# Supplementary Information

# Metal-free Synthesis of 3,3'-Bisindolylmethanes in Water Using $Ph_3C^+[B(C_6F_5)_4]^-$ as Pre-catalyst

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## 1. General information

All chemicals were purchased from *J&K* Scientific or Bidepharm unless otherwise specified. $Ph_3C^+[B(C_6F_5)_4]^-$ was purchased from Energy Chemical. Anhydrous solvents were purchased from J&K Scientific and directly used. Unless otherwise noted, reagents were commercially available and used as purchased. All reactions were conducted under a nitrogen atmosphere or air by using standard Schlenk or vacuum line techniques. All glassware and vials were oven-dried prior to use. All work-up and purification procedures were carried out with reagent-grade solvents. Analytical thin-layer chromatography (TLC) was performed using glass plates precoated with 0.25 mm Kiesegel 60 $F_{254}$(Merck). The developed chromatography was analyzed by UV lamp (254 nm and 365 nm). Flash chromatography was performed on 200-400 mesh silica gel with the indicated eluents. GC-MS analysis was conducted on an Agilent 7890A GC System with an Agilent 5975C MSD or Bruker SCION TQ with Bruker 456 GC System. Proton Nuclear magnetic resonance ($^1$H NMR) spectra were recorded at 400 MHz in indicated deuterated solvents and coupling constants (*J*) were reported in Hertz (Hz). Splitting patterns were designated as s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; br, broad; dd, doublet of doublets, *etc*. The chemical shifts were reported on the δ scale (*ppm*). Carbon nuclear magnetic resonance spectra ($^{13}$C NMR) were recorded at 101 MHz and the chemical shifts were accurate to one decimal place or two decimal places to help distinguish overlapping peaks. High resolution mass spectrometry (HRMS) data were obtained on a Waters LC-TOF mass spectrometer (Xevo G2-XS QTof) using electrospray ionization (ESI) in positive mode.

## 2. Starting materials

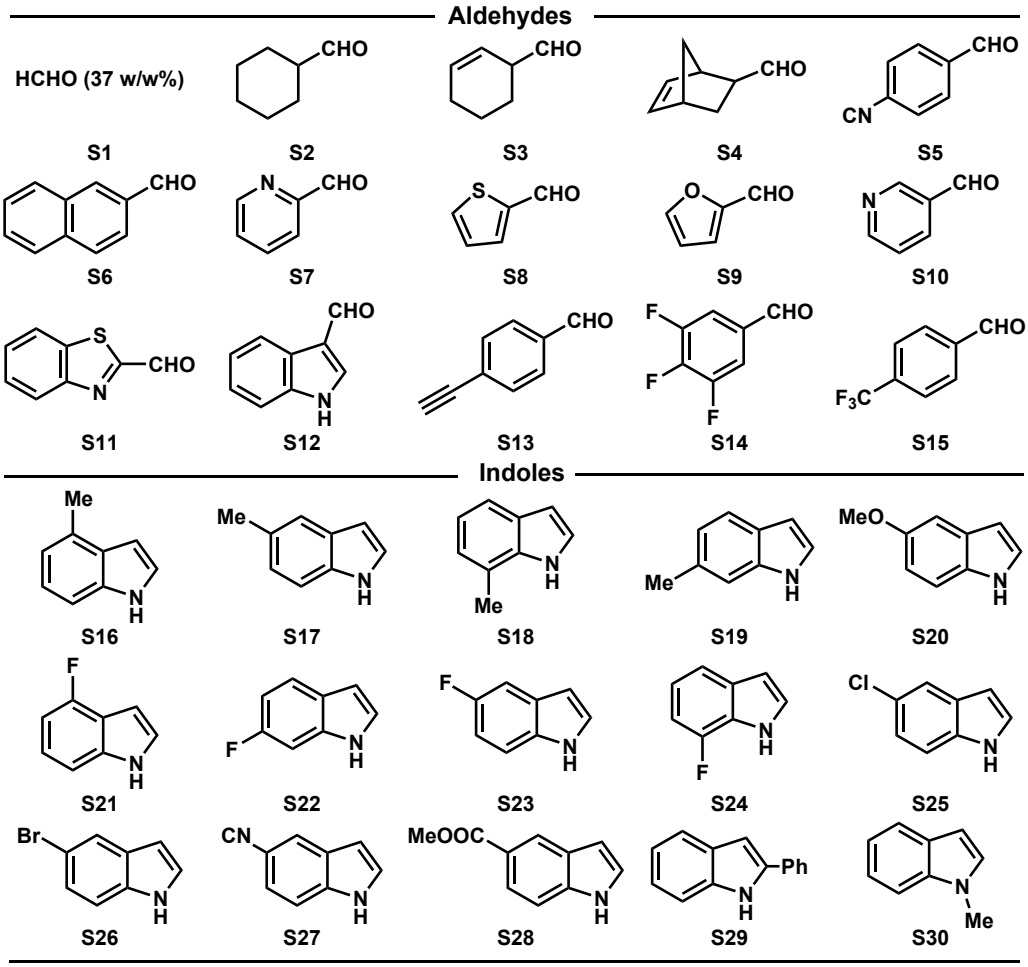



**Figure S1. The structure of aldehydes and indoles**

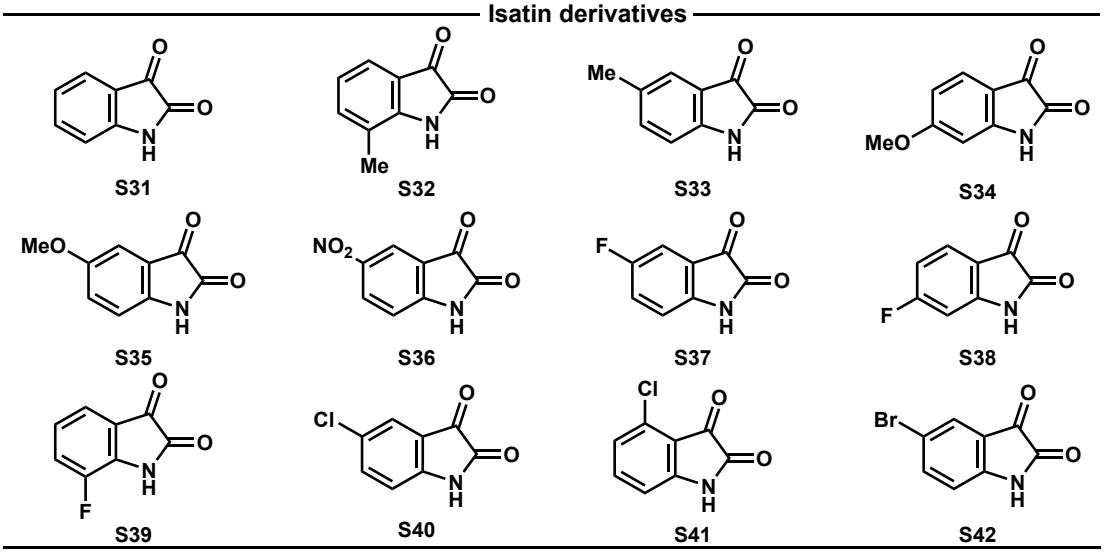



**Figure S2. The structure of isatins**

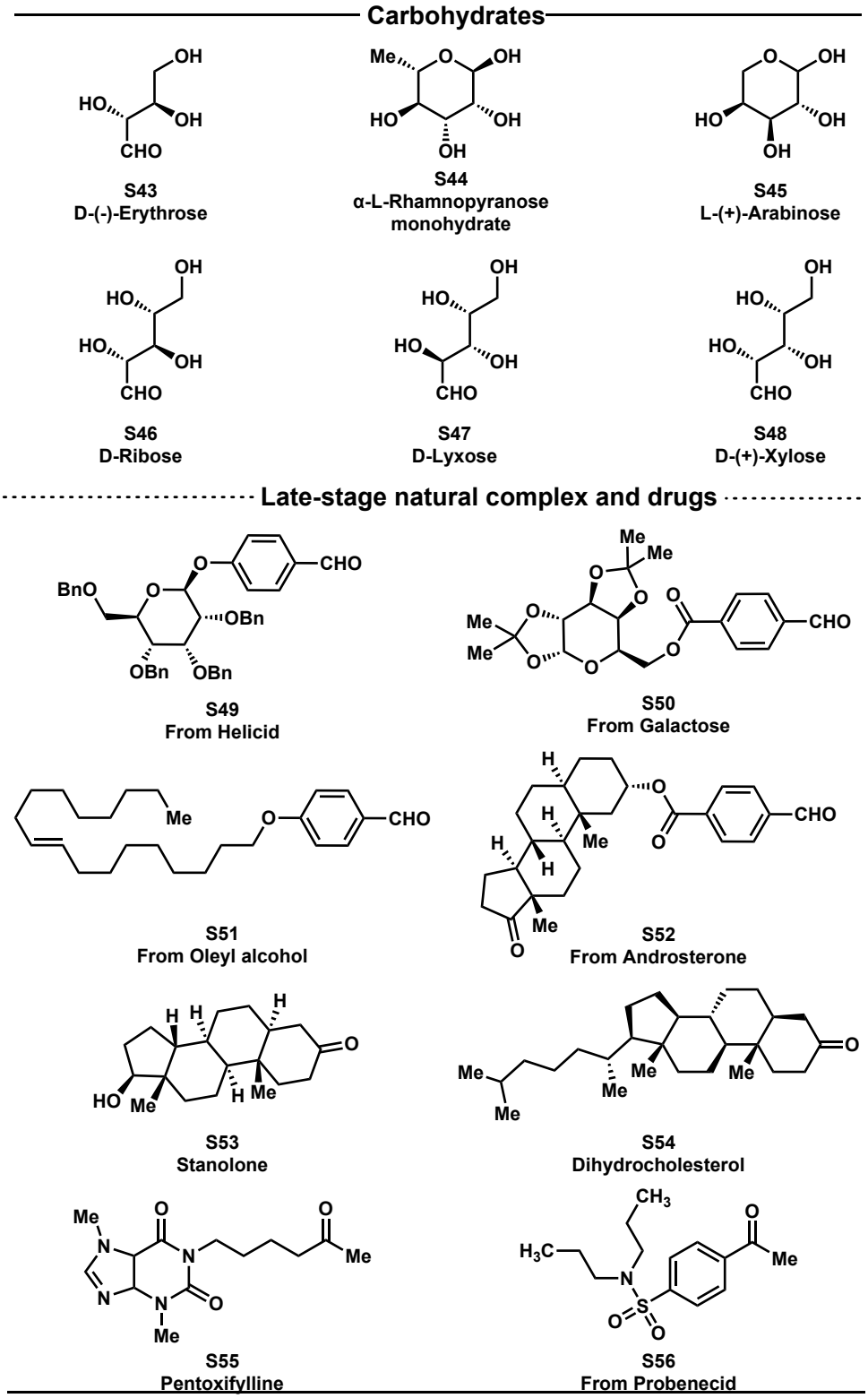


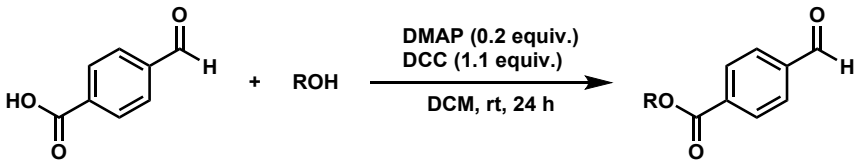

**Figure S3. The structure of carbohydrates, natural complex and drugs**

## 3. Synthesis and characterization of substrates

Substrates **S1**-**S49, S51-S53 and S55** in Figures S1-S3 are commercially available.

***Preparation of S50, S54 and S56***

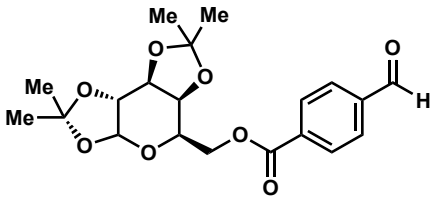
Substrates **S50** and **S54** in Supplementary **Figure S3** were prepared according to the method below.[1-7]




**S45** **S50, S54**

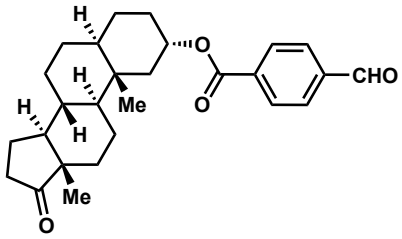
To a suspension of 4-formylbenzoic acid **S45** (0.5 g, 3.33 mmol) in dichloromethane (8 mL) were added *N*, *N*-dimethyl-4-aminopyridine (DMAP, 81.4 mg, 0.67 mmol), alcohol (1.13 g, 4.33 mmol) and *N*, *N*'-dicyclohexylcarbodiimide (DCC, 0.756 g, 3.66 mmol). The mixture was stirred at room temperature for 24 h then diethyl ether (20 mL) was added. The precipitate was filtered through celite and the filtrate was successively washed with a 1 N aqueous solution of HCl (2 × 20 mL), saturated aqueous $NaHCO_3$ solution (2 × 20 mL) and brine (2 × 20 mL). The organic phase was then dried over anhydrous $MgSO_4$, filtered and concentrated under reduced pressure. Purification by flash chromatography (PE/EA, 10:1, v/v) to yield the corresponding ester.

**(5*R*,5a*S*,8a*S*,8b*R*)-2,2,7,7-tetramethyltetrahydro-5*H*-bis([1,3]dioxolo)[4,5-*b*:4',5'-*d*]pyran-5-yl)methyl 4-formylbenzoate (S50)**



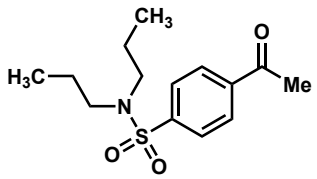
White soild: $R_f$ 0.40 (PE/EA, 5:1, v/v); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 10.08 (s, 1H), 8.18 (d, *J* = 8.3 Hz, 2H), 7.93 (d, *J* = 8.3 Hz, 2H), 5.55 (d, *J* = 5.0 Hz, 1H), 4.65 (dd, *J* = 7.9, 2.5 Hz, 1H), 4.54 (dd, *J* = 11.6, 4.6 Hz, 1H), 4.45 (dd, *J* = 11.6, 7.7 Hz, 1H), 4.36 – 4.29 (m, 2H), 4.20 – 4.15 (m, 1H), 1.50 (s, 3H), 1.46 (s, 3H), 1.34 (s, 3H), 1.32 (s, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 191.78, 165.52, 139.25, 135.07, 130.39, 129.61, 109.85, 108.93, 96.39, 77.47, 77.15, 76.83, 71.17, 70.79, 70.53, 66.14, 64.60, 26.09, 26.05, 25.03, 24.56. Data in accordance with the literature.[1]

**(2*S*,5*S*,8*R*,9*S*,10*S*,13*S*,14*S*)-10,13-dimethyl-17-oxohexadecahydro-1*H*-cyclopenta [*a*]phenanthrene-2-yl 4-formylbenzoate (S52)**




White soild: $R_f$ 0.63 (100% DCM); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 10.11 (s, 1H), 8.20 (d, *J* = 8.3 Hz, 2H), 7.96 (d, *J* = 8.0 Hz, 2H), 5.32 (1H), 2.45 (dd, *J* = 19.3, 8.6 Hz, 1H), 2.12-2.03 (m, 1H), 1.98-1.88 (m, 2H), 1.83-1.75 (m, 3H), 1.72-1.69 (m, 1H), 1.66-1.56 (m, 6H), 1.54-1.48 (m, 1H), 1.41-1.23 (m, 6H), 1.09-0.99 (m, 1H), 0.88 (s, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 221.5, 191.8, 165.0, 139.1, 136.2, 130.2, 129.6, 71.6, 54.5, 51.5, 47.9, 40.6, 36.2, 35.9, 35.1, 33.2, 33.0, 31.6, 30.8, 28.1, 26.3, 21.8, 26.3, 13.9, 11.5.

**4-acetyl-*N*,*N*-dipropylbenzenesulfonamide (S56)[8]**



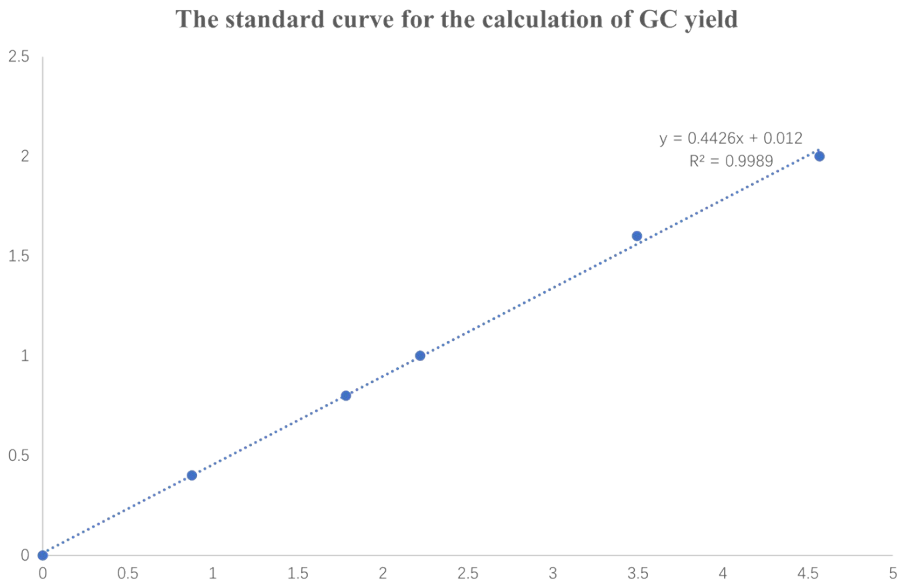

**The synthesis of S56**: A mixture of 4-acetylbenzenesulfonyl chloride (400 mg, 1.84 mmol), dipropylamine (2 M in THF, 1.0 mL, 2.0 mmol), and triethylamine (370 mg, 3.66 mmol) in anhydrous THF (10 mL) was stirred at room temperature overnight. Brine was added, and the reaction mixture was extracted with EA (3 times). The combined organic layer was washed with brine (30 mL), dried over anhydrous $Na_2SO_4$, and filtered. Removal of solvent in vacuo gave **S56** as an off-white solid (304 mg, 73%).

Off-white soild: $R_f$ 0.50 (PE/EA, 2:1, v/v); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.10-8.02 (m, 2H), 7.93-7.86 (m, 2H), 3.14-3.06 (m, 4H), 2.65 (s, 3H), 1.55 (dq, $J$ = 14.9, 7.3 Hz, 4H), 0.87 (t, $J$ = 7.4 Hz, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 196.98, 144.32, 139.70, 128.96, 127.36, 50.01, 26.96, 22.04, 11.25.

## 4. General procedure

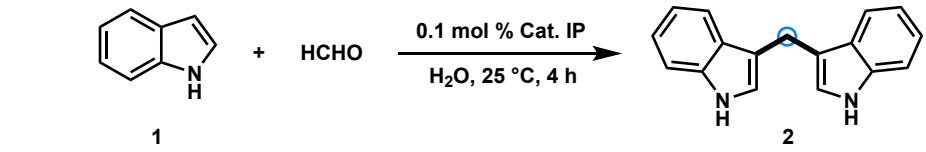
**General procedure for bisindolylmethanes (BIMs):** To a well-dried flask (25 mL) equipped with a magnetic stir bar, $Ph_3C^+[B(C_6F_5)_4]^-$ (0.01M Pre-stored solution in $H_2O$, 40.0 μL), tryptamines derivatives (0.5 mmol, 1.0 equiv.), aldehydes (0.3 mmol, 0.6 equiv.) were added. Then, 2.5 mL pure water was added *via* syringe. The resulting solution was heated in an oil bath at 80 ºC and stirred vigorously for 8 hours. When the reaction was complete, the mixture was diluted with EA (1 mL), and extracted with EA (3×5 mL), and the organic phase was dried over anhydrous sodium sulfate. The solvent was removed under reduced pressure, and the crude mixture was purified by preparative thin layer chromatography or flash column chromatography.

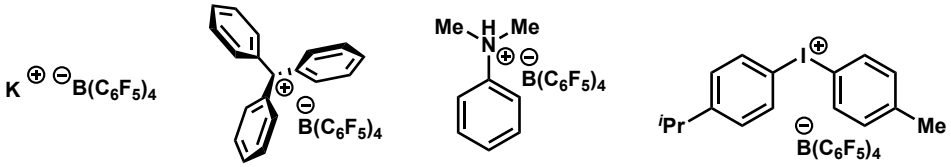
**Product Calibration**



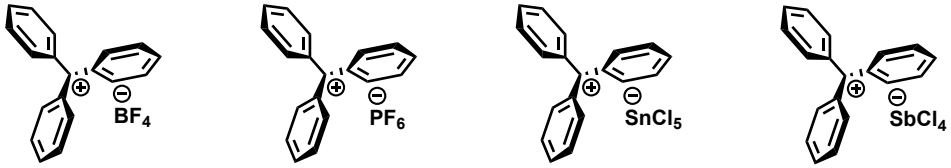
## 5. Optimization of the reaction conditions.

**Table S1. Screening Ion-pairs as catalyst.**




IP-1 IP-2 IP-3 IP-4

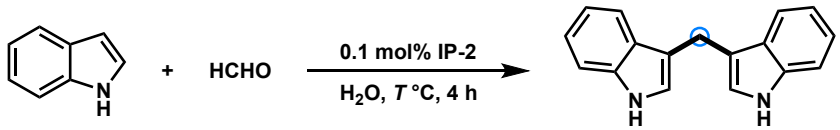



IP-5 IP-6 IP-7 IP-8

| Entry | Cat. | **2** Yield (%)[a] |
|---|---|---|
| 1 | -- | n.d. |
| 2 | IP-1 | 5 |
| 3 | IP-2 | 41 |
| 4 | IP-3 | 11 |
| 5 | IP-4 | 9 |
| 6 | IP-5 | 10 |
| 7 | IP-6 | 13 |
| 8 | IP-7 | 15 |
| 9 | IP-8 | 15 |

Reactions were performed on 0.5 mmol scale in 2.0 mL deionized $H_2O$. [a]Yield based on **1** and was determined by GC analysis by using anisole as an internal standard. n.d.: not detected.

**Table S2. Screening reaction temperature.**

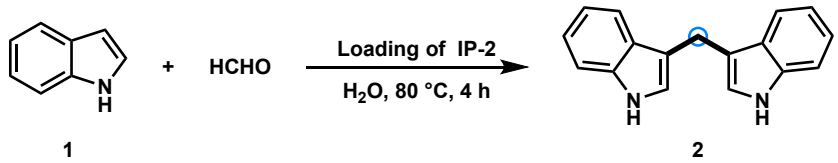



1 2

| Entry | T (°C) | **2** Yield (%)[a] |
|---|---|---|
| 1 | 30 | 42 |
| 2 | 40 | 62 |
| 3 | 50 | 76 |
| 4 | 60 | 80 |
| 5 | 70 | 82 |
| 6 | 80 | 86 |
| 7 | 90 | 84 |

Reactions were performed on 0.5 mmol scale in 2.0 mL deionized $H_2O$. [a]Yield based on **1** and was determined by GC analysis by using anisole as an internal standard.

**Table S3. Screening loading of catalyst.**

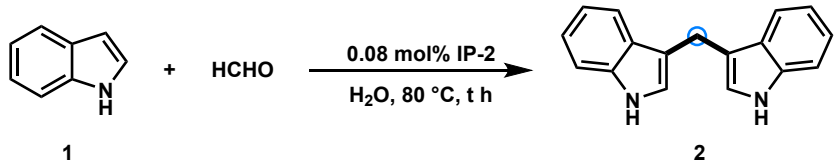



1 2

| Entry | Loading of Cat. IP-2 (%) | **3** Yield (%)[a] |
|---|---|---|
| 1 | 0.05 | 62 |
| 2 | 0.06 | 65 |
| 3 | 0.07 | 68 |
| 4 | 0.08 | 84 |
| 5 | 0.09 | 86 |
| 6 | 0.1 | 88 |

Reactions were performed on 0.5 mmol scale in 2.0 mL deionized $H_2O$. [a]Yield based on **1** and was determined by GC analysis by using anisole as an internal standard.

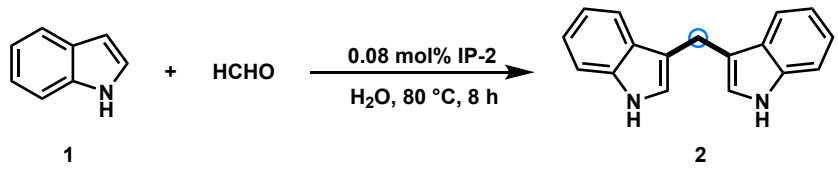
**Table S4. Screening reaction time.**




| Entry | t (h) | **2** Yield (%)[a] |
|---|---|---|
| 1 | 1 | 72 |
| 2 | 2 | 77 |
| 3 | 4 | 84 |
| 4 | 6 | 92 |
| 5 | 8 | 99 (98)[b] |
| 6 | 10 | 99 |
| 7 | 12 | 98 |

Reactions were performed on 0.5 mmol scale in 2.0 mL deionized $H_2O$. [a]Yield based on **1** and was determined by GC analysis by using anisole as an internal standard. [b]Isolated yield.

**Table S5. Screening the volume of $H_2O$.**

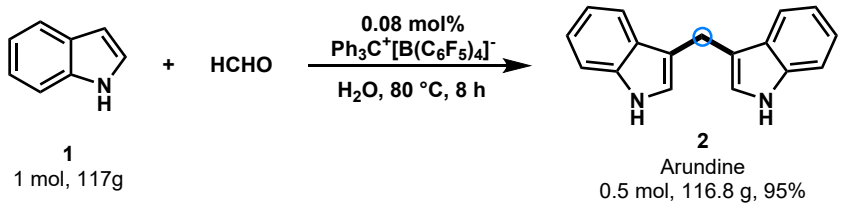



| Entry | Volume of $H_2O$ (mL) | **2** Yield (%)[a] |
|---|---|---|
| 1 | 0.5 | 92 |
| 2 | 1.0 | 97 |
| 3 | 1.5 | 98 |
| 4 | 2.0 | 98 |
| 5 | 2.5 | 99 (98)[b] |
| 6 | 3.0 | 99 |

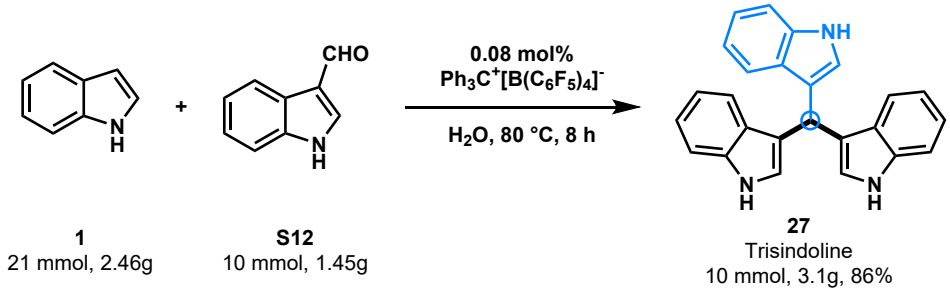
Reactions were performed on 0.5 mmol scale in deionized $H_2O$. [a]Yield based on **1** and was determined by GC analysis by using anisole as an internal standard. [b]Isolated yield.

## 6. Synthetic application

**Scheme S1: 100 gram-scale synthesis of Arudine**




**Procedure for the 100 gram-scale synthesis of Arundine:** To a 1000 mL well-dried round bottom flask equipped with a mechanical stir bar, $Ph_3C^+[B(C_6F_5)_4]^-$ (720 mg), indole (117 g, 1 mol, 1.0 equiv.), formaldehydes in water (37% w/w, 50 mL, 0.6 mol, 0.6 equiv.) were added. Then, 200 mL pure water was added. The mixture was heated in an oil bath at 80 ºC and stirred vigorously for 8 hours. When the reaction was complete, the mixture was filtered through Buchner funnel, and the residue was washed with PE (200 mL). The residue was further purified by recrystallization in PE/EA (5:1) to obtain the product (yellow solid, 116.8 g, 95%).




**1**
21 mmol, 2.46g

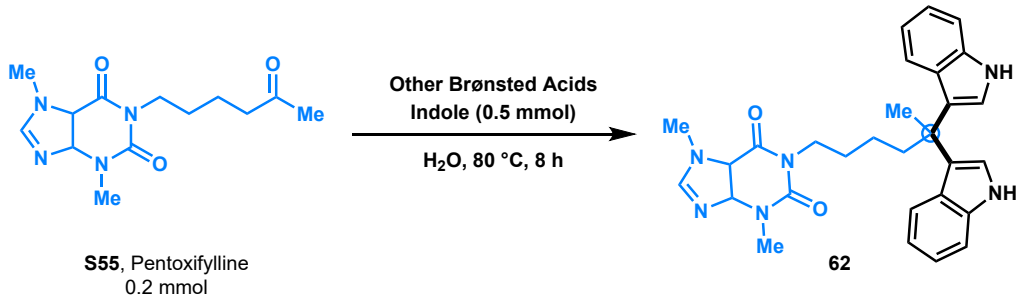
**S12**
10 mmol, 1.45g

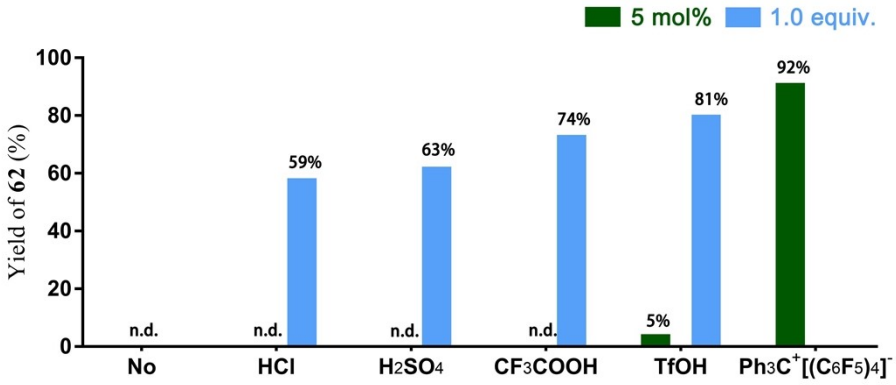
**27**
Trisindoline
10 mmol, 3.1g, 86%

**Procedure for the gram-scale synthesis of Trisindoline:** To a 100 mL well-dried round bottom flask equipped with a magnetic stir bar, $Ph_3C^+[B(C_6F_5)_4]^-$ (184.5 mg, 0.008 mmol), indole (2.46 g, 21 mmol), indole-3-carboxaldehyde (1.45 g, 10 mmol) were added. Then, 20 mL pure water was added. The mixture was heated in an oil bath at 80 ºC and stirred vigorously for 8 hours. When the reaction was complete, the mixture was filtered through Buchner funnel, and the residue was washed with PE (50 mL). The residue was further purified by recrystallization in EA to obtain the product (yellowish solid, 3.1 g, 86%).

## 7. Mechanistic studies

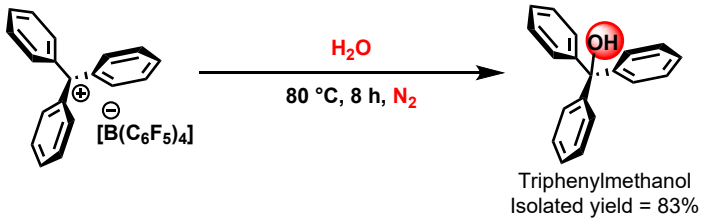
### 7.1 Comparison with other Brønsted acids



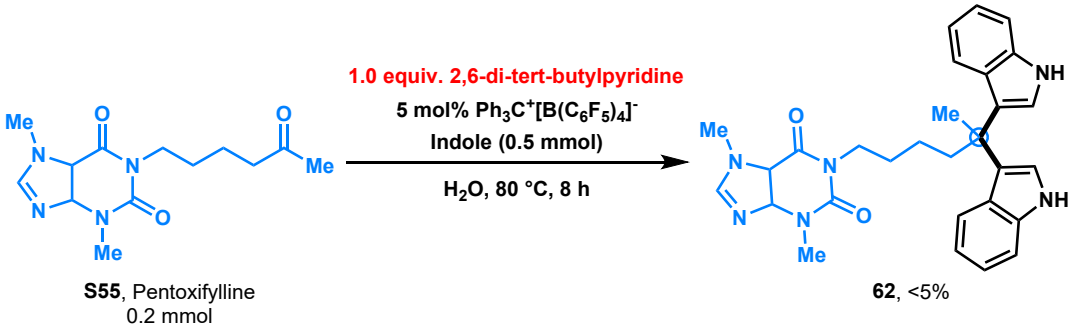

**Procedure:** To an over-dried reaction tube (25 mL) equipped with a magnetic stir bar, pentoxifylline (55.6 mg, 0.2 mmol), indole (58.5 mg, 0.5 mmol) and Brønsted acids (0.01 M pre-stored solution in $H_2O$, 5 mol% or 1 equiv.) were added. Then, 2.5 mL pure water was charged *via* syringe. The resulting solution was heated in an oil bath at 80 ºC and stirred vigorously for 8 h. When the reaction was complete, the mixture was diluted with EA (1 mL), filtered through a short pad of silica gel, and washed with EA (3×5 mL). The filtrate was concentrated under reduced pressure and the residue was analyzed by $^1$H NMR.

### 7.2 Hydrolysis of $Ph_3^+[B(C_6F_5)_4]^-$ in $H_2O$




**Procedure:** To an over-dried Schlenk tube (25 mL) equipped with a magnetic stir bar, $Ph_3^+[B(C_6F_5)_4]^-$ (36.8 mg, 0.04 mmol) was added. Then, 2.5 mL pure water was charged *via* syringe. The resulting solution was heated in an oil bath at 80 ºC and stirred vigorously for 8 h. When the reaction was complete, the mixture was diluted with EA (1 mL), filtered through a short pad of silica gel, and washed with EA (10 mL). The filtrate was concentrated under reduced pressure, and the residue was purified by silica gel column chromatography (PE/EA, 20/1, v/v) to give triphenylmethanol as a white solid, 8.6 mg, 83%. **$^1$H NMR** (400 MHz, $CDCl_3$-*d*) δ 7.35 - 7.22 (m, 15H), 2.86 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$-*d*) δ 146.95, 128.04, 128.05, 127.39, 82.12.

### 7.3 Proton scavenging experiment




**Procedure:** To an over-dried reaction tube (25 mL) equipped with a magnetic stir bar, pentoxifylline (0.2 mmol, 55.6 mg), indole (58.5 mg, 0.5 mmol), 2,6-di-tert-butylpyridine (38.2 mg, 0.2 mmol) and $Ph_3^+[B(C_6F_5)_4]^-$ (5 mol%, 9.2 mg, 0.01 mmol) were added. Then, 2.5 mL pure water was charged *via* syringe. The resulting solution was heated in an oil bath at 80 ºC and stirred vigorously for 8 h. When the reaction was complete, the mixture was diluted with EA (1 mL), filtered through a short pad of silica gel, and washed with EA (3×5 mL). The filtrate was concentrated under reduced pressure and the residue was analyzed by $^1$H NMR.

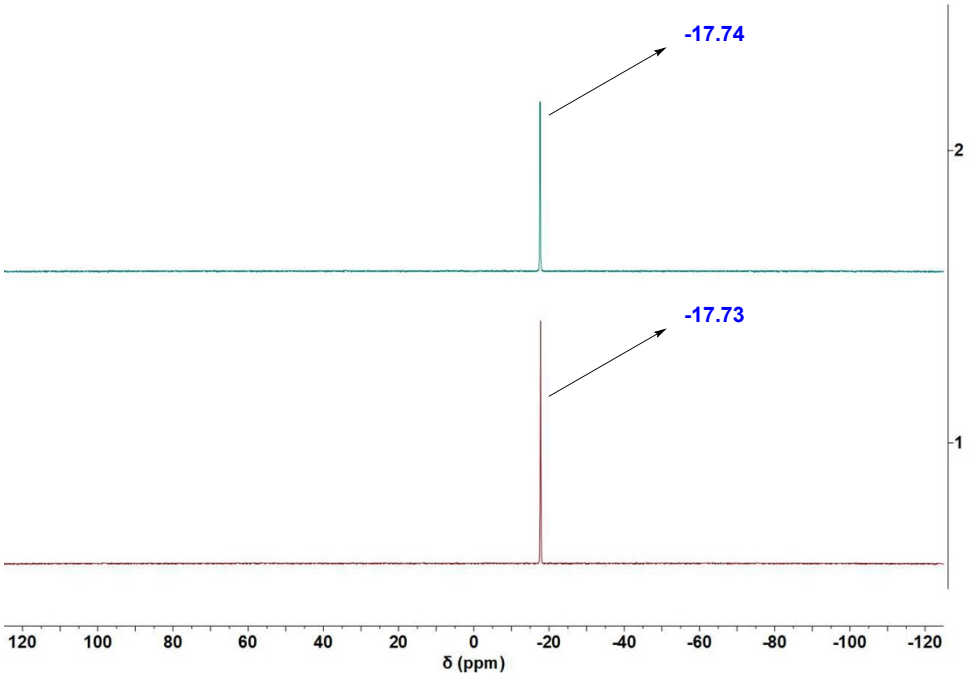



**Figure S4. $^{11}$B-NMR (400 MHz, $CDCl_3$-*d*) spectra of $Ph_3^+[B(C_6F_5)_4]^-$ before and after reaction under standard conditions.**

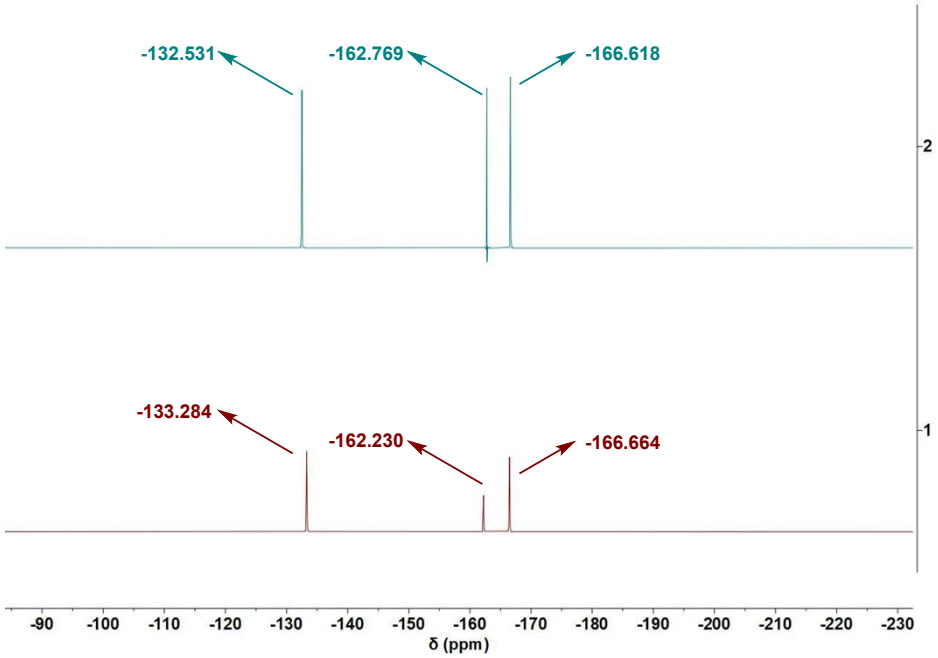



**Figure S5. $^{19}$F-NMR (400 MHz, $CDCl_3$-*d*) spectra of $Ph_3^+[B(C_6F_5)_4]^-$ before and after reaction under standard conditions.**

## 8. X-ray data of compound 53

**Table S5 Crystal data and structure refinement for 53.**

| | |
|---|---|
| Identification code | **53** |
| Empirical formula | $C_{21}H_{24}N_2O_5$ |
| Formula weight | 384.42 |
| Temperature/K | 170.00(10) |
| Crystal system | monoclinic |
| Space group | $P2_1$ |
| a/Å | 6.4858(3) |
| b/Å | 10.2602(5) |
| c/Å | 14.1368(6) |
| α/° | 90 |
| β/° | 96.740(4) |
| γ/° | 90 |
| Volume/Å$^3$ | 934.24(7) |
| Z | 2 |
| $\rho_{calc}$g/cm$^3$ | 1.367 |
| μ/mm$^{-1}$ | 0.807 |
| F(000) | 408.0 |
| Crystal size/mm$^3$ | 0.14 × 0.12 × 0.11 |
| Radiation | Cu Kα (λ = 1.54184) |
| 2Θ range for data collection/° | 6.296 to 142.916 |
| Index ranges | $-5 \leq h \leq 7$, $-12 \leq k \leq 12$, $-17 \leq l \leq 14$ |
| Reflections collected | 5076 |
| Independent reflections | 2956 [$R_{int}$ = 0.0204, $R_{sigma}$ = 0.0281] |
| Data/restraints/parameters | 2956/1/267 |
| Goodness-of-fit on $F^2$ | 1.195 |
| Final R indexes [I>=2σ (I)] | $R_1$ = 0.0464, $wR_2$ = 0.1350 |
| Final R indexes [all data] | $R_1$ = 0.0510, $wR_2$ = 0.1470 |
| Largest diff. peak/hole / e Å$^{-3}$ | 0.24/-0.32 |
| Flack parameter | 0.0(3) |

**Crystal structure determination of [53]**

**Crystal Data** for $C_{21}H_{24}N_2O_5$ (*M* =384.42 g/mol): monoclinic, space group $P2_1$ (no. 4), *a* = 6.4858(3) Å, *b* = 10.2602(5) Å, *c* = 14.1368(6) Å, *β* = 96.740(4)°, *V* = 934.24(7) Å$^3$, *Z* = 2, *T* = 170.00(10) K, μ(Cu Kα) = 0.807 mm$^{-1}$, *Dcalc* = 1.367 g/cm$^3$, 5076 reflections measured (6.296° ≤ 2Θ ≤ 142.916°), 2956 unique ($R_{int}$ = 0.0204, $R_{sigma}$ = 0.0281) which were used in all calculations. The final $R_1$ was 0.0464 (I > 2σ(I)) and $wR_2$ was 0.1470 (all data).

**Refinement model description**

**Table S6 Fractional Atomic Coordinates (×10$^4$) and Equivalent Isotropic Displacement Parameters (Å$^2$×10$^3$) for 53. $U_{eq}$ is defined as 1/3 of the trace of the orthogonalised $U_{IJ}$ tensor.**

| Atom | *x* | *y* | *z* | U(eq) |
|---|---|---|---|---|
| O1 | 7323(5) | 7223(4) | 2915(2) | 30.6(8) |
| O2 | 3575(5) | 6885(3) | 4569(2) | 28.5(8) |
| O3 | 7509(5) | 6866(4) | 5793(2) | 27.7(8) |
| O4 | 8296(5) | 9564(3) | 5303(2) | 30.3(8) |
| O5 | 11202(5) | 9222(4) | 4130(3) | 41.2(10) |
| N1 | 8535(6) | 3074(4) | 3124(3) | 29.3(9) |
| N2 | 4276(6) | 6404(5) | -13(3) | 33.8(10) |
| C1 | 5190(7) | 3137(5) | 2491(3) | 22.8(10) |
| C2 | 3316(8) | 2591(5) | 2085(3) | 27.5(10) |
| C3 | 3176(9) | 1253(5) | 1975(4) | 33.3(12) |
| C4 | 4883(9) | 446(5) | 2261(3) | 36.1(13) |
| C5 | 6746(9) | 953(5) | 2655(3) | 34.5(12) |
| C6 | 6894(7) | 2296(5) | 2770(3) | 26.8(10) |
| C7 | 7903(7) | 4356(5) | 3080(3) | 27.4(10) |
| C8 | 5866(7) | 4455(5) | 2705(3) | 23.2(10) |
| C9 | 4503(7) | 5649(5) | 2571(3) | 23.0(10) |
| C10 | 5344(6) | 6823(5) | 3165(3) | 22.3(9) |
| C11 | 5517(7) | 6564(5) | 4245(3) | 23.5(10) |
| C12 | 7200(7) | 7345(4) | 4828(3) | 20.8(9) |
| C13 | 6672(7) | 8789(5) | 4822(3) | 27.5(11) |
| C14 | 4040(7) | 6069(5) | 1545(3) | 24.6(10) |
| C15 | 5104(8) | 5755(5) | 793(3) | 31.9(11) |
| C16 | 2653(7) | 7168(5) | 202(3) | 26.1(10) |
| C17 | 2463(6) | 6988(5) | 1180(3) | 22.6(9) |
| C18 | 917(7) | 7678(5) | 1583(3) | 26.4(10) |
| C19 | -362(8) | 8507(6) | 1020(4) | 32.7(11) |
| C20 | -134(8) | 8678(6) | 49(4) | 33.3(11) |
| C21 | 1359(8) | 8008(6) | -368(3) | 32.7(11) |

**Table S7 Anisotropic Displacement Parameters (Å$^2$×10$^3$) for 53. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.**

| Atom | $U_{11}$ | $U_{22}$ | $U_{33}$ | $U_{23}$ | $U_{13}$ | $U_{12}$ |
|---|---|---|---|---|---|---|
| O1 | 35.1(18) | 36(2) | 20.8(17) | -3.4(16) | 4.6(14) | -9.6(15) |
| O2 | 29.6(16) | 28.8(18) | 28.3(16) | -0.2(15) | 7.9(13) | -0.7(15) |
| O3 | 33.4(17) | 32(2) | 17.6(15) | 1.2(14) | 1.1(13) | 2.2(16) |
| O4 | 26.0(16) | 27.1(19) | 36.7(19) | -8.5(15) | -1.5(14) | -2.6(14) |

**Table S7 Anisotropic Displacement Parameters ($Å^2×10^3$) for 53. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.**

| Atom | $U_{11}$ | $U_{22}$ | $U_{33}$ | $U_{23}$ | $U_{13}$ | $U_{12}$ |
|---|---|---|---|---|---|---|
| O5 | 31.2(19) | 33(2) | 60(3) | -3(2) | 6.2(18) | -0.5(16) |
| N1 | 26.2(19) | 33(2) | 27(2) | -0.8(18) | -2.6(16) | 7.1(18) |
| N2 | 39(2) | 44(3) | 19.2(19) | 1.3(18) | 6.9(17) | 11(2) |
| C1 | 27(2) | 24(2) | 17(2) | 0.5(18) | 1.8(17) | -0.2(19) |
| C2 | 32(2) | 28(3) | 22(2) | 0.2(19) | 0.5(18) | -0.8(19) |
| C3 | 45(3) | 31(3) | 24(2) | -1(2) | 5(2) | -10(2) |
| C4 | 60(4) | 23(3) | 26(2) | 2(2) | 9(2) | 1(2) |
| C5 | 49(3) | 29(3) | 26(2) | 6(2) | 5(2) | 8(2) |
| C6 | 33(2) | 32(3) | 16(2) | 0(2) | 3.2(18) | 2(2) |
| C7 | 30(2) | 26(3) | 25(2) | -5(2) | -0.8(18) | 4(2) |
| C8 | 25(2) | 24(3) | 19(2) | 0.9(19) | 0.8(17) | -2.4(19) |
| C9 | 22(2) | 27(2) | 19(2) | 0.4(18) | -0.8(17) | -3.6(18) |
| C10 | 24(2) | 22(2) | 20(2) | 0.0(19) | 0.1(16) | -2.5(19) |
| C11 | 27(2) | 23(3) | 20(2) | -0.6(18) | 3.0(17) | -0.1(18) |
| C12 | 28(2) | 18(2) | 16(2) | -2.3(17) | 1.7(16) | 5.1(18) |
| C13 | 25(2) | 27(3) | 28(2) | -7(2) | -4.9(19) | 0.9(19) |
| C14 | 24(2) | 28(3) | 21(2) | 1.5(19) | -0.6(17) | -2.9(19) |
| C15 | 31(2) | 39(3) | 25(2) | 2(2) | -0.2(19) | 8(2) |
| C16 | 30(2) | 29(3) | 19(2) | 1(2) | -0.7(18) | 0(2) |
| C17 | 23(2) | 22(2) | 22(2) | -1.0(19) | -0.4(16) | 0.6(18) |
| C18 | 28(2) | 32(3) | 19(2) | 1.1(19) | 1.1(17) | -2(2) |
| C19 | 31(3) | 36(3) | 31(3) | -1(2) | 0(2) | 3(2) |
| C20 | 34(3) | 32(3) | 32(2) | 1(2) | -6(2) | 7(2) |
| C21 | 39(3) | 38(3) | 20(2) | 3(2) | -3(2) | 0(2) |

**Table S8 Bond Lengths for 53.**

| Atom | Atom | Length/Å | Atom | Atom | Length/Å |
|---|---|---|---|---|---|
| O1 | C10 | 1.431(5) | C7 | C8 | 1.369(6) |
| O2 | C11 | 1.429(5) | C8 | C9 | 1.509(7) |
| O3 | C12 | 1.442(5) | C9 | C10 | 1.532(6) |
| O4 | C13 | 1.426(6) | C9 | C14 | 1.510(6) |
| N1 | C6 | 1.377(6) | C10 | C11 | 1.540(6) |
| N1 | C7 | 1.378(6) | C11 | C12 | 1.517(6) |
| N2 | C15 | 1.373(6) | C12 | C13 | 1.521(7) |
| N2 | C16 | 1.374(6) | C14 | C15 | 1.372(7) |
| C1 | C2 | 1.399(7) | C14 | C17 | 1.441(6) |
| C1 | C6 | 1.421(7) | C16 | C17 | 1.414(6) |

**Table S8 Bond Lengths for 53.**

| Atom | Atom | Length/Å | Atom | Atom | Length/Å |
|---|---|---|---|---|---|
| C1 | C8 | 1.443(7) | C16 | C21 | 1.392(7) |
| C2 | C3 | 1.383(7) | C17 | C18 | 1.402(6) |
| C3 | C4 | 1.403(8) | C18 | C19 | 1.375(7) |
| C4 | C5 | 1.373(8) | C19 | C20 | 1.408(7) |
| C5 | C6 | 1.390(8) | C20 | C21 | 1.376(8) |

**Table S9 Bond Angles for 53.**

| Atom | Atom | Atom | Angle/° | Atom | Atom | Atom | Angle/° |
|---|---|---|---|---|---|---|---|
| C6 | N1 | C7 | 108.9(4) | O2 | C11 | C10 | 108.3(3) |
| C15 | N2 | C16 | 109.2(4) | O2 | C11 | C12 | 108.0(3) |
| C2 | C1 | C6 | 118.7(4) | C12 | C11 | C10 | 114.3(4) |
| C2 | C1 | C8 | 133.6(4) | O3 | C12 | C11 | 110.2(4) |
| C6 | C1 | C8 | 107.7(4) | O3 | C12 | C13 | 110.1(4) |
| C3 | C2 | C1 | 119.1(5) | C11 | C12 | C13 | 111.4(4) |
| C2 | C3 | C4 | 120.9(5) | O4 | C13 | C12 | 112.8(4) |
| C5 | C4 | C3 | 121.4(5) | C15 | C14 | C9 | 128.0(4) |
| C4 | C5 | C6 | 117.9(5) | C15 | C14 | C17 | 106.1(4) |
| N1 | C6 | C1 | 107.0(4) | C17 | C14 | C9 | 125.7(4) |
| N1 | C6 | C5 | 131.1(5) | C14 | C15 | N2 | 110.2(4) |
| C5 | C6 | C1 | 121.9(5) | N2 | C16 | C17 | 107.3(4) |
| C8 | C7 | N1 | 110.9(4) | N2 | C16 | C21 | 130.6(4) |
| C1 | C8 | C9 | 125.1(4) | C21 | C16 | C17 | 122.1(4) |
| C7 | C8 | C1 | 105.5(4) | C16 | C17 | C14 | 107.2(4) |
| C7 | C8 | C9 | 129.3(4) | C18 | C17 | C14 | 134.1(4) |
| C8 | C9 | C10 | 113.8(4) | C18 | C17 | C16 | 118.7(4) |
| C8 | C9 | C14 | 113.5(4) | C19 | C18 | C17 | 119.2(4) |
| C14 | C9 | C10 | 108.7(4) | C18 | C19 | C20 | 121.1(5) |
| O1 | C10 | C9 | 111.2(4) | C21 | C20 | C19 | 121.0(5) |
| O1 | C10 | C11 | 109.4(3) | C20 | C21 | C16 | 117.9(5) |
| C9 | C10 | C11 | 112.8(4) | | | | |

**Table S10 Torsion Angles for 53.**

| A | B | C | D | Angle/° | A | B | C | D | Angle/° |
|---|---|---|---|---|---|---|---|---|---|
| O1 | C10 | C11 | O2 | 148.0(4) | C8 | C1 | C6 | C5 | -179.9(4) |
| O1 | C10 | C11 | C12 | 27.5(5) | C8 | C9 | C10 | O1 | 61.1(5) |
| O2 | C11 | C12 | O3 | 70.2(4) | C8 | C9 | C10 | C11 | -62.2(5) |

**Table S10 Torsion Angles for 53.**

| A | B | C | D | Angle/° | A | B | C | D | Angle/° |
|---|---|---|---|---|---|---|---|---|---|
| O2 | C11 | C12 | C13 | -52.3(5) | C8 | C9 | C14 | C15 | -19.6(7) |
| O3 | C12 | C13 | O4 | 62.0(5) | C8 | C9 | C14 | C17 | 166.2(4) |
| N1 | C7 | C8 | C1 | -0.6(5) | C9 | C10 | C11 | O2 | -87.7(5) |
| N1 | C7 | C8 | C9 | 176.5(4) | C9 | C10 | C11 | C12 | 151.9(4) |
| N2 | C16 | C17 | C14 | -0.5(5) | C9 | C14 | C15 | N2 | -175.8(5) |
| N2 | C16 | C17 | C18 | 179.3(4) | C9 | C14 | C17 | C16 | 176.0(4) |
| N2 | C16 | C21 | C20 | -178.7(5) | C9 | C14 | C17 | C18 | -3.7(9) |
| C1 | C2 | C3 | C4 | -0.3(8) | C10 | C9 | C14 | C15 | 108.2(6) |
| C1 | C8 | C9 | C10 | 159.2(4) | C10 | C9 | C14 | C17 | -66.0(6) |
| C1 | C8 | C9 | C14 | -75.8(6) | C10 | C11 | C12 | O3 | -169.2(4) |
| C2 | C1 | C6 | N1 | 178.7(4) | C10 | C11 | C12 | C13 | 68.3(5) |
| C2 | C1 | C6 | C5 | -0.5(7) | C11 | C12 | C13 | O4 | -175.5(4) |
| C2 | C1 | C8 | C7 | -178.5(5) | C14 | C9 | C10 | O1 | -66.5(5) |
| C2 | C1 | C8 | C9 | 4.2(8) | C14 | C9 | C10 | C11 | 170.2(4) |
| C2 | C3 | C4 | C5 | -0.2(8) | C14 | C17 | C18 | C19 | 179.6(5) |
| C3 | C4 | C5 | C6 | 0.3(7) | C15 | N2 | C16 | C17 | 0.0(6) |
| C4 | C5 | C6 | N1 | -178.9(4) | C15 | N2 | C16 | C21 | 179.1(5) |
| C4 | C5 | C6 | C1 | 0.0(7) | C15 | C14 | C17 | C16 | 0.7(5) |
| C6 | N1 | C7 | C8 | 0.1(6) | C15 | C14 | C17 | C18 | -179.0(5) |
| C6 | C1 | C2 | C3 | 0.6(7) | C16 | N2 | C15 | C14 | 0.4(6) |
| C6 | C1 | C8 | C7 | 0.8(5) | C16 | C17 | C18 | C19 | -0.1(7) |
| C6 | C1 | C8 | C9 | -176.5(4) | C17 | C14 | C15 | N2 | -0.7(6) |
| C7 | N1 | C6 | C1 | 0.4(5) | C17 | C16 | C21 | C20 | 0.2(7) |
| C7 | N1 | C6 | C5 | 179.5(5) | C17 | C18 | C19 | C20 | -0.4(8) |
| C7 | C8 | C9 | C10 | -17.4(7) | C18 | C19 | C20 | C21 | 0.8(8) |
| C7 | C8 | C9 | C14 | 107.7(5) | C19 | C20 | C21 | C16 | -0.7(8) |
| C8 | C1 | C2 | C3 | 179.8(5) | C21 | C16 | C17 | C14 | -179.6(5) |
| C8 | C1 | C6 | N1 | -0.7(5) | C21 | C16 | C17 | C18 | 0.1(7) |

**Table S11 Hydrogen Atom Coordinates (Å×10⁴) and Isotropic Displacement Parameters (Å²×10³) for 53.**

| Atom | *x* | *y* | *z* | U(eq) |
|---|---|---|---|---|
| H2 | 2935.21 | 6213.61 | 4653.64 | 43 |
| H4 | 9342.88 | 9490.65 | 5033.12 | 45 |
| H5A | 11942.82 | 9896.26 | 4081.26 | 62 |
| H5B | 11982.53 | 8555.68 | 4215.36 | 62 |
| H1A | 9756.31 | 2803.11 | 3337.65 | 35 |
| H2A | 4704.86 | 6342.98 | -563.79 | 41 |

**Table S11 Hydrogen Atom Coordinates (Å×10$^4$) and Isotropic Displacement Parameters (Å$^2$×10$^3$) for 53.**

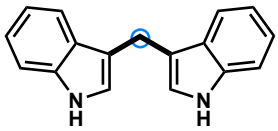
| Atom | *x* | *y* | *z* | U(eq) |
|---|---|---|---|---|
| H2B | 2180.37 | 3119.77 | 1890.89 | 33 |
| H3A | 1933.05 | 882.75 | 1707.35 | 40 |
| H4A | 4748.69 | -451.17 | 2181 | 43 |
| H5 | 7874.66 | 413.79 | 2840.72 | 41 |
| H7 | 8747.15 | 5060.67 | 3279.39 | 33 |
| H9 | 3170.87 | 5417.3 | 2789.54 | 28 |
| H10 | 4373.26 | 7547.38 | 3022.94 | 27 |
| H11 | 5789.59 | 5634.03 | 4358.14 | 28 |
| H12 | 8498.48 | 7233.61 | 4545.48 | 25 |
| H13A | 6390.83 | 9084.42 | 4167.8 | 33 |
| H13B | 5419.69 | 8914.41 | 5124.75 | 33 |
| H15 | 6224.04 | 5184.47 | 824.54 | 38 |
| H18 | 758.31 | 7577.03 | 2224.42 | 32 |
| H19 | -1393.77 | 8962.29 | 1284.27 | 39 |
| H20 | -1007.19 | 9252.36 | -315.57 | 40 |
| H21 | 1500.41 | 8113.35 | -1010.77 | 39 |
| H3 | 6330(80) | 6920(50) | 6060(30) | 21(12) |
| H1 | 7240(100) | 7210(80) | 2370(50) | 60(20) |

**Experimental**

Single crystals of $C_{21}H_{24}N_2O_5$ **[53]**: A suitable crystal was selected on a **XtaLAB AFC12 (RINC): Kappa single** diffractometer. The crystal was kept at 170.00(10) K during data collection. Using Olex2, the structure was solved with the SHELXT structure solution program using Intrinsic Phasing and refined with the SHELXL refinement package using Least Squares minimisation.

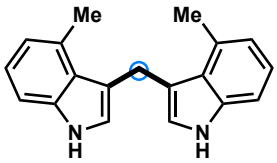
## 9. Compound characterization data

**3,3'-bisindolylmethane (Arundine) 2**



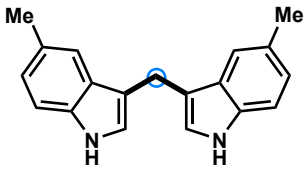
As a brown solid: $R_f$ 0.3 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.86 (s, 2H), 7.64 (d, *J* = 7.8 Hz, 2H), 7.36 (d, *J* = 8.1 Hz, 2H), 7.21 (t, *J* = 7.6 Hz, 2H), 7.11 (t, *J* = 7.8 Hz, 2H), 6.92 (d, *J* = 1.9 Hz, 2H), 4.26 (s, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 136.54, 127.66, 122.31, 121.99, 119.32, 119.27, 115.76, 111.15, 77.45, 77.13, 76.82, 21.30. Data in accordance with the literature.[9]

**bis(4-methyl-1H-indol-3-yl)methane 3**



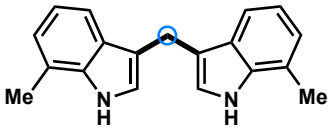
As a milky solid: $R_f$ 0.32 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.80 (s, 2H), 7.19 (d, *J* = 8.1 Hz, 2H), 7.10 (t, *J* = 7.7 Hz, 2H), 6.87 (d, *J* = 7.5 Hz, 2H), 6.67 (s, 2H), 4.57 (s, 2H), 2.68 (s, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 137.08, 131.44, 126.01, 123.08, 122.11, 120.82, 117.59, 109.12, 25.88, 20.21. Data in accordance with the literature.[9]

**bis(5-methyl-1H-indol-3-yl)methane 4**



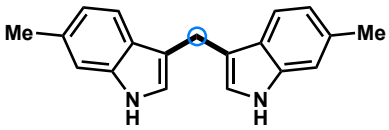

As a milky solid: $R_f$ 0.35 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.82 (s, 2H), 7.25 (d, *J* = 1.6 Hz, 1H), 7.23 (s, 1H), 7.06 (d, *J* = 2.5 Hz, 2H), 6.90 (d, *J* = 2.3 Hz, 2H), 6.85 (dd, *J* = 8.8, 2.5 Hz, 2H), 4.16 (s, 2H), 3.81 (s, 6H), 2.17 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 134.88, 128.46, 127.87, 123.57, 122.56, 118.96, 115.23, 110.84, 21.65, 21.26. Data in accordance with the literature.[9]

**bis(7-methyl-1H-indol-3-yl)methane 5**



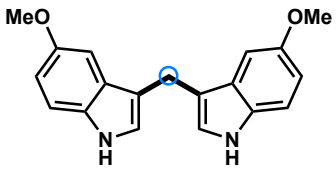

As a pale yellow solid: $R_f$ 0.40 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.80 (s, 1H), 7.50 (t, *J* = 5.6 Hz, 1H), 7.09 – 6.98 (m, 2H), 6.91 (d, *J* = 2.4 Hz, 1H), 4.24 (d, *J* = 4.7 Hz, 1H), 2.49 (d, *J* = 4.7 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 136.09, 127.18, 122.49, 122.03, 120.30, 119.48, 117.07, 116.32, 21.55, 16.73. Data in accordance with the literature.[9]

**bis(6-methyl-1H-indol-3-yl)methane 6**



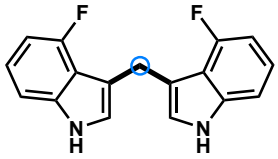
As a pale yellow solid: $R_f$ 0.38 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.64 (s, 1H), 7.53 (d, *J* = 8.0 Hz, 1H), 7.12 (s, 1H), 6.97 (dd, *J* = 8.0, 1.4 Hz, 1H), 6.82 – 6.77 (m, 1H), 4.21 (s, 1H), 2.50 (s, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 136.99, 131.72, 125.56, 121.69, 121.02, 119.01, 115.65, 111.16, 21.86, 21.40. Data in accordance with the literature.[9]

**bis(5-methoxy-1H-indol-3-yl)methane 7**




As a brown solid: $R_f$ 0.35 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.70 (s, 2H), 7.46 (s, 2H), 7.24 (d, *J* = 8.3 Hz, 2H), 7.06 (dd, *J* = 8.3, 1.7 Hz, 2H), 6.83 (d, *J* = 2.3 Hz, 2H), 4.21 (s, 2H), 2.48 (s, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.89, 131.68, 127.99, 123.18, 115.33, 112.14, 111.90, 101.07, 56.02, 21.39. Data in accordance with the literature.[9]

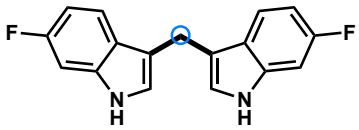
**bis(4-fluoro-1H-indol-3-yl)methane 8**




As a milky solid: $R_f$ 0.25 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.94 (s, 2H), 7.12 – 7.02 (m, 4H), 6.94 (s, 2H), 6.75 (ddd, *J* = 11.1, 7.0, 1.6 Hz, 2H), 4.44 (s, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 156.29 (d, *J* = 222.4 Hz), 139.29, 122.41, 122.34 (t, *J* = 2.2

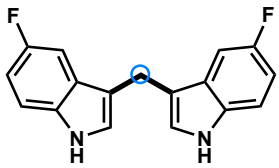
Hz), 116.19, 115.30 (d, *J* = 3.4 Hz), 107.28 (d, *J* = 3.8 Hz), 104.65, 23.32. **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -122.80 (d, J = 11.7 Hz). Data in accordance with the literature.[9]

**bis(6-fluoro-1H-indol-3-yl)methane 9**




As a milky solid: $R_f$ 0.30 (PE: EA = 5:1); **$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 8.09 (s, 2H), 7.37 (d, *J* = 7.9 Hz, 2H), 7.02 (td, *J* = 7.8, 4.8 Hz, 2H), 6.98 – 6.89 (m, 4H), 4.23 (s, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 160.08 (d, *J* = 237.6 Hz), 136.41 (d, *J* = 12.4 Hz), 124.18, 122.46, 119.95 (d, *J* = 10.1 Hz), 115.63, 108.08 (d, *J* = 24.5 Hz), 97.46 (d, *J* = 26.1 Hz), 21.33. **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -121.11 – 121.40 (m). Data in accordance with the literature.[9]

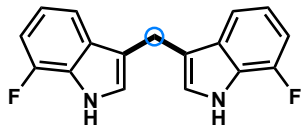
**bis(5-fluoro-1H-indol-3-yl)methane 10**




As a milky solid: $R_f$ 0.25 (PE: EA = 5:1); **$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 7.91 (s, 2H), 7.25 (q, *J* = 4.5 Hz, 2H), 7.20 (dd, *J* = 9.6, 2.5 Hz, 2H), 7.00 (s, 2H), 6.92 (td, *J* = 9.1, 2.5 Hz, 2H), 4.13 (s, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 157.72 (d, *J* = 234.2 Hz), 133.05, 127.89 (d, *J* = 9.8 Hz), 124.02, 115.50 (d, *J* = 4.9 Hz), 111.76 (d, *J* = 9.7 Hz), 110.42 (d,

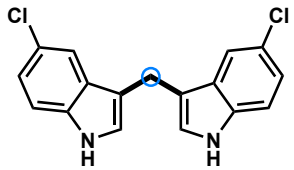
*J* = 26.4 Hz), 104.18 (d, *J* = 23.3 Hz), 21.40. **$^{19}$FNMR** (376 MHz, $CDCl_3$) δ -124.70. Data in accordance with the literature.[9]

**bis(7-fluoro-1H-indol-3-yl)methane 11**



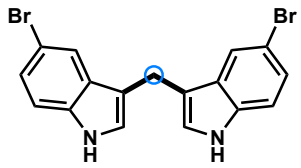

As a milky solid: $R_f$ 0.30 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.09 (s, 2H), 7.37 (d, *J* = 7.9 Hz, 2H), 7.02 (td, *J* = 7.8, 4.8 Hz, 2H), 6.98 – 6.89 (m, 4H), 4.23 (s, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 149.70 (d, *J* = 243.7 Hz), 131.30 (d, *J* = 5.9 Hz), 124.83 (d, *J* = 13.4 Hz), 123.02 (d, *J* = 1.5 Hz), 119.64 (d, *J* = 6.2 Hz), 116.31 (d, *J* = 2.4 Hz), 115.07 (d, *J* = 3.4 Hz), 106.95 (d, *J* = 16.0 Hz), 21.43. **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -135.27, -135.28, -135.30, -135.31. Data in accordance with the literature.[9]

**bis(5-chloro-1H-indol-3-yl)methane 12**



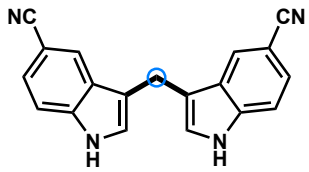

As a brown solid: $R_f$ 0.20 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.96 (s, 2H), 7.54 (d, *J* = 1.9 Hz, 2H), 7.26 (d, *J* = 8.6 Hz, 2H), 7.14 (dd, *J* = 8.6, 2.0 Hz, 2H), 6.96 (d, *J* = 2.4 Hz, 2H), 4.14 (s, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 134.91, 128.60, 125.07, 123.69, 122.38, 118.73, 115.04, 112.24, 21.20. Data in accordance with the literature.[9]

**bis(5-bromo-1H-indol-3-yl)methane 13**



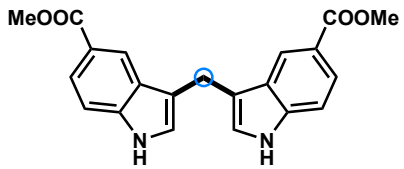

As a brown solid: $R_f$ 0.25 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.69 (s, 1H), 7.24 (q, *J* = 8.6 Hz, 2H), 6.93 (d, *J* = 2.3 Hz, 1H), 4.12 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 135.16, 129.25, 124.93, 123.51, 121.83, 114.94, 112.68, 112.64, 21.19. Data in accordance with the literature.[9]

**3,3'-methylenebis(1H-indole-5-carbonitrile) 14**



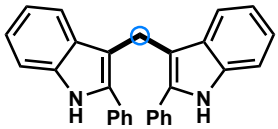

As a pale yellow solid: $R_f$ 0.3 (PE: EA = 2:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.40 (s, 2H), 8.09 (s, 2H), 7.55 – 7.45 (m, 4H), 7.38 (dd, J = 8.5, 1.6 Hz, 2H), 4.21 (s, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 138.62, 127.36, 126.24, 124.93, 124.15, 121.47, 115.58, 113.22, 100.73, 20.68. Data in accordance with the literature.[10]

**dimethyl 3,3'-methylenebis(1H-indole-5-carboxylate) 15**



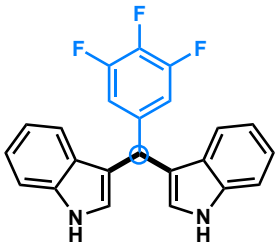
As a pale yellow solid: $R_f$ 0.4 (PE: EA = 2:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.19 (s, 2H), 7.66 (d, $J$ = 8.6 Hz, 2H), 7.38 (d, $J$ = 8.0 Hz, 2H), 7.20 (s, 2H), 4.20 (s, 2H), 3.76 (s, 6H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 167.81, 139.58, 127.19, 125.29, 122.48, 121.83, 120.19, 115.95, 111.92, 52.13, 21.10. Data in accordance with the literature.[10]

**bis(2-phenyl-1H-indol-3-yl)methane 16**




As a milky solid: $R_f$ 0.25 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.99 (s, 2H), 7.60 – 7.52 (m, 4H), 7.40 (t, $J$ = 7.4 Hz, 4H), 7.30 (dd, $J$ = 18.8, 7.7 Hz, 4H), 7.20 (d, $J$ = 8.0 Hz, 2H), 7.11 – 7.02 (m, 2H), 6.89 – 6.81 (m, 2H), 4.56 (s, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 135.98, 134.59, 133.40, 129.44, 128.80, 128.43, 127.61, 122.05, 120.11, 119.52, 112.13, 110.61, 21.40. Data in accordance with the literature.[11]

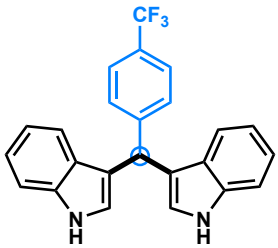
**3,3'-((3,4,5-trifluorophenyl)methylene)bis(1H-indole) 17**




As a fuchsia solid: $R_f$ 0.50 (PE: EA = 5:1); $^1$H NMR (400 MHz, $CDCl_3$) δ 7.97 (s, 2H), 7.41 – 7.34 (m, 4H), 7.24 – 7.18 (m, 2H), 7.09 – 7.02 (m, 2H), 6.95 (dd, $J$ = 8.7, 6.6 Hz,

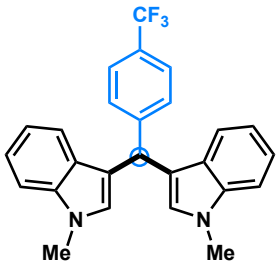
2H), 6.66 (d, *J* = 2.6 Hz, 2H), 5.82 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 151.18 (dd, *J* = 249.0, 11.0 Hz), 140.69, 139.51 (dt, *J* = 252.0, 20.0 Hz), 136.80, 126.73, 123.74, 122.45, 119.72, 118.26, 112.71 (d, *J* = 5.3 Hz), 112.56 (d, *J* = 5.3 Hz), 111.46, 39.71. **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -134.77 (d, J = 31.5 Hz), -163.57 (d, J = 26.0 Hz). Data in accordance with the literature.[17]

**3,3'-((4-(trifluoromethyl)phenyl)methylene)bis(1H-indole) 18**



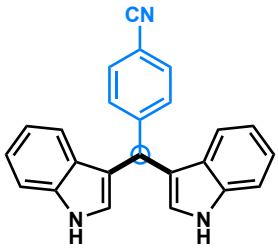

As a red solid: $R_f$ 0.45 (PE: EA = 5:1); **$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 7.97 (s, 2H), 7.54 (d, *J* = 8.1 Hz, 2H), 7.46 (d, *J* = 8.1 Hz, 2H), 7.37 (dd, *J* = 7.7, 3.6 Hz, 4H), 7.20 (t, *J* = 7.6 Hz, 2H), 7.06 – 7.00 (m, 2H), 6.65 (d, *J* = 2.5 Hz, 2H), 5.95 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 148.24, 136.77, 129.11, 126.91, 125.35, 125.30, 123.77, 122.28, 119.83, 119.54, 118.86, 111.27, 40.17. $^{19}$F NMR (376 MHz, $CDCl_3$) δ -62.05. Data in accordance with the literature.[15]

**3,3'-((4-(trifluoromethyl)phenyl)methylene)bis(1-methyl-1H-indole) 19**



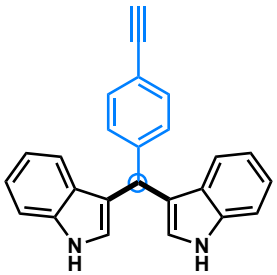

As a red solid: $R_f$ 0.25 (PE: EA = 50:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 8.0 Hz, 2H), 7.46 (d, *J* = 7.8 Hz, 2H), 7.36 (d, *J* = 7.9 Hz, 2H), 7.32 (d, *J* = 8.2 Hz, 1H), 7.25 – 7.20 (m, 2H), 7.05 – 7.00 (m, 2H), 6.53 (s, 1H), 5.94 (s, 1H), 3.70 (s, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 148.72, 137.54, 129.08, 128.41, 127.33, 125.32 (q, *J* = 4.1 Hz), 121.77, 119.93, 118.97, 117.40, 109.33, 40.09, 32.82. **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -61.97. Data in accordance with the literature.[16]

**4-(di(1H-indol-3-yl)methyl)benzonitrile 20**



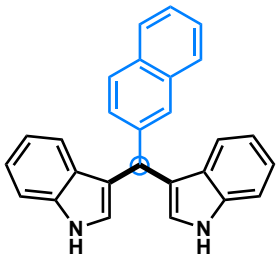

As a pink solid: $R_f$ 0.5 (PE: EA = 2:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 10.98 (d, *J* = 2.5 Hz, 2H), 7.83 (d, *J* = 7.8 Hz, 1H), 7.62 – 7.54 (m, 1H), 7.42 (dd, *J* = 24.5, 7.1 Hz, 4H), 7.25 (d, *J* = 8.0 Hz, 2H), 7.07 (t, *J* = 8.2 Hz, 2H), 6.94 – 6.88 (m, 2H), 6.85 (s, 2H), 6.16 (s, 1H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 148.74, 137.13, 133.70, 133.52, 129.74, 127.62, 126.83, 124.68, 121.73, 119.13, 118.63, 116.56, 112.23, 111.76, 38.77. Data in accordance with the literature.[14]

**3,3'-((4-ethynylphenyl)methylene)bis(1H-indole) 21**



As a red solid: $R_f$ 0.25 (PE: EA = 5:1); **$^1$H NMR** (401 MHz, $CDCl_3$) δ 7.78 (s, 1H), 7.44 (d, *J* = 8.3 Hz, 3H), 7.40 (d, *J* = 7.9 Hz, 2H), 7.35 – 7.29 (m, 6H), 7.21 (ddd, *J* = 8.2, 7.0, 1.2 Hz, 3H), 7.05 (ddd, *J* = 8.1, 7.0, 1.1 Hz, 3H), 6.57 (d, *J* = 1.4 Hz, 2H), 5.89 (s, 2H), 3.08 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 145.21, 136.76, 132.27, 128.88, 127.02, 123.81, 122.18, 119.95, 119.89, 119.47, 119.10, 112.43, 85.01, 40.21. Data in accordance with the literature.[17]

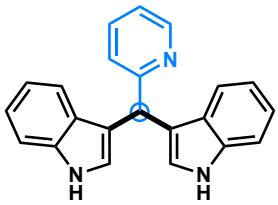
**3,3'-(naphthalen-2-ylmethylene)bis(1H-indole) 22**



As a red solid: $R_f$ 0.30 (PE: EA = 5:1); **$^1$H NMR** (401 MHz, $CDCl_3$) δ 7.83 (t, *J* = 4.7 Hz, 3H), 7.79 – 7.75 (m, 2H), 7.74 – 7.67 (m, 1H), 7.53 (dd, *J* = 8.6, 1.7 Hz, 1H), 7.46 – 7.41 (m, 4H), 7.34 (d, *J* = 8.2 Hz, 2H), 7.21 – 7.15 (m, 2H), 7.04 – 6.98 (m, 2H), 6.62 (d, *J* = 1.5 Hz, 2H), 6.07 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.70, 136.77, 133.70,

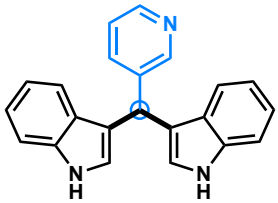
132.45, 128.03, 127.87, 127.69, 127.18, 126.85, 125.82, 125.41, 123.93, 122.07, 120.06, 119.58, 119.39, 111.19, 40.38. Data in accordance with the literature.[14]

**3,3'-(pyridin-2-ylmethylene)bis(1H-indole) 23**



As a white solid: $R_f$ 0.35 (PE: EA = 2:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 10.96 (s, 2H), 8.49 (d, $J$ = 5.1 Hz, 1H), 7.66 (t, $J$ = 7.7 Hz, 1H), 7.41 – 7.28 (m, 5H), 7.17 (t, $J$ = 7.1 Hz, 1H), 7.03 (t, $J$ = 6.6 Hz, 2H), 6.94 (s, 2H), 6.86 (t, $J$ = 8.5 Hz, 2H), 5.92 (s, 1H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 164.60, 149.30, 137.02, 136.99, 127.25, 124.17, 123.04, 121.82, 121.41, 119.51, 118.78, 117.43, 112.69, 43.20. Data in accordance with the literature.[14]

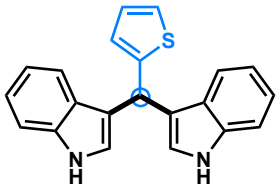
**3,3'-(pyridin-3-ylmethylene)bis(1H-indole) 24**



As a purple solid: $R_f$ 0.45 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$D_6$) δ 10.92, 8.62, 8.62, 8.40, 8.40, 8.39, 8.38, 7.71, 7.69, 7.38, 7.36, 7.31, 7.30, 7.29, 7.27, 7.07, 7.05, 7.03, 6.90, 6.88, 6.86, 5.92. **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 150.19, 147.69, 140.81,

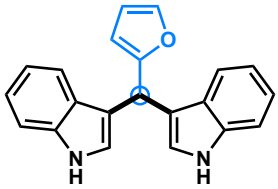
137.13, 136.15, 126.91, 124.22, 123.85, 121.59, 119.50, 118.88, 117.67, 112.10, 37.62. Data in accordance with the literature.[14]

**3,3'-(thiophen-2-ylmethylene)bis(1H-indole) 25**



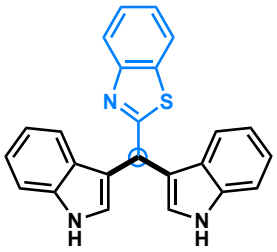
As an orange solid: $R_f$ 0.35 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.92 (s, 2H), 7.47 (d, J = 7.3 Hz, 2H), 7.36 (d, J = 8.2 Hz, 2H), 7.22 – 7.12 (m, 3H), 7.04 (t, J = 7.5 Hz, 2H), 6.95 – 6.88 (m, 2H), 6.83 (d, J = 1.5 Hz, 2H), 6.17 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 148.71, 136.64, 126.82, 126.54, 125.24, 123.73, 123.30, 122.12, 119.86, 119.76, 119.46, 111.24, 35.37. Data in accordance with the literature.[14]

**3,3'-(furan-2-ylmethylene)bis(1H-indole) 26**



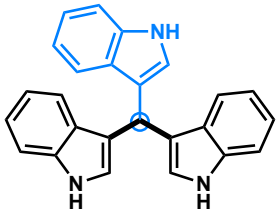
As an orange solid: $R_f$ 0.40 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.94 (s, 2H), 7.49 (d, *J* = 7.9 Hz, 2H), 7.35 (d, *J* = 8.2 Hz, 3H), 7.21 – 7.15 (m, 2H), 7.07 – 7.02 (m, 2H), 6.86 (d, *J* = 1.5 Hz, 2H), 6.31 (dd, *J* = 3.2, 1.8 Hz, 1H), 6.06 (d, *J* = 4.2 Hz, 1H), 5.95 (s, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 157.88, 141.36, 136.61, 126.85, 123.18, 122.07, 119.78, 119.46, 117.64, 111.25, 110.26, 106.73, 34.19. Data in accordance with the literature.[15]

**2-(di(1H-indol-3-yl)methyl)benzo[d]thiazole 27**



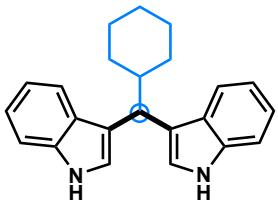
As a brown solid: $R_f$ 0.30 (PE: EA = 2:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.06 (s, 1H), 7.94 (t, *J* = 7.6 Hz, 2H), 7.46 (d, *J* = 8.1 Hz, 3H), 7.38 (dd, *J* = 12.7, 7.9 Hz, 3H), 7.23 (d, *J* = 2.4 Hz, 2H), 7.11 – 7.03 (m, 2H), 6.92 (t, *J* = 7.6 Hz, 2H), 6.39 (d, *J* = 6.0 Hz, 1H). $^{13}$C NMR (101 MHz, DMSO-$d_6$) δ 176.93, 153.51, 136.97, 135.61, 126.86, 126.43, 125.26, 124.59, 122.95, 122.63, 121.75, 119.46, 119.18, 115.81, 111.71. **HRMS** (EI) Calcd for $C_{24}H_{17}N_3S$: $[M+H]^+$ 380.1221. Found: m/z 380.1219.

**tri(1H-indol-3-yl)methane 28**



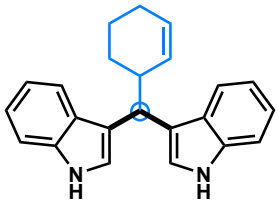
As a white solid: $R_f$ 0.45 (PE: EA = 2:1); **$^1$H NMR** (400 MHz, DMSO-*d*6) δ 10.75 (d, *J* = 2.4 Hz, 3H), 7.41 (d, *J* = 7.9 Hz, 3H), 7.34 (d, *J* = 8.1 Hz, 3H), 7.02 (t, *J* = 7.5 Hz, 3H), 6.95 (d, *J* = 2.3 Hz, 3H), 6.90 – 6.81 (m, 3H), 6.06 (s, 1H).**$^{13}$C NMR** (101 MHz, DMSO-*D*6) δ 137.09, 127.28, 123.74, 121.17, 119.84, 118.77, 118.48, 111.91, 31.44. Data in accordance with the literature.[16]

**3,3'-(cyclohexylmethylene)bis(1H-indole) 29**



As a brown solid: $R_f$ 0.25 (PE: EA = 5:1); **$^1$H NMR** (401 MHz, $CDCl_3$) δ 7.71 (s, 2H), 7.69 (s, 1H), 7.28 – 7.23 (m, 2H), 7.17 (td, *J* = 8.1, 7.5, 1.3 Hz, 2H), 7.10 (ddd, *J* = 8.0, 6.9, 1.2 Hz, 2H), 6.99 (d, *J* = 2.4 Hz, 2H), 4.29 (d, *J* = 8.8 Hz, 1H), 2.27 (dddd, *J* = 14.6, 11.6, 7.7, 3.2 Hz, 1H), 1.86 (d, *J* = 11.7 Hz, 2H), 1.72 (d, *J* = 13.6 Hz, 3H), 1.34 – 1.21 (m, 2H), 1.17 – 1.02 (m, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 136.33, 127.88, 121.70, 119.87, 119.80, 119.08, 111.12, 43.04, 40.23, 32.48, 26.83, 26.78. Data in accordance with the literature.[12]

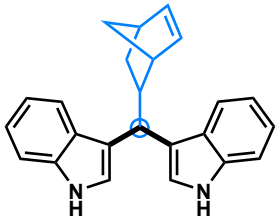
**3,3'-(cyclohex-2-en-1-ylmethylene)bis(1H-indole) 30**



As a brown solid: $R_f$ 0.35 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.8 Hz, 2H), 7.69 (d, *J* = 7.9 Hz, 2H), 7.30 (dd, *J* = 7.9, 3.5 Hz, 2H), 7.18 – 7.03 (m, 6H), 5.72 – 5.59 (m, 2H), 4.35 (d, *J* = 9.4 Hz, 1H), 2.67 – 2.54 (m, 1H), 2.18 – 2.02 (m, 3H), 1.98 – 1.83 (m, 2H), 1.43 – 1.31 (m, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 136.36, 136.33, 127.85, 127.67, 127.12, 127.01, 121.79, 121.73, 121.59, 119.71, 119.53, 119.48, 119.16,

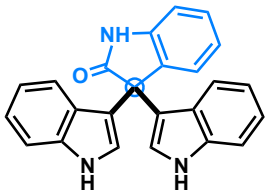
111.16, 39.38, 38.88, 30.96, 27.35, 25.25. **HRMS** (EI) Calcd for $C_{23}H_{22}N_2$: $[M+H]^+$ 327.1861. Found: m/z 327.1856. Data in accordance with the literature.[13]

**3,3'-(bicyclo[2.2.1]hept-5-en-2-ylmethylene)bis(1H-indole) 31**



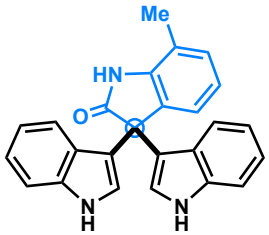
As a pale brown solid: $R_f$ 0.35 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.84 (s, 2H), 7.70 (d, *J* = 7.8 Hz, 1H), 7.56 (d, *J* = 6.8 Hz, 1H), 7.29 (d, *J* = 9.2 Hz, 1H), 7.19 (s, 1H), 7.15 (d, *J* = 2.7 Hz, 1H), 7.13 – 7.08 (m, 1H), 7.05 (d, *J* = 9.0 Hz, 2H), 7.00 – 6.95 (m, 1H), 6.28 – 6.23 (m, 1H), 6.13 (d, *J* = 8.7 Hz, 1H), 3.87 (d, *J* = 11.9 Hz, 1H), 3.21 – 3.12 (m, 1H), 2.82 (s, 1H), 2.65 (s, 1H), 1.98 (td, *J* = 8.6, 8.2, 4.5 Hz, 1H), 1.56 (s, 1H), 1.44 – 1.32 (m, 2H), 0.81 (d, *J* = 11.8 Hz, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 137.56, 136.53, 136.37, 133.10, 127.65, 126.97, 121.72, 121.63, 121.45, 121.21, 120.59, 120.48, 119.92, 119.63, 119.00, 111.25, 111.11, 49.63, 45.58, 44.48, 43.18, 38.82, 32.92. **HRMS** (EI) Calcd for $C_{24}H_{22}N_2$: $[M+H]^+$ 339.1861. Found: m/z 339.1867.

**1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 32**



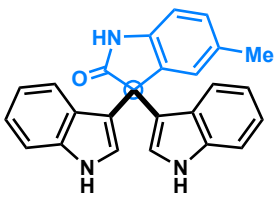
As a white solid: $R_f$ 0.35 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.01 (s, 1H), 10.64 (s, 1H), 7.36 (d, $J$ = 8.2 Hz, 2H), 7.23 (d, $J$ = 7.8 Hz, 3H), 7.04 – 6.98 (m, 1H), 6.93 (t, $J$ = 7.0 Hz, 0H), 6.86 (d, $J$ = 2.5 Hz, 2H), 6.80 (t, $J$ = 8.1 Hz, 1H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.31, 141.86, 137.45, 135.14, 128.38, 126.23, 125.44, 124.83, 122.01, 121.48, 121.31, 118.76, 115.19, 112.15, 110.76, 53.09. Data in accordance with the literature.[19]

**7'-methyl-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 33**



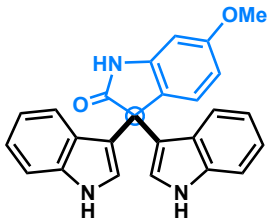

As a white solid: $R_f$ 0.4 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 10.95 (s, 2H), 10.64 (s, 1H), 7.34 (d, $J$ = 8.1 Hz, 2H), 7.23 (d, $J$ = 8.1 Hz, 2H), 7.02 (dd, $J$ = 18.0, 7.8 Hz, 4H), 6.87 – 6.76 (m, 5H), 2.31 (s, 3H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 180.90, 140.40, 137.45, 134.77, 129.56, 126.28, 124.76, 122.79, 121.91, 121.41, 119.36, 118.72, 115.01, 112.10, 80.22, 53.33, 16.76. Data in accordance with the literature.[19]

**5'-methyl-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 34**



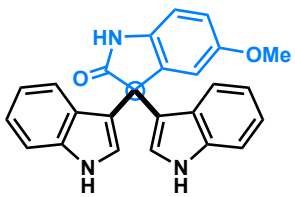
As a lavender solid: $R_f$ 0.4 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 10.93 (d, $J$ = 2.6 Hz, 2H), 10.49 (s, 1H), 7.32 (d, $J$ = 8.1 Hz, 2H), 7.21 (d, $J$ = 7.1 Hz, 2H), 7.02 – 6.95 (m, 4H), 6.85 (d, $J$ = 7.6 Hz, 1H), 6.81 (d, $J$ = 2.5 Hz, 2H), 6.80 – 6.74 (m, 2H), 2.15 (s, 3H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.34, 139.43, 137.45, 135.17, 130.71, 128.97, 126.24, 124.82, 121.46, 118.75, 114.92, 112.12, 109.93, 53.14, 21.35. Data in accordance with the literature.[19]

**6'-methoxy-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 35**



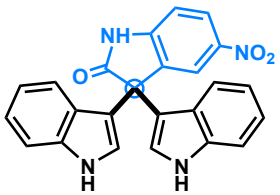

As a milky solid: $R_f$ 0.25 (PE: EA = 2:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 10.90 (s, 2H), 10.52 (s, 1H), 7.31 (d, $J$ = 8.1 Hz, 2H), 7.21 (d, $J$ = 8.1 Hz, 2H), 7.08 (d, $J$ = 8.2 Hz, 1H), 7.02 – 6.95 (m, 2H), 6.81 (s, 2H), 6.77 (t, $J$ = 7.6 Hz, 2H), 6.52 (s, 1H), 6.45 (d, $J$ = 8.3 Hz, 1H), 3.71 (d, $J$ = 1.7 Hz, 3H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.80, 159.08, 142.98, 137.48, 127.18, 126.26, 126.08, 124.75, 121.43, 121.34, 118.73, 115.26, 112.11, 106.88, 96.80, 54.79, 53.39. Data in accordance with the literature.[19]

**5'-methoxy-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 36**



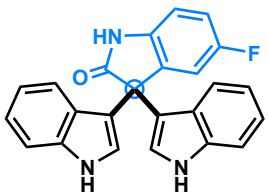
As a pale pink solid: $R_f$ 0.25 (PE: EA = 2:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.00 (s, 1H), 10.48 (s, 1H), 7.36 (d, $J$ = 8.1 Hz, 2H), 7.25 (d, $J$ = 8.1 Hz, 2H), 7.02 (t, $J$ = 8.2 Hz, 1H), 6.92 (d, $J$ = 8.9 Hz, 1H), 6.88 (d, $J$ = 2.5 Hz, 2H), 6.81 (dt, $J$ = 8.1, 3.7 Hz, 3H), 3.61 (s, 3H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 178.57, 154.71, 137.45, 136.49, 135.22, 126.20, 124.90, 121.48, 121.31, 118.77, 114.76, 112.62, 112.57, 112.16, 110.41, 55.82, 52.77. Data in accordance with the literature.[19]

**5'-nitro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 37**



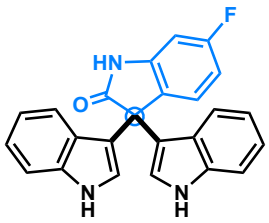

As a pale yellow solid: $R_f$ 0.25 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.39 (s, 1H), 11.14 (s, 2H), 8.24 (dd, $J$ = 8.6, 2.4 Hz, 1H), 7.98 (d, $J$ = 2.4 Hz, 1H), 7.38 (d, $J$ = 8.1 Hz, 2H), 7.22 (dd, $J$ = 8.4, 3.0 Hz, 3H), 7.04 (t, $J$ = 7.6 Hz, 2H), 6.96 (d, $J$ = 2.6 Hz, 2H), 6.84 (t, $J$ = 7.5 Hz, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 180.61, 148.36, 143.68, 137.56, 135.81, 126.01, 125.92, 125.15, 121.74, 120.86, 120.62, 119.12, 113.83, 112.40, 109.33, 54.79. Data in accordance with the literature.[19]

**5'-fluoro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 38**



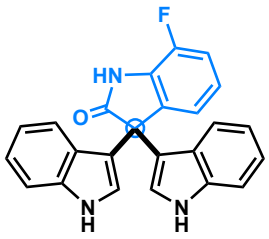
As a milky solid: $R_f$ 0.3 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 10.98 (s, 2H), 10.62 (s, 1H), 7.34 (d, $J$ = 8.2 Hz, 2H), 7.20 (d, $J$ = 8.0 Hz, 2H), 7.08 – 6.92 (m, 5H), 6.87 (s, 2H), 6.79 (t, $J$ = 7.5 Hz, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.22, 158.40 (d, $J$ = 236.6 Hz), 138.10, 137.48, 136.87 (d, $J$ = 7.5 Hz), 126.08, 124.98, 121.58, 121.14, 118.92, 114.76 (d, $J$ = 23.1 Hz), 114.19, 112.97 (d, $J$ = 24.3 Hz), 112.24, 110.90 (d, $J$ = 8.2 Hz), 53.64. **$^{19}$F NMR** (376 MHz, DMSO-$d_6$) δ -121.45 (td, $J$ = 8.9, 4.4 Hz). Data in accordance with the literature.[19]

**6'-fluoro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 39**



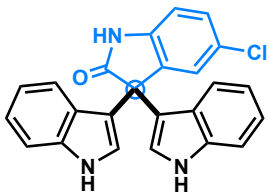

As a pale pink solid: $R_f$ 0.3 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.00 (s, 2H), 10.77 (s, 1H), 7.36 (d, $J$ = 8.1 Hz, 2H), 7.22 (d, $J$ = 8.1 Hz, 3H), 7.02 (t, $J$ = 7.0 Hz, 2H), 6.86 (d, $J$ = 2.5 Hz, 2H), 6.84 – 6.79 (m, 3H), 6.77 – 6.70 (m, 1H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.51, 162.34 (d, $J$ = 232.2 Hz), 143.40 (d, $J$ = 12.2 Hz), 137.48, 130.99, 126.66 (d, $J$ = 9.9 Hz), 126.12, 124.85, 121.51, 121.17, 118.83, 114.55, 112.20, 108.06 (d, $J$ = 21.8 Hz), 98.24 (d, $J$ = 26.6 Hz), 52.68. **$^{19}$F NMR** (376 MHz, DMSO-$d_6$) δ -113.23 – -113.32 (m). **HRMS** (EI) Calcd for $C_{24}H_{16}FN_3O$: $[M+H]^+$ 382.1365. Found: m/z 382.1356.

**7'-fluoro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 40**



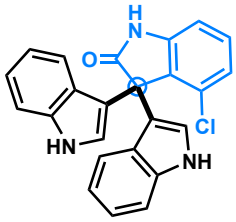

As a milky solid: $R_f$ 0.3 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 11.09 (s, 1H), 10.98 (s, 2H), 7.33 (d, $J$ = 8.1 Hz, 2H), 7.19 (d, $J$ = 8.0 Hz, 2H), 7.12 (t, $J$ = 9.3 Hz, 1H), 7.05 (d, $J$ = 5.6 Hz, 1H), 6.99 (t, $J$ = 7.6 Hz, 2H), 6.91 (q, $J$ = 7.7, 6.5 Hz, 1H), 6.83 (s, 2H), 6.81 – 6.73 (m, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.06, 147.01 (d, $J$ = 242.3 Hz), 138.01, 137.47, 128.92 (d, $J$ = 12.4 Hz), 126.09, 124.93, 122.87 (d, $J$ = 5.9 Hz), 121.57, 121.14, 118.91, 115.37 (d, $J$ = 17.2 Hz), 114.23, 112.23, 53.44. **$^{19}$F NMR** (376 MHz, DMSO-$d_6$) δ -132.49 (dd, $J$ = 10.4, 4.7 Hz). Data in accordance with the literature.[19]

**5'-chloro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 41**



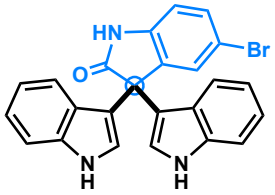

As a milky solid: $R_f$ 0.3 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 11.03 (s, 2H), 10.77 (s, 1H), 7.37 (d, $J$ = 8.3 Hz, 2H), 7.30 (d, $J$ = 8.3 Hz, 1H), 7.24 – 7.16 (m, 3H), 7.08 – 6.98 (m, 3H), 6.90 (s, 2H), 6.86 – 6.79 (m, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 178.93, 140.82, 137.48, 137.15, 128.39, 126.04, 125.98, 125.22, 124.97, 121.61, 121.06, 118.97, 114.04, 112.29, 111.67, 53.98. Data in accordance with the literature.[19]

**4'-chloro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 42**



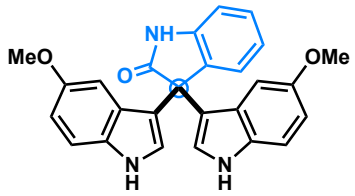
As a white solid: $R_f$ 0.3 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 10.99 (s, 2H), 10.77 (s, 1H), 7.35 (d, $J$ = 8.1 Hz, 2H), 7.25 (dd, $J$ = 22.3, 9.2 Hz, 4H), 7.04 – 6.95 (m, 3H), 6.88 (s, 2H), 6.85 – 6.79 (m, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.50, 144.28, 137.26, 131.54, 130.50, 126.40, 125.97, 123.39, 121.43, 121.08, 118.85, 112.21, 111.16, 109.13, 77.20, 53.97. **HRMS** (EI) Calcd for $C_{24}H_{16}ClN_3O$: $[M+H]^+$ 398.1060. Found: m/z 398.1057.

**5'-bromo-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 43**



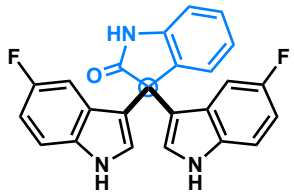
As a milky solid: $R_f$ 0.3 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 11.00 (s, 2H), 10.75 (s, 1H), 7.36 (dd, $J$ = 19.2, 8.1 Hz, 3H), 7.26 (s, 1H), 7.17 (d, $J$ = 7.9 Hz, 2H), 7.00 (t, $J$ = 7.6 Hz, 2H), 6.94 (d, $J$ = 8.2 Hz, 1H), 6.86 (s, 2H), 6.79 (t, $J$ = 7.6 Hz, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.80, 141.23, 137.53, 137.48, 131.24, 127.89, 126.03, 124.97, 121.62, 121.04, 118.97, 114.04, 113.68, 112.30, 112.23, 54.28. Data in accordance with the literature.[19]

**5,5''-dimethoxy-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 44**



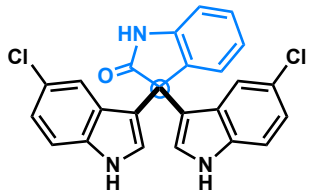

As a white solid: $R_f$ 0.3 (PE: EA = 2:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 10.77 (s, 2H), 10.57 (s, 1H), 7.20 (dd, $J$ = 17.4, 6.9 Hz, 4H), 6.97 (d, $J$ = 6.7 Hz, 1H), 6.94 – 6.88 (m, 1H), 6.82 (s, 2H), 6.66 (d, $J$ = 10.9 Hz, 4H), 3.49 (d, $J$ = 1.9 Hz, 6H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.31, 153.33, 142.39, 135.08, 132.34, 128.38, 126.65, 125.71, 125.52, 122.04, 114.16, 112.61, 110.96, 109.98, 103.84, 55.64, 53.04. Data in accordance with the literature.[19]

**5,5''-difluoro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 45**



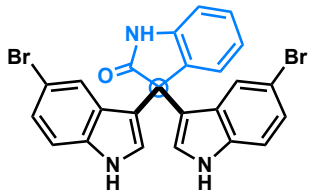

As a milky solid: $R_f$ 0.35 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 11.01 (s, 2H), 10.61 (s, 1H), 7.17 (m, 4H), 7.10 (d, $J$ = 10.1 Hz, 2H), 6.96 (d, $J$ = 7.7 Hz, 1H), 6.91 (t, $J$ = 7.5 Hz, 1H), 6.82 (s, 2H), 6.70 – 6.61 (m, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.05, 159.18 (d, $J$ = 234.9 Hz), 141.77, 137.34 (d, $J$ = 12.6 Hz), 134.65, 128.57, 125.37, 123.01, 122.24, 122.15, 114.99, 110.28, 107.43 (d, $J$ = 24.1 Hz), 98.02 (d, $J$ = 25.4 Hz), 52.87. **$^{19}$F NMR** (376 MHz, DMSO-$d_6$) δ -121.75 – -122.07 (m). Data in accordance with the literature.[19]

**5,5''-dichloro-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 46**



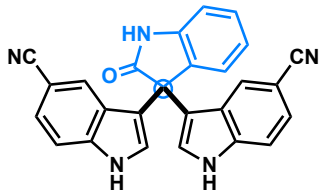

As a milky solid: $R_f$ 0.35 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.24 (s, 2H), 10.76 (s, 1H), 7.40 (d, $J$ = 8.6 Hz, 2H), 7.27 (t, $J$ = 7.7 Hz, 1H), 7.19 (d, $J$ = 10.0 Hz, 3H), 7.07 – 7.01 (m, 3H), 6.99 (t, $J$ = 8.0 Hz, 1H), 6.94 (d, $J$ = 2.4 Hz, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 178.10, 141.74, 136.00, 134.18, 128.79, 127.11, 126.67, 125.42, 123.50, 122.37, 121.66, 120.16, 114.43, 113.91, 110.39, 53.39. Data in accordance with the literature.[19]

**5,5''-dibromo-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 47**



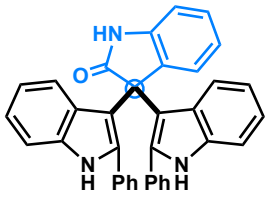

As a milky solid: $R_f$ 0.35 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, DMSO-$d_6$) δ 11.19 (d, $J$ = 2.7 Hz, 2H), 10.70 (s, 1H), 7.32 (dd, $J$ = 5.3, 3.3 Hz, 4H), 7.23 (td, $J$ = 7.7, 1.3 Hz, 1H), 7.11 (dd, $J$ = 8.7, 2.0 Hz, 3H), 6.96 (dd, $J$ = 18.0, 7.5 Hz, 2H), 6.87 (d, $J$ = 2.6 Hz, 2H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 178.10, 141.74, 136.22, 134.12, 128.82, 127.79, 126.53, 125.42, 124.18, 123.19, 122.38, 114.39, 114.33, 111.60, 53.17. Data in accordance with the literature.[19]

**2'-oxo-1',2'-dihydro-1H,1''H-[3,3':3',3''-terindole]-5,5''-dicarbonitrile 48**



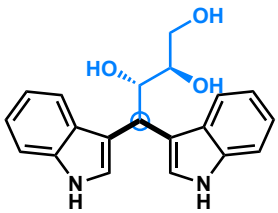

As a brown solid: $R_f$ 0.35 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.63 (s, 2H), 10.82 (s, 1H), 7.53 (d, $J$ = 8.6 Hz, 4H), 7.36 (dd, $J$ = 8.3, 1.6 Hz, 2H), 7.29 – 7.21 (m, 2H), 7.08 (d, $J$ = 2.5 Hz, 2H), 7.01 (d, $J$ = 7.7 Hz, 1H), 6.97 (t, $J$ = 7.5 Hz, 1H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 179.50, 141.68, 139.35, 133.68, 129.07, 127.62, 126.33, 125.73, 125.57, 124.39, 122.63, 121.20, 115.59, 113.91, 110.64, 101.15, 52.58. Data in accordance with the literature.[19]

**2,2''-diphenyl-1H,1''H-[3,3':3',3''-terindol]-2'(1'H)-one 49**



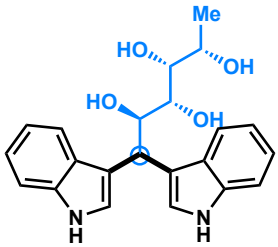

As a lavender solid: $R_f$ 0.3 (PE: EA = 1:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 11.05 (s, 1H), 10.74 (s, 1H), 10.46 (s, 1H), 7.39 – 7.14 (m, 7H), 6.90-7.07 (m, 10H), 6.84 (t, $J$ = 7.5 Hz, 1H), 6.65 (dt, $J$ = 23.9, 7.6 Hz, 3H), 6.31 (s, 1H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 177.98, 141.49, 136.07, 136.02, 135.34, 134.66, 133.99, 129.48, 129.22, 128.36, 128.06, 127.85, 127.73, 127.58, 127.16, 126.37, 125.94, 122.03, 121.80, 121.05, 120.74, 118.86, 118.48, 112.16, 111.43, 111.11, 110.93, 109.66, 53.88. Data in accordance with the literature.[20]

**(2R,3R)-4,4-di(1H-indol-3-yl)butane-1,2,3-triol 50**




As a pale yellow solid: $R_f$ 0.3 (DCM: $CH_3OH$ = 20:1); **$^1$H NMR** (401 MHz, $CD_3OD$) δ 7.70 (d, *J* = 7.9 Hz, 1H), 7.55 (d, *J* = 7.9 Hz, 1H), 7.34 – 7.26 (m, 3H), 7.19 (s, 1H), 7.07 – 7.00 (m, 2H), 6.97 – 6.88 (m, 2H), 5.07 (d, *J* = 3.9 Hz, 1H), 4.39 (dd, *J* = 7.7, 4.0 Hz, 1H), 3.81 (dd, *J* = 11.3, 3.2 Hz, 1H), 3.66 (dd, *J* = 11.2, 6.3 Hz, 1H), 3.61 – 3.51 (m, 1H). **$^{13}$C NMR** (101 MHz, $CD_3OD$) δ 128.35, 127.05, 123.70, 122.77, 120.79, 120.68, 119.04, 118.70, 118.09, 118.02, 117.39, 114.10, 110.77, 110.63, 75.16, 72.53, 63.85, 35.36. **HRMS** (EI) Calcd for $C_{20}H_{20}N_2O_3$: $[M+H]^+$ 337.1552. Found: m/z 337.1566.

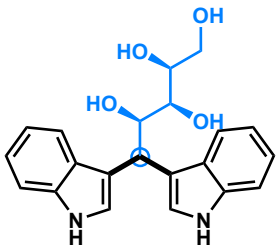
**(2S,3R,4R,5R)-1,1-di(1H-indol-3-yl)hexane-2,3,4,5-tetraol 51**




As a reddish solid: $R_f$ 0.25 (DCM: $CH_3OH$ = 20:1); **$^1$H NMR** (401 MHz, $CD_3OD$) δ 7.70 (d, *J* = 8.0 Hz, 1H), 7.58 (d, *J* = 7.9 Hz, 1H), 7.36 – 7.27 (m, 3H), 7.17 (s, 1H), 7.04 (dd,

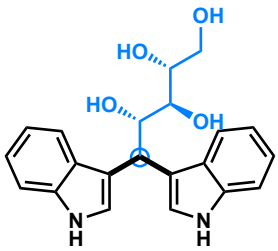
*J* = 8.2, 7.0 Hz, 2H), 6.93 (qd, *J* = 8.0, 1.0 Hz, 2H), 5.15 (d, *J* = 3.3 Hz, 1H), 4.52 (dd, *J* = 8.5, 3.3 Hz, 1H), 3.82 (d, *J* = 9.6 Hz, 1H), 3.80 – 3.75 (m, 1H), 3.66 (d, *J* = 7.5 Hz, 1H), 1.17 (d, *J* = 6.2 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CD_3OD$) δ 136.88, 136.45, 128.45, 127.09, 123.87, 120.76, 120.66, 119.12, 118.76, 118.07, 117.97, 117.72, 113.86, 110.76, 110.62, 100.08, 74.61, 73.78, 70.44, 67.82, 35.20, 19.19. **HRMS** (EI) Calcd for $C_{20}H_{20}N_2O_3$: $[M+H]^+$ 381.1814. Found: m/z 381.1814. Data in accordance with the literature.[21]

**(2S,3S,4R)-5,5-di(1H-indol-3-yl)pentane-1,2,3,4-tetraol 52**



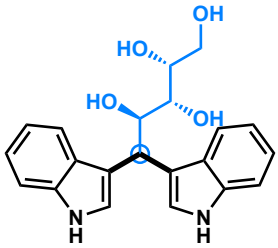

As a reddish solid: $R_f$ 0.3 (DCM: $CH_3OH$ = 10:1); **$^1$H NMR** (401 MHz, $CD_3OD$) δ 7.68 (d, *J* = 8.0 Hz, 1H), 7.62 (d, *J* = 6.8 Hz, 1H), 7.32 (s, 3H), 7.28 (t, *J* = 7.4 Hz, 5H), 7.20 (s, 3H), 7.06 – 6.98 (m, 4H), 6.92 (dd, *J* = 17.2, 7.5 Hz, 3H), 4.88 (s, 2H), 4.80 (d, *J* = 8.7 Hz, 1H), 4.64 (s, 5H), 3.76 (d, *J* = 9.3 Hz, 3H), 3.62 – 3.48 (m, 3H). **$^{13}$C NMR** (101 MHz, $CD_3OD$) δ 138.15, 138.00, 129.16, 128.51, 123.78, 123.61, 122.08, 120.32, 119.40, 119.30, 117.99, 117.69, 112.06, 74.12, 71.53, 65.09, 38.59. **HRMS** (EI) Calcd for $C_{21}H_{22}N_2O_4$: $[M+H]^+$ 367.1658. Found: m/z 367.1654. Data in accordance with the literature.[11]

**(2R,3R,4R)-5,5-di(1H-indol-3-yl)pentane-1,2,3,4-tetraol 53**




As a reddish solid: $R_f$ 0.25 (DCM: $CH_3OH$ = 10:1); **$^1$H NMR** (401 MHz, $CD_3OD$) δ 7.65 (d, *J* = 9.0 Hz, 1H), 7.60 (d, *J* = 9.1 Hz, 1H), 7.38 (s, 1H), 7.31 (t, *J* = 7.8 Hz, 2H), 7.12 (s, 1H), 7.07 – 7.01 (m, 2H), 6.94 (t, *J* = 7.5 Hz, 2H), 5.15 (d, *J* = 3.1 Hz, 1H), 4.64 (s, 2H), 4.41 (dd, *J* = 8.5, 3.2 Hz, 1H), 3.91 – 3.84 (m, 1H), 3.79 (dd, *J* = 11.4, 3.7 Hz, 1H), 3.71 – 3.60 (m, 2H). **$^{13}$C NMR** (101 MHz, $CD_3OD$) δ 138.14, 137.59, 129.70, 128.26, 125.14, 124.45, 122.06, 121.94, 120.23, 119.88, 119.36, 119.30, 118.54, 114.96, 112.07, 111.89, 77.98, 75.97, 73.66, 63.93, 37.08. **HRMS** (EI) Calcd for $C_{21}H_{22}N_2O_4$: $[M+H]^+$ 367.1658. Found: m/z 367.1663. Data in accordance with the literature.[11]

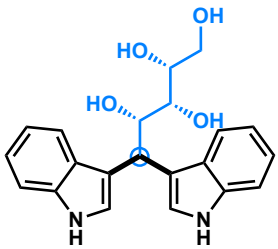
**(2R,3S,4S)-5,5-di(1H-indol-3-yl)pentane-1,2,3,4-tetraol 54**




As a pale yellow solid: $R_f$ 0.2 (DCM: $CH_3OH$ = 10:1); **$^1$H NMR** (401 MHz, $CD_3OD$) δ 7.69 (d, *J* = 8.0 Hz, 1H), 7.56 (d, *J* = 8.0 Hz, 1H), 7.36 – 7.26 (m, 4H), 7.18 (s, 1H), 7.09 – 6.99 (m, 3H), 6.97 – 6.88 (m, 1H), 5.13 (d, *J* = 3.1 Hz, 2H), 4.64 (s, 2H), 4.50 (dd, *J* = 8.6, 3.2 Hz, 2H), 4.00 (t, *J* = 6.2 Hz, 1H), 3.63 – 3.45 (m, 3H). **$^{13}$C NMR** (101 MHz, $CD_3OD$) δ 138.14, 137.68, 129.72, 128.35, 125.16, 124.18, 122.05, 121.95, 120.37,

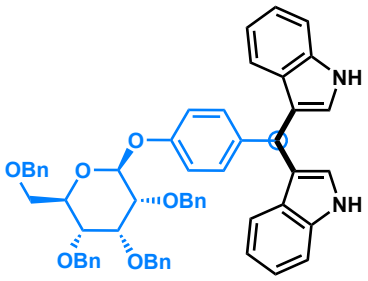
120.01, 119.37, 119.26, 118.95, 115.04, 112.04, 111.91, 75.38, 73.01, 72.06, 65.85, 37.18. **HRMS** (EI) Calcd for $C_{21}H_{22}N_2O_4$: $[M+H]^+$ 367.1658. Found: m/z 367.1660. Data in accordance with the literature.[11]

**(2R,3S,4R)-5,5-di(1H-indol-3-yl)pentane-1,2,3,4-tetraol 55**



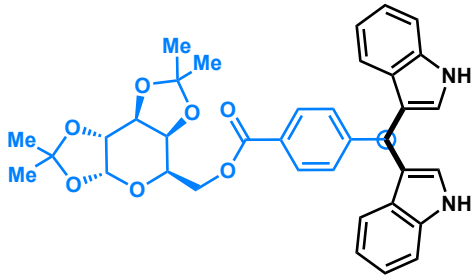

As a pale yellow solid: $R_f$ 0.2 (DCM: $CH_3OH$ = 10:1); **$^1$H NMR** (400 MHz, $CD_3OD$) δ 7.71 (d, *J* = 7.7 Hz, 1H), 7.59 (d, *J* = 8.8 Hz, 2H), 7.38 (s, 2H), 7.32 – 7.25 (m, 4H), 7.11 (s, 2H), 7.03 (q, *J* = 6.7 Hz, 4H), 6.98 – 6.87 (m, 4H), 4.63 (s, 1H), 3.80 (q, *J* = 5.1, 4.7 Hz, 1H), 3.66 (t, *J* = 3.7 Hz, 2H), 3.56 (t, *J* = 5.2 Hz, 4H). **$^{13}$C NMR** (101 MHz, $CD_3OD$) δ 138.05, 137.88, 129.16, 128.28, 124.09, 123.94, 122.08, 122.00, 120.17, 120.10, 119.38, 119.32, 117.88, 116.77, 112.08, 111.99, 76.70, 74.97, 72.40, 65.03, 39.18. **HRMS** (EI) Calcd for $C_{21}H_{22}N_2O_4$: $[M+H]^+$ 367.1658. Found: m/z 367.1651. Data in accordance with the literature.[11]

**3-((3a,7a-dihydro-1H-indol-3-yl)(4-(((2S,3R,4R,5R,6R)-3,4,5-tris(benzyloxy)-6-((benzyloxy)methyl)tetrahydro-2H-pyran-2-yl)oxy)cyclohexa-2,4-dien-1- yl)methyl)-1H-indole 56**




As an orange solid: $R_f$ 0.2 (PE: EA = 5:1); **$^1$H NMR** (401 MHz, $CDCl_3$) δ 7.89 (s, 2H), 7.42 – 7.30 (m, 15H), 7.29 – 7.26 (m, 2H), 7.25 (d, *J* = 1.9 Hz, 2H), 7.24 – 7.21 (m, 4H), 7.20 – 7.14 (m, 5H), 7.03 – 6.98 (m, 4H), 6.57 (t, *J* = 2.5 Hz, 3H), 5.84 (s, 1H), 5.51 (d, *J* = 7.9 Hz, 1H), 4.96 – 4.88 (m, 2H), 4.82 (d, *J* = 11.9 Hz, 1H), 4.73 (d, *J* = 12.1 Hz, 1H), 4.58 (d, *J* = 12.1 Hz, 1H), 4.53 – 4.46 (m, 2H), 4.39 (d, *J* = 11.5 Hz, 1H), 4.24 – 4.17 (m, 2H), 3.80 (dd, *J* = 10.8, 1.9 Hz, 1H), 3.69 (dd, *J* = 10.8, 4.9 Hz, 1H), 3.59 – 3.50 (m, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 156.02, 138.95, 138.66, 138.36, 138.08, 137.94, 136.79, 129.66, 128.55, 128.52, 128.40, 128.33, 128.16, 127.90, 127.87, 127.76, 127.58, 127.18, 123.90, 121.90, 120.07, 119.88, 119.23, 116.57, 111.19, 99.44, 78.84, 75.66, 74.85, 74.62, 73.47, 73.29, 72.67, 71.73, 69.28, 39.50. **HRMS** (EI) Calcd for $C_{20}H_{20}N_2O_3$: $[M+H]^+$ 861.3904. Found: m/z 861.3901.

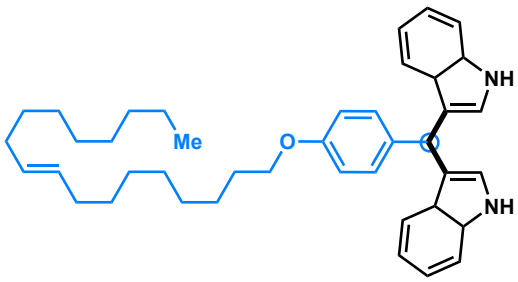
**((3aS,4R,8aS,8bS)-2,2,7,7-tetramethylhexahydrobenzo[1,2-d:3,4-d']bis([1,3]dioxole)-4-yl)methyl 4-(di(1H-indol-3-yl)methyl)benzoate 57**




As a red solid: $R_f$ 0.35 (PE: EA = 2:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.02 – 7.94 (m, 4H), 7.42 – 7.33 (m, 6H), 7.18 (t, *J* = 7.1 Hz, 2H), 7.01 (t, *J* = 7.0 Hz, 2H), 6.61 – 6.58 (m, 2H), 5.92 (s, 1H), 5.58 (d, *J* = 4.9 Hz, 1H), 4.66 (dd, *J* = 7.9, 2.5 Hz, 1H), 4.47 (qd, *J* = 11.5, 6.2 Hz, 2H), 4.34 (ddd, *J* = 9.8, 6.5, 2.2 Hz, 2H), 4.20 (ddd, *J* = 7.1, 5.1, 1.8 Hz, 1H), 1.50 (d, *J* = 13.4 Hz, 6H), 1.35 (d, *J* = 10.6 Hz, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 166.69, 149.78, 136.75, 129.92, 128.87, 128.05, 126.95, 123.83, 122.16, 119.85, 119.45, 118.82, 111.28, 109.79, 108.96, 96.42, 71.20, 70.79, 70.60, 66.21, 63.83, 40.35, 26.17, 26.09, 25.09, 24.59. **HRMS** (EI) Calcd for $C_{43}H_{58}N_2$: $[M+H]^+$ 609.2601. Found: m/z 609.2608.

**(E)-3,3'-((4-(octadec-9-en-1-yloxy)phenyl)methylene)bis(3a,7a-dihydro-1H-indole)**

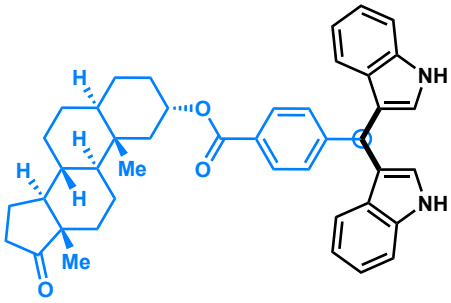
**58**




As an orange solid: $R_f$ 0.35 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.78 (s, 2H), 7.42 (d, *J* = 7.9 Hz, 2H), 7.33 (d, *J* = 8.1 Hz, 2H), 7.25 (d, *J* = 8.3 Hz, 2H), 7.19 (t, *J* =

7.5 Hz, 2H), 7.03 (t, *J* = 7.5 Hz, 2H), 6.83 (d, *J* = 8.5 Hz, 2H), 6.59 (s, 2H), 5.85 (s, 1H), 5.42 – 5.38 (m, 1H), 3.94 (t, *J* = 6.5 Hz, 2H), 2.06 (d, *J* = 6.3 Hz, 3H), 1.79 (p, *J* = 6.8 Hz, 2H), 1.48 (s, 2H), 1.33 (d, *J* = 19.2 Hz, 23H), 0.97 – 0.89 (m, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 157.59, 136.78, 136.11, 130.12, 130.00, 129.69, 127.17, 123.68, 121.98, 120.13, 119.28, 114.24, 111.16, 68.48, 39.43, 32.06, 29.91, 29.86, 29.68, 29.63, 29.56, 29.53, 29.48, 29.40, 27.36, 26.25, 22.85, 14.30. **HRMS** (EI) Calcd for $C_{21}H_{22}N_2O_4$: $[M+H]^+$ 593.4471. Found: m/z 593.4463.

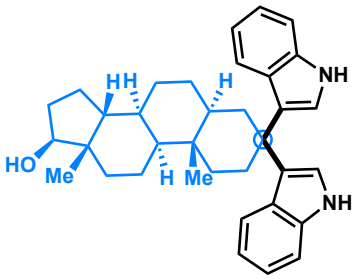
**(2S,5S,8R,9S,10S,13S,14S)-10,13-dimethyl-17-oxohexadecahydro-1H-cyclopenta[a]phenanthren-2-yl 4-(di(1H-indol-3-yl)methyl)benzoate 59**




As a red solid: $R_f$ 0.35 (PE: EA = 2:1); **$^1$H NMR** (401 MHz, $CDCl_3$) δ 8.07 (d, *J* = 2.5 Hz, 2H), 7.99 (d, *J* = 8.3 Hz, 2H), 7.43 (d, *J* = 8.3 Hz, 2H), 7.37 (t, *J* = 8.1 Hz, 4H), 7.18 (ddd, *J* = 8.1, 7.0, 1.2 Hz, 2H), 7.06 – 6.98 (m, 2H), 6.68 – 6.62 (m, 2H), 5.95 (s, 1H), 5.28 (s, 1H), 2.45 (dd, *J* = 19.2, 8.6 Hz, 1H), 2.07 (dt, *J* = 18.3, 9.0 Hz, 1H), 1.98 – 1.65 (m, 7H), 1.64 – 1.44 (m, 6H), 1.41 – 1.19 (m, 7H), 1.02 (qd, *J* = 12.0, 5.6 Hz, 1H), 0.87 (d, *J* = 3.9 Hz, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 221.88, 166.15, 149.57, 136.79, 129.74, 129.11, 128.87, 126.97, 123.83, 123.79, 122.16, 119.86, 119.43, 118.84, 111.30, 70.42, 54.49, 51.52, 47.96, 40.52, 40.36, 36.14, 36.00, 35.10, 33.27, 33.06, 31.62, 30.82,

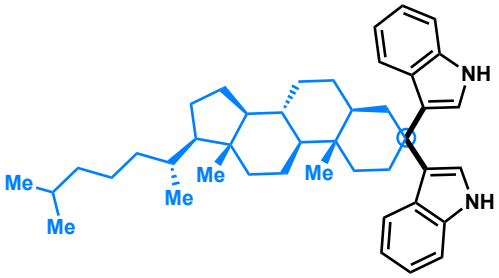
28.14, 26.39, 21.84, 20.19, 13.94, 11.52. **HRMS** (EI) Calcd for $C_{43}H_{46}N_2O_3$: $[M+H]^+$ 639.3587. Found: m/z 639.3587.

**(5S,8S,9S,10S,13S,14R,17S)-3,3-di(1H-indol-3-yl)-10,13-dimethylhexadecahydro-1H-cyclopenta[a]phenanthren-17-ol 60**




As a white solid: $R_f$ 0.30 (PE: EA = 2:1); **$^1$H NMR** (400 MHz, DMSO-$d_6$) δ 10.74 (s, 1H), 10.61 (s, 1H), 7.42 (d, $J$ = 2.4 Hz, 1H), 7.32 (d, $J$ = 8.1 Hz, 1H), 7.26 (d, $J$ = 8.1 Hz, 1H), 7.22 (d, $J$ = 8.0 Hz, 1H), 7.17 (d, $J$ = 8.9 Hz, 1H), 7.08 (d, $J$ = 2.5 Hz, 1H), 6.84 (q, $J$ = 7.5, 7.0 Hz, 2H), 6.64 (t, $J$ = 7.1 Hz, 2H), 4.38 (d, $J$ = 4.8 Hz, 1H), 3.31 (d, $J$ = 2.3 Hz, 1H), 2.75 (d, $J$ = 13.5 Hz, 1H), 2.40 (d, $J$ = 13.3 Hz, 1H), 2.02 (q, $J$ = 11.7, 11.0 Hz, 2H), 1.75 (dt, $J$ = 9.4, 5.4 Hz, 1H), 1.66 (d, $J$ = 12.5 Hz, 1H), 1.59 – 1.50 (m, 2H), 1.46 (d, $J$ = 11.2 Hz, 1H), 1.36 (s, 2H), 1.35 – 1.24 (m, 3H), 1.18 (d, $J$ = 12.7 Hz, 3H), 1.11 – 1.01 (m, 1H), 0.86 (s, 4H), 0.78 (dd, $J$ = 11.2, 7.3 Hz, 1H), 0.73 – 0.63 (m, 1H), 0.58 (s, 3H), 0.54 – 0.45 (m, 1H). **$^{13}$C NMR** (101 MHz, DMSO-$d_6$) δ 137.51, 137.41, 126.64, 126.16, 125.91, 124.16, 121.11, 120.89, 120.76, 120.62, 120.56, 119.53, 118.01, 117.91, 111.85, 82.47, 80.58, 55.02, 51.10, 43.08, 42.07, 39.47, 38.98, 37.08, 36.57, 35.81, 35.66, 33.14, 31.84, 30.34, 28.78, 23.57, 20.69, 12.91, 11.88. **HRMS** (EI) Calcd for $C_{35}H_{42}N_2O$: $[M+H]^+$ 507.3375. Found: m/z 507.3369.

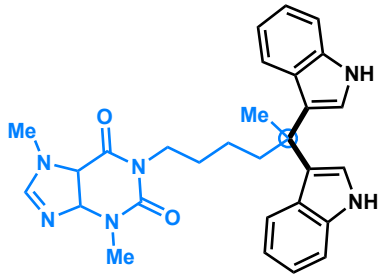
**3,3'-((5S,8R,9S,10S,13R,14S,17R)-10,13-dimethyl-17-((R)-6-methylheptan-2-yl)hexadecahydro-1H-cyclopenta[a]phenanthrene-3,3-diyl)bis(1H-indole) 61**




As a brown solid: $R_f$ 0.2 (PE: EA = 10:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.98 (s, 1H), 7.73 (s, 1H), 7.62 (d, *J* = 8.0 Hz, 1H), 7.47 (d, *J* = 8.1 Hz, 1H), 7.31 (d, *J* = 7.7 Hz, 2H), 7.24 (d, *J* = 6.4 Hz, 1H), 7.10 – 7.01 (m, 2H), 6.96 – 6.79 (m, 3H), 2.70 (d, *J* = 11.3 Hz, 1H), 2.44 – 2.24 (m, 3H), 1.95 (dt, *J* = 12.6, 3.4 Hz, 1H), 1.85 – 1.71 (m, 1H), 1.69 – 1.56 (m, 2H), 1.56 – 1.40 (m, 6H), 1.38 – 1.28 (m, 5H), 1.23 (t, *J* = 13.2 Hz, 3H), 1.12 (d, *J* = 39.5 Hz, 4H), 1.05 (s, 6H), 0.93 – 0.84 (m, 9H), 0.79 (d, *J* = 4.7 Hz, 1H), 0.65 (s, 3H), 0.62 – 0.55 (m, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 137.21, 137.03, 126.86, 125.98, 123.16, 121.90, 121.31, 121.27, 121.18, 121.05, 120.79, 118.66, 118.62, 111.25, 111.09, 56.64, 56.38, 54.61, 42.70, 41.93, 40.14, 40.04, 39.61, 38.83, 36.46, 36.28, 35.92, 35.67, 35.59, 32.79, 32.06, 28.84, 28.36, 28.11, 24.27, 23.97, 22.94, 22.68, 21.04, 18.78, 12.88, 12.19. **HRMS** (EI) Calcd for $C_{43}H_{58}N_2$: $[M+H]^+$ 603.4678. Found: m/z 603.4670.

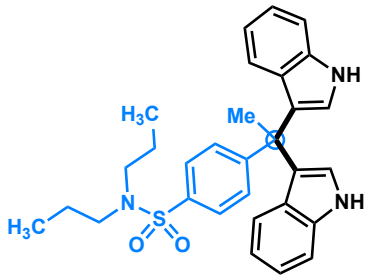
**1-(5,5-di(1H-indol-3-yl)hexyl)-3,7-dimethyl-3,4,5,7-tetrahydro-1H-purine-2,6-dione**

**62**




As a grey solid: $R_f$ 0.35 (PE: EA = 1:1); **$^1$H NMR** (401 MHz, $CDCl_3$) δ 7.98 (d, *J* = 8.7 Hz, 2H), 7.45 (d, *J* = 4.8 Hz, 1H), 7.34 (d, *J* = 8.1 Hz, 2H), 7.28 (d, *J* = 8.2 Hz, 2H), 7.03 (t, *J* = 8.1 Hz, 4H), 6.82 (t, *J* = 8.1 Hz, 2H), 3.97 – 3.86 (m, 5H), 3.54 (s, 3H), 2.45 – 2.37 (m, 2H), 1.83 (s, 3H), 1.62 (q, *J* = 7.7 Hz, 2H), 1.31 – 1.19 (m, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.84, 151.53, 148.74, 141.43, 137.11, 126.49, 124.24, 121.34, 118.65, 111.05, 107.76, 41.56, 40.25, 38.48, 33.62, 29.76, 28.61, 27.06, 22.19. **HRMS** (EI) Calcd for $C_{21}H_{22}N_2O_4$: $[M+H]^+$ 497.2665. Found: m/z 497.2668.

**4-(1,1-di(1H-indol-3-yl)ethyl)-N,N-dipropylbenzenesulfonamide 63**

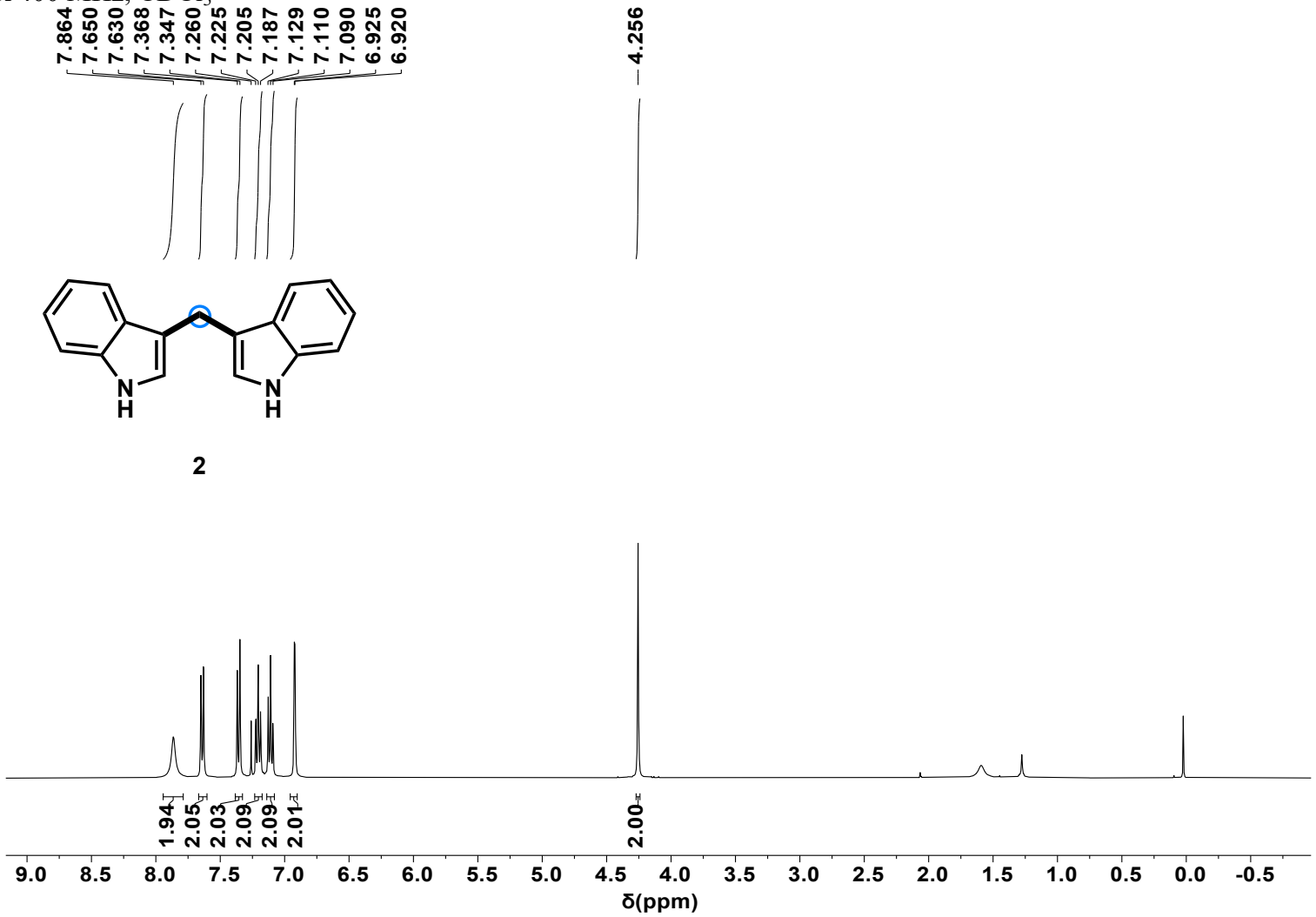



As a brown solid: $R_f$ 0.2 (PE: EA = 5:1); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.98 (s, 2H), 7.67 (d, *J* = 8.6 Hz, 2H), 7.52 (d, *J* = 8.6 Hz, 2H), 7.36 (d, *J* = 8.2 Hz, 2H), 7.24 (d, *J* = 9.1 Hz, 2H), 7.18 – 7.12 (m, 2H), 6.98 – 6.90 (m, 2H), 6.61 (d, *J* = 2.4 Hz, 2H), 3.11 – 3.02 (m, 4H), 2.36 (s, 3H), 1.51 (h, *J* = 7.4 Hz, 4H), 0.83 (t, *J* = 7.4 Hz, 6H). **$^{13}$C NMR**

(101 MHz, $CDCl_3$) δ 153.01, 137.64, 137.20, 128.87, 126.73, 126.19, 123.71, 123.51, 121.85, 121.81, 119.20, 111.44, 49.83, 44.47, 28.78, 22.36, 11.29. **HRMS** (EI) Calcd for $C_{30}H_{33}N_3O_2S$: $[M+H]^+$ 500.2372. Found: m/z 500.2373.

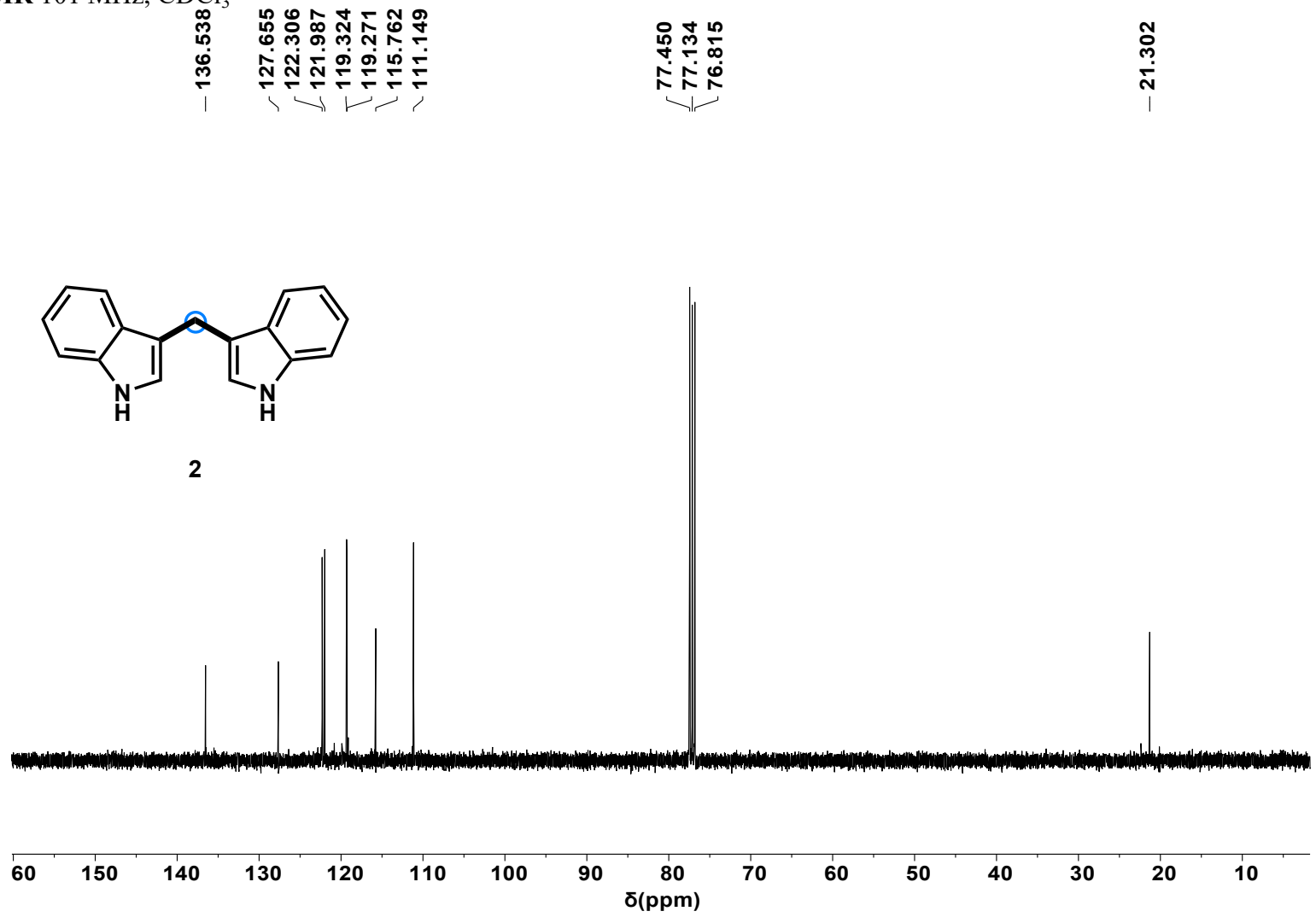
## 10. Spectra for compounds

**$^1$H NMR** 400 MHz, $CDCl_3$

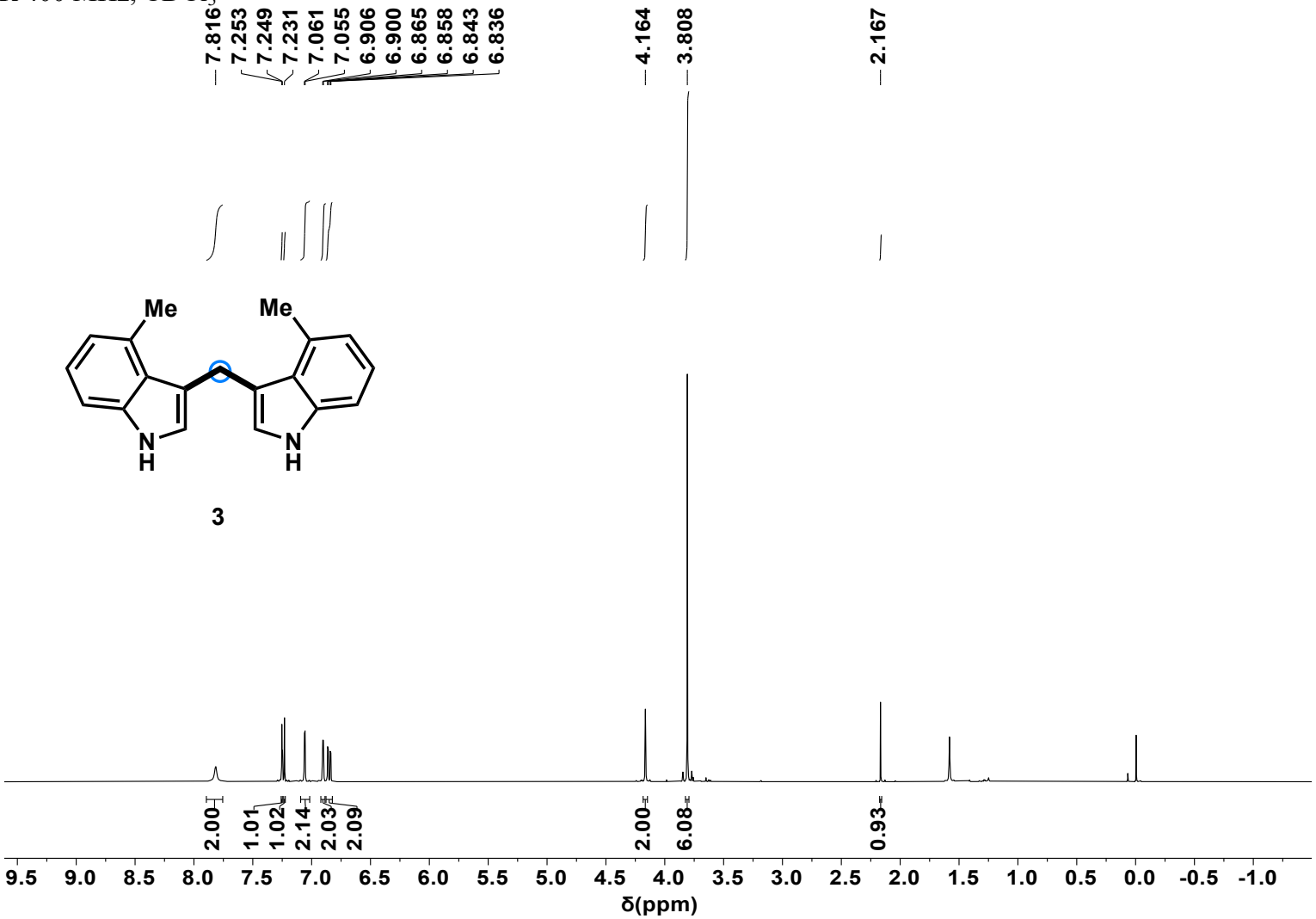



2

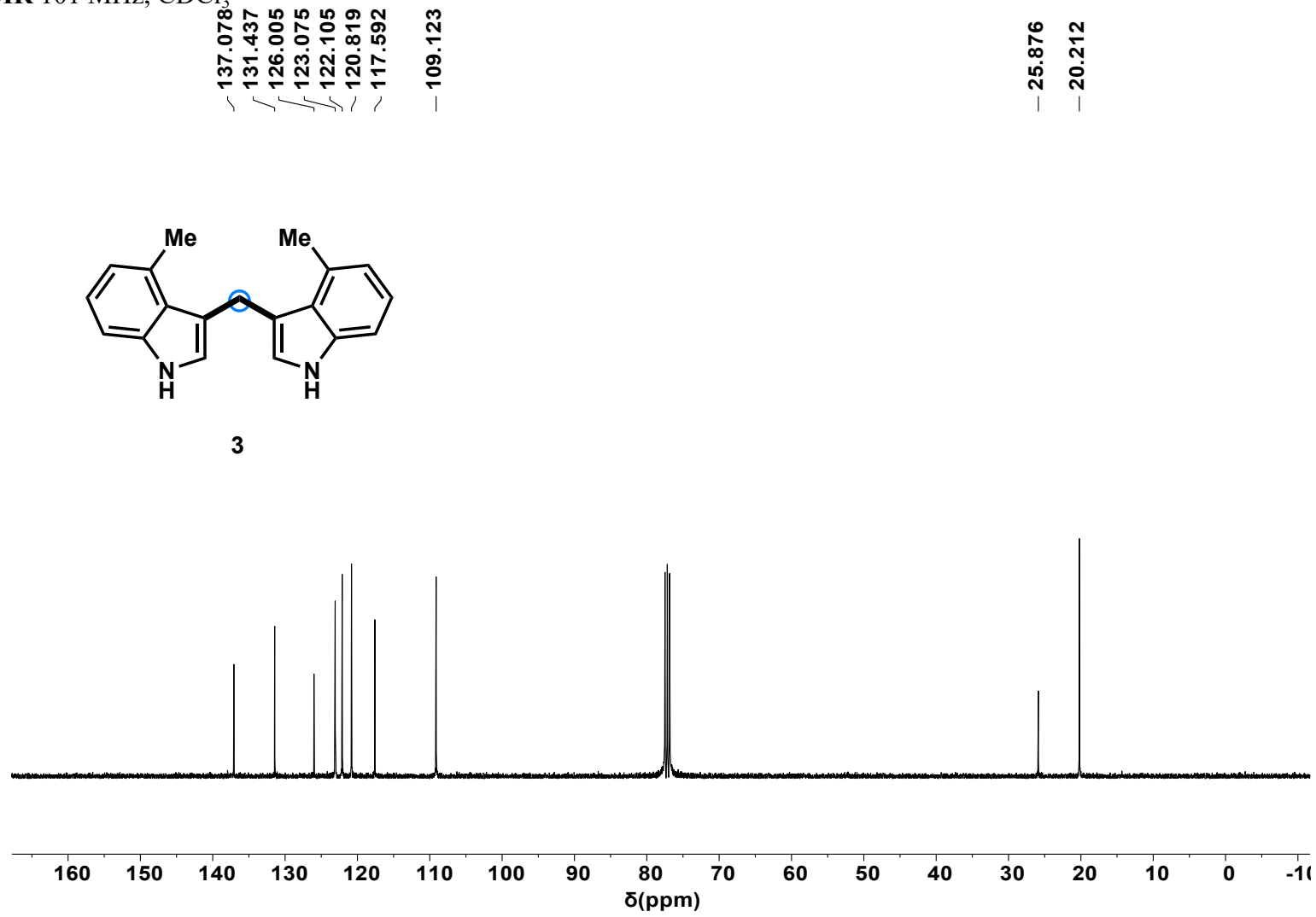
**$^{13}$C NMR** 101 MHz, $CDCl_3$



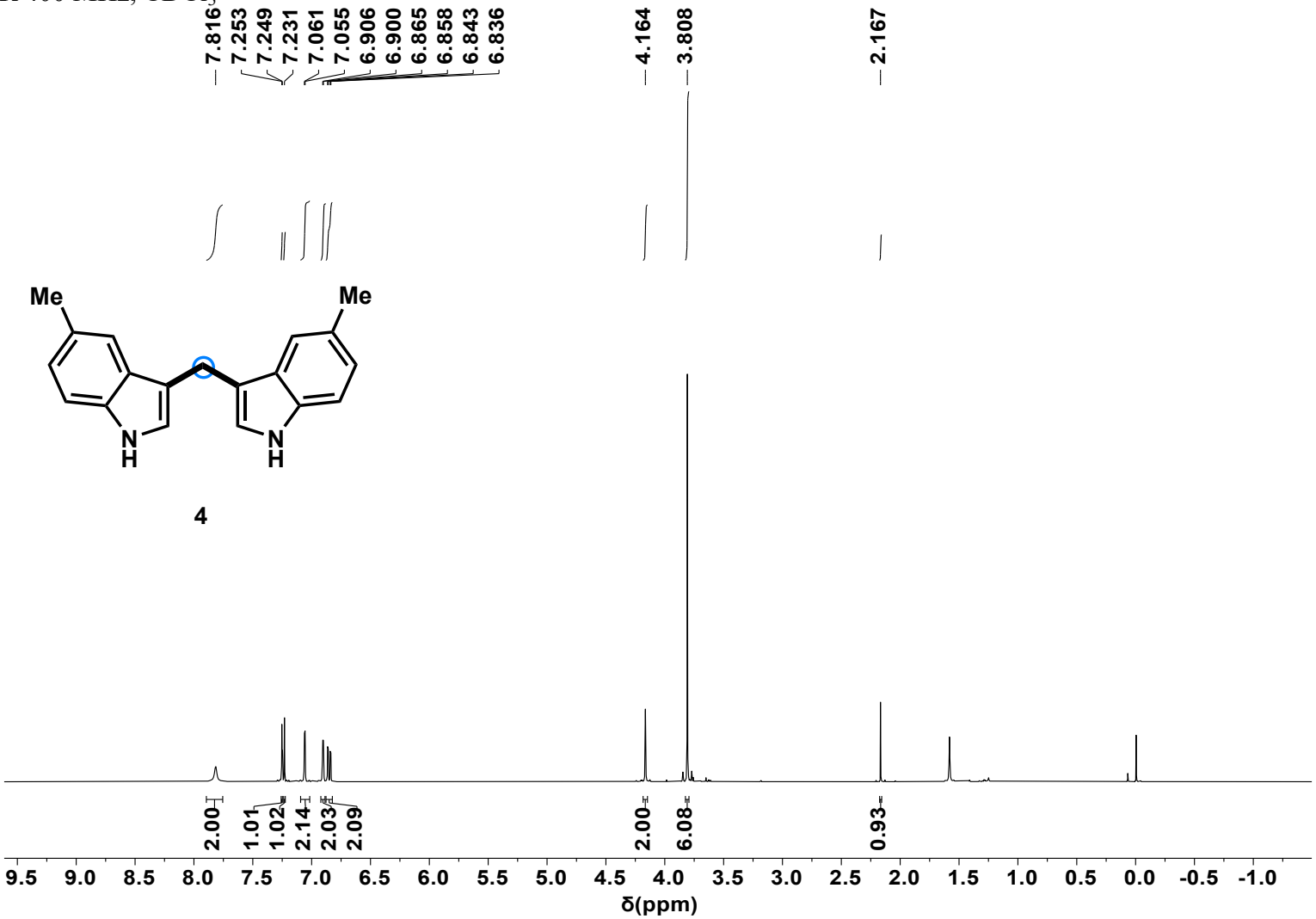
**$^1$H NMR** 400 MHz, $CDCl_3$



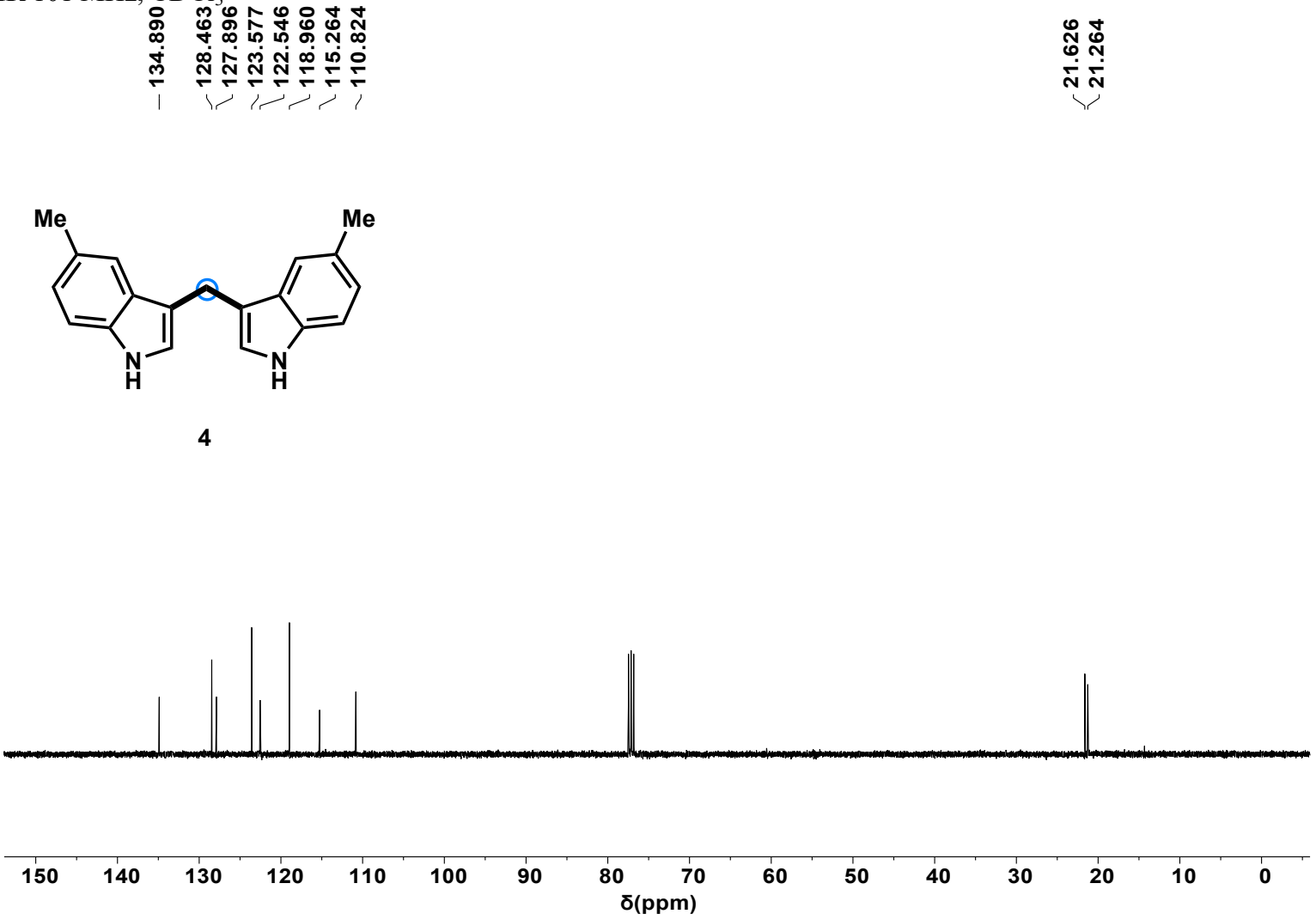
**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^1$H NMR** 400 MHz, $CDCl_3$

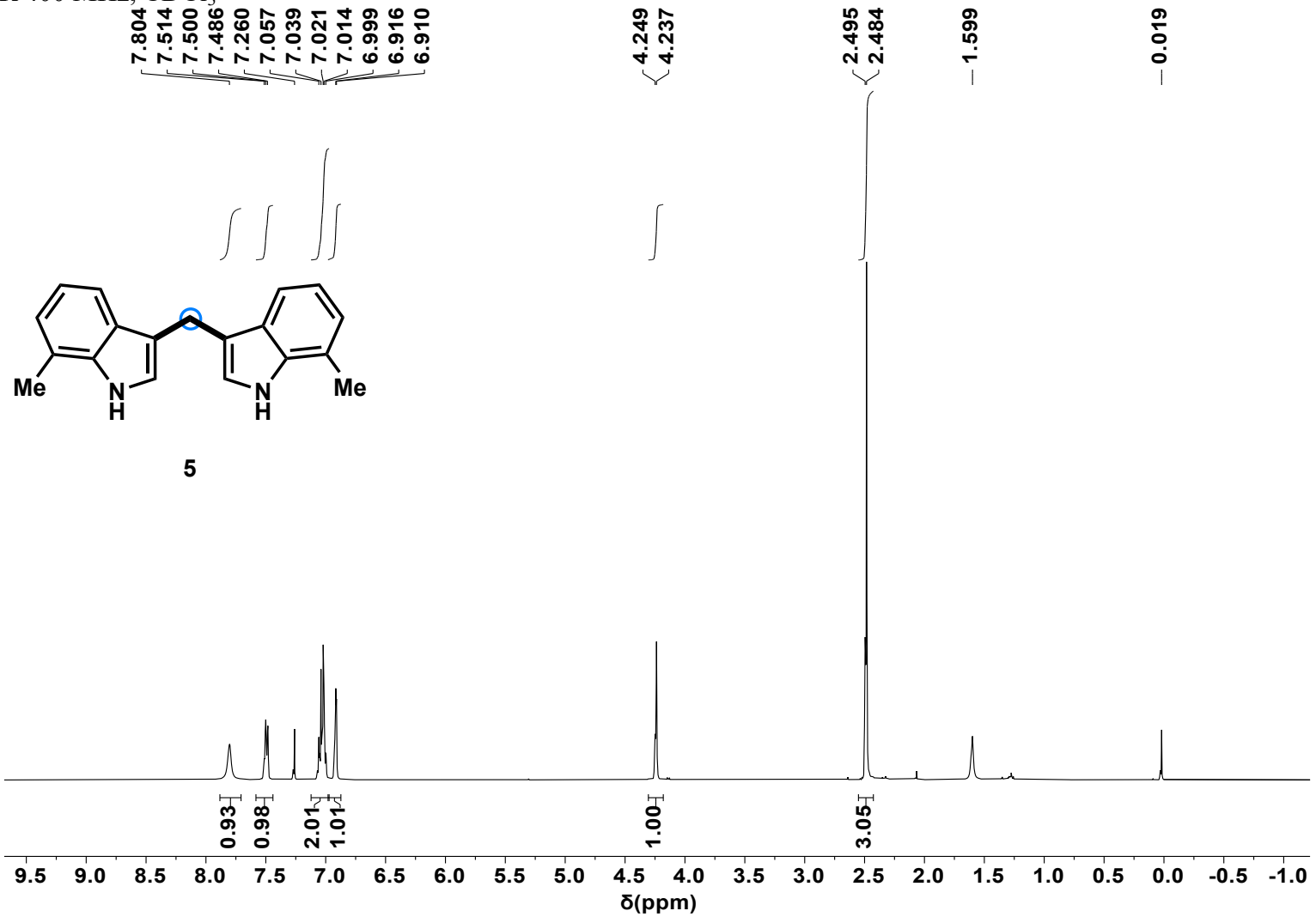


**$^{13}$C NMR** 101 MHz, $CDCl_3$



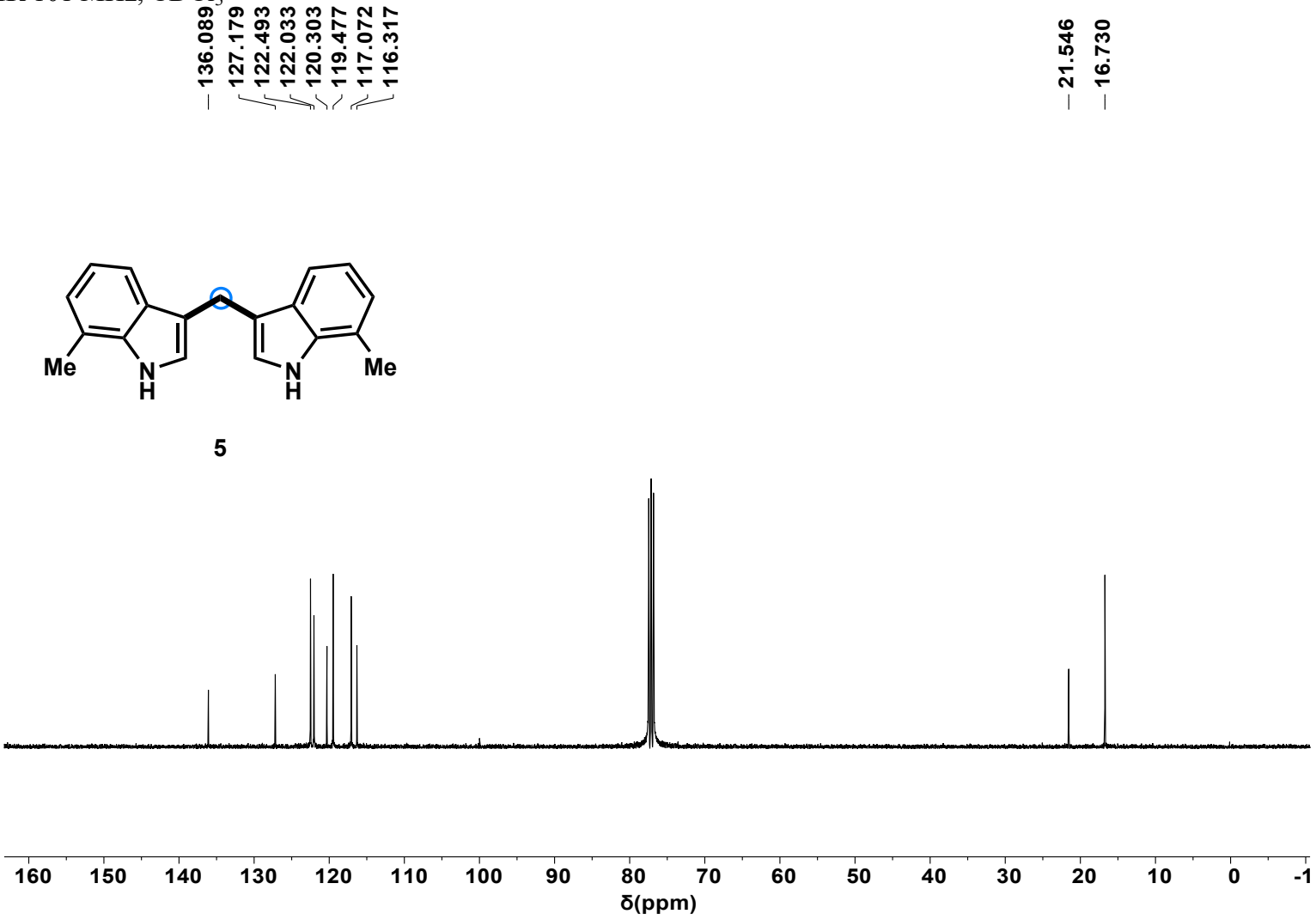

4

**$^1$H NMR** 400 MHz, $CDCl_3$



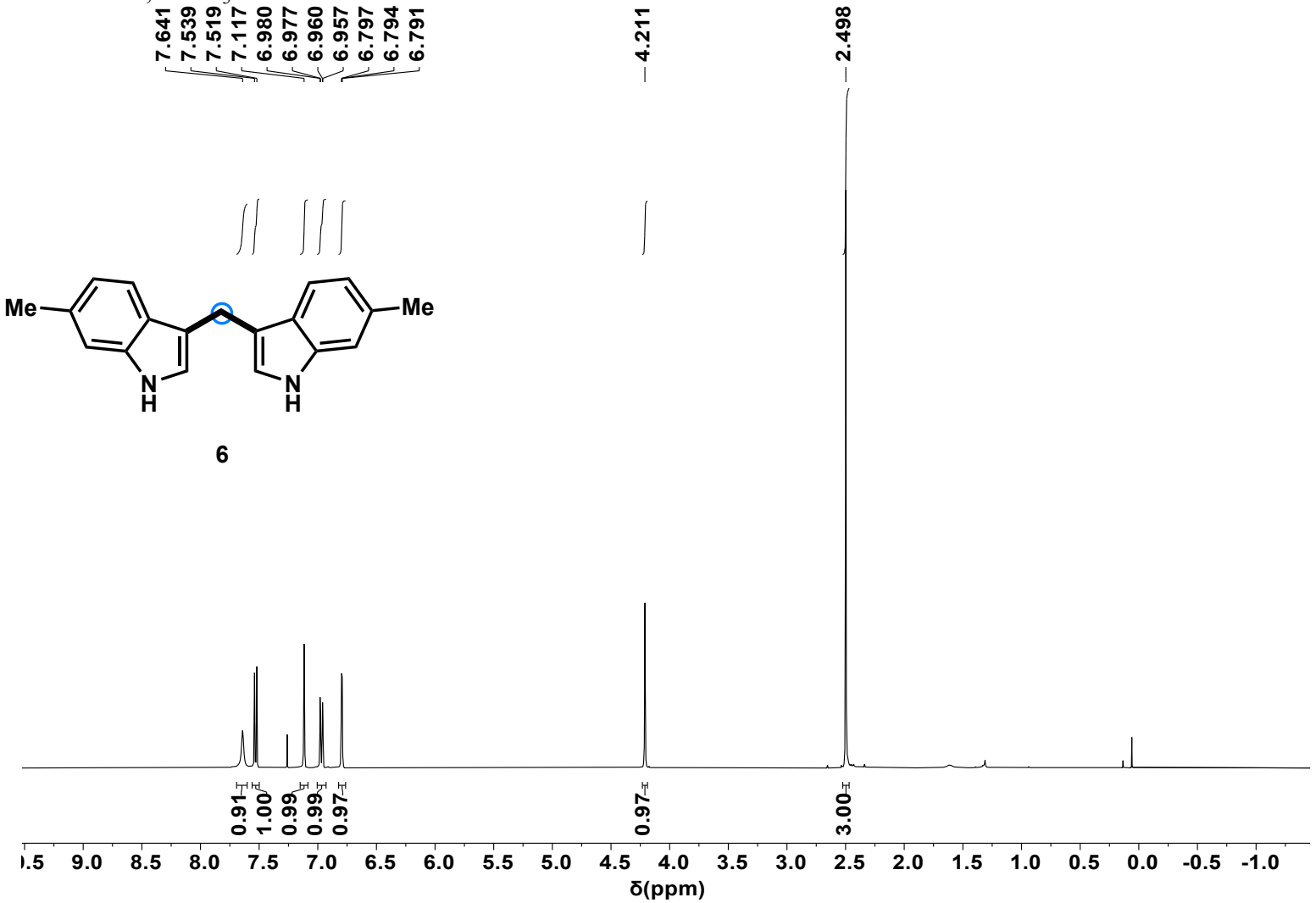

**5**

**$^{13}$C NMR** 101 MHz, $CDCl_3$

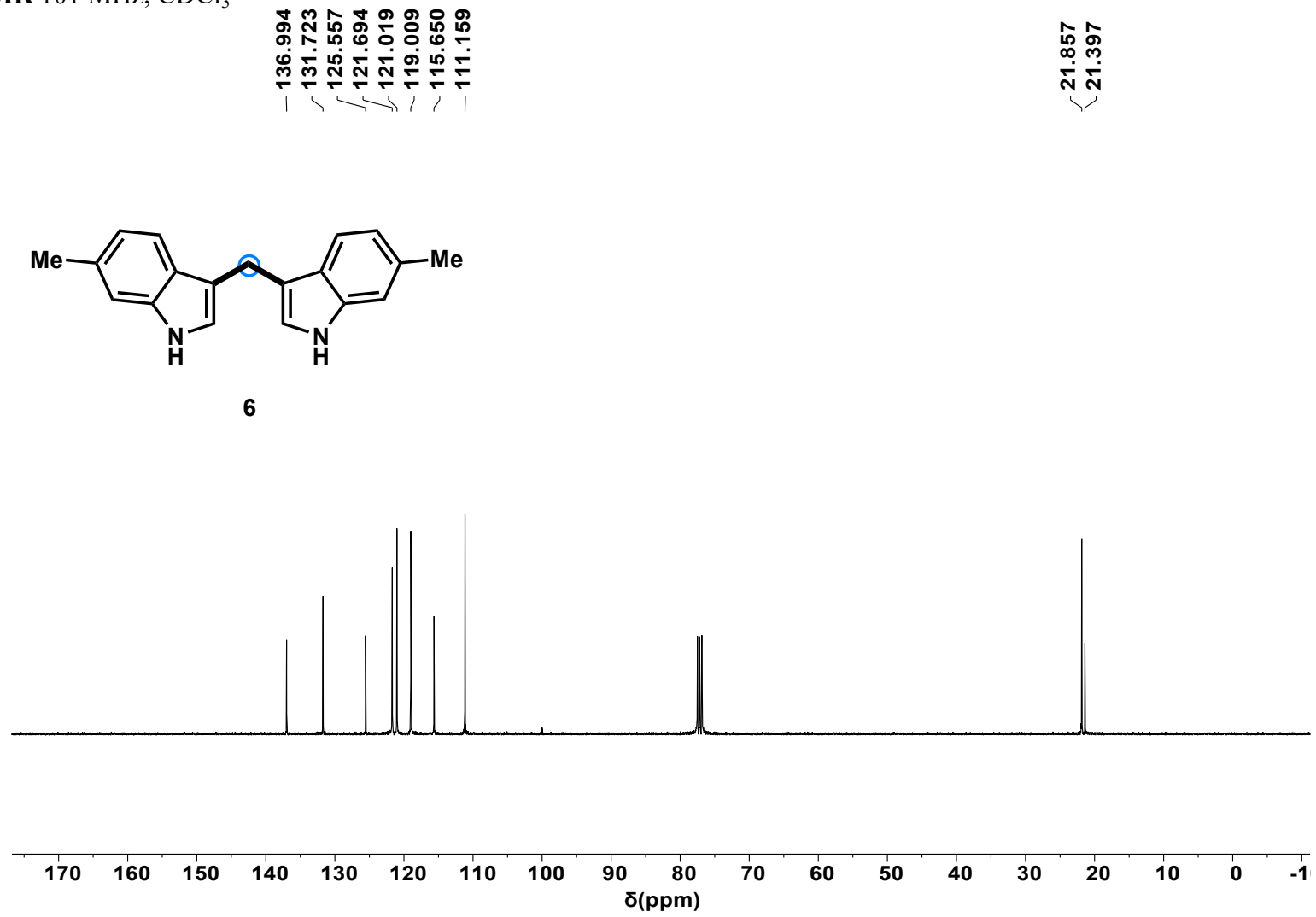



**5**

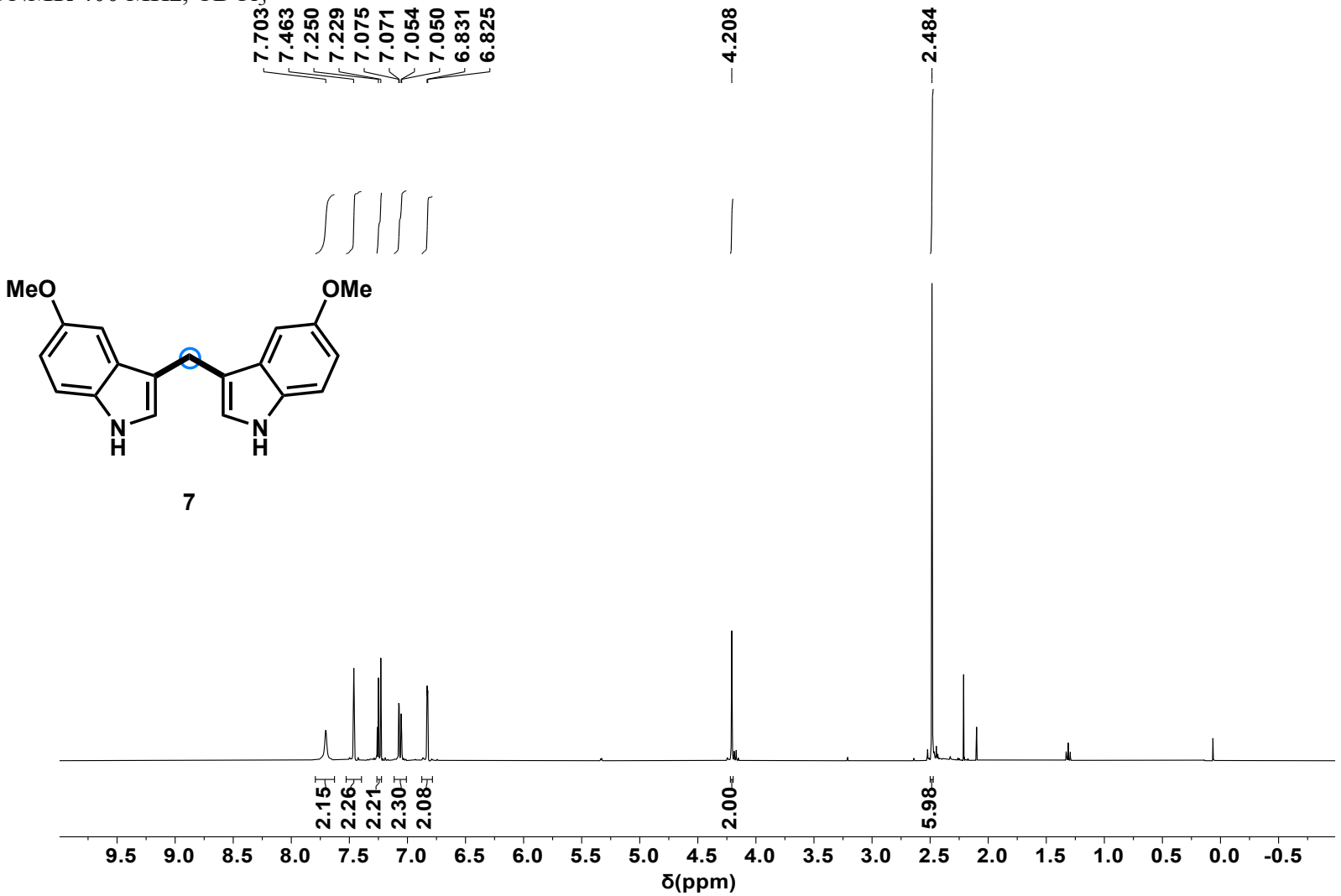
**$^1$H NMR** 400 MHz, $CDCl_3$



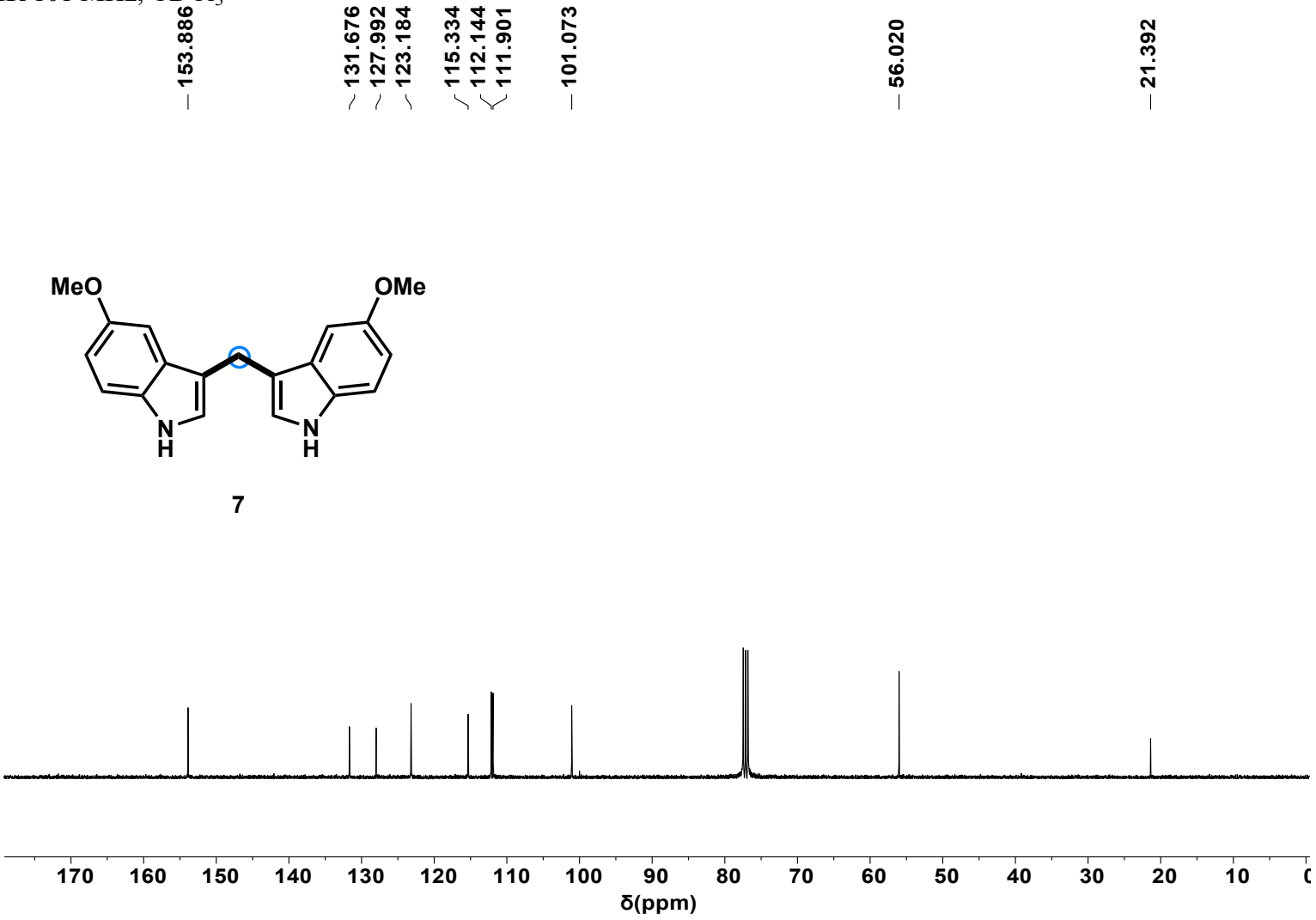
**$^{13}$C NMR** 101 MHz, $CDCl_3$



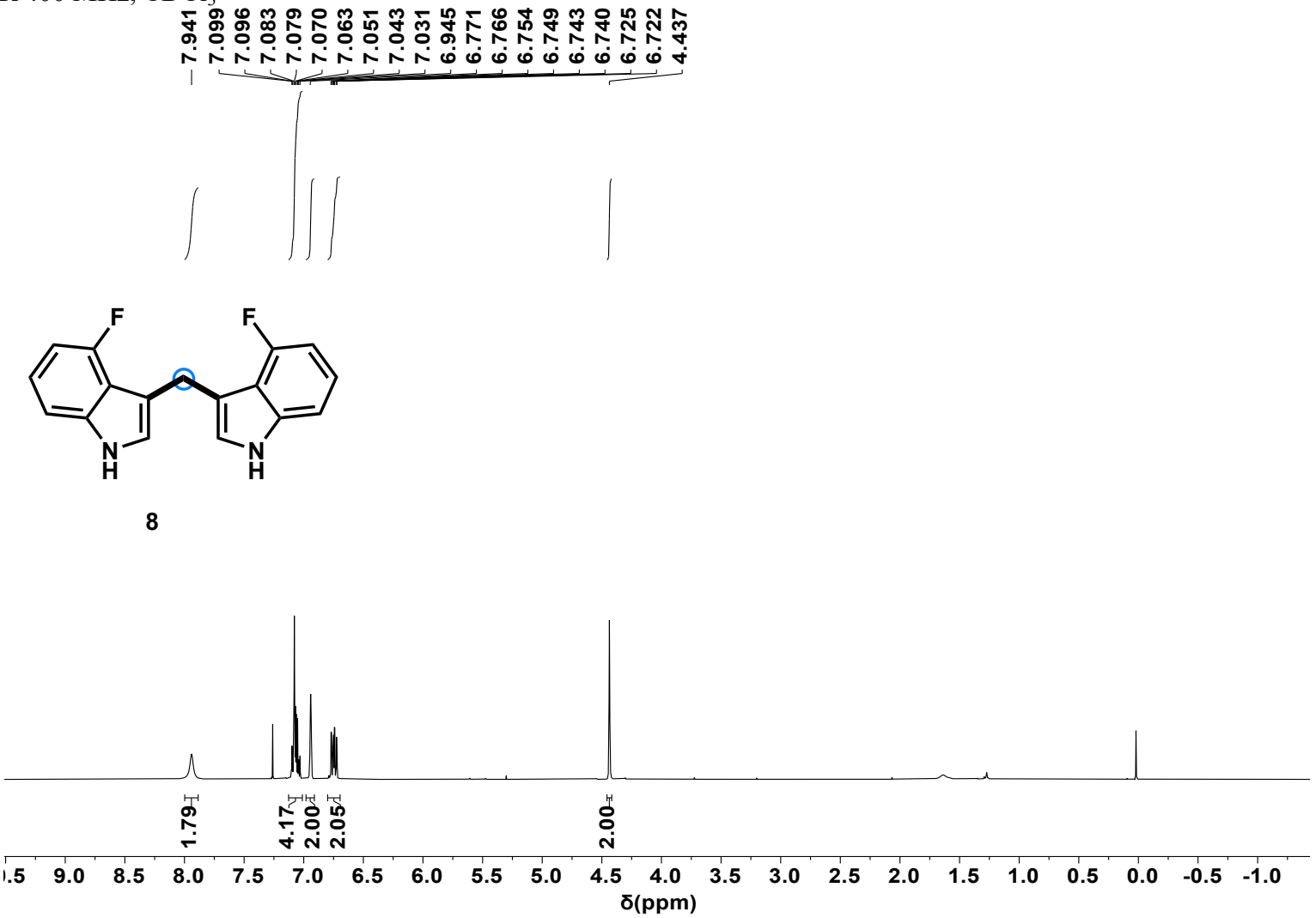
**$^1$H NMR** 400 MHz, $CDCl_3$



**$^{13}$C NMR** 101 MHz, $CDCl_3$

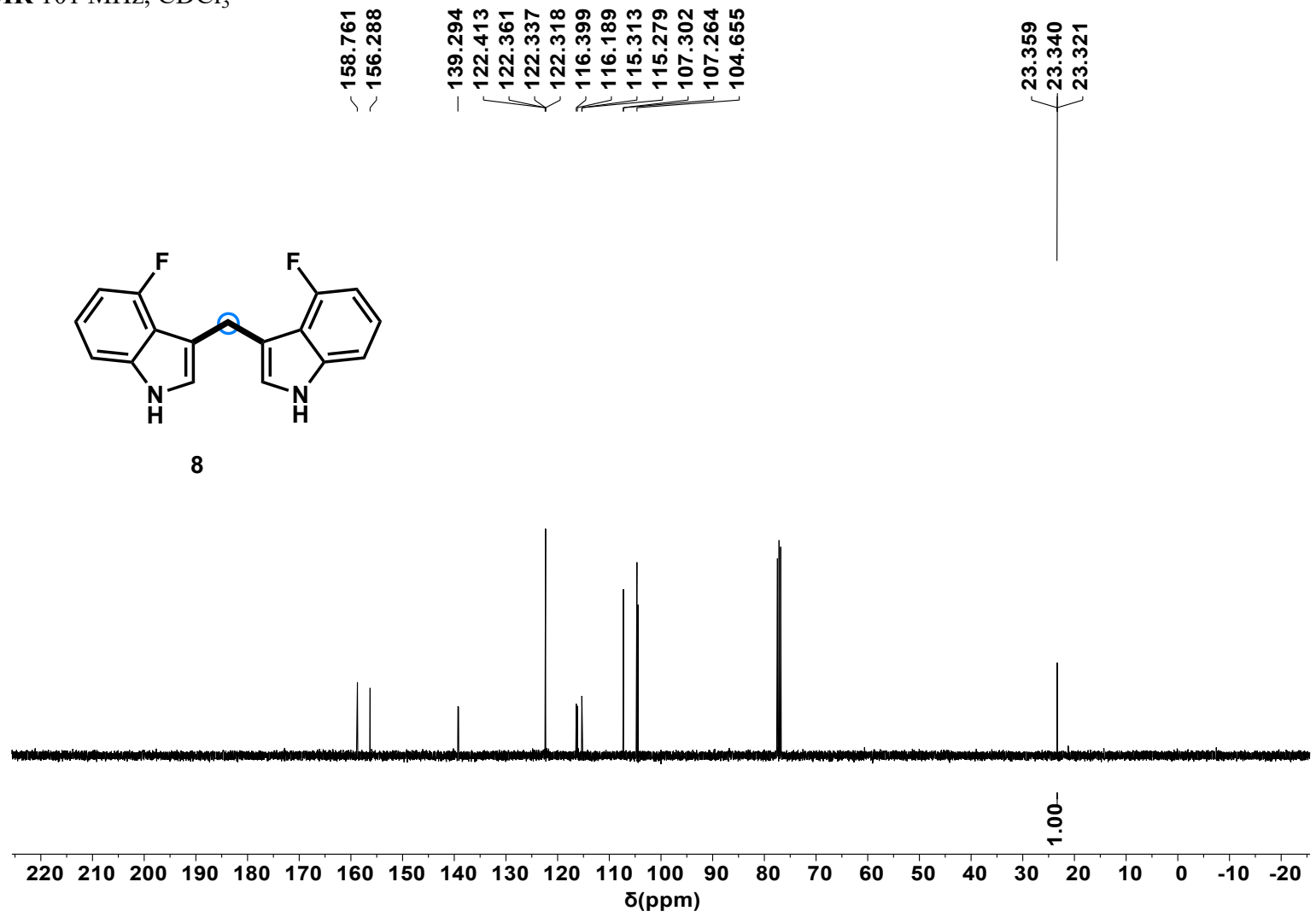


**$^1$H NMR** 400 MHz, $CDCl_3$

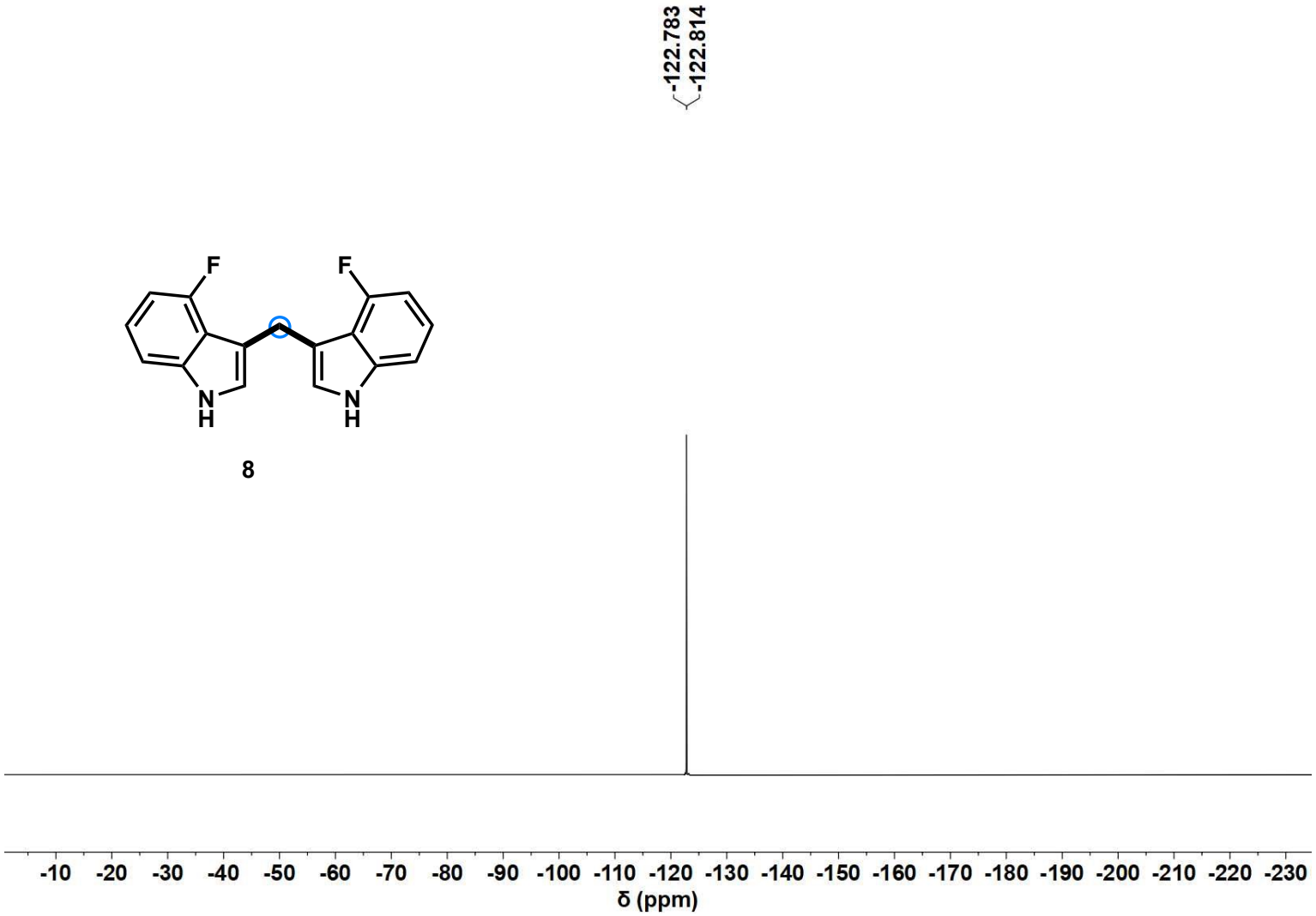



**8**

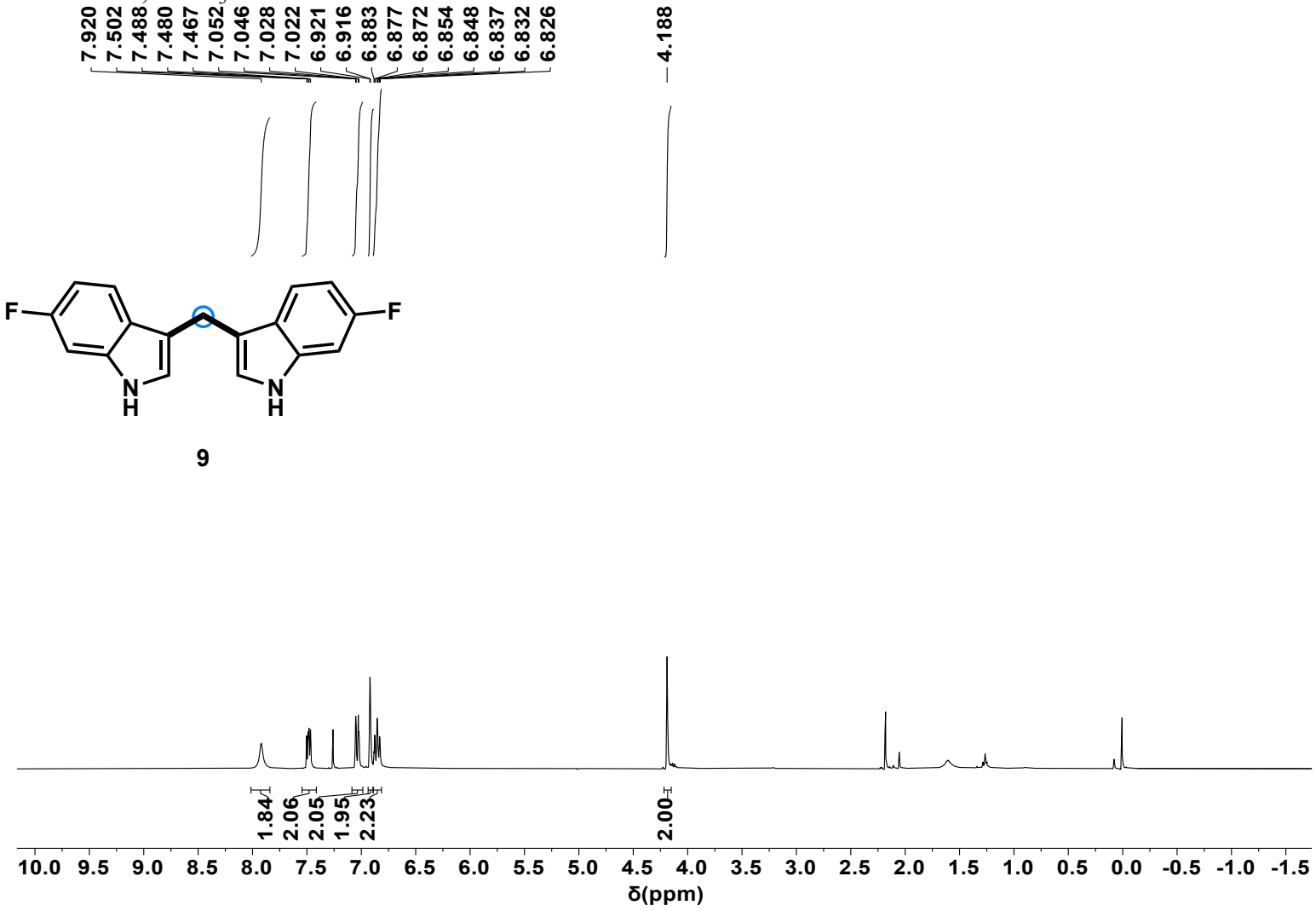
**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^{19}$F NMR** 376 MHz, $CDCl_3$

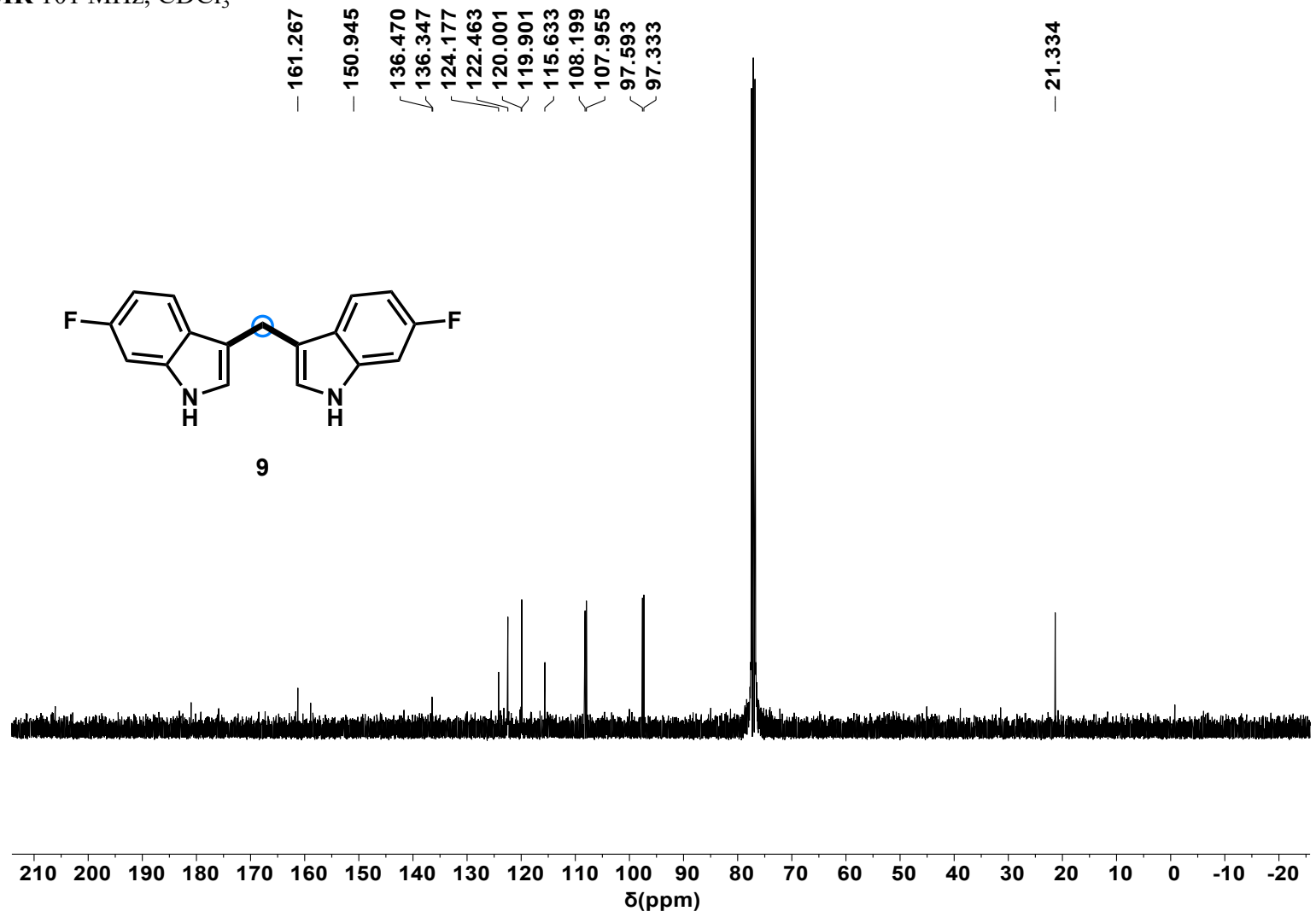


**$^1$H NMR** 400 MHz, $CDCl_3$

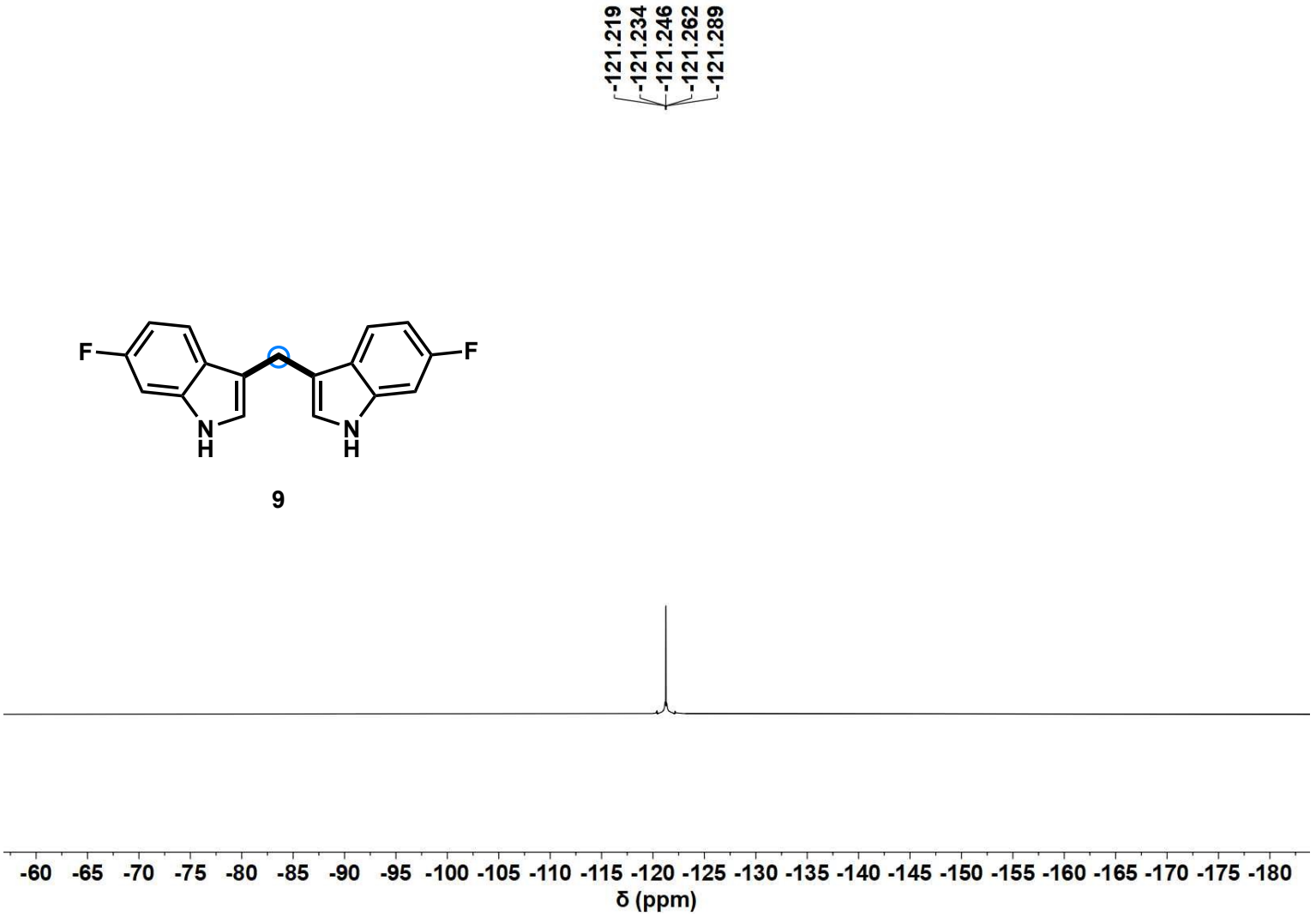



**9**

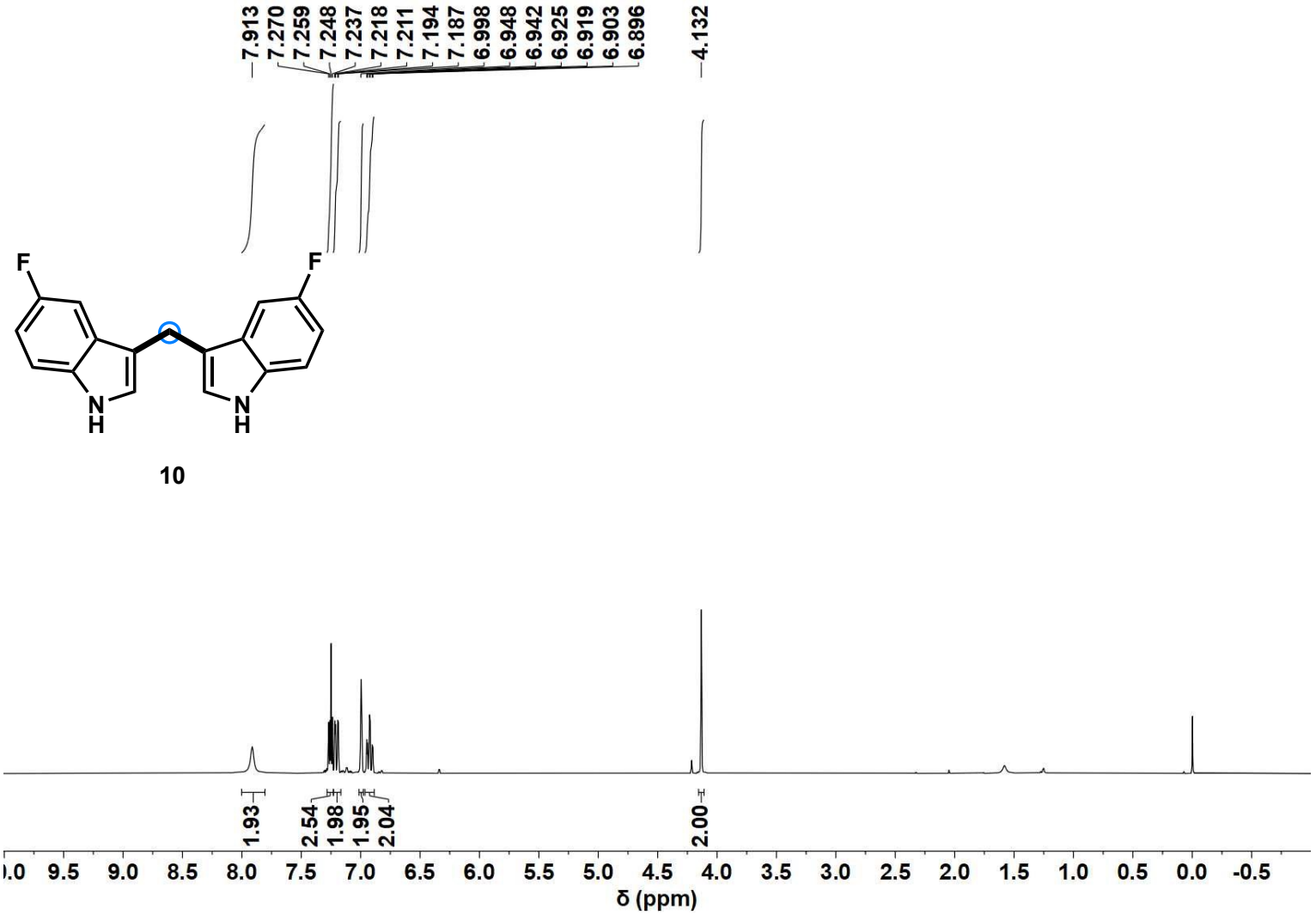
**$^{13}$C NMR** 101 MHz, $CDCl_3$



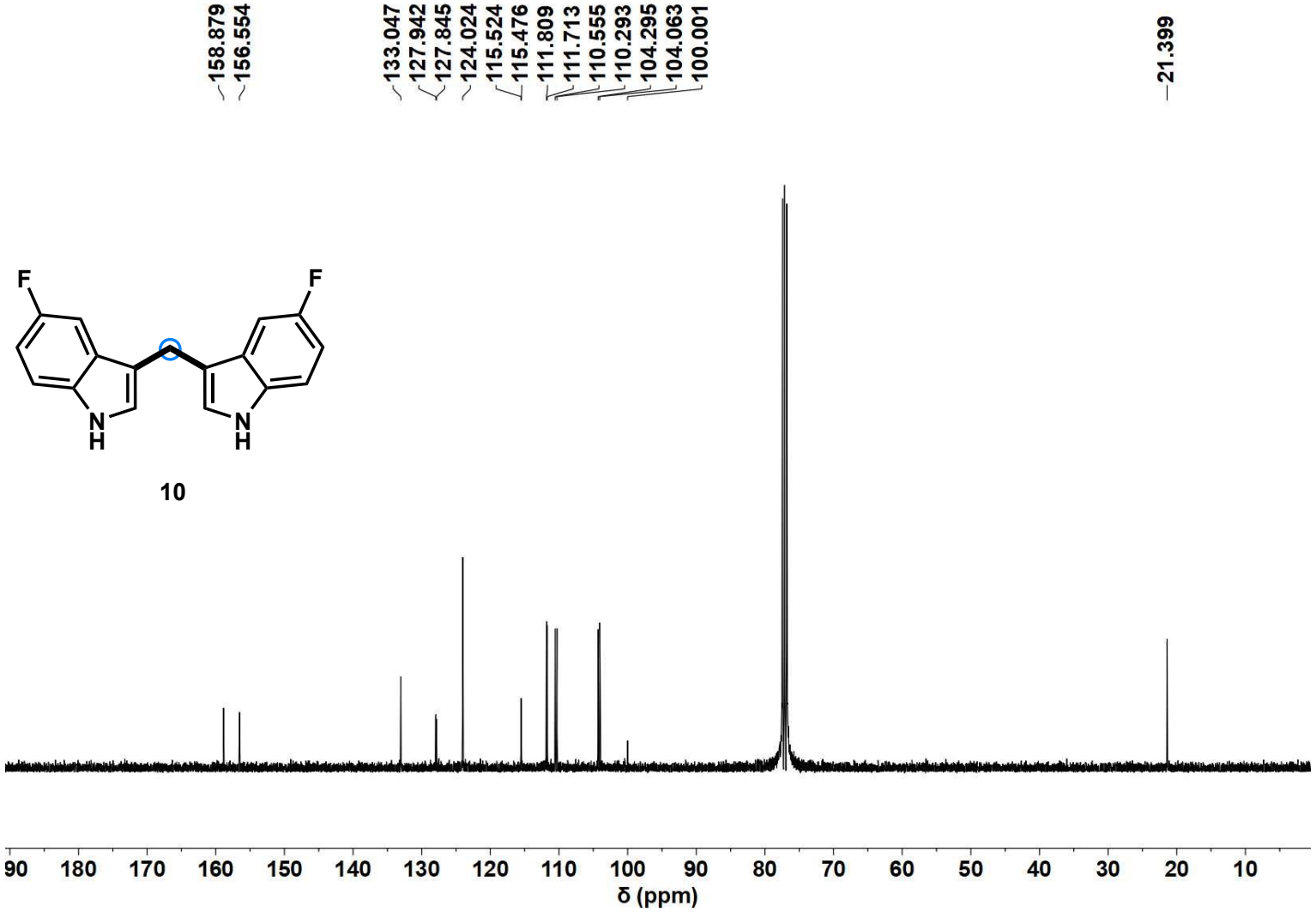
**$^{19}$F NMR** 376 MHz, $CDCl_3$



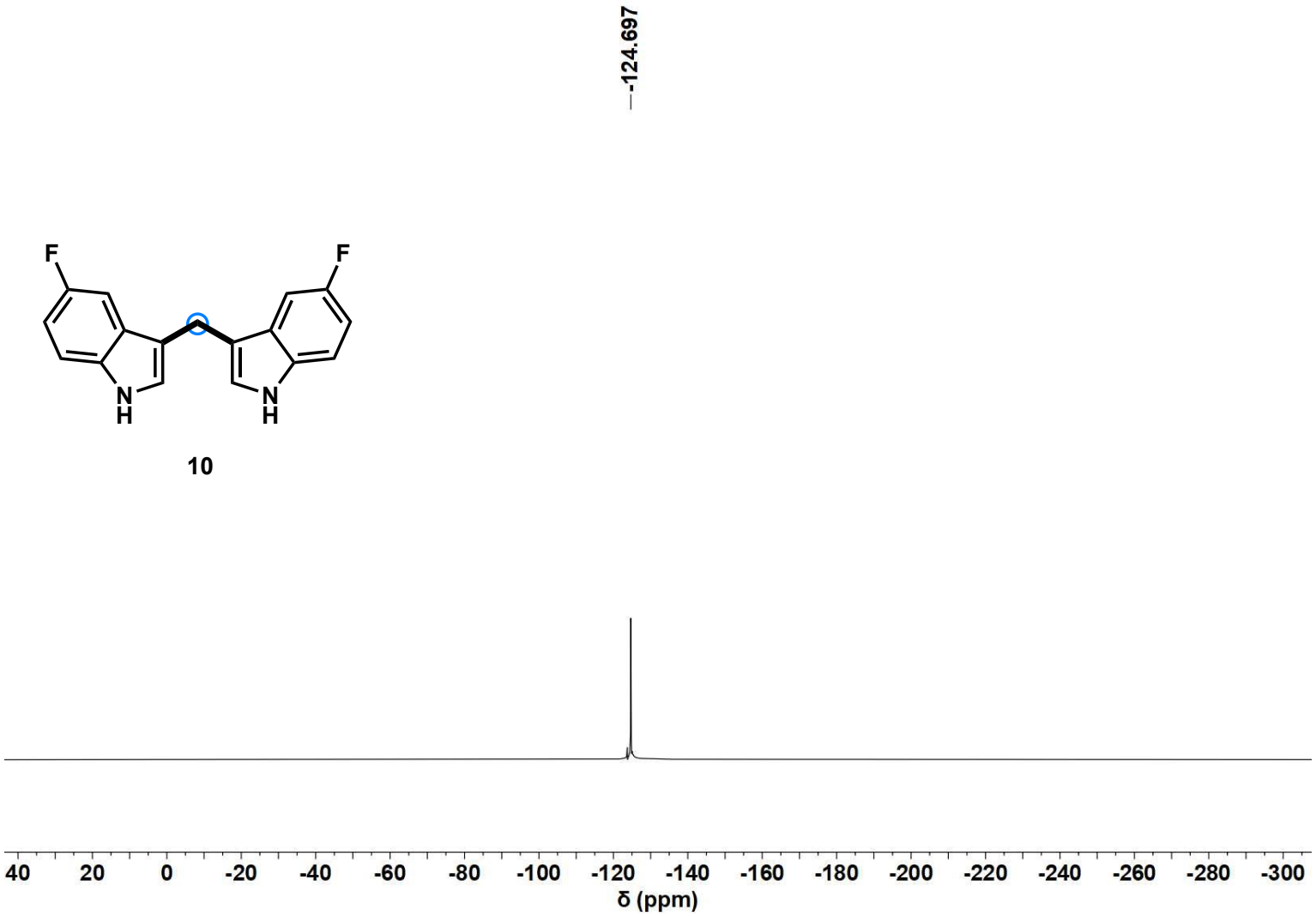
**$^1$H NMR** 400 MHz, $CDCl_3$



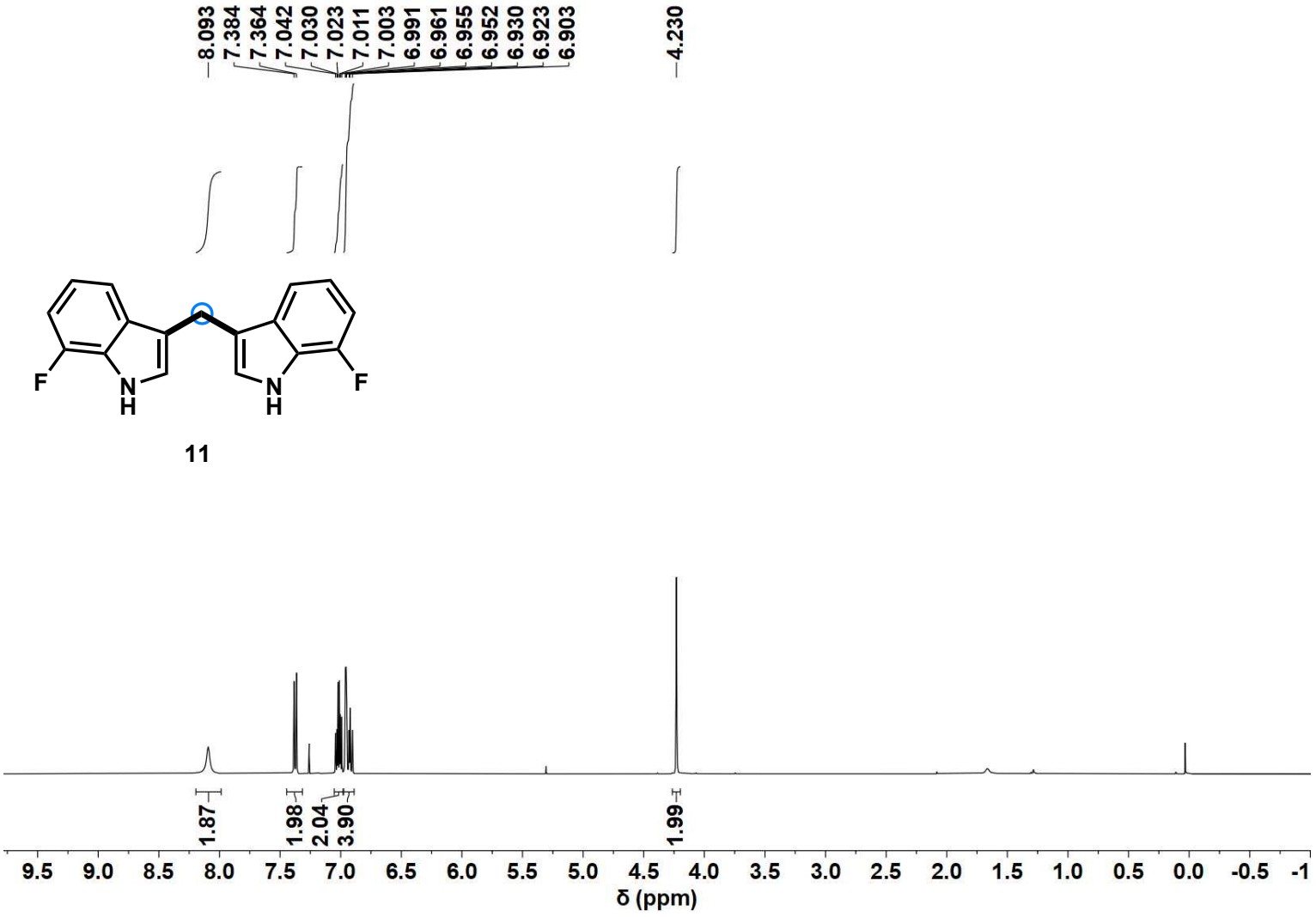
**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^{19}$F NMR** 376 MHz, $CDCl_3$

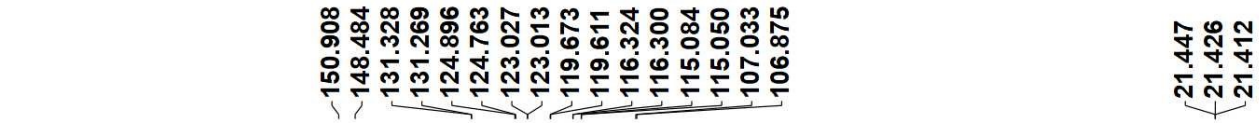


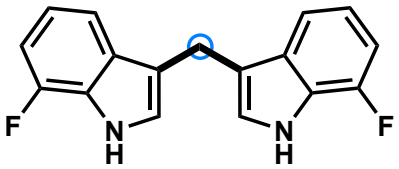
**$^1$H NMR** 400 MHz, $CDCl_3$



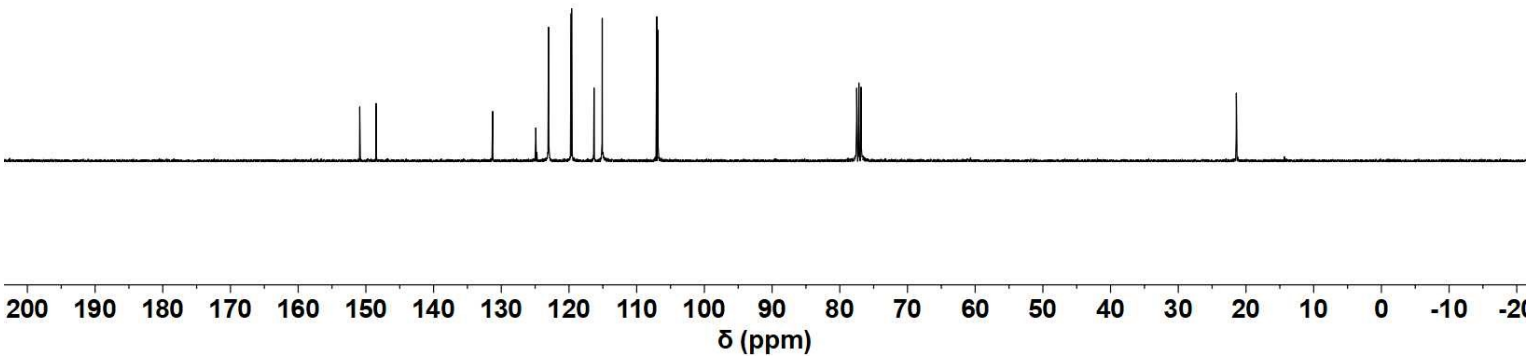
**$^{13}$C NMR** 101 MHz, $CDCl_3$

19F NMR 376 MHz，

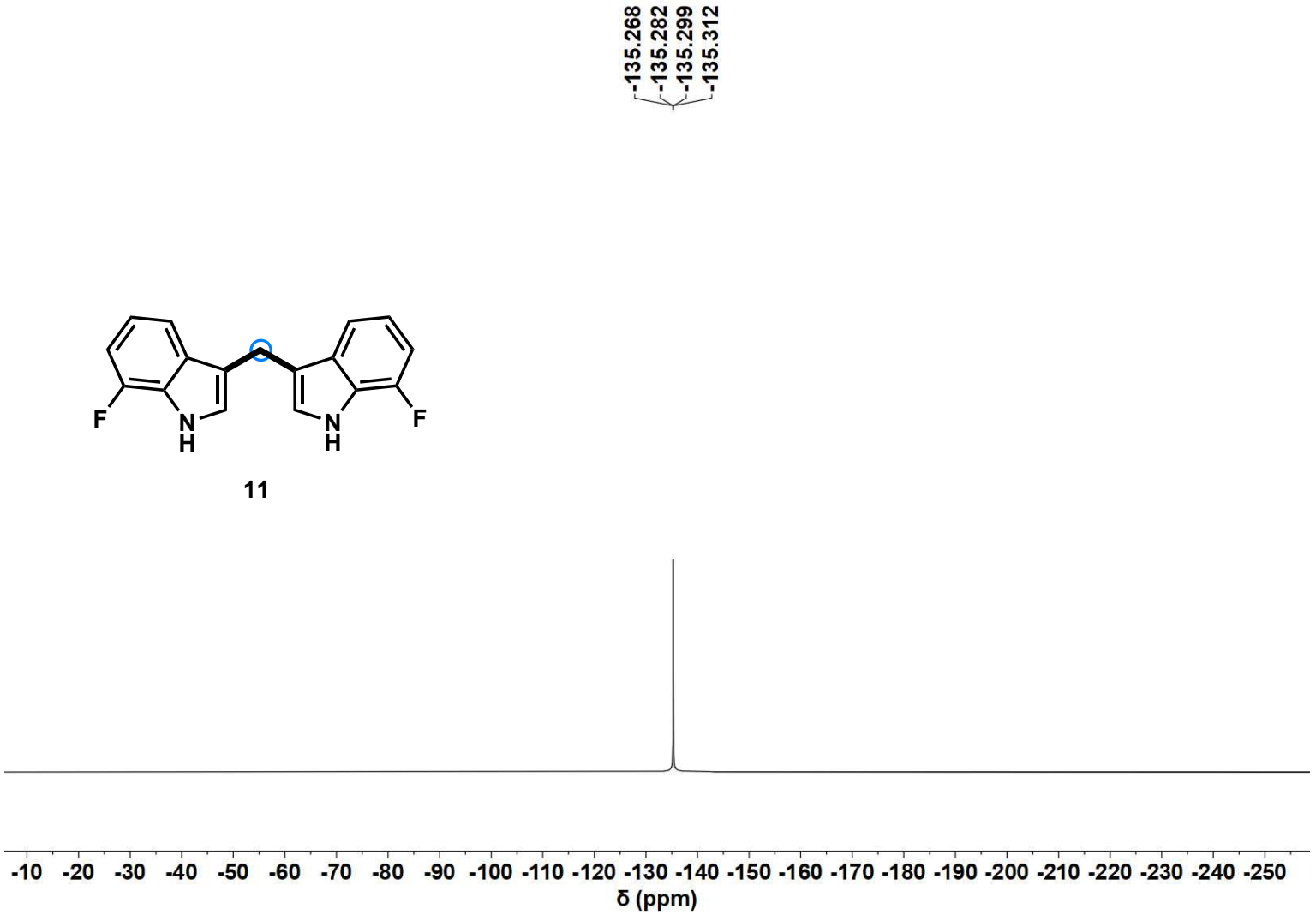


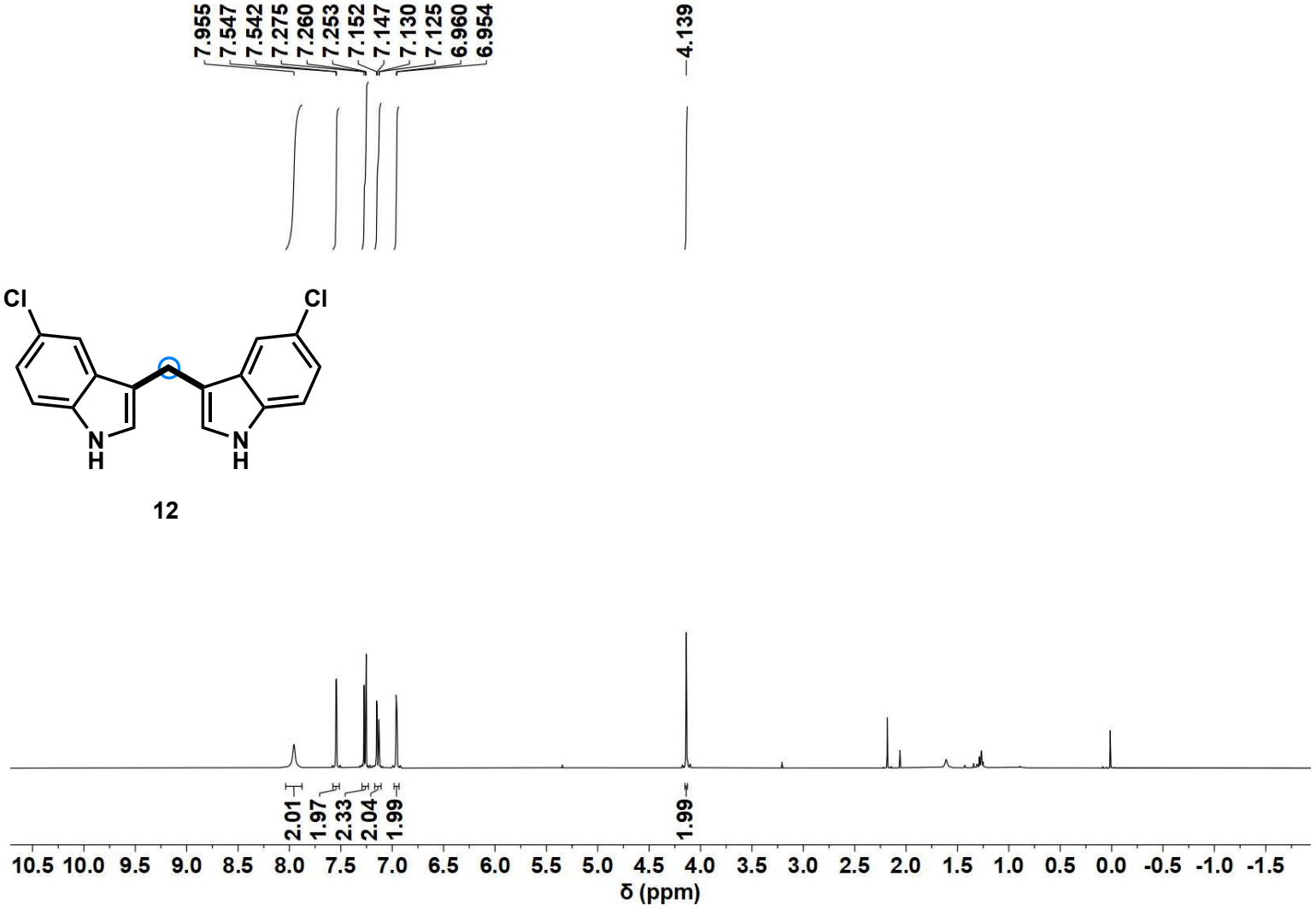

**11**



**$^{19}$F NMR** 376 MHz, $CDCl_3$

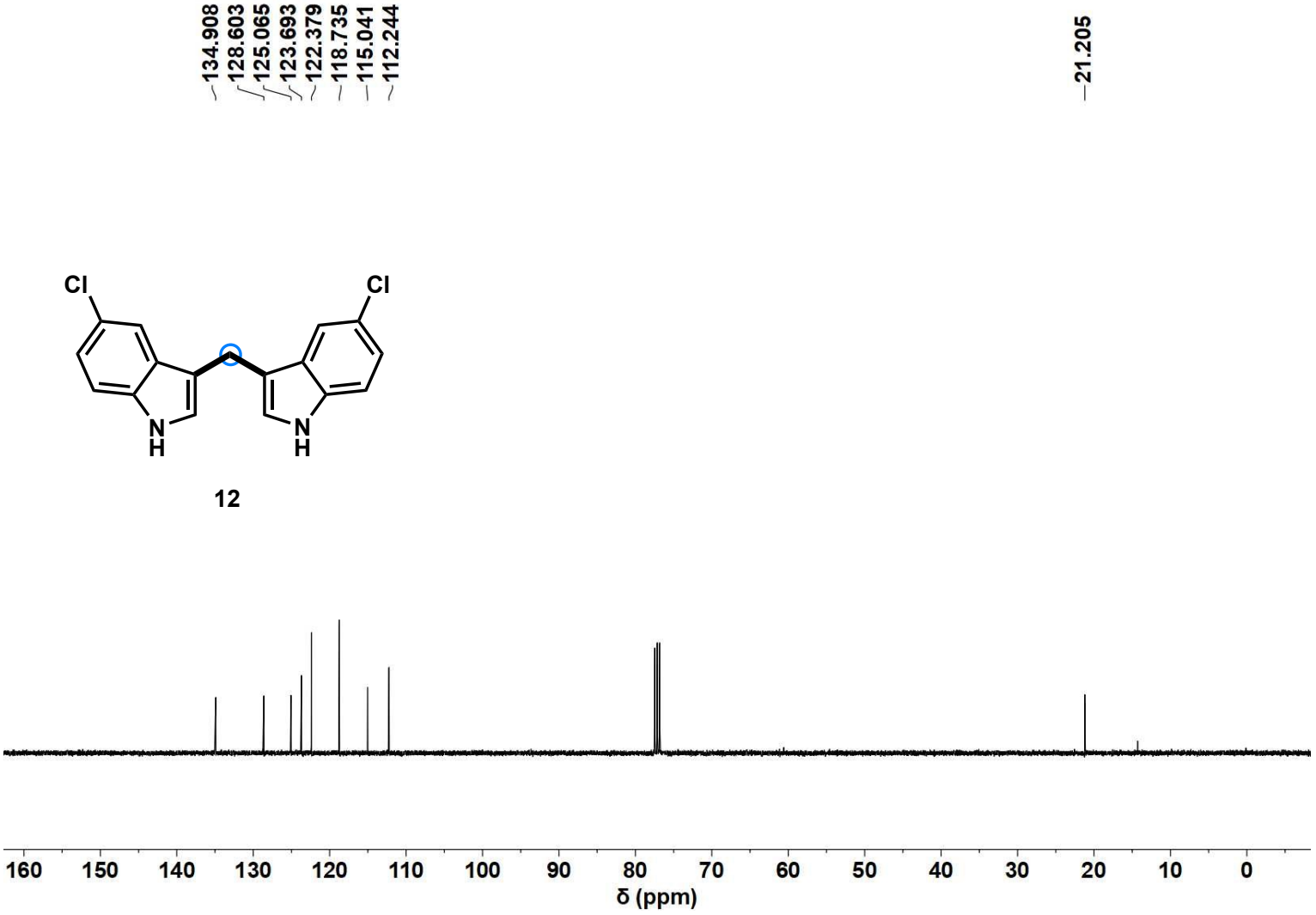


**$^1$H NMR** 400 MHz, $CDCl_3$



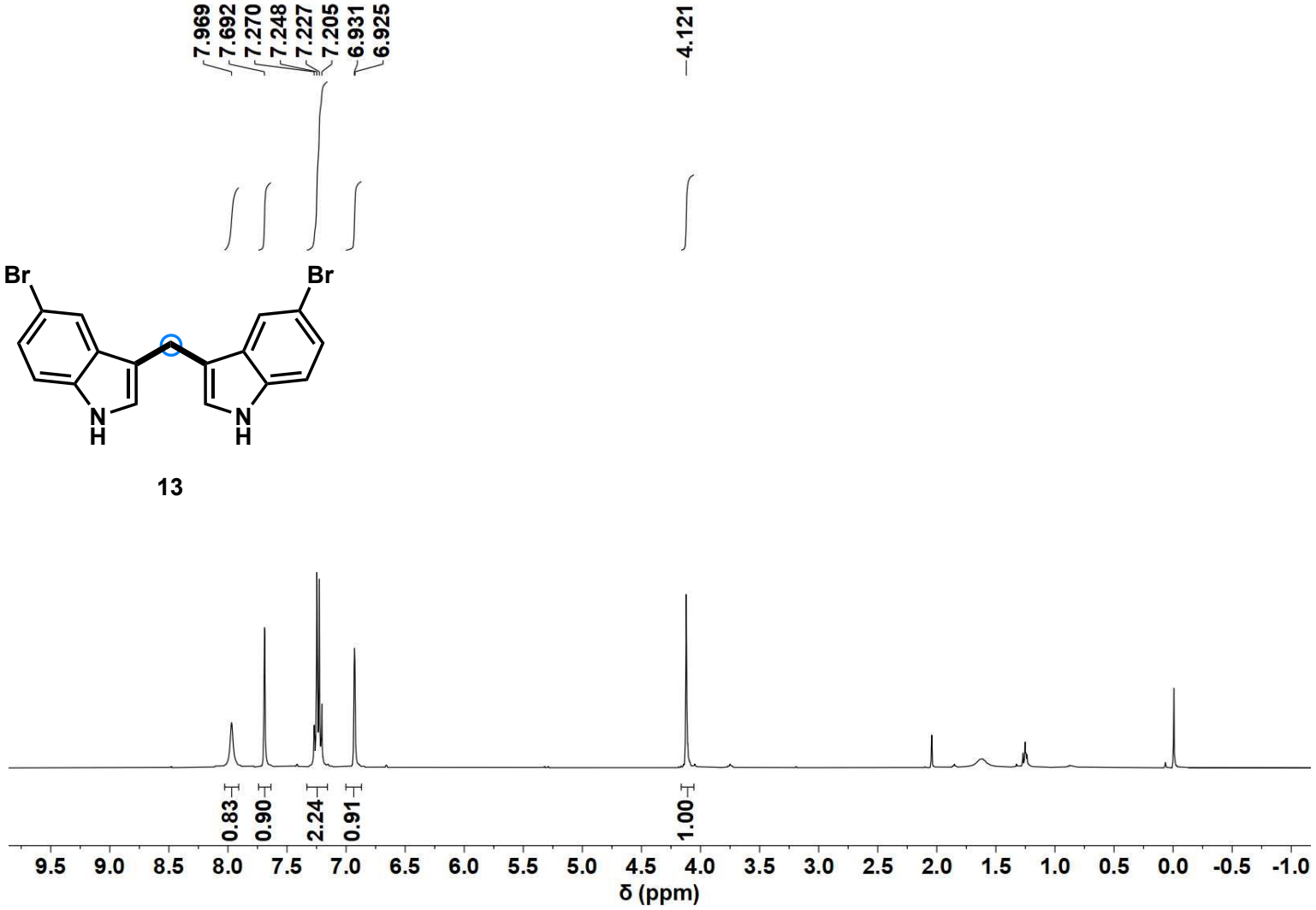

**12**

**$^{13}$C NMR** 101 MHz, $CDCl_3$

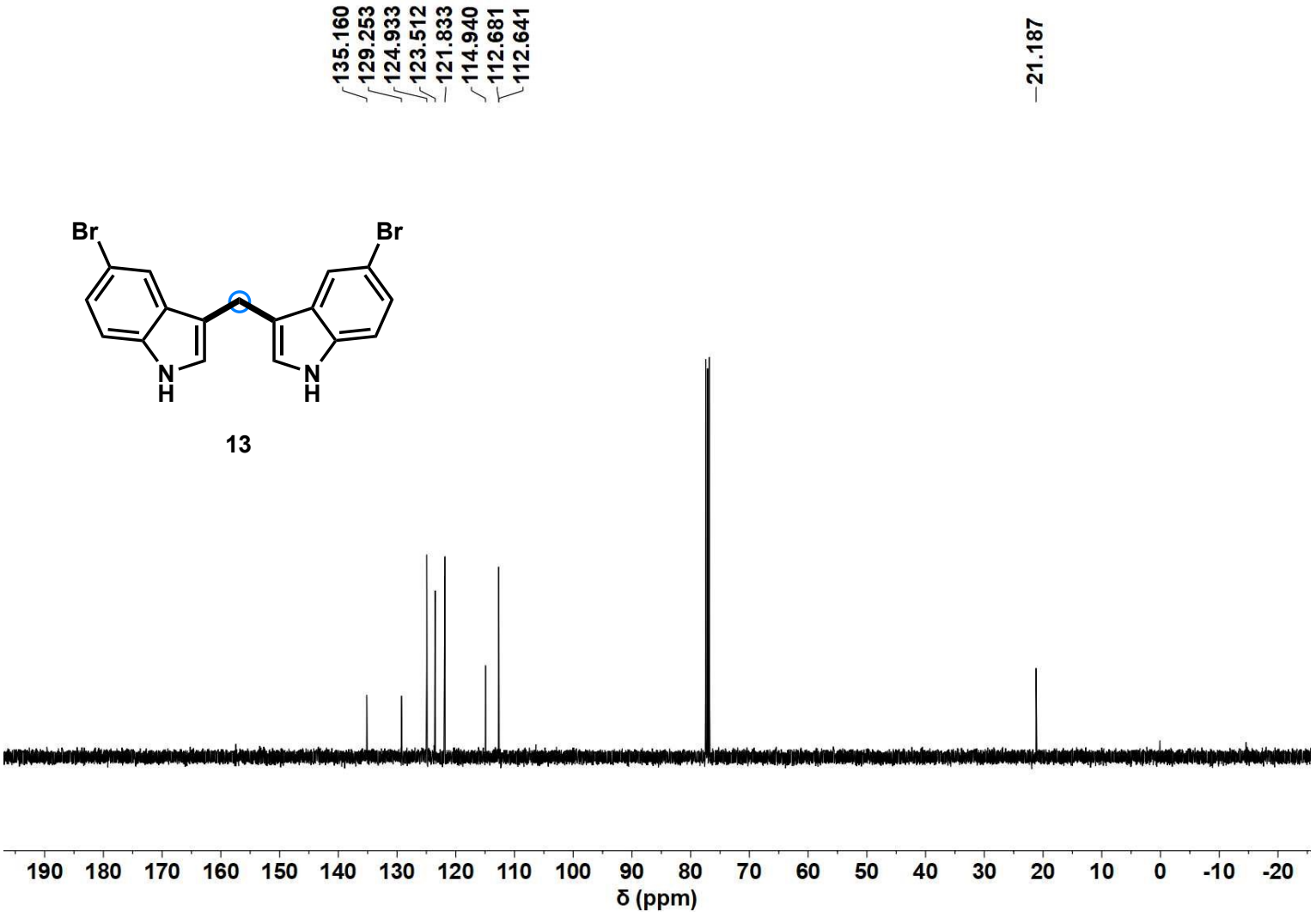



**12**

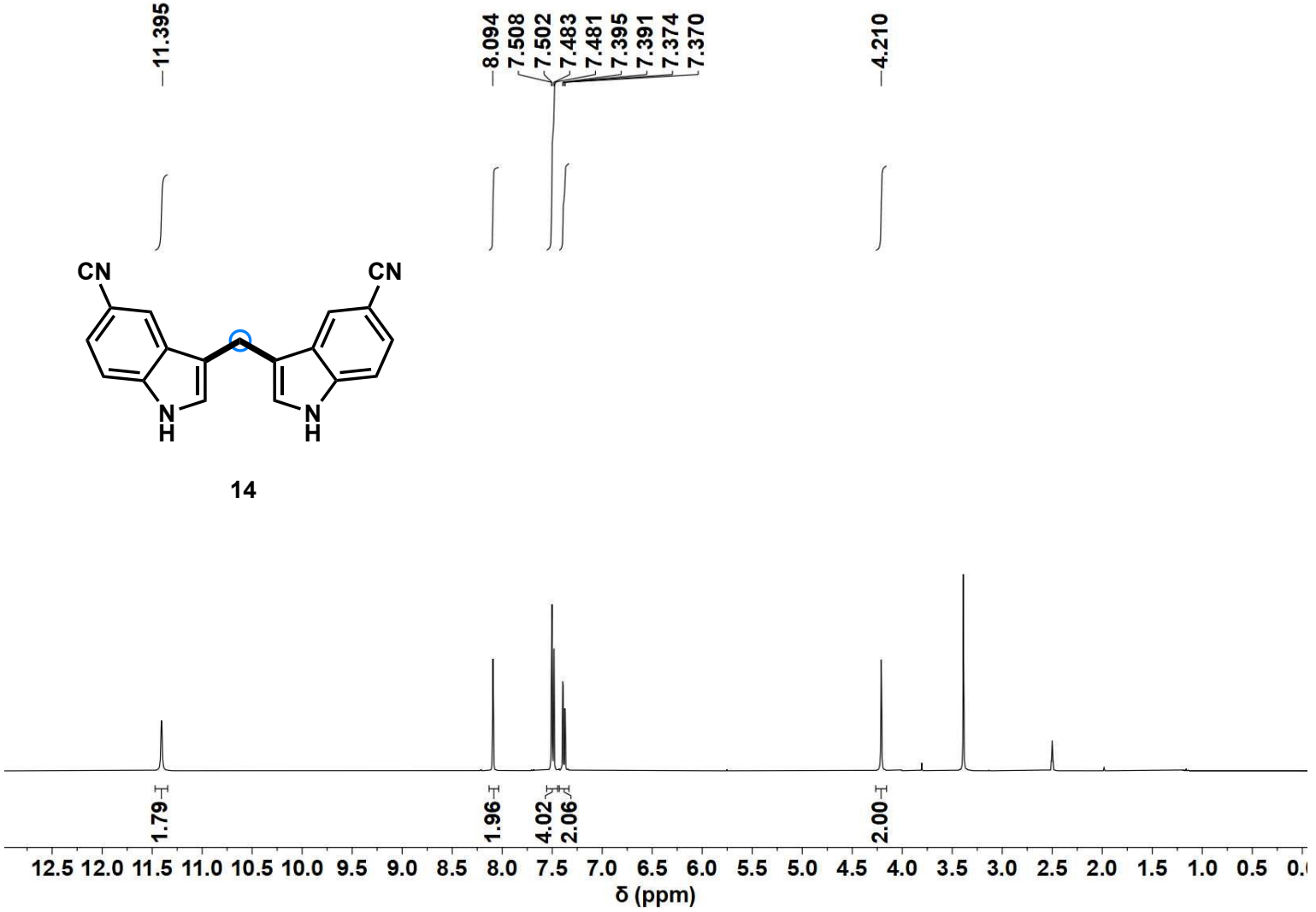
**$^1$H NMR** 400 MHz, $CDCl_3$



**$^{13}$C NMR** 101 MHz, $CDCl_3$

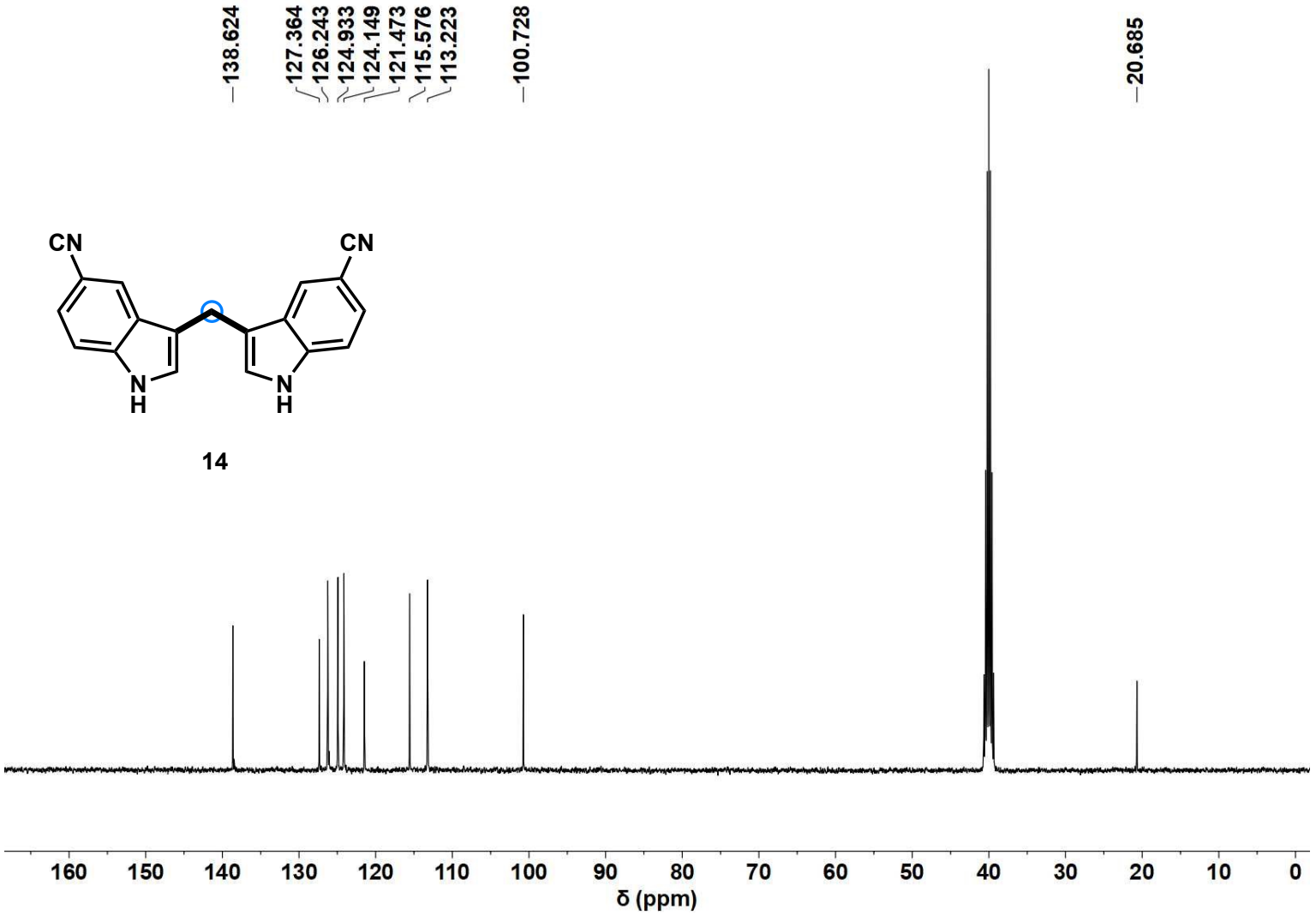


**$^1$H NMR** 400 MHz, DMSO-$d_6$

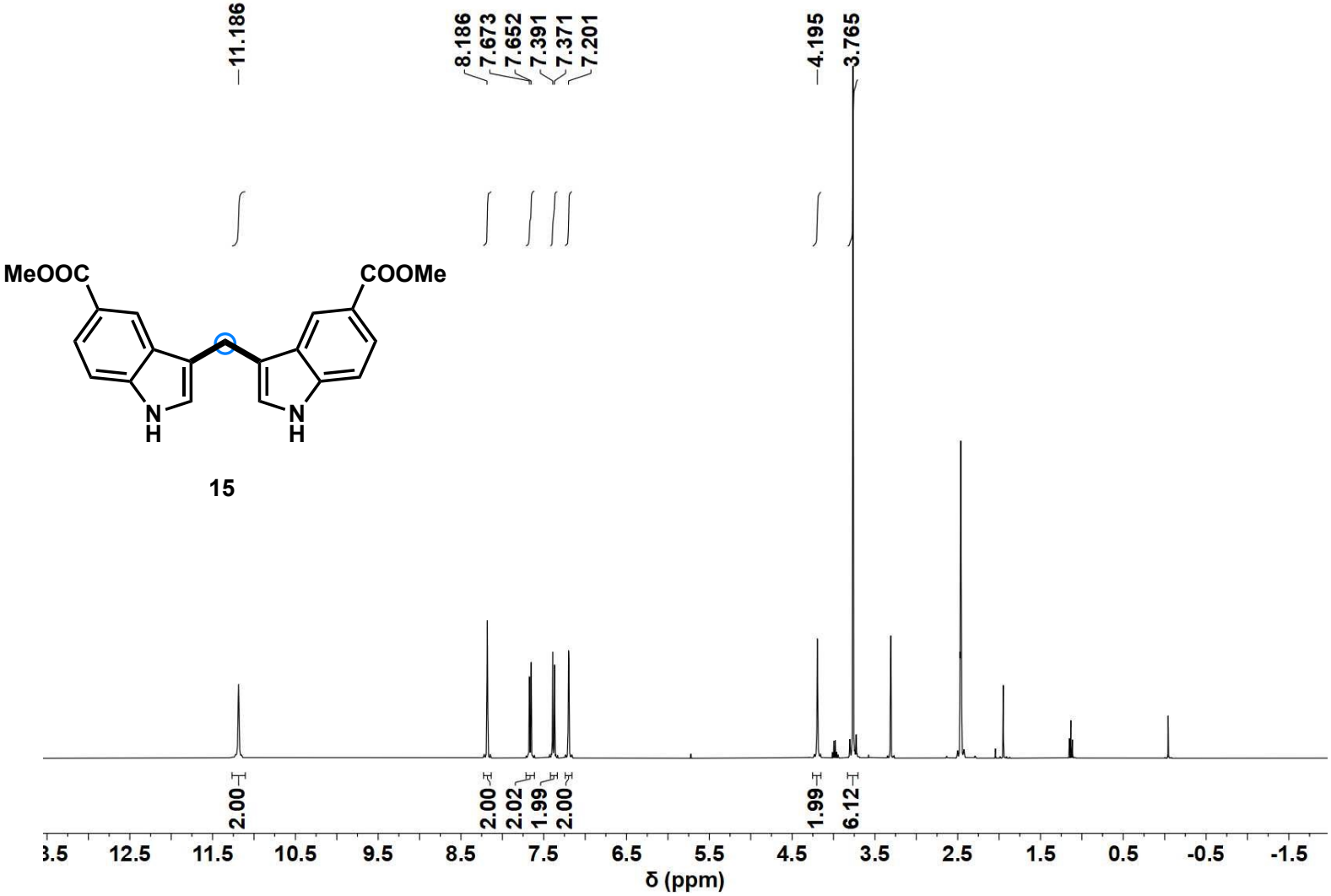



14

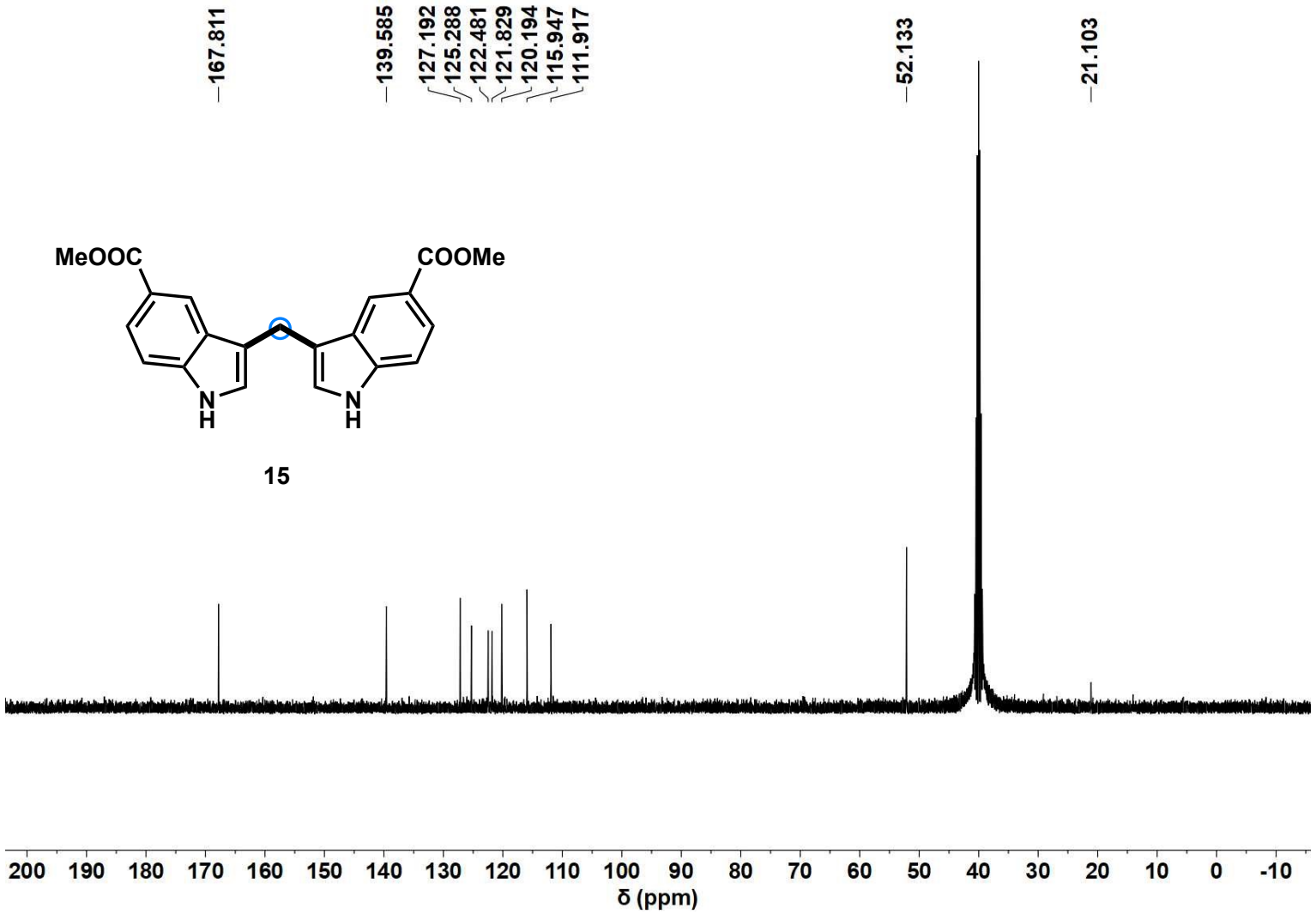
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



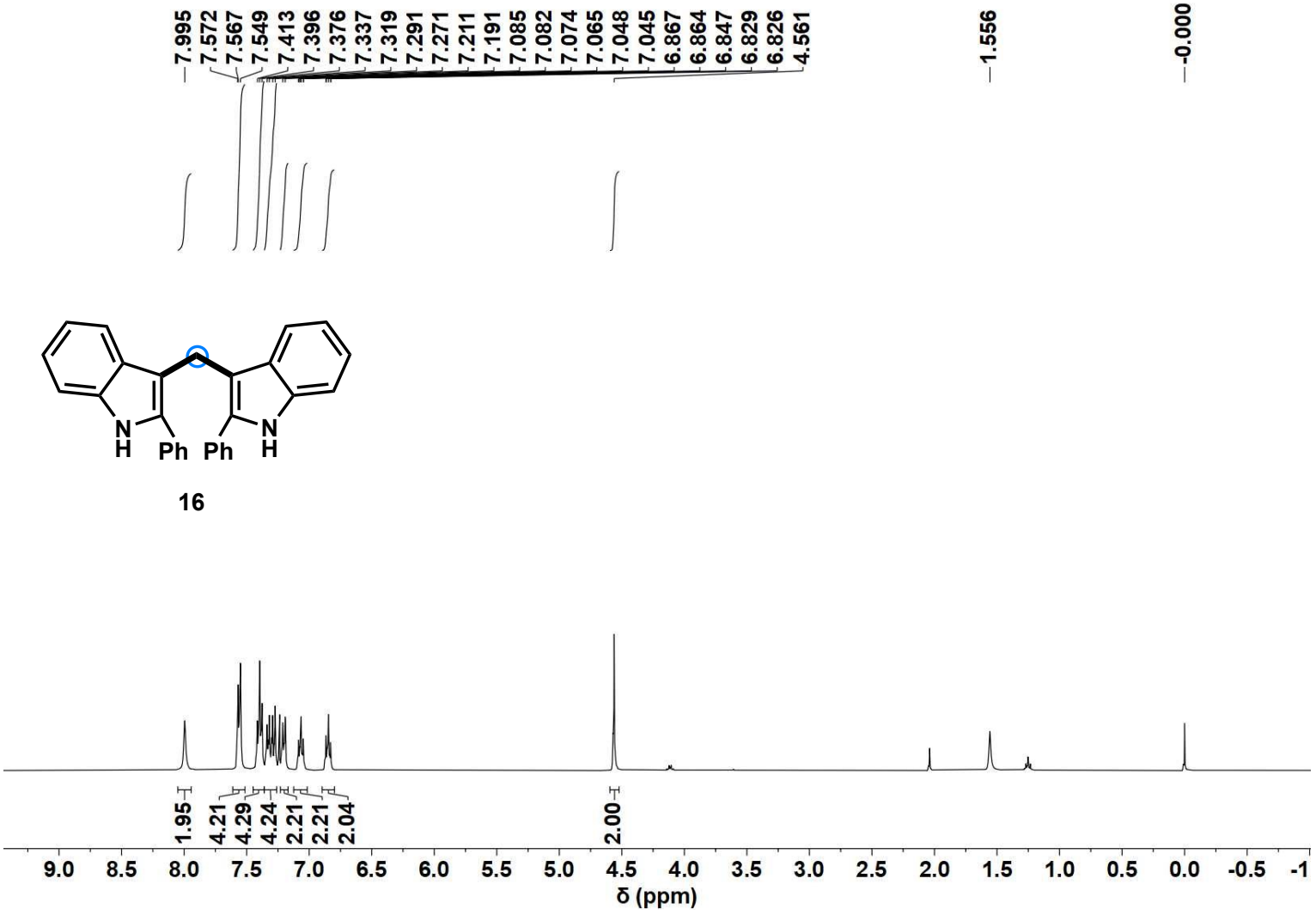
**$^1$H NMR** 400 MHz, DMSO-$d_6$



**$^{13}$C NMR** 101 MHz, DMSO-$d_6$

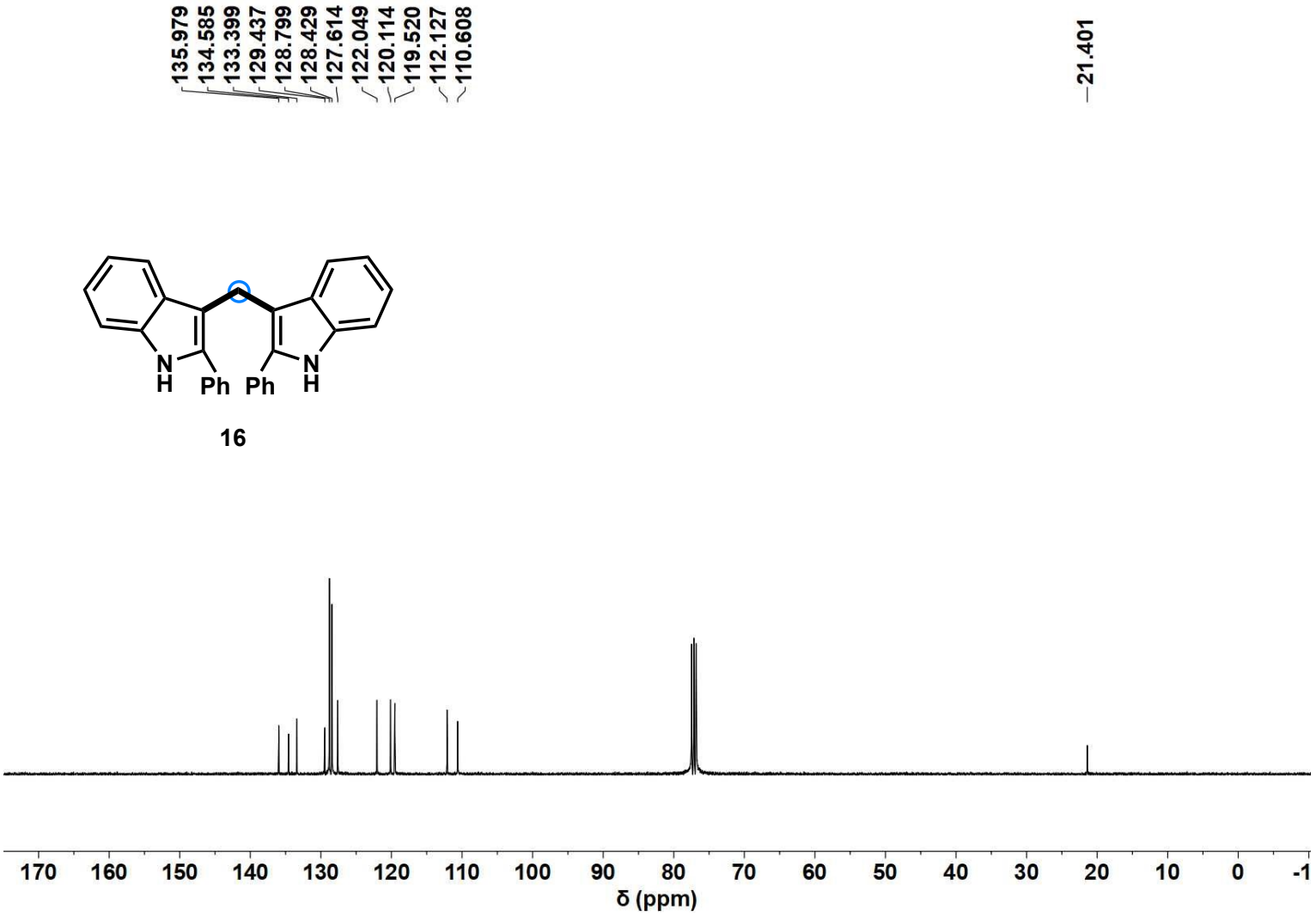


**$^1$H NMR** 400 MHz, $CDCl_3$



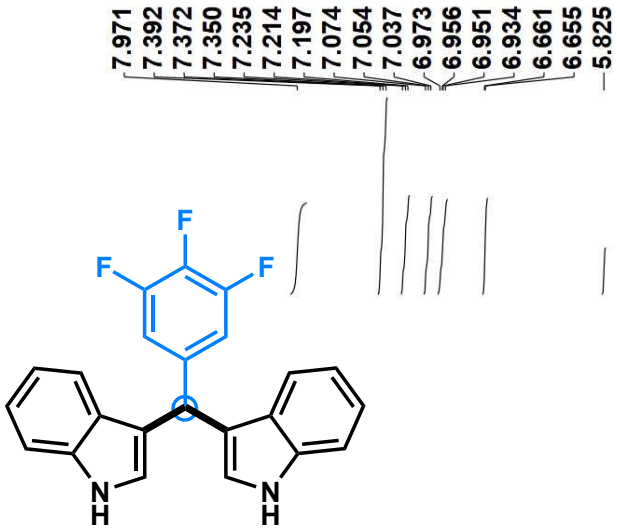

16

**$^{13}$C NMR** 101 MHz, $CDCl_3$

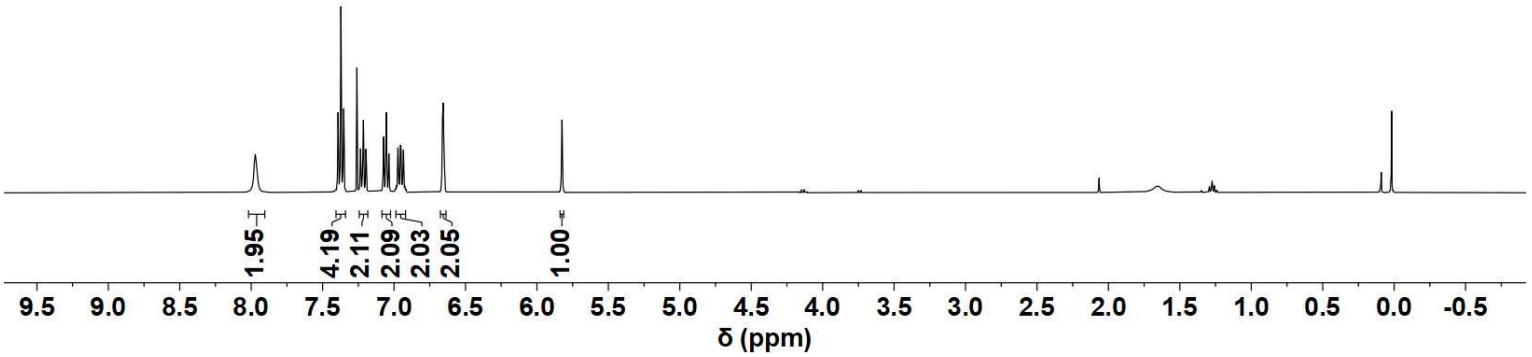



**16**

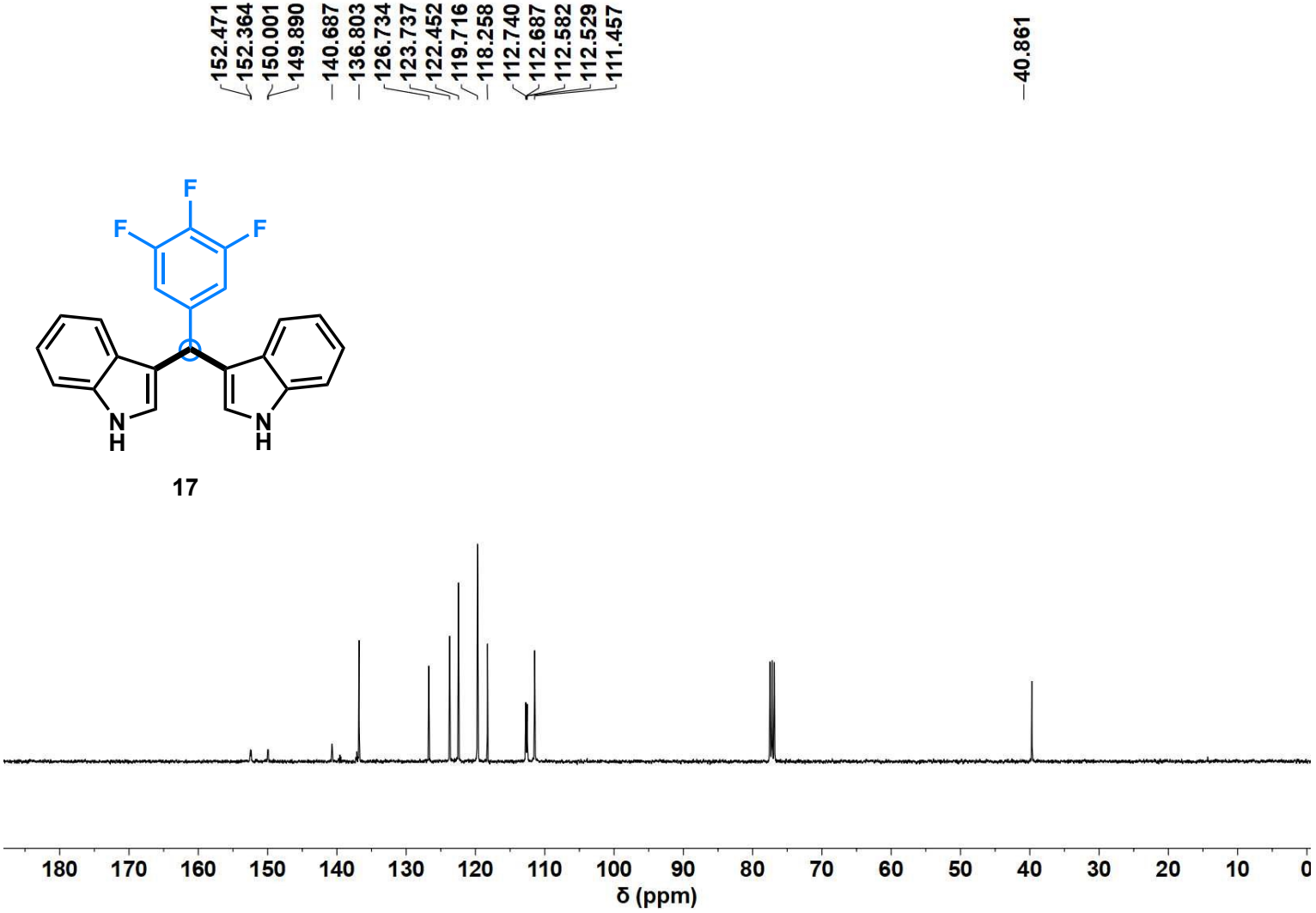
**$^1$H NMR** 400 MHz, $CDCl_3$



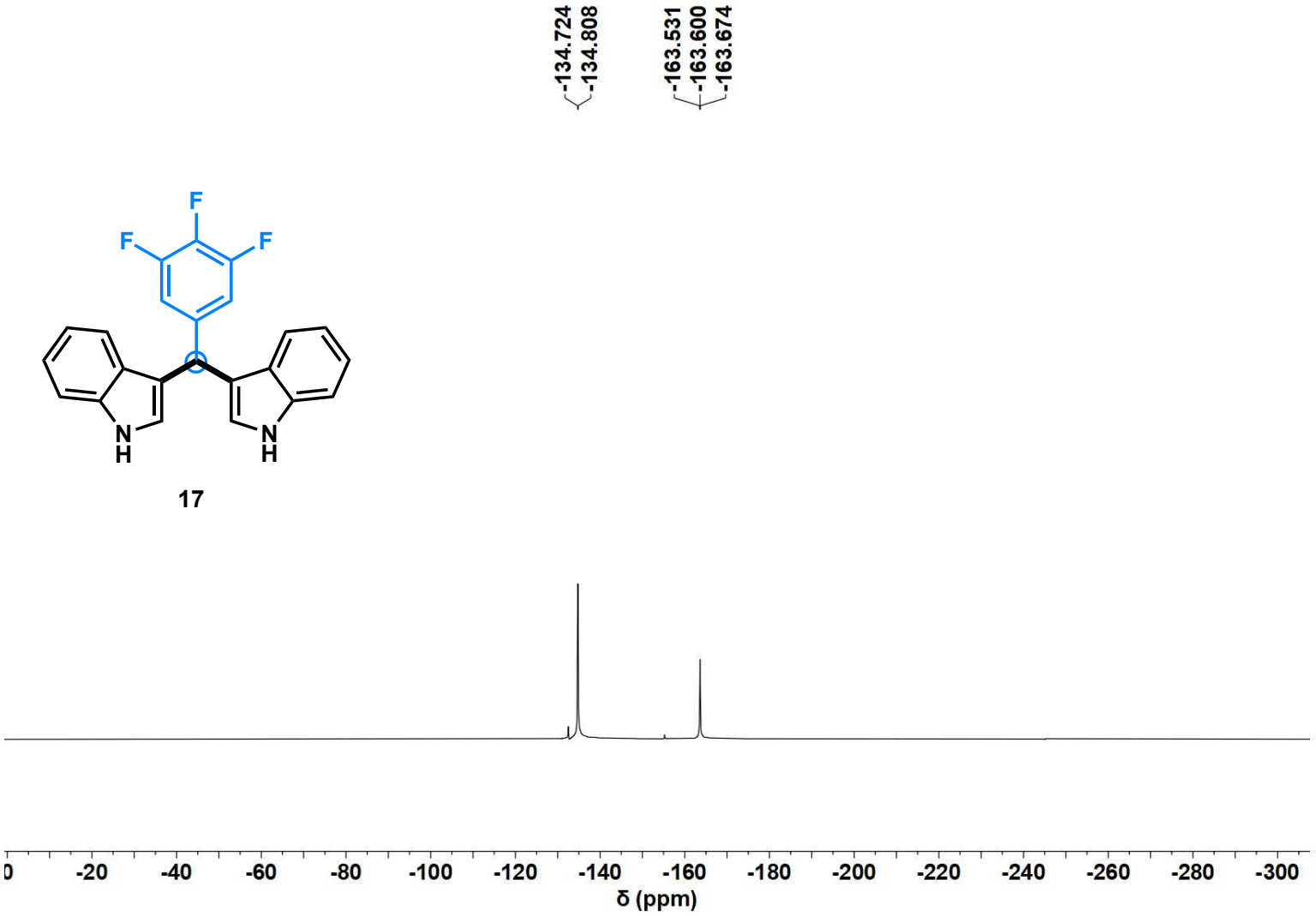

**17**



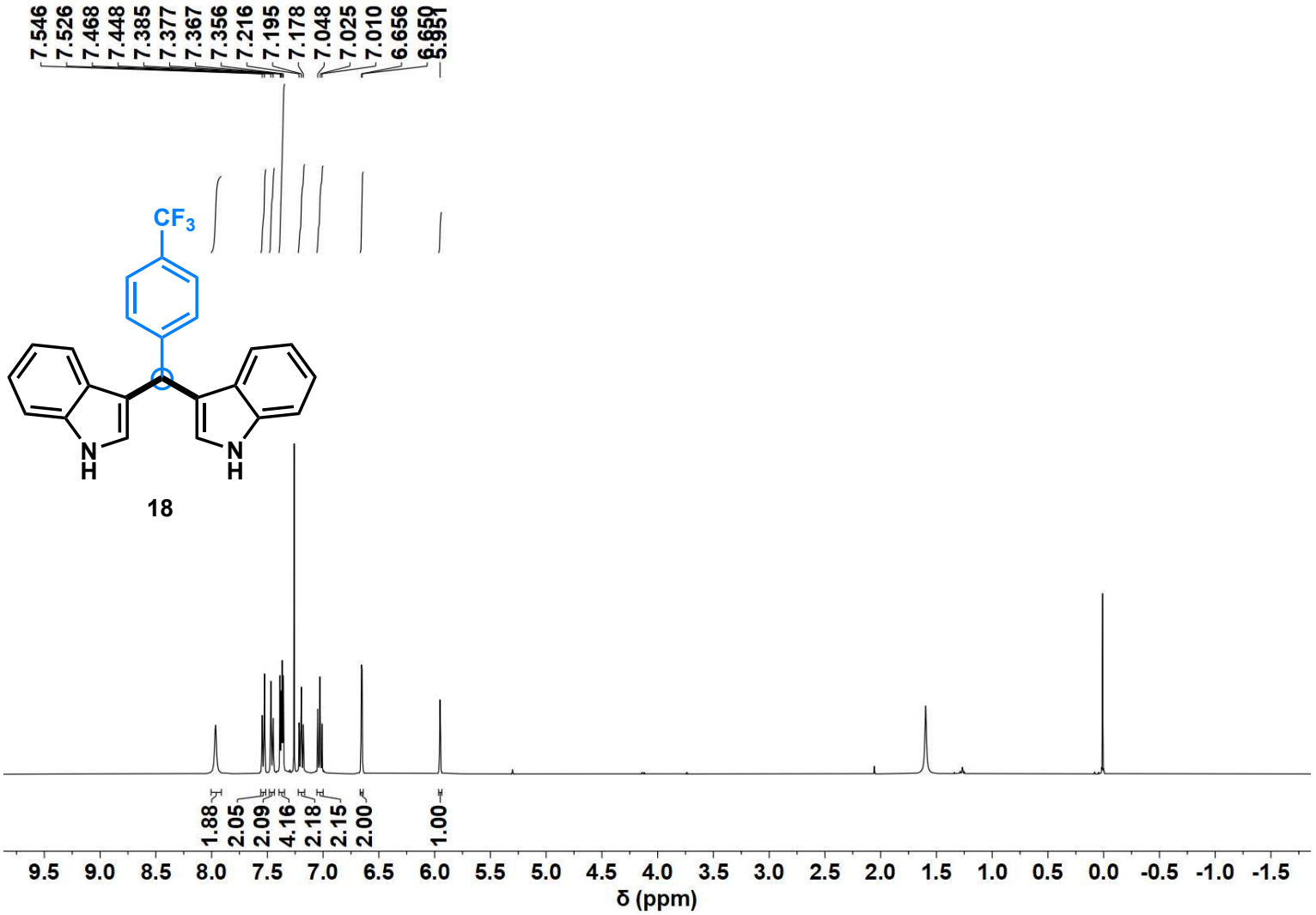
**$^{13}$C NMR** 101 MHz, $CDCl_3$



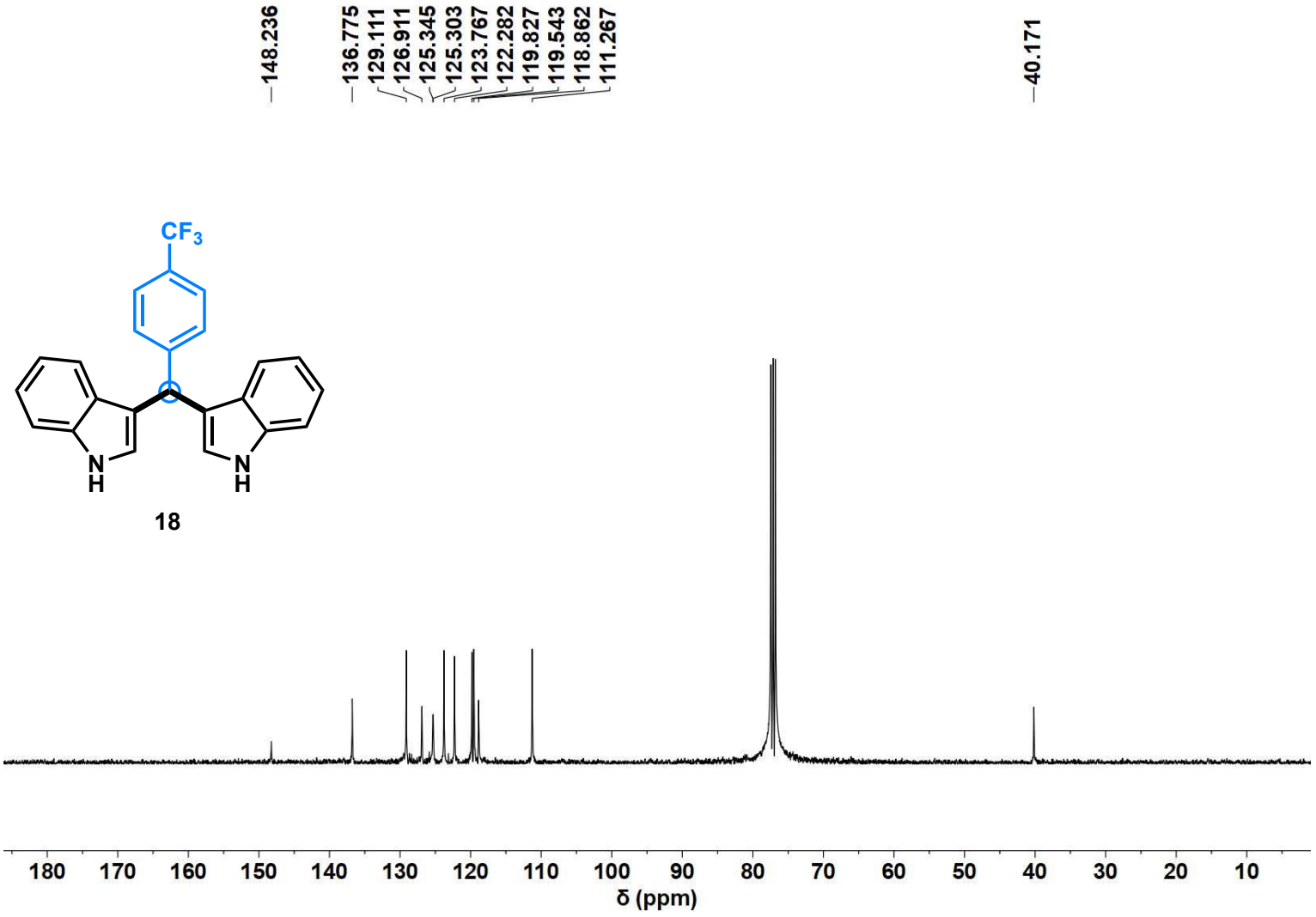
**$^{19}$F NMR** 376 MHz, $CDCl_3$



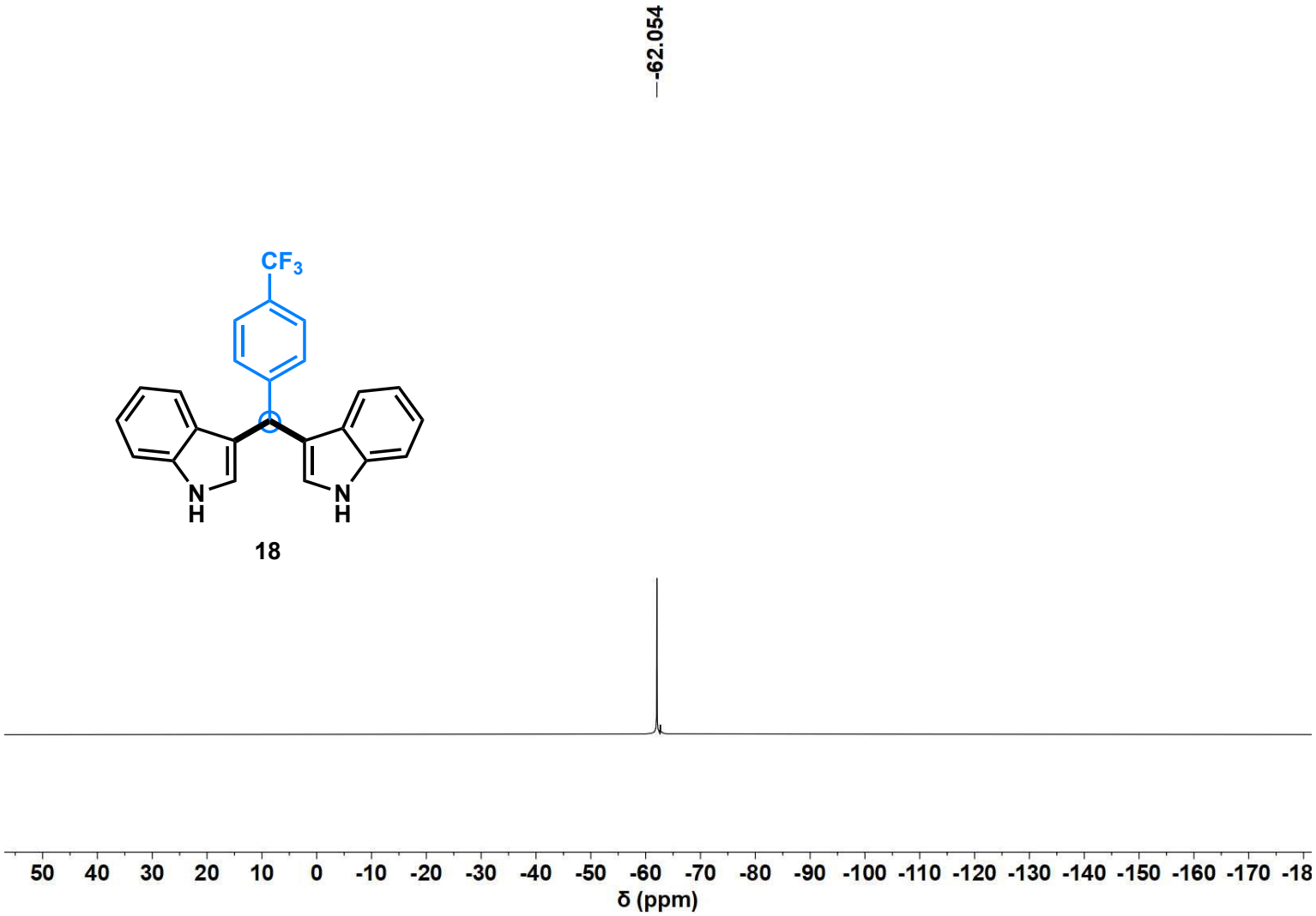
**$^1$H NMR** 400 MHz, $CDCl_3$



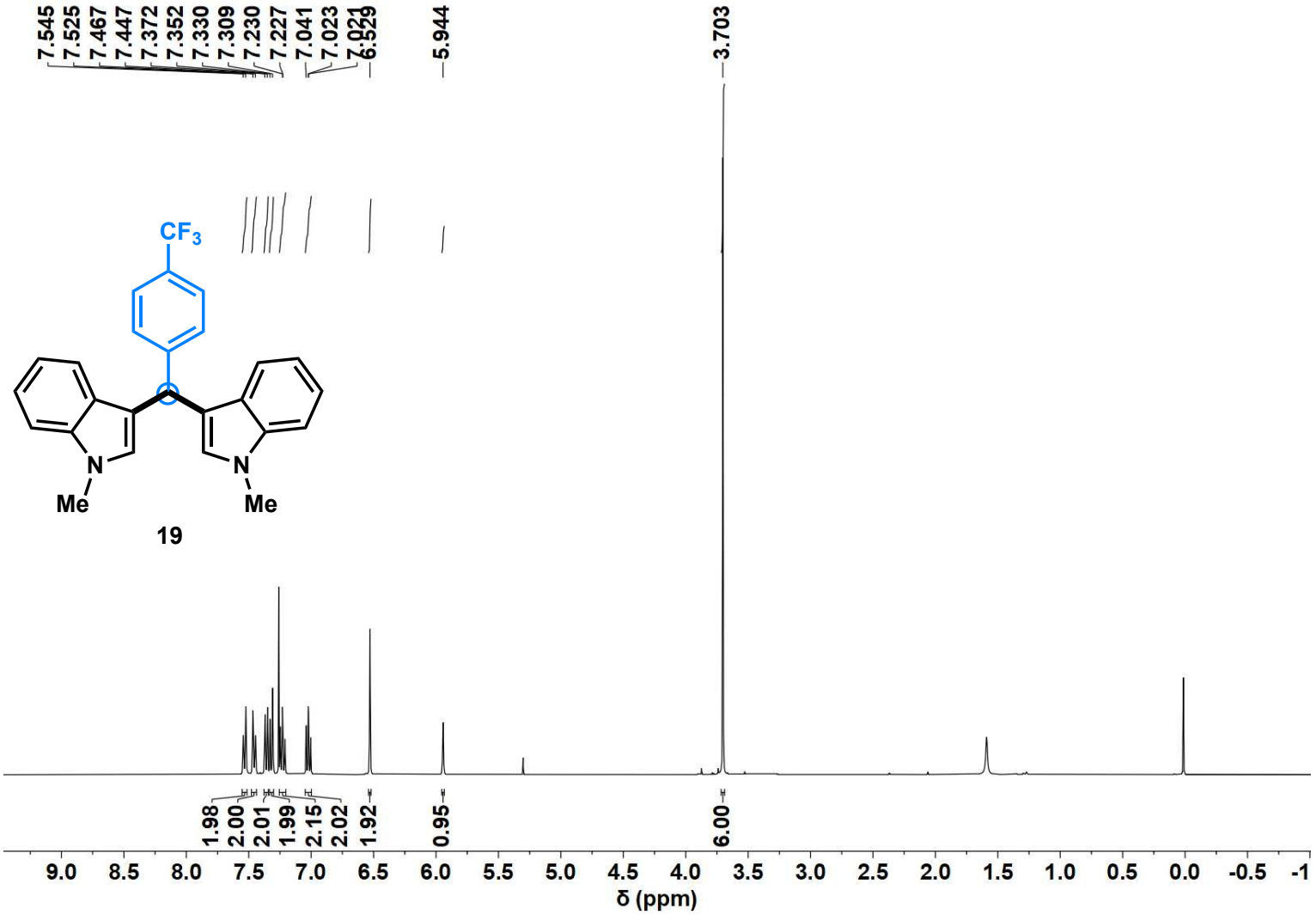
**$^{13}$C NMR** 101 MHz, $CDCl_3$



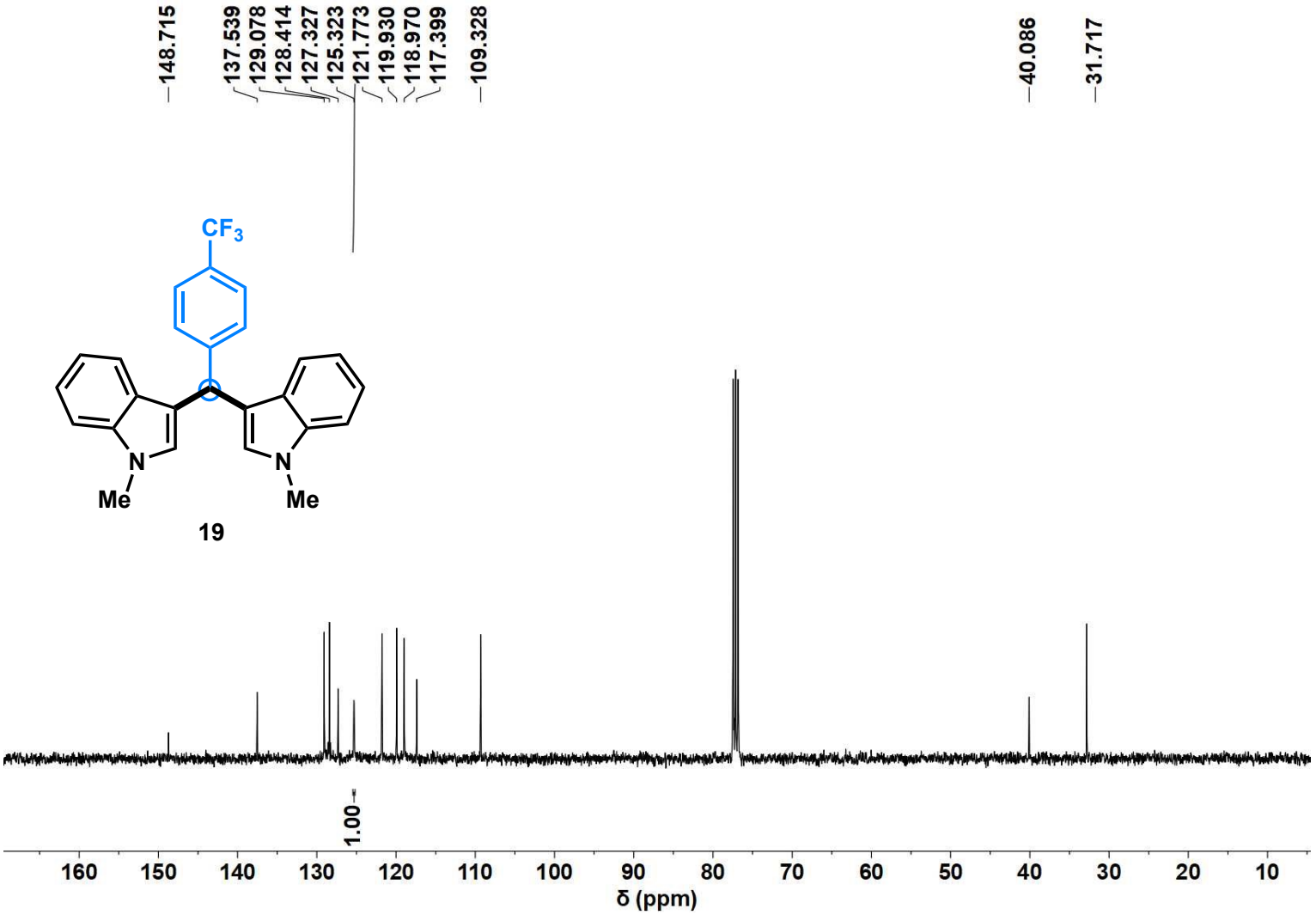
**$^{19}$F NMR** 376 MHz, $CDCl_3$



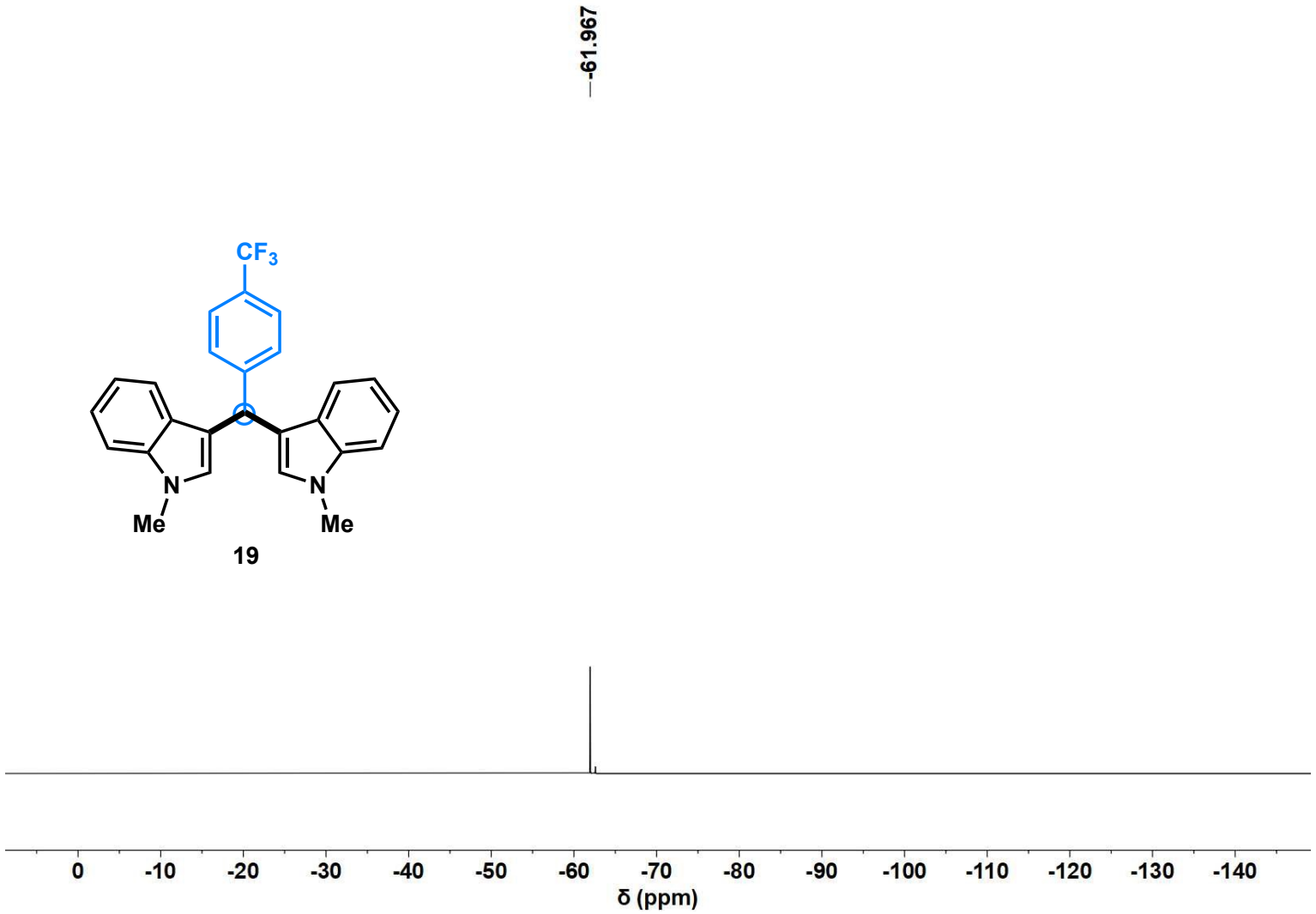
**$^1$H NMR** 400 MHz, $CDCl_3$



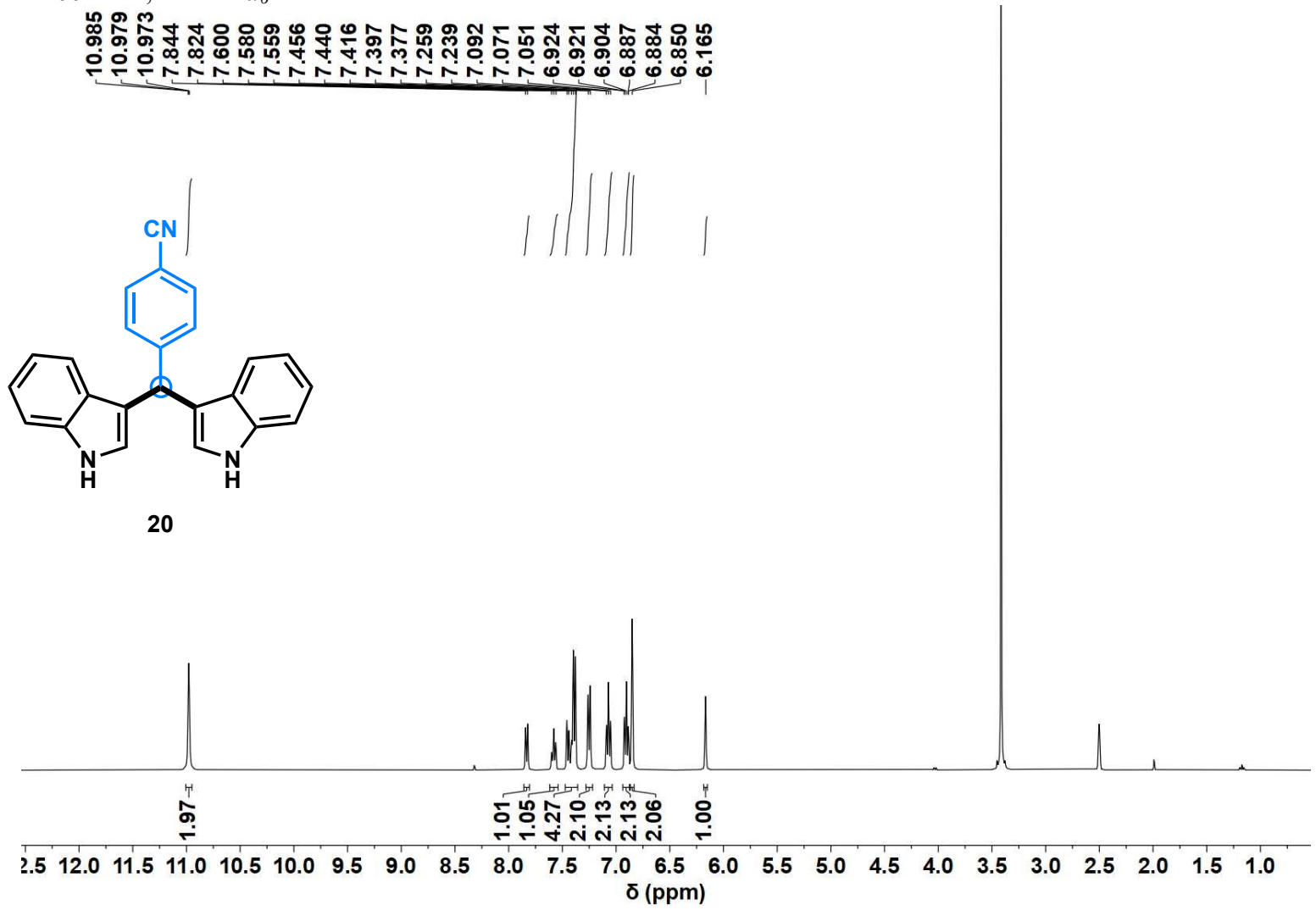
**$^{13}$C NMR** 101 MHz, $CDCl_3$



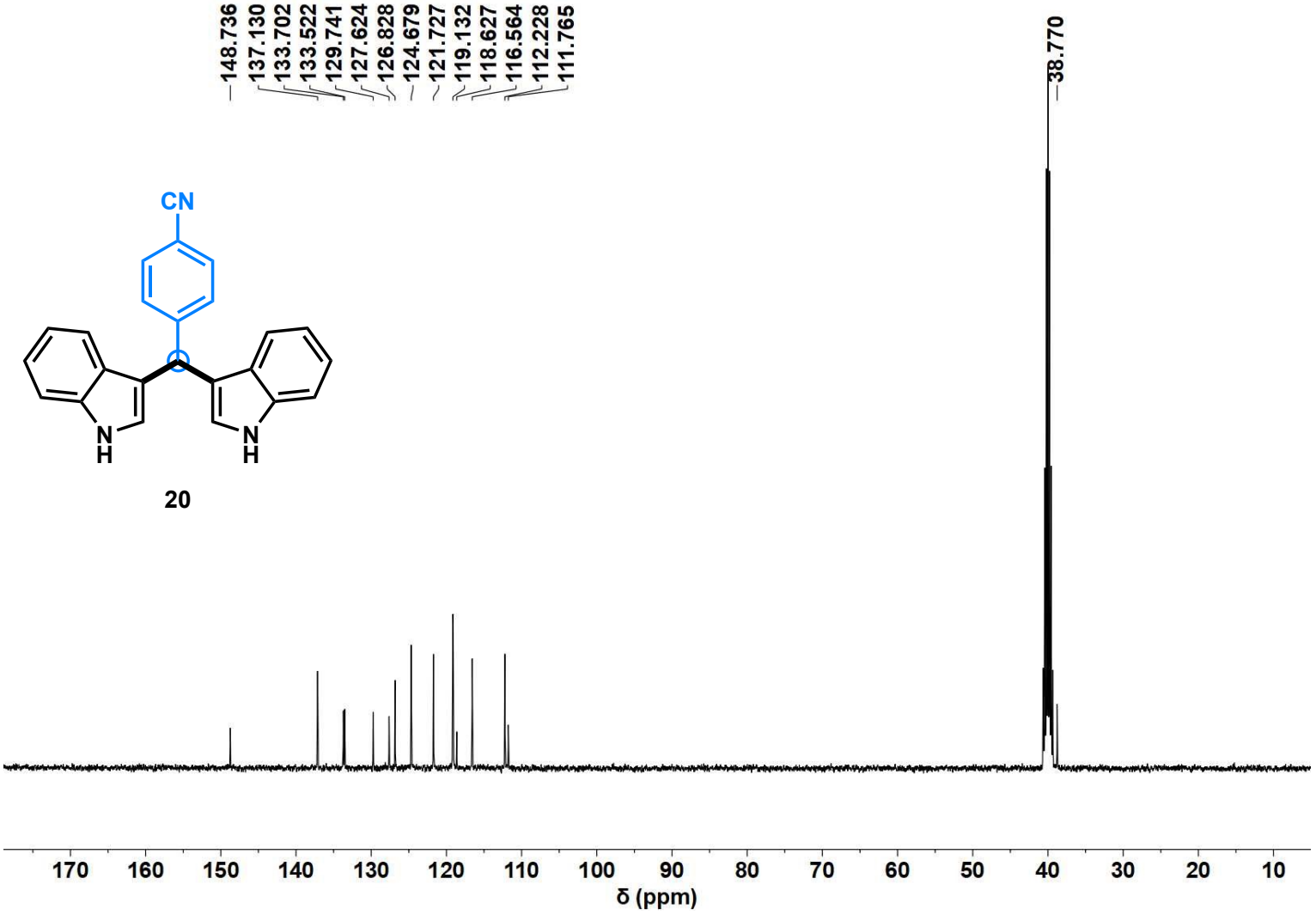
**$^{19}$F NMR** 376 MHz, $CDCl_3$



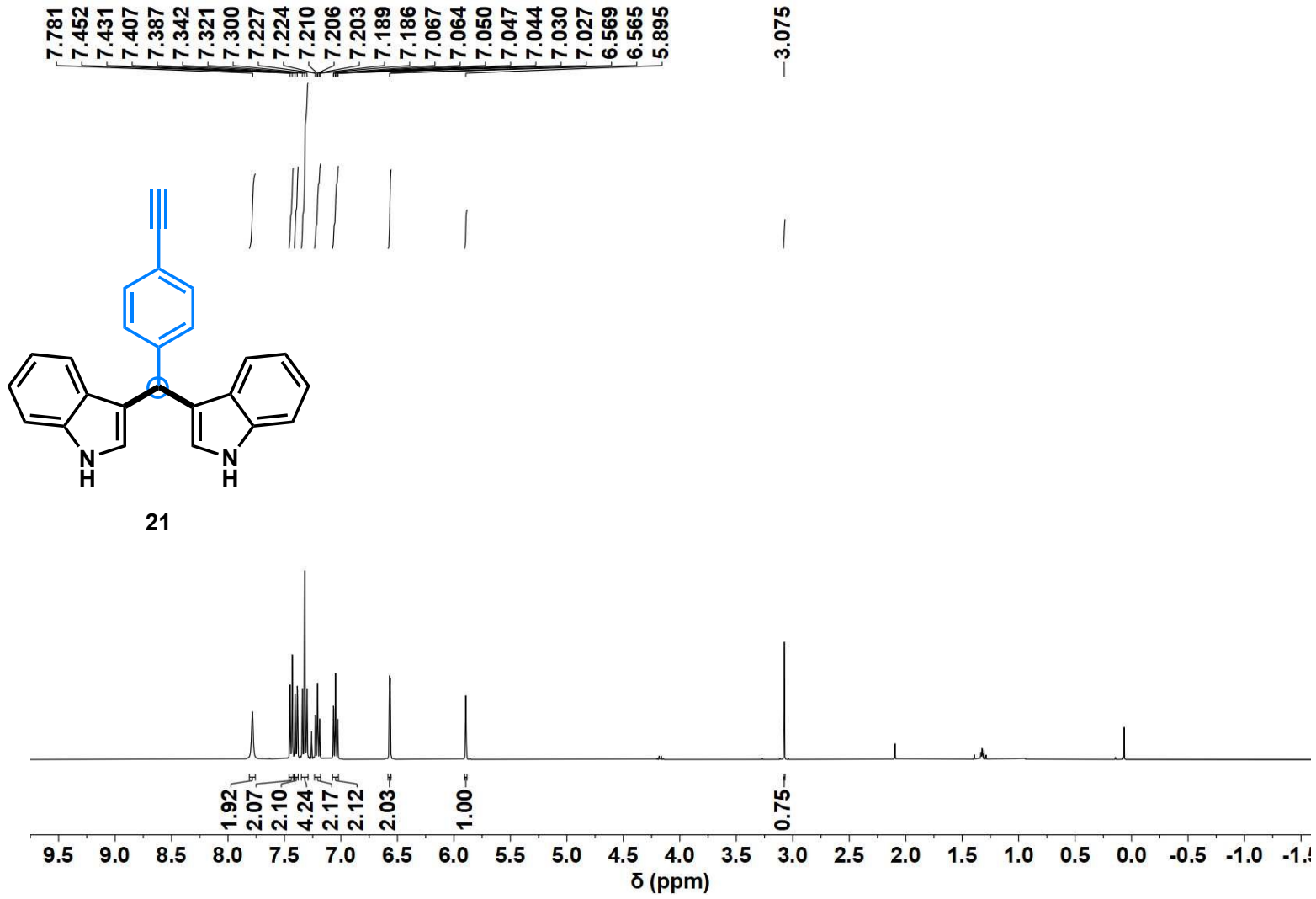
**$^1$H NMR** 400 MHz, DMSO-$d_6$



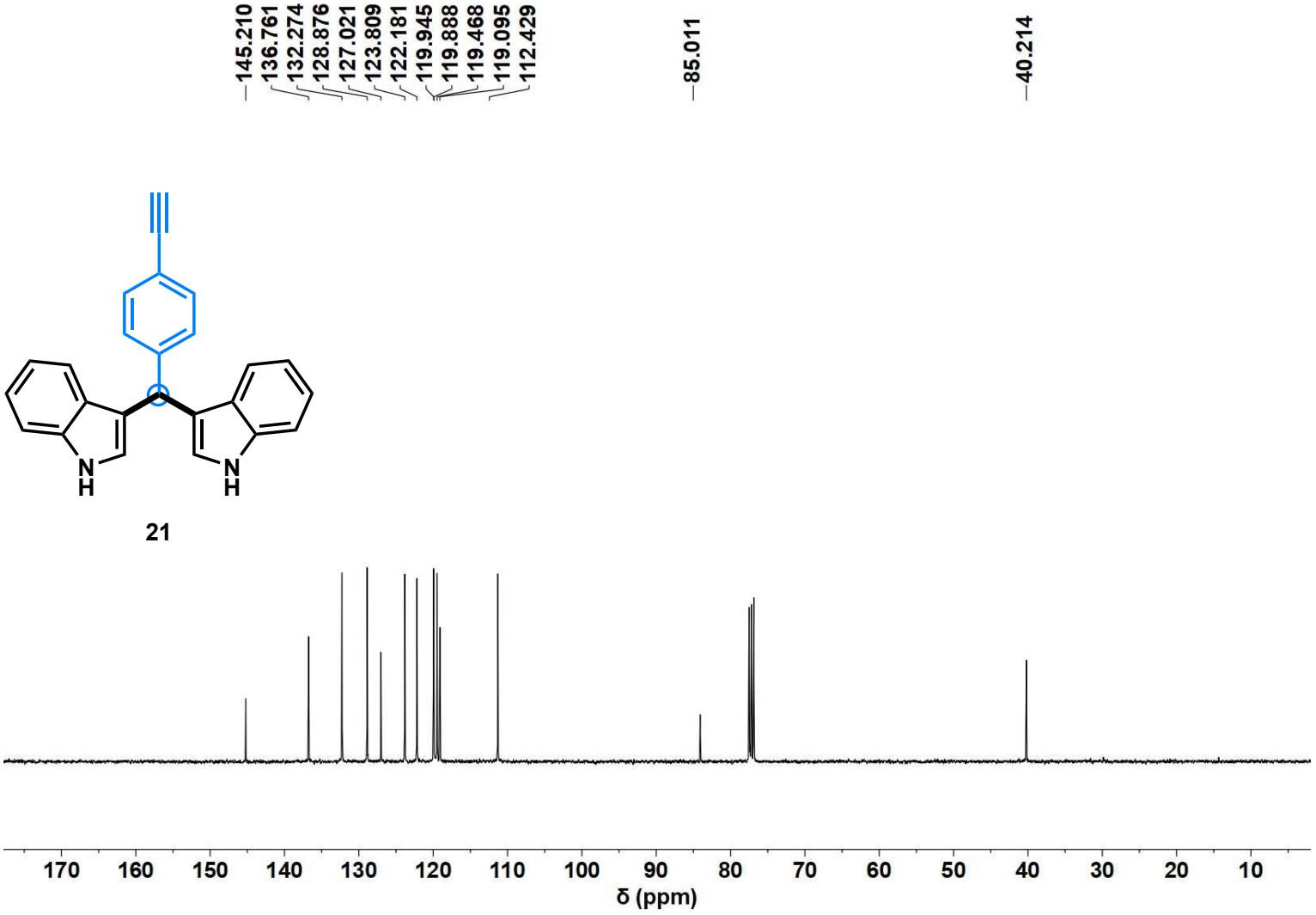
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



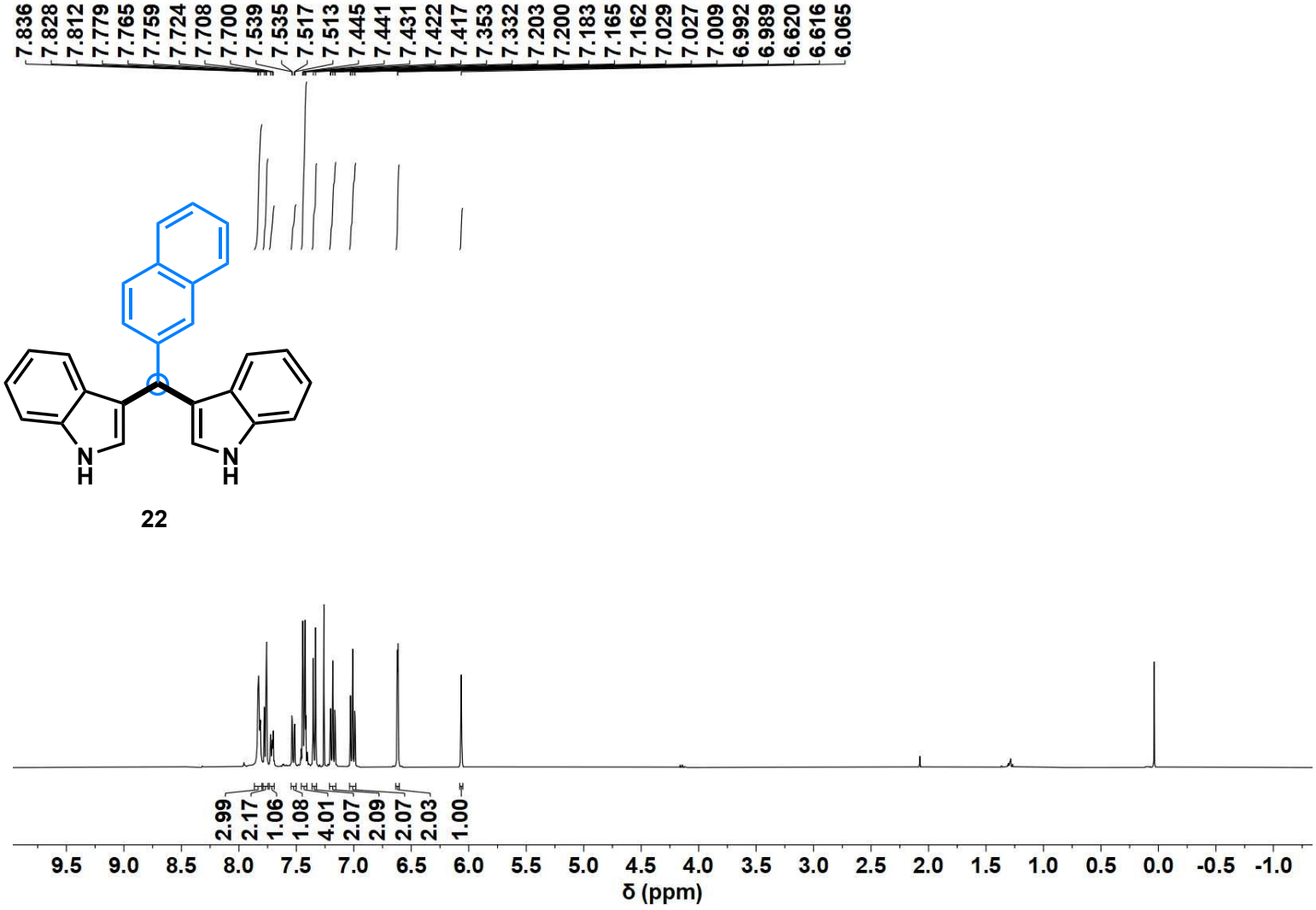
**$^1$H NMR** 400 MHz, $CDCl_3$



**$^{13}$C NMR** 101 MHz, $CDCl_3$

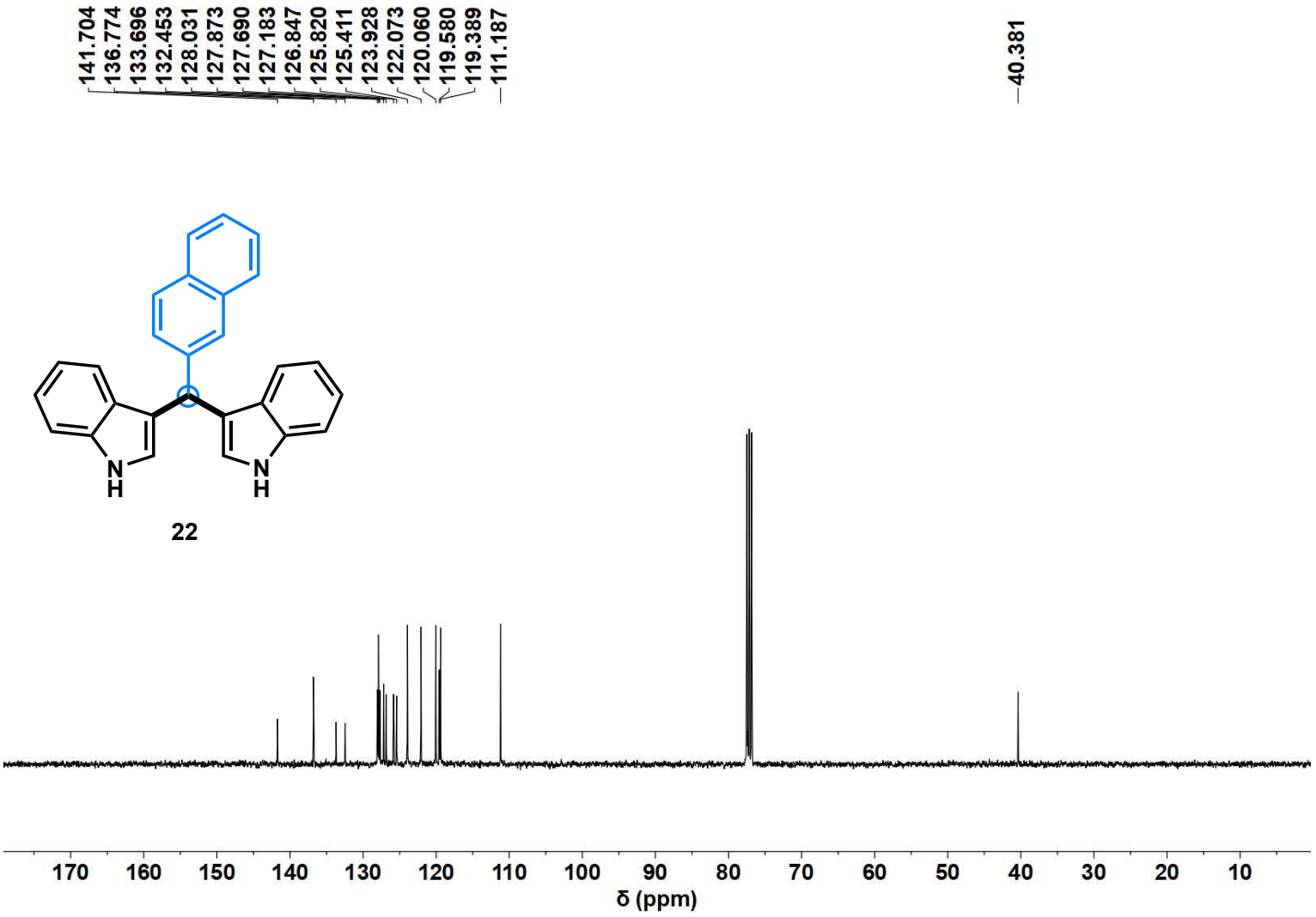


**$^1$H NMR** 400 MHz, $CDCl_3$

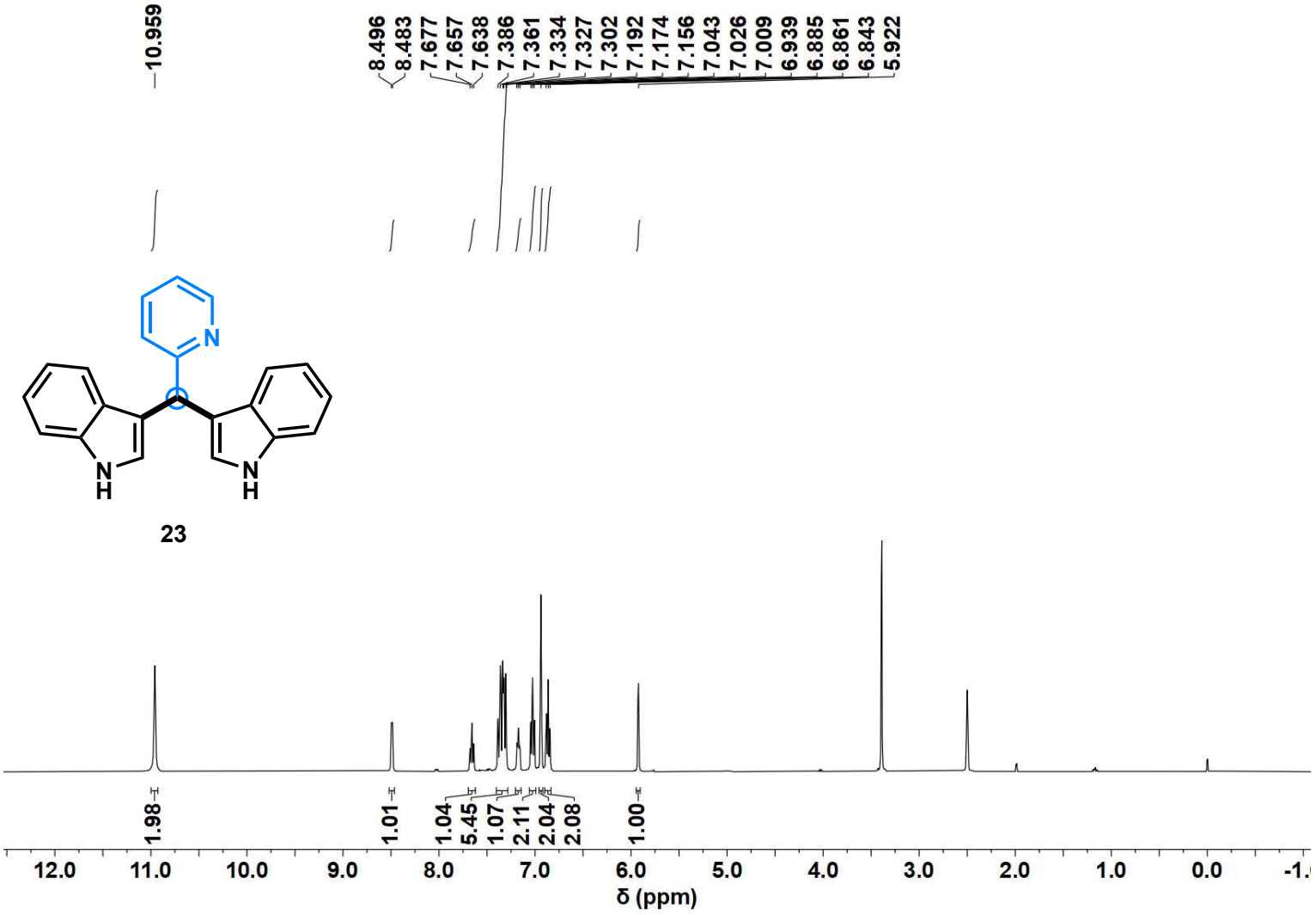



**22**

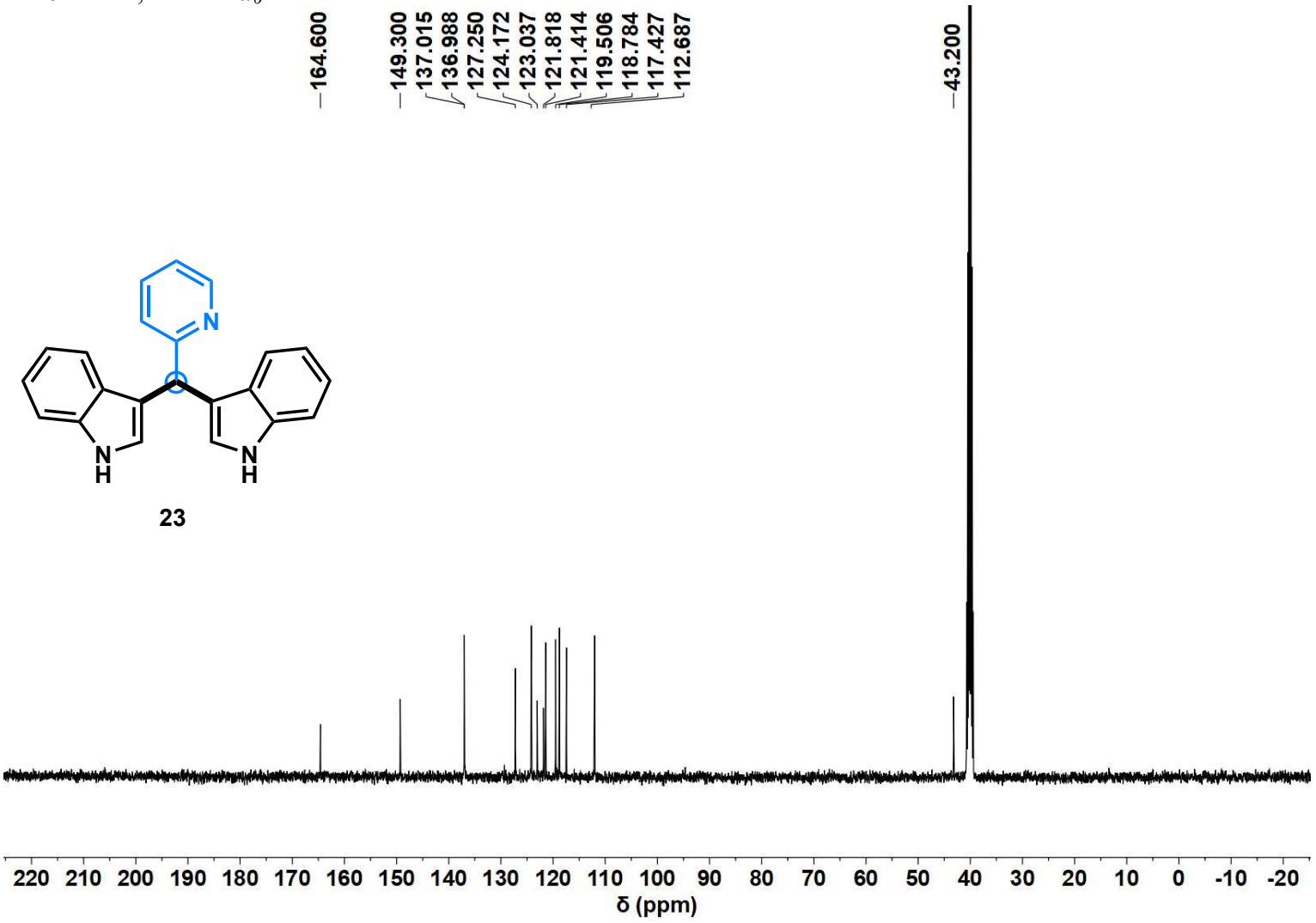
**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^1$H NMR** 400 MHz, DMSO-$d_6$

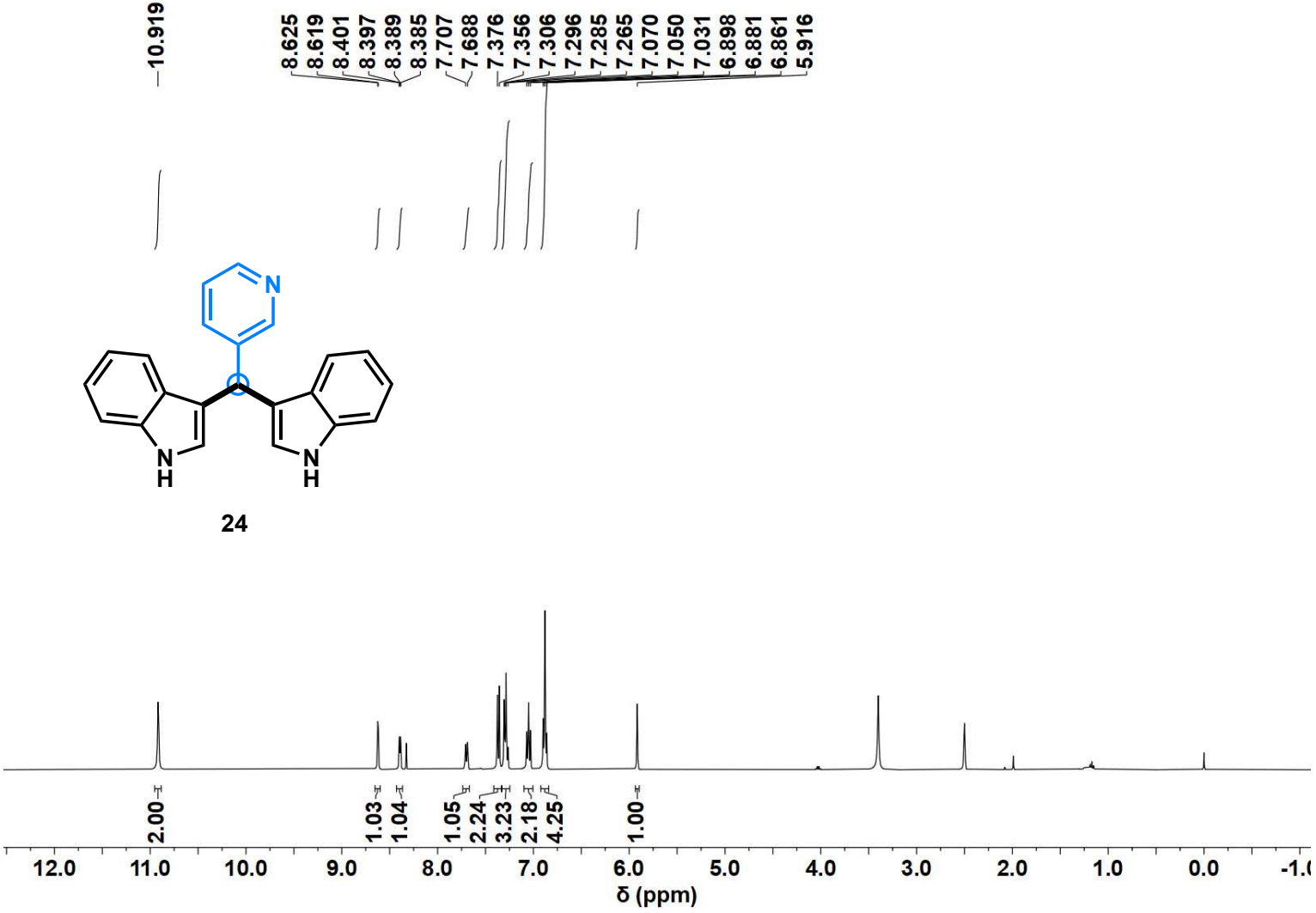


**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



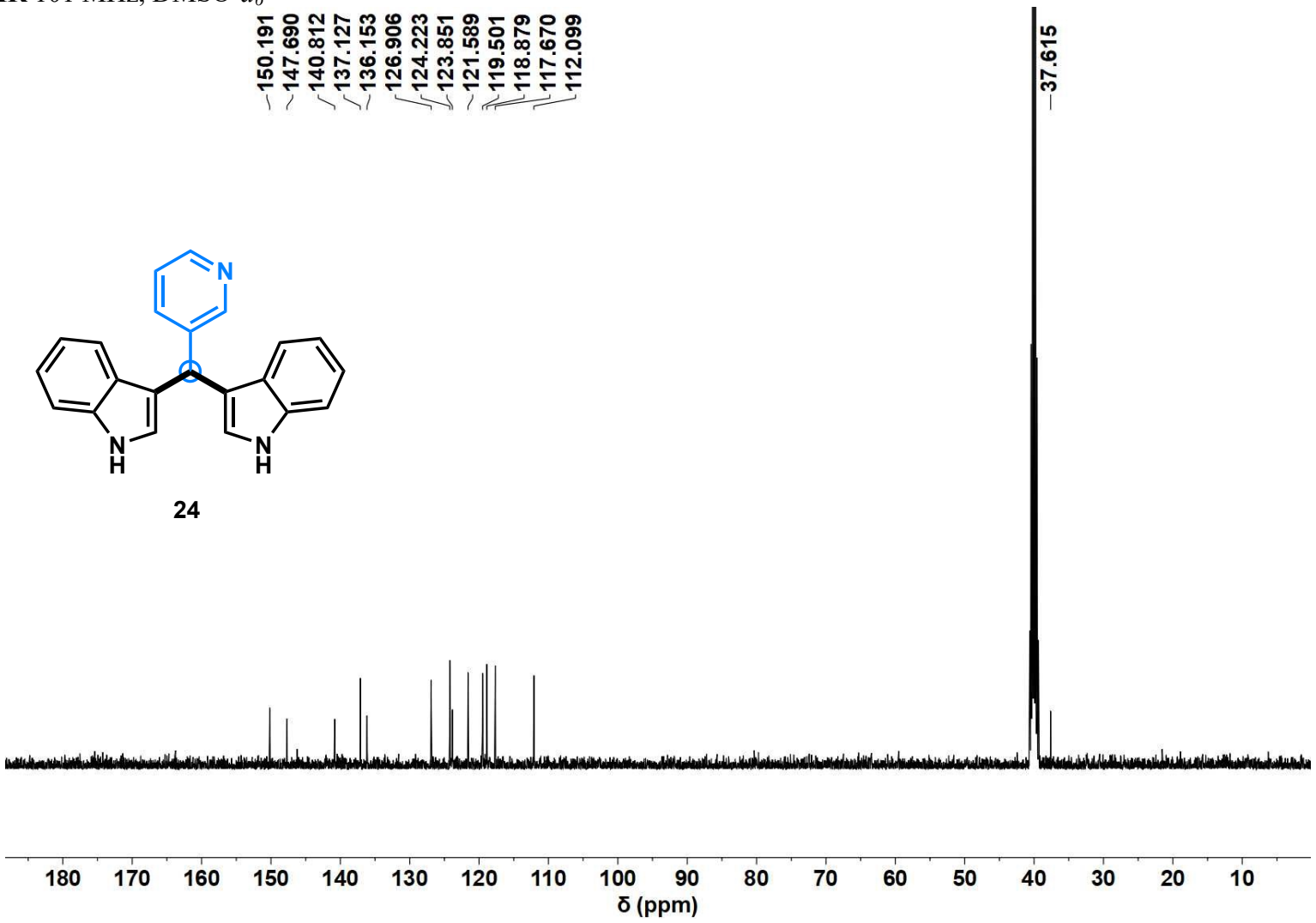

23

**$^1$H NMR** 400 MHz, DMSO-$d_6$



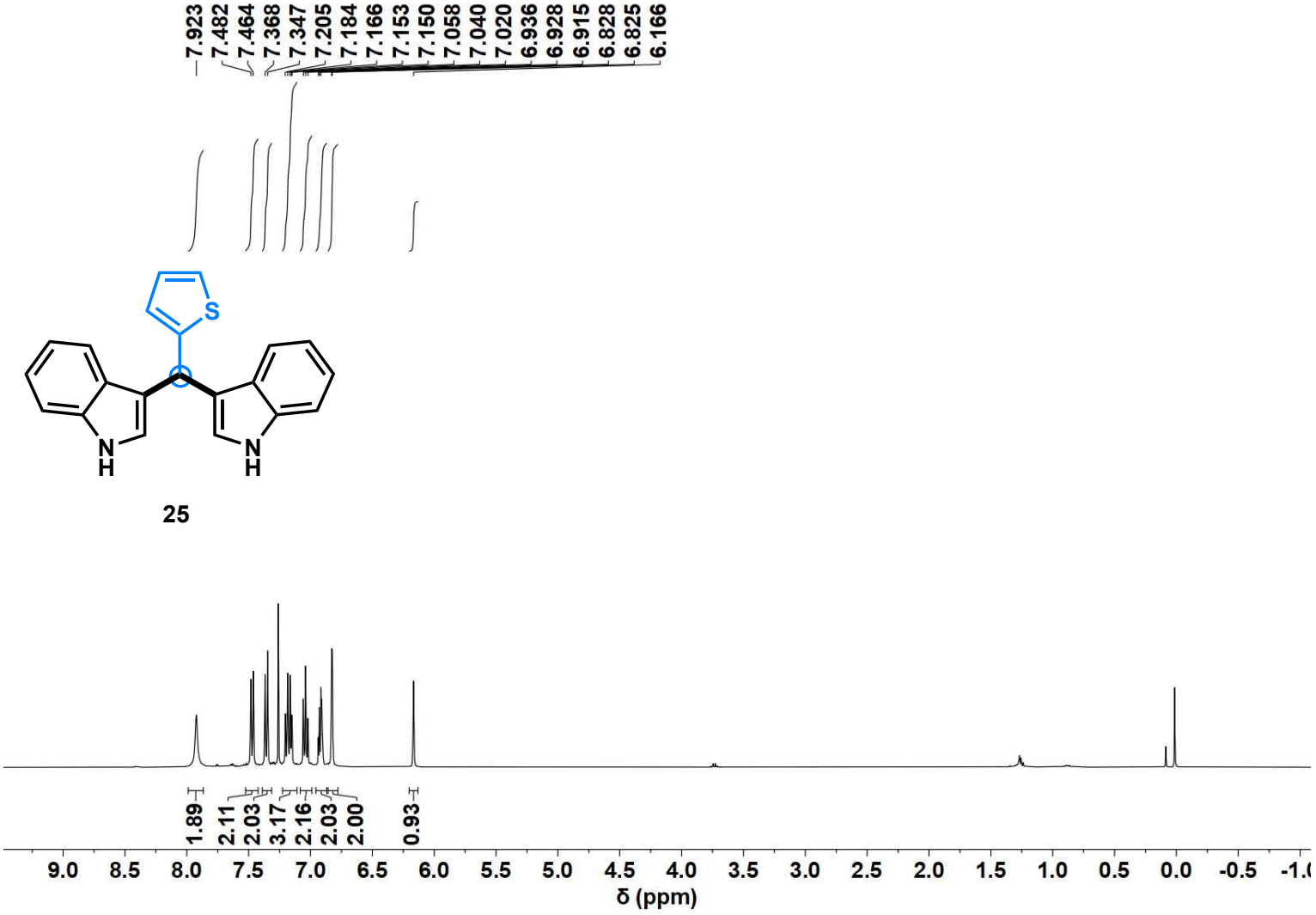

24

**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



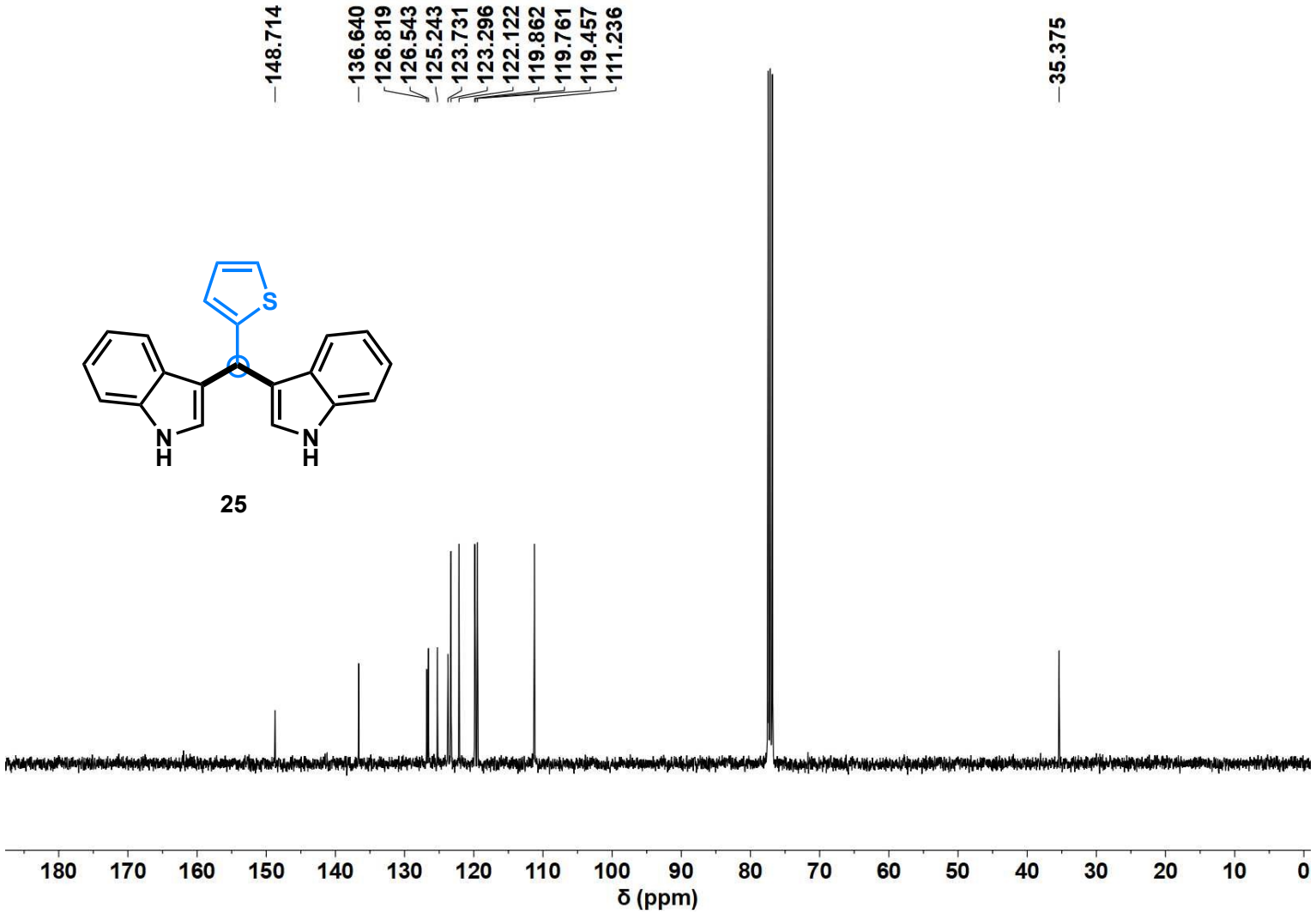

**24**

**$^1$H NMR** 400 MHz, $CDCl_3$

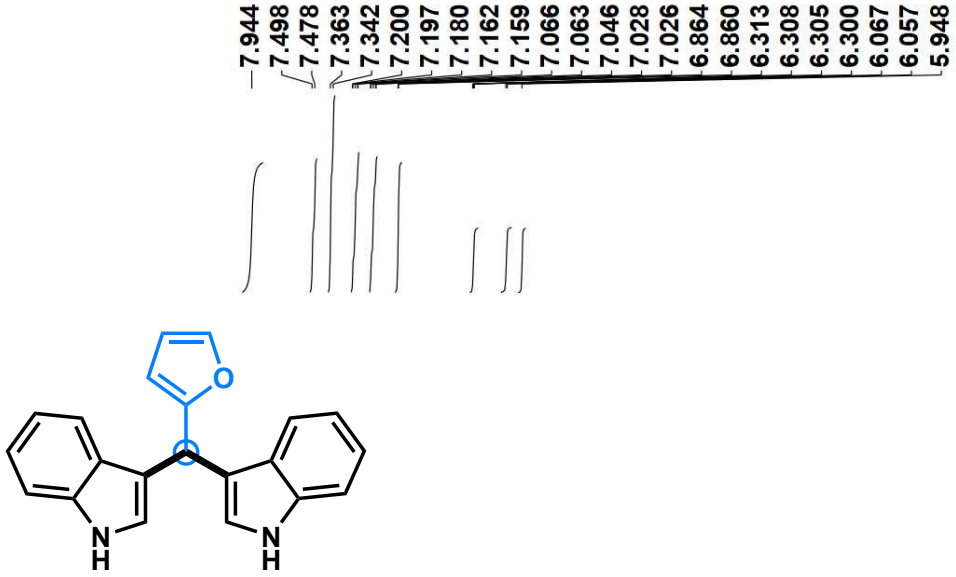



**25**

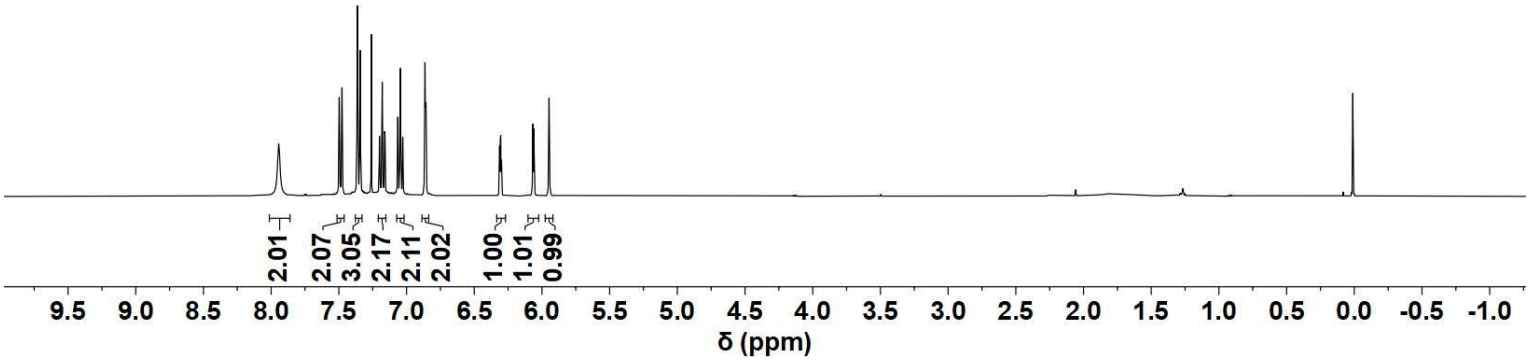
**$^{13}$C NMR** 101 MHz, $CDCl_3$



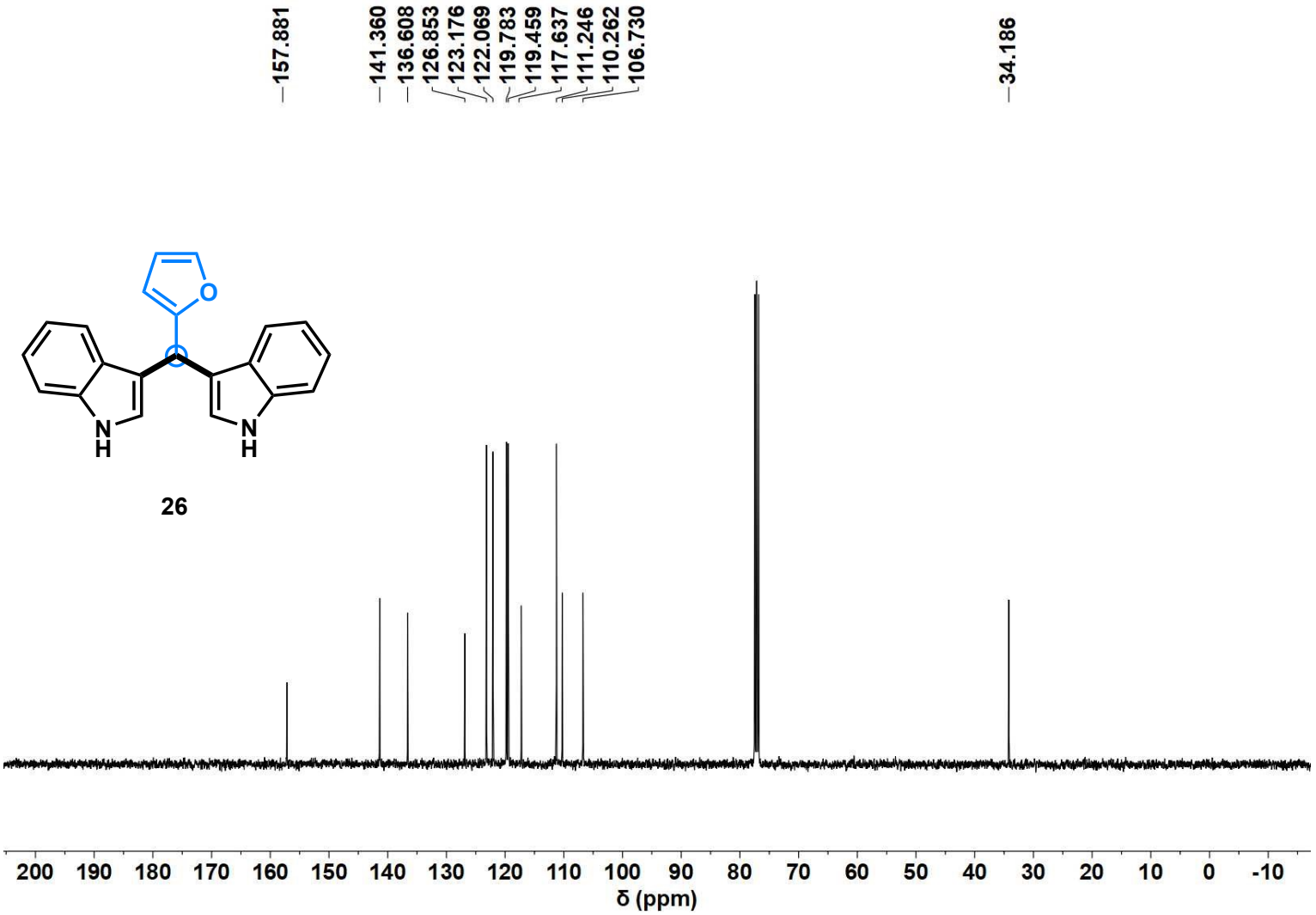
**$^1$H NMR** 400 MHz, $CDCl_3$



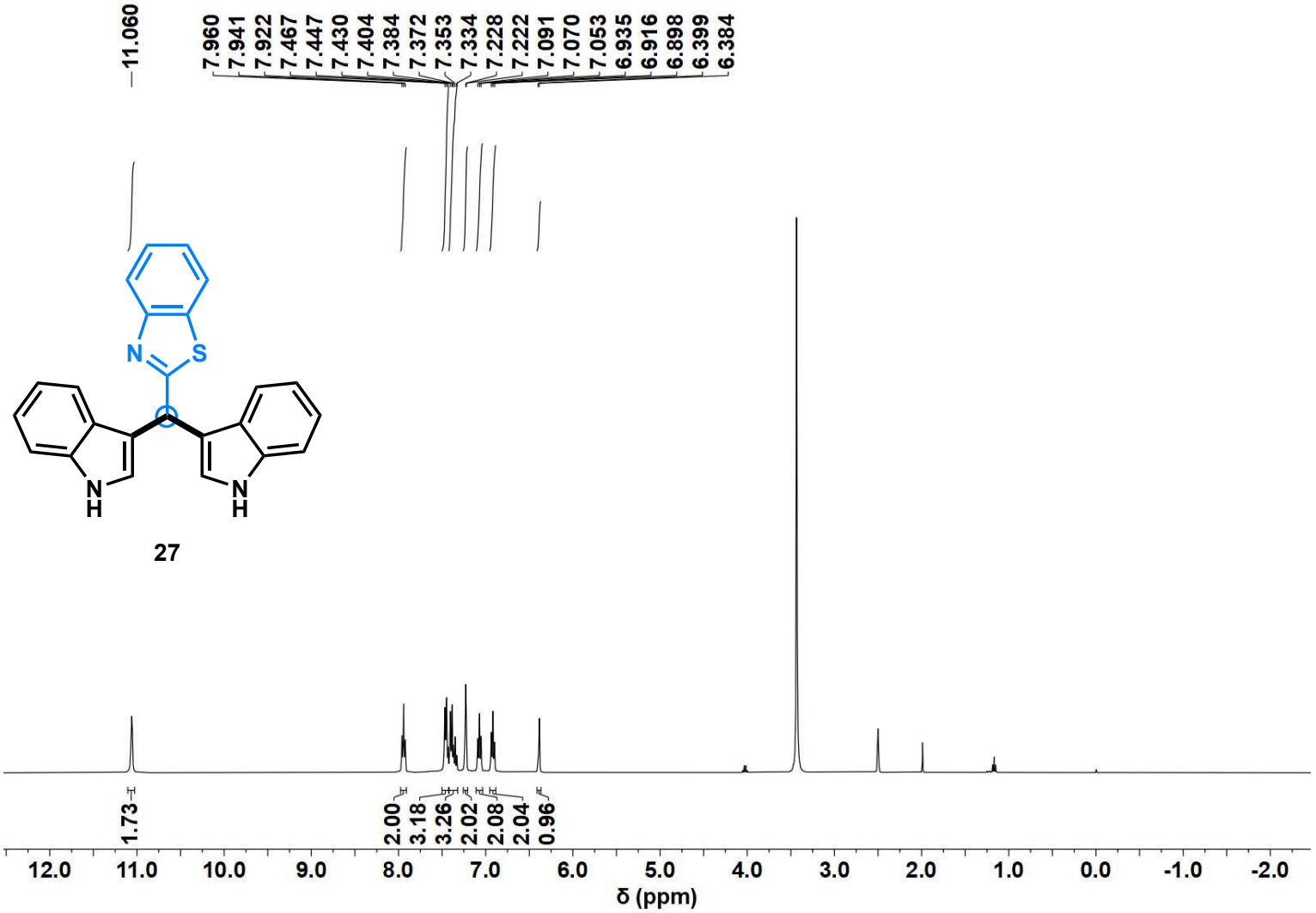

**26**



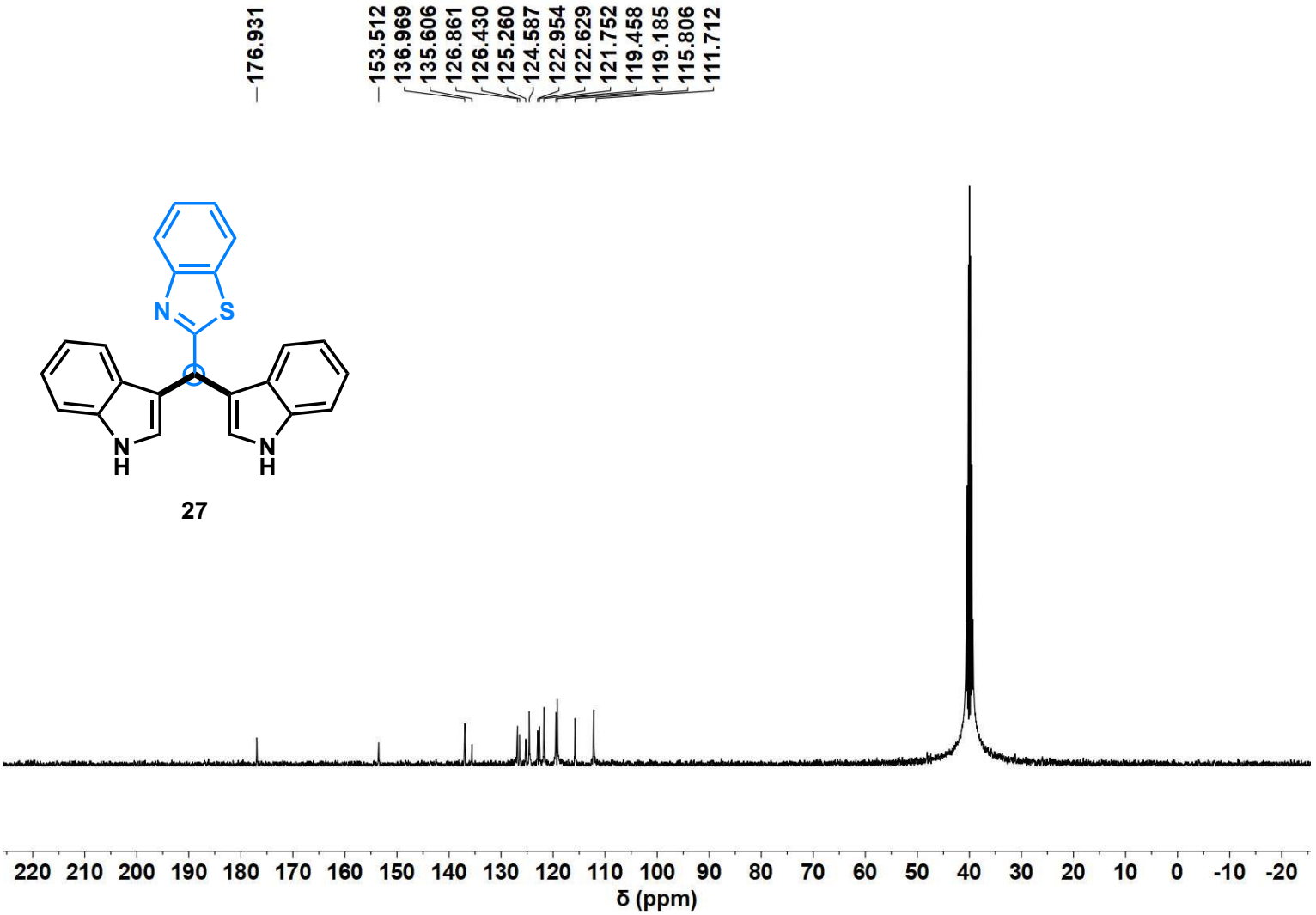
**$^{13}$C NMR** 101 MHz, $CDCl_3$



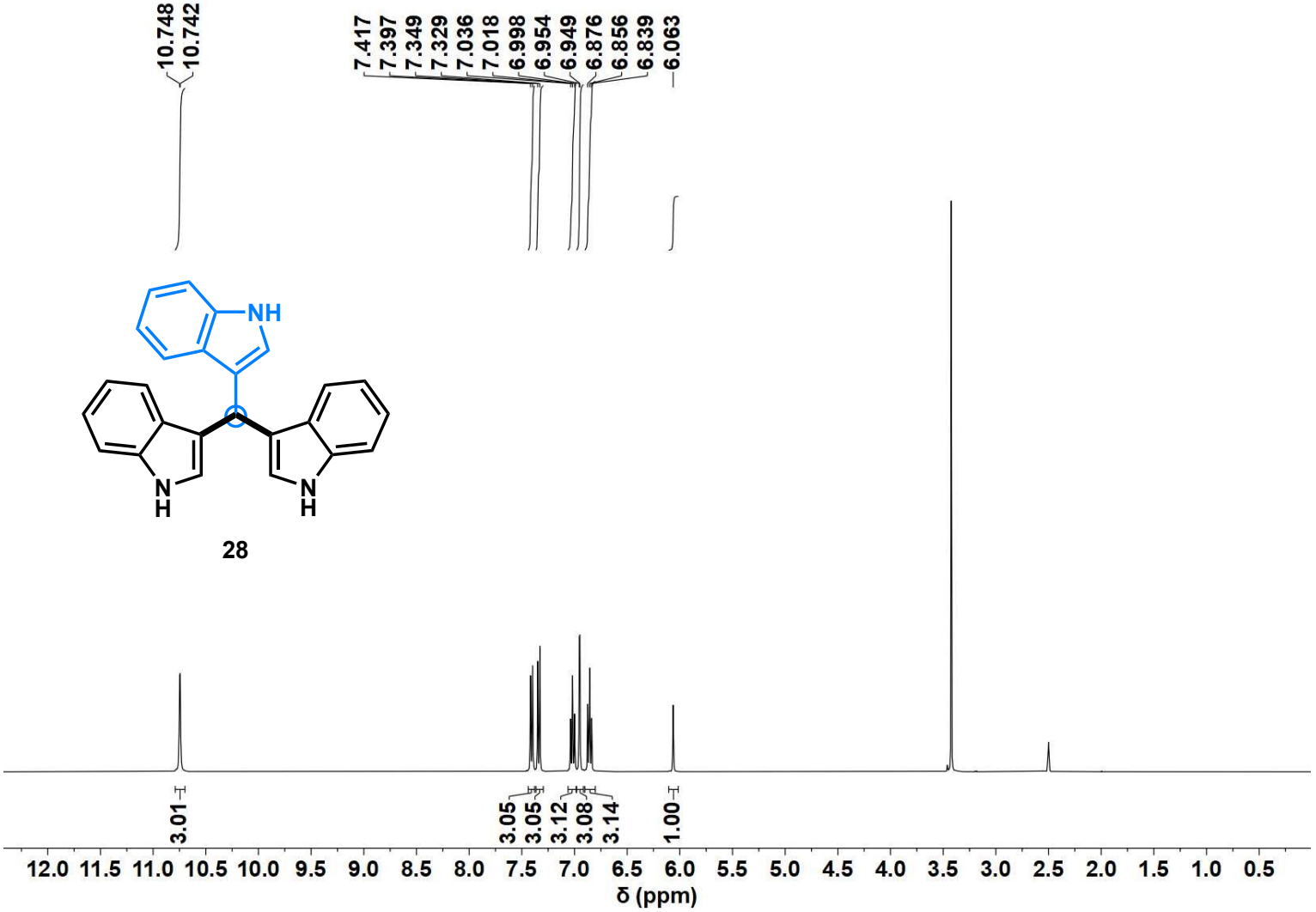
**$^1$H NMR** 400 MHz, DMSO-$d_6$



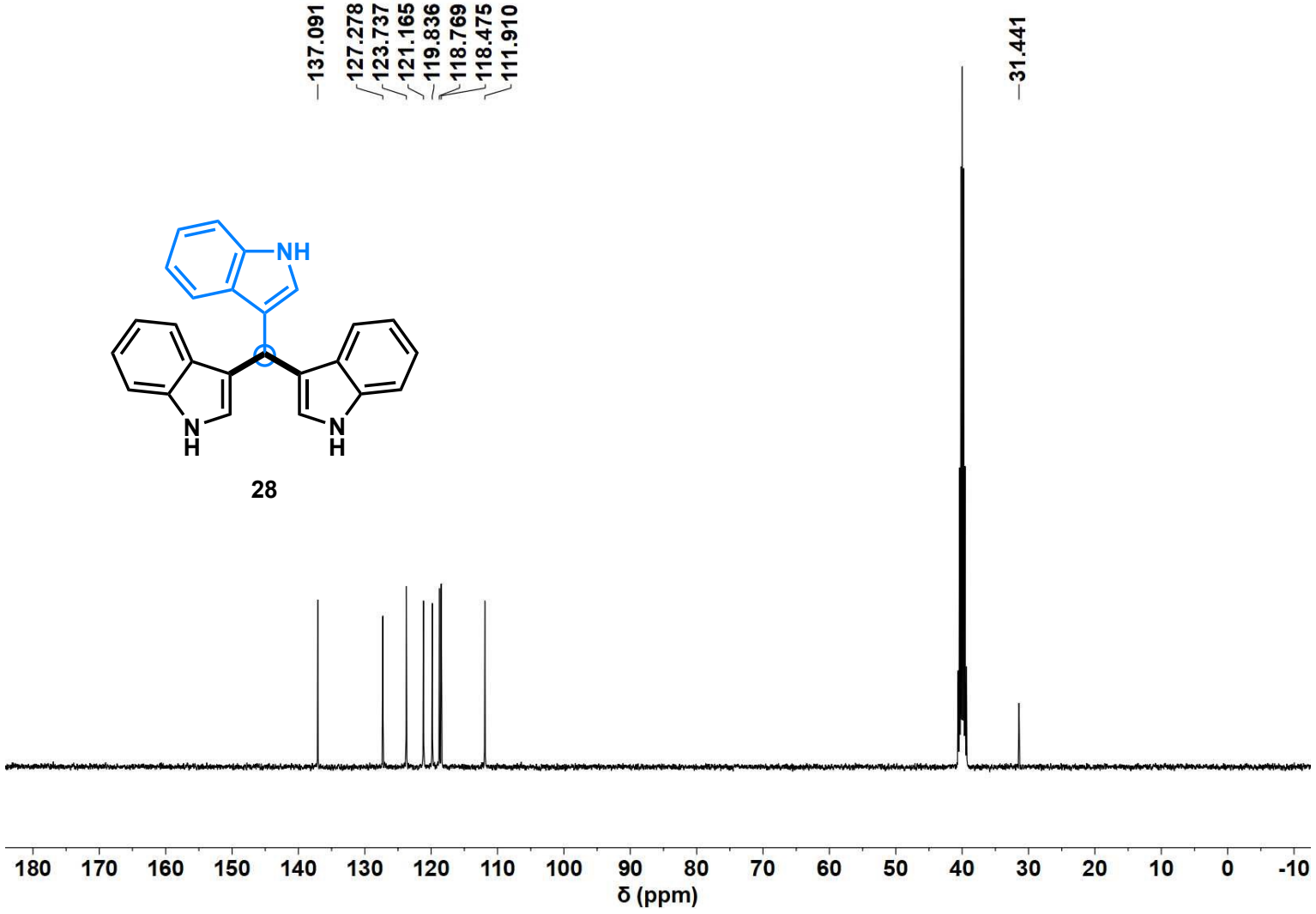
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



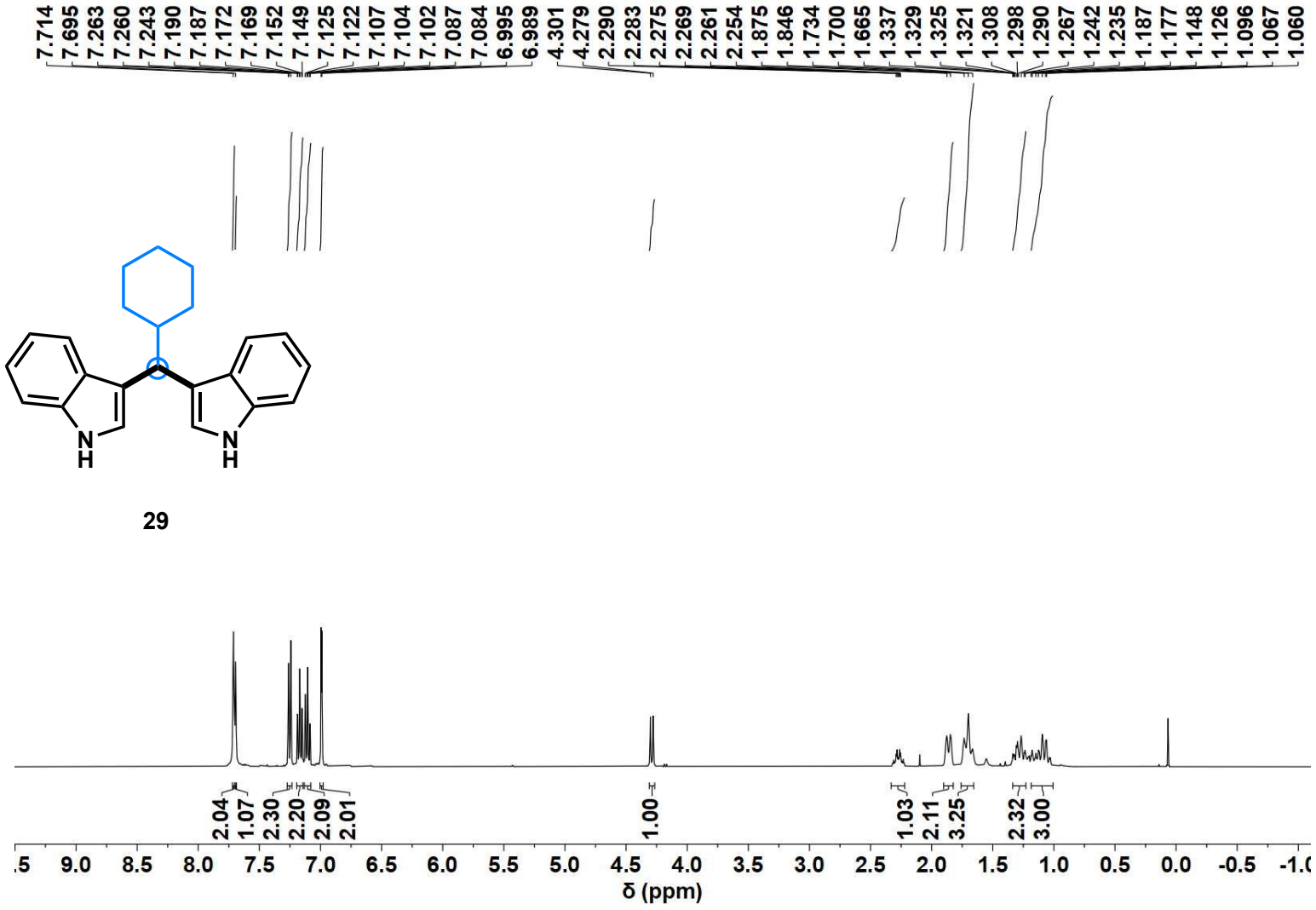
**$^1$H NMR** 400 MHz, DMSO-$d_6$



**$^{13}$C NMR** 400 MHz, DMSO-$d_6$

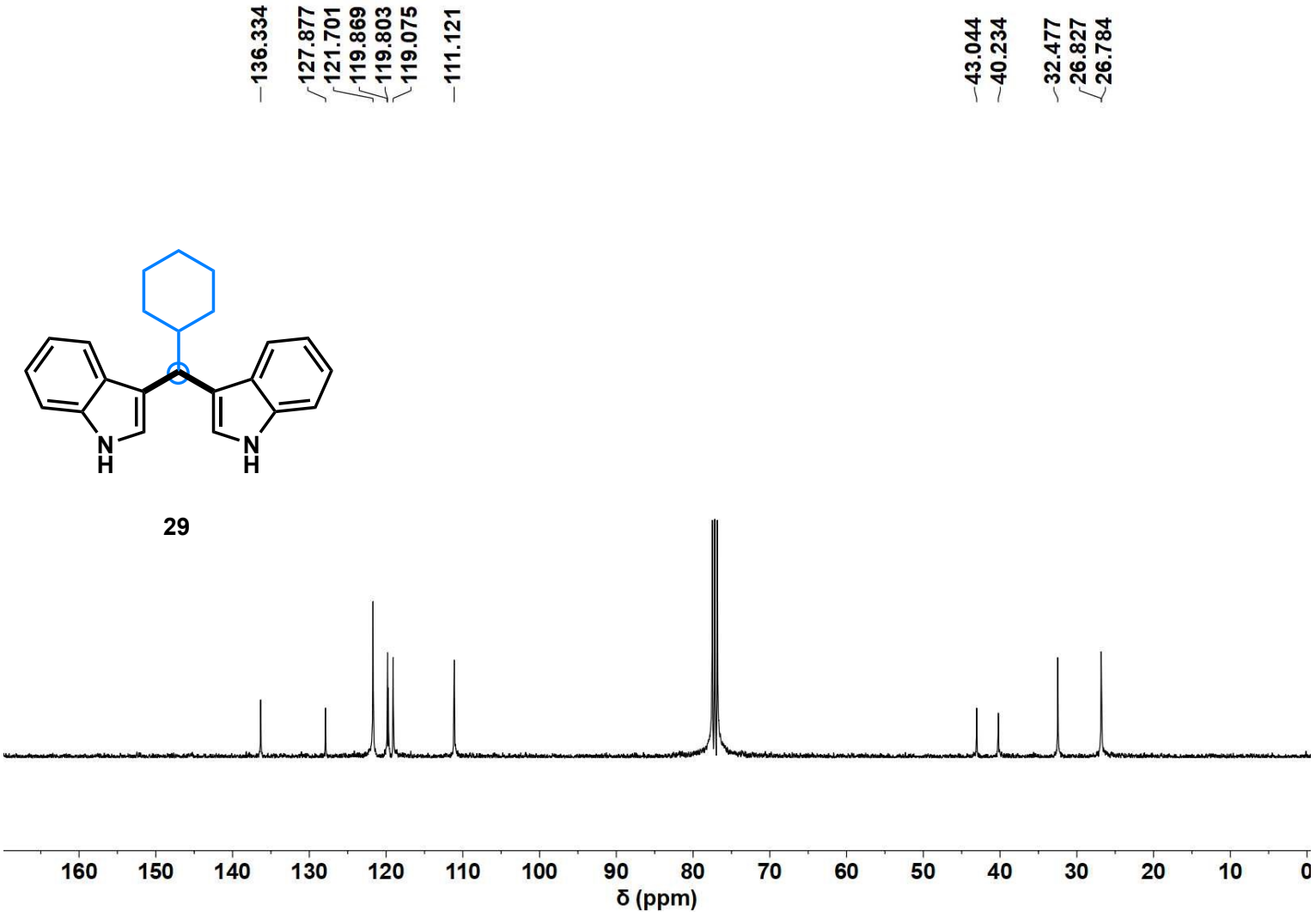


**$^1$H NMR** 400 MHz, $CDCl_3$



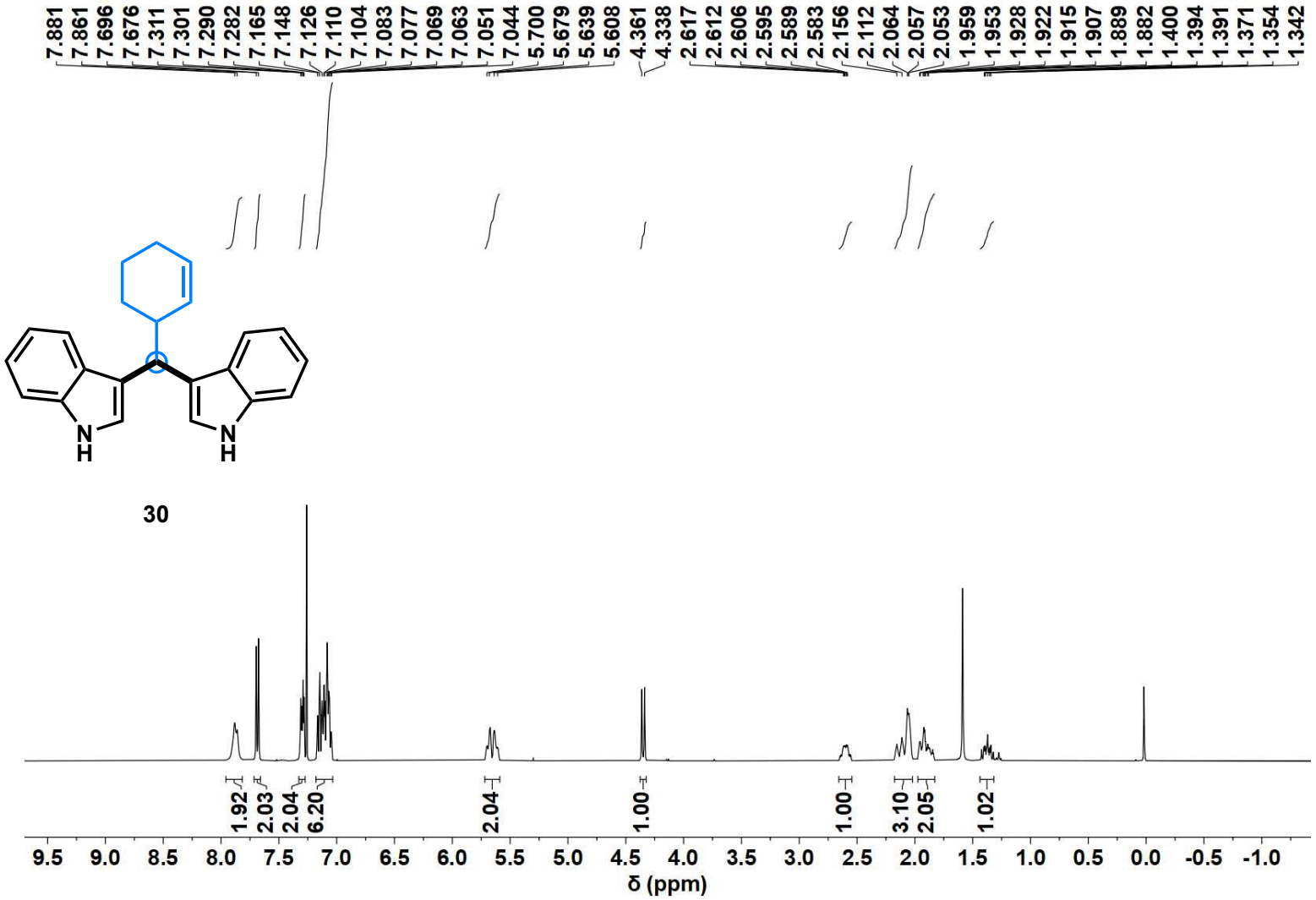

**29**

**$^{13}$C NMR** 101 MHz, $CDCl_3$

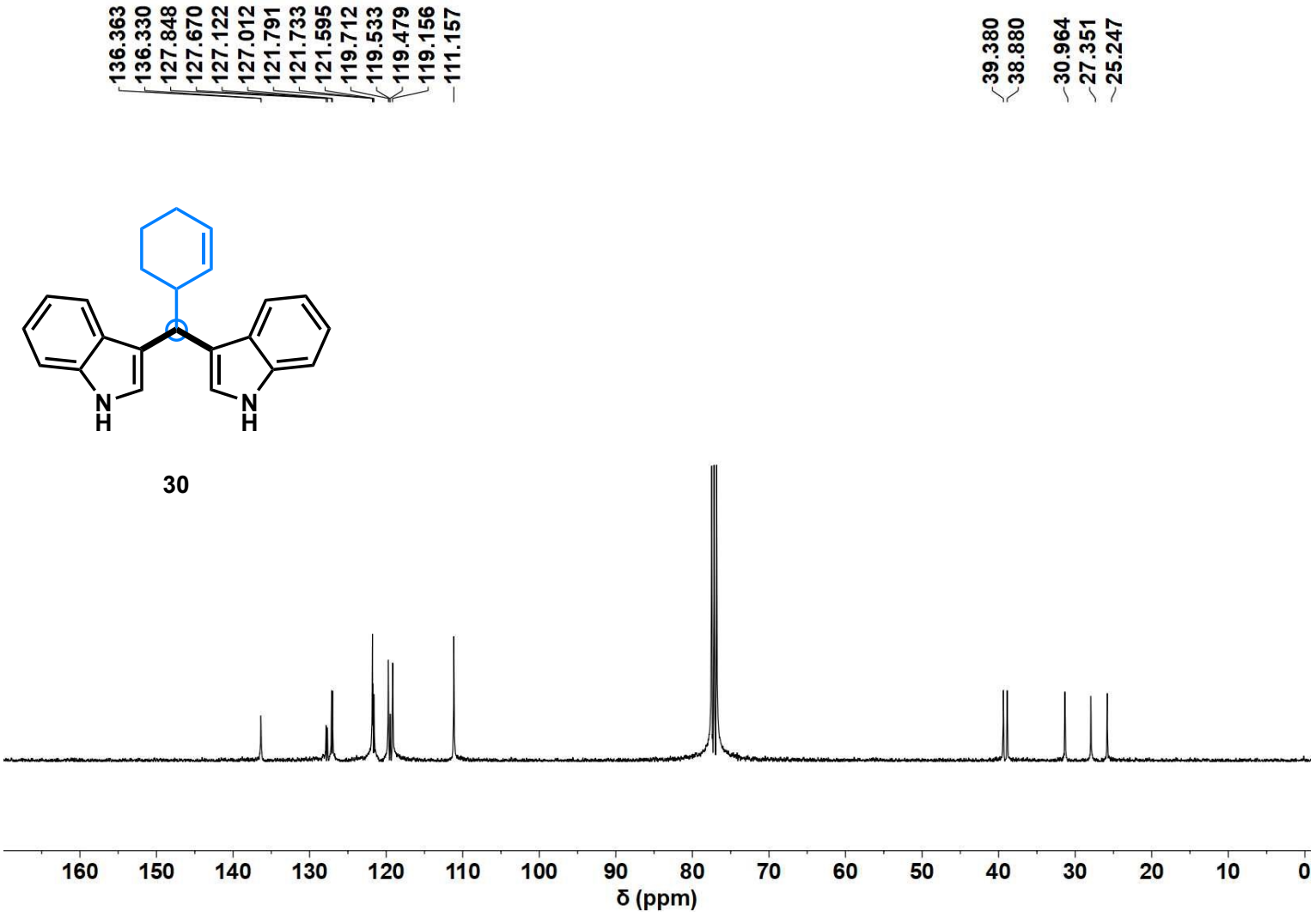



**29**

**$^1$H NMR** 400 MHz, $CDCl_3$

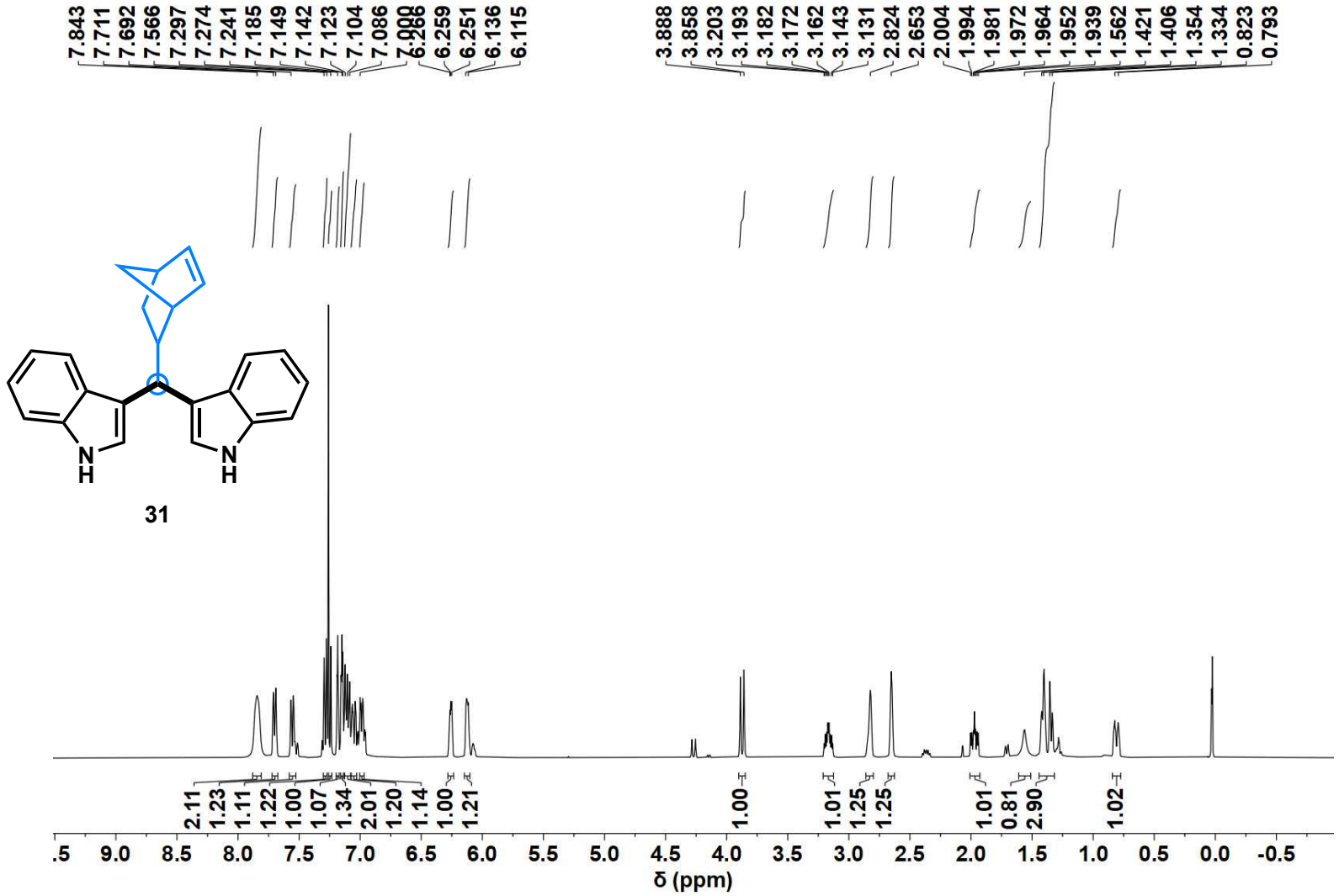


**$^{13}$C NMR** 101 MHz, $CDCl_3$

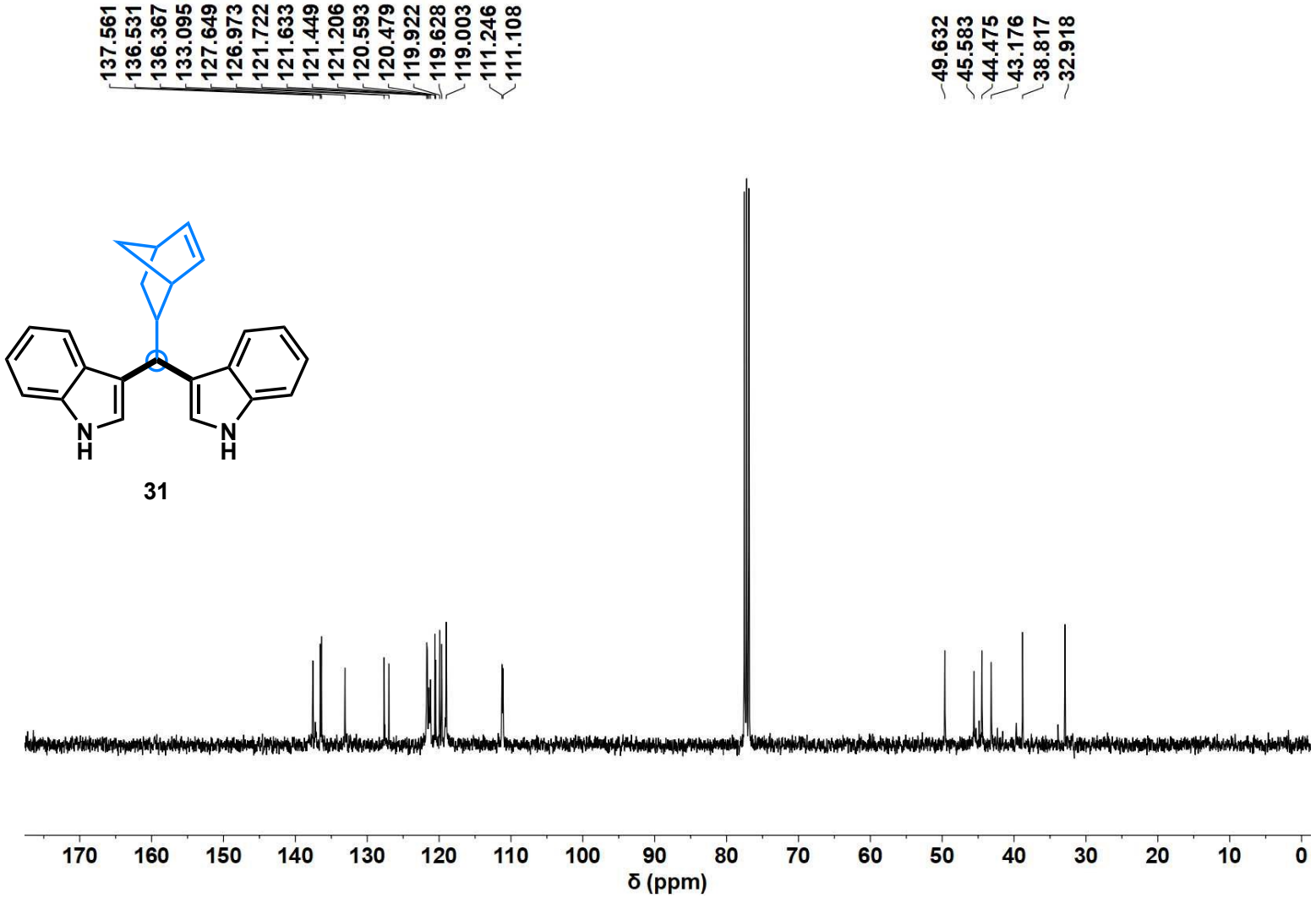



**30**

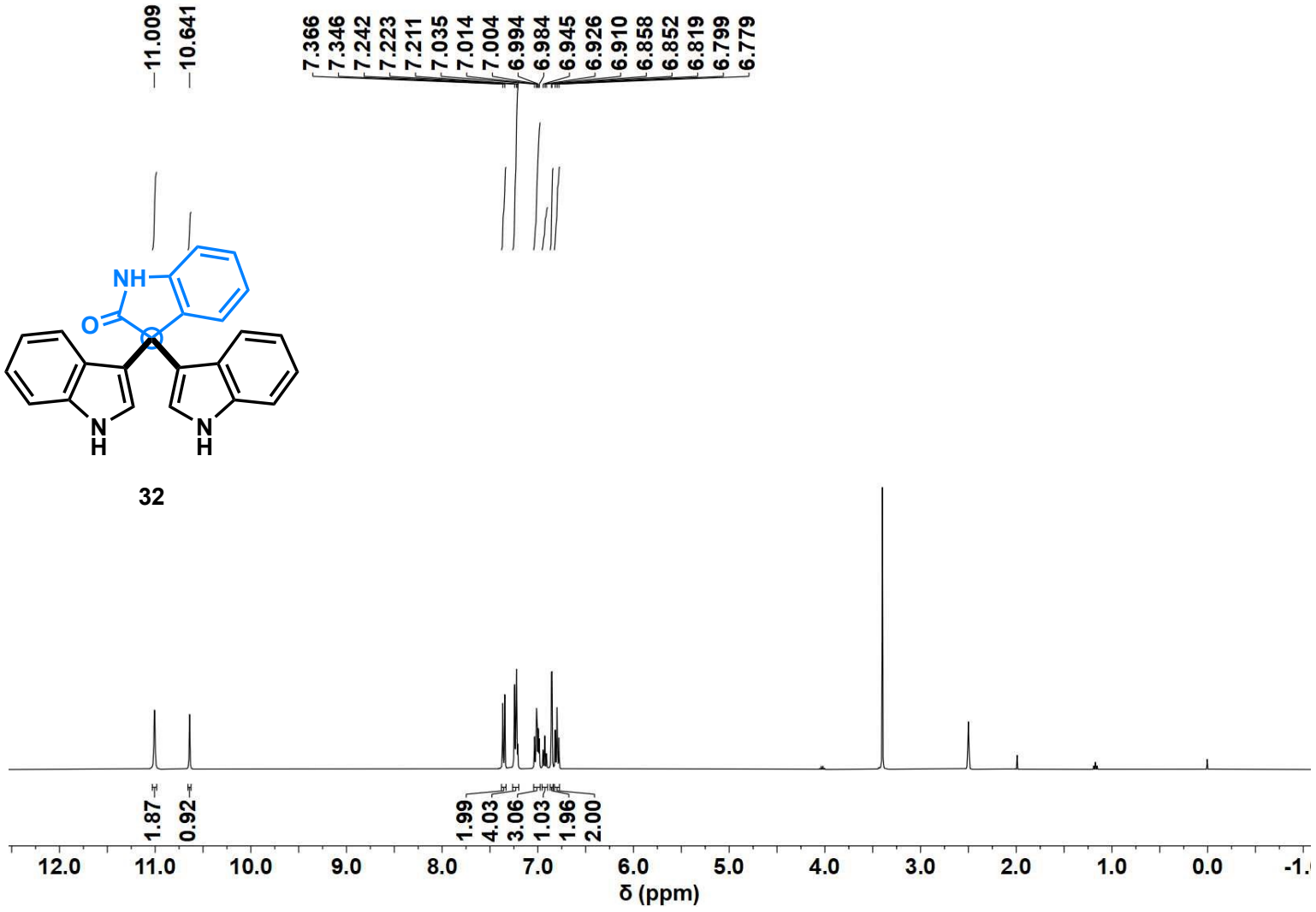
**$^1$H NMR** 400 MHz, $CDCl_3$



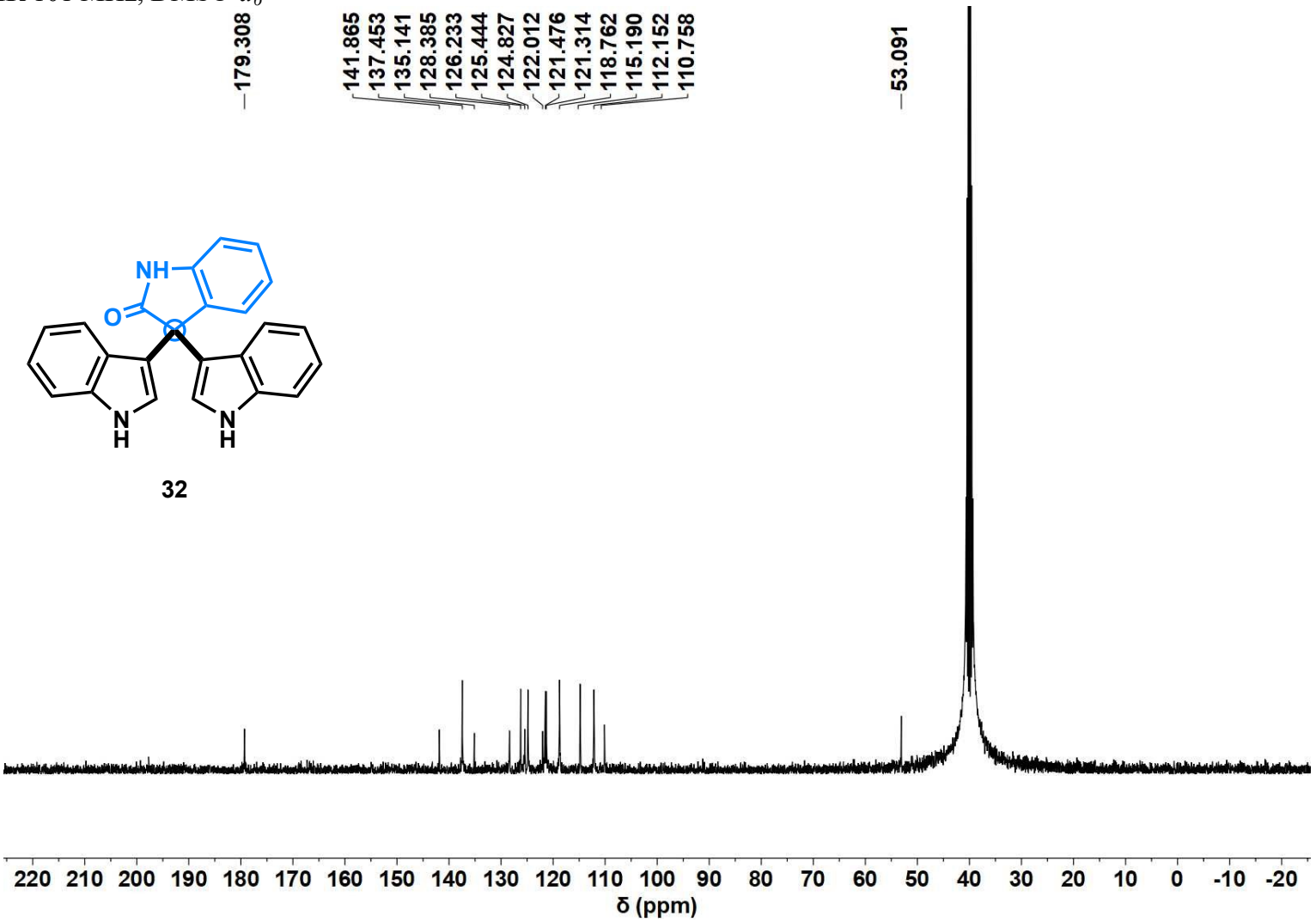
**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^1$H NMR** 400 MHz, DMSO-$d_6$

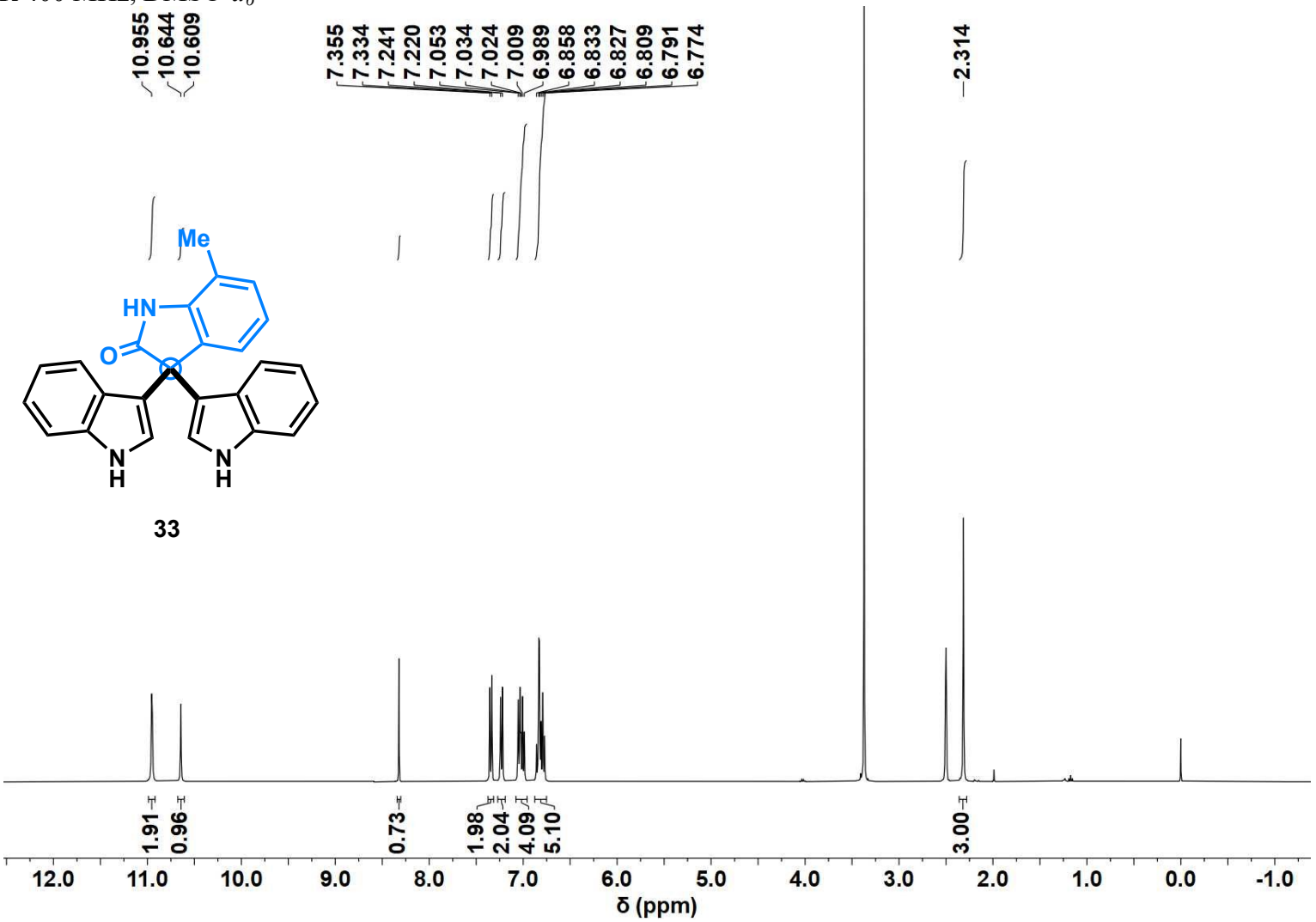


**$^{13}$C NMR** 101 MHz, DMSO-$d_6$

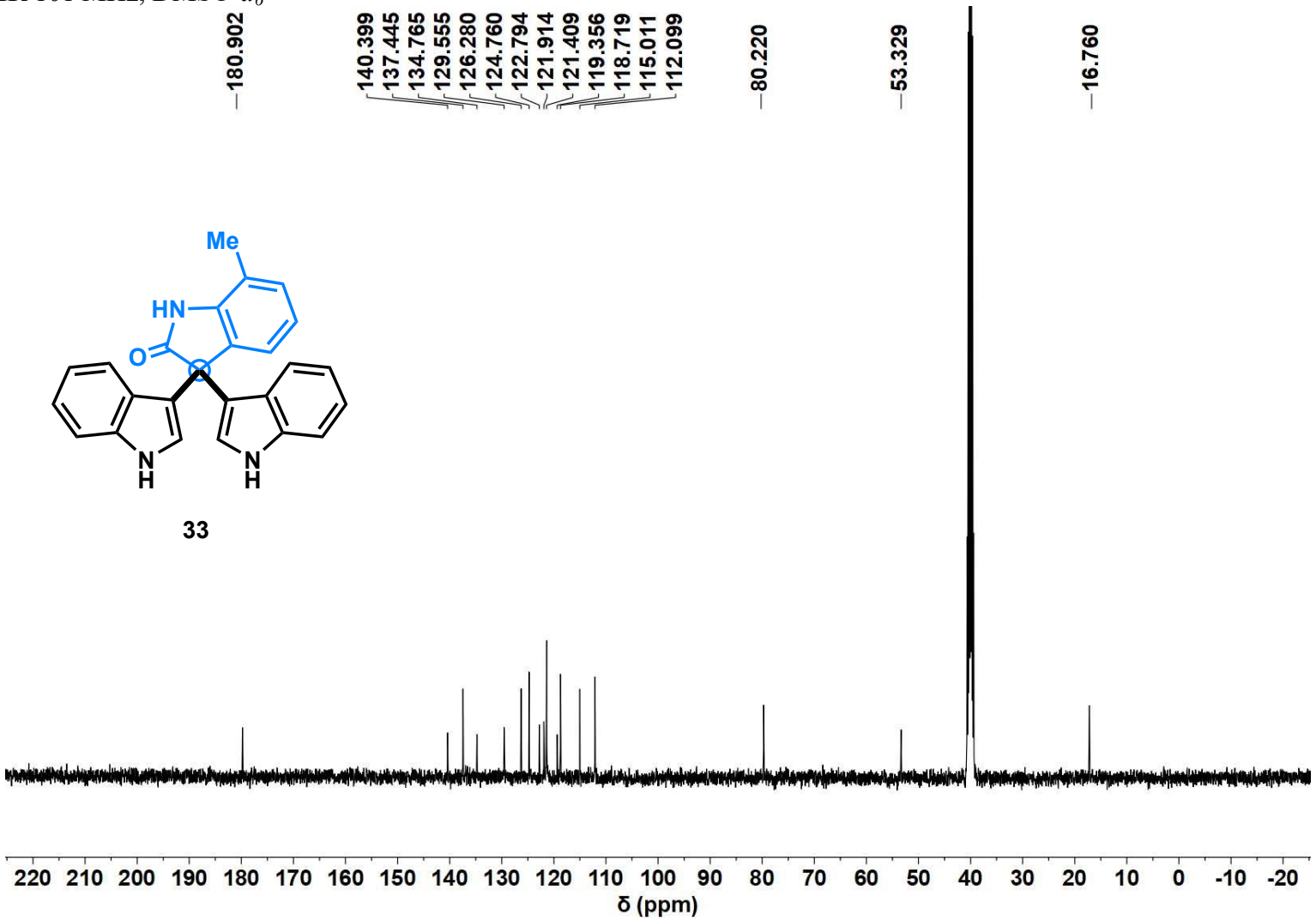



**32**

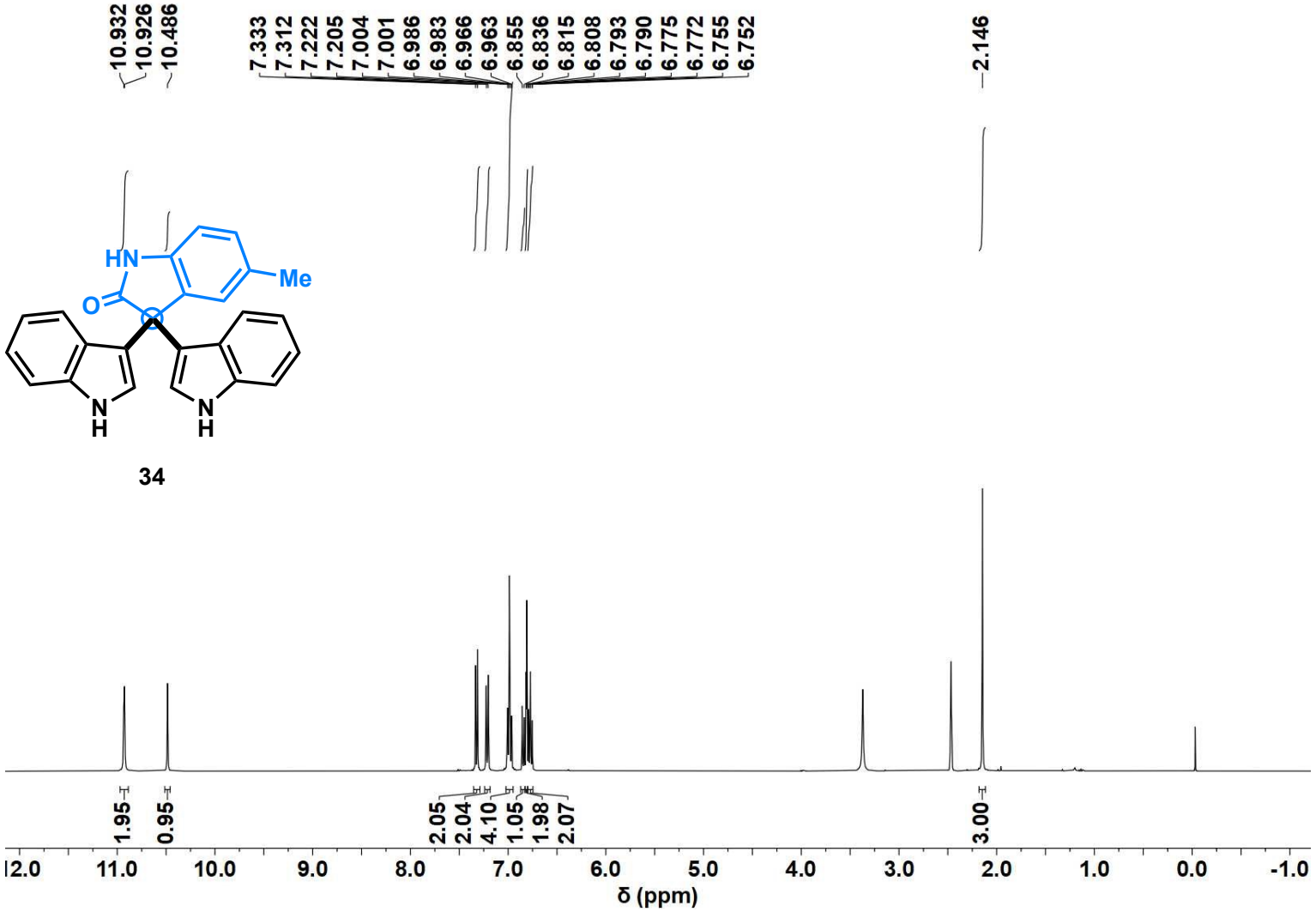
**$^1$H NMR** 400 MHz, DMSO-$d_6$



**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



**$^1$H NMR** 400 MHz, DMSO-$d_6$

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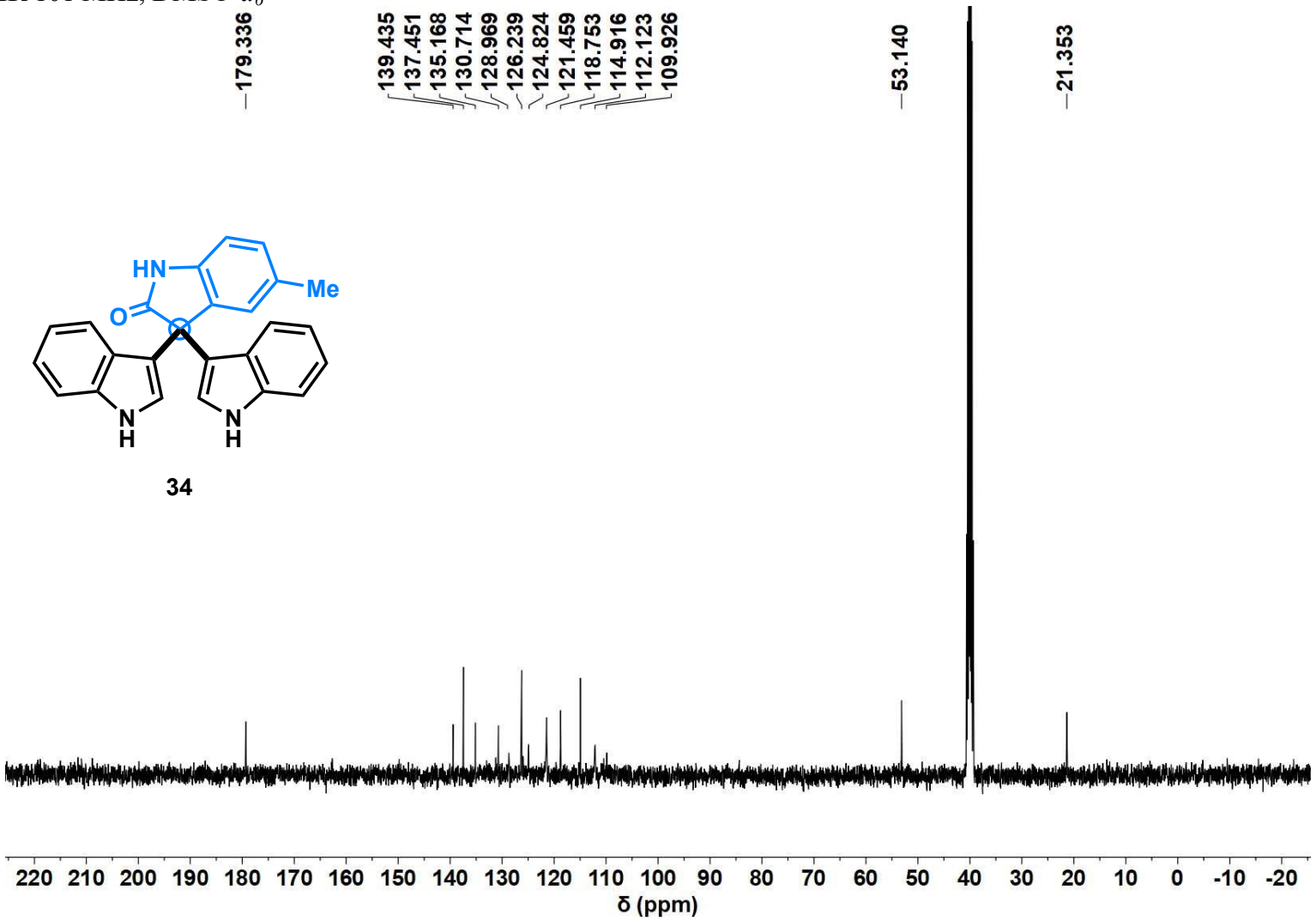
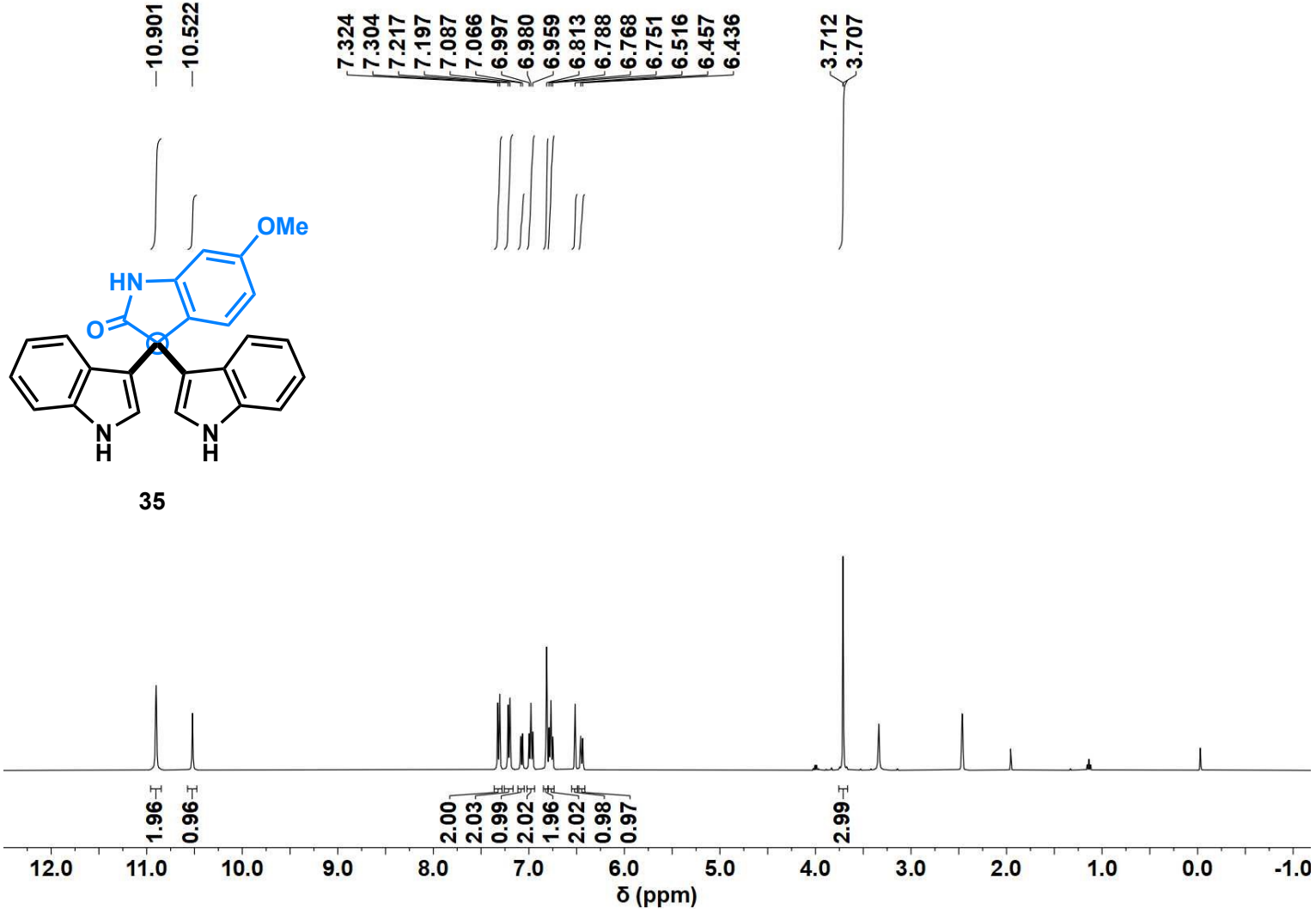
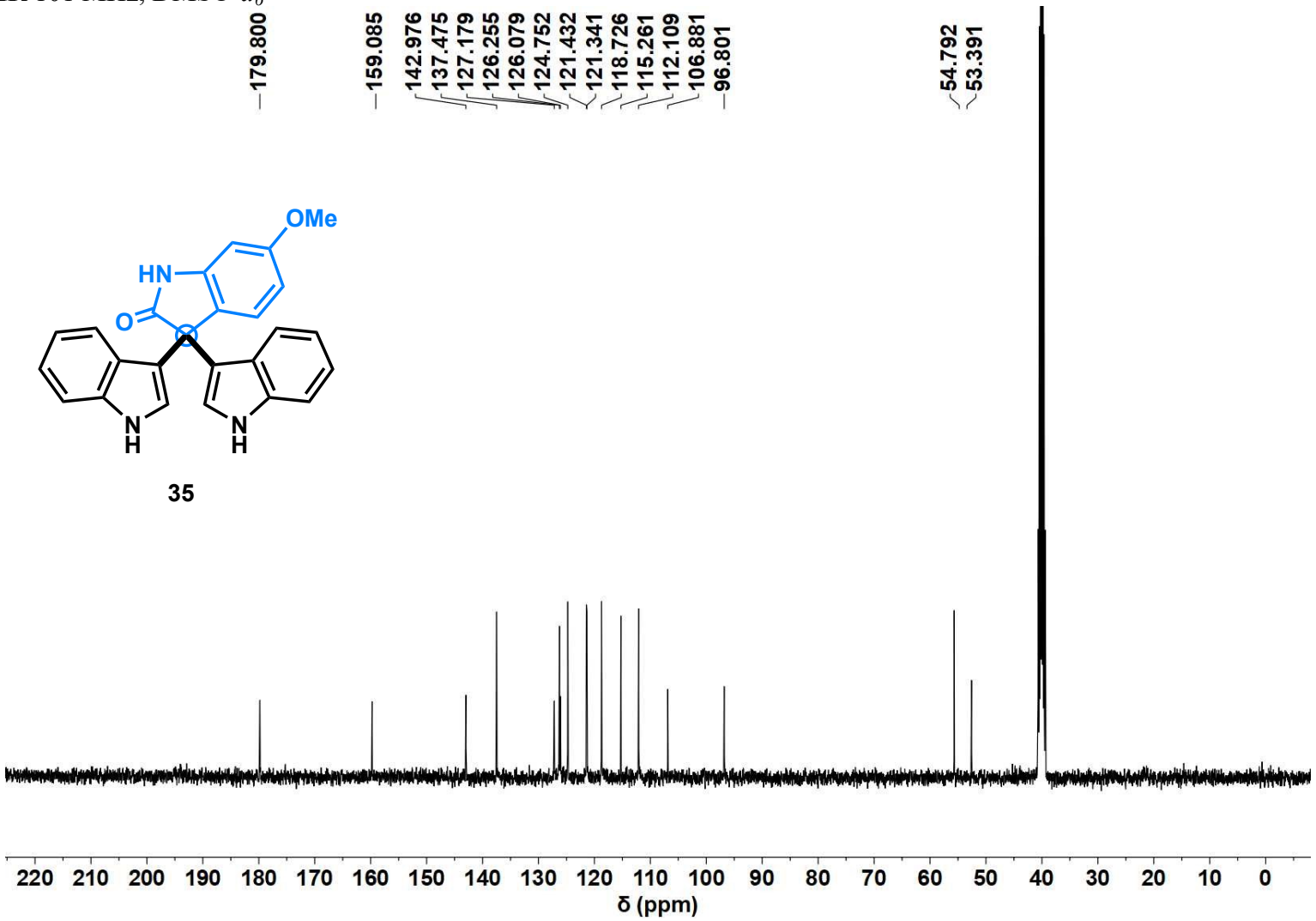
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



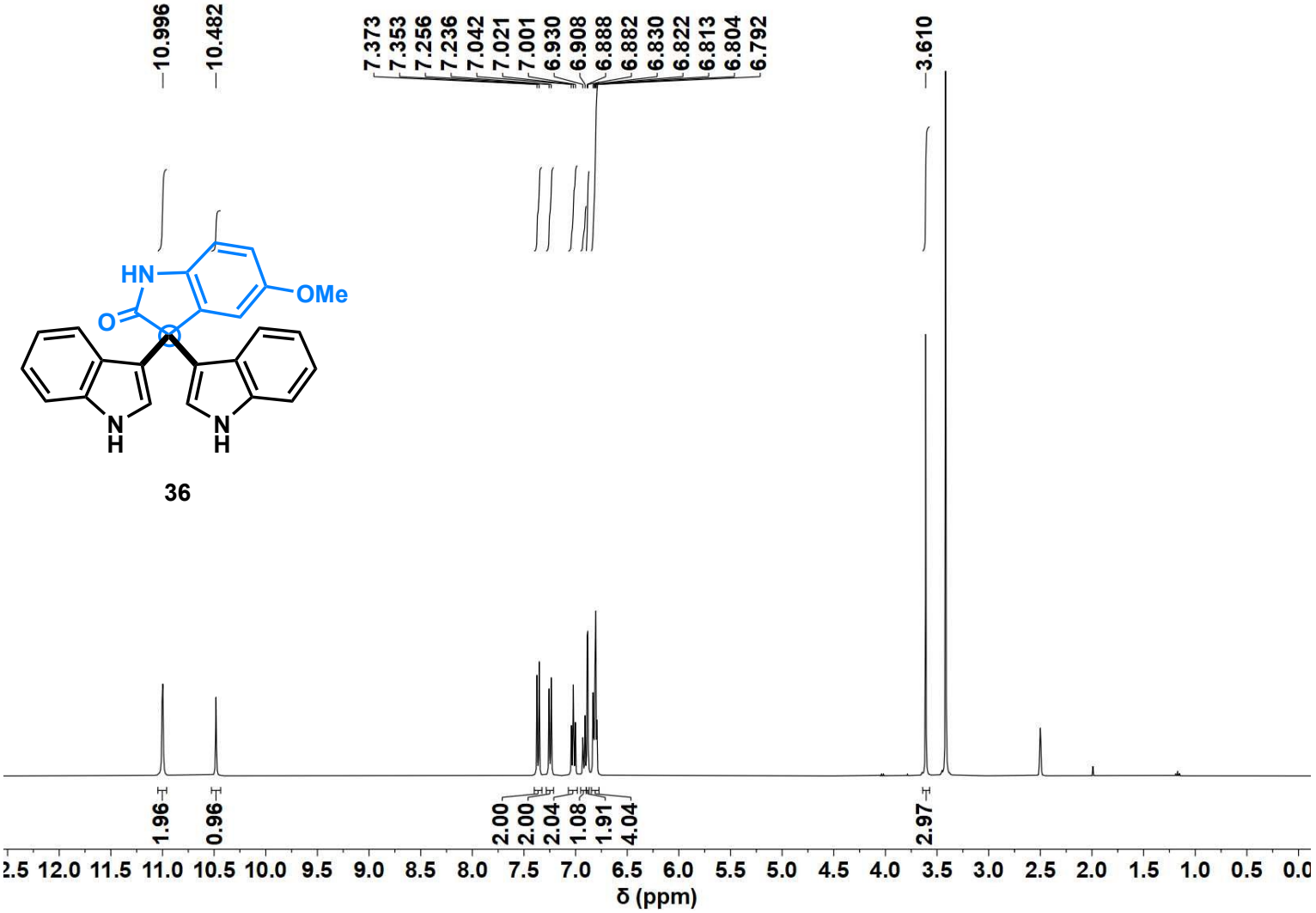
**$^1$H NMR** 400 MHz, DMSO-$d_6$



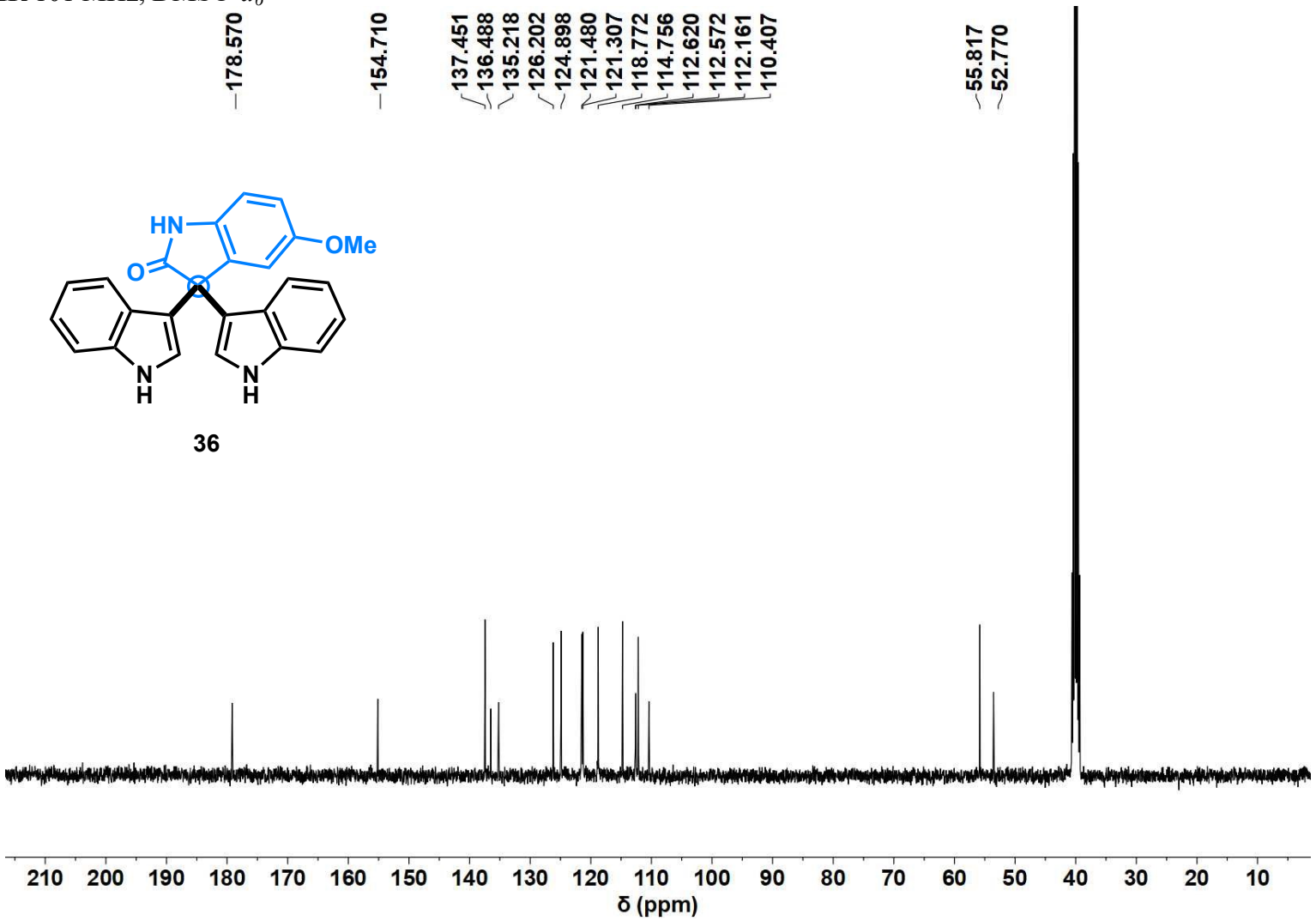
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



**$^1$H NMR** 400 MHz, DMSO-$d_6$

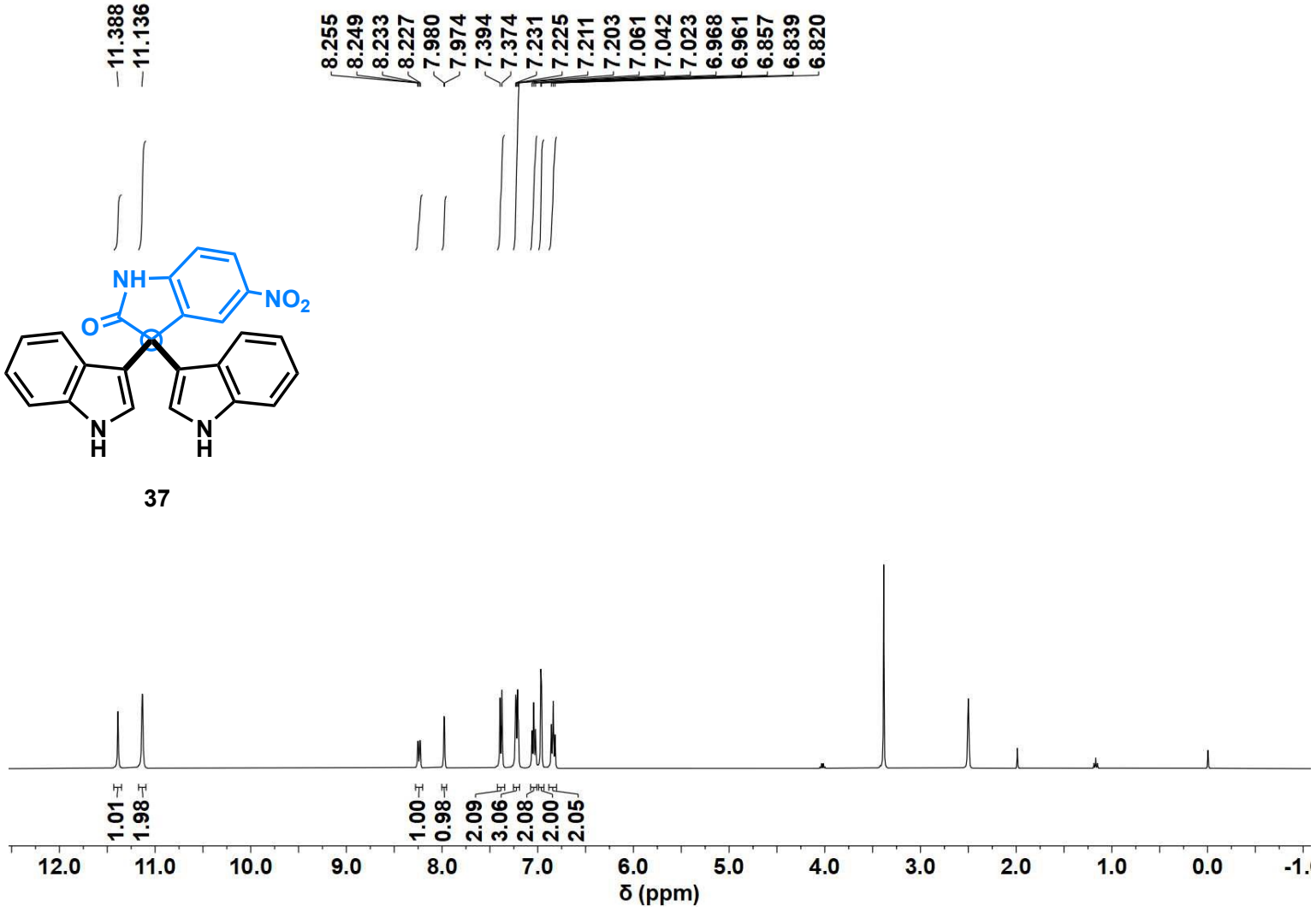


**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



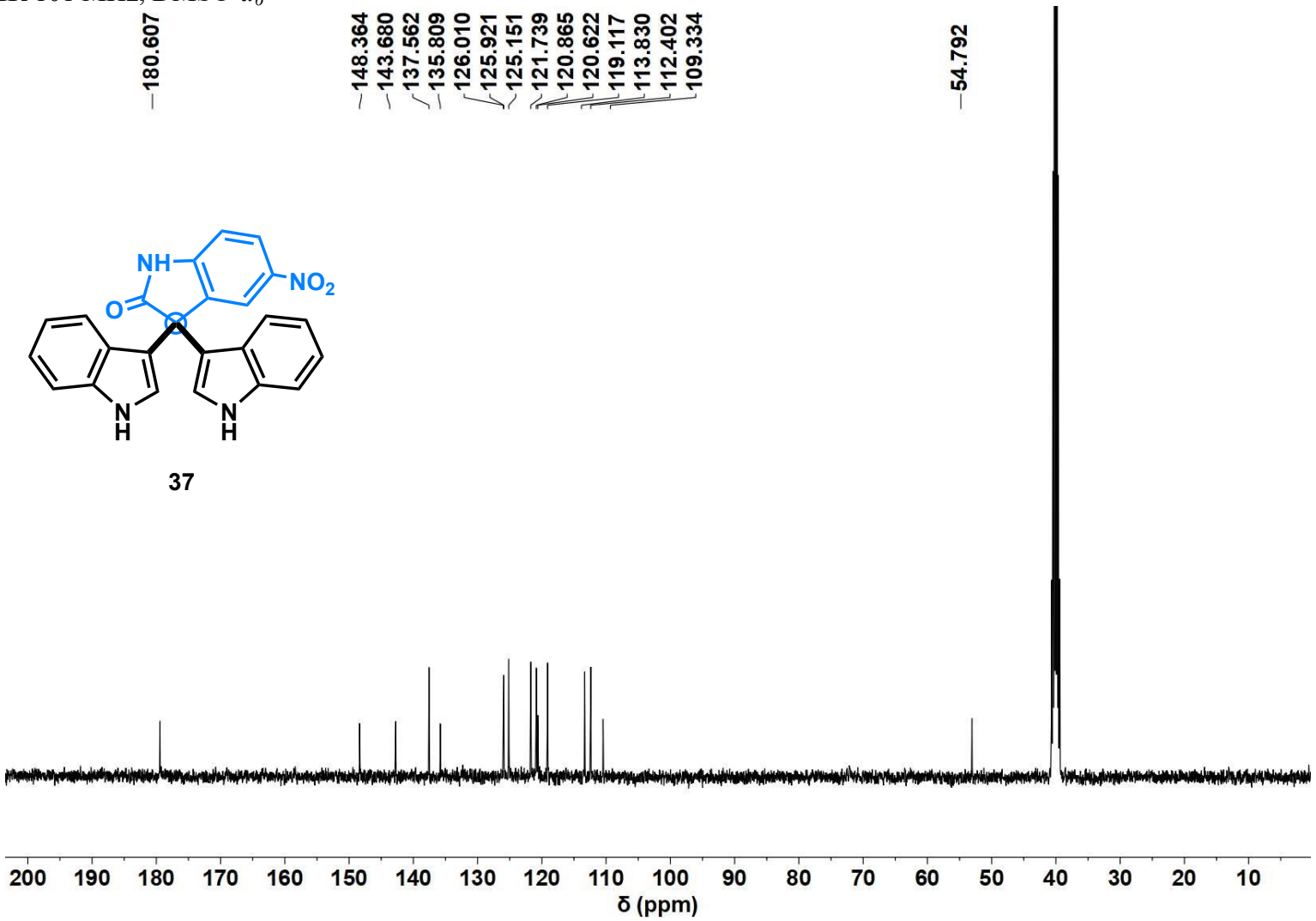

**36**

**$^1$H NMR** 400 MHz, DMSO-$d_6$



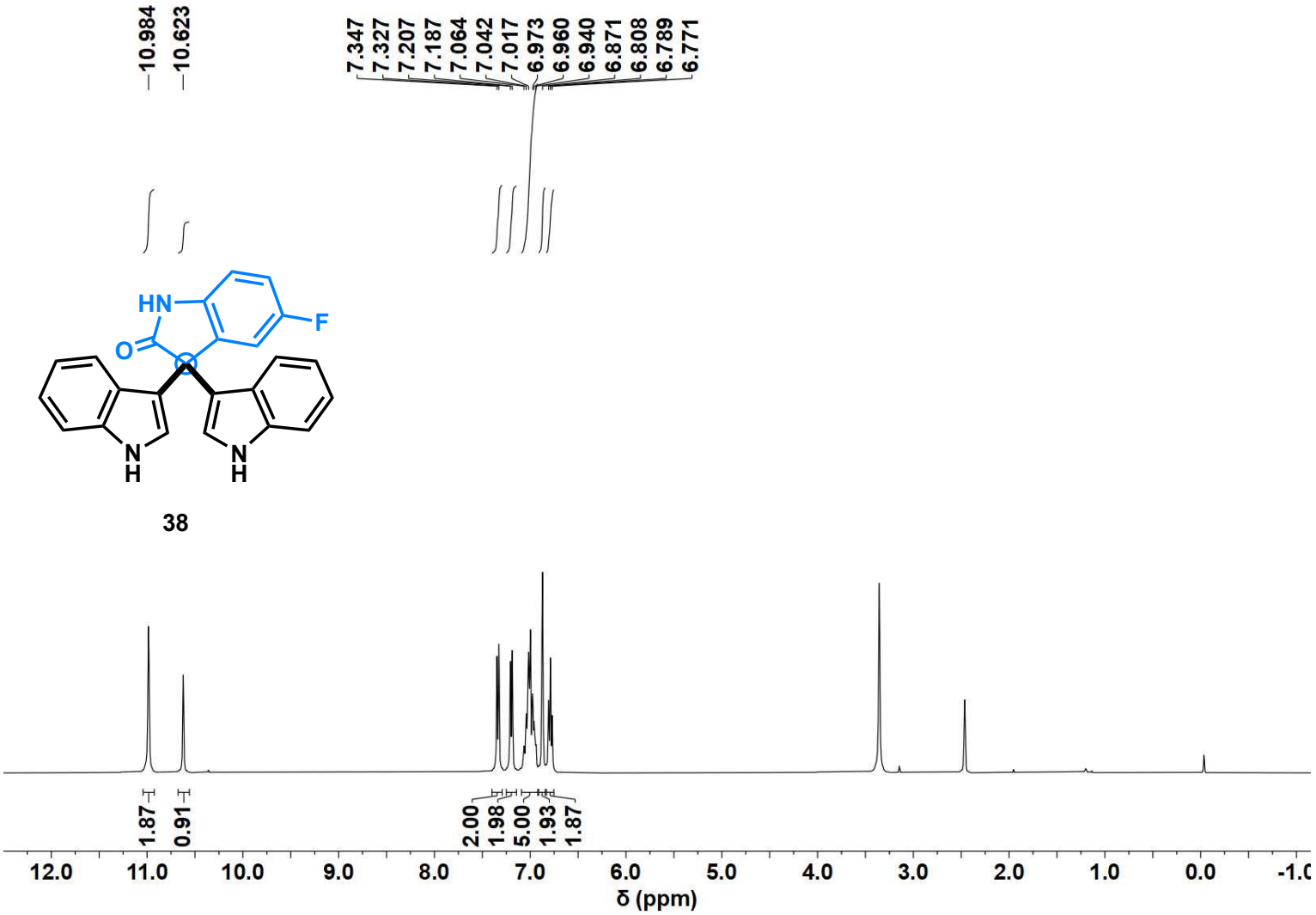

37

**$^{13}$C NMR** 101 MHz, DMSO-$d_6$

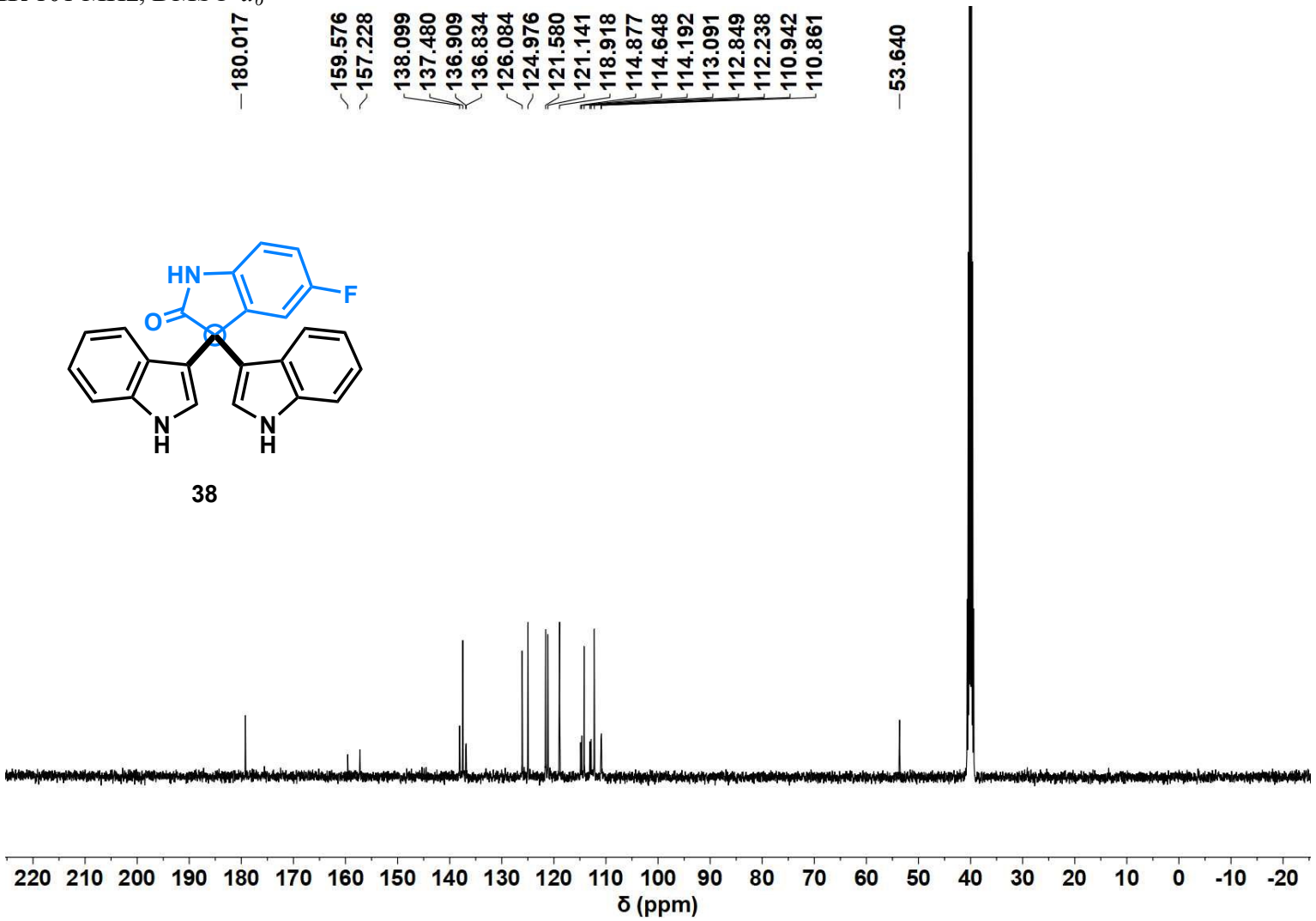



**37**

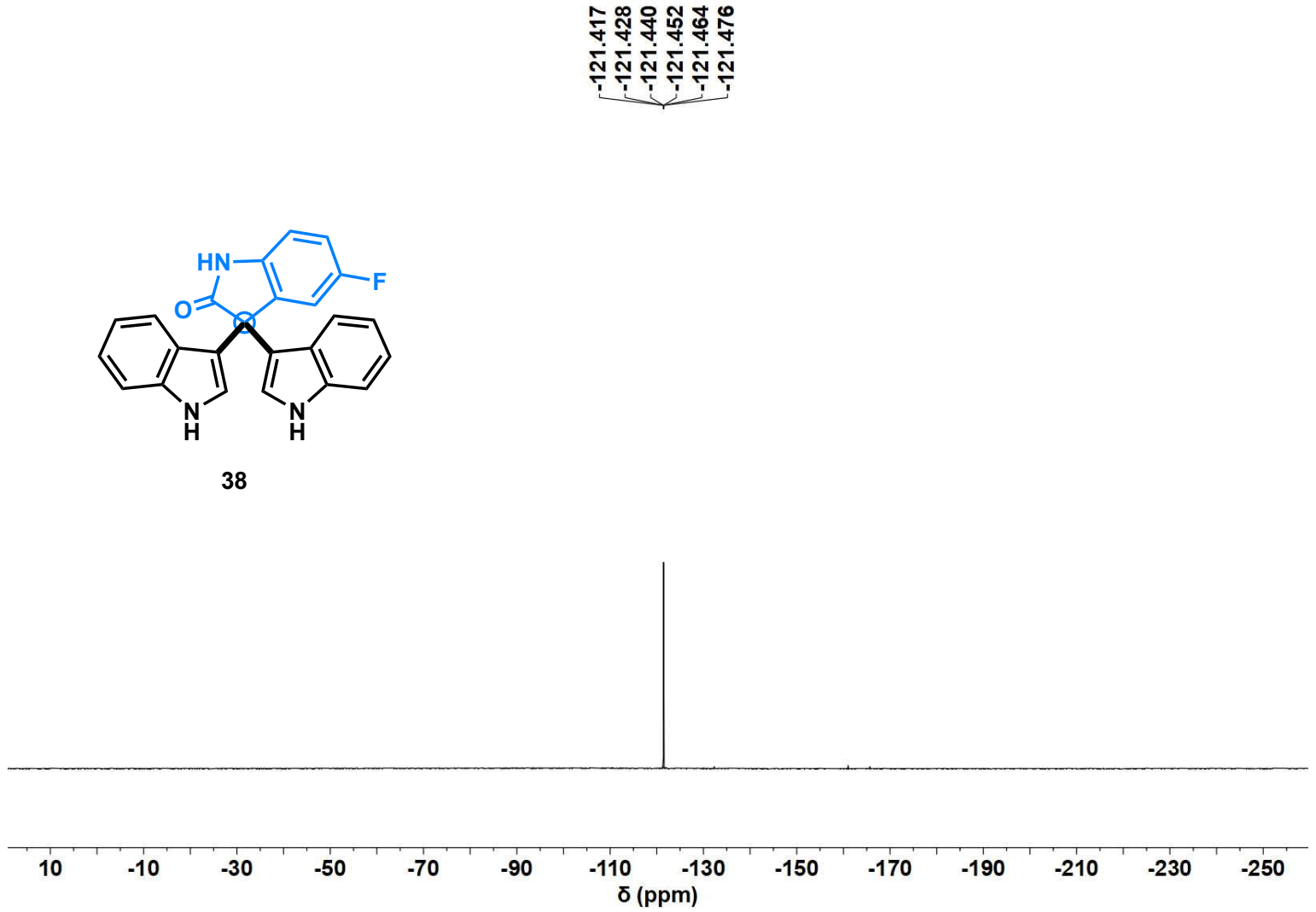
**$^1$H NMR** 400 MHz, DMSO-$d_6$



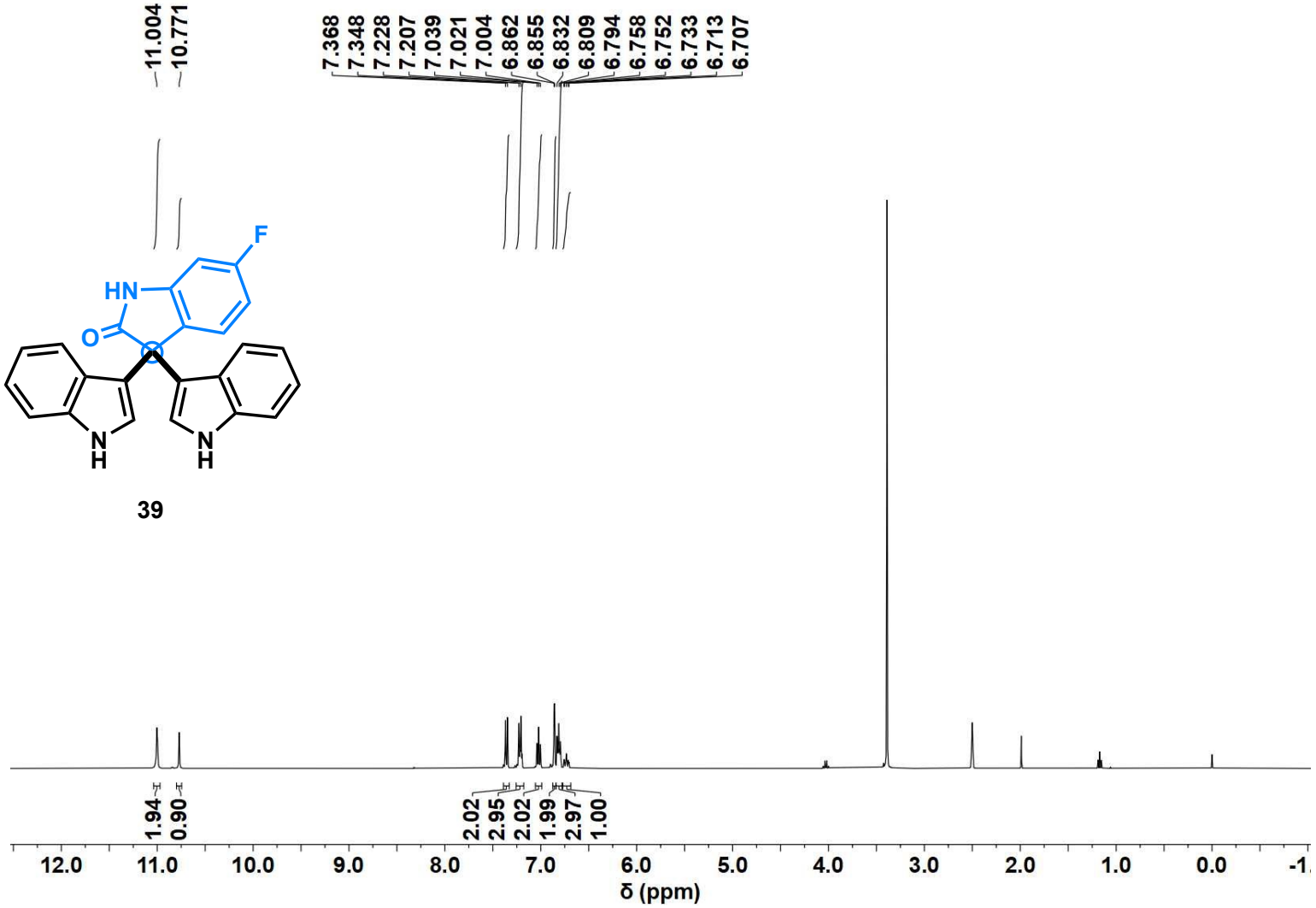
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



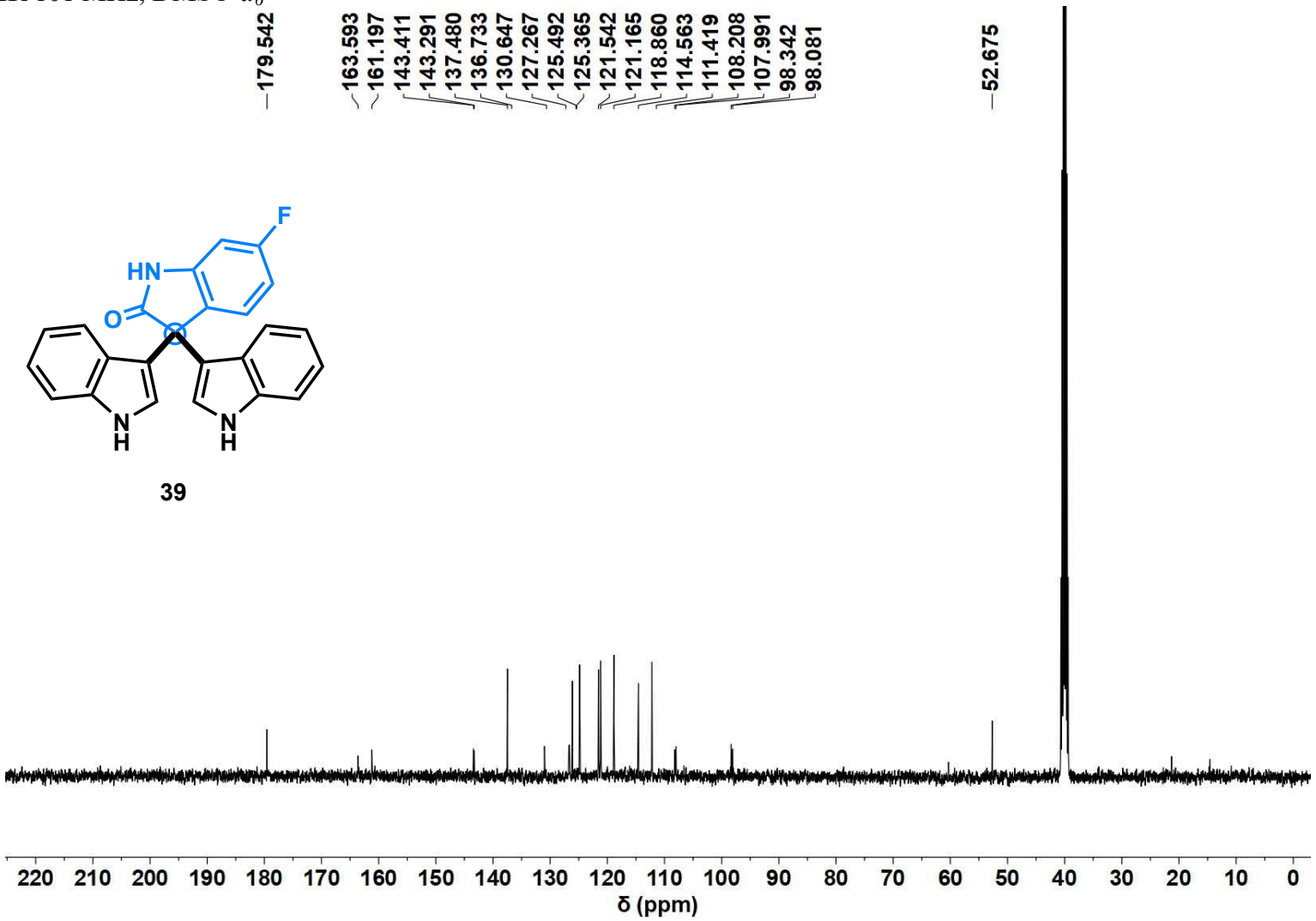
**$^{19}$F NMR** 376 MHz, DMSO-$d_6$



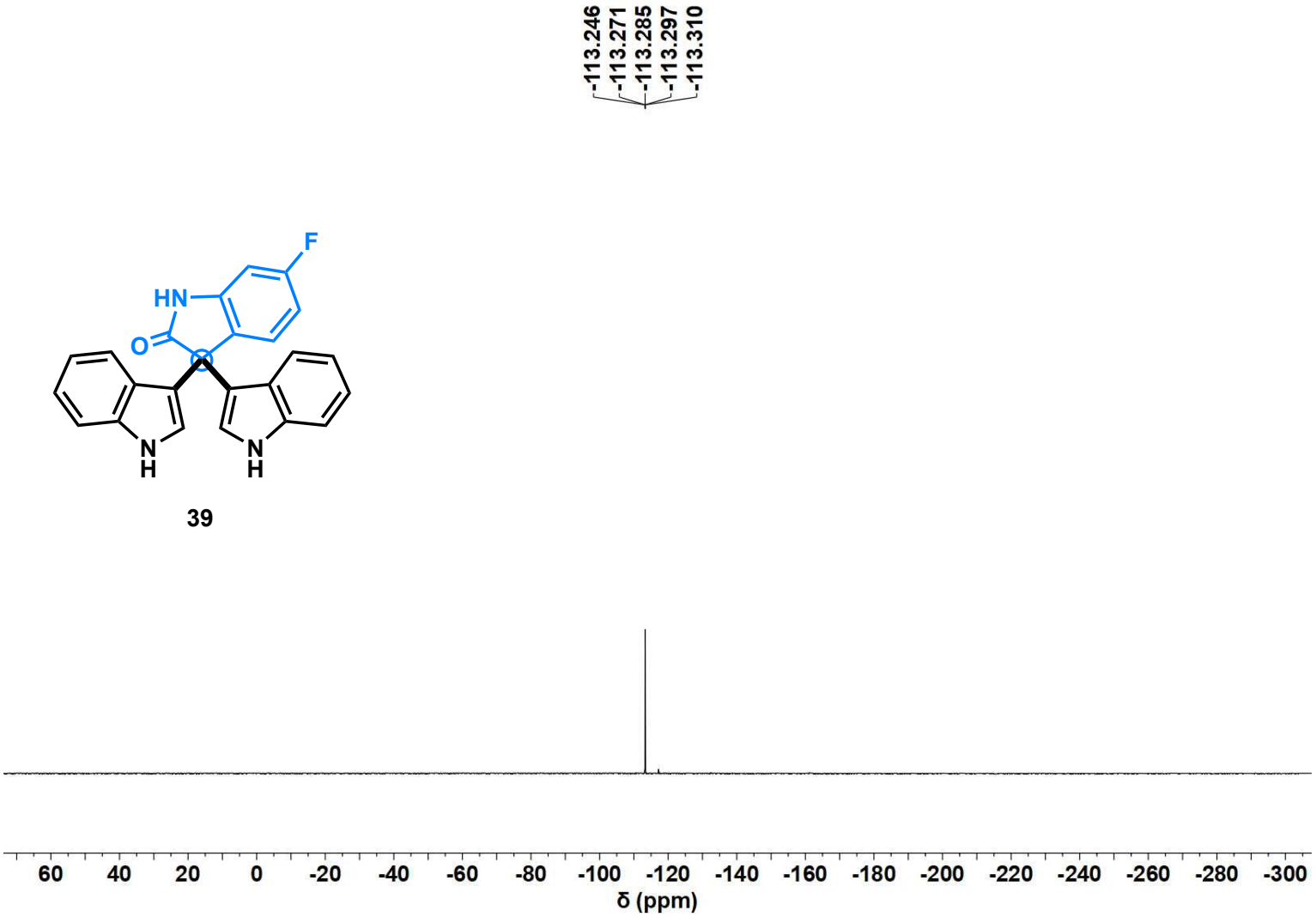
**$^1$H NMR** 400 MHz, DMSO-$d_6$



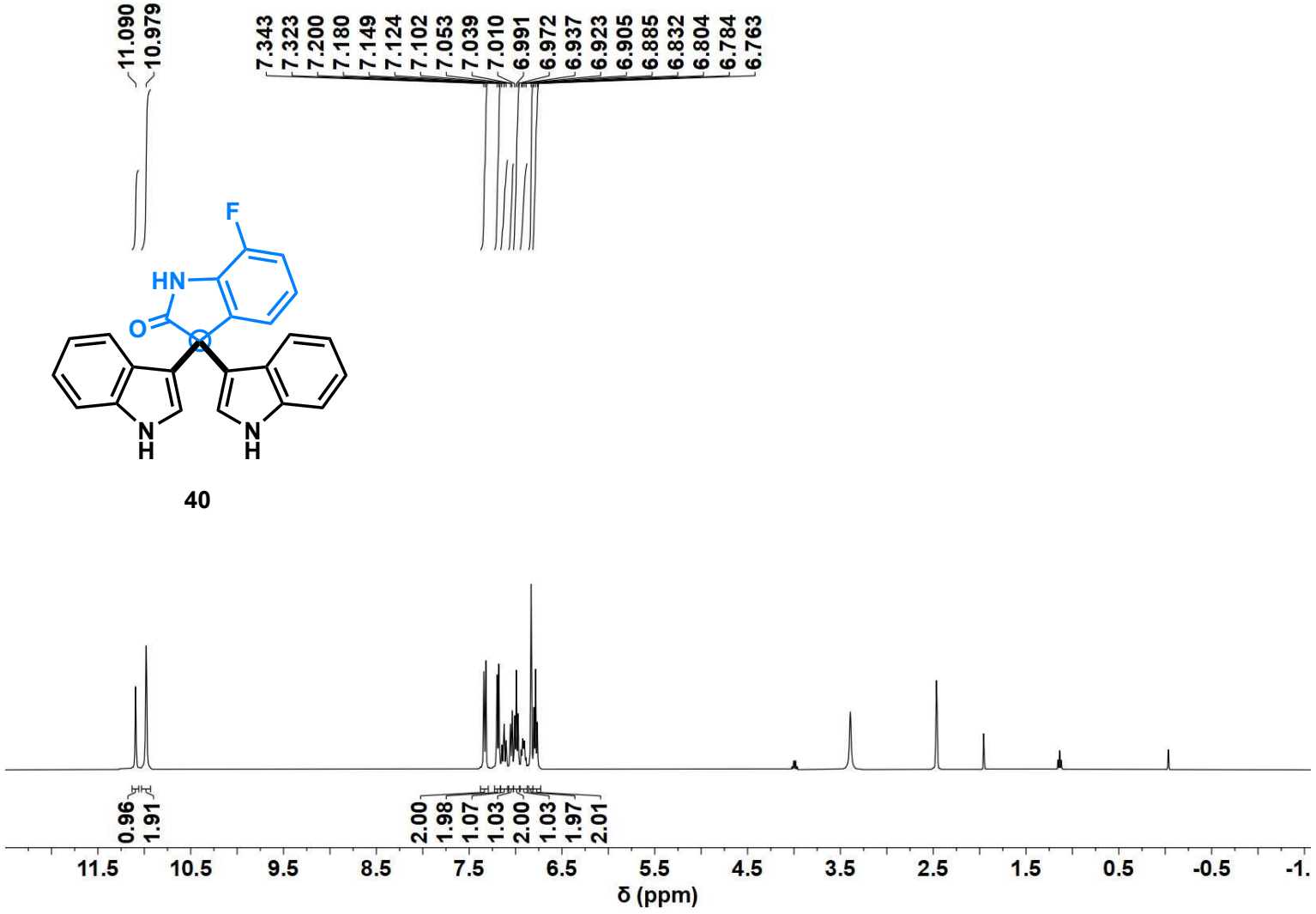
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



**$^{19}$F NMR** 376 MHz, DMSO-$d_6$

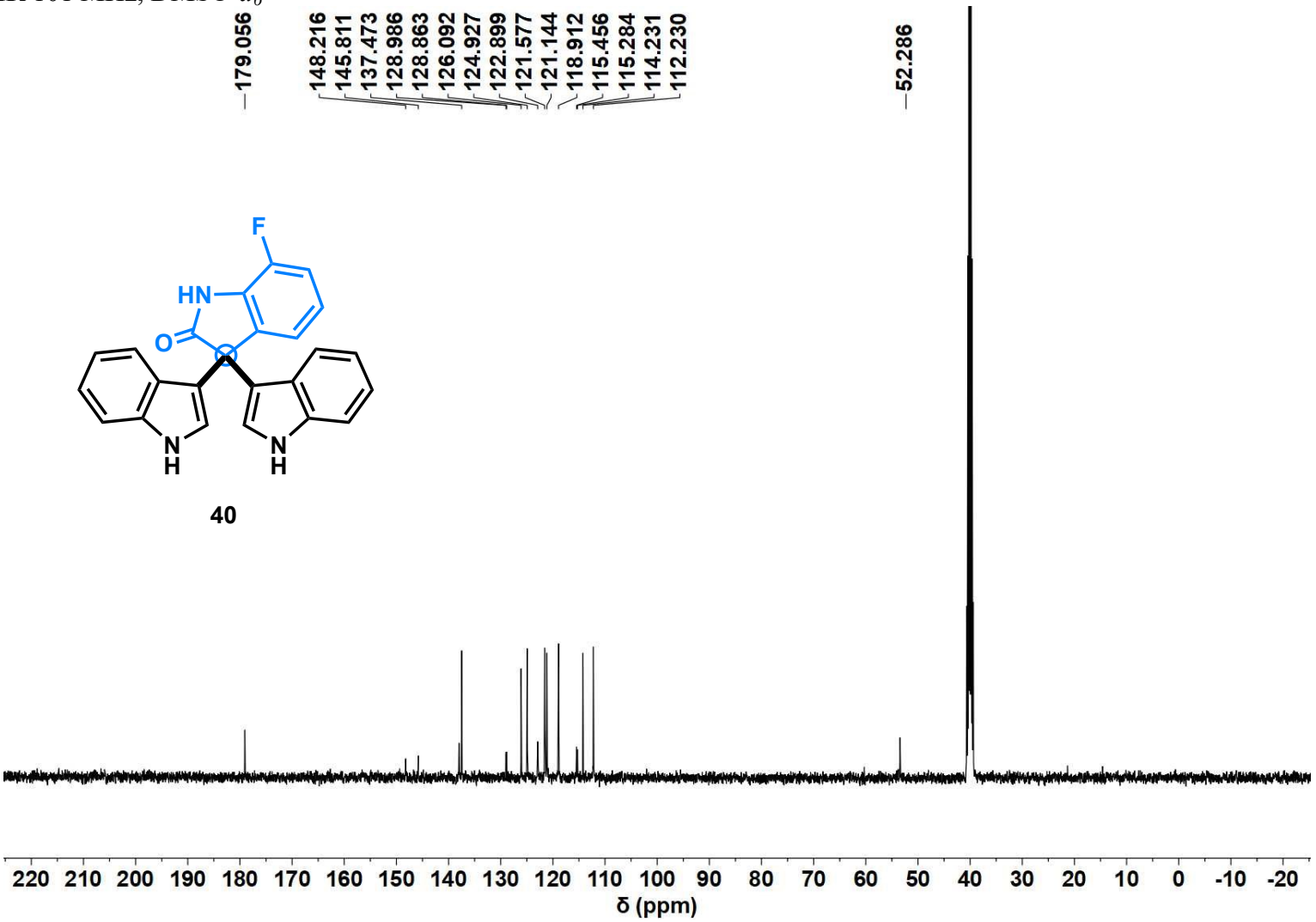


**$^1$H NMR** 400 MHz, DMSO-$d_6$



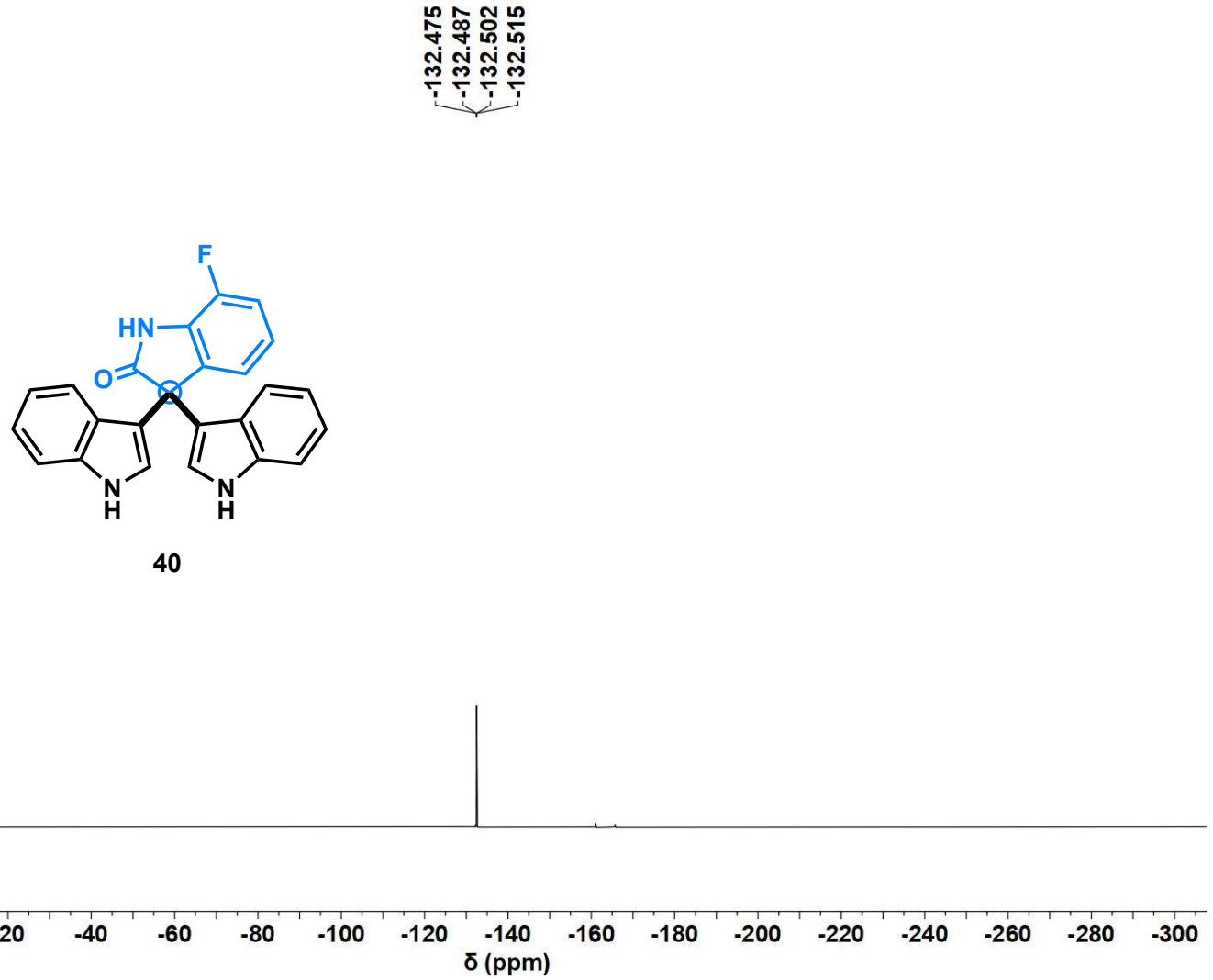

40

**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



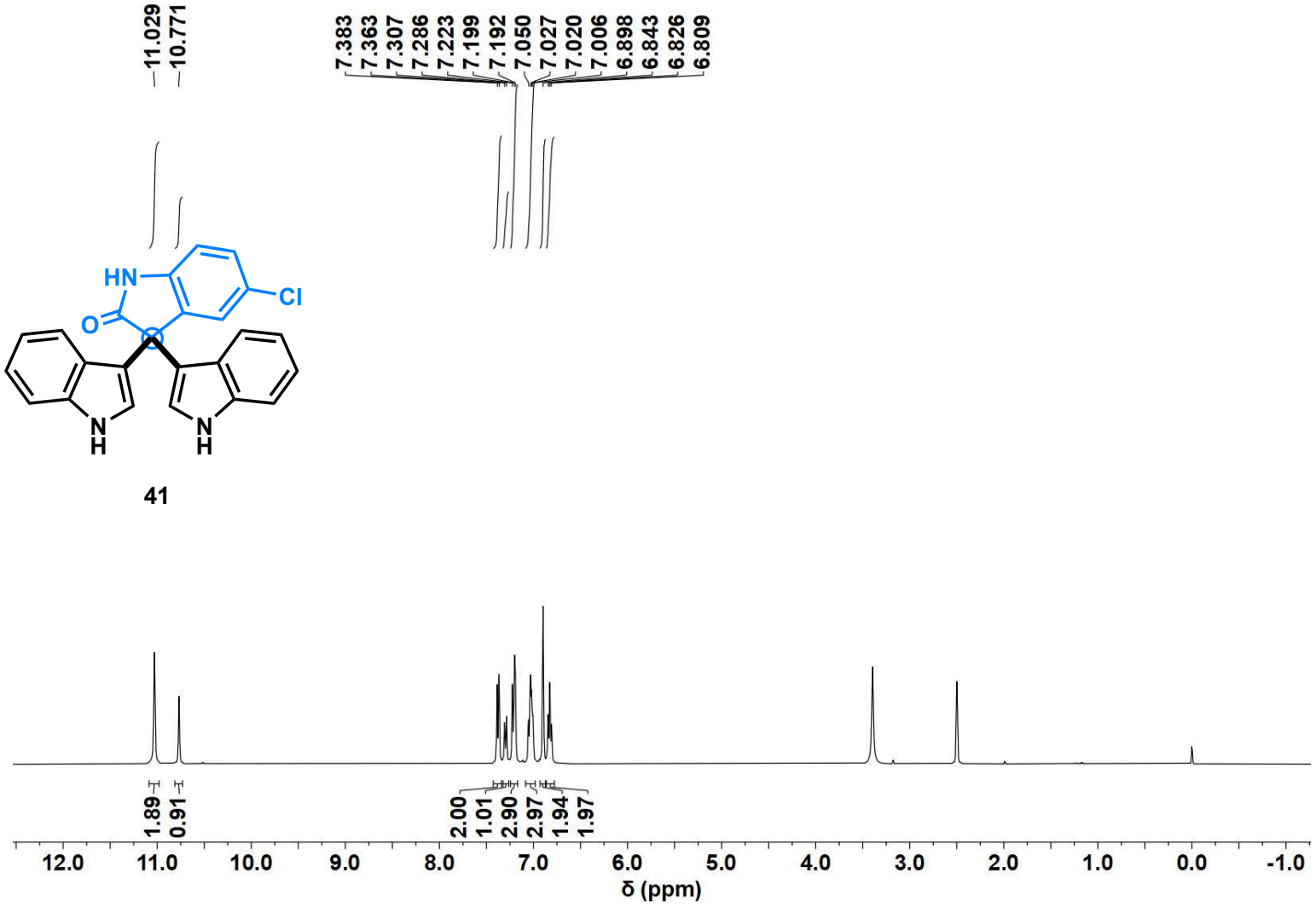

**40**

**$^{19}$F NMR** 376 MHz, DMSO-$d_6$

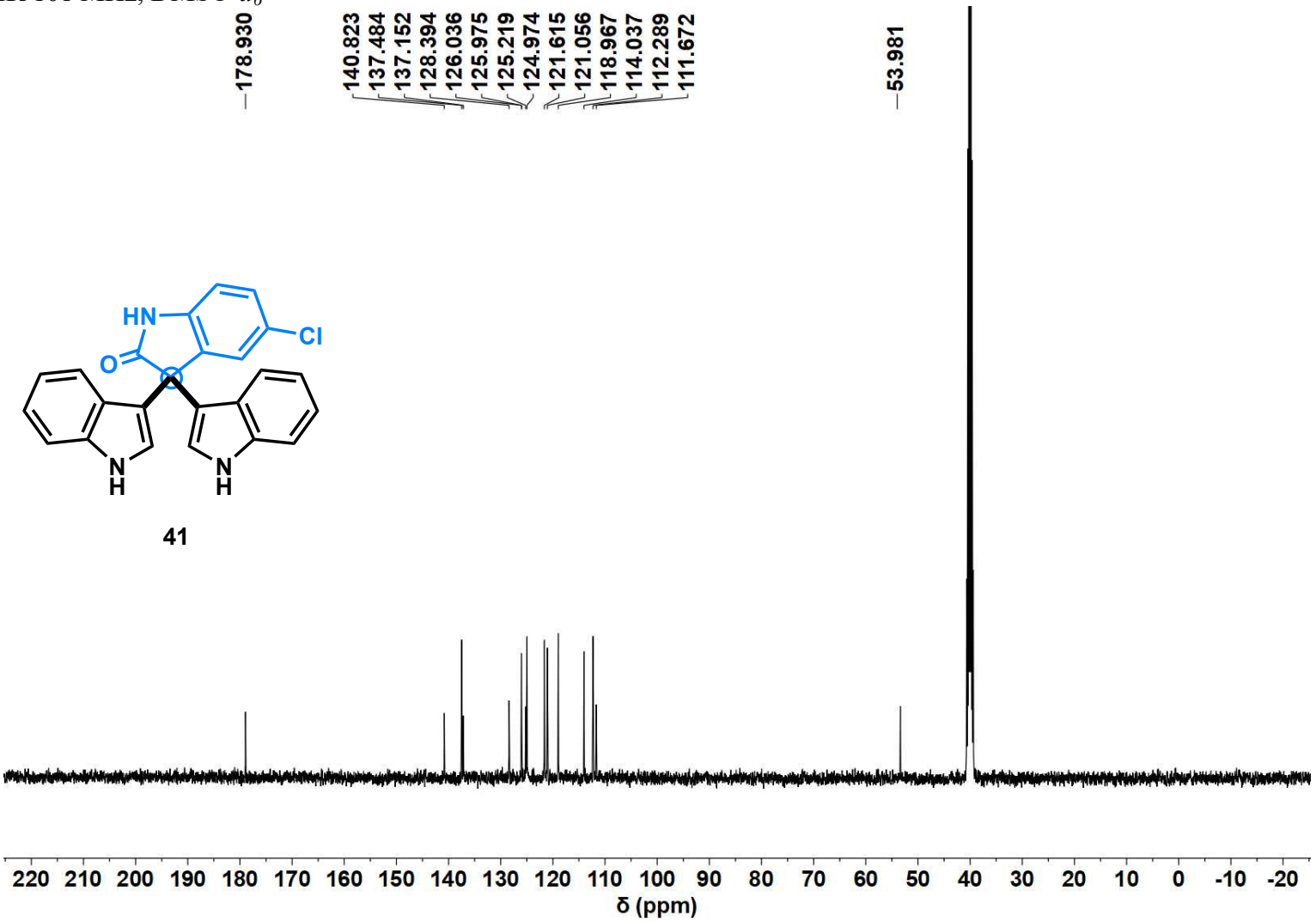



**40**

**$^1$H NMR** 400 MHz, DMSO-$d_6$

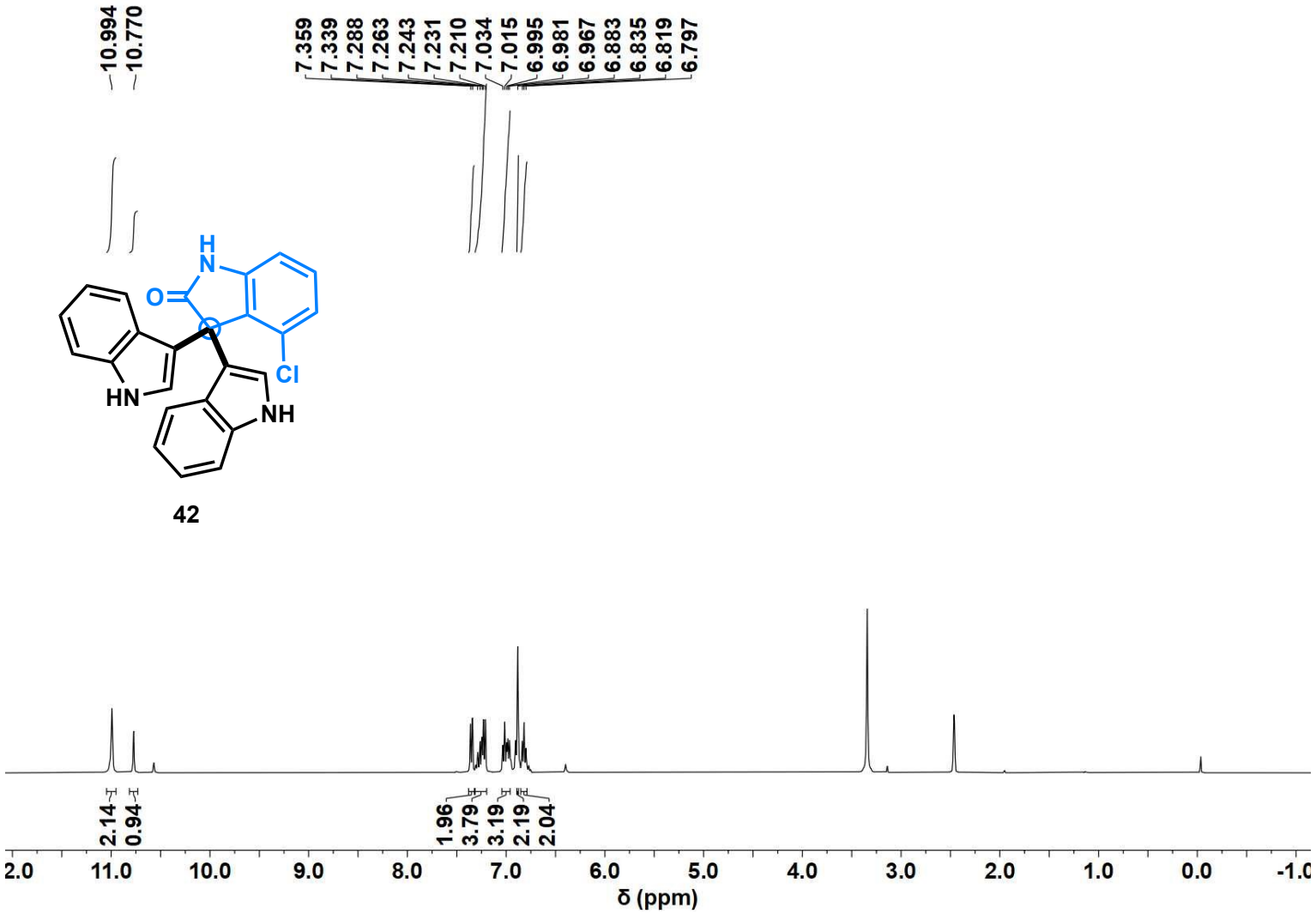


**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



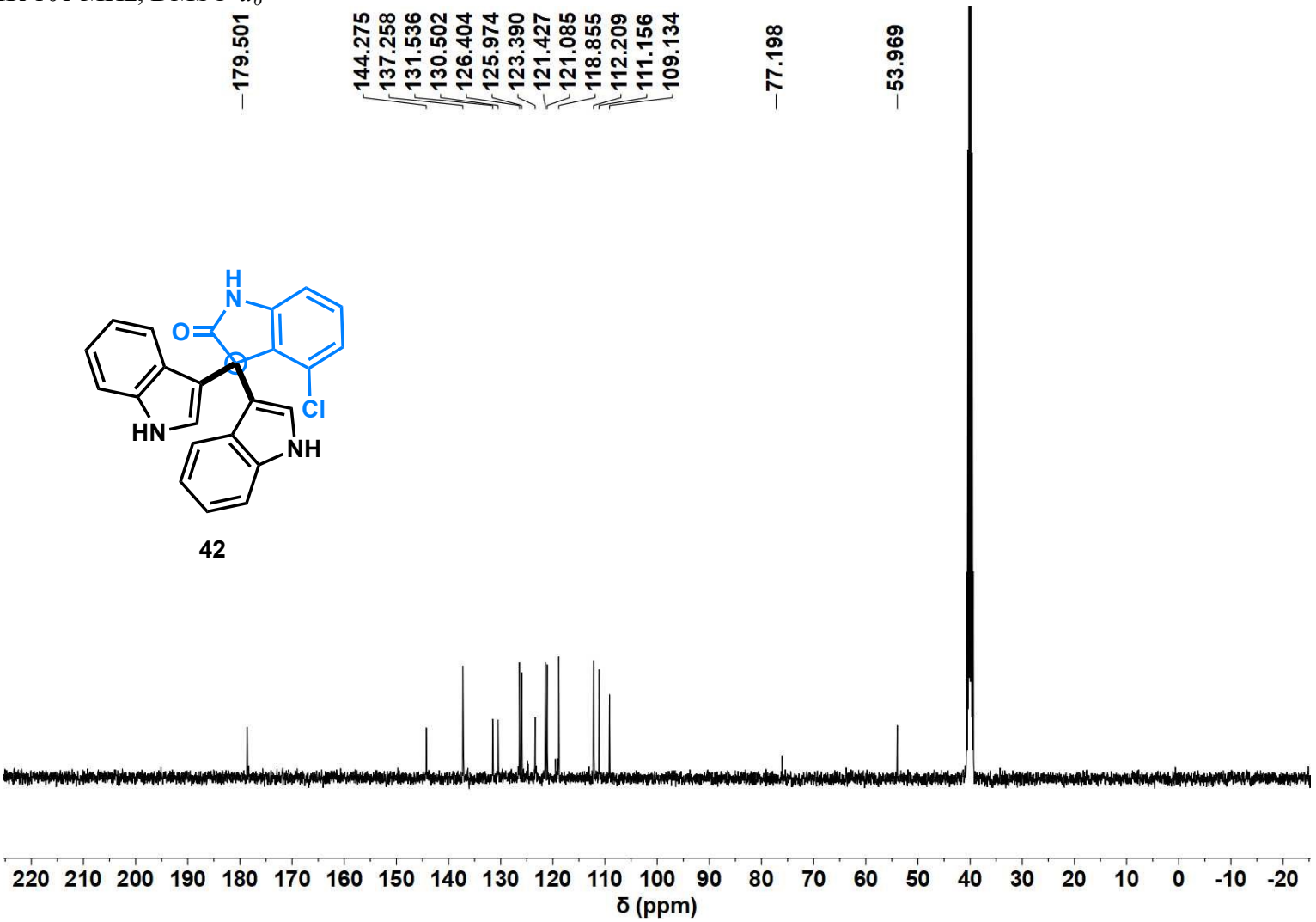

**41**

**$^1$H NMR** 400 MHz, DMSO-$d_6$

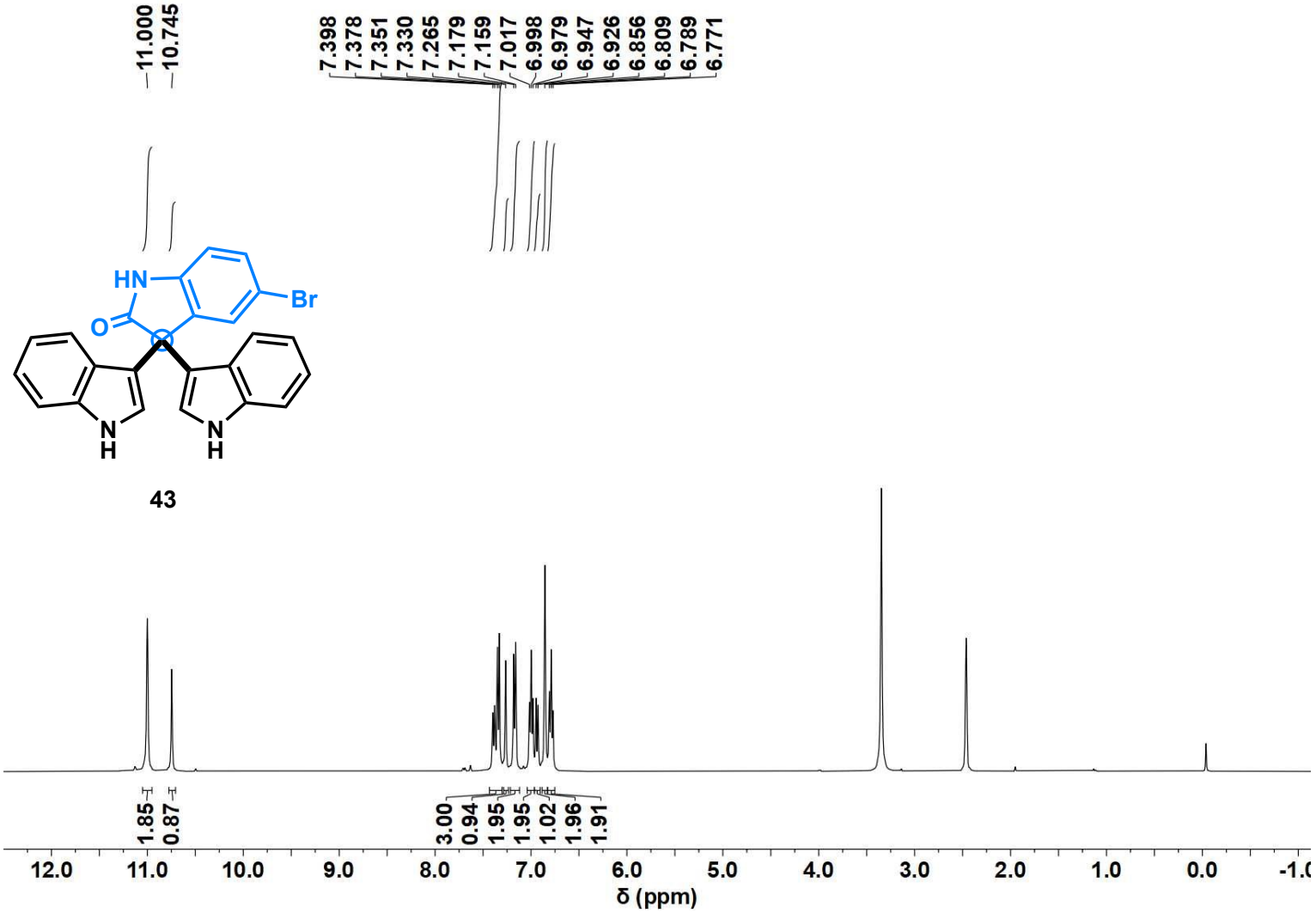



**42**

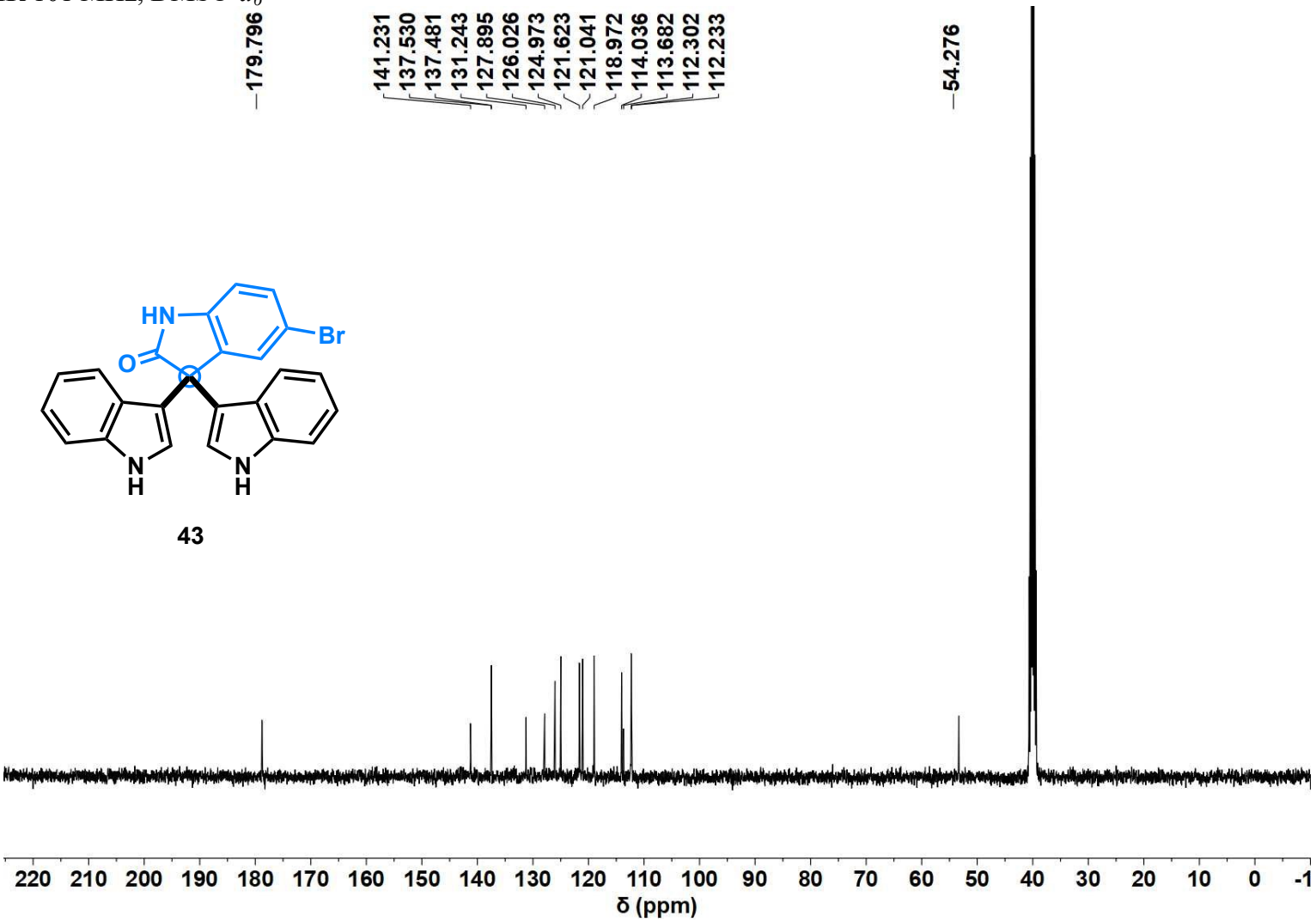
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



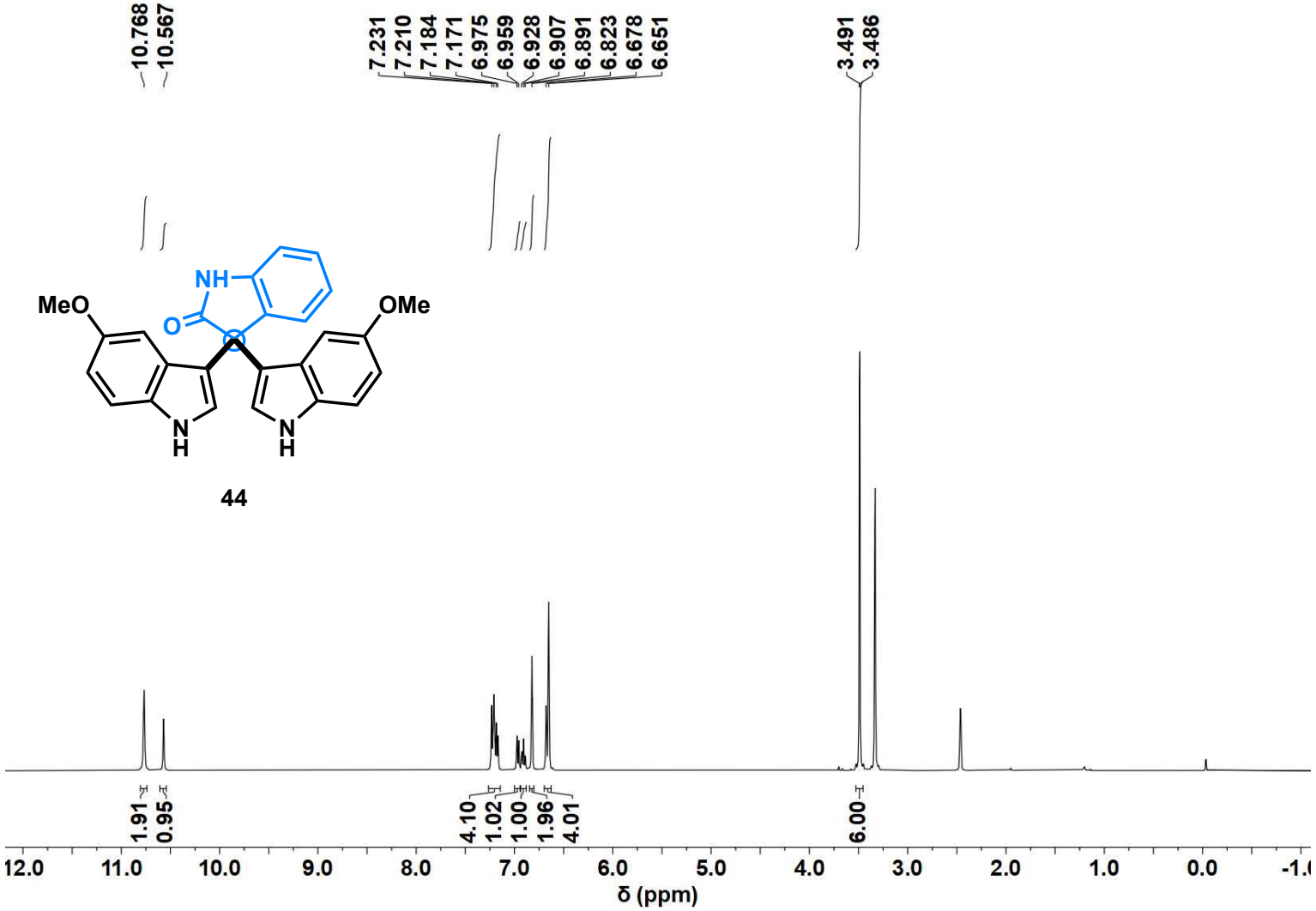
**$^1$H NMR** 400 MHz, DMSO-$d_6$



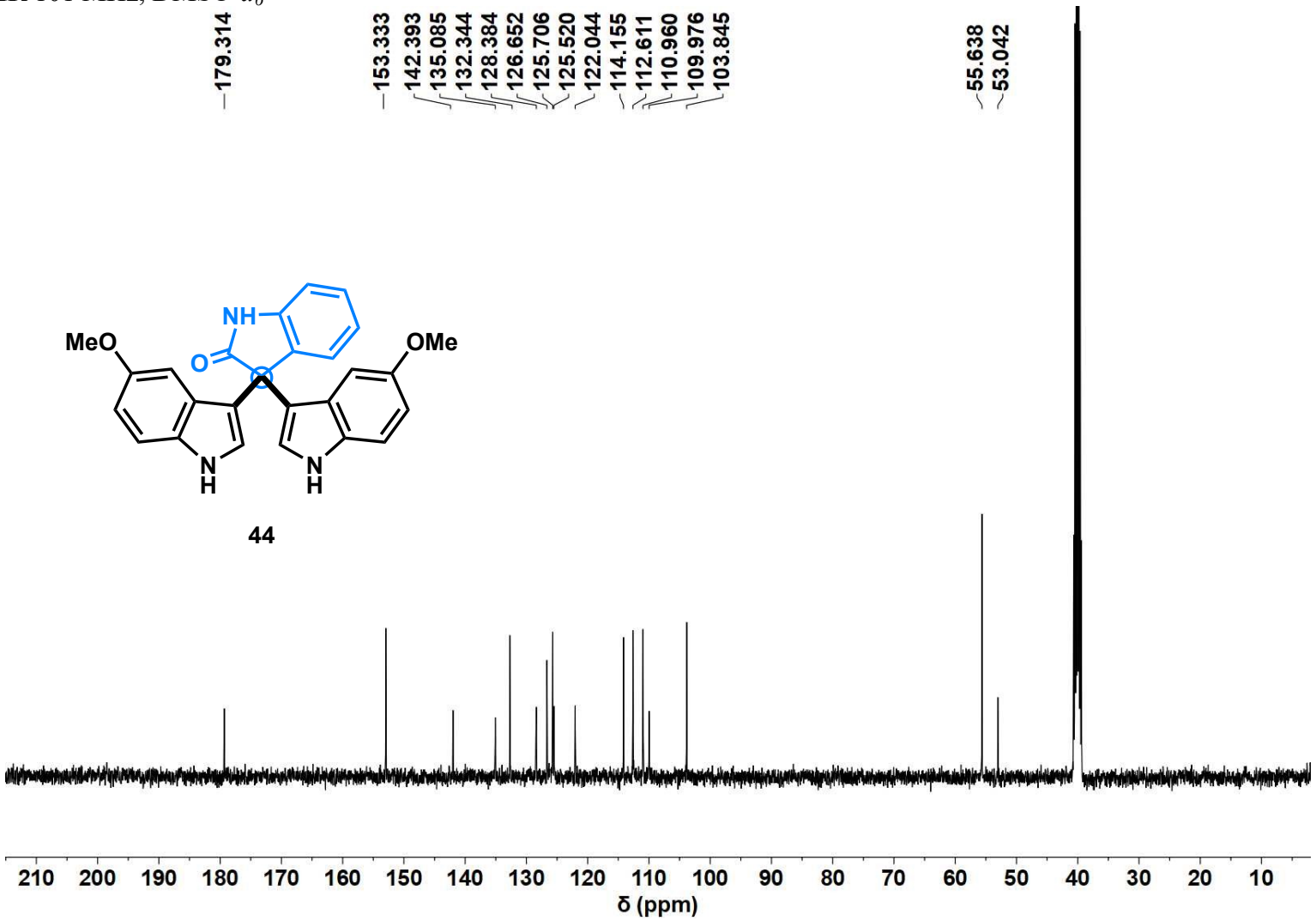
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



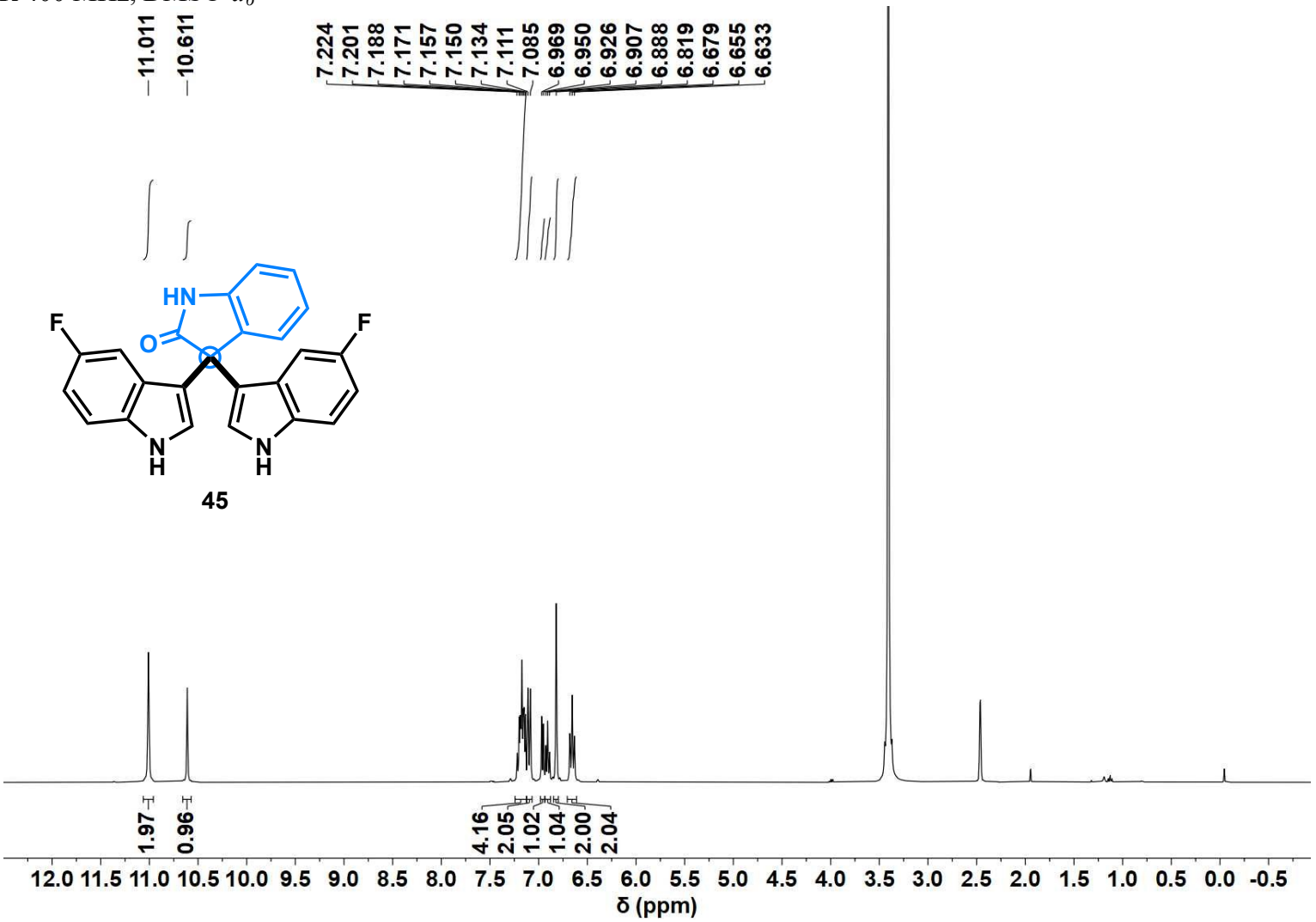
**$^1$H NMR** 400 MHz, DMSO-$d_6$



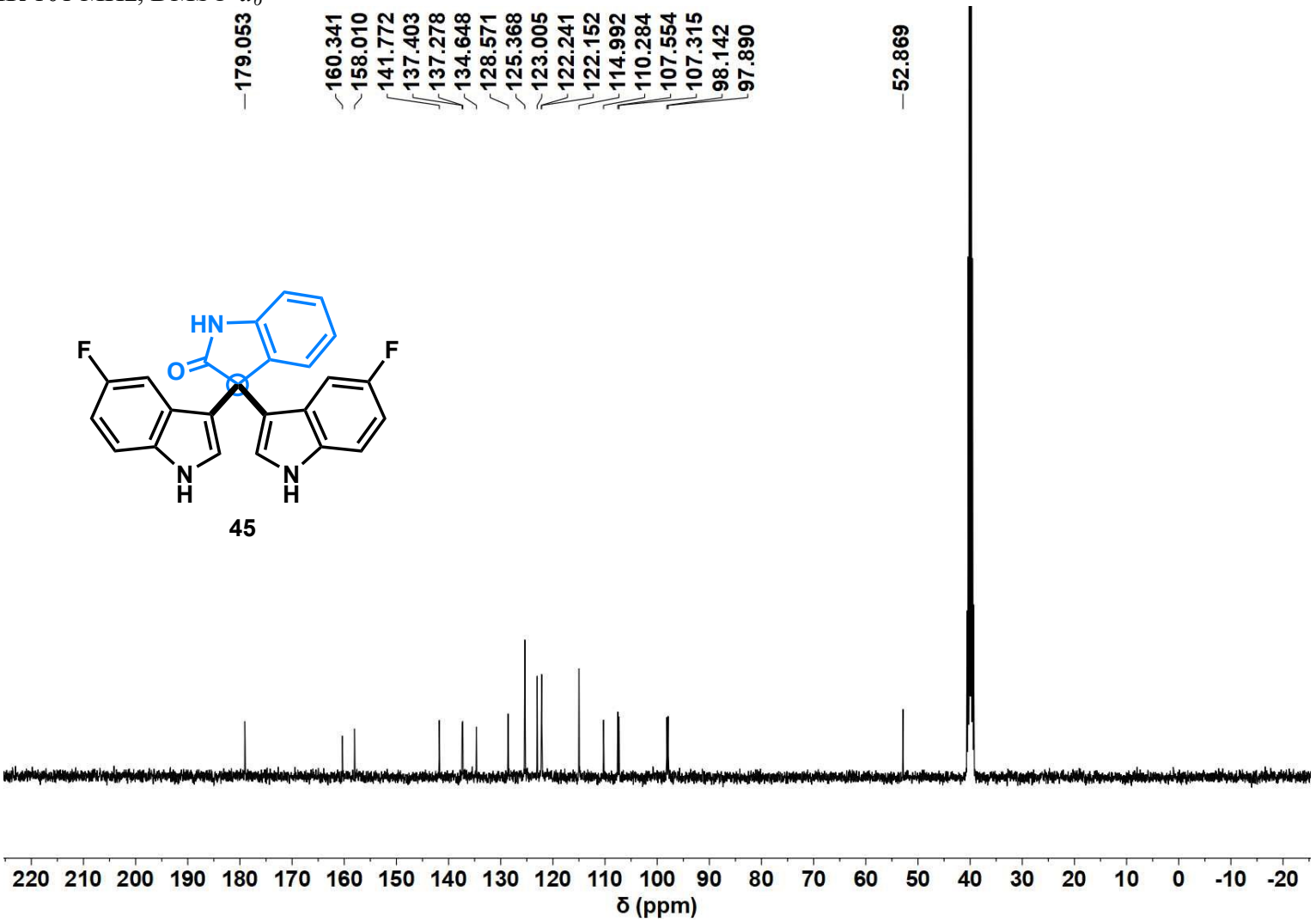
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



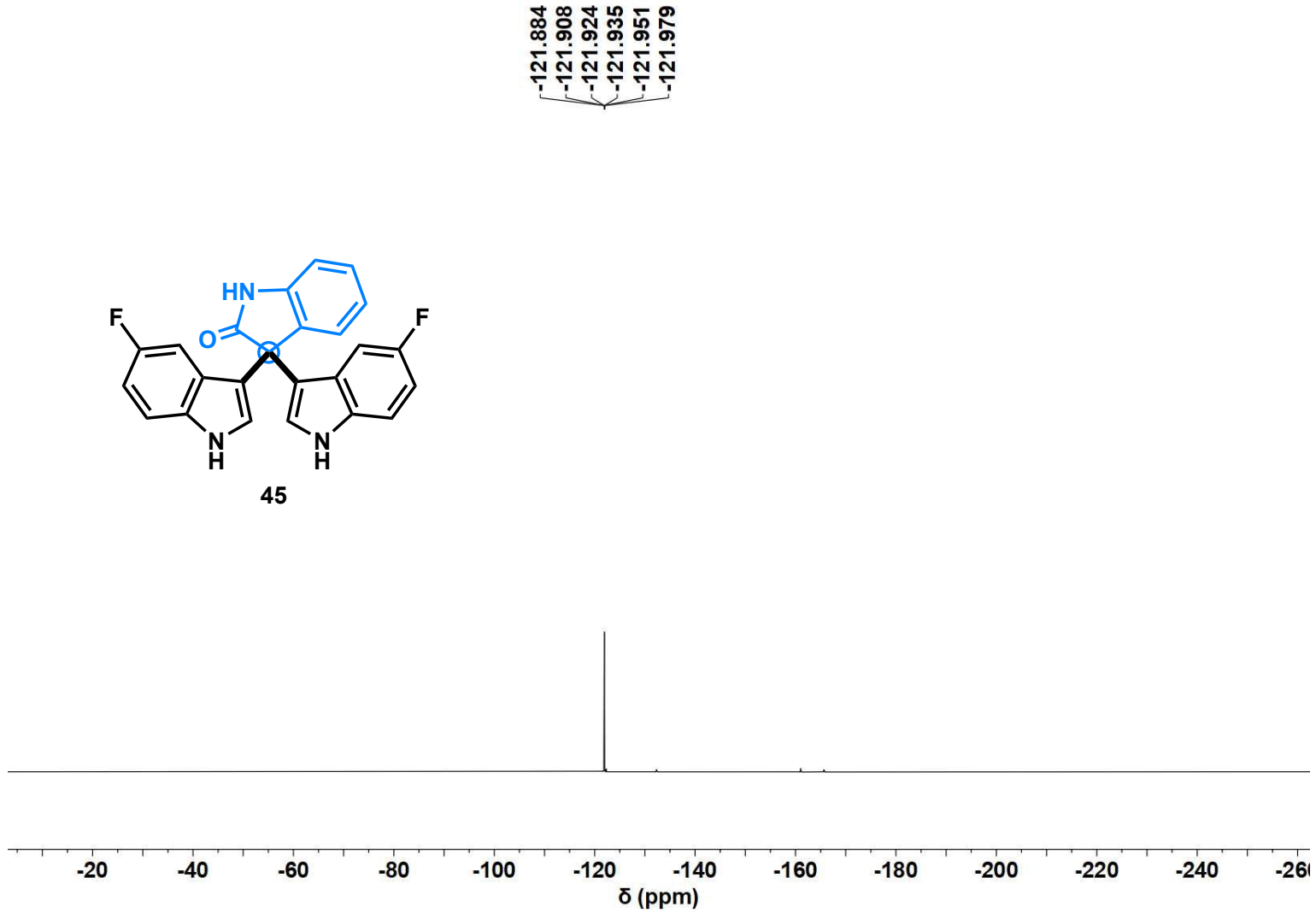
**$^1$H NMR** 400 MHz, DMSO-$d_6$



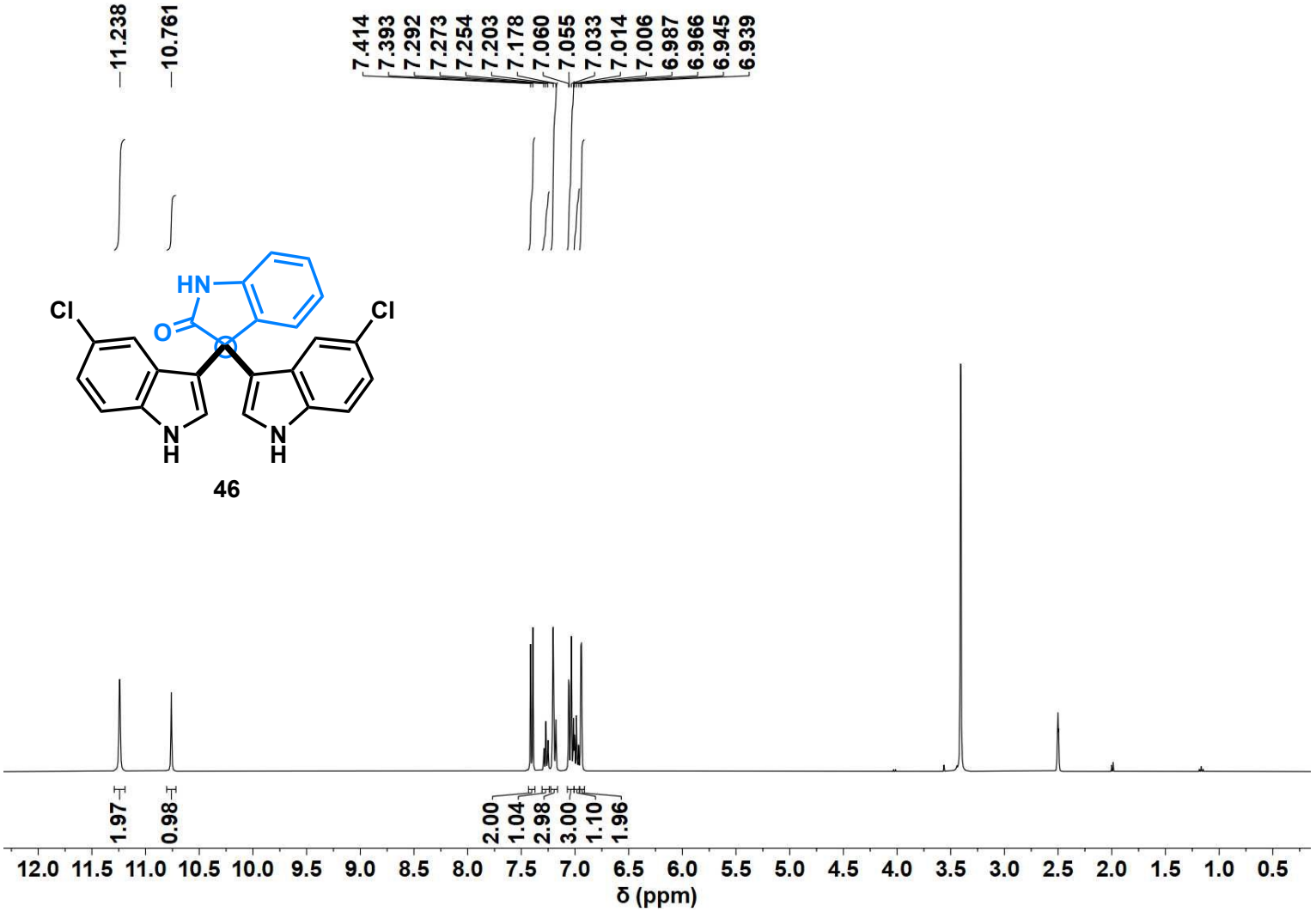
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



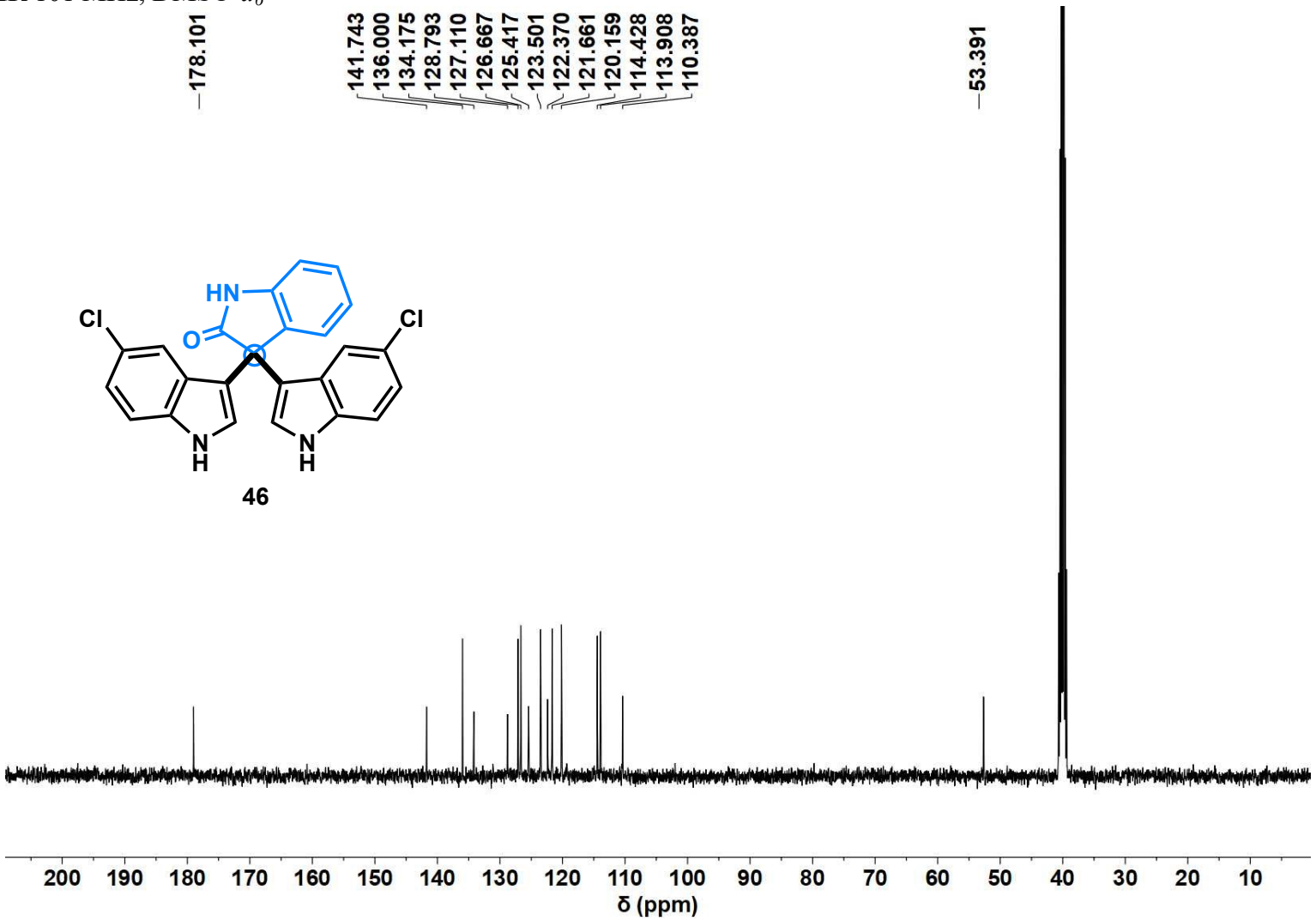
**$^{19}$F NMR** 376 MHz, DMSO-$d_6$



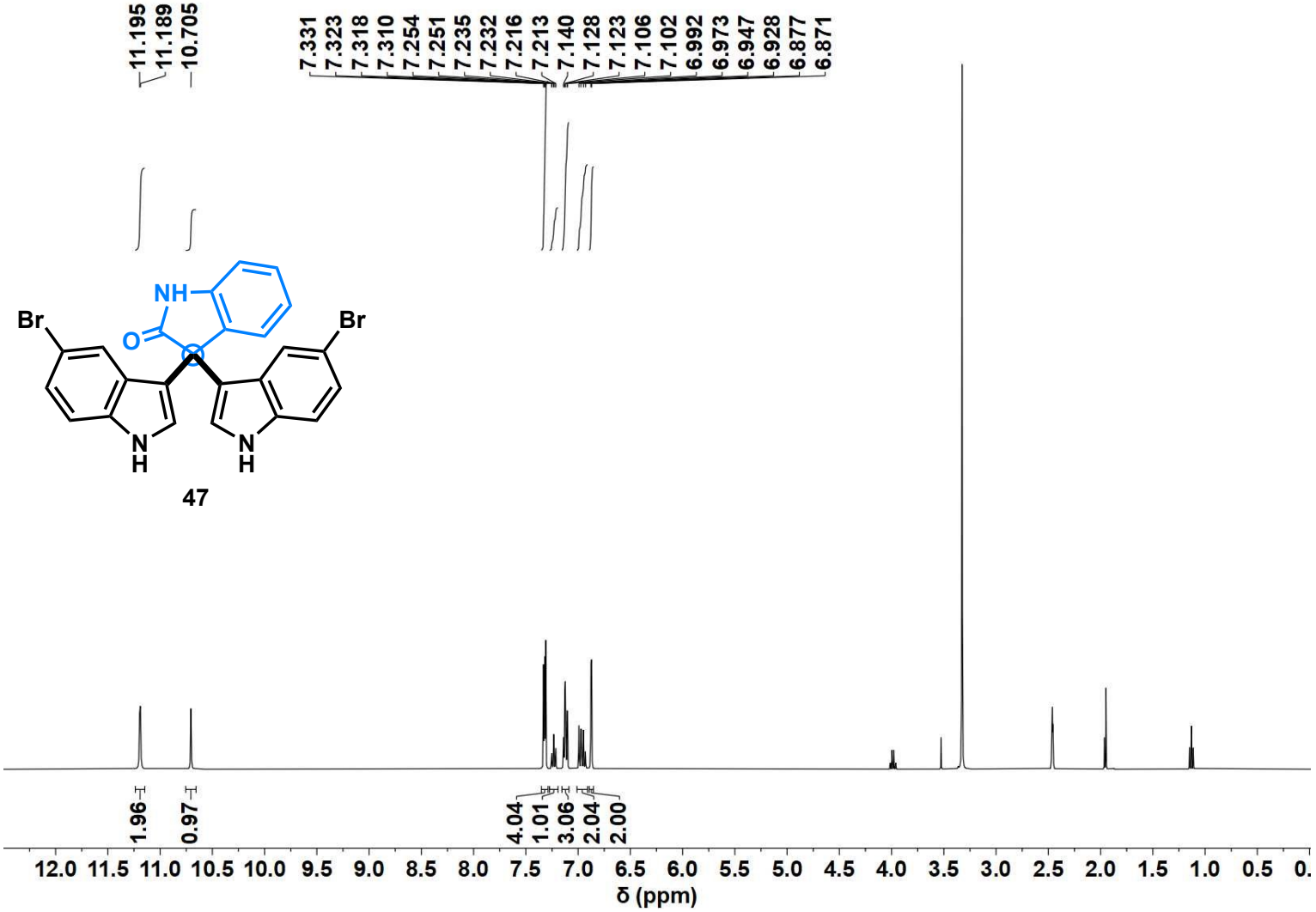
**$^1$H NMR** 400 MHz, DMSO-$d_6$



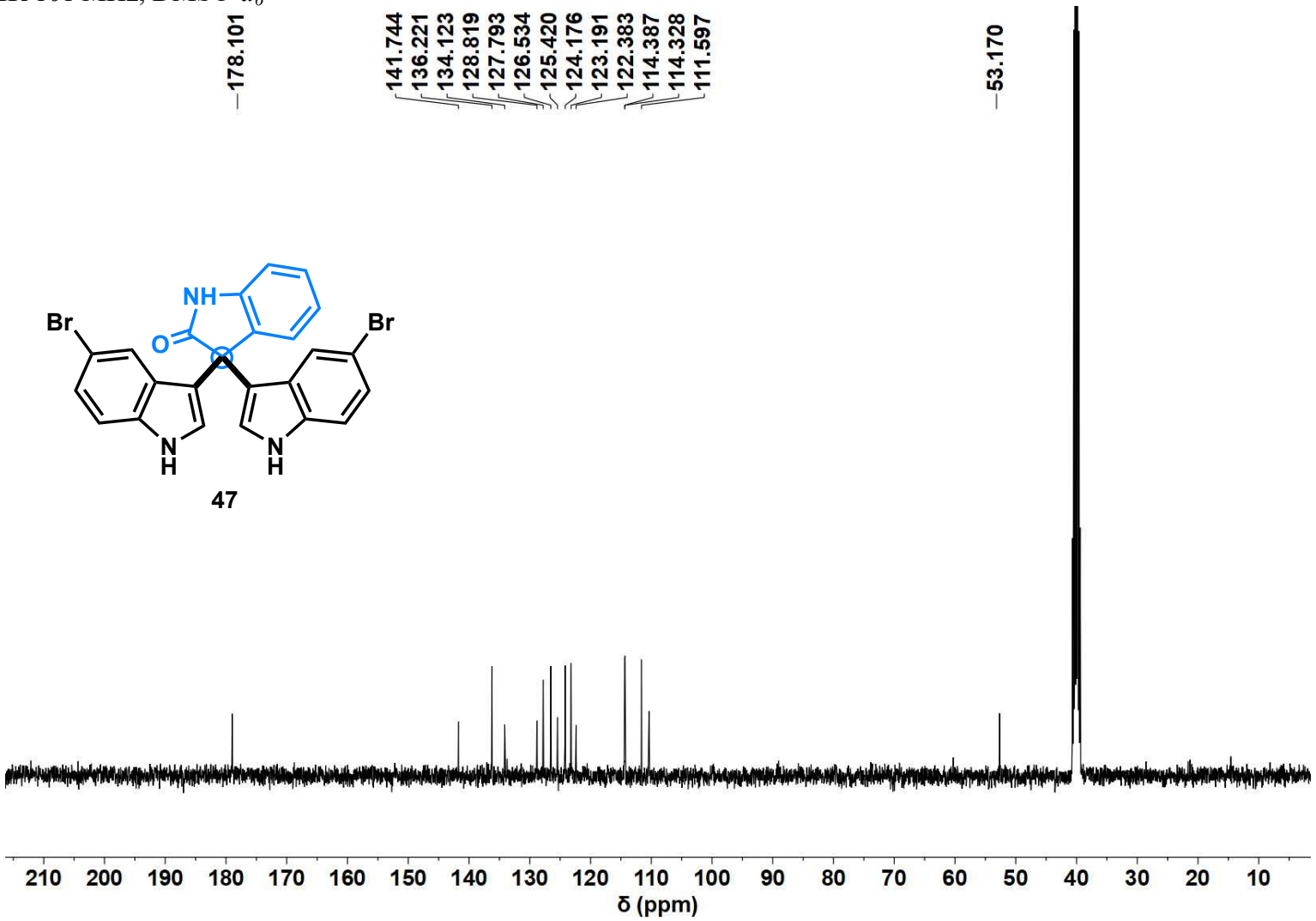
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



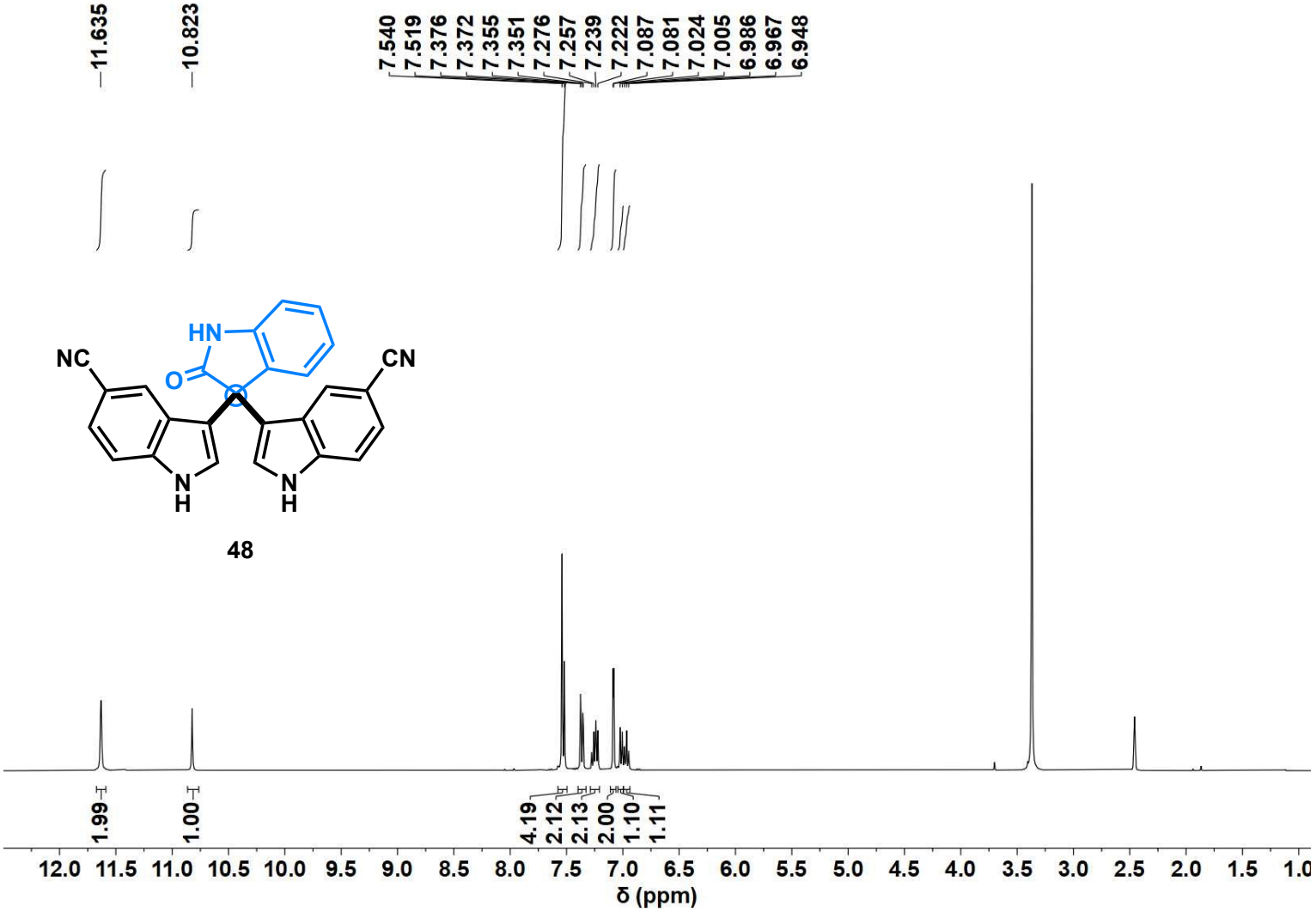
**$^1$H NMR** 400 MHz, DMSO-$d_6$



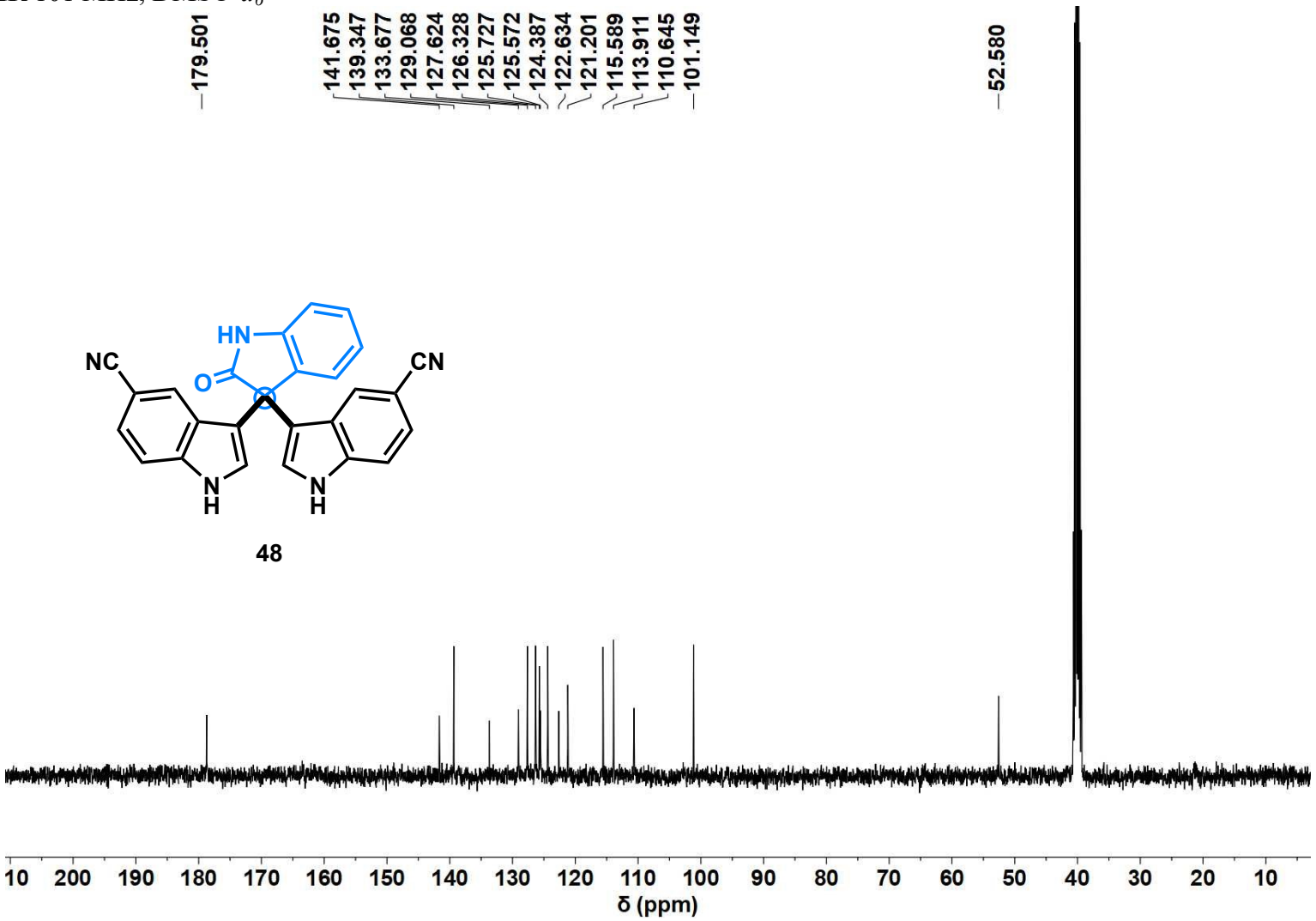
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



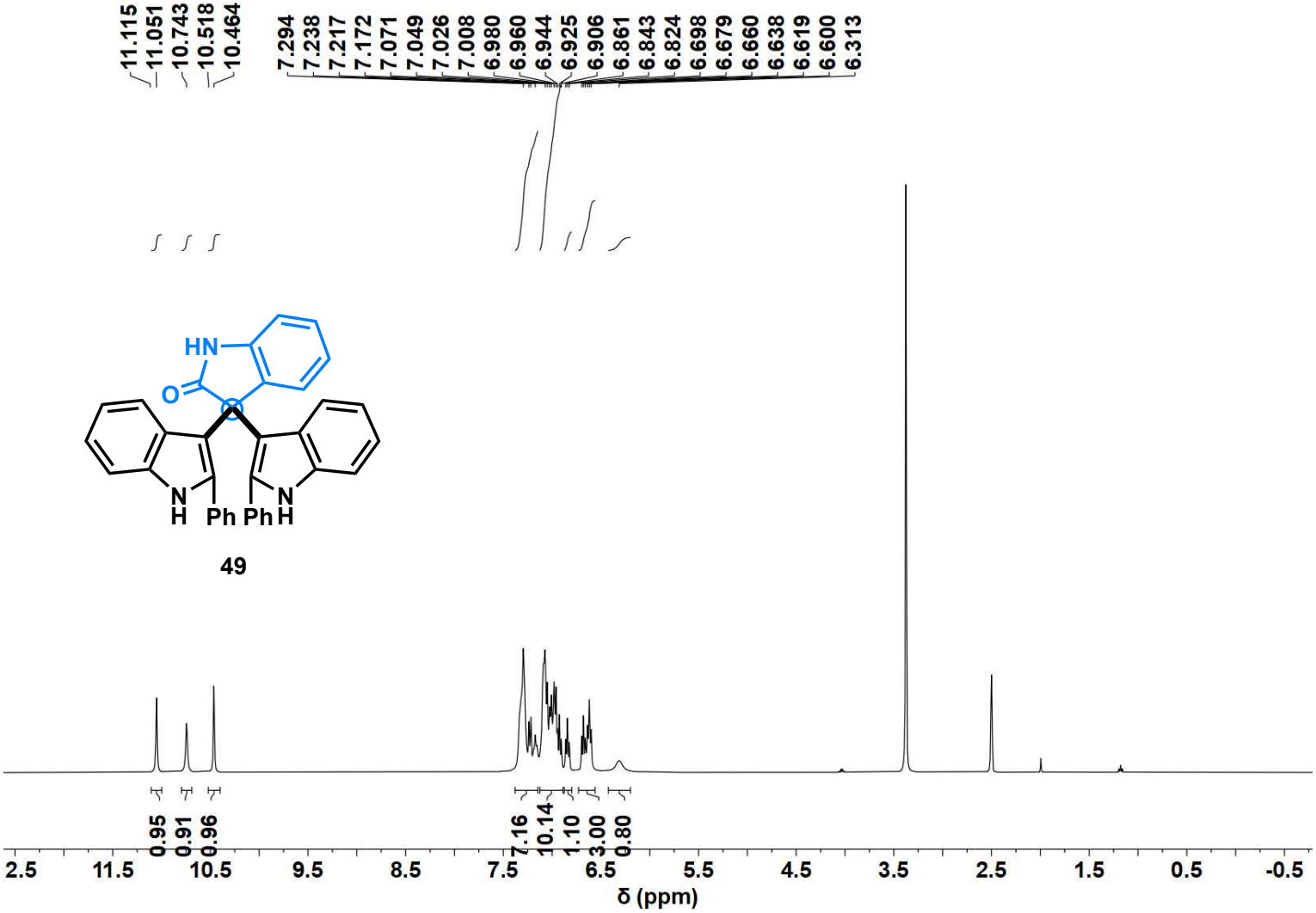
**$^1$H NMR** 400 MHz, DMSO-$d_6$



**$^{13}$C NMR** 101 MHz, DMSO-$d_6$

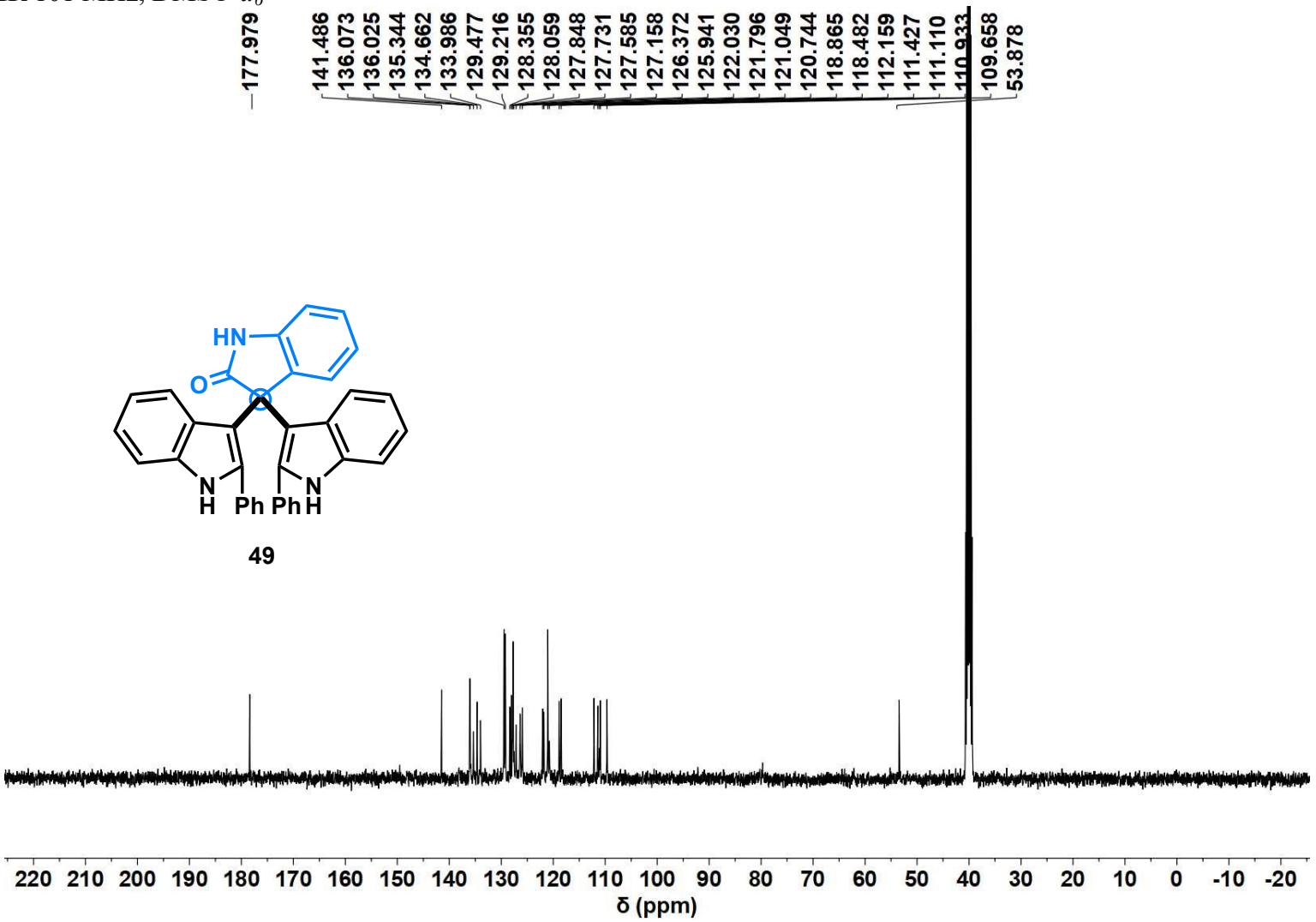


**$^1$H NMR** 400 MHz, DMSO-$d_6$



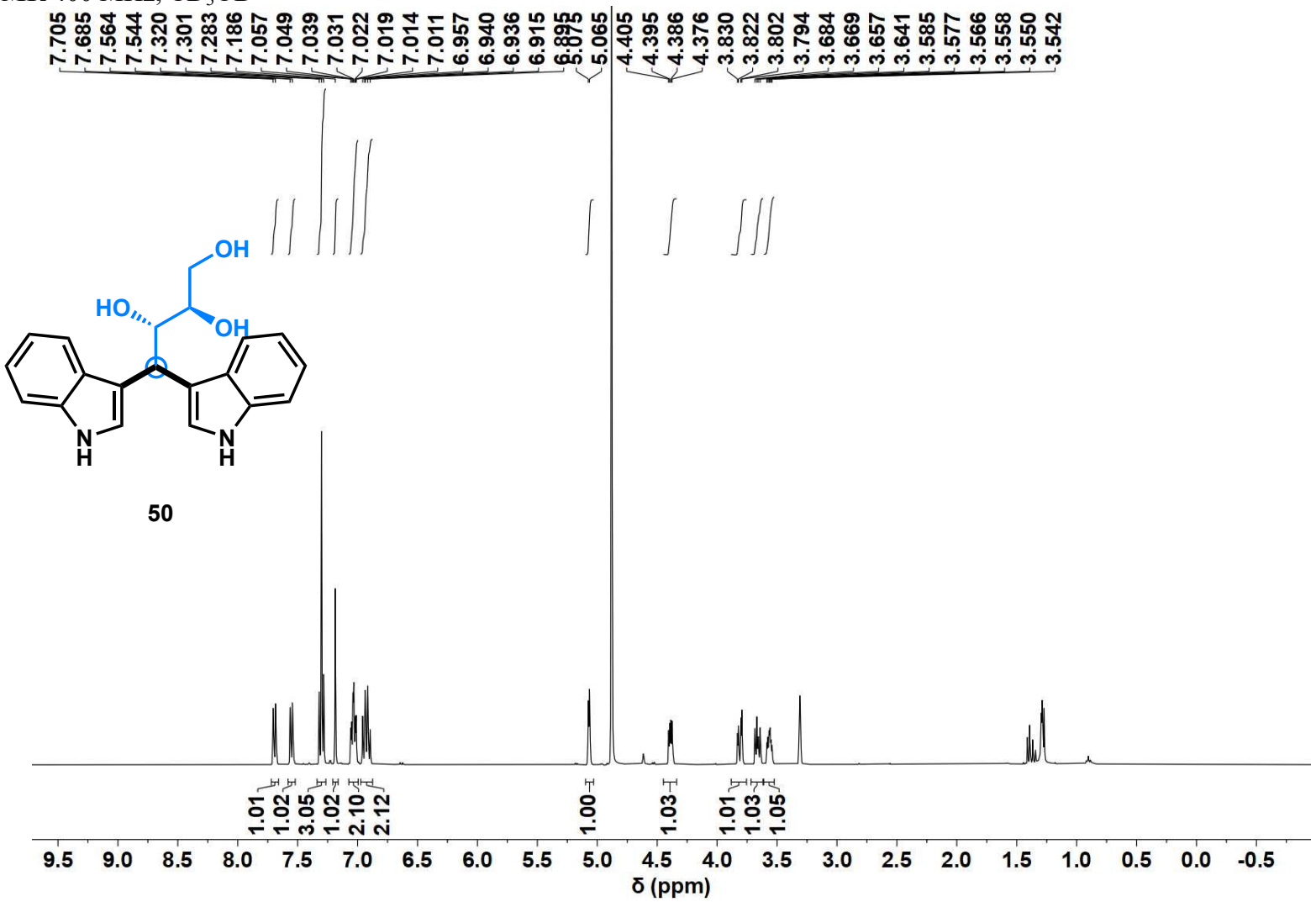

**49**

**$^{13}$C NMR** 101 MHz, DMSO-$d_6$

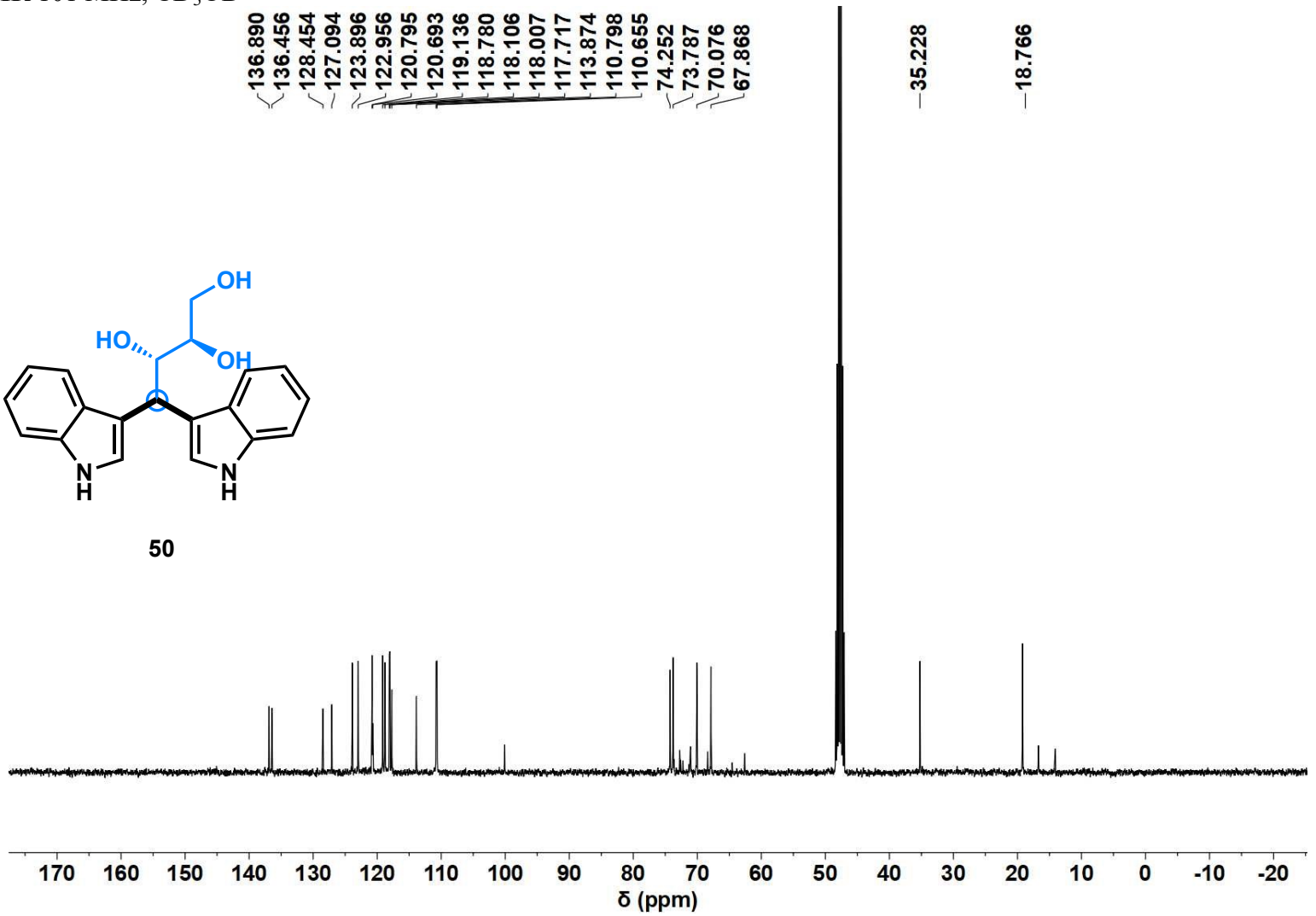



**49**

**$^1$H NMR** 400 MHz, $CD_3OD$

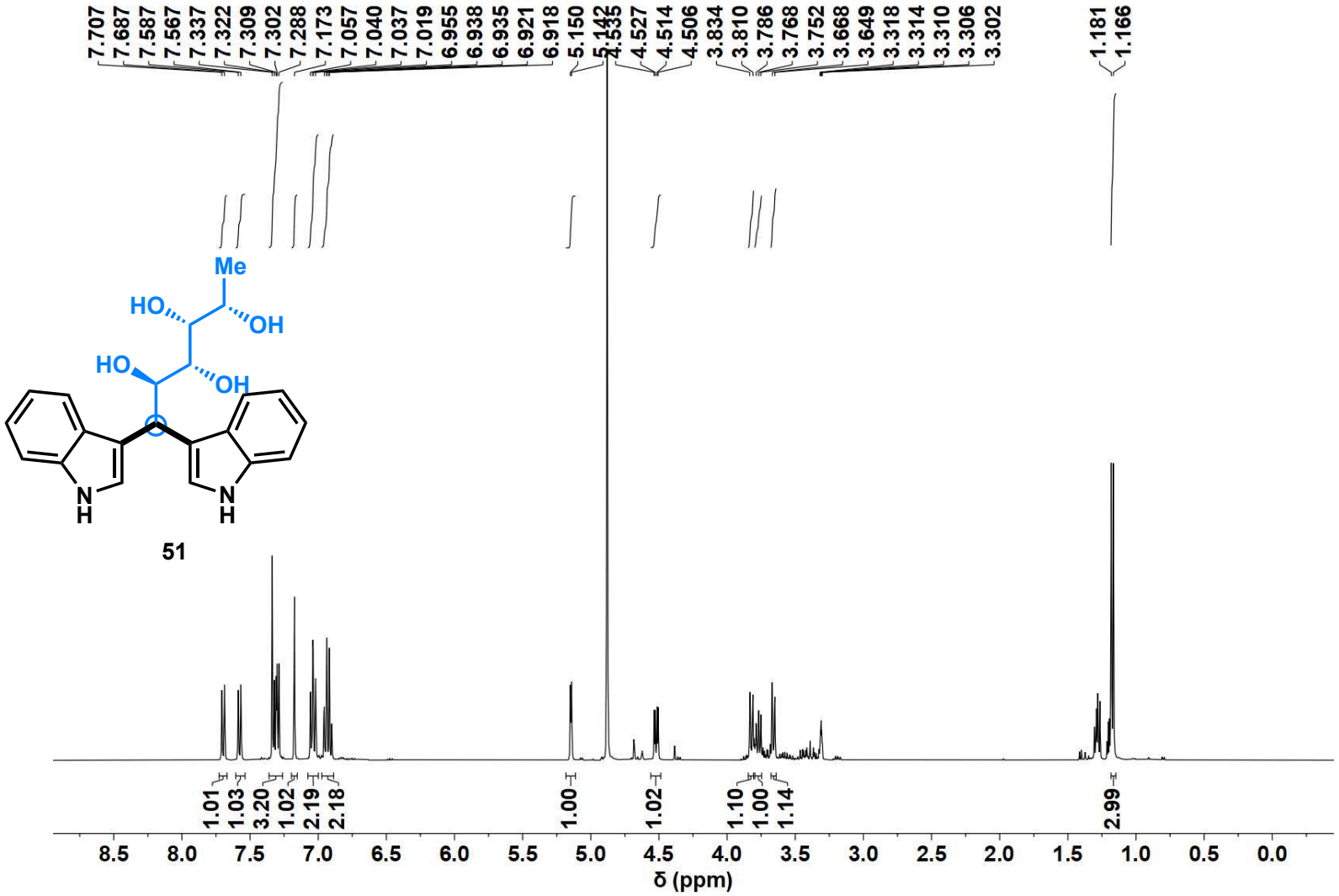


**$^{13}$C NMR** 101 MHz, $CD_3OD$

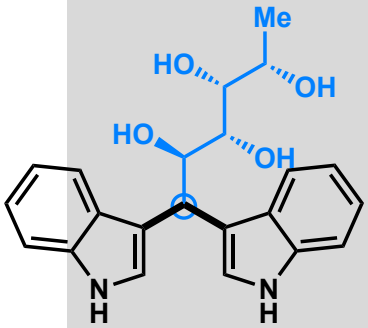



**50**

**$^1$H NMR** 400 MHz, $CD_3OD$

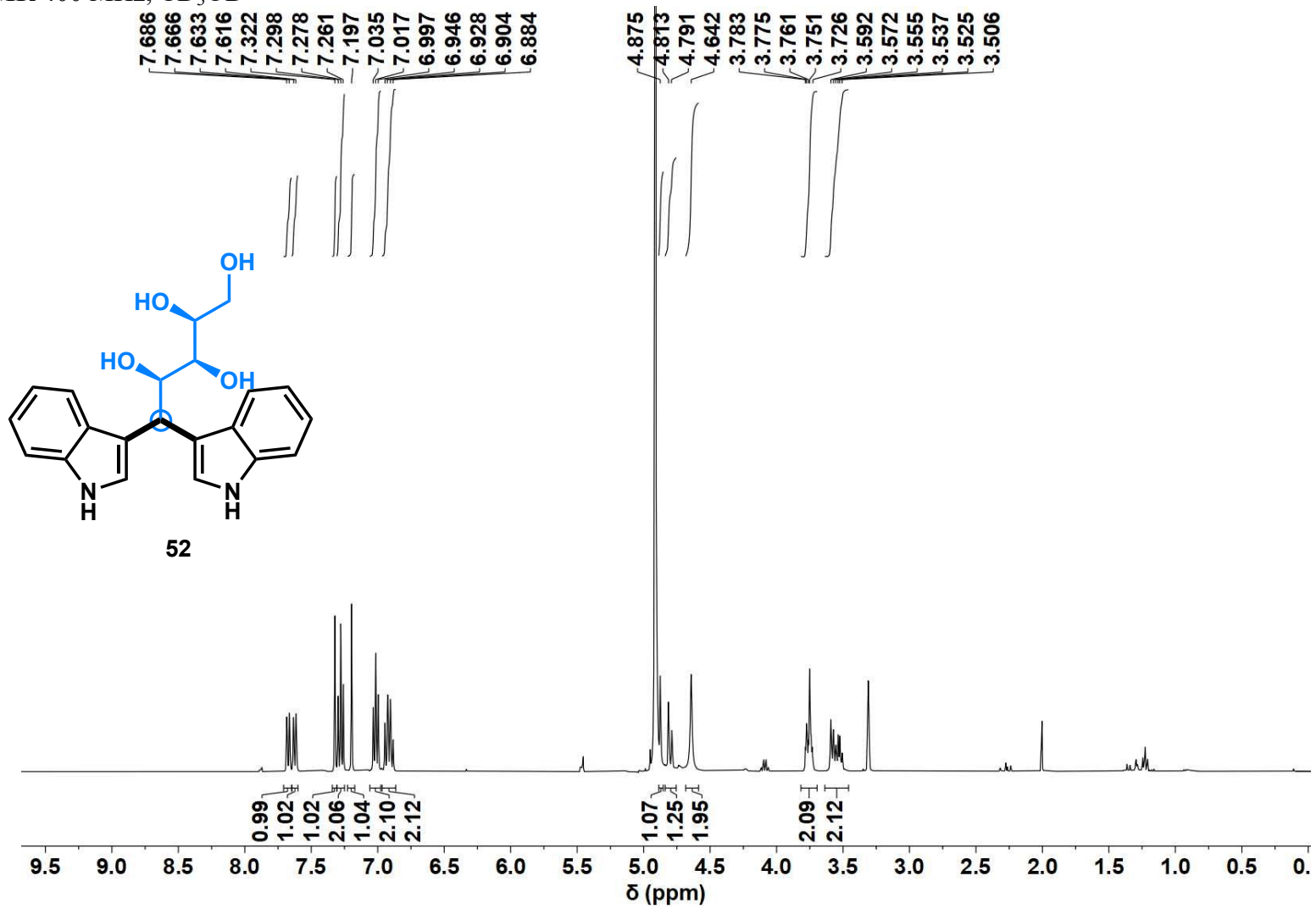


**$^{13}$C NMR** 101 MHz, $CD_3OD$

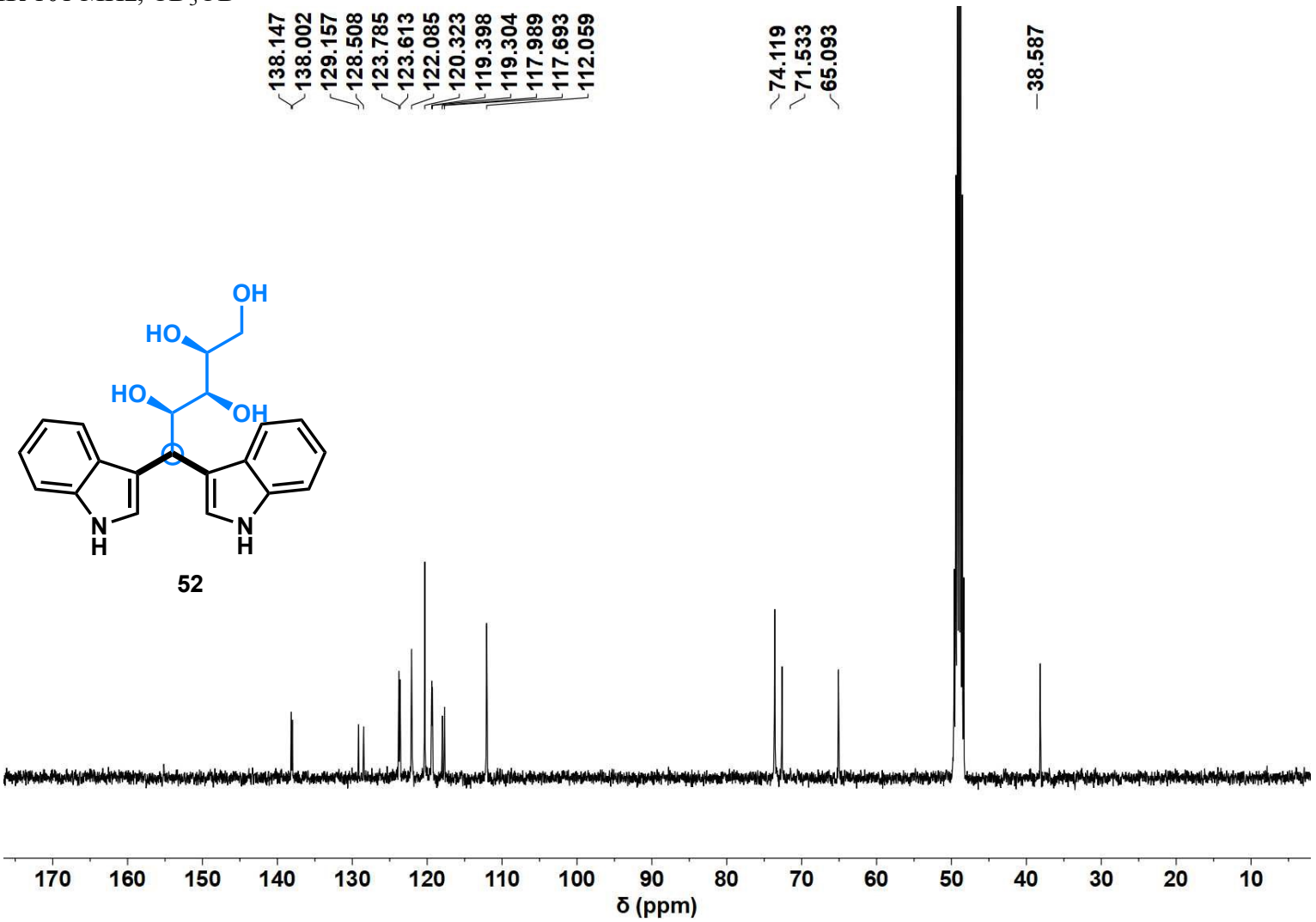



**51**

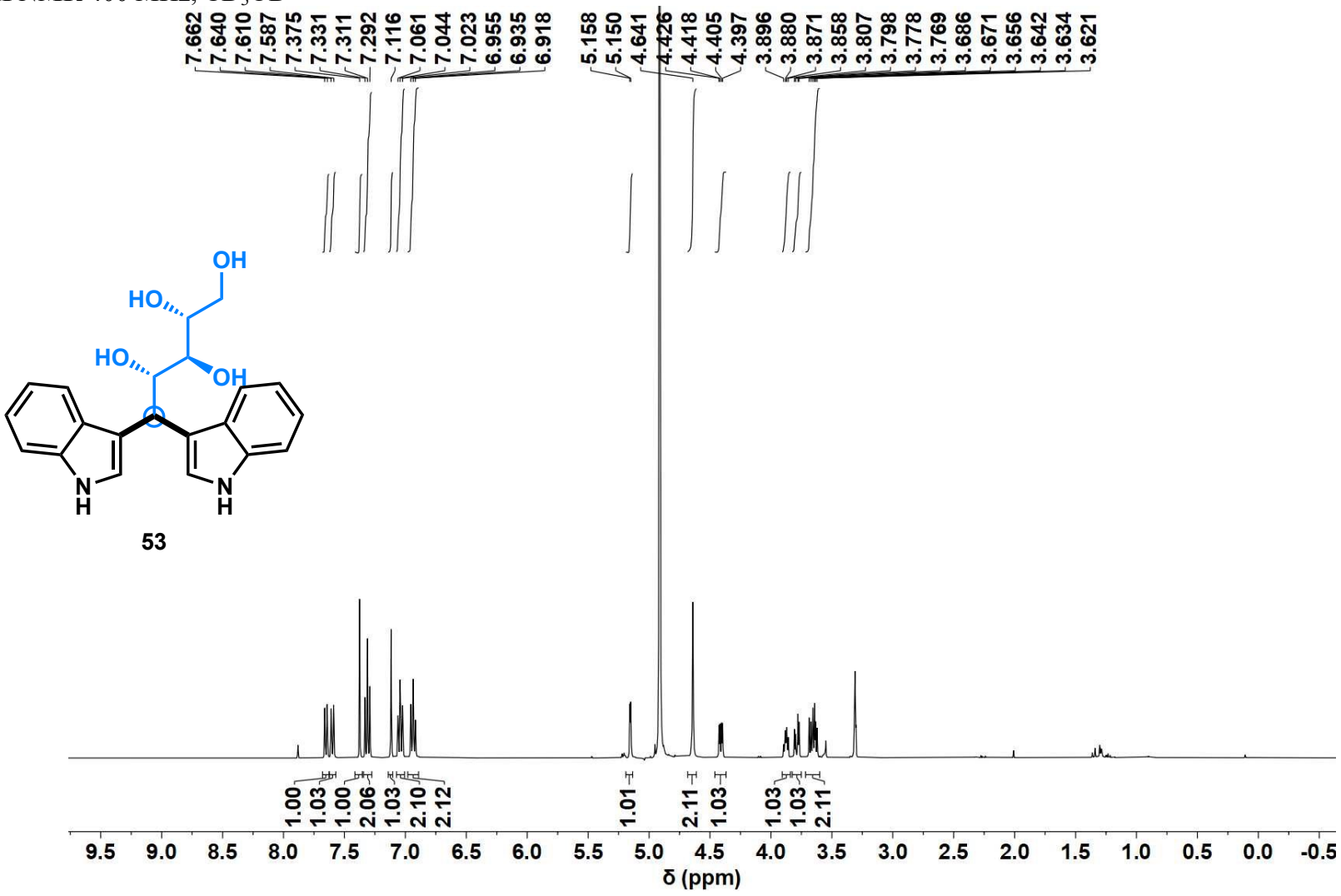
**$^1$H NMR** 400 MHz, $CD_3OD$



**$^{13}$C NMR** 101 MHz, $CD_3OD$



**$^1$H NMR** 400 MHz, $CD_3OD$

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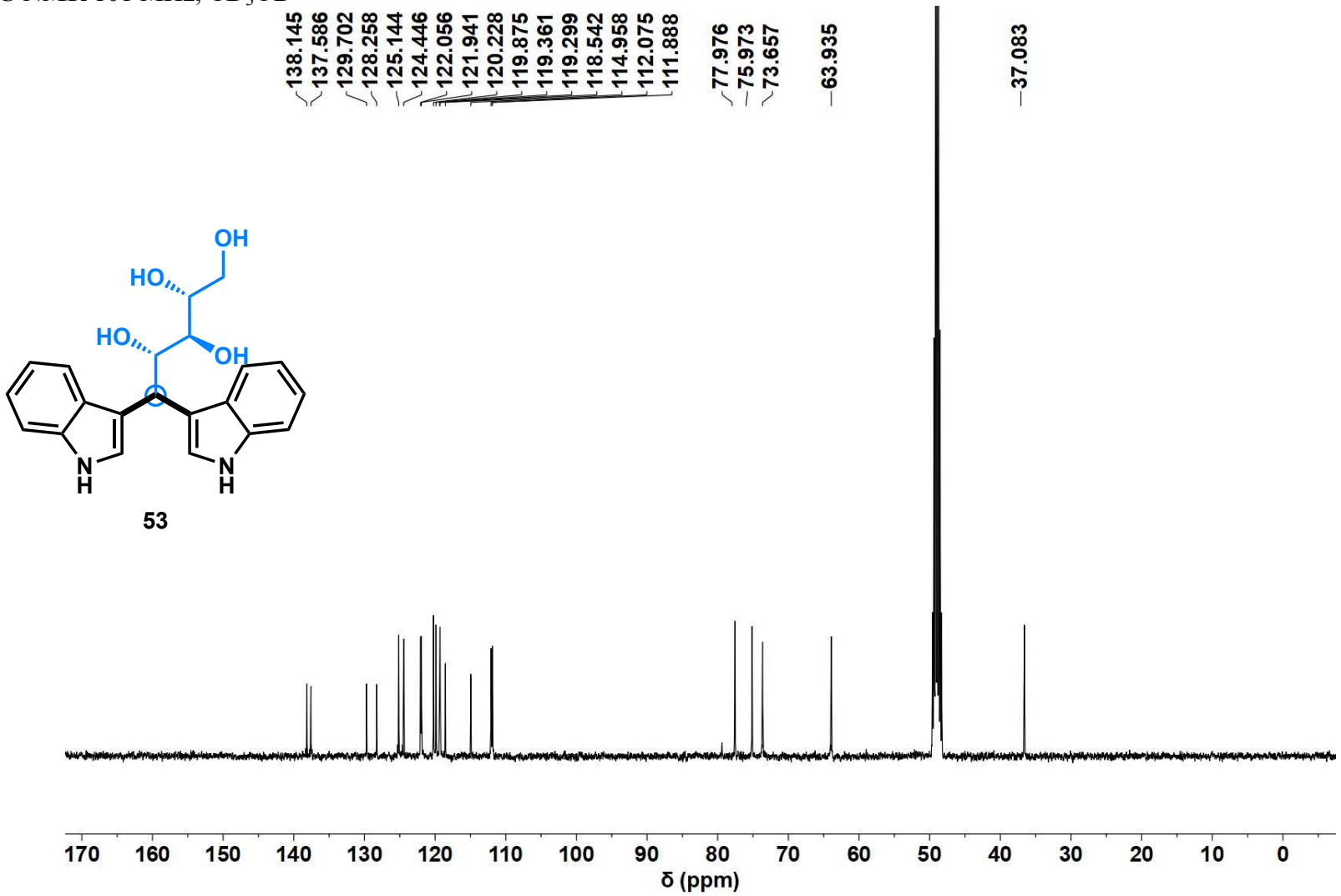
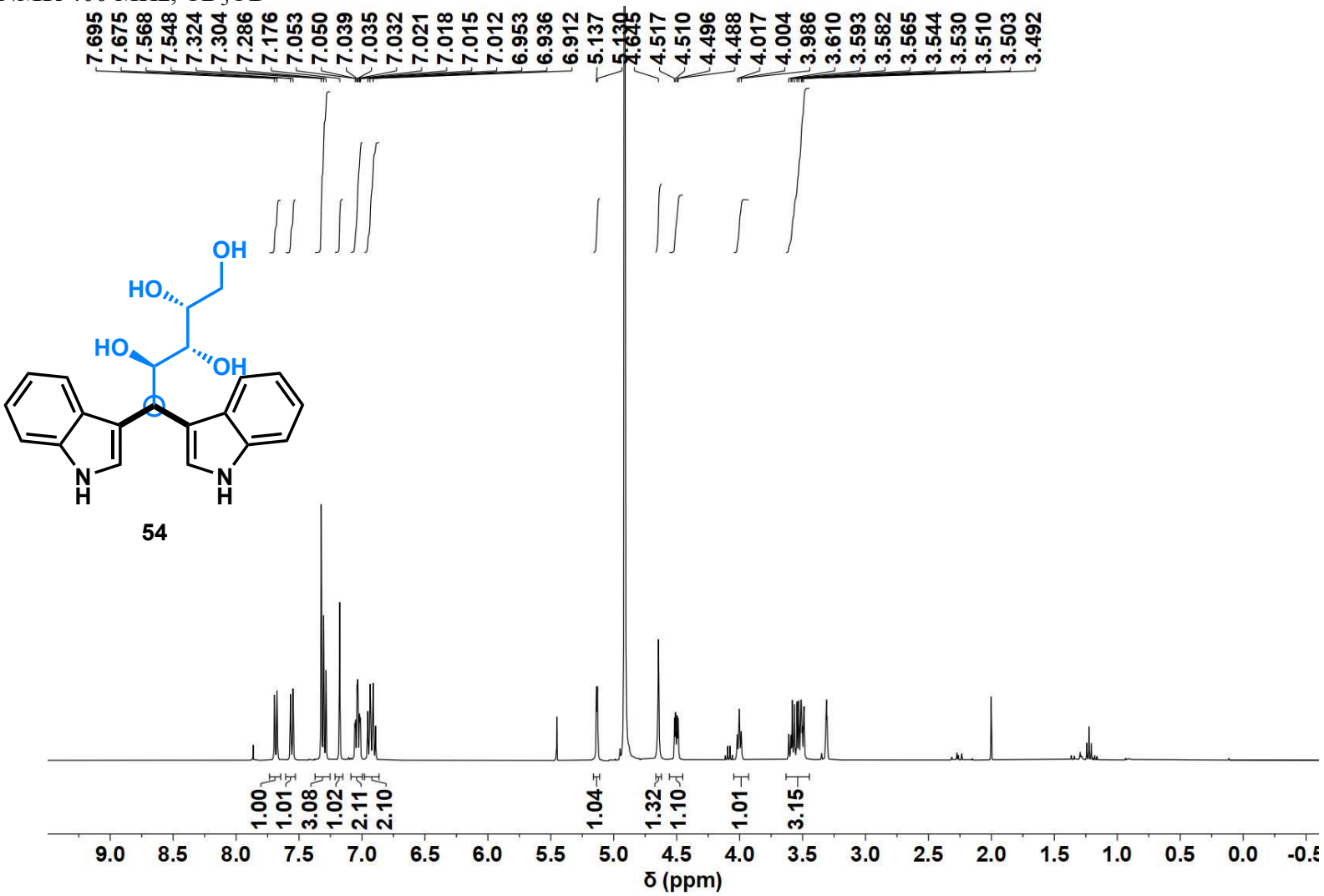
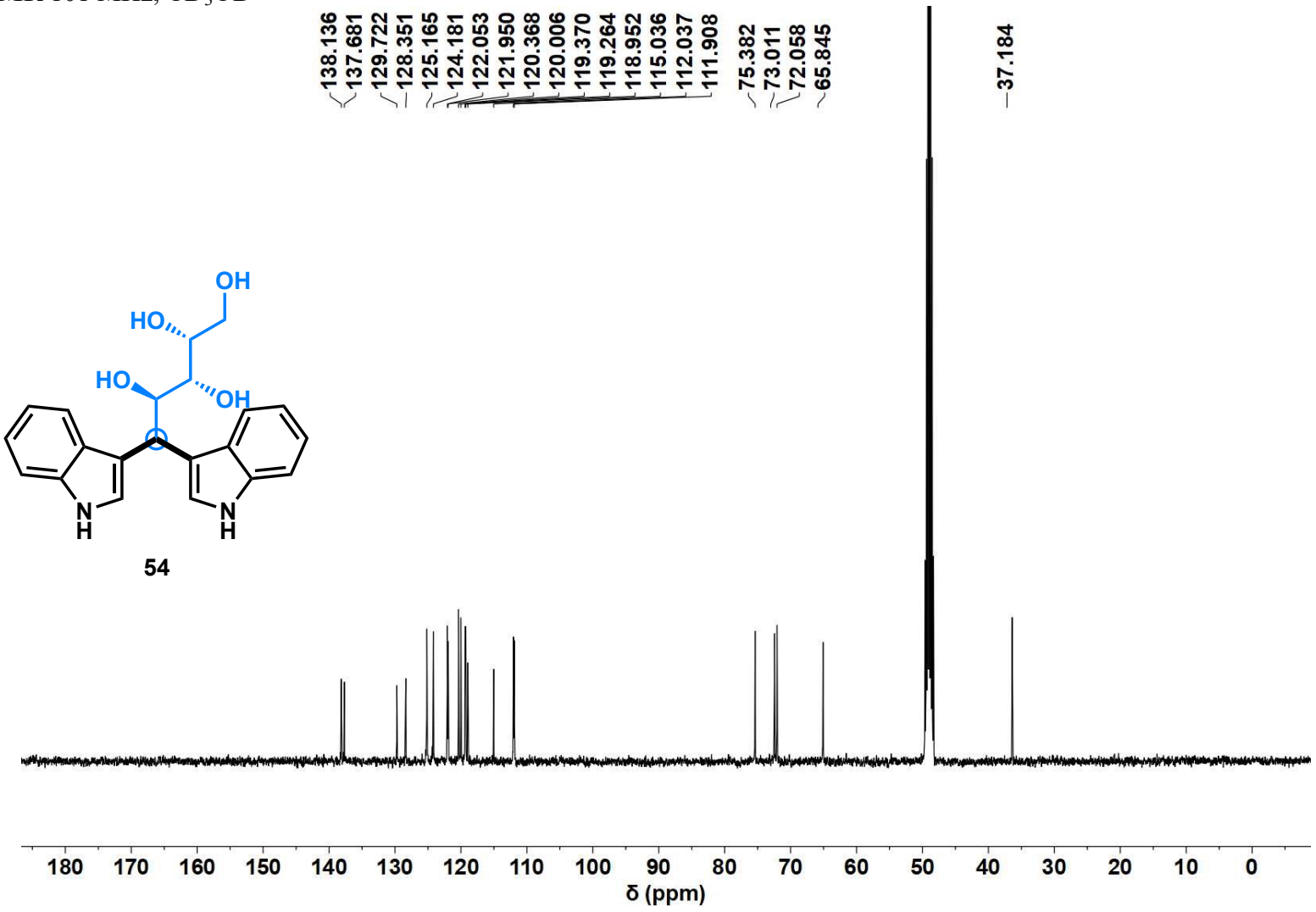
**$^{13}$C NMR** 101 MHz, $CD_3OD$



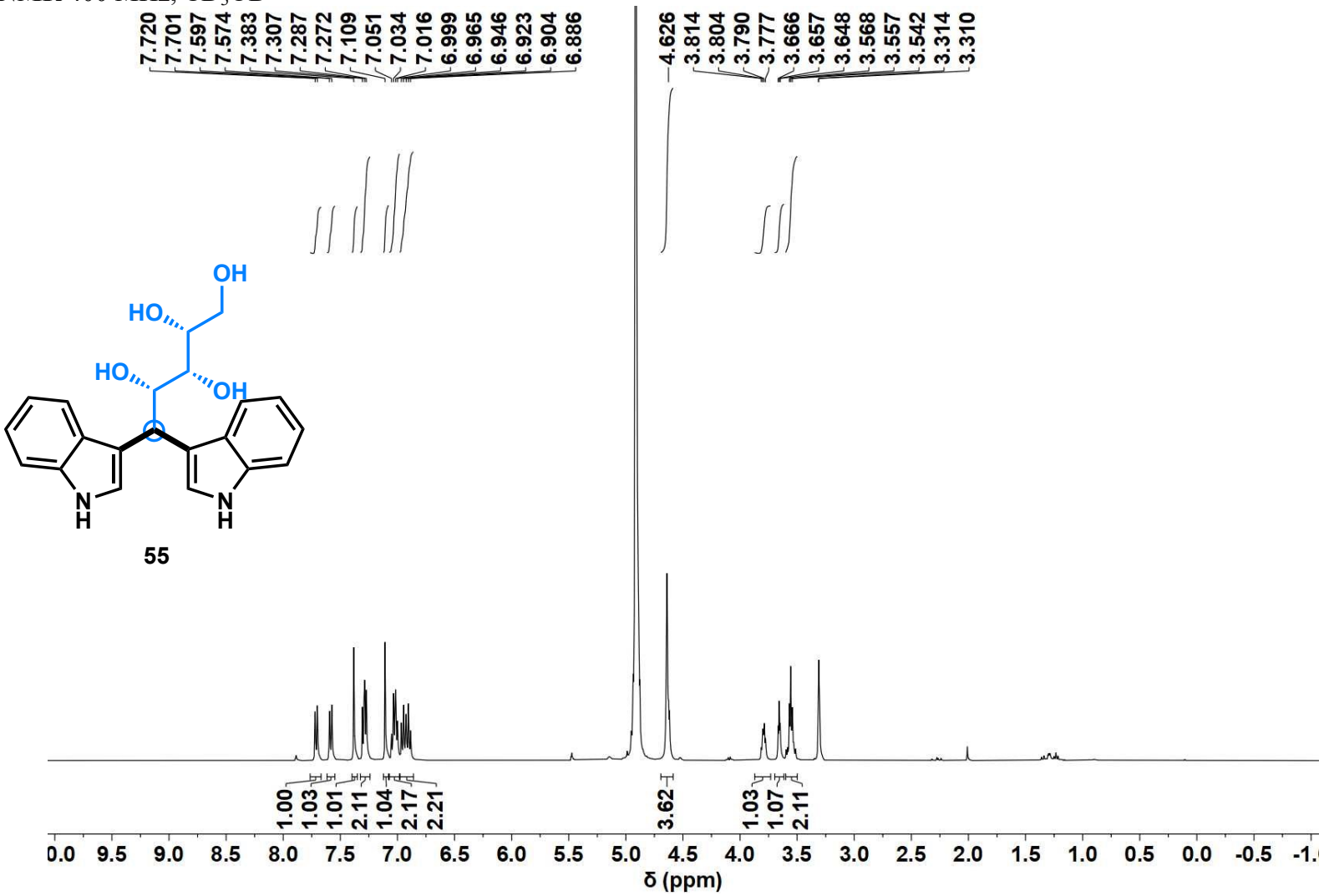
**$^1$H NMR** 400 MHz, $CD_3OD$



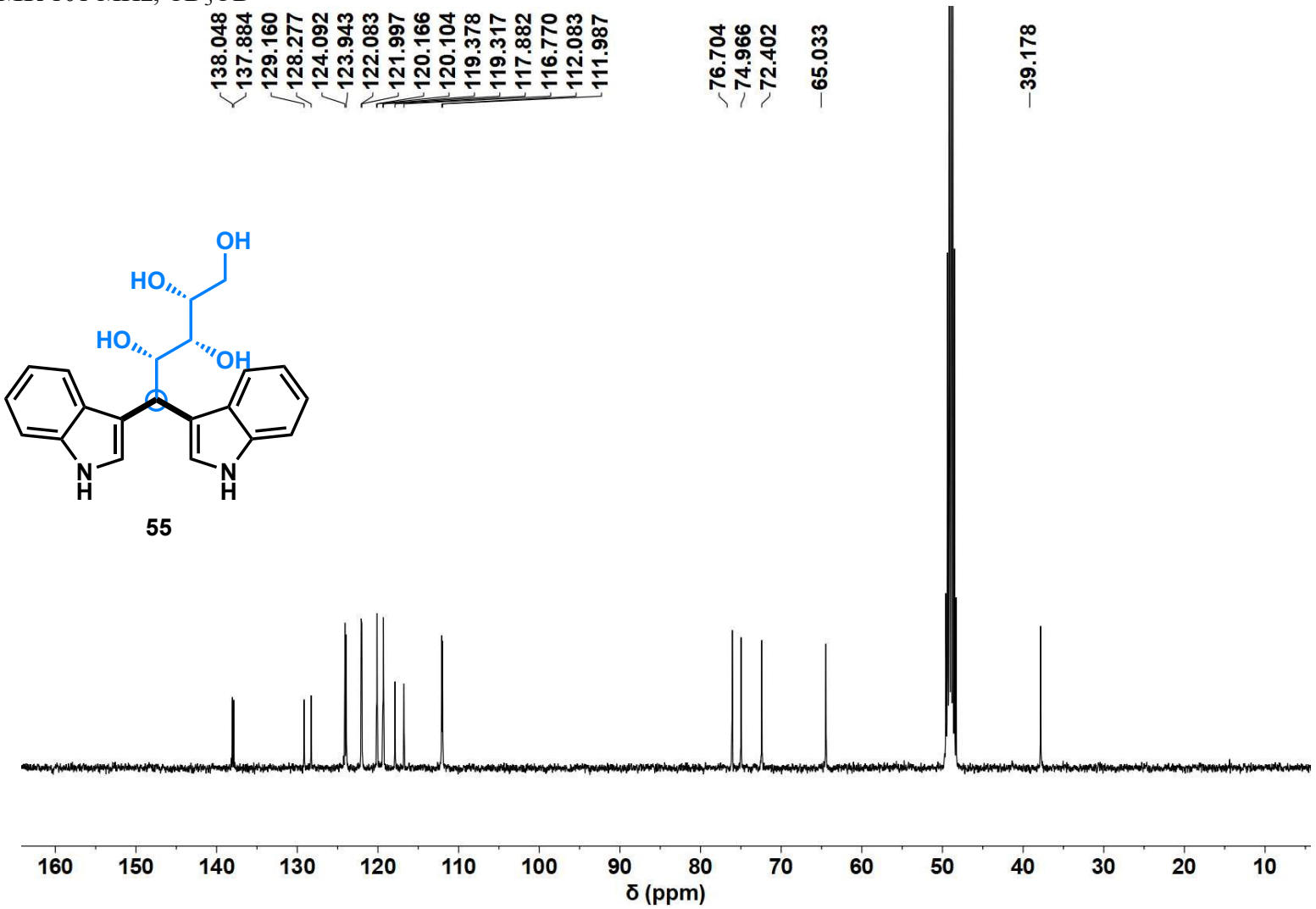
**$^{13}$C NMR** 101 MHz, $CD_3OD$



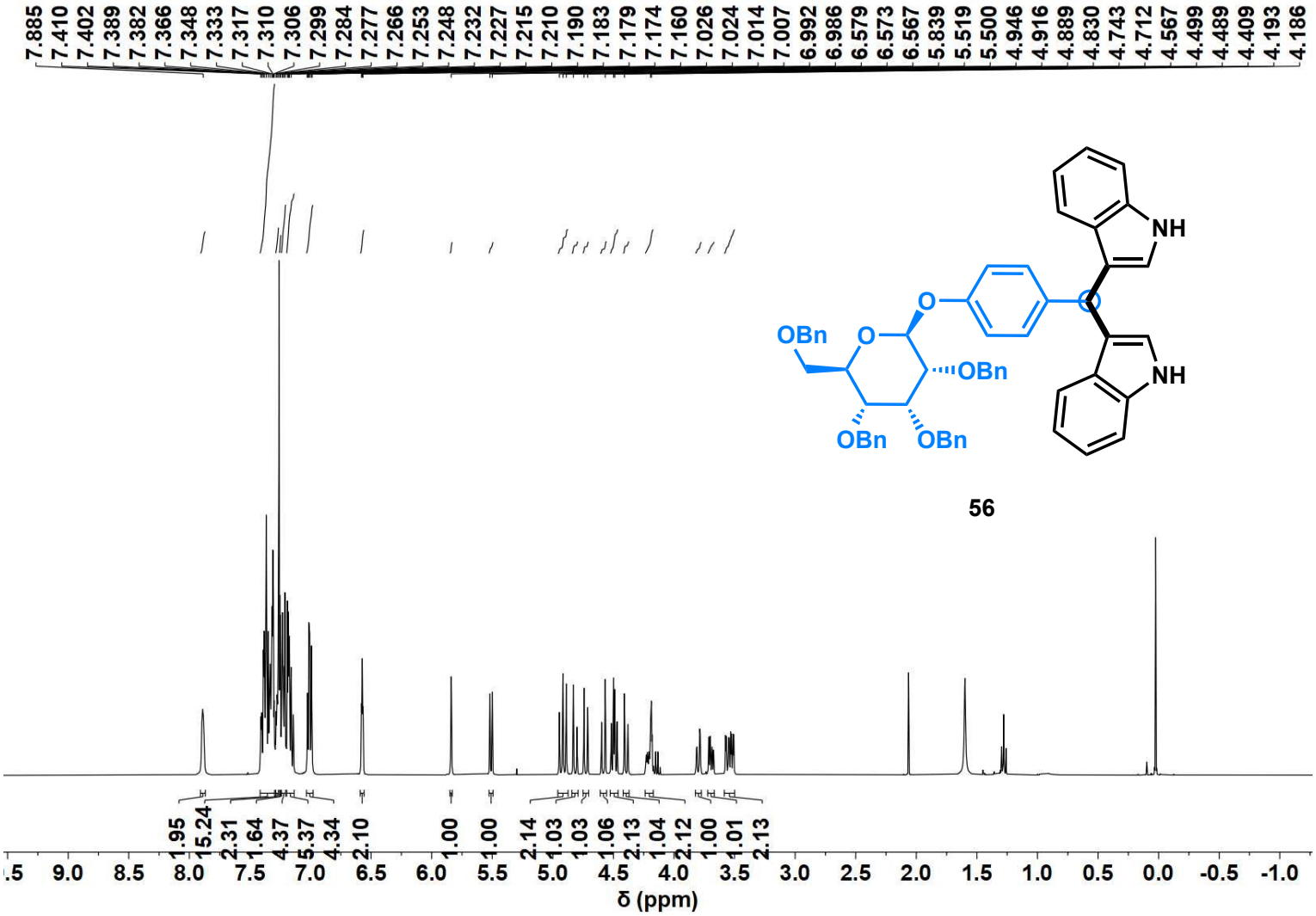
**$^1$H NMR** 400 MHz, $CD_3OD$



**$^{13}$C NMR** 101 MHz, $CD_3OD$



**$^1$H NMR** 400 MHz, $CDCl_3$

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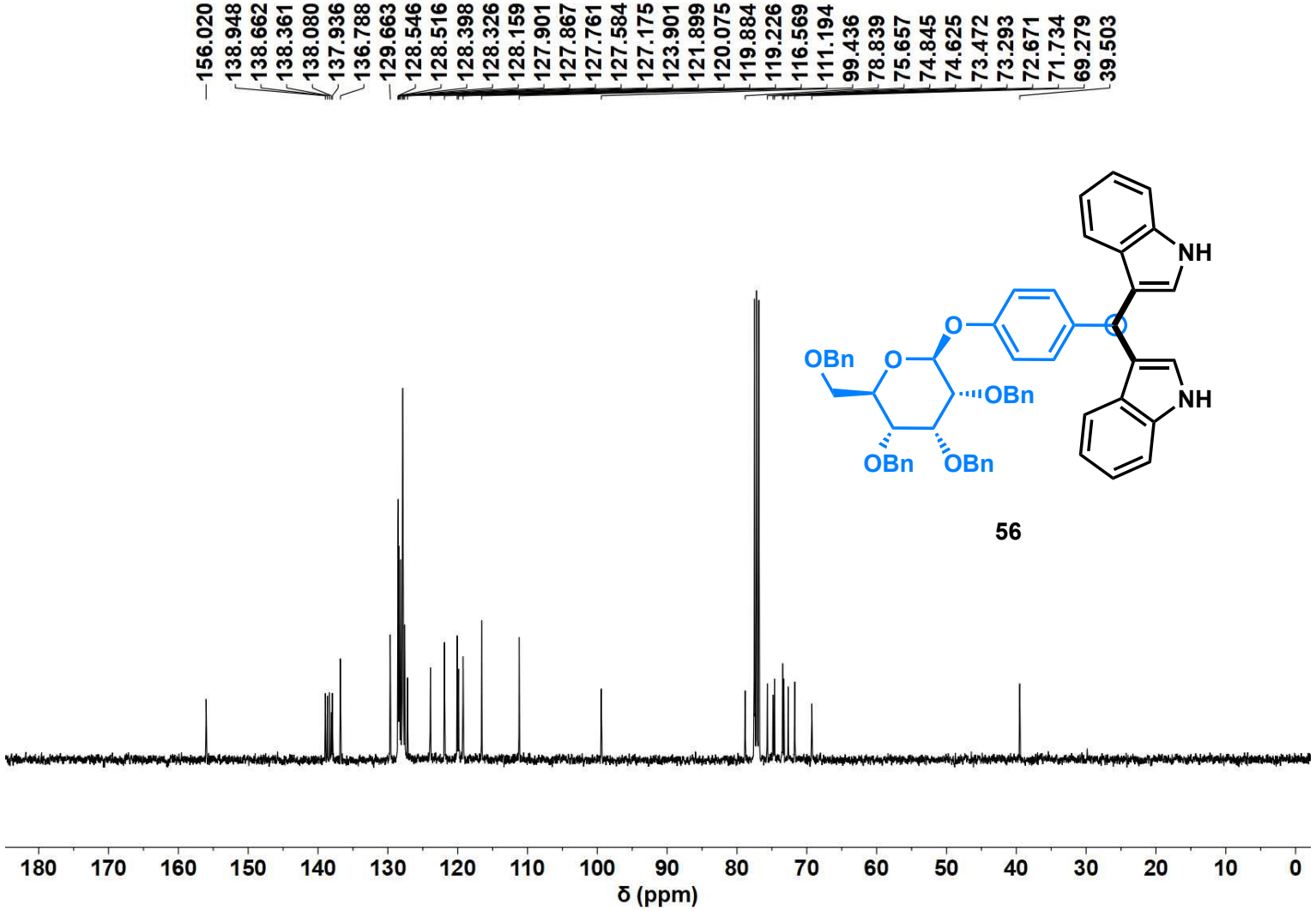
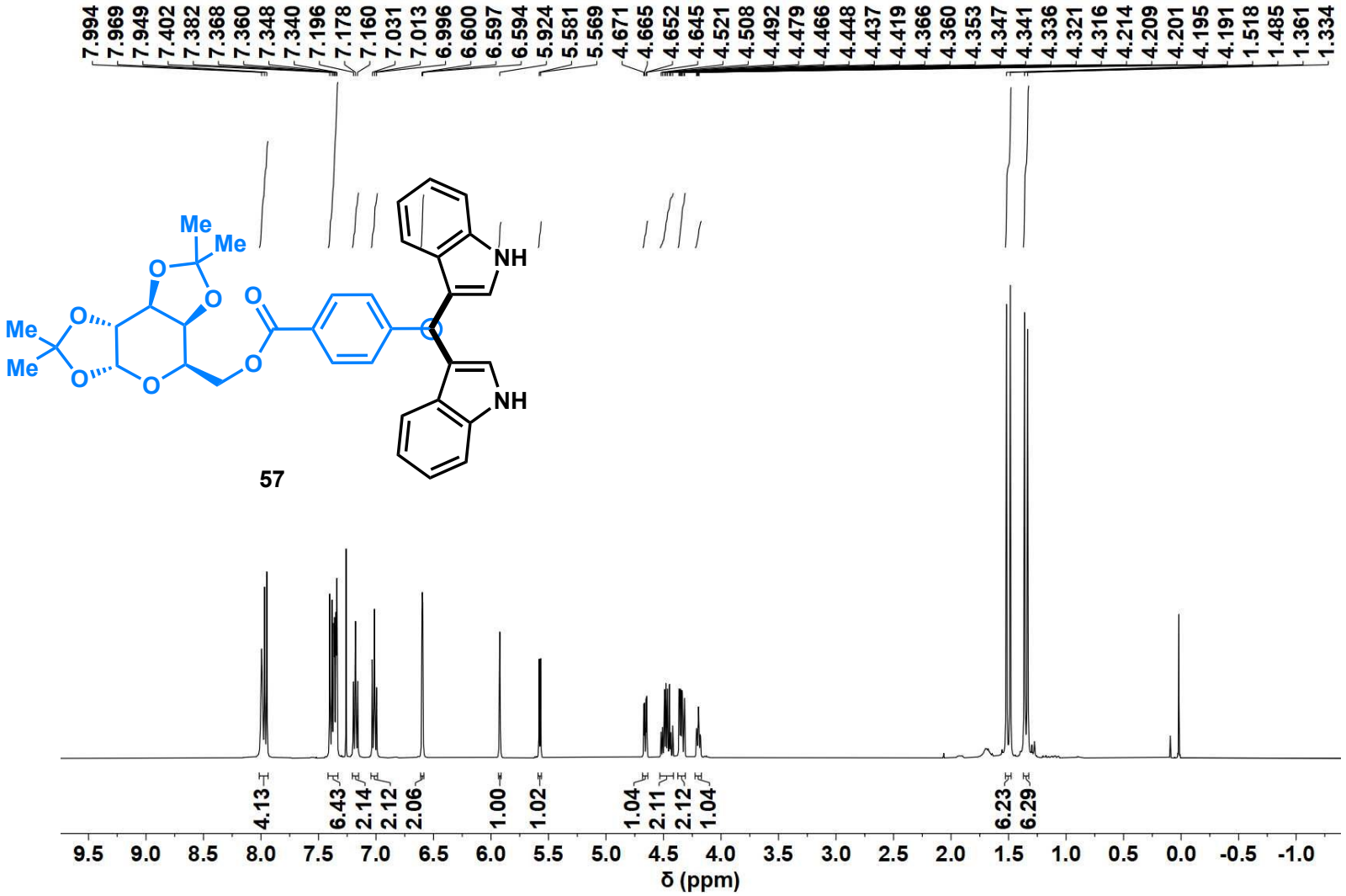
**$^{13}$C NMR** 101 MHz, $CDCl_3$

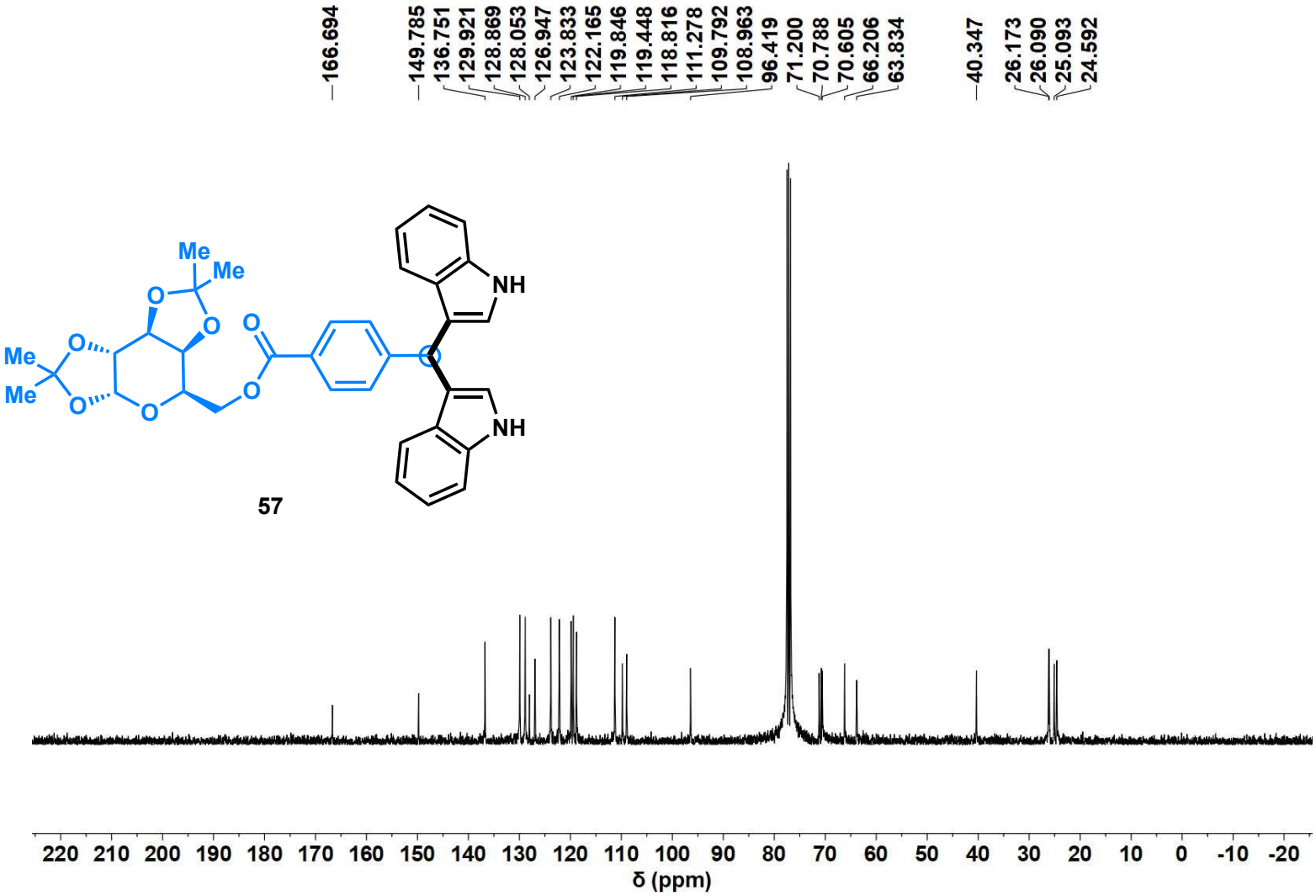



**56**

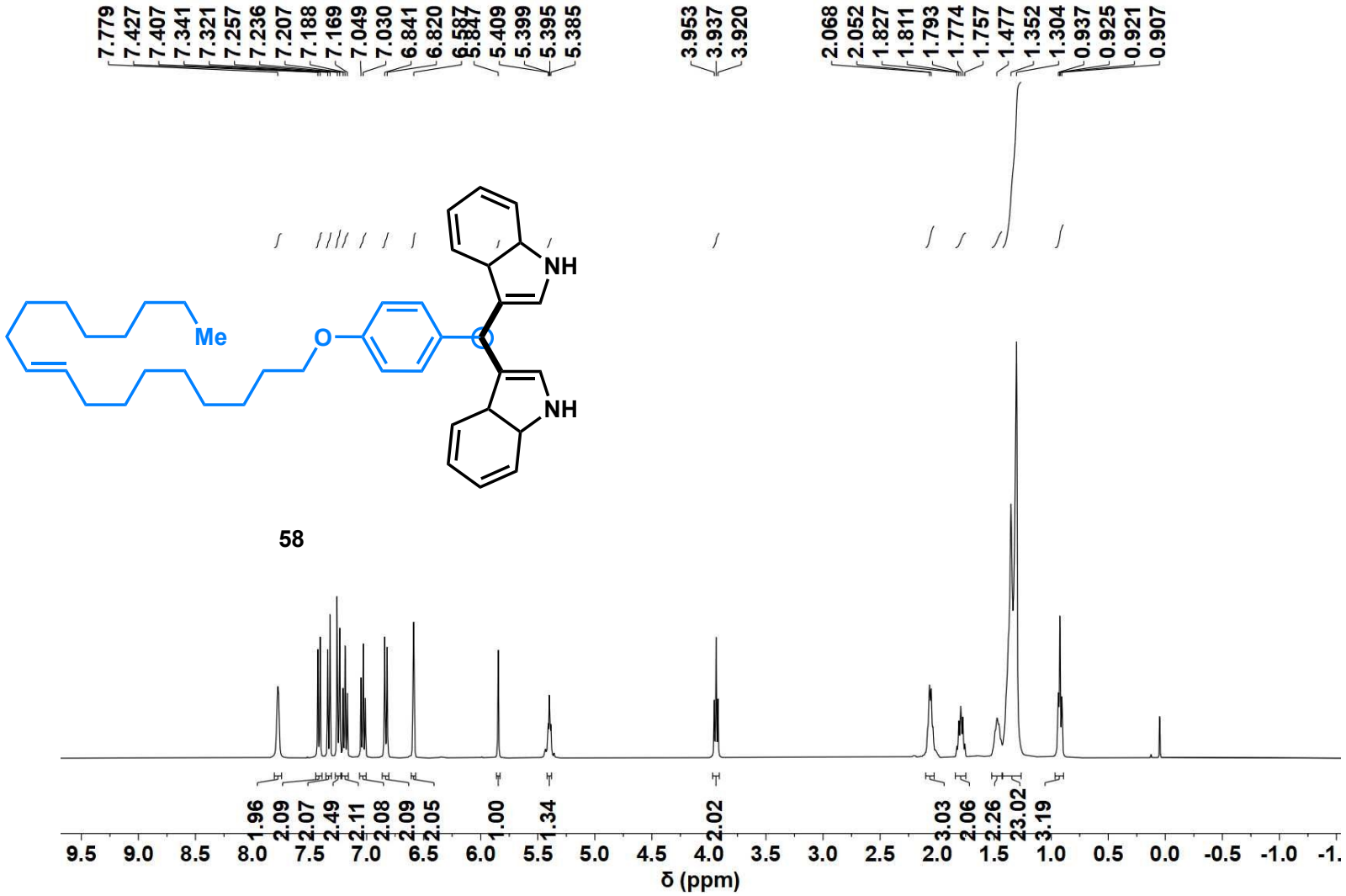
**$^1$H NMR** 400 MHz, $CDCl_3$



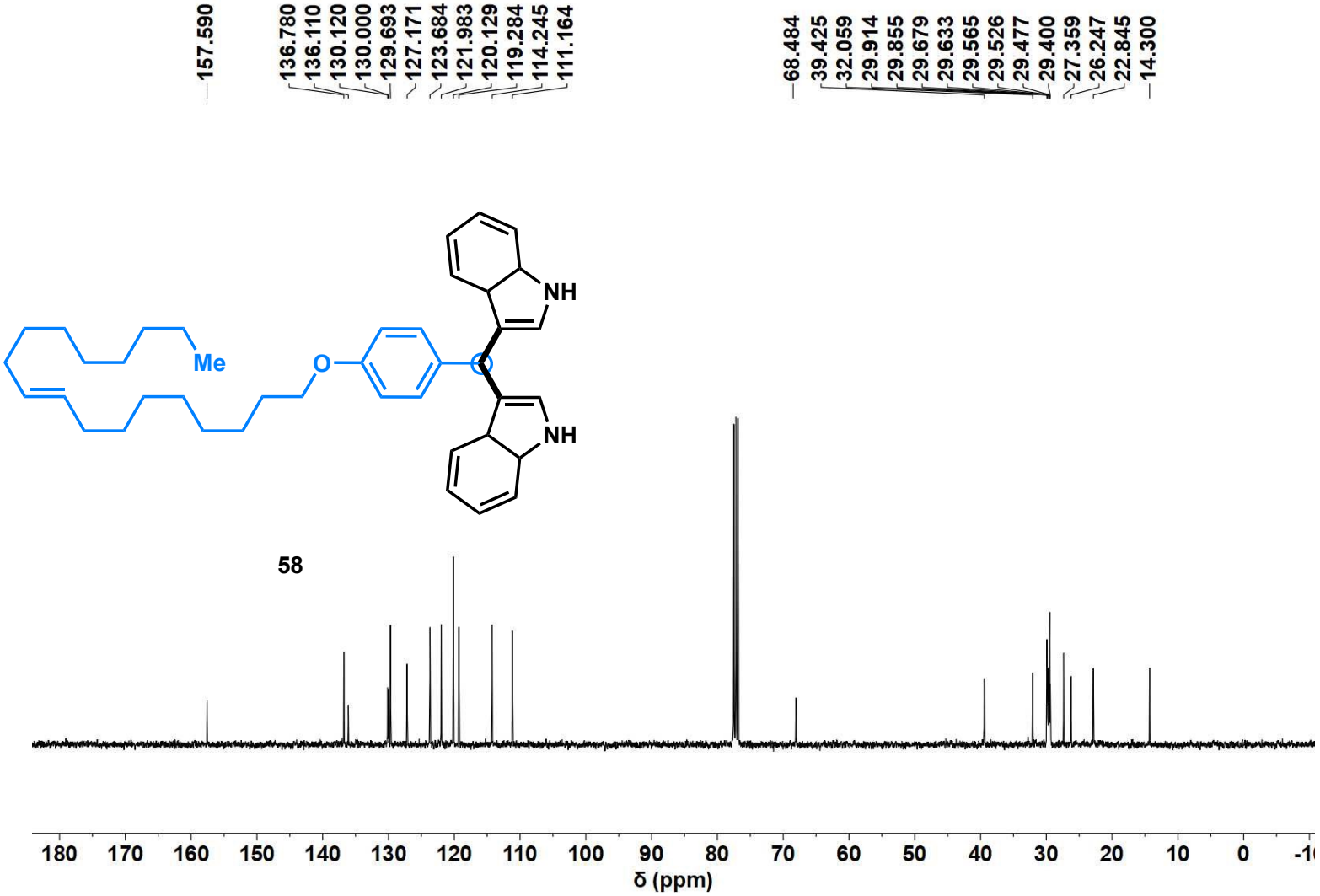
**$^{13}$C NMR** 101 MHz, $CDCl_3$



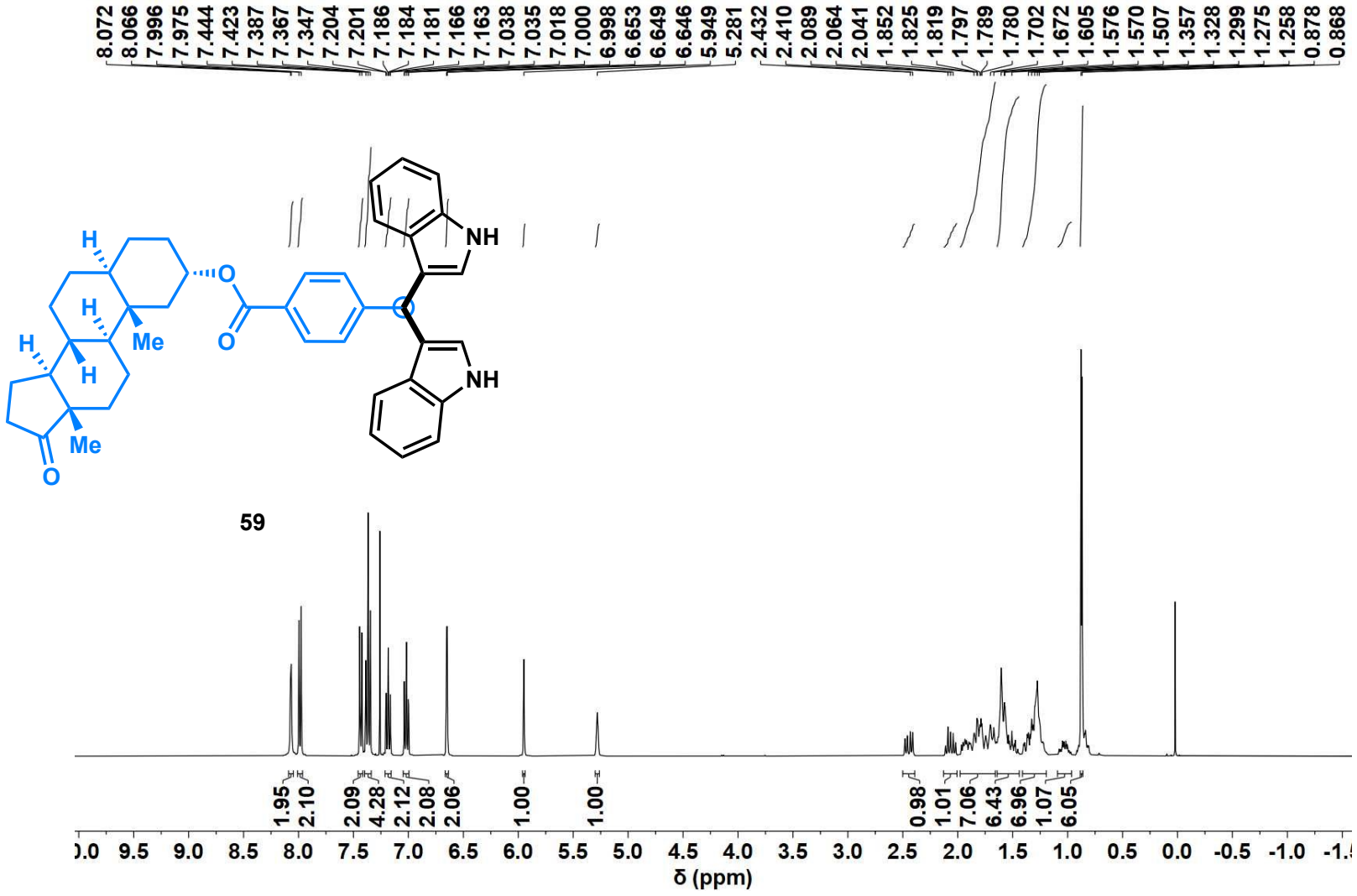
**$^1$H NMR** 400 MHz, $CDCl_3$



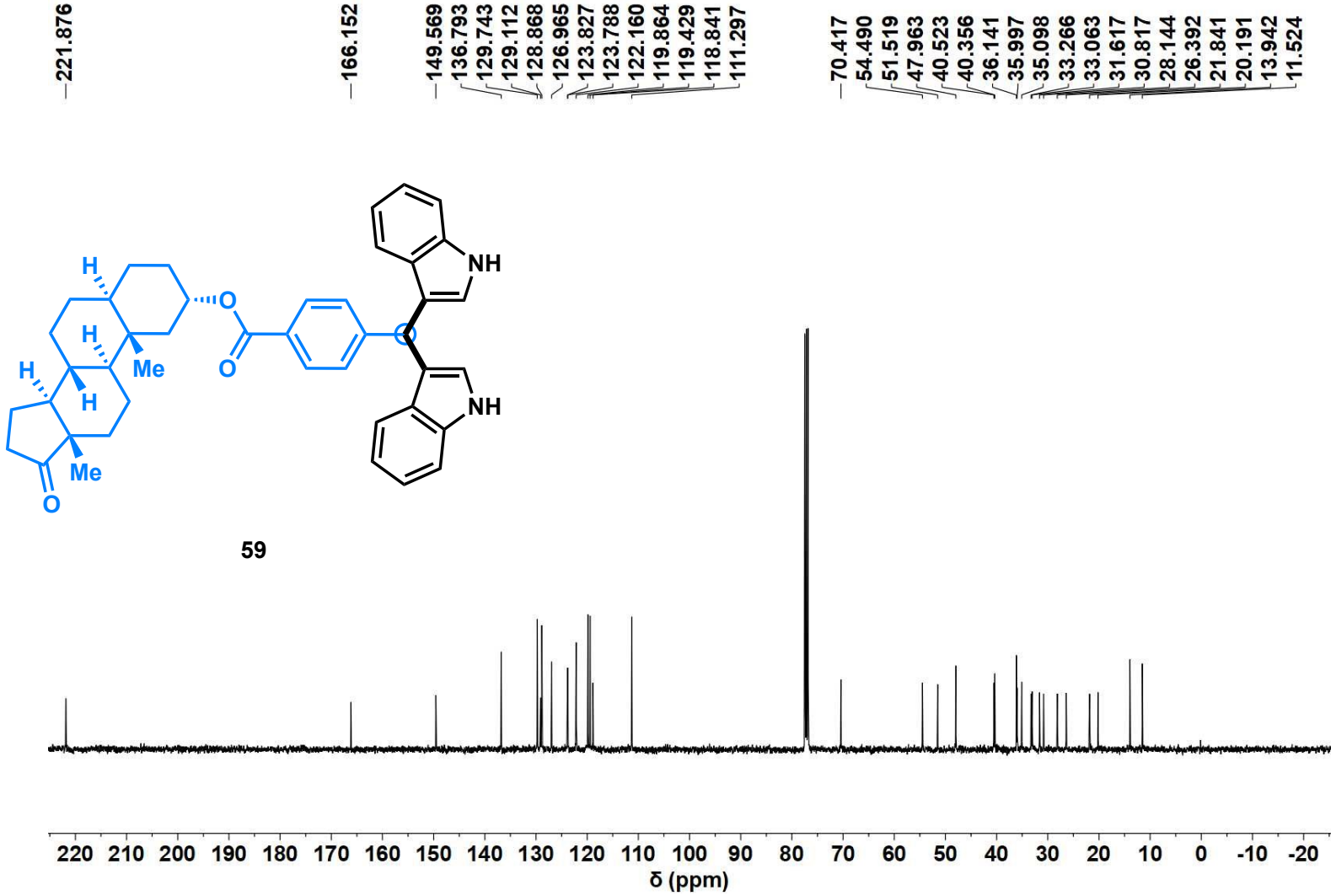
**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^1$H NMR** 400 MHz, $CDCl_3$

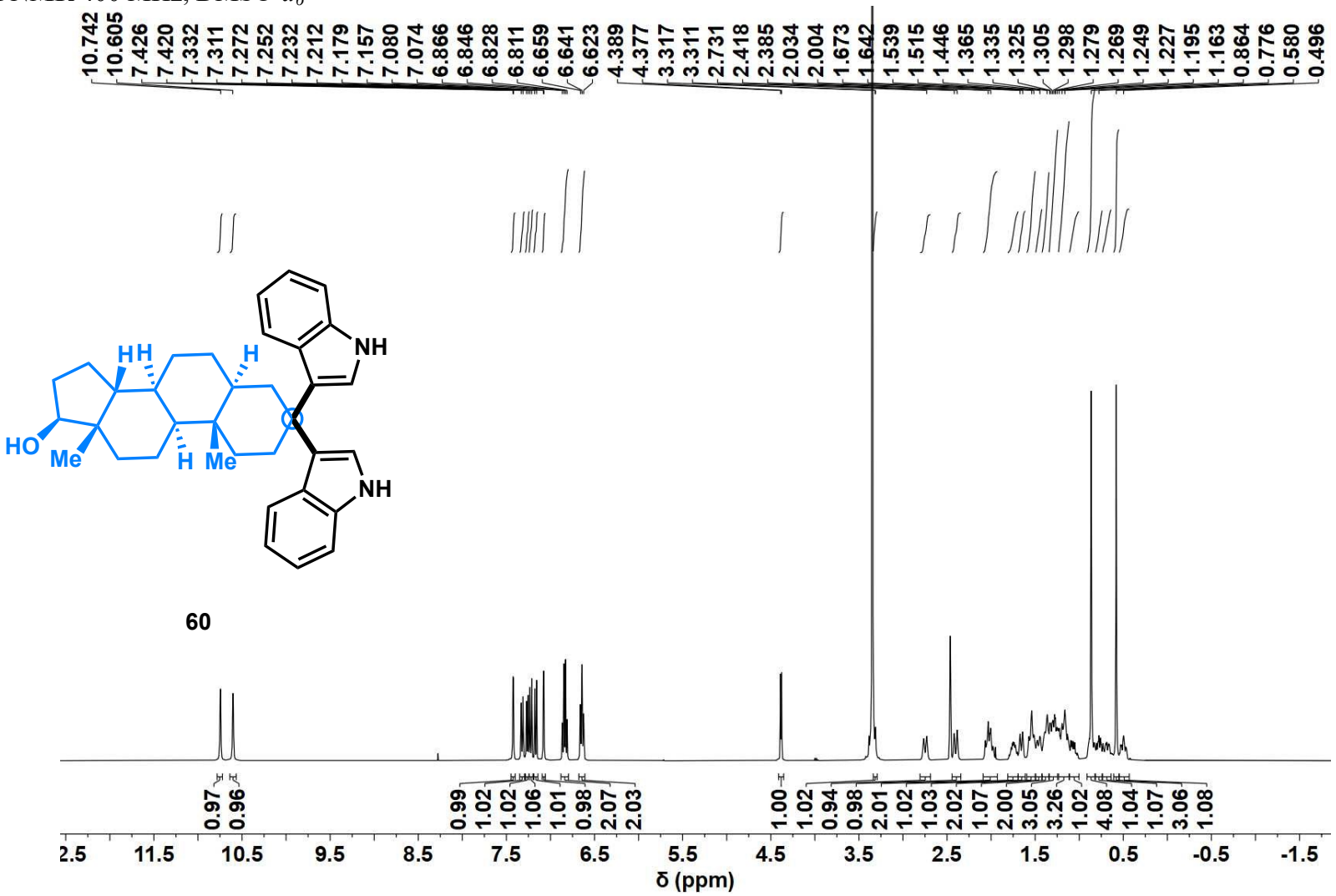


**$^{13}$C NMR** 101 MHz, $CDCl_3$

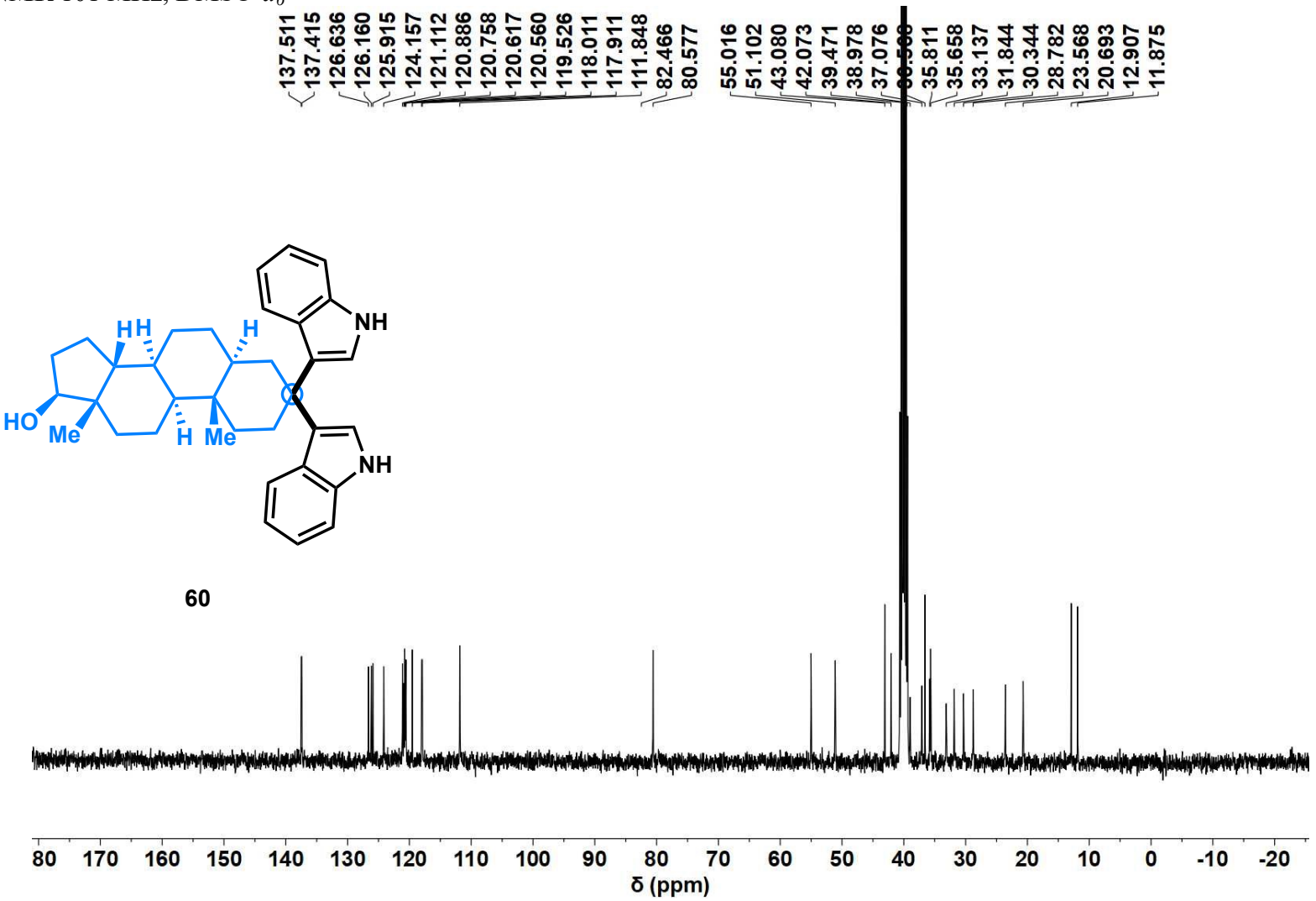



**59**

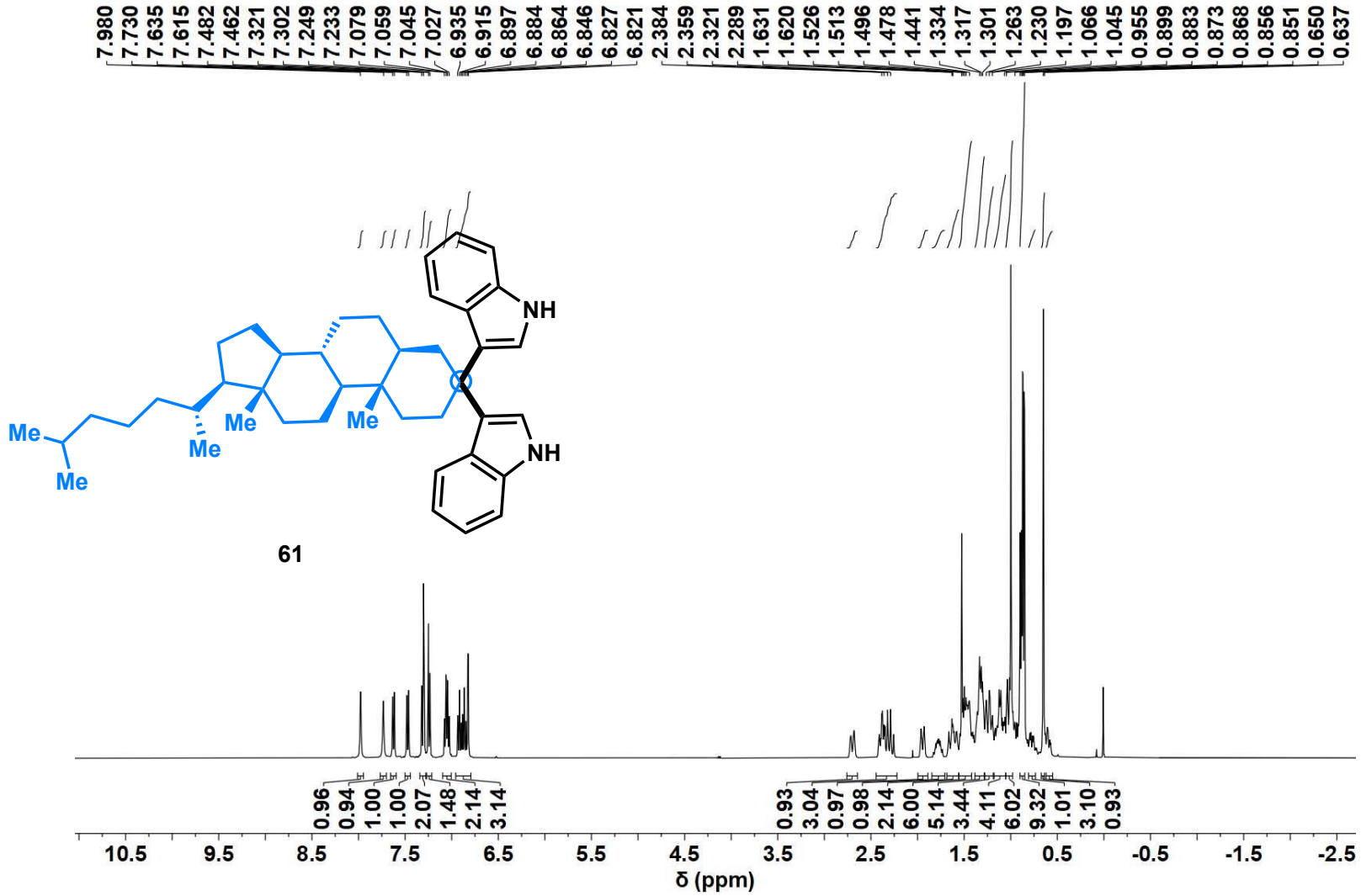
**$^1$H NMR** 400 MHz, DMSO-$d_6$



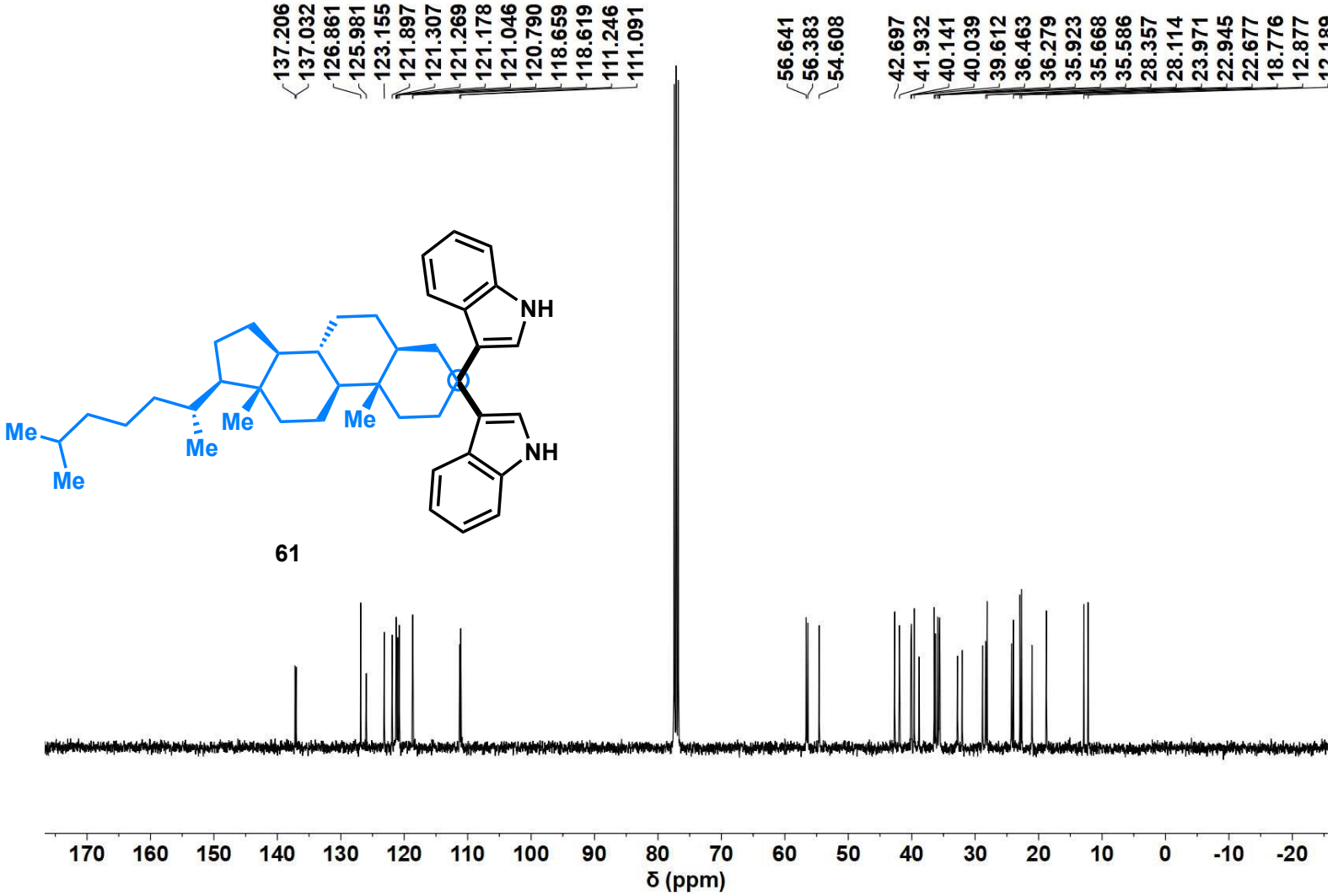
**$^{13}$C NMR** 101 MHz, DMSO-$d_6$



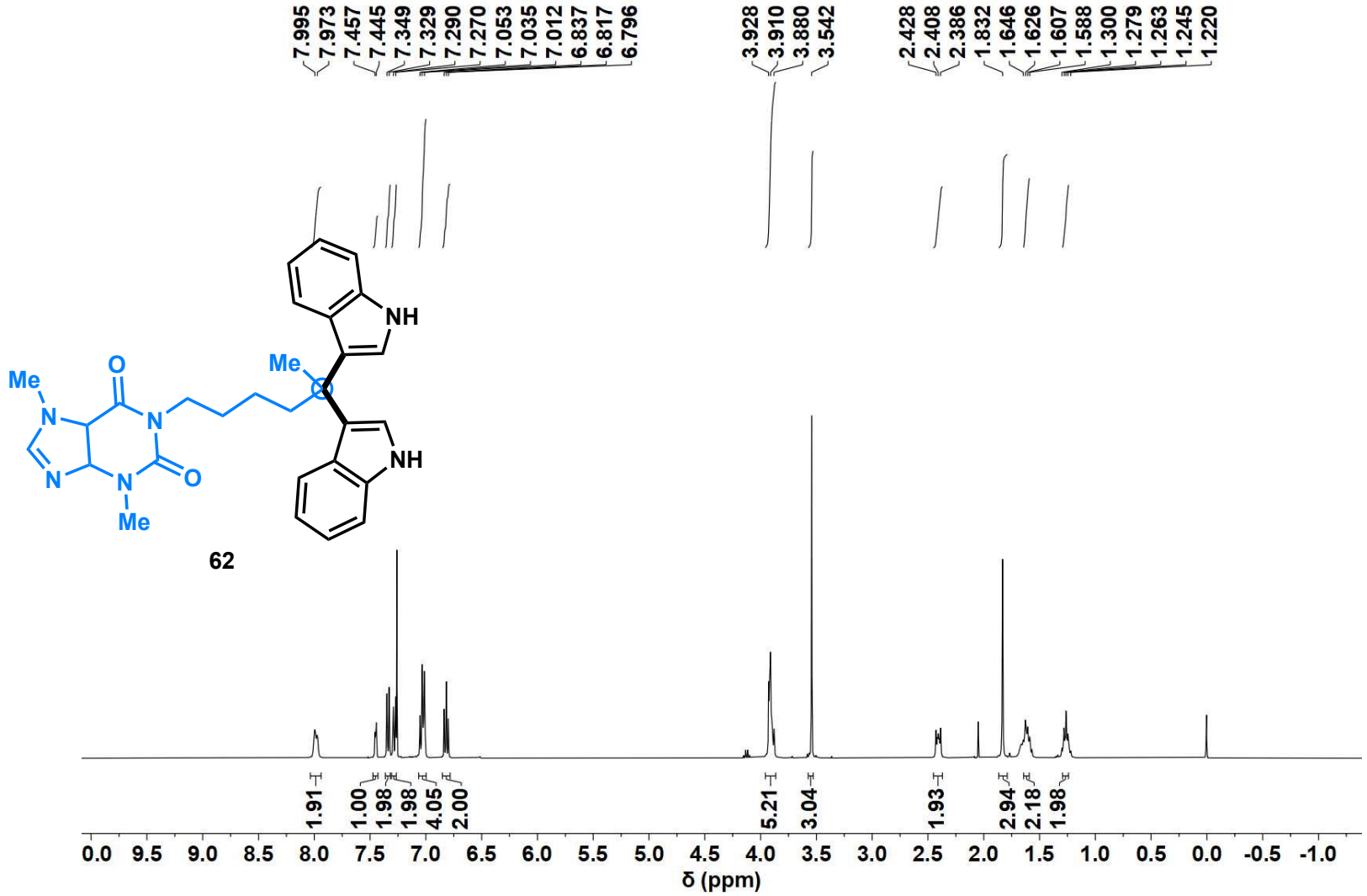
**$^1$H NMR** 400 MHz, $CDCl_3$



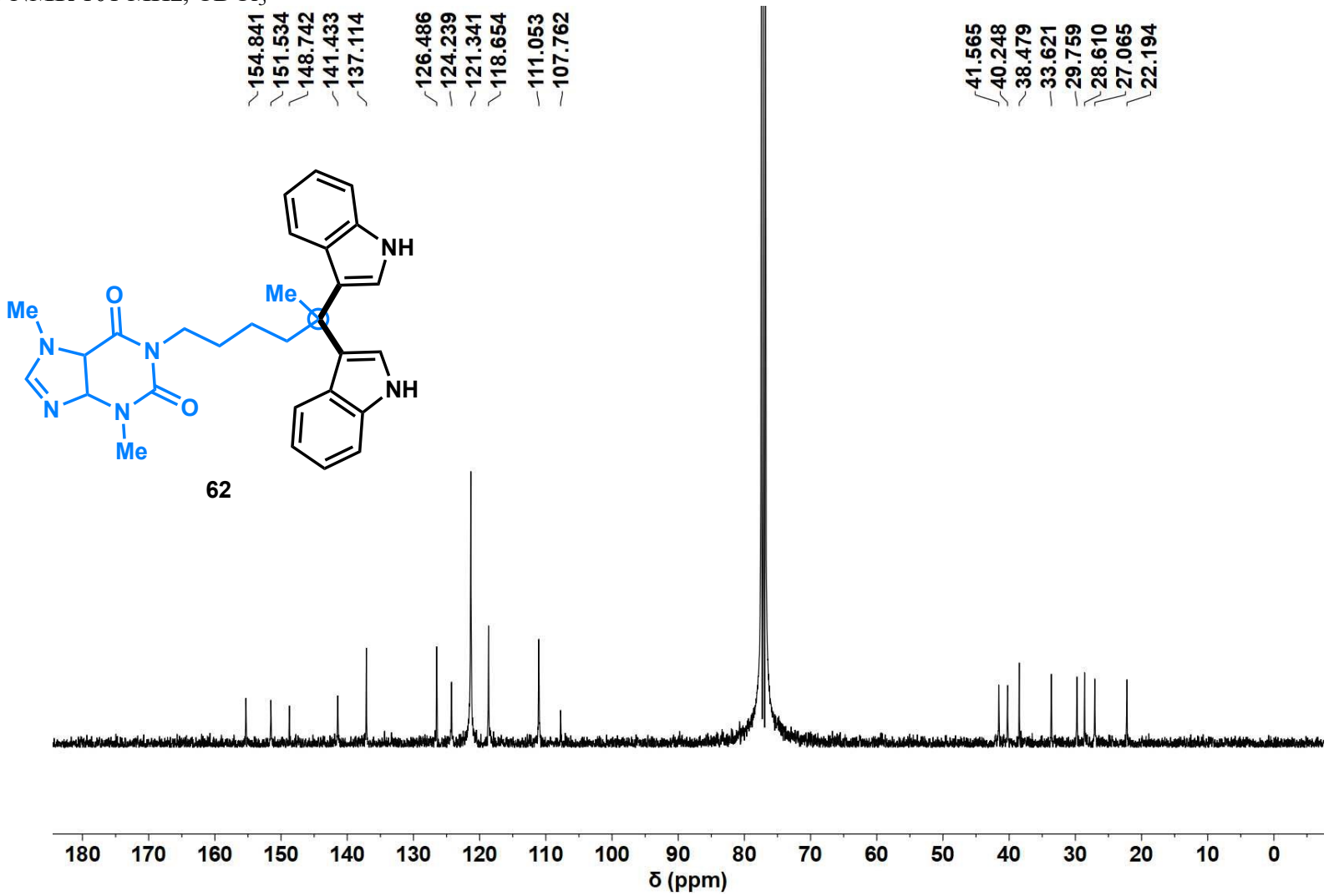
**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^1$H NMR** 400 MHz, $CDCl_3$

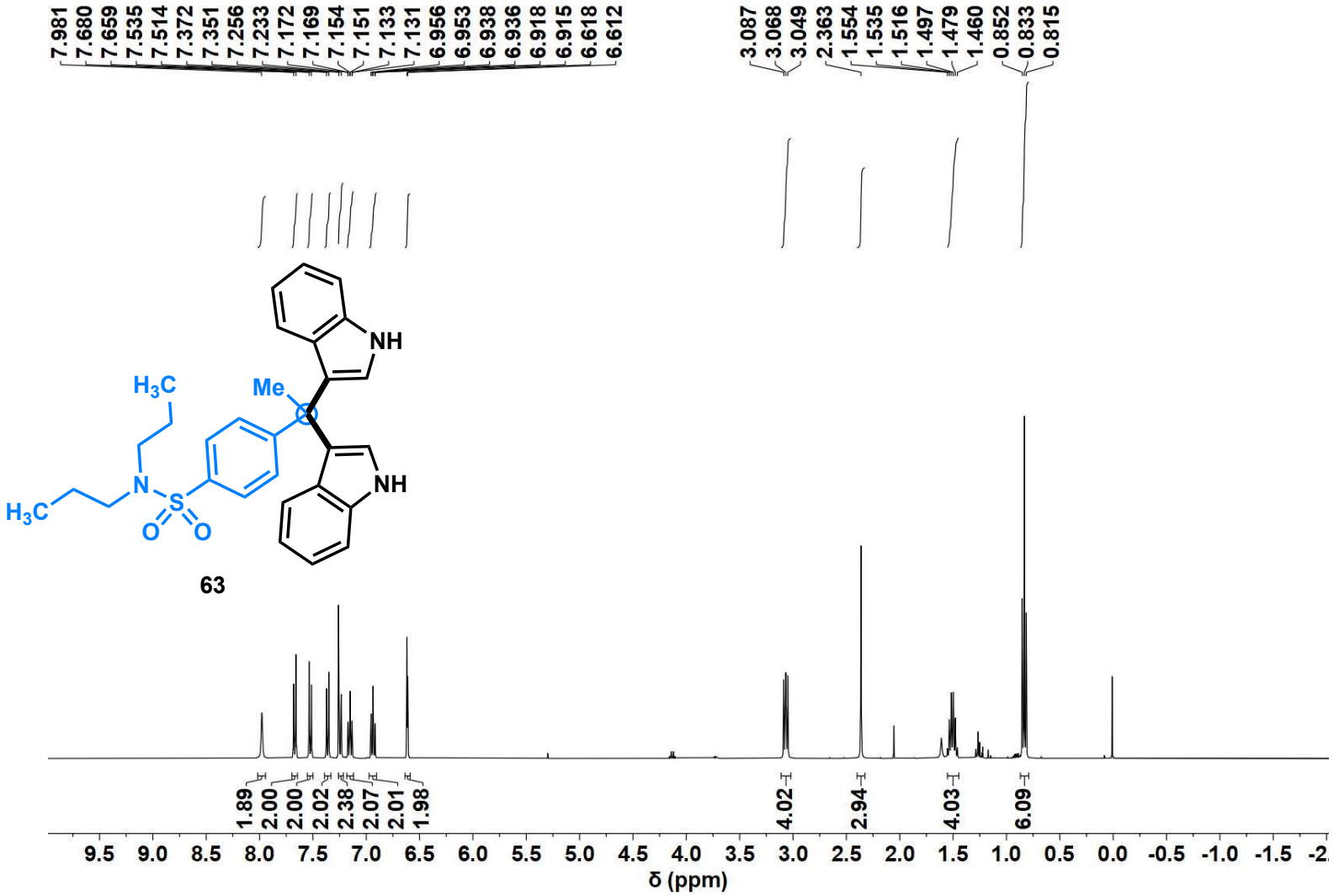


**$^{13}$C NMR** 101 MHz, $CDCl_3$

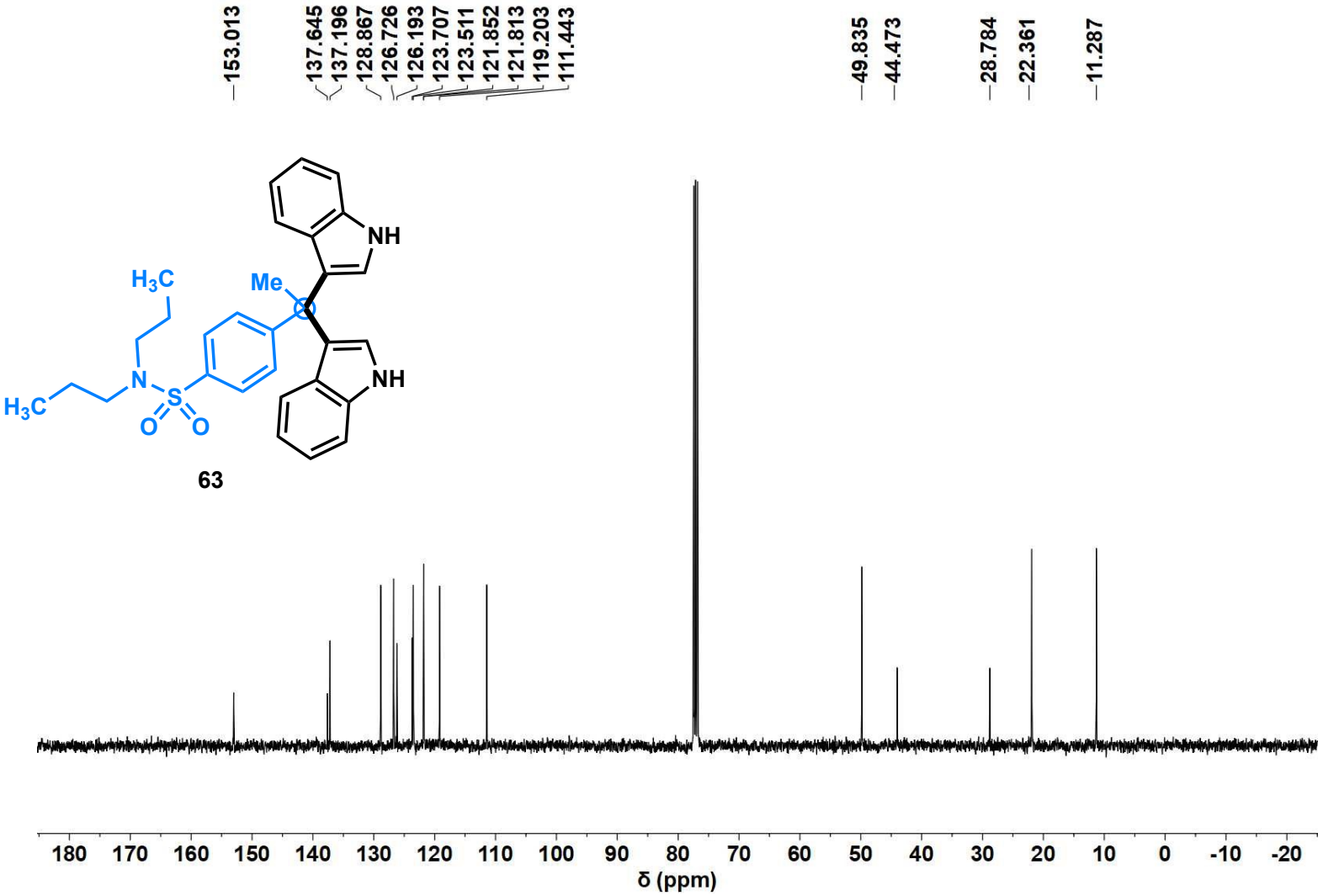



**62**

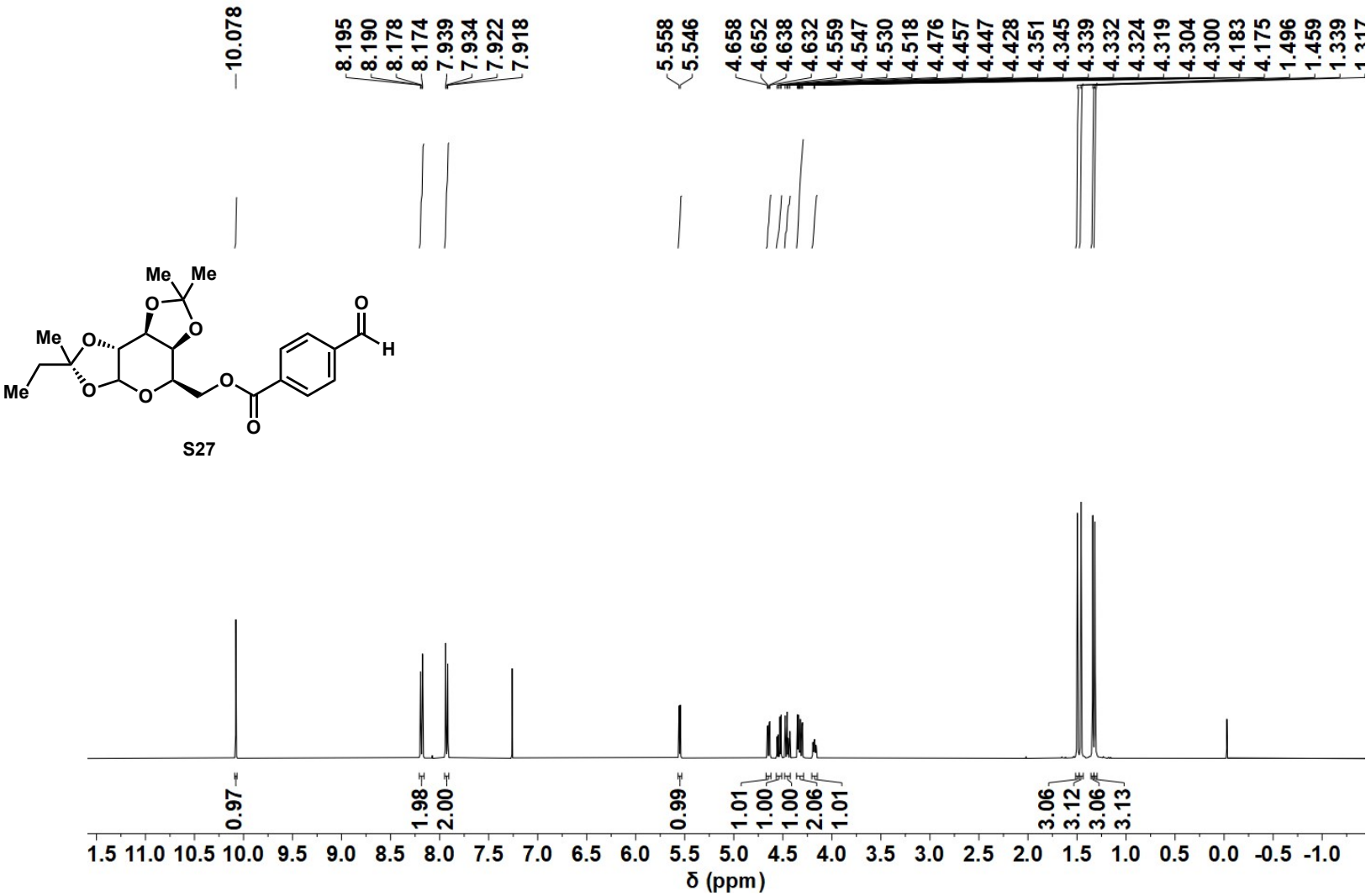
**$^1$H NMR** 400 MHz, $CDCl_3$



**$^{13}$C NMR** 101 MHz, $CDCl_3$



**$^1$H NMR** 400 MHz, $CDCl_3$



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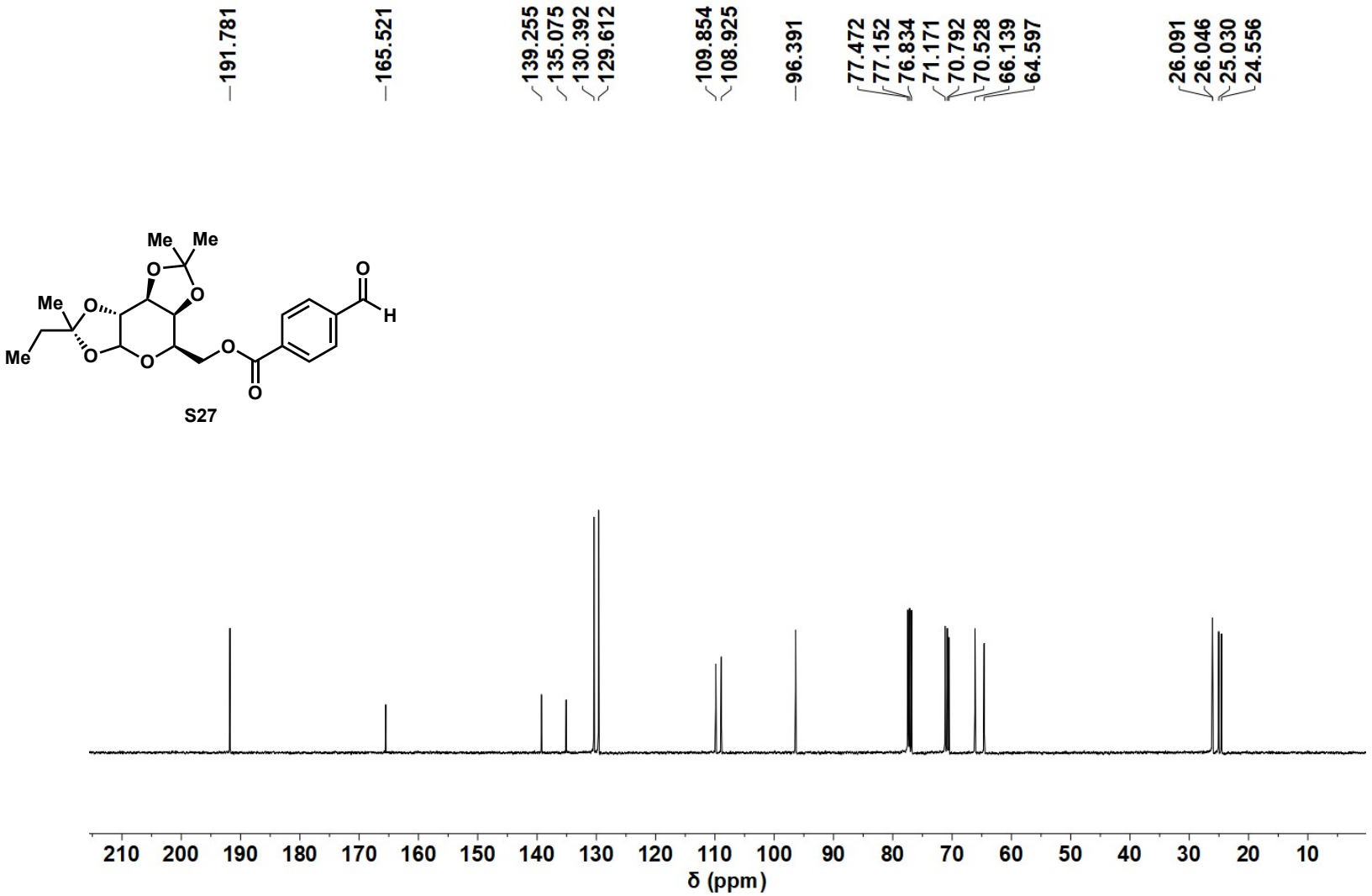

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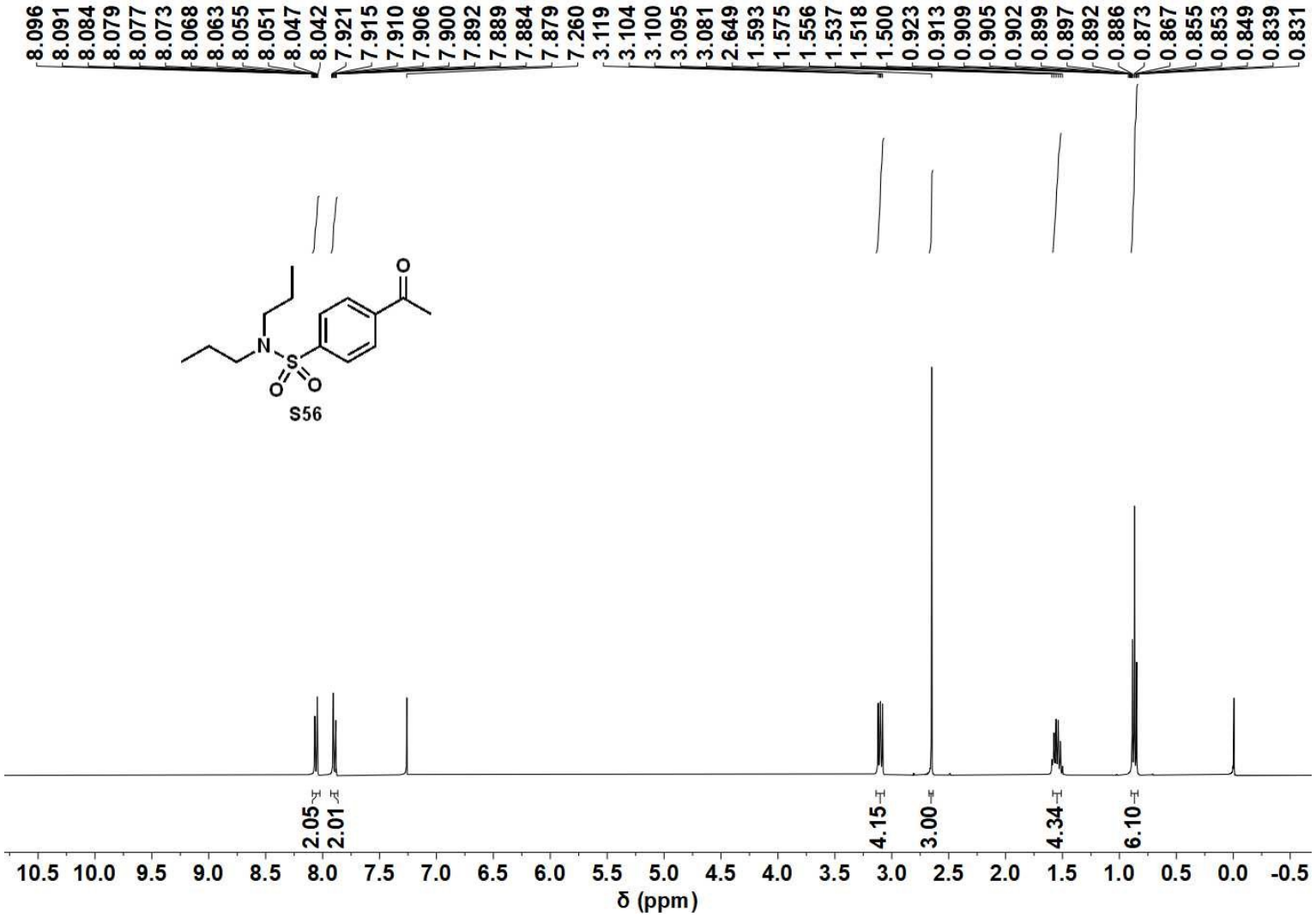

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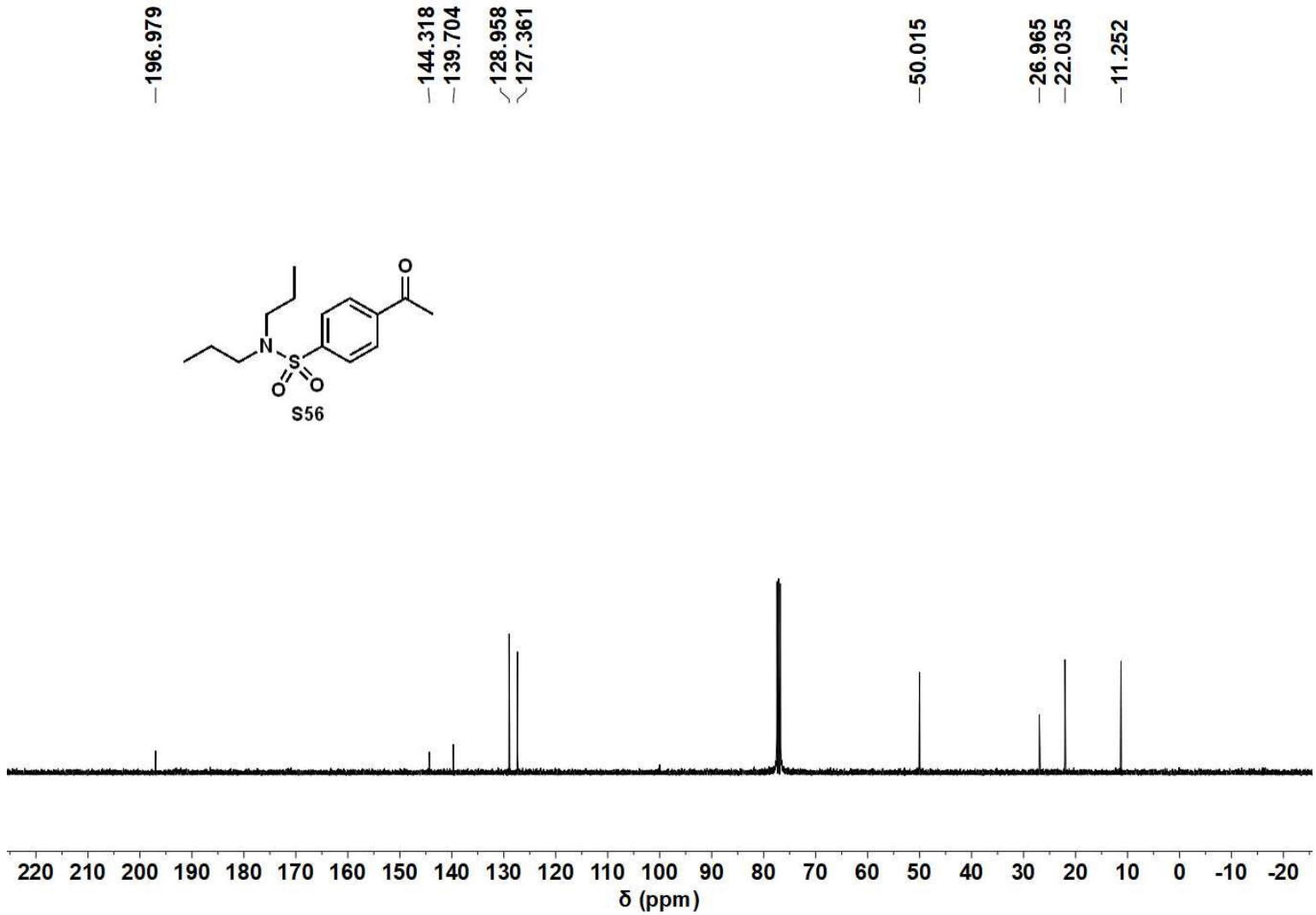

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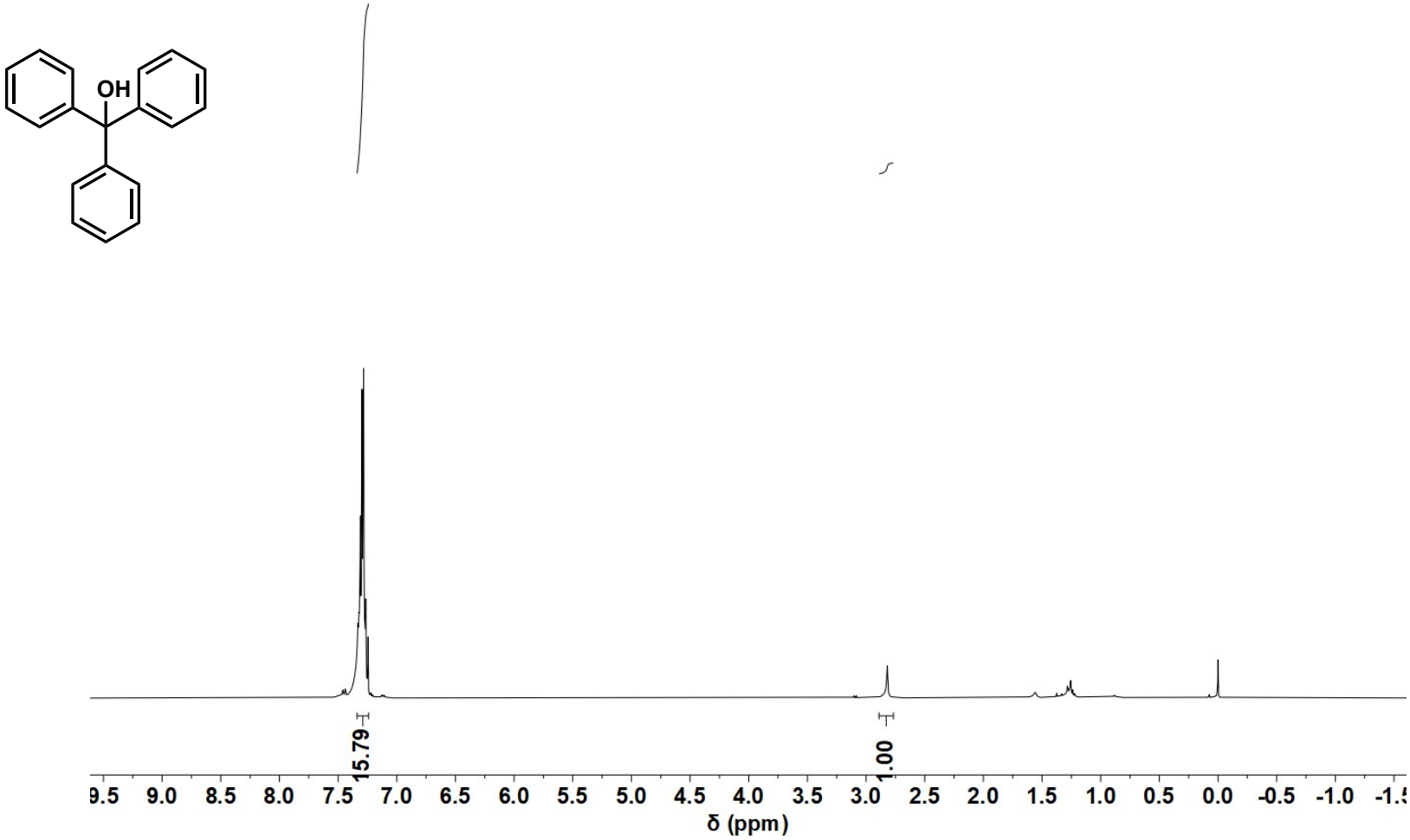
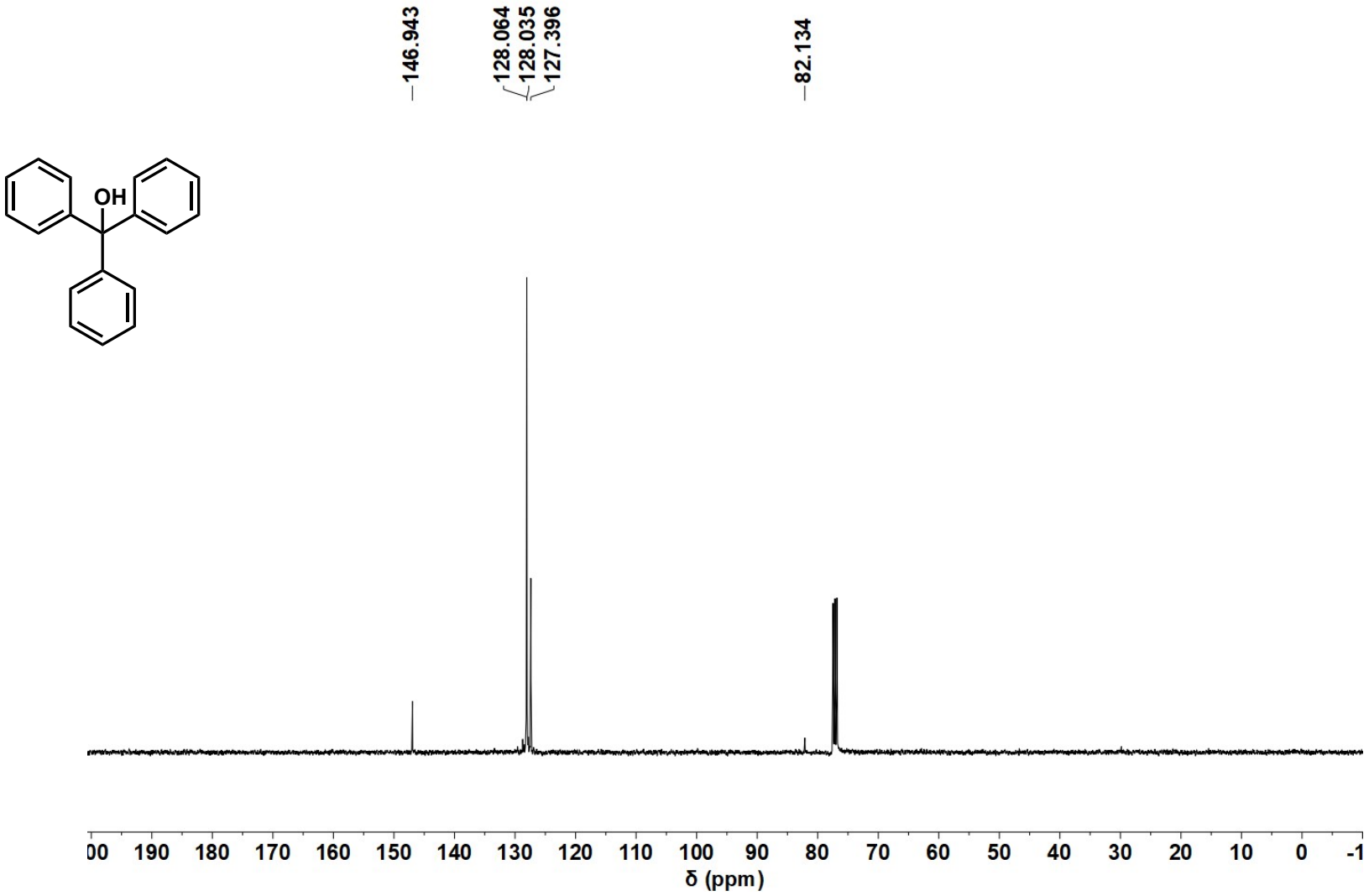


**$^{13}$C NMR** 100 MHz, $CDCl_3$



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