Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Syn- versus *anti*-Carbopalladation of Alkynes with Organoborons: Access to Indoles Symmetrically and Unsymmetrically Substituted on their 2,3-Positions

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Contents

1 General remarks

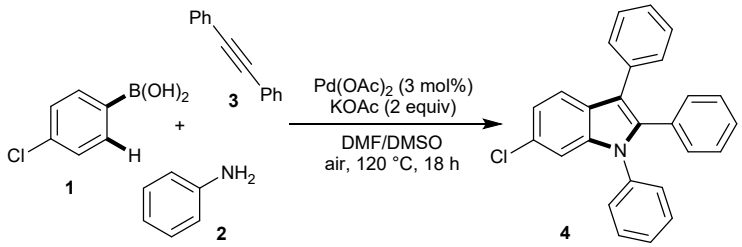
The following includes general experimental procedures, specific details for representative reactions and spectroscopic information for new compounds. Palladium catalysts and ligands were commercially available and used as received. The reactions were carried out in oil bath using microwave vials (2-5 mL). ^{1}H NMR spectra were recorded at room temperature on 500 MHz spectrometer, using $CDCl_3$ as the NMR solvent. ^{1}H NMR spectra are referenced to tetramethylsilane (0.00 ppm) and ^{13}C NMR spectra are referenced from the solvent central peak (77.23 and 39.51 ppm for $CDCl_3$ and DMSO-d_6 respectively). Chemical shifts are given in ppm. Elemental analyses (CHN) were recorded on a Thermo Finnigan Flash EA 1112 elemental analyzer.

2 General experimental procedure for synthesis of indoles

A vial equipped with a stir bar was charged with aryl boronic acid (0.2 mmol, 1 equiv), amine (0.4 mmol, 2 equiv), $Pd(OAc)_2$ (0.006 mmol, 3 mol%), alkyne (0.2 mmol, 1 equiv), KOAc (0.4 mmol, 2 equiv) and DMF/DMSO (2 ml) was added and the vial was capped. The resulting mixture was heated in a sand bath at 120°C for 18 h, cooled then filtered through a short plug of silica. Removal of the solvent gave a crude mixture which was purified by column chromatography (hexane/EtOAc gradient).

3 Optimization of reaction conditions

Table S1. Optimization of reaction conditions[a]

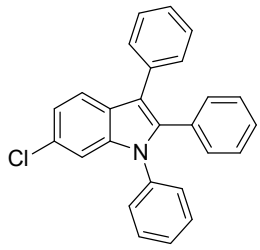


Entry	Catalyst	Base	Solvent	Ligand	Yield (%)[b]
1	$PdCl_2$	Cs_2CO_3	DMF	PPh_3	21
2	$Pd(OAc)_2$	Cs_2CO_3	DMF	PPh_3	39
3	$Pd(dba)_2$	Cs_2CO_3	DMF	PPh_3	20
4	$Pd(OAc)_2$	$NaHCO_3$	DMF	PPh_3	43
5	$Pd(OAc)_2$	K_2CO_3	DMF	PPh_3	40
6	$Pd(OAc)_2$	DMAP[c]	DMF	PPh_3	35
7	$Pd(OAc)_2$	Na_3PO_4	DMF	PPh_3	43
8	$Pd(OAc)_2$	NaOAc	DMF	PPh_3	47
9	$Pd(OAc)_2$	DABCO[d]	DMF	PPh_3	29
10	$Pd(OAc)_2$	NaOH	DMF	PPh_3	Trace
11	$Pd(OAc)_2$	K_3PO_4	DMF	PPh_3	49
12	$Pd(OAc)_2$	KOAc	DMF	PPh_3	54
13	$Pd(OAc)_2$	KOAc	ACN	PPh_3	25
14	$Pd(OAc)_2$	KOAc	THF	PPh_3	Trace
15	$Pd(OAc)_2$	KOAc	H_2O	PPh_3	0
16	$Pd(OAc)_2$	KOAc	DMSO	PPh_3	58
17	$Pd(OAc)_2$	KOAc	Chlorobenzene	PPh_3	32
18	$Pd(OAc)_2$	KOAc	Ethanol	PPh_3	0
19	$Pd(OAc)_2$	KOAc	Toluene	PPh_3	34
20	$Pd(OAc)_2$	KOAc	TFA	PPh_3	0
21	$Pd(OAc)_2$	KOAc	DMF/DMSO	PPh_3	68
22	**$Pd(OAc)_2$**	**KOAc**	**DMF/DMSO**		**68**
23	$Pd(OAc)_2$	KOAc	DMF/DMSO		48[e]
24	$Pd(OAc)_2$	KOAc	DMF/DMSO		40[f]
25	Pd(OAc)2	KOAc	DMF/DMSO		21[g]

[a]All reactions were run under the following conditions: Arylboronic acid (0.2 mmol, 1 equiv), acetylene (1 equiv), amine (2 equiv), Pd catalyst (3 mol %), Ligand (10 mol %), Solvent (2 mL), 120 °C, 18 h. [b]Isolated yields. [c]4-Dimethylaminopyridine. [d]1,4-Diazabicyclo[2.2.2]octane. [e]12h. [f]80 °C. [g]Under N_2

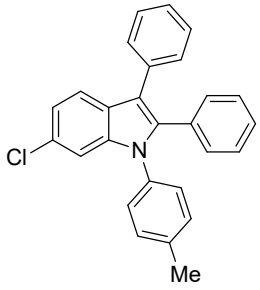
4 Experimental characterization data

6-Chloro-1, 2, 3-triphenyl-1*H*-indole (4)



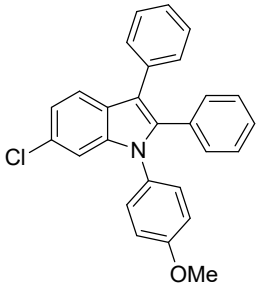
White solid; Yield: 68% (52 mg); mp: 184-186 °C; R_f = 0.5 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.09-7.11 (m, 2H), 7.14-7.24 (m, 7H), 7.27-7.29 (m, 1H), 7.33-7.36 (m, 5H), 7.40-7.43 (m, 2H), 7.72 (d, *J* = 8.4 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 110.6, 116.7, 120.6, 121.5, 126.2, 127.6, 127.6, 128.0, 128.2, 128.4, 128.6, 129.3, 130.1, 131.1, 131.2, 134.4, 137.6, 137.7, 138.3. EI-MS *m/z* (%): 379 (M•+, 100), 344 (10), 302 (48). Anal. Calcd. for $C_{26}H_{18}ClN$: C, 82.20; H, 4.78; N, 3.69; Found: C, 82.51; H, 4.89; N, 3.89.

6-Chloro-2, 3-diphenyl-1-(*p*-tolyl)-1*H*-indole (5)



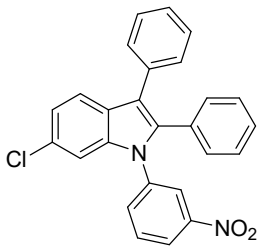
white solid; Yield: 77% (61 mg); mp:169-171 °C; R_f = 0.7, on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.40 (s, 3H), 7.10-7.12 (m, 4H), 7.16-7.21 (m, 6H), 7.28-7.30 (m, 2H), 7.34-7.36 (m, 4H), 7.70-7.72 (d, *J* = 8.52 Hz ,1H) .^{13}C NMR (125 MHz, $CDCl_3$) δ 21.1, 110.6, 116.4, 120.5, 121.3, 126.0, 126.1, 127.5, 127.9, 127.9, 128.3, 128.4, 129.9, 130.1, 131.1, 131.2, 134.5, 134.9, 137.4, 137.7, 138.4. EI-MS m/z (%): 393 (M•+,100), 316 (33), 239 (47), 148 (56). Anal. Calcd for $C_{27}H_{20}ClN$: C, 82.33; H, 5.12; N, 3.56; Found: C, 82.03; H, 5.02; N, 3.32.

6-Chloro-1-(4-methoxyphenyl)-2, 3-diphenyl-1*H*-indole (6)



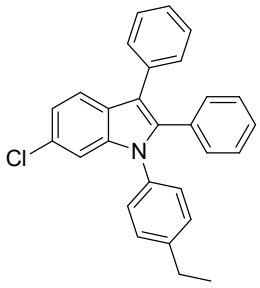
White solid; Yield: 79% (65 mg); mp: 153-155 °C; R_f = 0.40 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.85 (s, 3H), 6.92-6.93 (m, 2H), 7.11-7.13 (m, 2H), 7.15-7.21 (m, 6H), 7.27-7.28 (m, 2H), 7.33-7.38 (m, 4H), 7.72 (d, *J* = 8.5 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.5, 110.6, 114.5, 116.3, 120.5, 121.3, 126.0, 126.1, 127.5, 128.0, 128.4, 128.4, 129.3, 130.1, 130.3, 131.1, 131.3, 134.6, 137.9, 138.7, 158.8. EI-MS *m/z* (%): 409 (M•+, 100), 378 (12), 374 (20), 332 (48). Anal. Calcd for $C_{27}H_{20}ClNO$: C, 79.11; H, 4.92; N, 3.42; Found: C, 78.79; H, 4.80; N, 3.21.

6-Chloro-1-(3-nitrophenyl)-2, 3-diphenyl-1*H*-indole (7)



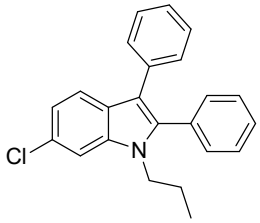
Yellow solid; Yield= 71% (59 mg); mp: 194-196 °C; R_f = 0.35 on silicagel (Hexane/EtOAc 95:5). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.10 (d, (*J* = 7.6 Hz, 2H), 7.17-7.25 (m, 4H), 7.27-7.31 (m, 2H), 7.35-7.37 (m, 4H), 7.53-7.60 (m, 2H), 7.72 (d, *J* = 8.4 Hz, 1H), 8.13 (s, 1H), 8.21 (d, *J* = 7.6 Hz). ^{13}C NMR (125 MHz, $CDCl_3$) δ 110.0, 118.0, 121.0, 122.2, 123.0, 126.5, 126.6, 128.1, 128.4, 128.6, 129.3, 130.0, 130.1, 130.4, 131.1, 131.4, 133.7, 134.0, 137.2, 138.0, 139.0, 147.8. EI-MS *m/z* (%):424 (M•+,100), 389 (53), 302 (62), 347 (73), 270 (13). Anal. Calcd for $C_{26}H_{17}ClN_2O_2$: C, 73.50; H, 4.03; N, 6.59; Found: C, 73.22; H, 3.90; N, 6.38.

6-Chloro-1-(4-ethylphenyl)-2, 3-diphenyl-1*H*-indole (8)



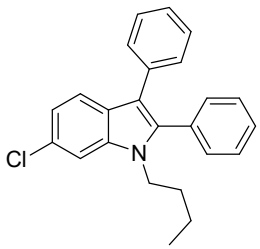
White solid; Yield: 73% (59 mg); mp: 176-178 °C; R_f = 0.75 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.30 (t, *J* = 7.5 Hz, 3H), 2.71 (q, *J* = 7.5 Hz, 2H), 7.11-7.24 (m, 10H), 7.26-7.29 (m, 1H), 7.32-7.38 (m, 5H), 7.72 (d, *J* = 8.4 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 15.3, 28.5, 110.7, 116.5, 120.5, 121.4, 126.1, 126.2, 127.5, 127.9, 128.0, 128.4, 128.5, 128.7, 130.1, 131.1, 131.3, 134.5, 135.1, 137.8, 138.5, 143.7. EI-MS *m/z* (%): 407 (M•+,100), 372 (32), 330 (27), 302 (53). Anal. Calcd for $C_{28}H_{22}ClN$: C, 82.44; H, 5.44; N, 3.43; Found: C, 82.14; H, 5.30; N, 3.21.

6-Chloro-2, 3-diphenyl-1-propyl-1*H*-indole (9)



White solid; Yield: 59% (41 mg); mp: 130-132 °C; R_f = 0.65 on silica gel (Hexane/EtOAc 99:1); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.80 (t, *J* = 7.3 Hz, 3H), 1.71 (sex, *J* = 7.5 Hz, 2H), 4.01 (t, *J* = 7.5 Hz, 2H), 7.13-7.22 (m, 3H), 7.27 (s, 3H), 7.31-7.33 (m, 2H), 7.39-7.42 (m, 4H), 7.69 (d, *J* = 8.4 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 11.3, 23.2, 45.6, 109.9, 115.4, 120.6, 125.7, 125.8, 127.8, 128.2, 128.3, 128.5, 129.7, 131.1, 131.8, 134.7, 136.9, 138.2. EI-MS *m/z* (%): 345 (M•+,100), 310 (12), 268 (55), 191 (31). Anal. Calcd for $C_{23}H_{20}ClN$: C, 79.87; H, 5.83; N, 4.05; Found: C, 80.17; H, 5.95; N, 4.26.

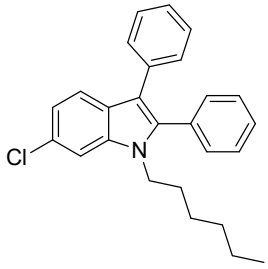
1-Butyl-6-chloro-2, 3-diphenyl-1*H*-indole (10)



White solid; Yield: 62% (45 mg); mp: 76-78 °C; R_f = 0.55 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.80 (t, *J* = 7.4 Hz, 3H), 1.17-1.22 (m, 2H), 1.62-1.68 (m, 2H), 4.02-4.10 (m, 2H), 7.13 (d, *J* = 8.5 Hz, 1H), 7.17-7.19 (m, 1H), 7.21 (s, 1H), 7.25 (s, 2H), 7.30-7.33 (m, 3H), 7.38-7.41 (m, 4H), 7.68 (d, *J* = 8.4 Hz, 1H). ^{13}C NMR (125 MHz,

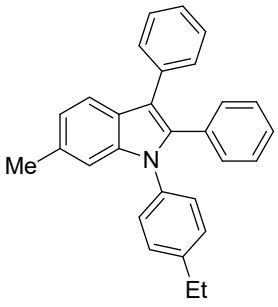
$CDCl_3$) δ 13.6, 20.0, 32.0, 43.8, 109.9, 119.4, 120.2, 120.6, 122.1, 125.7, 127.8, 128.2, 128.5, 129.7, 131.0, 131.1, 131.8, 134.7, 136.8, 138.1. EI-MS *m/z* (%): 359 (M•+,100), 324 (15), 282 (42), 205 (50). Anal. Calcd for $C_{24}H_{22}ClN$: C, 80.10; H, 6.16; N, 3.89; Found: C, 79.79; H, 6.03; N, 3.69.

6-Chloro-1-hexyl-2, 3-diphenyl-1*H*-indole (11)



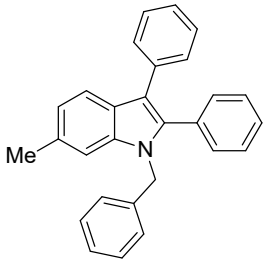
White solid; Yield: 71% (55 mg); mp: 105-107 °C; R_f = 0.55 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.84 (t, *J* = 7.2 Hz, 3H), 1.16-1.23 (m, 6H), 1.65-171 (m, 2H), 4.01 (t, *J* = 7.7 2H), 7.15-7.20 (m, 2H), 7.23 (s, 1H), 7.27 (d, *J* = 4.7 Hz, 3H), 7.32-7.35 (m, 2H), 7.40-7.43 (m, 4H), 7.71 (d, *J* = 8.5 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 13.9, 22.4, 26.4, 29.8, 31.2, 44.0, 109.9, 115.3, 120.6, 122.1, 125.6, 125.7, 128.2, 128.3, 128.5, 127.7, 129.7, 131.1, 131.8, 134.7, 136.8, 138.1. EI-MS *m/z* (%): 325 (M•+,100), 282 (80), 249 (10). Anal. Calcd for $C_{26}H_{26}ClN$: C, 88.50; H, 6.76; N, 3.61; Found: C, 88.82; H, 6.89; N, 3.88.

1-(4-Ethylphenyl)-6-methyl-2, 3-diphenyl-1*H*-indole (12)



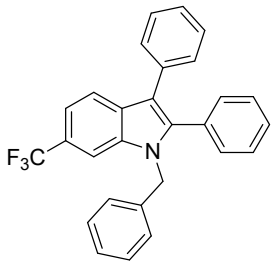
White solid; Yield: 80% (62 mg); mp: 126-128 °C; R_f = 0.8, on silica gel (Hexane/EtOAc 98;2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.30-1.33 (t, *J* = 7.62 Hz, 3H), 2.49 (s, 3H), 2.71-2.75 (m, 2H), 7.08-7.10 (m, 1H), 7.12-7.14 (m, 2H), 7.16-7.18 (m, 7H), 7.22-7.24 (m, 2H), 7.26-7.28 (m, 1H), 7.31-7.35 (m, 2H), 7.41-7.43 (m, 1H) 7.72-7.74 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 15.3, 21.8, 28.4, 110.6, 116.3, 119.2, 122.5, 125.4, 125.8, 127.1, 127.8, 128.2, 128.4, 129, 130.2, 131.2, 131.9, 132.6, 135.2, 135.8, 136.5, 138.4, 143.1. EI-MS *m/z* (%): 387 (M•+,100), 311 (44), 235 (51), 131 (68). Anal. Calcd for $C_{29}H_{25}N$: C, 89.88; H, 6.50; N, 3.61; Found: C, 90.18; H, 6.62; N, 3.84.

1-Benzyl-6-methyl-2, 3-diphenyl-1*H*-indole (13)



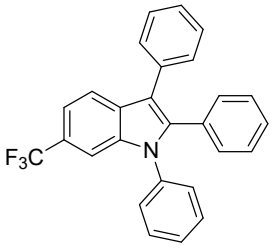
White solid; Yield: 80% (75 mg); mp: 135-137 °C; R_f = 0.75 on silica gel (Hexane/EtOAc 99:1); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.45 (s, 3H), 5.27 (s, 2H), 7.02-7.06 (m, 4H), 7.16-7.21 (m, 2H), 7.23-7.25 (m, 3H), 7.27-7.35 (m, 8H), 7.71(d, *J* = 8.0 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 21.9, 47.5, 110.3, 119.4, 122.2, 125.3, 125.5, 126.1, 127.1, 128.0, 128.1, 128.3, 128.6, 128.9, 129.8, 131.1, 131.9, 132.3, 135.3, 137.3, 137.4, 138.3. EI-MS *m/z* (%): 373 (M•+,100), 358 (21), 282 (46), 219 (58). Anal. Calcd for $C_{28}H_{23}N$: C, 90.04; H, 6.21; N, 3.75; Found: C, 89.74; H, 6.10; N, 3.55.

1-Benzyl-2, 3-diphenyl-6-(trifluoromethyl)-1*H*-indole (14)



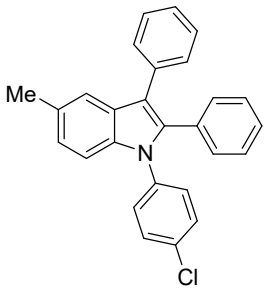
White solid; Yield: 82% (70 mg); mp: 132-134 °C; R_f = 0.45 on silica gel (Hexane/EtOAc 90:10); ^{1}H NMR (500 MHz, $CDCl_3$) δ 5.38 (s, 2H), 7.01-7.04 (m, 2H), 7.25-7.30 (m, 3H), 7.31-7.38 (m, 10H), 7.45 (d, *J* = 8.5 Hz, 1H), 7.58 (s, 1H), 7.92 (d, *J* = 8.3 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 47.7, 107.9 (q, *J* = 3.8 Hz), 116.1, 117.1 (q, *J* = 3.8 Hz), 120.1, 124.2, 124.5, 126.0, 126.1, 127.5, 128.4, 128.5, 128.6, 128.8, 129.6, 129.9, 130.9, 131.1, 134.3, 135.9, 137.3, 140.5. EI-MS *m/z* (%): 426 (M•+,100), 329 (52), 357 (43), 335 (48). Anal. Calcd for $C_{28}H_{20}F_3N$: C, 78.67; H, 4.72; N, 3.28; Found: C, 78.33; H, 4.60; N, 3.06.

1,2,3-Triphenyl-6-(trifluoromethyl)-1*H*-indole (15)



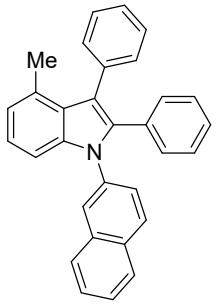
White solid; Yield: 77% (64 mg); mp: 168-170 °C; R_f = 0.45 on silica gel (Hexane/EtOAc 90:10); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.09-7.12 (m, 2H), 7.13-7.22 (m, 3H), 7.24-7.31 (m, 4H), 7.34-7.52 (m, 7H), 7.58 (s, 1H), 7.88 (d, *J* = 8.4 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 108.2, 110.9, 116.8, 117.4, 119.1, 120.0, 121.2, 123.0, 125.2, 126.3, 127.8 (q, *J* = 3.8 Hz), 128.0, 128.2 (q, *J* = 3.7 Hz), 128.4, 129.3, 130.1 (q, *J* = 3.8 Hz), 131.1, 134.1, 136.9, 137.3, 139.6. EI-MS *m/z* (%): 413 (M•+,100), 344 (50), 267 (28), 336 (42). Anal. Calcd for $C_{27}H_{18}F_3N$: C, 78.44; H, 4.39; N, 3.39; Found: C, 78.16; H, 4.28; N, 3.17.

1-(4-Chlorophenyl)-5-methyl-2, 3-diphenyl-1*H*-indole (16)



White solid; Yield: 63% (50 mg); mp: 157-159 °C; R_f = 0.4 on silica gel (Hexane/EtOAc 97:3); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.32 (s, 3H), 7.05-7.11 (m, 4H), 7.15-7.25 (m, 9H), 7.30 (d, *J* = 8.3 Hz, 1H), 7.33-7.35 (m, 2H), 7.80 (d, *J* = 7 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 21.5, 110.4, 117.2, 119.8, 121.0, 122.9, 126.8, 127.3, 127.5, 127.7, 128.0, 128.2, 129.3, 129.4, 130.8, 131.1, 131.4, 132.8, 136.8, 137.7, 137.8. EI-MS *m/z* (%): 393 (M•+,100), 316 (47), 282 (30), 239 (20). Anal. Calcd for $C_{27}H_{20}ClN$: C, 82.33; H, 5.12; N, 3.56; Found: C, 82.03; H, 5.03; N, 3.36.

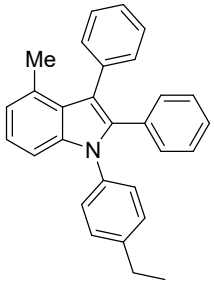
4-Methyl-1-(naphthalen-2-yl)-2, 3-diphenyl-1*H*-indole (17)



White solid; Yield: 48% (39 mg); mp: 198-200 °C; R_f = 0.65 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.96 (s, 3H), 6.76-6.82 (m, 6H), 7.02-7.26 (m, 11H), 7.43 (t, *J* = 8.3 Hz, 1H), 7.51-7.53 (m,

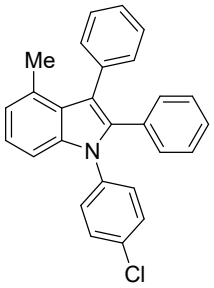
1H), 7.80-7.87 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 25.3, 110.2, 120.0, 122.6, 124.9, 125.1, 125.3, 125.3, 126.1, 126.2, 126.3, 126.4, 126.5, 126.7, 127.4, 127.8, 127.9, 128.9, 130.2, 130.3, 131.1, 131.2, 131.2, 131.3, 131.4, 131.9, 142.9. EI-MS *m/z* (%): 409 (M•+,100), 282 (52), 267 (40), 332 (25). Anal. Calcd for $C_{31}H_{23}N$: C, 90.92; H, 5.66; N, 3.42; Found: C, 91.22; H, 5.78; N, 3.64.

1-(4-Ethylphenyl)-4-methyl-2, 3-diphenyl-1*H*-indole (18)



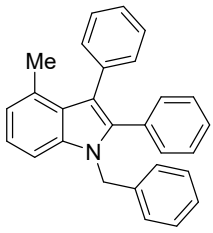
Yellow oil; Yield: 77% (60 mg); mp: 136-138 °C; R_f = 0.7 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.32 (t, *J* = 7.5 Hz, 3H), 2.06 (s, 3H), 2.74 (q, *J* = 7.6 Hz, 2H), 7.05-7.06 (m, 2H), 7.10-7.14 (m, 3H), 7.19-7.29 (m, 9H), 7.40 (dd, *J* = 8.7, 7.2 Hz, 2H), 7.47 (d, *J* = 7.8 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 15.4, 20.3, 28.5, 110.7, 116.7, 119.9, 120.5, 122.5, 125.5, 126.9, 127.8, 128.0, 128.5, 130.1, 130.3, 132.0, 132.1, 134.4, 136.1, 137.2, 137.8, 138.0, 143.0. EI-MS *m/z* (%): 387 (M•+,100), 372 (27), 358 (22), 310 (52). Anal. Calcd for $C_{29}H_{25}N$: C, 89.88; H, 6.50; N, 3.61; Found: C, 90.18; H, 6.63; N, 3.81.

1-(4-Chlorophenyl)-4-methyl-2, 3-diphenyl-1*H*-indole (19)



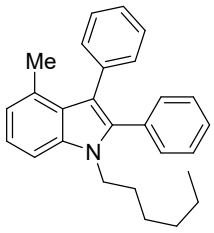
Yellow solid; Yield: 89% (70 mg); mp: 120-122 °C; R_f = 0.45 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.05 (s, 3H), 7.03-7.05 (m, 2H), 7.13-7.17 (m, 3H), 7.20-7.24 (m, 3H), 7.27-7.30 (m, 3H), 7.35-7.41 (m, 5H), 7.47 (d, *J* = 7.8 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 20.3, 110.3, 117.4, 120.2, 120.9, 122.9, 125.6, 127.1, 127.3, 128.0, 128.7, 129.3, 129.4, 130.2, 130.3, 131.7, 131.9, 132.7, 134.0, 137.0, 137.2, 137.7, 137.8. EI-MS *m/z* (%): 393 (M•+,100), 378 (15), 316 (12), 282 (20). Anal. Calcd for $C_{27}H_{20}ClN$: C, 82.33; H, 5.12; N, 3.56; Found: C, 82.03; H, 5.03; N, 3.36.

1-Benzyl-4-methyl-2, 3-diphenyl-1*H*-indole (20)



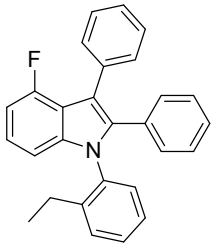
White solid; Yield: 69% (51 mg); mp: 123-125 °C; R_f = 0.65 on silica gel (Hexane/EtOAc 99:1); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.05 (s, 3H), 5.41 (s, 2H), 7.09 (d, *J* = 7.5 Hz, 1H), 7.15-7.26 (m, 9H), 7.28-7.34 (m, 6H), 7.45 (d, *J* = 7.8 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 20.3, 47.9, 110.5, 115.7, 120.1, 122.2, 125.4, 126.0, 126.8, 127.2, 127.8, 128.3, 128.4, 128.8, 129.9, 130.3, 132.0, 134.4, 137.0, 137.7, 138.2, 138,4. EI-MS *m/z* (%): 373 (M•+,100), 296 (47), 219 (40), 128 (20). Anal. Calcd for $C_{28}H_{23}N$: C, 90.04; H, 6.21; N, 3.75; Found: C, 89.74; H, 6.12; N, 3.55.

1-Hexyl-4-methyl-2, 3-diphenyl-1*H*-indole (21)



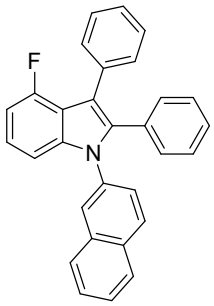
Orange oil; Yield: 91% (67 mg); mp: 107-109 °C; R_f = 0.75 on silica gel (Hexane/EtOAc 100:0); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.83 (t, *J* = 7.1 Hz, 3H), 1.17-1.23 (m, 6H), 1.74 (t, *J* = 7.2 Hz, 2H), 2.02 (s, 3H), 4.18 (t, *J* = 7.8 Hz, 2H), 7.12-7.16 (m, 2H), 7.18-7.23 (m, 3H), 7.26-7.27 (m, 2H), 7.30-7.33 (m, 4H), 7.39 (d, *J* = 8.0 Hz, 1H), 7.46 (d, *J* = 8.2 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 13.9, 20.3, 22.5, 26.5, 29.9, 31.2, 44.1, 107.7, 110.0, 115.3, 119.6, 120.1, 121.7, 125.2, 126.6, 127.6, 128.2, 129.8, 130.4, 131.1, 132.1, 132.5, 134.5, 136.4, 137.8. EI-MS *m/z* (%): 367 (M•+, 100), 352 (16), 290 (49), 282 (46). Anal. Calcd for $C_{27}H_{29}N$: C, 88.24; H, 7.95; N, 3.81; Found: C, 87.94; H, 7.86; N, 3.61.

1-(2-Ethylphenyl)-4-fluoro-2, 3-diphenyl-1*H*-indole (22)



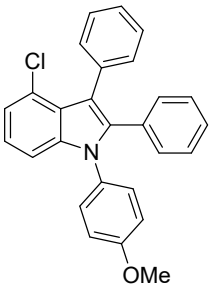
white solid; Yield: 61% (48 mg); mp 153-154 °C; R_f = 0.50 on silica gel (Hexane/EtOAc 100:0); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.95 (t, *J*= 7.6 Hz, 3H), 2.17-2.34 (m, 2H), 7.02-7.06 (m, 1H), 7.07-7.17 (m, 7H), 7.21-7.31 (m, 4H), 7.32-7.42 (m, 4H), 7.62-7.69 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 13.8, 23.4, 109.9, 110.9, 115.8 (d, *J*= 22.35 Hz), 119.7 (d, *J*= 2.34 Hz), 120.6, 122.5, 122.8 (d, *J*= 15.83 Hz), 123.9 (d, *J*= 3.40 Hz), 126.4, 127.4, 127.5, 127.7, 127.7, 128.2 (d, *J*= 8.04 Hz), 128.7, 129.0, 130.0, 130.3, 131.7, 133.0 (d, *J*= 3.8 Hz), 136.4, 138.3, 138.7, 142.6, 144.2, 160.5 (d, *J*= 245.01 Hz); EI-MS *m/z* (%): 391(M•+, 100), 314 (51), 286 (50), 297 (33), 362 (15). Anal. Calcd for $C_{28}H_{22}FN$: C, 85.90; H, 5.66; N, 3.58; Found: C, 86.22; H, 5.80; N, 3.80.

4-Fluoro-1-(naphthalen-2-yl)-2, 3-diphenyl-1*H*-indole (23)



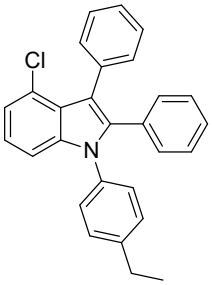
White solid; Yield: 55% (45 mg); mp 168-169 °C; R_f = 0.50 on silica gel (Hexane/EtOAc 100:0); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.08-7.16 (m, 7H), 7.24-7.35 (m, 5H), 7.37-7.43 (m, 1H), 7.50-7.55 (m, 2H), 7.61-7.66 (m, 1H), 7.79-7.88 (m, 4H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 110.7, 110.9, 115.8 (d, *J*= 22.30 Hz), 119.8 (d, *J*= 2.31 Hz), 121.0, 122.5 (d, *J*= 15.63 Hz), 122.8, 123.9 (d, *J*= 3.52 Hz), 126.4 (d, *J*= 3.82 Hz), 126.4, 126.6, 127.4, 127.8, 127.9, 127.9, 128.3 (d, *J*= 7.9 Hz), 128.9, 130.5, 131.5, 132.1, 133.0 (d, *J*= 3.82 Hz), 133.4, 135.7, 138.0, 138.3, 160.6 (d, *J*= 245.58 Hz); EI-MS *m/z* (%): 413 (M•+, 100), 336 (48), 286 (51), 319 (19). Anal. Calcd for $C_{30}H_{20}FN$: C, 87.14; H, 4.88; N, 3.39; Found: C, 87.44; H, 5.03; N, 3.59.

4-Chloro-1-(4-methoxyphenyl)-2, 3-diphenyl-1*H*-indole (24)



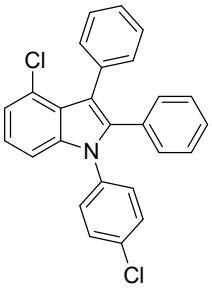
White solid; Yield: 61% (50 mg); mp: 104-106 °C; R_f = 0.5, on silica gel (Hexane/EtOAc 98;2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.88 (s, 3H), 6.97-6.98 (m, 2H), 7.23-7.26 (m, 7H), 7.32-7.34 (m, 2H), 7.39-7.44 (m, 3H), 7.50-7.52 (m, 2H), 7.93-7.95 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.4, 110.8, 114.3, 116.4, 119.6, 120.8, 122.7, 125.9, 127.4, 127.4, 128, 128.3, 129.5, 130.3, 131, 131.3, 131.8, 135.1, 137.4, 138.4, 158.5. EI-MS *m/z* (%): 409 (M•+,100), 333 (40), 257(53), 151 (65). Anal. Calcd for $C_{27}H_{20}ClNO$: C, 79.11; H, 4.92; N, 3.42; Found: C, 78.80; H, 4.80; N, 3.21.

4-Chloro-1-(4-ethylphenyl)-2, 3-diphenyl-1*H*-indole (25)



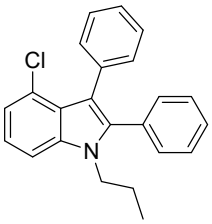
White solid; Yield: 70% (57 mg); mp:128-130 °C; R_f = 0.8, on silica gel (Hexane/EtOAc 98;2); 1H NMR (500 MHz, $CDCl_3$) δ 1.27-1.30 (t, *J* = 7.65 Hz, 3H), 2.68-2.72 (q, *J* = 7.65 Hz, 2H), 7.11-7.19 (m, 6H), 7.22-7.27 (m, 5H), 7.33-7.36 (m, 3H), 7.39-7.41 (m, 2H), 7.82-7.83 (d, *J* = 7.00 Hz ,1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 15.3, 28.4, 110.7, 116.4, 119.5, 120.7, 122.6, 125.8, 127.2, 127.5, 127.8, 128.0, 128.2, 128.4, 130.2, 131.2, 131.7, 135.0, 135.6, 137.1, 138.0, 143.2. EI-MS m/z (%): 408 (M•+,100), 332 (45), 256 (58), 153 (74). Anal. Calcd for $C_{28}H_{22}ClN$: C, 82.44; H, 5.44; N, 3.43; Found: C, 82.13; H, 5.30; N, 3.20.

4-Chloro-1-(4-chlorophenyl)-2, 3-diphenyl-1*H*-indole (26)



White solid; Yield: 72% (59 mg); mp:110-112 °C; R_f = 0.7, on silica gel (Hexane/EtOAc 98;2); 1H NMR (500 MHz, $CDCl_3$) δ 7.10-7.12 (m, 2H), 7.16-7.21 (m, 4H), 7.30-7.34 (m, 3H), 7.36-7.41 (m, 7H),7.83 (d, *J* = 6.25 Hz ,1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 110.4, 117.2, 119.7, 121.1, 123.0, 126.1, 127.5, 127.7, 128.1, 128.3, 129.3, 129.4, 130.2, 131.1, 131.3, 132.8, 134.6, 136.7, 136.8, 137.8. EI-MS m/z (%): 414 (M•+, 100), 338 (42), 262 (53), 152 (70). Anal. Calcd for $C_{26}H_{17}Cl_2N$: C, 75.37; H, 4.14; N, 3.38; Found: C, 75.68; H, 4.23; N, 3.60.

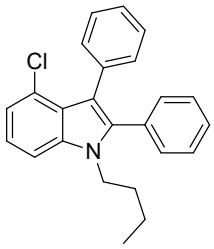
4-Chloro-2, 3-diphenyl-1-propyl-1*H*-indole (27)



White solid; Yield: 65% (45 mg); mp: 117-119 °C; R_f = 0.65 on silica gel (Hexane/EtOAc 97:3); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.82 (t, *J* = 7.3 Hz, 3H), 1.76 (sex, *J* = 7.4 Hz, 2H), 4.09 (t, *J* = 7.5 Hz, 2H), 7.18-7.24 (m, 2H), 7.28-7.31 (m, 2H), 7.33-7.35 (m, 3H), 7.37-7.38 (m, 2H), 7.41-7.42 (m, 2H), 7.47 (d, *J* = 8.2 Hz, 1H), 7.85 (d, *J* = 7.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 11.4, 23.4, 45.5, 110.0, 115.3, 119.7, 120.1, 122.0, 125.4, 127.2, 128.0, 128.1,

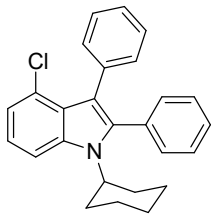
128.4, 129.9, 131.2, 132.4, 135.3, 136.5, 137.6. EI-MS *m/z* (%): 345 (M•+, 100), 310 (15), 268 (49), 191 (32). Anal. Calcd for $C_{23}H_{20}ClN$: C, 79.87; H, 5.83; N, 4.05; Found: C, 80.17; H, 5.92; N, 4.25.

1-Butyl-4-chloro-2, 3-diphenyl-1*H*-indole (28)



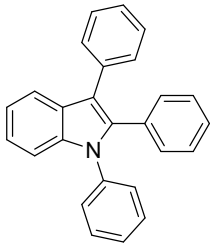
White solid; Yield: 70% (50 mg); mp: 88-90 °C; R_f = 0.50 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.83 (t, *J* = 7.2 Hz, 3H), 1.24 (sex, *J* = 7.4 Hz, 2H), 1.71 (quin, *J* = 7.4 Hz, 2H), 4.13 (t, *J* = 7.6 Hz, 2H), 7.18-7.24 (m, 2H), 7.28-7.31 (m, 2H), 7.33-7.35 (m, 3H), 7.37-7.38 (m, 2H), 7.41-7.42 (m, 2H), 7.48 (d, *J* = 8.2 Hz, 1H), 7.86 (d, *J* = 7.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 13.7, 20.1, 32.1, 43.7, 110.0, 115.3, 119.8, 120.1, 122.0, 125.4, 127.2, 128.1, 128.1, 128.4, 129.9, 131.2, 132.3, 135.3, 136.4, 137.6. EI-MS *m/z* (%): 359 (M•+, 100), 310 (15), 268 (53), 191 (29). Anal. Calcd for $C_{24}H_{22}ClN$: C, 80.10; H, 6.16; N, 3.89; Found: C, 79.80; H, 6.03; N, 3.69.

4-Chloro-1-cyclohexyl-2, 3-diphenyl-1*H*-indole (29)



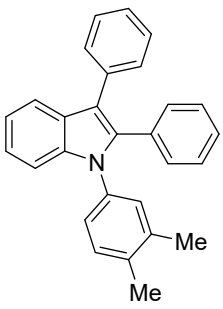
White solid; Yield: 55% (42 mg); mp: 186-188 °C; R_f = 0.65 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.23-1.33 (m, 3H), 1.71-1.73 (m, 1H), 1.88-1.97 (m, 4H), 2.37-2.42 (m, 1H), 4.09-4.14 (m, 1H), 6.88 (s, 1H), 7.12 (s, 1H), 7.15-7.18 (m, 2H), 7.24-7.26 (m, 2H), 7.31-7.33 (m, 2H), 7.39-7.41 (m, 3H), 7.72 (d, *J* = 8.4 Hz, 1H), 7.81 (d, *J* = 7.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 25.5, 26.2, 31.5, 56.4, 113.5, 115.1, 119.6, 119.8, 121.3, 125.3, 128.0, 128.1, 128.3, 129.9, 131.1, 131.3, 132.8, 135.0, 135.3, 137.7. EI-MS *m/z* (%): 385 (M•+, 100), 304 (63), 350 (42), 226 (15). Anal. Calcd for $C_{26}H_{24}ClN$: C, 80.92 H, 6.27; N, 3.67; Found: C, 81.26; H, 6.38; N, 3.90.

1,2,3-Triphenyl-1*H*-indole (30)



White solid; Yield: 79% (55 mg); mp 183-184 °C; R_f = 0.6, silica gel (Hexane /EtOAc 99:1); ^{1}H NMR (500 MHz $CDCl_3$) δ 7.08-7.17 (m, 5H), 7.20-7.25 (m, 5H), 7.31-7.40 (m, 8H), 7.80-7.83 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 110.6, 116.7, 119.5, 120.8, 122.7, 125.9, 127.1, 127.3, 127.5, 127.8, 128.2, 128.2, 129.0, 130.2, 131.1, 131.6, 134.9, 137.0, 137.9, 138.1; EI-MS *m/z* (%) 345 (M•+, 100), 269 (22), 268 (55). Anal. Calcd for $C_{26}H_{19}N$: C, 90.40; H, 5.54; N, 4.05; Found: C, 90.70; H, 5.65; N, 4.26.

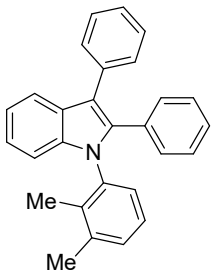
1-(3,4-Dimethylphenyl)-2, 3-diphenyl-1*H*-indole (31)



White solid; Yield: 66% (49 mg); mp: 153-155 °C; R_f = 0.8, on silica gel (Hexane/EtOAc 98;2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.27 (s, 3H), 2.31 (s, 3H), 6.93-6.96 (m, 1H), 7.10-7.20 (m, 7H), 7.21-7.29 (m, 3H), 7.35-7.44 (m,

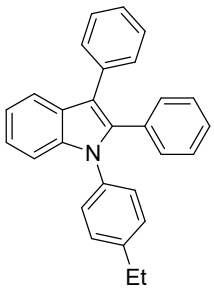
5H), 7.84-7.86 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.5, 19.8, 110.8, 116.3, 119.5, 120.7, 122.5, 125.6, 125.8, 127.2, 127.4, 127.8, 128.2, 129.1, 130.1, 130.2, 131.2, 131.8, 135.1, 135.6, 135.7, 137.2, 137.4, 138.1. EI-MS *m/z* (%): 373 (M•+, 100), 297 (38), 221(52), 117 (60). Anal. Calcd for $C_{28}H_{23}N$: C, 90.04; H, 6.21; N, 3.75; Found: C, 89.74; H, 6.11; N, 3.52.

1-(2,3-Dimethylphenyl)-2, 3-diphenyl-1*H*-indole (32)



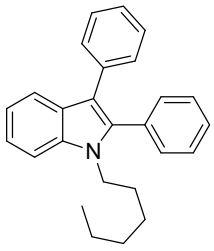
White solid; Yield: 77% (57 mg); mp: 142-144 °C; R_f = 0.7, on silica gel (Hexane/EtOAc 98;2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.81 (s, 3H), 2.28 (s, 3H), 6.99-7.01 (m, 1H), 7.11-7.18 (m, 7H), 7.19-7.28 (m, 4H), 7.33-7.37 (m, 2H), 7.42-7.44 (m, 2H), 7.84-7.87 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 14.3, 20.3, 111.0, 115.9, 119.5, 120.5, 122.4, 125.7, 125.8, 127.2, 127.2, 127.4, 127.7, 128.2, 129.7, 130.2, 130.8, 131.7, 135.2, 135.6, 136.9, 137.7, 138.1, 138.1. EI-MS *m/z* (%): 373 (M•+, 100), 297 (41), 221(48), 117 (62). Anal. Calcd for $C_{28}H_{23}N$: C, 90.04; H, 6.21; N, 3.75; Found: C, 90.34; H, 6.32; N, 3.97.

1-(4-Ethylphenyl)-2, 3-diphenyl-1*H*-indole (33)



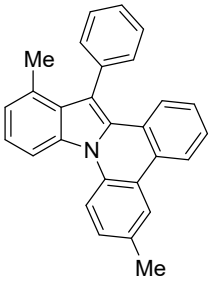
White solid; Yield: 83% (62 mg); mp:140-142 °C; R_f = 0.8, on silica gel (Hexane/EtOAc 98;2); 1H NMR (500 MHz, $CDCl_3$) δ 1.27-1.31 (t, *J* =7.64 Hz, 3H), 2.67-2.73 (q, *J* = 7.64, 2H), 7.11-7.20 (m, 7H), 7.21-7.28 (m, 5H), 7.33-7.41 (m, 5H), 7.82-7.84 (d, *J* = 8.56 Hz ,1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 15.3, 28.4, 110.8, 116.4, 119.5, 120.7, 122.6, 125.8, 127.2, 127.4, 127.8, 128.0, 128.2, 128.4, 130.2, 131.2, 131.7, 135.0, 135.6, 137.1, 138.0, 143.2. EI-MS m/z (%): 373.5 (M•+, 100), 296.5 (45), 219 (52), 114.5 (61). Anal. Calcd for $C_{28}H_{23}N$: C, 90.04; H, 6.21; N, 3.75; Found: C, 90.35; H, 6.33; N, 3.97.

1-Hexyl-2, 3-diphenyl-1*H*-indole (34)



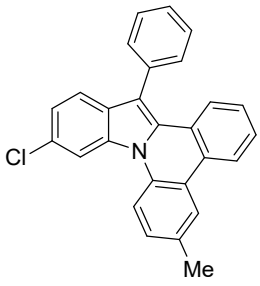
White solid; Yield: 78% (55 mg); mp: 102-104 °C; R_f = 0.75 on silica gel (Hexane/EtOAc 100:0); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.83 (t, *J* = 6.5 Hz, 3H), 1.16-1.22 (m, 6H), 1.70 (qui, *J* = 7.4 Hz, 2H), 4.10 (t, *J* = 7.6 Hz, 2H), 7.16-7.23 (m, 3H), 7.28-7.29 (m, 2H), 7.32-7.33 (m, 3H), 7.35-7.37 (m, 2H), 7.40-7.41 (m, 2H), 7.45 (d, *J* = 8.2 Hz, 1H), 7.83 (d, *J* = 7.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 13.9, 22.5, 26.5, 29.9, 31.2, 43.9, 110.0, 115.2, 119.7, 120.0, 122.0, 122.5, 125.4, 126.5, 127.6, 128.1, 128.4, 129.9, 131.2, 132.3, 135.3, 136.4, 137.6, 139.6. EI-MS *m/z* (%): 373 (M•+, 100), 353 (45), 276 (38), 199 (18). Anal. Calcd for $C_{26}H_{27}N$: C, 88.34; H, 7.70; N, 3.96; Found: C, 88.04; H, 7.61; N, 3.76.

6,13-Dimethyl-14-phenylindolo[1,2-f]phenanthridine (35)



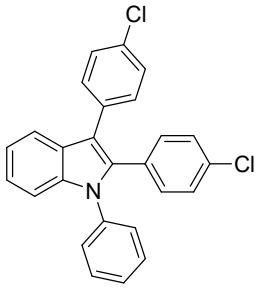
White solid; Yield: 69% (51 mg); mp: 159-161 °C; R_f = 0.40 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.11 (s, 3H), 2.54 (s, 3H), 7.17 (t, *J* = 9.5 Hz, 1H), 7.26-7.30 (m, 1H), 7.38-7.45 (m, 8H), 7.53 (d, *J* = 8.1 Hz, 1H), 8.15 (s, 1H), 8.25 (d, *J* = 8.2 Hz, 1H), 8.43 (d, *J* = 8.6 Hz, 1H), 8.51 (d, *J* = 8.5 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 20.0, 21.2, 112.3, 113.9, 116.4, 119.9, 121.5, 122.2, 122.4, 124.2, 124.7, 126.4, 127.2, 127.3, 127.5, 127.8, 127.9, 129.6, 130.4, 130.9, 131.5, 132.4, 132.7, 133.9, 135.4, 138.4. EI-MS *m/z* (%): 371/ (M•+, 100), 357 (52), 294 (65). Anal. Calcd for $C_{28}H_{21}N$: C, 90.53; H, 5.70; N, 3.77; Found: C, 90.21; H, 5.56; N, 3.55.

11-Chloro-6-methyl-14-phenylindolo[1,2-f]phenanthridine (36)



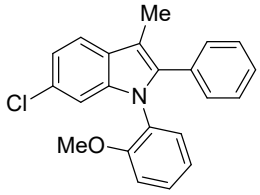
White solid; Yield: 72% (56 mg); mp: 192-194 °C; R_f = 0.35 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.52 (s, 3H), 7.14-7.29 (m, 3H), 7.37-7.59 (m, 9H), 7.73 (d, *J* = 8.1 Hz, 1H), 8.1-8.4 (m, 5H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 21.2, 113.4, 113.8, 116.2, 120.5, 122.1, 122.4, 124.3, 125.3, 126.5, 127.5, 127.6, 127.7, 127.8, 128.2, 129.2, 129.4, 129.6, 129.7, 129.8, 130.9, 132.5, 132.9, 134.7, 135.5. EI-MS *m/z* (%): 391 (M•+, 100), 314 (48), 377 (52), 355 (40). Anal. Calcd for $C_{27}H_{18}ClN$: C, 82.75; H, 4.63; N, 3.57; Found: C, 82.43; H, 4.50; N, 3.36.

2,3-Bis(4-chlorophenyl)-1-phenyl-1*H*-indole (37)



White solid; Yield: 59% (49 mg); mp: 159-161 °C; Rf = 0.40 on silica gel (Hexane/EtOAc 98:2). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.00 (d, 2H, *J*= 8.5 Hz), 7.14 (d, 2H, *J* = 8.5 Hz), 7.21-7.24 (m, 2H), 7.25-7.31 (m, 4H), 7.32-7.38 (m, 4H), 7.42 (t, 2H, *J* = 7.5 Hz), 7.75 (d, 1H, *J* = 7.1 Hz). ^{13}C NMR (125 MHz, $CDCl_3$): δ 110.8, 115.9, 119.3, 121.2, 123.2, 127.2, 127.5, 128.2, 128.4, 128.6, 129.3, 129.8, 131.3, 132.0, 132.2, 133.1, 133.6, 135.8, 137.7, 138.0. EI-MS m/z (%): 413 (M•+, 100), 336 (63), 302 (40), 337 (22). Anal. Calcd for $C_{26}H_{17}C_{l2}N$: C, 75.37; H, 4.14; N, 3.38. Found: C, 75.68; H, 4.26; N, 3.60.

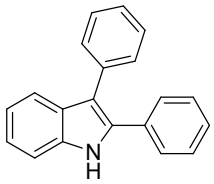
6-Chloro-1-(2-methoxyphenyl)-3-methyl-2-phenyl-1*H*-indole (38)



Pale yellow solid; Yield: 73% (51 mg); mp: 132-133 °C; R_f = 0.50 on silica gel (Hexane/EtOAc 100:0); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.41 (s, 3H), 3.55 (s, 3H), 6.92 (d, *J*= 8.3 Hz, 1H), 6.97 (t, *J*= 7.5, 1H), 7.05-7.07 (m, 1H), 7.15 (d, *J*= 8.4, 1H), 7.19 (d, *J* = 7.7 Hz, 1H), 7.22-7.29 (m, 5H), 7.30-7.35 (m, 1H), 7.56 (d, *J* = 8.3 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$)

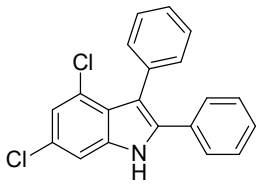
δ 9.5, 55.3, 109.6, 110.4, 112.1, 119.6, 120.2, 120.7, 126.7, 127.1, 127.6, 127.7, 127.9, 129.2, 129.8, 130.0, 132.0, 138.0, 138.4, 155.3; EI-MS *m/z* (%): 347 (M•+,100), 332 (55), 237 (50), 312 (38), 316 (20), 240 (18). Anal. Calcd for $C_{22}H_{18}ClNO$: C, 75.97; H, 5.22; N, 4.03; Found: C, 76.24; H, 5.33; N, 4.27.

2, 3-Diphenyl-1*H*-indole (39)

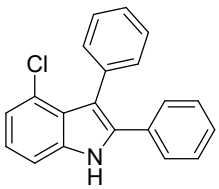


White solid; Yield: 71% (38 mg); mp: 121-123 °C; R_f = 0.35 on silica gel (Hexane/EtOAc 90:10); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.20 (t, *J* = 7.4 Hz, 1H), 7.28-7.38 (m, 5H), 7.40-7.50 (m, 7H), 7.73 (d, *J* = 8.0 Hz, 1H), 8.25 (s, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 110.9, 115.0, 119.7, 120.4, 122.7, 126.2, 127.8, 128.2, 128.5, 128.7, 128.8, 130.1, 132.7, 134.1, 135.1, 135.9. EI-MS *m/z* (%): 269 (M•+, 100), 194 (60), 117 (22). Anal. Calcd for $C_{20}H_{17}N$: C, 88.52; H, 6.31; N, 5.16; Found: C, 88.80; H, 6.42; N, 5.37.

4,6-Dichloro-2, 3-diphenyl-1*H*-indole (40)



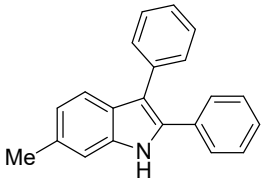
White solid; Yield: 56% (43 mg); mp: 111-113 °C; R_f = 0.40 on silica gel (Hexane/EtOAc 90:10); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.11 (d, *J*= 8.5 Hz, 1H), 7.26-7.36 (m, 4H), 7.37-7.42 (m, 6H), 7.56 (d, *J* = 8.5 Hz, 1H), 8.35 (s, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 110.8, 115.0, 120.5, 121.1, 126.5, 127.4, 127.9, 128.1, 128.3, 128.6, 128.7, 130.0, 132.2, 134.5, 134.6, 136.2. EI-MS *m/z* (%): 337 (M•+, 100), 302 (65), 267 (52), 260 (56). Anal. Calcd for $C_{20}H_{13}Cl_2N$: C, 71.02; H, 3.87; N, 4.14; Found: C, 70.71; H, 3.75; N, 3.91.



4-Chloro-2, 3-diphenyl-1*H*-indole (41)

White solid; Yield: 63% (38 mg); mp: 118-120 °C; R_f = 0.40 on silica gel (Hexane/EtOAc 90:10); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.17 (t, *J* = 9.7 Hz, 1H), 7.23-7.26 (m, 1H), 7.29-7.51 (m, 10H), 7.60-7.63 (m, 1H), 8.44 (s, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 116.0, 116.5, 118.4, 121.3, 122.0, 126.7, 128.1, 128.4, 128.7, 128.9, 130.2, 130.3, 132.2, 133.3, 134.7, 134.9. EI-MS *m/z* (%): 303 (M•+, 100), 268 (43), 191 (26). Anal. Calcd for $C_{20}H_{14}ClN$: C, 79.07; H, 4.65; N, 4.61; Found: C, 79.42; H, 4.78; N, 4.83.

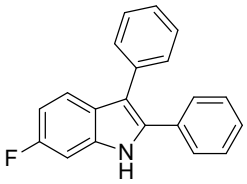
6-Methyl-2, 3-diphenyl-1*H*-indole (42)



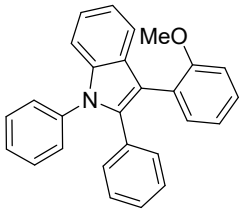
White solid; Yield: 73% (41 mg); mp: 102-104 °C; R_f = 0.35 on silica gel (Hexane/EtOAc 90:10); ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.45 (s, 3H), 7.08 (d, *J* = 8.2 Hz, 1H), 7.28-7.35 (m, 5H), 7.37-7.49 (m, 7H), 8.13 (s, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 21.5, 110.5, 114.6, 119.2, 124.3, 126.1, 127.5, 128.1, 128.5, 128.6, 129.0, 129.7, 130.2, 132.8, 134.1, 134.2, 135.2. EI-MS *m/z* (%): 283 (M•+, 100), 268 (65), 117 (20). Anal. Calcd

for $C_{21}H_{17}N$: C, 89.01; H, 6.05; N, 4.94; Found: C, 89.34; H, 6.18; N, 5.15.

6-Fluoro-2, 3-diphenyl-1*H*-indole (43)



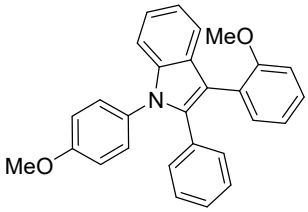
White solid; Yield: 54% (31 mg); mp: 108-110 °C; R_f = 0.35 on silica gel (Hexane/EtOAc 90:10); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.04 (t, *J* = 7.4 Hz, 1H), 7.32-7.38 (m, 5H), 7.39-7.49 (m, 7H), 8.18 (s, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 104.5, 104.7, 111.0 (d, *J* = 8.7 Hz), 111.6 (d, *J*= 10.0 Hz), 115.2 (d, *J* = 5 Hz), 126.4, 128.0, 128.1, 128.7 (d, *J* = 10.0 Hz), 129.2 (d, *J* = 8.7 Hz), 129.9, 132.4(d, *J* = 6.2 Hz), 134.6, 135.9, 157.6, 159.4. EI-MS *m/z* (%): 287 (M•+, 100), 268 (55), 191 (19). Anal. Calcd for $C_{20}H_{14}FN$: C, 83.60; H, 4.91; N, 4.87; Found: C, 83.28; H, 4.79; N, 4.66.



3-(2-Methoxyphenyl)-1, 2-diphenyl-1*H*-indole (44)

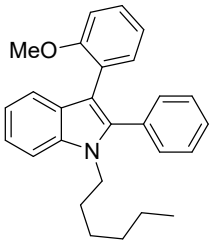
White solid; Yield: 56% (42 mg); mp: 176-178 °C; R_f = 0.70 on silica gel (Hexane/EtOAc 95:5); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.85 (s, 3H), 7.06-7.13 (m, 7H), 7.35-7.44 (m, 4H), 7.58-7.62 (m, 1H), 7.71-7.75 (m, 3H), 7.98 (d, *J* = 8.1 Hz, 1H), 8.34 (d, *J* = 8.1 Hz, 1H), 8.58 (d, *J* = 8.2 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 54.8, 108.7, 110.6, 115.9, 120.1, 123.4, 123.5, 125.4, 125.7, 125.8, 126.0, 126.2, 126.3, 126.9, 127.5, 127.7, 128.2, 128.5, 129.0, 130.3, 133.0, 139.5, 142.8. EI-MS *m/z* (%): 375 (M•+, 100), 300 (42), 344 (30). Anal. Calcd for $C_{27}H_{21}NO$: C, 86.37; H, 5.64; N, 3.73; Found: C, 86.68; H, 5.73; N, 3.95.

3-(2-Methoxyphenyl)-1-(4-methoxyphenyl)-2-phenyl-1*H*-indole (45)



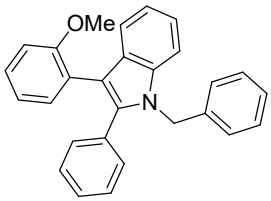
White solid; Yield: 67% (54 mg); mp: 186-188 °C; R_f = 0.55 on silica gel (Hexane/EtOAc 95:5); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.52 (s, 3H), 3.86 (s, 3H), 6.93-7.01 (m, 4H), 7.11-7.16 (m, 5H), 7.20-7.25 (m, 4H), 7.31-7.35 (m, 2H), 7.38 (d, *J* = 7.4 Hz, 1H), 7.62 (d, J = 7.6 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.0, 55.4, 110.6, 111.2, 112.7, 114.3, 120.1, 120.4, 120.5, 122.3, 124.0, 126.9, 127.6, 127.9, 128.0, 129.4, 130.4, 131.3, 132.7, 132.8, 137.9, 138.2, 157.4, 158.4. EI-MS *m/z* (%): 405 (M•+, 100), 374 (50), 343 (45), 328 (12). Anal. Calcd for $C_{28}H_{23}NO_2$: C, 82.94; H, 5.72; N, 3.45; Found: C, 83.24; H, 5.81; N, 3.68.

1-Hexyl-3-(2-methoxyphenyl)-2-phenyl-1*H*-indole (46)



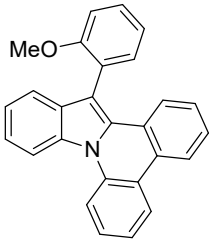
Yellow oil; Yield: 60% (46 mg); mp: 160-162 °C; R_f = 0.40 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.85 (t, *J* = 6.0 Hz, 3H), 1.19-1.26 (m, 6H), 1.73-1.79 (m, 2H), 3.49 (s, 3H), 4.14 (t, *J* = 7.6 Hz, 2H), 6.86 (d, *J* = 8.2 Hz, 1H), 6.92 (t, *J* = 7.4 Hz, 1H), 7.15 (t, *J* = 7.4 Hz, 1H), 7.23-7.29 (m, 4H), 7.31-7.35 (m, 4H), 7.44 (d, *J* = 8.2 Hz, 1H), 7.55 (d, *J* = 7.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 14.0, 22.5, 26.6, 30.0, 31.3, 44.1, 54.9, 103.1, 109.9, 111.0, 111.5, 119.6, 120.3, 120.3, 121.6, 124.2, 127.5, 127.9, 128.0, 130.5, 132.7, 133.1, 136.5, 138.4, 157.2. EI-MS *m/z* (%): 383 (M•+, 100), 352 (54), 298 (42), 276 (15). Anal. Calcd for $C_{27}H_{29}NO$: C, 84.55; H, 7.62; N, 3.65; Found: C, 84.25; H, 7.53; N, 3.42.

1-Benzyl-4-methoxy-2,3-diphenyl-1*H*-indole (47)



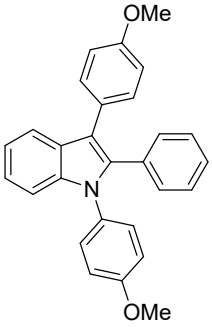
White solid; Yield: 80% (62 mg); 150-152 °C; R_f = 0.40 on silica gel (Hexane/EtOAc 98:2); 1H NMR (500 MHz, $CDCl_3$) δ 3.55 (s, 3H), 5.40 (s, 2H), 6.92-6.99 (m, 2H), 7.14-7.21 (m, 5H), 7.22-7.25 (m, 4H), 7.28-7.36 (m, 6H), 7.63-7.64 (d, *J* = 7.64 Hz ,1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 47.9, 54.9, 110.5, 111.1, 112.0, 120.1, 120.3, 120.4, 122.0, 124.0, 126.2, 127.1, 127.7, 127.7, 128.1, 128.1, 128.7, 130.3, 132.5, 132.7, 137.0, 138.4, 138.8, 157.3. EI-MS m/z (%): 389.5 (M•+, 100), 312.5 (40), 235.5 (53), 144.5 (68). Anal. Calcd for $C_{28}H_{23}NO$: C, 86.34; H, 5.95; N, 3.60; Found: C, 86.64; H, 6.07; N, 3.83.

13-Methoxy-14-phenylindolo[1,2-f]phenanthridine (48)



Yellow solid; Yield: 77% (57 mg); mp: 181-183 °C; R_f = 0.55 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.69 (s, 3H), 7.14-7.21 (m, 3H), 7.31 (t, *J* = 7.0 Hz, 1H), 7.35-7.44 (m, 3H), 7.47-7.53 (m, 3H), 7.60 (t, *J* = 7.4 Hz, 1H), 7.74 (d, *J* = 8.2 Hz, 1H), 8.24 (d, *J* = 8.1 Hz, 1H), 8.35 (d, *J* = 8 Hz, 1H), 8.44 (d, *J* = 8.5 Hz, 1H), 8.61 (d, *J* = 8.4 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.6, 109.3, 111.6, 114.0, 116.6, 120.1, 121.2, 121.6, 122.2, 122.4, 123.0, 124.0, 124.0, 124.6, 125.2, 127.3, 127.4, 127.5, 127.6, 128.7, 129.1, 130.6, 131.3, 132.9, 136.1, 158.2. EI-MS *m/z* (%): 373 (M•+, 100), 342 (55), 373 (10), 296 (41). Anal. Calcd for $C_{27}H_{19}NO$: C, 86.84; H, 5.13; N, 3.75; Found: C, 87.14; H, 5.24; N, 3.98.

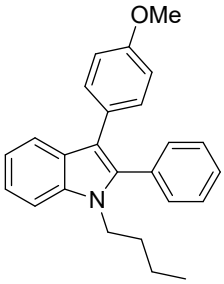
6-Methoxy-1-(4-methoxyphenyl)-2,3-diphenyl-1*H*-indole (49)



White solid; Yield: 73% (59 mg); mp: 208-210 °C; R_f = 0.35 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.85 (s, 3H), 3.86 (s, 3H), 6.91-6.92 (m, 4H), 7.13-7.15 (m,2H), 7.17-7.19 (m, 5H), 7.22-7.24 (m,2H), 7.29-7.34 (m,3H), 7.8 (s,1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.2, 55.4, 110.6, 113.8, 114.2, 115., 119.53, 120.6, 122.5, 127.1, 127.5, 127.9, 129.3, 130.1, 131, 131.1, 131.2, 131.8, 136.9, 138.2, 157.8, 158.4. EI-MS *m/z*

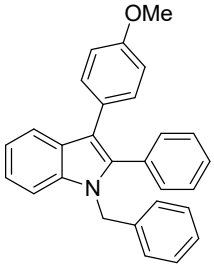
(%): 405 (M•+,100), 329 (43), 253(50), 147 (73). Anal. Calcd for $C_{28}H_{23}NO_2$: Elemental Analysis: C, 82.94; H, 5.72; N, 3.45; Found: C, 83.28; H, 5.83; N, 3.67.

1-Butyl-6-methoxy-2,3-diphenyl-1*H*-indole (50)



White solid; Yield: 60% (42 mg); mp: 93-35 °C; R_f = 0.65 on silica gel (Hexane/EtOAc 98:2); ^{1}H NMR (500 MHz, CDCl3) δ 0.80-0.84 (t, *J* = 7.4 Hz, 3H), 1.17-1.25 (m, 2H), 1.64-1.72 (m, 2H), 3.95 (s, 3H), 4.03-4.07 (t, *J* = 7.6 Hz, 2H), 6.86-6.92 (m, 2H), 7.15-7.19 (m, 1H), 7.25-7.25 (m, 3H), 7.33-7.40 (m, 6H), 7.69-7.71 (d, *J* = 8.7 Hz ,1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 13.6, 20.0, 31.87, 43.57, 55.94, 93.9, 109.3, 115.0, 120.4, 121.7, 125.3, 127.8, 128.1, 128.3, 129.7, 131.2, 132.4, 135.3, 136.5, 137.1, 156.44. EI-MS m/z (%): 355 (M•+, 100), 278 (40), 201 (51), 144 (63). Anal. Calcd for $C_{23}H_{25}NO$: Elemental Analysis: C, 84.47; H, 7.09; N, 3.94; Found: C, 83.97; H, 6.97; N, 3.68**.**

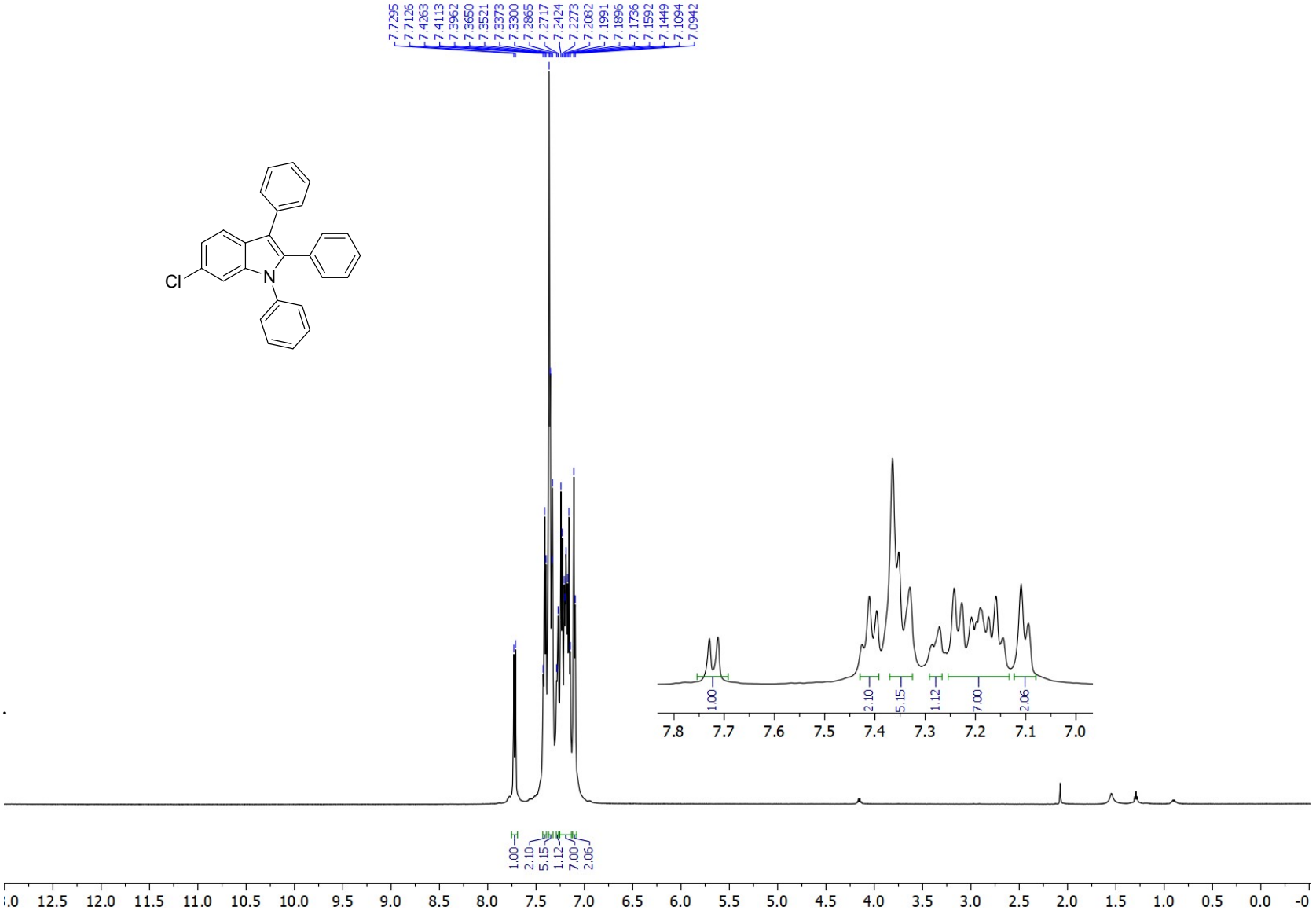
1-Benzyl-3-(4-methoxyphenyl)-2-phenyl-1*H*-indole (51)



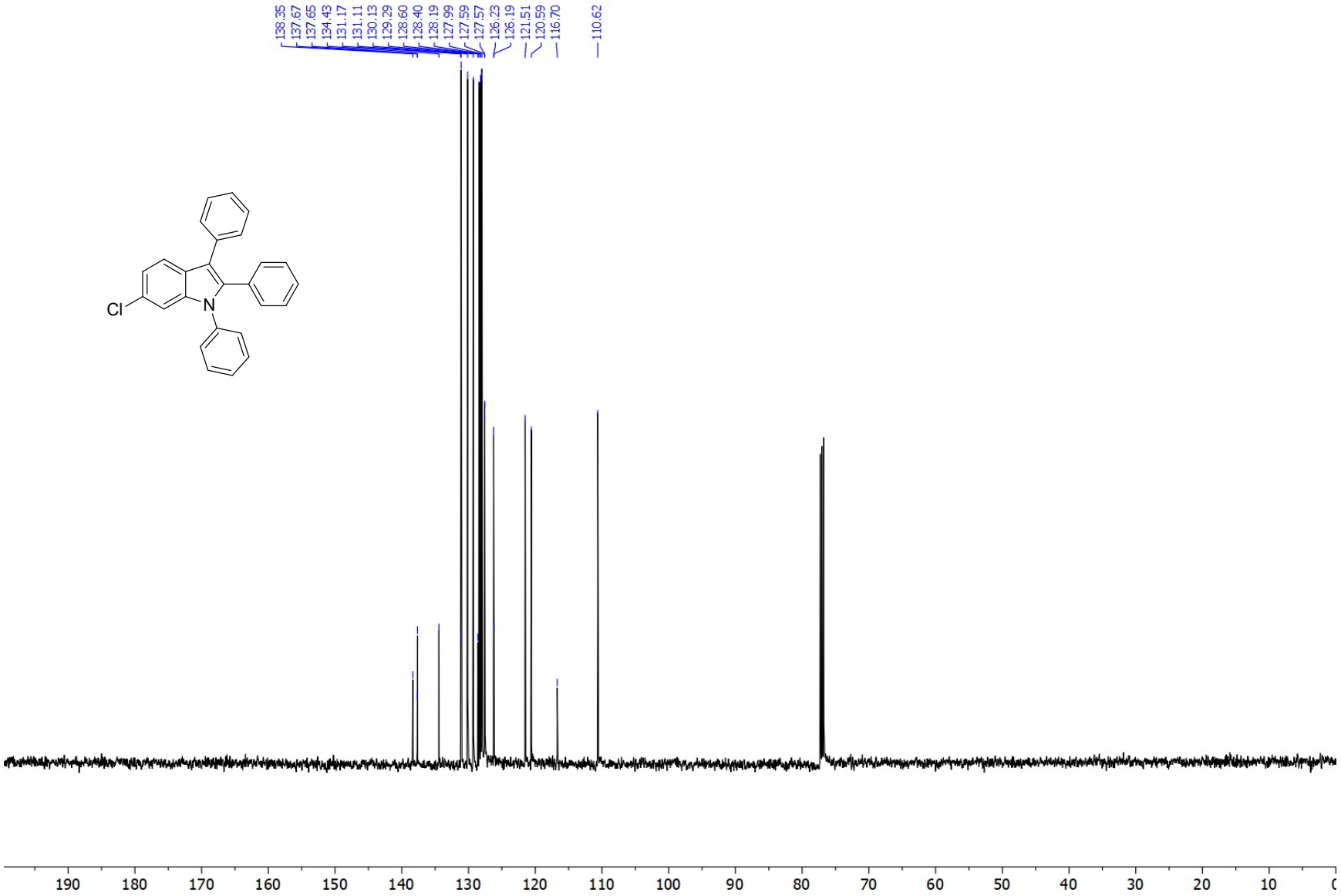
White solid; Yield: 79% (61 mg); mp: 174-175 °C; Rf = 0.35 on silica gel (Hexane/EtOAc 97:3); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.81 (s, 3H), 5.26 (s, 2H), 6.75 (s, 1H), 6.89 (d, *J* = 8.6 Hz, 1H), 7.06 (d, *J* = 7.9 Hz, 2H), 7.17-7.22 (m, 1H), 7.25-7.32 (m, 10H), 7.35 (d, *J* = 7.0 Hz, 2H), 7.72 (d, *J* = 8.6 Hz, 1H). ^{13}C NMR (125 MHz, CDCl3) δ 47.6, 55.7, 94.3, 109.9, 115.5, 120.4, 121.8, 125.5, 126.1, 127.1, 127.9, 128.1, 128.3, 128.7, 129.8, 131.1, 131.9, 135.2, 136.8, 137.8, 138.0, 156.6. EI-MS *m/z* (%): 389 (M•+, 100), 312 (47), 298 (42), 283 (26), 358 (17). Anal. Calcd for $C_{28}H_{23}NO$: Elemental Analysis: C, 86.34; H, 5.95; N, 3.60; Found: C, 86.55; H, 6.09; N, 3.80.

5 Copies of ^{1}H and ^{13}C NMR Spectra

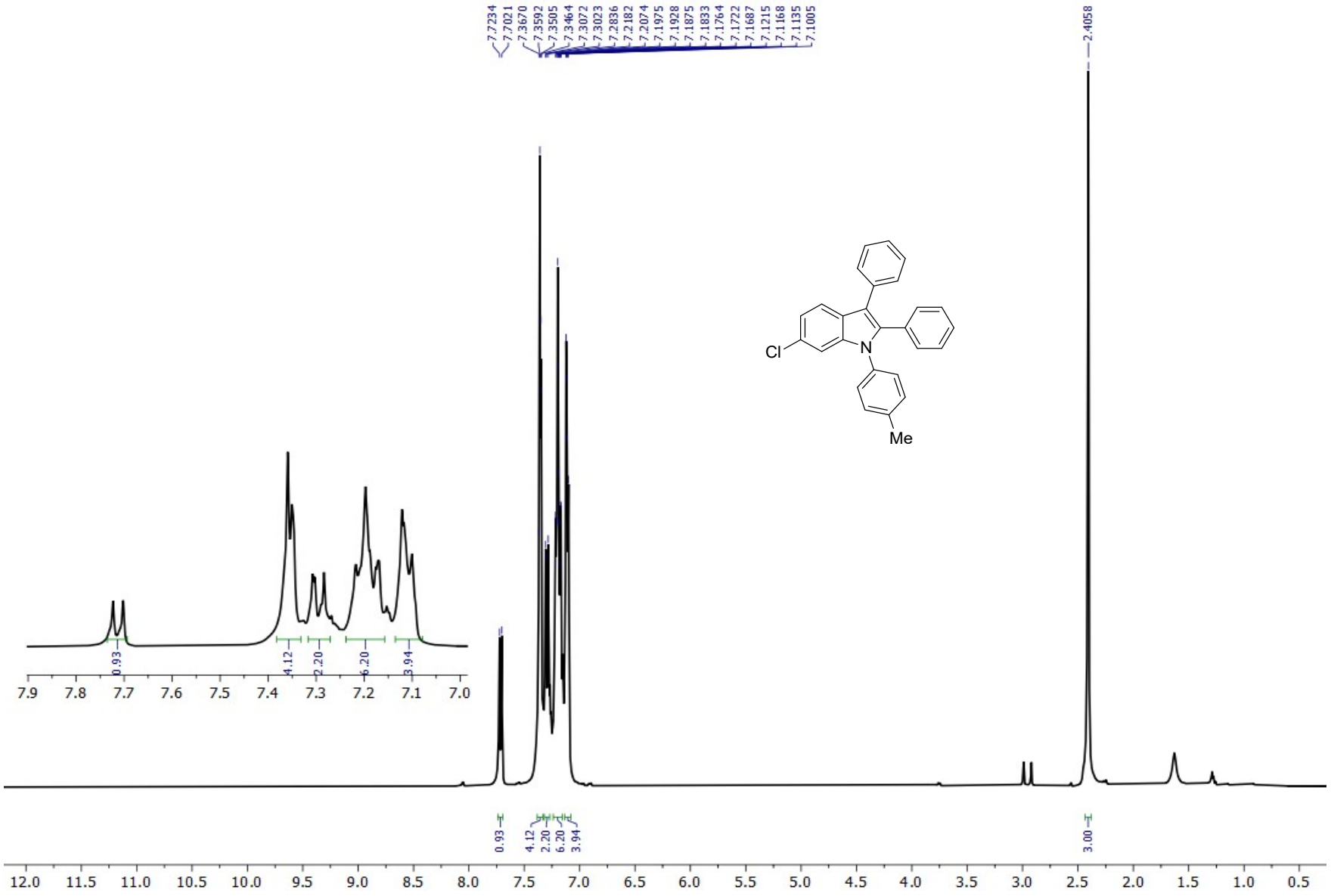
^{1}H NMR of compound **4** ($CDCl_3$, 500 MHz)



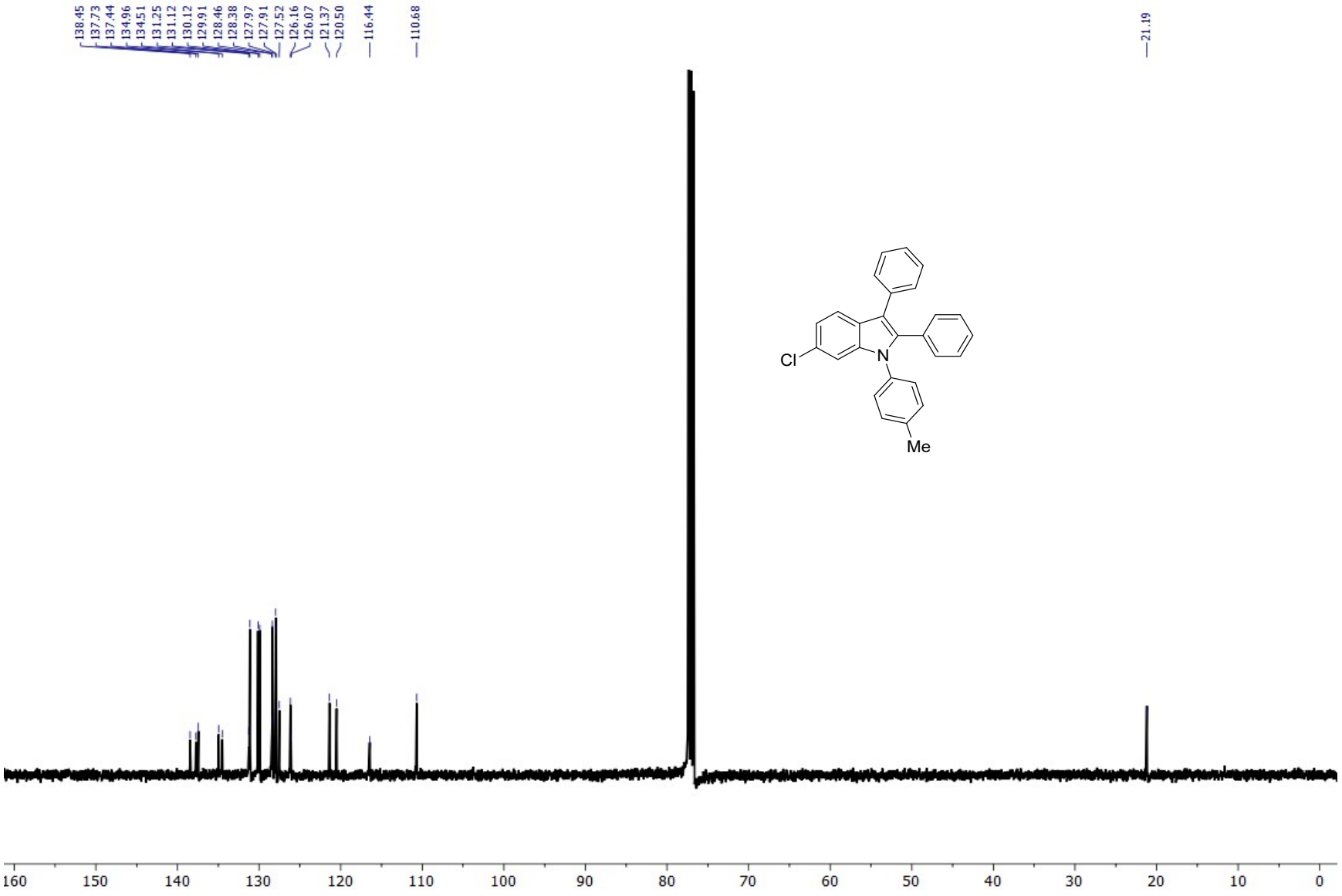
^{13}C NMR of compound **4** ($CDCl_3$, 125 MHz)



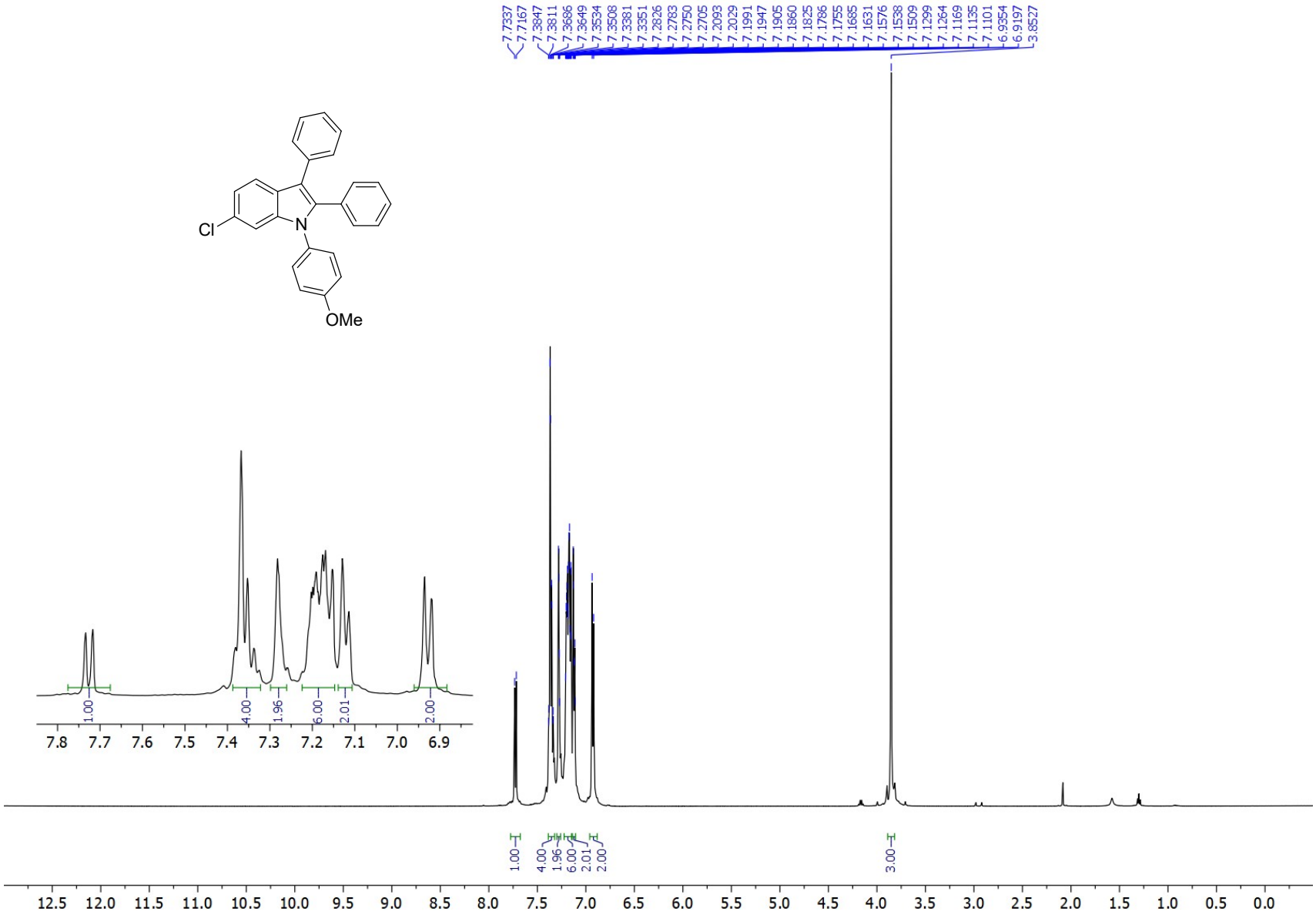
^{1}H NMR of compound **5** ($CDCl_3$, 500 MHz)



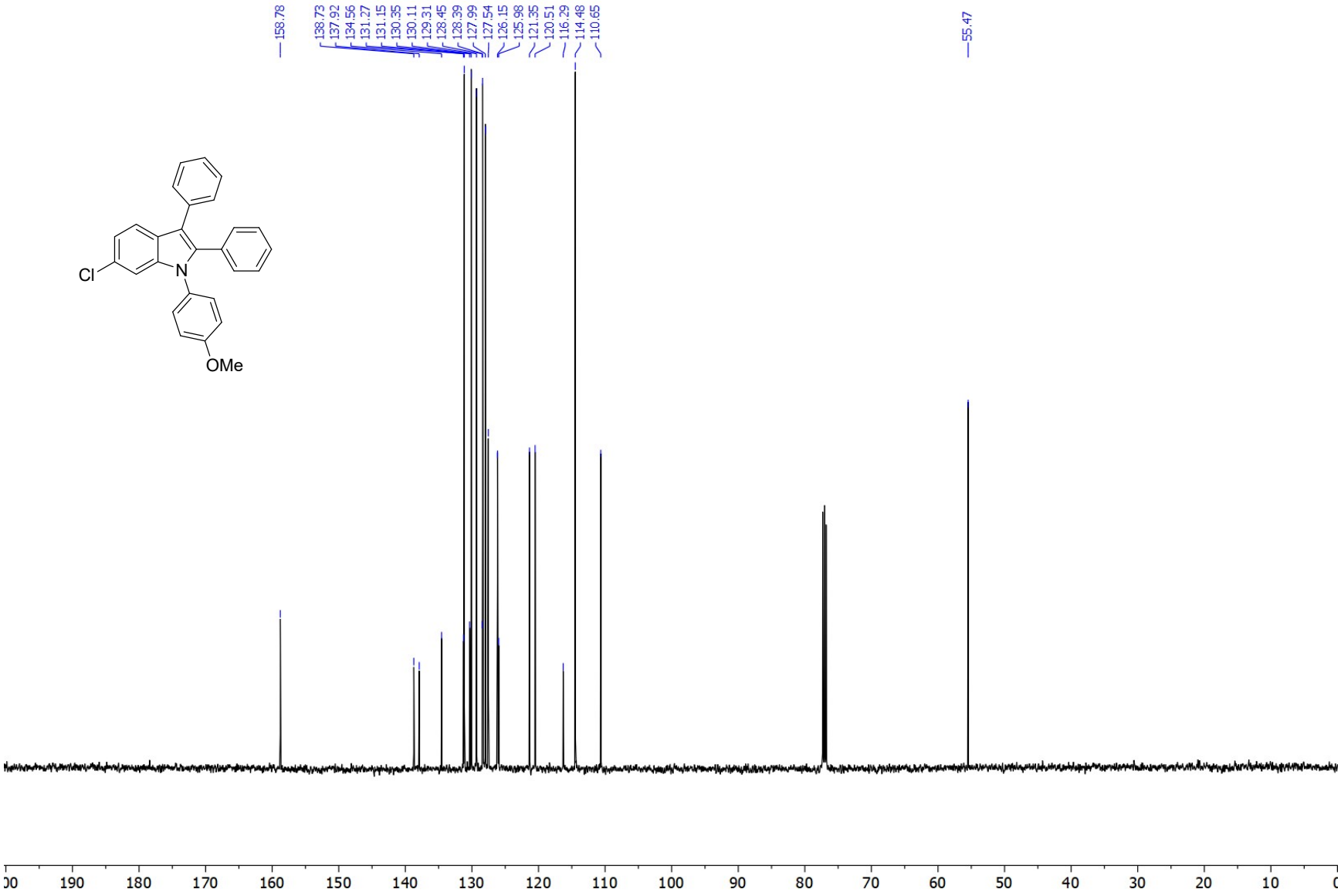
^{13}C NMR of compound **5** ($CDCl_3$, 125 MHz)



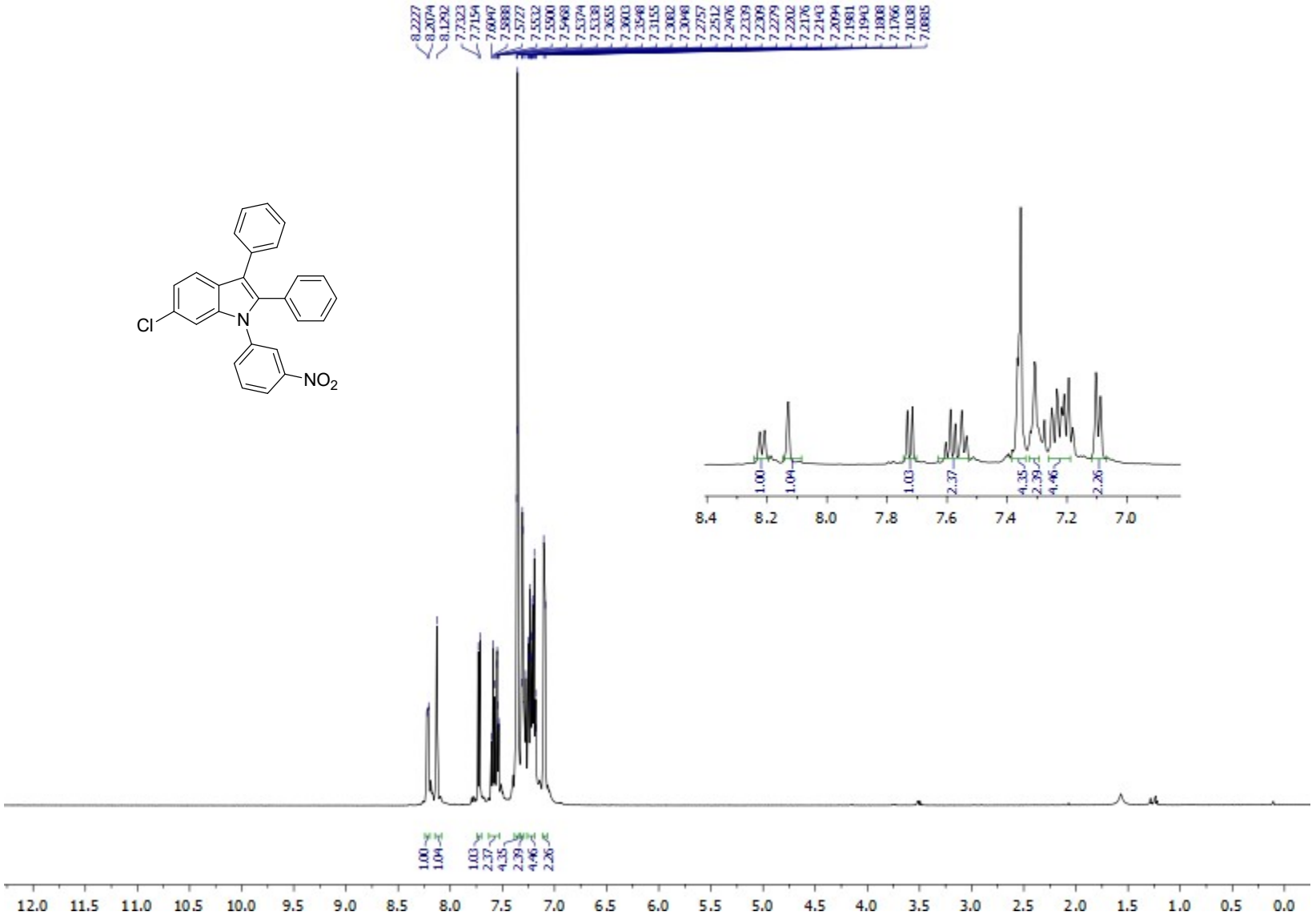
^{1}H NMR of compound **6** ($CDCl_3$, 500 MHz)



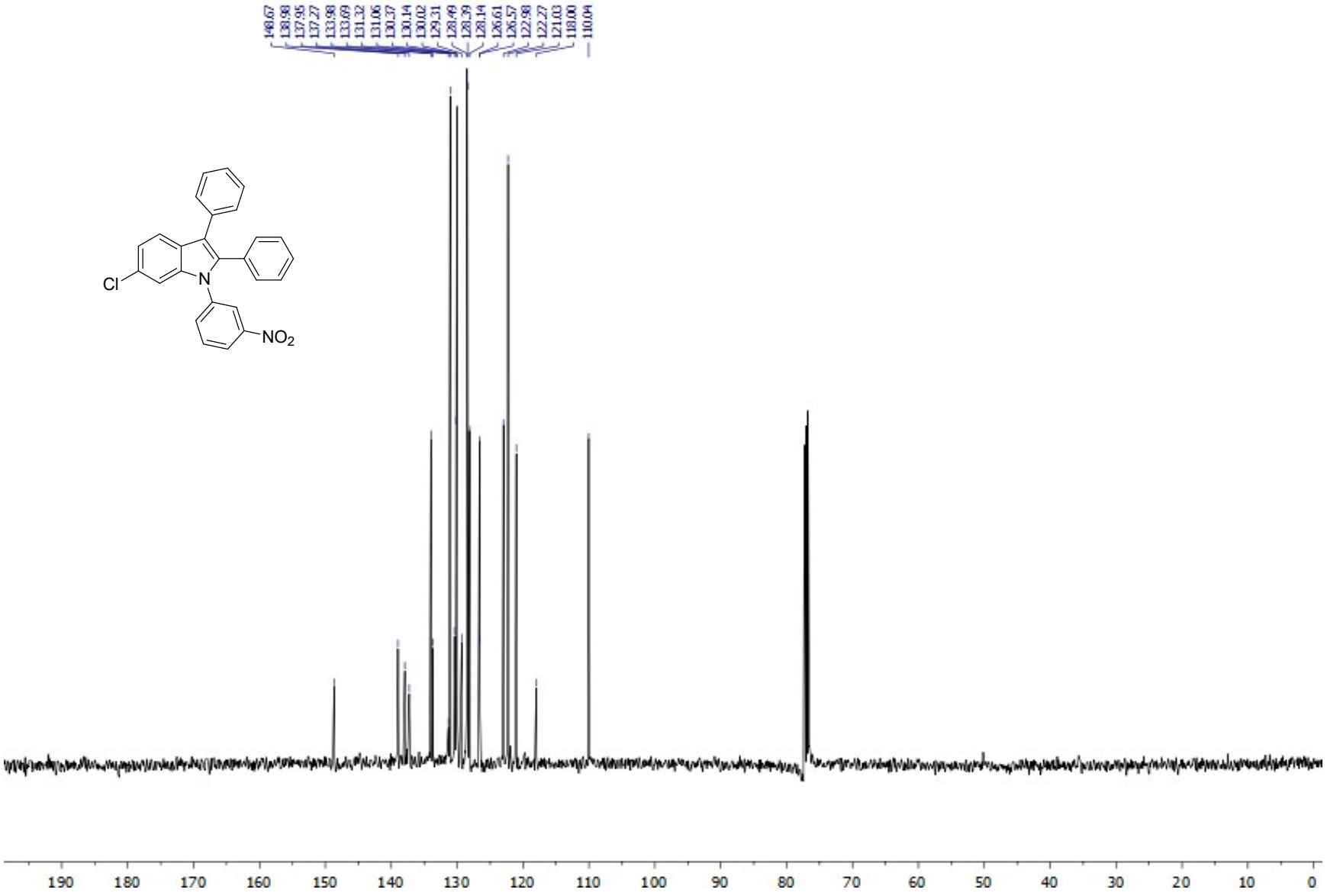
^{13}C NMR of compound **6** ($CDCl_3$, 125 MHz)



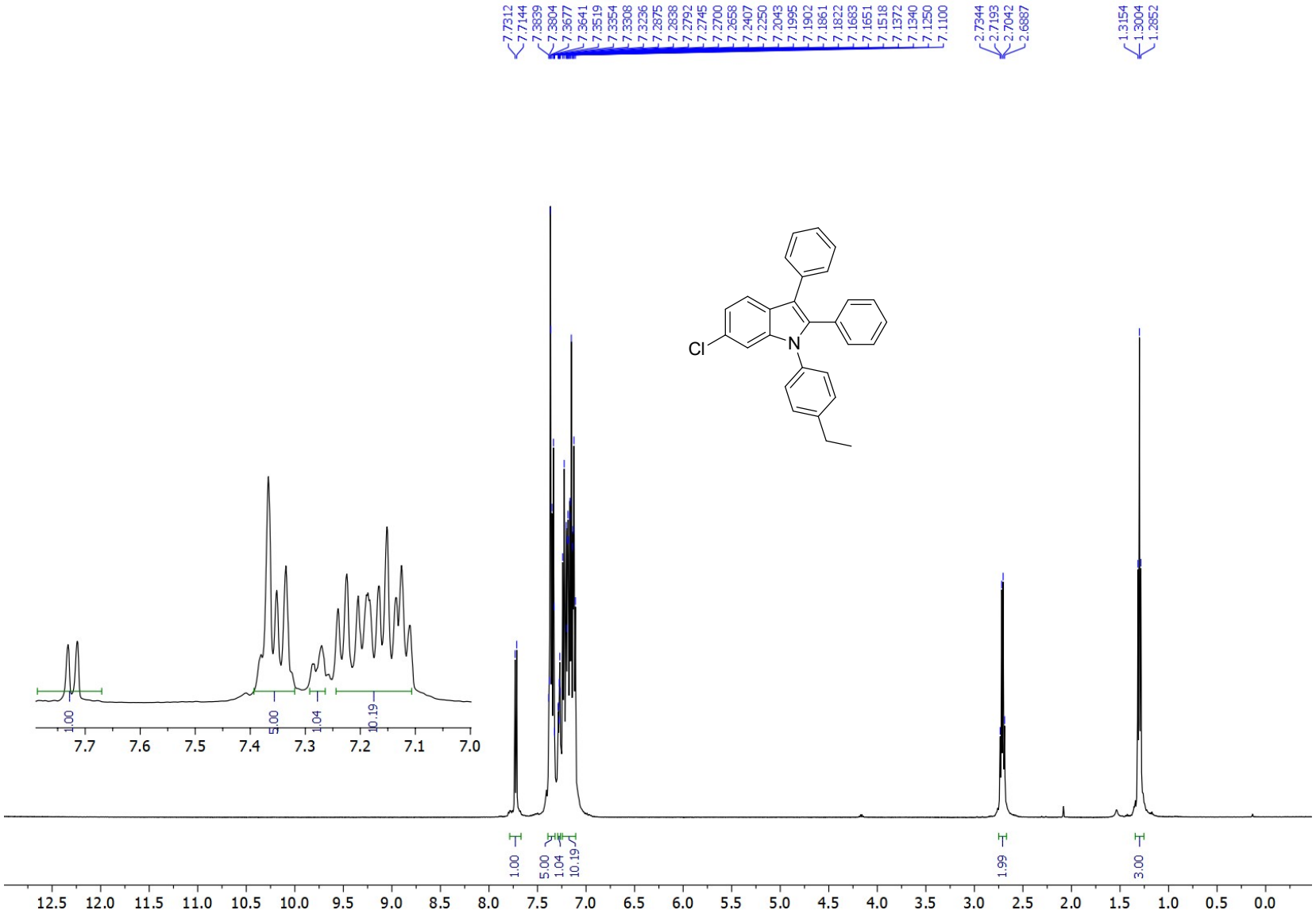
^{1}H NMR of compound **7** ($CDCl_3$, 500 MHz)



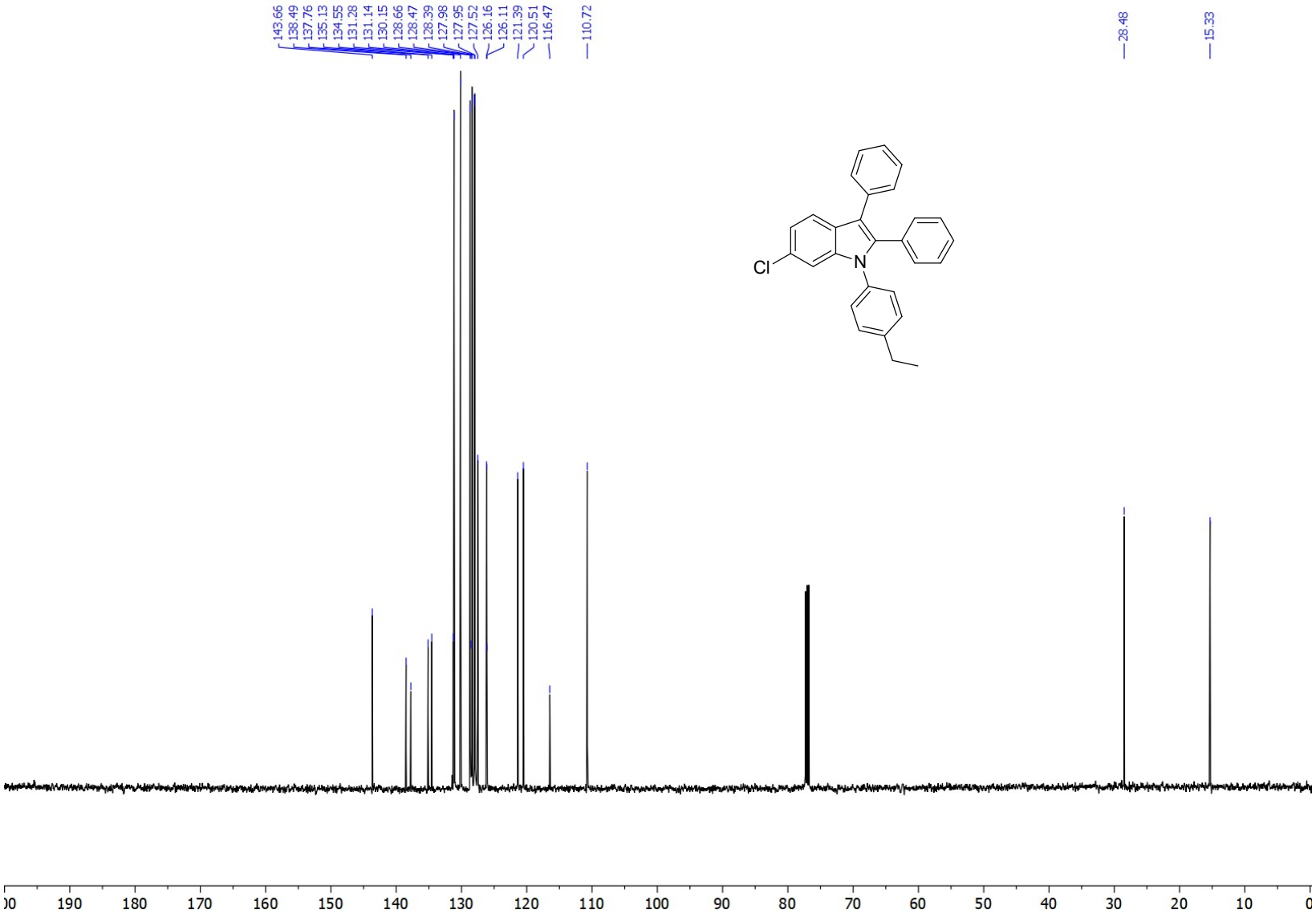
^{13}C NMR of compound **7** ($CDCl_3$, 125 MHz)



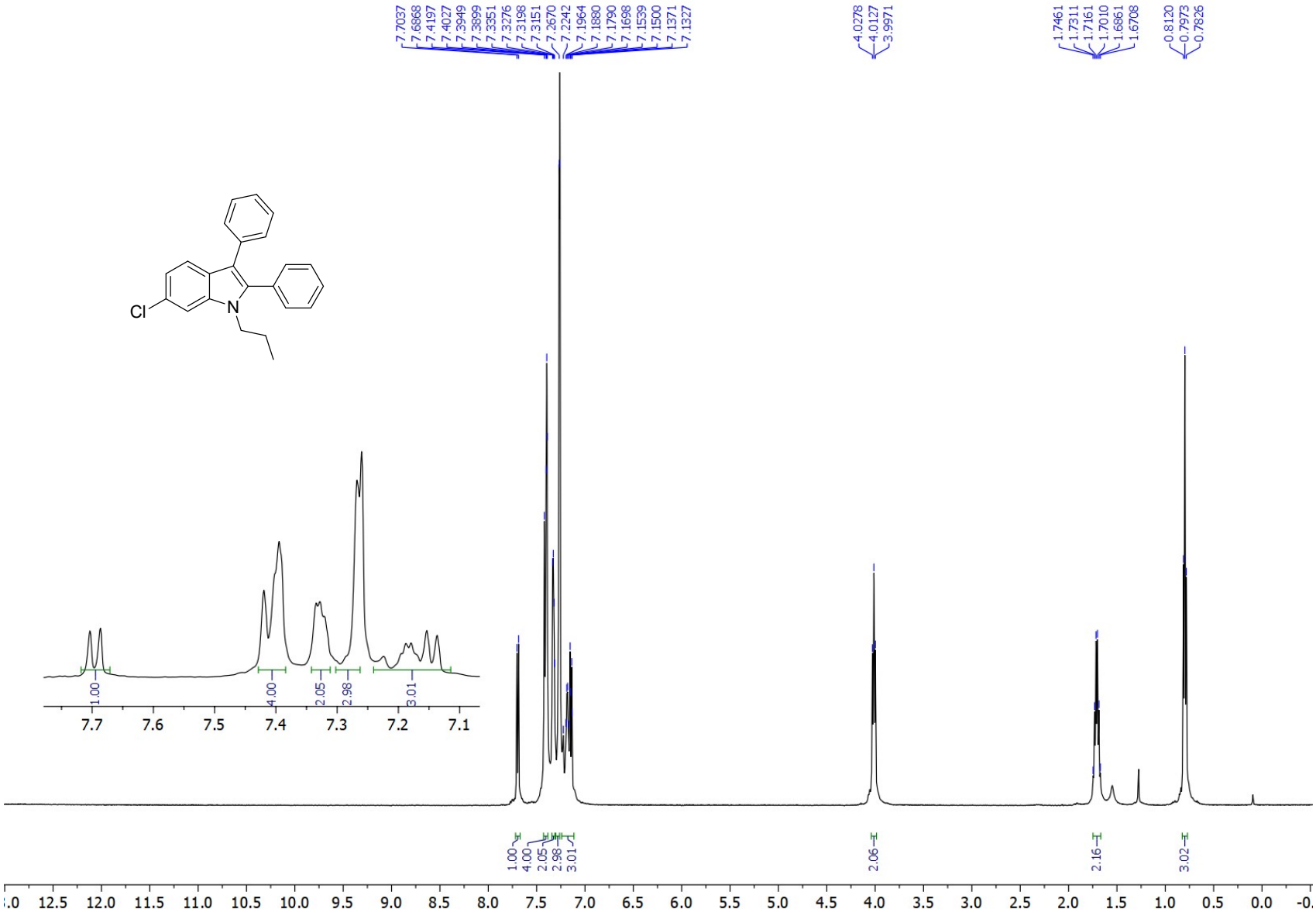
^{1}H NMR of Compound **8** ($CDCl_3$, 500 MHz)



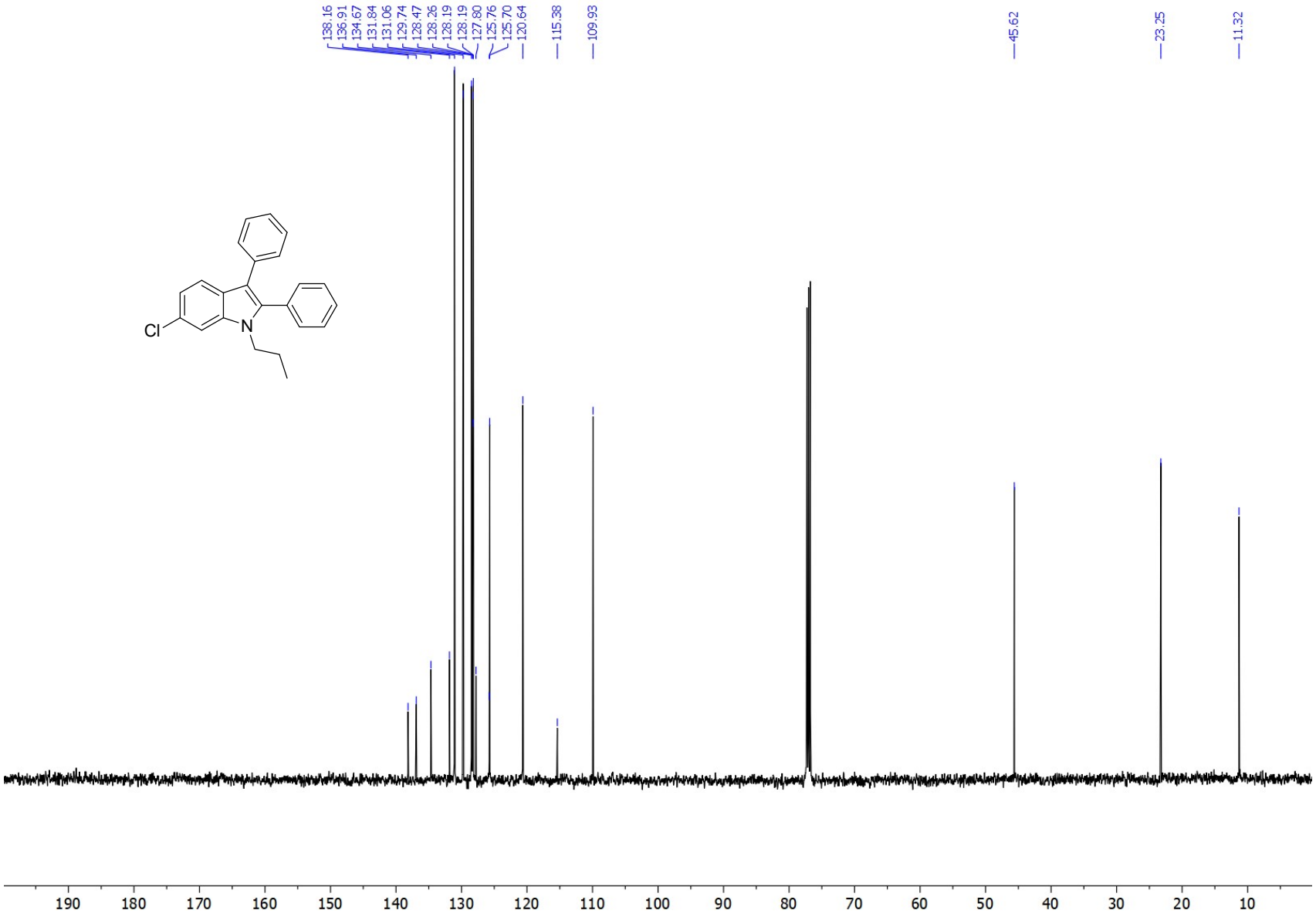
^{13}C NMR of compound **8** ($CDCl_3$, 125 MHz)



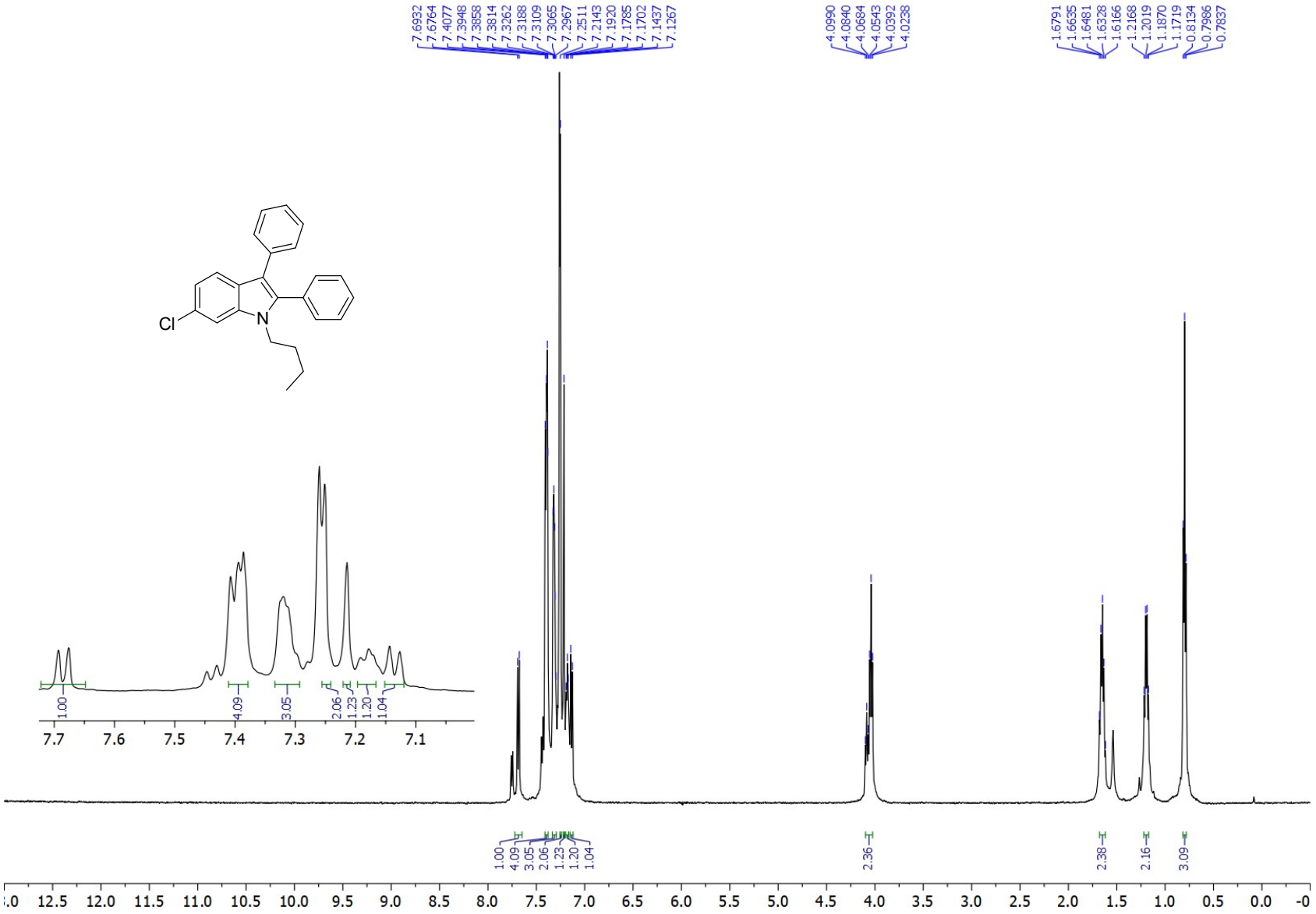
^{1}H NMR of Compound **9** ($CDCl_3$, 500 MHz)



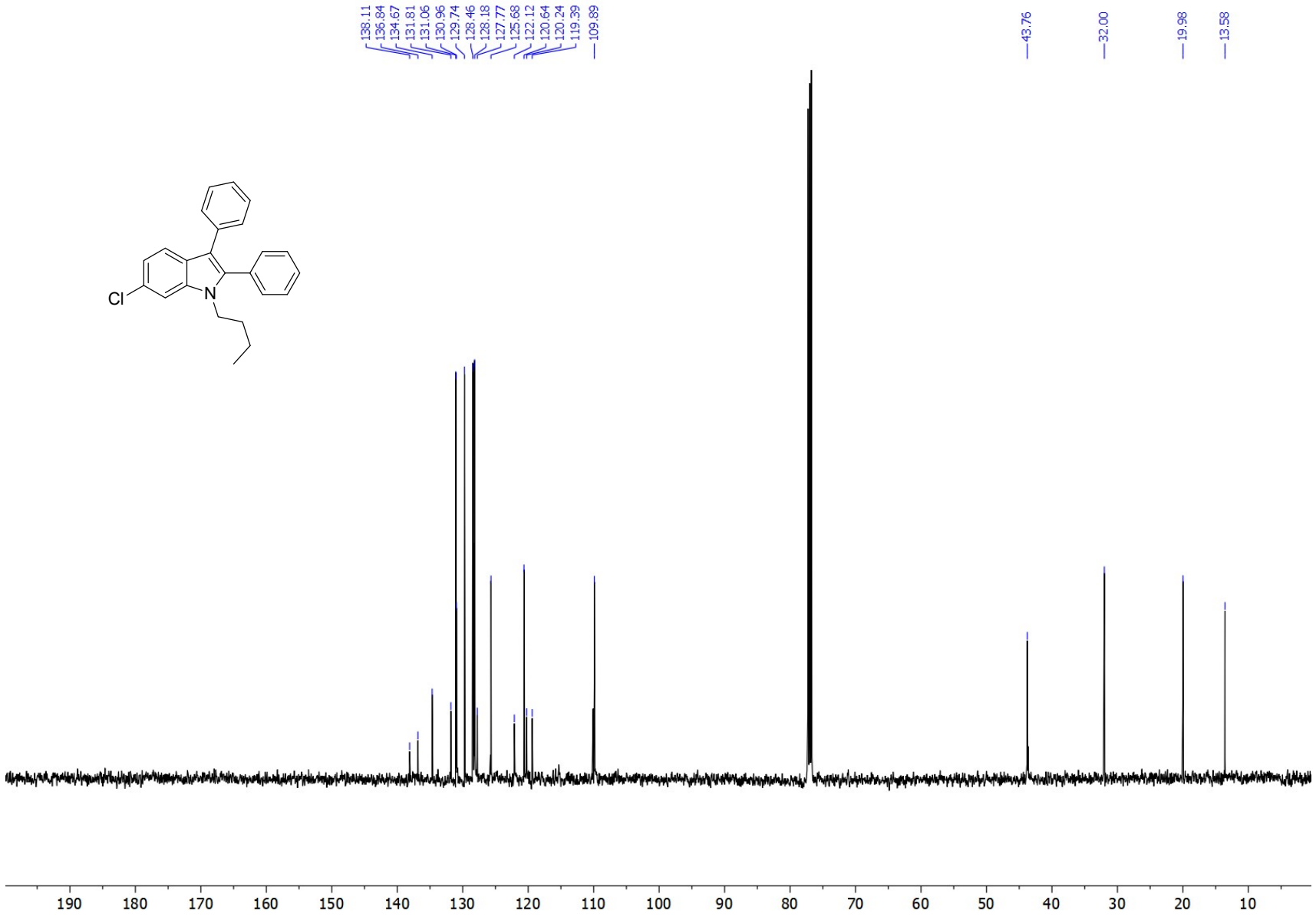
^{13}C NMR of compound **9** ($CDCl_3$, 125 MHz)



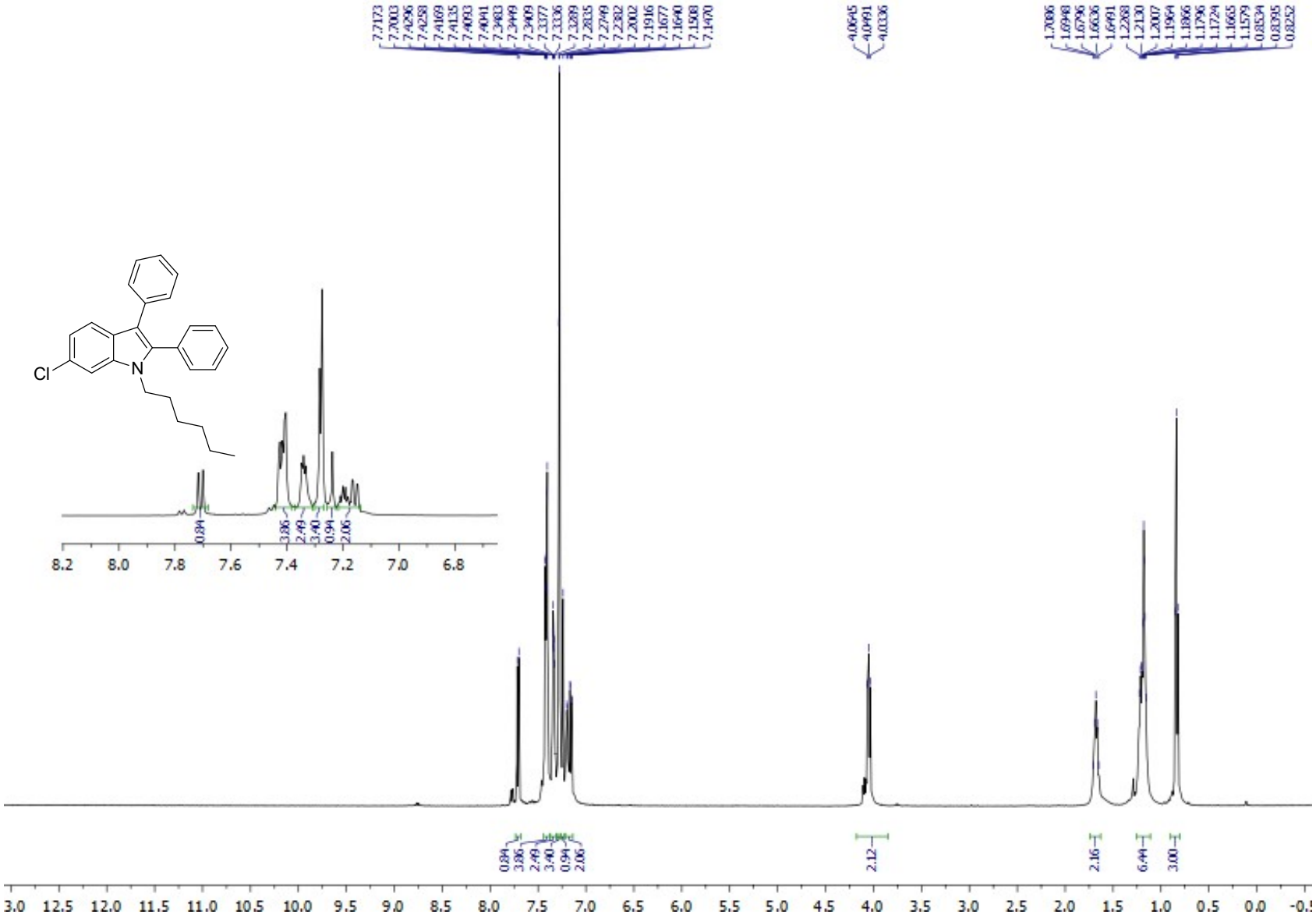
^{1}H NMR of Compound **10** ($CDCl_3$, 500 MHz)



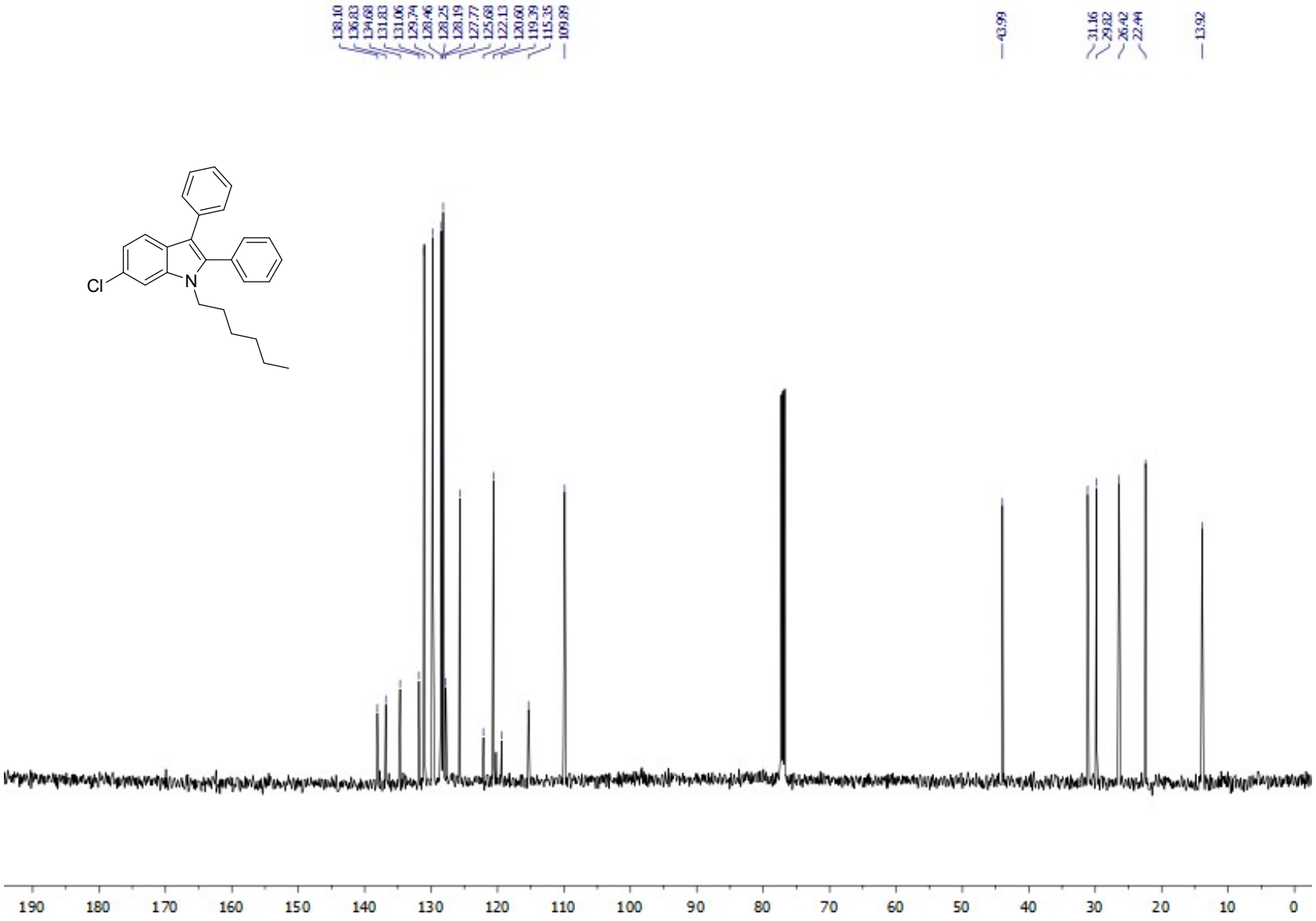
^{13}C NMR of compound **10** ($CDCl_3$, 125 MHz)



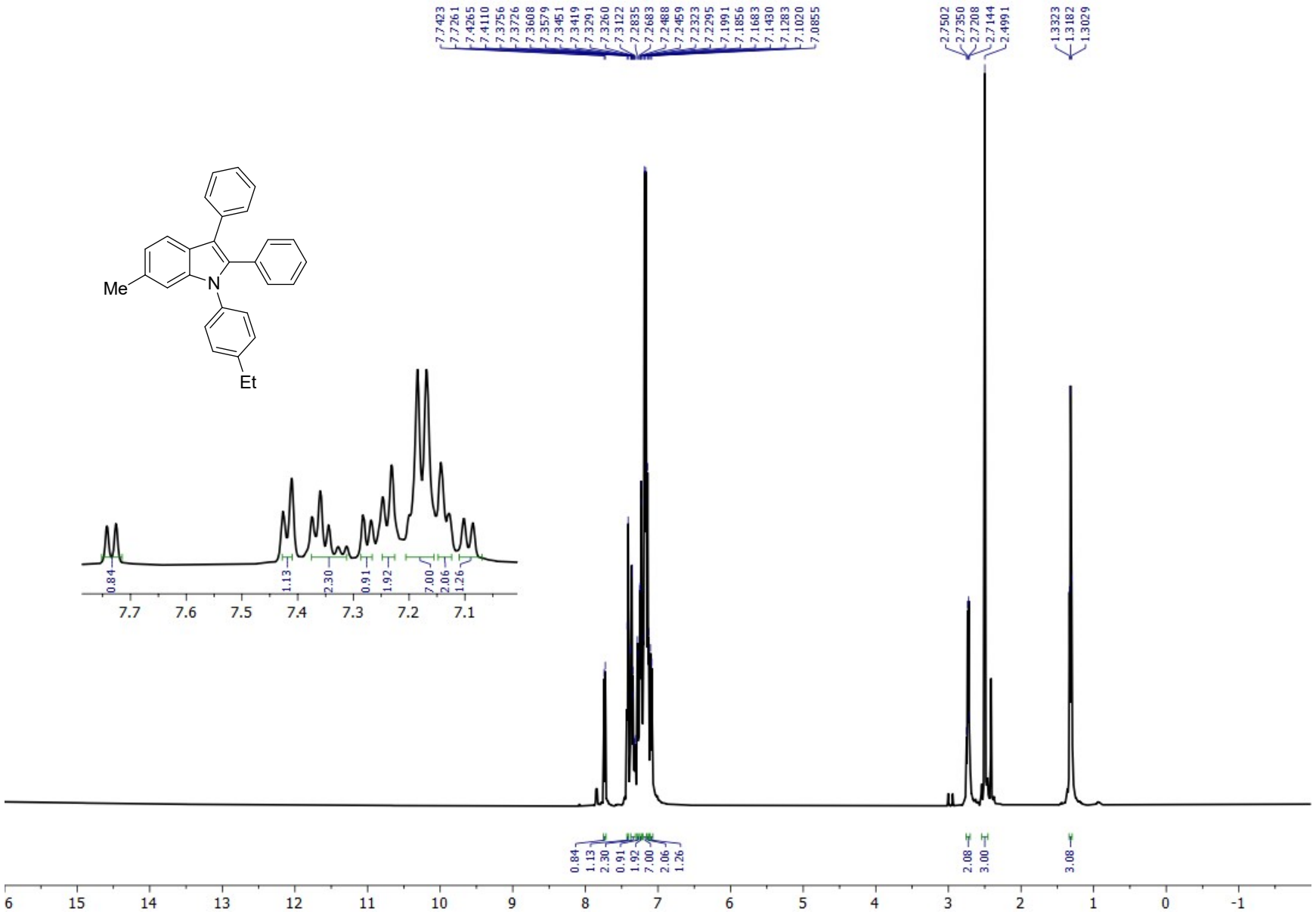
^{1}H NMR of Compound **11** ($CDCl_3$, 500 MHz)



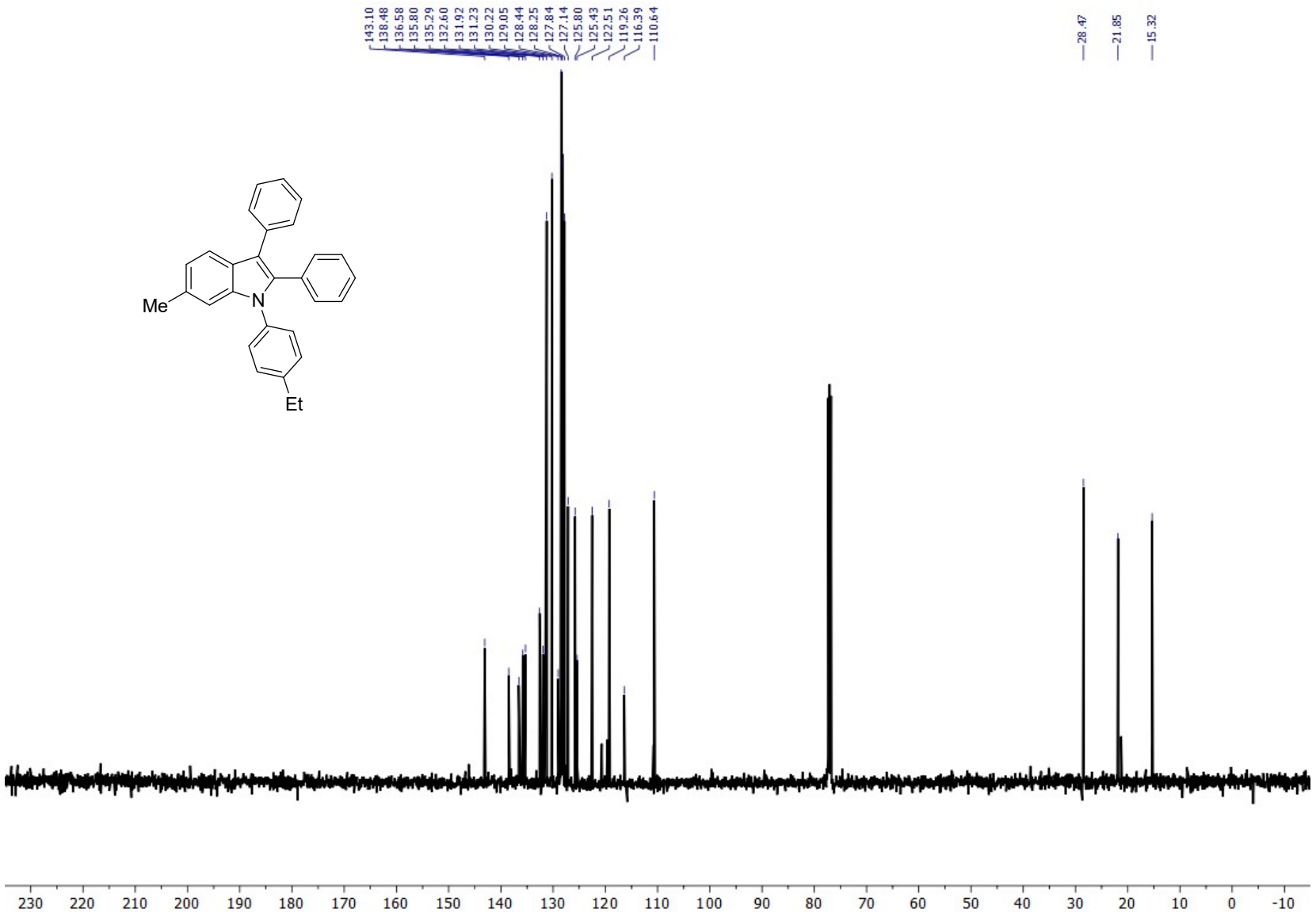
^{13}C NMR of compound **11** ($CDCl_3$, 125 MHz)



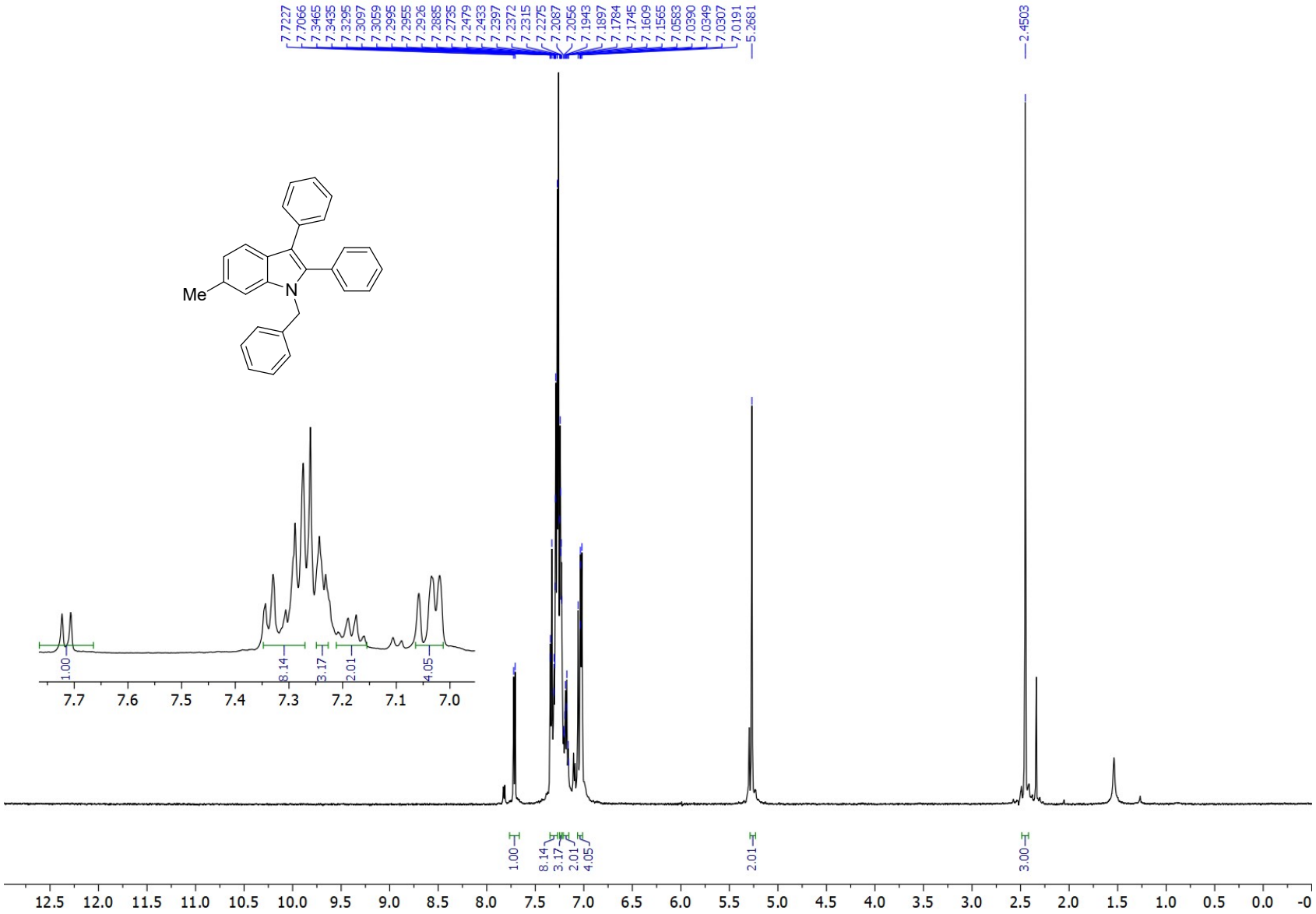
^{1}H NMR of Compound **12** ($CDCl_3$, 500 MHz)



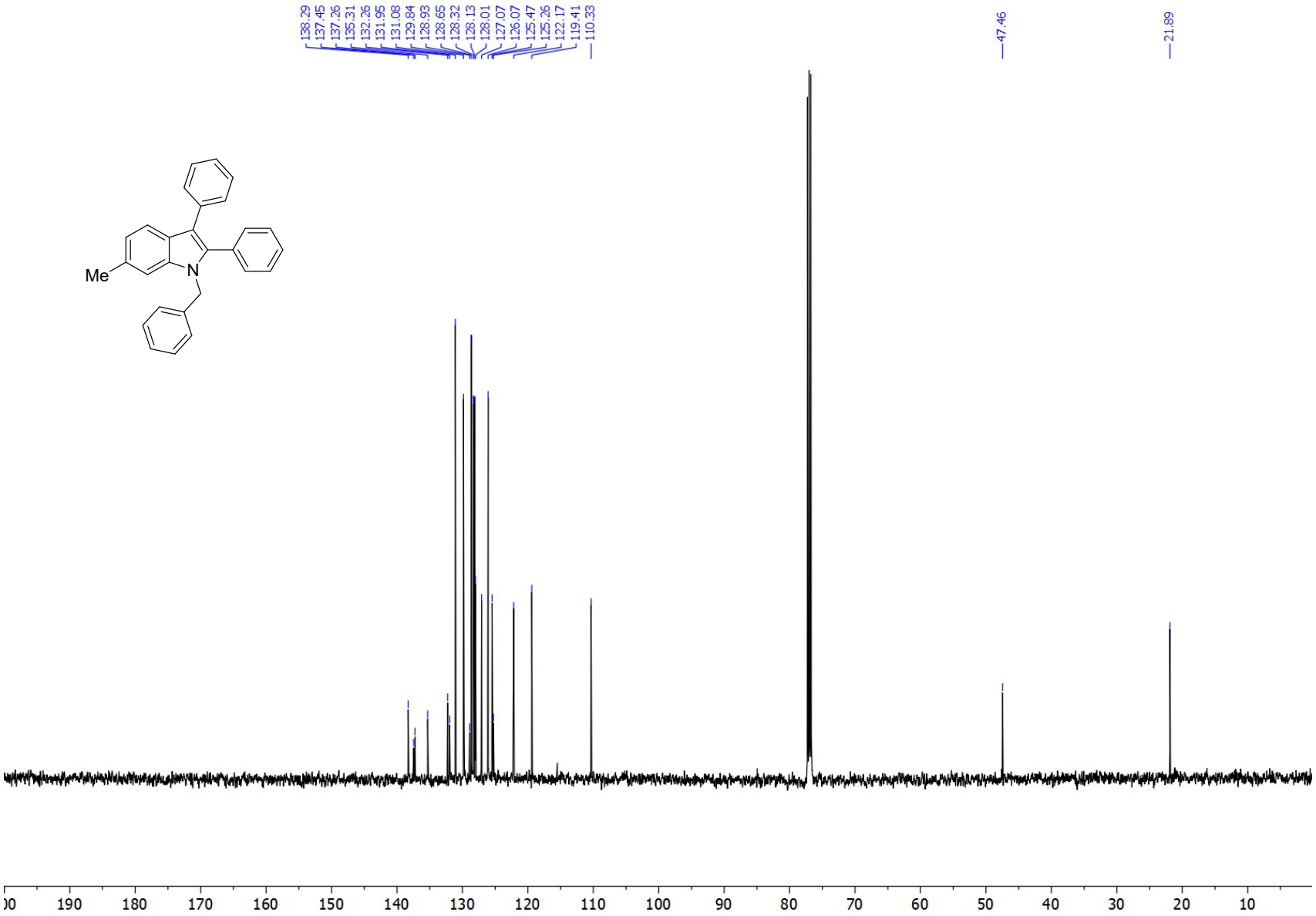
^{13}C NMR of compound **12** ($CDCl_3$, 125 MHz)



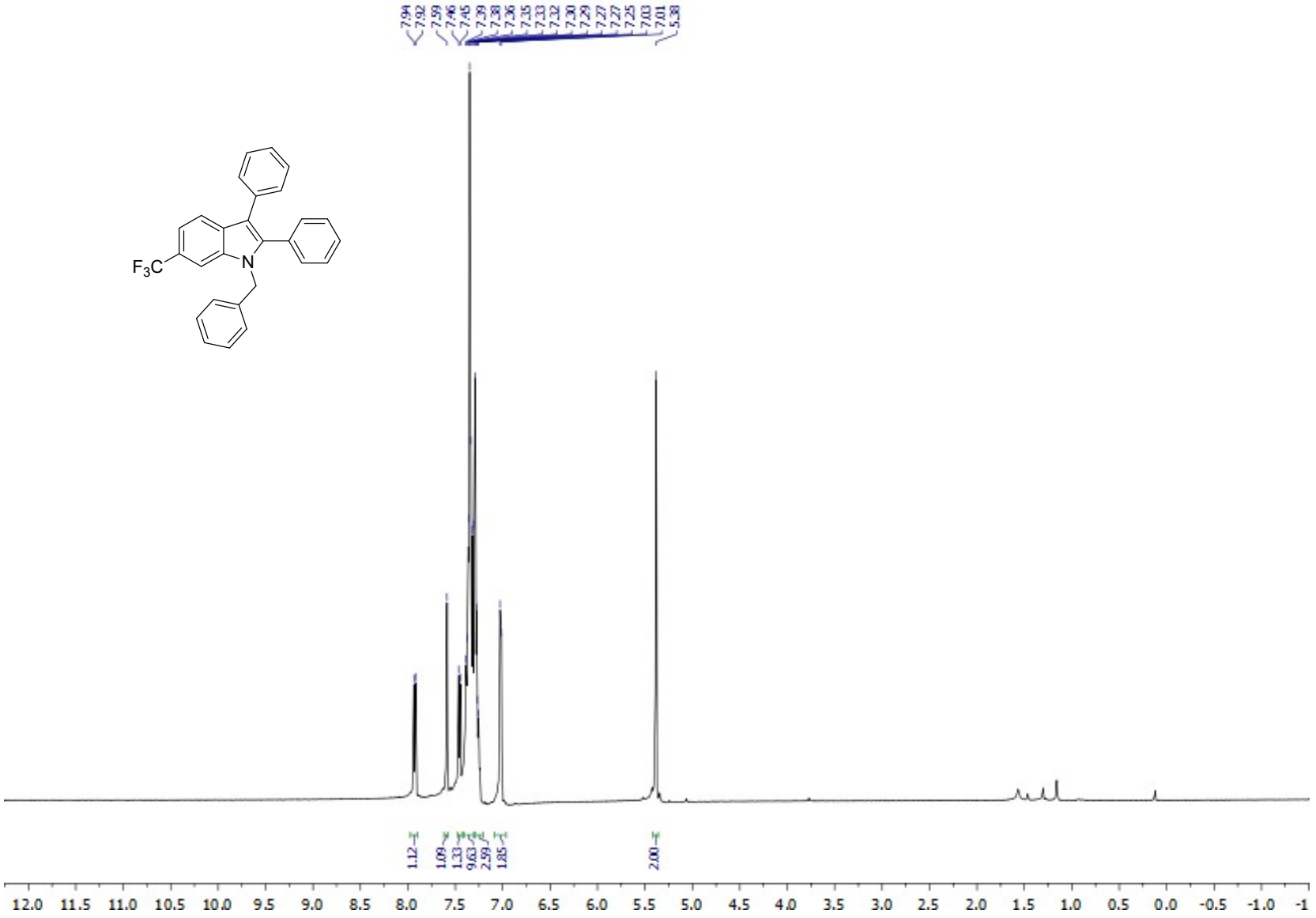
^{1}H NMR of Compound **13** ($CDCl_3$, 500 MHz)



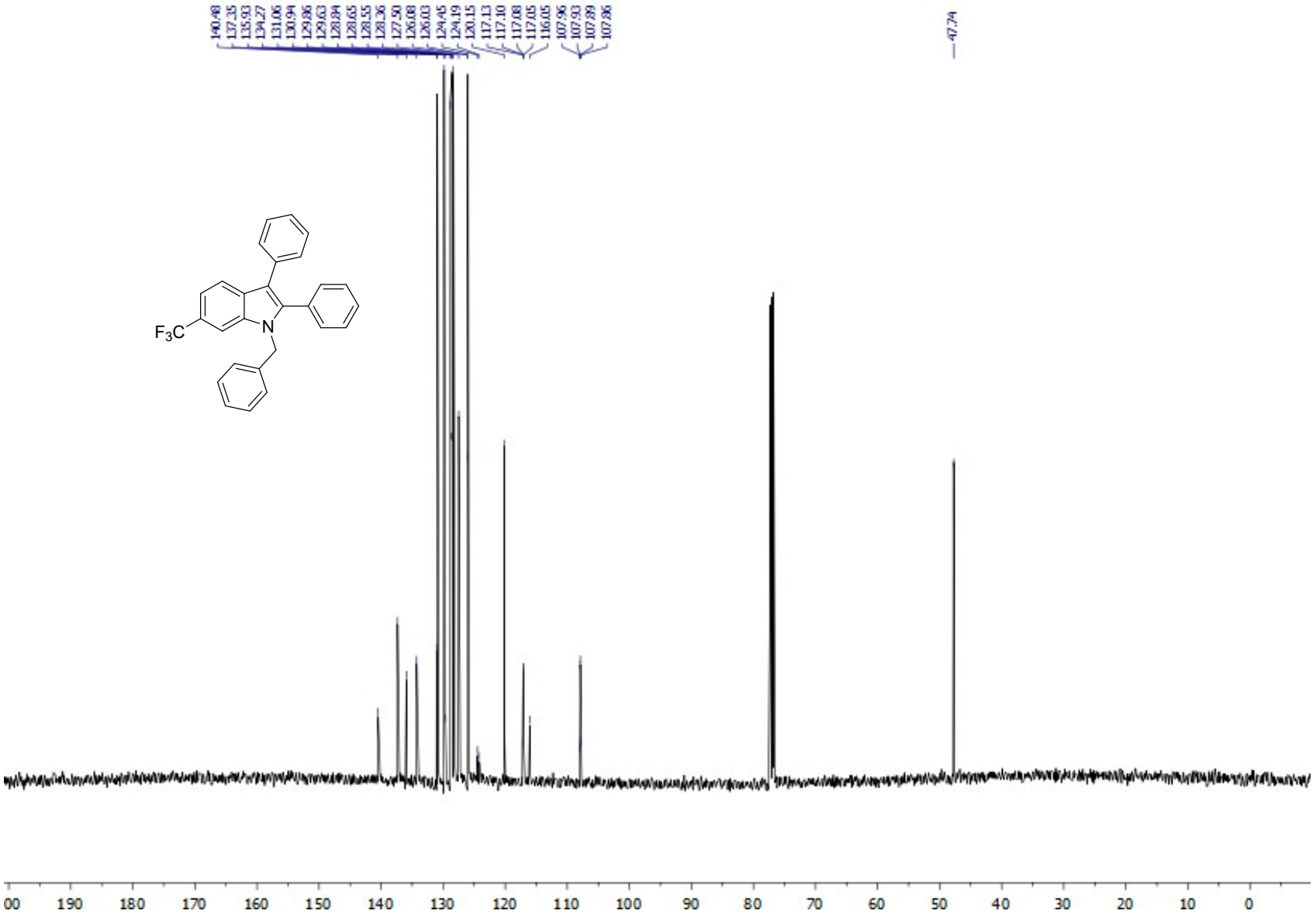
^{13}C NMR of compound **13** ($CDCl_3$, 125 MHz)



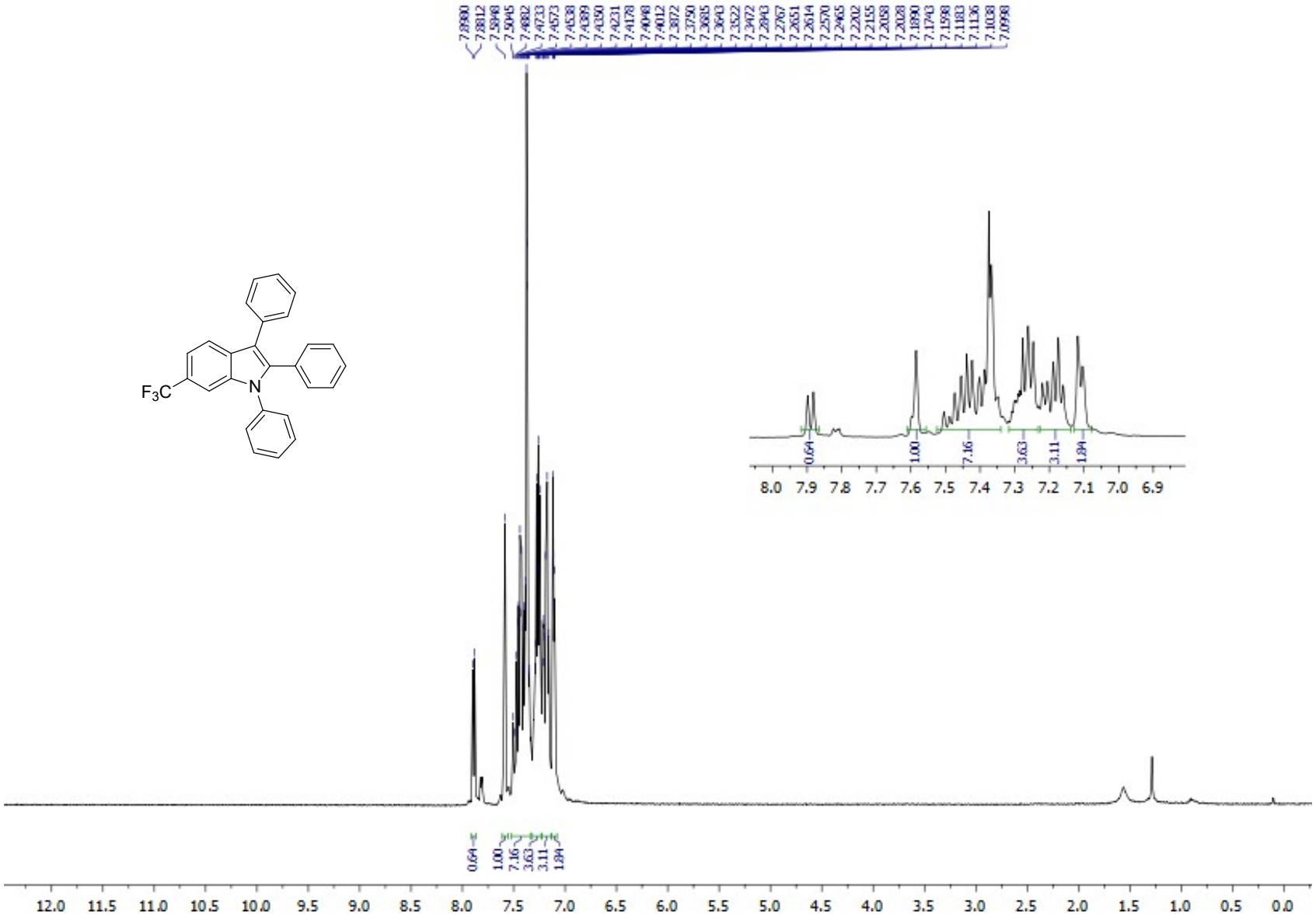
^{1}H NMR of Compound **14** ($CDCl_3$, 500 MHz)



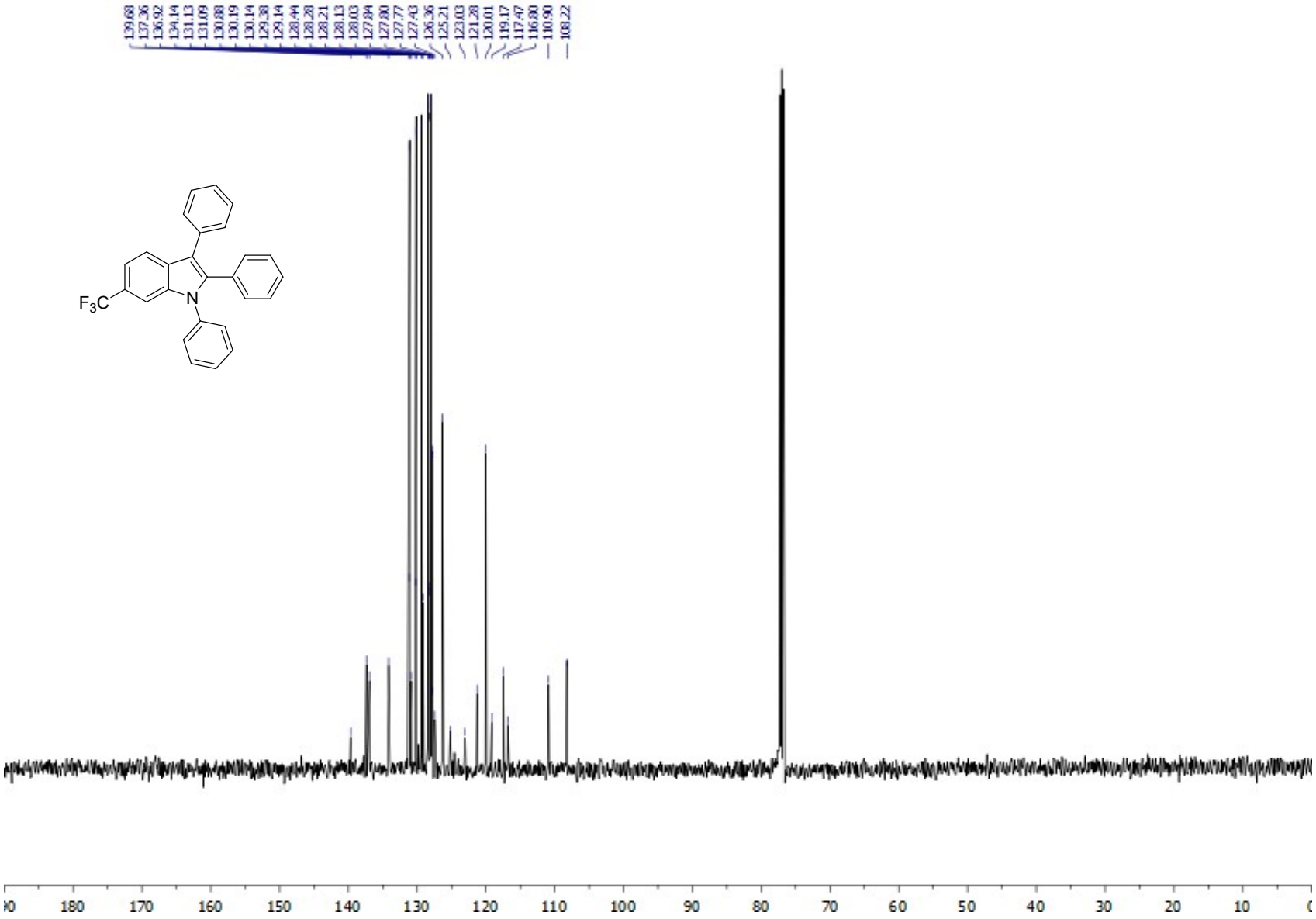
^{13}C NMR of compound **14** ($CDCl_3$, 125 MHz)



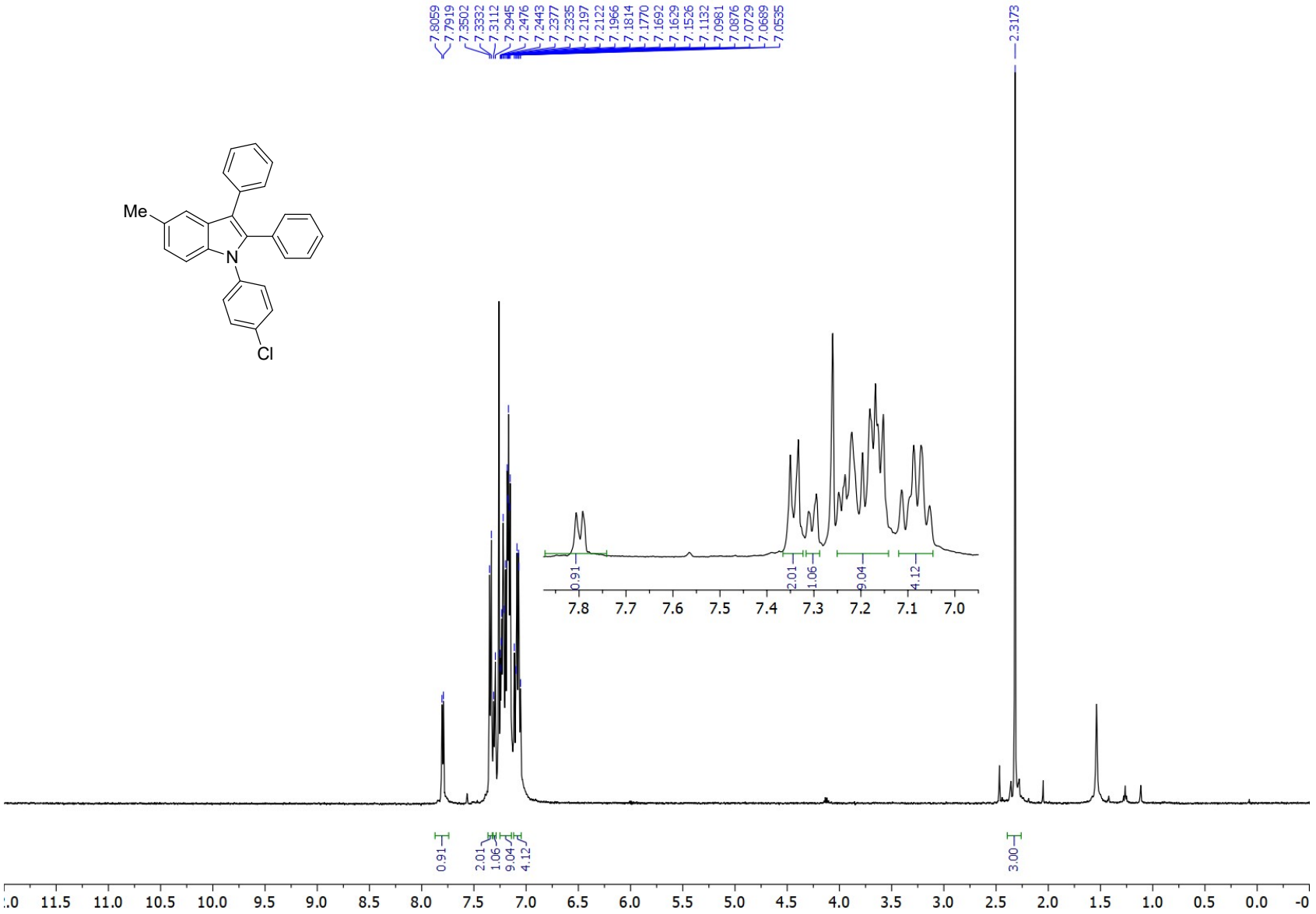
^{1}H NMR of Compound **15** ($CDCl_3$, 500 MHz)



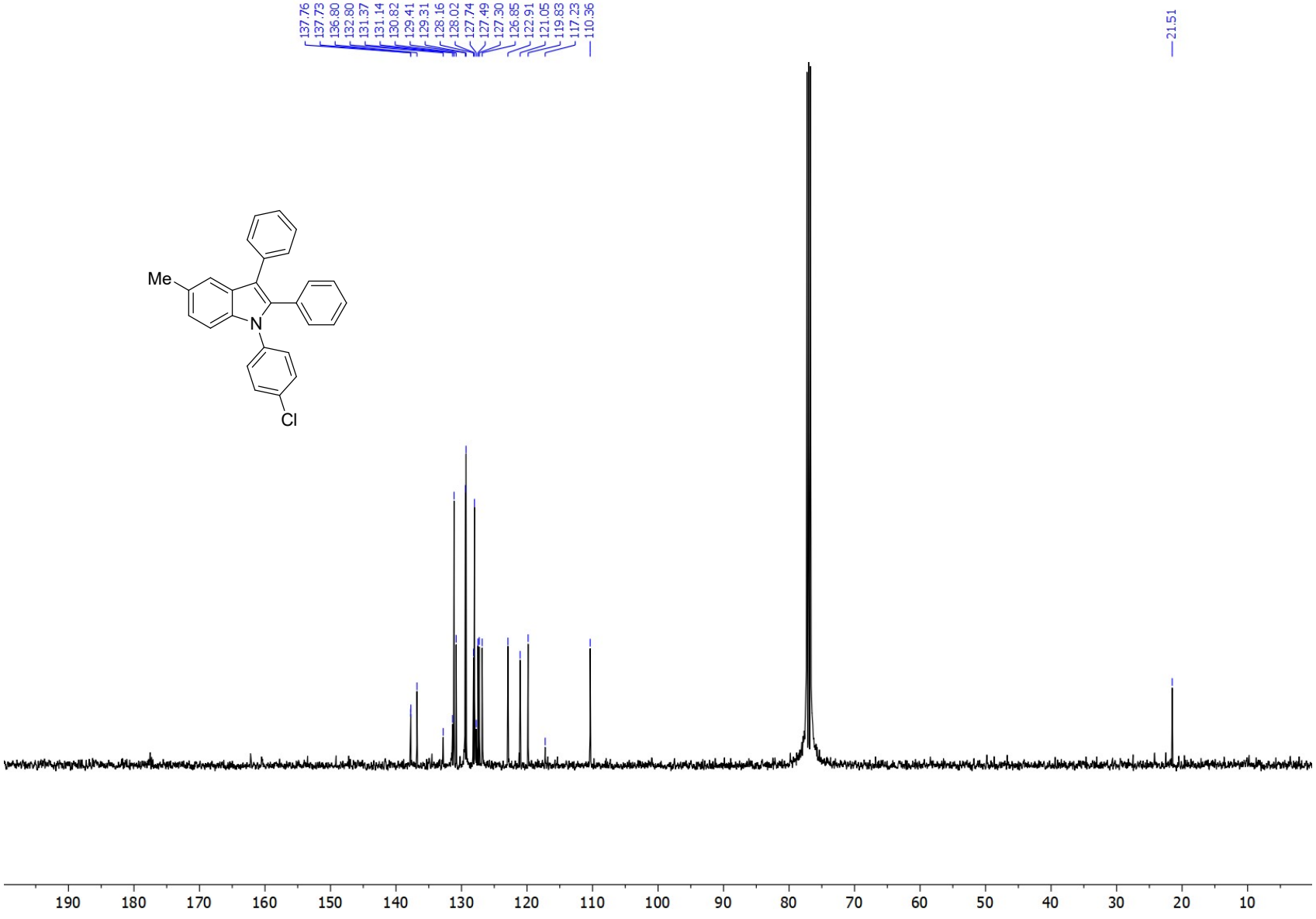
^{13}C NMR of compound **15** ($CDCl_3$, 125 MHz)



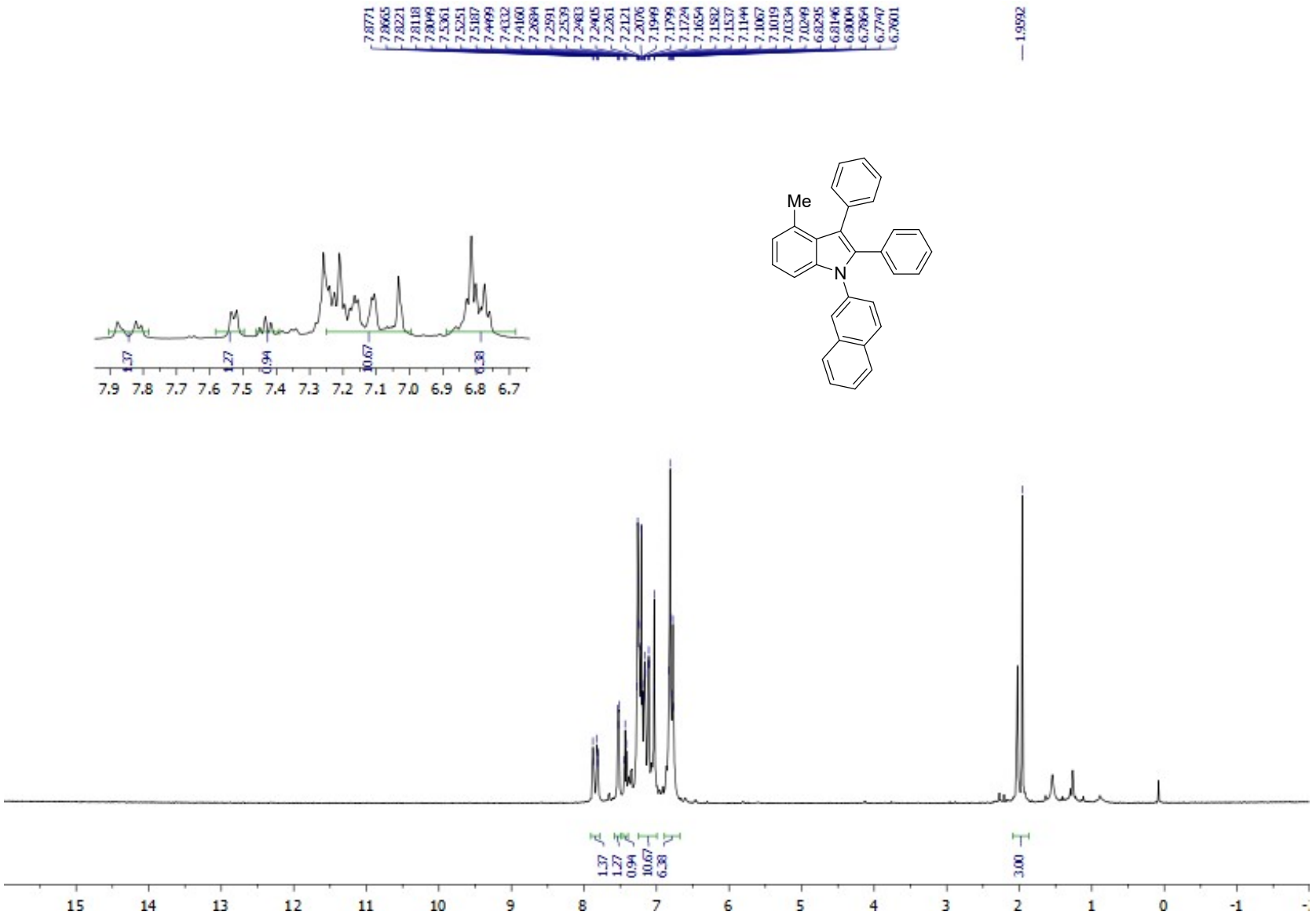
^{1}H NMR of Compound **16** ($CDCl_3$, 500 MHz)



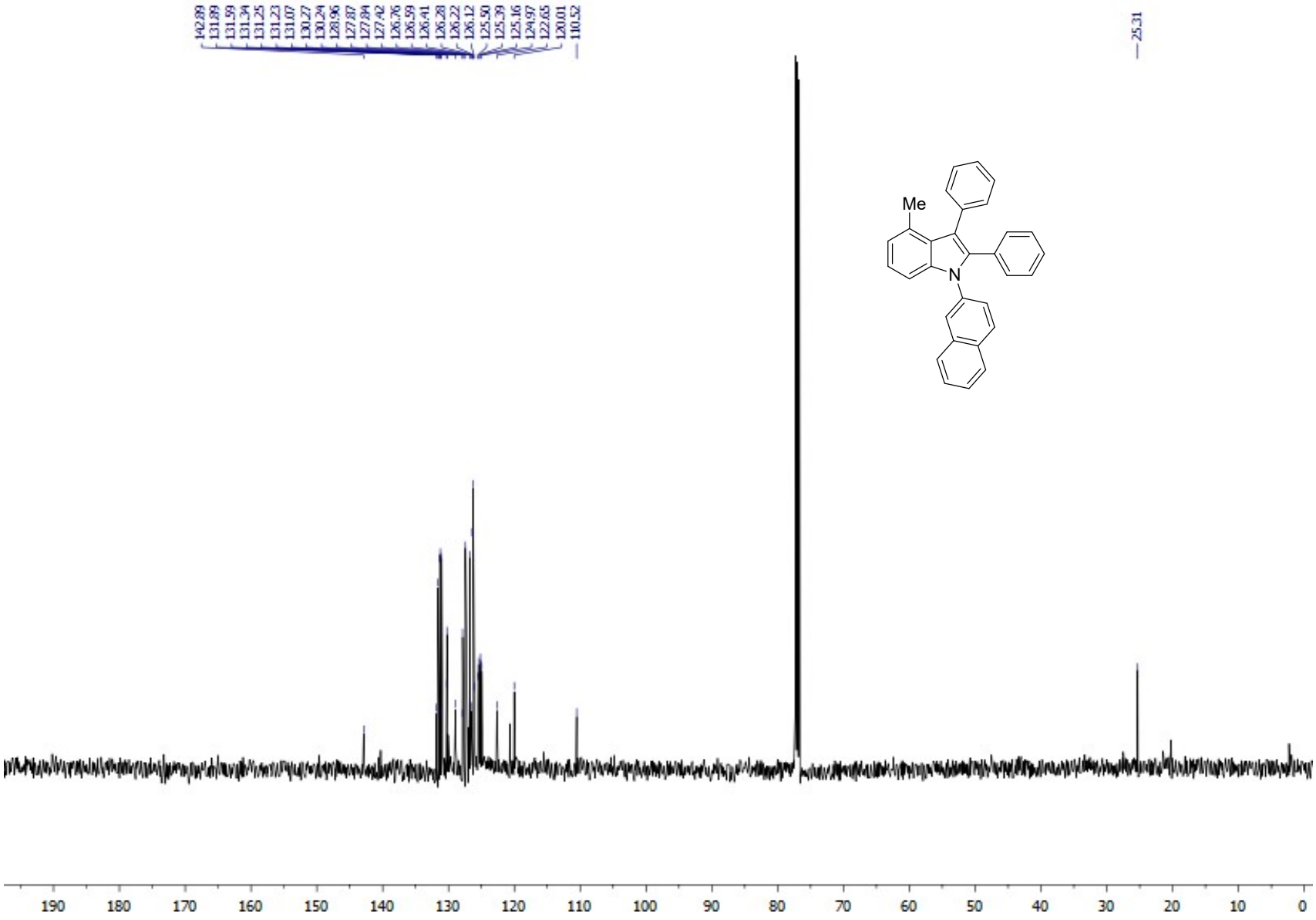
^{13}C NMR of compound **16** ($CDCl_3$, 125 MHz)



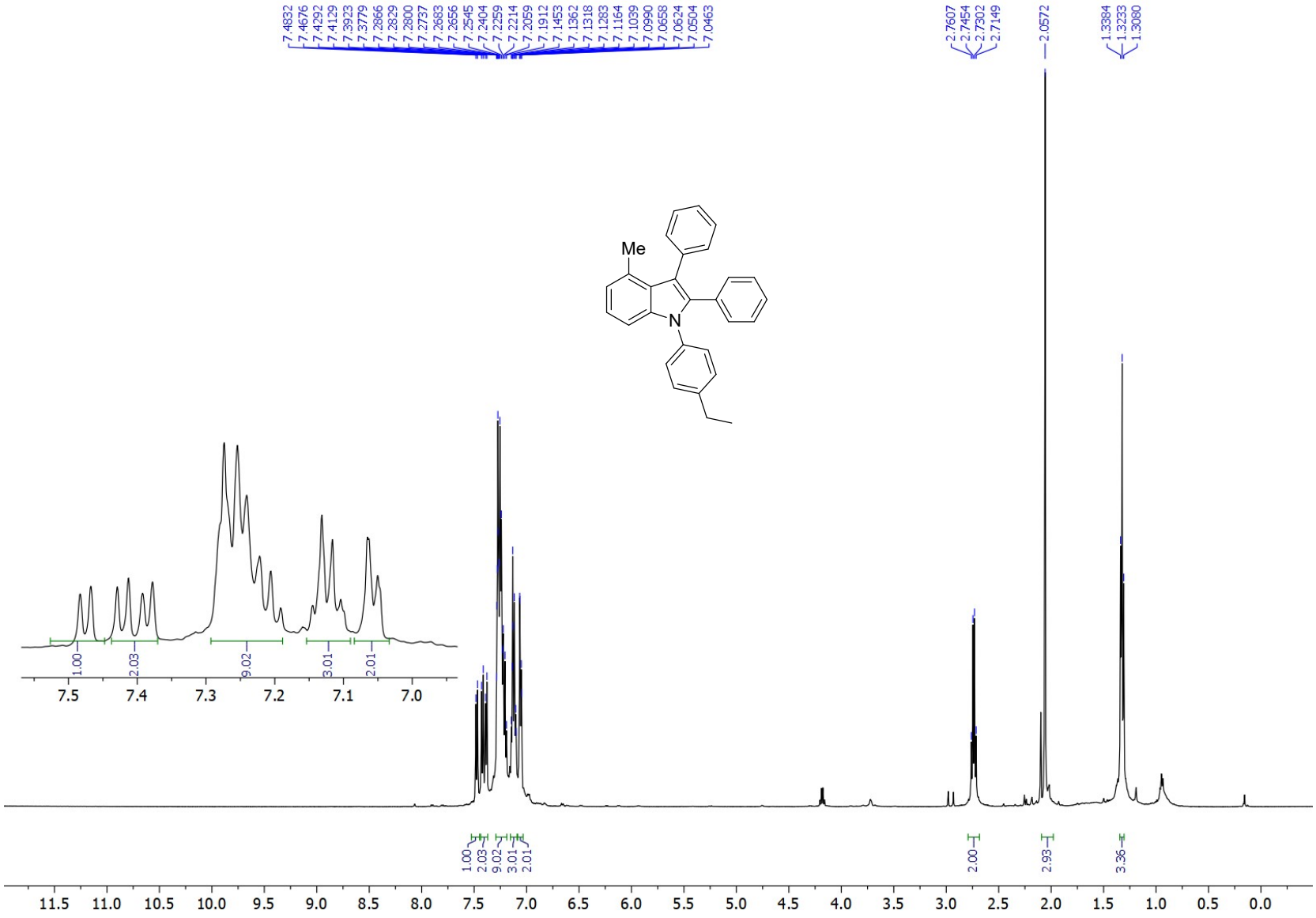
^{1}H NMR of Compound **17** ($CDCl_3$, 500 MHz)



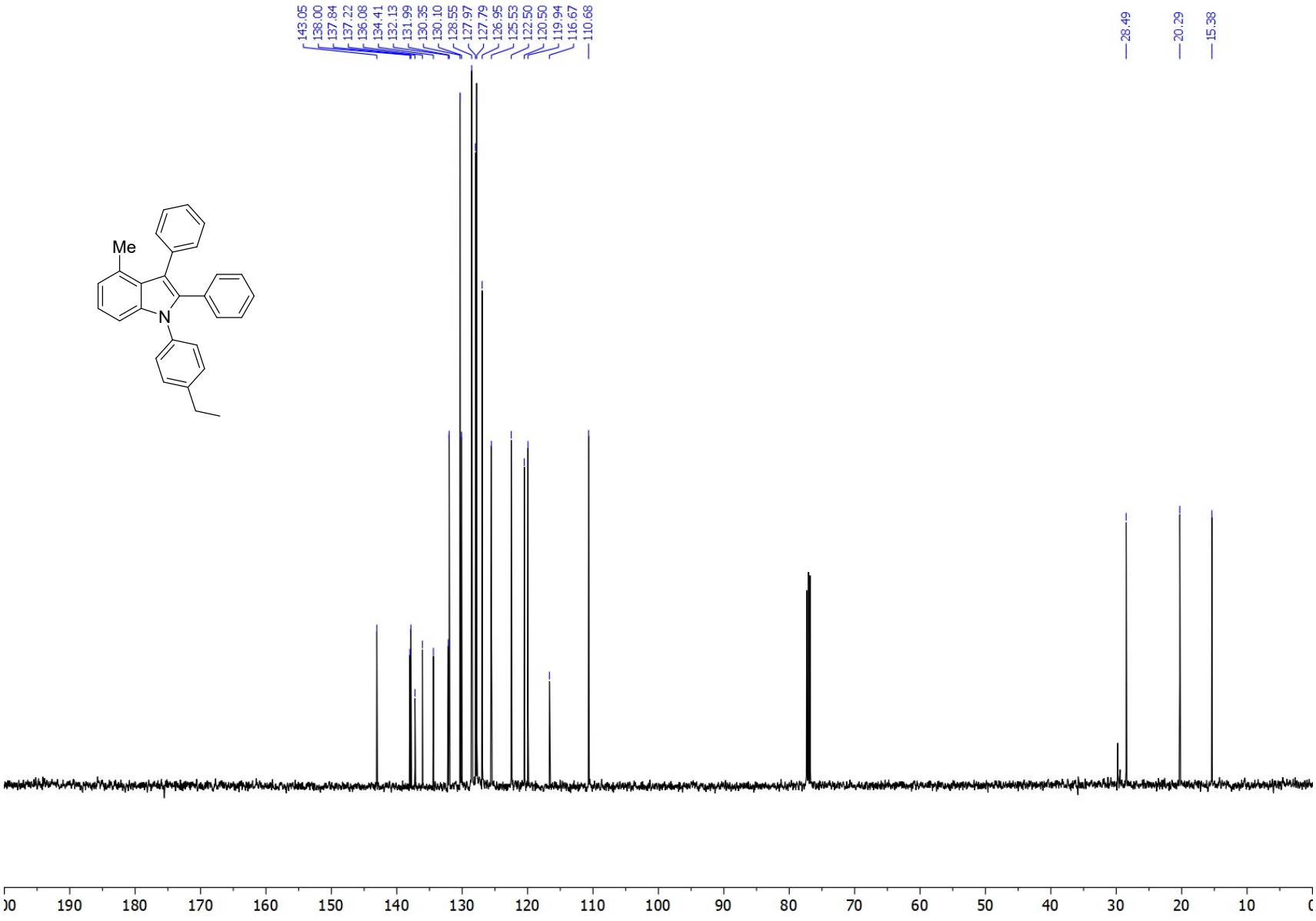
^{13}C NMR of compound **17** ($CDCl_3$, 125 MHz)



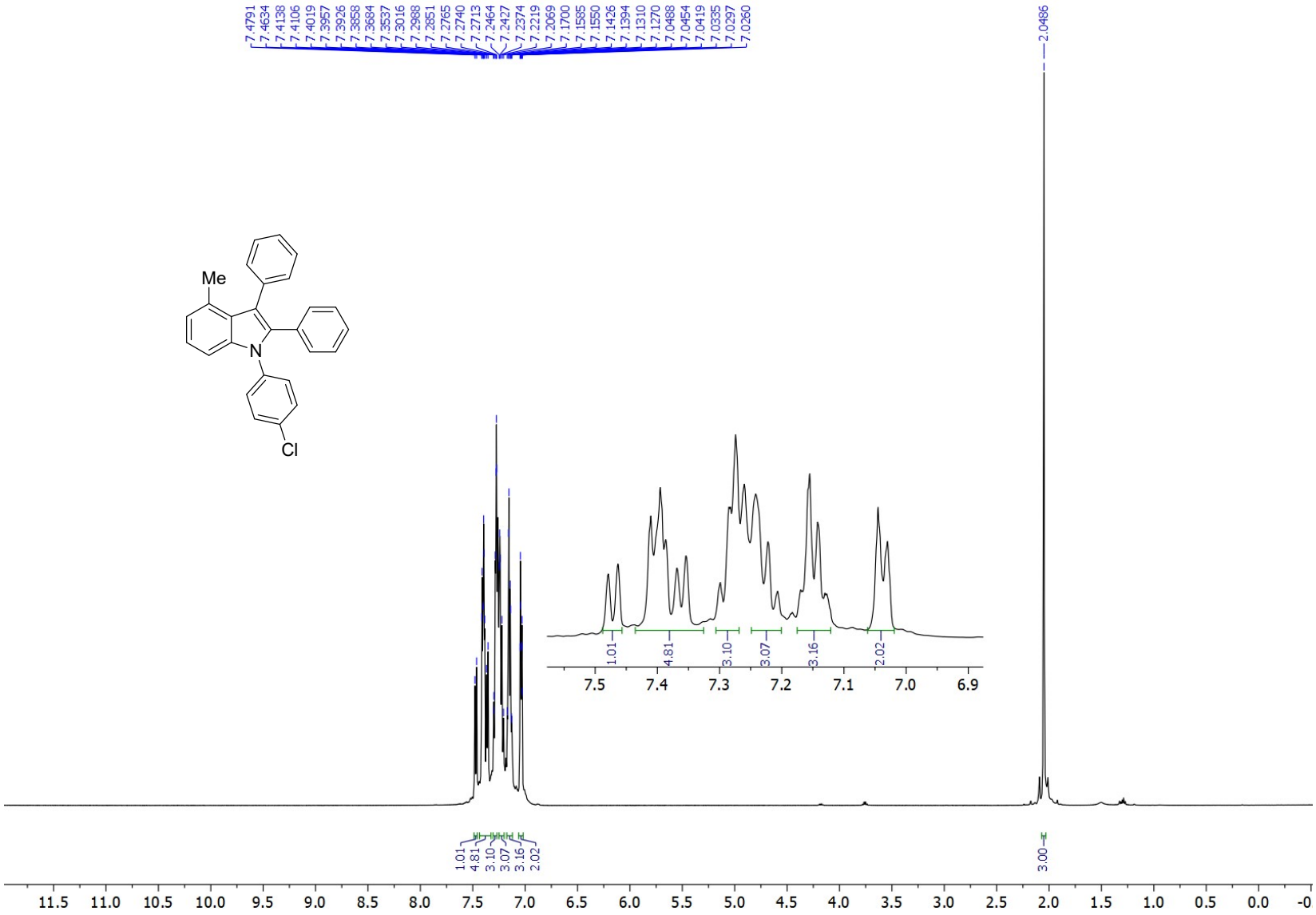
^{1}H NMR of Compound **18** ($CDCl_3$, 500 MHz)



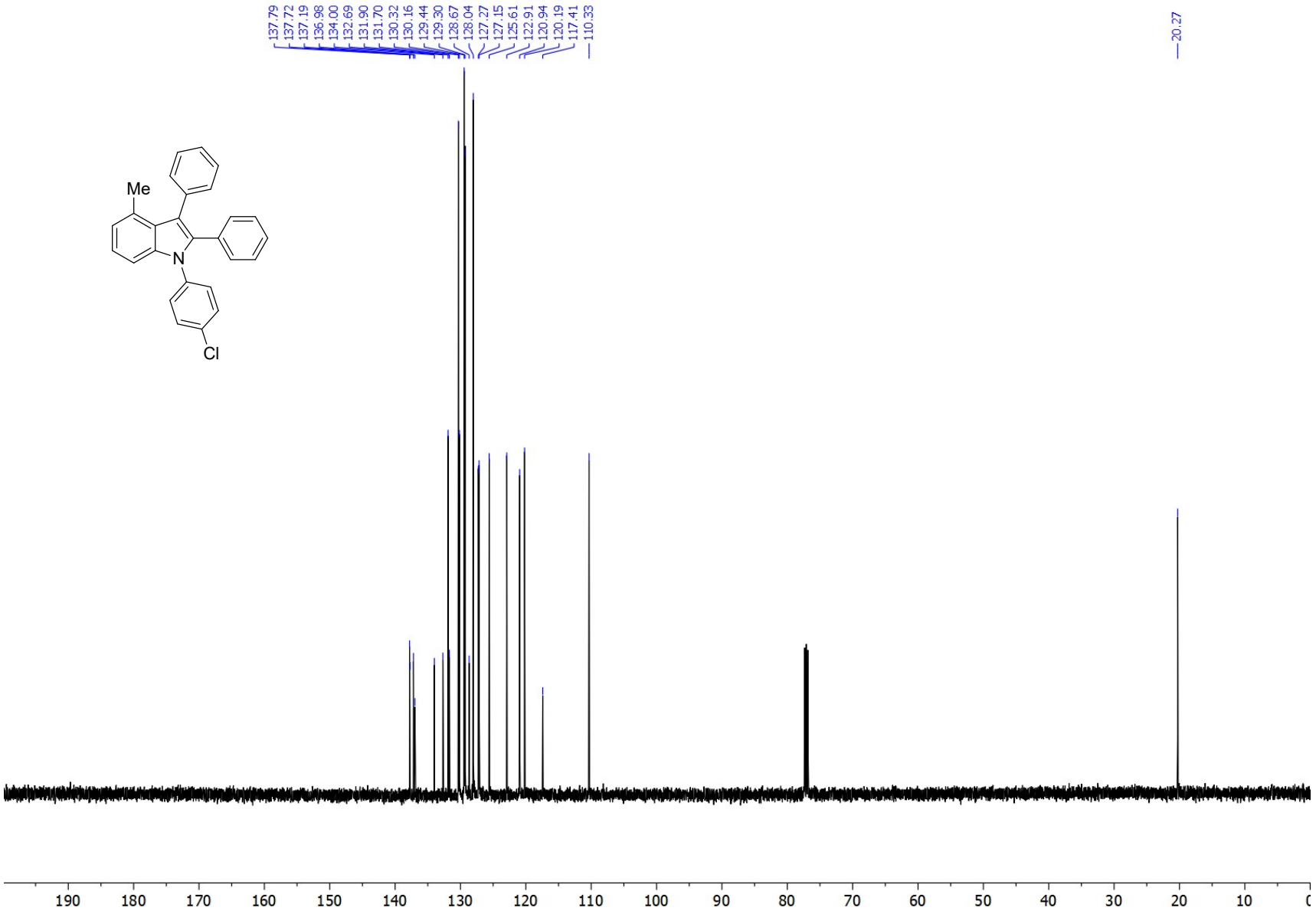
^{13}C NMR of compound **18** ($CDCl_3$, 125 MHz)



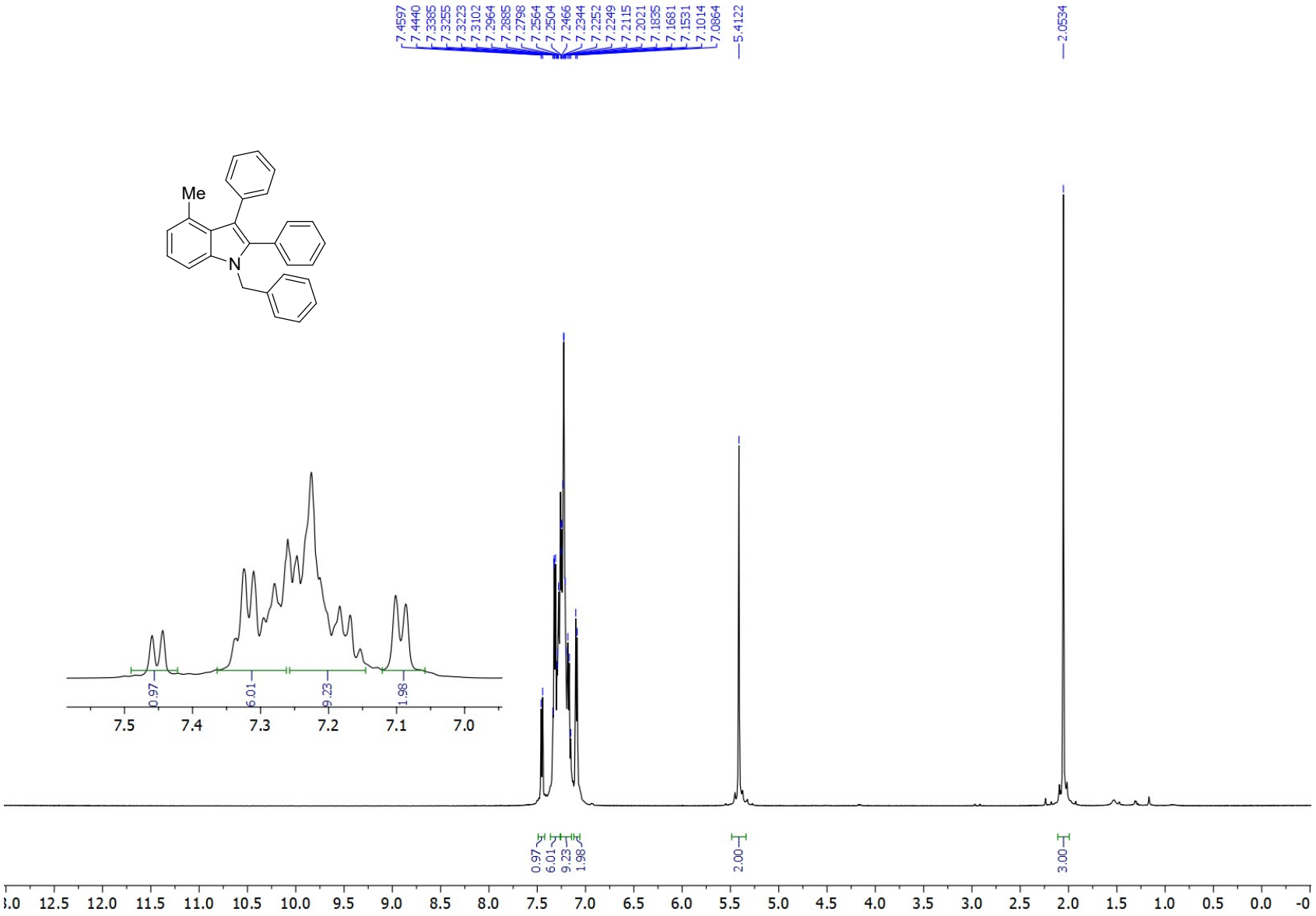
^{1}H NMR of Compound **19** ($CDCl_3$, 500 MHz)



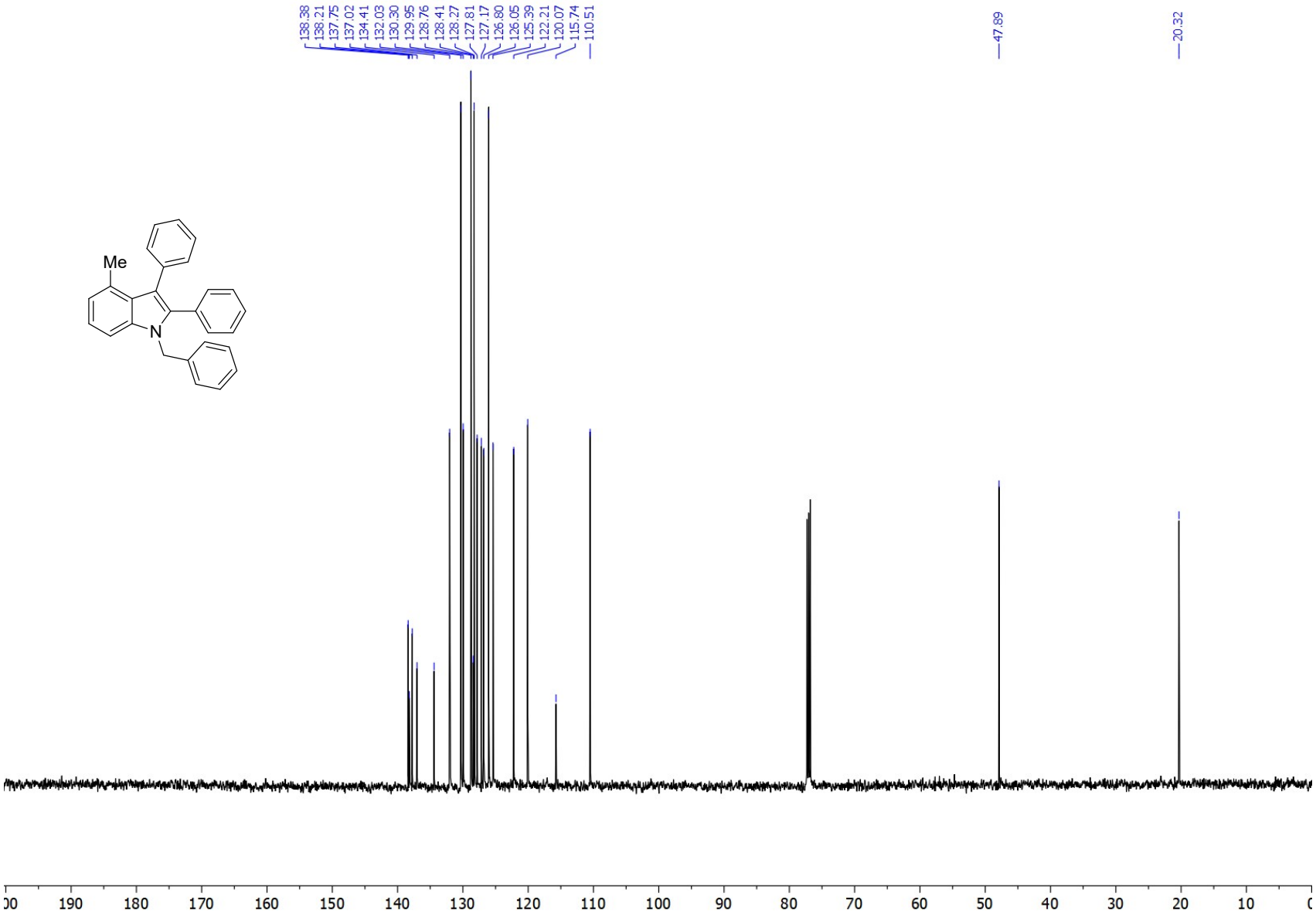
^{13}C NMR of compound **19** ($CDCl_3$, 125 MHz)



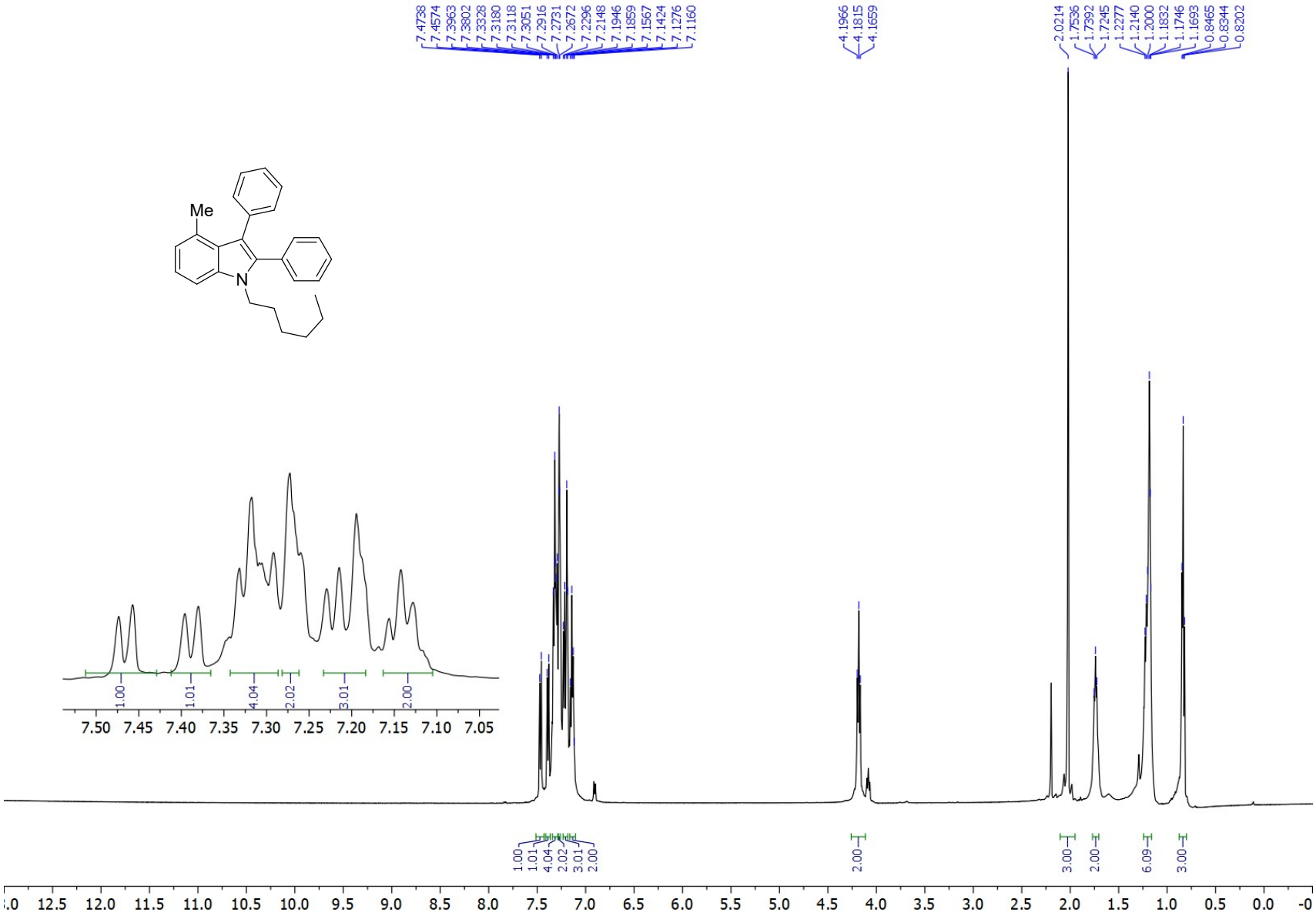
^{1}H NMR of Compound **20** ($CDCl_3$, 500 MHz)



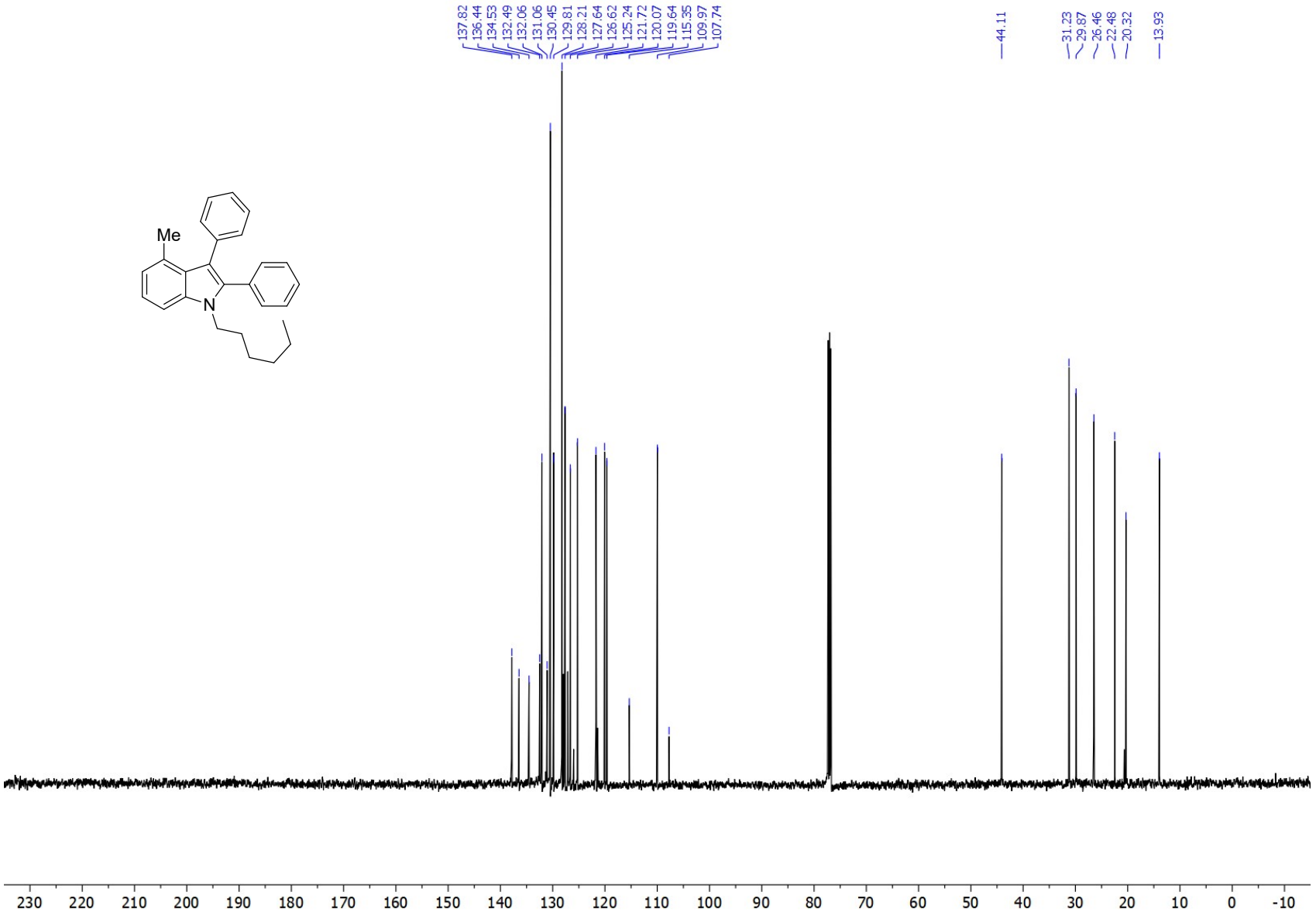
^{13}C NMR of compound **20** ($CDCl_3$, 125 MHz)



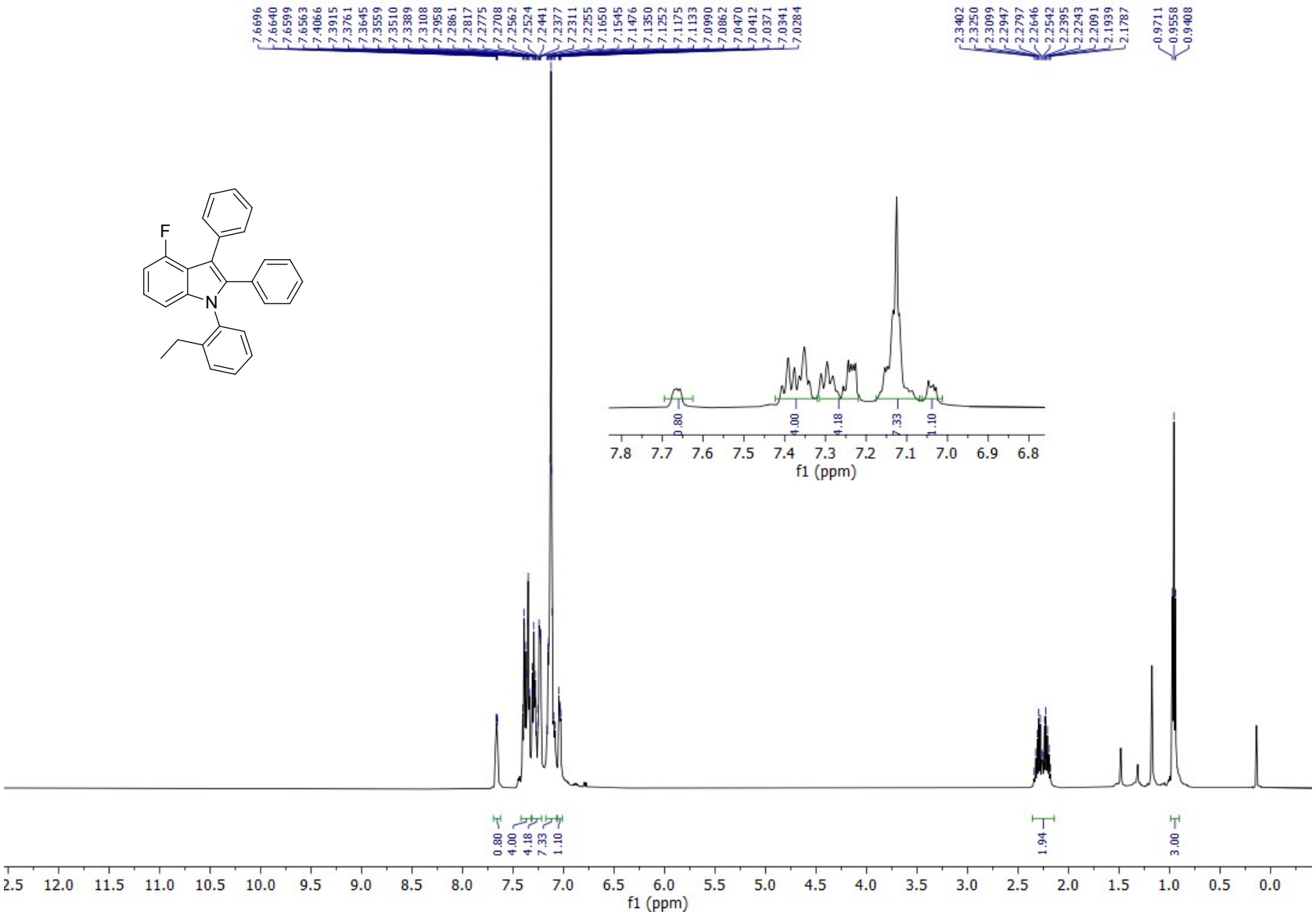
^{1}H NMR of Compound **21** ($CDCl_3$, 500 MHz)



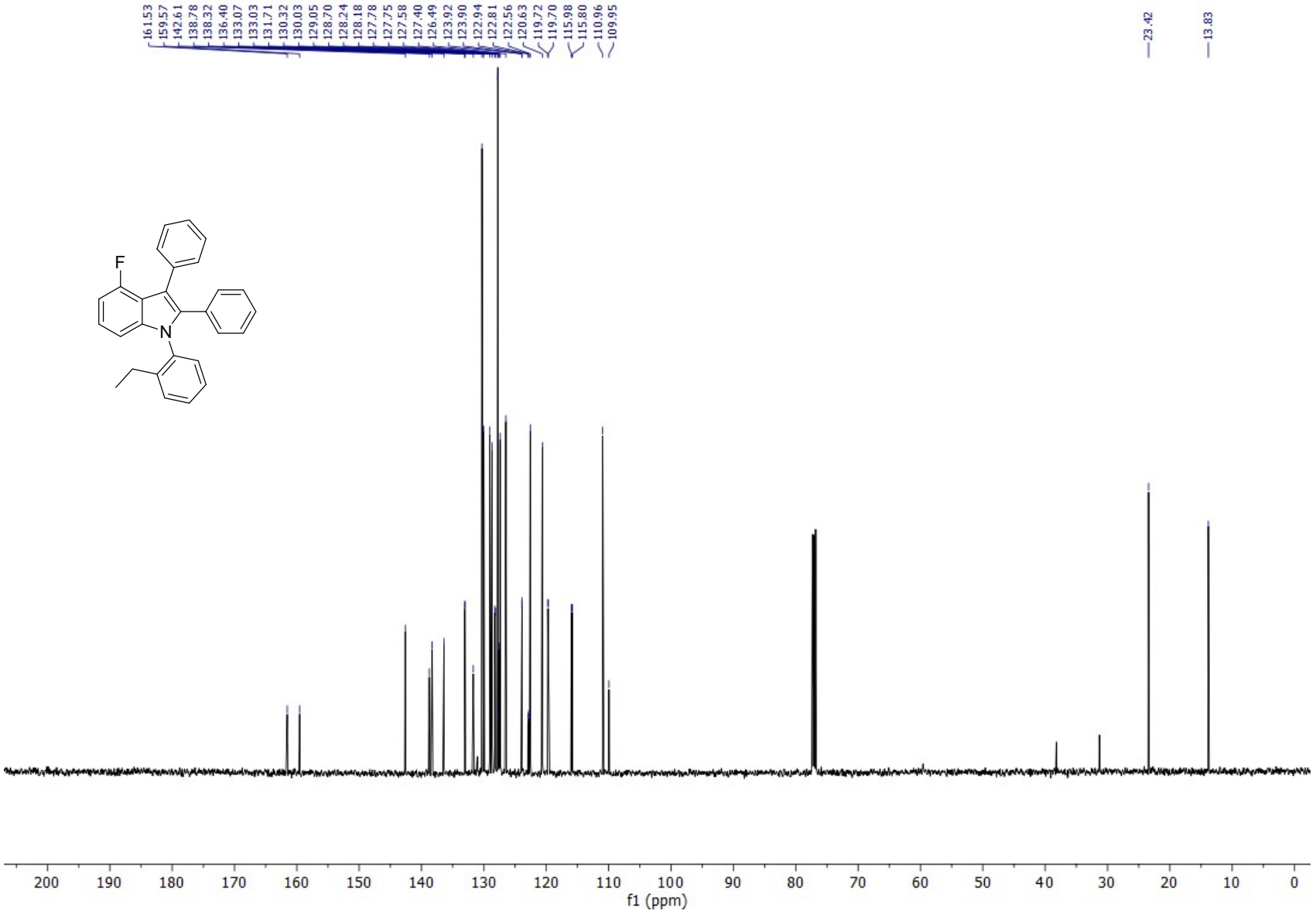
^{13}C NMR of compound **21** ($CDCl_3$, 125 MHz)



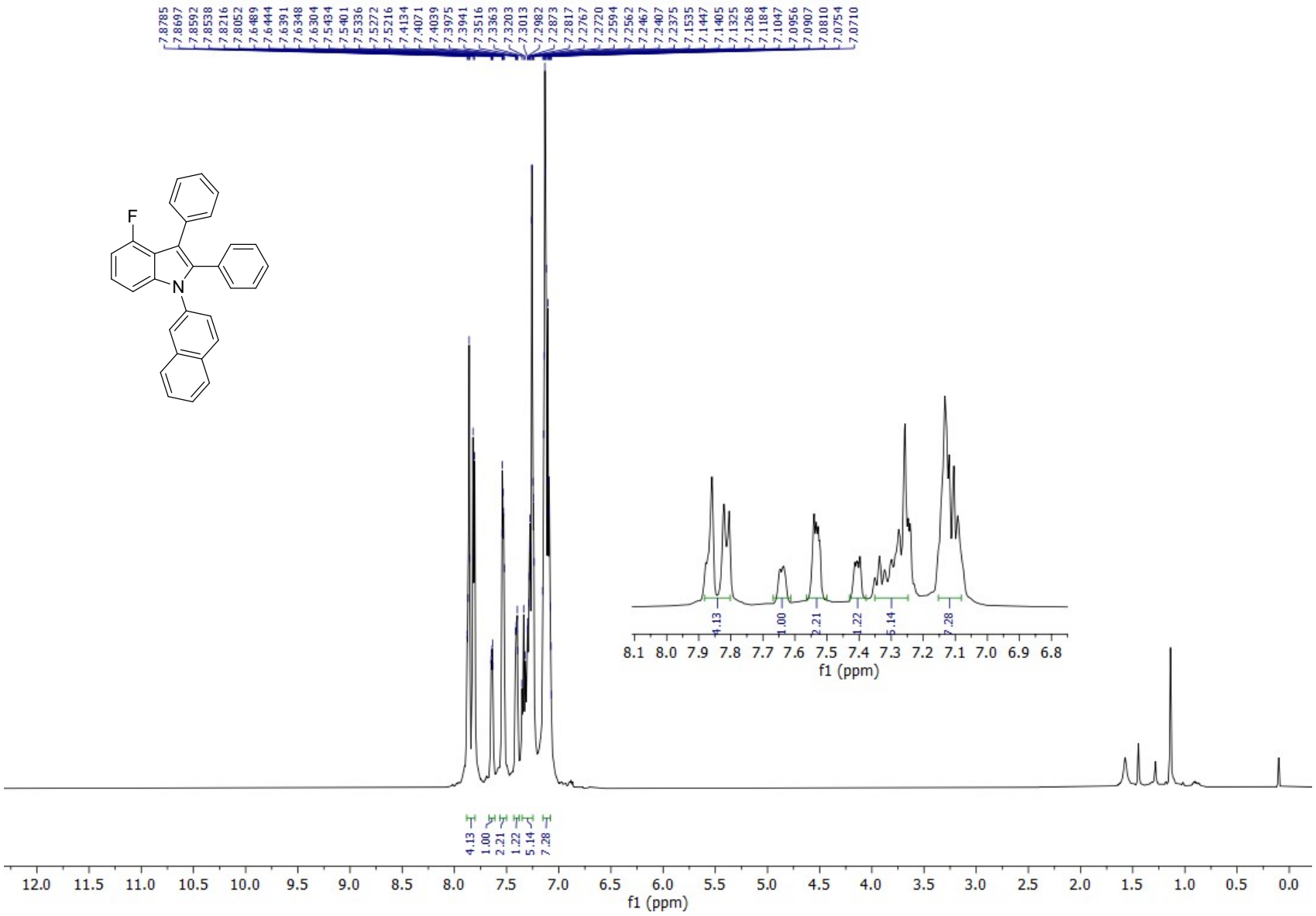
^{1}H NMR of Compound **22** ($CDCl_3$, 500 MHz)



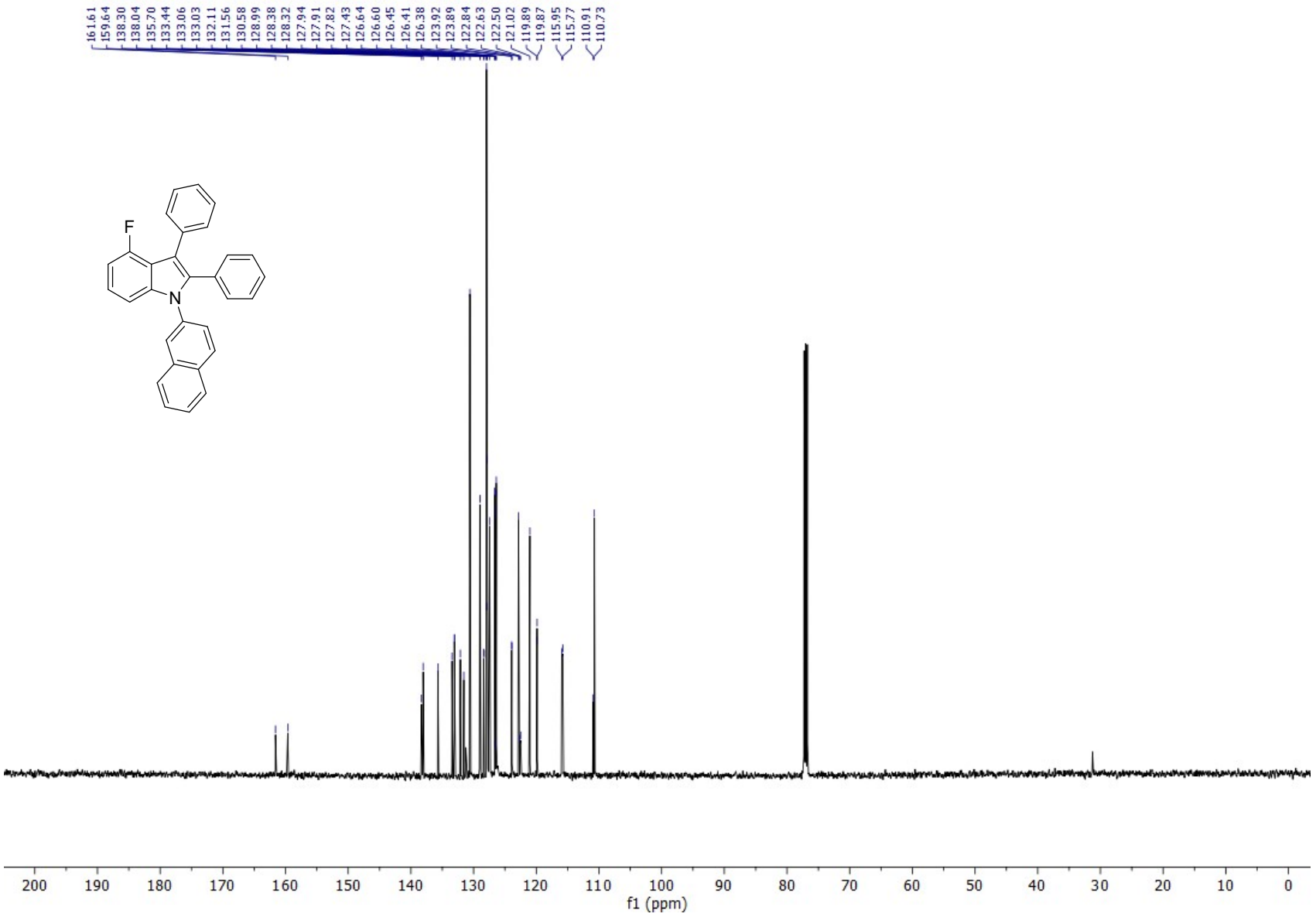
^{13}C NMR of compound **22** ($CDCl_3$, 125 MHz)



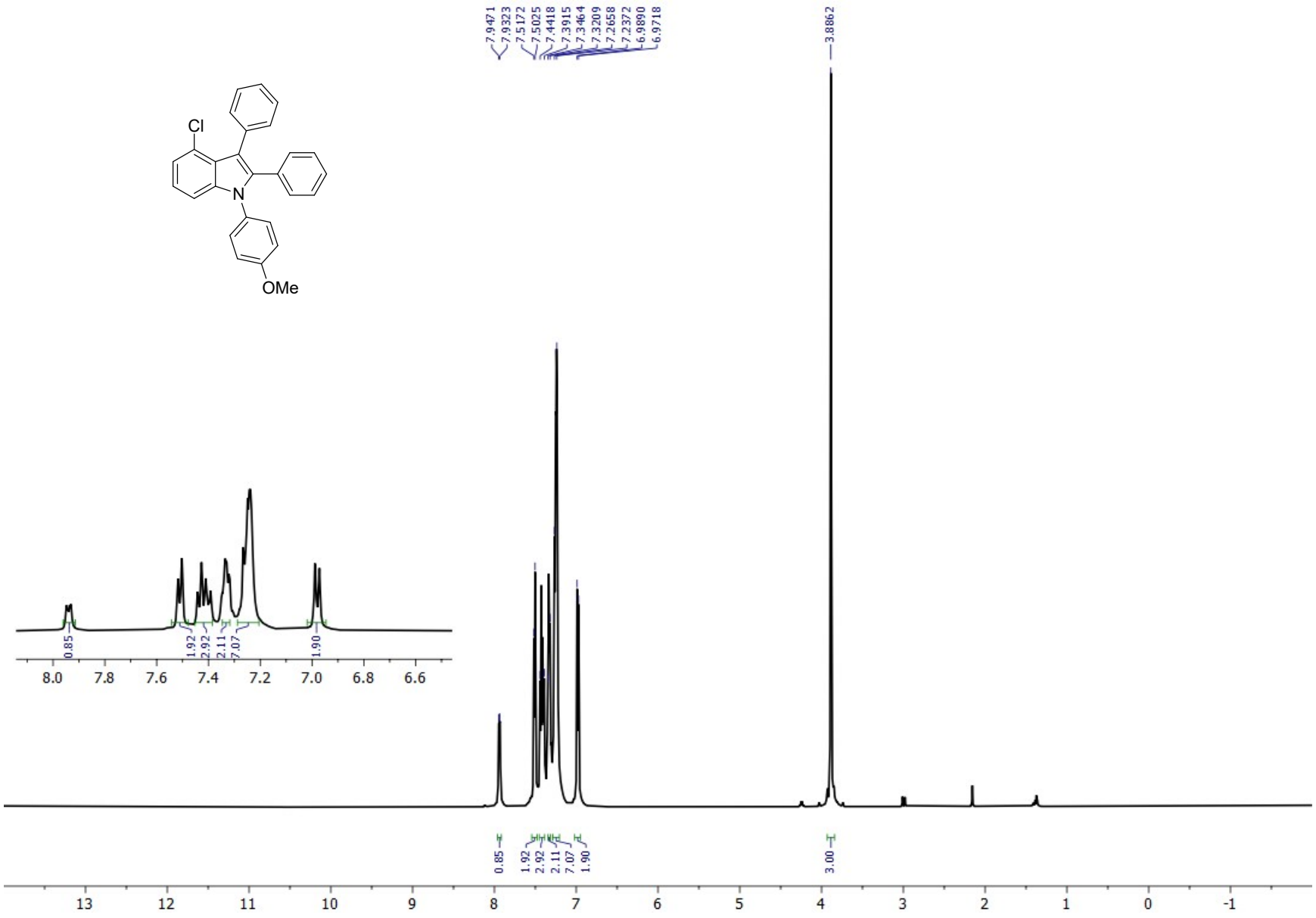
^{1}H NMR of Compound **23** ($CDCl_3$, 500 MHz)



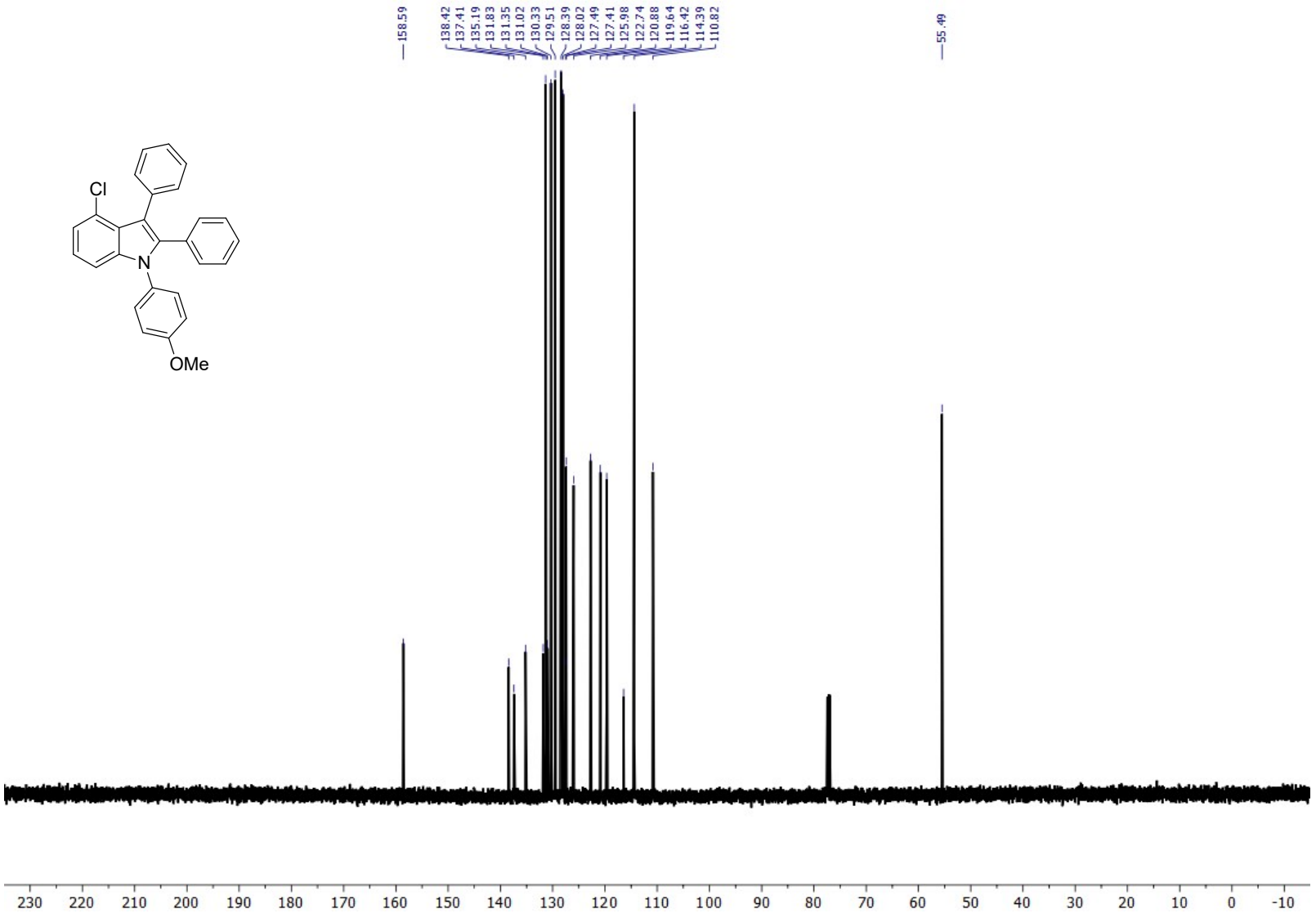
^{13}C NMR of compound **23** ($CDCl_3$, 125 MHz)



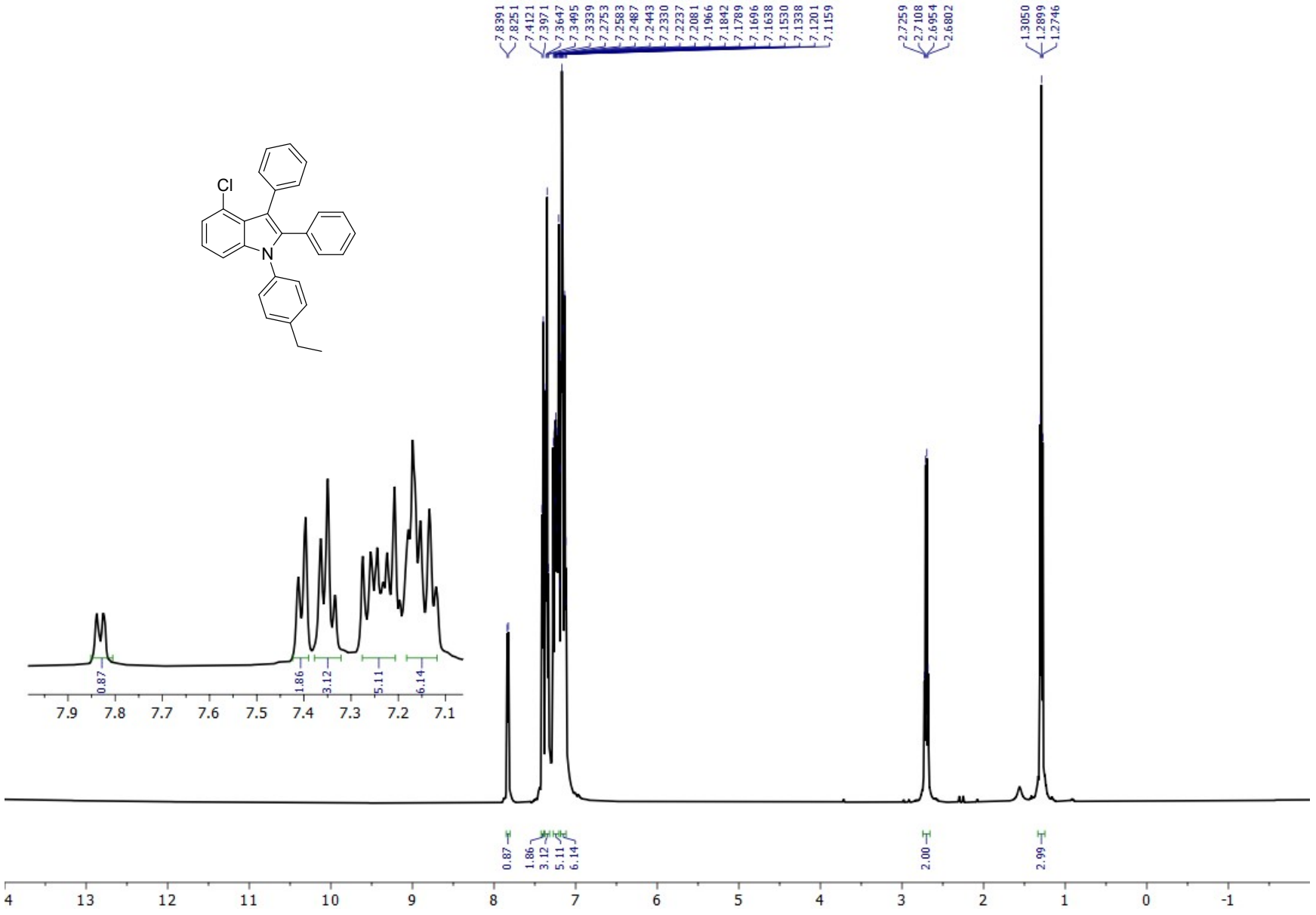
^{1}H NMR of Compound **24** ($CDCl_3$, 500 MHz)



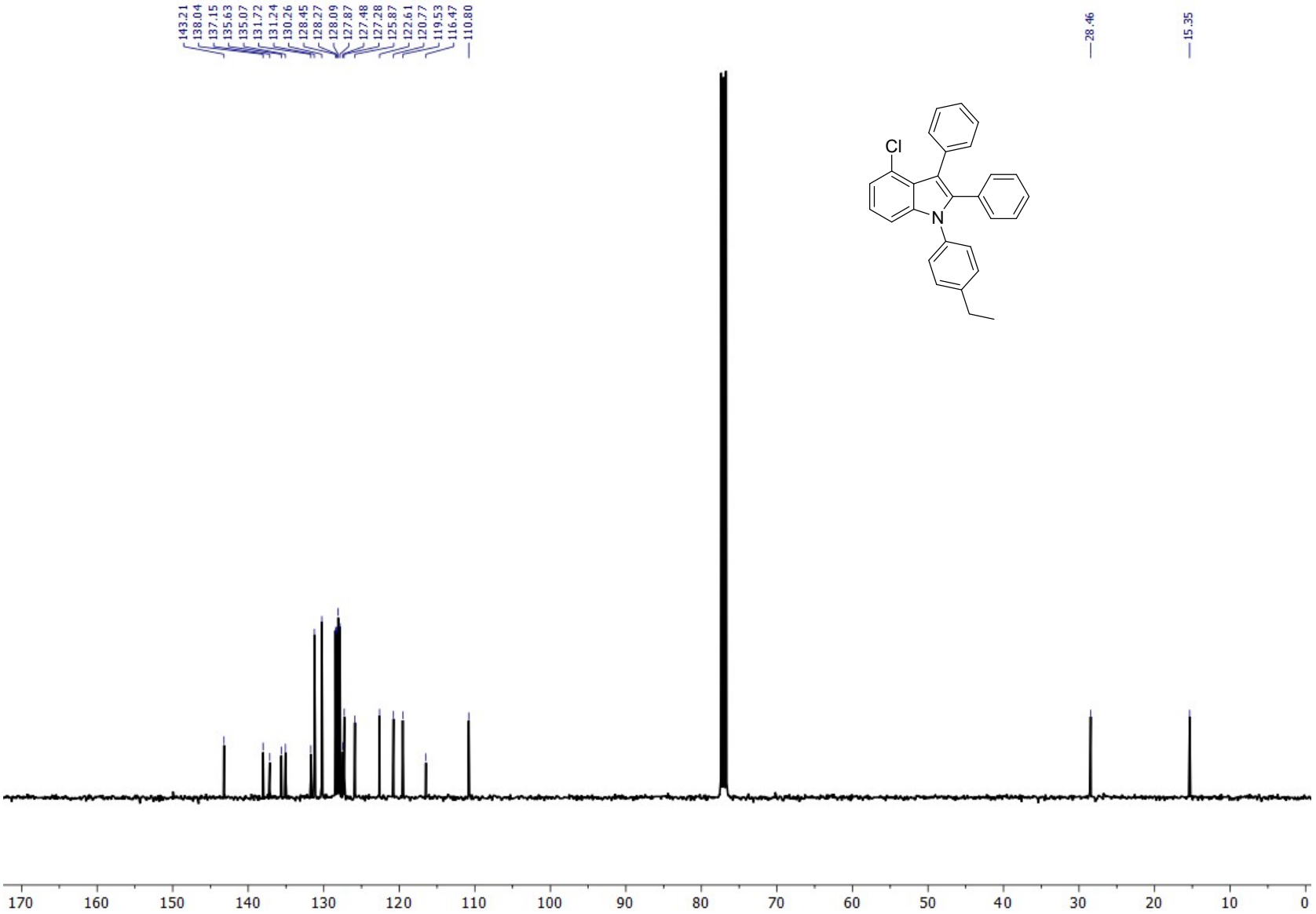
^{13}C NMR of compound **24** ($CDCl_3$, 125 MHz)



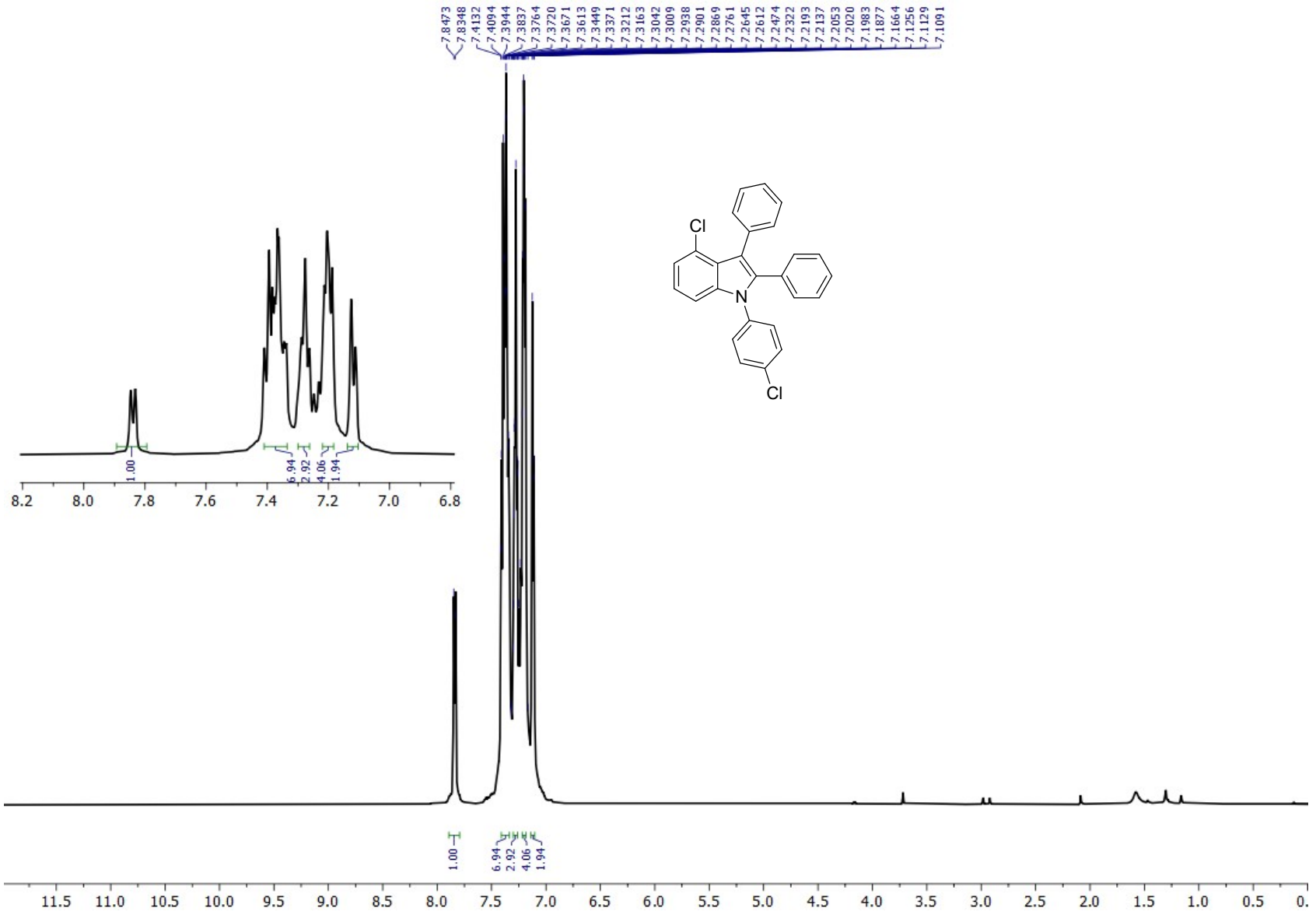
^{1}H NMR of Compound **25** ($CDCl_3$, 500 MHz)



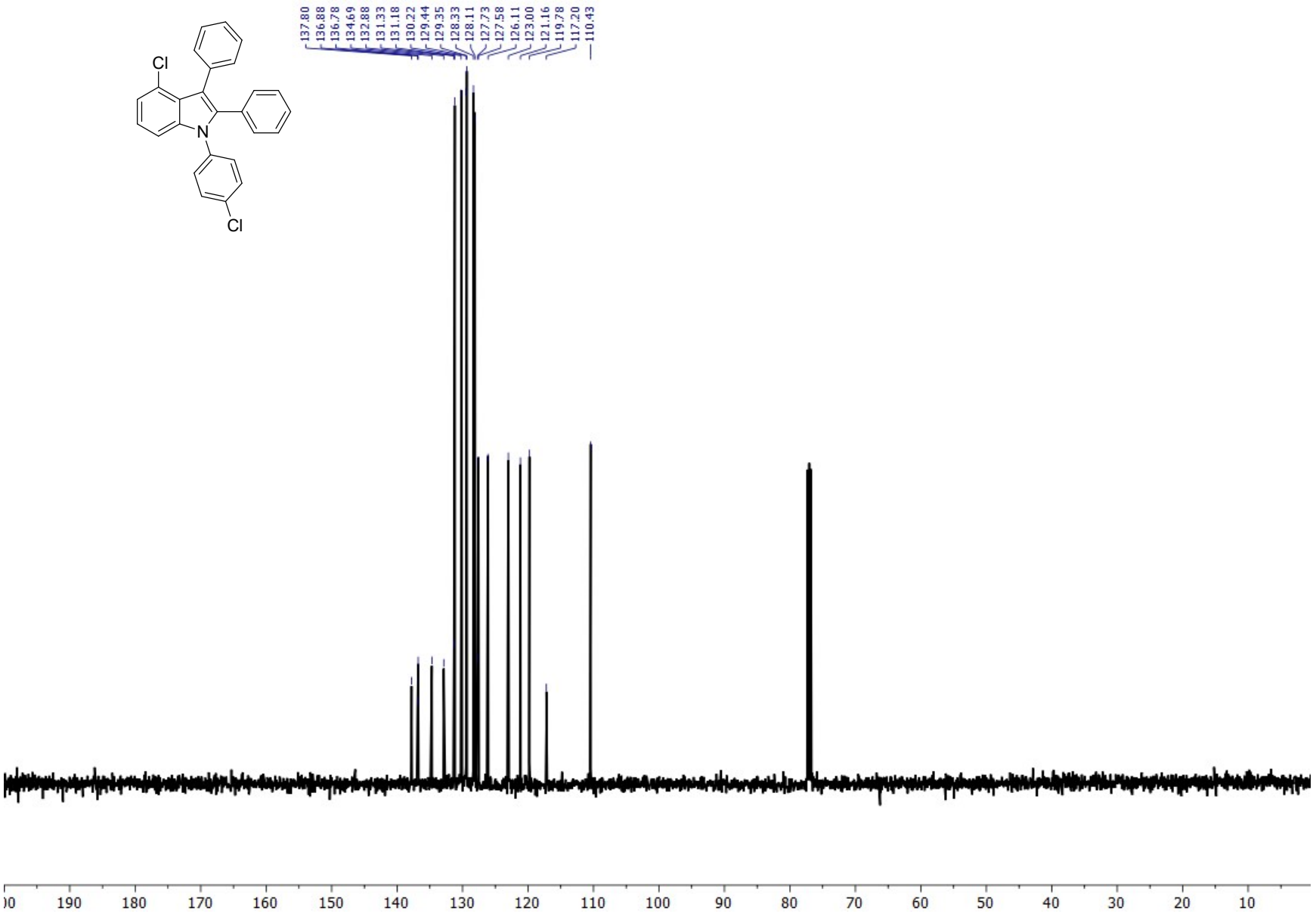
^{13}C NMR of compound **25** ($CDCl_3$, 125 MHz)



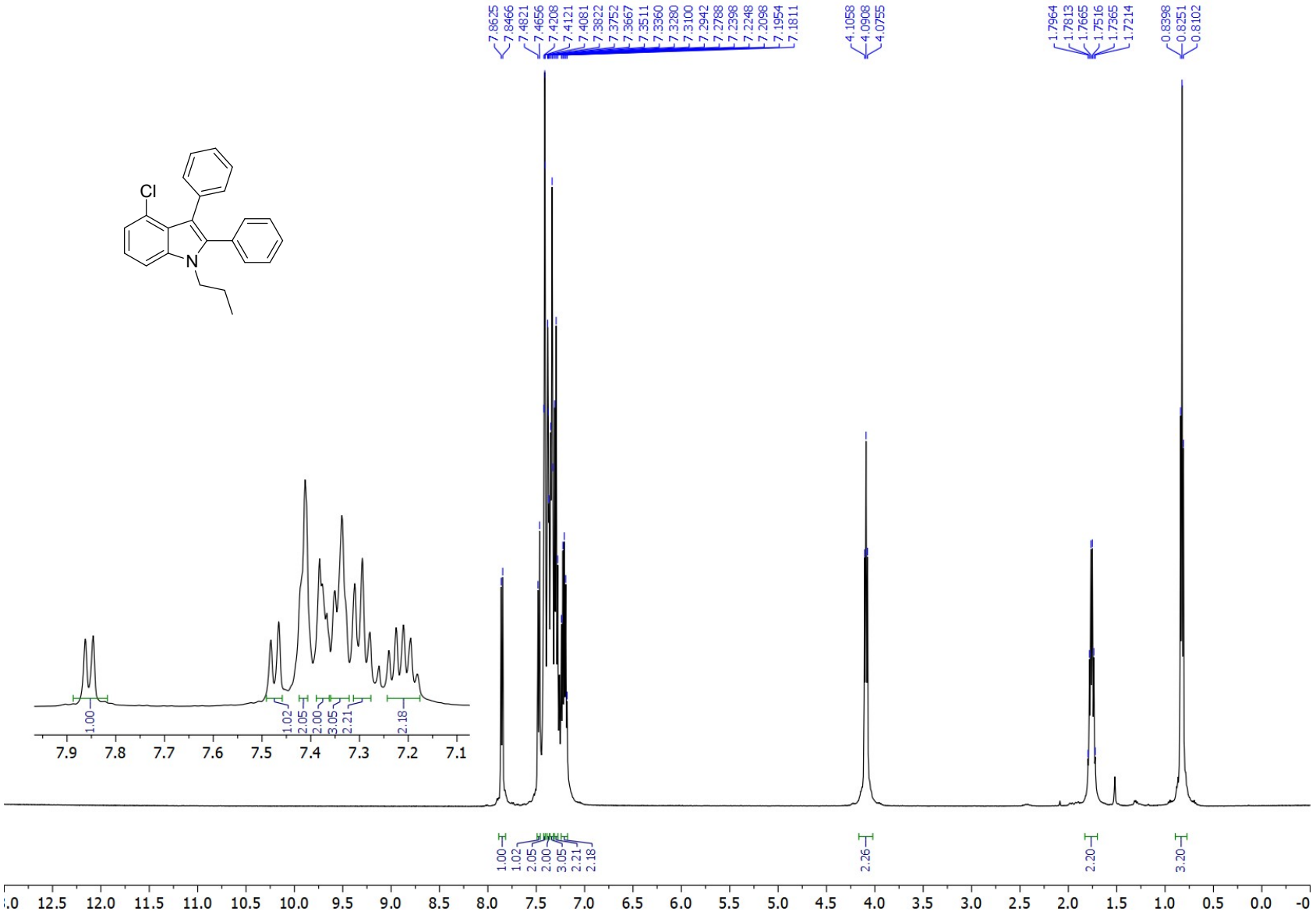
^{1}H NMR of Compound **26** ($CDCl_3$, 500 MHz)



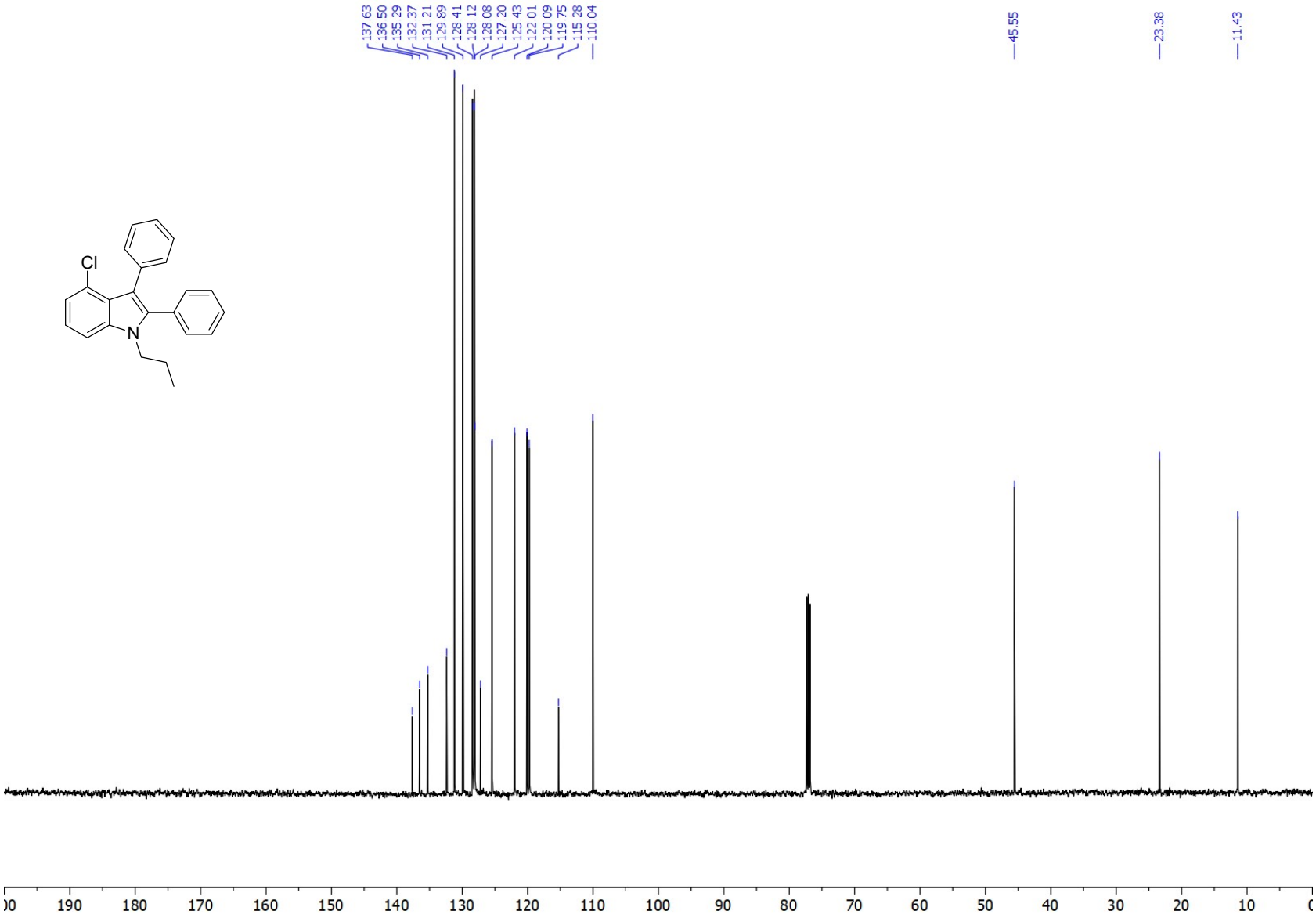
^{13}C NMR of compound **26** ($CDCl_3$, 125 MHz)



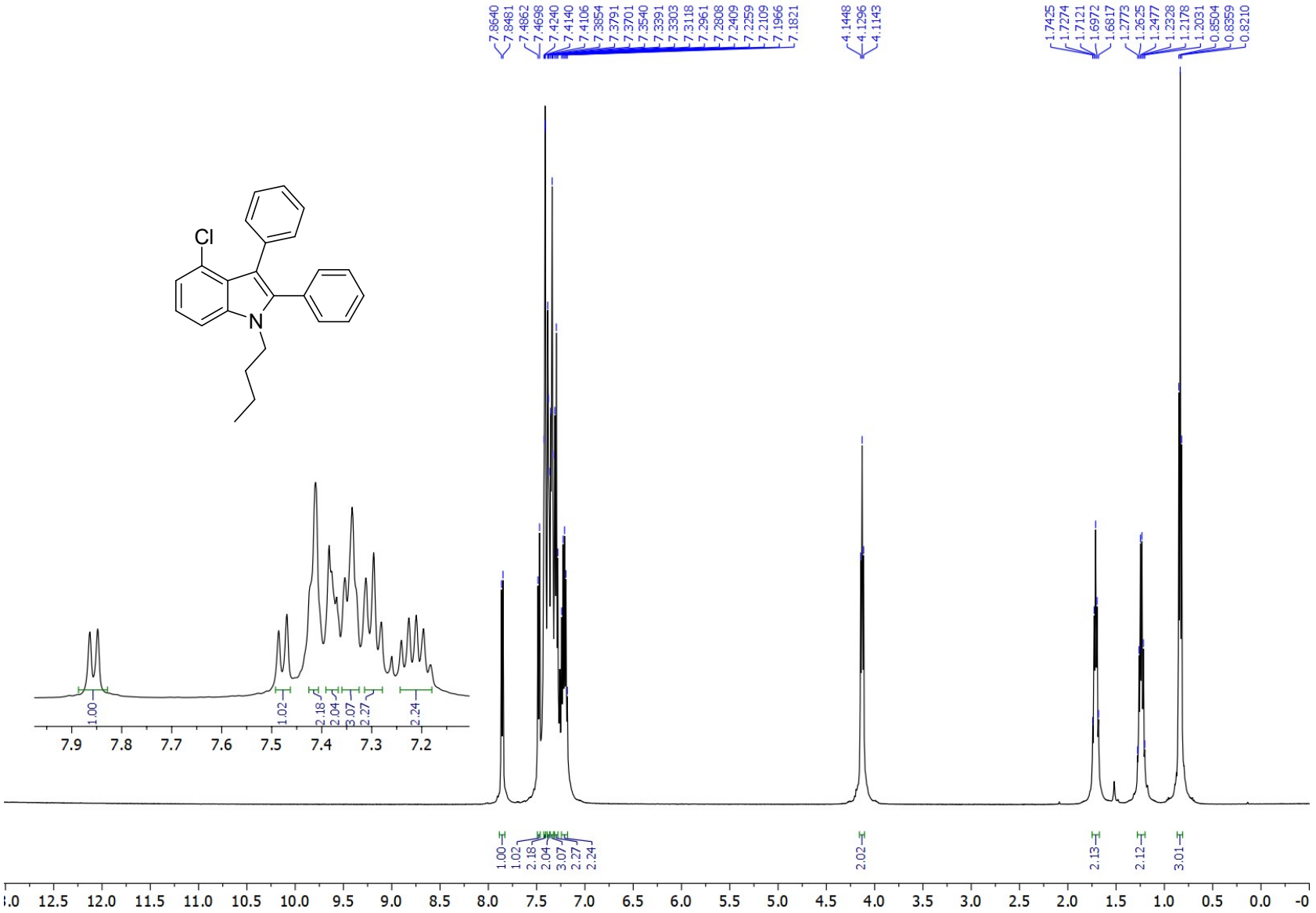
^{1}H NMR of Compound **27** ($CDCl_3$, 500 MHz)



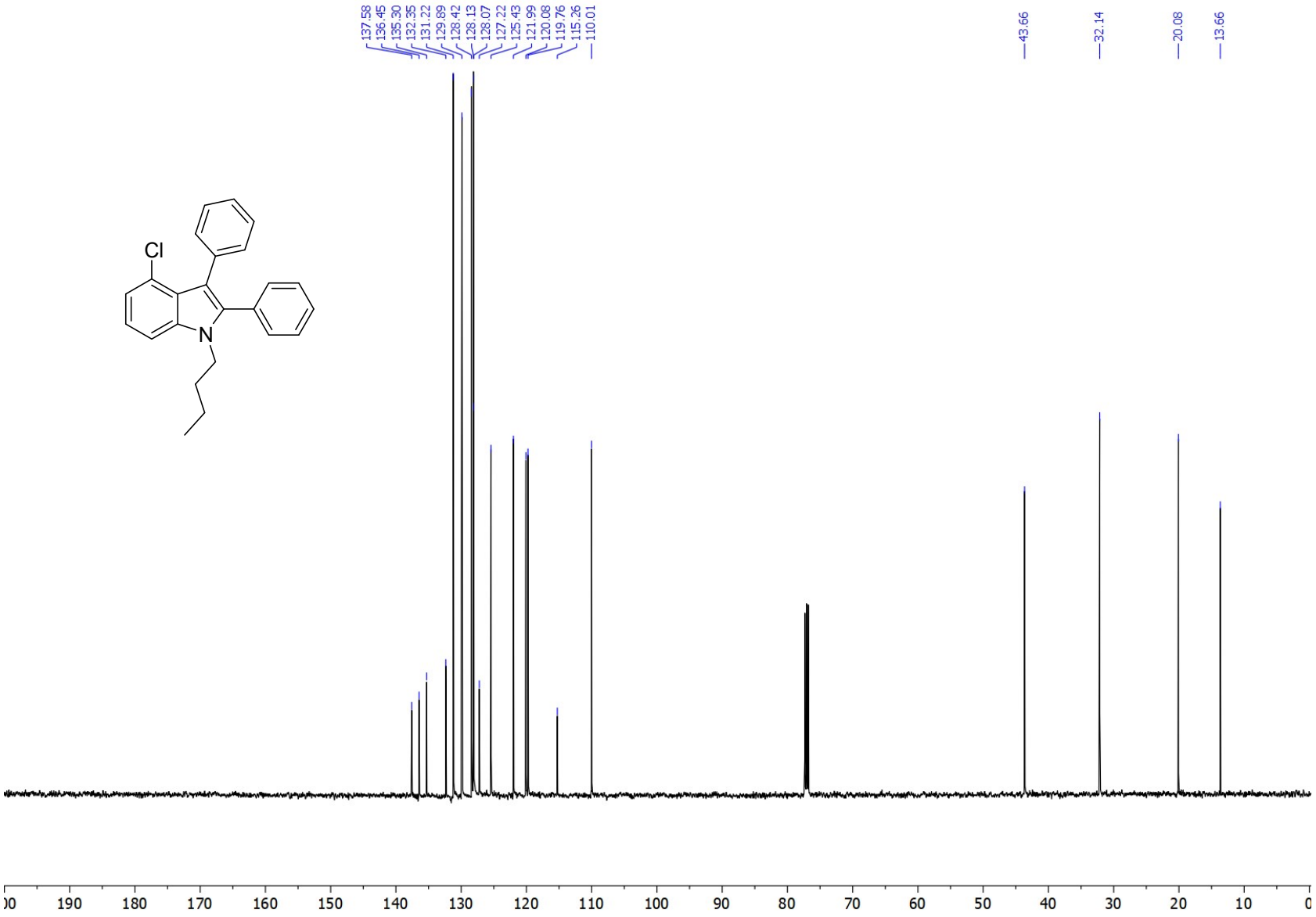
^{13}C NMR of compound **27** ($CDCl_3$, 125 MHz)



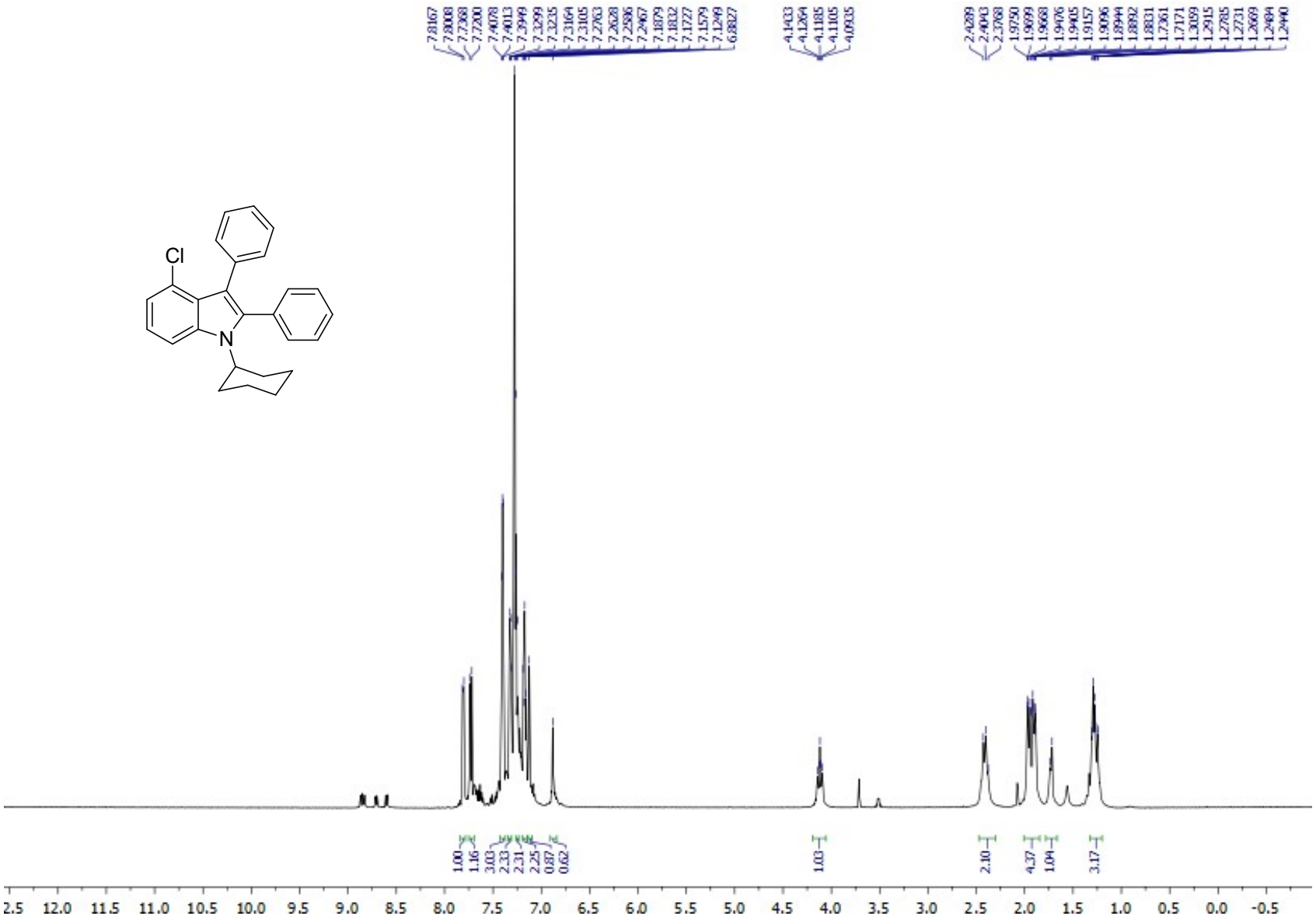
^{1}H NMR of Compound **28** ($CDCl_3$, 500 MHz)



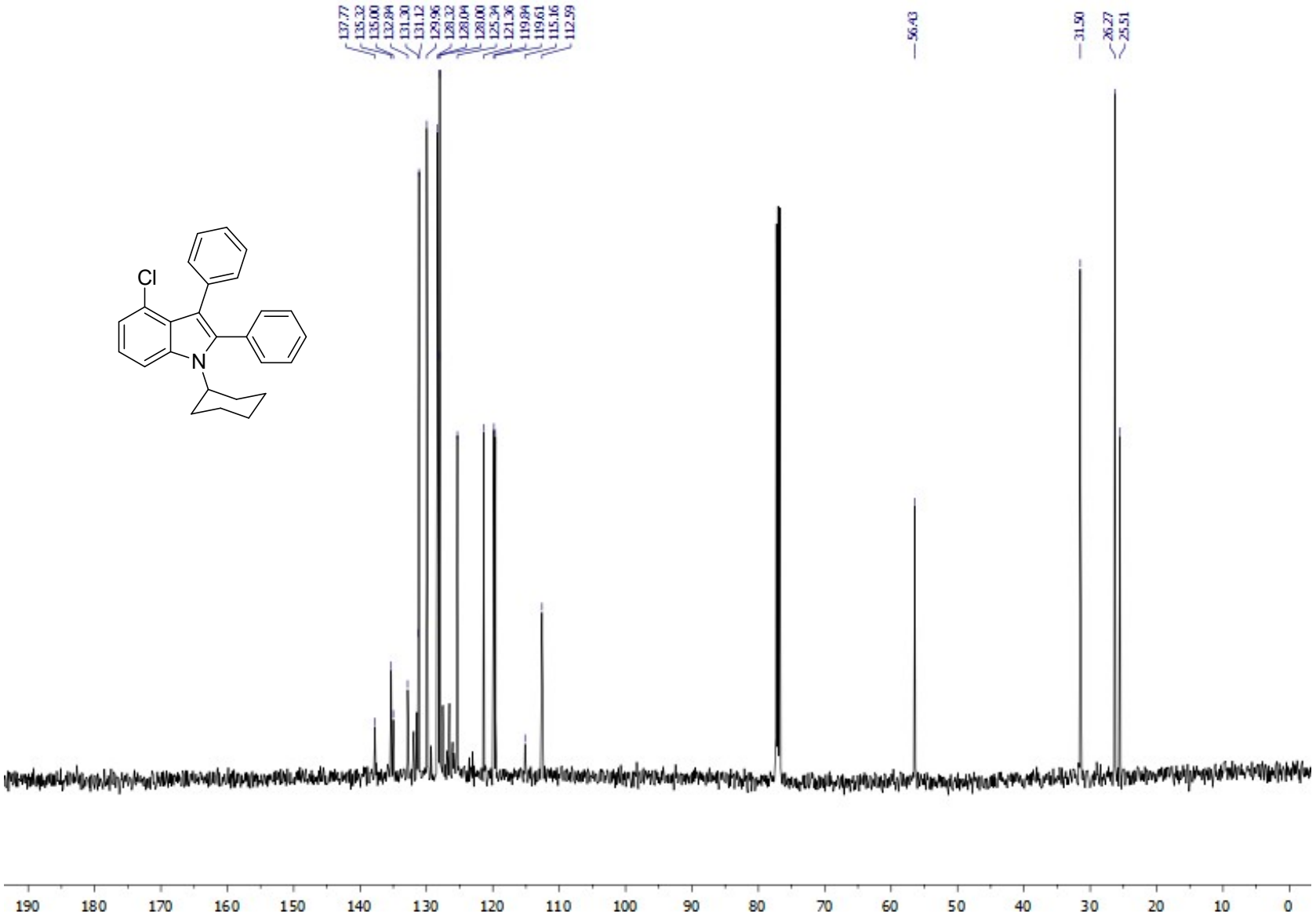
^{13}C NMR of compound **28** ($CDCl_3$, 125 MHz)



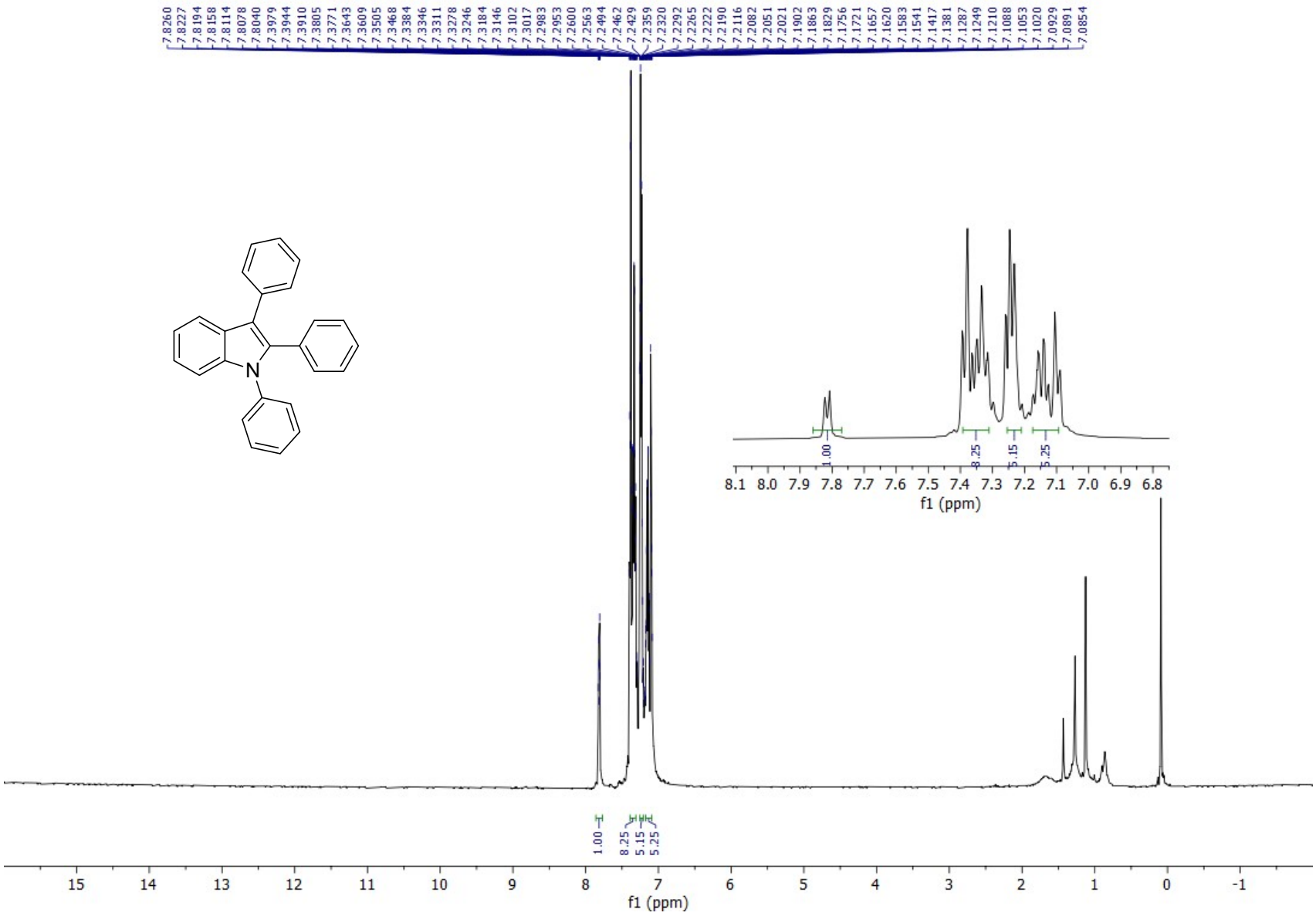
^{1}H NMR of Compound **29** ($CDCl_3$, 500 MHz)



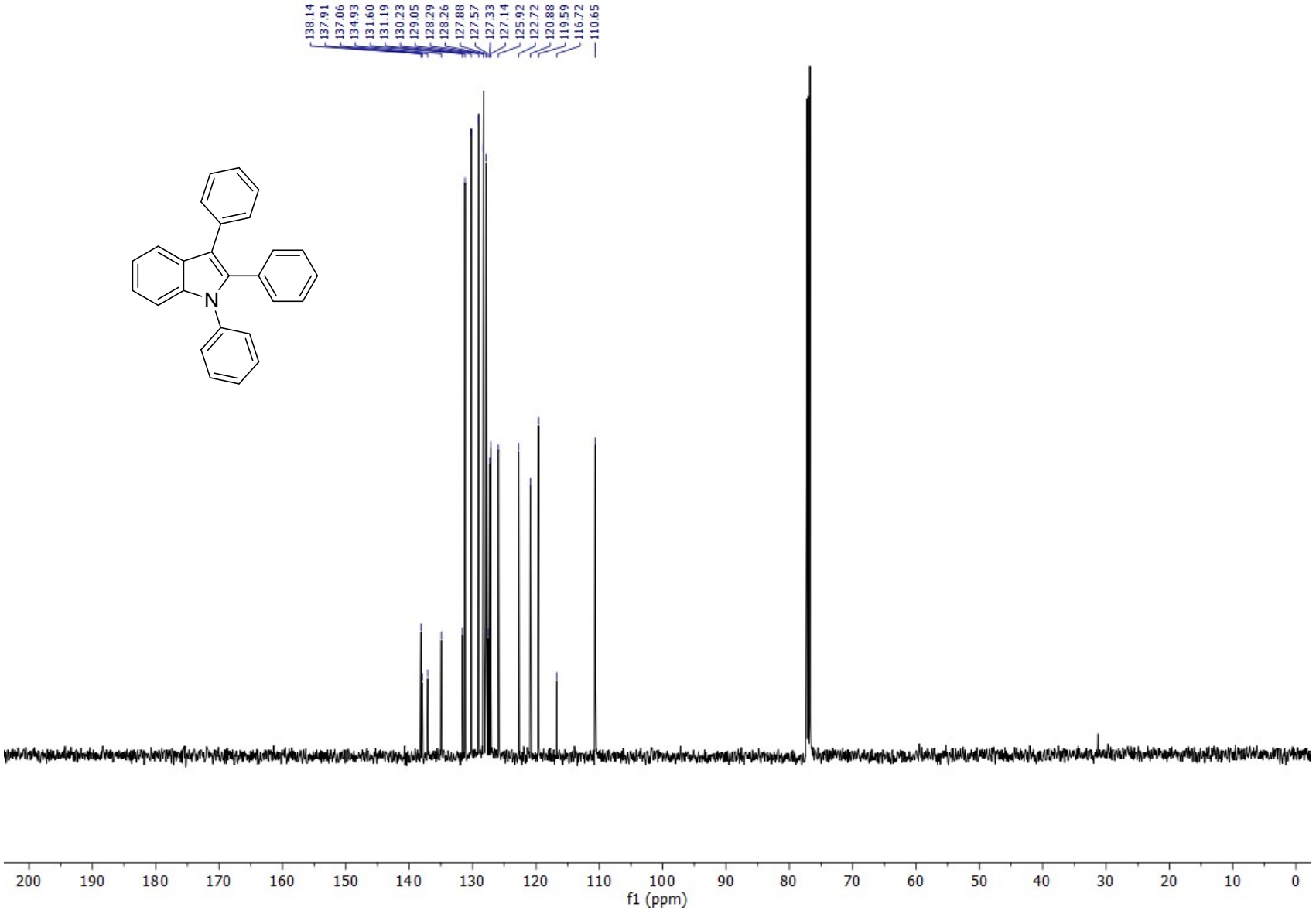
^{13}C NMR of compound **29** ($CDCl_3$, 125 MHz)



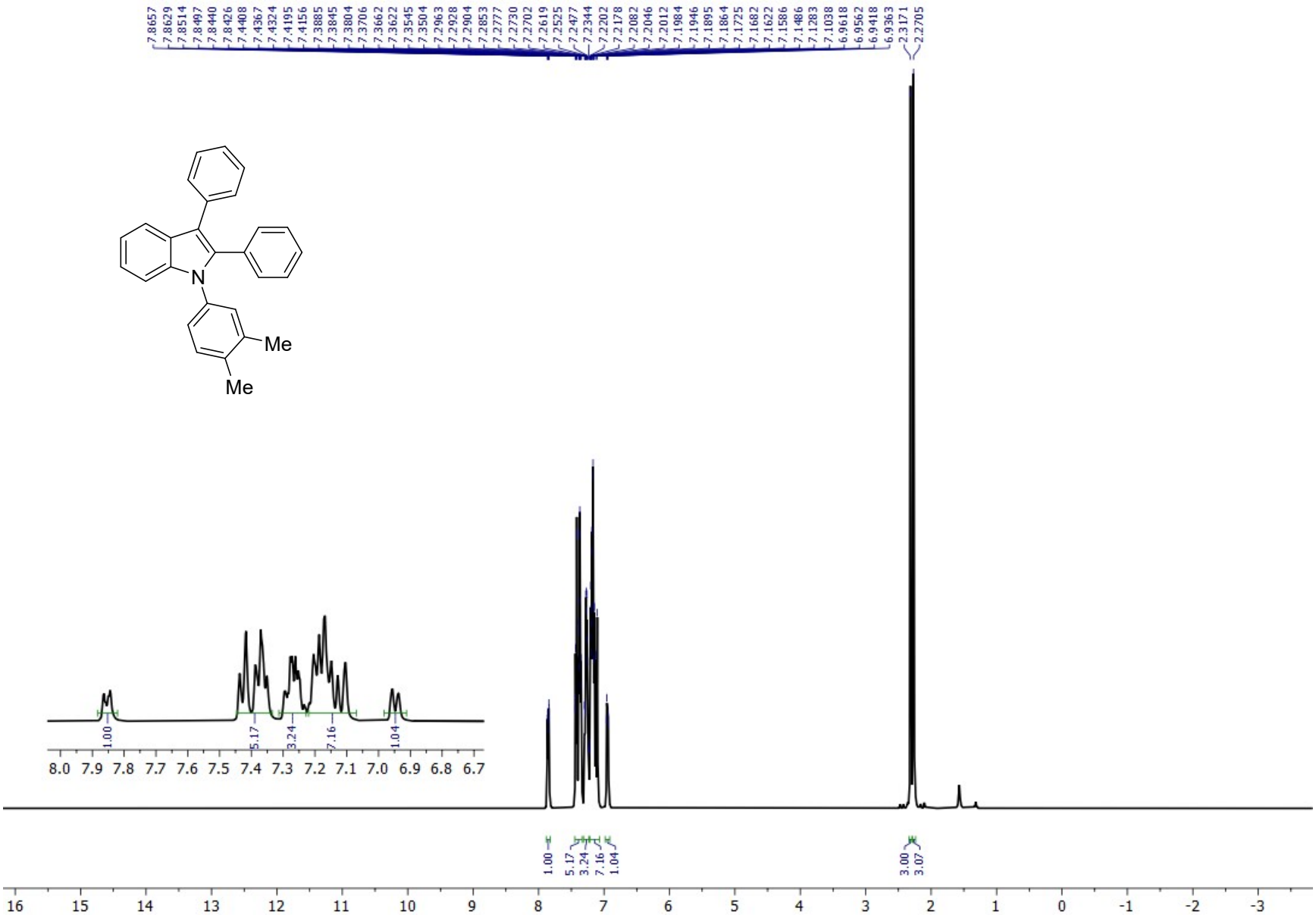
^{1}H NMR of Compound **30** ($CDCl_3$, 500 MHz)



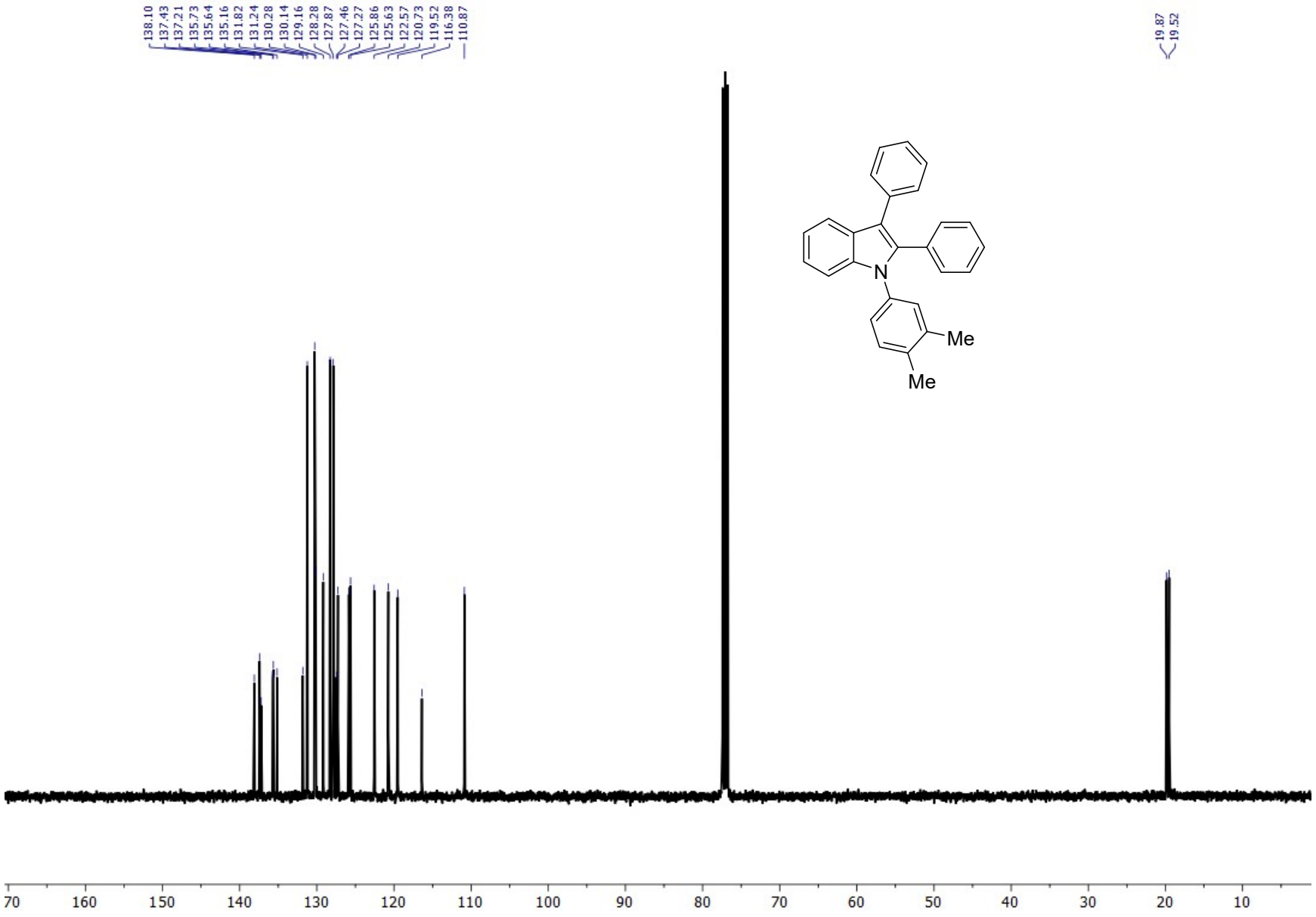
^{13}C NMR of compound **30** ($CDCl_3$, 125 MHz)



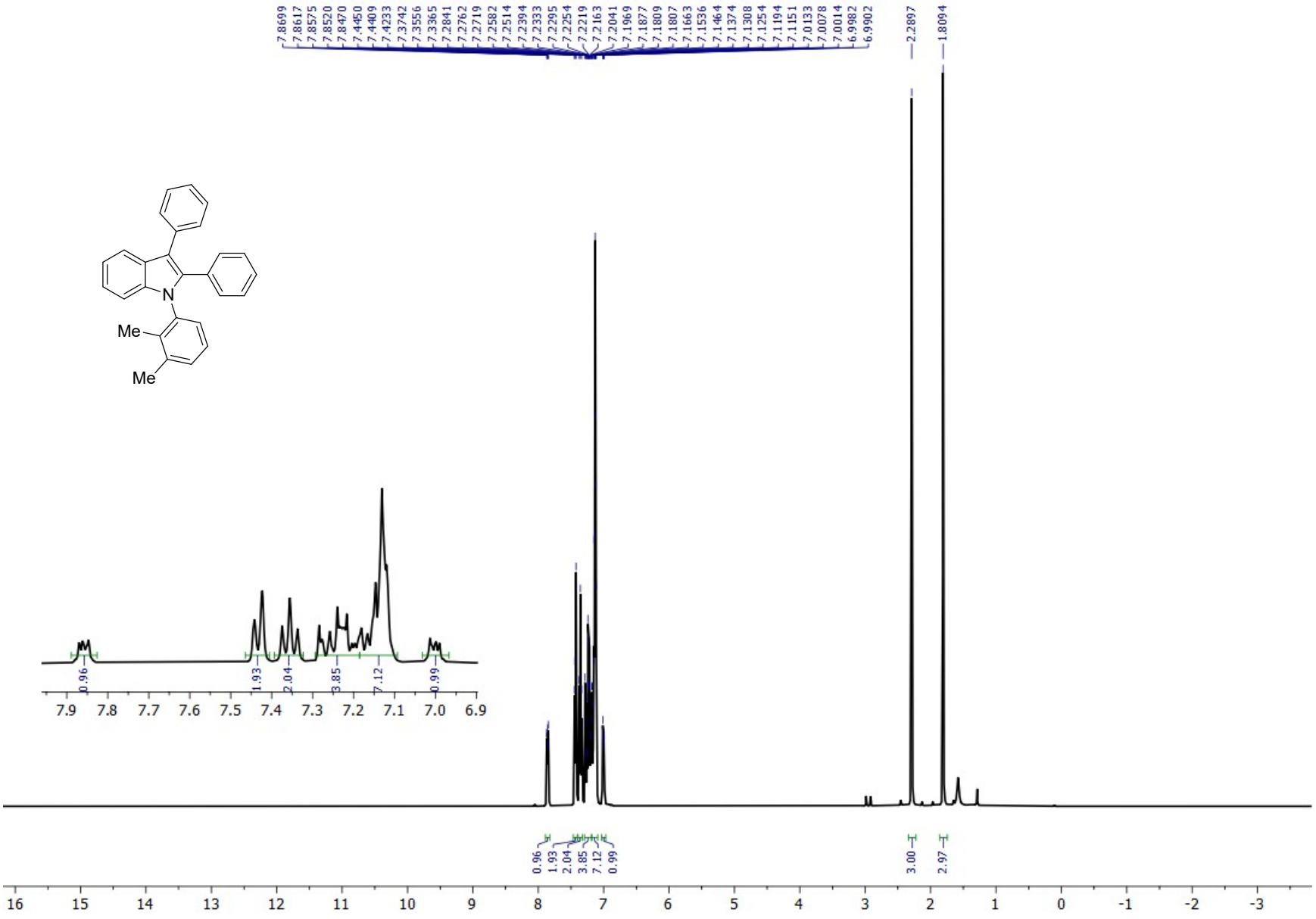
^{1}H NMR of Compound **31** ($CDCl_3$, 500 MHz)



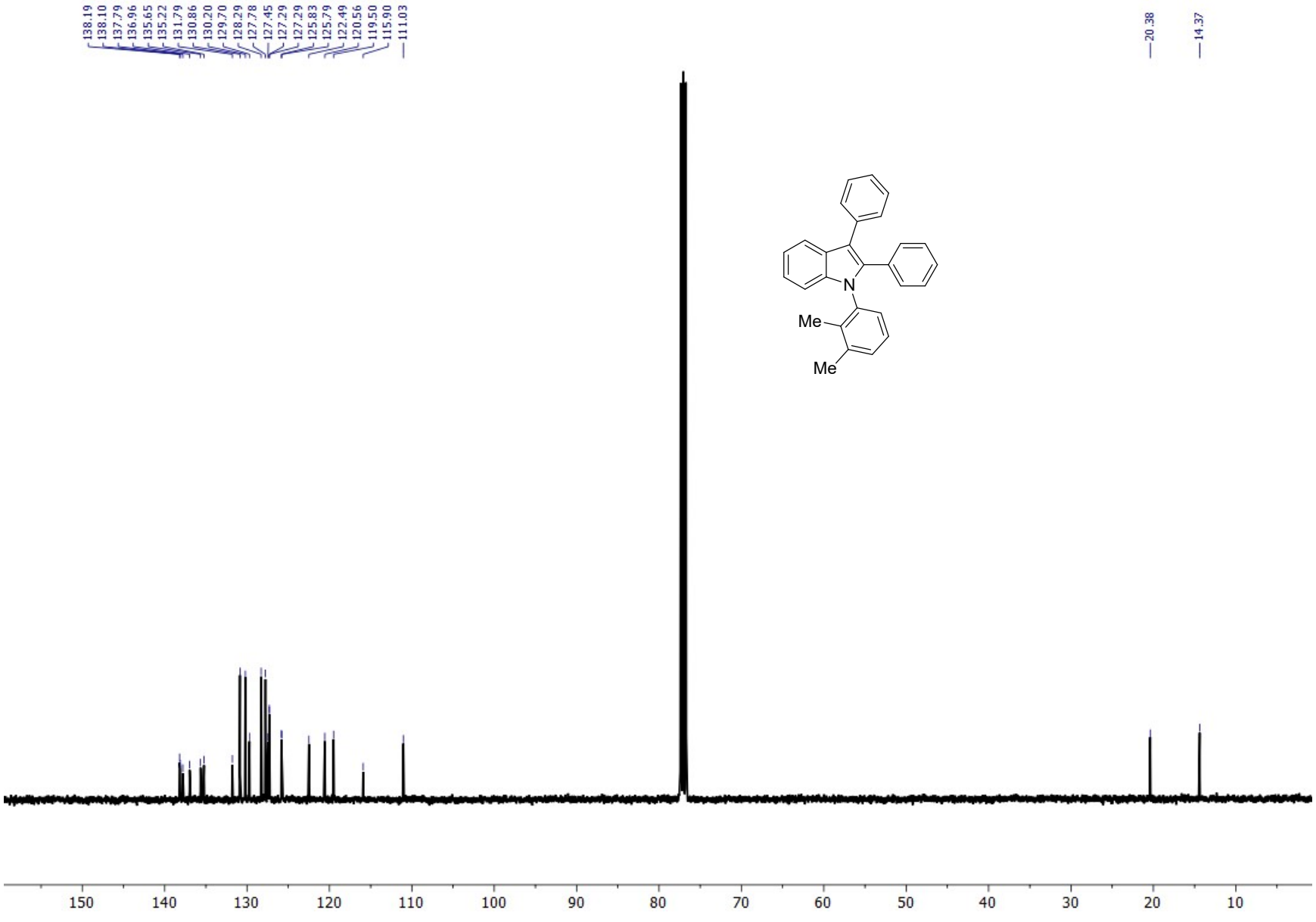
^{13}C NMR of compound **31** ($CDCl_3$, 125 MHz)



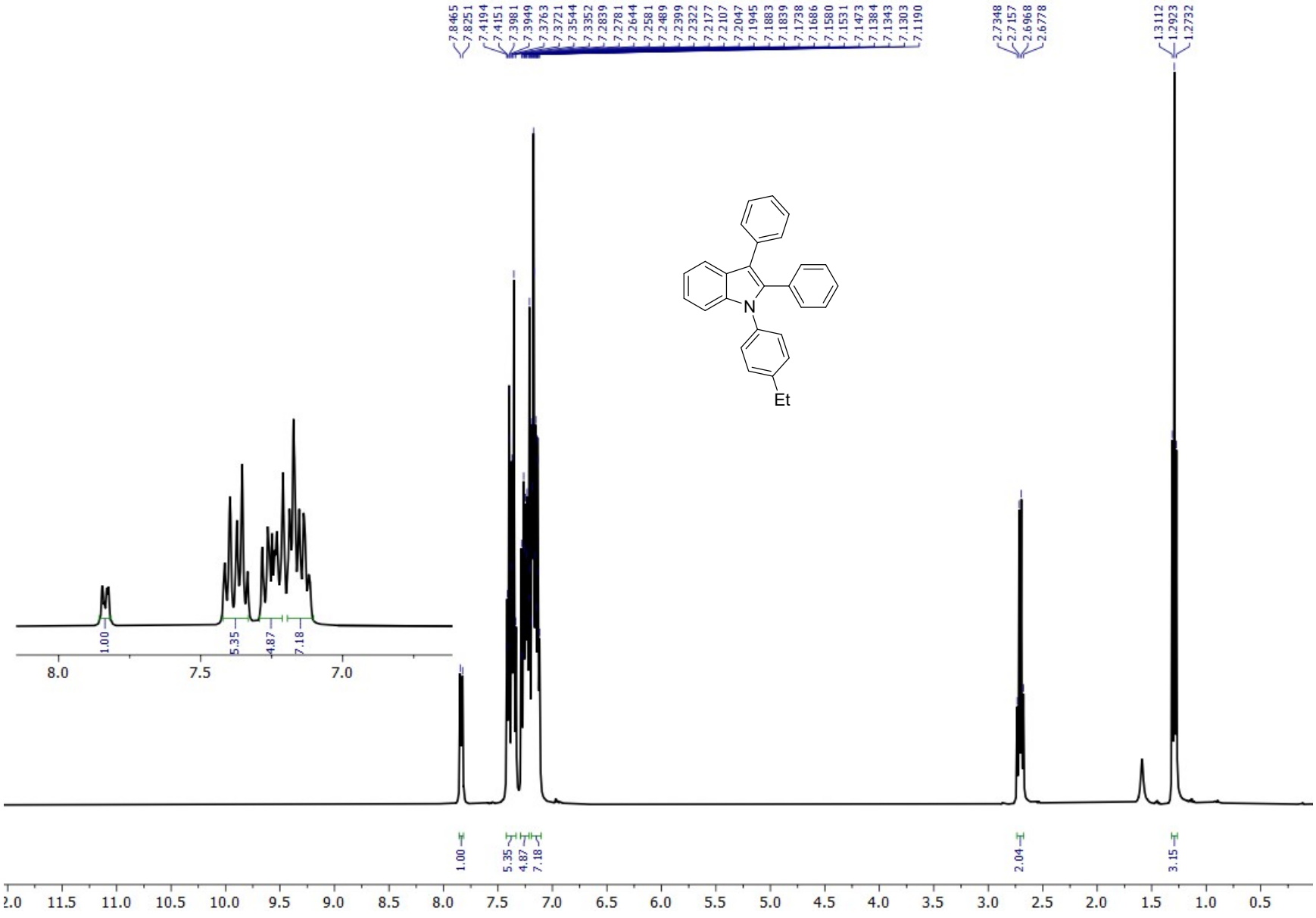
^{1}H NMR of Compound **32** ($CDCl_3$, 500 MHz)



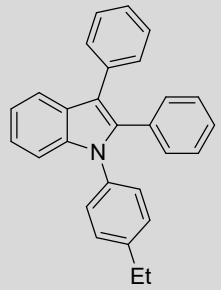
^{13}C NMR of compound **32** ($CDCl_3$, 125 MHz)



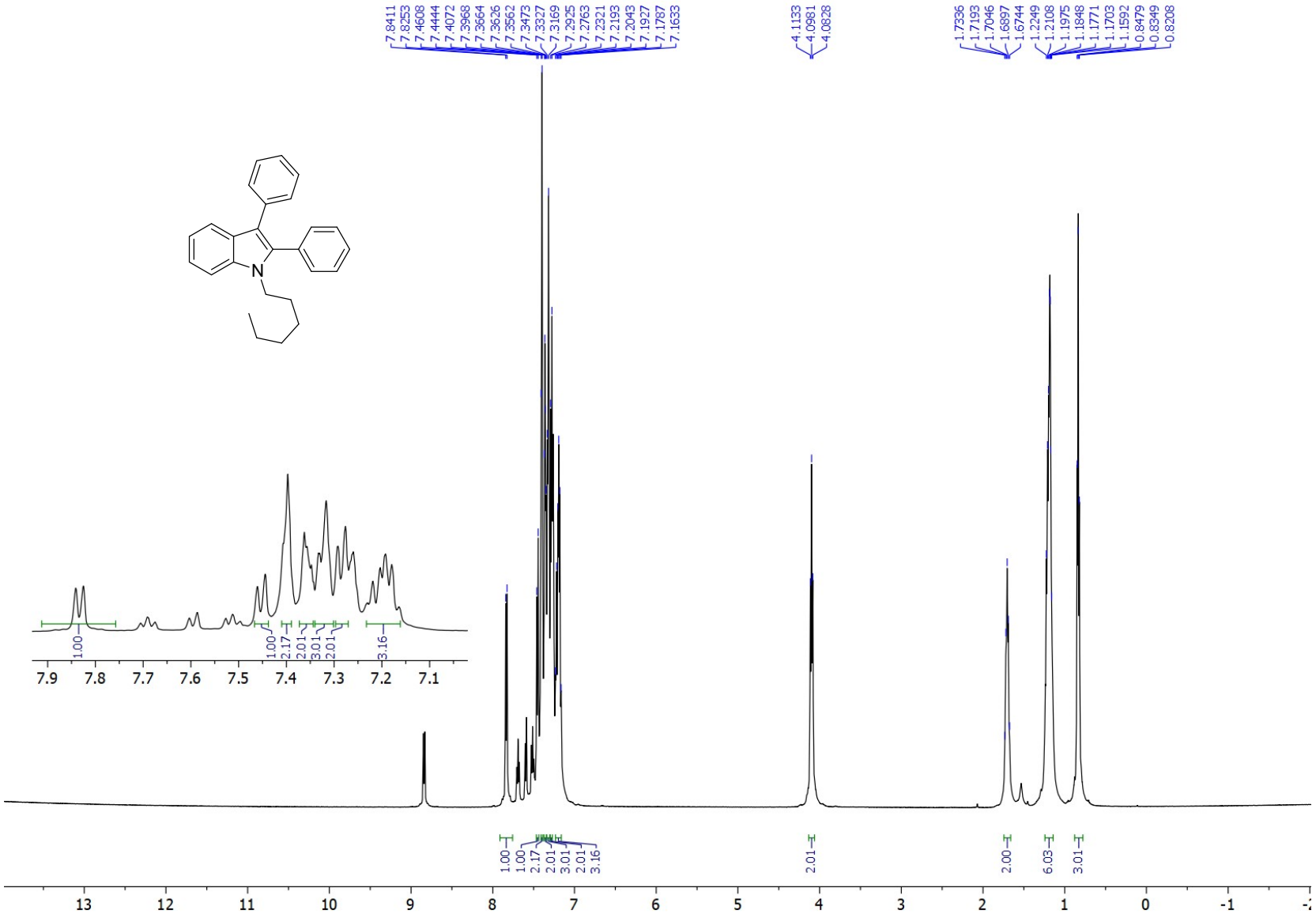
^{1}H NMR of Compound **33** ($CDCl_3$, 500 MHz)



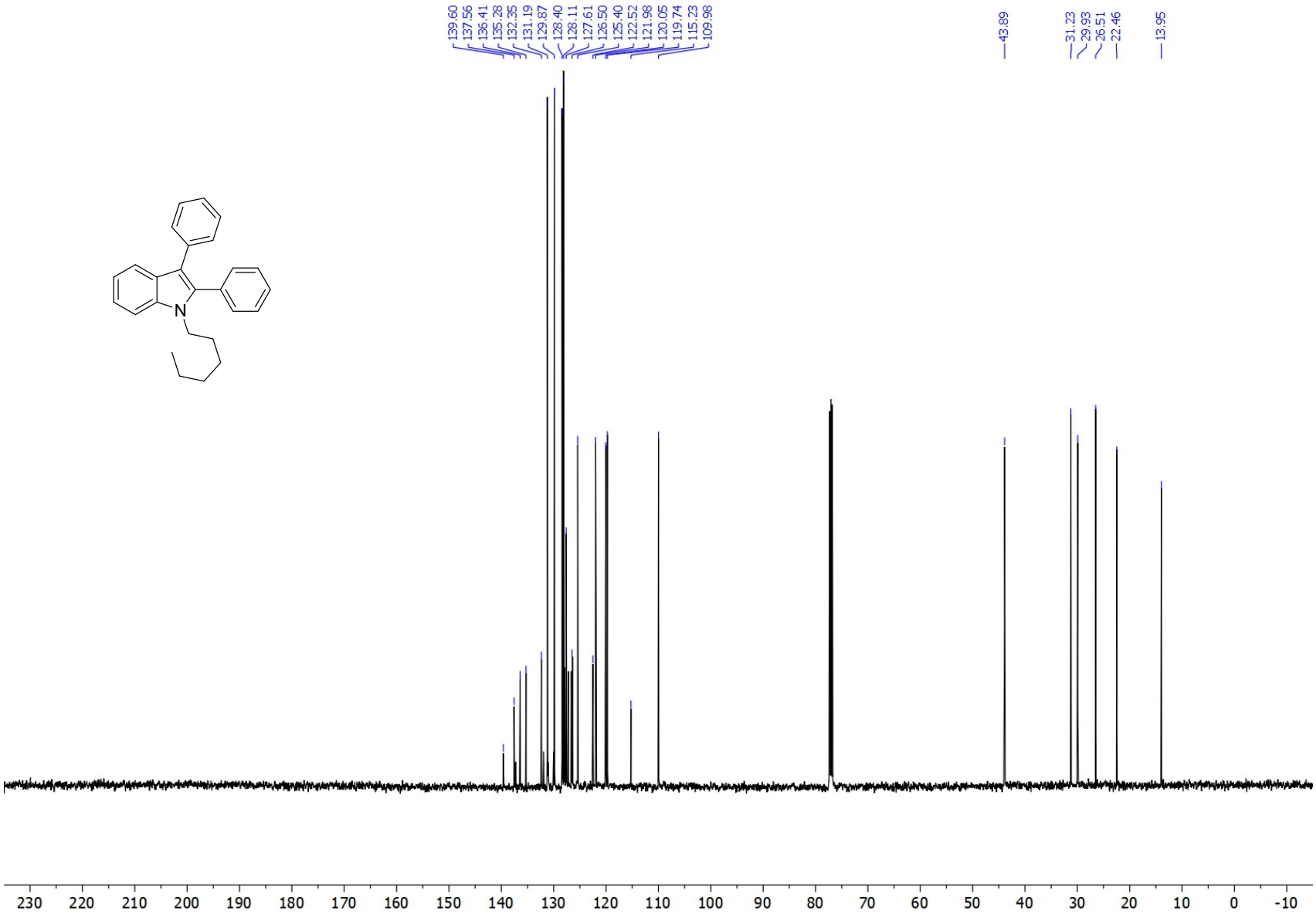
^{13}C NMR of compound **33** ($CDCl_3$, 125 MHz)



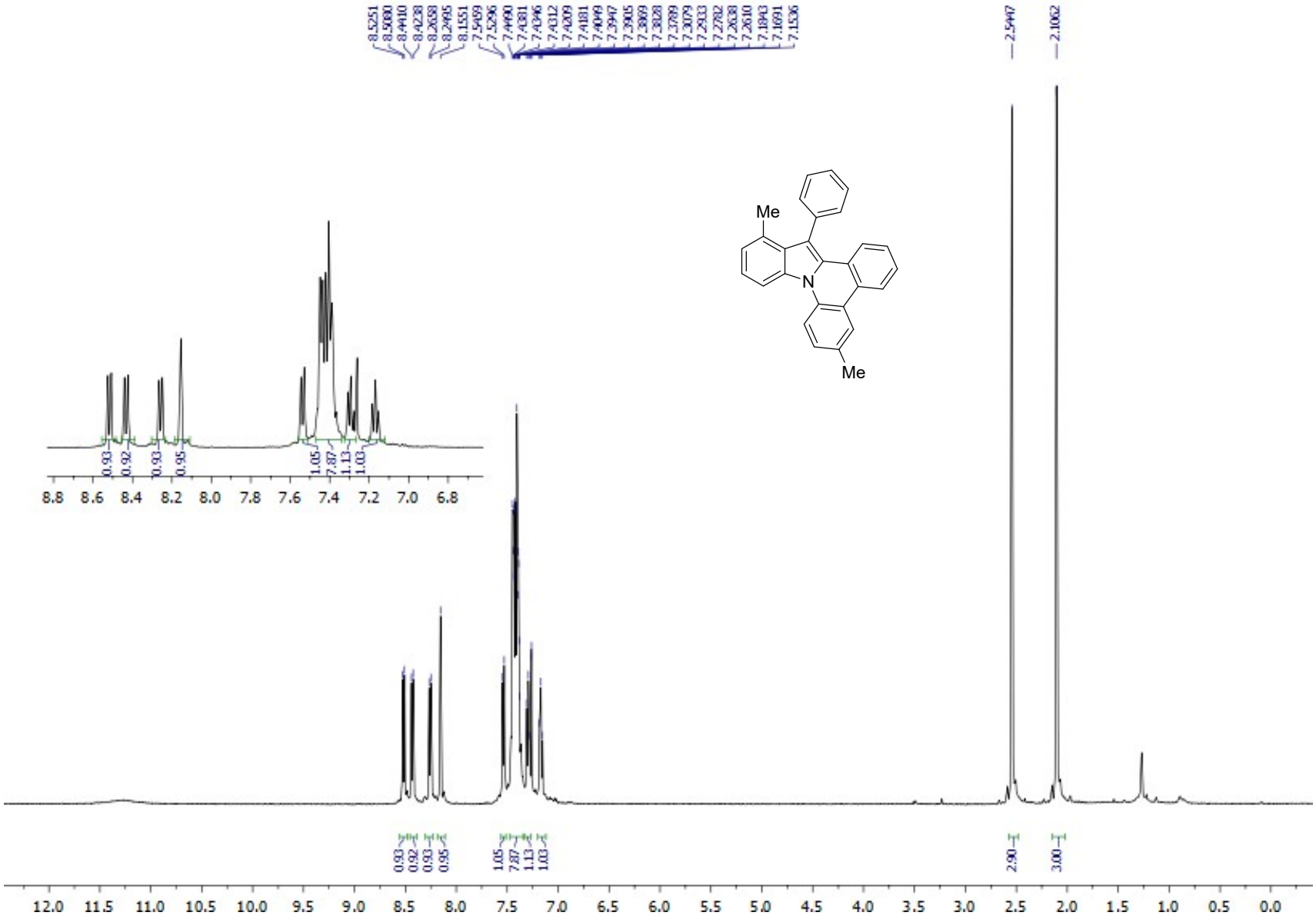
^{1}H NMR of Compound **34** ($CDCl_3$, 500 MHz)



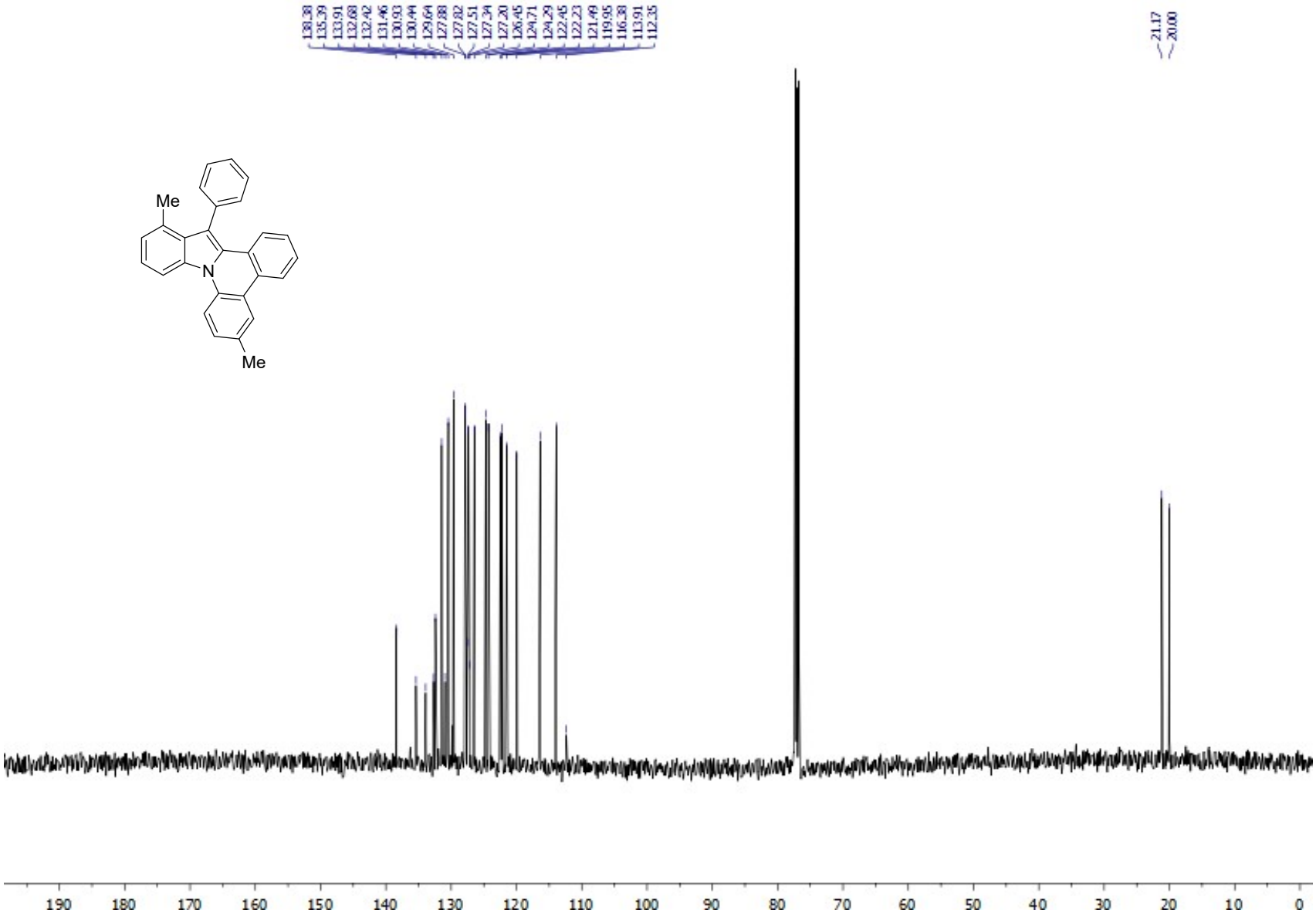
^{13}C NMR of compound **34** ($CDCl_3$, 125 MHz)



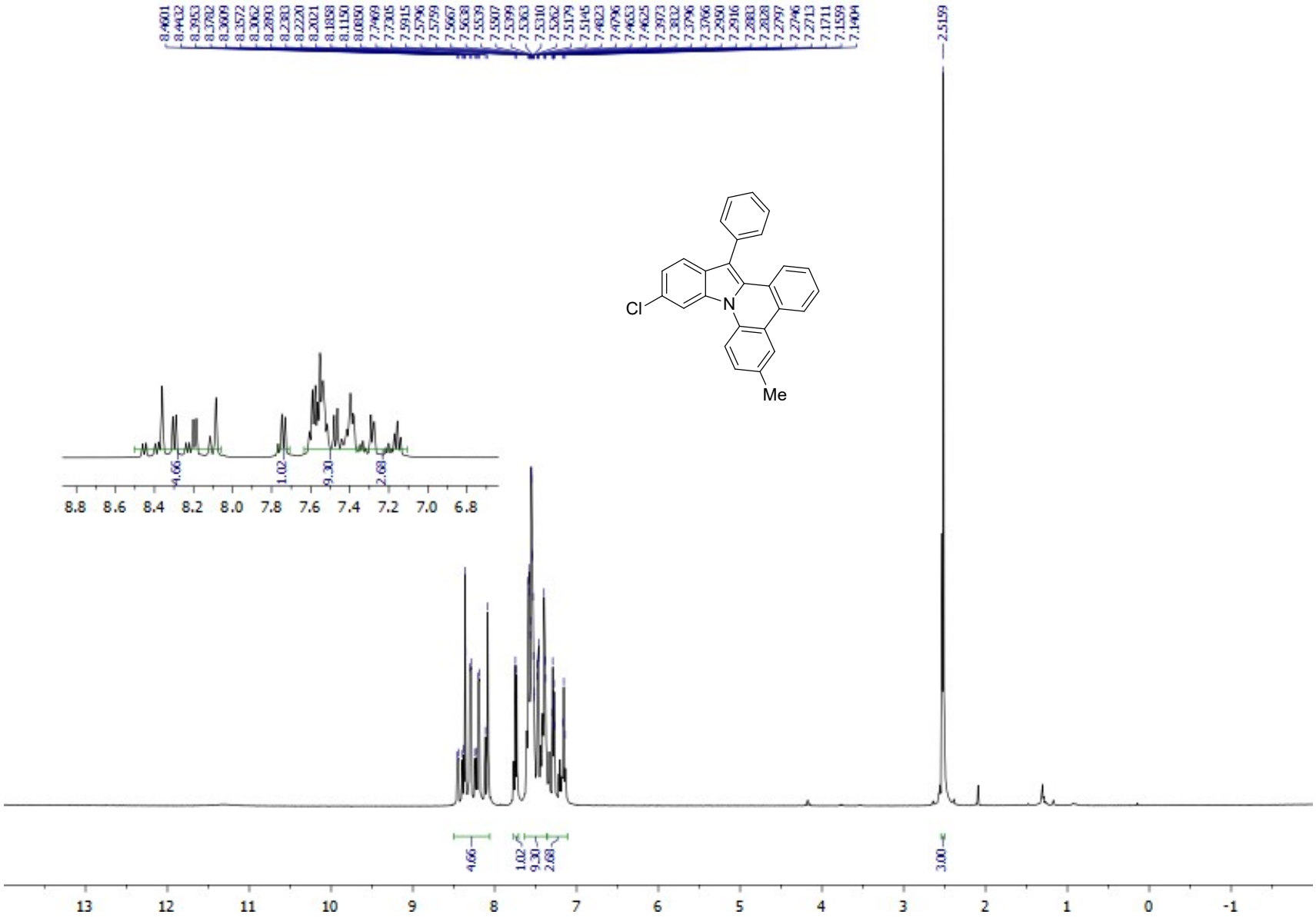
^{1}H NMR of Compound **35** ($CDCl_3$, 500 MHz)



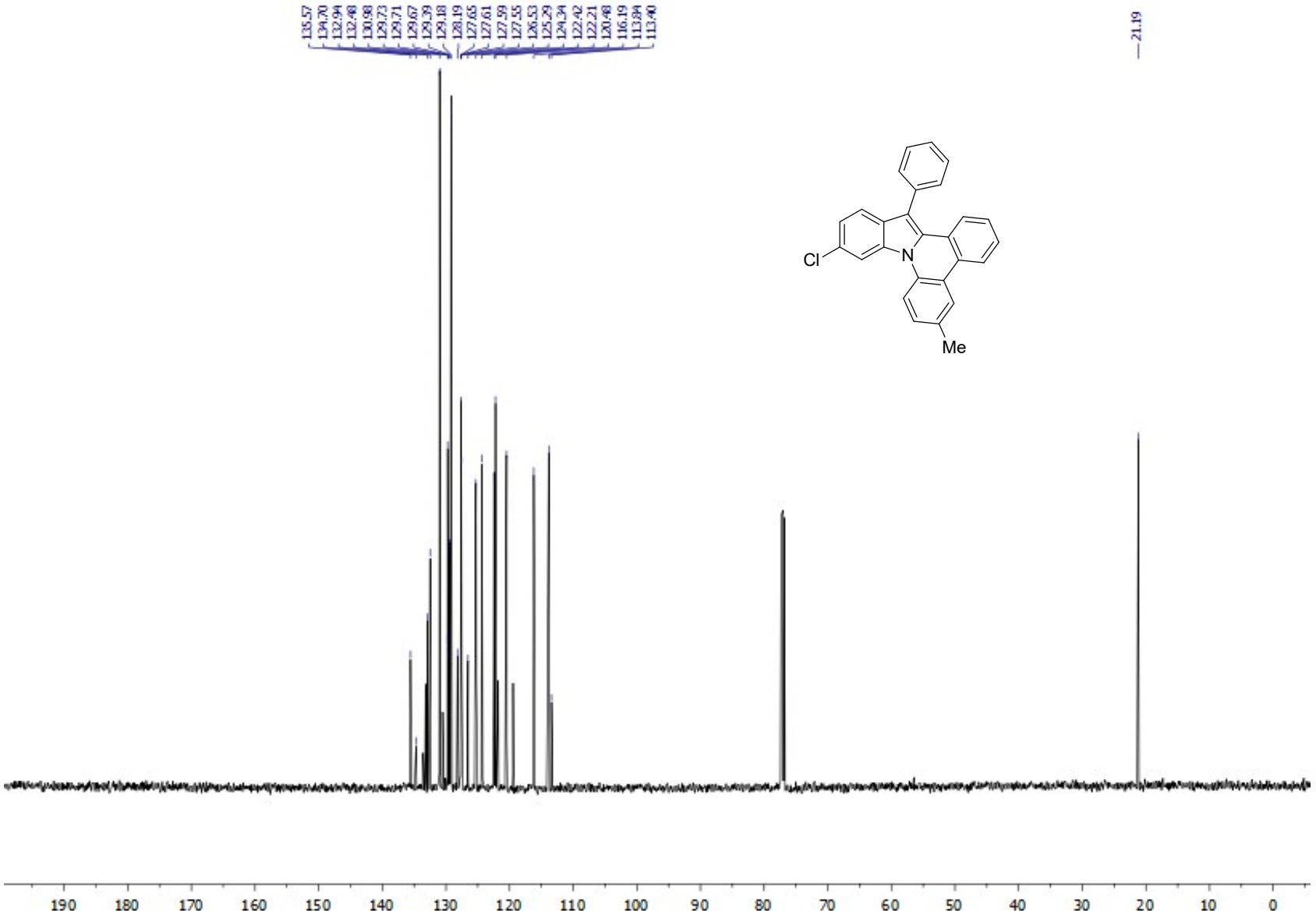
^{13}C NMR of compound **35** ($CDCl_3$, 125 MHz)



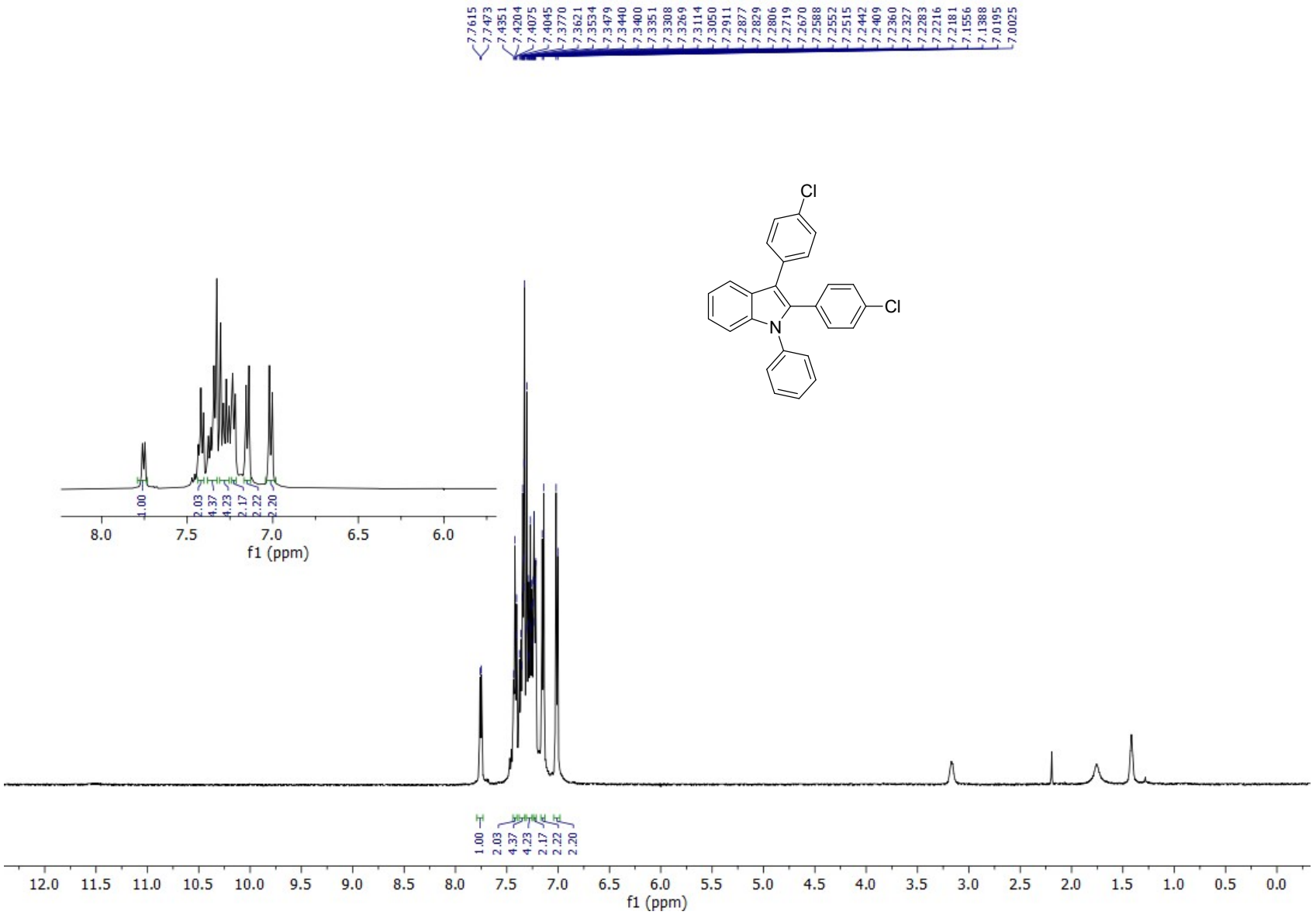
^{1}H NMR of Compound **36** ($CDCl_3$, 500 MHz)



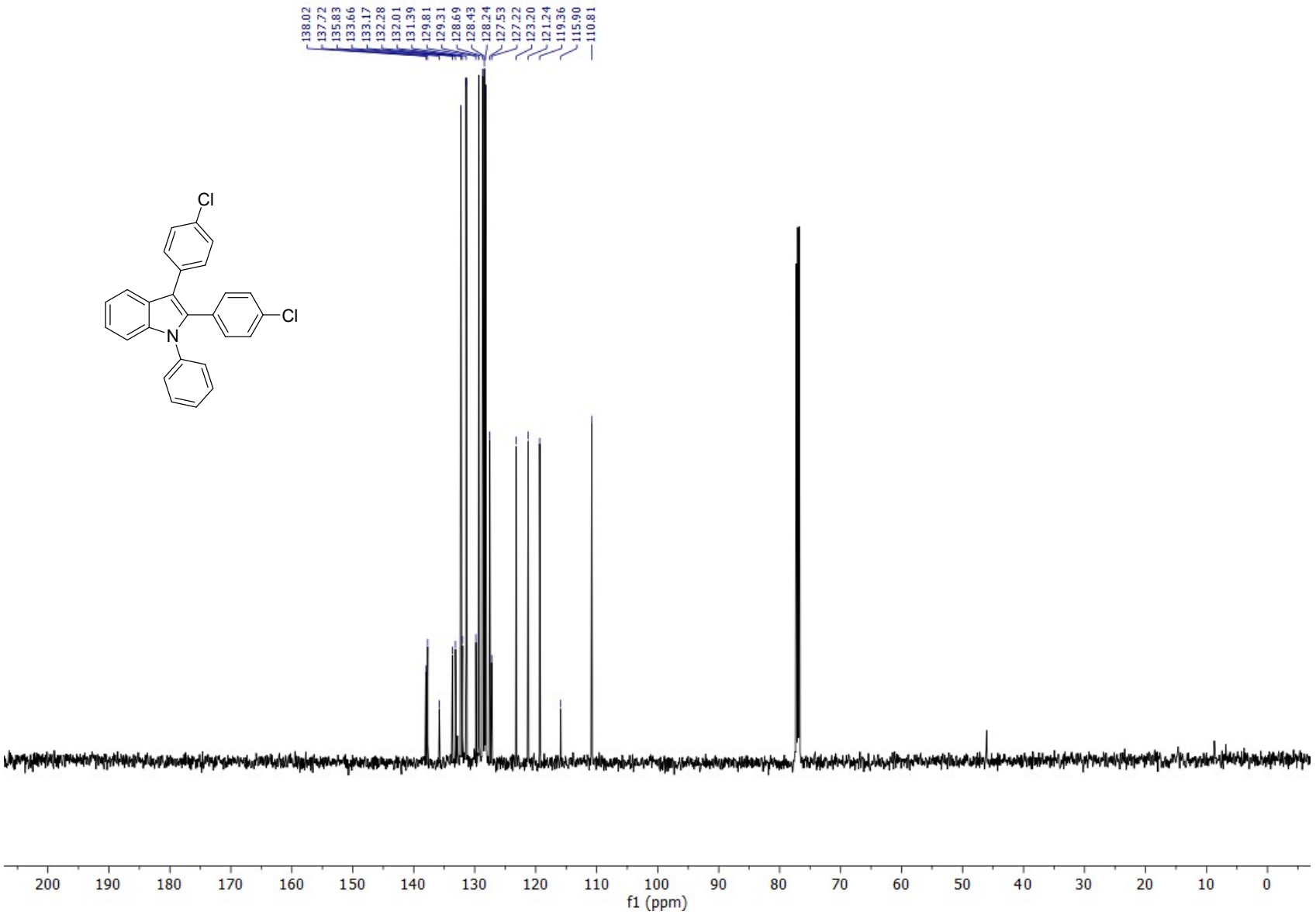
^{13}C NMR of compound **36** ($CDCl_3$, 125 MHz)



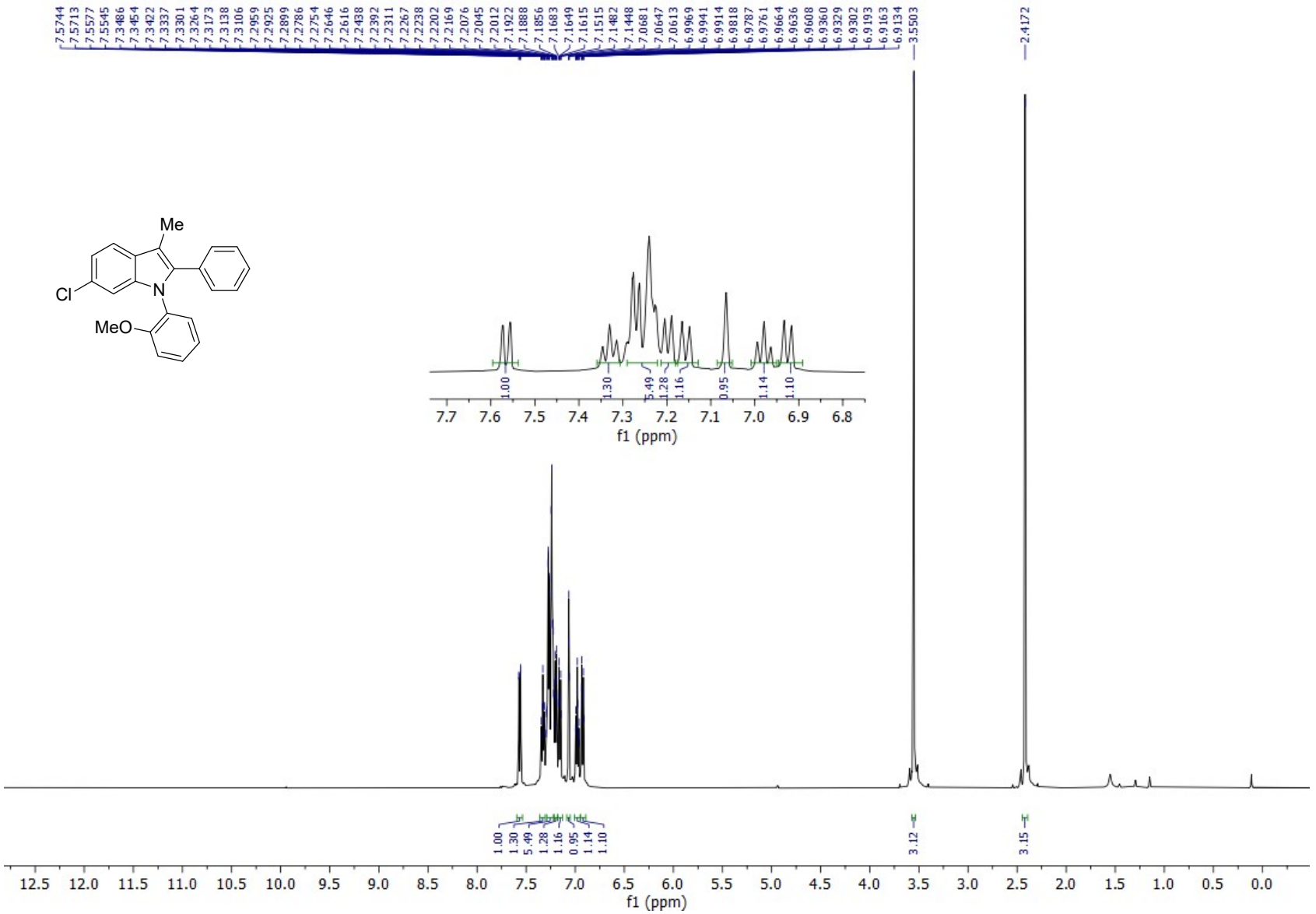
^{1}H NMR of Compound **37** ($CDCl_3$, 500 MHz)



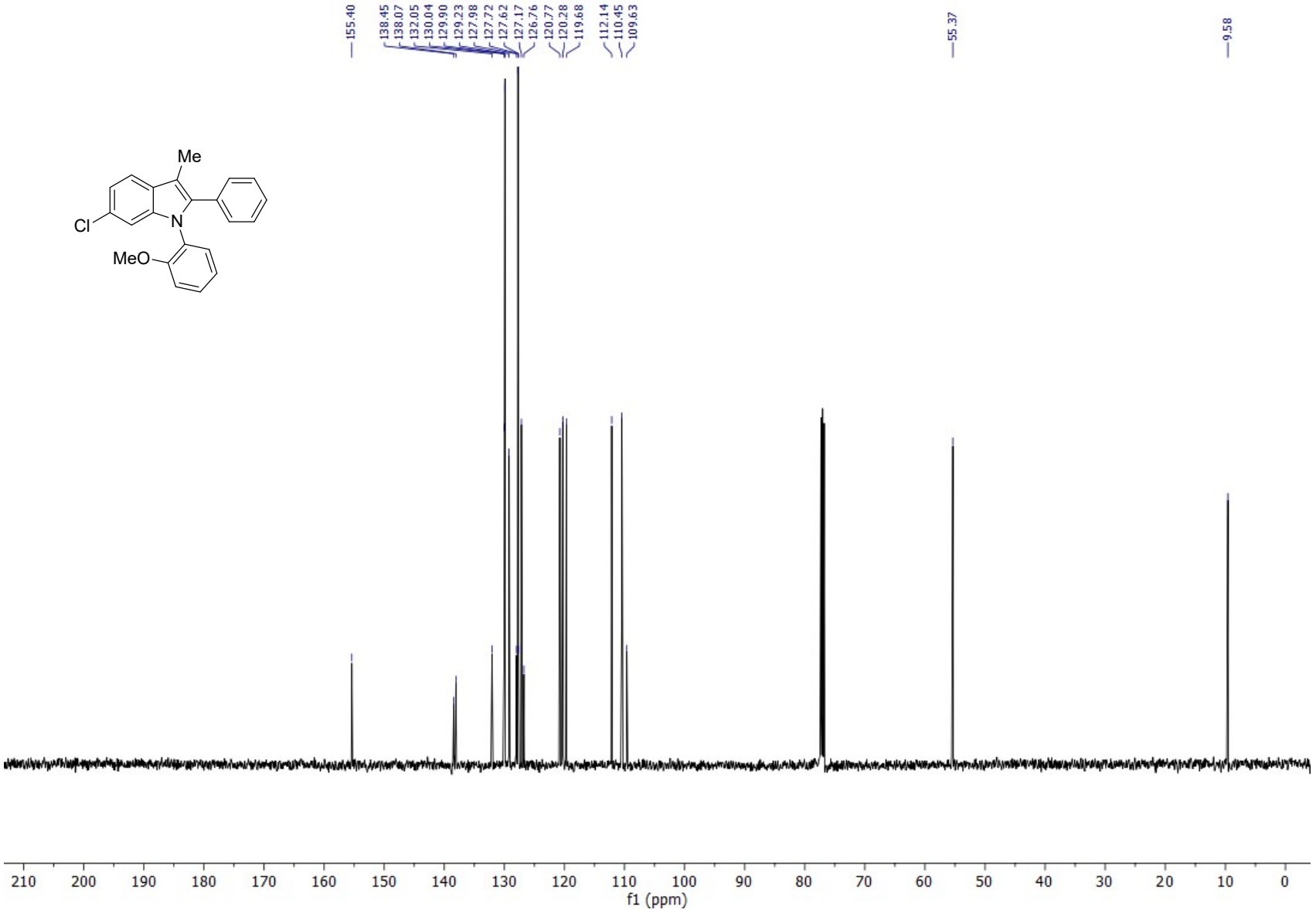
^{13}C NMR of compound **37** ($CDCl_3$, 125 MHz)



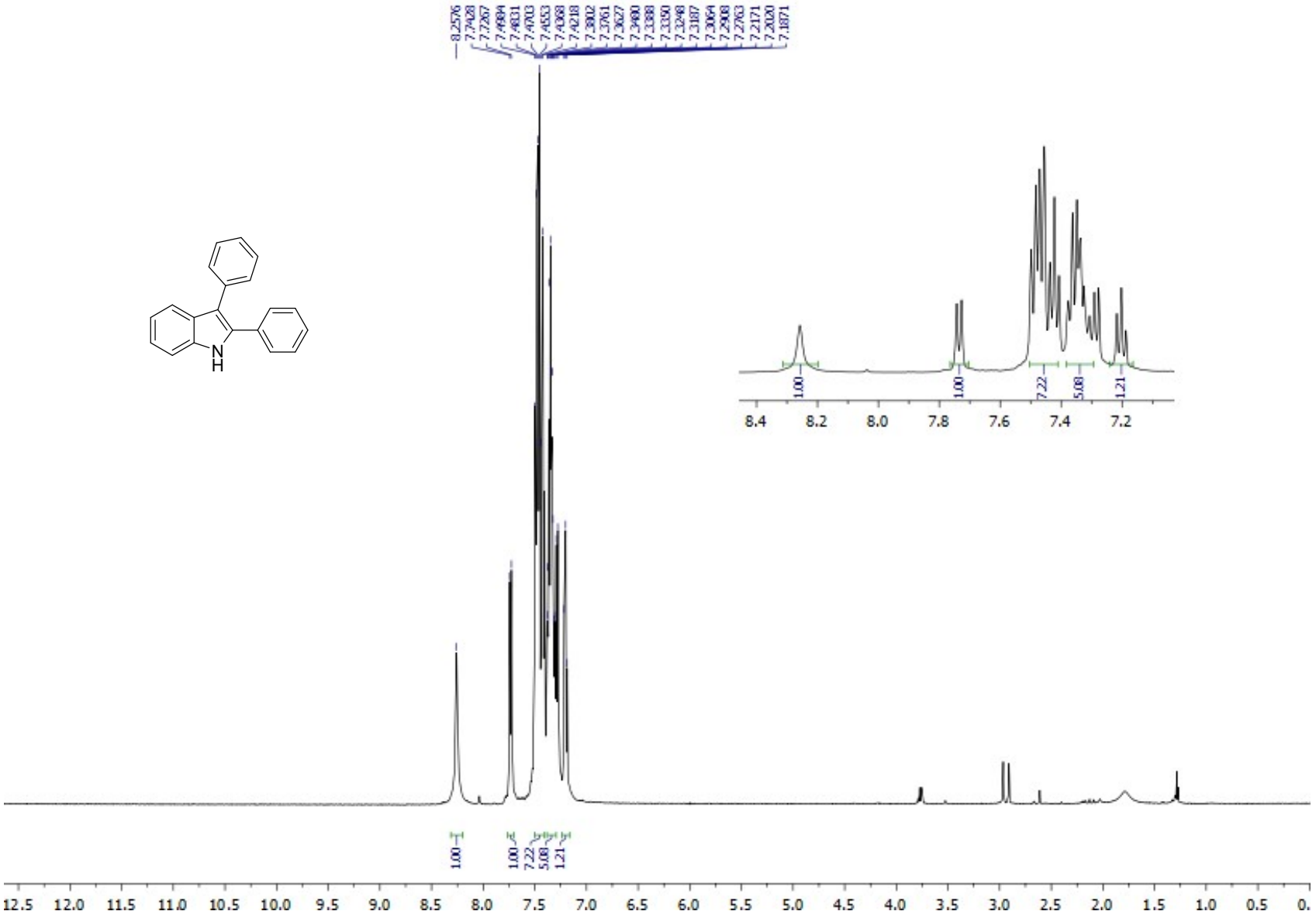
^{1}H NMR of Compound **38** ($CDCl_3$, 500 MHz)



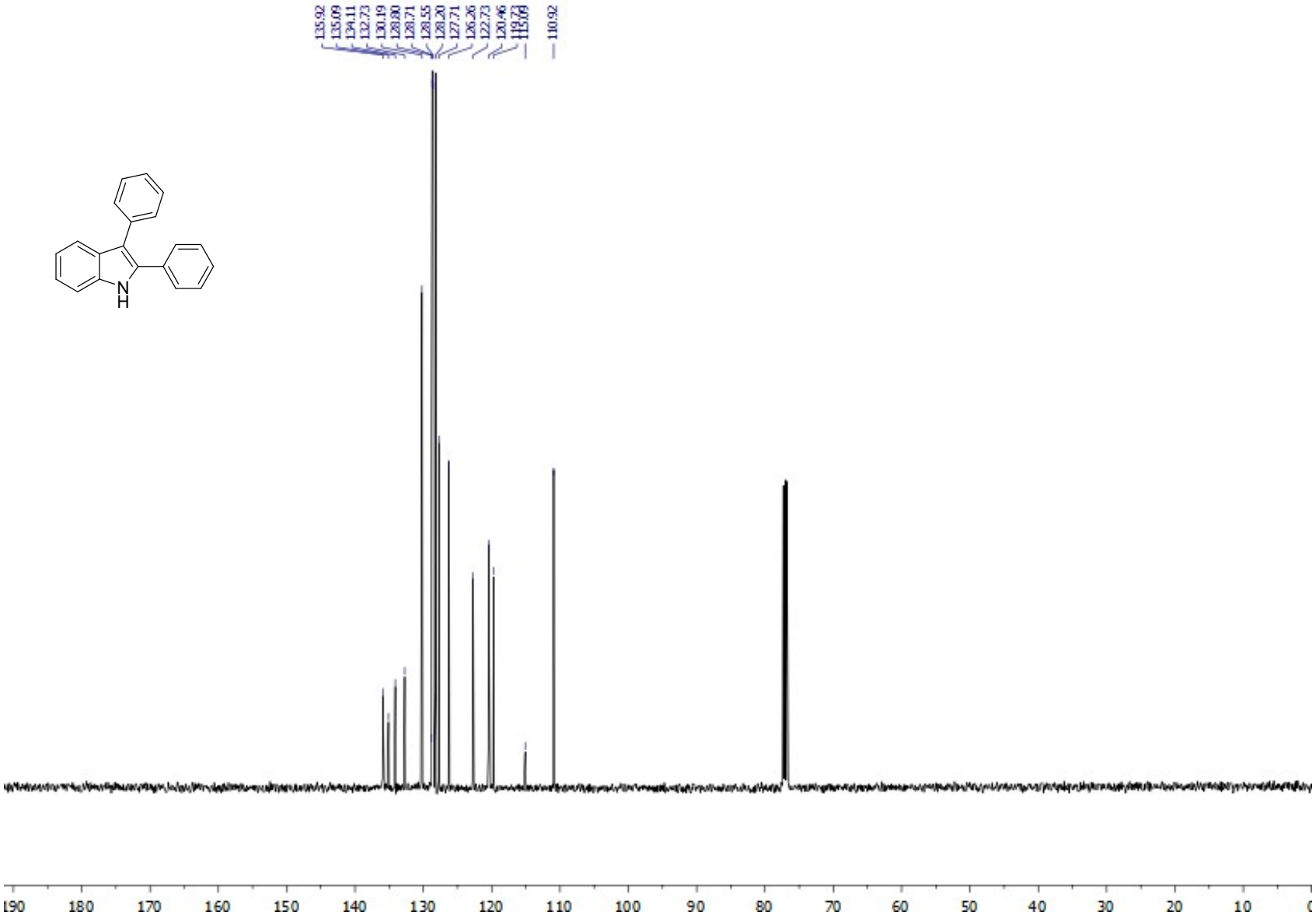
^{13}C NMR of compound **38** ($CDCl_3$, 125 MHz)



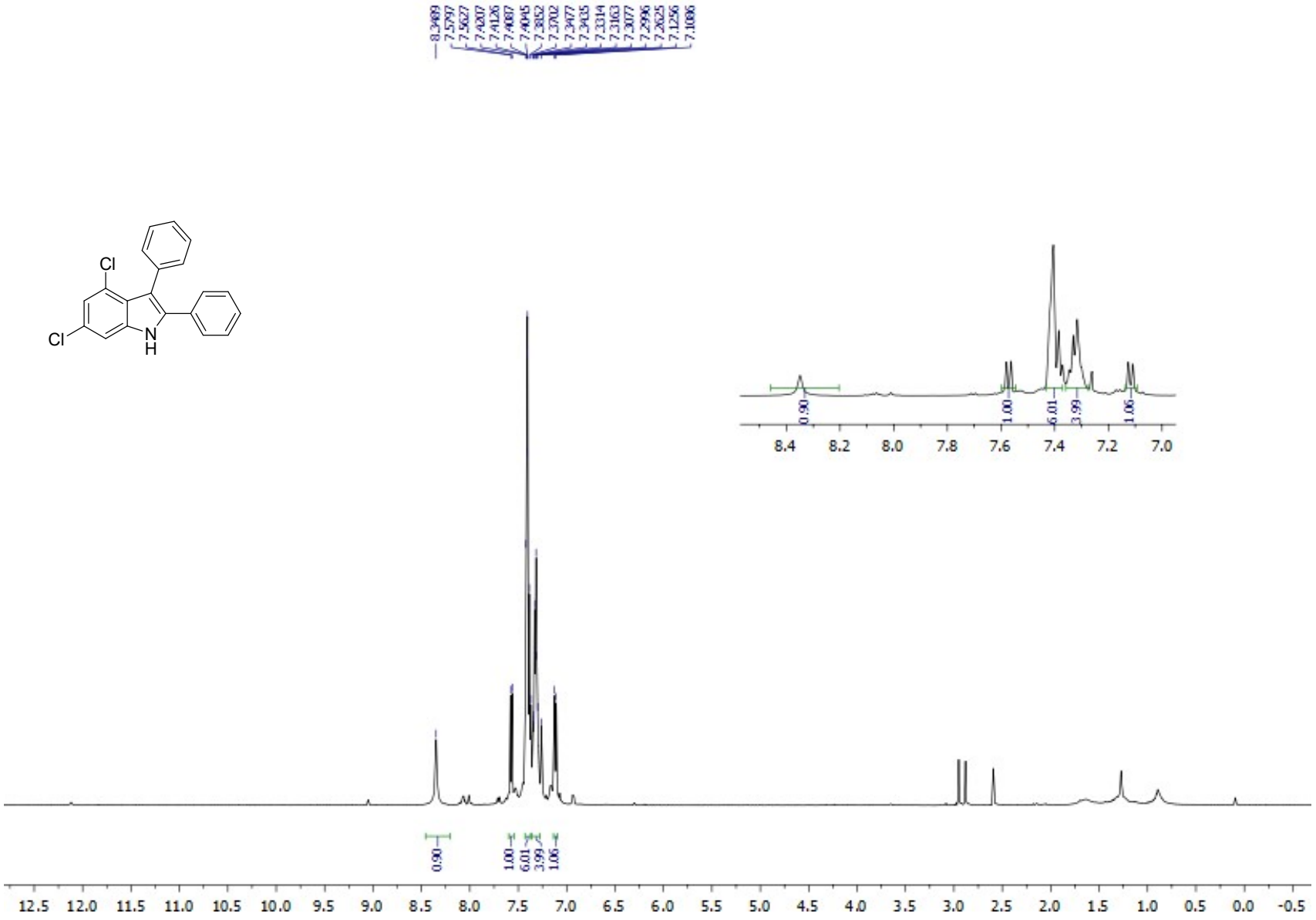
^{1}H NMR of Compound **39** ($CDCl_3$, 500 MHz)



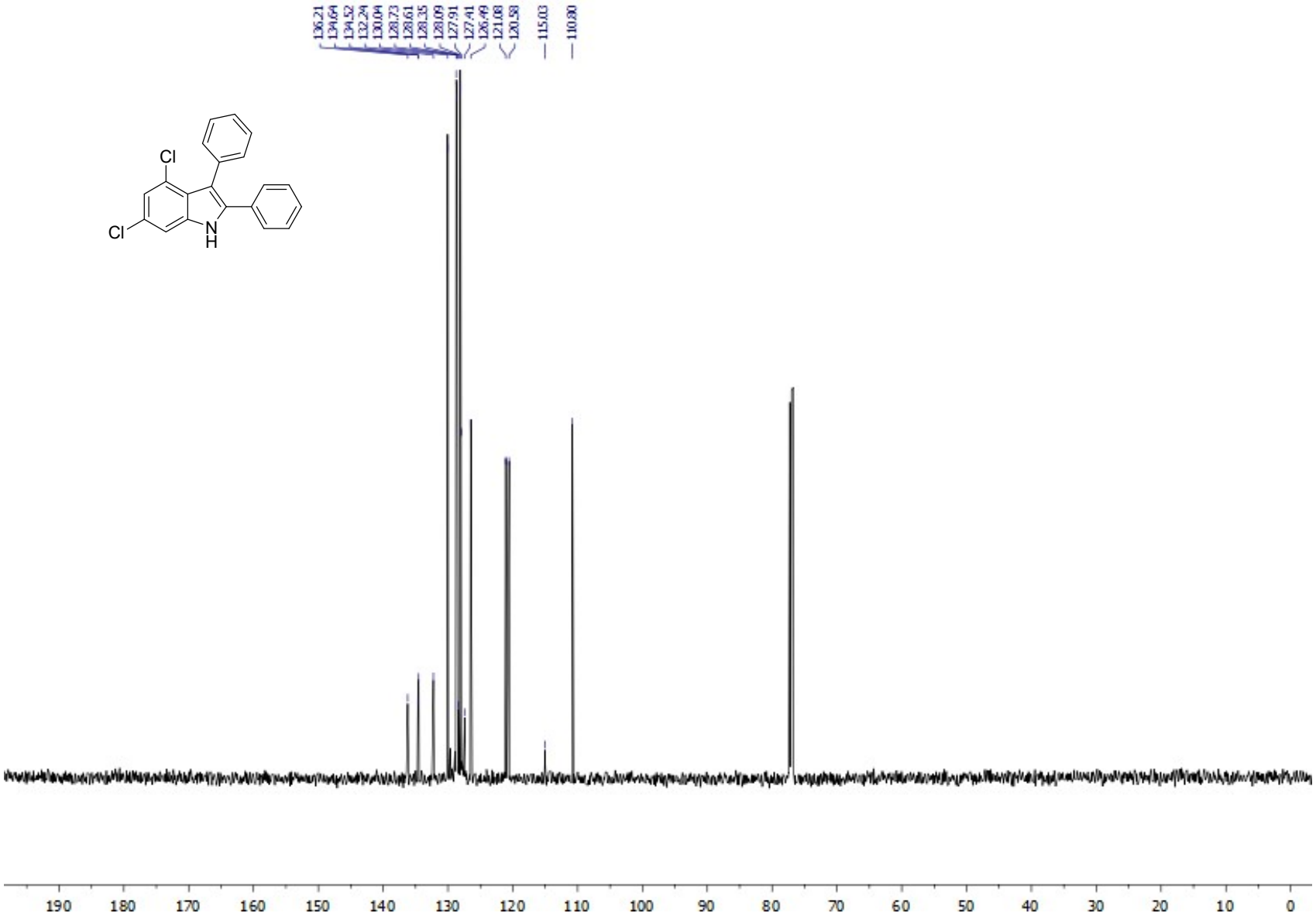
^{13}C NMR of compound **39** ($CDCl_3$, 125 MHz)



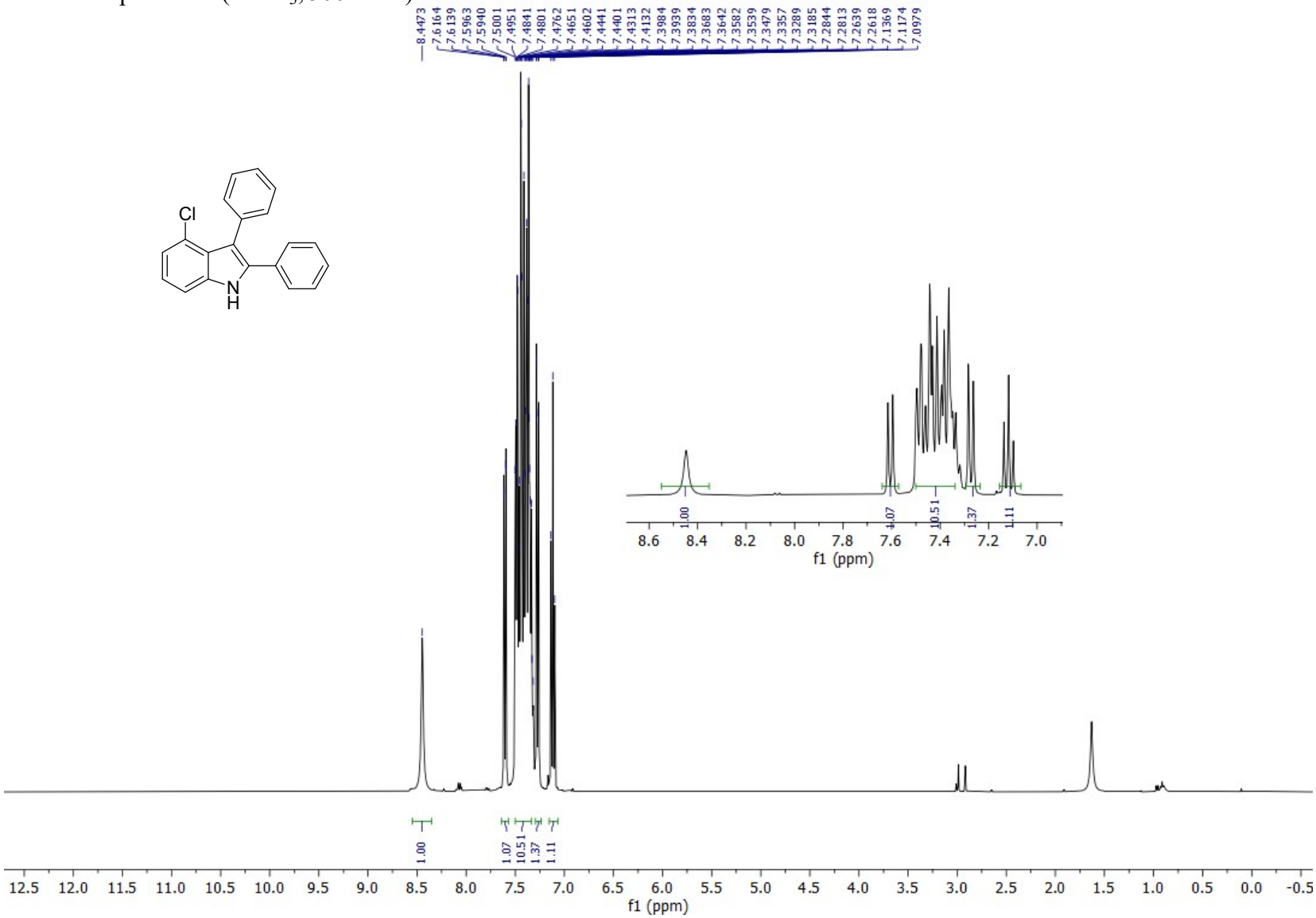
^{1}H NMR of Compound **40** ($CDCl_3$, 500 MHz)



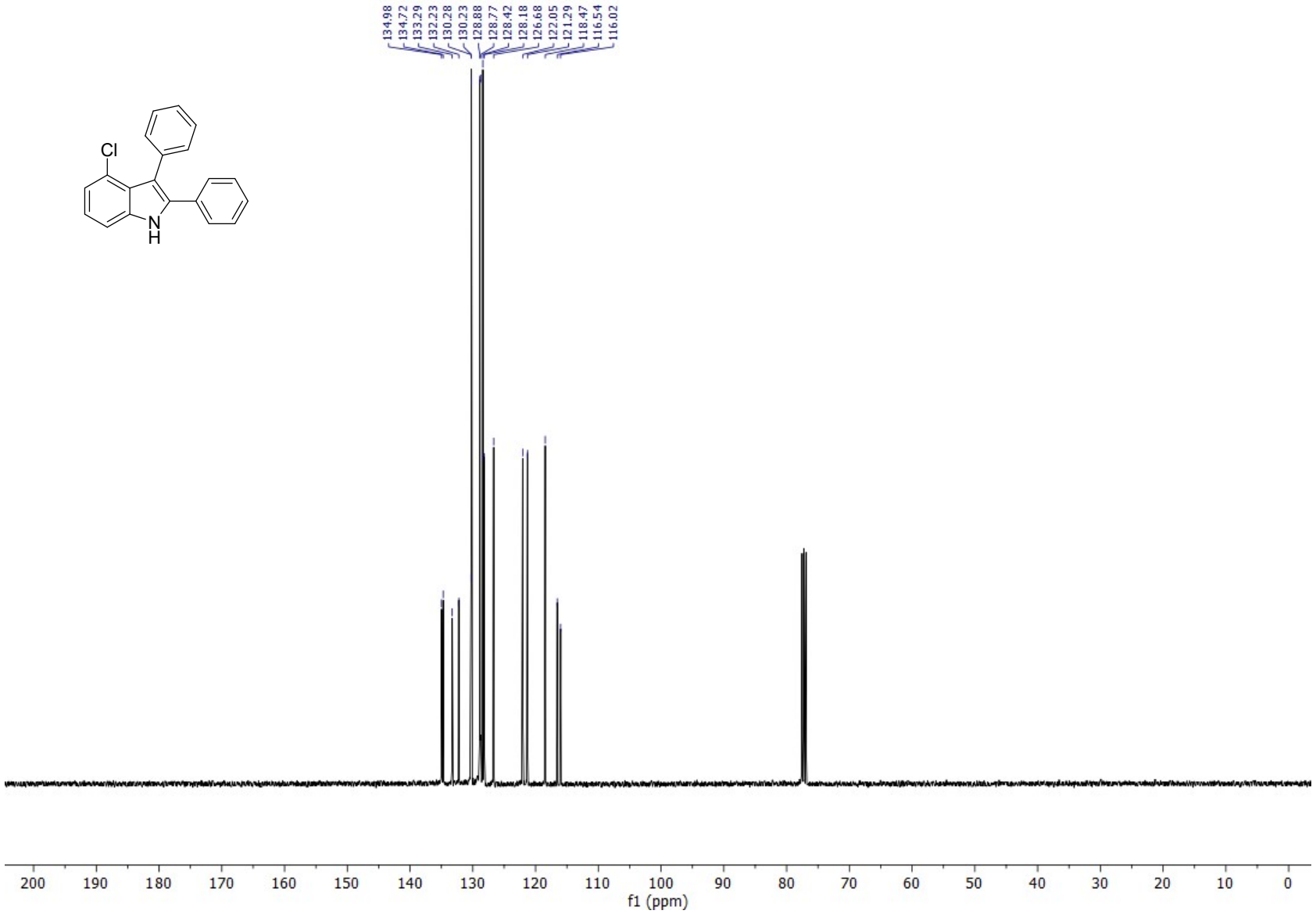
^{13}C NMR of compound **40** ($CDCl_3$, 125 MHz)



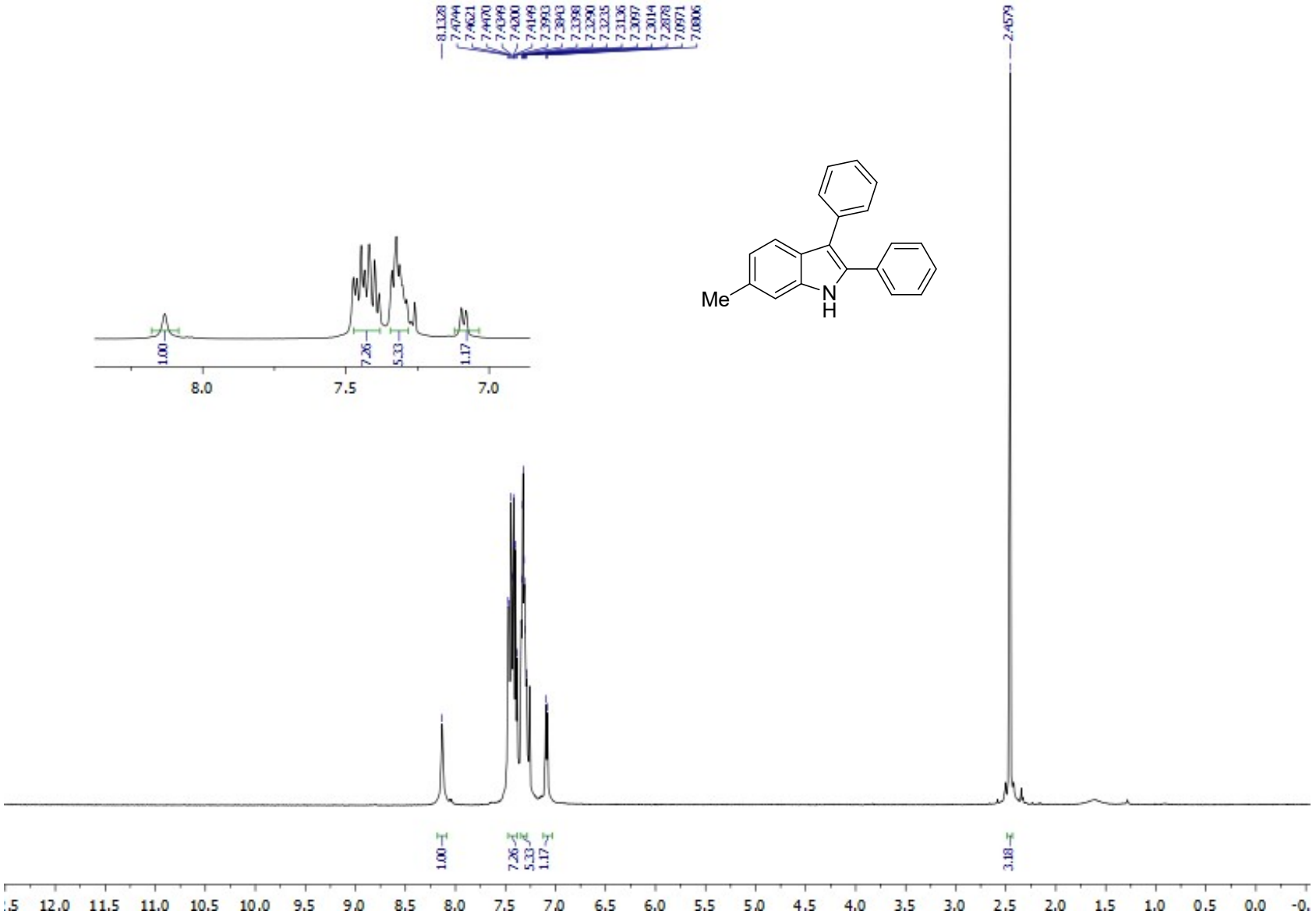
^{1}H NMR of Compound **41** ($CDCl_3$, 500 MHz)



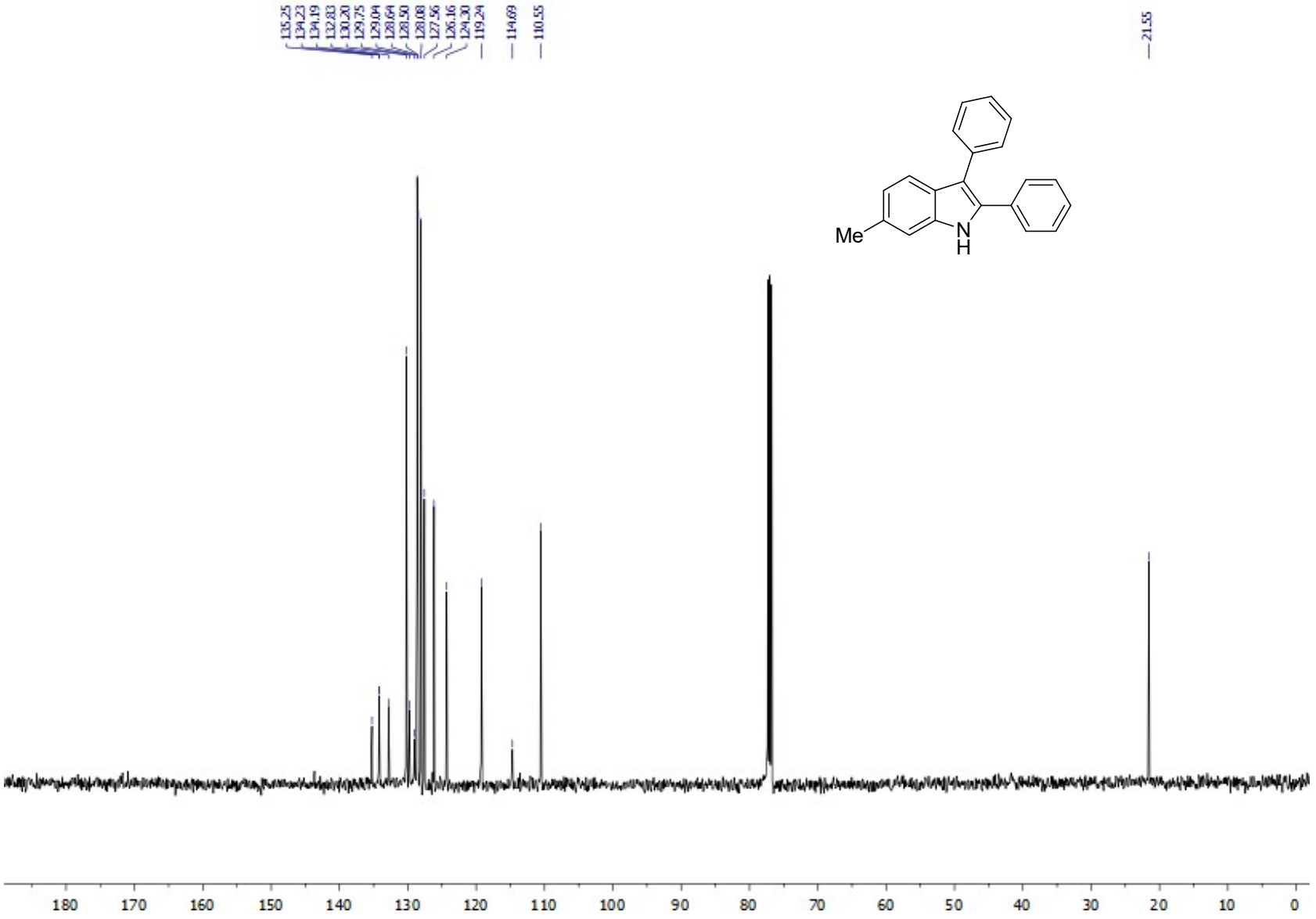
^{13}C NMR of compound **41** ($CDCl_3$, 125 MHz)



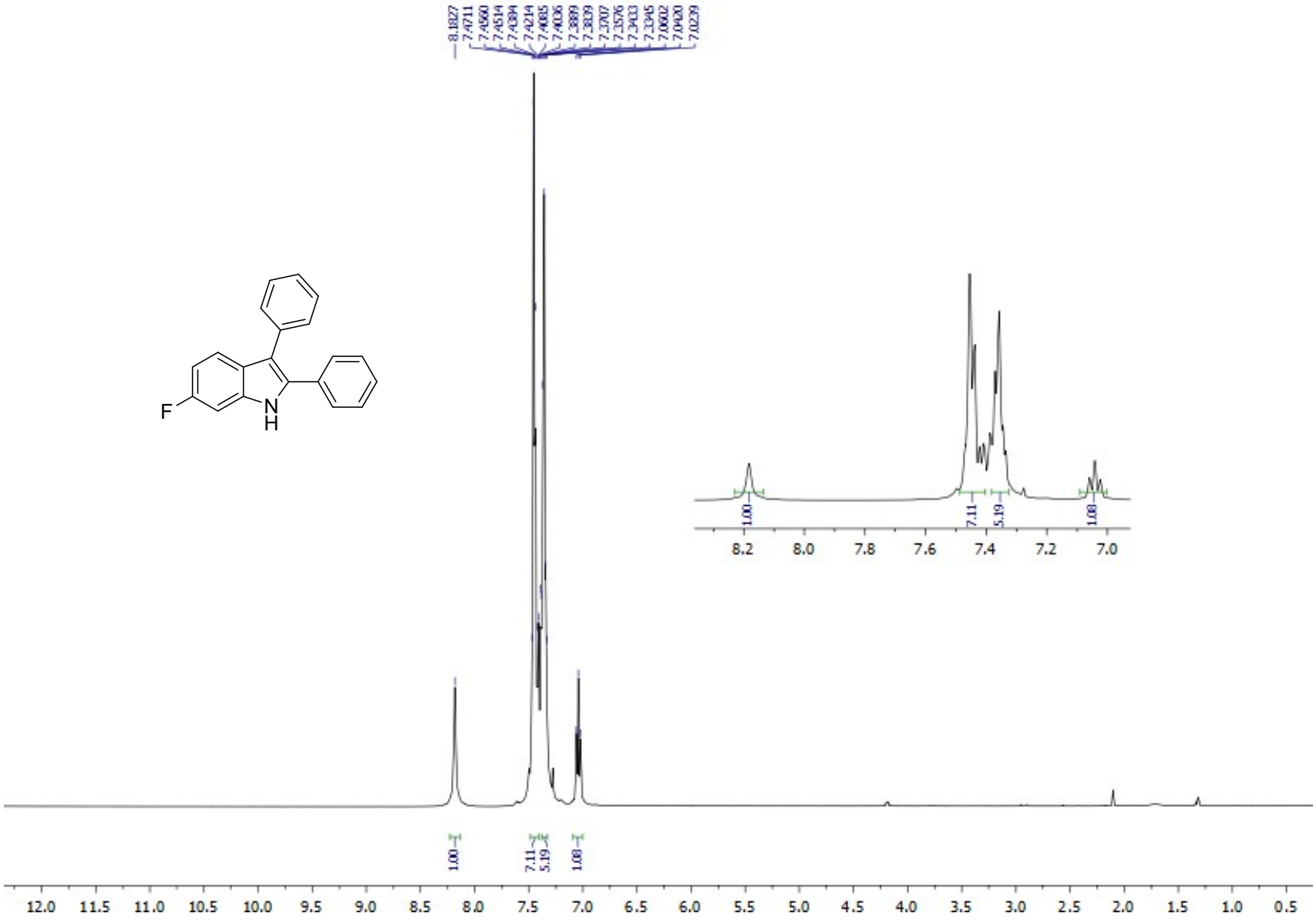
^{1}H NMR of Compound **42** ($CDCl_3$, 500 MHz)



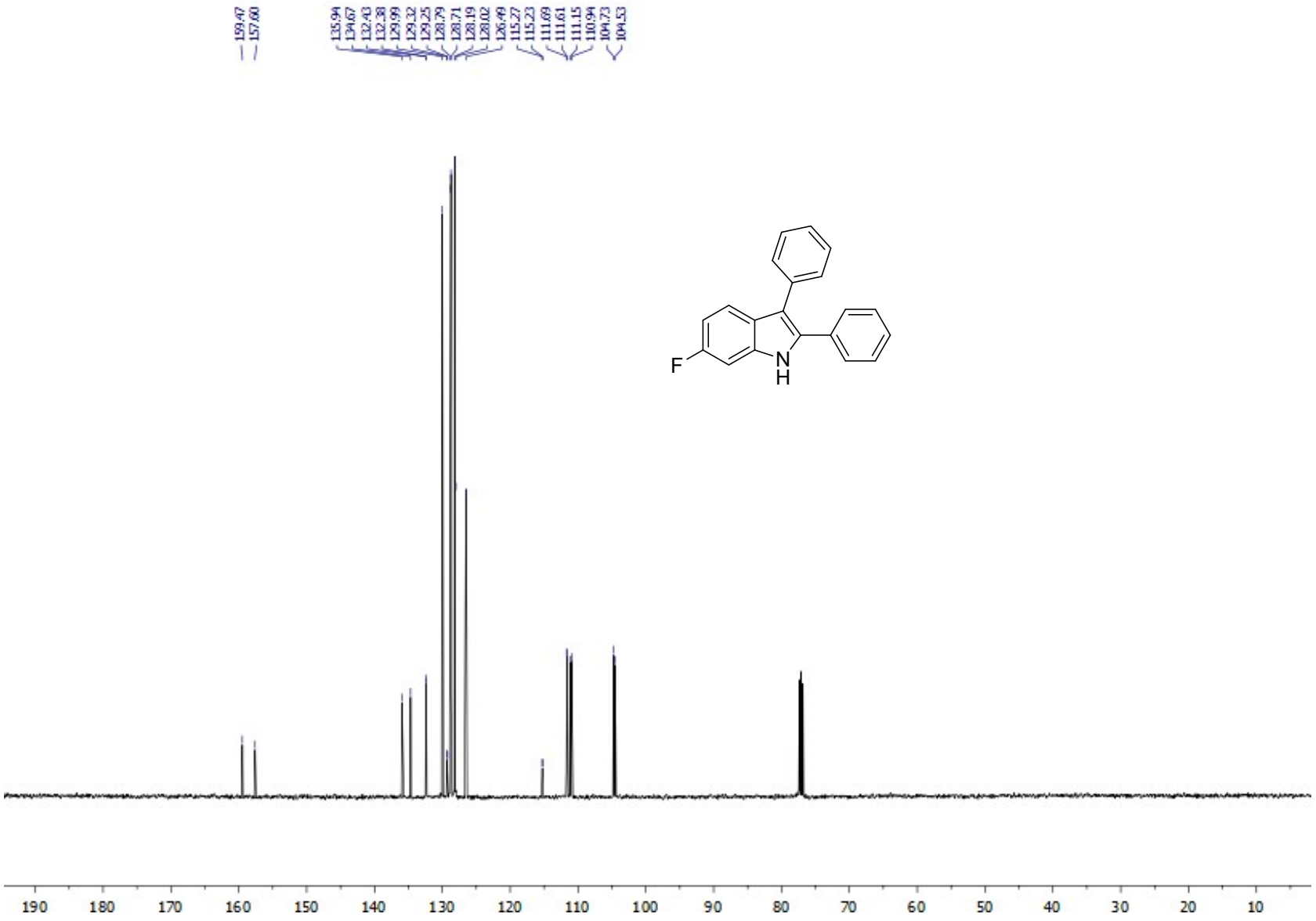
^{13}C NMR of compound **42** ($CDCl_3$, 125 MHz)



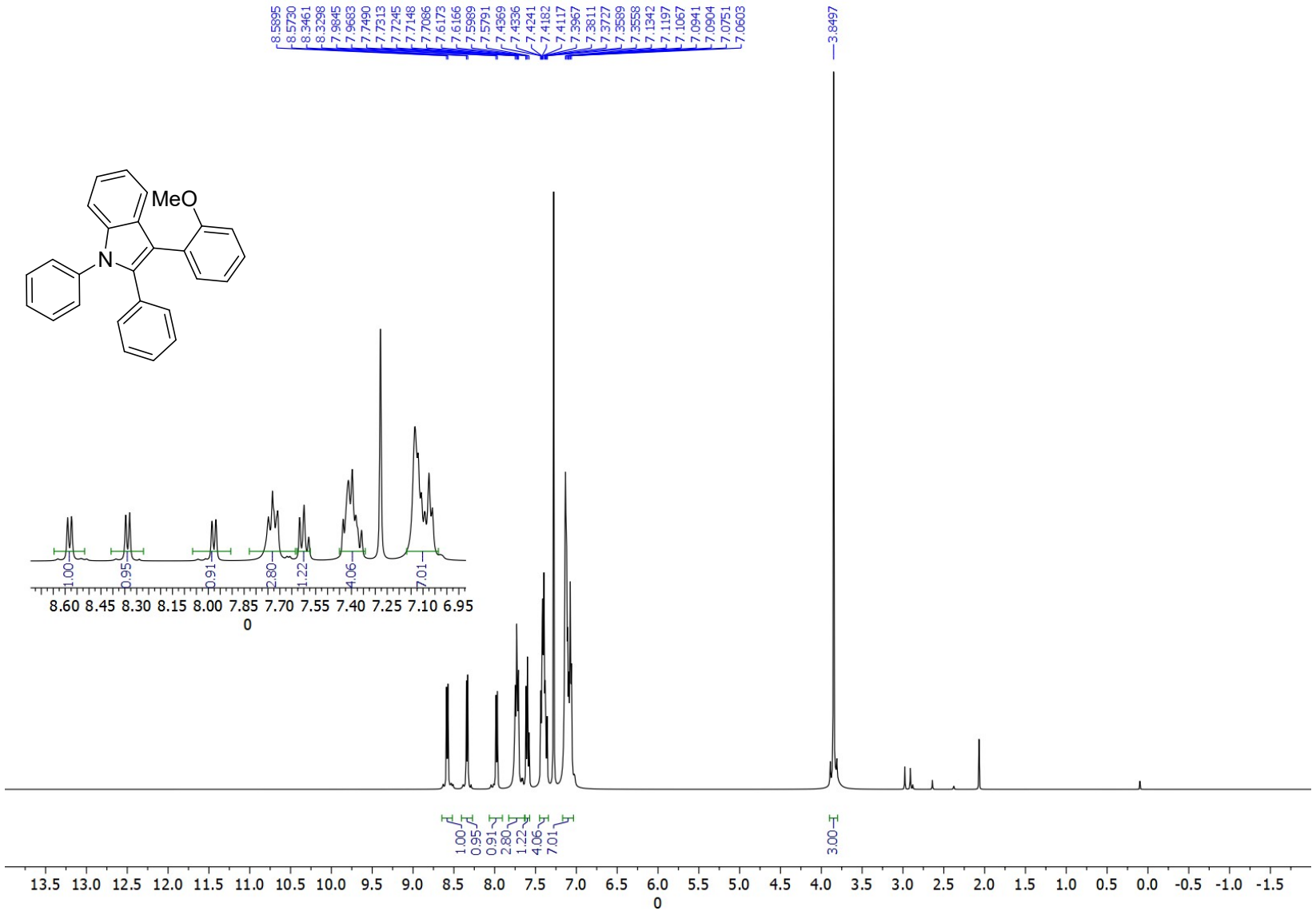
^{1}H NMR of Compound **43** ($CDCl_3$, 500 MHz)



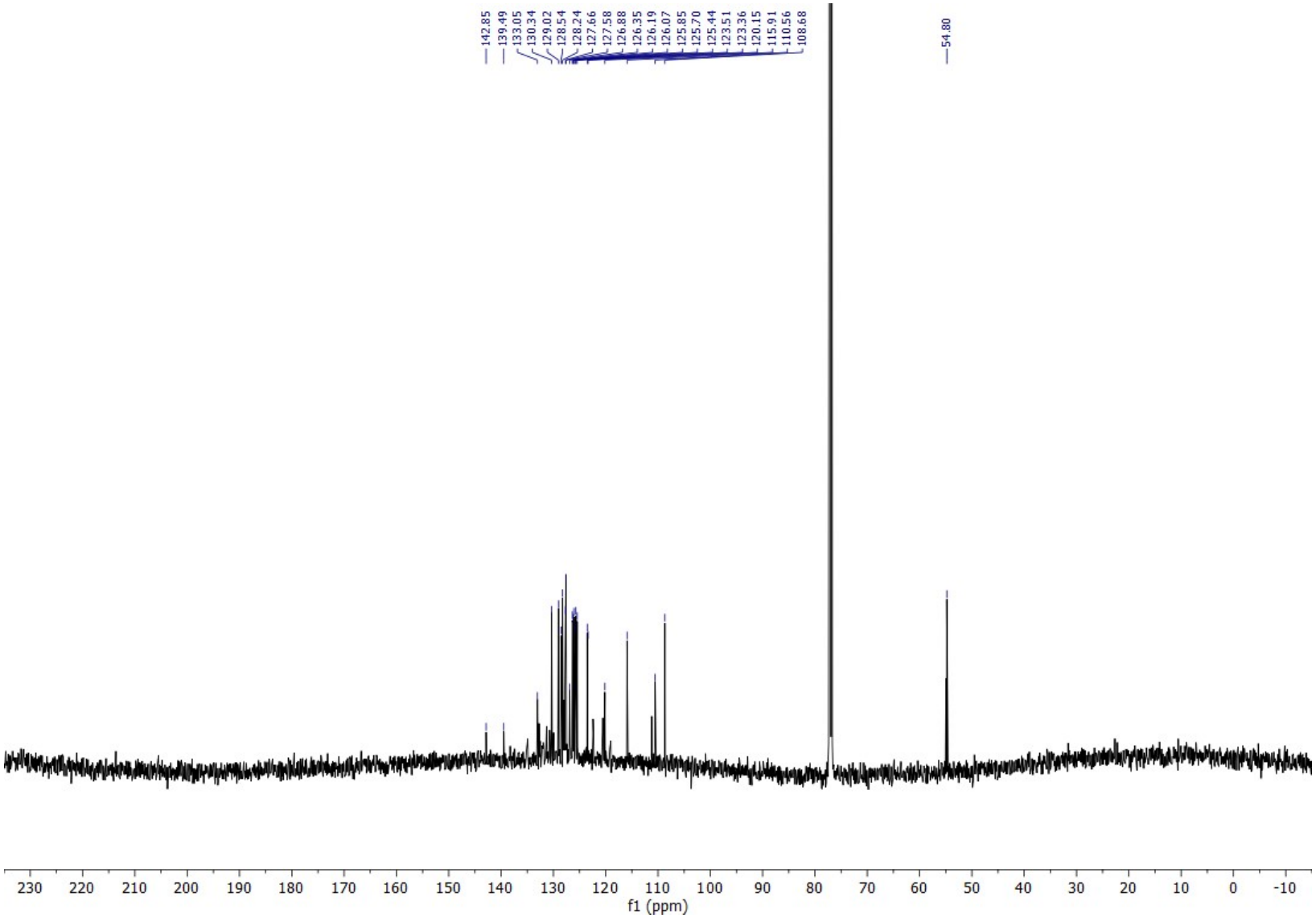
^{13}C NMR of compound **43** ($CDCl_3$, 125 MHz)



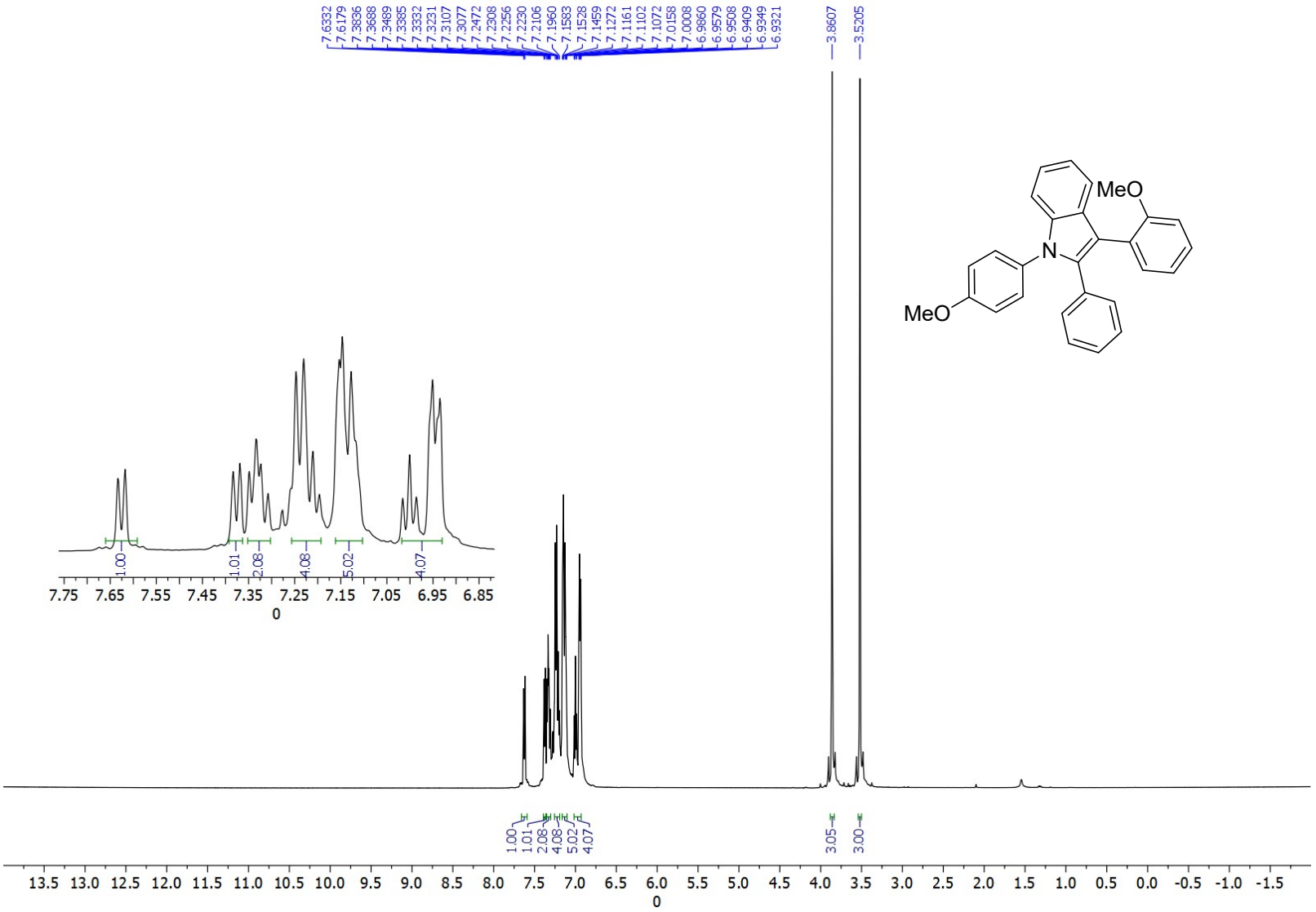
^{1}H NMR of Compound **44** ($CDCl_3$, 500 MHz)



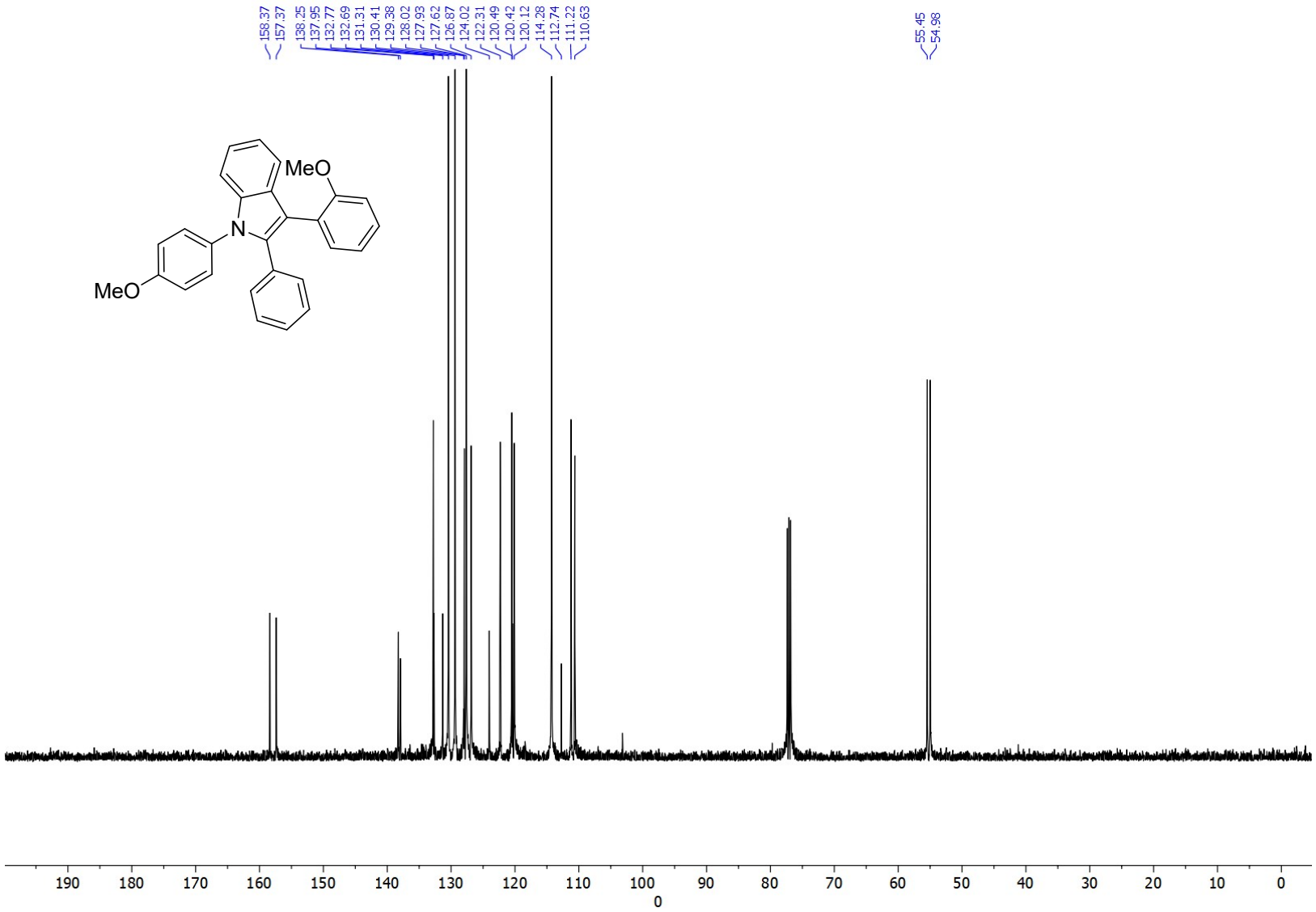
^{13}C NMR of compound **44** ($CDCl_3$, 125 MHz)



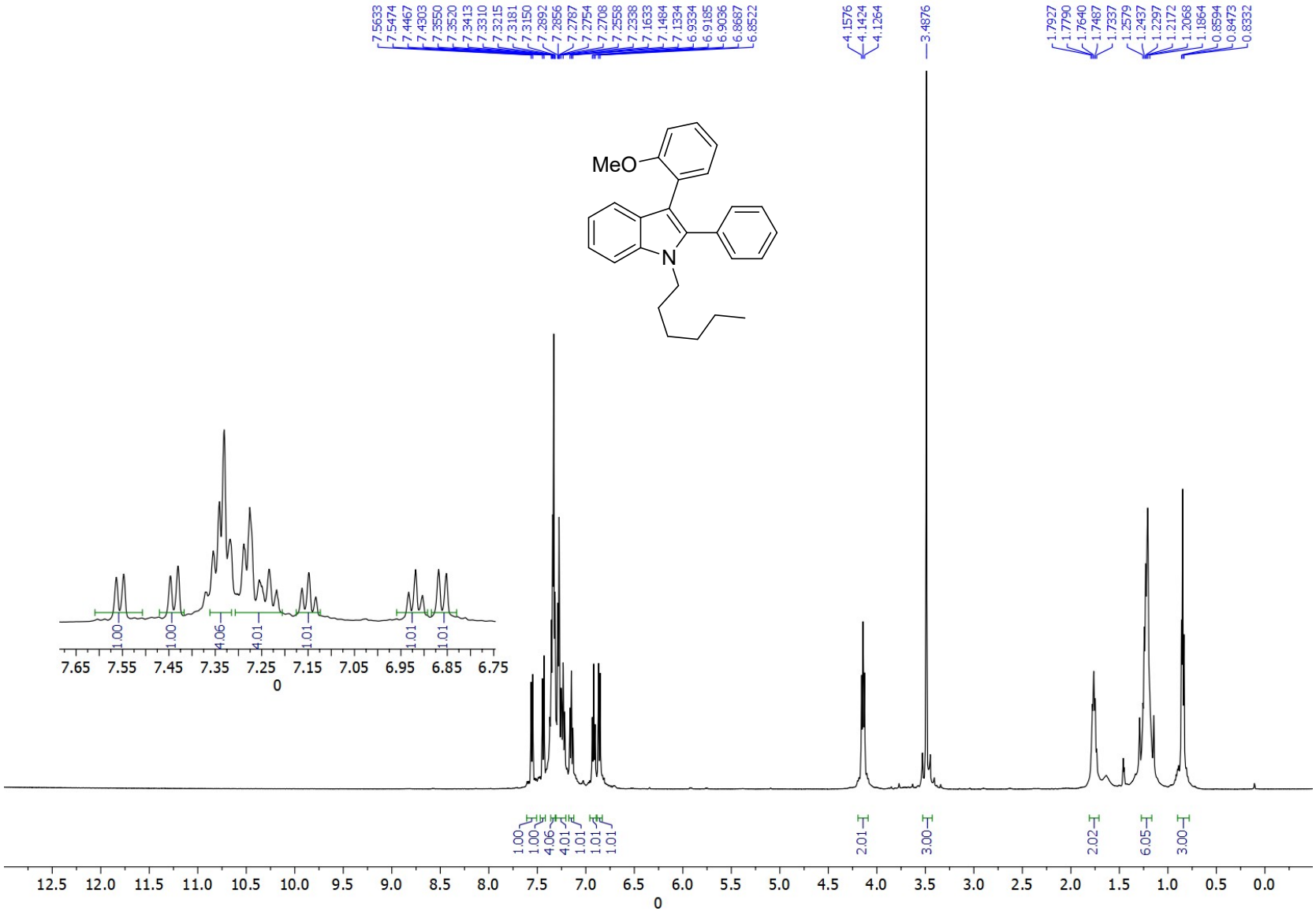
^{1}H NMR of Compound **45** ($CDCl_3$, 500 MHz)



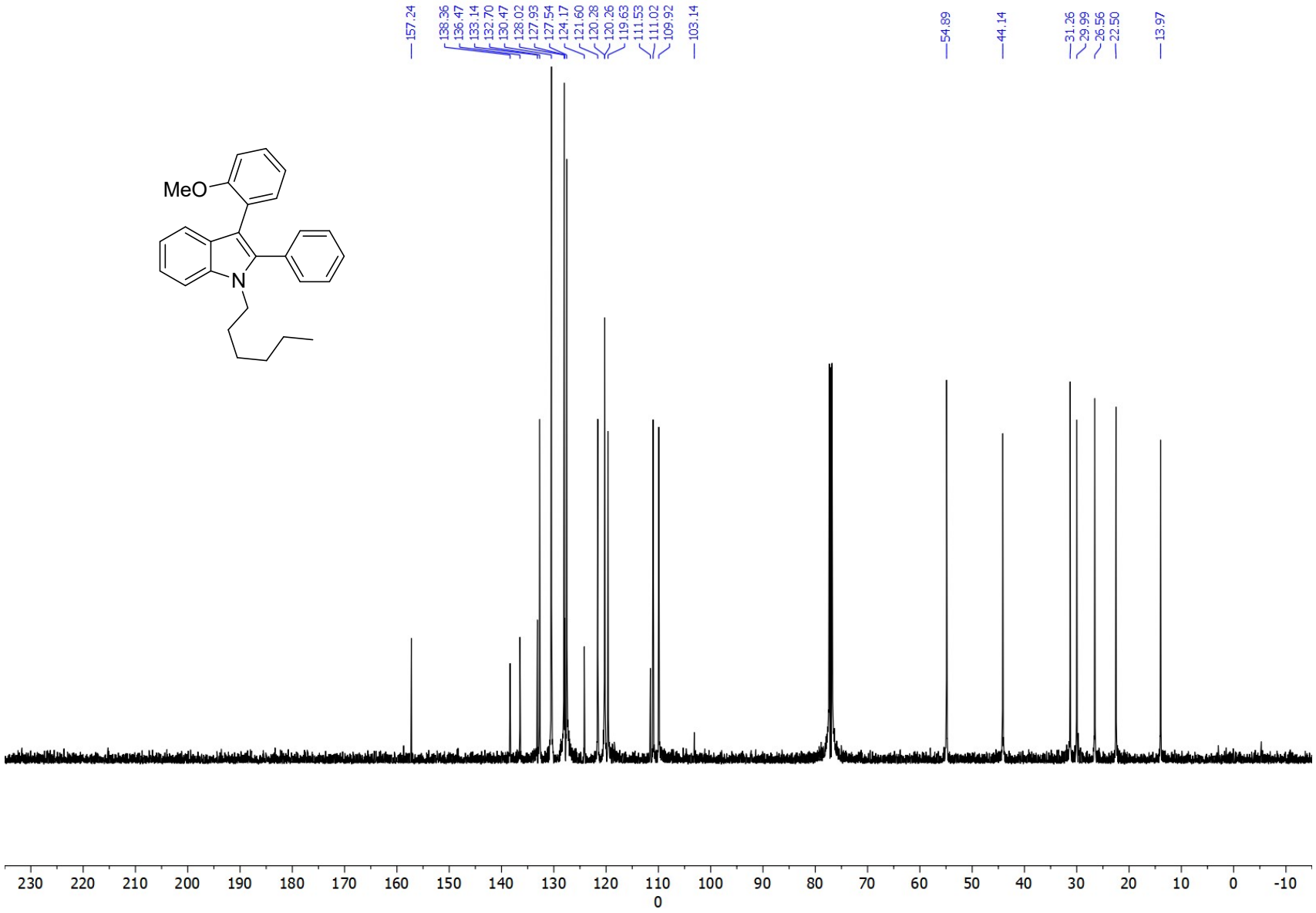
^{13}C NMR of compound **45** ($CDCl_3$, 125 MHz)



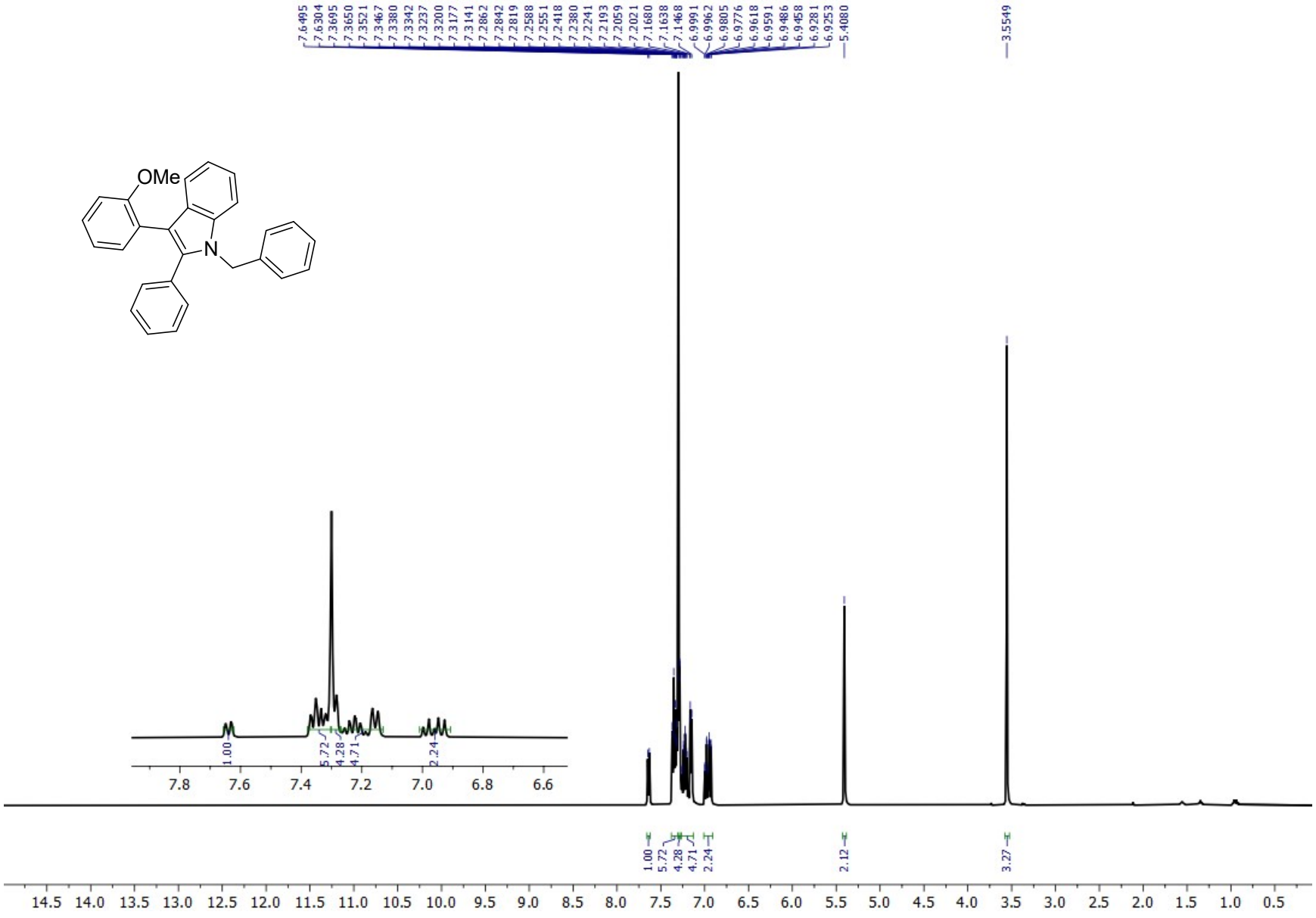
^{1}H NMR of Compound **46** ($CDCl_3$, 500 MHz)



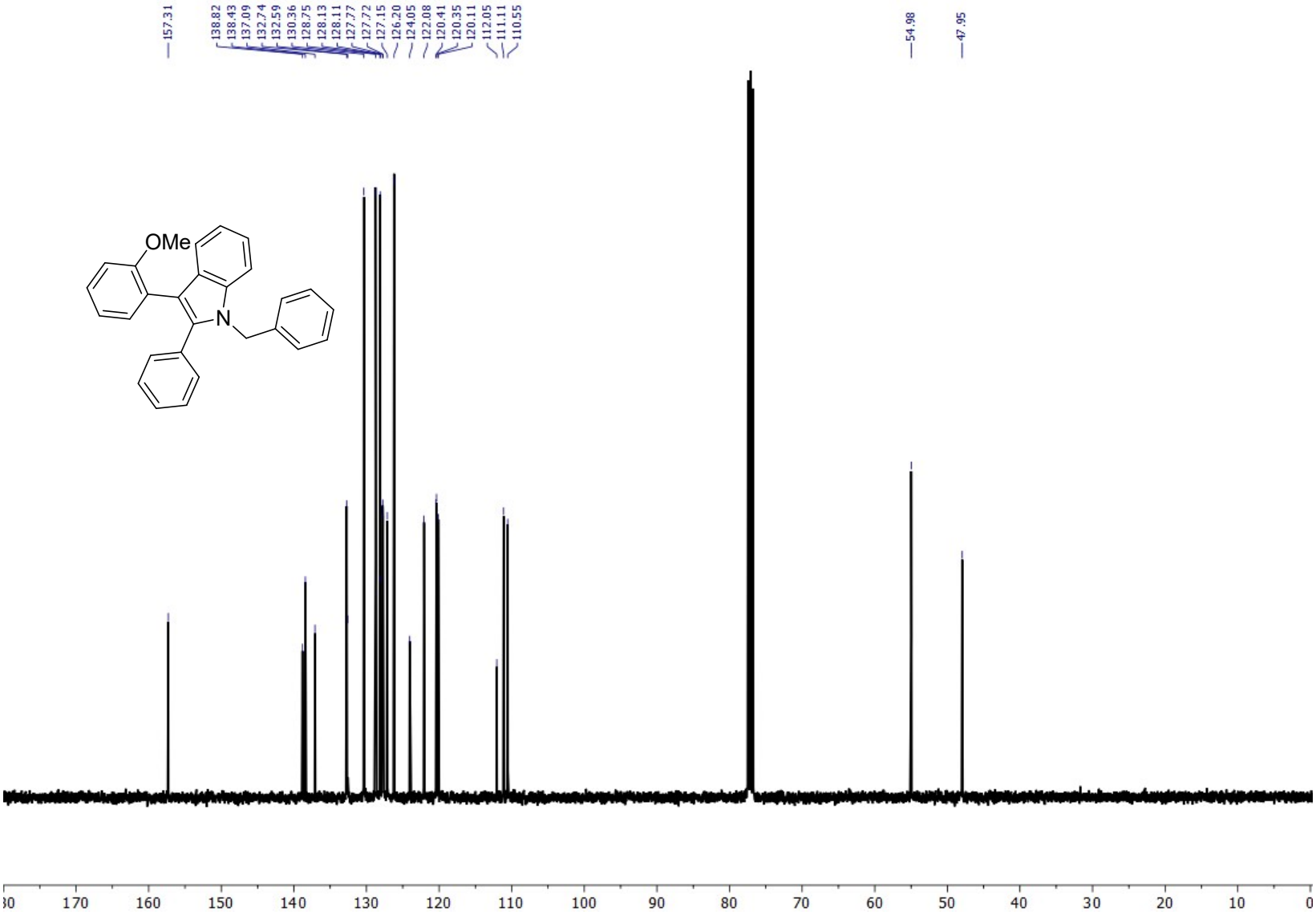
^{13}C NMR of compound **46** ($CDCl_3$, 125 MHz)



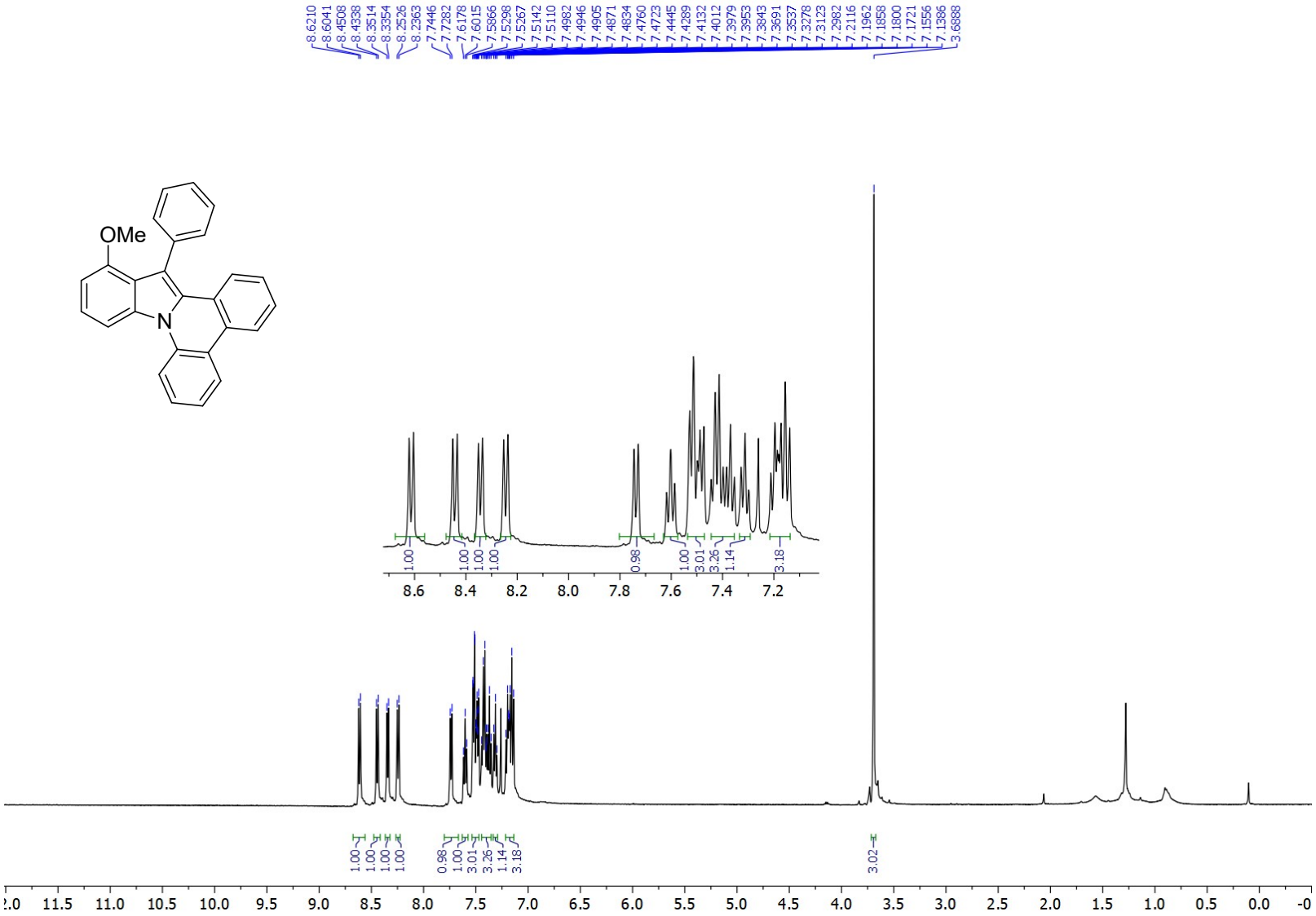
^{1}H NMR of Compound **47** ($CDCl_3$, 500 MHz)



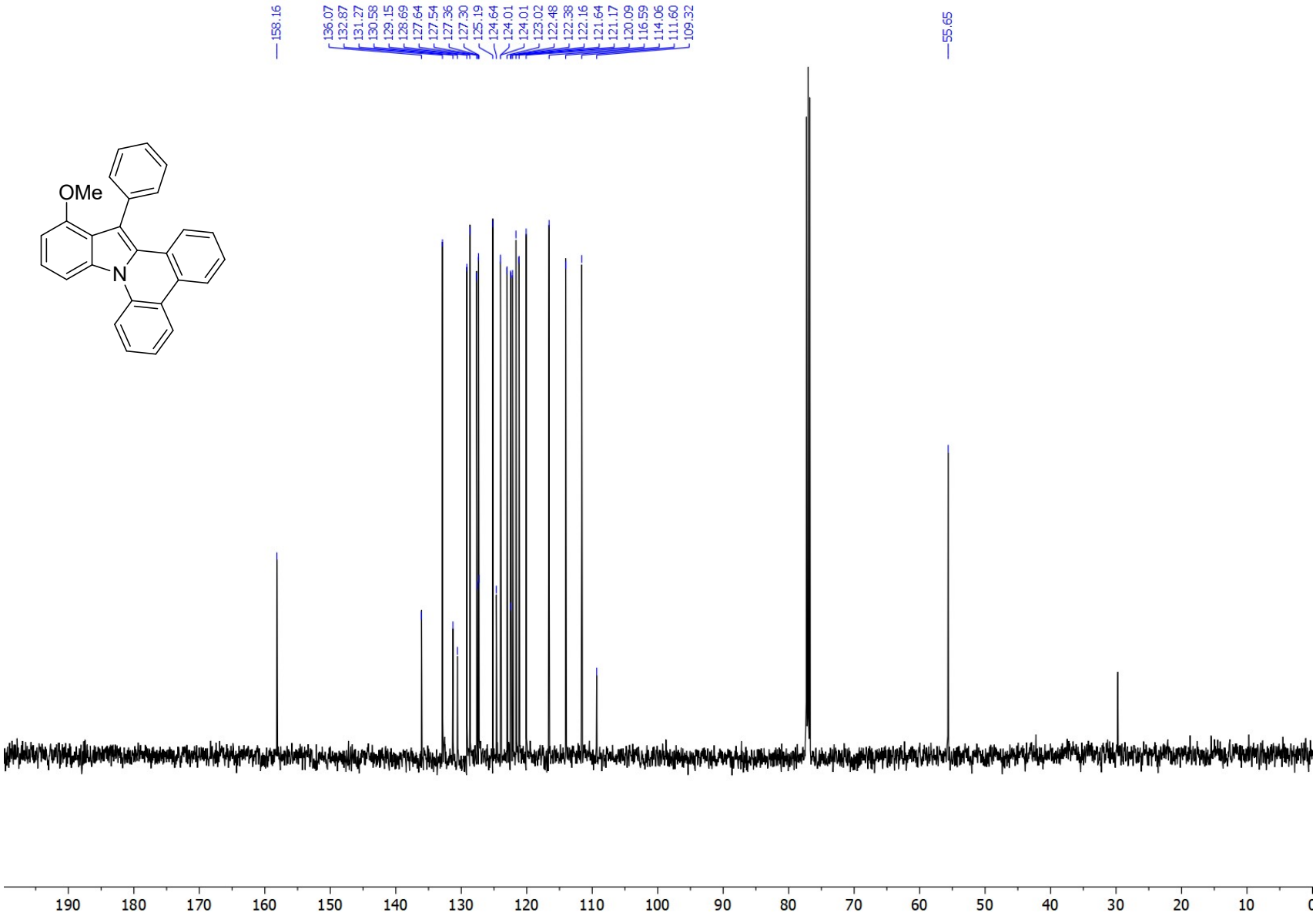
^{13}C NMR of compound **47** ($CDCl_3$, 125 MHz)



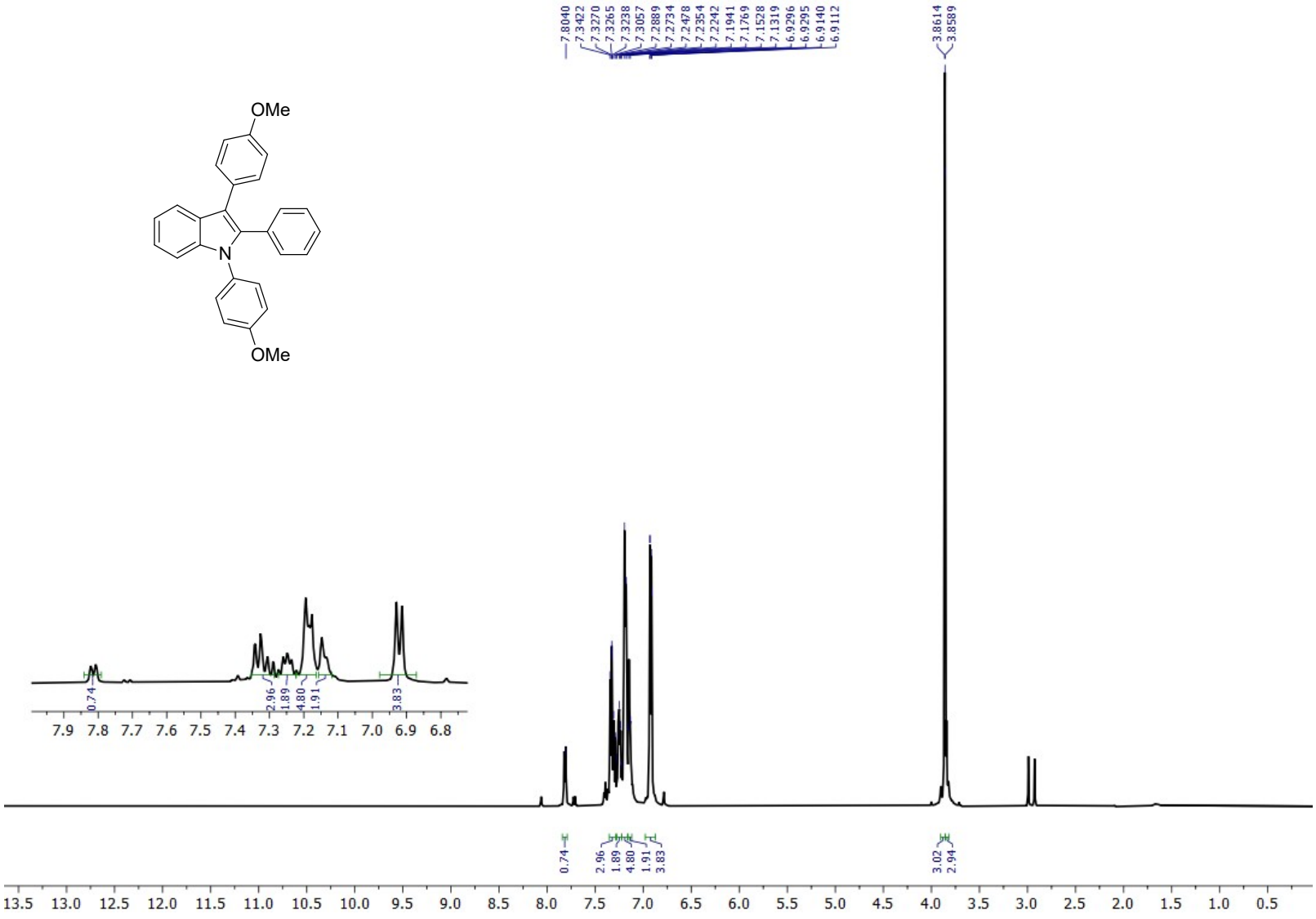
^{1}H NMR of Compound **48** ($CDCl_3$, 500 MHz)



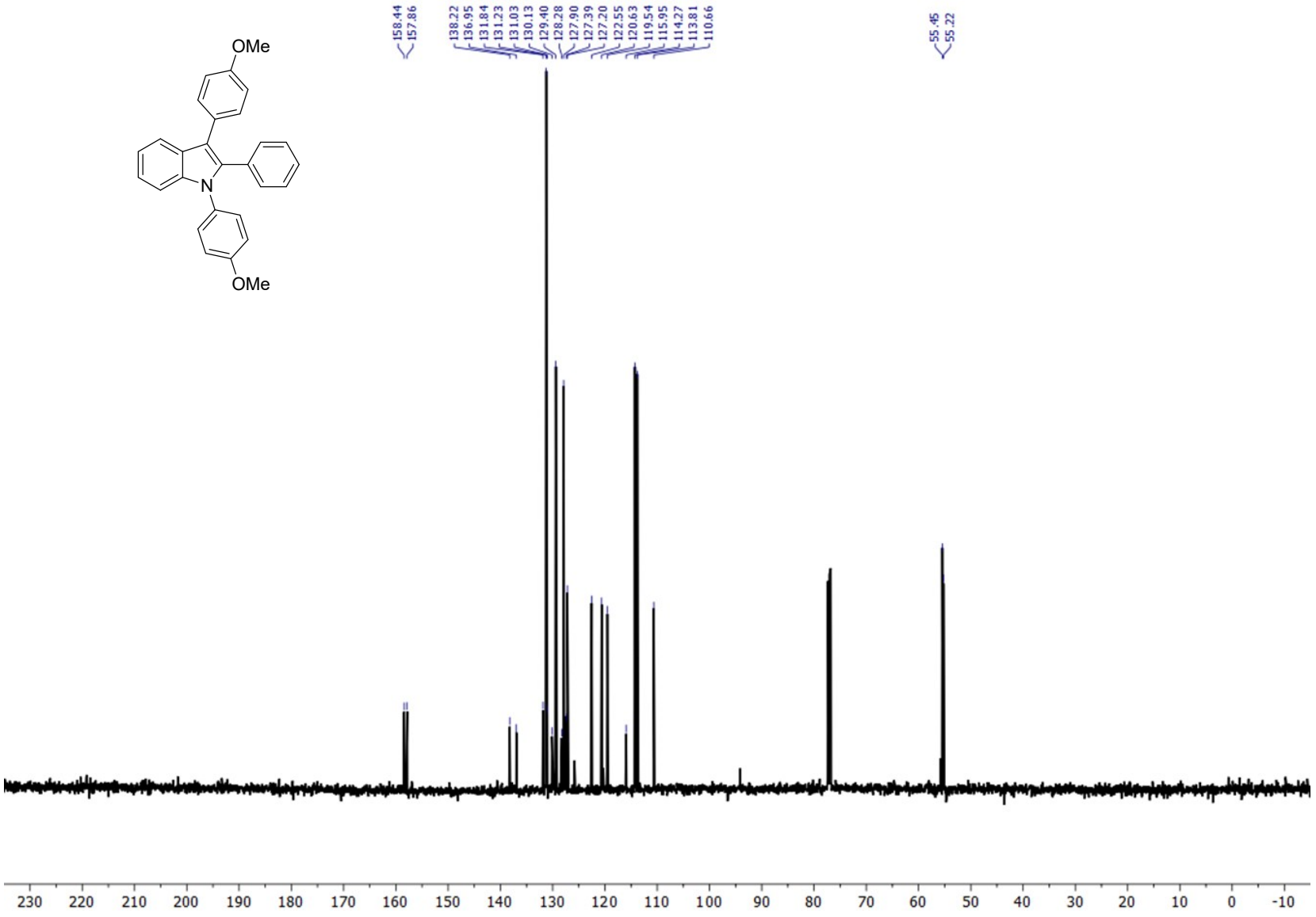
^{13}C NMR of compound **48** ($CDCl_3$, 125 MHz)



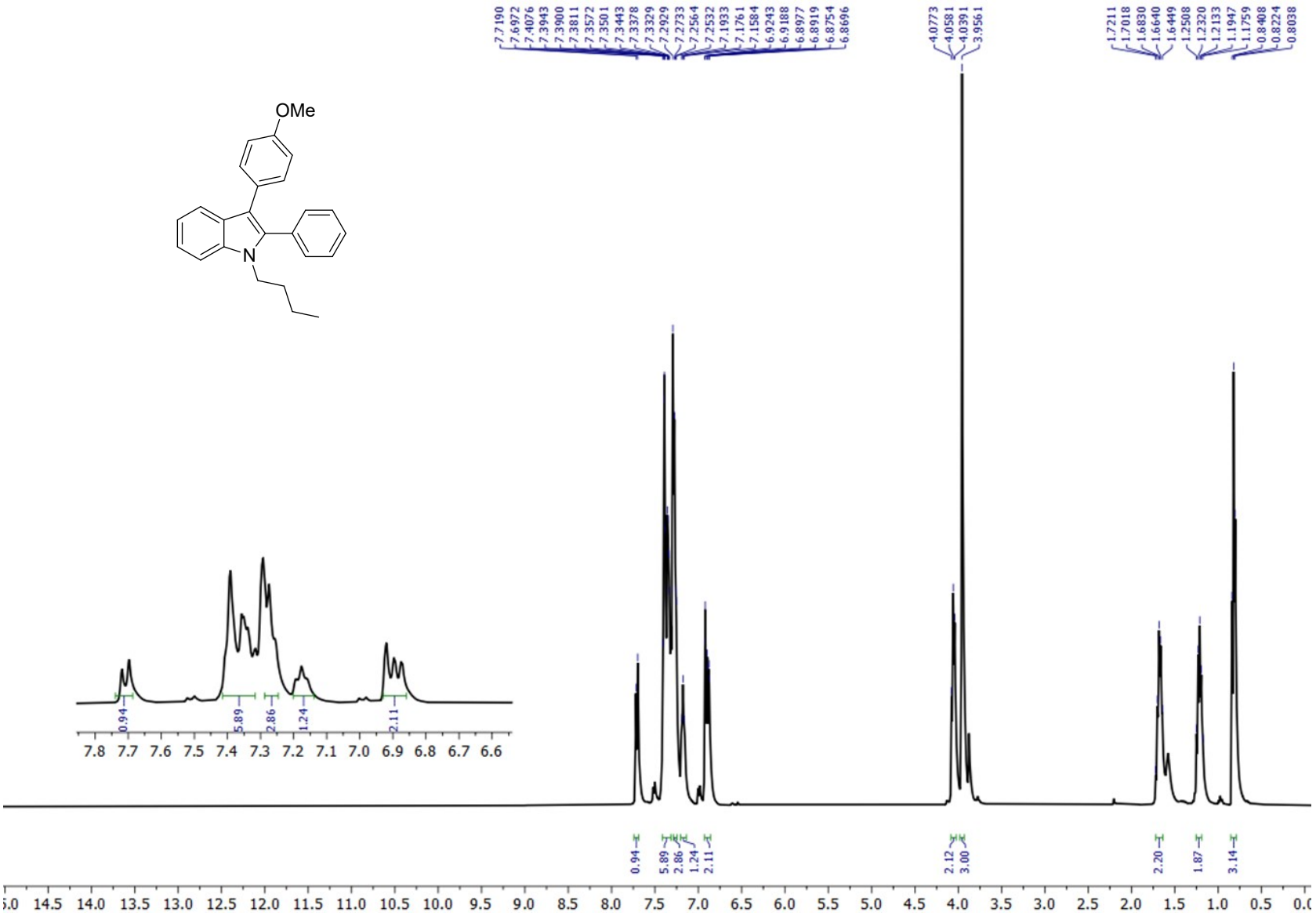
^{1}H NMR of Compound **49** ($CDCl_3$, 500 MHz)



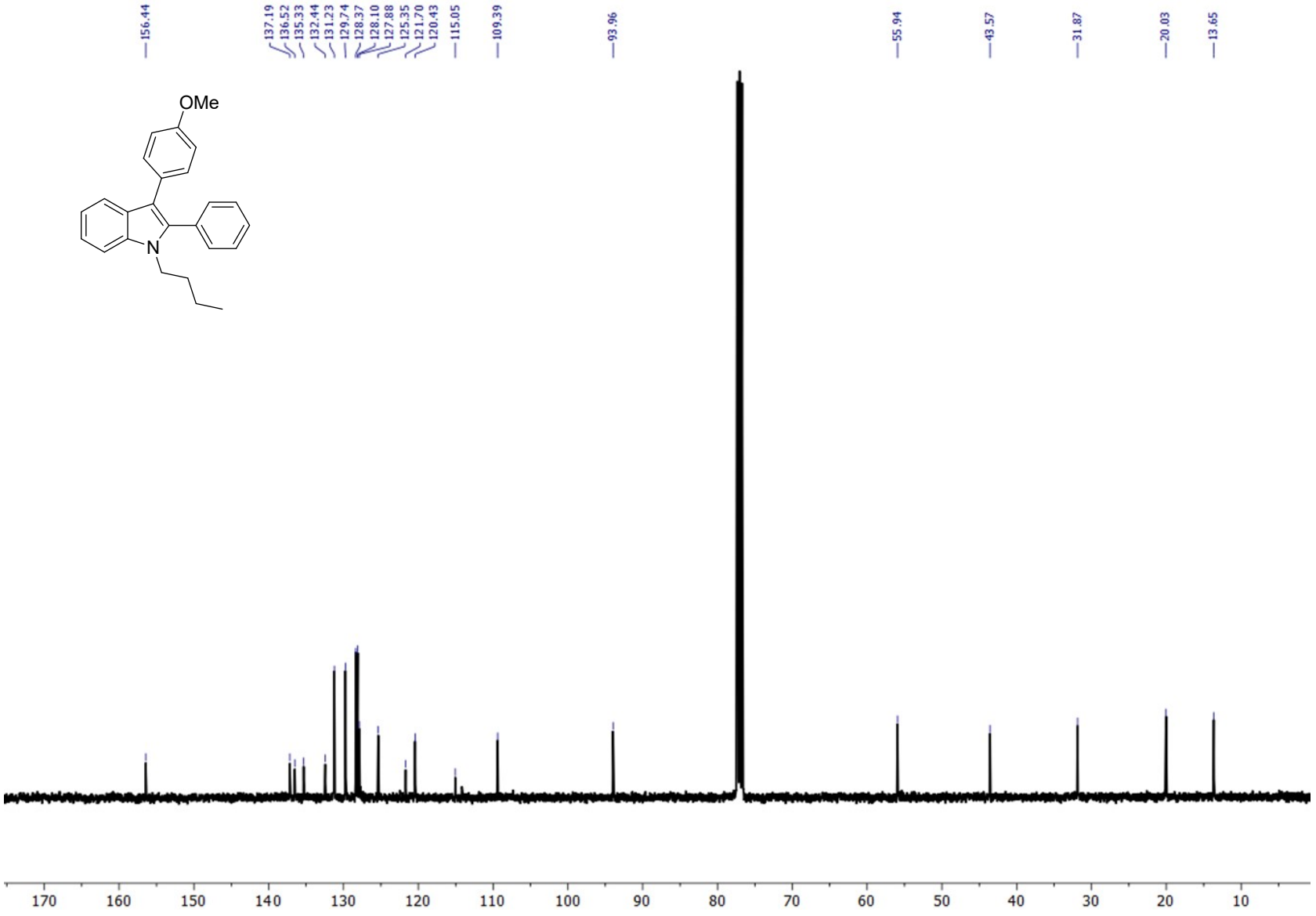
^{13}C NMR of compound **49** ($CDCl_3$, 125 MHz)



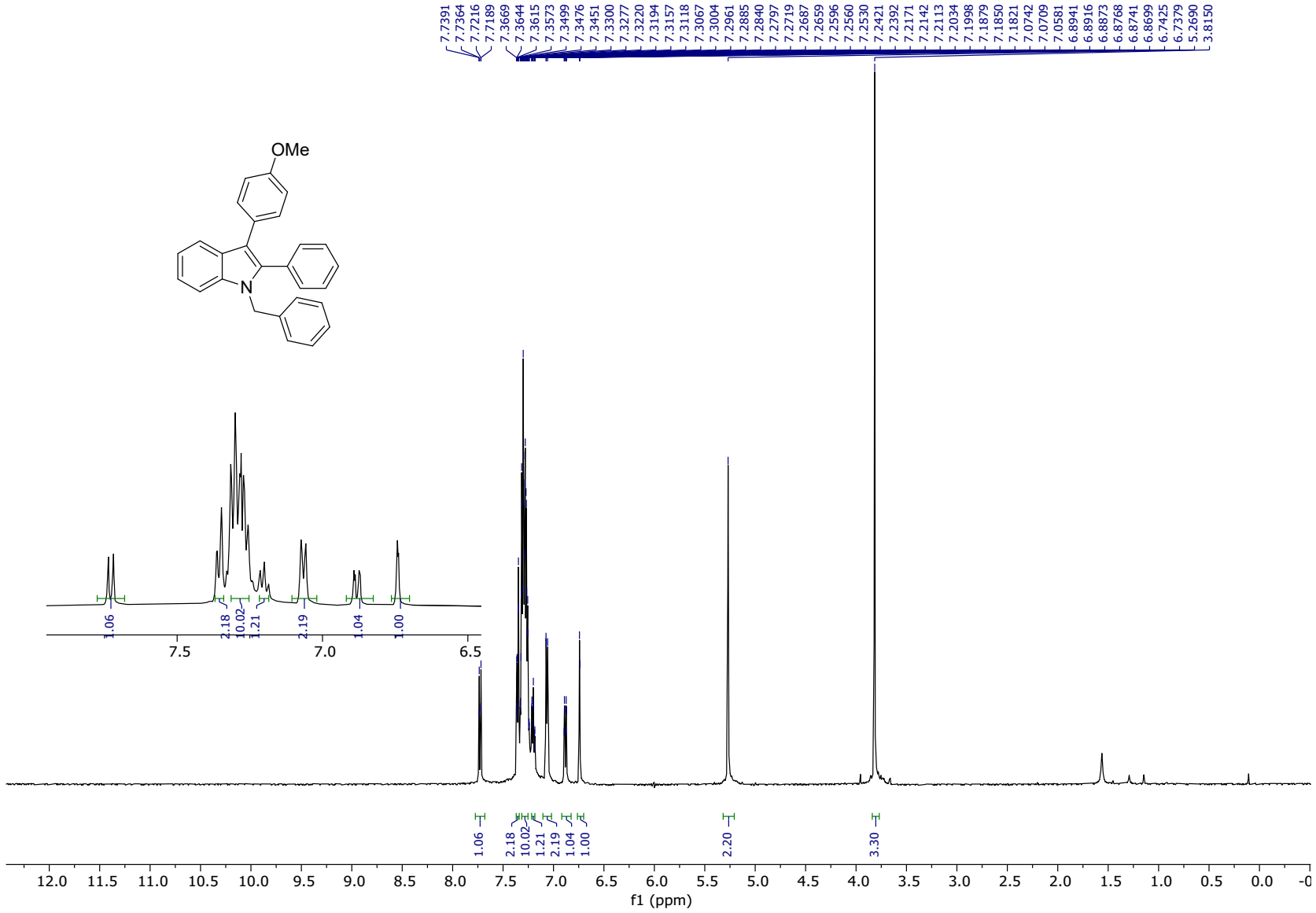
^{1}H NMR of Compound **50** ($CDCl_3$, 500 MHz)



^{13}C NMR of compound **50** ($CDCl_3$, 125 MHz)



^{1}H NMR of Compound **51** ($CDCl_3$, 500 MHz)



^{13}C NMR of compound **51** ($CDCl_3$, 125 MHz)