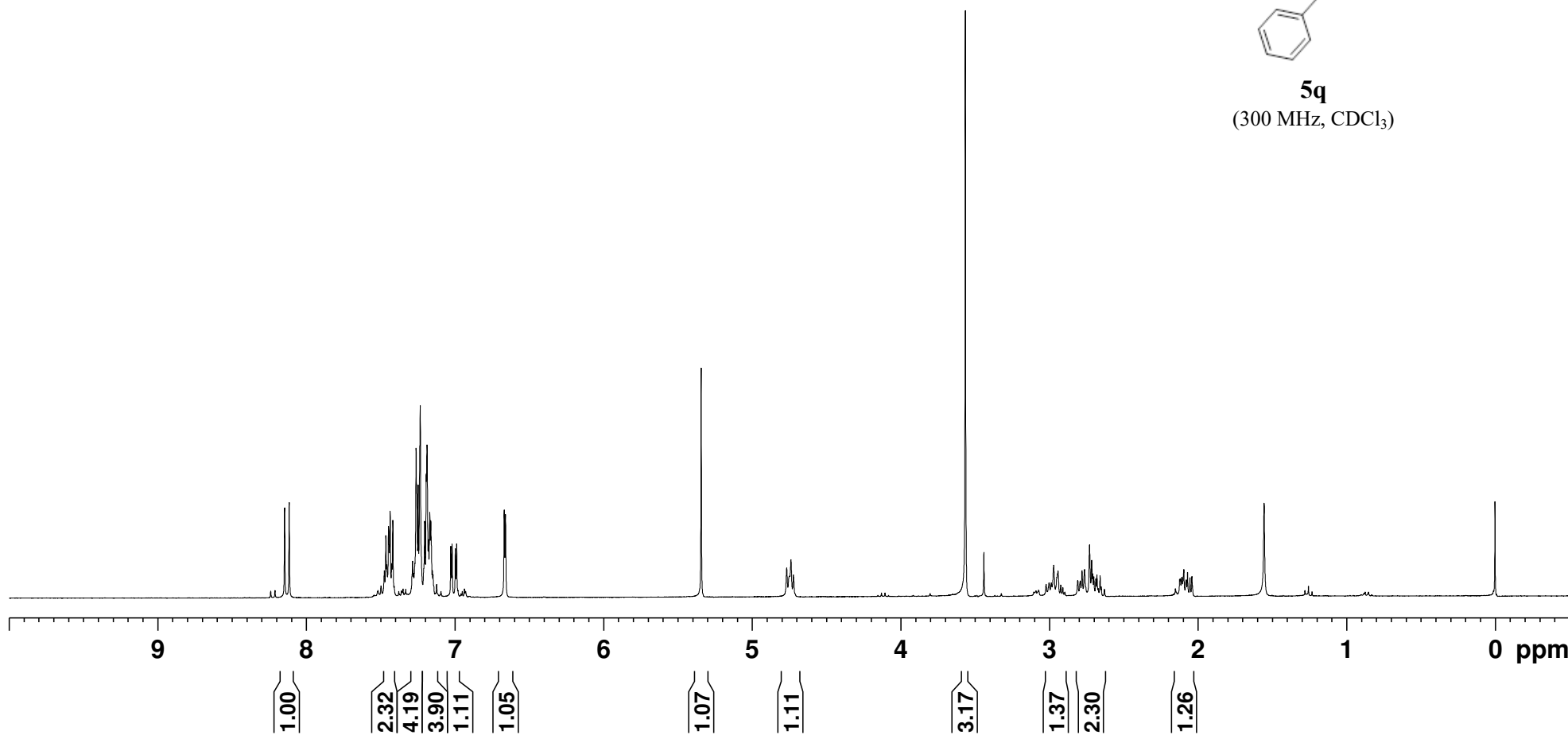


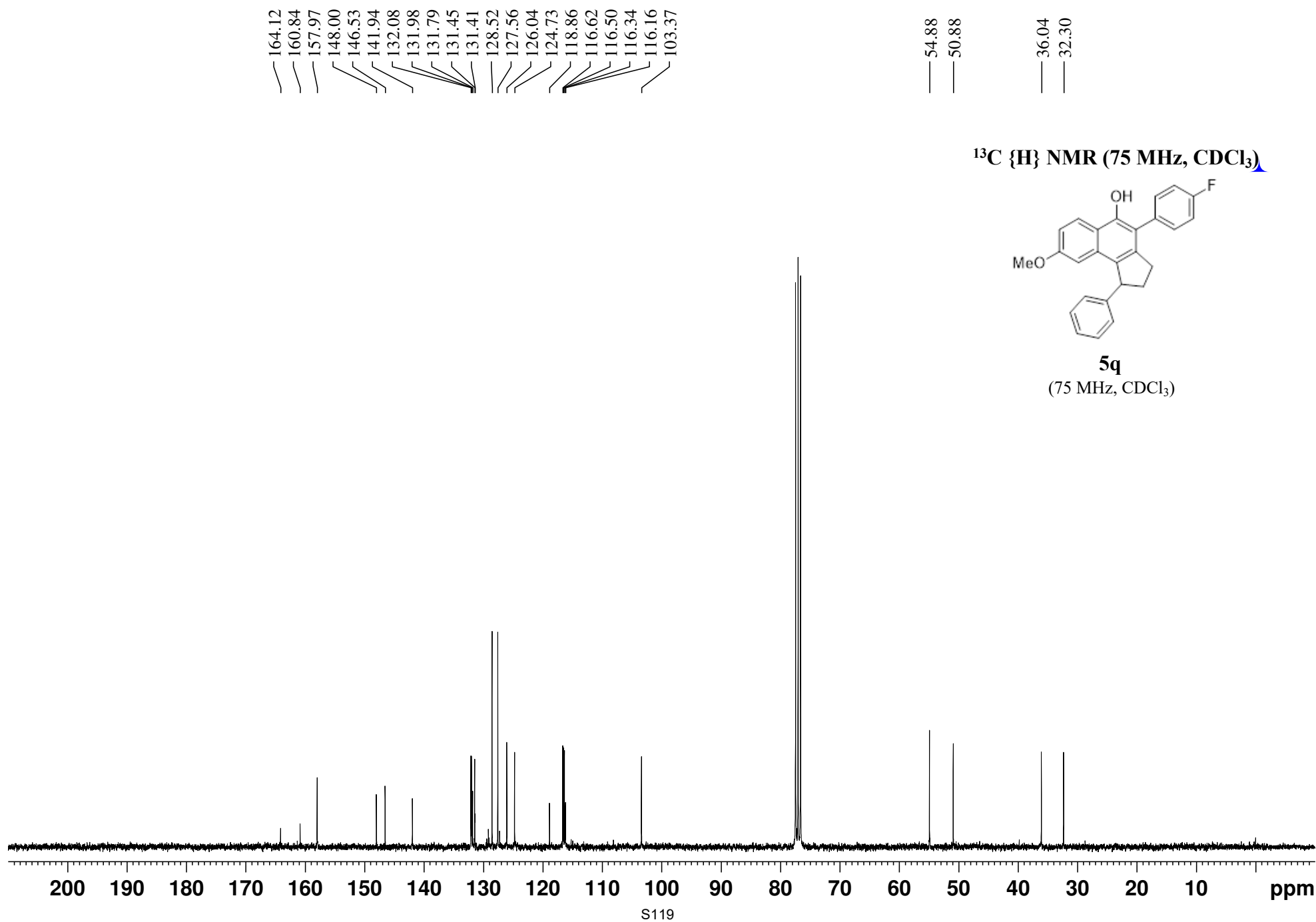
8.146
8.115
7.474
7.465
7.458
7.447
7.436
7.425
7.418
7.285
7.279
7.261
7.247
7.233
7.203
7.192
7.188
7.177
7.169
7.162
7.152
7.147
7.027
7.019
6.997
6.988
6.668
6.659
5.342
4.767
4.748
4.738
4.722
3.564
3.021
3.001
2.986
2.970
2.949
2.941
2.922
2.909
2.808
2.791
2.779
2.762
2.728
2.714
2.707
2.699
2.687
2.678
2.670
2.658
2.650
2.122
2.117
2.109
2.106
2.094
2.078
2.069
2.052
2.040
2.036

¹H NMR (300 MHz, CDCl₃)



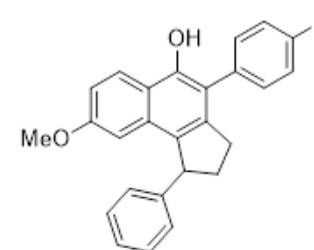
5q
(300 MHz, CDCl₃)





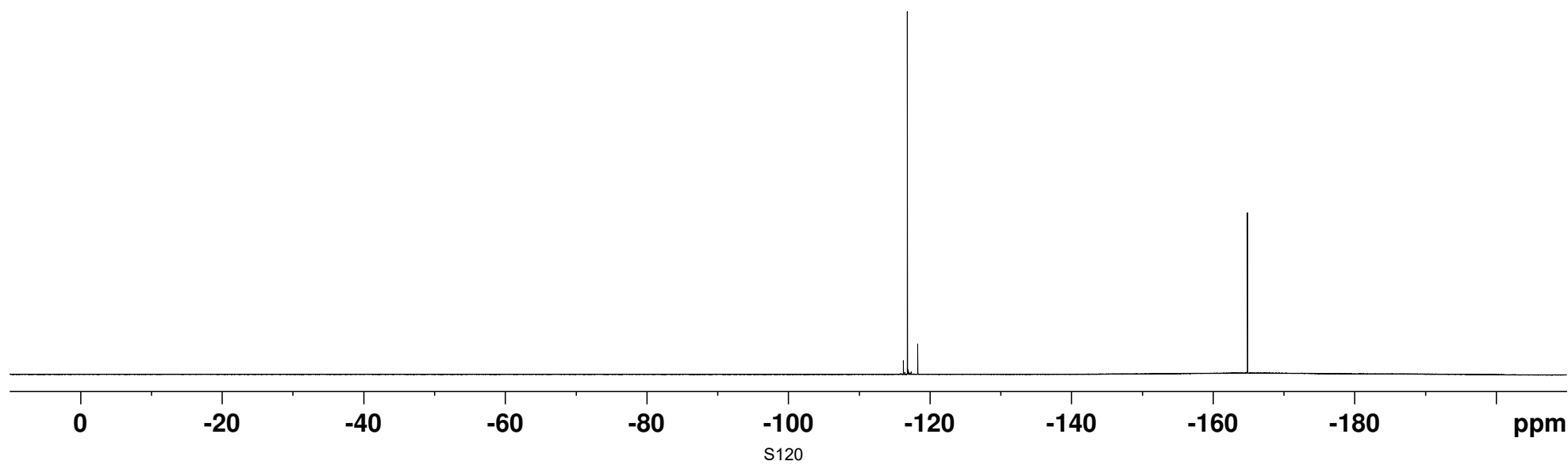
— -116.85

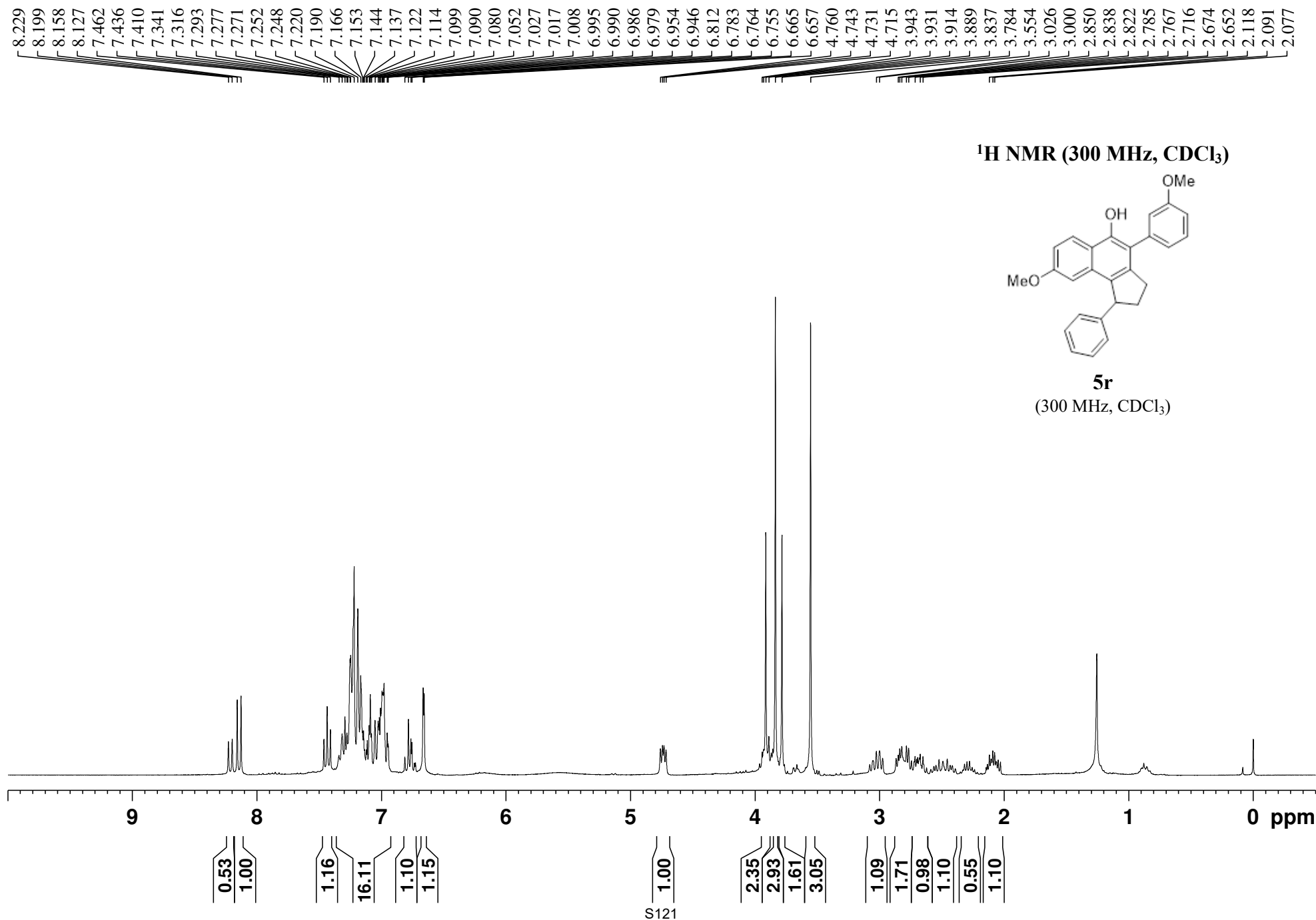
^{19}F NMR (282 MHz, CDCl_3)

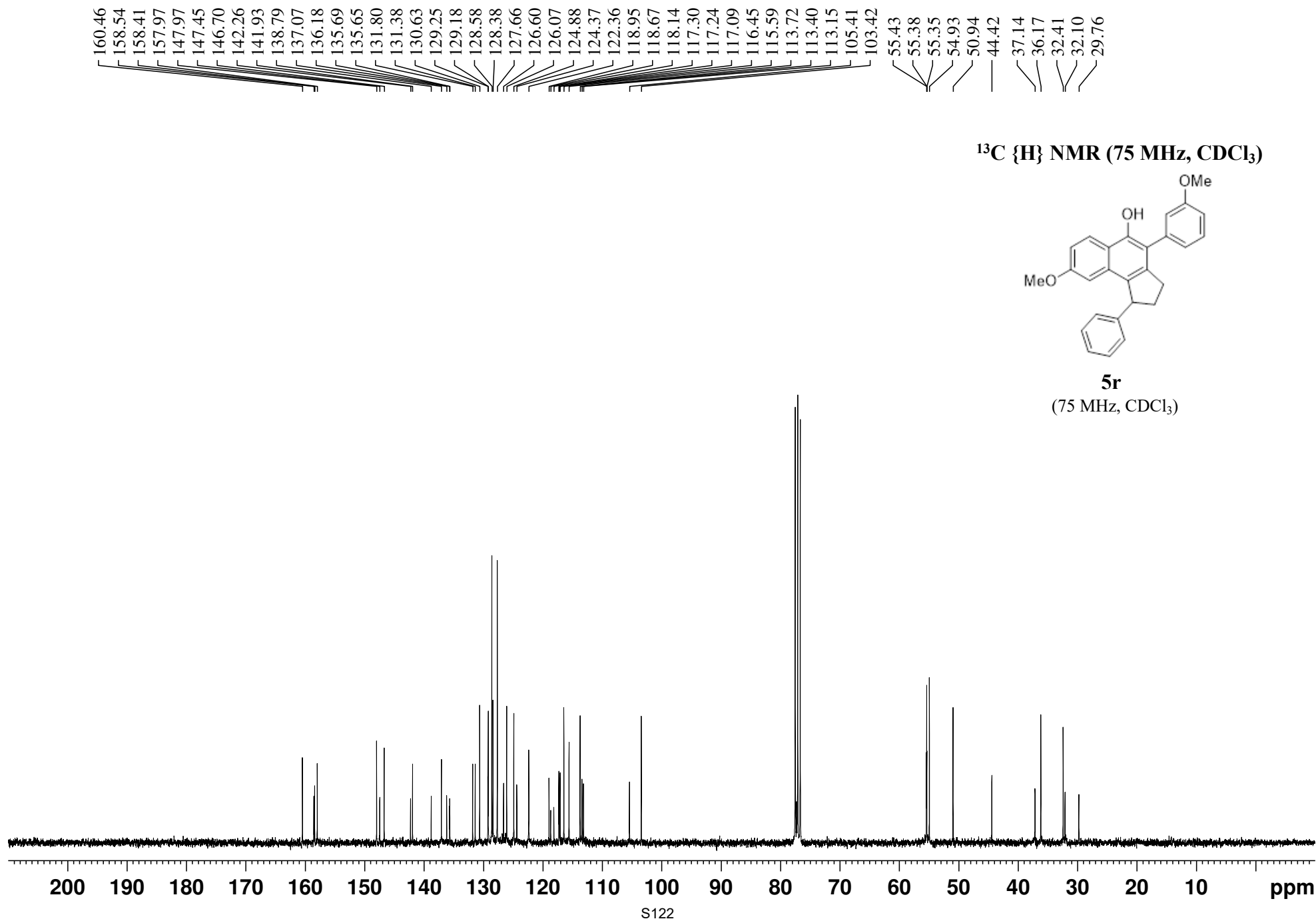


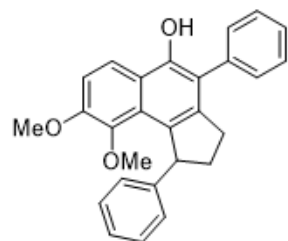
5q

(282 MHz, CDCl_3)





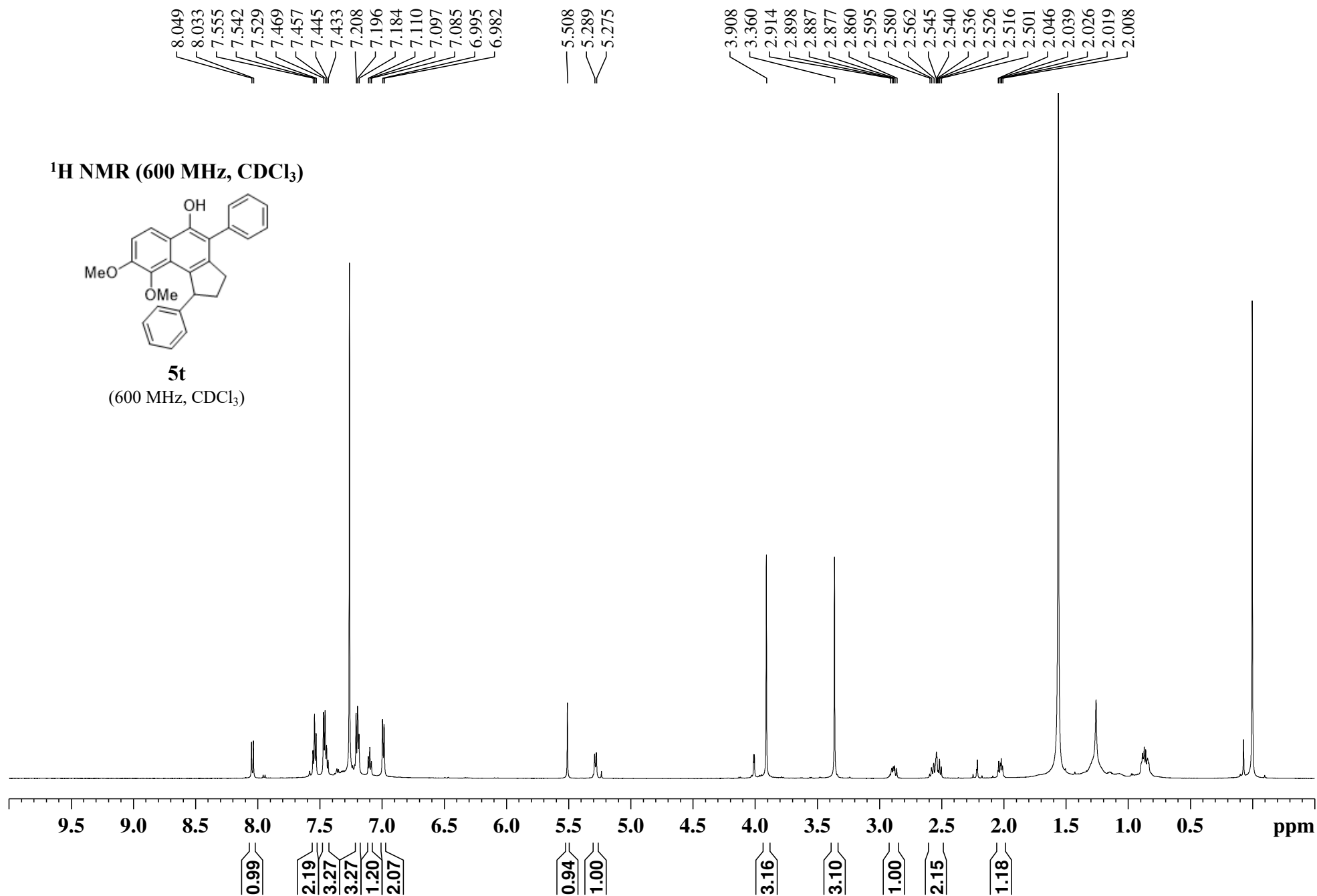


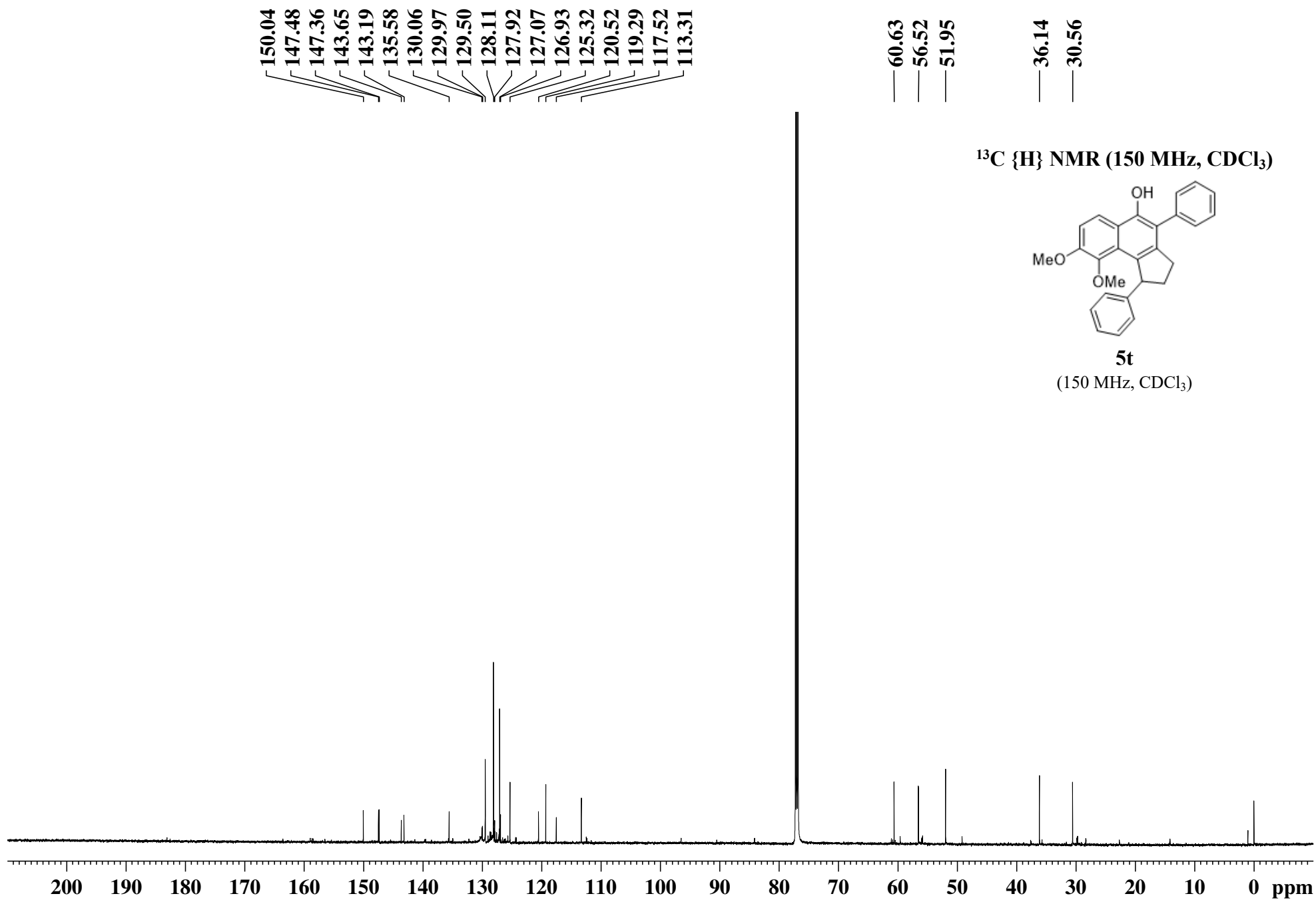


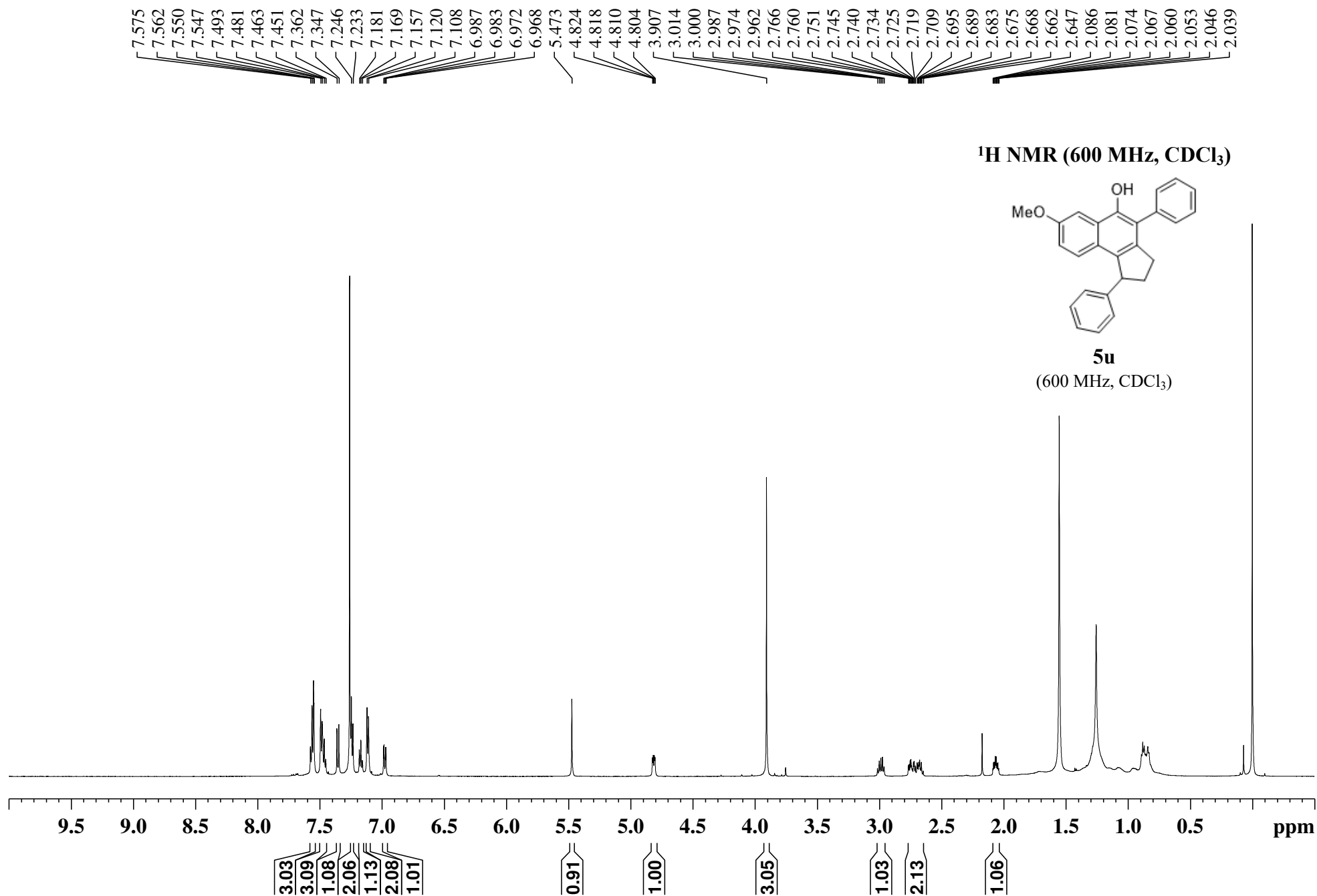
5t

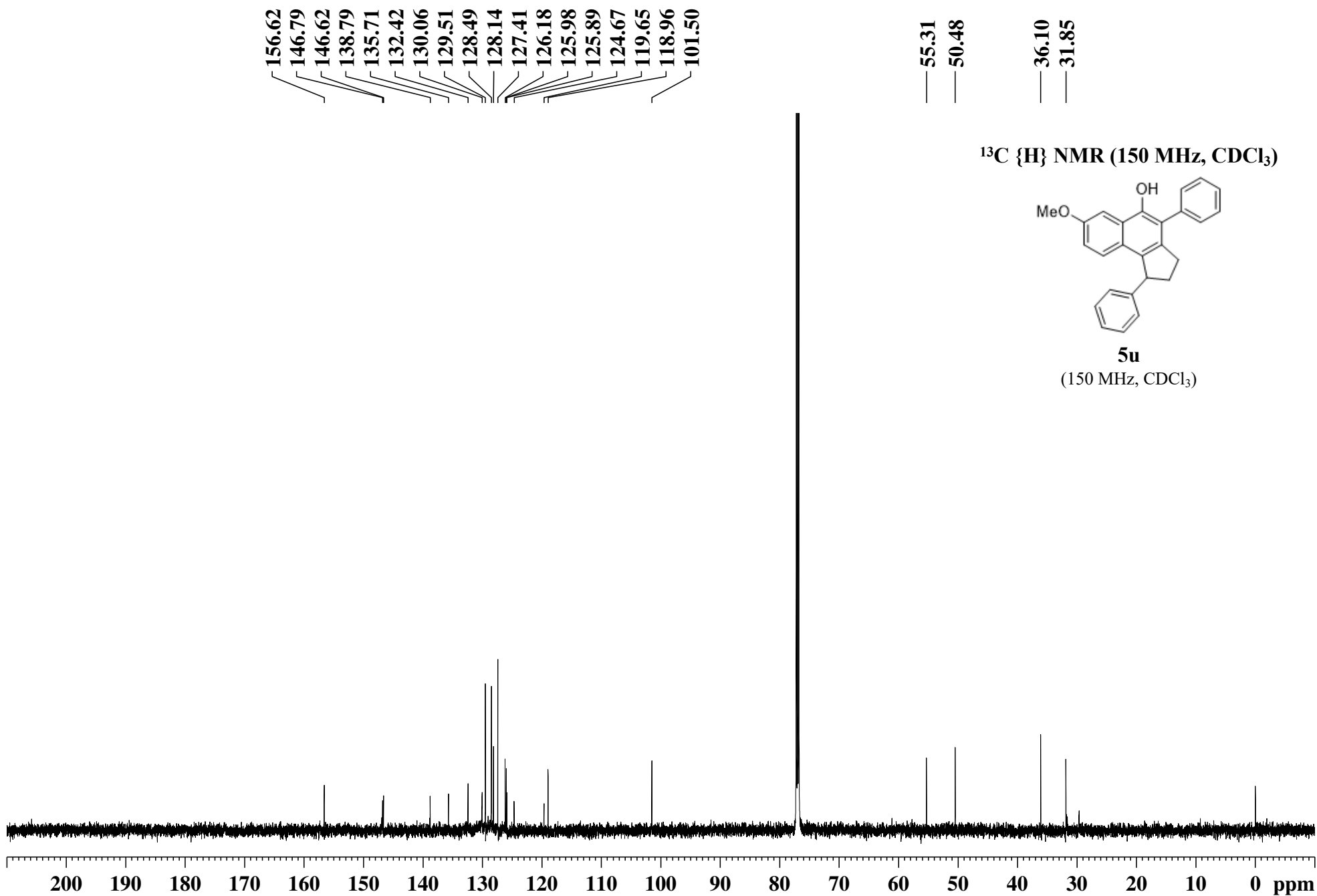
(600 MHz, CDCl₃)

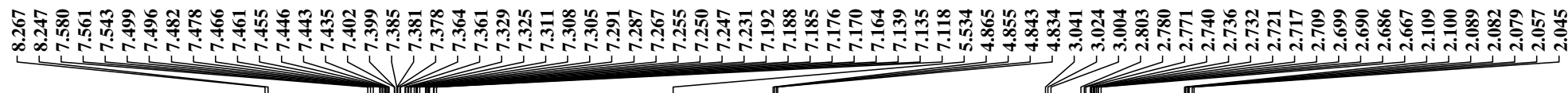
¹H NMR (600 MHz, CDCl₃)



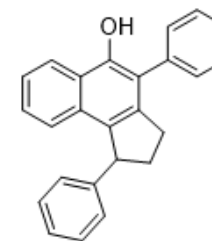






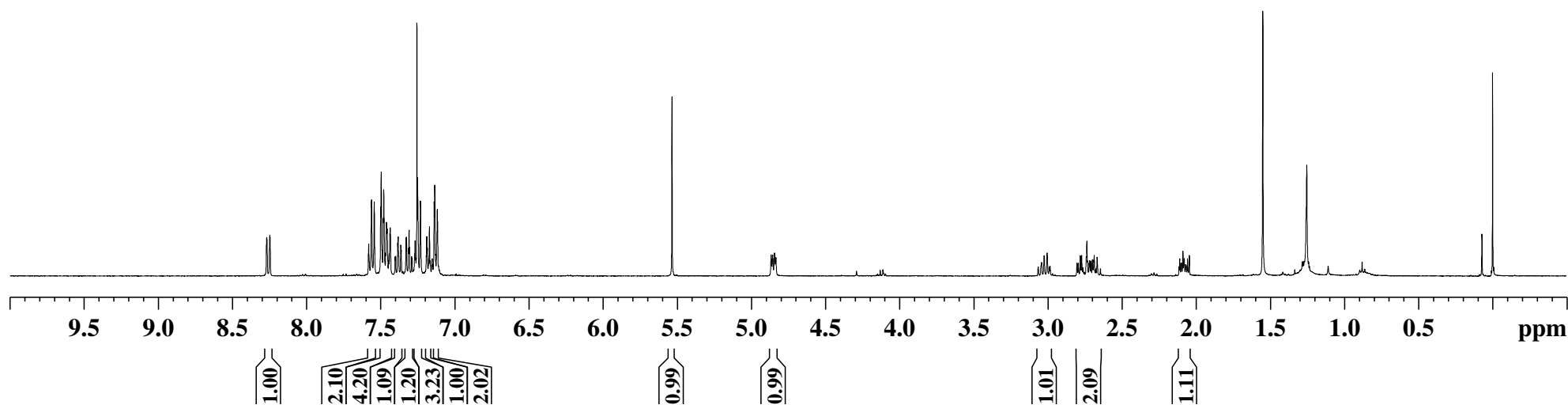


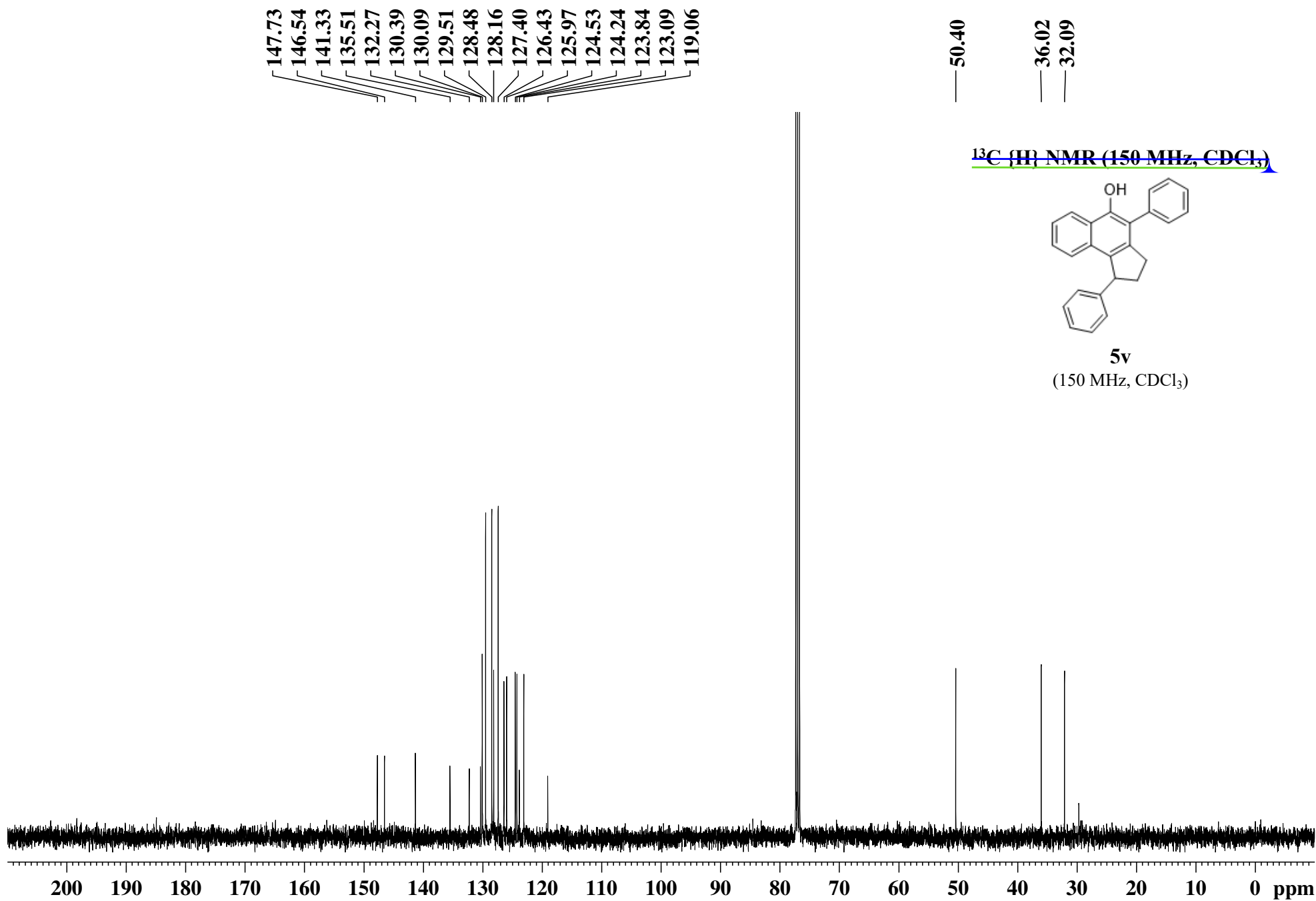
¹H NMR (600 MHz, CDCl₃)



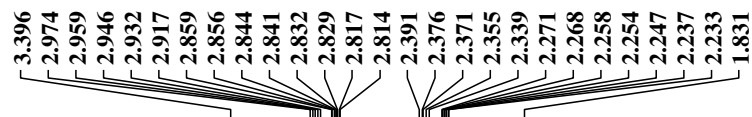
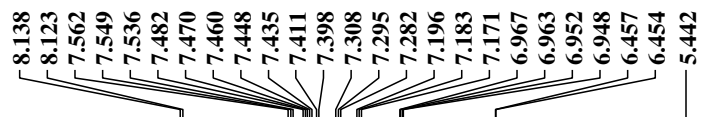
5v

(600 MHz, CDCl₃)

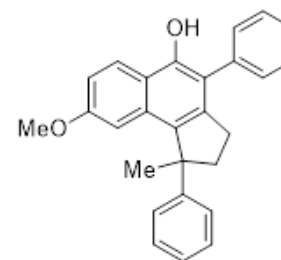




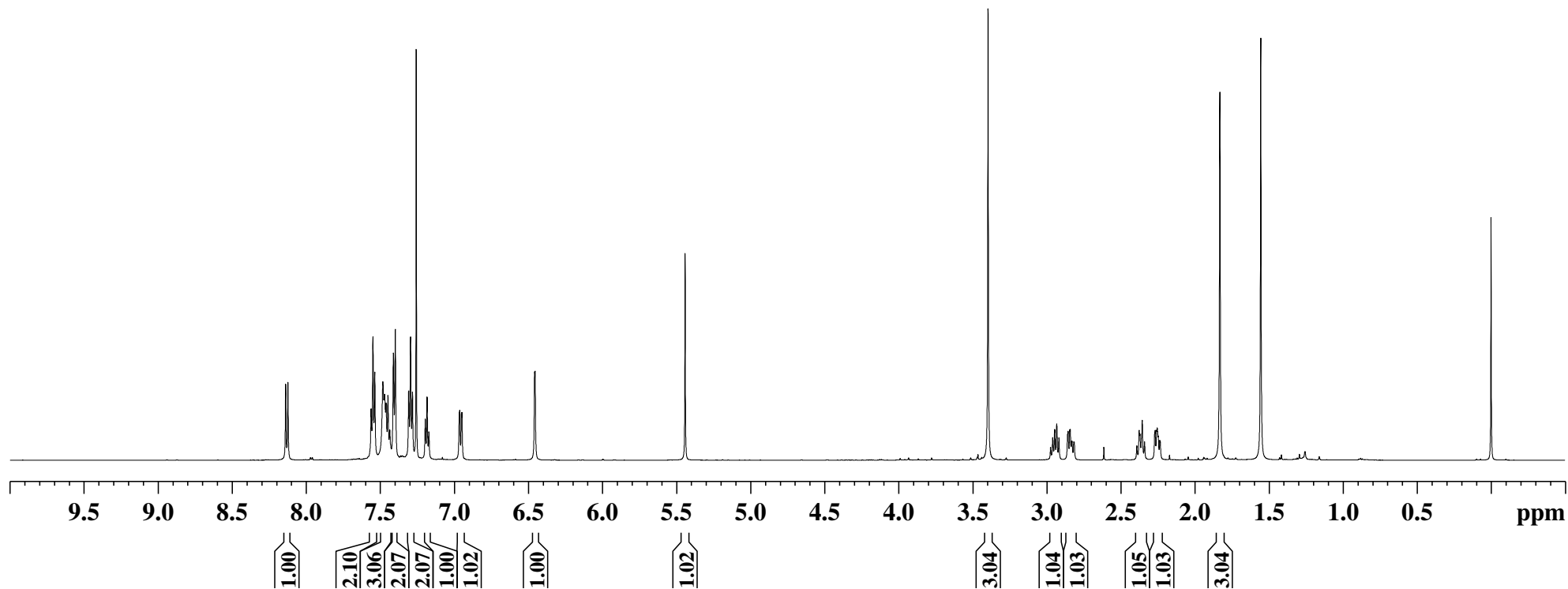
PY-2-085 ¹H NMR 600 MHz CDCl₃



¹H NMR (600 MHz, CDCl₃)



5X
(600 MHz, CDCl₃)



PY-2-085 ^{13}C NMR 150 MHz CDCl_3

157.40
150.36
147.77
140.78
136.10
135.61
130.78
130.26
129.46
128.25
128.00
126.72
125.60
124.83
119.23
117.12
116.27
103.18

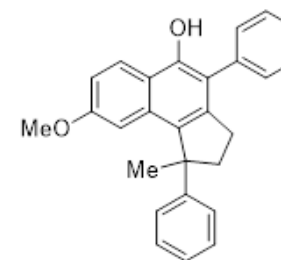
54.71
53.12

45.95

31.25

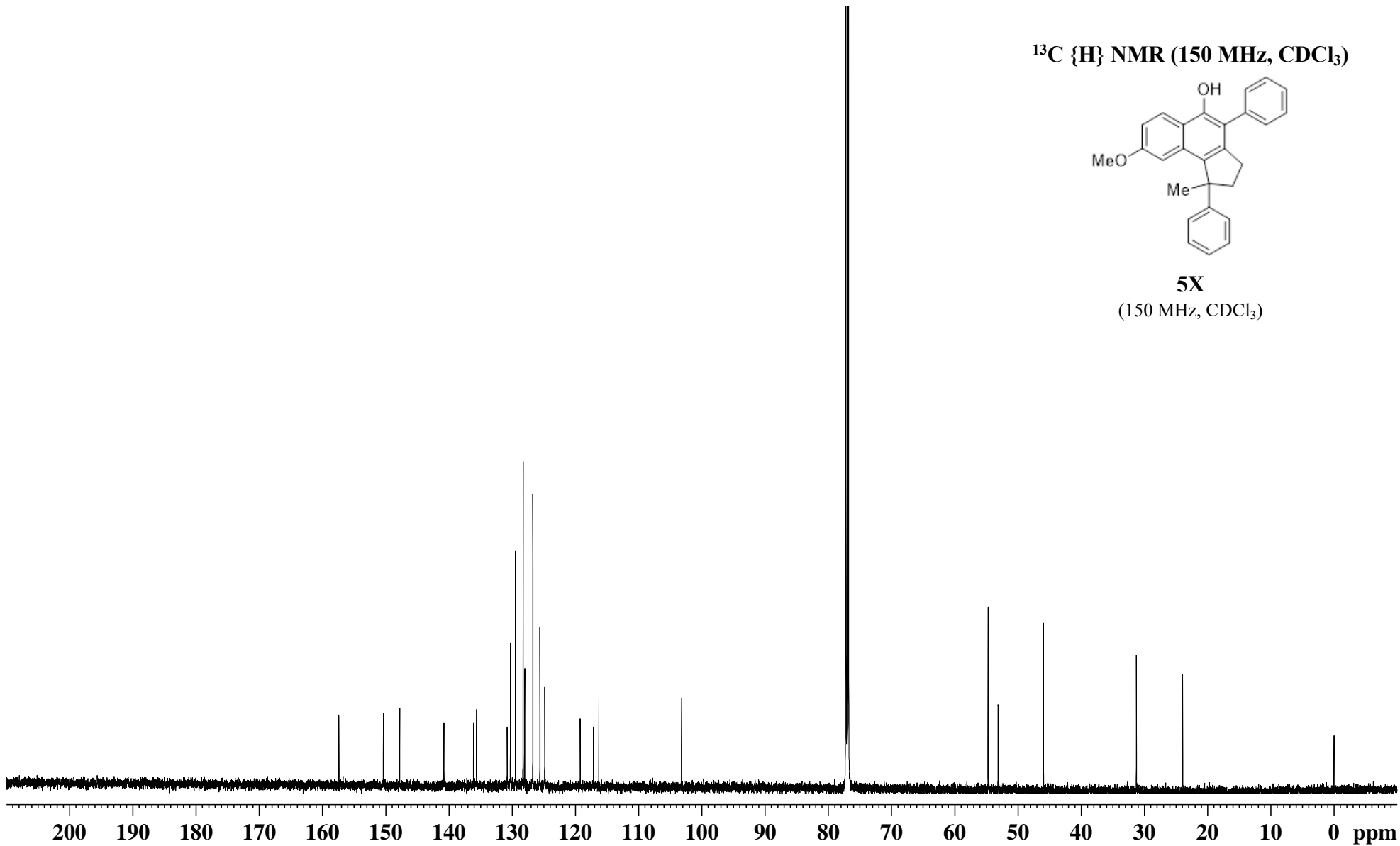
23.92

^{13}C {H} NMR (150 MHz, CDCl_3)

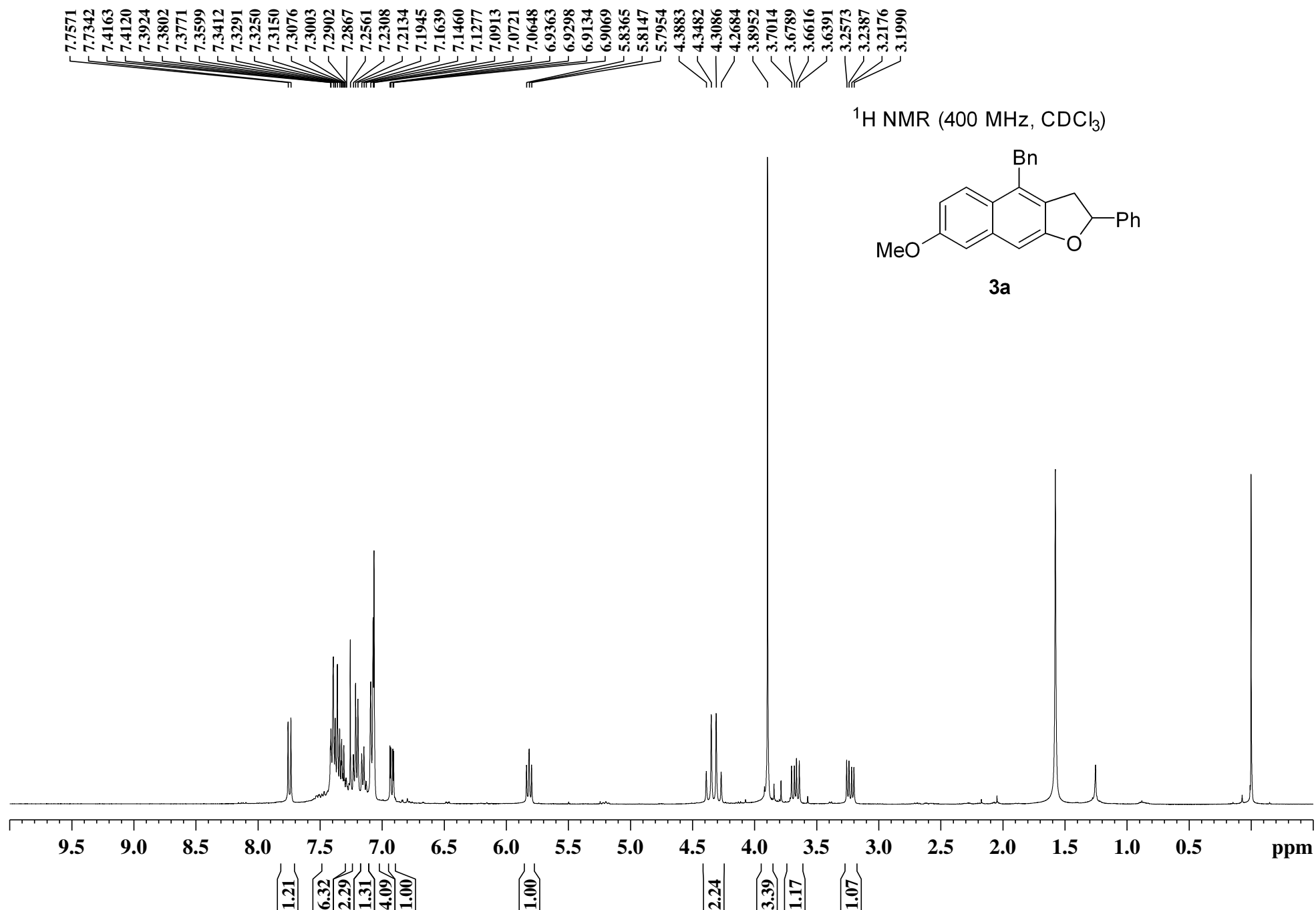


5X

(150 MHz, CDCl_3)



JJ-1-079 F1 ¹H-NMR 400MHz in CDCl₃



JJ-1-079 F2

158.28
148.38
144.23
138.91
135.23
134.97
131.01
130.95
129.55
129.52
128.39
128.32
127.44
125.73
124.04
120.44
118.21
117.77
117.29
105.06

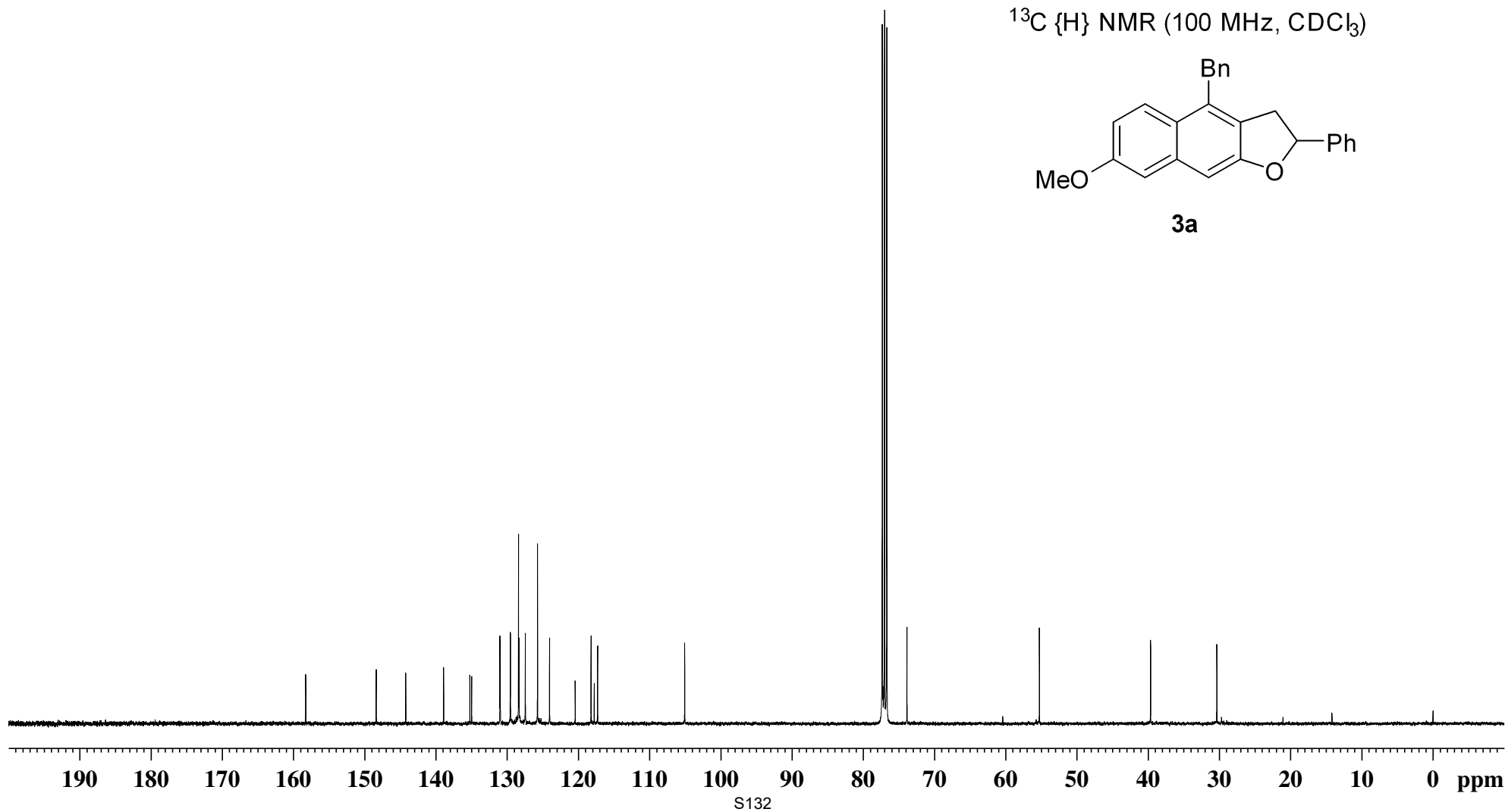
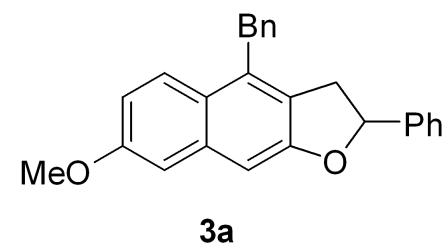
— 73.84

— 55.25

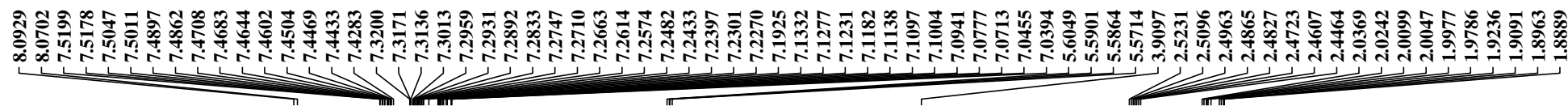
— 39.63

— 30.33

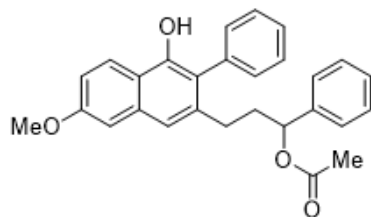
^{13}C {H} NMR (100 MHz, CDCl_3)



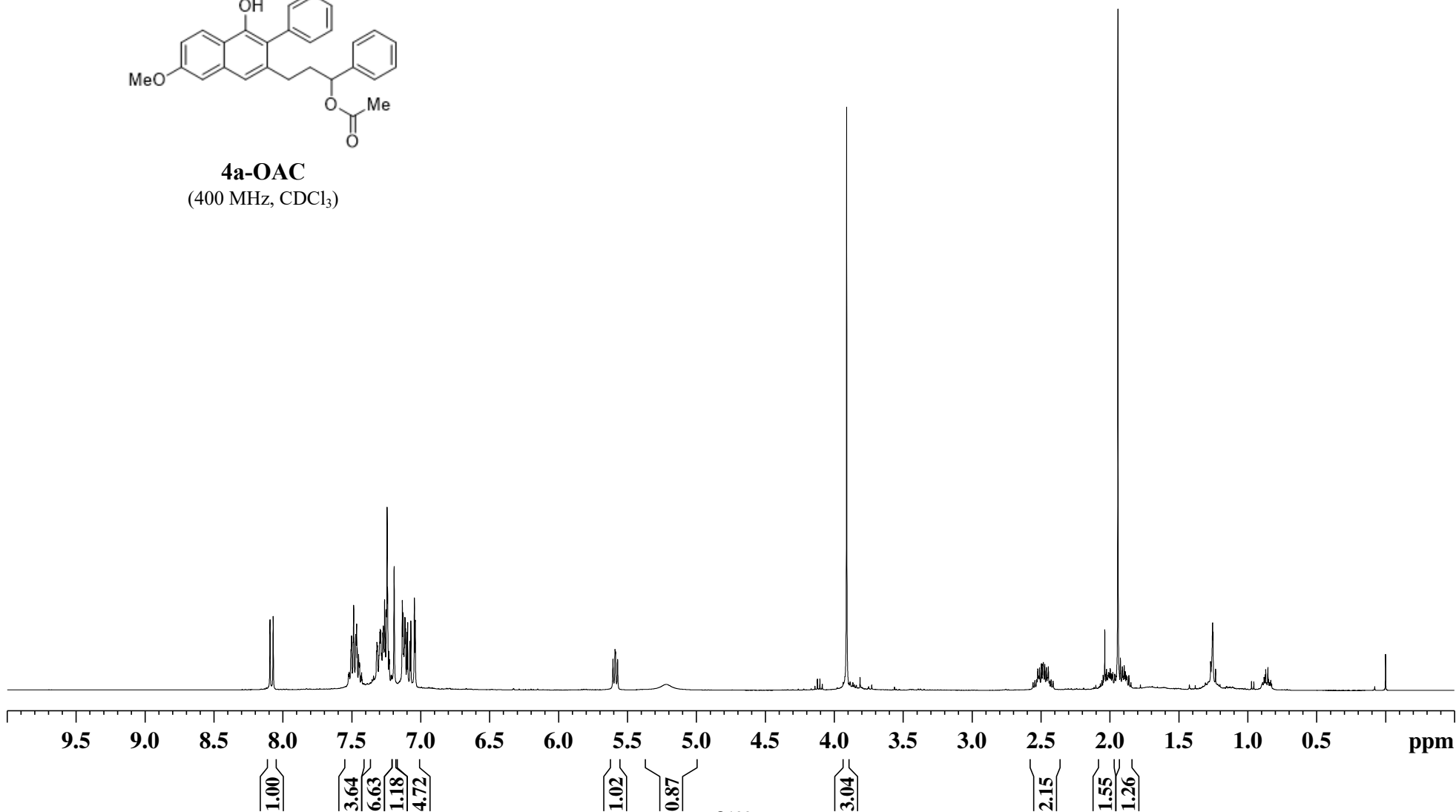
JJ-1-077 F2 ^1H NMR 400 MHz in CDCl_3



^1H NMR (400 MHz, CDCl_3)



4a-OAC
(400 MHz, CDCl_3)



JJ-1-077 F2 ¹³C NMR 100 MHz in CDCl₃

171.15
159.20
149.31
141.01
139.37
136.15
135.77
131.89
131.82
130.45
130.38
129.27
129.21
128.67
127.24
124.95
121.27
119.13
118.71
118.25
105.95

— 76.35

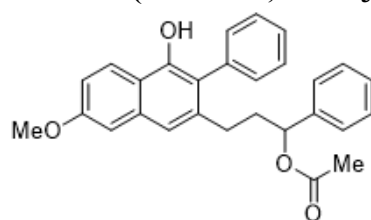
— 56.15

— 38.09

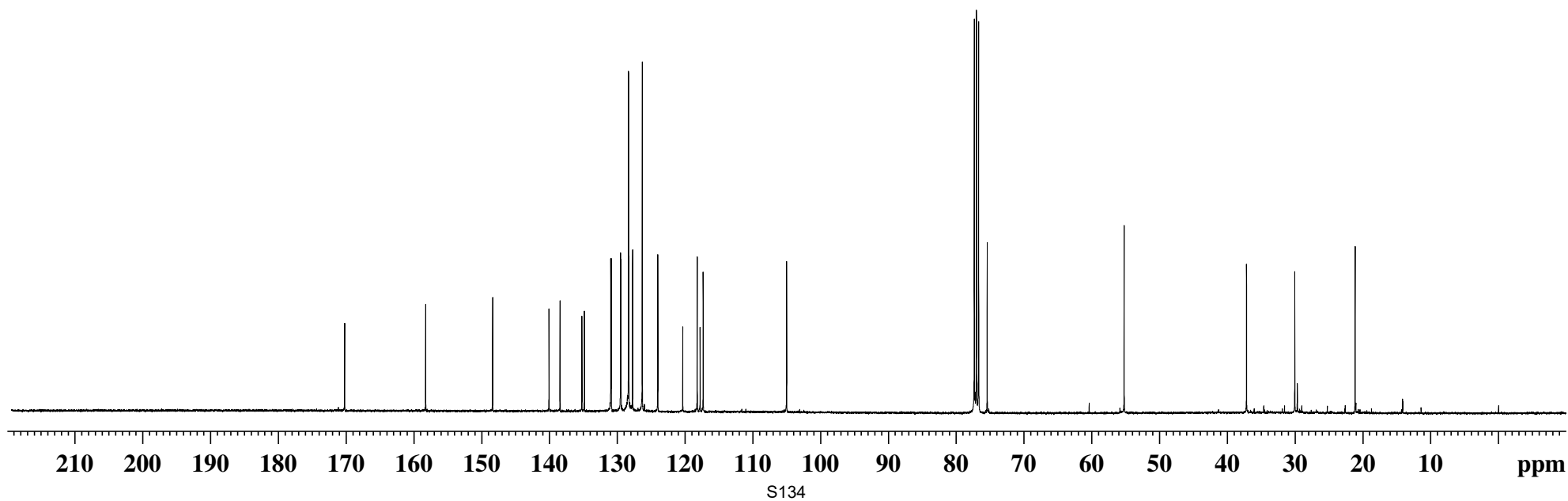
— 30.97

— 22.06

¹H NMR (100 MHz, CDCl₃)



4a-OAC
(100 MHz, CDCl₃)



PY-2-086 1H NMR 600 MHz CDCl3

8.100
8.085
7.556
7.543
7.531
7.483
7.470
7.458
7.361
7.349
7.229
7.109
7.105
7.094
7.090
7.069
7.066

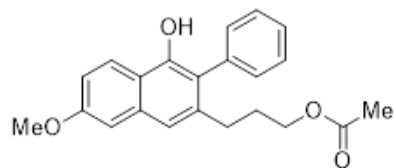
5.188

3.941
3.935
3.920

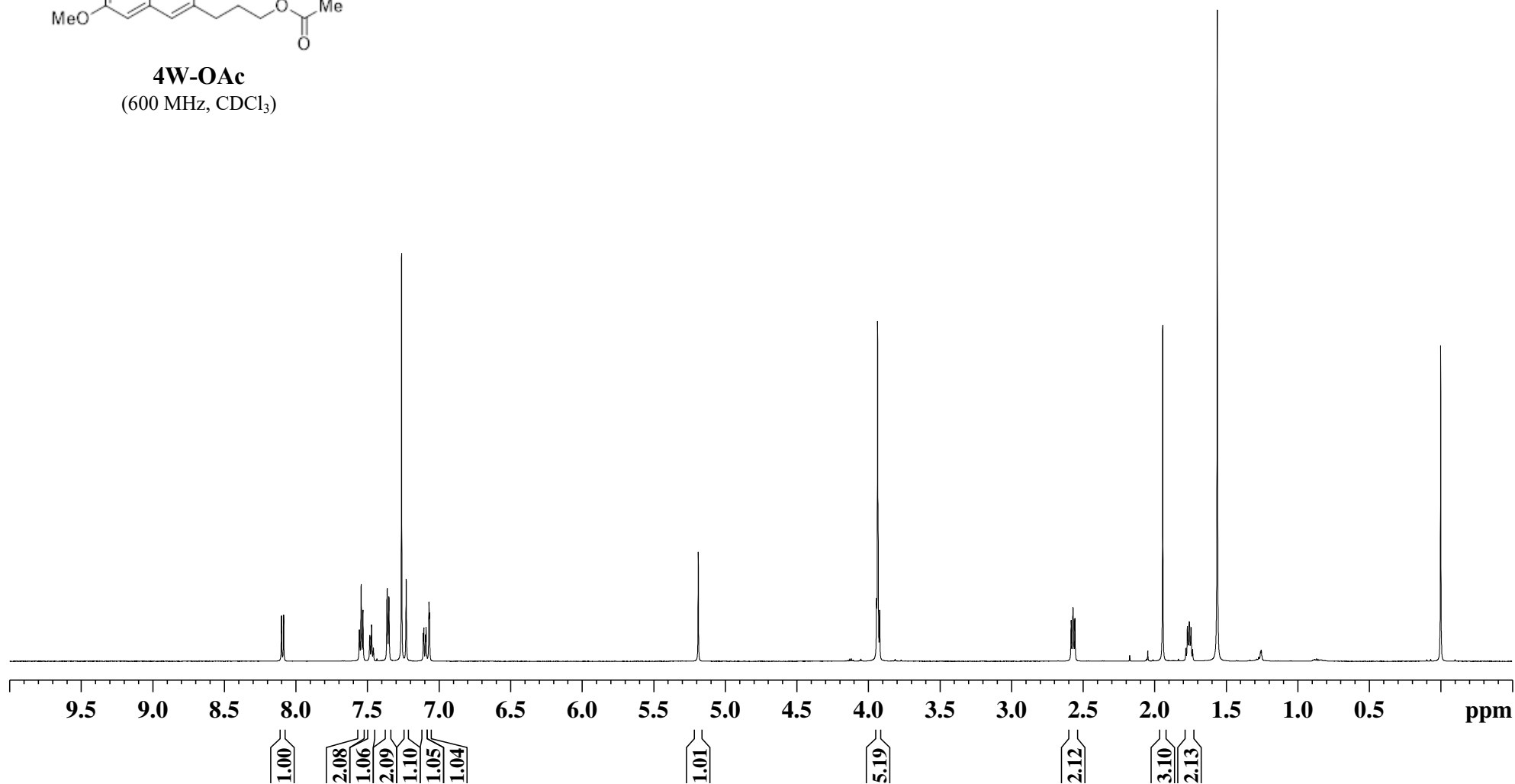
2.582
2.569
2.556

1.942
1.781
1.770
1.756
1.744
1.733

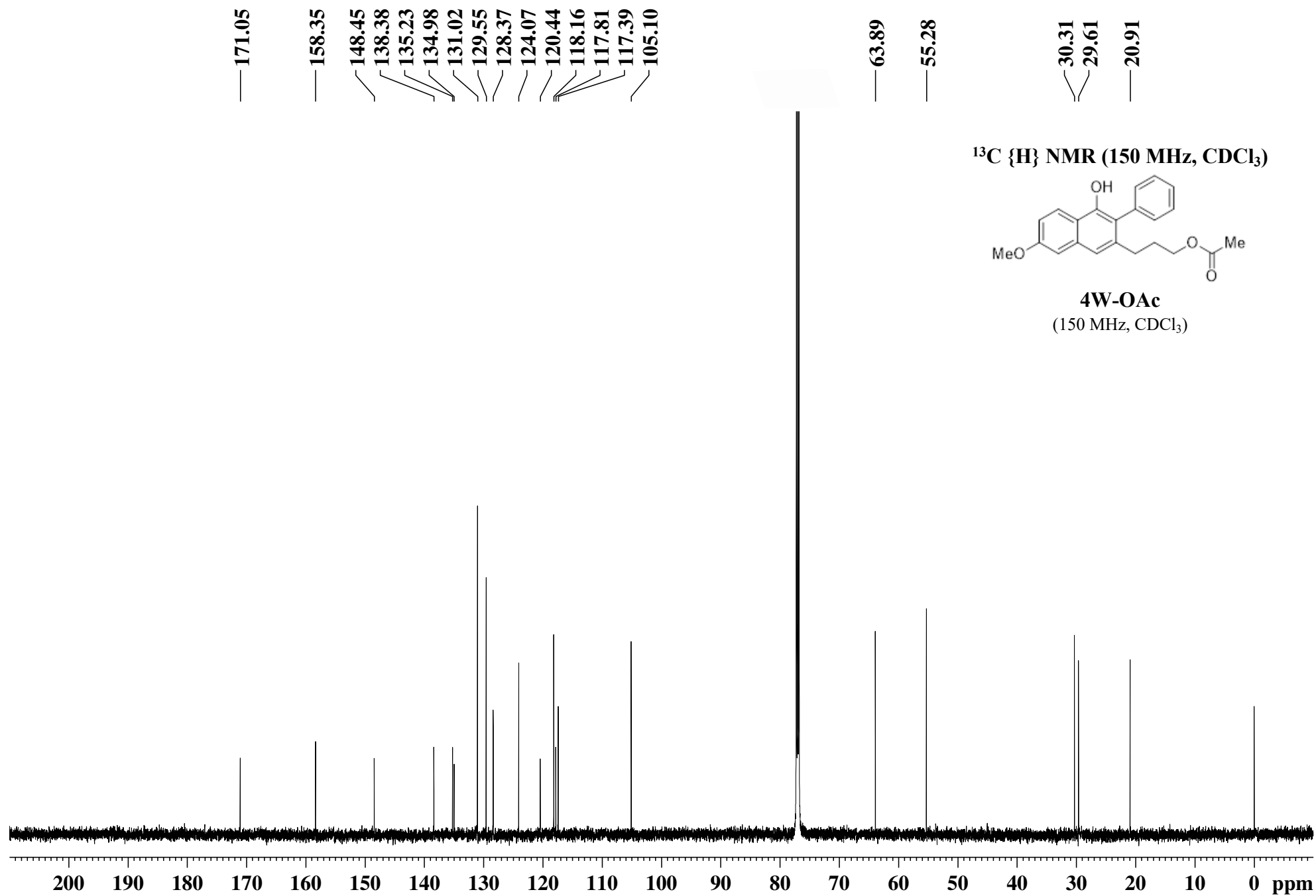
¹H NMR (600 MHz, CDCl₃)

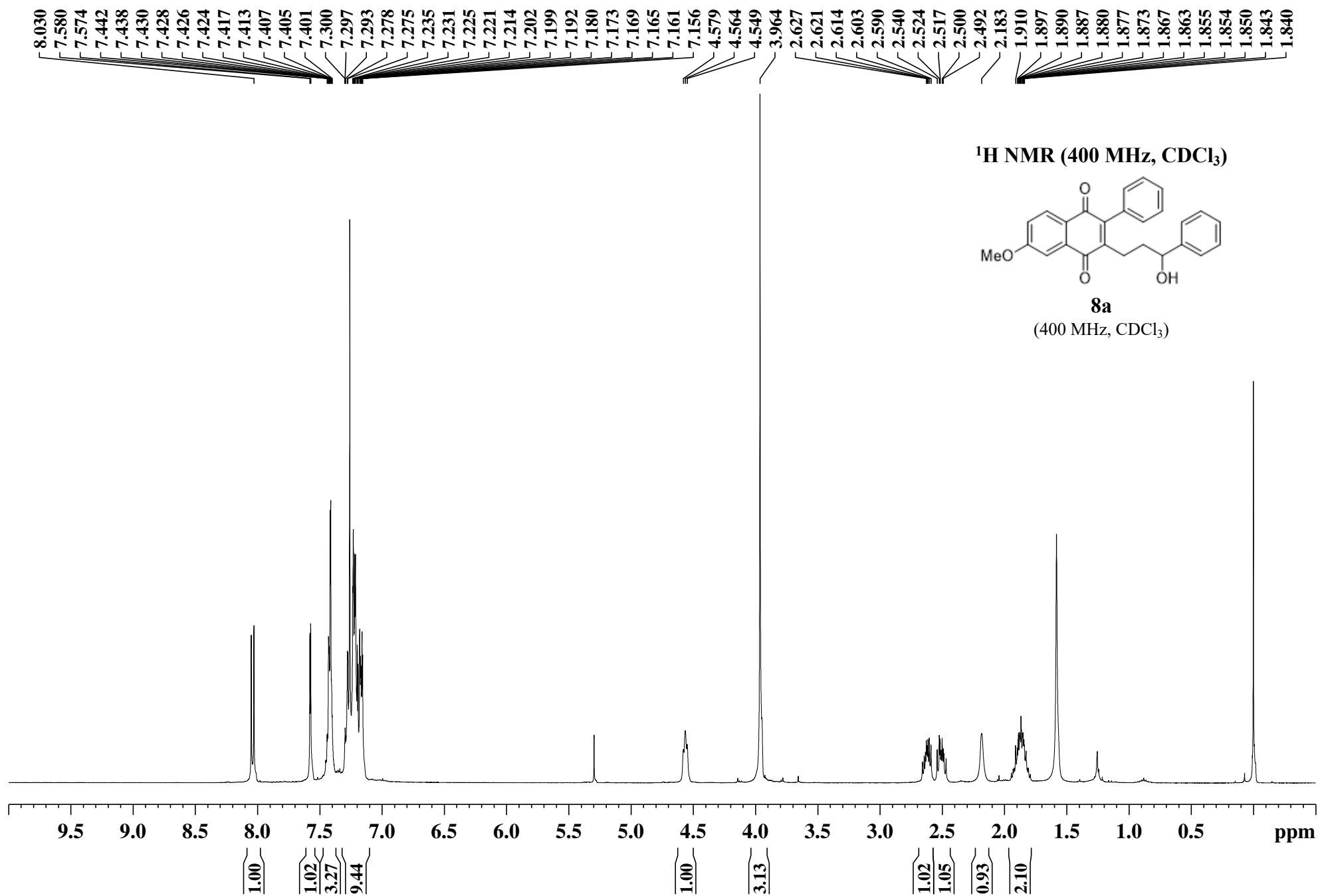


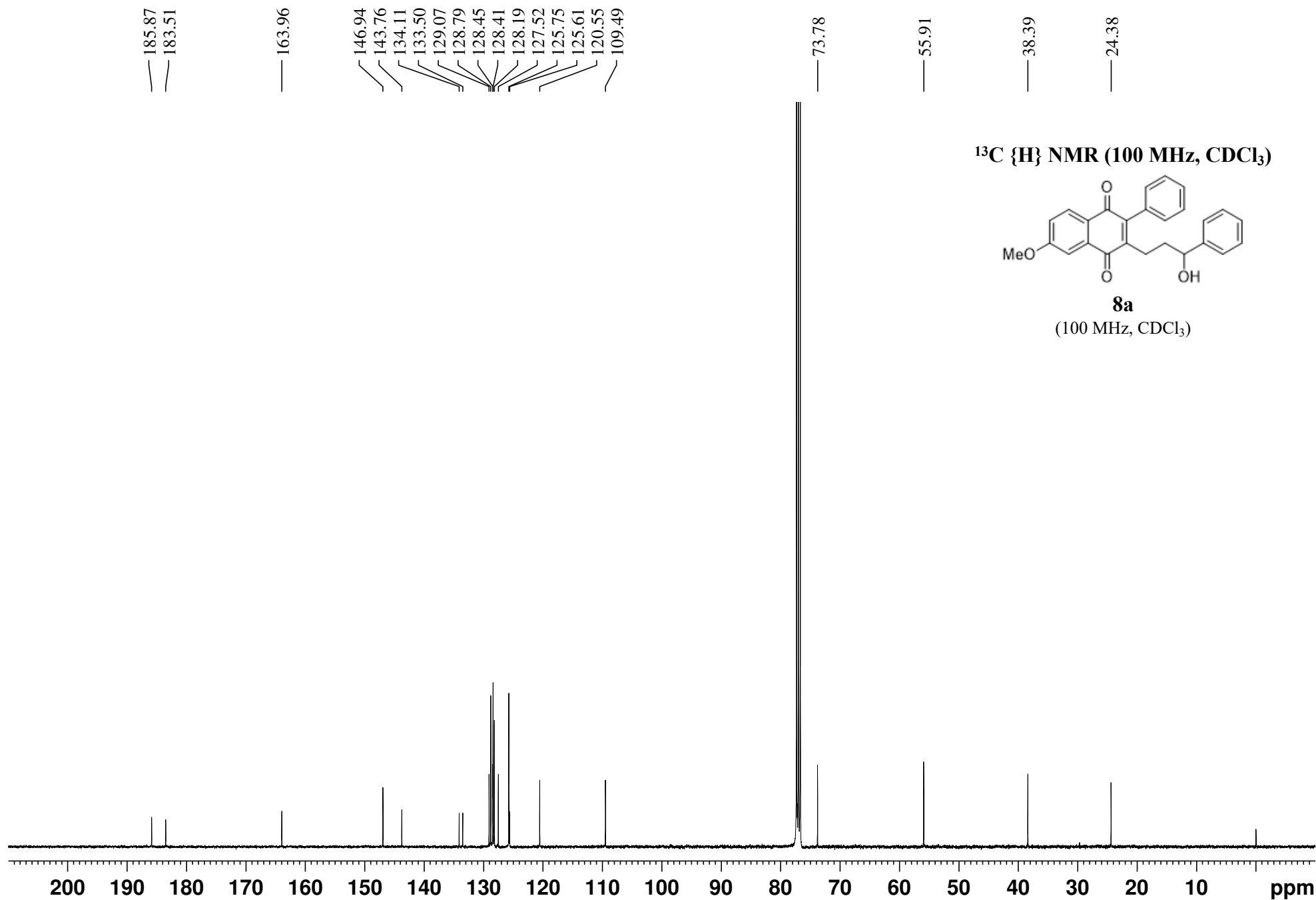
4W-OAc
(600 MHz, CDCl₃)



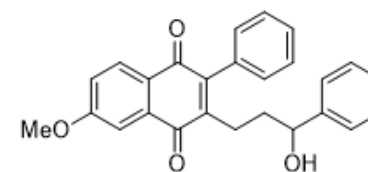
PY-2-086 ¹³C NMR 150 MHz CDCl₃





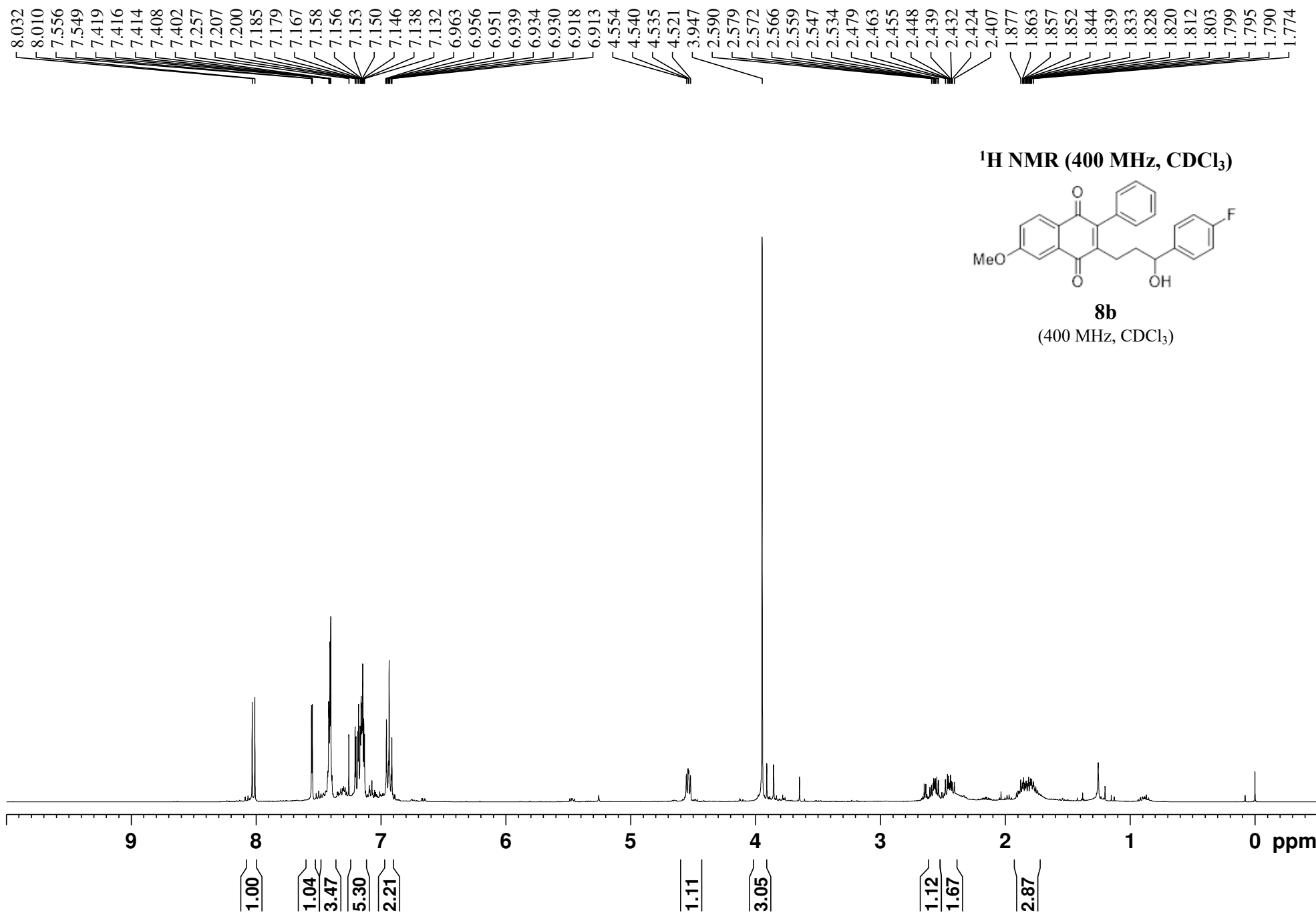


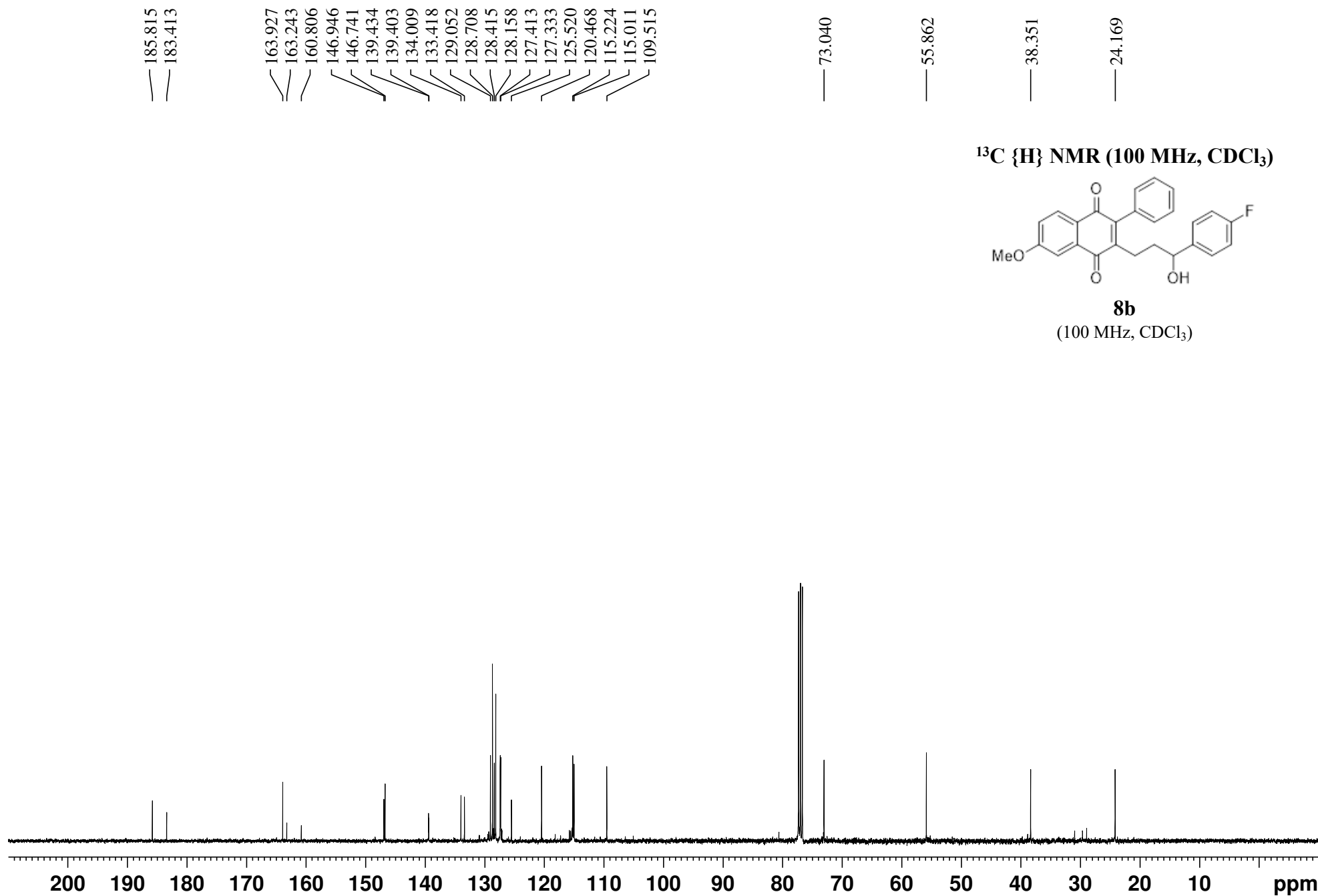
^{13}C {H} NMR (100 MHz, CDCl_3)



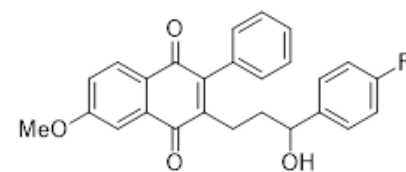
8a

(100 MHz, CDCl_3)



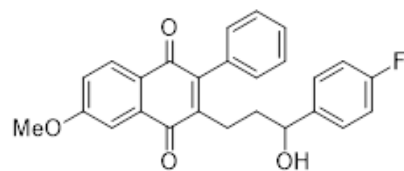


^{13}C {H} NMR (100 MHz, CDCl_3)



8b
(100 MHz, CDCl_3)

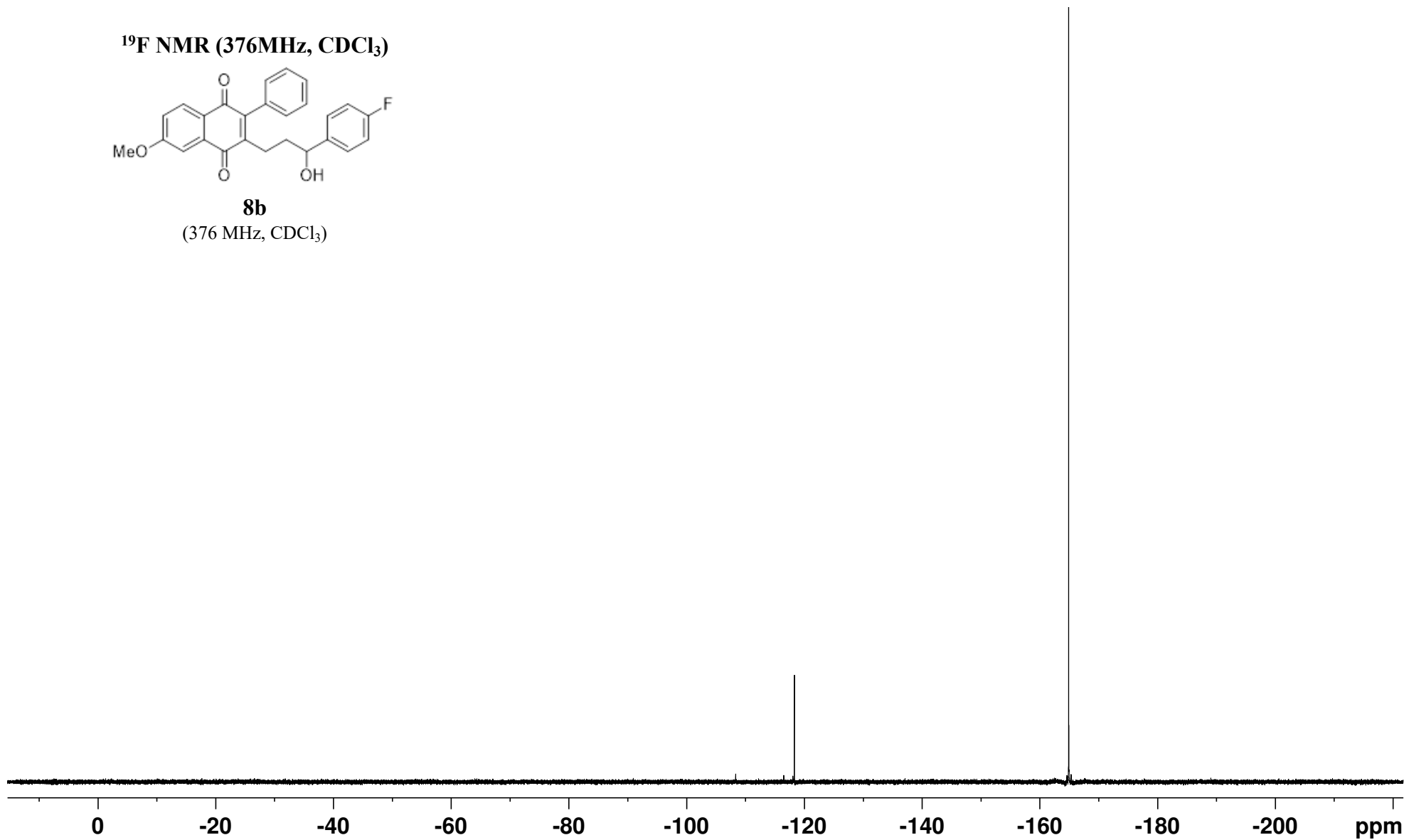
^{19}F NMR (376MHz, CDCl_3)

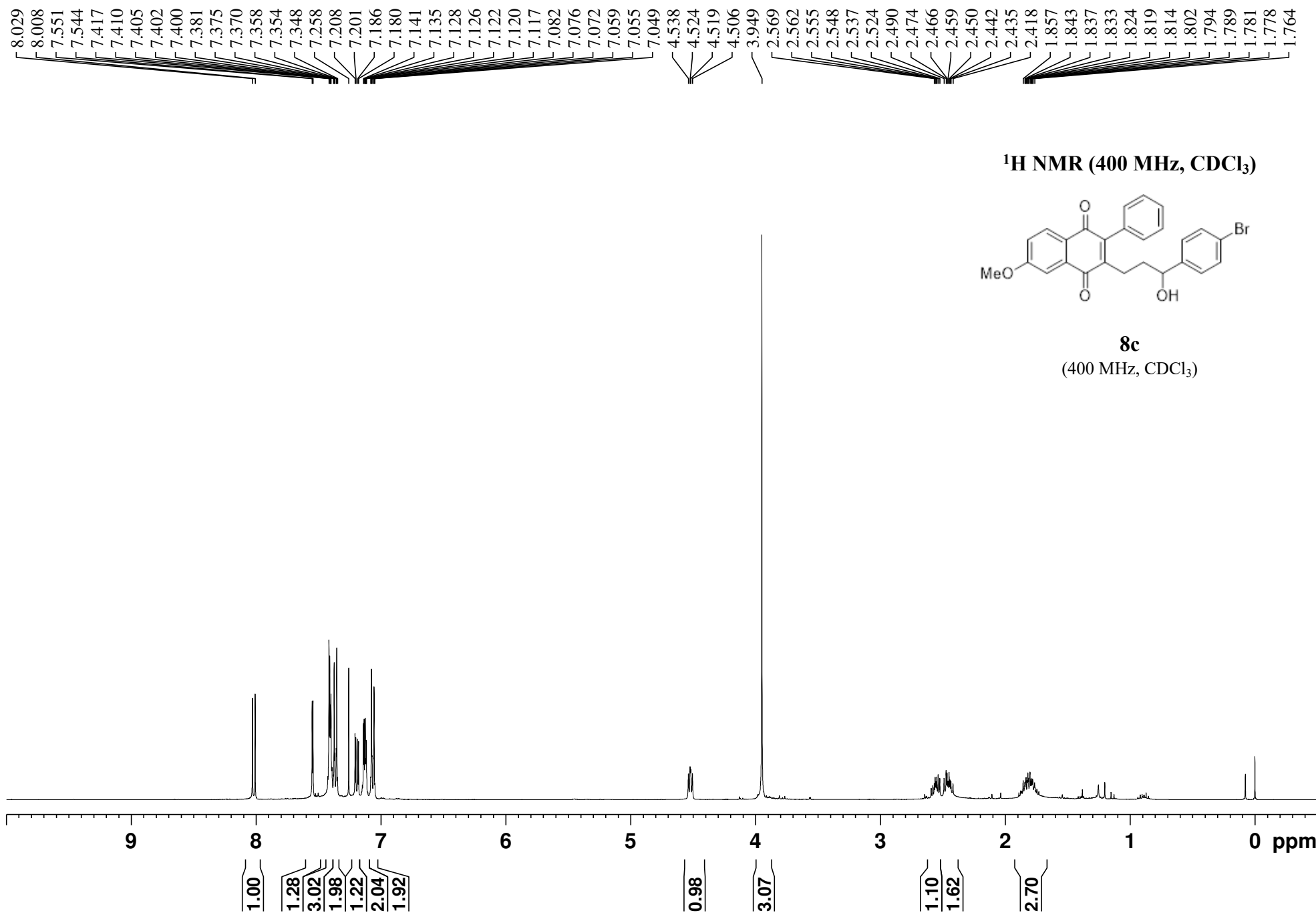


8b

(376 MHz, CDCl_3)

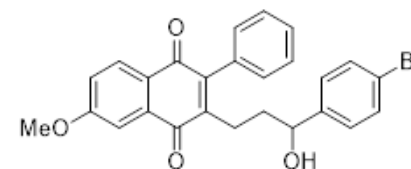
— -118.322



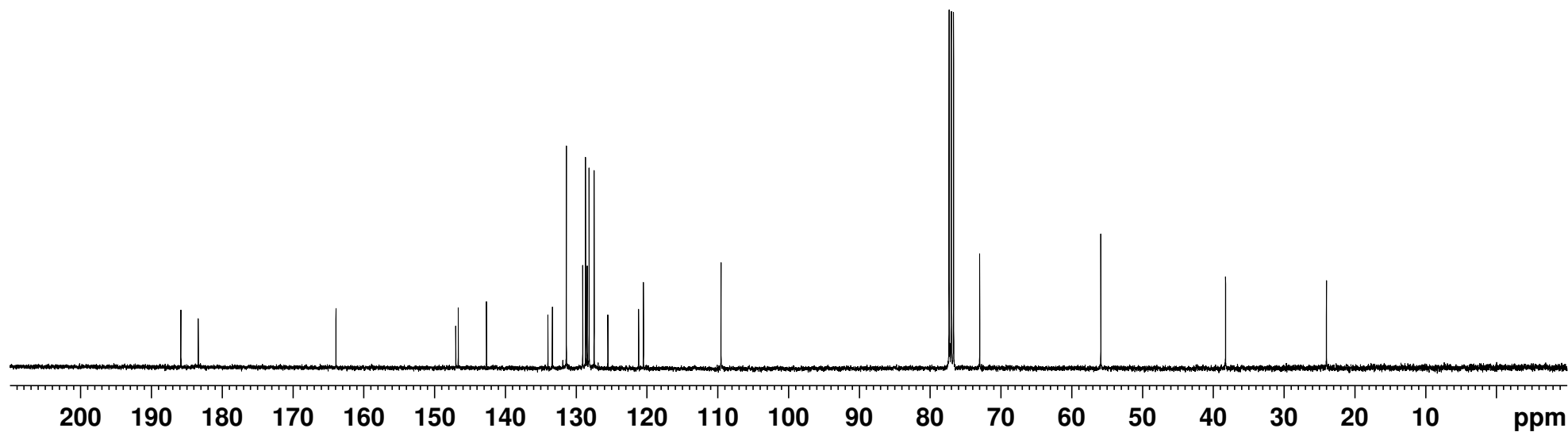


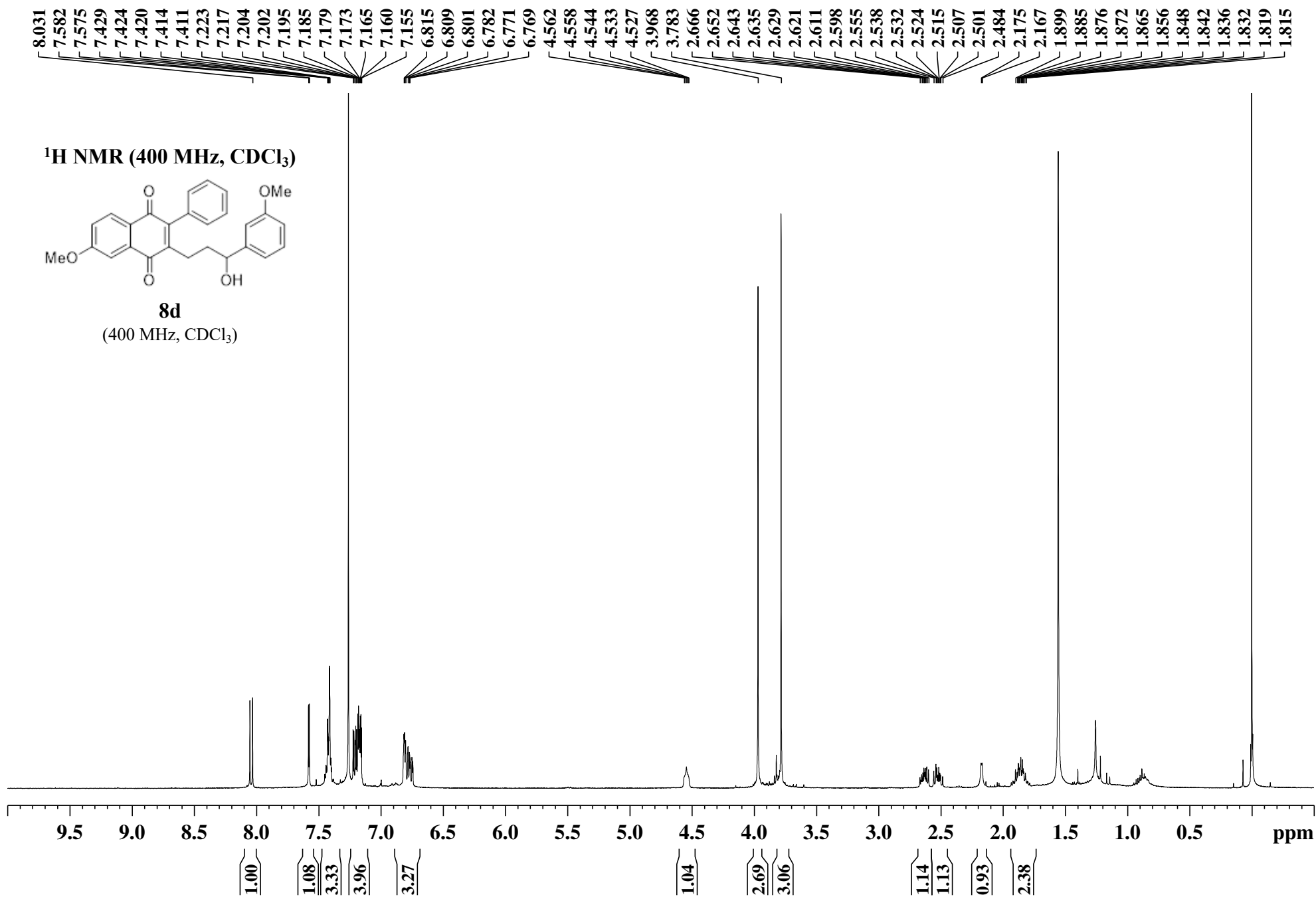


^{13}C {H} NMR (100 MHz, CDCl_3)



8c
(100 MHz, CDCl_3)





185.86
 183.49
 163.93
 159.64
 146.92
 146.89
 145.50
 134.09
 133.47
 129.39
 129.04
 128.78
 128.43
 128.15
 125.59
 120.50
 118.02
 112.96
 111.25
 109.49

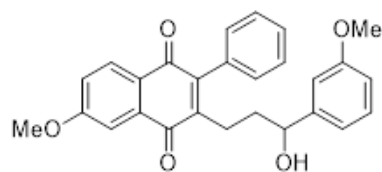
73.69

55.89
55.15

38.31

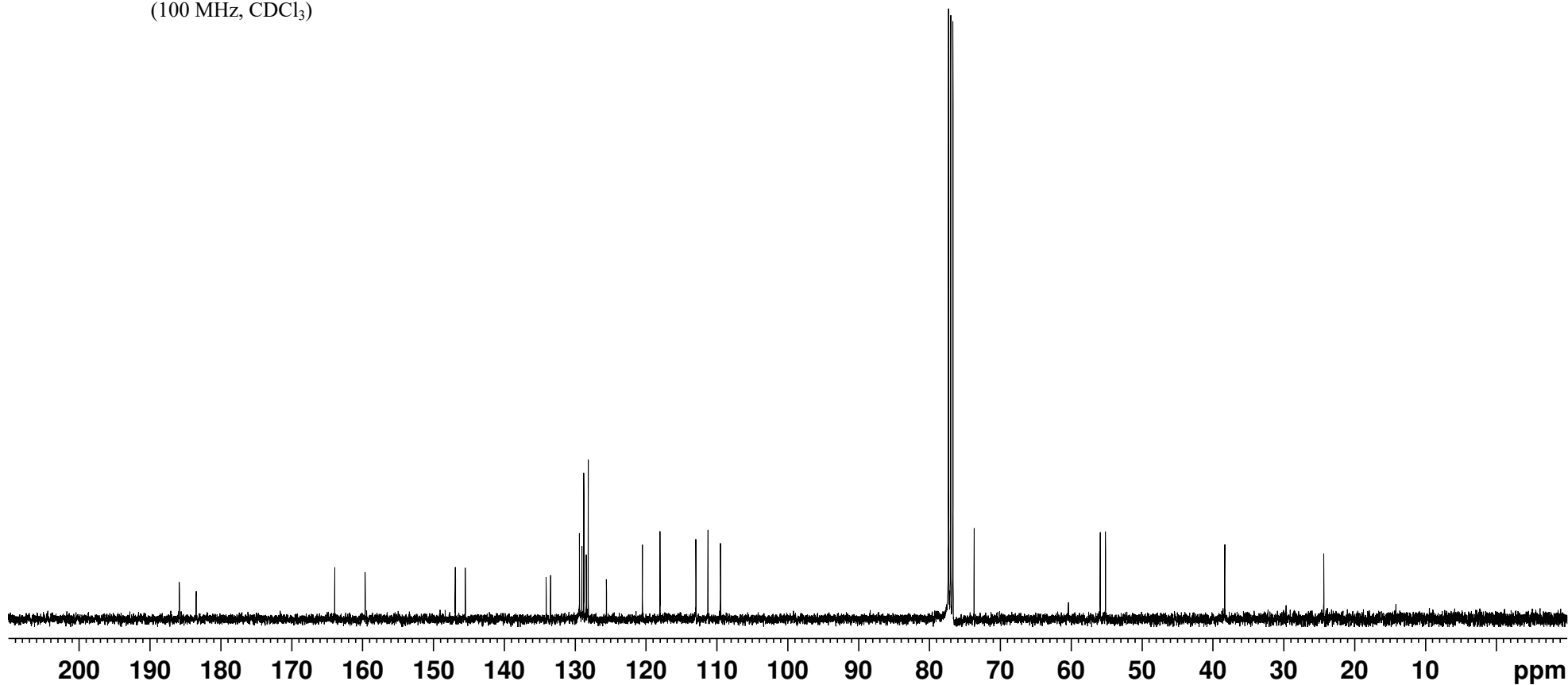
24.34

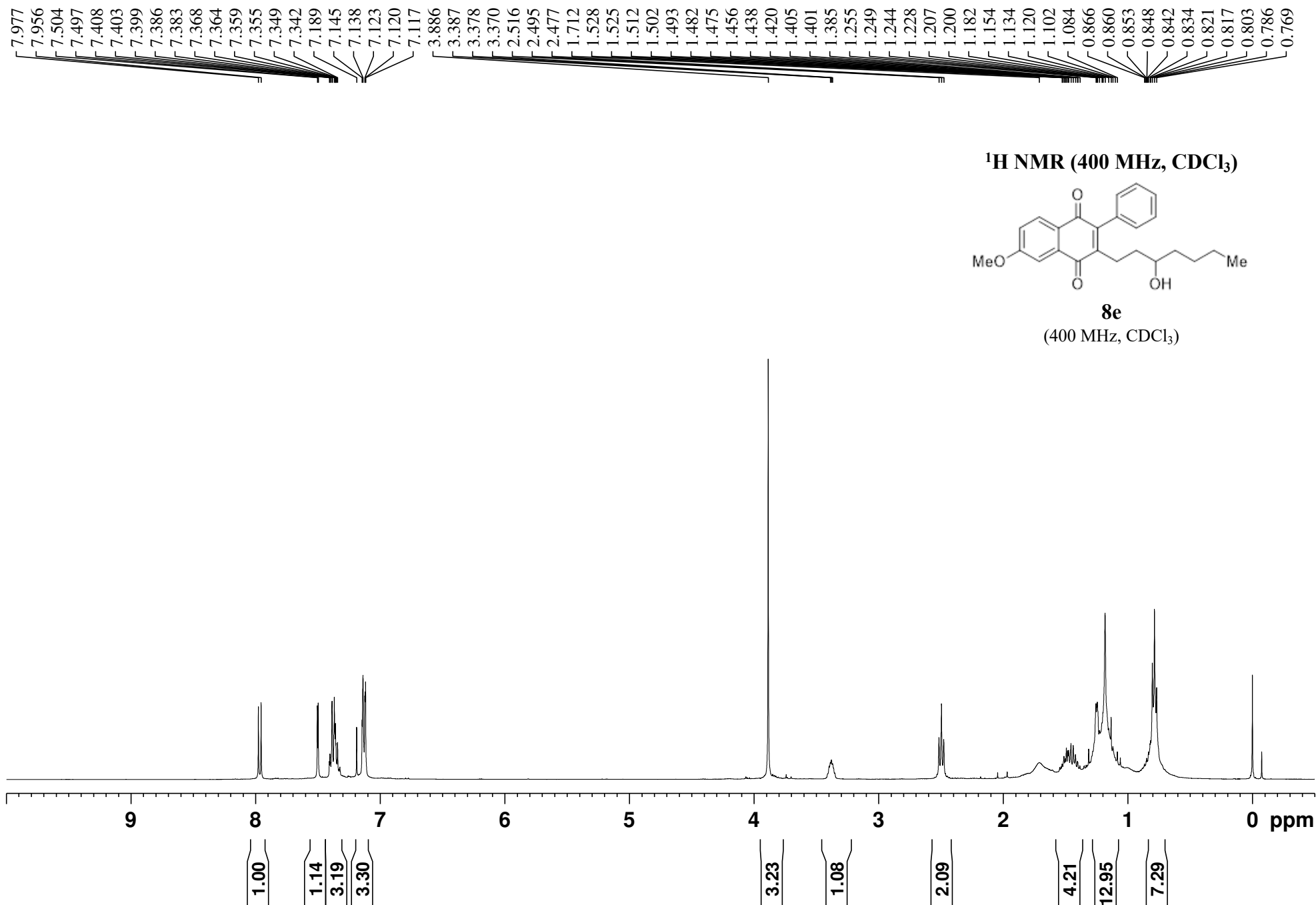
^{13}C {H} NMR (100 MHz, CDCl_3)



8d

(100 MHz, CDCl_3)





$\text{— } 185.95$
 $\text{— } 183.51$

 $\text{— } 163.93$

 $\text{— } 147.30$
 $\text{— } 146.87$
 $\text{— } 134.09$
 $\text{— } 133.59$
 $\text{— } 129.04$
 $\text{— } 128.80$
 $\text{— } 128.45$
 $\text{— } 128.17$
 $\text{— } 125.59$
 $\text{— } 120.50$

 $\text{— } 109.49$

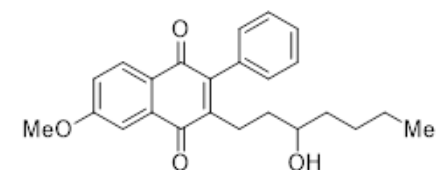
 $\text{— } 71.10$

 $\text{— } 55.87$

 $\text{— } 36.89$
 $\text{— } 36.59$
 $\text{— } 27.65$
 $\text{— } 23.92$
 $\text{— } 22.65$

 $\text{— } 13.99$

$^{13}\text{C} \{^1\text{H}\}$ NMR (100 MHz, CDCl_3)



8e

(100 MHz, CDCl_3)

