Electronic Supplementary Information

Metal-Free Reduction of Unsaturated Carbonyls, Quinones, and Pyridinium Salts with Tetrahydroxydiboron/Water

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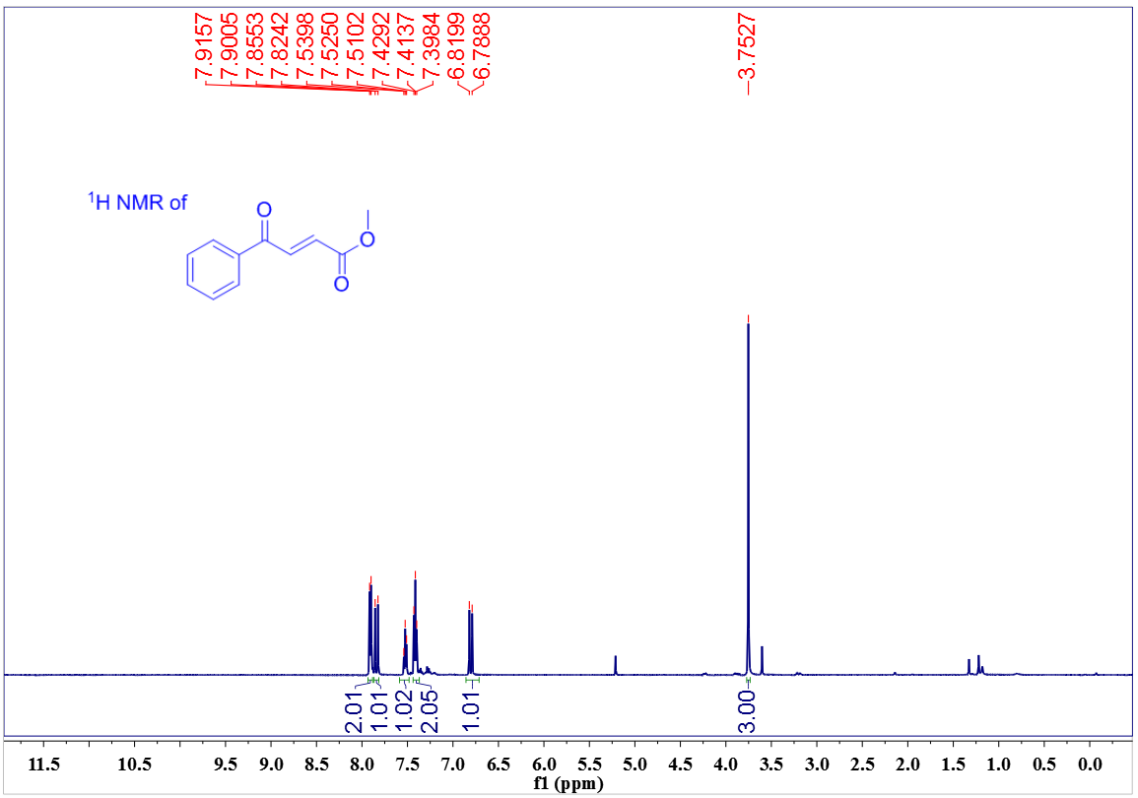
b. Nephrology and Rheumatology, Shanghai Tenth People's Hospital, School of Medicine, Tongji University, Shanghai 200072, China.
c. School of Chemistry and Materials Science, Hangzhou Institute for Advanced Study, University of Chinese Academy of Sciences, 1 Sub-lane Xiangshan, Hangzhou 310024, China.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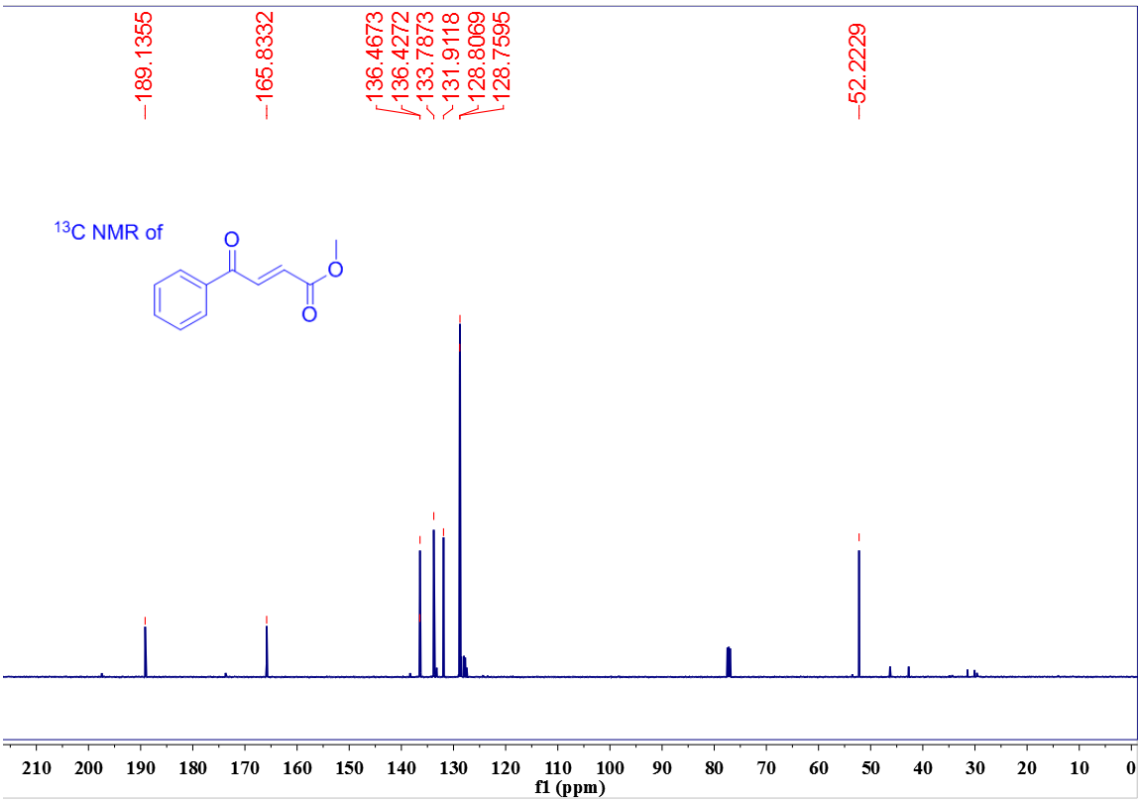
6.7888
3.7527
1H NMR of
2.01
1.01
1.02
2.05
1.01
3.00
f1 (ppm)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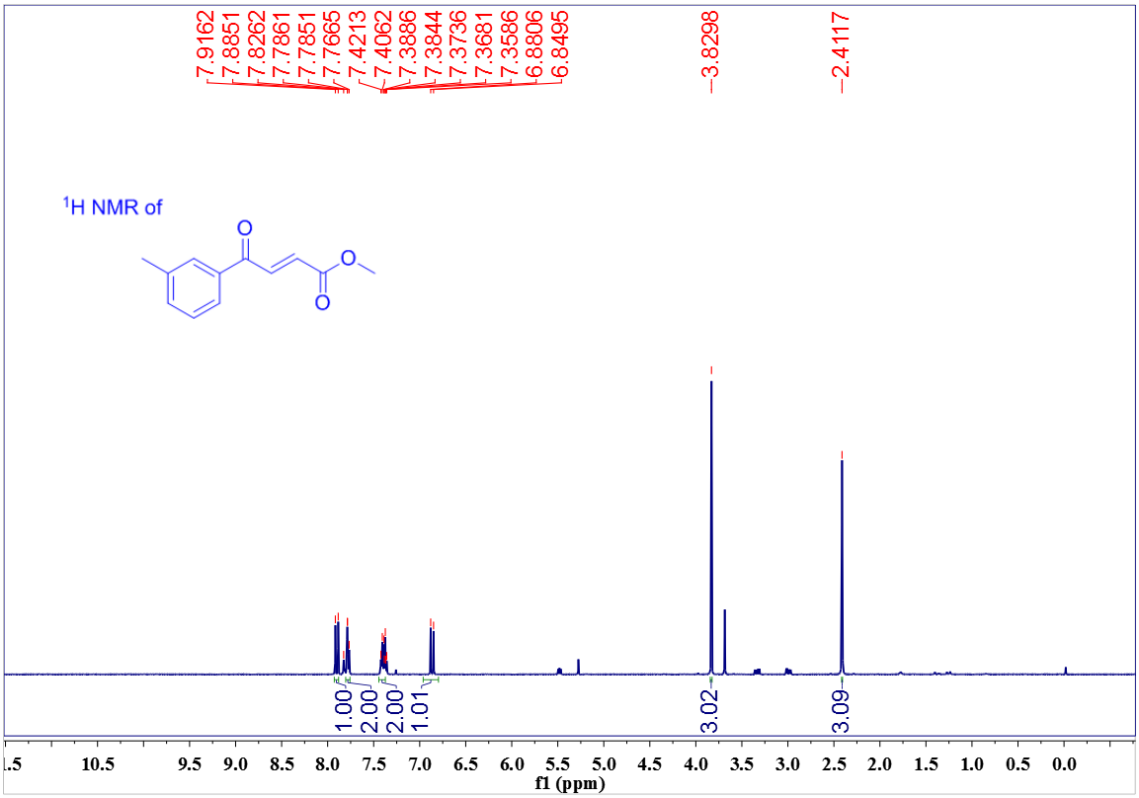
13C NMR of
f1 (ppm)

1a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7.3736
7.3681
7.3586
6.8806
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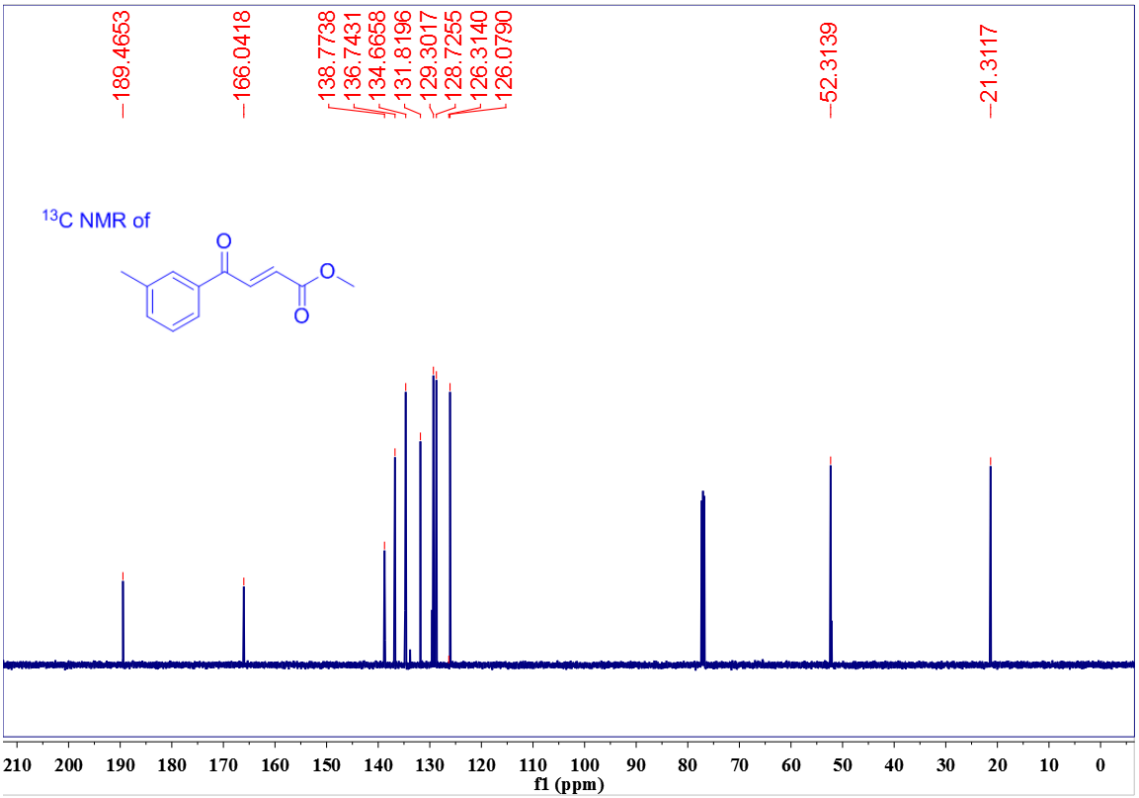
1H NMR of
1.00
2.00
2.00
1.01
3.02
3.09
f1 (ppm)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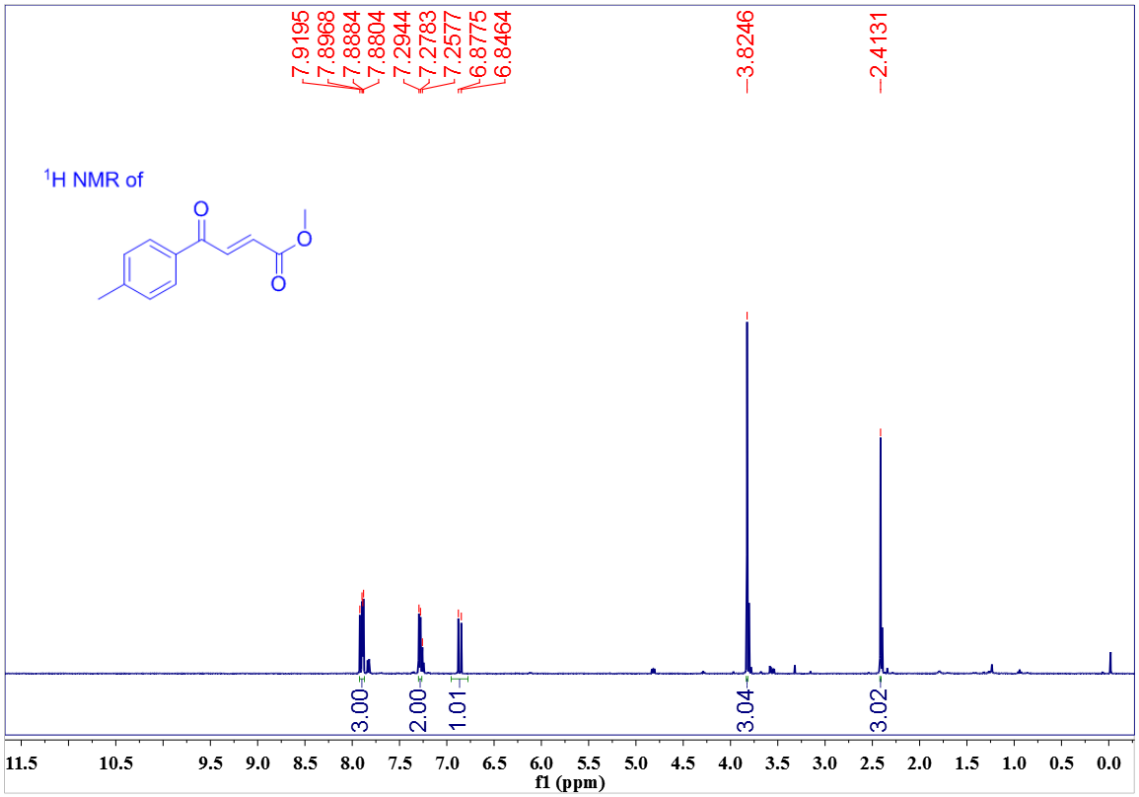
52.3139
21.3117
13C NMR of
f1 (ppm)

1c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7.2783
7.2577
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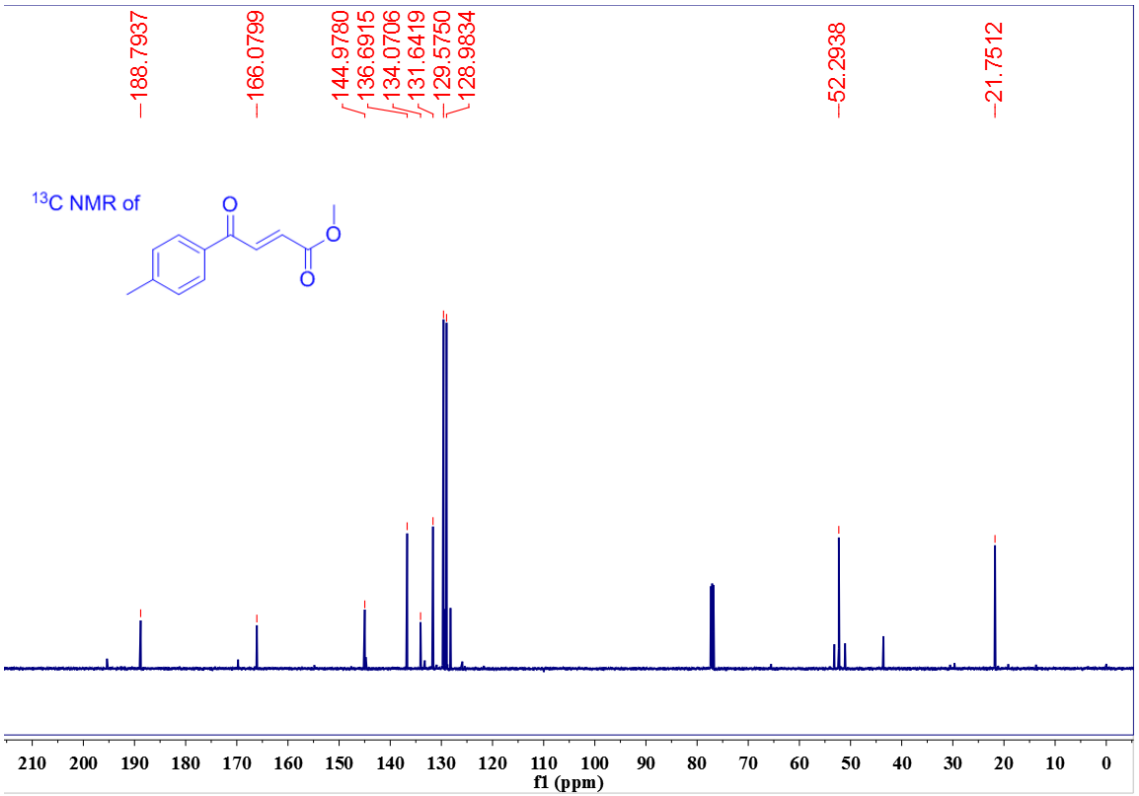
2.4131
1H NMR of
3.00
2.00
1.01
3.04
3.02
f1 (ppm)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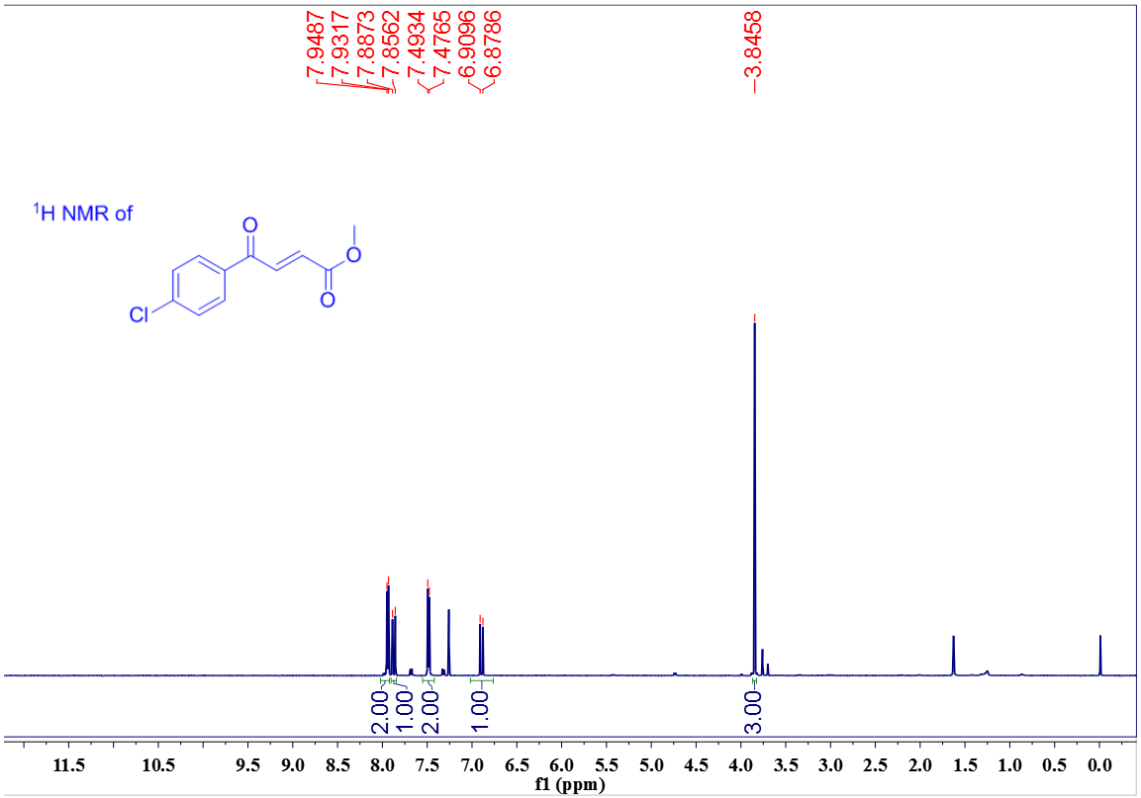
21.7512
13C NMR of
f1 (ppm)

1d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O
O
O
2.00
1.00
2.00
1.00
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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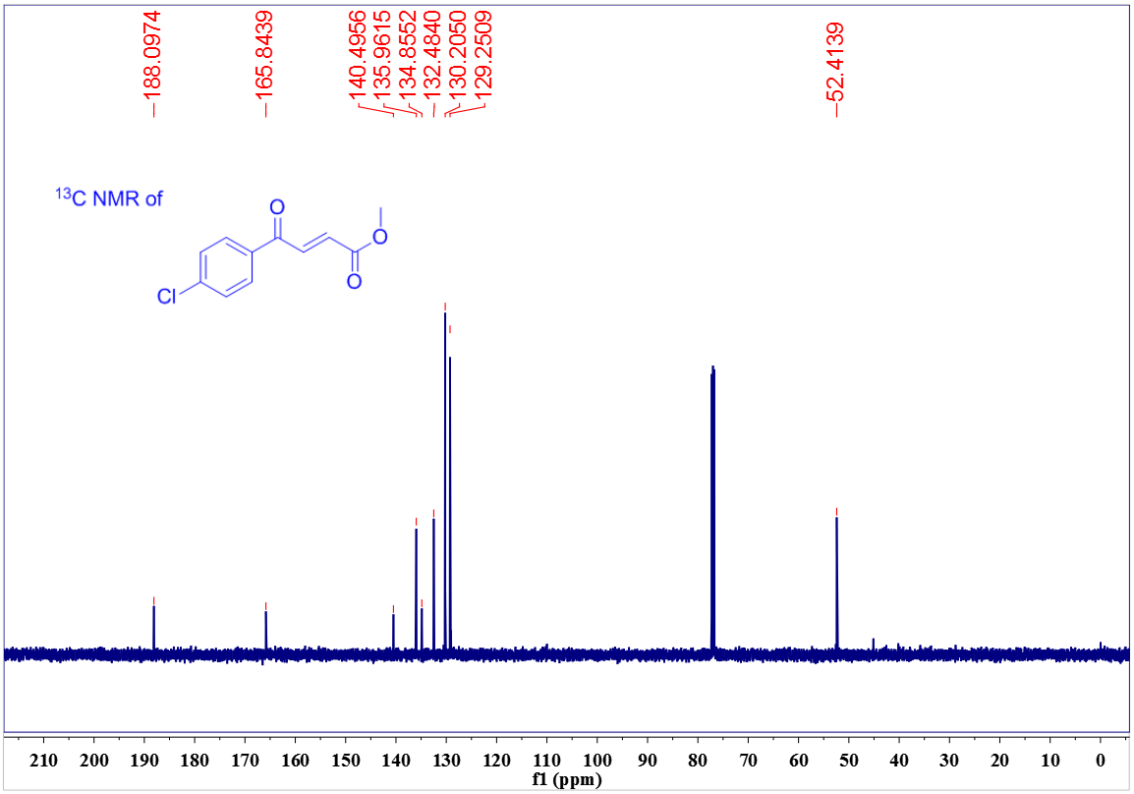
0.0
f1 (ppm)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13C NMR of
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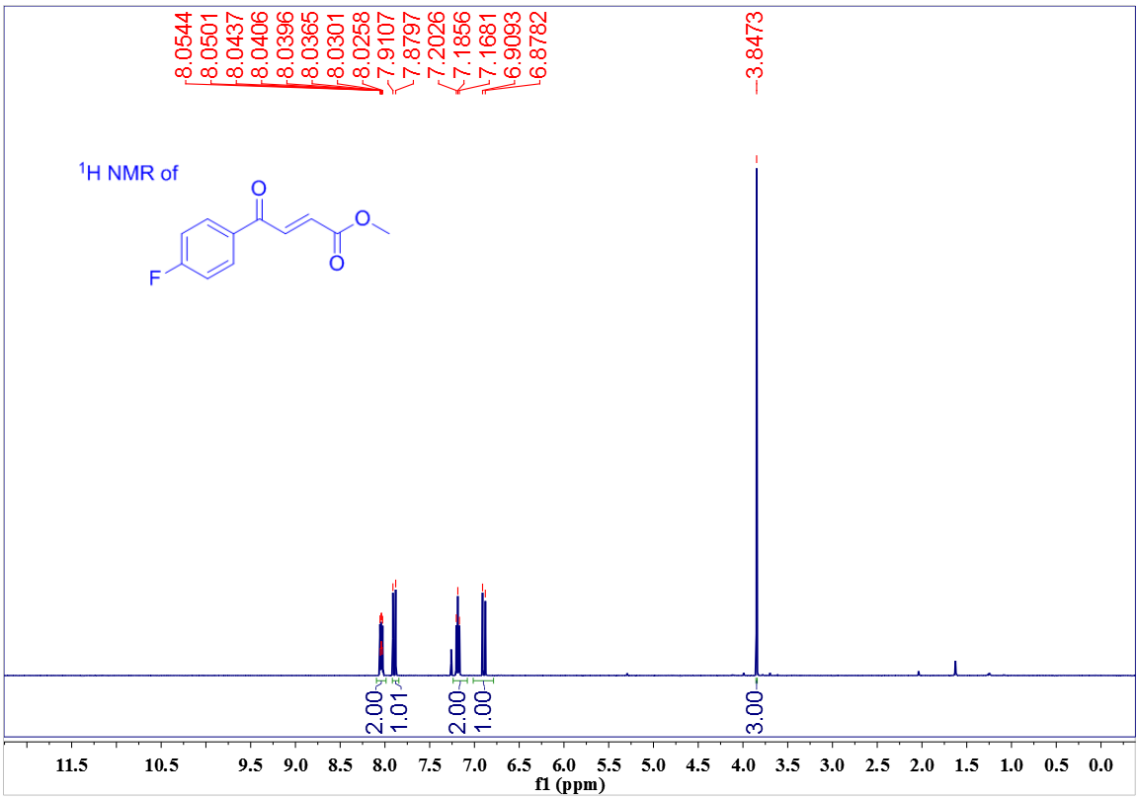
O
O
O
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

1e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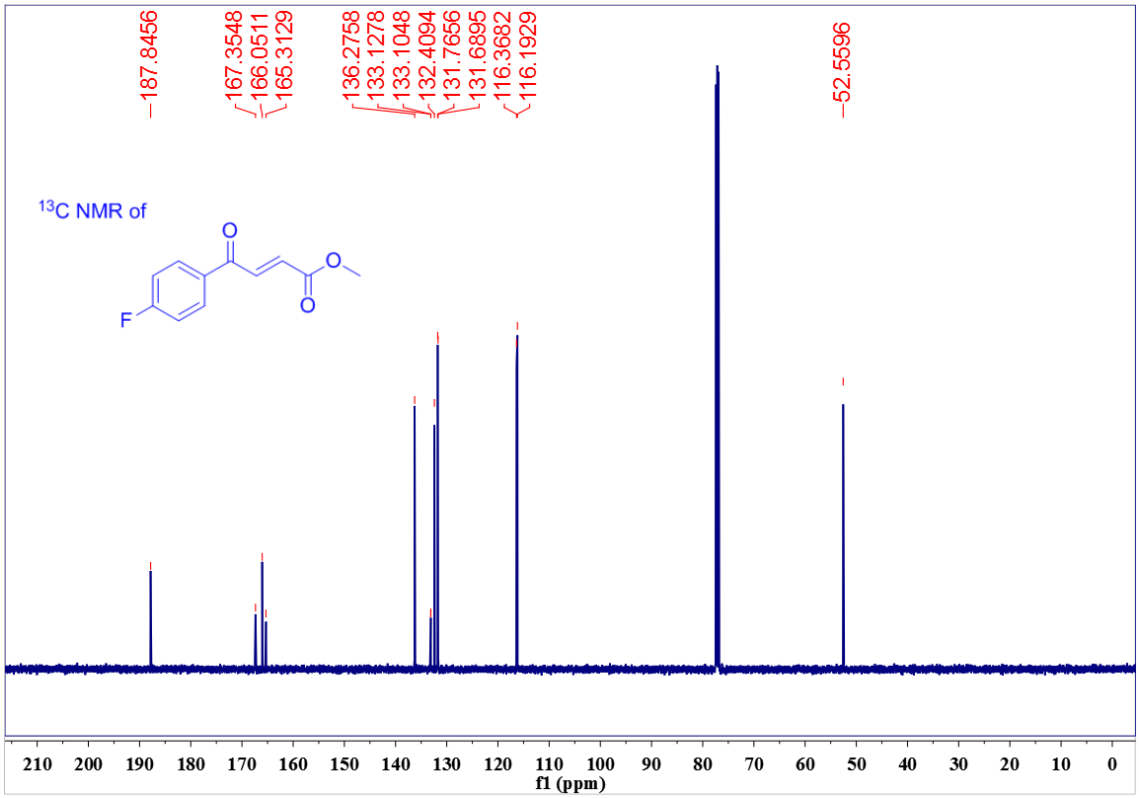
7.2026
7.1856
7.1681
6.9093
6.8782
3.8473
1H NMR of
O
O
O
F
2.00
1.01
2.00
1.00
3.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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116.3682
116.1929
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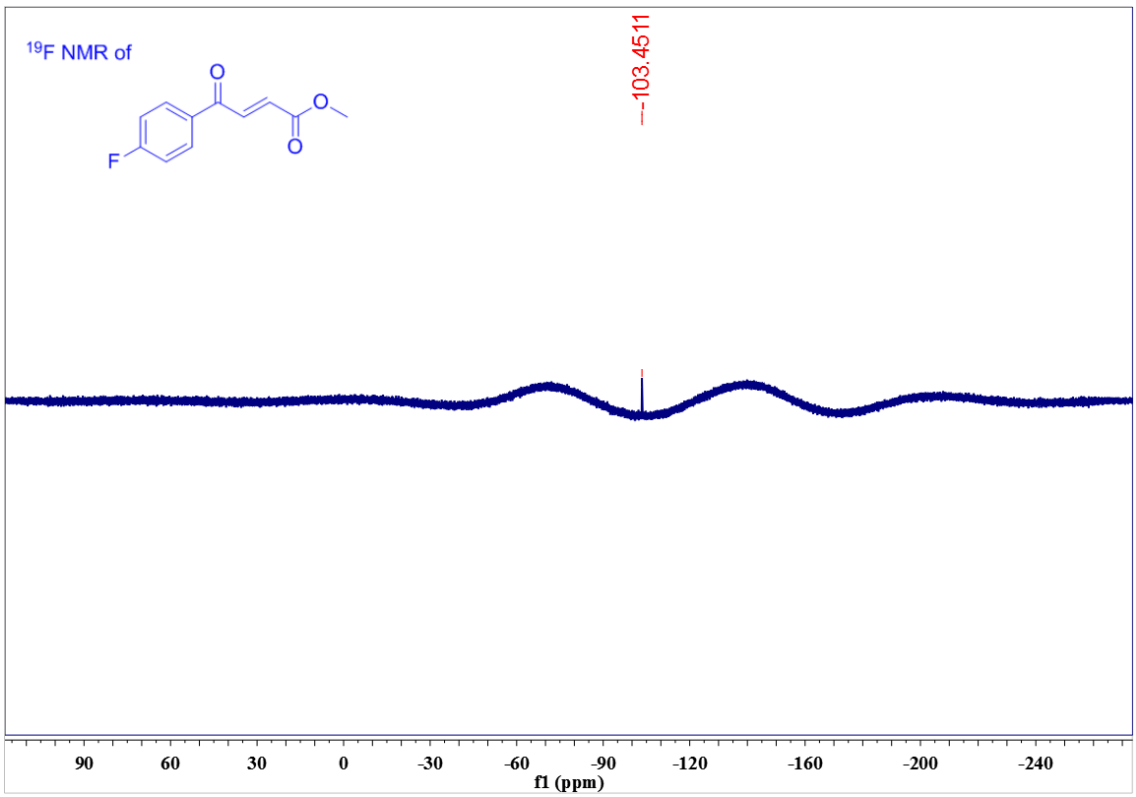
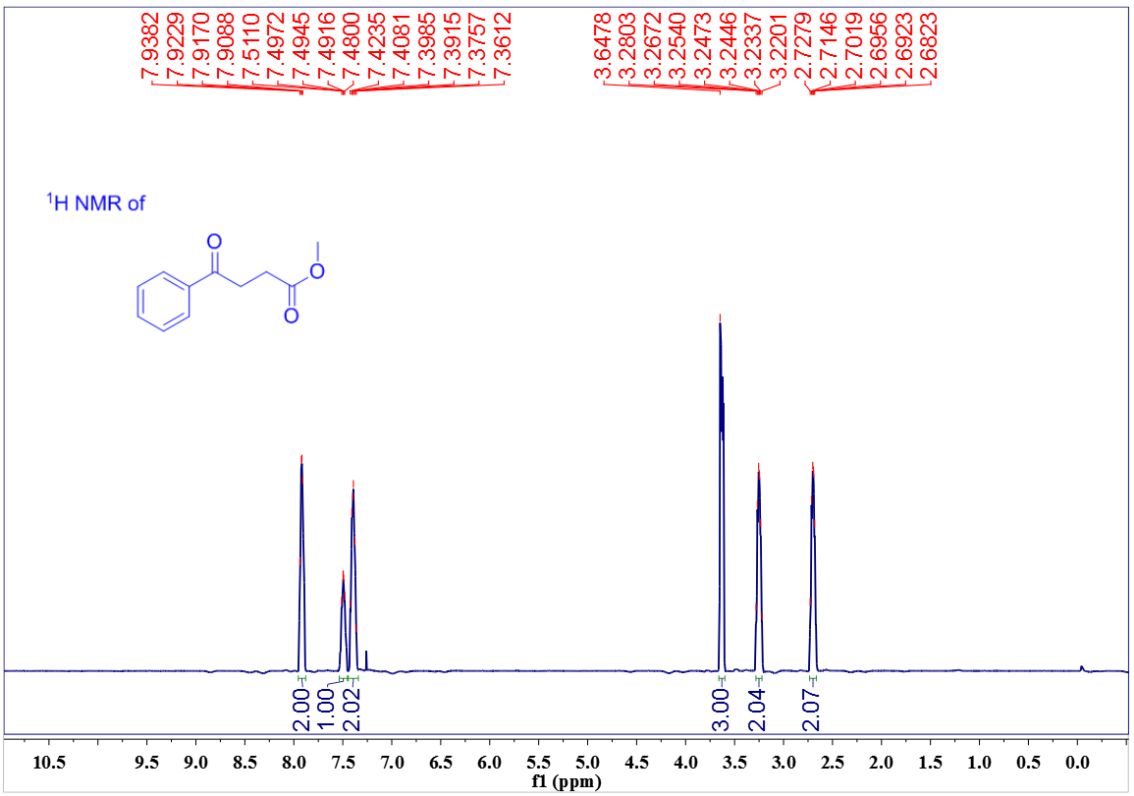
13C NMR of
O
O
O
F
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

1f



1f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3.2803
3.2672
3.2540
3.2473
3.2446
3.2337
3.2201
2.7279
2.7146
2.7019
2.6956
2.6923
2.6823
1H NMR of
O
O
O
2.00
1.00
2.02
3.00
2.04
2.07
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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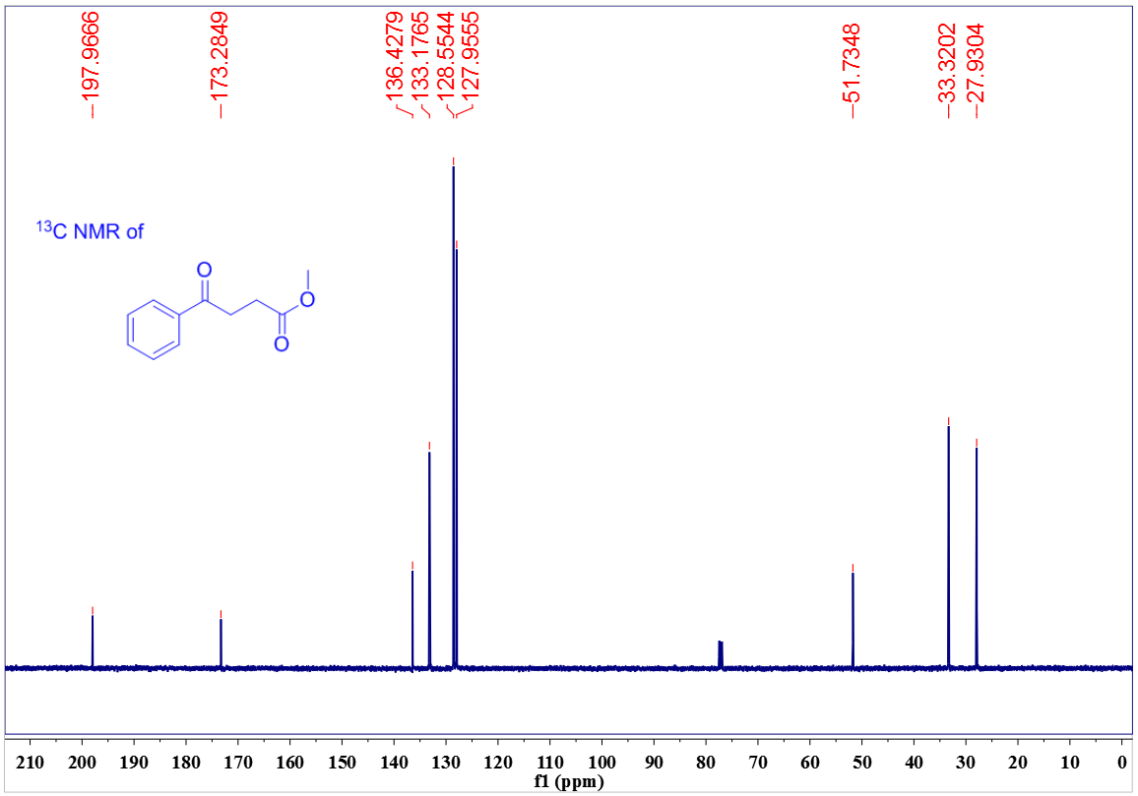
f1 (ppm)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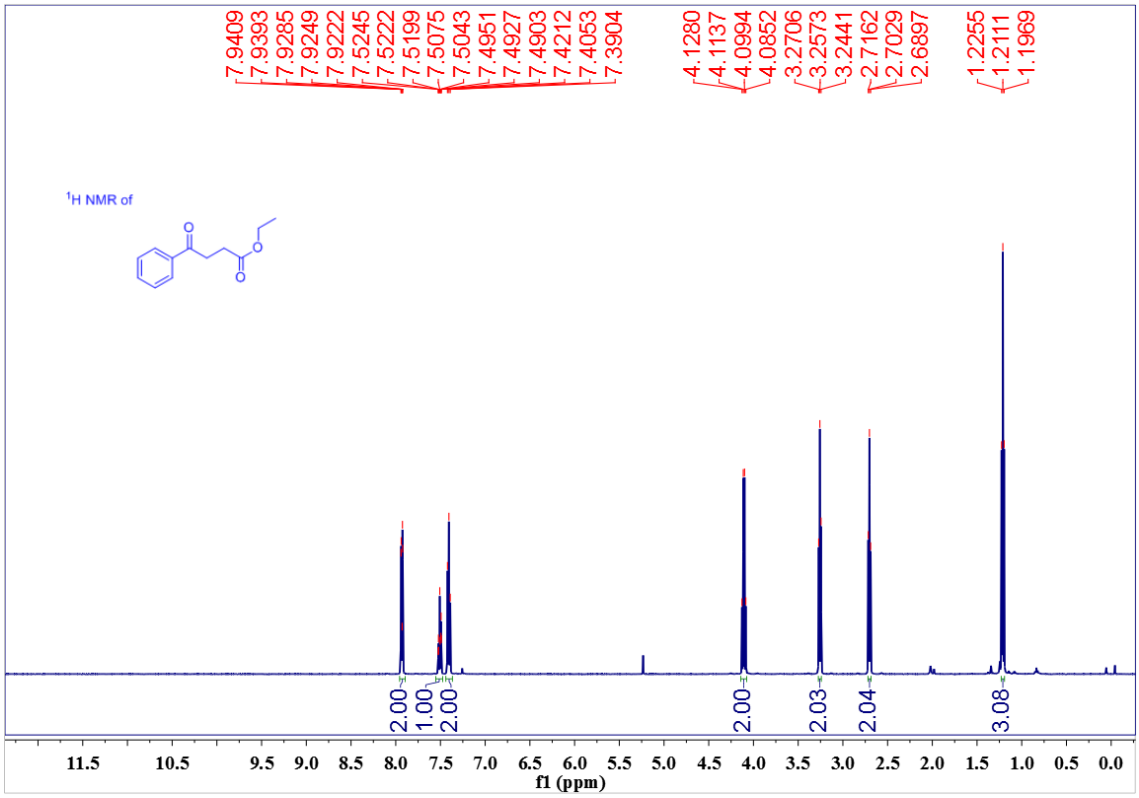
O
O
O
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

2a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4.0852
3.2706
3.2573
3.2441
2.7162
2.7029
2.6897
1.2255
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1H NMR of
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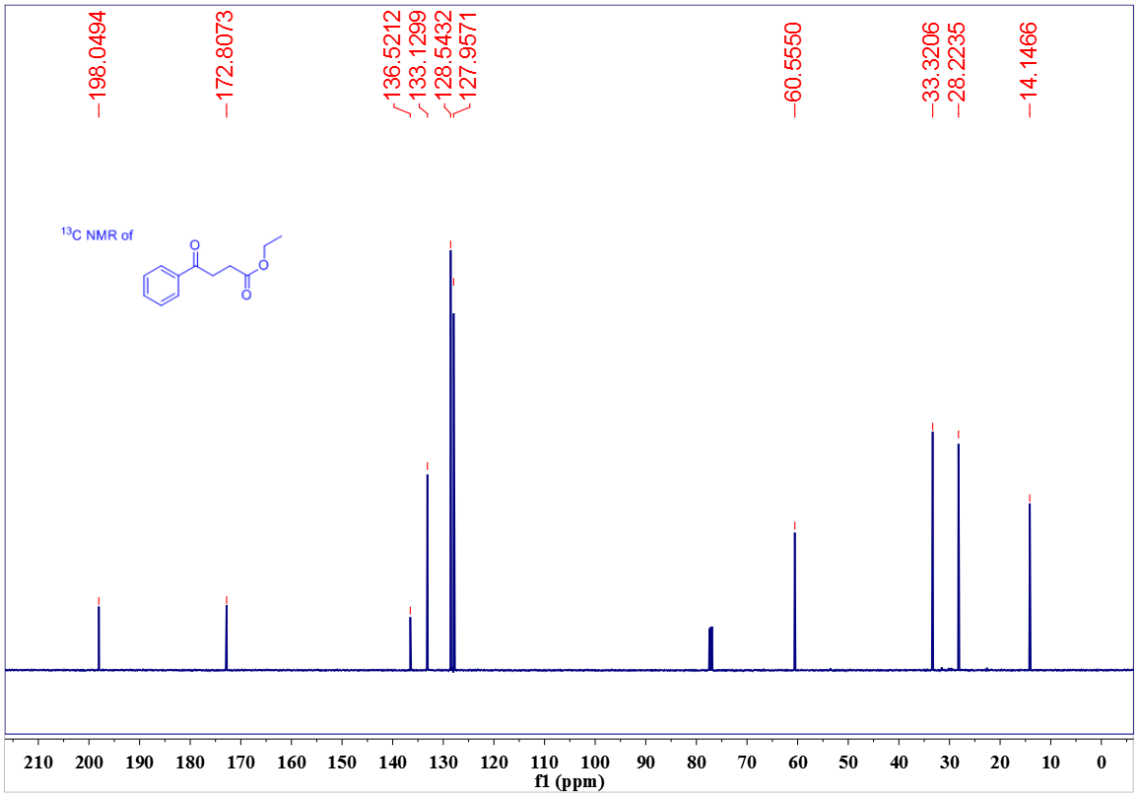
2.04
3.08
f1 (ppm)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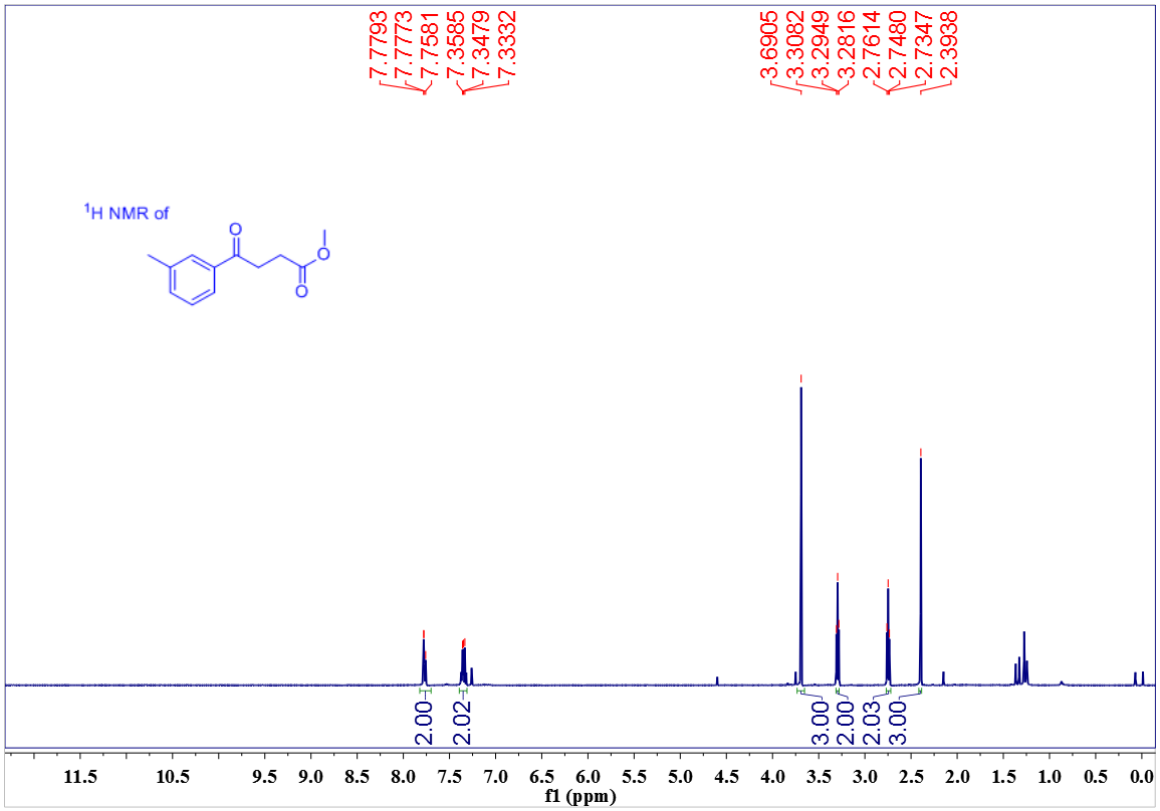
13C NMR of
f1 (ppm)

2b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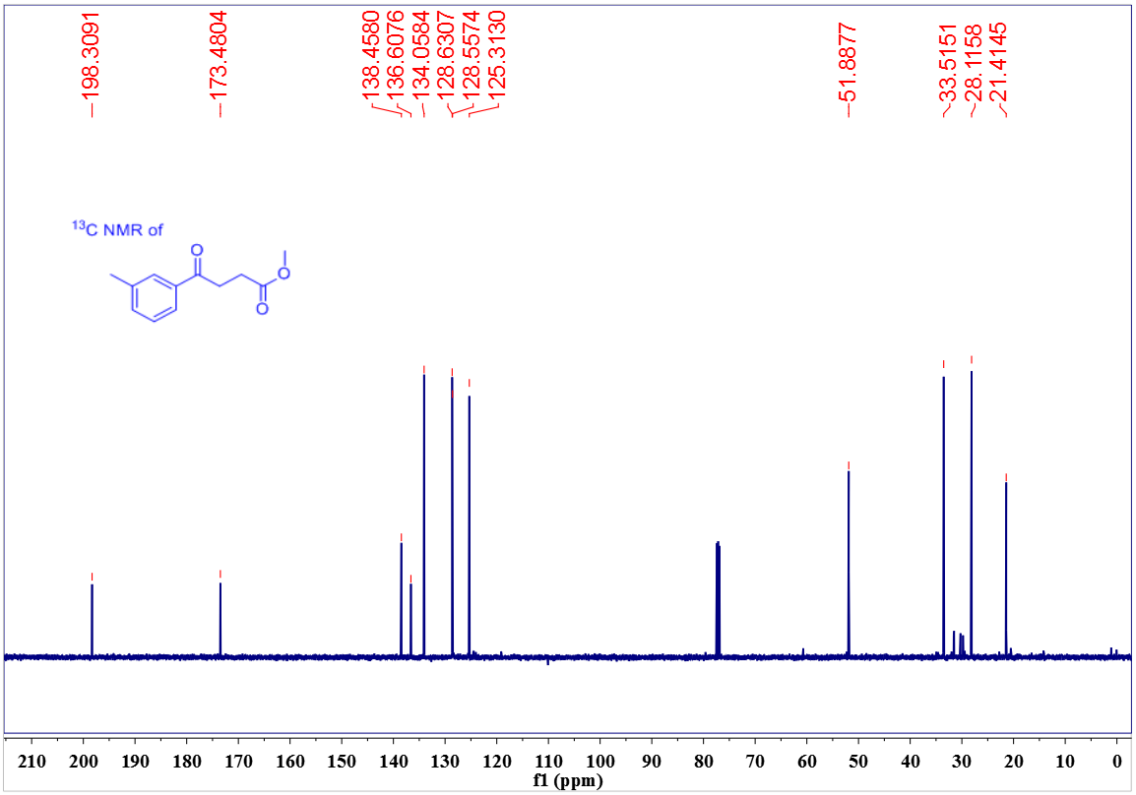
2.7614
2.7480
2.7347
2.3938
1H NMR of
2.00
2.02
3.00
2.00
2.03
3.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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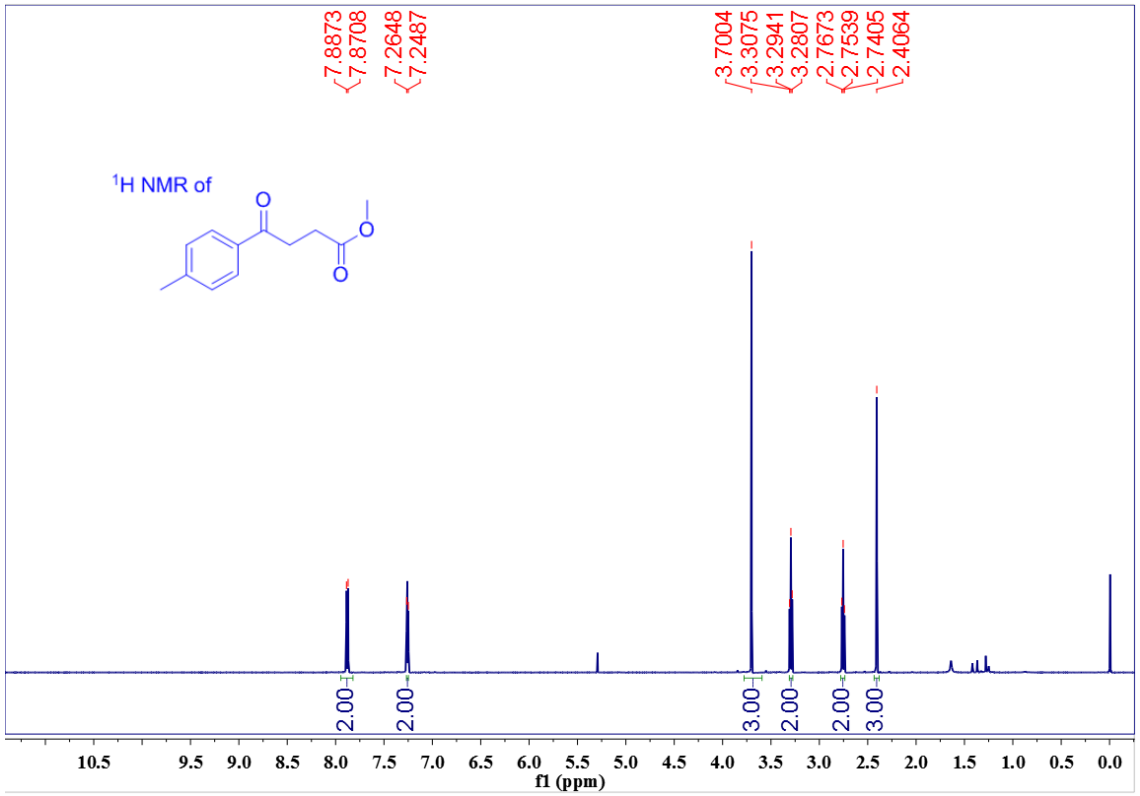
f1 (ppm)

2c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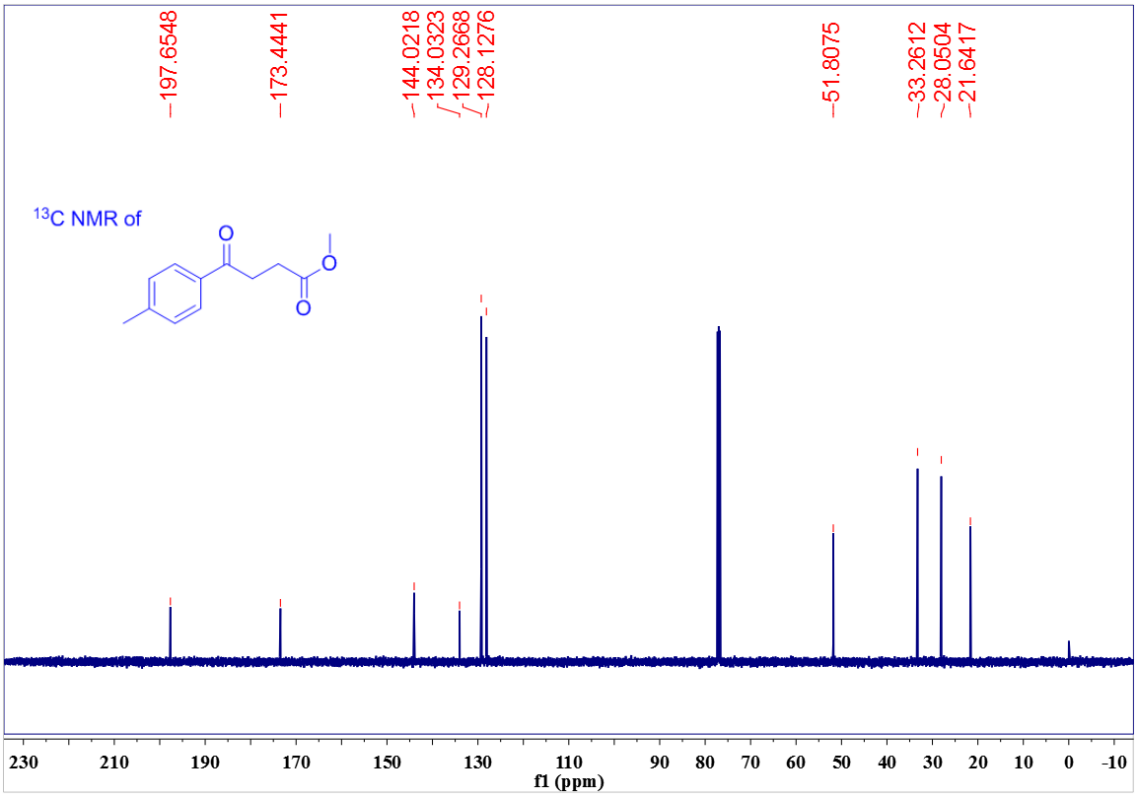
2.7405
2.4064
1H NMR of
2.00
2.00
3.00
2.00
2.00
3.00
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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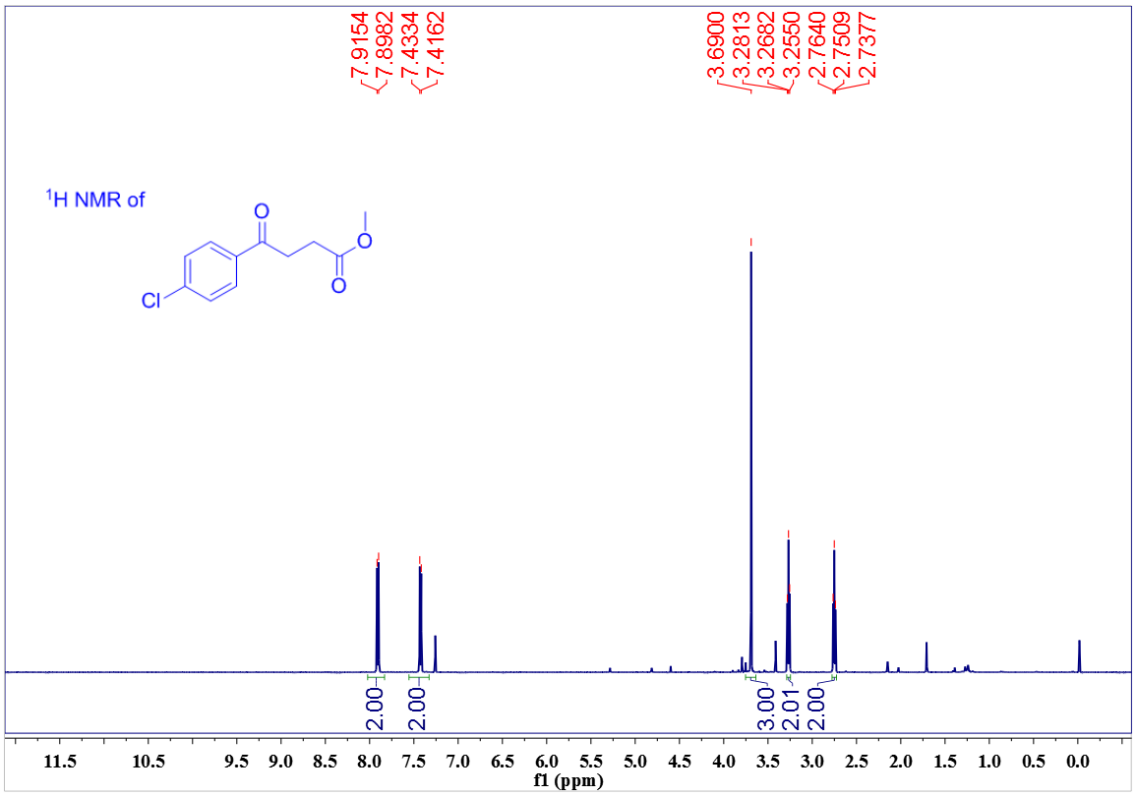
f1 (ppm)

2d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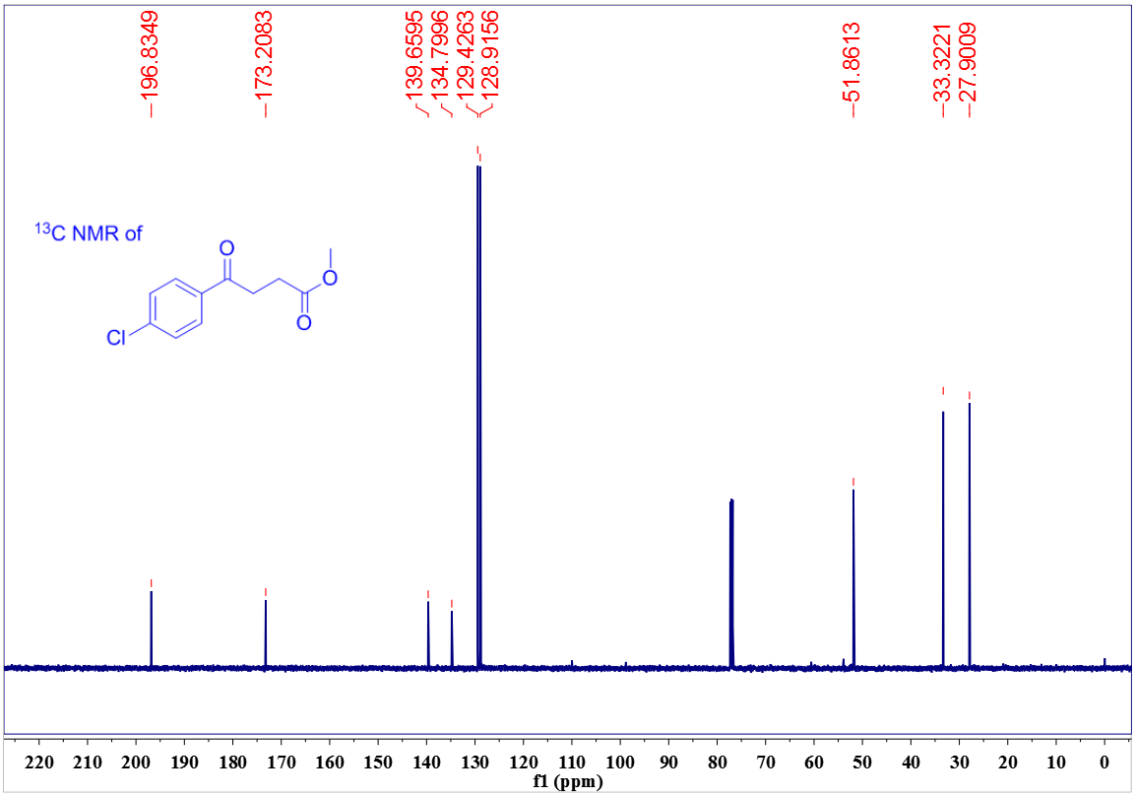
1H NMR of
Cl
O
O
O
2.00
2.00
3.00
2.01
2.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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Cl
O
O
O
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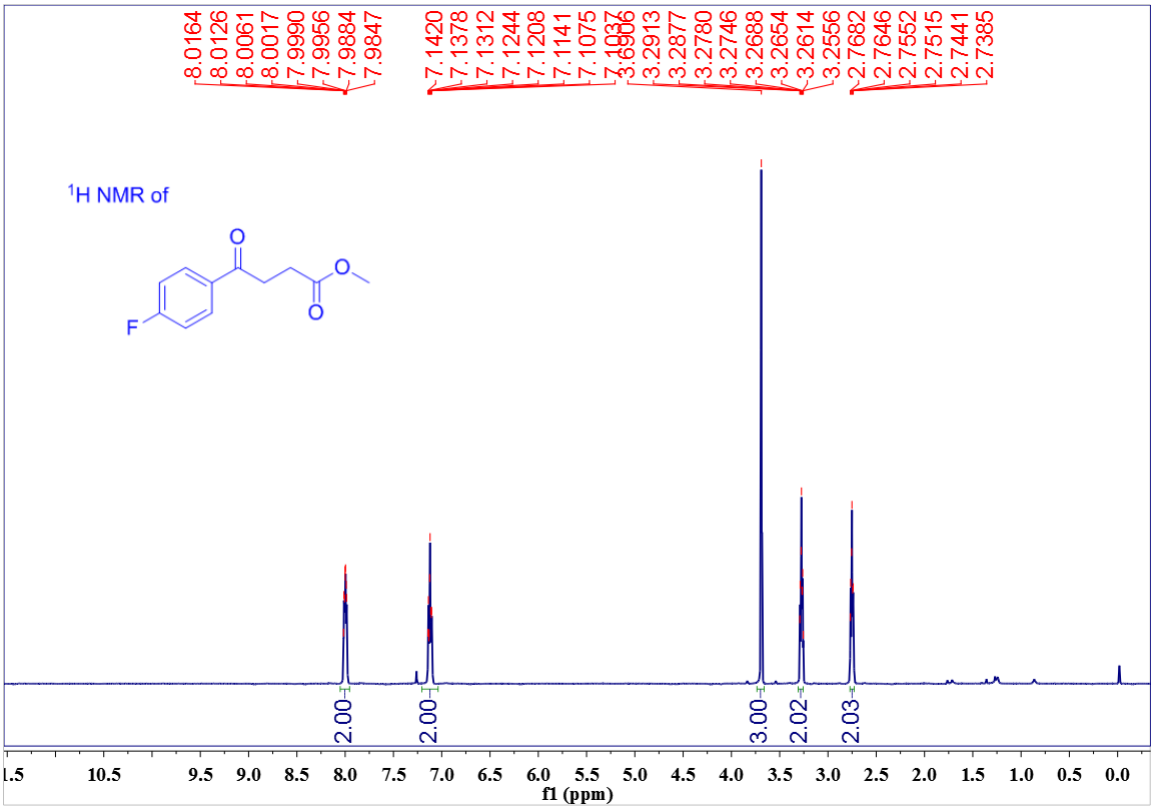
f1 (ppm)

2e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7.1075
7.1037
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3.2913
3.2877
3.2780
3.2746
3.2688
3.2654
3.2614
3.2556
2.7682
2.7646
2.7552
2.7515
2.7441
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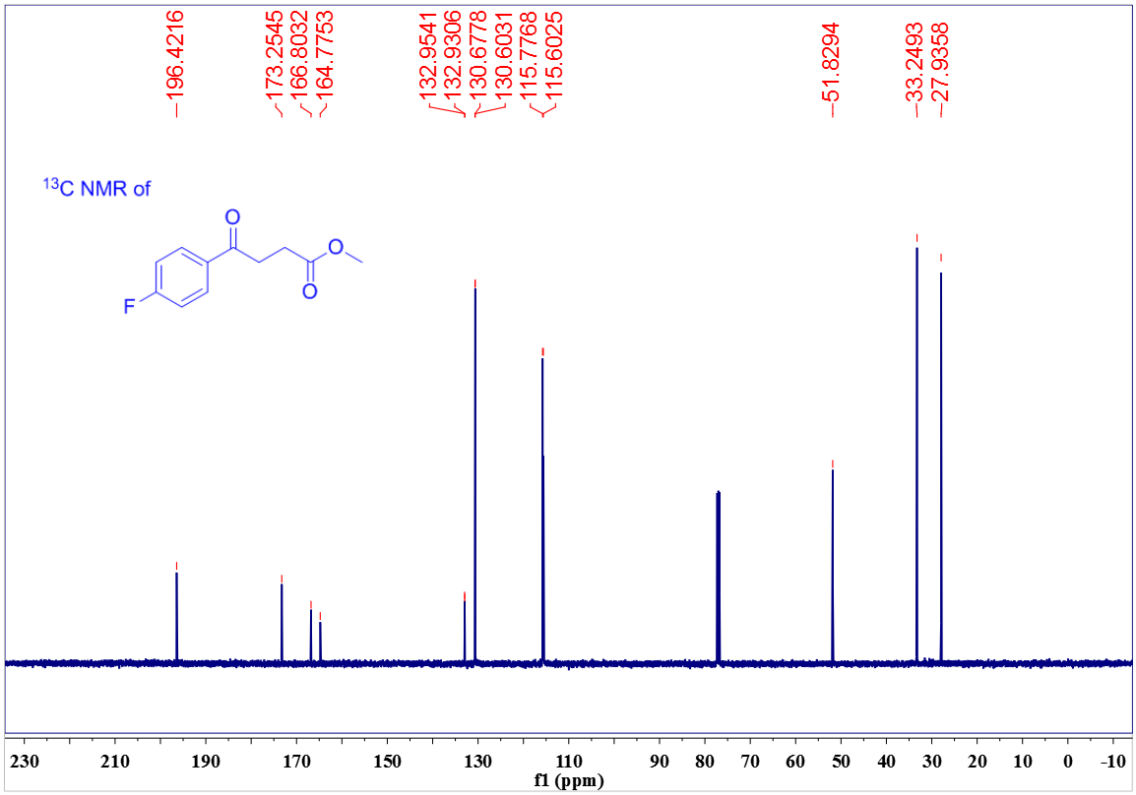
1H NMR of
O
O
O
F
2.00
2.00
3.00
2.02
2.03
f1 (ppm)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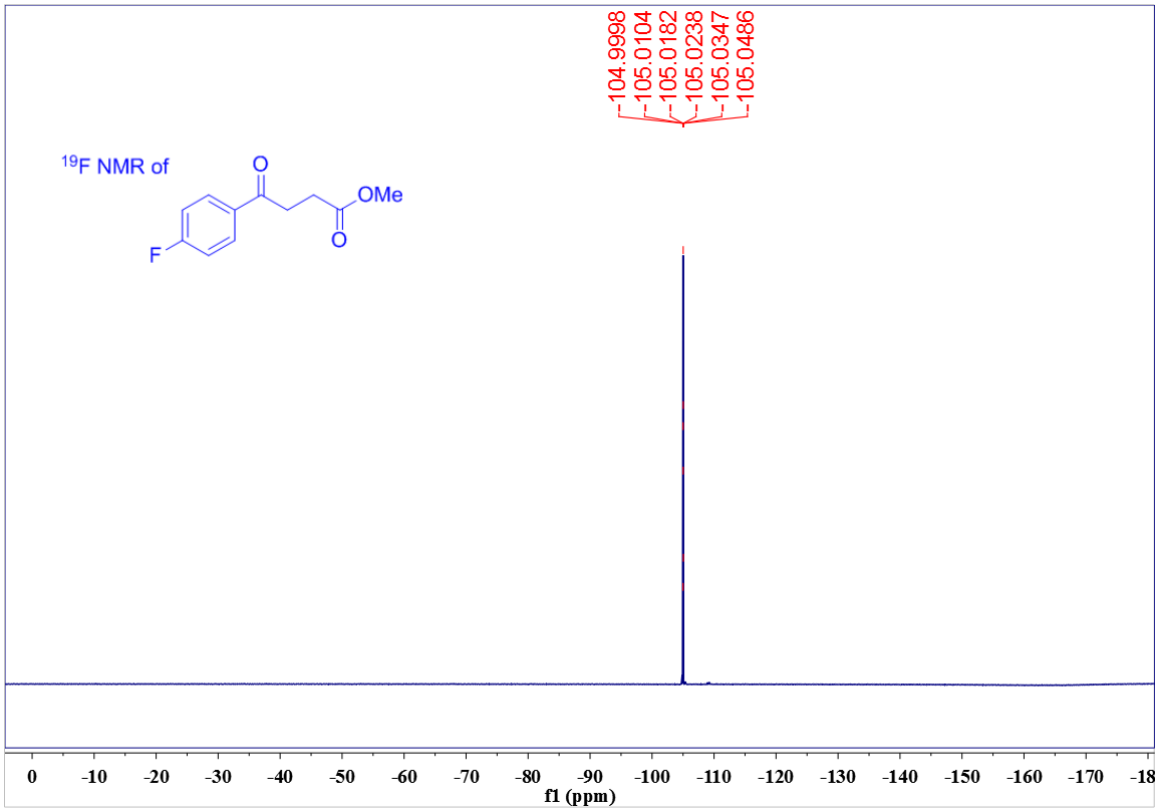
13C NMR of
O
O
O
F
f1 (ppm)

2f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OMe
O
F
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-10
-20
-30
-40
-50
-60
-70
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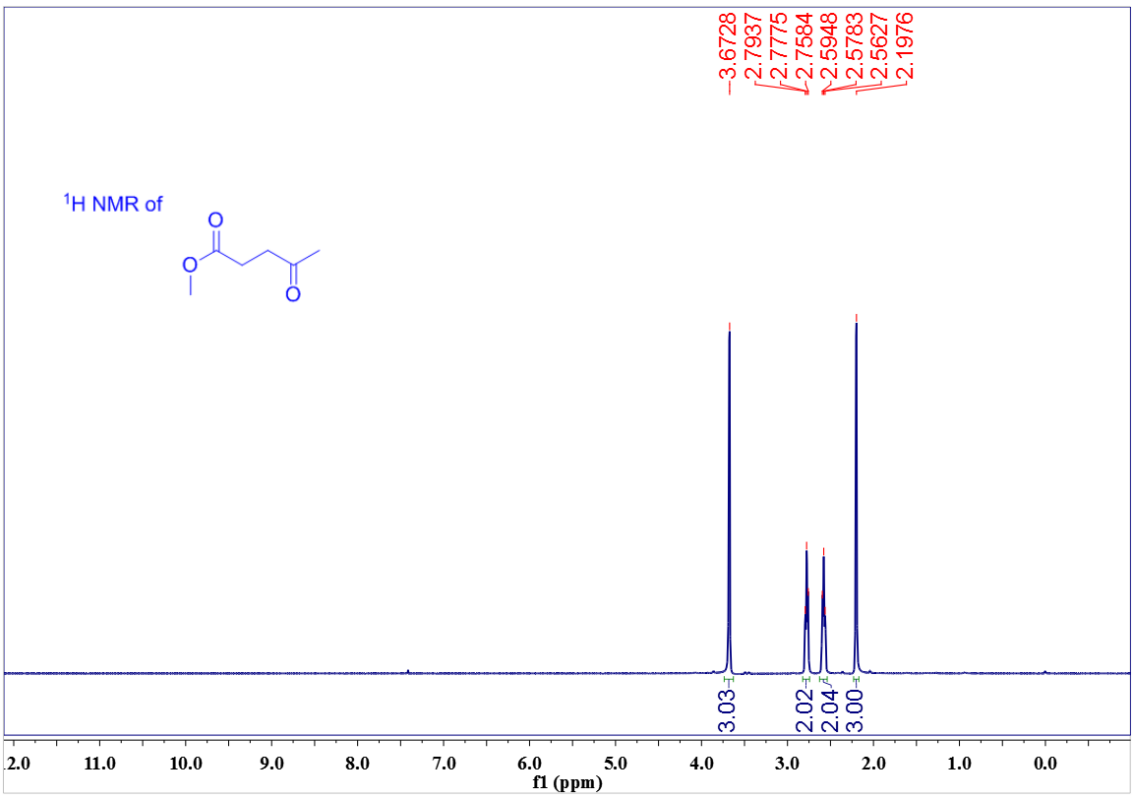
-130
-140
-150
-160
-170
-18
f1 (ppm)

2f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1H NMR of
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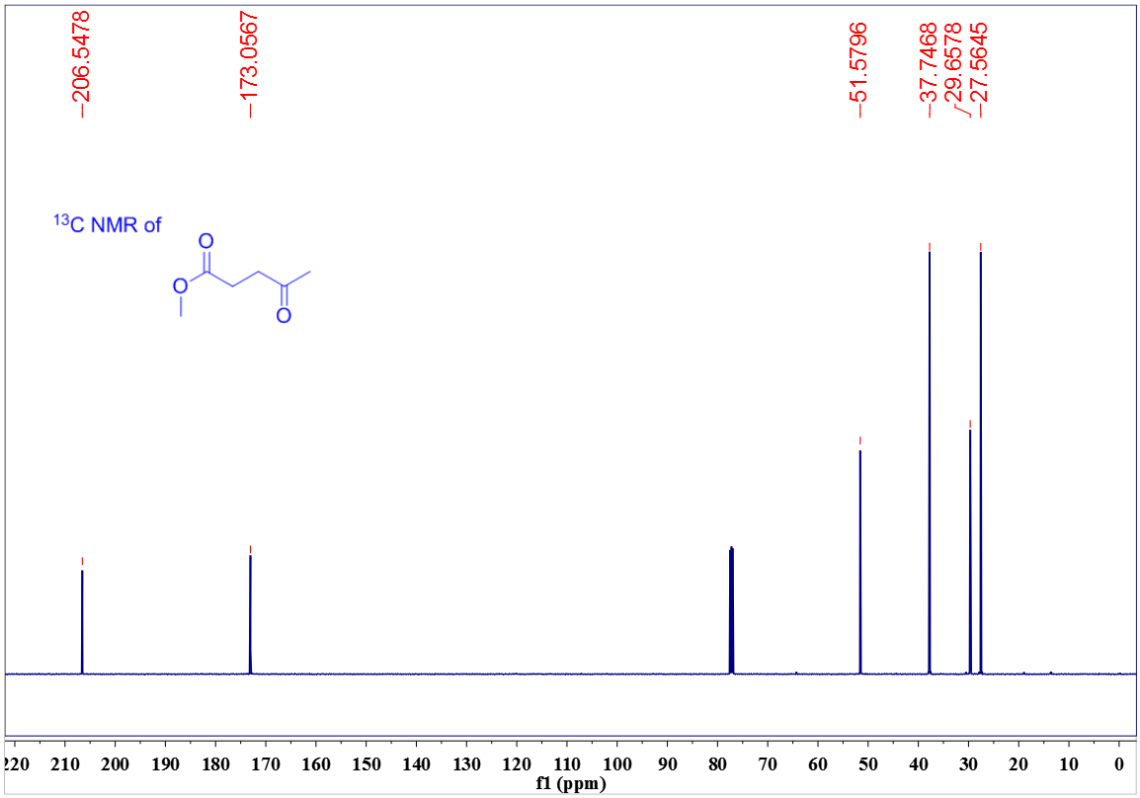
2.04
3.00
f1 (ppm)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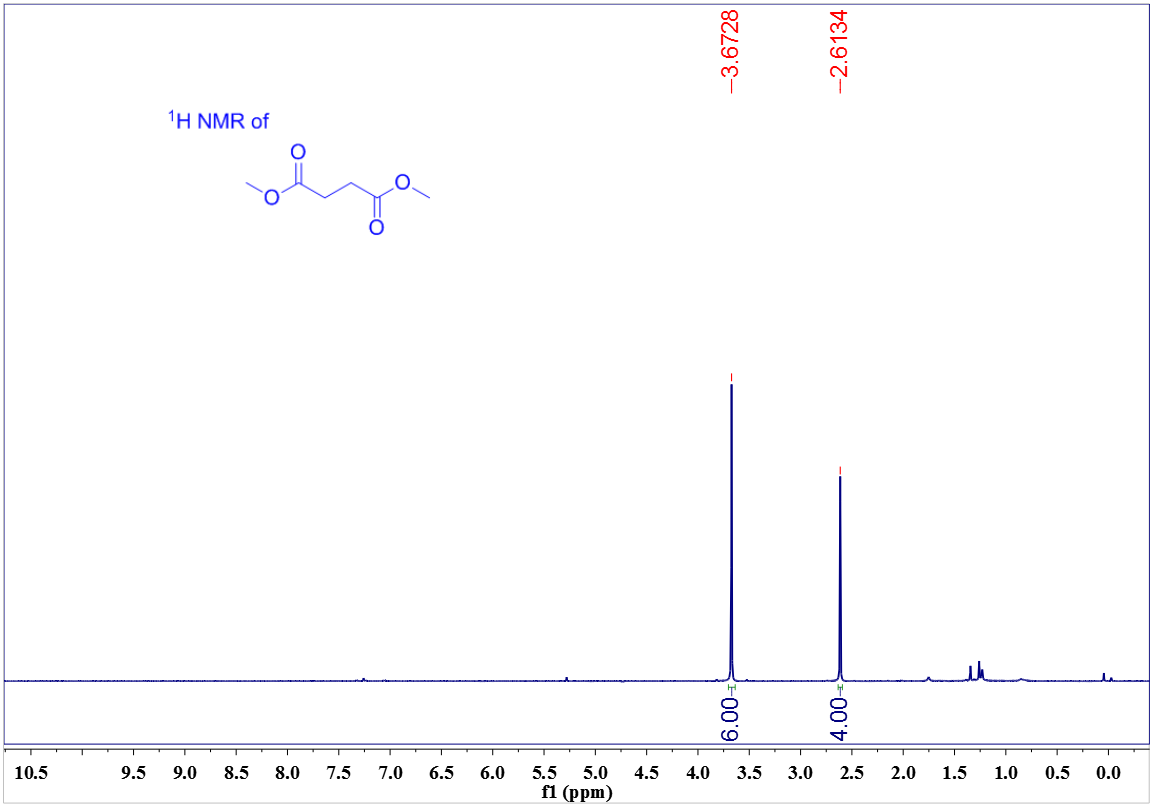
f1 (ppm)

2g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4.00
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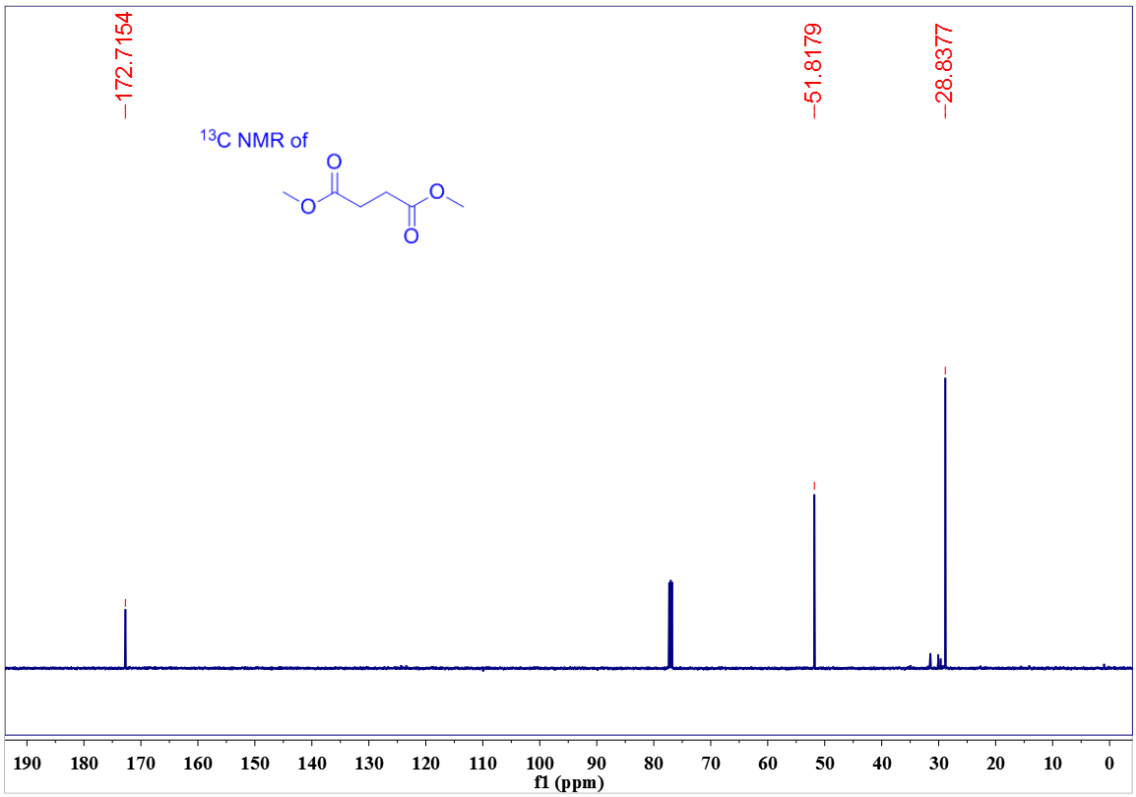
f1 (ppm)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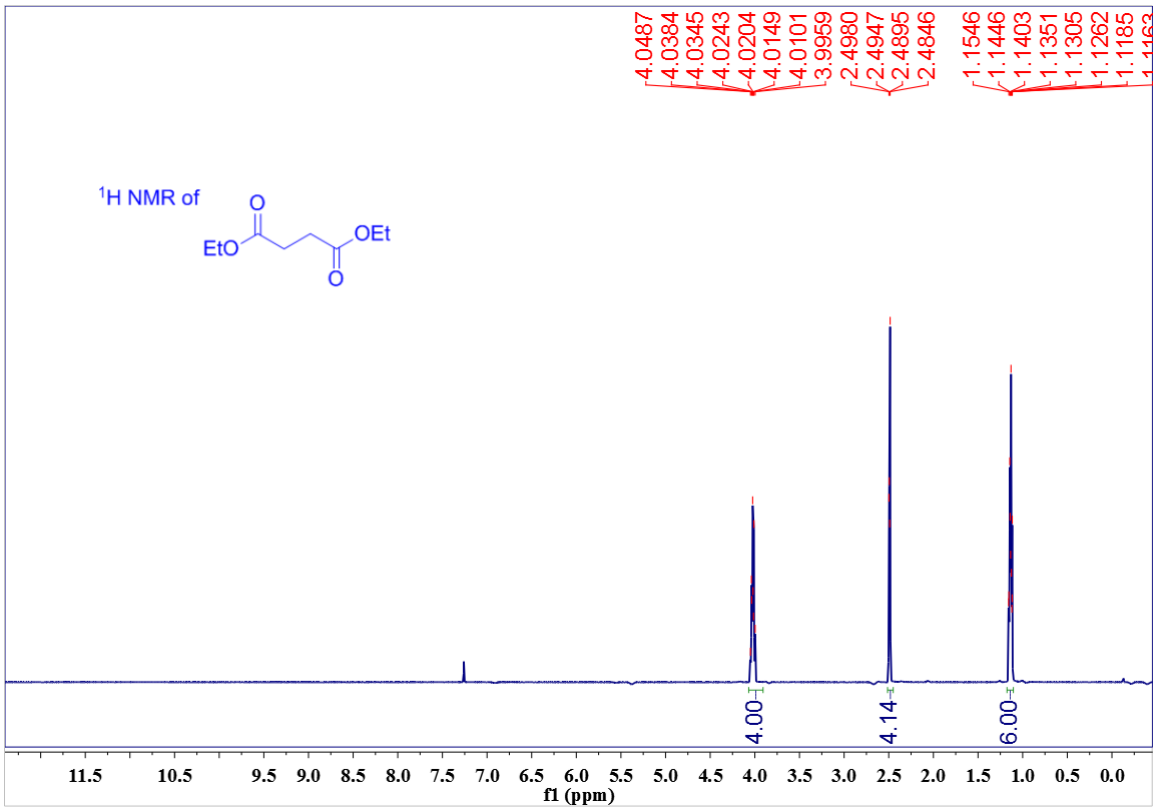
f1 (ppm)

2h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2.4846
1.1546
1.1446
1.1403
1.1351
1.1305
1.1262
1.1185
1.1163
1H NMR of
EtO
OEt
O
O
4.00
4.14
6.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
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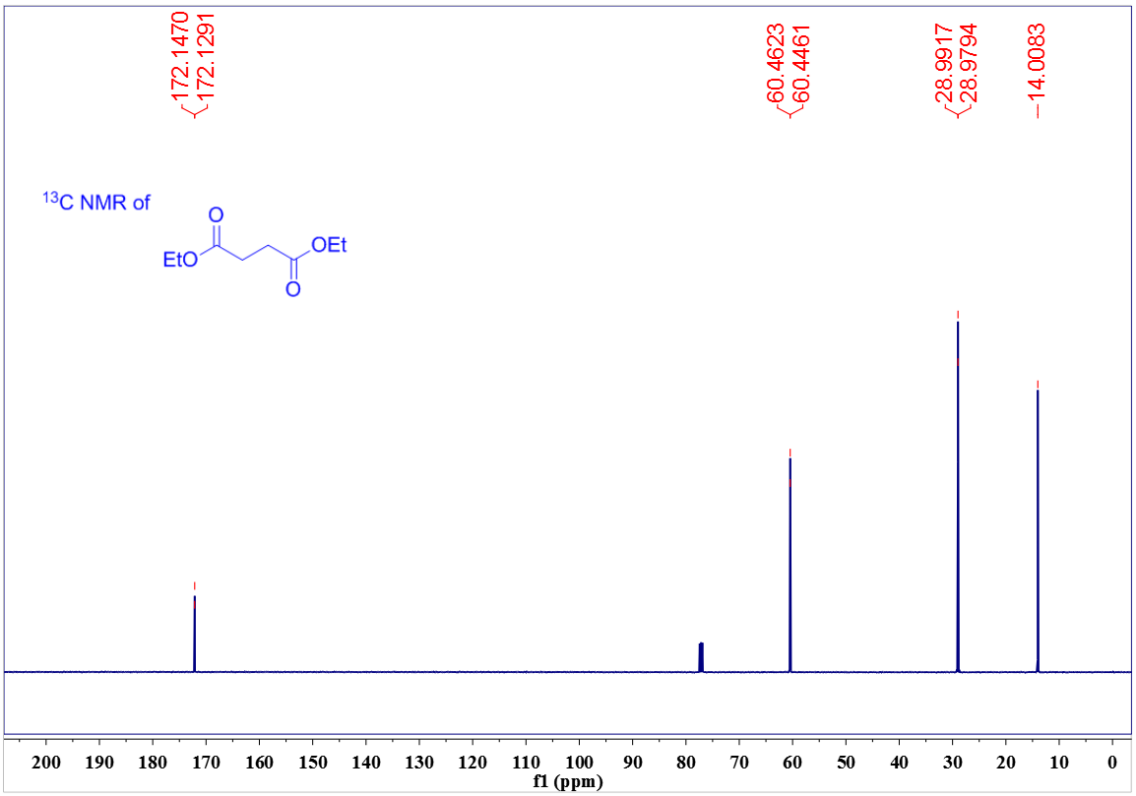
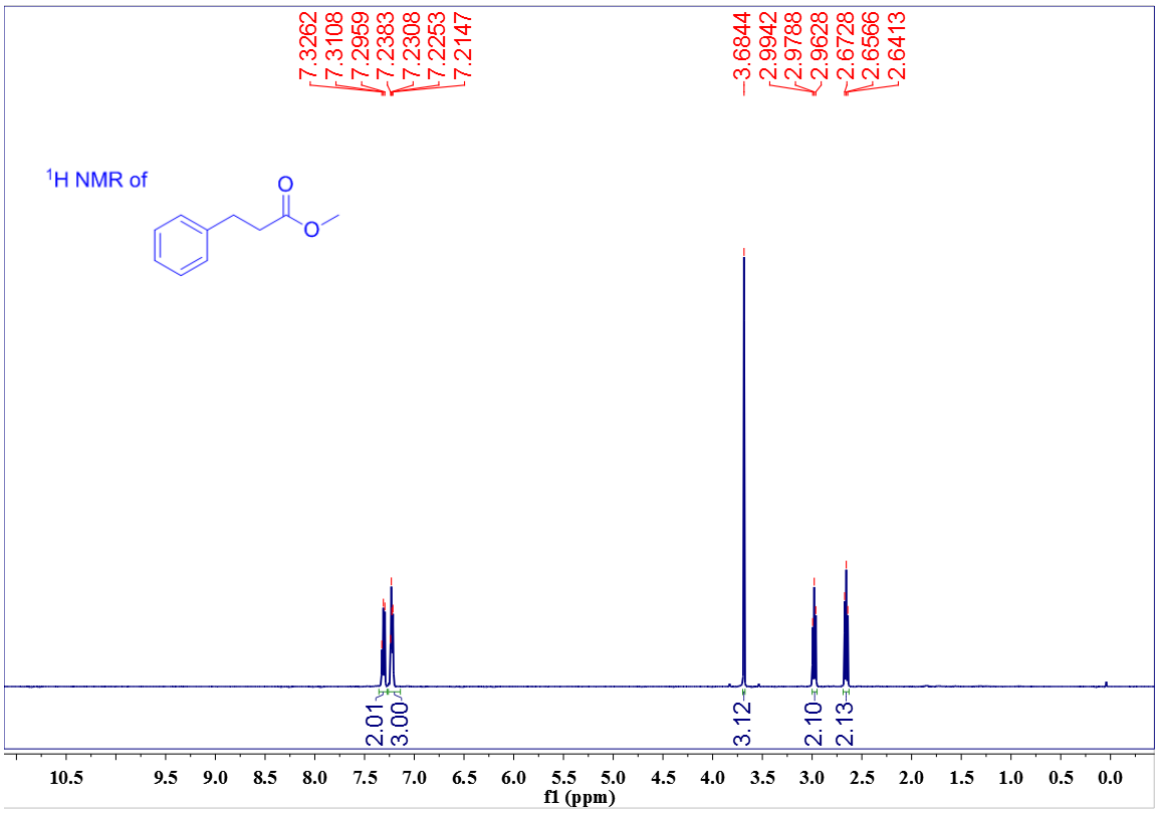
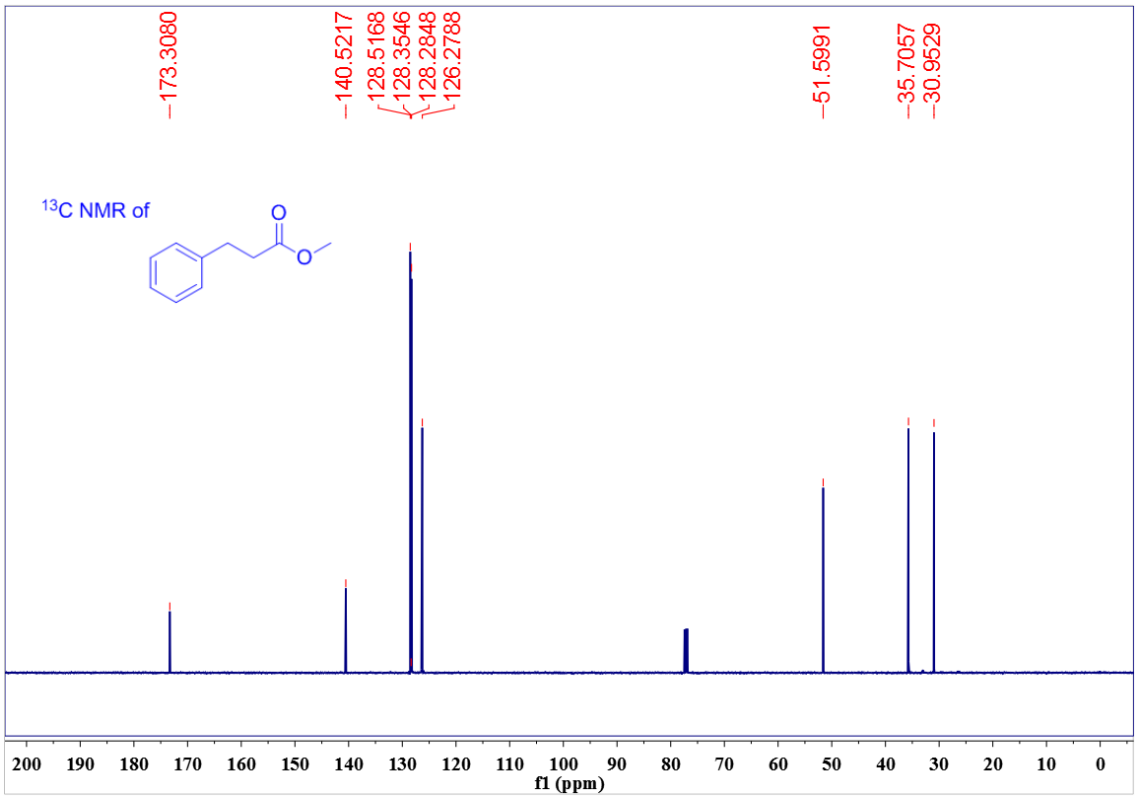
f1 (ppm)

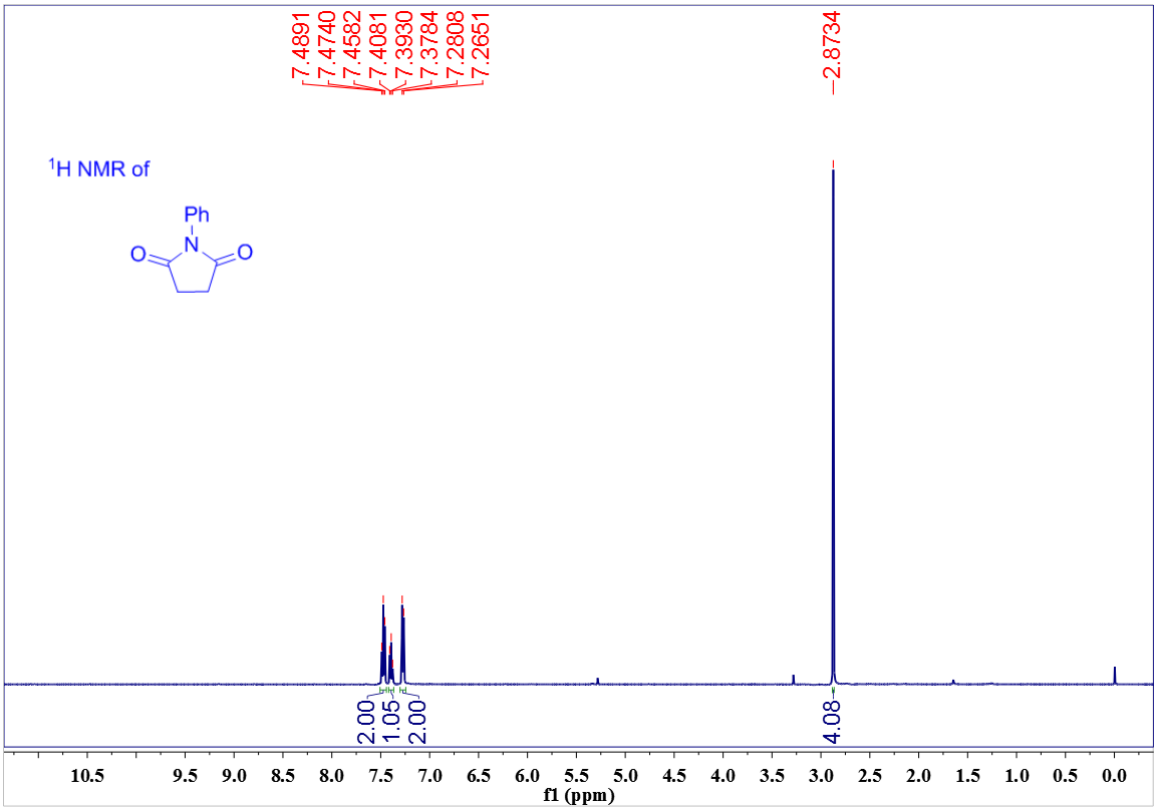

172.1470
172.1291
60.4623
60.4461
28.9917
28.9794
14.0083
13C NMR of
EtO
OEt
O
O
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

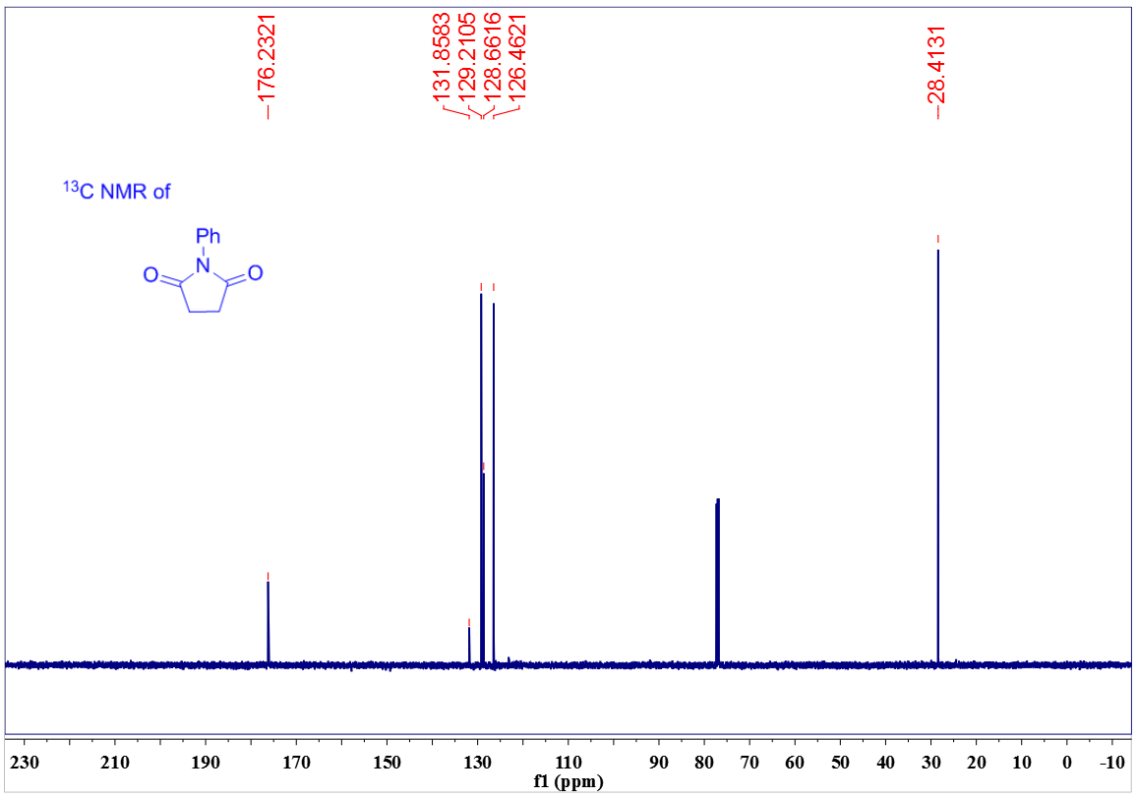
2i


7.3262
7.3108
7.2959
7.2383
7.2308
7.2253
7.2147
3.6844
2.9942
2.9788
2.9628
2.6728
2.6566
2.6413
1H NMR of
O
O
2.01
3.00
3.12
2.10
2.13
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

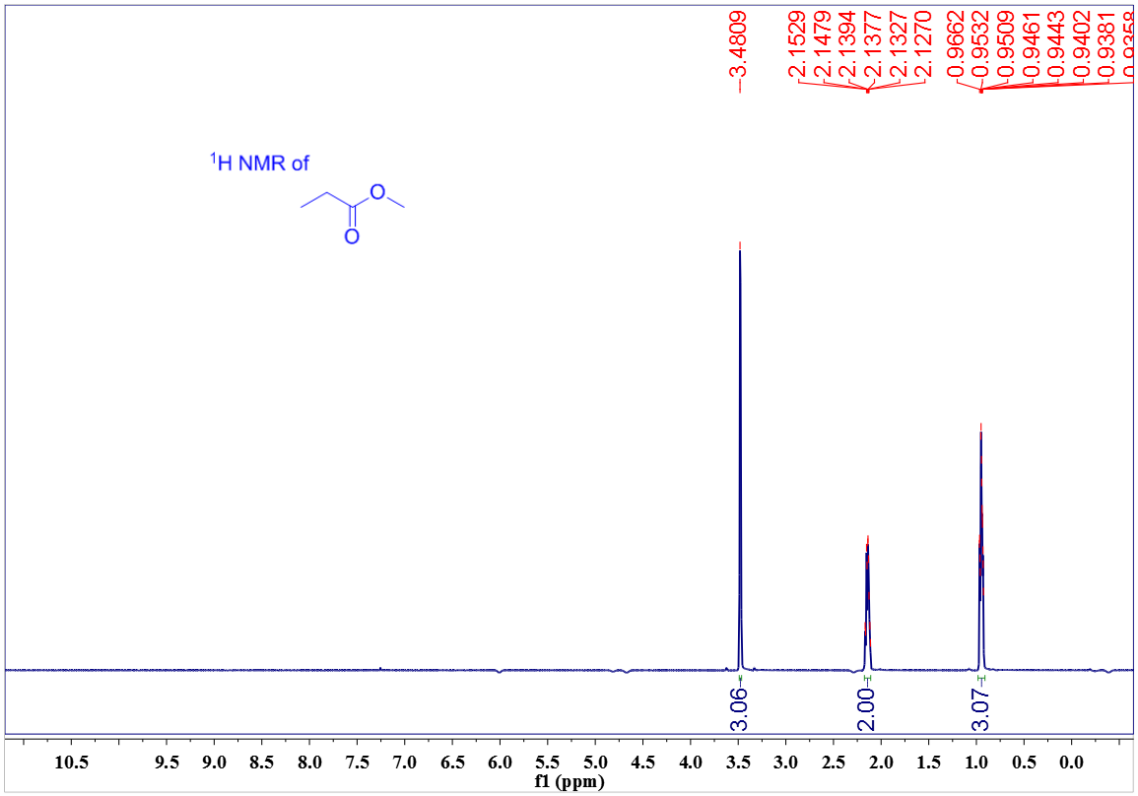

173.3080
140.5217
128.5168
128.3546
128.2848
126.2788
51.5991
35.7057
30.9529
13C NMR of
O
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

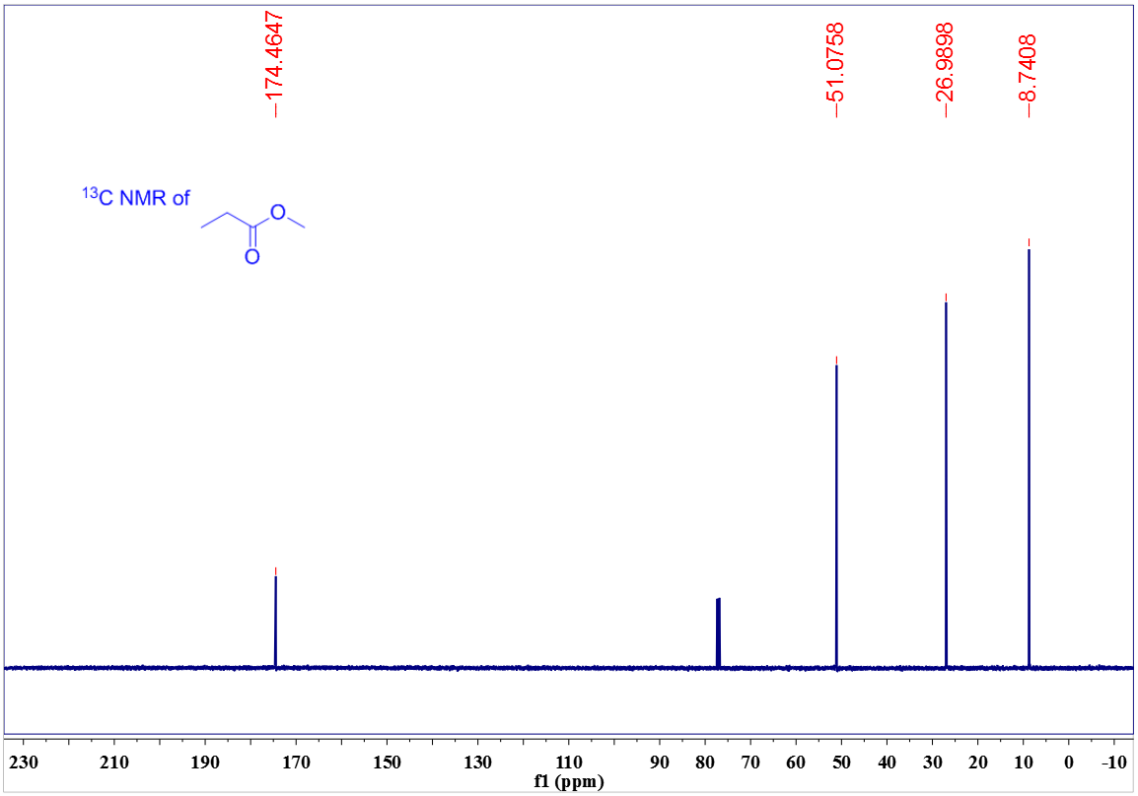
2j/4a


7.4891
7.4740
7.4582
7.4081
7.3930
7.3784
7.2808
7.2651
2.8734
1H NMR of
Ph
N
O
O
2.00
1.05
2.00
4.08
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

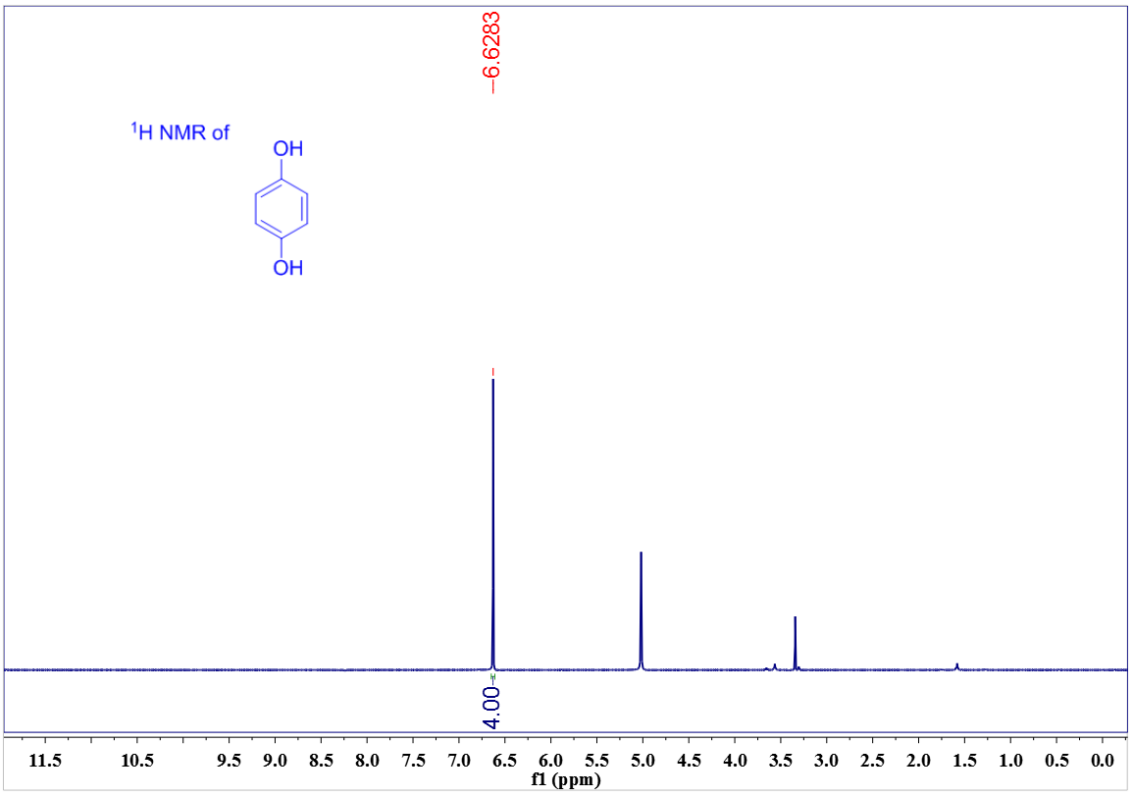

176.2321
131.8583
129.2105
128.6616
126.4621
28.4131
13C NMR of
Ph
N
O
O
230 210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

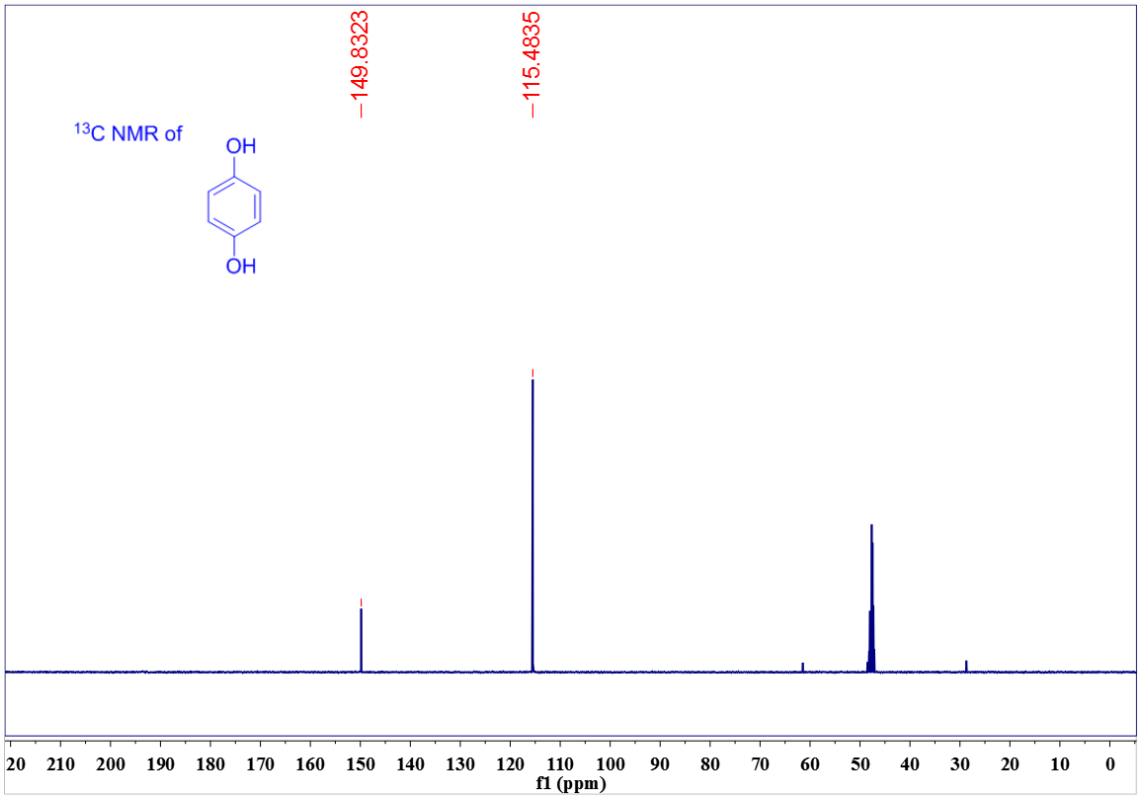
2k


3.4809
2.1529
2.1479
2.1394
2.1377
2.1327
2.1270
0.9662
0.9532
0.9509
0.9461
0.9443
0.9402
0.9381
1H NMR of
3.06
2.00
3.07
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

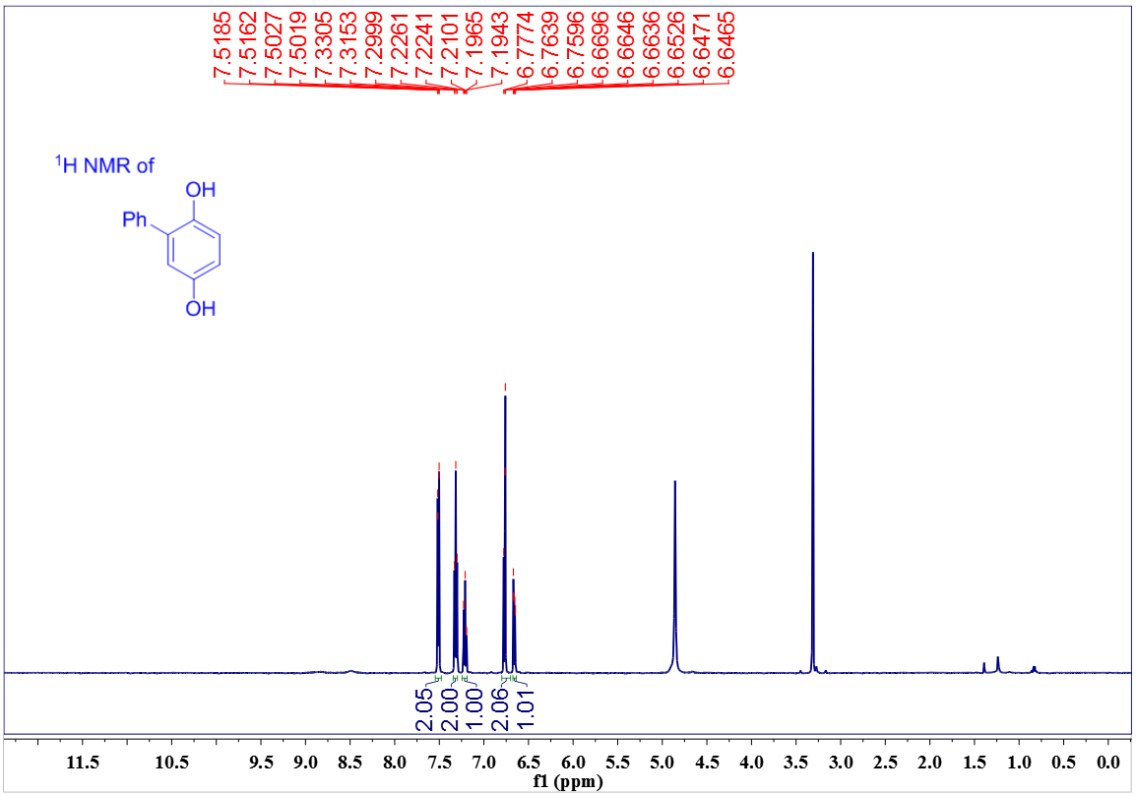

174.4647
51.0758
26.9898
8.7408
13C NMR of
230 210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

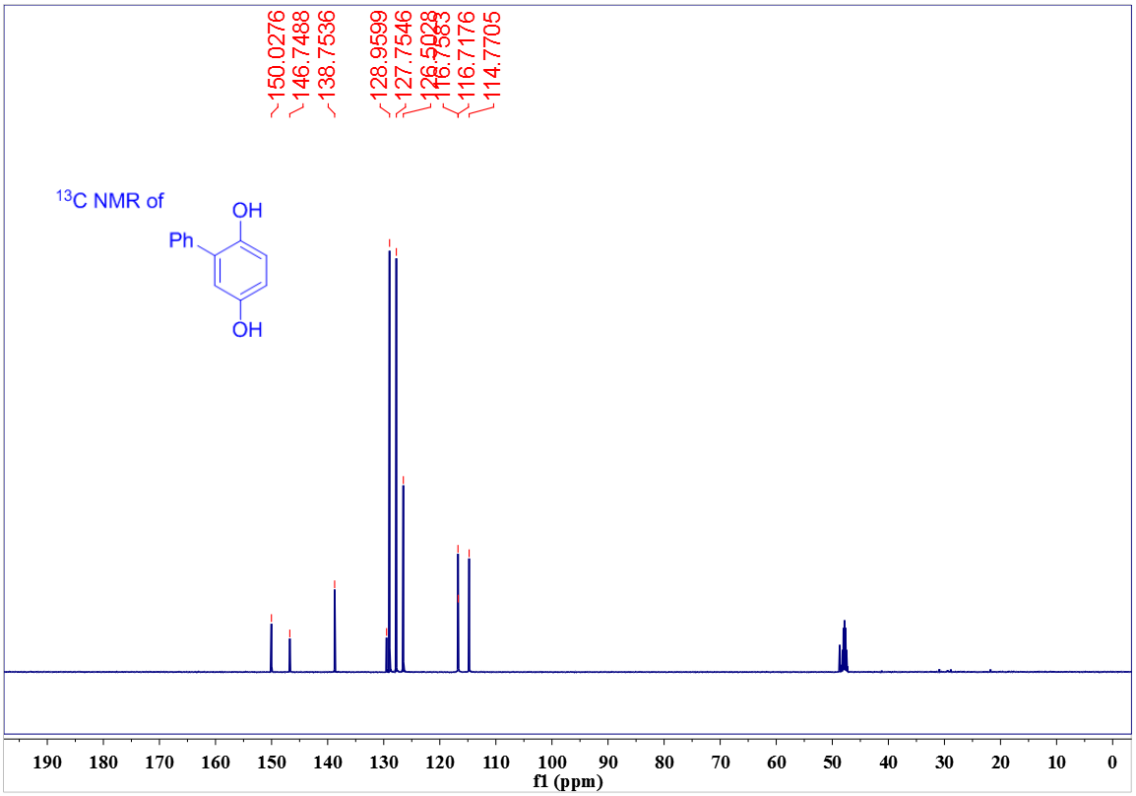
2l/4b


6.6283
1H NMR of
OH
OH
4.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

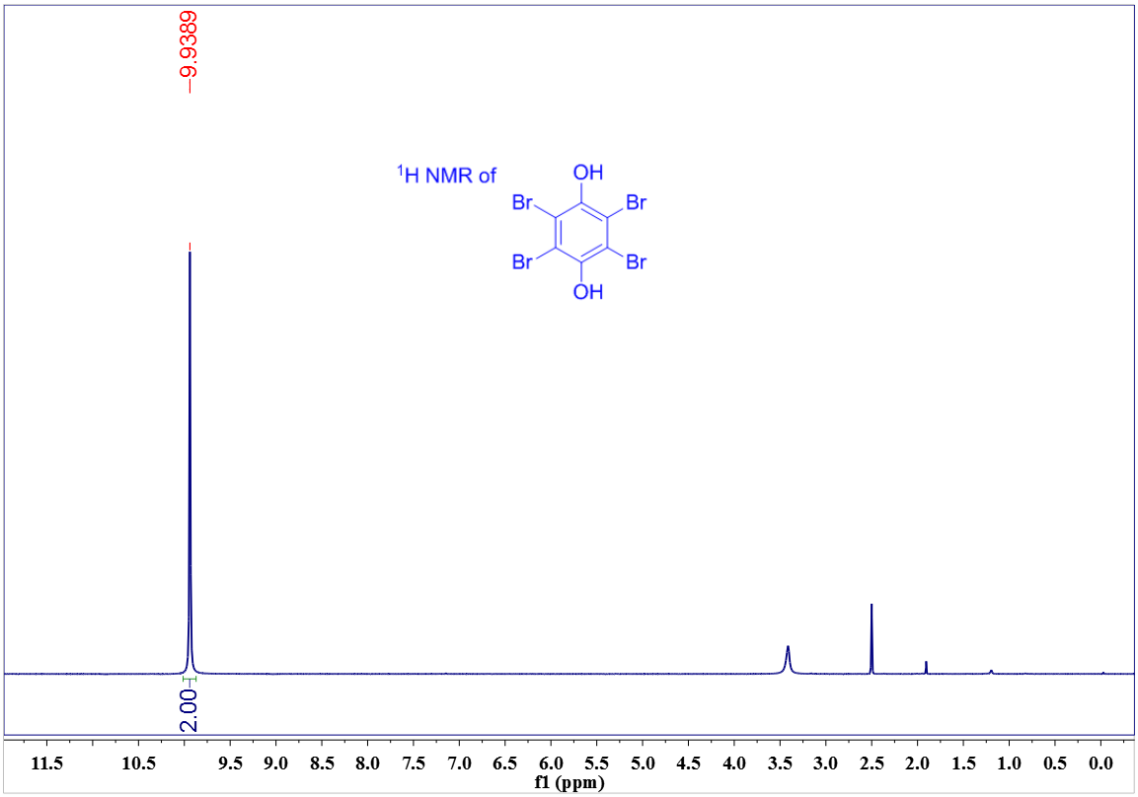

149.8323
115.4835
13C NMR of
OH
OH
20
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

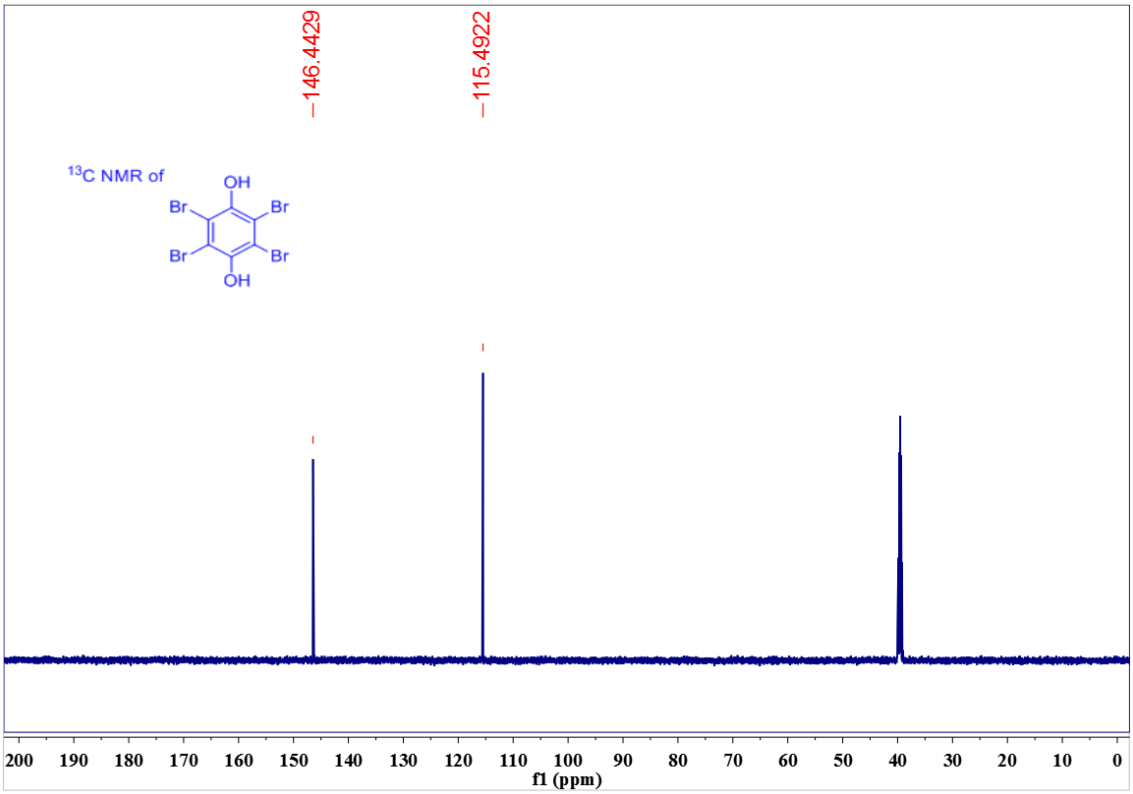
6a


7.5185
7.5162
7.5027
7.5019
7.3305
7.3153
7.2999
7.2261
7.2241
7.2101
7.1965
7.1943
6.7774
6.7639
6.7596
6.6696
6.6646
6.6636
6.6526
6.6471
6.6465
1H NMR of
OH
Ph
OH
2.05
2.00
1.00
2.06
1.01
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

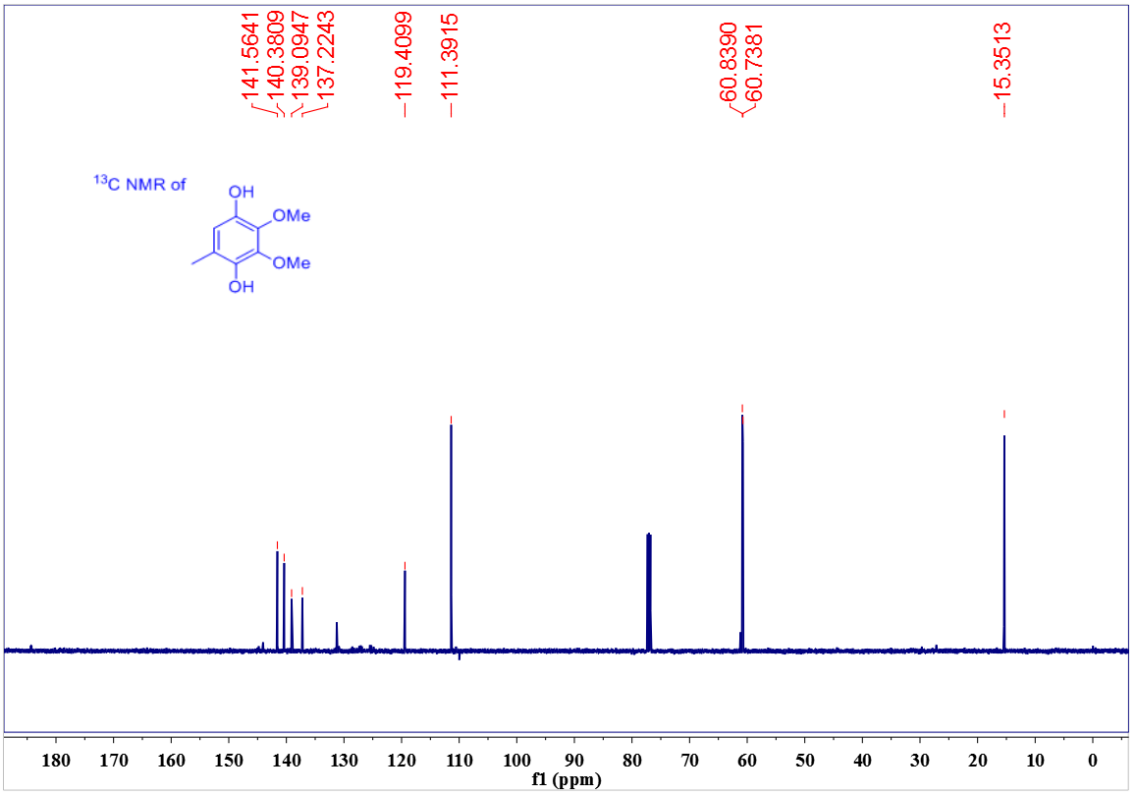

150.0276
146.7488
138.7536
128.9599
127.7546
126.5028
116.7583
116.7176
114.7705
13C NMR of
OH
Ph
OH
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

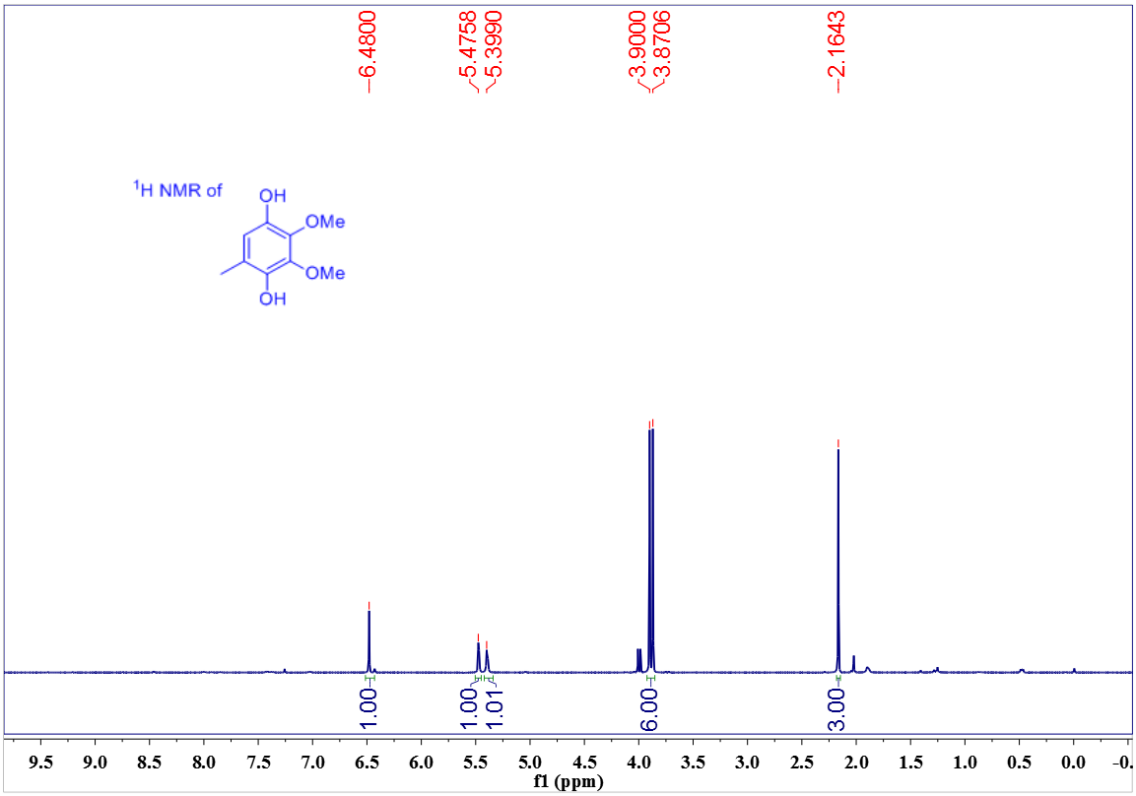
6b


9.9389
^{1}H NMR of
OH
Br
Br
Br
Br
OH
2.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

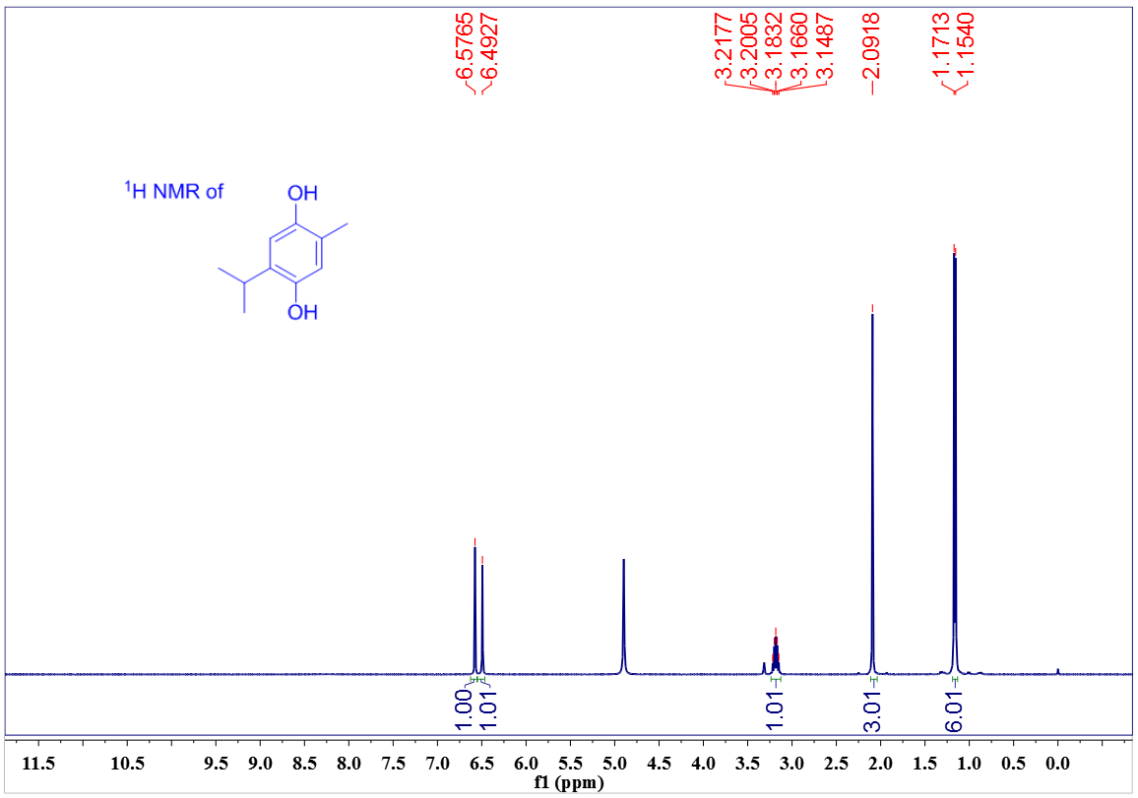

146.4429
115.4922
^{13}C NMR of
OH
Br
Br
Br
Br
OH
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

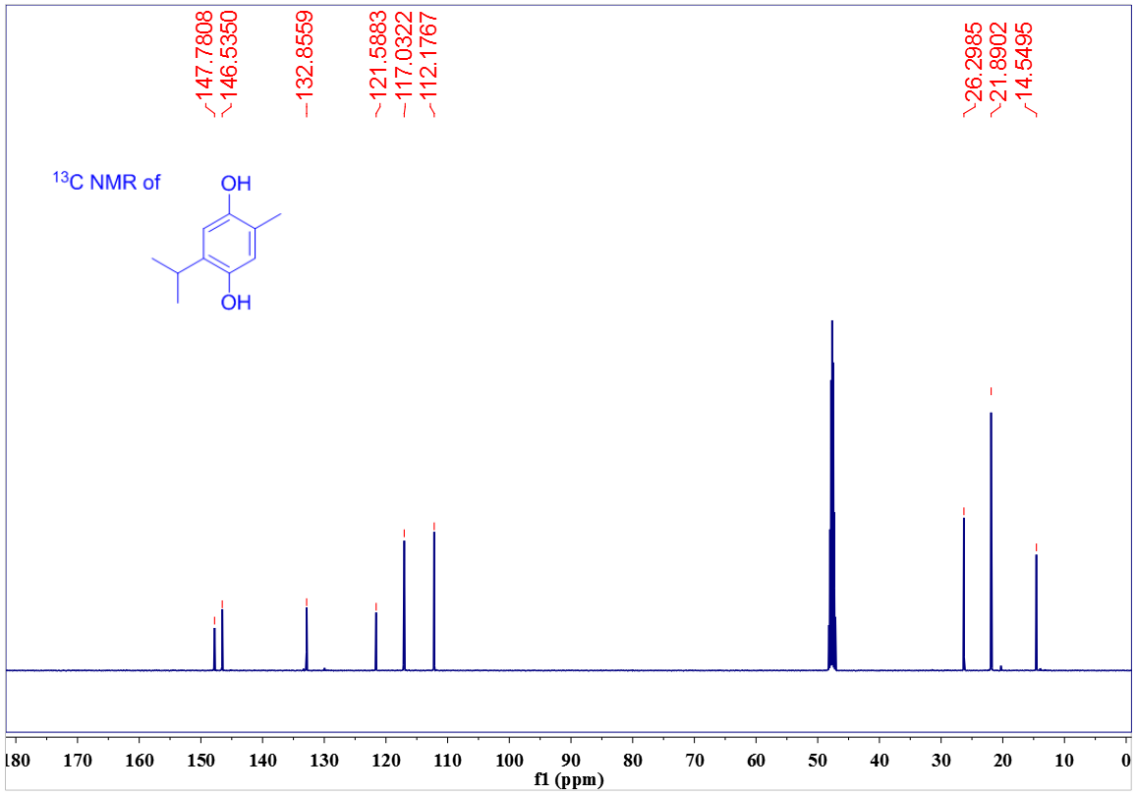
6c


141.5641
140.3809
139.0947
137.2243
119.4099
111.3915
60.8390
60.7381
15.3513
13C NMR of
OH
OMe
OMe
OH
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

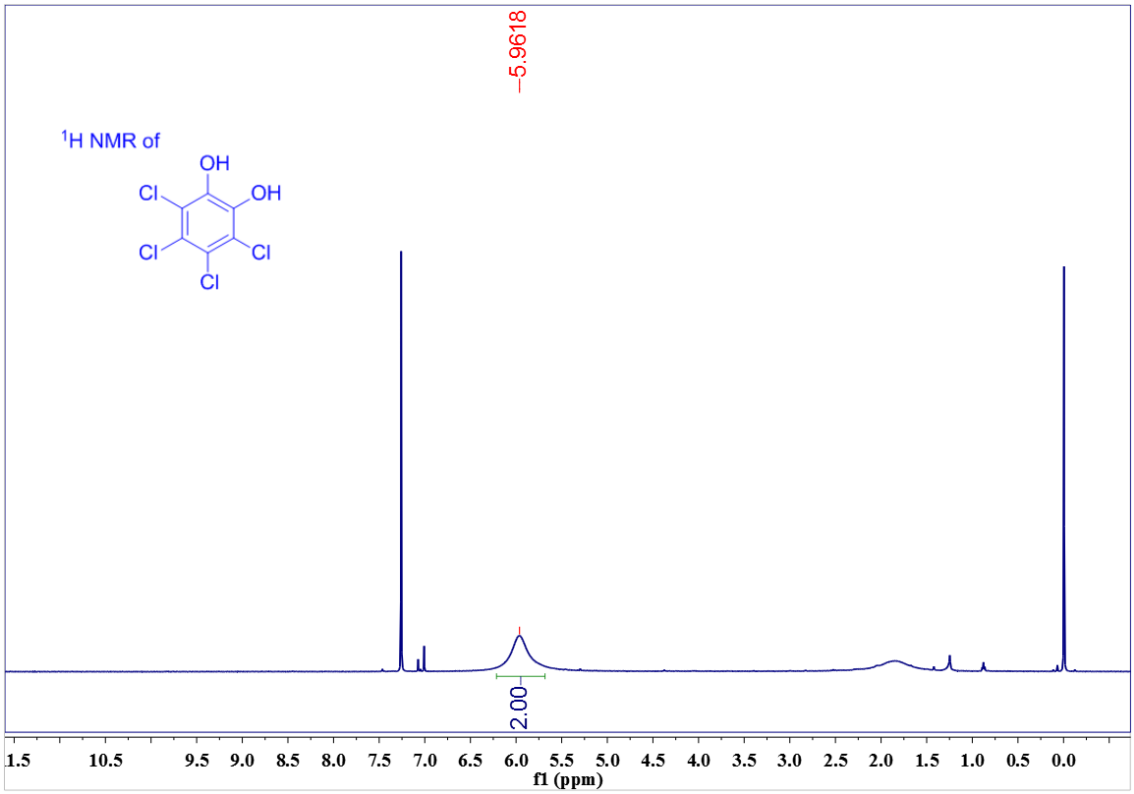

6.4800
5.4758
5.3990
3.9000
3.8706
2.1643
1H NMR of
OH
OMe
OMe
OH
1.00
1.00
1.01
6.00
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

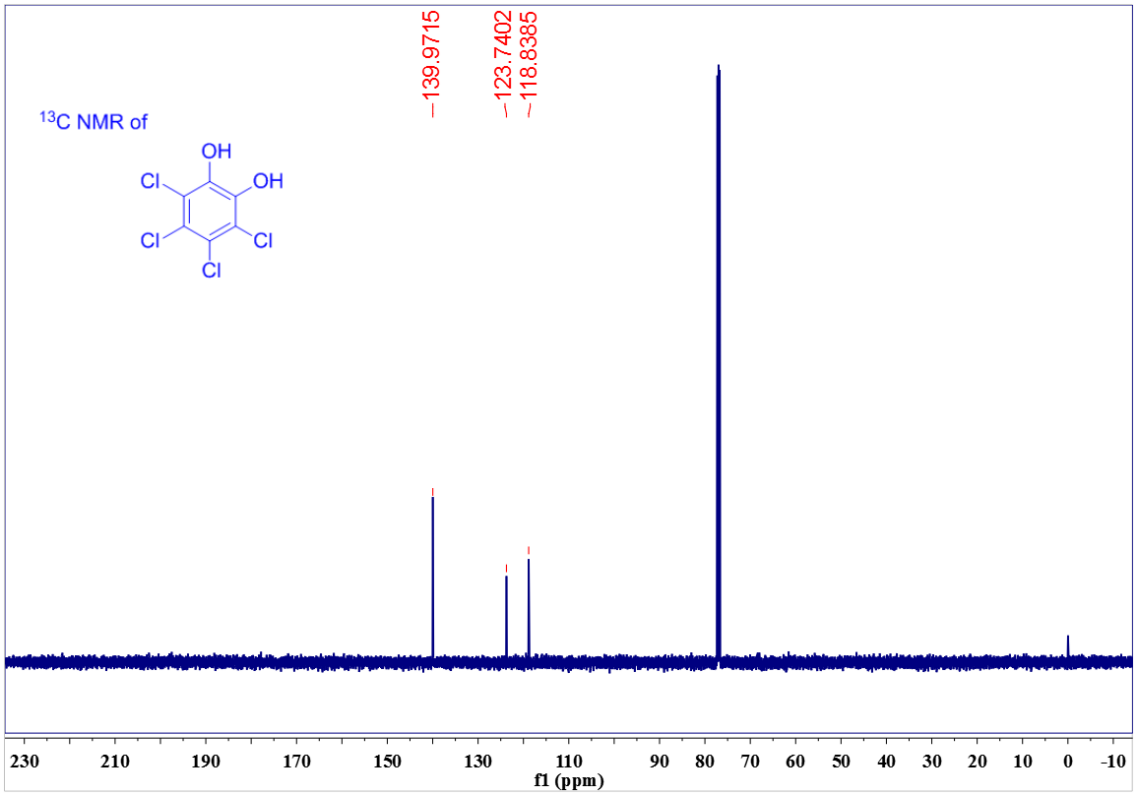
6d


6.5765
6.4927
3.2177
3.2005
3.1832
3.1660
3.1487
2.0918
1.1713
1.1540
1H NMR of
OH
OH
1.00
1.01
1.01
3.01
6.01
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

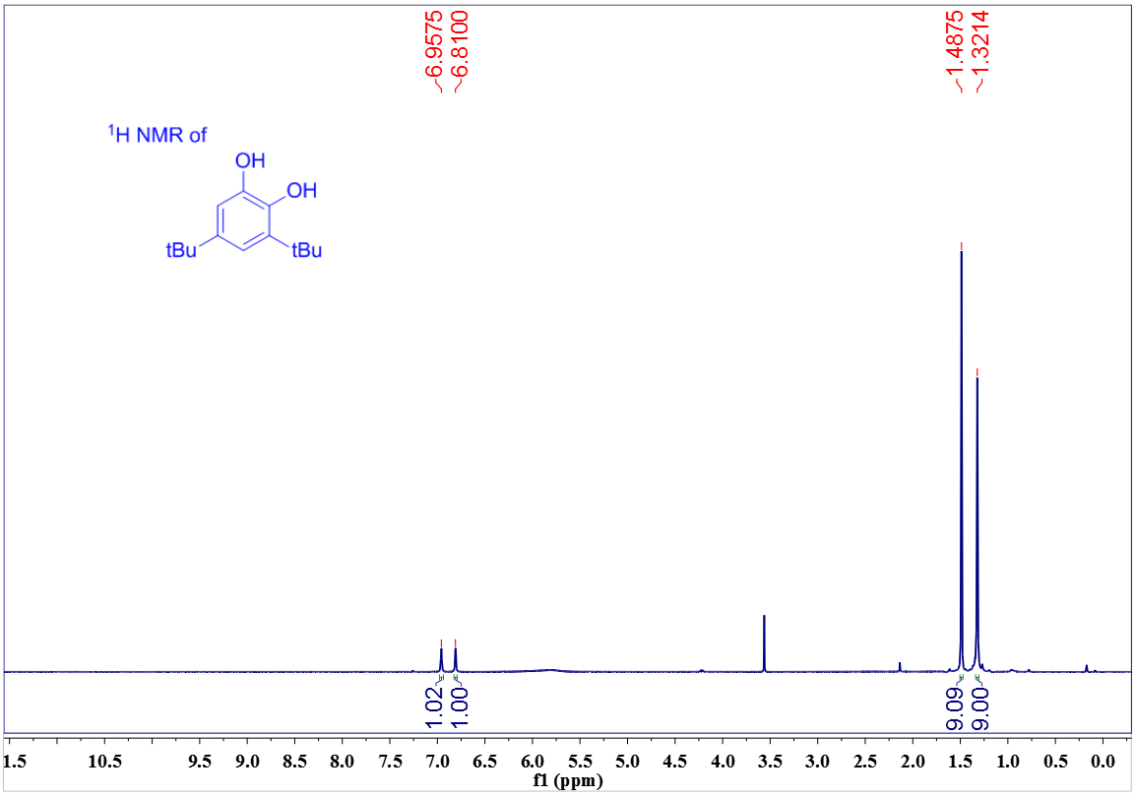

147.7808
146.5350
132.8559
121.5883
117.0322
112.1767
26.2985
21.8902
14.5495
13C NMR of
OH
OH
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

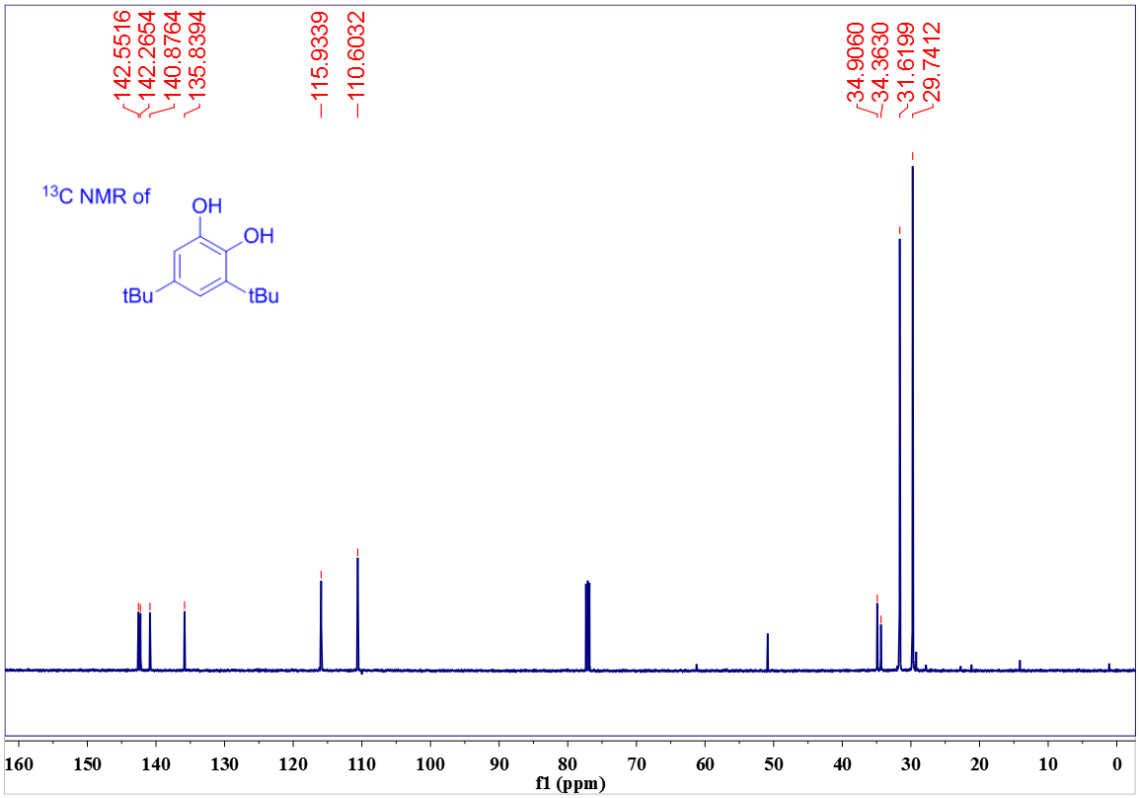
6e


5.9618
1H NMR of
OH
Cl
OH
Cl
Cl
Cl
2.00
1.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

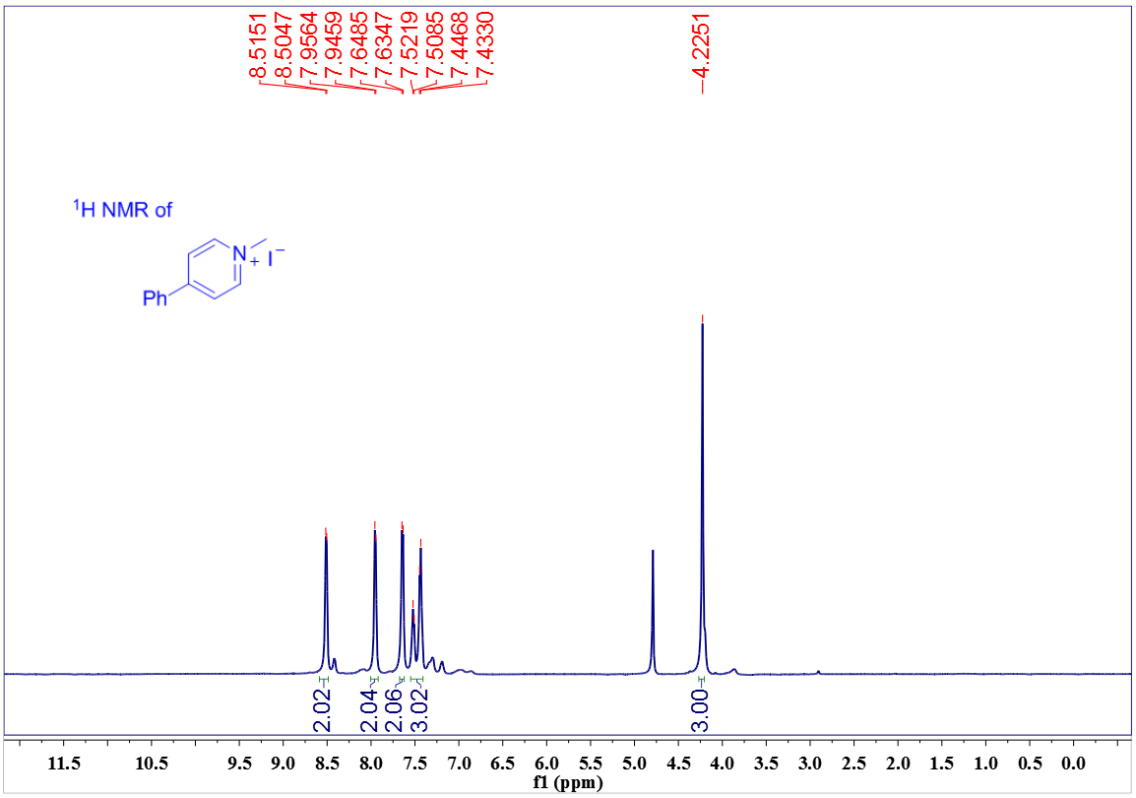

139.9715
123.7402
118.8385
13C NMR of
OH
Cl
OH
Cl
Cl
Cl
230
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

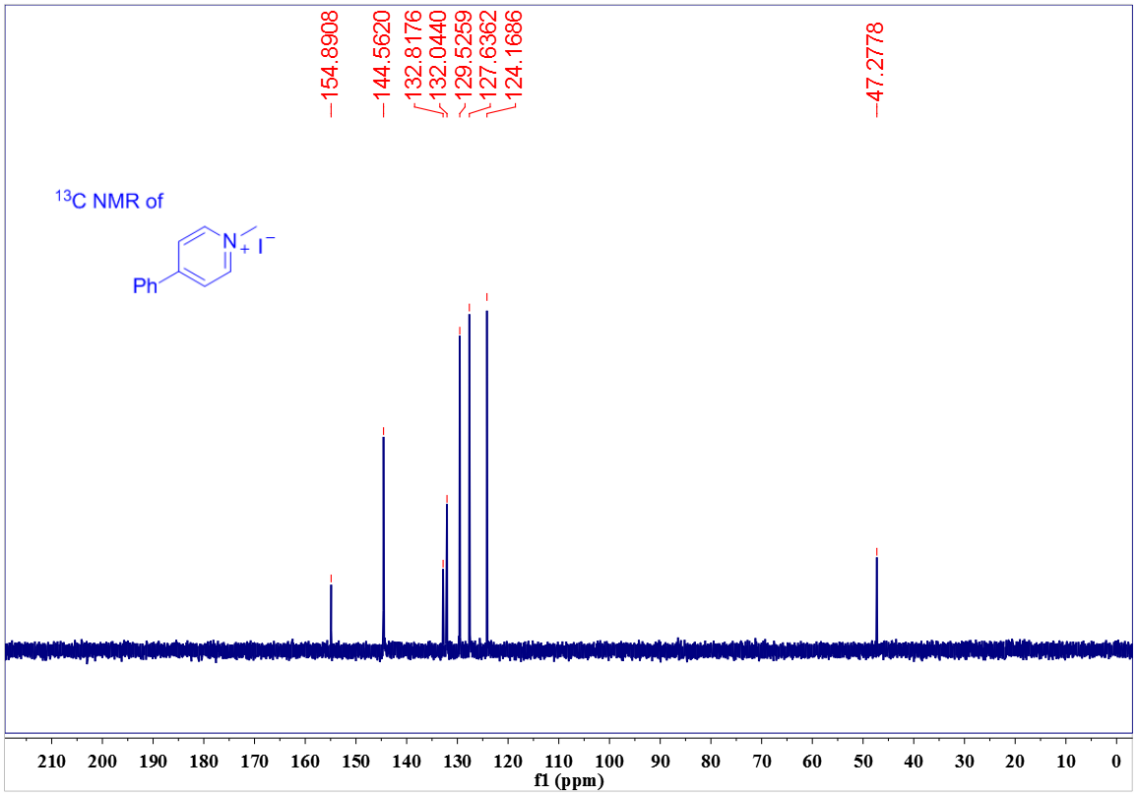
8a


6.9575
6.8100
1.4875
1.3214
^{1}H NMR of
OH
OH
tBu
tBu
1.02
1.00
9.09
9.00
f1 (ppm)

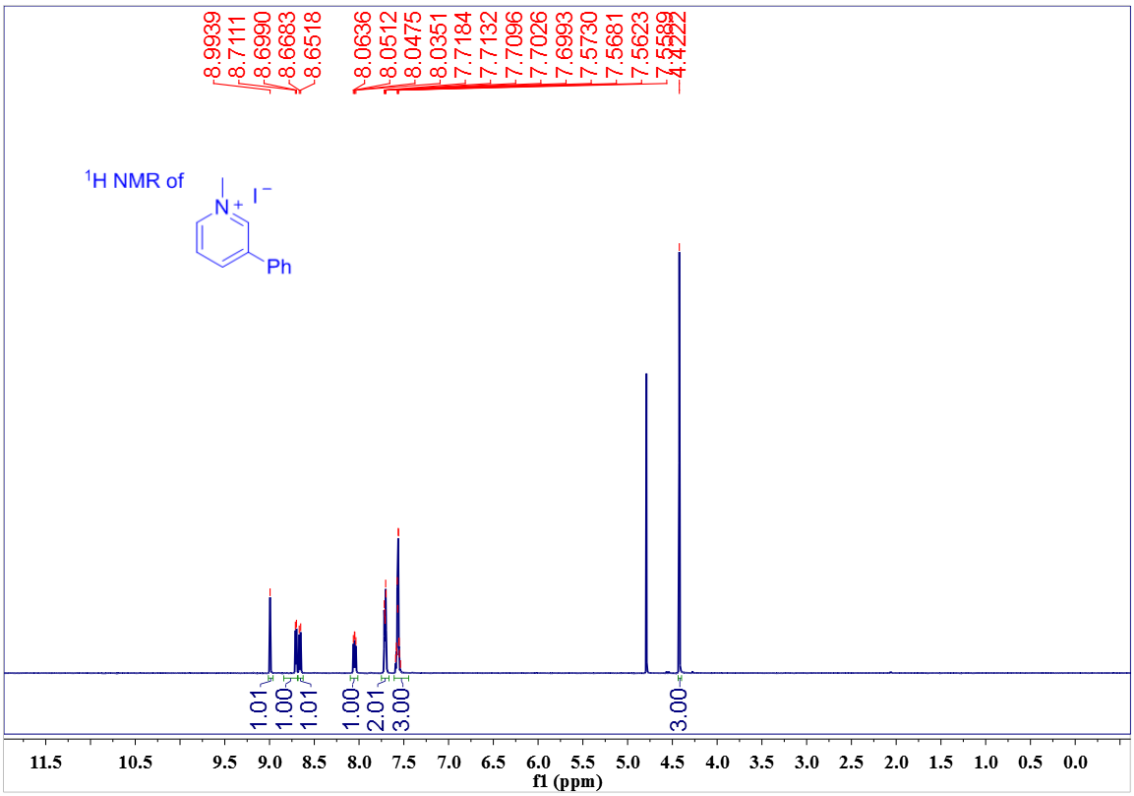

142.5516
142.2654
140.8764
135.8394
115.9339
110.6032
34.9060
34.3630
31.6199
29.7412
^{13}C NMR of
OH
OH
tBu
tBu
f1 (ppm)

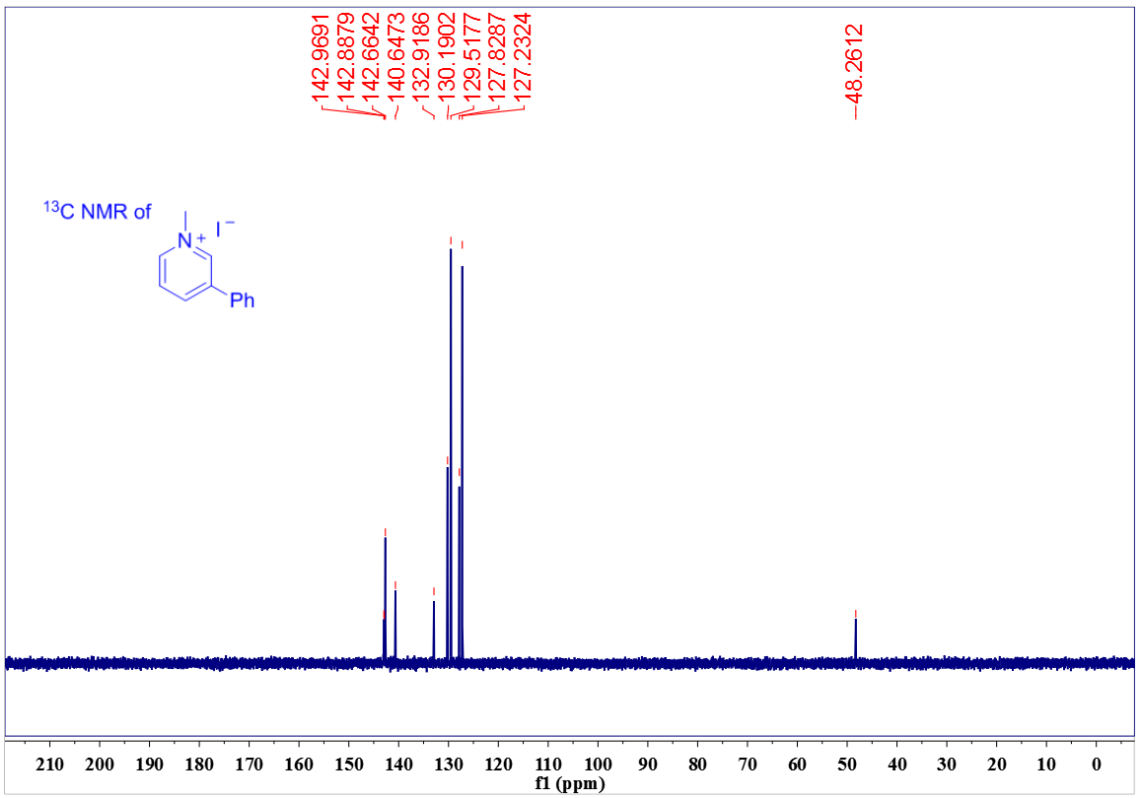
8b


8.5151
8.5047
7.9564
7.9459
7.6485
7.6347
7.5219
7.5085
7.4468
7.4330
4.2251
1H NMR of
Ph
2.02
2.04
2.06
3.02
3.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

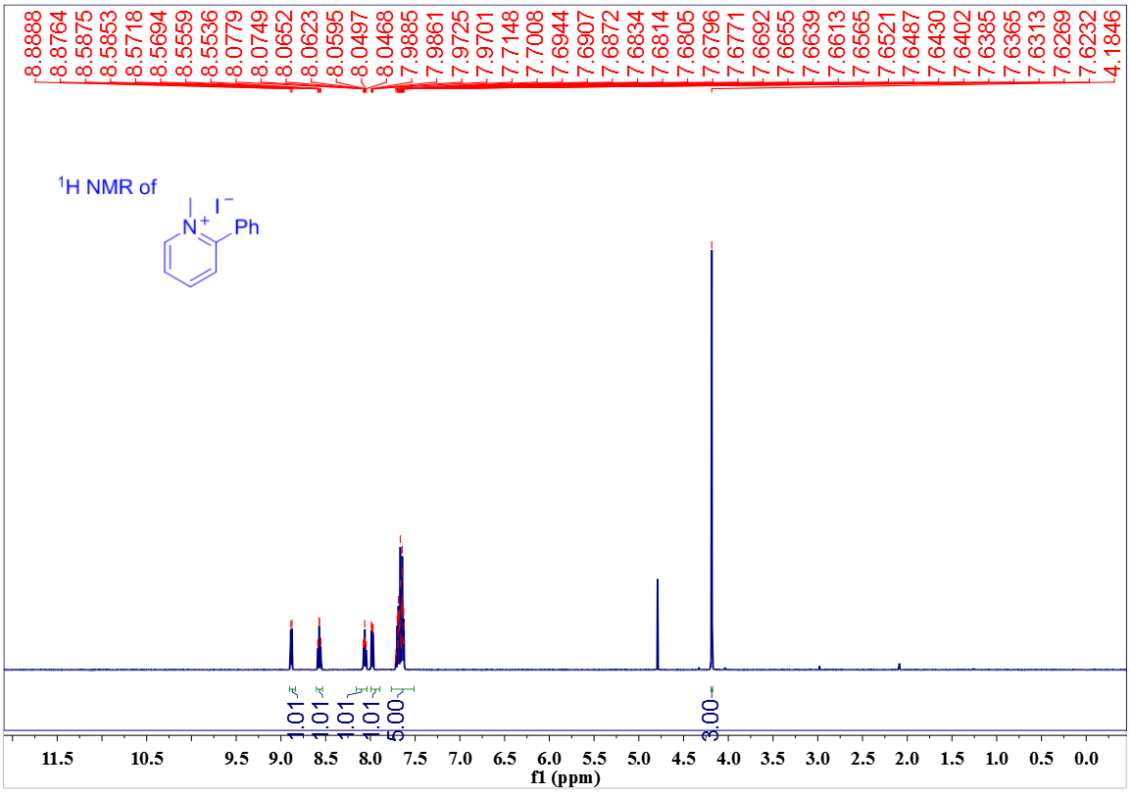

154.8908
144.5620
132.8176
132.0440
129.5259
127.6362
124.1686
47.2778
13C NMR of
Ph
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

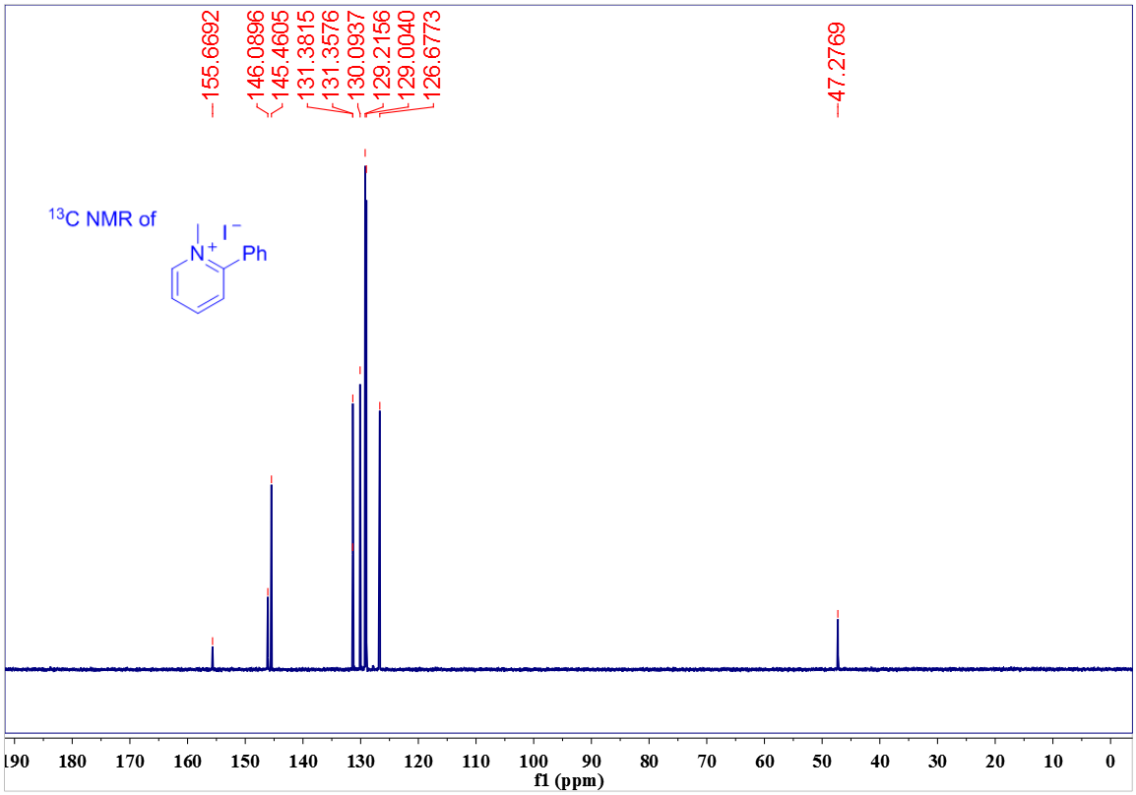
9a


8.9939
8.7111
8.6990
8.6683
8.6518
8.0636
8.0512
8.0475
8.0351
7.7184
7.7132
7.7096
7.7026
7.6993
7.5730
7.5681
7.5623
7.5589
4.4222
1H NMR of
N+
I−
Ph
1.01
1.00
1.01
1.00
2.01
3.00
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

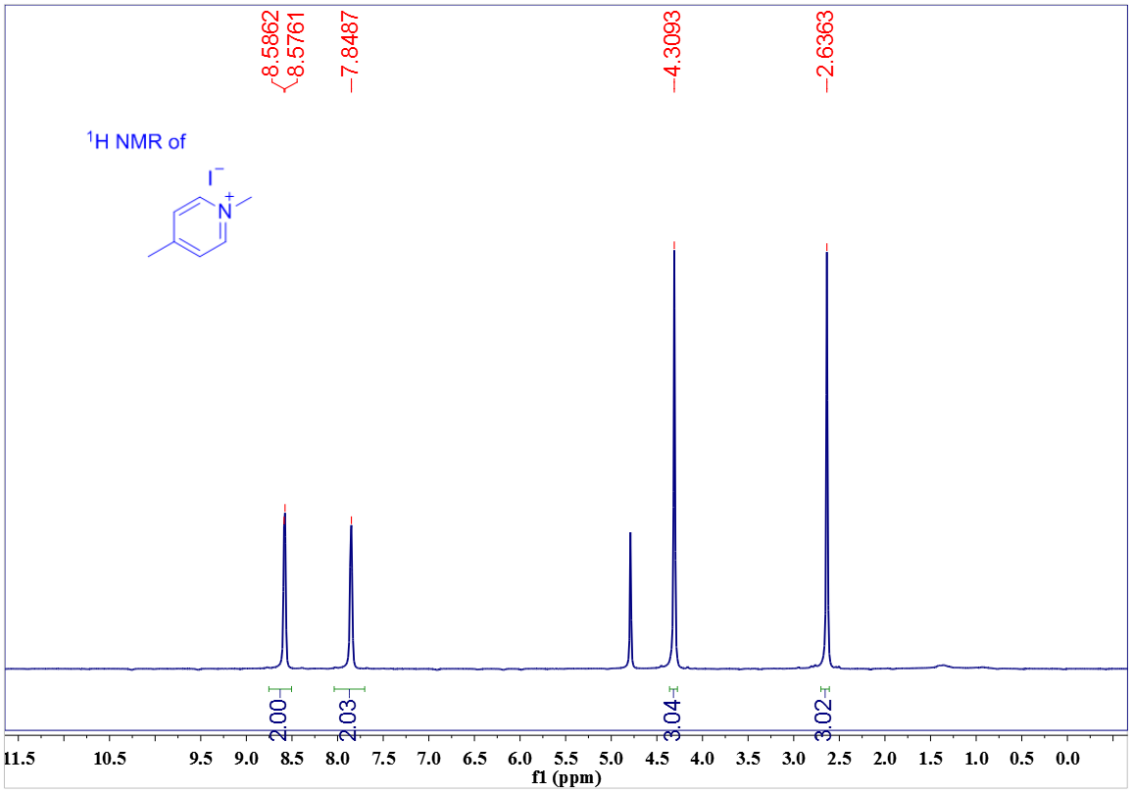

142.9691
142.8879
142.6642
140.6473
132.9186
130.1902
129.5177
127.8287
127.2324
48.2612
13C NMR of
N+
I−
Ph
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

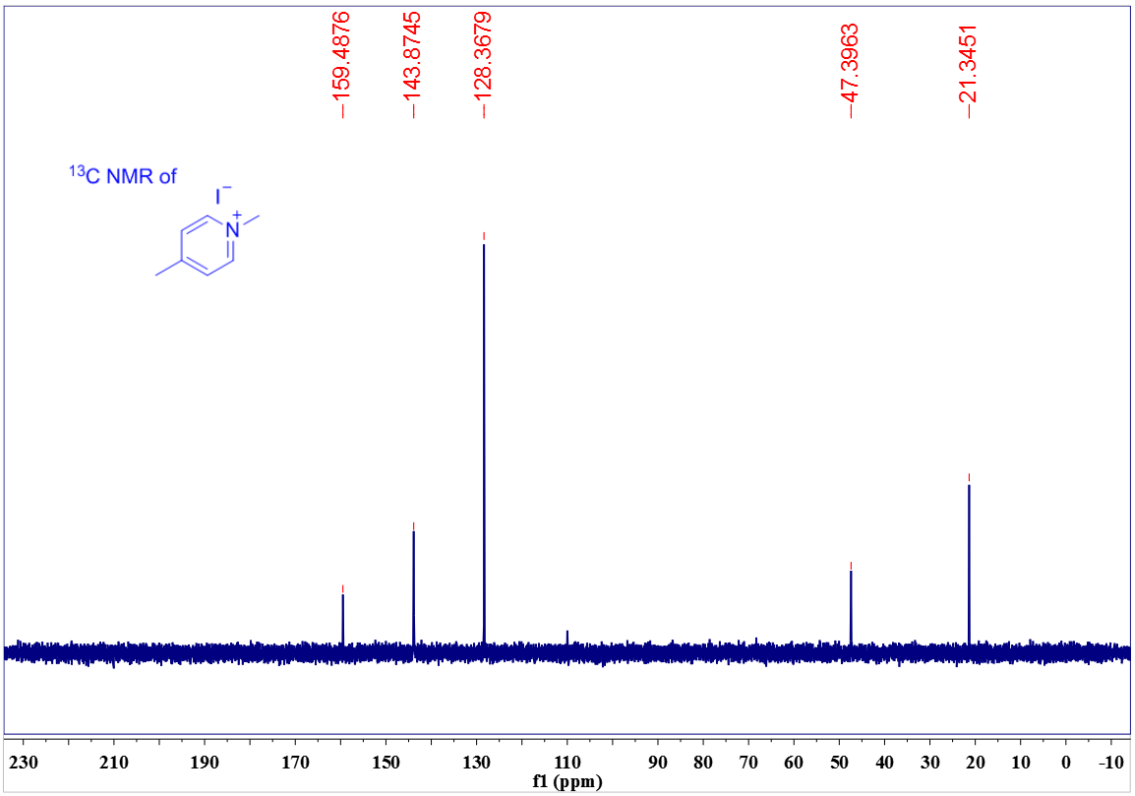
9b


8.8888
8.8764
8.5875
8.5853
8.5718
8.5694
8.5559
8.5536
8.0779
8.0749
8.0652
8.0623
8.0595
8.0497
8.0468
7.9885
7.9861
7.9725
7.9701
7.7148
7.7008
7.6944
7.6907
7.6872
7.6834
7.6814
7.6805
7.6796
7.6771
7.6692
7.6655
7.6639
7.6613
7.6565
7.6521
7.6487
7.6430
7.6402
7.6385
7.6365
7.6313
7.6269
7.6232
4.1846
1H NMR of
Ph
1.01
1.01
1.01
1.01
5.00
3.00
f1 (ppm)

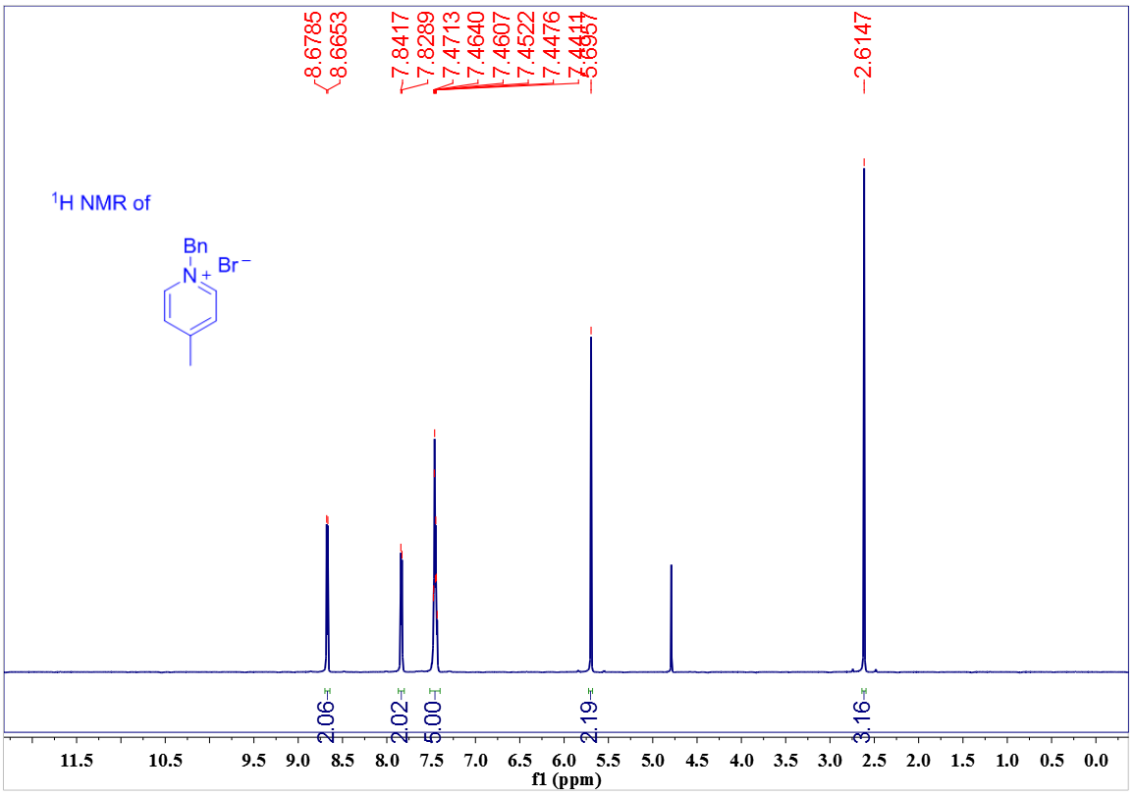

155.6692
146.0896
145.4605
131.3815
131.3576
130.0937
129.2156
129.0040
126.6773
47.2769
13C NMR of
Ph
f1 (ppm)

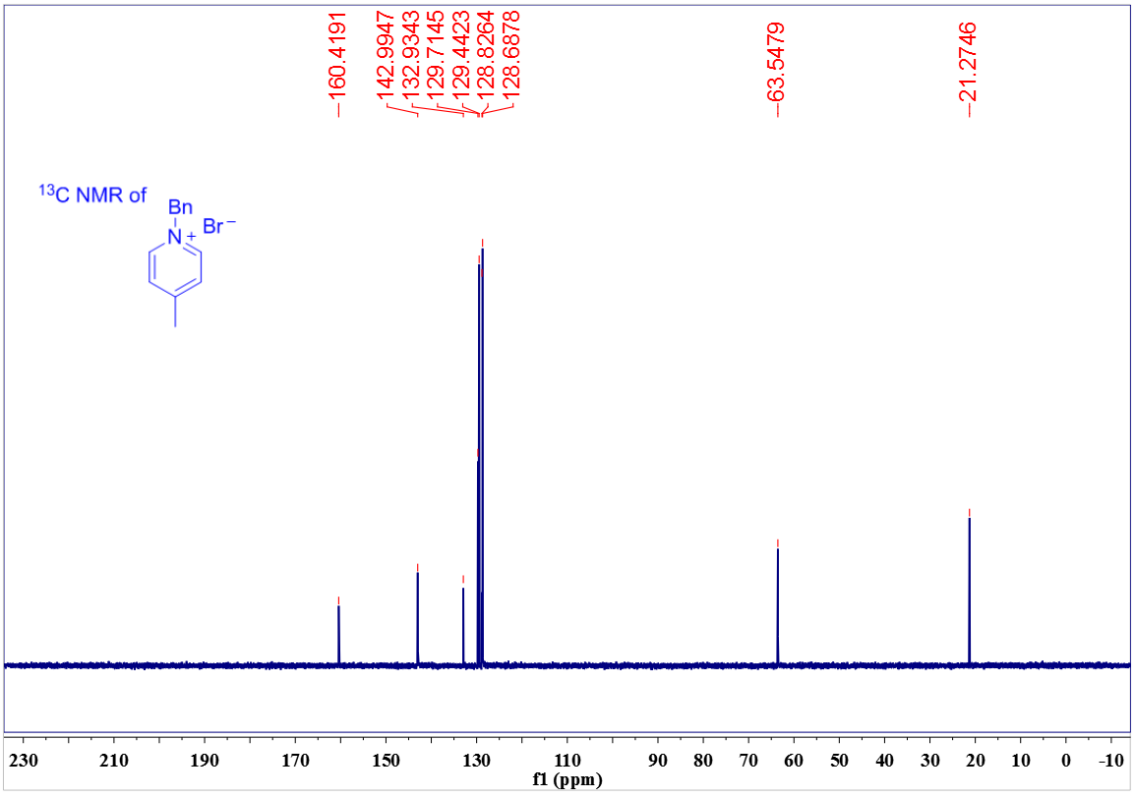
9c


8.5862
8.5761
7.8487
4.3093
2.6363
1H NMR of
2.00
2.03
3.04
3.02
f1 (ppm)

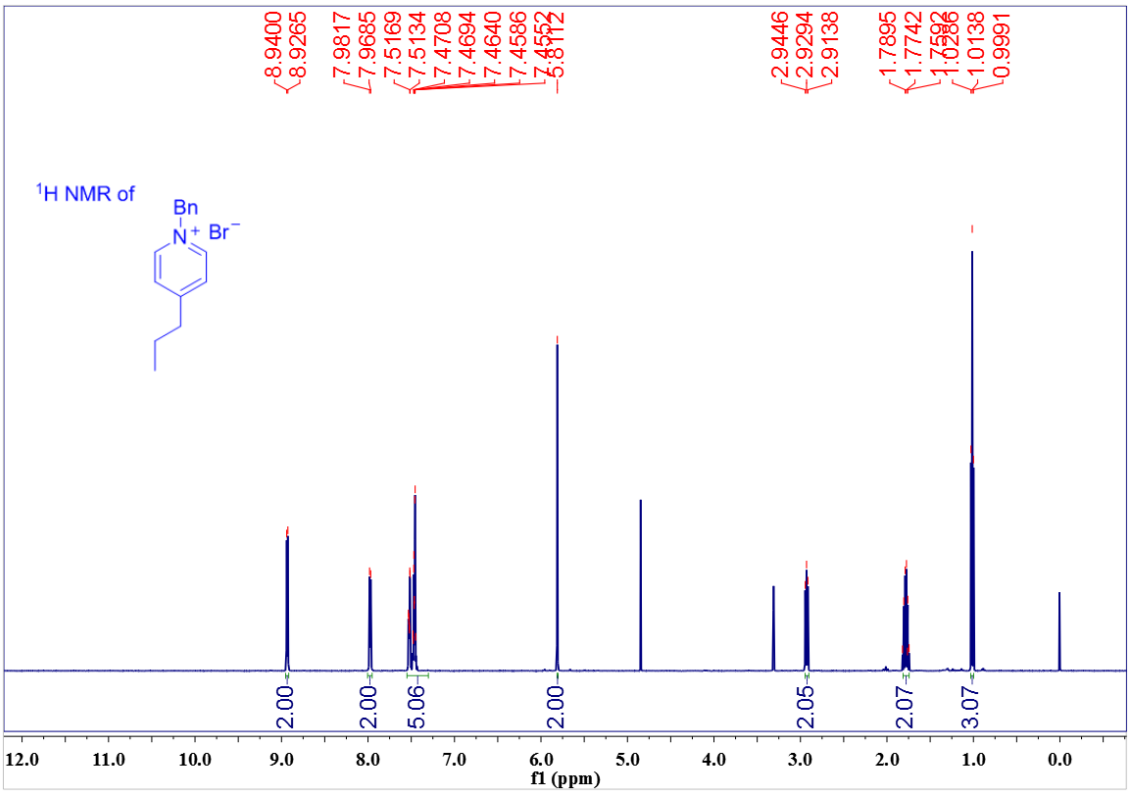

159.4876
143.8745
128.3679
47.3963
21.3451
13C NMR of
f1 (ppm)

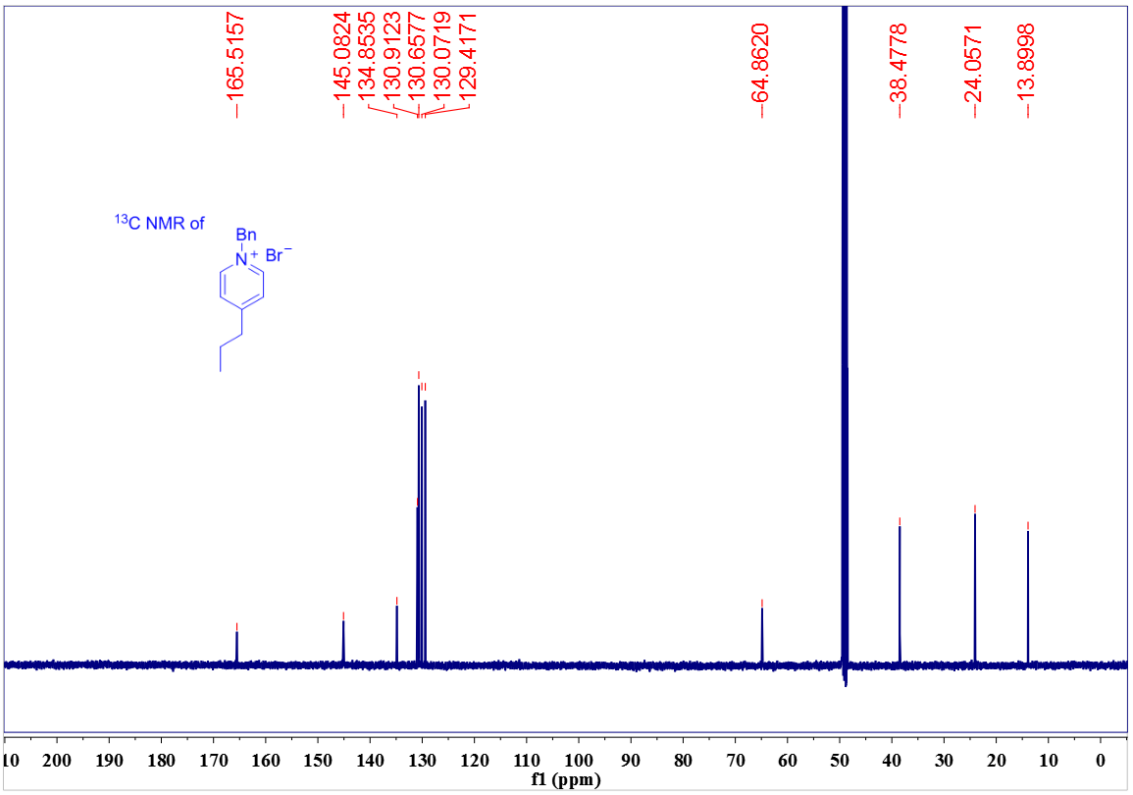
9d


8.6785
8.6653
7.8417
7.8289
7.4713
7.4640
7.4607
7.4522
7.4476
7.4441
7.4357
2.6147
1H NMR of
Bn
N+
Br−
2.06
2.02
5.00
2.19
3.16
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

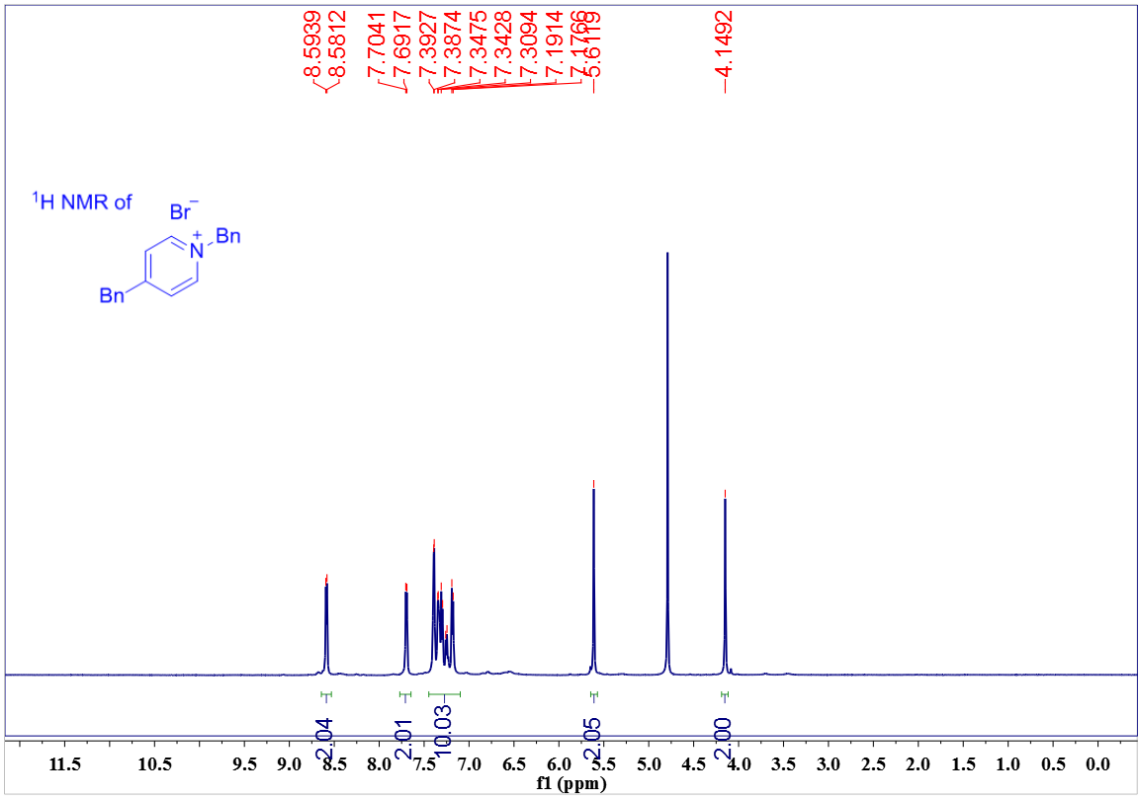

160.4191
142.9947
132.9343
129.7145
129.4423
128.8264
128.6878
63.5479
21.2746
13C NMR of
Bn
N+
Br−
230 210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

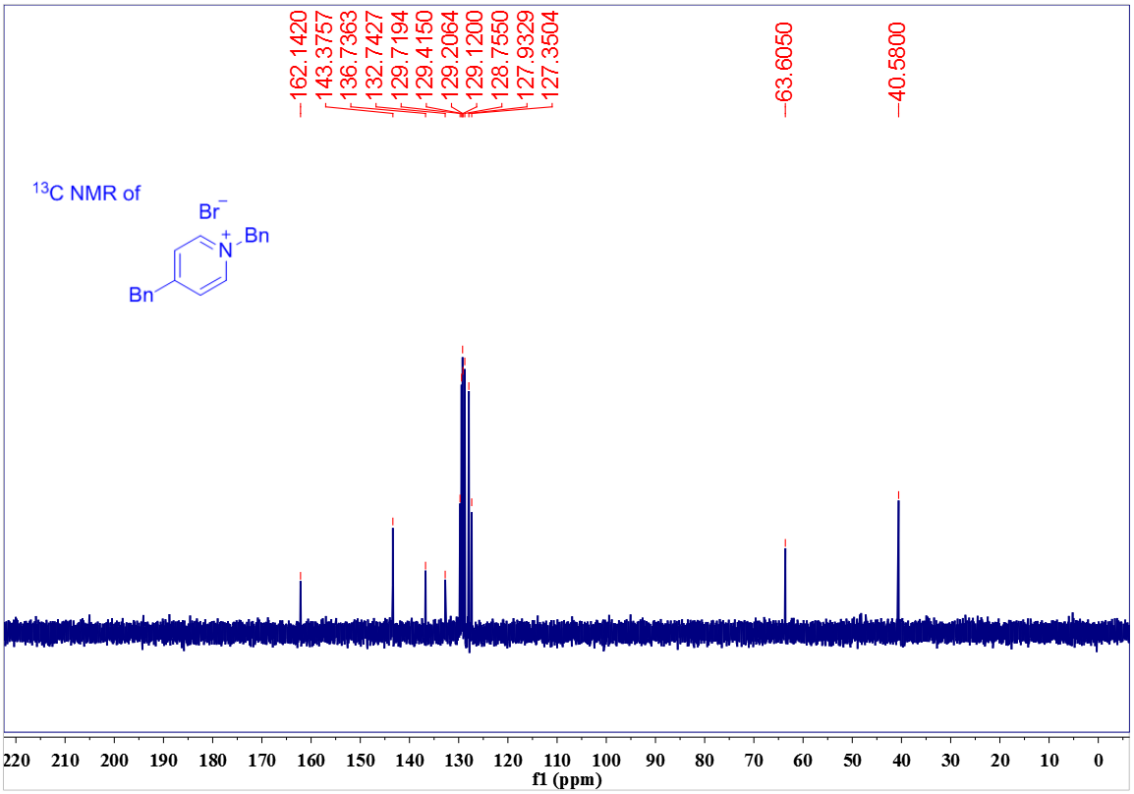
9f


8.9400
8.9265
7.9817
7.9685
7.5169
7.5134
7.4708
7.4694
7.4640
7.4586
2.9446
2.9294
2.9138
1.7895
1.7742
1.0138
0.9991
1H NMR of
Bn
N+ Br−
2.00
2.00
5.06
2.00
2.05
2.07
3.07
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

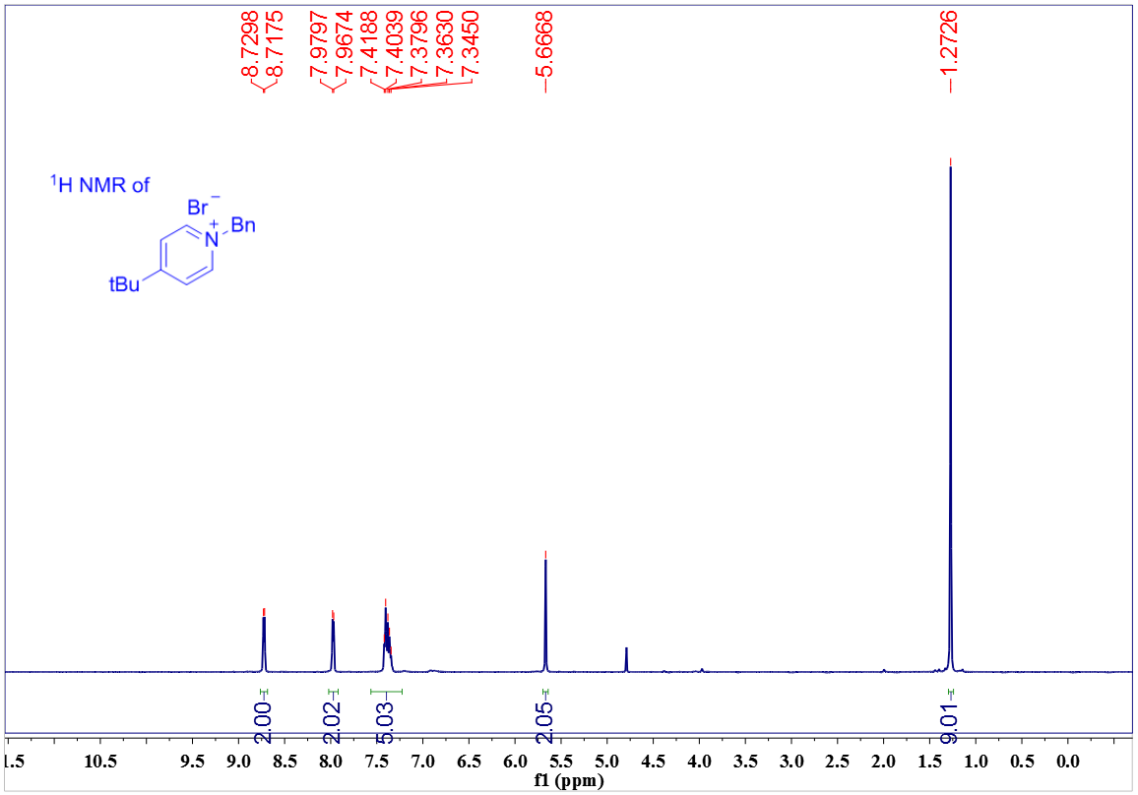

165.5157
145.0824
134.8535
130.9123
130.6577
130.0719
129.4171
64.8620
38.4778
24.0571
13.8998
13C NMR of
Bn
N+ Br−
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

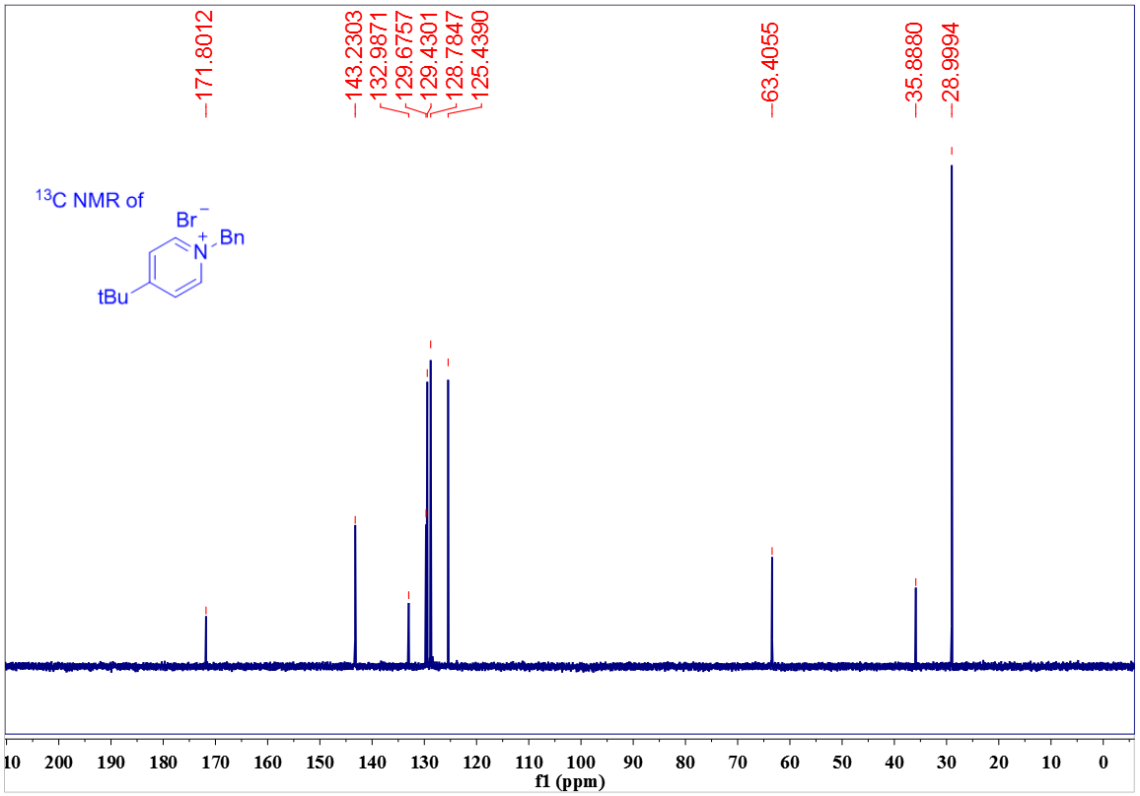
9h


8.5939
8.5812
7.7041
7.6917
7.3927
7.3874
7.3475
7.3428
7.3094
7.1914
7.1766
5.6119
4.1492
1H NMR of
Br−
N+
Bn
Bn
2.04
2.01
10.03
2.05
2.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

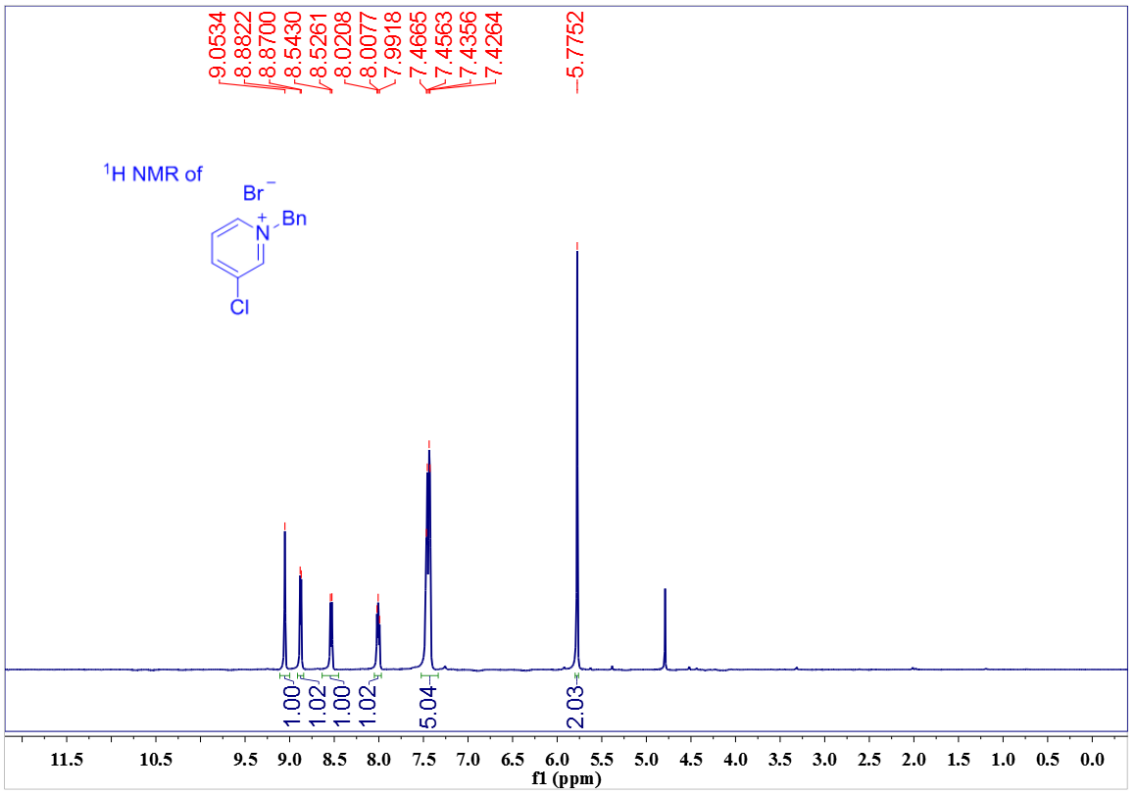

162.1420
143.3757
136.7363
132.7427
129.7194
129.4150
129.2064
129.1200
128.7550
127.9329
127.3504
63.6050
40.5800
13C NMR of
Br−
N+
Bn
Bn
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

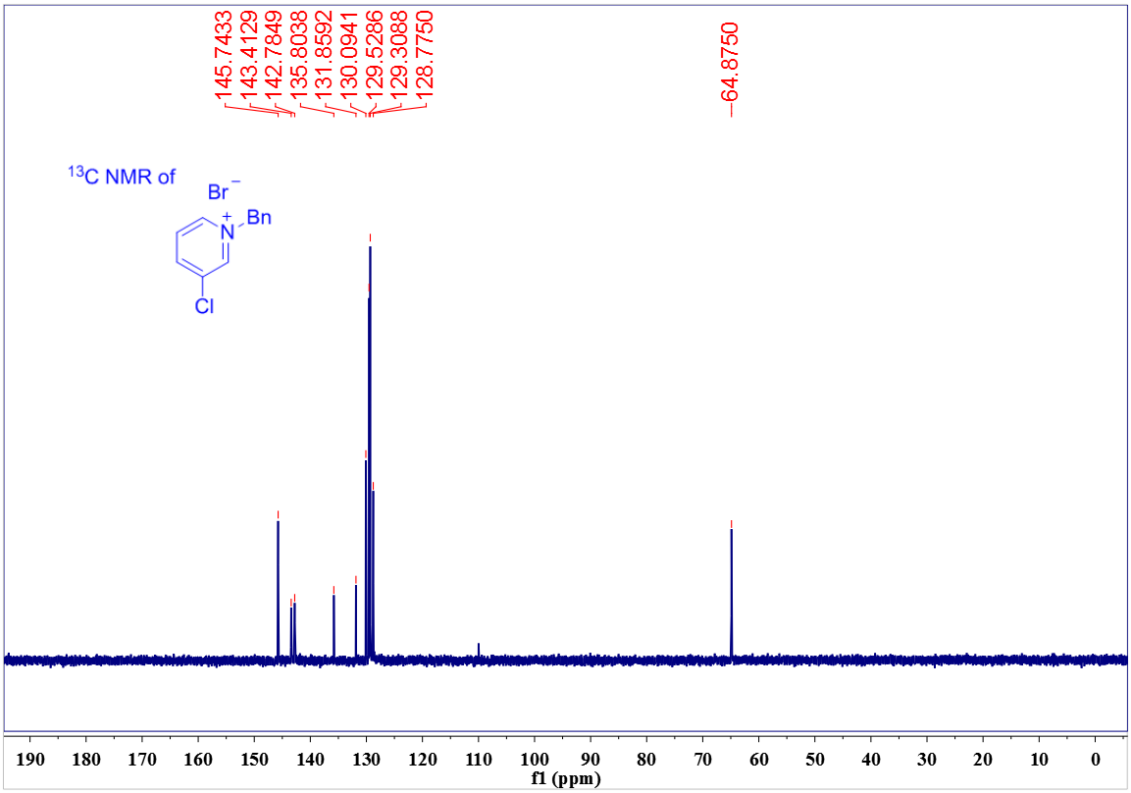
9i


8.7298
8.7175
7.9797
7.9674
7.4188
7.4039
7.3796
7.3630
7.3450
5.6668
1.2726
1H NMR of
Br
N
Bn
tBu
2.00
2.02
5.03
2.05
9.01
f1 (ppm)

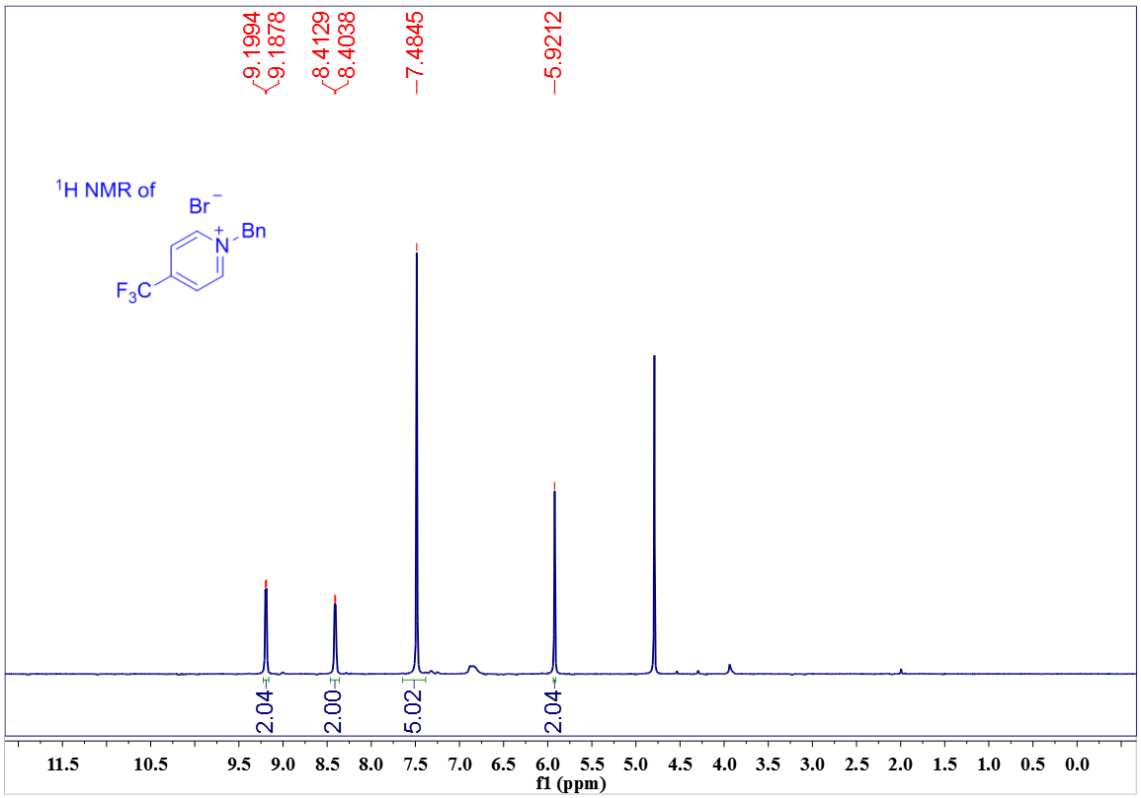

171.8012
143.2303
132.9871
129.6757
129.4301
128.7847
125.4390
63.4055
35.8880
28.9994
13C NMR of
Br
N
Bn
tBu
f1 (ppm)

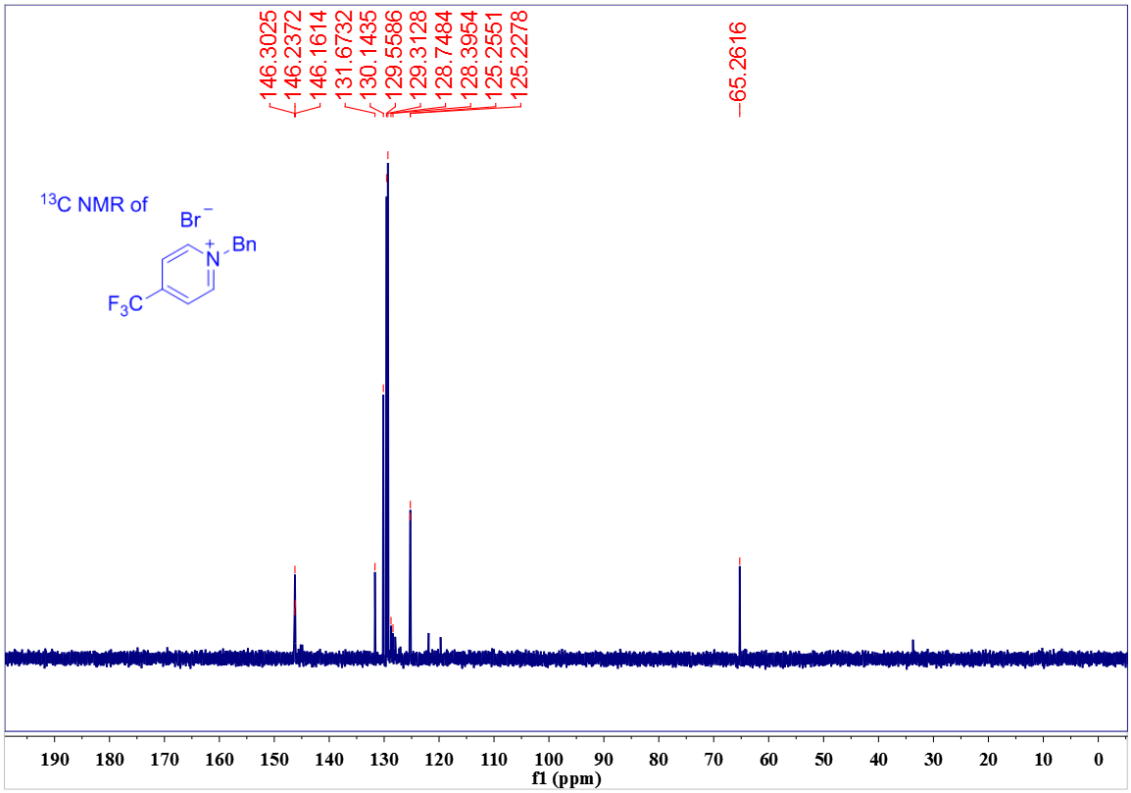
9j


9.0534
8.8822
8.8700
8.5430
8.5261
8.0208
8.0077
7.9918
7.4665
7.4563
7.4356
7.4264
5.7752
1H NMR of
Br
Bn
Cl
1.00
1.02
1.00
1.02
5.04
2.03
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

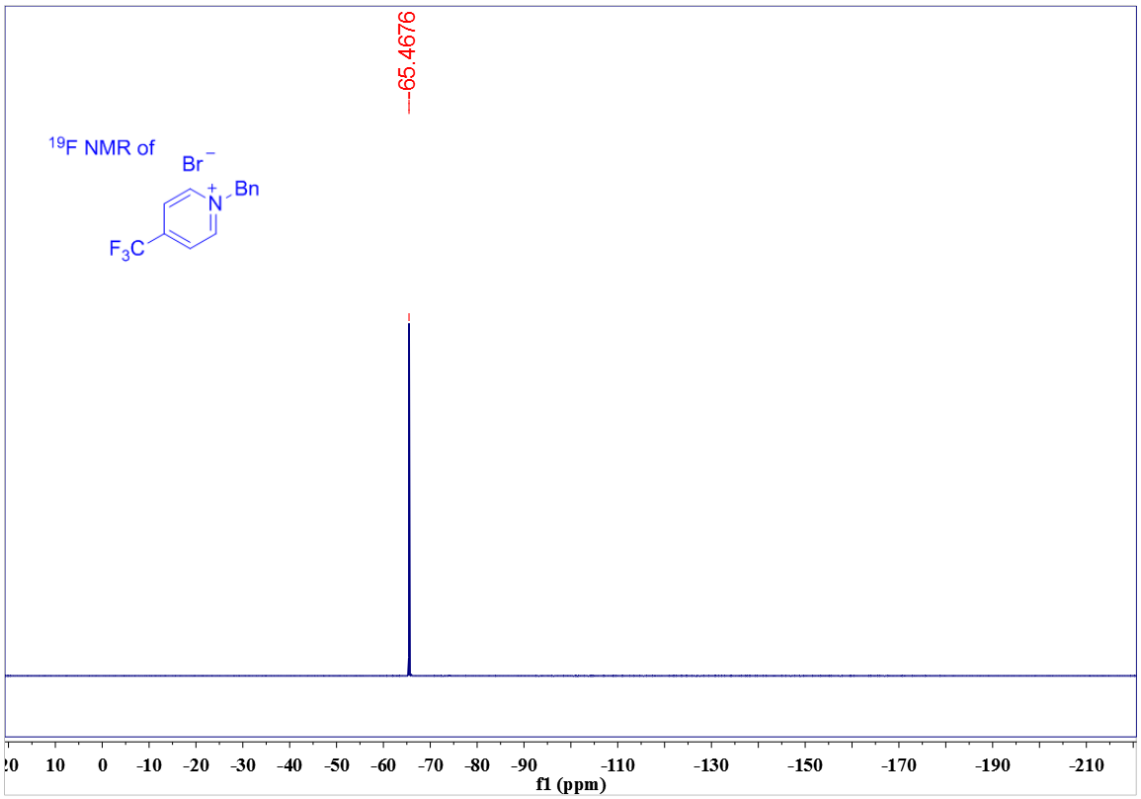

145.7433
143.4129
142.7849
135.8038
131.8592
130.0941
129.5286
129.3088
128.7750
64.8750
13C NMR of
Br
Bn
Cl
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

9l

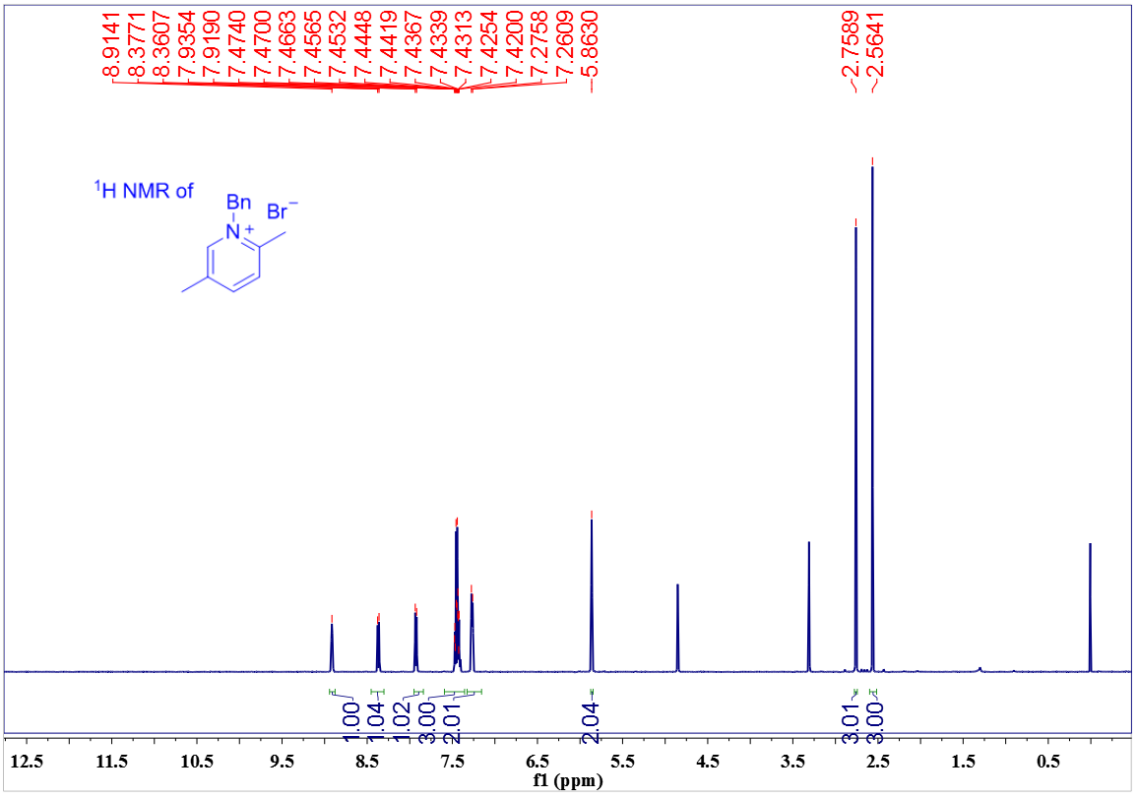

9.1994
9.1878
8.4129
8.4038
7.4845
5.9212
1H NMR of
Br−
N+
Bn
F3C
2.04
2.00
5.02
2.04
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

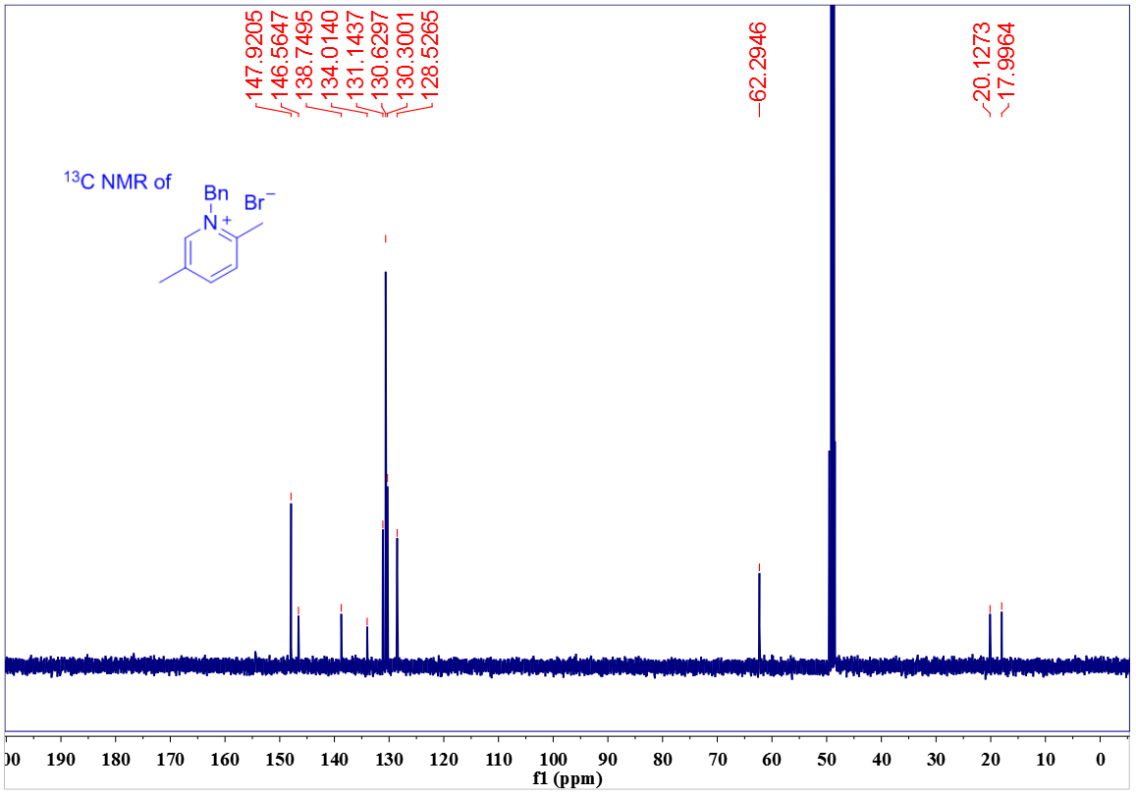

146.3025
146.2372
146.1614
131.6732
130.1435
129.5586
129.3128
128.7484
128.3954
125.2551
125.2278
65.2616
13C NMR of
Br−
N+
Bn
F3C
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

9m

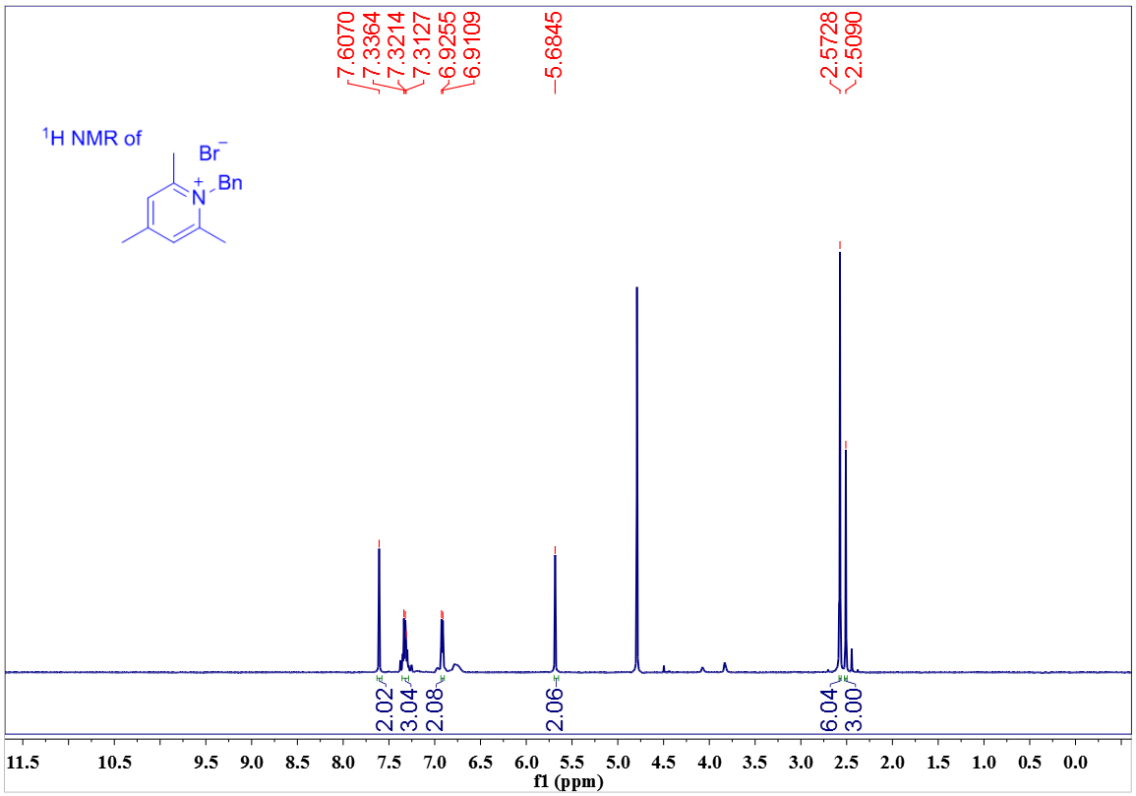

-65.4676
19F NMR of
Br−
Bn
N+
F3C
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -110 -130 -150 -170 -190 -210
f1 (ppm)

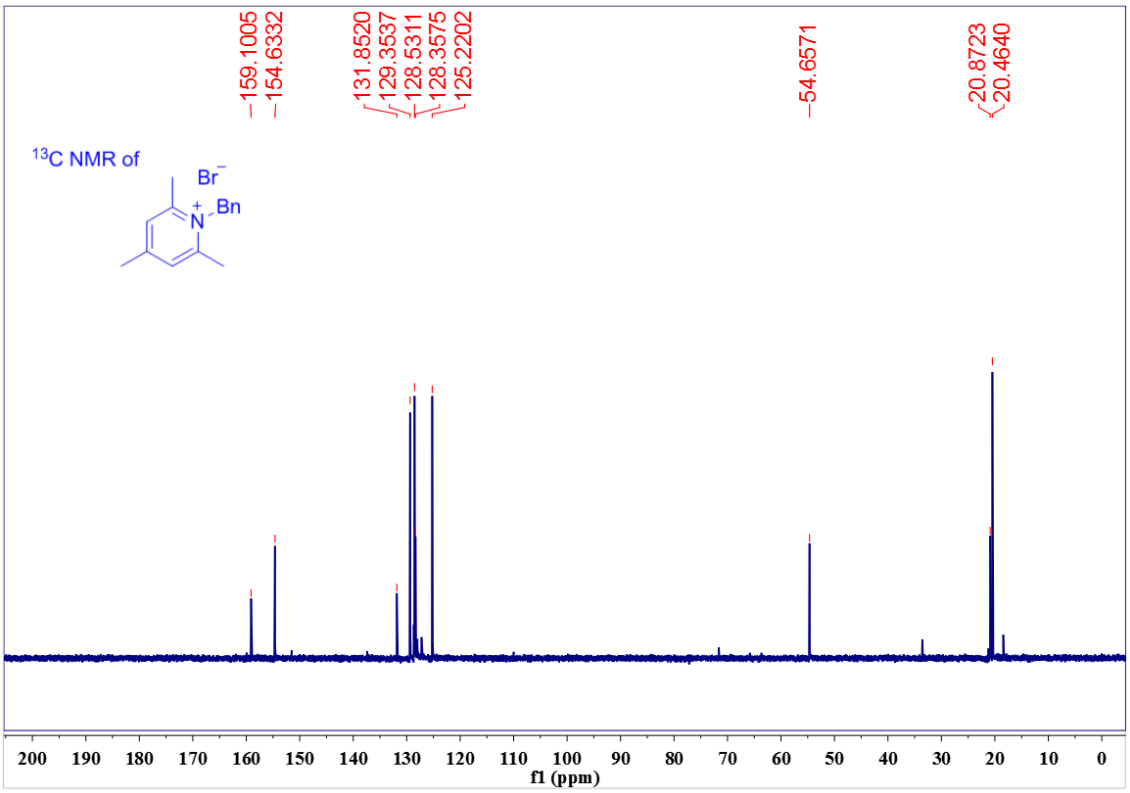
9m


8.9141
8.3771
8.3607
7.9354
7.9190
7.4740
7.4700
7.4663
7.4565
7.4532
7.4448
7.4419
7.4367
7.4339
7.4313
7.4254
7.4200
7.2758
7.2609
5.8630
2.7589
2.5641
1H NMR of
Bn
Br−
N+
1.00
1.04
1.02
3.00
2.01
2.04
3.01
3.00
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
f1 (ppm)

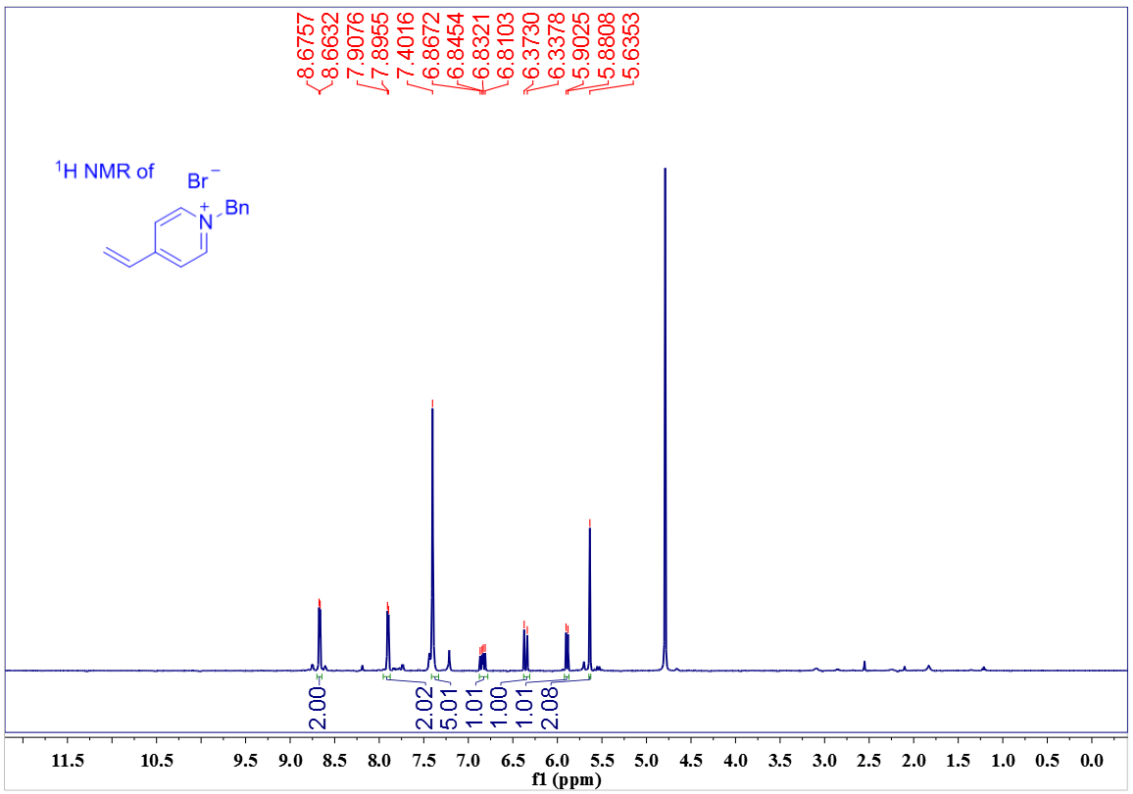

147.9205
146.5647
138.7495
134.0140
131.1437
130.6297
130.3001
128.5265
62.2946
20.1273
17.9964
13C NMR of
Bn
Br−
N+
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

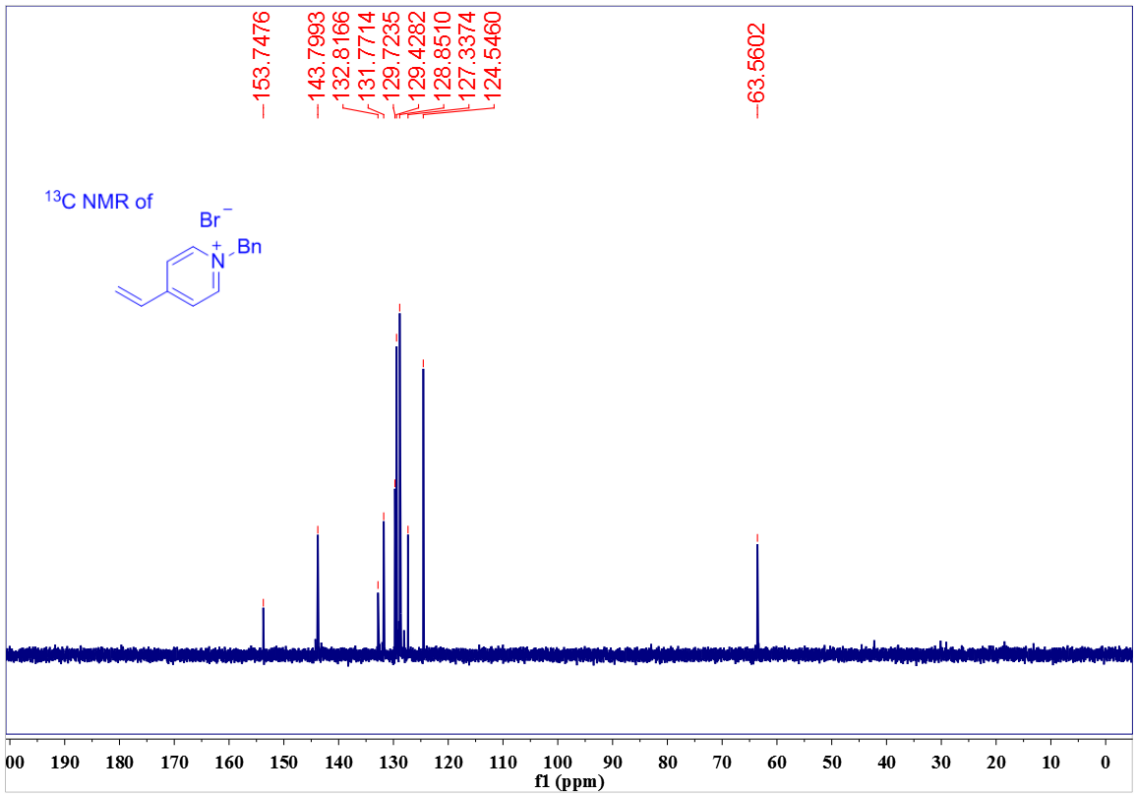
9n


7.6070
7.3364
7.3214
7.3127
6.9255
6.9109
5.6845
2.5728
2.5090
1H NMR of
Br−
N+
Bn
2.02
3.04
2.08
2.06
6.04
3.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

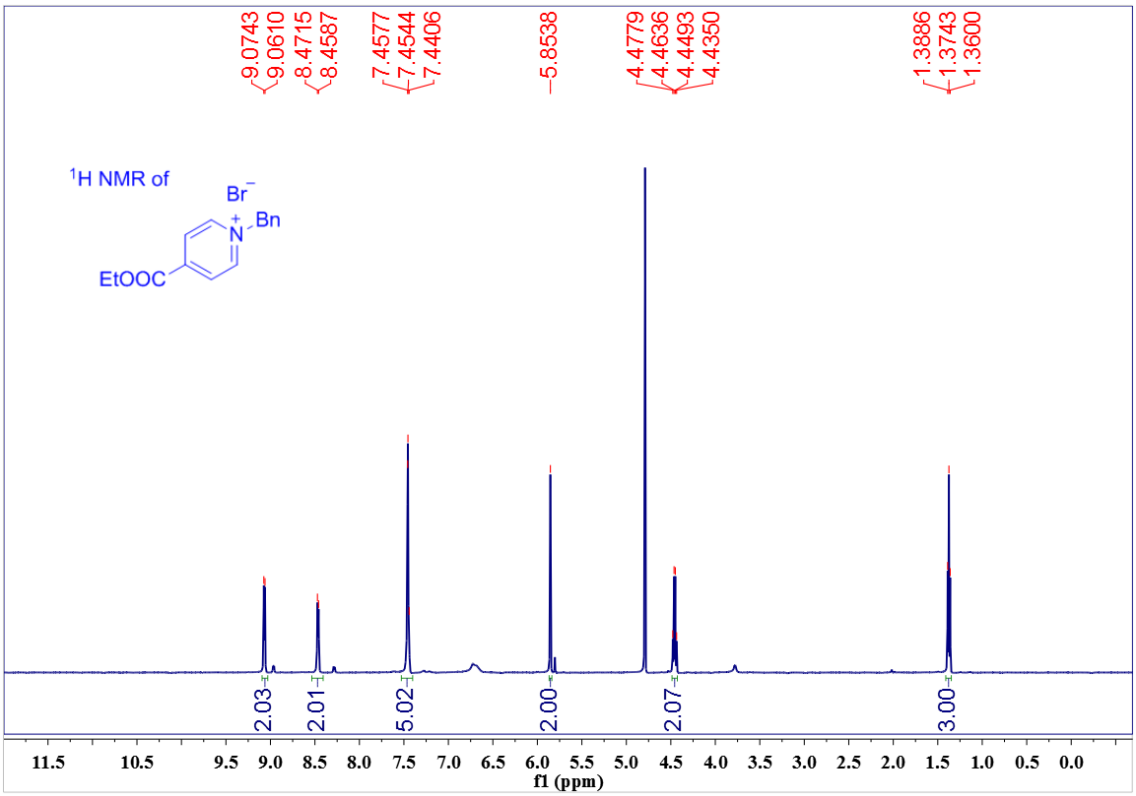

159.1005
154.6332
131.8520
129.3537
128.5311
128.3575
125.2202
54.6571
20.8723
20.4640
13C NMR of
Br−
N+
Bn
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

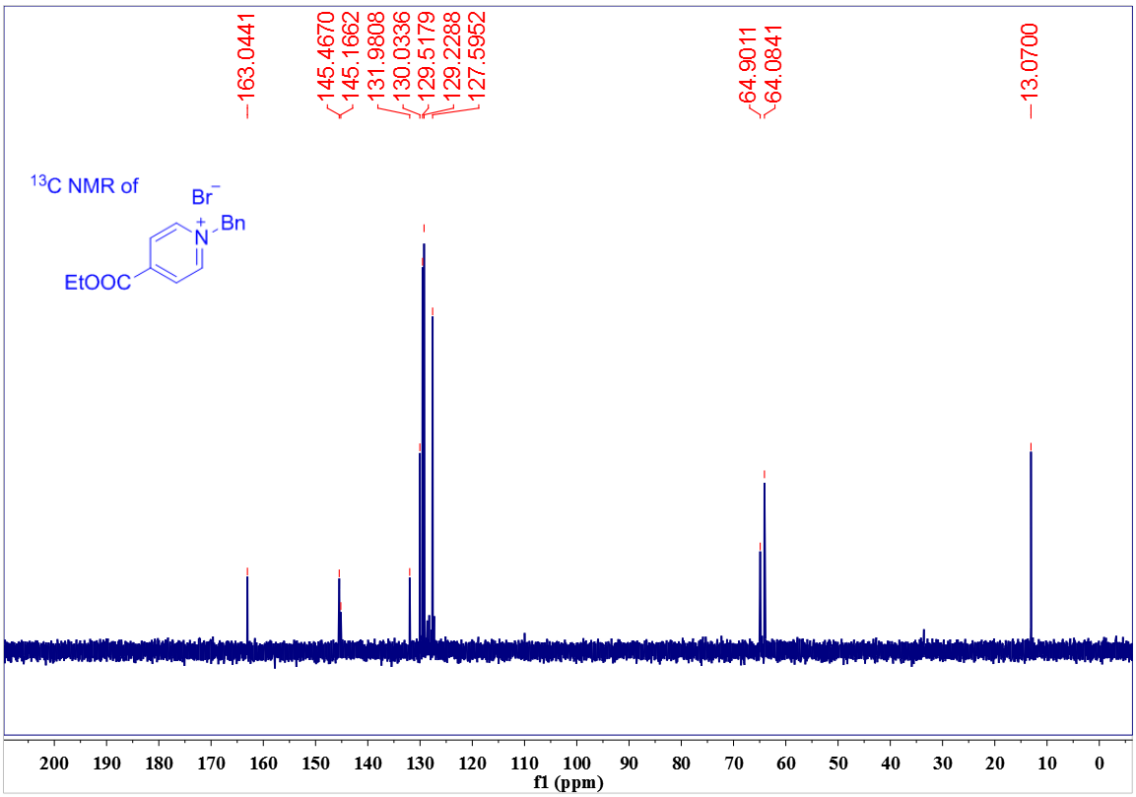
9o


8.6757
8.6632
7.9076
7.8955
7.4016
6.8672
6.8454
6.8321
6.8103
6.3730
6.3378
5.9025
5.8808
5.6353
1H NMR of
Br−
N+
Bn
2.00
2.02
5.01
1.01
1.00
1.01
2.08
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

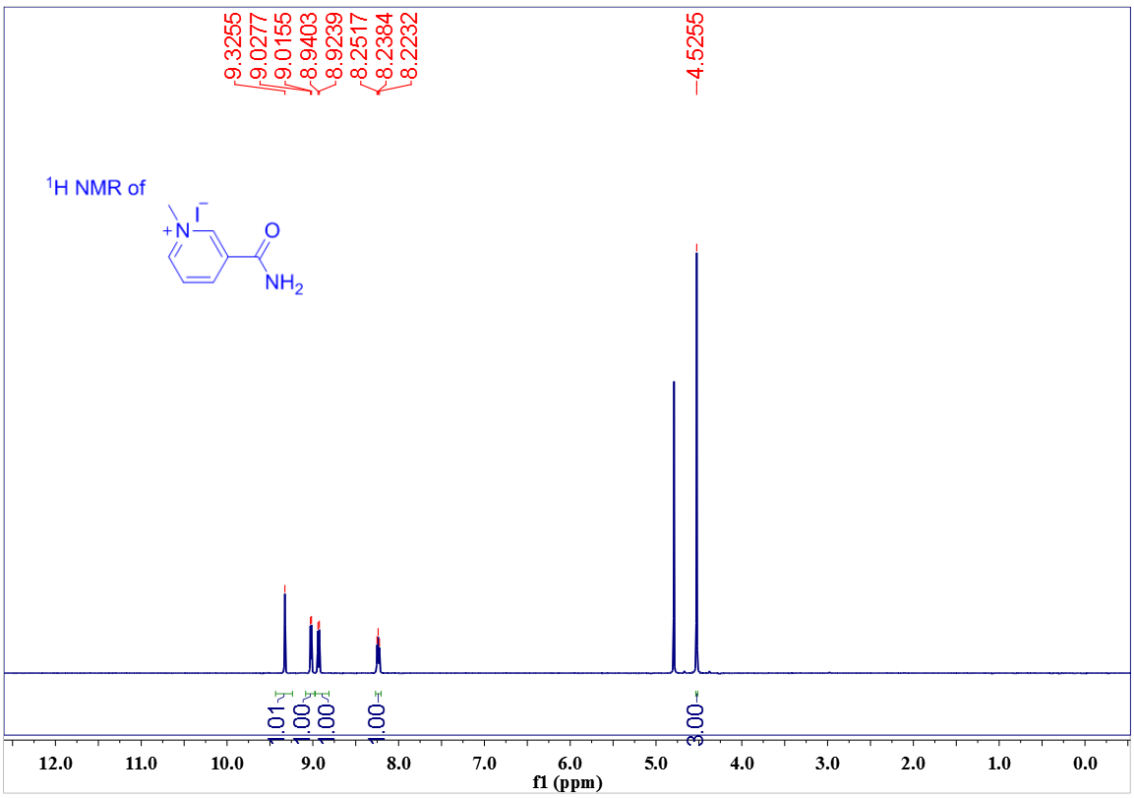

153.7476
143.7993
132.8166
131.7714
129.7235
129.4282
128.8510
127.3374
124.5460
63.5602
13C NMR of
Br−
N+
Bn
00
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

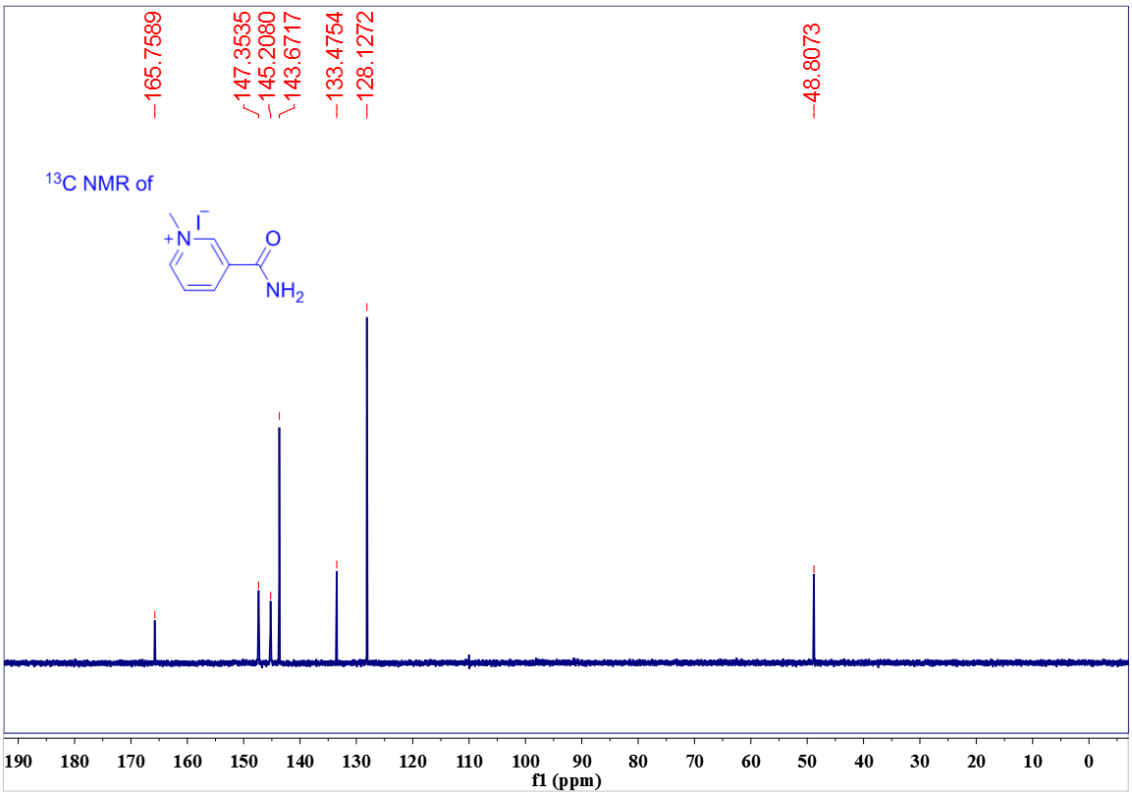
9p


9.0743
9.0610
8.4715
8.4587
7.4577
7.4544
7.4406
5.8538
4.4779
4.4636
4.4493
4.4350
1.3886
1.3743
1.3600
1H NMR of
Br−
N+
Bn
EtOOC
2.03
2.01
5.02
2.00
2.07
3.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

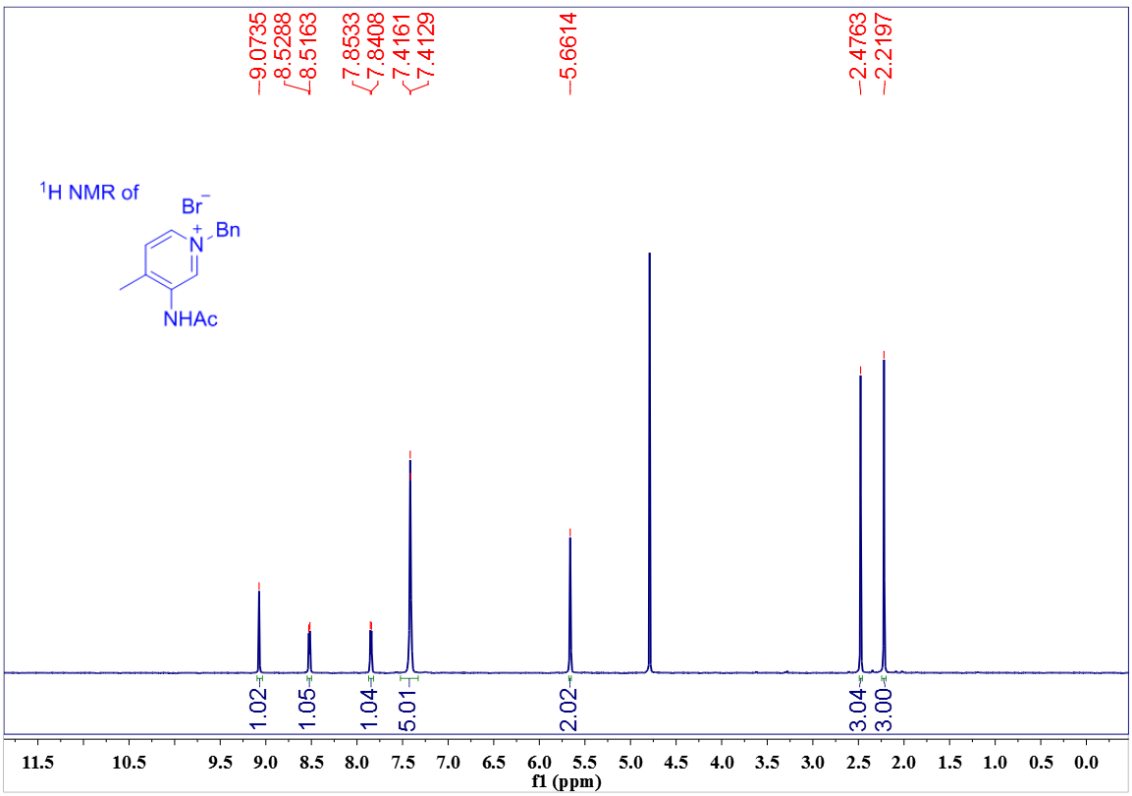

163.0441
145.4670
145.1662
131.9808
130.0336
129.5179
129.2288
127.5952
64.9011
64.0841
13.0700
13C NMR of
Br−
N+
Bn
EtOOC
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

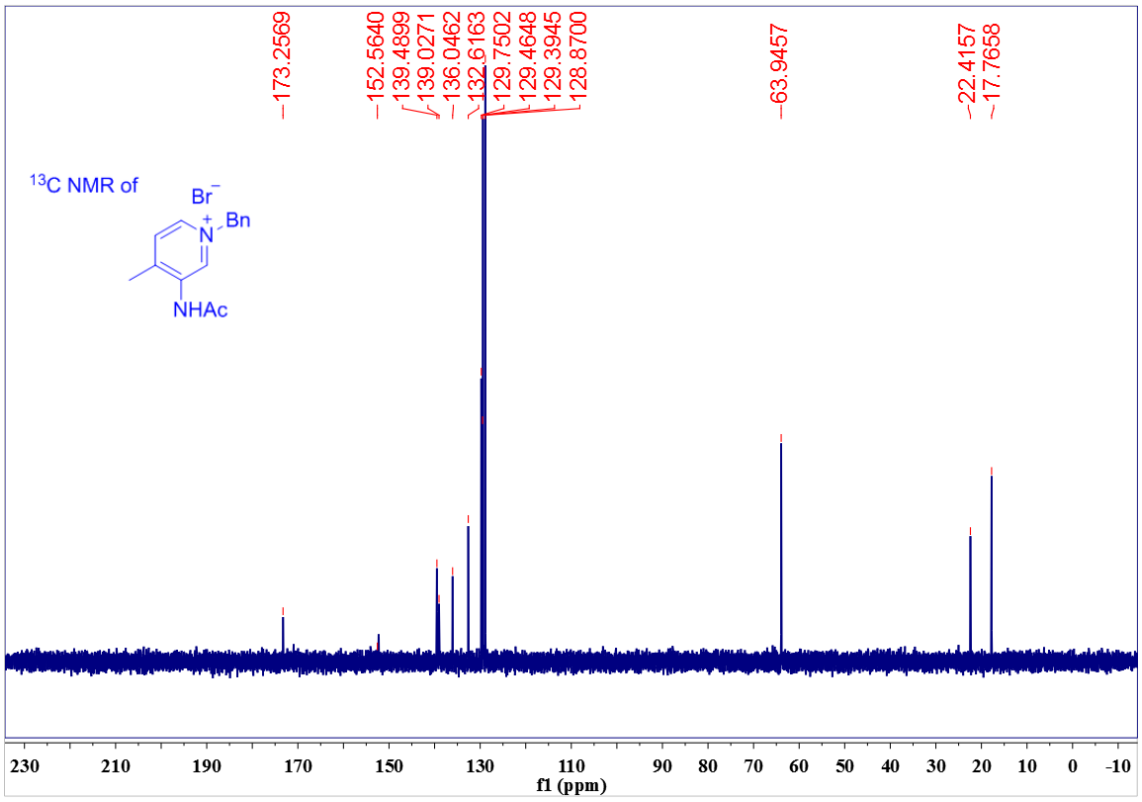
9q


9.3255
9.0277
9.0155
8.9403
8.9239
8.2517
8.2384
8.2232
4.5255
1H NMR of
1.01
1.00
1.00
1.00
3.00
12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
f1 (ppm)


165.7589
147.3535
145.2080
143.6717
133.4754
128.1272
48.8073
13C NMR of
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

9r


9.0735
8.5288
8.5163
7.8533
7.8408
7.4161
7.4129
5.6614
2.4763
2.2197
1H NMR of
Br⁻
N
Bn
NHAc
1.02
1.05
1.04
5.01
2.02
3.04
3.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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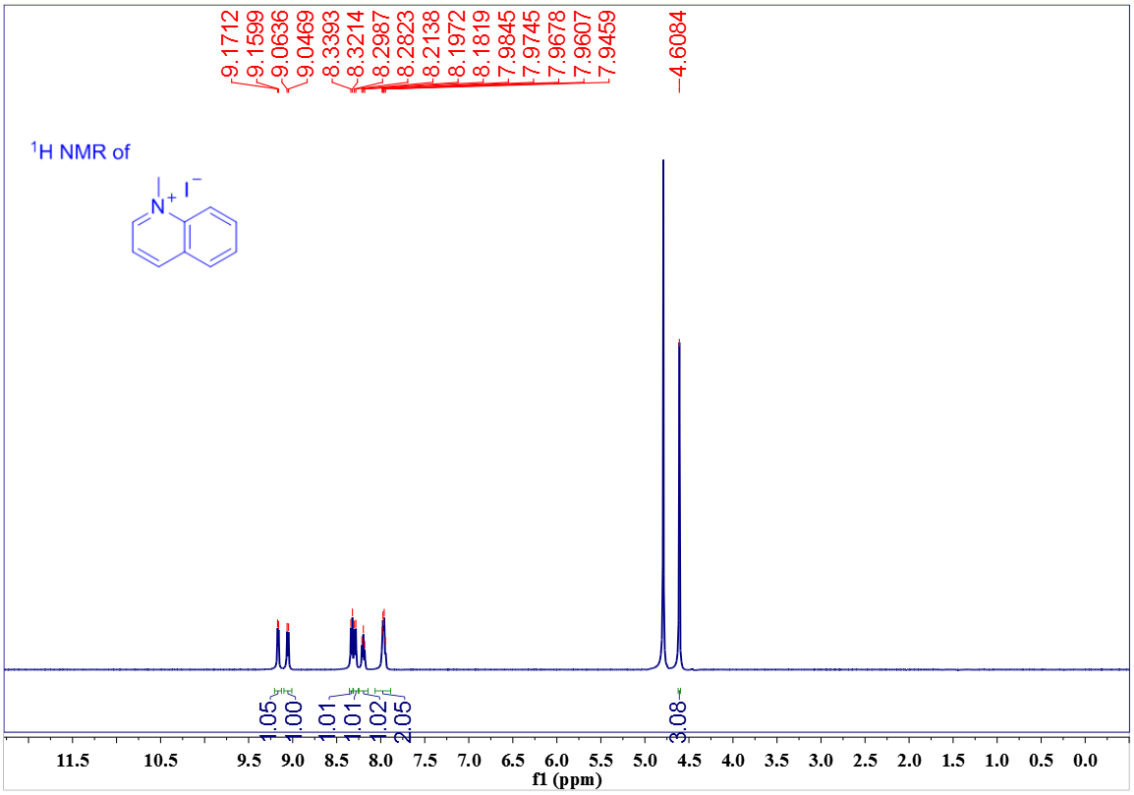
139.4899
139.0271
136.0462
132.6163
129.7502
129.4648
129.3945
128.8700
63.9457
22.4157
17.7658
13C NMR of
Br⁻
N
Bn
NHAc
230 210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

9s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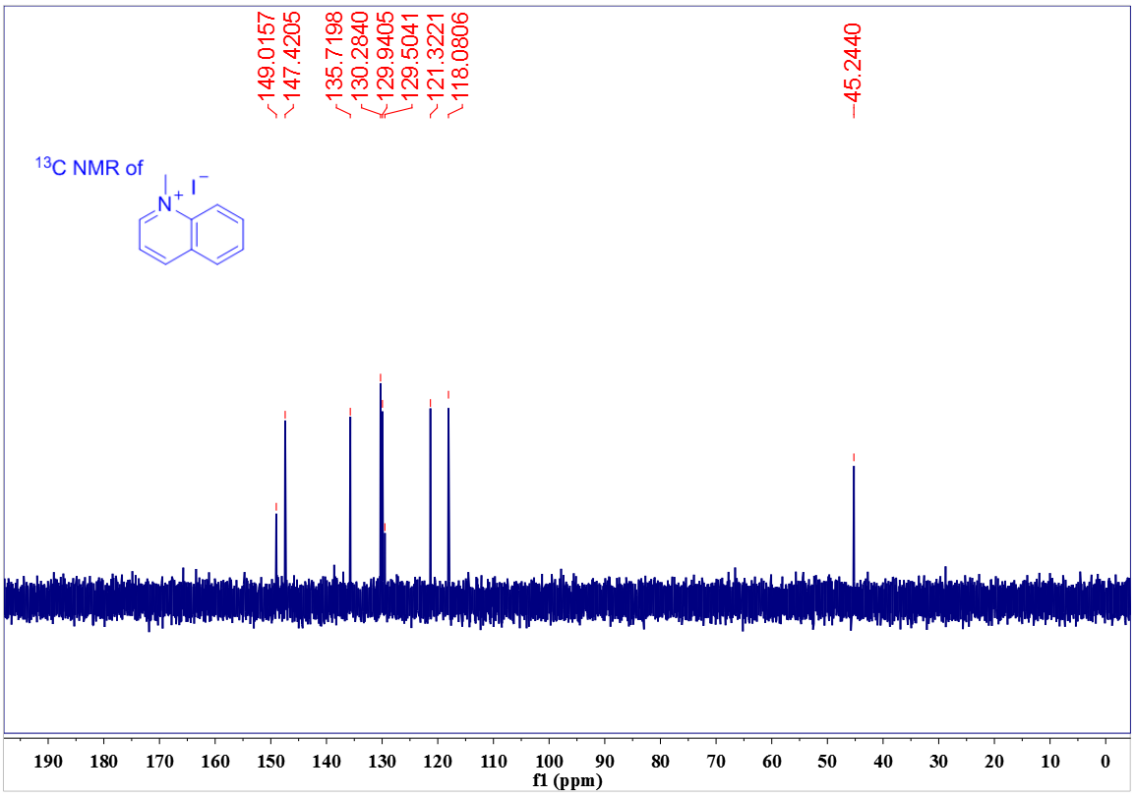
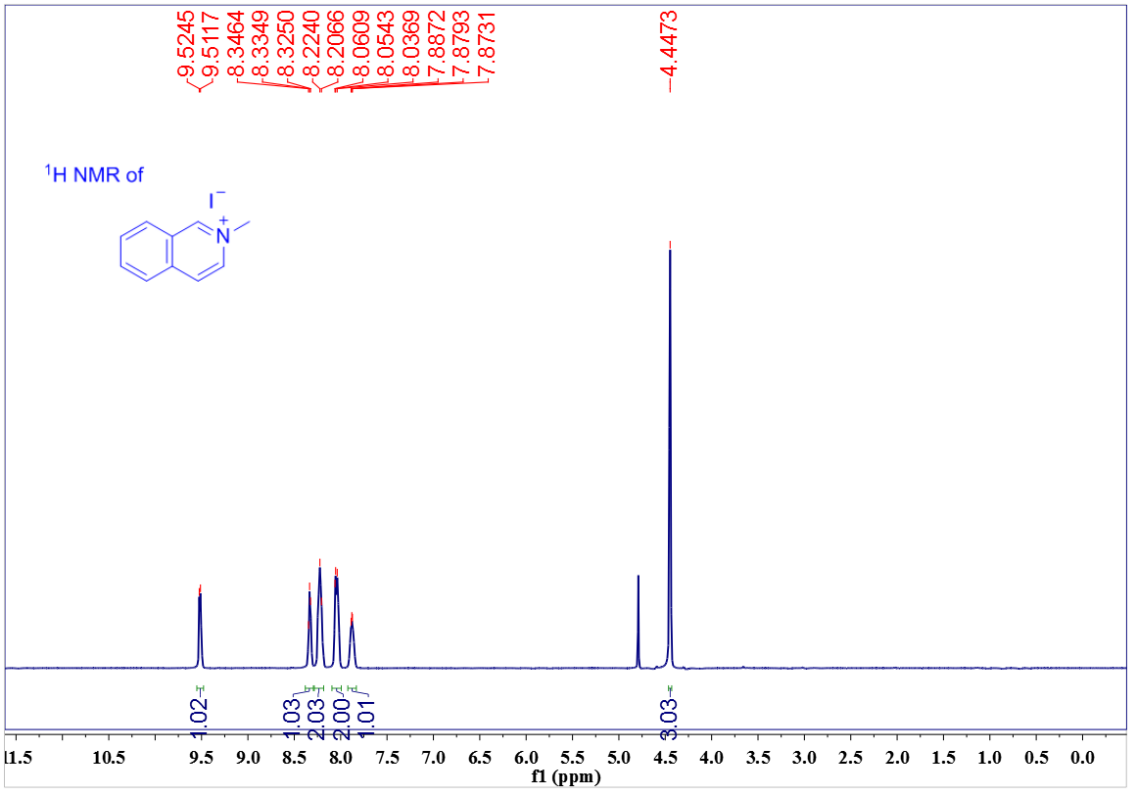
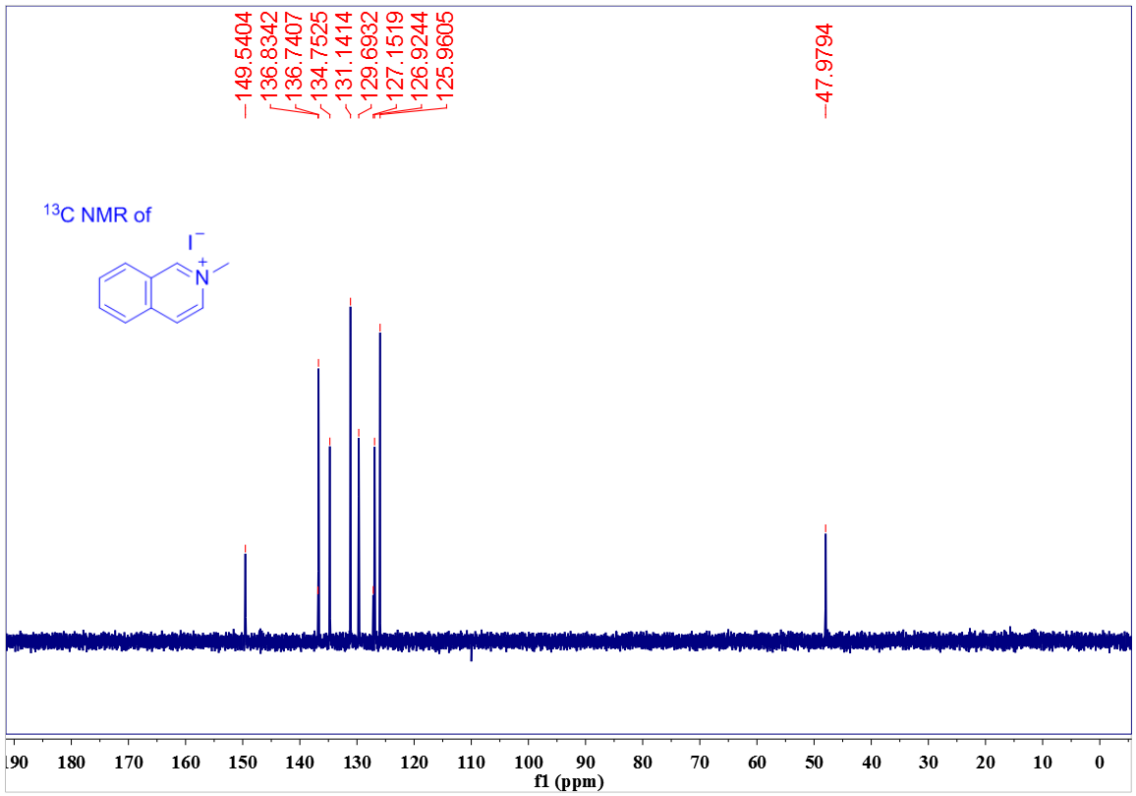
9.1599
9.0636
9.0469
8.3393
8.3214
8.2987
8.2823
8.2138
8.1972
8.1819
7.9845
7.9745
7.9678
7.9607
7.9459
4.6084
1H NMR of
1.05
1.00
1.01
1.01
1.02
2.05
3.08
f1 (ppm)

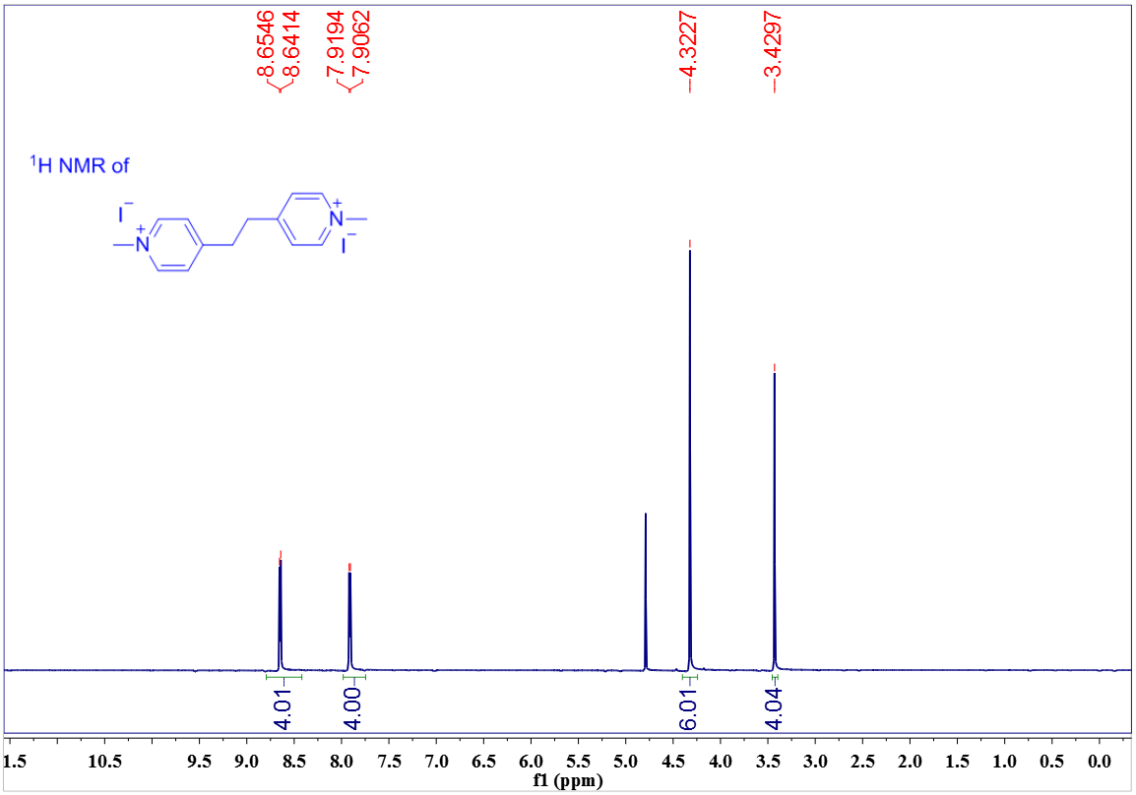

149.0157
147.4205
135.7198
130.2840
129.9405
129.5041
121.3221
118.0806
45.2440
13C NMR of
f1 (ppm)

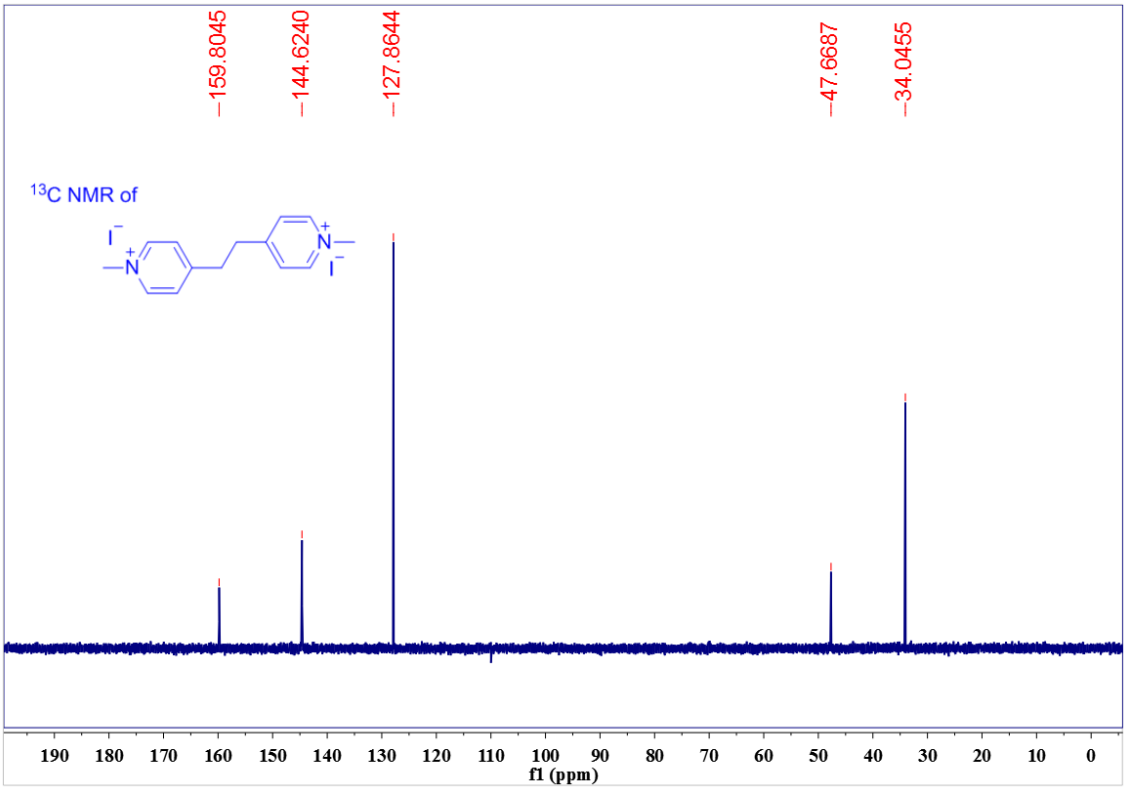
9t


9.5245
9.5117
8.3464
8.3349
8.3250
8.2240
8.2066
8.0609
8.0543
8.0369
7.8872
7.8793
7.8731
4.4473
1H NMR of
1.02
1.03
2.03
2.00
1.01
3.03
f1 (ppm)

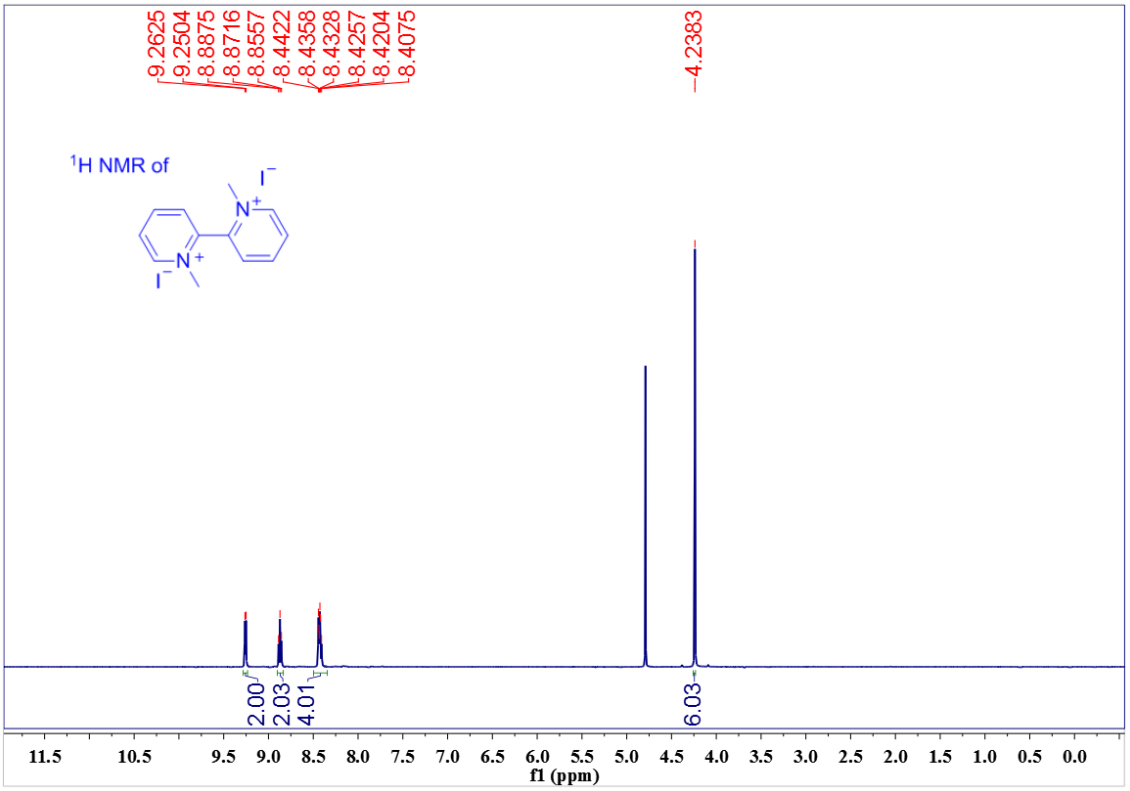

149.5404
136.8342
136.7407
134.7525
131.1414
129.6932
127.1519
126.9244
125.9605
47.9794
13C NMR of
f1 (ppm)

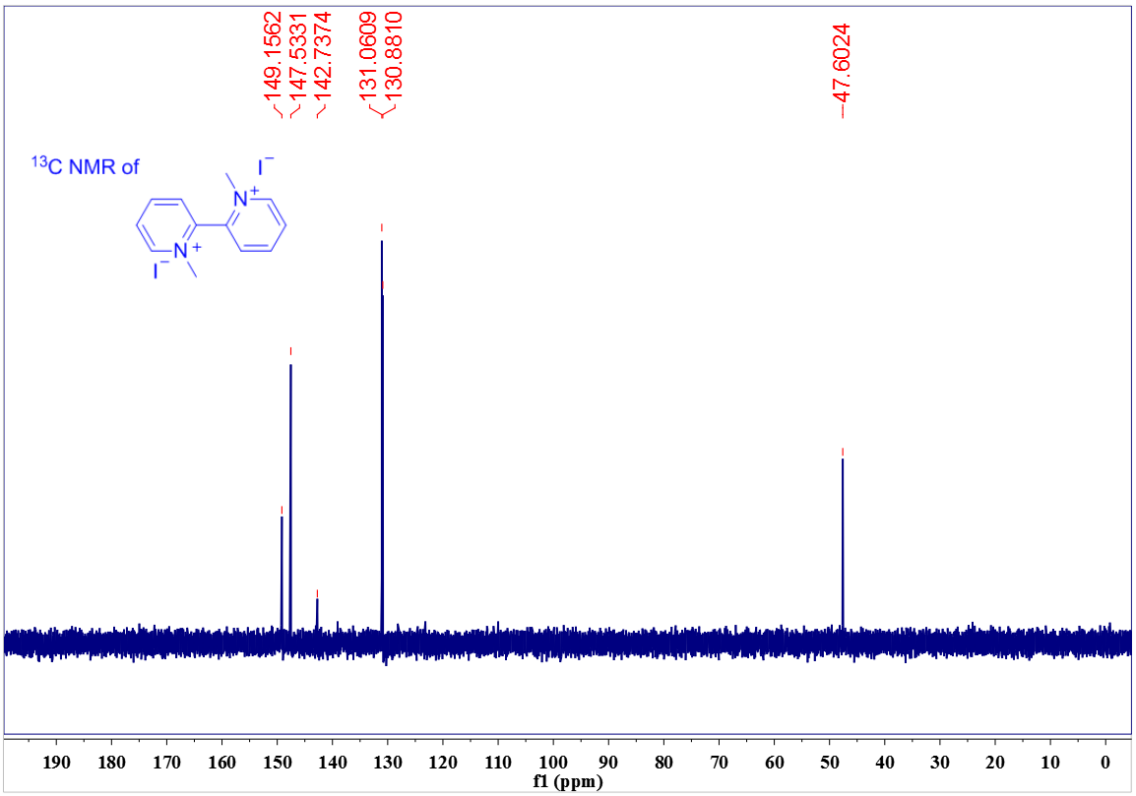
9u


8.6546
8.6414
7.9194
7.9062
4.3227
3.4297
1H NMR of
4.01
4.00
6.01
4.04
f1 (ppm)

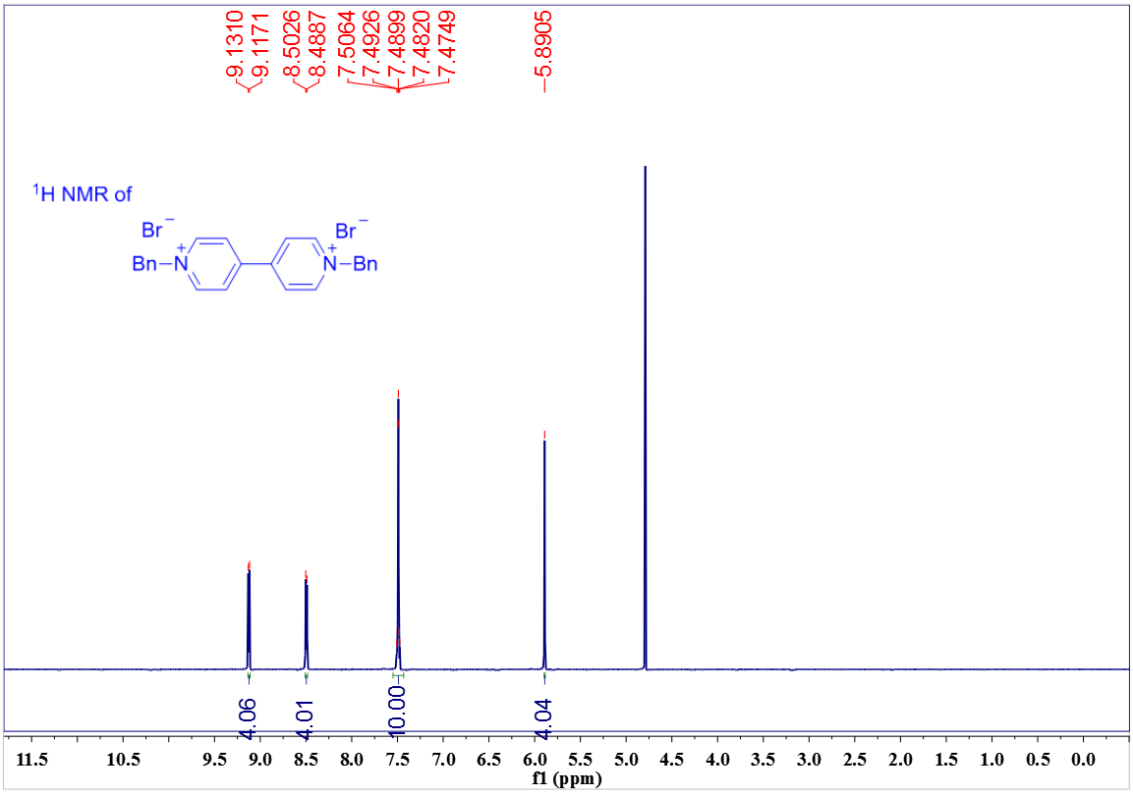

159.8045
144.6240
127.8644
47.6687
34.0455
13C NMR of
f1 (ppm)

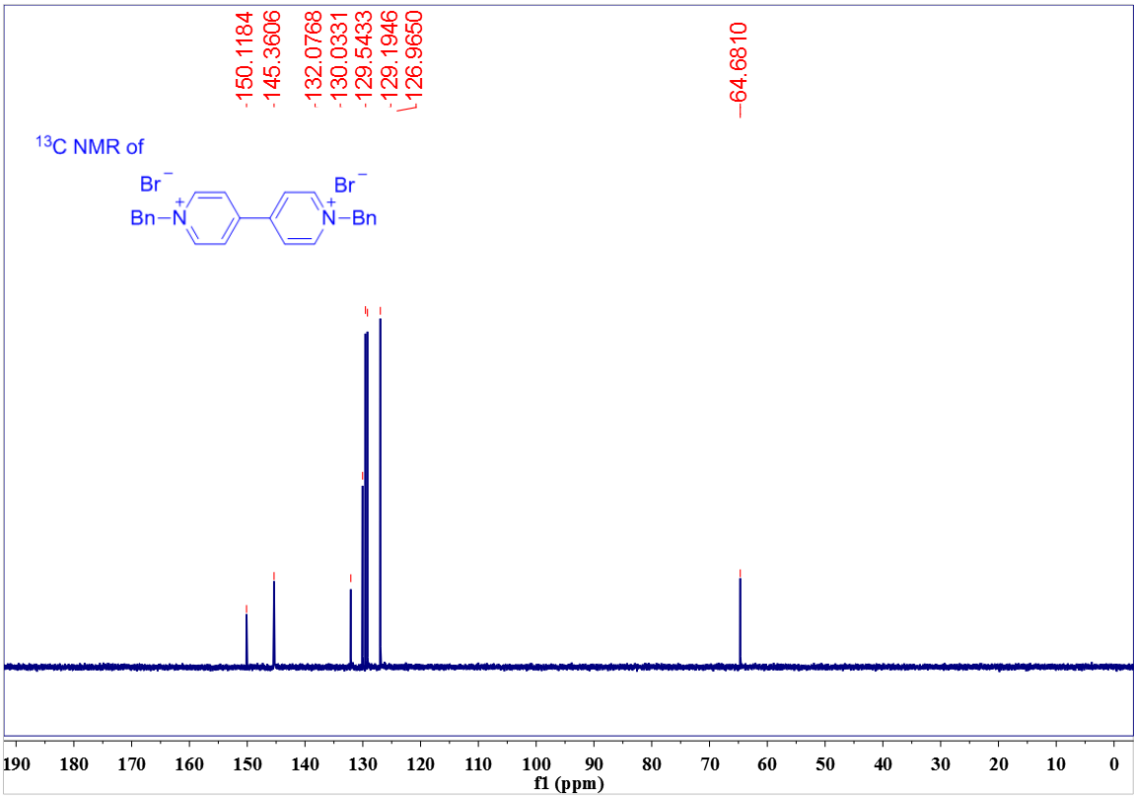
9w


9.2625
9.2504
8.8875
8.8716
8.8557
8.4422
8.4358
8.4328
8.4257
8.4204
8.4075
4.2383
1H NMR of
2.00
2.03
4.01
6.03
f1 (ppm)

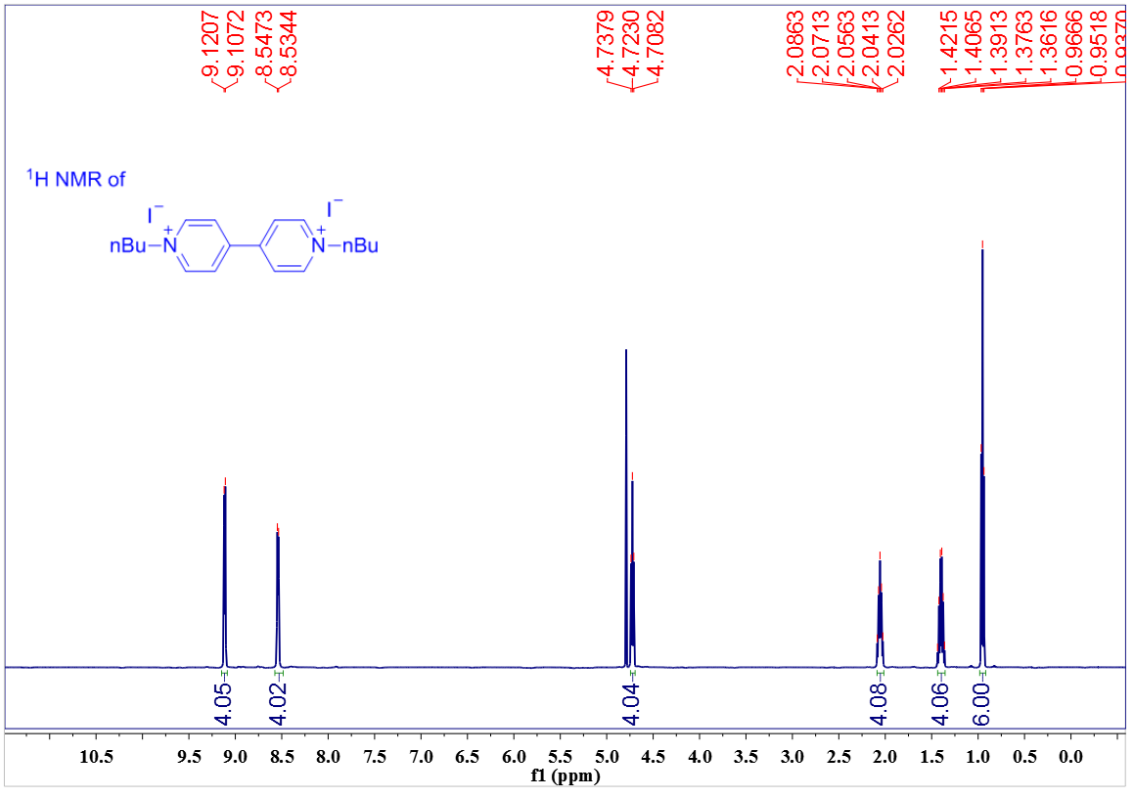

149.1562
147.5331
142.7374
131.0609
130.8810
47.6024
13C NMR of
f1 (ppm)

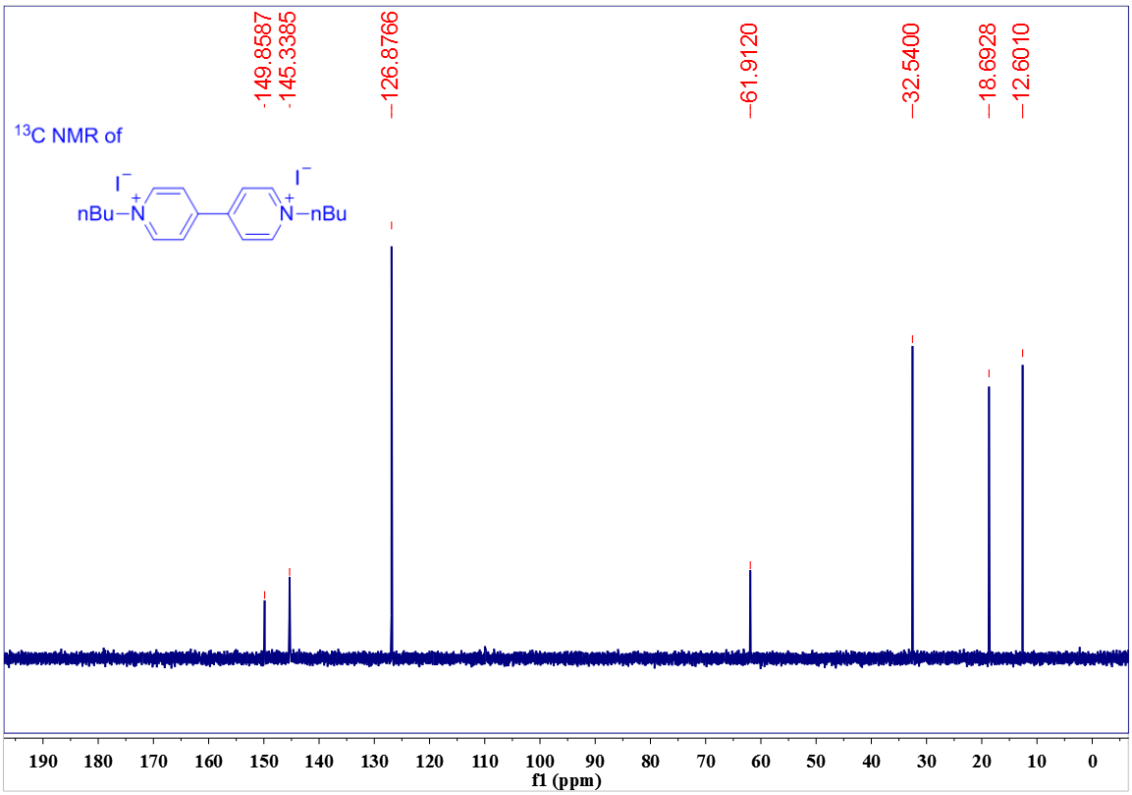
9aa


9.1310
9.1171
8.5026
8.4887
7.5064
7.4926
7.4899
7.4820
7.4749
5.8905
1H NMR of
Br⁻
Bn–N⁺
Br⁻
N⁺–Bn
4.06
4.01
10.00
4.04
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

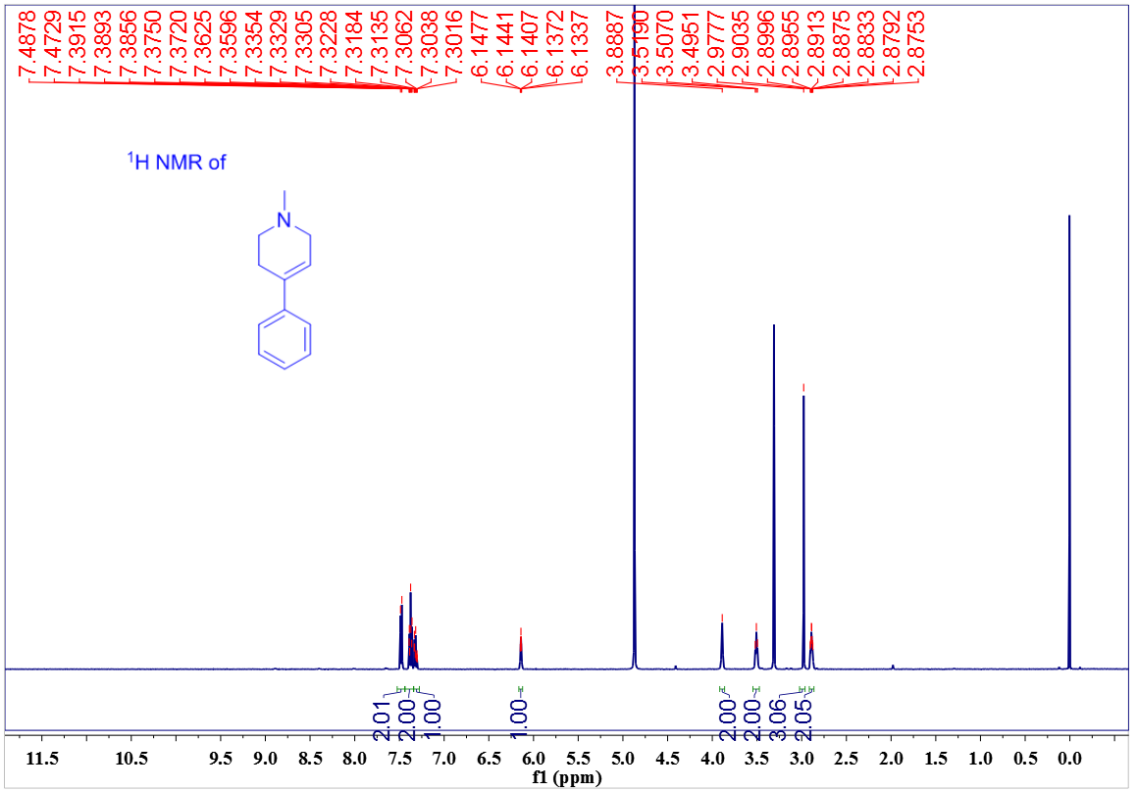

150.1184
145.3606
132.0768
130.0331
129.5433
129.1946
126.9650
64.6810
13C NMR of
Br⁻
Bn–N⁺
Br⁻
N⁺–Bn
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

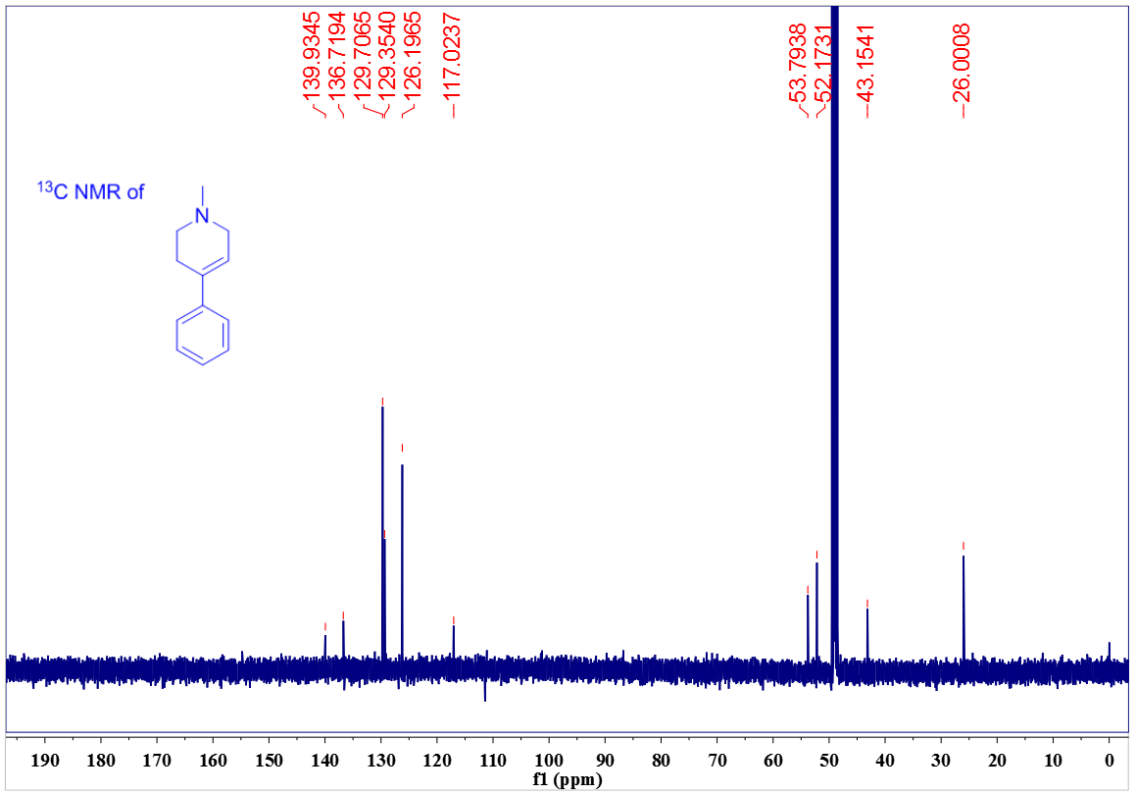
9ab


9.1207
9.1072
8.5473
8.5344
4.7379
4.7230
4.7082
2.0863
2.0713
2.0563
2.0413
2.0262
1.4215
1.4065
1.3913
1.3763
1.3616
0.9666
0.9518
1H NMR of
nBu–N
N–nBu
4.05
4.02
4.04
4.08
4.06
6.00
f1 (ppm)

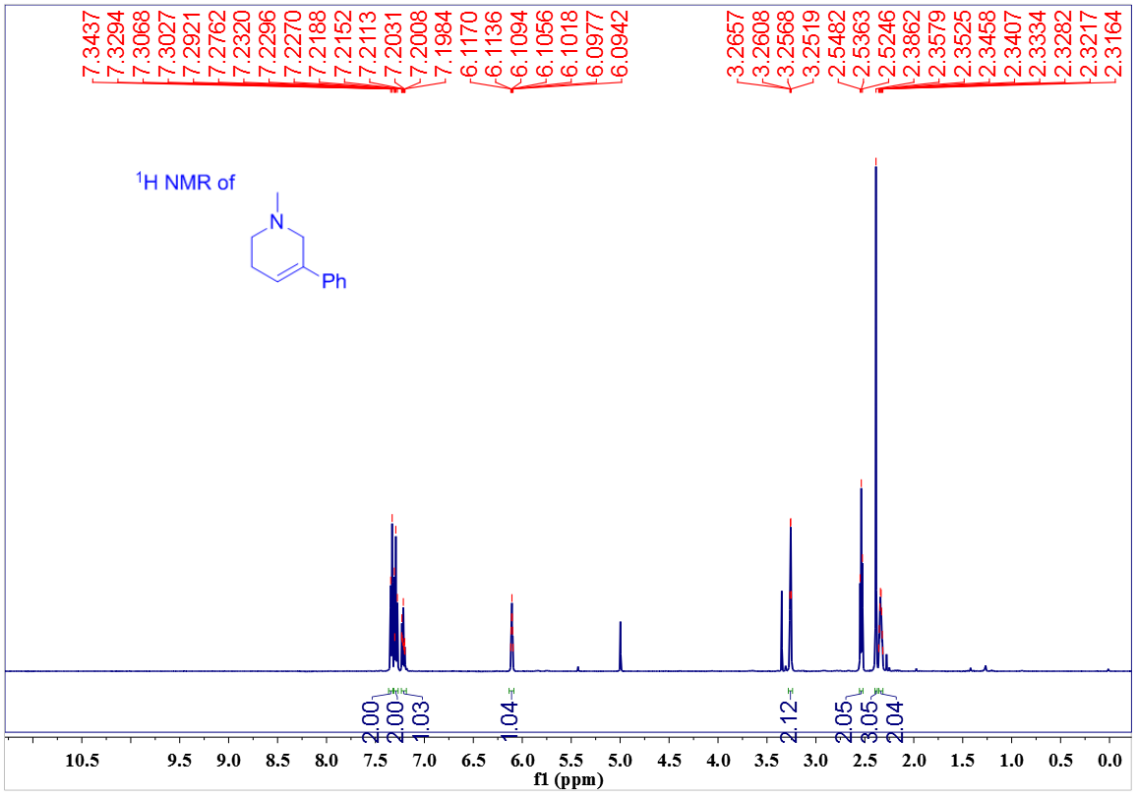

149.8587
145.3385
126.8766
61.9120
32.5400
18.6928
12.6010
13C NMR of
nBu–N
N–nBu
f1 (ppm)

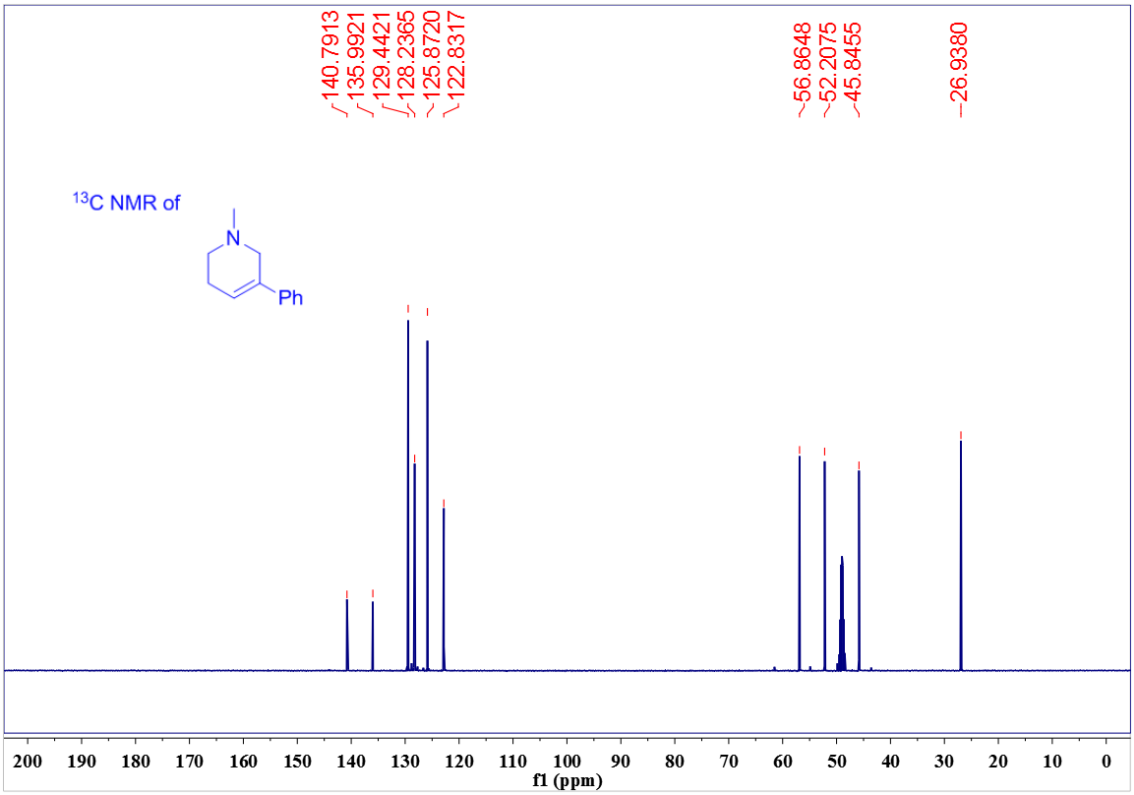
9ac


7.4878
7.4729
7.3915
7.3893
7.3856
7.3750
7.3720
7.3625
7.3596
7.3354
7.3329
7.3305
7.3228
7.3184
7.3135
7.3062
7.3038
7.3016
6.1477
6.1441
6.1407
6.1372
6.1337
3.8887
3.5190
3.5070
3.4951
2.9777
2.9035
2.8996
2.8955
2.8913
2.8875
2.8833
2.8792
2.8753
1H NMR of
N
2.01
2.00
1.00
1.00
2.00
2.00
3.06
2.05
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

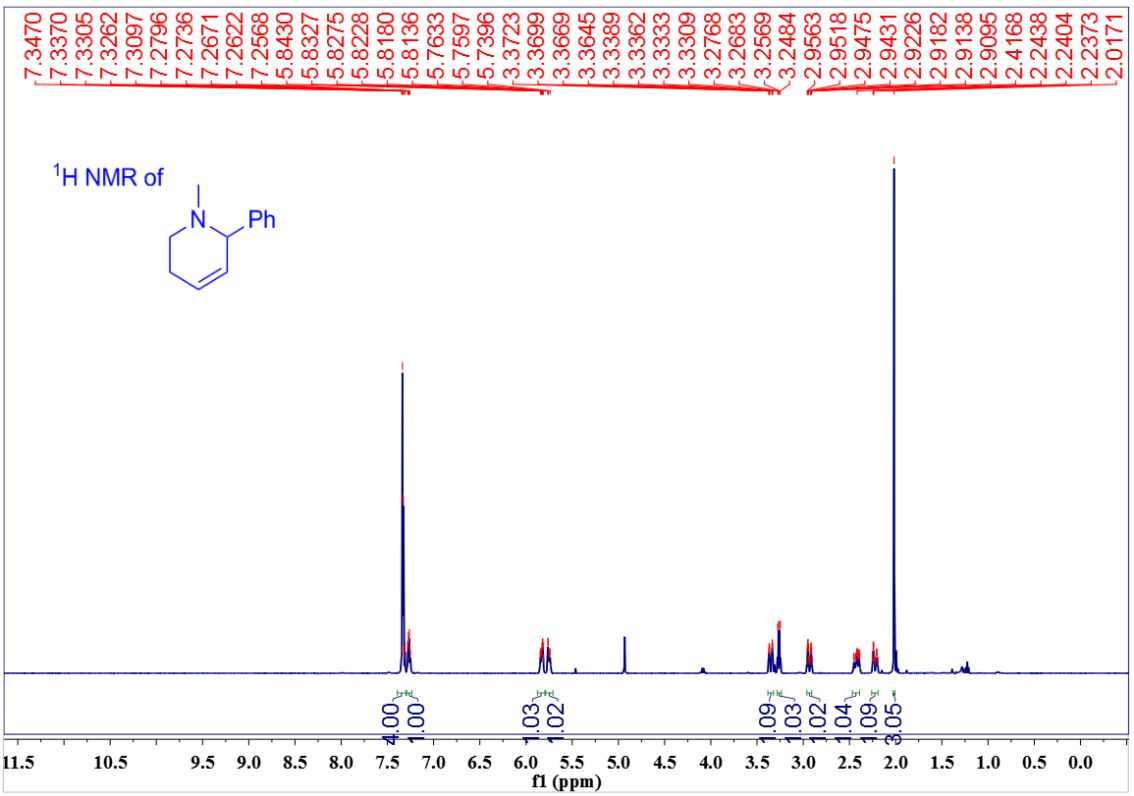

139.9345
136.7194
129.7065
129.3540
126.1965
117.0237
53.7938
52.1731
43.1541
26.0008
13C NMR of
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

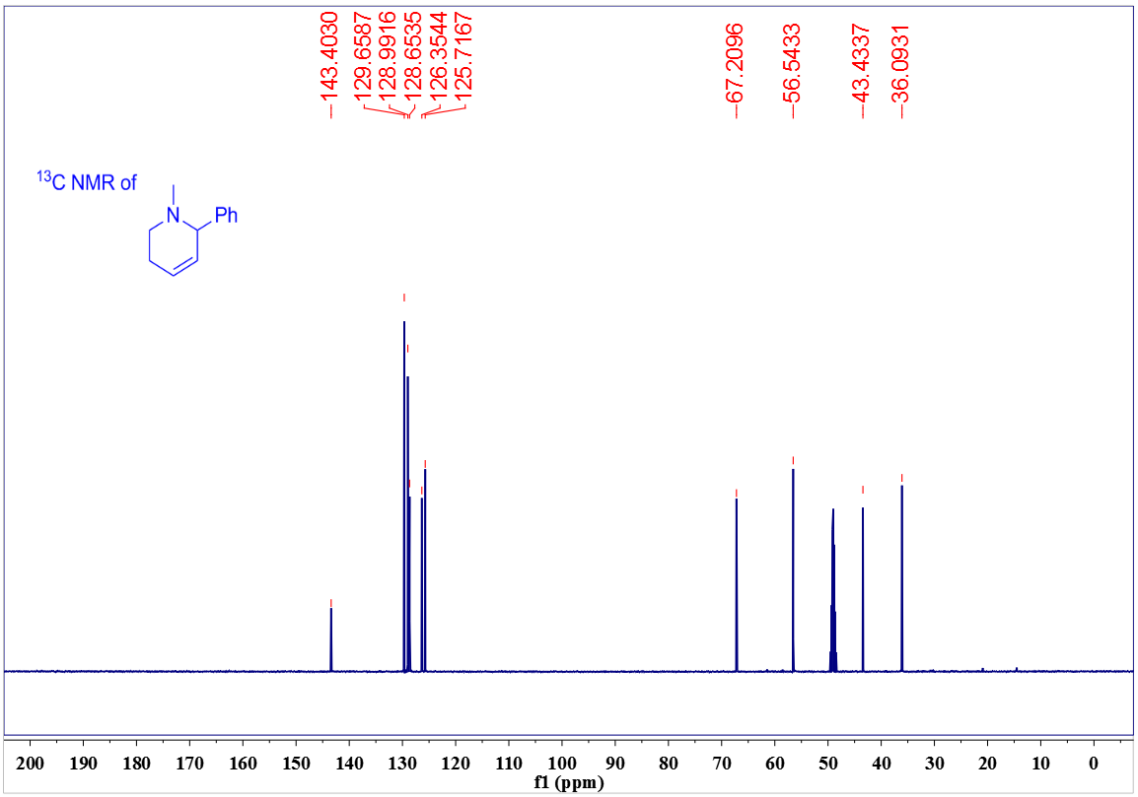
10a


7.3437
7.3294
7.3068
7.3027
7.2921
7.2762
7.2320
7.2296
7.2270
7.2188
7.2152
7.2113
7.2031
7.2008
7.1984
6.1170
6.1136
6.1094
6.1056
6.1018
6.0977
6.0942
3.2657
3.2608
3.2568
3.2519
2.5482
2.5363
2.5246
2.3862
2.3579
2.3525
2.3458
2.3407
2.3334
2.3282
2.3217
2.3164
1H NMR of
N
Ph
2.00
2.00
1.03
1.04
2.12
2.05
3.05
2.04
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

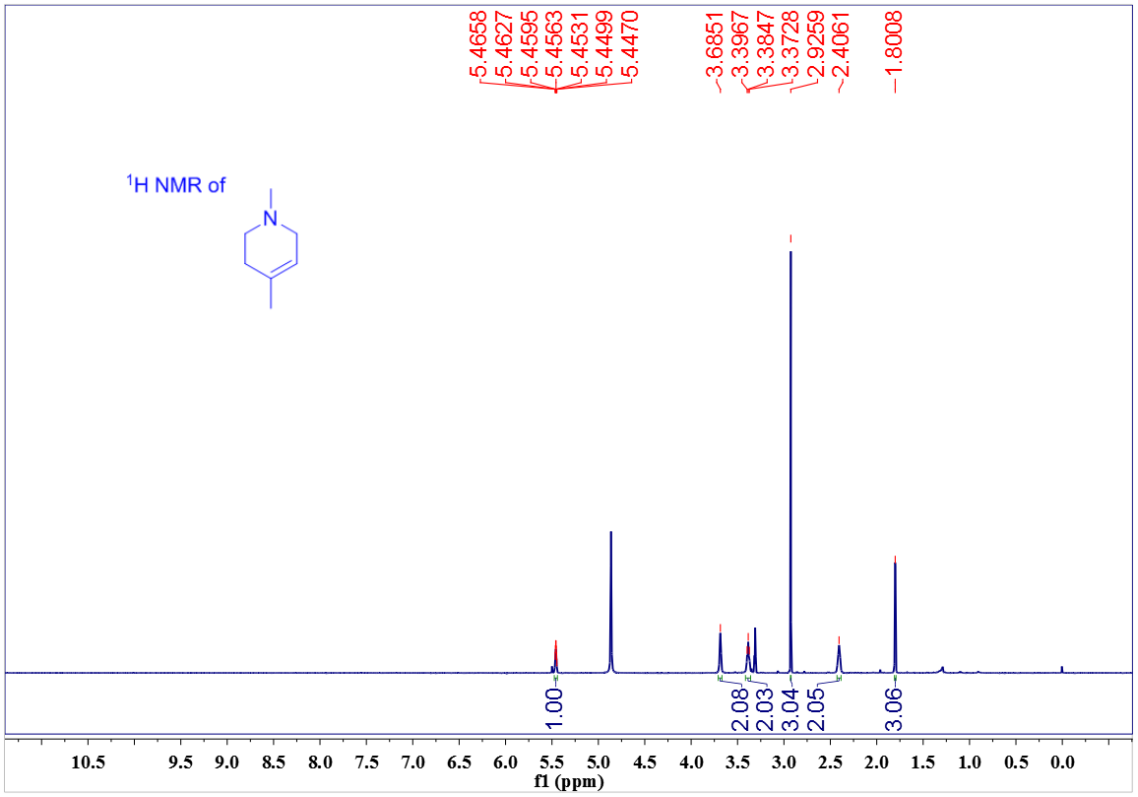

140.7913
135.9921
129.4421
128.2365
125.8720
122.8317
56.8648
52.2075
45.8455
26.9380
13C NMR of
N
Ph
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

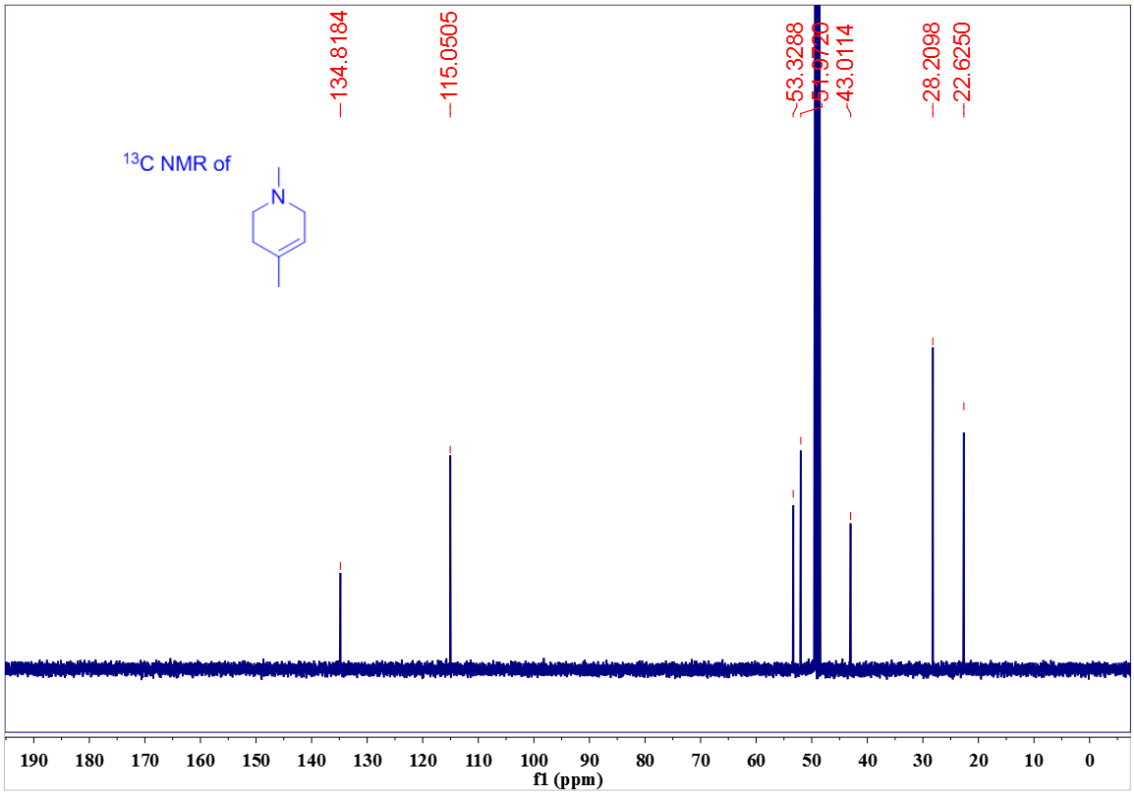
10b


7.3470
7.3370
7.3305
7.3262
7.3097
7.2796
7.2736
7.2671
7.2622
7.2568
5.8430
5.8327
5.8275
5.8228
5.8180
5.8136
5.7633
5.7597
5.7396
3.3723
3.3699
3.3669
3.3645
3.3389
3.3362
3.3333
3.3309
3.2768
3.2683
3.2569
3.2484
2.9563
2.9518
2.9475
2.9431
2.9226
2.9182
2.9138
2.9095
2.4168
2.2438
2.2404
2.2373
2.0171
1H NMR of
N
Ph
4.00
1.00
1.03
1.02
1.09
1.03
1.02
1.04
1.09
3.05
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

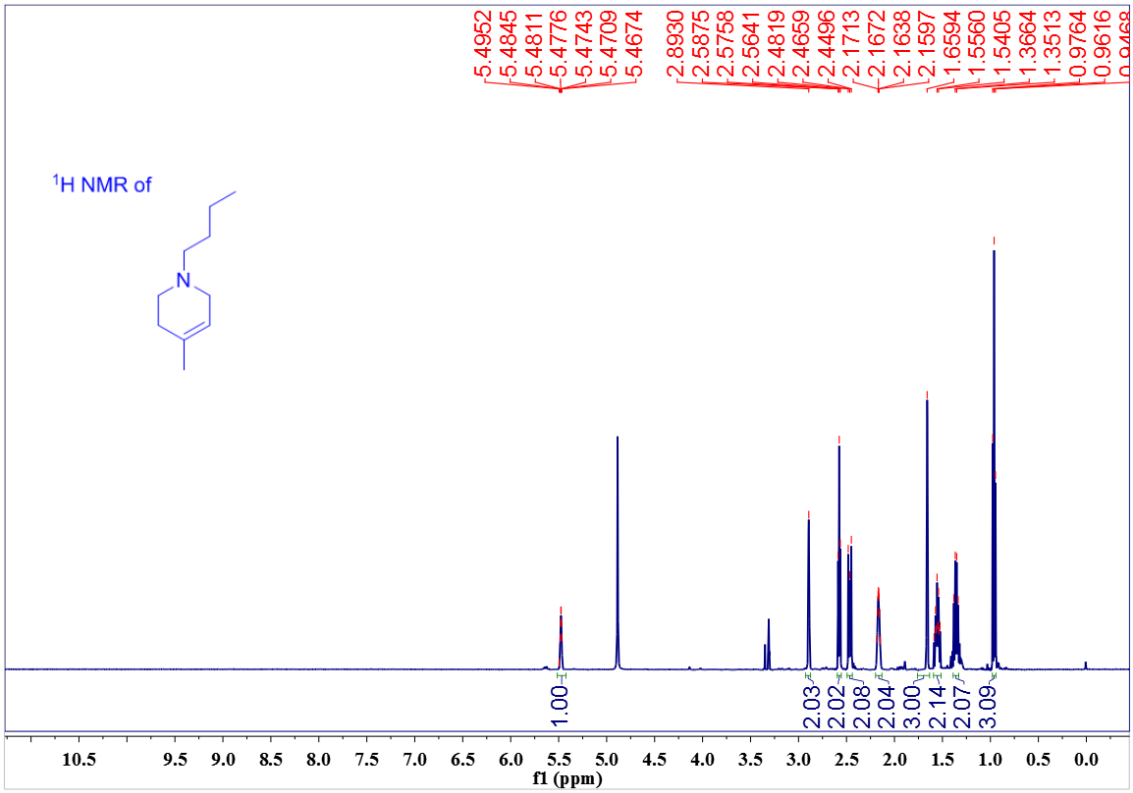

143.4030
129.6587
128.9916
128.6535
126.3544
125.7167
67.2096
56.5433
43.4337
36.0931
13C NMR of
N
Ph
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

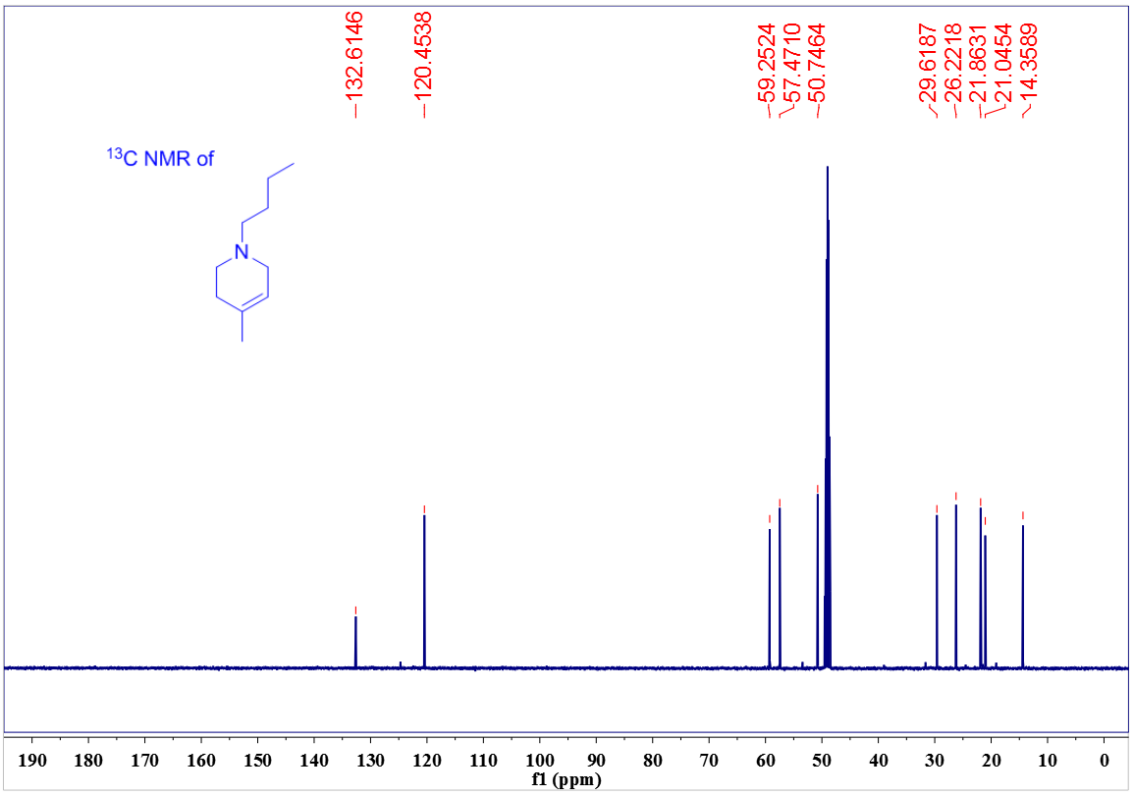
10c


5.4658
5.4627
5.4595
5.4563
5.4531
5.4499
5.4470
3.6851
3.3967
3.3847
3.3728
2.9259
2.4061
1.8008
1H NMR of
N
1.00
2.08
2.03
3.04
2.05
3.06
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

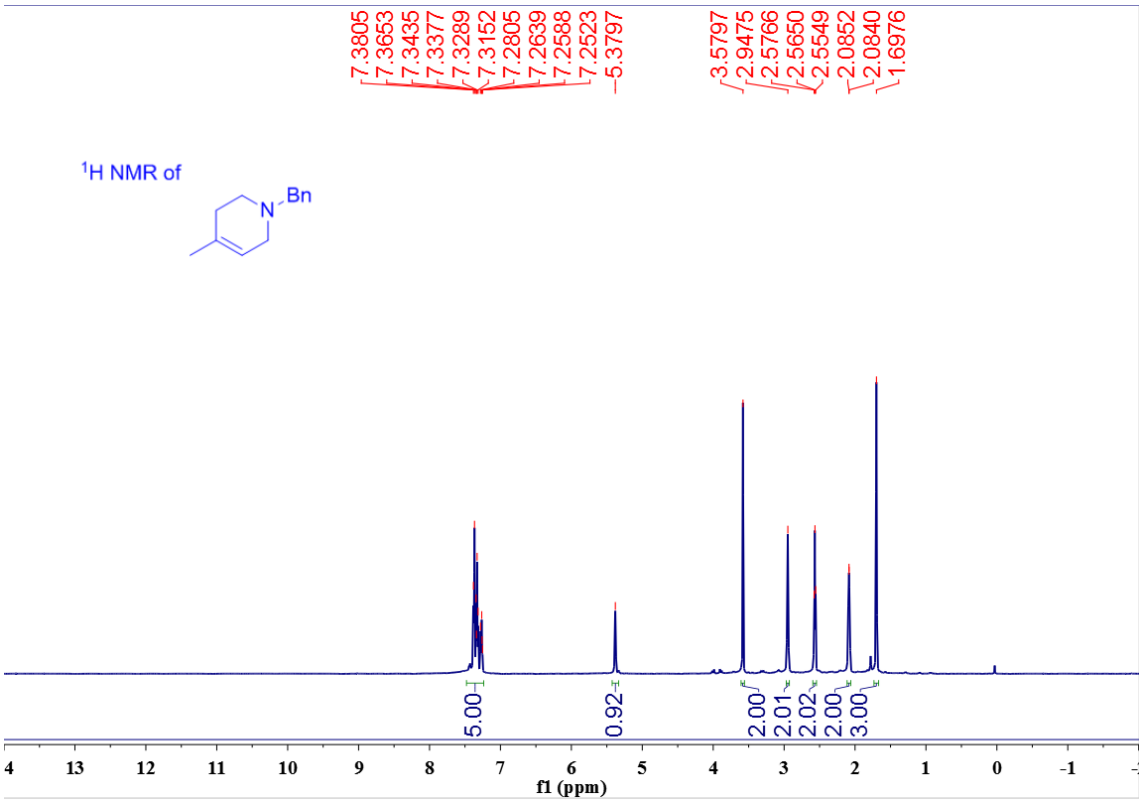

134.8184
115.0505
53.3288
51.9720
43.0114
28.2098
22.6250
13C NMR of
N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

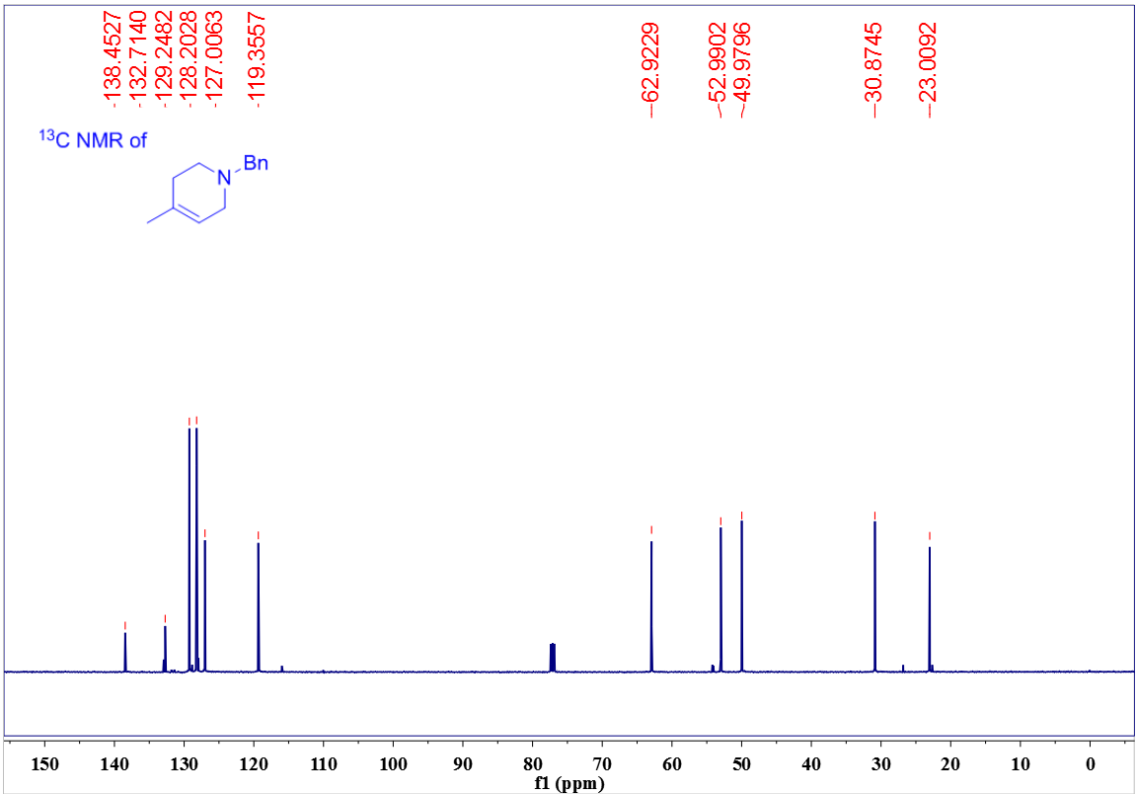
10d


5.4952
5.4845
5.4811
5.4776
5.4743
5.4709
5.4674
2.8930
2.5875
2.5758
2.5641
2.4819
2.4659
2.4496
2.1713
2.1672
2.1638
2.1597
1.6594
1.5560
1.5405
1.3664
1.3513
0.9764
0.9616
1H NMR of
N
1.00
2.03
2.02
2.08
2.04
3.00
2.14
2.07
3.09
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

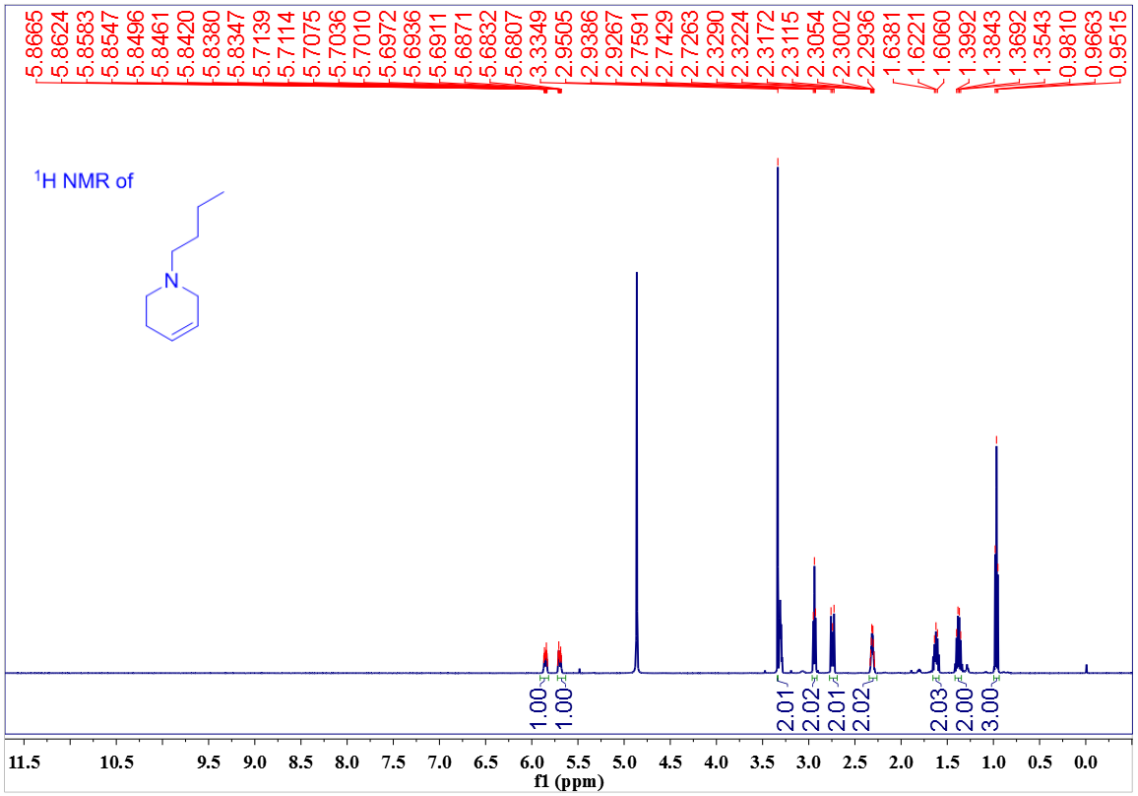

132.6146
120.4538
59.2524
57.4710
50.7464
29.6187
26.2218
21.8631
21.0454
14.3589
13C NMR of
N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

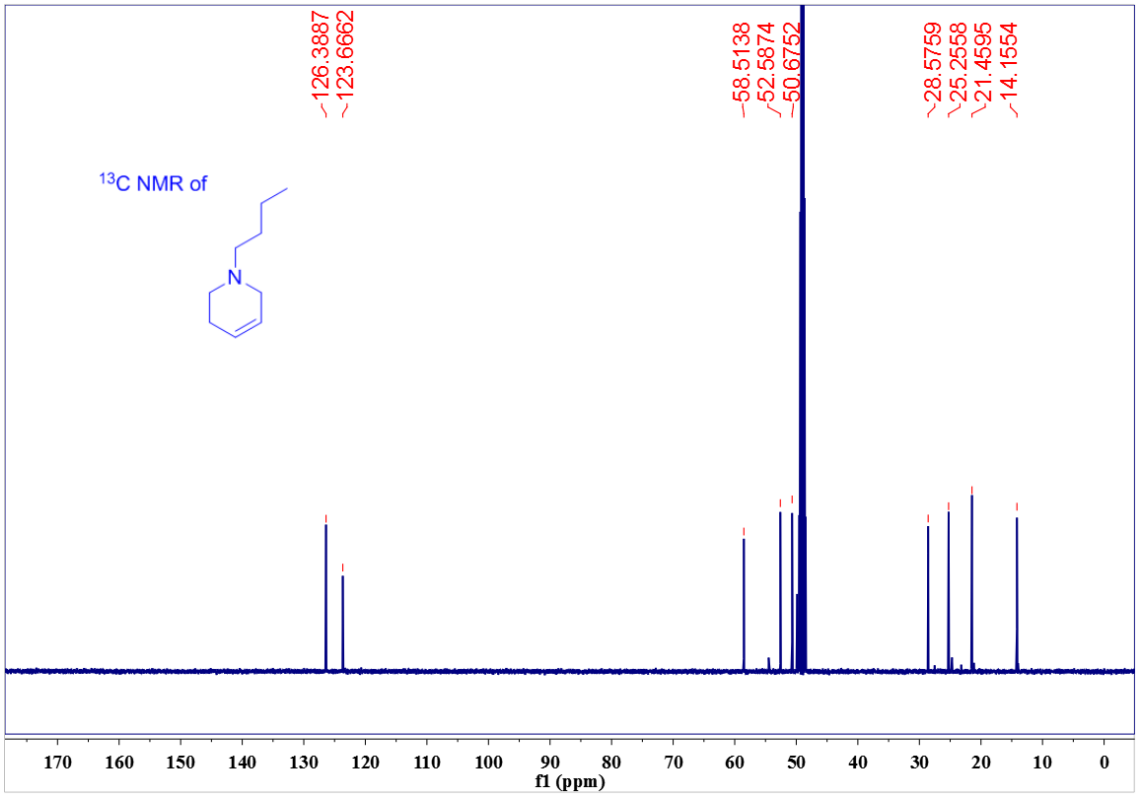
10e


7.3805
7.3653
7.3435
7.3377
7.3289
7.3152
7.2805
7.2639
7.2588
7.2523
5.3797
3.5797
2.9475
2.5766
2.5650
2.5549
2.0852
2.0840
1.6976
1H NMR of
N
Bn
5.00
0.92
2.00
2.01
2.02
2.00
3.00
f1 (ppm)

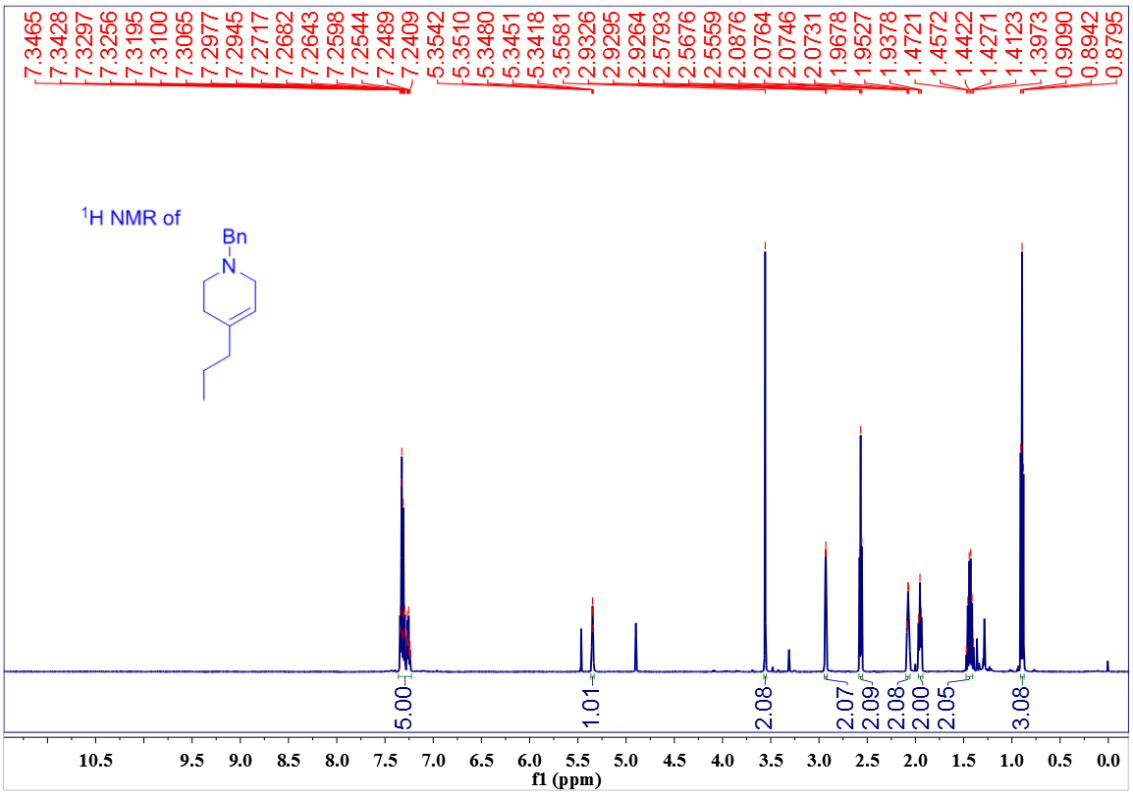

138.4527
132.7140
129.2482
128.2028
127.0063
119.3557
62.9229
52.9902
49.9796
30.8745
23.0092
13C NMR of
N
Bn
f1 (ppm)

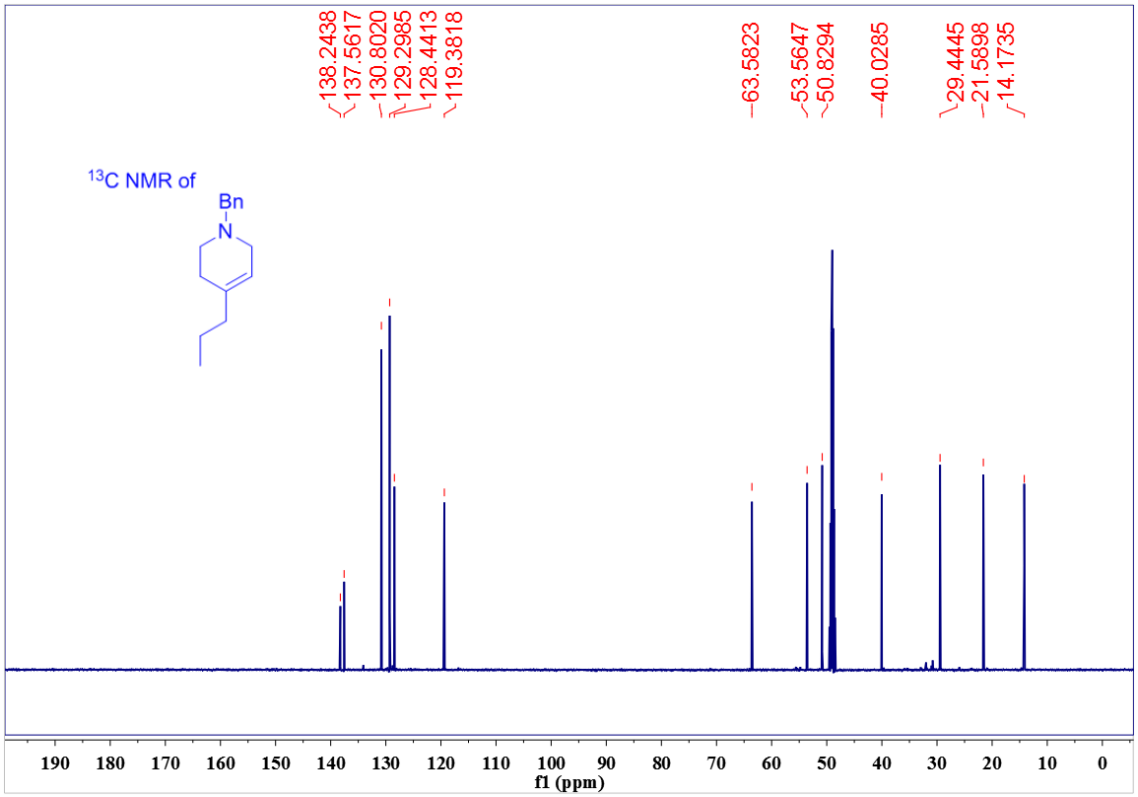
10f


5.8665
5.8624
5.8583
5.8547
5.8496
5.8461
5.8420
5.8380
5.8347
5.7139
5.7114
5.7075
5.7036
5.7010
5.6972
5.6936
5.6911
5.6871
5.6832
5.6807
3.3349
2.9505
2.9386
2.9267
2.7591
2.7429
2.7263
2.3290
2.3224
2.3172
2.3115
2.3054
2.3002
2.2936
1.6381
1.6221
1.6060
1.3992
1.3843
1.3692
1.3543
0.9810
0.9663
0.9515
1H NMR of
N
1.00
1.00
2.01
2.02
2.01
2.02
2.03
2.00
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

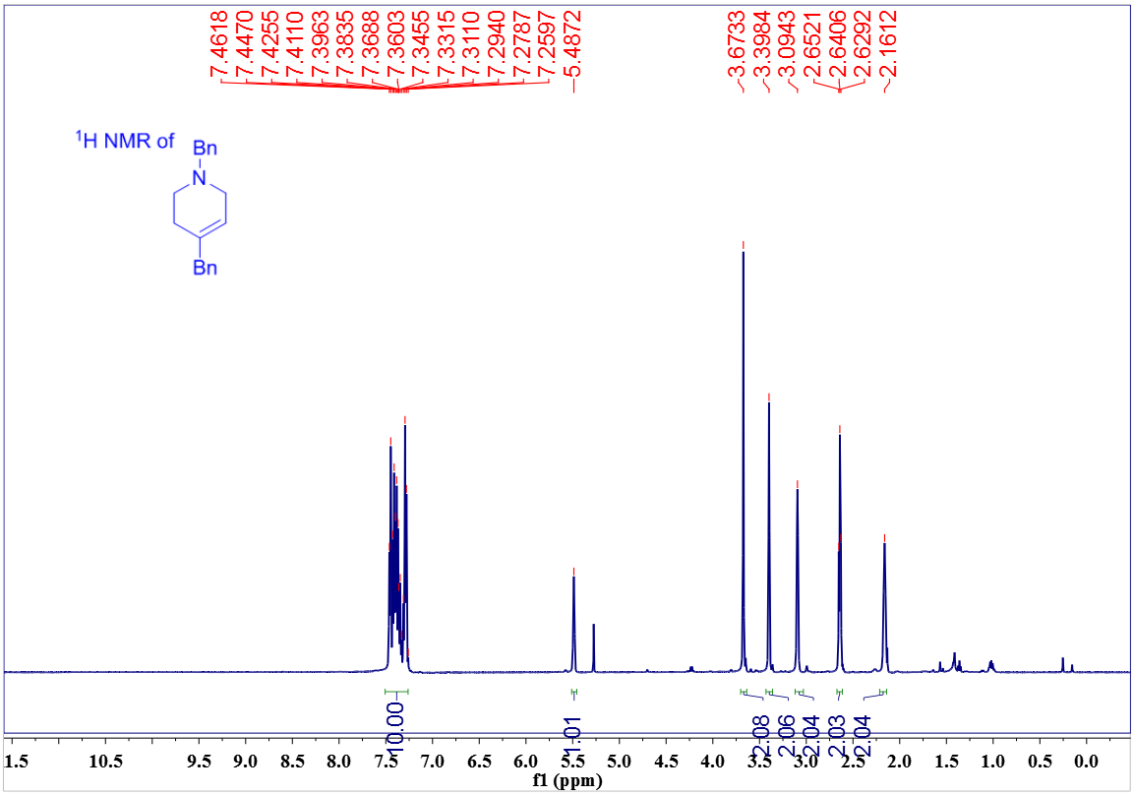

126.3887
123.6662
58.5138
52.5874
50.6752
28.5759
25.2558
21.4595
14.1554
13C NMR of
N
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

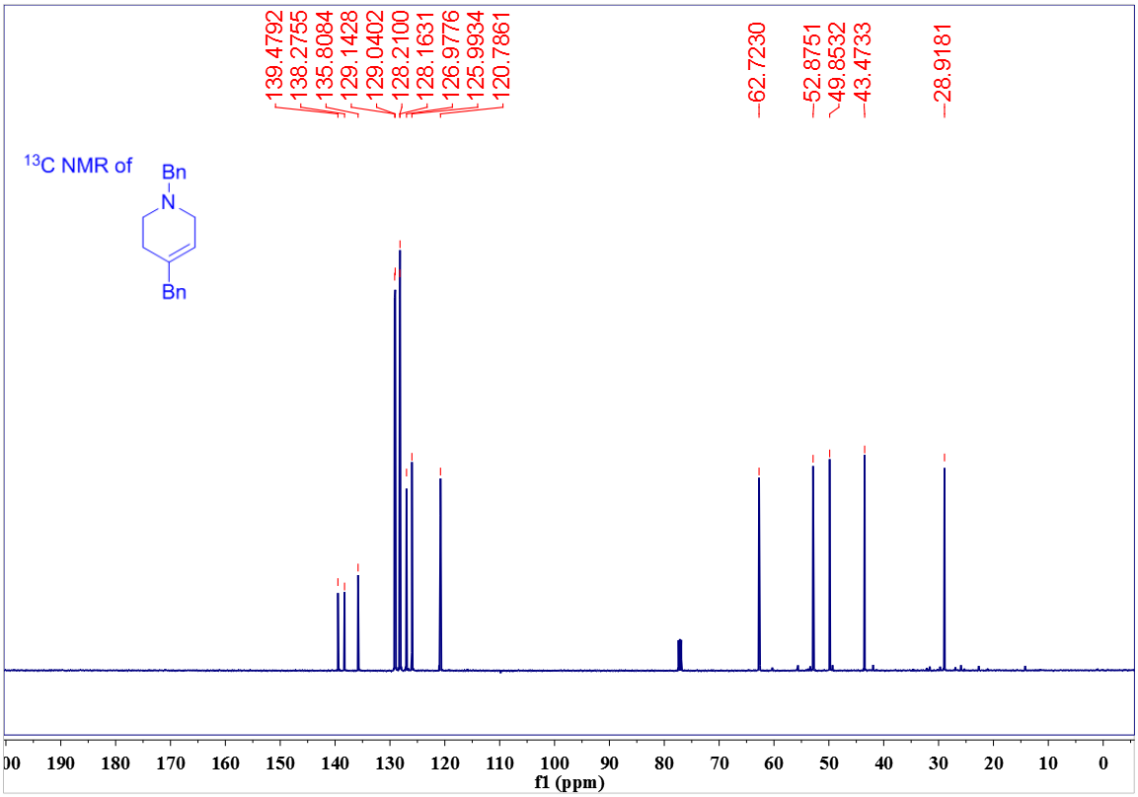
10g


7.3465
7.3428
7.3297
7.3256
7.3195
7.3100
7.3065
7.2977
7.2945
7.2717
7.2682
7.2643
7.2598
7.2544
7.2489
7.2409
5.3542
5.3510
5.3480
5.3451
5.3418
3.5581
2.9326
2.9295
2.9264
2.5793
2.5676
2.5559
2.0876
2.0764
2.0746
2.0731
1.9678
1.9527
1.9378
1.4721
1.4572
1.4422
1.4271
1.4123
1.3973
0.9090
0.8942
0.8795
1H NMR of
Bn
N
5.00
1.01
2.08
2.07
2.09
2.08
2.00
2.05
3.08
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

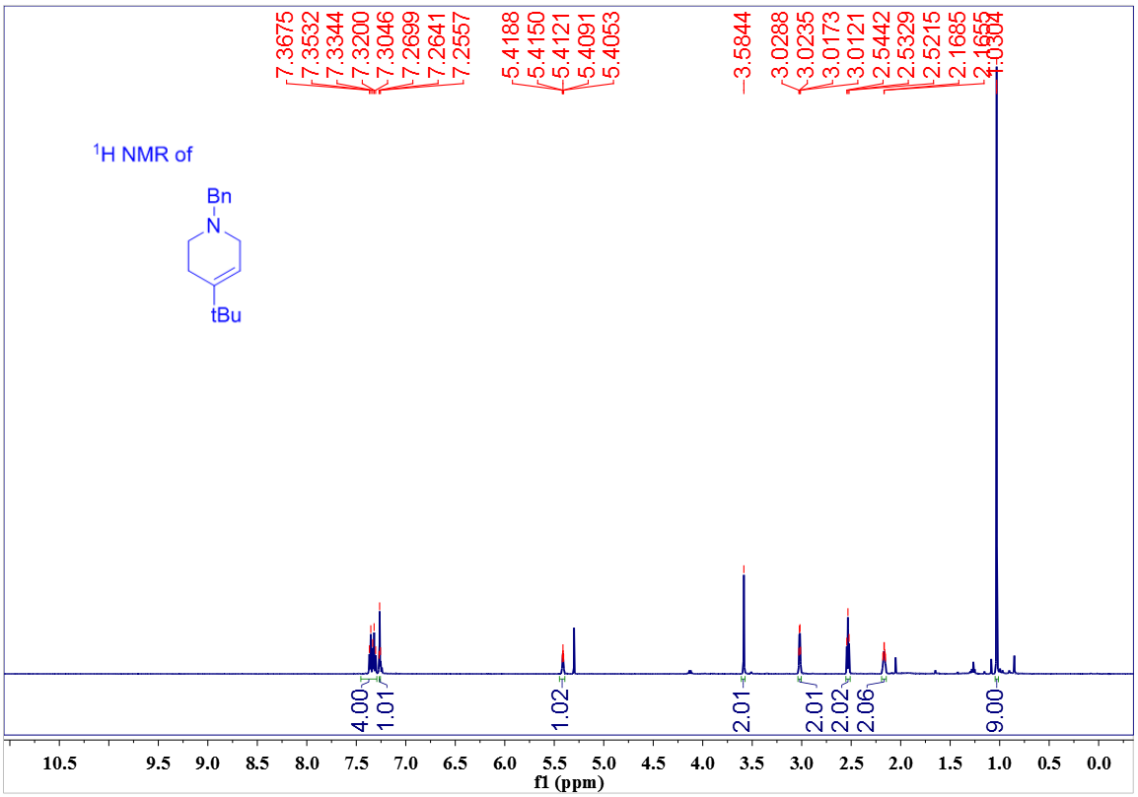

138.2438
137.5617
130.8020
129.2985
128.4413
119.3818
63.5823
53.5647
50.8294
40.0285
29.4445
21.5898
14.1735
13C NMR of
Bn
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

10h


7.4618
7.4470
7.4255
7.4110
7.3963
7.3835
7.3688
7.3603
7.3455
7.3315
7.3110
7.2940
7.2787
7.2597
5.4872
3.6733
3.3984
3.0943
2.6521
2.6406
2.6292
2.1612
1H NMR of
Bn
N
Bn
10.00
1.01
2.08
2.06
2.04
2.03
2.04
f1 (ppm)


139.4792
138.2755
135.8084
129.1428
129.0402
128.2100
128.1631
126.9776
125.9934
120.7861
62.7230
52.8751
49.8532
43.4733
28.9181
13C NMR of
Bn
N
Bn
f1 (ppm)

10i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7.3344
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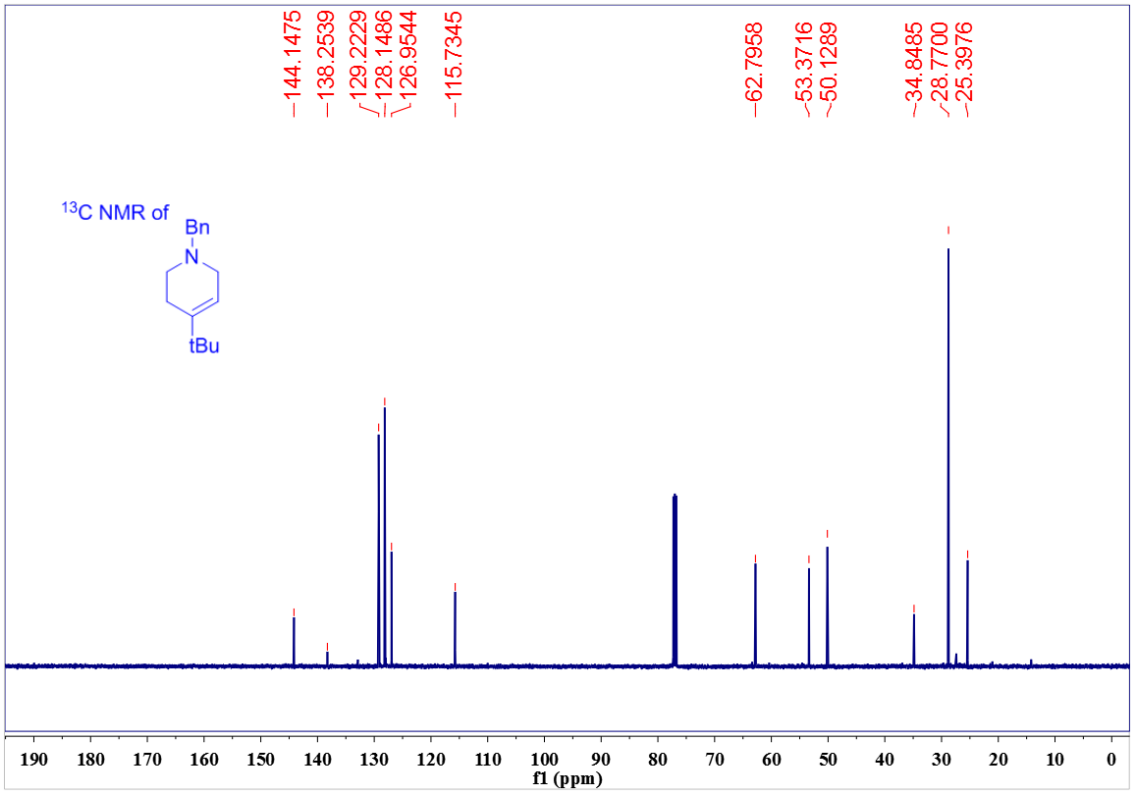
7.3046
7.2699
7.2641
7.2557
5.4188
5.4150
5.4121
5.4091
5.4053
3.5844
3.0288
3.0235
3.0173
3.0121
2.5442
2.5329
2.5215
2.1685
1.0304
1H NMR of
Bn
N
tBu
4.00
1.01
1.02
2.01
2.01
2.02
2.06
9.00
f1 (ppm)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138.2539
129.2229
128.1486
126.9544
115.7345
62.7958
53.3716
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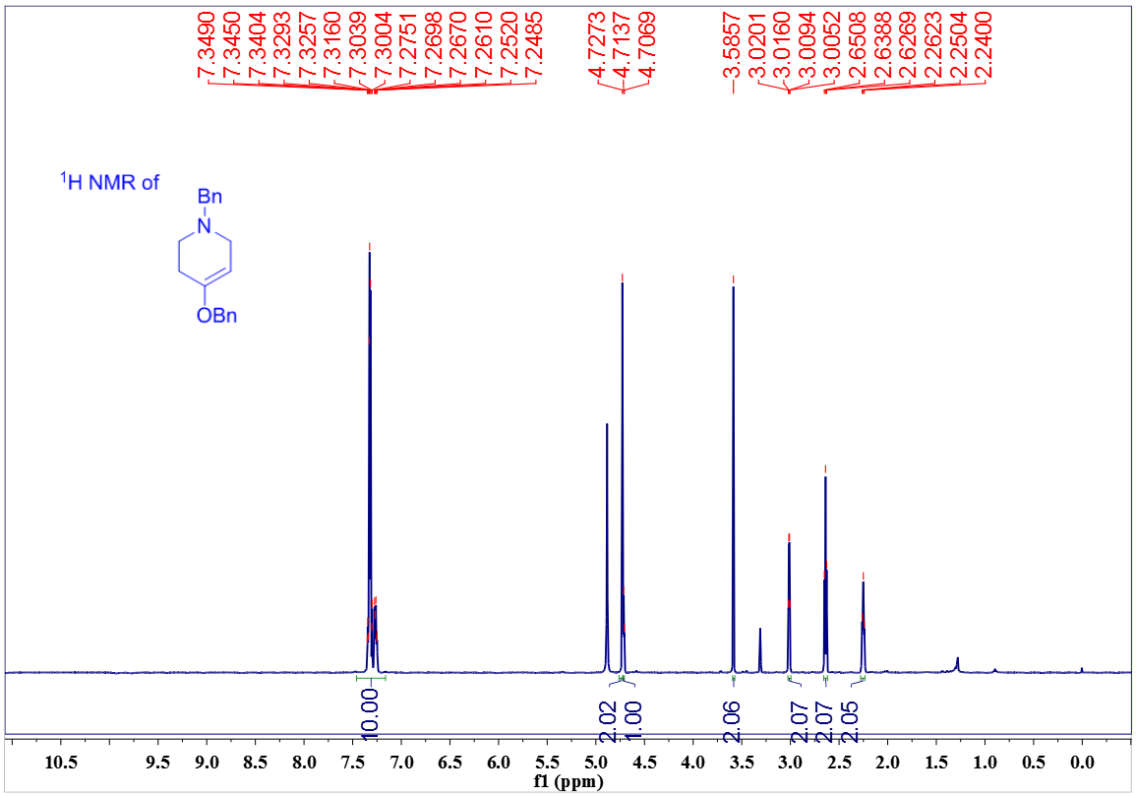
34.8485
28.7700
25.3976
13C NMR of
Bn
N
tBu
f1 (ppm)

10j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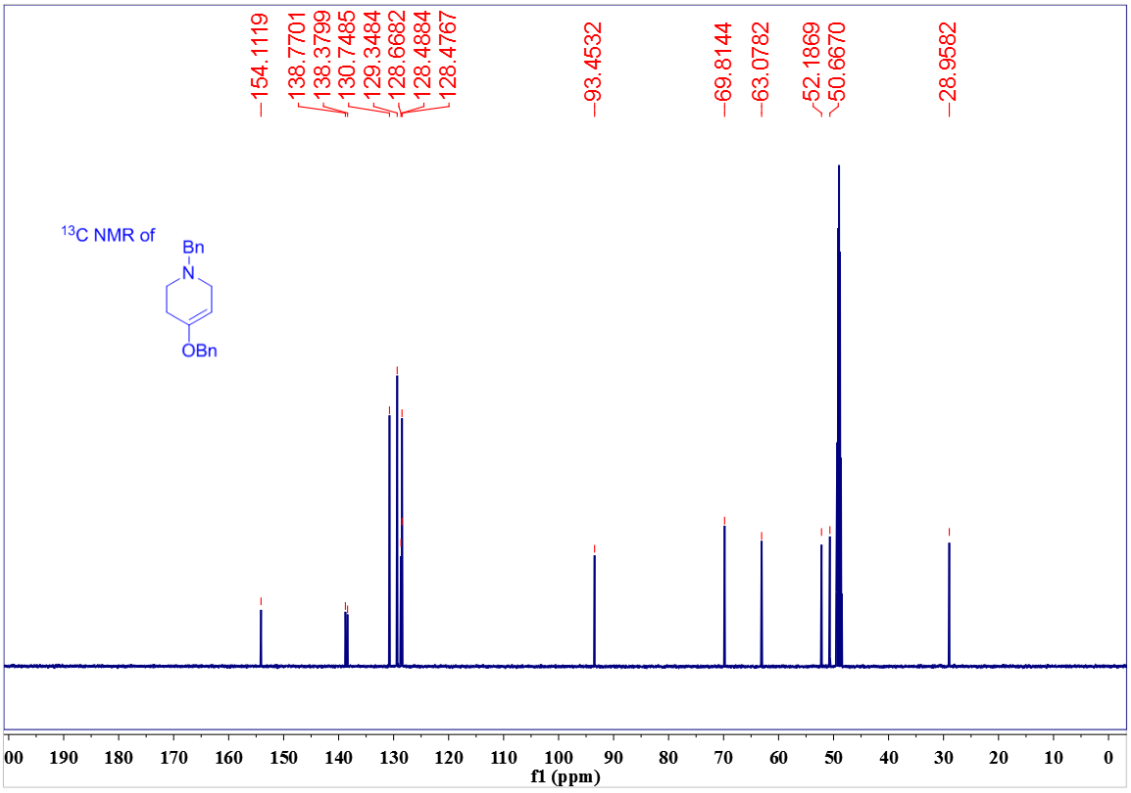
7.3293
7.3257
7.3160
7.3039
7.3004
7.2751
7.2698
7.2670
7.2610
7.2520
7.2485
4.7273
4.7137
4.7069
3.5857
3.0201
3.0160
3.0094
3.0052
2.6508
2.6388
2.6269
2.2623
2.2504
2.2400
1H NMR of
Bn
N
OBn
10.00
2.02
1.00
2.06
2.07
2.07
2.05
f1 (ppm)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138.3799
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129.3484
128.6682
128.4884
128.4767
93.4532
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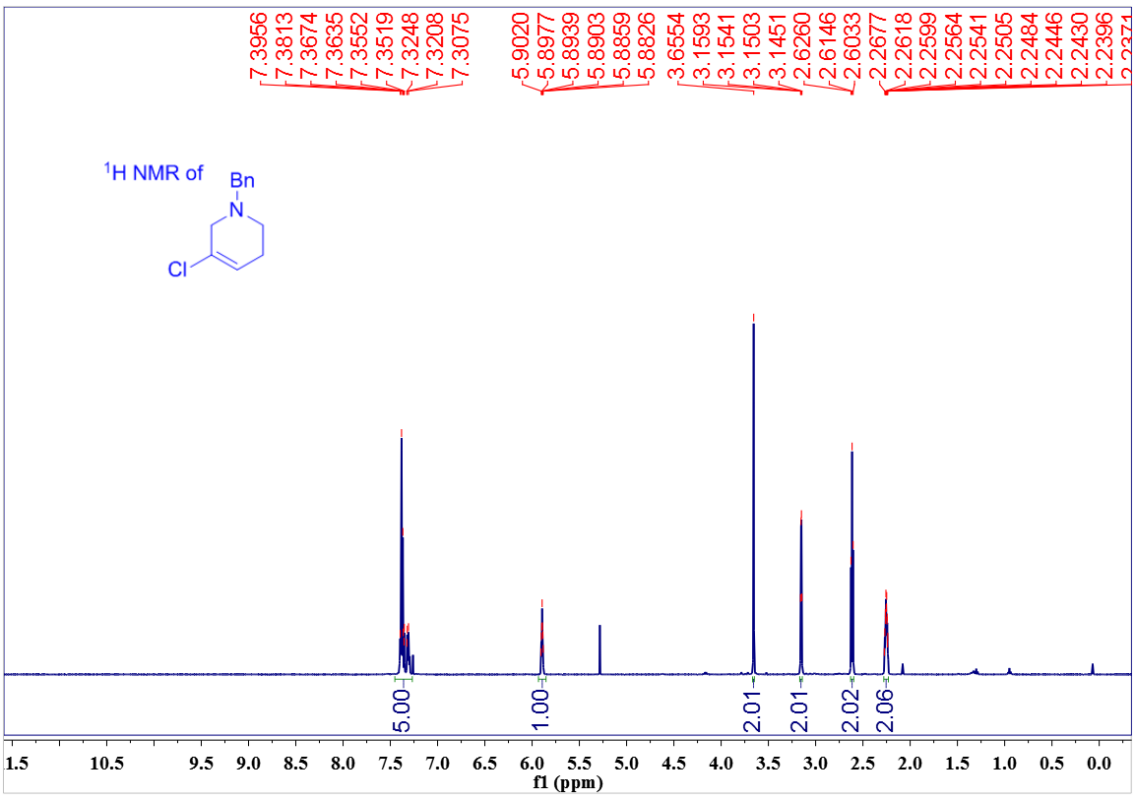
63.0782
52.1869
50.6670
28.9582
13C NMR of
Bn
N
OBn
f1 (ppm)

10k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7.3813
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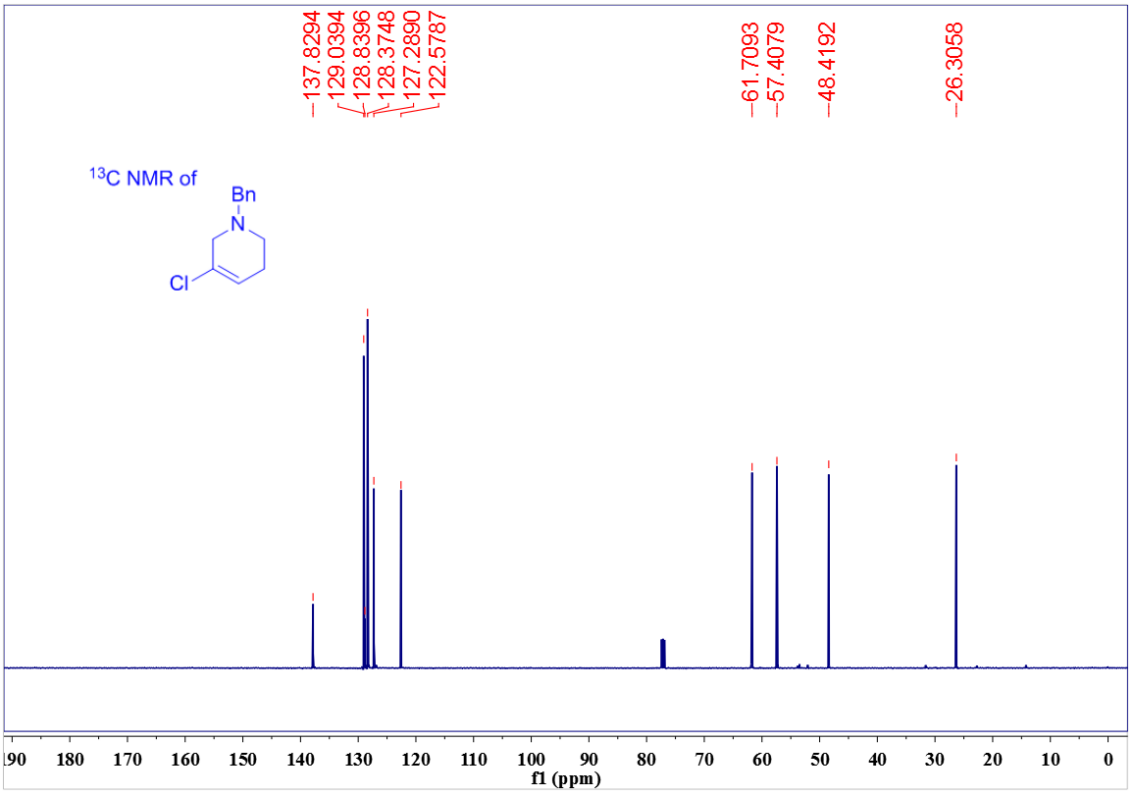
7.3635
7.3552
7.3519
7.3248
7.3208
7.3075
5.9020
5.8977
5.8939
5.8903
5.8859
5.8826
3.6554
3.1593
3.1541
3.1503
3.1451
2.6260
2.6146
2.6033
2.2677
2.2618
2.2599
2.2564
2.2541
2.2505
2.2484
2.2446
2.2430
2.2396
1H NMR of
Bn
N
Cl
5.00
1.00
2.01
2.01
2.02
2.06
f1 (ppm)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128.8396
128.3748
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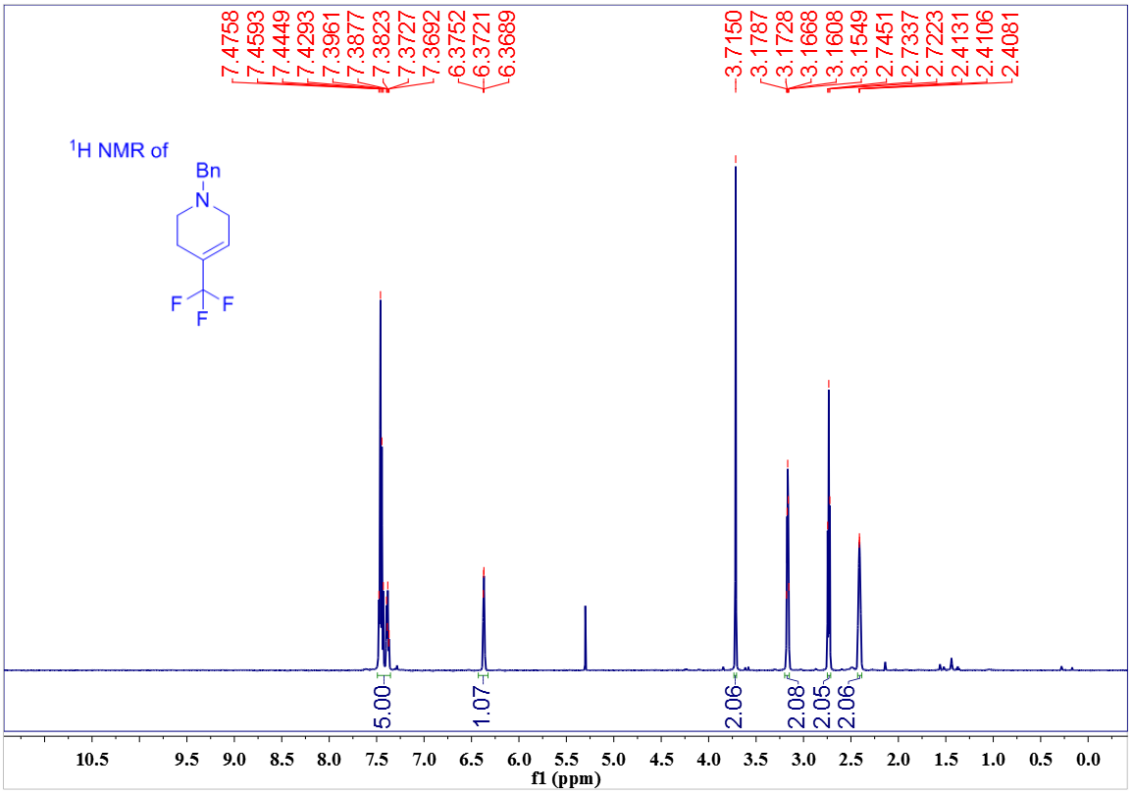
61.7093
57.4079
48.4192
26.3058
13C NMR of
Bn
N
Cl
f1 (ppm)

10l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7.4593
7.4449
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7.3823
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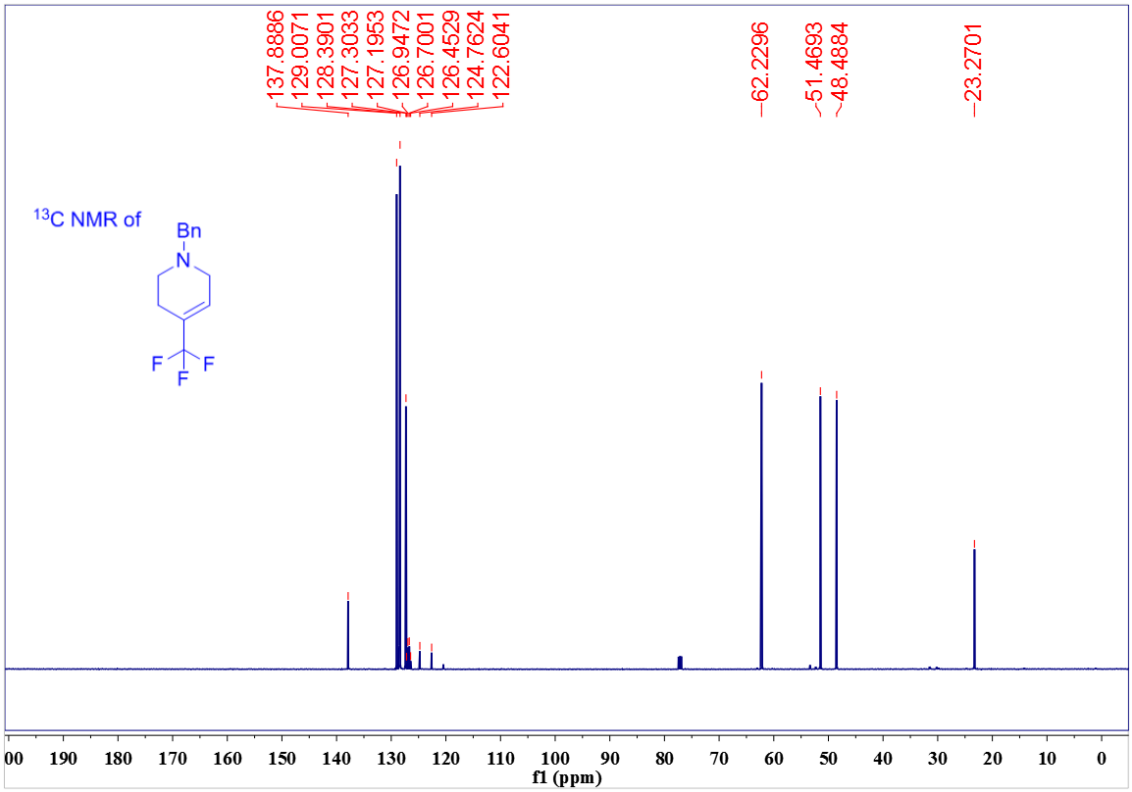
7.3692
6.3752
6.3721
6.3689
3.7150
3.1787
3.1728
3.1668
3.1608
3.1549
2.7451
2.7337
2.7223
2.4131
2.4106
2.4081
1H NMR of
Bn
N
F
F
F
5.00
1.07
2.06
2.08
2.05
2.06
f1 (ppm)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128.3901
127.3033
127.1953
126.9472
126.7001
126.4529
124.7624
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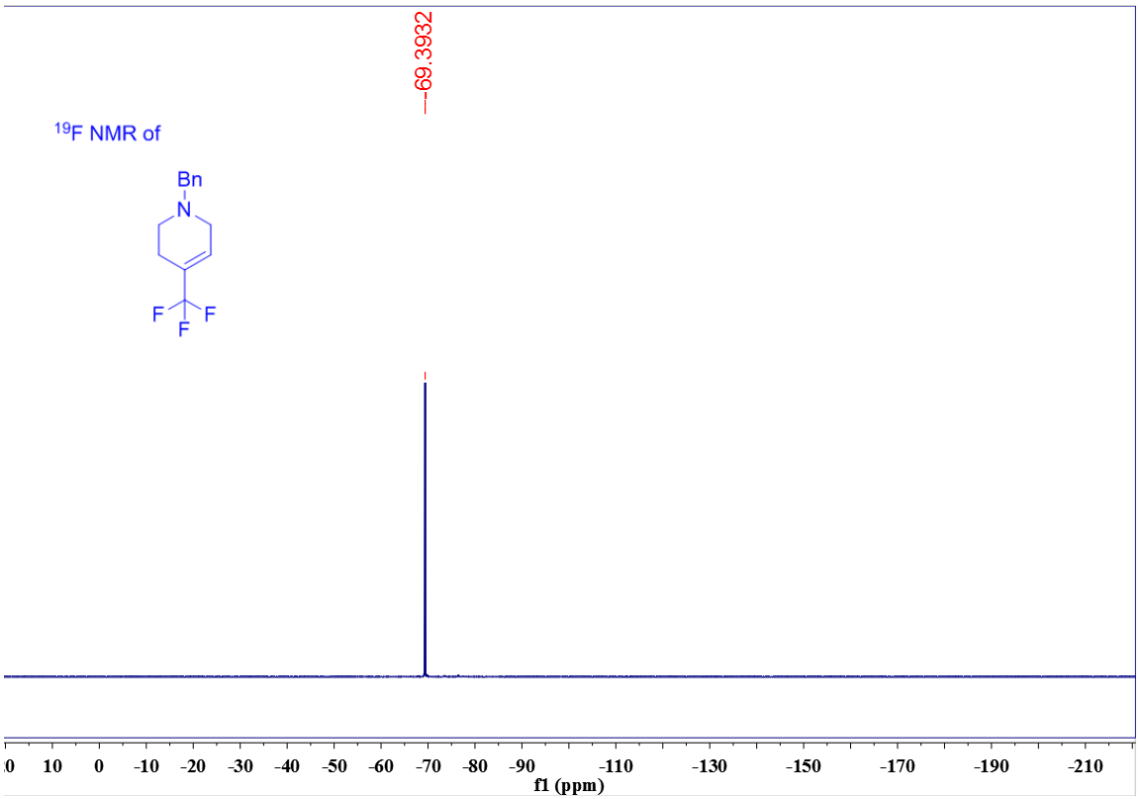
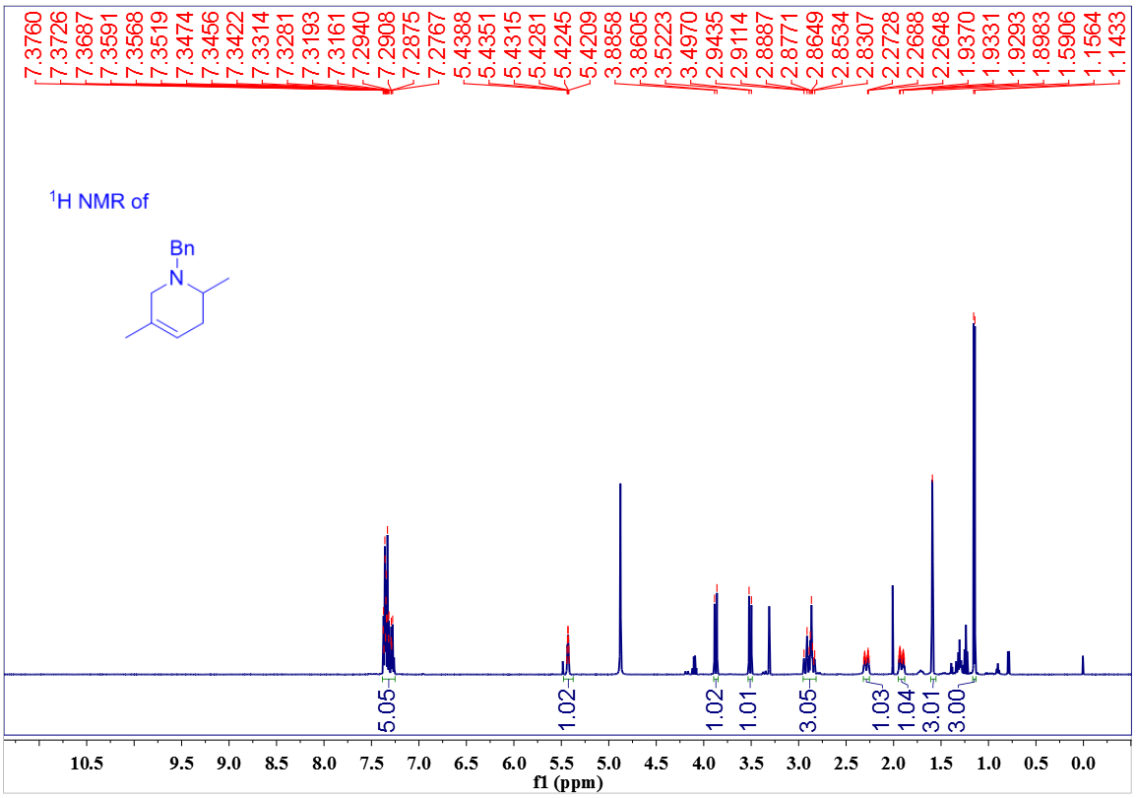
51.4693
48.4884
23.2701
13C NMR of
Bn
N
F
F
F
f1 (ppm)

10m


-69.3932
19F NMR of
Bn
N
F
F
F
0 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -110 -130 -150 -170 -190 -210
f1 (ppm)

10m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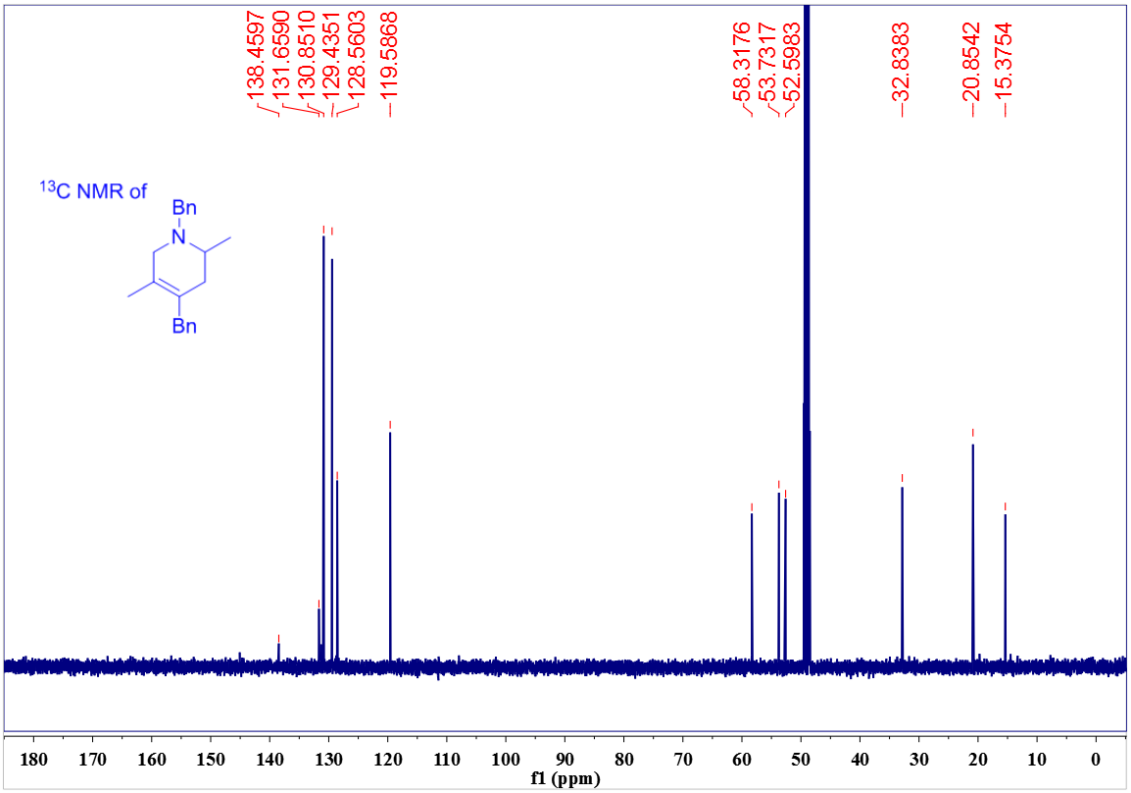
7.3314
7.3281
7.3193
7.3161
7.2940
7.2908
7.2875
7.2767
5.4388
5.4351
5.4315
5.4281
5.4245
5.4209
3.8858
3.8605
3.5223
3.4970
2.9435
2.9114
2.8887
2.8771
2.8649
2.8534
2.8307
2.2728
2.2688
2.2648
1.9370
1.9331
1.9293
1.8983
1.5906
1.1564
1.1433
1H NMR of
Bn
N
5.05
1.02
1.02
1.01
3.05
1.03
1.04
3.01
3.00
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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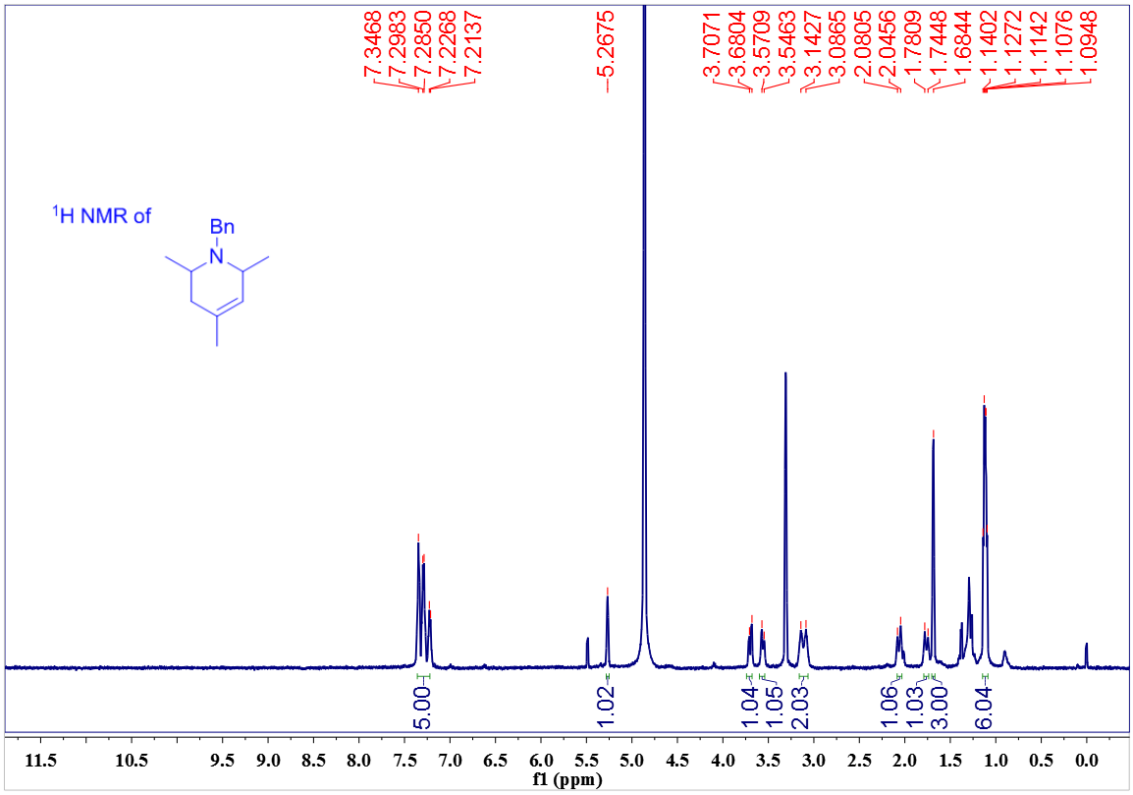
131.6590
130.8510
129.4351
128.5603
119.5868
58.3176
53.7317
52.5983
32.8383
20.8542
15.3754
13C NMR of
Bn
N
Bn
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

10n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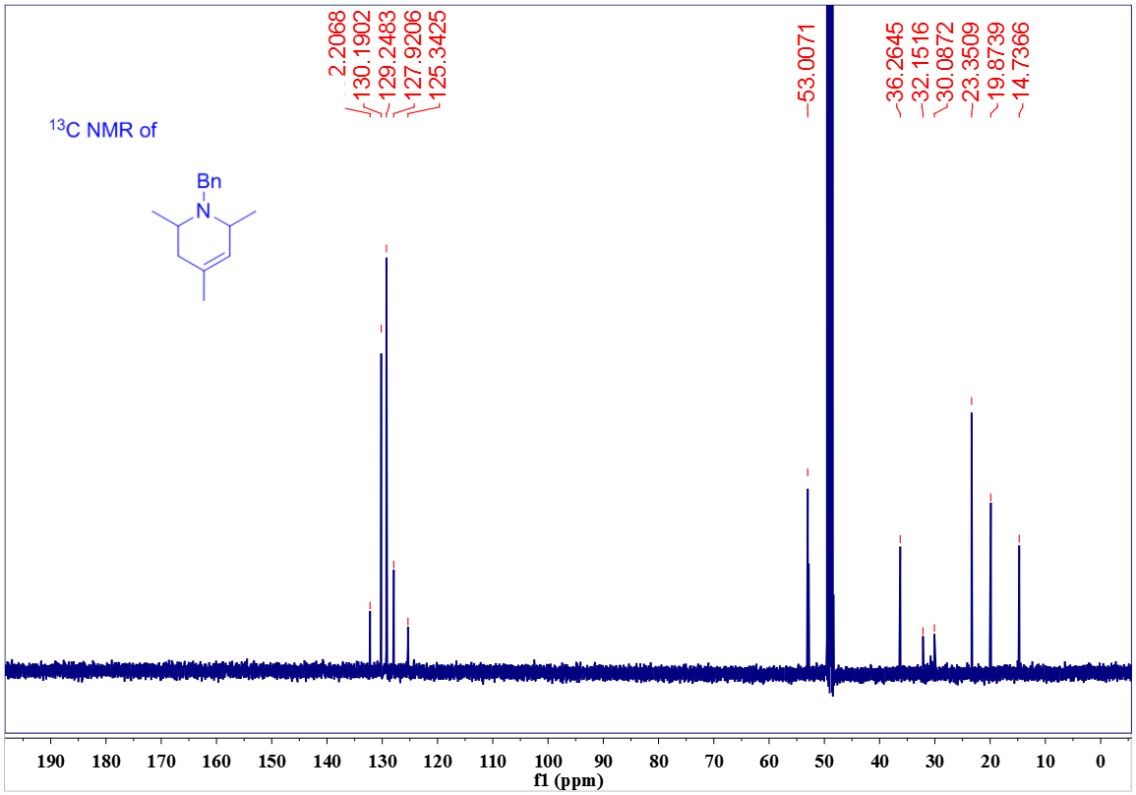
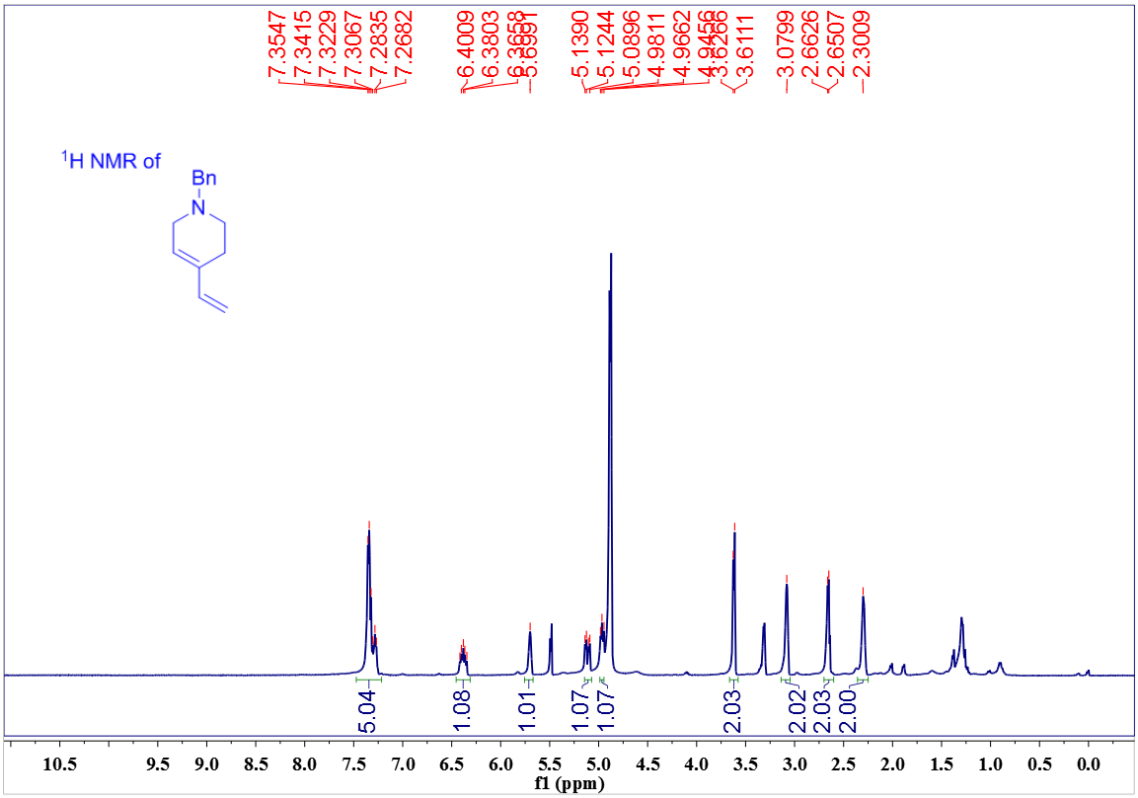
7.2983
7.2850
7.2268
7.2137
5.2675
3.7071
3.6804
3.5709
3.5463
3.1427
3.0865
2.0805
2.0456
1.7809
1.7448
1.6844
1.1402
1.1272
1.1142
1.1076
1.0948
1H NMR of
Bn
N
5.00
1.02
1.04
1.05
2.03
1.06
1.03
3.00
6.04
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


2.2068
130.1902
129.2483
127.9206
125.3425
53.0071
36.2645
32.1516
30.0872
23.3509
19.8739
14.7366
13C NMR of
Bn
N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

10o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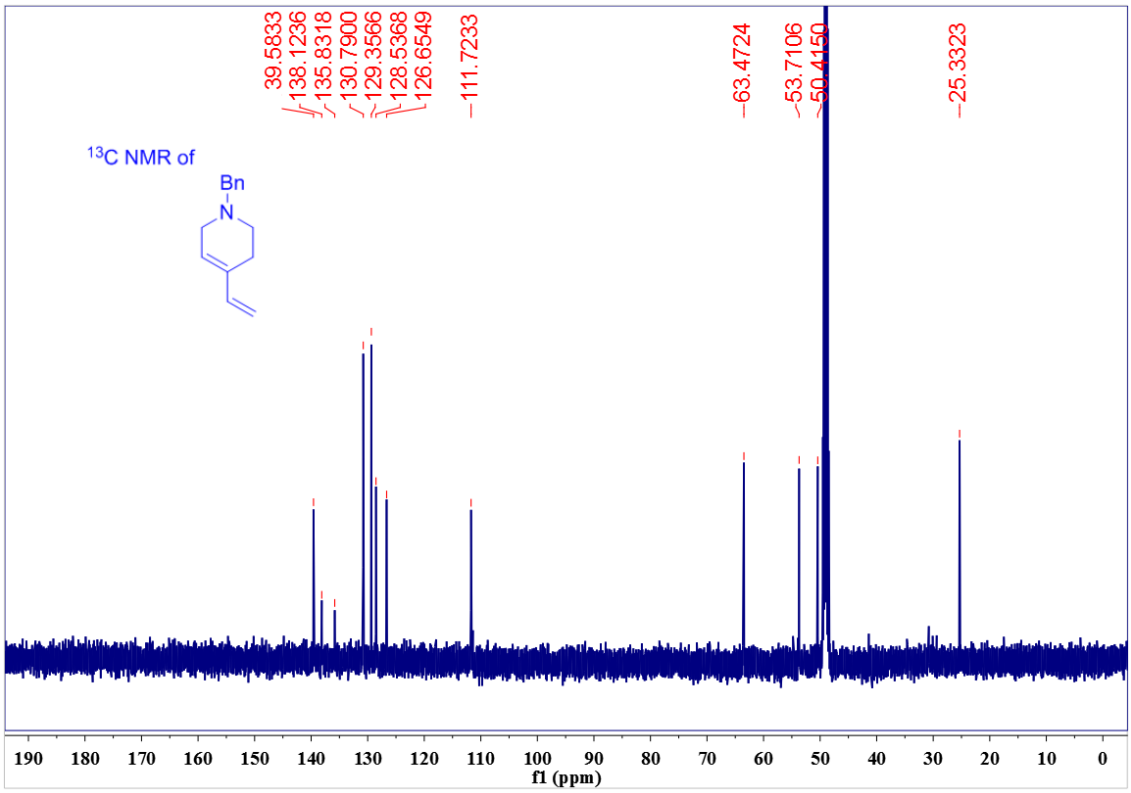
7.3229
7.3067
7.2835
7.2682
6.4009
6.3803
6.3658
6.3501
5.1390
5.1244
5.0896
4.9811
4.9662
4.9456
4.9266
3.6111
3.0799
2.6626
2.6507
2.3009
1H NMR of
Bn
N
5.04
1.08
1.01
1.07
1.07
2.03
2.02
2.03
2.00
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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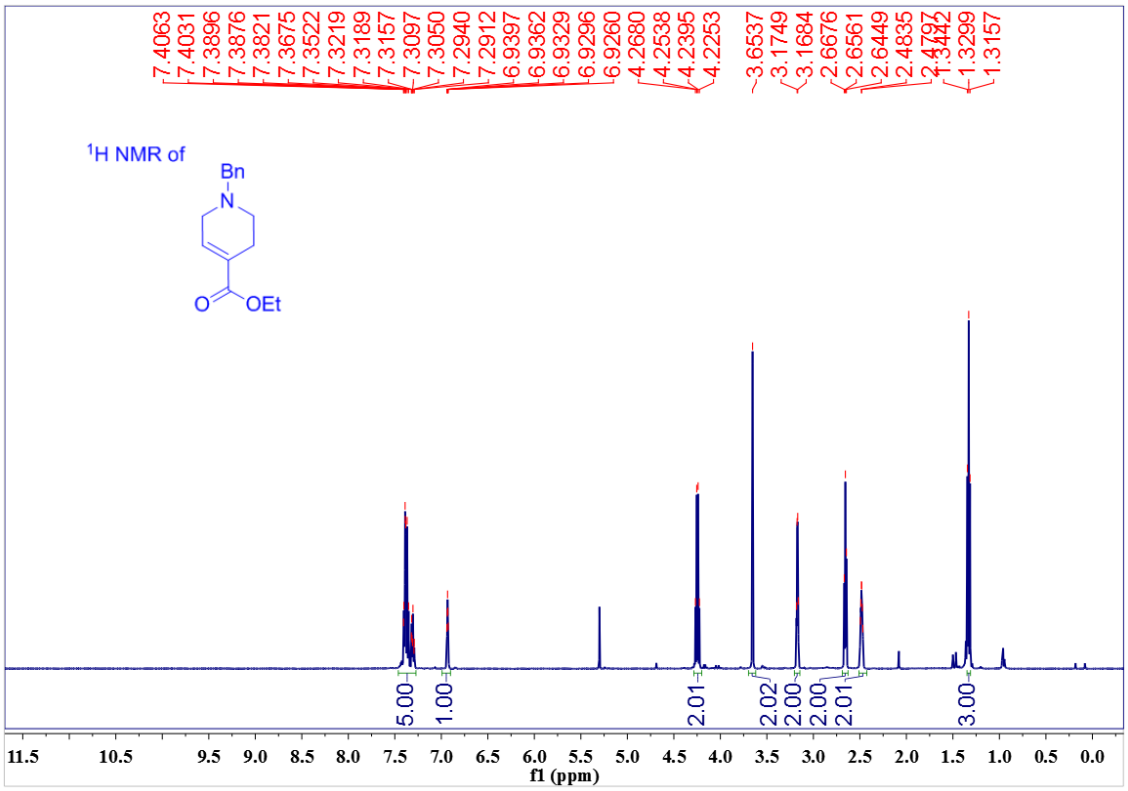
138.1236
135.8318
130.7900
129.3566
128.5368
126.6549
111.7233
63.4724
53.7106
50.4150
25.3323
13C NMR of
Bn
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

10p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7.3876
7.3821
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7.3522
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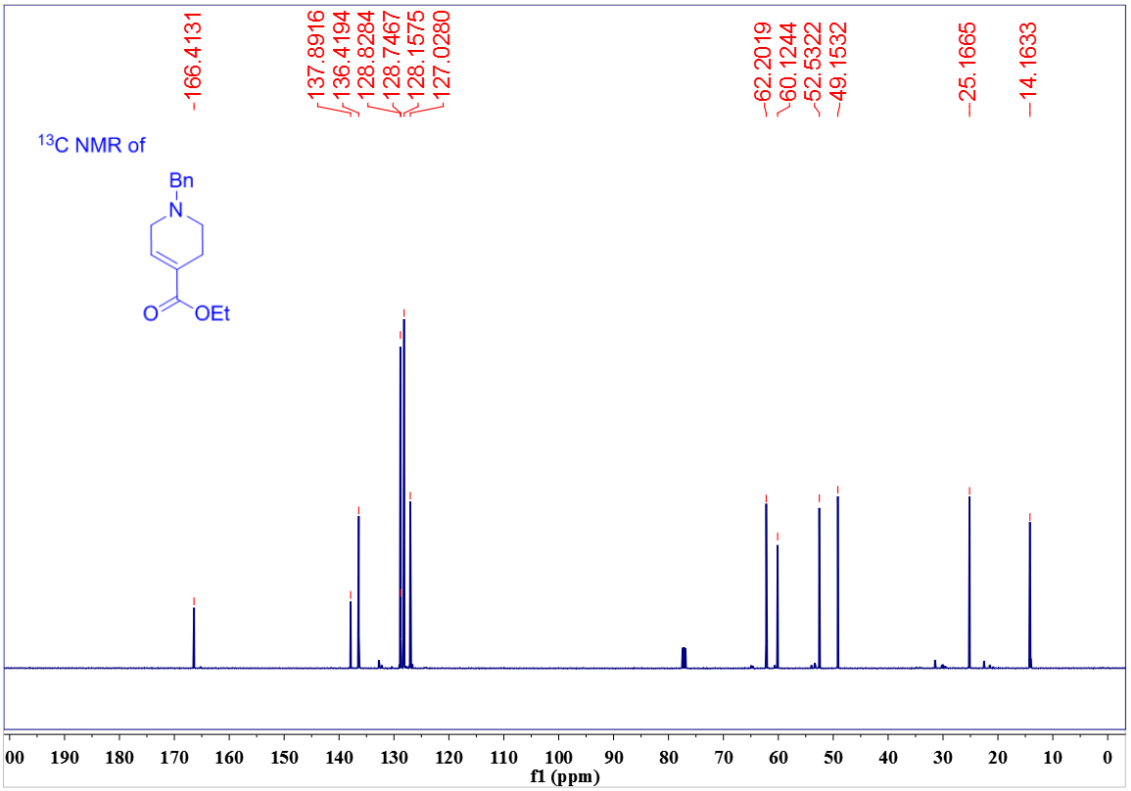
7.3189
7.3157
7.3097
7.3050
7.2940
7.2912
6.9397
6.9362
6.9329
6.9296
6.9260
4.2680
4.2538
4.2395
4.2253
3.6537
3.1749
3.1684
2.6676
2.6561
2.6449
2.4835
2.4797
1.3442
1.3299
1.3157
1H NMR of
Bn
N
O
OEt
5.00
1.00
2.01
2.02
2.00
2.00
2.01
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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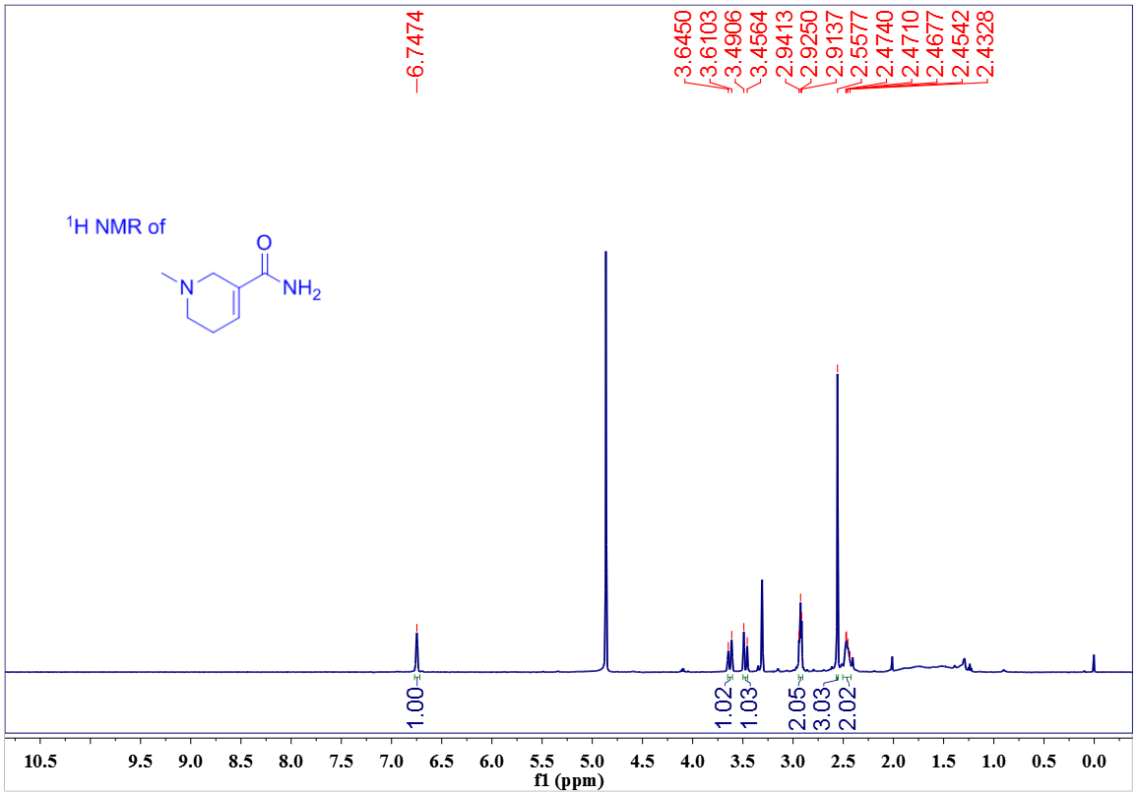
128.8284
128.7467
128.1575
127.0280
62.2019
60.1244
52.5322
49.1532
25.1665
14.1633
13C NMR of
Bn
N
O
OEt
00
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

10q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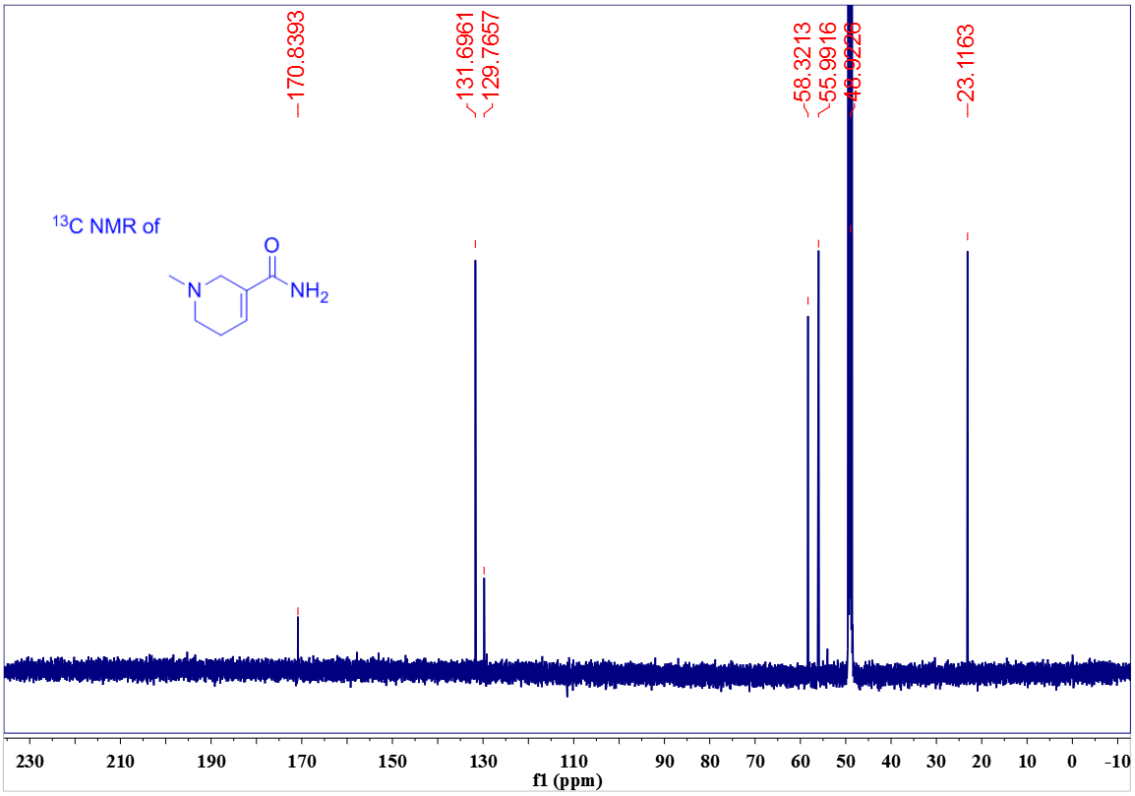
3.6103
3.4906
3.4564
2.9413
2.9250
2.9137
2.5577
2.4740
2.4710
2.4677
2.4542
2.4328
1H NMR of
O
N
NH2
1.00
1.02
1.03
2.05
3.03
2.02
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


170.8393
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129.7657
58.3213
55.9916
48.9220
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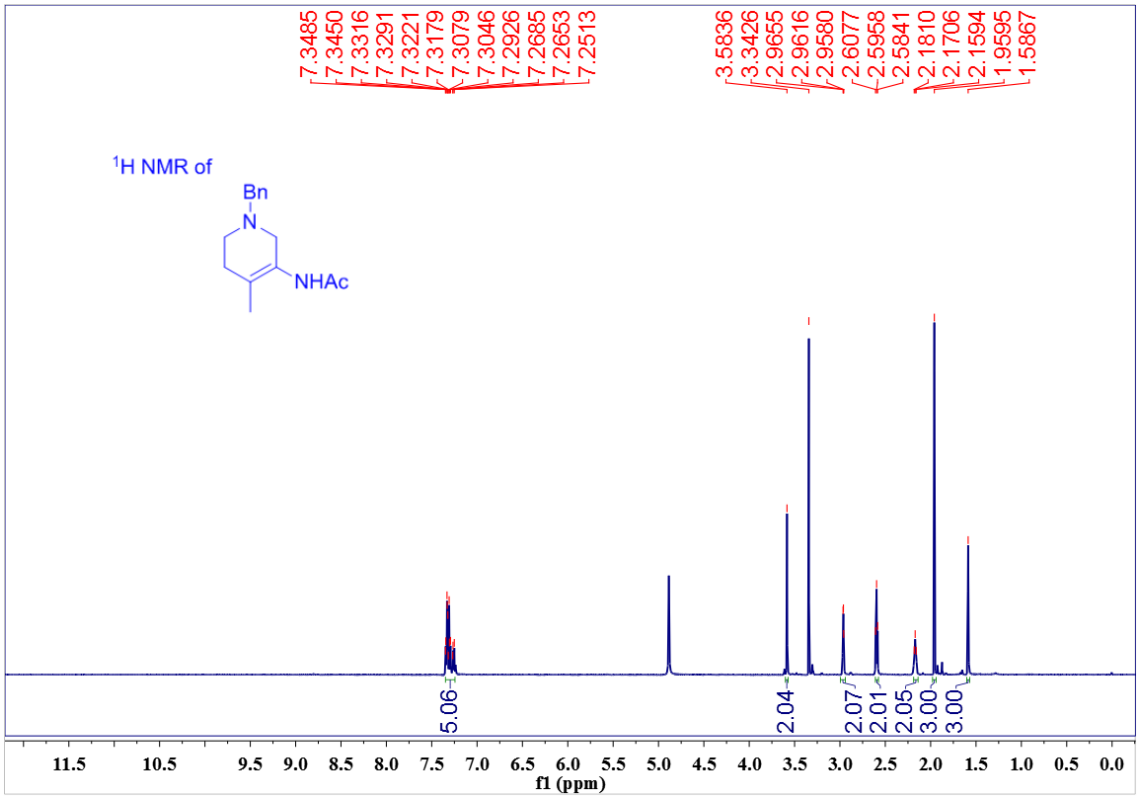
O
N
NH2
230 210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

10r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7.3221
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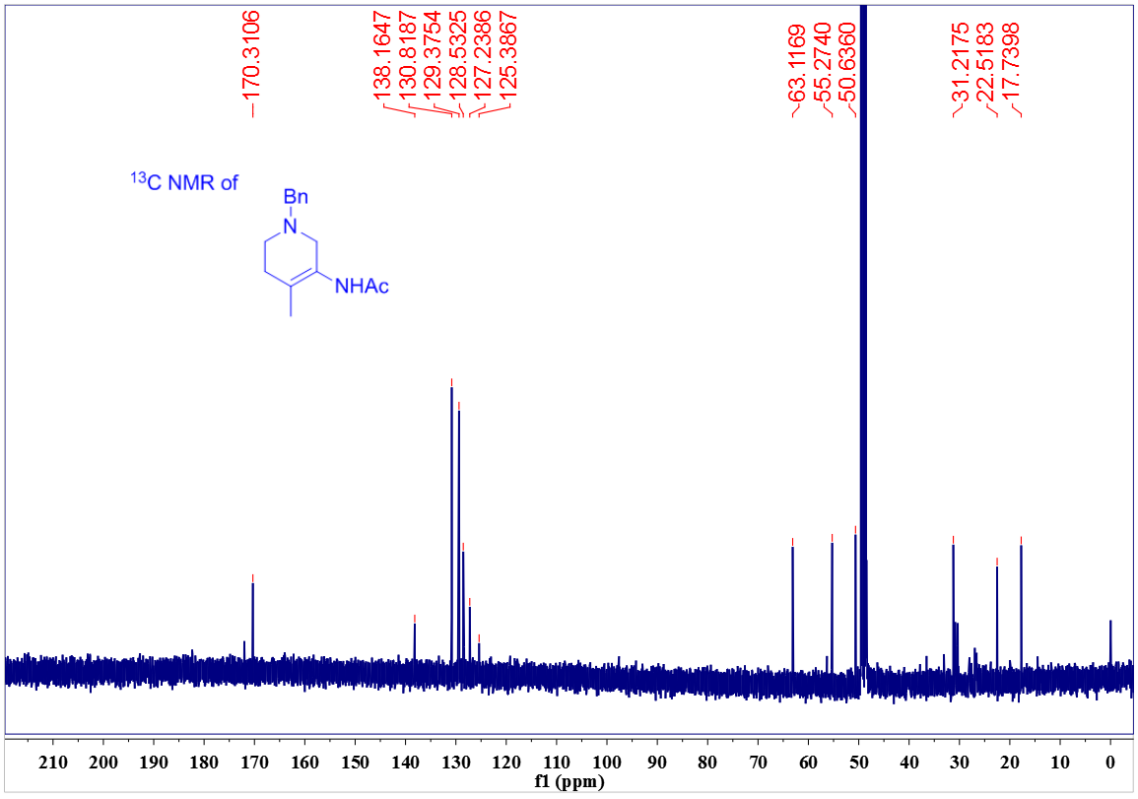
7.2926
7.2685
7.2653
7.2513
3.5836
3.3426
2.9655
2.9616
2.9580
2.6077
2.5958
2.5841
2.1810
2.1706
2.1594
1.9595
1.5867
1H NMR of
Bn
N
NHAc
5.06
2.04
2.07
2.01
2.05
3.00
3.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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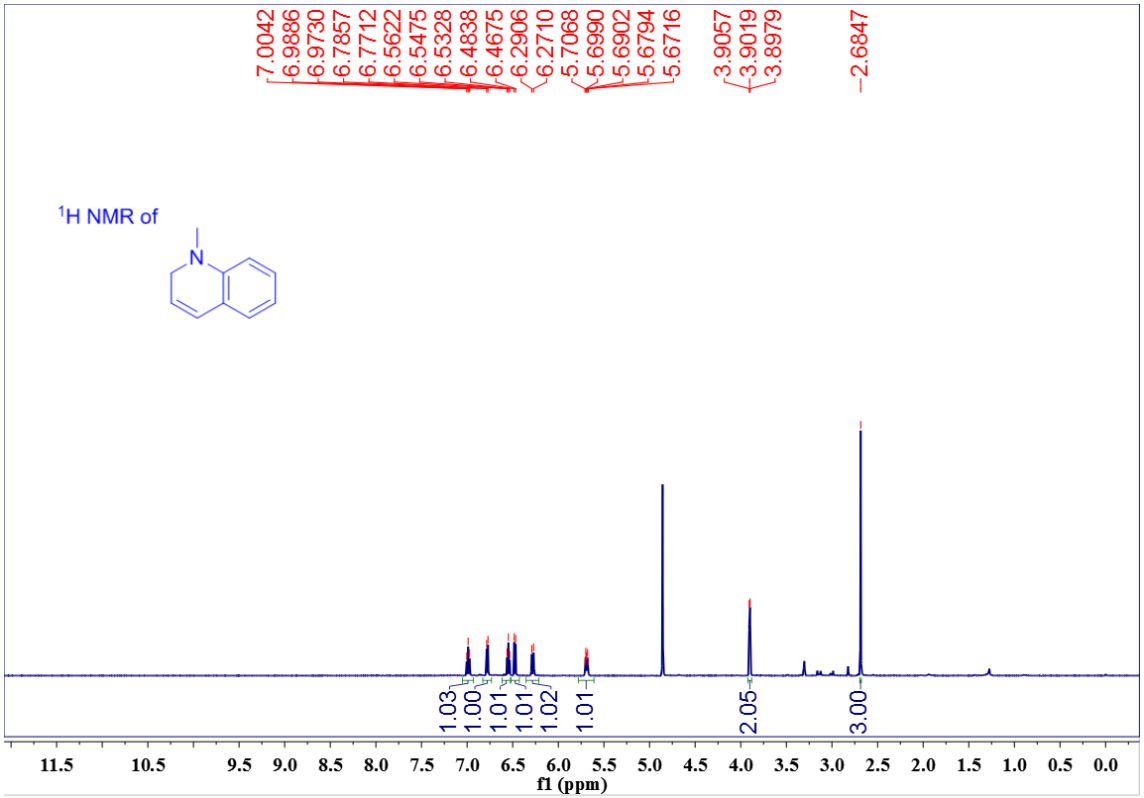
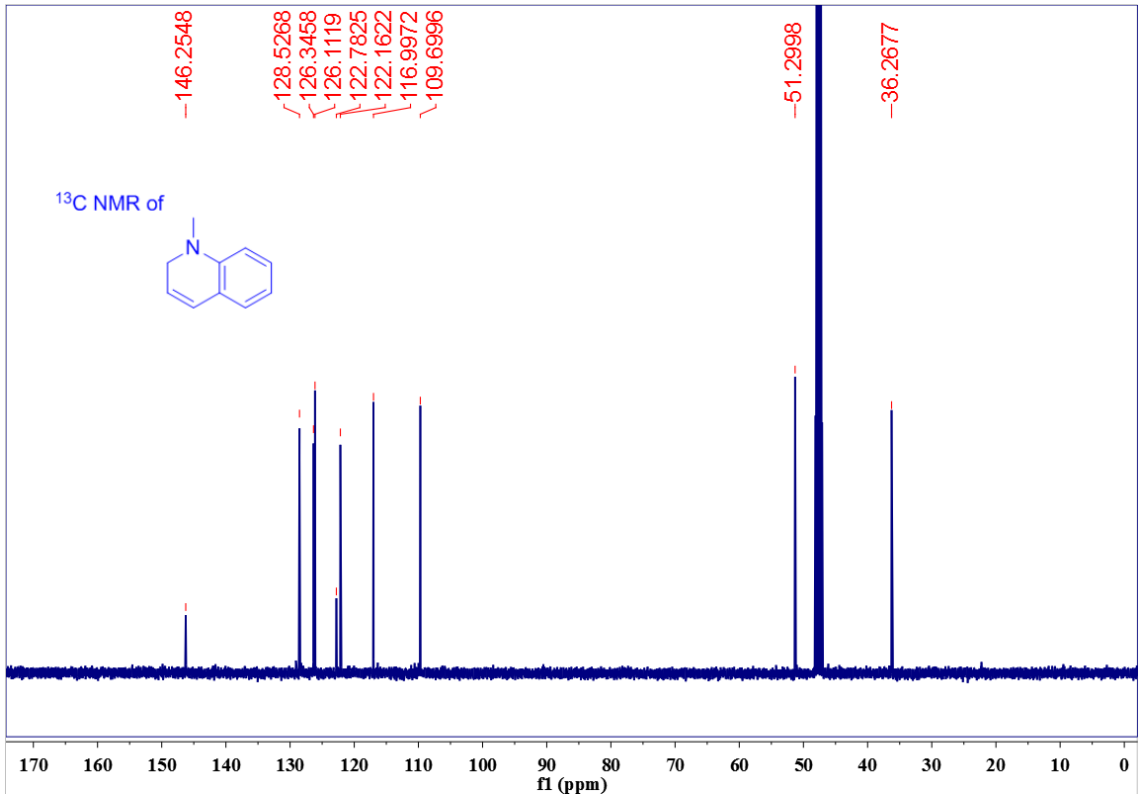
129.3754
128.5325
127.2386
125.3867
63.1169
55.2740
50.6360
31.2175
22.5183
17.7398
13C NMR of
Bn
N
NHAc
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

10s


7.0042
6.9886
6.9730
6.7857
6.7712
6.5622
6.5475
6.5328
6.4838
6.4675
6.2906
6.2710
5.7068
5.6990
5.6902
5.6794
5.6716
3.9057
3.9019
3.8979
2.6847
1H NMR of
1.03
1.00
1.01
1.01
1.02
1.01
2.05
3.00
f1 (ppm)


146.2548
128.5268
126.3458
126.1119
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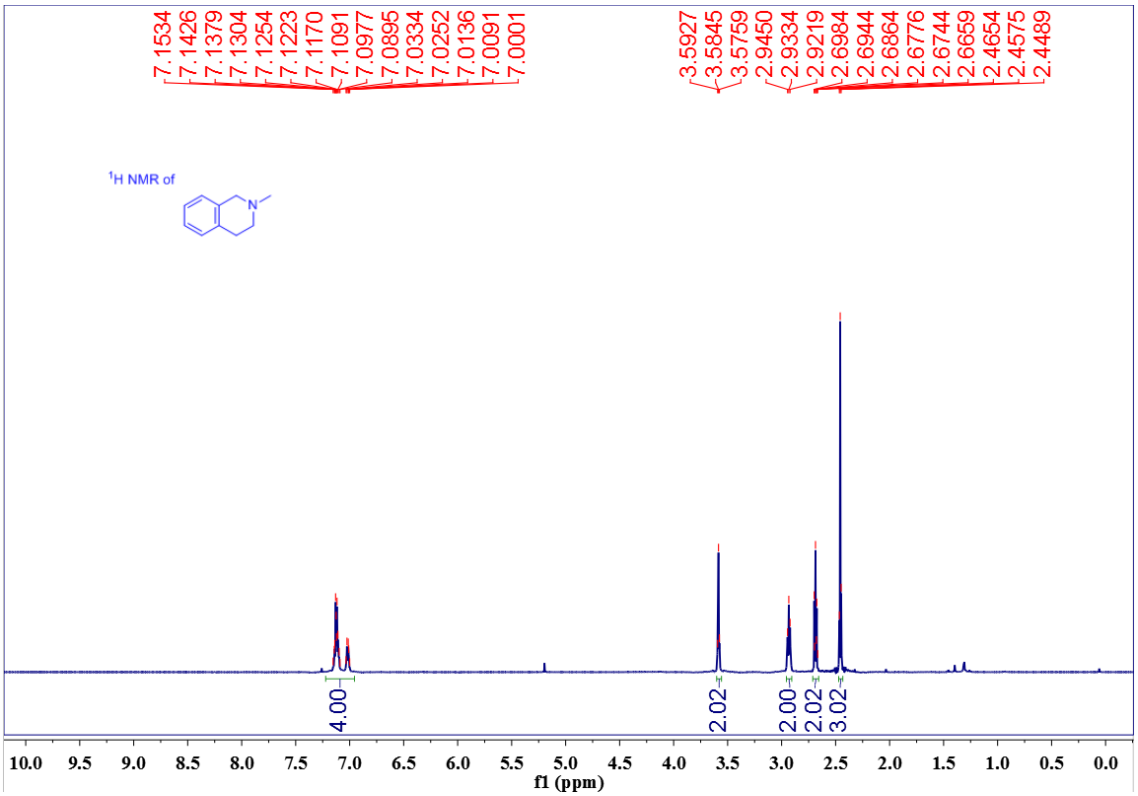
122.1622
116.9972
109.6996
51.2998
36.2677
13C NMR of
f1 (ppm)

10t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7.1223
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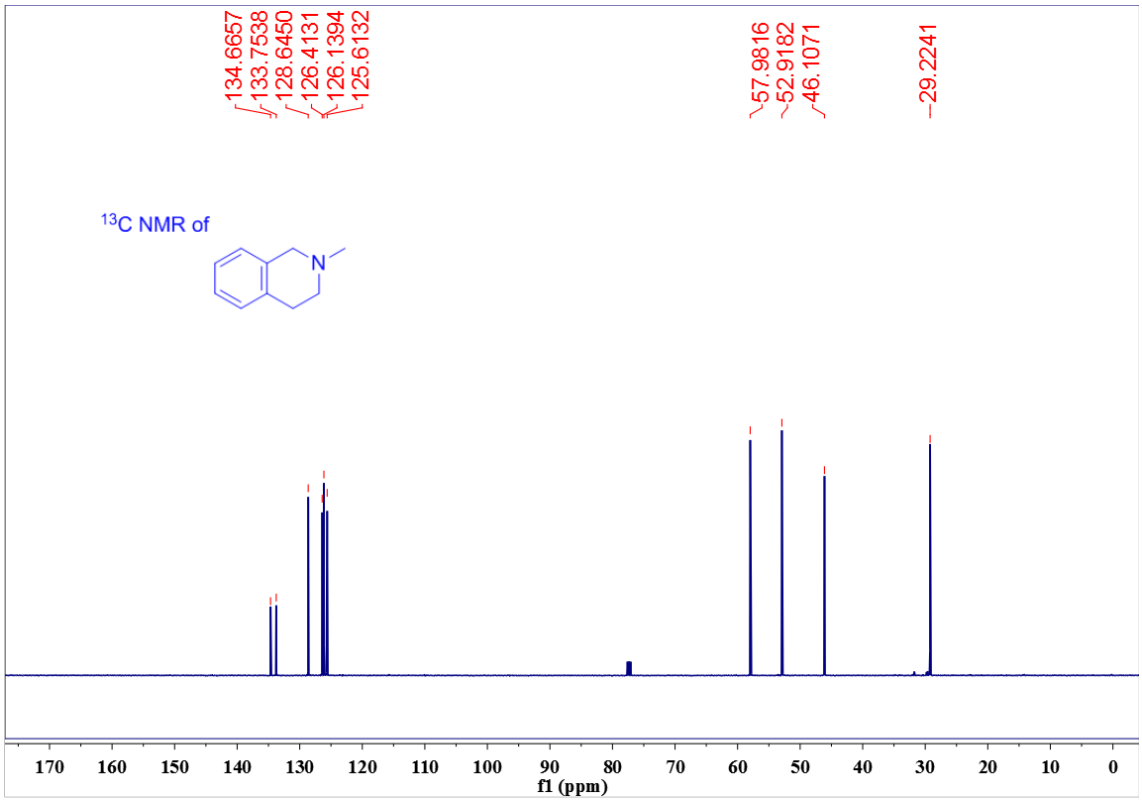
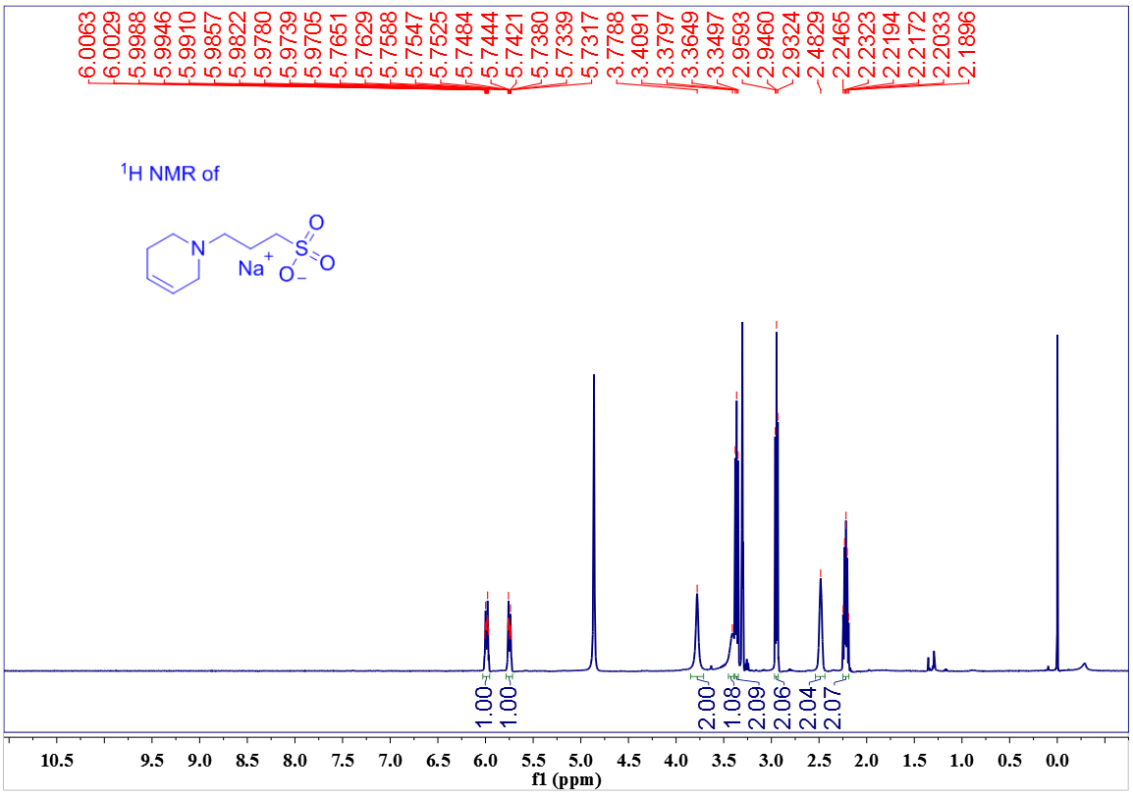
7.0334
7.0252
7.0136
7.0091
7.0001
3.5927
3.5845
3.5759
2.9450
2.9334
2.9219
2.6984
2.6944
2.6864
2.6776
2.6744
2.6659
2.4654
2.4575
2.4489
1H NMR of
N
4.00
2.02
2.00
2.02
3.02
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


134.6657
133.7538
128.6450
126.4131
126.1394
125.6132
57.9816
52.9182
46.1071
29.2241
13C NMR of
N
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

10u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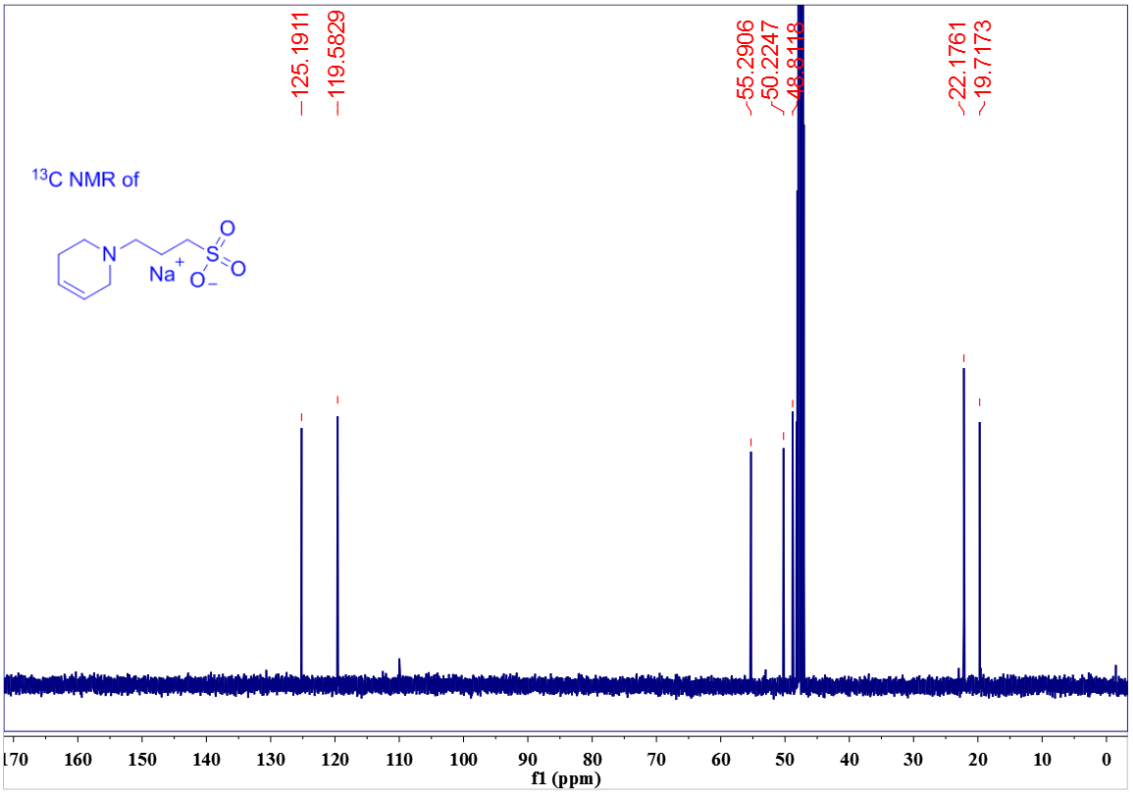
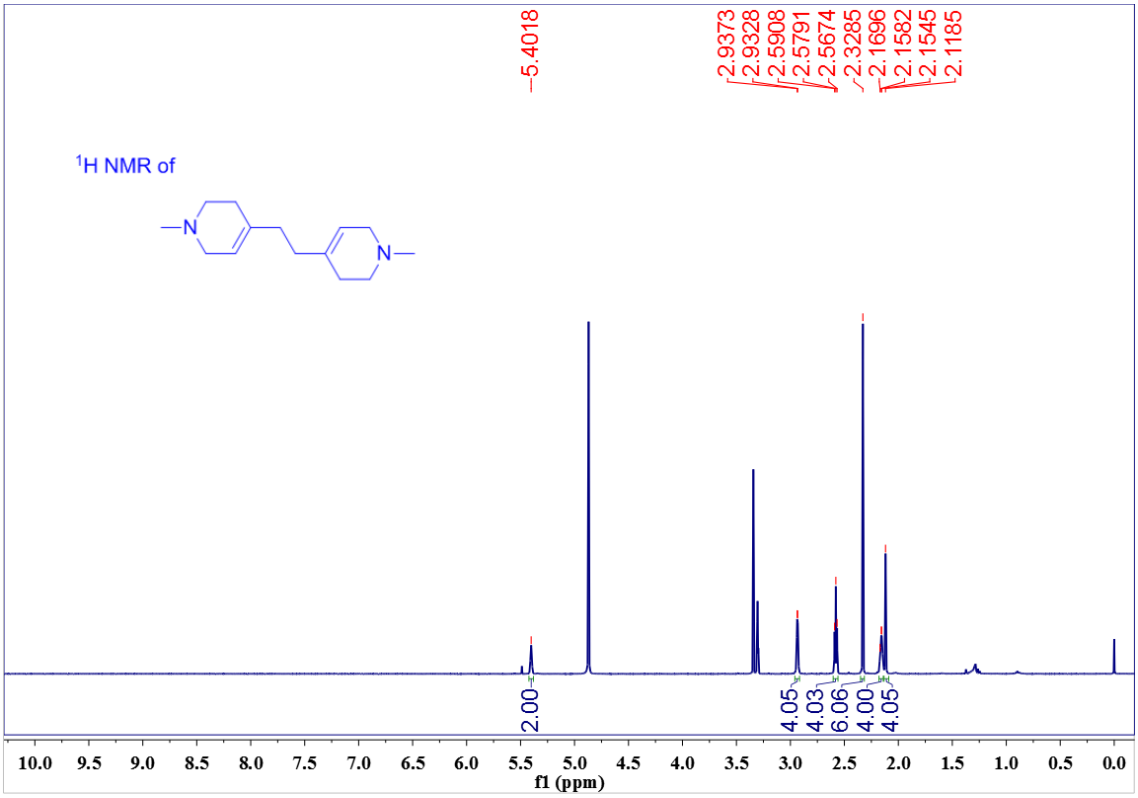
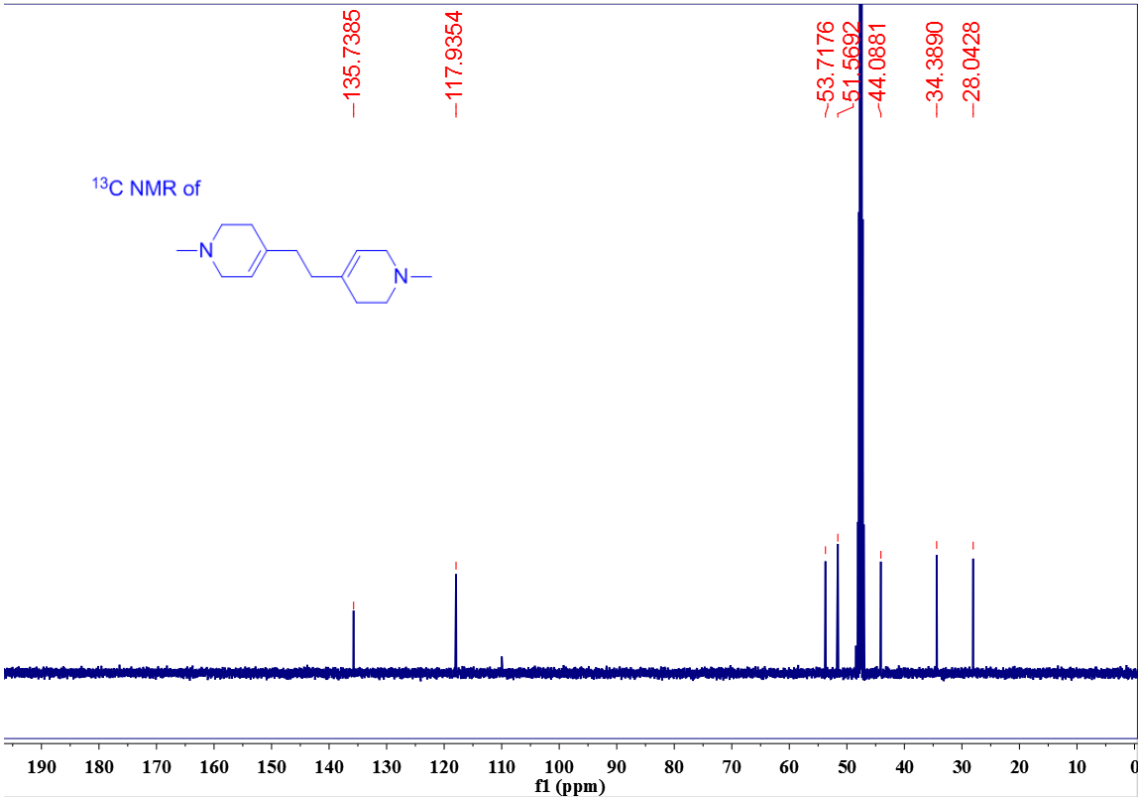
5.9910
5.9857
5.9822
5.9780
5.9739
5.9705
5.7651
5.7629
5.7588
5.7547
5.7525
5.7484
5.7444
5.7421
5.7380
5.7339
5.7317
3.7788
3.4091
3.3797
3.3649
3.3497
2.9593
2.9460
2.9324
2.4829
2.2465
2.2323
2.2194
2.2172
2.2033
2.1896
1H NMR of
1.00
1.00
2.00
1.08
2.09
2.06
2.04
2.07
f1 (ppm)

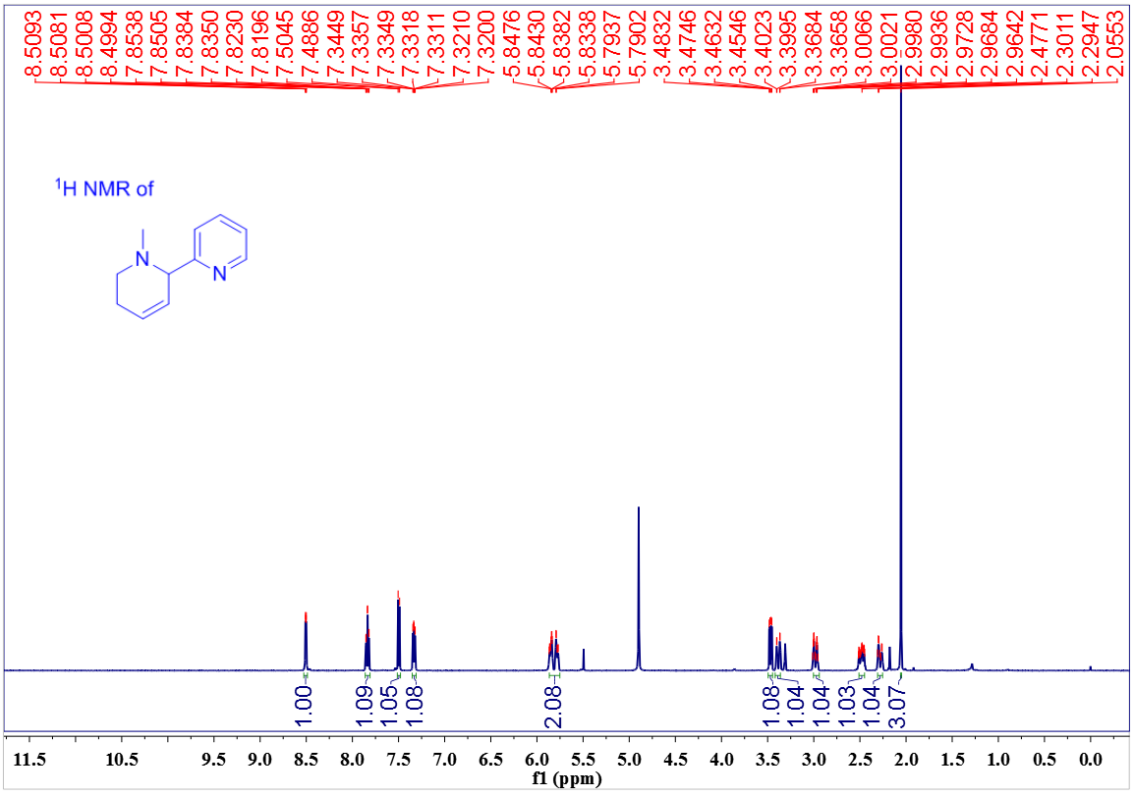

125.1911
119.5829
55.2906
50.2247
48.8118
22.1761
19.7173
13C NMR of
f1 (ppm)

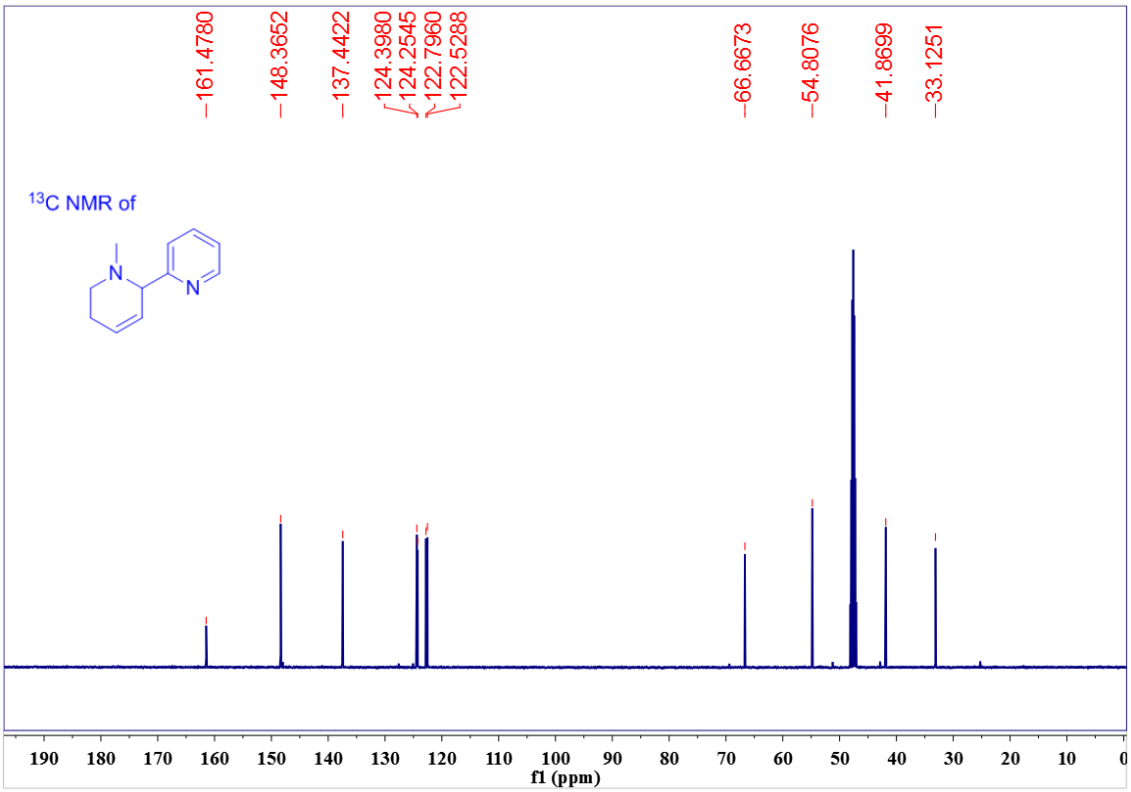
10v


5.4018
2.9373
2.9328
2.5908
2.5791
2.5674
2.3285
2.1696
2.1582
2.1545
2.1185
1H NMR of
2.00
4.05
4.03
6.06
4.00
4.05
f1 (ppm)

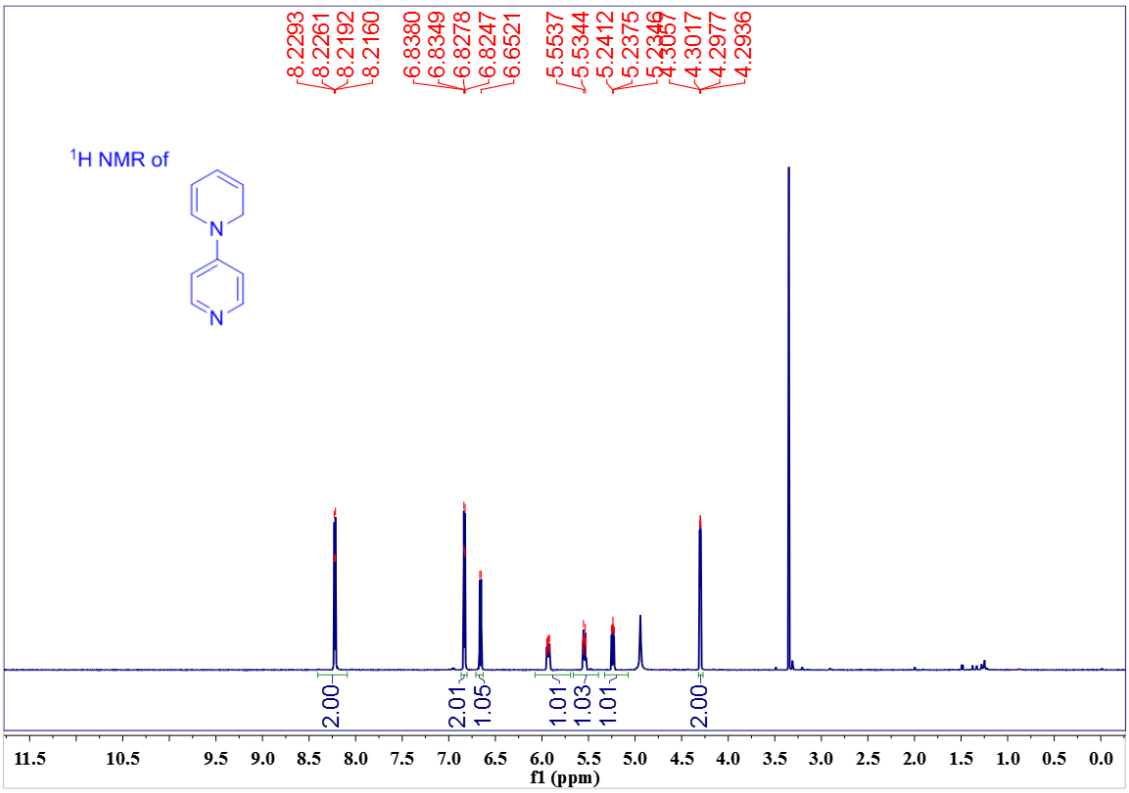

135.7385
117.9354
53.7176
51.5692
44.0881
34.3890
28.0428
13C NMR of
f1 (ppm)

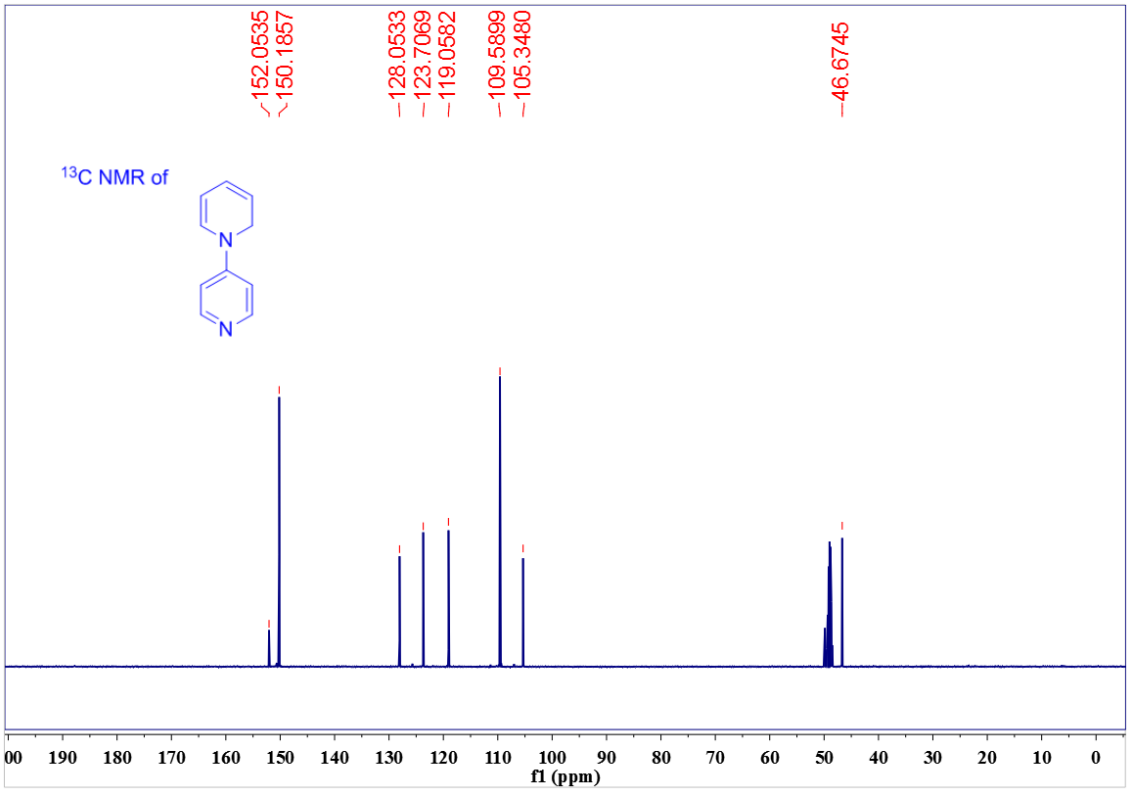
10w


8.5093
8.5081
8.5008
8.4994
7.8538
7.8505
7.8384
7.8350
7.8230
7.8196
7.5045
7.4886
7.3449
7.3357
7.3349
7.3318
7.3311
7.3210
7.3200
5.8476
5.8430
5.8382
5.8338
5.7937
5.7902
3.4832
3.4746
3.4632
3.4546
3.4023
3.3995
3.3684
3.3658
3.0066
3.0021
2.9980
2.9936
2.9728
2.9684
2.9642
2.4771
2.3011
2.2947
2.0553
1H NMR of
1.00
1.09
1.05
1.08
2.08
1.08
1.04
1.04
1.03
1.04
3.07
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

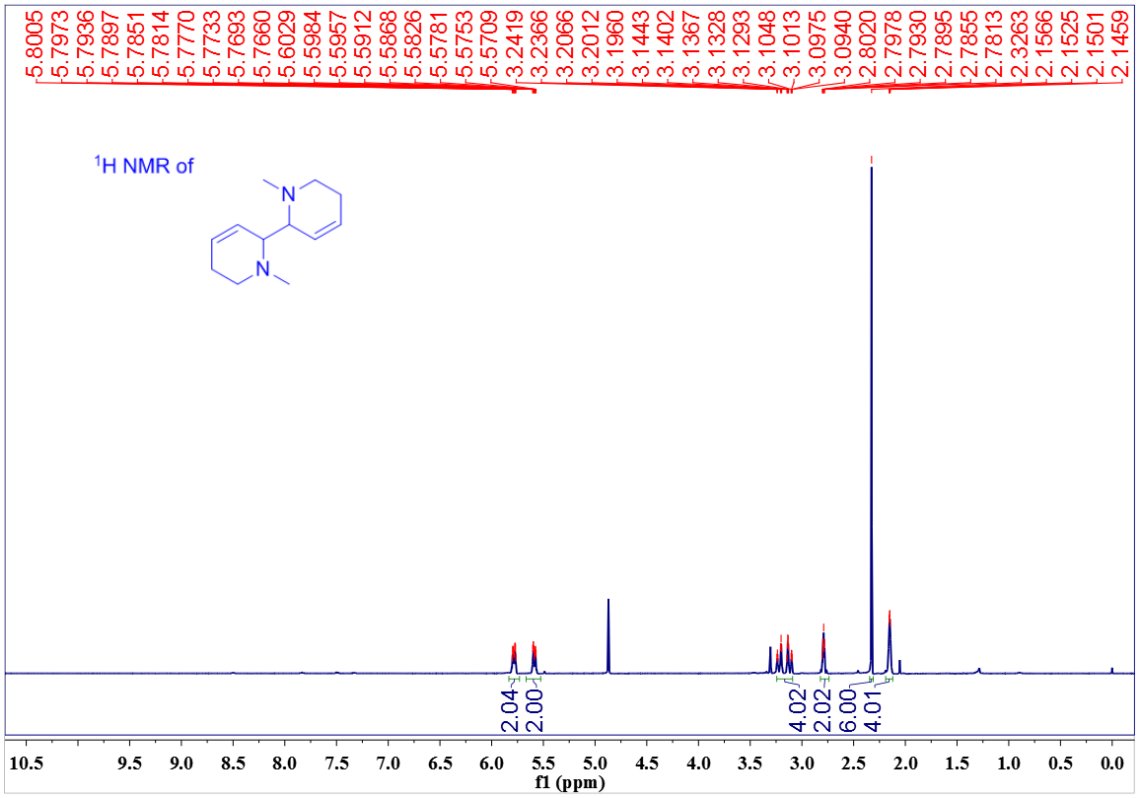

161.4780
148.3652
137.4422
124.3980
124.2545
122.7960
122.5288
66.6673
54.8076
41.8699
33.1251
13C NMR of
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

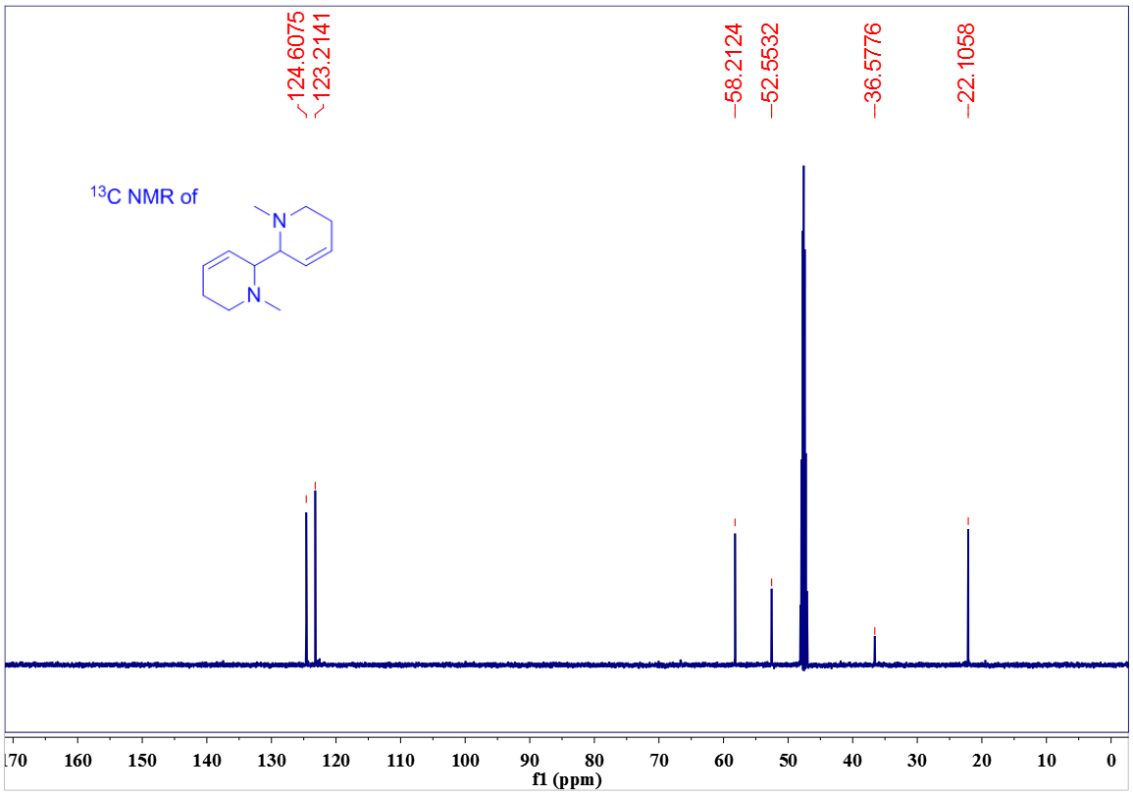
10x


8.2293
8.2261
8.2192
8.2160
6.8380
6.8349
6.8278
6.8247
6.6521
5.5537
5.5344
5.2412
5.2375
4.3057
4.3017
4.2977
4.2936
1H NMR of
N
N
2.00
2.01
1.05
1.01
1.03
1.01
2.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

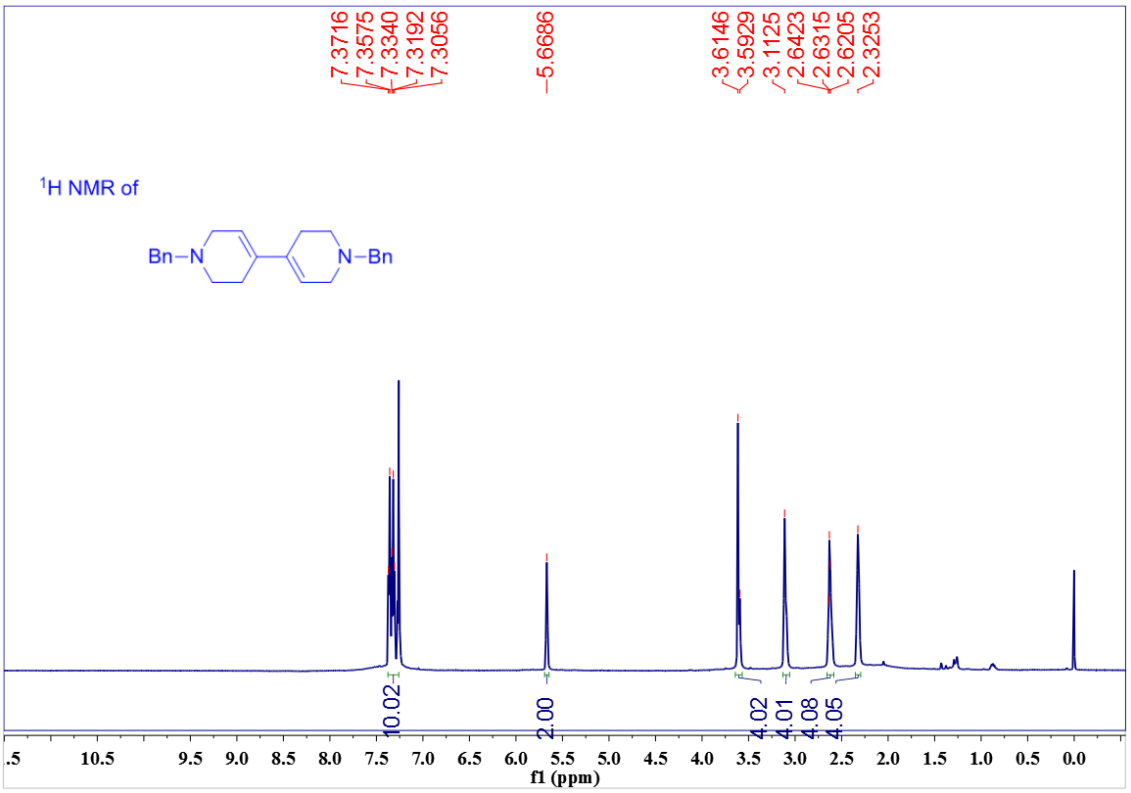

152.0535
150.1857
128.0533
123.7069
119.0582
109.5899
105.3480
46.6745
13C NMR of
N
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

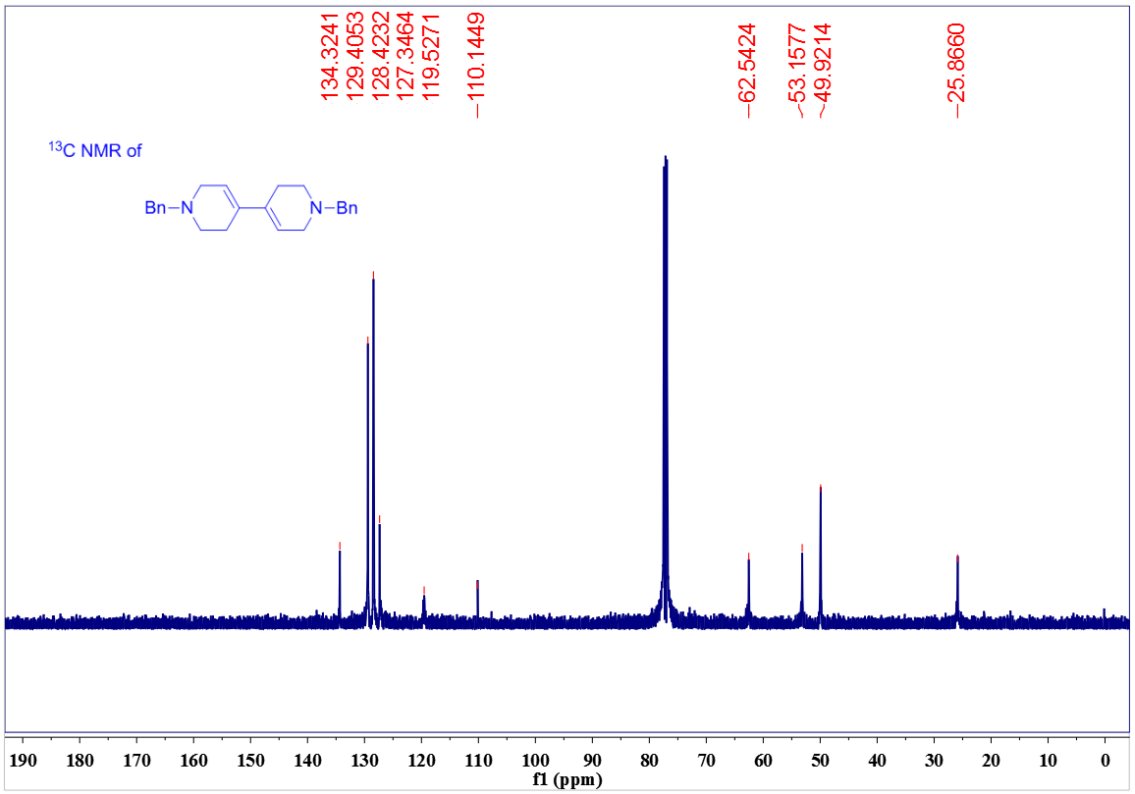
10y


5.8005
5.7973
5.7936
5.7897
5.7851
5.7814
5.7770
5.7733
5.7693
5.7660
5.6029
5.5984
5.5957
5.5912
5.5868
5.5826
5.5781
5.5753
5.5709
3.2419
3.2366
3.2066
3.2012
3.1960
3.1443
3.1402
3.1367
3.1328
3.1293
3.1048
3.1013
3.0975
3.0940
2.8020
2.7978
2.7930
2.7895
2.7855
2.7813
2.3263
2.1566
2.1525
2.1501
2.1459
1H NMR of
N
N
2.04
2.00
4.02
2.02
6.00
4.01
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

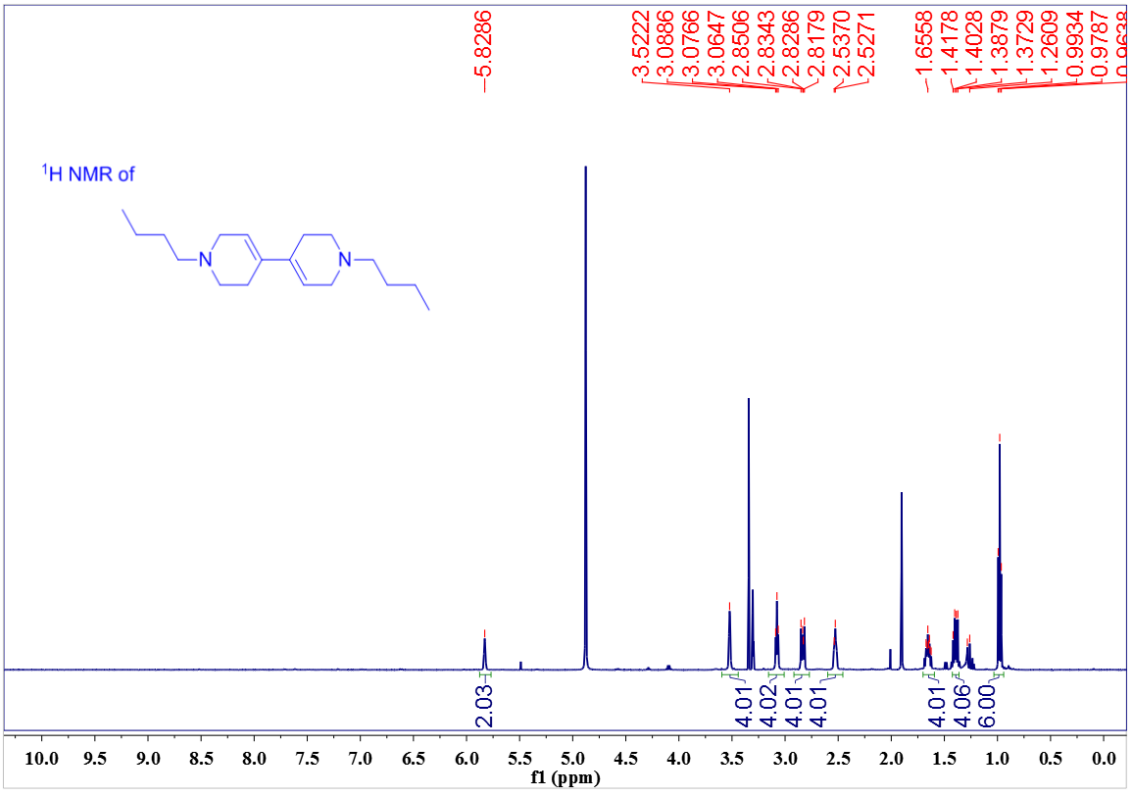

124.6075
123.2141
58.2124
52.5532
36.5776
22.1058
13C NMR of
N
N
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

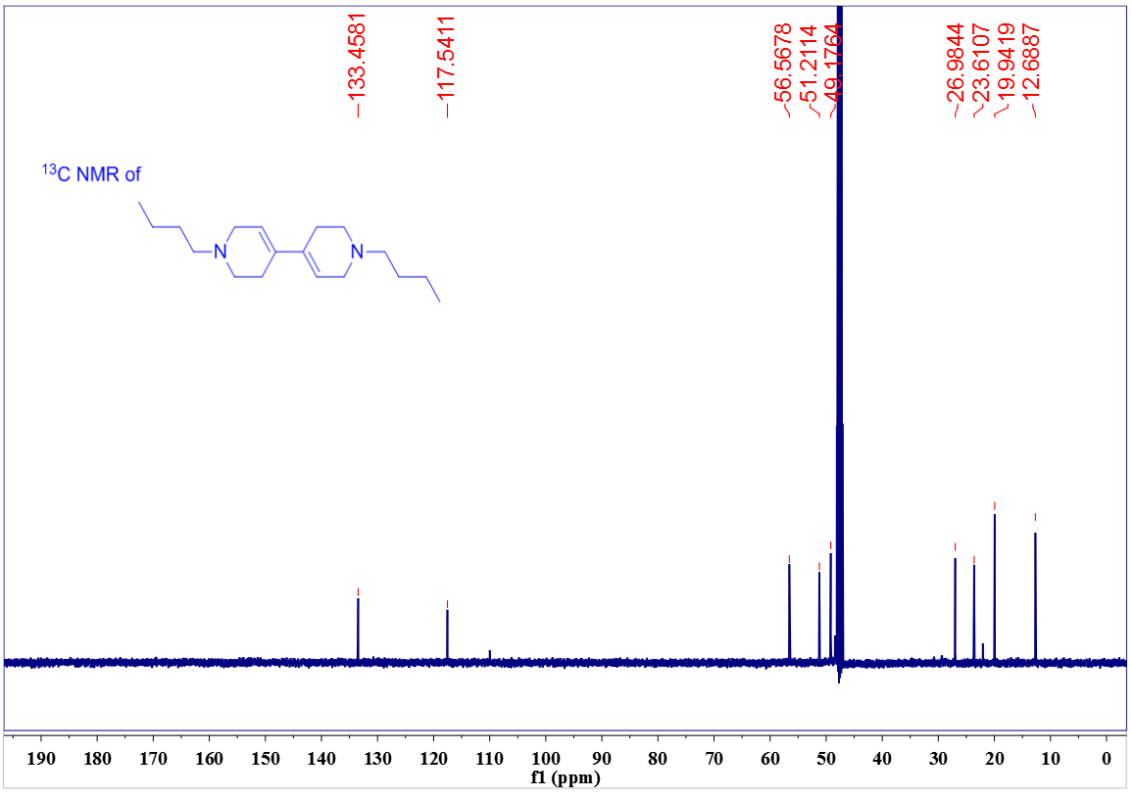
10aa


7.3716
7.3575
7.3340
7.3192
7.3056
5.6686
3.6146
3.5929
3.1125
2.6423
2.6315
2.6205
2.3253
1H NMR of
Bn–N
N–Bn
10.02
2.00
4.02
4.01
4.08
4.05
f1 (ppm)

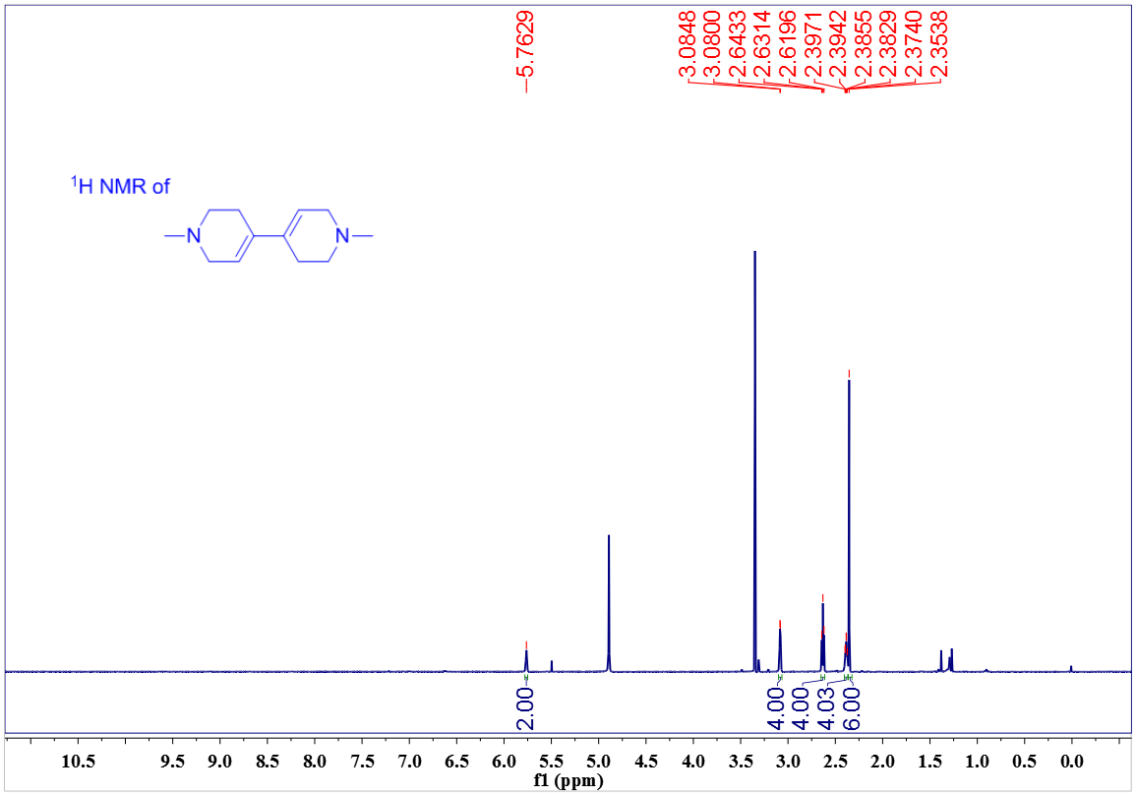

134.3241
129.4053
128.4232
127.3464
119.5271
110.1449
62.5424
53.1577
49.9214
25.8660
13C NMR of
Bn–N
N–Bn
f1 (ppm)

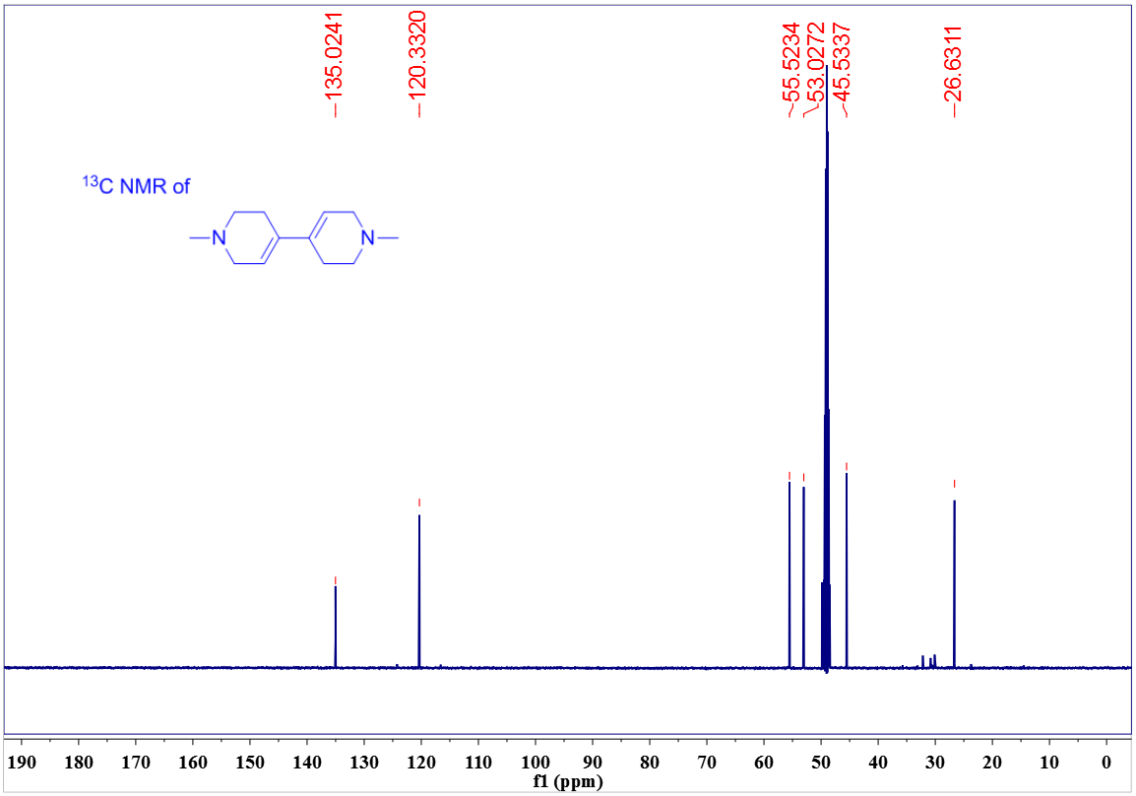
10ab


5.8286
3.5222
3.0886
3.0766
3.0647
2.8506
2.8343
2.8286
2.8179
2.5370
2.5271
1.6558
1.4178
1.4028
1.3879
1.3729
1.2609
0.9934
0.9787
1H NMR of
N
N
2.03
4.01
4.02
4.01
4.01
4.01
4.06
6.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

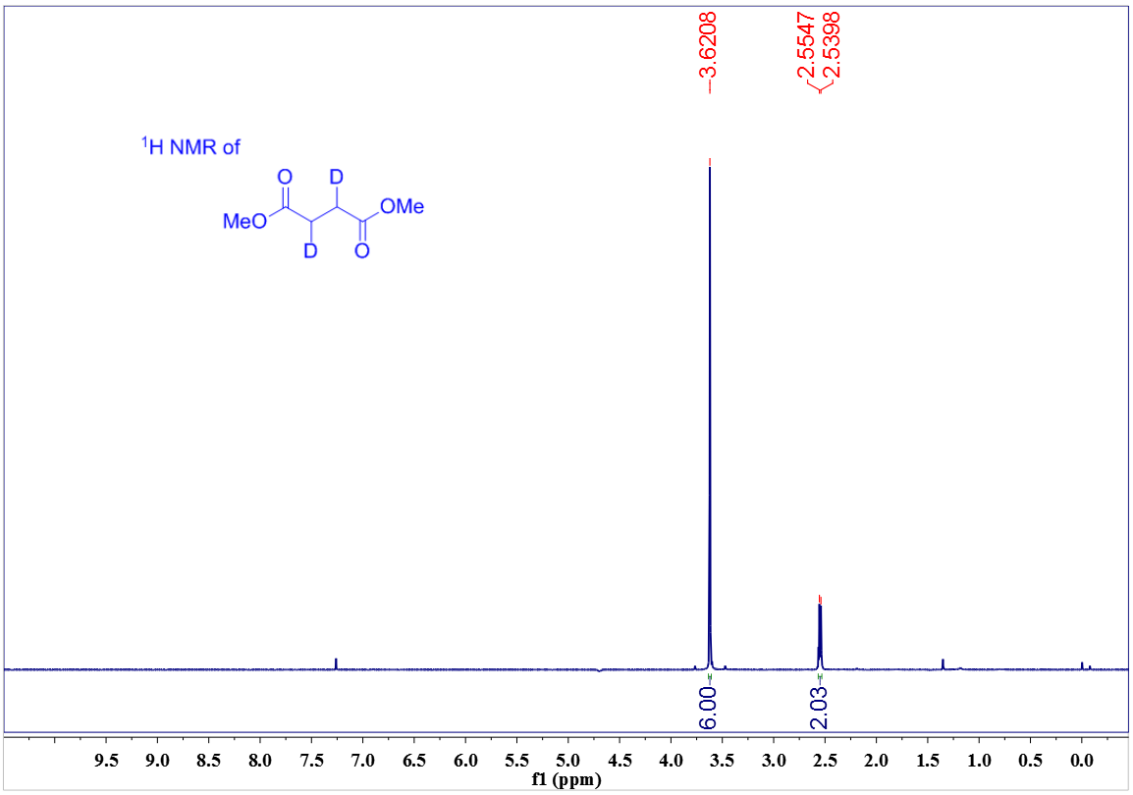

133.4581
117.5411
56.5678
51.2114
49.1764
26.9844
23.6107
19.9419
12.6887
13C NMR of
N
N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

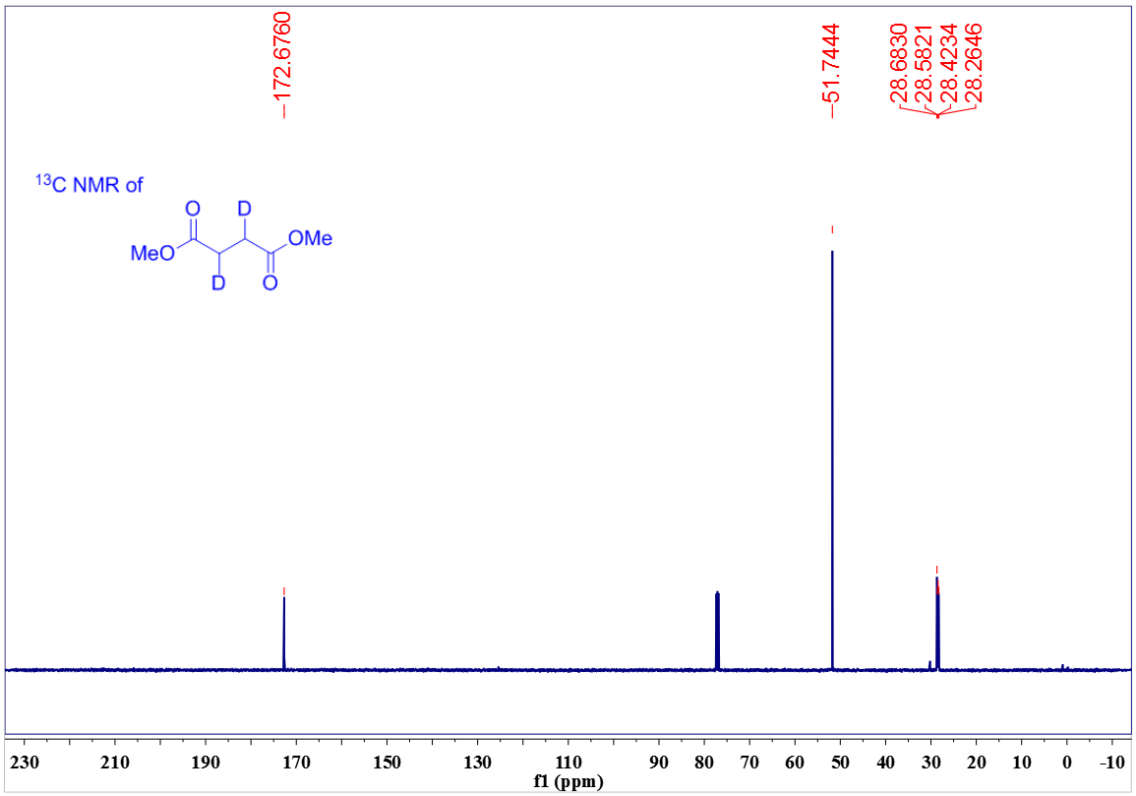
10ac


5.7629
3.0848
3.0800
2.6433
2.6314
2.6196
2.3971
2.3942
2.3855
2.3829
2.3740
2.3538
1H NMR of
2.00
4.00
4.00
4.03
6.00
f1 (ppm)

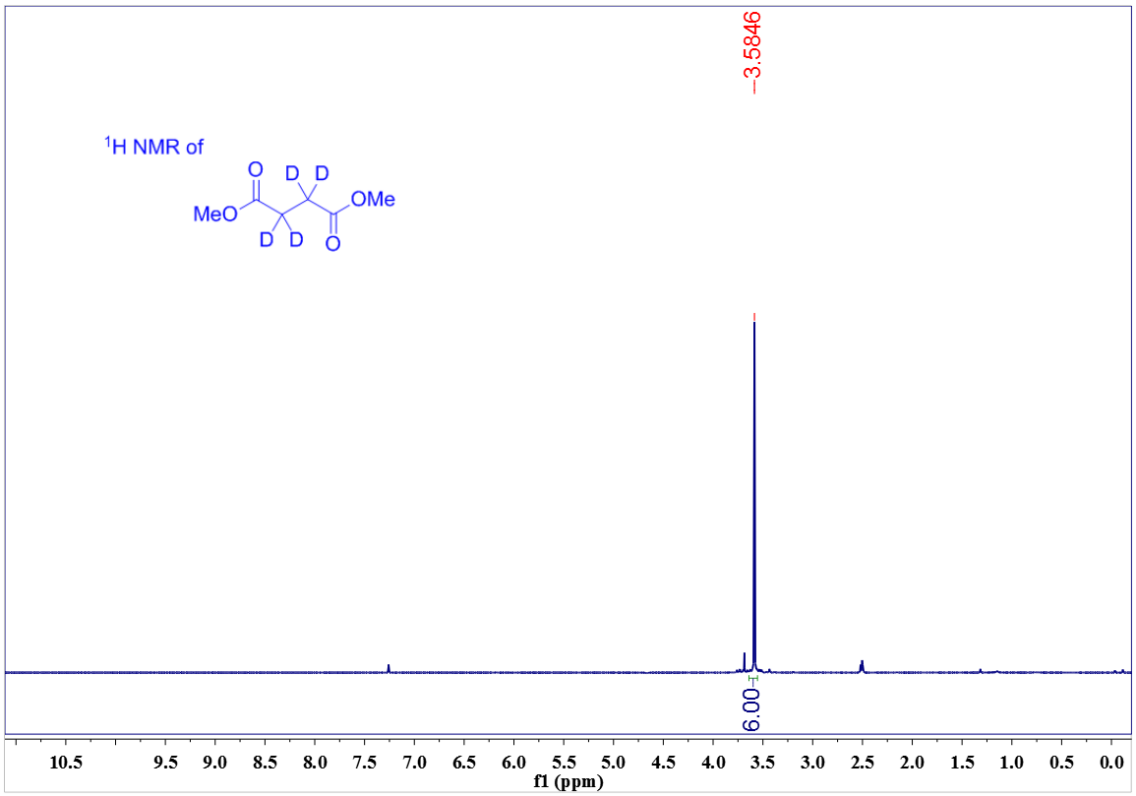

135.0241
120.3320
55.5234
53.0272
45.5337
26.6311
13C NMR of
f1 (ppm)

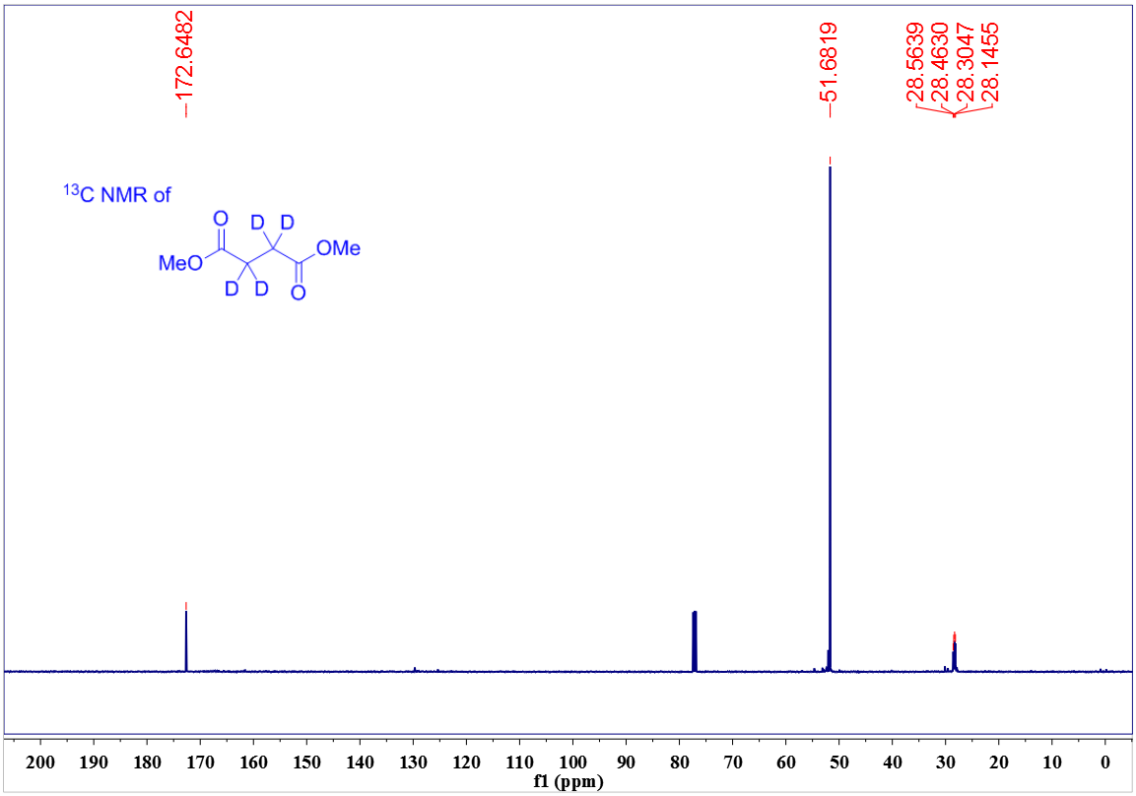
12


3.6208
2.5547
2.5398
1H NMR of
MeO
OMe
D
D
O
O
6.00
2.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

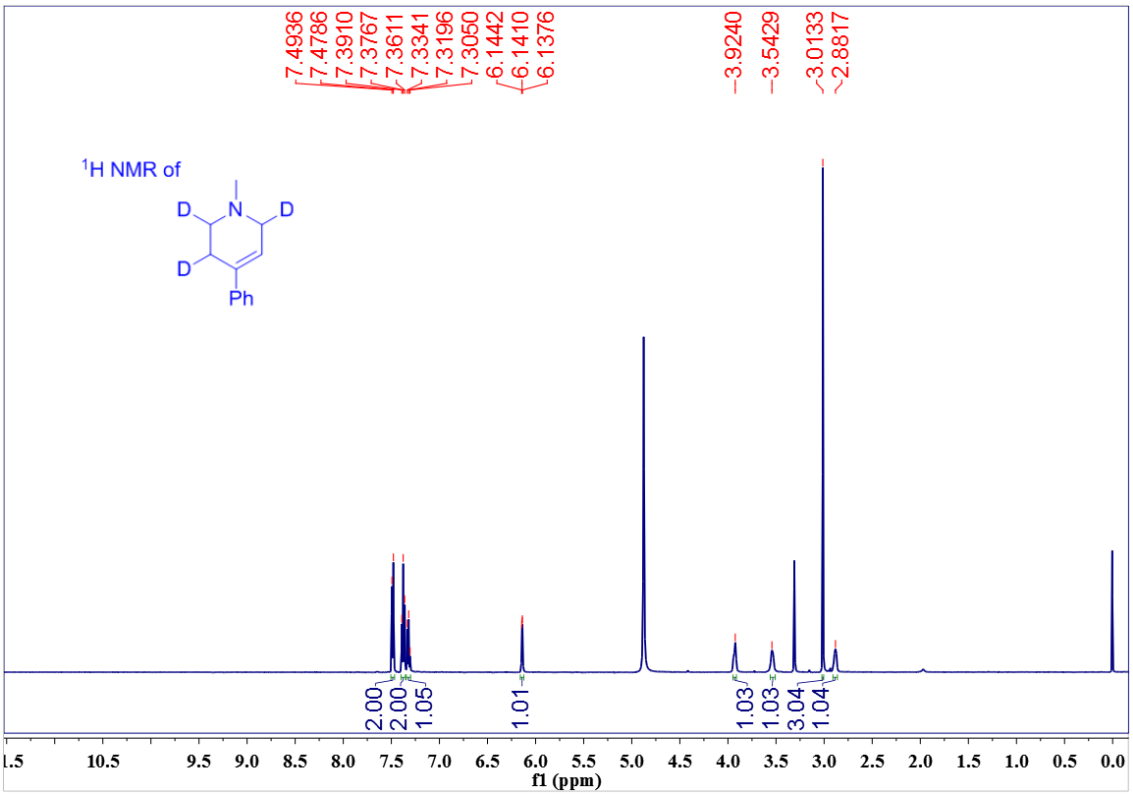

172.6760
51.7444
28.6830
28.5821
28.4234
28.2646
13C NMR of
MeO
OMe
D
D
O
O
230 210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

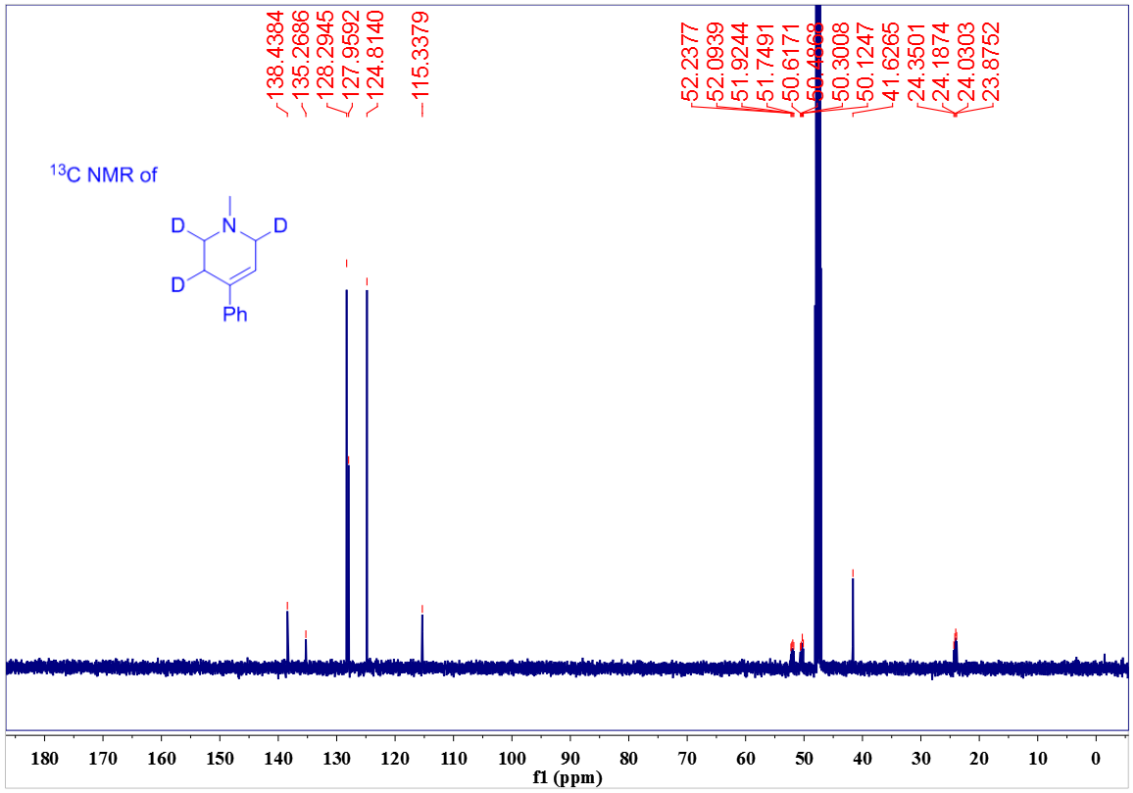
2h'


3.5846
1H NMR of
MeO
OMe
D D
D D
O
6.00
10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

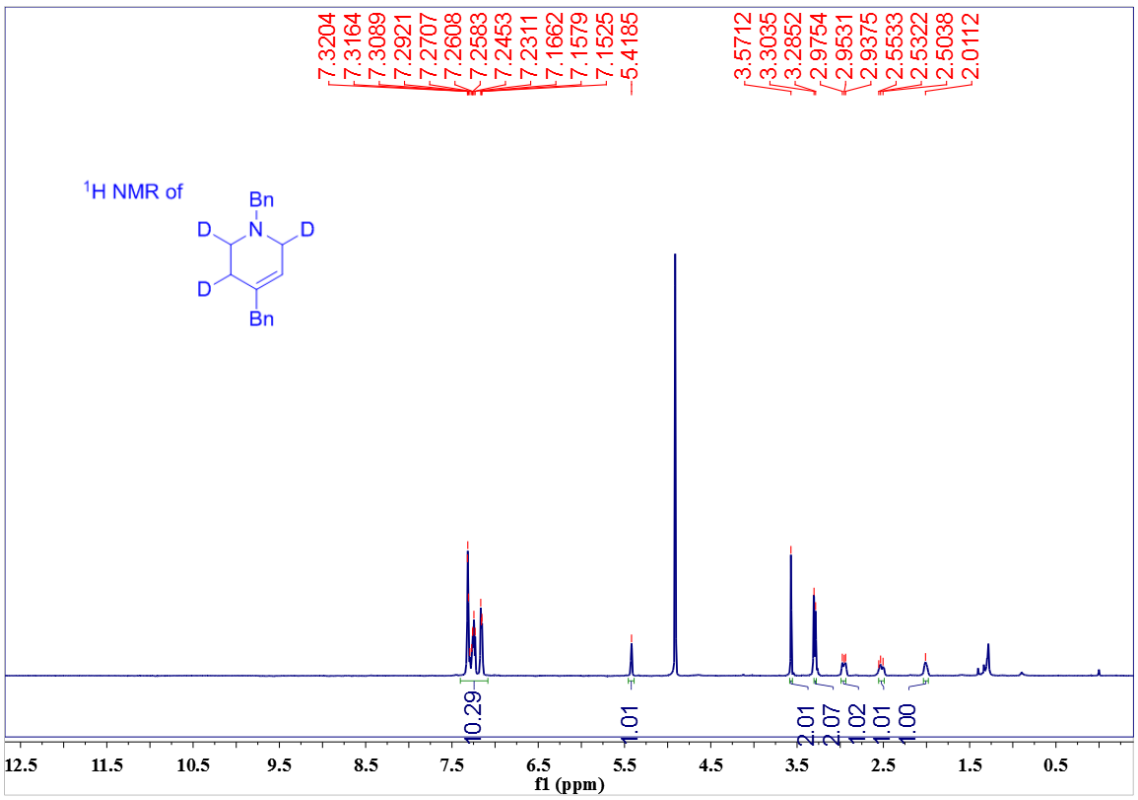

172.6482
51.6819
28.5639
28.4630
28.3047
28.1455
13C NMR of
MeO
OMe
D D
D D
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

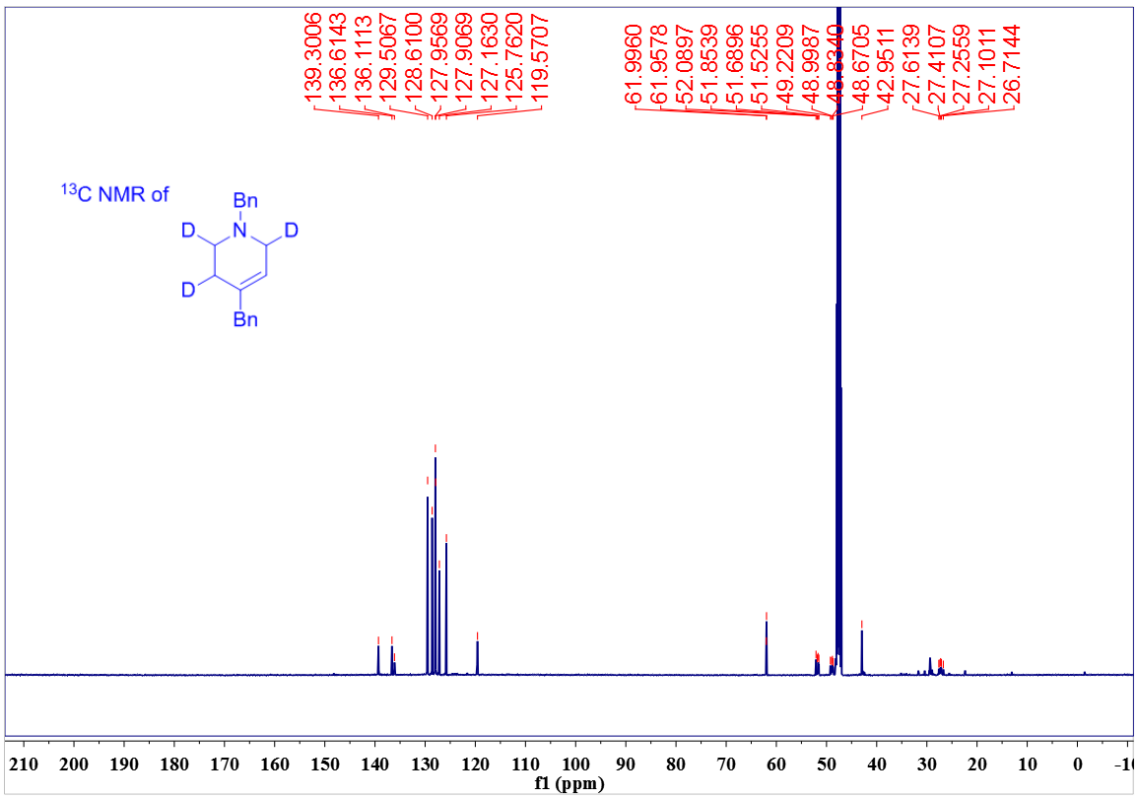
2h''


7.4936
7.4786
7.3910
7.3767
7.3611
7.3341
7.3196
7.3050
6.1442
6.1410
6.1376
3.9240
3.5429
3.0133
2.8817
1H NMR of
D
N
D
D
Ph
2.00
2.00
1.05
1.01
1.03
1.03
3.04
1.04
f1 (ppm)


138.4384
135.2686
128.2945
127.9592
124.8140
115.3379
52.2377
52.0939
51.9244
51.7491
50.6171
50.3008
50.1247
41.6265
24.3501
24.1874
24.0303
23.8752
13C NMR of
D
N
D
D
Ph
f1 (ppm)

10a'


7.3204
7.3164
7.3089
7.2921
7.2707
7.2608
7.2583
7.2453
7.2311
7.1662
7.1579
7.1525
5.4185
3.5712
3.3035
3.2852
2.9754
2.9531
2.9375
2.5533
2.5322
2.5038
2.0112
1H NMR of
Bn
N
D
D
D
Bn
10.29
1.01
2.01
2.07
1.02
1.01
1.00
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
f1 (ppm)


139.3006
136.6143
136.1113
129.5067
128.6100
127.9569
127.9069
127.1630
125.7620
119.5707
61.9960
61.9578
52.0897
51.8539
51.6896
51.5255
49.2209
48.9987
48.8340
48.6705
42.9511
27.6139
27.4107
27.2559
27.1011
26.7144
13C NMR of
Bn
N
D
D
D
Bn
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

10i'