

## SUPPORTING INFORMATION

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### **Catalytic (5+1) Cycloaddition of Diazoindoles with Imidazolidines to Access Novel Piperazine-Spirooxindole Frameworks**

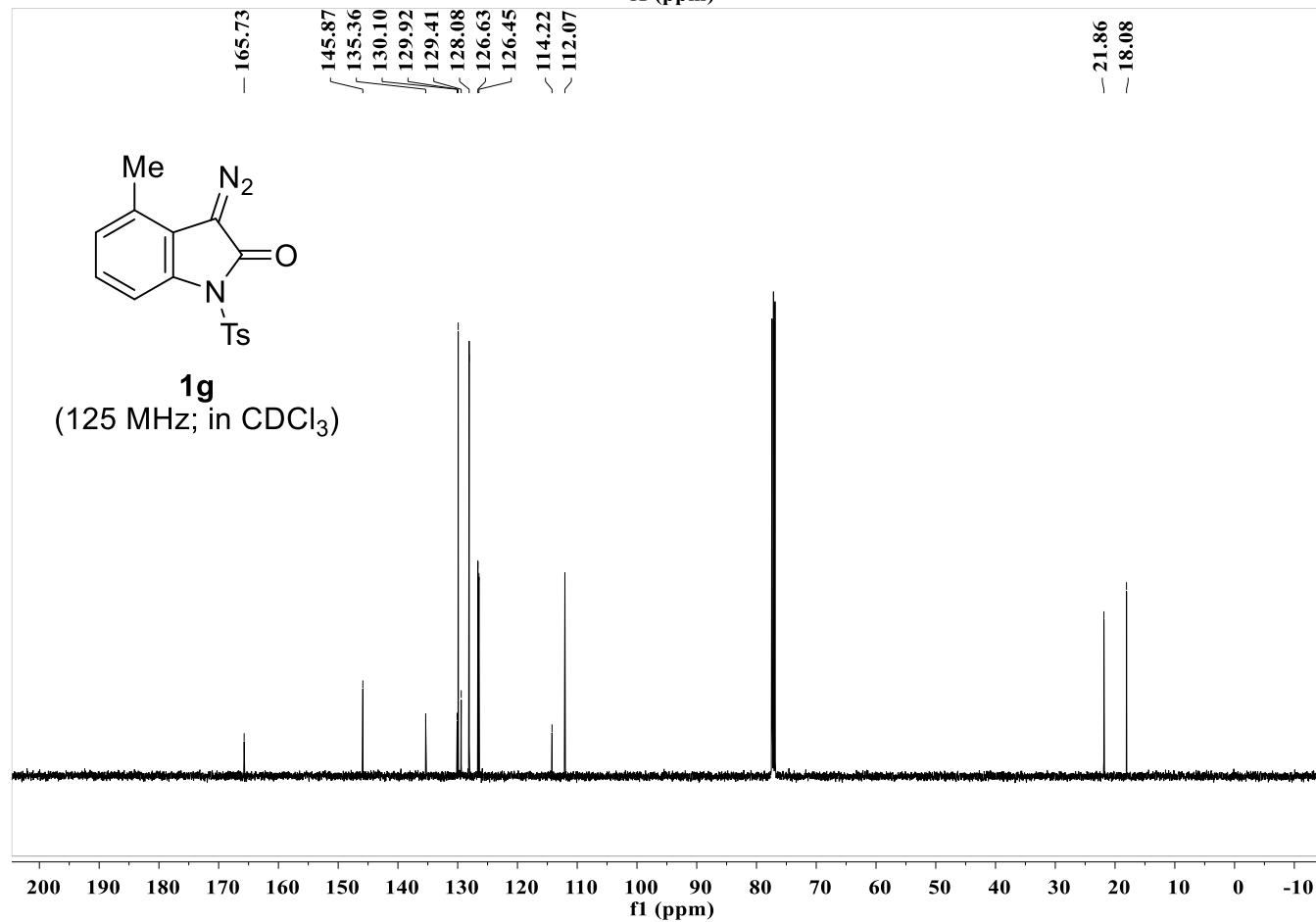
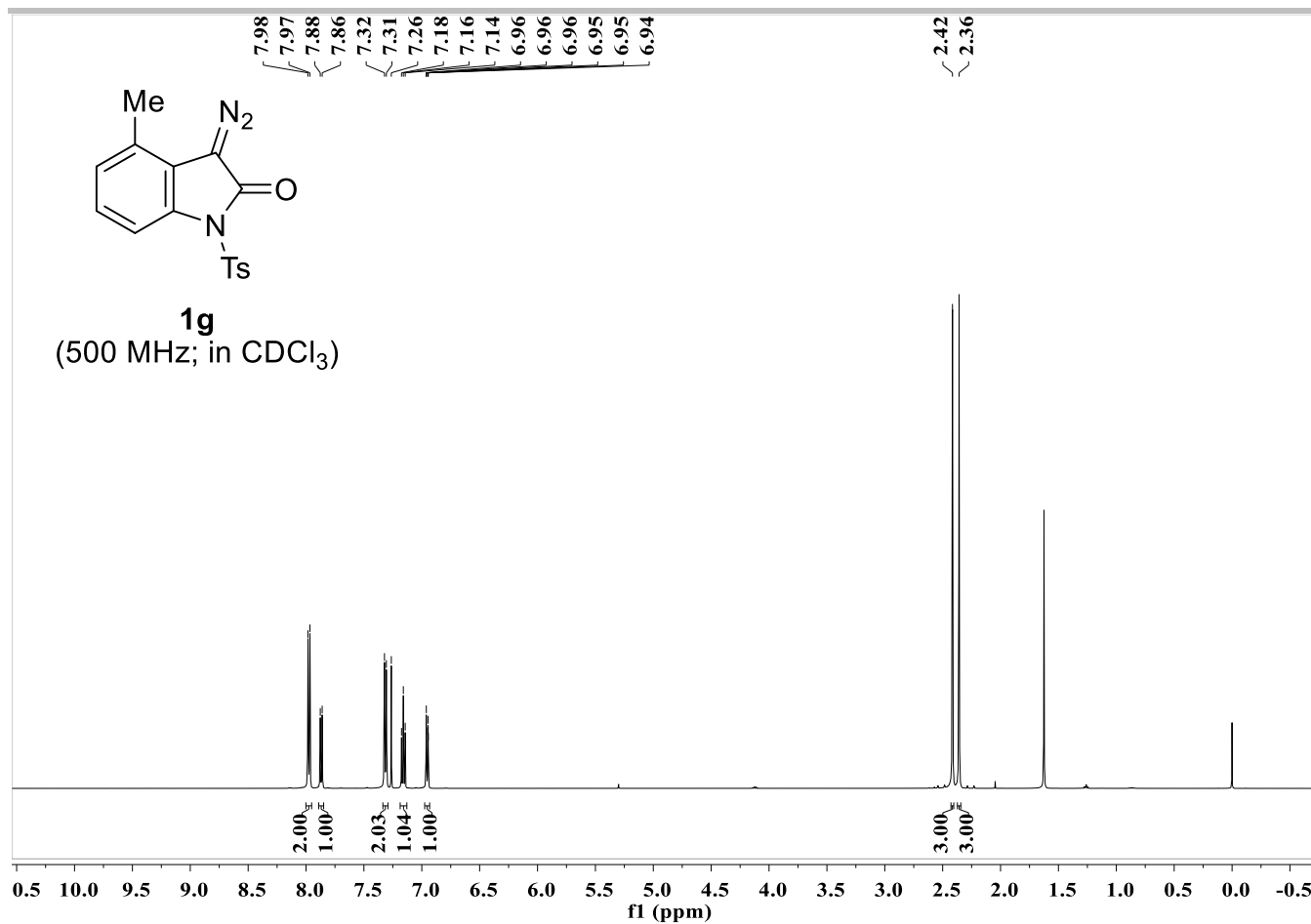
Yijun Duan,<sup>#,a</sup> Feng Chen,<sup>#,a</sup> Yuncheng Liu,<sup>#,a</sup> Wendi Xu,<sup>#,a</sup> Xue Zhang,<sup>#,a</sup> Ming Lang<sup>a</sup> and Shiyong Peng<sup>\*,a</sup>

<sup>a</sup>School of Pharmacy and Food Engineering, Wuyi University, Jiangmen 529020, P. R. China

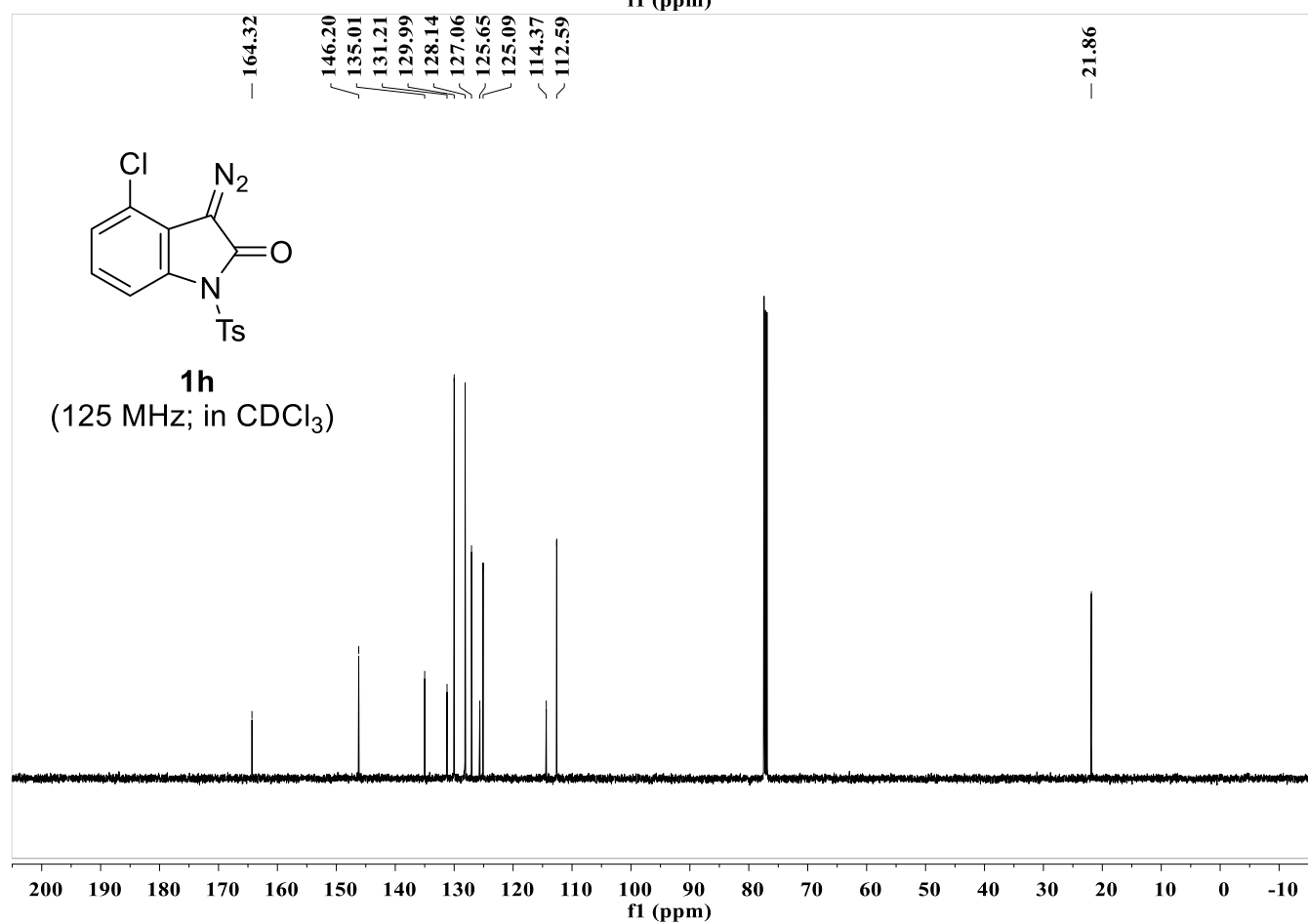
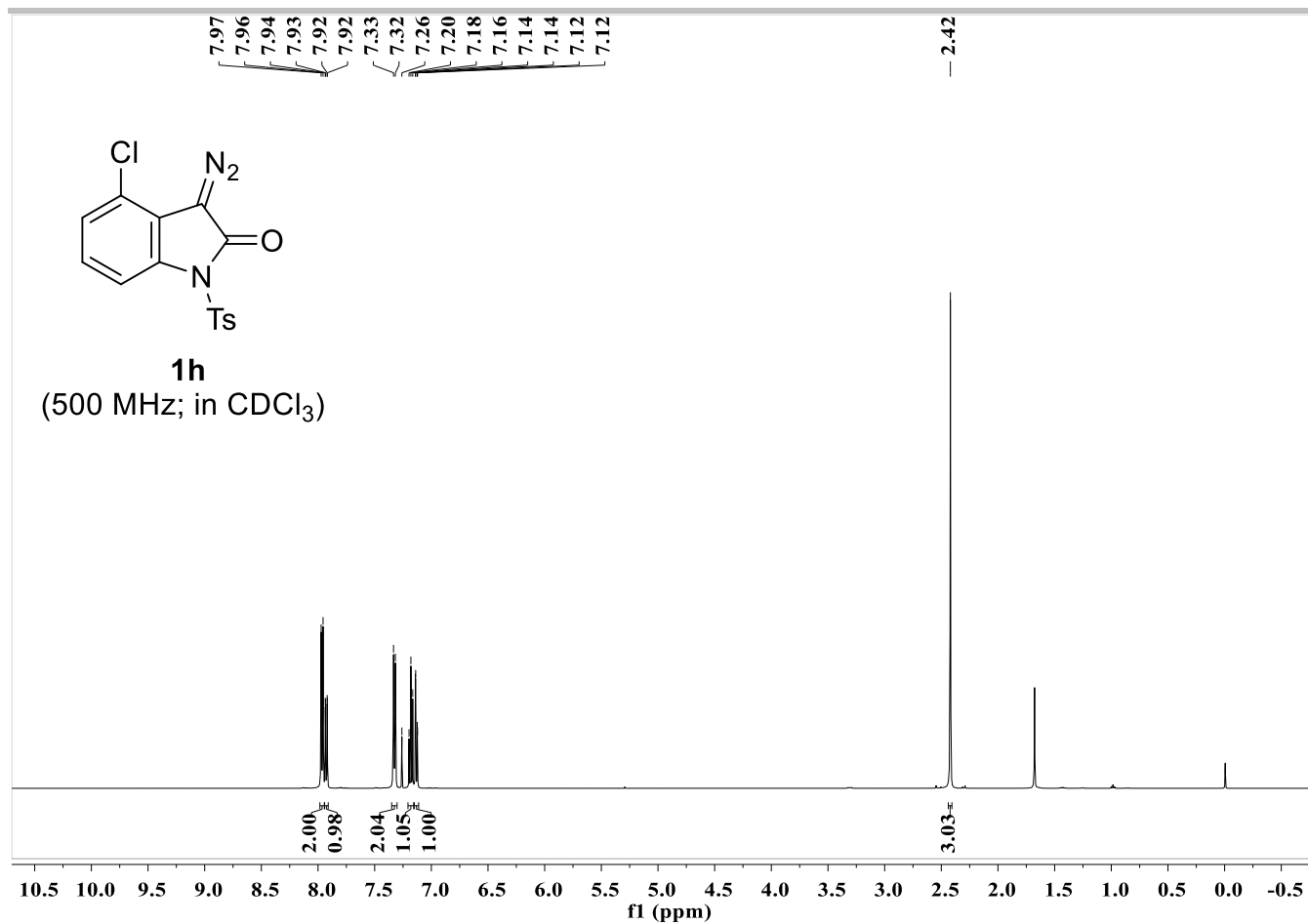
\*psy880124@mail.nankai.edu.cn

<sup>#</sup>The authors contributed equally to this work

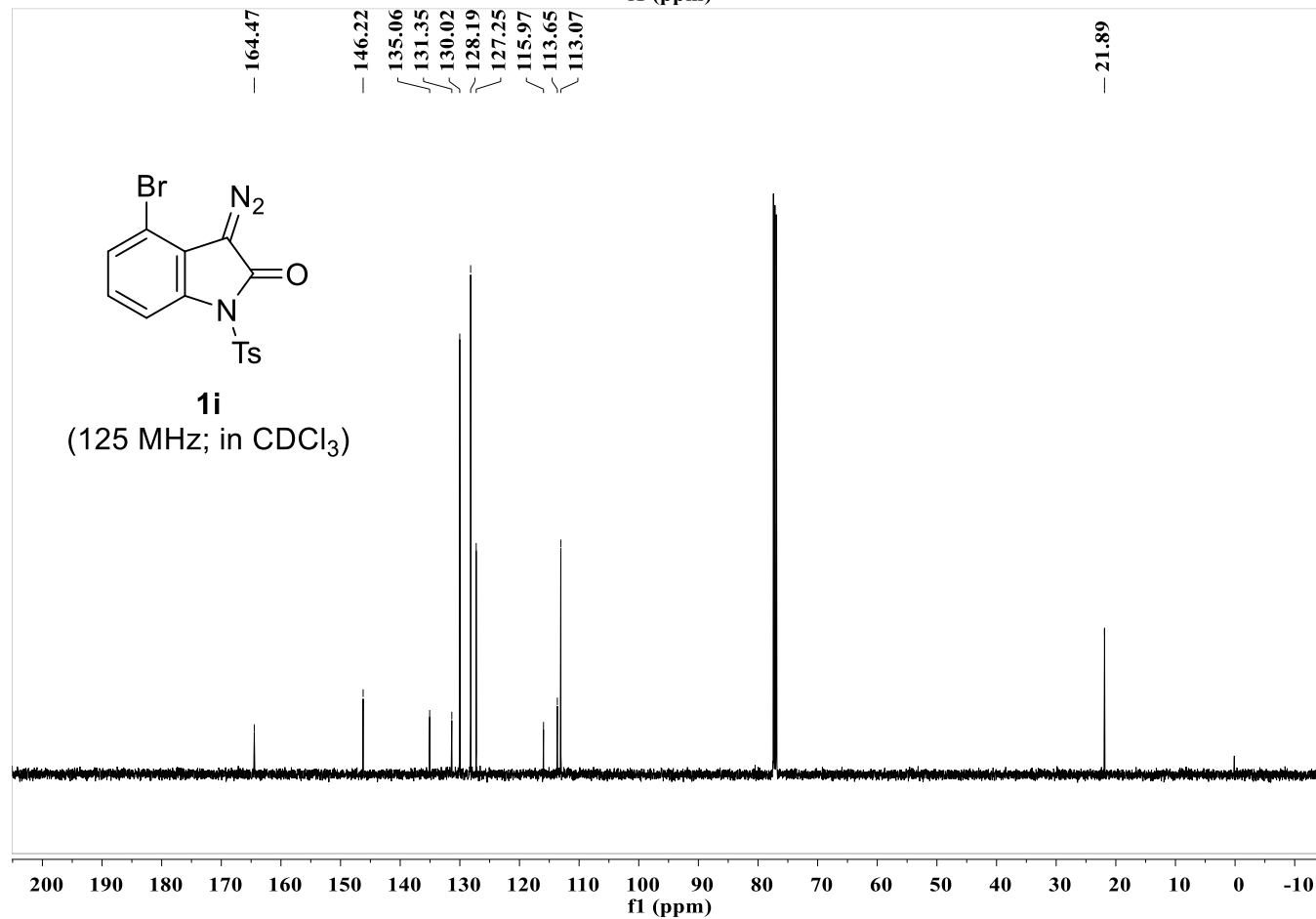
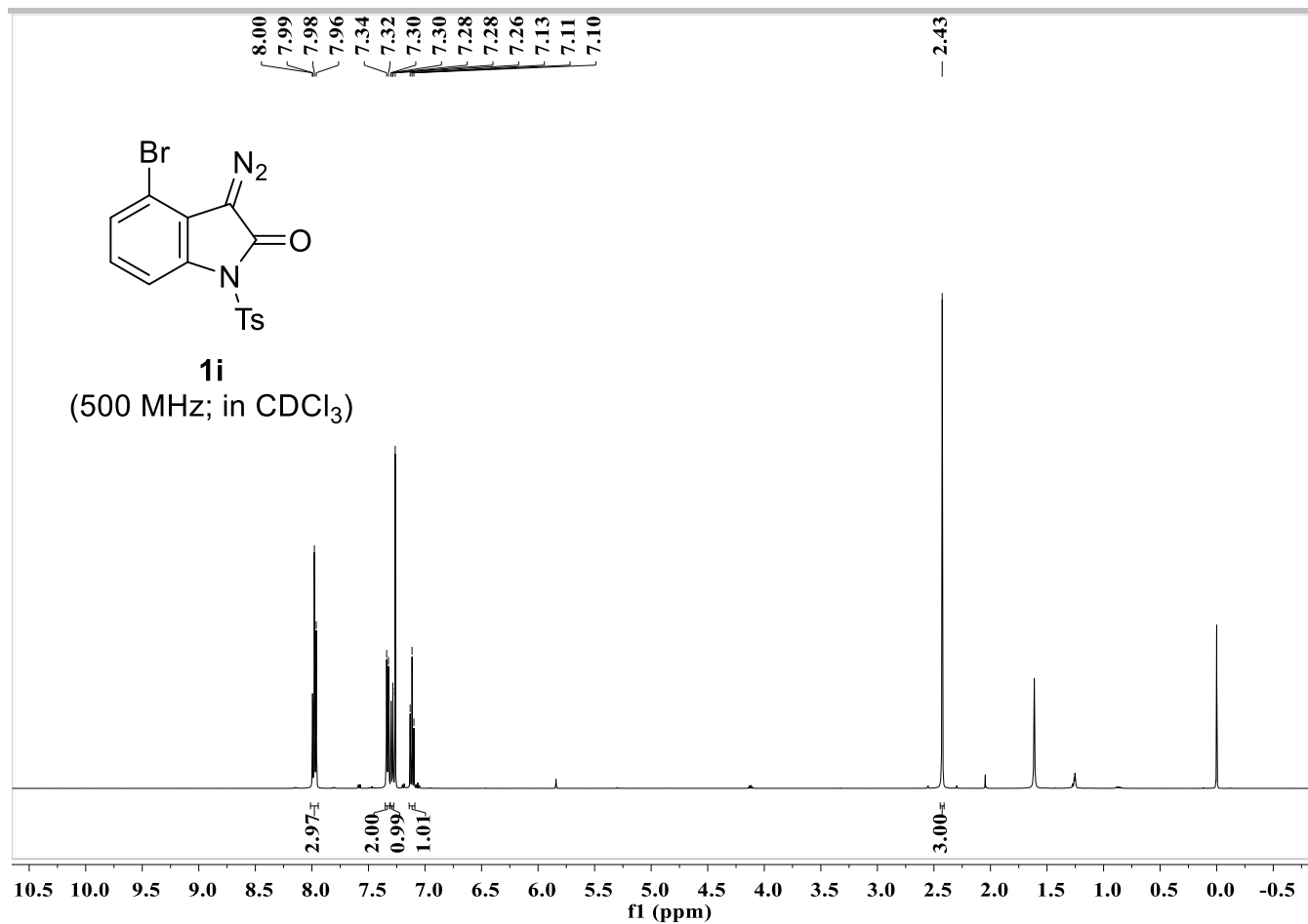
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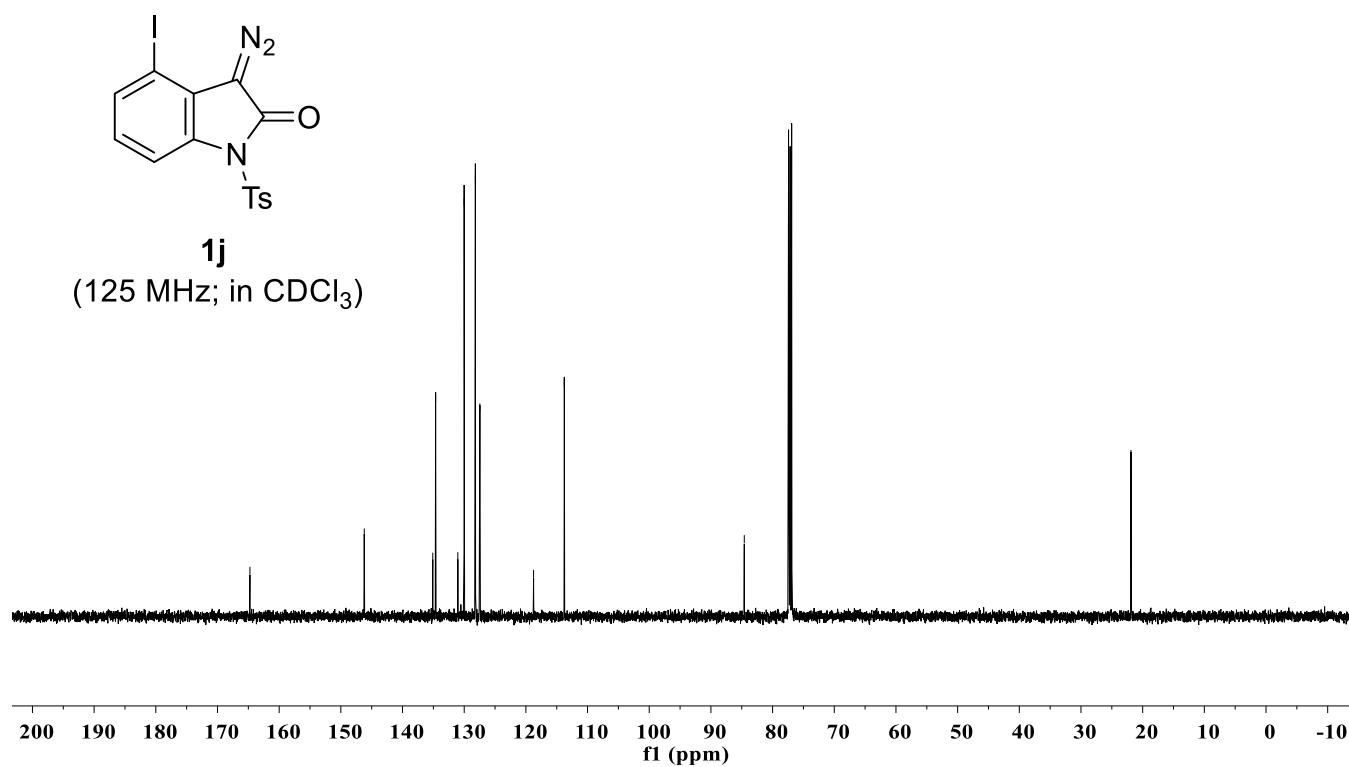
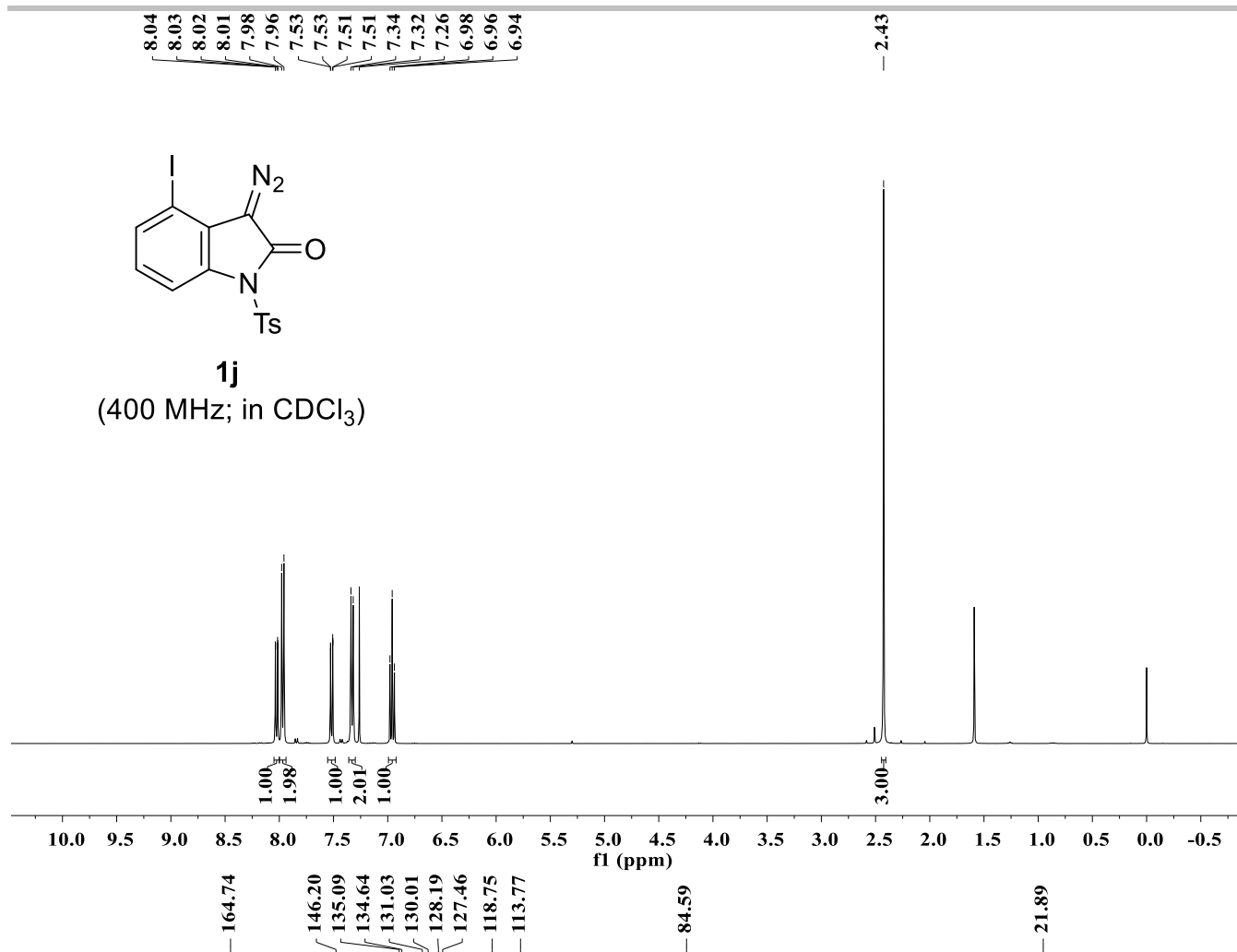


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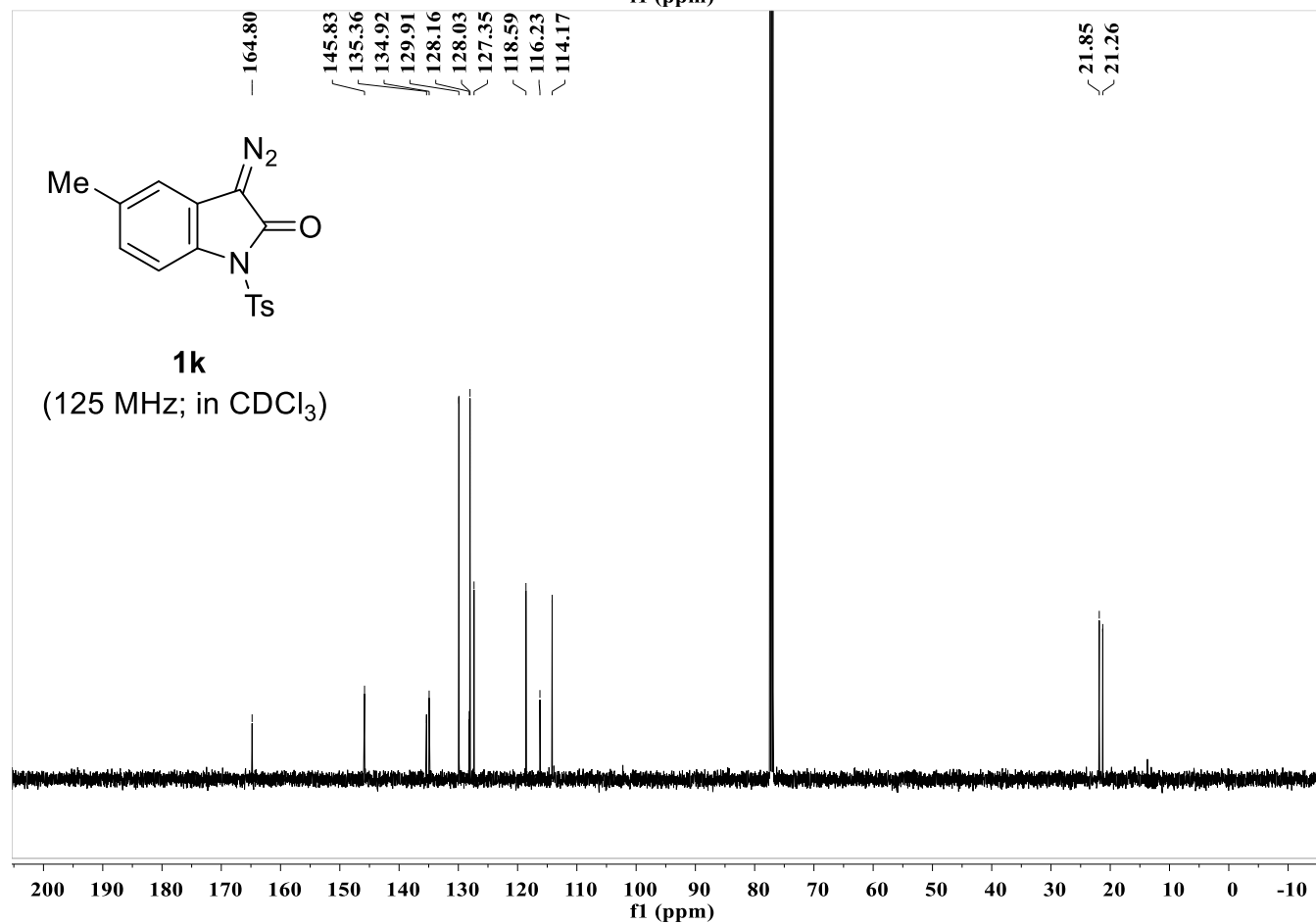
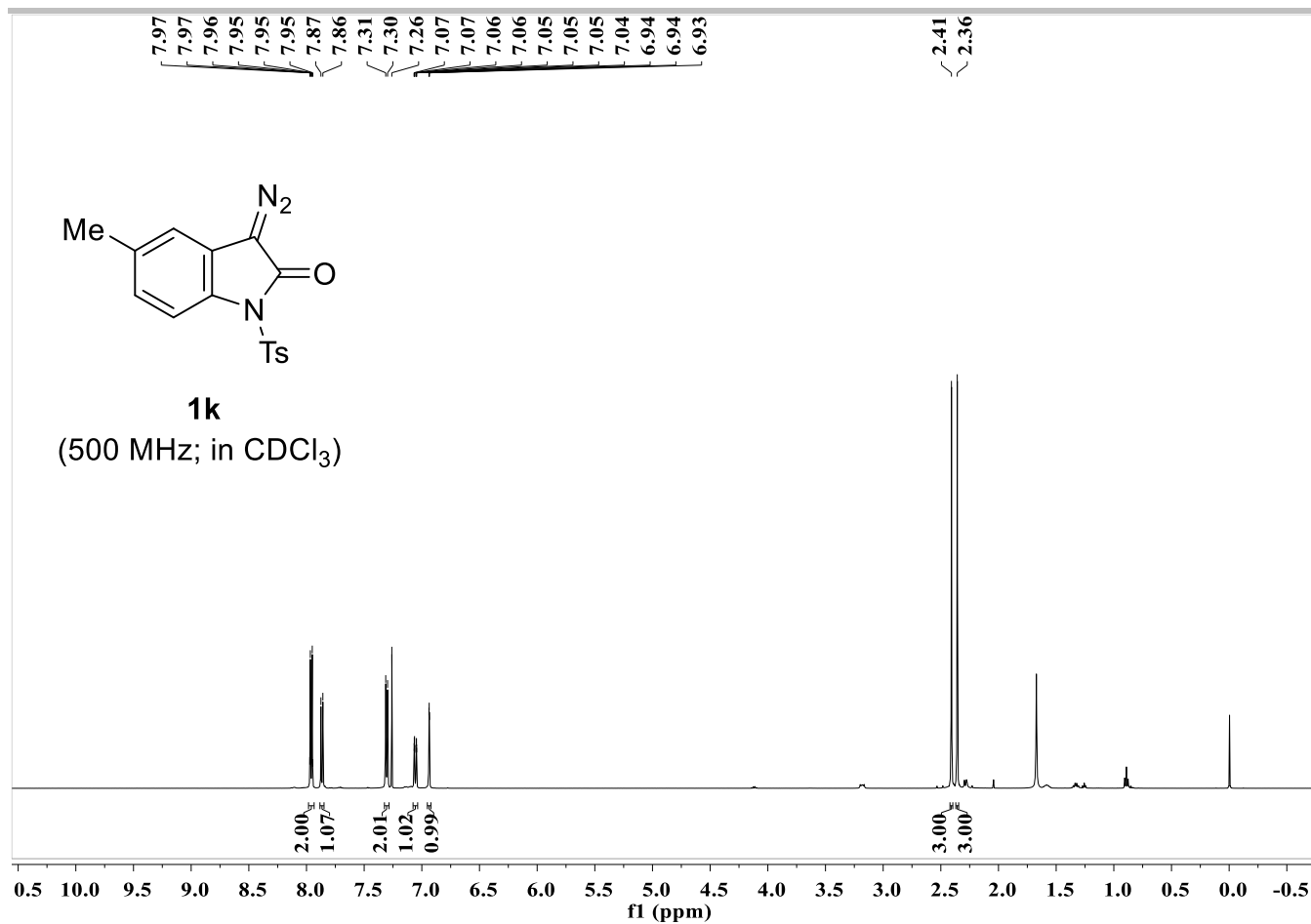




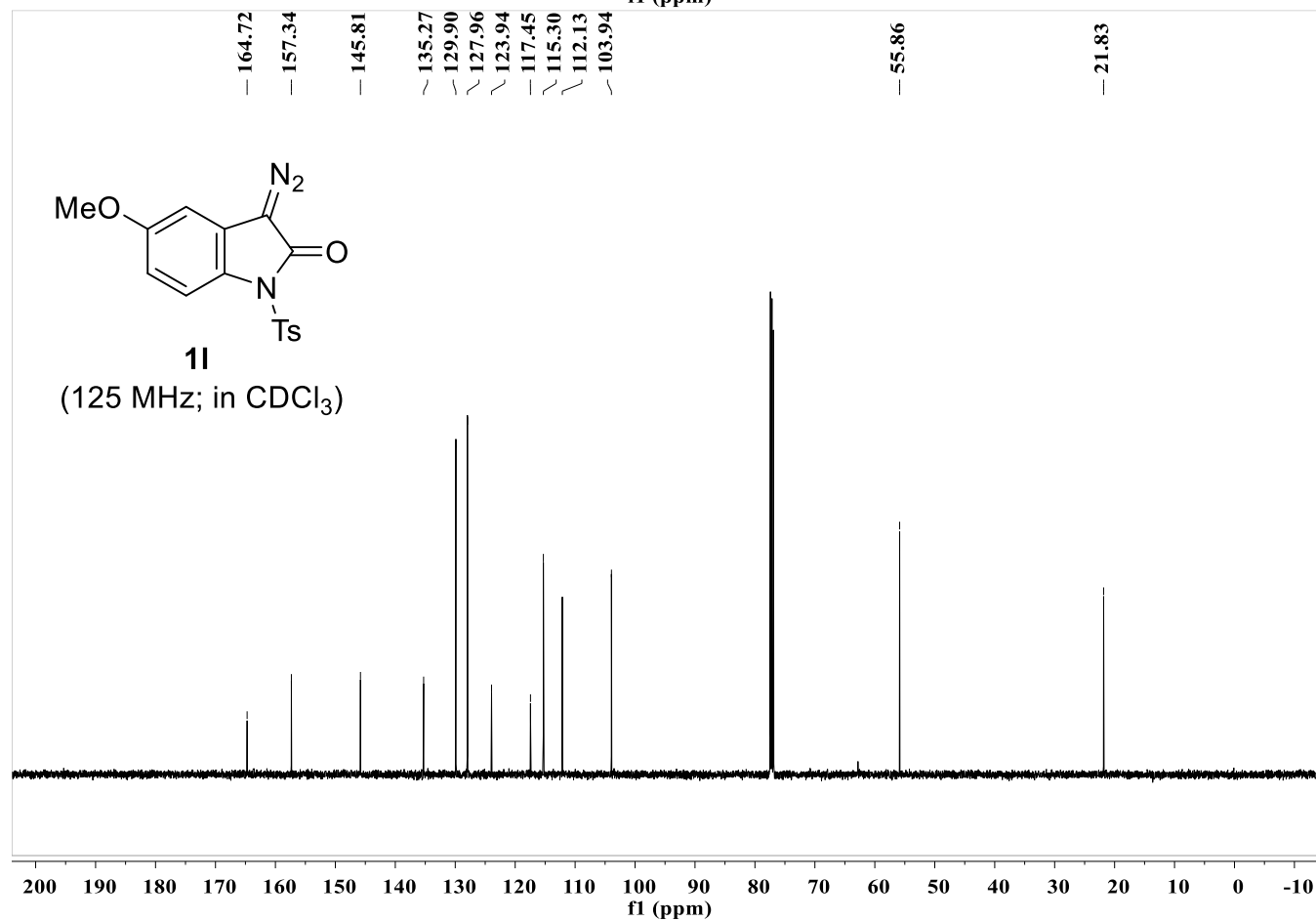
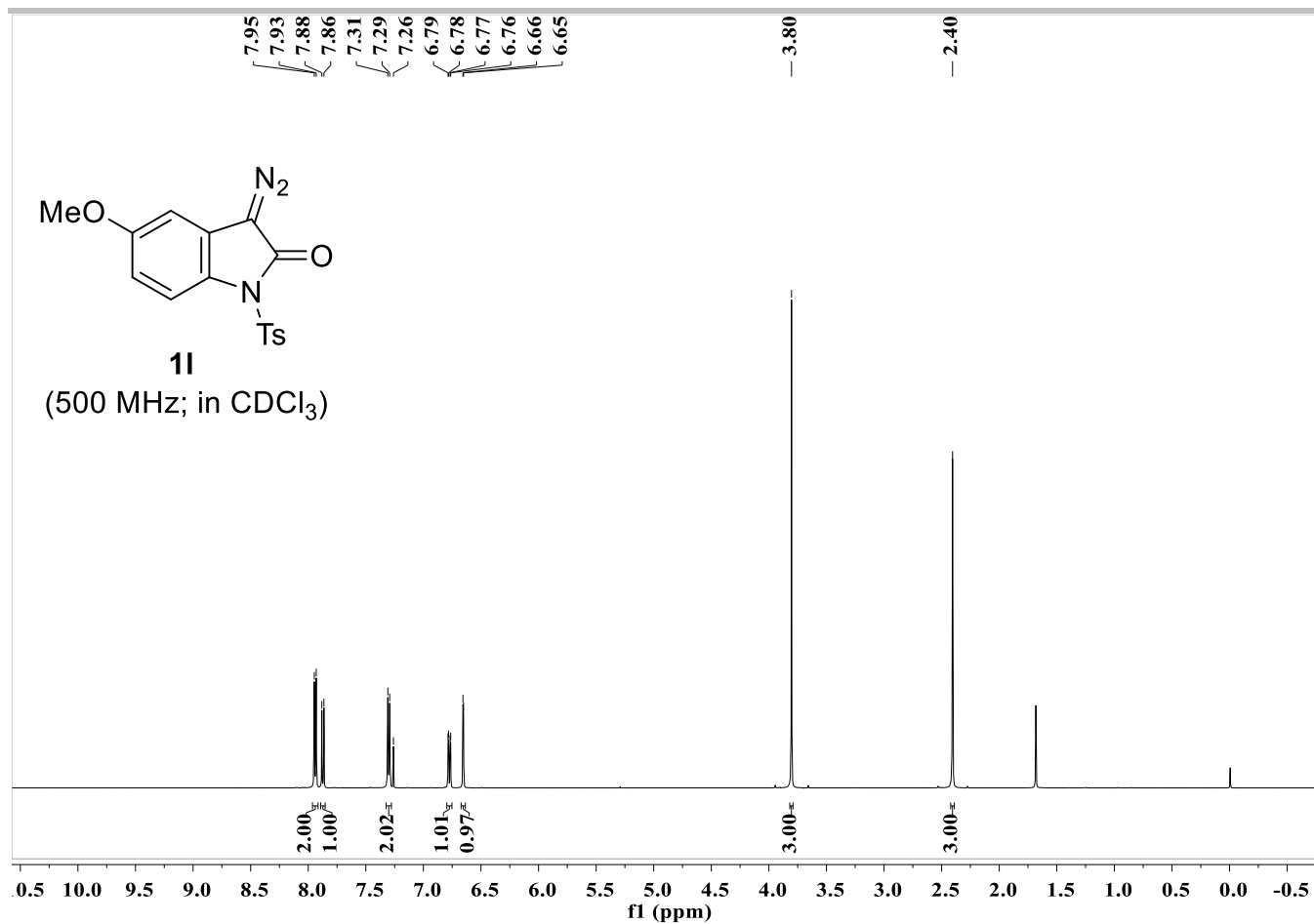
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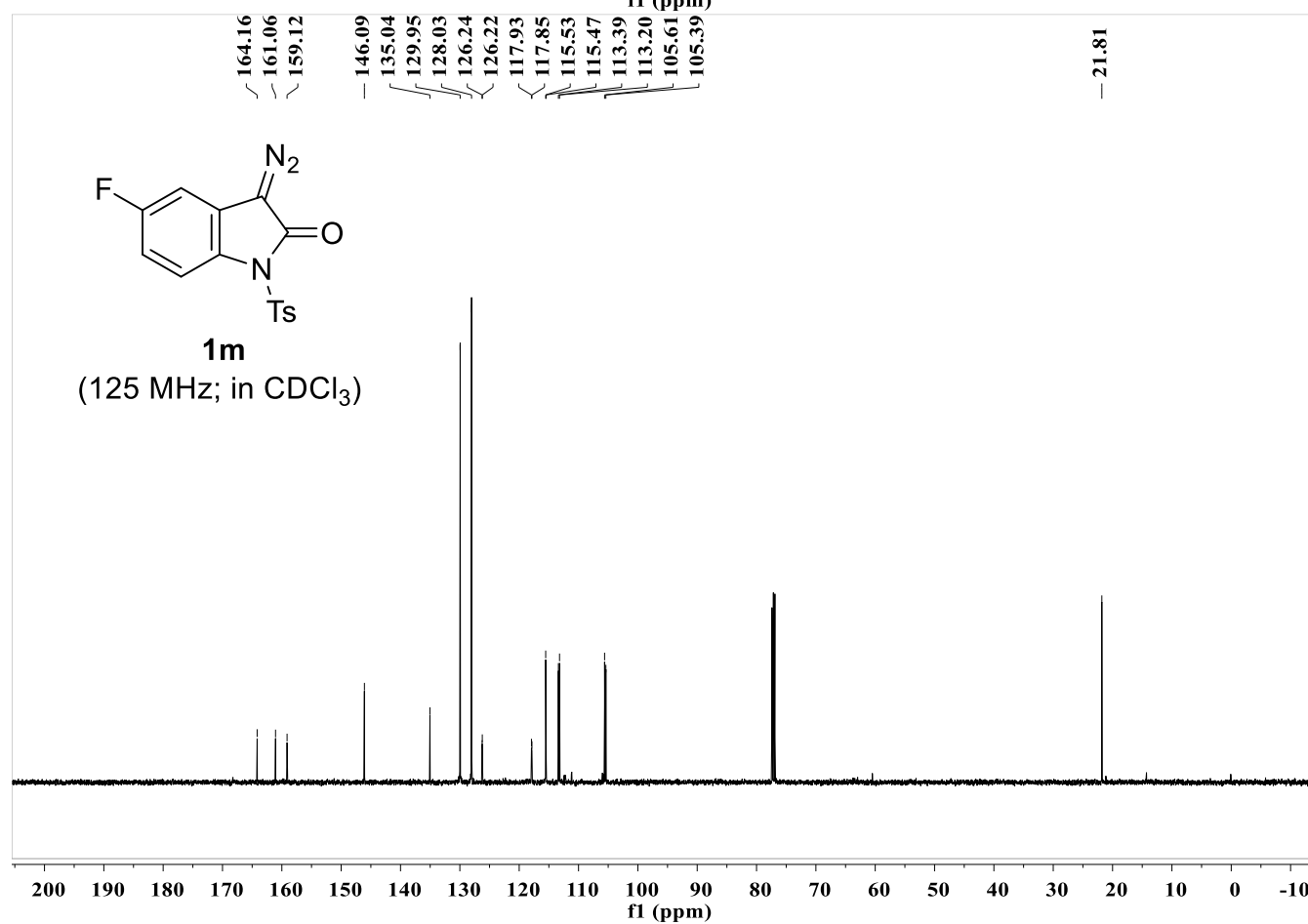
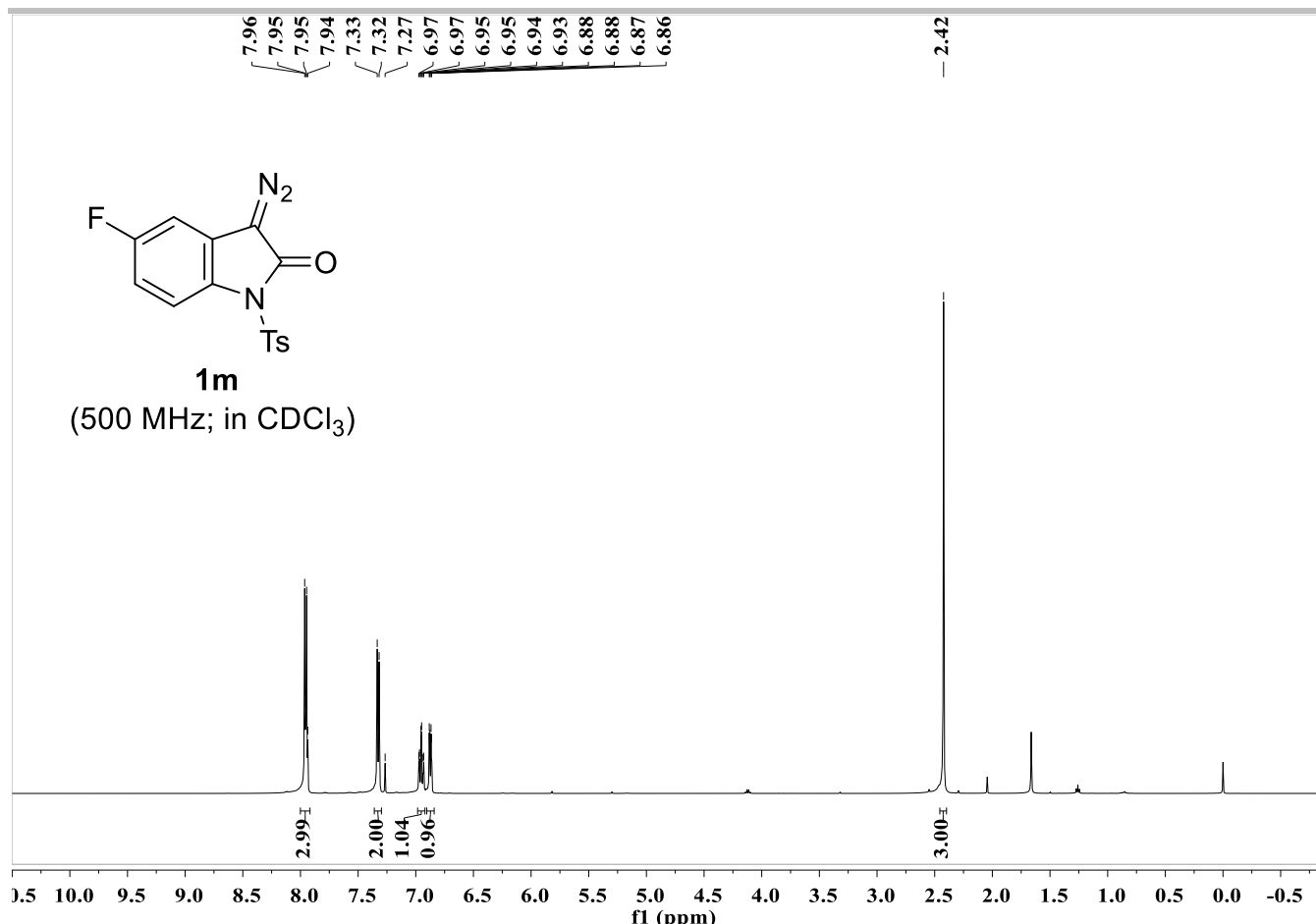
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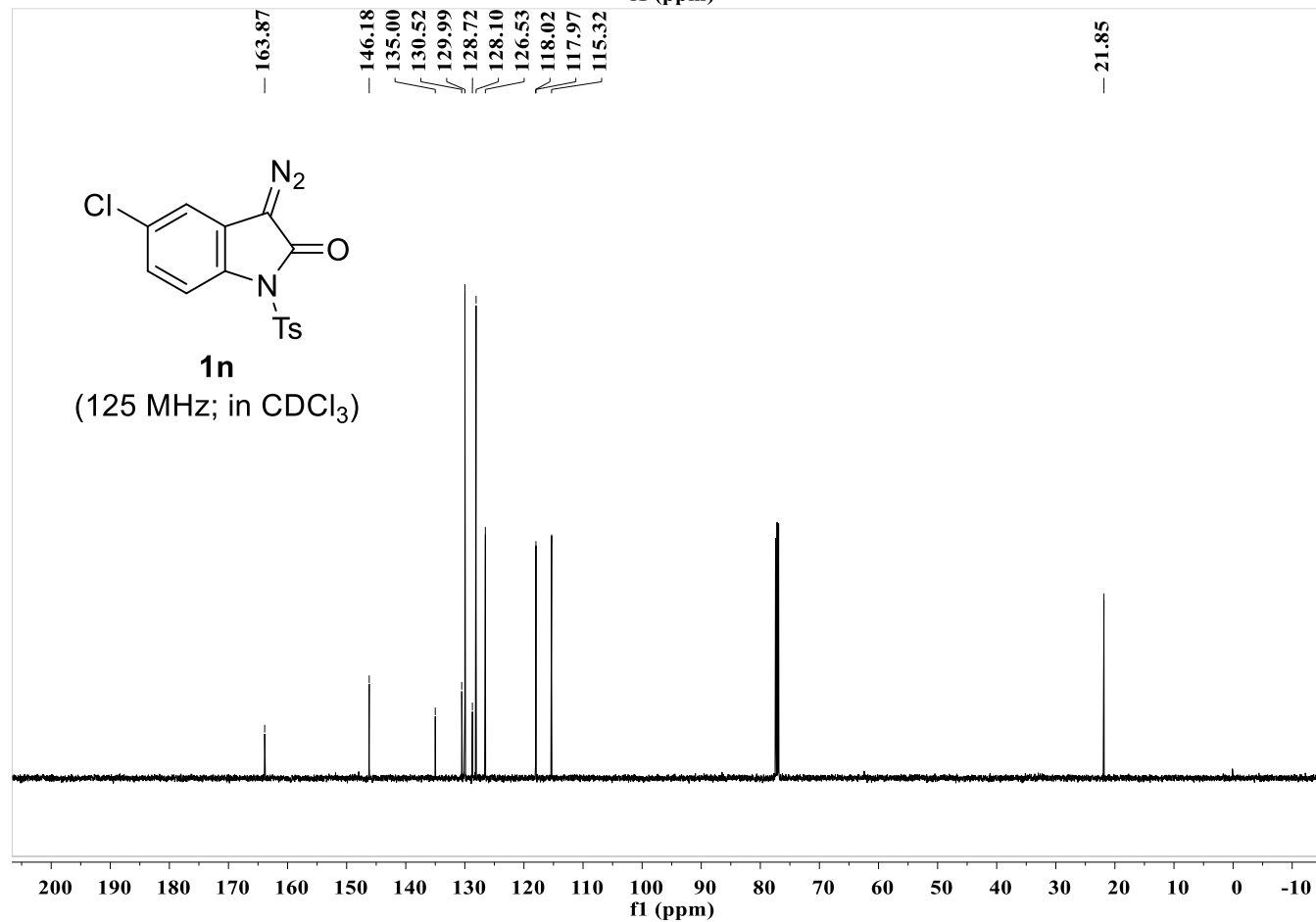
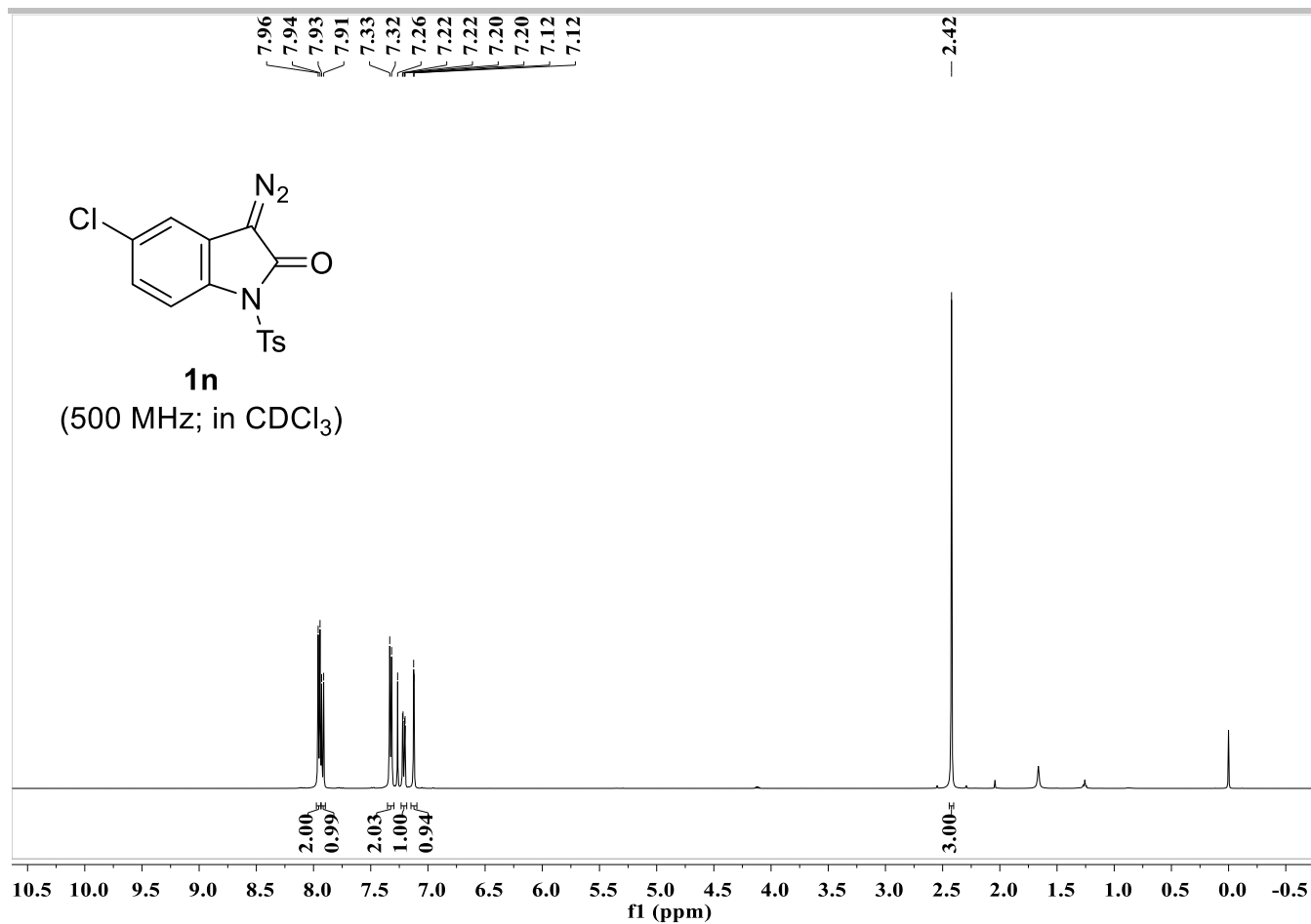
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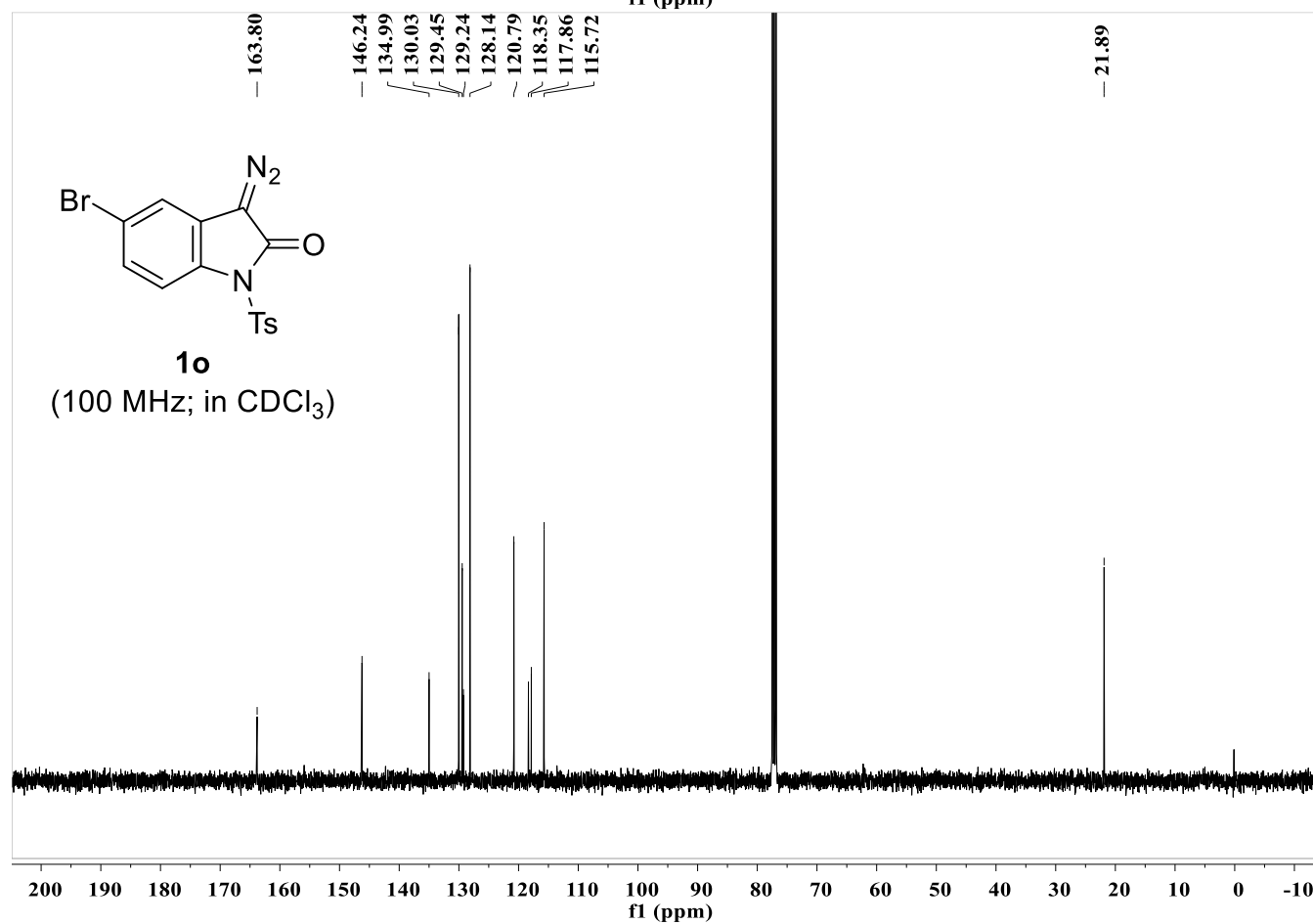
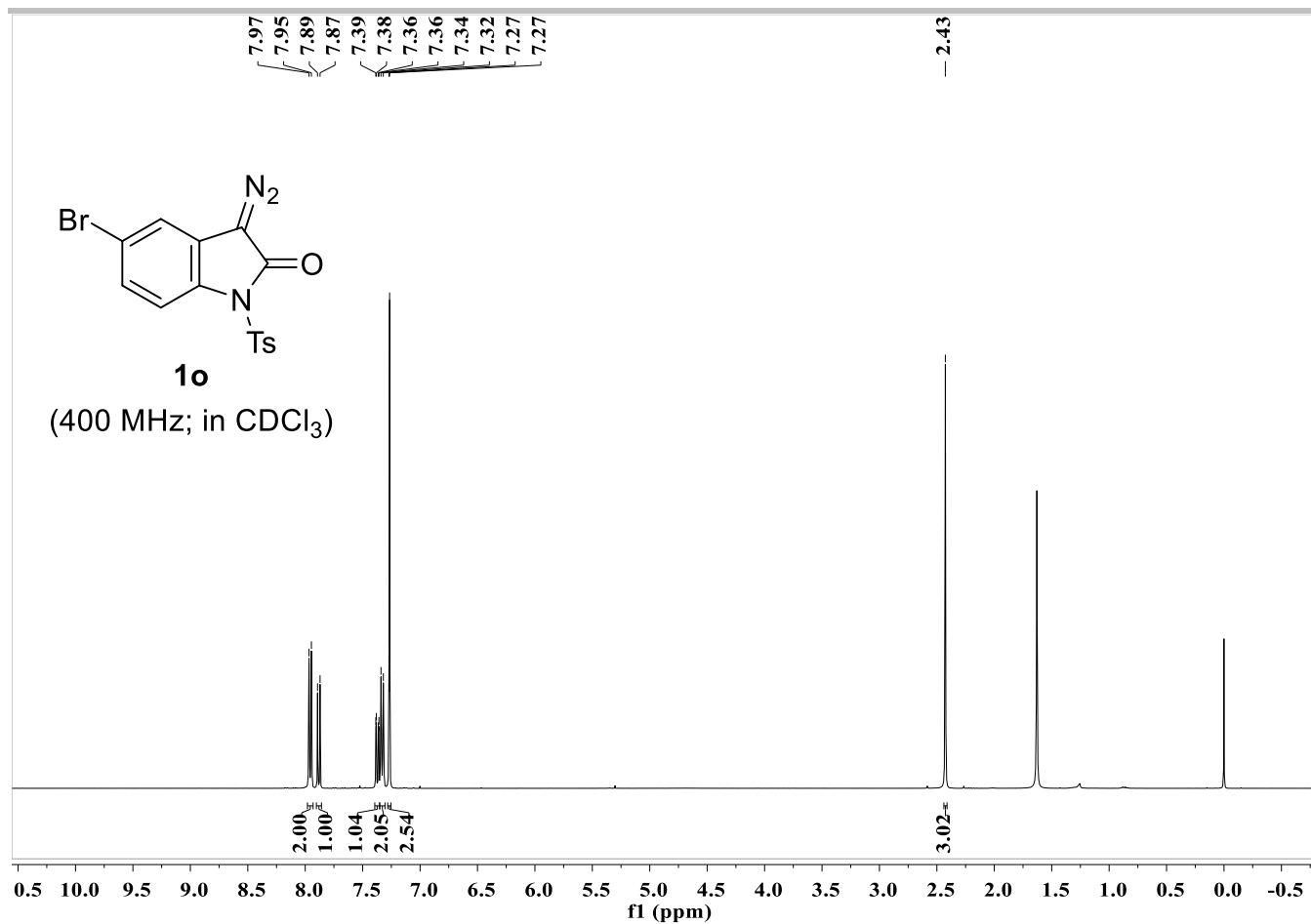
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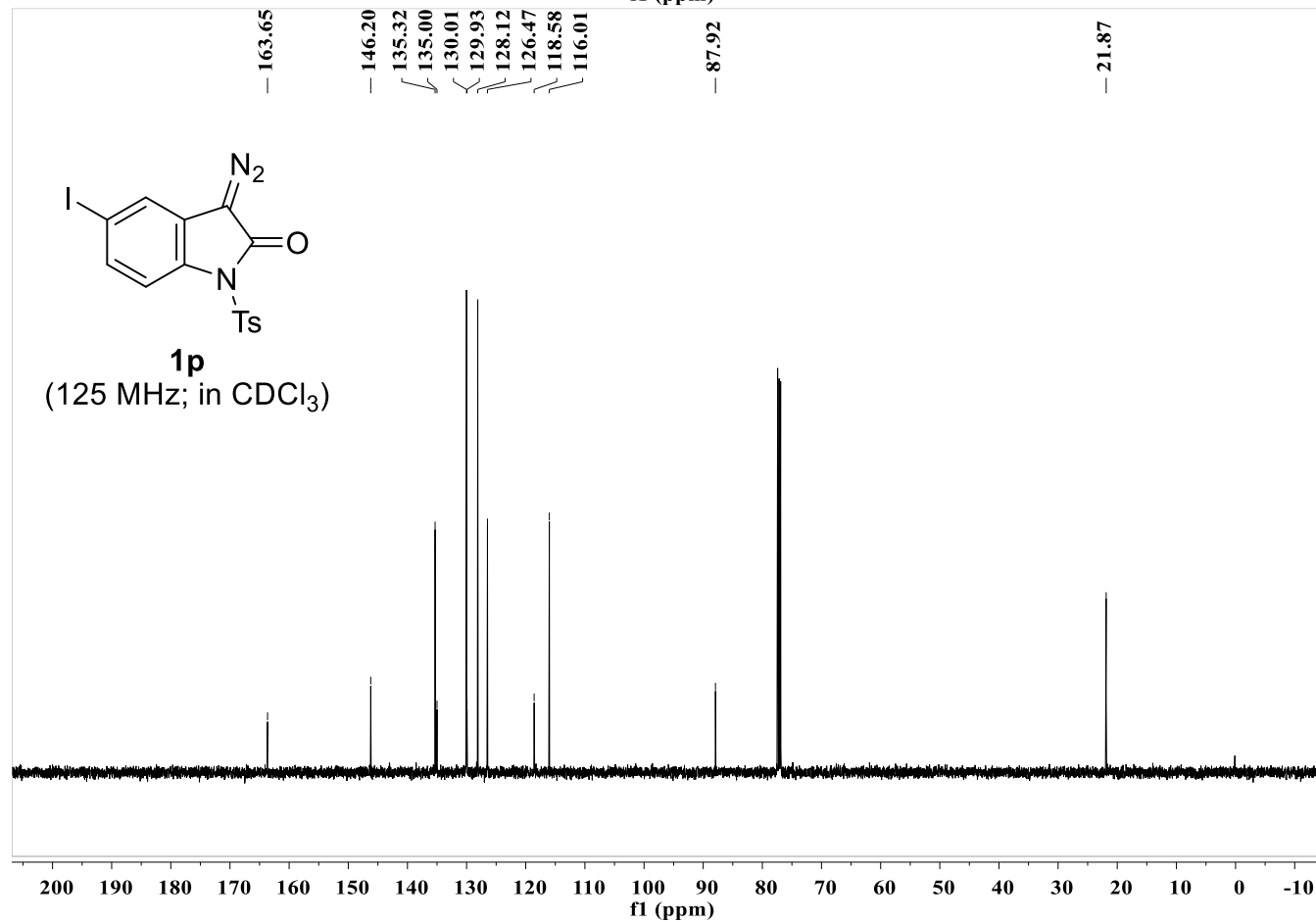
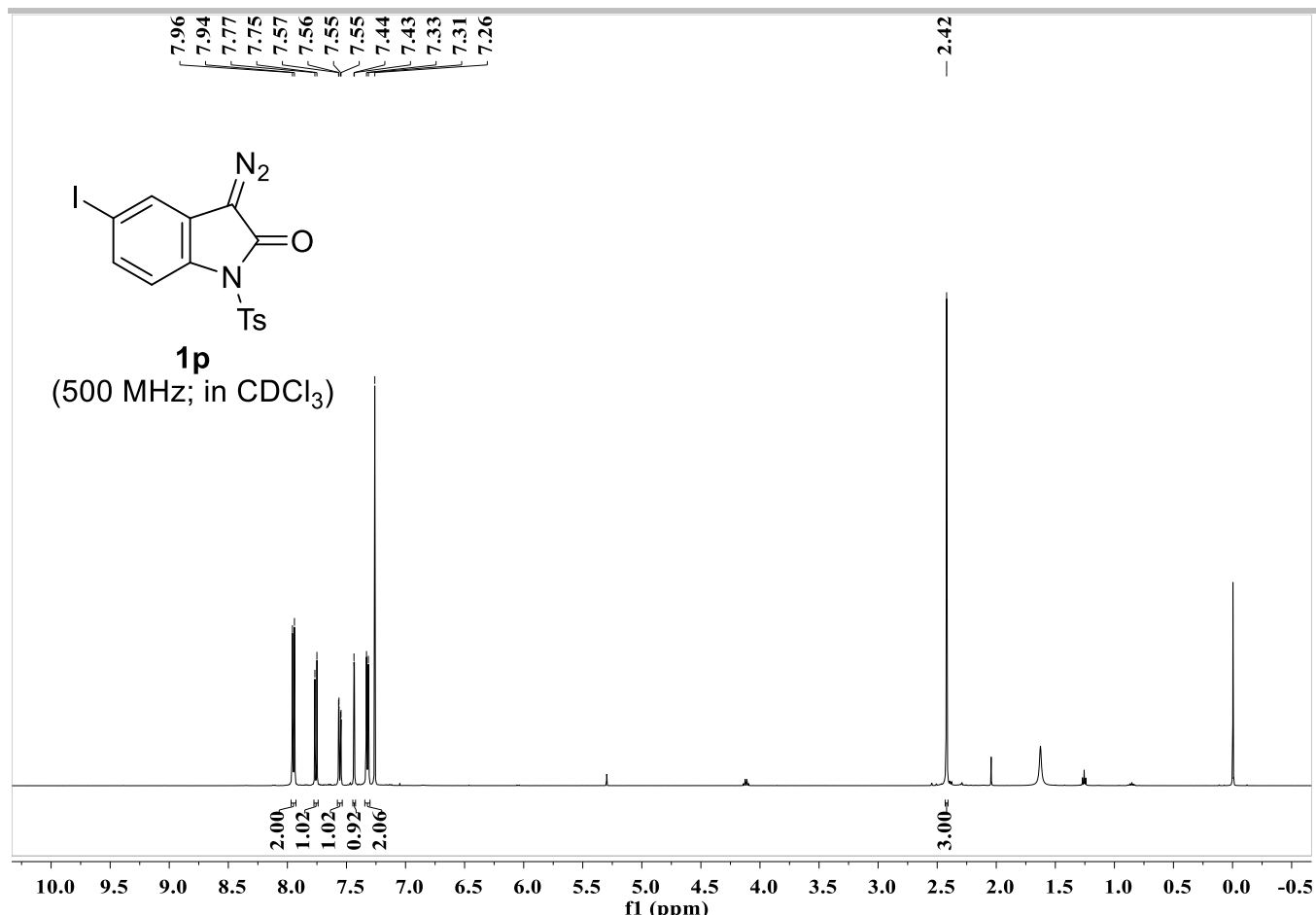
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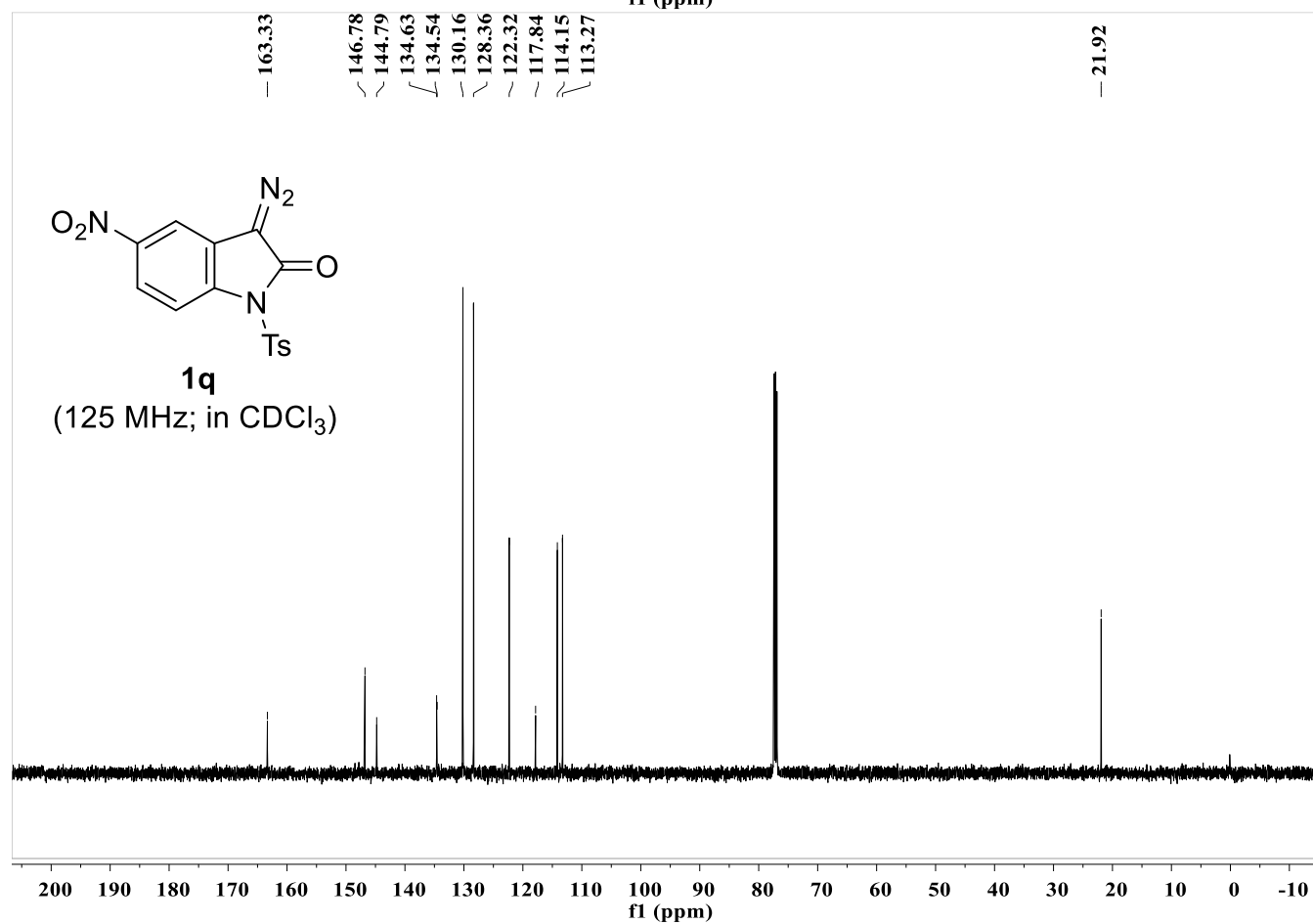
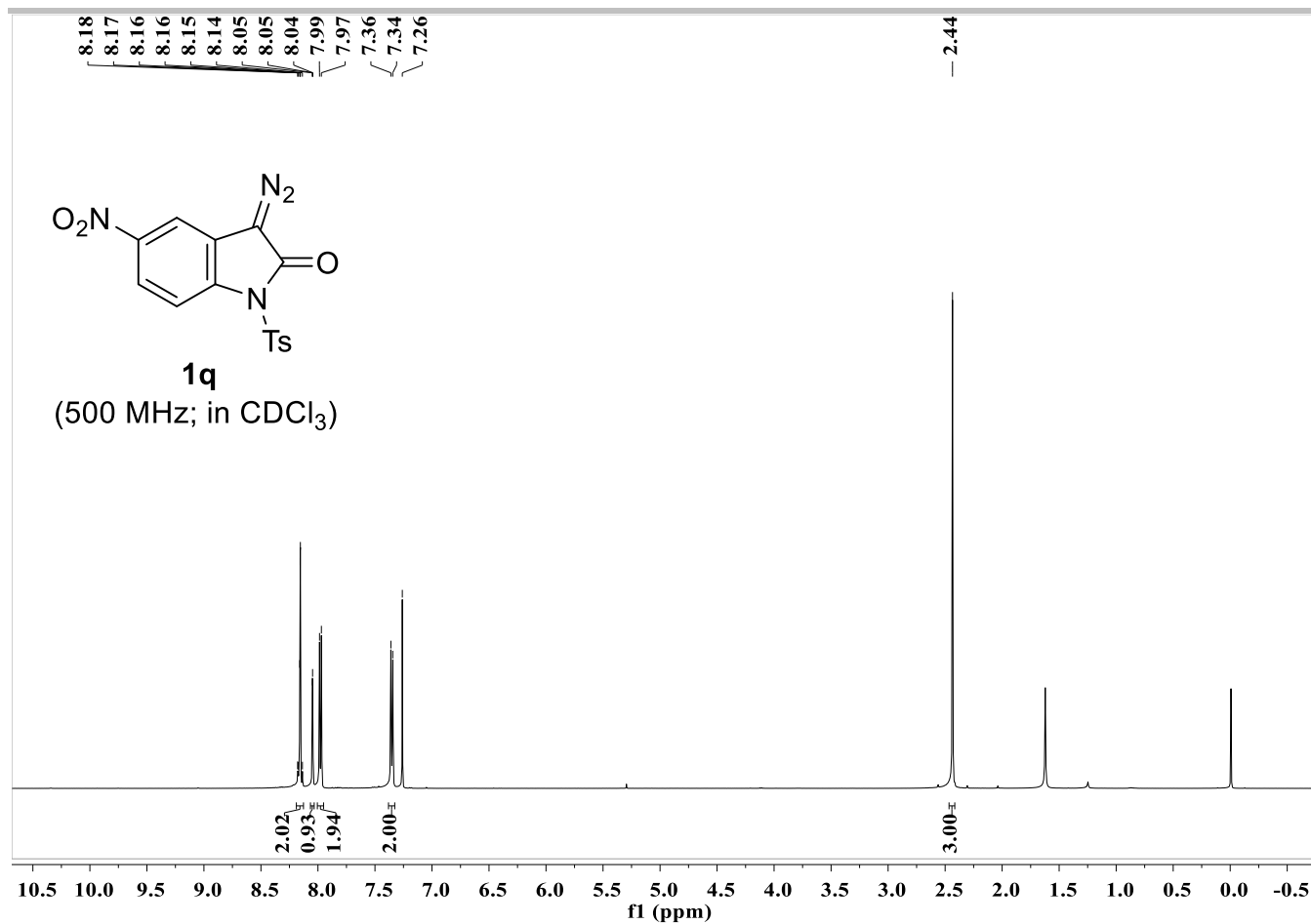
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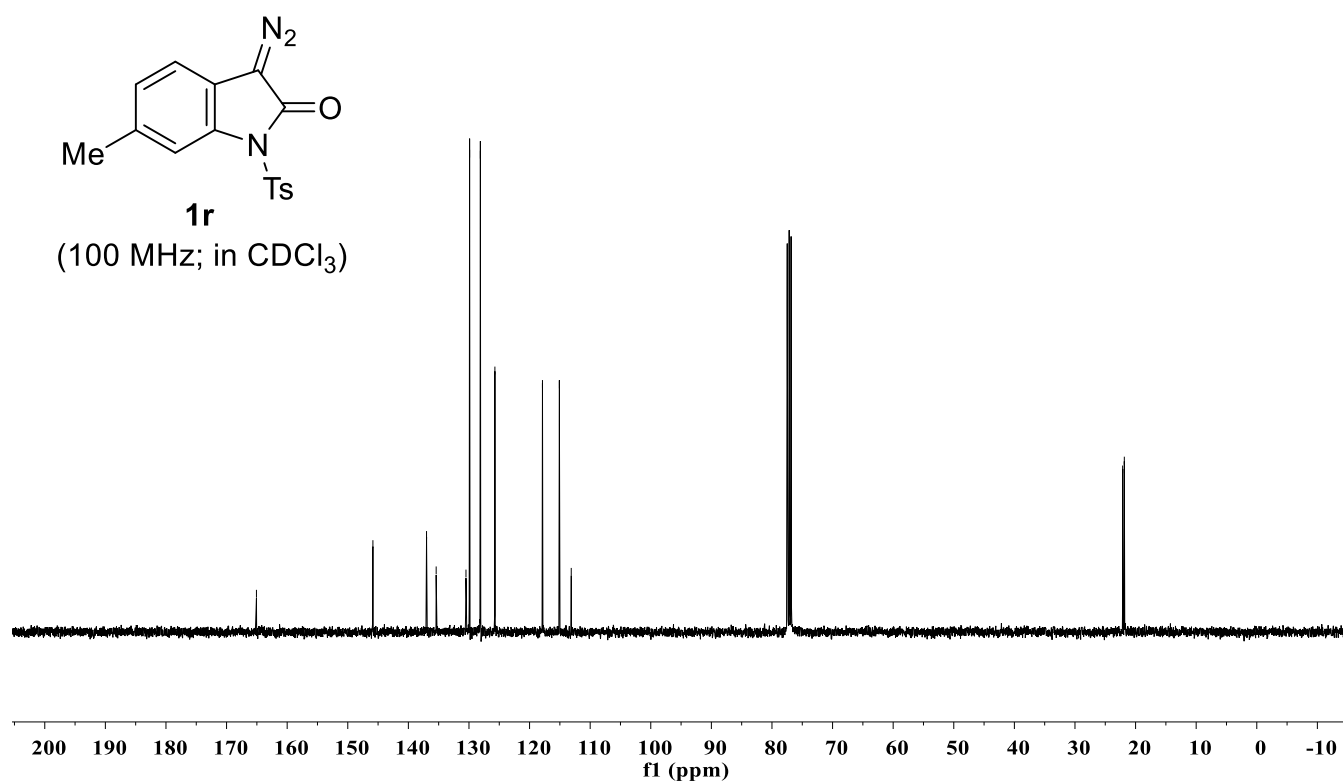
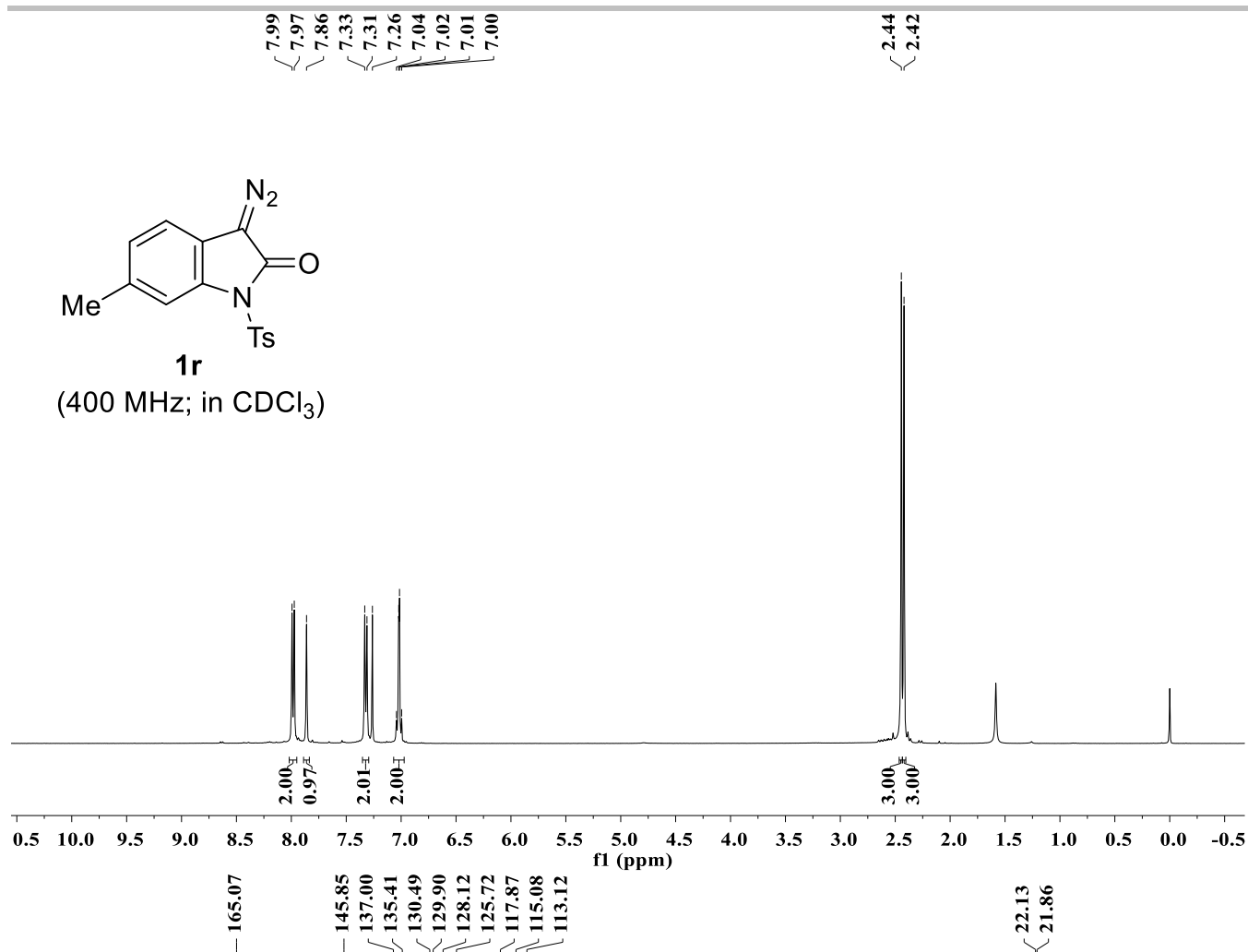


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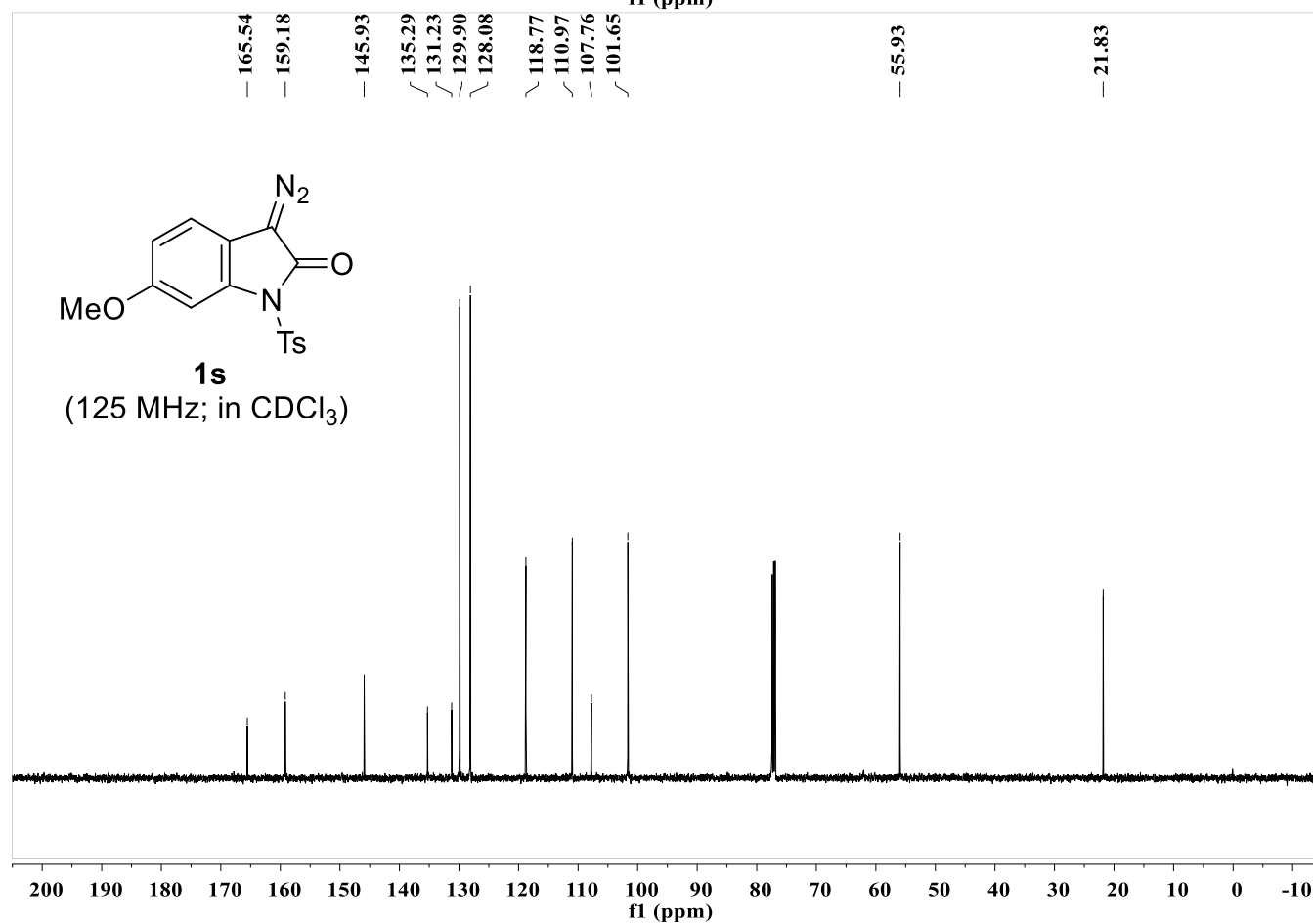
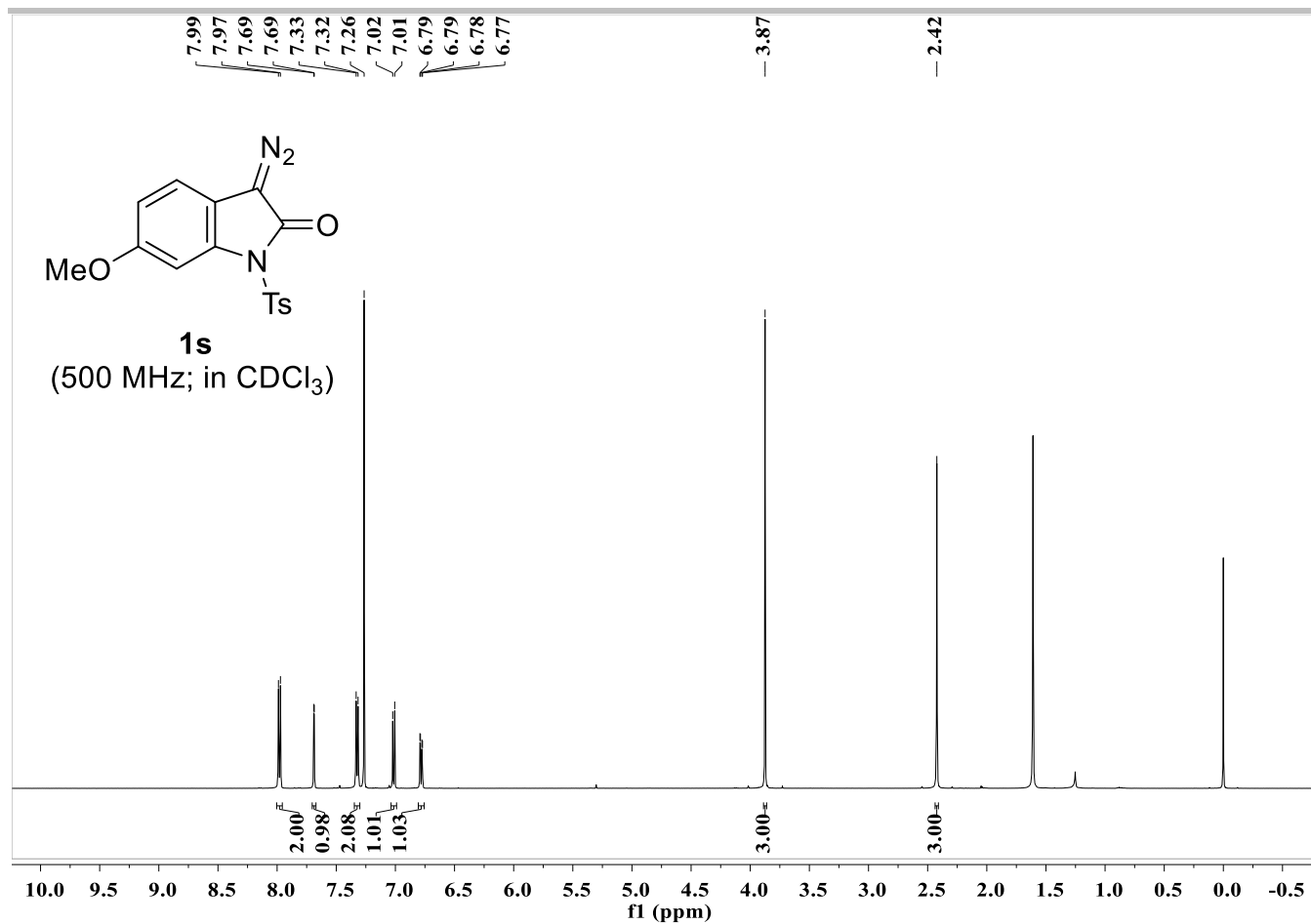




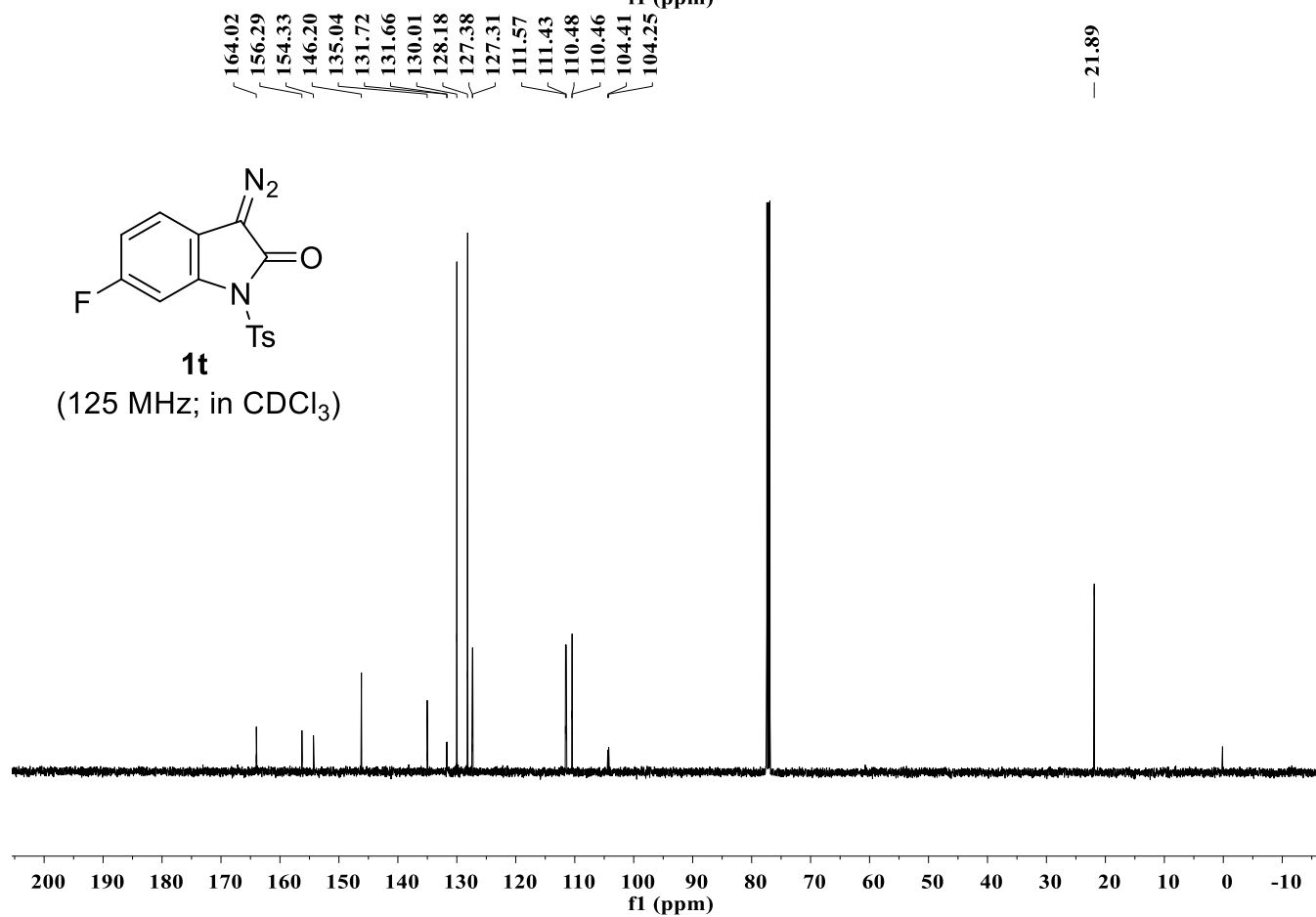
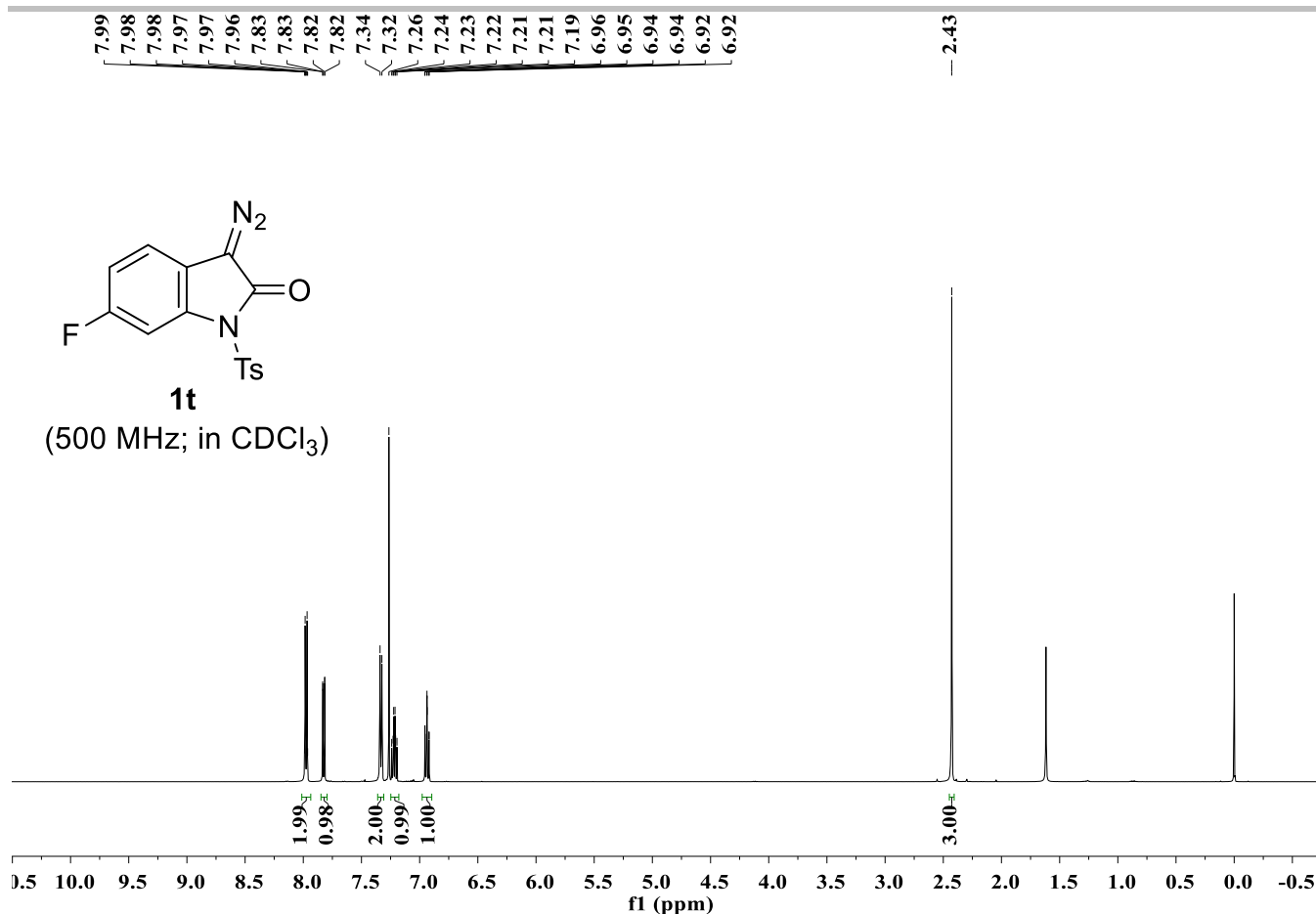
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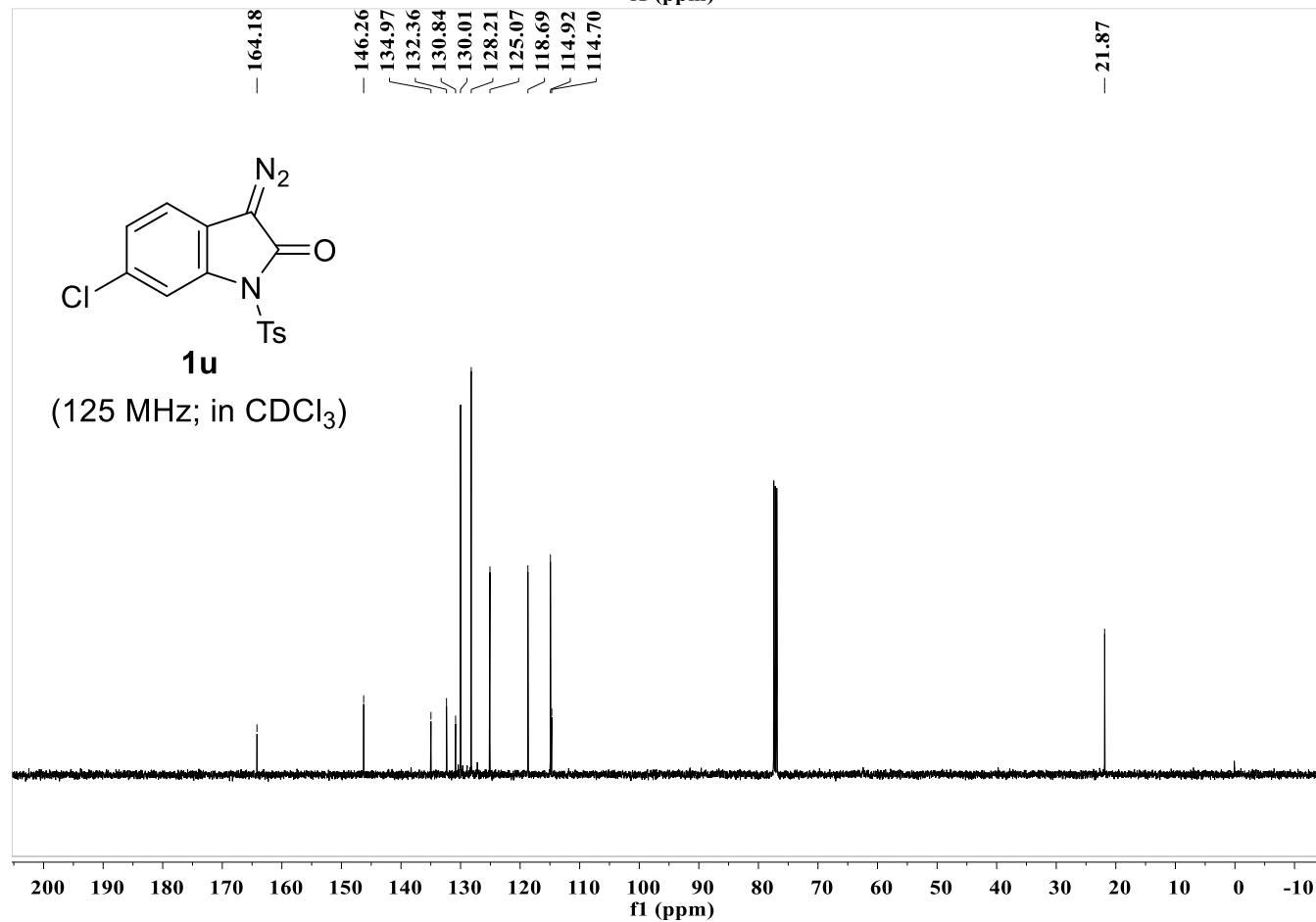
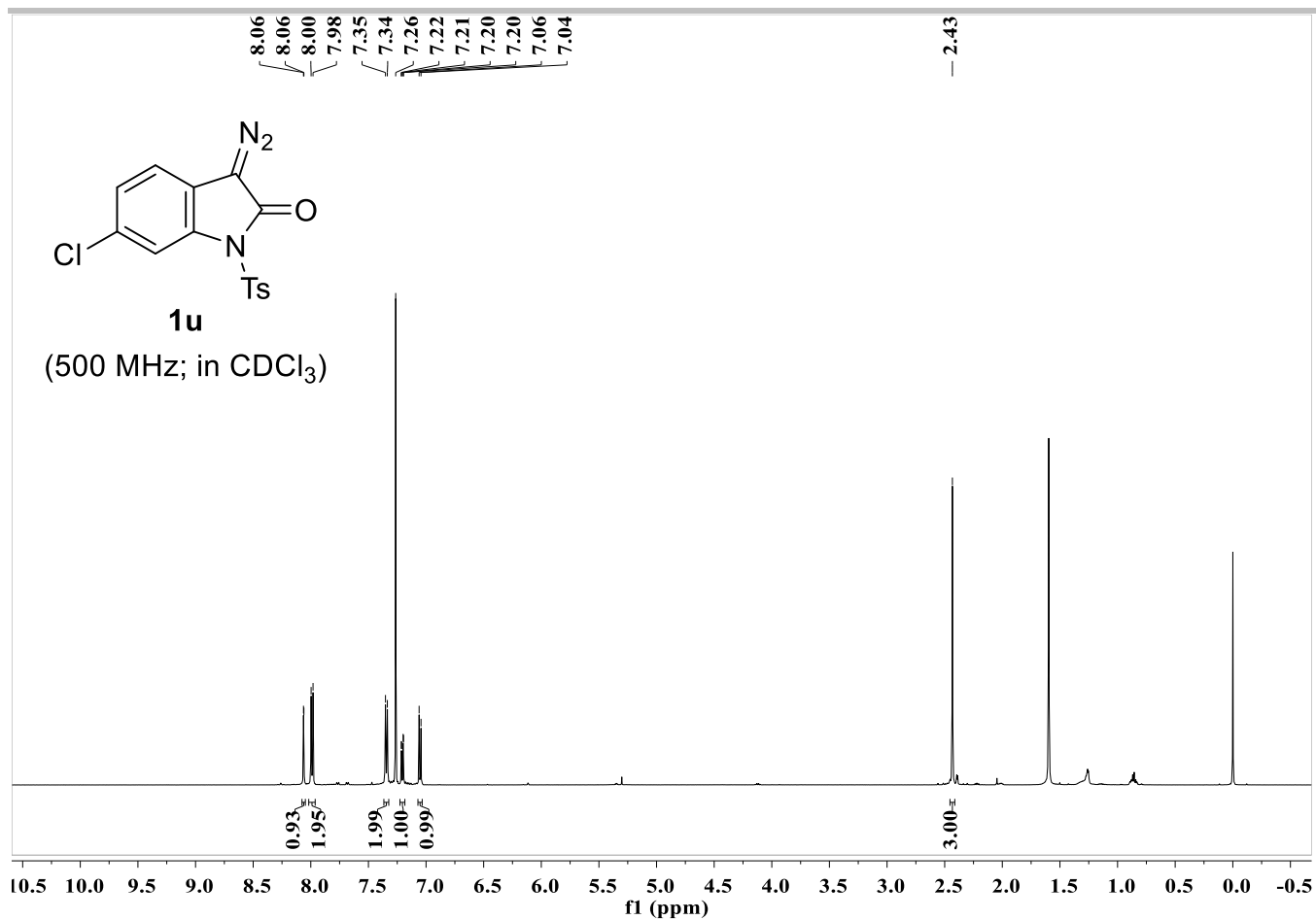
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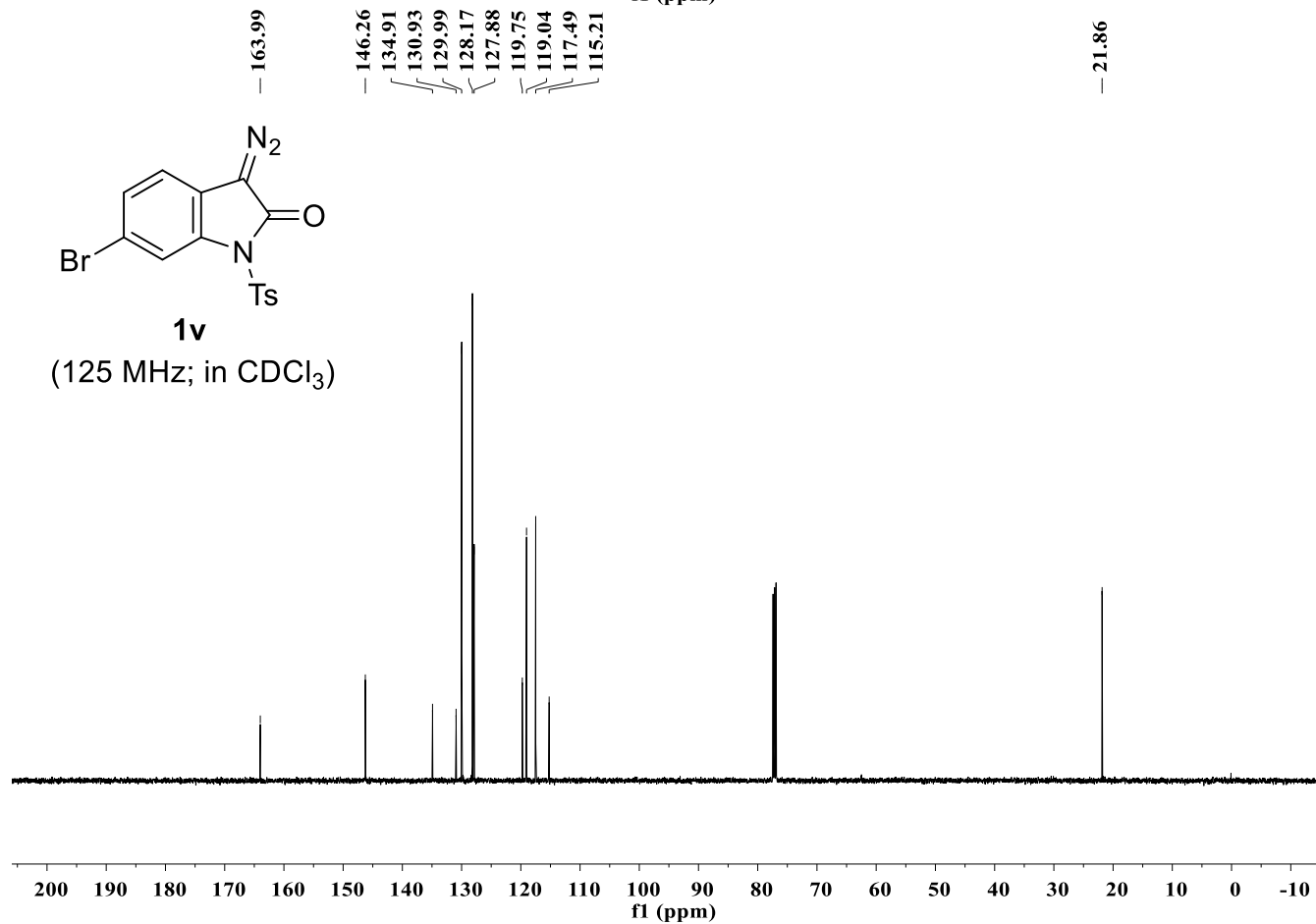
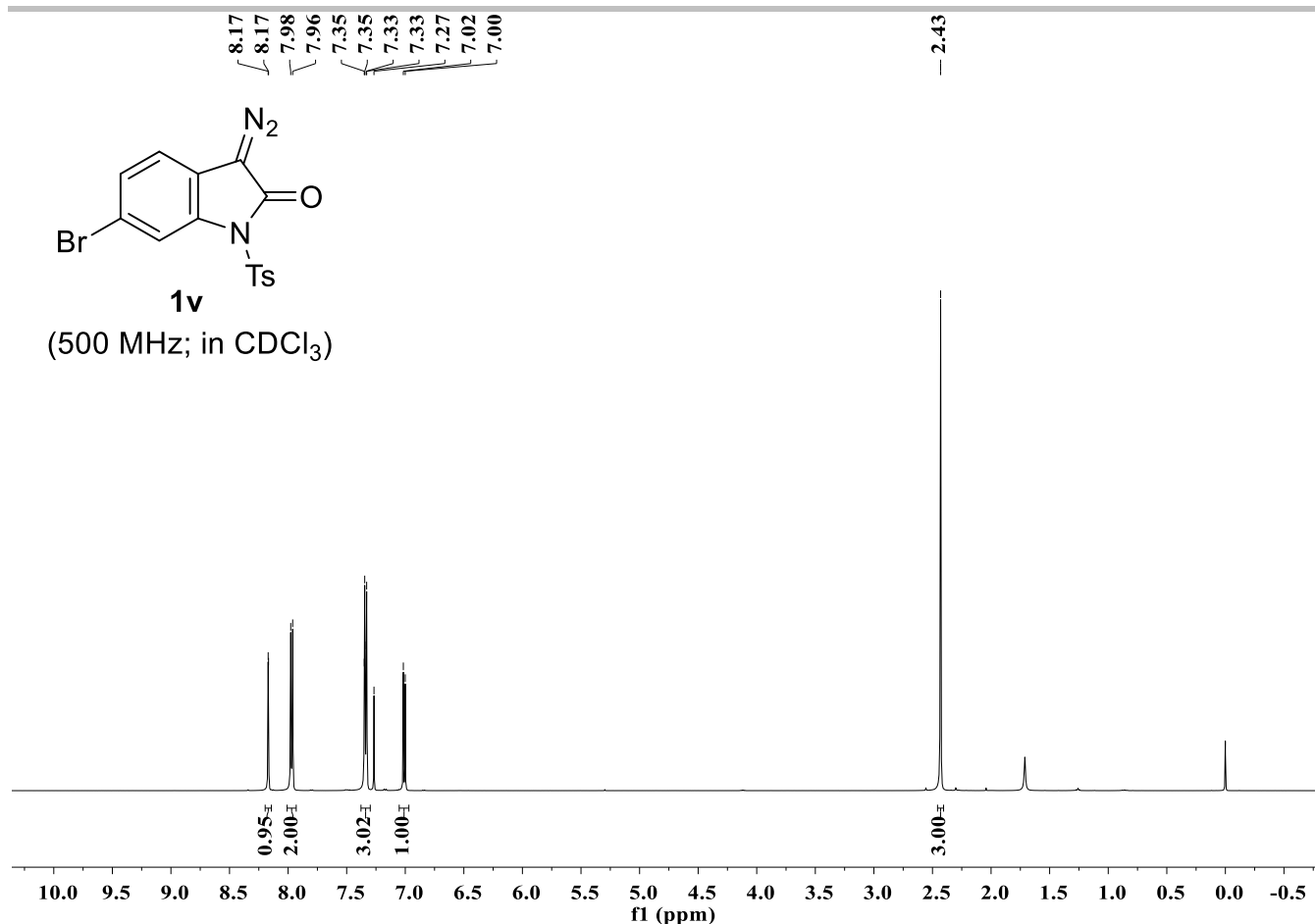
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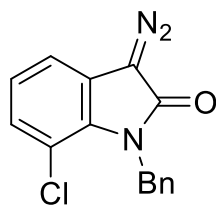
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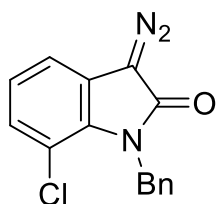
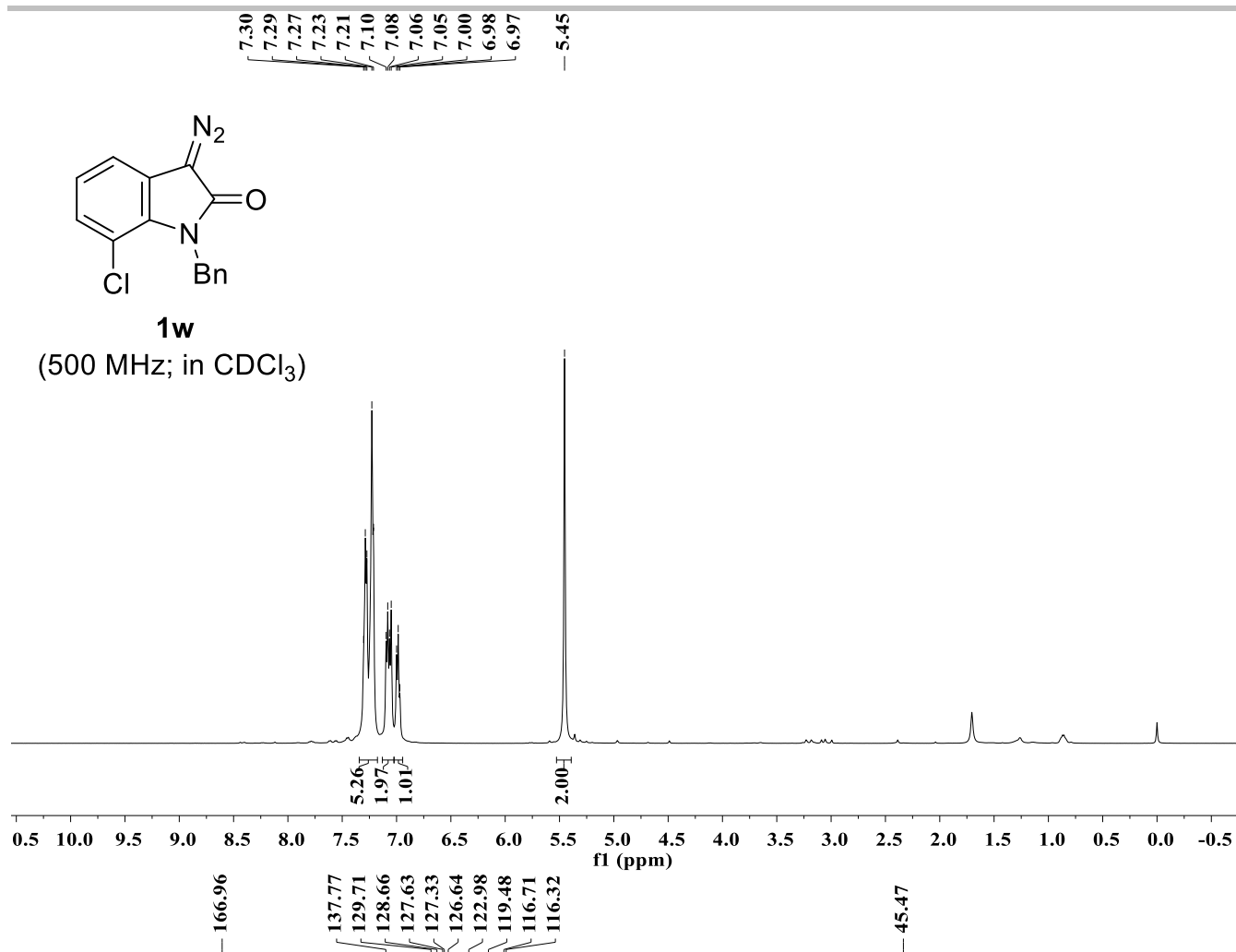


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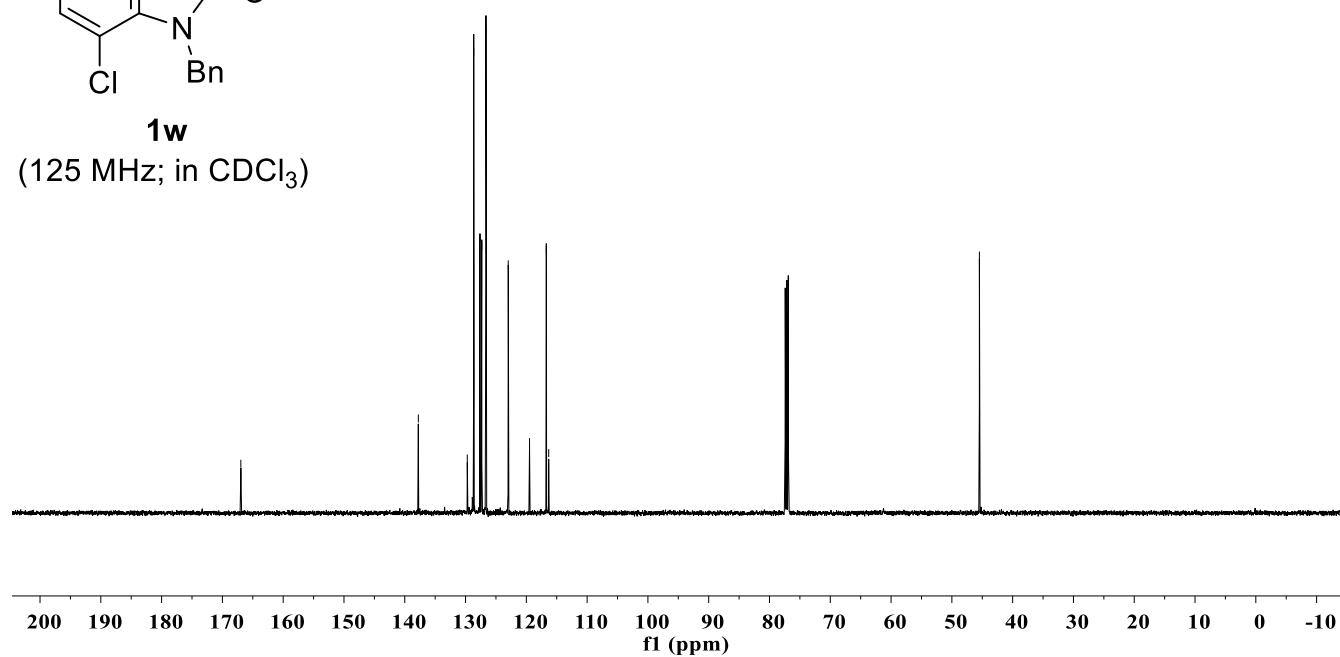
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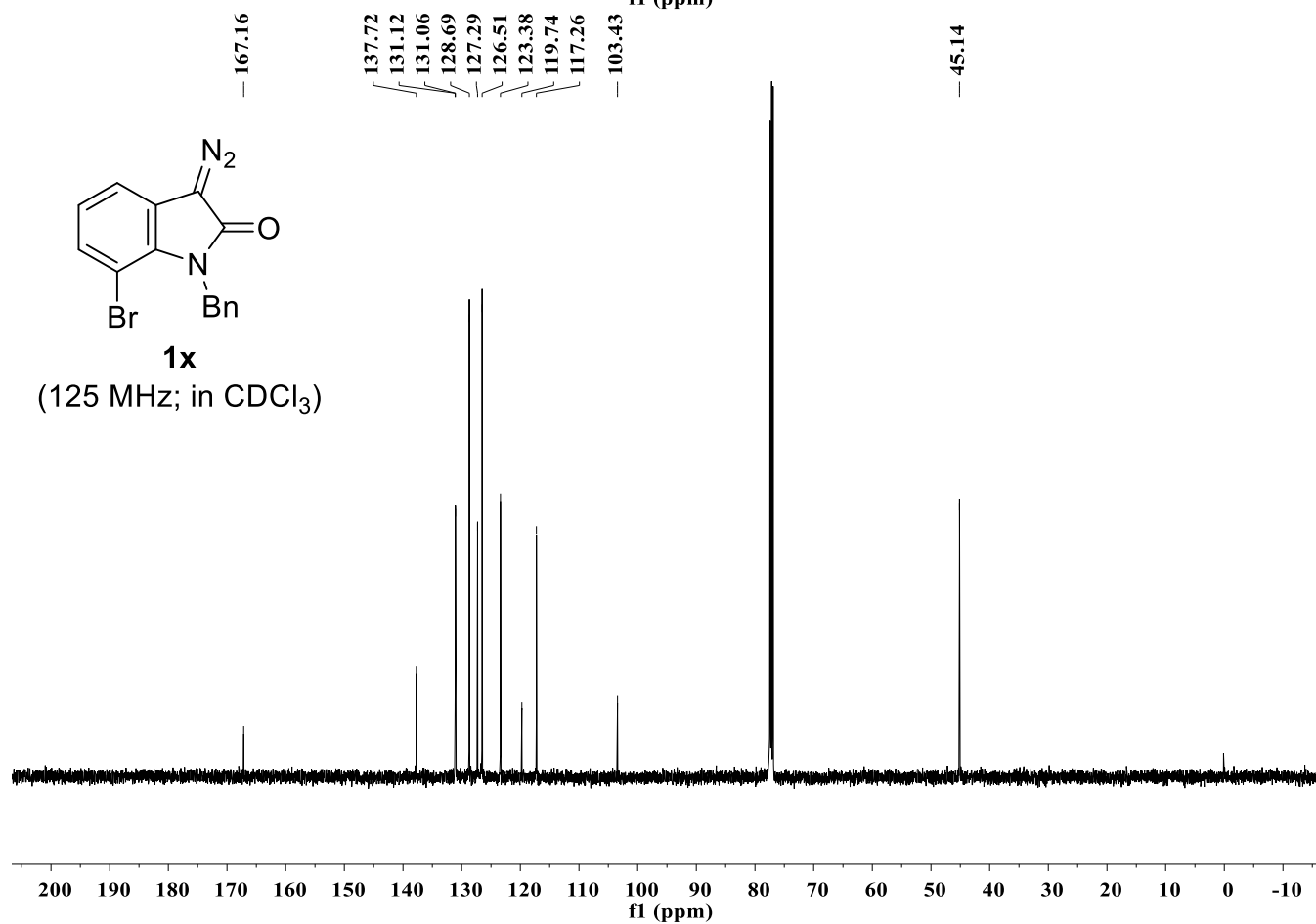
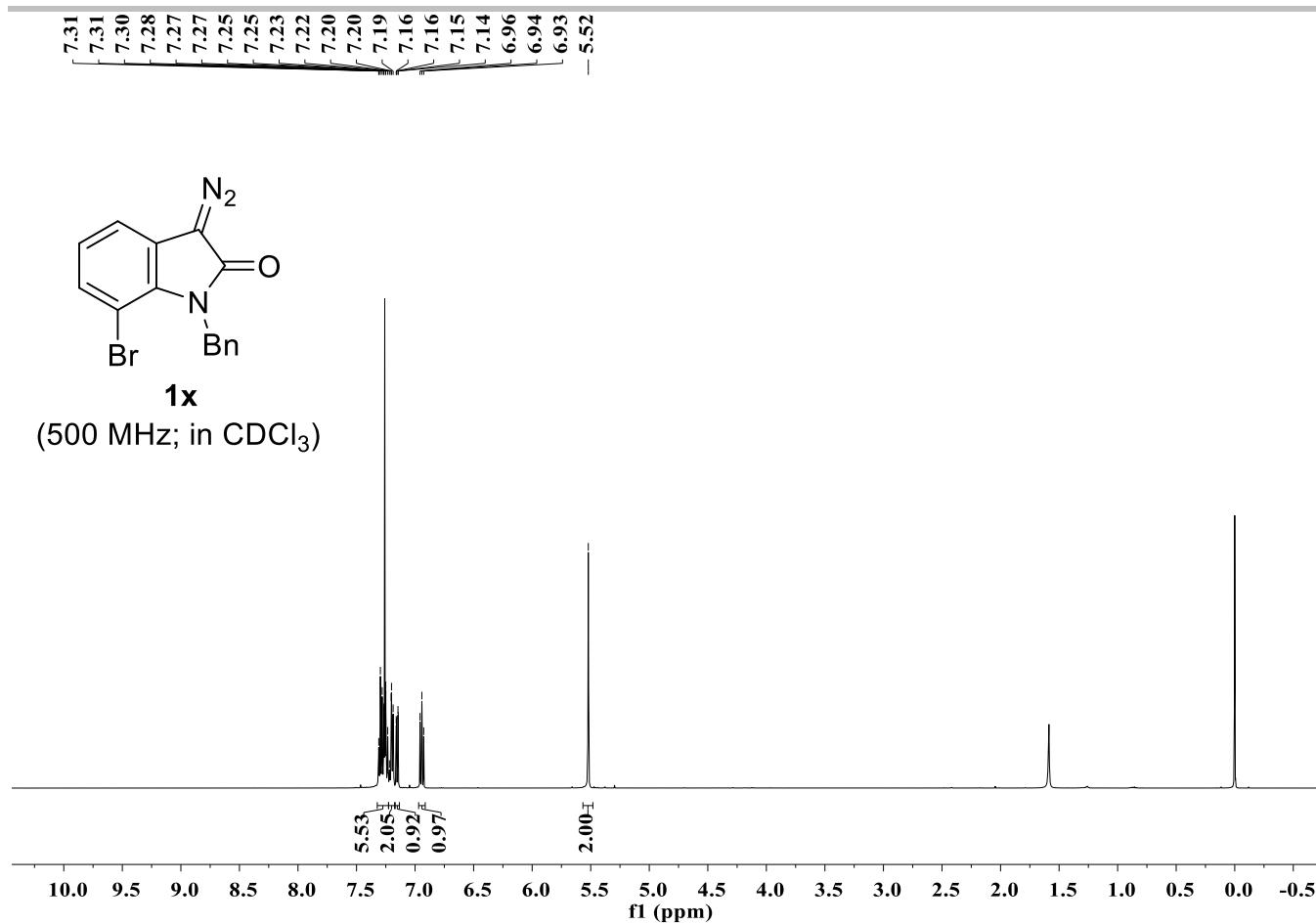


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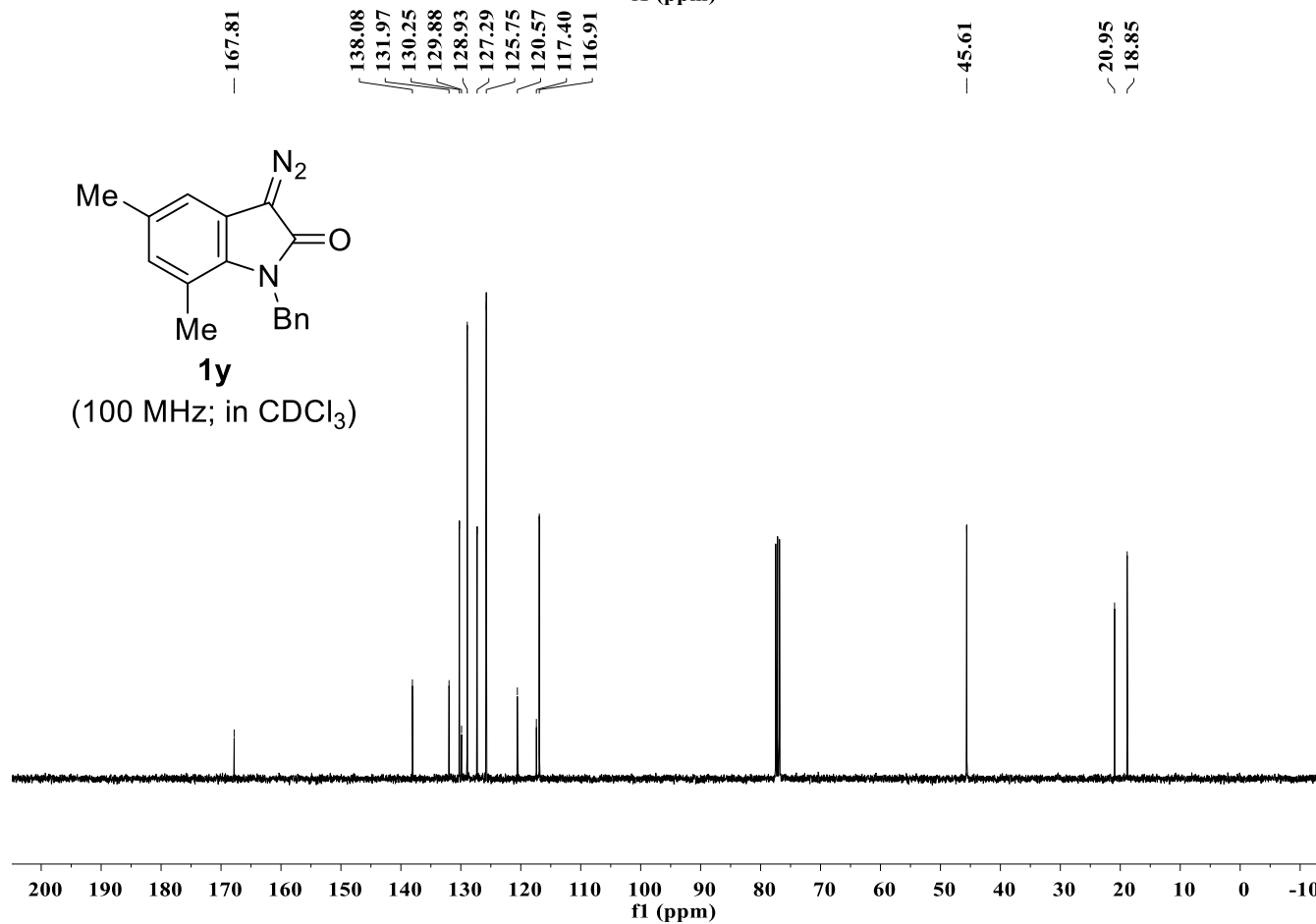
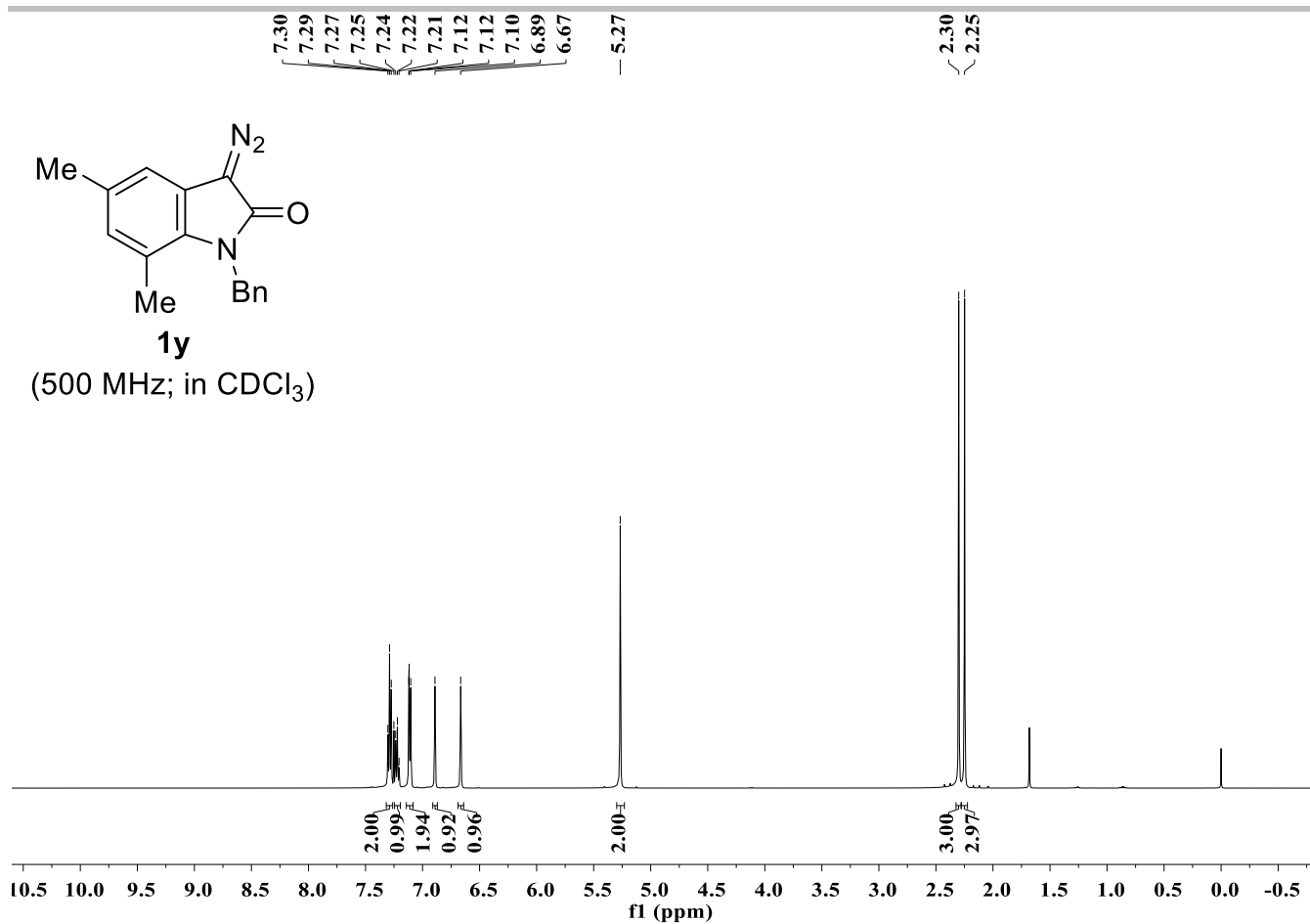
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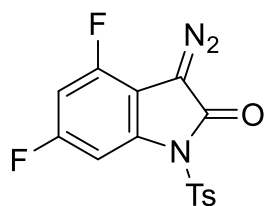


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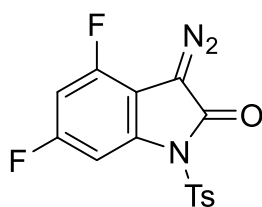
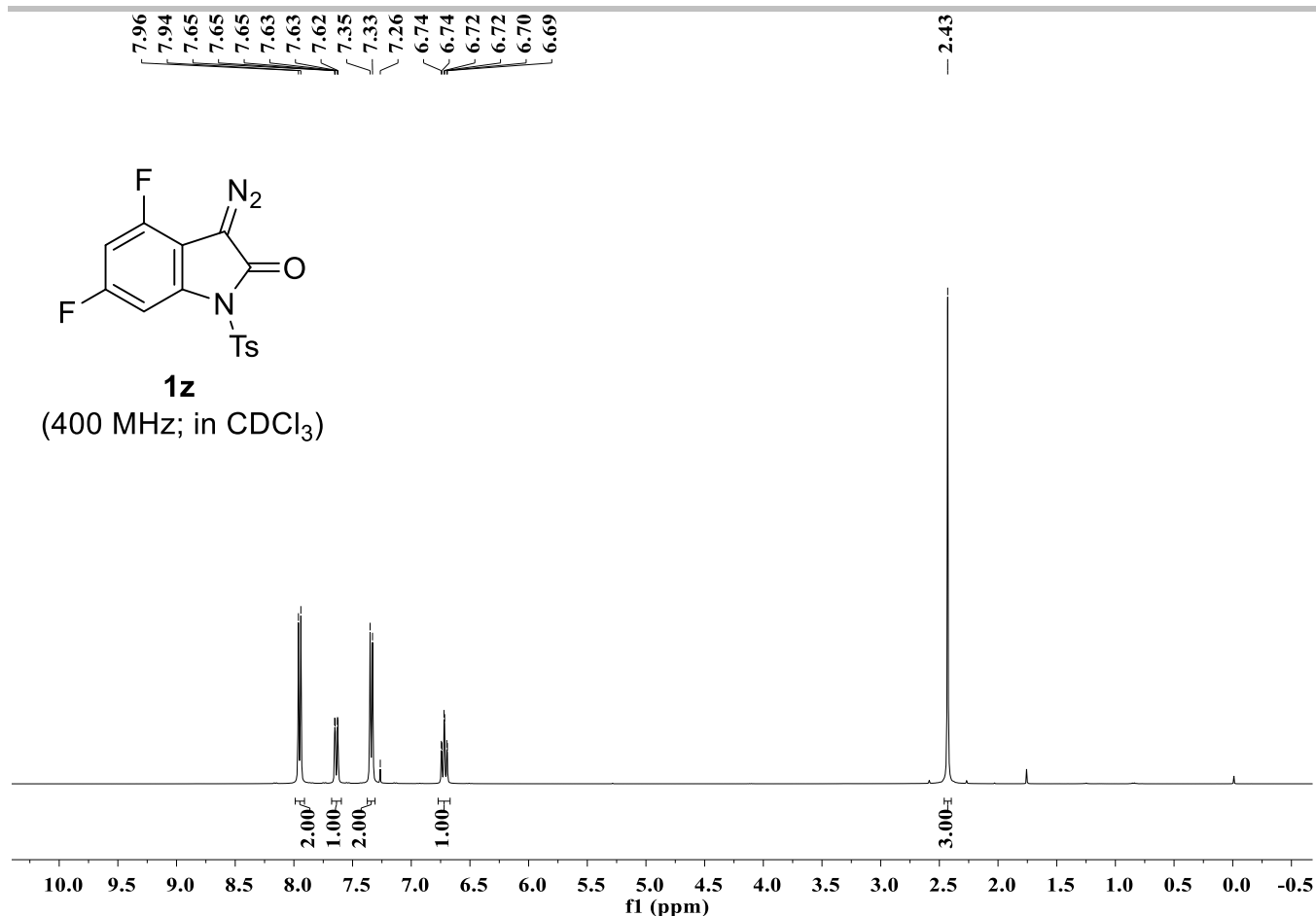


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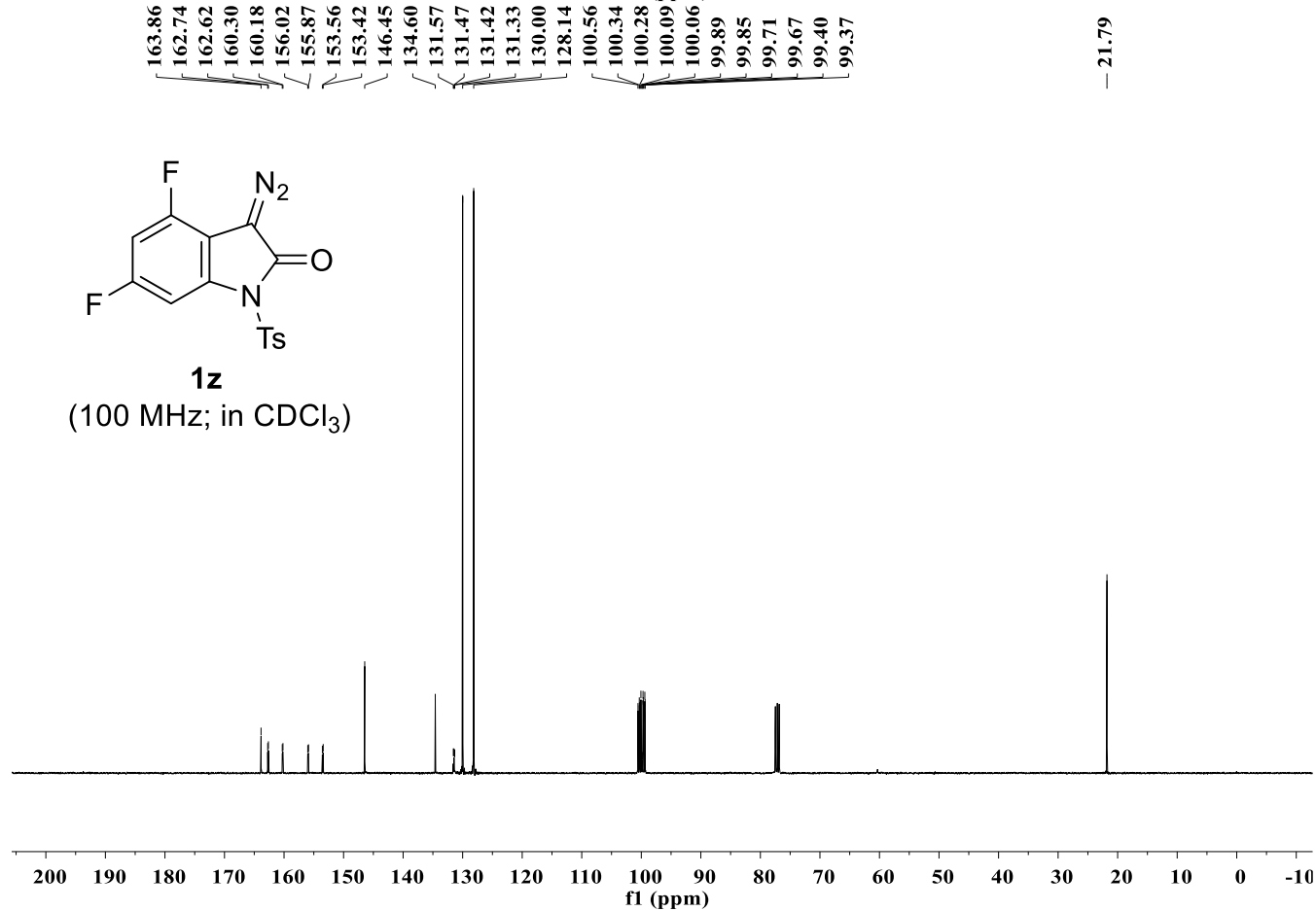
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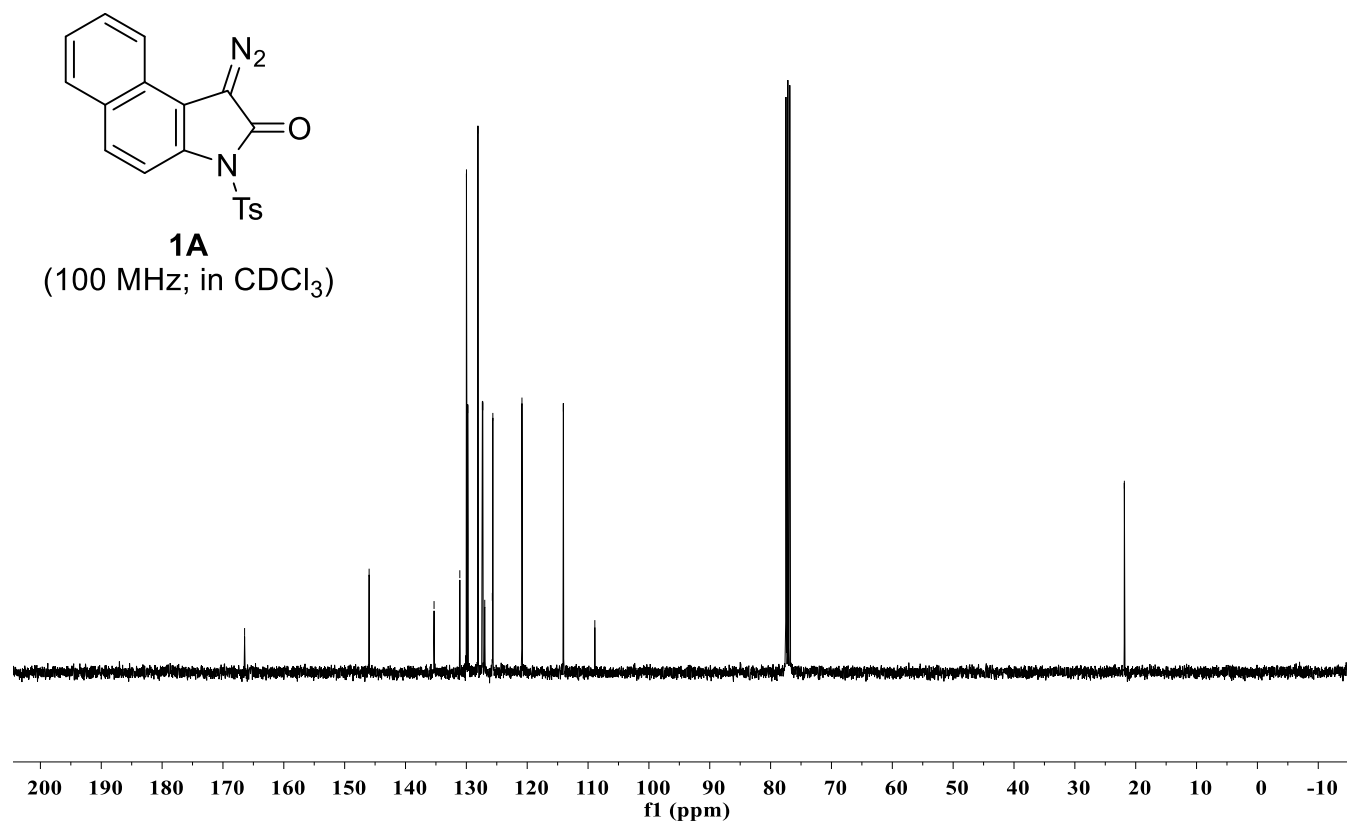
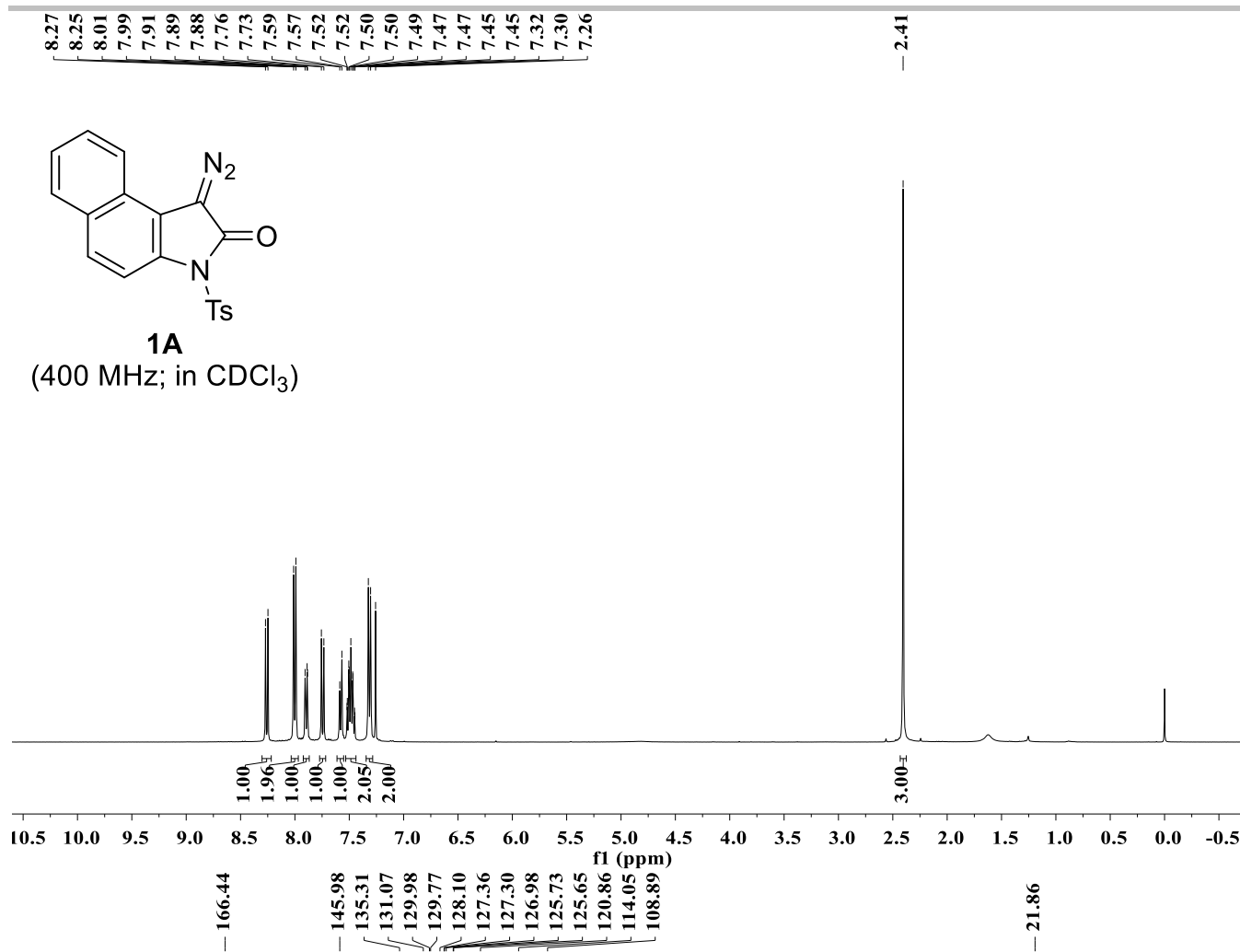


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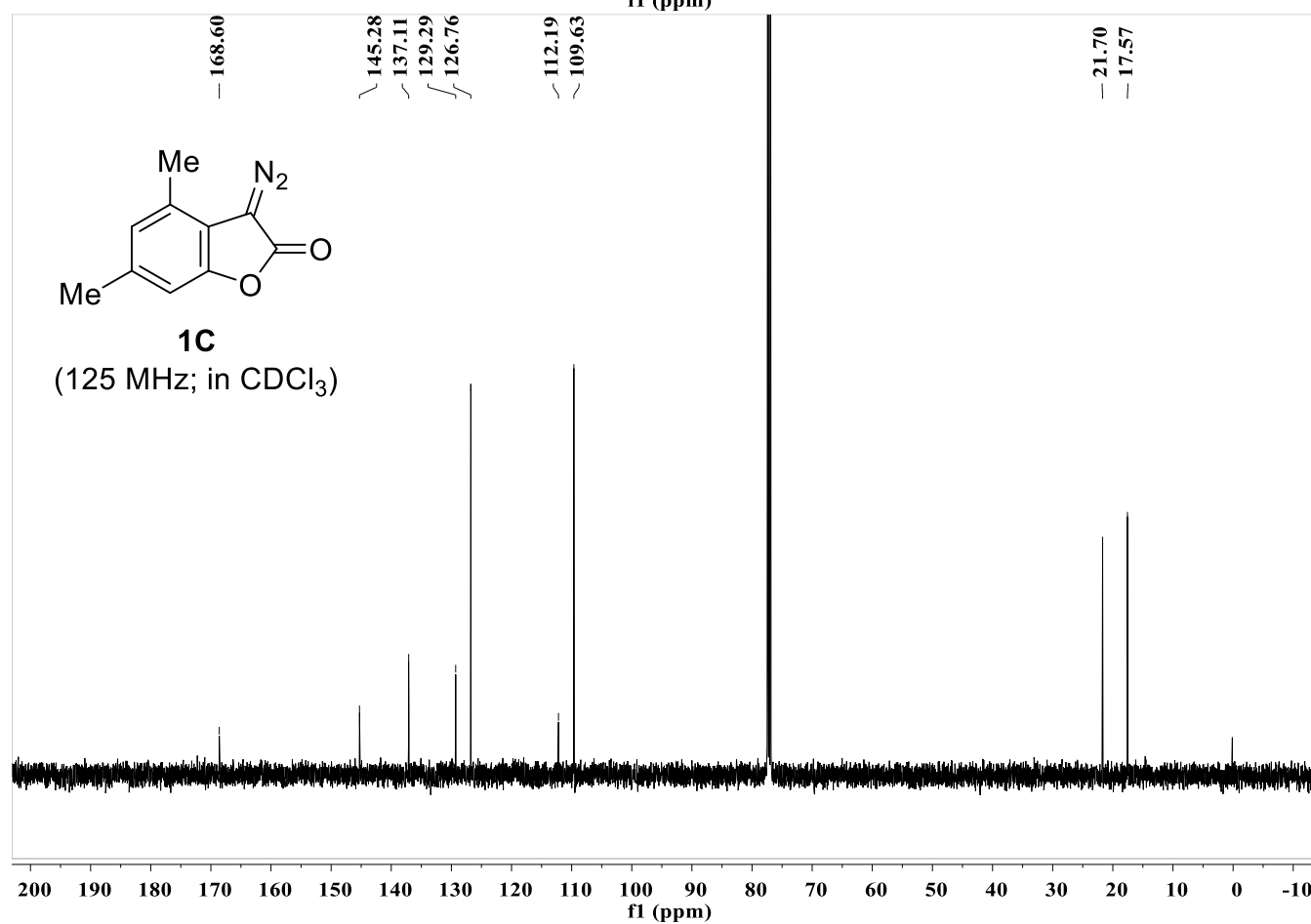
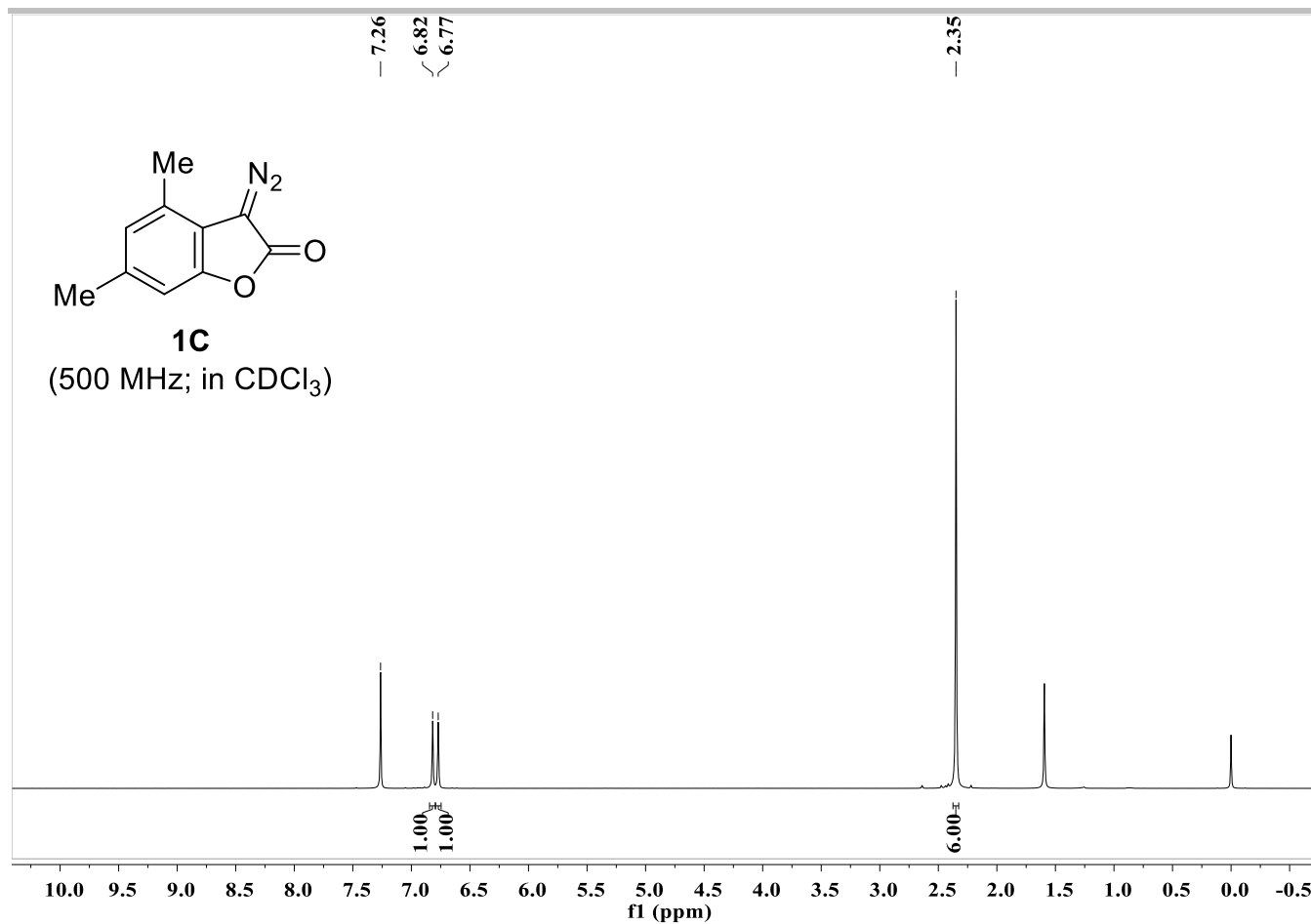
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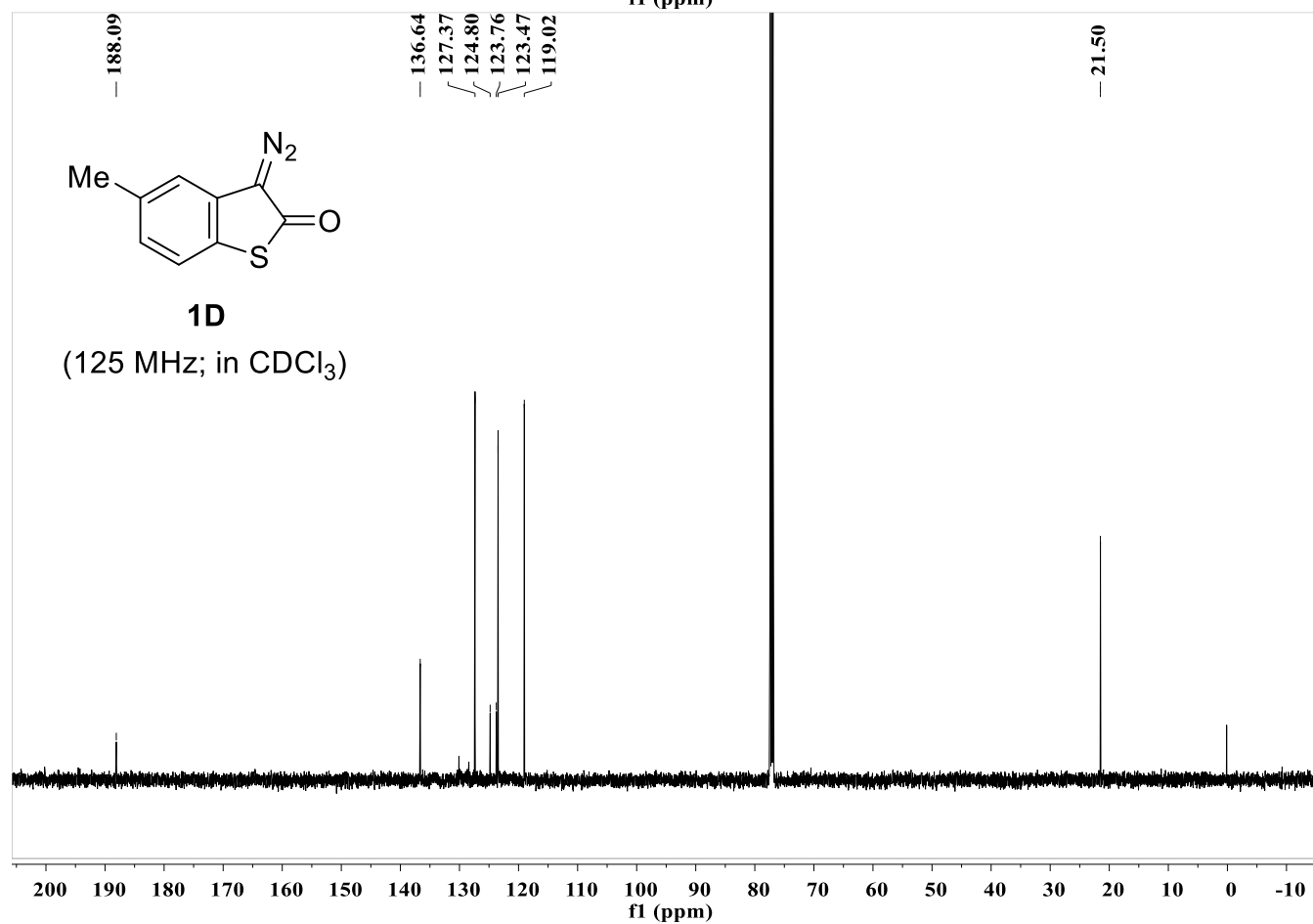
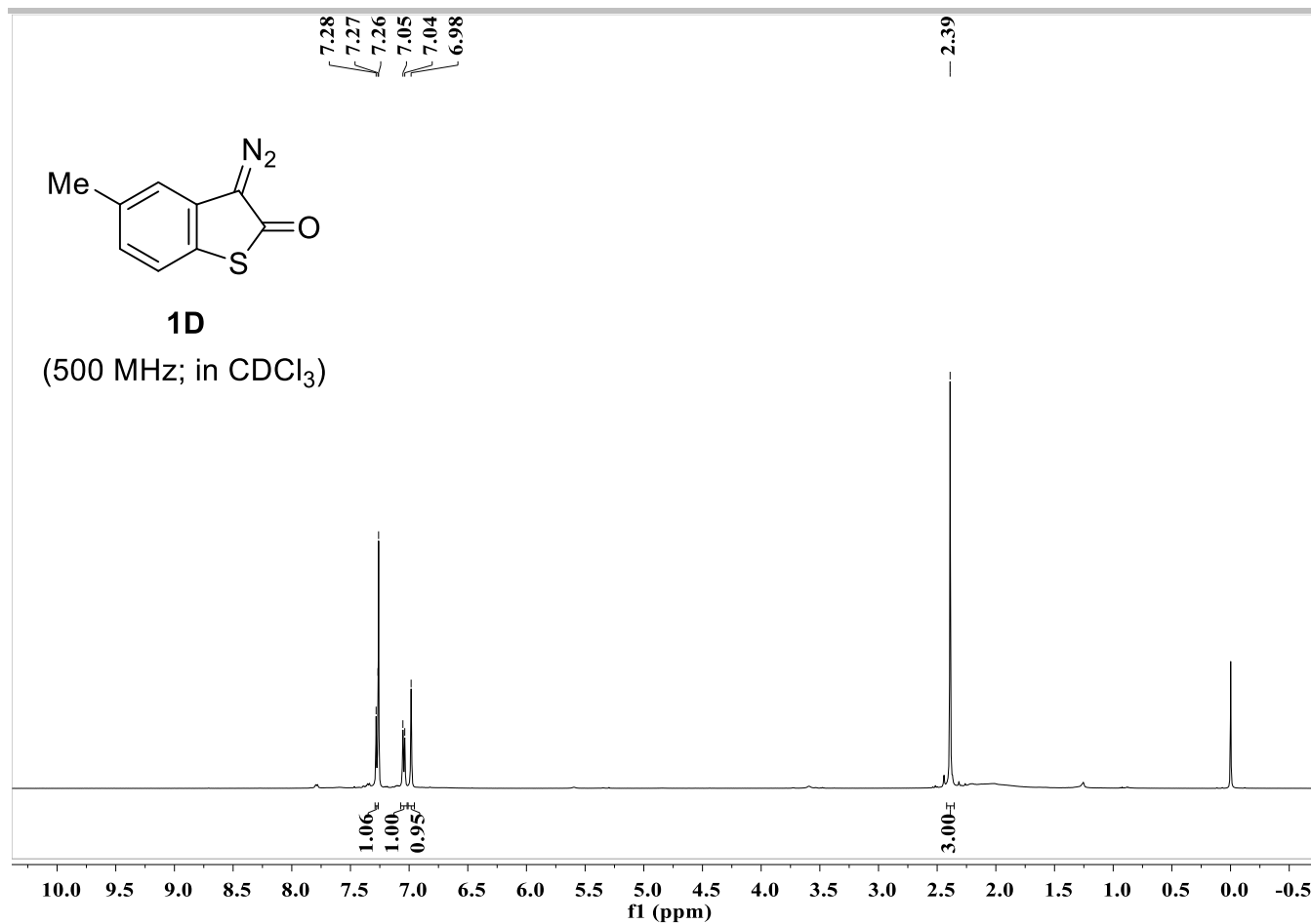
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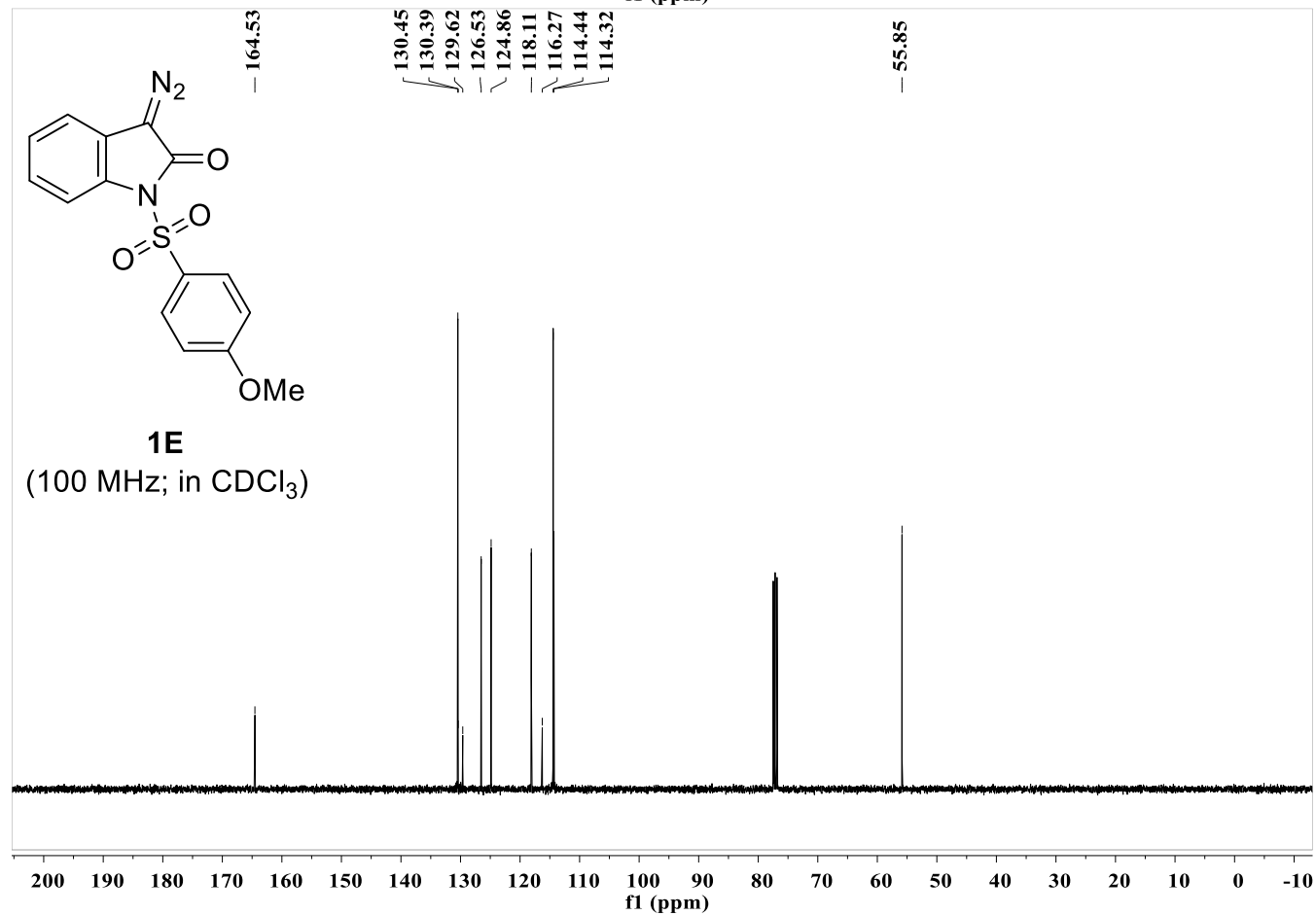
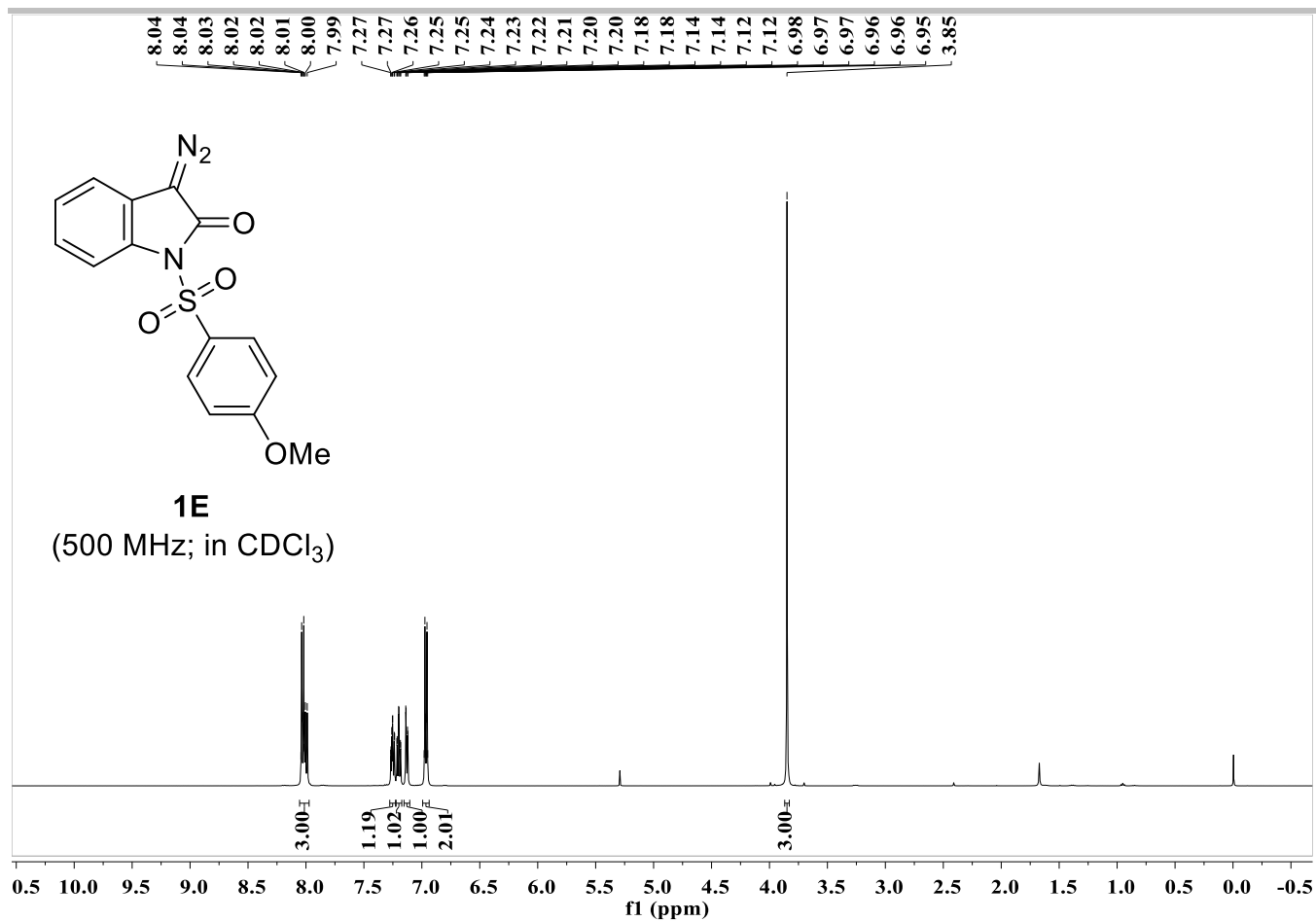
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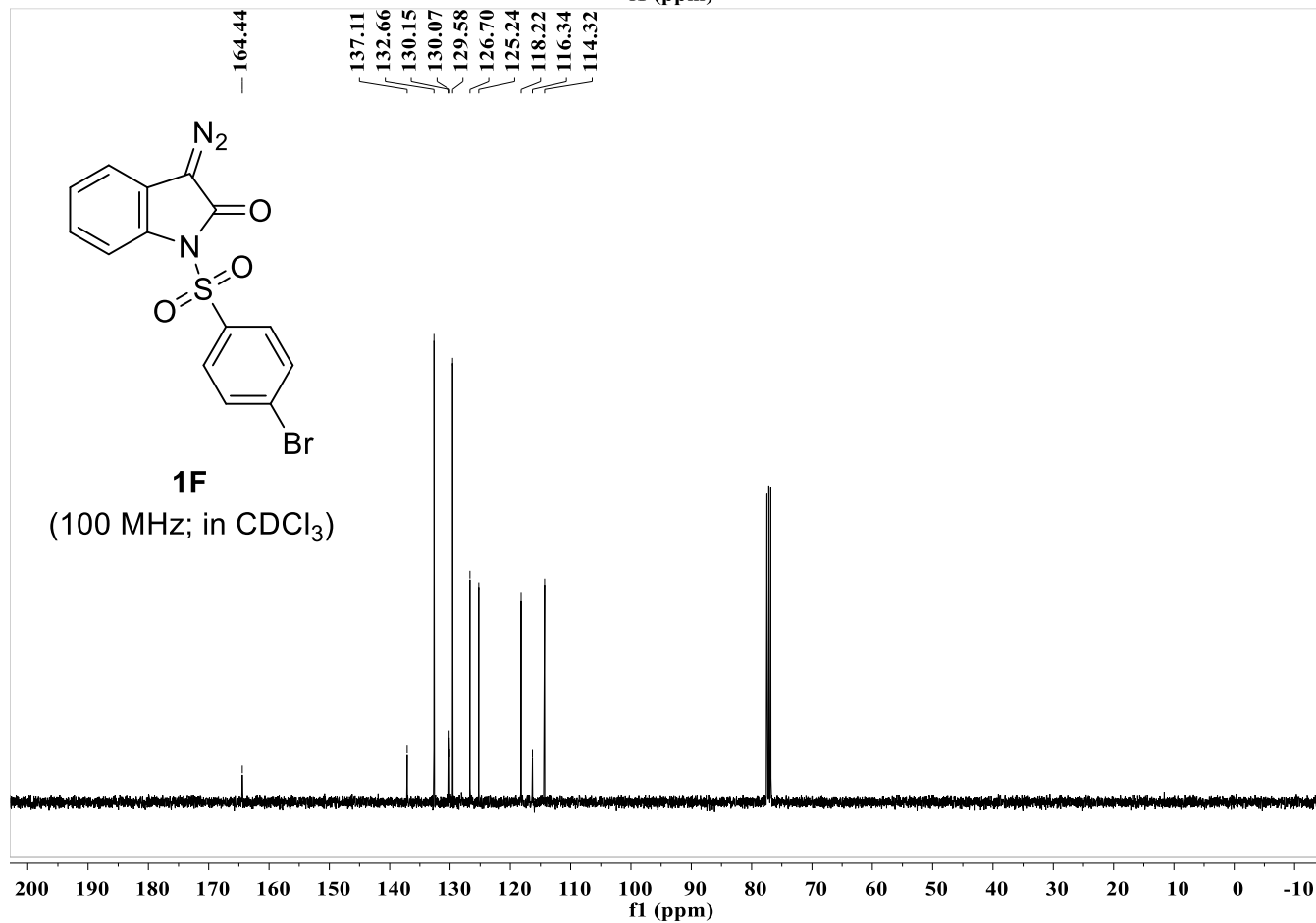
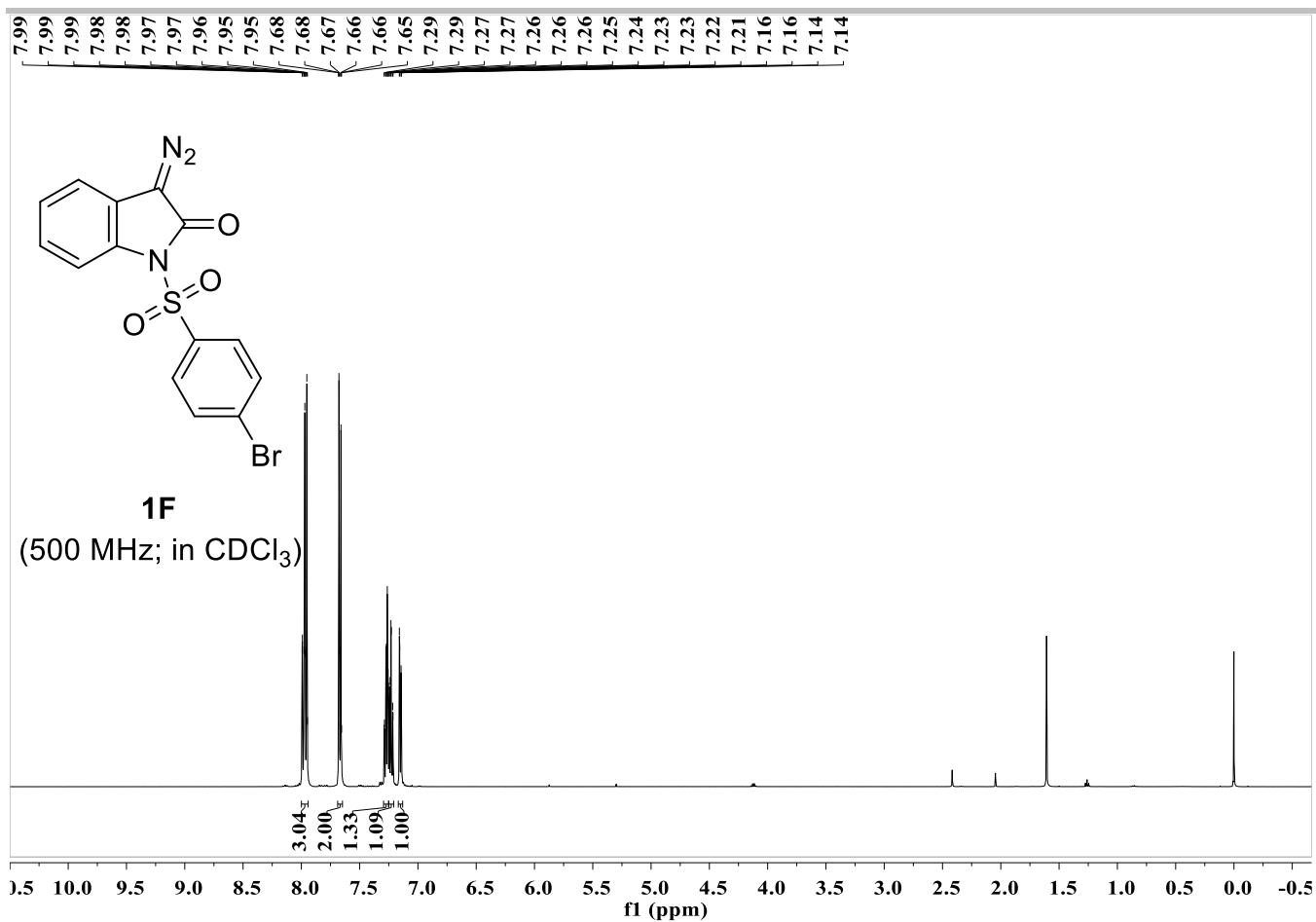
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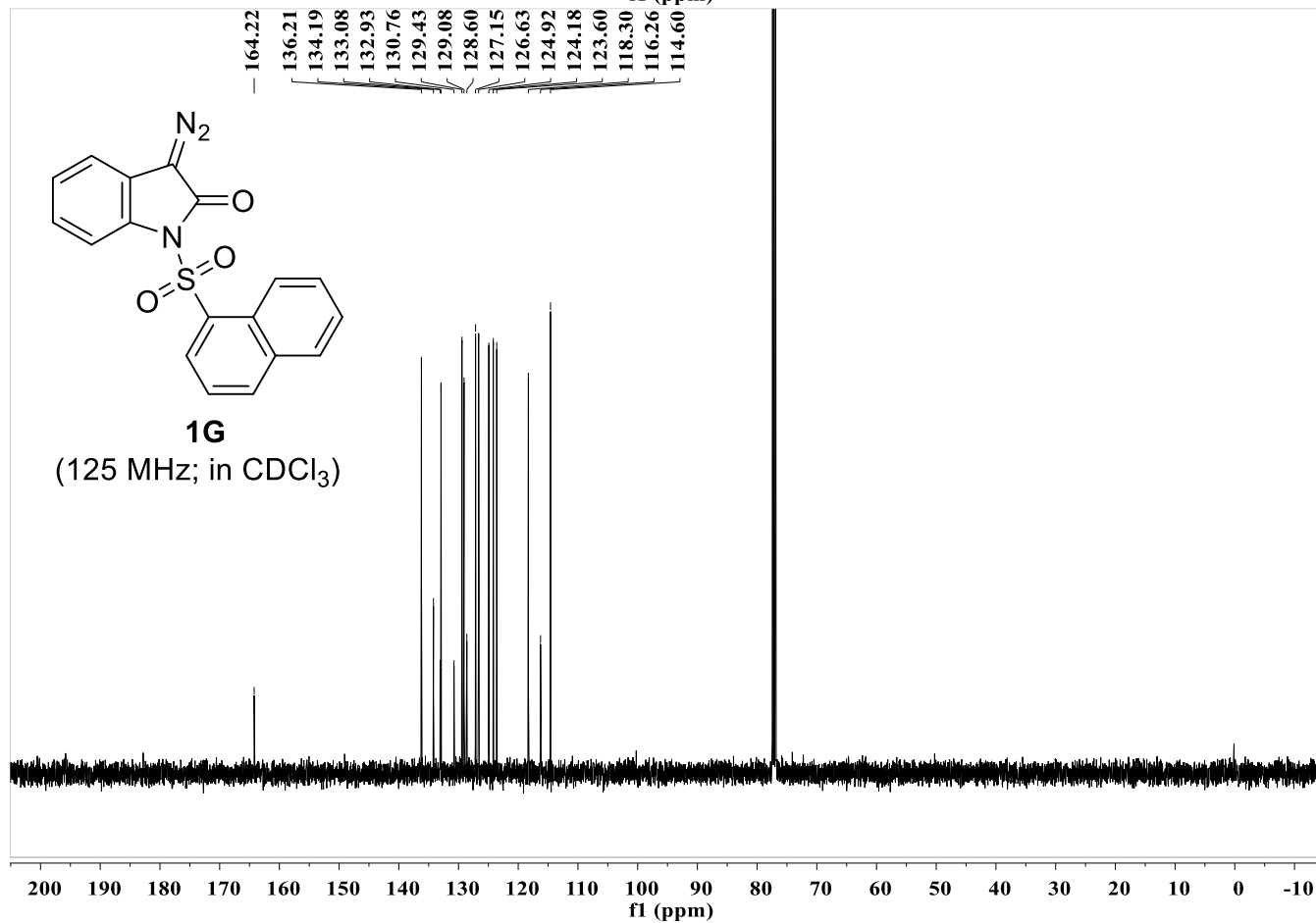
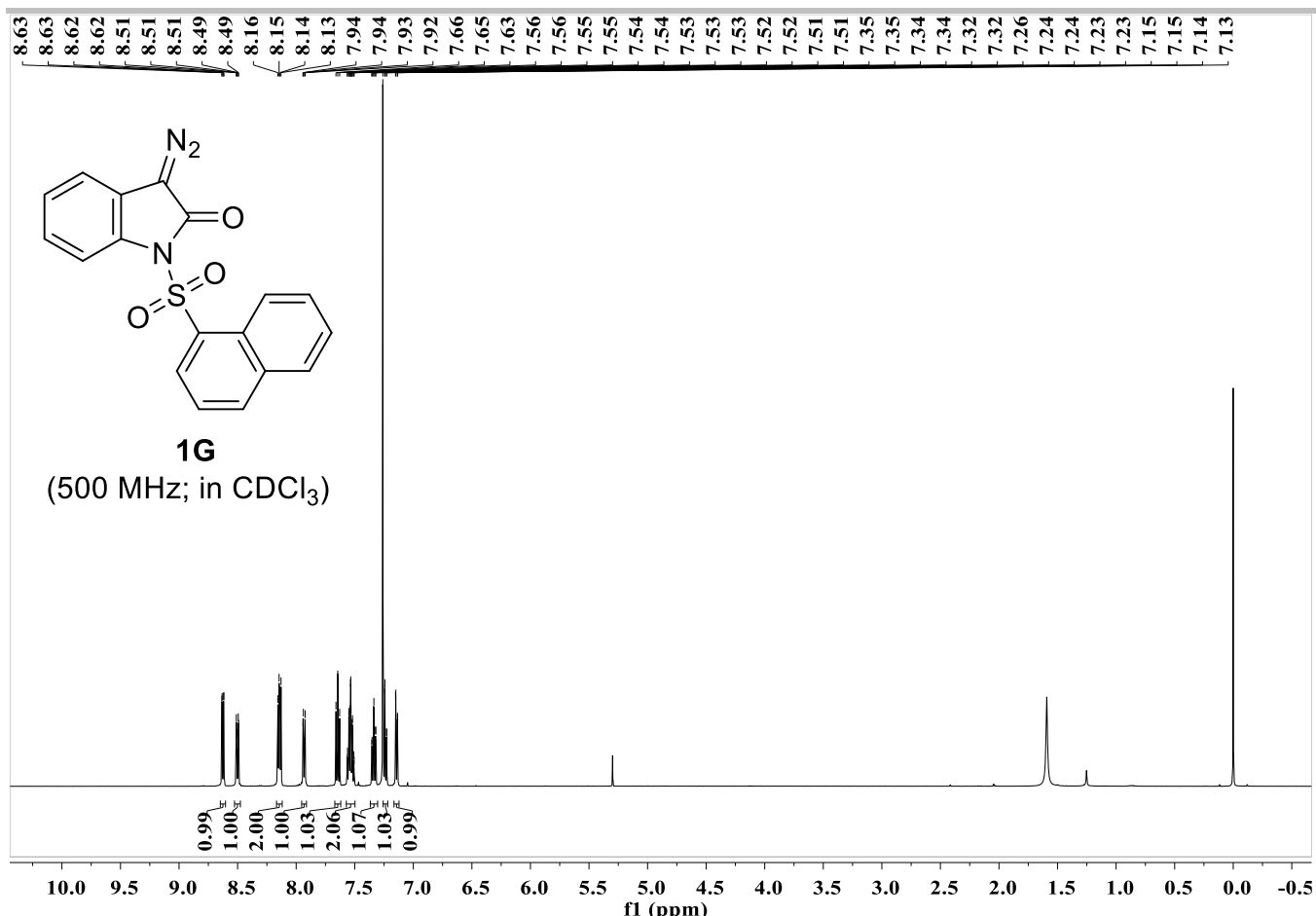
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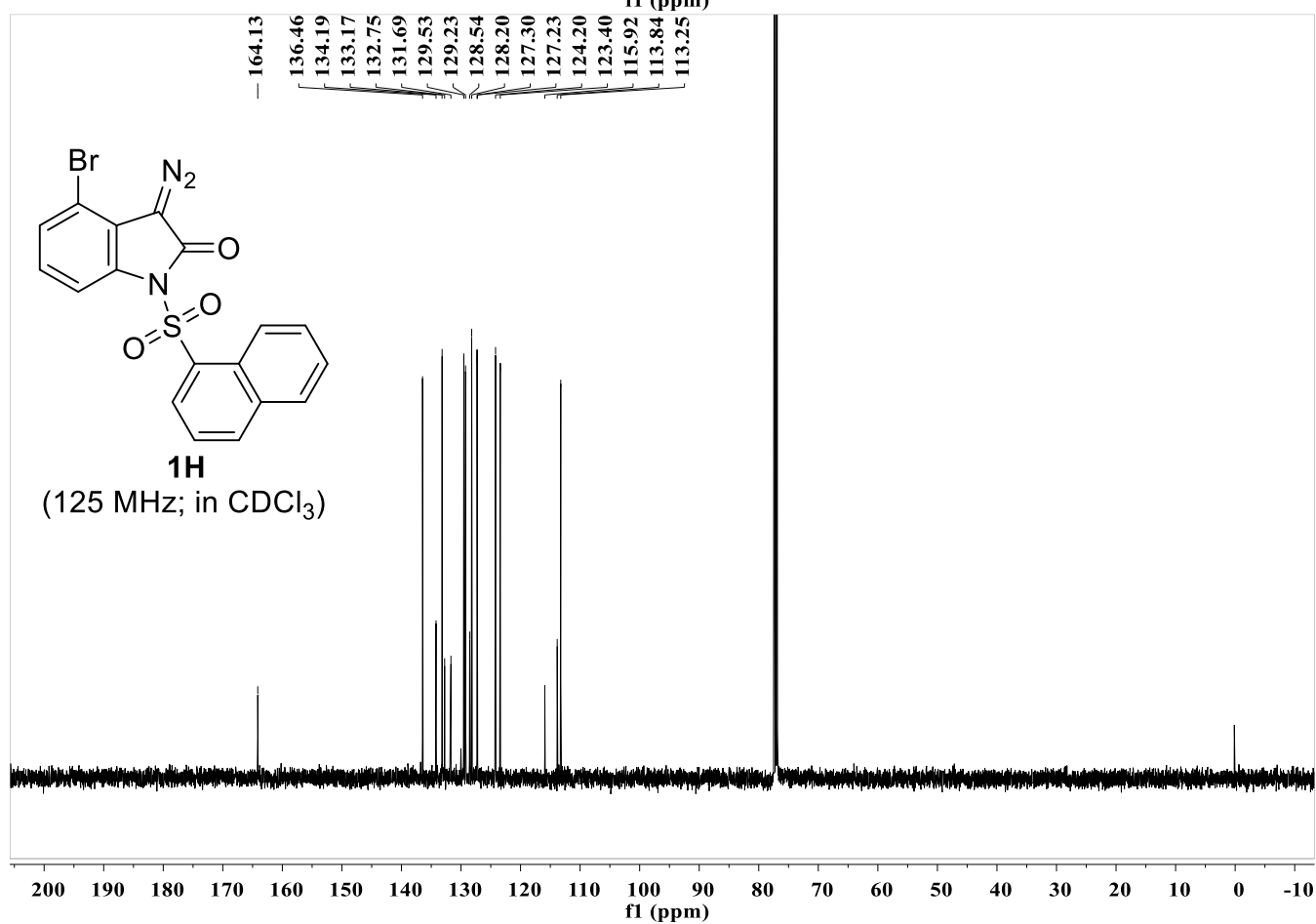
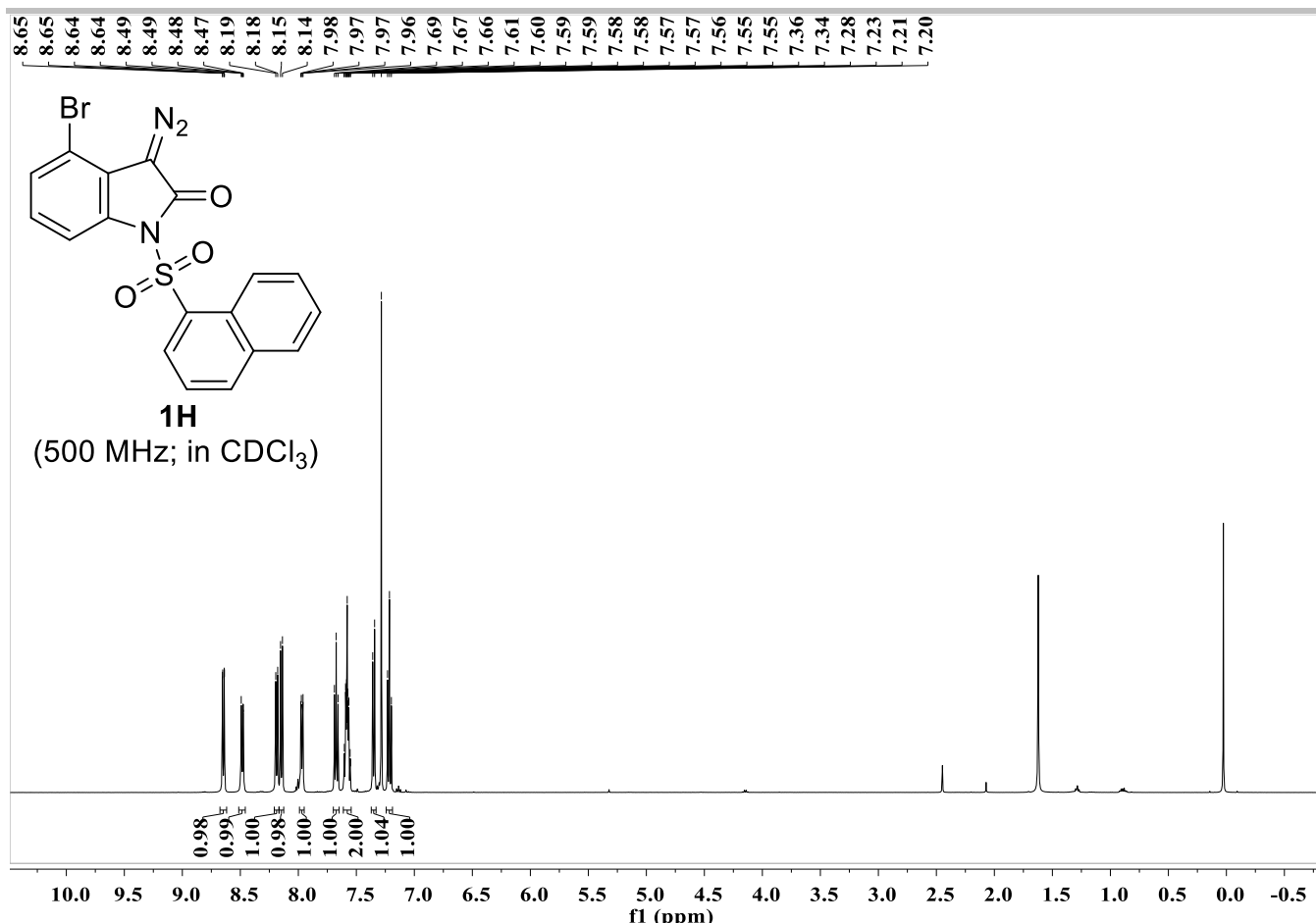
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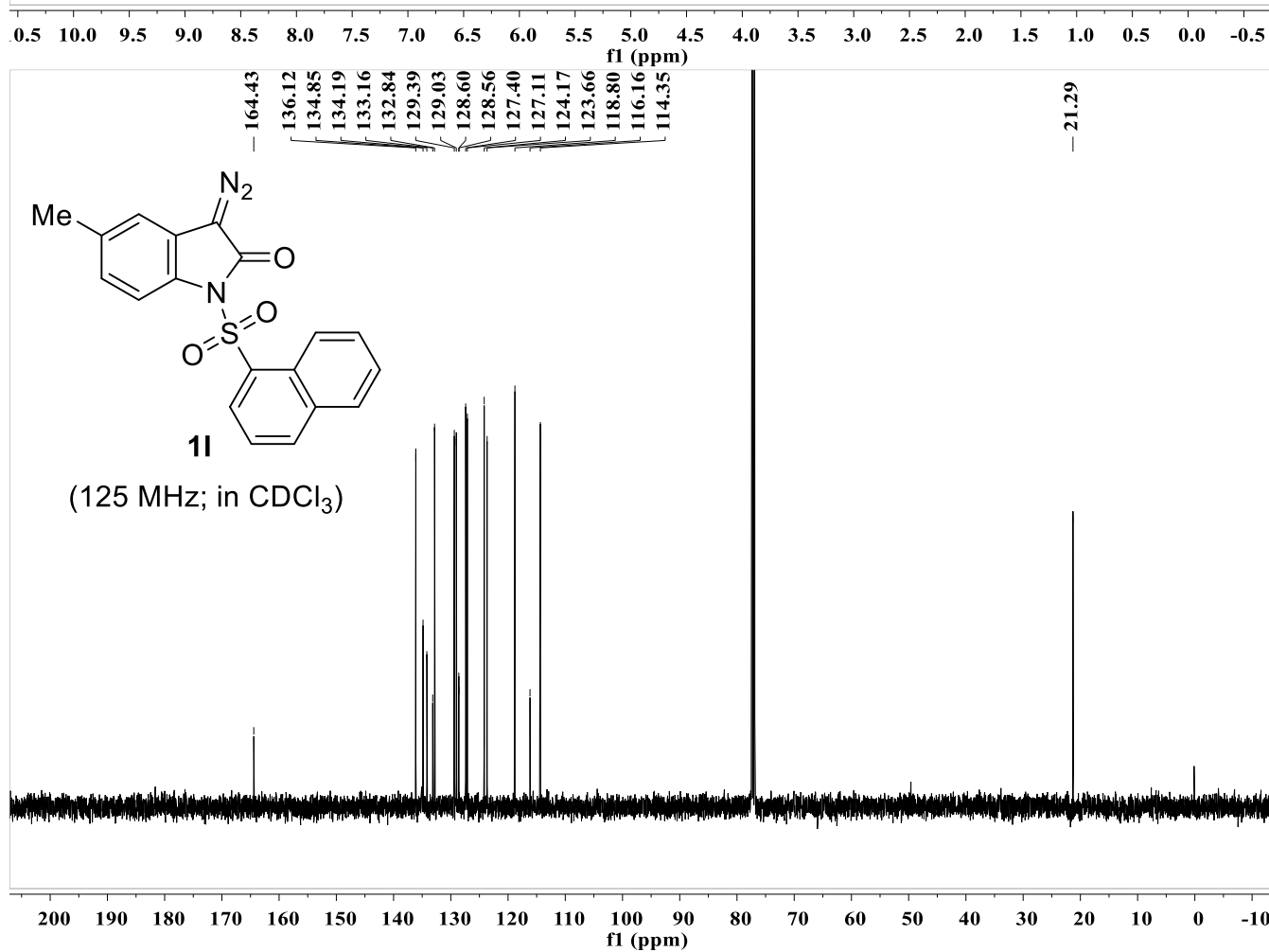
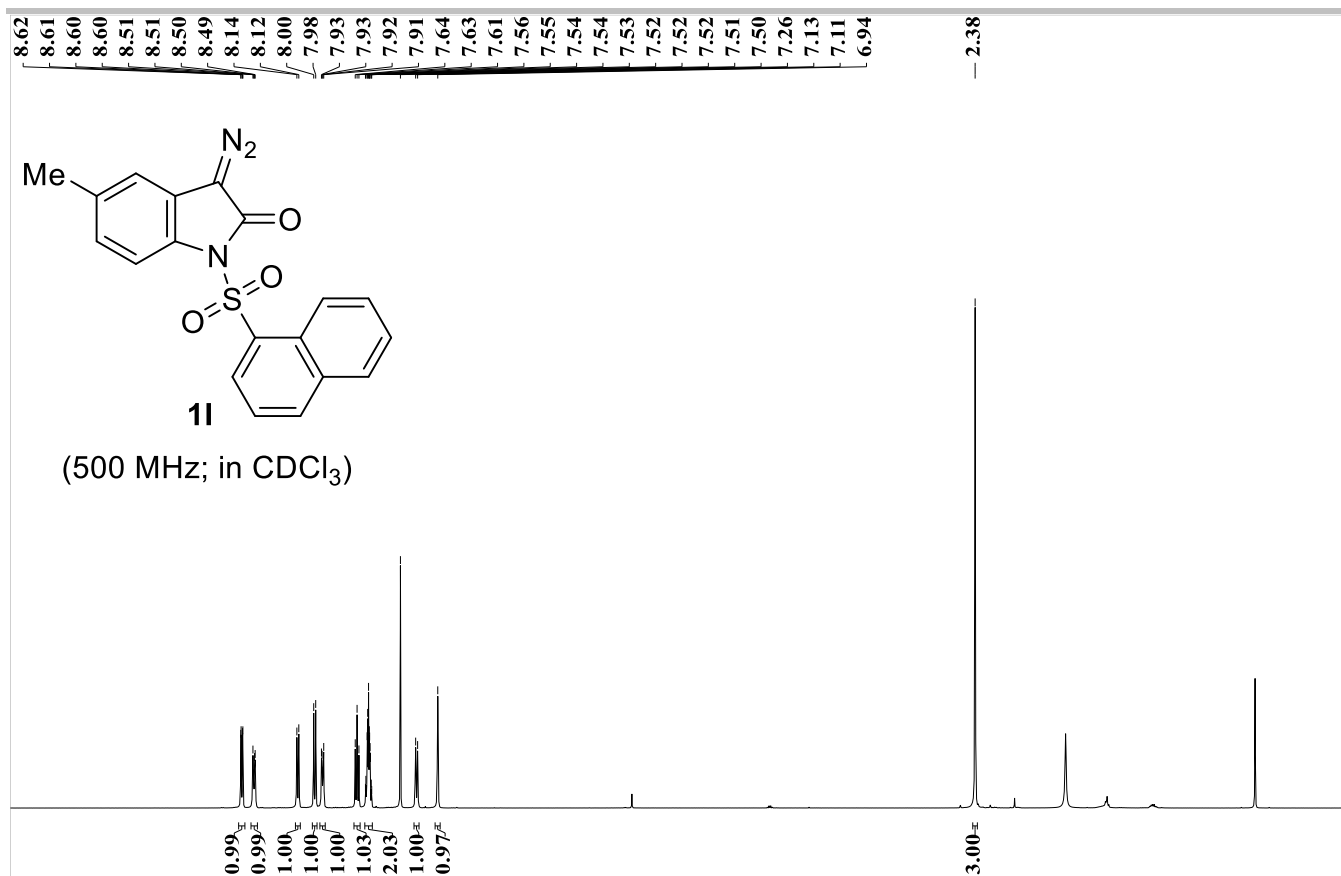


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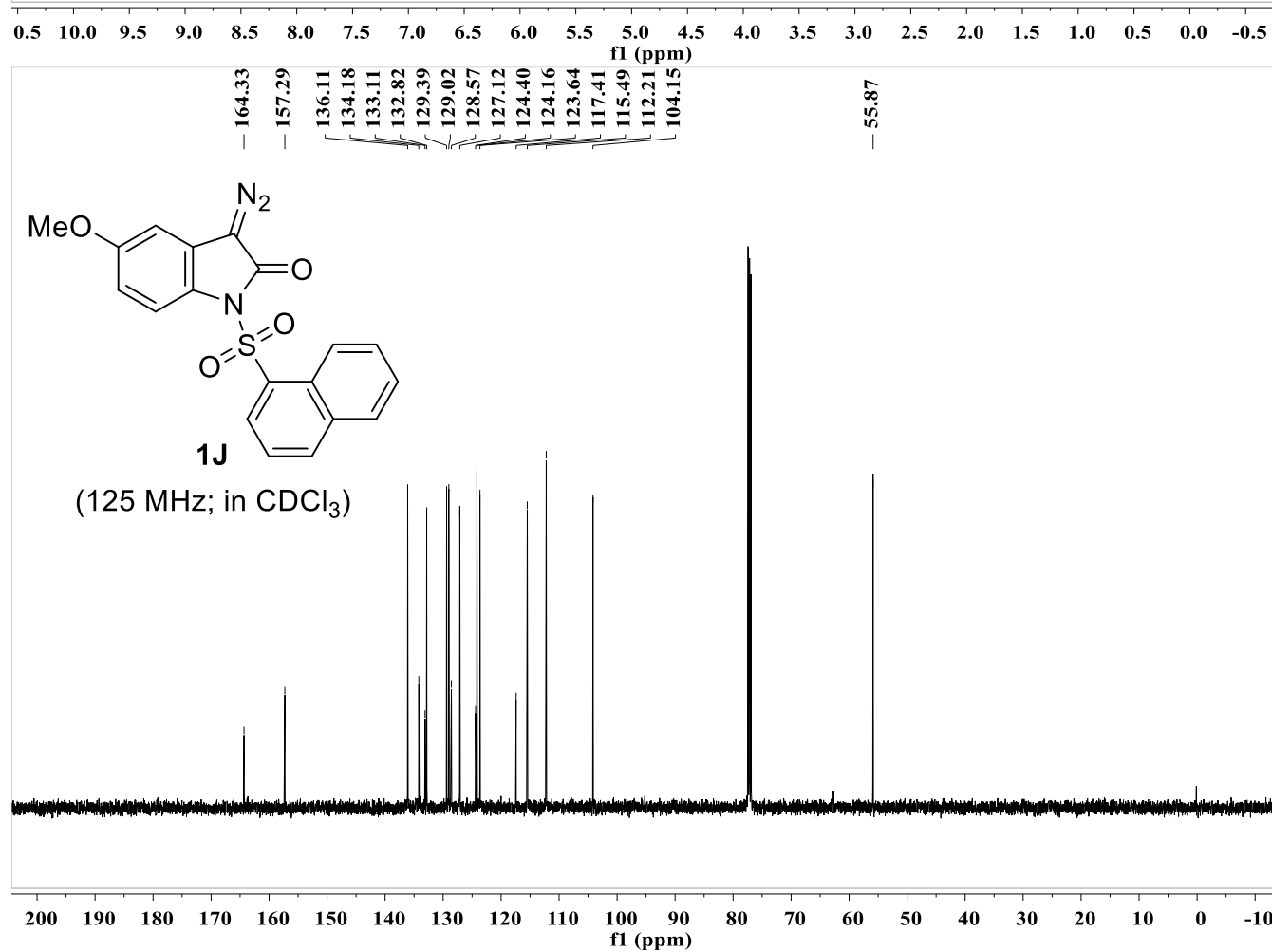
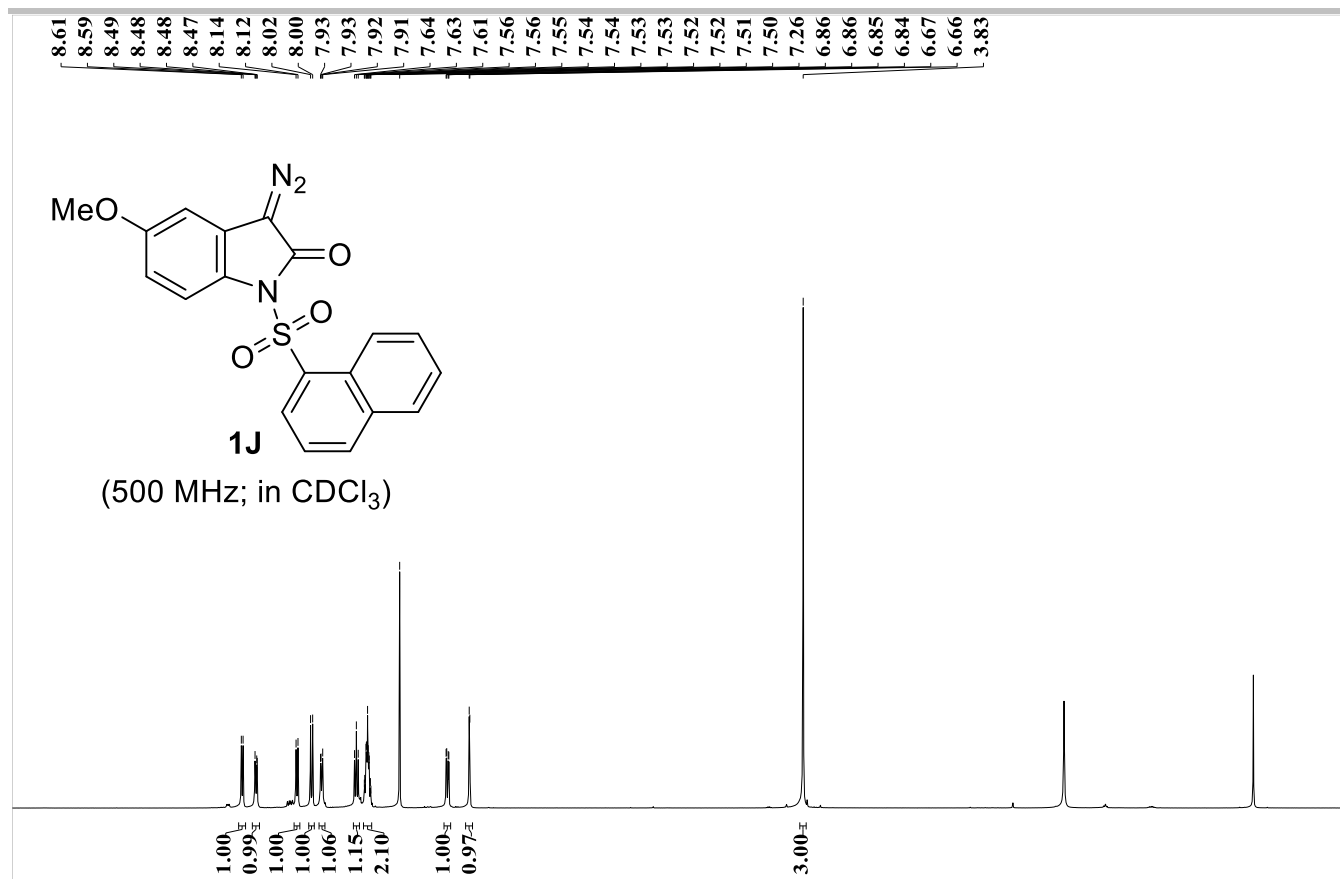




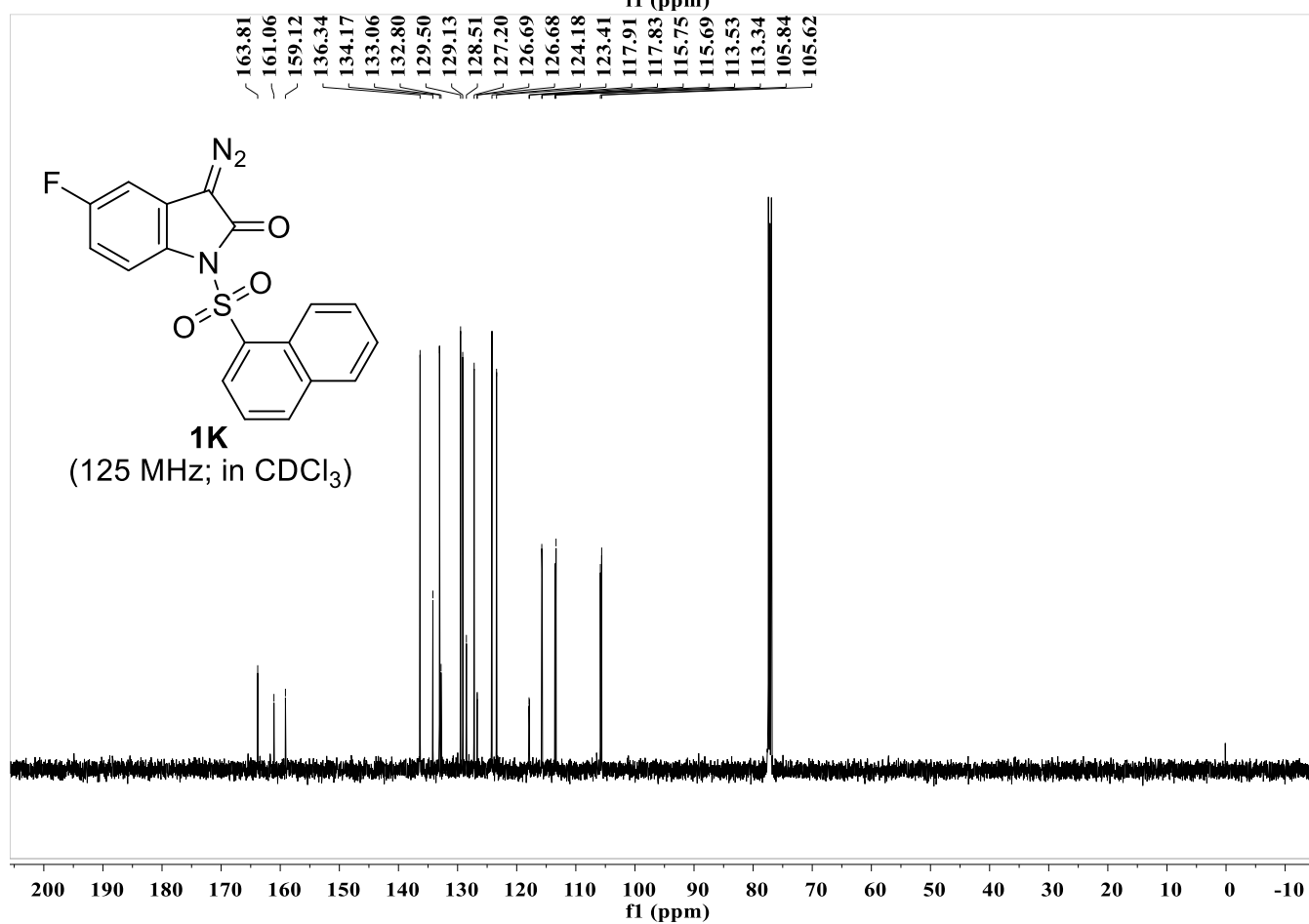
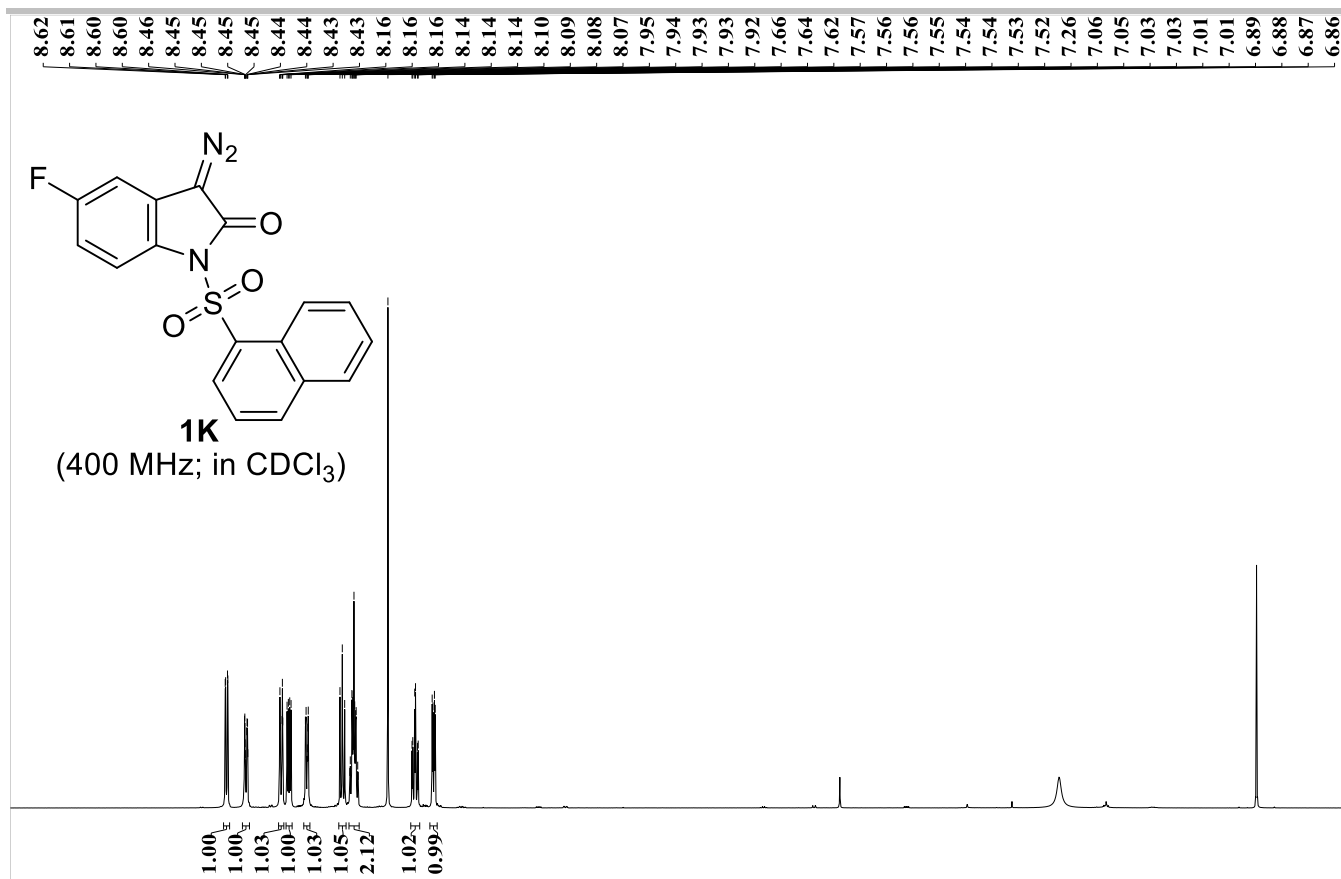
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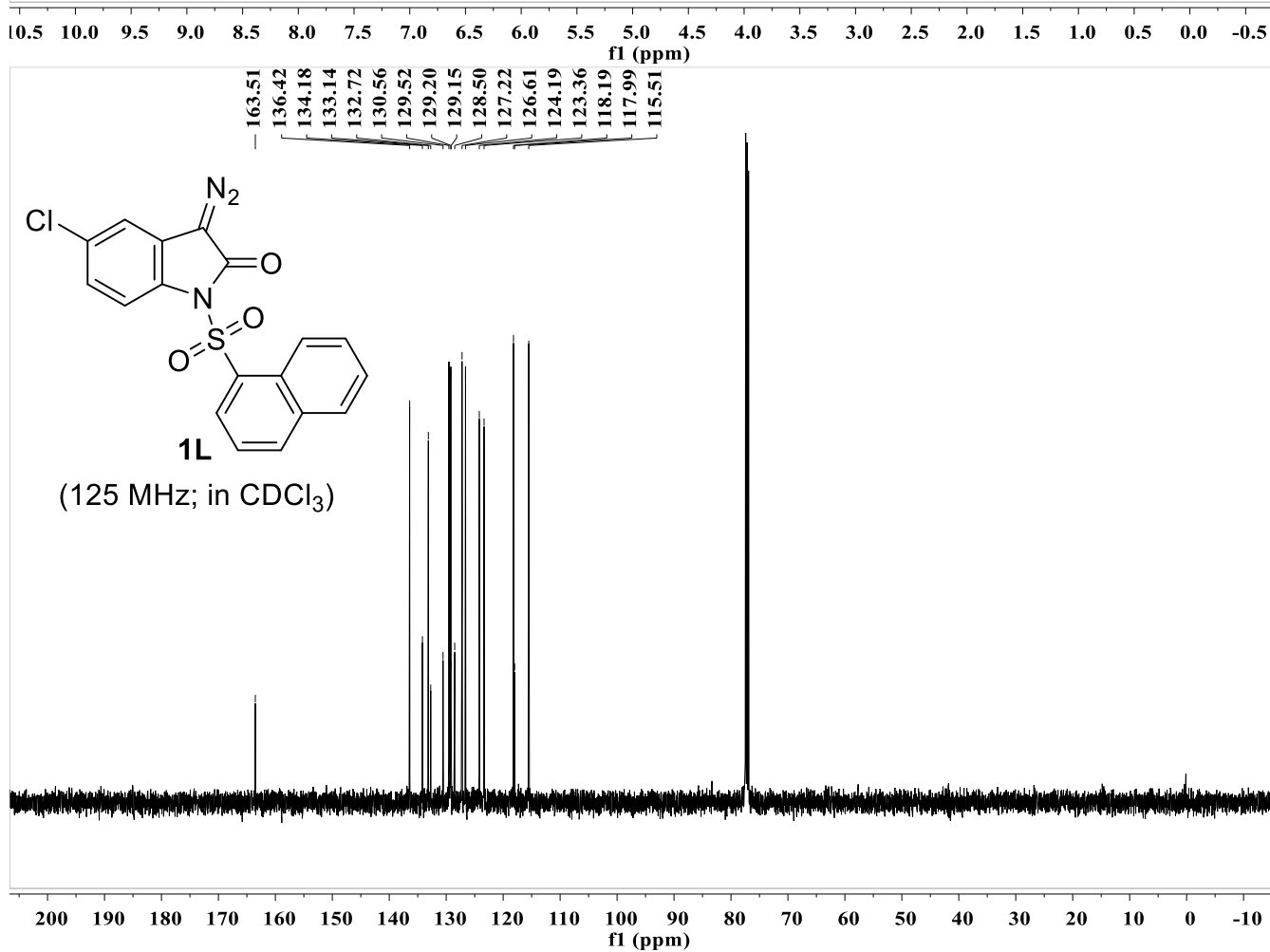
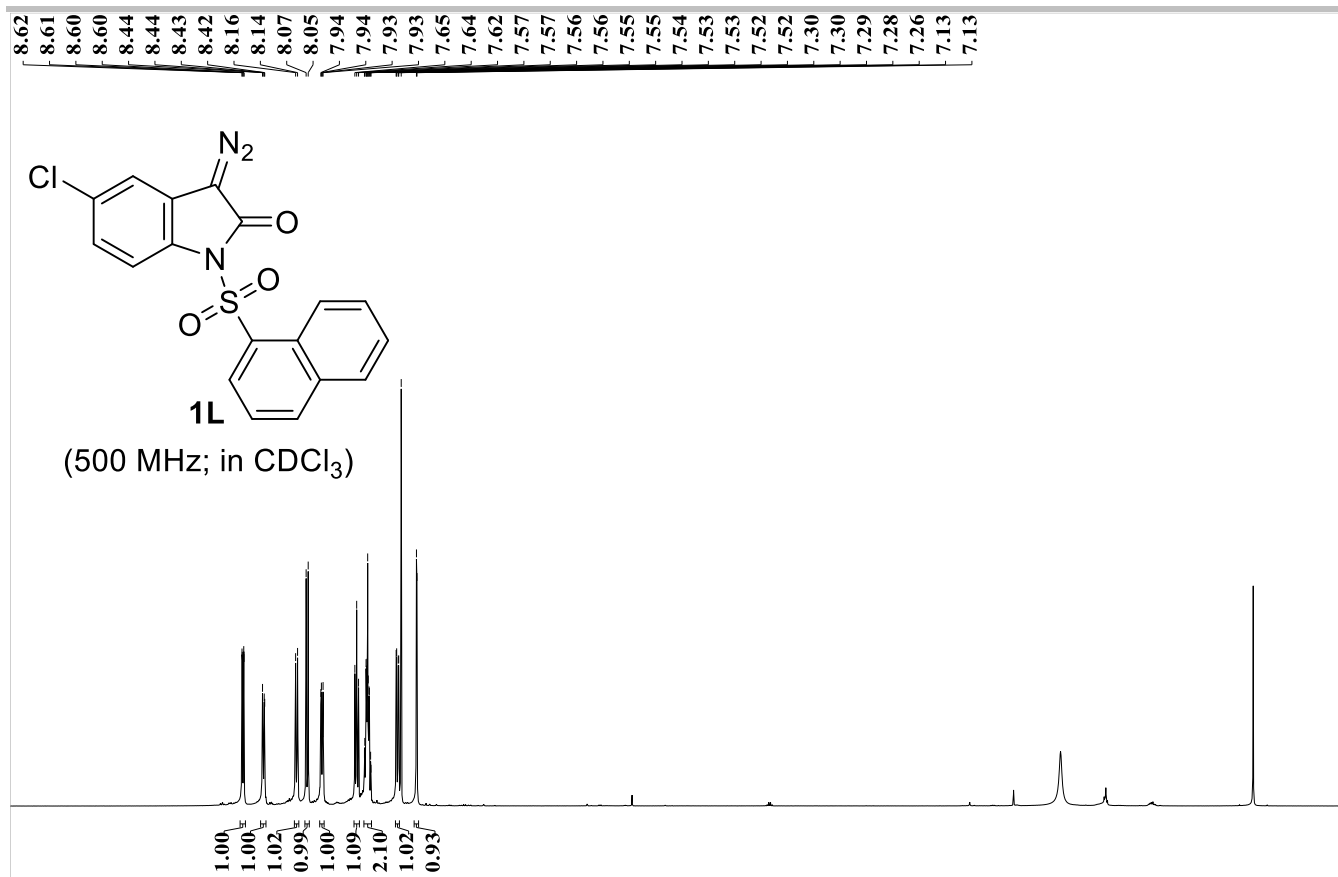
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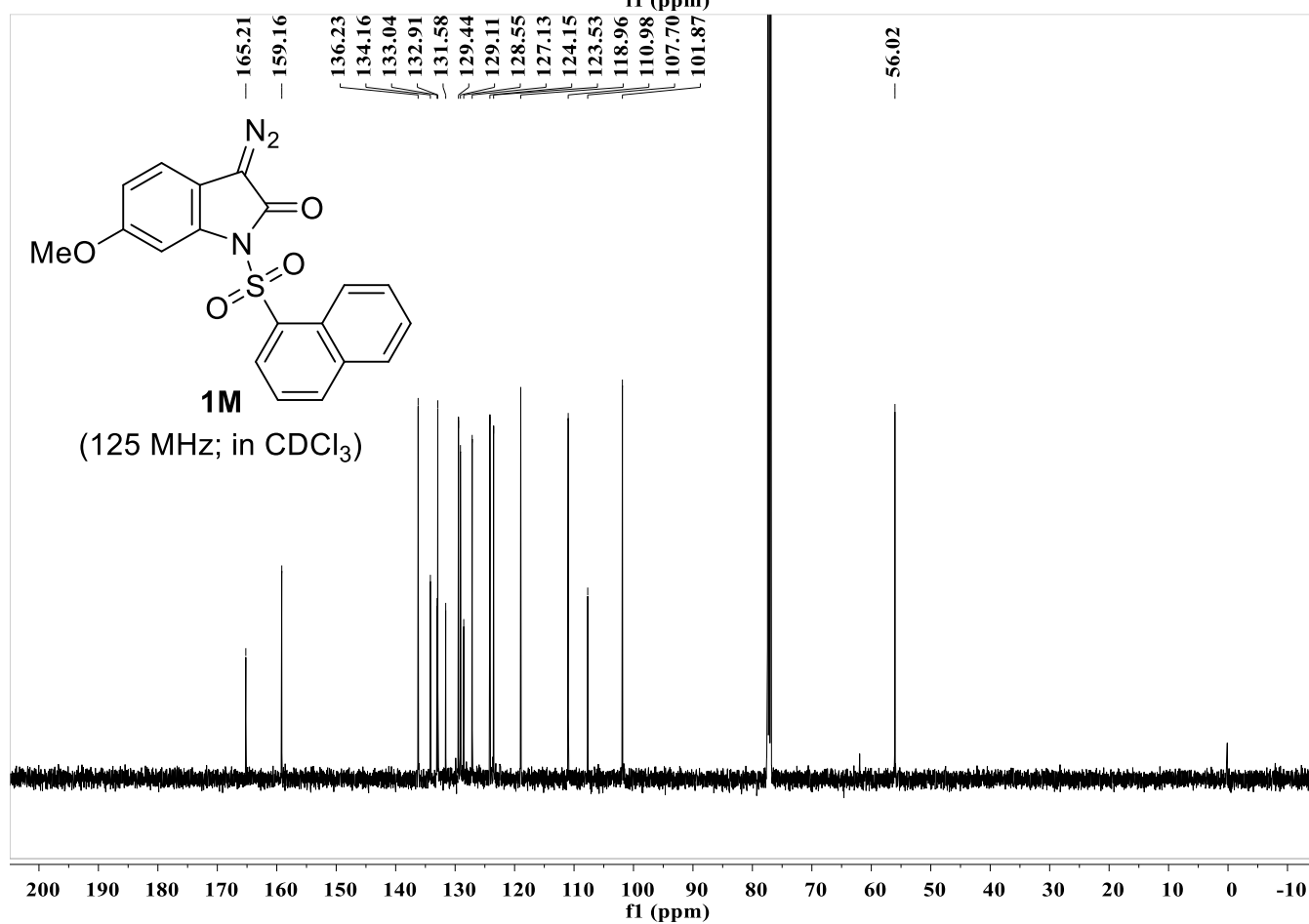
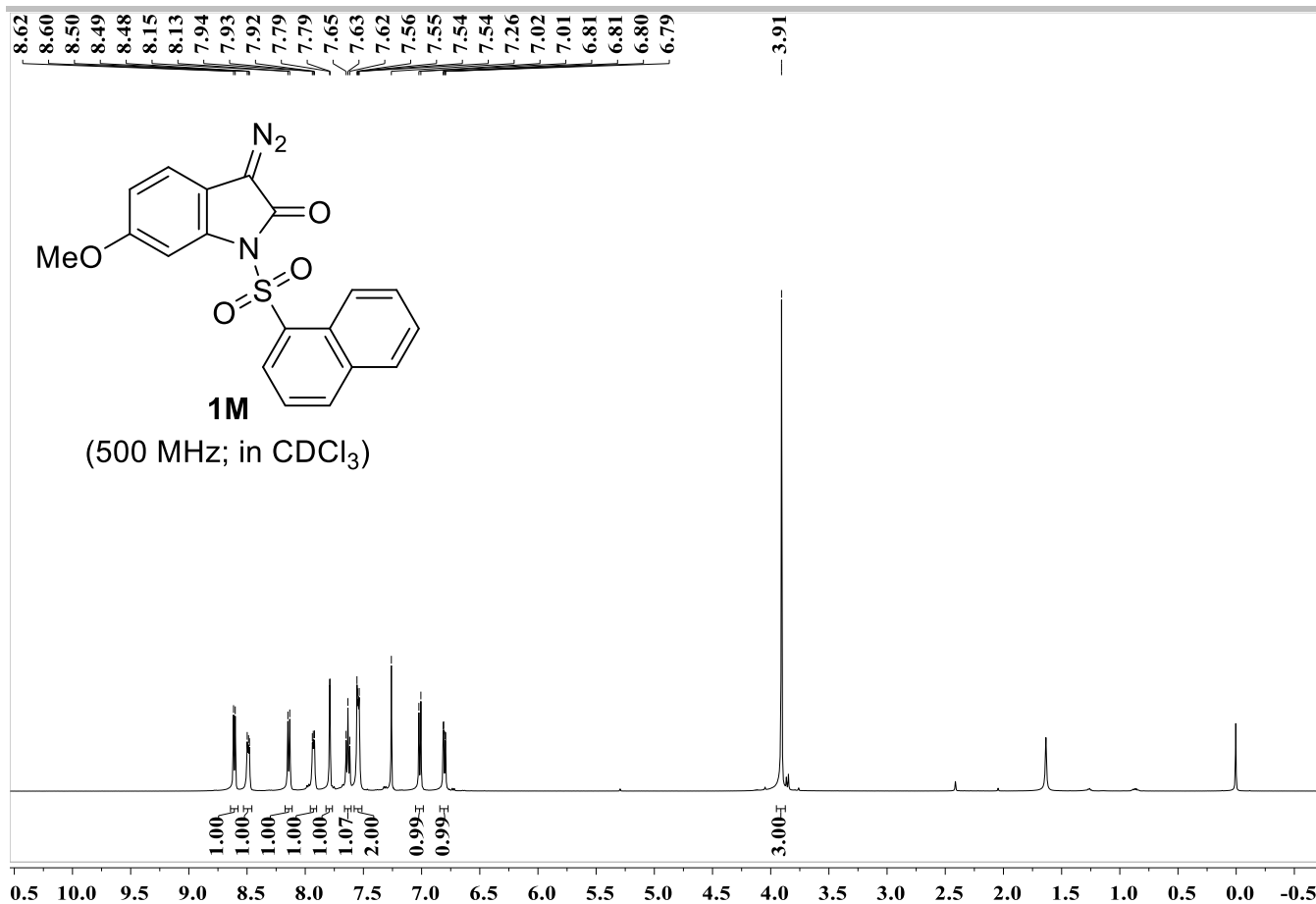
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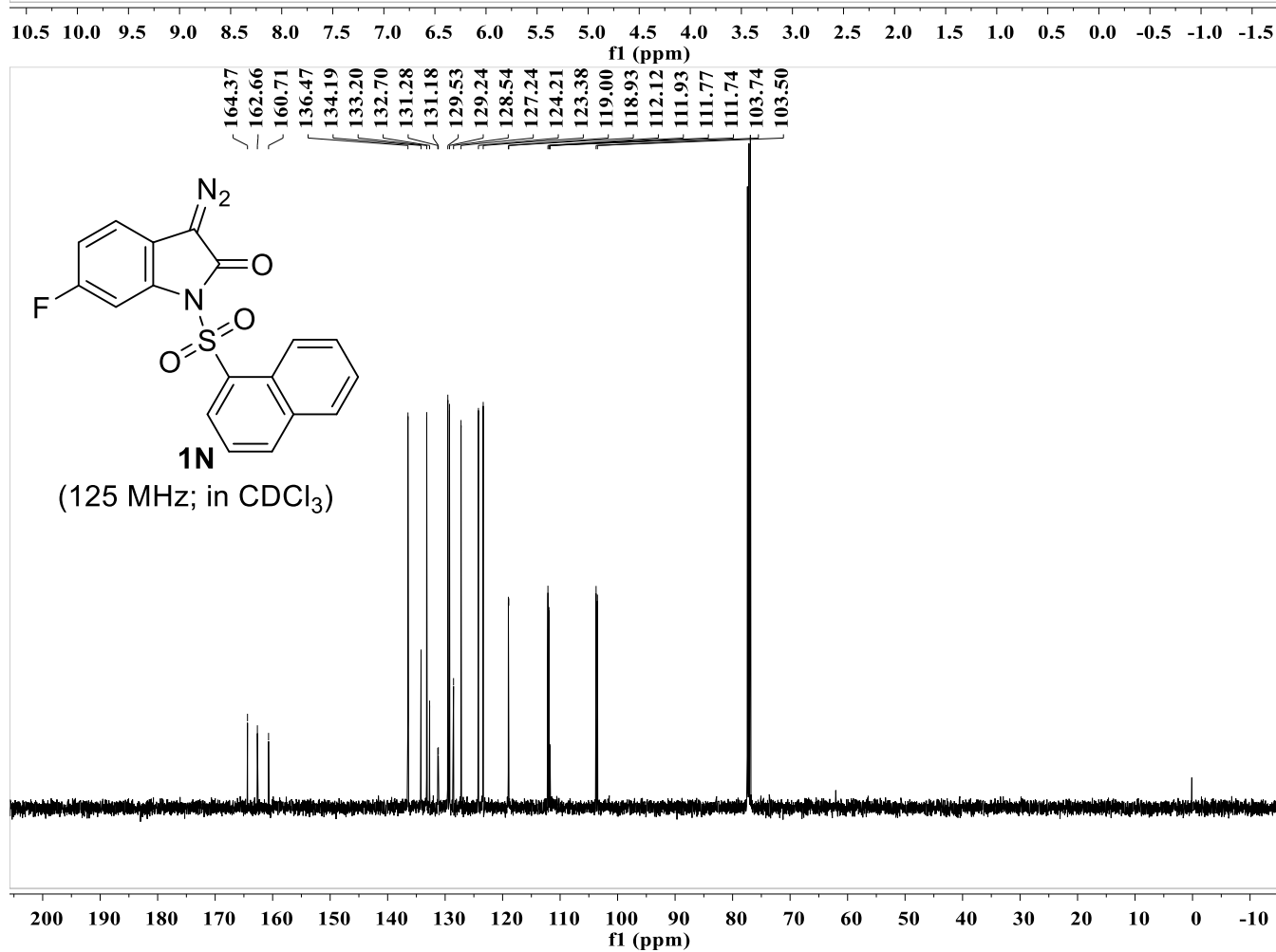
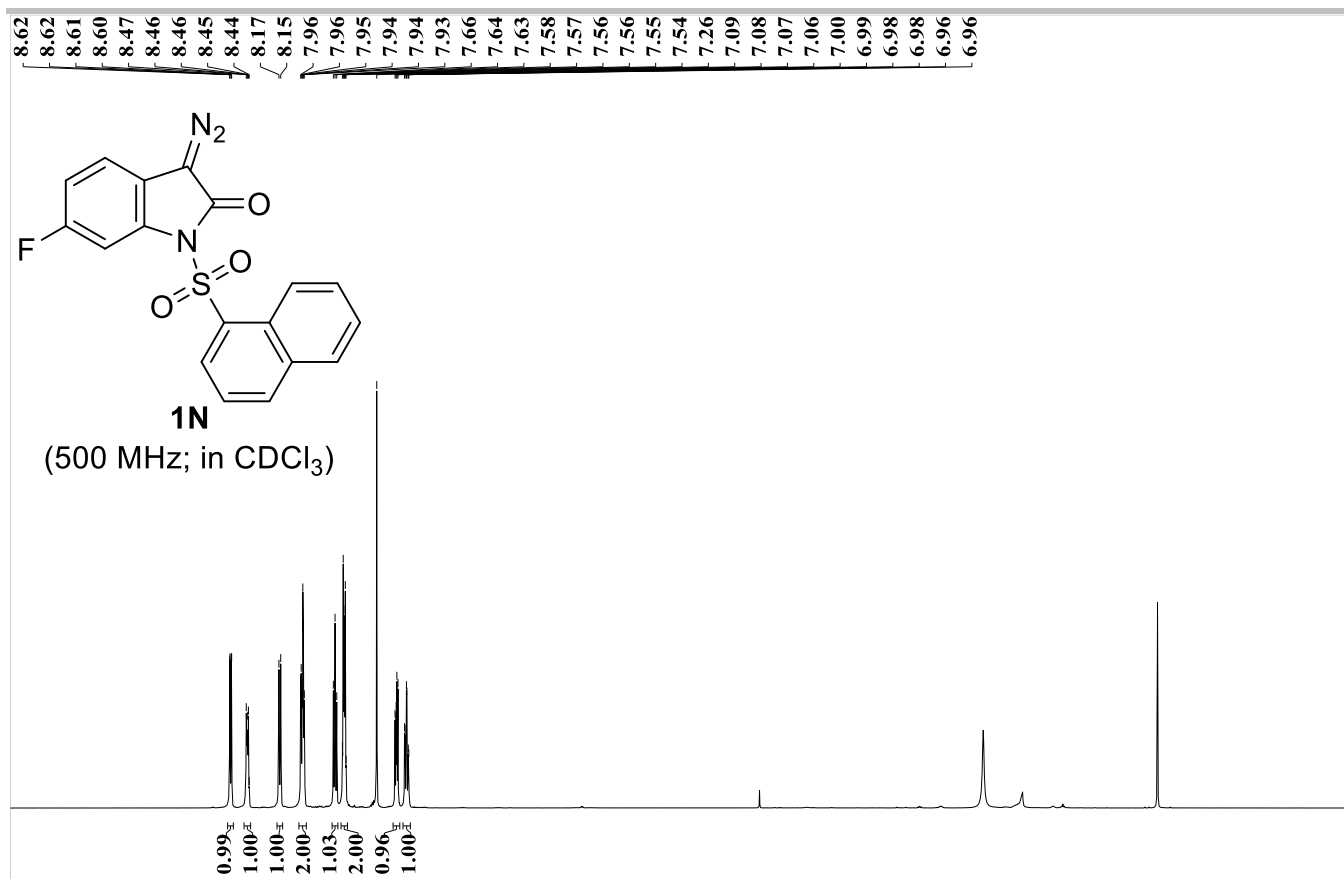
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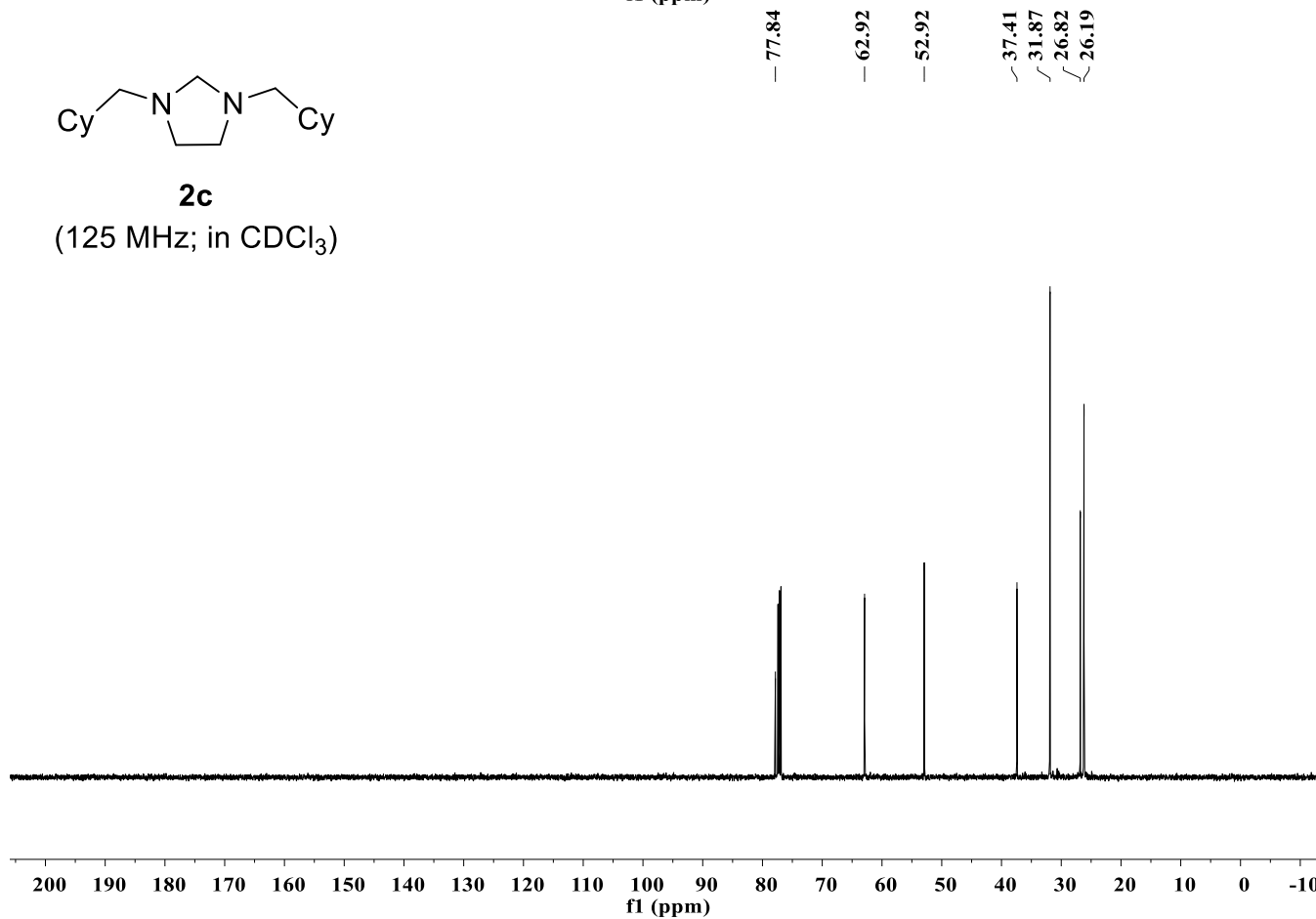
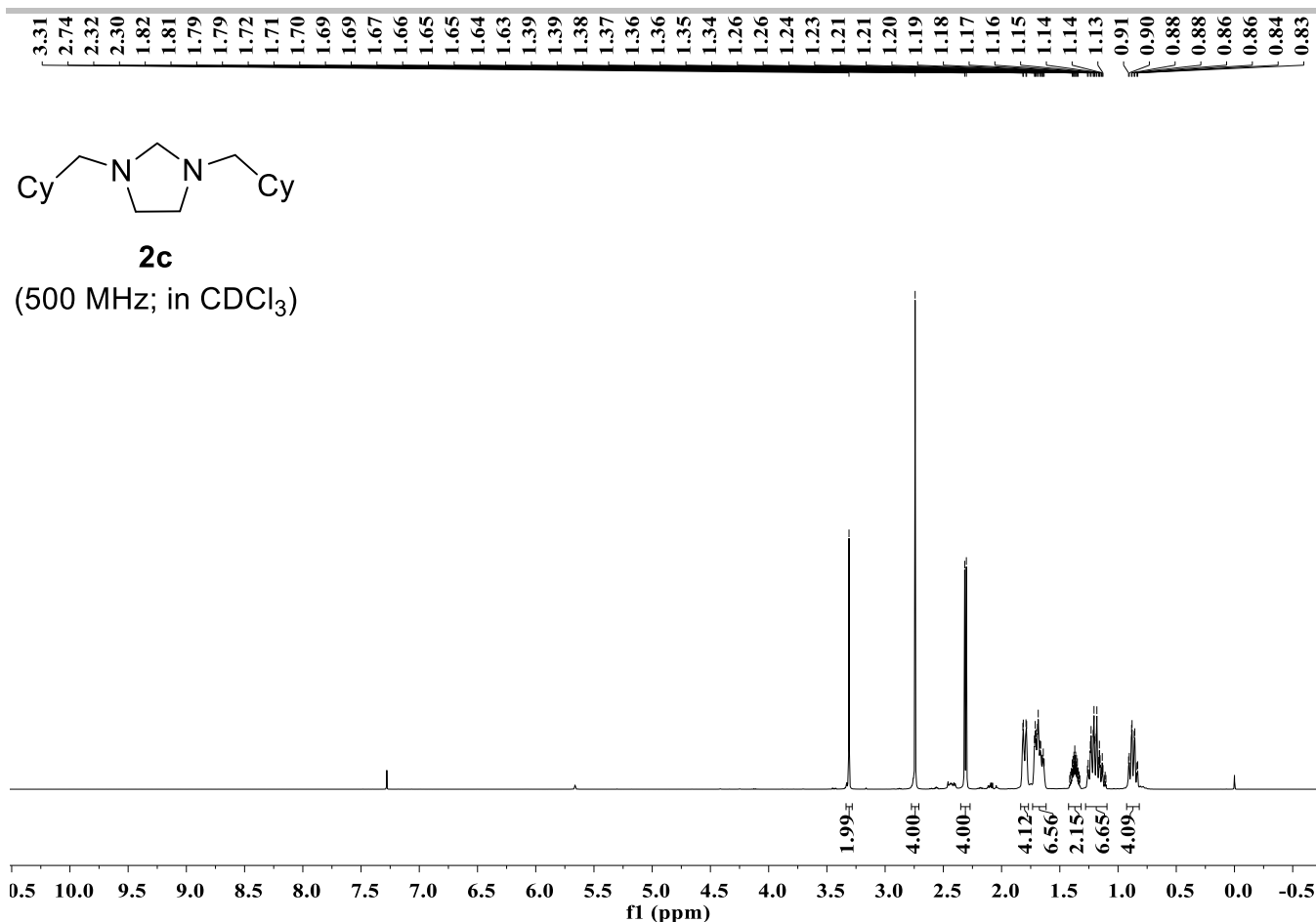
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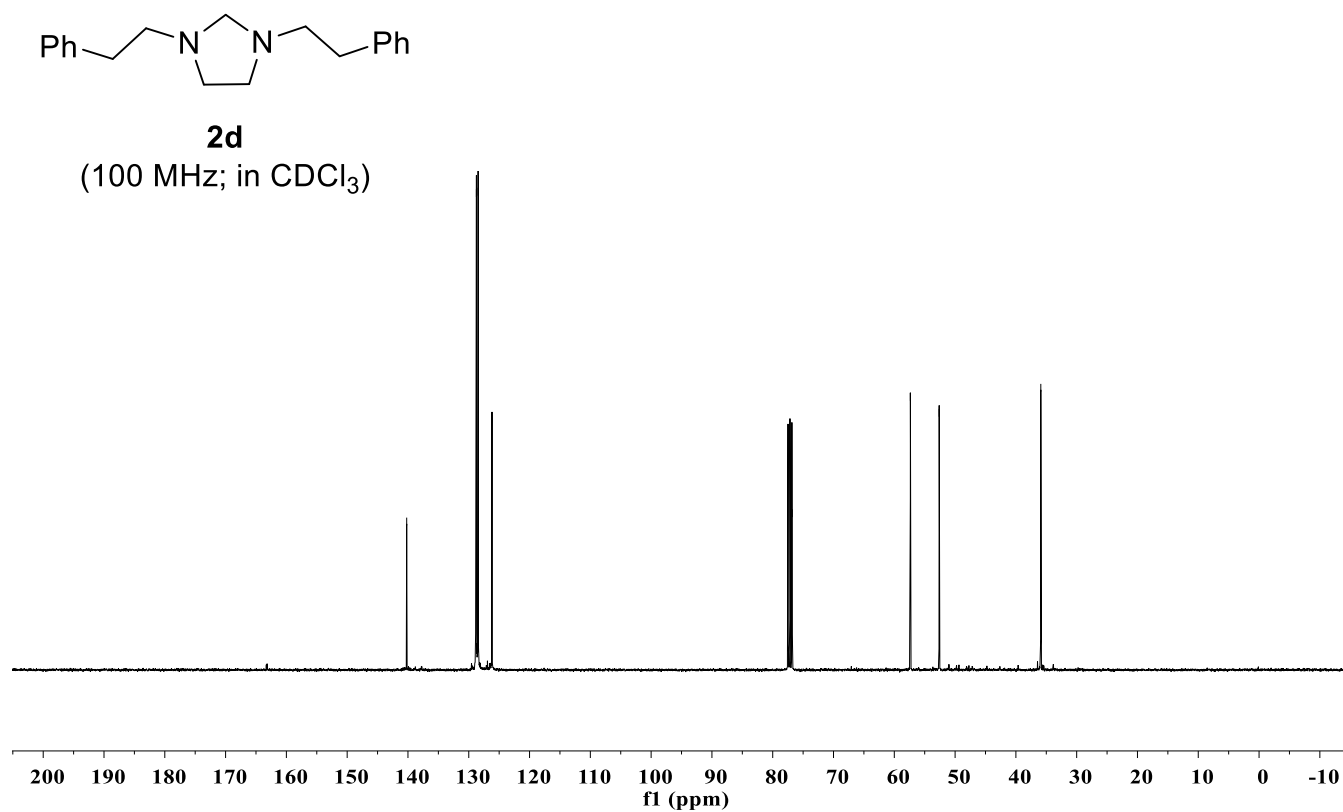
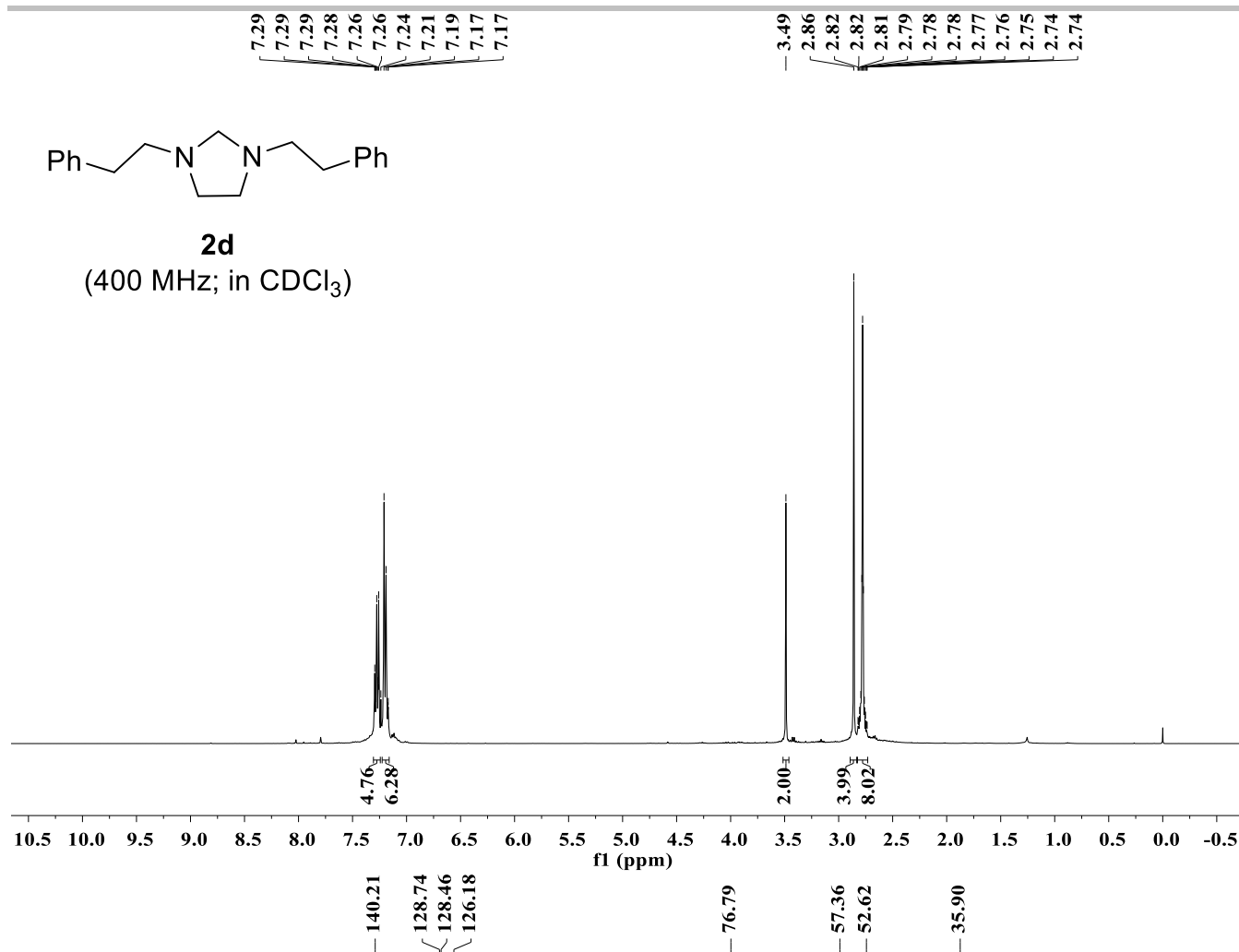
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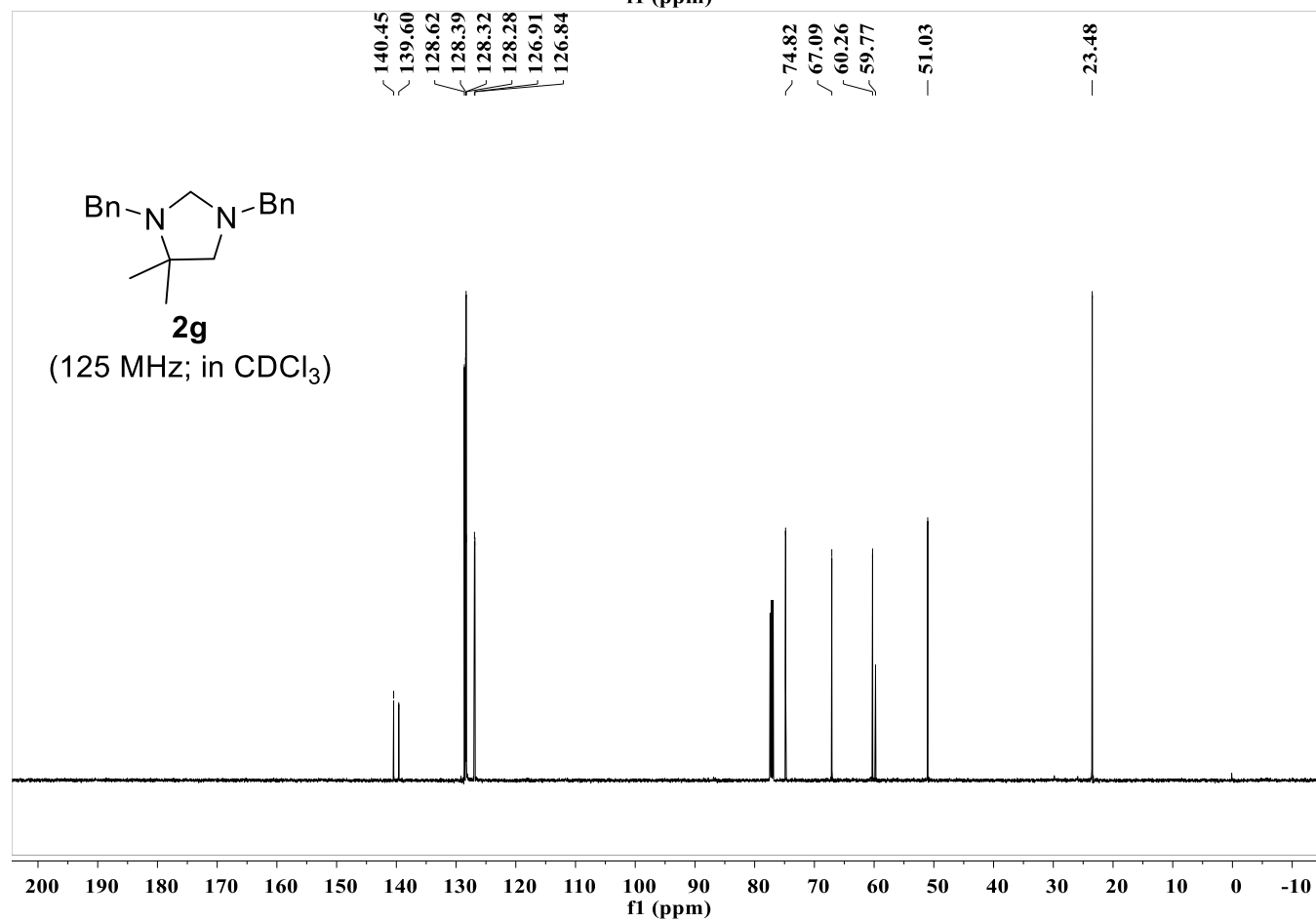
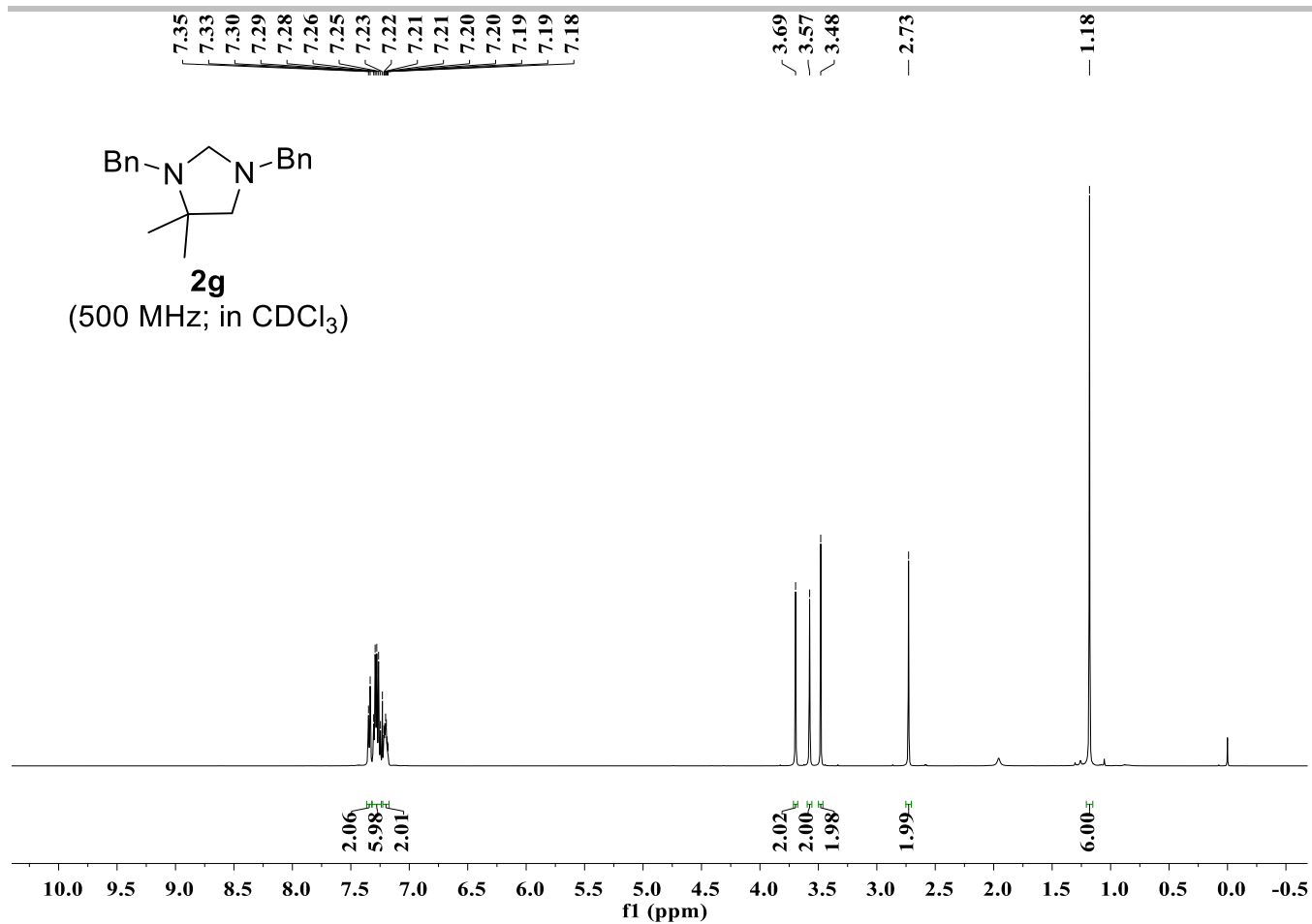


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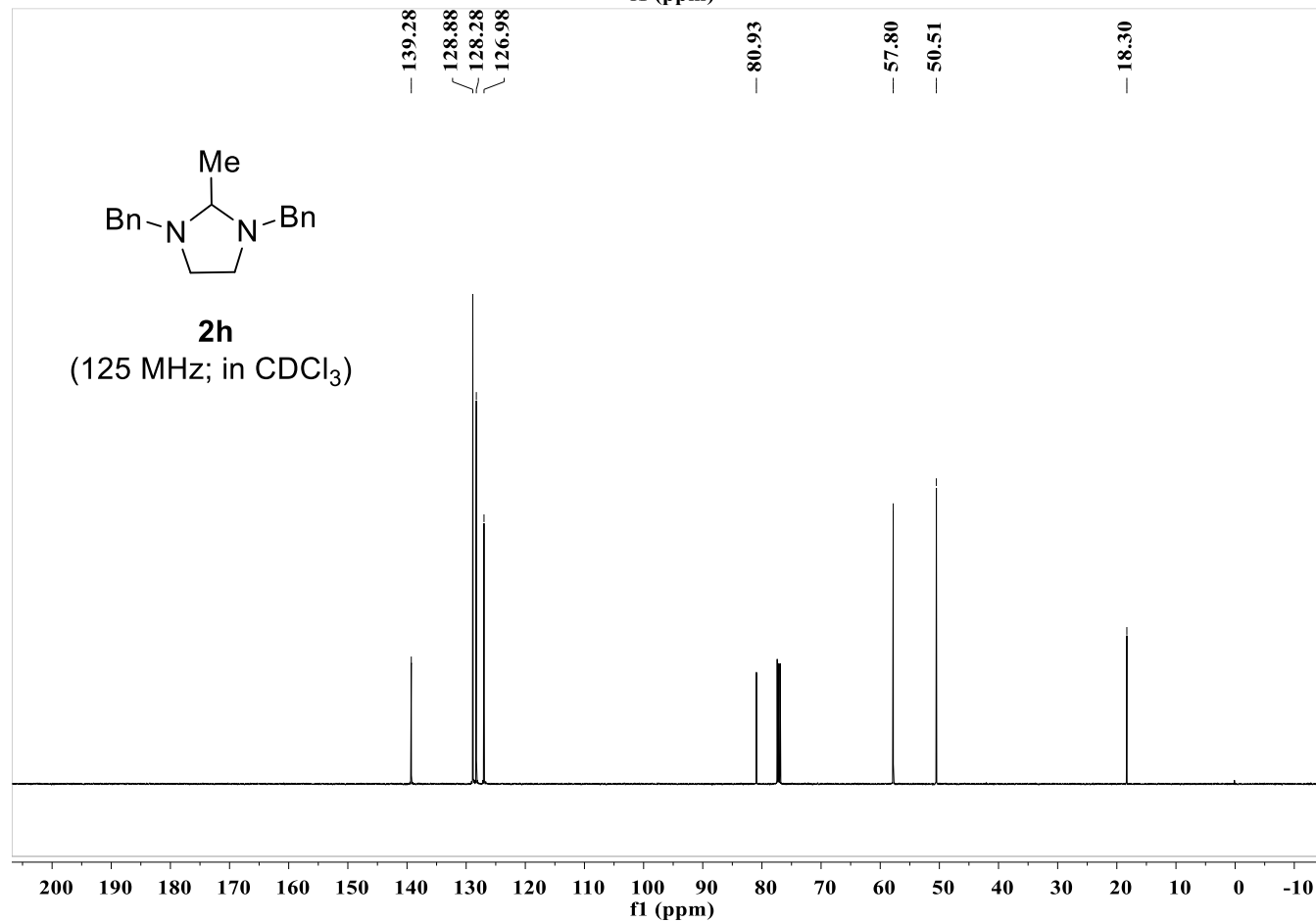
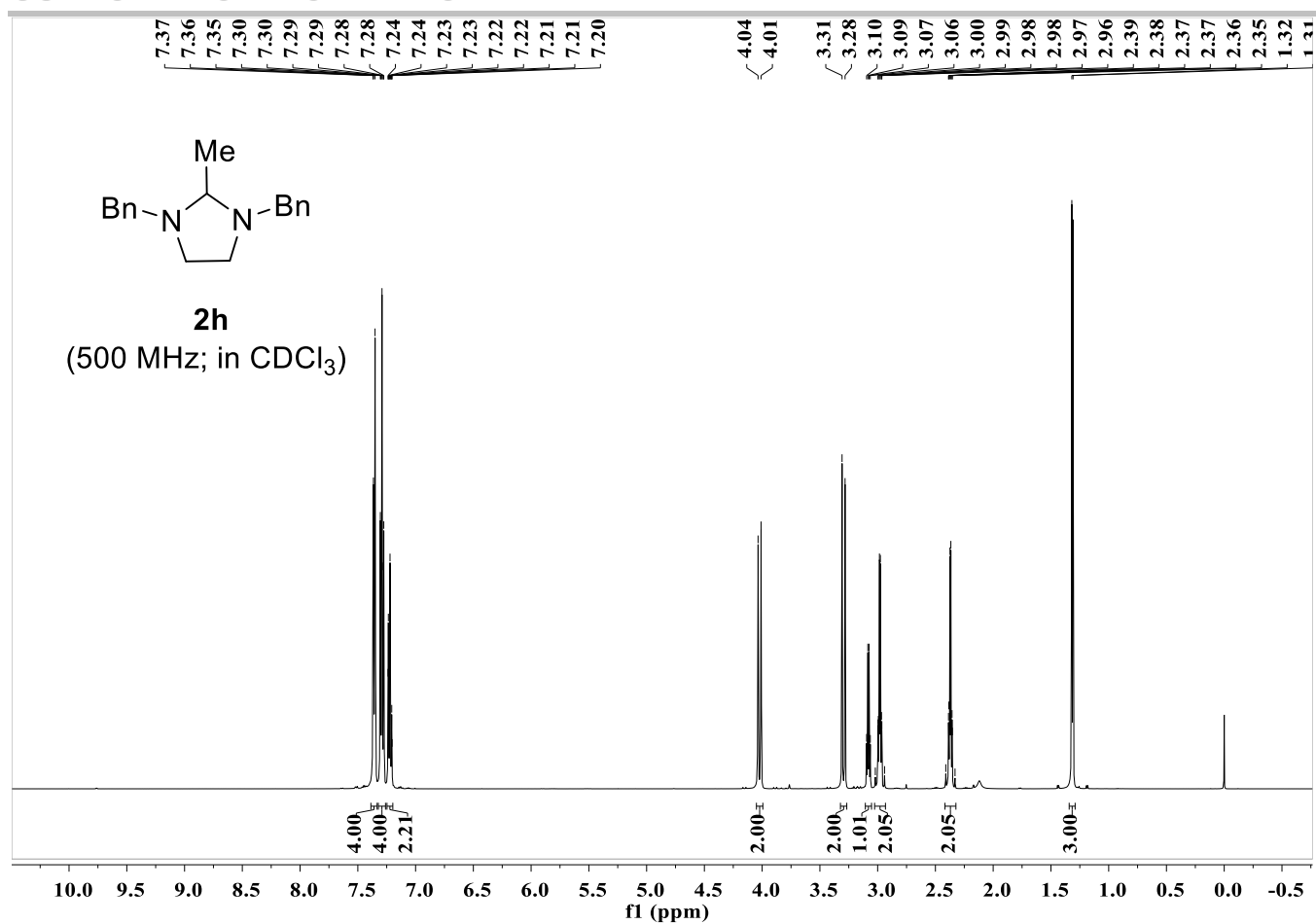




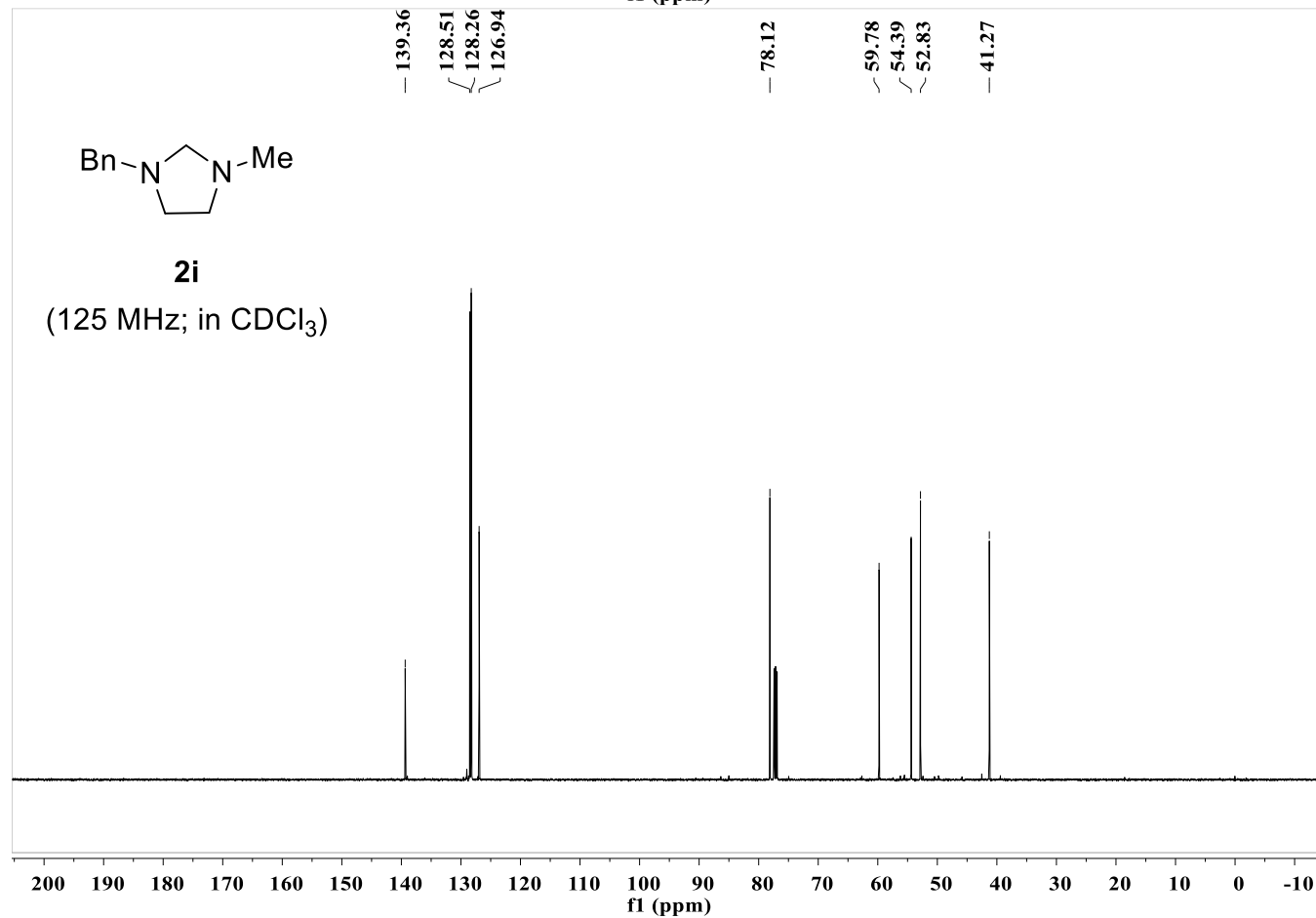
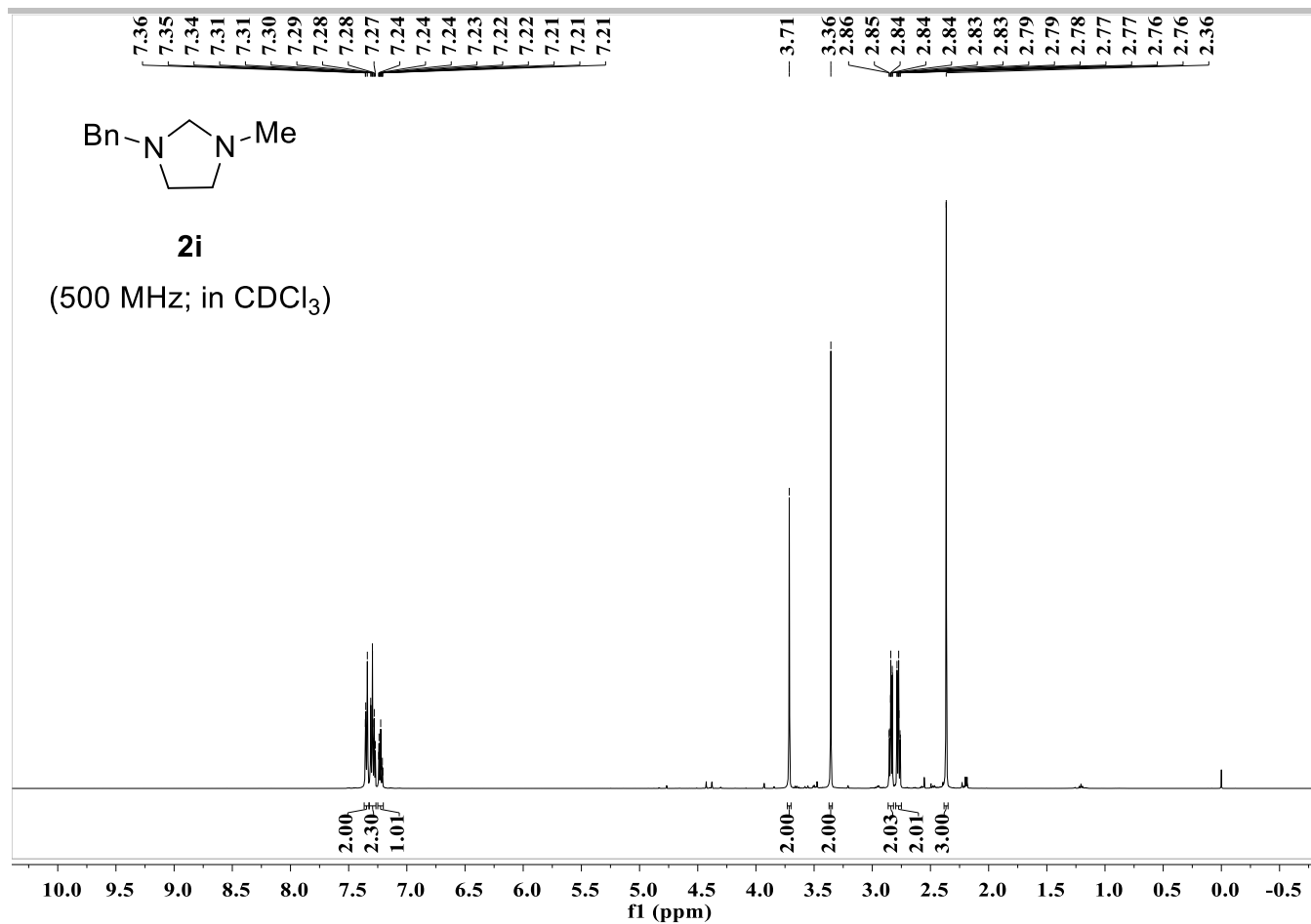
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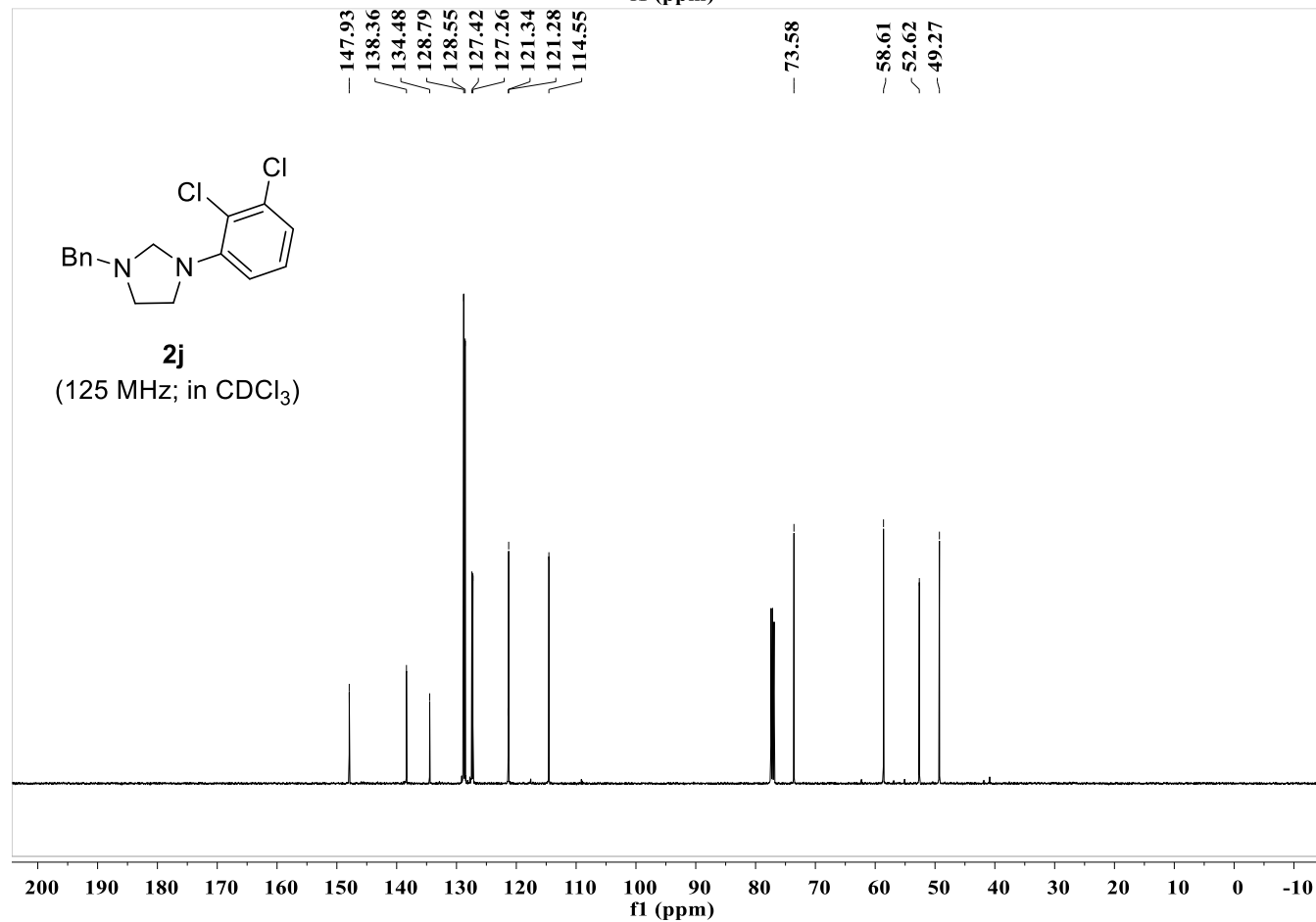
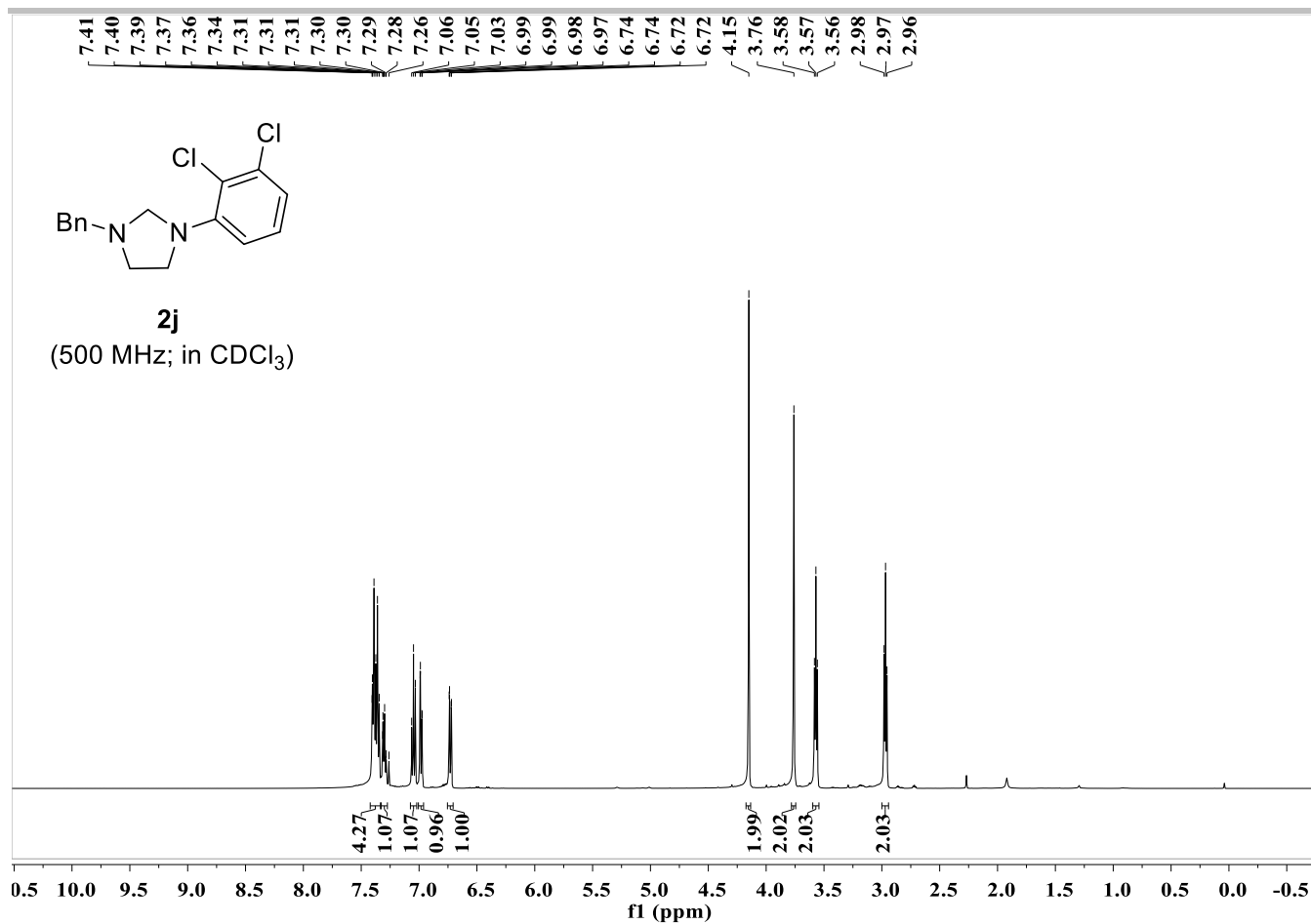
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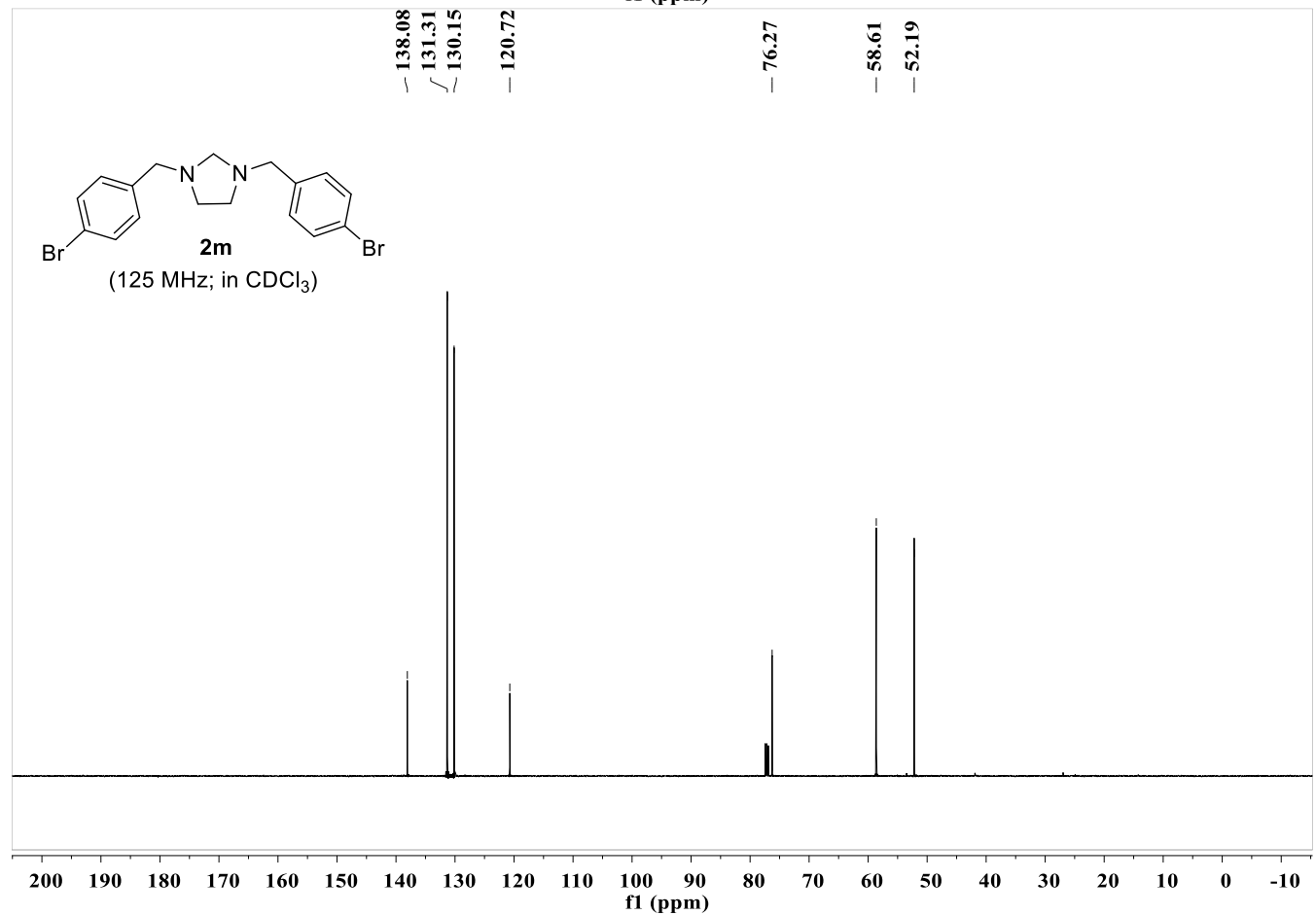
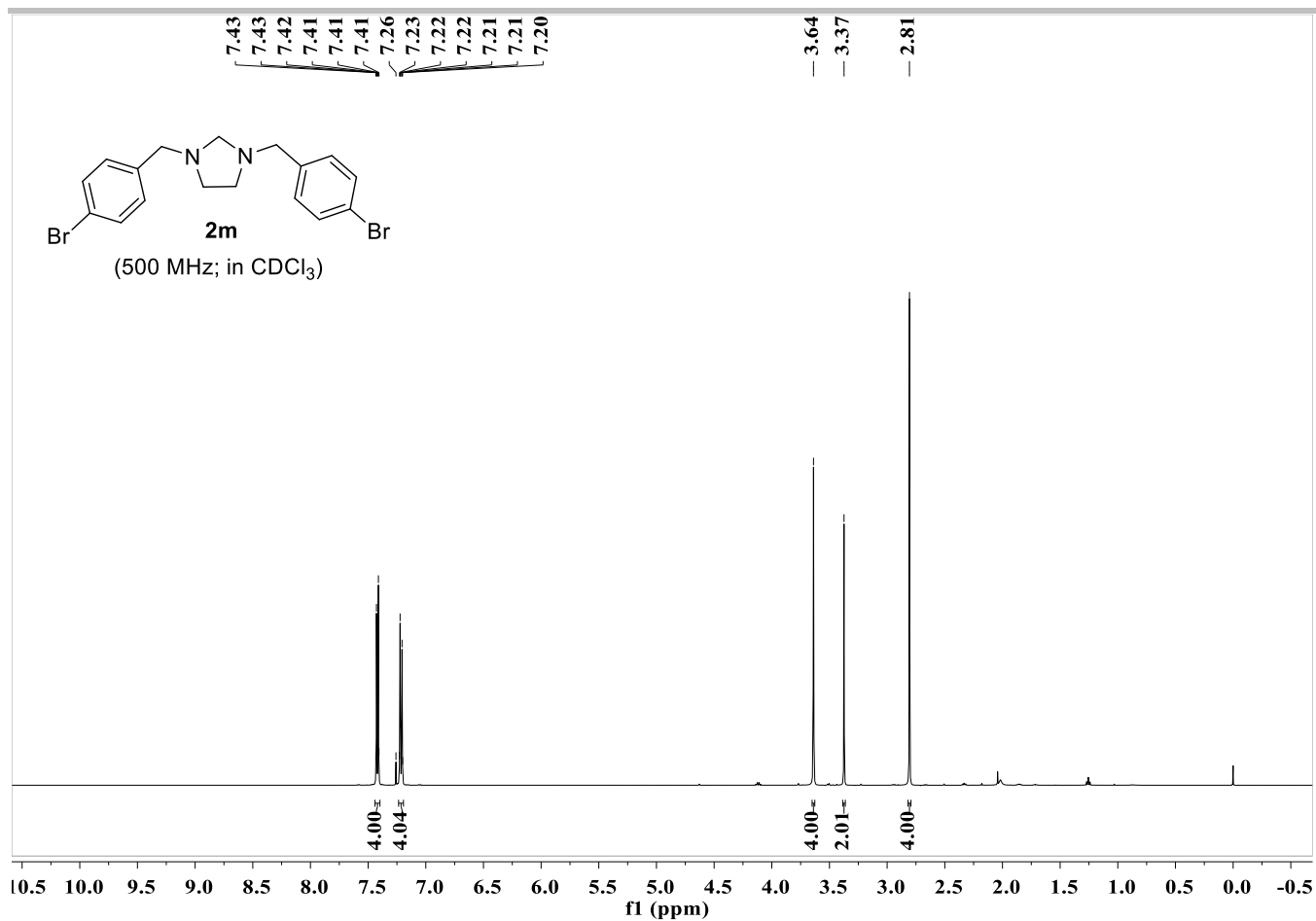
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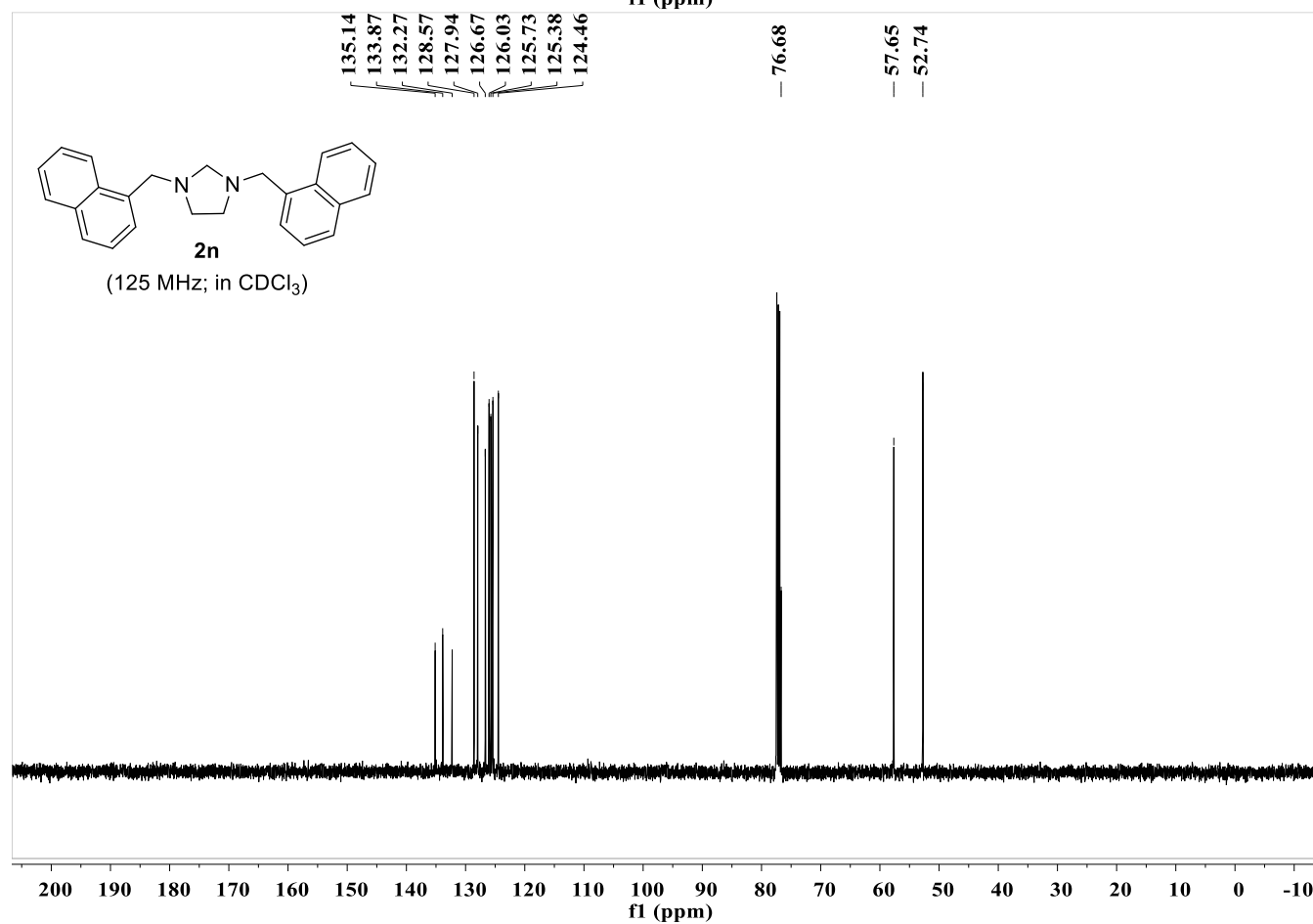
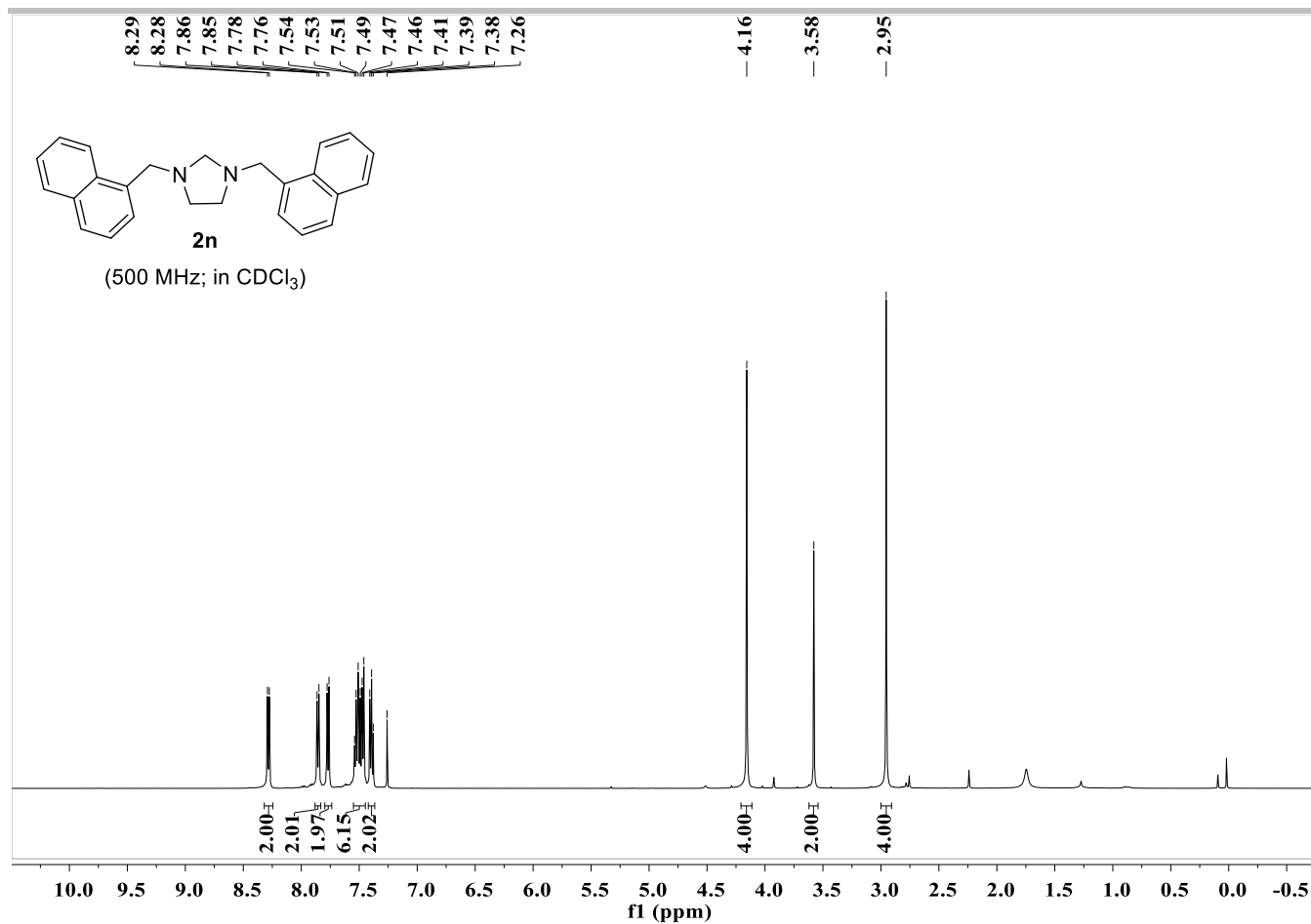
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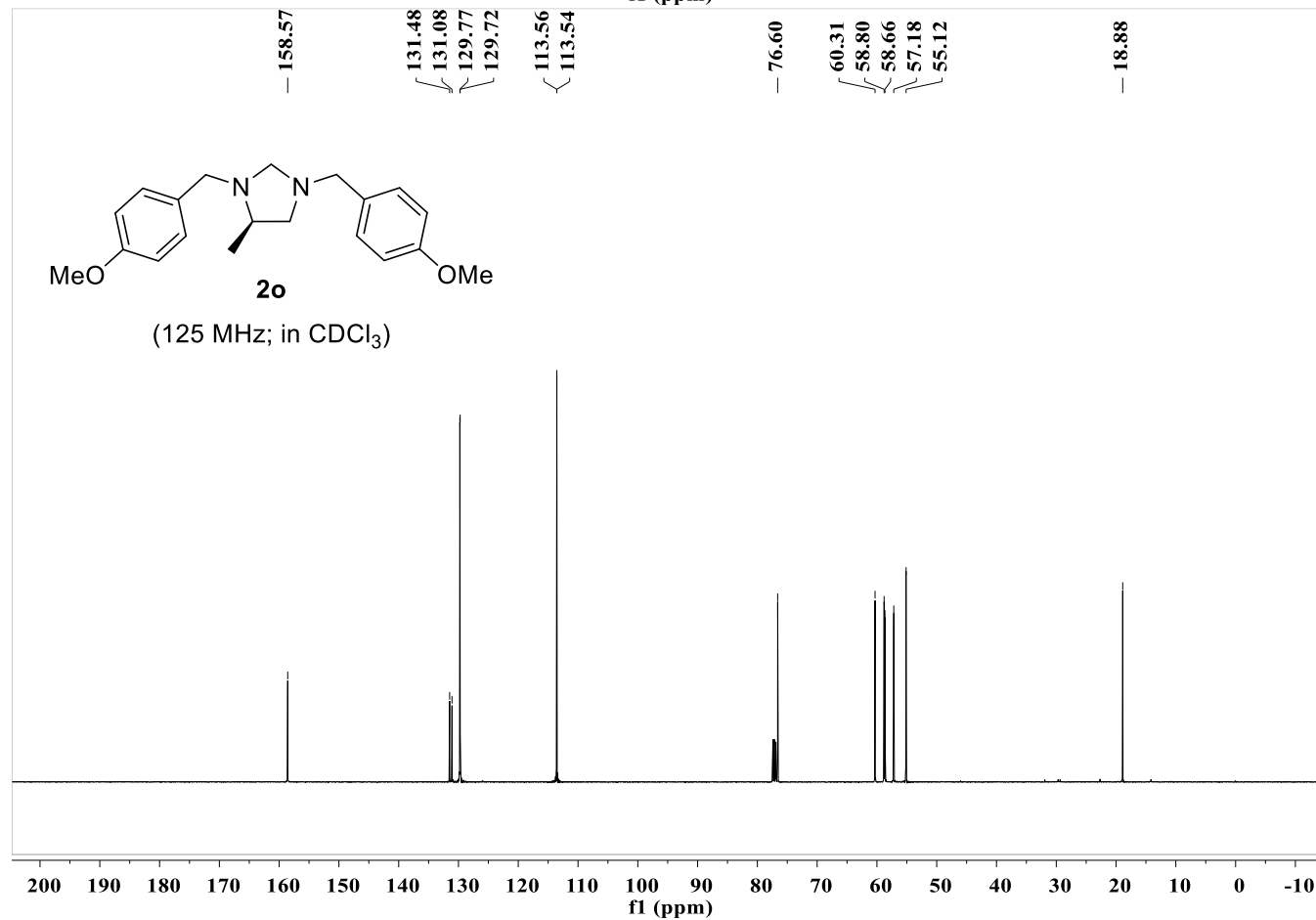
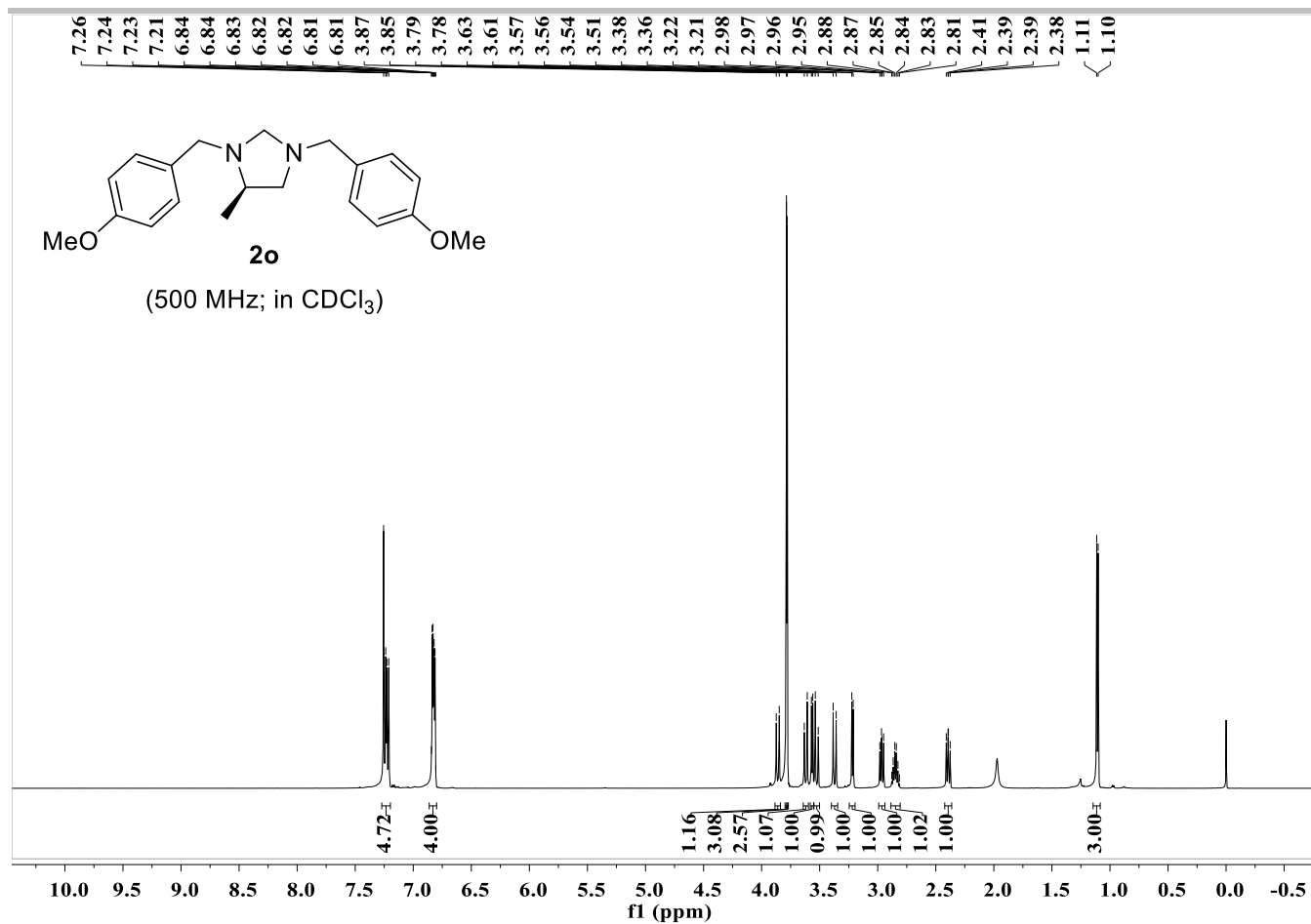
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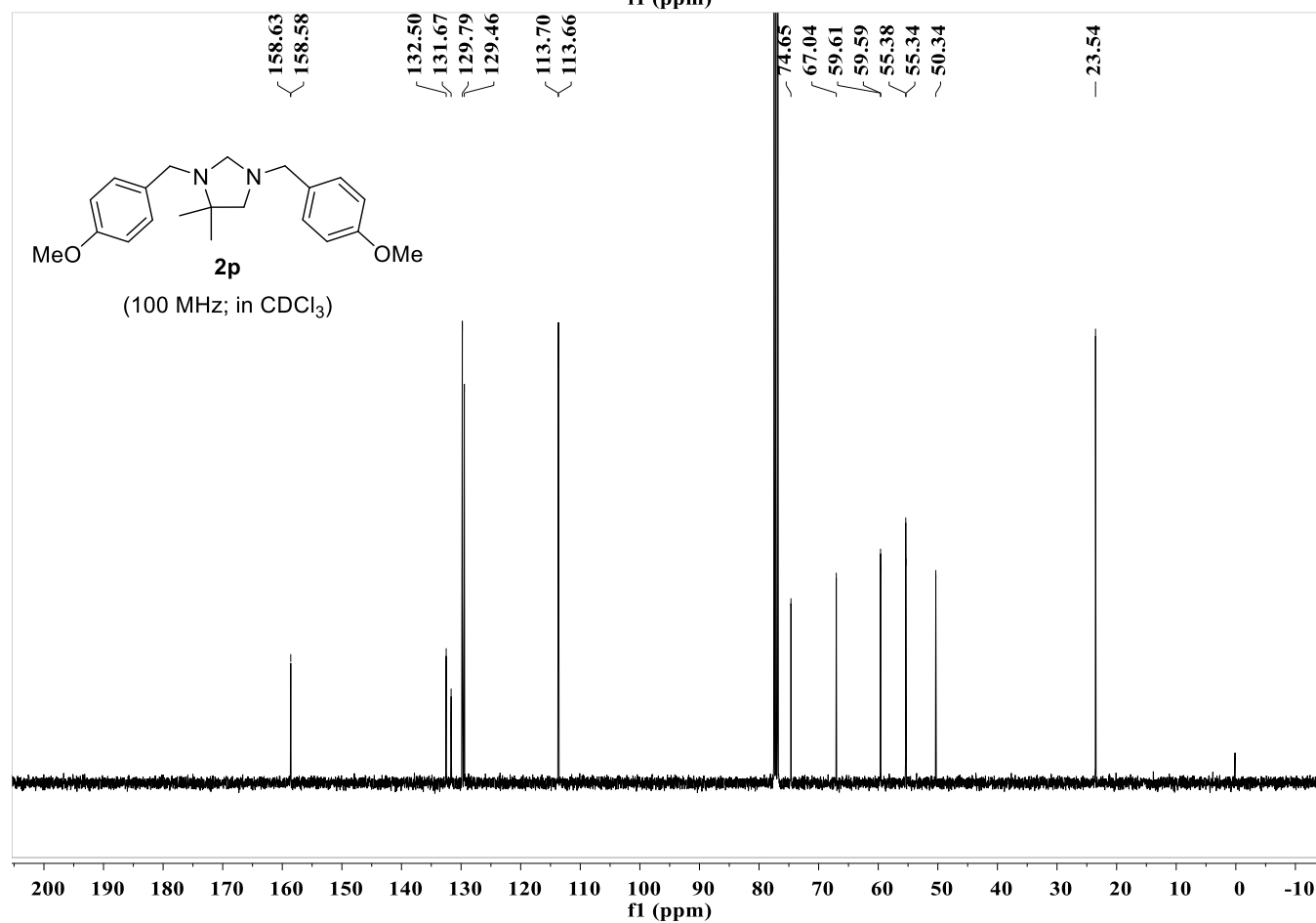
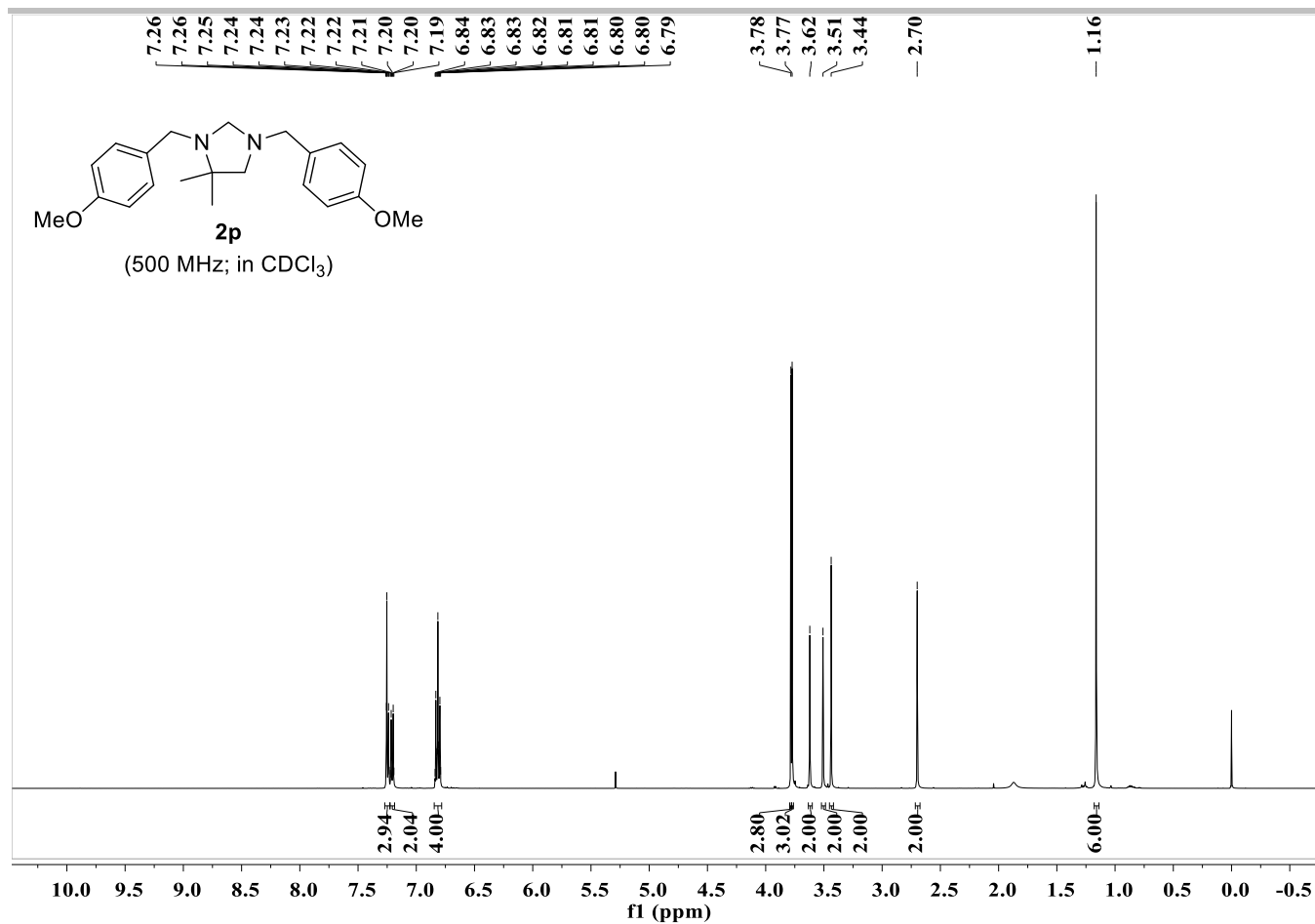
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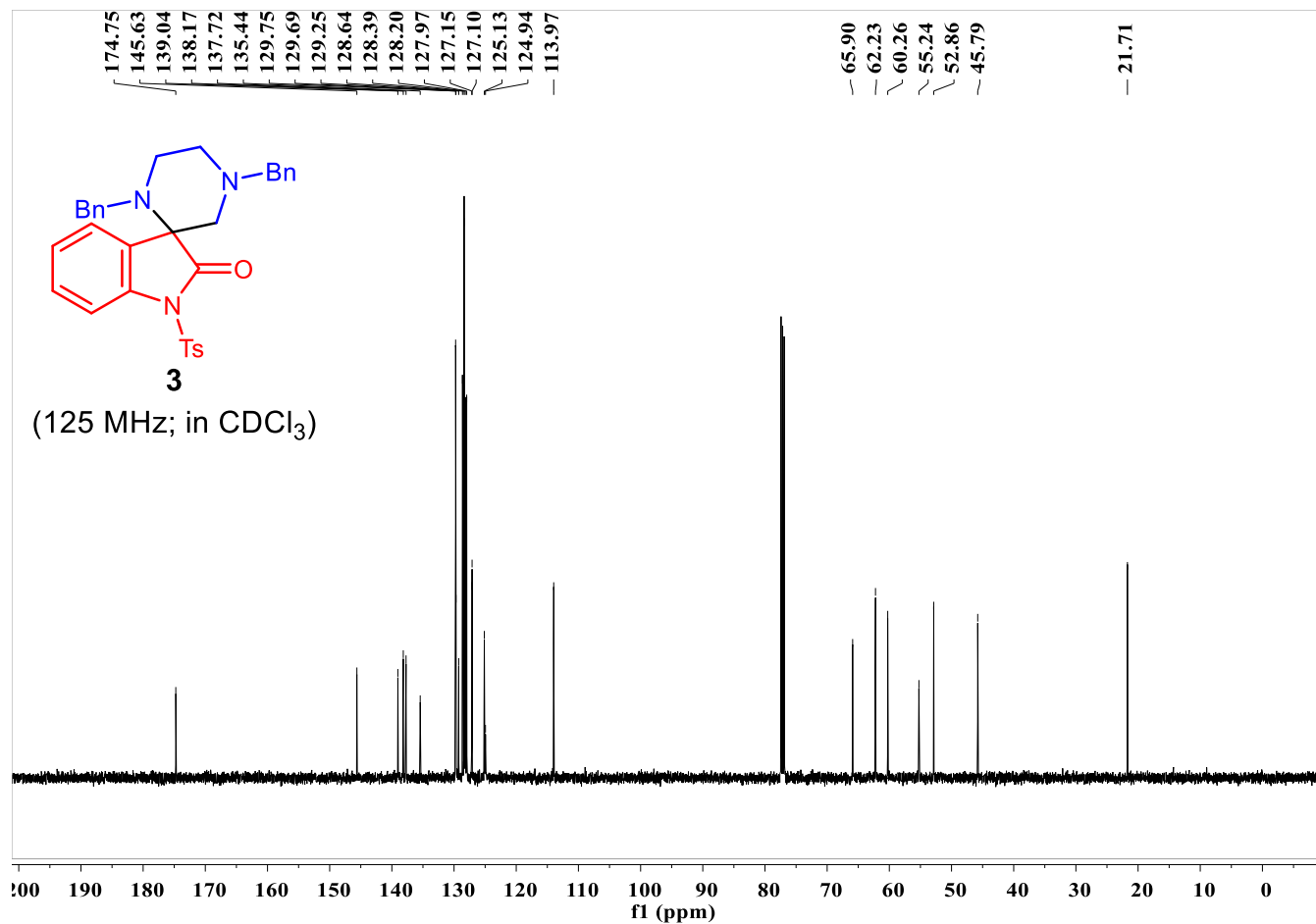
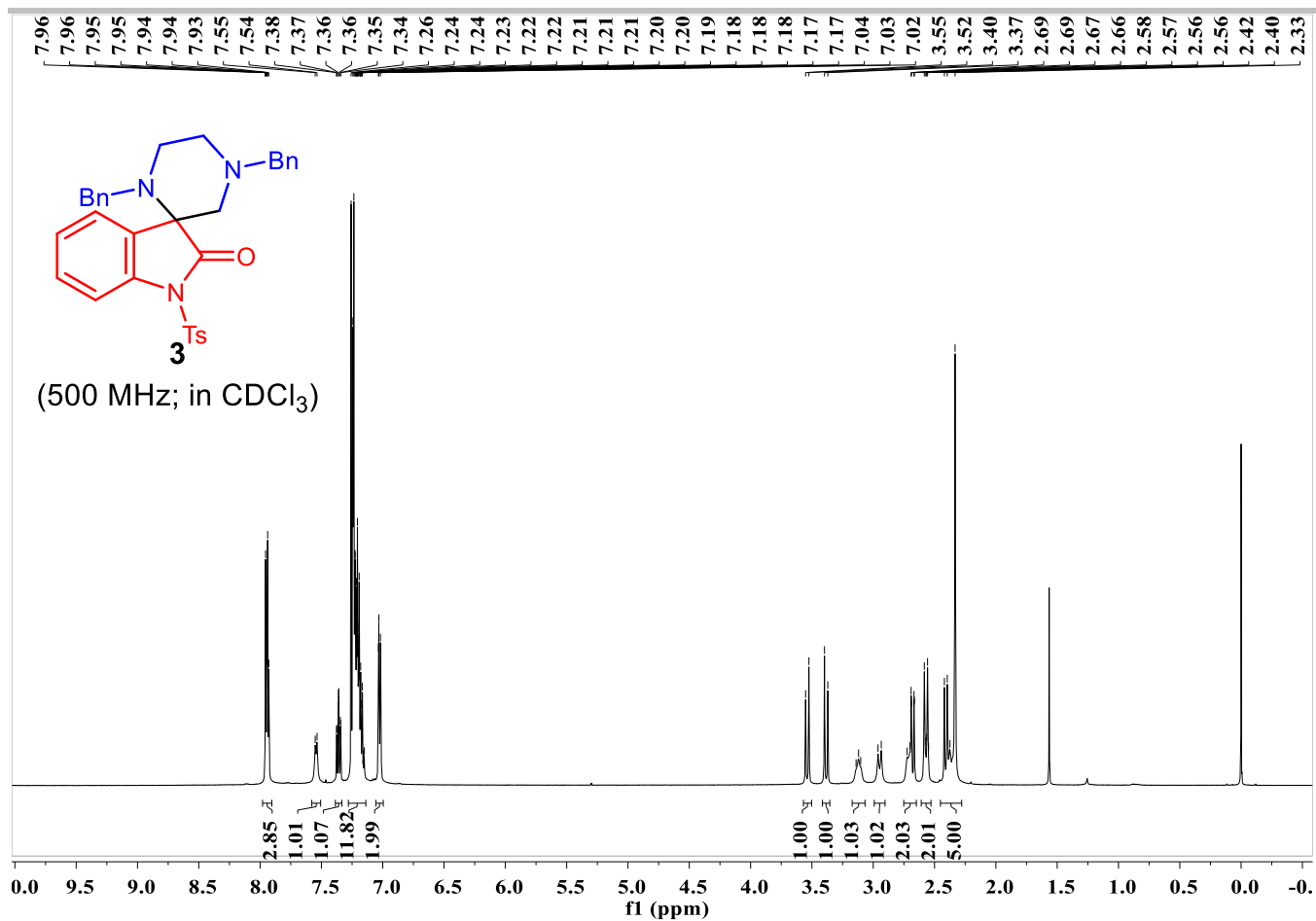


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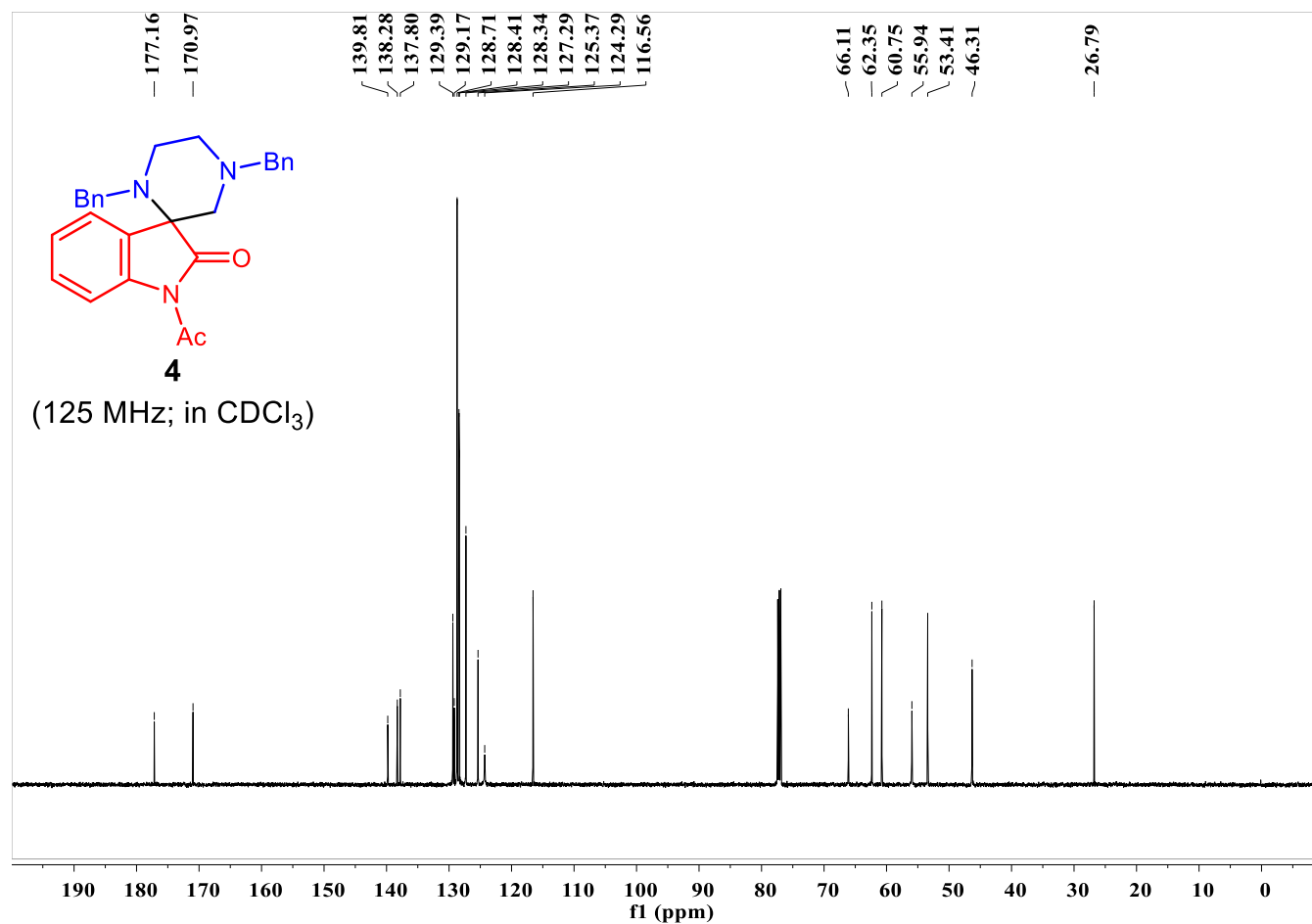
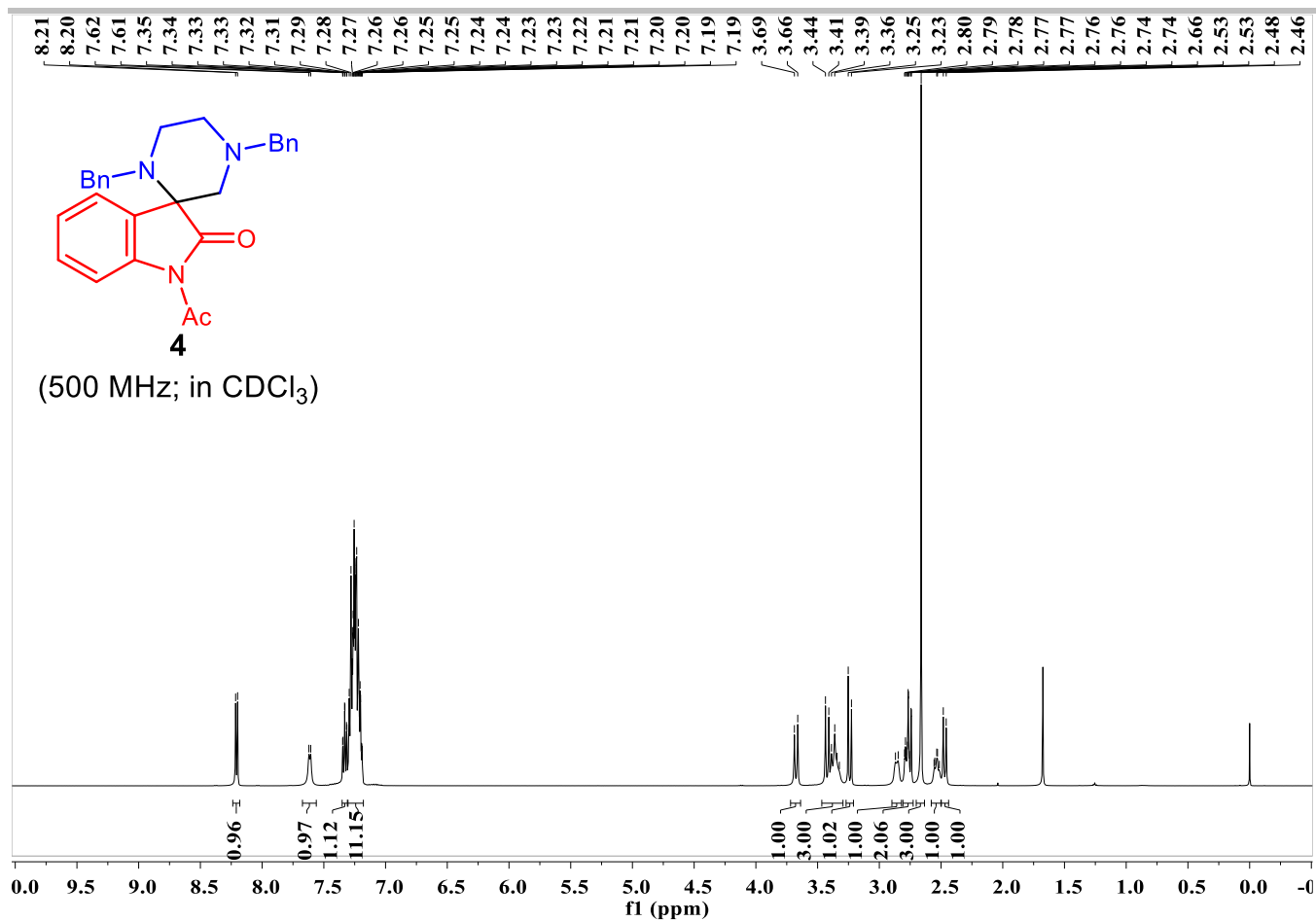




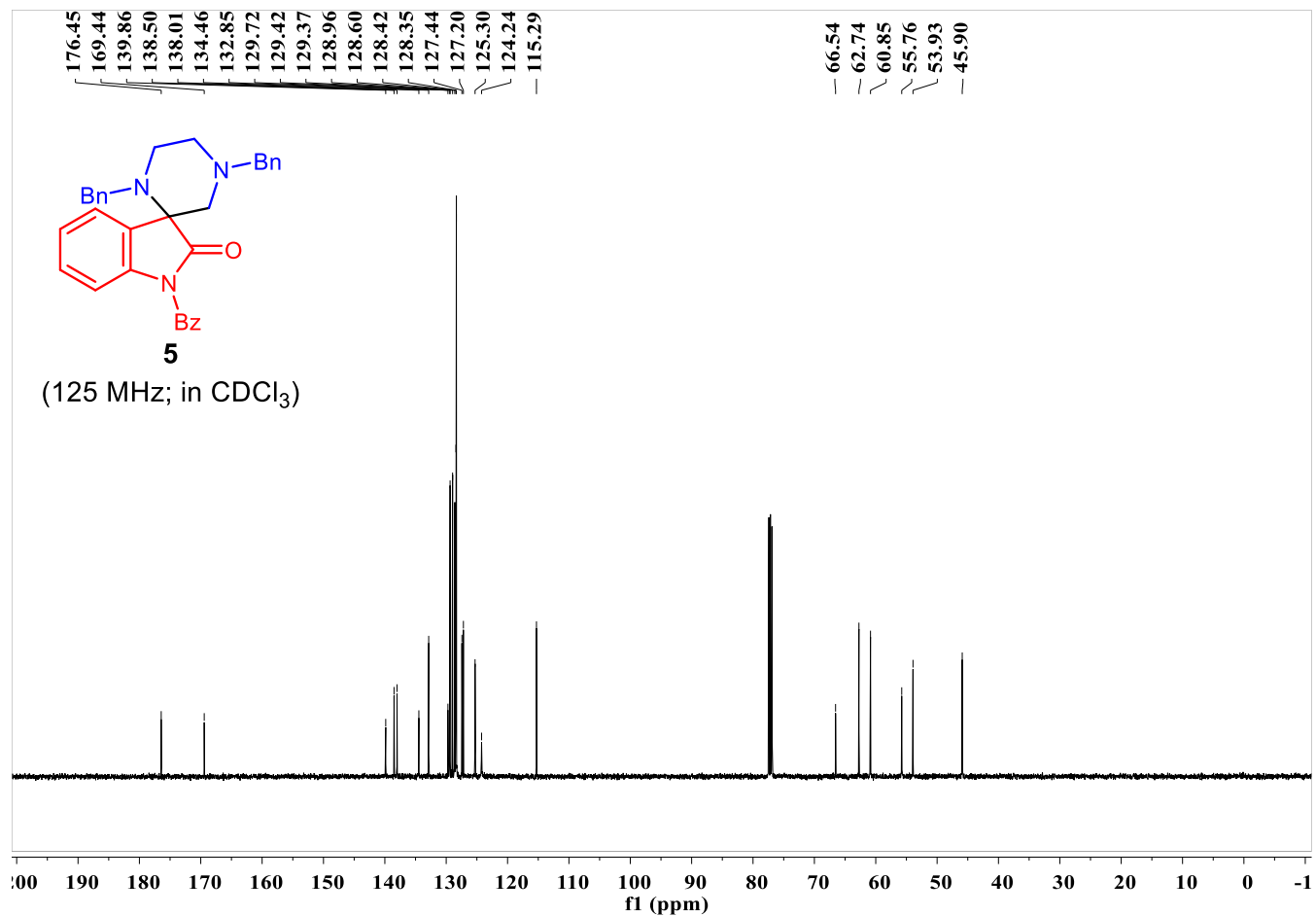
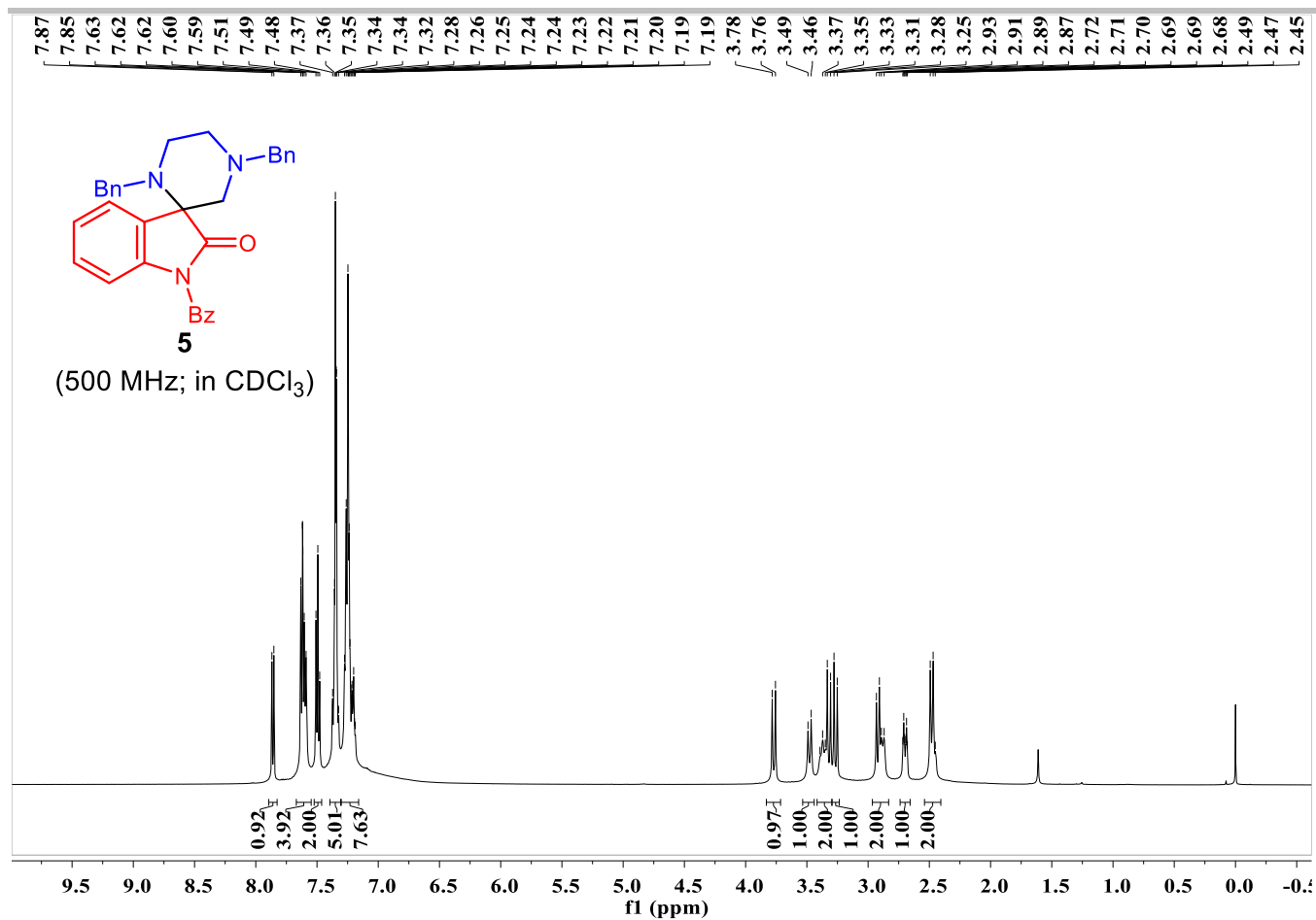
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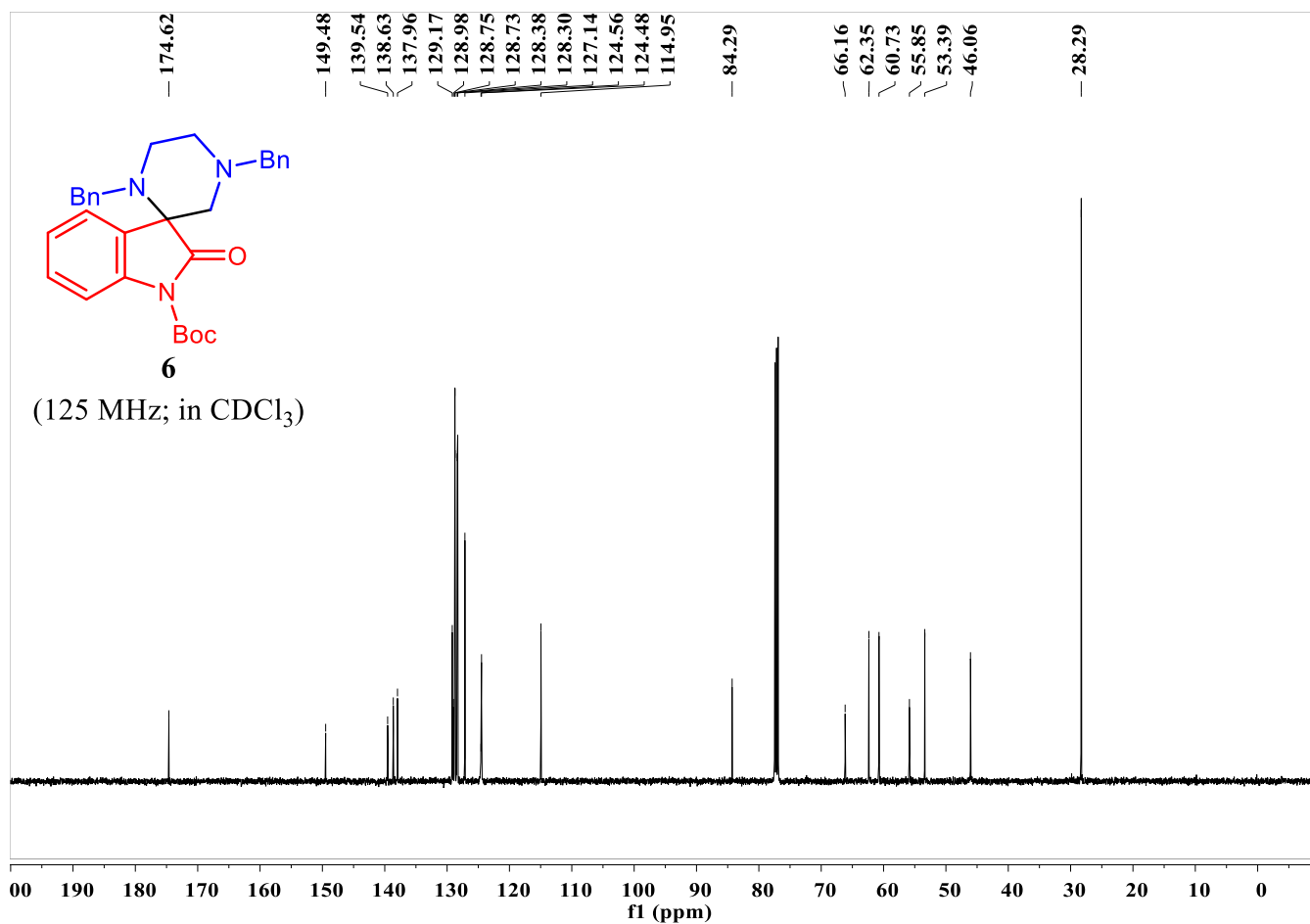
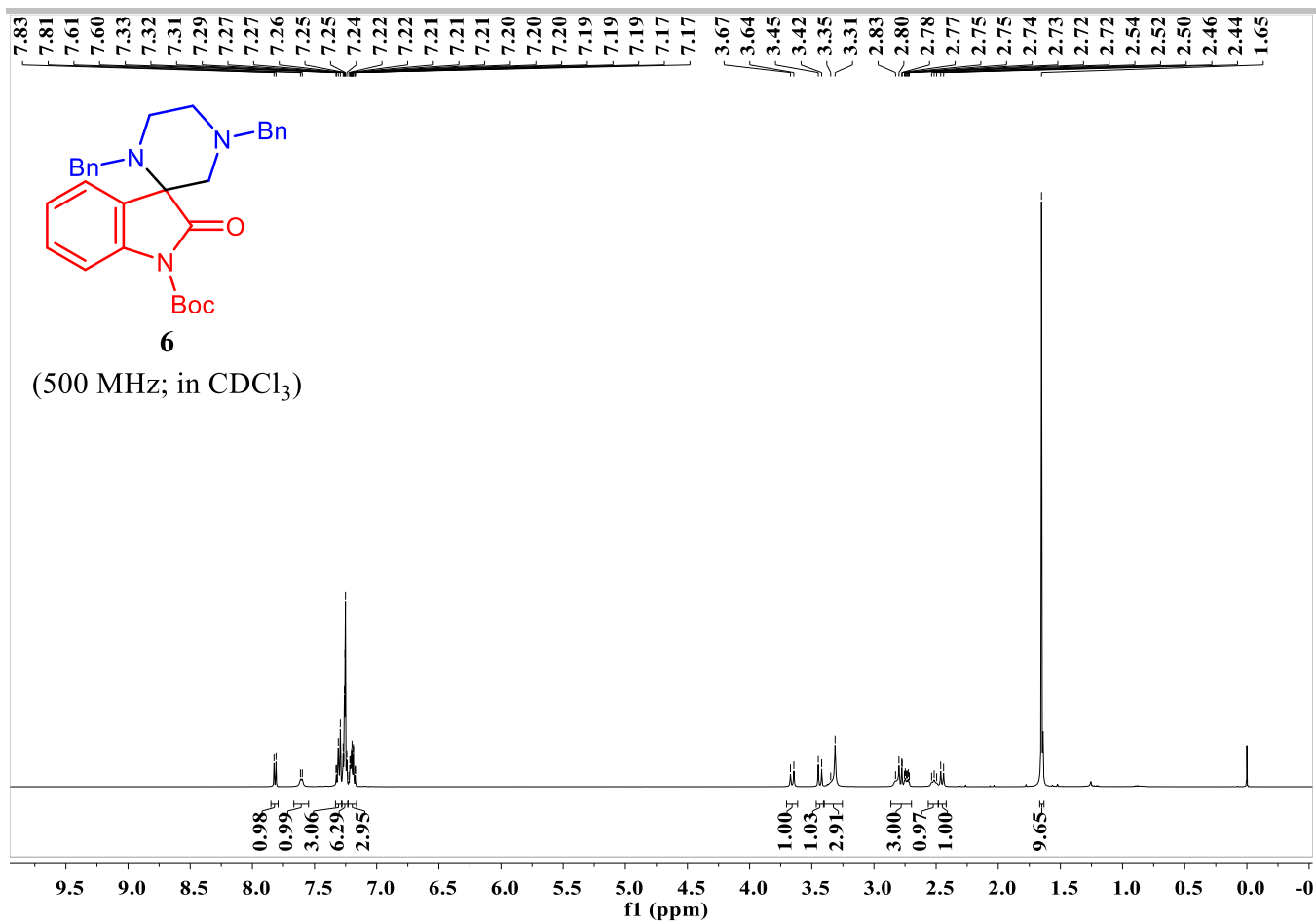
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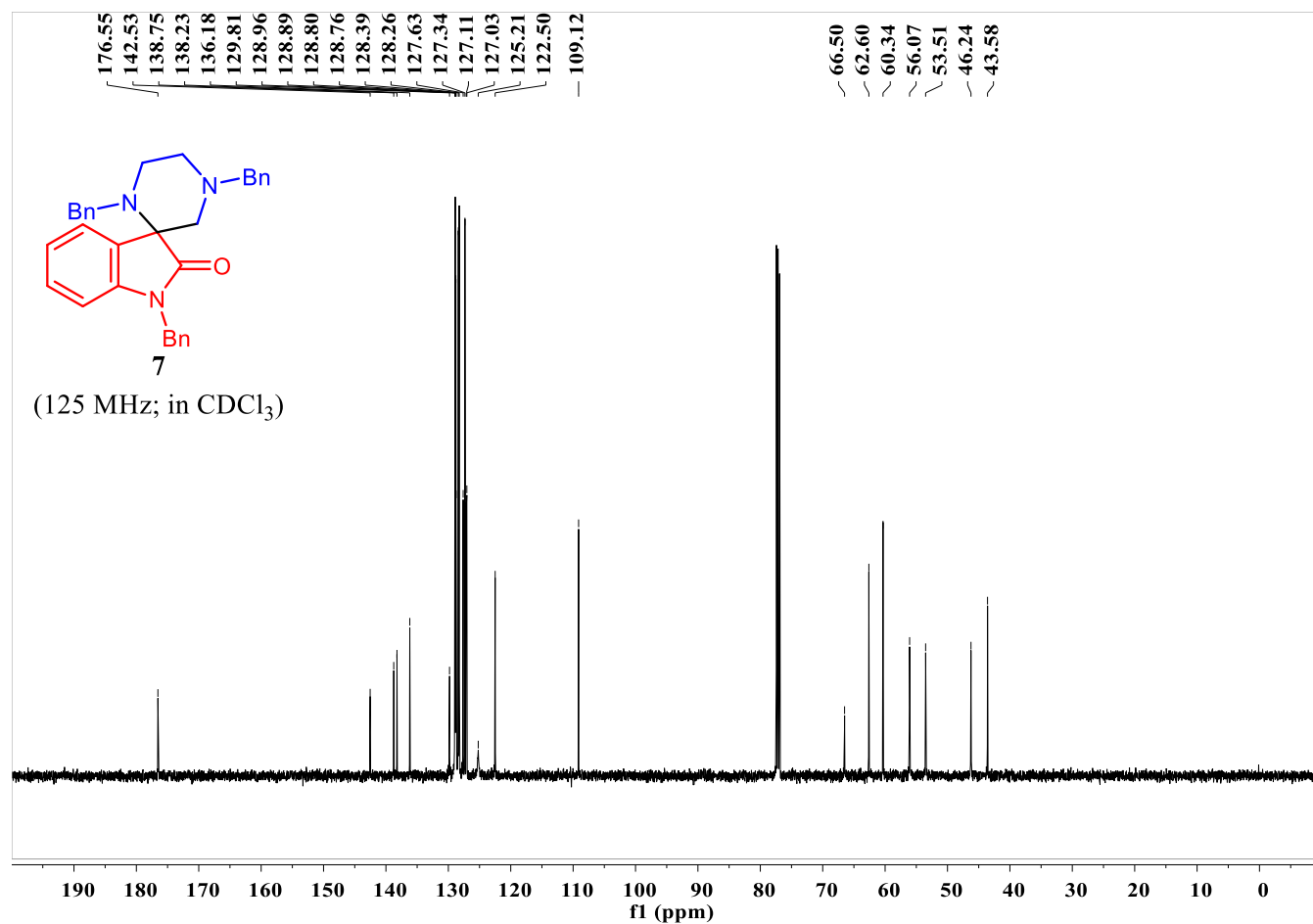
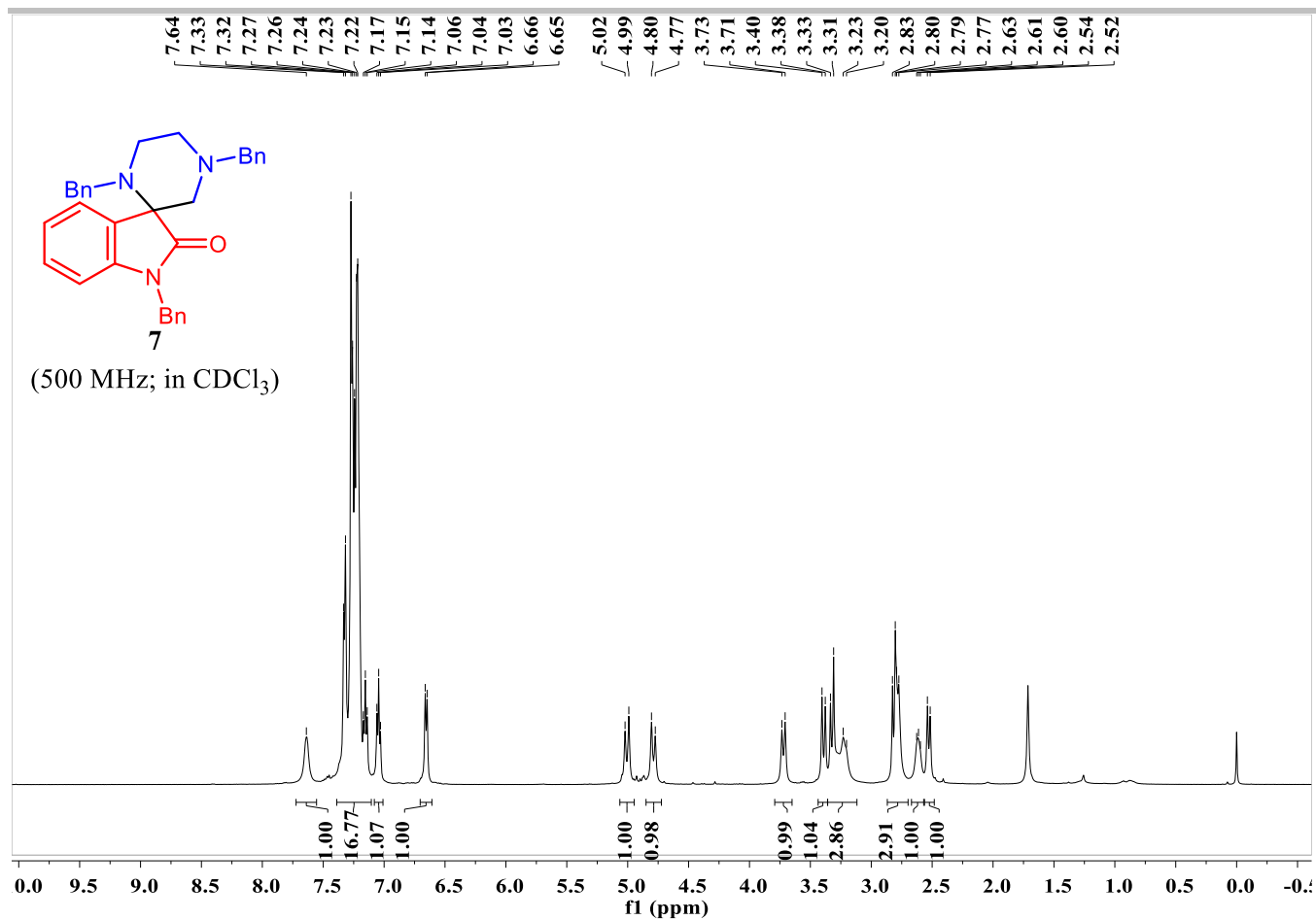
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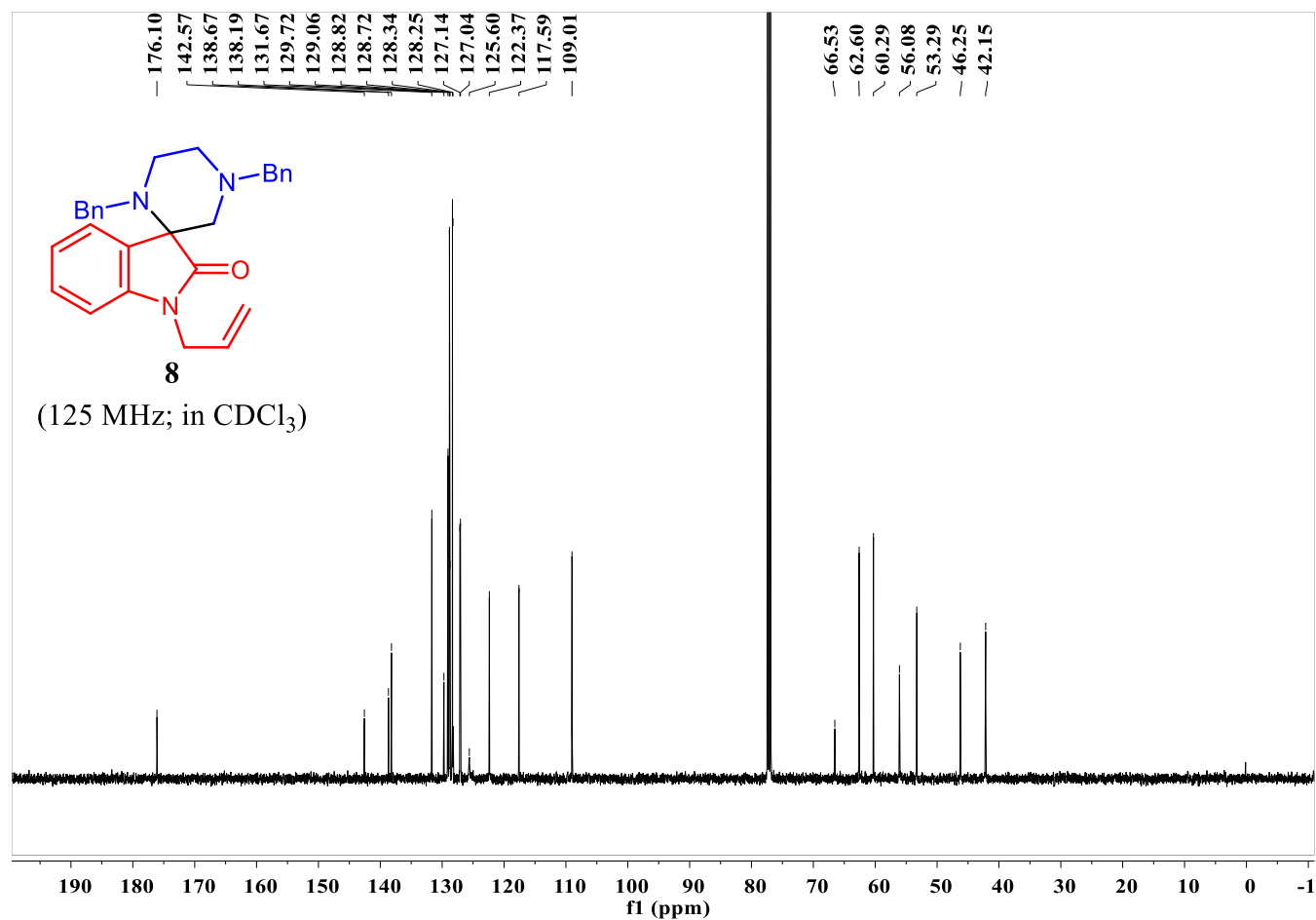
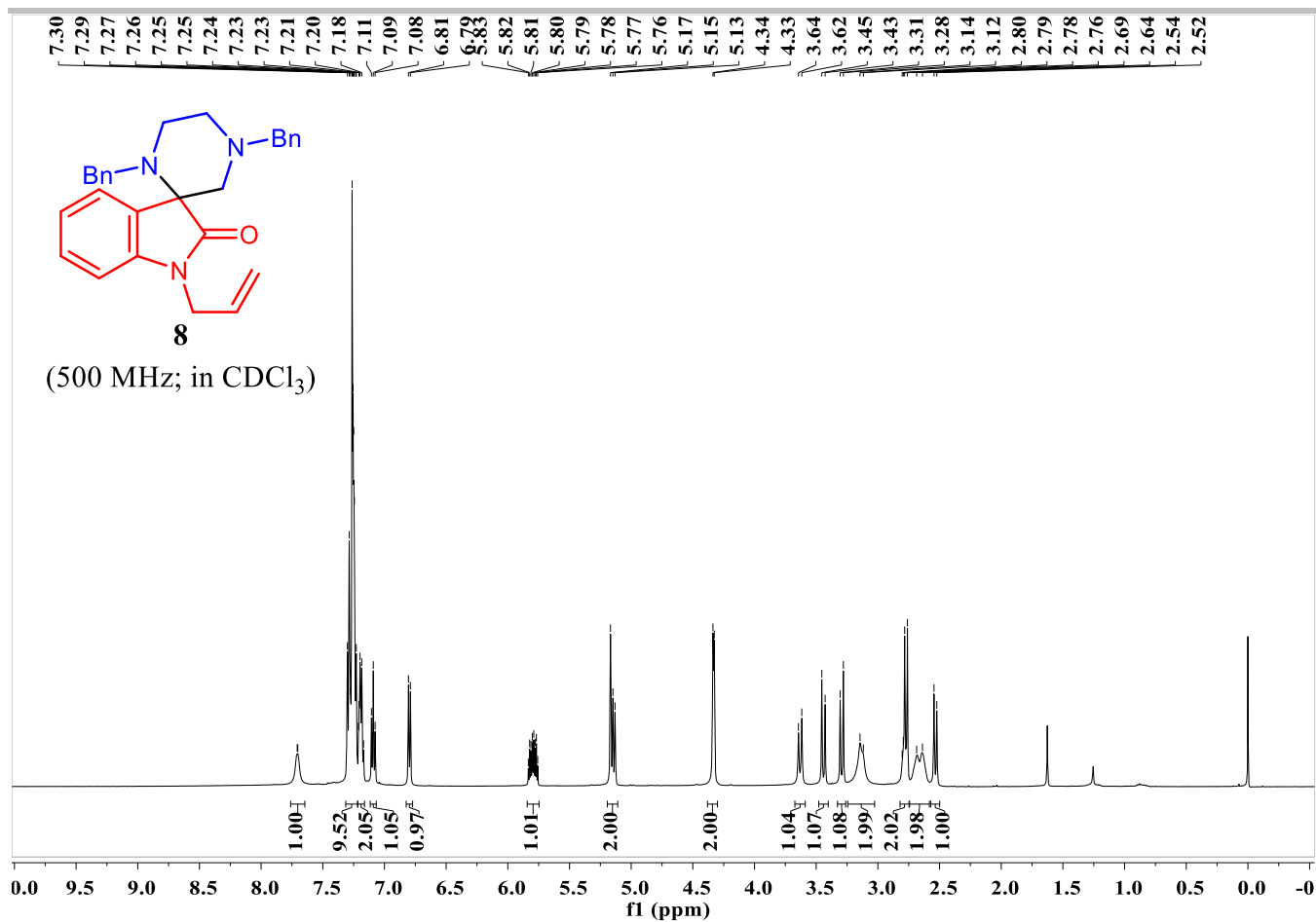
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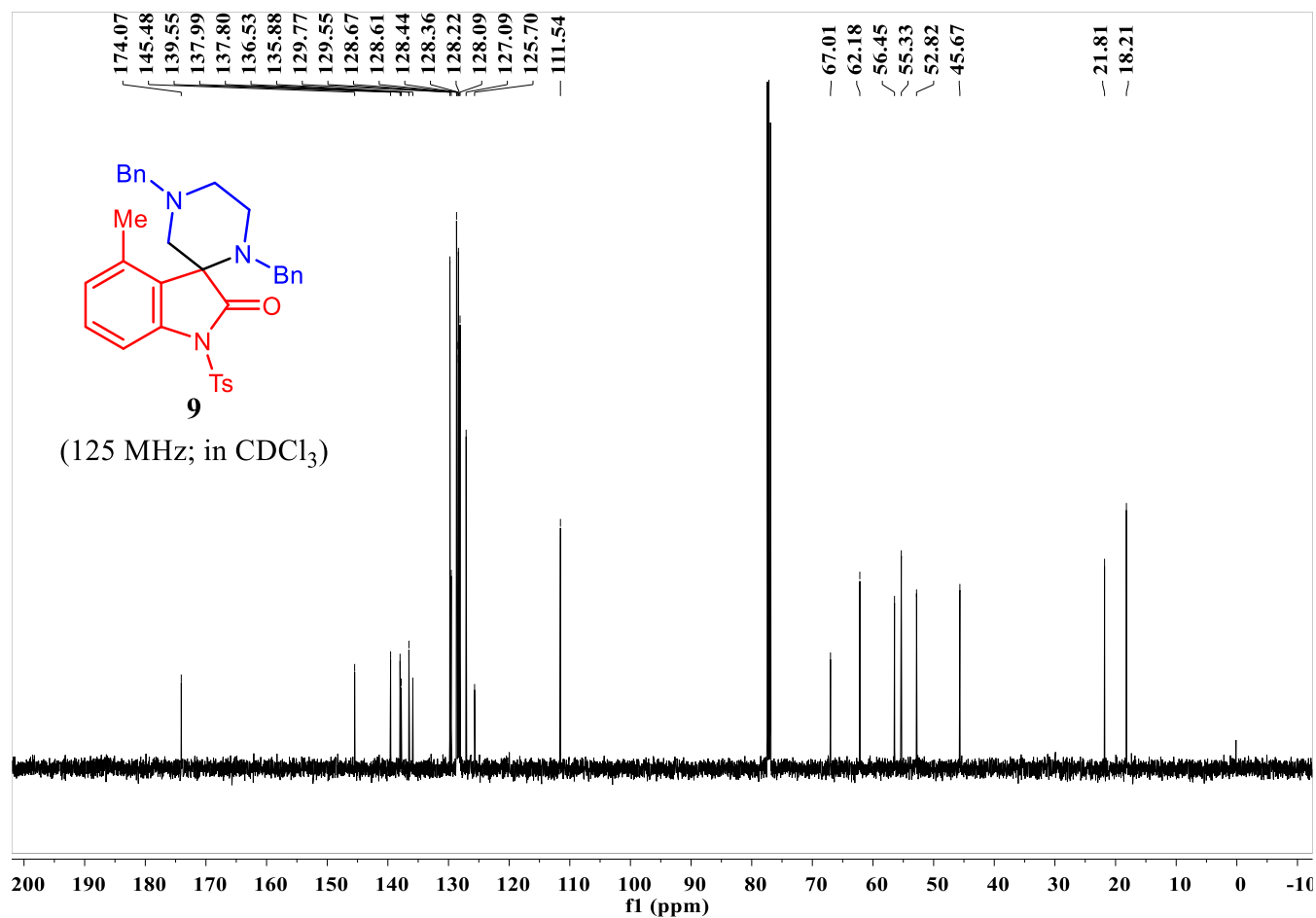
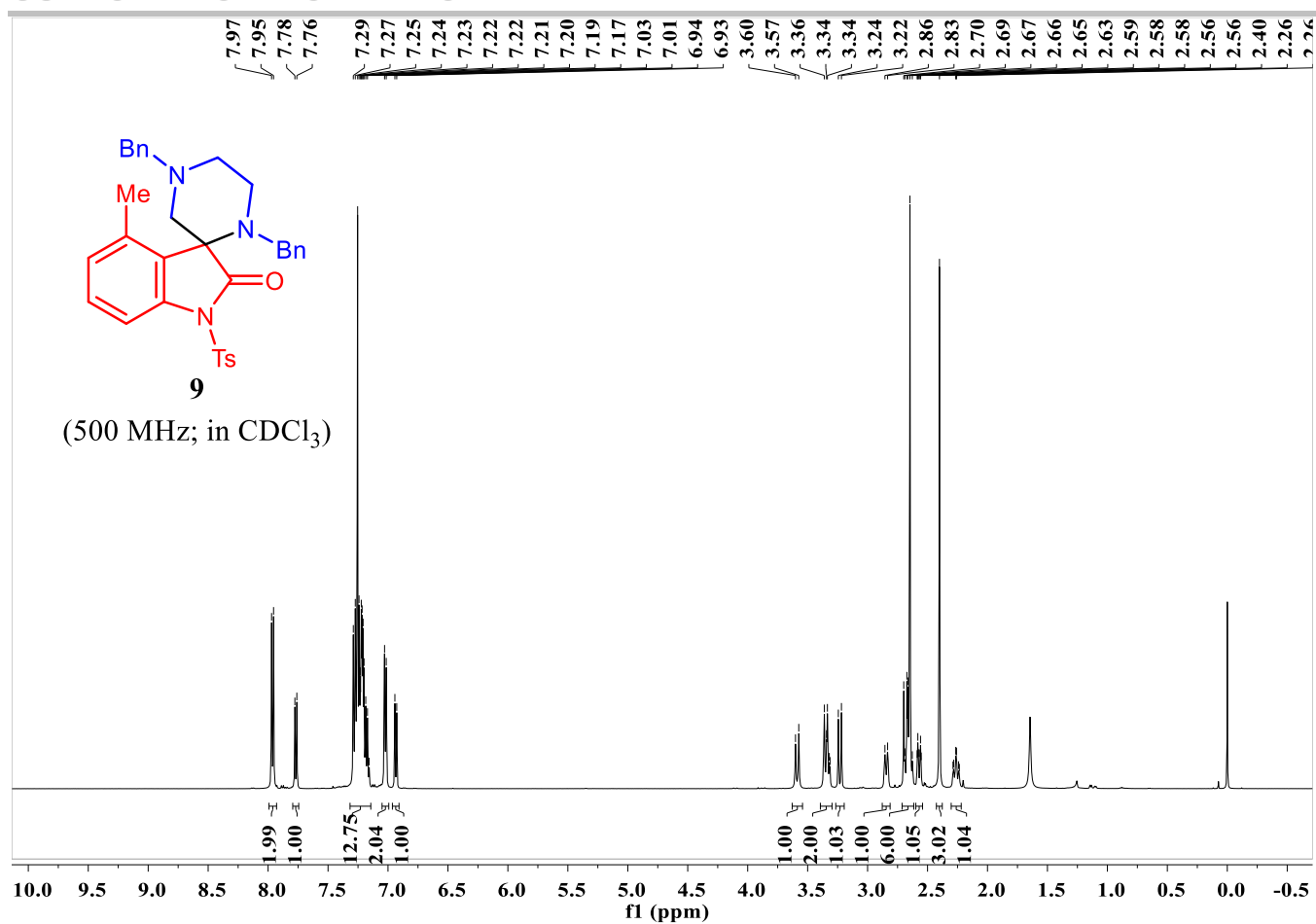
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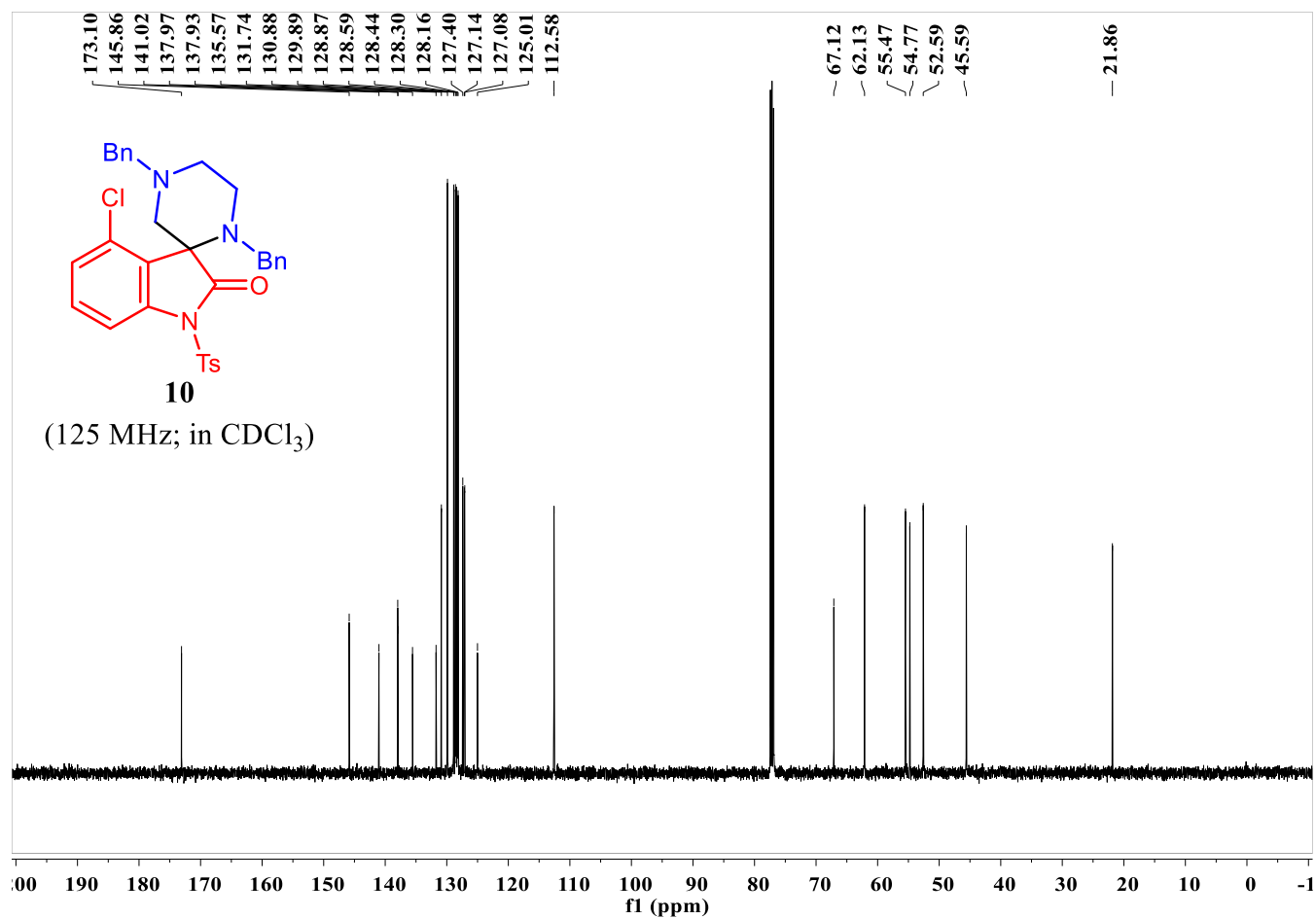
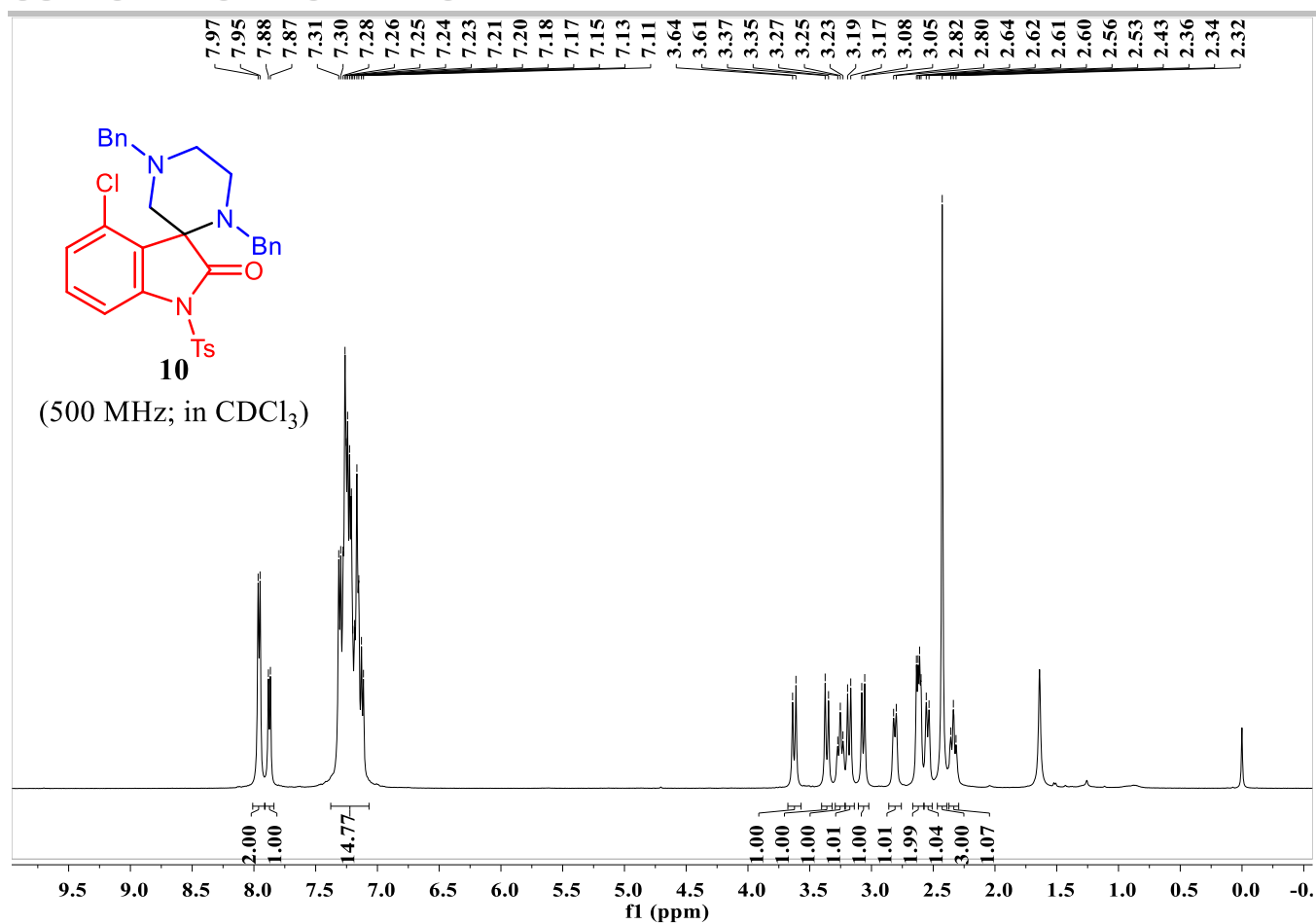
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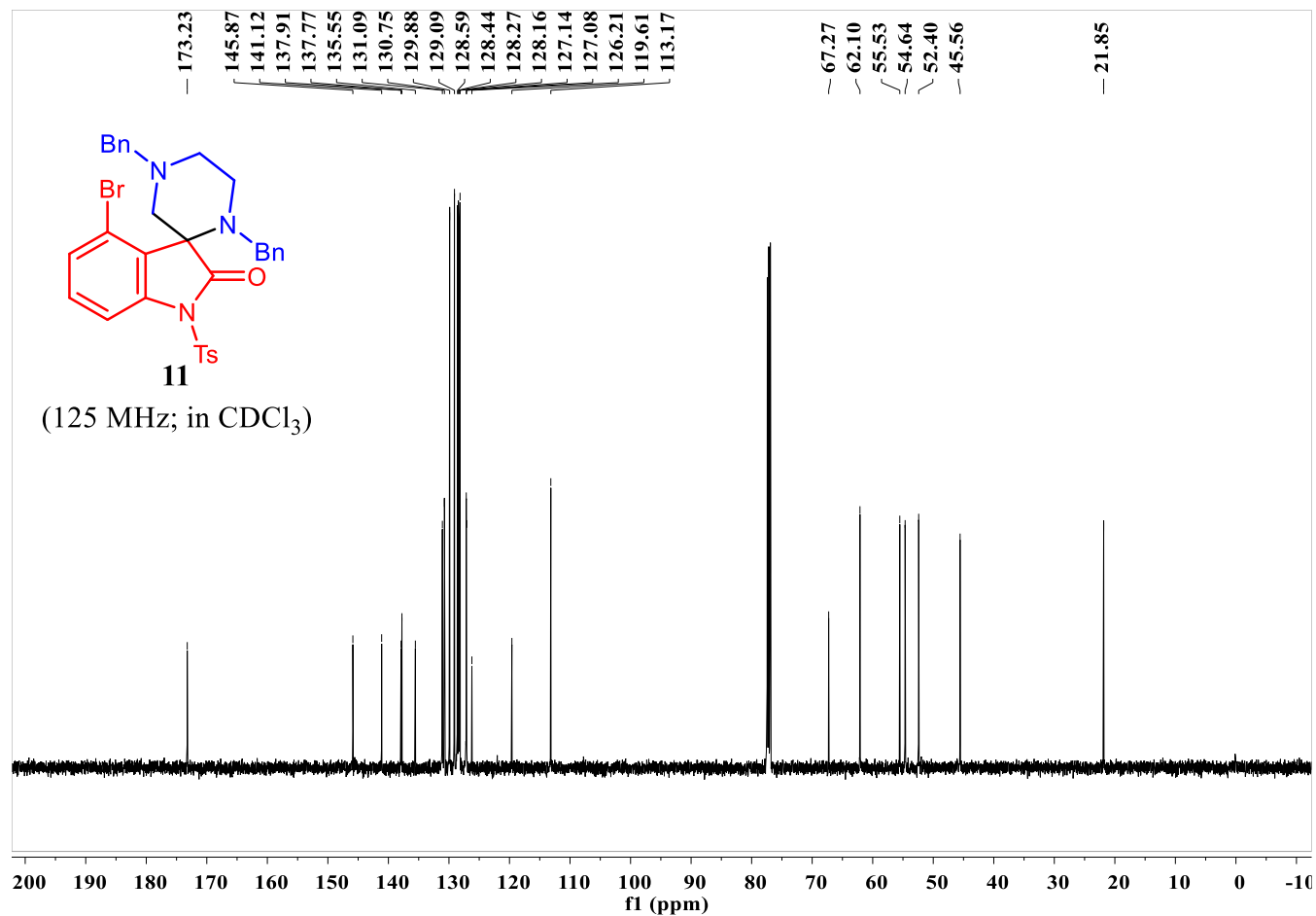
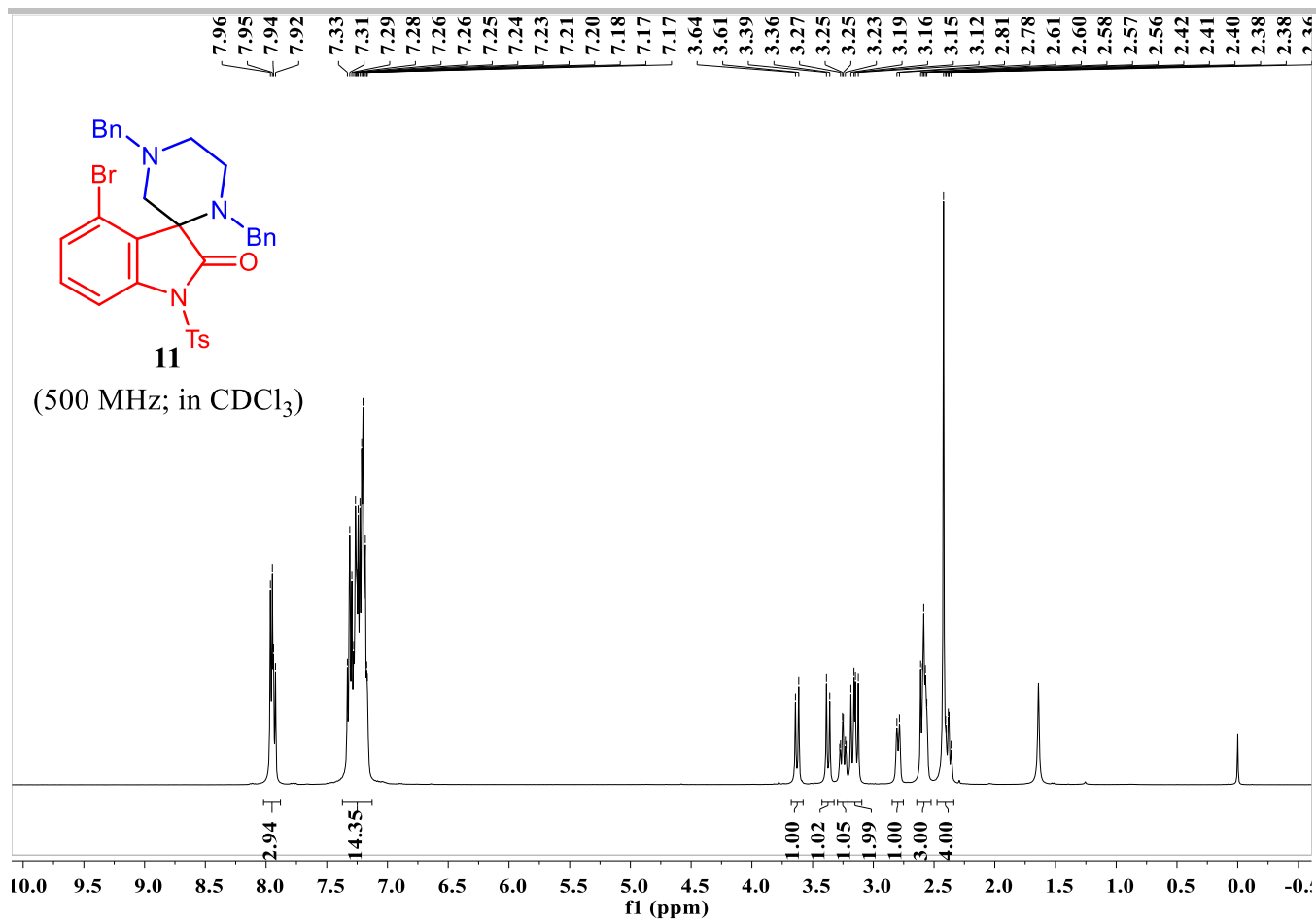


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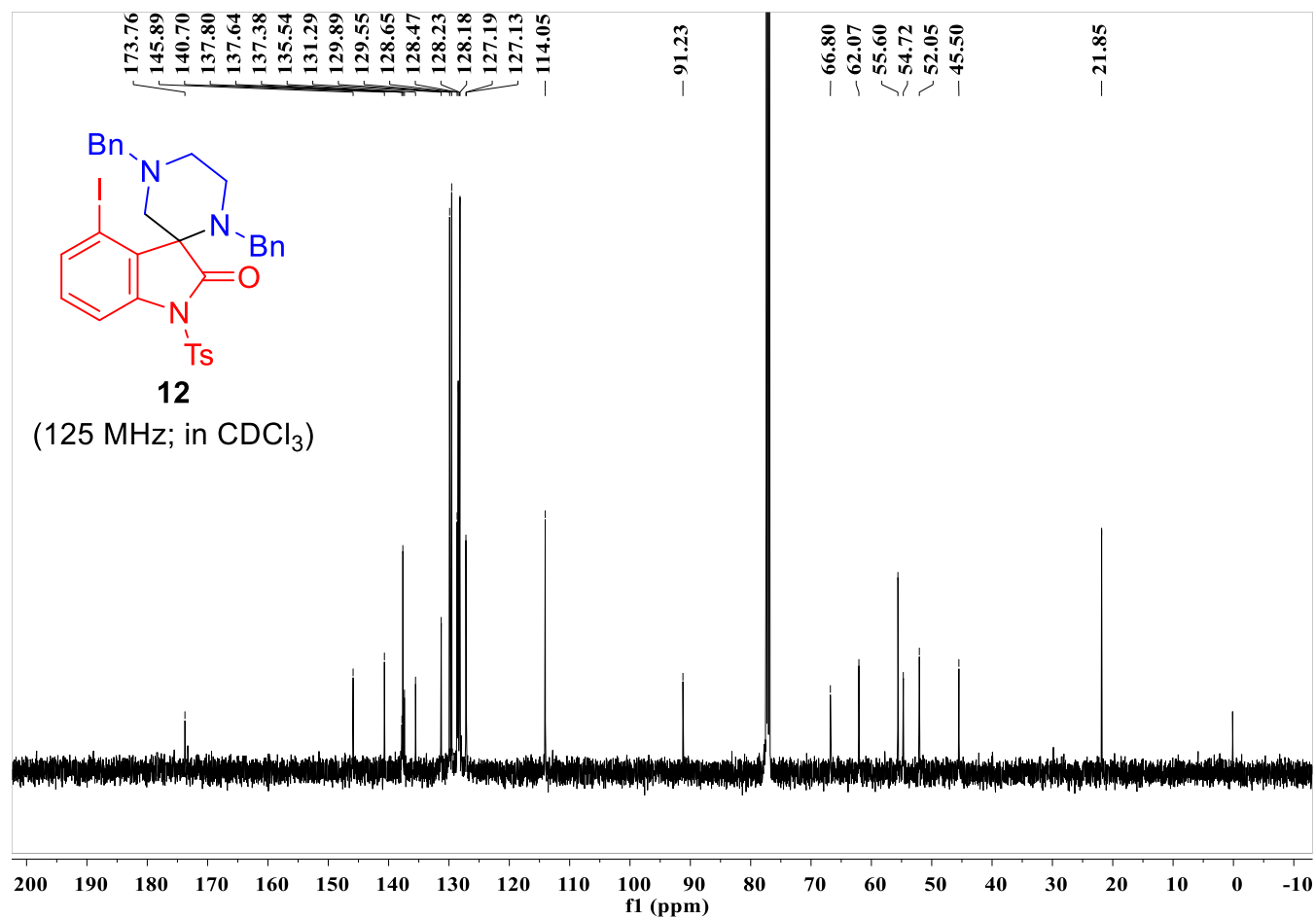
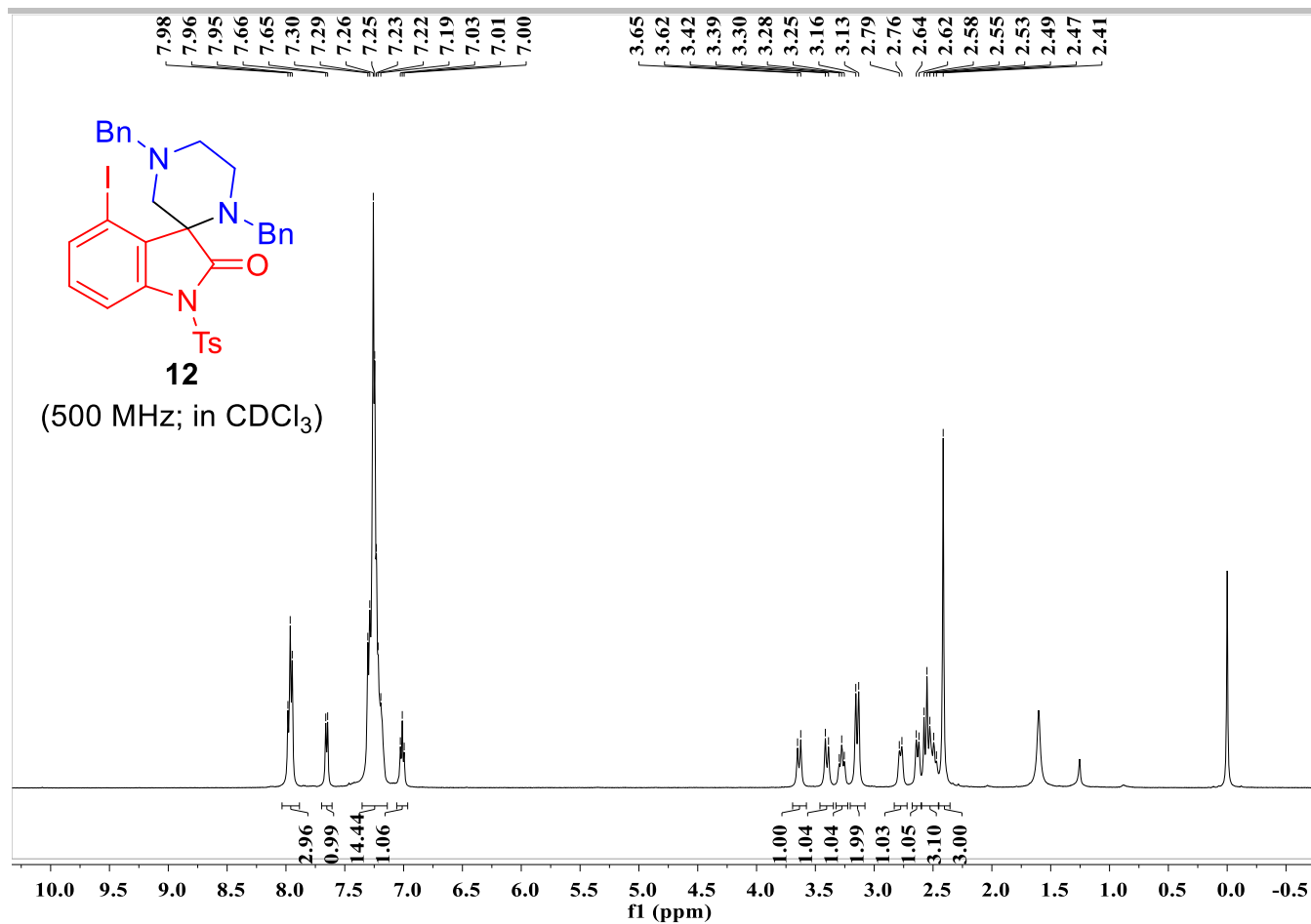




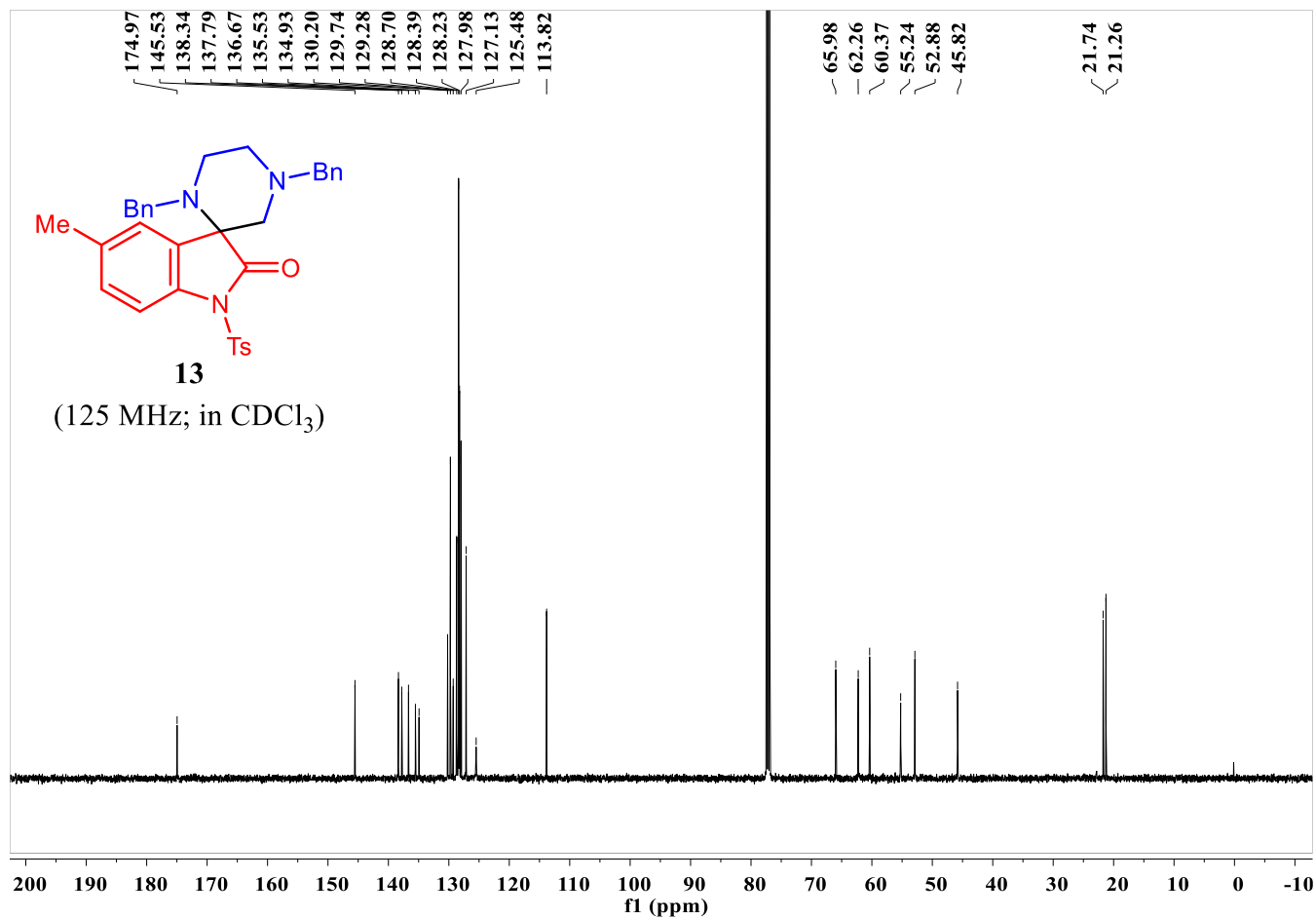
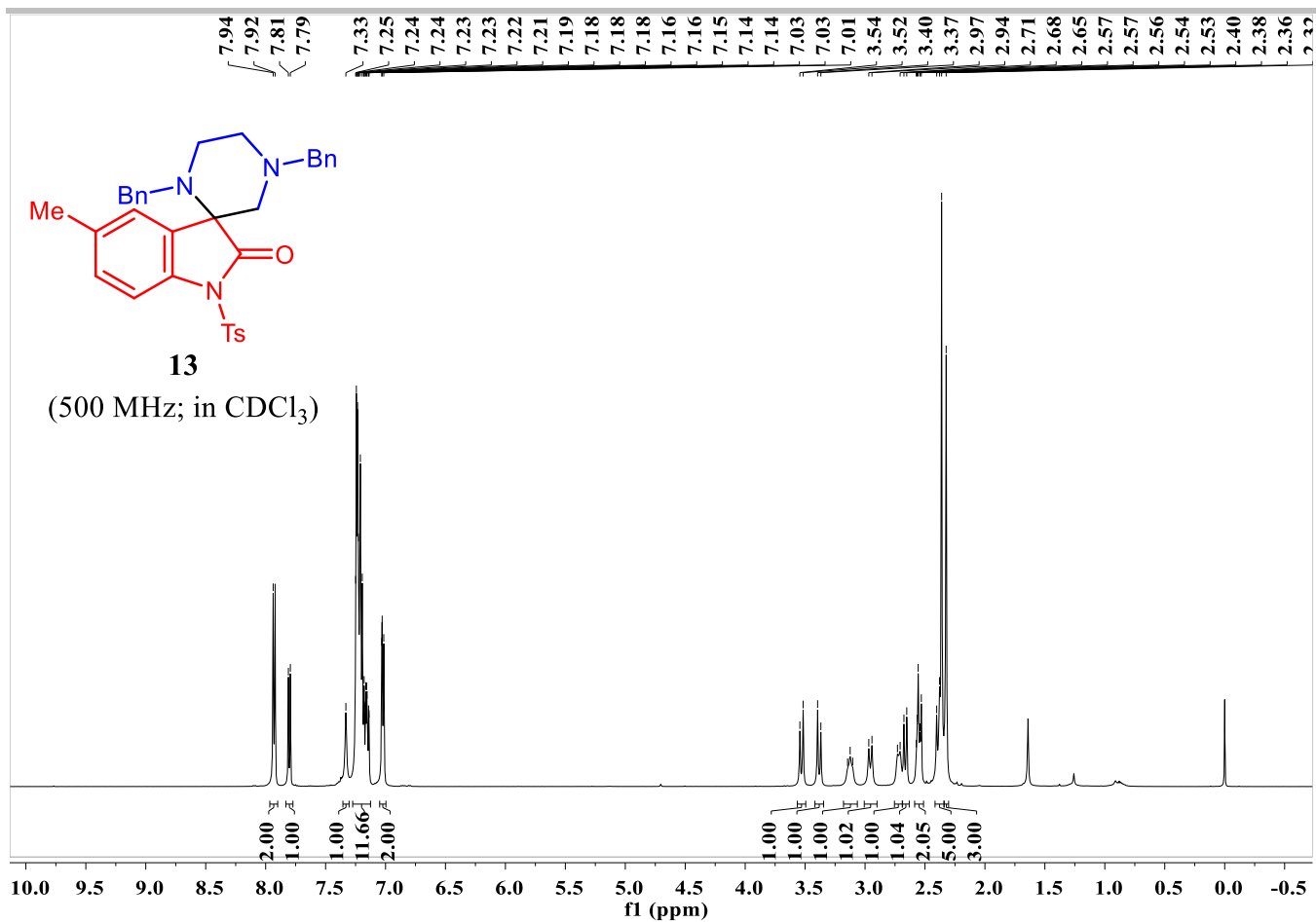
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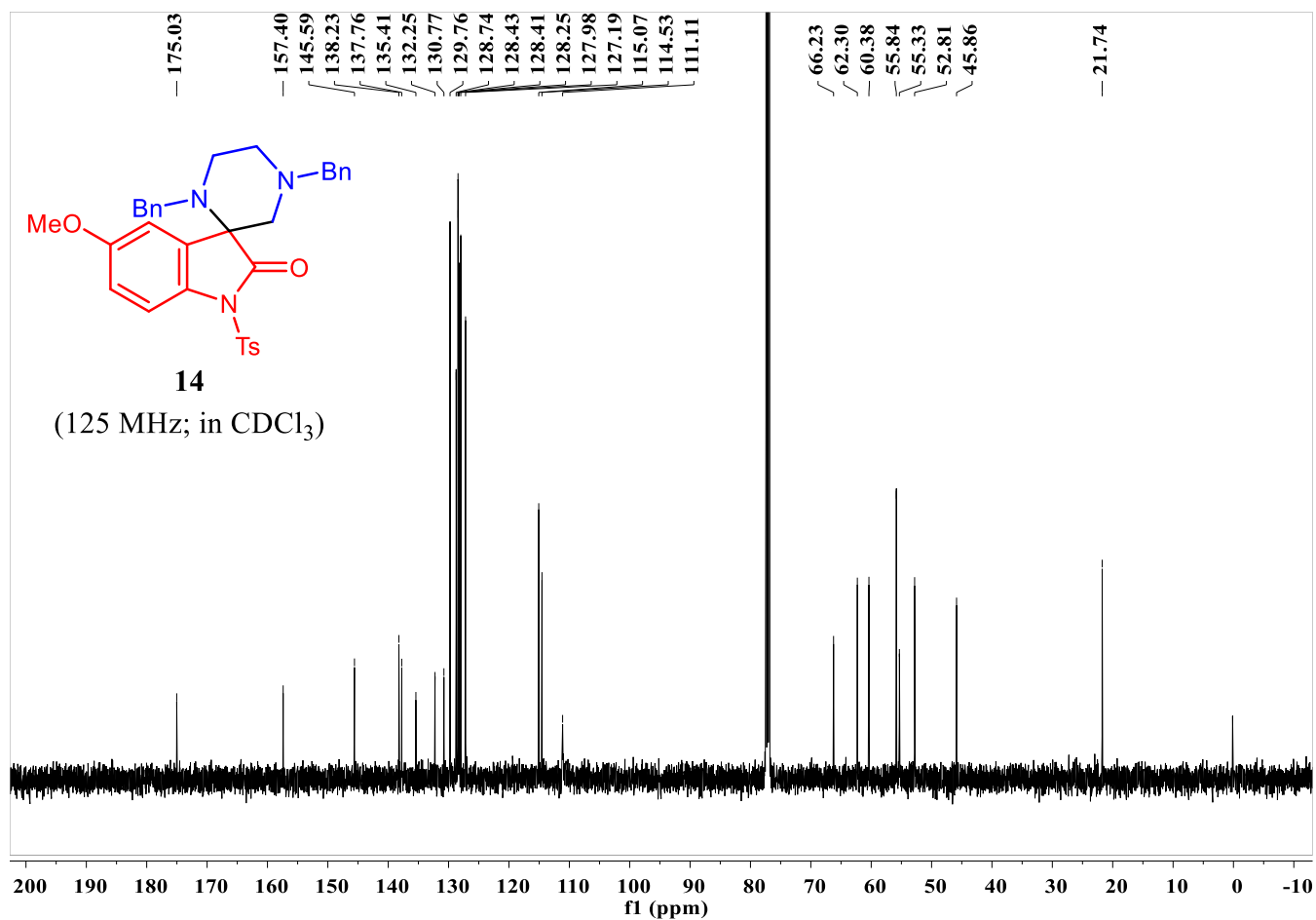
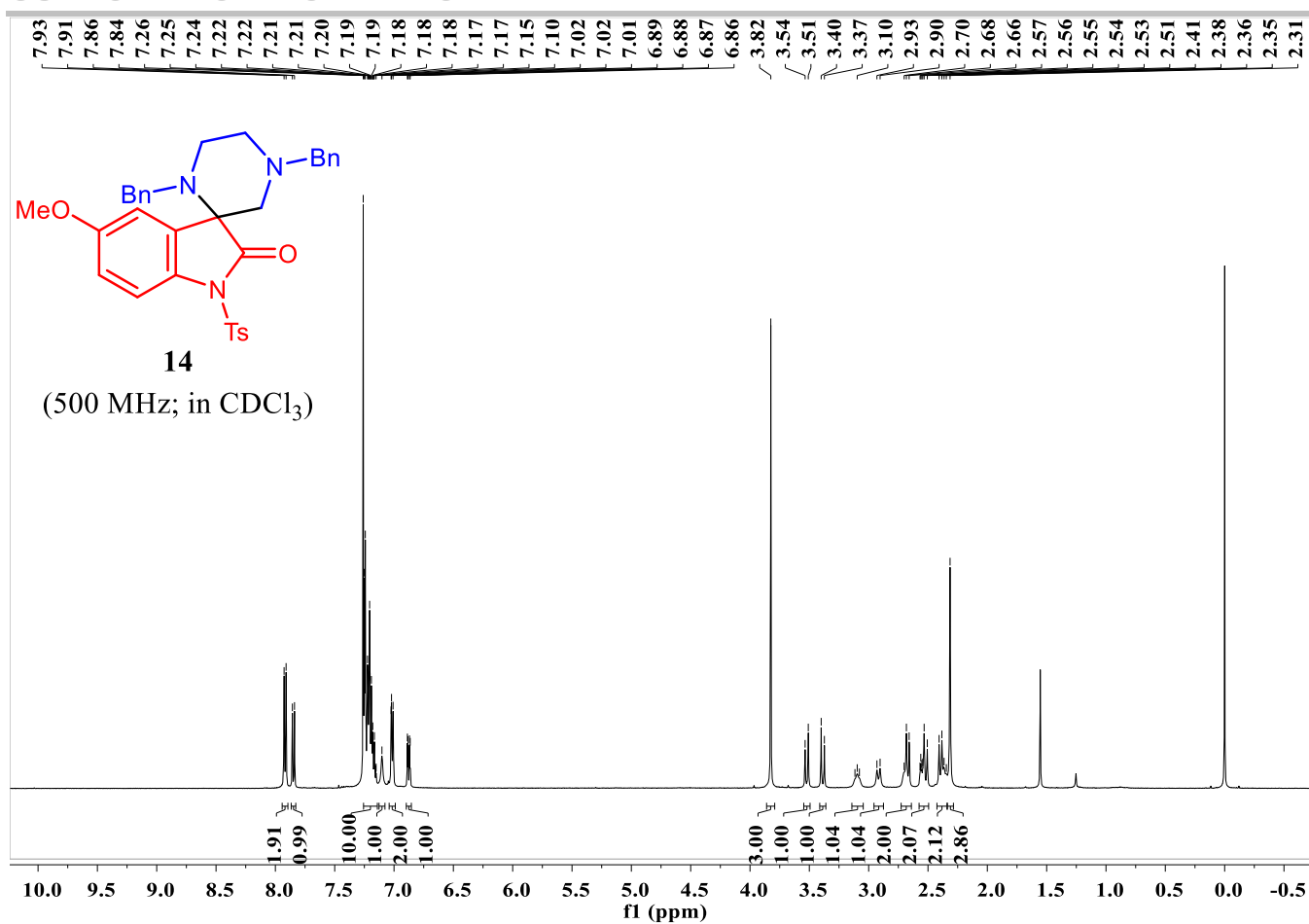
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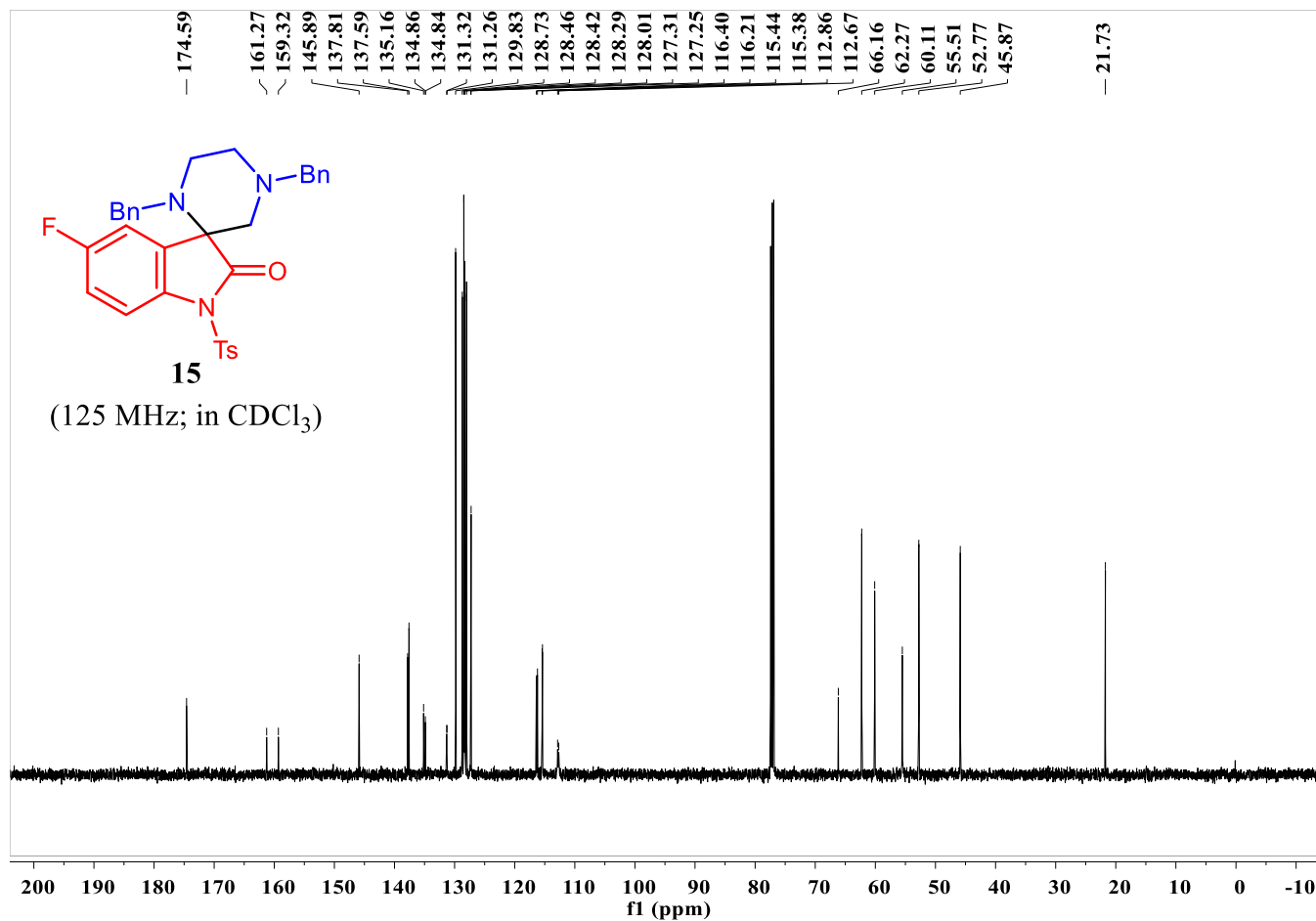
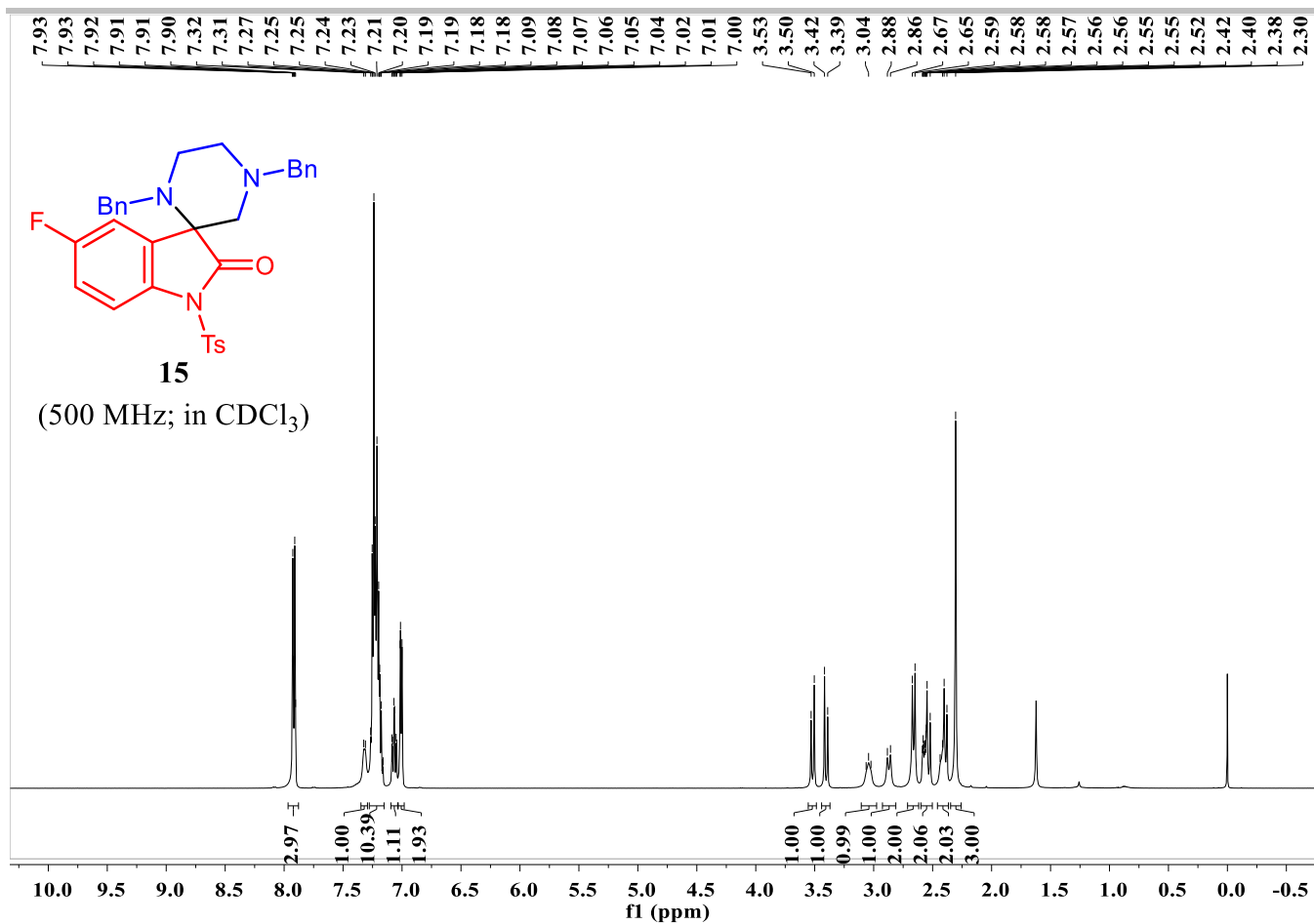
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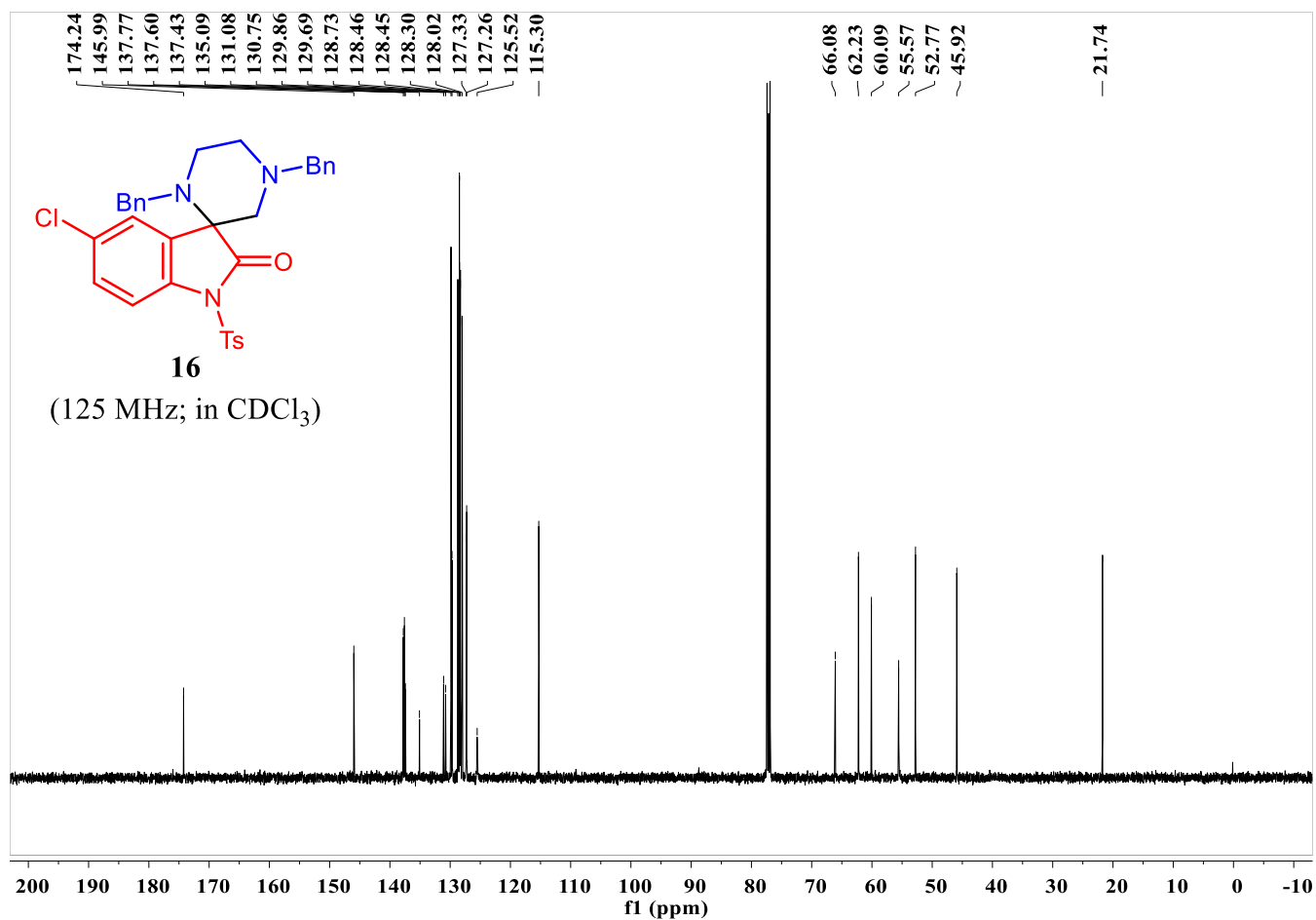
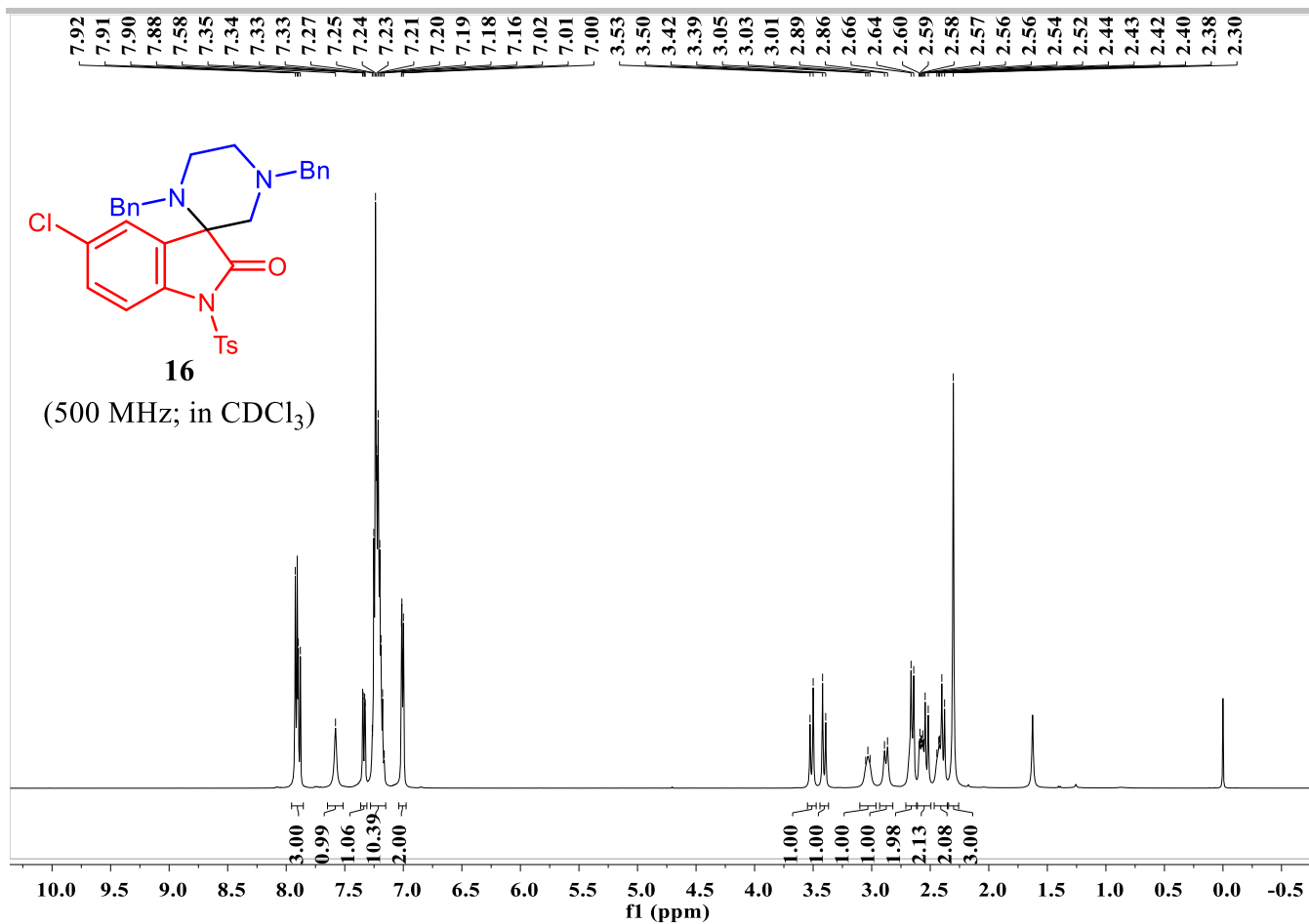
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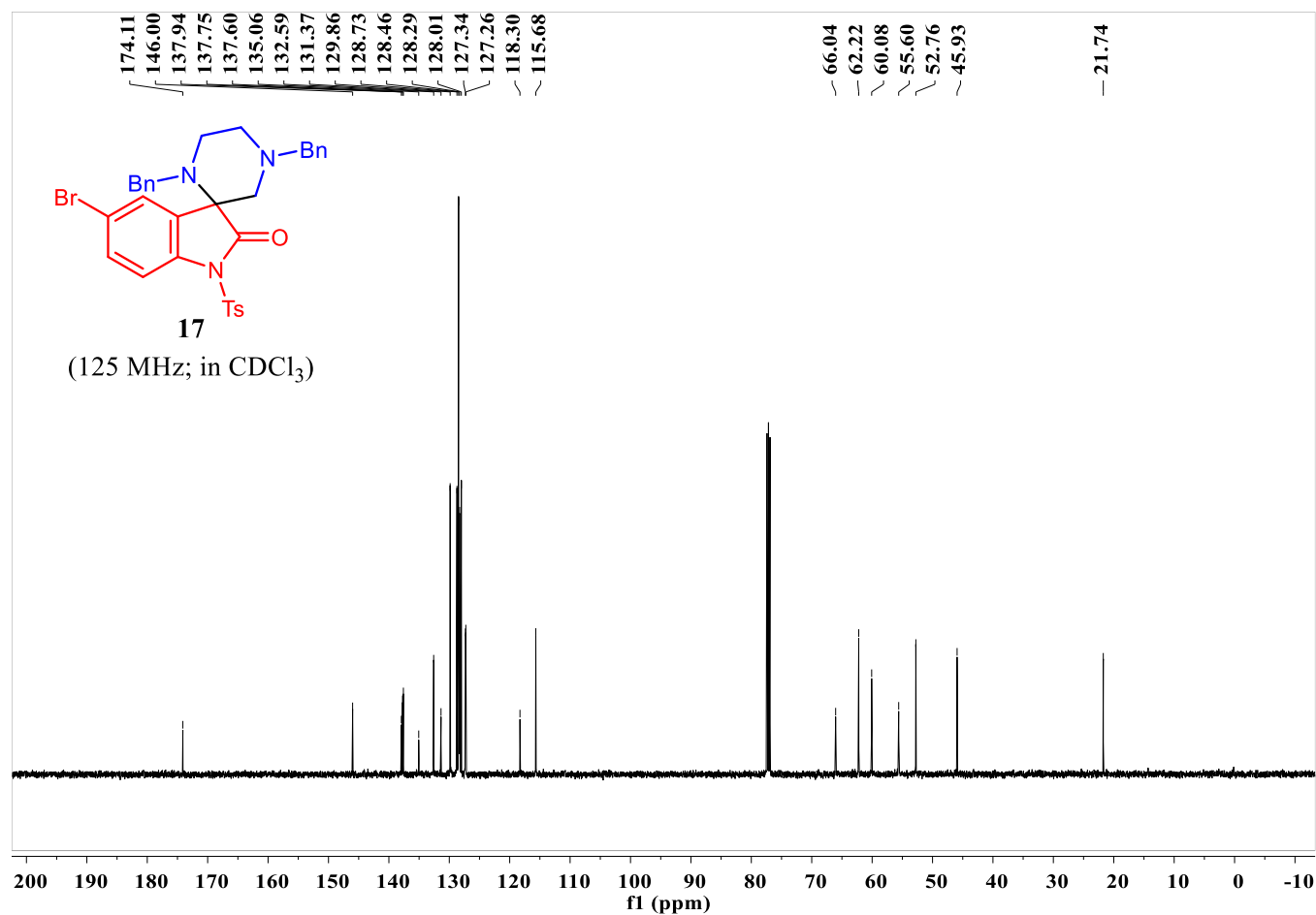
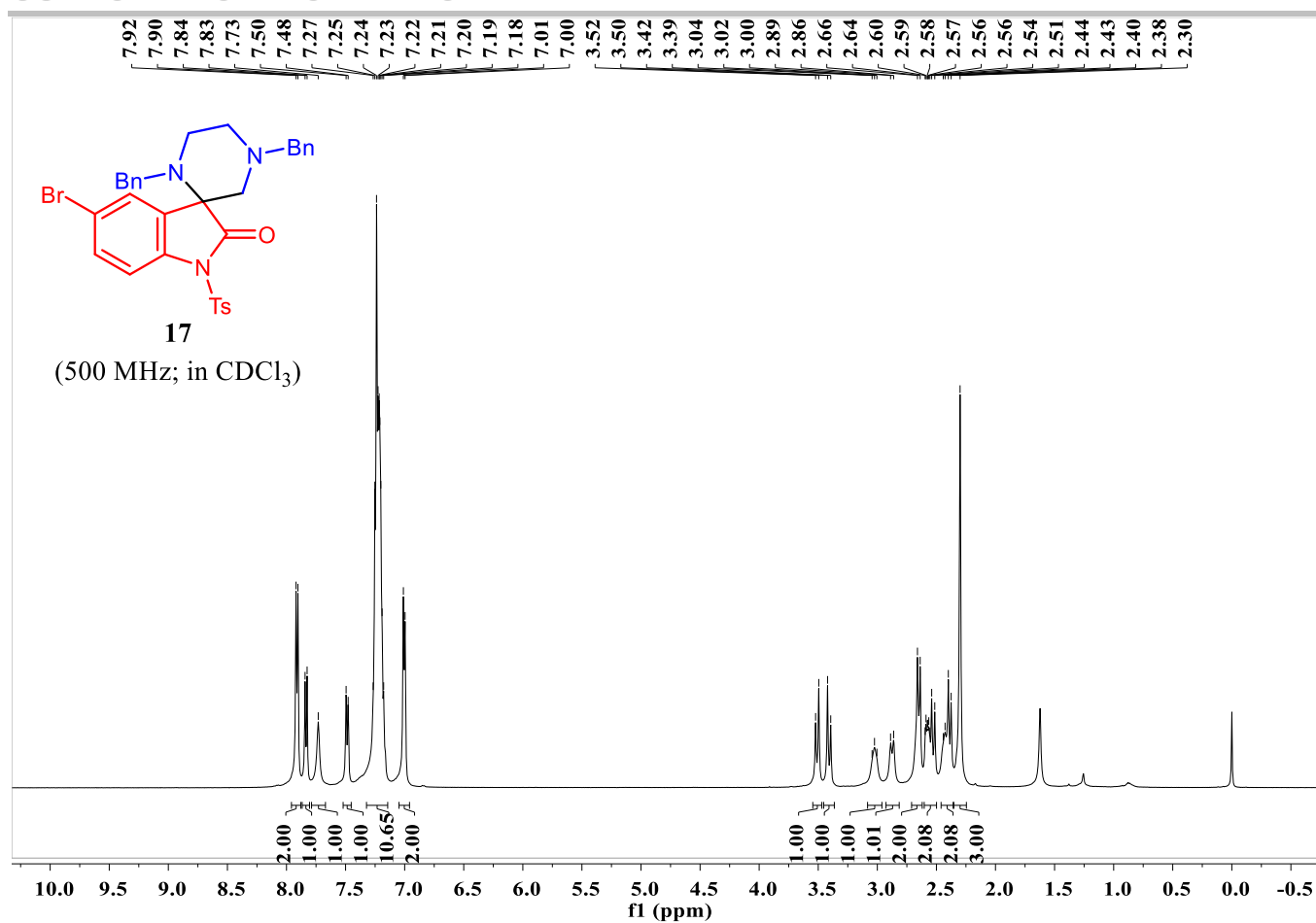
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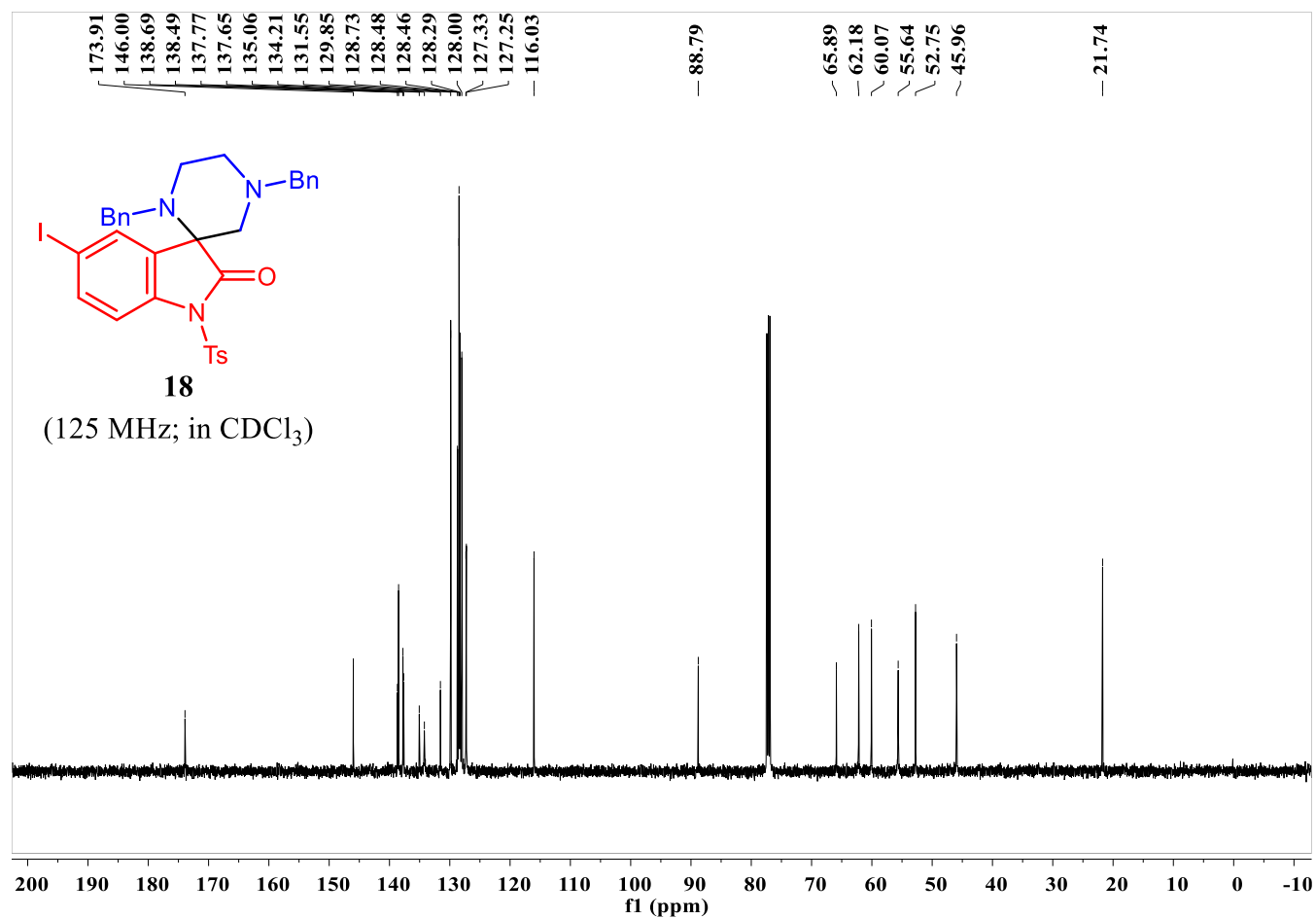
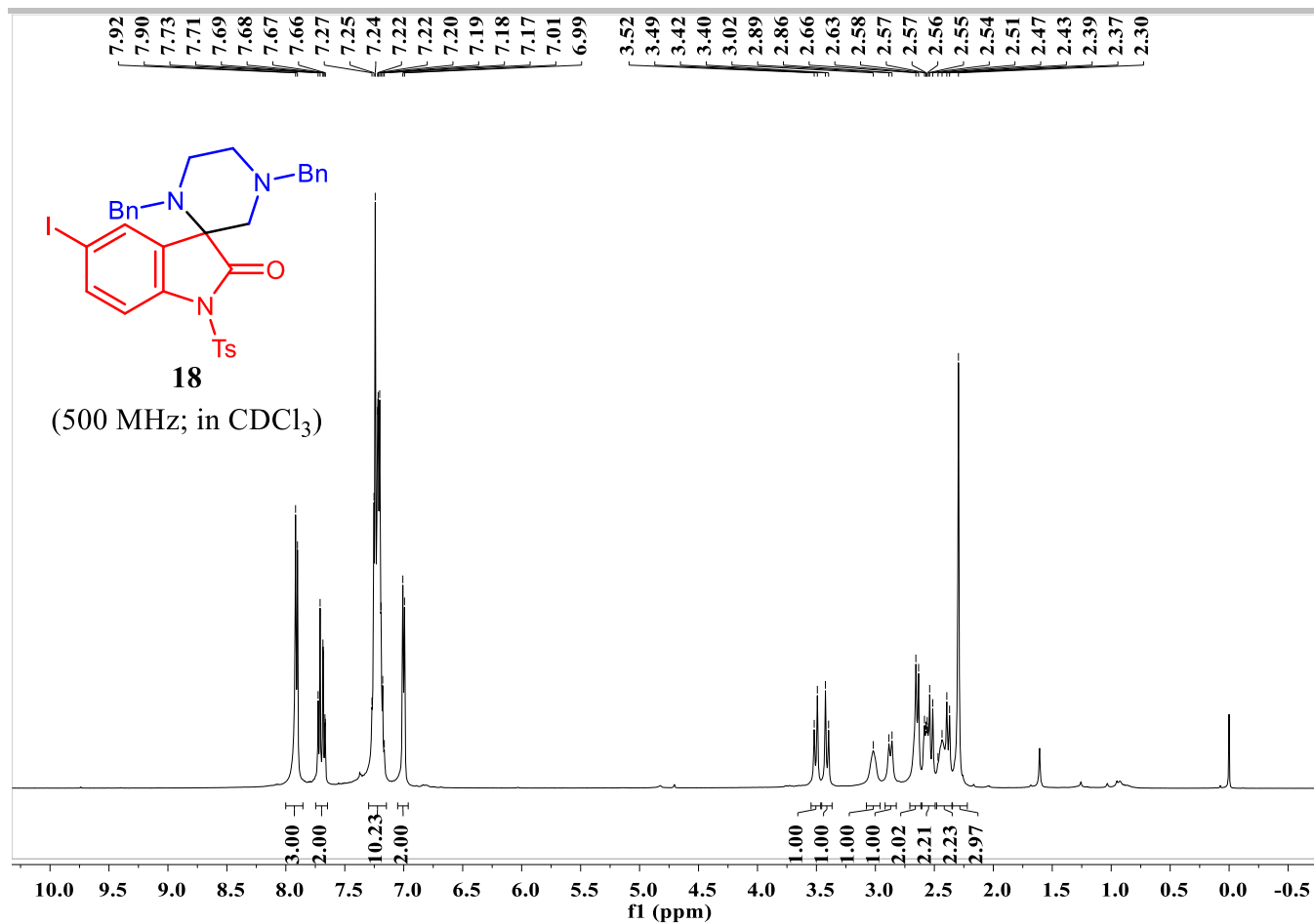
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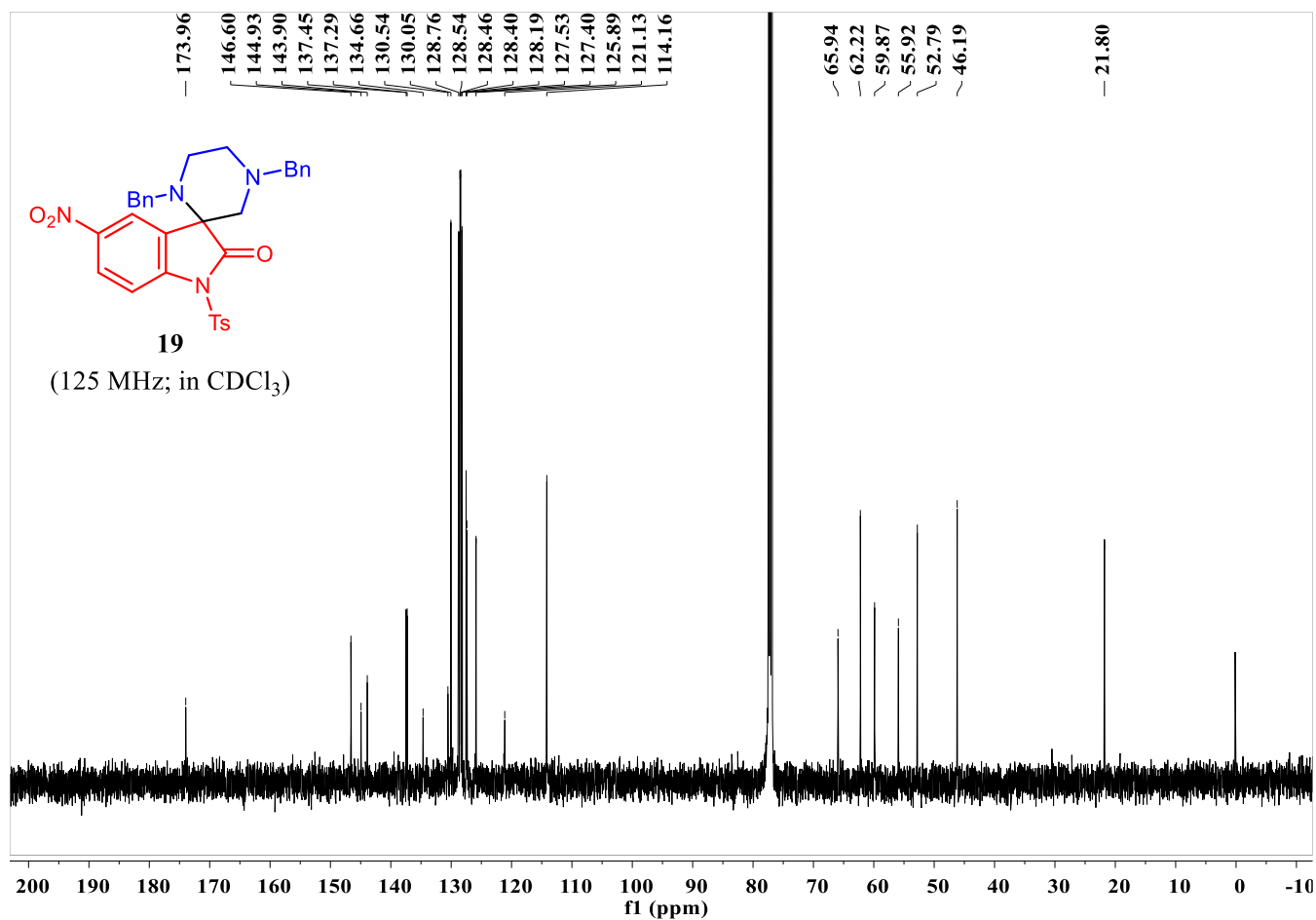
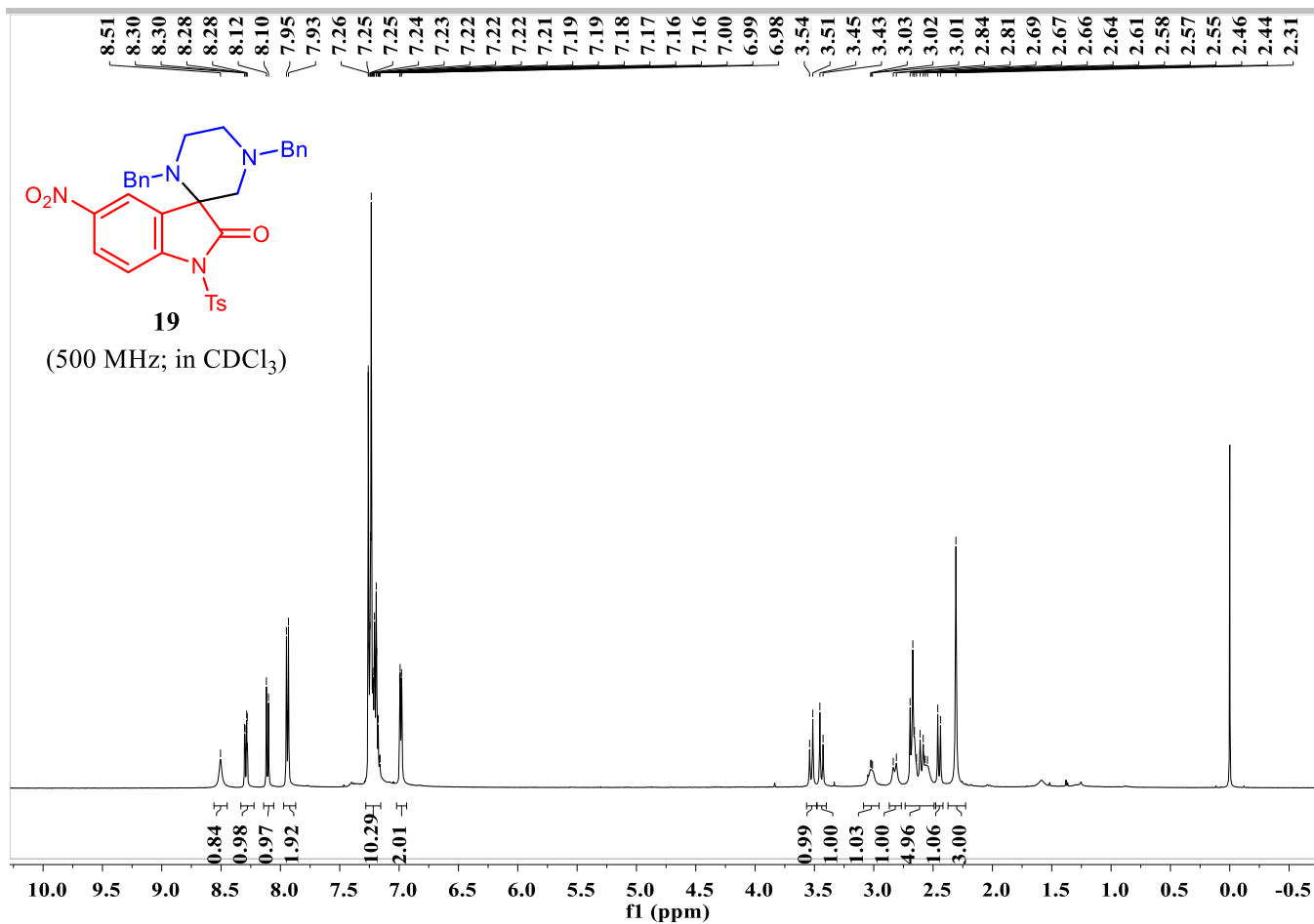


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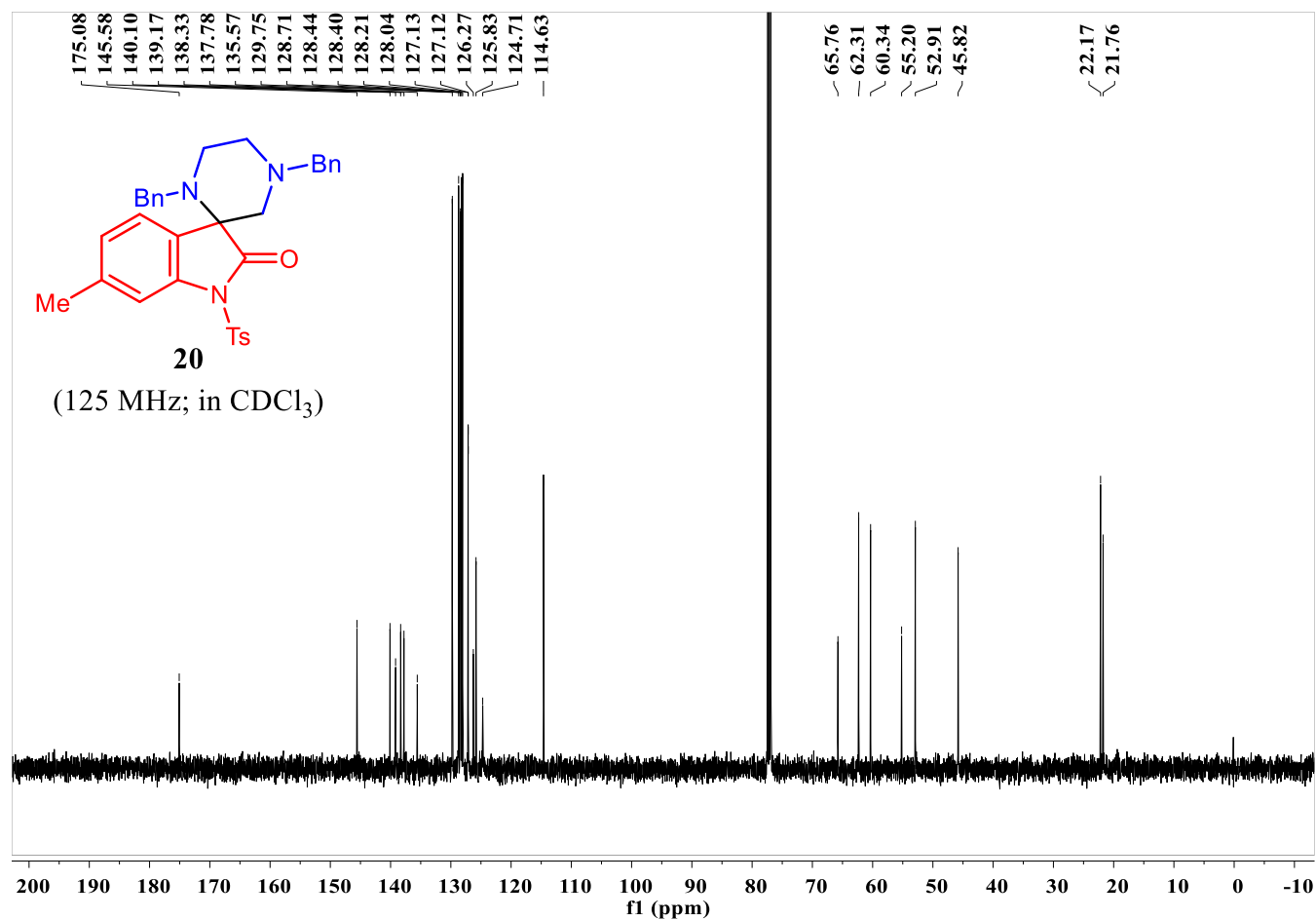
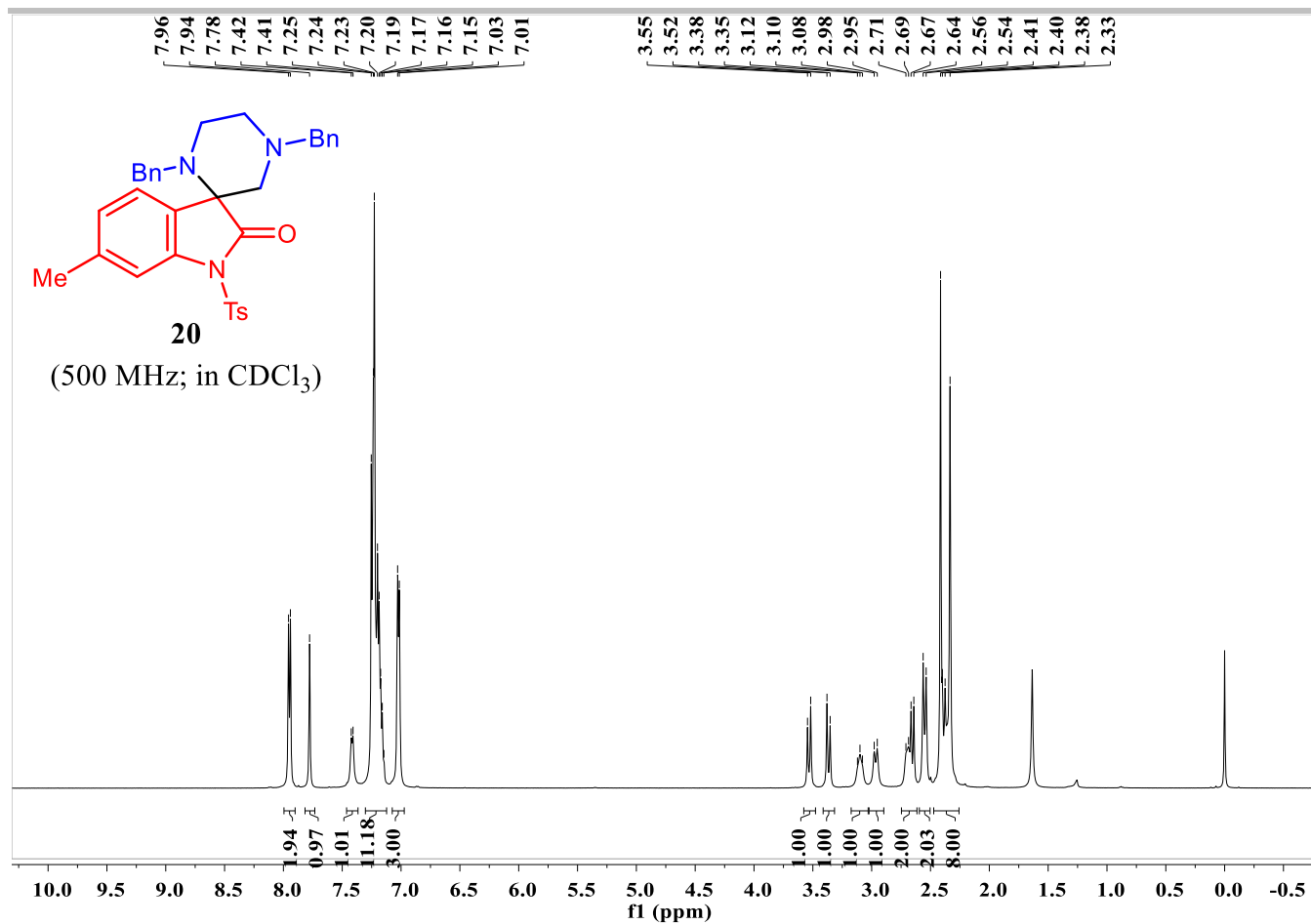




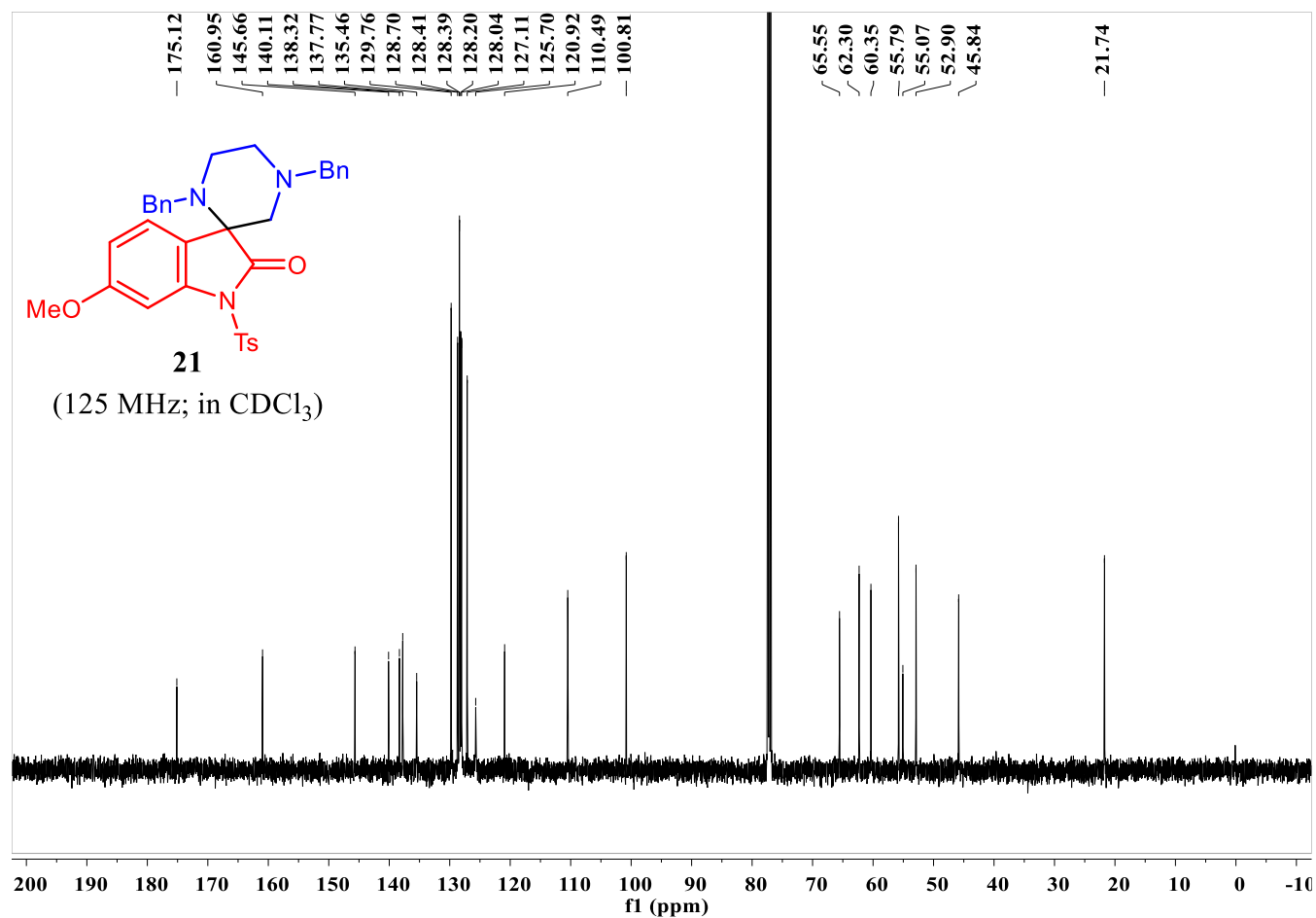
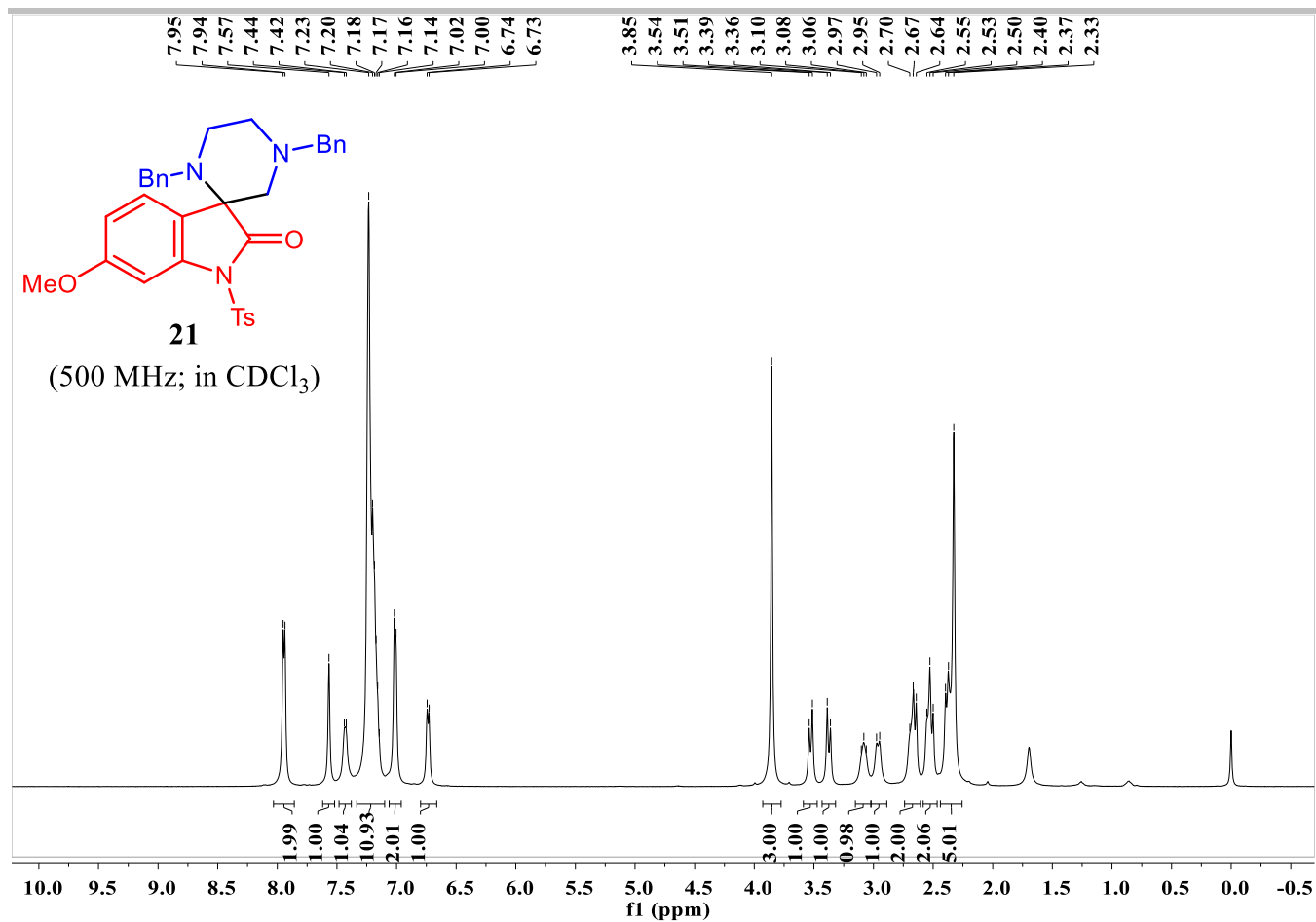
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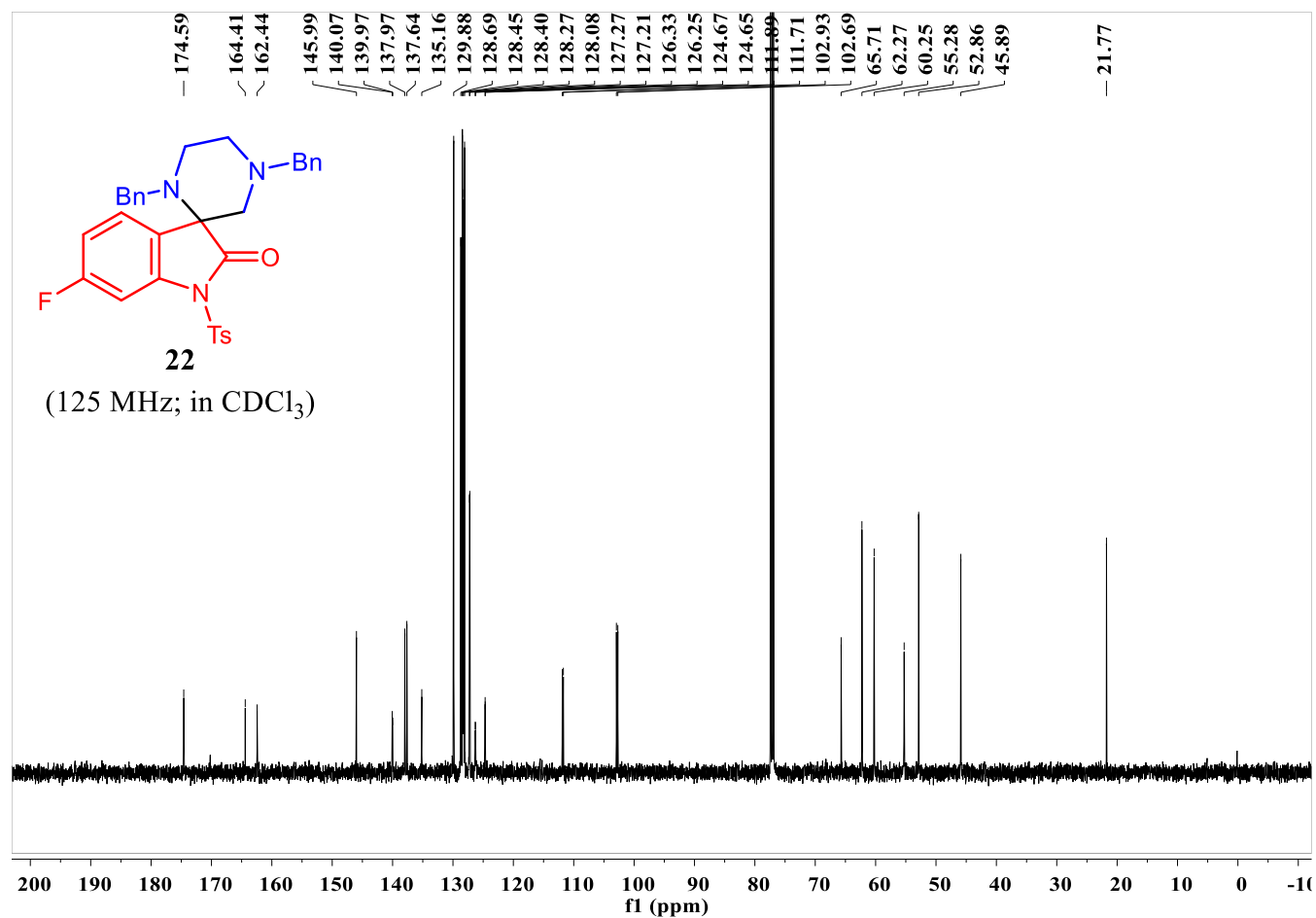
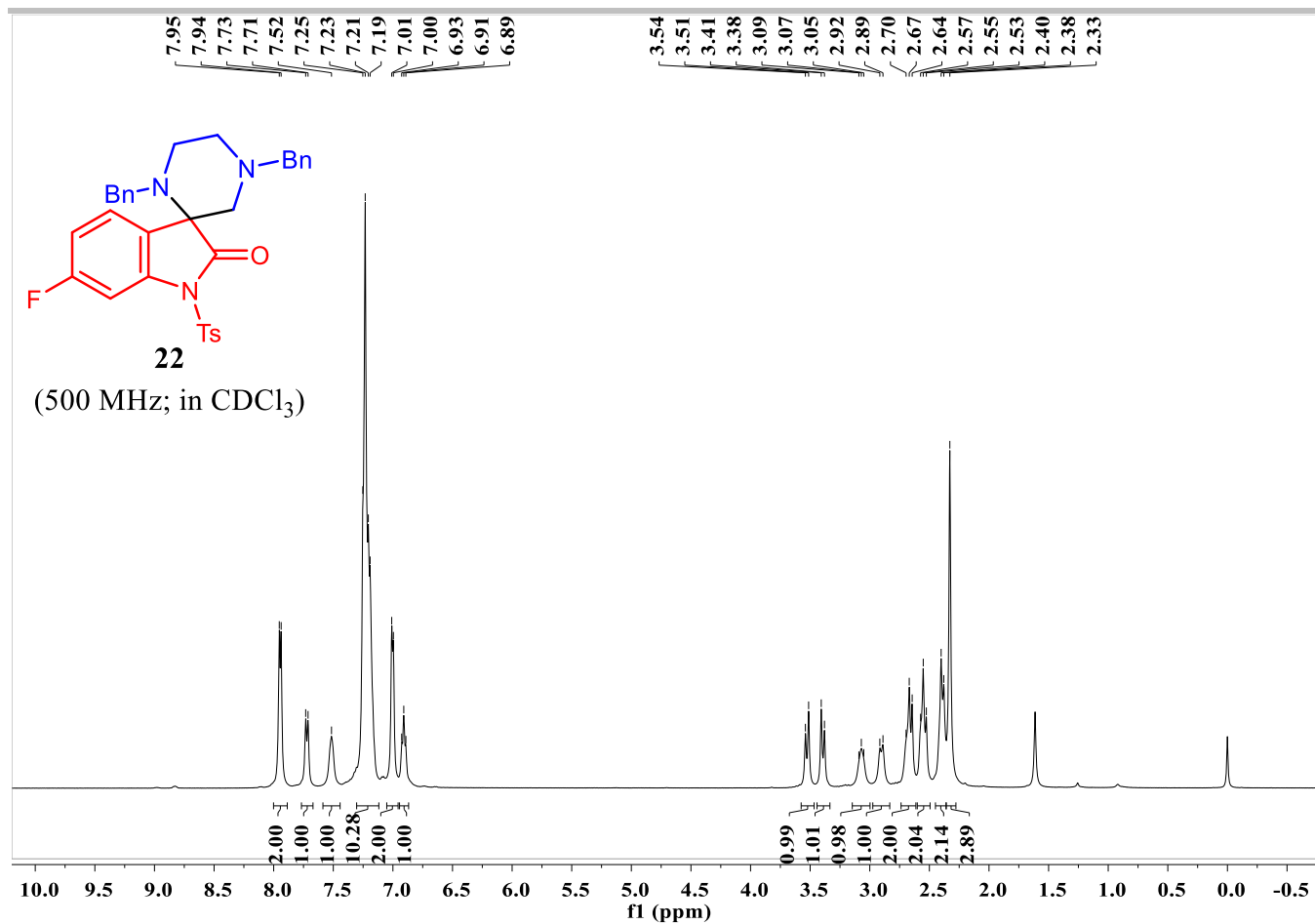
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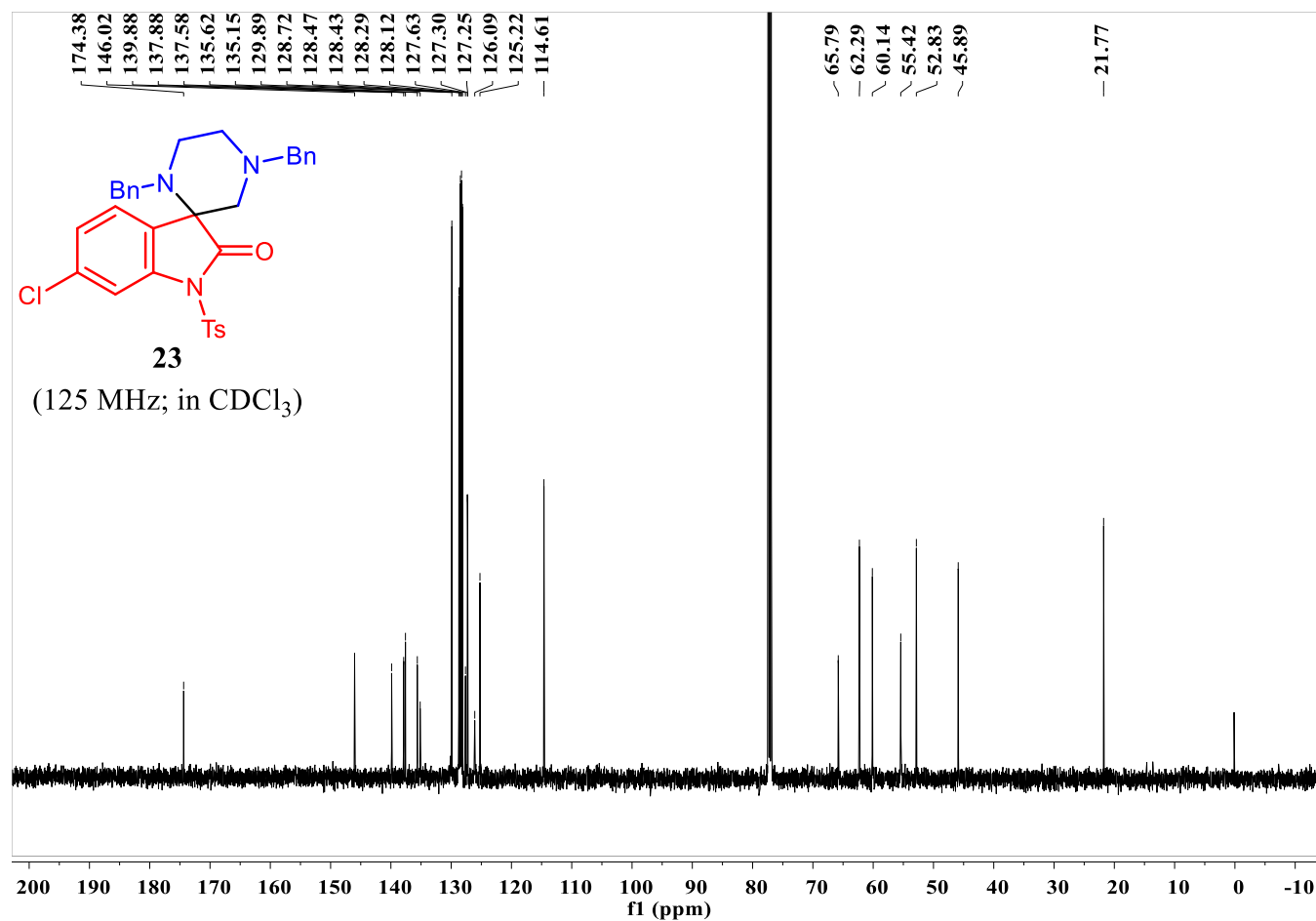
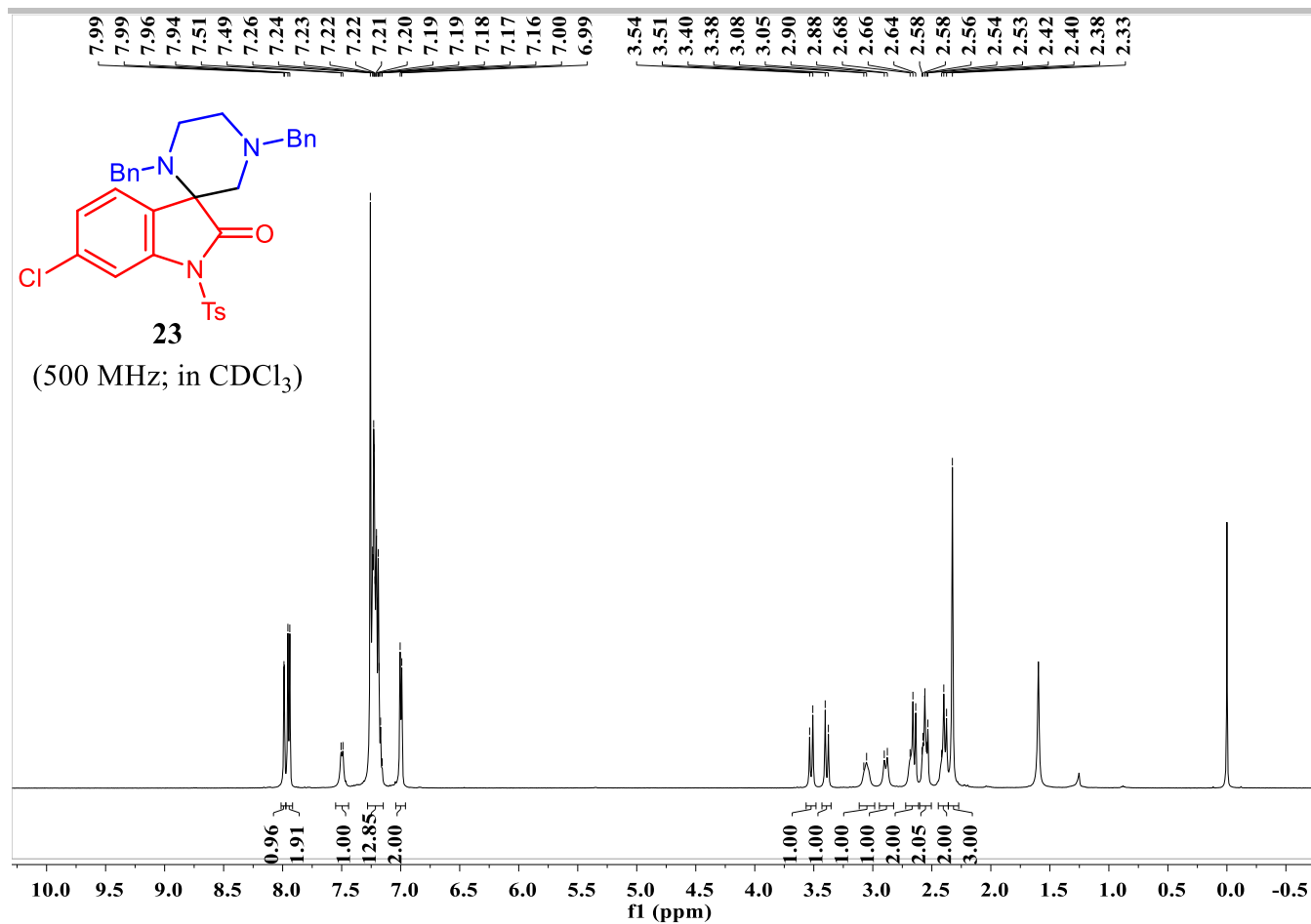
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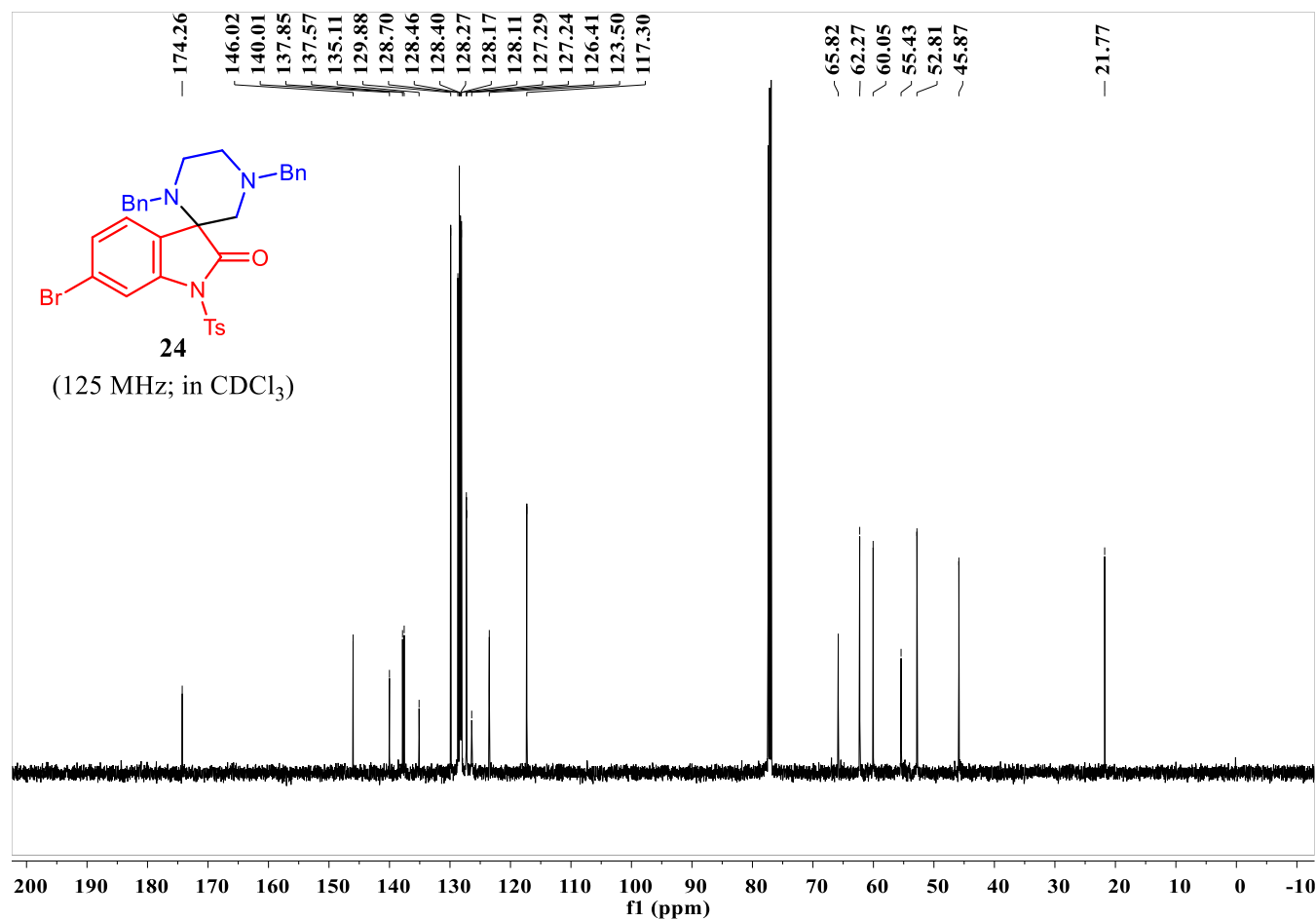
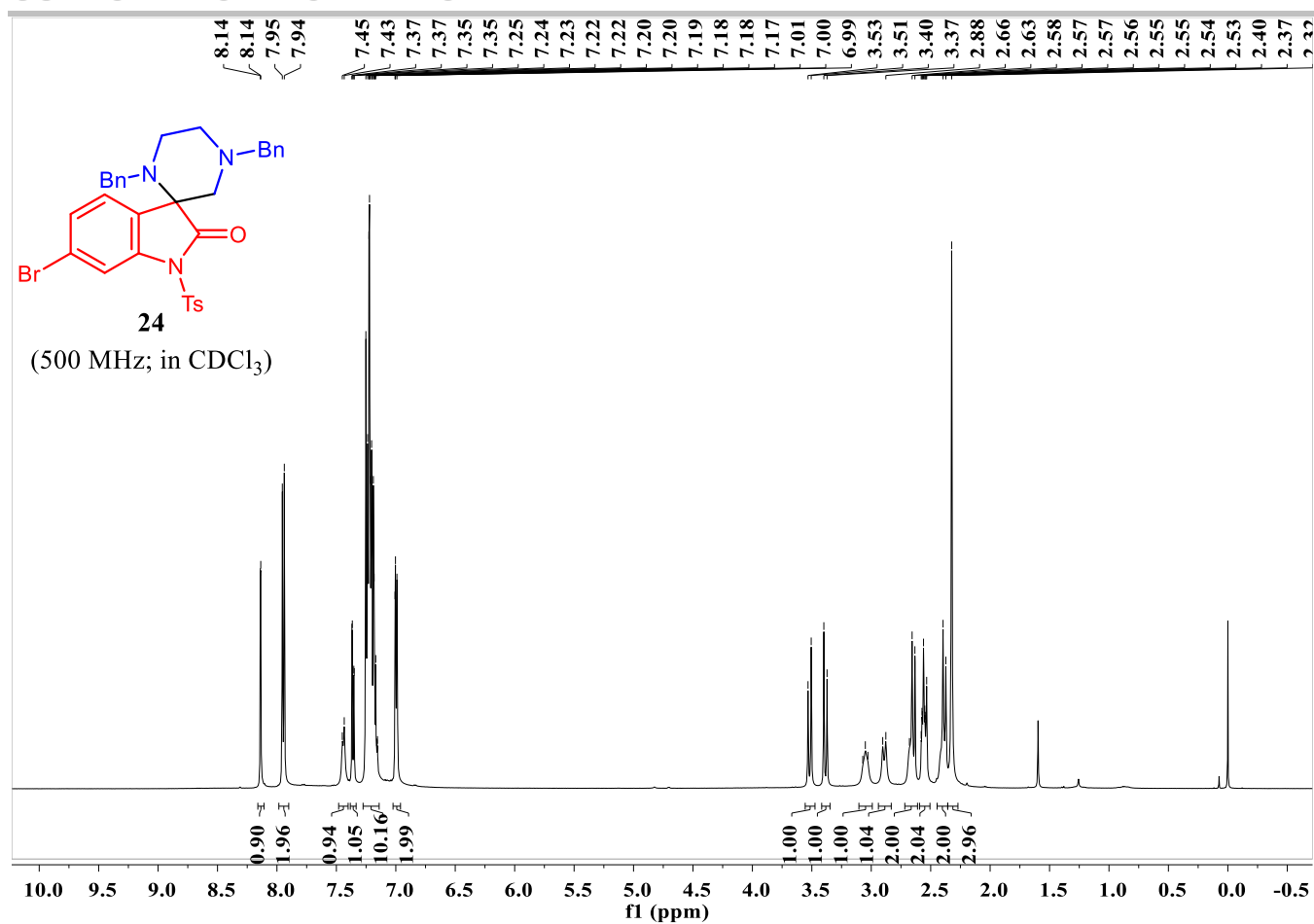
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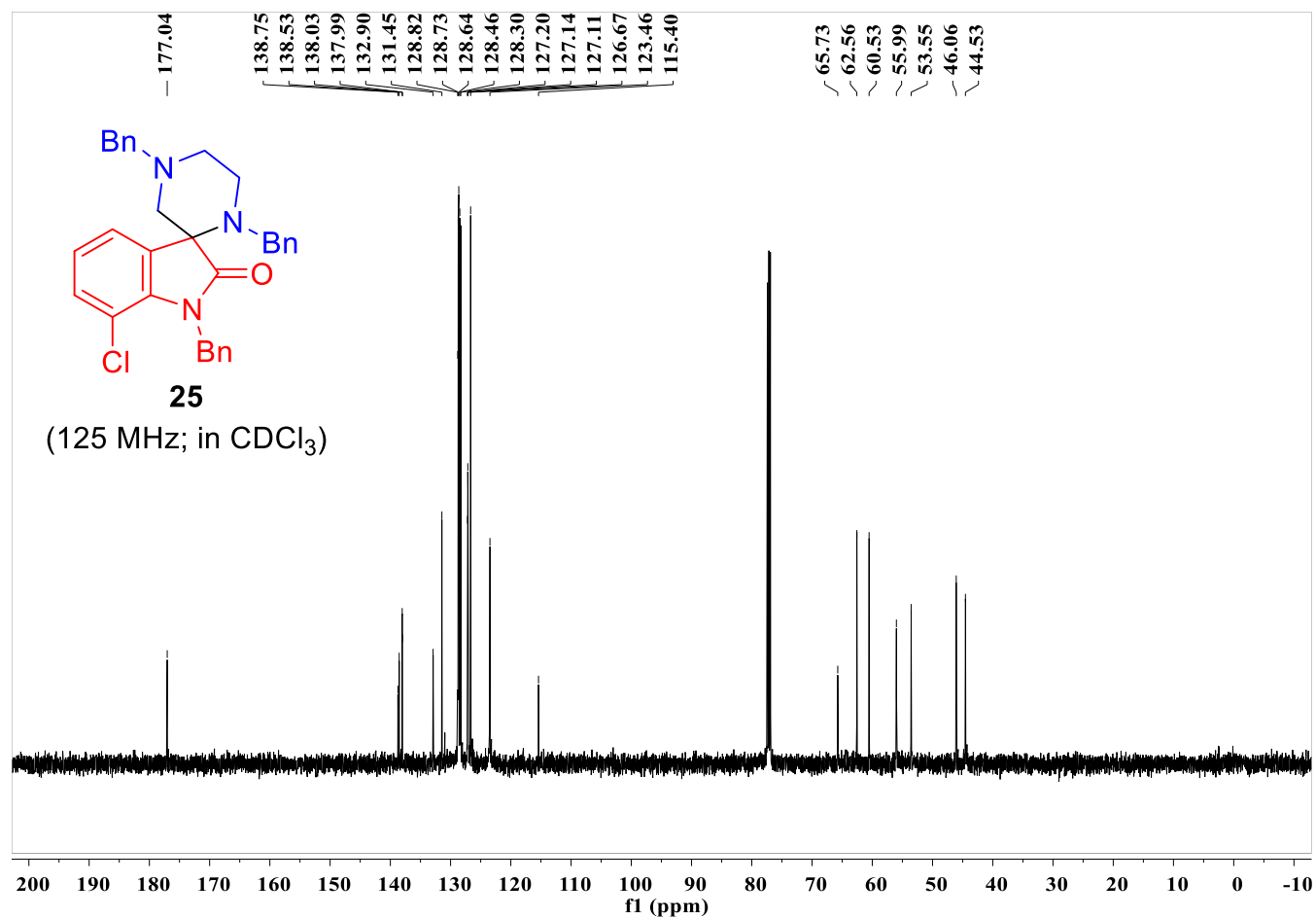
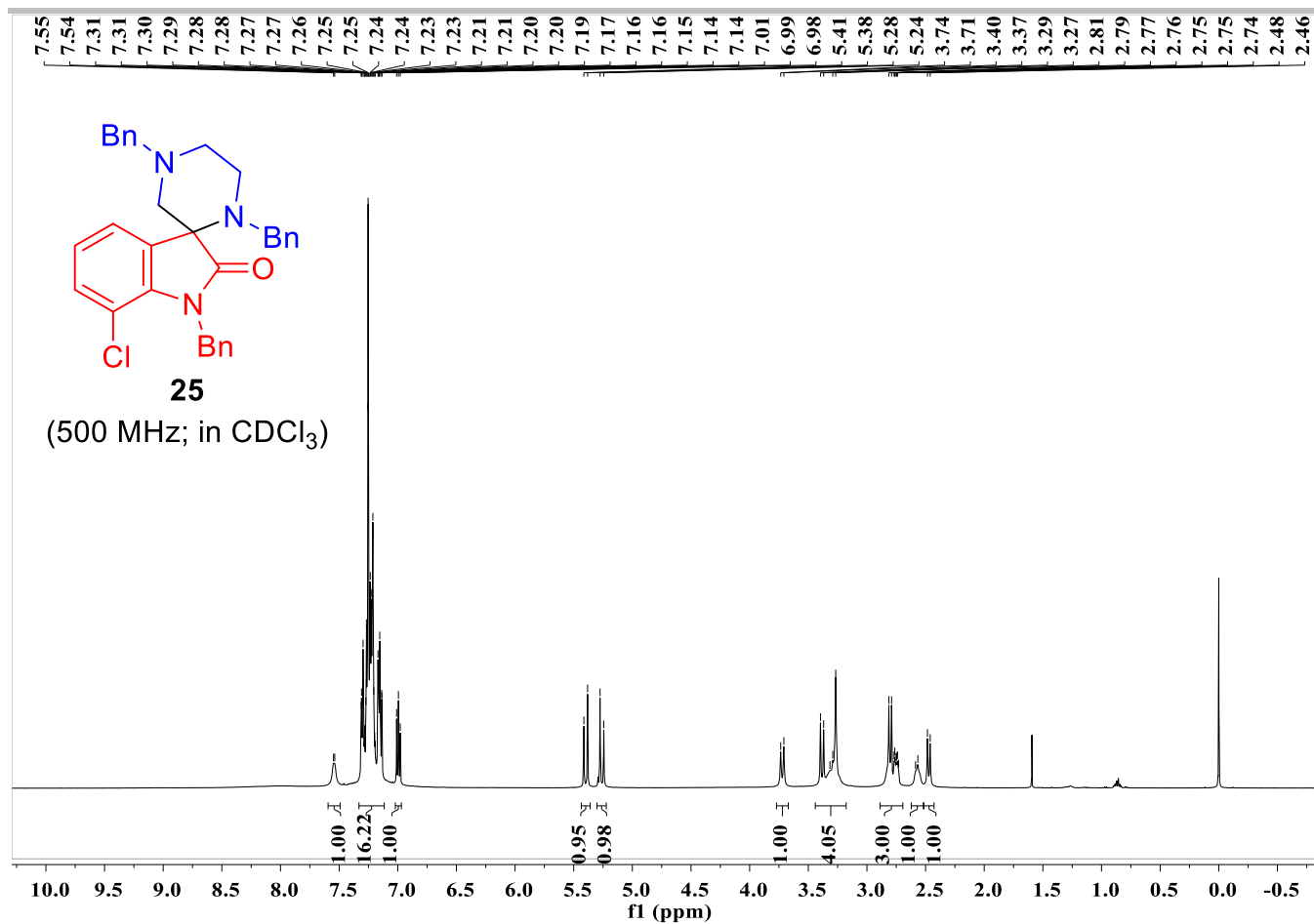
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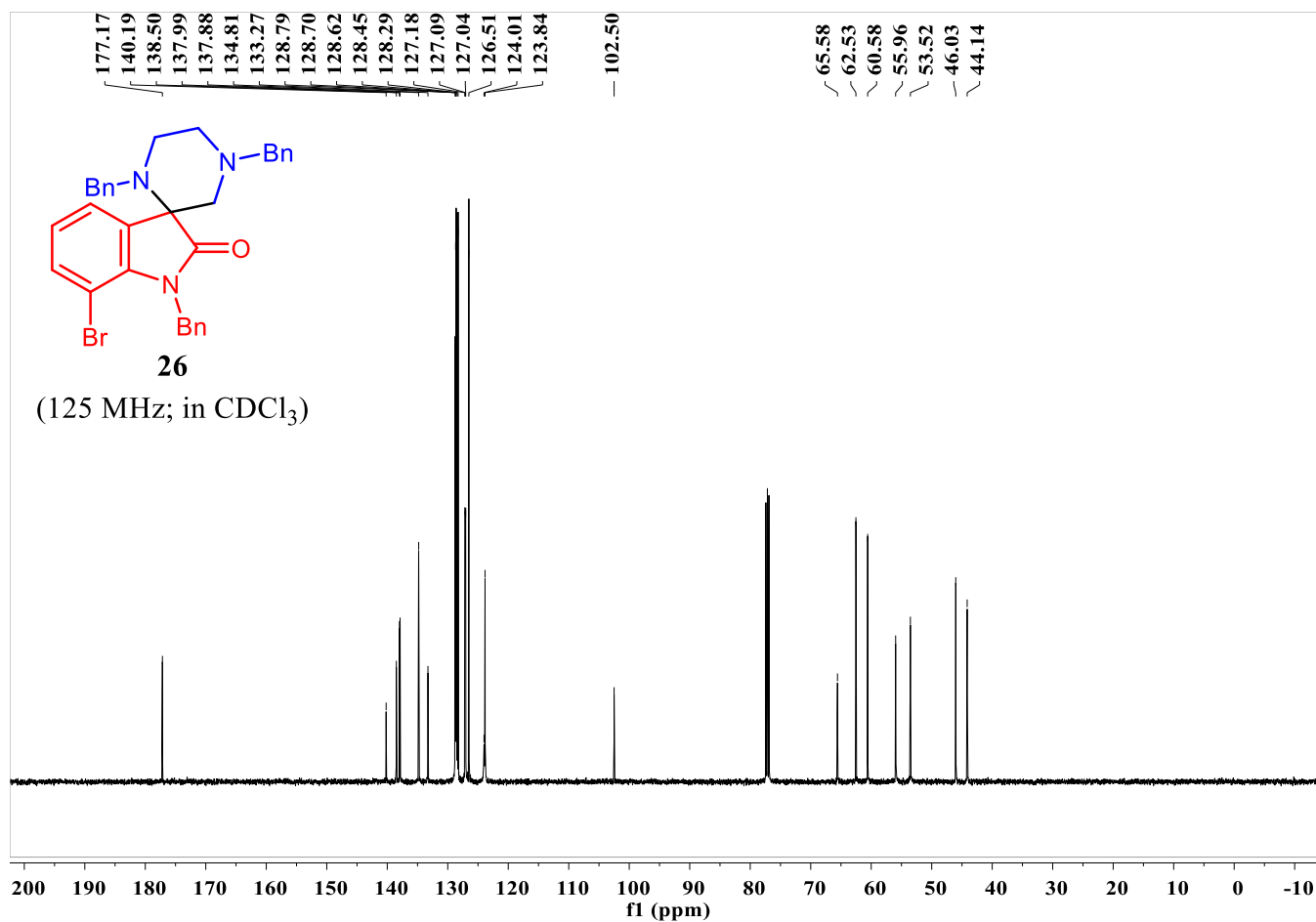
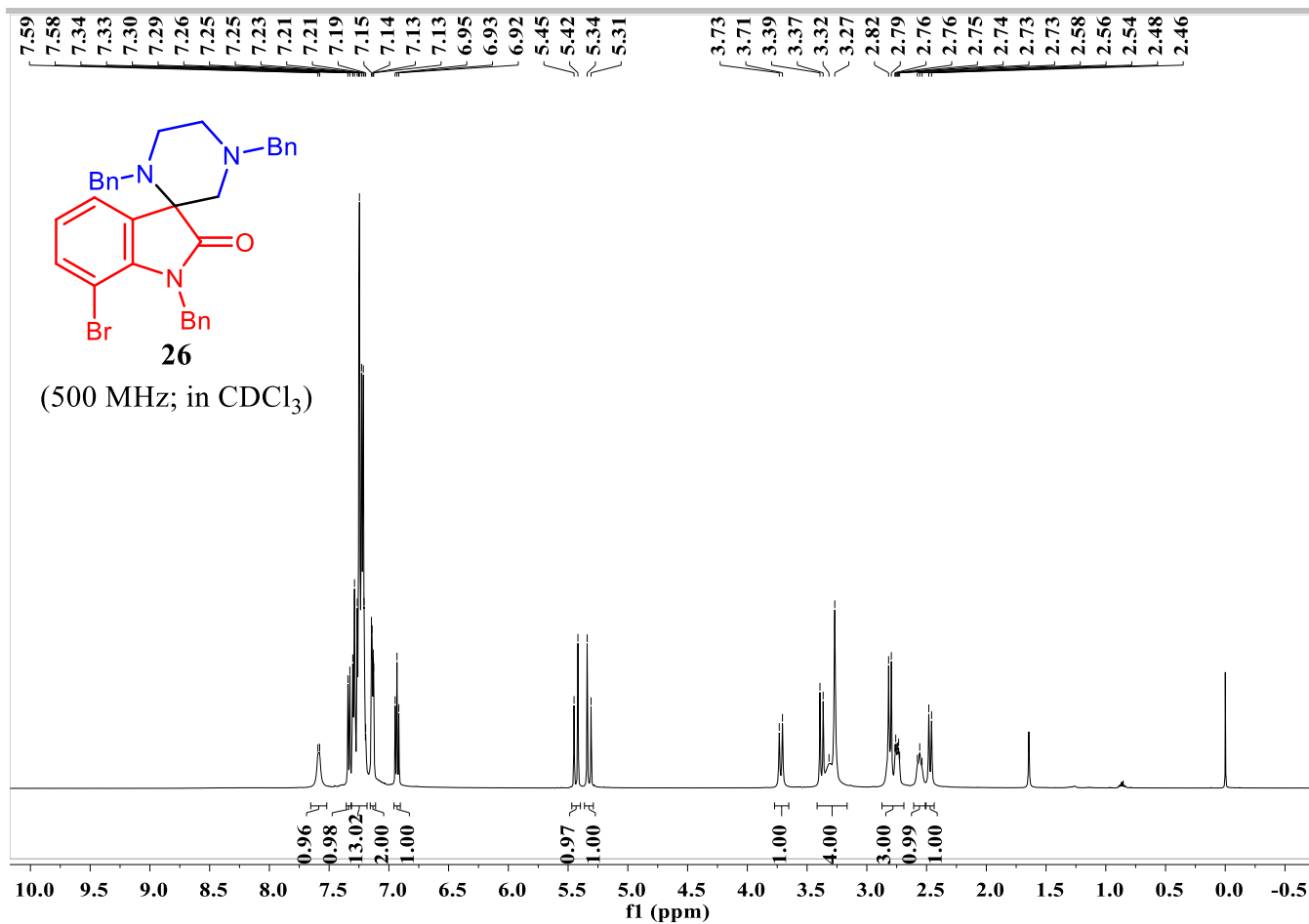
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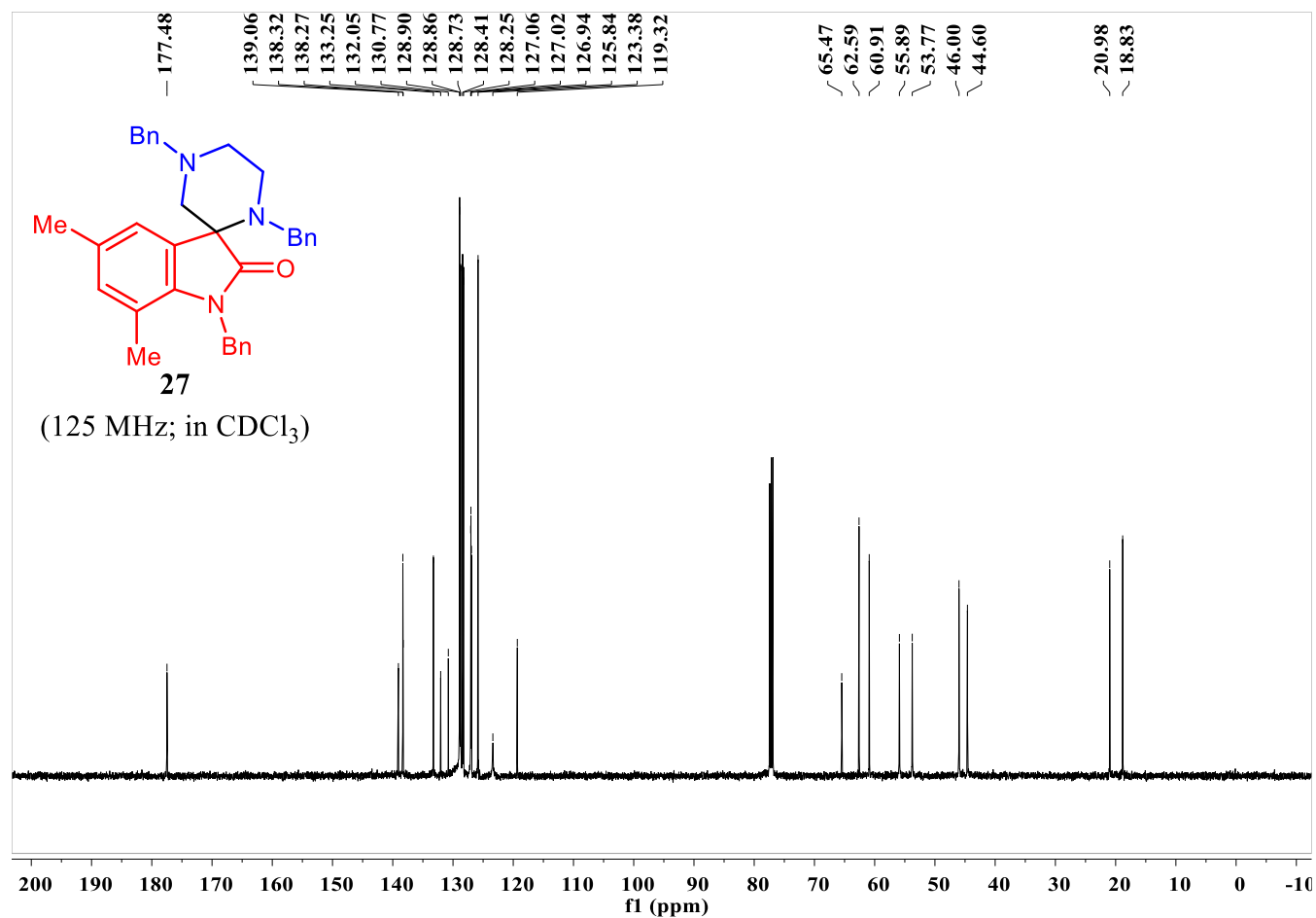
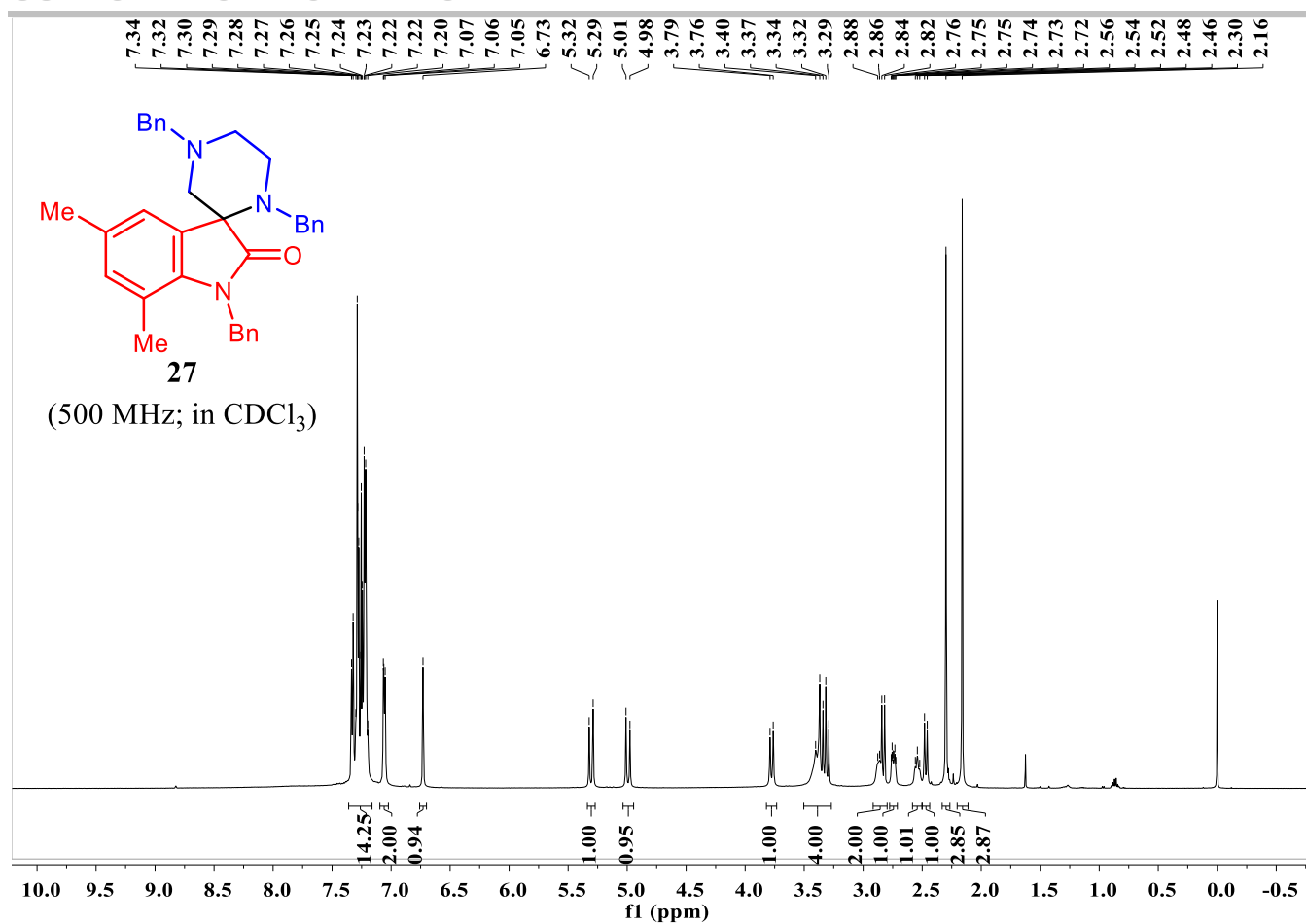


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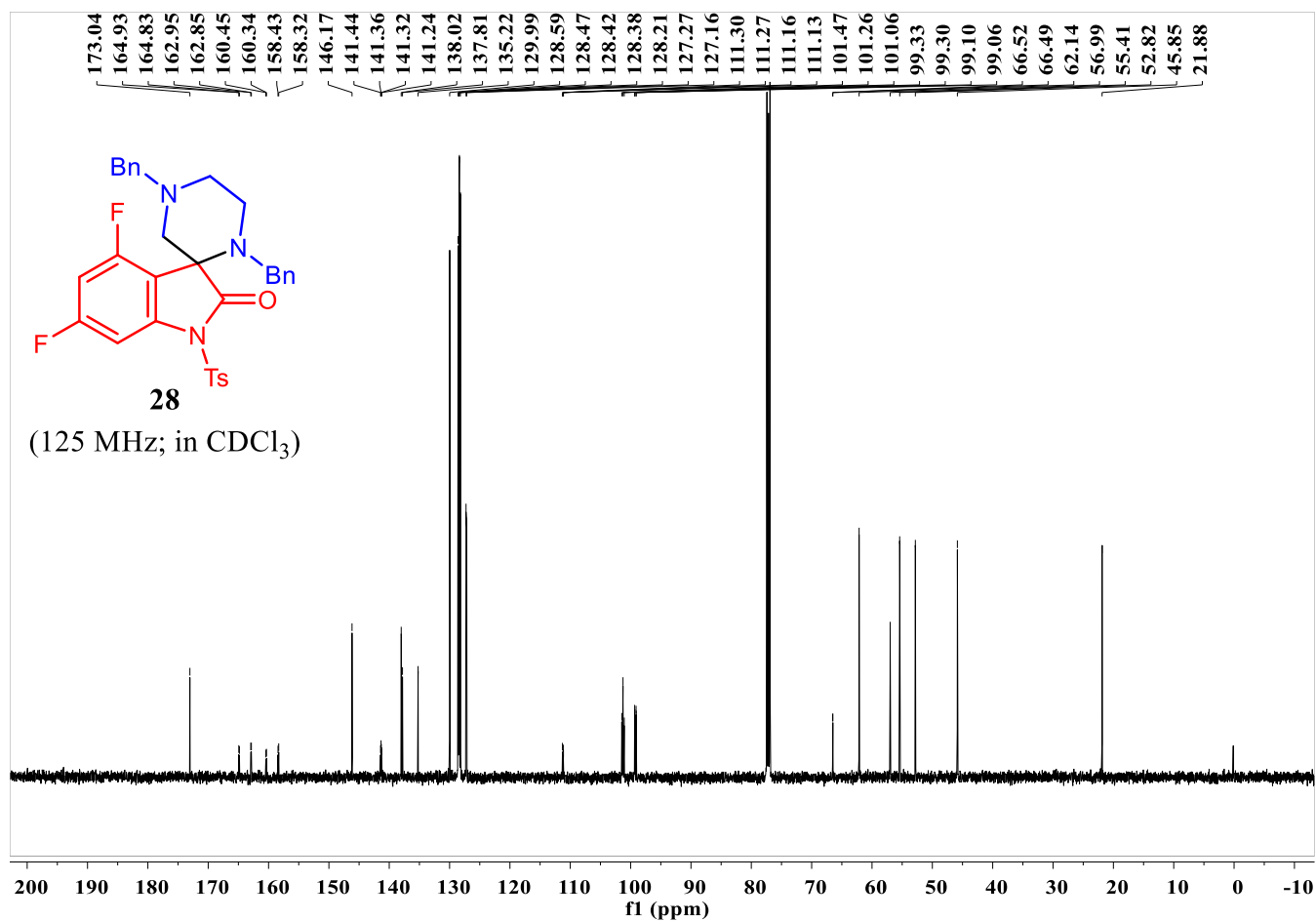
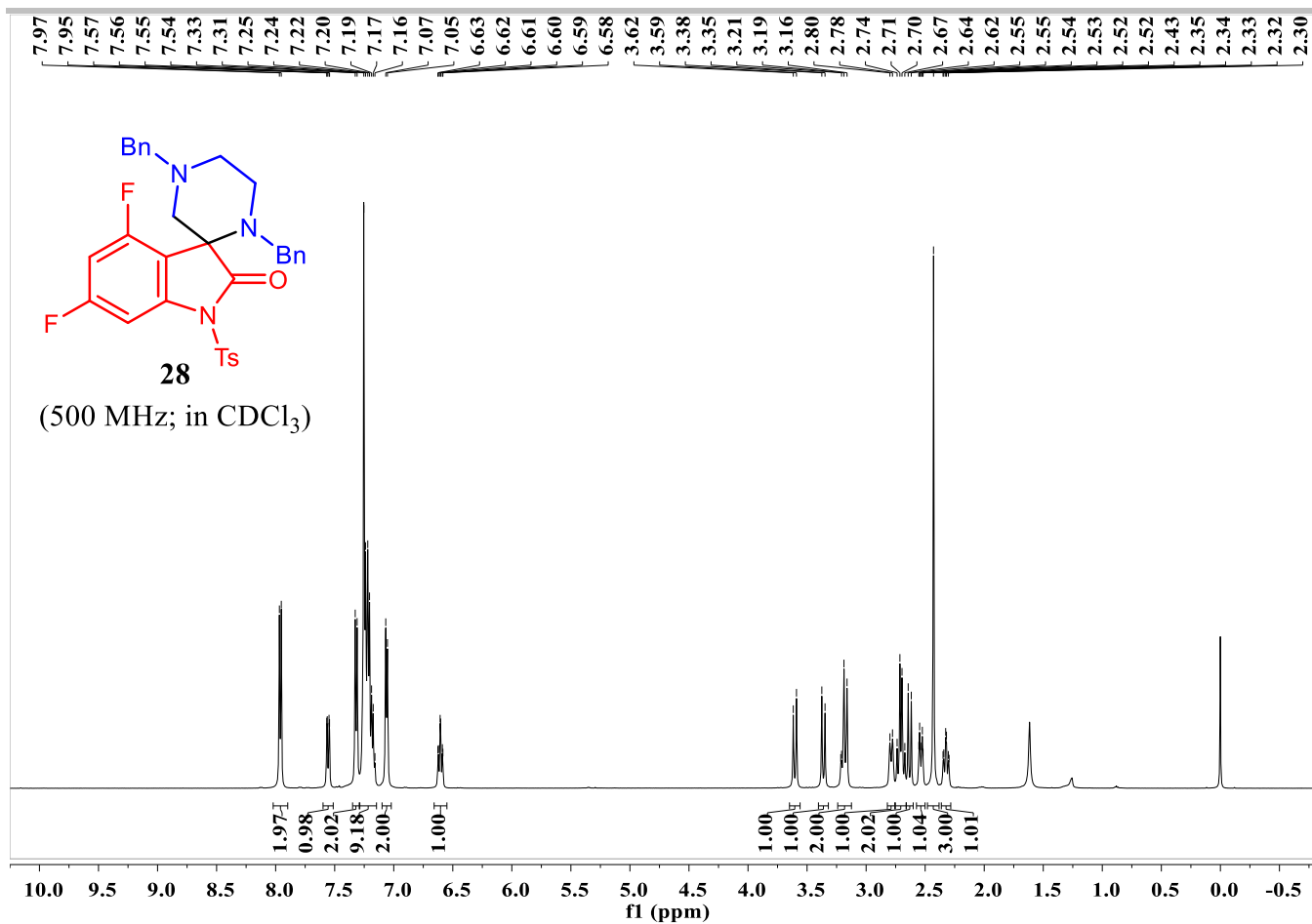




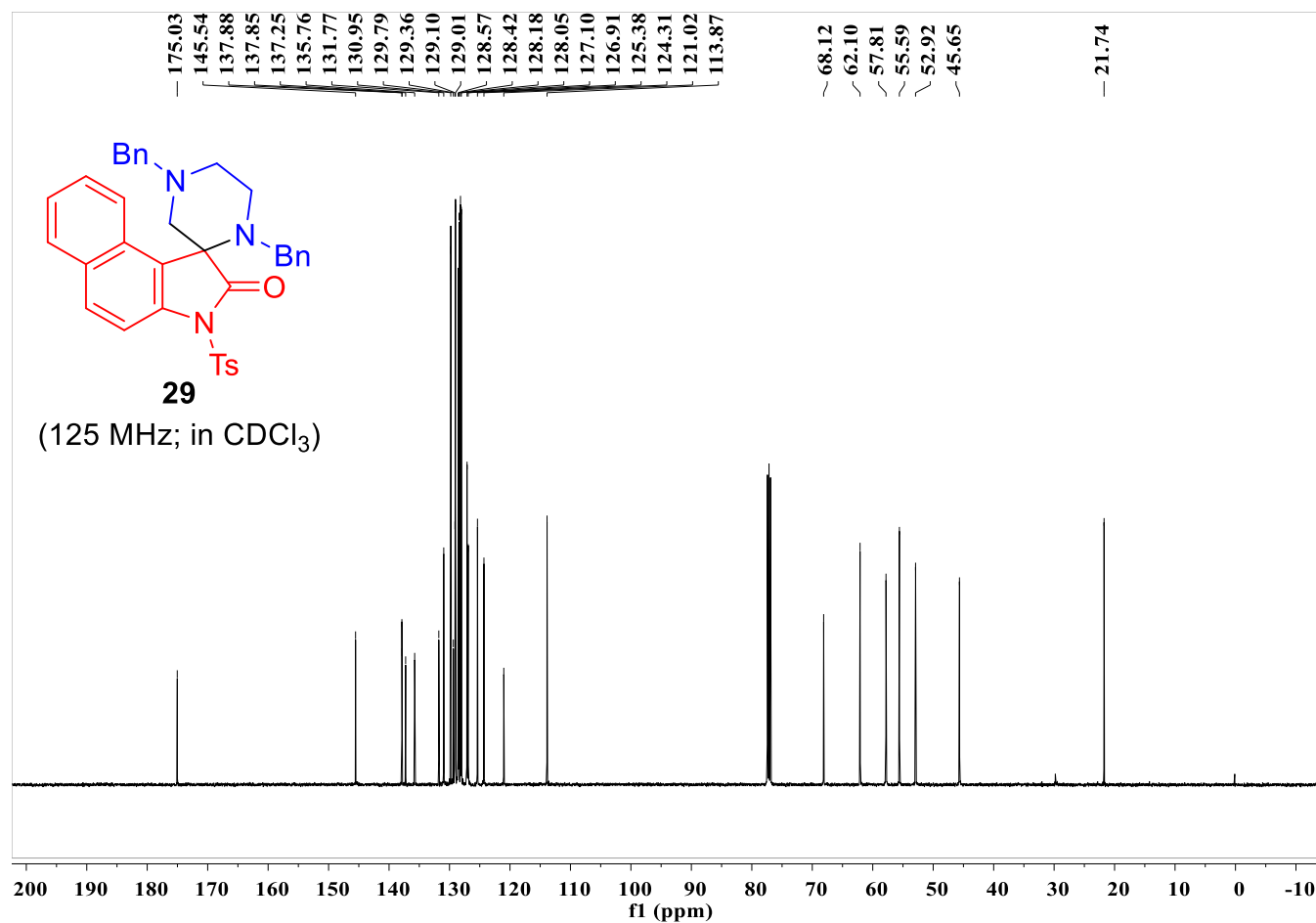
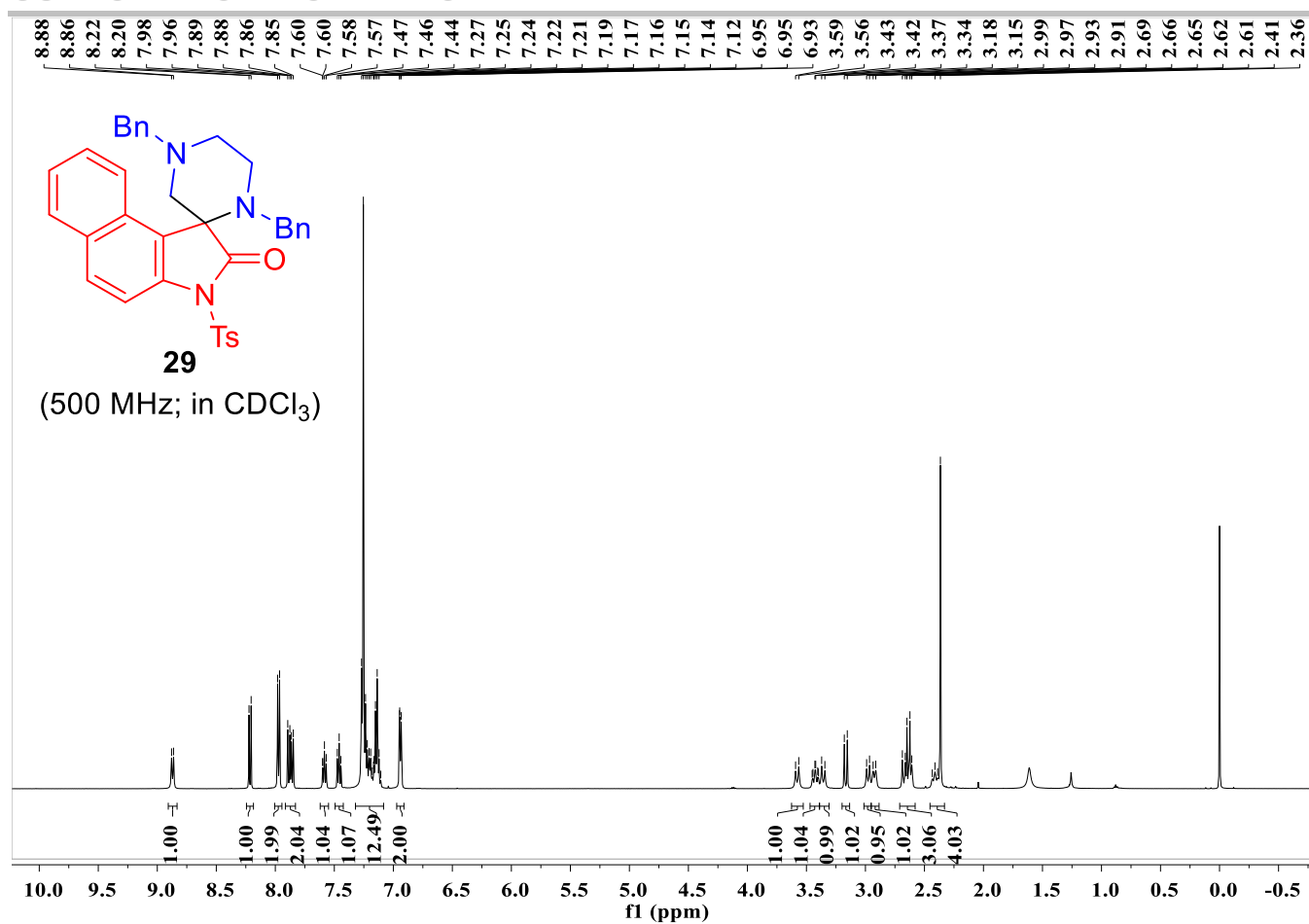
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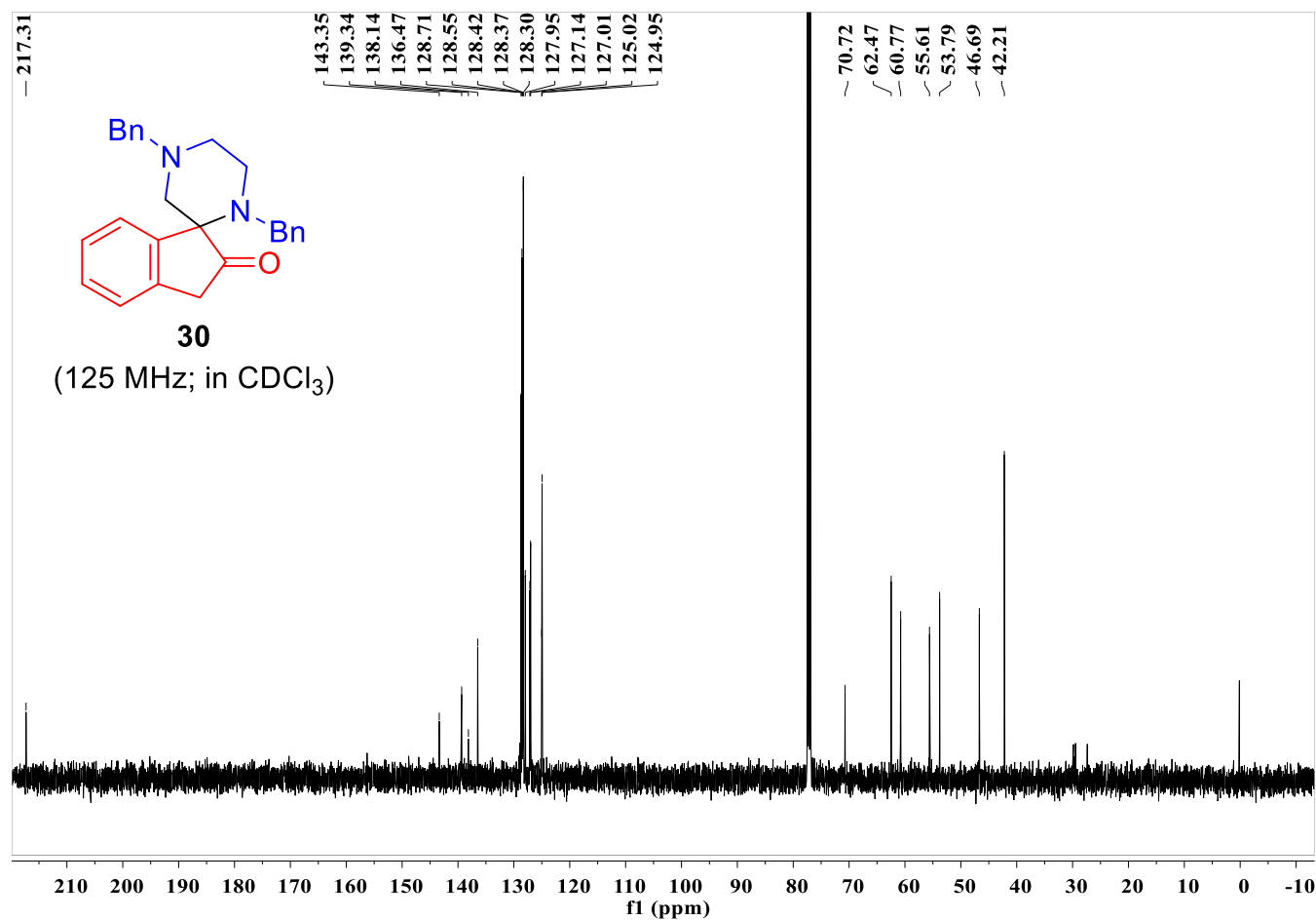
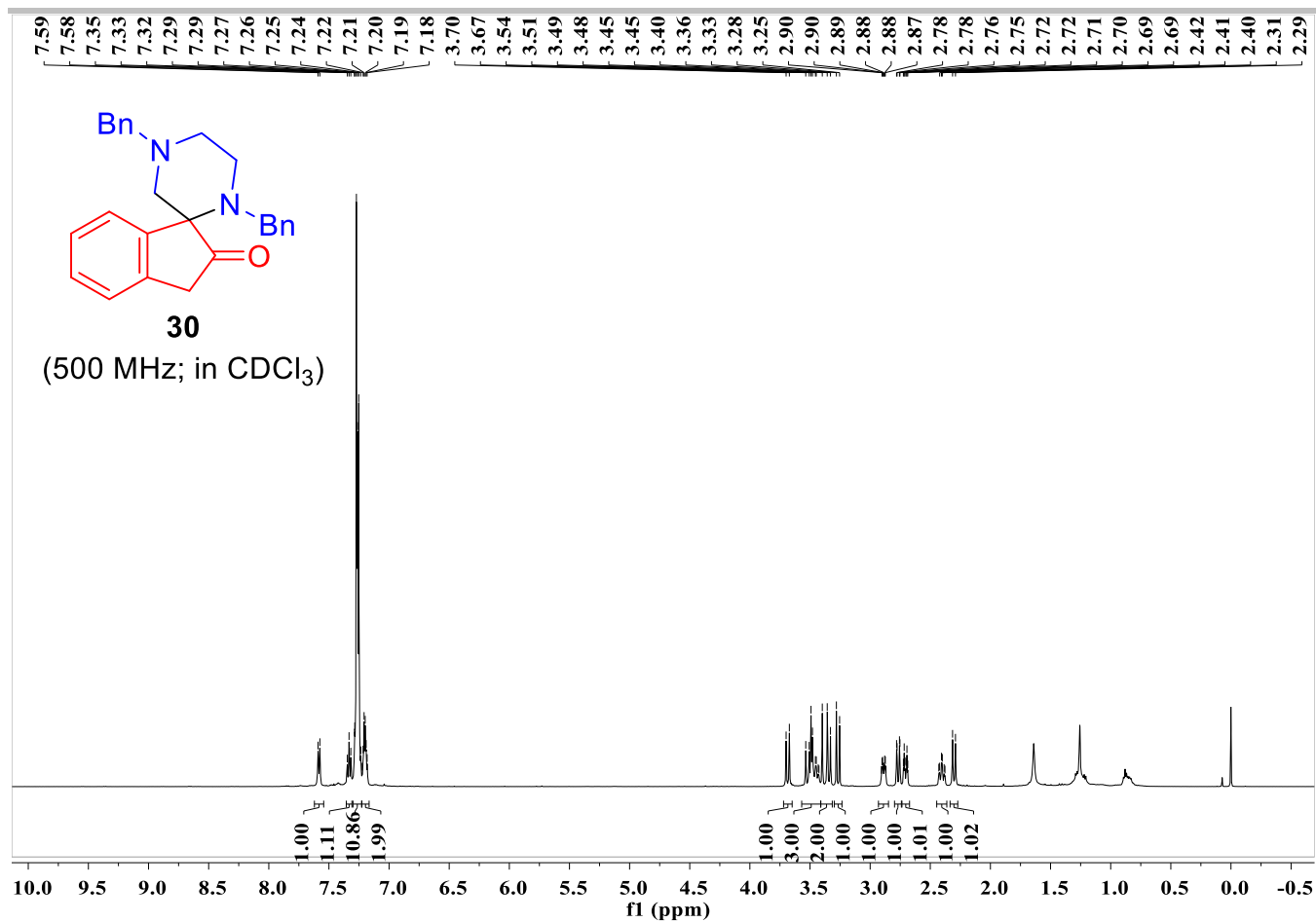
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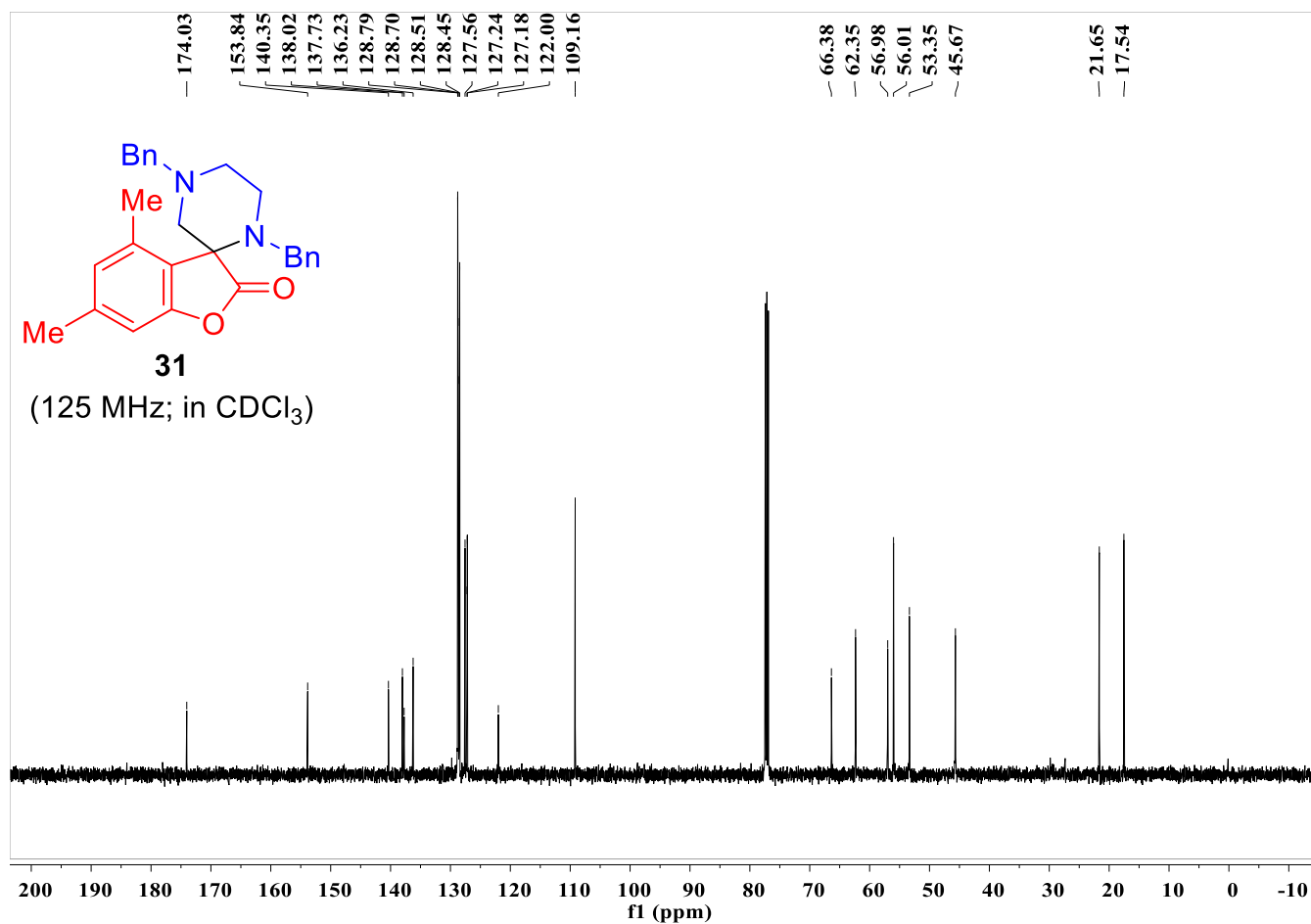
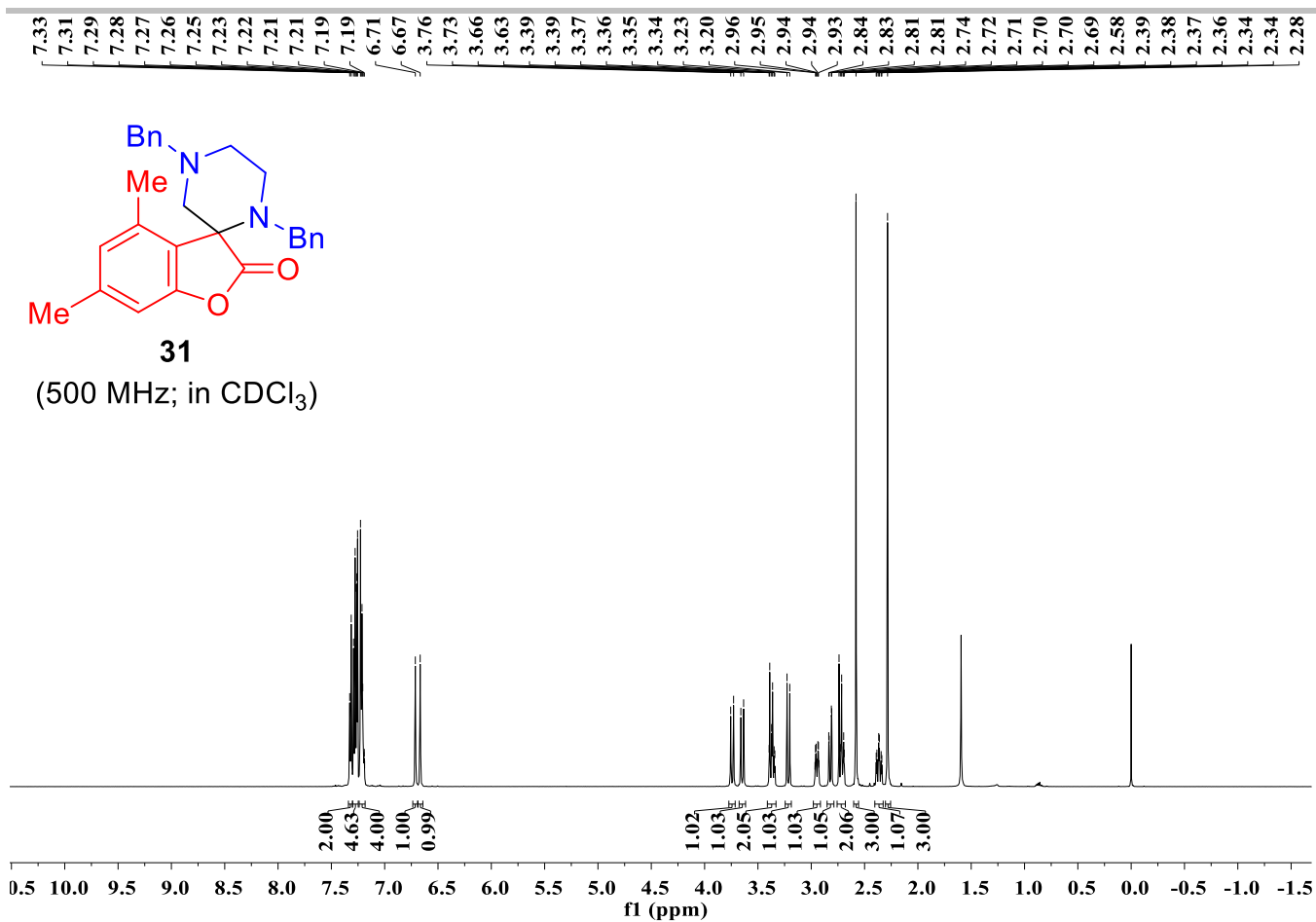
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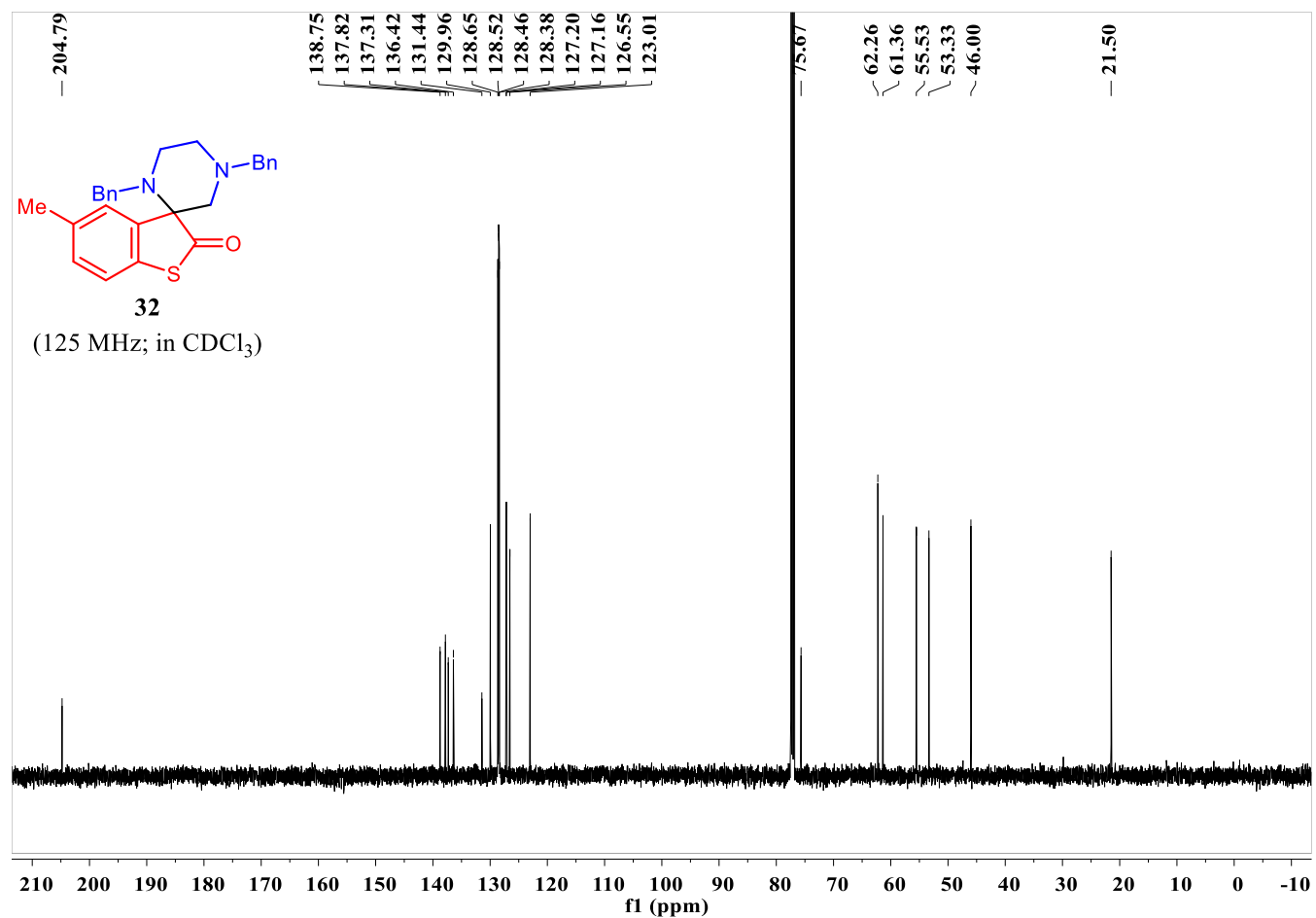
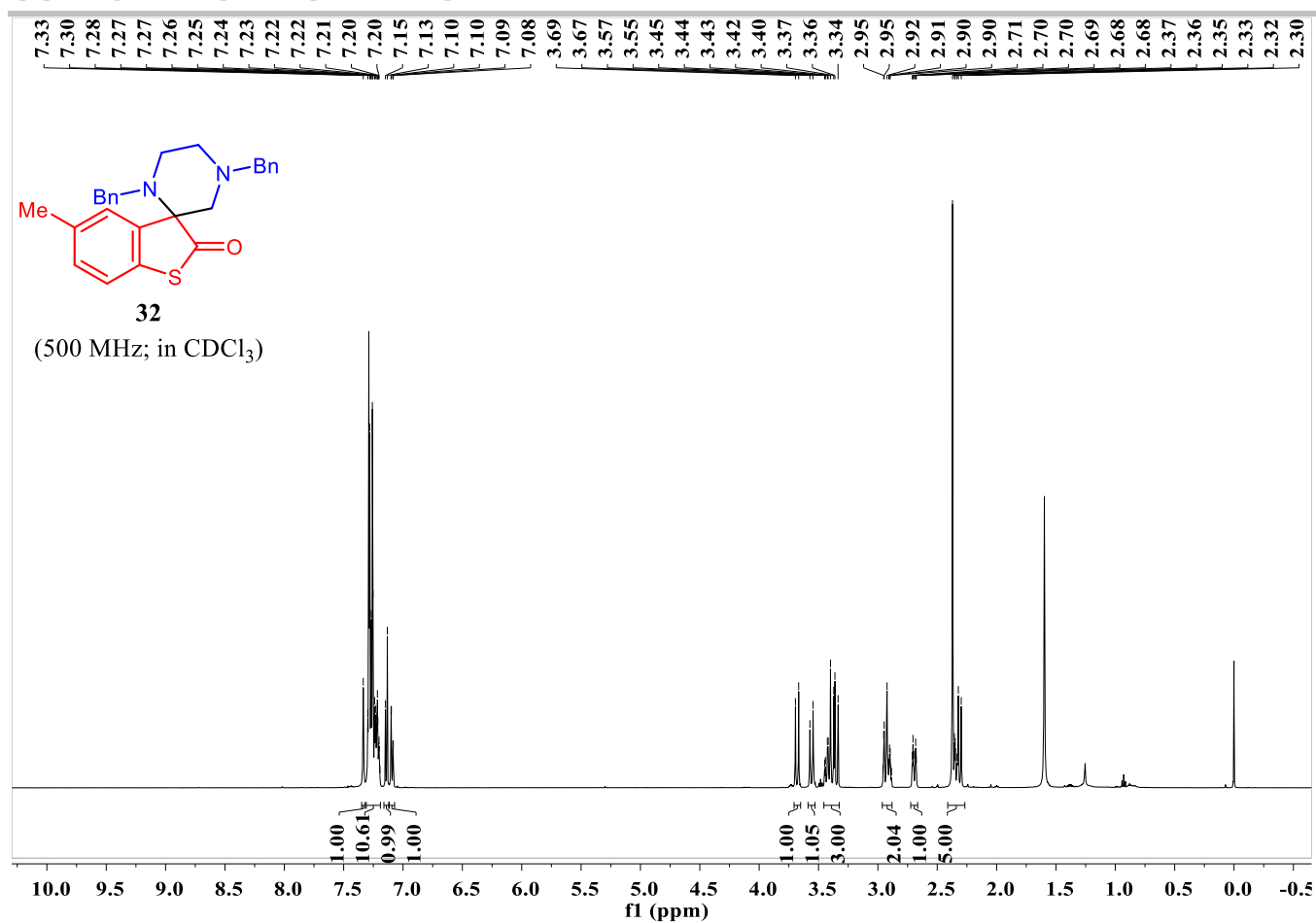
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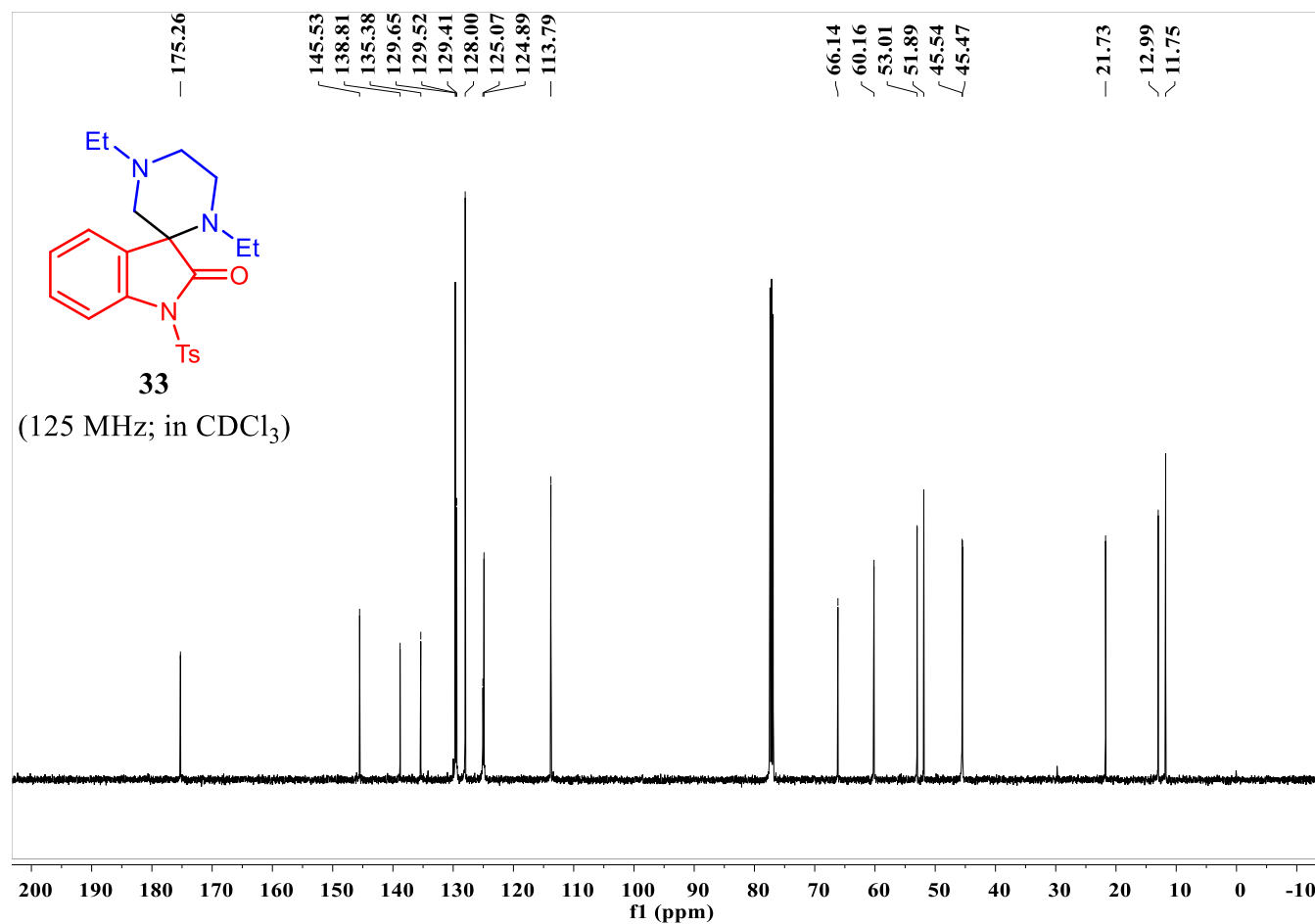
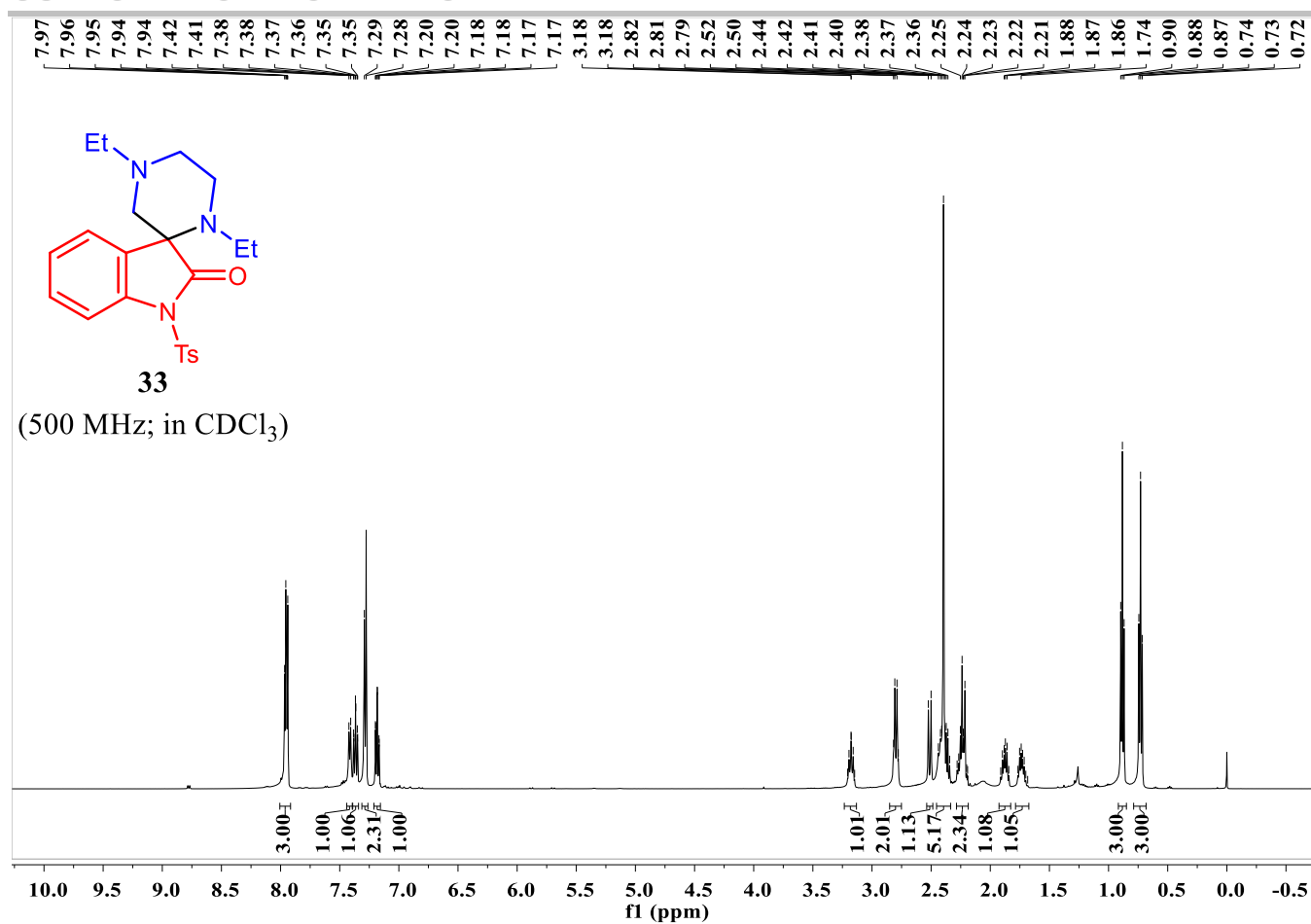
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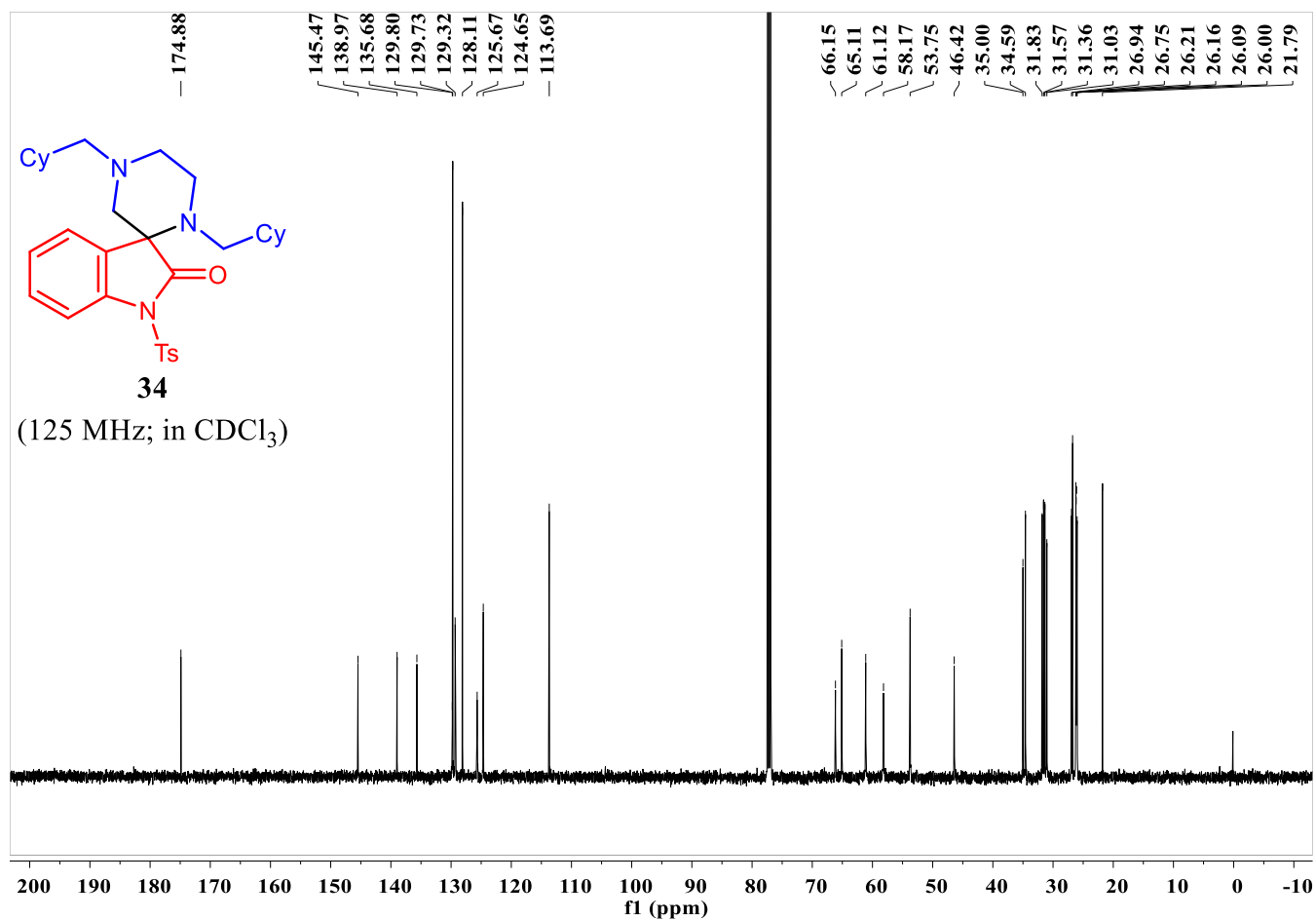
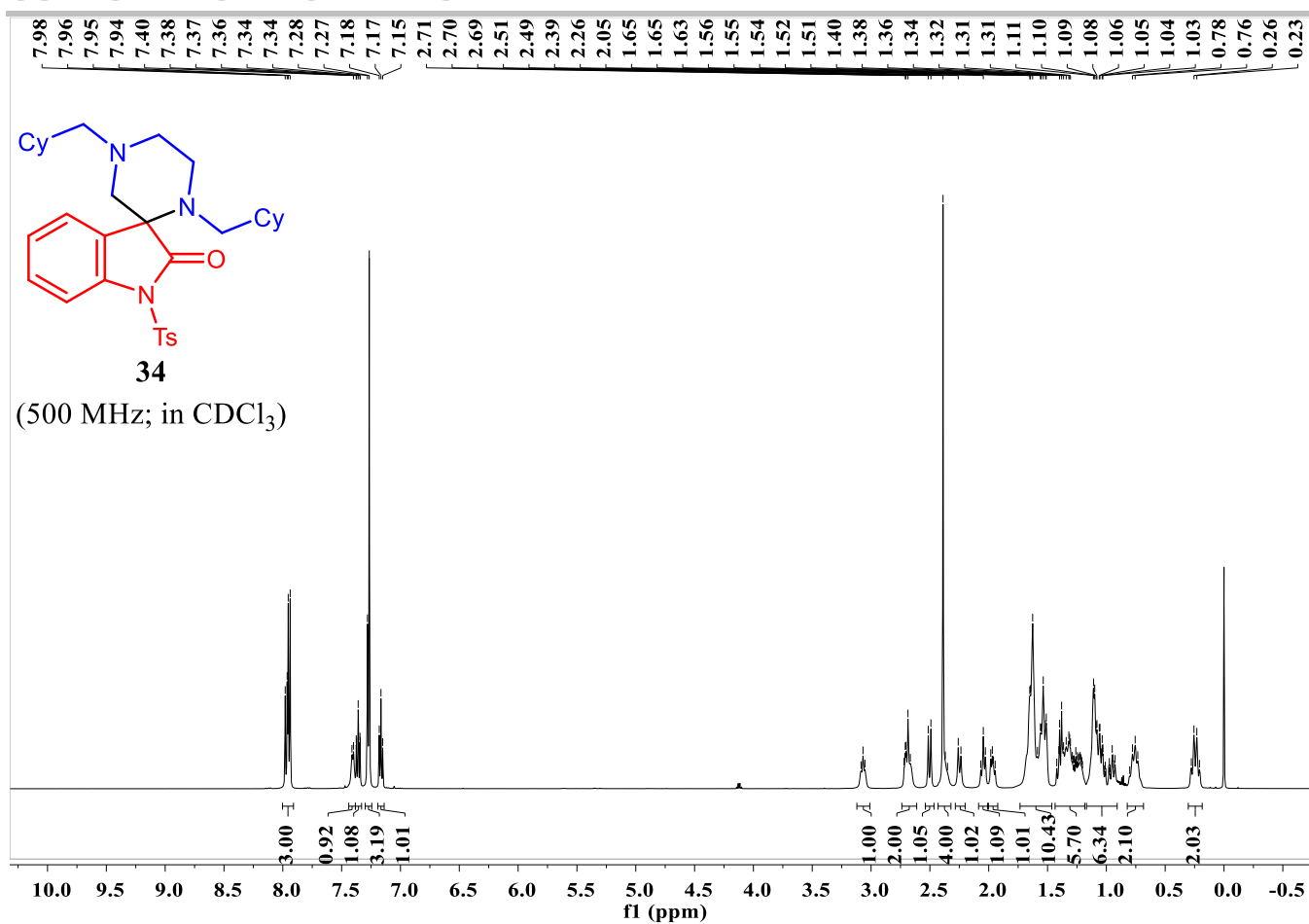
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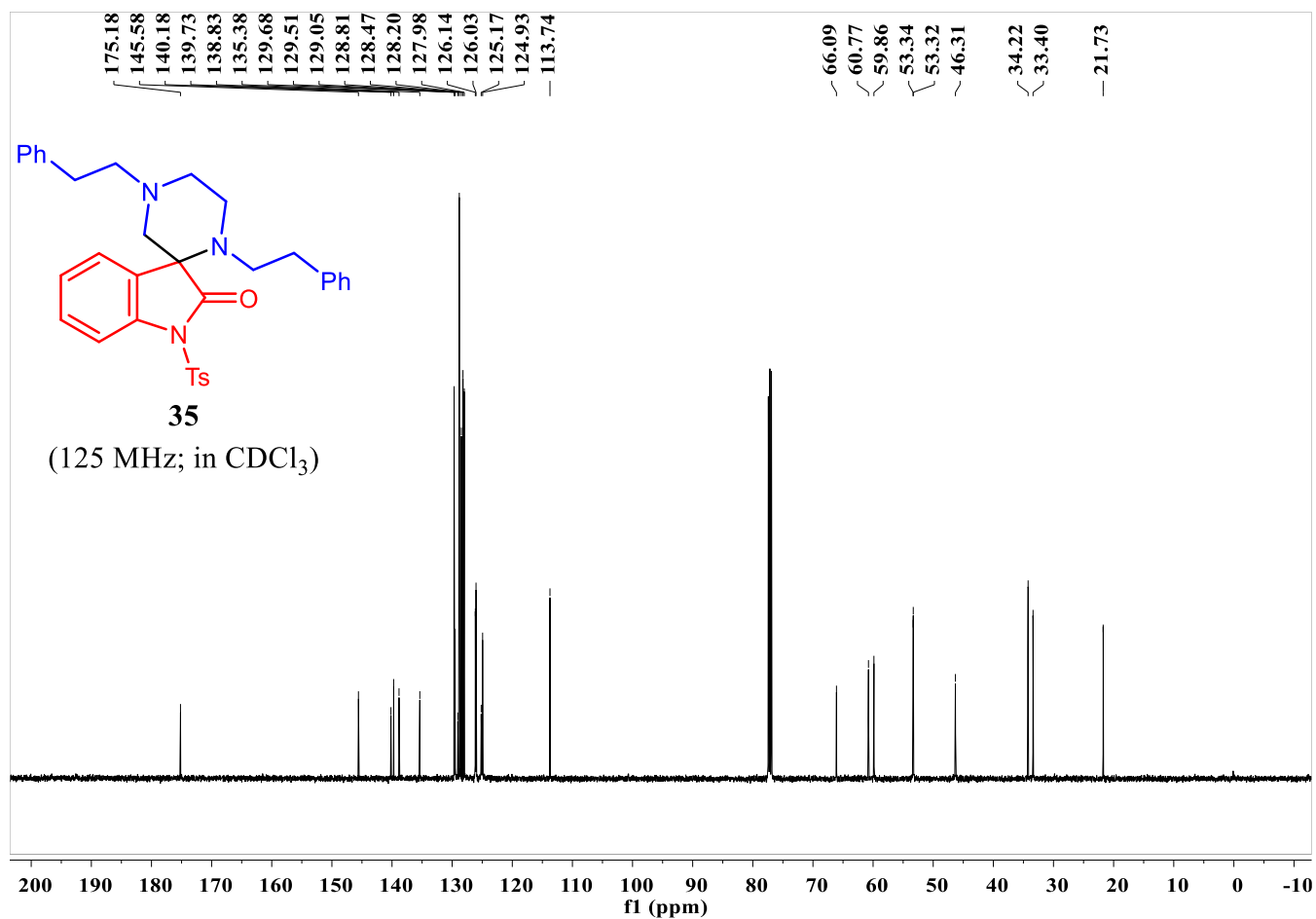
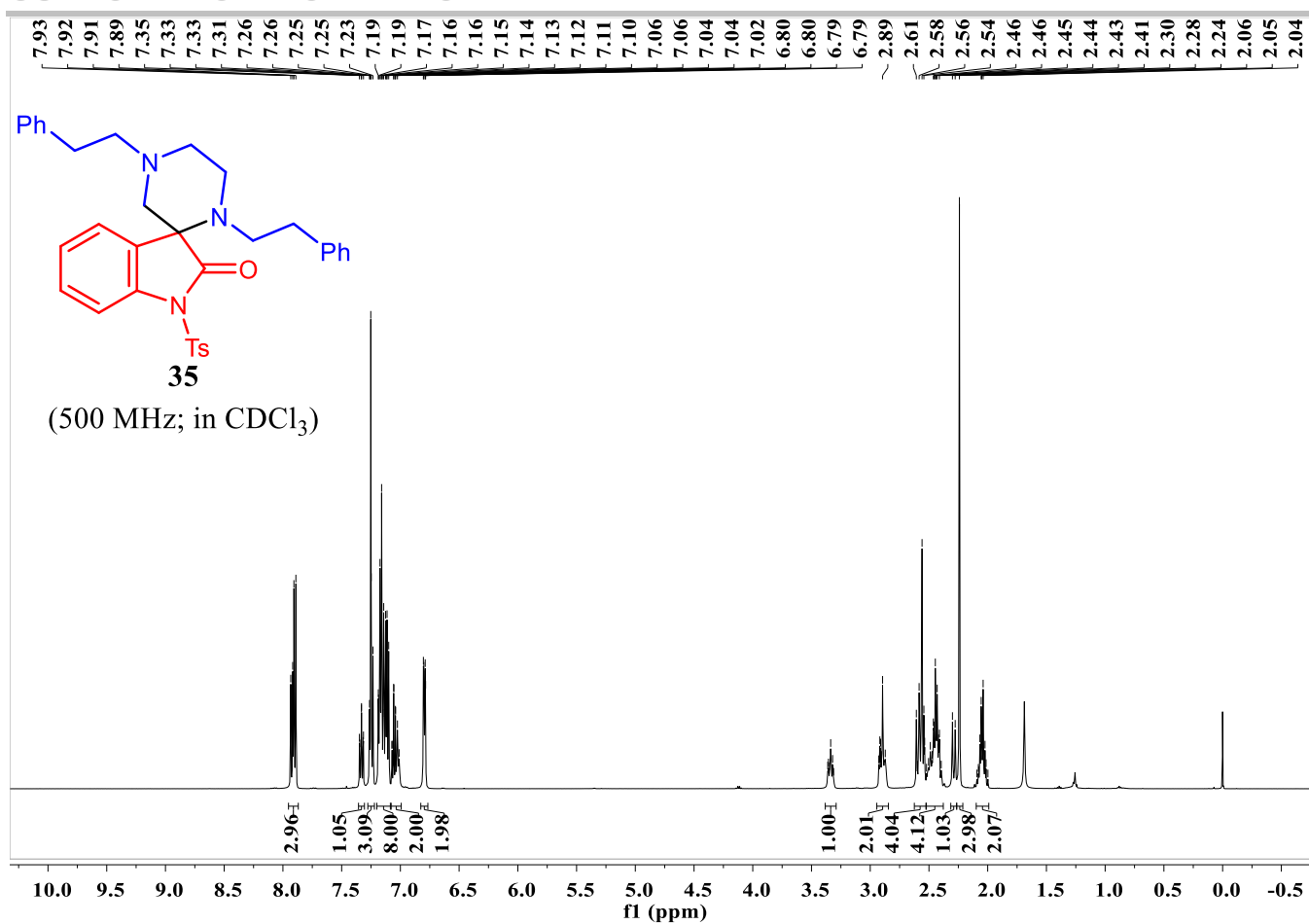


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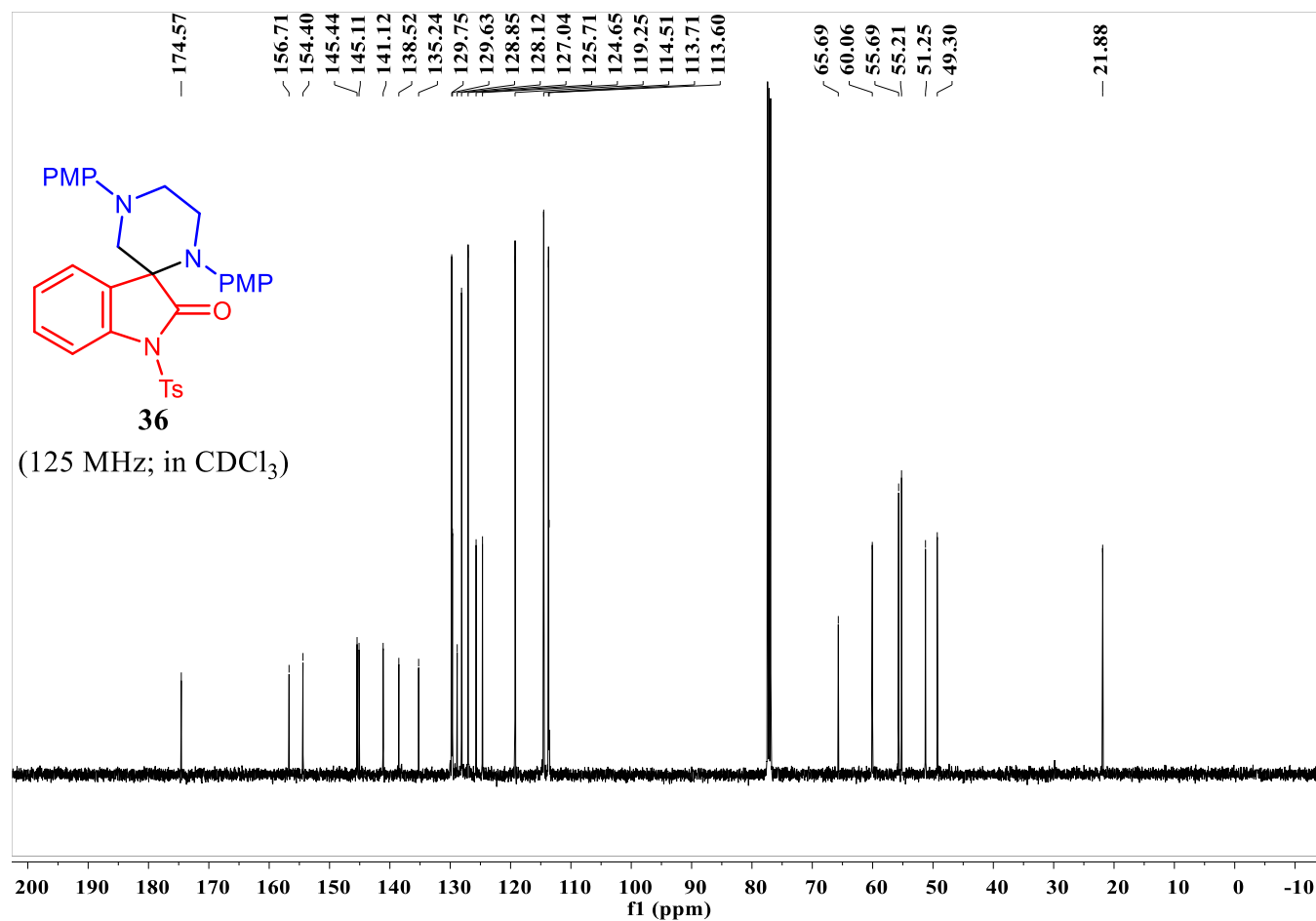
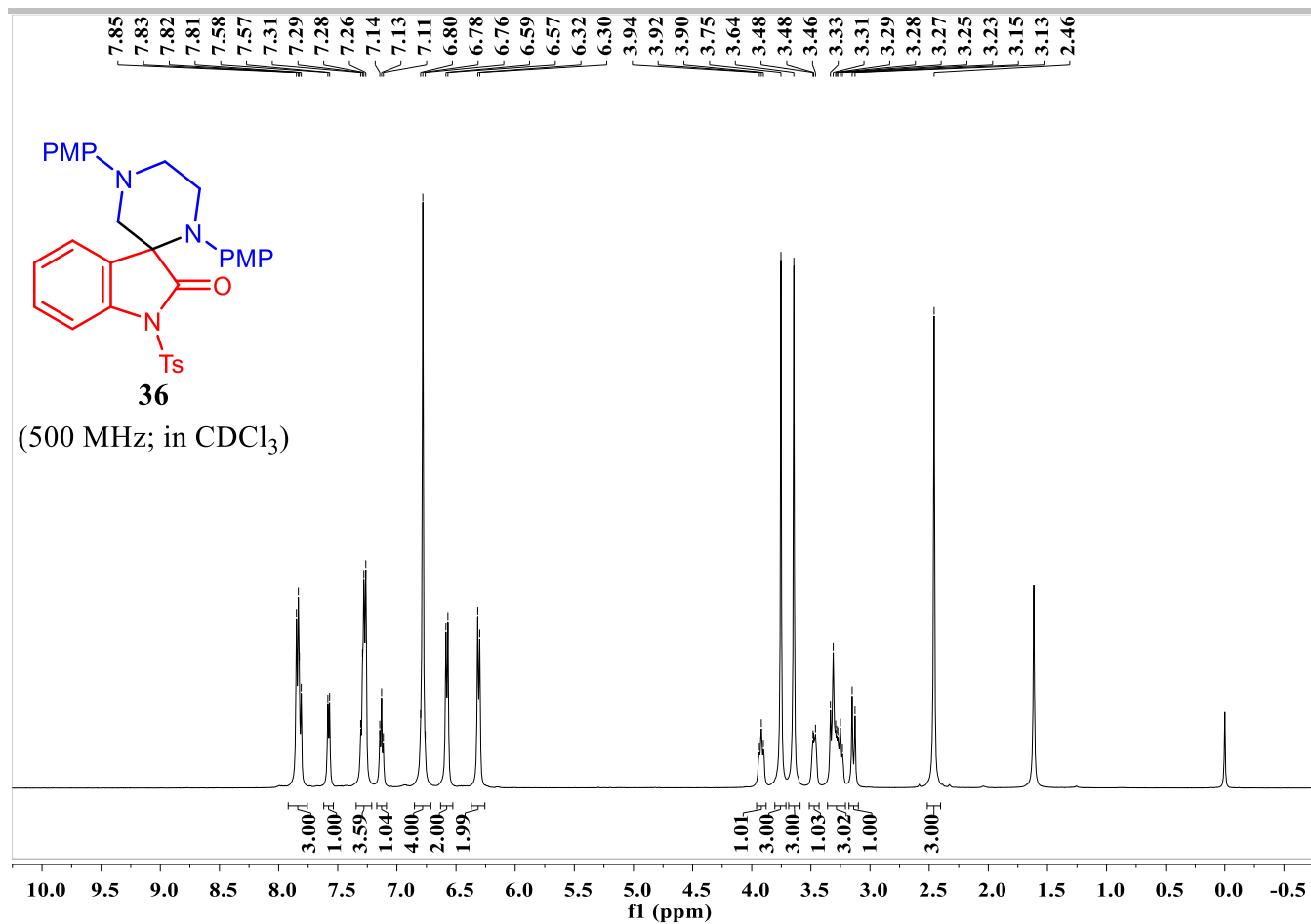




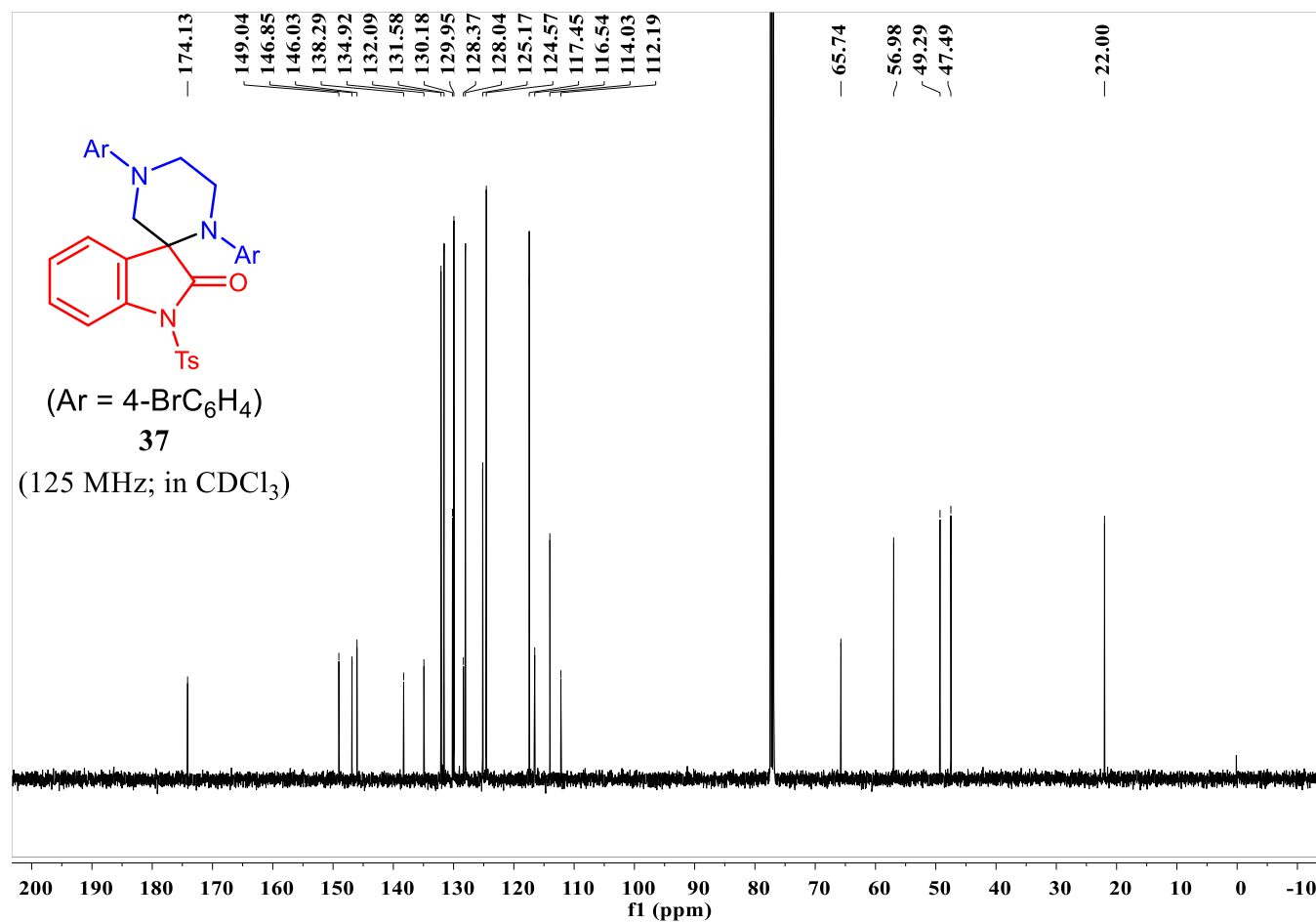
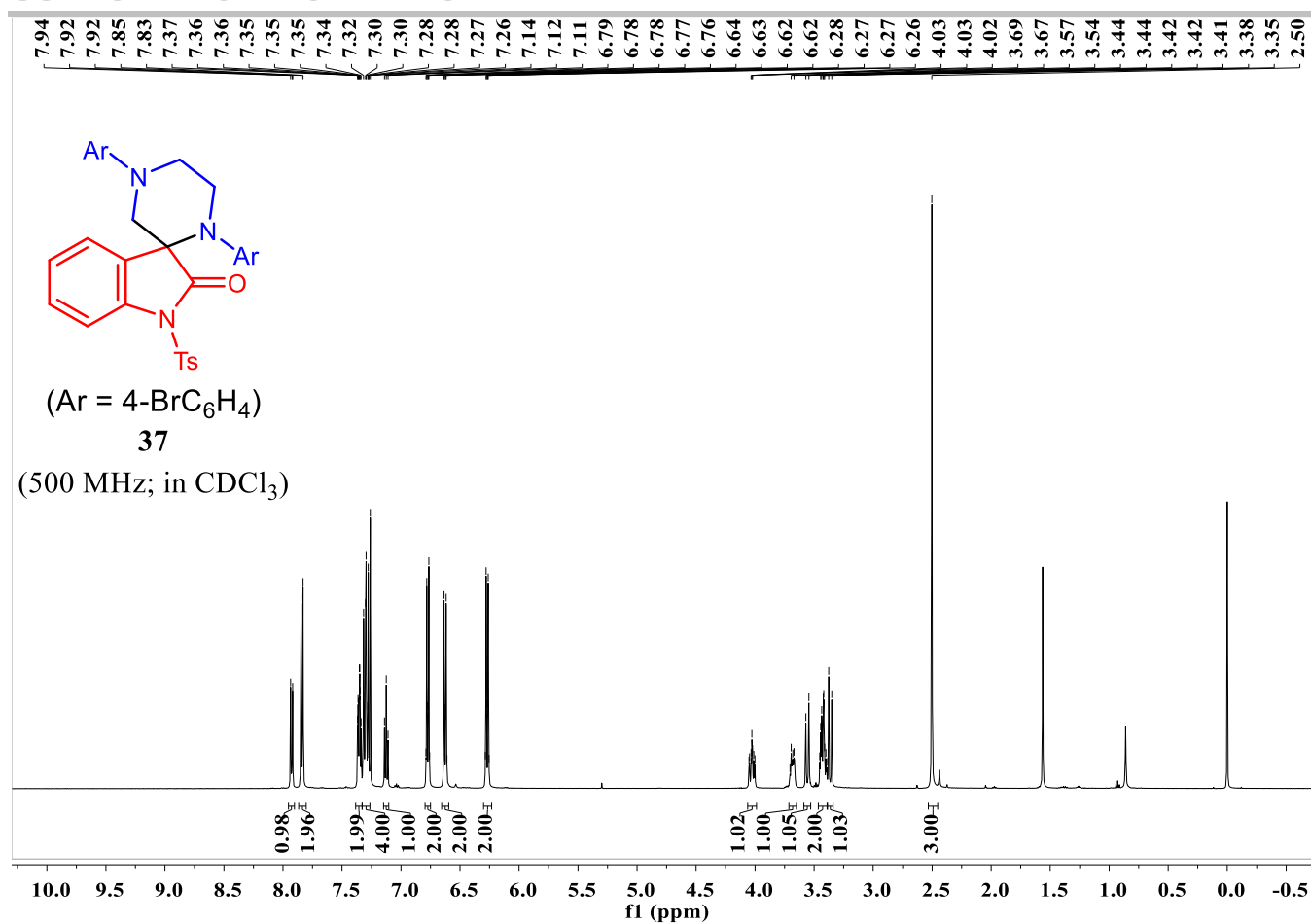
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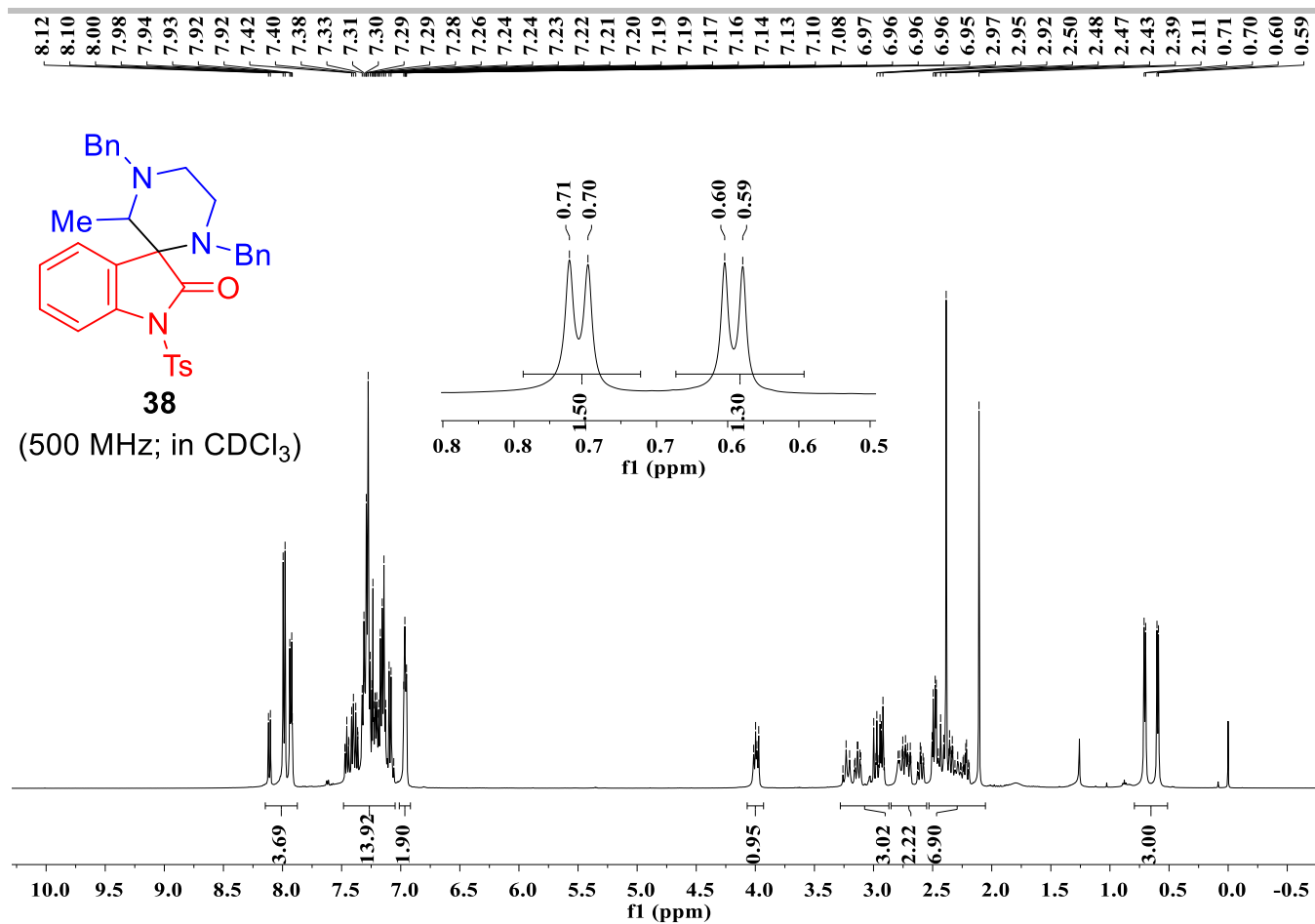
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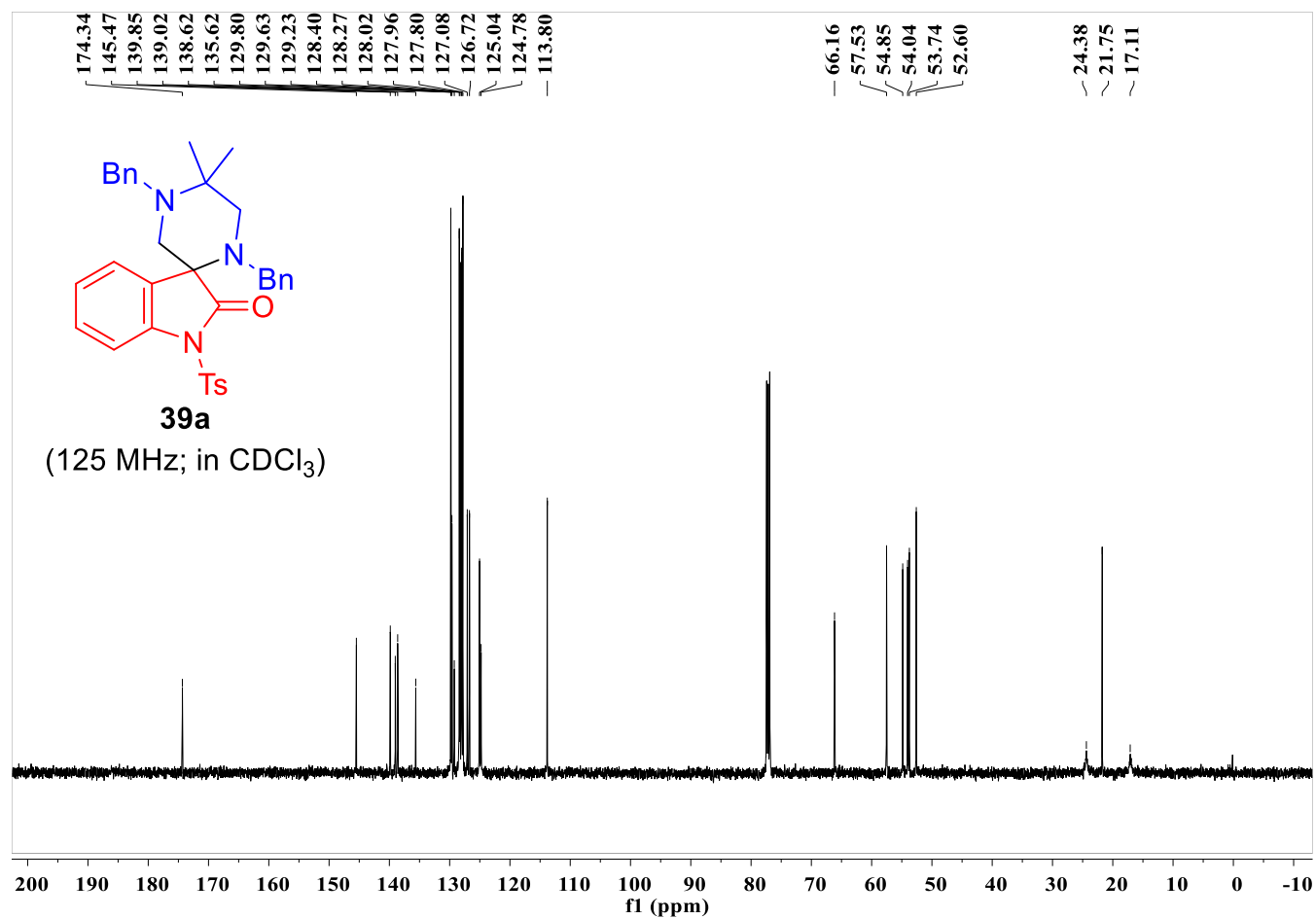
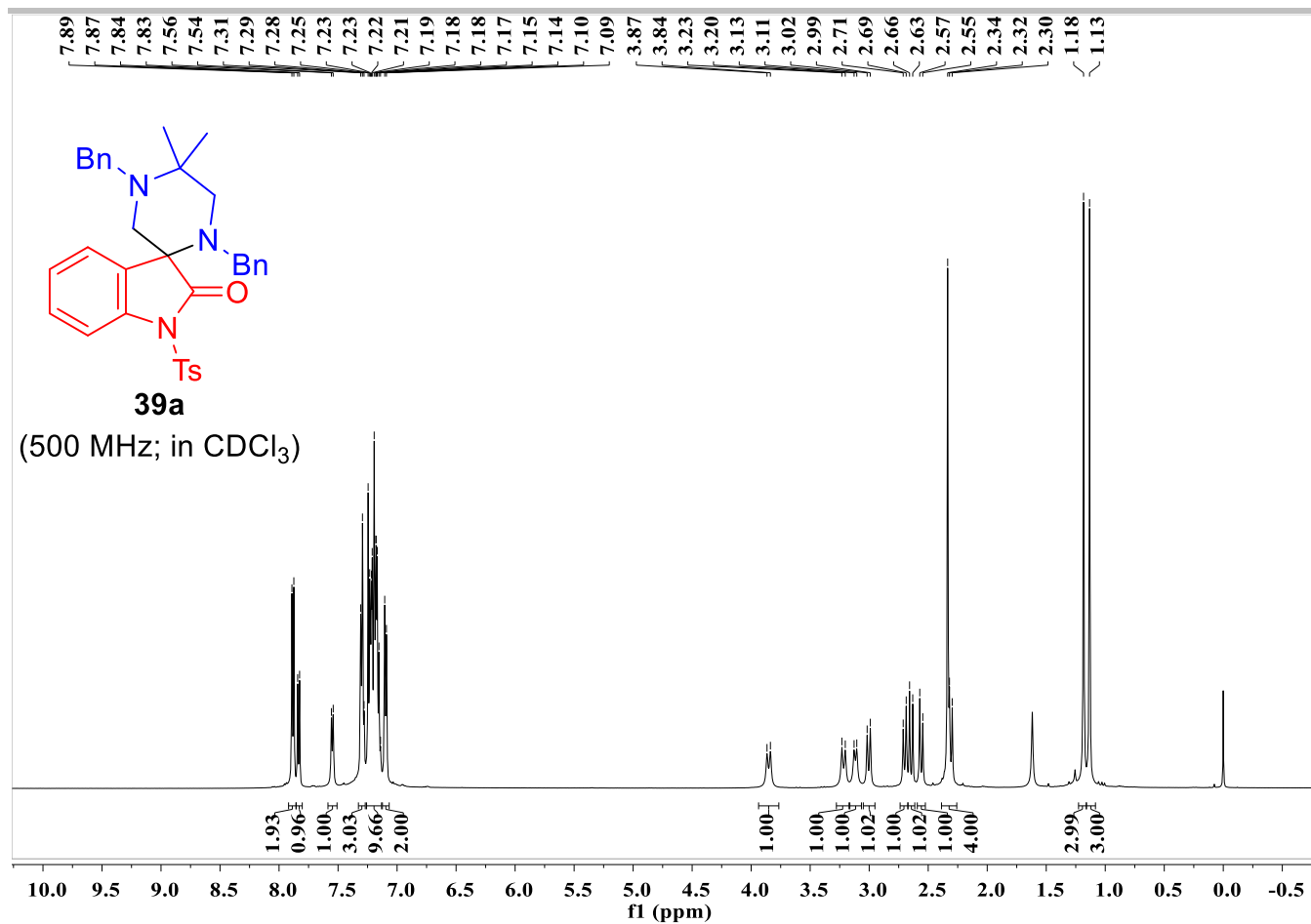
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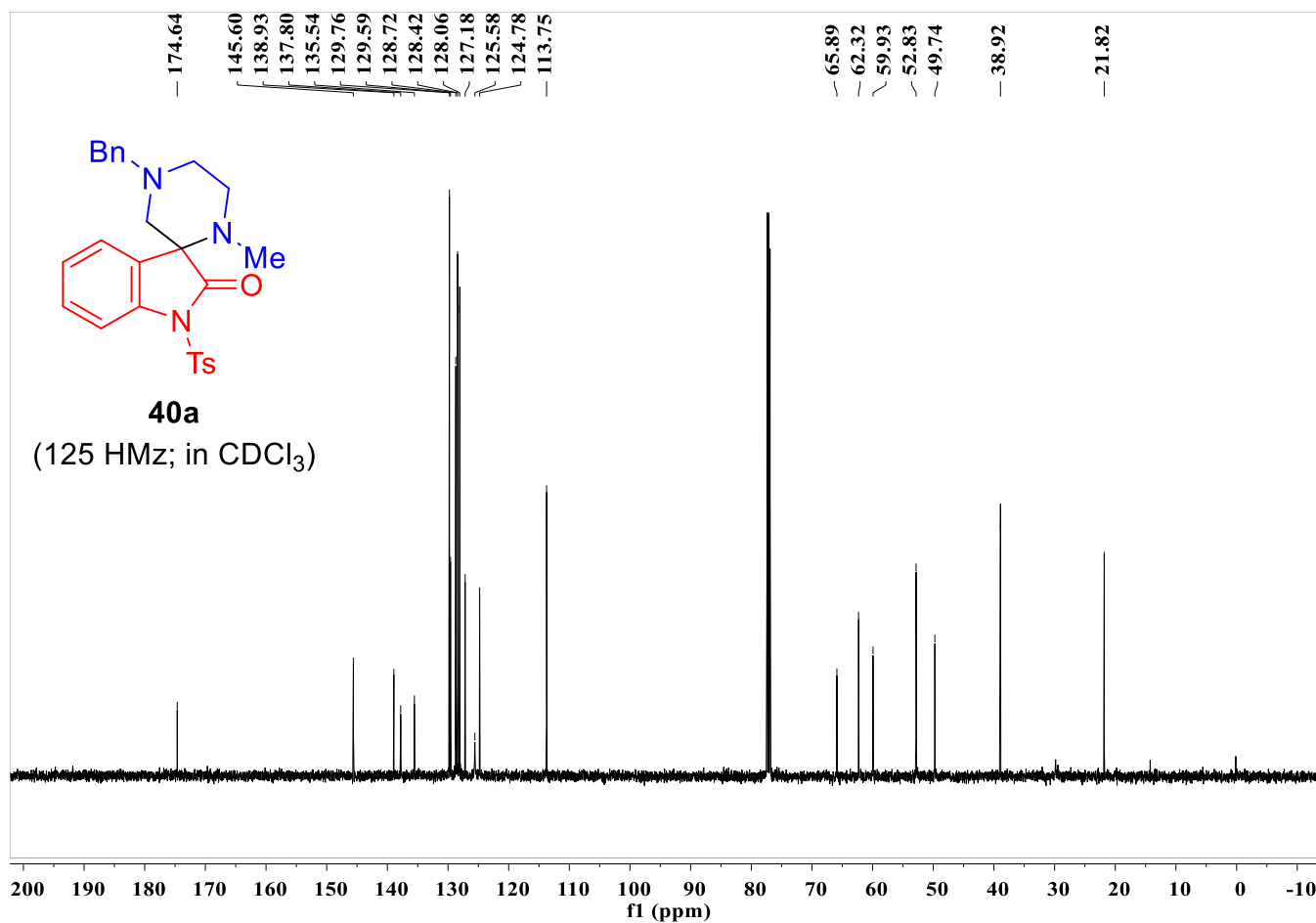
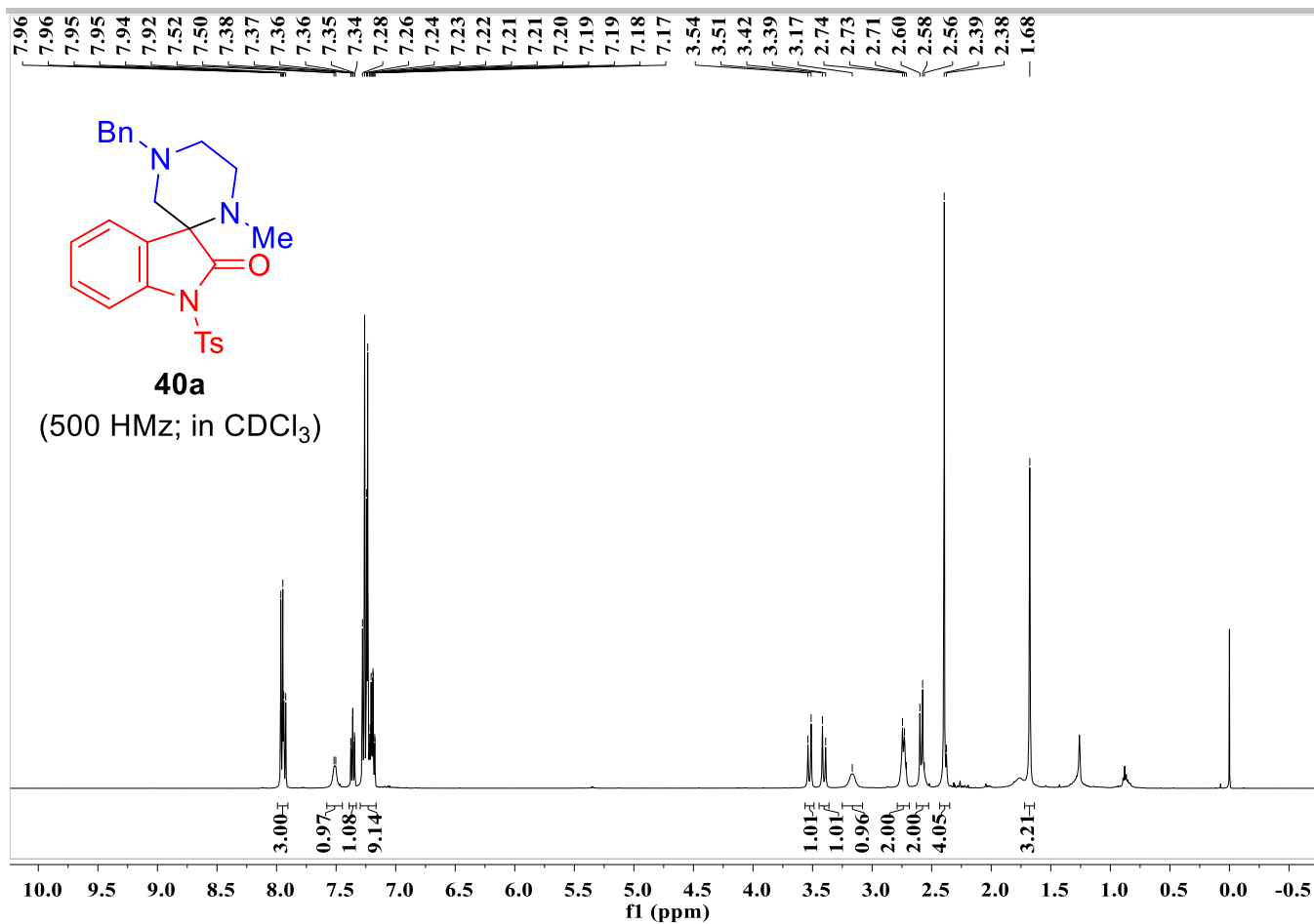
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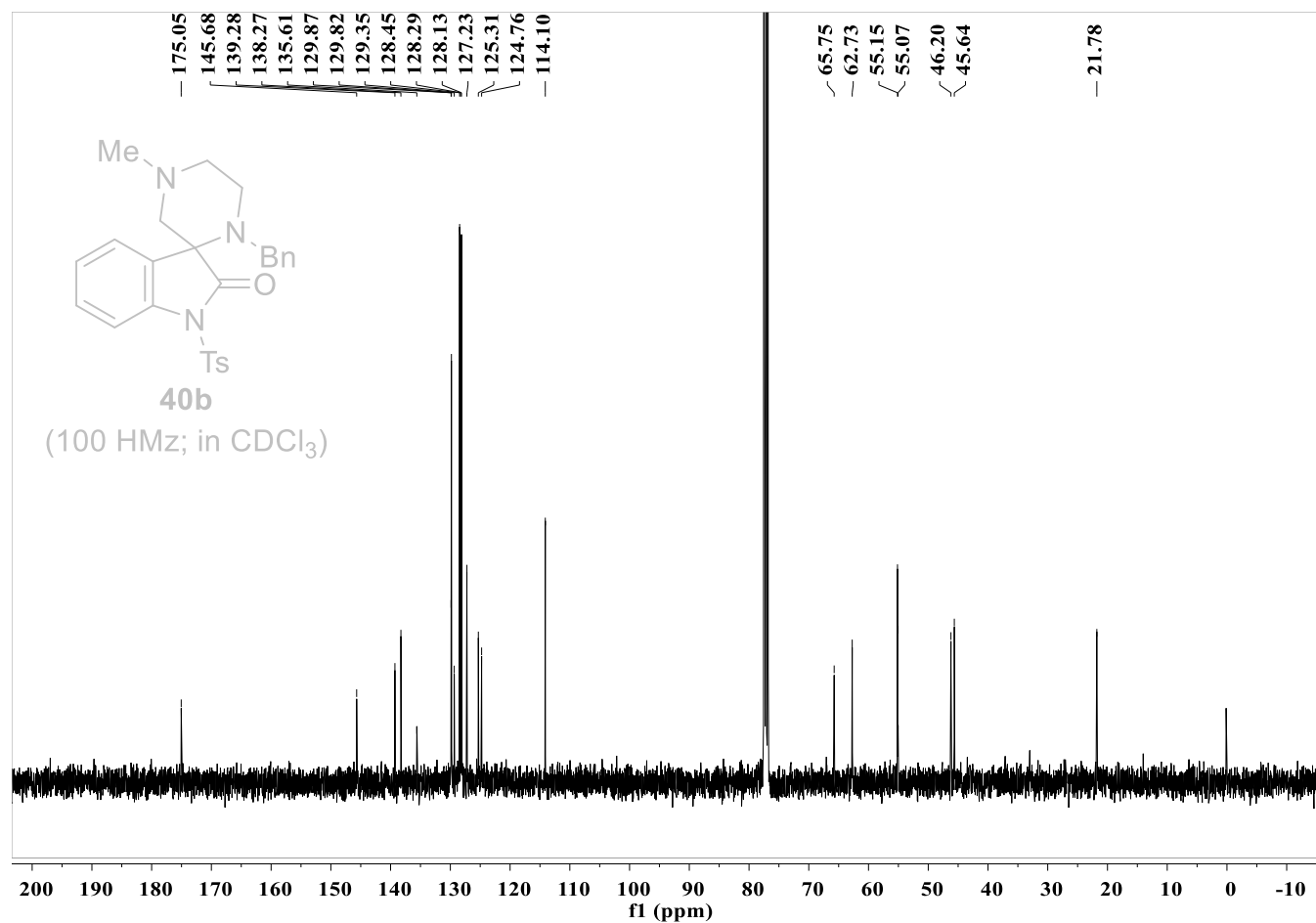
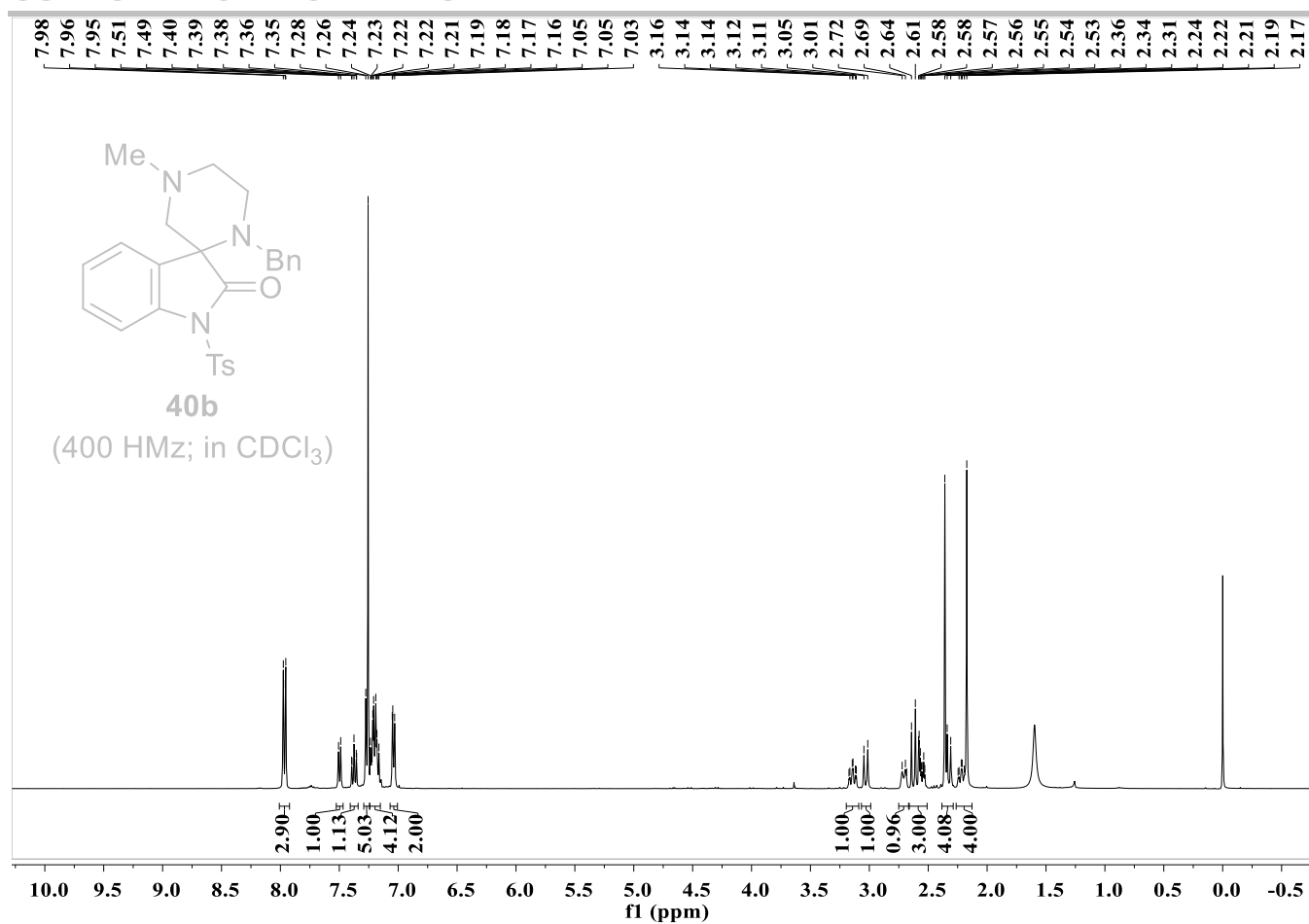
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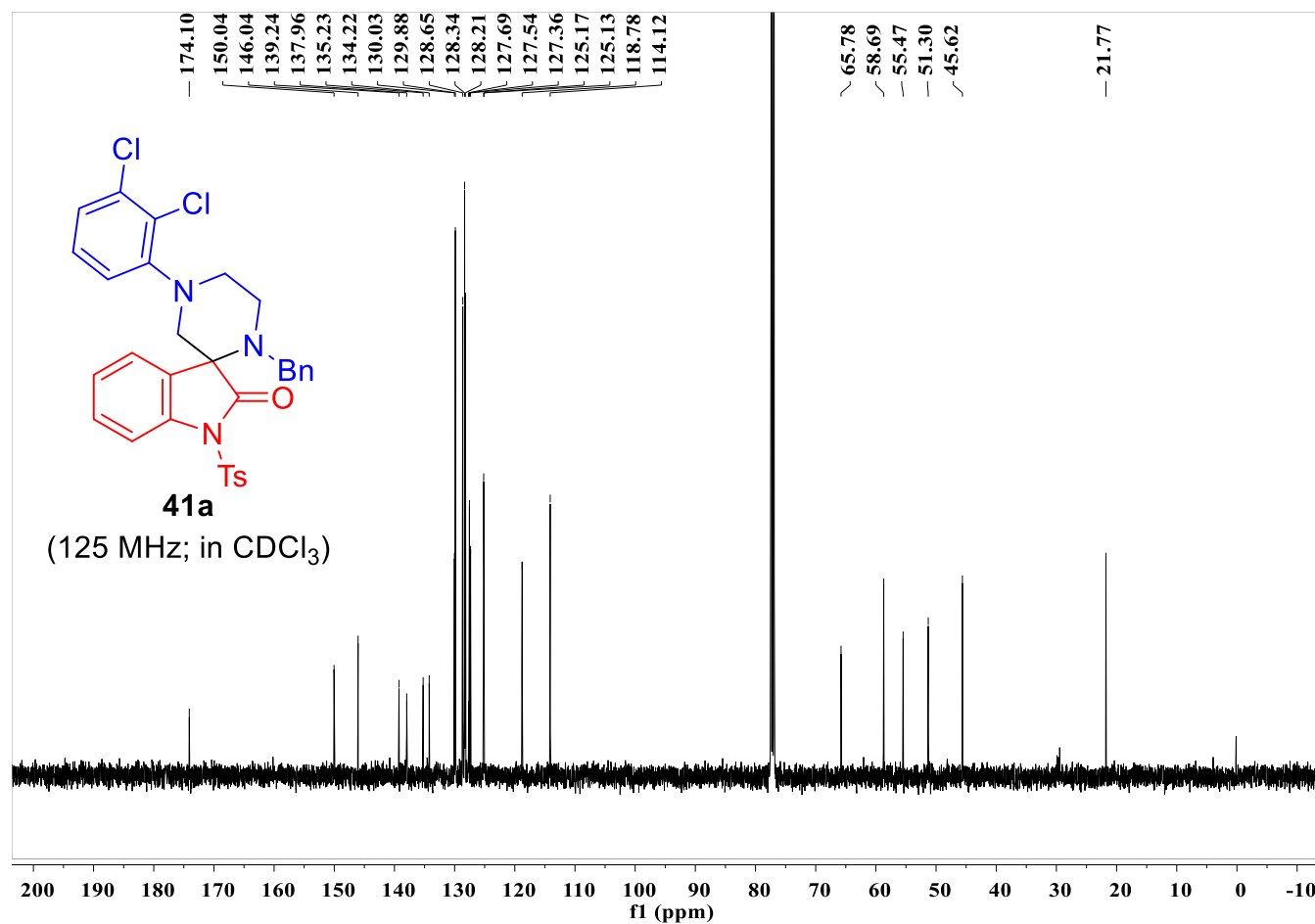
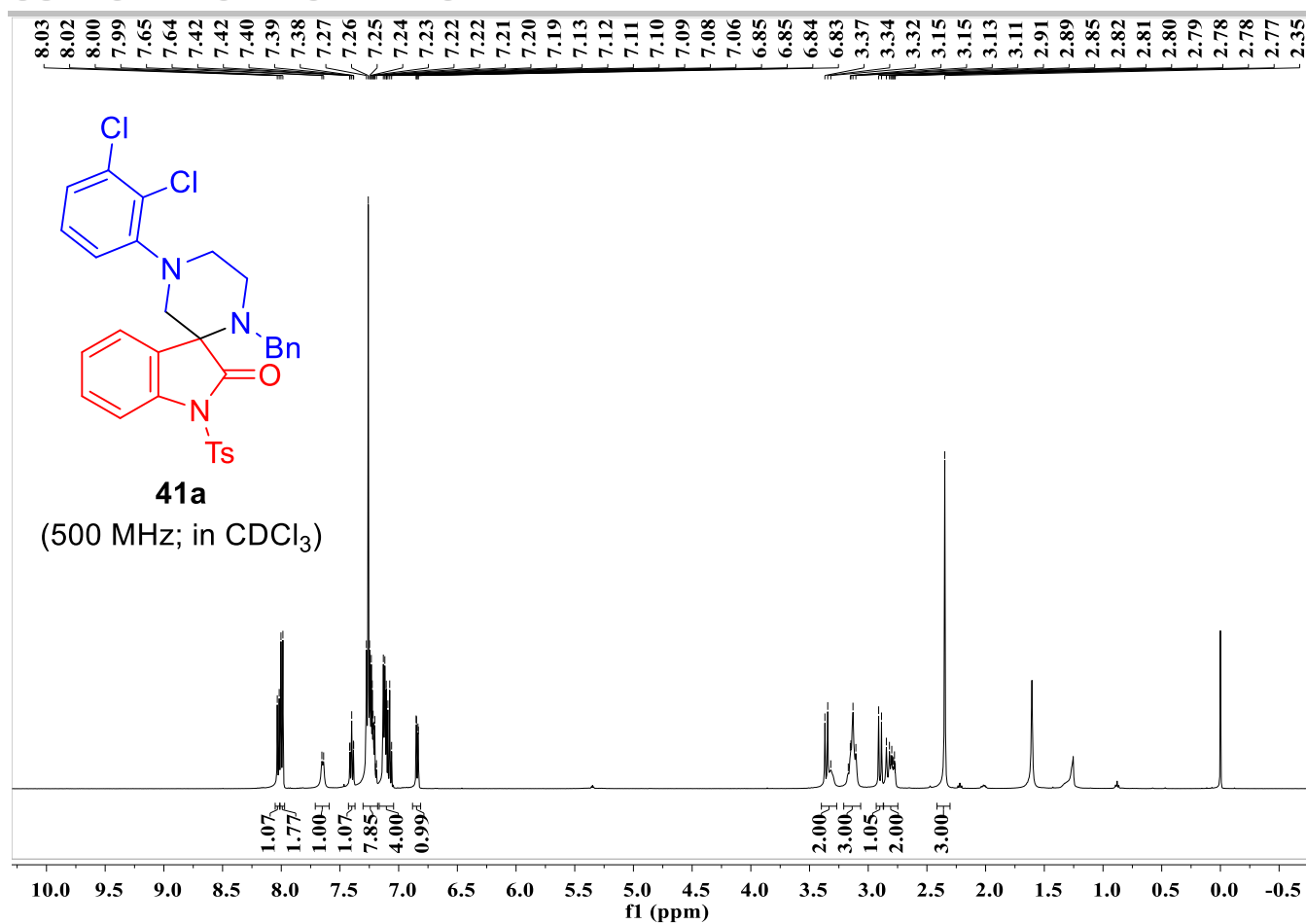
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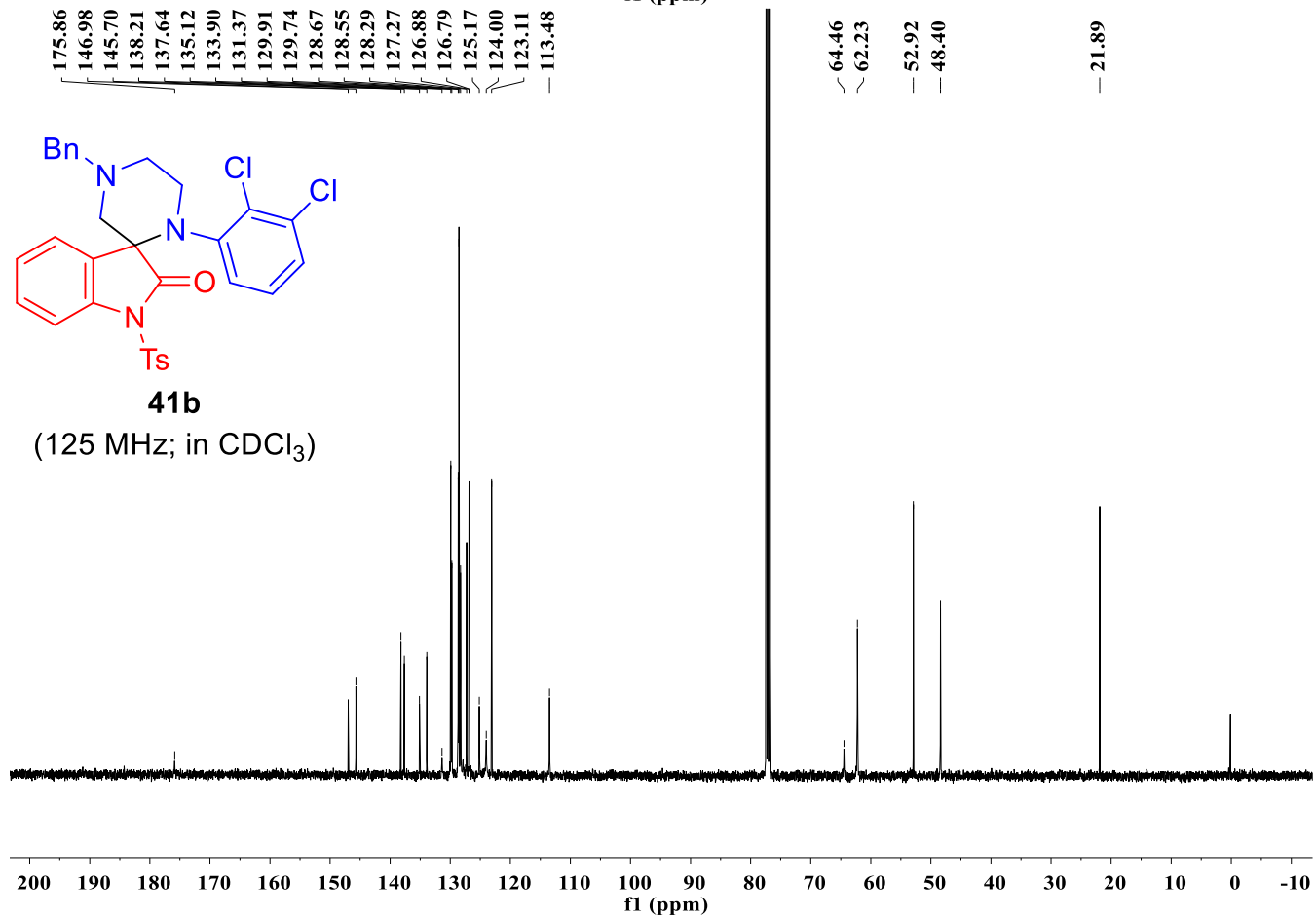
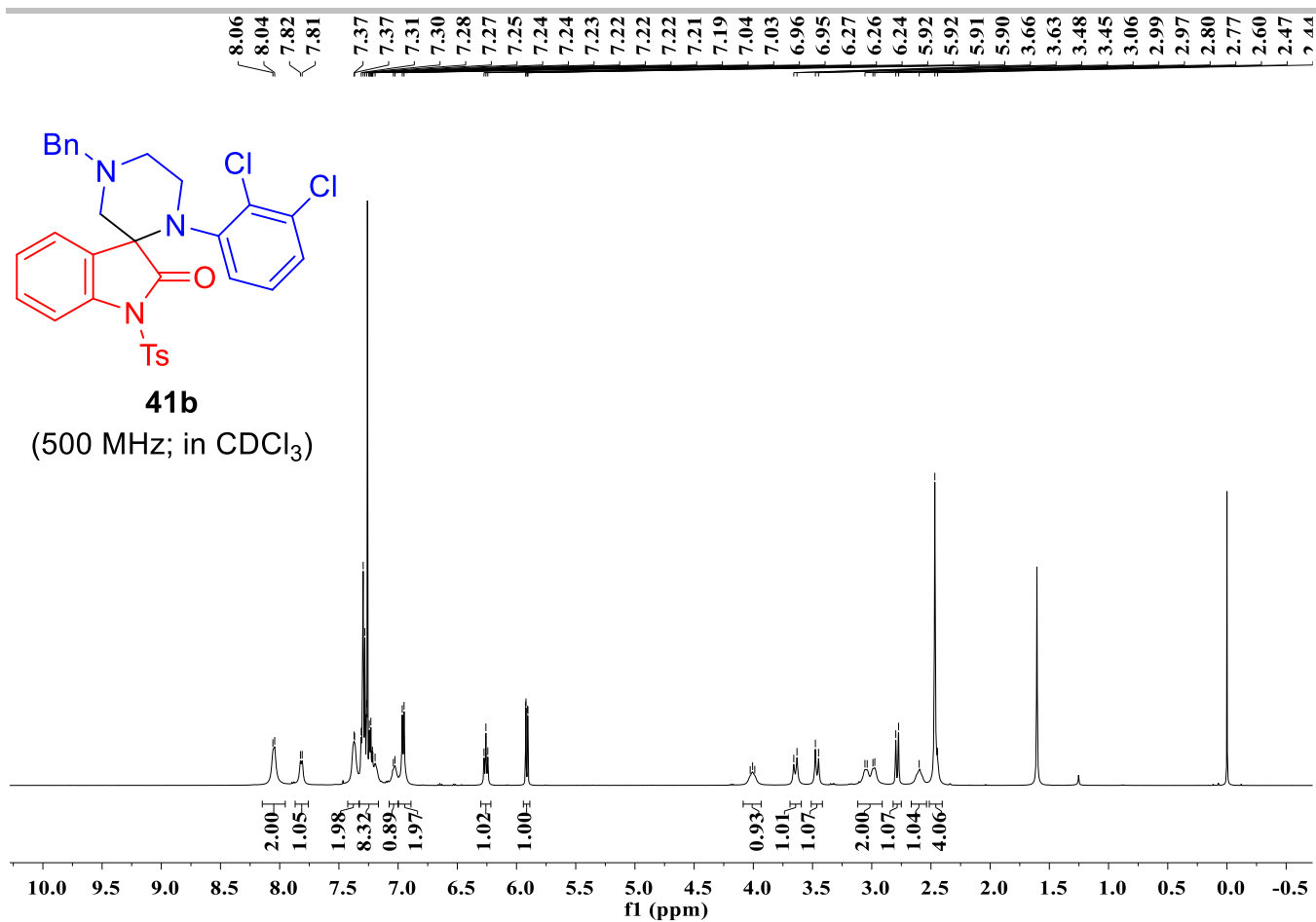


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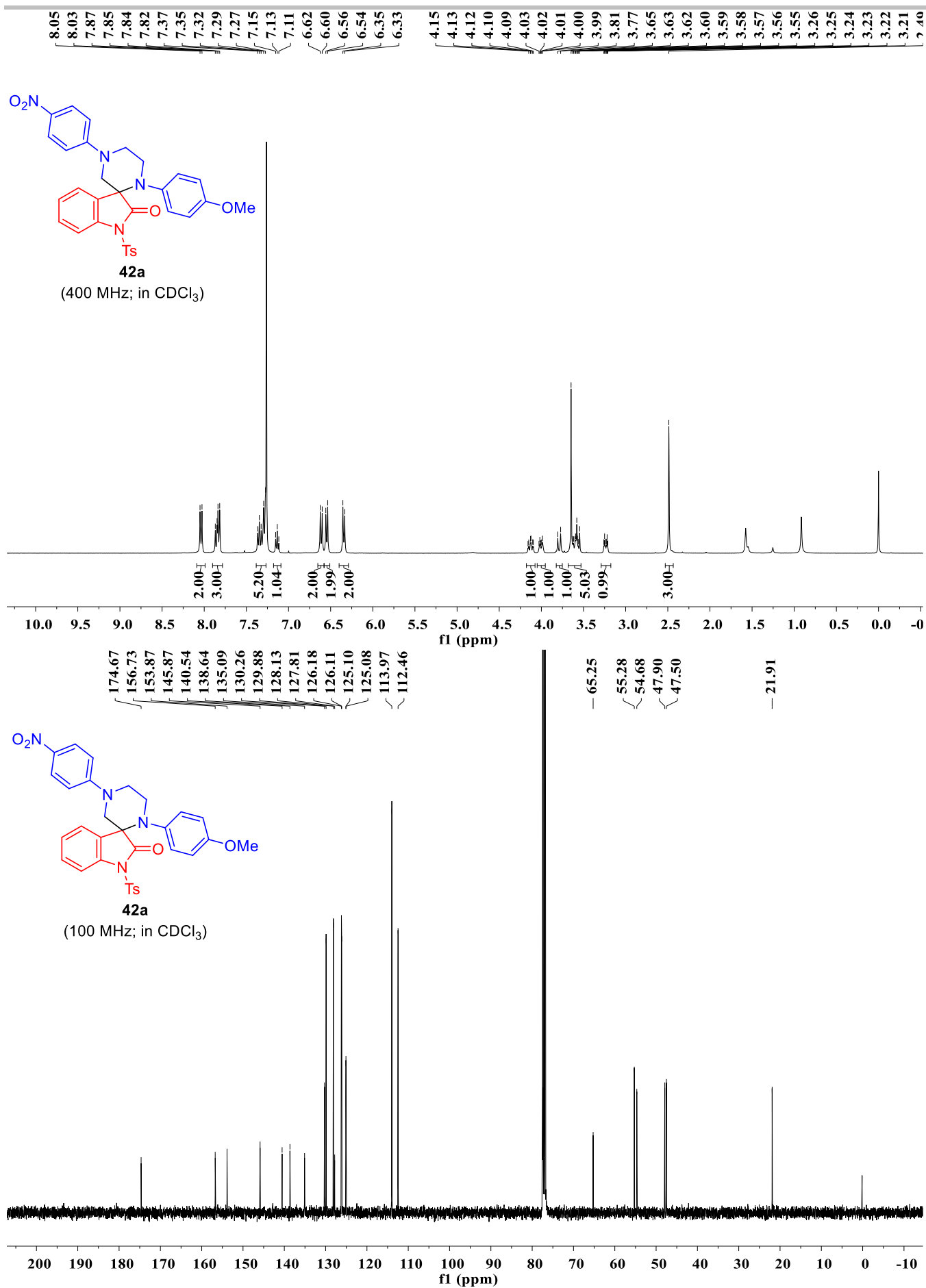




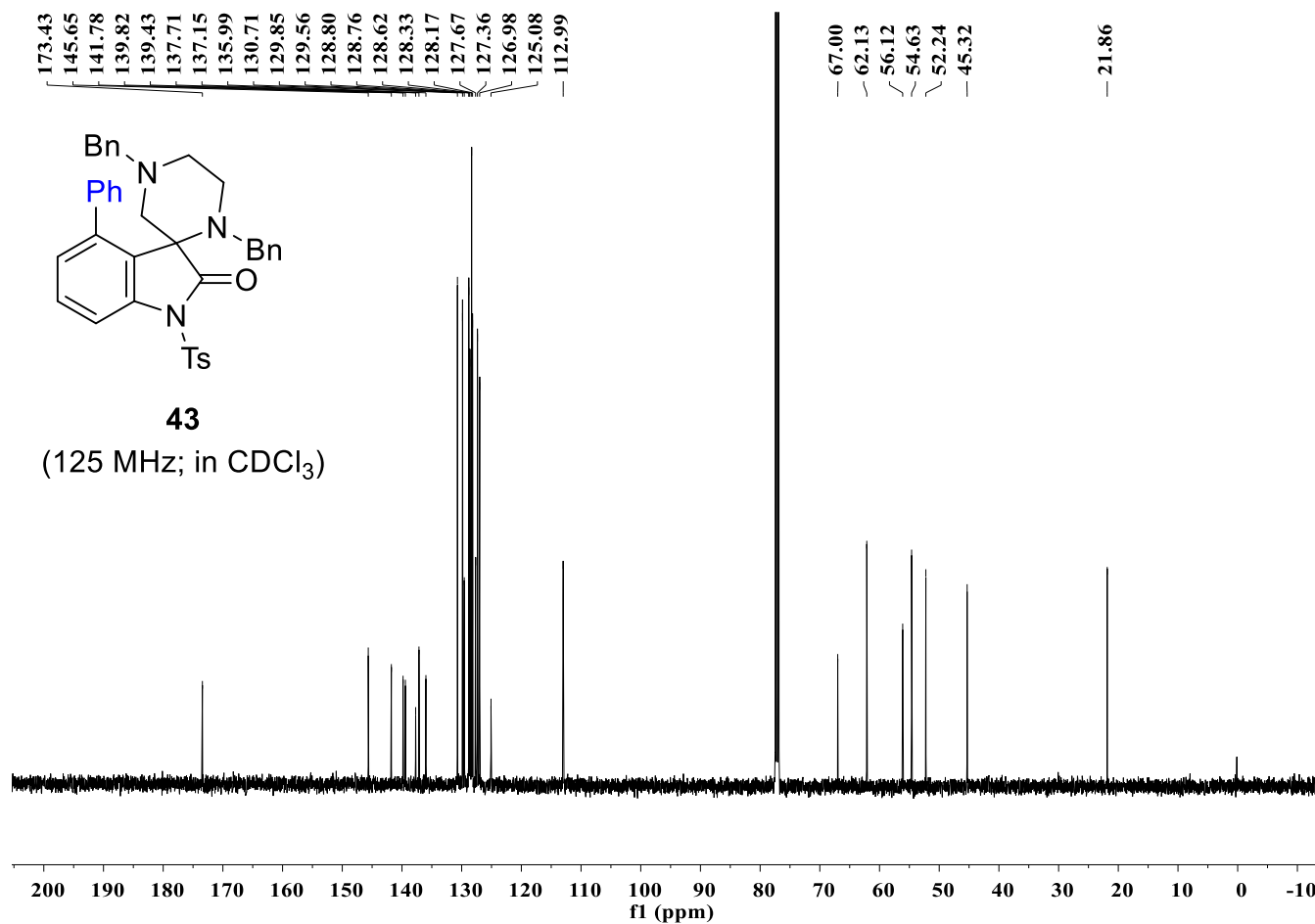
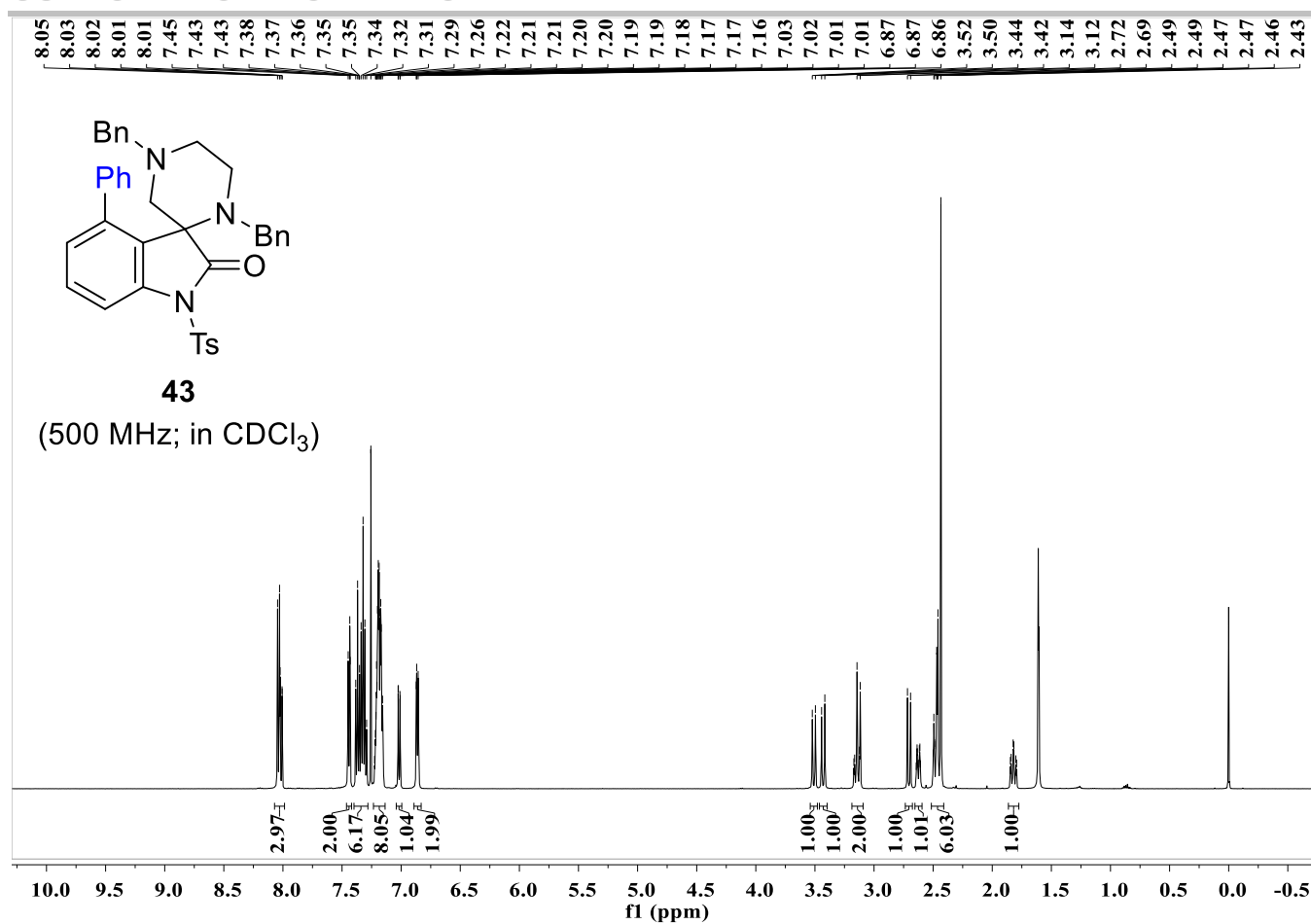
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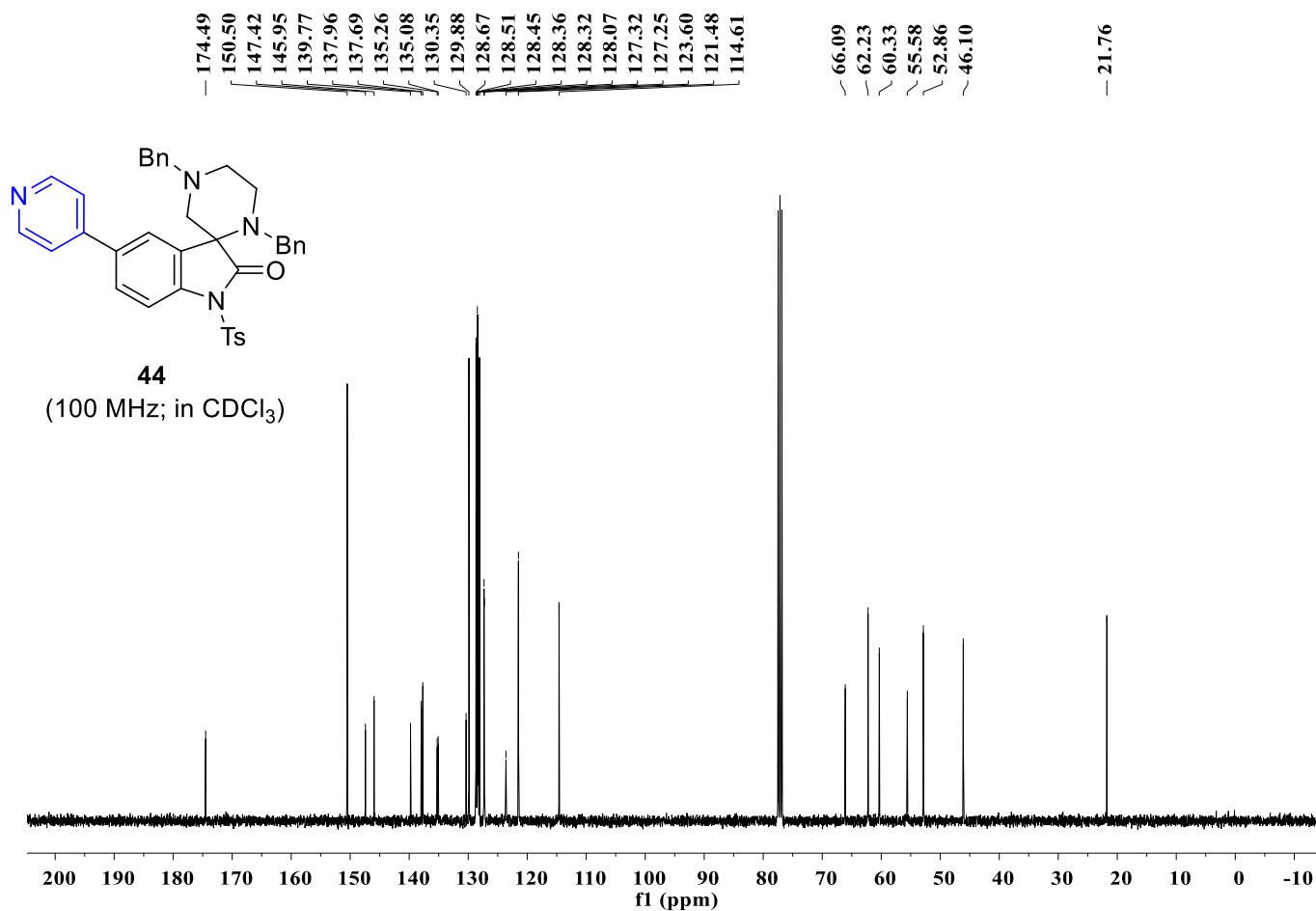
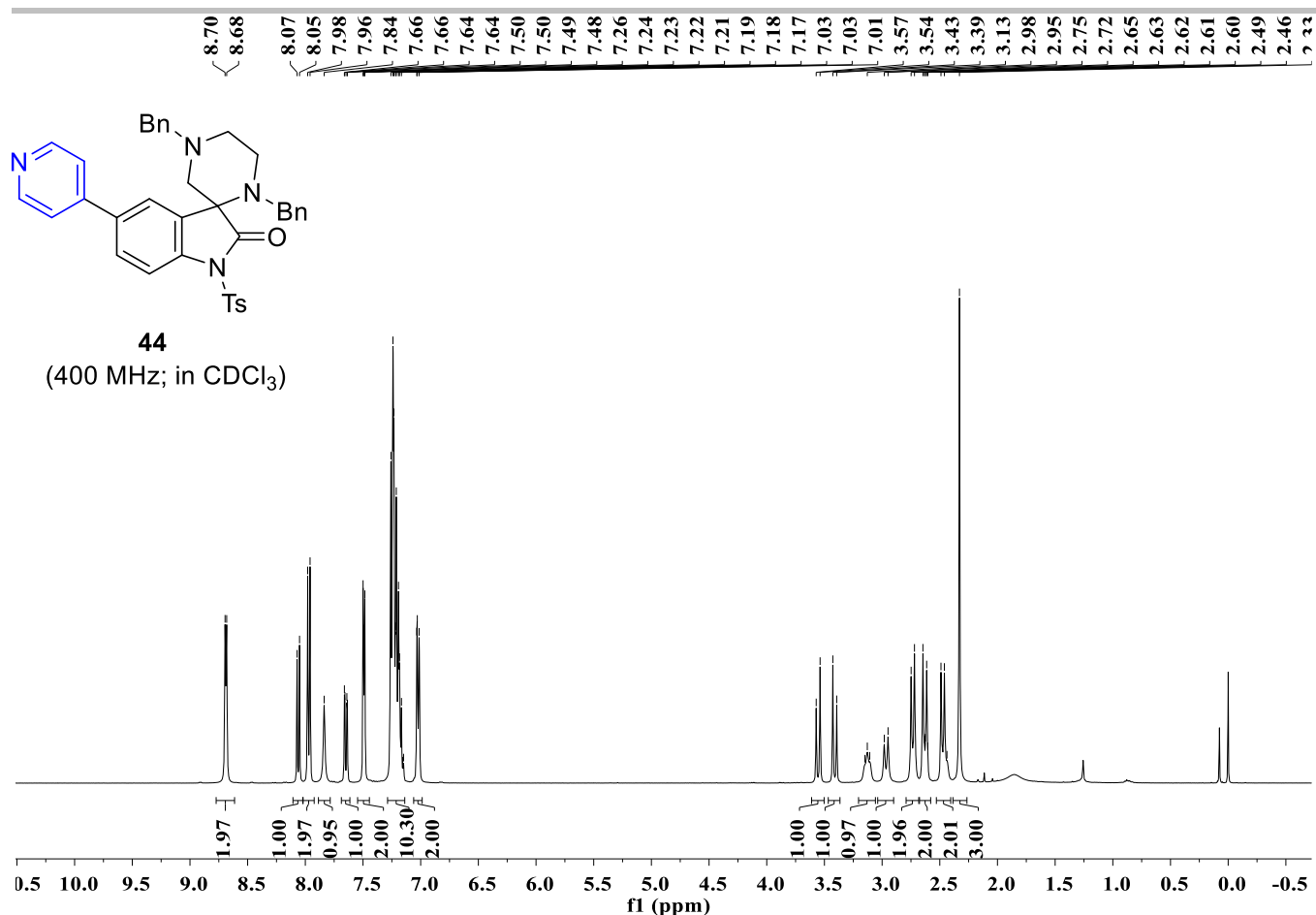
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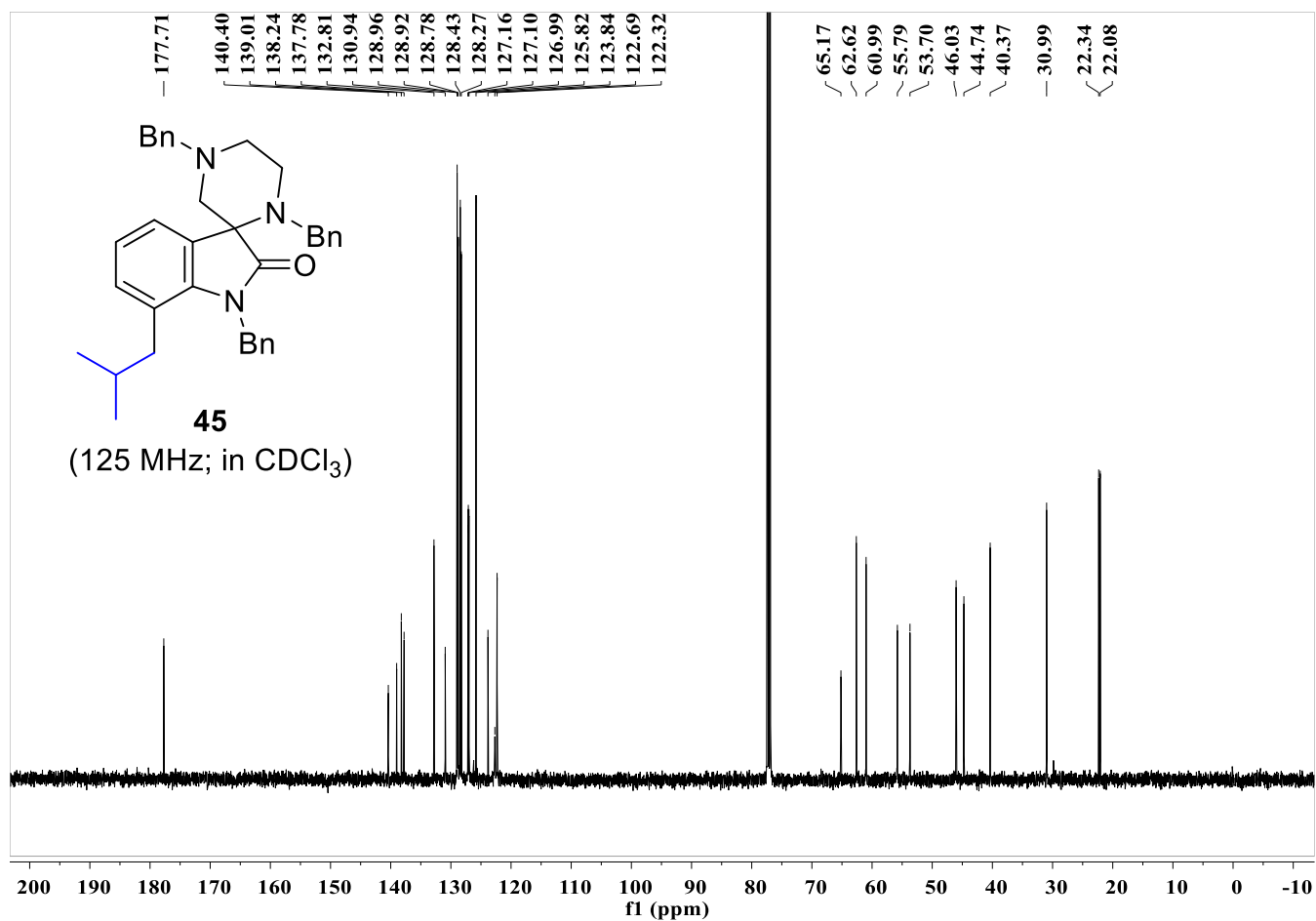
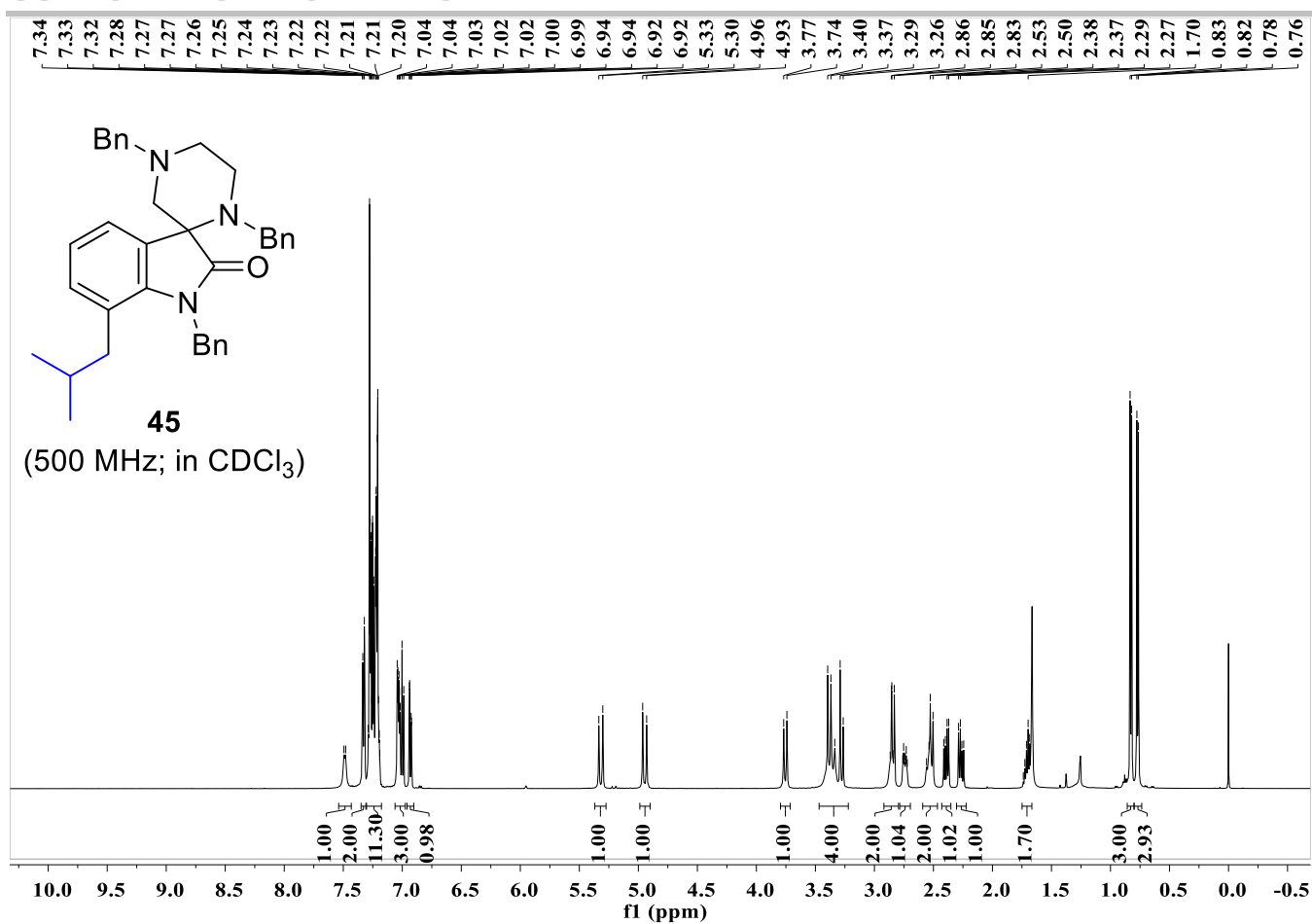
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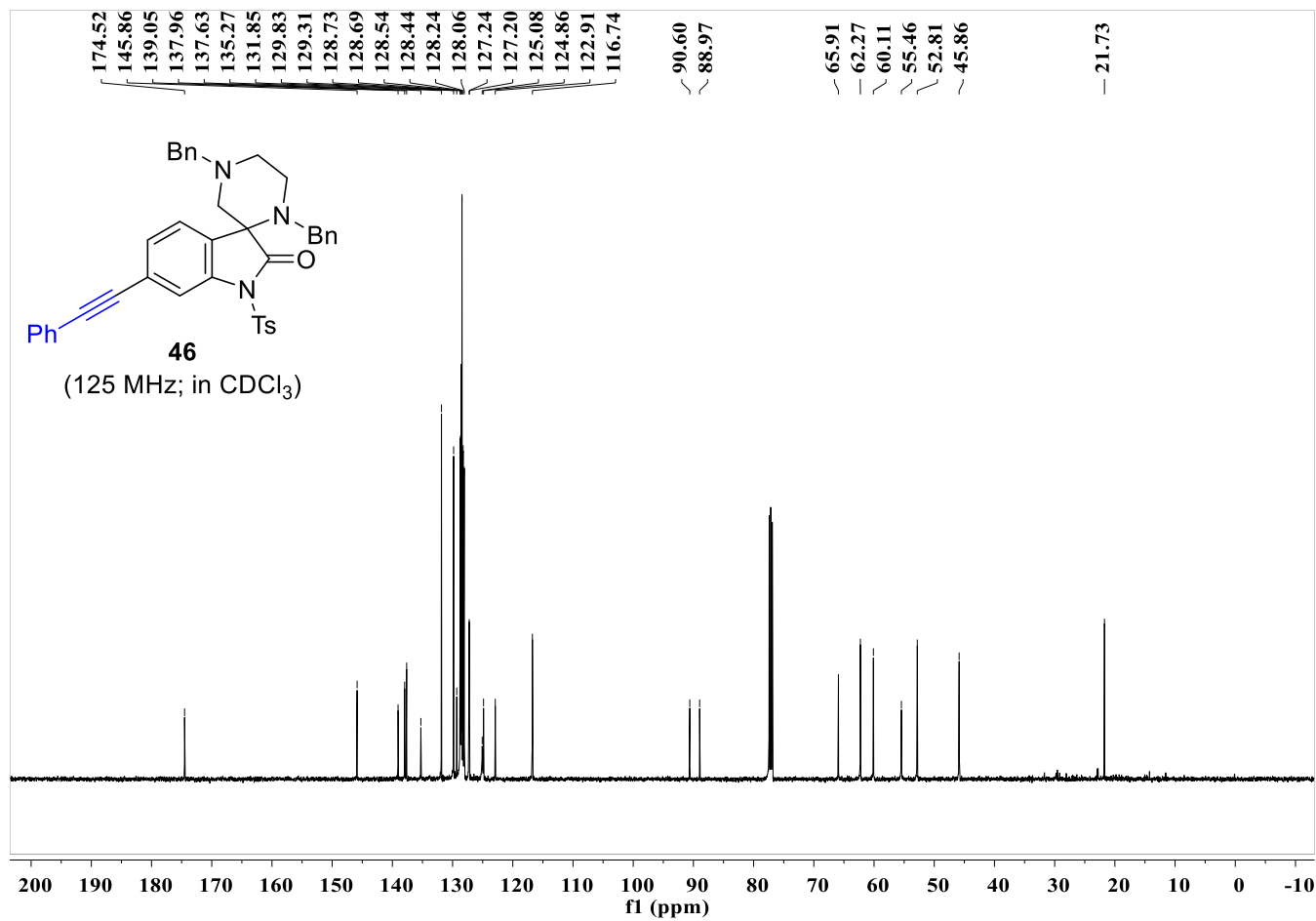
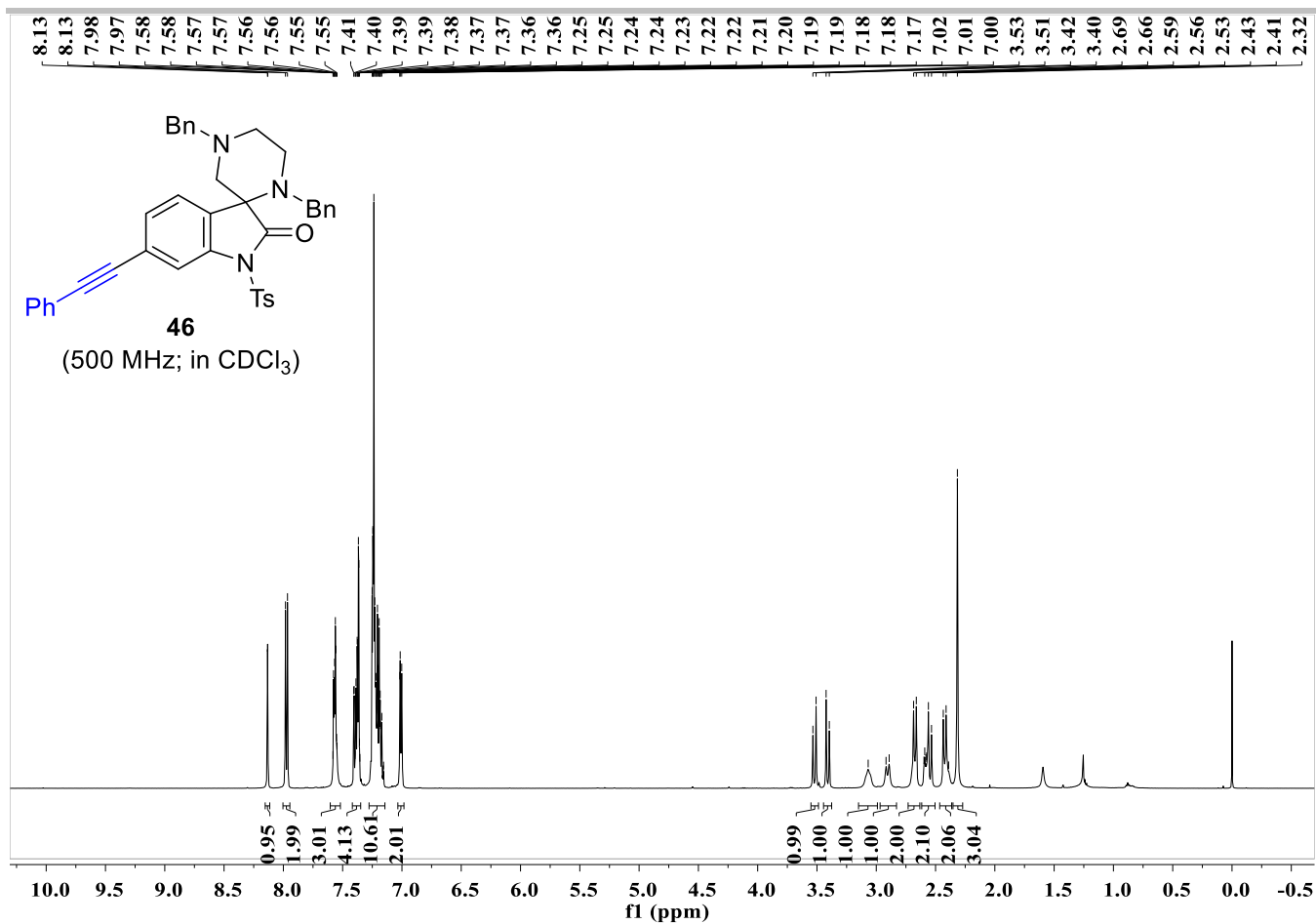
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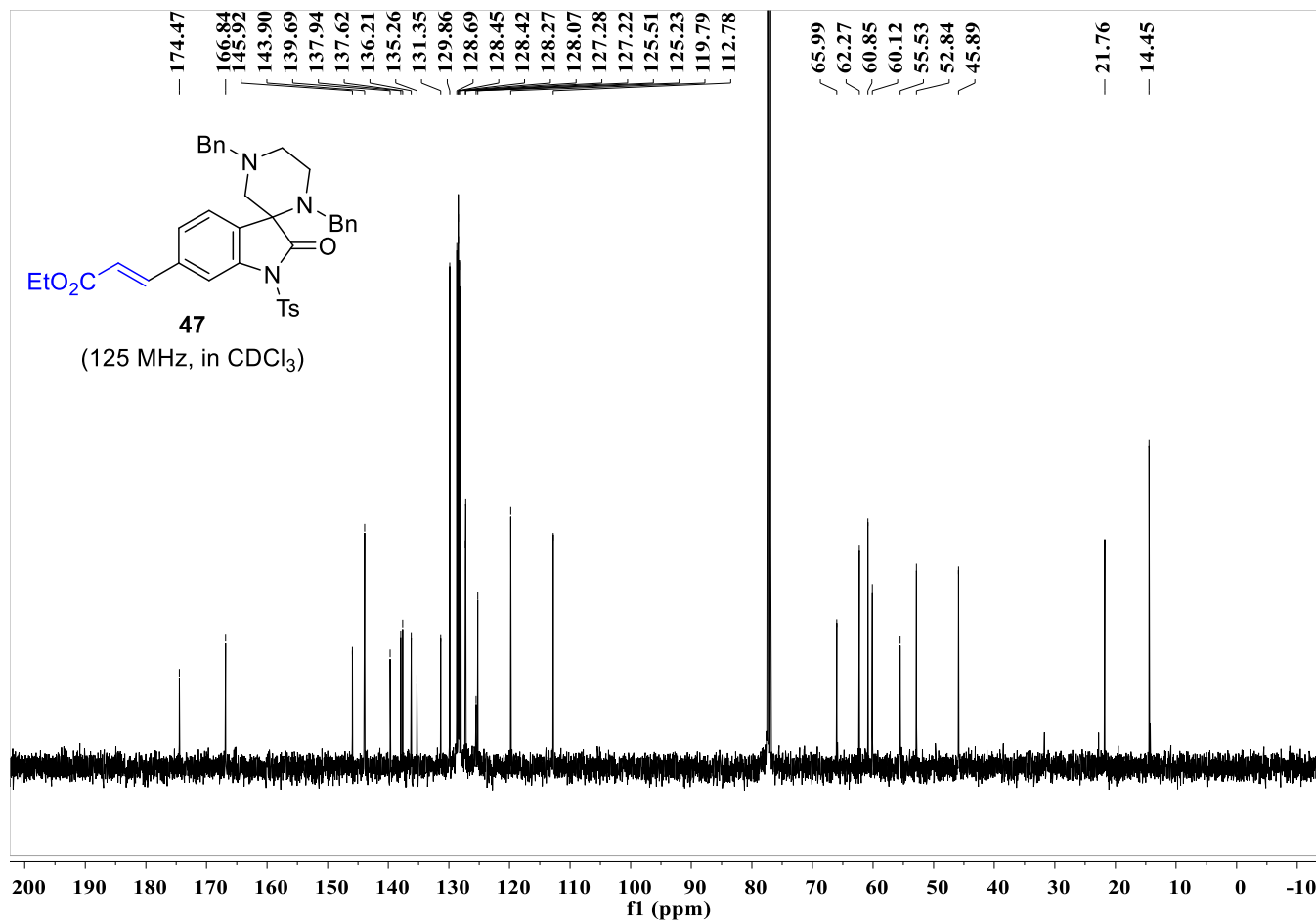
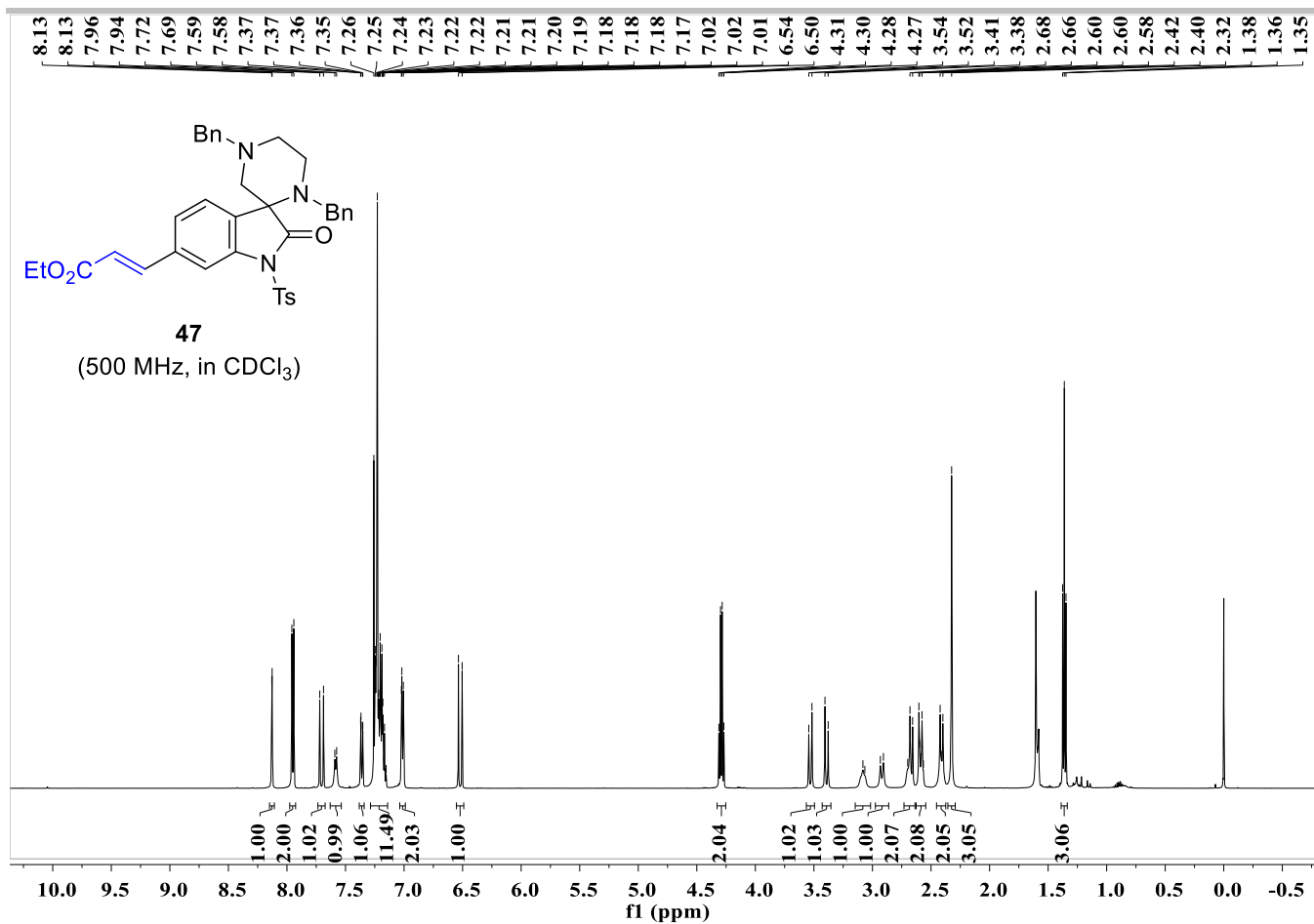
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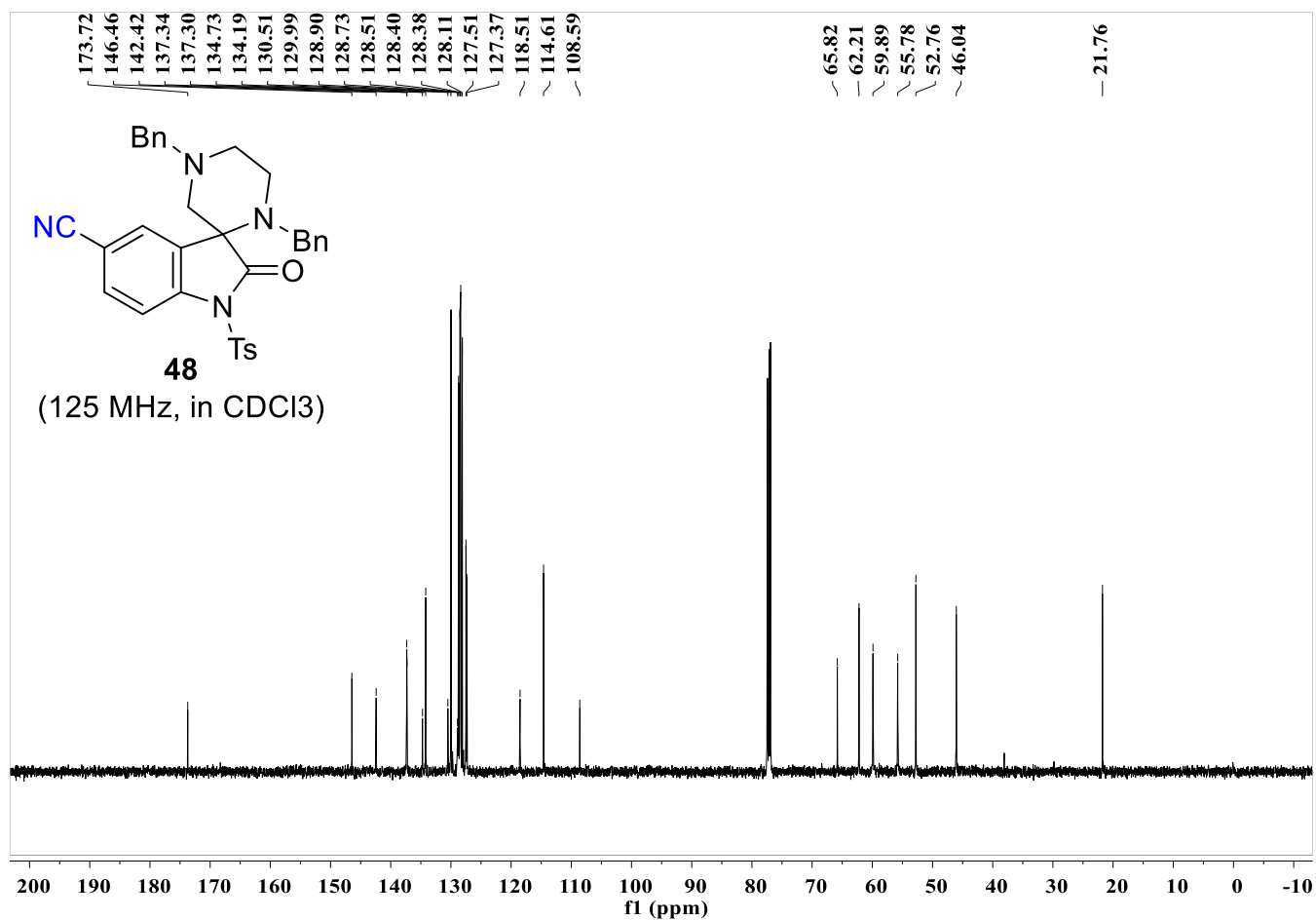
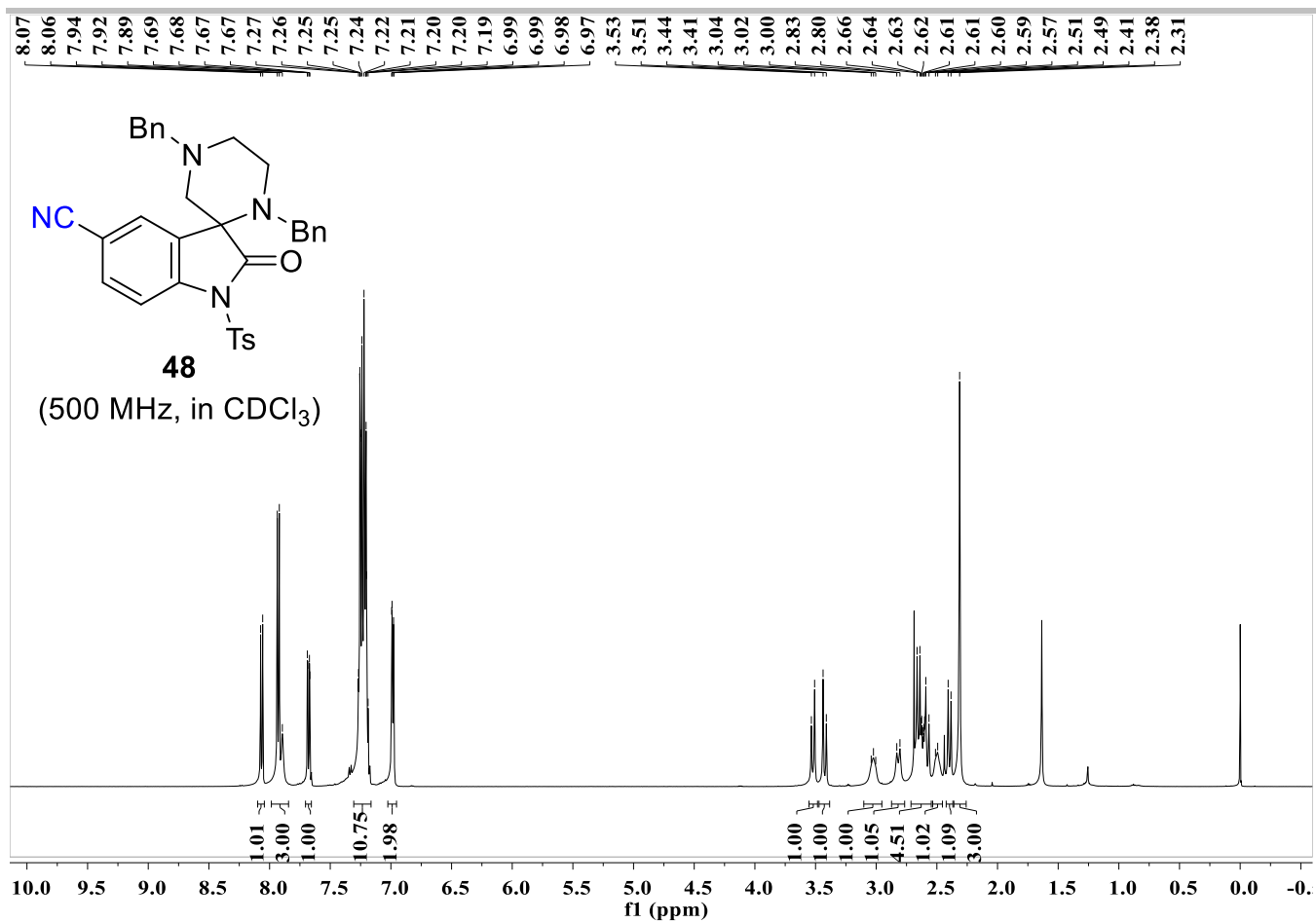
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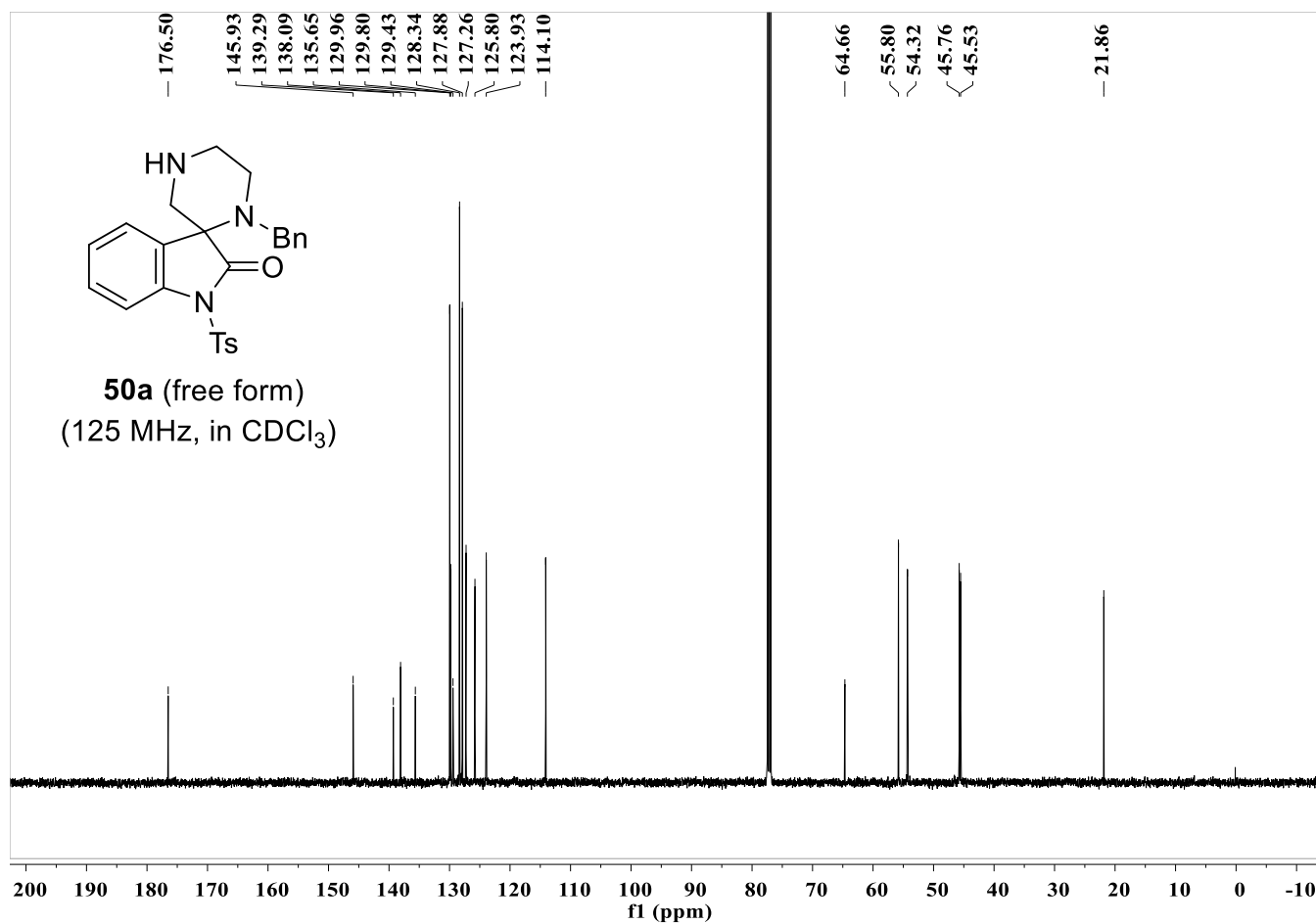
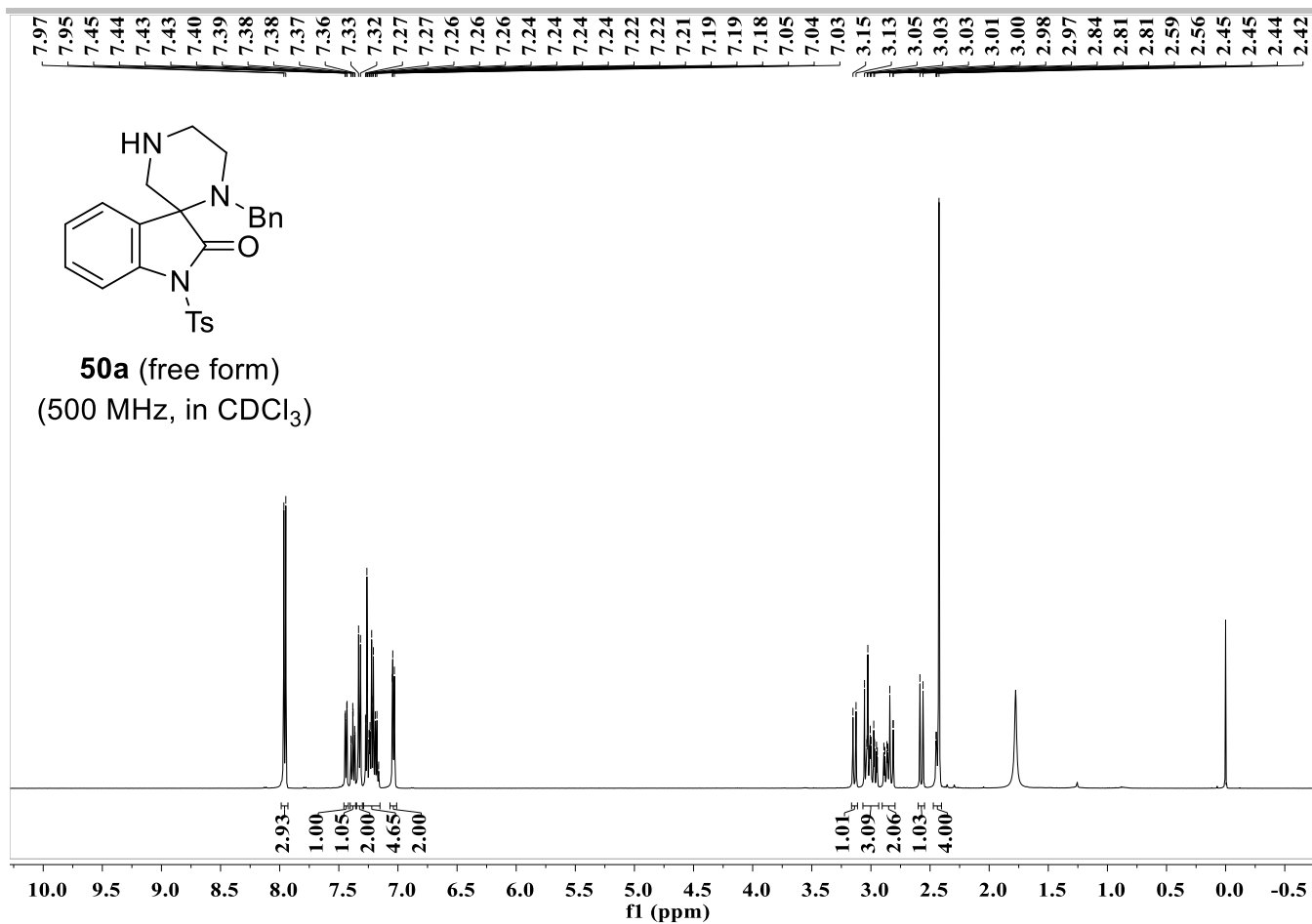


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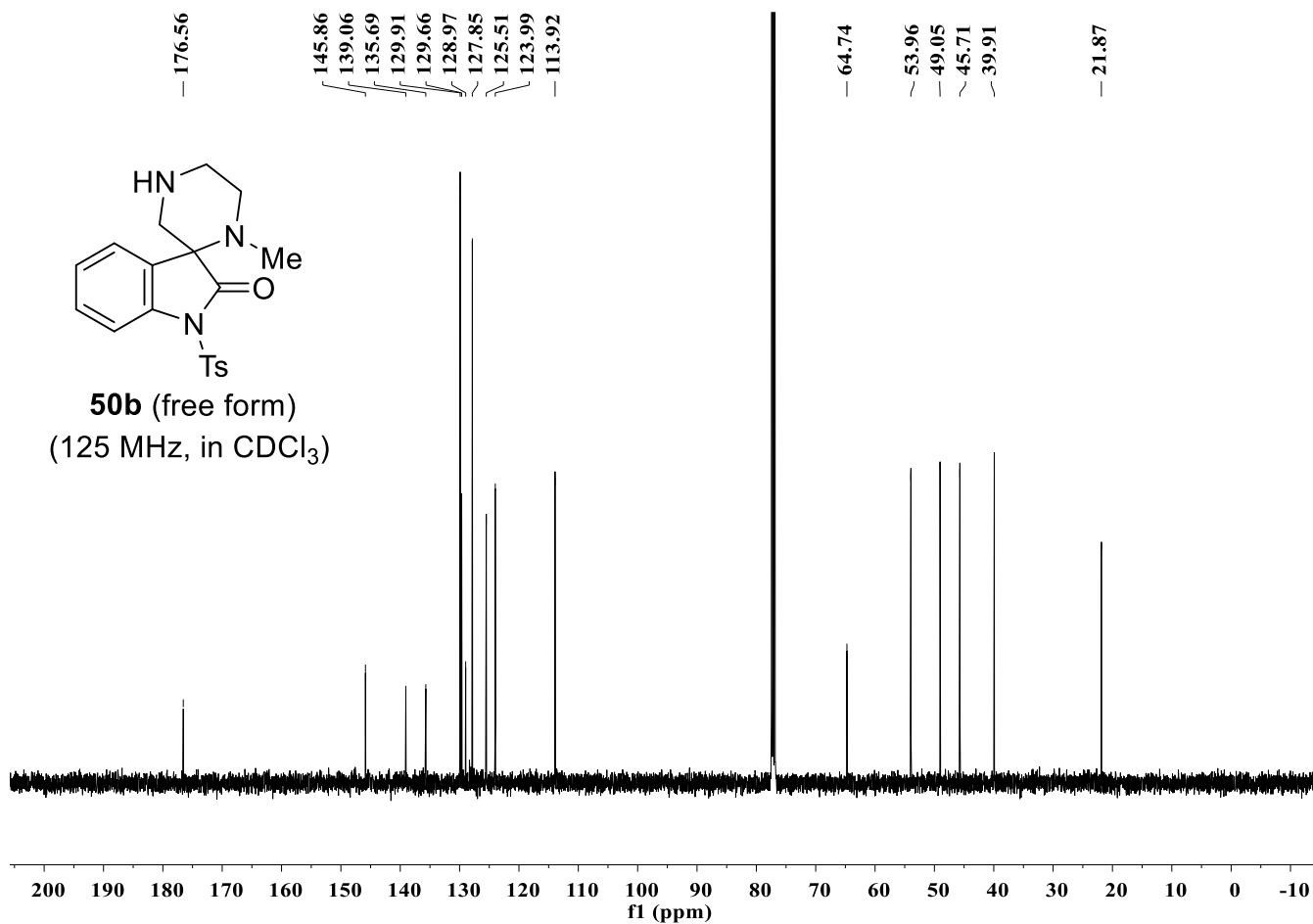
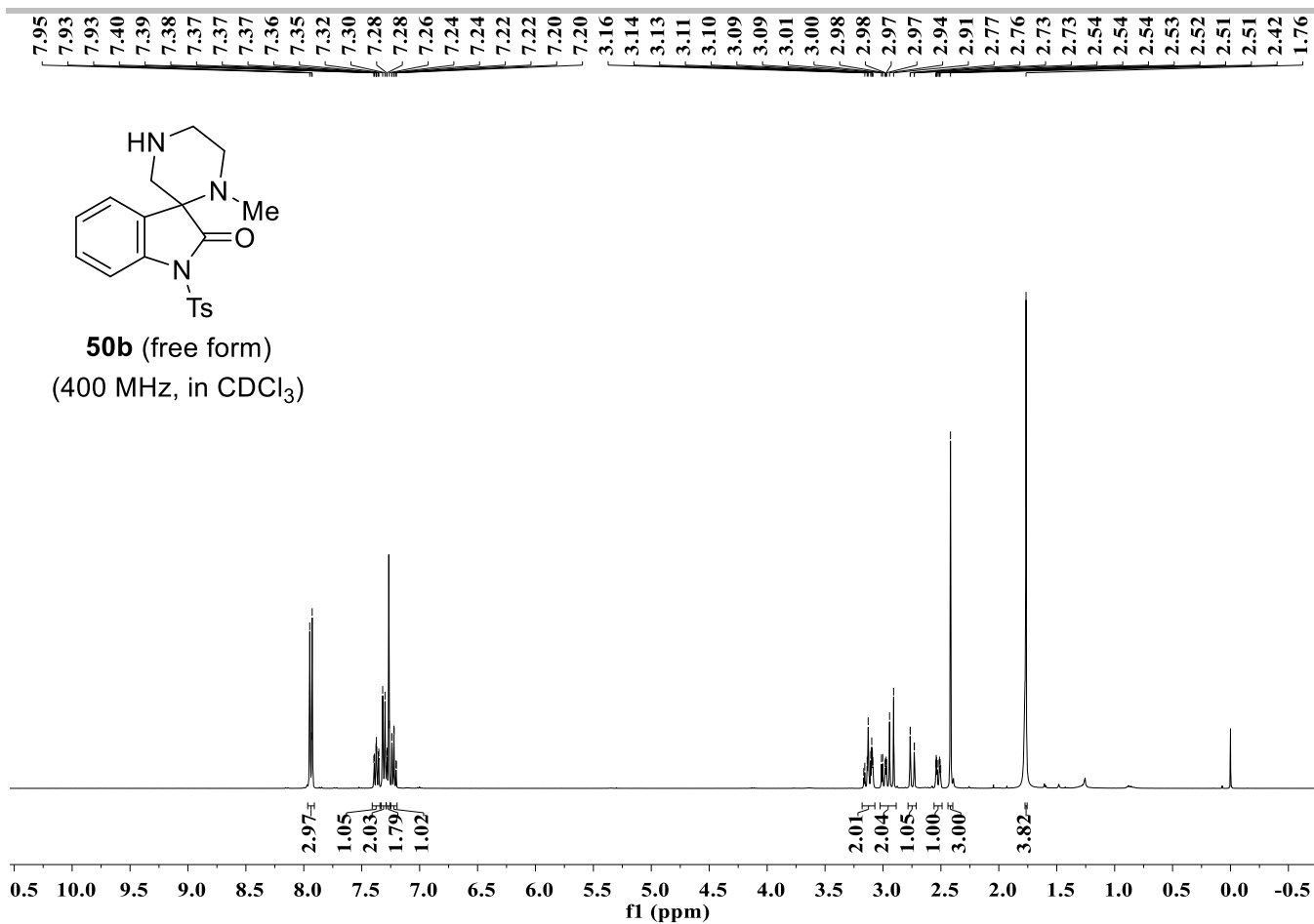




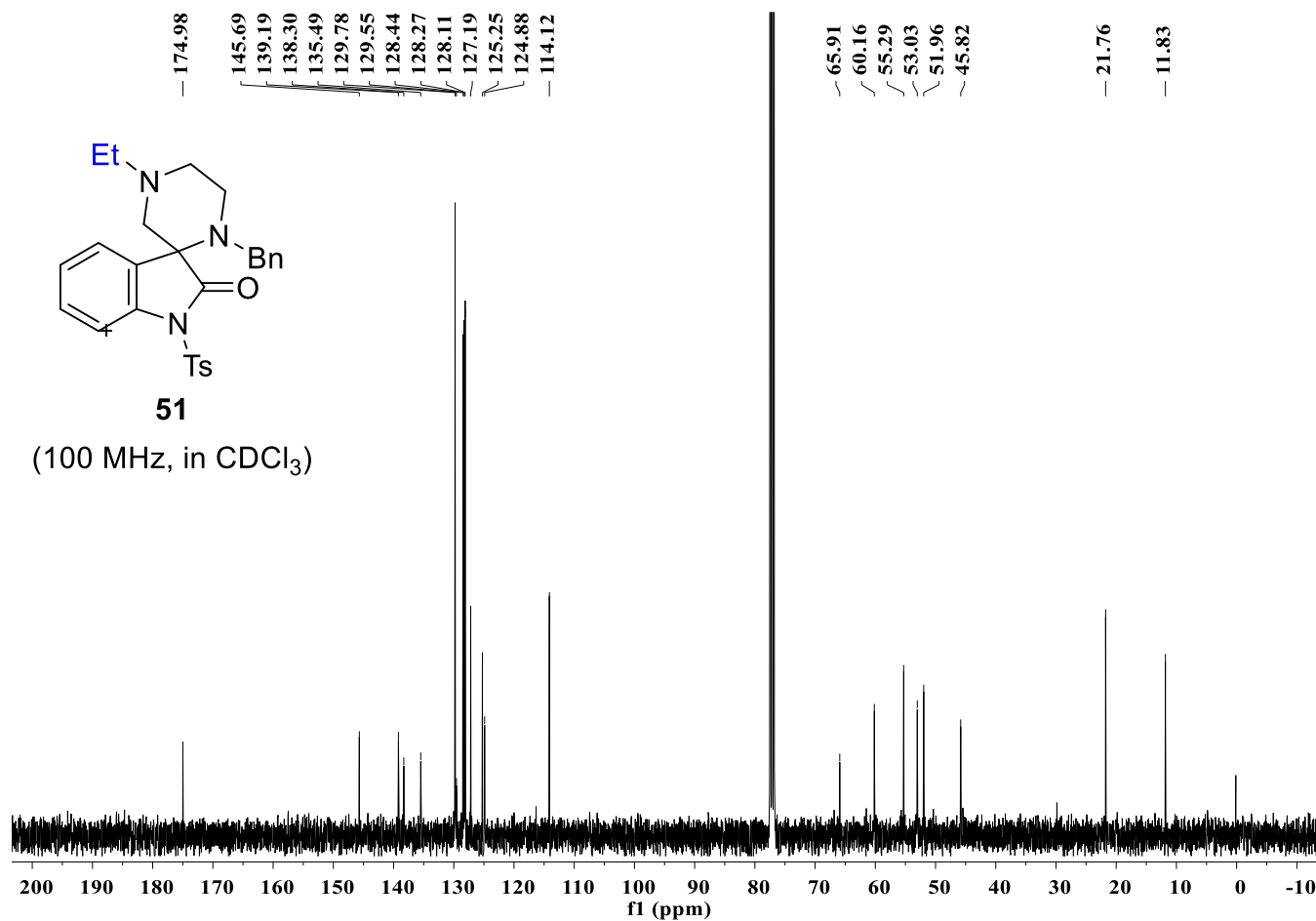
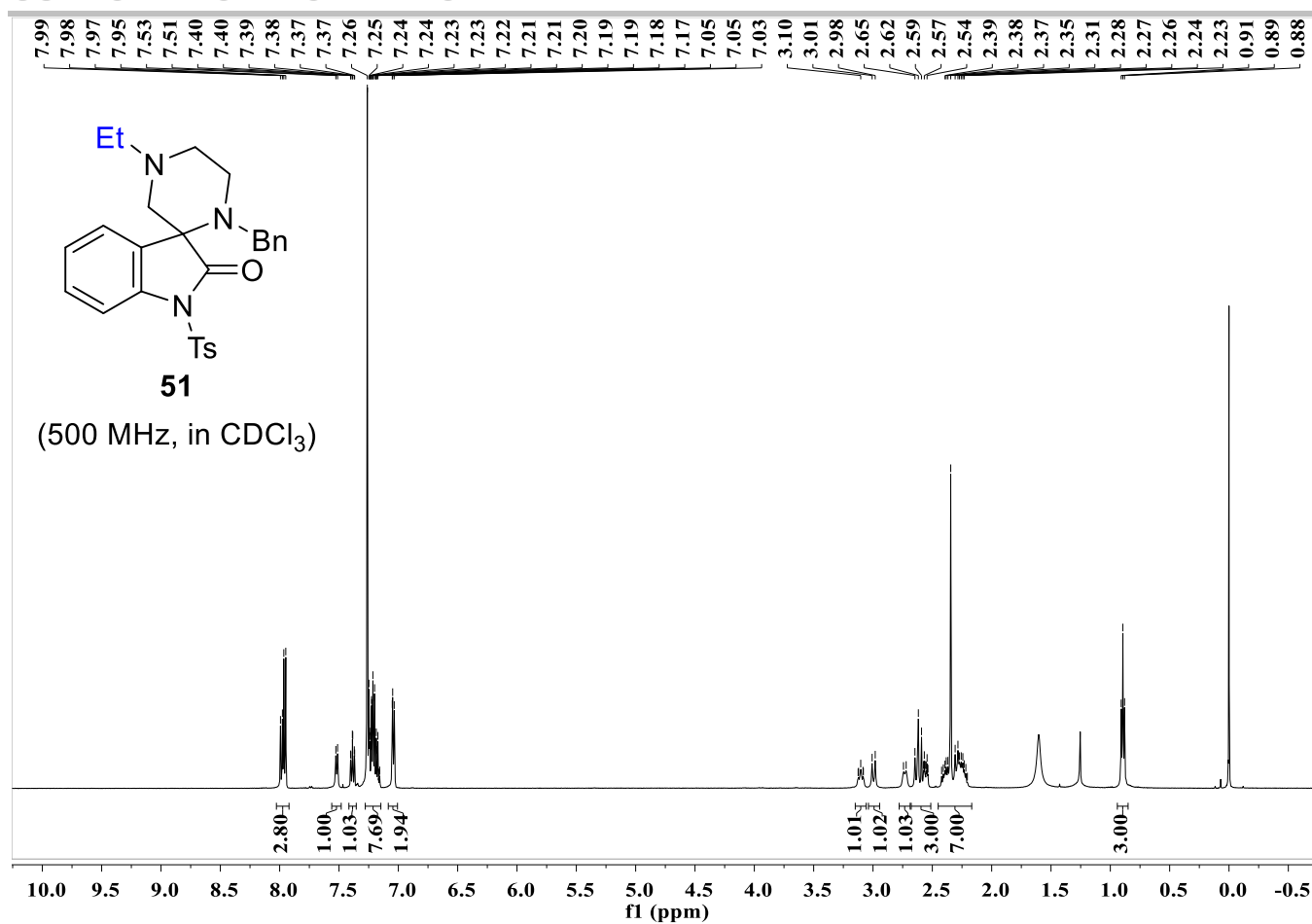
# SUPPORTING INFORMATION



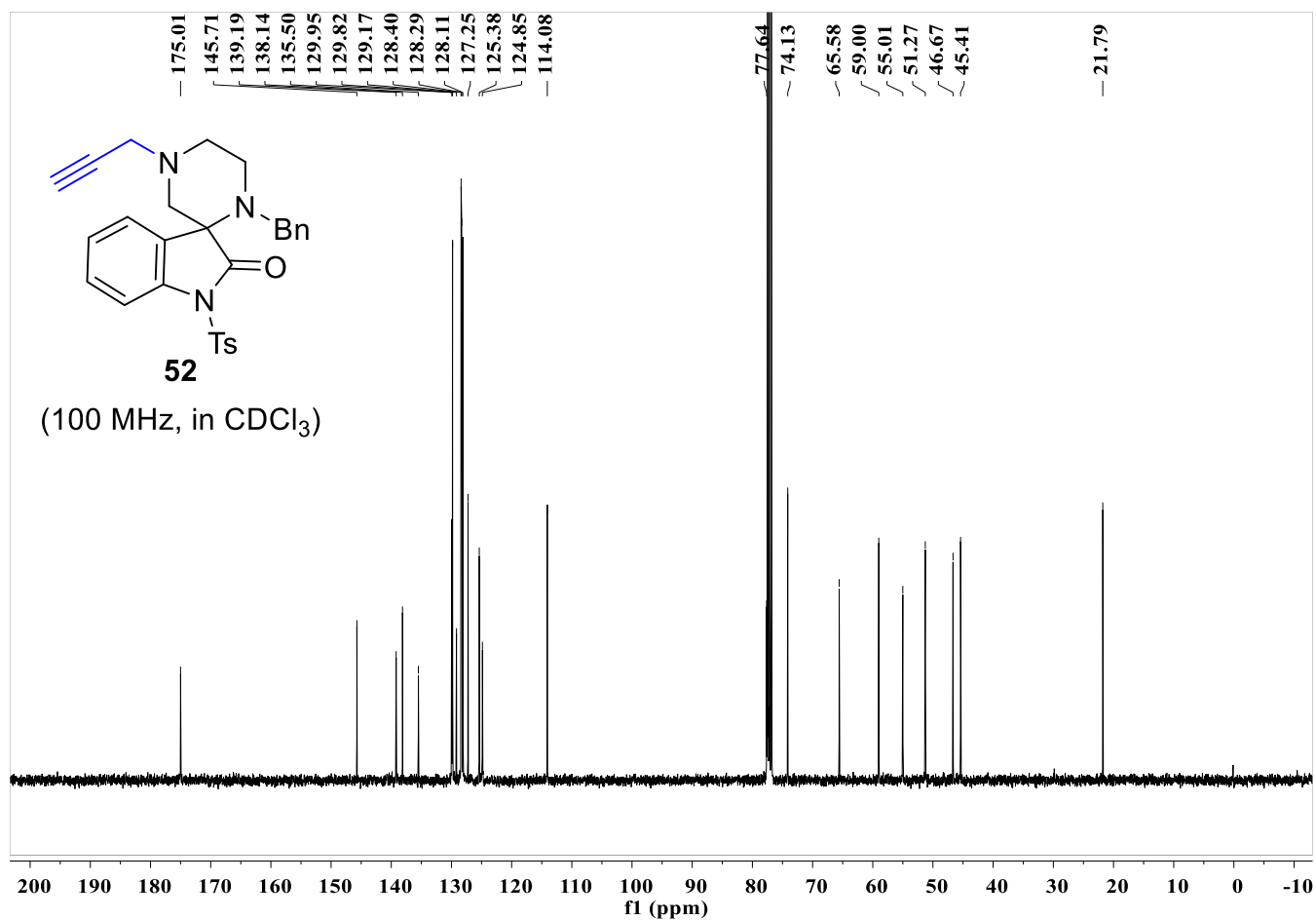
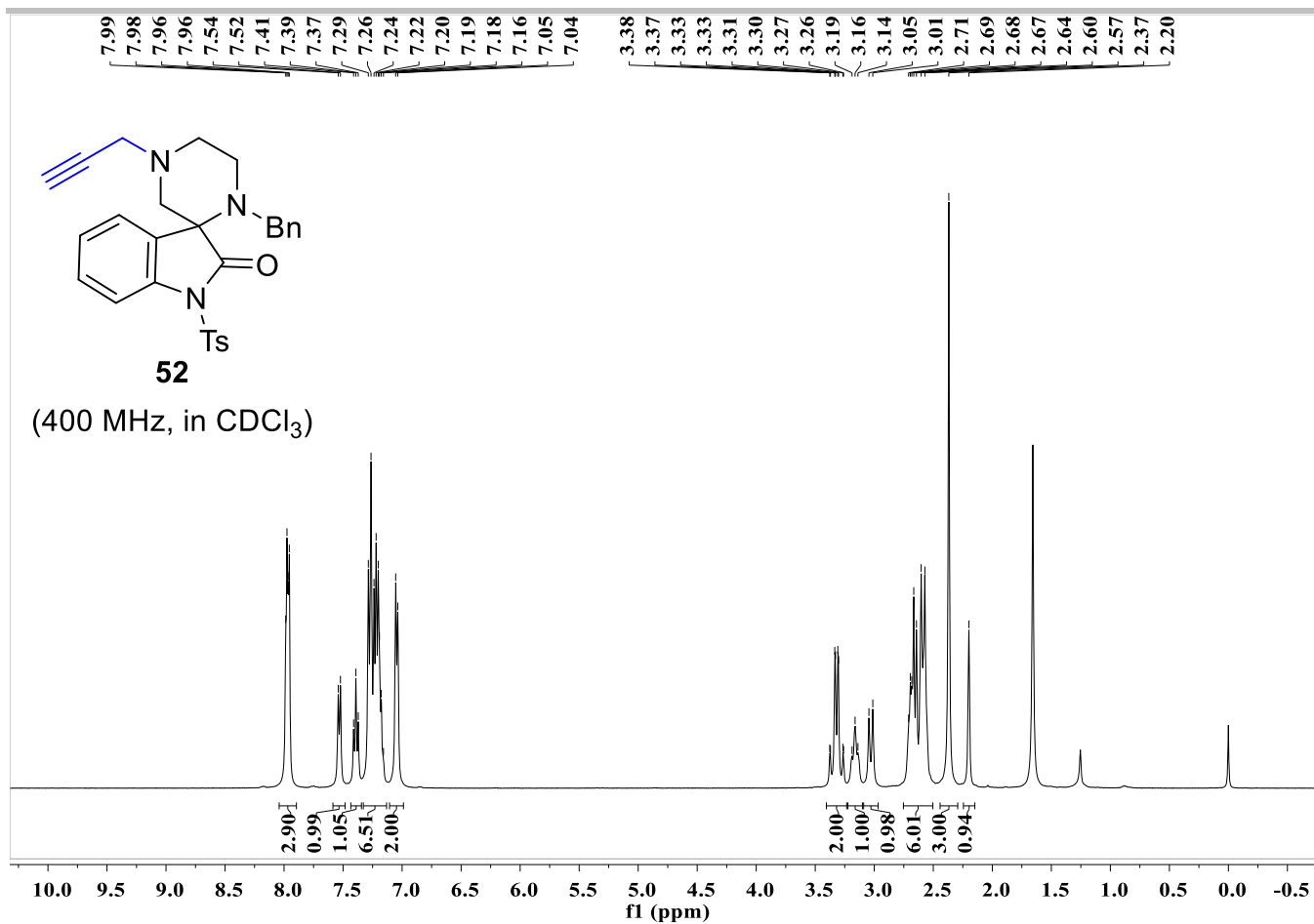
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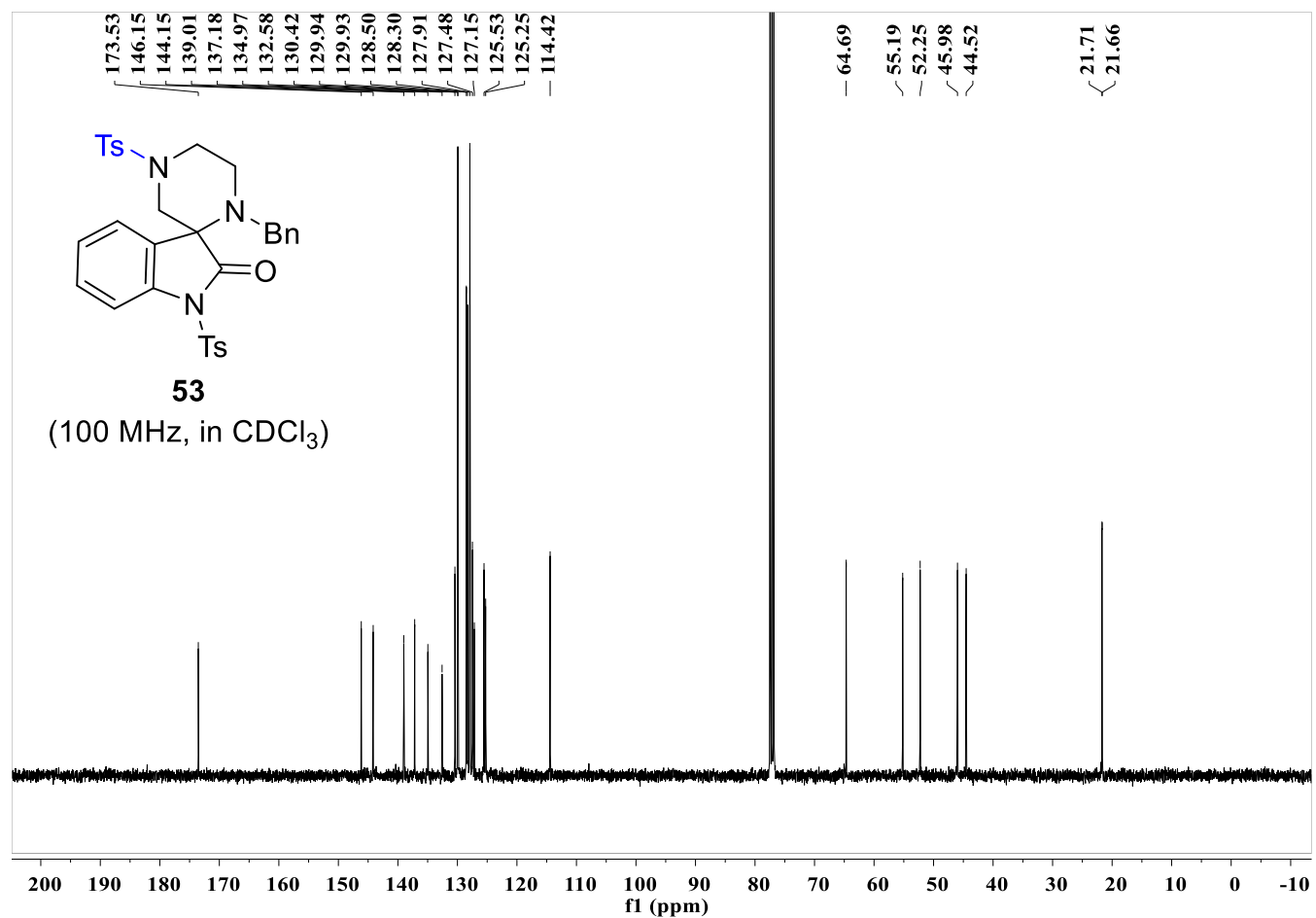
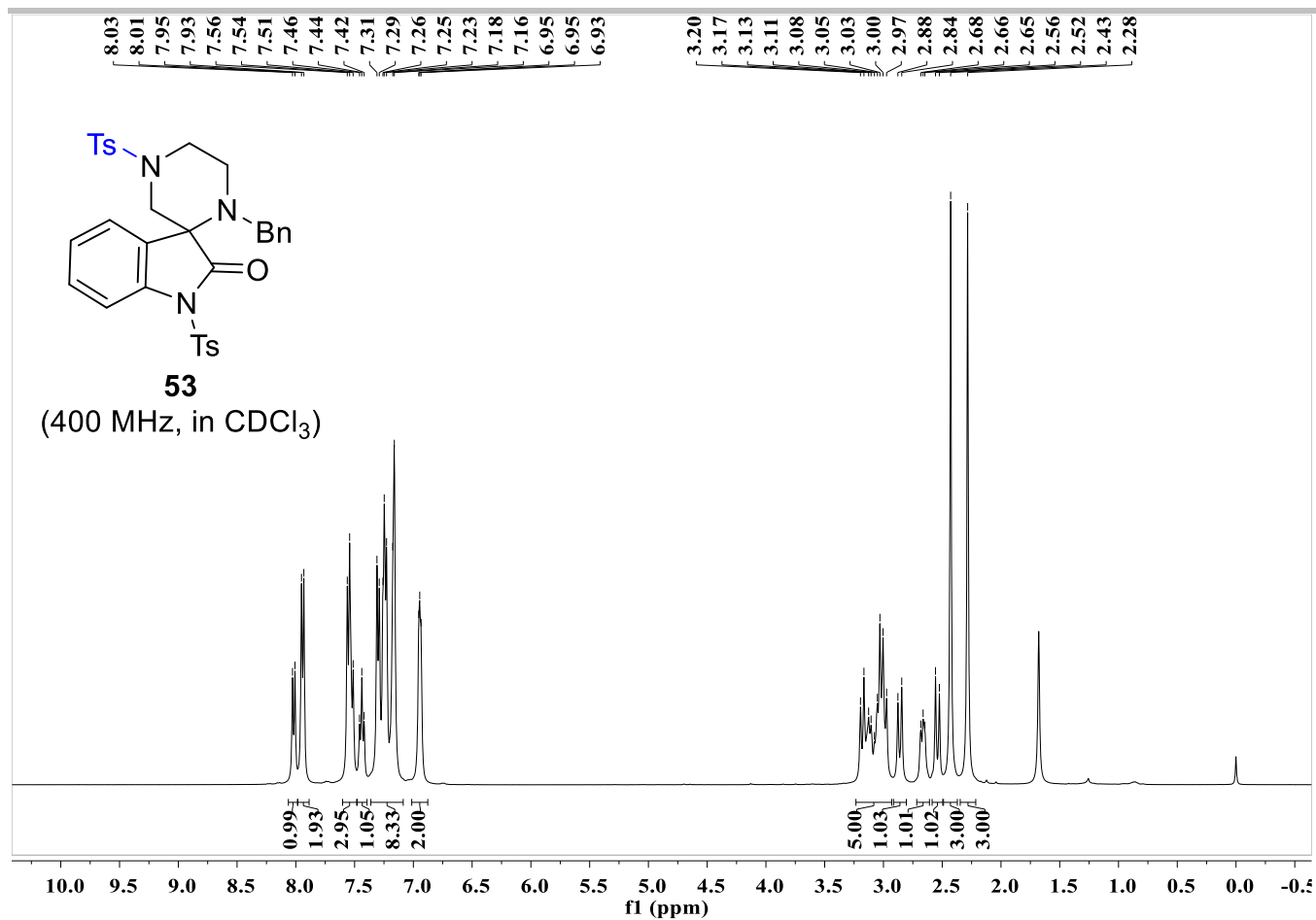
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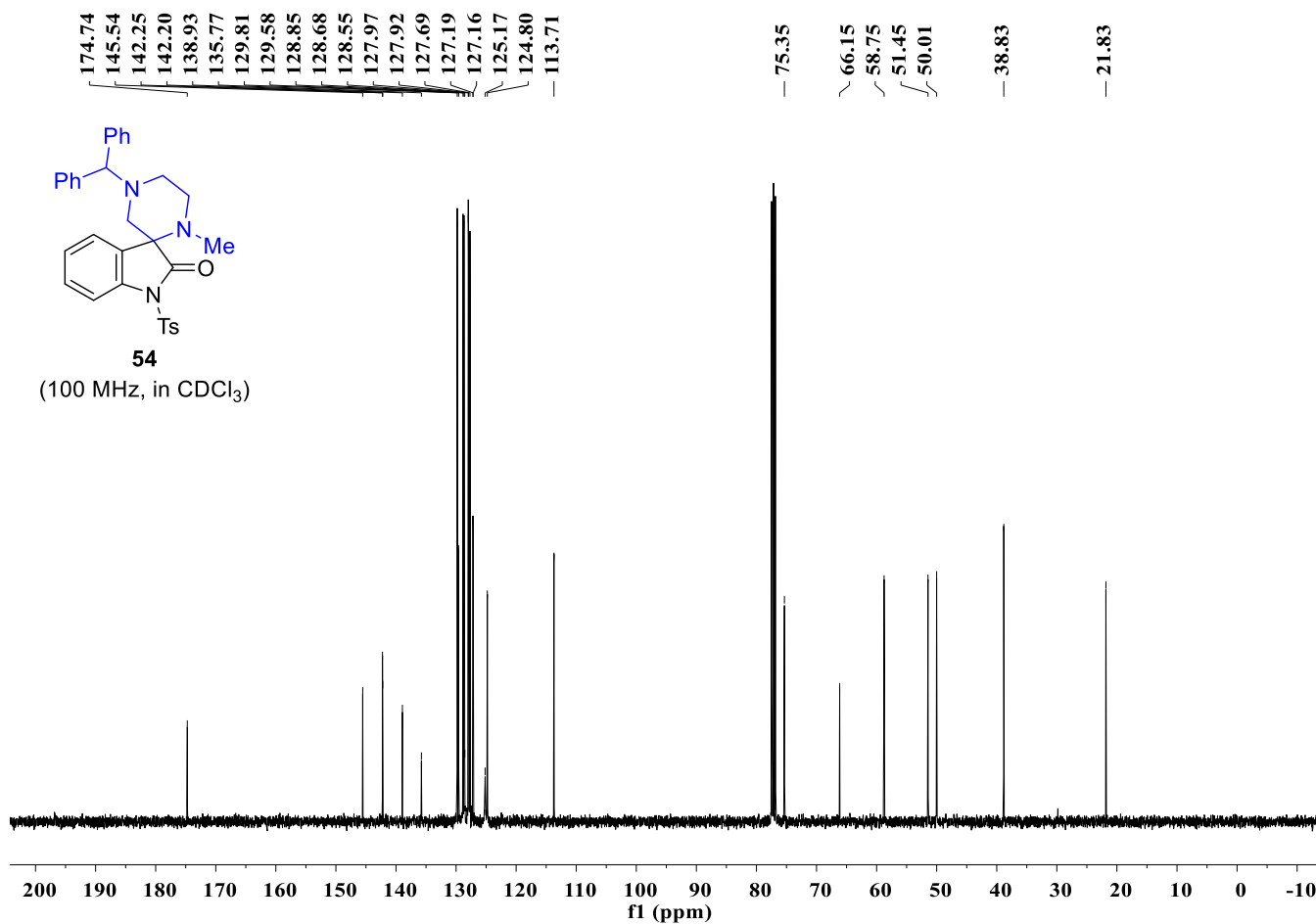
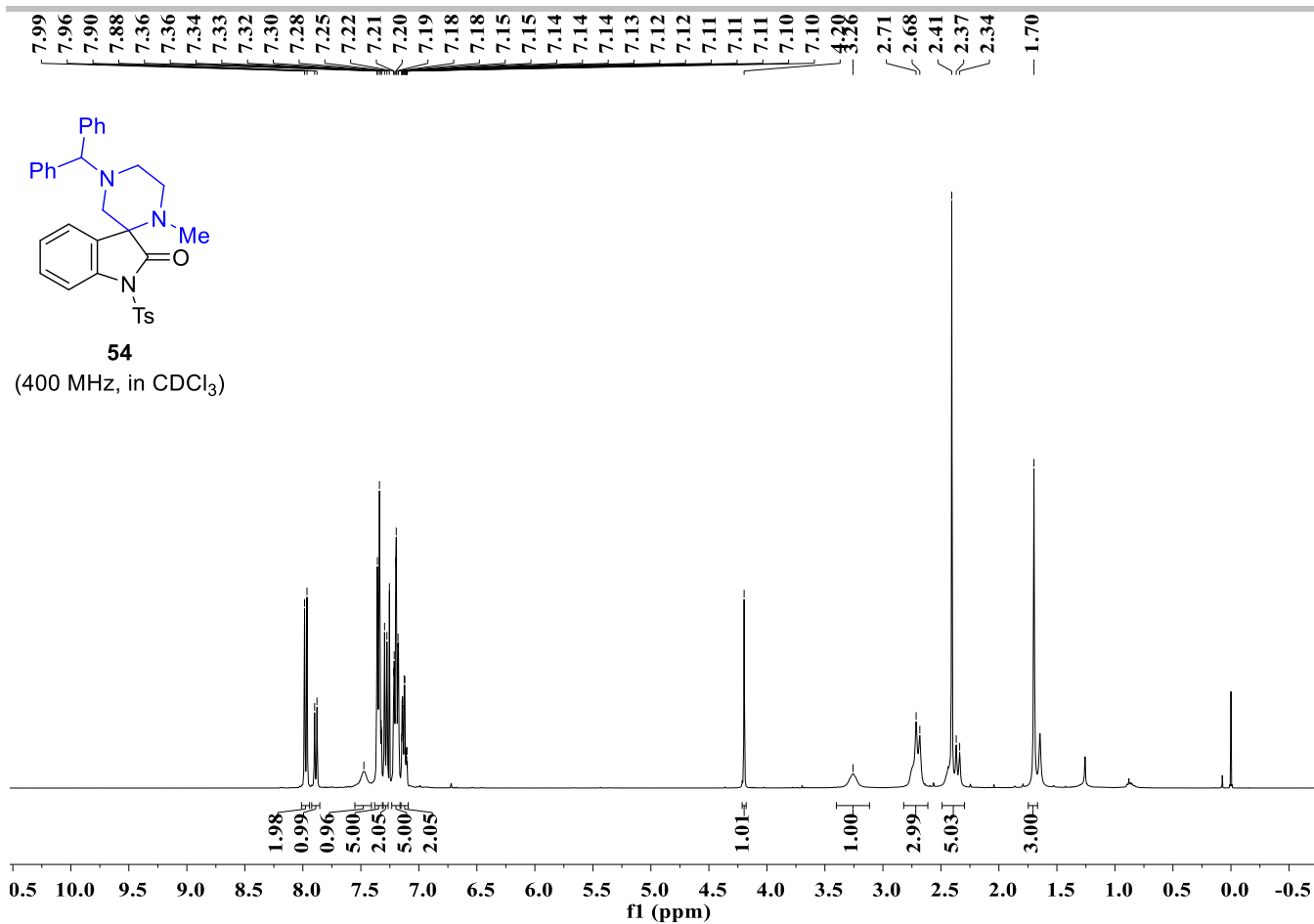
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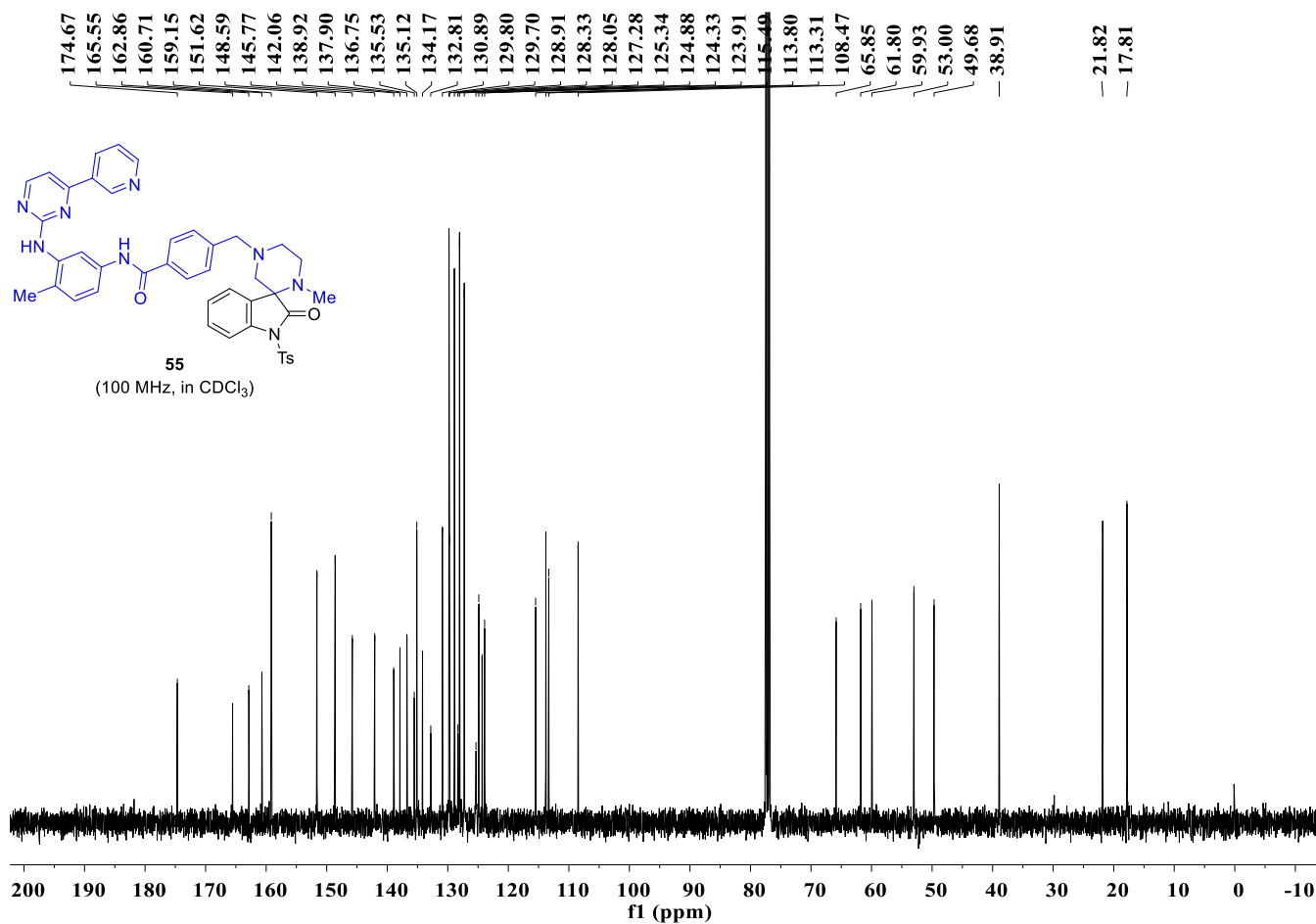
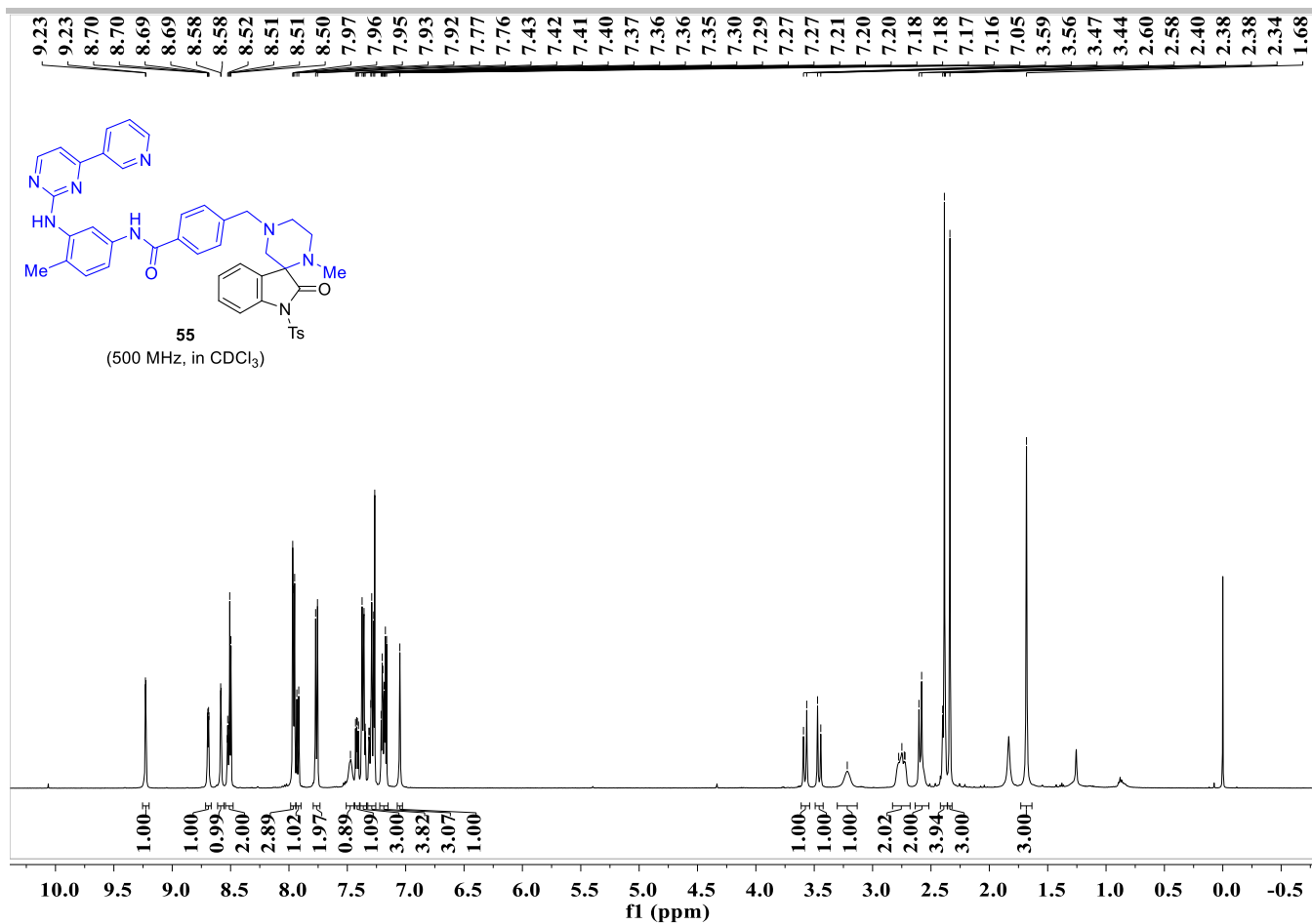
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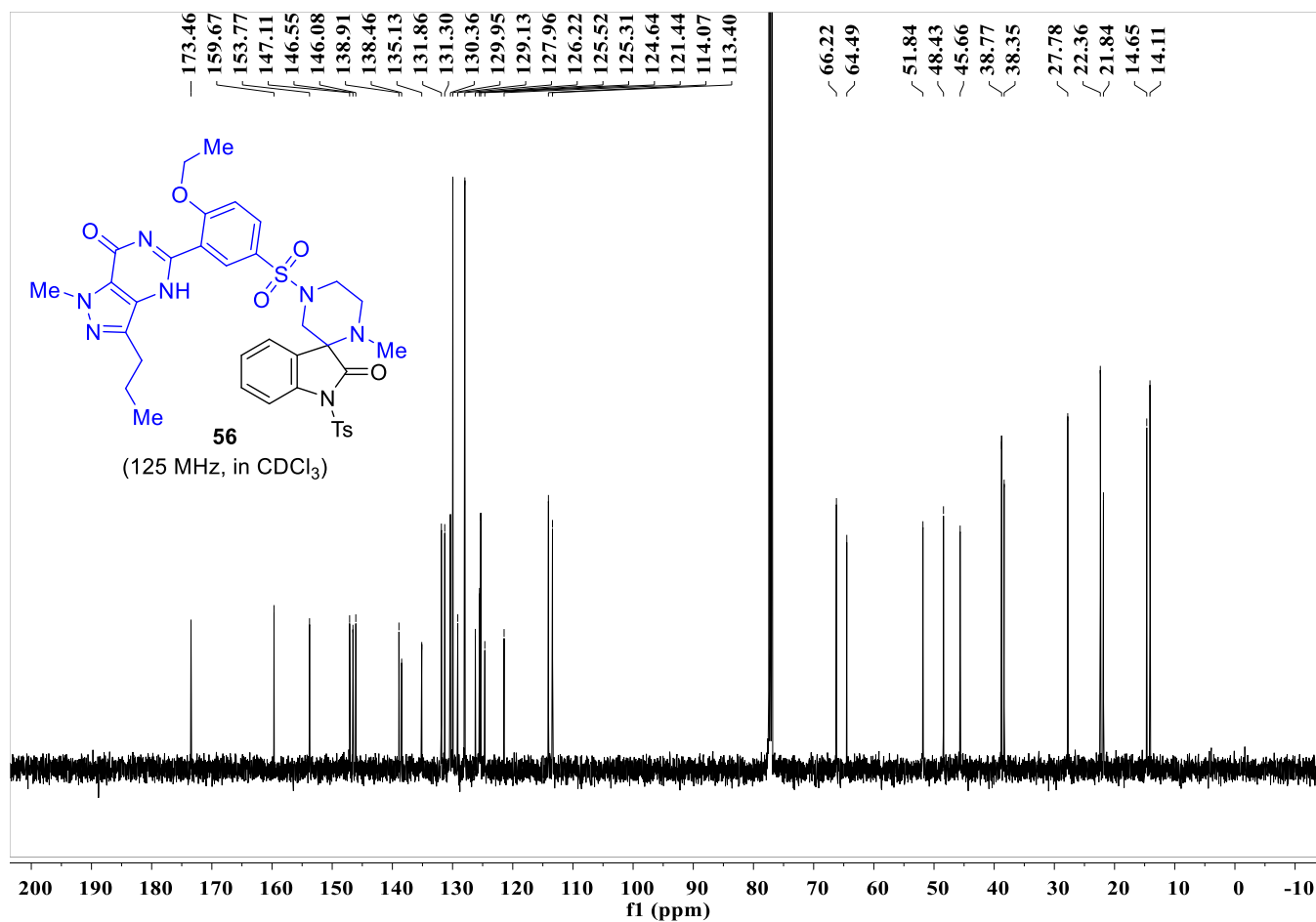
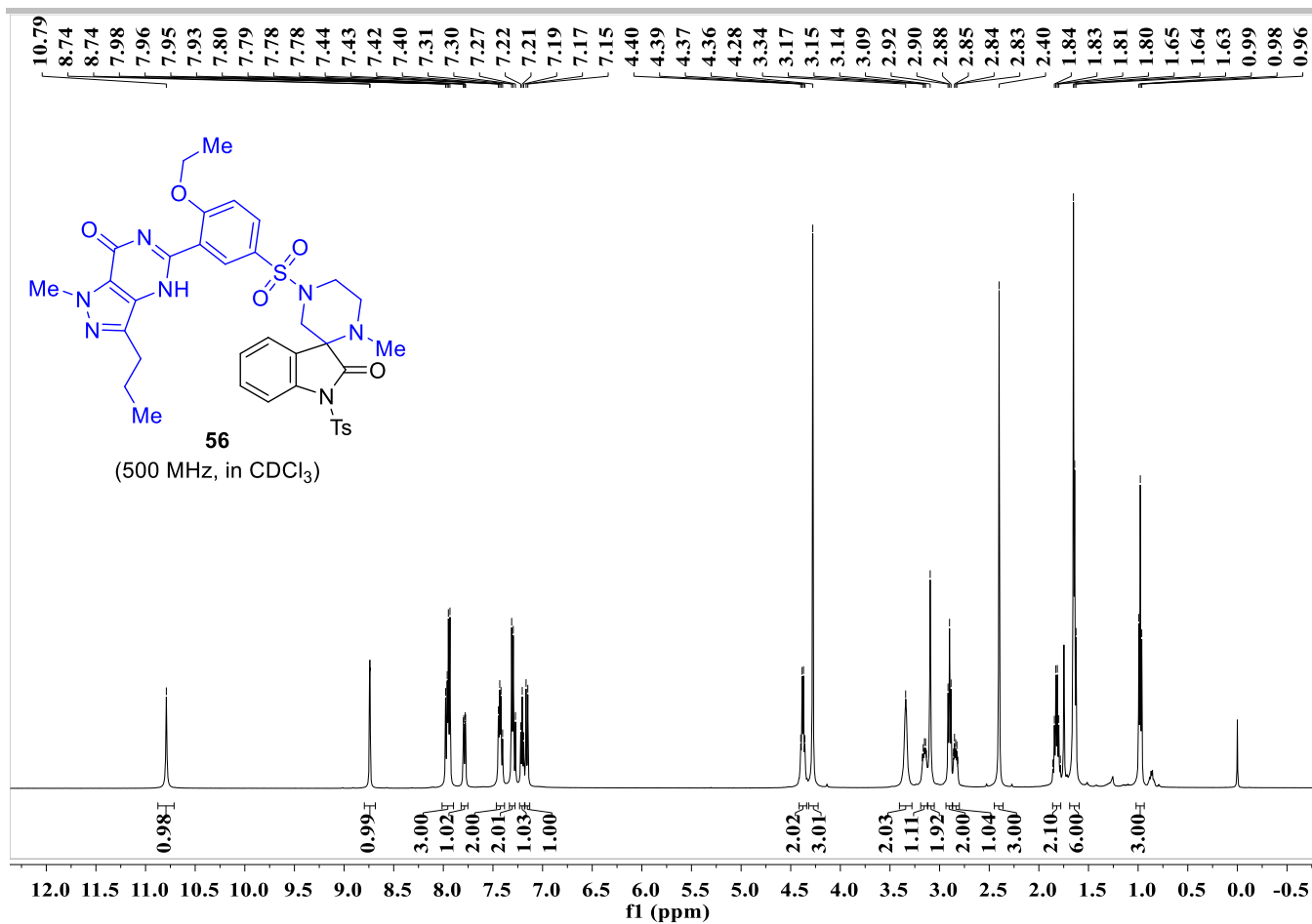
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# SUPPORTING INFORMATION

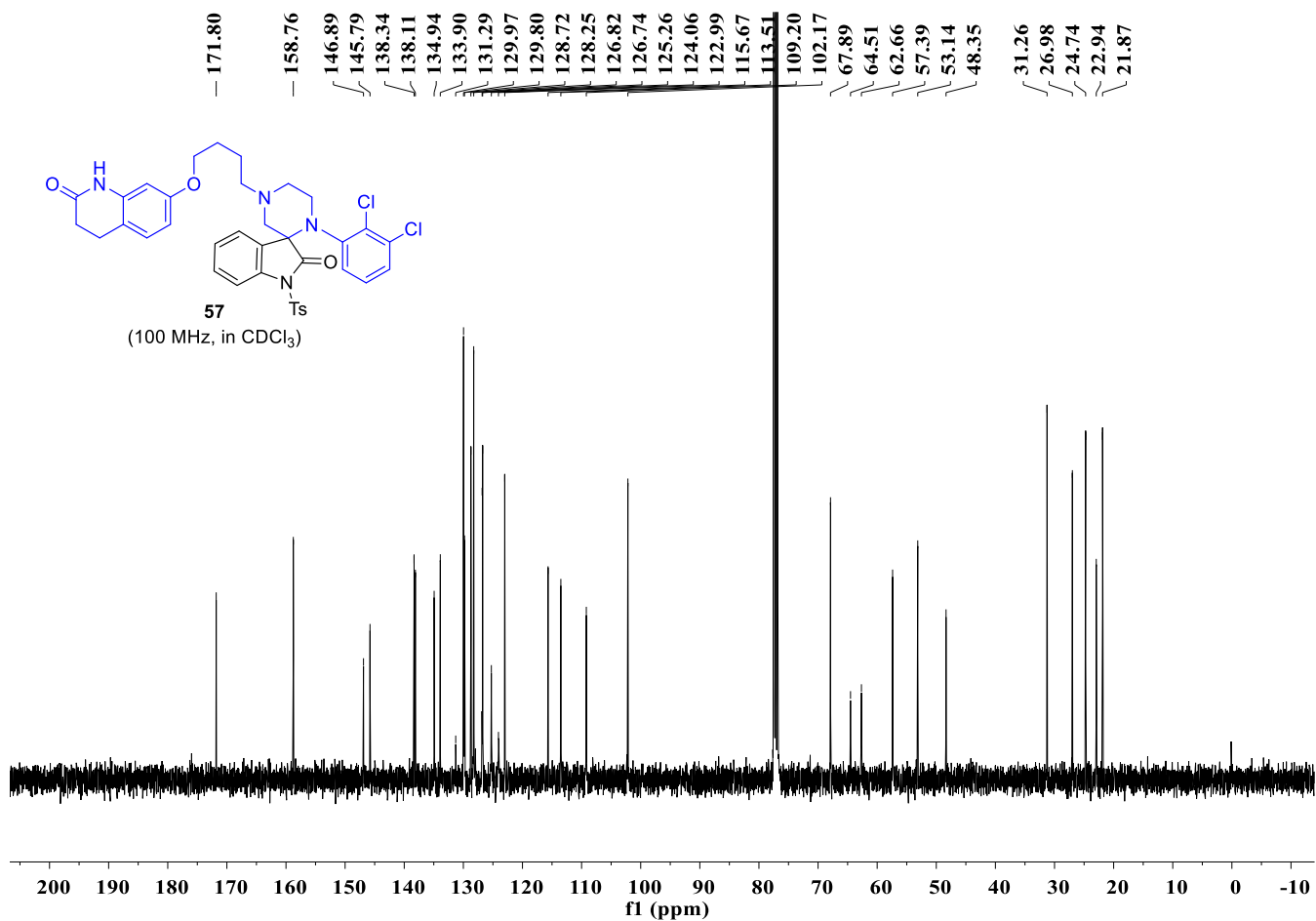
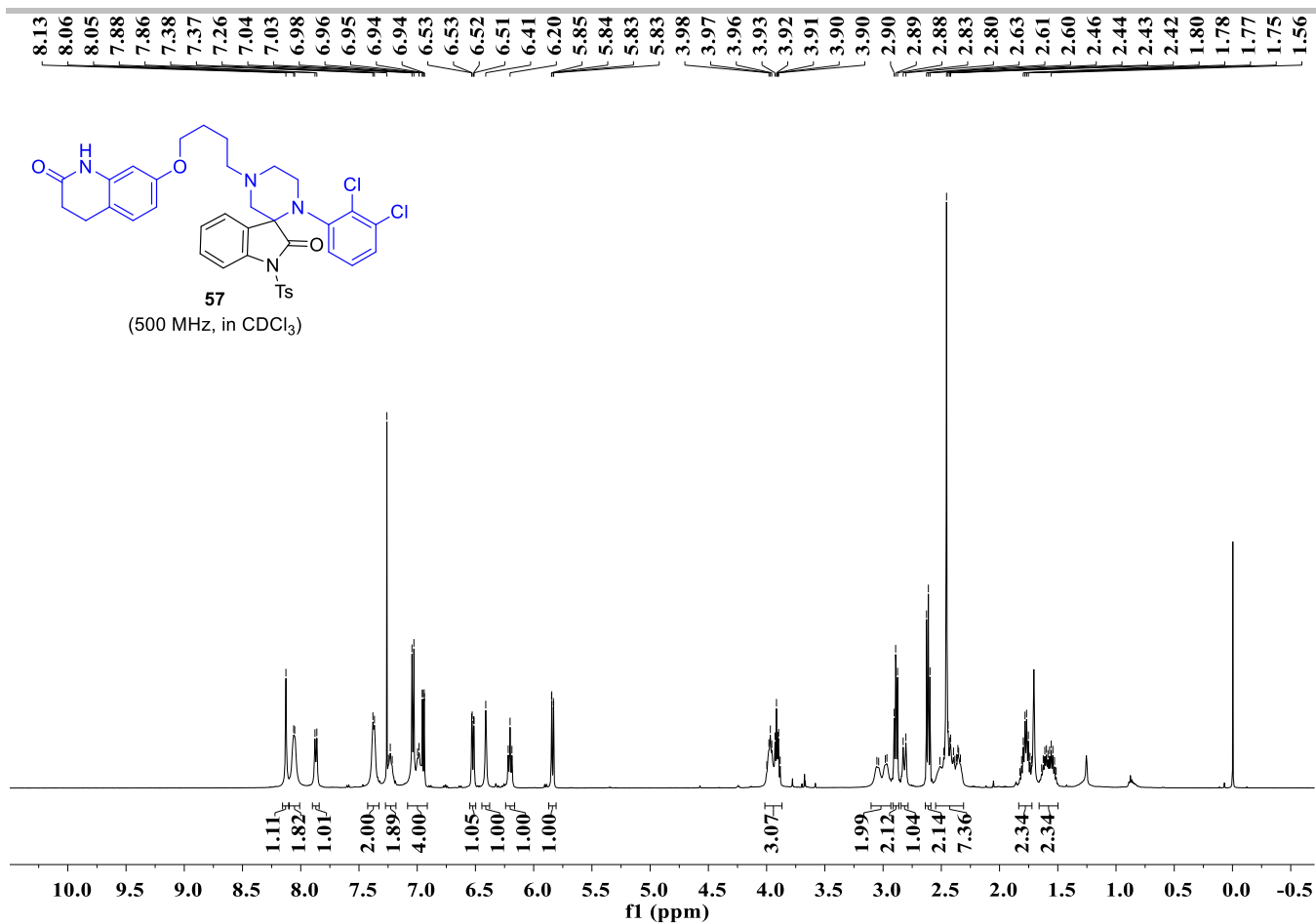


# SUPPORTING INFORMATION





# SUPPORTING INFORMATION



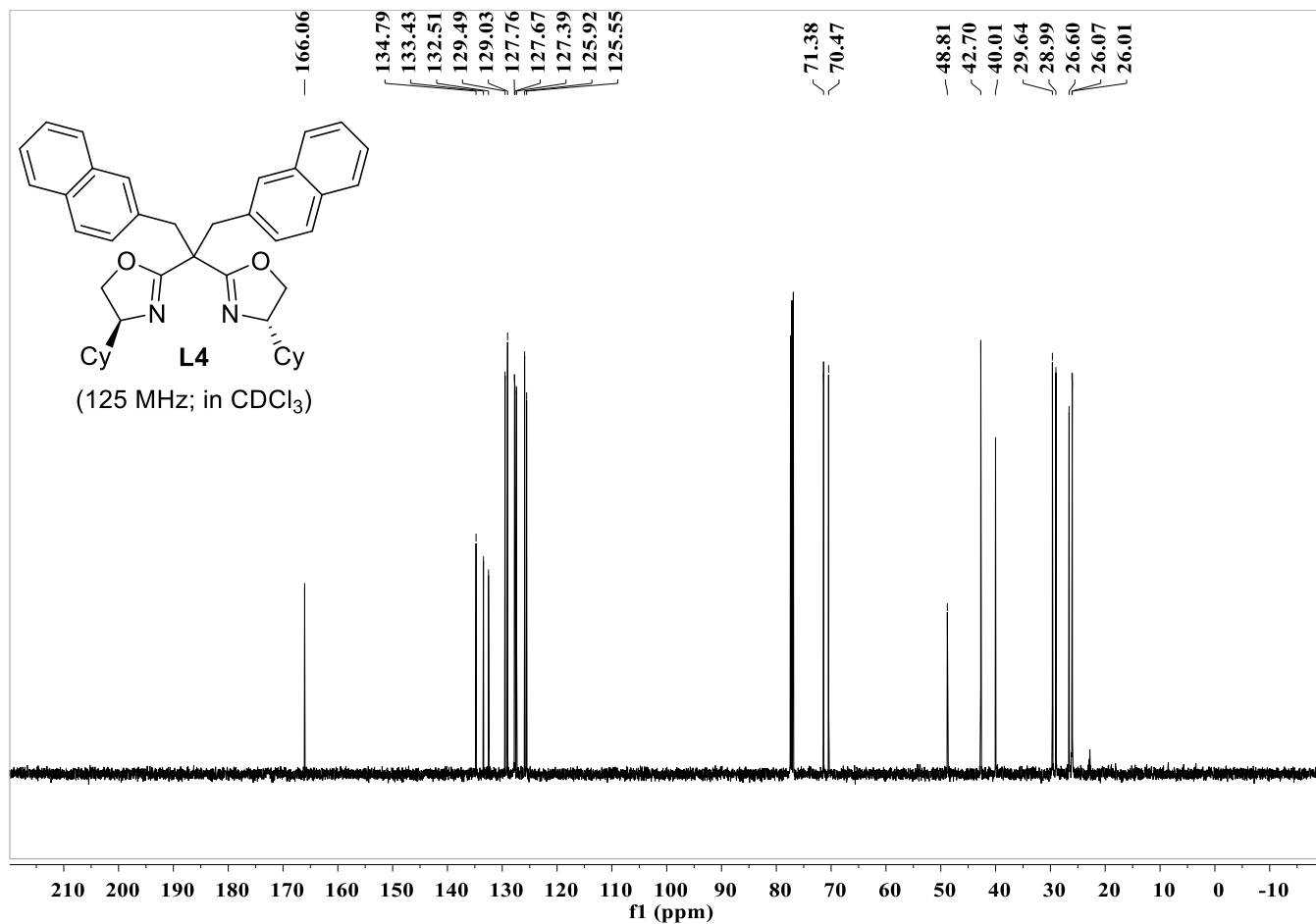
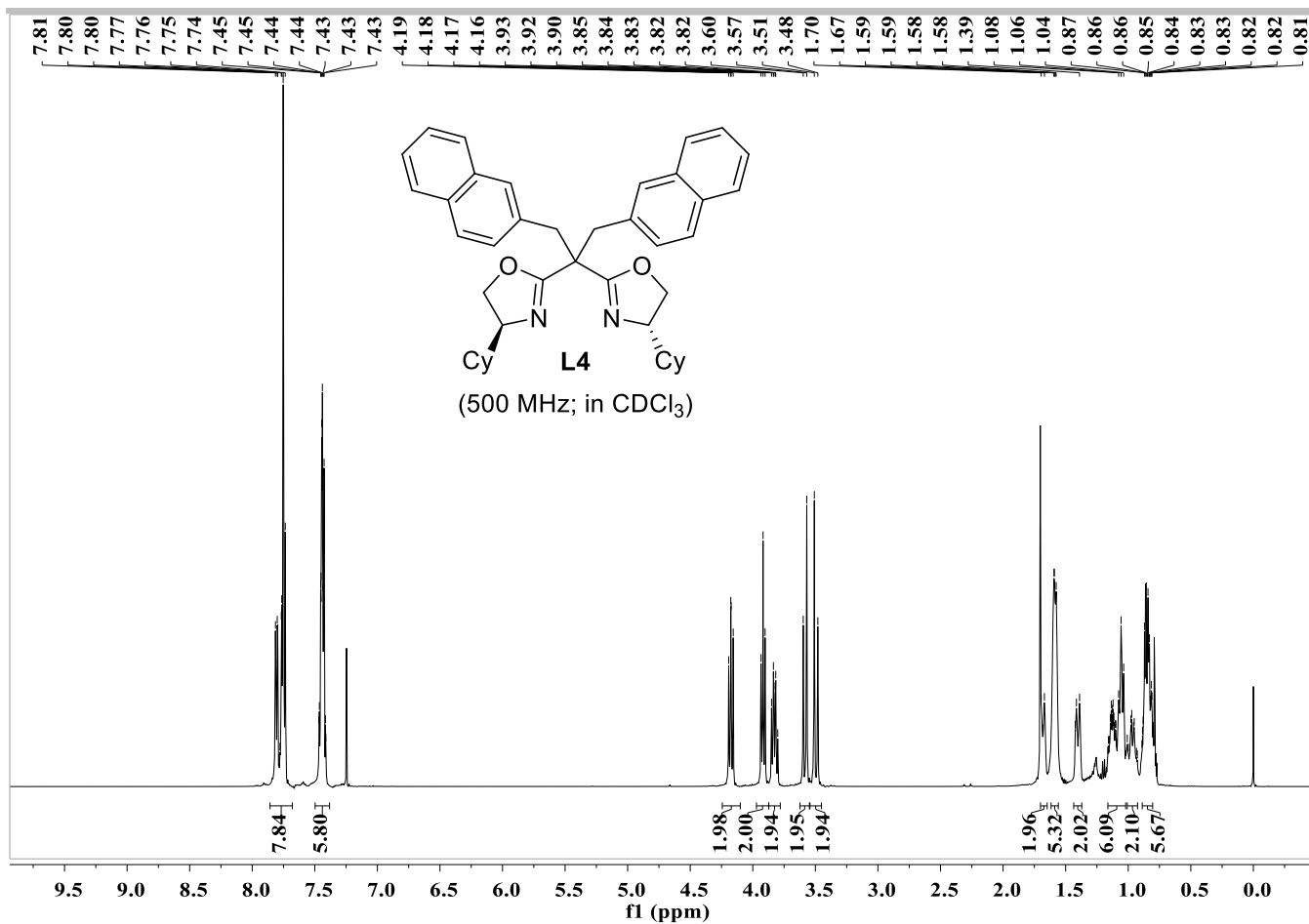
**<sup>1</sup>H NMR spectrum (500 MHz; in CDCl<sub>3</sub>)**

Chemical structure of **L3** is shown. The spectrum displays peaks in the aromatic region (7.1-7.3 ppm), a methine region (3.0-4.3 ppm), and aliphatic regions (0.9-2.3 ppm). Integration values are provided below the peaks.

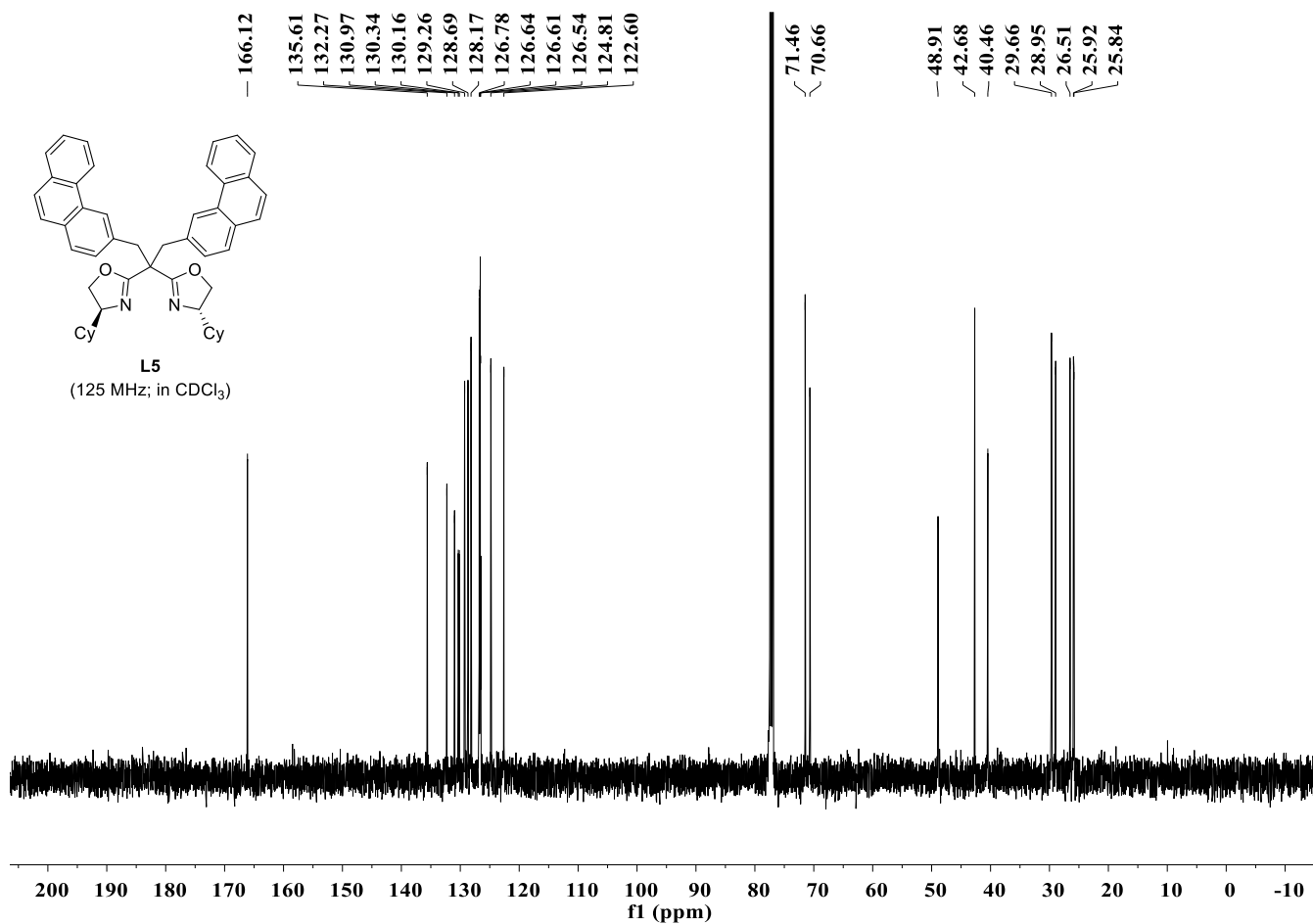
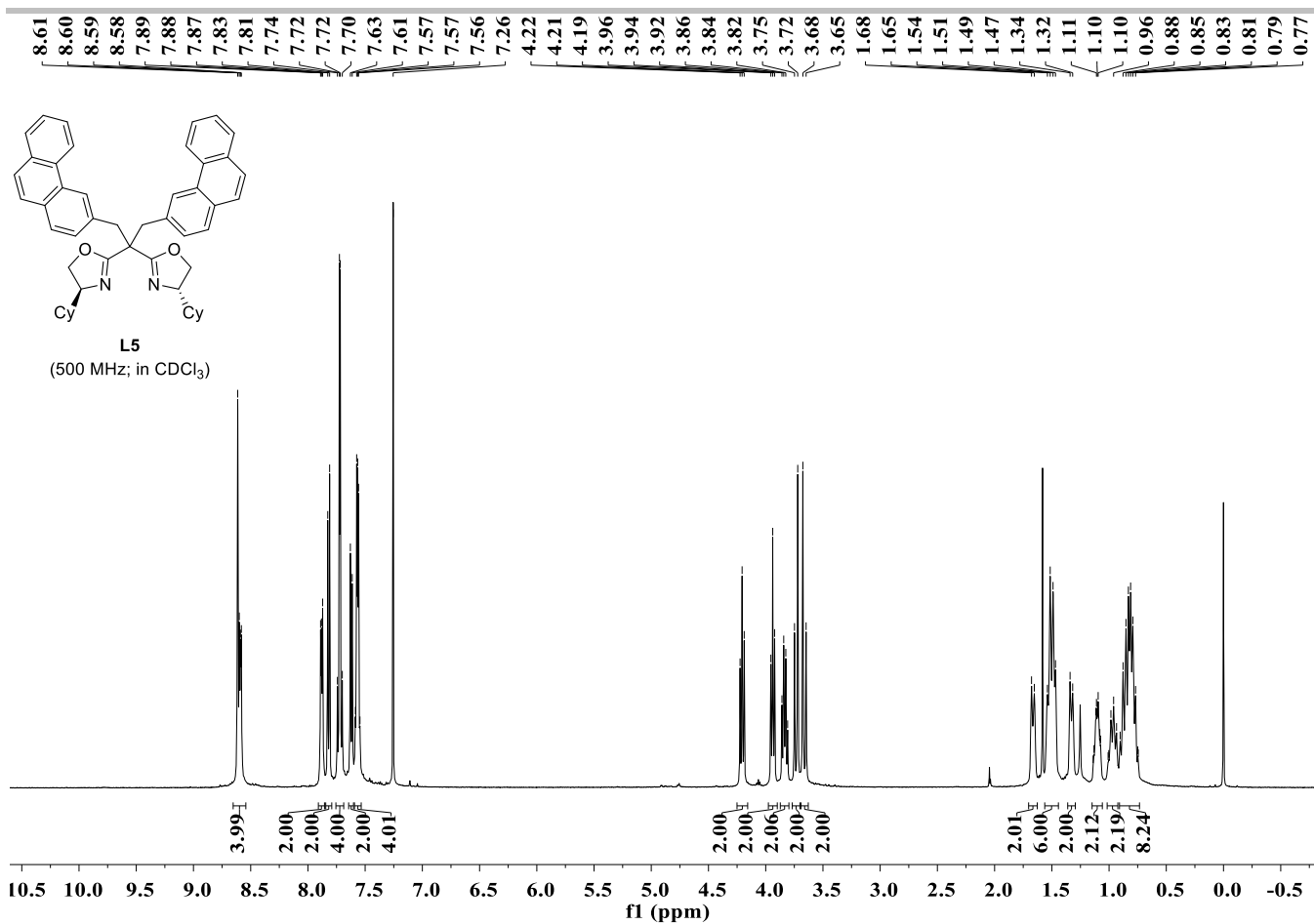
**<sup>13</sup>C NMR spectrum (125 MHz; in CDCl<sub>3</sub>)**

Chemical structure of **L3** is shown. The spectrum displays peaks in the carbonyl region (163-167 ppm), the CDCl<sub>3</sub> solvent triplet (70-71 ppm), and aliphatic regions (26-43 ppm).

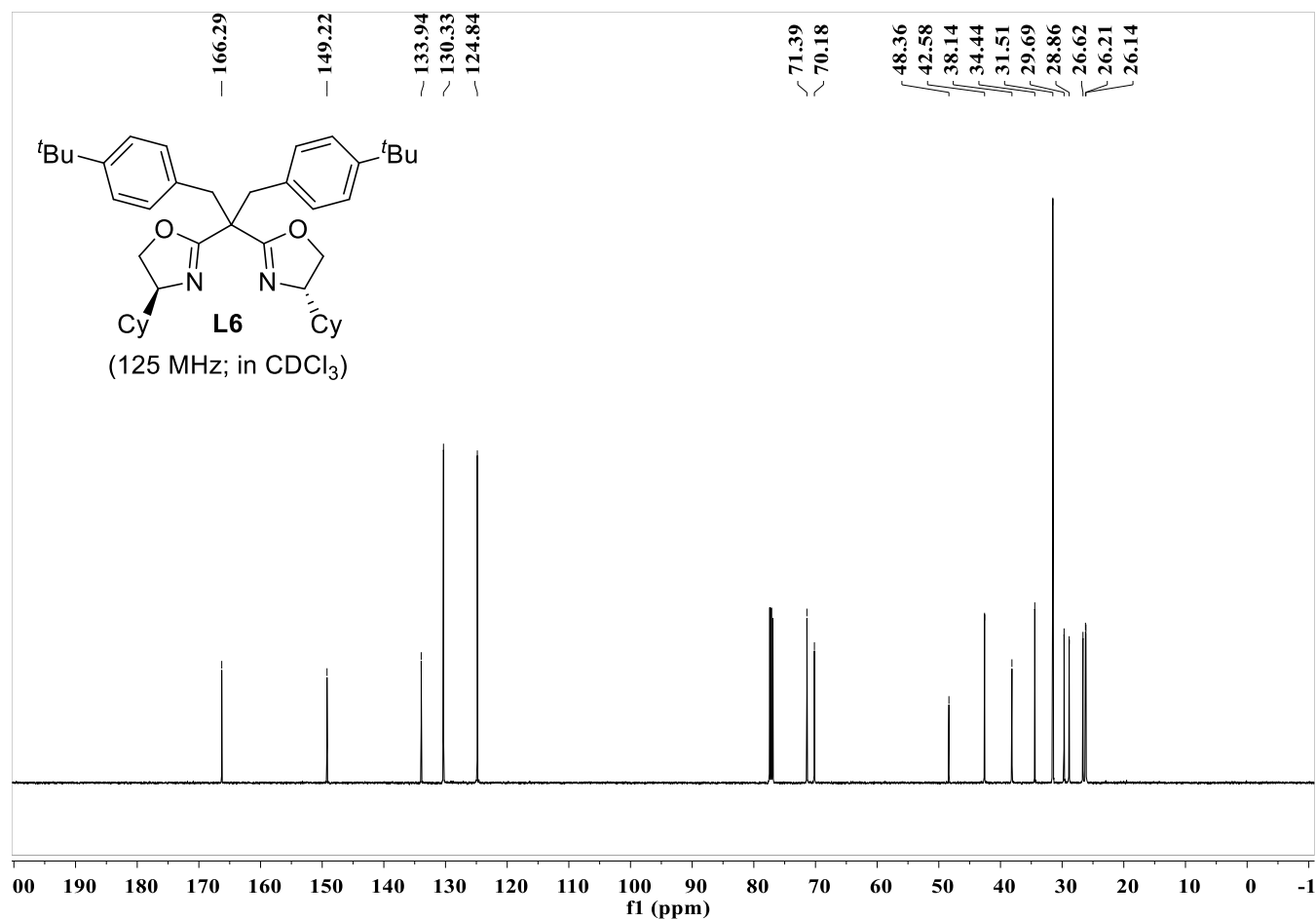
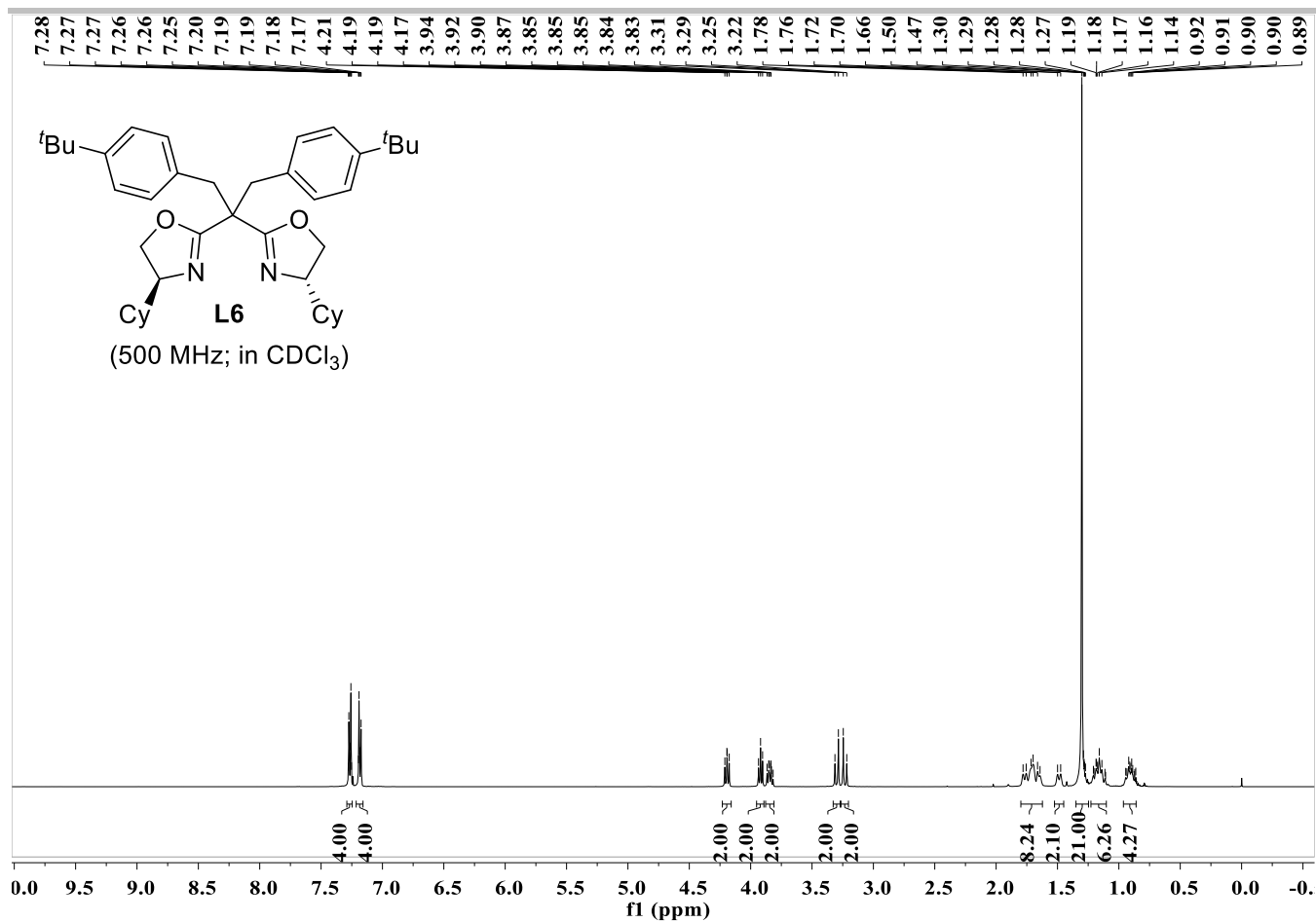
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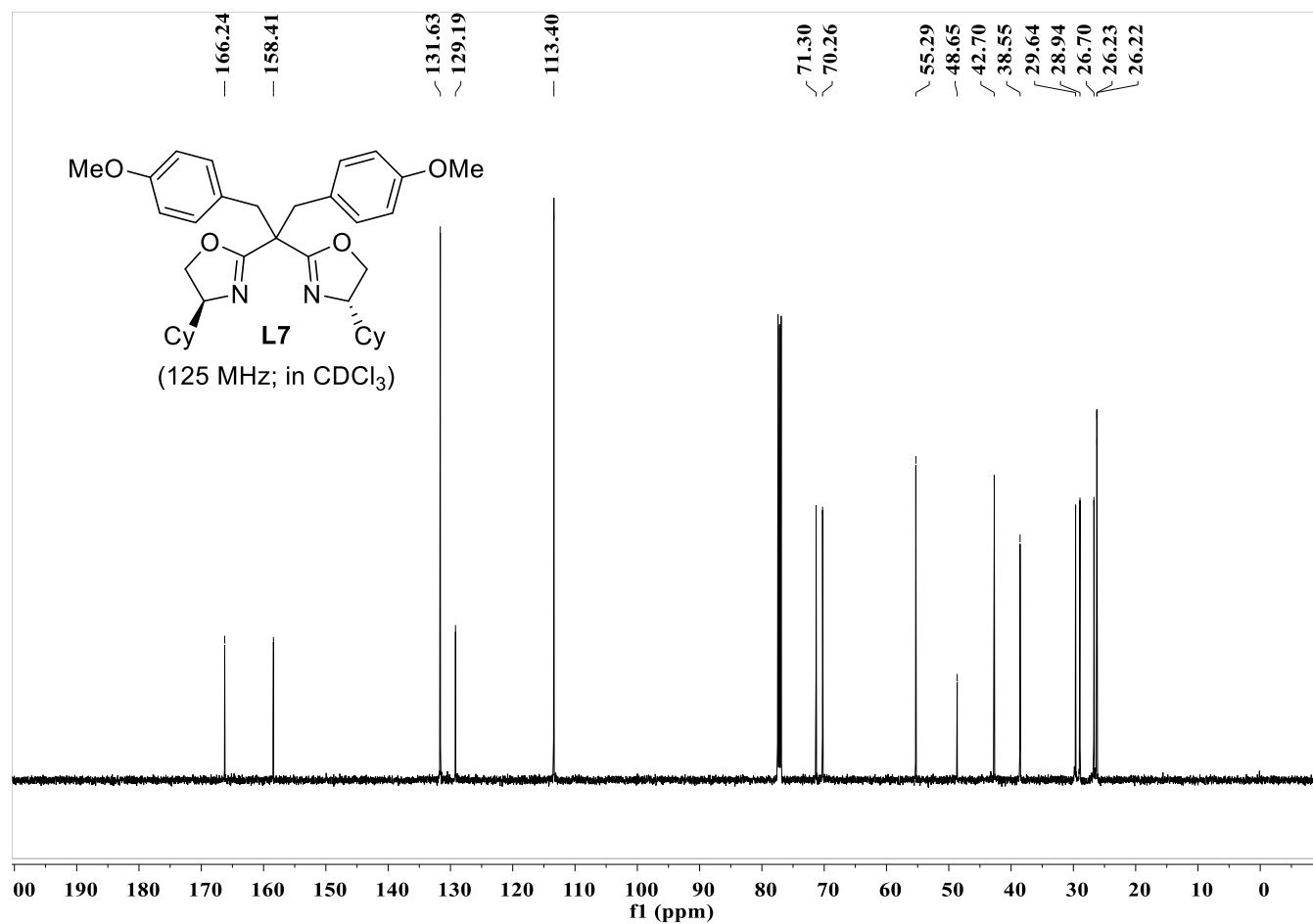
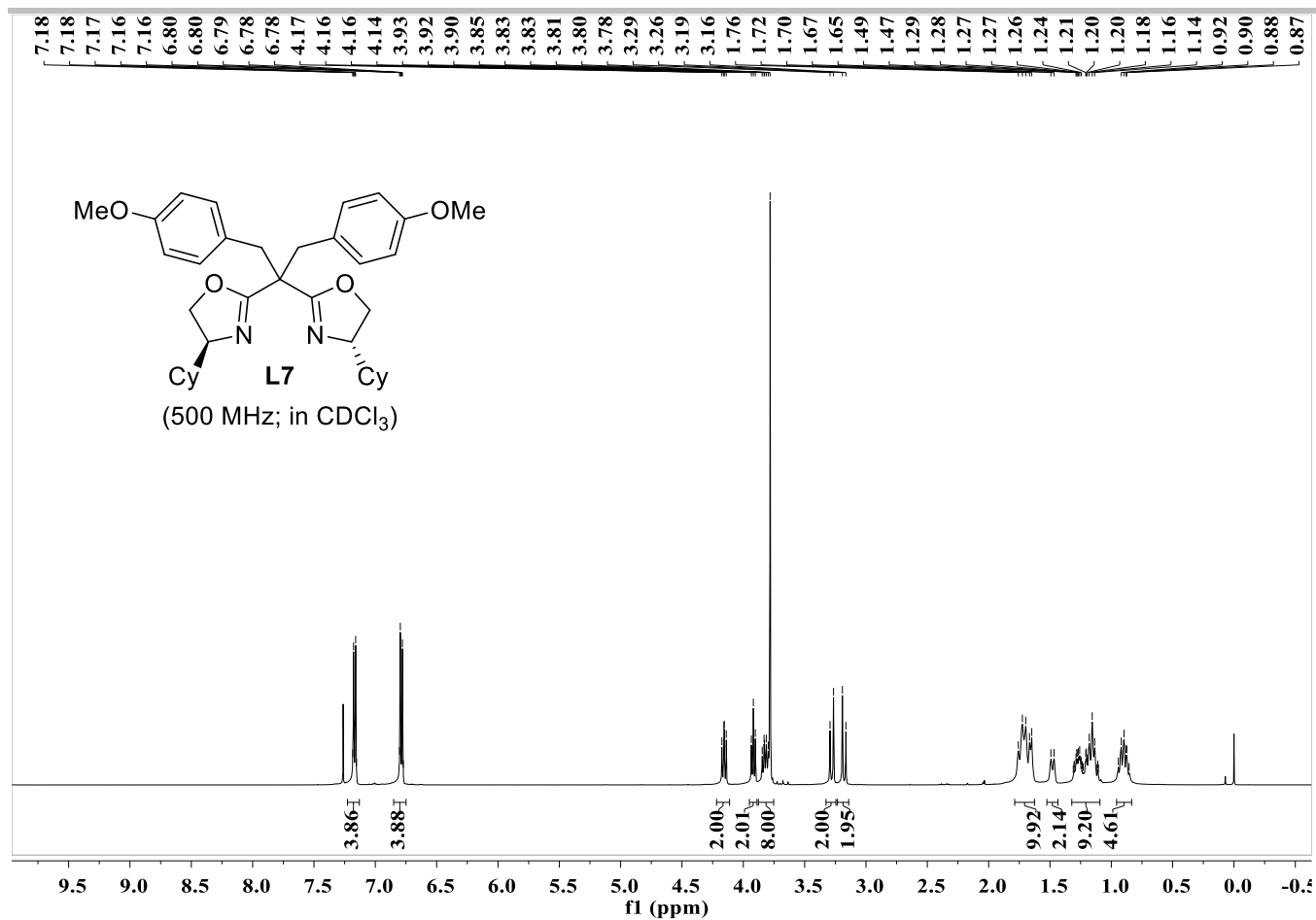
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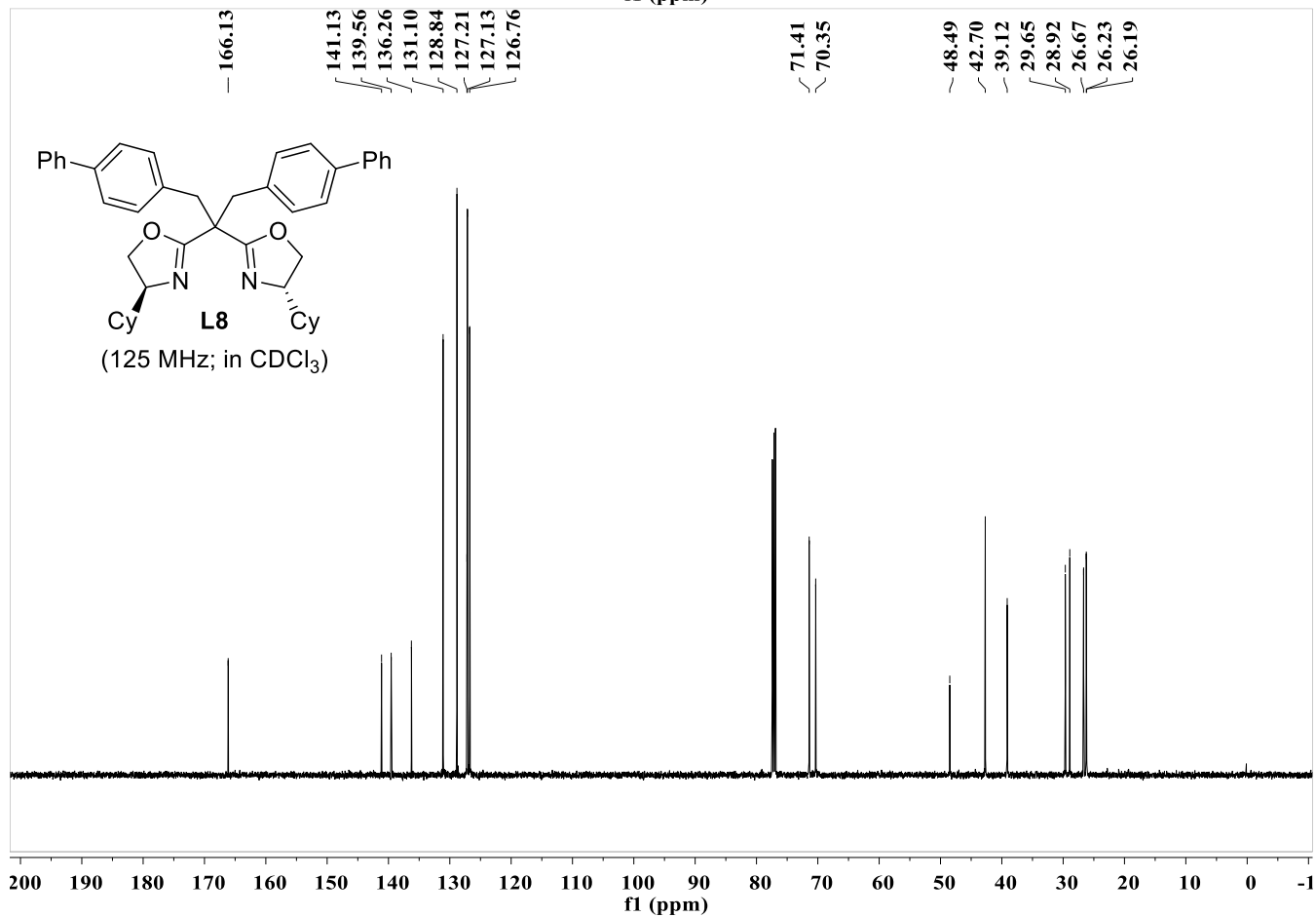
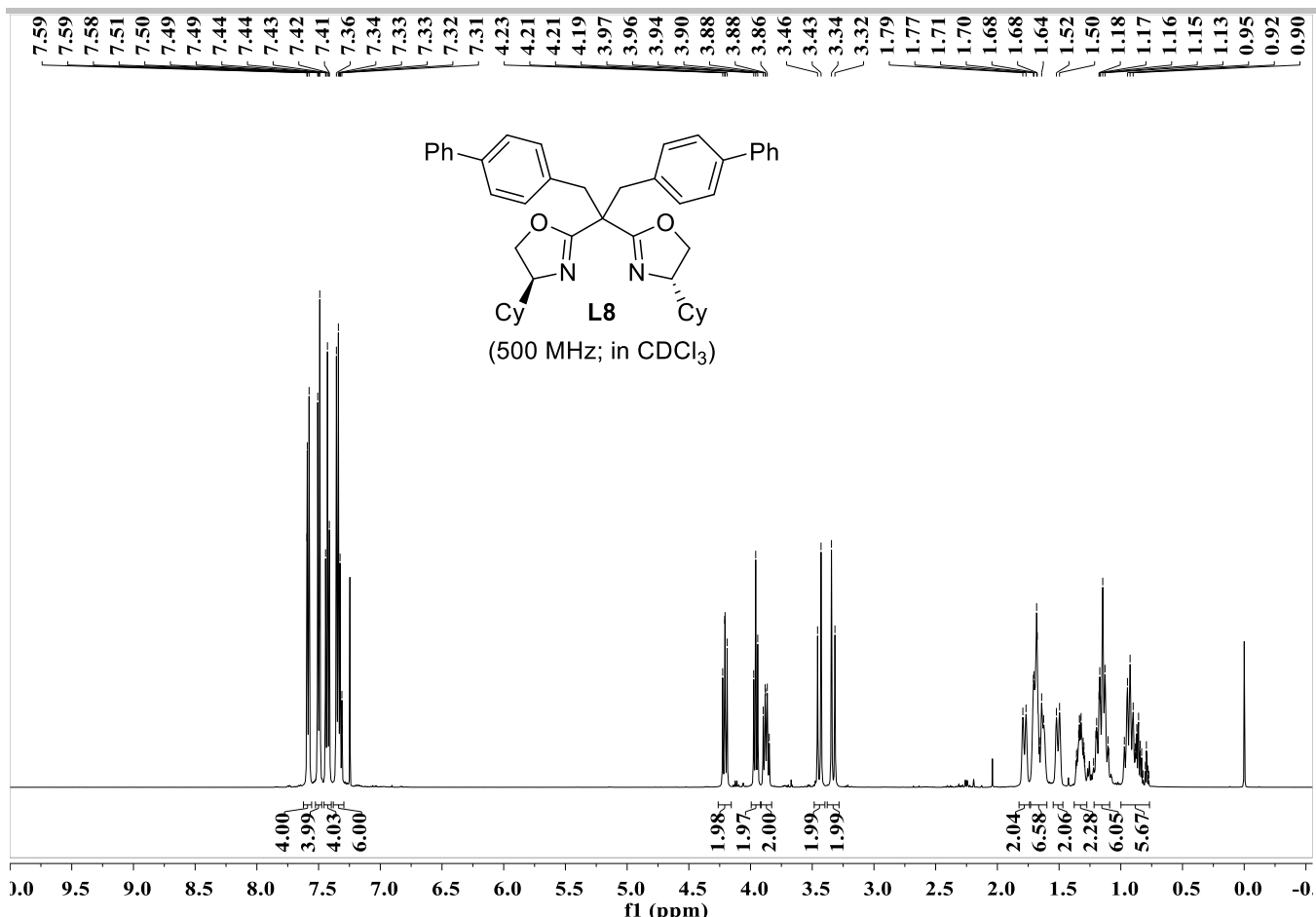
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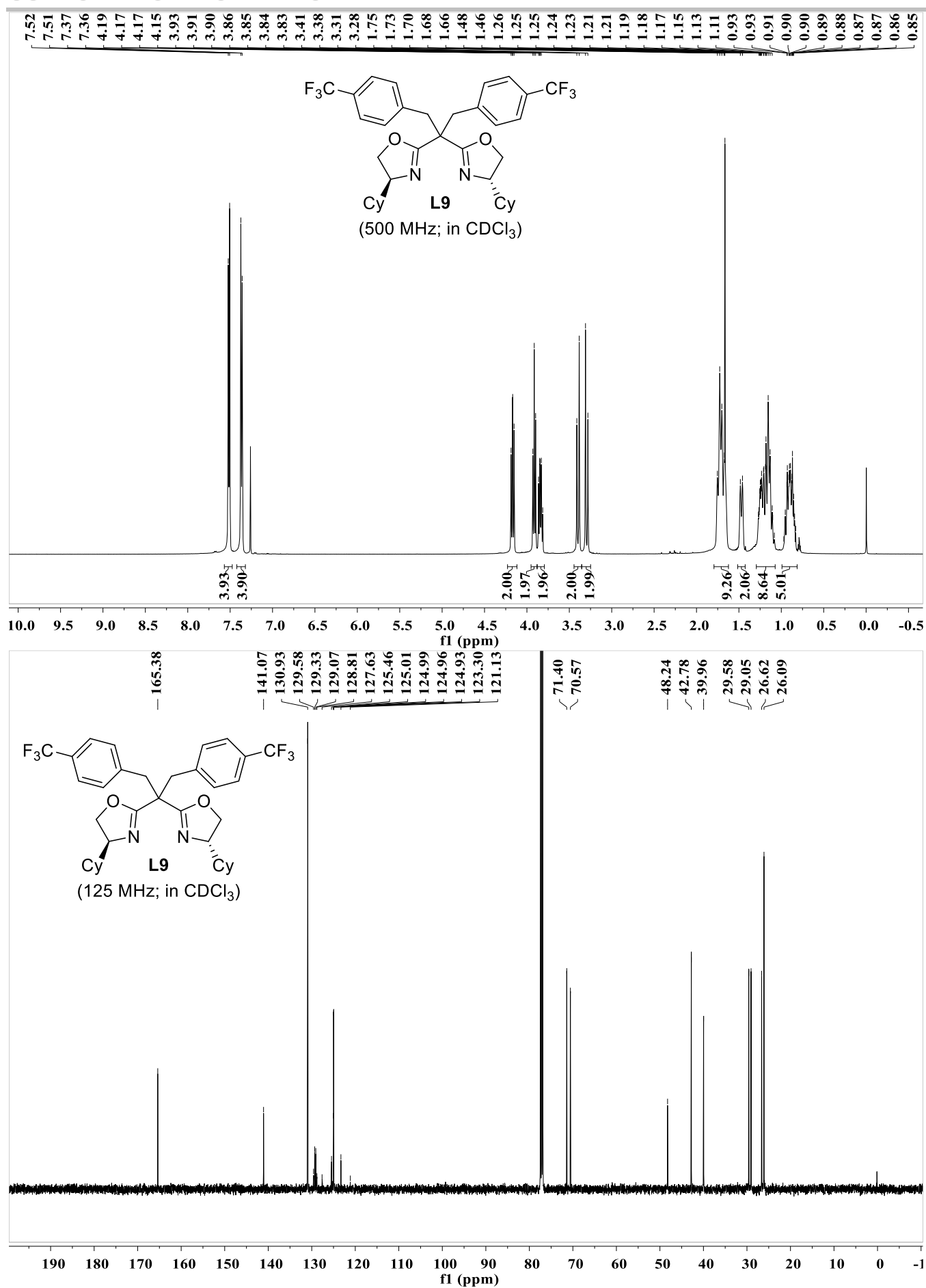
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION

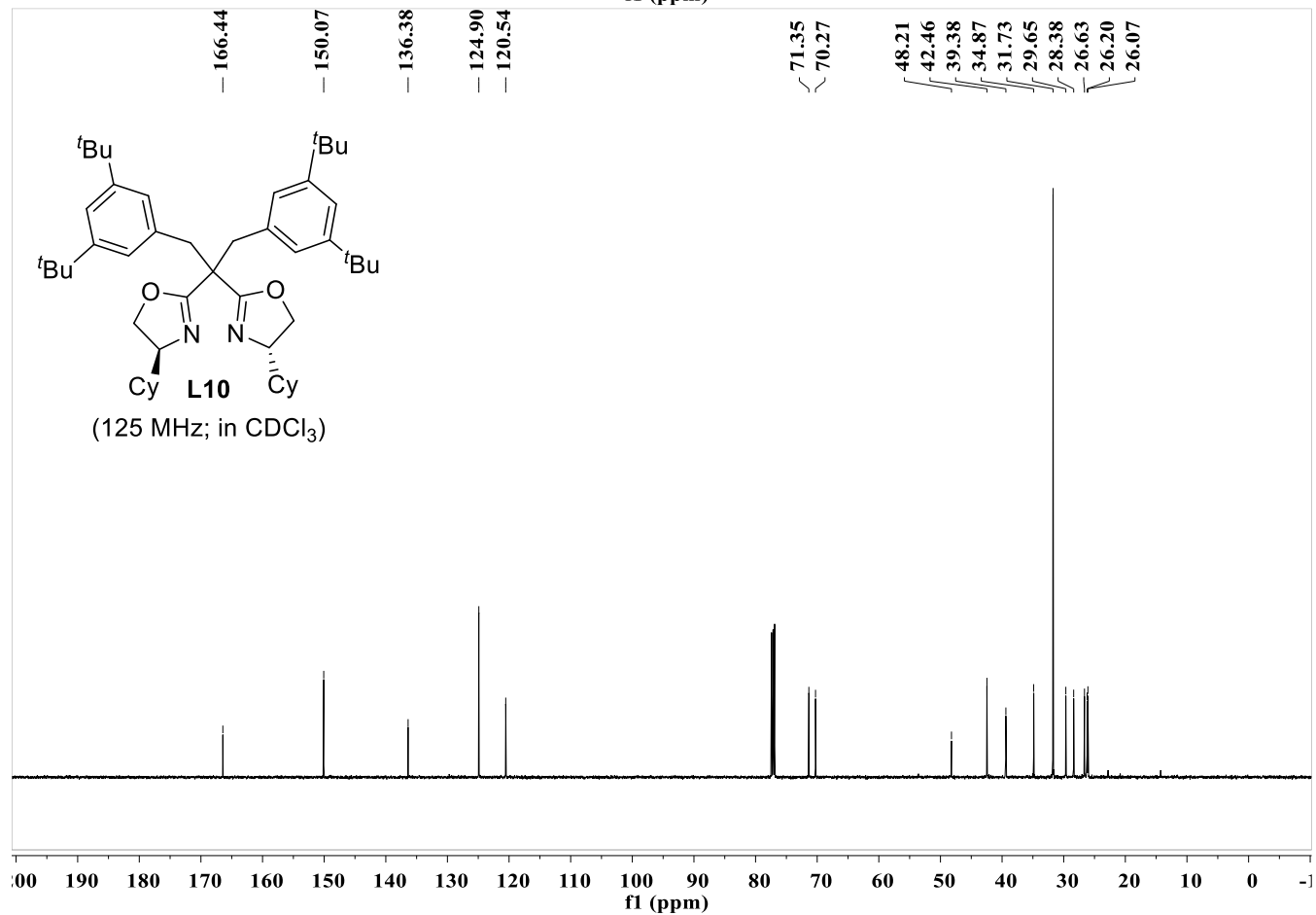
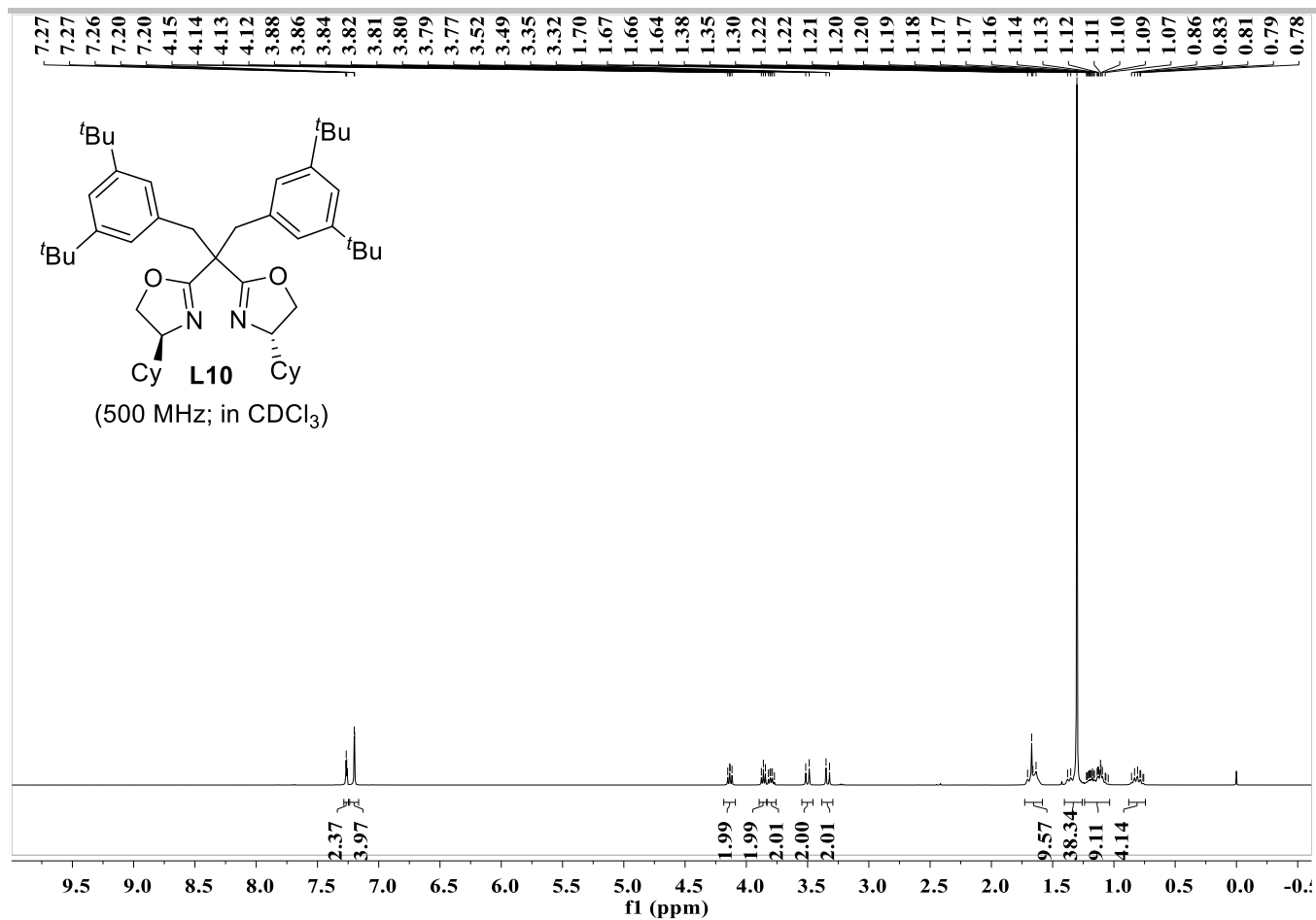


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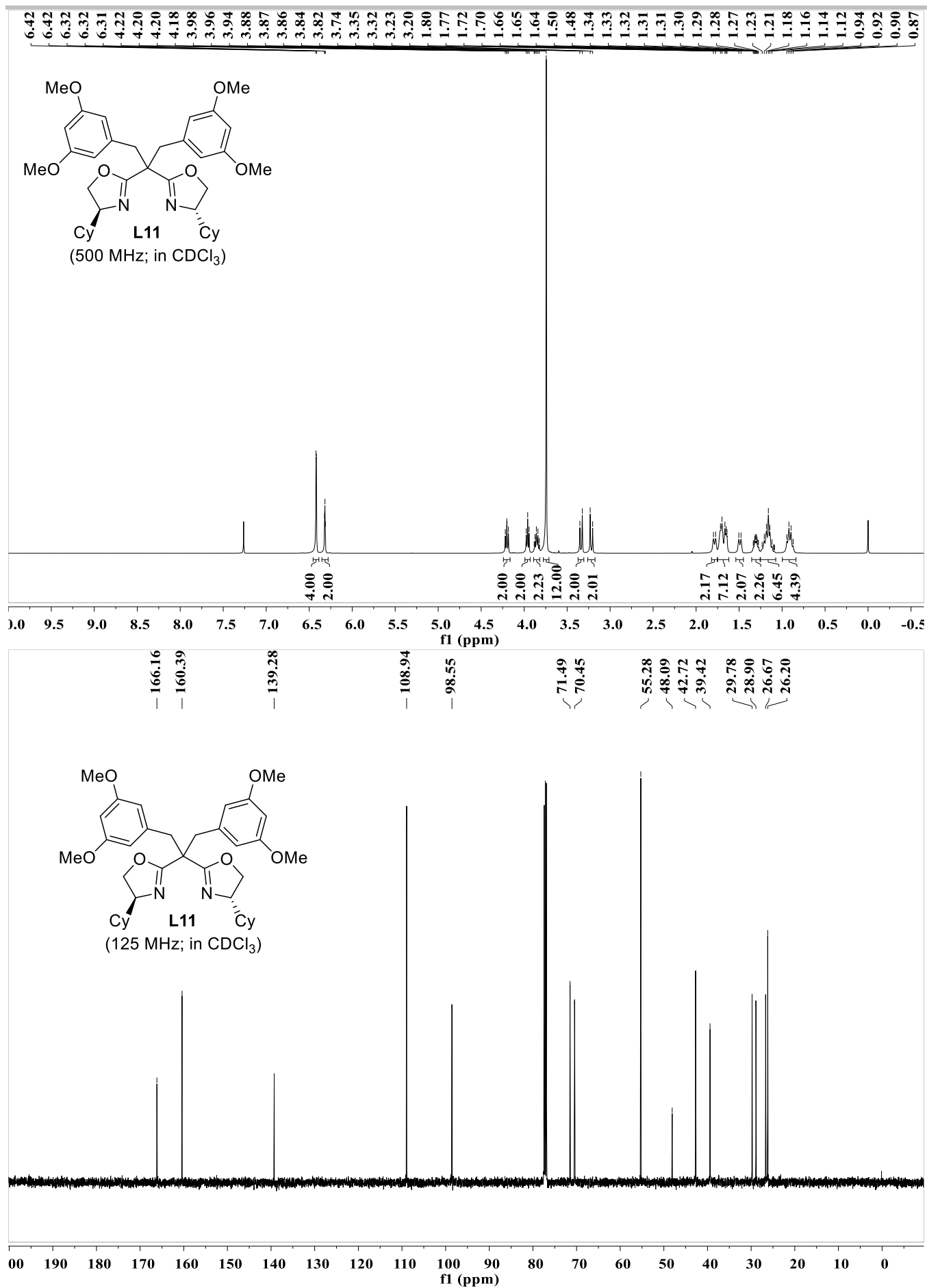




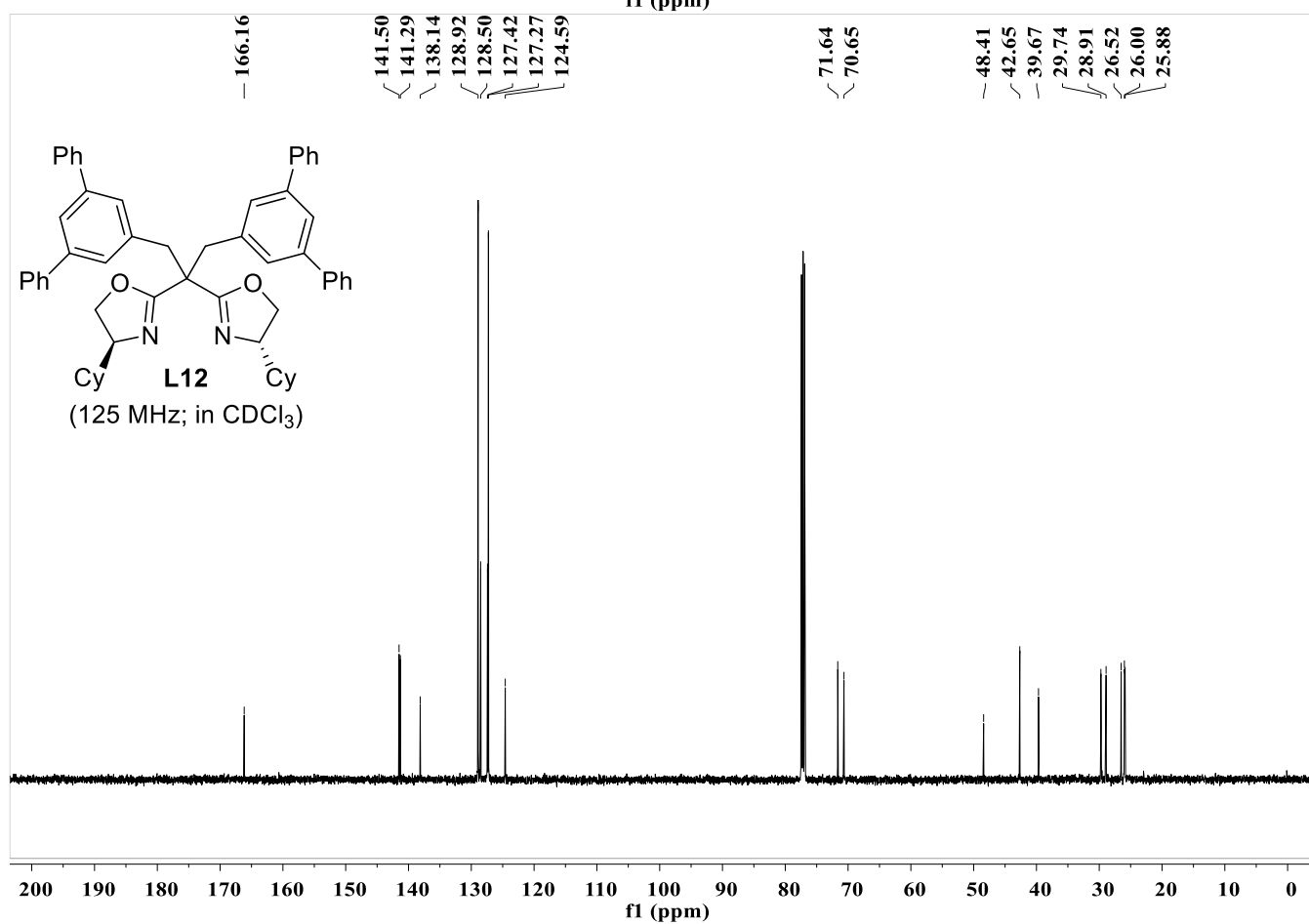
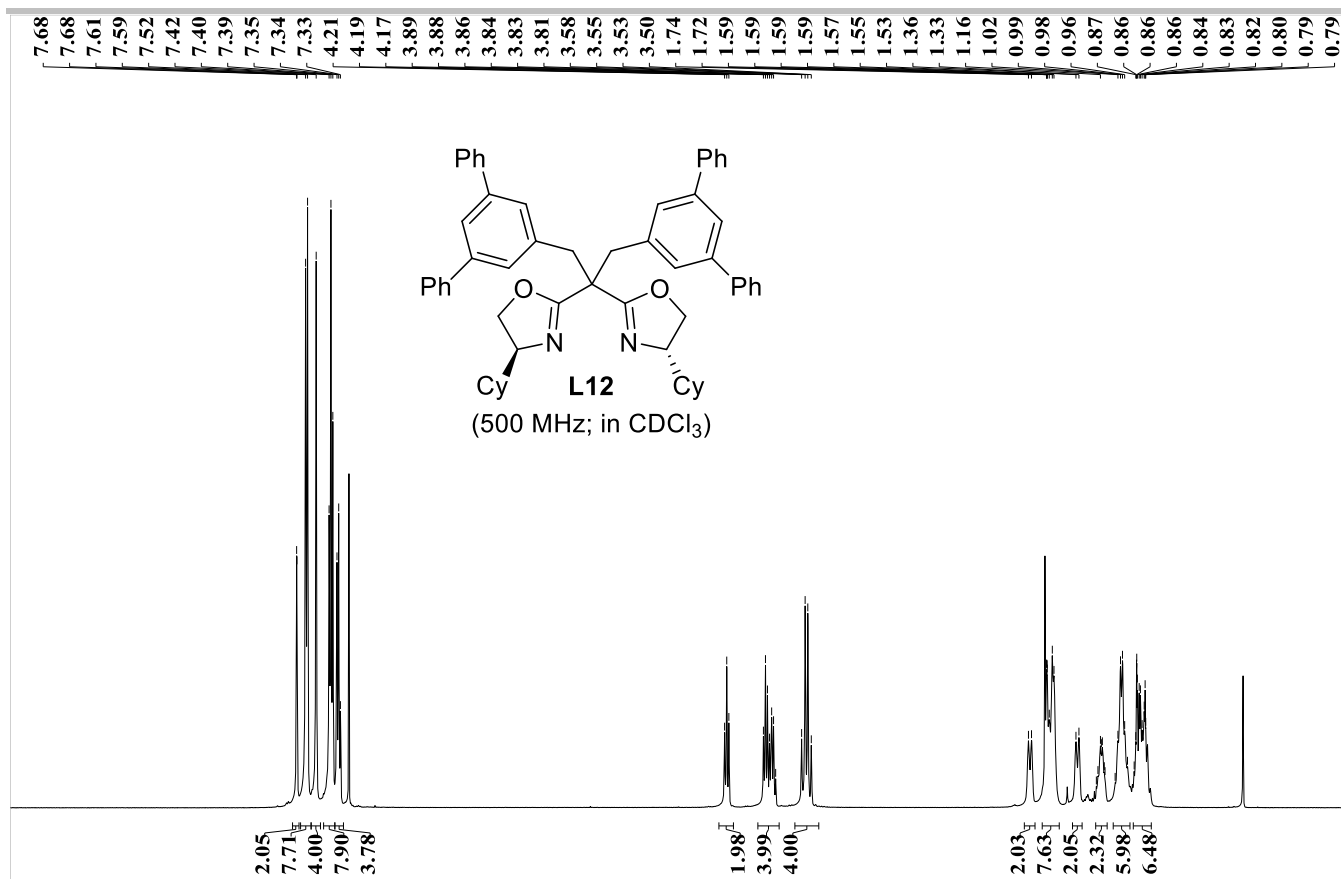
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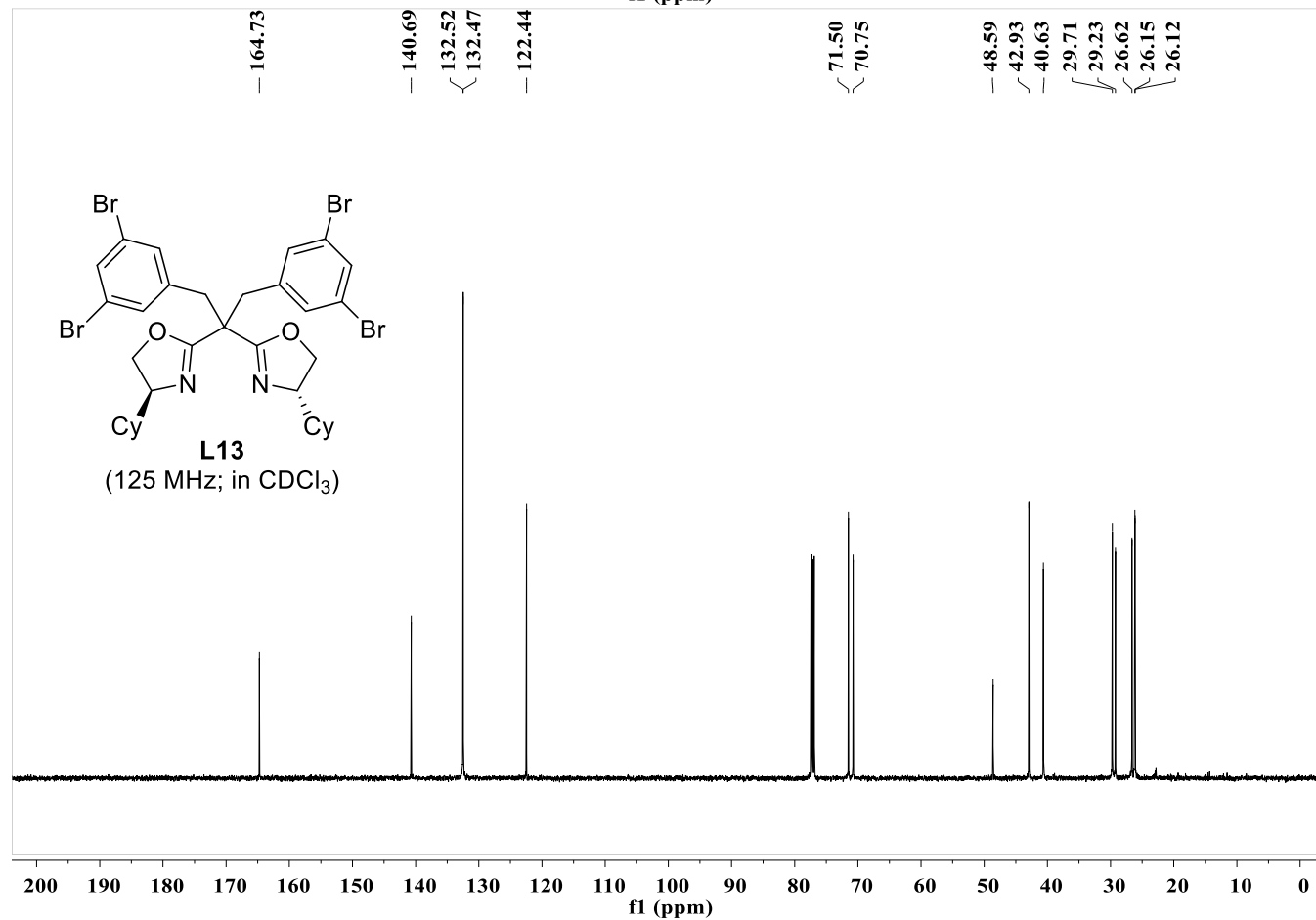
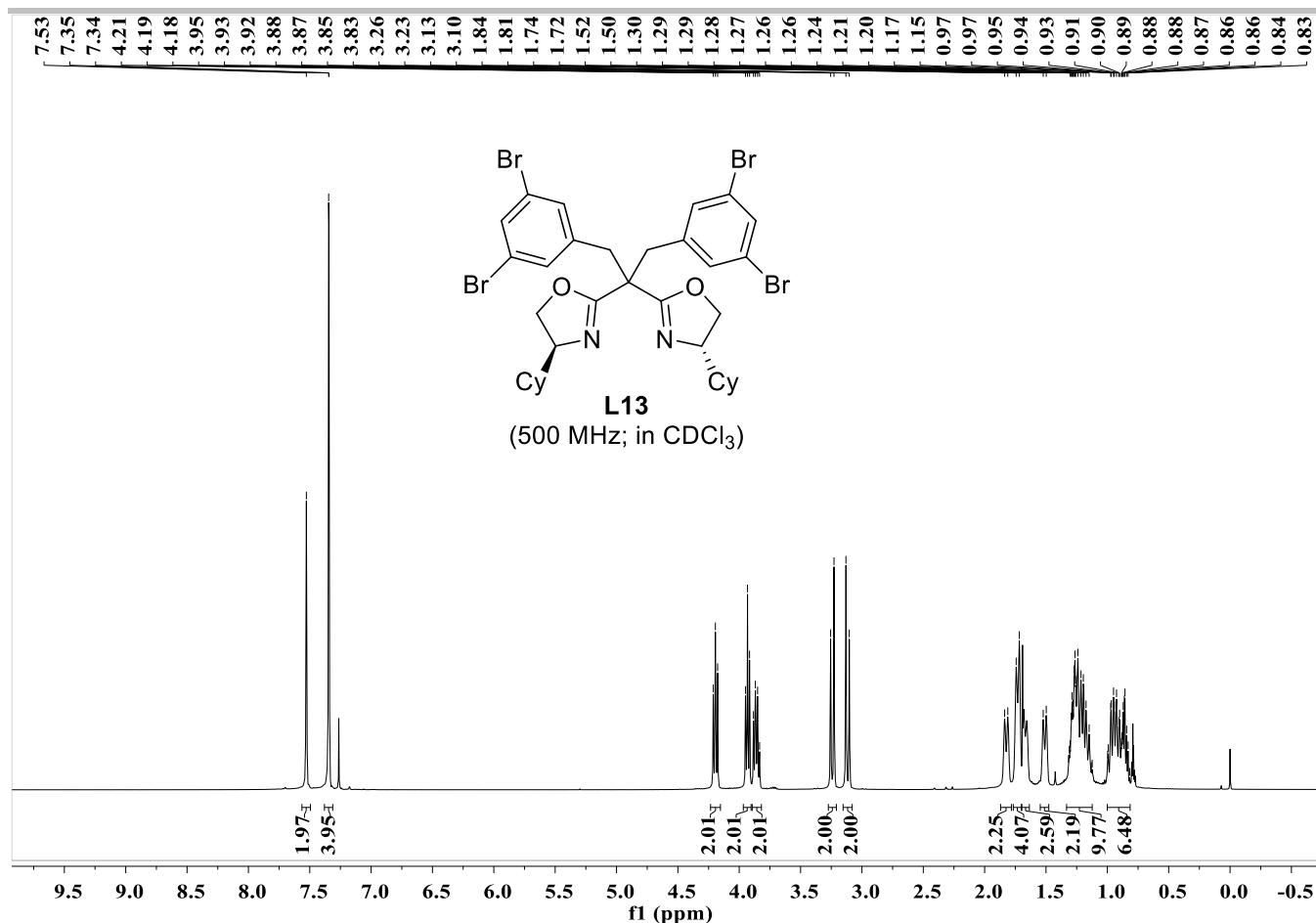
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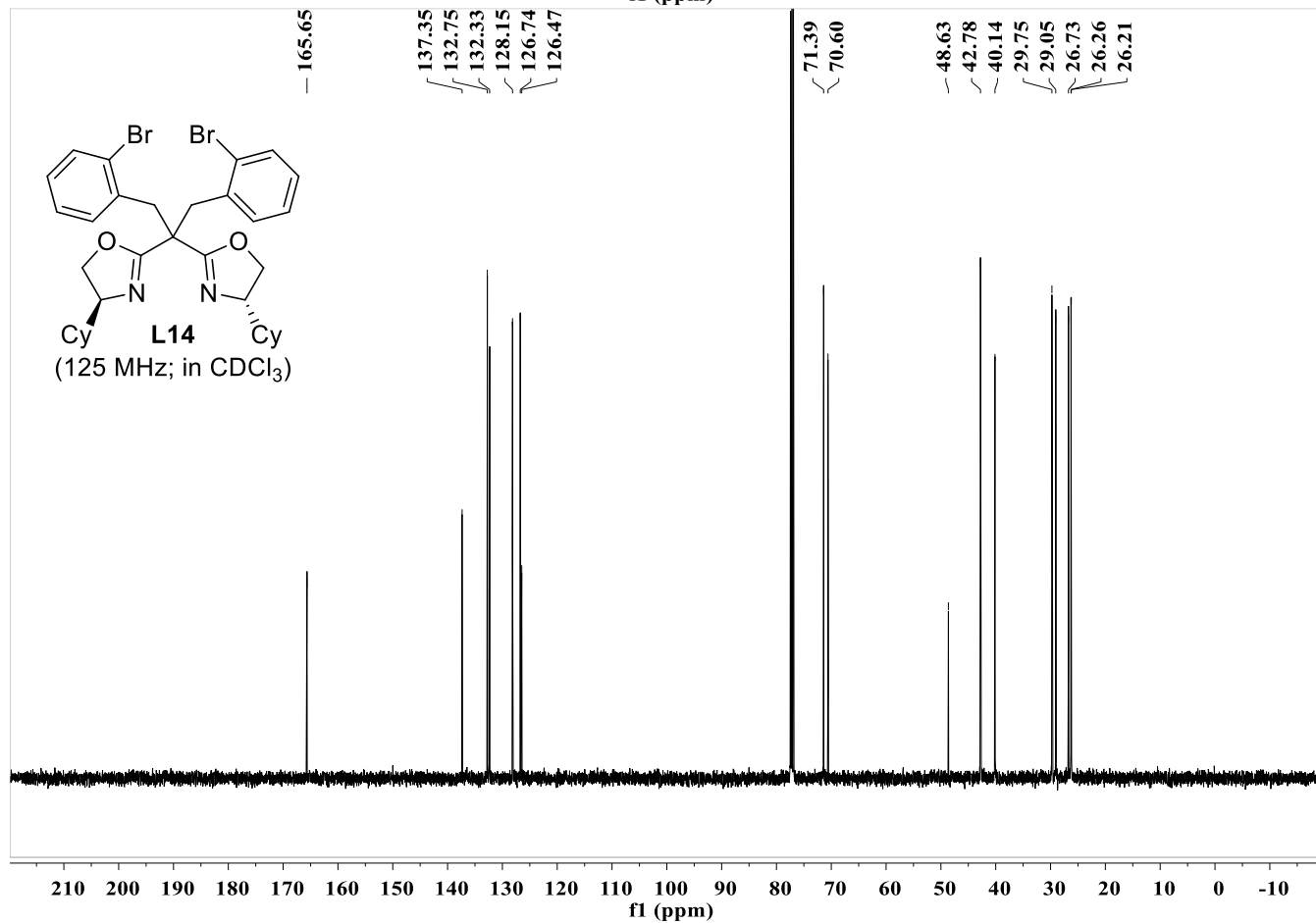
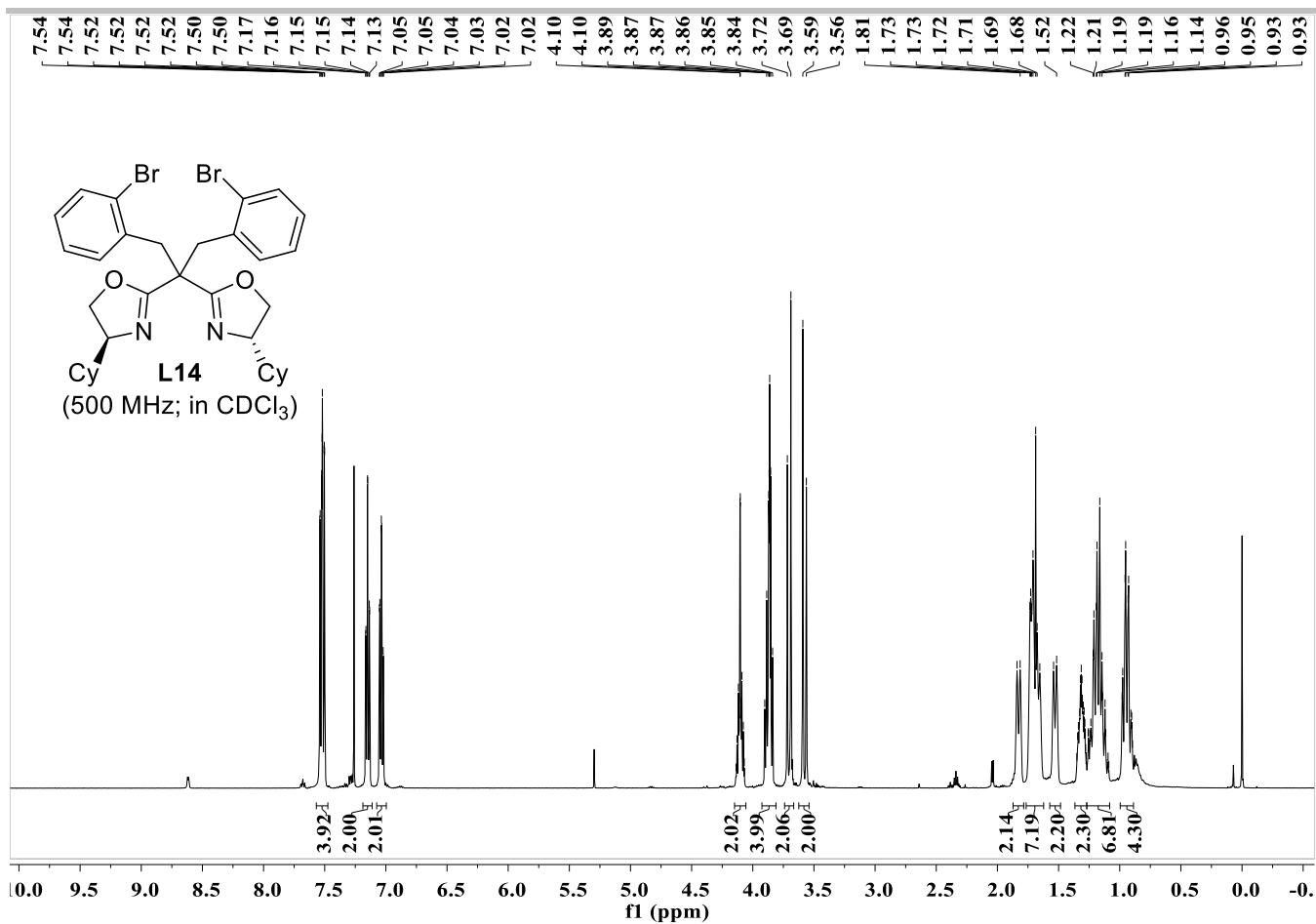
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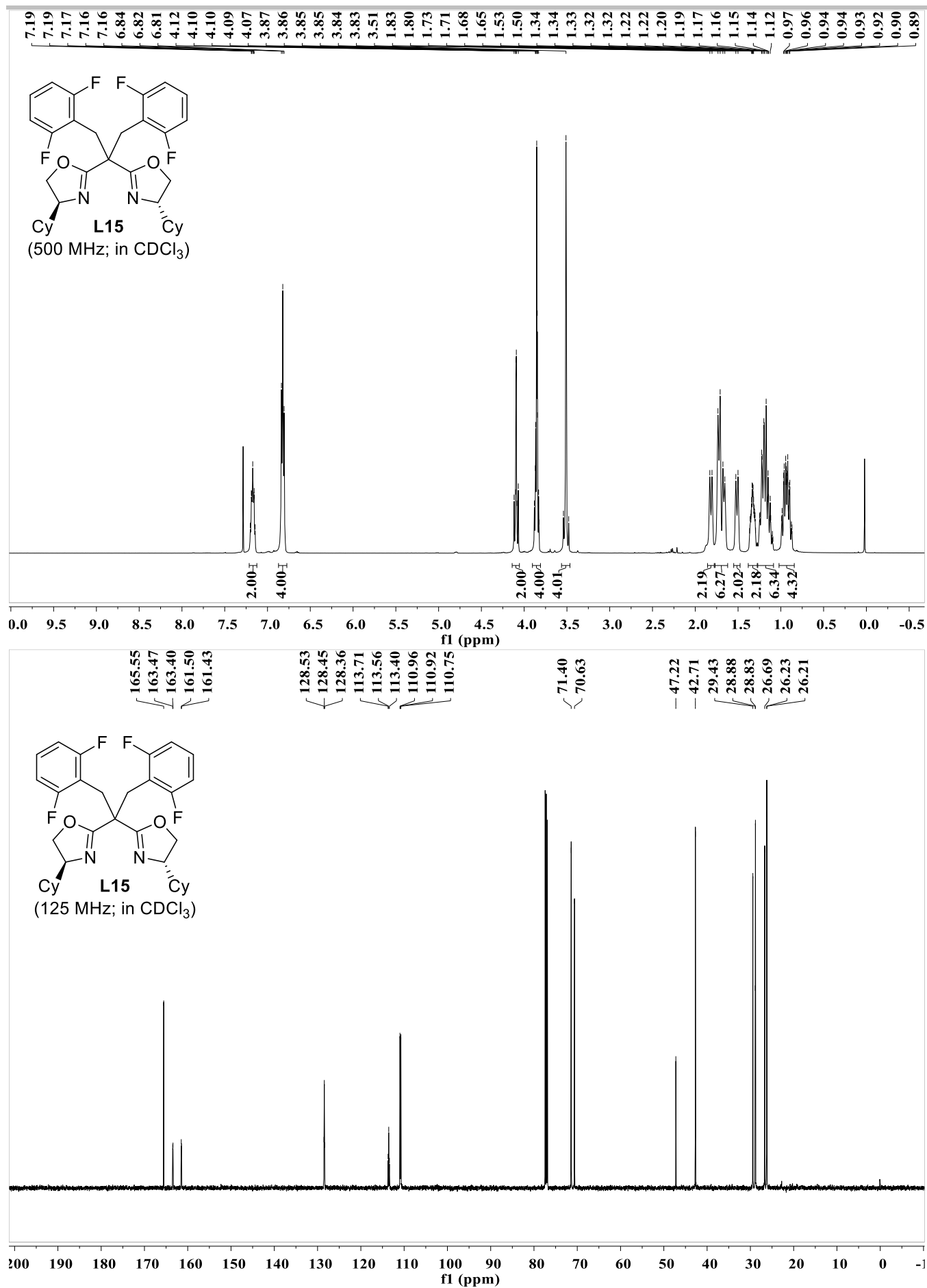
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION



# SUPPORTING INFORMATION



**L16**  
(500 MHz; in CDCl<sub>3</sub>)

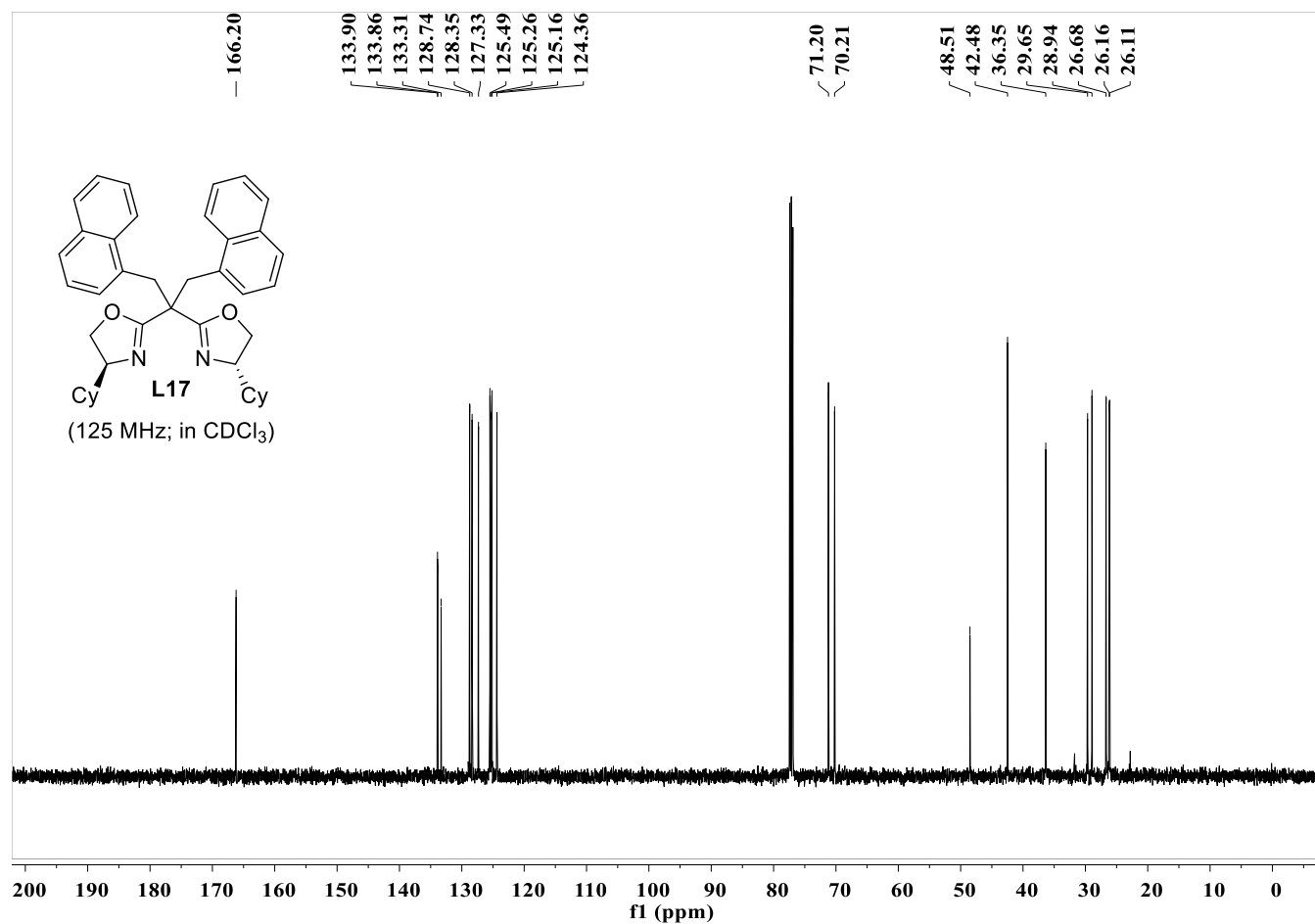
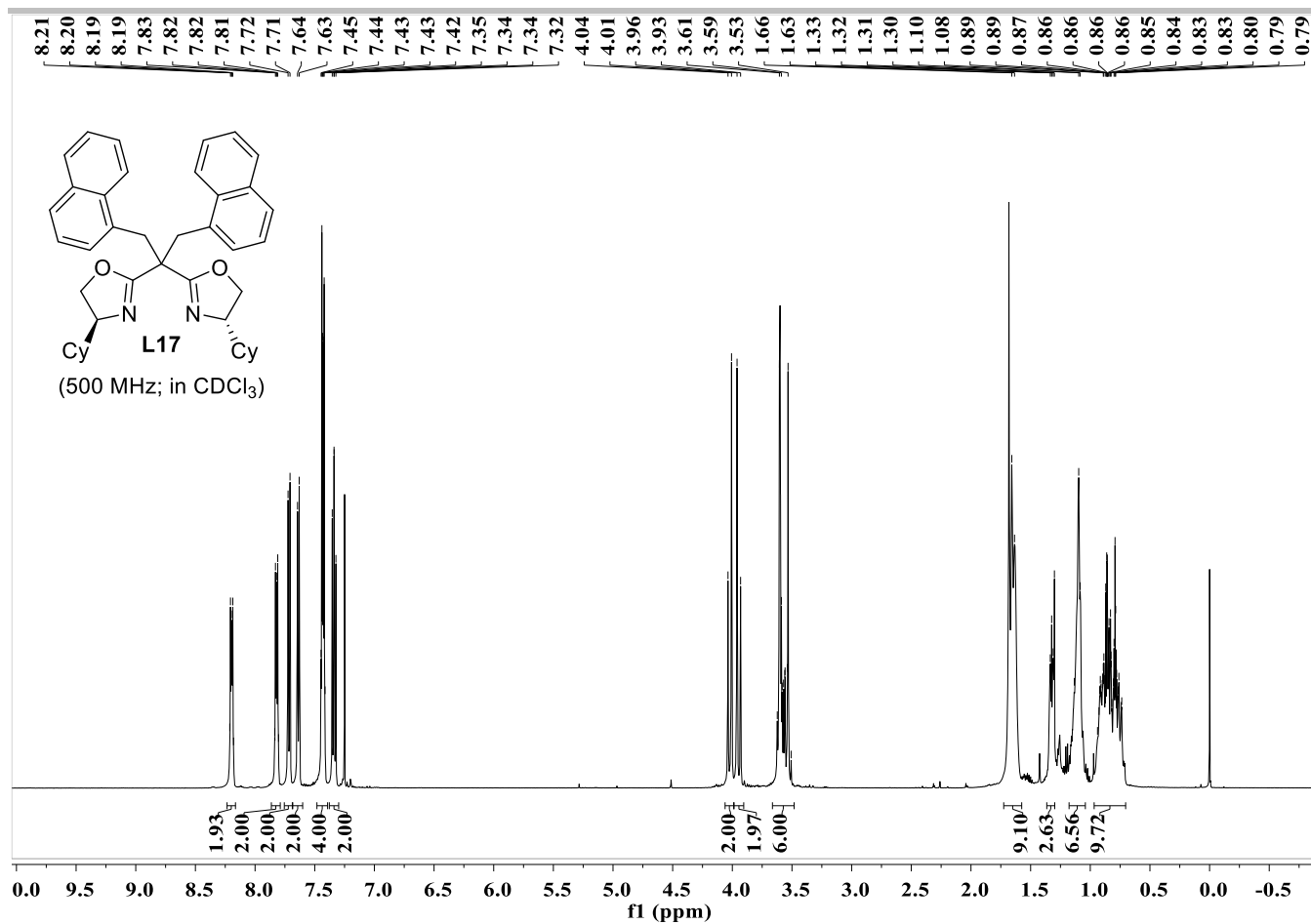
Chemical structure of L16 is shown, featuring two 4,6-di-tert-butyl-2-methoxyphenyl groups connected to a central carbon, which is also bonded to two 1,3-dioxolane rings, each with a cyano group.

<sup>1</sup>H NMR spectrum (500 MHz, CDCl<sub>3</sub>) of L16. The x-axis represents the chemical shift in ppm (f1), ranging from 0.0 to 10.0. The spectrum shows several peaks, with integration values provided below the baseline.

Integration values (from left to right): 3.93, 1.99, 4.03, 6.00, 2.00, 1.99, 8.74, 38.25, 9.11, 5.01.

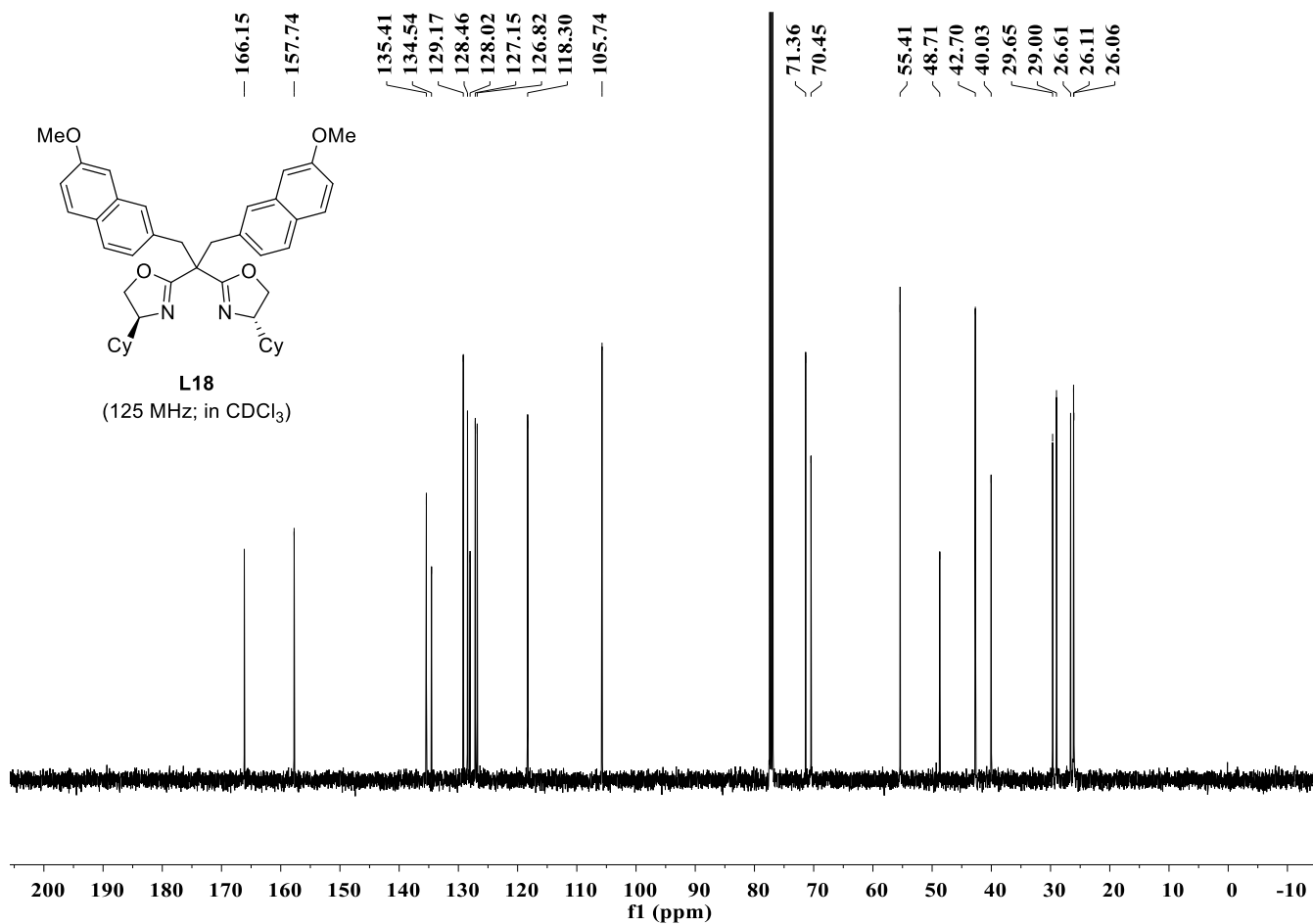
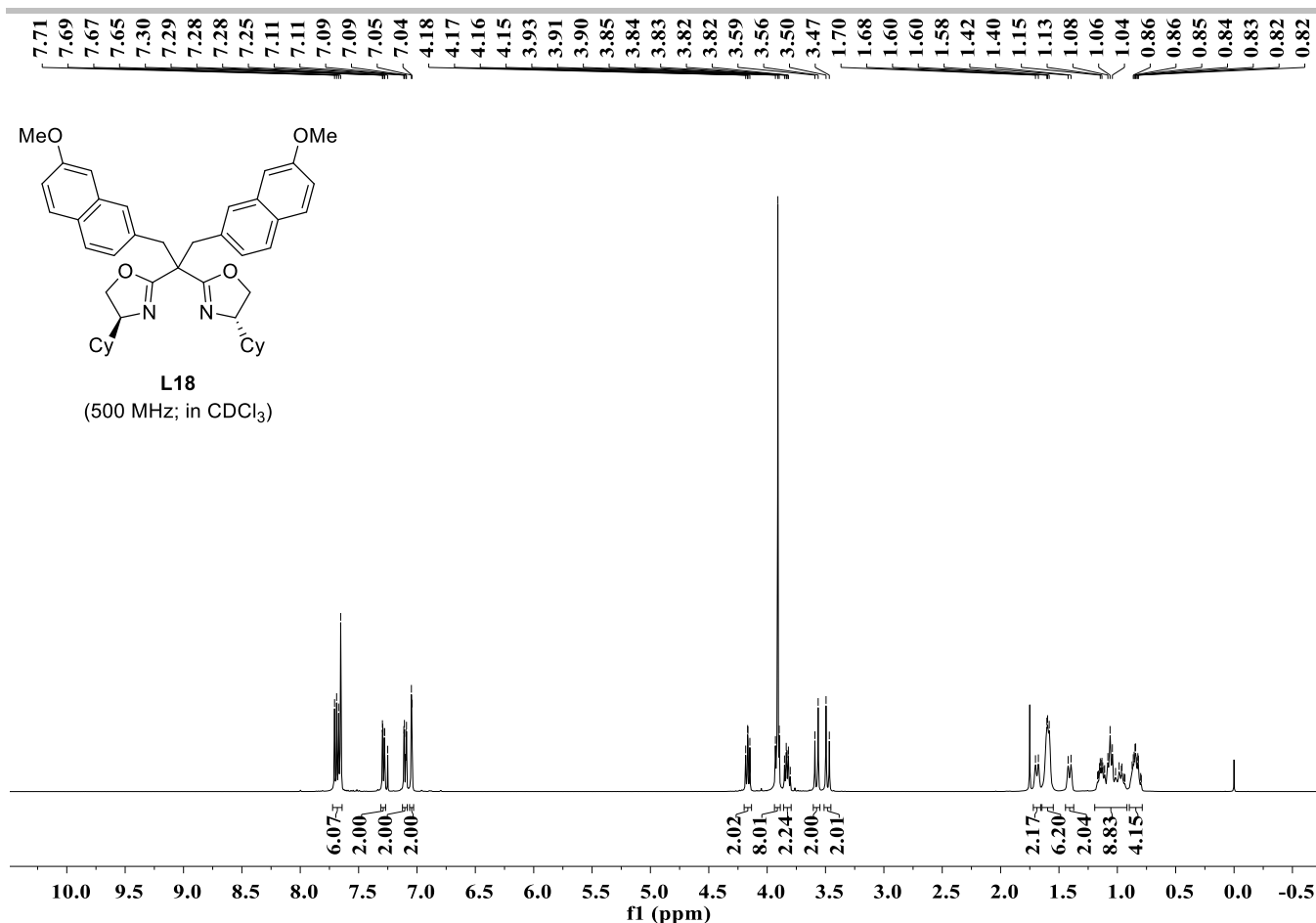


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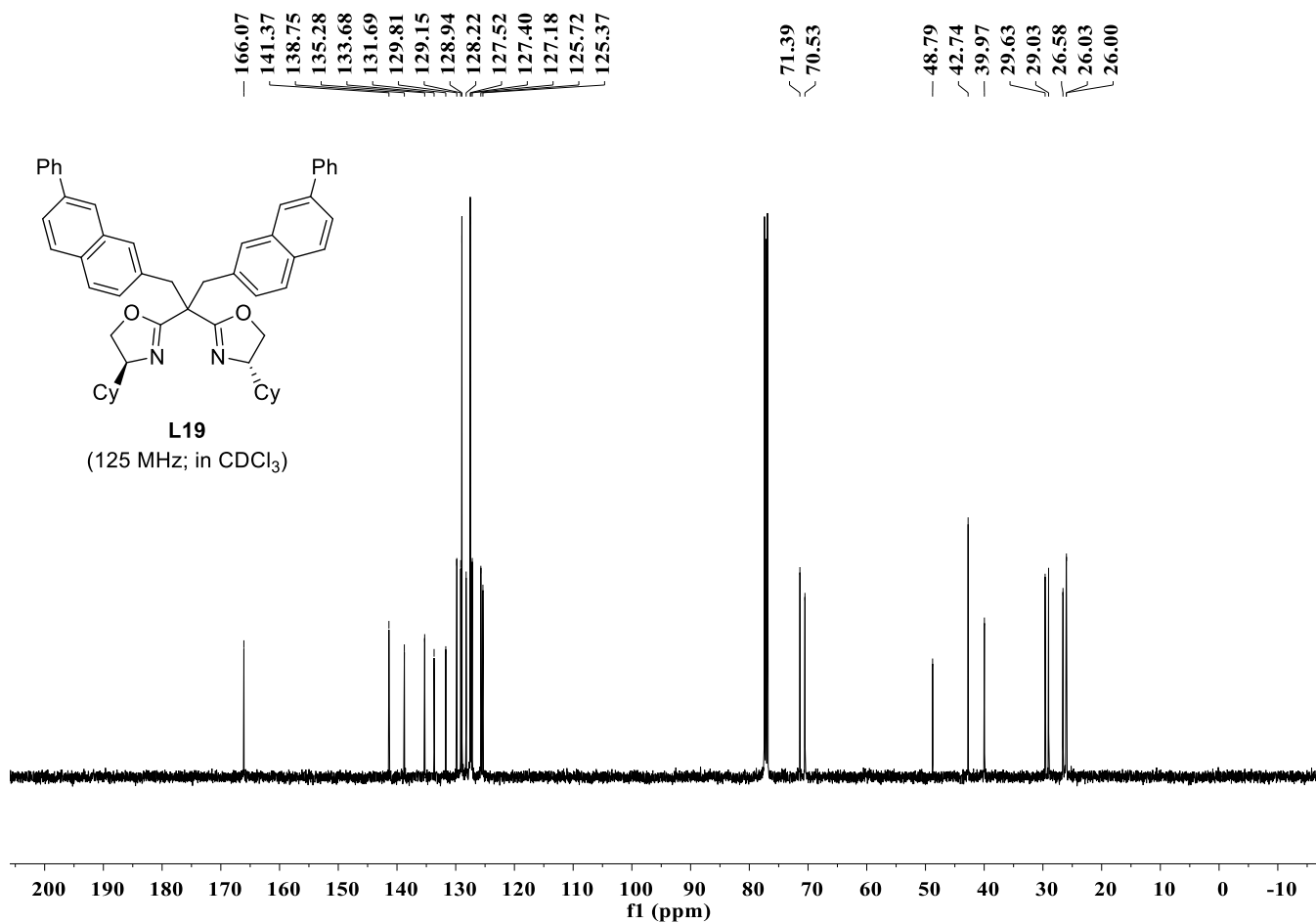
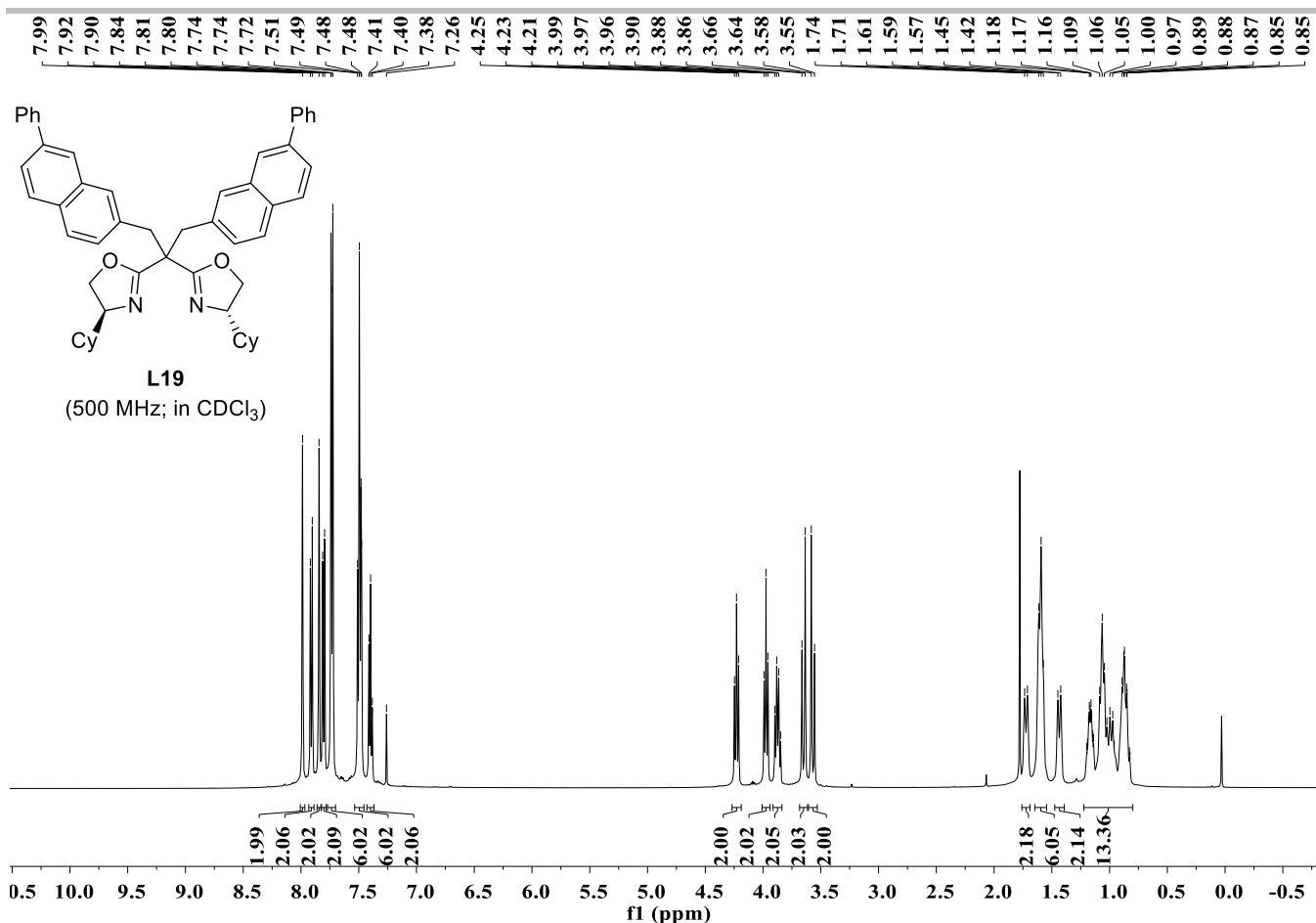




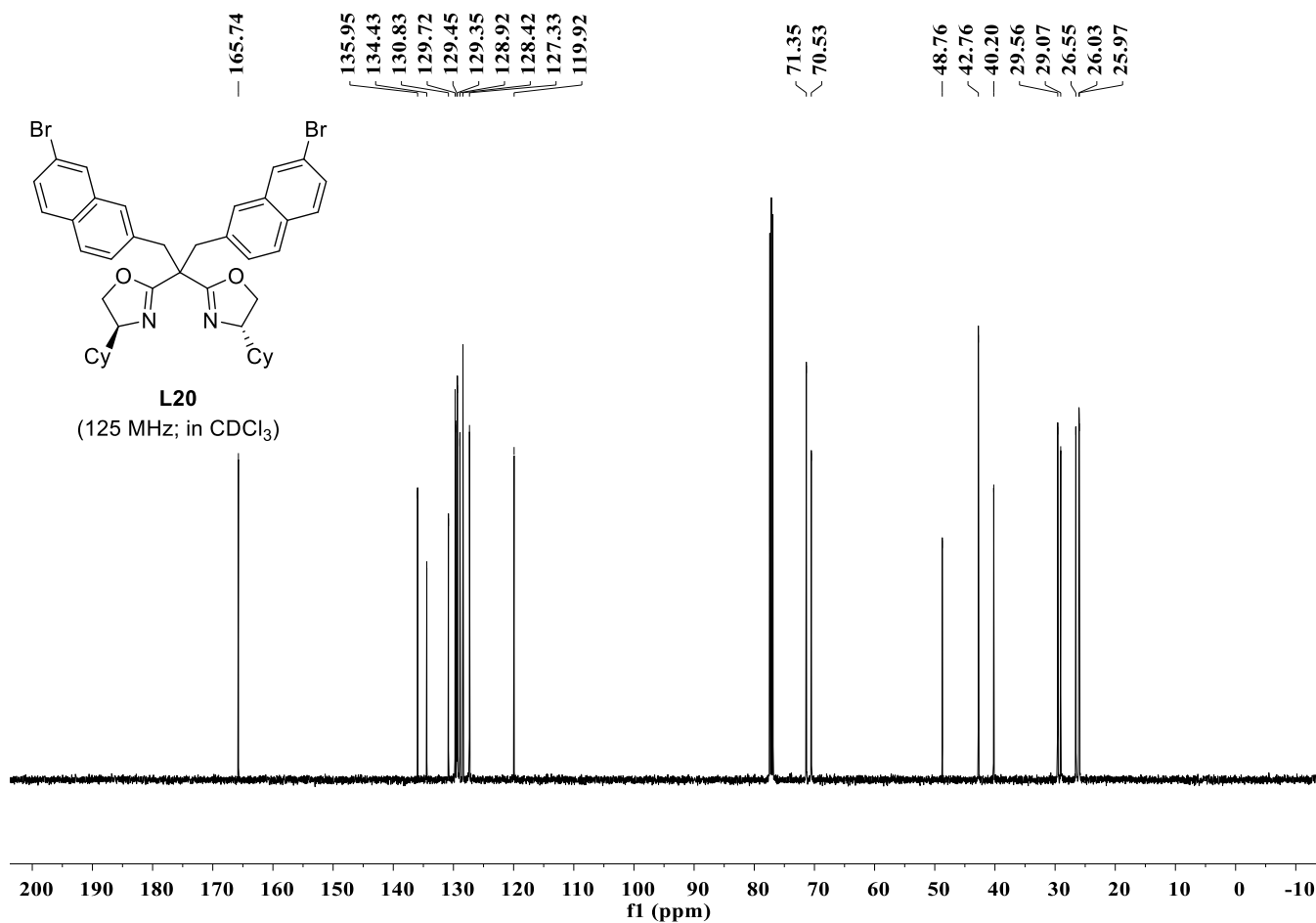
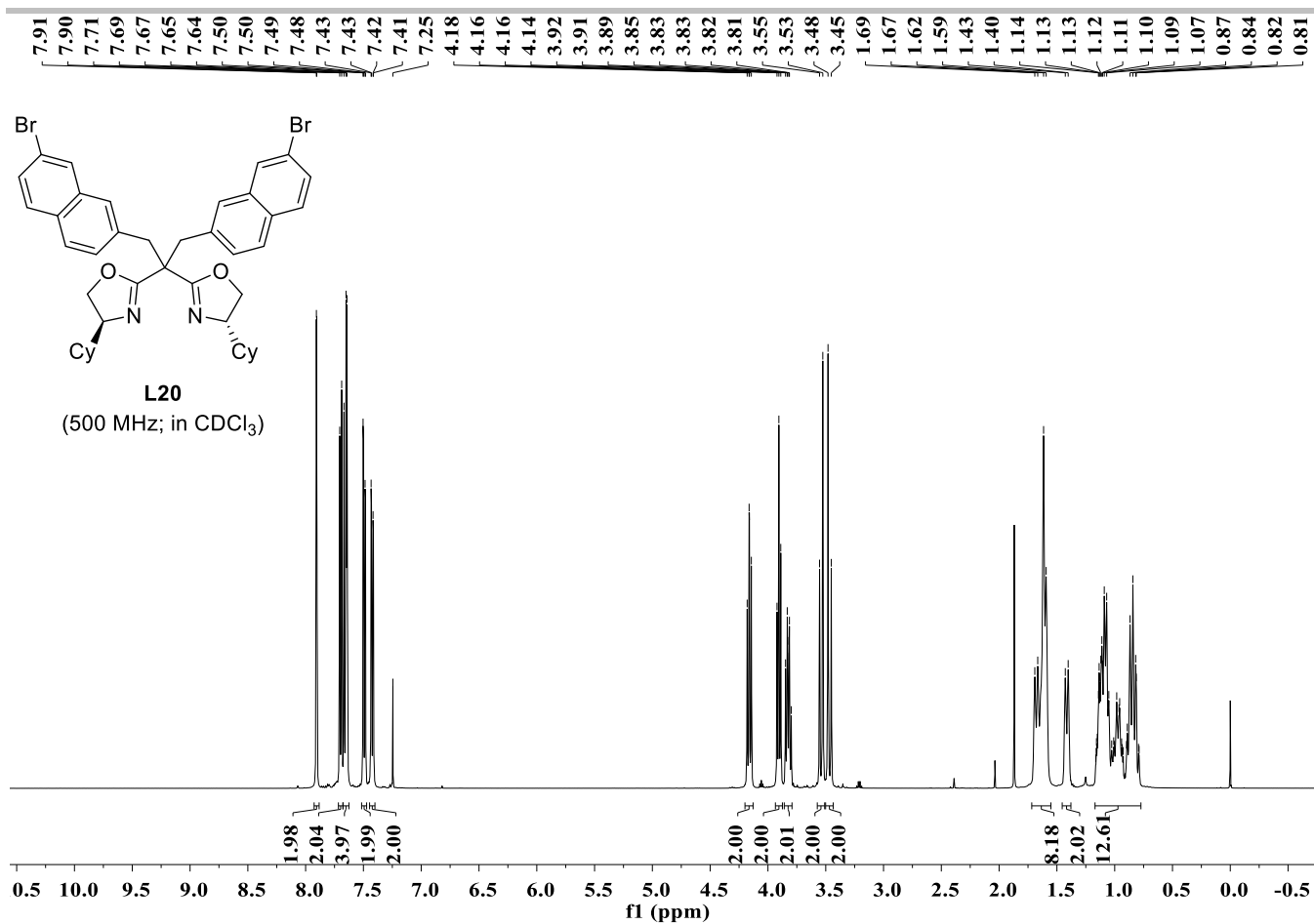
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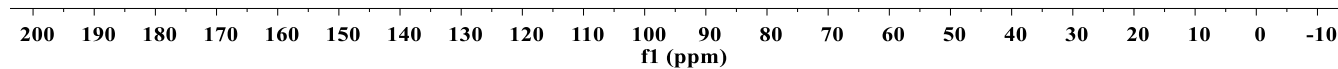
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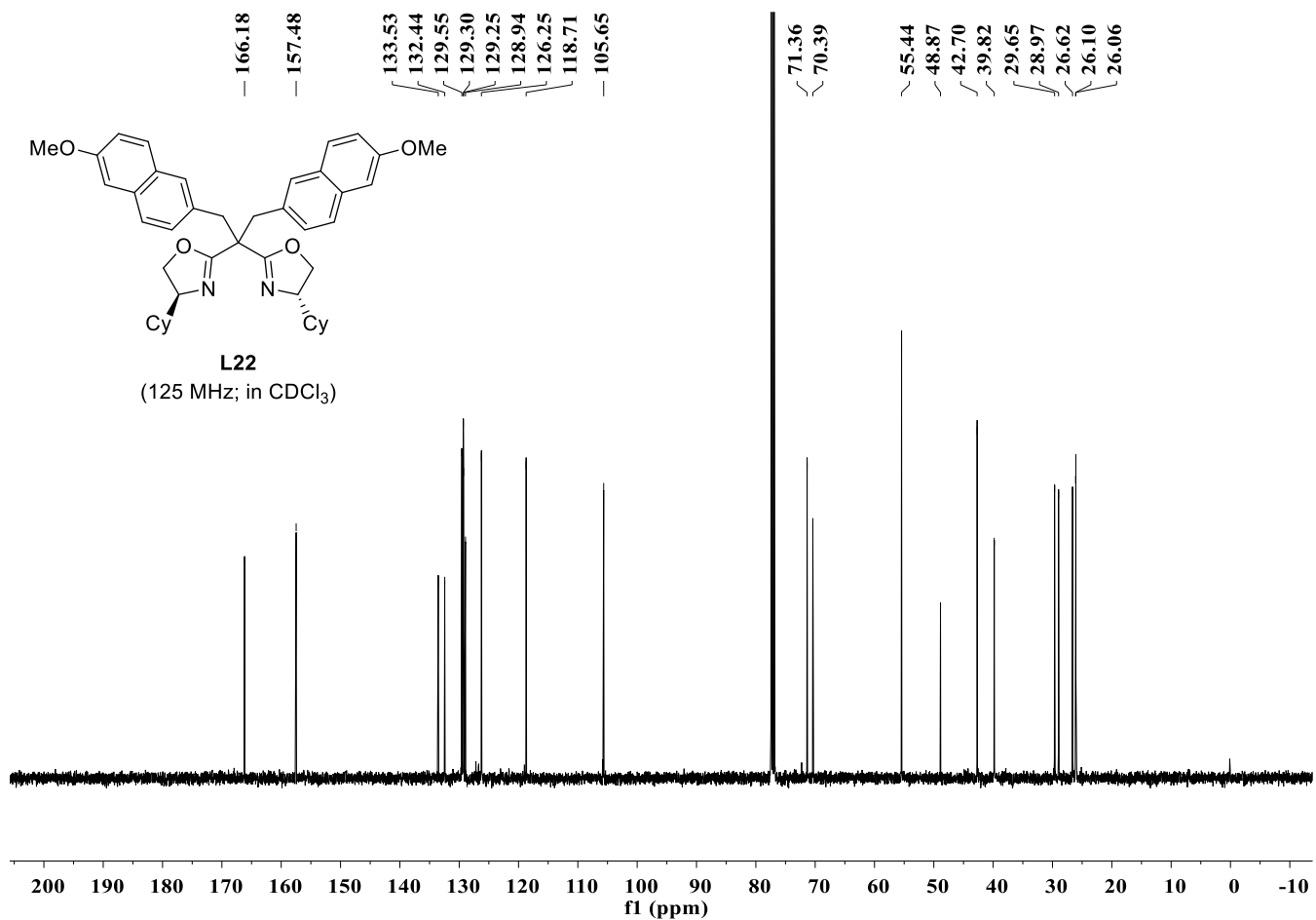
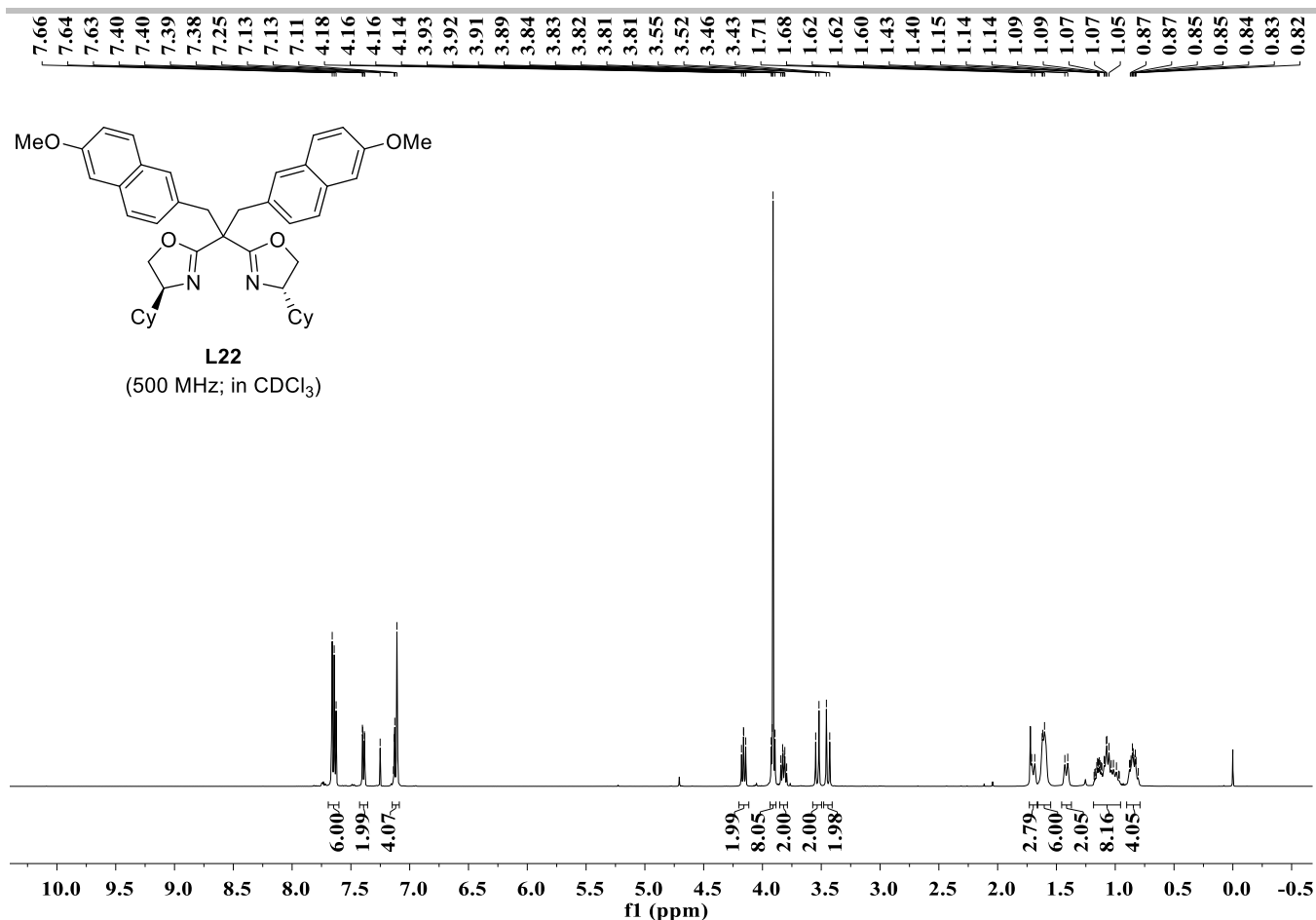
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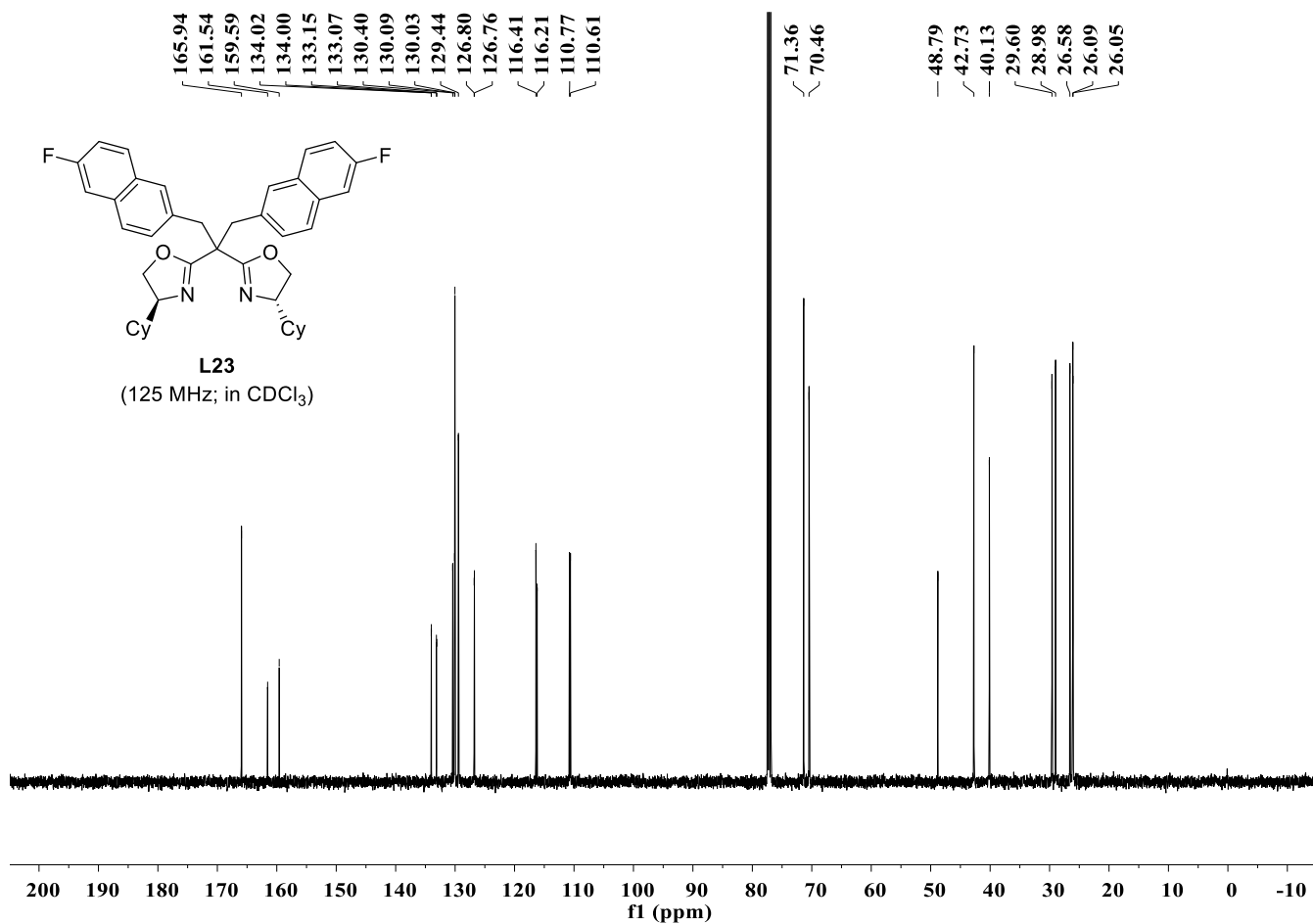
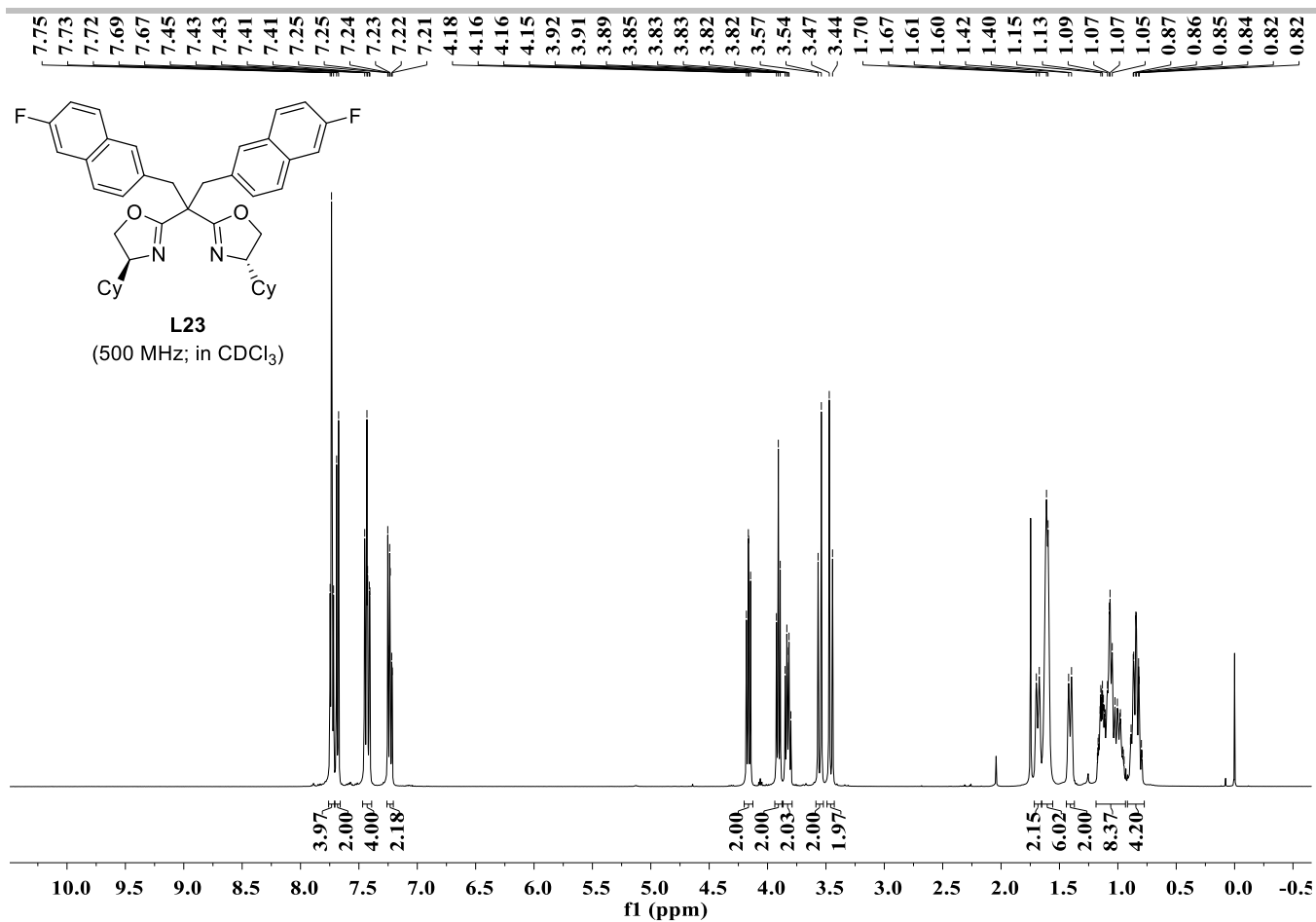
Year	Age Group	Sex	Population (millions)
2010	15-64 years	Men	8.01
		Women	8.01
	65-74 years	Men	7.85
		Women	7.83
	75 years and over	Men	7.82
		Women	7.80
2015	15-64 years	Men	7.79
		Women	7.74
	65-74 years	Men	7.73
		Women	7.72
	75 years and over	Men	7.72
		Women	7.72
2020	15-64 years	Men	7.71
		Women	7.71
	65-74 years	Men	7.70
		Women	7.70
	75 years and over	Men	7.50
		Women	7.49
2010	15-64 years	Men	7.49
		Women	7.49
	65-74 years	Men	7.48
		Women	7.47
	75 years and over	Men	7.47
		Women	7.46
2015	15-64 years	Men	7.39
		Women	7.39
	65-74 years	Men	7.38
		Women	7.38
	75 years and over	Men	7.37
		Women	7.36
2020	15-64 years	Men	7.36
		Women	7.36
	65-74 years	Men	7.23
		Women	7.23
	75 years and over	Men	4.21
		Women	4.19
2010	15-64 years	Men	4.19
		Women	4.19
	65-74 years	Men	4.17
		Women	4.17
	75 years and over	Men	3.95
		Women	3.94
2015	15-64 years	Men	3.92
		Women	3.92
	65-74 years	Men	3.85
		Women	3.85
	75 years and over	Men	3.84
		Women	3.84
2020	15-64 years	Men	3.83
		Women	3.83
	65-74 years	Men	3.63
		Women	3.63
	75 years and over	Men	3.60
		Women	3.54
2010	15-64 years	Men	3.51
		Women	3.51
	65-74 years	Men	1.61
		Women	1.61
	75 years and over	Men	1.58
		Women	1.58
2015	15-64 years	Men	1.07
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	65-74 years	Men	1.04
		Women	1.04
	75 years and over	Men	0.86
		Women	0.86
2020	15-64 years	Men	0.85
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	65-74 years	Men	0.83
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	75 years and over	Men	0.83
		Women	0.83



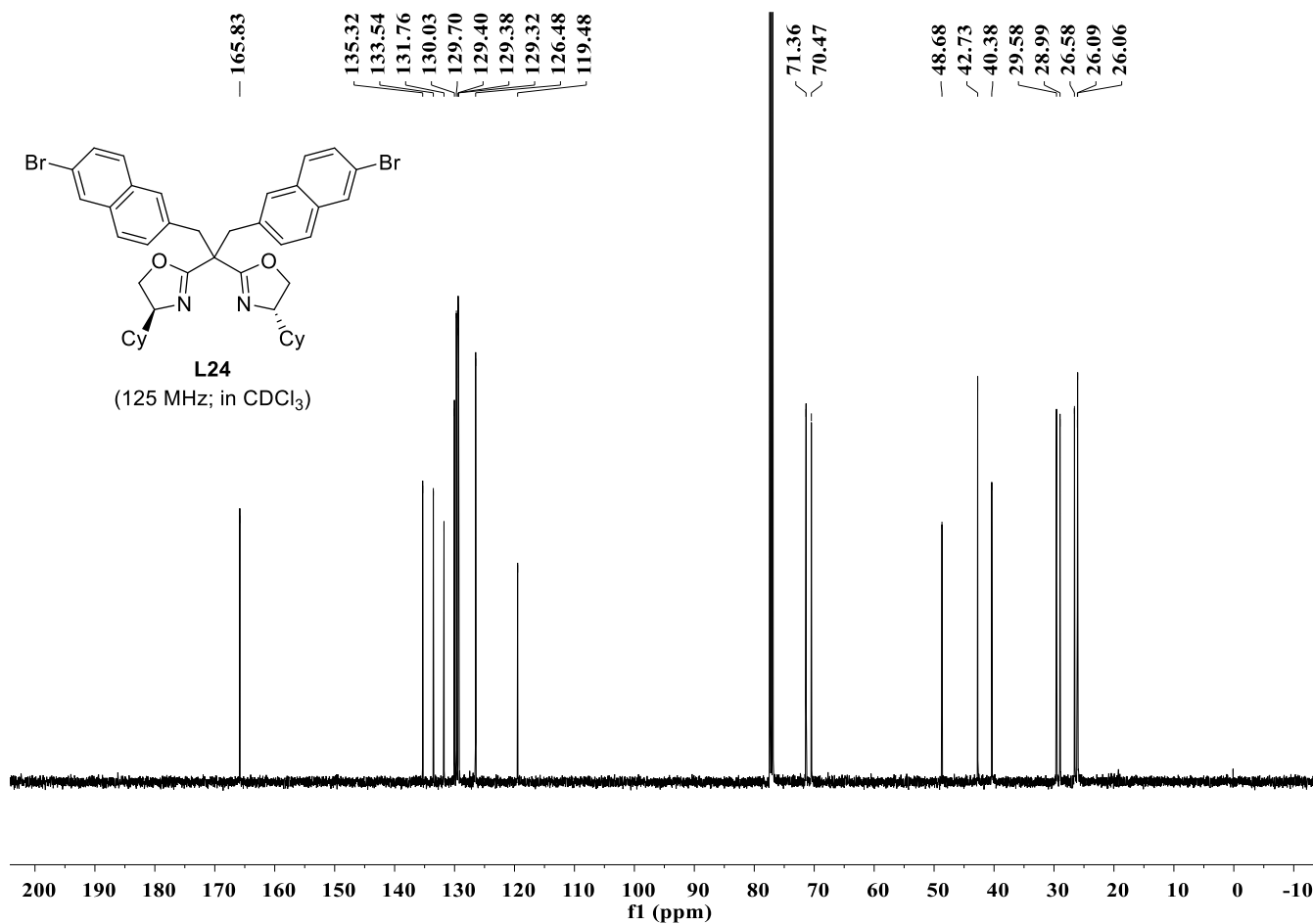
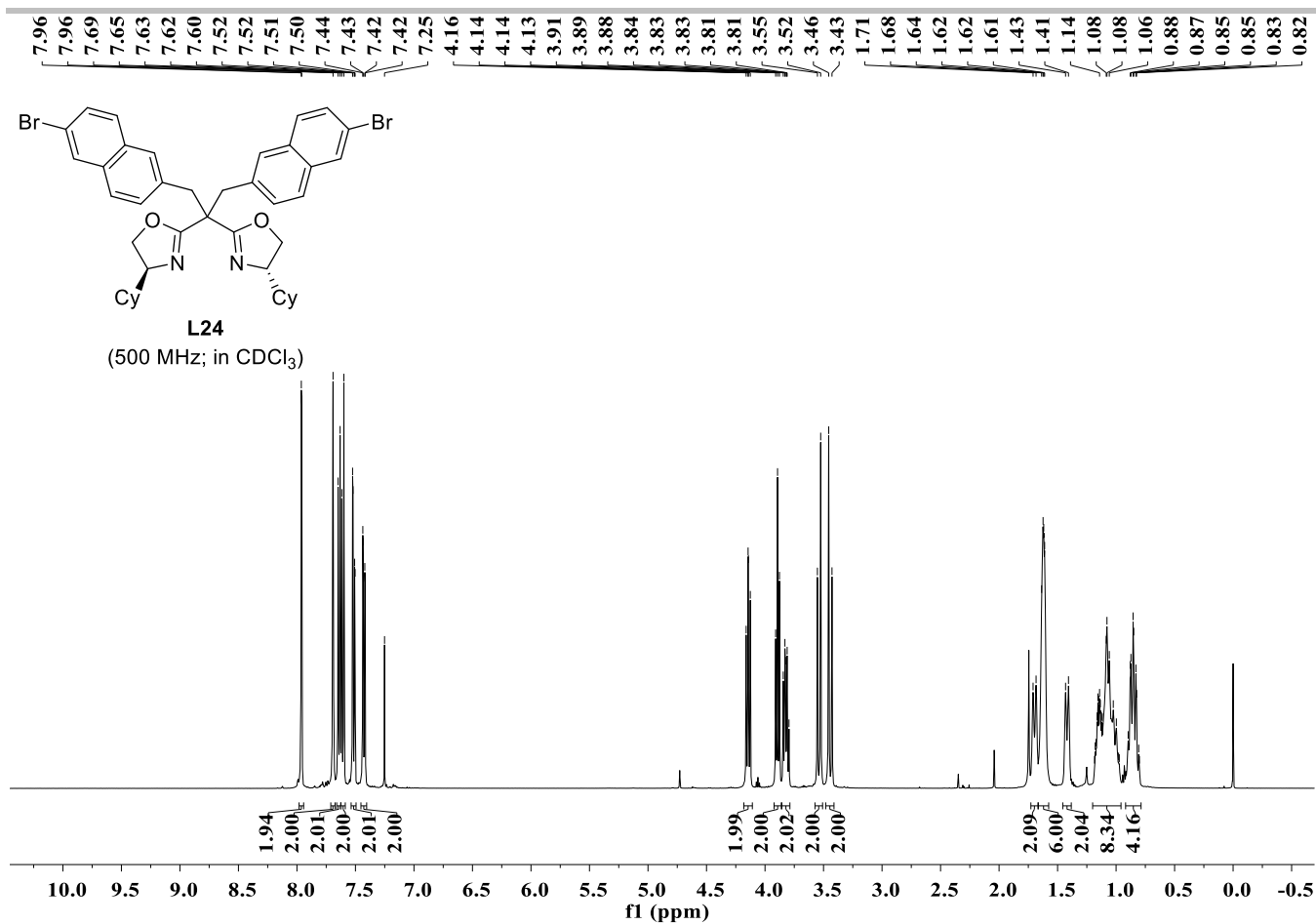
# SUPPORTING INFORMATION



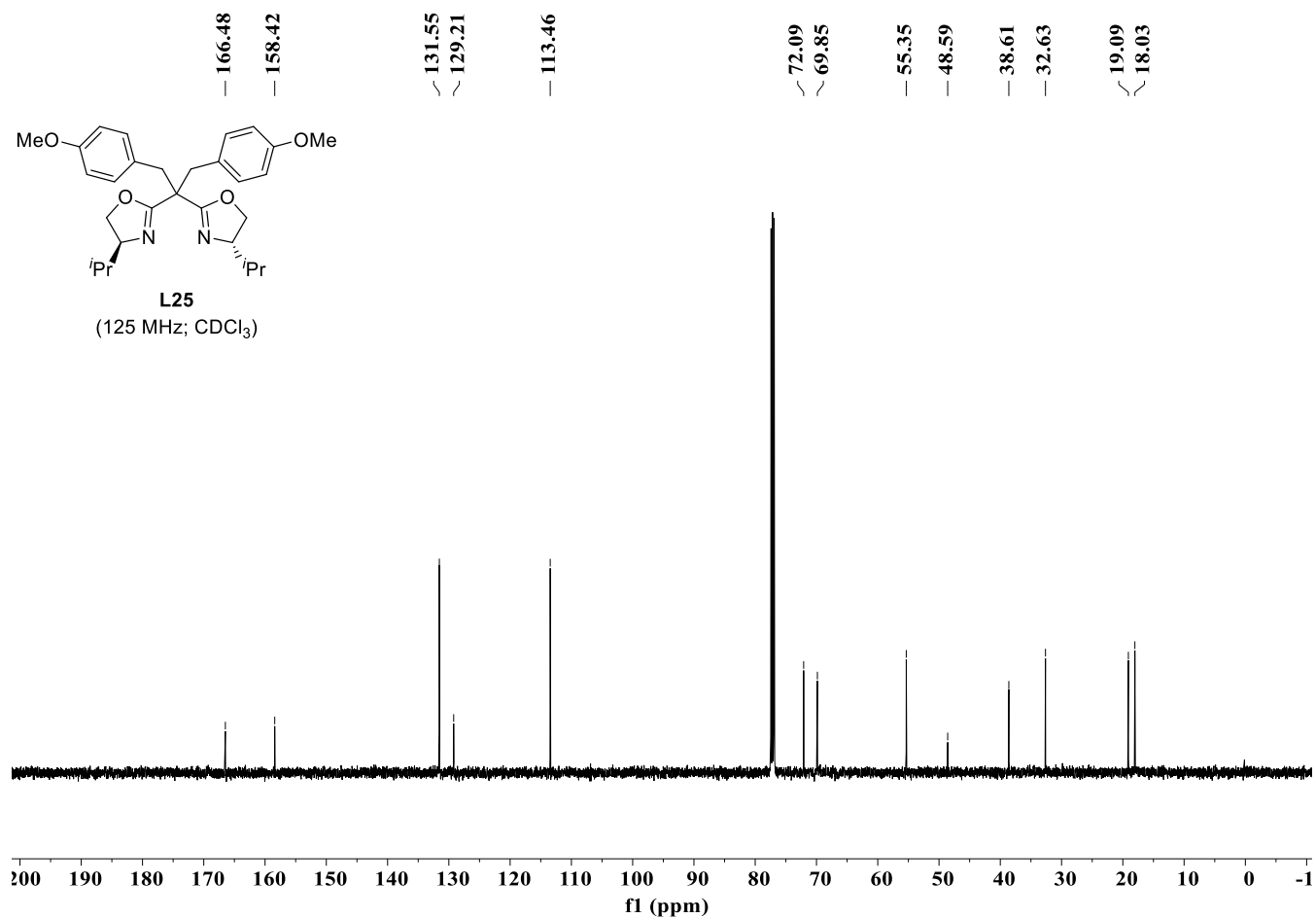
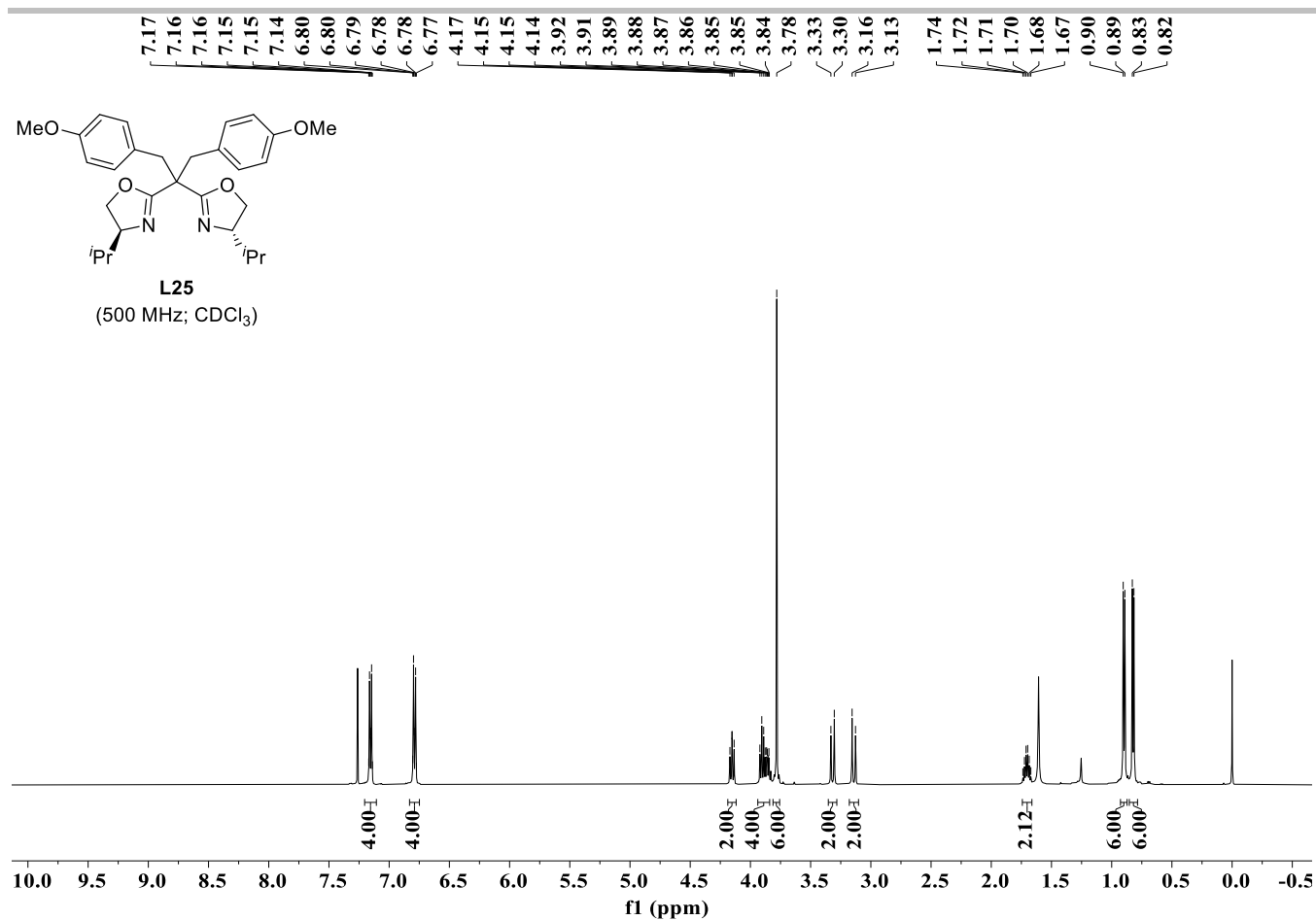
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION

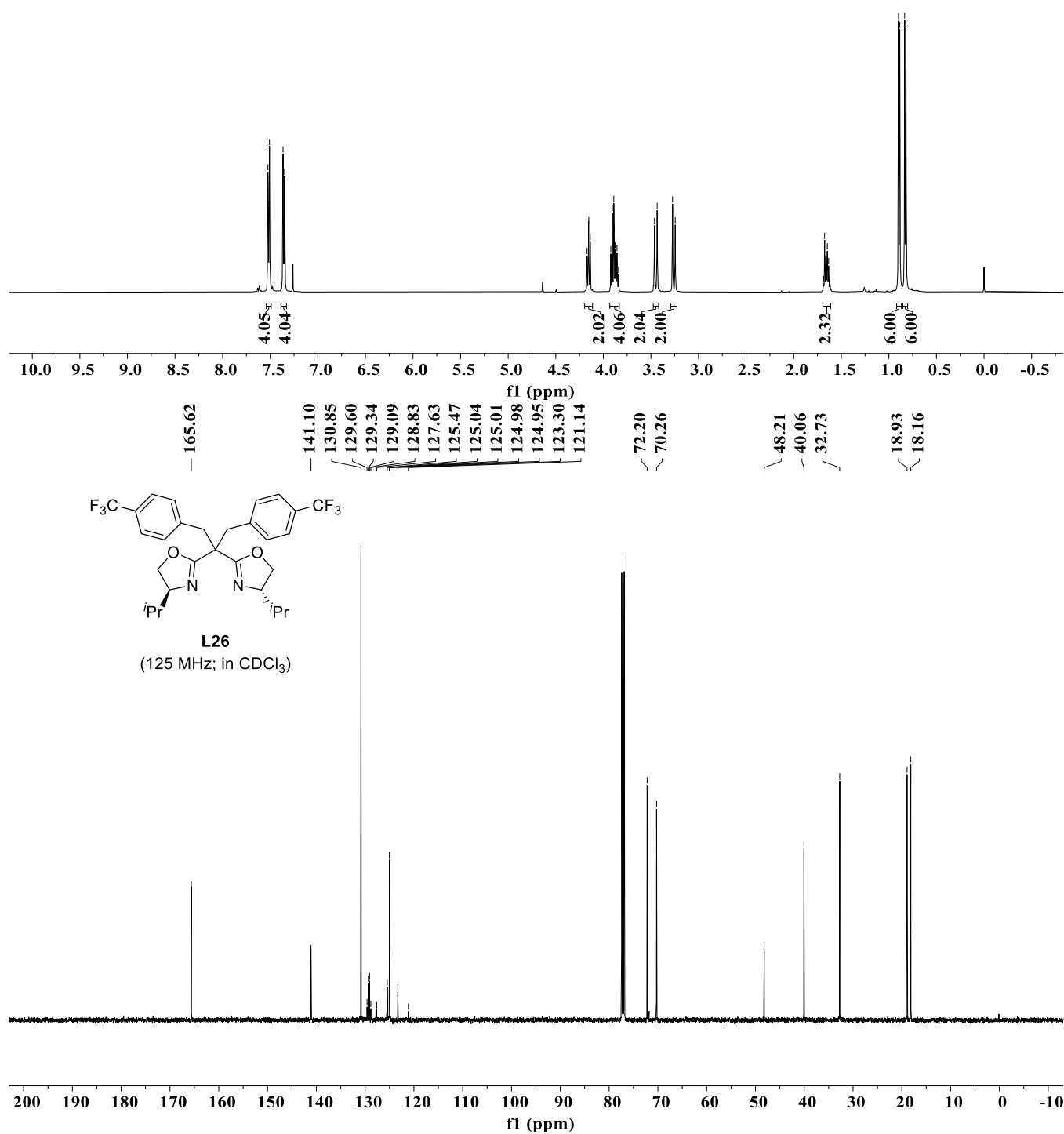
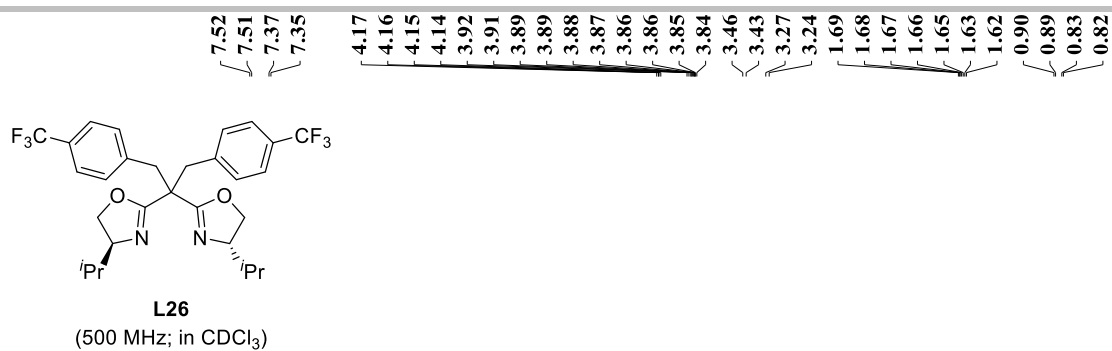


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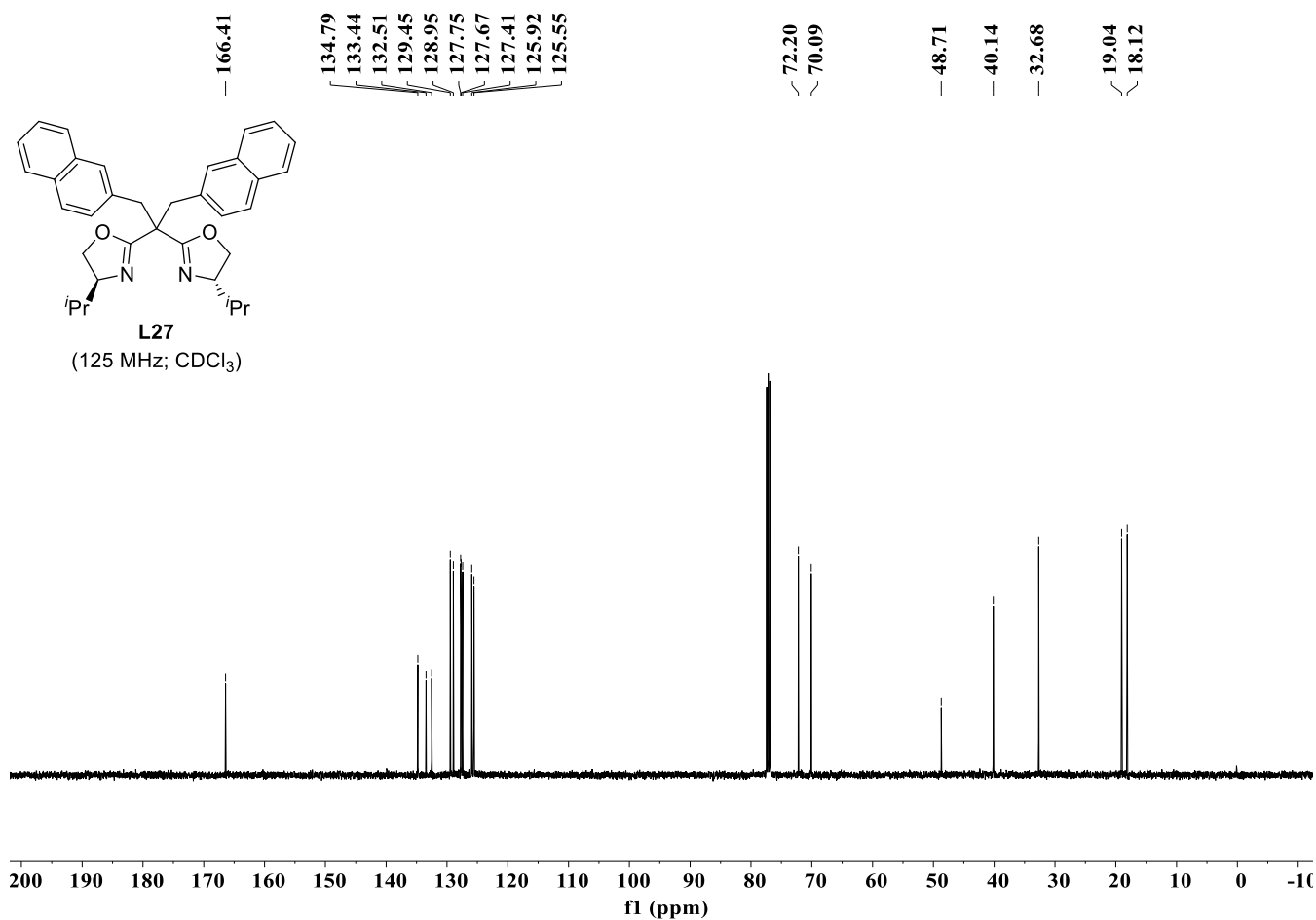
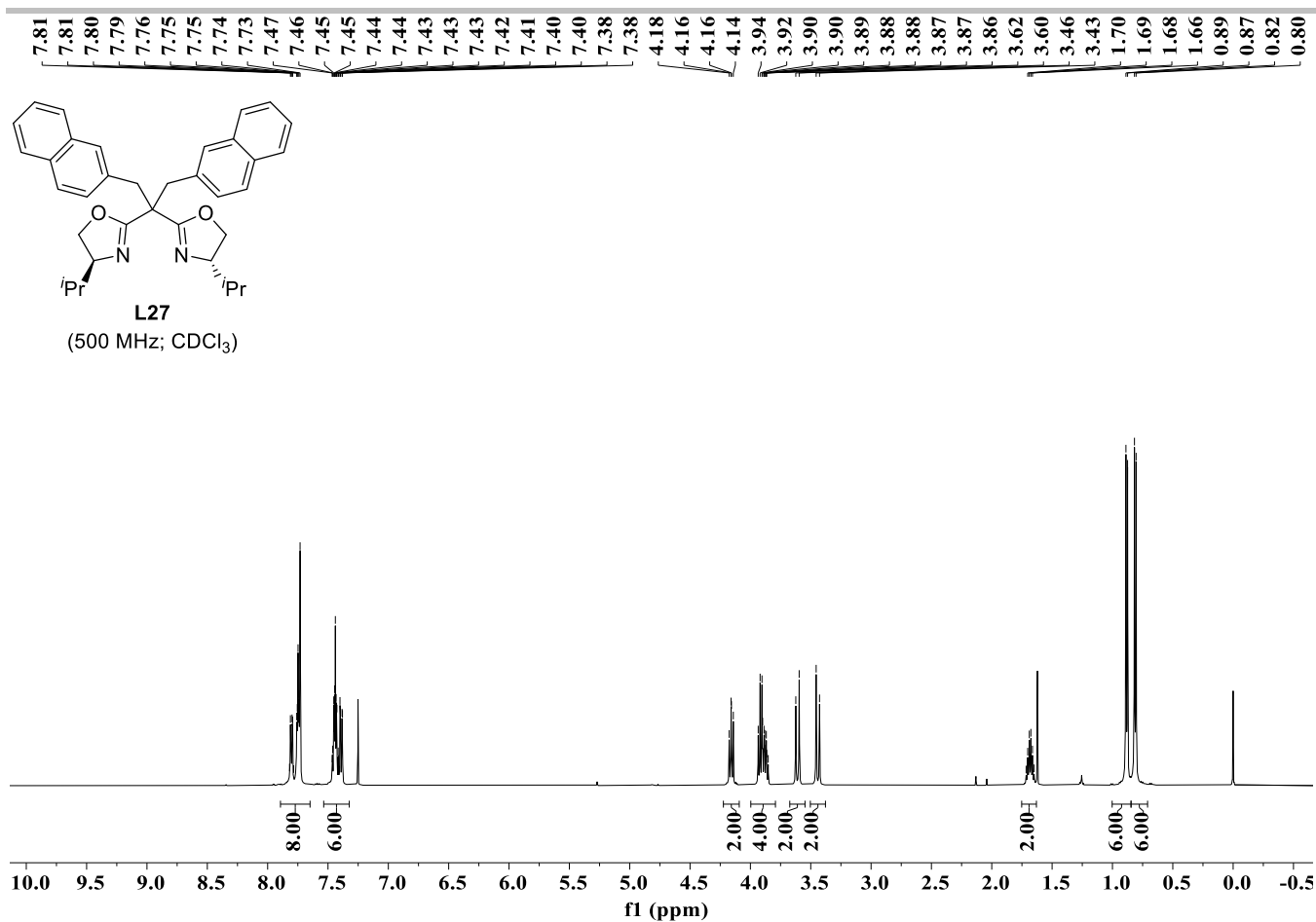




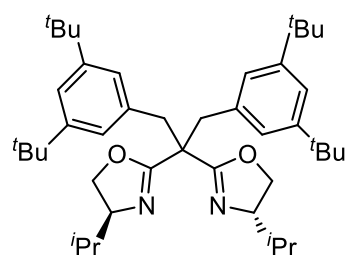
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# SUPPORTING INFORMATION

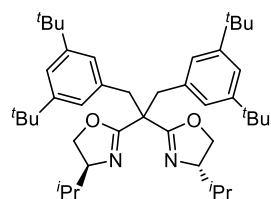
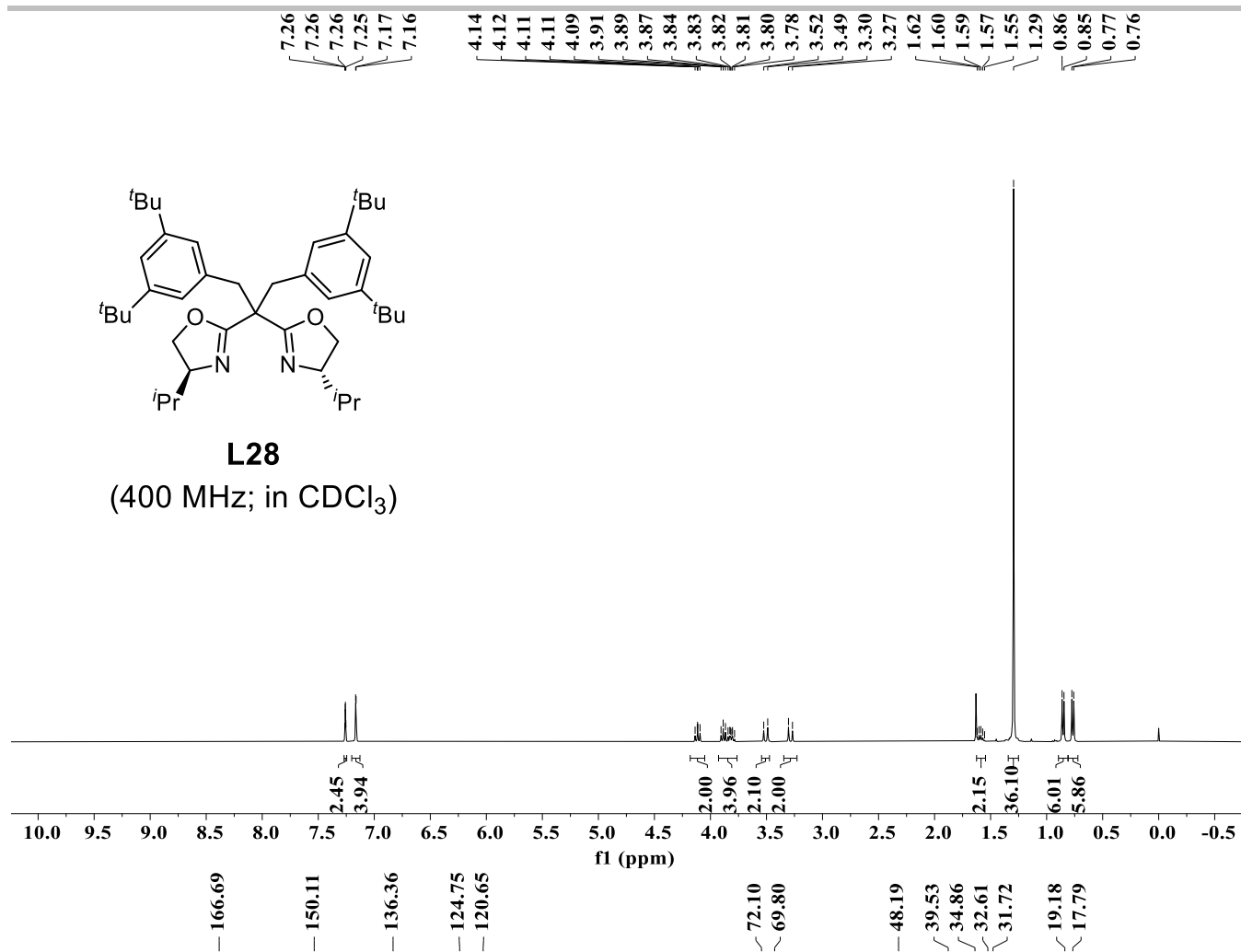


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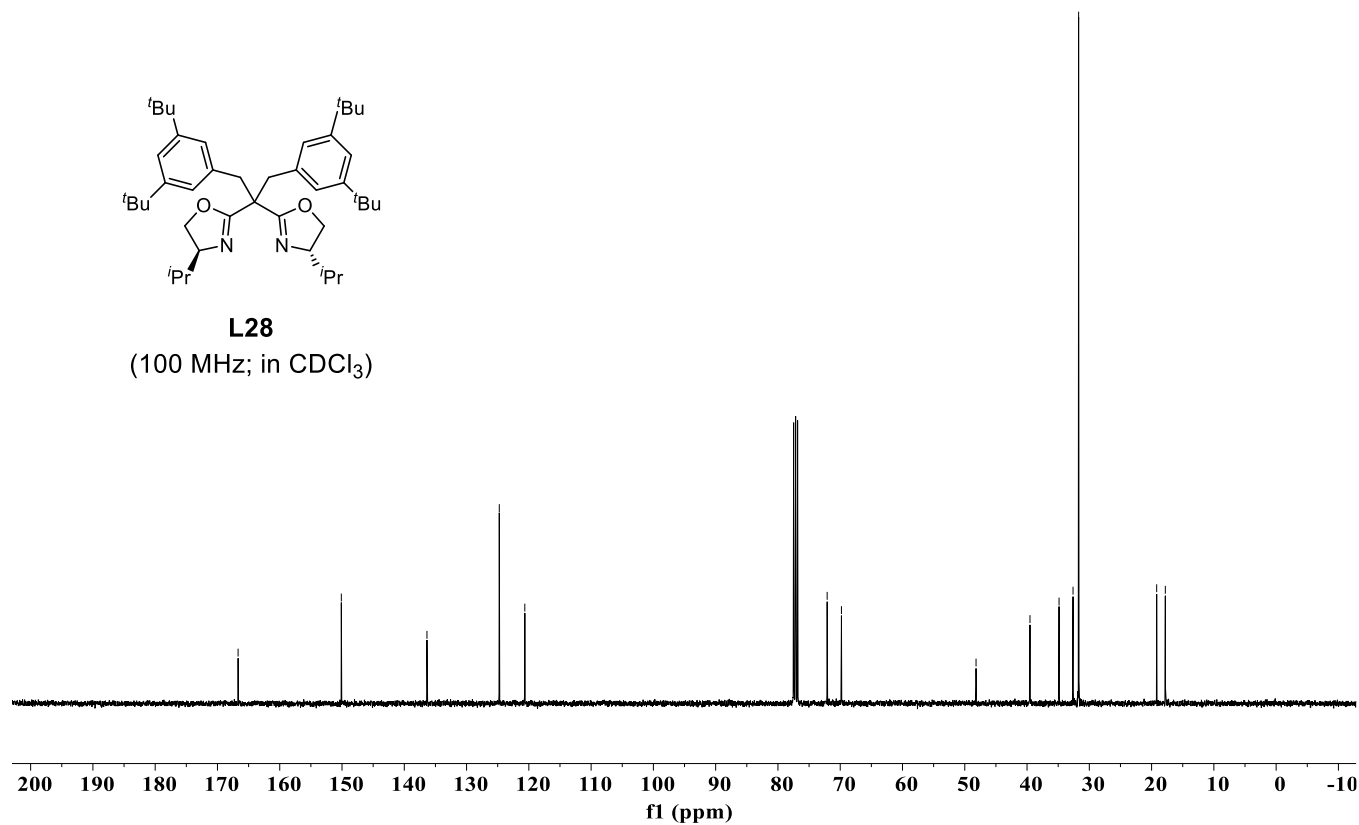
**L28**

(400 MHz; in CDCl<sub>3</sub>)

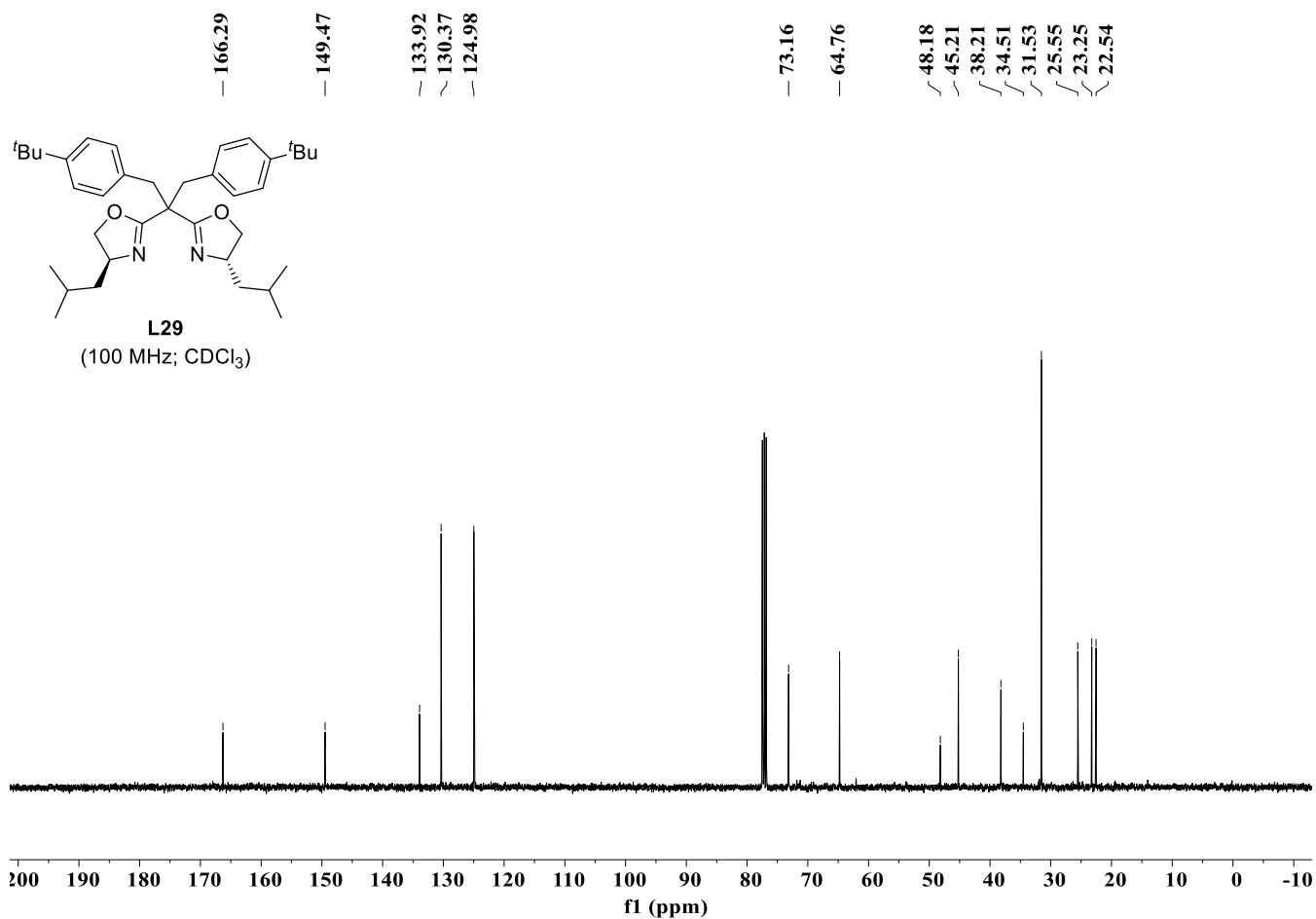
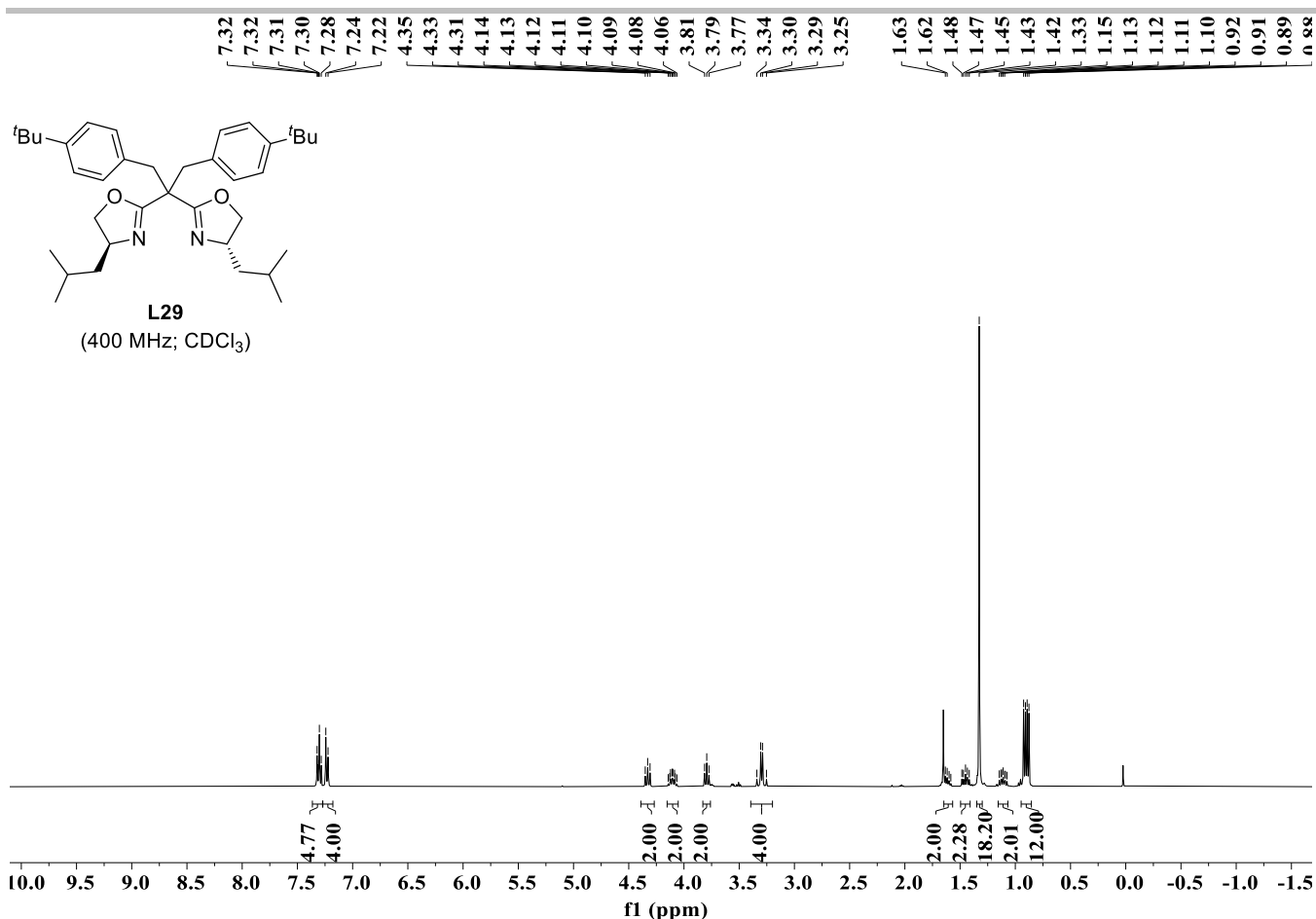


**L28**

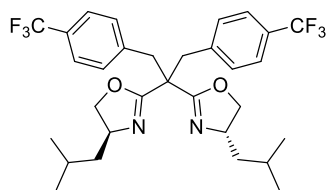
(100 MHz; in CDCl<sub>3</sub>)



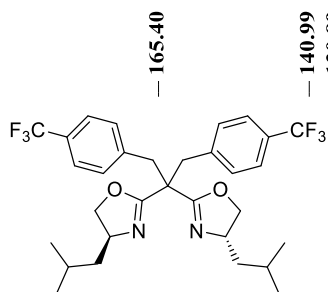
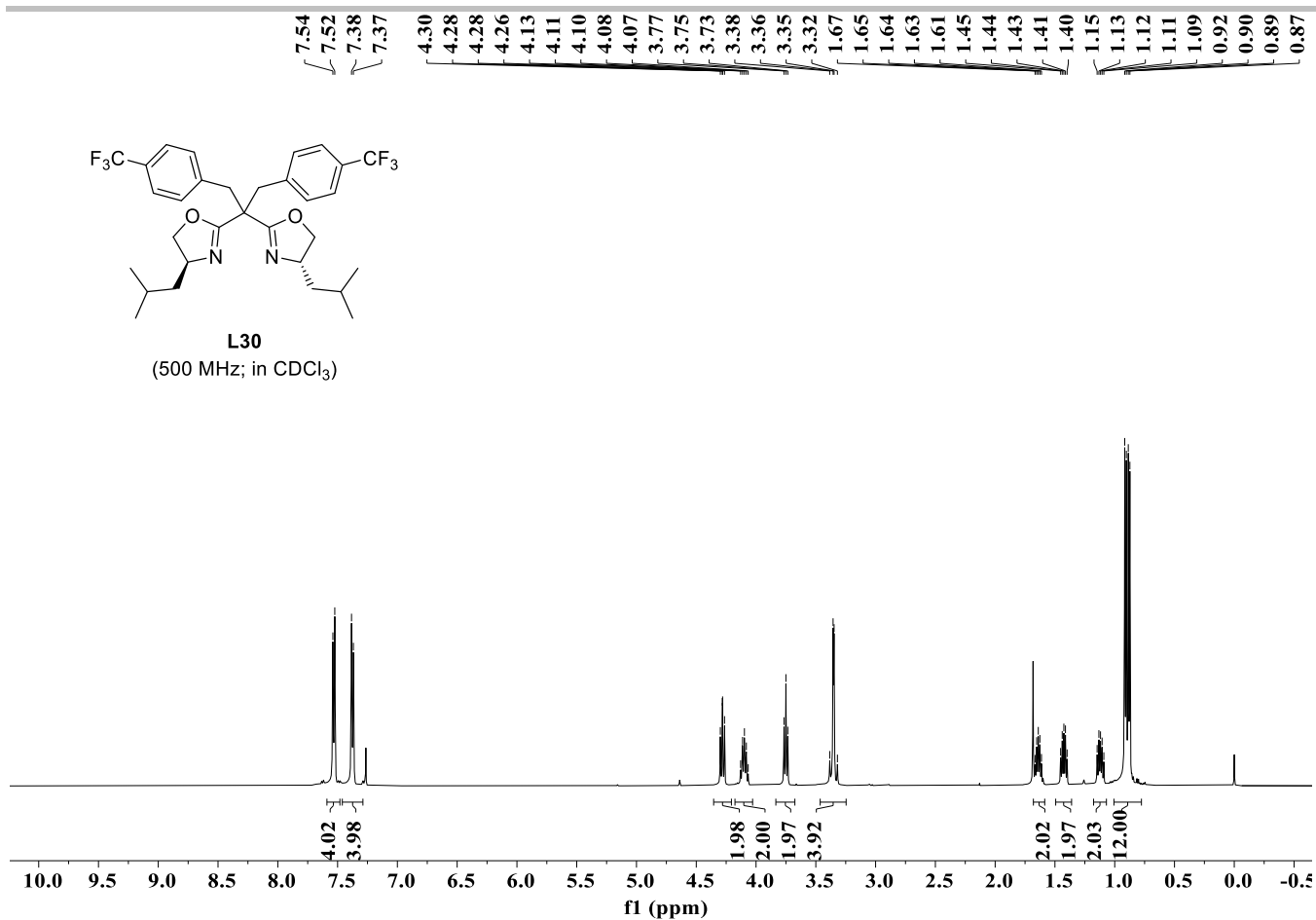
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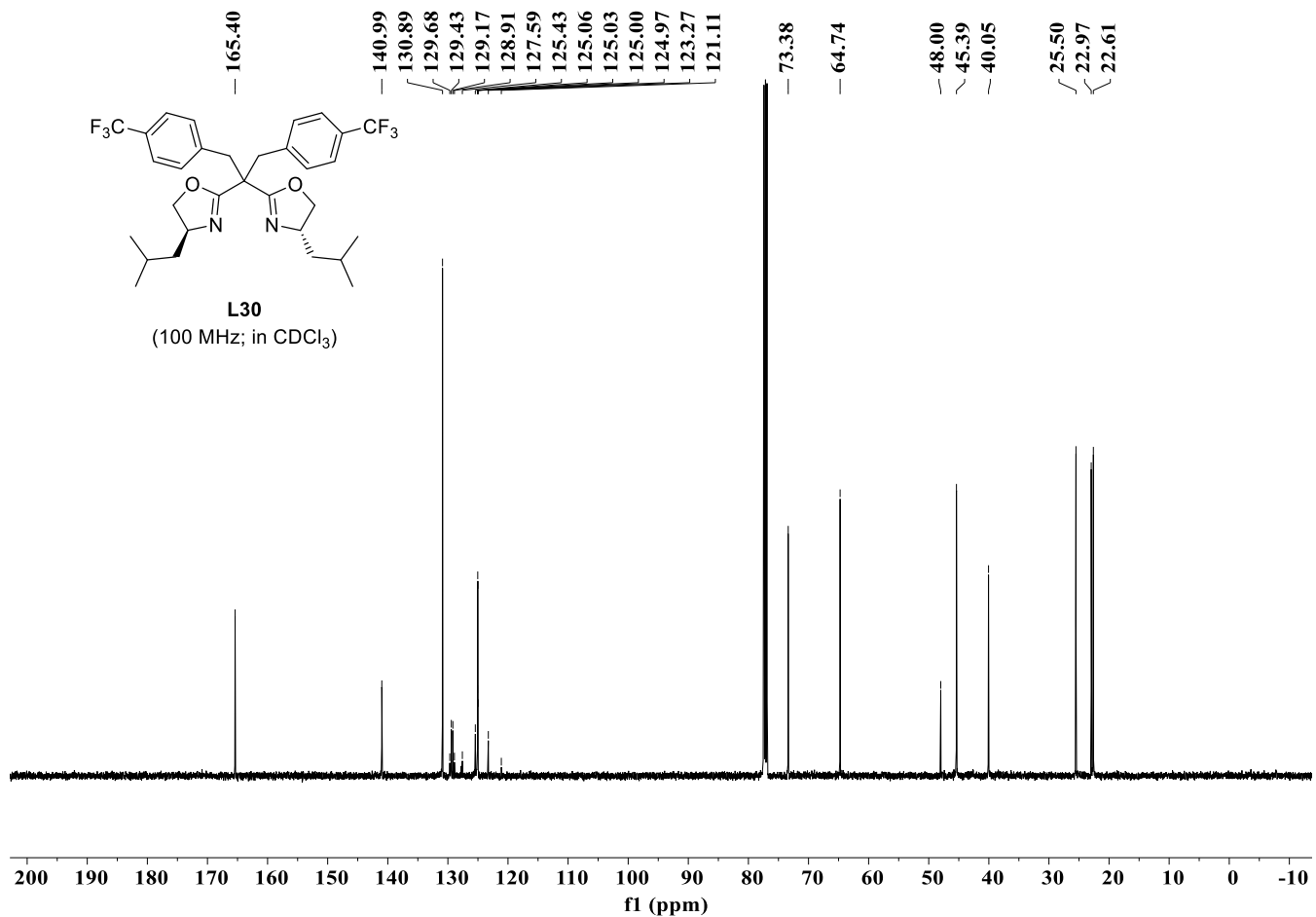
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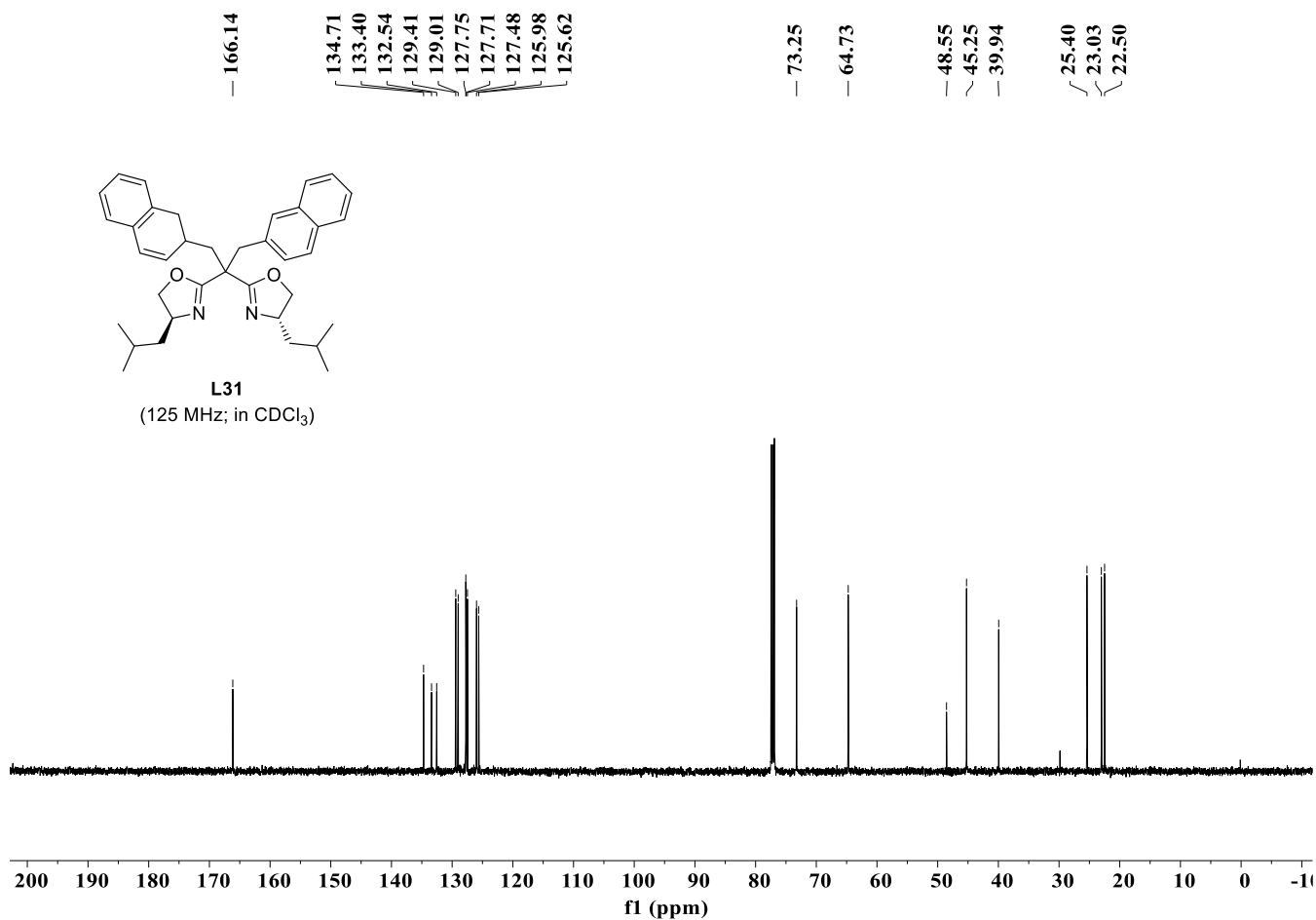
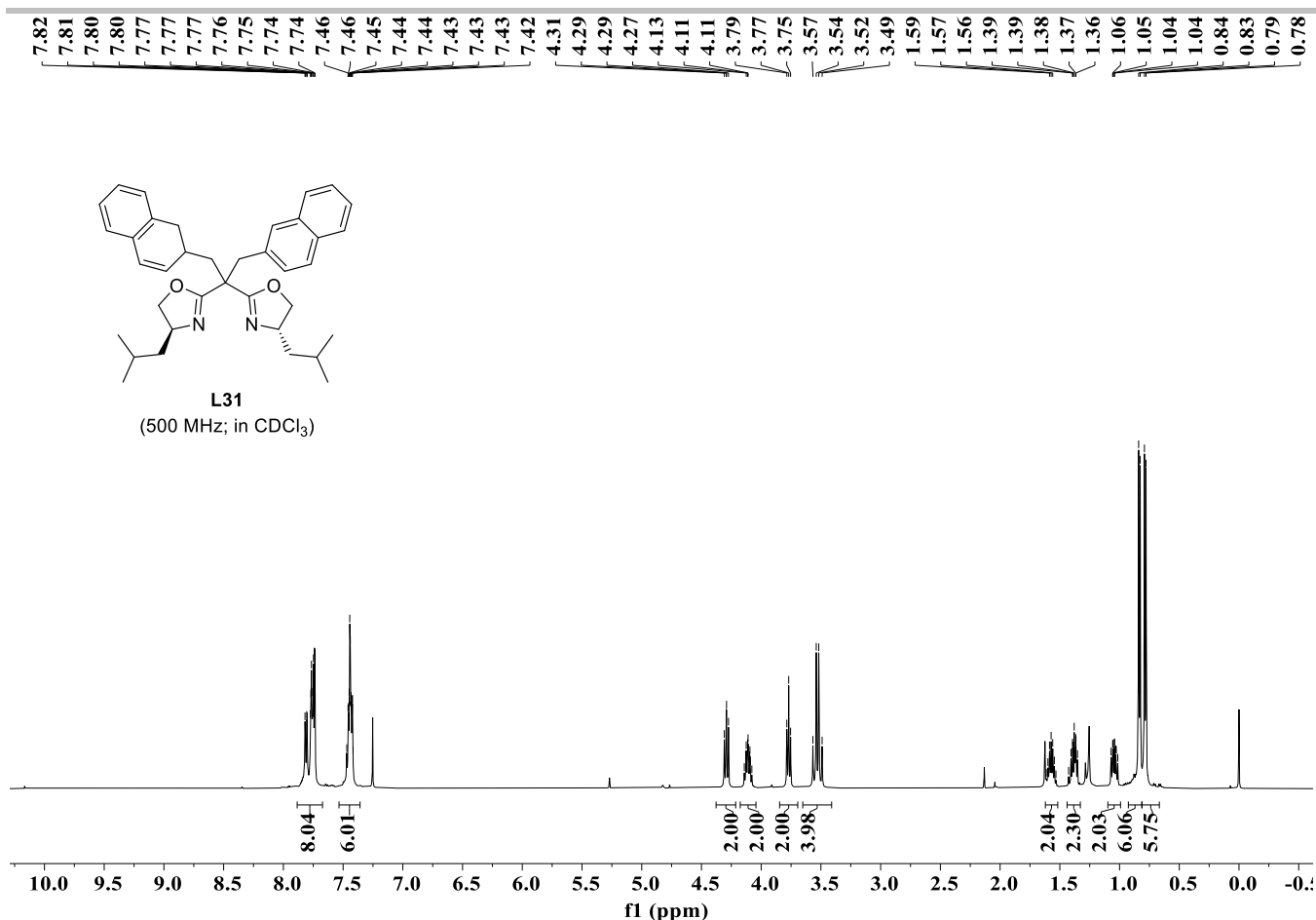
**L30**  
(500 MHz; in CDCl<sub>3</sub>)



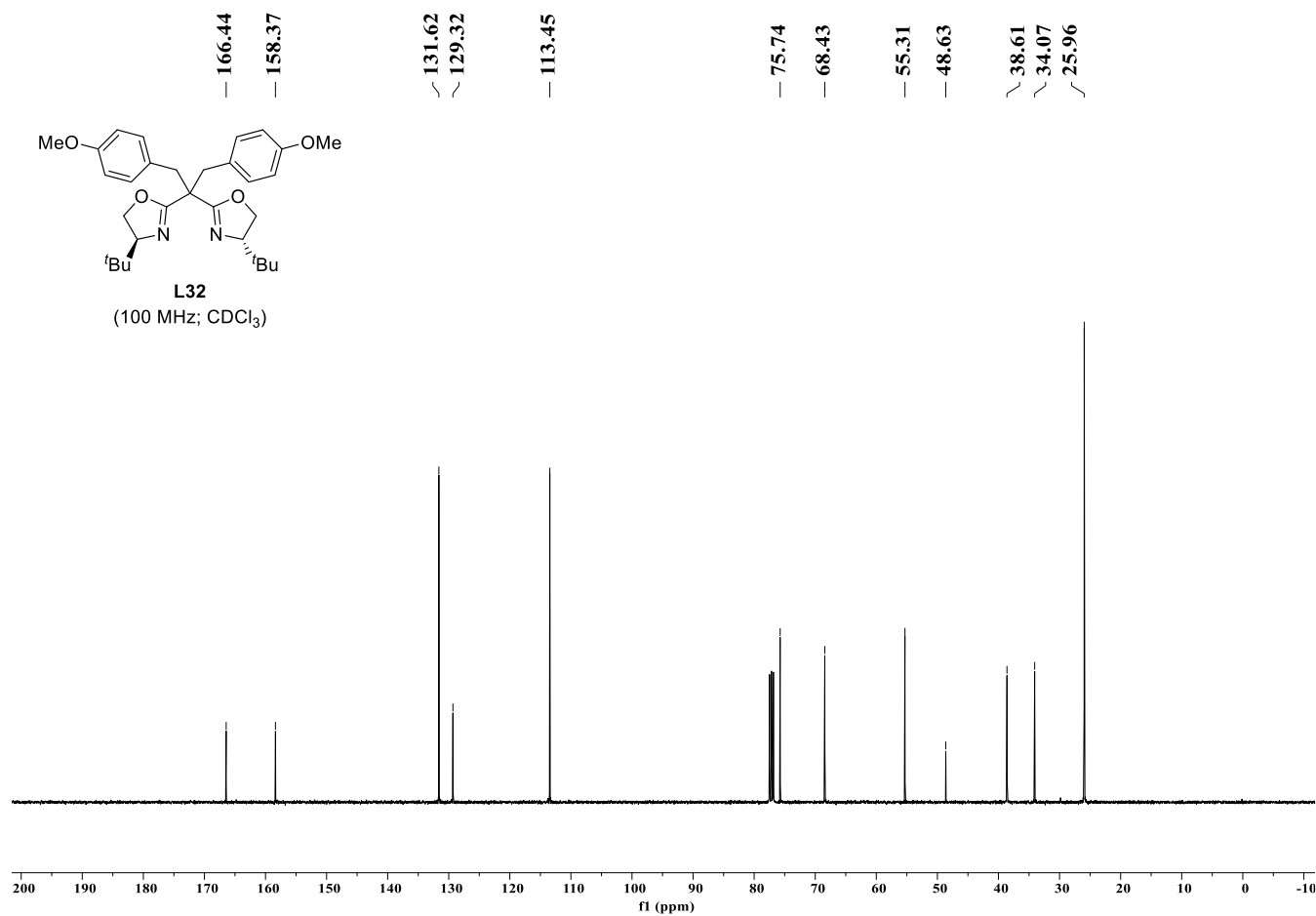
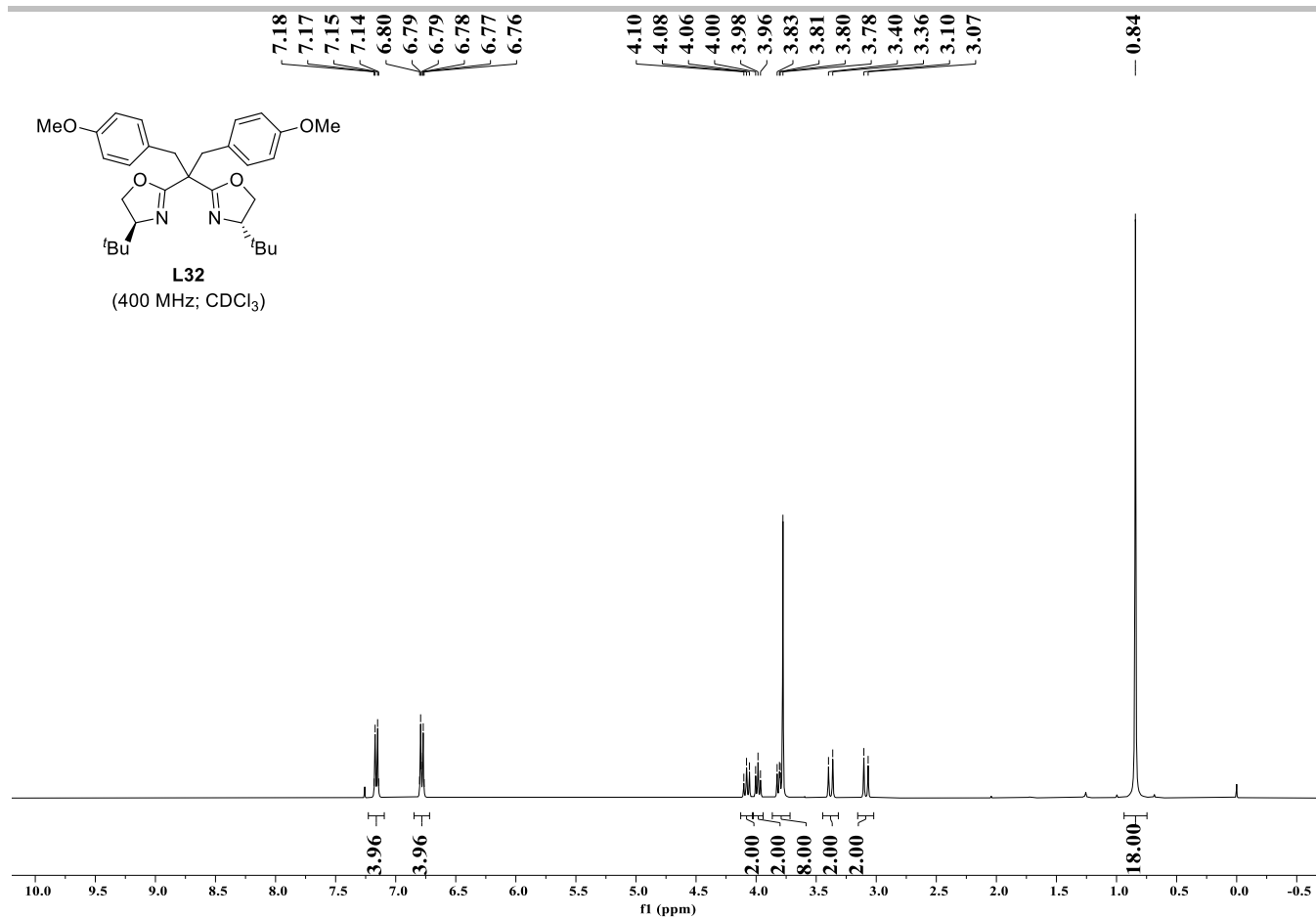
**L30**  
(100 MHz; in CDCl<sub>3</sub>)



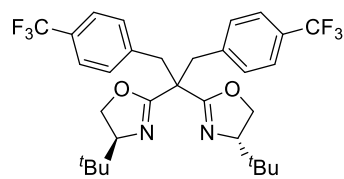
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# SUPPORTING INFORMATION

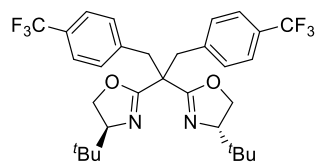
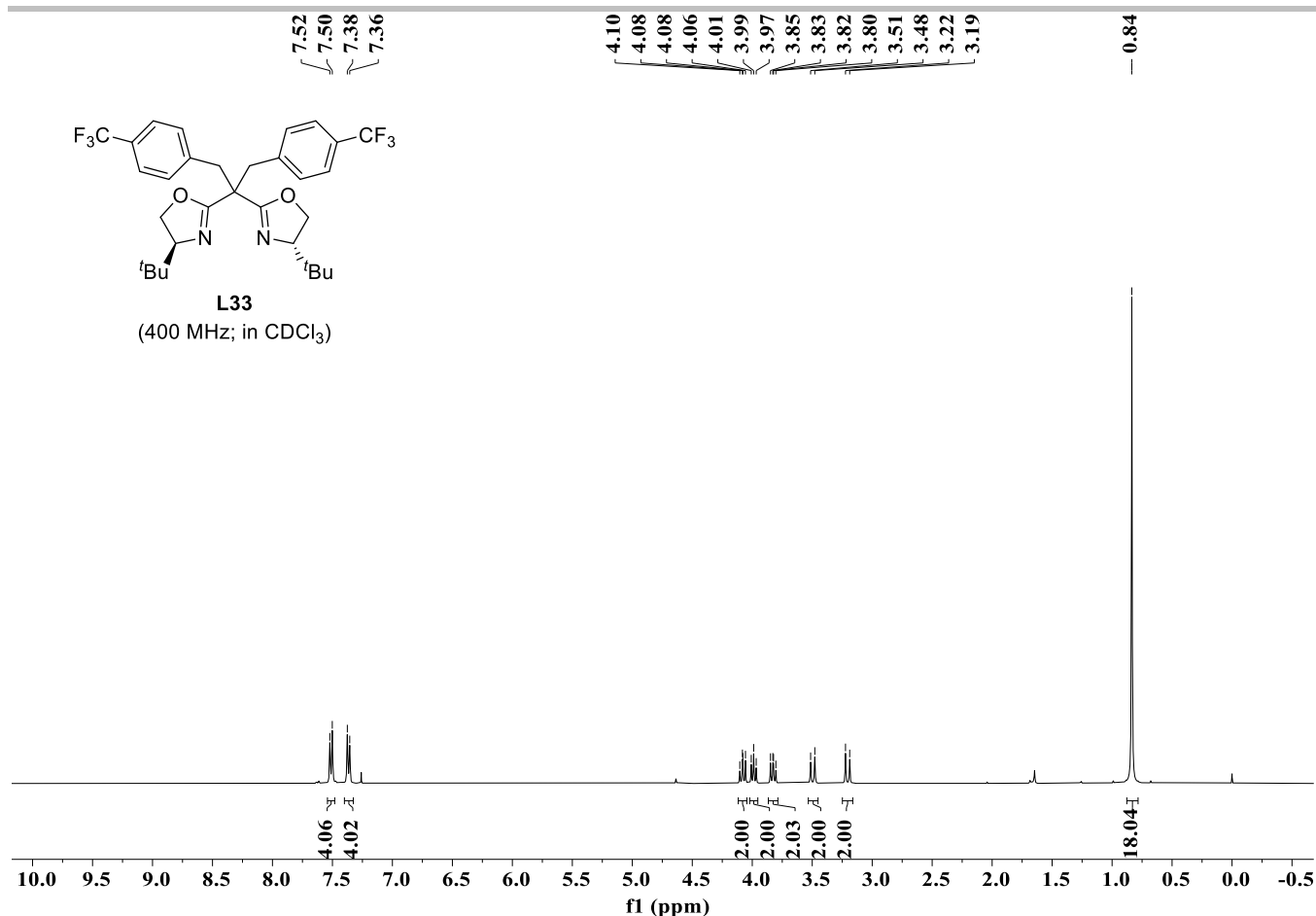


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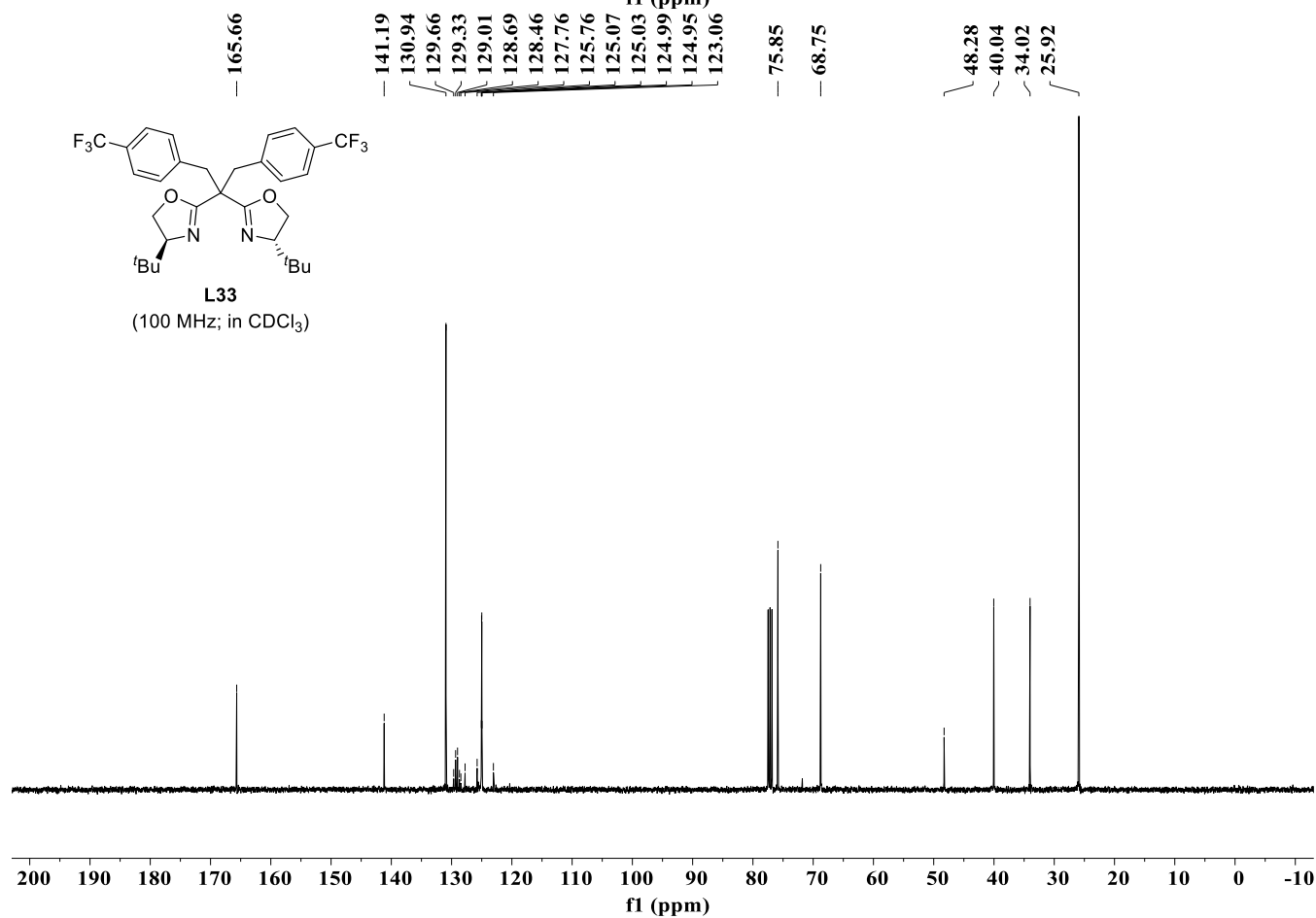
**L33**

(400 MHz; in  $\text{CDCl}_3$ )



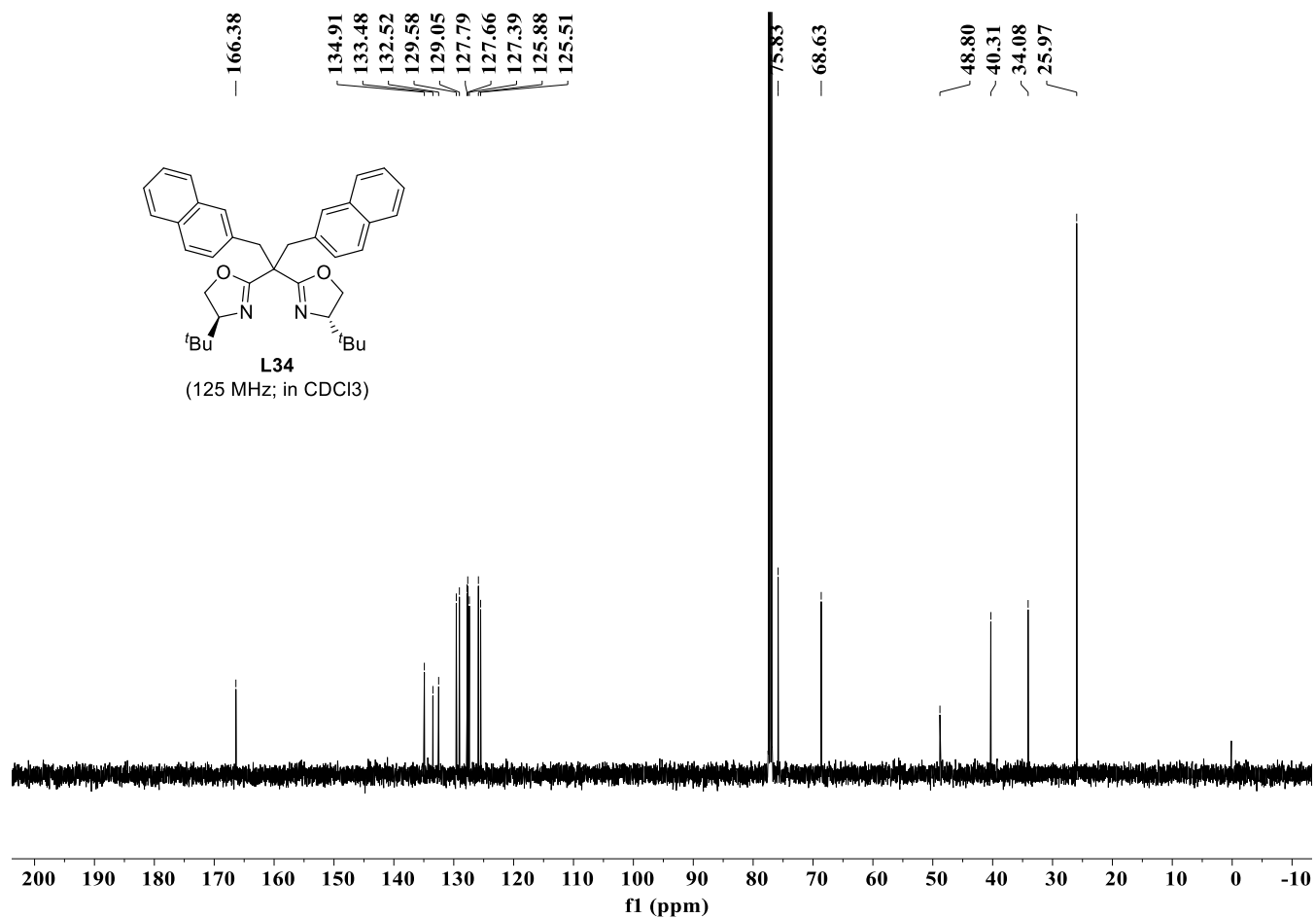
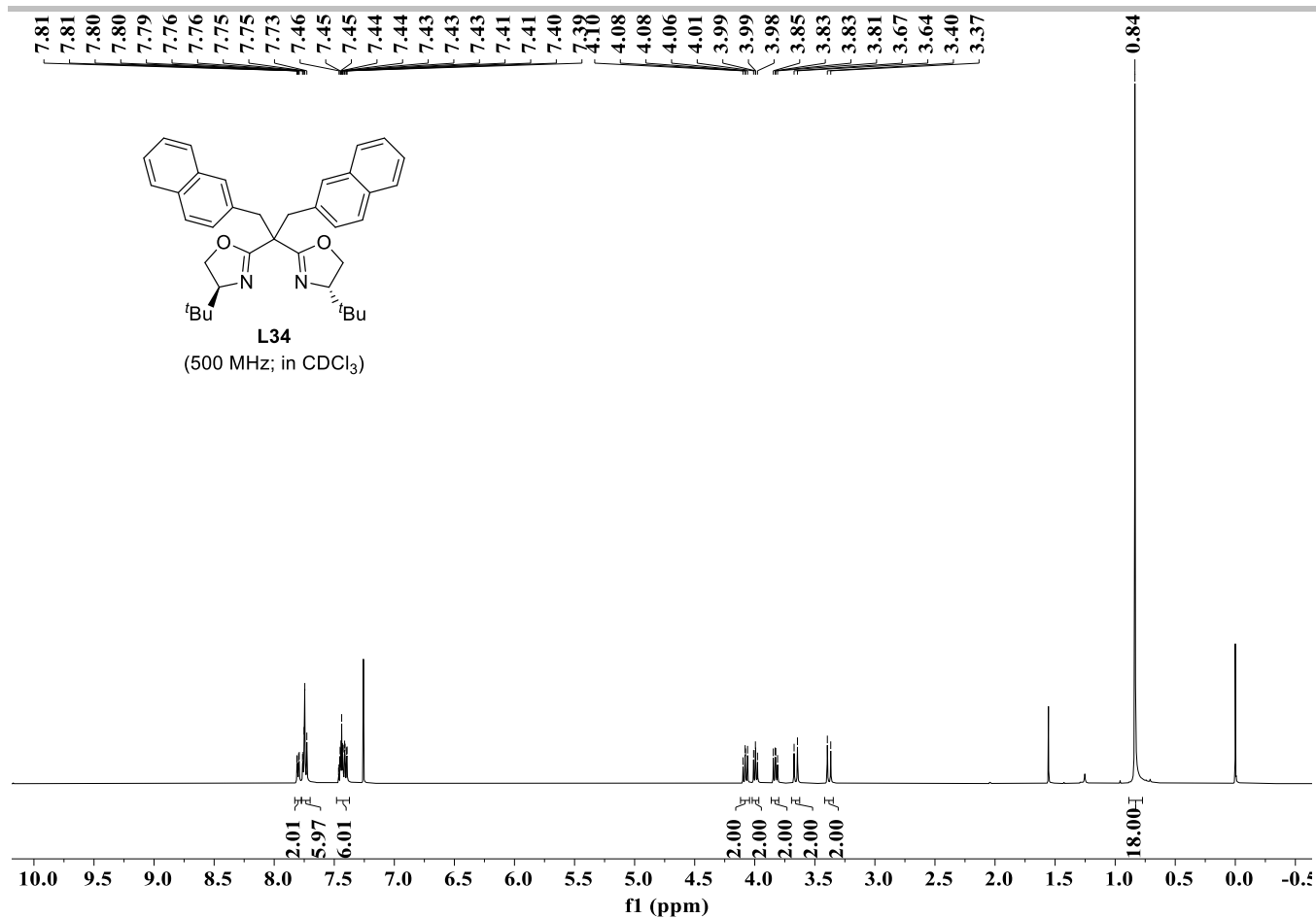
**L33**

(100 MHz; in  $\text{CDCl}_3$ )

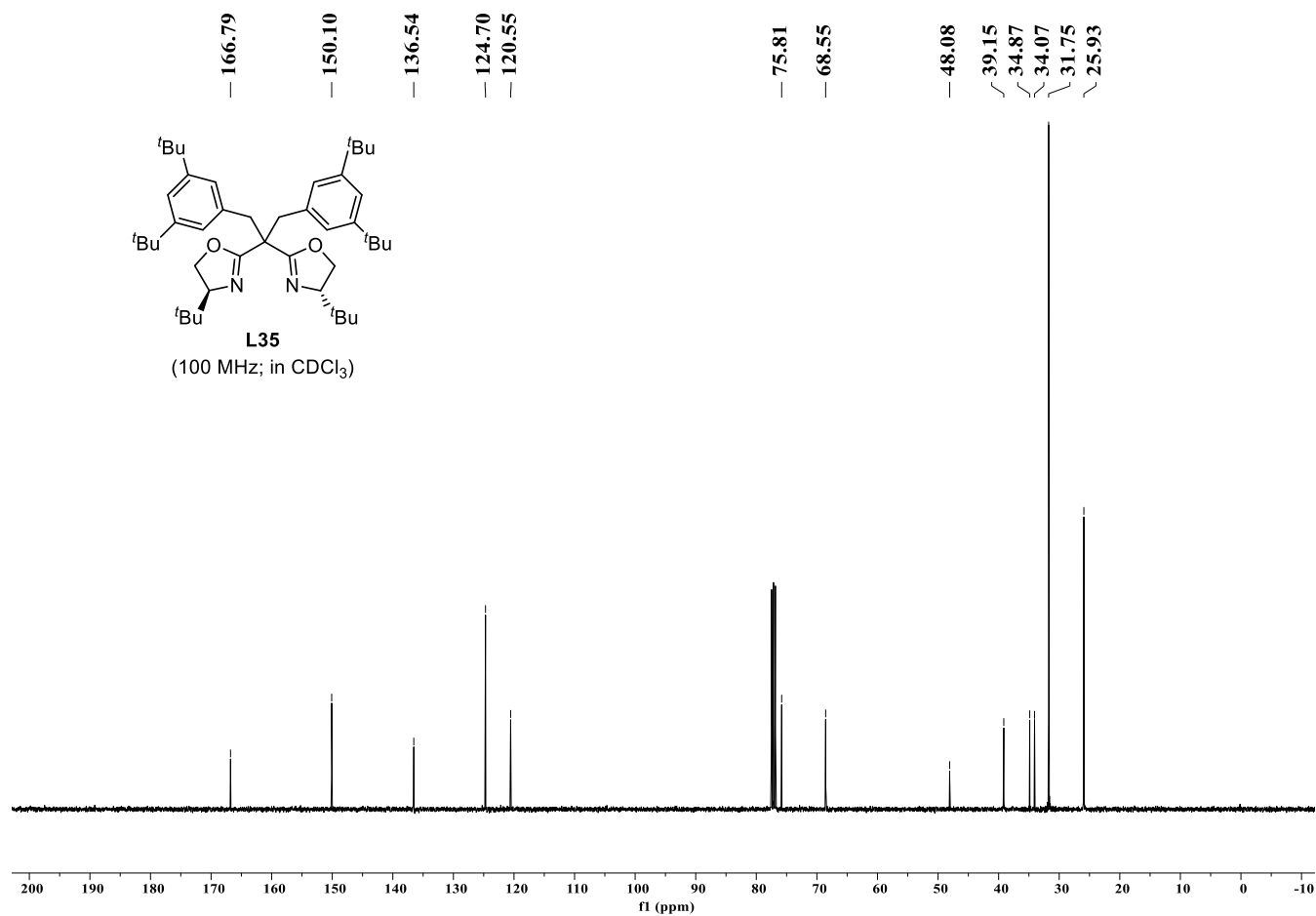
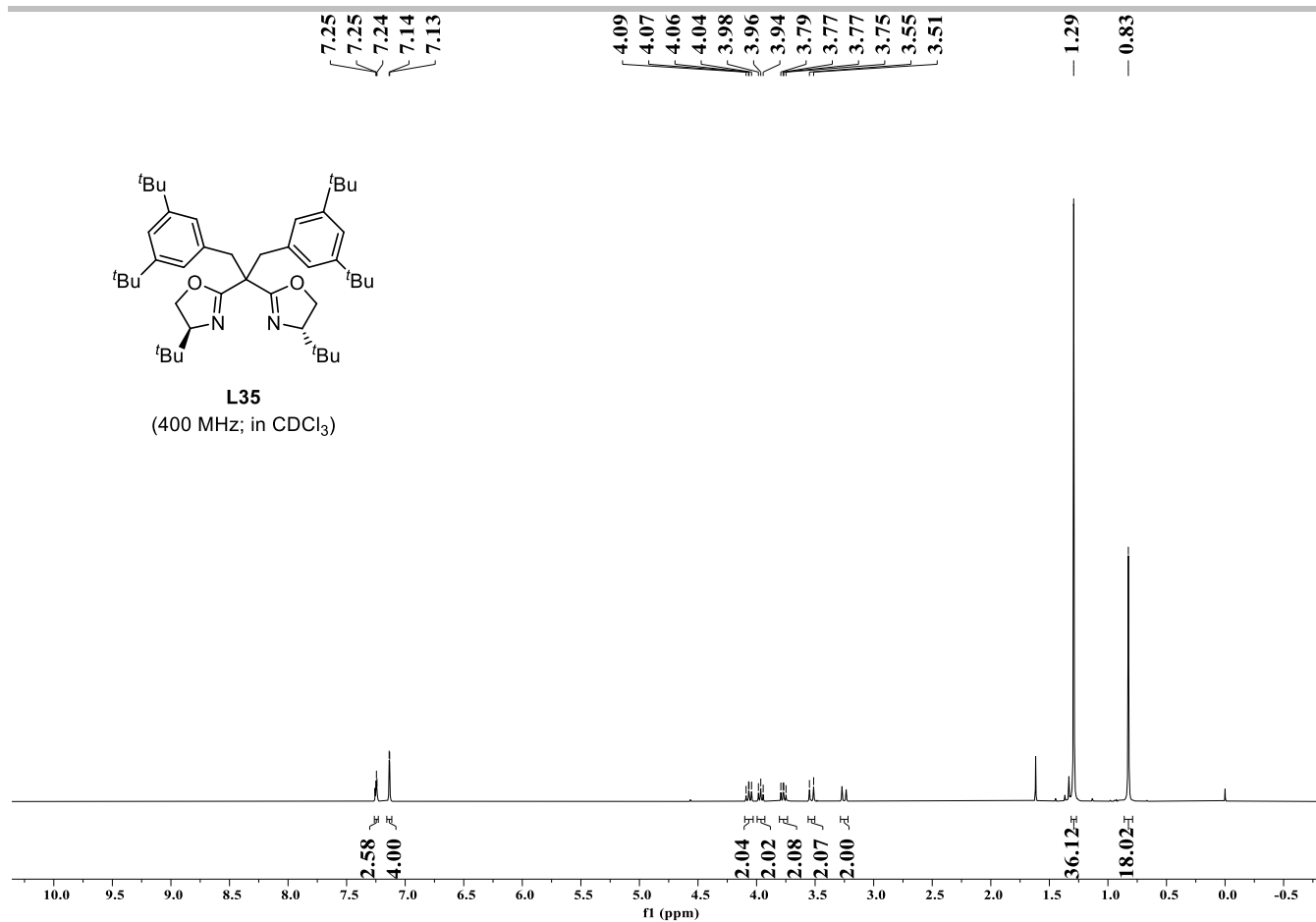




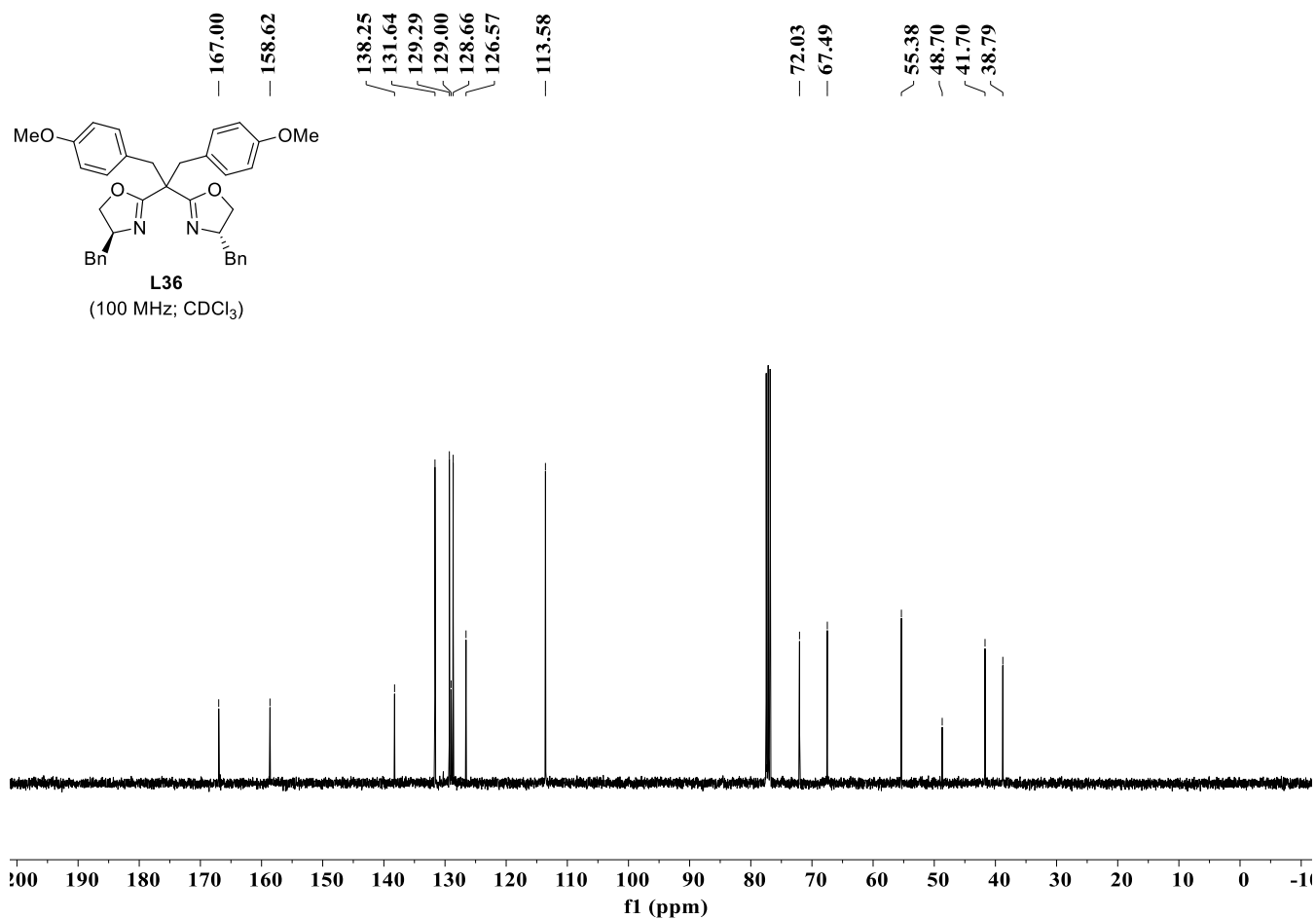
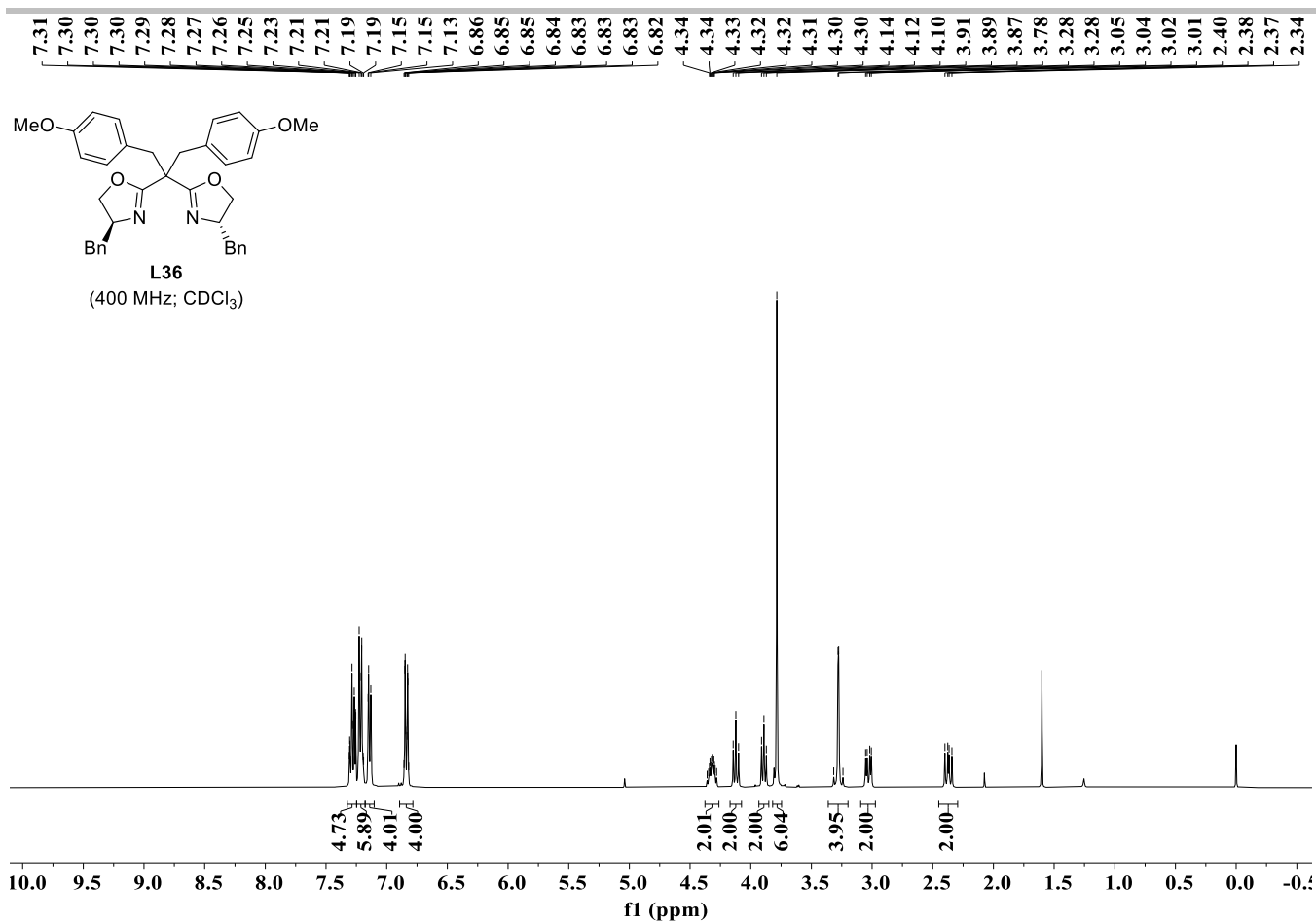
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION



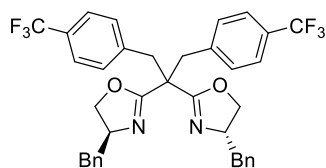
# SUPPORTING INFORMATION



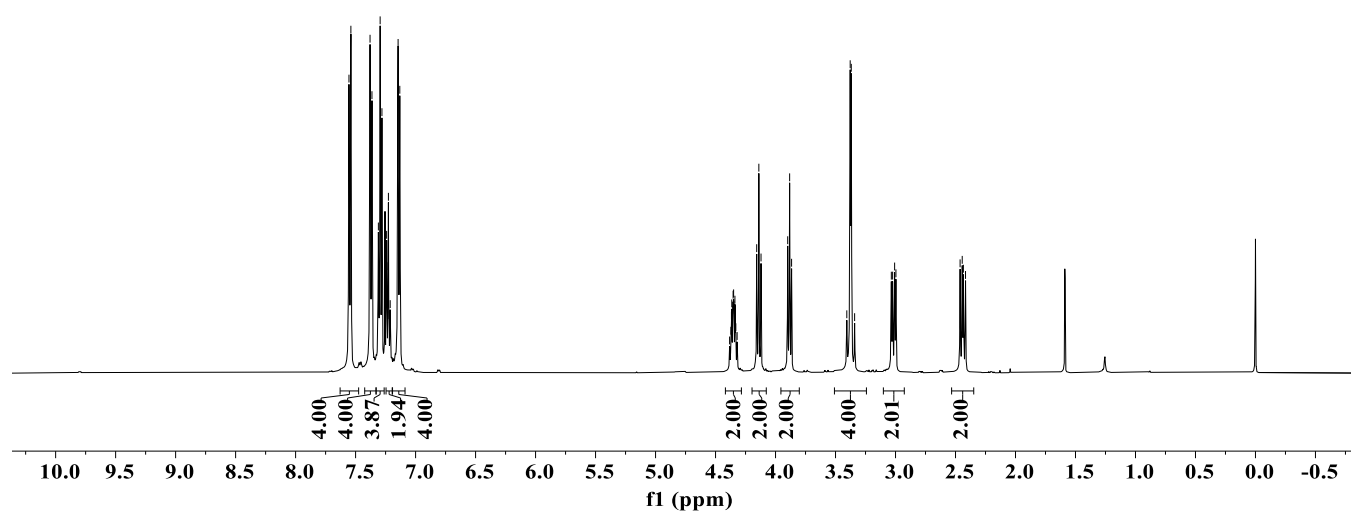
# SUPPORTING INFORMATION

7.56  
7.54  
7.38  
7.36  
7.31  
7.30  
7.28  
7.24  
7.24  
7.23  
7.23  
7.22  
7.21  
7.21  
7.15  
7.15  
7.13

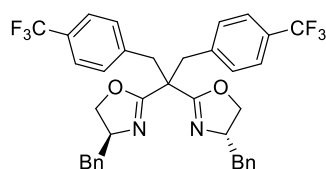
4.37  
4.37  
4.36  
4.36  
4.35  
4.35  
4.35  
4.34  
4.34  
4.33  
4.32  
4.16  
4.14  
4.12  
3.90  
3.88  
3.87  
3.41  
3.38  
3.37  
3.34  
3.03  
3.02  
3.01  
3.00  
2.46  
2.44  
2.43  
2.42



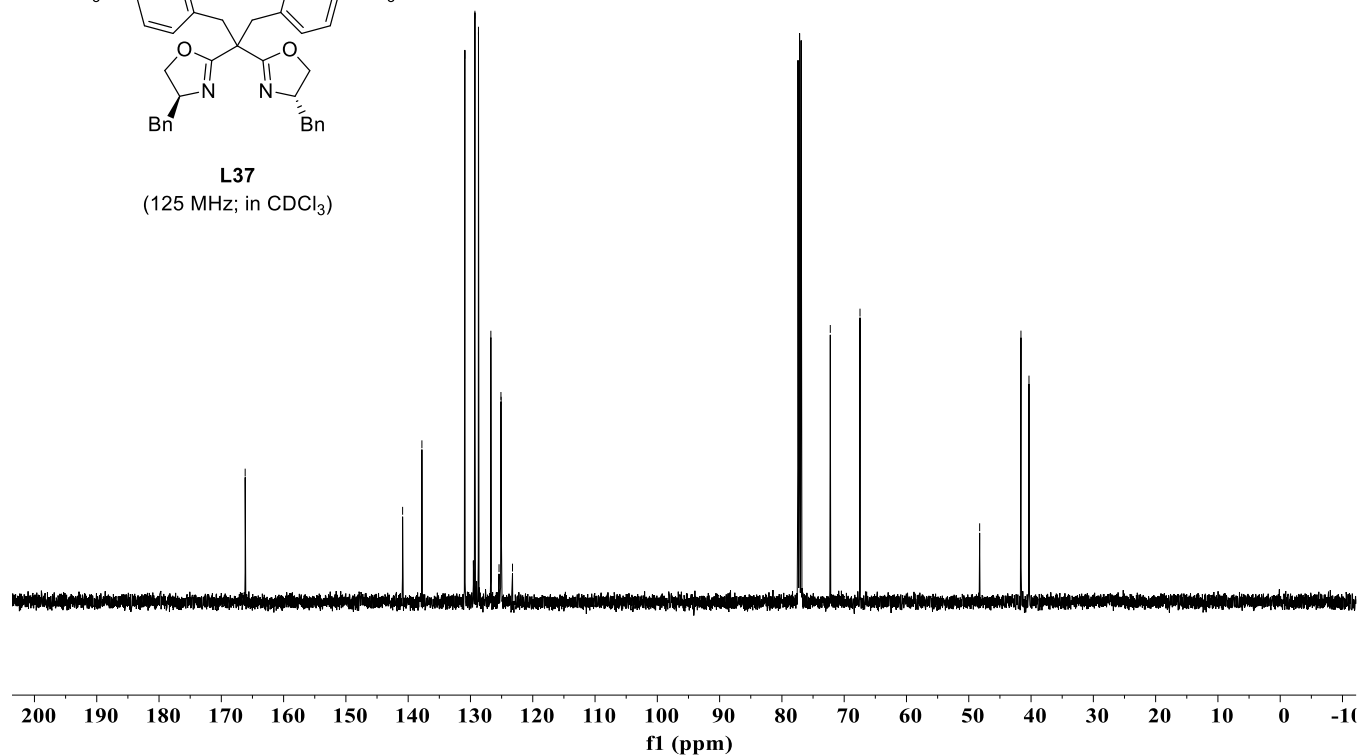
**L37**  
(500 MHz; in CDCl<sub>3</sub>)



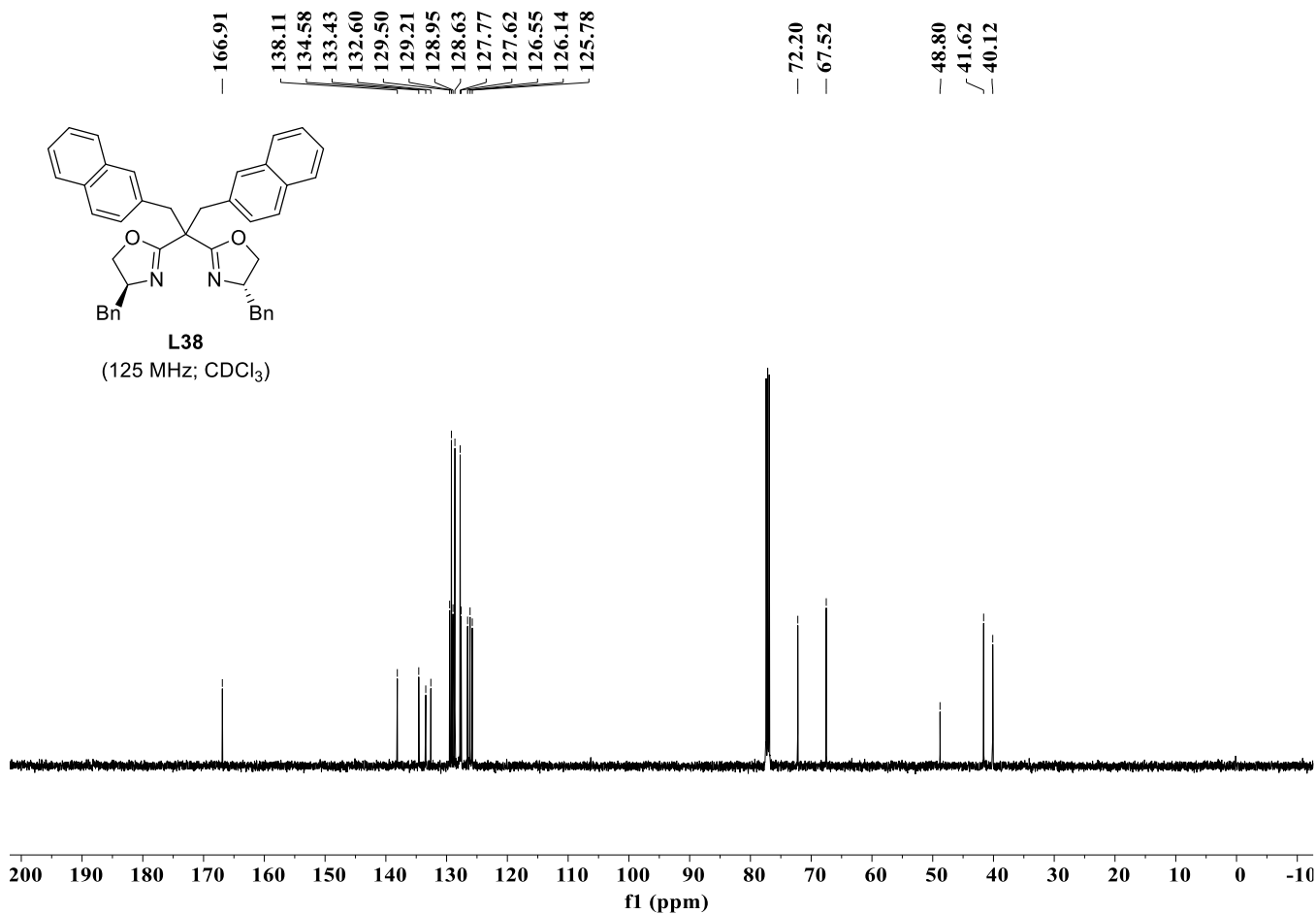
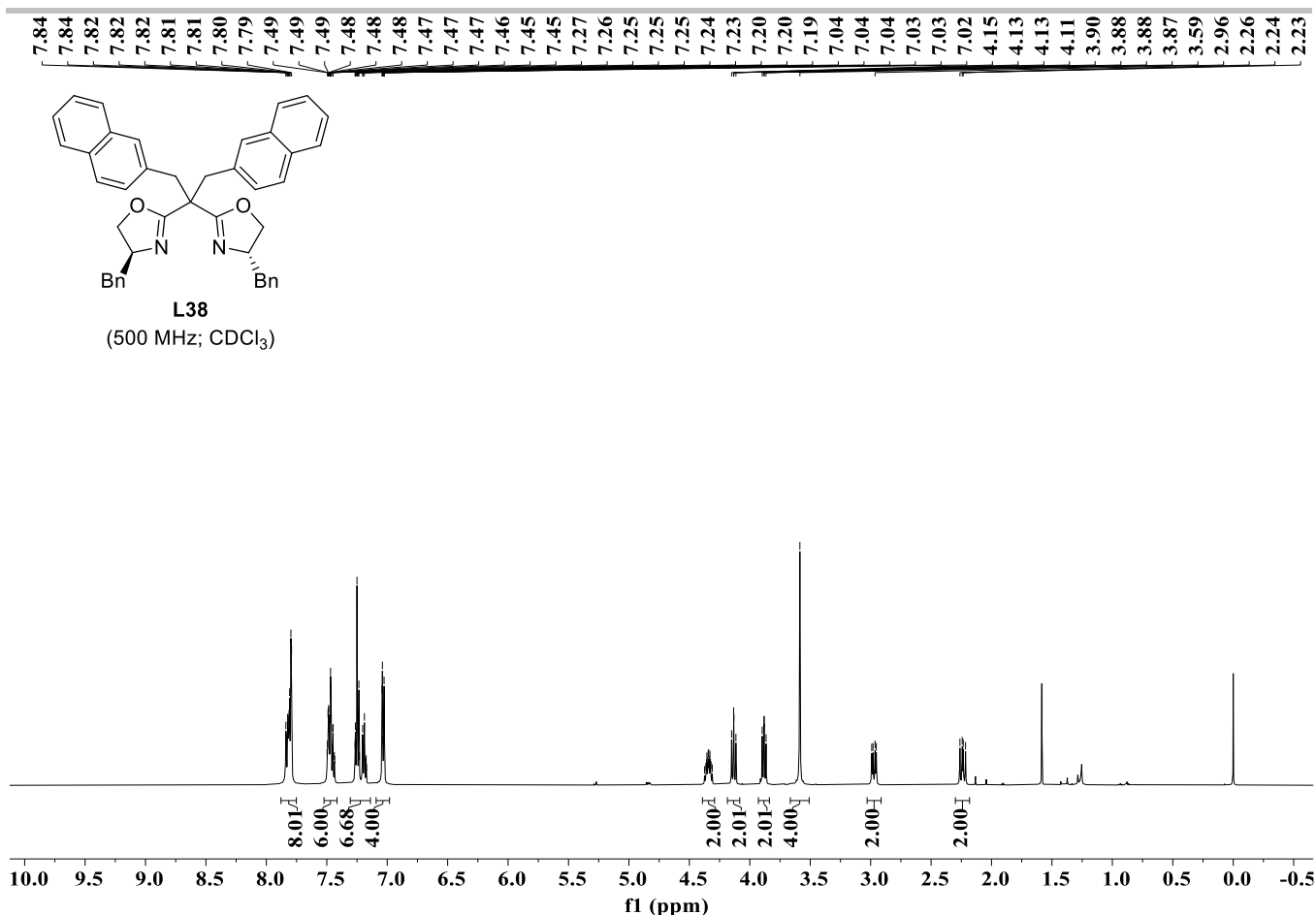
166.17  
140.89  
137.79  
130.91  
129.29  
128.71  
126.73  
125.41  
125.11  
125.08  
125.05  
123.25  
72.23  
67.46  
48.25  
41.62  
40.33



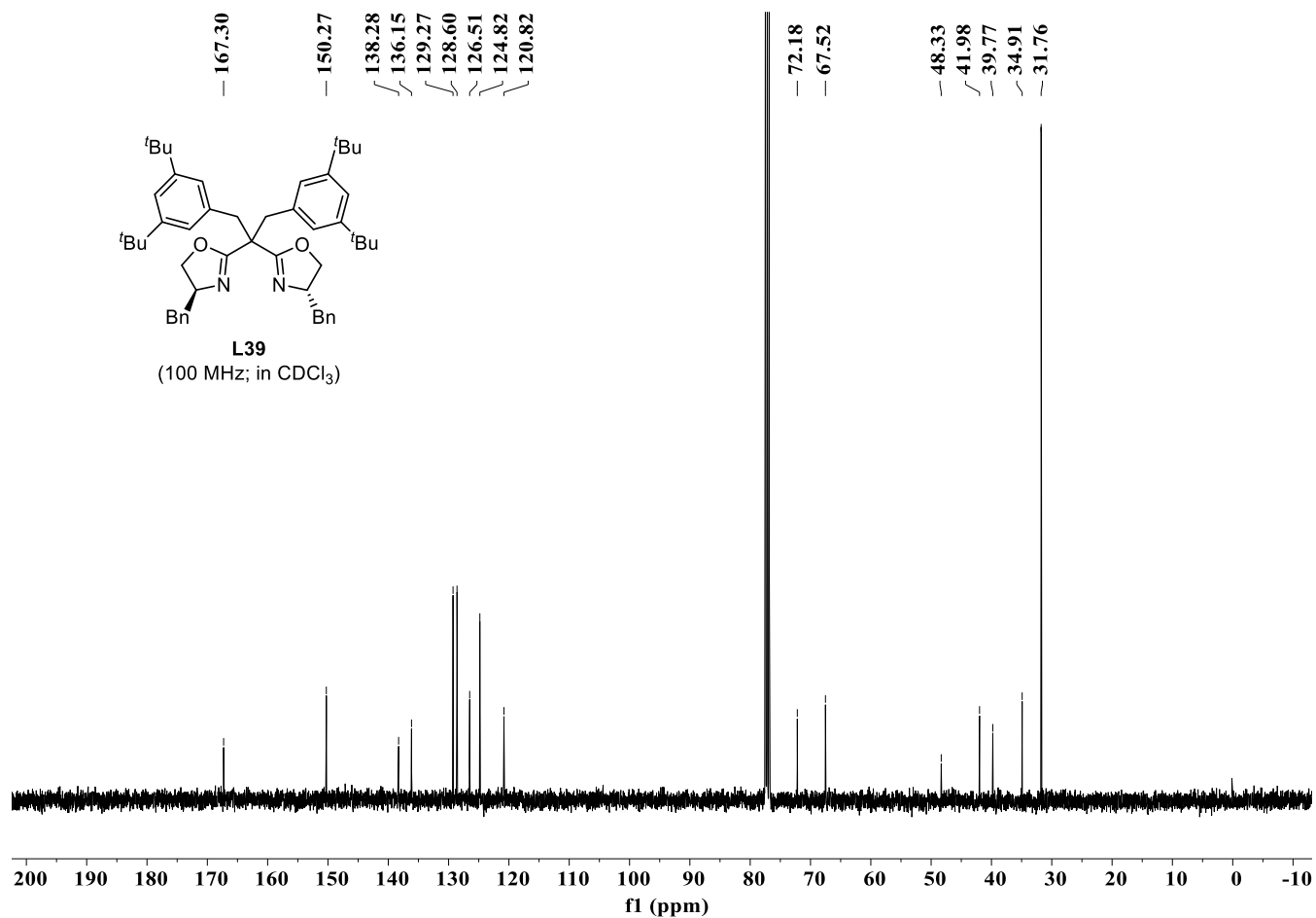
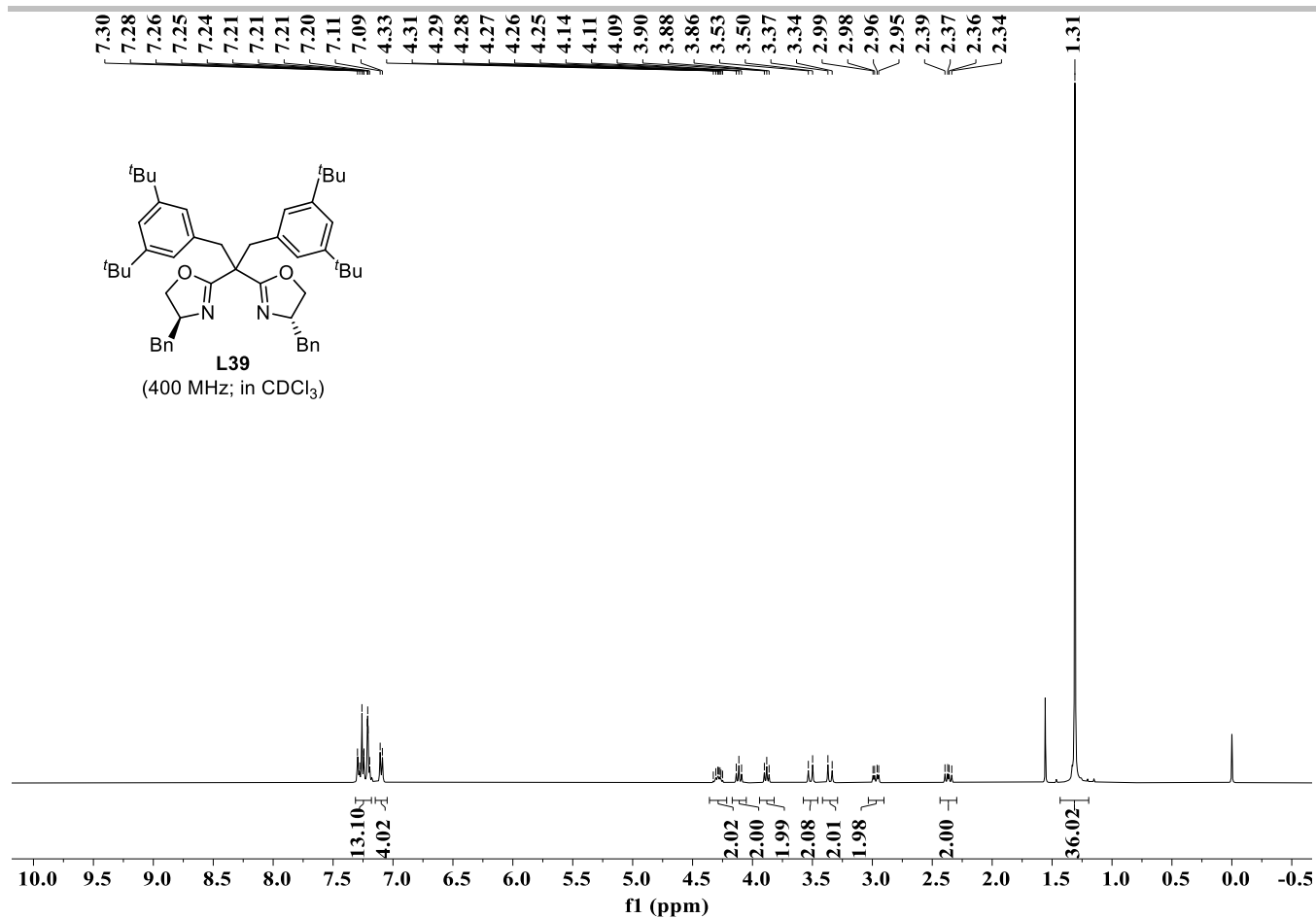
**L37**  
(125 MHz; in CDCl<sub>3</sub>)



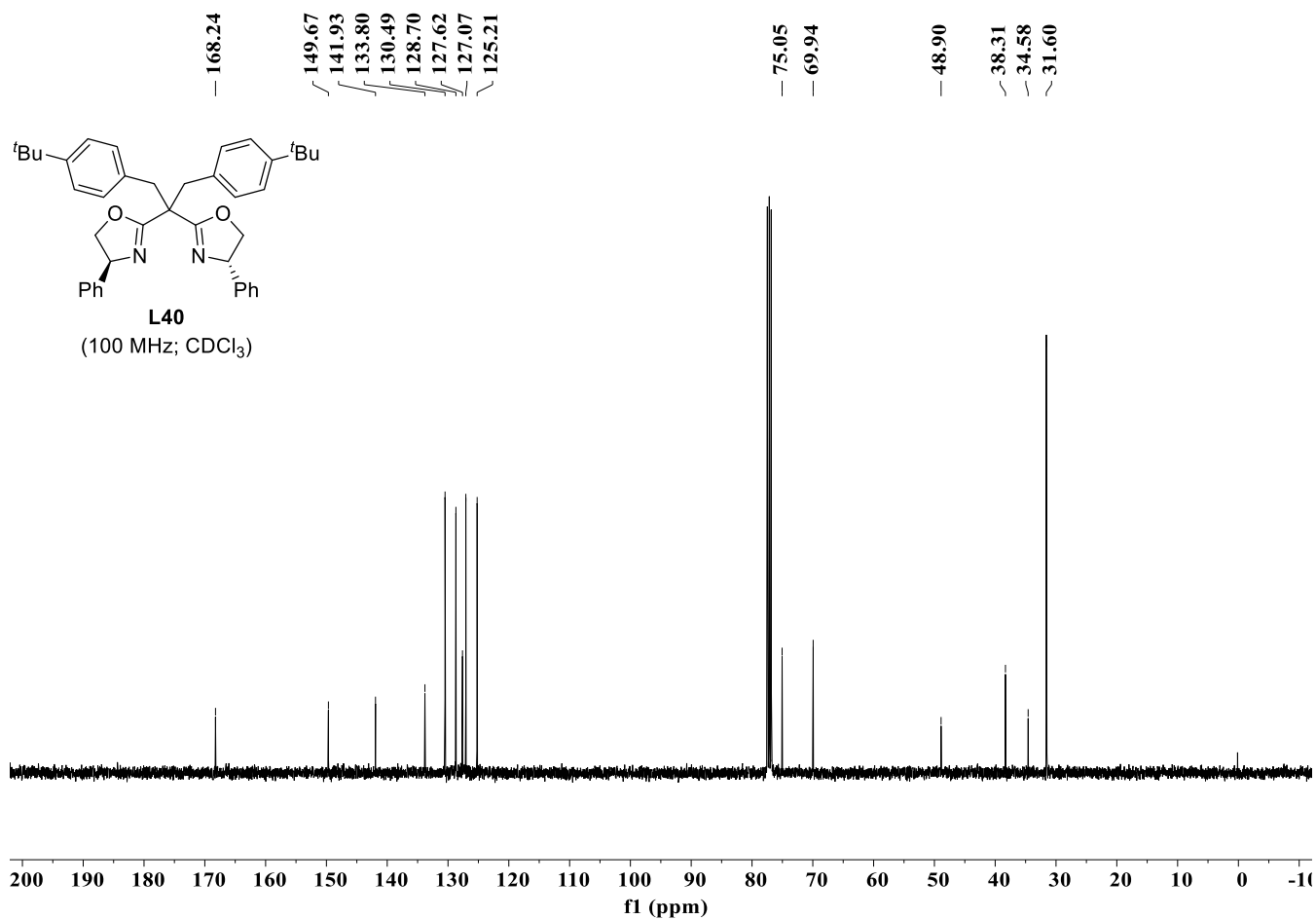
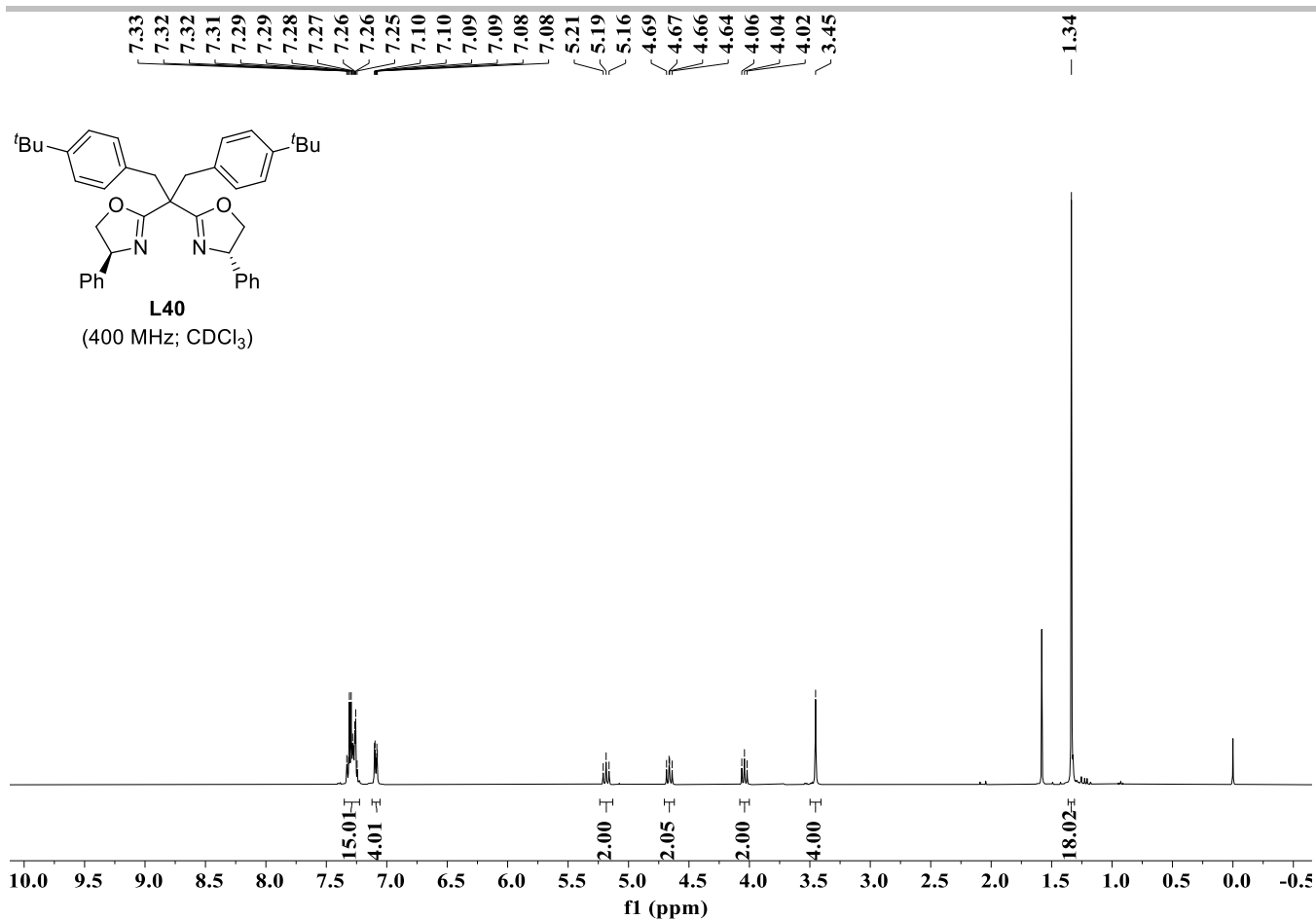
# SUPPORTING INFORMATION



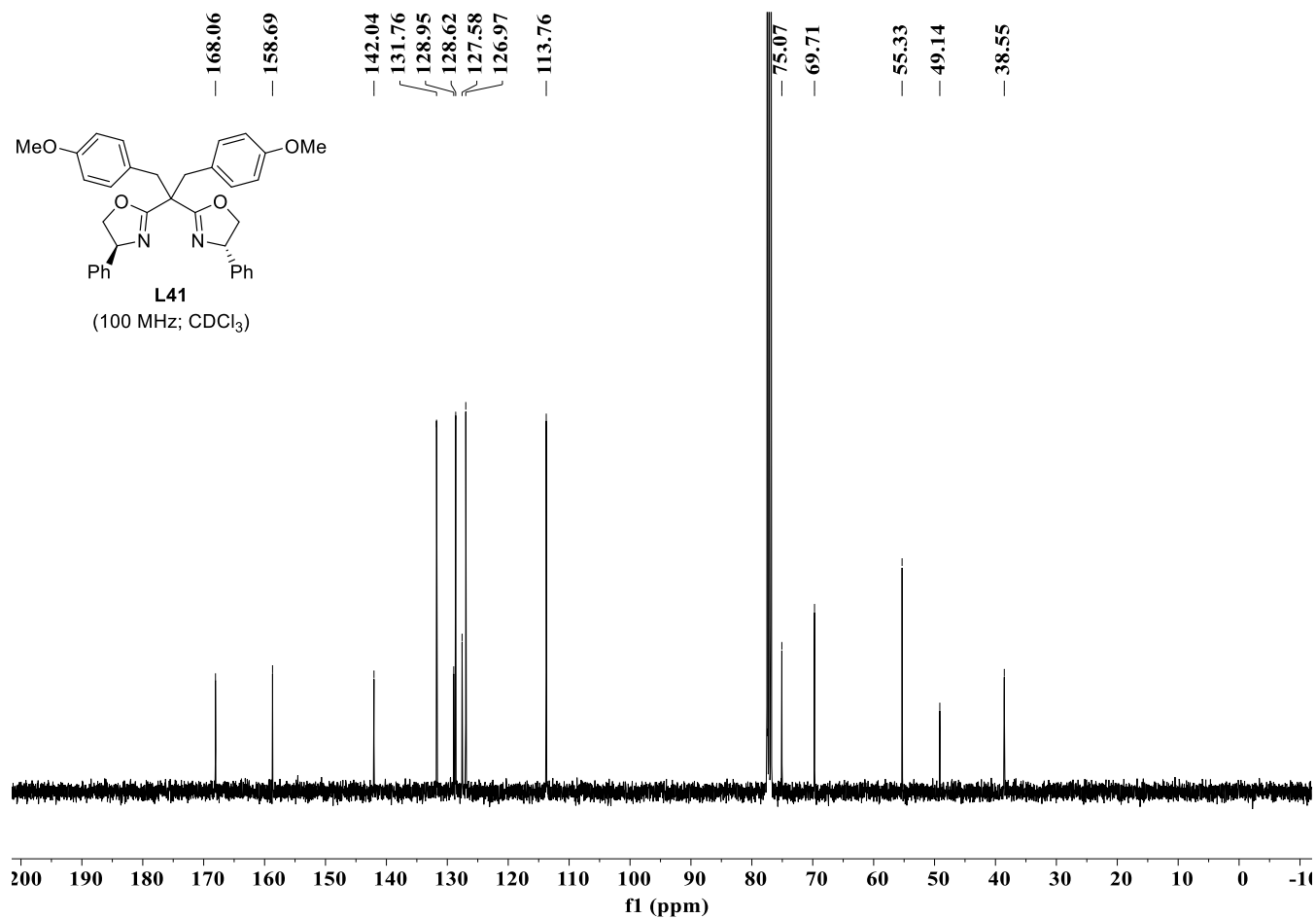
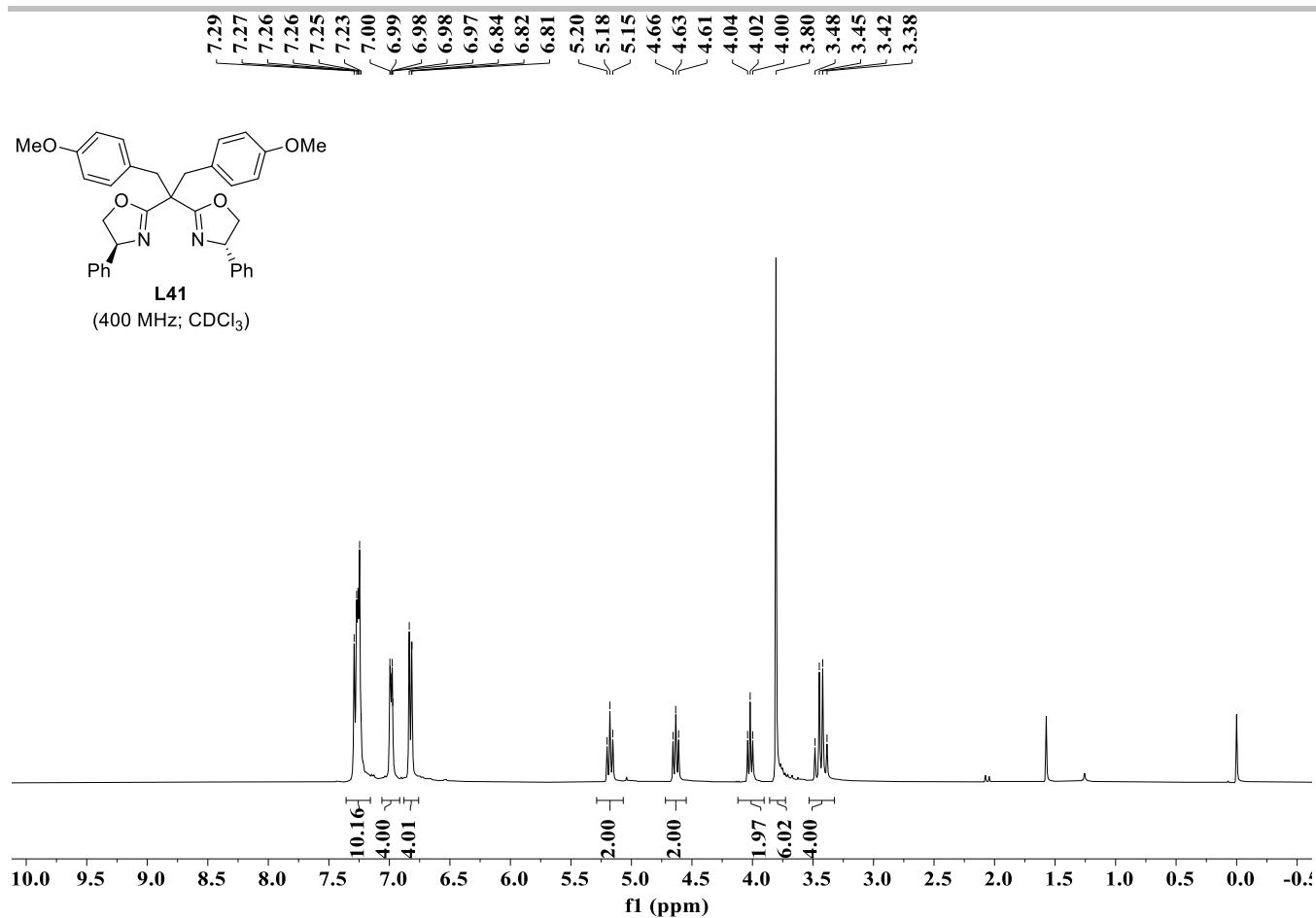
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION



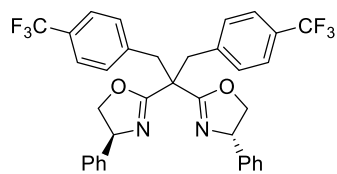
# SUPPORTING INFORMATION





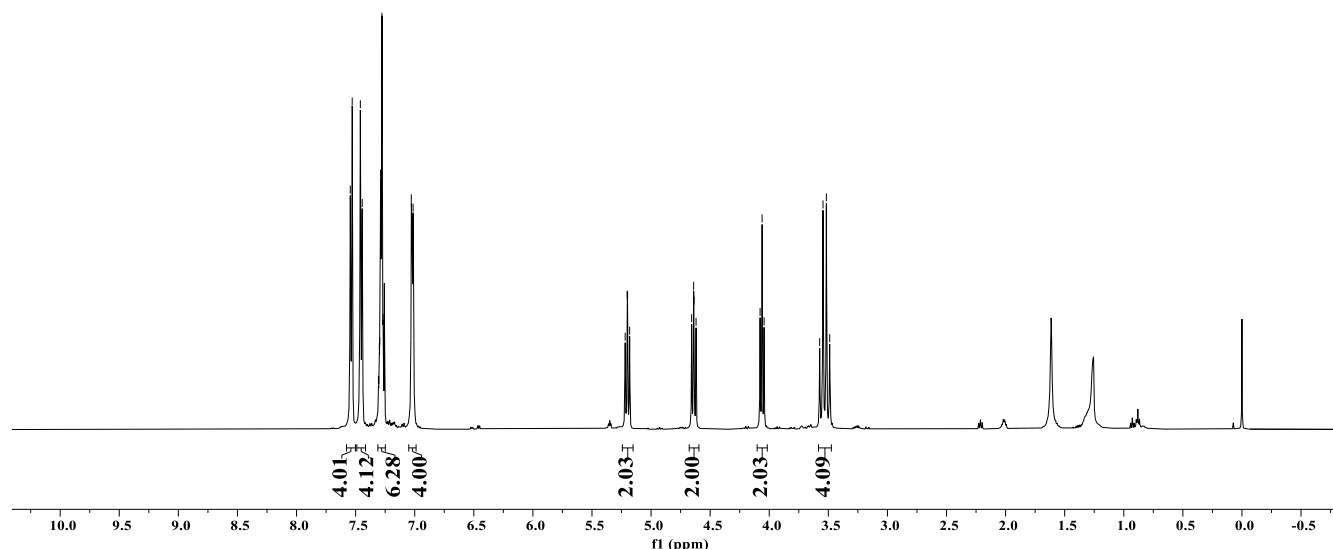
# SUPPORTING INFORMATION

7.54  
7.53  
7.46  
7.44  
7.31  
7.30  
7.30  
7.29  
7.28  
7.28  
7.27  
7.27  
7.26  
7.03  
7.02  
7.01  
7.01  
5.22  
5.20  
5.20  
5.18  
4.66  
4.64  
4.64  
4.62  
4.08  
4.06  
4.04  
3.57  
3.55  
3.52  
3.49

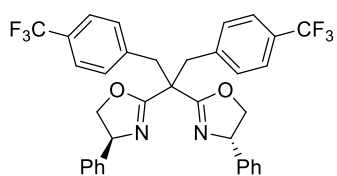


**L42**

(500 MHz; in CDCl<sub>3</sub>)

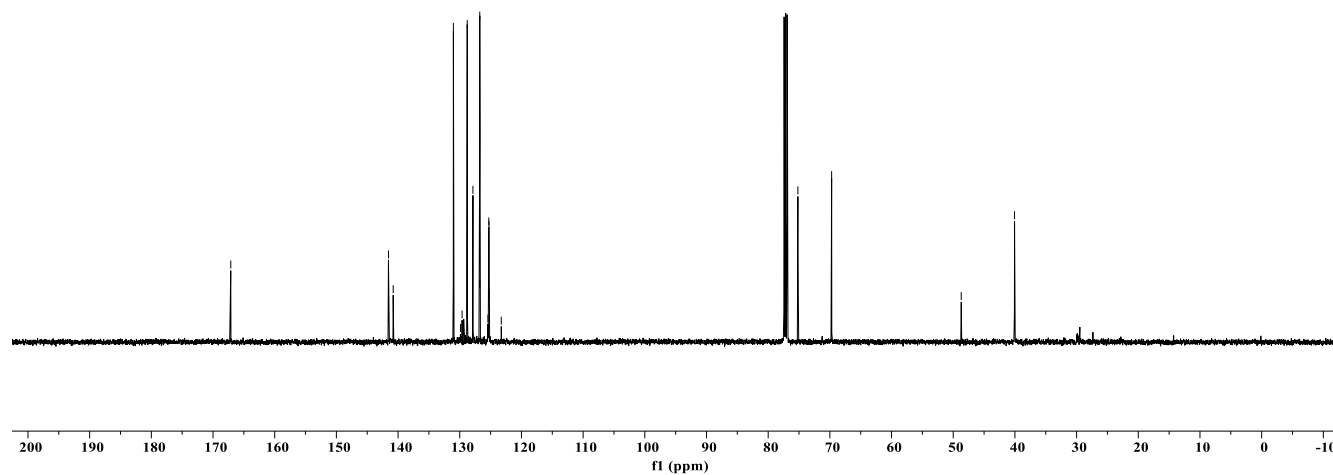


167.12  
141.56  
140.79  
131.03  
129.88  
129.62  
128.79  
127.86  
126.78  
126.76  
125.43  
125.33  
125.30  
125.26  
125.23  
123.27  
75.19  
69.71  
48.70  
40.06

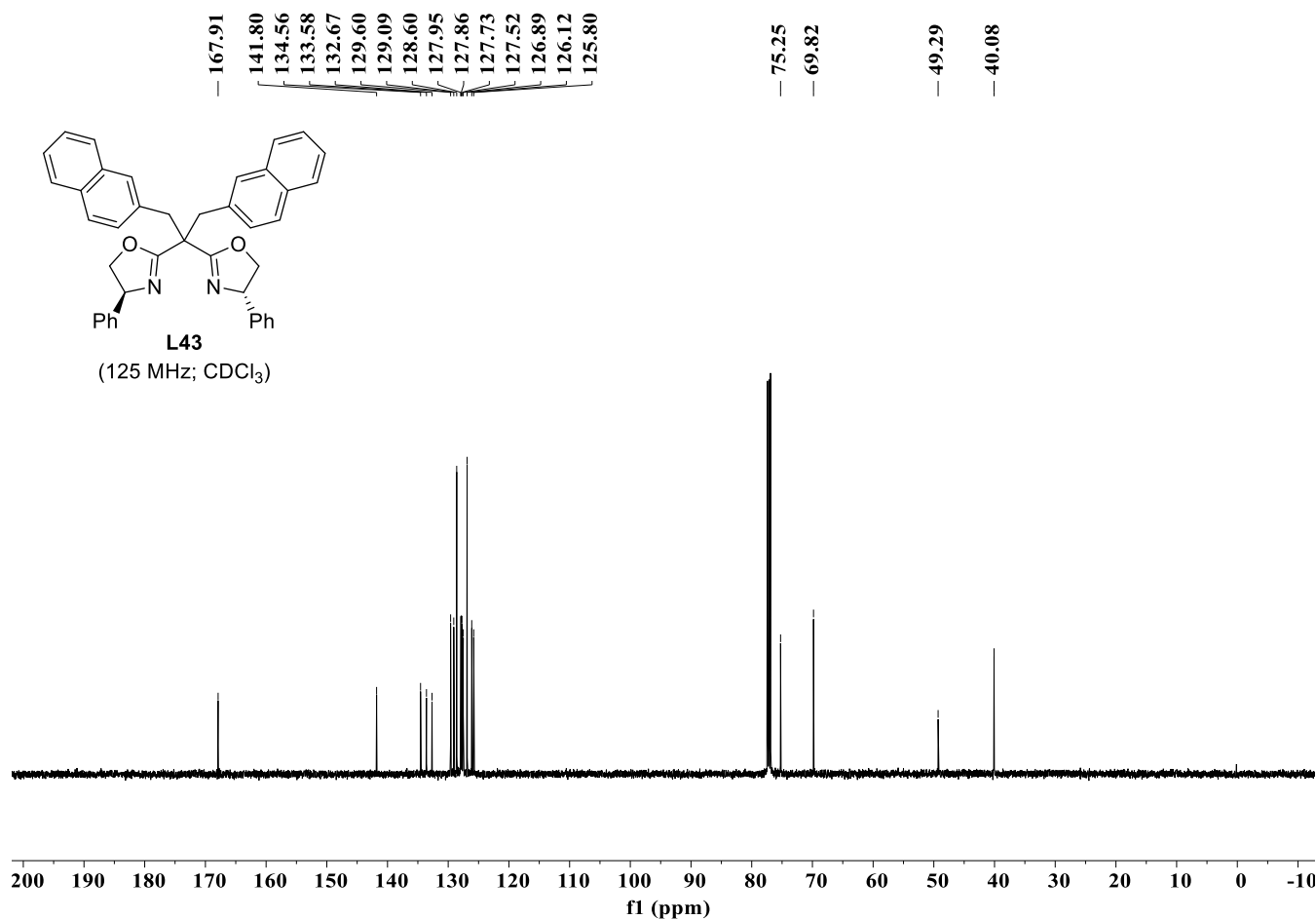
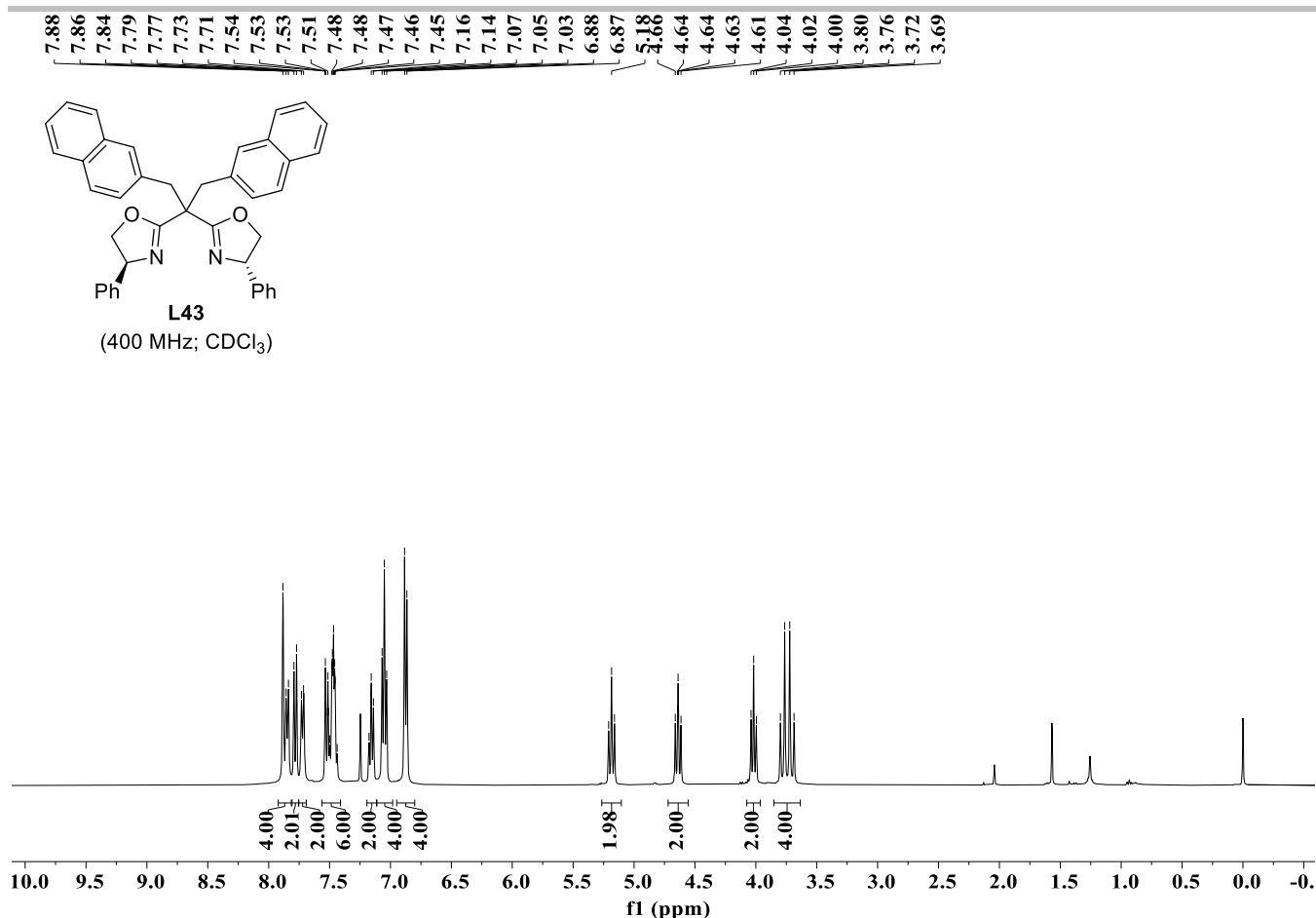


**L42**

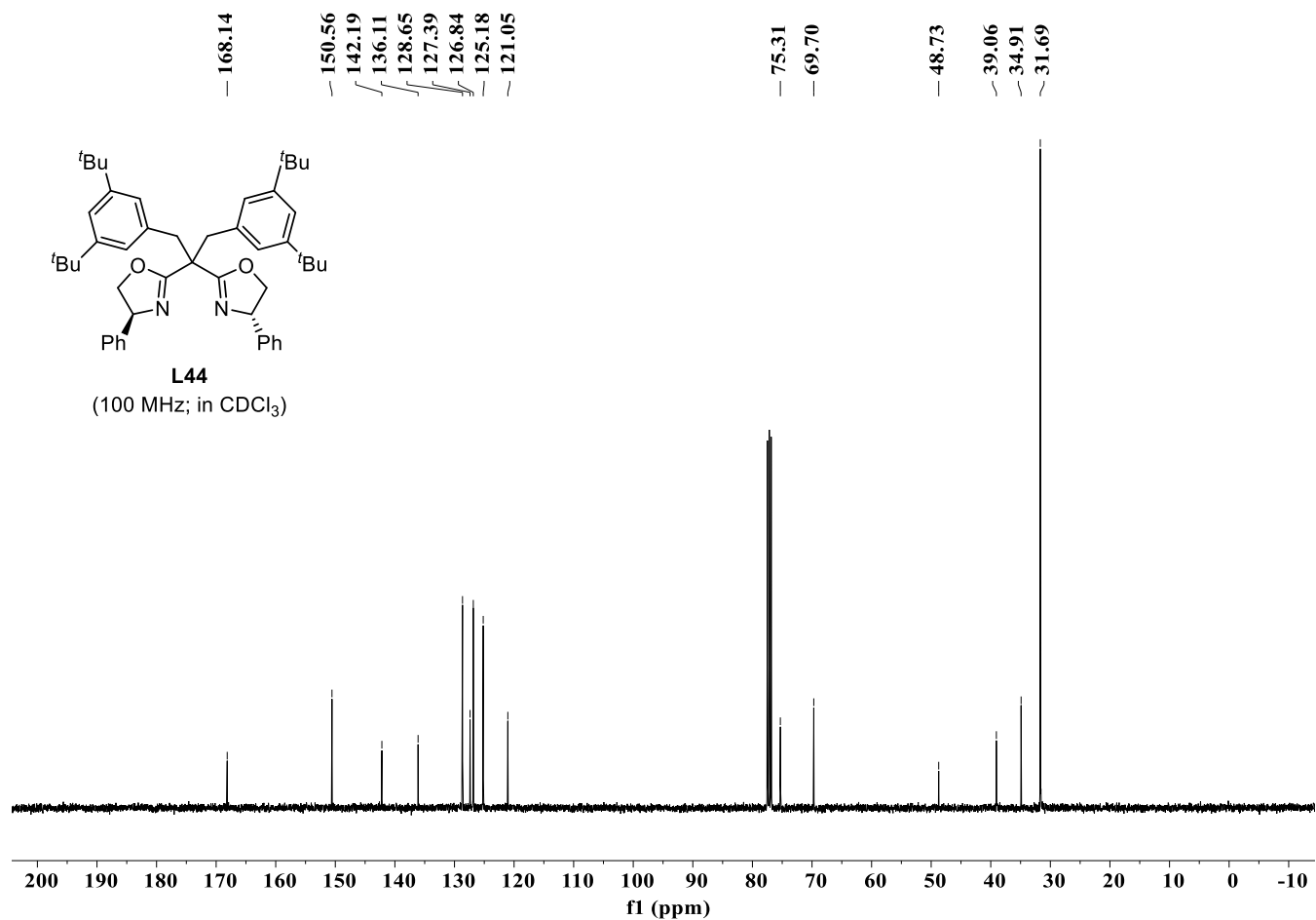
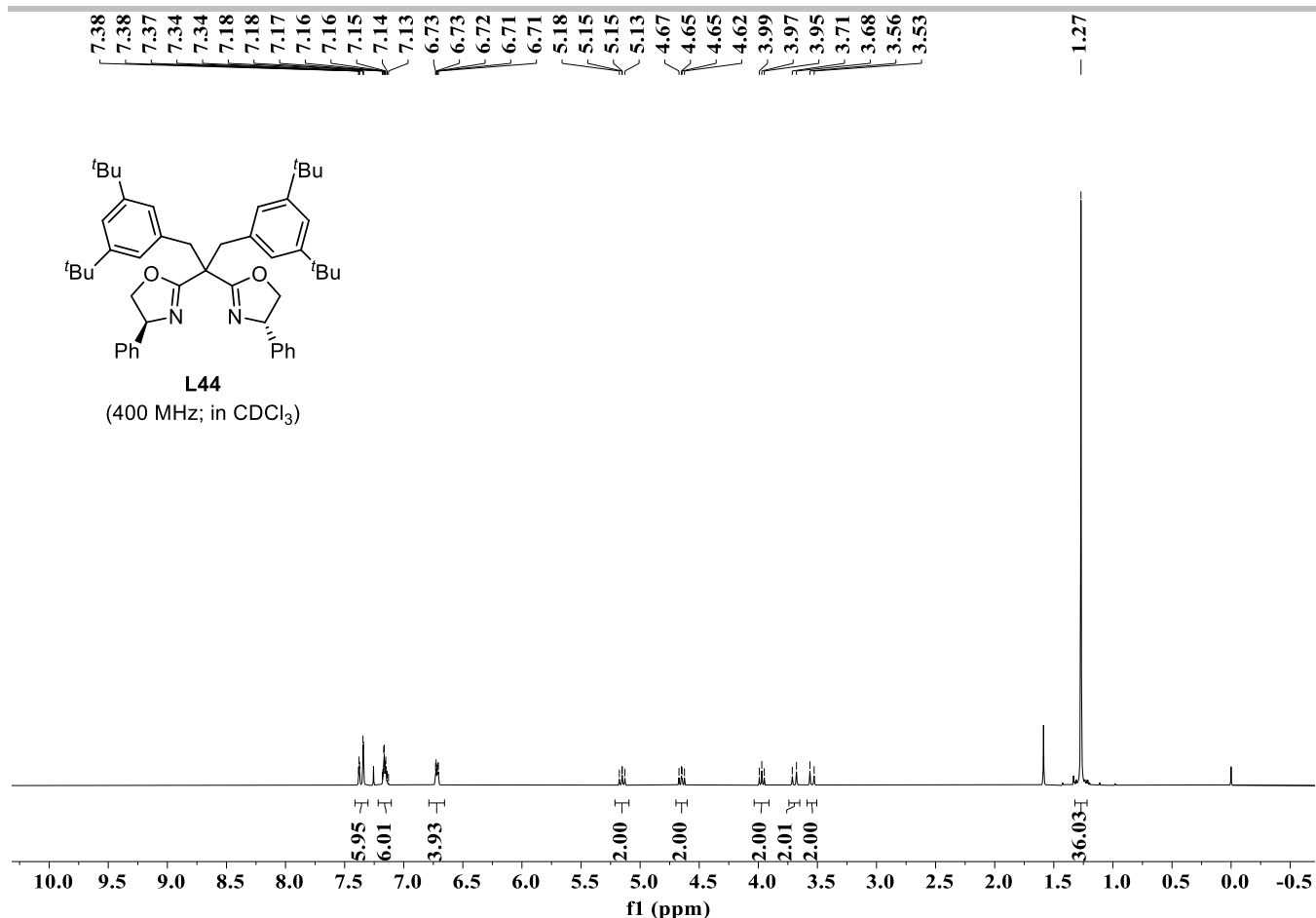
(125 MHz; in CDCl<sub>3</sub>)



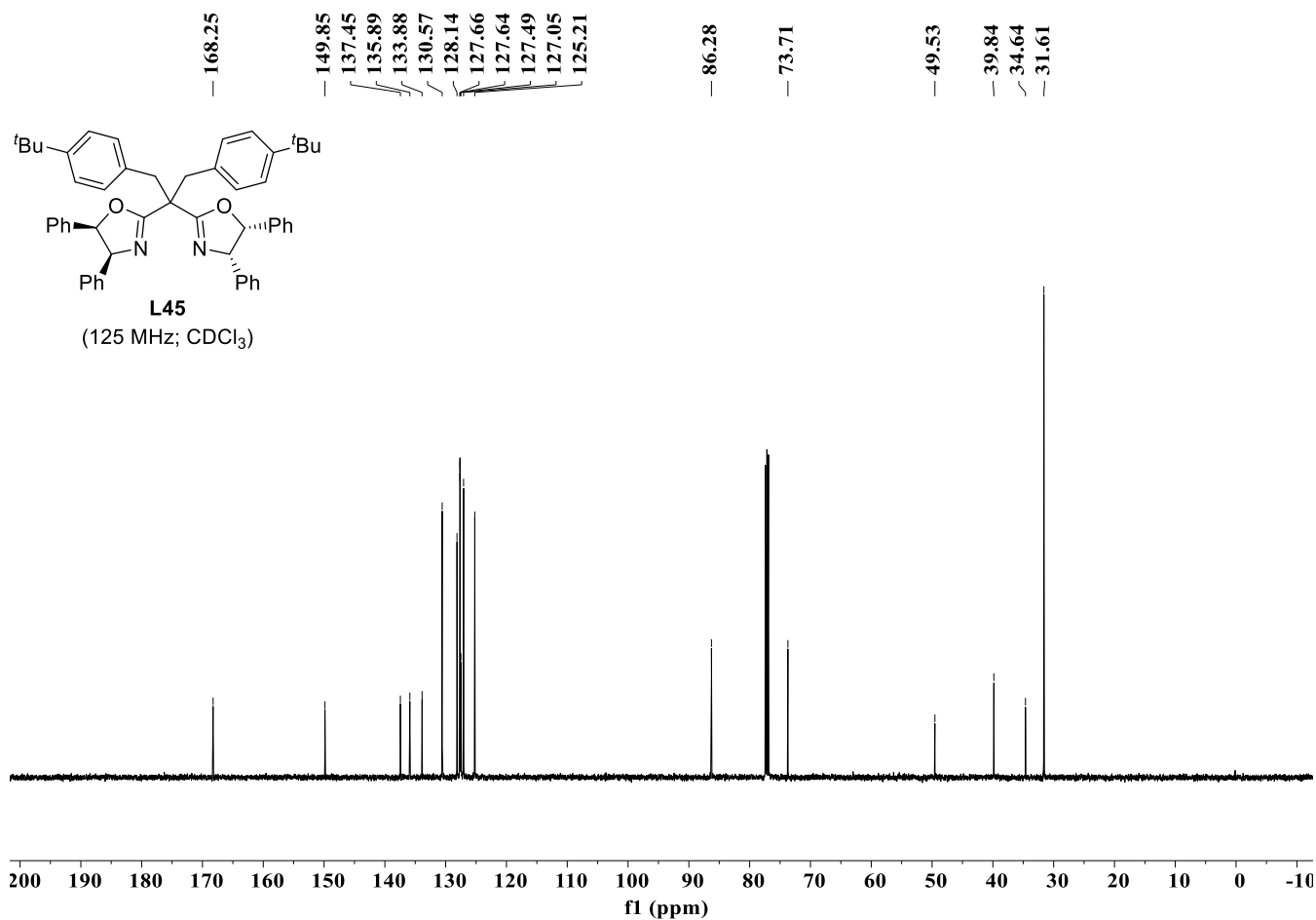
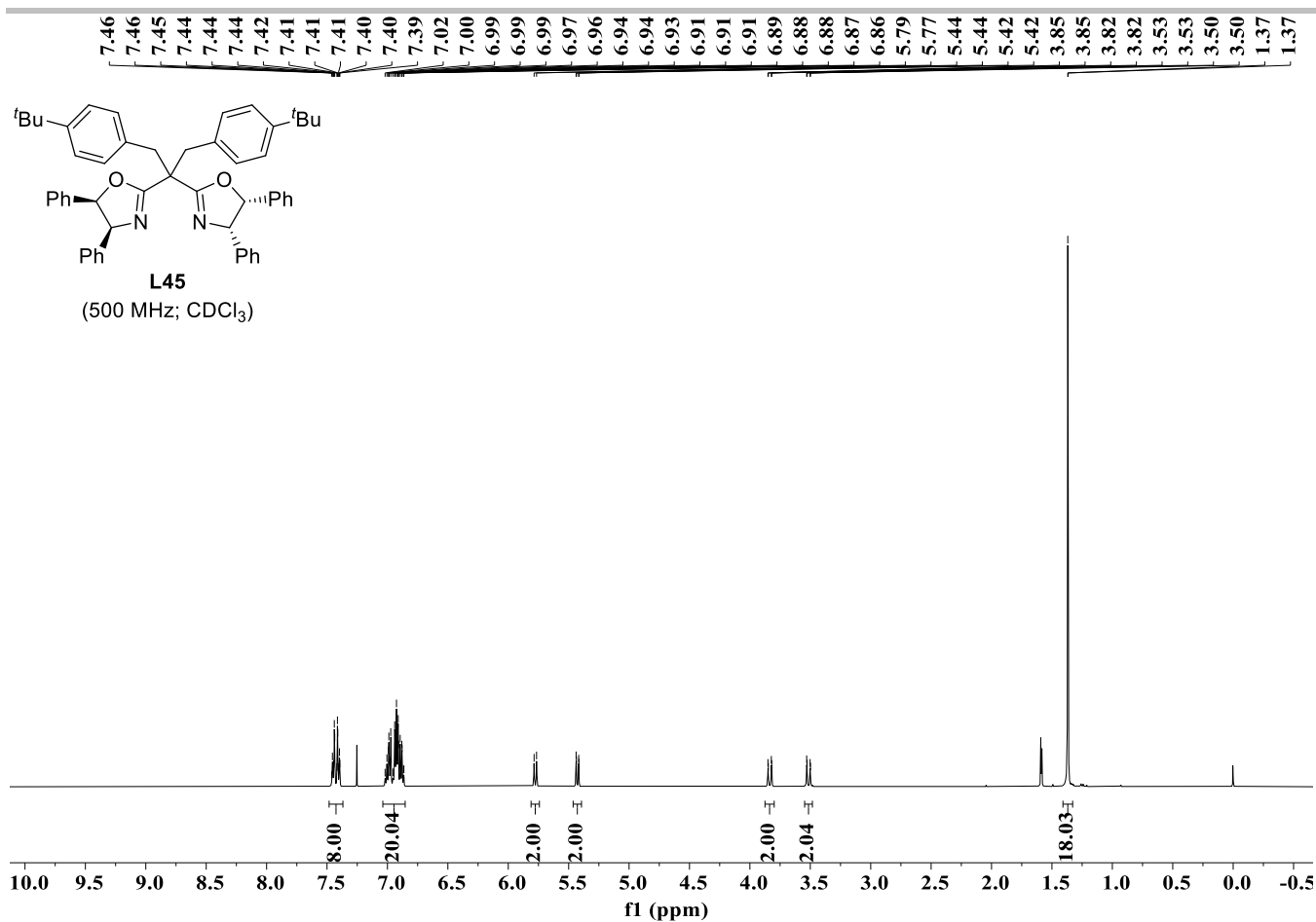
# SUPPORTING INFORMATION



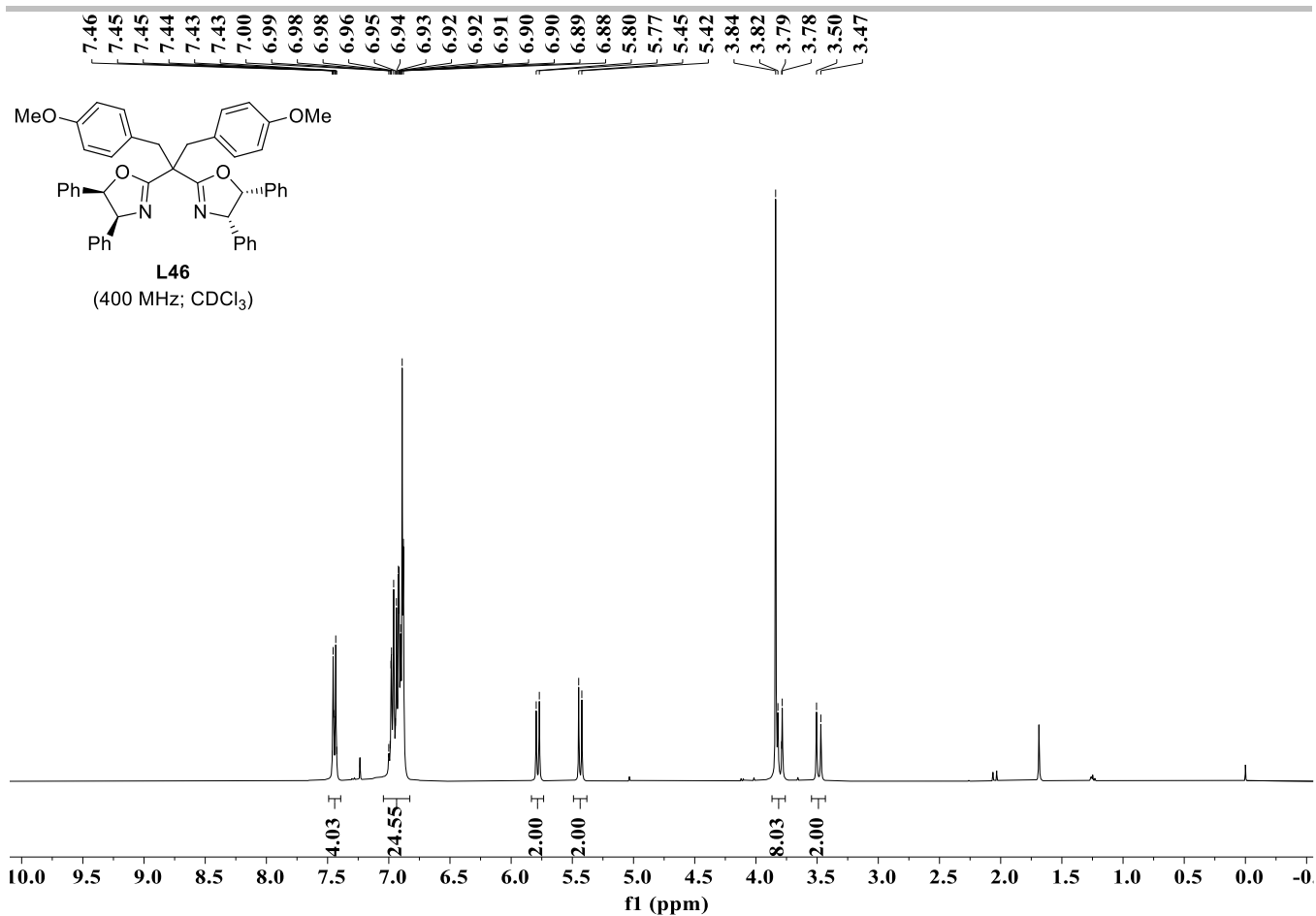
# SUPPORTING INFORMATION

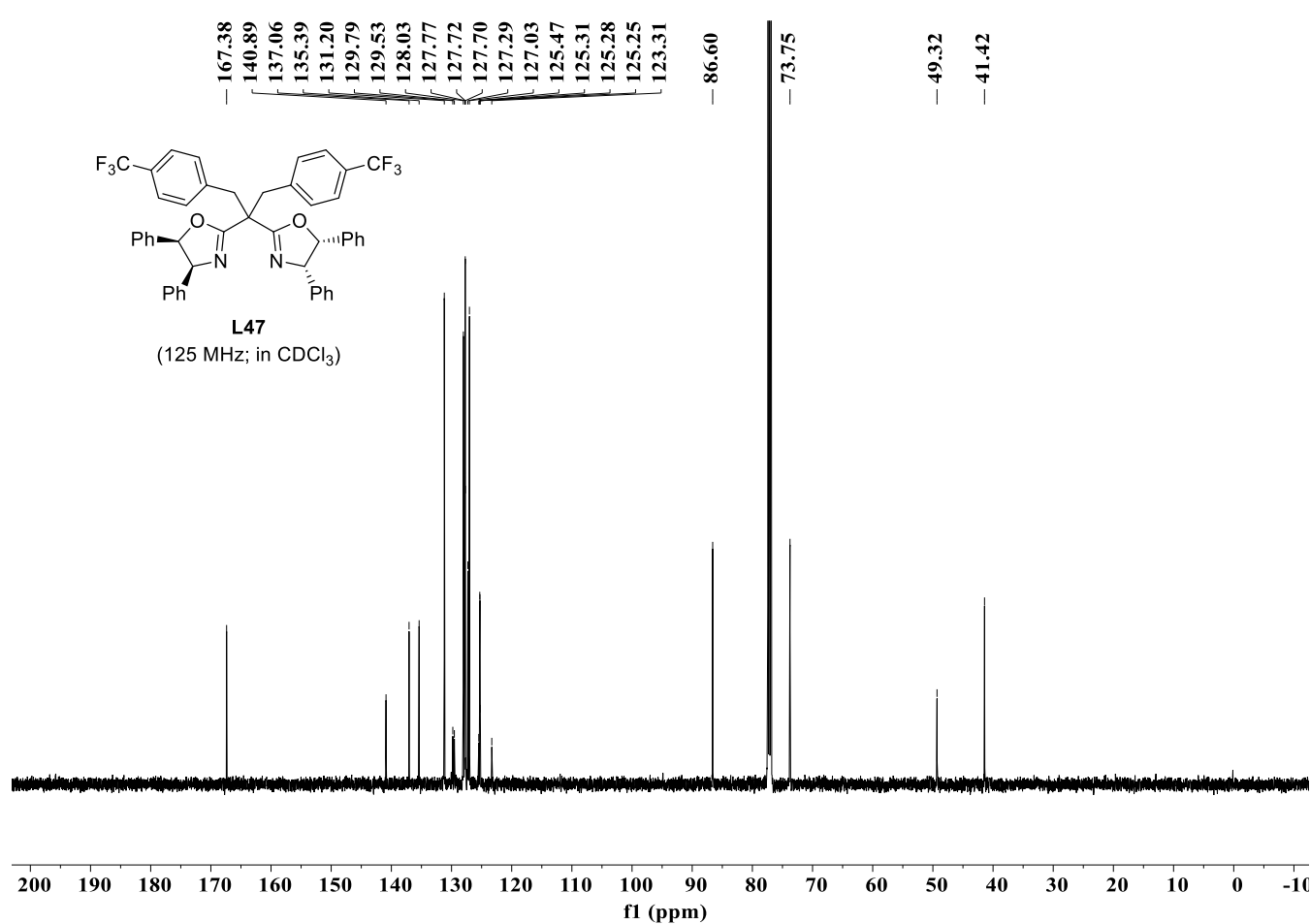


# SUPPORTING INFORMATION

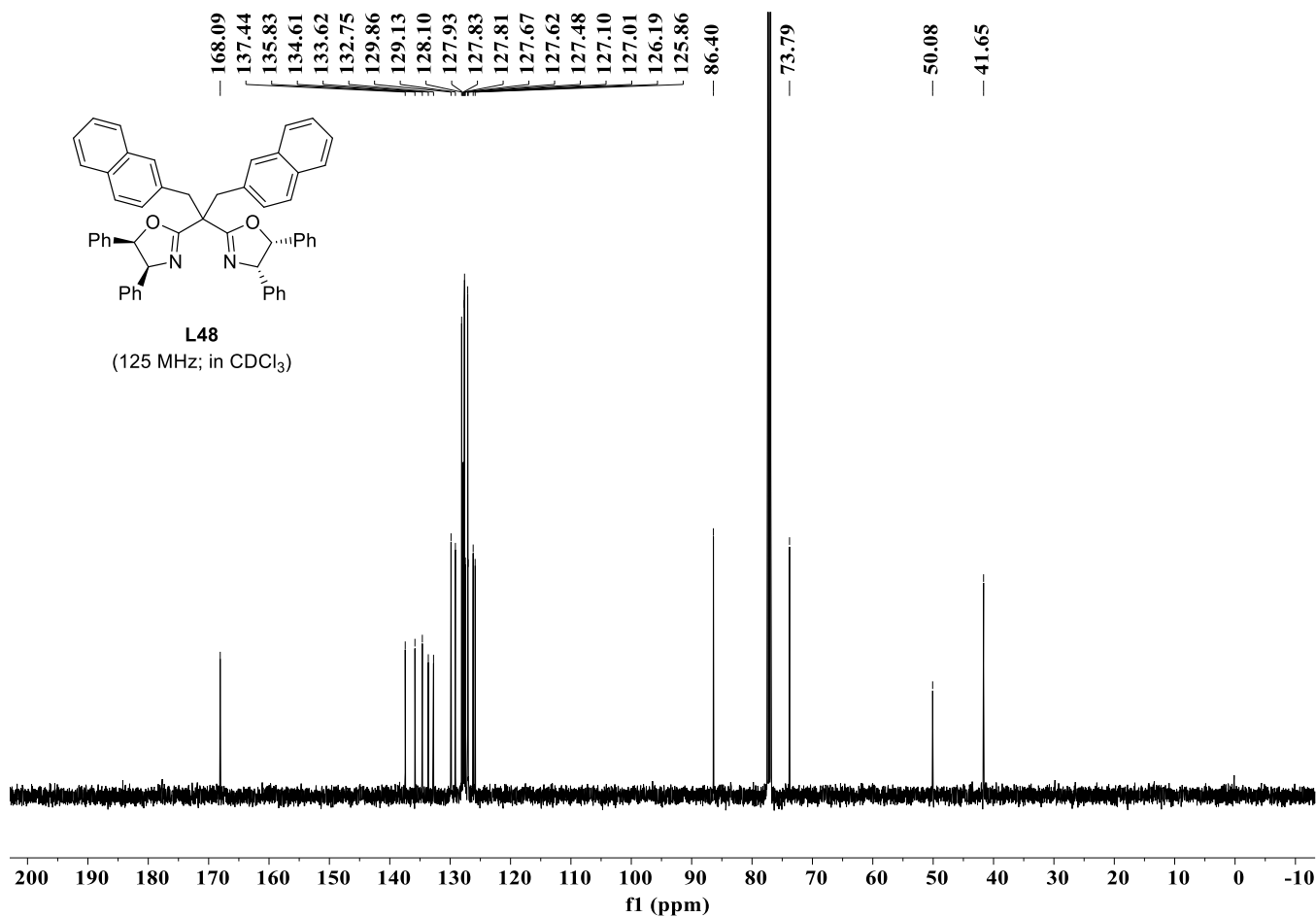
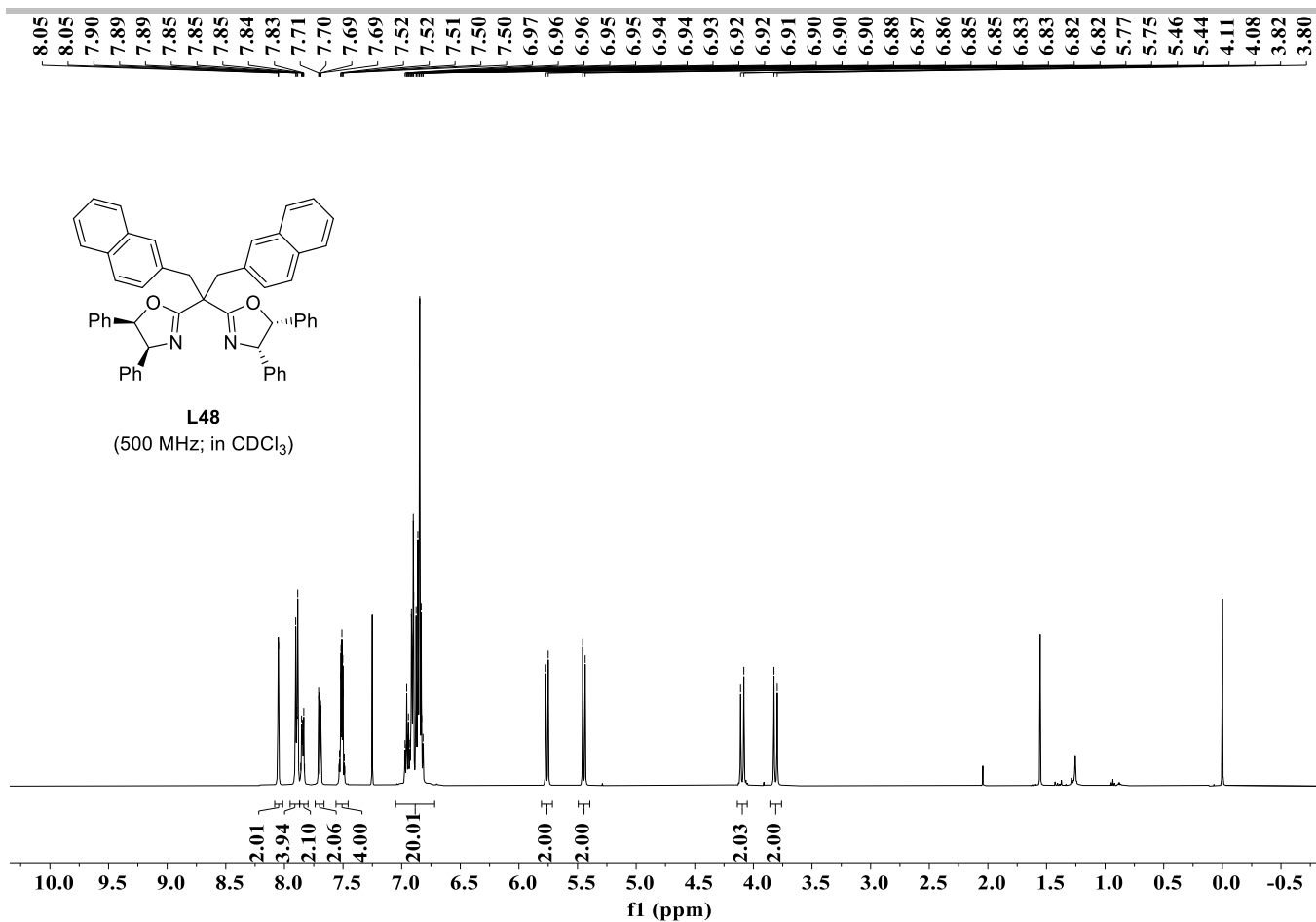


# SUPPORTING INFORMATION

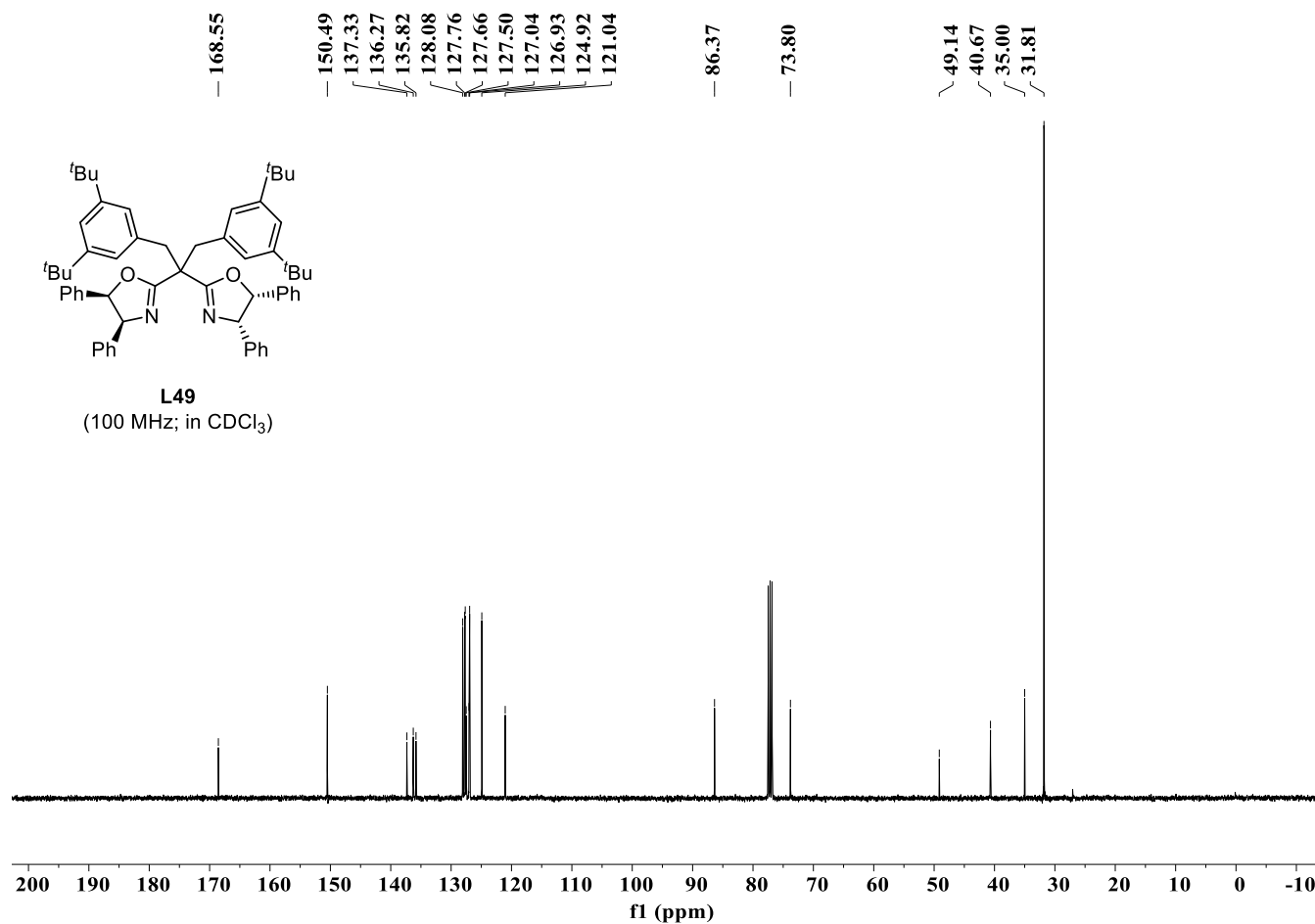
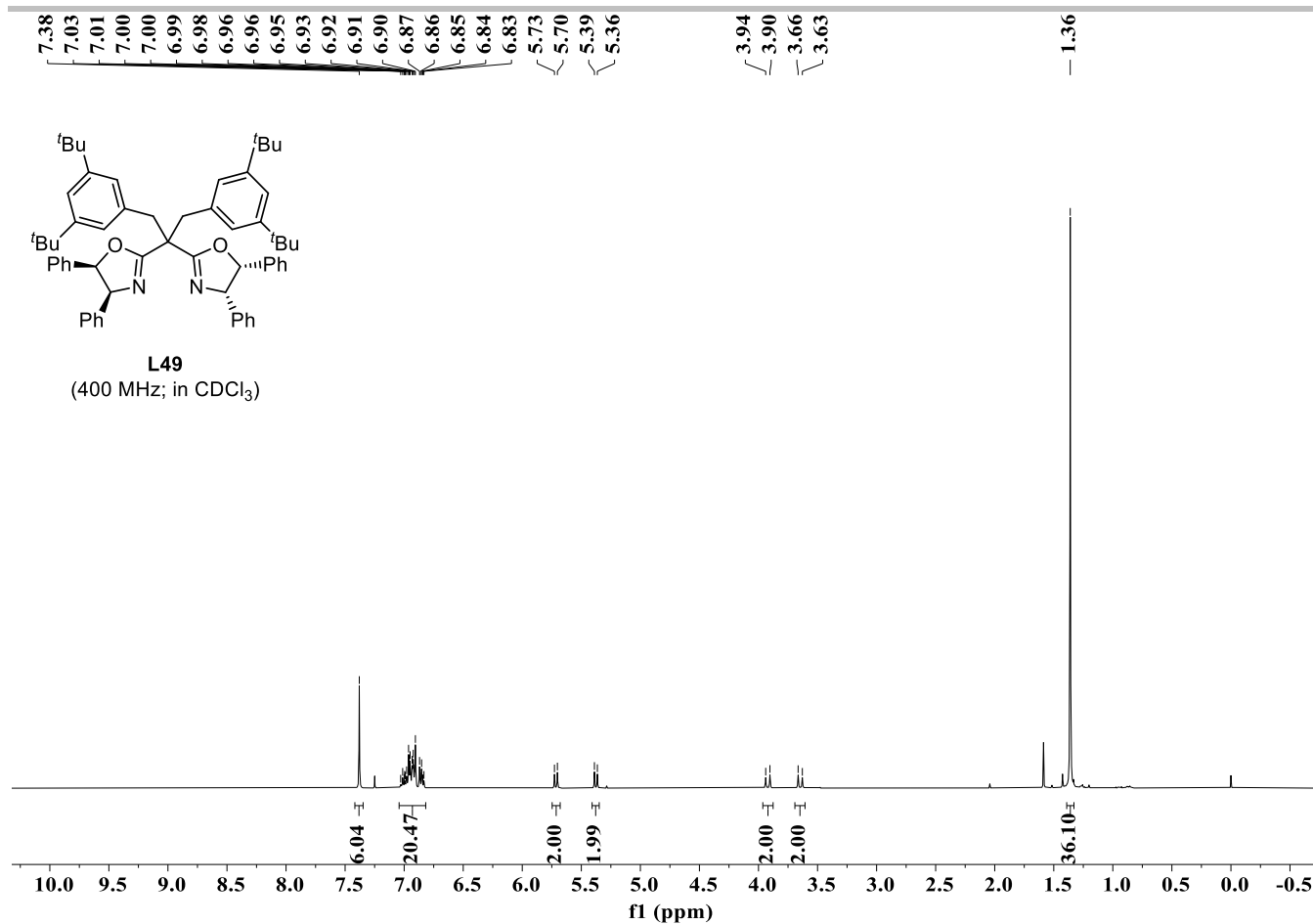




# SUPPORTING INFORMATION

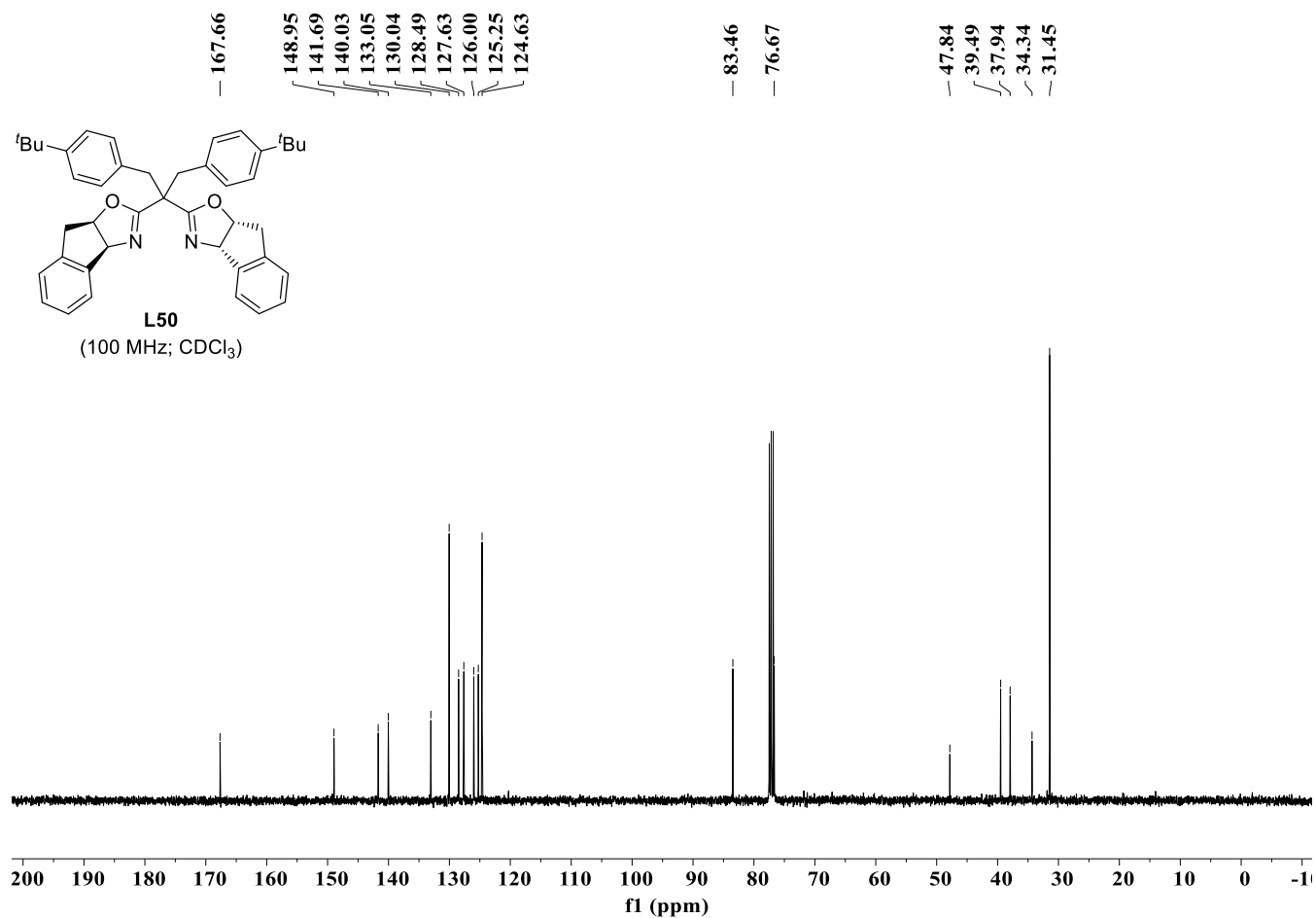
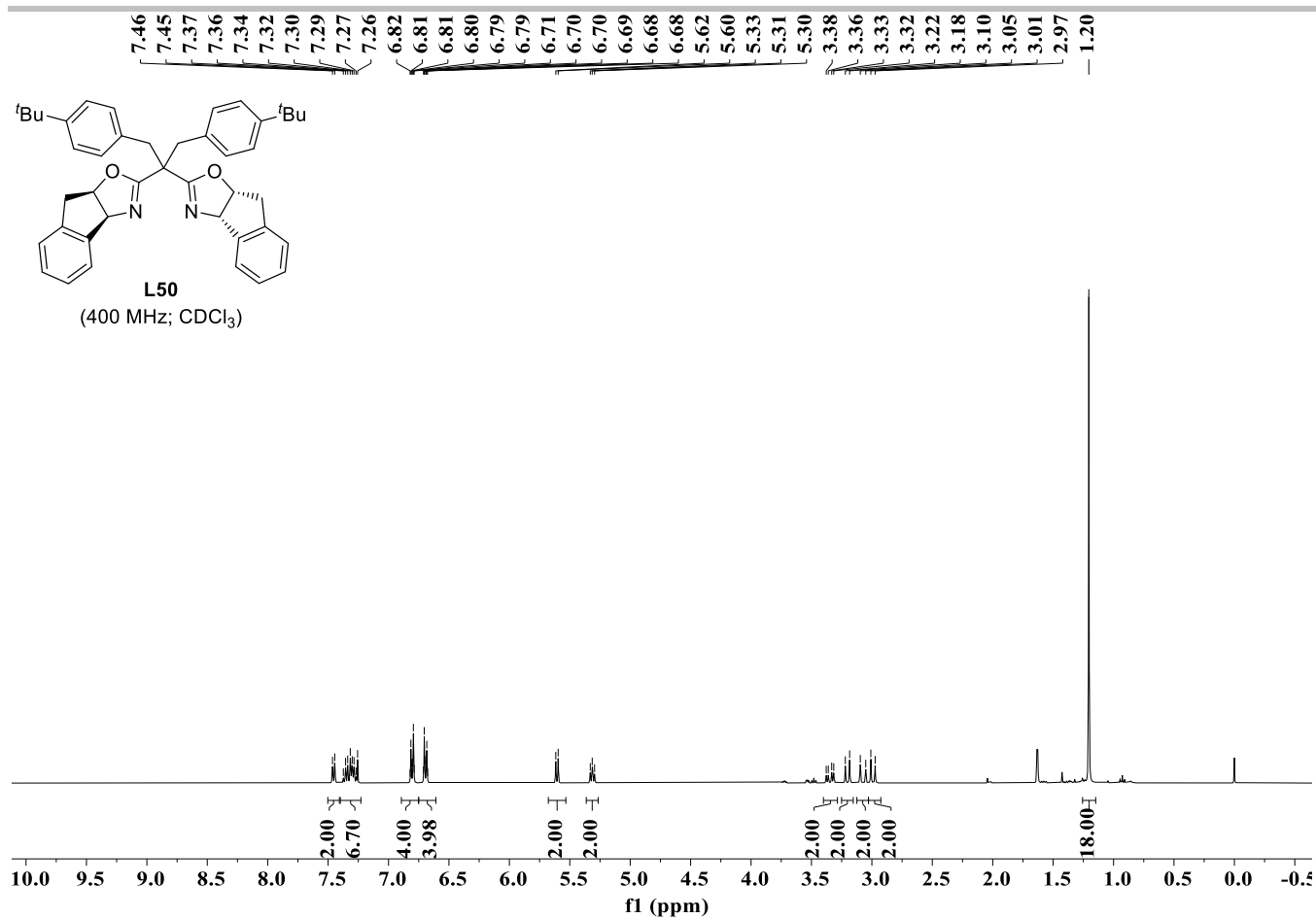


# SUPPORTING INFORMATION

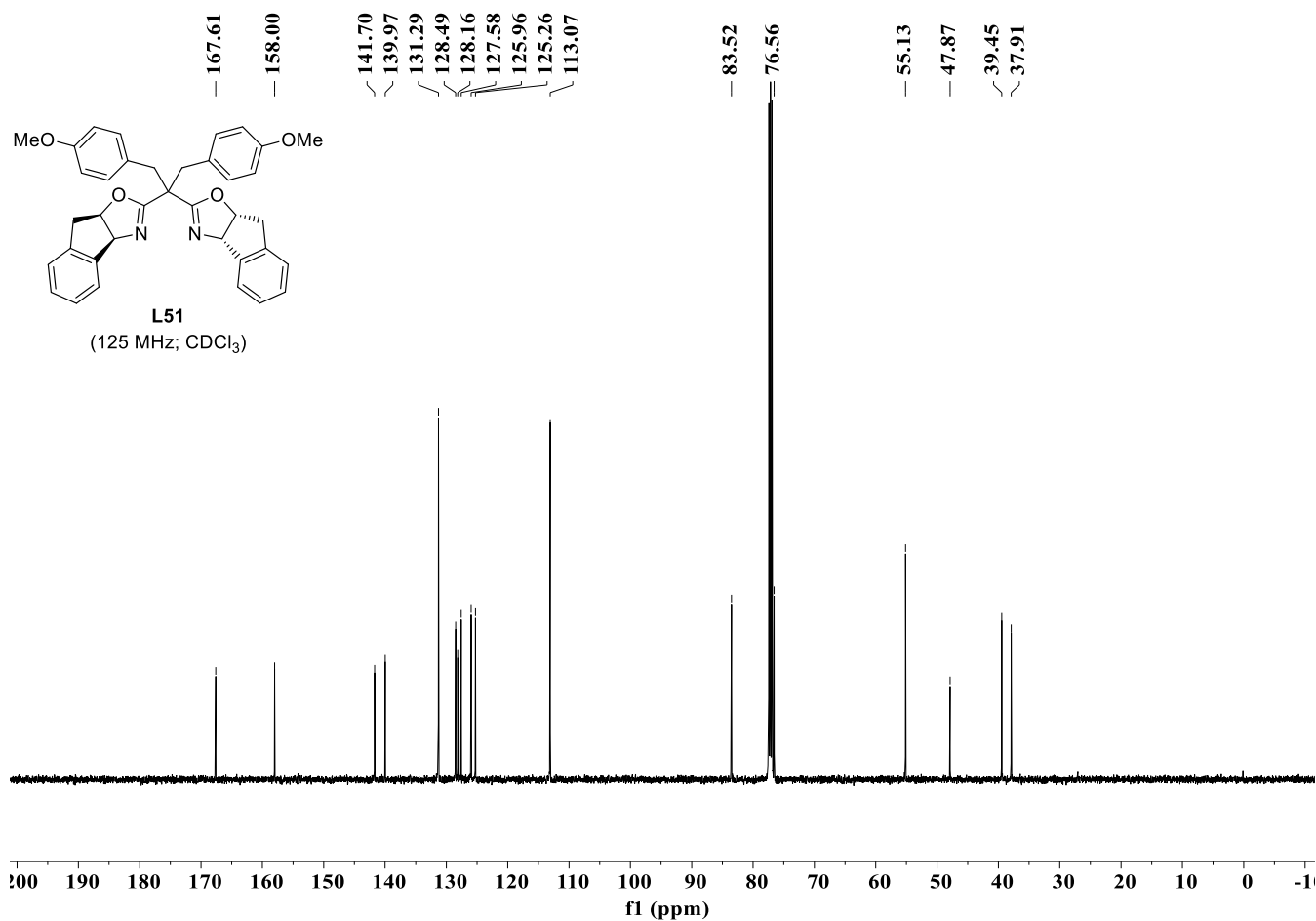
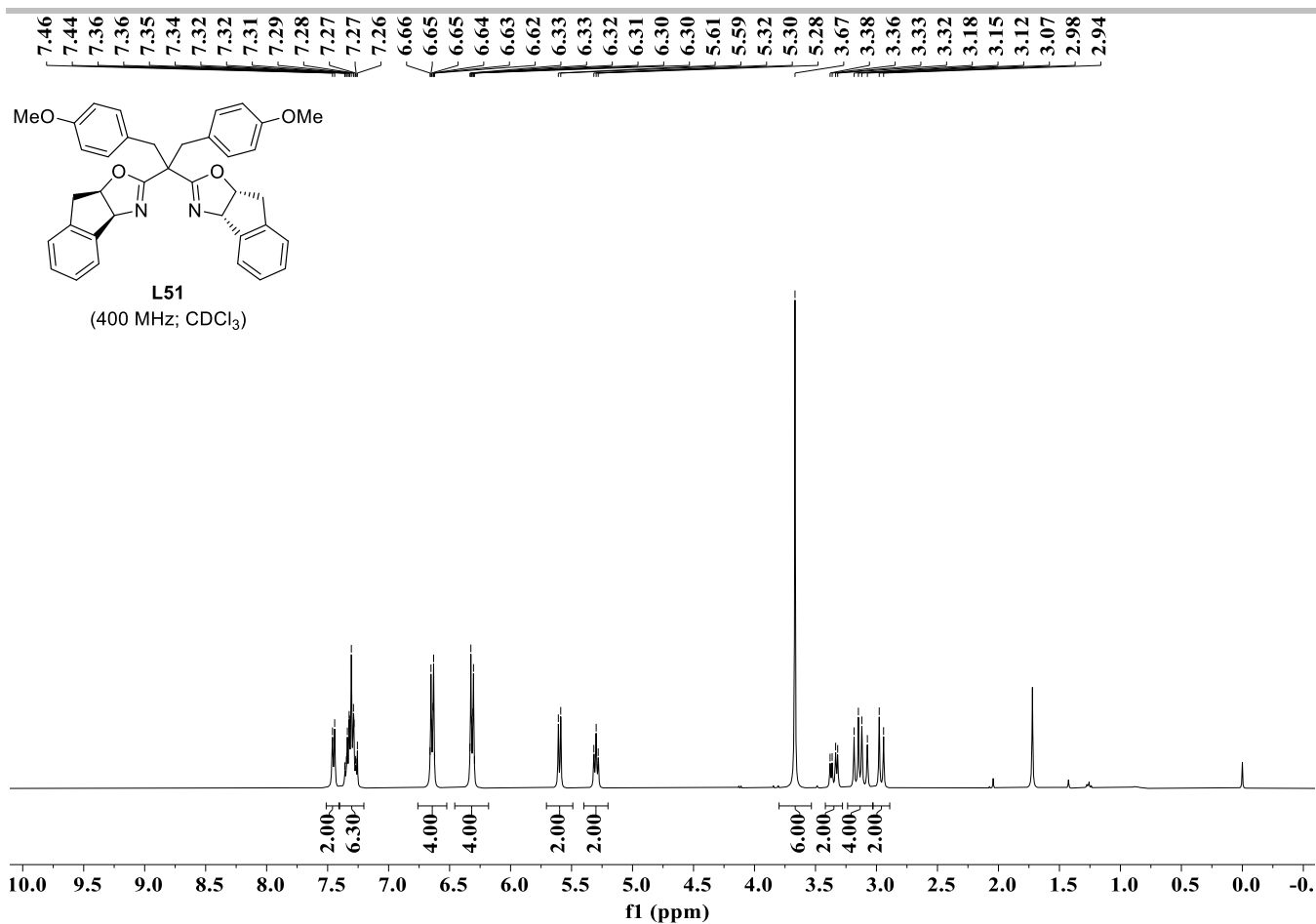




# SUPPORTING INFORMATION

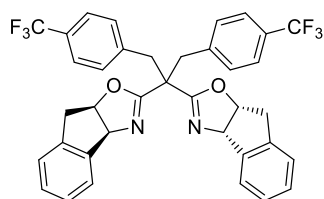


# SUPPORTING INFORMATION

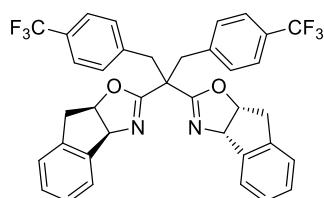
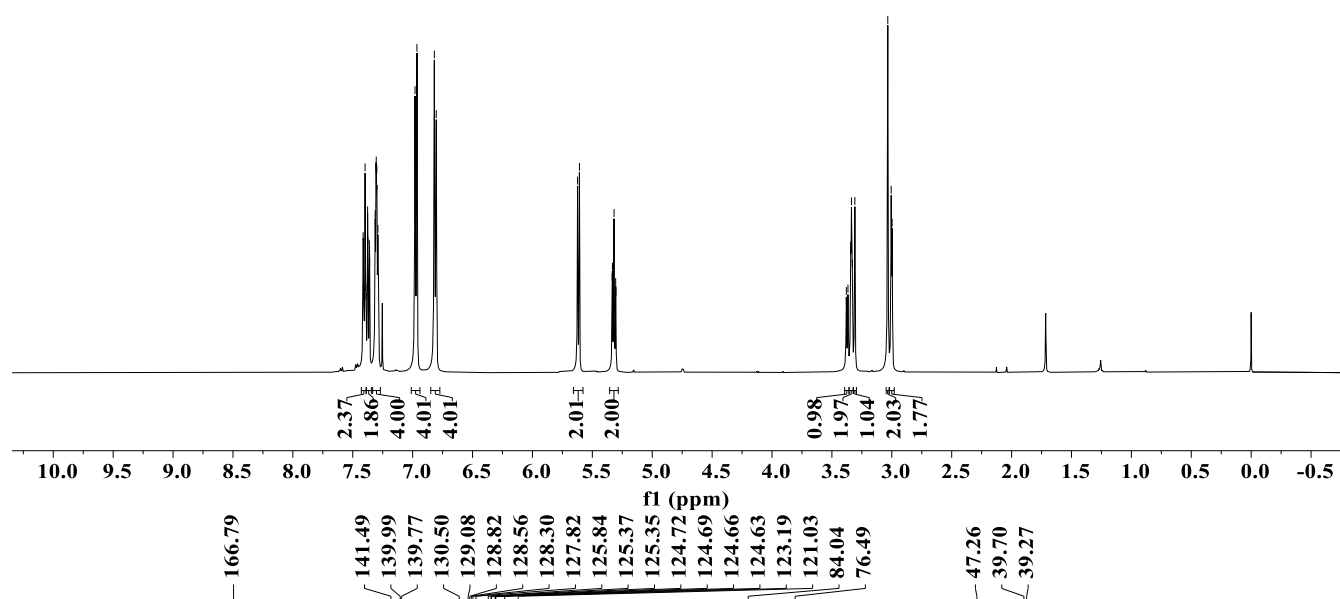


# SUPPORTING INFORMATION

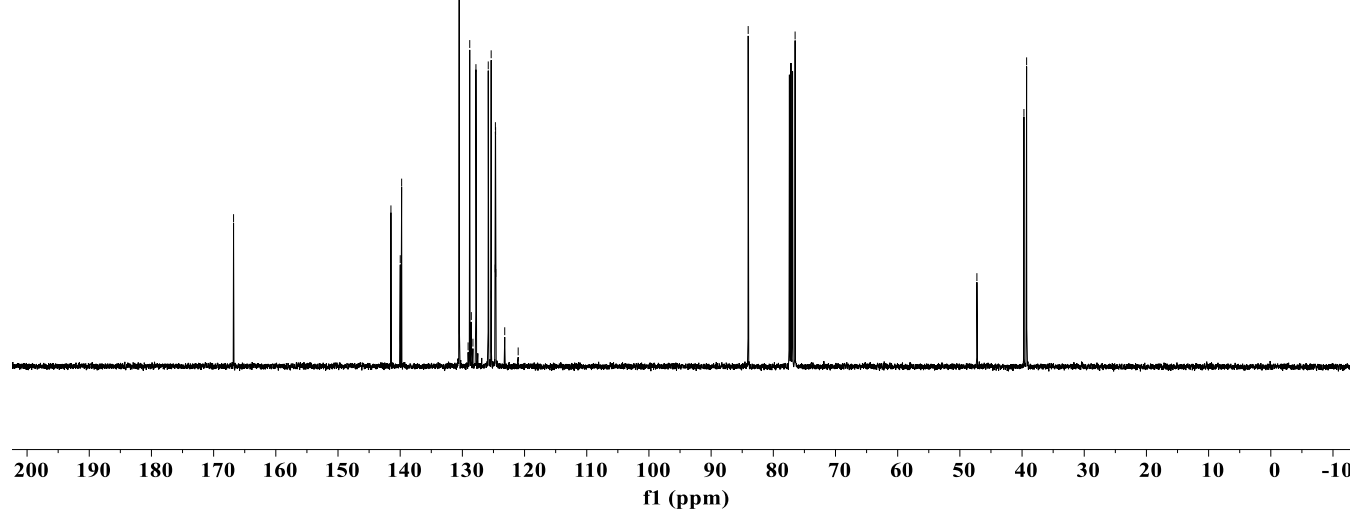
7.41  
7.41  
7.40  
7.39  
7.38  
7.37  
7.36  
7.36  
7.31  
7.30  
7.30  
7.29  
7.28  
6.98  
6.96  
6.82  
6.80  
5.61  
5.33  
5.33  
5.32  
5.32  
5.31  
5.30  
3.38  
3.37  
3.34  
3.34  
3.33  
3.31  
3.03  
3.01  
3.00



**L52**  
(500 MHz; in CDCl<sub>3</sub>)

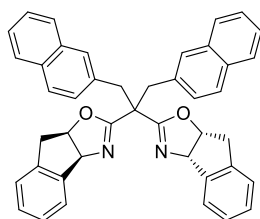


**L52**  
(125 MHz; in CDCl<sub>3</sub>)



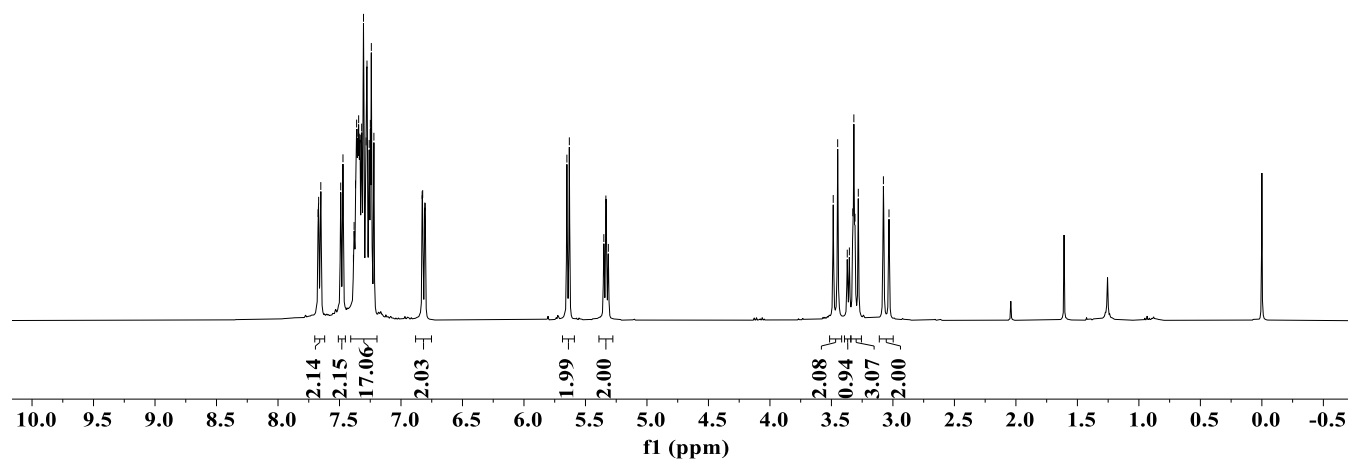
# SUPPORTING INFORMATION

7.65 7.49 7.47 7.37 7.36 7.35 7.34 7.34 7.33 7.32 7.32 7.30 7.28 7.28 7.26 7.25 7.24 7.22 7.22 5.63 5.35 5.33 5.33 5.31 3.49 3.45 3.37 3.35 3.33 3.32 3.31 3.28 3.08 3.03

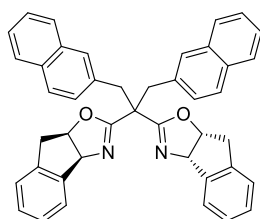


**L53**

(400 MHz; in CDCl<sub>3</sub>)

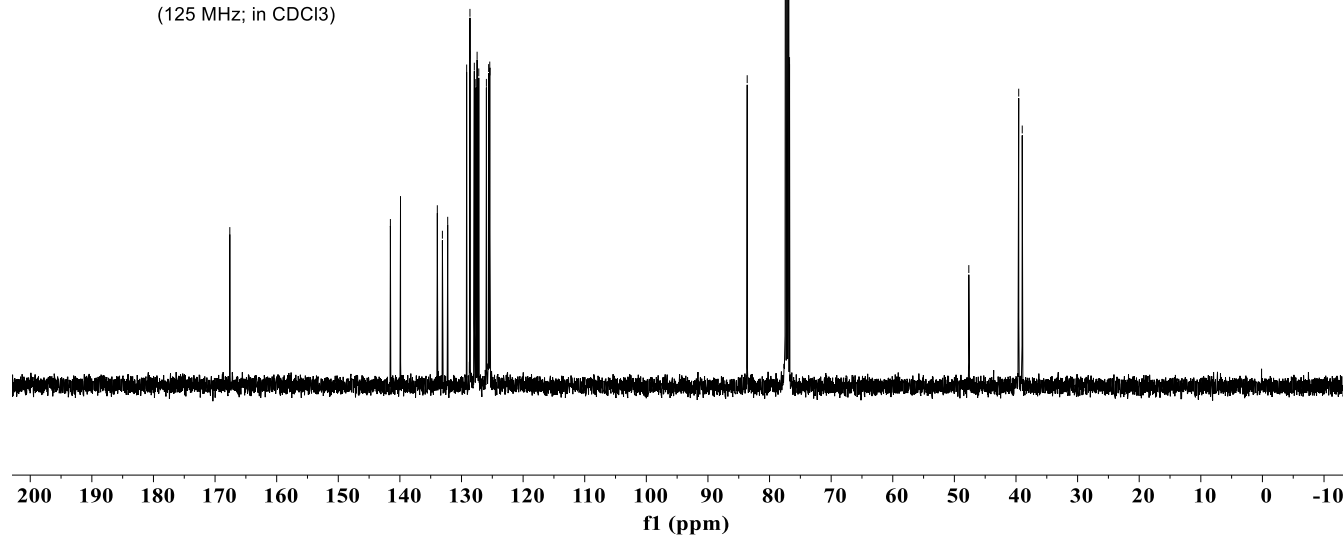


167.61 141.54 139.90 133.93 133.10 132.24 129.16 128.65 128.63 127.92 127.68 127.47 127.20 125.96 125.60 125.41 125.39 83.63 76.75 47.66 39.56 38.98

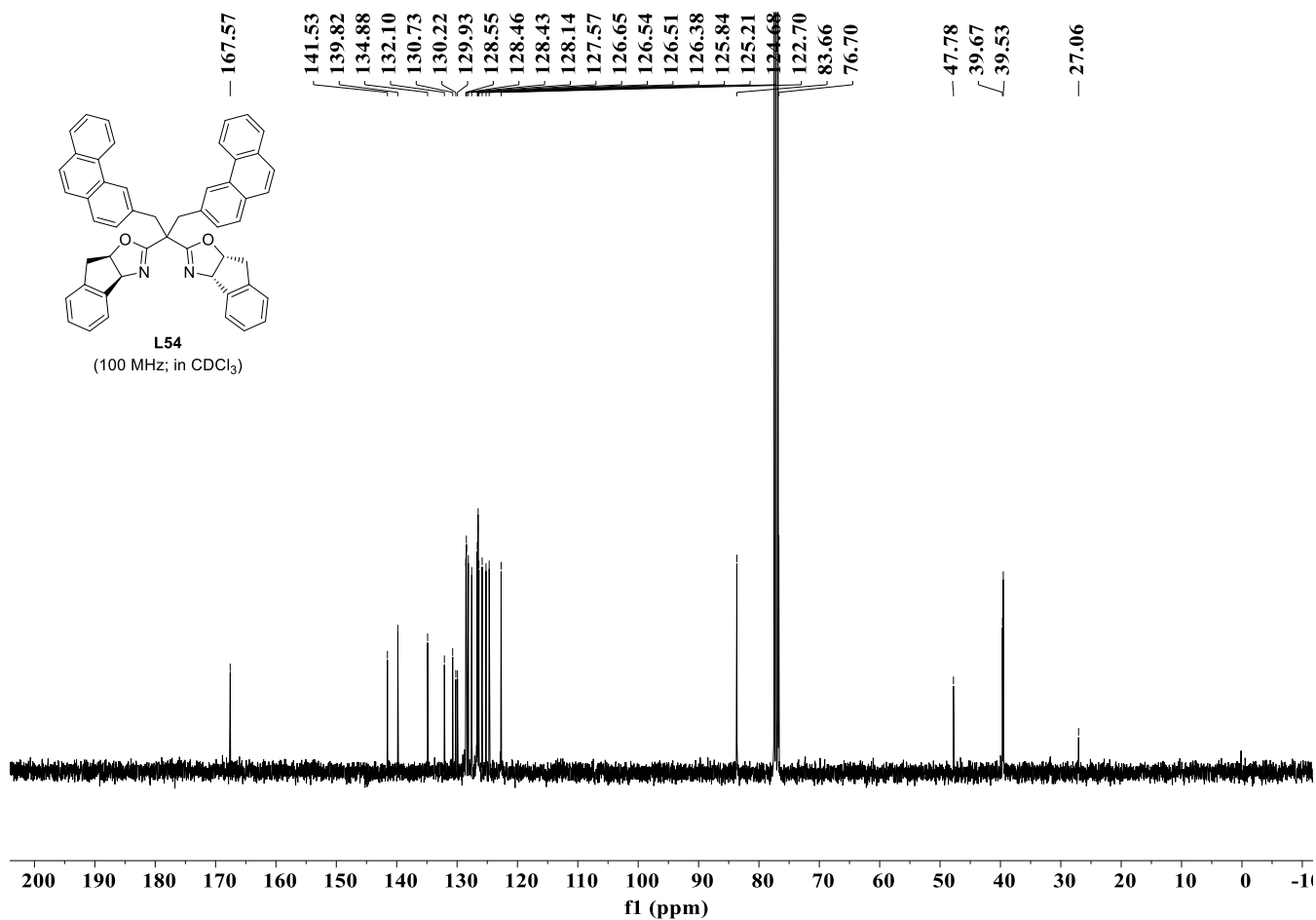
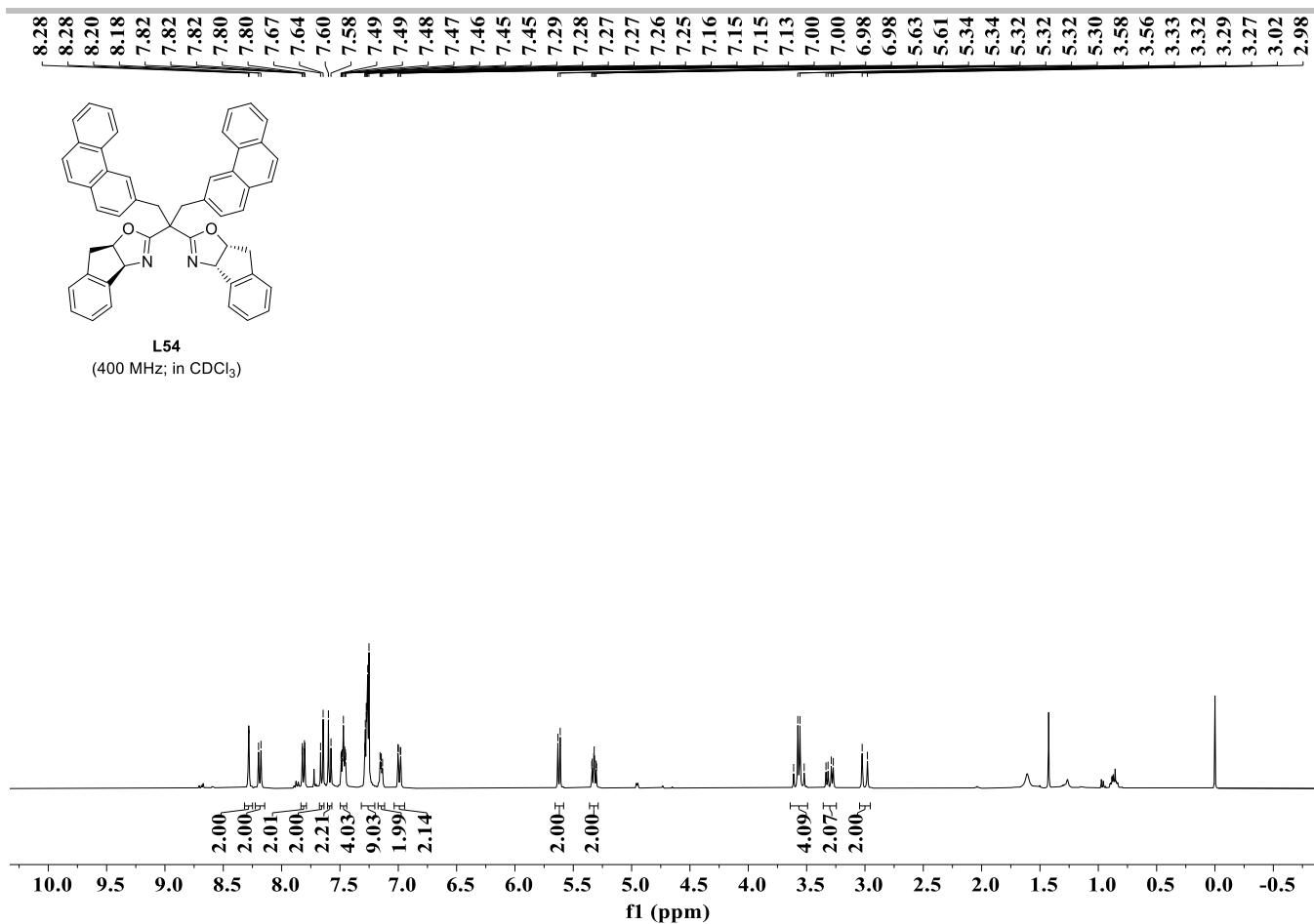


**L53**

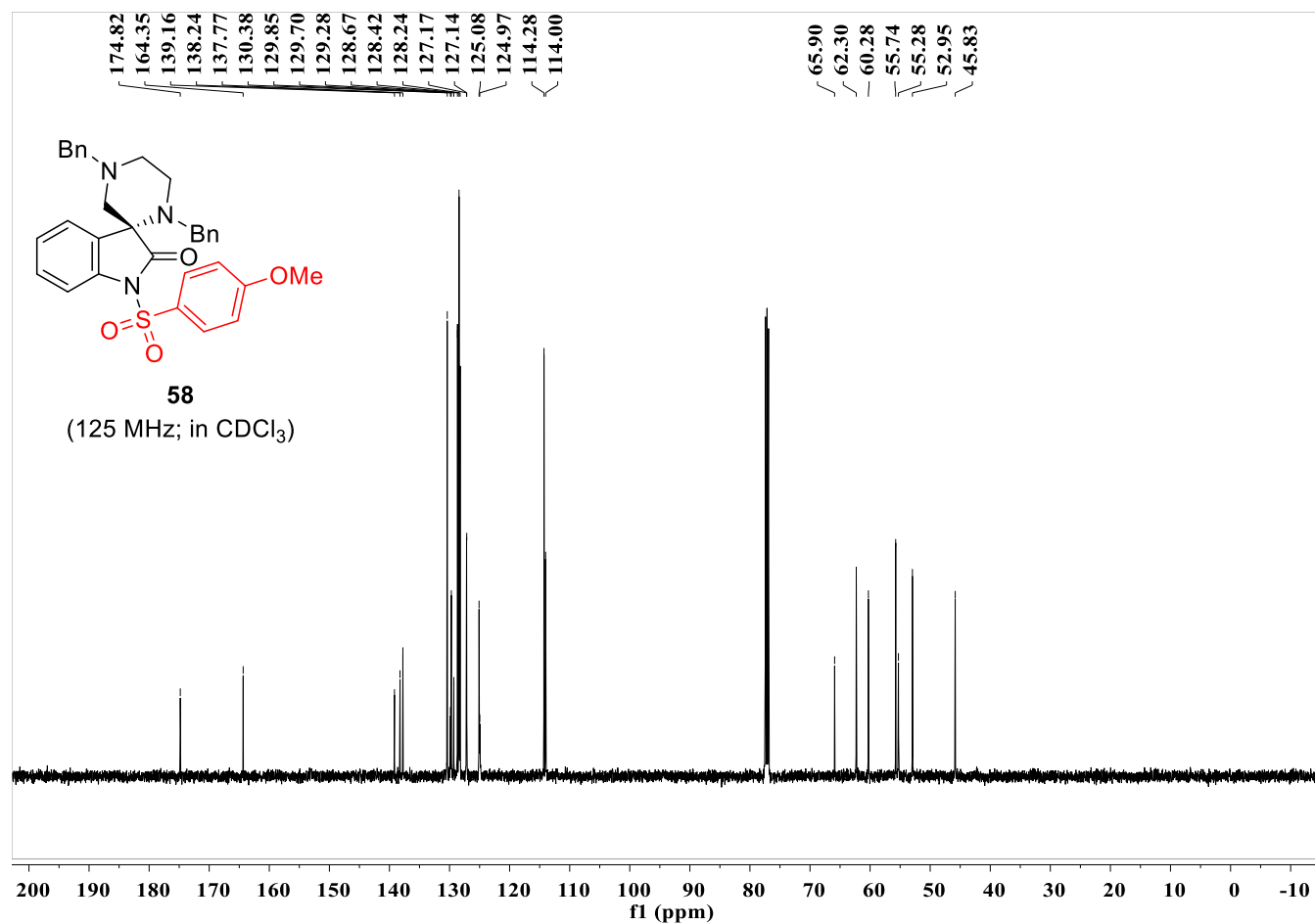
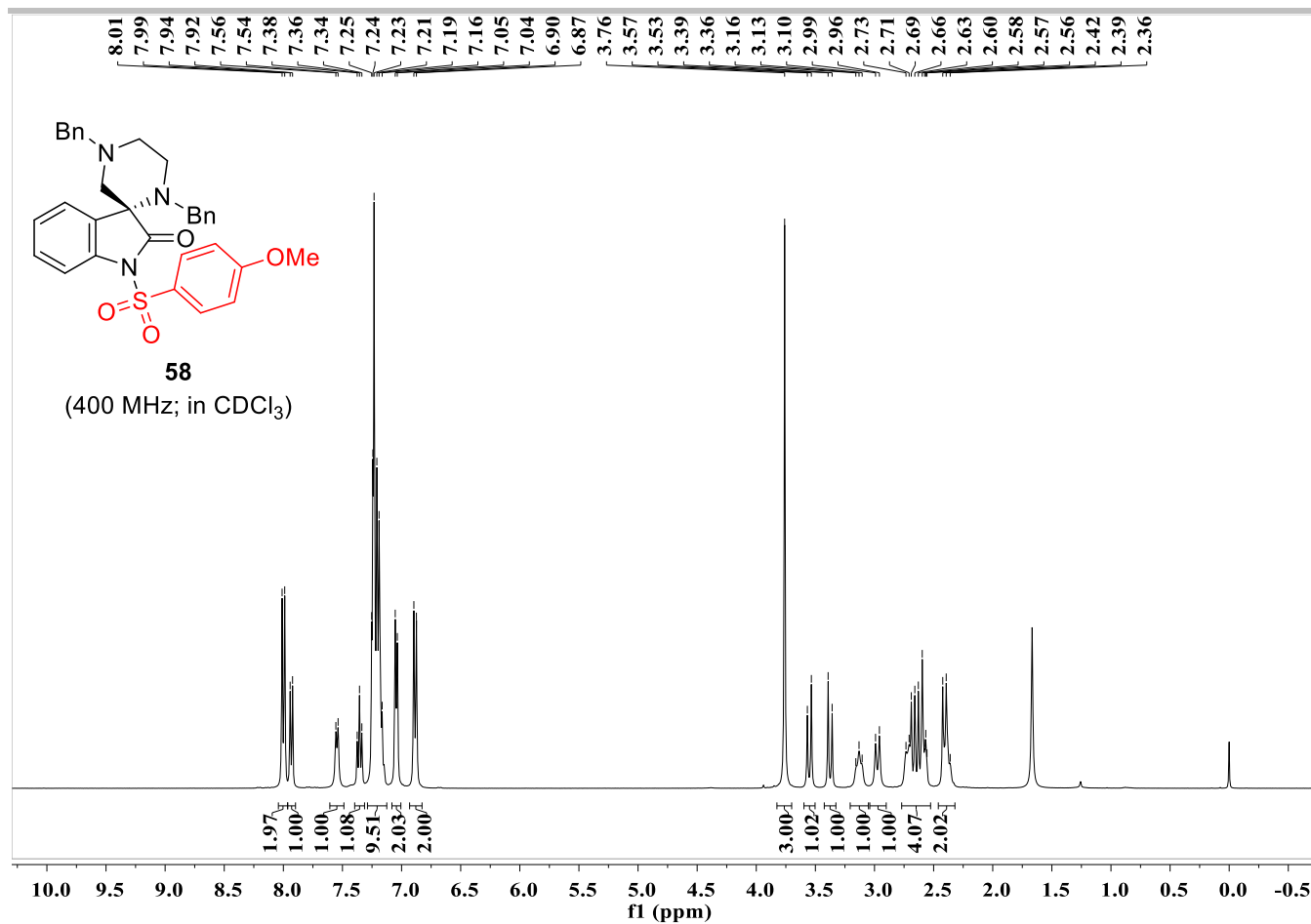
(125 MHz; in CDCl<sub>3</sub>)



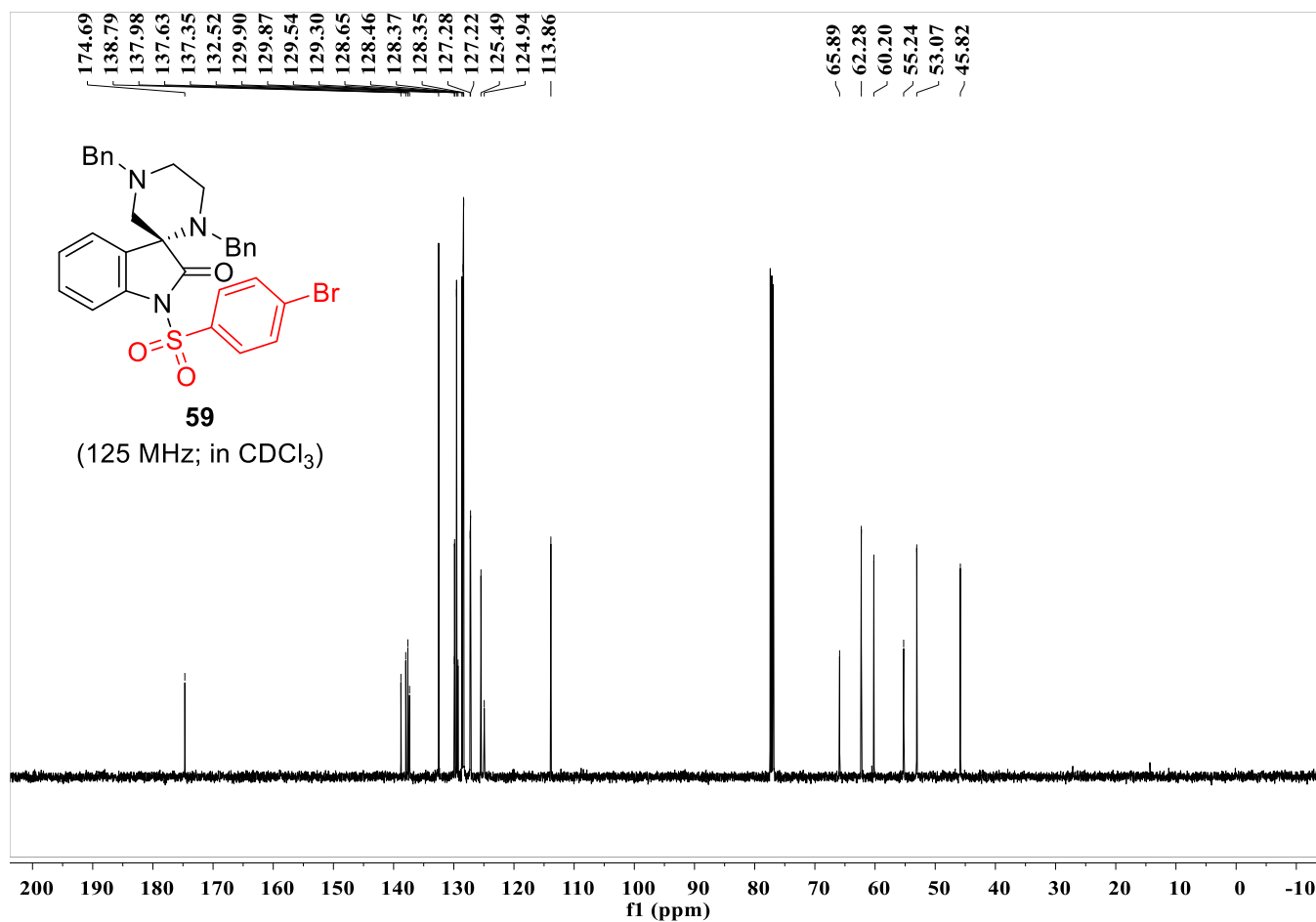
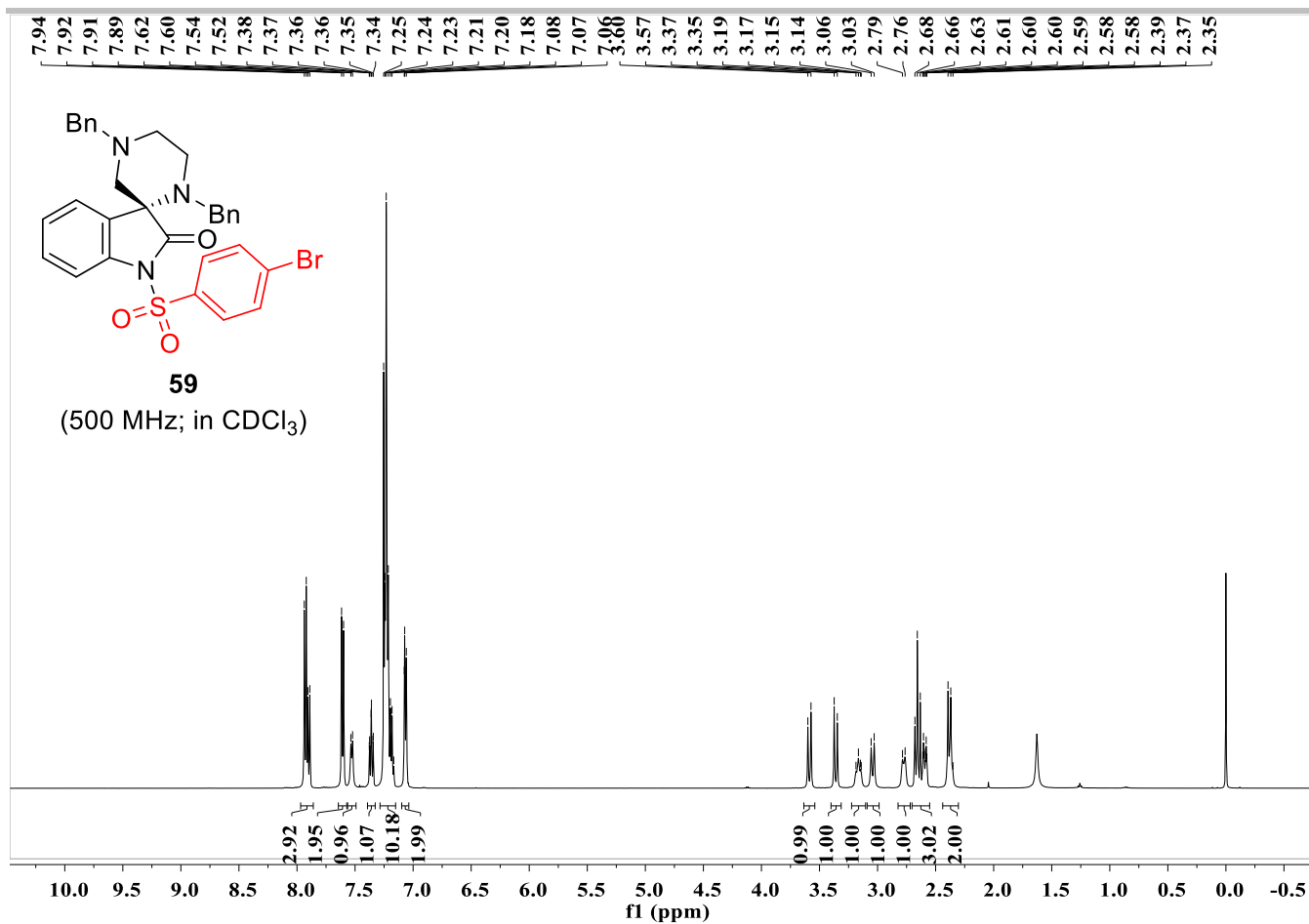
# SUPPORTING INFORMATION



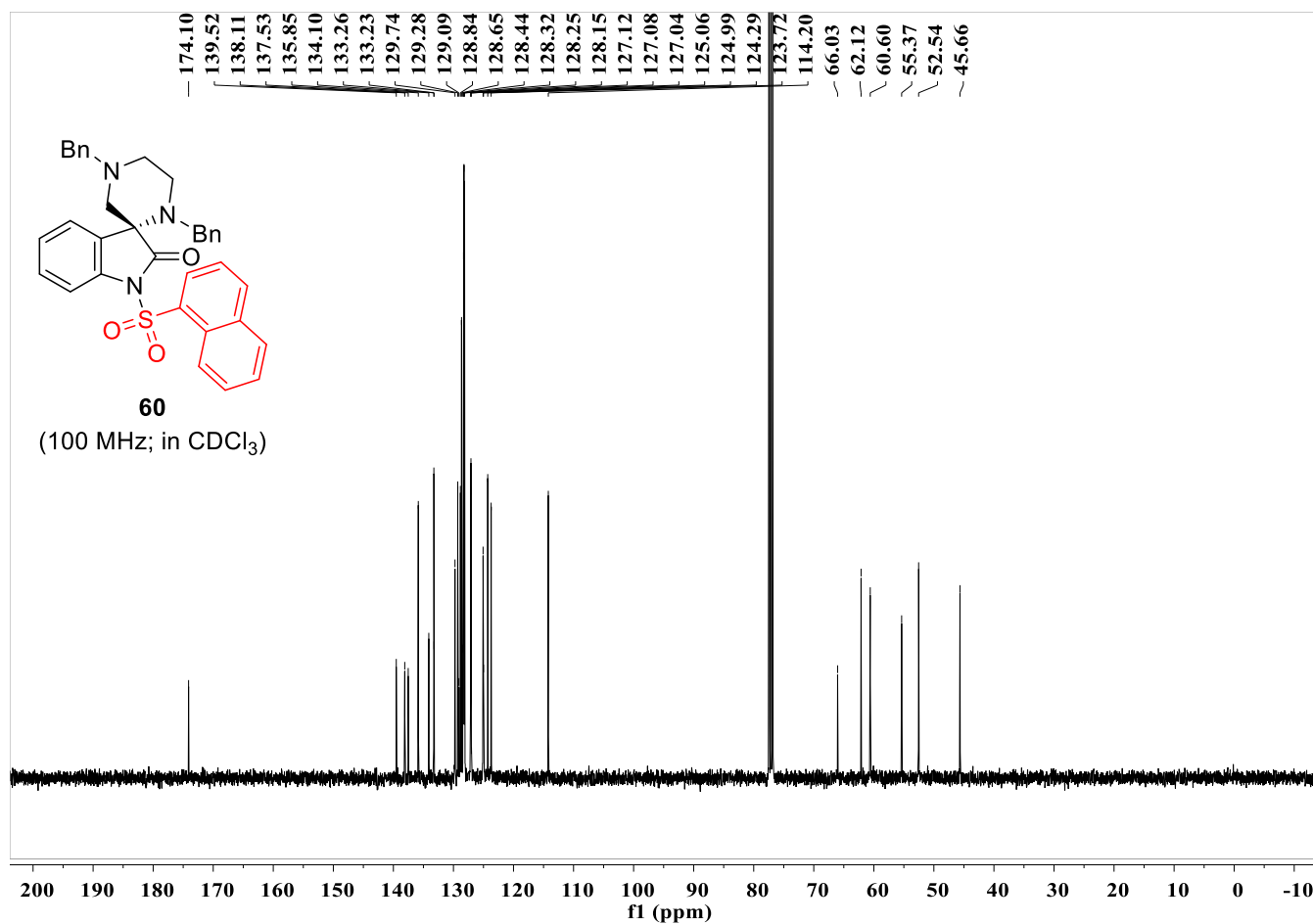
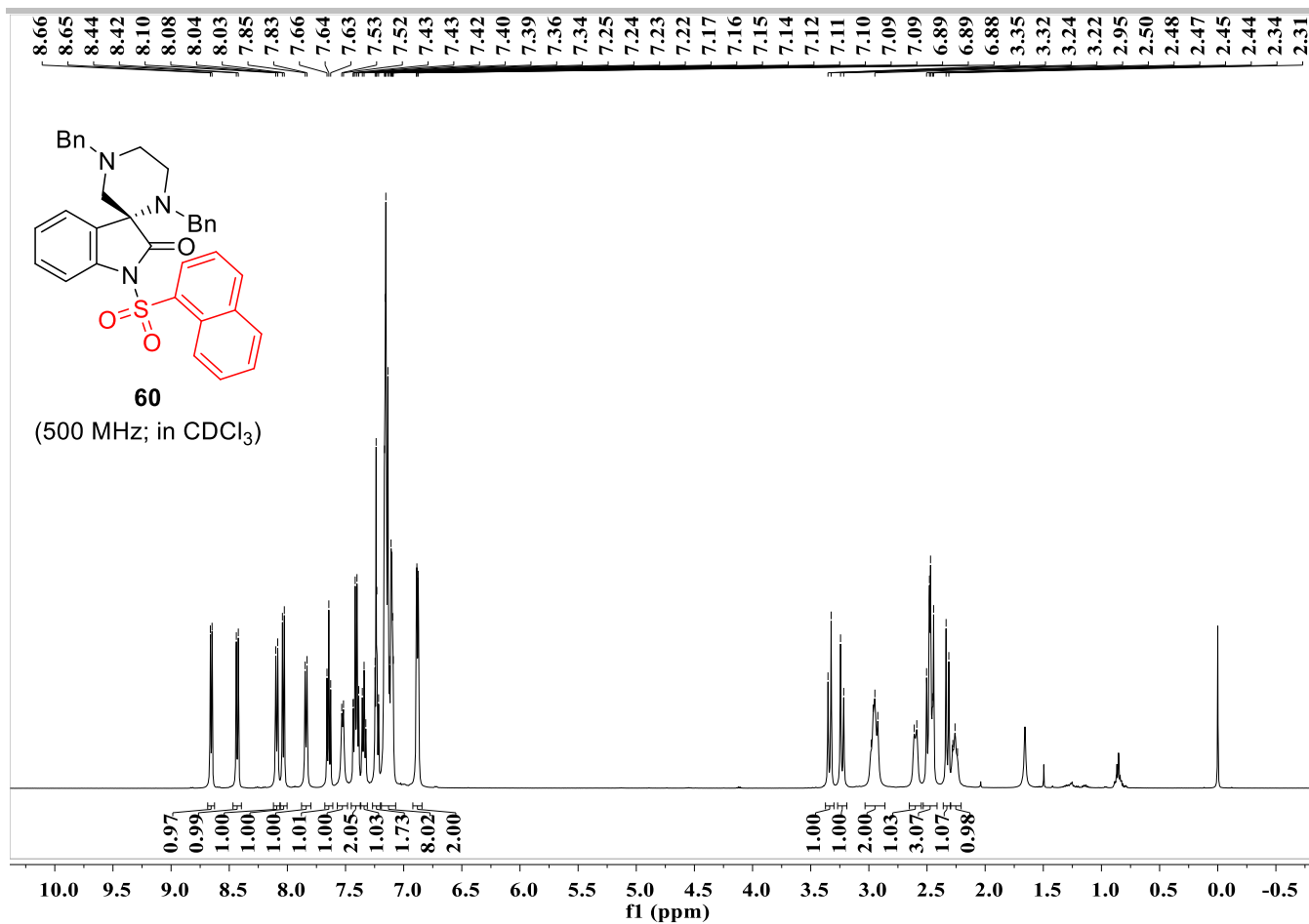
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION

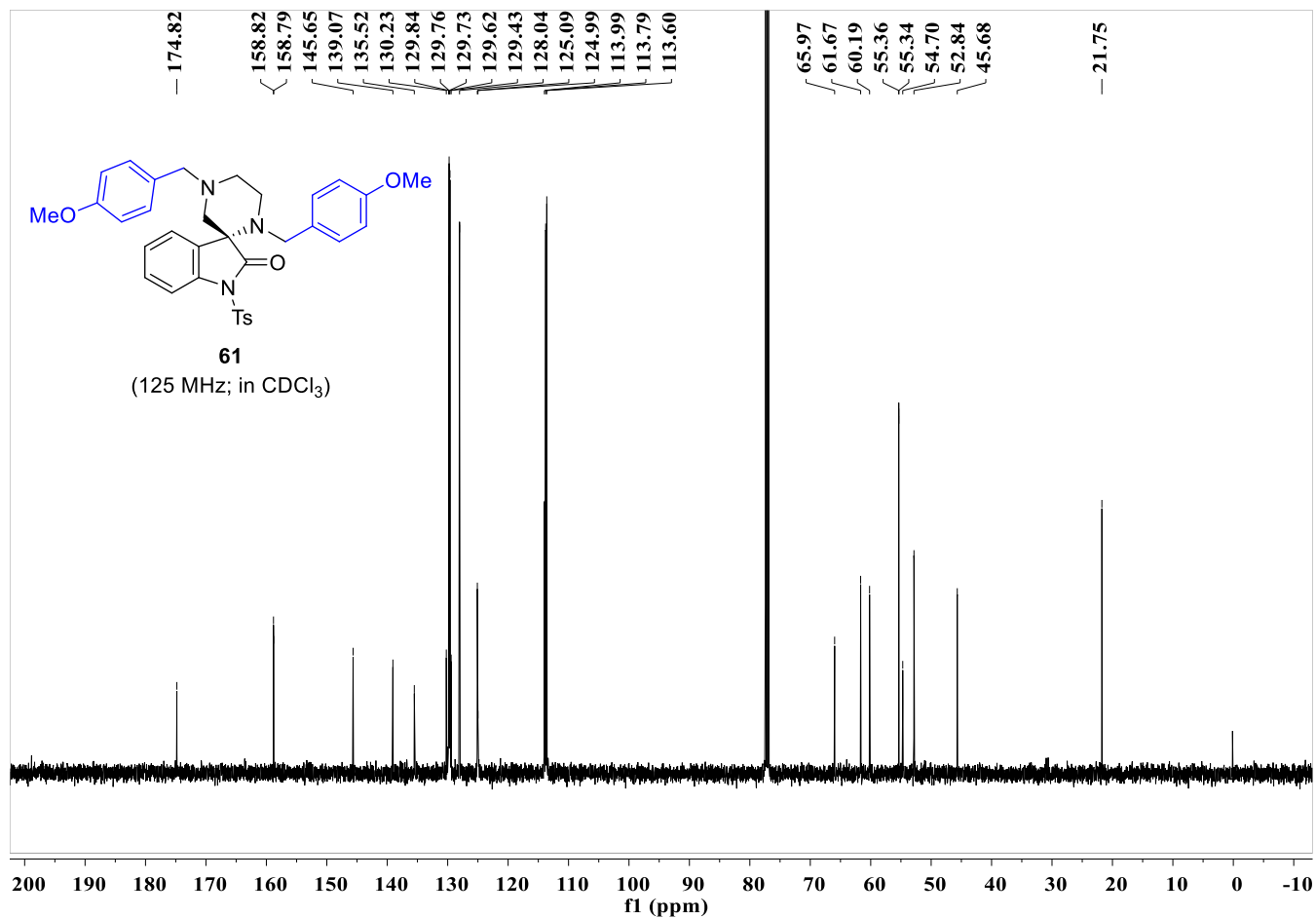
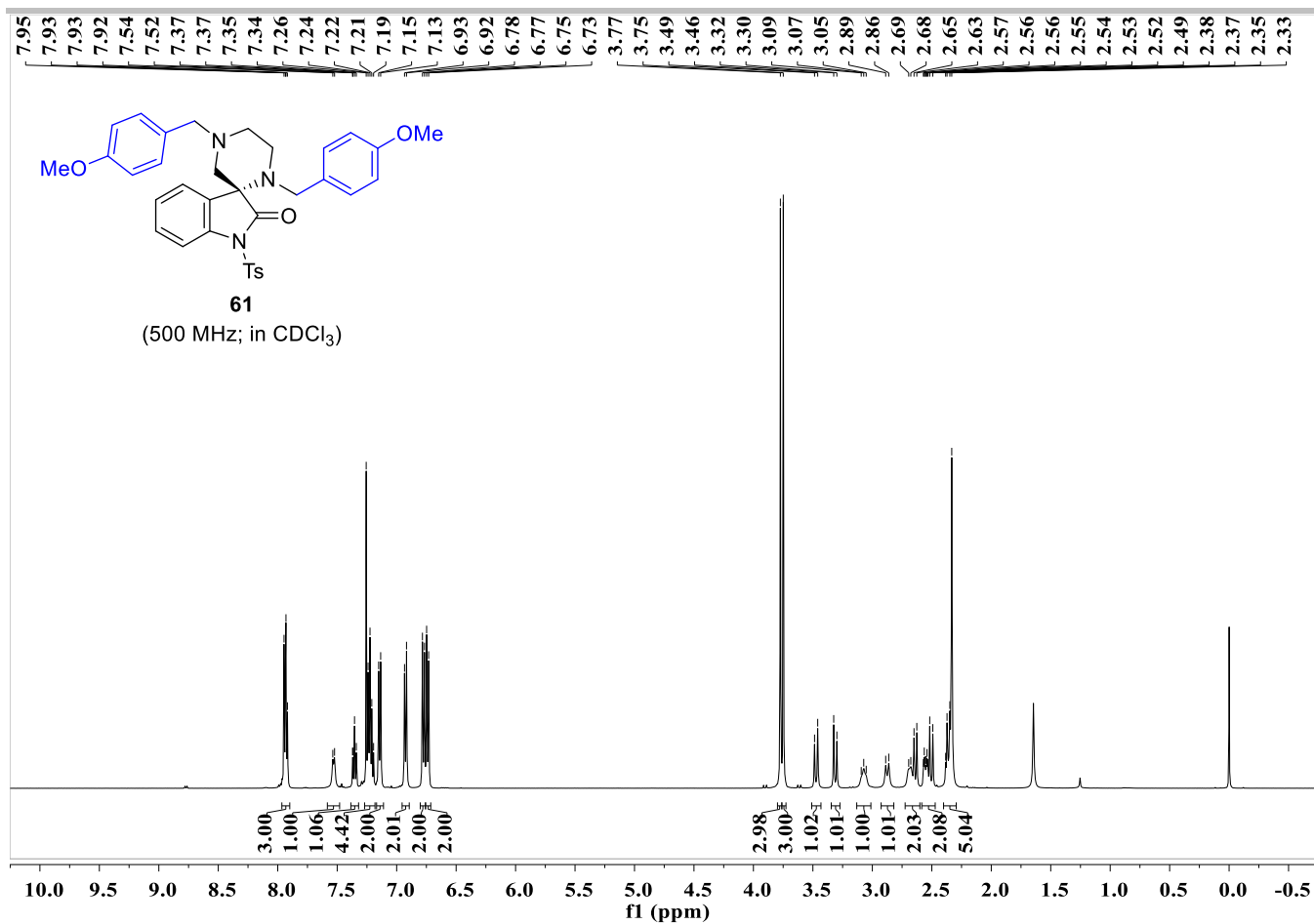


# SUPPORTING INFORMATION

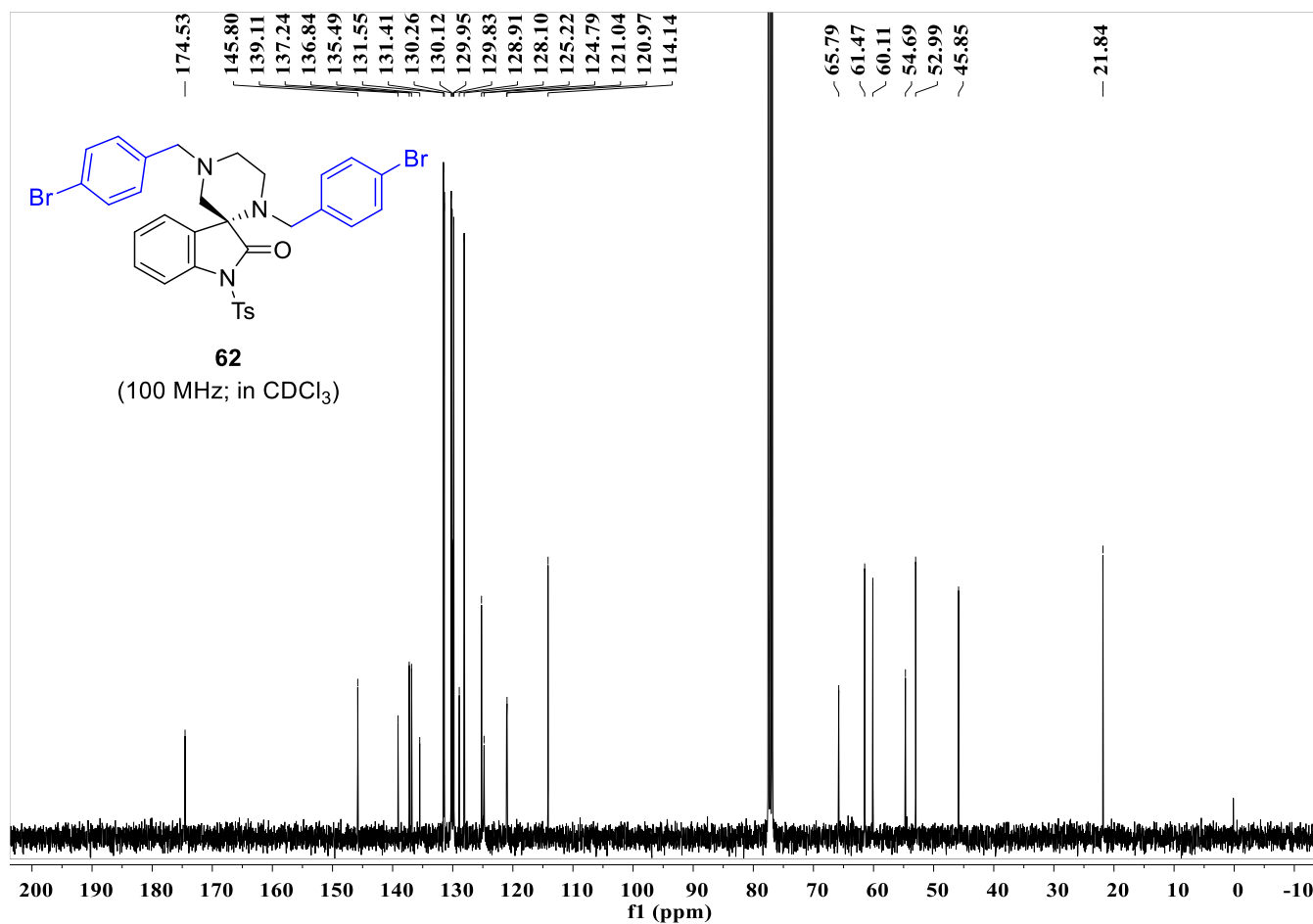
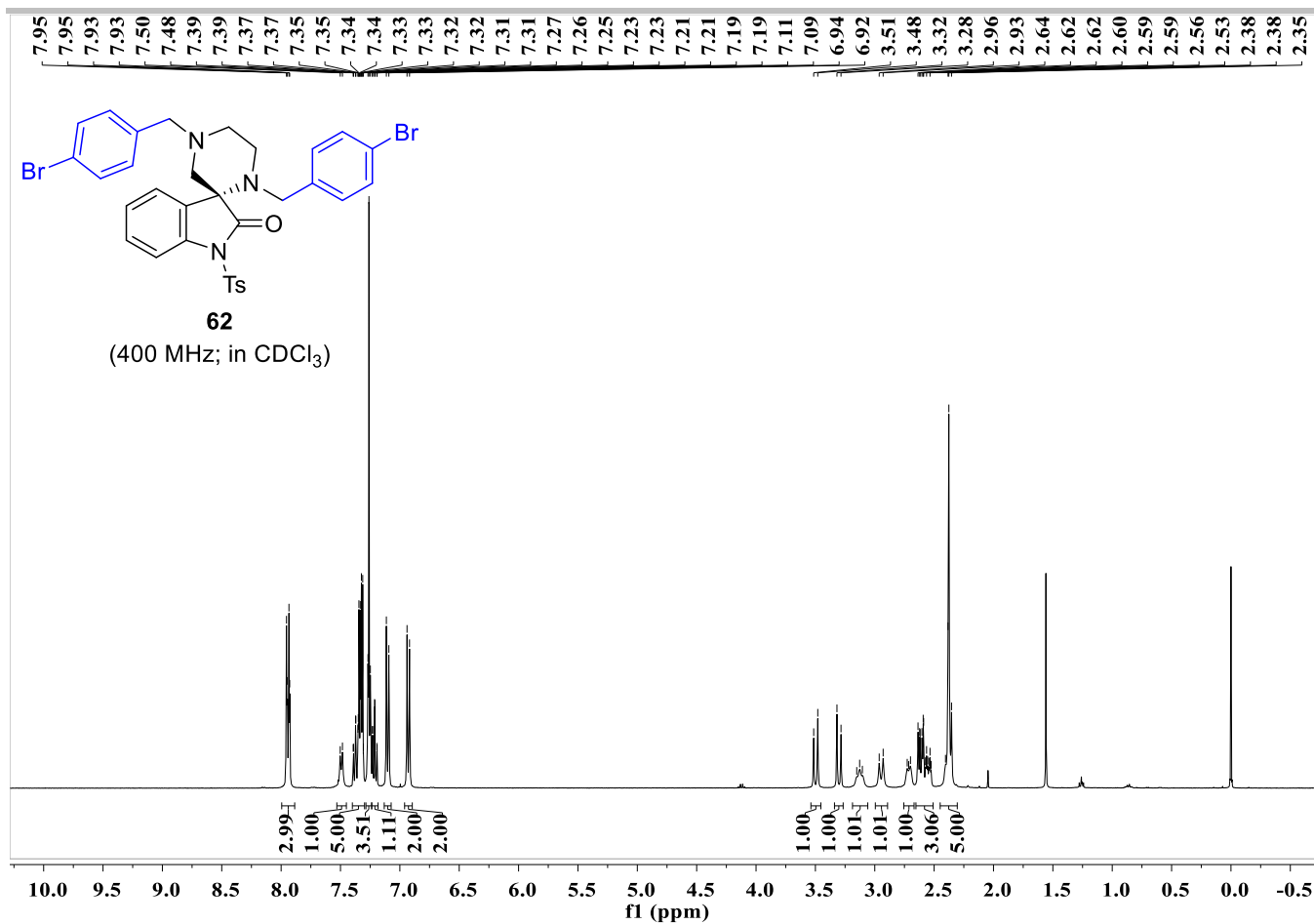




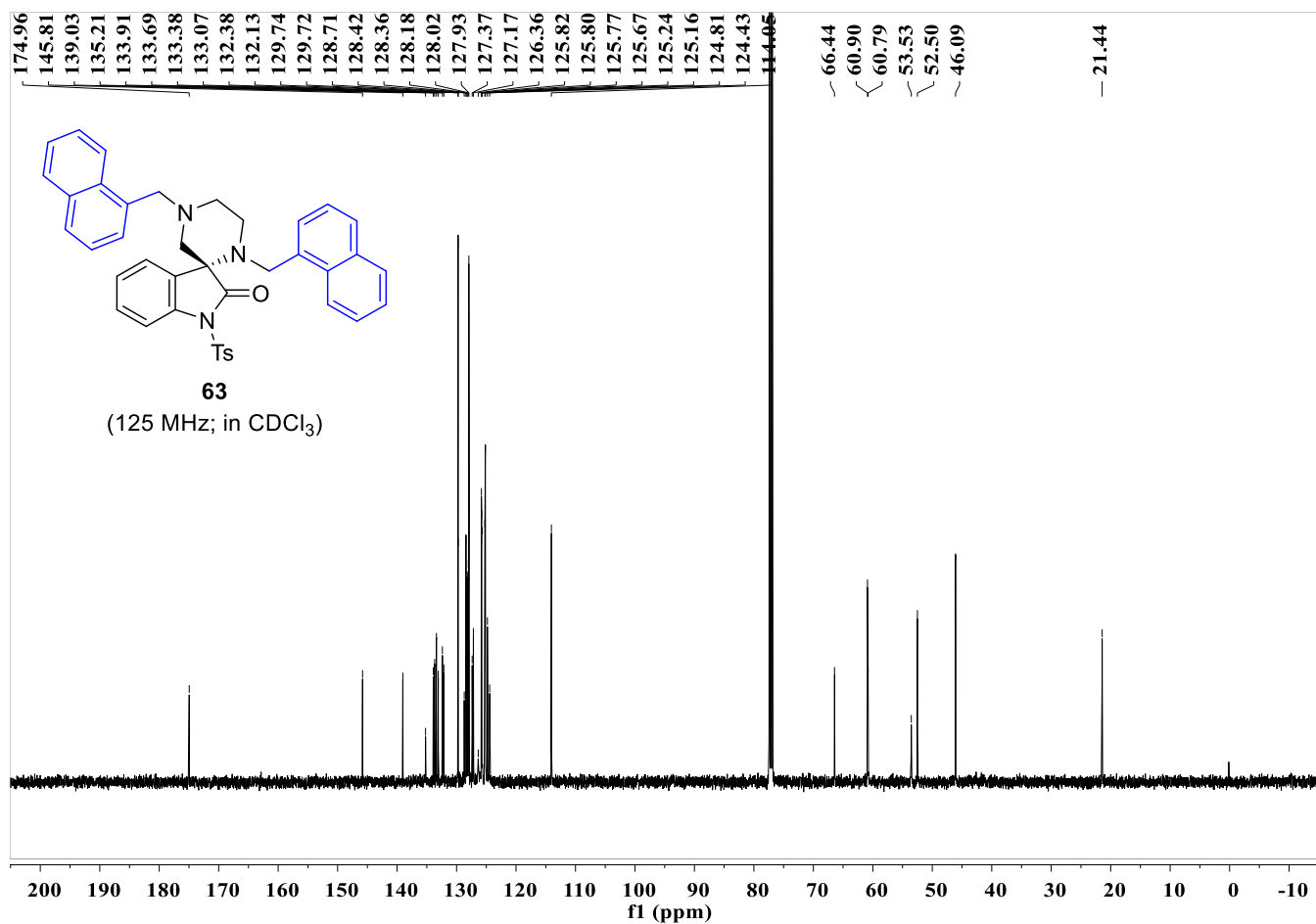
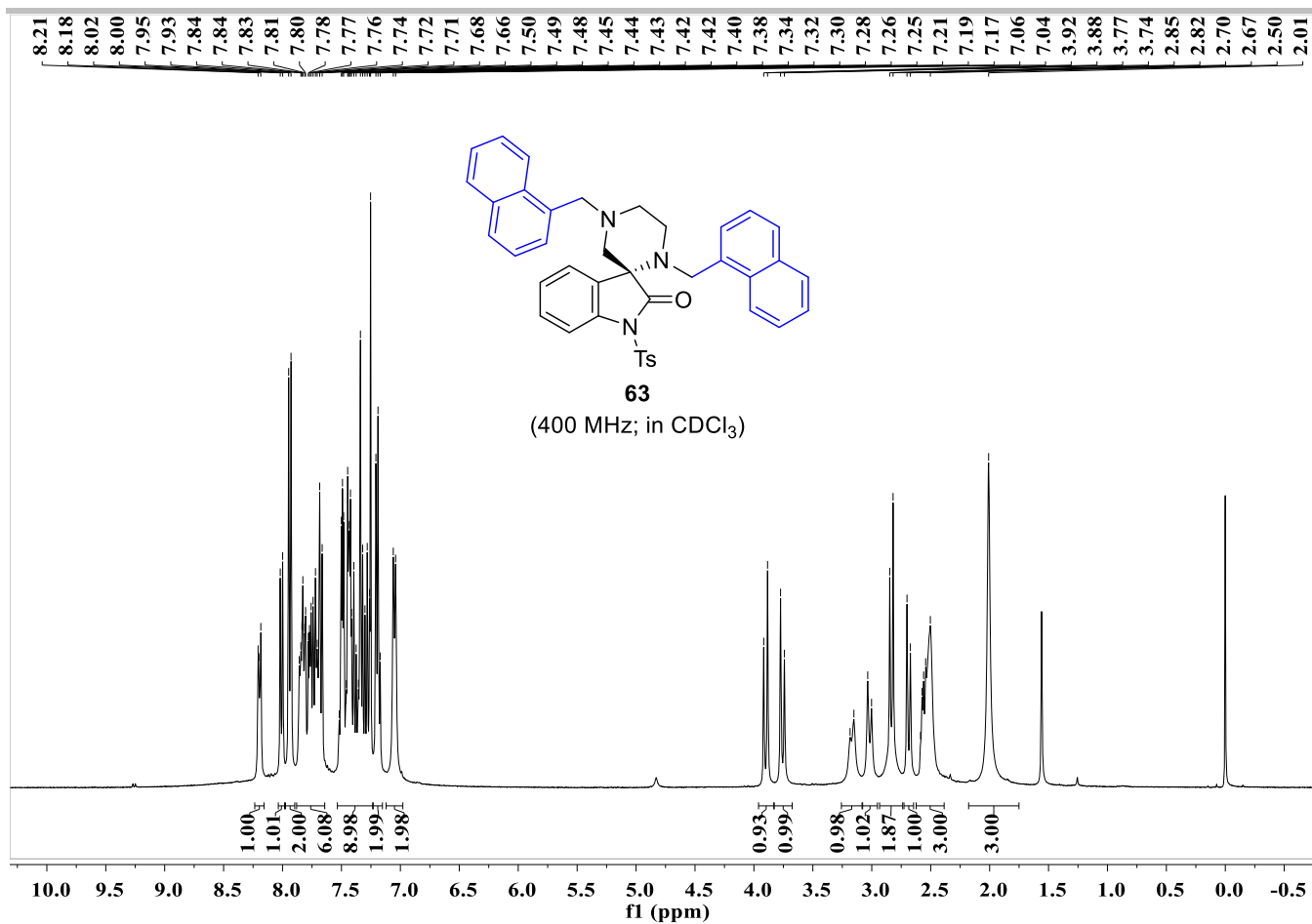
# SUPPORTING INFORMATION



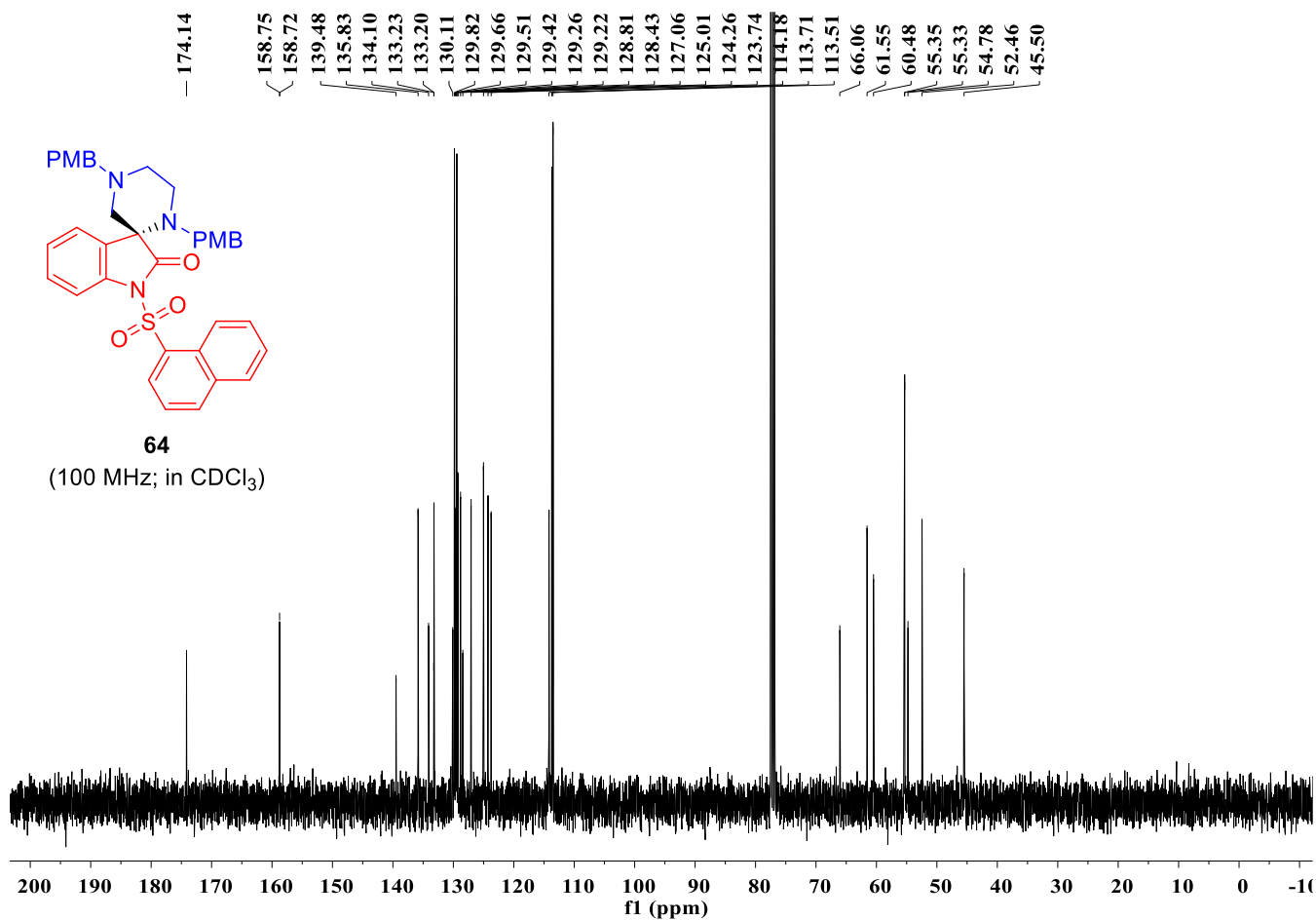
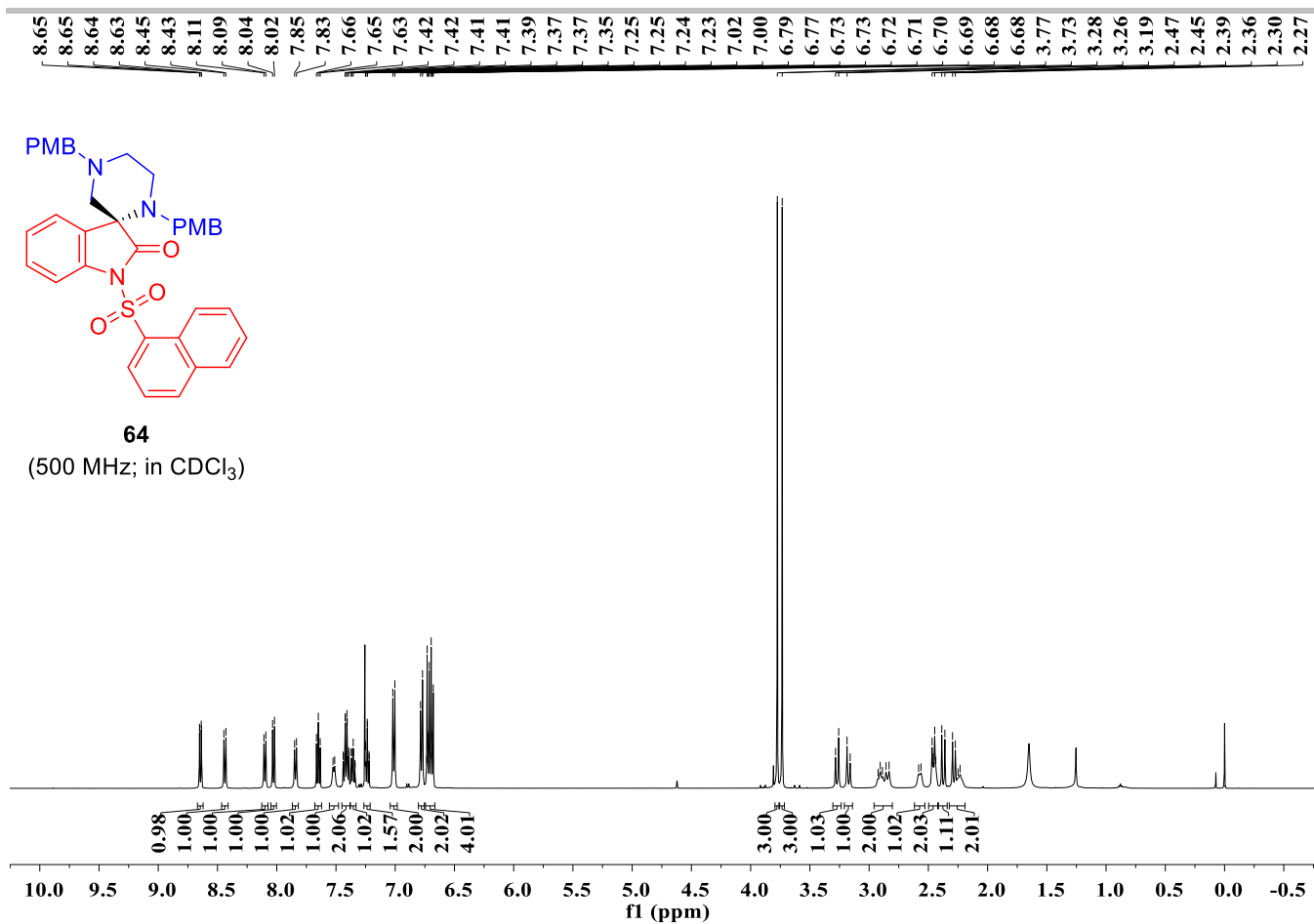
# SUPPORTING INFORMATION



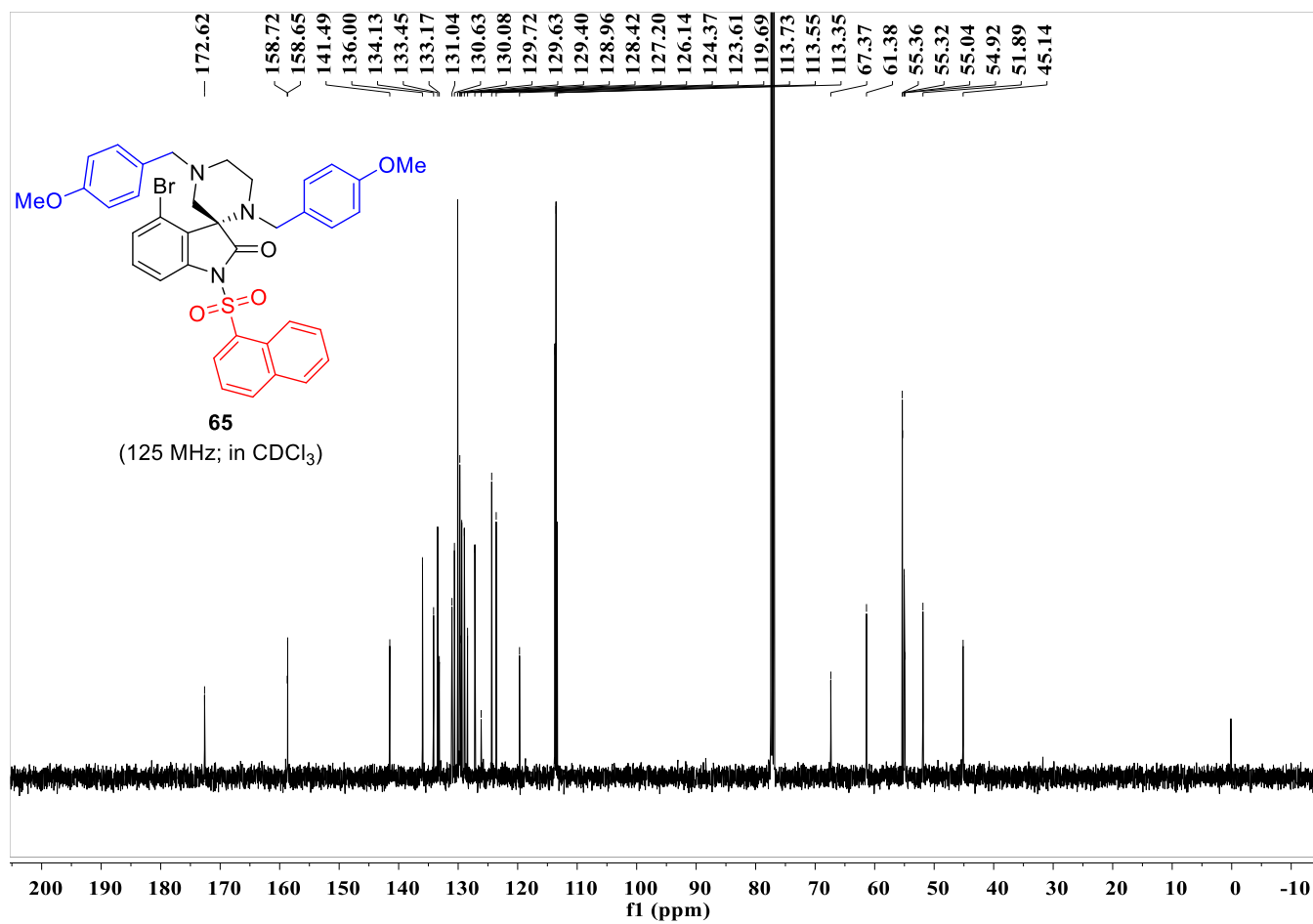
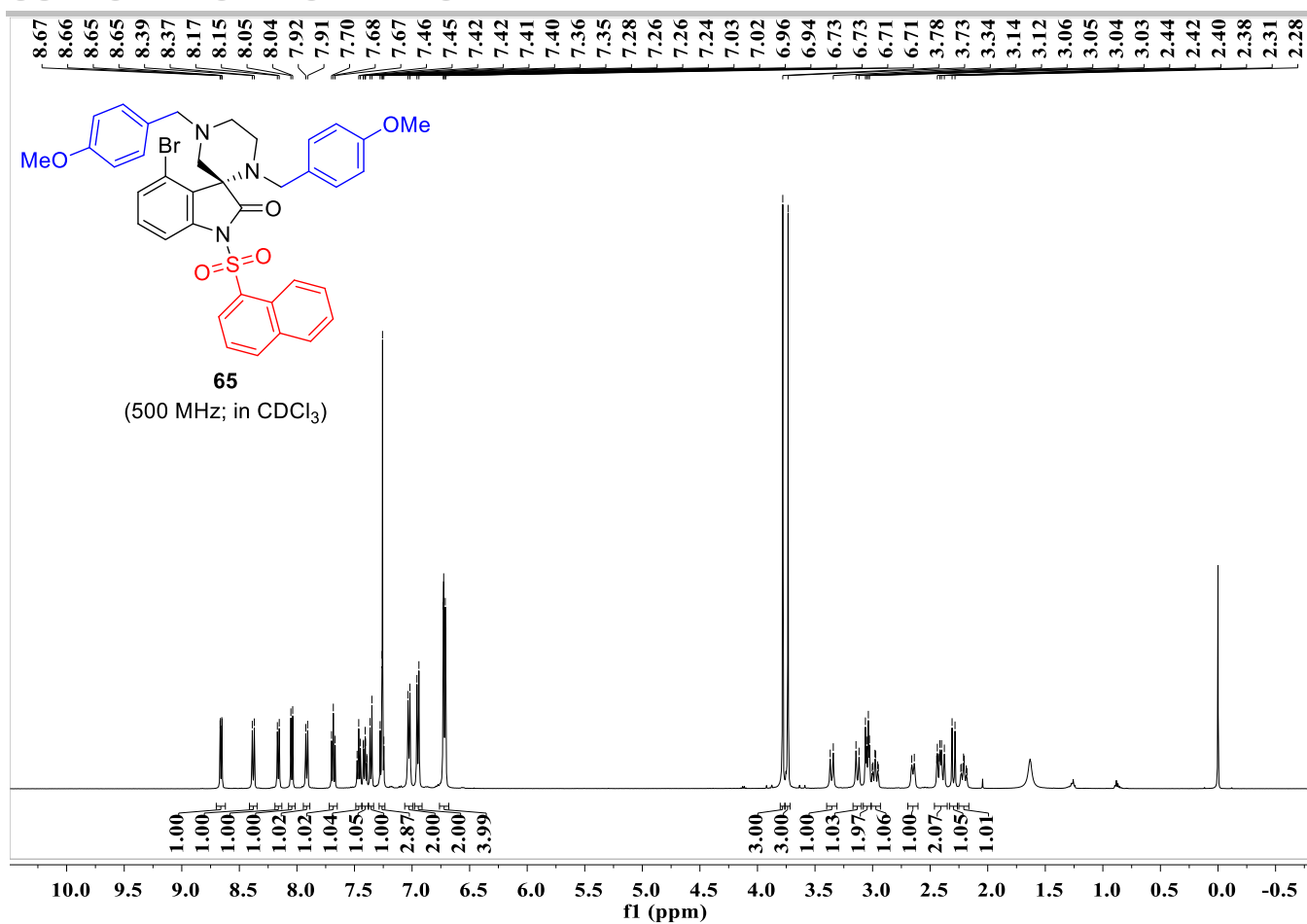
# SUPPORTING INFORMATION



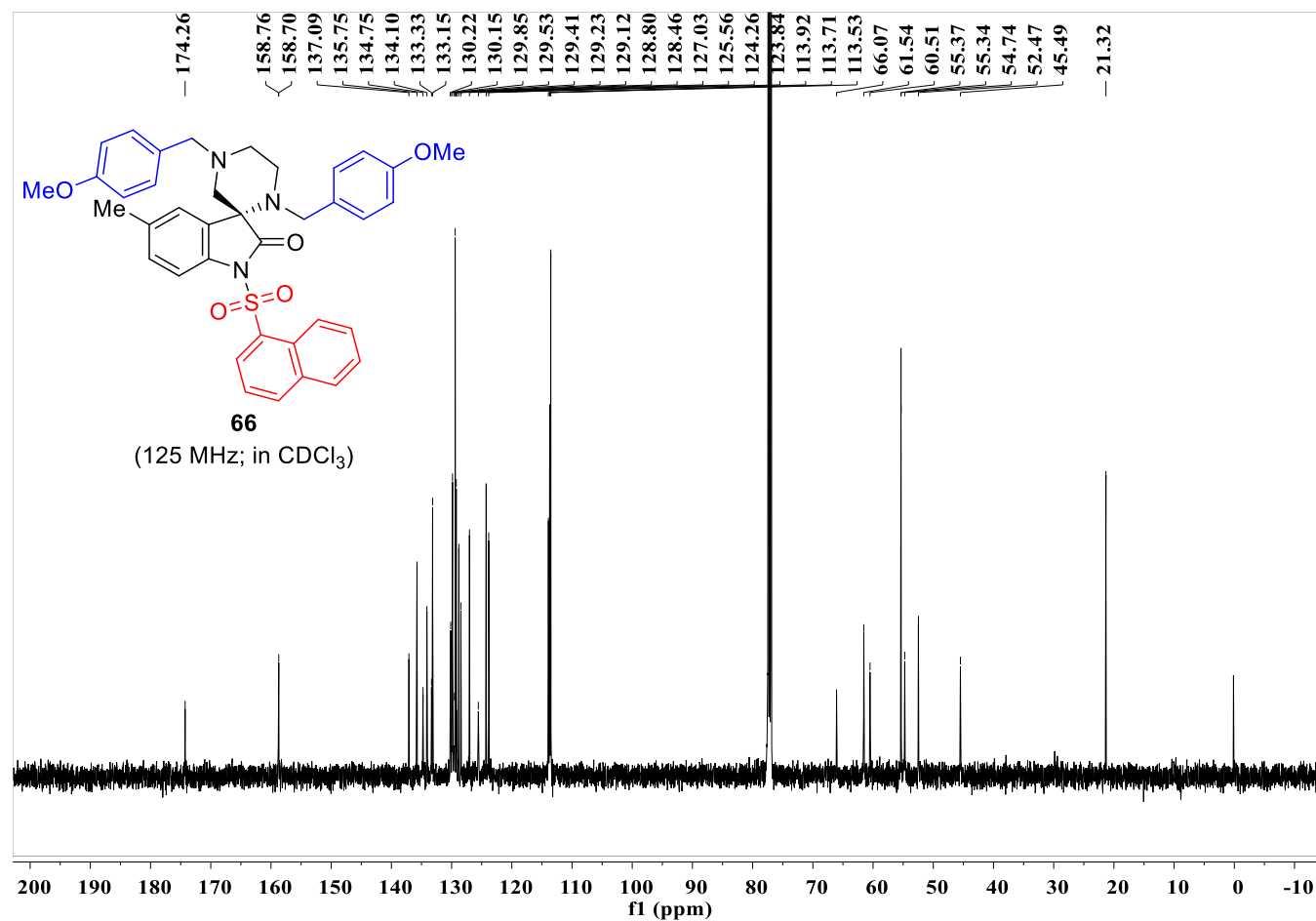
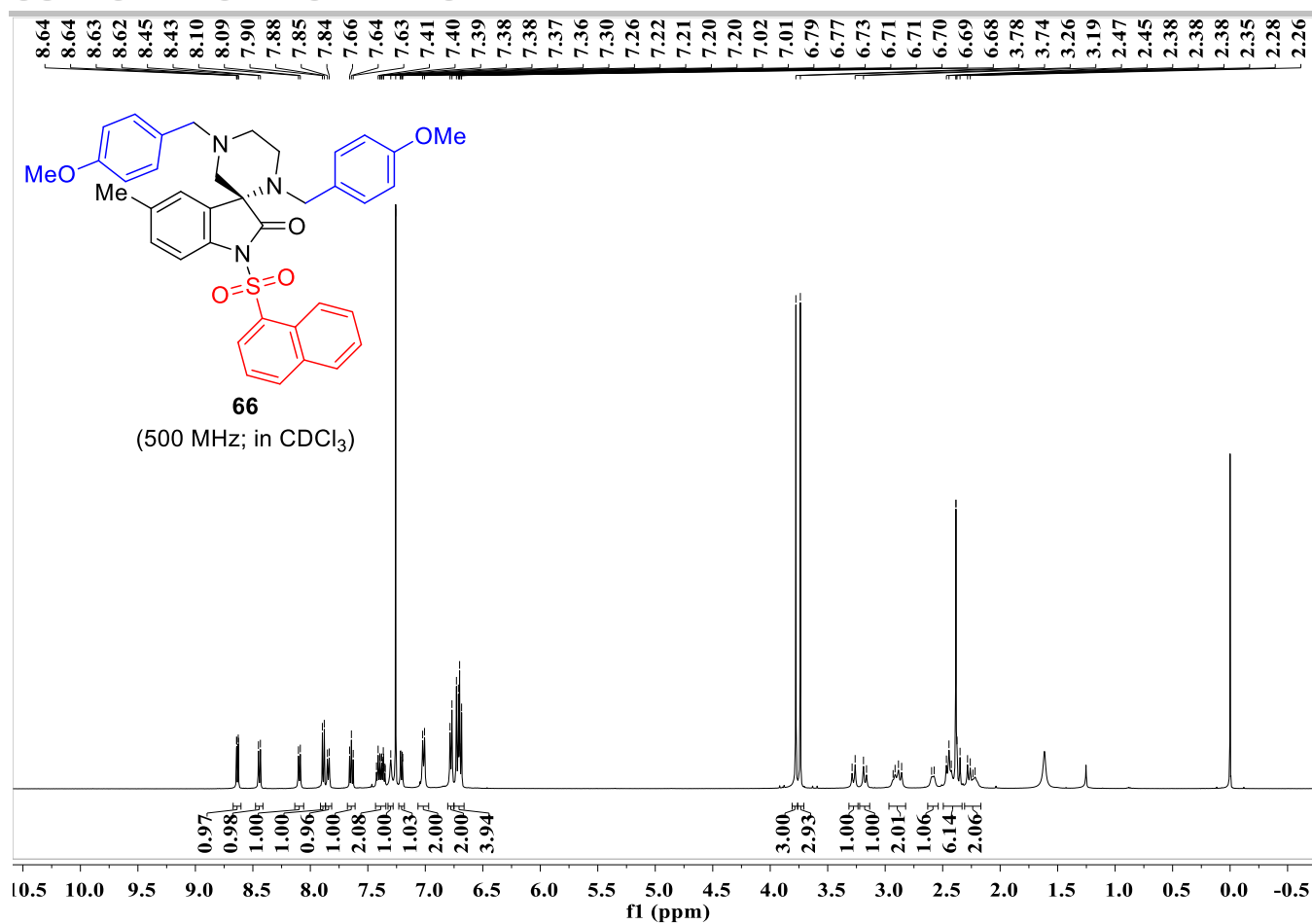
# SUPPORTING INFORMATION



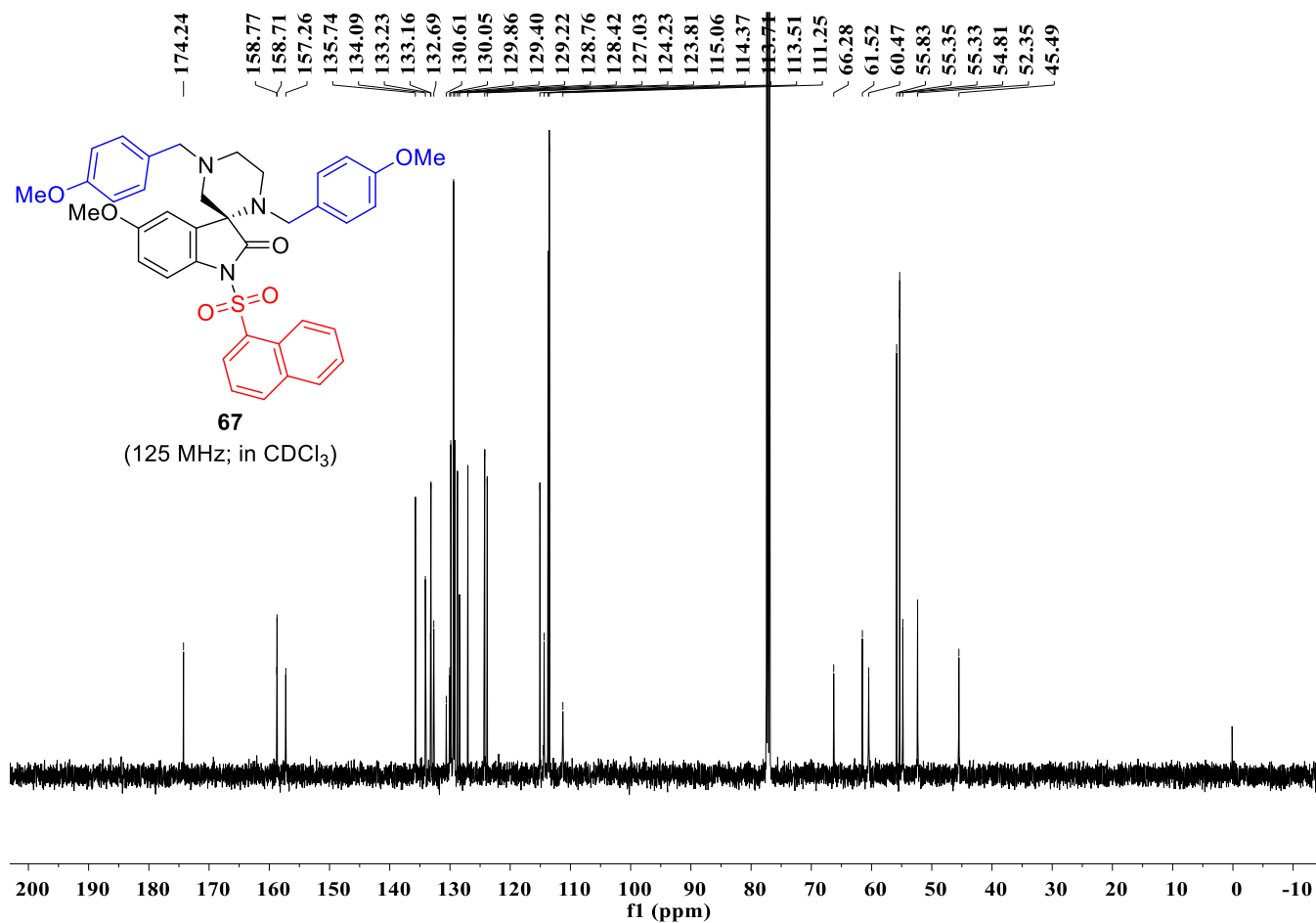
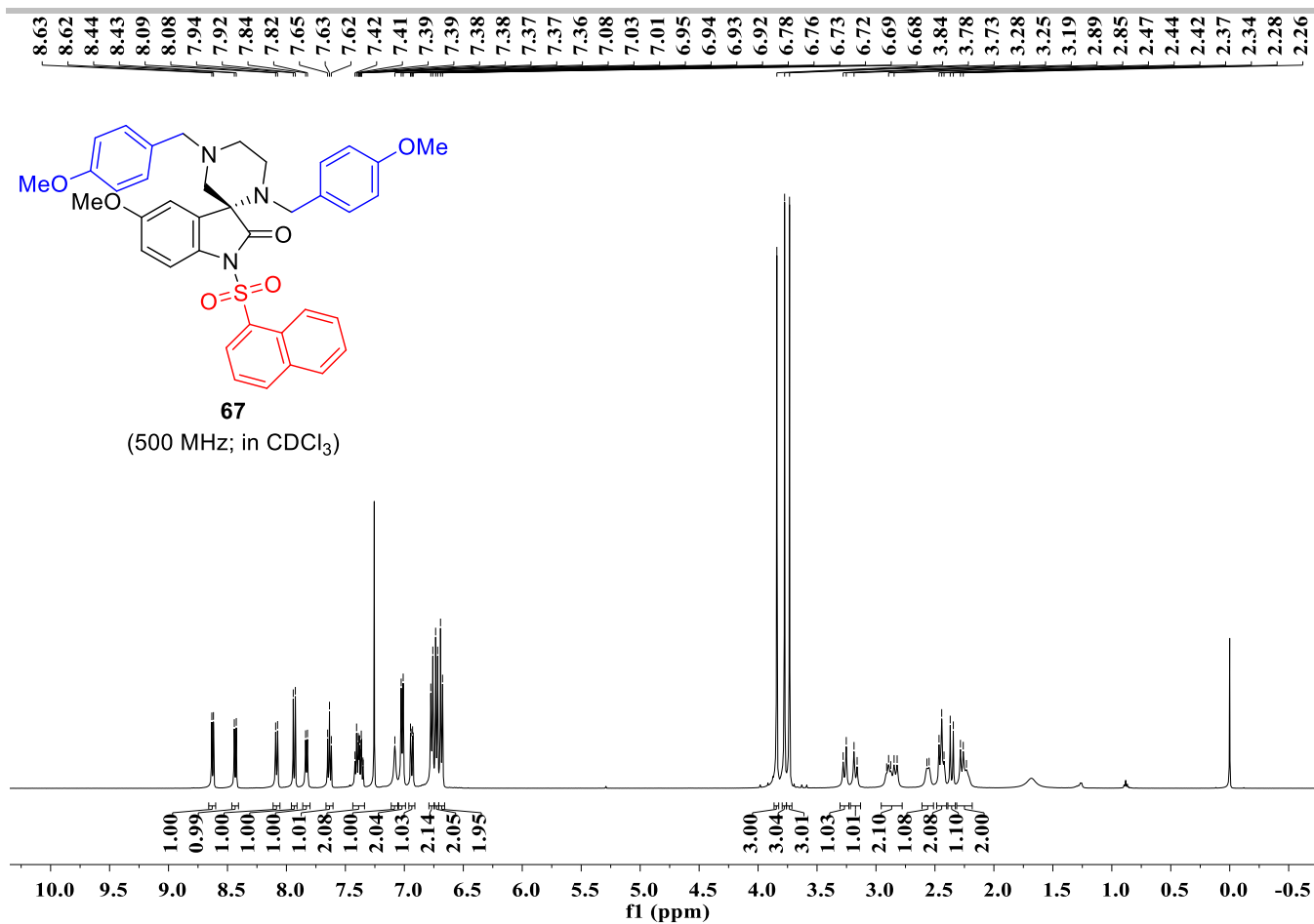
# SUPPORTING INFORMATION



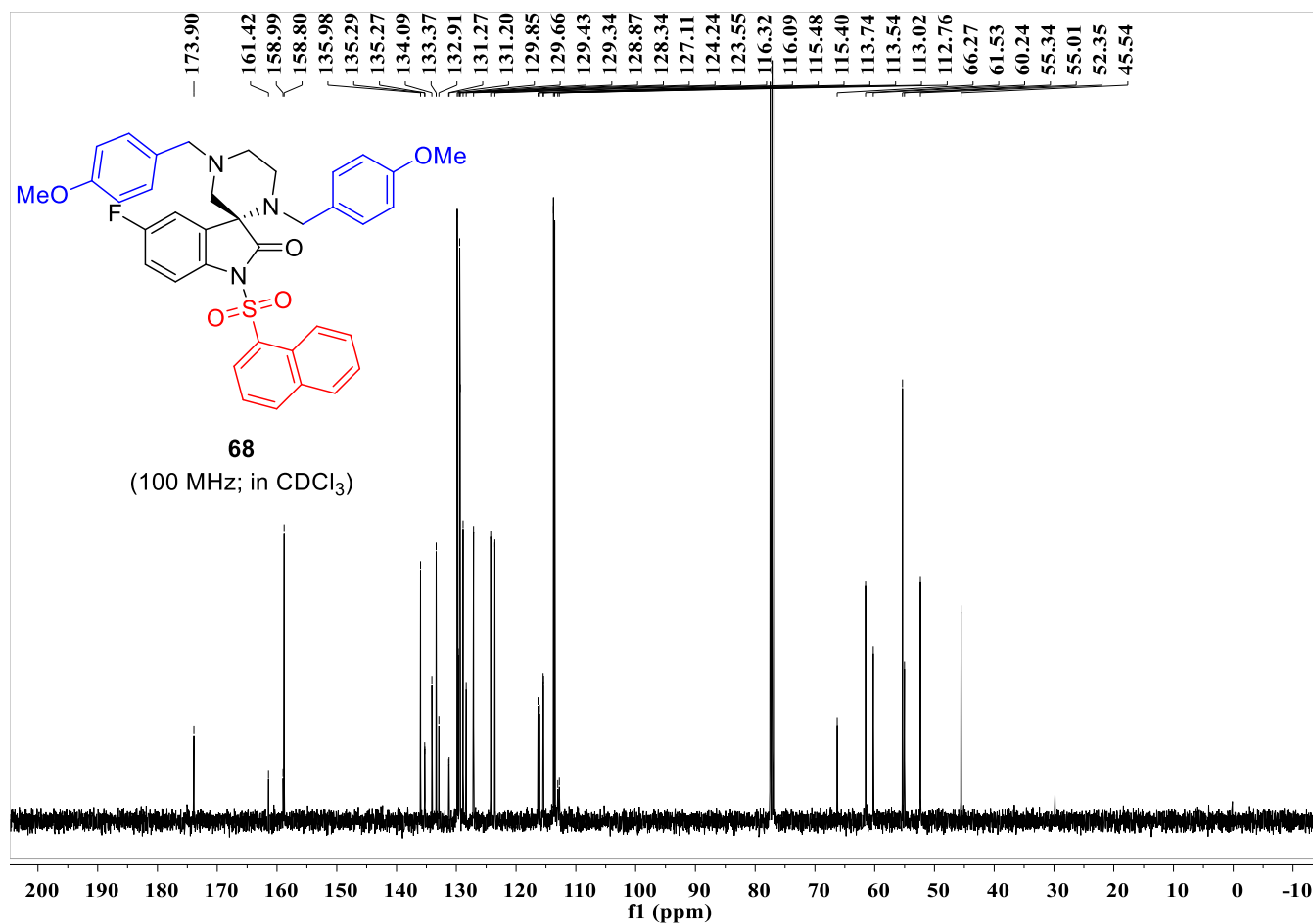
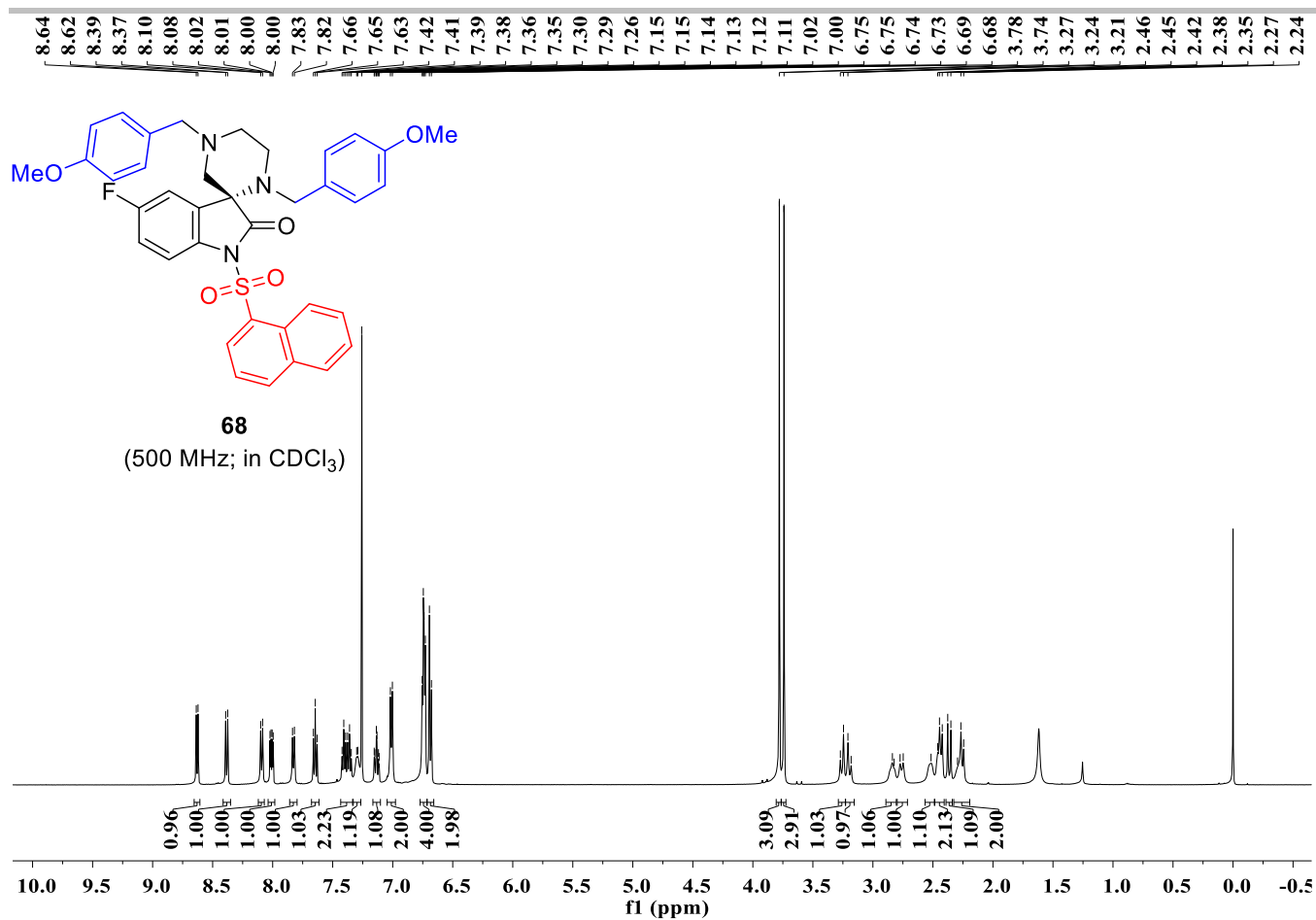
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION

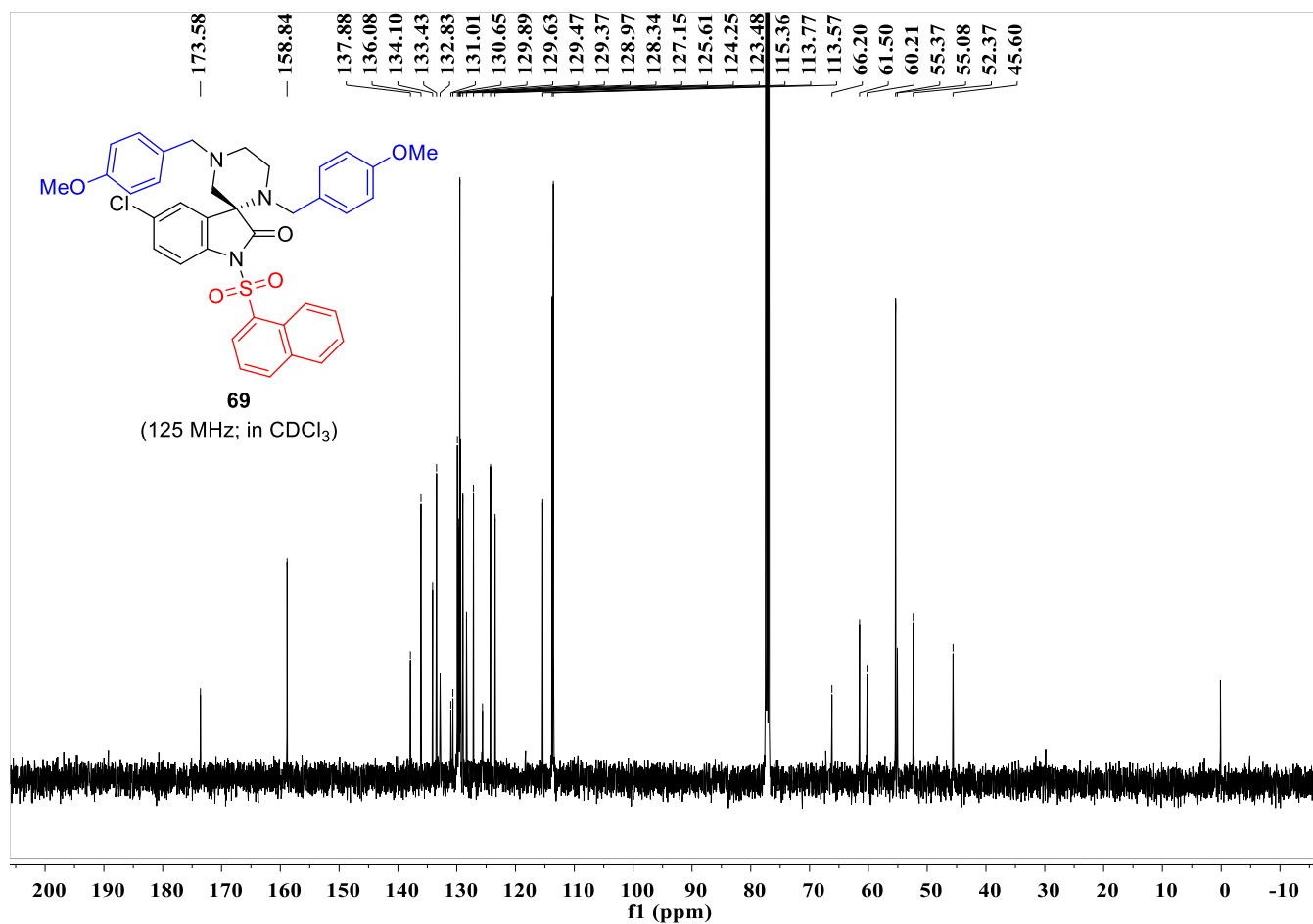
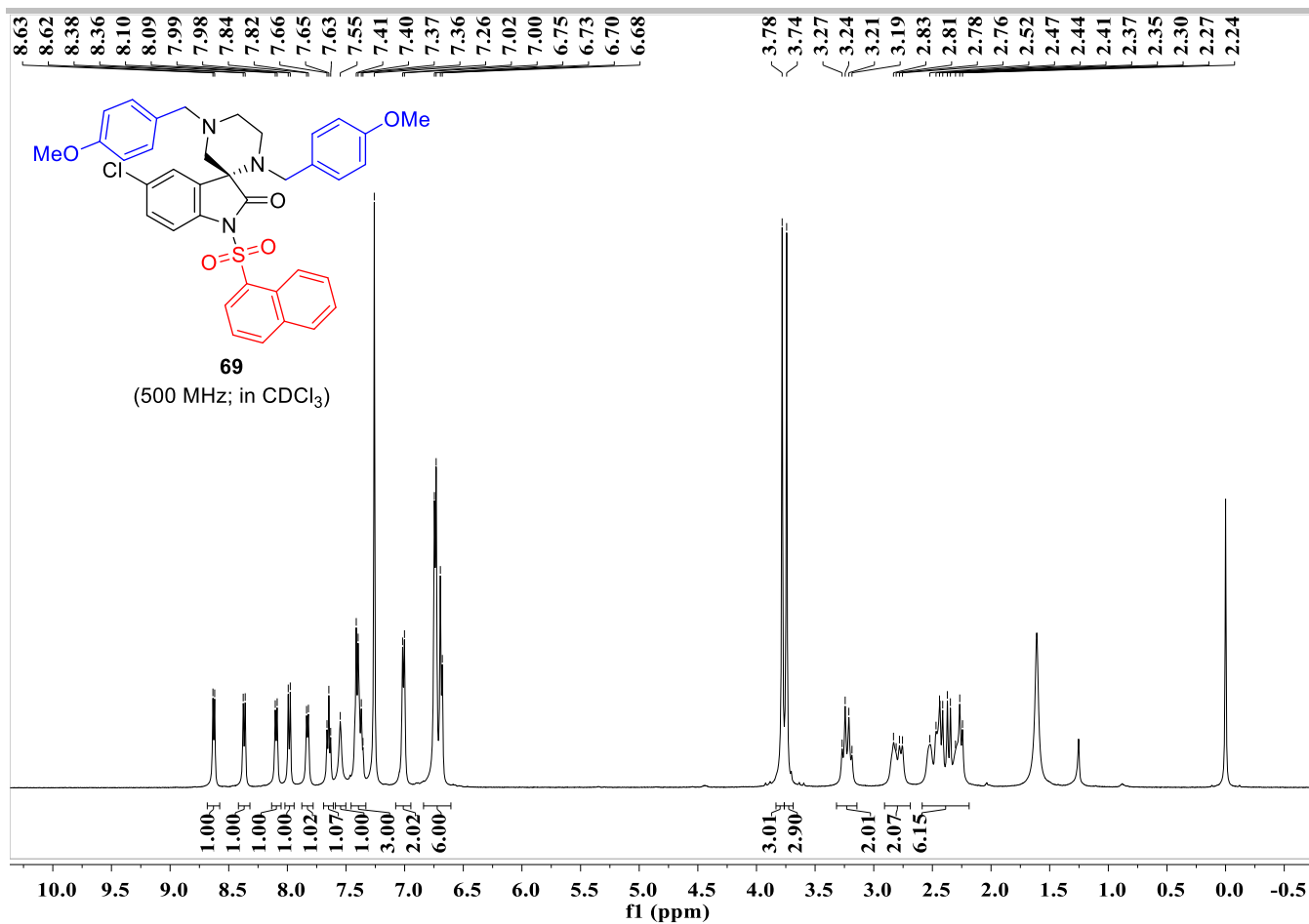


# SUPPORTING INFORMATION

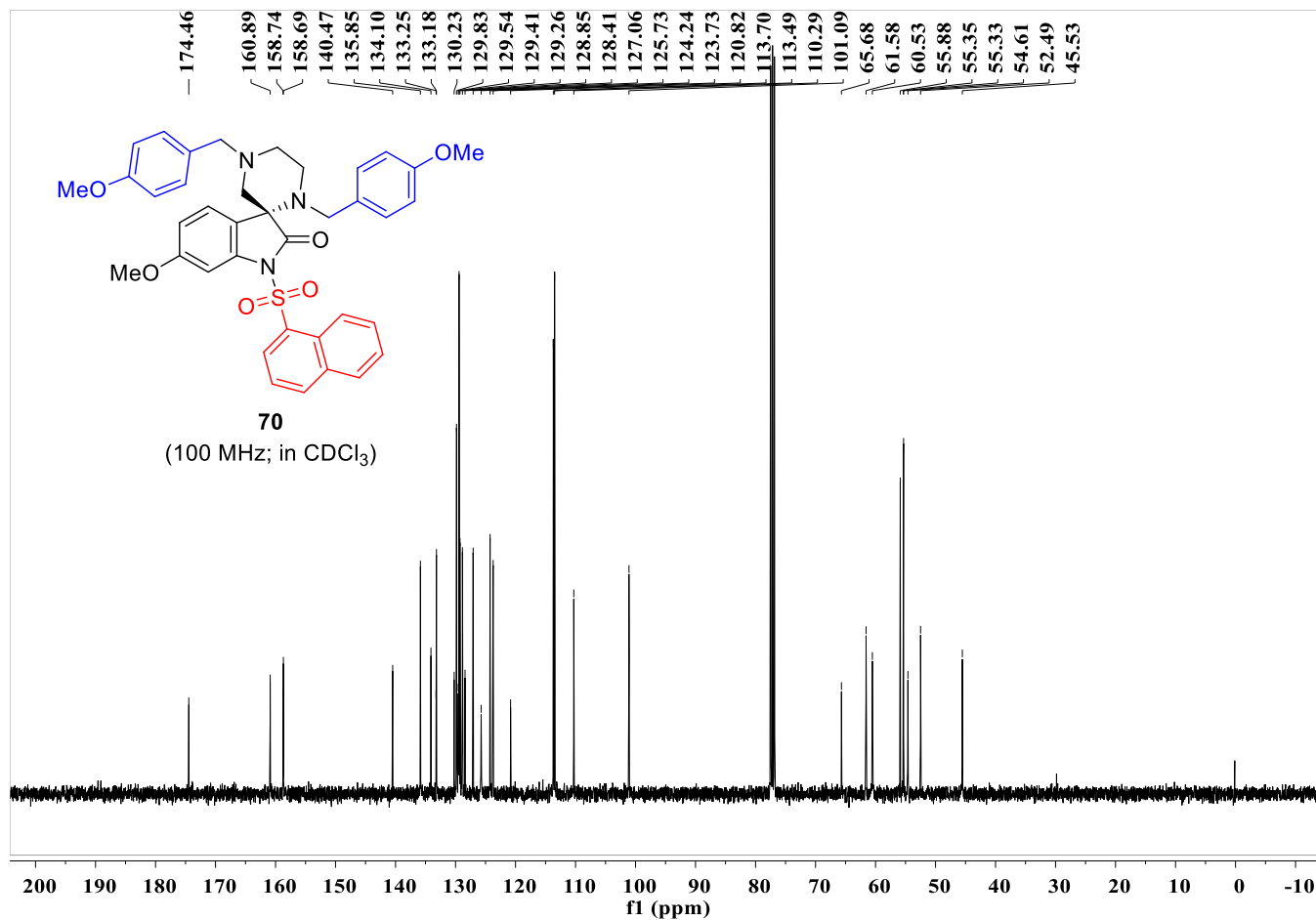
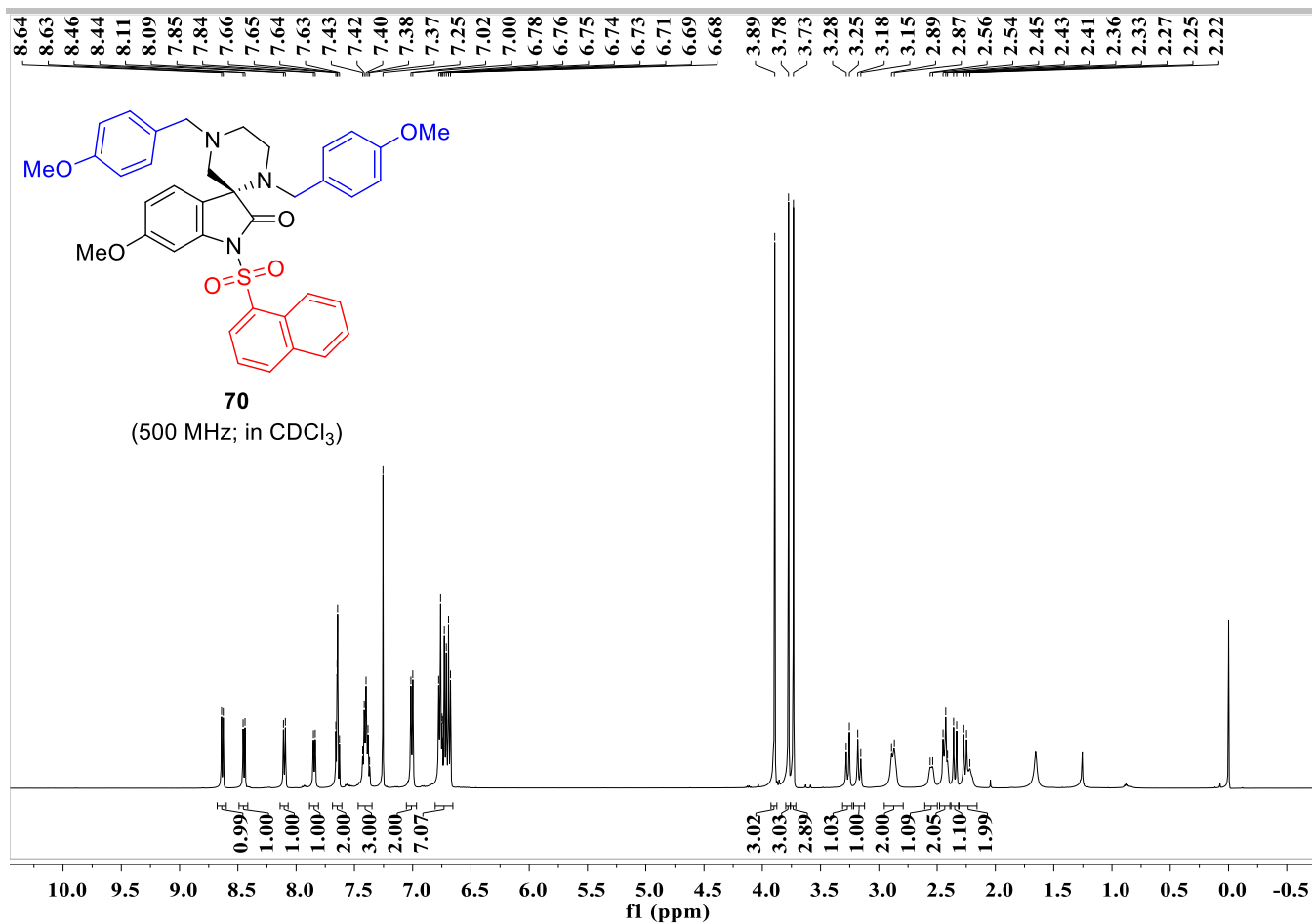




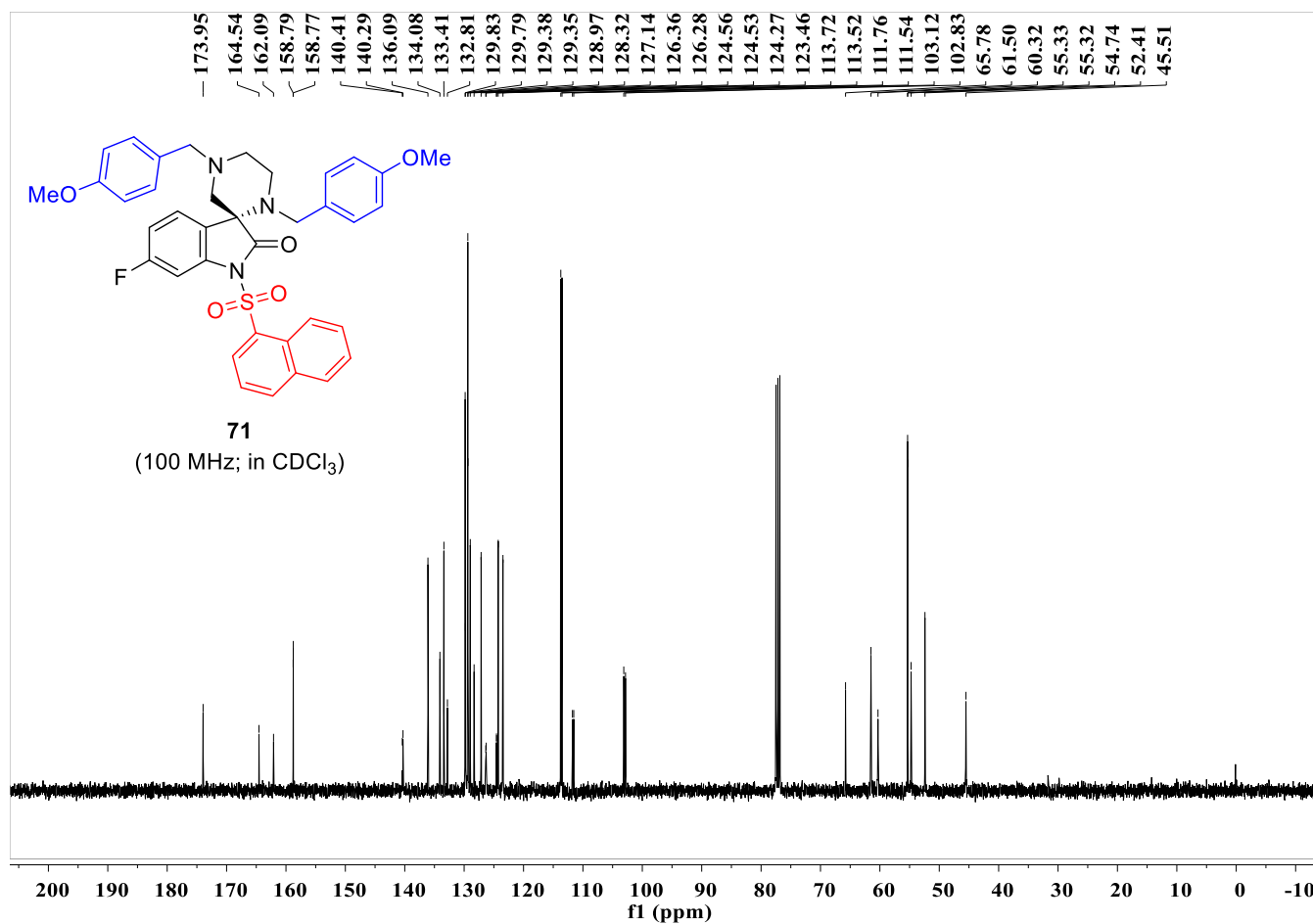
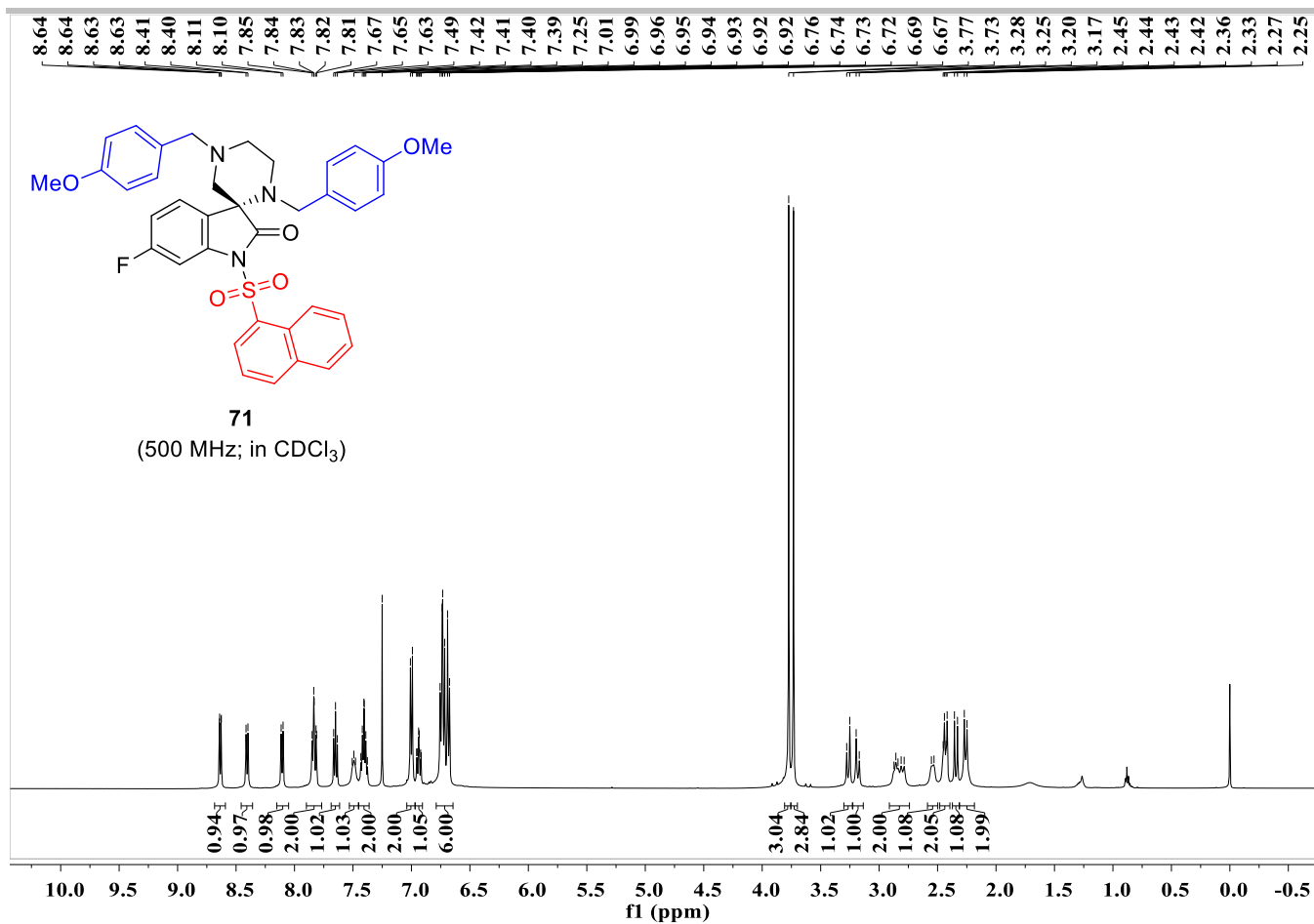
# SUPPORTING INFORMATION



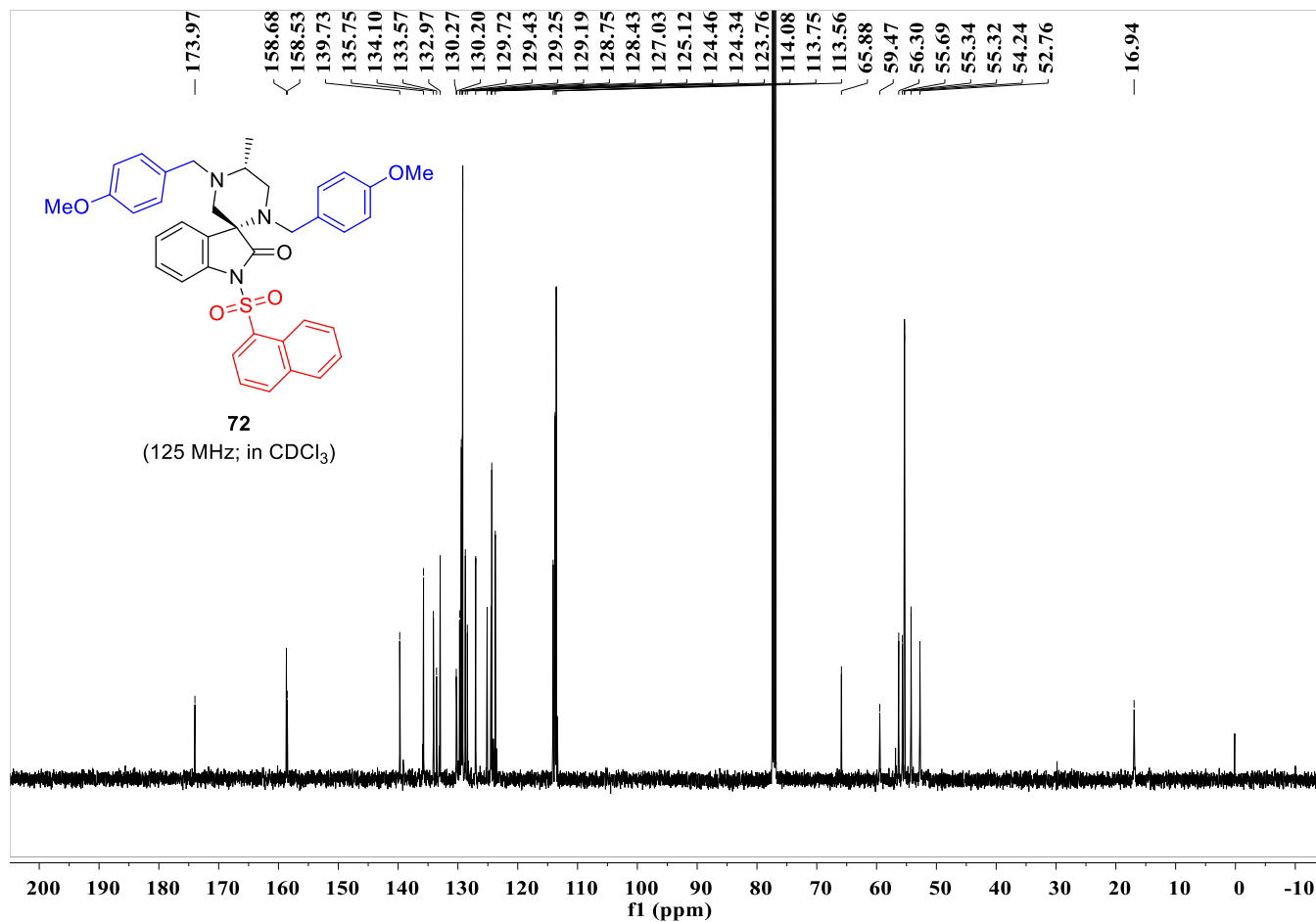
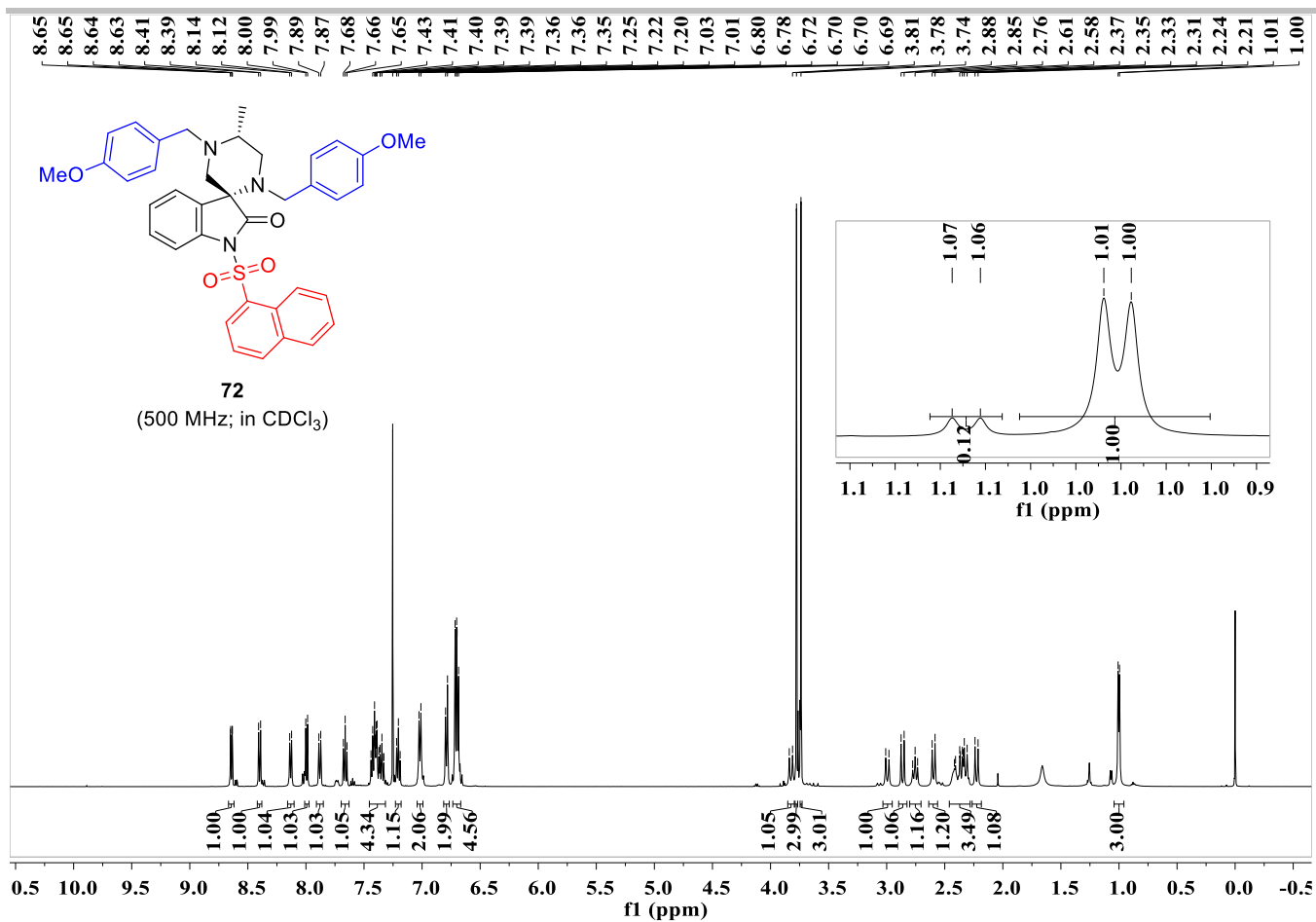
# SUPPORTING INFORMATION



# SUPPORTING INFORMATION



# SUPPORTING INFORMATION



# SUPPORTING INFORMATION

