Iron-Catalyzed Hydroboration of Vinylcyclopropanes

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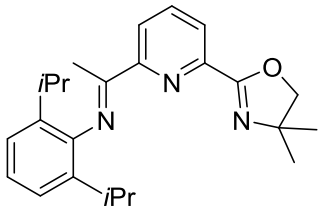
I. General Information

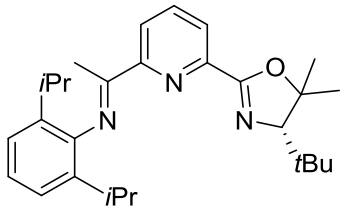
Ether, THF, and toluene were distilled from sodium benzophenone ketyl prior to use. HBpin (97%) was purchased from TCI and used as received. $NaHBEt_3$ (1.0 M in THF), $FeCl_2$ (99.7%), $FeBr_2$ (97%) were purchased from Aldrich and used as received. 1,2-Bis(diphenylphosphino)ethane (98%), $Pd(OAc)_2$ (98%) were purchased from energy and used as received. The other commercially available chemicals were used as received. NMR spectra were recorded on a Bruker-400 instrument. ^1H NMR chemical shifts were referenced to tetramethylsilane signal (0ppm), ^{13}C NMR chemical shifts were referenced to the solvent resonance (77.00 ppm, $CDCl_3$). The following abbreviations (or combinations) were used to explain multiplicities: s = singlet, d = doublet, t = triplet, m= multiplet, br = broad, q = quadruplet. HPLC analyses were performed on a Shimadzu SPD-20A. High-resolution mass spectra (HRMS) were recorded on EI-TOF (electro-spray ionization-time of flight) or ESI-TOF (LCMS-IT-TOF). IR spectra were recorded

on a Perkin-Elmer Spectrum One FTIR spectrometer with diamond ATR accessory. The X-ray diffraction data was obtained on Gemini A Ultra.

II. Procedures for Preparation of Metal Complexes

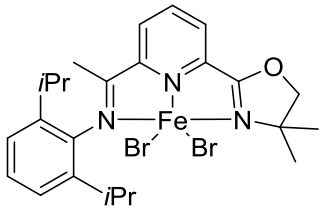


(*E*)-*N*-(2,6-diisopropylphenyl)-1-(6-(4,4-dimethyl-4,5-dihydrooxazol-2-yl)pyridin-2-yl)ethan-1-imine (L1),[1] A 50 mL Schlenk flask was charged with 3.6047 g (10.0 mmol) of (*E*)-1-(6-bromopyridin-2-yl)-*N*-(2,6-diisopropylphenyl)ethan-1-imine, 1.1976 g (12.0 mmol) of 4,4-dimethyl-4,5-dihydrooxazole, 0.0595 g (0.25 mmol) of $Pd(OAc)_2$, 0.1159 g (0.28 mmol) of 1,2-bis(diphenylphosphino)ethane, 1.6815 g (20.0 mmol) of *t*BuOLi and 20 mL of 1,4-dioxane in the atmosphere of nitrogen, the mixture was placed in an oil bath and stirring at 110 ^{o}C for 74 h. Then the mixture was cooled to room temperature, filtered, and concentrated. The residue was purified by flash column chromatography using PE/EA (10/1) with 1 vol% of Et_3N as the eluent to give 2.7135 g (7.19 mmol, 72% yield) of the title compound as a yellow solid, mp: 193.3-195.2 ℃ (by flash column chromatography using PE/EA); IR (cm^{-1}): 2963, 1642, 1573, 1460, 1365. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.50 (dd, J = 7.8, 1.0 Hz, 1H), 8.18 (dd, J = 7.6, 1.0 Hz, 1H), 7.88 (dd, J = 7.8, 7.6 Hz, 1H), 7.19-7.13 (m, 2H), 7.12-7.06 (m, 1H), 4.24 (s, 2H), 2.79-2.66 (m, 2H), 2.29 (s, 3H), 1.44 (s, 6H), 1.13 (d, J = 6.8 Hz, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 166.7, 161.3, 156.1, 146.3, 146.2, 136.9, 135.6, 125.3, 123.6, 123.0, 122.9, 79.7, 67.9, 28.4, 28.2, 23.2, 22.8, 17.2; HRMS (EI) calculated for $[C_{24}H_{31}N_3O]^+$ requires m/z 377.2467, found m/z 377.2466.

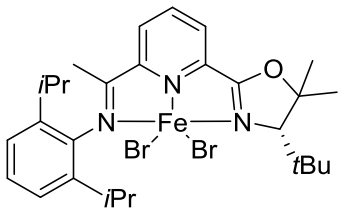


(*S*,*E*)-1-(6-(4-(tert-butyl)-5,5-dimethyl-4,5-dihydrooxazol-2-yl)pyridin-2-yl)-*N*-(2,6-diisopropylphenyl)ethan-1-imine (L2),[1] A 50 mL Schlenk flask was charged with 0.9338 g (2.5 mmol) of (*E*)-1-(6-bromopyridin-2-yl)-*N*-(2,6-diisopropylphenyl)ethan-1-imine, 0.4828 g (3.0 mmol) of (*S*)-4-(*tert*-butyl)-5,5-dimethyl-4,5-dihydrooxazole, 0.0179 g (0.0625 mmol) of $Pd(OAc)_2$, 0.0300 g (0.07 mmol) of 1,2-bis(diphenylphosphino)ethane, 0.4060 g (5.0 mmol) of *t*BuOLi and 10 mL of 1,4-dioxane in the atmosphere of nitrogen, the mixture was placed in an oil bath and stirring at 110 ^{o}C for 39 h. Then the mixture was cooled to room

temperature, filtered, and concentrated. The residue was purified by flash column chromatography using PE/EA (20/1 to 10/1) as the eluent to give 0.2289 g (0.53 mmol, 20% yield) of the title compound as a yellow solid, mp: 130.3-132.3 ℃ (by flash column chromatography using PE/EA). IR (cm^{-1}): 2961, 1641, 1572, 1461, 1367. ^1H NMR ($CDCl_3$, 400 MHz): δ 8.48 (dd, J = 8.0, 1.0 Hz, 1H), 8.12 (dd, J = 7.8, 1.0 Hz, 1H), 7.86 (dd, J = 8.0, 7.8 Hz, 1H), 7.19-7.13 (m, 2H), 7.12-7.06 (m, 1H), 3.68 (s, 1H), 2.79-2.66 (m, 2H), 2.29 (s, 3H), 1.60 (s, 3H), 1.56 (s, 3H), 1.17-1.10 (m, 21H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 167.0, 161.2, 156.1, 146.9, 146.4, 136.7, 135.73, 135.68, 125.0, 123.5, 123.0, 122.7, 88.4, 83.2, 34.2, 30.8, 28.19, 28.15, 27.8, 23.3, 23.2, 22.8, 17.2; HRMS (EI) calculated for $[C_{28}H_{39}N_3O]^+$ requires m/z 433.3093, found m/z 433.3096.



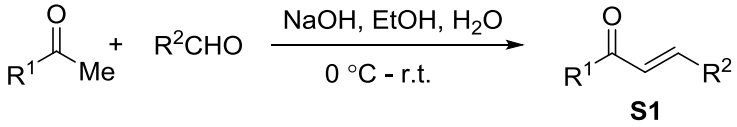
DMiPOIP-$FeBr_2$ Prepared according to the previously reported procedure[1b], in a glove-box, a 50 mL Schlenk flask was charged with 1.0304 g (2.73 mmol) of **L1**, 25 mL of THF and 0.5749 g (2.68 mmol) of $FeBr_2$ under the atmosphere of nitrogen, then the mixture was stirred at room temperature for 3 h, then 25 mL of ether was injected to precipitate the complex. The resulting mixture was filtered under air. The cake was washed with ether and dried in vacuo to afford 1.3293 g (2.24 mmol, 84% yield) of blue powder; Anal. Calcd for $C_{24}H_{31}Br_2FeN_3O$: C, 48.60; H, 5.27; N, 7.08; Found: C, 48.16; H, 5.36; N, 6.89.



L2-$FeBr_2$ Prepared according to the previously reported procedure[1b], in a glove-box, a 50 mL Schlenk flask was charged with 0.4367 g (1.01 mmol) of **L2**, 10 mL of THF and 0.2112 g (0.98 mmol) of $FeBr_2$ under the atmosphere of nitrogen, then the mixture was stirred at room temperature for 3 h, then 10 mL of ether was injected to precipitate the complex. The resulting mixture was filtered under air. The cake was washed with ether and dried in vacuo to afford 0.4737 g (0.74 mmol, 74% yield) of blue powder; Anal. Calcd for $C_{28}H_{41}Br_2FeN_3O_2$ (M + H_2O): C, 50.40; H, 6.19; N, 6.30; Found: C, 50.36; H, 5.92; N, 6.19.

III. Procedures for Synthesis of Vinylcyclopropanes

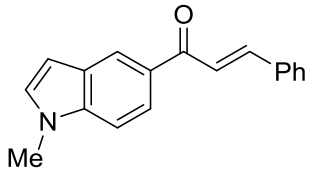
1. General procedure for the synthesis of chalcones



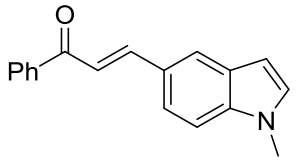
S1

Method A： Prepared according to a previously reported procedure,[2a] acetophenone (100 mmol) was dissolved in ethanol (150 mL) in a 500 mL round-bottom flask and cooled to 0 ℃, a solution of sodium hydroxide (200 mmol) in water (60 mL) was added. Then the solution of alcohol (150 mL) containing benzaldehyde (100 mmol) was added drop wise with stirring over a period of 10 min. The reaction mixture was stirred at room temperature for about 4-12 h until the starting material disappeared (monitored by TLC with PE/EA (10/1)). The reaction mixture was concentrated by rotary evaporation and extracted with DCM (50 mL x 3). The combined organic layers were washed with saturated $NaHCO_3$ and then brine, dried over Na_2SO_4, concentrated by rotary evaporation and further purified by flash chromatography on silica gel or crystallized from ethanol.

The chalcones without additionally noted were prepared according to the method A, **S1am**[2b], **S1an**, **S1aq** and **S1ar**[2c], **S1at**[2d] were prepared according to a previously reported procedure.

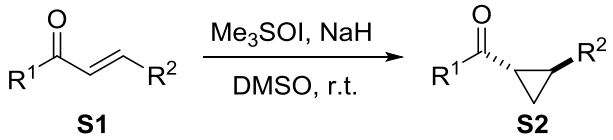


(*E*)-1-(1-methyl-1*H*-indol-5-yl)-3-phenylprop-2-en-1-one (S1p), using 8.74g (50.5 mmol) of **1-(1-methyl-1H-indol-5-yl)ethan-1-one** and 5.10 ml (50 mmol) of benzaldehyde to give 10.74g (41.1 mmol, 81% yield) of **S1p**; yellow solid; mp: 105.7-106.9 ℃ (crystallized from ethanol); IR (cm^{-1}): 2922, 1653, 1596, 1338, 1156.. ^1H NMR ($CDCl_3$, 400 MHz): δ 8.40 (d, J = 1.6 Hz, 1H), 7.99 (dd, J = 8.8, 1.6 Hz, 1H), 7.83 (d, J = 15.8 Hz, 1H), 7.74-7.64 (m, 3H), 7.45-7.36 (m, 4H), 7.12 (d, J = 3.2 Hz, 1H), 6.63 (d, J = 3.0 Hz, 1H), 3.82 (s, 3H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 190.0, 143.1, 139.0, 135.2, 130.4, 130.1, 130.0, 128.8, 128.2, 127.9, 123.1, 122.5, 122.2, 109.3, 102.9, 32.9; HRMS (EI) calculated for $[C_{18}H_{15}NO]^+$ requires m/z 261.1154, found m/z 261.1152.



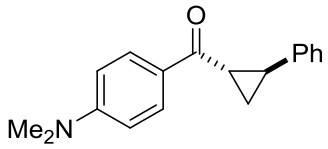
(*E*)-3-(1-methyl-1*H*-indol-6-yl)-1-phenylprop-2-en-1-one (S1al), using 6.01g (50.0 mmol) of **1-methyl-1H-indole-5-carbaldehyde** and 5.85 ml (50.0 mmol) of acetophenone to give 10.08g (38.6 mmol, 77% yield) of **S1al**; yellow solid; mp: 101.2-103.1 ℃ (crystallized from ethanol); IR (cm^{-1}): 2947, 1656, 1586, 1298, 1225. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.06-8.01 (m, 2H), 7.98 (d, J = 15.6 Hz, 1H), 7.89 (d, J = 1.6 Hz, 1H), 7.60-7.45 (m, 5H), 7.32 (d, J = 8.6 Hz, 1H), 7.06 (d, J = 3.2 Hz, 1H), 6.53 (dd, J = 3.2, 0.8 Hz, 1H), 3.79 (s, 3H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 190.7, 147.1, 138.8, 138.1, 132.3, 130.1, 128.8, 128.5, 128.4, 126.4, 123.2, 121.5, 119.1, 109.8, 102.1, 33.0; HRMS (EI) calculated for $[C_{18}H_{15}NO]^+$ requires m/z 261.1154, found m/z 261.1157.

2. General procedure for the synthesis of cyclopropyl ketones



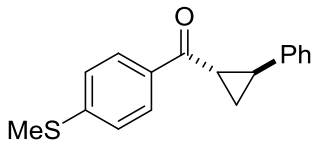
Method B: Prepared according to a previously reported procedure,[3a] Me_3SOI (1.2 equiv.) and NaH (1.2 equiv., 60% dispersion in mineral oil) was mixed in a 250 mL three-necked flame-dried round-bottom flask under the atmosphere of nitrogen. 150 mL of DMSO were added dropwise and stirred at room temperature for 30 min. Then chalcone **S1** was added in portion and stirred at room temperature for about 4-12 h until the starting material disappeared (monitored by TLC with PE/EA (10/1)). The mixture was then treated with H_2O (150 mL) and extracted with DCM (50 mL x 3). The combined organic layers were washed with H_2O (50 mL x 2) and saturated $NaHCO_3$ (50 mL x 2) and then brine, dried over Na_2SO_4, concentrated by rotary evaporation and further purified by flash chromatography on silica gel or crystallized from ethanol.

The cyclopropyl ketones without noted were prepared according to method B. **S2q**, **S2ae-ag** and **S2an** were prepared according to a previously reported procedure.[3b]

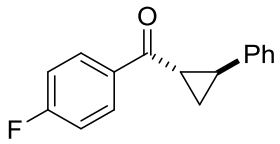


***trans*-(4-(dimethylamino)phenyl)(2-phenylcyclopropyl)methanone (S2f)**, using 9.33g (37.1 mmol) of **S1f** to give 9.54g (35.9 mmol, 97% yield) of **S2f**; yellow solid; mp: 98.0-99.2 ℃

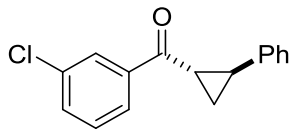
(crystallized from ethanol); IR (cm^{-1}): 2921, 1603, 1396, 1196. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.96-7.90 (m, 2H), 7.33-7.26 (m, 2H), 7.24-7.15 (m, 3H), 6.68-6.62 (m, 2H), 3.04 (s, 6H), 2.88-2.81 (m, 1H), 2.67-2.60 (m, 1H), 1.90-1.82 (m, 1H), 1.49-1.41 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 196.1, 153.3, 141.2, 130.3, 128.4, 126.23, 126.20, 125.6, 110.6, 40.0, 28.8, 28.4, 18.4; HRMS (EI) calculated for $[C_{18}H_{19}NO]^+$ requires m/z 265.1467, found m/z 265.1471.



***trans*-(4-(methylthio)phenyl)(2-phenylcyclopropyl)methanone (S2g)**, using 13.07g (51.4 mmol) of **S1g** to give 6.14g (22.9 mmol, 45% yield) of **S2g**; yellow oil; IR (cm^{-1}): 2922, 1656, 1589, 1406, 1228. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.92-7.87 (m, 2H), 7.33-7.27 (m, 2H), 7.27-7.20 (m, 3H), 7.19-7.14 (m, 2H), 2.87-2.81 (m, 1H), 2.71-2.64 (m, 1H), 2.49 (s, 3H), 1.93-1.87 (m, 1H), 1.56-1.49 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 197.3, 145.6, 140.5, 133.9, 128.49, 128.48, 126.5, 126.2, 125.0, 29.7, 29.0, 19.0, 14.7; HRMS (EI) calculated for $[C_{17}H_{16}OS]^+$ requires m/z 268.0922, found m/z 268.0919.

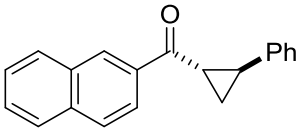


***trans*-(4-fluorophenyl)(2-phenylcyclopropyl)methanone (S2i)**, using 6.10g (26.9 mmol) of **S1i** to give 4.33g (18.0 mmol, 67% yield) of **S2i**; light yellow oil; IR (cm^{-1}): 3032, 1667, 1598, 1223. ^1H NMR ($CDCl_3$, 400 MHz): δ 8.05-7.97 (m, 2H), 7.35-7.27 (m, 2H), 7.26-7.20 (m, 1H), 7.20-7.15 (m, 2H), 7.15-7.08 (m, 2H), 2.87-2.80 (m, 1H), 2.73-2.65 (m, 1H), 1.95-1.88 (m, 1H), 1.60-1.52 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 196.7, 165.5 (d, J = 255.8 Hz), 140.2, 133.9 (d, J = 2.8 Hz), 130.6 (d, J = 9.6 Hz), 128.4, 126.5, 126.0, 115.5 (d, J = 22.0 Hz), 29.8, 29.0, 19.1; ^{19}F NMR: ($CDCl_3$, 376 MHz): δ -105.4; HRMS (EI) calculated for $[C_{16}H_{13}FO]^+$ requires m/z 240.0950, found m/z 240.0949.

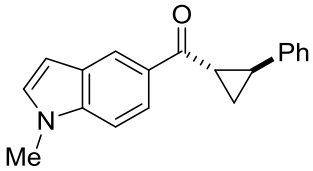


***trans*-(3-chlorophenyl)(-2-phenylcyclopropyl)methanone (S2l)**, using 8.38g (34.5 mmol) of **S1l** to give 3.89g (15.2 mmol, 44% yield) of **S2l**; light yellow oil; IR (cm^{-1}): 3065, 1670, 1572, 1456, 1218. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.95 (dd, J = 1.8, 1.6 Hz, 1H), 7.88-7.83 (m, 1H), 7.54-7.49 (m, 1H), 7.39 (dd, J = 8.0, 7.8 Hz, 1H), 7.35-7.28 (m, 2H), 7.26-7.20 (m, 1H), 7.20-7.14 (m, 2H), 2.86-2.79

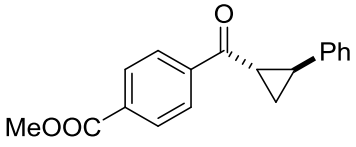
(m, 1H), 2.76-2.68 (m, 1H), 1.95-1.88 (m, 1H), 1.62-1.55 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 197.3, 140.0, 139.1, 134.8, 132.8, 129.9, 128.6, 128.1, 126.7, 126.17, 126.15, 30.4, 29.4, 19.7; HRMS (EI) calculated for $[C_{16}H_{13}ClO]^+$ requires m/z 256.0655, found m/z 256.0657.



***trans*-naphthalen-2-yl(2-phenylcyclopropyl)methanone (S2n)**, using 20.67g (80.0 mmol) of **S1n** to give 16.07g (59.0 mmol, 74% yield) of **S2n**; white solid; mp: 98.4-100.0 ℃ (crystallized from ethanol); IR (cm^{-1}): 3059, 1661, 1398, 1189, 1125. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.52 (s, 1H), 8.06 (dd, J = 8.6, 1.6 Hz, 1H), 7.95 (d, J = 7.8 Hz, 1H), 7.88 (dd, J = 8.8, 8.6 Hz, 2H), 7.63-7.50 (m, 2H), 7.38-7.30 (m, 2H), 7.27-7.20 (m, 3H), 3.10-3.03 (m, 1H), 2.82-2.74 (m, 1H), 2.01-1.94 (m, 1H), 1.66-1.60 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 198.4, 140.5, 135.5, 135.0, 132.5, 129.7, 129.5, 128.5, 128.4, 128.3, 127.7, 126.7, 126.6, 126.2, 123.9, 30.0, 29.3, 19.4; HRMS (EI) calculated for $[C_{20}H_{16}O]^+$ requires m/z 272.1201, found m/z 272.1209.

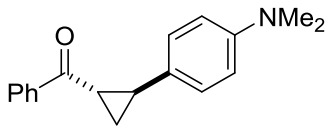


***trans*-(1-methyl-1*H*-indol-5-yl)(2-phenylcyclopropyl)methanone (S2p)**, using 10.43g (39.9 mmol) of **S1p** to give 8.15g (29.6 mmol, 75% yield) of **S2p**; yellow solid; mp: 91.1-92.8 ℃ (crystallized from ethanol); IR (cm^{-1}): 2925, 1651, 1605, 1397, 1341, 1246, 1153. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.36 (d, J = 1.4 Hz, 1H), 7.93 (dd, J = 8.8, 1.6 Hz, 1H), 7.37-7.27 (m, 3H), 7.26-7.18 (m, 3H), 7.10 (d, J = 3.0 Hz, 1H), 6.59 (dd, J = 3.2, 0.8 Hz, 1H), 3.81 (s, 3H), 3.07-2.98 (m, 1H), 2.76-2.66 (m, 1H), 1.97-1.89 (m, 1H), 1.57-1.49 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 198.2, 140.9, 139.0, 130.3, 129.8, 128.4, 127.9, 126.3, 126.2, 122.8, 121.7, 109.0, 102.9, 32.9, 29.2, 29.0, 18.8; HRMS (EI) calculated for $[C_{19}H_{17}NO]^+$ requires m/z 275.1310, found m/z 275.1308.

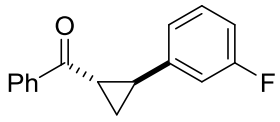


***trans*-methyl-4-(2-phenylcyclopropane-1-carbonyl)benzoate (1h-S1)**, using 16.85g (63.3 mmol) to give 10.63g (37.9 mmol, 60% yield) of **1h-S1**; white solid; mp: 98.5-100.2 ℃ (crystallized from ethanol); IR (cm^{-1}): 3032, 1718, 1660, 1281, 1110. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.11 (d, J = 8.4 Hz, 2H), 8.03 (d, J = 8.2 Hz, 2H), 7.36-7.28 (m, 2H), 7.27-7.21 (m, 1H), 7.21-7.14 (m, 2H), 3.94 (s, 3H), 2.94-2.85 (m, 1H), 2.77-2.69 (m, 1H), 1.99-1.91 (m, 1H),

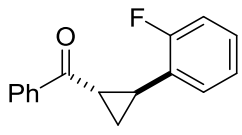
1.65-1.56 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 198.1, 166.2, 140.9, 140.1, 133.6, 129.8, 128.6, 128.0, 126.7, 126.2, 52.4, 30.5, 29.7, 19.6; HRMS (EI) calculated for $[C_{18}H_{16}O_3]^+$ requires m/z 280.1099, found m/z 280.1102.



***trans*-(2-(4-(dimethylamino)phenyl)cyclopropyl)(phenyl)methanone (S2ac)**, using 10.75g (42.8 mmol) of **S1ac** to give 13.83g (43.0 mmol, 99% yield) of **S2ac**; yellow solid; mp: 96.3-98.5 ℃ (crystallized from ethanol); IR (cm^{-1}): 2886, 2803, 1664, 1615, 1525, 1345, 1222. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.01-7.96 (m, 2H), 7.57-7.50 (m, 1H), 7.48-7.41 (m, 2H), 7.10-7.04 (m, 2H), 6.72-6.66 (m, 2H), 2.93 (s, 6H), 2.84-2.77 (m, 1H), 2.67-2.59 (m, 1H), 1.92-1.85 (m, 1H), 1.55-1.48 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 198.8, 149.6, 137.9, 132.7, 128.5, 128.1, 128.0, 127.1, 112.8, 40.7, 30.2, 29.3, 18.7; HRMS (EI) calculated for $[C_{18}H_{19}NO]^+$ requires m/z 265.1467, found m/z 265.1467.

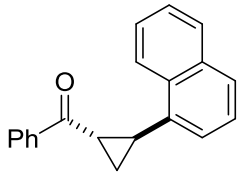


***trans*-(2-(3-fluorophenyl)cyclopropyl)(phenyl)methanone (S2af)**, using 4.91g (21.7 mmol) of **S1af** to give 3.30g (13.7 mmol, 63% yield) of **S2af**; colorless oil; IR (cm^{-1}): 3062, 1667, 1586, 1397, 1224. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.02-7.97 (m, 2H), 7.60-7.53 (m, 1H), 7.50-7.44 (m, 2H), 7.30-7.22 (m, 1H), 6.97 (d, J = 7.6 Hz, 1H), 6.95-6.88 (m, 1H), 6.88-6.82 (m, 1H), 2.93-2.87 (m, 1H), 2.72-2.66 (m, 1H), 1.96-1.89 (m, 1H), 1.56-1.50 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 197.9, 162.9 (d, J = 245.6 Hz), 143.1 (d, J = 7.8 Hz), 137.3, 132.8, 129.9 (d, J = 8.8 Hz), 128.4, 127.9, 121.9 (d, J = 3.0 Hz), 113.3 (d, J = 21.2 Hz), 112.7 (d, J = 22.0 Hz), 29.1 (d, J = 1.4 Hz), 29.0, 19.1; ^{19}F NMR: ($CDCl_3$, 376 MHz): δ -112.8; HRMS (ESI) calculated for $[C_{16}H_{14}FO]^+$ [M + H^+] requires m/z 241.1029, found m/z 241.1028.

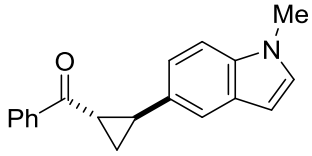


***trans*-(2-(2-fluorophenyl)cyclopropyl)(phenyl)methanone (S2ag)**, using 8.33g (36.8 mmol) of **S1ag** to give 6.29g (26.2 mmol, 71% yield) of **S2ag**; colorless oil; IR (cm^{-1}): 3063, 1668, 1495, 1451, 1398, 1223. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.03-7.97 (m, 2H), 7.57-7.51 (m, 1H), 7.48-7.41 (m, 2H), 7.22-7.14 (m, 1H),

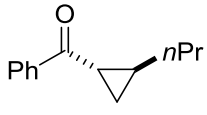
7.12-7.04 (m, 2H), 7.04-6.98 (m, 1H), 2.97-2.90 (m, 1H), 2.86-2.78 (m, 1H), 1.92-1.85 (m, 1H), 1.60-1.53 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 198.5, 161.7 (d, J = 246.4 Hz), 137.6, 132.9, 128.5, 128.1, 128.0, 127.4 (d, J = 14.2 Hz), 127.2 (d , 3.6 Hz), 124.1 (d, J = 3.6 Hz), 115.4 (d, J = 21.2 Hz), 27.3, 23.6 (d, J = 4.4 Hz), 17.6; ^{19}F NMR: ($CDCl_3$, 376 MHz): δ -118.2; HRMS (EI) calculated for $[C_{16}H_{13}FO]^+$ requires m/z 240.0950, found m/z 240.0952.



***trans*-(2-(naphthalen-1-yl)cyclopropyl)(phenyl)methanone (S2ah)**, using 15.50g (60.0 mmol) of **S1ah** to give 8.61g (31.6 mmol, 53% yield) of **S2ah**; white solid; mp: 73.7-75.0 ℃ (crystallized from ethanol); IR (cm^{-1}): 3058, 1664, 1596, 1385, 1221. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.13 (d, J = 8.2 Hz, 1H), 8.08-8.02 (m, 2H), 7.86 (d, J = 7.6 Hz, 1H), 7.78 (d, J = 8.4 Hz, 1H), 7.60-7.54 (m, 1H), 7.52-7.40 (m, 5H), 7.36 (d, J = 7.2 Hz, 1H), 3.30-3.21 (m, 1H), 2.93-2.86 (m, 1H), 2.02-1.94 (m, 1H), 1.79-1.71 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 199.1, 137.7, 136.2, 133.5, 133.0, 128.6, 128.5, 128.2, 127.6, 126.3, 125.9, 125.3, 124.0, 123.8, 27.5, 27.3, 17.8; HRMS (EI) calculated for $[C_{20}H_{16}O]^+$ requires m/z 272.1201, found m/z 272.1200.

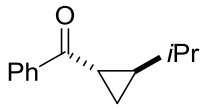


***trans*-(2-(1-methyl-1*H*-indol-5-yl)cyclopropyl)(phenyl)methanone (S2al)**, using 9.16g (35.1 mmol) of **S1al** to give 10.77g (35.0 mmol, 99% yield) of **S2al**; yellow solid; mp: 86.3-87.9 ℃ (crystallized from ethanol); IR (cm^{-1}): 2953, 1663, 1450, 1397, 1223. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.02-7.97 (m, 2H), 7.56-7.50 (m, 1H), 7.47-7.40 (m, 3H), 7.25 (d, J = 8.4 Hz, 1H), 7.07 (dd, J = 8.4, 1.4 Hz, 1H), 7.04 (d, J = 3.2 Hz, 1H), 6.43 (dd, J = 3.2, 0.8 Hz, 1H), 3.77 (s, 3H), 2.93-2.87 (m, 1H), 2.85-2.78 (m, 1H), 2.00-1.93 (m, 1H), 1.67-1.59 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 198.9, 137.9, 135.8, 132.7, 131.2, 129.4, 128.6, 128.5, 128.1, 120.6, 118.1, 109.2, 100.8, 32.9, 31.0, 29.8, 19.0; HRMS (EI) calculated for $[C_{19}H_{17}NO]^+$ requires m/z 275.1310, found m/z 275.1307.

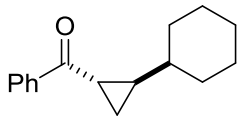


***trans*-phenyl(2-propylcyclopropyl)methanone (S2ao)**, using 6.50g (37.3 mmol) of **S1ao** to give 3.35g (17.8 mmol, 48% yield) of **S2ao**; colorless oil; IR (cm^{-1}): 2959, 2926, 1667, 1450, 1220. ^{1}H NMR ($CDCl_3$, 300 MHz): δ 8.04-7.97 (m, 2H),

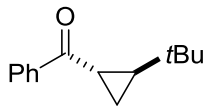
7.60-7.52 (m, 1H), 7.51-7.42 (m, 2H), 2.48-2.40 (m, 1H), 1.66-1.54 (m, 1H), 1.54-1.37 (m, 5H), 0.97-0.88 (m, 4H); ^{13}C NMR: ($CDCl_3$, 75 MHz): δ 200.2, 138.1, 132.6, 128.4, 127.9, 35.6, 27.1, 25.2, 22.4, 19.0, 13.9; HRMS (EI) calculated for $[C_{13}H_{16}O]^+$ requires m/z 188.1201, found m/z 188.1204.



***trans*-(2-isopropylcyclopropyl)(phenyl)methanone (S2aq)**, using 5.89g (33.8 mmol) of **S1aq** to give 4.76g (25.3 mmol, 75% yield) of **S2aq**; colorless oil; IR (cm^{-1}): 2958, 1668, 1357, 1222. ^{1}H NMR ($CDCl_3$, 300 MHz): δ 8.05-7.98 (m, 2H), 7.60-7.53 (m, 1H), 7.52-7.43 (m, 2H), 2.53-2.45 (m, 1H), 1.51-1.40 (m, 2H), 1.27-1.15 (m, 1H), 1.04 (d, J = 4.0 Hz, 3H), 1.02 (d, J = 4.0 Hz, 3H), 1.09-0.93 (m, 1H); ^{13}C NMR: ($CDCl_3$, 75 MHz): δ 200.2, 138.1, 132.6, 128.5, 127.9, 35.2, 32.7, 24.3, 22.0, 21.8, 18.0; HRMS (EI) calculated for $[C_{13}H_{16}O]^+$ requires m/z 188.1201, found m/z 188.1202.

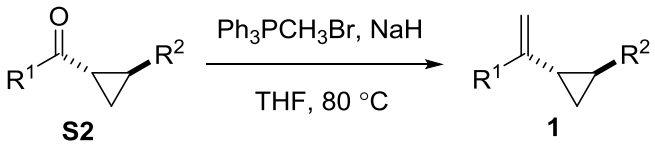


***trans*-(2-cyclohexylcyclopropyl)(phenyl)methanone (S2ar)**, using 4.53g (21.1 mmol) of **S1ar** to give 4.11g (18.0 mmol, 85% yield) of **S2ar**; colorless oil; IR (cm^{-1}): 2923, 2850, 1666, 1448, 1218. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.04-7.97 (m, 2H), 7.58-7.51 (m, 1H), 7.51-7.42 (m, 2H), 2.51-2.45 (m, 1H), 1.84-4.67 (m, 4H), 1.67-1.59 (m, 1H), 1.50-1.41 (m, 2H), 1.27-1.05 (m, 5H), 0.97-0.92 (m, 1H), 0.90-0.79 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 200.1, 138.1, 132.5, 128.4, 127.9, 42.2, 33.9, 32.8, 32.5, 26.3, 26.1, 26.0, 23.9, 17.5; HRMS (EI) calculated for $[C_{16}H_{20}O]^+$ requires m/z 228.1514, found m/z 228.1516.



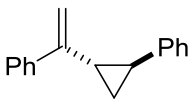
***trans*-(2-(*tert*-butyl)cyclopropyl)(phenyl)methanone (S2as)**, using 1.82g (9.67 mmol) of **S1i** to give 1.30g (6.41 mmol, 66% yield) of **S2as**; colorless oil; IR (cm^{-1}): 2957, 1667, 1332, 1221. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.04-7.96 (m, 2H), 7.59-7.52 (m, 1H), 7.51-7.43 (m, 2H), 2.60-2.53 (m, 1H), 1.62-1.53 (m, 1H), 1.43-1.36 (m, 1H), 1.07-1.01 (m, 1H), 0.93 (s, 9H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 200.4, 138.1, 132.5, 128.4, 127.9, 38.7, 30.0, 28.3, 21.3, 14.8; HRMS (EI) calculated for $[C_{14}H_{18}O]^+$ requires m/z 202.1358, found m/z 202.1358.

3. General procedure for the synthesis of vinylcyclopropanes

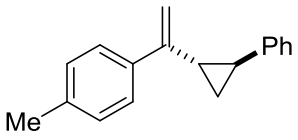


Method C: prepared by Wittig olefination of the corresponding ketones **S2** according to previously reported procedures,[4a] a 250 mL of three-necked flame-dried round-bottom flask was cooled at room temperature under the atmosphere of nitrogen, charged with Methyltriphenylphosphonium bromide (1.2 equiv.), NaH (1.3 equiv., 60% dispersion in mineral oil), THF (150 mL). The mixture was refluxed in 80 ℃ for 1 h and then cooled to 0 ℃, a solution of cyclopropyl ketone in THF (20 mL) was added dropwise and continued to reflux for about 4-12 h. The reaction was quenched by 1.0 mL saturated NH_4Cl until the starting material disappeared (monitored by TLC with PE). The reaction mixture was concentrated by rotary evaporation and then filtrated on silica gel. The combined filtrates were concentrated by rotary evaporation and further purified by flash chromatography on silica gel.

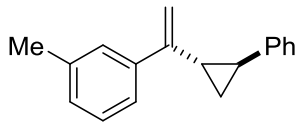
The vinylcyclopropanes without noted were prepared according to method C except. **1h** and **1ap,**[4b] **1r-t**[4c] were prepared of the corresponding ketones according to a previously reported procedure.



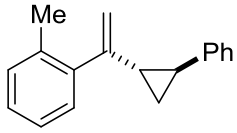
***trans*-(1-(-2-phenylcyclopropyl)vinyl)benzene (1a)**,[4d,4e] using 17.16g (77.2 mmol) of **S2a** to give 14.43g (65.5 mmol, 85% yield) of **1a**; white solid; ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.54-7.48 (m, 2H), 7.33-7.22 (m, 5H), 7.21-7.11 (m, 3H), 5.36 (s, 1H), 5.03 (s, 1H), 2.04-1.92 (m, 2H), 1.43-1.35 (m, 1H), 1.30-1.23 (m, 1H).



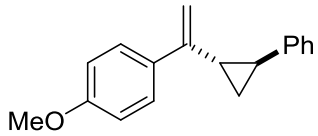
***trans*-1-methyl-4-(1-(2-phenylcyclopropyl)vinyl)benzene (1b)**, using 7.17g (30.4 mmol) of **S2b** to give 5.72g (24.4 mmol, 80% yield) of **1b**; colorless oil; IR (cm^{-1}): 3026, 1622, 1605, 1511, 1458. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.44-7.37 (m, 2H), 7.32-7.25 (m, 2H), 7.21-7.07 (m, 5H), 5.33 (s, 1H), 4.99 (s, 1H), 2.32 (s, 3H), 2.02-1.90 (m, 2H), 1.42-1.34 (m, 1H), 1.29-1.21 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.0, 142.6, 138.1, 137.3, 128.9, 128.4, 125.9, 125.7, 108.6, 27.9, 26.3, 21.1, 15.8; HRMS (EI) calculated for $[C_{18}H_{18}]^+$ requires m/z 234.1409, found m/z 234.1403.



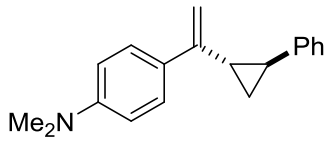
***trans*-1-methyl-3-(1-(2-phenylcyclopropyl)vinyl)benzene (1c)**, using 9.99g (42.3 mmol) of **S2c** to give 6.16g (26.3 mmol, 62% yield) of **1c**; colorless oil; IR (cm^{-1}): 3028, 1603, 1496, 1458, 1078. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.34-7.25 (m, 4H), 7.20-7.11 (m, 4H), 7.06 (d, J = 7.6 Hz, 1H), 5.34 (s, 1H), 5.01 (s, 1H), 2.31 (s, 3H), 2.03-1.96 (m, 1H), 1.96-1.89 (m, 1H), 1.40-1.33 (m, 1H), 1.30-1.24 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.4, 142.5, 141.0, 137.6, 128.4, 128.3, 128.1, 126.9, 125.70, 125.66, 123.2, 109.1, 28.0, 26.3, 21.4, 15.8; HRMS (EI) calculated for $[C_{18}H_{18}]^+$ requires m/z 234.1409, found m/z 234.1405.



***trans*-1-methyl-2-(1-(2-phenylcyclopropyl)vinyl)benzene (1d)**, using 16.32g (69.1 mmol) of **S2d** to give 15.60g (66.7 mmol, 96% yield) of **1d**; colorless oil; IR (cm^{-1}): 3023, 1603, 1492, 1456, 1077. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.28-7.21 (m, 2H), 7.19-7.11 (m, 4H), 7.10-7.03 (m, 3H), 5.18 (s, 1H), 4.84 (s, 1H), 2.30 (s, 3H), 1.91-1.85 (m, 2H), 1.22-1.15 (m, 1H), 1.14-1.06 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 149.9, 142.5, 141.1, 135.5, 129.9, 128.9, 128.3, 127.1, 125.8, 125.6, 125.3, 111.5, 29.7, 25.2, 20.0, 16.0; HRMS (EI) calculated for $[C_{18}H_{18}]^+$ requires m/z 234.1409, found m/z 234.1412.

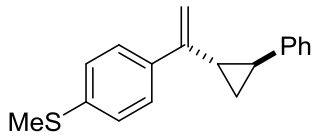


***trans*-1-methoxy-4-(1-(2-phenylcyclopropyl)vinyl)benzene (1e)**, using 20.49g (81.2 mmol) of **S2e** to give 17.40g (69.6 mmol, 86% yield) of **1e**; white solid; mp: 58.0−59.9 ℃ (crystallized from ethanol); IR (cm^{-1}): 2927, 1607, 1511, 1247, 1180. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.48-7.42 (m, 2H), 7.34-7.26 (m, 2H), 7.22-7.16 (m, 1H), 7.16-7.12 (m, 2H), 6.86-6.80 (m, 2H), 5.29 (s, 1H), 4.96 (s, 1H), 3.79 (s, 3H), 2.01-1.89 (m, 2H), 1.44-1.36 (m, 1H), 1.30-1.21 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 159.2, 147.5, 142.6, 133.5, 128.4, 127.1, 125.7, 113.6, 107.7, 55.2, 28.0, 26.3, 15.7; HRMS (EI) calculated for $[C_{18}H_{18}O]^+$ requires m/z 250.1358, found m/z 250.1353.

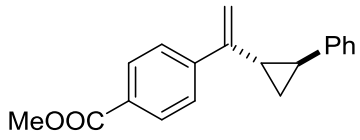


***trans*-*N*,*N*-dimethyl-4-(1-(2-phenylcyclopropyl)vinyl)aniline (1f)**, using 9.54g (36.0 mmol) of **S2f** to give 4.07g (15.5 mmol, 43% yield) of **1f**; yellow solid; mp: 82.8-84.4 ℃ (crystallized from ethanol); IR (cm^{-1}): 2891, 1608, 1521, 1353, 1226. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.46-7.40 (m,

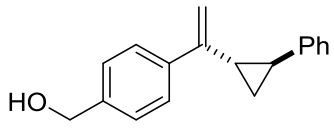
2H), 7.33-7.26 (m, 2H), 7.21-7.12 (m, 3H), 6.69-6.63 (m, 2H), 5.26 (s, 1H), 4.88 (s, 1H), 2.93 (s, 6H), 1.99-1.90 (m, 2H), 1.44-1.36 (m, 1H), 1.27-1.19 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 150.1, 147.5, 142.9, 129.0, 128.4, 126.7, 125.6, 125.5, 112.1, 105.8, 40.4, 28.0, 26.2, 15.6; HRMS (EI) calculated for $[C_{19}H_{21}N]^+$ requires m/z 263.1674, found m/z 263.1677.



***trans*-methyl(4-(1-(2-phenylcyclopropyl)vinyl)phenyl)sulfane (1g)**, using 6.14g (22.9 mmol) of **S2g** to give 5.17g (19.4 mmol, 85% yield) of **1g**; yellow oil; IR (cm^{-1}): 3025, 1603, 1494, 1434, 1110. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.46-7.39 (m, 2H), 7.33-7.25 (m, 2H), 7.22-7.10 (m, 5H), 5.35 (s, 1H), 5.01 (s, 1H), 2.44 (s, 3H), 2.00-1.86 (m, 2H), 1.44-1.35 (m, 1H), 1.29-1.21 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.2, 142.3, 137.7, 137.5, 128.3, 126.3, 126.1, 125.6, 125.5, 108.7, 27.7, 26.2, 15.6, 15.5; HRMS (EI) calculated for $[C_{18}H_{18}S]^+$ requires m/z 266.1129, found m/z 266.1126.

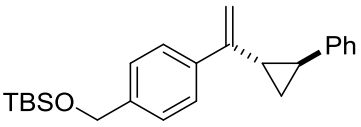


***trans*-methyl-4-(1-(2-phenylcyclopropyl)vinyl)benzoate (1h-S2)**, using 10.03g (35.8 mmol) of **1h-S1** to give 7.60g (27.3 mmol, 76% yield) of **1h-S2**; white solid; mp: 63.9-66.2 ℃ (crystallized from ethanol); IR (cm^{-1}): 2950, 1721, 1606, 1457, 1279. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.99-7.94 (m, 2H), 7.58-7.53 (m, 2H), 7.33-7.26 (m, 2H), 7.22-7.16 (m, 1H), 7.16-7.11 (m, 2H), 5.46 (s, 1H), 5.14 (s, 1H), 3.89 (s, 3H), 2.04-1.96 (m, 1H), 1.96-1.90 (m, 1H), 1.43-1.36 (m, 1H), 1.34-1.27 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 166.9, 147.5, 145.4, 142.1, 129.6, 129.1, 128.5, 126.0, 125.9, 125.7, 111.4, 52.0, 27.6, 26.3, 15.8; HRMS (EI) calculated for $[C_{19}H_{18}O_2]^+$ requires m/z 278.1307, found m/z 278.1302.

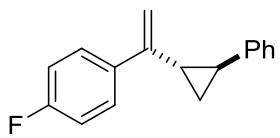


***trans*-(4-(1-(2-phenylcyclopropyl)vinyl)phenyl)methanol (1h-S3)**, a 100 mL of three-necked flame-dried round-bottom flask was cooled at 0 ℃ under the atmosphere of nitrogen, charged with $LiAlH_4$ (0.3978 g, 10.5 mmol, 1.0 equiv.) and 30 mL ether. A solution of **1h-S2** (2.8046 g, 10.1 mmol, 1.0 equiv.) in 10 mL ether was added dropwise at 0 ℃. Then the reaction was stirred at room temperature for 7 h until the starting material disappeared (monitored by TLC

with PE/EA (10/1)). The reaction was quenched by 20 mL saturated NH_4Cl and extracted with EA (20 mL x 3) . The combined organic layers were washed with brine (30 mL), dried over Na_2SO_4, filtered, and concentrated under reduced pressure to give 2.5034 g (10.0 mmol, 99% yield) of the title compound as colorless oil; IR (cm^{-1}): 3335, 2923, 1604, 1498, 1214. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.54-7.49 (m, 2H), 7.33-7.23 (m, 3H), 7.11-7.06 (m, 2H), 7.88-7.83 (m, 2H), 5.35 (s, 1H), 5.02 (s, 1H), 3.80 (s, 3H), 1.99-1.92 (m, 1H), 1.91-1.84 (m, 1H), 1.39-1.32 (m, 1H), 1.24-1.17 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 157.8, 148.4, 141.1, 134.5, 128.2, 127.5, 126.8, 126.1, 113.9, 109.1, 55.3, 27.4, 25.7, 15.4; HRMS (EI) calculated for $[C_{18}H_{18}O]^+$ requires m/z 250.1358, found m/z 250.1358.

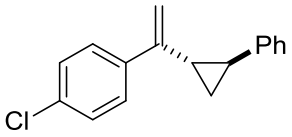


***trans-tert*-butyldimethyl((4-(1-(2-phenylcyclopropyl)vinyl)benzyl)oxy)silane (1h)**, prepared according to a previously reported procedure,[4b] to a solution of **1h-S3** (0.2534 g, 10.0 mmol, 1.0 equiv.), DMAP (0.0184 g, 0.15 mmol, 0.015 equiv.), and Et_3N (1.7 mL, 1.2 equiv.) in 10 mL DCM was added *tert*-butylchlorodimethylsilane (1.7556 g, 11.6 mmol, 1.16 equiv.). The reaction mixture was stirred at room temperature for 11 h. The reaction mixture was diluted with DCM (50 mL) and washed with water (30 mL) and then brine (30 mL). The organic layer was dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by flash column chromatography on silica gel using PE/EA (50/1) to give 3.2224 g (8.84 mmol, 88% yield) of the title compound as a colorless oil; IR (cm^{-1}): 2954, 2856, 1500, 1466, 1255. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.50-7.44 (m, 2H), 7.33-7.22 (m, 4H), 7.22-7.16 (m,, 1H), 7.16-7.12 (m, 2H), 5.35 (s, 1H), 5.02 (s, 1H), 4.72 (s, 2H), 2.02-1.95 (m, 2H), 1.42-1.35 (m, 1H), 1.30-1.22 (m, 1H), 0.93 (s, 9H), 0.09 (s, 6H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.1, 142.6, 140.8, 139.7, 128.4, 125.9, 125.73, 125.70, 109.0, 64.7, 27.9, 26.3, 26.0, 18.4, 15.9, -5.3; HRMS (EI) calculated for $[C_{24}H_{32}OSi]^+$ requires m/z 364.2222, found m/z 364.2223.

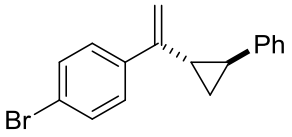


***trans*-1-fluoro-4-(1-(2-phenylcyclopropyl)vinyl)benzene (1i)**, using 4.33g (18.0 mmol) of **S2i** to give 3.02g (12.7 mmol, 70% yield) of **1i**; colorless oil; IR (cm^{-1}): 3028, 1603, 1507, 1230, 1160. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.50-7.42 (m, 2H), 7.33-7.26 (m, 2H), 7.22-7.16 (m, 1H), 7.16-7.10 (m, 2H),

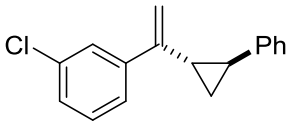
7.01-6.92 (m, 2H), 5.30 (s, 1H), 5.02 (s, 1H), 2.01-1.94 (m, 1H), 1.93-1.86 (m, 1H), 1.42-1.35 (m, 1H), 1.30-1.23 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 162.4 (d, J = 246.6 Hz), 147.2, 142.3, 137.0 (d, J = 2.8Hz), 128.5, 127.7 (d, J = 8.2Hz), 125.8, 125.6, 115.0 (d, J = 21.2Hz), 109.2, 27.9, 26.3, 15.7; ^{19}F NMR ($CDCl_3$, 376 MHz,): δ -114.8; HRMS (EI) calculated for $[C_{17}H_{15}F]^+$ requires m/z 238.1158, found m/z 238.1157.



***trans*-1-chloro-4-(1-(2-phenylcyclopropyl)vinyl)benzene (1j)**, using 10.29g (40.1 mmol) of **S2j** to give 6.32g (24.9 mmol, 62% yield) of **1j**; colorless oil; IR (cm^{-1}): 3028, 1602, 1492, 1096. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.46-7.40 (m, 2H), 7.35-7.23 (m, 4H), 7.23-7.17 (m, 1H), 7.17-7.11 (m, 2H), 5.35 (s, 1H), 5.06 (s, 1H), 2.02-1.94 (m, 1H), 1.94-1.86 (m, 1H), 1.44-1.35 (m, 1H), 1.33-1.23 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.2, 142.3, 139.4, 133.4, 128.5, 128.4, 127.4, 125.9, 125.7, 109.9, 27.8, 26.3, 15.8; HRMS (EI) calculated for $[C_{17}H_{15}Cl]^+$ requires m/z 254.0862, found m/z 254.0862.

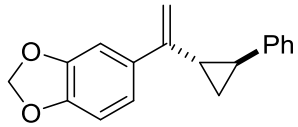


***trans*-1-bromo-4-(1-(2-phenylcyclopropyl)vinyl)benzene (1k)**, using 12.83g (42.6 mmol) of **S2k** to give 10.99g (36.8 mmol, 86% yield) of **1k**; white solid; mp: 32.2-33.4 ℃ (crystallized from ethanol); IR (cm^{-1}): 3027, 2923, 1622, 1488, 1390. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.45-7.34 (m, 4H), 7.33-7.26 (m, 2H), 7.23-7.16 (m, 1H), 7.13 (d, J = 7.6 Hz, 2H), 5.36 (s, 1H), 5.06 (s, 1H), 2.00-1.93 (m, 1H), 1.93-1.86 (m, 1H), 1.42-1.34 (m, 1H), 1.32-1.23 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.2, 142.2, 139.9, 131.3, 128.5, 127.7, 125.8, 125.7, 121.6, 110.0, 27.7, 26.3, 15.7; HRMS (EI) calculated for $[C_{17}H_{15}Br]^+$ requires m/z 298.0357, found m/z 298.0350.

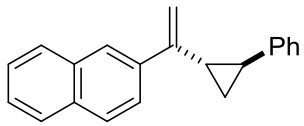


***trans*-1-chloro-3-(1-(2-phenylcyclopropyl)vinyl)benzene (1l)**, using 3.71g (14.5 mmol) of **S2l** to give 3.00g (11.8 mmol, 82% yield) of **1l**; colorless oil; IR (cm^{-1}): 3027, 1595, 1563, 1475, 1256. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.50 (s, 1H), 7.39-7.34 (m, 1H), 7.33-7.26 (m, 2H), 7.25-7.18 (m, 3H), 7.18-7.12 (m, 2H), 5.36 (s, 1H), 5.08 (s, 1H), 2.04-1.97 (m, 1H), 1.93-1.85 (m, 1H), 1.40-1.33 (m, 1H), 1.33-1.27 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.2, 143.0, 142.1, 134.2, 129.5, 128.5,

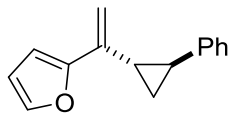
127.6, 126.3, 125.9, 125.8, 124.3, 110.7, 27.7, 26.2, 15.9; HRMS (EI) calculated for $[C_{17}H_{15}Cl]^+$ requires m/z 254.0862, found m/z 254.0863.



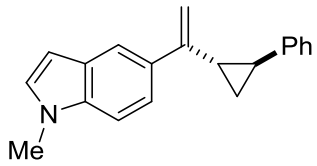
***trans*-5-(1-(2-phenylcyclopropyl)vinyl)benzo[d][1,3]dioxole (1m)**, using 13.40g (50.3 mmol) of **S2m** to give 10.66g (40.4 mmol, 80% yield) of **1m**; yellow oil; IR (cm^{-1}): 3026, 2889, 1603, 1488, 1439, 1227. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.32-7.25 (m, 2H), 7.21-7.15 (m, 1H), 7.15-7.11 (m, 2H), 7.03-6.97 (m, 2H), 6.75-6.70 (m, 1H), 5.93-5.90 (m, 2H), 5.25 (s, 1H), 4.95 (s, 1H), 2.01-1.93 (m, 1H), 1.92-1.85 (m, 1H), 1.41-1.34 (m, 1H), 1.27-1.22 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.6, 147.5, 147.0, 142.4, 135.3, 128.4, 125.7, 125.6, 119.6, 108.3, 107.9, 106.5, 100.9, 28.0, 26.3, 15.7; HRMS (EI) calculated for $[C_{18}H_{16}O_2]^+$ requires m/z 264.1150, found m/z 264.1149.



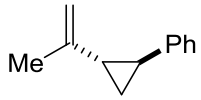
***trans*-2-(1-(2-phenylcyclopropyl)vinyl)naphthalene (1n)**, using 13.67g (50.2 mmol) of **S2n** to give 10.63g (39.3 mmol, 78% yield) of **1n**; white solid; mp: 40.2-41.2 ℃ (crystallized from ethanol); IR (cm^{-1}): 3057, 1602, 1499, 1276. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.94 (s, 1H), 7.80-7.64 (m, 4H), 7.44-7.37 (m, 2H), 7.35-7.28 (m, 2H), 7.24-7.15 (m, 3H), 5.51 (s, 1H), 5.15 (s, 1H), 2.04 (dd, J = 7.2, 7.4 Hz, 2H), 1.47-1.40 (m, 1H), 1.38-1.31 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.0, 142.4, 138.1, 133.3, 132.8, 128.4, 128.3, 127.7, 127.4, 126.0, 125.8, 125.7, 125.0, 124.3, 110.0, 28.1, 26.3, 15.6; HRMS (EI) calculated for $[C_{21}H_{18}]^+$ requires m/z 270.1409, found m/z 270.1414.



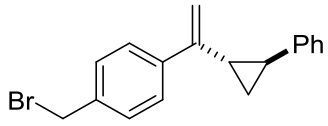
***trans*-2-(1-(2-phenylcyclopropyl)vinyl)furan (1o)**, using 1.78g (8.40 mmol) of **S2o** to give 1.73g (8.23 mmol, 97% yield) of **1o**; yellow solid; mp: 36.5-38.5 ℃ (crystallized from ethanol); IR (cm^{-1}): 3027, 2924, 1606, 1494, 1160. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.37-7.34 (m, 1H), 7.33-7.25 (m, 2H), 7.22-7.17 (m, 1H), 7.16-7.10 (m, 2H), 6.35-6.28 (m, 2H), 5.52 (s, 1H), 4.95 (s, 1H), 2.00-1.86 (m, 2H), 1.40-1.31 (m, 1H), 1.24-1.18 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 154.8, 142.4, 142.0, 137.8, 128.4, 125.74, 125.71, 111.1, 106.9, 106.8, 25.4, 25.2, 14.7; HRMS (EI) calculated for $[C_{15}H_{14}O]^+$ requires m/z 210.1045, found m/z 210.1042.



***trans*-1-methyl-5-(1-(2-phenylcyclopropyl)vinyl)-1*H*-indole (1p)**, using 8.01g (29.1 mmol) of **S2p** to give 7.04g (25.8 mmol, 88% yield) of **1p**; white solid; mp: 69.4-70.6 ℃ (crystallized from ethanol); IR (cm^{-1}): 2924, 1612, 1493, 1336, 1247. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.78 (s, 1H), 7.42 (dd, J = 8.6, 1.6 Hz, 1H), 7.34-7.27 (m, 2H), 7.26-7.22 (m, 1H), 7.22-7.15 (m, 3H), 7.01 (d, J = 3.0 Hz, 1H), 6.43 (d, J = 2.8 Hz, 1H), 5.34 (s, 1H), 5.00 (s, 1H), 3.76 (s, 3H), 2.09-2.02 (m, 2H), 1.46-1.38 (m, 1H), 1.33-1.27 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 149.1, 142.8, 136.3, 132.6, 129.2, 128.4, 128.3, 125.8, 125.6, 120.3, 118.5, 108.8, 107.5, 101.3, 32.7, 28.5, 26.3, 16.0; HRMS (EI) calculated for $[C_{20}H_{19}N]^+$ requires m/z 273.1517, found m/z 273.1513.

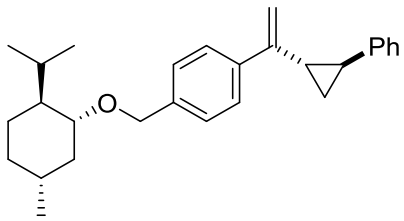


***trans*-(2-(prop-1-en-2-yl)cyclopropyl)benzene (1q)**, using 4.20g (26.2 mmol) of **S2q** to give 1.84g (11.7 mmol, 44% yield) of **1q**; colorless oil; IR (cm^{-1}): 2957, 2926, 1645, 1497, 1457. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.29-7.21 (m, 2H), 7.17-7.11 (m, 1H), 7.11-7.05 (m, 2H), 4.77-4.71 (m, 2H), 2.00-1.94 (m, 1H), 1.73 (s, 3H), 1.69-1.61 (m, 1H), 1.25-1.18 (m, 1H), 1.12-1.05 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 145.3, 142.9, 128.3, 125.8, 125.5, 108.6, 30.0, 24.0, 20.7, 15.2; HRMS (EI) calculated for $[C_{12}H_{14}]^+$ requires m/z 158.1096, found m/z 158.1098.

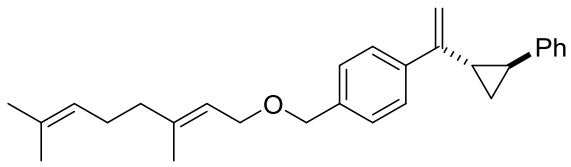


***trans*-1-(bromomethyl)-4-(1-(2-phenylcyclopropyl)vinyl)benzen e (1r-S1)**, a 100 mL of three-necked round-bottom flask was charged with **1h-S3** (2.9103 g, 11.6 mmol, 1.0 equiv.), CBr_4 (5.03 g, 15.2 mmol, 1.25 equiv.) and 20 mL ether. A solution of triphenylphosphine (3.99 g, 15.2 mmol, 1.25 equiv.) in 20 mL ether was added dropwise and stirred at room temperature for 5 h. The reaction mixture was filtrated on silica gel and washed with ether. The combined filtrates were concentrated by rotary evaporation and purified by flash column chromatography on silica gel using PE/EA (20/1) to give 3.1310 g (10.0 mmol, 86% yield) of the title compound as a colorless oil; IR (cm^{-1}): 3057, 1603, 1498, 1406, 1227. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.51-7.45 (m, 2H), 7.34-7.25 (m, 4H), 7.22-7.16 (m, 1H), 7.16-7.10 (m, 2H), 5.38 (s, 1H), 5.06 (s, 1H), 4.46 (s, 2H), 2.01-1.98 (m, 2H), 1.43-1.35 (m, 1H), 1.31-1.23 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.5, 142.3, 141.1, 137.0, 129.0, 128.4, 126.4, 125.8, 125.6, 110.0, 33.3, 27.8, 26.4, 15.7; HRMS (EI)

calculated for $[C_{18}H_{17}Br]^+$ requires m/z 312.0514, found m/z 312.0517.

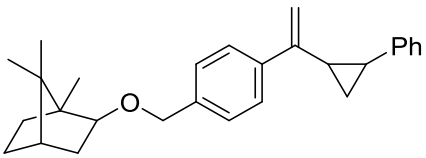


***trans*-1-((((1*R*,2*S*,5*R*)-2-isopropyl-5-methylcyclohexyl)oxy)methyl)-4-(1-(2-phenylcyclopropyl)vinyl)benzene (1r)**, prepared according to a previously reported procedure,[4e] a 100 mL of three-necked flame-dried round-bottom flask was cooled at room temperature under the atmosphere of nitrogen, charged with **1r-S1** (0.8687 g, 2.8 mmol, 1.0 equiv.), menthol (0.7556 g, 4.8 mmol, 1.7 equive) and 25 mL THF. A solution of NaH (0.2527 g, 6.3 mmol, 2.3 equiv., 60% dispersion in mineral oil) in 25 mL THF was added dropwise at room temperature. Then the reaction was stirred reflux for 11 h until the starting material disappeared (monitored by TLC with PE/EA (100/1)). The reaction was quenched by 20 mL saturated NH_4Cl and extracted with EA (20 mL x 3). The combined organic layers were washed with brine, dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by flash column chromatography on silica gel using PE/EA (100/1) to give 1.0271 g (2.64 mmol, 1:1 *dr*, 95% yield) of the title compound as a yellow oil; IR (cm^{-1}): 2953, 2921, 2867, 1623, 1457, 1368. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.50-7.44 (m, 2H), 7.32-7.25 (m, 4H), 7.21-7.17 (m, 1H), 7.16-7.11 (m, 2H), 5.35 (d, J = 1.6 Hz, 1H), 5.02 (s, 1H), 4.63 (d, J = 11.6 Hz, 1H), 4.37 (d, J = 11.6 Hz, 1H), 3.15 (td, J = 10.4, 3.4 Hz, 1H), 2.35-2.23 (m, 1H), 2.21-2.13 (m, 1H), 2.02-1.91 (m, 2H), 1.70-1.67 (m, 2H), 1.42-1.32 (m, 2H), 1.30-1.22 (m, 2H), 0.99-0.82 (m, 9H), 0.71 (d, J = 6.8 Hz, 3H); HRMS (EI) calculated for $[C_{28}H_{36}O]^+$ requires m/z 388.2766, found m/z 388.2767.



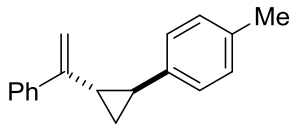
***trans*-(*E*)-1-(((3,7-dimethylocta-2,6-dien-1-yl)oxy)methyl)-4-(1-(2-phenylcyclopropyl)vinyl)benzene (1s)**, prepared according to a previously reported procedure,[4e] a 100 mL of three-necked flame-dried round-bottom flask was cooled at room temperature under the atmosphere of nitrogen, charged with **1r-S1** (3.1310 g, 10.0 mmol, 1.0 equiv.), geraniol (1.8 mL, 1.0 equive) and 50 mL THF. A solution of NaH (0.69 g, 17.3 mmol, 1.7 equiv., 60% dispersion in mineral oil) in 20 mL THF was added dropwise at room temperature. Then the reaction was stirred at room temperature for 9 h until the starting material

disappeared (monitored by TLC with PE/EA (100/1)). The reaction was quenched by 20 mL saturated NH_4Cl and extracted with EA (20 mL x 3). The combined organic layers were washed with brine, dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by flash column chromatography on silica gel using PE/EA (100/1) to give 3.3851 g (8.76 mmol, 88% yield) of the title compound as a yellow oil; IR (cm^{-1}): 2916, 2854, 1775, 1672, 1442, 1104. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.51-7.45 (m, 2H), 7.34-7.26 (m, 4H), 7.22-7.16 (m, 1H), 7.16-7.12 (m, 2H), 5.42-5.34 (m, 2H), 5.13-5.05 (m, 1H), 5.03 (s, 1H), 4.48 (s, 2H), 4.01 (d, J = 6.8 Hz, 2H), 2.15-2.07 (m, 2H), 2.07-2.01 (m, 2H), 2.01-1.91 (m, 2H), 1.67 (s, 3H), 1.64 (s, 3H), 1.60 (s, 3H), 1.42-1.35 (m, 1H), 1.31-1.24 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.0, 142.5, 140.4, 140.3, 138.0, 131.6, 128.4, 127.7, 126.1, 125.7, 124.0, 120.8, 109.3, 71.6, 66.6, 39.6, 27.9, 26.4, 26.3, 25.7, 17.7, 16.5, 15.8; HRMS (EI) calculated for $[C_{28}H_{34}O]^+$ requires m/z 386.2610, found m/z 386.2608.

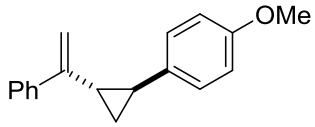


***trans*-1,7,7-trimethyl-2-((4-(1-(2-phenylcyclopropyl)vinyl)benzyl)oxy)bicyclo[2.2.1]heptane (1t)**, prepared according to a previously reported procedure,[4e] a 100 mL of three-necked flame-dried round-bottom flask was cooled at room temperature under the atmosphere of nitrogen, charged with **1r-S1** (1.2621 g, 4.0 mmol, 1.0 equiv.), borneol (0.7942 g, 5.1 mmol, 1.2 equive) and 25 mL THF. A solution of NaH (0.2488 g, 6.2 mmol, 1.5 equiv., 60% dispersion in mineral oil) in 25 mL THF was added dropwise at room temperature. Then the reaction was stirred reflux for 18 h until the starting material disappeared (monitored by TLC with PE/EA (100/1)). The reaction was quenched by 20 mL saturated NH_4Cl and extracted with EA (20 mL x 3). The combined organic layers were washed with brine, dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by flash column chromatography on silica gel using PE/EA (100/1) to give 1.3885 g (3.59 mmol, 89% yield) of the title compound as a yellow oil; IR (cm^{-1}): 2948, 2873, 1622, 1455, 1358, 1119. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.51-7.45 (m, 2H), 7.34-7.25 (m, 4H), 7.22-7.16 (m, 1H), 7.16-7.12 (m, 2H), 5.36 (s, 1H), 5.02 (s, 1H), 4.54 (d, J = 12.2 Hz, 1H), 4.42 (d, J = 12.2 Hz, 1H), 3.72-7.65 (m, 1H), 2.17-2.03 (m, 2H), 2.03-1.92 (m, 2H), 1.76-1.66 (m, 1H), 1.66-1.61 (m, 1H), 1.43-1.36 (m, 1H), 1.30-1.18 (m, 3H), 1.08 (dd, J = 13.0, 3.4 Hz, 1H), 0.89 (s, 3H), 0.84 (s, 3H), 0.82 (s, 3H); ^{13}C

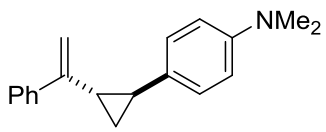
NMR: ($CDCl_3$, 100 MHz): δ 148.1, 142.6, 139.9, 138.9, 128.4, 127.1, 125.9, 125.7, 109.1, 84.3, 71.3, 49.3, 47.8, 45.0, 36.1, 28.2, 27.9, 26.8, 26.3, 19.8, 18.9, 15.8, 14.0; HRMS (EI) calculated for $[C_{28}H_{34}O]^+$ requires m/z 386.2610, found m/z 386.2608.



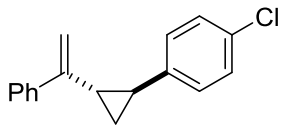
***trans*-1-methyl-4-(2-(1-phenylvinyl)cyclopropyl)benzene (1aa)**, using 14.23g (60.2 mmol) of **S2aa** to give 14.81g (60.0 mmol, 99% yield) of **1aa**; colorless oil; IR (cm^{-1}): 2922, 1622, 1517, 1448. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.53-7.48 (m, 2H), 7.32-7.20 (m, 3H), 7.13-7.01 (m, 4H), 5.35 (s, 1H), 5.02 (s, 1H), 2.32 (s, 3H), 2.00-1.88 (m, 2H), 1.40-1.33 (m, 1H), 1.27-1.19 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.4, 141.1, 139.4, 135.2, 129.1, 128.2, 127.5, 126.1, 125.6, 109.2, 27.6, 26.1, 21.0, 15.6; HRMS (EI) calculated for $[C_{18}H_{18}]^+$ requires m/z 234.1409, found m/z 234.1413.



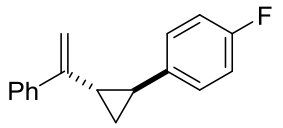
***trans*-1-methoxy-4-(2-(1-phenylvinyl)cyclopropyl)benzene (1ab)**, using 7.97g (31.8 mmol) of **S2ab** to give 6.05g (24.2 mmol, 76% yield) of **1ab**; white solid; mp: 48.3-50.0 ℃ (crystallized from ethanol); IR (cm^{-1}): 3002, 1617, 1514, 1248, 1179. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.54-7.49 (m, 2H), 7.33-7.23 (m, 3H), 7.11-7.06 (m, 2H), 7.88-7.83 (m, 2H), 5.35 (s, 1H), 5.02 (s, 1H), 3.80 (s, 3H), 1.99-1.92 (m, 1H), 1.91-1.84 (m, 1H), 1.39-1.32 (m, 1H), 1.24-1.17 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 157.8, 148.4, 141.1, 134.5, 128.2, 127.5, 126.8, 126.1, 113.9, 109.1, 55.3, 27.4, 25.7, 15.4; HRMS (EI) calculated for $[C_{18}H_{18}O]^+$ requires m/z 250.1358, found m/z 250.1360.



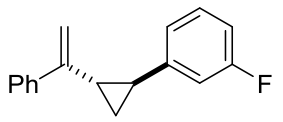
***trans*-*N*,*N*-dimethyl-4-(2-(1-phenylvinyl)cyclopropyl)aniline (1ac)**, using 11.34g (42.7 mmol) of **S2ac** to give 8.07g (30.6 mmol, 72% yield) of **1ac**; yellow oil; IR (cm^{-1}): 3003, 1617, 1524, 1346, 1259. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.55-7.50 (m, 2H), 7.32-7.20 (m, 3H), 7.07-7.02 (m, 2H), 6.73-6.67 (m, 2H), 5.32 (s, 1H), 5.00 (s, 1H), 2.90 (s, 6H), 1.96-1.89 (m, 1H), 1.89-1.82 (m, 1H), 1.35-1.28 (m, 1H), 1.21-1.14 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 149.1, 148.7, 141.3, 130.5, 128.2, 127.4, 126.6, 126.1, 113.0, 108.8, 40.8, 27.1, 25.9, 15.1; HRMS (EI) calculated for $[C_{19}H_{21}N]^+$ requires m/z 263.1674, found m/z 263.1674.



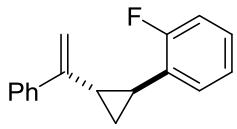
***trans*-1-chloro-4-(2-(1-phenylvinyl)cyclopropyl)benzene (1ad)**, using 8.71g (33.9 mmol) of **S2ad** to give 6.90g (27.1 mmol, 80% yield) of **1ad**; white solid; mp: 44.0-44.9 ℃ (crystallized from ethanol); IR (cm^{-1}): 3027, 1623, 1494, 1092. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.51-7.46 (m, 2H), 7.36-7.23 (m, 5H), 7.10-7.04 (m, 2H), 5.37 (s, 1H), 5.03 (s, 1H), 1.99-1.88 (m, 2H), 1.45-1.38 (m, 1H), 1.28-1.21 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.9, 141.1, 140.8, 131.3, 128.5, 128.3, 127.7, 127.0, 126.0, 109.6, 28.1, 25.8, 15.9; HRMS (EI) calculated for $[C_{17}H_{15}Cl]^+$ requires m/z 254.0862, found m/z 254.0859.



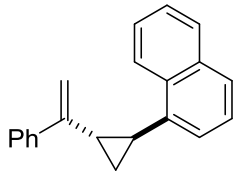
***trans*-1-fluoro-4-(2-(1-phenylvinyl)cyclopropyl)benzene (1ae)**, using 12.75g (53.1 mmol) of **S2ae** to give 9.95g (41.7 mmol, 78% yield) of **1ae**; colorless oil; IR (cm^{-1}): 3055, 1623, 1511, 1228, 1159. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.52-7.47 (m, 2H), 7.33-7.22 (m, 3H), 7.12-7.05 (m, 2H), 7.01-7.94 (m, 2H), 5.36 (s, 1H), 5.02 (s, 1H), 2.01-1.93 (m, 1H), 1.93-1.85 (m, 1H), 1.41-1.34 (m, 1H), 1.25-1.17 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 161.2 (d, J = 243.2 Hz), 148.0, 140.9, 138.0 (d, J = 2.8 Hz), 128.2, 127.6, 127.1 (d, J = 7.4 Hz), 126.0, 115.2 (d, J = 21.2 Hz), 109.4, 27.7, 25.6, 15.7; ^{19}F NMR ($CDCl_3$, 376 MHz): δ -117.2; HRMS (ESI) calculated for $[C_{17}H_{16}F]^+$ [M + H^+] requires m/z 239.1236, found m/z 239.1232.



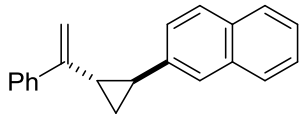
***trans*-1-fluoro-3-(2-(1-phenylvinyl)cyclopropyl)benzene (1af)**, using 3.07g (12.8 mmol) of **S2af** to give 2.18g (9.15 mmol, 71% yield) of **1af**; colorless oil; IR (cm^{-1}): 3081, 1616, 1586, 1492, 1251, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.52-7.46 (m, 2H), 7.34-7.20 (m, 4H), 6.93 (d, J = 7.8 Hz, 1H), 6.91-6.84 (m, 1H), 6.84-6.78 (m, 1H), 5.37 (s, 1H), 5.03 (s, 1H), 2.01-1.91 (m, 2H), 1.46-1.39 (m, 1H), 1.29-1.22 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 163.1 (d, J = 245.2 Hz), 147.8, 145.4 (d, J = 7.4 Hz), 140.7, 129.8 (d, J = 8.8 Hz), 128.3, 127.6, 126.0, 121.5 (d, J = 3.0 Hz), 112.6 (d, J = 18.2 Hz), 112.3 (d, J = 19.0 Hz), 109.6, 28.2, 26.0 (d, J = 1.6 Hz), 16.0; ^{19}F NMR ($CDCl_3$, 376 MHz): δ - 113.2; HRMS (ESI) calculated for $[C_{17}H_{16}F]^+$ [M + H^+] requires m/z 239.1236, found m/z 239.1232.



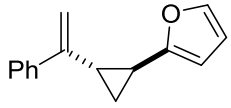
***trans*-1-fluoro-2-(2-(1-phenylvinyl)cyclopropyl)benzene (1ag)**, using 7.63g (31.7 mmol) of **S2ag** to give 4.56g (19.2 mmol, 60% yield) of **1ag**; colorless oil; IR (cm^{-1}): 3083, 1623, 1495, 1239, 1100. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.55-7.49 (m, 2H), 7.35-7.20 (m, 3H), 7.18-7.11 (m, 1H), 7.09-6.95 (m, 3H), 5.37 (s, 1H), 5.09 (s, 1H), 2.31-2.24 (m, 1H), 2.03-1.95 (m, 1H), 1.40-1.27 (m, 2H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 161.7 (d, J = 245.2 Hz), 148.0, 141.0, 129.3 (d, J = 13.4 Hz), 128.2, 127.5, 126.9 (d, J = 8.2 Hz), 126.1, 125.9 (d, J = 3.6 Hz), 124.0 (d, J = 3.6 Hz), 115.1 (d, J = 21.8 Hz), 109.9, 26.6, 19.1 (d, J = 5.2 Hz), 14.9; ^{19}F NMR ($CDCl_3$, 376 MHz): δ -119.5; HRMS (ESI) calculated for $[C_{17}H_{16}F]^+$ [M + H^+] requires m/z 239.1236, found m/z 239.1232.



***trans*-1-(2-(1-phenylvinyl)cyclopropyl)naphthalene (1ah)**, using 8.61g (31.6 mmol) of **S2ah** to give 5.79g (21.4 mmol, 68% yield) of **1ah**; white solid; mp: 36.8-39.1 ℃ (crystallized from ethanol); IR (cm^{-1}): 3049, 1621, 1494, 1388, 1256. ^1H NMR ($CDCl_3$, 400 MHz): δ 8.29-8.22 (m, 1H), 7.85-7.79 (m, 1H), 7.69 (d, J = 8.2 Hz, 1H), 7.57-7.52 (m, 2H), 7.48-7.42 (m, 2H), 7.37 (dd, J = 7.2, 8.0 Hz, 1H), 7.31-7.21 (m, 4H), 5.38 (s, 1H), 5.16 (s, 1H), 2.62-2.56 (m, 1H), 2.08-2.01 (m, 1H), 1.41-1.34 (m, 2H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 149.1, 141.5, 138.1, 133.6, 133.2, 128.5, 128.2, 127.6, 126.8, 126.3, 125.9, 125.7, 125.5, 124.4, 123.2, 109.4, 25.3, 23.1, 15.4; HRMS (EI) calculated for $[C_{21}H_{18}]^+$ requires m/z 270.1409, found m/z 270.1407.

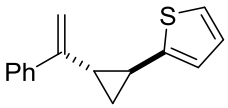


***trans*-2-(2-(1-phenylvinyl)cyclopropyl)naphthalene (1ai)**, using 8.20g (30.1 mmol) of **S2ai** to give 7.20g (26.6 mmol, 88% yield) of **1ai**; white solid; mp: 73.1-74.4 ℃ (crystallized from ethanol); IR (cm^{-1}): 3054, 1626, 1509, 1263. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.74 (m, 3H), 7.60 (s, 1H), 7.55-7.50 (m, 2H), 7.48-7.38 (m, 2H), 7.32-7.21 (m, 4H), 5.40 (s, 1H), 5.08 (s, 1H), 2.19-2.11 (m, 1H), 2.11-2.03 (m, 1H), 1.53-1.45 (m, 1H), 1.43-1.36 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.2, 141.0, 140.1, 133.6, 132.0, 128.3, 128.1, 127.62, 127.58, 127.3, 126.09, 126.06, 125.1, 124.5, 123.8, 109.4, 28.1, 26.8, 15.8; HRMS (EI) calculated for $[C_{21}H_{18}]^+$ requires m/z 270.1409, found m/z 270.1411.

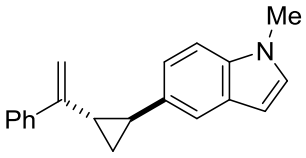


***trans*-2-(2-(1-phenylvinyl)cyclopropyl)furan (1aj)**, using 13.31g (62.7

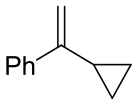
mmol) of **S2aj** to give 11.29g (53.7 mmol, 86% yield) of **1aj**; yellow oil; IR (cm^{-1}): 2925, 1598, 1498, 1446, 1075. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.60-7.53 (m, 2H), 7.36-7.24 (m, 4H), 6.30 (dd, J = 3.2, 1.8 Hz, 1H), 6.05 (d, J = 3.0 Hz, 1H), 5.36 (s, 1H), 5.01 (s, 1H), 2.10-1.98 (m, 2H), 1.36-1.25 (m, 2H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 155.8, 147.4, 140.7, 140.6, 128.2, 127.6, 126.0, 110.3, 109.7, 103.9, 25.1, 19.2, 13.4; HRMS (EI) calculated for $[C_{15}H_{14}O]^+$ requires m/z 210.1045, found m/z 210.1044.



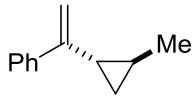
***trans*-2-(2-(1-phenylvinyl)cyclopropyl)thiophene (1ak)**, using 8.63g (37.8 mmol) of **S2ak** to give 7.87g (34.8 mmol, 92% yield) of **1ak**; yellow oil; IR (cm^{-1}): 3078, 1623, 1494, 1443, 1259. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.59-7.53 (m, 2H), 7.36-7.24 (m, 3H), 7.07 (dd, J = 5.2, 1.0 Hz, 1H), 6.92 (dd, J = 5.2, 3.4 Hz, 1H), 6.84 (d, J = 3.4 Hz, 1H), 5.37 (s, 1H), 5.01 (s, 1H), 2.22-2.14 (m, 1H), 2.03-1.96 (m, 1H), 1.46-1.40 (m, 1H), 1.31-1.24 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 147.6, 146.9, 140.7, 128.2, 127.6, 126.9, 126.0, 122.7, 122.2, 109.6, 28.5, 21.7, 16.7; HRMS (EI) calculated for $[C_{15}H_{14}S]^+$ requires m/z 226.0816, found m/z 226.0820.



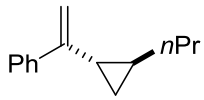
***trans*-1-methyl-5-(2-(1-phenylvinyl)cyclopropyl)-1*H*-indole (1al)**, using 9.63g (35.0 mmol) of **S2al** to give 5.59g (20.4 mmol, 58% yield) of **1al**; yellow oil; IR (cm^{-1}): 2954, 1592, 1511, 1247. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.58-7.51 (m, 2H), 7.41 (d, J = 1.6 Hz, 1H), 7.33-7.19 (m, 4H), 7.04 (dd, J = 8.6, 1.8 Hz, 1H), 7.01 (d, J = 3.0 Hz, 1H), 6.41 (dd, J = 3.0, 0.4 Hz, 1H), 5.35 (s, 1H), 5.04 (s, 1H), 3.75 (s, 3H), 2.14-2.6 (m, 1H), 2.00-1.93 (m, 1H), 1.43-1.36 (m, 1H), 1.33-1.25 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.8, 141.3, 135.5, 133.2, 129.1, 128.7, 128.2, 127.4, 126.1, 120.3, 117.4, 109.1, 108.8, 100.5, 32.8, 27.6, 26.9, 15.5; HRMS (EI) calculated for $[C_{20}H_{19}N]^+$ requires m/z 273.1517, found m/z 273.1516.



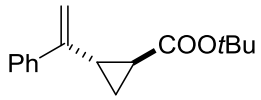
(1-Cyclopropylvinyl)benzene (1am),[4f] using 4.83g (33.0 mmol) of **S2am** to give 4.14g (28.7 mmol, 87% yield) of **1am**; colorless oil. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.62-7.56 (m, 2H), 7.36-7.30 (m, 2H), 7.30-7.24 (m, 1H), 5.27 (d, J = 0.8 Hz, 1H), 4.93 (t, J = 1.0 Hz, 1H), 1.69-1.60 (m, 1H), 0.86-0.80 (m, 2H), 0.62-0.56 (m, 2H).



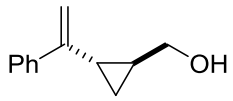
***trans*-(1-(2-methylcyclopropyl)vinyl)benzene (1an)**, using 8.83g (55.1 mmol) of **S2an** to give 6.42g (40.6 mmol, 74% yield) of **1an**; colorless oil. IR (cm^{-1}): 2955, 2925, 1622, 1459, 1400. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.57-7.52 (m, 2H), 7.36-7.30 (m, 2H), 7.29-7.22 (m, 1H), 5.23 (s, 1H), 4.87 (s, 1H), 1.36-1.28 (m, 1H), 1.21 (d, J = 5.6 Hz, 3H), 0.94-0.80 (m, 2H), 0.60-0.53 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 149.4, 141.8, 128.1, 127.3, 126.0, 108.4, 24.4, 19.0, 16.0, 14.4; HRMS (EI) calculated for $[C_{12}H_{14}]^+$ requires m/z 158.1096, found m/z 158.1094.



***trans*-(1-(2-propylcyclopropyl)vinyl)benzene (1ao)**, using 3.35g (17.8 mmol) of **S2ao** to give 1.78g (9.54 mmol, 54% yield) of **1ao**; colorless oil. IR (cm^{-1}): 2998, 2958, 1623, 1494, 1449, 1235. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.56-7.52 (m, 2H), 7.36-7.31 (m, 2H), 7.31-7.23 (m, 1H), 5.21 (d, J = 1.0 Hz, 1H), 4.87 (t, J = 1.0 Hz, 1H), 1.57-1.41 (m, 3H), 1.41-1.34 (m, 1H), 1.31-1.20 (m, 1H), 0.97-0.89 (m, 4H), 0.81-0.75 (m, 1H), 0.64-0.57 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 149.6, 141.9, 128.1, 127.3, 126.1, 108.6, 36.4, 23.2, 22.5, 21.3, 14.0, 13.8; HRMS (EI) calculated for $[C_{14}H_{18}]^+$ requires m/z 186.1409, found m/z 186.1406.

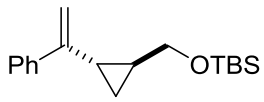


***trans-tert*-Butyl-2-(1-phenylvinyl)cyclopropanecarboxylate (1ap-S1)**, using 15.89g (65.0 mmol) to give 10.51g (43.0 mmol, 66% yield) of **1ap-S1**; colorless oil. IR (cm^{-1}): 2977, 2868, 1720, 1626, 1399, 1367, 1343, 1152. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.55-7.49 (m, 2H), 7.38-7.26 (m, 3H), 5.37 (s, 1H), 5.00 (s, 1H), 2.28-2.17 (m, 1H), 1.72-1.64 (m, 1H), 1.48 (s, 9H), 1.45-1.37 (m, 1H), 1.18-1.10 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 172.7, 146.3, 140.3, 128.3, 127.7, 126.0, 110.7, 80.5, 28.2, 25.8, 23.4, 14.8; HRMS (EI) calculated for $[C_{16}H_{20}O2]^+$ requires m/z 244.1463, found m/z 244.1466.

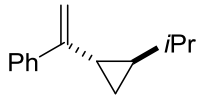


***trans*-(2-(1-phenylvinyl)cyclopropyl)methanol (1ap-S2)**, a 100 mL of three-necked flame-dried round-bottom flask was cooled at 0 ℃ under the atmosphere of nitrogen, charged with $LiAlH_4$ (1.04 g, 27.4 mmol, 1.0 equiv.) and 50 mL ether. A solution of **1ap-S1** (5.9822 g, 24.5 mmol, 1.0 equiv.) in 20 mL ether was added dropwise at 0 ℃.

Then the reaction was stirred at room temperature for 12 h until the starting material disappeared (monitored by TLC with PE/EA (10/1)). The reaction was quenched by 20 mL saturated NH_4Cl.and ectracted with EA (30 mL x 3). The combined organic layers were washed with brine (30 mL), dried over Na_2SO_4, filtered, and concentrated under reduced pressure to give 3.6665 g (21.0 mmol, 86% yield) of the title compound as colorless oil. IR (cm^{-1}): 3333, 2915, 1623, 1493, 1443, 1239. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.58-7.53 (m, 2H), 7.36-7.30 (m, 2H), 7.30-7.23 (m, 1H), 5.28 (s, 1H), 4.94 (s, 1H), 3.67-3.57 (m, 2H), 1.75 (br, 1H), 1.62-1.55 (m, 1H), 1.36-1.26 (m, 1H), 0.91-0.84 (m, 1H), 0.81-0.74 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.0, 141.4, 128.2, 127.5, 126.0, 109.7, 66.5, 23.1, 21.5, 11.4; HRMS (EI) calculated for $[C_{12}H_{14}O]^+$ requires m/z 174.1045, found m/z 174.1046.

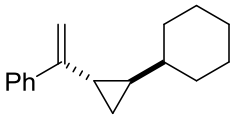


***trans-tert*-butyldimethyl((2-(1-phenylvinyl)cyclopropyl)methoxy)silane (1ap)**, prepared according to a previously reported procedure,[4b] to a solution of **1ap-S2** (1.73 g, 9.9 mmol, 1.0 equiv.), DMAP (0.0192 g, 0.16 mmol, 0.016 equiv.), and Et_3N (1.7 mL, 1.2 equiv.) in 10 mL DCM was added *tert*-butylchlorodimethylsilane (1.6872 g, 11.2 mmol, 1.12 equiv.). The reaction mixture was stirred at room temperature for 23 h. The reaction mixture was diluted with DCM (50 mL) and washed with water (30 mL) and brine (30 mL). The organic layer were dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by flash column chromatography on silica gel using PE/EA (50/1) to give 2.6711 g (9.26 mmol, 93% yield) of the title compound as a colorless oil;. IR (cm^{-1}): 2955, 2888, 1624, 1495, 1255. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.76-7.71 (m, 2H), 7.42-7.36 (m, 2H), 7.36-7.31 (m, 1H), 5.35 (s, 1H), 4.99 (s, 1H), 3.89 (dd, J = 10.8, 5.4 Hz, 1H), 3.59 (dd, J = 10.8, 7.2 Hz, 1H), 1.68-1.60 (m, 1H), 1.31-1.22 (m, 1H), 0.99 (s, 9H), 0.98-0.93 (m, 1H), 0.82-0.75 (m, 1H), 0.15 (s, 6H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 148.5, 141.6, 128.1, 127.4, 126.2, 109.2, 66.4, 26.0, 24.0, 21.5, 18.4, 9.9, -5.23, -5.25; HRMS (EI) calculated for $[C_{18}H_{28}OSi]^+$ requires m/z 288.1909, found m/z 288.1912.

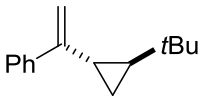


***trans*-(1-(2-isopropylcyclopropyl)vinyl)benzene (1aq)**, using 4.76g (25.3 mmol) of **S2aq** to give 3.60g (19.3 mmol, 76% yield) of **1aq**; colorless oil. IR (cm^{-1}): 2957, 2870, 1668, 1532, 1494, 1282. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.56-7.51 (m, 2H),

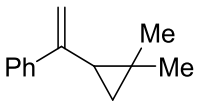
7.35-7.29 (m, 2H), 7.29-7.23 (m, 1H), 5.18 (d, J = 1.0 Hz, 1H), 4.88 (t, J = 1.2 Hz, 1H), 1.48-1.41 (m, 1H), 1.19-1.09 (m, 1H), 1.04 (d, J = 6.4 Hz, 3H), 0.99 (d, J = 6.4 Hz, 3H), 0.87-0.77 (m, 1H), 0.73-0.63 (m, 2H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 149.8, 142.1, 128.1, 127.3, 126.2, 108.8, 32.9, 29.2, 22.3, 21.7, 13.3; HRMS (EI) calculated for $[C_{14}H_{18}]^+$ requires m/z 186.1409, found m/z 186.1407.



***trans*-(1-(2-cyclohexylcyclopropyl)vinyl)benzene (1ar)**, using 4.11g (18.0 mmol) of **S2ar** to give 3.10g (13.7 mmol, 76% yield) of **1ar**; colorless oil. IR (cm^{-1}): 2922, 2850, 1670, 1622, 1541, 1447, 1029. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.56-7.50 (m, 2H), 7.36-7.29 (m, 2H), 7.29-7.22 (m, 1H), 5.17 (s, 1H), 4.87 (s, 1H), 1.90-1.58 (m, 5H), 1.48-1.41 (m, 1H), 1.27-1.01 (m, 5H), 0.87-0.72 (m, 2H), 0.71-0.62 (m, 2H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 150.0, 142.2, 128.0, 127.3, 126.3, 108.8, 42.6, 33.2, 32.5, 27.9, 26.6, 26.3, 21.9, 13.0; HRMS (EI) calculated for $[C_{17}H_{22}]^+$ requires m/z 226.1722, found m/z 226.1725.



***trans*-(1-(2-(*tert*-Butyl)cyclopropyl)vinyl)benzene (1as)**, using 1.30g (6.43 mmol) of **S2as** to give 1.09g (5.44 mmol, 85% yield) of **1as**; colorless oil. IR (cm^{-1}): 2957, 2867, 1670, 1622, 1470, 1396, 1364, 1267. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.56-7.51 (m, 2H), 7.35-7.29 (m, 2H), 7.29-7.22 (m, 1H), 5.19 (s, 1H), 4.90 (s, 1H), 1.60-1.52 (m, 1H), 0.98-0.93 (m, 1H), 0.90 (s, 9H), 0.79-0.72 (m, 1H), 0.62-0.55 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 150.1, 142.2, 128.1, 127.3, 126.3, 108.9, 32.8, 29.8, 28.5, 19.1, 10.3; HRMS (EI) calculated for $[C_{15}H_{20}]^+$ requires m/z 200.1565, found m/z 200.1563.

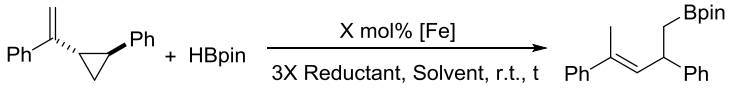


(1-(2,2-Dimethylcyclopropyl)vinyl)benzene (1at), using 2.91g (16.7 mmol) of **S2at** to give 2.45g (14.2 mmol, 85% yield) of **1at**; colorless oil. IR (cm^{-1}): 2942, 2867, 1622, 1493, 1448, 1381, 1253. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.52-7.46 (m, 2H), 7.37-7.30 (m, 2H), 7.29-7.22 (m, 1H), 5.49 (s, 1H), 4.90 (s, 1H), 1.52 (t, J = 6.8 Hz, 1H), 1.29 (s, 3H), 0.92 (s, 3H), 0.72-0.63 (m, 2H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 146.3, 141.7, 128.2, 127.3, 125.9, 111.1, 30.4, 26.9, 19.1, 18.9, 17.5; HRMS (EI) calculated for $[C_{13}H_{16}]^+$ requires m/z 172.1252, found m/z 172.1256.

IV. Optimization for Hydroboration of Vinylcyclopropanes

A variety of precatalysts, solvents and reductants, the ratio of **1**/HBpin, the loading of precatalysts, and time of reaction have been investigated for the Hydroboration of Vinylcyclopropanes.

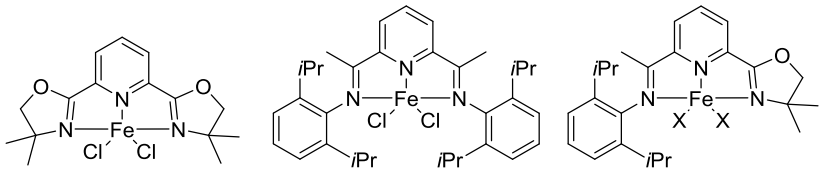
Table S1. Optimization for Hydroboration of Vinylcyclopropanes. [a]



Entry	Reductant	Solvent (mL)	[Fe] (mol%)	t	Yield (%)[a]	*E*/*Z*[a]
1	$NaBHEt_3$	Toluene (1)	Pybox-$FeCl_2$ (5)	3	< 2	-
2	$NaBHEt_3$	Toluene (1)	PDI-$FeCl_2$ (5)	3	< 2	-
3	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeCl_2$ (5)	3	90	12/1
4	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	93	15/1
5 [b]	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	54	12/1
6[c]	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	56	13/1
7[d]	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	49	10/1
8[e]	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	69	11/1
9	$NaBHsBu_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	82	11/1
10	$LiBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	21	-
11	$ZnEt_2$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	0	-
12	$AlMe_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	0	-
14	MeMgBr	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	0	-
15	*t*BuOLi	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	0	-
16	*t*BuONa	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	<2	-
17	*t*BuOK	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	0	-
18	NaOH	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (5)	3	0	-
14	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (2.5)	3	85	12/1
14[f]	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP-$FeBr_2$ (1.0)	3	24	-
15	$NaBHEt_3$	Toluene (0.5)	^{DMiP}OIP-$FeBr_2$ (2.5)	3	79	11/1
16	$NaBHEt_3$	Et_2O (0.5)	^{DMiP}OIP-$FeBr_2$ (2.5)	3	77	11/1

17	$NaBHEt_3$	THF (0.5)	^{DMiP}OIP·$FeBr_2$ (2.5)	3	57	8/1
18	$NaBHEt_3$	neat	^{DMiP}OIP·$FeBr_2$ (2.5)	3	53	10/1
19	$NaBHEt_3$	dioxane (0.5)	^{DMiP}OIP·$FeBr_2$ (2.5)	3	82	11/1
20	$NaBHEt_3$	DCM (0.5)	^{DMiP}OIP·$FeBr_2$ (2.5)	3	0	-
21	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP·$FeBr_2$ (5)	0.17	85(79)	13/1
22	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP·$FeBr_2$ (5)	0.33	80(75)	12/1
23	**$NaBHEt_3$**	**Toluene (1)**	**^{DMiP}OIP·$FeBr_2$ (5)**	**0.5**	**97(87)**	**12/1**
24	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP·$FeBr_2$ (5)	1.0	93(86)	13/1
25	$NaBHEt_3$	Toluene (1)	^{DMiP}OIP·$FeBr_2$ (5)	2.0	90(86)	10/1
26	$NaBHEt_3$	Toluene (1)	$FeBr_2$ (5)	3.0	0	-
27	-	Toluene (1)	^{DMiP}OIP·$FeBr_2$ (5)	3.0	0	-
28	$NaBHEt_3$	Toluene (1)	-	3.0	0	-

[a] Using HBpin (0.5 mmol), **1a** (1.0 mmol), [Fe] (5 mol%), $NaBHEt_3$ (15 mol%), and toluene (1 mL). Yields and ratio of *E*/*Z* were determined by ^{1}H NMR analysis, and isolated yield in the parenthesis. [b] **1**/HBpin = 1/2. [c] **1**/HBpin = 1/1. [d] **1**/HBpin = 1.2/1. [e] **1**/HBpin = 1.5/1. [f] 6 mol% $NaBHEt_3$.



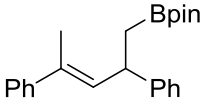
V. Iron-Catalyzed Hydroboration of Vinylcyclopropanes

General Procedure A for Hydroboration of Vinylcyclopropanes: to a 25 mL flame-dried Schlenk flask cooled under nitrogen, ^{DMiP}OIP·$FeBr_2$ complex (0.025 mmol, 5 mol%) and vinylcyclopropane (1.0 mmol, 2.0 equiv.) were added. The mixture was vacuumed and flushed with nitrogen for three times, and then, 1.0 mL of toluene (0.5 M) and HBpin (75 μL, 97%, 0.5 mmol, 1.0 equiv.) were added in sequence. The mixture was injected with $NaBHEt_3$ (1.0 M in THF, 75 μL, 0.075 mmol) by dropwise. The reaction was run at ambient temperature for 0.5 h. Then the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored

by ^{1}H NMR analysis. The resulting mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give the corresponding product.

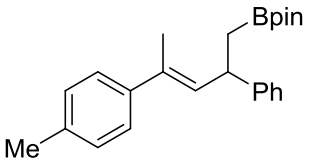
General Procedure B for Hydroboration of Vinylcyclopropanes: to a 25 mL flame-dried Schlenk flask cooled under nitrogen, ^{DMiP}OIP·FeBr$_2$ complex (0.05 mmol, 10 mol%) and vinylcyclopropane (1.0 mmol, 2.0 equiv.) were added. The mixture was vacuumed and flushed with nitrogen for three times, and then, 1.0 mL of toluene (0.5 M) and HBpin (75 μL, 97%, 0.5 mmol, 1.0 equiv.) were added in sequence. The mixture was injected with NaBHEt$_3$ (1.0 M in THF, 75 μL, 0.075 mmol) by dropwise. The reaction was run at ambient temperaturefor 3 h. Then the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The resulting mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give the corresponding product.

General Procedure C for Hydroboration of Vinylcyclopropanes: to a 25 mL flame-dried Schlenk flask cooled under nitrogen, ^{DMiP}OIP·FeBr$_2$ complex (0.05 mmol, 10 mol%) and vinylcyclopropane (1.0 mmol, 2.0 equiv.) were added. The mixture was vacuumed and flushed with nitrogen for three times, and then, 1.0 mL of toluene (0.5 M) and HBpin (75 μL, 97%, 0.5 mmol, 1.0 equiv.) were added in sequence. The mixture was injected with NaBHEt$_3$ (1.0 M in THF, 150 μL, 0.150 mmol) by dropwise. The reaction was run at ambient temperature for 10 h. Then the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The resulting mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give the corresponding product.

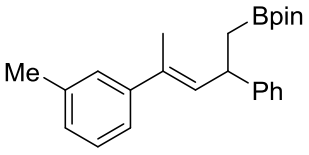


(*E*)-2-(2,4-diphenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2a) Prepared according to the general procedure A, using 0.2198 g (1.0 mmol) of **1a**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·FeBr$_2$, 75 μL (1.0 M in THF, 0.075 mmol) of NaBHEt$_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by

ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1510 g (0.435 mmol, 12/1 *E/Z*, 87% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2927, 1600, 1493, 1448, 1366, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.40-7.33 (m, 2H), 7.33-7.23 (m, 6H), 7.22-7.11 (m, 2H), 5.89 (dd, J = 9.8, 0.8 Hz, 1H), 4.04-3.95 (m, 1H), 2.13 (s, 3H), 1.41-1.28 (m, 2H), 1.14 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.8, 144.0, 133.8, 133.3, 128.3, 128.0, 127.1, 126.5, 125.84, 125.81, 83.1, 40.3, 24.8, 24.7, 16.3. HRMS (EI) calculated for $[C_{23}H_{29}BO_2]^+$ requires m/z 348.2261, found m/z 348.2260.

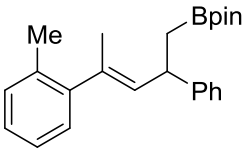


(*E*)-4,4,5,5-tetramethyl-2-(2-phenyl-4-(*p*-tolyl)pent-3-en-1-yl)-1,3,2-dioxaborolane (2b) Prepared according to the general procedure A, using 0.2339 g (1.0 mmol) of **1b**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1485 g (0.410 mmol, 11/1 *E/Z*, 82% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3025, 2978, 1602, 1366, 1327, 1145. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.31-7.23 (m, 6H), 7.17-7.13 (m, 1H), 7.10-7.05 (m, 2H), 5.86 (dd, J = 9.8, 1.2 Hz, 1H), 4.04-3.94 (m, 1H), 2.31 (s, 3H), 2.10 (d, J = 1.2 Hz, 3H), 1.38-1.30 (m, 2H), 1.14 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.9, 141.1, 136.1, 133.1, 133.0, 128.7, 128.3, 127.1, 125.74, 125.69, 83.1, 40.2, 24.8, 24.7, 21.0, 16.3. HRMS (EI) calculated for $[C_{24}H_{31}BO_2]^+$ requires m/z 362.2417, found m/z 362.2415.

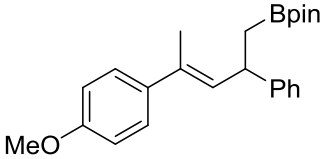


(*E*)-4,4,5,5-tetramethyl-2-(2-phenyl-4-(*m*-tolyl)pent-3-en-1-yl)-1,3,2-dioxaborolane (2c) Prepared according to the general procedure A, using 0.2368 g (1.0 mmol) of **1c**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0152 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of

ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1539 g (0.425 mmol, 15/1 *E/Z*, 85% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3026, 2978, 1602, 1364, 1325, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.31-7.21 (m, 4H), 7.19-7.10 (m, 4H), 7.01-6.97 (m, 1H), 5.88 (dd, J = 9.8, 1.2 Hz, 1H), 4.04-3.65 (m, 1H), 2.31 (s, 3H), 2.11 (d, J = 1.6 Hz, 3H), 1.41-1.30 (m, 2H), 1.13 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.7, 143.9, 137.4, 133.6, 133.3, 128.2, 127.9, 127.3, 127.0, 126.6, 125.7, 122.9, 83.0, 40.2, 24.7, 24.6, 21.4, 16.3. HRMS (EI) calculated for $[C_{24}H_{31}BO_2]^+$ requires m/z 362.2417, found m/z 362.2419.

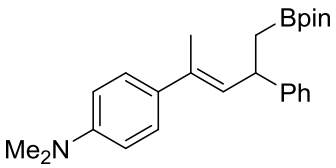


(*E*)-4,4,5,5-tetramethyl-2-(2-phenyl-4-(*o*-tolyl)pent-3-en-1-yl)-1,3,2-dioxaborolane (2d) Prepared according to the general procedure C, using 0.2344 g (1.0 mmol) of **1d**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0303 g (0.051 mmol) of ^{DMiP}OIP·$FeBr_2$, 150 μL (1.0 M in THF, 0.150 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 10 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0879 g (0.245 mmol, > 99/1 *E/Z*, 49% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3023, 2978, 1600, 1367, 1325, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.34-7.23 (m, 4H), 7.19-7.14 (m, 1H), 7.14-7.08 (m, 3H), 7.06-7.00 (m, 1H), 5.46 (dd, J = 9.6, 1.2 Hz, 1H), 4.05-3.89 (m, 1H), 2.20 (s, 3H), 1.99 (d, J = 1.4 Hz, 3H), 1.32 (d, J = 7.6 Hz, 2H), 1.17 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 147.0, 145.4, 135.3, 134.9, 134.4, 130.0, 128.2, 127.1, 126.4, 125.7, 125.4, 83.1, 39.9, 24.79, 24.77, 19.8, 18.3. HRMS (EI) calculated for $[C_{24}H_{31}BO_2]^+$ requires m/z 362.2417, found m/z 362.2418.

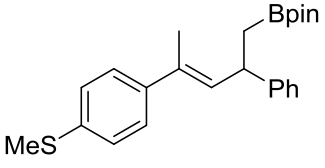


(*E*)-2-(4-(4-methoxyphenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2e) Prepared according to the

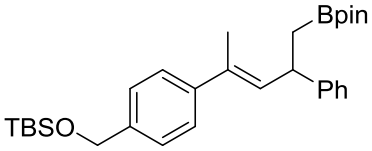
general procedure A, using 0.2499 g (1.0 mmol) of **1e**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1657 g (0.440 mmol, 12/1 *E/Z*, 88% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2930, 1729, 1607, 1511, 1365. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.32-7.22 (m, 6H), 7.17-7.09 (m, 1H), 6.85-6.79 (m, 2H), 5.82 (dd, J = 9.8, 1.2 Hz, 1H), 4.02-3.94 (m, 1H), 3.78 (s, 3H), 2.10 (d, J = 1.2 Hz, 3H), 1.40-1.27 (m, 2H), 1.14 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 158.4, 146.9, 136.5, 132.6, 132.3, 128.3, 127.1, 126.8, 125.7, 113.4, 83.1, 55.2, 40.2, 24.8, 24.7, 16.3. HRMS (EI) calculated for $[C_{24}H_{31}BO_3]^+$ requires m/z 378.2366, found m/z 378.2369.



(*E*)-*N*,*N*-dimethyl-4-(4-phenyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pent-2-en-2-yl)aniline (2f) Prepared according to the general procedure A, using 0.2634 g (1.0 mmol) of **1f**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1490 g (0.380 mmol, 7/1 *E/Z*, 76% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2977, 2926, 1610, 1521, 1361, 1326, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.32-7.20 (m, 6H), 7.16-7.09 (m, 1H), 6.69-6.60 (m, 2H), 5.80 (dd, J = 9.8, 1.2 Hz, 1H), 4.05-3.93 (m, 1H), 2.89 (s, 6H), 2.09 (d, J = 1.2 Hz, 3H), 1.36-1.27 (m, 2H), 1.13 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 149.4, 147.2, 132.7, 132.1, 130.7, 128.1, 127.0, 126.4, 125.6, 112.2, 82.9, 40.5, 40.1, 24.7, 24.6, 16.1. HRMS (EI) calculated for $[C_{25}H_{34}BNO_2]^+$ requires m/z 391.2683, found m/z 391.2688.

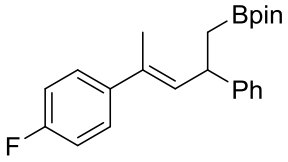


(*E*)-4,4,5,5-tetramethyl-2-(4-(4-(methylthio)phenyl)-2-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2g) Prepared according to the general procedure B, using 0.2690 g (1.0 mmol) of **1g**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1255 g (0.320 mmol, 16/1 *E/Z*, 64% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3025, 2922, 1643, 1492, 1364, 1325, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.34-7.25 (m, 6H), 7.20-7.13 (m, 3H), 5.89 (dd, J = 9.8, 1.2 Hz, 1H), 4.05-3.93 (m, 1H), 2.44 (s, 3H), 2.10 (dd, J = 1.2 Hz, 3H), 1.40-1.30 (m, 2H), 1.13 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.6, 140.8, 136.3, 133.4, 132.5, 128.3, 127.0, 126.5, 126.2, 125.8, 83.0, 40.2, 24.7, 24.6, 16.1, 16.0. HRMS (EI) calculated for $[C_{24}H_{31}BO_2S]^+$ requires m/z 394.2138, found m/z 394.2134.

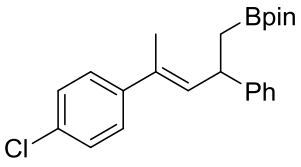


(*E*)-*tert*-butyldimethyl((4-(4-phenyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pent-2-en-2-yl)benzyl)oxy)silane (2h) Prepared according to the general procedure B, using 0.3665 g (1.0 mmol) of **1h**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0147 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.2154 g (0.435 mmol, 12/1 *E/Z*, 87% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3026, 2887, 1511, 1364, 1325, 1254, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.42-7.38 (m, 2H), 7.36-7.27 (m, 6H), 7.23-7.18 (m, 1H), 5.95 (dd, J = 9.8, 1.2 Hz, 1H), 4.77 (s, 2H), 4.10-4.01 (m, 1H), 2.18 (d, J = 1.2 Hz, 3H), 1.45-1.34 (m, 2H), 1.20 (s, 12H), 1.00 (s, 9H), 0.15 (s, 6H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.8, 142.6, 139.7, 133.4, 133.1, 128.3, 127.1, 125.90, 125.86, 125.7, 83.1, 64.8, 40.3, 25.9, 24.8, 24.7, 18.4, 16.3, -5.2. HRMS (EI) calculated for $[C_{30}H_{45}BO_3Si]^+$ requires m/z 492.3231, found

m/z 492.3234.

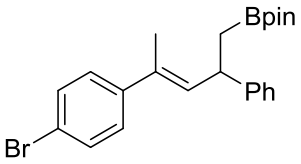


(*E*)-2-(4-(4-fluorophenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2i) Prepared according to the general procedure A, using 0.2391 g (1.0 mmol) of **1i**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1655 g (0.450 mmol, 13/1 *E/Z*, 90% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3027, 2929, 1601, 1508, 1365, 1226, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.24-7.14 (m, 6H), 7.08-7.02 (m, 1H), 6.88-6.82 (m, 2H), 5.75 (dd, J = 9.8, 1.2 Hz, 1H), 3.94-3.84 (m, 1H), 2.01 (d, J = 1.2 Hz, 3H), 1.32-1.20 (m, 2H), 1.04 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 161.8 (d, J = 241.4 Hz), 146.6, 139.9 (d, J = 2.7 Hz), 133.7, 132.3, 128.3, 127.3 (d, J = 8.2 Hz), 127.0, 125.9, 114.8 (d, J = 20.9 Hz), 83.1, 40.3, 24.75, 24.67, 16.4; ^{19}F NMR: ($CDCl_3$, 376 MHz): δ -116.6. HRMS (EI) calculated for $[C_{23}H_{28}BFO_2]^+$ requires m/z 366.2166, found m/z 366.2162.

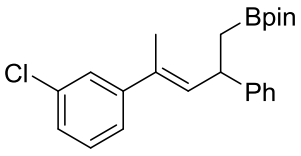


(*E*)-2-(4-(4-chlorophenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2j) Prepared according to the general procedure A, using 0.2554 g (1.0 mmol) of **1j**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0150 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1776 g (0.465 mmol, 16/1 *E/Z*, 93% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2928, 1599, 1490, 1364, 1325, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.32-7.25 (m, 6H), 7.25-7.19 (m, 2H), 7.18-7.11 (m, 1H), 5.88 (dd, J = 9.8, 1.2 Hz, 1H), 4.04-3.93 (m, 1H), 2.10 (d, J = 1.2 Hz, 3H), 1.40-1.29 (m, 2H), 1.13

(s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.4, 142.2, 134.3, 132.2, 132.1, 128.3, 128.1, 127.03, 126.99, 125.9, 83.1, 40.3, 24.7, 24.6, 16.1. HRMS (EI) calculated for $[C_{23}H_{28}BClO_2]^+$ requires m/z 382.1871, found m/z 382.1871.

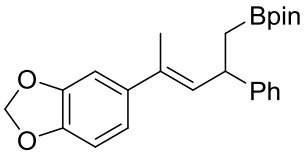


(*E*)-2-(4-(4-bromophenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2k) Prepared according to the general procedure C, using 0.2988 g (1.0 mmol) of **1k**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0299 g (0.050 mmol) of ^{DMiP}OIP·$FeBr_2$, 150 μL (1.0 M in THF, 0.150 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 10 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1227 g (0.285 mmol, 11/1 *E/Z*, 57% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3026, 2977, 1487, 1364, 1325, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.41-7.35 (m, 2H), 7.30-7.28 (m, 4H), 7.24-7.20 (m, 2H), 7.19-7.10 (m, 1H), 5.89 (dd, J = 9.8, 1.2 Hz, 1H), 4.04-3.90 (m, 1H), 2.10 (d, J = 1.2 Hz, 3H), 1.40-1.29 (m, 2H), 1.13 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.4, 142.7, 134.4, 132.2, 131.1, 128.4, 127.4, 127.0, 125.9, 120.3, 83.1, 40.3, 24.74, 24.66, 16.1. HRMS (EI) calculated for $[C_{23}H_{28}BBrO_2]^+$ requires m/z 426.1366, found m/z 426.1372.

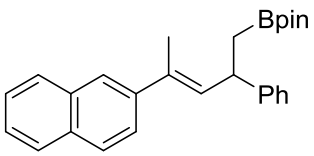


(*E*)-2-(4-(3-chlorophenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2l) Prepared according to the general procedure A, using 0.2555 g (1.0 mmol) of **1l**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0147 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1536 g (0.405 mmol, > 99/1 *E/Z*, 81% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3026, 2977, 1593, 1364, 1325, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.36-7.32 (m,

1H), 7.30-7.23 (m, 4H), 7.23-7.20 (m, 1H), 7.19-7.11 (m, 3H), 5.91 (dd, J = 9.8, 1.2 Hz, 1H), 4.05-3.91 (m, 1H), 2.10 (d, J = 1.2 Hz, 3H), 1.38-1.29 (m, 2H), 1.14 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.3, 145.7, 134.9, 134.0, 132.1, 129.2, 128.3, 127.0, 126.5, 126.0, 125.9, 123.9, 83.1, 40.3, 24.7, 24.6, 16.1. HRMS (EI) calculated for $[C_{23}H_{28}BClO_2]^+$ requires m/z 382.1871, found m/z 382.1863.

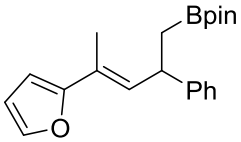


(*E*)-2-(4-(benzo[d][1,3]dioxol-5-yl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2m) Prepared according to the general procedure C, using 0.2642 g (1.0 mmol) of **1m**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0304 g (0.051 mmol) of ^{DMiP}OIP·$FeBr_2$, 150 μL (1.0 M in THF, 0.150 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 10 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1513 g (0.385 mmol, 11/1 *E/Z*, 77% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3025, 2978, 1603, 1486, 1363, 1323, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.31-7.21 (m, 4H), 7.18-7.10 (m, 1H), 6.89-6.86 (m, 1H), 6.85-6.80 (m, 1H), 6.74-6.69 (m, 1H), 5.88 (s, 2H), 5.80 (dd, J = 9.8, 1.2 Hz, 1H), 4.05-3.90 (m, 1H), 2.08 (d, J = 1.2 Hz, 3H), 1.39-1.29 (m, 2H), 1.13 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 147.4, 146.7, 146.2, 138.3, 132.83, 132.76, 128.3, 127.0, 125.7, 119.1, 107.7, 106.4, 100.8, 83.0, 40.2, 24.7, 24.6, 16.5. HRMS (EI) calculated for $[C_{24}H_{29}BO_4]^+$ requires m/z 392.2159, found m/z 392.2160.

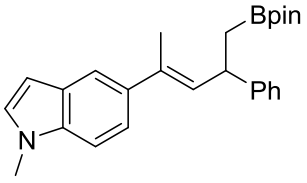


(*E*)-4,4,5,5-tetramethyl-2-(4-(naphthalen-2-yl)-2-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2n) Prepared according to the general procedure A, using 0.2707 g (1.0 mmol) of **1n**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to

20/1, 250 mL) as the eluent to give 0.1752 g (0.440 mmol, 23/1 *E/Z*, 88% yield) of the title compound as a white solid. mp: 69.4-71.2 ℃ (by flash column chromatography using PE/EA). IR (cm^{-1}): 3025, 2979, 1598, 1365, 1326, 1144. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.80-7.71 (m, 4H), 7.56 (dd, J = 8.8, 1.8 Hz, 1H), 7.45-7.36 (m, 2H), 7.36-7.31 (m, 2H), 7.31-7.25 (m, 2H), 7.19-7.13 (m, 1H), 6.07 (dd, J = 9.8, 1.2 Hz, 1H), 4.11-4.01 (m, 1H), 2.23 (d, 3H), 1.45-1.33 (m, 2H), 1.14 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.7, 141.0, 134.4, 133.4, 133.2, 132.4, 128.4, 127.9, 127.45, 127.41, 127.1, 125.91, 125.85, 125.4, 124.5, 124.2, 83.1, 40.4, 24.8, 24.7, 16.3. HRMS (EI) calculated for $[C_{27}H_{31}BO_2]^+$ requires m/z 398.2417, found m/z 398.2422.

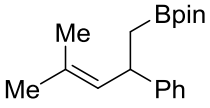


(*E*)-2-(4-(furan-2-yl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2o) Prepared according to the general procedure A, using 0.2093 g (1.0 mmol) of **1o**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0148 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^1H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1103 g (0.325 mmol, 20/1 *E/Z*, 65% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3027, 2978, 1799, 1366, 1327, 1144. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.32-7.23 (m, 5H), 7.16-7.11 (m, 1H), 6.32 (dd, J = 3.4, 1.8 Hz, 1H), 6.22-6.16 (m, 2H), 4.02-3.92 (m, 1H), 2.01 (d, J = 1.6 Hz, 3H), 1.41-1.29 (m, 2H), 1.111 (s, 6H), 1.107 (s, 6H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 156.1, 146.5, 141.2, 130.8, 128.3, 127.1, 125.9, 123.1, 110.9, 104.9, 83.1, 39.6, 24.7, 24.6, 13.7. HRMS (EI) calculated for $[C_{21}H_{27}BO_3]^+$ requires m/z 338.2053, found m/z 338.2052.

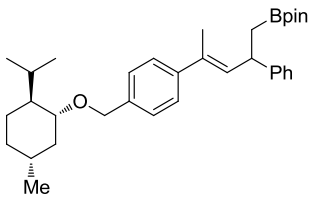


(*E*)-1-methyl-5-(4-phenyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pent-2-en-2-yl)-1*H*-indole (2p) Prepared according to the general procedure A, using 0.2734 g (1.0 mmol) of **1p**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by

ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (50/1, 150 mL to 10/1, 250 mL) as the eluent to give 0.1759 g (0.440 mmol, 15/1 *E/Z*, 88% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2977, 2925, 1602, 1489, 1365, 1329, 1246, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.60 (d, J = 1.6 Hz, 1H), 7.35-7.30 (m, 2H), 7.29-7.23 (m, 3H), 7.19-7.10 (m, 2H), 6.93 (d, J = 2.8 Hz, 1H), 6.41 (d, J = 2.8 Hz, 1H), 5.89 (dd, J = 9.8, 1.0 Hz, 1H), 4.08-3.98 (m, 1H), 3.66 (s, 3H), 2.19 (d, 3H), 1.41-1.32 (m, 2H), 1.13 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 147.2, 135.8, 135.6, 134.2, 132.1, 128.9, 128.3, 128.2, 127.1, 125.6, 120.2, 117.9, 108.6, 101.0, 83.0, 40.3, 32.7, 24.8, 24.7, 24.6, 16.9. HRMS (EI) calculated for $[C_{20}H_{20}N]^+$ ([M-Bpin]$^+$) requires m/z 274.1596, found m/z 274.1597.

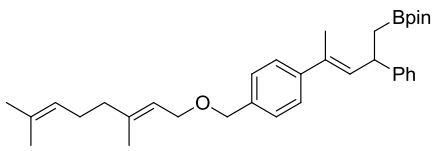


4,4,5,5-Tetramethyl-2-(4-methyl-2-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2q) Prepared according to the general procedure B, using 0.1601 g (1.0 mmol) of **1q**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0297 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0758 g (0.265 mmol, 53% yield) of the title compound as a colorless oil. IR (cm^{-1}): 3026, 2977, 1601, 1366, 1324, 1145. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.26-7.21 (m, 4H), 7.15-7.10 (m, 1H), 5.31-5.23 (m, 1H), 3.86-3.72 (m, 1H), 1.71 (s, 3H), 1.66 (s, 3H), 1.21-1.17 (m, 2H), 1.14 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 147.5, 130.4, 129.9, 128.2, 126.9, 125.6, 83.0, 39.7, 25.8, 24.7, 24.6, 18.2. HRMS (EI) calculated for $[C_{18}H_{27}BO_2]^+$ requires m/z 286.2104, found m/z 286.2107.

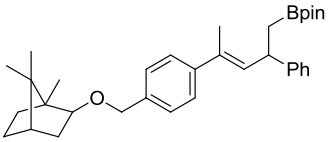


2-((*E*)-4-(4-((((1*R*,2*S*,5*R*)-2-isopropyl-5-methylcyclohexyl)oxy)methyl)phenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2r) Prepared according to the general procedure C, using 0.2002 g (0.51 mmol) of **1r**, 37.5 μL (97%, 0.5 mmol) of HBpin, 0.0152 g (0.051 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 10 h, the resulting solution was added 10 mL of ether and

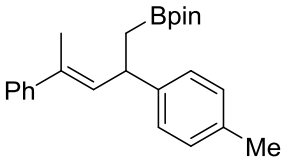
filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1123 g (0.218 mmol, > 20/1 *E/Z*, 87% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2954, 2923, 1491, 1365, 1327, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.35-7.29 (m, 2H), 7.29-7.22 (m, 6H), 7.17-7.11 (m, 1H), 5.88 (dd, J = 9.8, 1.0 Hz, 1H), 4.61 (d, J = 11.4 Hz, 1H), 4.36 (d, J = 11.4 Hz, 1H), 4.03-3.94 (m, 1H), 3.15 (td, J = 10.6, 3.8 Hz, 1H), 2.36-2.22 (m, 1H), 2.21-2.14 (m, 1H), 2.12 (s, 3H), 1.69-1.66 (m, 2H), 1.37-1.25 (m, 4H), 1.14 (s, 12H), 0.95-0.85 (m, 9H), 0.70 (d, J = 7.2 Hz, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 146.8, 143.1, 137.4, 133.5, 133.2, 128.3, 127.65, 127.61, 127.1, 125.8, 83.1, 78.6, 70.1, 48.3, 40.30, 40.26, 34.6, 31.5, 25.5, 24.8, 24.7, 23.2, 22.4, 21.0, 16.3, 16.1. HRMS (EI) calculated for $[C_{34}H_{49}BO_3]^+$ requires m/z 516.3775, found m/z 516.3770.



2-((*E*)-4-(4-((((*E*)-3,7-dimethylocta-2,6-dien-1-yl)oxy)methyl)phenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2s) Prepared according to the general procedure C, using 0.1968 g (0.51 mmol) of **1s**, 37.5 μL (97%, 0.5 mmol) of HBpin, 0.0148 g (0.050 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 10 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1132 g (0.220 mmol, > 20/1 *E/Z*, 88% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2976, 2923, 1730, 1364, 1325, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.36-7.29 (m, 2H), 7.29-7.22 (m, 6H), 7.18-7.11 (m, 1H), 5.89 (d, J = 9.8 Hz, 1H), 5.39 (t, J = 6.8 Hz, 1H), 5.10 (t, J = 5.4 Hz, 1H), 4.46 (s, 2H), 4.03-3.95 (m, 3H), 2.15-2.00 (m, 7H), 1.67 (s, 3H), 1.63 (s, 3H), 1.60 (s, 3H), 1.40-1.29 (m, 2H), 1.14 (s, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 146.8, 143.2, 140.3, 136.8, 133.6, 133.1, 131.6, 128.3, 127.6, 127.1, 125.8, 124.0, 120.9, 83.1, 71.7, 66.4, 40.3, 39.6, 26.3, 25.7, 24.8, 24.7, 17.7, 16.5, 16.3. HRMS (EI) calculated for $[C_{34}H_{47}BO_3]^+$ requires m/z 514.3618, found m/z 514.3610.

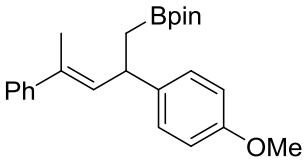


4,4,5,5-tetramethyl-2-((E)-2-phenyl-4-(4-((((2S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl)oxy)methyl)phenyl)pent-3-en-1-yl)-1,3,2-dioxaborolane (2t) Prepared according to the general procedure C, using 0.1967 g (0.51 mmol) of **1t**, 37.5 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.050 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 10 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1106 g (0.215 mmol, > 20/1 *E/Z*, 86% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2948, 1452, 1364, 1326, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.35-7.27 (m, 5H), 7.27-7.24 (m, 2H), 7.24-7.22 (m, 1H), 7.17-7.11 (m, 1H), 5.89 (d, J = 9.8 Hz, 1H), 4.54 (d, J = 12.4 Hz, 1H), 4.41 (d, J = 12.4 Hz, 1H), 4.03-3.94 (m, 1H), 3.70-3.64 (m, 1H), 2.15-2.03 (m, 5H), 1.76-1.65 (m, 1H), 1.65-1.60 (m, 1H), 1.38-1.29 (m, 2H), 1.27-1.21 (m, 2H), 1.14 (s, 12H), 1.08 (dd, J = 13.2, 3.2 Hz, 1H), 0.89 (s, 3H), 0.84 (s, 3H), 0.81 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 146.8, 142.9, 137.8, 133.5, 133.1, 128.3, 127.1, 127.0, 125.8, 125.7, 84.2, 83.1, 71.3, 49.3, 47.8, 45.0, 40.3, 36.1, 28.2, 26.8, 24.8, 24.7, 19.8, 18.9, 16.3, 14.03. HRMS (EI) calculated for $[C_{34}H_{47}BO_3]^+$ requires m/z 514.3618, found m/z 514.3615.

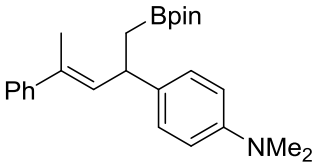


(*E*)-4,4,5,5-tetramethyl-2-(4-phenyl-2-(p-tolyl)pent-3-en-1-yl)-1,3,2-dioxaborolanee (2aa) Prepared according to the general procedure A, using 0.2541 g (1.0 mmol) of **1aa**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0148 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1358 g (0.375 mmol, 18/1 *E/Z*, 75% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2926, 1598, 1364, 1326, 1144.

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.36-7.34 (m, 2H), 7.29-7.23 (m, 2H), 7.21-7.16 (m, 3H), 7.10-7.04 (m, 2H), 5.88 (d, J = 10.0 Hz, 1H), 4.03-3.91 (m, 1H), 2.29 (s, 3H), 2.12 (s, 3H), 1.36-1.27 (m, 2H), 1.15 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 144.0, 143.8, 135.2, 133.9, 133.1, 129.0, 128.0, 126.9, 126.5, 125.8, 83.1, 39.8, 24.8, 24.7, 20.9, 16.2. HRMS (EI) calculated for $[C_{24}H_{31}BO_2]^+$ requires m/z 362.2417, found m/z 362.2415.

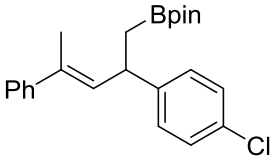


(*E*)-2-(2-(4-methoxyphenyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2ab) Prepared according to the general procedure A, using 0.2509 g (1.0 mmol) of **1ab**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1802 g (0.475 mmol, 10/1 *E/Z*, 95% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2930, 1609, 1510, 1364, 1325, 1247, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.38-7.33 (m, 2H), 7.30-7.15 (m, 5H), 6.85-6.78 (m, 2H), 5.86 (dd, J = 9.8, 1.2 Hz, 1H), 4.01-3.91 (m, 1H), 3.75 (s, 3H), 2.12 (d, J = 1.2 Hz, 3H), 1.38-1.25 (m, 2H), 1.14 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 157.7, 144.0, 138.9, 134.1, 132.9, 128.0, 127.9, 126.5, 125.8, 113.7, 113.6, 83.0, 55.2, 39.4, 24.8, 24.7, 16.2. HRMS (EI) calculated for $[C_{24}H_{31}BO_3]^+$ requires m/z 378.2366, found m/z 378.2362.

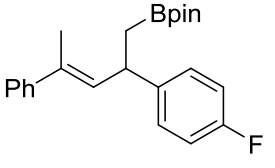


(*E*)-*N*,*N*-dimethyl-4-(4-phenyl-1-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pent-3-en-2-yl)aniline (2ac) Prepared according to the general procedure B, using 0.2610 g (1.0 mmol) of **1ac**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0147 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to

20/1, 250 mL) as the eluent to give 0.1825 g (0.465 mmol, 12/1 *E/Z*, 93% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2973, 2927, 1612, 1521, 1364, 1332, 1142. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.38-7.34 (m, 2H), 7.29-7.23 (m, 2H), 7.20-7.14 (m, 3H), 6.71-6.65 (m, 2H), 5.86 (dd, J = 10.0, 1.2 Hz, 1H), 3.96-3.88 (m, 1H), 2.89 (s, 6H), 2.12 (d, J = 1.0 Hz, 3H), 1.38-1.25 (m, 2H), 1.15 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 149.0, 144.2, 135.1, 134.4, 132.5, 128.0, 127.6, 126.4, 125.8, 113.0, 83.0, 40.9, 39.2, 24.8, 24.7, 16.2. HRMS (EI) calculated for $[C_{25}H_{34}BNO_2]^+$ requires m/z 391.2683, found m/z 391.2687.

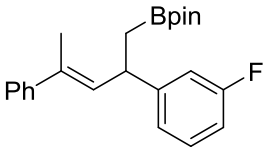


(*E*)-2-(2-(4-chlorophenyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2ad) Prepared according to the general procedure A, using 0.2557 g (1.0 mmol) of **1ad**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0150 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^1H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1676 g (0.440 mmol, 16/1 *E/Z*, 88% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2956, 2925, 1491, 1367, 1326, 1144. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.37-7.33 (m, 2H), 7.31-7.26 (m, 2H), 7.24-7.21 (m, 4H), 7.21-7.17 (m, 1H), 5.83 (dd, J = 9.6, 1.2 Hz, 1H), 4.01-3.91 (m, 1H), 2.11 (d, J = 1.2 Hz, 3H), 1.33-1.28 (m, 2H), 1.15 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 145.3, 143.7, 133.9, 133.2, 131.4, 128.5, 128.4, 128.1, 126.7, 125.8, 83.2, 39.7, 24.8, 24.7, 16.3. HRMS (ESI) calculated for $[C_{23}H_{28}BClO_2Na]^+$ [M + Na^+] requires m/z 405.1767, found m/z 405.1768.

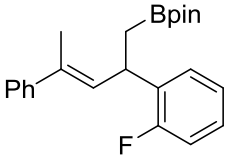


(*E*)-2-(2-(4-fluorophenyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2ae) Prepared according to the general procedure B, using 0.2395 g (1.0 mmol) of **1ae**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0300 g (0.051 mmol) of ^{DMiP}OIP·$FeBr_2$, 150 μL (1.0 M in THF, 0.150 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates

were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1699 g (0.460 mmol, 14/1 *E/Z*, 92% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2931, 1601, 1508, 1365, 1326, 1224, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.41-7.33 (m, 2H), 7.30-7.16 (m, 5H), 6.99-6.91 (m, 2H), 5.85 (dd, J = 9.8, 1.2 Hz, 1H), 4.01-3.94 (m, 1H), 2.11 (d, J = 1.2 Hz, 3H), 1.36-1.28 (m, 2H), 1.14 (s, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 161.2 (d, J = 243.4 Hz), 143.7, 142.4 (d, J = 2.8 Hz), 133.6, 133.4, 128.4 (d, J = 8.4 Hz), 128.1, 126.6, 125.8,114.9 (d, J = 20.9 Hz), 83.1, 39.5, 24.72, 24.66, 16.2; ^{19}F NMR ($CDCl_3$, 100 MHz) : δ -117.6. HRMS (ESI) calculated for $[C_{23}H_{29}BFO_2]^+$ [M + H$^+$] requires m/z 367.2245, found m/z 367.2234.

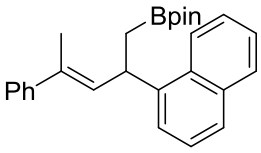


(*E*)-2-(2-(3-fluorophenyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2af) Prepared according to the general procedure B, using 0.2419 g (1.0 mmol) of **1af**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0300 g (0.051 mmol) of ^{DMiP}OIP·$FeBr_2$, 150 μL (1.0 M in THF, 0.150 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1179 g (0.320 mmol, > 20/1 *E/Z*, 64% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2979, 2928, 1589, 1366, 1328, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.39-7.33 (m, 2H), 7.31-7.25 (m, 2H), 7.25-7.16 (m, 2H), 7.10-7.04 (m, 1H), 7.03-6.97 (m, 1H), 6.87-6.80 (m, 1H), 5.84 (dd, J = 9.6, 0.8 Hz, 1H), 4.04-3.94 (m, 1H), 2.12 (d, J = 1.2 Hz, 3H), 1.49-1.28 (m, 2H), 1.15 (s, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 162.9 (d, J = 244.9 Hz), 149.4 (d, J = 6.6 Hz), 143.7, 134.0, 133.0, 129.6 (d, J = 8.7 Hz), 128.1, 126.7, 125.8, 122.7 (d, J = 2.2 Hz), 114.0 (d, J = 21.2 Hz), 112.6 (d, J = 21.2 Hz), 83.2, 40.0, 24.72, 24.66, 16.3; ^{19}F NMR ($CDCl_3$, 100 MHz) : δ -113.6. HRMS (EI) calculated for $[C_{23}H_{28}BFO_2]^+$ requires m/z 366.2166, found m/z 366.2166.



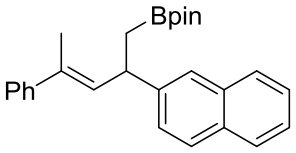
(*E*)-2-(2-(2-fluorophenyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-

1,3,2-dioxaborolane (2ag) Prepared according to the general procedure B, using 0.2390 g (1.0 mmol) of **1ag**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0302 g (0.051 mmol) of ^{DMiP}OIP-$FeBr_2$, 150 μL (1.0 M in THF, 0.150 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1535 g (0.420 mmol, 9/1 *E/Z*, 84% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2979, 1489, 1367, 1327, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.38-7.33 (m, 2H), 7.33-7.29 (m, 1H), 7.29-7.23 (m, 2H), 7.21-7.15 (m, 1H), 7.15-7.08 (m, 1H), 7.08-7.02 (m, 1H), 7.00-6.94 (m, 1H), 5.88 (d, J = 9.8 Hz, 1H), 4.34-4.24 (m, 1H), 2.12 (s, 3H), 1.37 (d, J = 7.8 Hz, 2H), 1.13 (d, J = 2.4 Hz, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 160.5 (d, J = 245.5 Hz), 143.9, 134.1, 133.4 (d, J = 133.4 Hz), 132.4, 128.4 (d, J = 5.1 Hz), 128.04, 127.97, 127.8, 127.2 (d, J = 8.8 Hz), 126.6, 125.8, 124.0 (d, J = 3.7 Hz), 115.3 (d, J = 22.7 Hz), 83.1, 33.9, 24.72, 24.65, 24.5, 16.2; ^{19}F NMR ($CDCl_3$, 100 MHz) : δ -117.4. HRMS (EI) calculated for $[C_{23}H_{28}BFO_2]^+$ requires m/z 366.2166, found m/z 366.2162.

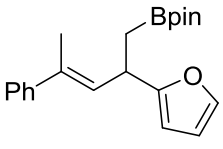


(*E*)-4,4,5,5-tetramethyl-2-(2-(naphthalen-1-yl)-4-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2ah) Prepared according to the general procedure A, using 0.1371 g (0.51 mmol) of **1ah**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0152 g (0.026 mmol) of ^{DMiP}OIP-$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1196 g (0.300 mmol, 9/1 *E/Z*, 60% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2936, 1598, 1363, 1326, 1143. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.28 (d, J = 8.4 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.67 (d, J = 8.0 Hz, 1H), 7.54-7.48 (m, 2H), 7.47-7.39 (m, 2H), 7.39-7.34 (m, 2H), 7.29-7.23 (m, 2H), 7.22-7.16 (m, 1H), 6.07 (d, J = 9.4 Hz, 1H), 4.82-4.73 (m, 1H), 2.16 (s, 3H), 1.60-1.50 (m, 1H), 1.49-1.39 (m, 1H), 1.11 (s, 6H), 1.08 (s, 6H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 143.9, 143.3, 134.0, 133.9, 133.7, 131.4, 128.8, 128.1, 126.6, 126.4, 125.8,

125.62, 125.59, 125.2, 123.8, 123.6, 83.1, 35.6, 24.7, 24.6, 16.5. HRMS (EI) calculated for $[C_{27}H_{31}BO_2]^+$ requires m/z 398.2417, found m/z 398.2412.

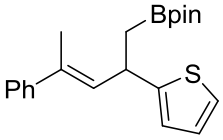


(*E*)-4,4,5,5-tetramethyl-2-(2-(naphthalen-2-yl)-4-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2ai) Prepared according to the general procedure A, using 0.2731 g (1.0 mmol) of **1ai**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1681 g (0.420 mmol, 20/1 *E/Z*, 84% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2931, 1599, 1362, 1325, 1142. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.80-7.70 (m, 4H), 7.42-7.34 (m, 5H), 7.31-7.24 (m, 2H), 7.21-7.15 (m, 1H), 5.98 (dd, J = 9.8, 1.0 Hz, 1H), 4.21-4.12 (m, 1H), 2.16 (d, J = 1.0 Hz, 3H), 1.51-1.39 (m, 2H), 1.12 (s, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 144.3, 143.9, 133.7, 133.6, 132.1, 128.1, 127.9, 127.6, 127.5, 126.6, 126.2, 125.9, 125.7, 125.1, 124.8, 83.1, 40.4, 24.8, 24.7, 16.4. HRMS (EI) calculated for $[C_{27}H_{31}BO_2]^+$ requires m/z 398.2417, found m/z 398.2415.

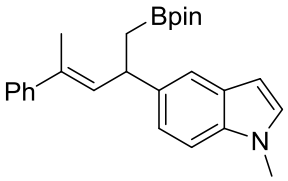


(*E*)-2-(2-(furan-2-yl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2aj) Prepared according to the general procedure A, using 0.2139 g (1.0 mmol) of **1aj**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0148 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography

using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.0811 g (0.240 mmol, > 20/1 *E/Z*, 48% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2979, 2931, 1595, 1367, 1328, 1145. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.41-7.36 (m, 2H), 7.32-7.27 (m, 3H), 7.24-7.18 (m, 1H), 6.27-6.23 (m, 1H), 6.03-5.99 (m, 1H), 5.76 (dd, J = 9.8, 1.2 Hz, 1H), 4.10-4.01 (m, 1H), 2.15 (d, J = 1.2 Hz, 3H), 1.45-1.37 (m, 1H), 1.27-1.23 (m, 1H), 1.20 (s, 6H), 1.19 (s, 6H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 159.2, 143.7, 140.9, 134.7, 130.6, 128.1, 126.7, 125.9, 109.9, 103.8, 83.2, 34.3, 24.8, 24.7, 16.2. HRMS (EI) calculated for $[C_{21}H_{27}BO_3]^+$ requires m/z 338.2053, found m/z 338.2056.

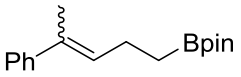


(*E*)-4,4,5,5-tetramethyl-2-(4-phenyl-2-(thiophen-2-yl)pent-3-en-1-yl)-1,3,2-dioxaborolane (2ak) Prepared according to the general procedure A, using 0.2247 g (1.0 mmol) of **1ak**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^1H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.0961 g (0.270 mmol, > 20/1 *E/Z*, 54% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2979, 2938, 1605, 1366, 1327, 1144. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.41-7.36 (m, 2H), 7.31-7.26 (m, 2H), 7.24-7.18 (m, 1H), 7.11-7.08 (m, 1H), 6.92-6.88 (m, 1H), 6.86-6.83 (m, 1H), 5.83 (dd, J = 9.8, 1.0 Hz, 1H), 4.30-4.21 (m, 1H), 2.15 (d, J = 1.2 Hz, 3H), 1.53-1.45 (m, 1H), 1.39-1.31 (m, 1H), 1.17 (s, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 151.1, 143.7, 133.9, 133.0, 128.1, 126.7, 126.5, 125.9, 122.9, 122.5, 83.2, 35.8, 24.8, 24.7, 16.2. HRMS (EI) calculated for $[C_{21}H_{27}BO_2S]^+$ requires m/z 354.1825, found m/z 354.1827.

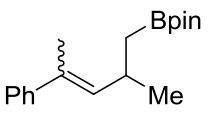


(*E*)-1-methyl-5-(4-phenyl-1-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pent-3-en-2-yl)-1*H*-indole (2al) Prepared according to the general procedure B, using 0.2728 g (1.0 mmol) of **1al**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of

ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (50/1, 150 mL to 10/1, 250 mL) as the eluent to give 0.2035 g (0.495 mmol, 11/1 *E/Z*, 99% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2927, 1491, 1363, 1326, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.53 (s, 1H), 7.39-7.34 (m, 2H), 7.30-7.23 (m, 2H), 7.22-7.14 (m, 3H), 6.98 (d, J = 3.2 Hz, 1H), 6.42-6.38 (m, 1H), 6.00-5.94 (m, 1H), 4.15-4.05 (m, 1H), 3.73 (s, 3H), 2.15 (s, 3H), 1.46-1.35 (m, 2H), 1.14 (s, 12H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 144.2, 137.9, 135.4, 134.8, 132.6, 128.7, 128.5, 128.0, 126.3, 125.9, 121.3, 118.5, 109.0, 100.7, 83.0, 40.2, 32.8, 24.8, 24.7, 16.3. HRMS (EI) calculated for $[C_{26}H_{32}BNO_2]^+$ requires m/z 401.2526, found m/z 401.2531.

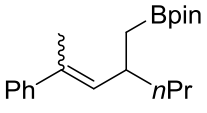


(*E*)-4,4,5,5-tetramethyl-2-(4-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2am) Prepared according to the general procedure B, using 0.0746 g (0.5 mmol) of **1am**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0147 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0882 g (0.325 mmol, 3/1 *E/Z*, 65% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2978, 2935, 1600, 1374, 1326, 1145. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.40-7.36 (m, 2.08H), 7.32-7.24 (m, 2.98H), 7.22-7.16 (m, 1.59H), 5.78 (t, J = 7.4 Hz, 1H), 5.46 (t, J = 7.4 Hz, 0.29H), 2.32 (q, J = 7.6 Hz, 2H), 2.09 (q, J = 7.6 Hz, 0.44H), 2.03 (s, 3H), 2.01 (s, 0.62H), 1.24 (s, 12H), 1.22 (s, 3.55H), 0.95 (t, J = 7.4 Hz, 2H), 0.82 (t, J = 7.4 Hz, 0.48H); HRMS (EI) calculated for $[C_{17}H_{25}BO_2]^+$ requires m/z 272.1948, found m/z 272.1949.

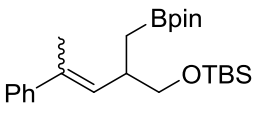


(*E*)-4,4,5,5-tetramethyl-2-(2-methyl-4-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2an) Prepared according to the general procedure A, using 0.0824 g (0.52 mmol) of **1an**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the

resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1209 g (0.420 mmol, 3.7/1 *E/Z*, 84% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2977, 2926, 1599, 1366, 1324, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.40-7.34 (m, 2.06H), 7.32-7.25 (m, 2.60H), 7.24-7.16 (m, 1.96H), 5.60 (d, J = 9.4 Hz, 1H), 5.31 (d, J = 10.2 Hz, 0.27H), 2.91-2.77 (m, 1H), 2.57-2.46 (m, 0.29H), 2.06 (s, 3H), 1.98 (s, 0.82H), 1.22 (s, 16.02H), 1.07 (d, J = 6.6 Hz, 3H), 0.97 (d, J = 6.6 Hz, 0.95H), 0.92 (d, J = 7.2 Hz, 2H), 0.81 (d, J = 7.2 Hz, 0.56H). HRMS (EI) calculated for $[C_{18}H_{27}BO_2]^+$ requires m/z 286.2104, found m/z 286.2105.

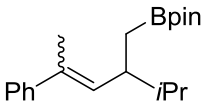


(*E*)-4,4,5,5-tetramethyl-2-(4-phenyl-2-propylpent-3-en-1-yl)-1,3,2-dioxaborolane (2ao) Prepared according to the general procedure A, using 0.0933 g (0.50 mmol) of **1ao**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0150 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1386 g (0.440 mmol, 5.1/1 *E/Z*, 88% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2977, 2927, 1599, 1370, 1321, 1145. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.39-7.34 (m, 2H), 7.31-7.24 (m, 2.69H), 7.22-7.15 (m, 1.27H), 5.51 (s, J = 10.2 Hz, 1H), 5.25 (s, J = 10.2 Hz, 0.20H), 2.77-2.65 (m, 1H), 2.46-2.35 (m, 0.22H), 2.06 (s, 3H), 1.99 (s, 0.62H), 1.45-1.25 (m, 5.03H), 1.23 (s, 2.37H), 1.20 (s, 12H), 1.01-0.94 (m, 1.03H), 0.91-0.82 (m, 4.15H), 0.74-0.67 (m, 0.87H). HRMS (EI) calculated for $[C_{20}H_{31}BO_2]^+$ requires m/z 314.2417, found m/z 314.2415.

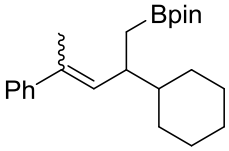


(*E*)-*tert*-butyldimethyl((4-phenyl-2-((4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl)pent-3-en-1-yl)oxy)silane (2ap) Prepared according to the general procedure A, using 0.1459 g (0.51 mmol) of **1ap**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of

$NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^1H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1938 g (0.465 mmol, 4.7/1 *E/Z*, 93% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2954, 2857, 1491, 1368, 1322, 1254, 1145, 1067. ^1H NMR ($CDCl_3$, 400 MHz): δ 77.40-7.33 (m, 2.11H), 7.32-7.25 (m, 2.99H), 7.23-7.16 (m, 1.32H), 5.52 (d, J = 10.0 Hz, 1H), 5.25 (d, J = 10.0 Hz, 0.21H), 3.51 (d, J = 6.8 Hz, 2H), 3.43 (d, J = 6.8 Hz, 0.41H), 2.94-2.83 (m, 1H), 2.67-2.56 (m, 0.21H), 2.08 (s, 3H), 2.01 (s, 0.65H), 1.20 (s, 14. 1H), 1.13-1.02 (m, 1H), 0.88 (s, 9H), 0.85 (s, 2.03H), 0.82-0.73 (m, 1H), 0.03 (s, 3H), 0.02 (s, 3H), -0.03 (s, 0.60H), -0.04 (s, 0.60H). HRMS (ESI) calculated for $[c]^+$ $[M + H^+]$ requires m/z 417.2996, found m/z 417.2988.

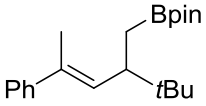


(*E*)-2-(2-isopropyl-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2aq) Prepared according to the general procedure A, using 0.0934 g (0.50 mmol) of **1aq**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0149 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^1H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1515 g (0.480 mmol, 6.5/1 *E/Z*, 88% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2974, 2928, 1599, 1365, 1319, 1145. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.39-7.34 (m, 2.01H), 7.31-7.25 (m, 2.61H), 7.22-7.16 (m, 1.14H), 5.57 (dd, J = 10.6, 1.2 Hz, 1H), 5.32 (dd, J = 10.6, 1.2 Hz, 0.15H), 2.58-2.47 (m, 1H), 2.31-2.20 (m, 0.18H), 2.06 (s, 3H), 2.01 (s, 0.50H), 1.65-1.54 (m, 1H), 1.50-1.42 (m, 0.23H), 1.23 (s, 2.08H), 1.18 (s, 12H), 1.07-1.00 (m, 1H), 0.92 (d, J = 6.6 Hz, 3H), 0.87 (d, J = 6.6 Hz, 3H), 0.85-0.79 (m, 1H), 0.74 (d, J = 2.8 Hz, 0.43H), 0.72 (d, J = 2.8 Hz, 0.43H). HRMS (EI) calculated for $[C_{20}H_{31}BO_2]^+$ requires m/z 314.2417, found m/z 314.2415.

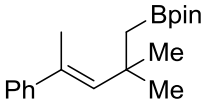


(*E*)-2-(2-cyclohexyl-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-d

ioxaborolane (2ar) Prepared according to the general procedure A, using 0.1145 g (0.51 mmol) of **1ar**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0147 g (0.025 mmol) of ^{DMiP}OIP·FeBr$_2$, 75 μL (1.0 M in THF, 0.75 mmol) of NaBHEt$_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1782 g (0.495 mmol, 6.4/1 *E/Z*, 99% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2925, 2852, 1449, 1367, 1323, 1146. ^{1}H NMR (CDCl$_3$, 400 MHz): δ 7.39-7.35 (m, 2.04H), 7.31-7.25 (m, 2.60H), 7.22-7.16 (m, 1.12H), 5.57 (dd, J = 10.6, 1.2 Hz, 1H), 5.31 (dd, J = 10.6, 1.2 Hz, 0.15H), 2.57-2.47 (m, 1H), 2.31-2.19 (m, 0.16H), 2.04 (d, J = 1.2 Hz, 3H), 2.00 (d, J = 1.2 Hz, 0.51H), 1.82-1.50 (m, 6.24H), 1.23 (s, 2.15H), 1.18 (s, 12H), 1.15-0.76 (m, 8.45H). HRMS (EI) calculated for $[C_{23}H_{35}BO_2]^+$ requires m/z 354.2730, found m/z 354.2730.



(*E*)-2-(2-(*tert*-butyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2as) Prepared according to the general procedure A, using 0.1000 g (0.50 mmol) of **1as**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0148 g (0.025 mmol) of ^{DMiP}OIP·FeBr$_2$, 75 μL (1.0 M in THF, 0.75 mmol) of NaBHEt$_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1478 g (0.450 mmol, 10.6/1 *E/Z*, 90% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2970, 1599, 1364, 1327, 1145. ^{1}H NMR (CDCl$_3$, 400 MHz): δ 7.40-7.34 (m, 2H), 7.31-7.25 (m, 2H), 7.22-7.16 (m, 1H), 5.60 (dd, J = 11.0, 1.2 Hz, 1H), 2.52 (td, J = 11.6, 3.4 Hz, 1H), 2.07 (d, J = 1.2 Hz, 3H), 1.16 (s, 6H), 1.15 (s, 6H), 1.10-1.03 (m, 1H), 0.90 (s, 9H), 0.84-0.75 (m, 1H); ^{13}C NMR (CDCl$_3$, 100 MHz) : δ 144.6, 134.2, 132.6, 128.0, 126.3, 125.9, 82.9, 44.4, 34.8, 27.2, 25.0, 24.7, 16.7. HRMS (EI) calculated for $[C_{21}H_{33}BO_2]^+$ requires m/z 328.2574, found m/z 328.2570.

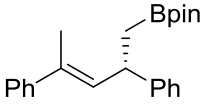


(*E*)-2-(2,2-dimethyl-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2at)

Prepared according to the general procedure A, using 0.0886 g (0.51 mmol) of **1at**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0152 g (0.026 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0961 g (0.320 mmol, > 30/1 *E/Z*, 64% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2977, 1598, 1354, 1321, 1142. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.37-7.32 (m, 2H), 7.30-7.24 (m, 2H), 7.21-7.15 (m, 1H), 5.79 (s, 1H), 2.14 (s, 3H), 1.29 (s, 6H), 1.21 (s, 12H), 1.14 (s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) : δ 146.4, 140.0, 133.6, 127.9, 126.1, 126.0, 82.8, 34.4, 31.3, 24.9, 17.2. HRMS (EI) calculated for $[C_{19}H_{29}BO_2]^+$ requires m/z 300.2261, found m/z 300.2259.

VI. Stereospecific Hydroboration of Vinylcyclopropanes

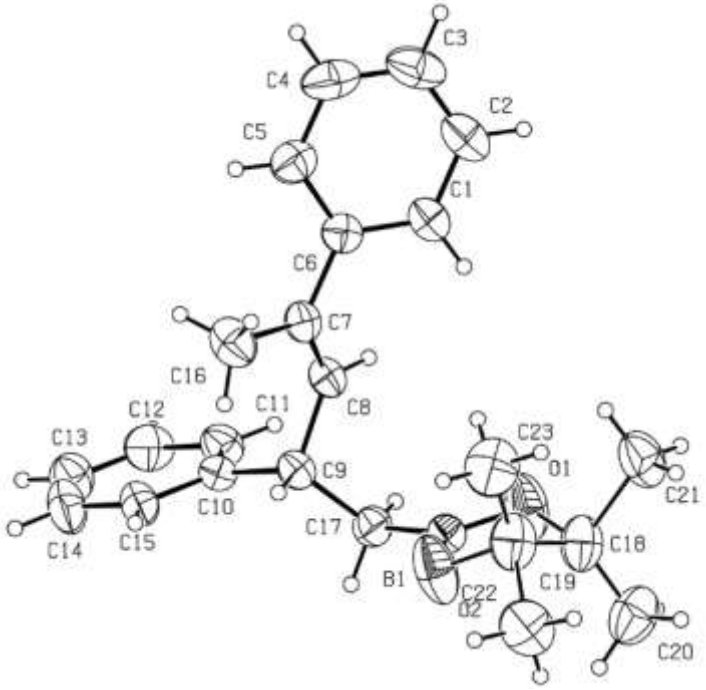
General Procedure D for Stereospecific Hydroboration of Vinylcyclopropanes: to a 25 mL flame-dried Schlenk flask cooled under nitrogen, **L2**·$FeBr_2$ complex (0.0125 mmol, 5 mol%) and vinylcyclopropane (1.0 mmol, 4.0 equiv.) were added. The mixture was vacuumed and flushed with nitrogen for three times, and then, 0.5 mL of toluene (0.5 M) and HBpin (37.5 μL, 97%, 0.25 mmol, 1.0 equiv.) were added in sequence. The mixture was injected with $NaBHEt_3$ (1.0 M in THF, 37.5 μL, 0.0375 mmol) by dropwise. The reaction was run at ambient temperature for 0.5 h. Then the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The resulting mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give the corresponding product.

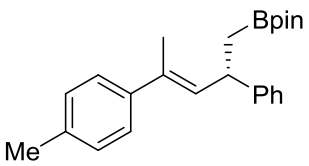


(*S*,*E*)-2-(2,4-diphenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (*S*-2a) Prepared according to the general procedure D, using 0.2234 g (1.0 mmol) of **1a**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0085 g (0.0131 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of

toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0502 g (0.144 mmol, 10/1 *E/Z*, 58% yield) of the title compound as a white solid, Optical Rotation: $[\alpha]_{20}^{D}$ = +6.3 (c 1.03, $CHCl_3$), 83.3% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 4.2 (minor), 5.2 (major). The analysis data are same as **2a**. 98.8 % *ee* of ***S*-2a** was afforded by crystallized from ethanol at 0 ℃, mp: 78.3-79.2 ℃ (crystallized from ethanol). Optical Rotation: $[\alpha]_{20}^{D}$ = +12.1 (c 1.05, $CHCl_3$). 98.8% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 4.2 (minor), 5.2 (major).

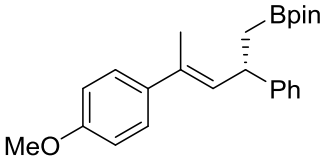
X-ray diffraction of *S*-2a;CCDC 1528870



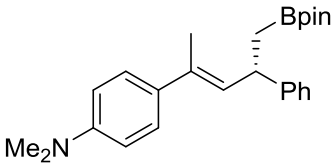


(*S*,*E*)-4,4,5,5-tetramethyl-2-(2-phenyl-4-(*p*-tolyl)pent-3-en-1-yl)-1,3,2-dioxaborolane (*S*-2b) Prepared according to the general procedure D, using 0.2343 g (1.0 mmol) of **1b**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0080 g (0.0124 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by

ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0876 g (0.242 mmol, 13/1 *E/Z*, 97% yield) of the title compound as a colorless oil; Optical Rotation: $[\alpha]_{20}^{D}$ = -0.4 (c 1.08, $CHCl_3$), 86.3% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 4.4 (minor), 6.1 (major). The analysis data are same as **2b**.

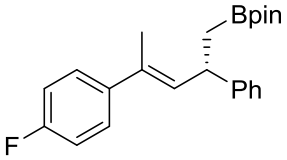


(*S*,*E*)-2-(4-(4-methoxyphenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (*S*-2e) Prepared according to the general procedure D, using 0.2510 g (1.0 mmol) of **1e**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0082 g (0.0126 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.0895 g (0.237 mmol, 12/1 *E/Z*, 95% yield) of the title compound as a colorless oil; Optical Rotation: $[\alpha]_{20}^{D}$ = -5.6 (c 1.08, $CHCl_3$), 86.7% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 5.8 (minor), 7.9 (major). The analysis data are same as **2e**.

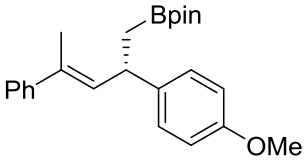


(*S*,*E*)-*N*,*N*-dimethyl-4-(4-phenyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pent-2-en-2-yl)aniline (*S*-2f) Prepared according to the general procedure D, using 0.2658 g (1.0 mmol) of **1f**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0082 g (0.0126 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.0907 g (0.232 mmol, 12/1 *E/Z*, 93% yield) of the title compound as light yellow oil; Optical

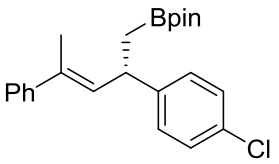
Rotation: $[\alpha]_{20}^{D}$ = -26.6 (c 1.04, $CHCl_3$), 83.8% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 6.0 (minor), 9.6 (major). The analysis data are same as **2f**.



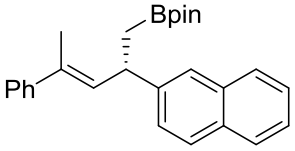
(*S*,*E*)-2-(4-(4-fluorophenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetra methyl-1,3,2-dioxaborolane (*S*-2i) Prepared according to the general Procedure D, using 0.2376 g (1.0 mmol) of **1i**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0086 g (0.0133 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 3.0 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0824 g (0.225 mmol, >20/1 *E/Z*, 90% yield) of the title compound as a colorless oil; Optical Rotation: $[\alpha]_{20}^{D}$ = +6.1 (c 1.03, $CHCl_3$), 80.1% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 4.4 (minor), 5.4 (major). The analysis data are same as **2i**.



(*S*,*E*)-2-(2-(4-methoxyphenyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-te tramethyl-1,3,2-dioxaborolane (*S*-2ab) Prepared according to the general Procedure D, using 0.2366 g (1.0 mmol) of **1ab**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0086 g (0.0133 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.0903 g (0.239 mmol, >20/1 *E/Z*, 95% yield) of the title compound as a colorless oil; Optical Rotation: $[\alpha]_{20}^{D}$ = +3.3 (c 1.02, $CHCl_3$), 77.3% ee determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 5.5 (minor), 9.5 (major). The analysis data are same as **2ab**.



(*S*,*E*)-2-(2-(4-chlorophenyl)-4-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (*S*-2ad) Prepared according to the general procedure D, using 0.2526 g (1.0 mmol) of **1ad**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0085 g (0.0131 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 3.0 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.0582 g (0.152 mmol, >20/1 *E/Z*, 61% yield) of the title compound as a colorless oil; Optical Rotation: $[\alpha]_{20}^{D}$ = -1.0 (c 1.06, $CHCl_3$), 87.1% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 4.5 (minor), 6.3 (major). The analysis data are same as **2ad**.

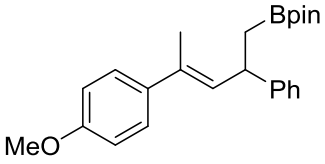


(*S*,*E*)-4,4,5,5-tetramethyl-2-(2-(naphthalen-2-yl)-4-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (*S*-2ai) Prepared according to the general procedure D, using 0.2721 g (1.0 mmol) of **1ai**, 37.5 μL (97%, 0.25 mmol) of HBpin, 0.0083 g (0.0129 mmol) of **L2**·$FeBr_2$, 37.5 μL (1.0 M in THF, 0.0375 mmol) of $NaBHEt_3$, and 0.5 mL (0.5 M) of toluene. After 3.0 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.0390 g (0.098 mmol, >20/1 *E/Z*, 39% yield) of the title compound as a colorless oil; Optical Rotation: $[\alpha]_{20}^{D}$ = -16.1 (c 1.43, $CHCl_3$), 90.1% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 99/1, 1.0 mL/min, n = 254 nm, tr 7.2 (minor), 11.4 (major). The analysis data are same as **2ai**.

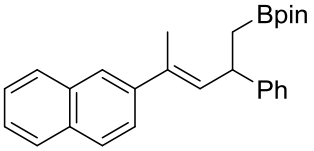
VII. Gram-Scale Reactions

General Procedure E: to a 50 mL flame-dried Schlenk flask cooled under nitrogen, ^{DMiP}OIP·$FeBr_2$ complex (0.25 mmol, 5 mol%) and vinylcyclopropane (10.0 mmol, 2.0 equiv.) were added. The mixture was vacuumed and flushed with nitrogen for three times, and then, 10.0

mL toluene (0.5 M) and HBpin (750 μL, 97%, 5.0 mmol, 1.0 equiv.) were added in sequence. The mixture was injected with $NaBHEt_3$ (1.0 M in THF, 750 μL, 0.75 mmol) by dropwise. Then the reaction was run at ambient temperature. After 3 h, the resulting solution was added 20 mL of ether and filtered through a pad of silica gel, washed by ether (20 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The resulting solution was purified by flash column chromatography using PE/EA (100/1 to 20/1) as the eluent to give the corresponding product.

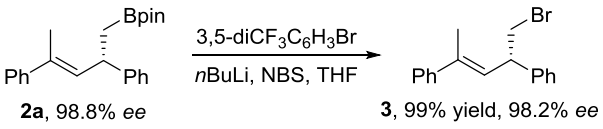


(*E*)-2-(4-(4-methoxyphenyl)-2-phenylpent-3-en-1-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (2e) Prepared according to the general procedure E, using 2.5029 g (10.0 mmol) of **1e**, 750 μL (97%, 5.0 mmol) of HBpin, 0.1483 g (0.25 mmol) of ^{DMiP}OIP·$FeBr_2$, 750 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 10.0 mL (0.5 M) of toluene. After 3.0 h, the resulting solution was added 20 mL of ether and filtered through a pad of silica gel, washed by ether (20 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1 to 20/1) as the eluent to give 1.7160 g (4.54 mmol, 11/1 *E/Z*, 91% yield) of the title compound as a colorless oil.



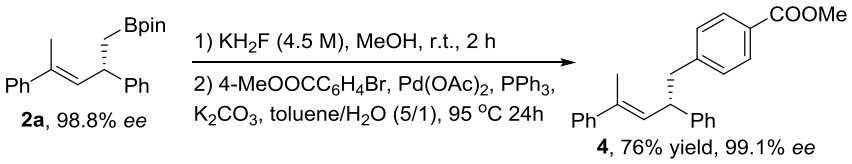
(*E*)-4,4,5,5-tetramethyl-2-(4-(naphthalen-2-yl)-2-phenylpent-3-en-1-yl)-1,3,2-dioxaborolane (2n) Prepared according to the general procedure E, using 2.7124 g (10.0 mmol) of **1n**, 750 μL (97%, 0.5 mmol) of HBpin, 0.1483 g (0.25 mmol) of ^{DMiP}OIP·$FeBr_2$, 750 μL (1.0 M in THF, 0.75 mmol) of $NaBHEt_3$, and 10.0 mL (0.5 M) of toluene. After 3.0 h, the resulting solution was added 20 mL of ether and filtered through a pad of silica gel, washed by ether (20 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1 to 20/1) as the eluent to give 1.6948 g (4.25 mmol, > 20/1 *E/Z*, 85% yield) of the title compound as a white solid.

VIII. Further Derivatizations



2a, 98.8% *ee* **3**, 99% yield, 98.2% *ee*

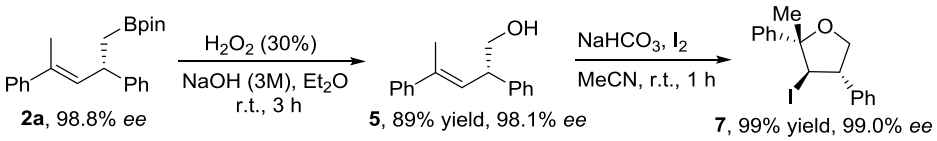
(*S*,*E*)-(5-bromopent-2-ene-2,4-diyl)dibenzene (3): Prepared according to a previously reported procedure,[5] a 10 mL flame-dried Schlenk flask cooled under nitrogen was charged with 3,5-bis(trifluoromethyl)-1-bromobenzene (0.1766 g, 2.0 equiv.) and THF (1 mL), then cooled to -78 ℃. A solution of *n*BuLi (240 μL, 2.5 M in hexanes, 2.0 equiv.) was added dropwise. After stirred at -78 ℃ for 1 h, a solution of **2a** (0.1032 g, 0.3 mmol) in THF (1 mL) was then added dropwise. The reaction mixture was allowed to stir at -78 ℃ for 30 min and at r.t. for 30 min. Then a solution of NBS (0.1087 g, 2.0 equiv.) in THF (1 mL) was added dropwise and stir at r.t. for 1 h. The reaction was quenched with saturated aqueous $Na_2S_2O_3$ (2 mL), extracted with ethyl acetate (15 mL x 3). The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated in vacuo. The crude product was purified by column chromatography using PE/EA (50/1) as the eluent to give 0.1007 g (0.297 mmol, 99% yield) of the title compound as a brown oil. Optical Rotation: $[\alpha]_{20}^{D}$ = +5.4 (c 1.34, $CHCl_3$), 98.2% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H x 2, *n*-hexane/*i*-PrOH = 99.1/0.1, 0.5 mL/min, n = 220 nm, tr 30.0 (minor), 33.2 (major). IR (cm^{-1}): 3027, 2956, 1599, 1493, 1449, 1279. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.42-7.37 (m, 2H), 7.37-7.22 (m, 8H), 5.95 (dd, J = 9.4, 1.6 Hz, 1H), 4.13-4.04 (m, 1H), 3.71-7.59 (m, 2H), 2.07 (d, J = 1.2 Hz, 3H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 143.2, 142.2, 137.8, 128.7, 128.5, 128.2, 127.6, 127.14, 127.06, 125.9, 47.2, 37.8, 16.6. HRMS (EI) calculated for $[C_{17}H_{17}Br]^+$ requires m/z 300.0514, found m/z 300.0508.



2a, 98.8% *ee* **4**, 76% yield, 99.1% *ee*

Methyl (*S*,*E*)-4-(2,4-diphenylpent-3-en-1-yl)benzoate (4): Prepared according to a previously reported procedure,[6] to a solution of **2a** (0.1056 g, 0.3 mmol, 1.0 equiv.) in 1.5 mL of MeOH (0.20 M), KH_2F (0.3 mL, 4.5 M in water) was added dropwise. Then the mixture was stirred at ambient

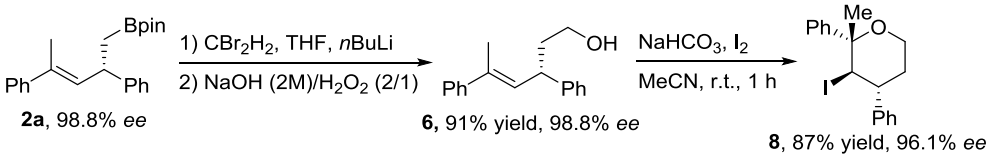
for 2 h. Then the mixture was concentrated in vacuo and the solid residue was triturated with dry acetone (5 mL). The liquid phase was carefully decanted, and the residual inorganic salts were washed with additional acetone (3×2 mL). The combined solution was concentrated in vacuo to give a white solid. The solid was washed with ether (3×5 mL) to remove pinacol and dried under vacuum, affording potassium alkyltrifluoroborate 0.0860 g (0.262 mmol, 86% yield). To a 25 mL dried seal tube cooled under nitrogen was charged with potassium alkyltrifluoroborate (0.0667 g, 0.2 mmol) obtained above, methyl 4-bromobenzoate (0.0450 g, 0.2 mmol, 1.0 equiv.), K_2CO_3 (0.0846 g, 0.6 mmol, 3.0 equiv.), PPh_3 (0.0121 g, 0.04 mmol, 20 mol%), $Pd(OAc)_2$ (0.0046 g, 0.02 mmol, 10 mol%), toluene (2.0 mL) and H_2O (0.4 mL). The mixture was added and stirred at 95 ℃ for 24 h, then cooled to room temperature and extracted with Et_2O (15 mL x 3). The organic layers were combined, washed with brine, dried over Na_2SO_4, concentrated and purified by column chromatography using PE/EA (100/1 to 20/1) as the eluent to give 0.0635 g (0.178 mmol, 76% total yield via two steps) of the title compound as a colorless oil. Optical Rotation: $[\alpha]_{20}^{D}$ = +47.5 (c 0.90, $CHCl_3$), 99.1% *ee* determined by HPLC, HPLC conditions: Chiralcel OJ-H, *n*-hexane/*i*-PrOH = 90/10, 1.0 mL/min, n = 254 nm, tr 13.8 (major), 24.0 (minor). IR (cm^{-1}): 2950, 1720, 1680, 1438, 1280. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.90 (d, J = 8.4 Hz, 2H), 7.32-7.15 (m, 12H), 5.94 (dd, J = 9.6, 1.2 Hz, 1H), 3.97-3.89 (m, 1H), 3.89 (s, 3H), 3.16 (dd, J = 13.2, 6.2 Hz, 1H), 3.04 (dd, J = 13.2, 9.0 Hz, 1H), 1.80 (d, J = 1.2 Hz, 3H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 167.2, 145.7, 144.3, 143.7, 135.8, 130.6, 129.4, 129.3, 128.6, 128.1, 127.9, 127.4, 126.8, 126.3, 125.8, 52.0, 46.8, 43.8, 16.2. HRMS (EI) calculated for $[C_{25}H_{24}O_2]^+$ requires m/z 356.1776, found m/z 356.1174.



(S,E)-2,4-diphenylpent-3-en-1-ol (5): Prepared according to a previously reported procedure,[8] to a solution of **2a** (0.1759 g, 0.5 mmol, 1.0 equiv.) in 4 mL of Et_2O (0.125 M), hydrogen peroxide (3.0 mL, 30% aqueous solution) and NaOH aqueous solution (4.0 mL, 3.0 M) were added in sequence. The mixture was stirred at r.t. for 3 h and then extracted with Et_2O (5 mL x 3). The combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated in vacuo.

The residue was purified by column chromatography using PE/EA (5/1) as the eluent to give 0.1138 g (0.451 mmol, 89% yield) of the title compound as a white solid. mp: 56.0–56.9 ℃ (by column chromatography using PE/EA). Optical Rotation: $[\alpha]_{20}^{D}$ = -67.5 (c 1.01, $CHCl_3$), 98.1% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 90/10, 1.0 mL/min, n = 254 nm, tr 6.9 (major), 7.7 (minor). IR (cm^{-1}): 3373, 3027, 2924, 1599, 1493, 1448, 1381. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.42-7.37 (m, 2H), 7.37-7.28 (m, 6H), 7.27-7.20 (m, 2H), 5.97 (dd, J = 9.2, 1.0 Hz, 1H), 3.98-3.78 (m, 3H), 2.10 (d, J = 1.0 Hz, 3H), 1.48 (t, J = 6.6 Hz, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 143.3, 141.6, 138.1, 128.8, 128.2, 127.9, 127.5, 127.1, 126.8, 125.8, 67.3, 47.9, 16.5. HRMS (EI) calculated for $[C_{17}H_{18}O]^+$ requires m/z 238.1358, found m/z 238.1360.

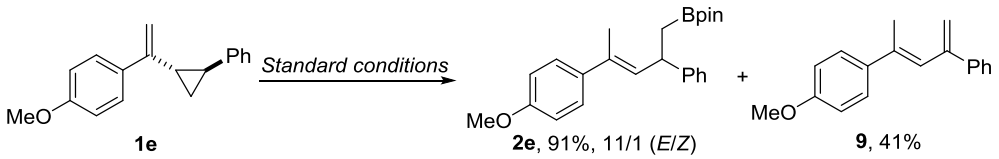
(2*S*,3*R*,4*S*)-3-iodo-2-methyl-2,4-diphenyltetrahydrofuran (7): Prepared according to a previously reported procedure,[7] under the atmosphere of nitrogen, to a solution of **5** (0.0493 g, 0.2 mmol, 1.0 equiv.) in 20 mL of MeCN, $NaHCO_3$ (0.0548 g, 0.60 mmol, 3.0 equiv.) and I_2 (0.1052 g, 0.4 mmol, 2.0 equiv.) were added in sequence. The mixture was stirred at r.t. for 1 h. Then the mixture was quenched with saturated aqueous $Na_2S_2O_3$, extracted with ethyl acetate (15 mL x 3). The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated in vacuo. The crude product was purified by column chromatography using PE/EA (100/1 to 50/1) as the eluent to give 0.0778 g (0.198 mmol, 99% yield) of the title compound as a colorless oil. Optical Rotation: $[\alpha]_{20}^{D}$ = -24.3 (c 1.09, $CHCl_3$), 99.0% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H x 2, *n*-hexane/*i*-PrOH = 99.9/0.1, 1.0 mL/min, n = 220 nm, tr 18.1 (major), 20.4 (minor). IR (cm^{-1}): 3030, 2927, 1671, 1602, 1495, 1447, 1375, 1214. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.66-7.61 (m, 2H), 7.41-7.25 (m, 6H), 7.25-7.20 (m, 2H), 4.32 (dd, J = 8.6, 8.4 Hz, 1H), 4.24 (d, J = 10.8 Hz, 1H), 3.94 (dd, J = 9.6, 8.6 Hz, 1H), 3.84-3.75 (m, 1H), 1.88 (s, 3H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 145.4, 137.7, 128.8, 128.5, 127.62, 127.58, 127.4, 124.8, 85.2, 72.8, 56.8, 42.9, 29.4. HRMS (EI) calculated for $[C_{16}H_{14}IO]^+$ ($[M\text{-}Me]^+$)requires m/z 349.0089, found m/z 349.0092.



(S,E)-3,5-diphenylhex-4-en-1-ol (6): Prepared according to a previously reported procedure,[5] a 10 mL flame-dried Schlenk flask cooled under nitrogen was charged with **2a** (0.1036 g, 0.3 mmol), dibromomethane (52.6 uL, 2.5 equiv) and THF (2 mL), then cooled to -78 ℃. A solution of *n*BuLi (264 uL, 2.5 M in hexanes, 2.2 equiv) was added dropwise. The resulting mixture was stirred at -78 ℃ for 10 min and warm to room temperature. After stirred at r.t. for 2 h, the reaction mixture was cooled to 0 ℃, a premixed solution of NaOH (2 M, aq.)/30% H_2O_2 (2:1, 3 mL) was added dropwise and stirred at r.t. for 3 h. The reaction was quenched with 10 mL water, extracted with ethyl acetate (15 mL x 3). The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated in vacuo. The crude product was purified by column chromatography using PE/EA (10/1) as the eluent to give 0.0684 g (0.271 mmol, 91% yield) of the title compound as a colorless oil. Optical Rotation: $[\alpha]_{20}^{D}$ = -30.3 (c 0.90, $CHCl_3$), 98.8% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H x 2, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 254 nm, tr 52.0 (major), 54.0 (minor). IR (cm^{-1}): 3362, 3026, 1599, 1493, 1449, 1381. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.40-7.34 (m, 2H), 7.34-7.25 (m, 6H), 7.24-7.16 (m, 2H), 5.92 (dd, J = 9.6, 1.0 Hz, 1H), 3.92-3.85 (m, 1H), 3.70-3.61 (m, 2H), 2.10 (d, J = 1.0 Hz, 3H), 2.07-1.95 (m, 2H), 1.31 (br, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 144.8, 143.6, 135.3, 131.5, 128.6, 128.1, 127.4, 126.8, 126.2, 125.8, 61.0, 41.3, 39.9, 16.3. HRMS (EI) calculated for $[C_{18}H_{20}O]^+$ requires m/z 252.1514, found m/z 252.1518.

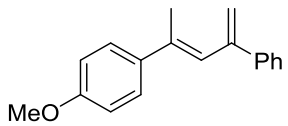
(2*S*,3*R*,4*R*)-3-iodo-2-methyl-2,4-diphenyltetrahydro-2*H*-pyran (8): Prepared according to a previously reported procedure,[7] under the atmosphere of nitrogen, to a solution of **6** (0.0382 g, 0.15 mmol, 1.0 equiv.) in 15 mL of MeCN, $NaHCO_3$ (0.0399 g, 0.45 mmol, 3.0 equiv.) and I_2 (0.0791 g, 0.30 mmol, 2.0 equiv.) were added in sequence. The mixture was stirred at r.t. for 1 h. Then the mixture was quenched with saturated aqueous $Na_2S_2O_3$, extracted with ethyl acetate (15 mL x 3). The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated in vacuo. The crude product was purified by column chromatography using PE/EA (100/1 to 50/1) as the eluent to give 0.0499 g (0.132 mmol, 87% yield) of the title compound as a

white solid, mp: >130 ℃ (decomposed, by column chromatography using PE/EA). Optical Rotation: $[\alpha]_{20}^{D}$ = +80.5 (c 1.40, $CHCl_3$), 96.1% *ee* determined by HPLC, HPLC conditions: Chiralcel AD-H, *n*-hexane/*i*-PrOH = 98/2, 1.0 mL/min, n = 220 nm, tr 5.4 (minor), 6.1 (major). IR (cm^{-1}): 2922, 1726, 1492, 1451, 1375, 1146. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.70-7.65 (m, 2H), 7.40-7.25 (m, 6H), 7.23-7.17 (m, 2H), 4.37 (d, J = 12.4 Hz, 1H), 4.10 (td, J = 12.4, 2.6 Hz, 1H), 4.04-3.97 (m, 1H), 3.40 (td, J = 12.4, 4.0 Hz, 1H), 2.21-2.10 (m, 1H), 2.09 (d, 3H), 1.96-7.88 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 145.4, 145.3, 128.6, 127.9, 127.8, 127.2, 127.1, 126.2, 78.9, 61.5, 48.9, 48.6, 37.0, 17.0. HRMS (EI) calculated for $[C_{18}H_{19}IO]^+$ requires m/z 378.0481, found m/z 378.0473.

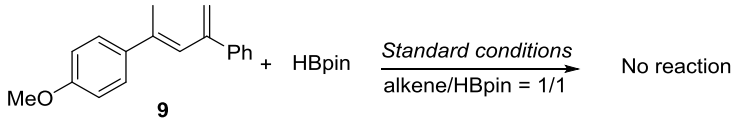


1e **2e**, 91%, 11/1 (*E*/*Z*) **9**, 41%

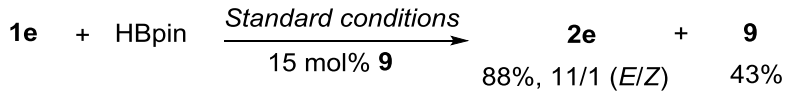
Prepared according to the general procedure A, using 0.2499 g (1.0 mmol) of **1e**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated, yield and stereoselectivity were monitored by ^1H NMR analysis (using 10 uL trimethylphenylsilane as internal standard).



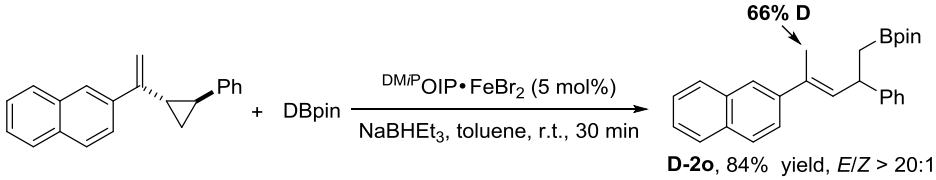
(*E*)-1-methoxy-4-(4-phenylpenta-2,4-dien-2-yl)benzene (9), 41% NMR yield; white solid; mp: 124.6-126.5 ℃ (crystallized from ethanol). IR (cm^{-1}): 2954, 2835, 1598, 1512, 1447, 1257, 1186. ^1H NMR ($CDCl_3$, 400 MHz): δ 7.49-7.41 (m, 4H), 7.32 (t, J = 7.6 Hz, 2H), 7.24-7.14 (m, 2H), 6.89 (d, J = 8.2 Hz, 2H), 6.68-6.55 (m, 2H), 3.83 (s, 3H), 2.25 (s, 3H); ^{13}C NMR: ($CDCl_3$, 100 MHz): δ 159.0, 137.9, 136.3, 135.5, 132.0, 128.6, 127.2, 126.7, 126.2, 126.0, 125.8, 113.7, 55.3, 16.2; HRMS (EI) calculated for $[C_{18}H_{18}O]^+$ requires m/z 250.1358, found m/z 250.1357.



Prepared according to the general procedure A, using 0.1266 g (0.5 mmol) of **9**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.025 mmol) of ^{DMiP}OIP·FeBr$_2$, 75 μL (1.0 M in THF, 0.075 mmol) of NaBHEt$_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated, yield and stereoselectivity were monitored by ^{1}H NMR analysis (using 10 uL trimethylphenylsilane as internal standard).

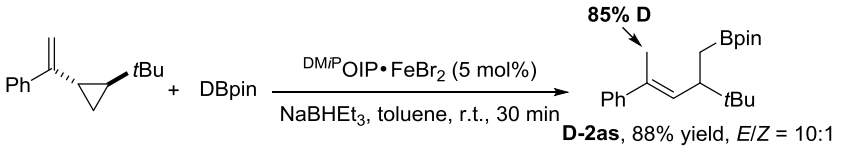


Prepared according to the general procedure A, using 0.2503 g (1.0 mmol) of **1e**, 0.0187 g (0.075 mmol) of **9**, 75 μL (97%, 0.5 mmol) of HBpin, 0.0151 g (0.025 mmol) of ^{DMiP}OIP·FeBr$_2$, 75 μL (1.0 M in THF, 0.075 mmol) of NaBHEt$_3$, and 1.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated, yield and stereoselectivity were monitored by ^{1}H NMR analysis (using 10 uL trimethylphenylsilane as internal standard).



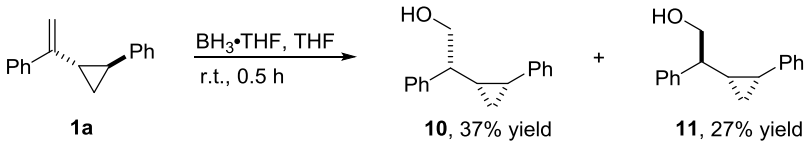
(*E*)-4,4,5,5-tetramethyl-2-(4-(naphthalen-2-yl)-2-phenylpent-3-en-1-yl-5-*d*)-1,3,2-dioxaborolane (D-2o): to a 25 mL flame-dried Schlenk flask cooled under nitrogen, 0.0148 g of ^{DMiP}OIP·FeBr$_2$ complex (0.025 mmol, 5 mol%) and 0.2717 g of **1n** (1.0 mmol, 2.0 equiv.) were added. The mixture was vacuumed and flushed with nitrogen for three times, and then, 1.0 mL of toluene (0.5 M) and DBpin (75 μL, 96%, 0.5 mmol, 1.0 equiv.) were added in sequence. The mixture was injected with NaBHEt$_3$ (1.0 M in THF, 75 μL, 0.075 mmol) by dropwise. Then the reaction was run at ambient temperature. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates

were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (100/1, 150 mL to 20/1, 250 mL) as the eluent to give 0.1682 g (0.421 mmol, > 20/1 *E/Z*, 84% yield) of the title compound as a white solid. mp: 70.5-72.5 ℃ (by flash column chromatography using PE/EA). IR (cm^{-1}): 2978, 1598, 1365, 1327, 1144. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.81-7.71 (m, 4H), 7.57 (dd, J = 8.6, 1.8 Hz, 1H), 7.46-7.37 (m, 2H), 7.36-7.31 (m, 2H), 7.31-7.25 (m, 2H), 7.19-7.13 (m, 1H), 6.09-6.04 (m, 1H), 4.10-4.02 (m, 1H), 2.25-2.20 (m, 2.34H), 1.45-1.34 (m, 2H), 1.15 (s, 12H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 146.7, 141.1, 134.4, 133.4, 133.2, 133.1, 132.4, 128.4, 128.0, 127.5, 127.4, 127.1, 125.9, 125.9, 125.4, 124.6, 124.2, 83.1, 40.4, 24.8, 24.7, 16.4-15.8 (m); ^{2}D NMR: ($CDCl_3$, 77 MHz) : δ 2.34. HRMS (EI) calculated for $[C_{27}H_{30}DBO_2]^+$ requires m/z 399.2480, found m/z 399.2479.



(*E*)-2-(2-(tert-butyl)-4-phenylpent-3-en-1-yl-5-*d*)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (D-2as): to a 25 mL flame-dried Schlenk flask cooled under nitrogen, 0.0150 g of ^{DMiP}OIP•$FeBr_2$ complex (0.025 mmol, 5 mol%) and 0.1020 g of **1as** (1.0 mmol, 2.0 equiv.) were added. The mixture was vacuumed and flushed with nitrogen for three times, and then, 1.0 mL of toluene (0.5 M) and DBpin (75 μL, 96%, 0.5 mmol, 1.0 equiv.) were added in sequence. The mixture was injected with $NaBHEt_3$ (1.0 M in THF, 75 μL, 0.075 mmol) by dropwise. Then the reaction was run at ambient temperature. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE (150 mL) to PE/EA (50/1, 250 mL) as the eluent to give 0.1451 g (0.441 mmol, 10/1 *E/Z*, 88% yield) of the title compound as a colorless oil. IR (cm^{-1}): 2965, 1491, 1365, 1328, 1145. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.40-7.34 (m, 2H), 7.31-7.24 (m, 2H), 7.22-7.16 (m, 1H), 5.60 (d, J = 10.8 Hz, 1H), 2.52 (td, J = 11.6, 3.6 Hz, 1H), 2.08-2.03 (m, 2.15H), 1.16 (s, 6H), 1.15 (s, 6H), 1.10-1.03 (m, 1H), 0.89 (s, 9H), 0.86-0.73 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 144.6, 134.1, 132.6, 128.0, 126.3, 125.9, 82.9, 44.4, 34.8,

27.2, 25.0, 24.7, 16.7-16.2 (m); ^{2}D NMR: ($CDCl_3$, 77 MHz) : δ 2.10. HRMS (EI) calculated for $[C_{21}H_{32}DBO_2]^+$ requires m/z 329.2636, found m/z 329.2635.

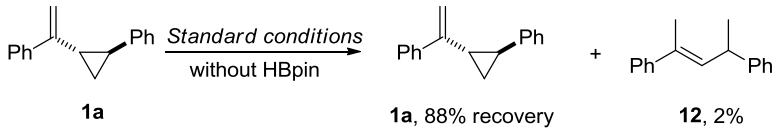


1a **10**, 37% yield **11**, 27% yield

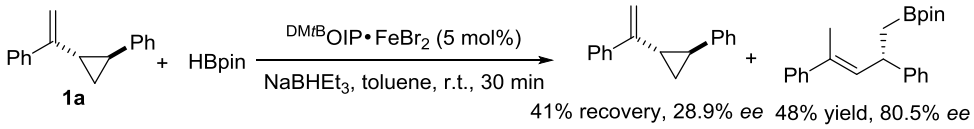
***cis*/*trans*-2-phenyl-2-(-2-phenylcyclopropyl)ethan-1-ol (10/11):** A 25 mL flame-dried Schlenk flask cooled under nitrogen charged with 0.1154 g of **1a** (0.5 mmol) and 1.0 mL of THF (0.5 M). The mixture was injected with $BH_3 \cdot$THF (1.0 M in THF, 500 μL, 0.5 mmol) by dropwise and stirred at ambient temperature. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated and stereoselectivity was monitored by ^{1}H NMR analysis. The crude mixture was purified by flash column chromatography using PE/EA (10/1) as the eluent to give 0.0465 g (0.195 mmol, 37% yield) of **10** as a colorless oil and 0.0331 g (0.139 mmol, 27% yield) of **11** as a colorless oil.

***cis*-2-phenyl-2-(-2-phenylcyclopropyl)ethan-1-ol (10):** ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.39-7.32 (m, 2H), 7.31-7.24 (m, 5H), 7.19-7.13 (m, 1H), 7.11-7.06 (m, 2H), 3.98-3.83 (m, 2H), 2.35-2.27 (m, 1H), 1.94-1.87 (m, 1H), 1.47 (tr, 1H), 1.35-1.24 (m, 1H), 0.96-0.89 (m, 1H), 0.85-0.78 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 142.8, 141.6, 128.6, 128.4, 128.0, 126.9, 125.7, 125.6, 67.3, 53.2, 25.8, 23.8, 14.1. HRMS (EI) calculated for $[C_{17}H_{18}O]^+$ requires m/z 238.1358, found m/z 238.1359.

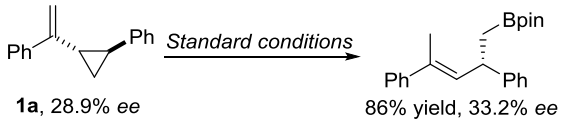
***trans*-2-phenyl-2-(-2-phenylcyclopropyl)ethan-1-ol (11):** ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.34-7.28 (m, 2H), 7.27-7.22 (m, 3H), 7.22-7.16 (m, 2H), 7.14-7.07 (m, 1H), 6.99-6.93 (m, 2H), 4.00-3.85 (m, 2H), 2.38-2.29 (m, 1H), 1.75-1.67 (m, 1H), 1.48 (tr, 1H), 1.43-1.33 (m, 1H), 1.14-1.07 (m, 1H), 1.03-0.95 (m, 1H); ^{13}C NMR: ($CDCl_3$, 100 MHz) : δ 142.7, 141.6, 128.6, 128.2, 128.0, 126.8, 126.0, 125.4, 67.2, 53.0, 24.7, 21.7, 15.7. HRMS (EI) calculated for $[C_{17}H_{18}O]^+$ requires m/z 238.1358, found m/z 238.1361.



Prepared according to the general procedure A, using 0.2499 g (1.0 mmol) of **1a**, 0.0147 g (0.025 mmol) of ^{DMiP}OIP·$FeBr_2$, 75 μL (1.0 M in THF, 0.075 mmol) of $NaBHEt_3$, and 1.0 mL (0.5 M) of toluene. After 3 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated. The yield and stereoselectivity were monitored by ^{1}H NMR analysis (using 10 uL trimethylphenylsilane as internal standard).



Prepared according to the general procedure A, using 0.8787 g (4.0 mmol) of **1a**, 300 μL (97%, 2.0 mmol) of HBpin, 0.0649 g (0.10 mmol) of ^{DMtB}OIP·$FeBr_2$, 300 μL (1.0 M in THF, 0.3 mmol) of $NaBHEt_3$, and 4.0 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (20 mL x 3). The combined filtrates were concentrated, yield and stereoselectivity were monitored by ^{1}H NMR analysis (using 40 uL trimethylphenylsilane as internal standard).



Prepared according to the general procedure A, using 0.1382 g (0.6 mmol) of **1a**, 45 μL (97%, 0.3 mmol) of HBpin, 0.0.091 g (0.015 mmol) of ^{DMiP}OIP·$FeBr_2$, 45 μL (1.0 M in THF, 0.045 mmol) of $NaBHEt_3$, and 0.6 mL (0.5 M) of toluene. After 0.5 h, the resulting solution was added 10 mL of ether and filtered through a pad of silica gel, washed by ether (10 mL x 3). The combined filtrates were concentrated, yield and stereoselectivity were monitored by ^{1}H NMR analysis (using 10 uL trimethylphenylsilane as internal standard).

IX. References

(1) (a) J.-H. Chen, T. Xi, Z. Lu, *Org. Lett.* **2014**, 1*6*, 6452-6455. (b) J.-H. Chen, T. Xi, X. Ren, B. Cheng, J. Guo, Z. Lu, *Org. Chem. Front.* **2014**, 1, 1306-1309. (c) T. Xi, Y.-C. Mei, Z. Lu, *Org. Lett.* **2015**, 17, 5939-5941.

(2) (a) R.-Y. Jin, X.-H. Sun, Y.-F. Liu, W. Long, B. Chen, S.-Q. Shen, H.-X. Ma, *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* **2016**, 1*52*, 226. (b) M. Breugst, E. Detmar, D. von der Heiden, *ACS Catal.* **2016**, 6, 3203. (c) K. Kumar, S. S. More, S. Goyal, M. Gangar, G. L. Khatik, R. K. Rawal, V. A. Nair, *Tetrahedron Letters* **2016**, *57*, 2315. (d) M. R. Harris, M. O. Konev, E. R. Jarvo, *J. Am. Chem. Soc.* **2014**, 1*36*, 7825.

(3) (a) J. A. Ciaccio, C. E. Aman, *Synthetic Communications* **2006**, *36*, 1333. (b) J. Xu, N. B. Samsuri, H. A. Duong, *Chem. Commun.* **2016**, *52*, 3372.

(4) (a) M. Yilmaz, *Tetrahedron* **2011**, *6*7, 8255. (b) T. Ikawa, K. Hattori, H. Sajiki, K. Hirota, *Tetrahedron* **2004**, *60*, 6901. (c) G. Urgoitia, R. SanMartin, M. T. Herrero, E. Dominguez, *Adv. Synth. Catal*. **2016**, *35*8, 3307. (d) Y. Arai, R. Tomita, G. Ando, T. Koike, M. Akita, *Chem. Eur. J.* **2016**, *22*, 1262. (e) K. Miyazawa, T. Koike, M. Akita, *Chem. Eur. J.* **2015**, *21*, 11677. (f) C. Chatalova-Sazepin, Q. Wang, G. M. Sammis, J. Zhu, *Angew. Chem. Int. Ed.* **2015**, *54*, 5443.

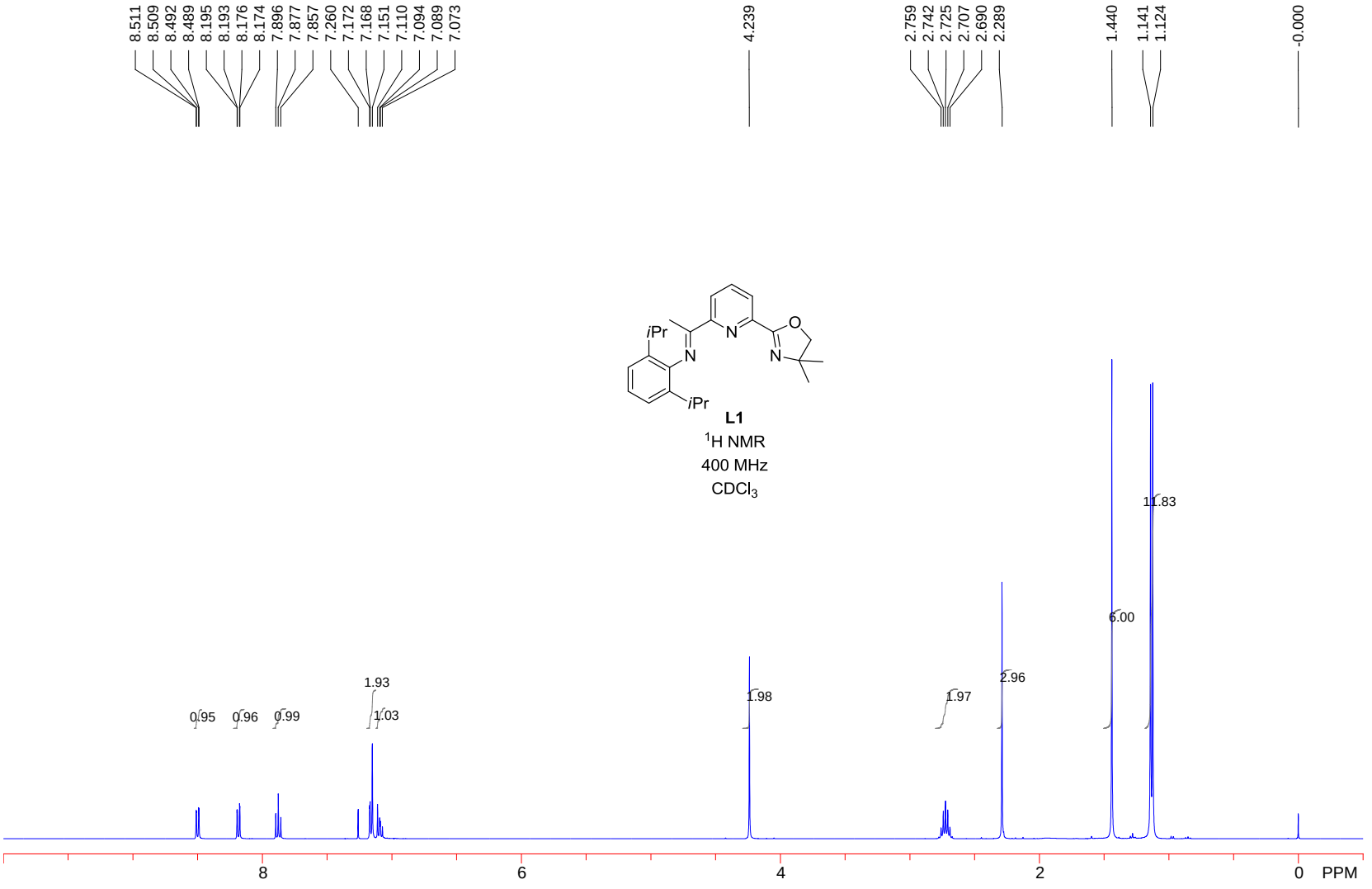
(5) Y. Xi, J. F. Hartwig, *J. Am. Chem. Soc.* **2016**, 1*38*, 6703.

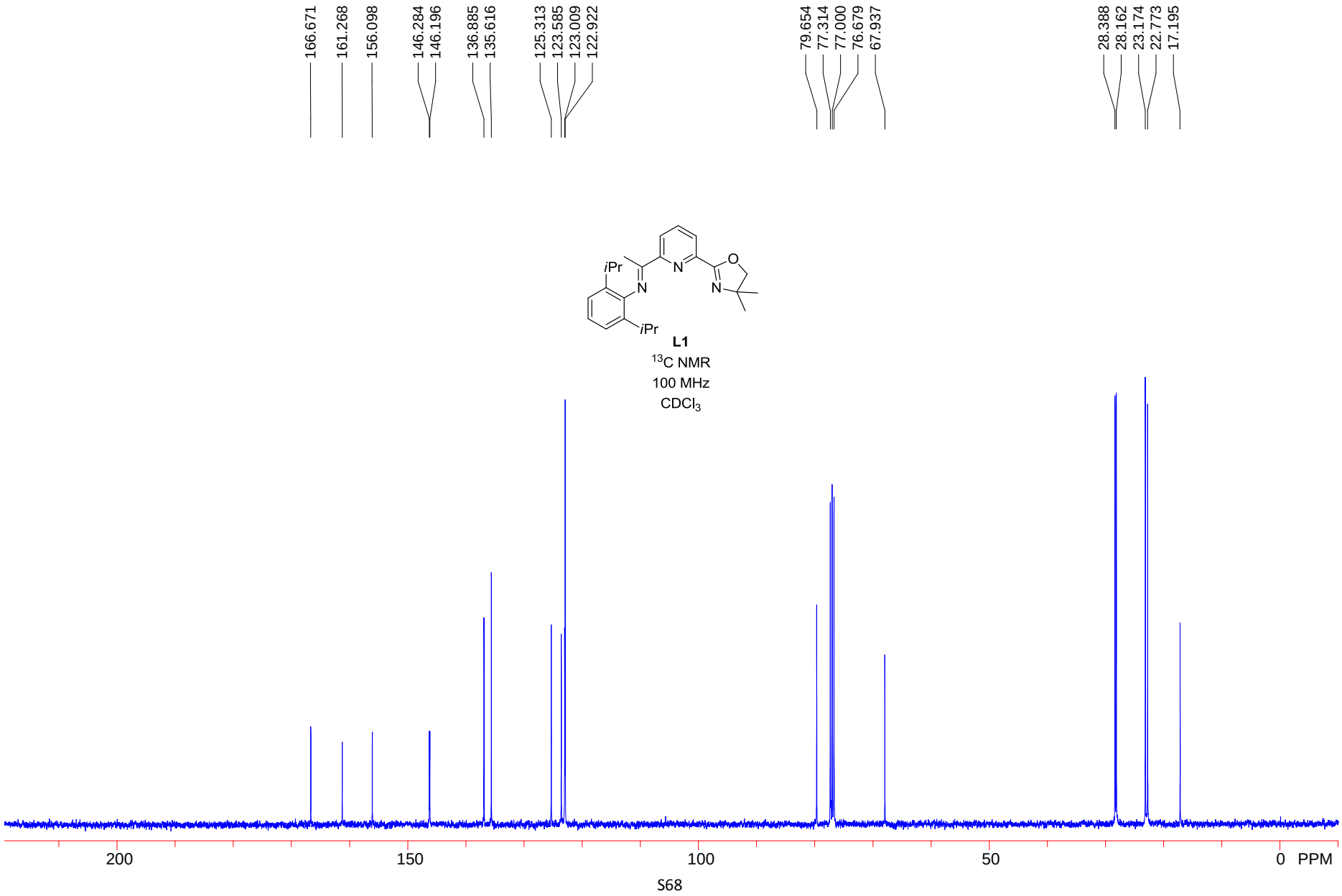
(6) H. Zhang, Z. Lu, *ACS Catal.* **2016**, 6, 6596.

(7) J. L. Nallasivam, R. A. Fernandes, *J. Am. Chem. Soc*. **2016**, 1*38*, 13238.

(8) C. Mazet, D. Geirard, *Chem. Commun.* **2011**, *47*, 298.

X. NMR Spectra

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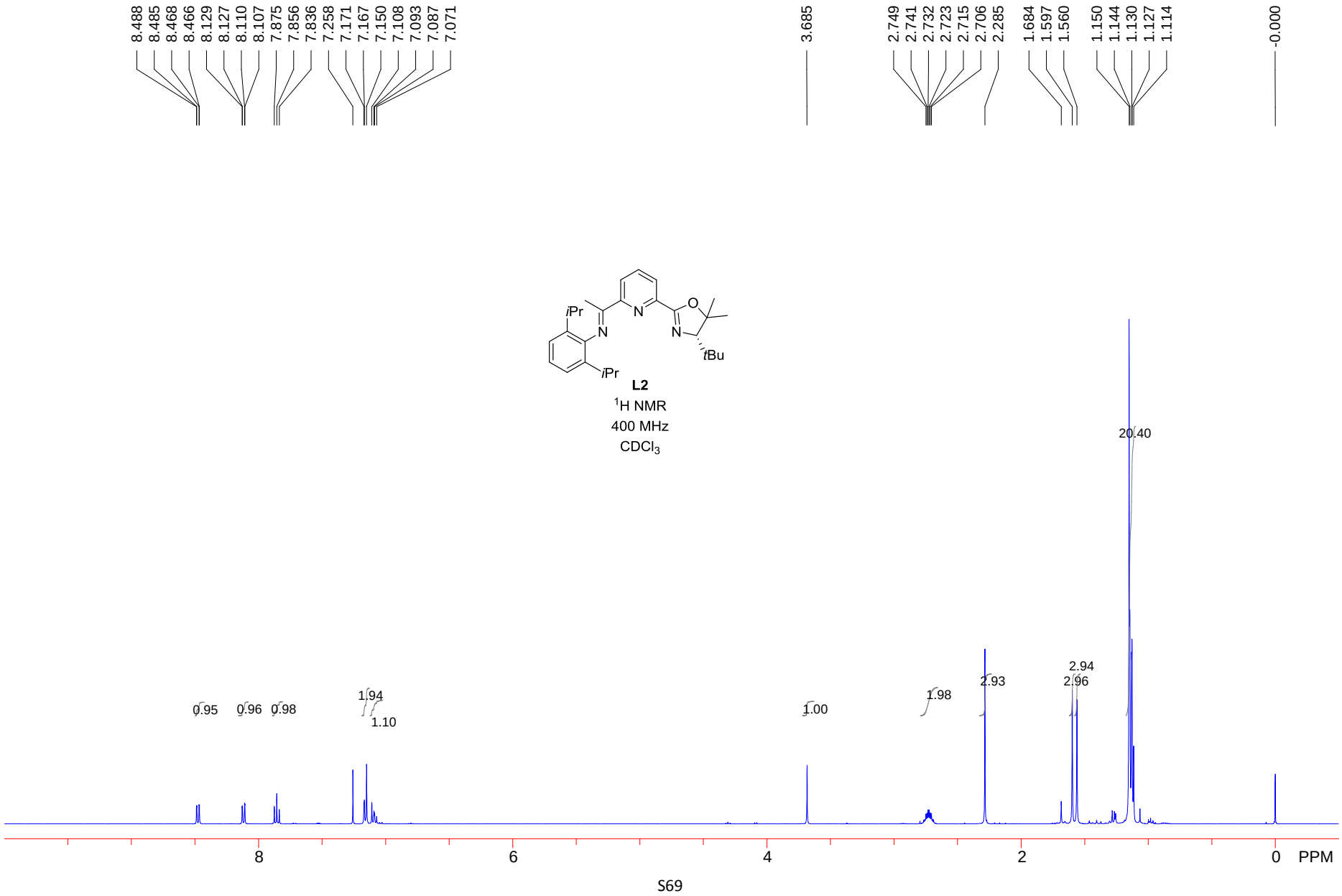
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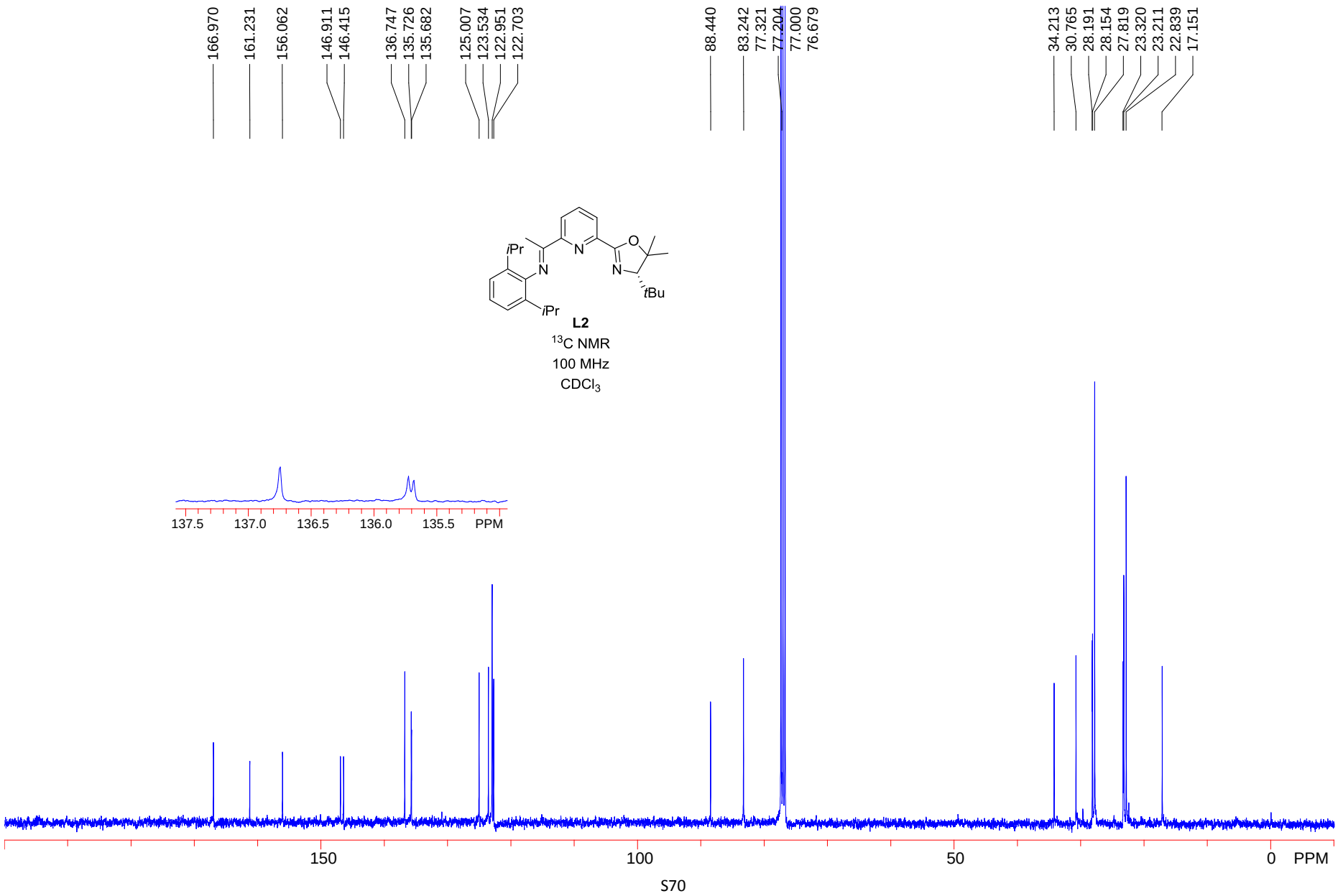
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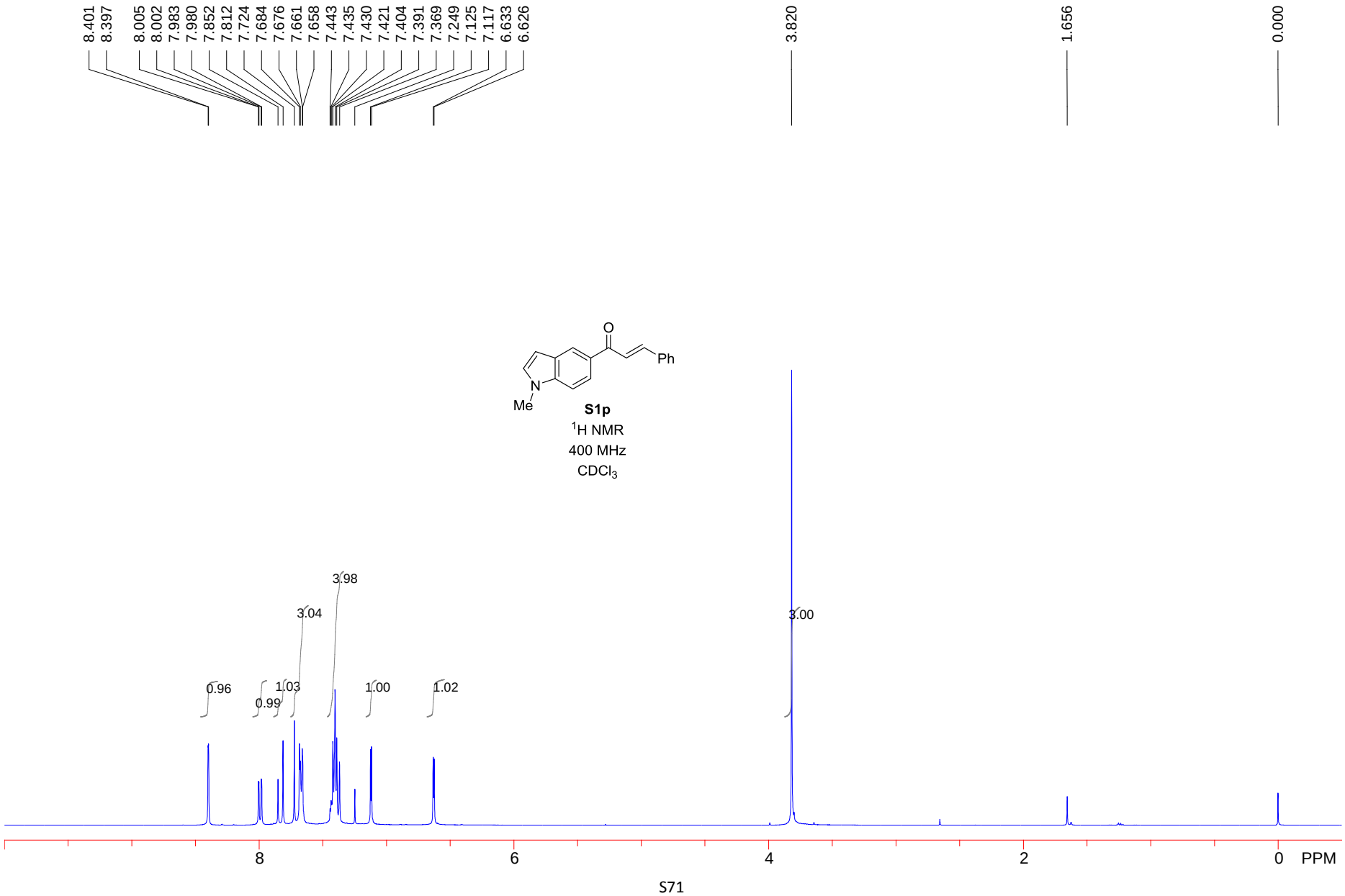
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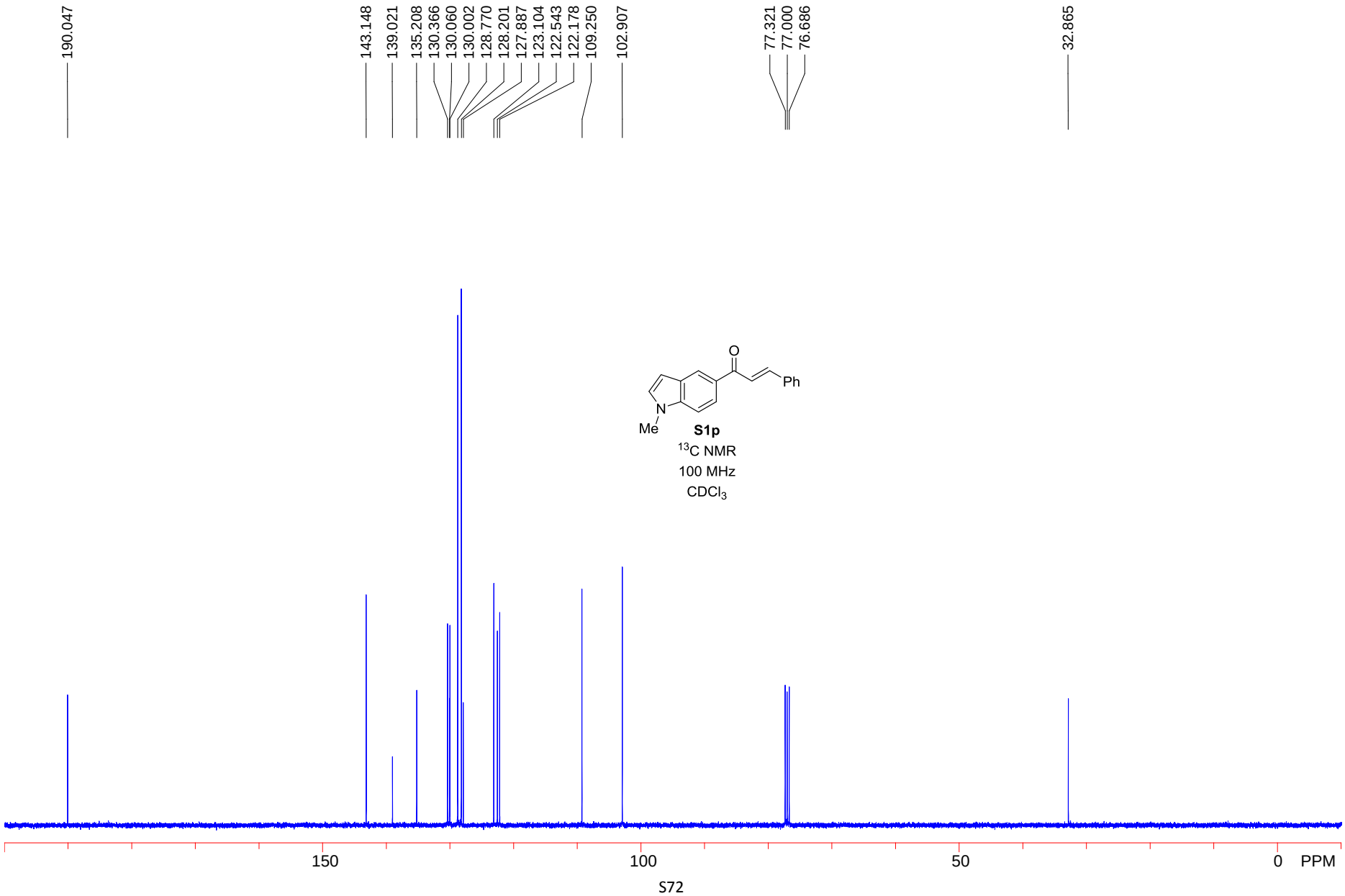
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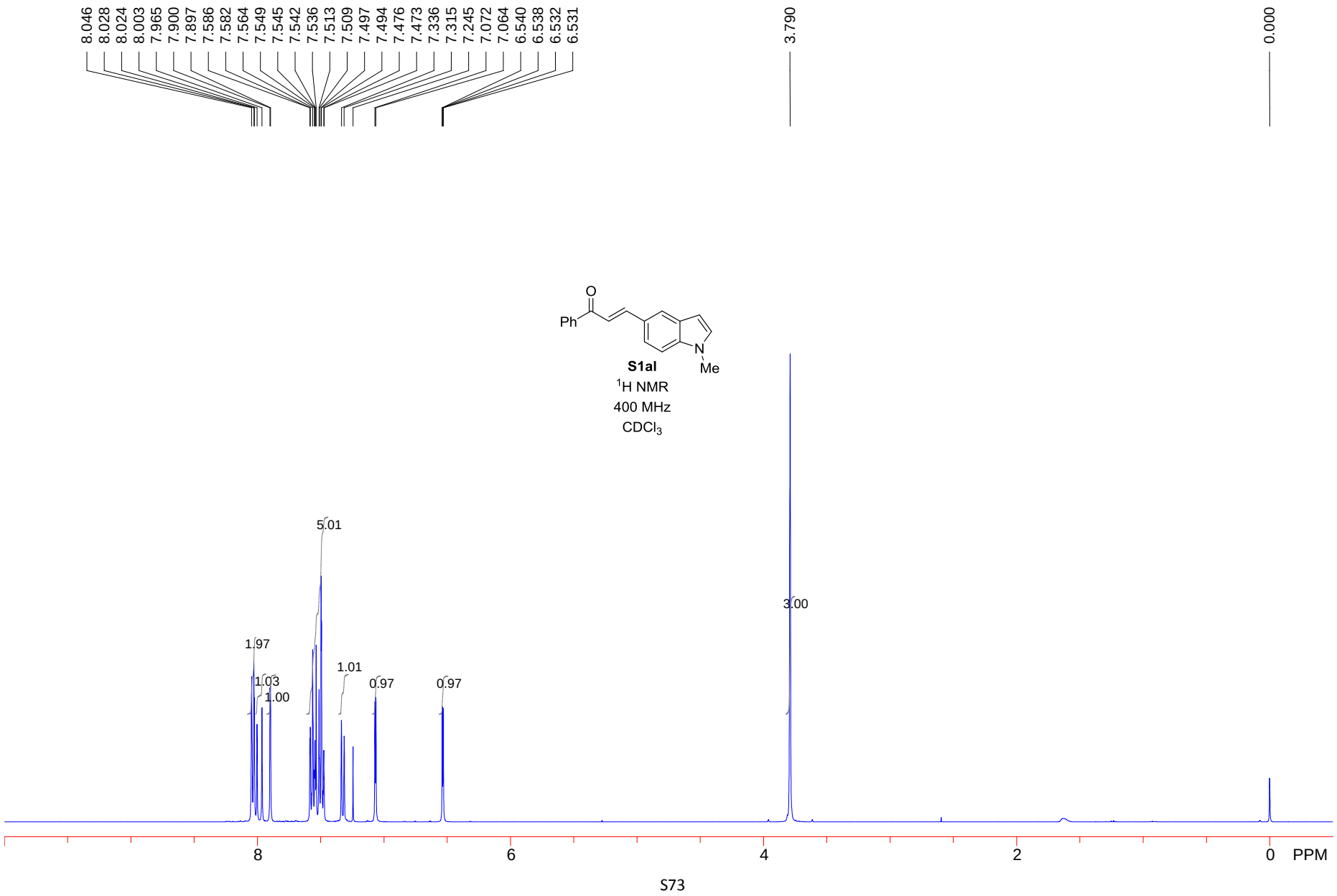
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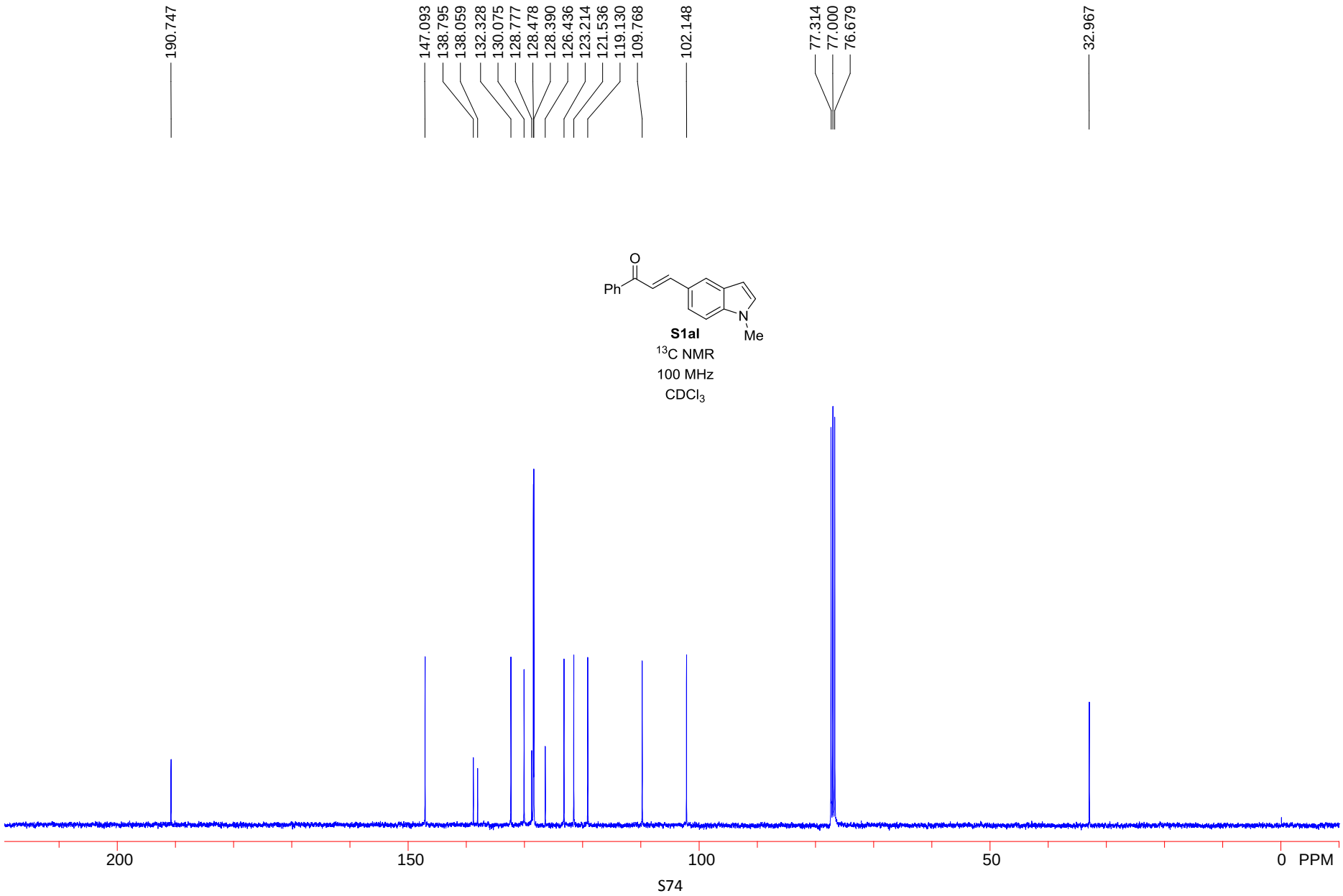
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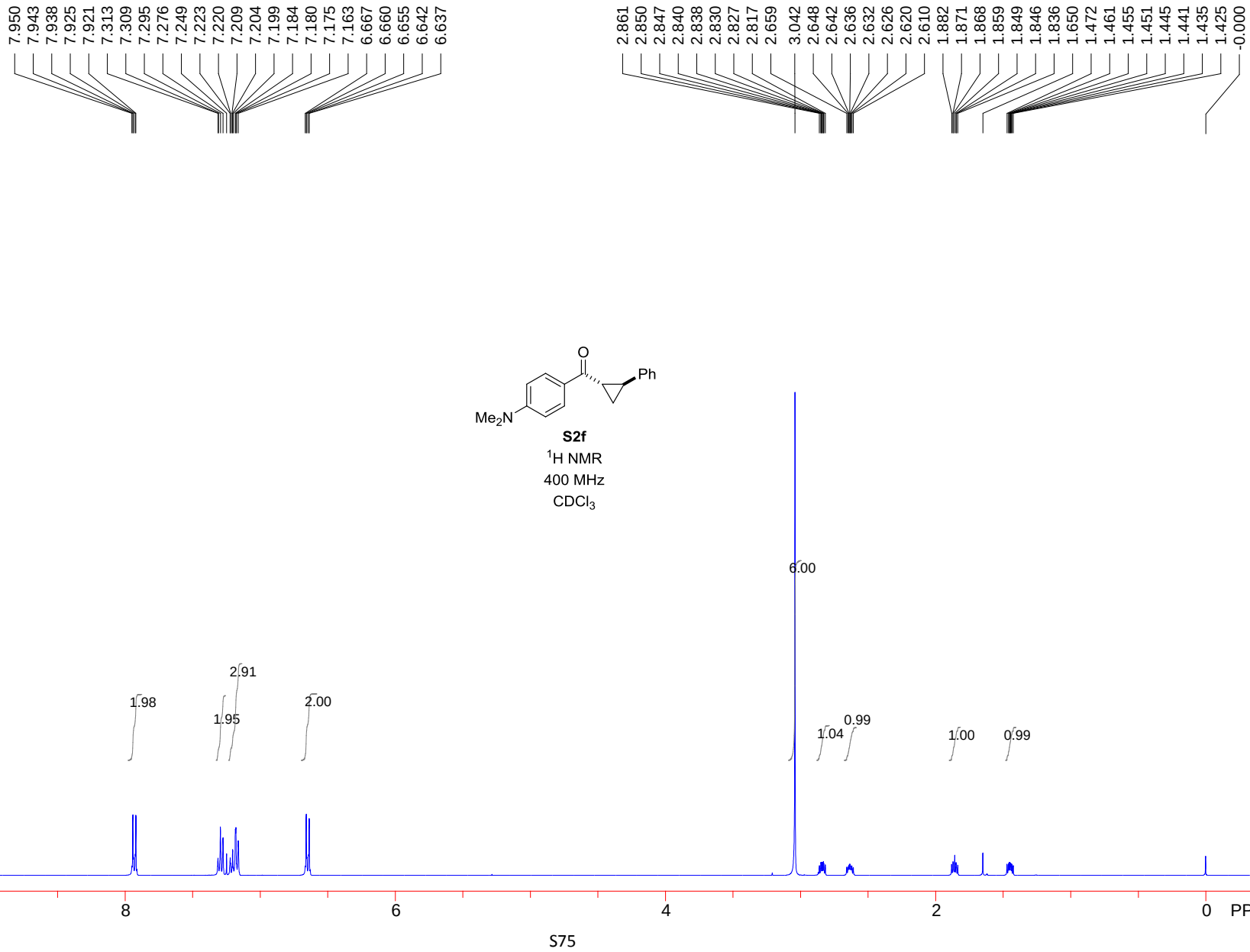
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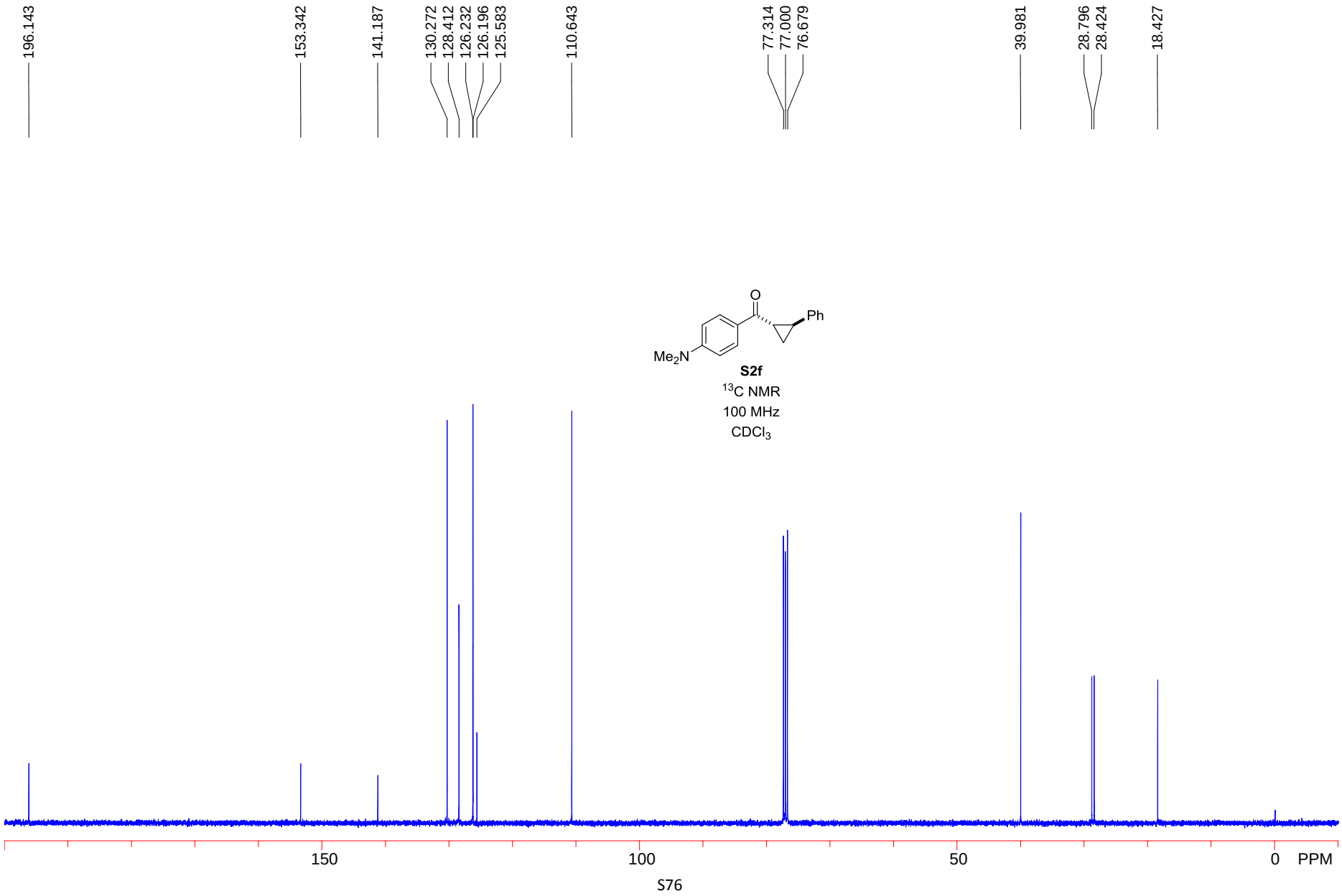
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141.187
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128.412
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126.196
125.583
110.643
77.314
77.000
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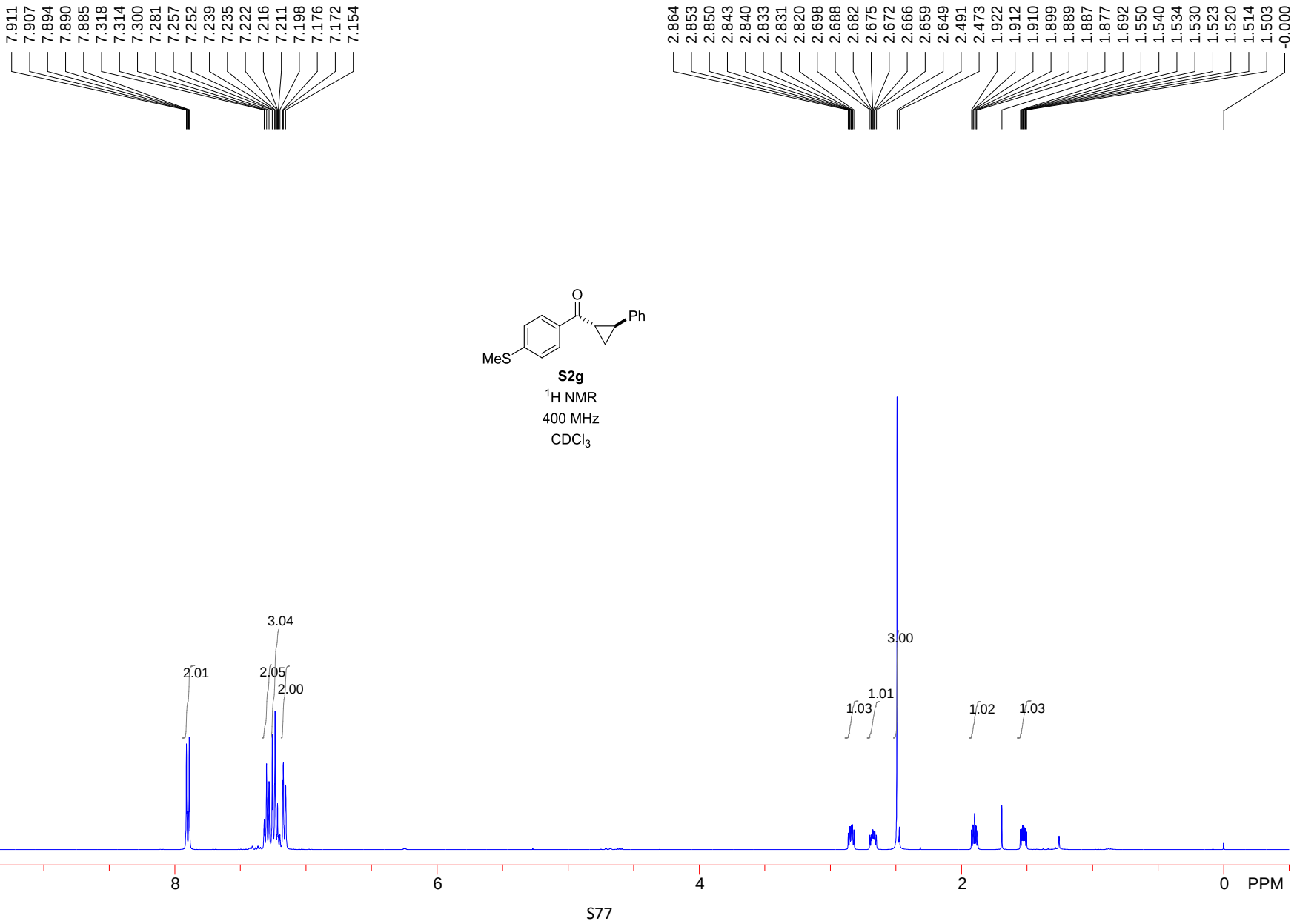
39.981
28.796
28.424
18.427
O
Ph
Me2N
S2f
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.907
7.894
7.890
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7.318
7.314
7.300
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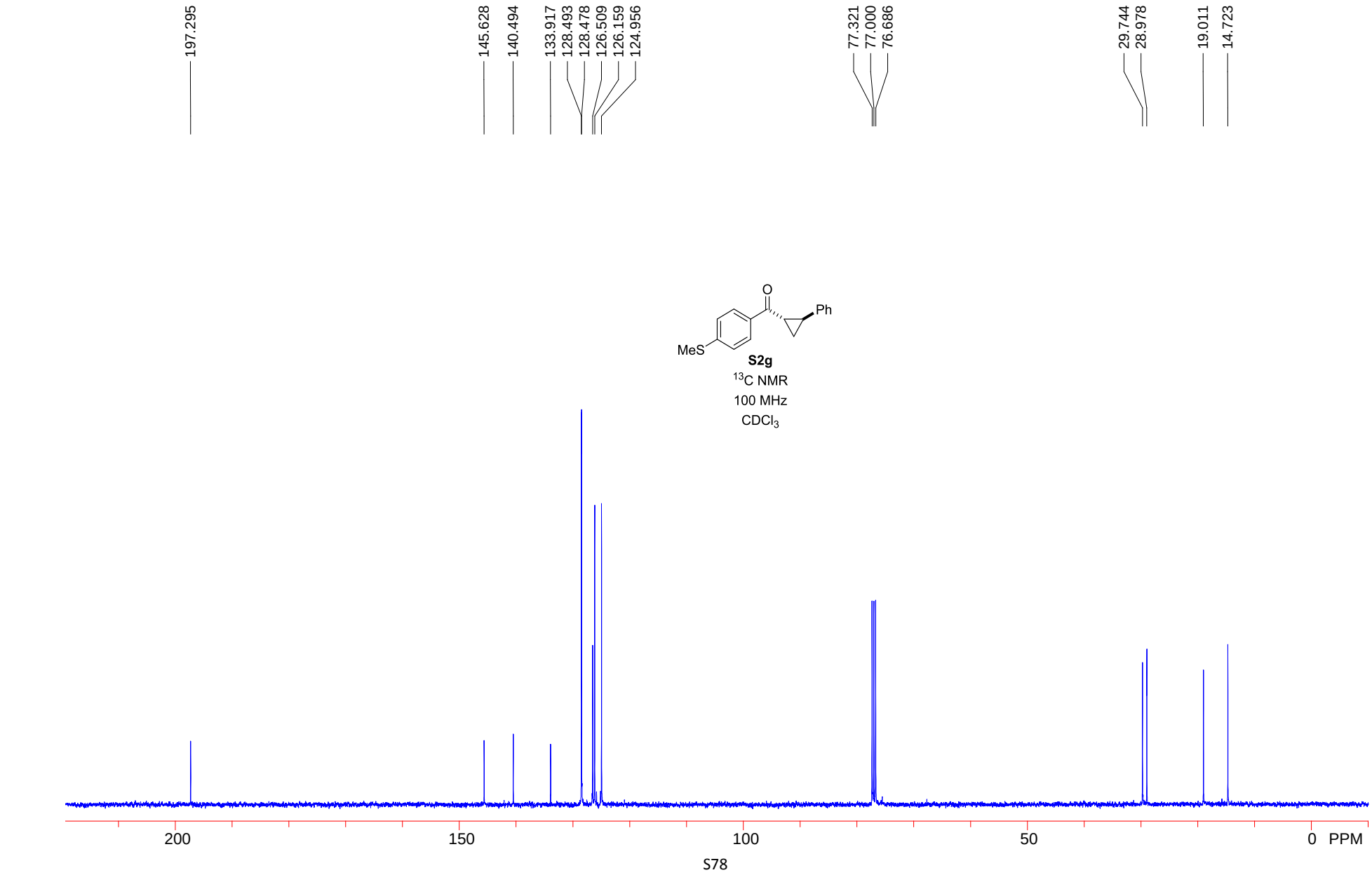
7.257
7.252
7.239
7.235
7.222
7.216
7.211
7.198
7.176
7.172
7.154
2.864
2.853
2.850
2.843
2.840
2.833
2.831
2.820
2.698
2.688
2.682
2.675
2.672
2.666
2.659
2.649
2.491
2.473
1.922
1.912
1.910
1.899
1.889
1.887
1.877
1.692
1.550
1.540
1.534
1.530
1.523
1.520
1.514
1.503
-0.000
O
Ph
MeS
S2g
1H NMR
400 MHz
CDCl3
3.04
2.01
2.05
2.00
3.00
1.01
1.03
1.02
1.03
8
6
4
2
0
PPM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133.917
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126.159
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77.000
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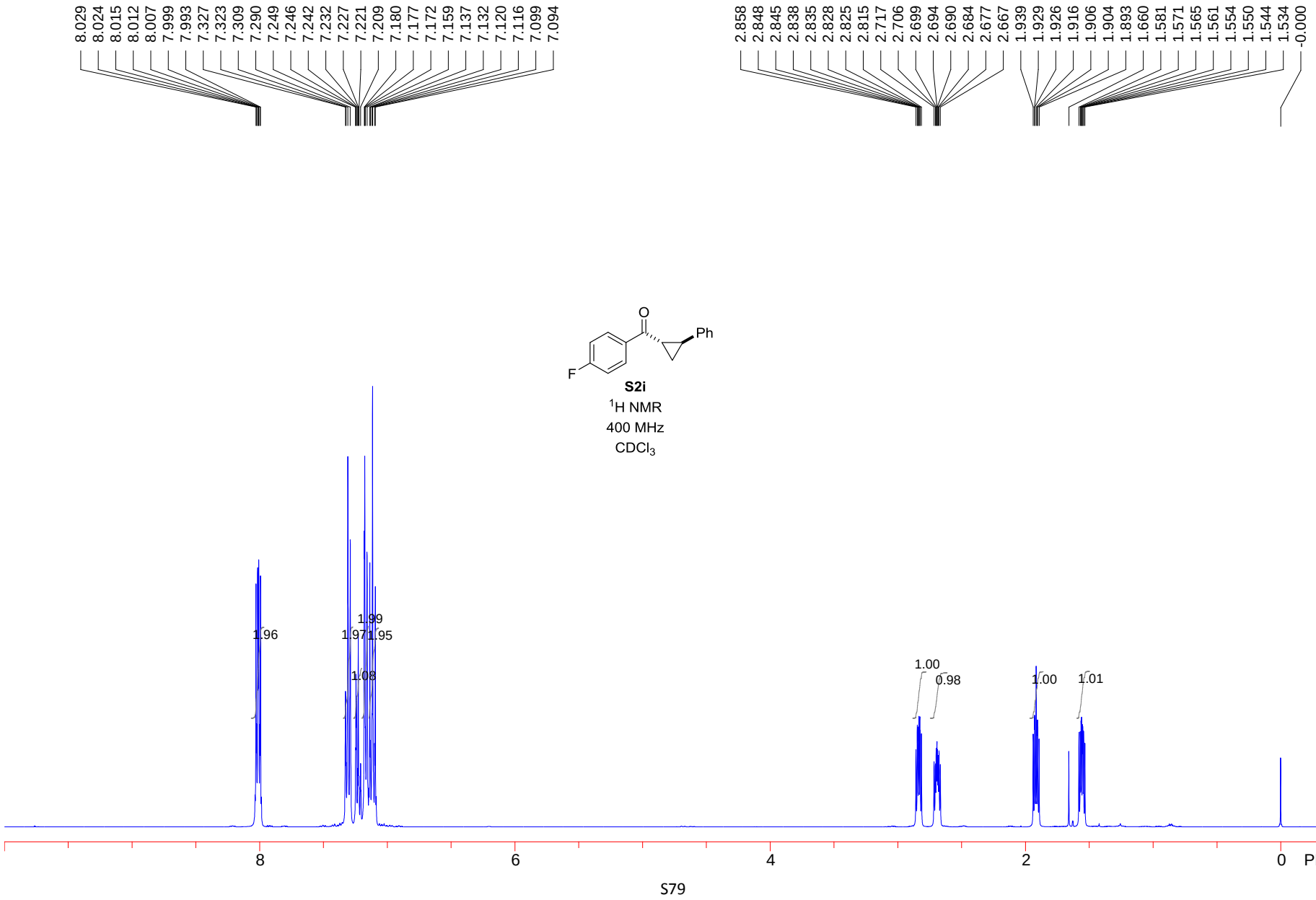
29.744
28.978
19.011
14.723
O
Ph
MeS
S2g
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM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8.012
8.007
7.999
7.993
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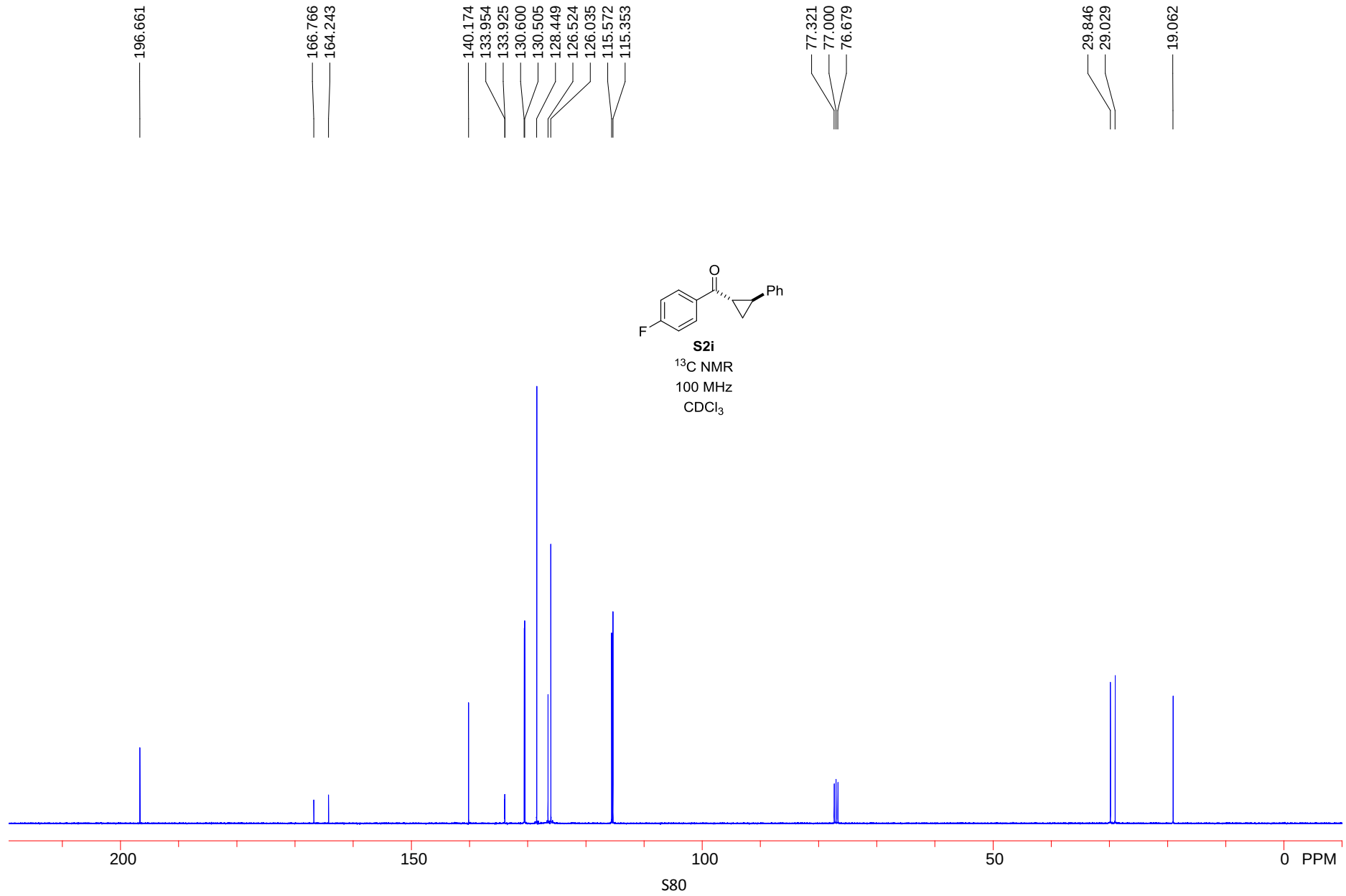
7.246
7.242
7.232
7.227
7.221
7.209
7.180
7.177
7.172
7.159
7.137
7.132
7.120
7.116
7.099
7.094
2.858
2.848
2.845
2.838
2.835
2.828
2.825
2.815
2.717
2.706
2.699
2.694
2.690
2.684
2.677
2.667
1.939
1.929
1.926
1.916
1.906
1.904
1.893
1.660
1.581
1.571
1.565
1.561
1.554
1.550
1.544
1.534
-0.000
O
Ph
F
S2i
1H NMR
400 MHz
CDCl3
1.96
1.99
1.97
1.95
1.08
1.00
0.98
1.00
1.01
8
6
4
2
0
PPM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164.243
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133.954
133.925
130.600
130.505
128.449
126.524
126.035
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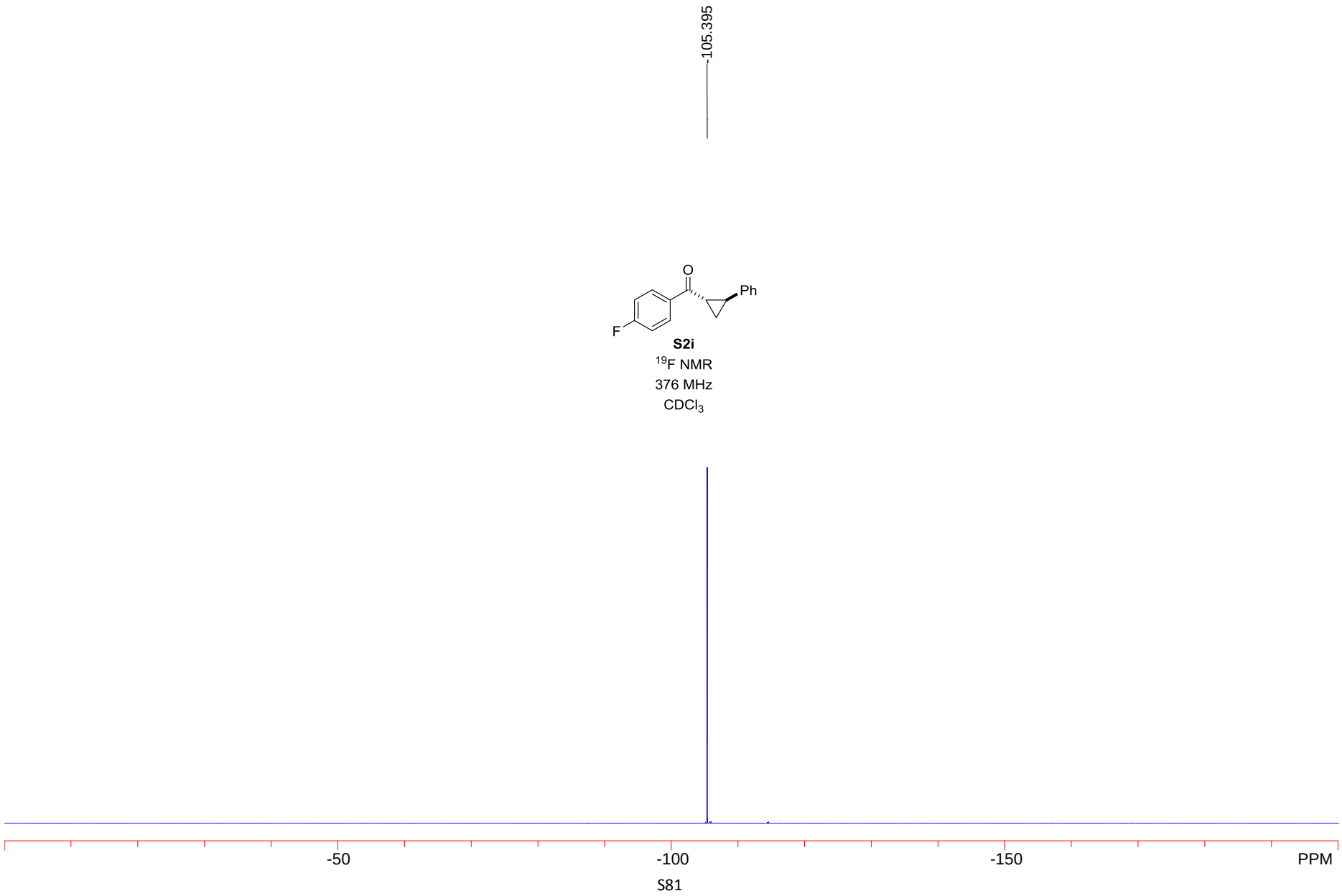
115.353
77.321
77.000
76.679
29.846
29.029
19.062
O
Ph
F
S2i
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM


-105.395
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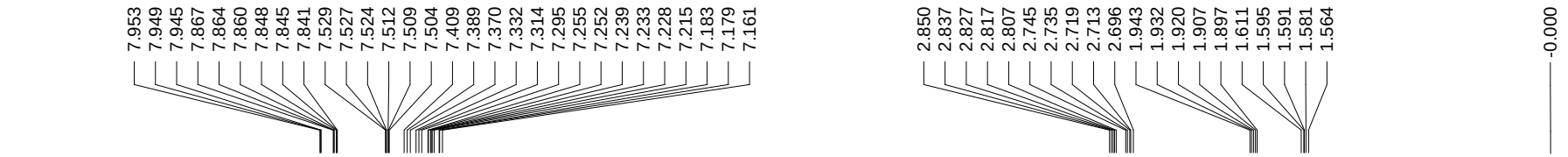
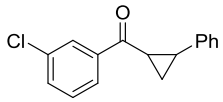
Ph
F
S2i
19F NMR
376 MHz
CDCl3
-50
-100
-150
PPM



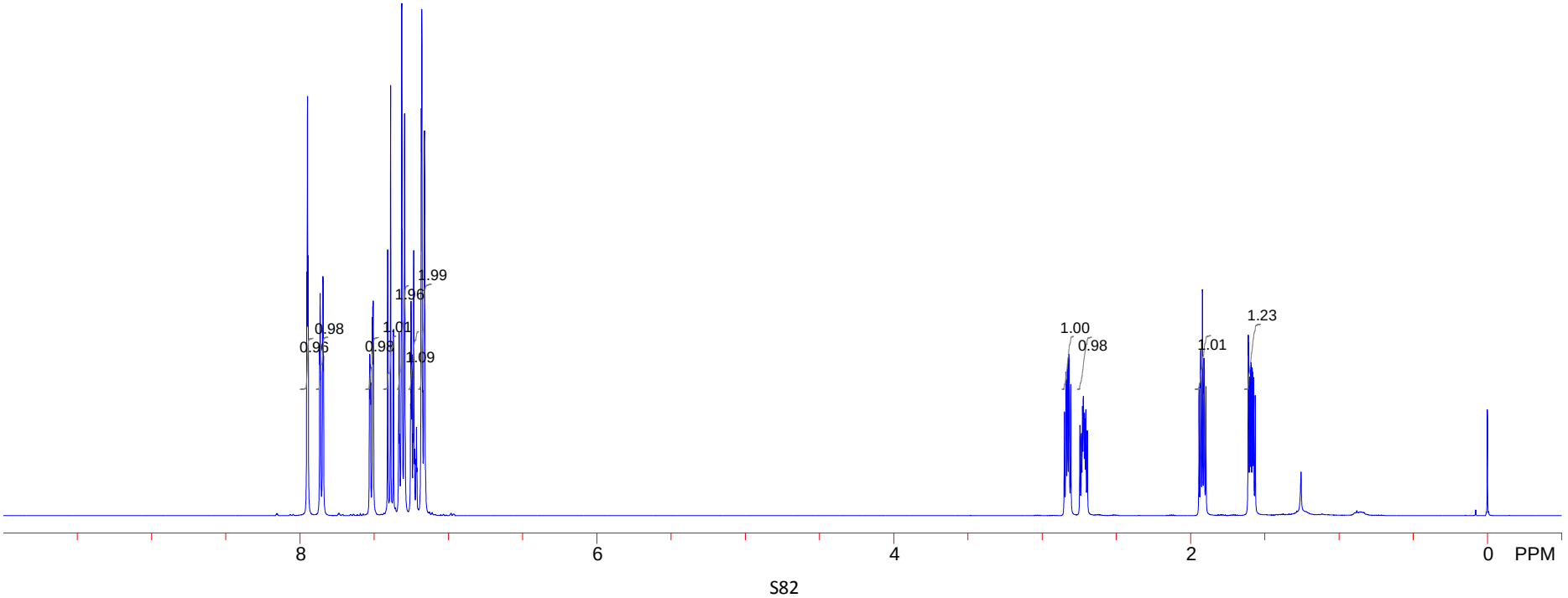


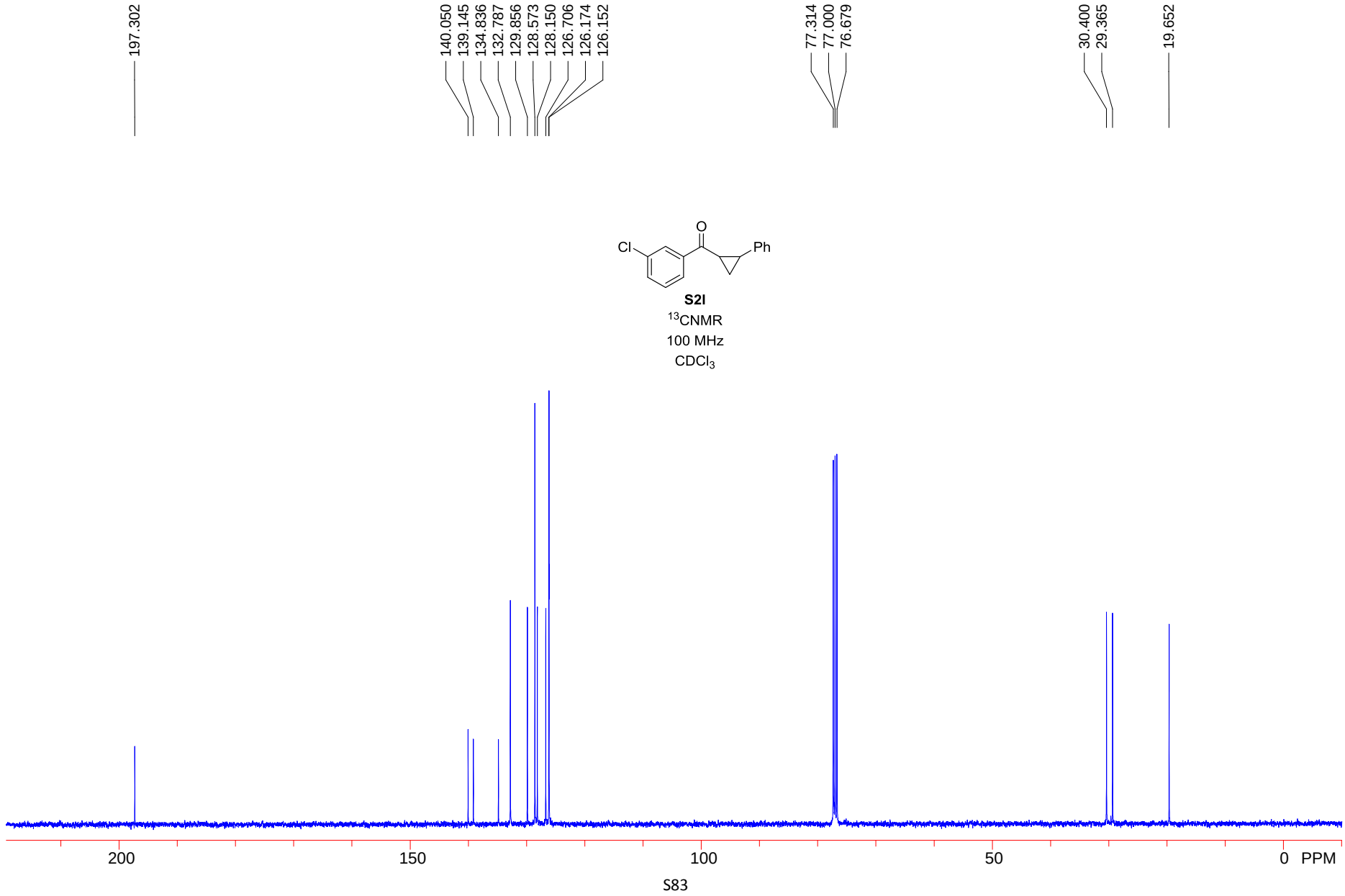
S2l

^{1}H NMR

400 MHz

$CDCl_3$

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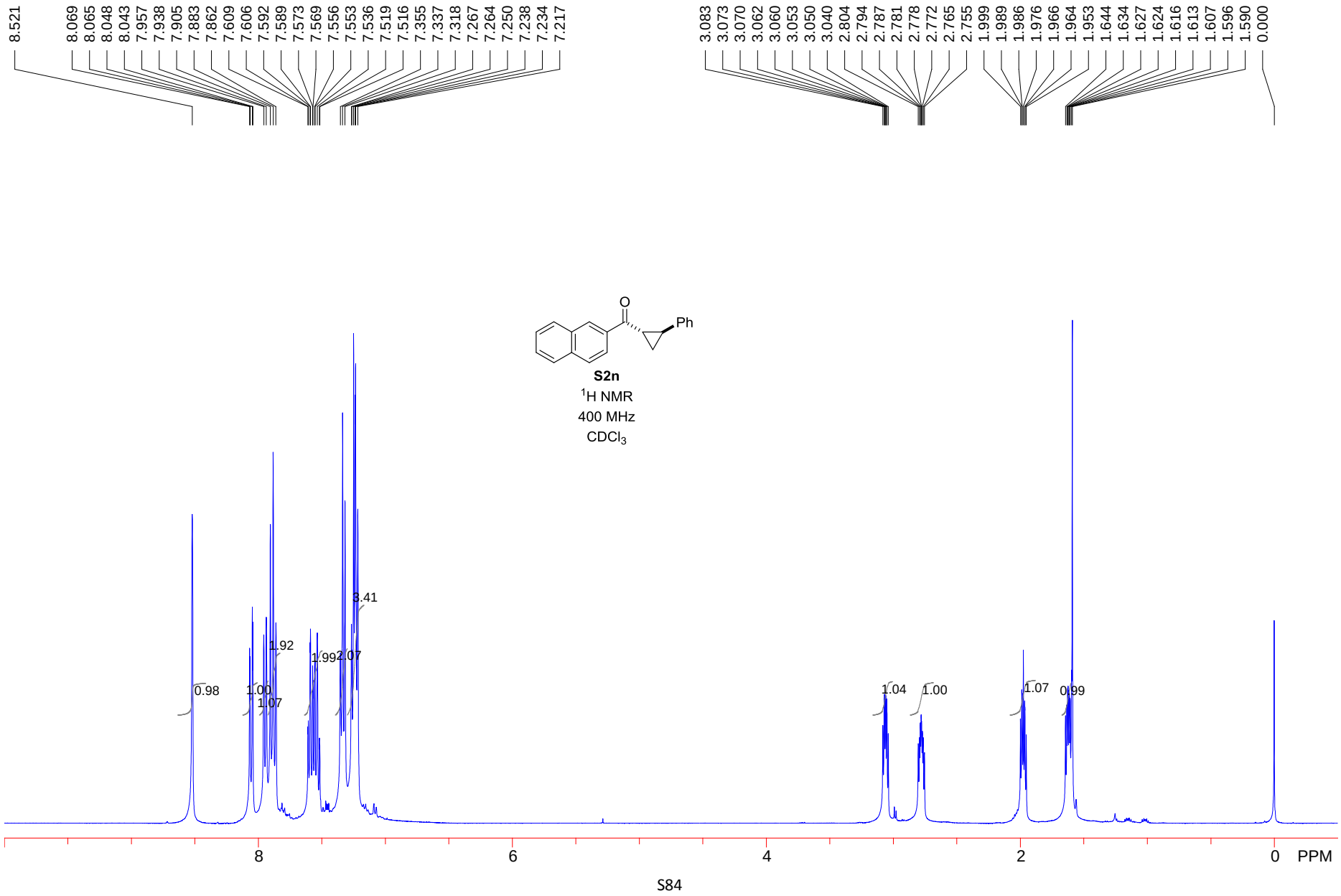
139.145
134.836
132.787
129.856
128.573
128.150
126.706
126.174
126.152
77.314
77.000
76.679
30.400
29.365
19.652
O
Cl
Ph
S2l
13CNMR
100 MHz
CDCl3
200
150
100
50
0 PPM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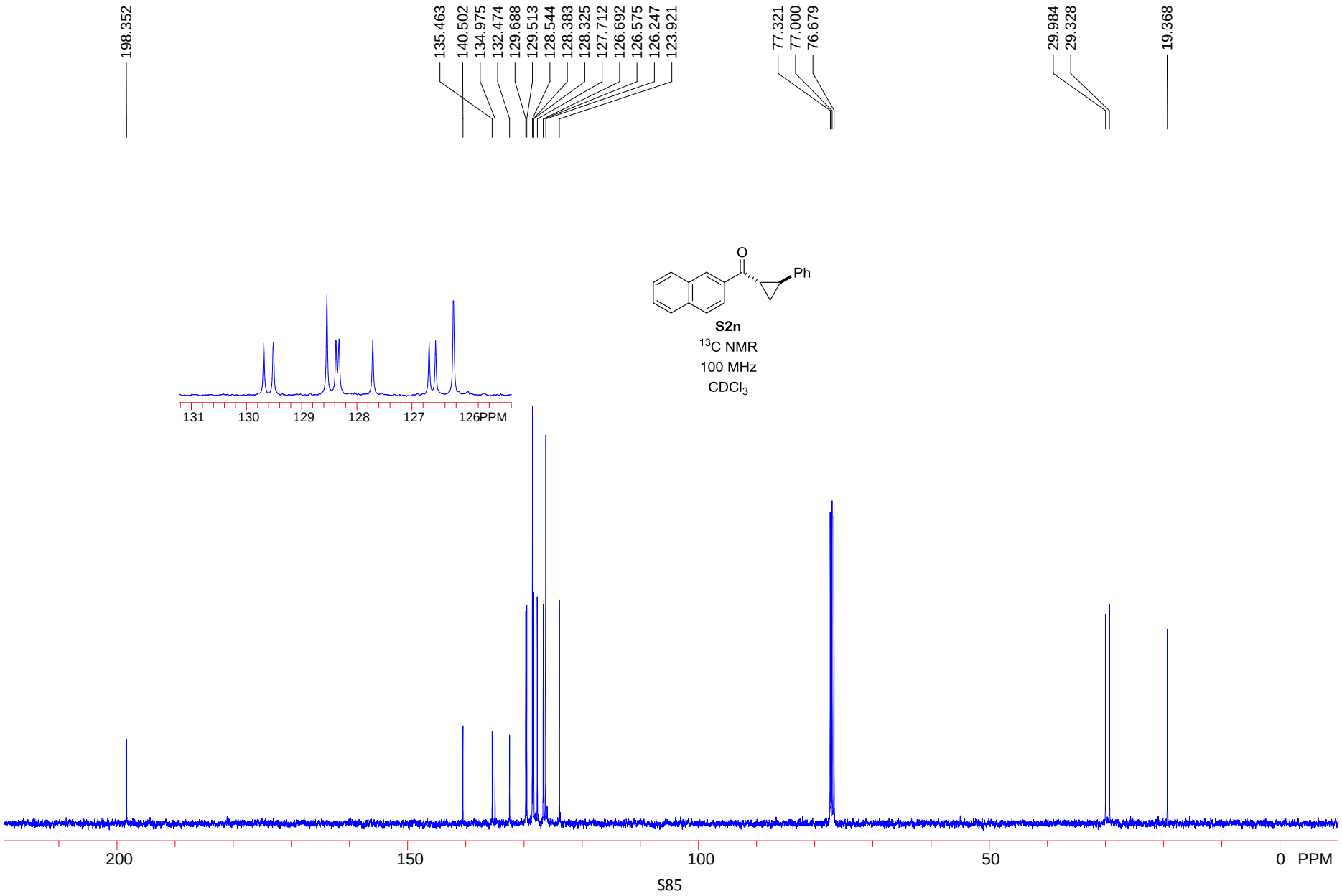
8.065
8.048
8.043
7.957
7.938
7.905
7.883
7.862
7.609
7.606
7.592
7.589
7.573
7.569
7.556
7.553
7.536
7.519
7.516
7.355
7.337
7.318
7.267
7.264
7.250
7.238
7.234
7.217
3.083
3.073
3.070
3.062
3.060
3.053
3.050
3.040
2.804
2.794
2.787
2.781
2.778
2.772
2.765
2.755
1.999
1.989
1.986
1.976
1.966
1.964
1.953
1.644
1.634
1.627
1.624
1.616
1.613
1.607
1.596
1.590
0.000
O
Ph
S2n
1H NMR
400 MHz
CDCl3
0.98
1.00
1.07
1.92
1.99
2.07
3.41
1.04
1.00
1.07
0.99
8
6
4
2
0
PPM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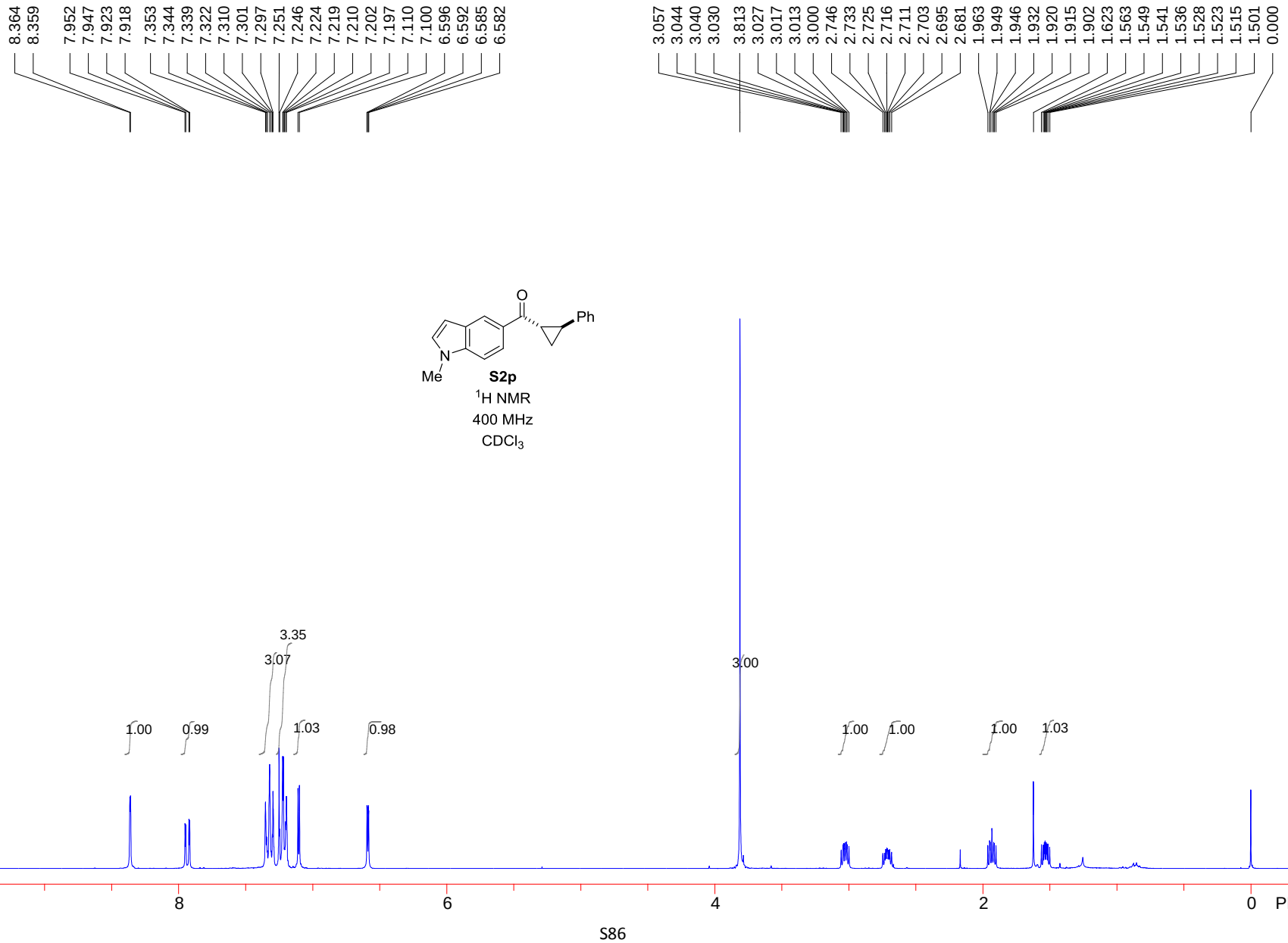
132.474
129.688
129.513
128.544
128.383
128.325
127.712
126.692
126.575
126.247
123.921
77.321
77.000
76.679
29.984
29.328
19.368
O
Ph
S2n
13C NMR
100 MHz
CDCl3
131
130
129
128
127
126PPM
200
150
100
50
0 PPM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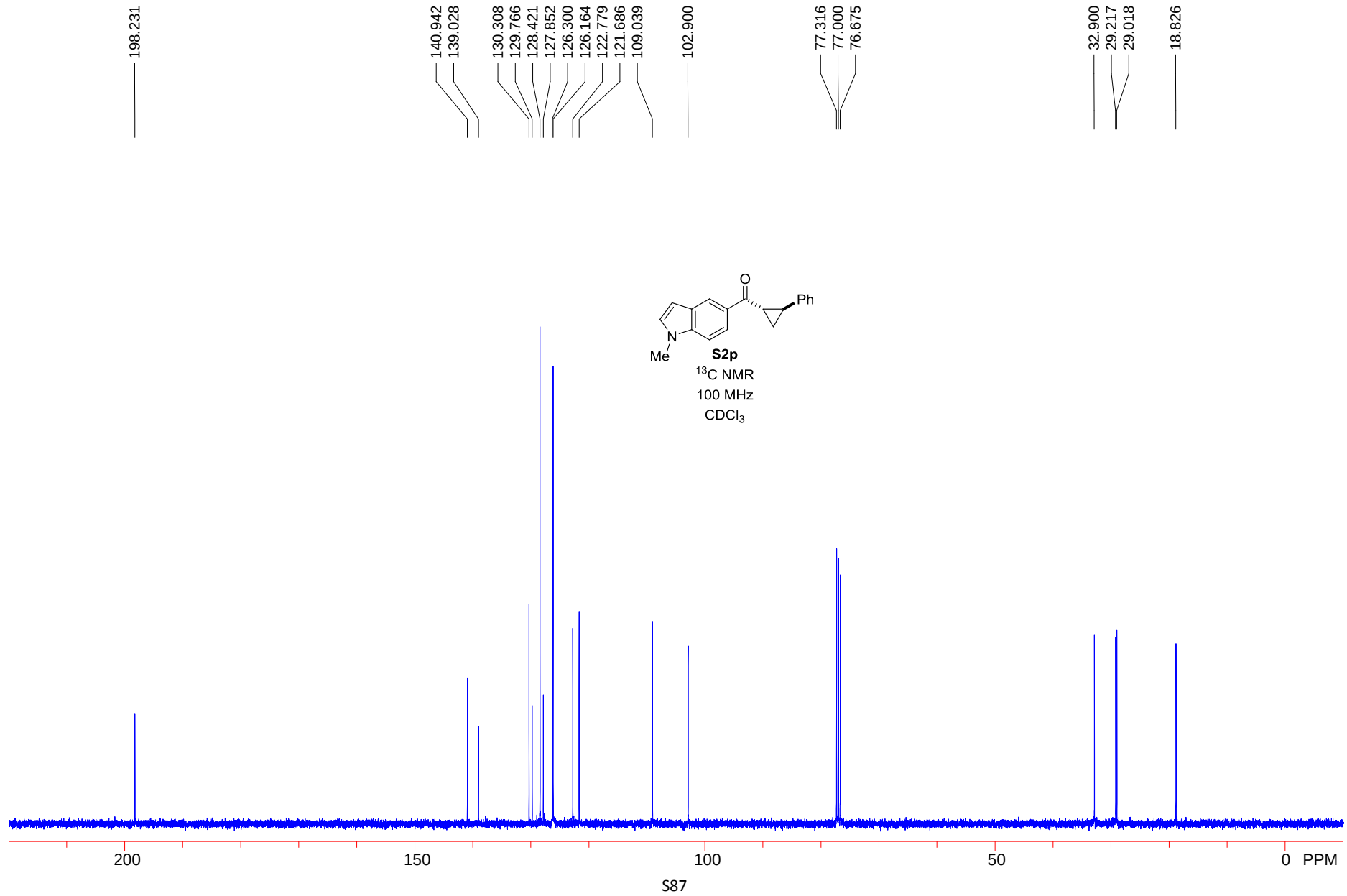
7.923
7.918
7.353
7.344
7.339
7.322
7.310
7.301
7.297
7.251
7.246
7.224
7.219
7.210
7.202
7.197
7.110
7.100
6.596
6.592
6.585
6.582
3.057
3.044
3.040
3.030
3.813
3.027
3.017
3.013
3.000
2.746
2.733
2.725
2.716
2.711
2.703
2.695
2.681
1.963
1.949
1.946
1.932
1.920
1.915
1.902
1.623
1.563
1.549
1.541
1.536
1.528
1.523
1.515
1.501
0.000
O
Ph
N
Me
S2p
1H NMR
400 MHz
CDCl3
3.35
3.07
3.00
1.00
0.99
1.03
0.98
1.00
1.00
1.00
1.03
8
6
4
2
0
PPM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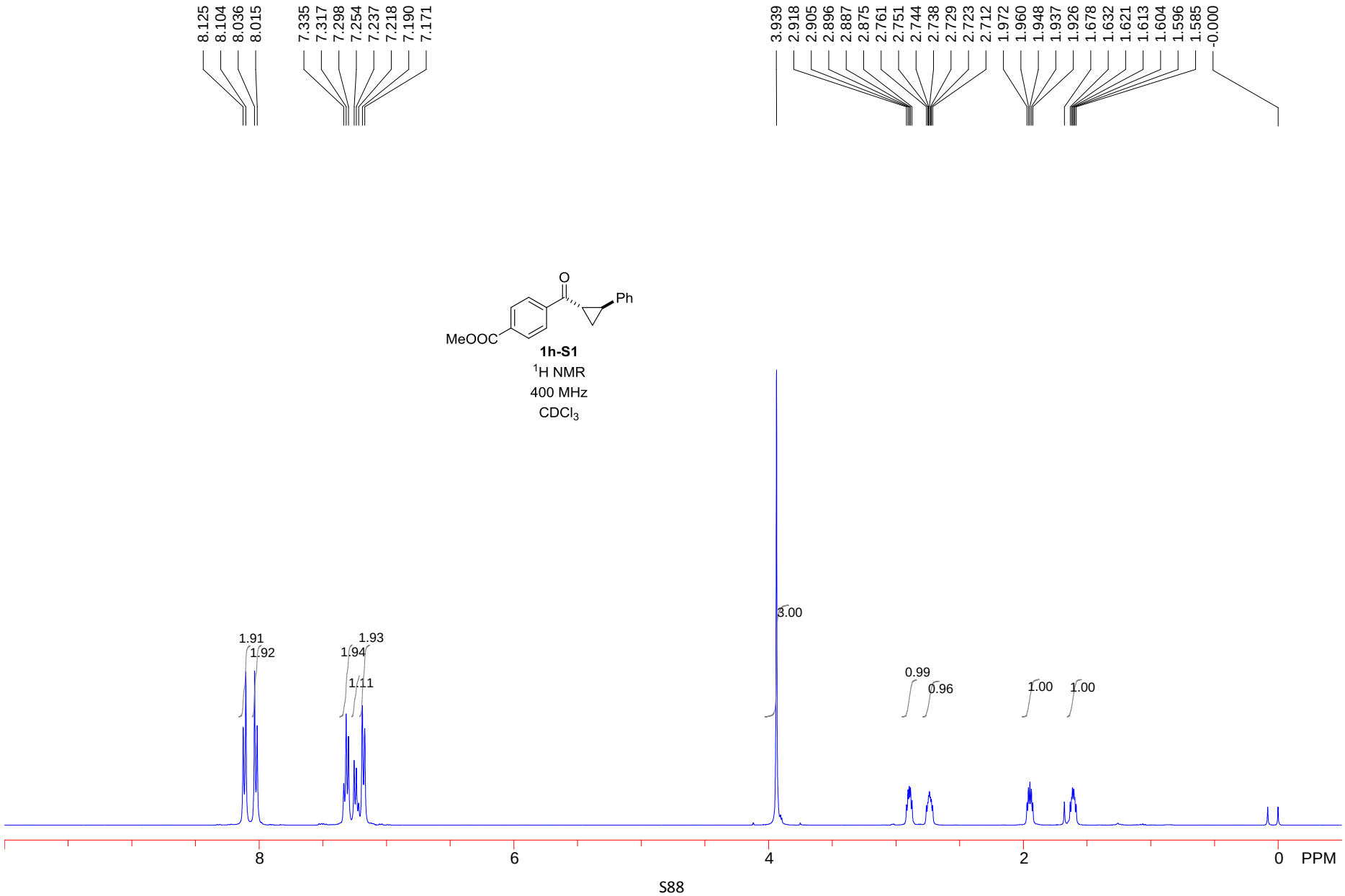
128.421
127.852
126.300
126.164
122.779
121.686
109.039
102.900
77.316
77.000
76.675
32.900
29.217
29.018
18.826
O
Ph
N
Me
S2p
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM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8.104
8.036
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7.335
7.317
7.298
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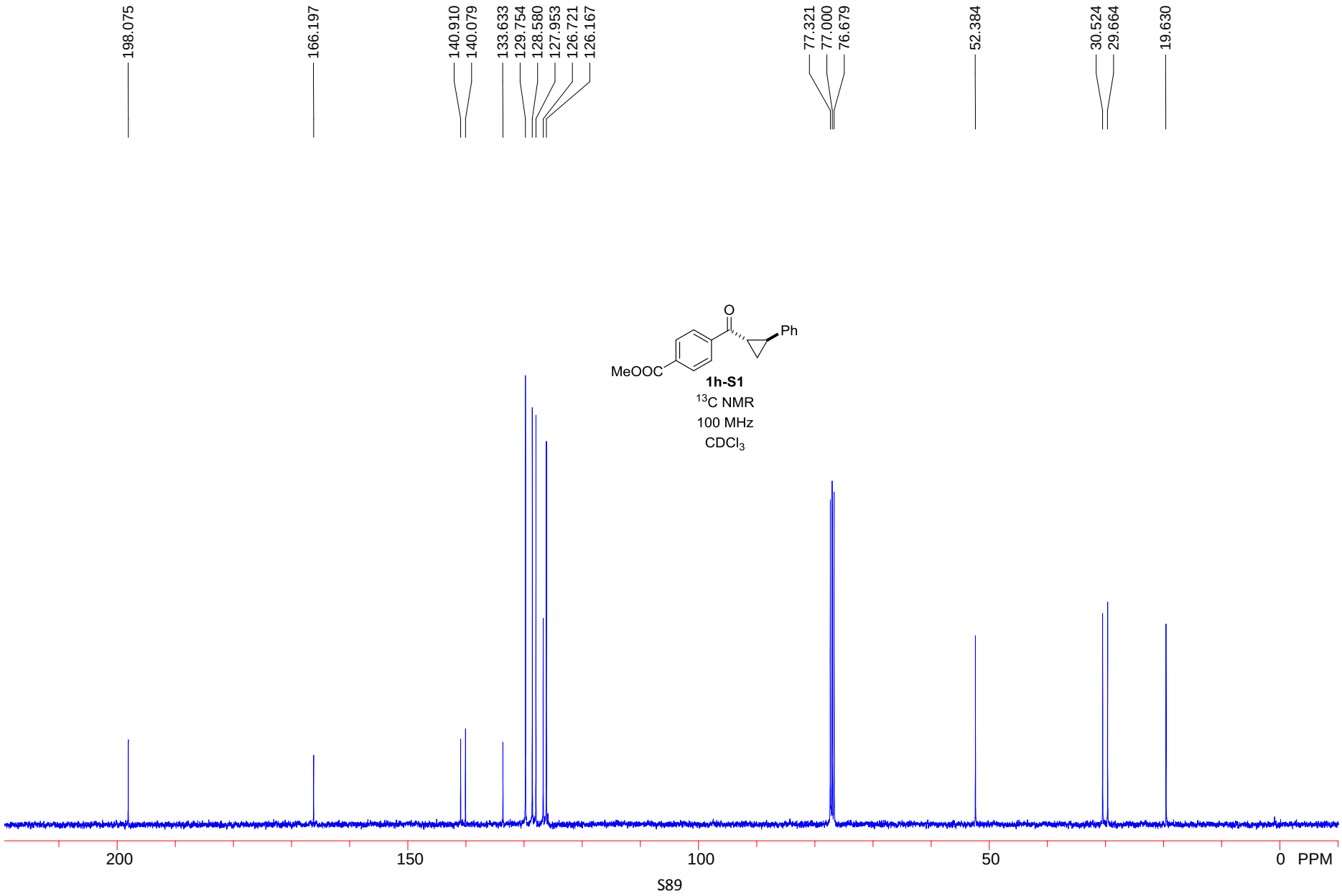
7.237
7.218
7.190
7.171
3.939
2.918
2.905
2.896
2.887
2.875
2.761
2.751
2.744
2.738
2.729
2.723
2.712
1.972
1.960
1.948
1.937
1.926
1.678
1.632
1.621
1.613
1.604
1.596
1.585
-0.000
O
Ph
MeOOC
1h-S1
1H NMR
400 MHz
CDCl3
1.91
1.92
1.93
1.94
1.11
3.00
0.99
0.96
1.00
1.00
8
6
4
2
0
PPM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127.953
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126.167
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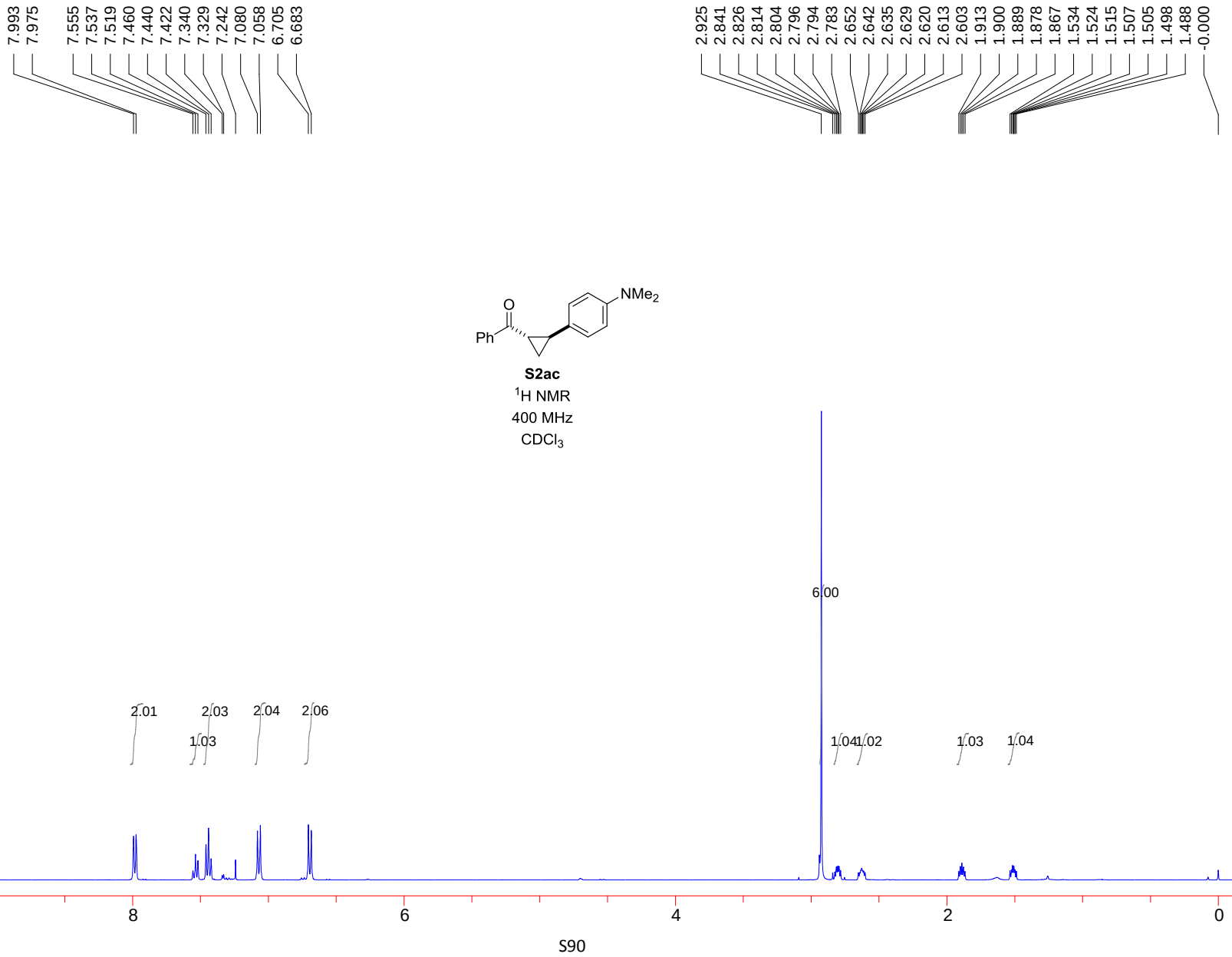
76.679
52.384
30.524
29.664
19.630
O
Ph
MeOOC
1h-S1
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM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7.422
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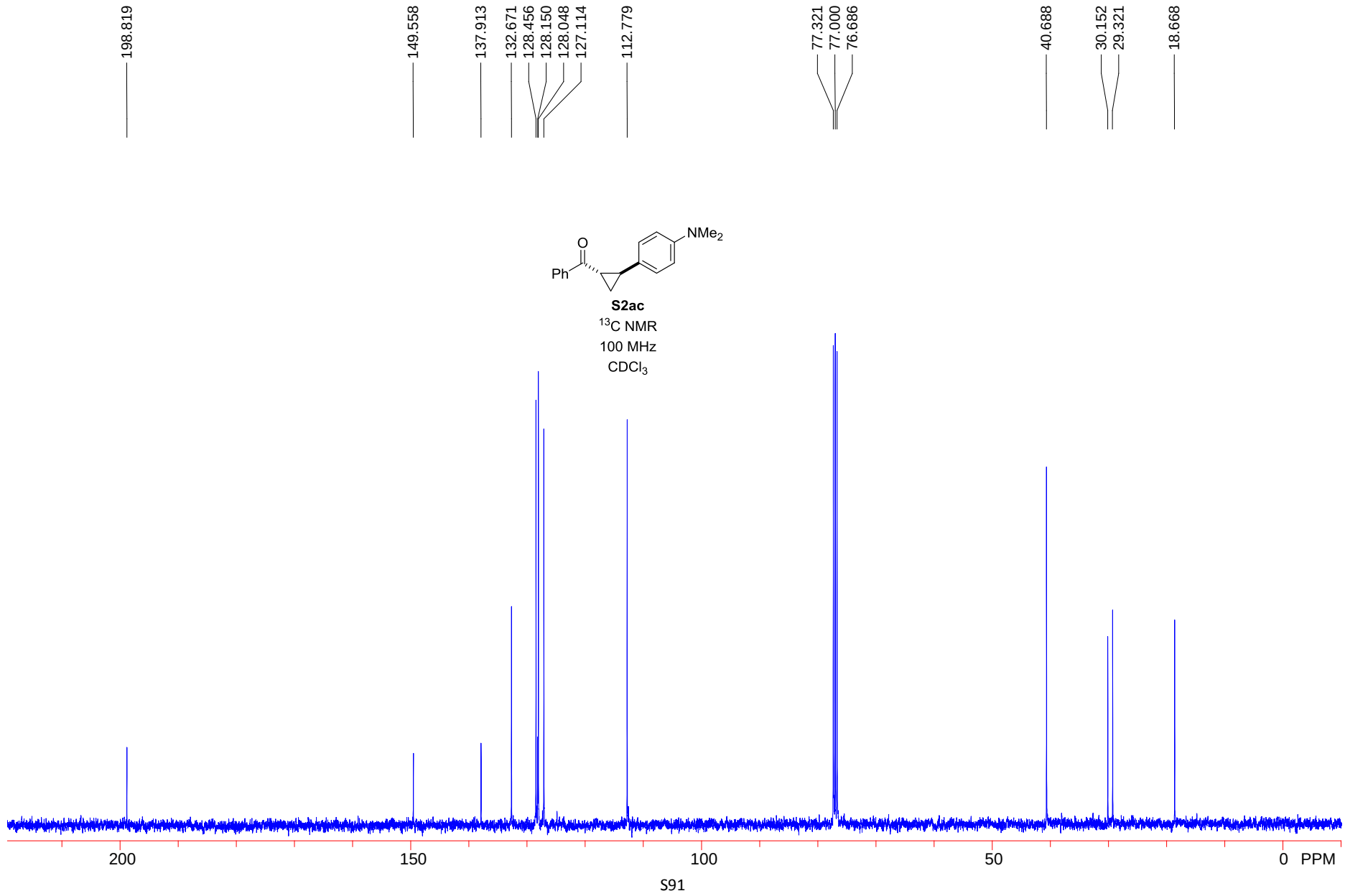
7.329
7.242
7.080
7.058
6.705
6.683
2.925
2.841
2.826
2.814
2.804
2.796
2.794
2.783
2.652
2.642
2.635
2.629
2.620
2.613
2.603
1.913
1.900
1.889
1.878
1.867
1.534
1.524
1.515
1.507
1.505
1.498
1.488
-0.000
NMe2
O
Ph
S2ac
1H NMR
400 MHz
CDCl3
6.00
2.01
2.03
2.04
2.06
1.03
1.04
1.02
1.03
1.04
8
6
4
2
0
PPM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112.779
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77.000
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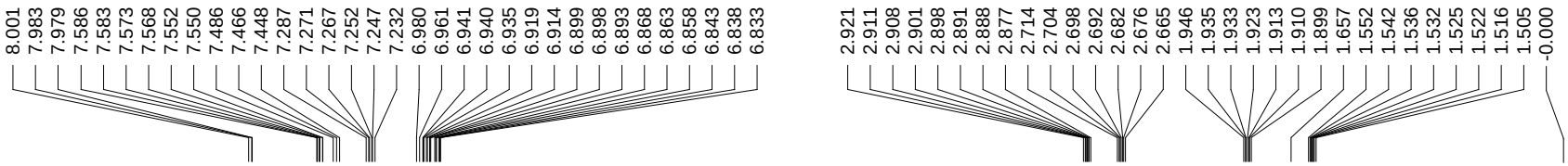
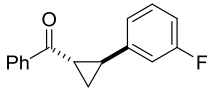
40.688
30.152
29.321
18.668
O
Ph
NMe2
S2ac
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM



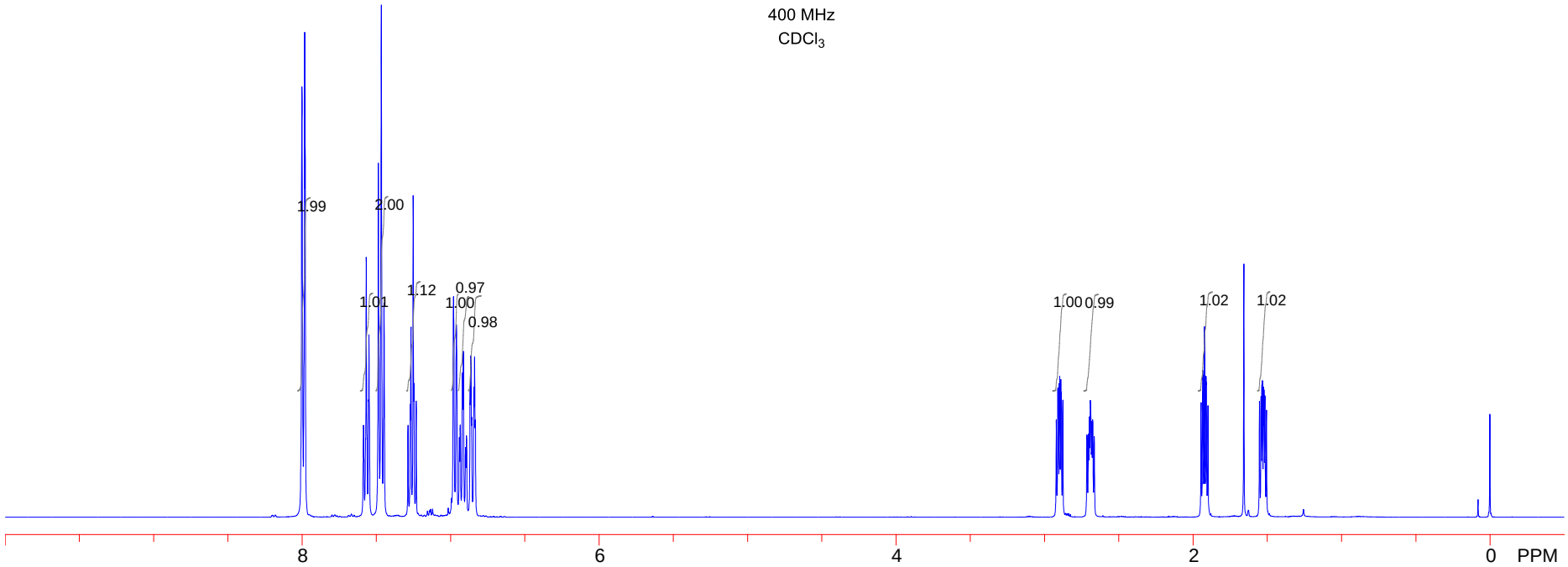


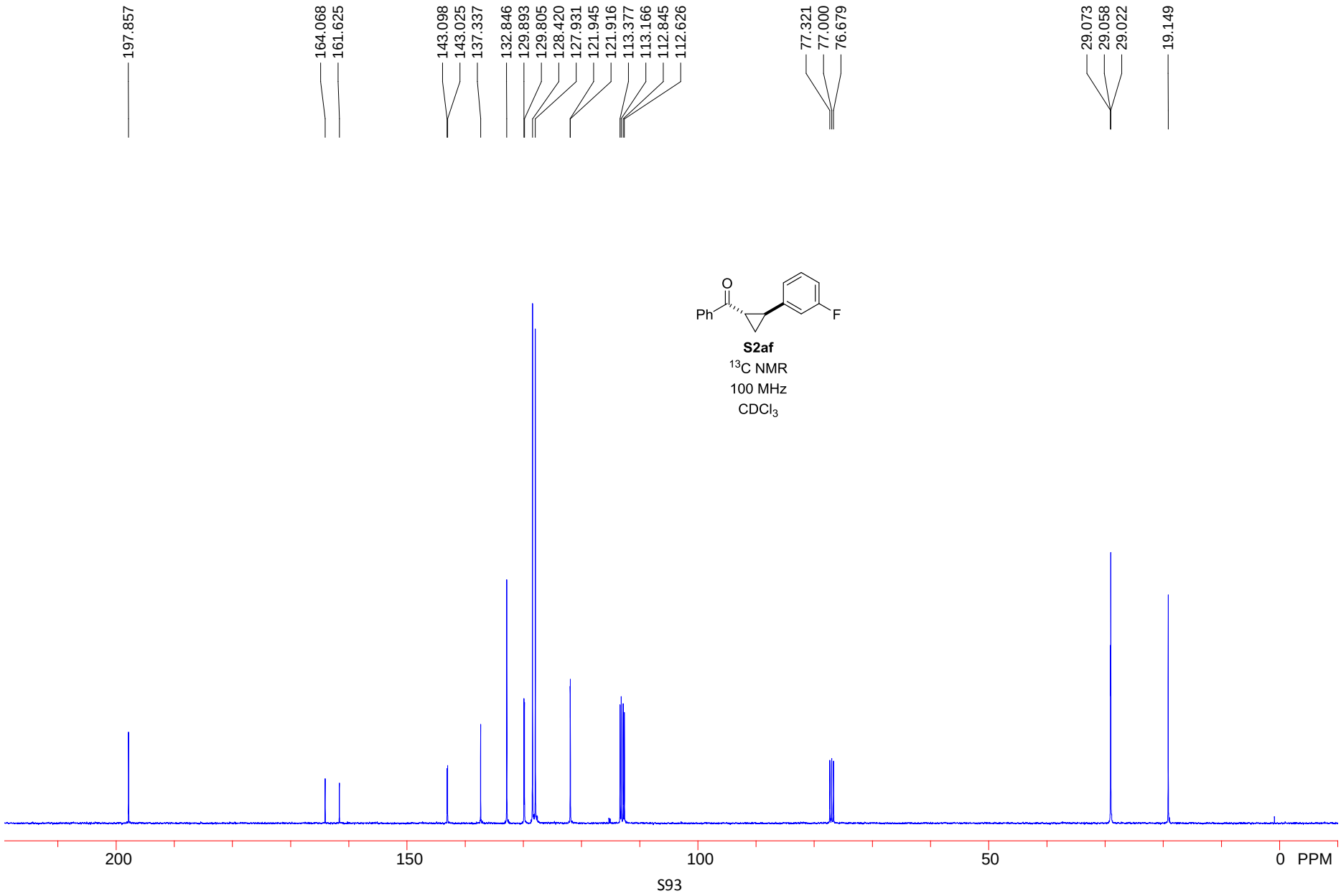
S2af

^{1}H NMR

400 MHz

$CDCl_3$

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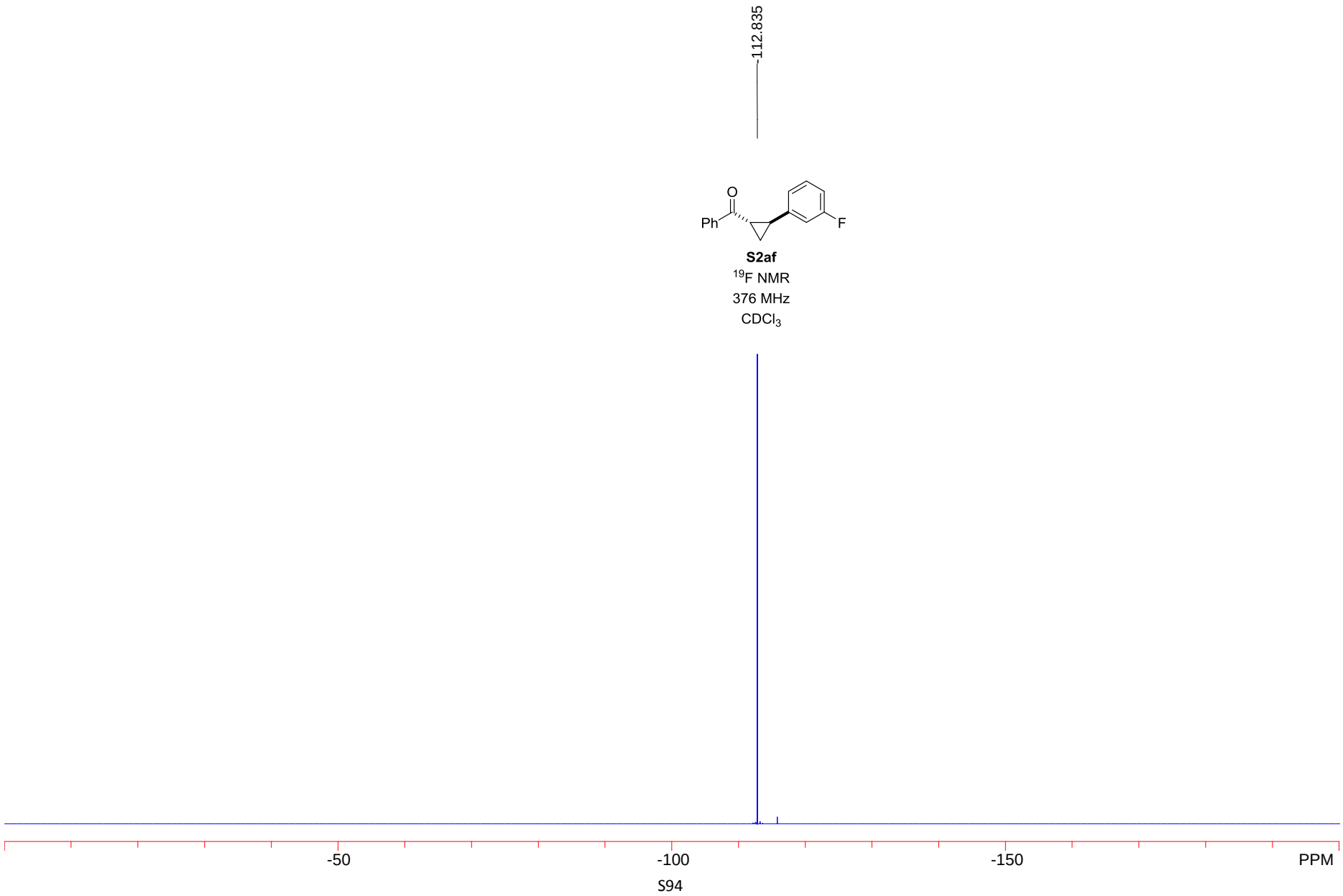
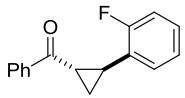
164.068
161.625
143.098
143.025
137.337
132.846
129.893
129.805
128.420
127.931
121.945
121.916
113.377
113.166
112.845
112.626
77.321
77.000
76.679
29.073
29.058
29.022
19.149
O
Ph
F
S2af
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM


-112.835
O
Ph
F
S2af
19F NMR
376 MHz
CDCl3
-50
-100
-150
PPM

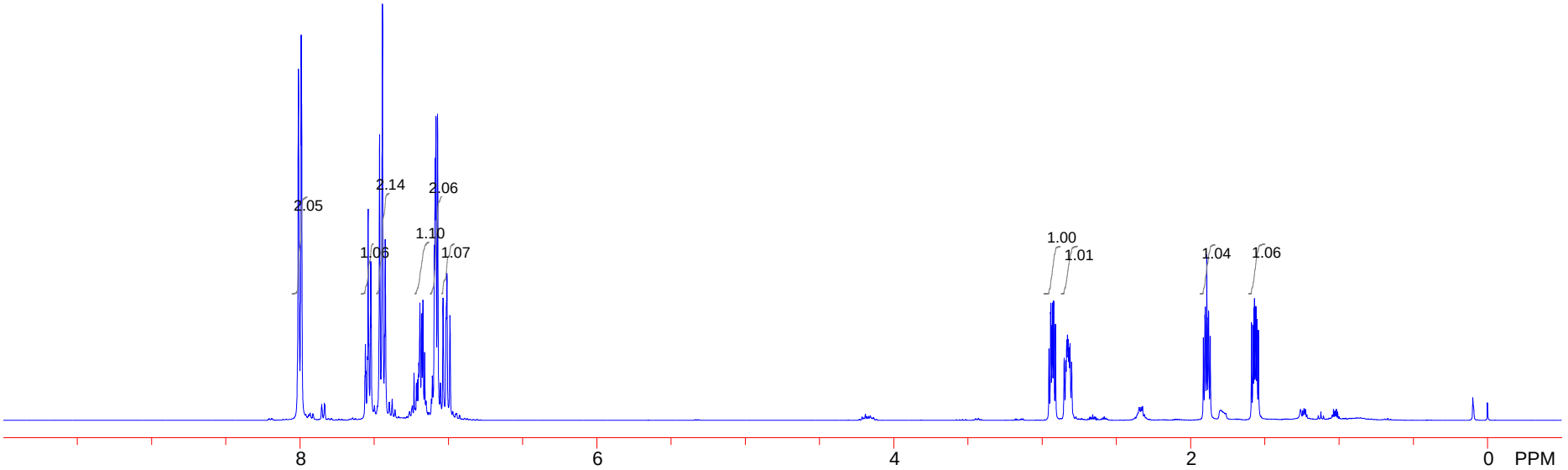


S2ag

^{1}H NMR

400 MHz

$CDCl_3$



198.491
162.930
160.480
137.636
132.875
128.500
128.055
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77.321
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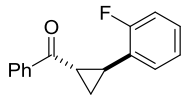
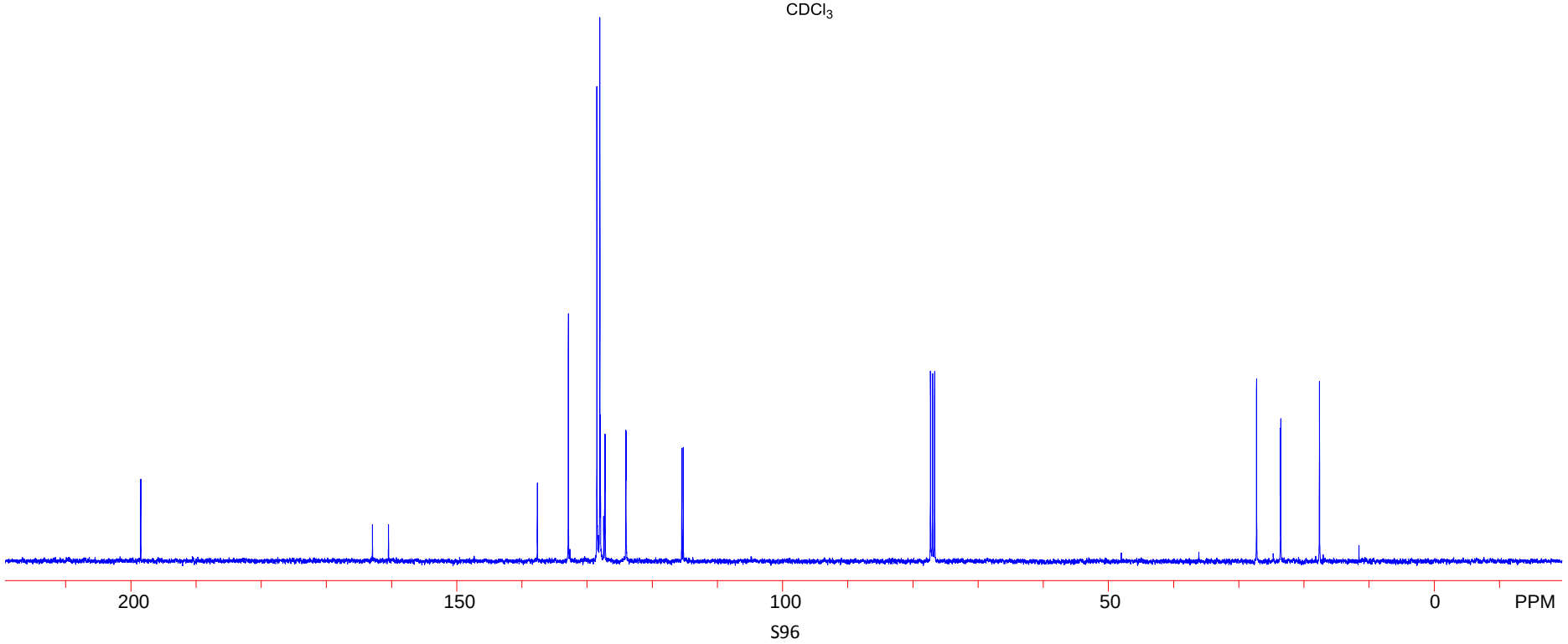


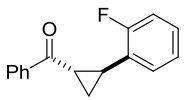
S2ag

^{12}C NMR

100 MHz

$CDCl_3$



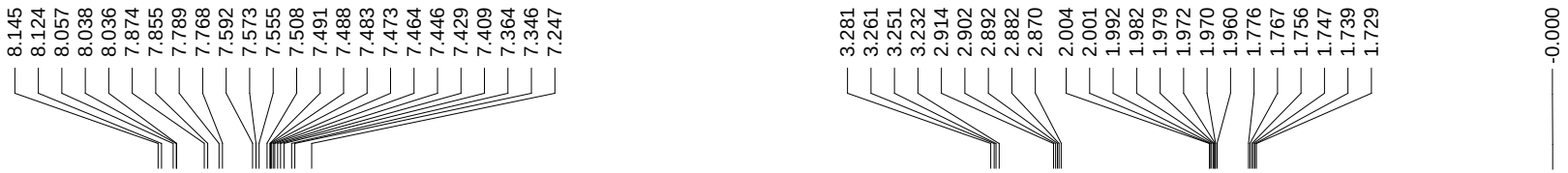


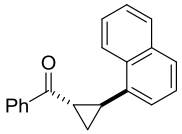
S2ag

^{19}F NMR

376 MHz

$CDCl_3$



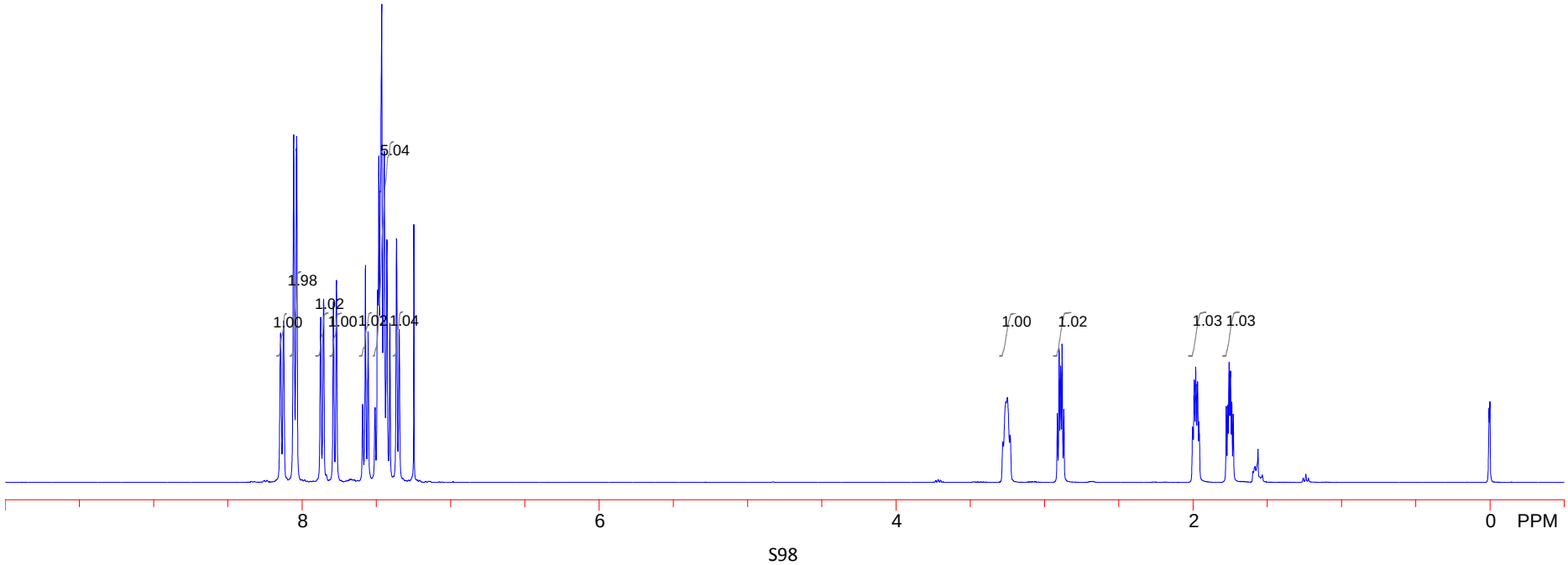


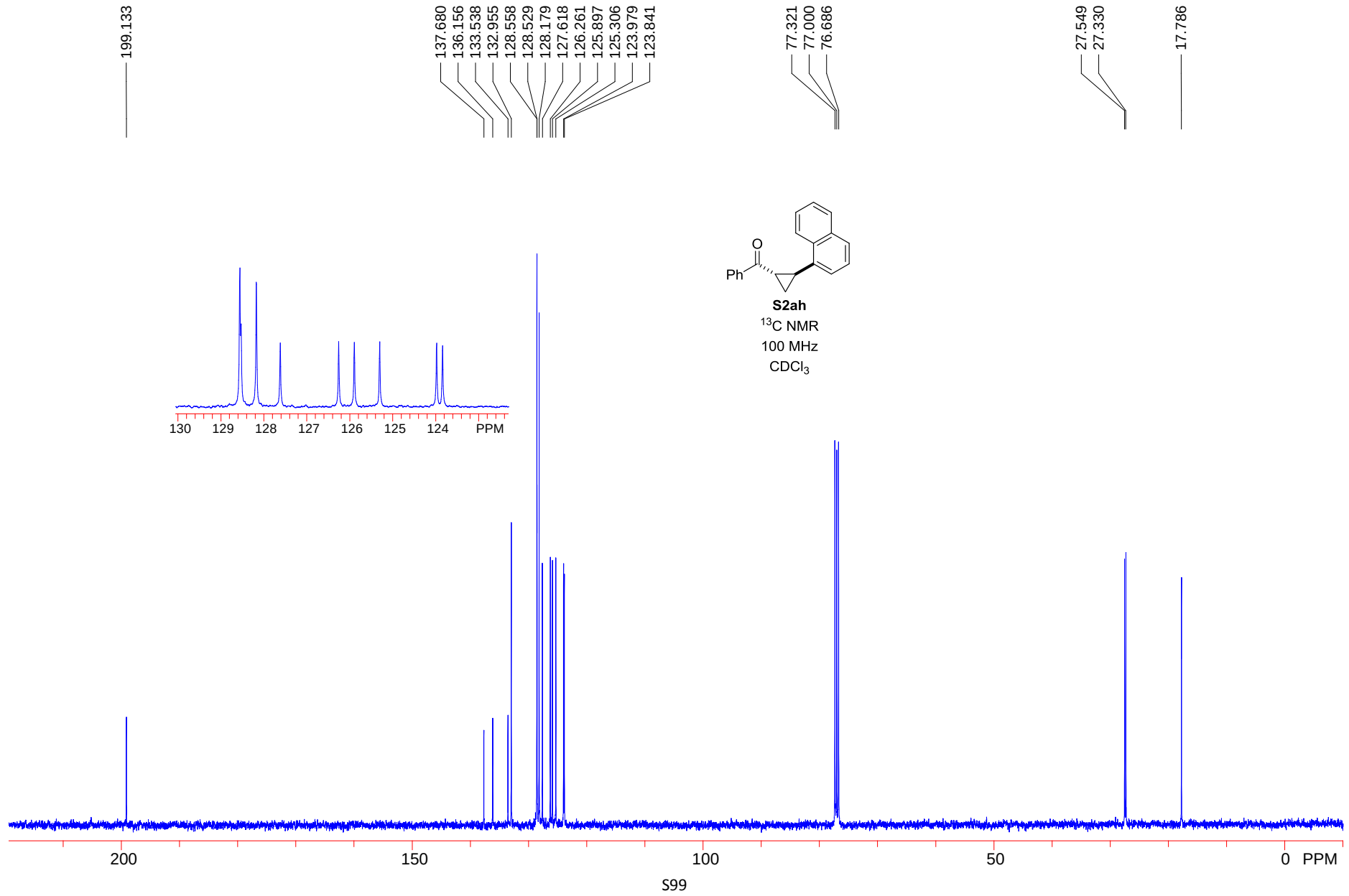
S2ah

^{1}H NMR

400 MHz

$CDCl_3$

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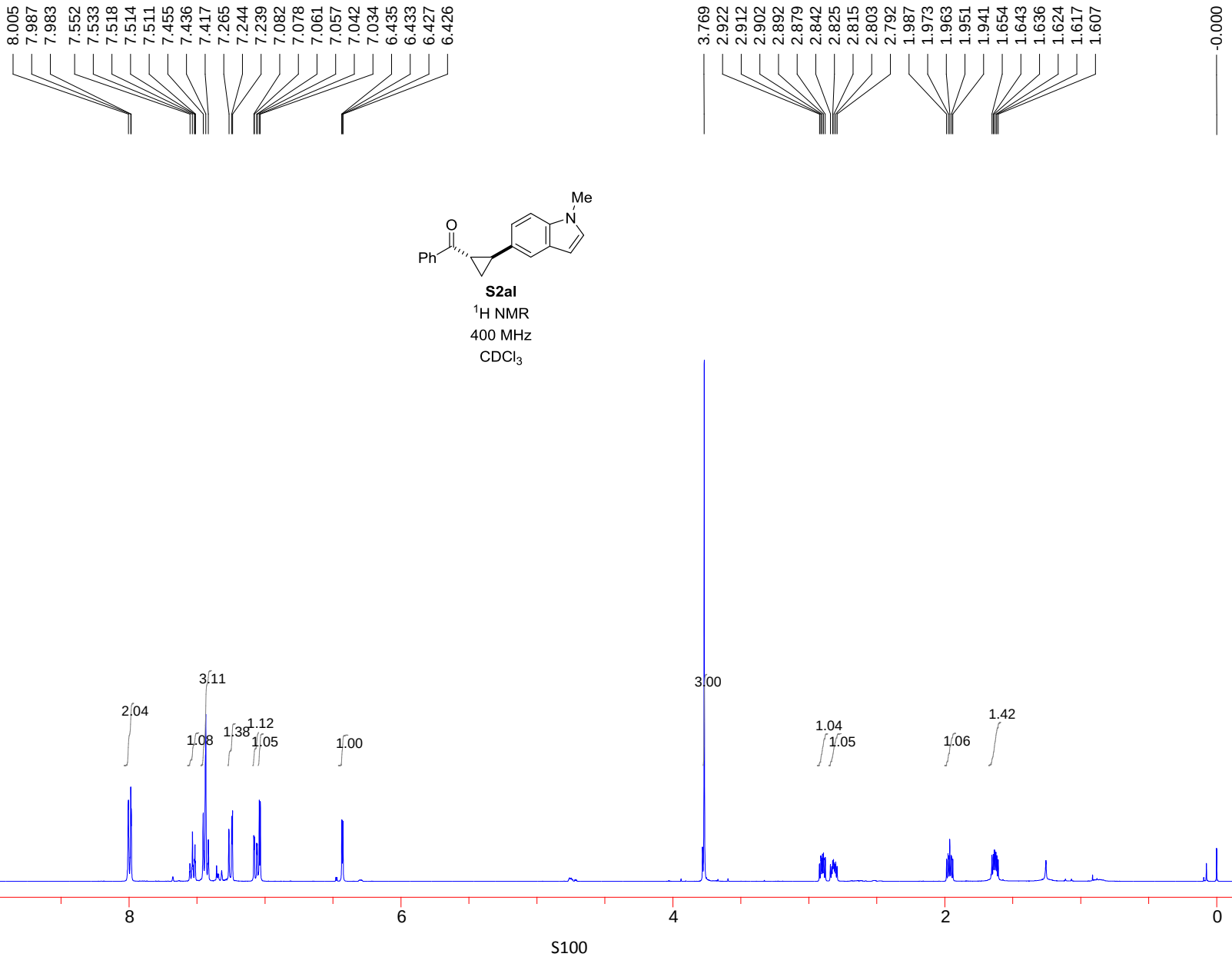
137.680
136.156
133.538
132.955
128.558
128.529
128.179
127.618
126.261
125.897
125.306
123.979
123.841
77.321
77.000
76.686
27.549
27.330
17.786
O
Ph
S2ah
13C NMR
100 MHz
CDCl3
130
129
128
127
126
125
124
PPM
200
150
100
50
0
PPM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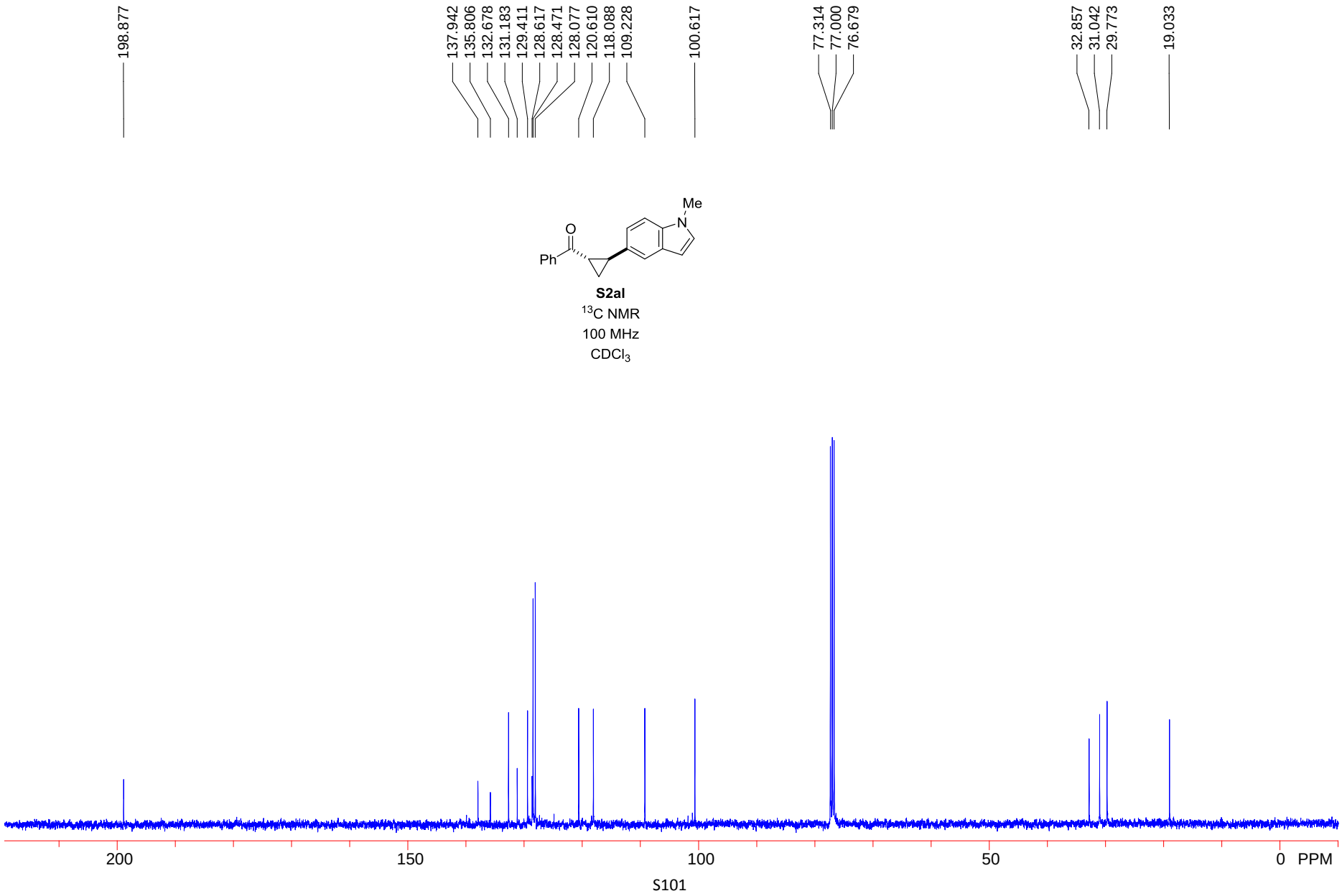
7.987
7.983
7.552
7.533
7.518
7.514
7.511
7.455
7.436
7.417
7.265
7.244
7.239
7.082
7.078
7.061
7.057
7.042
7.034
6.435
6.433
6.427
6.426
3.769
2.922
2.912
2.902
2.892
2.879
2.842
2.825
2.815
2.803
2.792
1.987
1.973
1.963
1.951
1.941
1.654
1.643
1.636
1.624
1.617
1.607
-0.000
Me
N
O
Ph
S2al
1H NMR
400 MHz
CDCl3
2.04
3.11
1.08
1.38
1.12
1.05
1.00
3.00
1.04
1.05
1.06
1.42
8
6
4
2
0
PPM

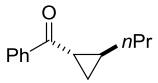


S2al

^{13}C NMR

100 MHz

$CDCl_3$

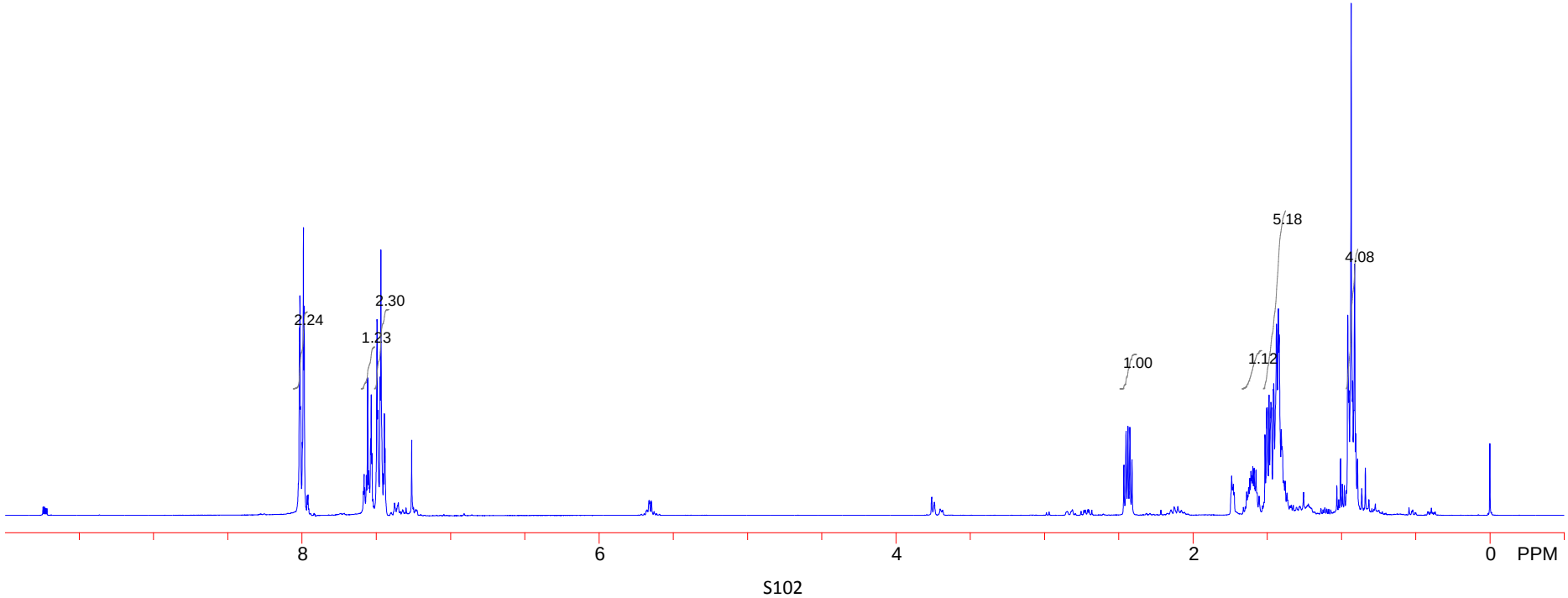


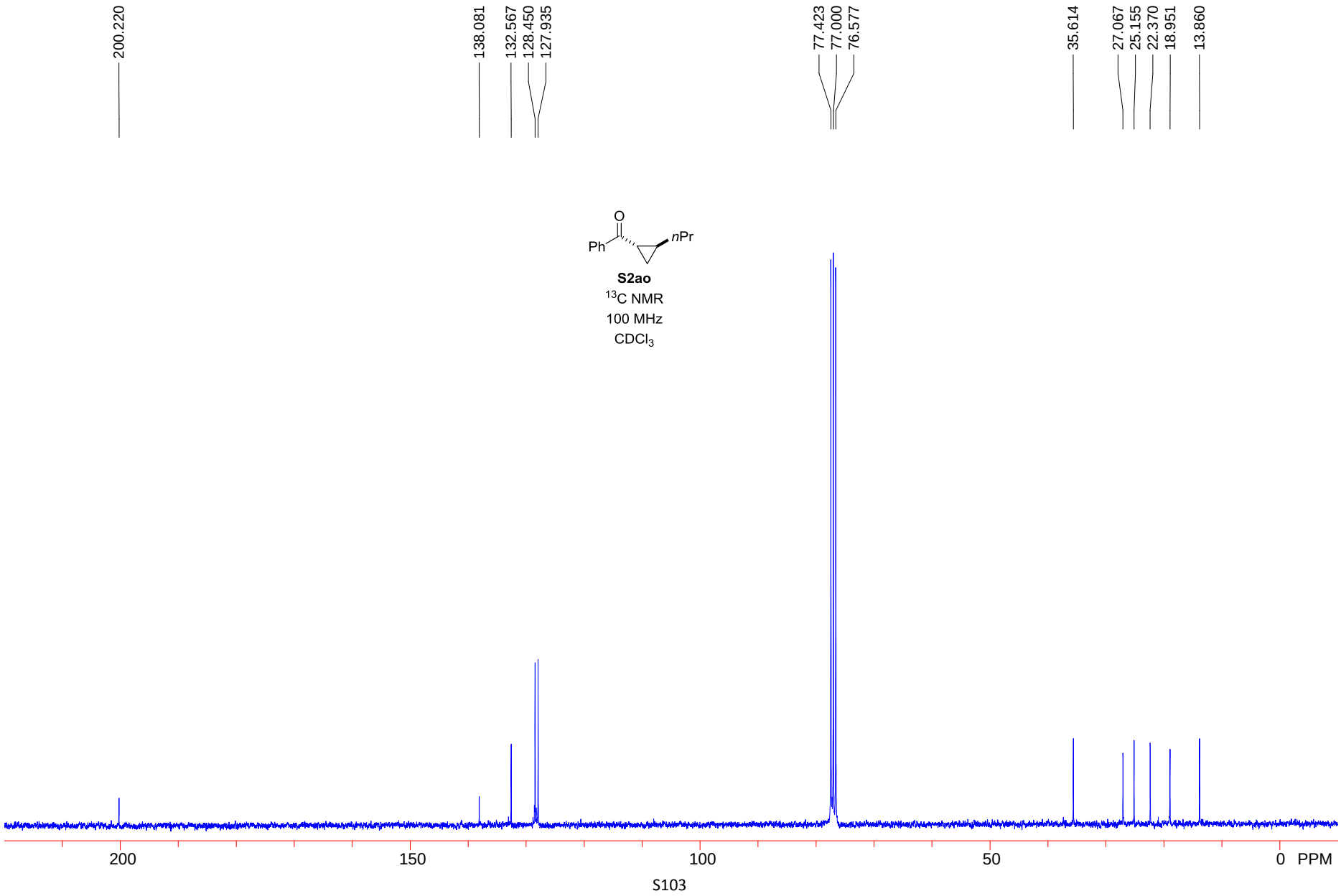
S2ao

^{1}H NMR

400 MHz

$CDCl_3$

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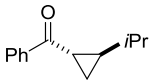
138.081
132.567
128.450
127.935
77.423
77.000
76.577
35.614
27.067
25.155
22.370
18.951
13.860
O
Ph
nPr
S2ao
13C NMR
100 MHz
CDCl3
200
150
100
50
0 PPM

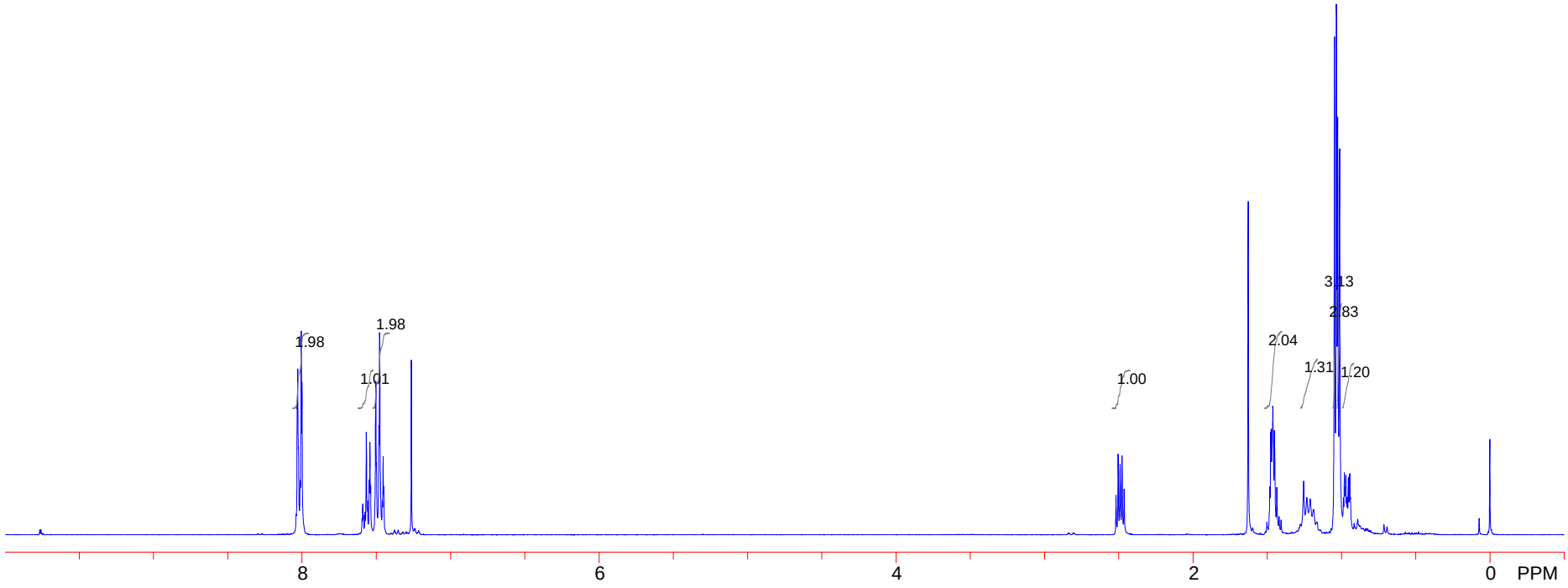


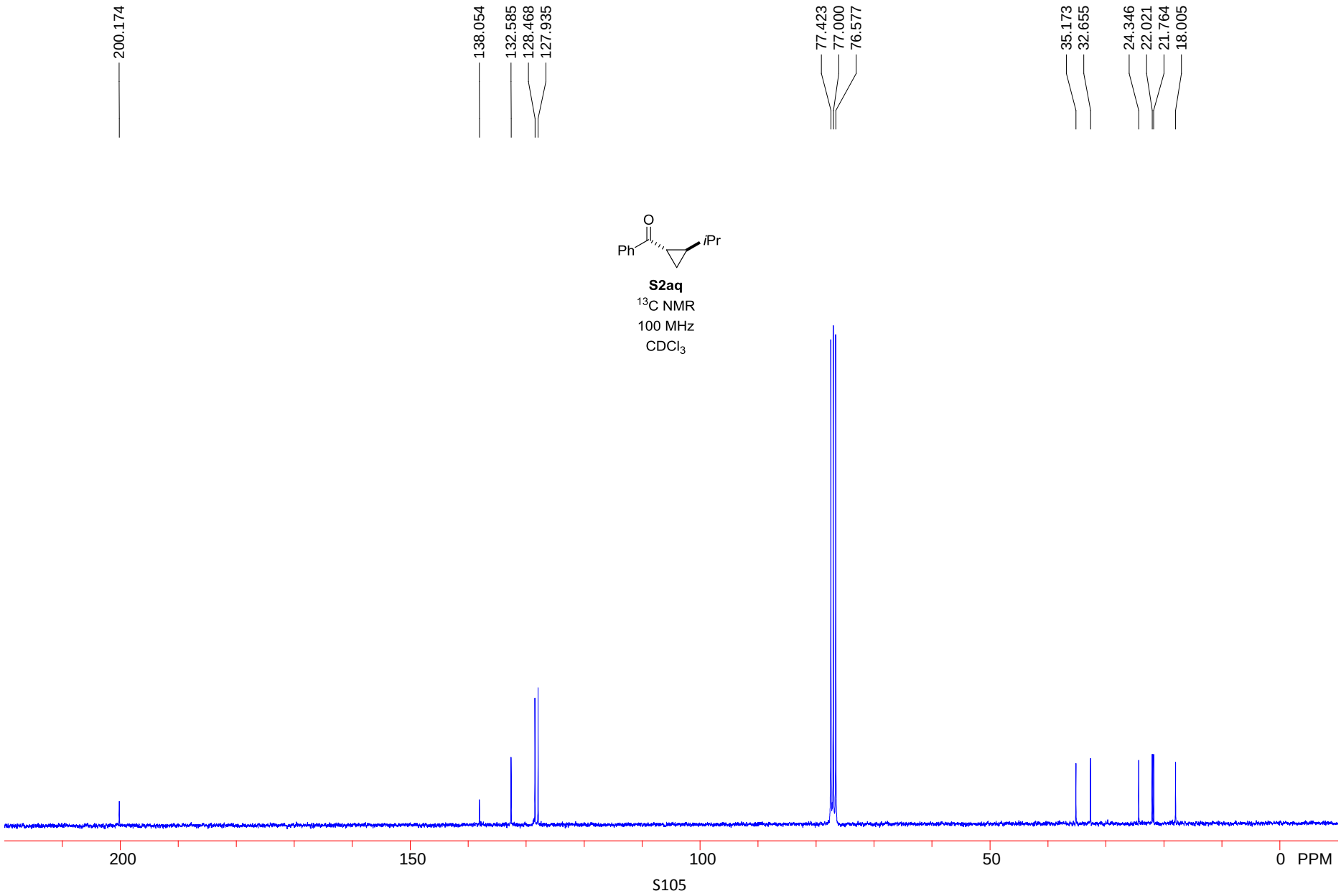
S2aq

^{1}H NMR

400 MHz

$CDCl_3$

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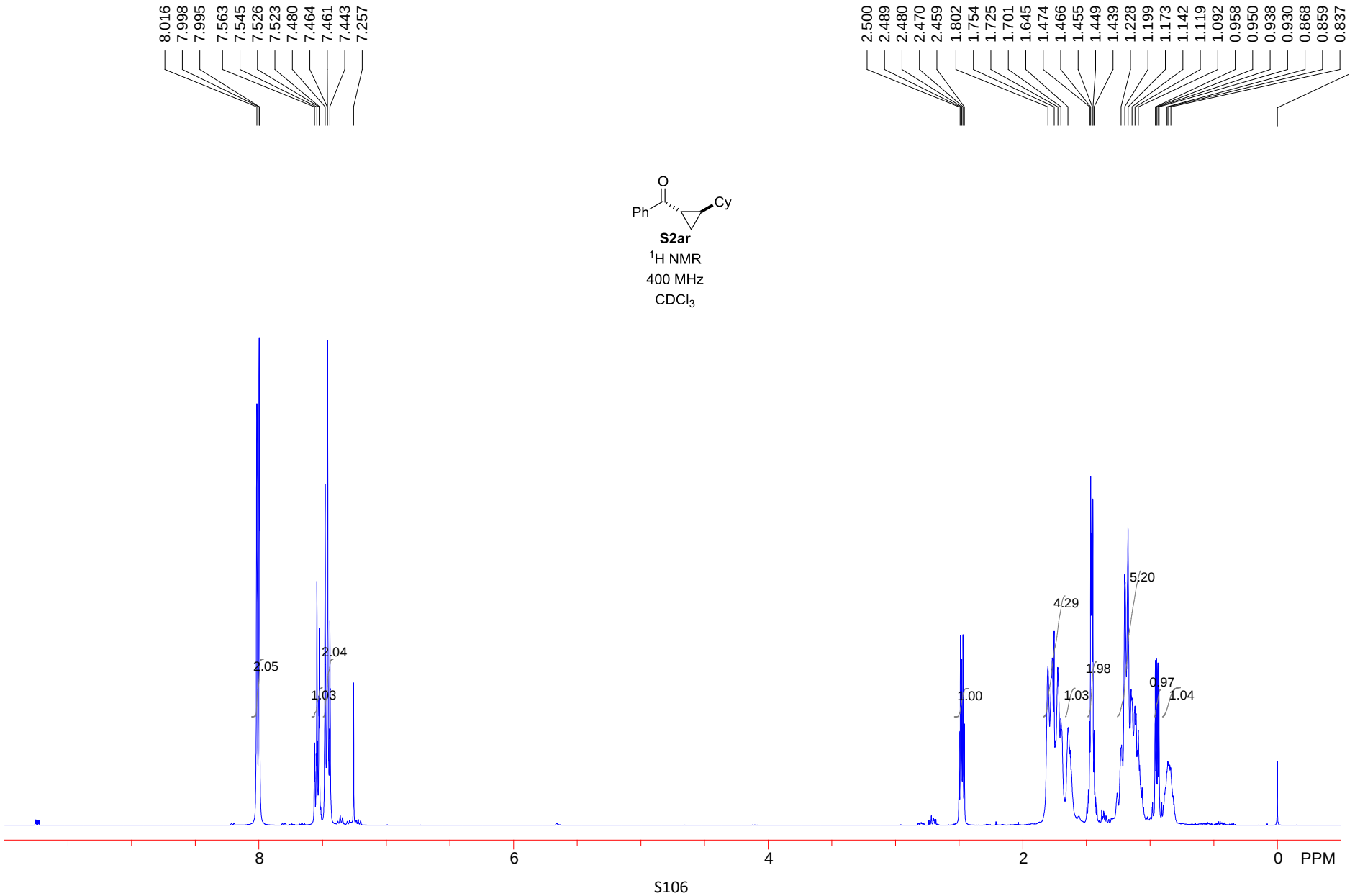
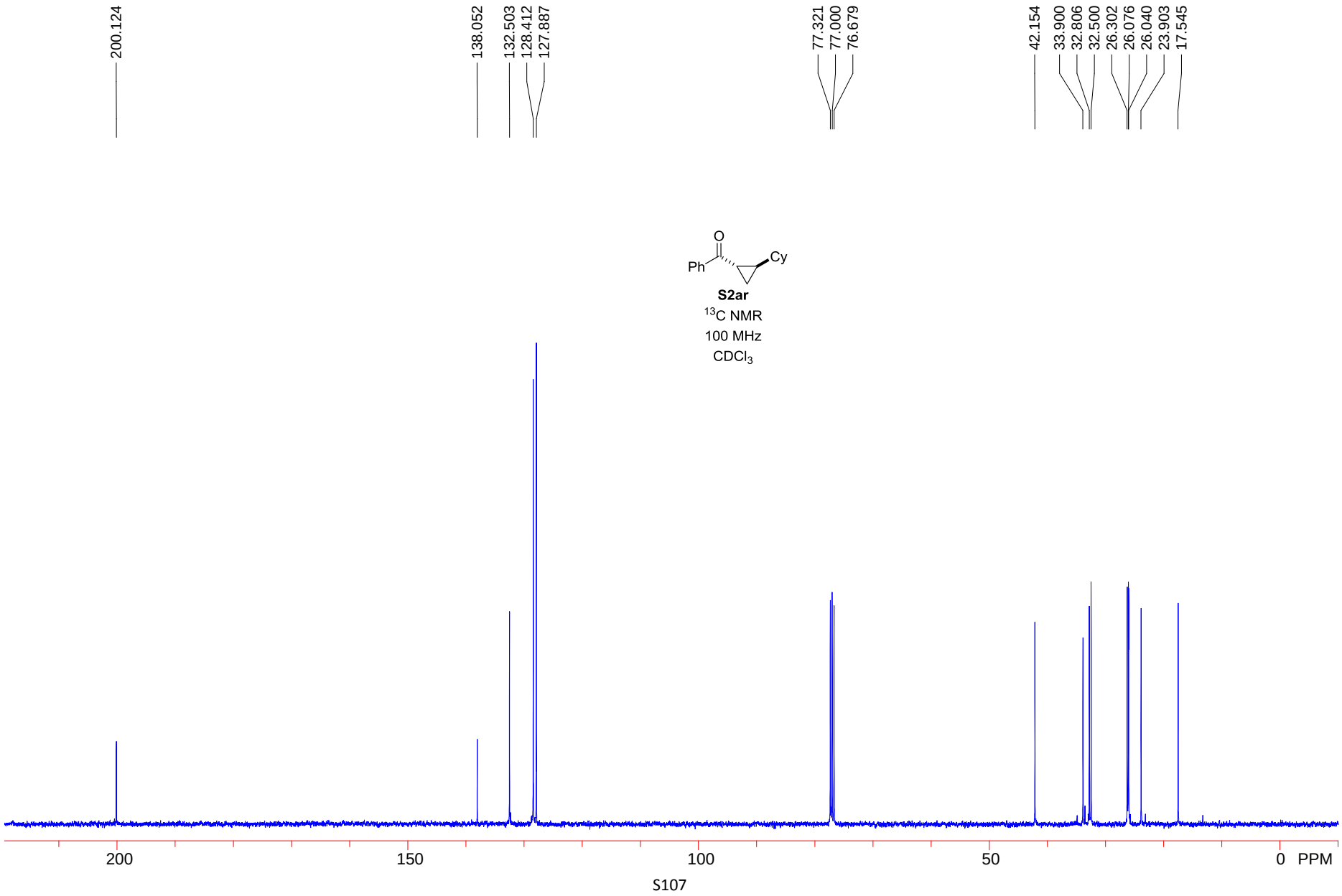
138.054
132.585
128.468
127.935
77.423
77.000
76.577
35.173
32.655
24.346
22.021
21.764
18.005
O
Ph
iPr
S2aq
13C NMR
100 MHz
CDCl3
200
150
100
50
0 PPM


8.016
7.998
7.995
7.563
7.545
7.526
7.523
7.480
7.464
7.461
7.443
7.257
2.500
2.489
2.480
2.470
2.459
1.802
1.754
1.725
1.701
1.645
1.474
1.466
1.455
1.449
1.439
1.228
1.199
1.173
1.142
1.119
1.092
0.958
0.950
0.938
0.930
0.868
0.859
0.837
O
Ph
Cy
S2ar
1H NMR
400 MHz
CDCl3
2.05
2.04
1.03
1.00
4.29
1.03
1.98
5.20
0.97
1.04
8
6
4
2
0
PPM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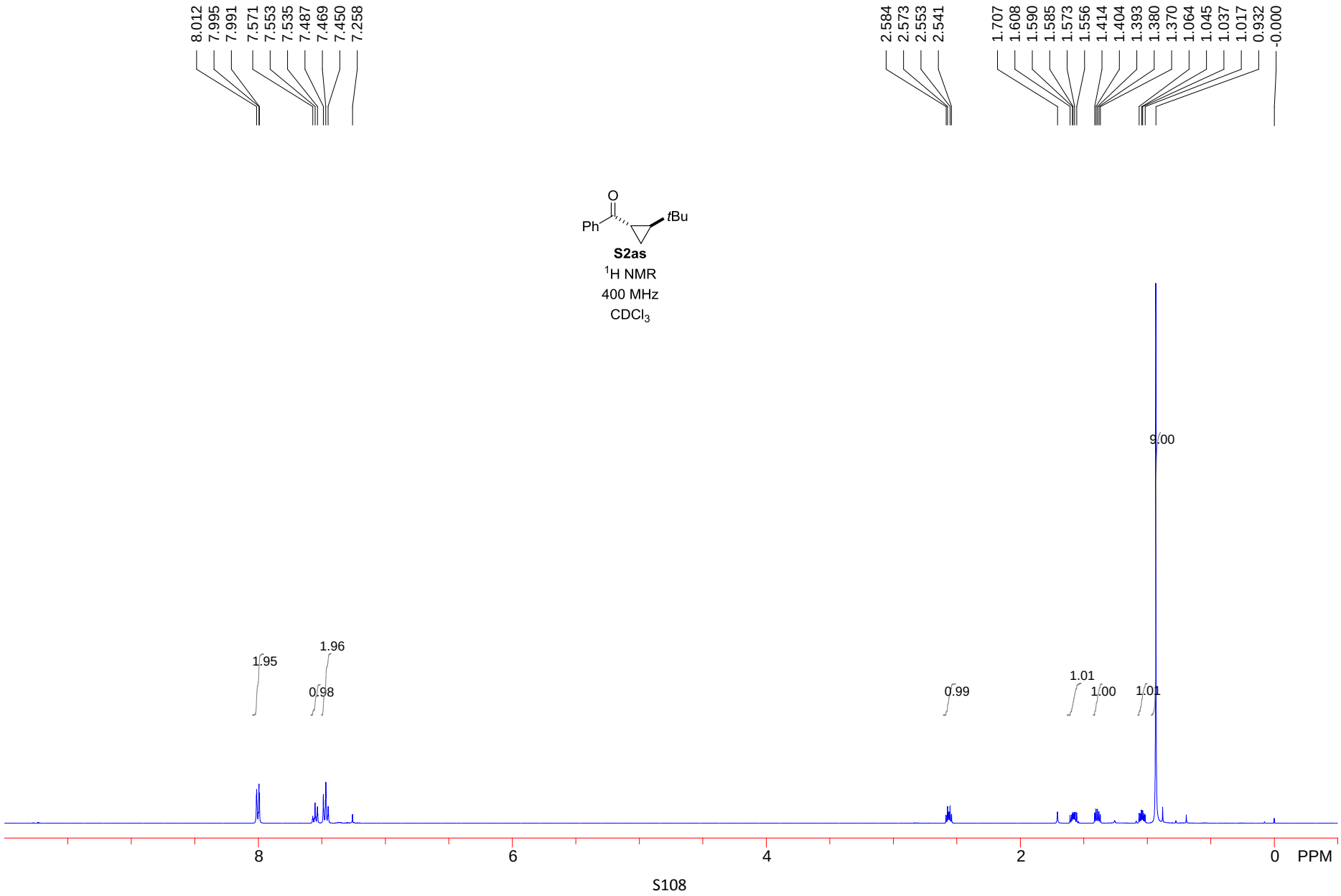
138.052
132.503
128.412
127.887
77.321
77.000
76.679
42.154
33.900
32.806
32.500
26.302
26.076
26.040
23.903
17.545
O
Ph
Cy
S2ar
13C NMR
100 MHz
CDCl3
200
150
100
50
0 PPM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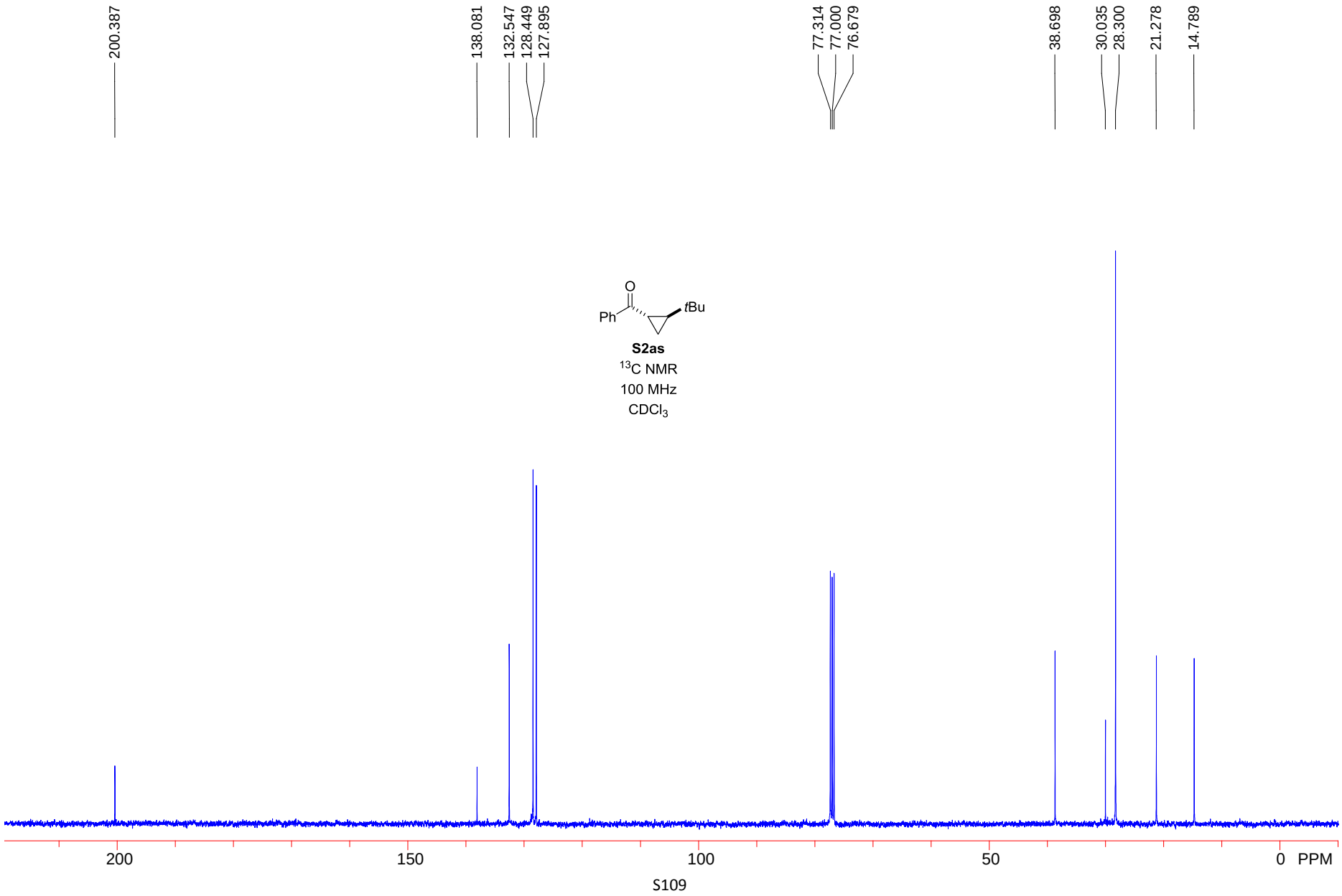
7.995
7.991
7.571
7.553
7.535
7.487
7.469
7.450
7.258
2.584
2.573
2.553
2.541
1.707
1.608
1.590
1.585
1.573
1.556
1.414
1.404
1.393
1.380
1.370
1.064
1.045
1.037
1.017
0.932
-0.000
O
Ph
tBu
S2as
1H NMR
400 MHz
CDCl3
9.00
1.96
1.95
0.98
0.99
1.01
1.00
1.01
8
6
4
2
0
PPM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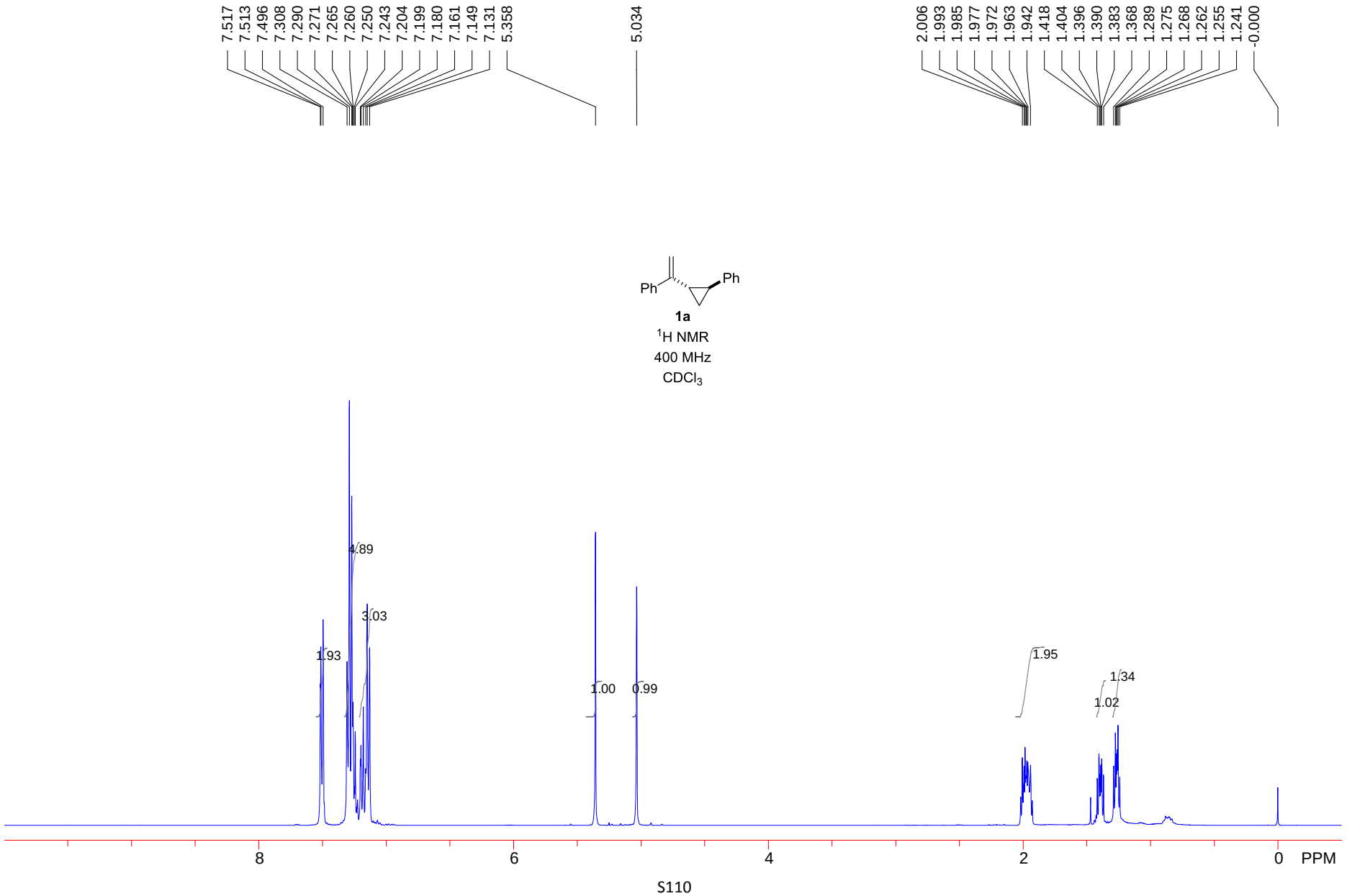
128.449
127.895
77.314
77.000
76.679
38.698
30.035
28.300
21.278
14.789
O
Ph
tBu
S2as
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM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7.496
7.308
7.290
7.271
7.265
7.260
7.250
7.243
7.204
7.199
7.180
7.161
7.149
7.131
5.358
5.034
2.006
1.993
1.985
1.977
1.972
1.963
1.942
1.418
1.404
1.396
1.390
1.383
1.368
1.289
1.275
1.268
1.262
1.255
1.241
-0.000
Ph
Ph
1a
1H NMR
400 MHz
CDCl3
4.89
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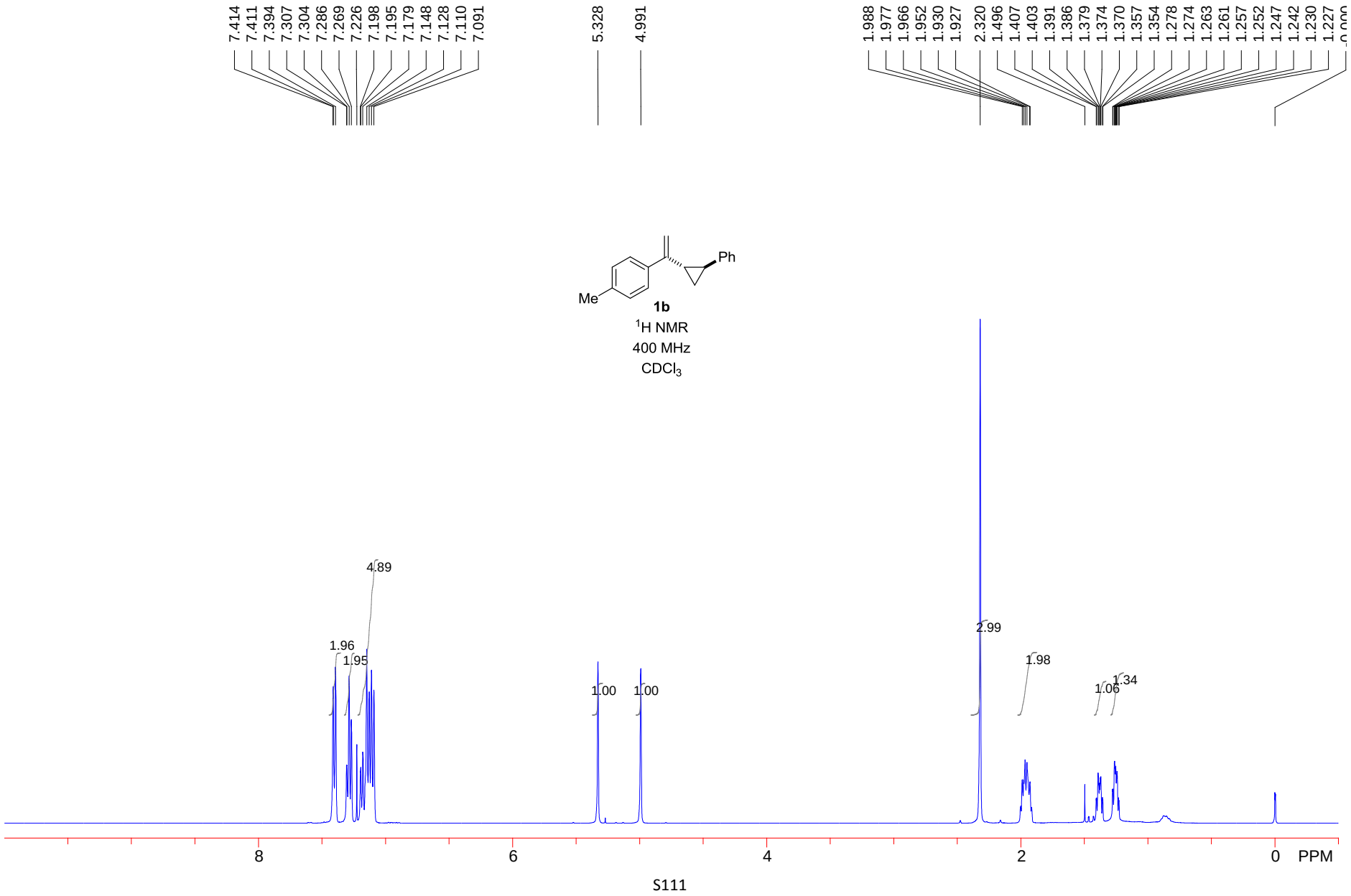
1.93
1.00
0.99
1.95
1.34
1.02
8
6
4
2
0
PPM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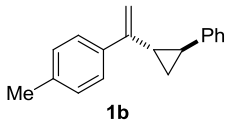
7.307
7.304
7.286
7.269
7.226
7.198
7.195
7.179
7.148
7.128
7.110
7.091
5.328
4.991
1.988
1.977
1.966
1.952
1.930
1.927
2.320
1.496
1.407
1.403
1.391
1.386
1.379
1.374
1.370
1.357
1.354
1.278
1.274
1.263
1.261
1.257
1.252
1.247
1.242
1.230
1.227
Ph
Me
1b
1H NMR
400 MHz
CDCl3
4.89
1.96
1.95
1.00
1.00
2.99
1.98
1.06
1.34
8
6
4
2
0
PPM

148.026
142.602
138.110
137.286
128.923
128.405
125.941
125.707
108.587
77.321
77.000
76.686
27.914
26.280
21.060
15.788

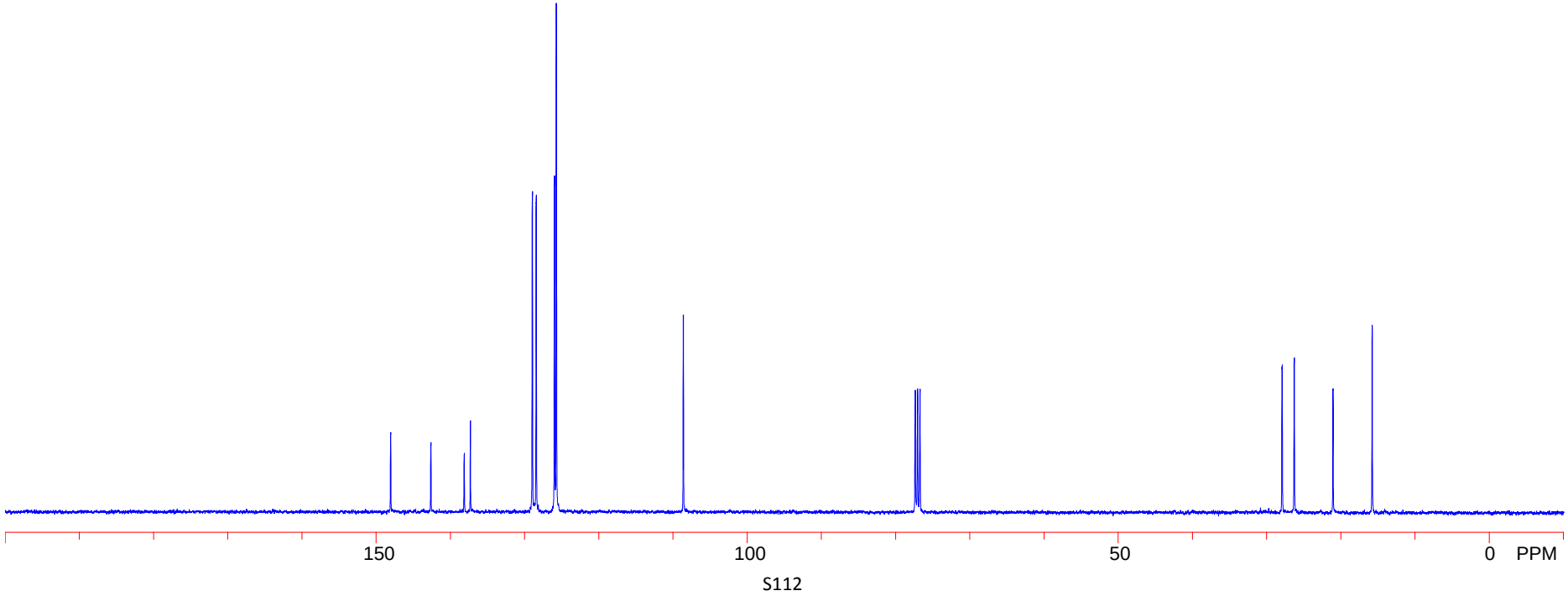


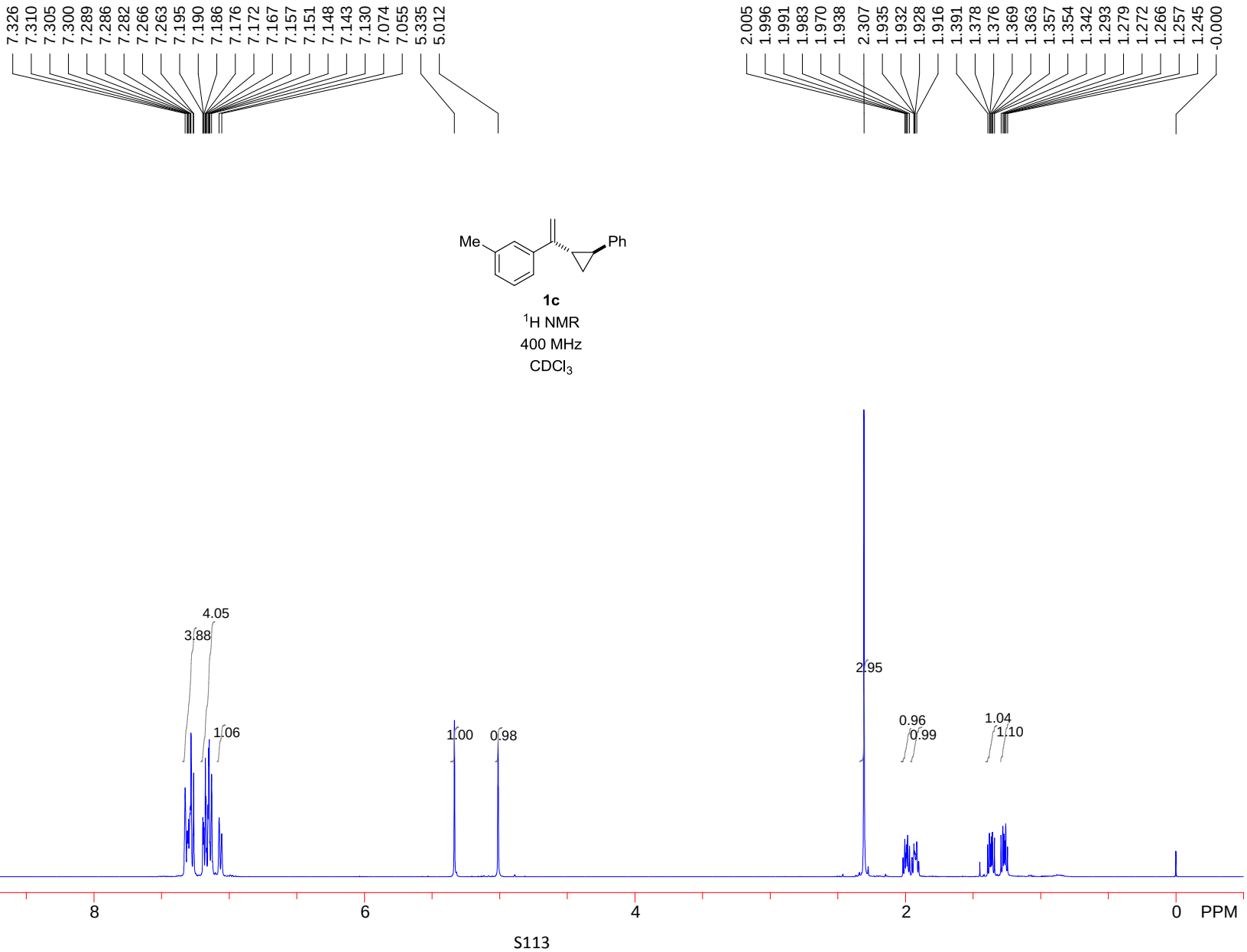
1b

^{13}C NMR

100 MHz

$CDCl_3$

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7.310
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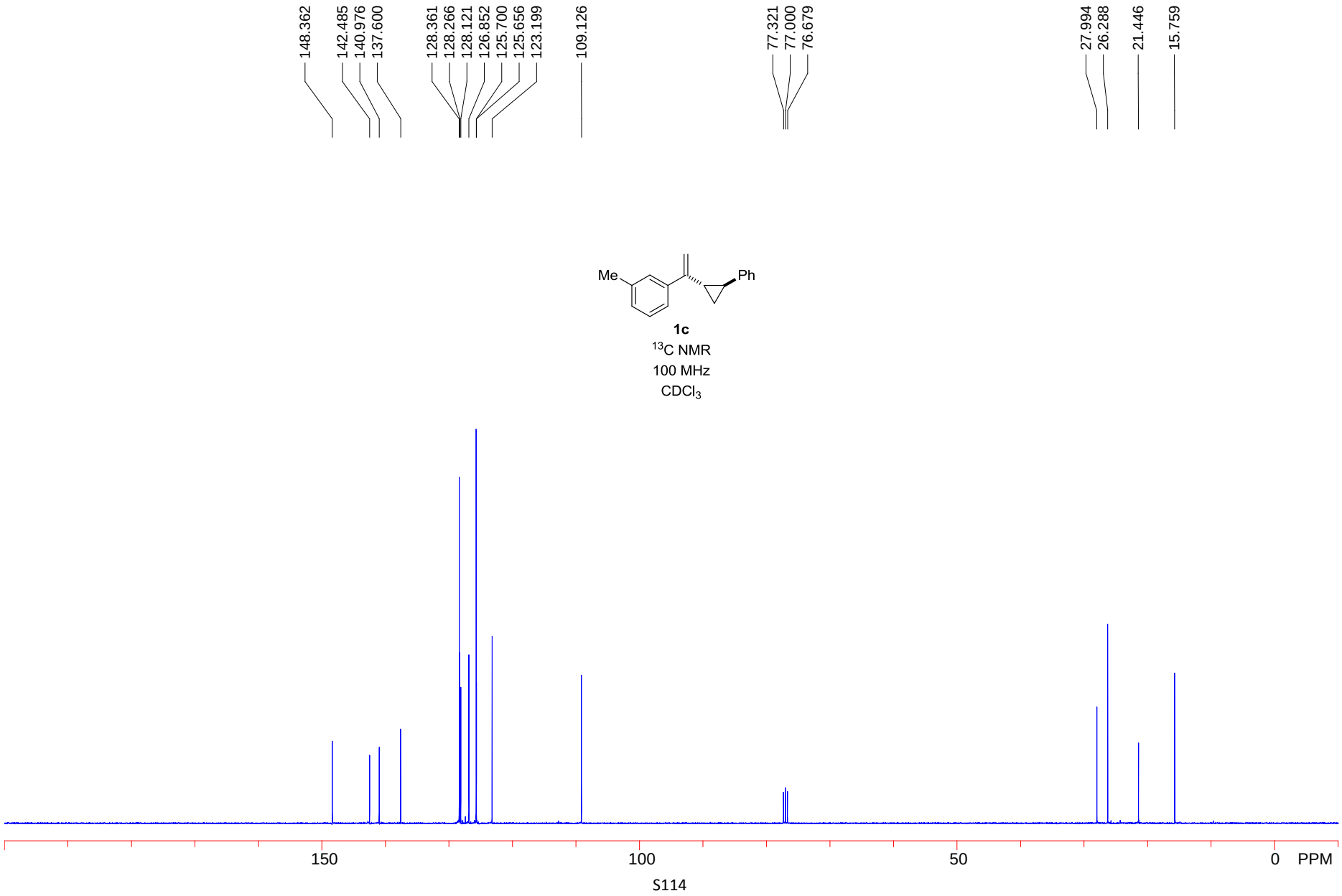
7.300
7.289
7.286
7.282
7.266
7.263
7.195
7.190
7.186
7.176
7.172
7.167
7.157
7.151
7.148
7.143
7.130
7.074
7.055
5.335
5.012
2.005
1.996
1.991
1.983
1.970
1.938
2.307
1.935
1.932
1.928
1.916
1.391
1.378
1.376
1.369
1.363
1.357
1.354
1.342
1.293
1.279
1.272
1.266
1.257
1.245
-0.000
Me
Ph
1c
1H NMR
400 MHz
CDCl3
4.05
3.88
1.06
1.00
0.98
2.95
0.96
0.99
1.04
1.10
8
6
4
2
0
PPM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142.485
140.976
137.600
128.361
128.266
128.121
126.852
125.700
125.656
123.199
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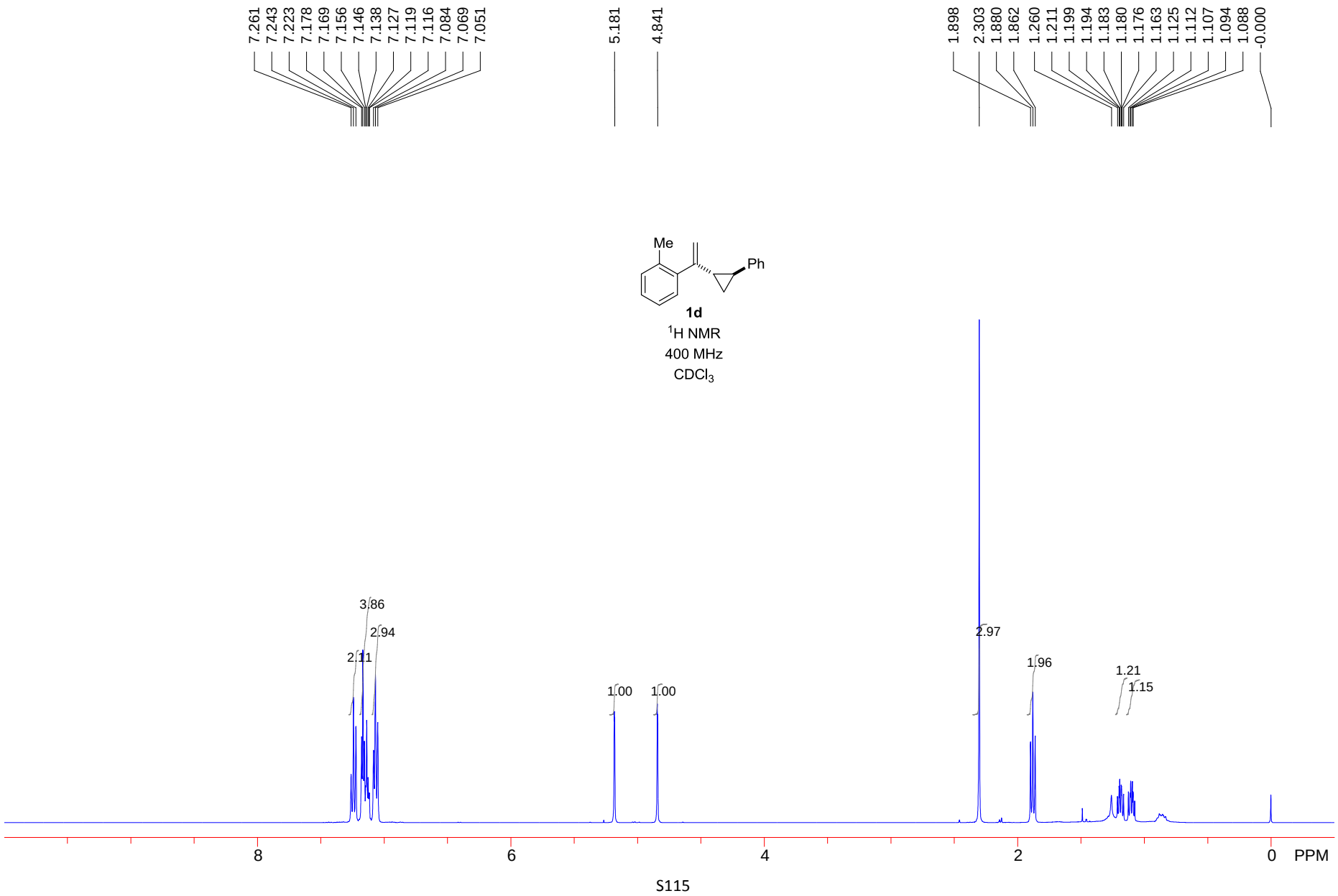
77.321
77.000
76.679
27.994
26.288
21.446
15.759
Me
Ph
1c
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.243
7.223
7.178
7.169
7.156
7.146
7.138
7.127
7.119
7.116
7.084
7.069
7.051
5.181
4.841
1.898
2.303
1.880
1.862
1.260
1.211
1.199
1.194
1.183
1.180
1.176
1.163
1.125
1.112
1.107
1.094
1.088
-0.000
Me
Ph
1d
1H NMR
400 MHz
CDCl3
3.86
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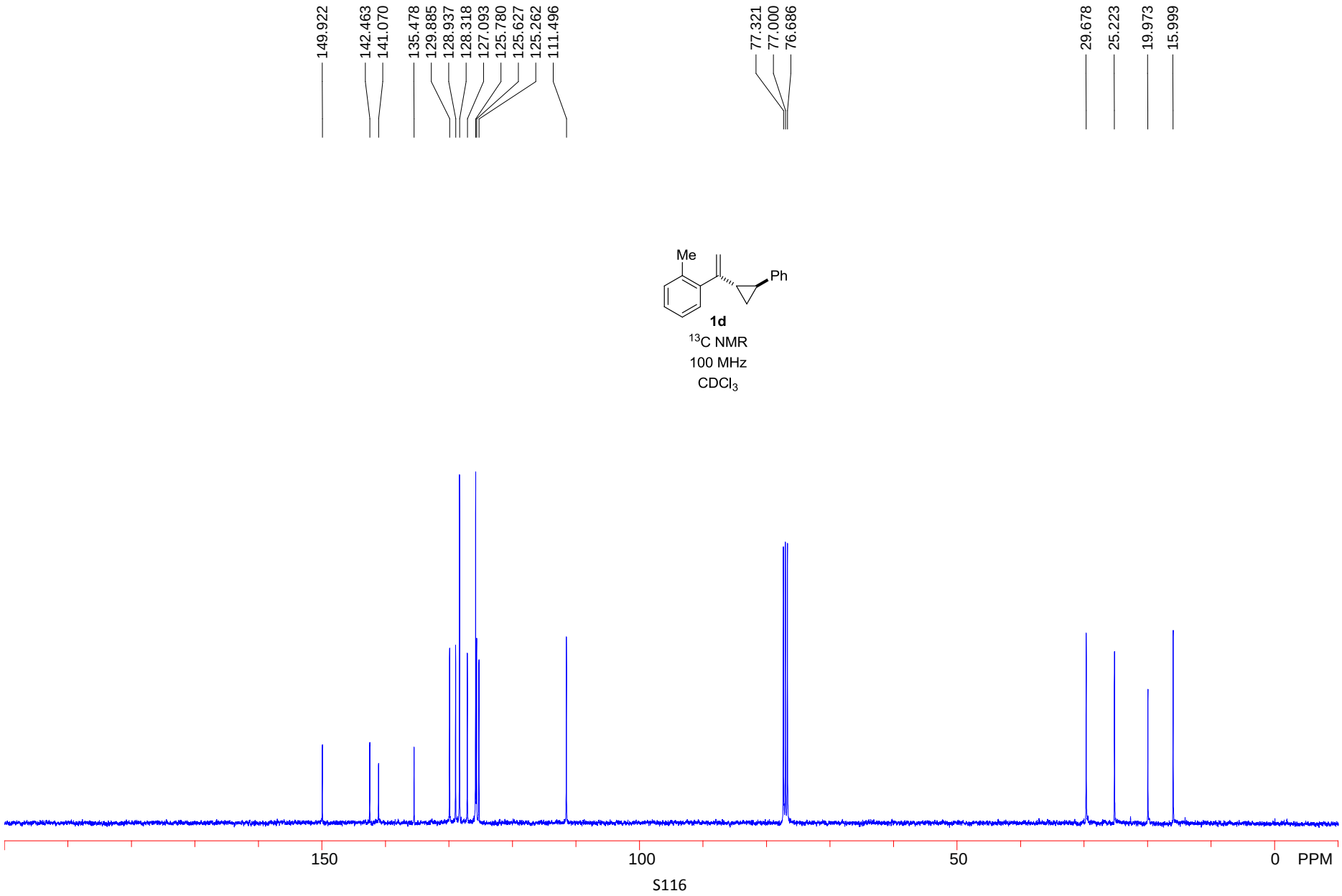
1.00
1.00
2.97
1.96
1.21
1.15
8
6
4
2
0
PPM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142.463
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135.478
129.885
128.937
128.318
127.093
125.780
125.627
125.262
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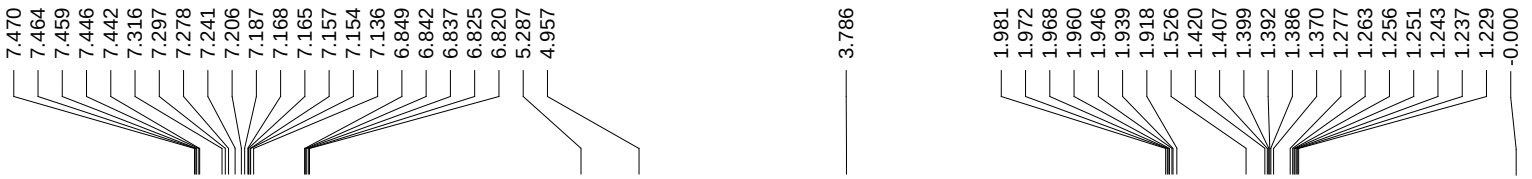
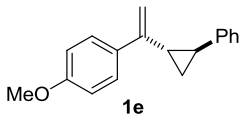
77.321
77.000
76.686
29.678
25.223
19.973
15.999
Me
Ph
1d
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM



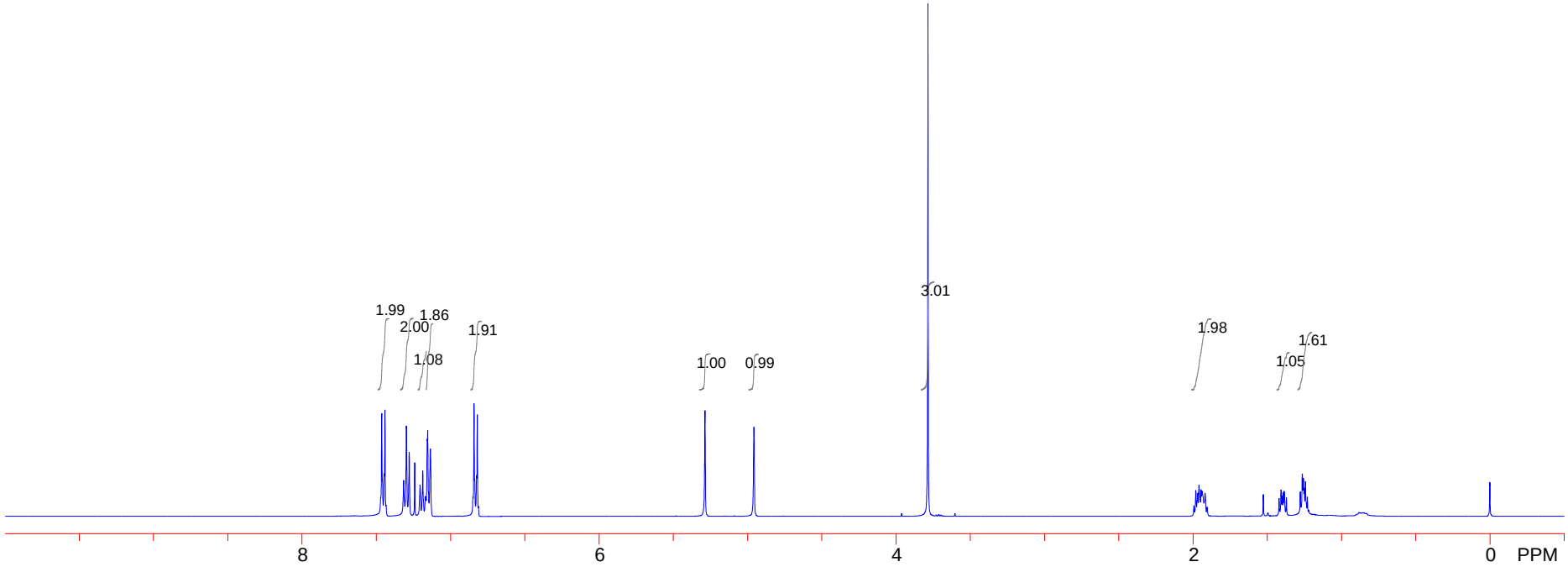


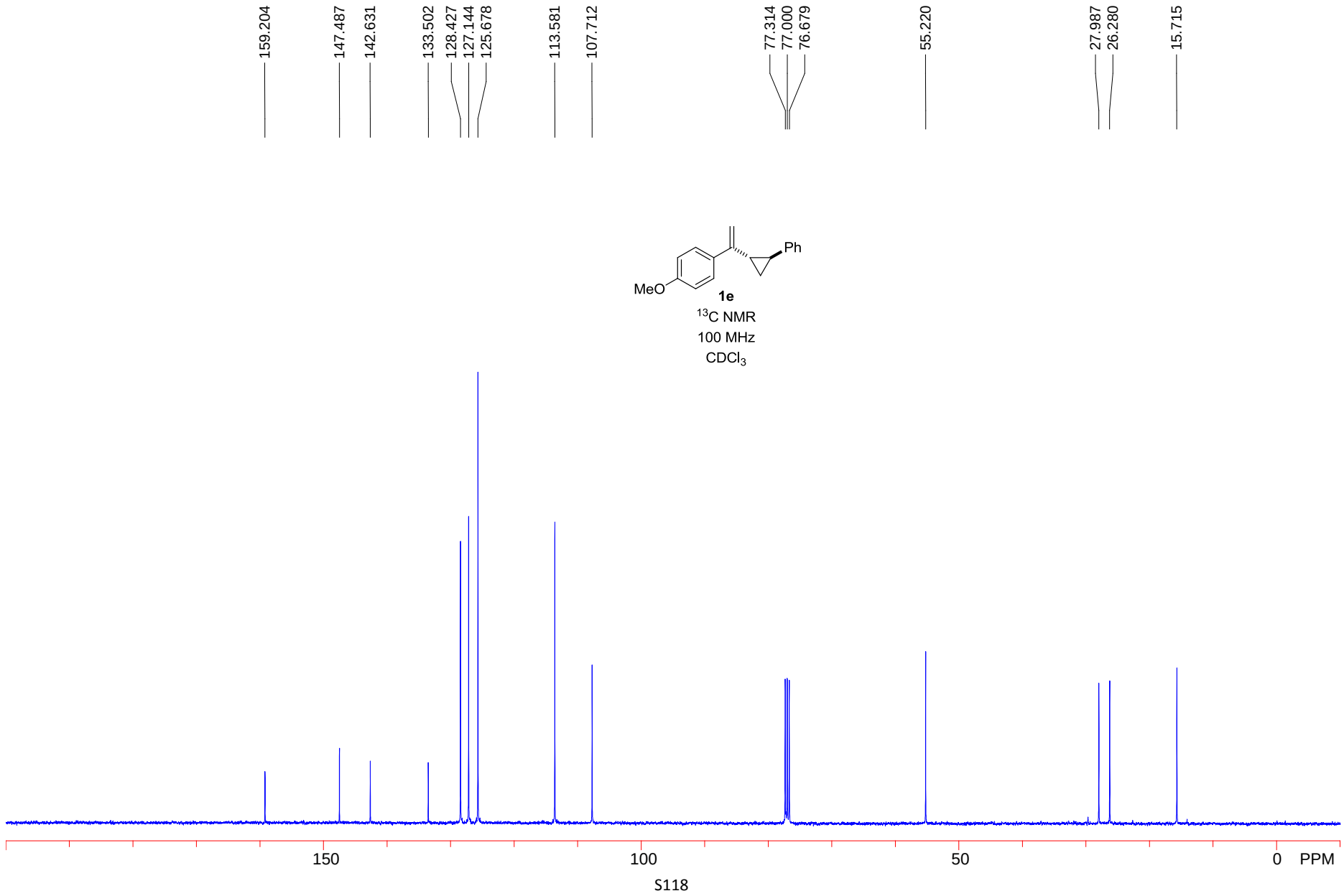
1e

^{1}H NMR

400 MHz

$CDCl_3$

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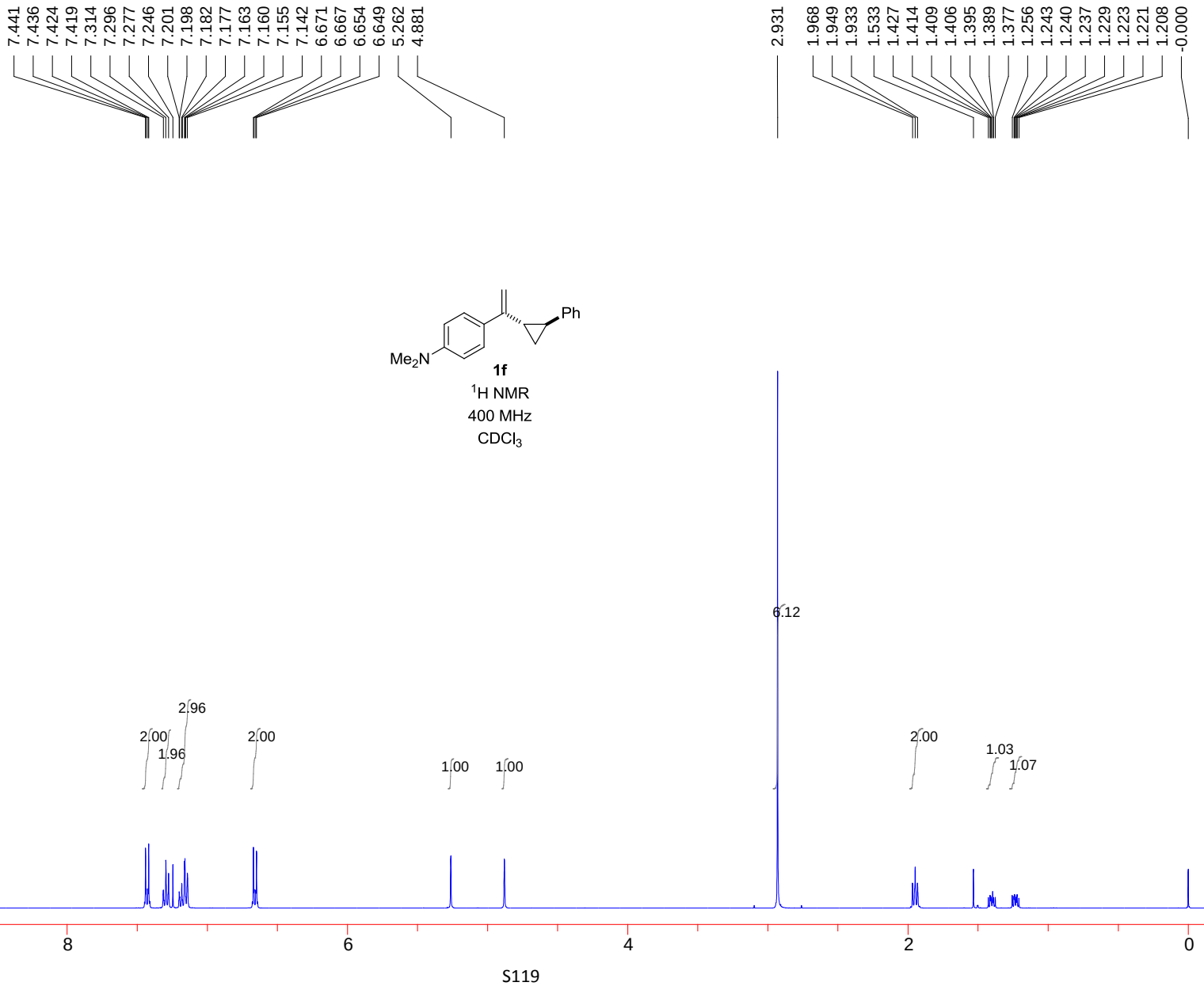
142.631
133.502
128.427
127.144
125.678
113.581
107.712
77.314
77.000
76.679
55.220
27.987
26.280
15.715
Ph
MeO
1e
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.314
7.296
7.277
7.246
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7.198
7.182
7.177
7.163
7.160
7.155
7.142
6.671
6.667
6.654
6.649
5.262
4.881
2.931
1.968
1.949
1.933
1.533
1.427
1.414
1.409
1.406
1.395
1.389
1.377
1.256
1.243
1.240
1.237
1.229
1.223
1.221
1.208
-0.000
Ph
Me2N
1f
1H NMR
400 MHz
CDCl3
2.00
1.96
2.96
2.00
1.00
1.00
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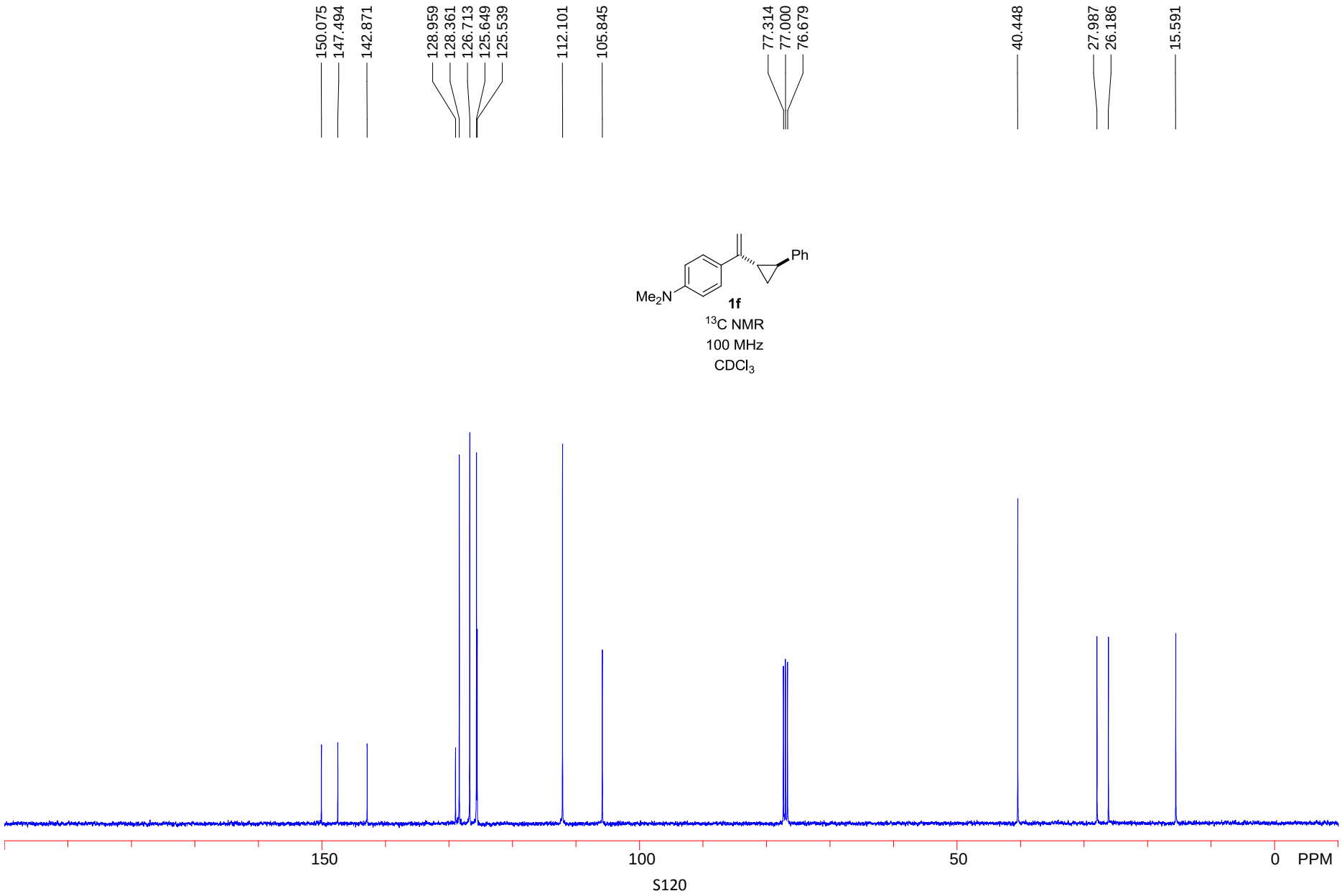
2.00
1.03
1.07
8
6
4
2
0
PPM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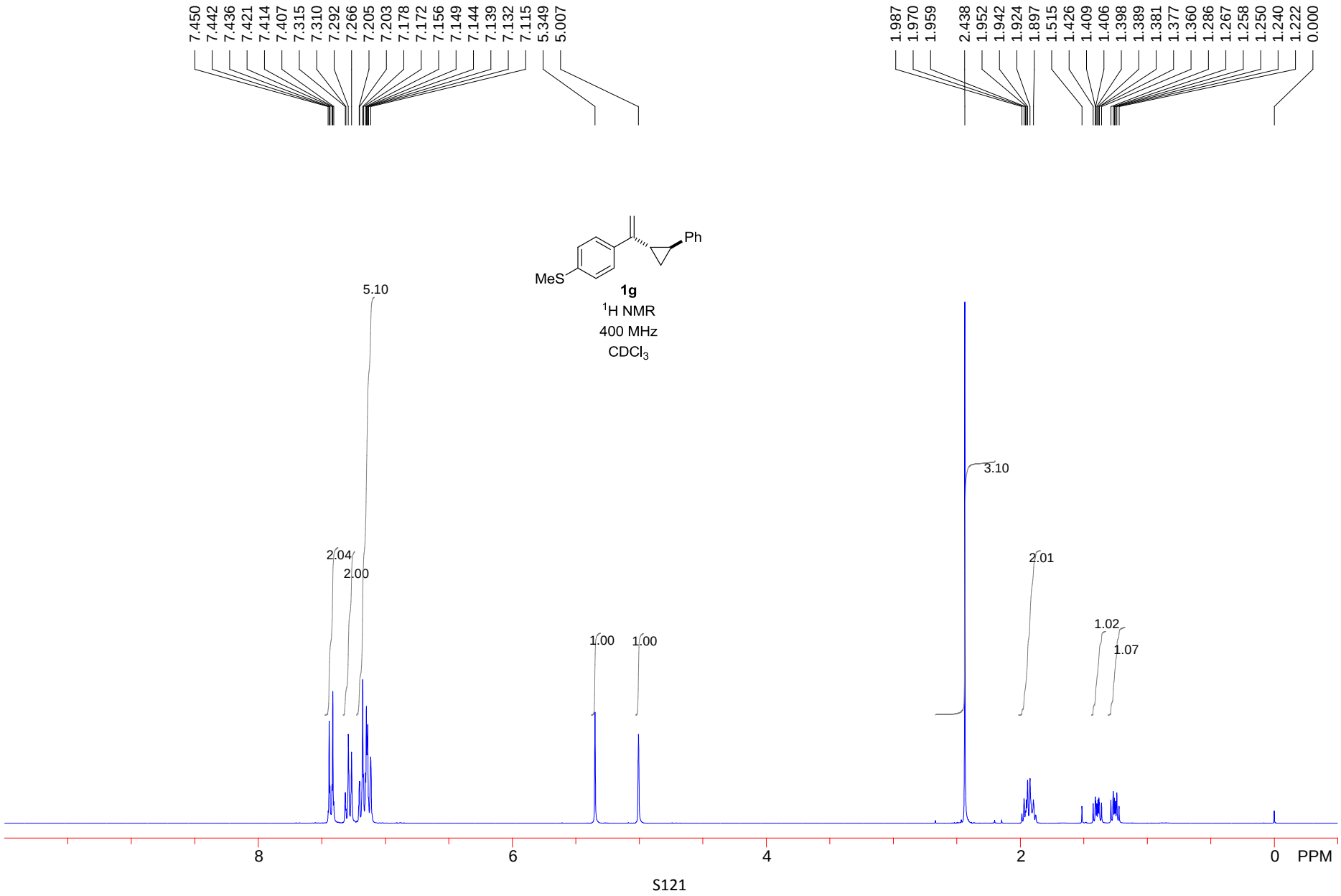
128.361
126.713
125.649
125.539
112.101
105.845
77.314
77.000
76.679
40.448
27.987
26.186
15.591
Ph
Me2N
1f
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.442
7.436
7.421
7.414
7.407
7.315
7.310
7.292
7.266
7.205
7.203
7.178
7.172
7.156
7.149
7.144
7.139
7.132
7.115
5.349
5.007
1.987
1.970
1.959
2.438
1.952
1.942
1.924
1.897
1.515
1.426
1.409
1.406
1.398
1.389
1.381
1.377
1.360
1.286
1.267
1.258
1.250
1.240
1.222
0.000
Ph
MeS
1g
1H NMR
400 MHz
CDCl3
5.10
2.04
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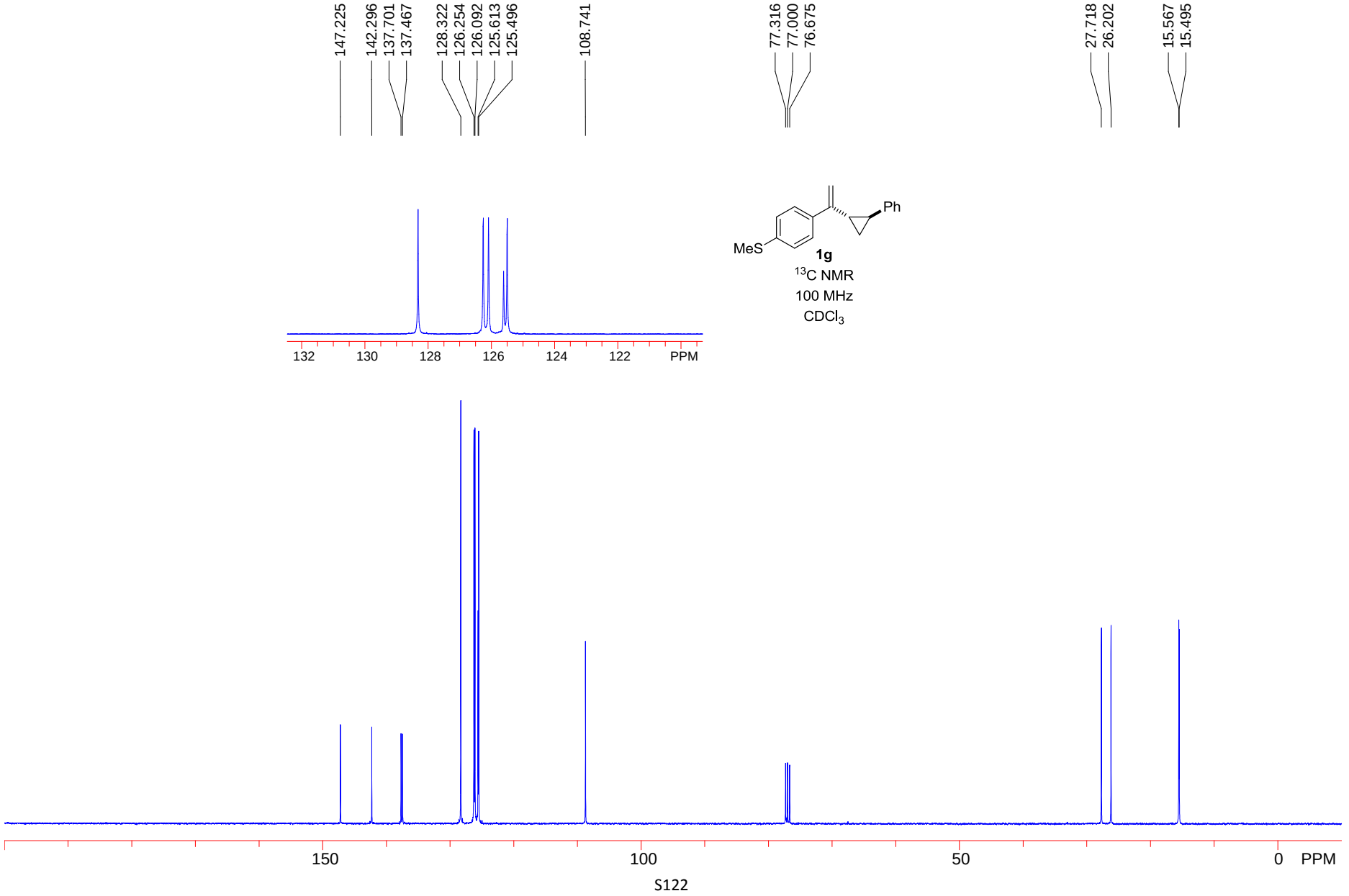
1.00
1.00
3.10
2.01
1.02
1.07
8
6
4
2
0
PPM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142.296
137.701
137.467
128.322
126.254
126.092
125.613
125.496
108.741
77.316
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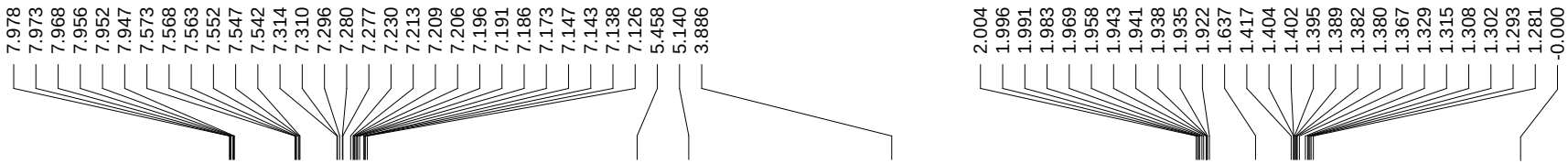
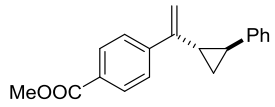
76.675
27.718
26.202
15.567
15.495
Ph
MeS
1g
13C NMR
100 MHz
CDCl3
132
130
128
126
124
122
PPM
150
100
50
0
PPM



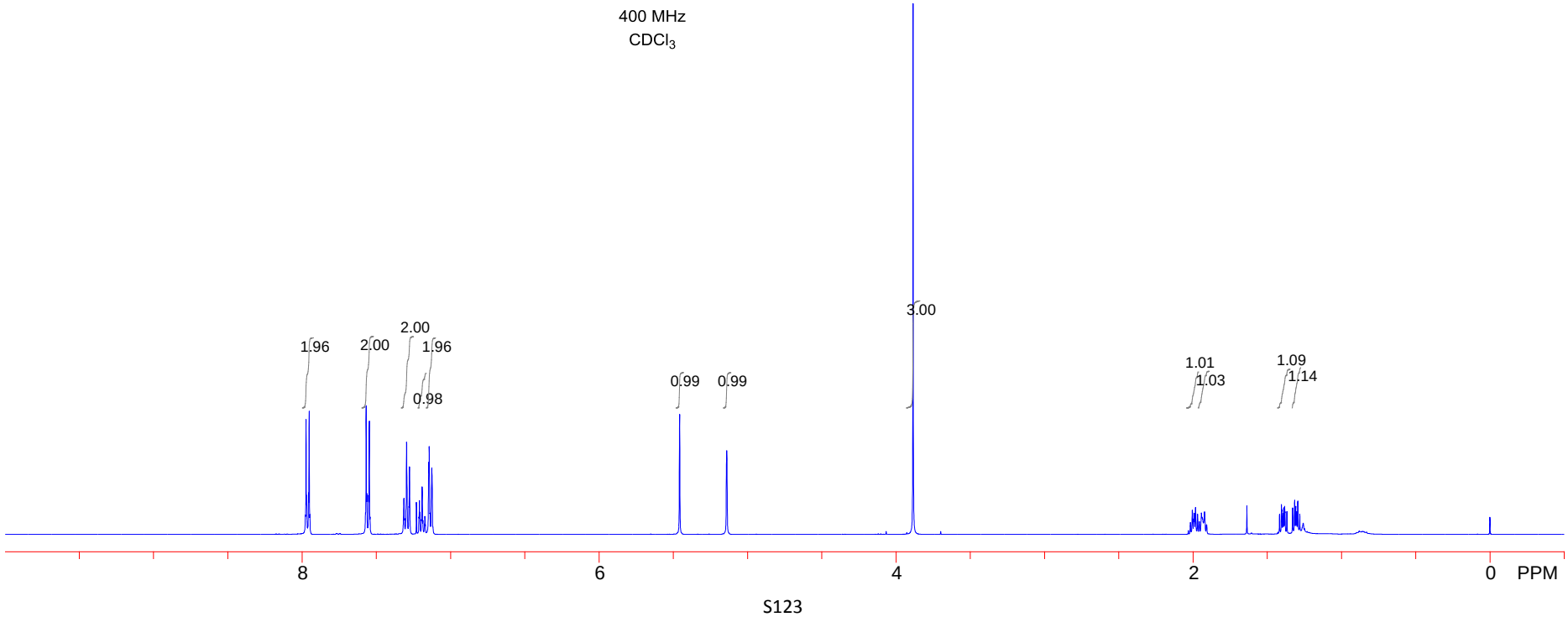


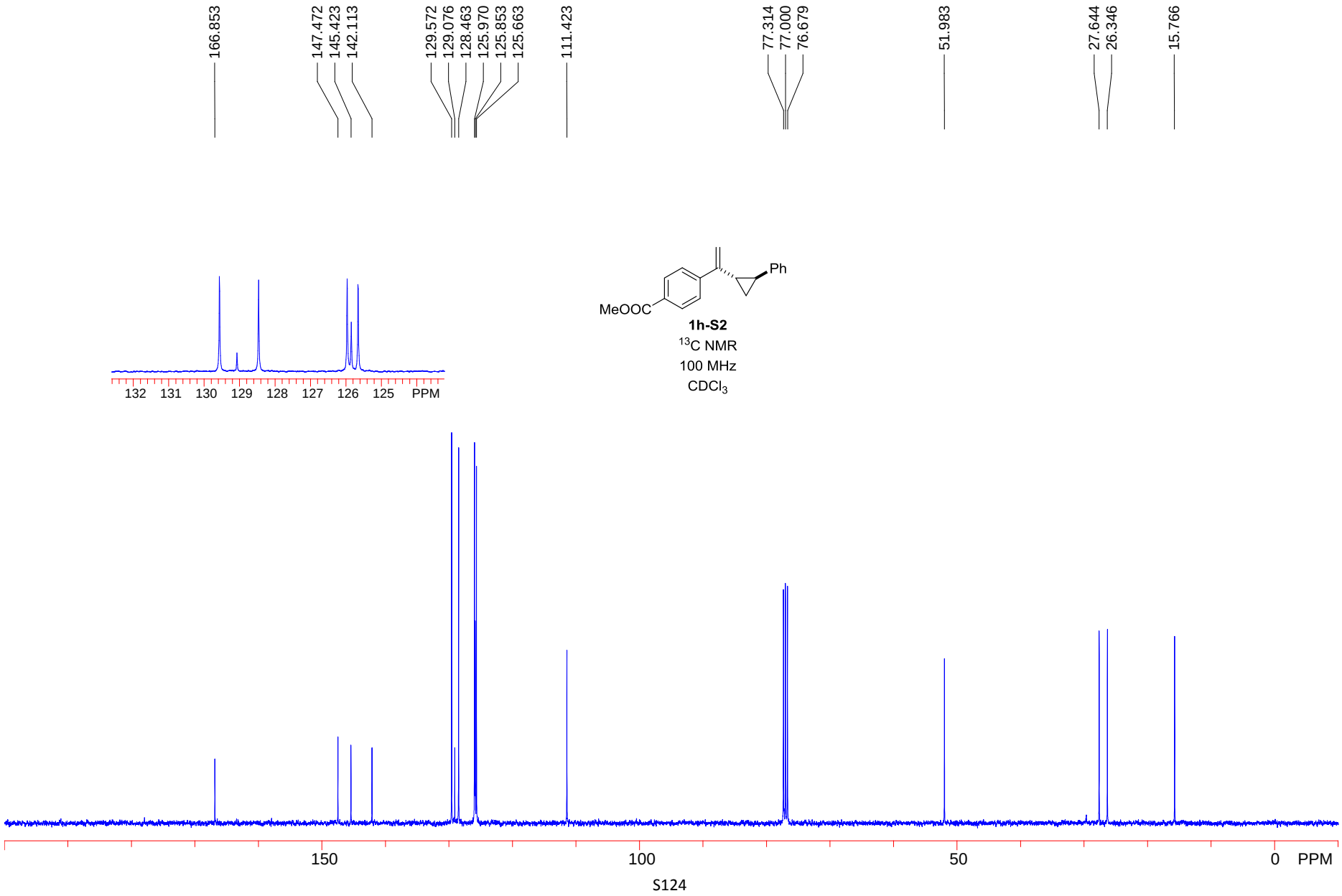
1h-S2

^{1}H NMR

400 MHz

$CDCl_3$

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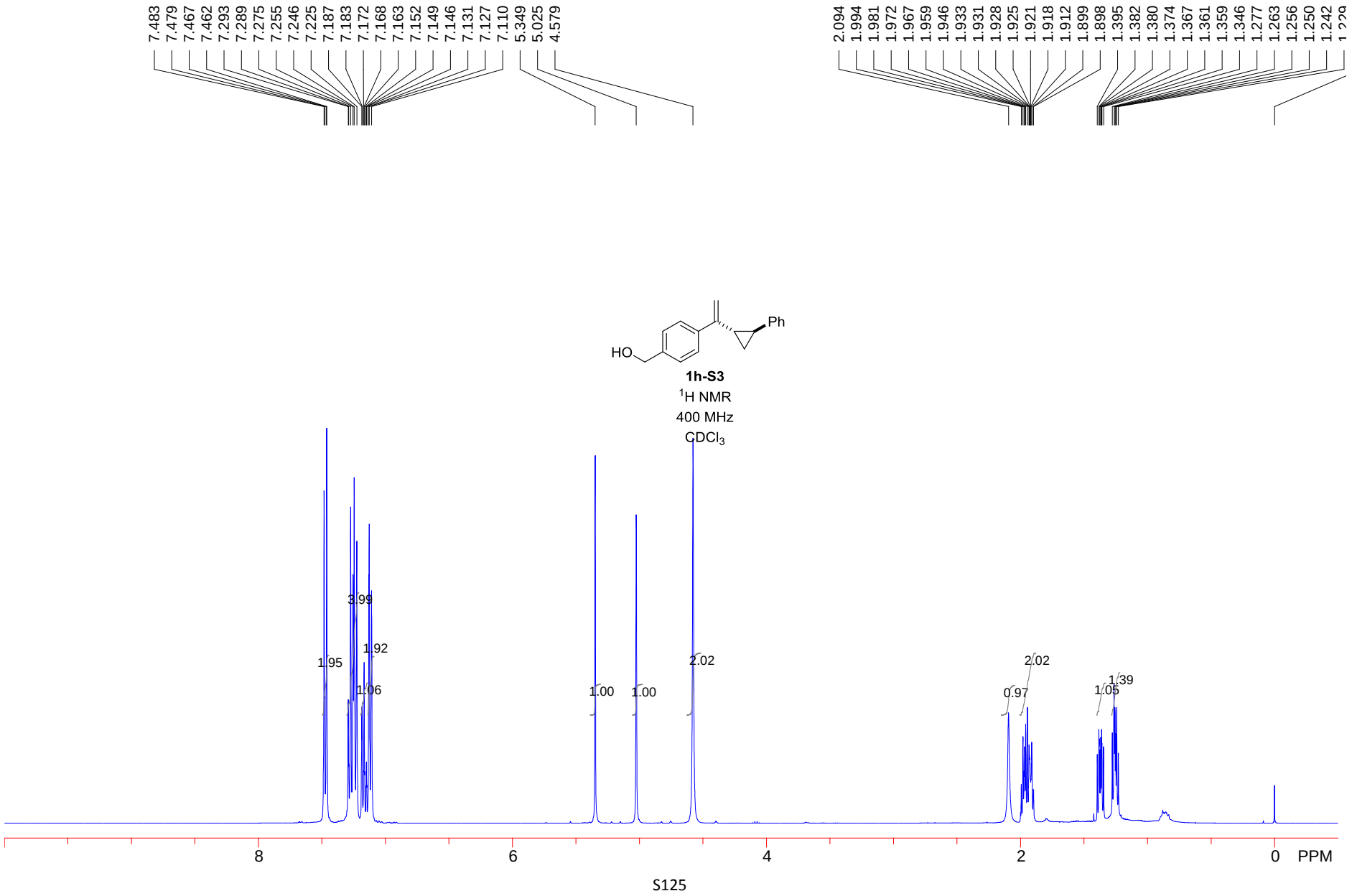
147.472
145.423
142.113
129.572
129.076
128.463
125.970
125.853
125.663
111.423
77.314
77.000
76.679
51.983
27.644
26.346
15.766
132 131 130 129 128 127 126 125 PPM
MeOOC
Ph
1h-S2
13C NMR
100 MHz
CDCl3
150
100
50
0 PPM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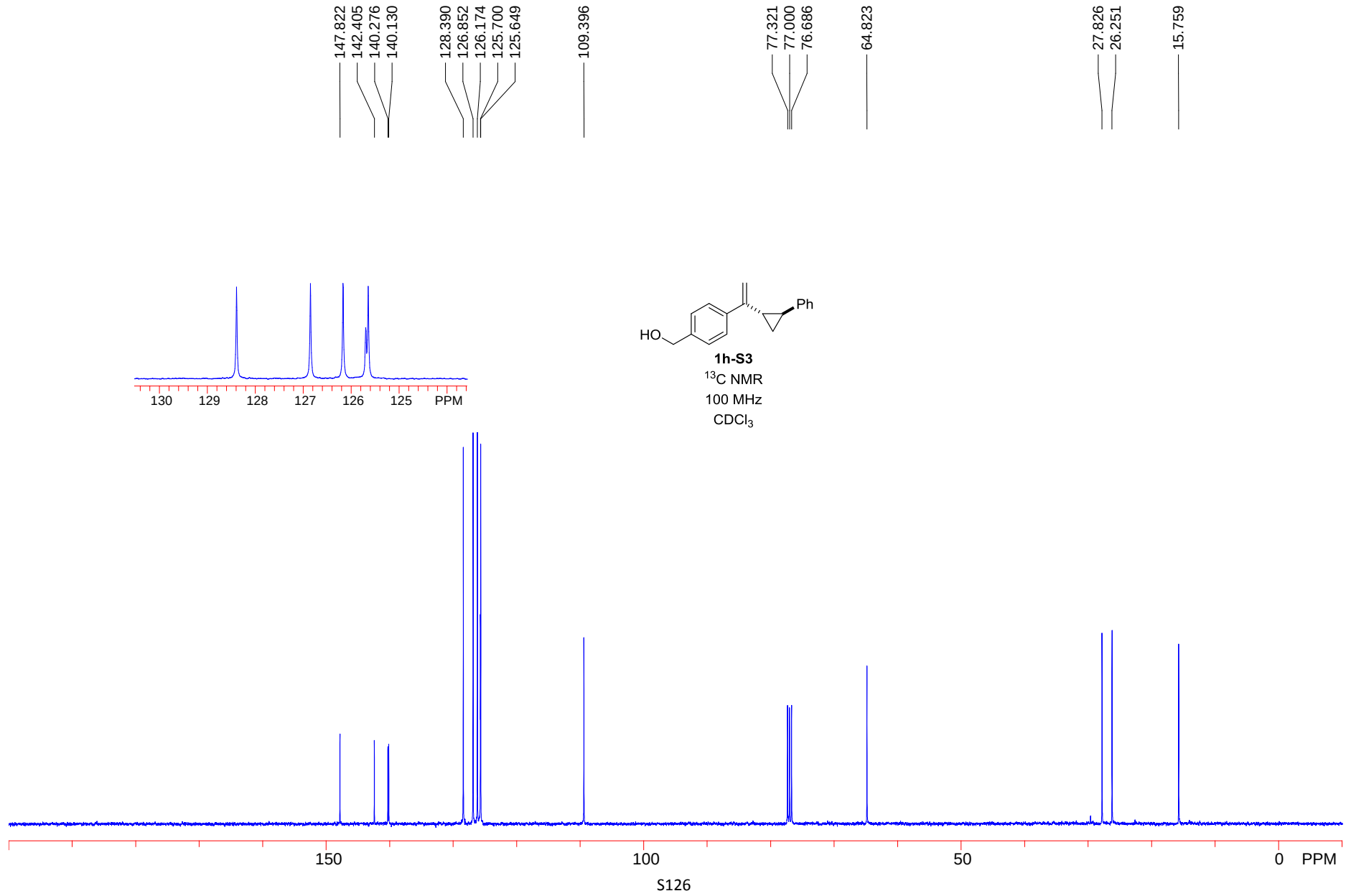
7.293
7.289
7.275
7.255
7.246
7.225
7.187
7.183
7.172
7.168
7.163
7.152
7.149
7.146
7.131
7.127
7.110
5.349
5.025
4.579
2.094
1.994
1.981
1.972
1.967
1.959
1.946
1.933
1.931
1.928
1.925
1.921
1.918
1.912
1.899
1.898
1.395
1.382
1.380
1.374
1.367
1.361
1.359
1.346
1.277
1.263
1.256
1.250
1.242
HO
Ph
1h-S3
1H NMR
400 MHz
CDCl3
1.95
3.99
1.92
1.06
1.00
1.00
2.02
0.97
2.02
1.05
1.39
8
6
4
2
0
PPM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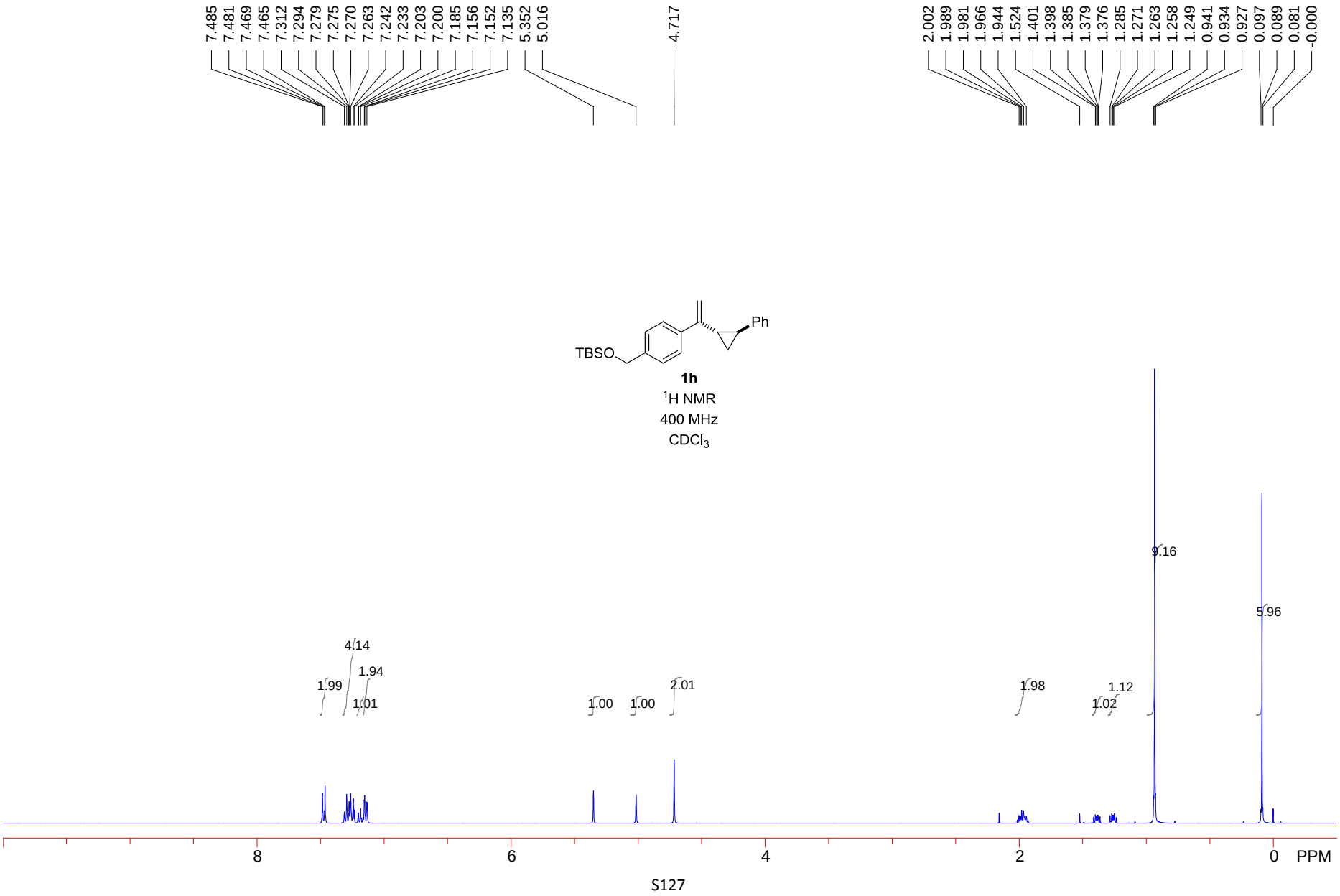
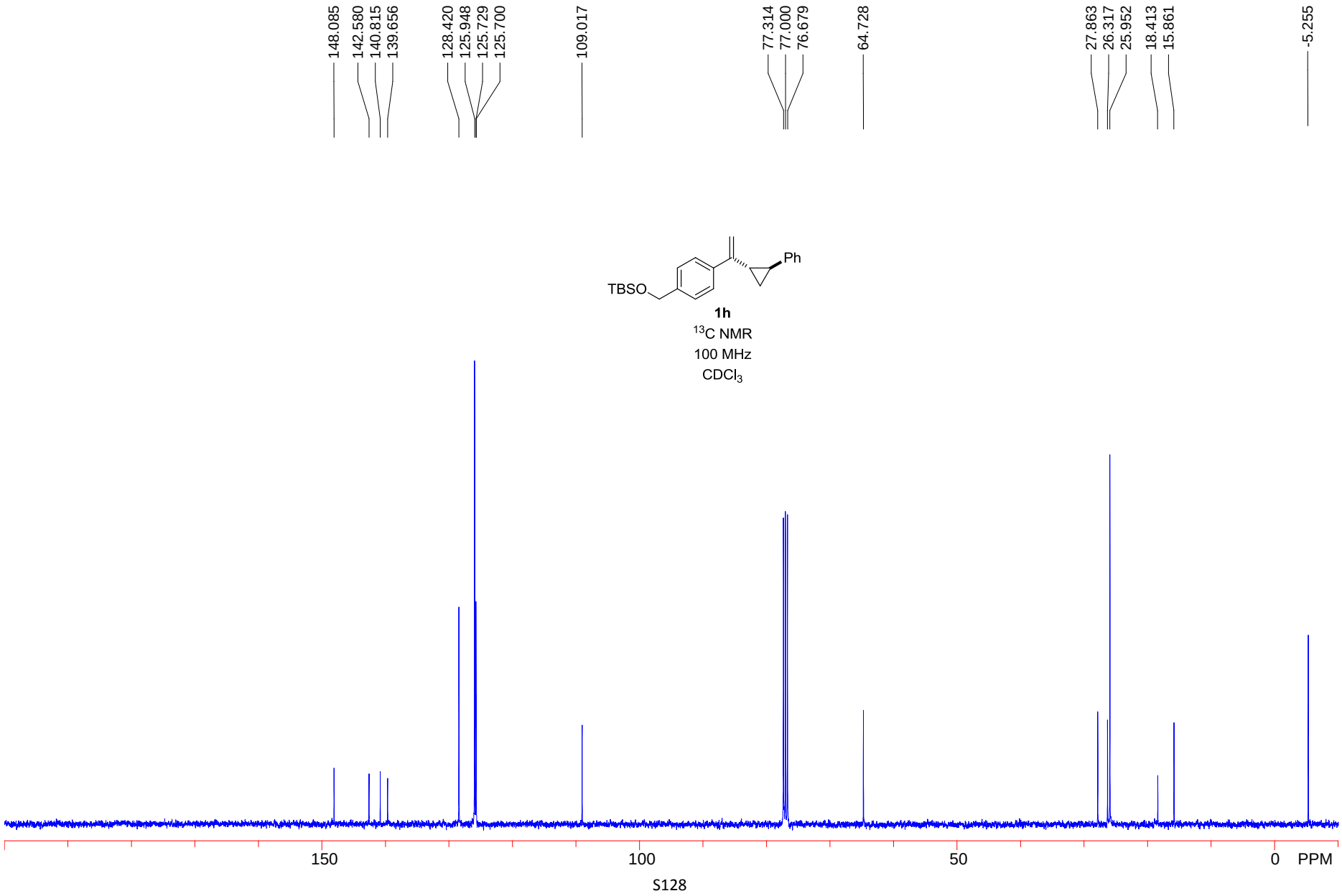
142.405
140.276
140.130
128.390
126.852
126.174
125.700
125.649
109.396
77.321
77.000
76.686
64.823
27.826
26.251
15.759
130
129
128
127
126
125
PPM
HO
Ph
1h-S3
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


7.485
7.481
7.469
7.465
7.312
7.294
7.279
7.275
7.270
7.263
7.242
7.233
7.203
7.200
7.185
7.156
7.152
7.135
5.352
5.016
4.717
2.002
1.989
1.981
1.966
1.944
1.524
1.401
1.398
1.385
1.379
1.376
1.285
1.271
1.263
1.258
1.249
0.941
0.934
0.927
0.097
0.089
0.081
-0.000
TBSO
Ph
1h
1H NMR
400 MHz
CDCl3
4.14
1.99
1.94
1.01
1.00
1.00
2.01
1.98
1.12
1.02
9.16
5.96
8
6
4
2
0
PPM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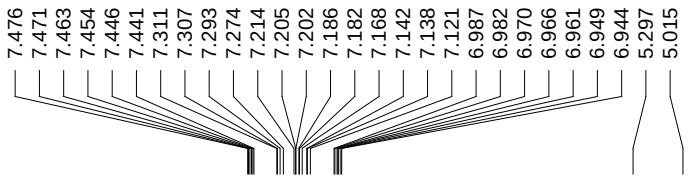
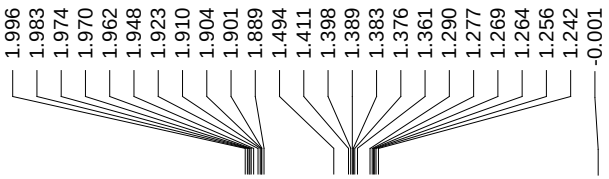
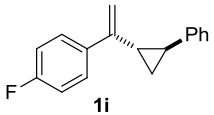
142.580
140.815
139.656
128.420
125.948
125.729
125.700
109.017
77.314
77.000
76.679
64.728
27.863
26.317
25.952
18.413
15.861
-5.255
TBSO
Ph
1h
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM





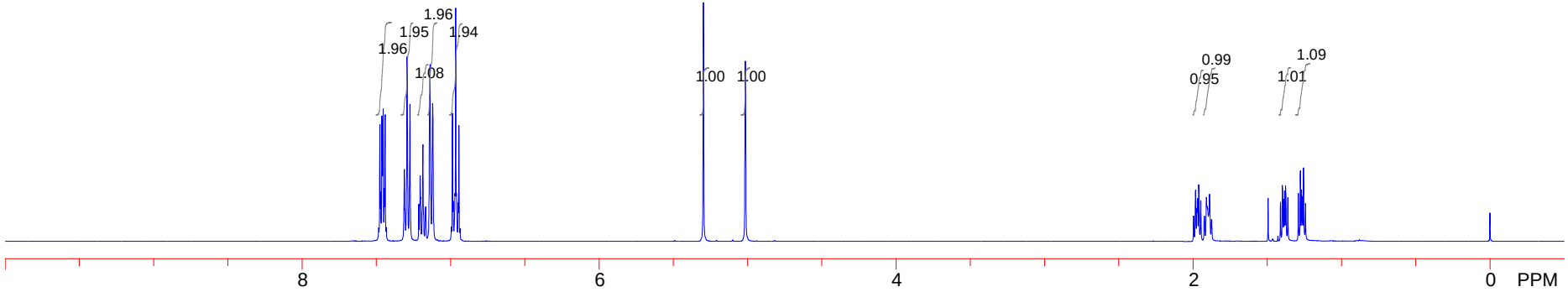


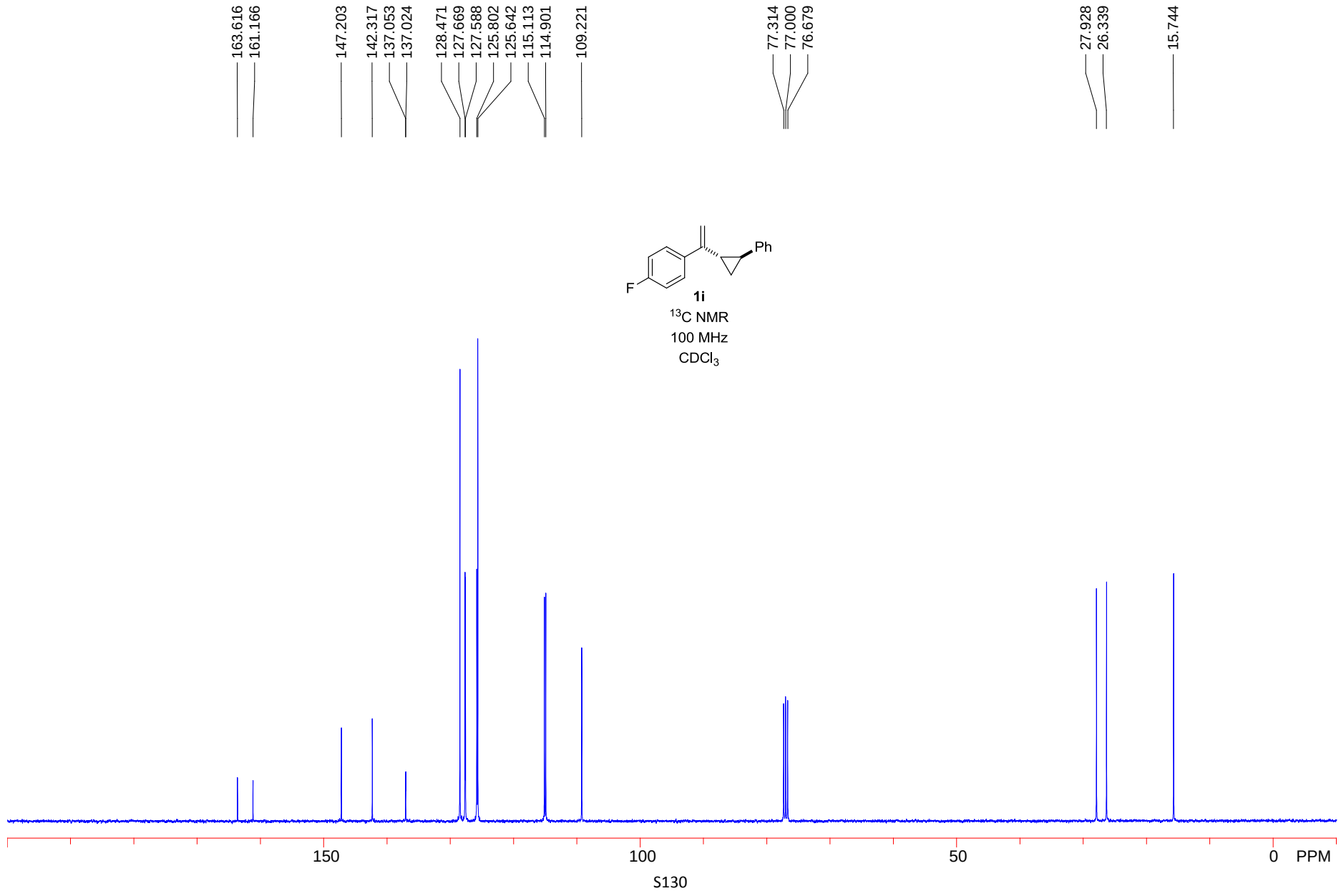
1i

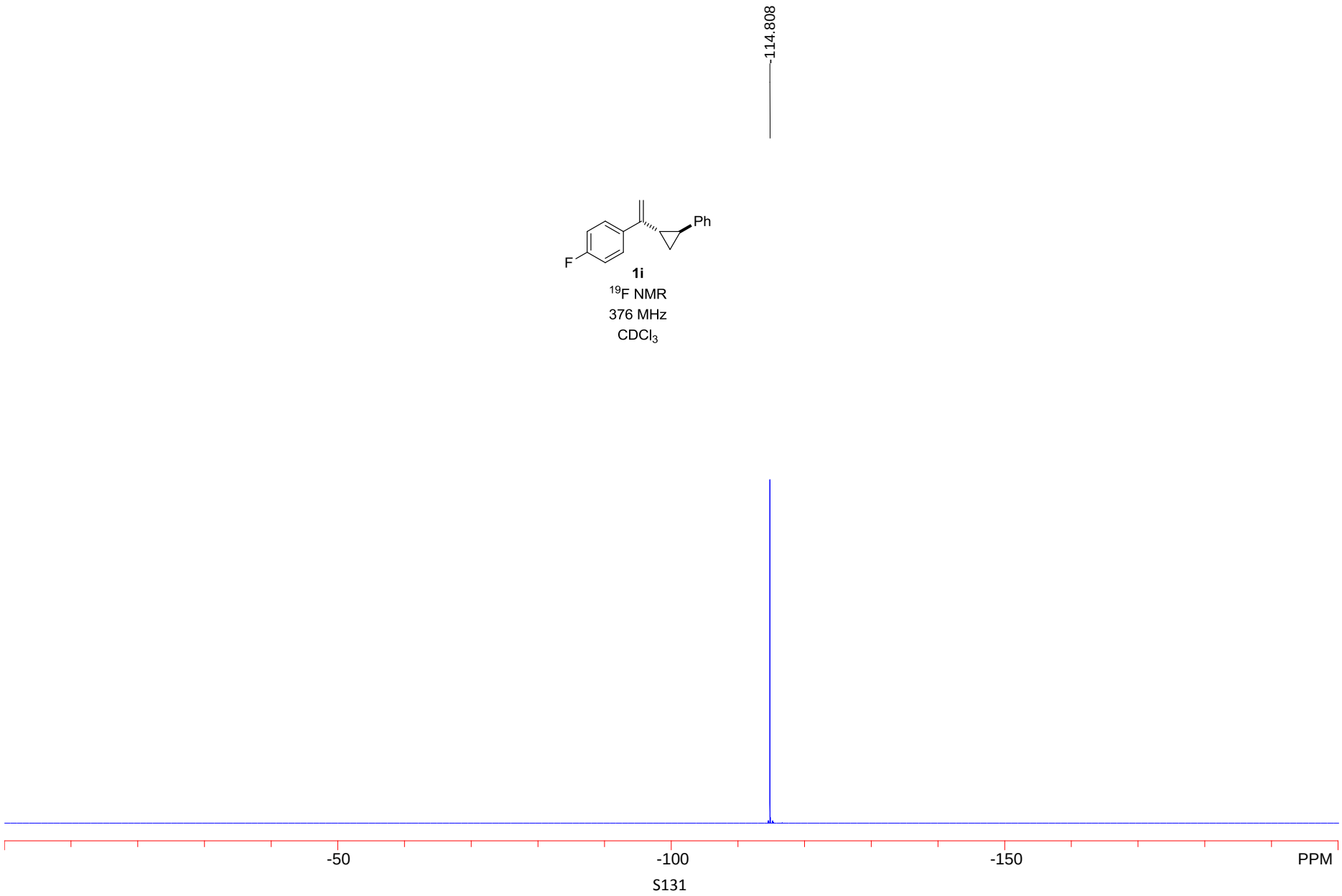
^{1}H NMR

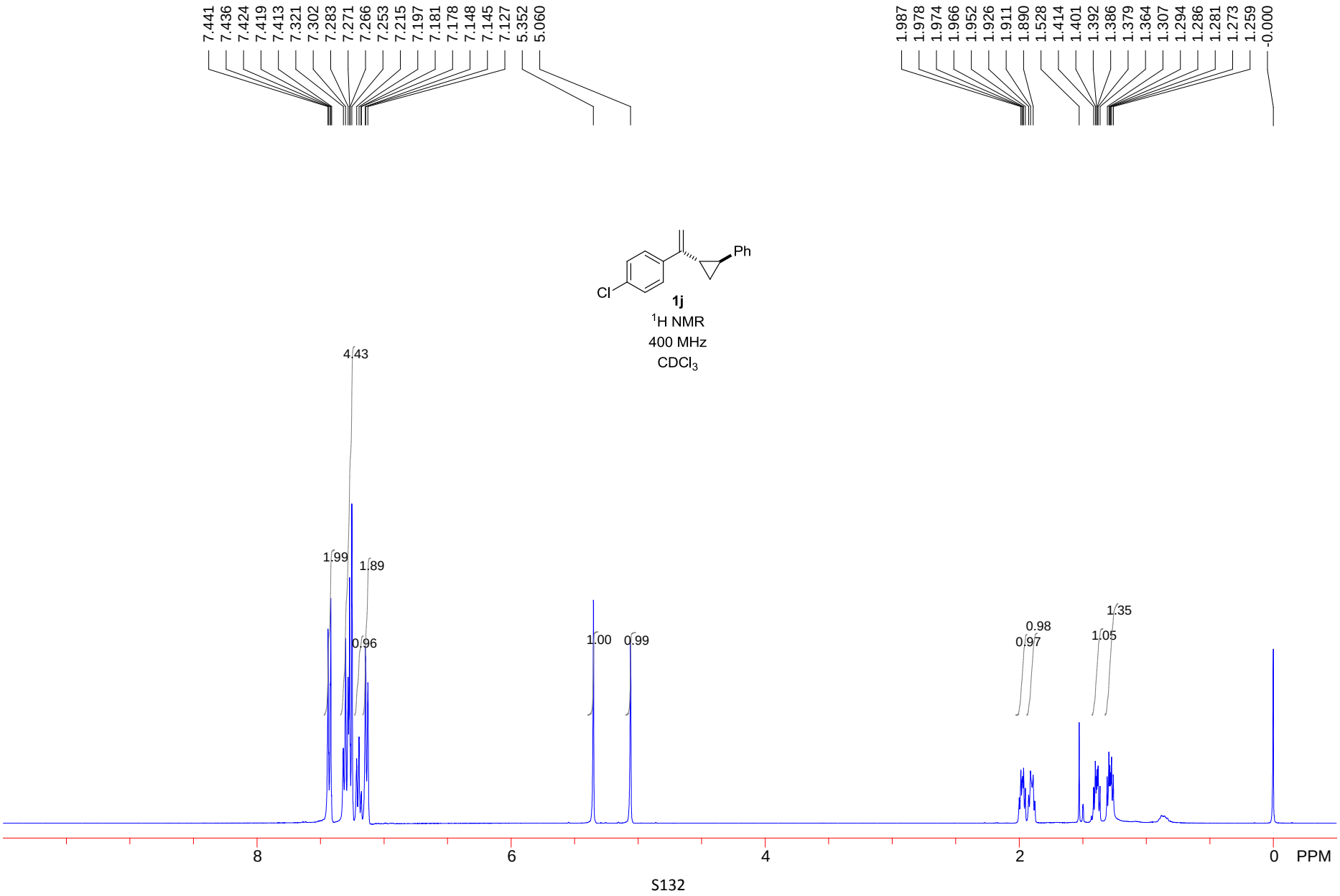
400 MHz

$CDCl_3$




163.616
161.166
147.203
142.317
137.053
137.024
128.471
127.669
127.588
125.802
125.642
115.113
114.901
109.221
77.314
77.000
76.679
27.928
26.339
15.744
Ph
F
1i
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


-114.808
Ph
F
1i
19F NMR
376 MHz
CDCl3
-50
-100
-150
PPM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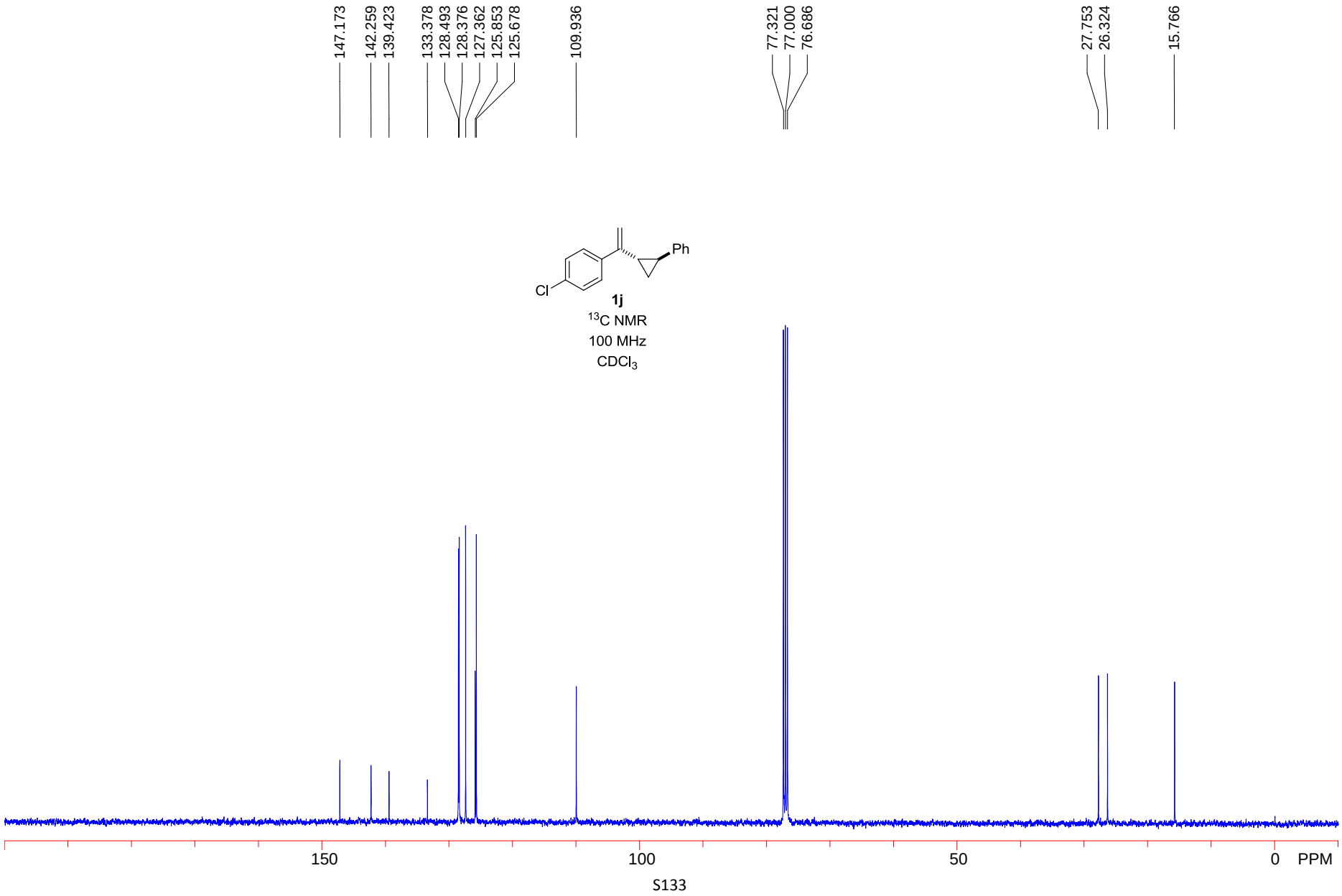
7.419
7.413
7.321
7.302
7.283
7.271
7.266
7.253
7.215
7.197
7.181
7.178
7.148
7.145
7.127
5.352
5.060
1.987
1.978
1.974
1.966
1.952
1.926
1.911
1.890
1.528
1.414
1.401
1.392
1.386
1.379
1.364
1.307
1.294
1.286
1.281
1.273
1.259
-0.000
Cl
Ph
1j
1H NMR
400 MHz
CDCl3
4.43
1.99
1.89
0.96
1.00
0.99
0.98
0.97
1.35
1.05
8
6
4
2
0
PPM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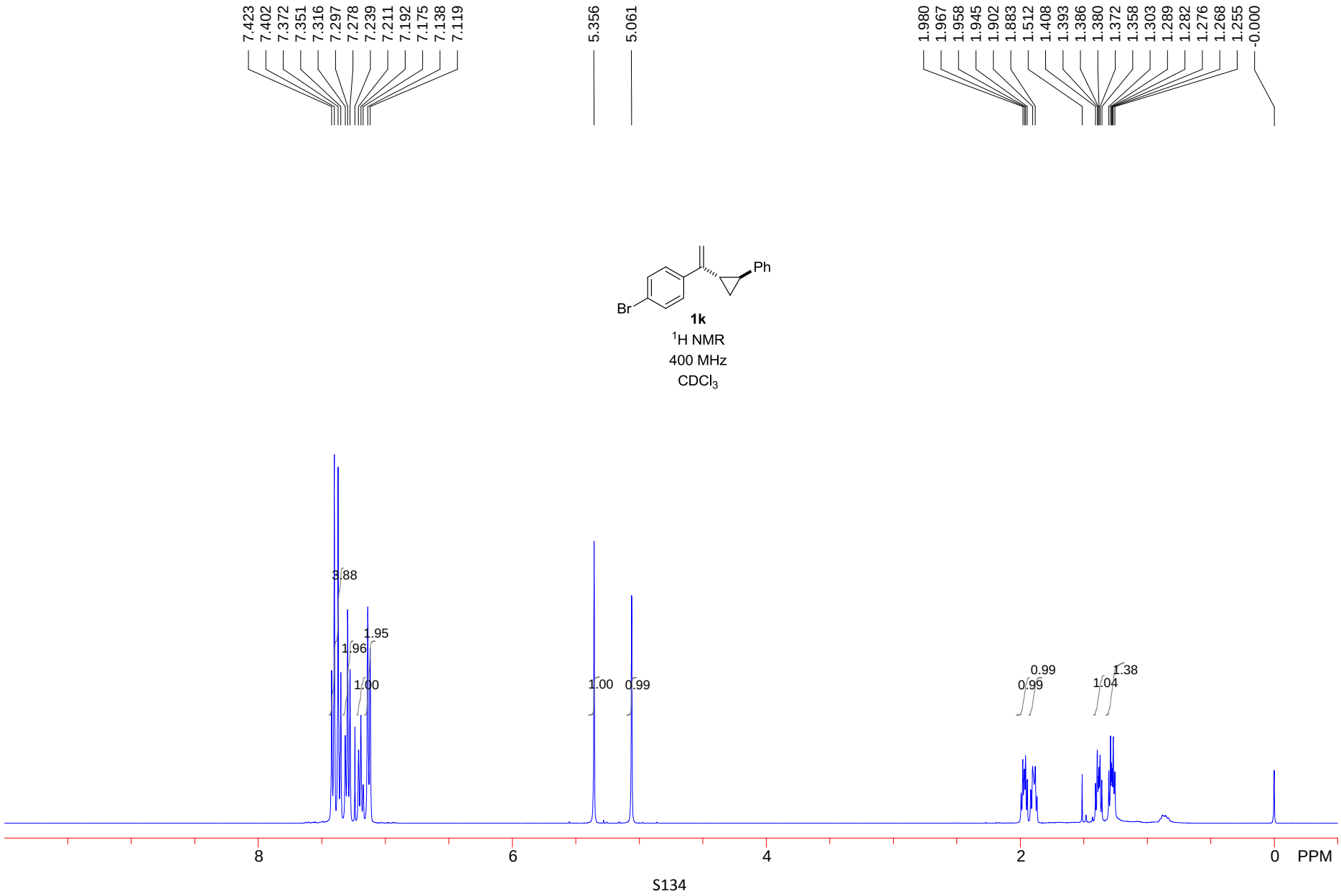
139.423
133.378
128.493
128.376
127.362
125.853
125.678
109.936
77.321
77.000
76.686
27.753
26.324
15.766
Ph
Cl
1j
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.351
7.316
7.297
7.278
7.239
7.211
7.192
7.175
7.138
7.119
5.356
5.061
1.980
1.967
1.958
1.945
1.902
1.883
1.512
1.408
1.393
1.386
1.380
1.372
1.358
1.303
1.289
1.282
1.276
1.268
1.255
-0.000
Br
Ph
1k
1H NMR
400 MHz
CDCl3
3.88
1.96
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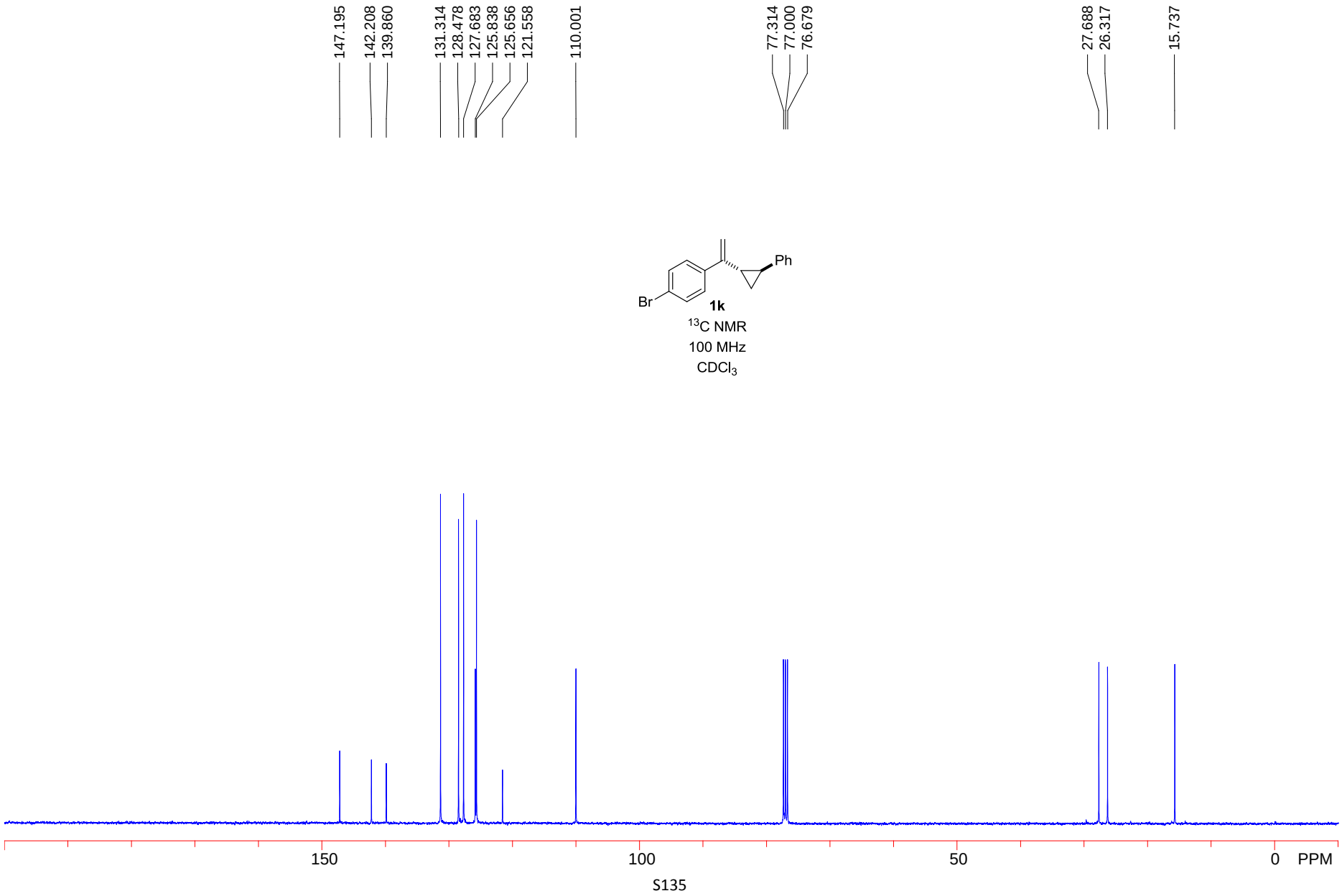
1.00
0.99
0.99
0.99
1.04
1.38
8
6
4
2
0
PPM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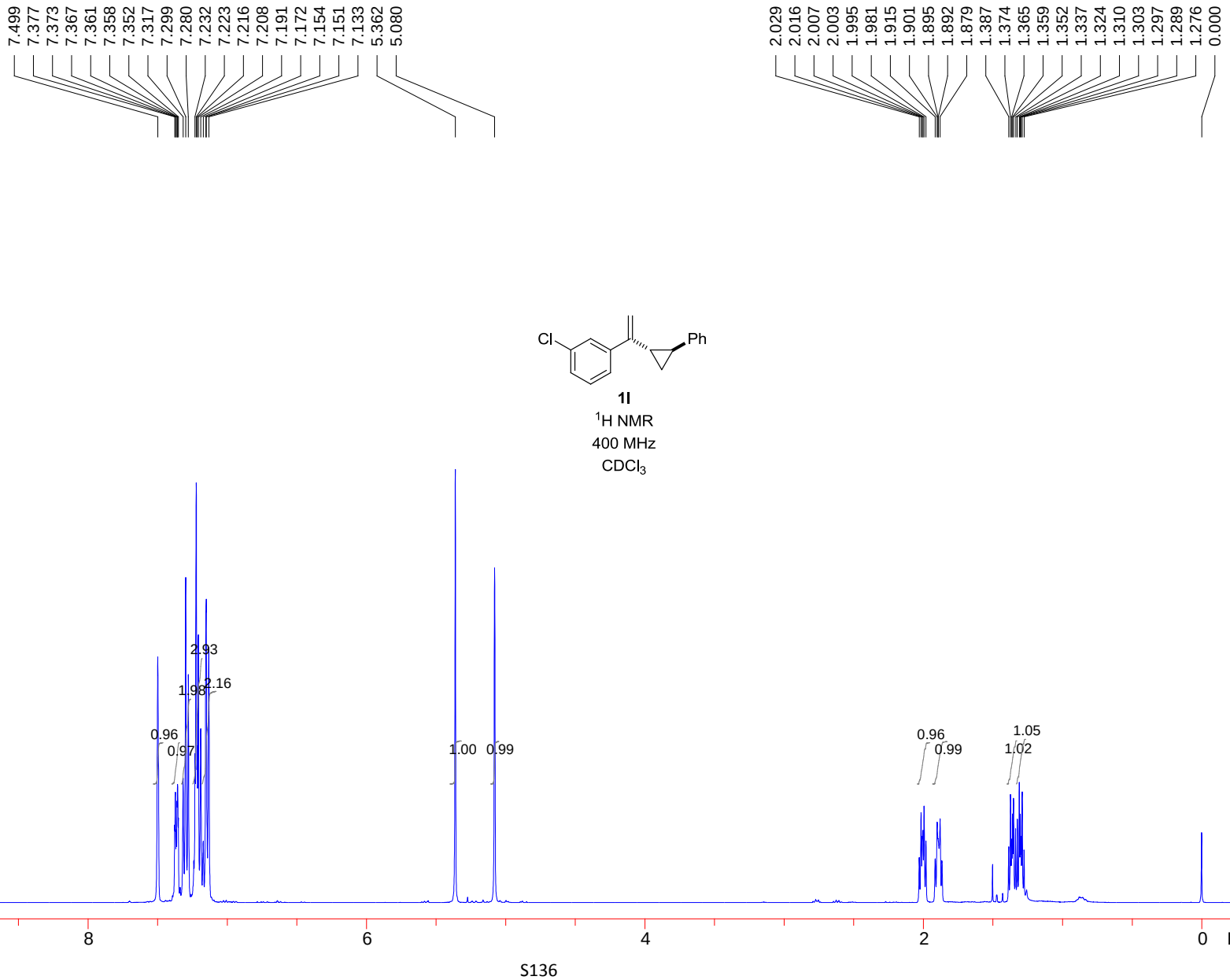
131.314
128.478
127.683
125.838
125.656
121.558
110.001
77.314
77.000
76.679
27.688
26.317
15.737
Ph
Br
1k
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.367
7.361
7.358
7.352
7.317
7.299
7.280
7.232
7.223
7.216
7.208
7.191
7.172
7.154
7.151
7.133
5.362
5.080
2.029
2.016
2.007
2.003
1.995
1.981
1.915
1.901
1.895
1.892
1.879
1.387
1.374
1.365
1.359
1.352
1.337
1.324
1.310
1.303
1.297
1.289
1.276
0.000
Cl
Ph
1l
1H NMR
400 MHz
CDCl3
2.93
2.16
1.98
0.96
0.97
1.00
0.99
0.96
0.99
1.05
1.02
8
6
4
2
0
PPM

147.217
142.952
142.135
134.224
129.506
128.514
127.559
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125.897
125.766
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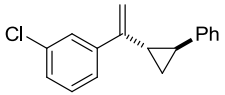
110.650
77.321
77.000
76.686
27.702
26.215
15.861

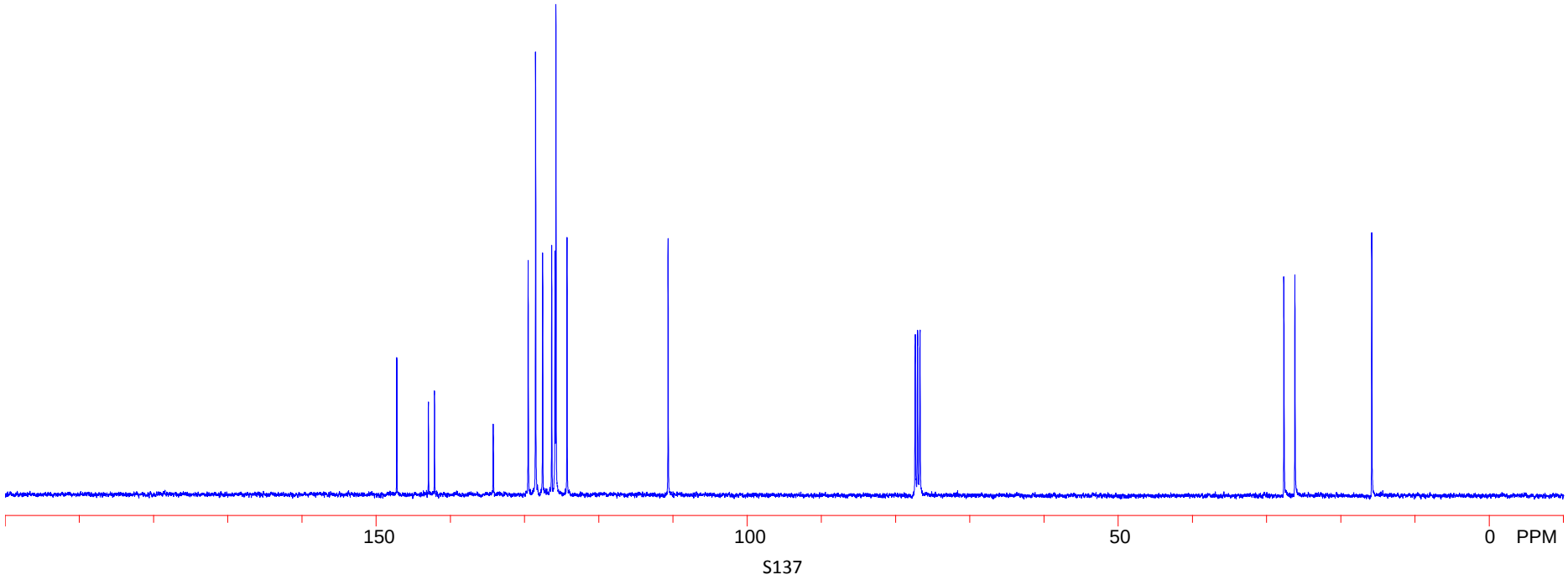


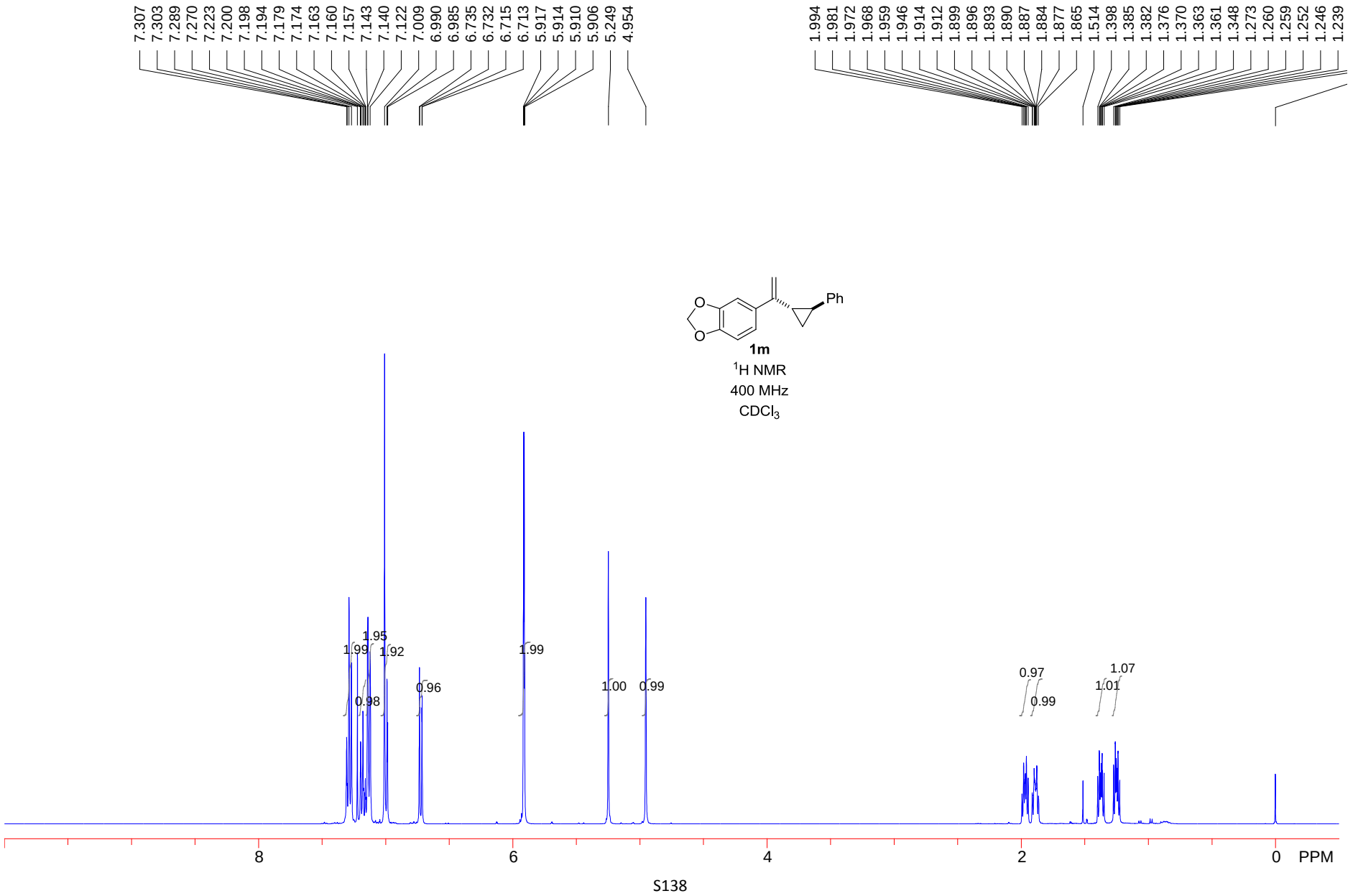
1l

^{13}C NMR

100 MHz

$CDCl_3$

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7.194
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7.174
7.163
7.160
7.157
7.143
7.140
7.122
7.009
6.990
6.985
6.735
6.732
6.715
6.713
5.917
5.914
5.910
5.906
5.249
4.954
1.994
1.981
1.972
1.968
1.959
1.946
1.914
1.912
1.899
1.896
1.893
1.890
1.887
1.884
1.877
1.865
1.514
1.398
1.385
1.382
1.376
1.370
1.363
1.361
1.348
1.273
1.260
1.259
1.252
1.246
1.239
O
O
Ph
1m
1H NMR
400 MHz
CDCl3
1.99
1.95
1.92
0.98
0.96
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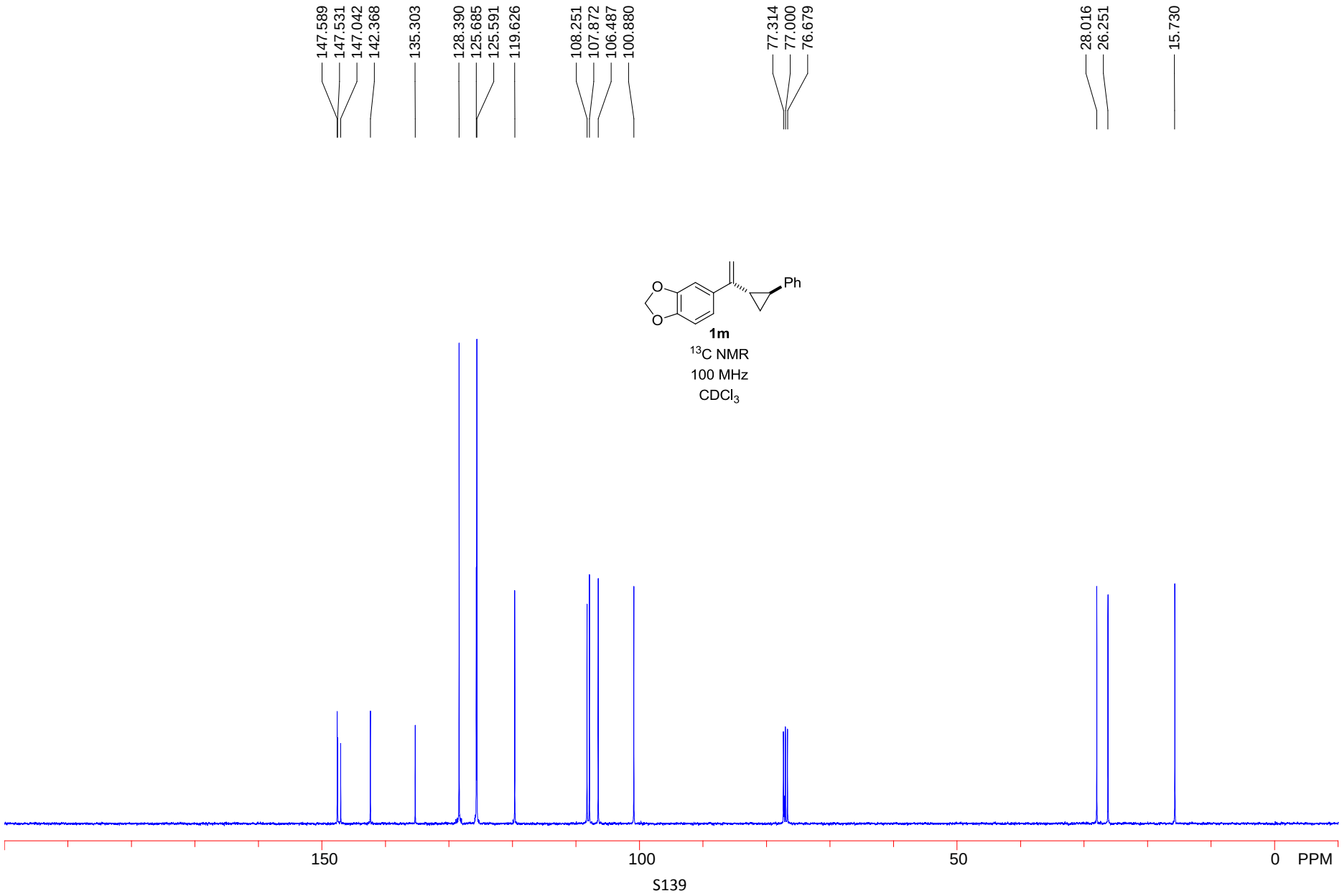
1.00
0.99
0.97
0.99
1.01
1.07
8
6
4
2
0
PPM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147.531
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142.368
135.303
128.390
125.685
125.591
119.626
108.251
107.872
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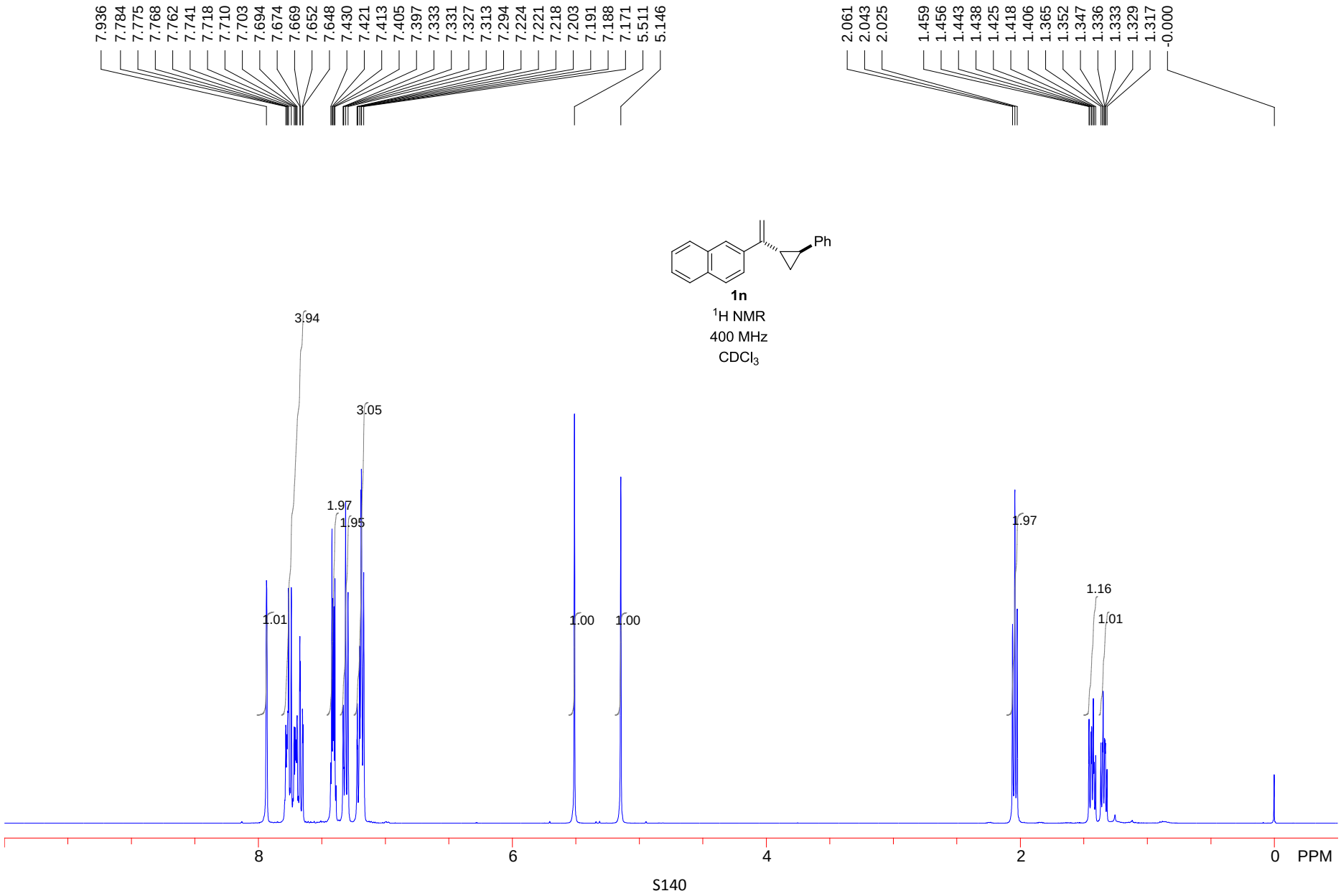
100.880
77.314
77.000
76.679
28.016
26.251
15.730
O
O
Ph
1m
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.762
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7.652
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7.331
7.327
7.313
7.294
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7.221
7.218
7.203
7.191
7.188
7.171
5.511
5.146
2.061
2.043
2.025
1.459
1.456
1.443
1.438
1.425
1.418
1.406
1.365
1.352
1.347
1.336
1.333
1.329
1.317
-0.000
Ph
1n
1H NMR
400 MHz
CDCl3
3.94
3.05
1.97
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1.00
1.00
1.97
1.16
1.01
8
6
4
2
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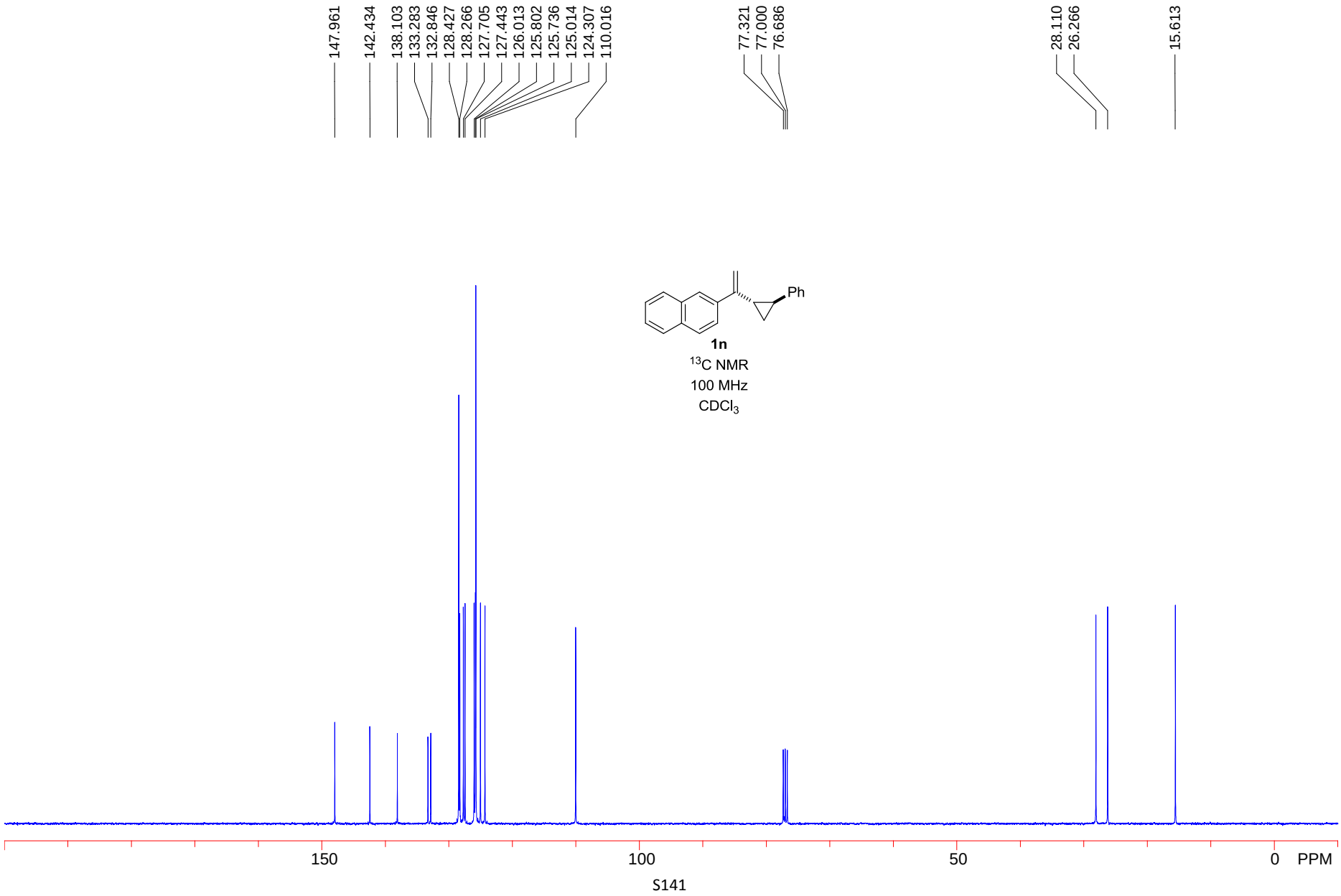
PPM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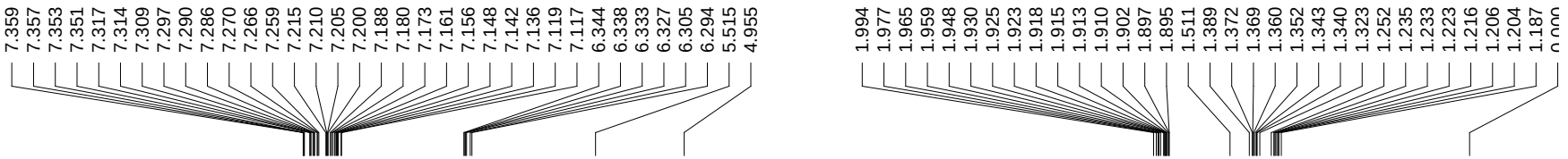
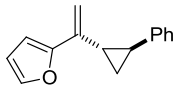
128.427
128.266
127.705
127.443
126.013
125.802
125.736
125.014
124.307
110.016
77.321
77.000
76.686
28.110
26.266
15.613
Ph
1n
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM



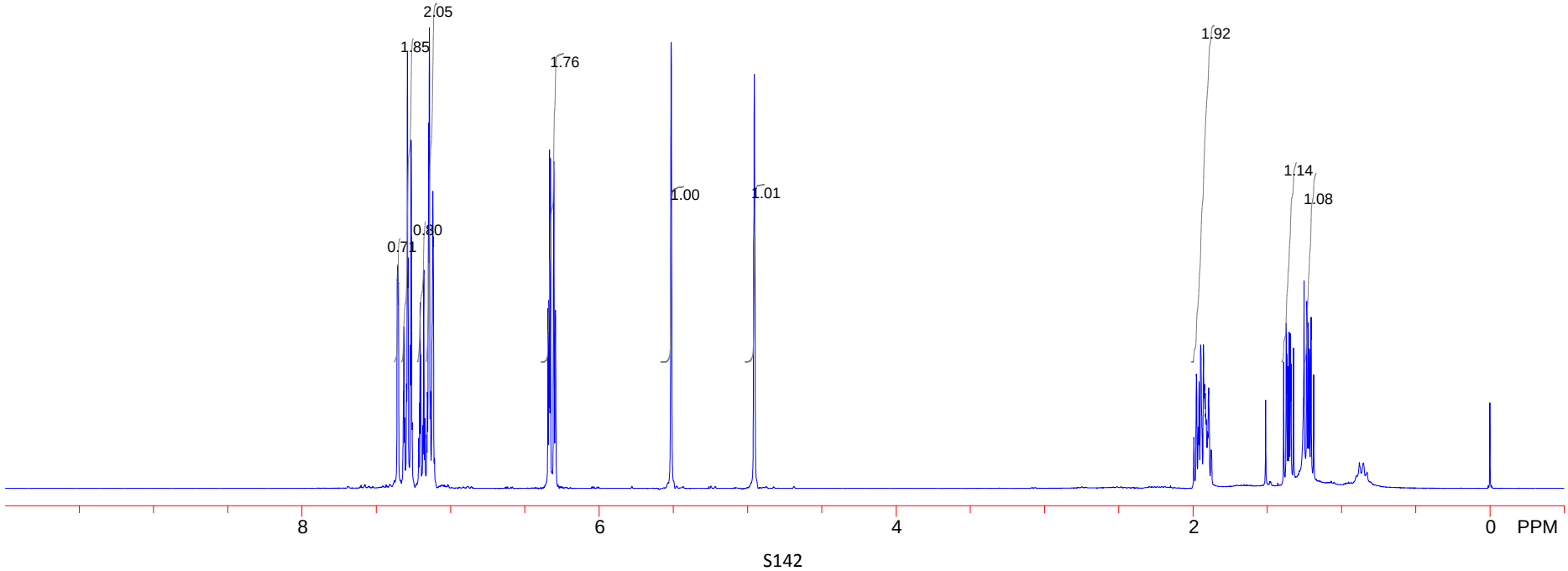


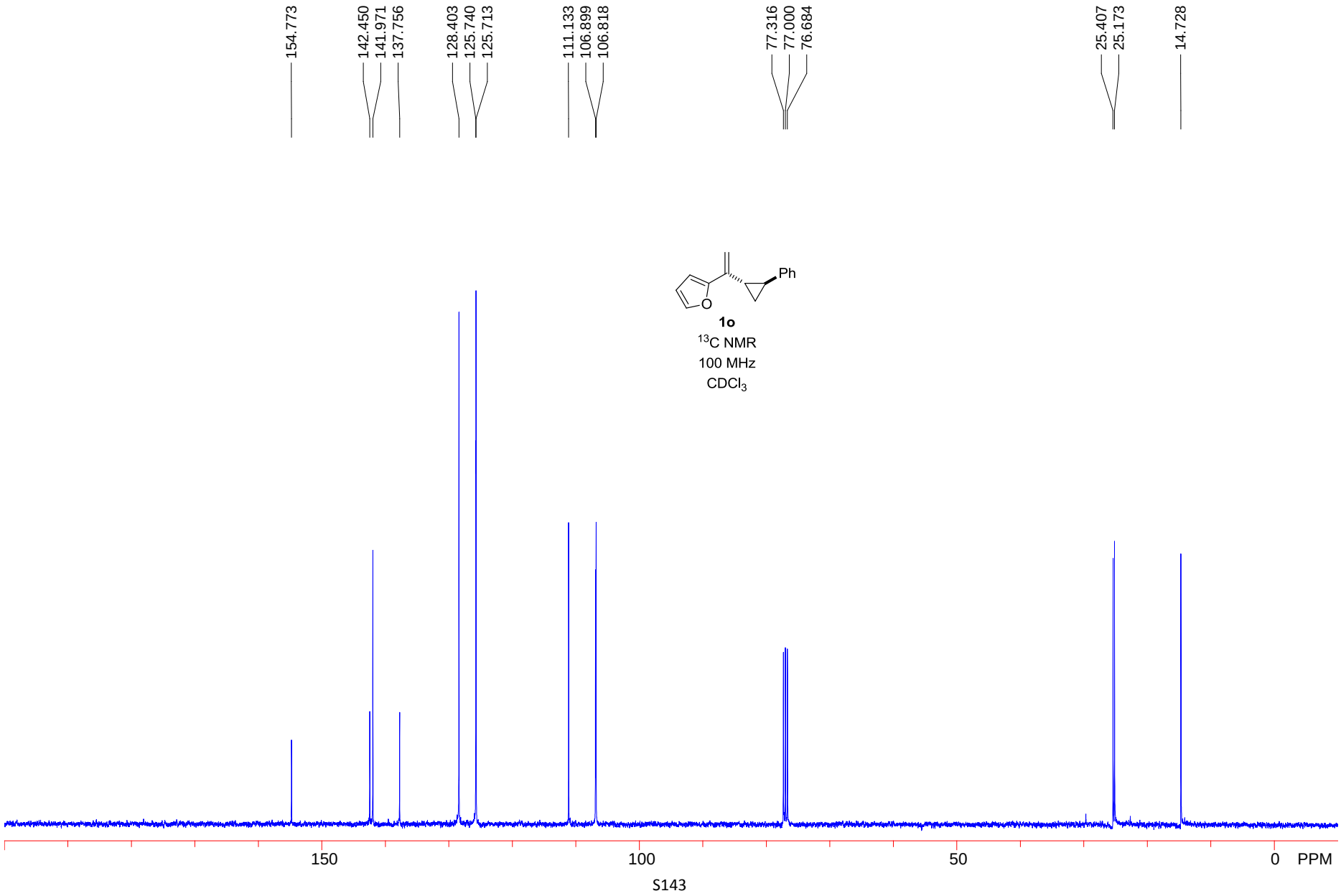
1o

^{1}H NMR

400 MHz

$CDCl_3$

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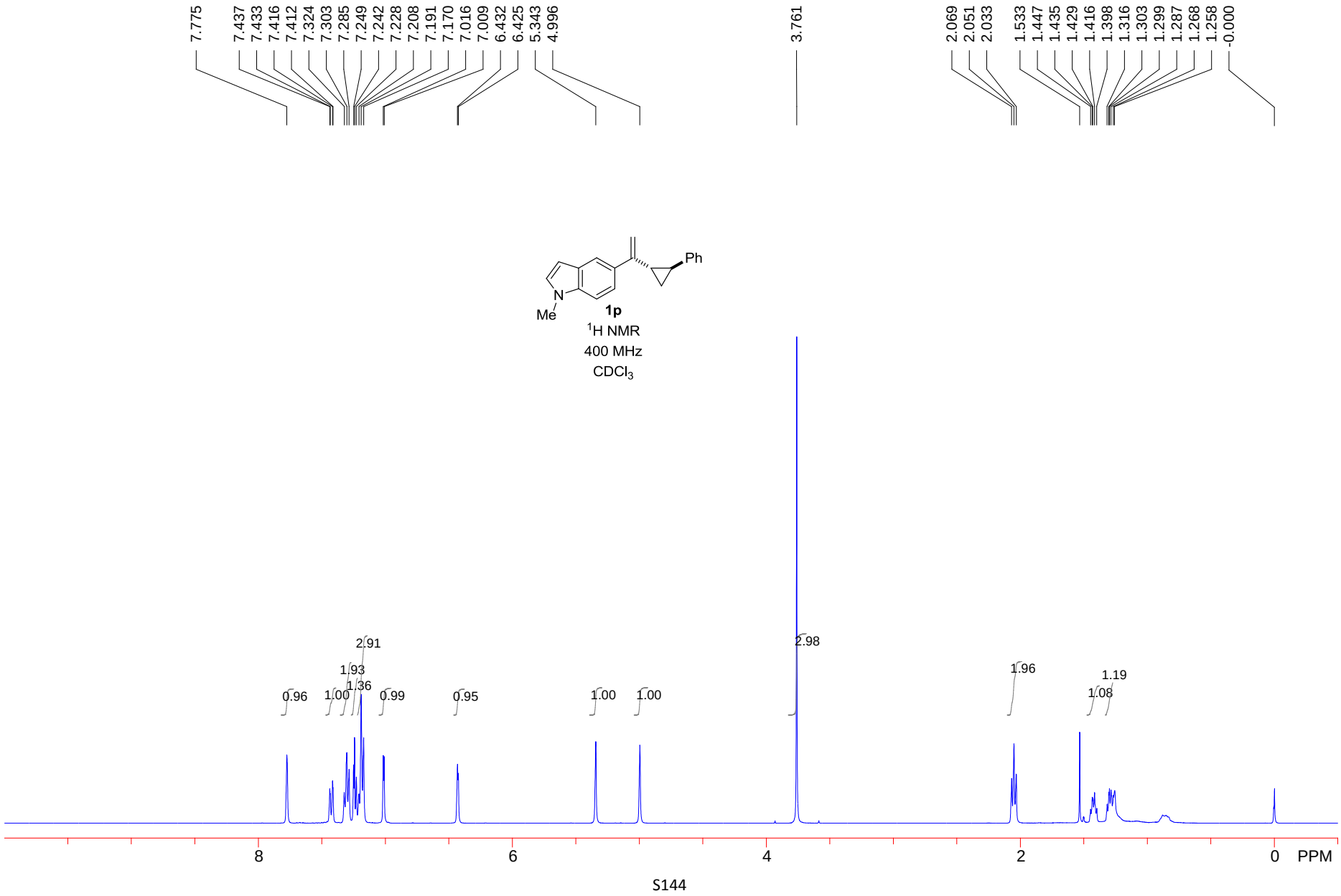
141.971
137.756
128.403
125.740
125.713
111.133
106.899
106.818
77.316
77.000
76.684
25.407
25.173
14.728
Ph
O
1o
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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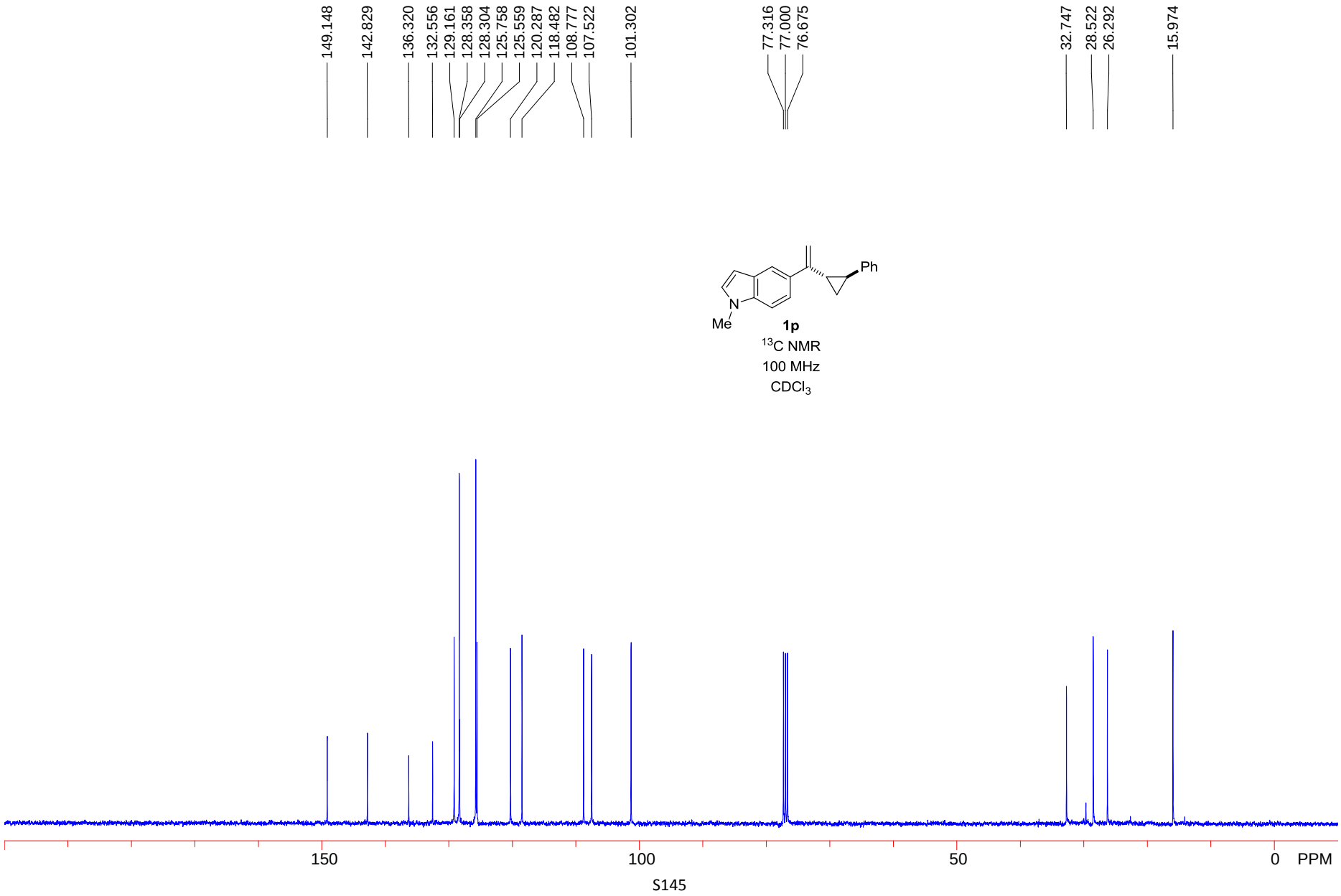
7.437
7.433
7.416
7.412
7.324
7.303
7.285
7.249
7.242
7.228
7.208
7.191
7.170
7.016
7.009
6.432
6.425
5.343
4.996
3.761
2.069
2.051
2.033
1.533
1.447
1.435
1.429
1.416
1.398
1.316
1.303
1.299
1.287
1.268
1.258
-0.000
Ph
N
Me
1p
1H NMR
400 MHz
CDCl3
2.91
1.93
1.36
0.96
1.00
0.99
0.95
1.00
1.00
2.98
1.96
1.19
1.08
8
6
4
2
0
PPM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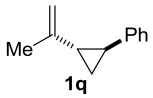
142.829
136.320
132.556
129.161
128.358
128.304
125.758
125.559
120.287
118.482
108.777
107.522
101.302
77.316
77.000
76.675
32.747
28.522
26.292
15.974
Ph
N
Me
1p
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM

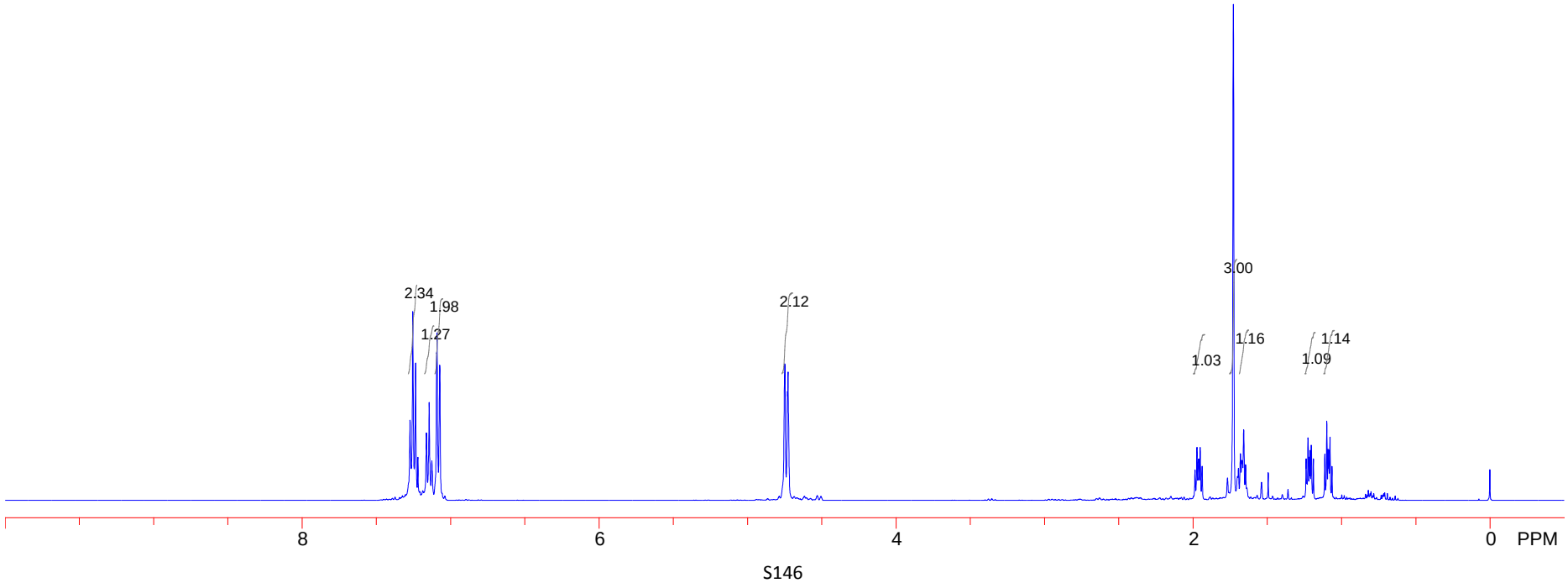


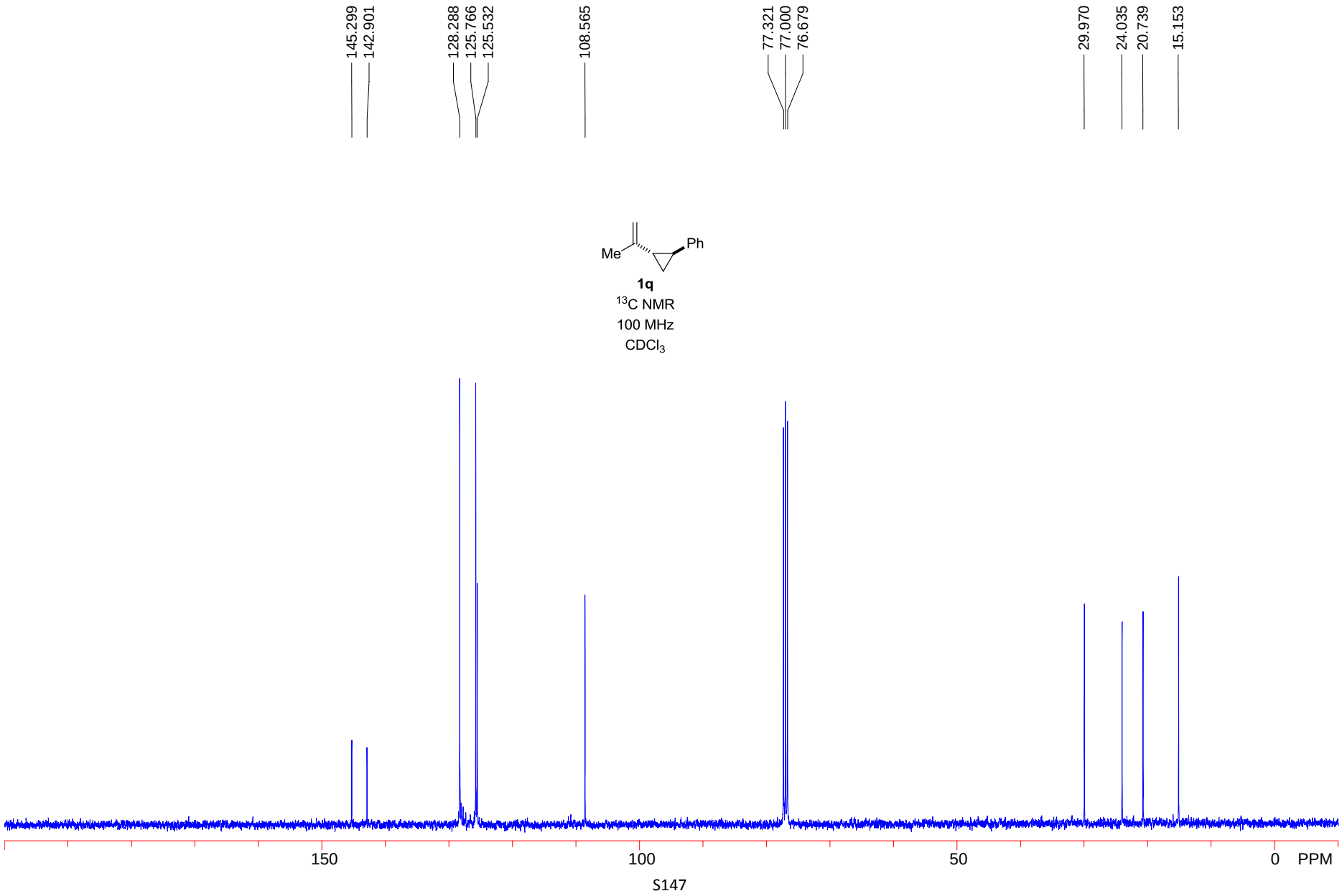
1q

^{1}H NMR

400 MHz

$CDCl_3$

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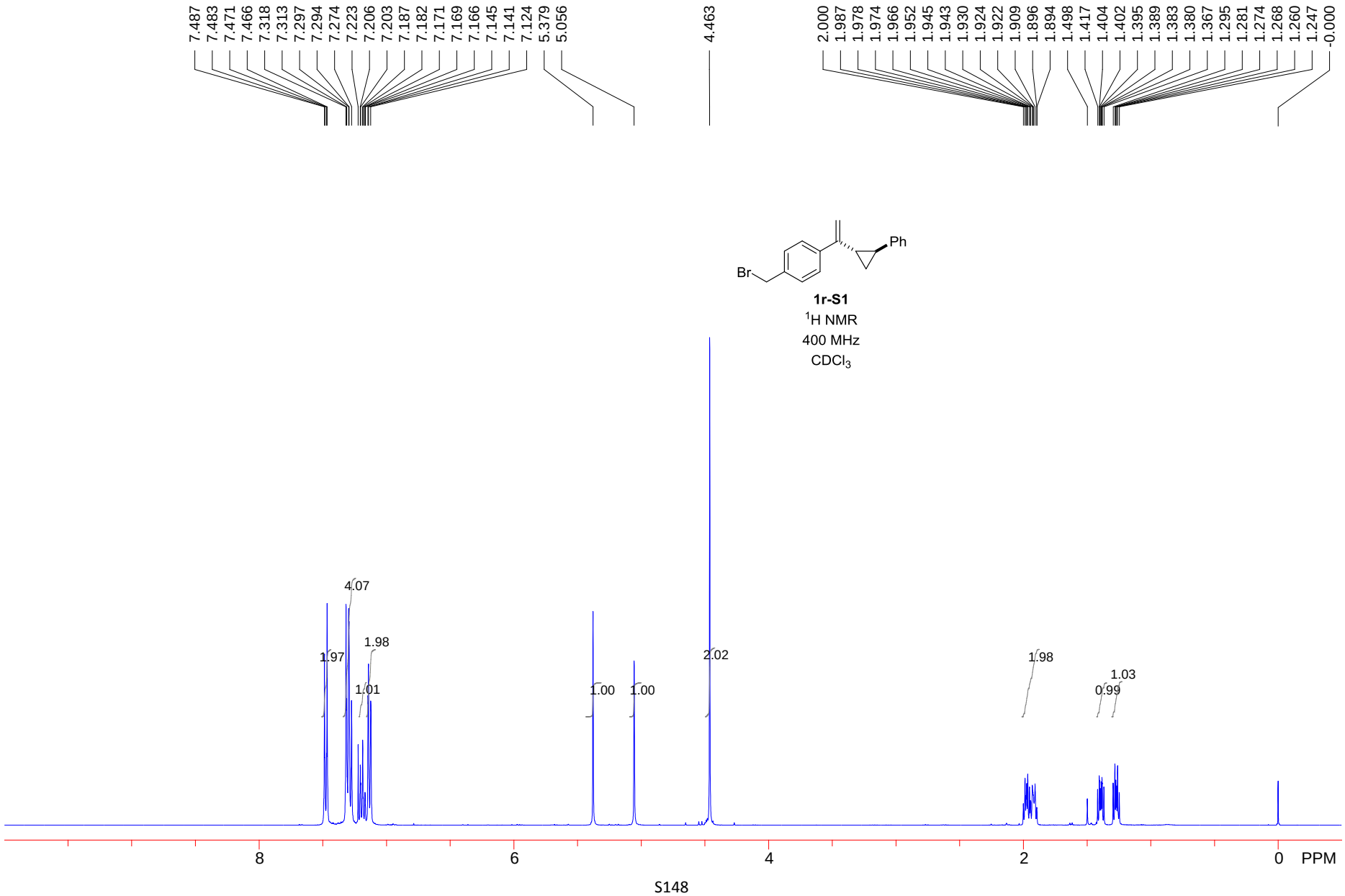
142.901
128.288
125.766
125.532
108.565
77.321
77.000
76.679
29.970
24.035
20.739
15.153
Me
Ph
1q
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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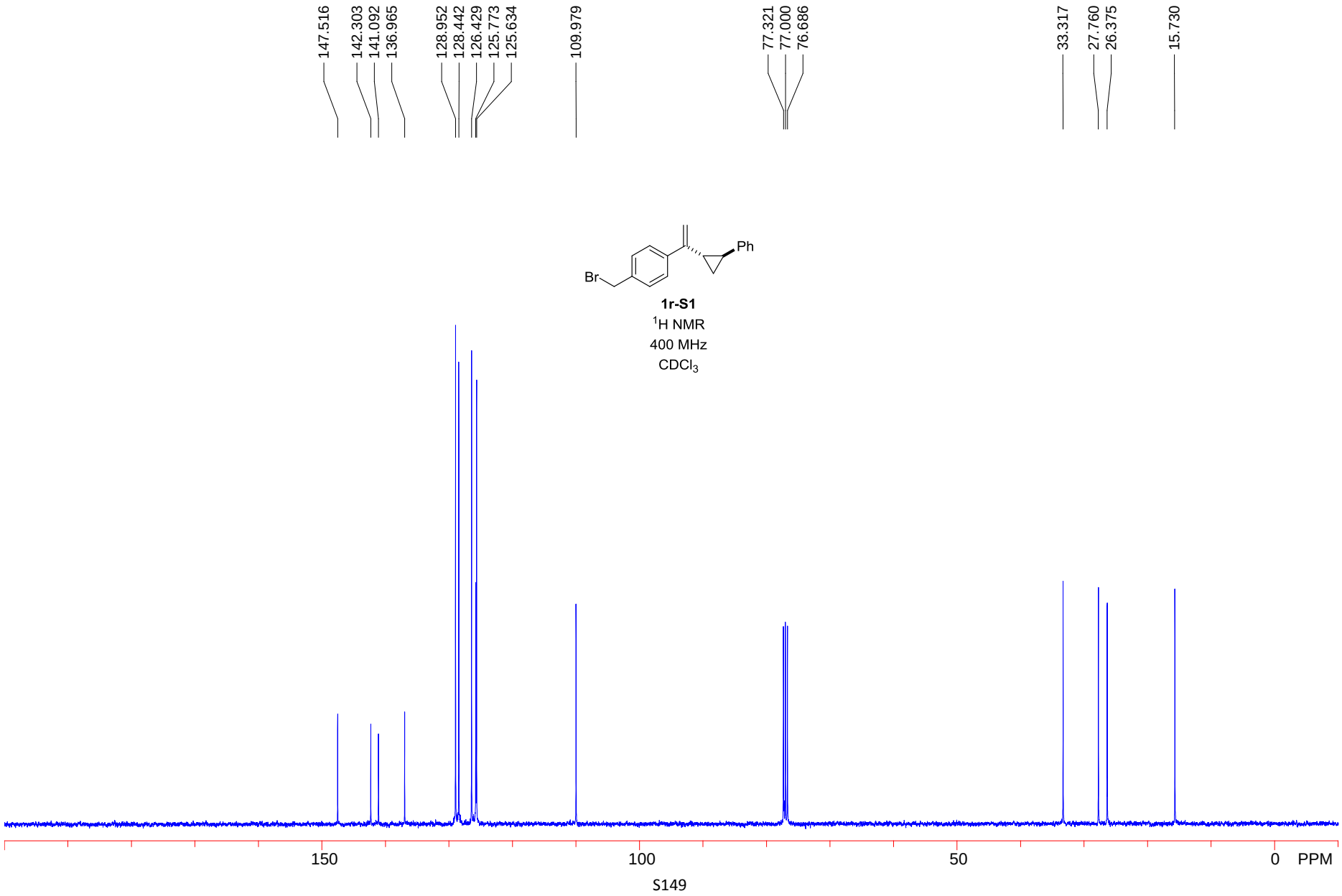
7.483
7.471
7.466
7.318
7.313
7.297
7.294
7.274
7.223
7.206
7.203
7.187
7.182
7.171
7.169
7.166
7.145
7.141
7.124
5.379
5.056
4.463
2.000
1.987
1.978
1.974
1.966
1.952
1.945
1.943
1.930
1.924
1.922
1.909
1.896
1.894
1.498
1.417
1.404
1.402
1.395
1.389
1.383
1.380
1.367
1.295
1.281
1.274
1.268
1.260
1.247
-0.000
Br
Ph
1r-S1
1H NMR
400 MHz
CDCl3
4.07
1.97
1.98
1.01
1.00
1.00
2.02
1.98
1.03
0.99
8
6
4
2
0
PPM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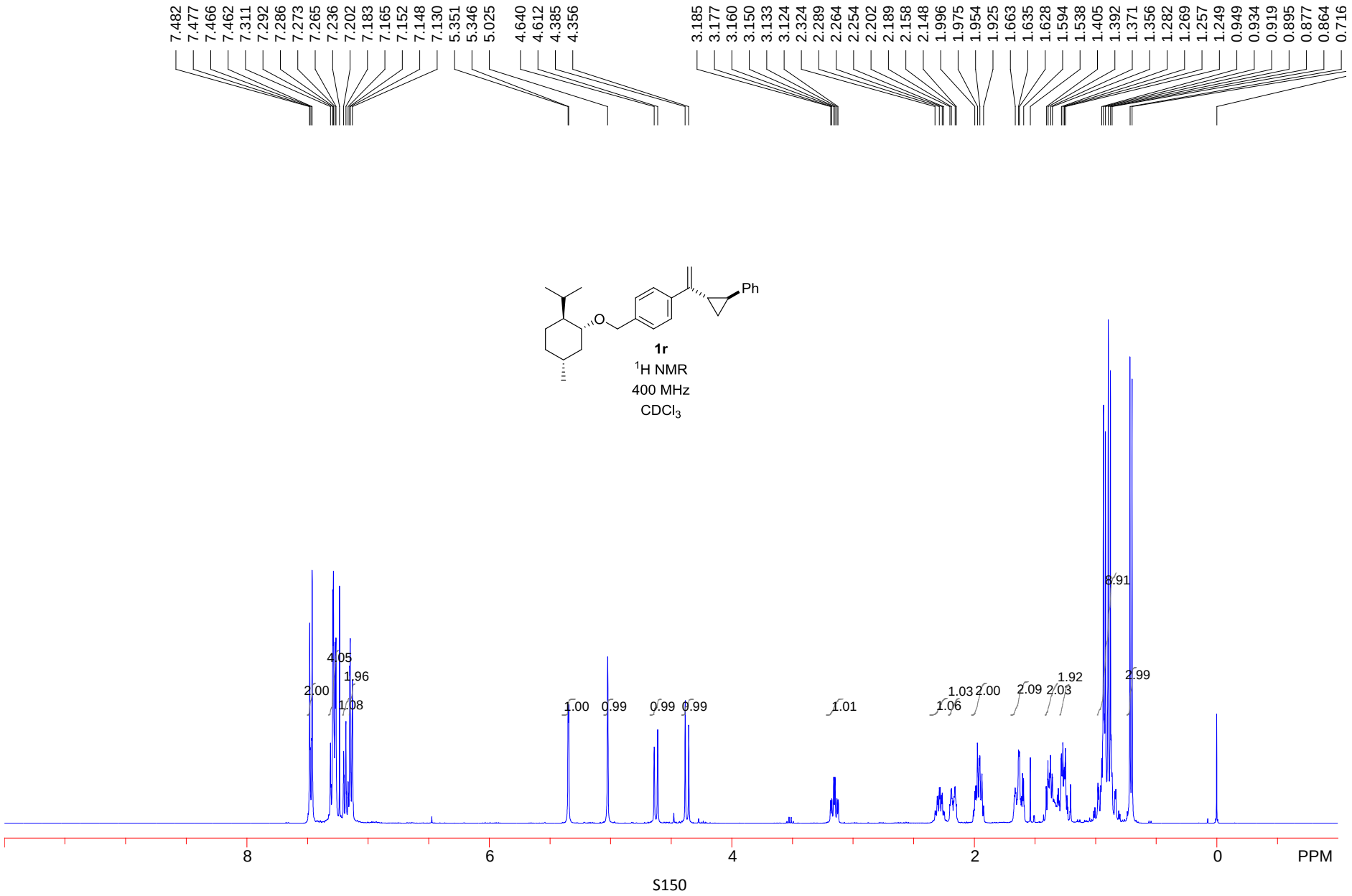
142.303
141.092
136.965
128.952
128.442
126.429
125.773
125.634
109.979
77.321
77.000
76.686
33.317
27.760
26.375
15.730
Br
Ph
1r-S1
1H NMR
400 MHz
CDCl3
150
100
50
0
PPM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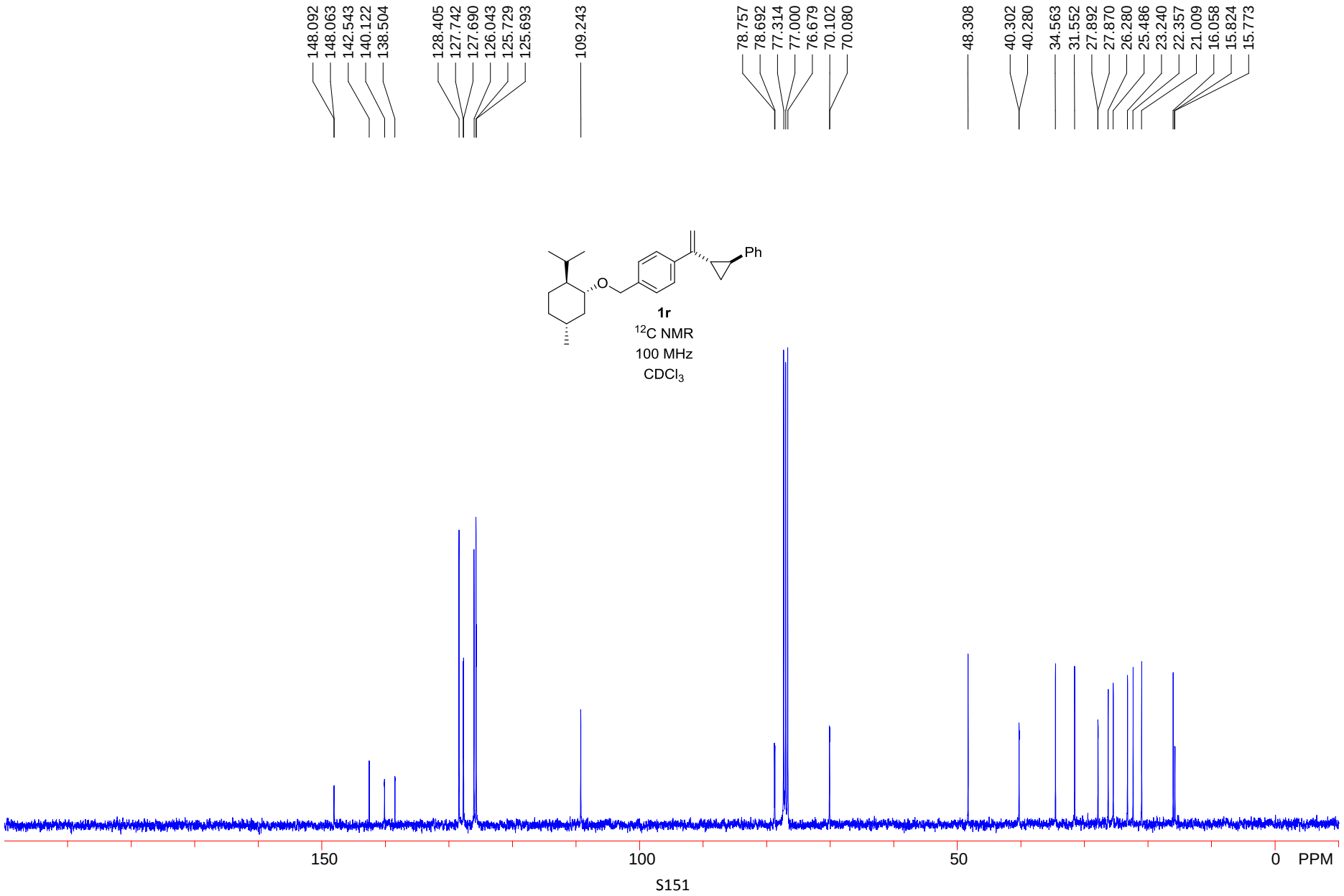
7.477
7.466
7.462
7.311
7.292
7.286
7.273
7.265
7.236
7.202
7.183
7.165
7.152
7.148
7.130
5.351
5.346
5.025
4.640
4.612
4.385
4.356
3.185
3.177
3.160
3.150
3.133
3.124
2.324
2.289
2.264
2.254
2.202
2.189
2.158
2.148
1.996
1.975
1.954
1.925
1.663
1.635
1.628
1.594
1.538
1.405
1.392
1.371
1.356
1.282
1.269
1.257
1.249
0.949
0.934
0.919
0.895
0.877
0.864
0.716
Ph
O
1r
1H NMR
400 MHz
CDCl3
2.00
4.05
1.96
1.08
1.00
0.99
0.99
0.99
1.01
1.06
1.03
2.00
2.09
2.03
1.92
8.91
2.99
8
6
4
2
0
PPM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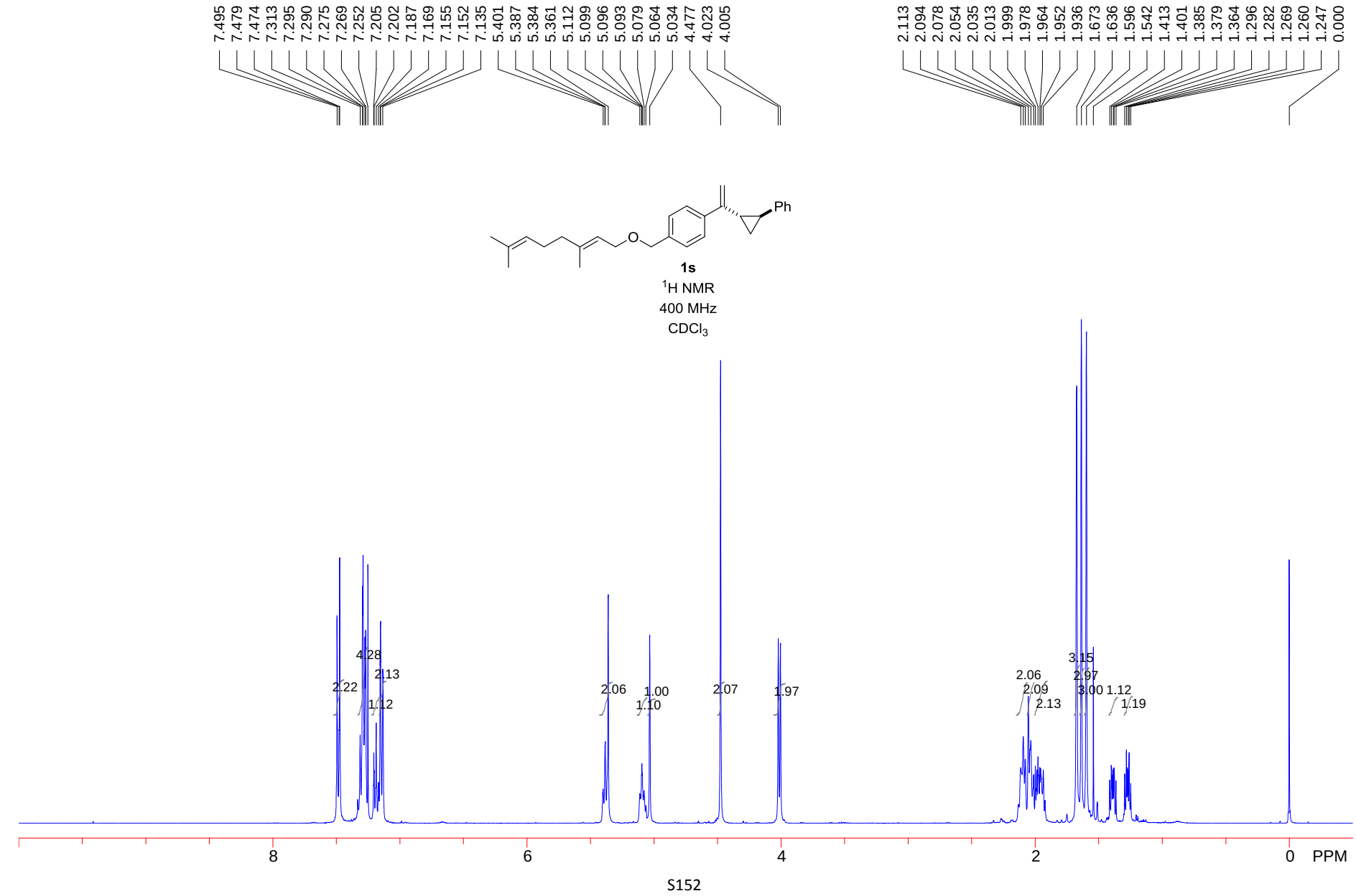
140.122
138.504
128.405
127.742
127.690
126.043
125.729
125.693
109.243
78.757
78.692
77.314
77.000
76.679
70.102
70.080
48.308
40.302
40.280
34.563
31.552
27.892
27.870
26.280
25.486
23.240
22.357
21.009
16.058
15.824
15.773
O
Ph
1r
12C NMR
100 MHz
CDCl3
150
100
50
0
PPM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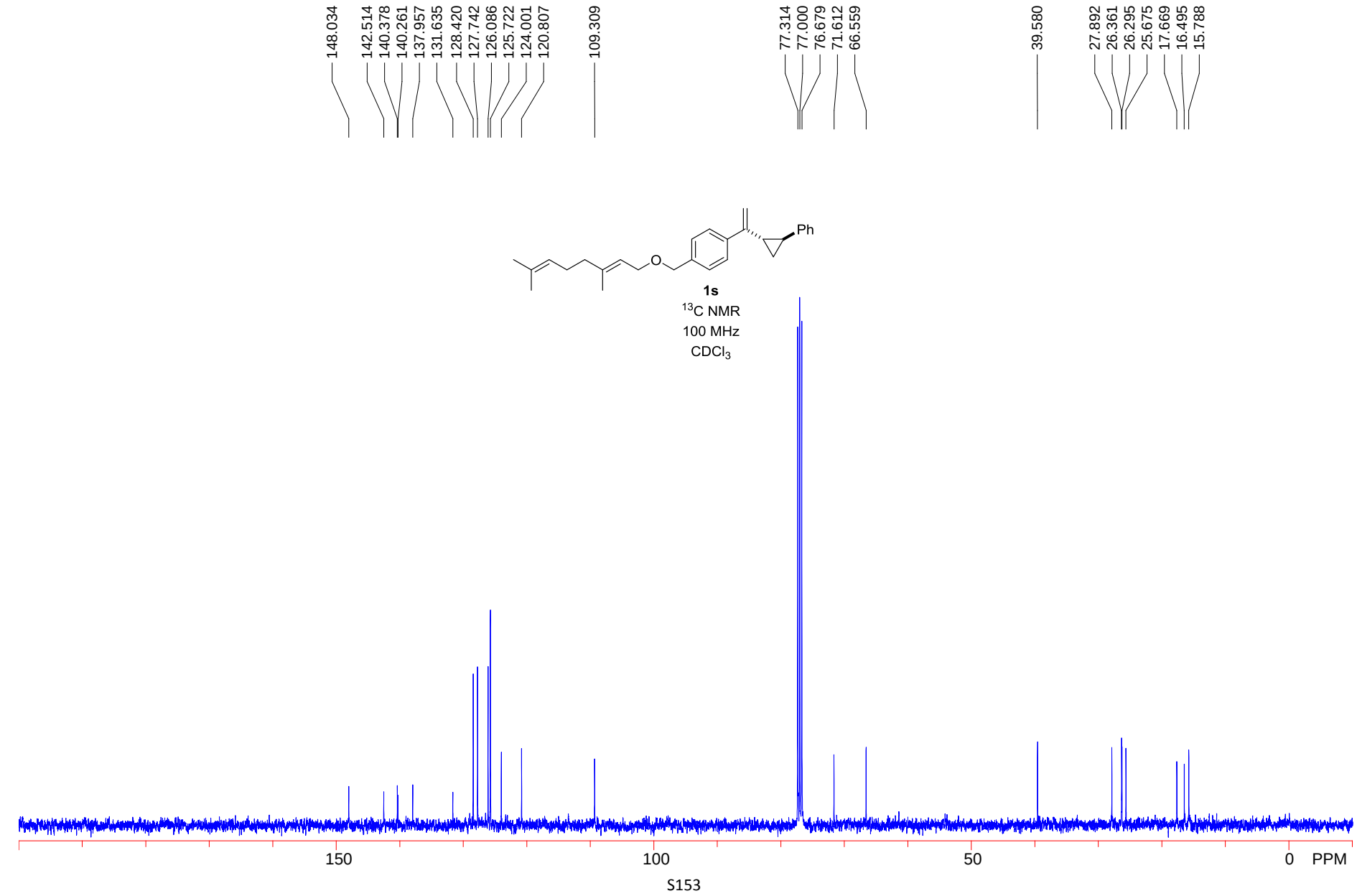
7.479
7.474
7.313
7.295
7.290
7.275
7.269
7.252
7.205
7.202
7.187
7.169
7.155
7.152
7.135
5.401
5.387
5.384
5.361
5.112
5.099
5.096
5.093
5.079
5.064
5.034
4.477
4.023
4.005
2.113
2.094
2.078
2.054
2.035
2.013
1.999
1.978
1.964
1.952
1.936
1.673
1.636
1.596
1.542
1.413
1.401
1.385
1.379
1.364
1.296
1.282
1.269
1.260
1.247
0.000
Ph
O
1s
1H NMR
400 MHz
CDCl3
4.28
2.13
2.22
1.12
2.06
1.00
1.10
2.07
1.97
2.06
2.09
2.13
3.15
2.97
3.00
1.12
1.19
8
6
4
2
0
PPM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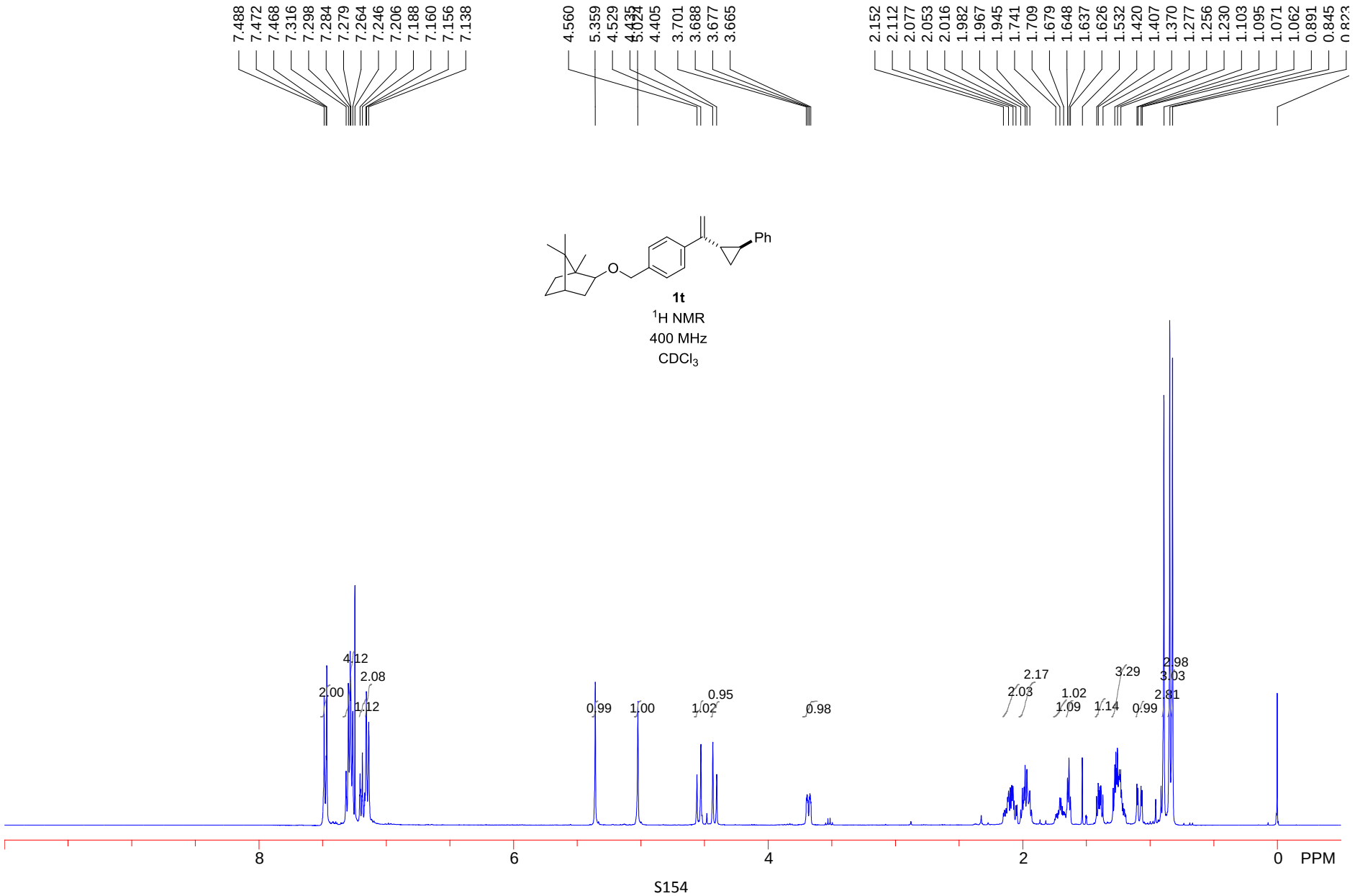
140.261
137.957
131.635
128.420
127.742
126.086
125.722
124.001
120.807
109.309
77.314
77.000
76.679
71.612
66.559
39.580
27.892
26.361
26.295
25.675
17.669
16.495
15.788
Ph
O
1s
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.284
7.279
7.264
7.246
7.206
7.188
7.160
7.156
7.138
4.560
5.359
4.529
4.435
4.424
4.405
3.701
3.688
3.677
3.665
2.152
2.112
2.077
2.053
2.016
1.982
1.967
1.945
1.741
1.709
1.679
1.648
1.637
1.626
1.532
1.420
1.407
1.370
1.277
1.256
1.230
1.103
1.095
1.071
1.062
0.891
0.845
Ph
O
1t
1H NMR
400 MHz
CDCl3
4.12
2.08
2.00
1.12
0.99
1.00
1.02
0.95
0.98
2.17
2.03
1.02
1.09
1.14
3.29
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3.03
2.81
8
6
4
2
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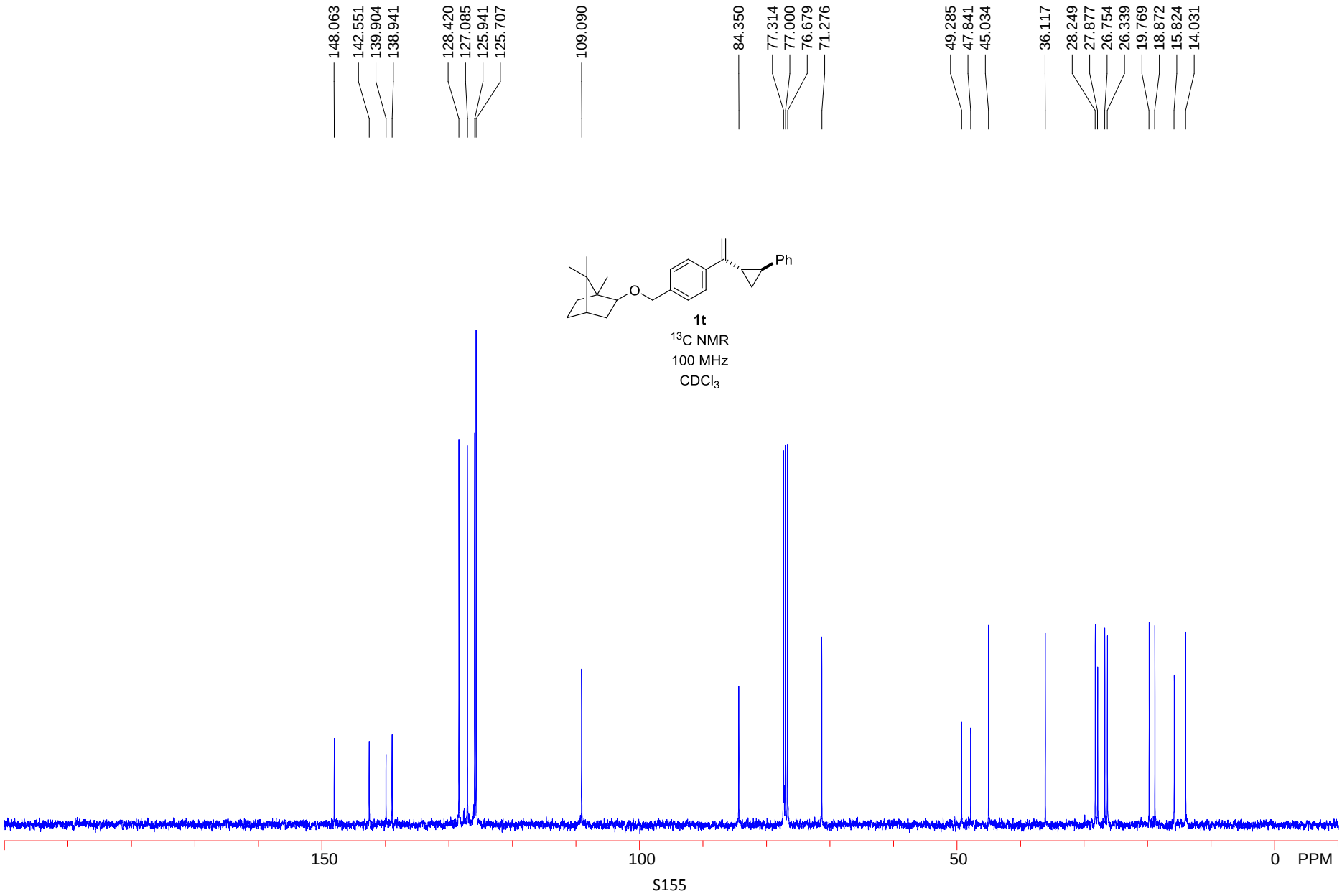
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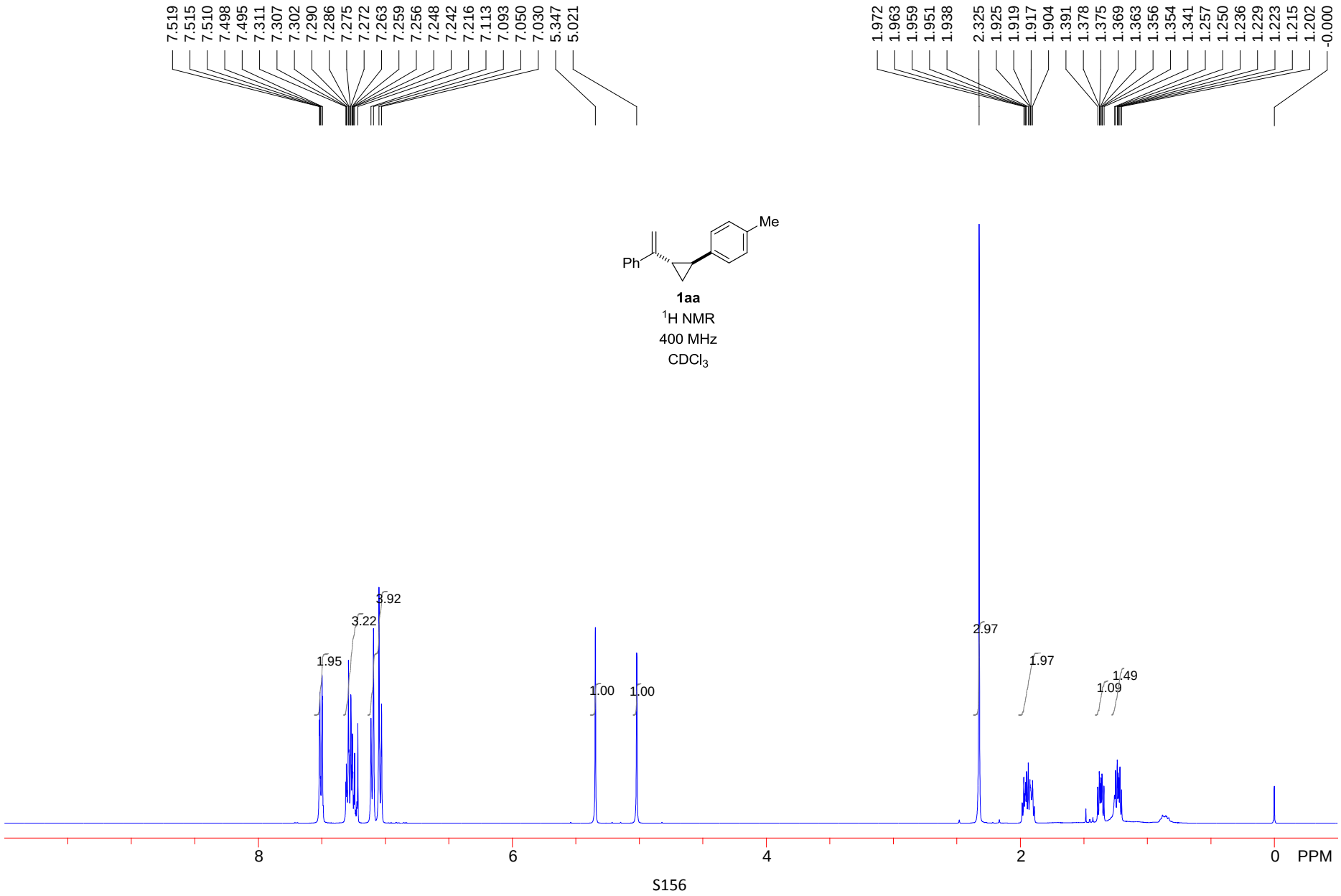
127.085
125.941
125.707
109.090
84.350
77.314
77.000
76.679
71.276
49.285
47.841
45.034
36.117
28.249
27.877
26.754
26.339
19.769
18.872
15.824
14.031
Ph
O
1t
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.495
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7.307
7.302
7.290
7.286
7.275
7.272
7.263
7.259
7.256
7.248
7.242
7.216
7.113
7.093
7.050
7.030
5.347
5.021
1.972
1.963
1.959
1.951
1.938
2.325
1.925
1.919
1.917
1.904
1.391
1.378
1.375
1.369
1.363
1.356
1.354
1.341
1.257
1.250
1.236
1.229
1.223
1.215
1.202
-0.000
Me
Ph
1aa
1H NMR
400 MHz
CDCl3
1.95
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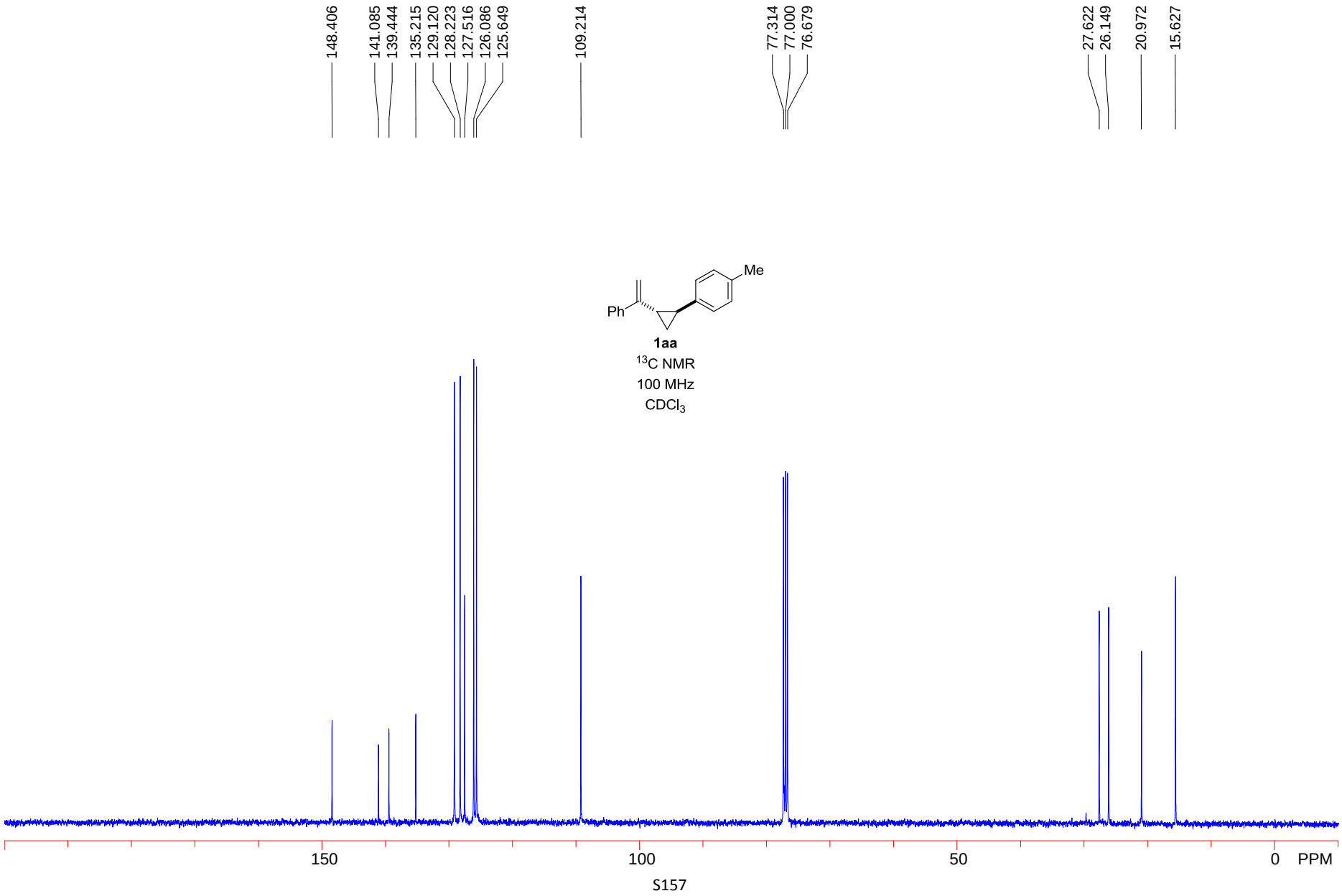
1.00
1.00
2.97
1.97
1.09
1.49
8
6
4
2
0
PPM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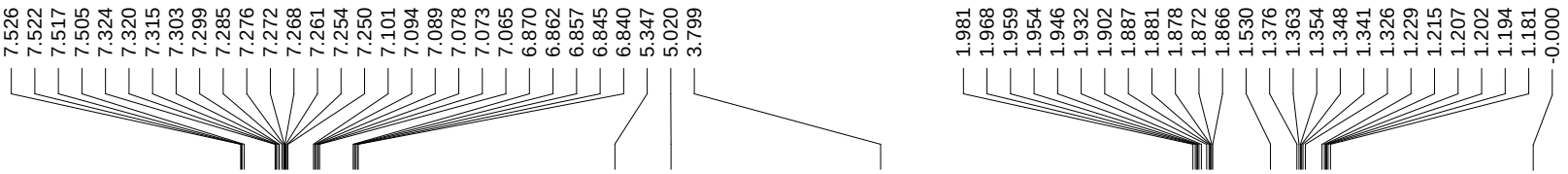
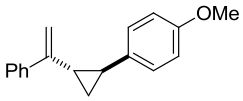
135.215
129.120
128.223
127.516
126.086
125.649
109.214
77.314
77.000
76.679
27.622
26.149
20.972
15.627
Me
Ph
1aa
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM



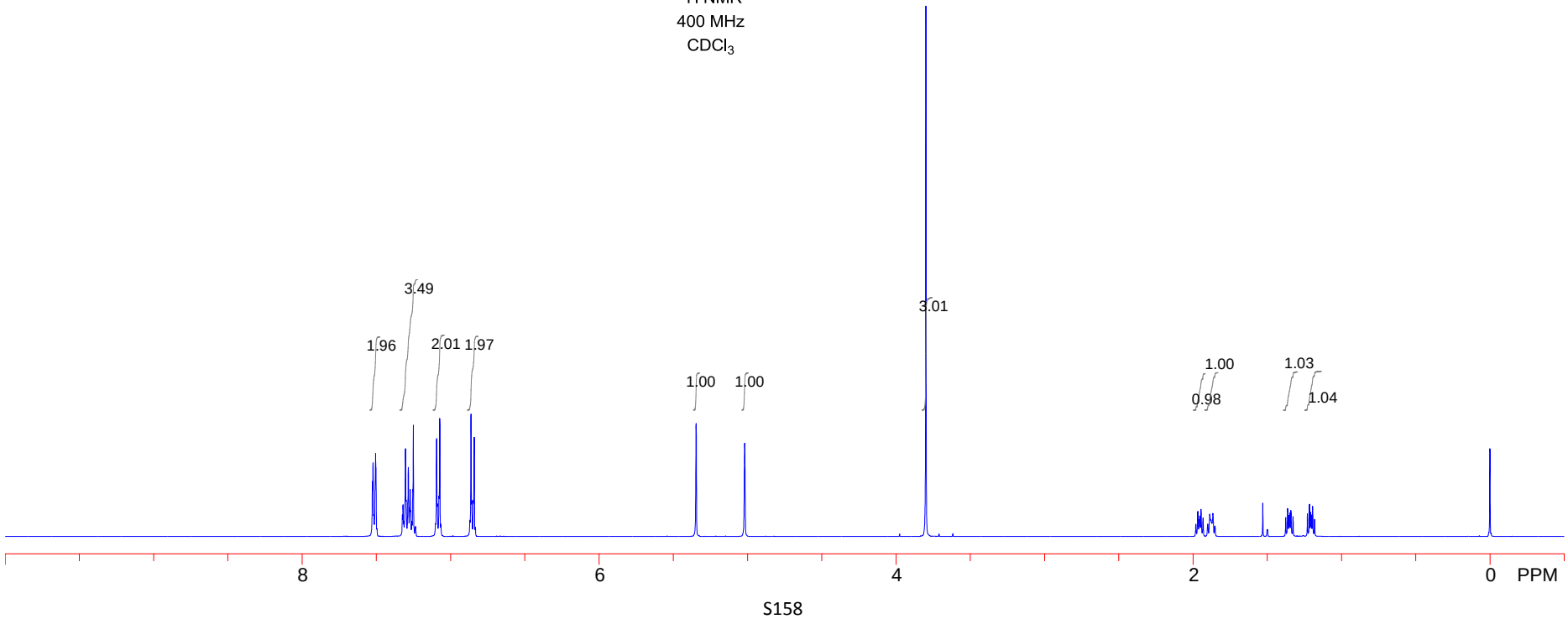


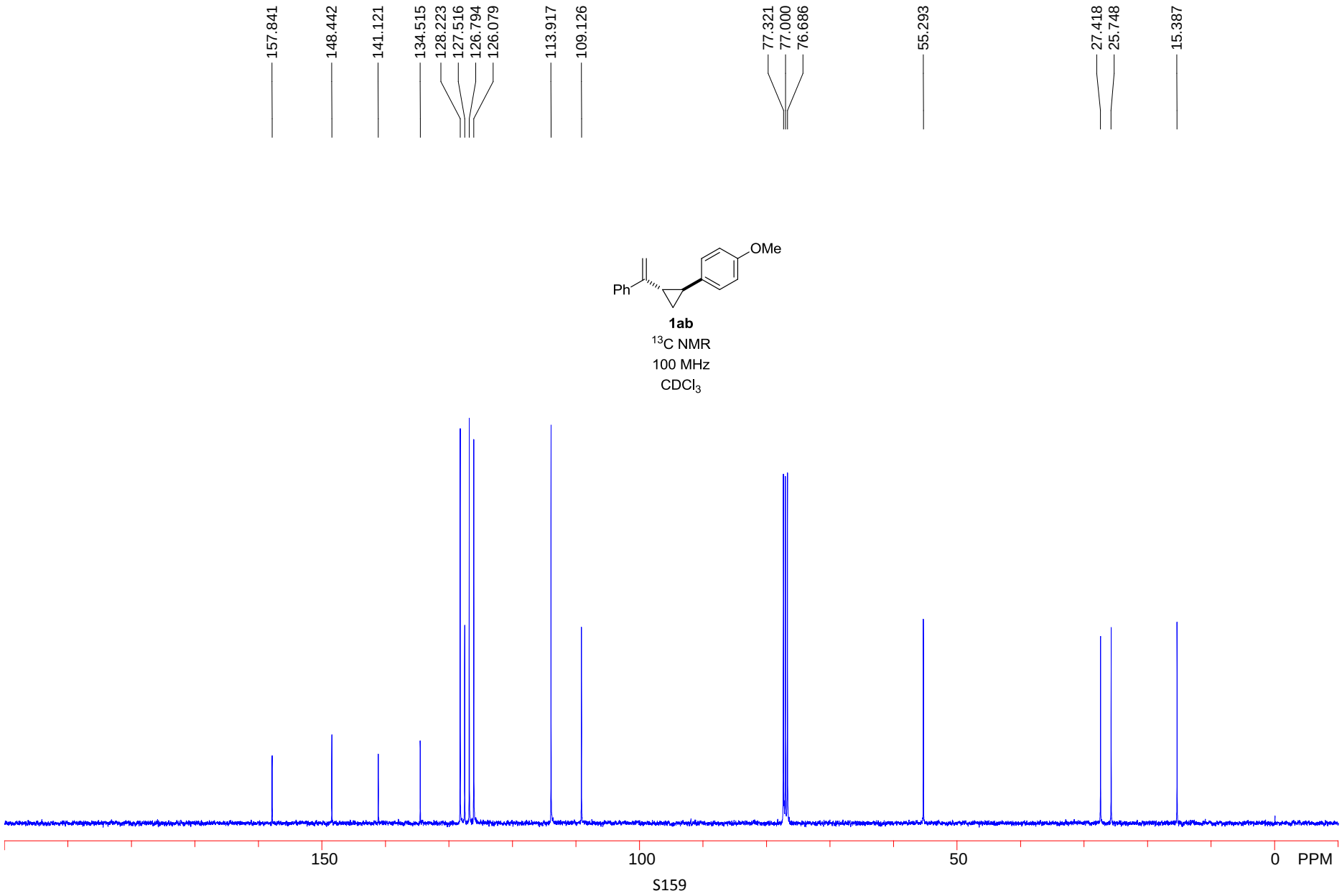
1ab

^{1}H NMR

400 MHz

$CDCl_3$

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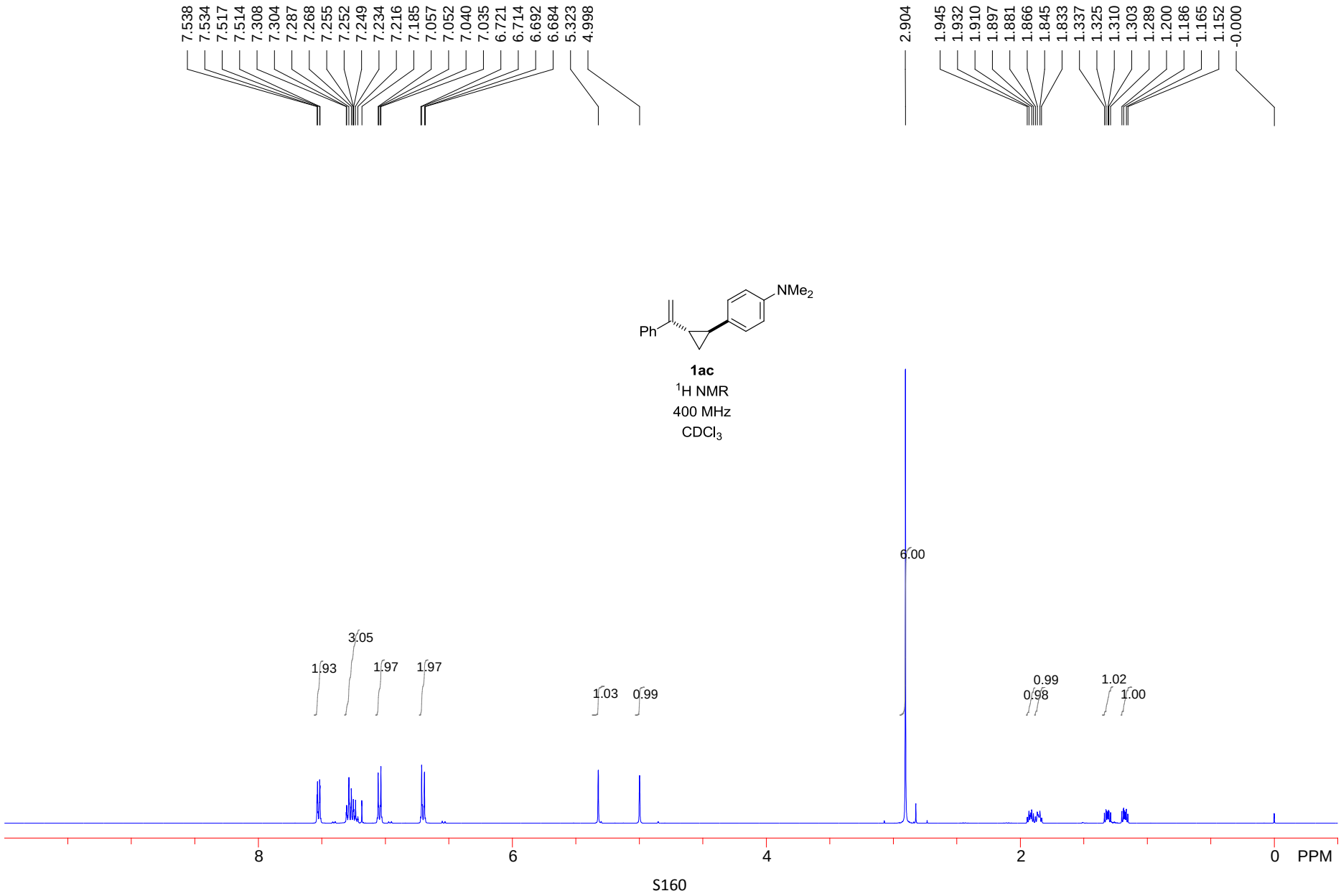
148.442
141.121
134.515
128.223
127.516
126.794
126.079
113.917
109.126
77.321
77.000
76.686
55.293
27.418
25.748
15.387
OMe
Ph
1ab
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


7.538
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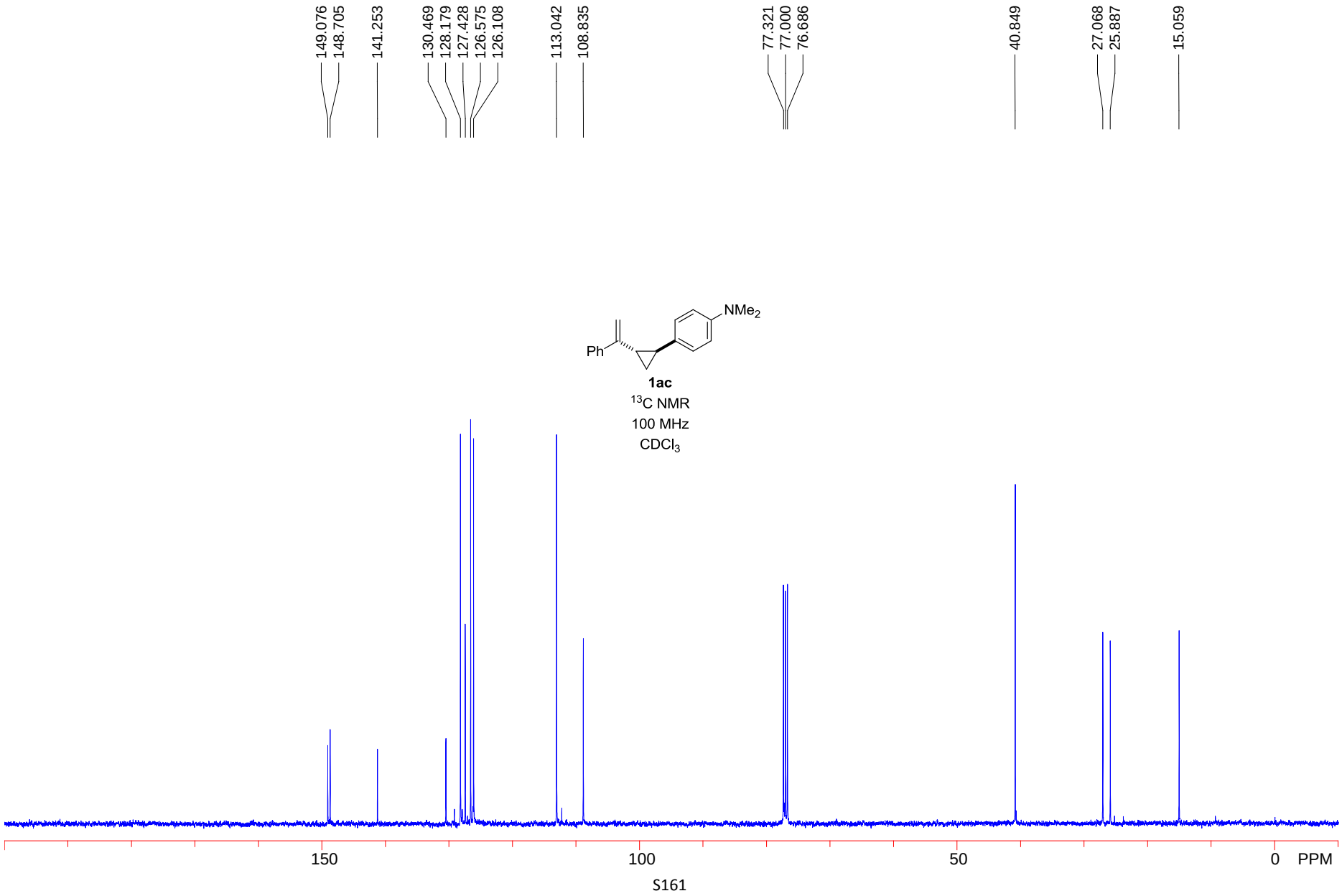
7.514
7.308
7.304
7.287
7.268
7.255
7.252
7.249
7.234
7.216
7.185
7.057
7.052
7.040
7.035
6.721
6.714
6.692
6.684
5.323
4.998
2.904
1.945
1.932
1.910
1.897
1.881
1.866
1.845
1.833
1.337
1.325
1.310
1.303
1.289
1.200
1.186
1.165
1.152
-0.000
NMe2
Ph
1ac
1H NMR
400 MHz
CDCl3
6.00
3.05
1.93
1.97
1.97
1.03
0.99
0.99
0.98
1.02
1.00
8
6
4
2
0
PPM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127.428
126.575
126.108
113.042
108.835
77.321
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76.686
40.849
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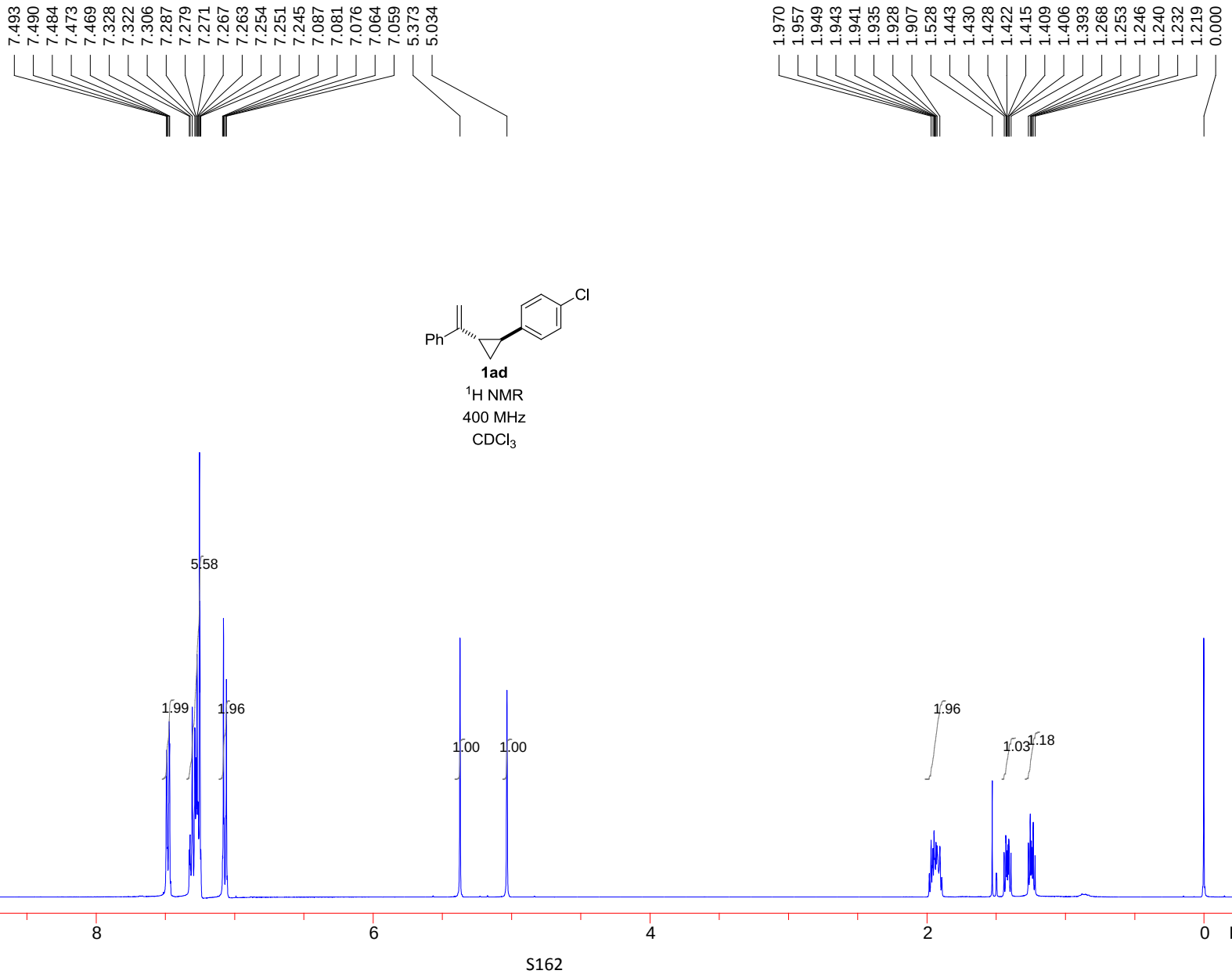
25.887
15.059
NMe2
Ph
1ac
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.473
7.469
7.328
7.322
7.306
7.287
7.279
7.271
7.267
7.263
7.254
7.251
7.245
7.087
7.081
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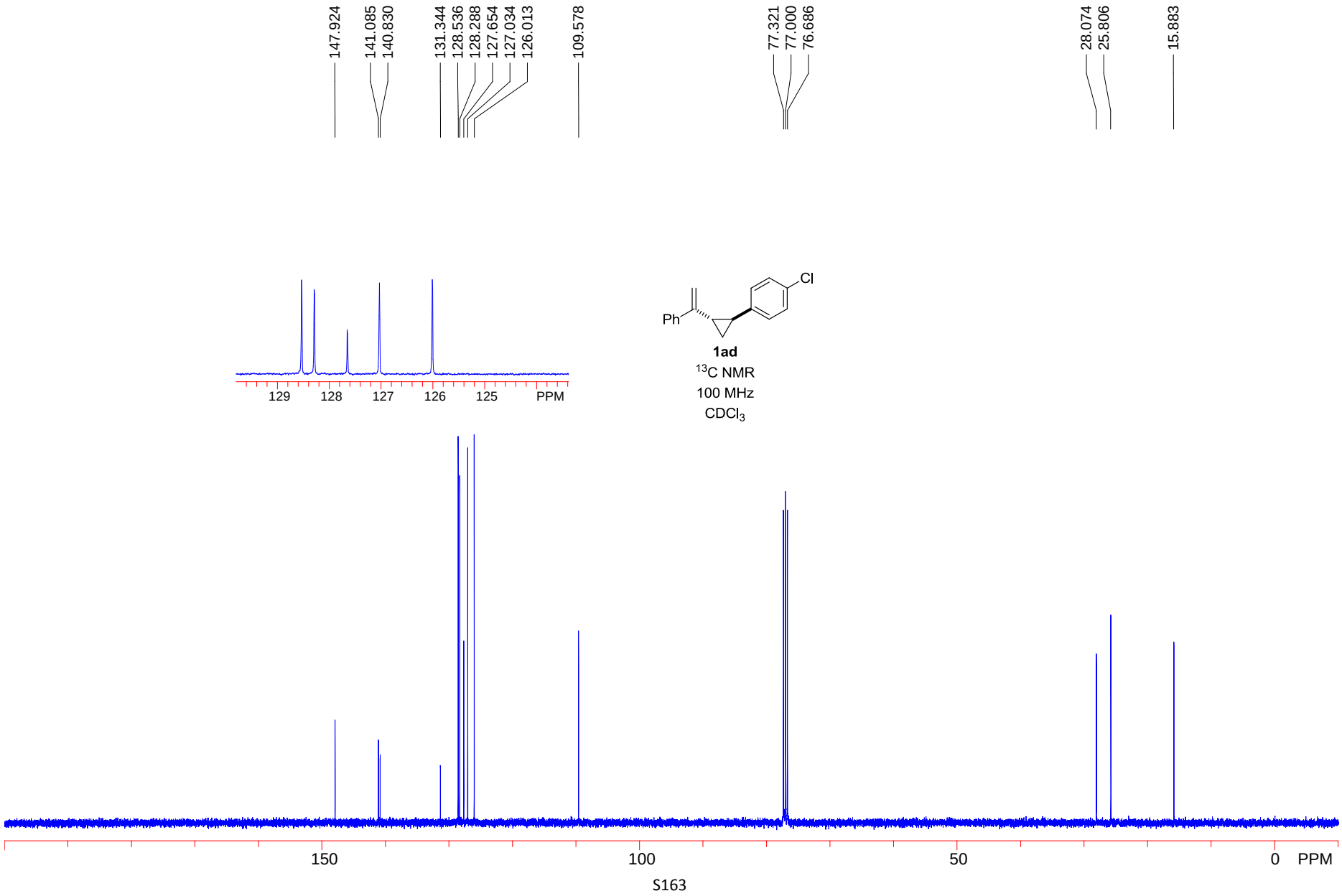
7.064
7.059
5.373
5.034
1.970
1.957
1.949
1.943
1.941
1.935
1.928
1.907
1.528
1.443
1.430
1.428
1.422
1.415
1.409
1.406
1.393
1.268
1.253
1.246
1.240
1.232
1.219
0.000
Cl
Ph
1ad
1H NMR
400 MHz
CDCl3
5.58
1.99
1.96
1.00
1.00
1.96
1.03
1.18
8
6
4
2
0
PPM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141.085
140.830
131.344
128.536
128.288
127.654
127.034
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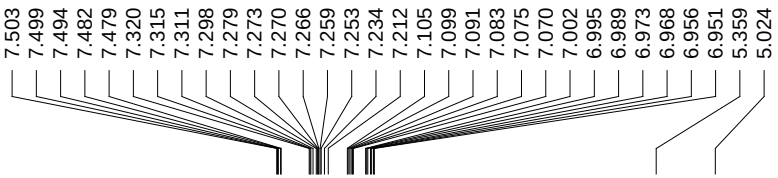
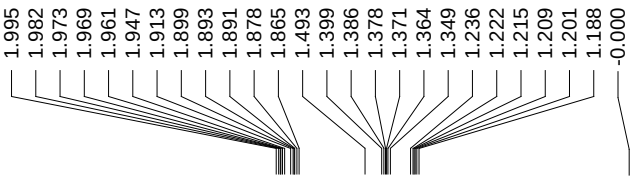
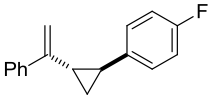
109.578
77.321
77.000
76.686
28.074
25.806
15.883
129
128
127
126
125
PPM
Cl
Ph
1ad
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM





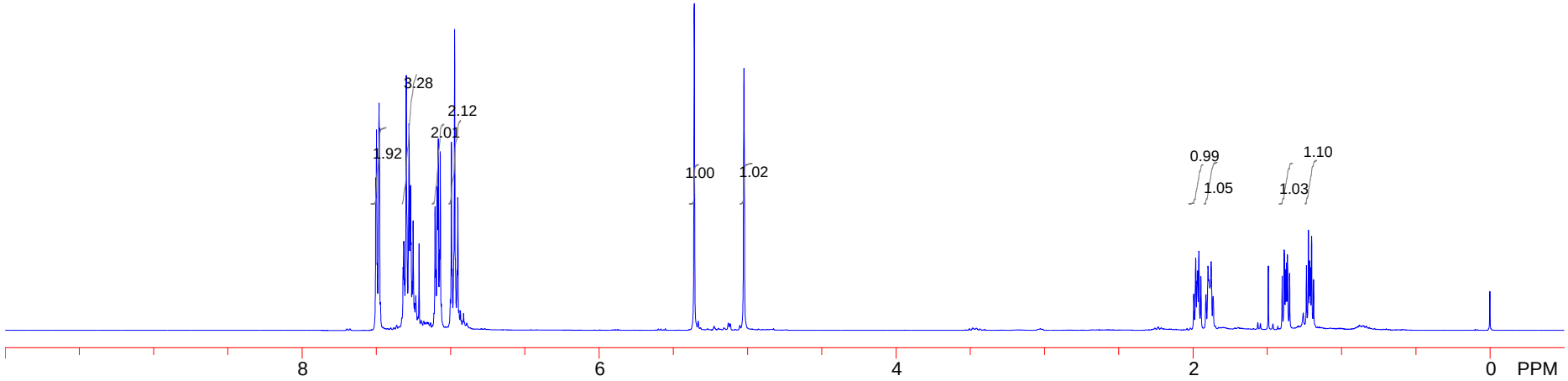


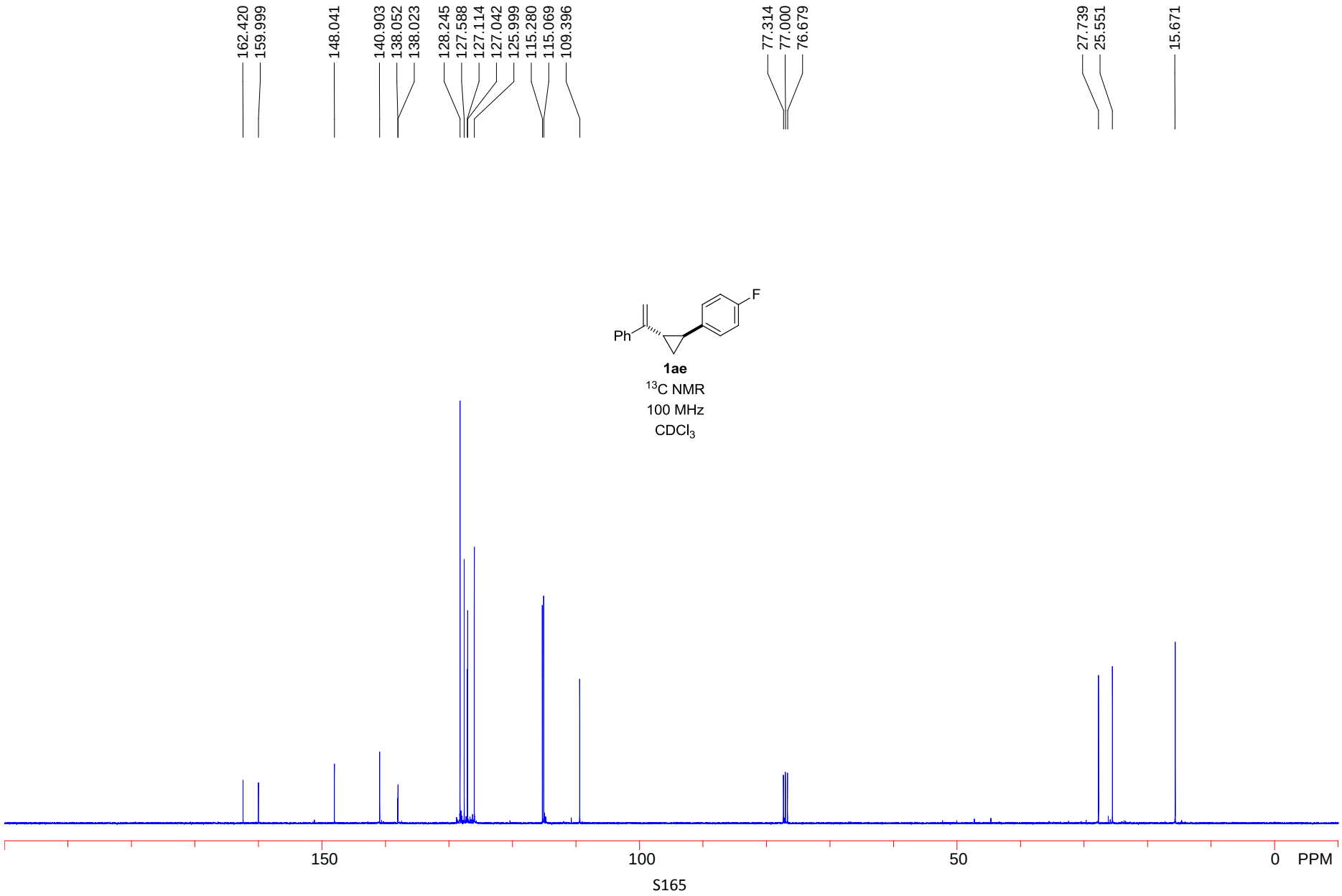
1ae

^{1}H NMR

400 MHz

$CDCl_3$

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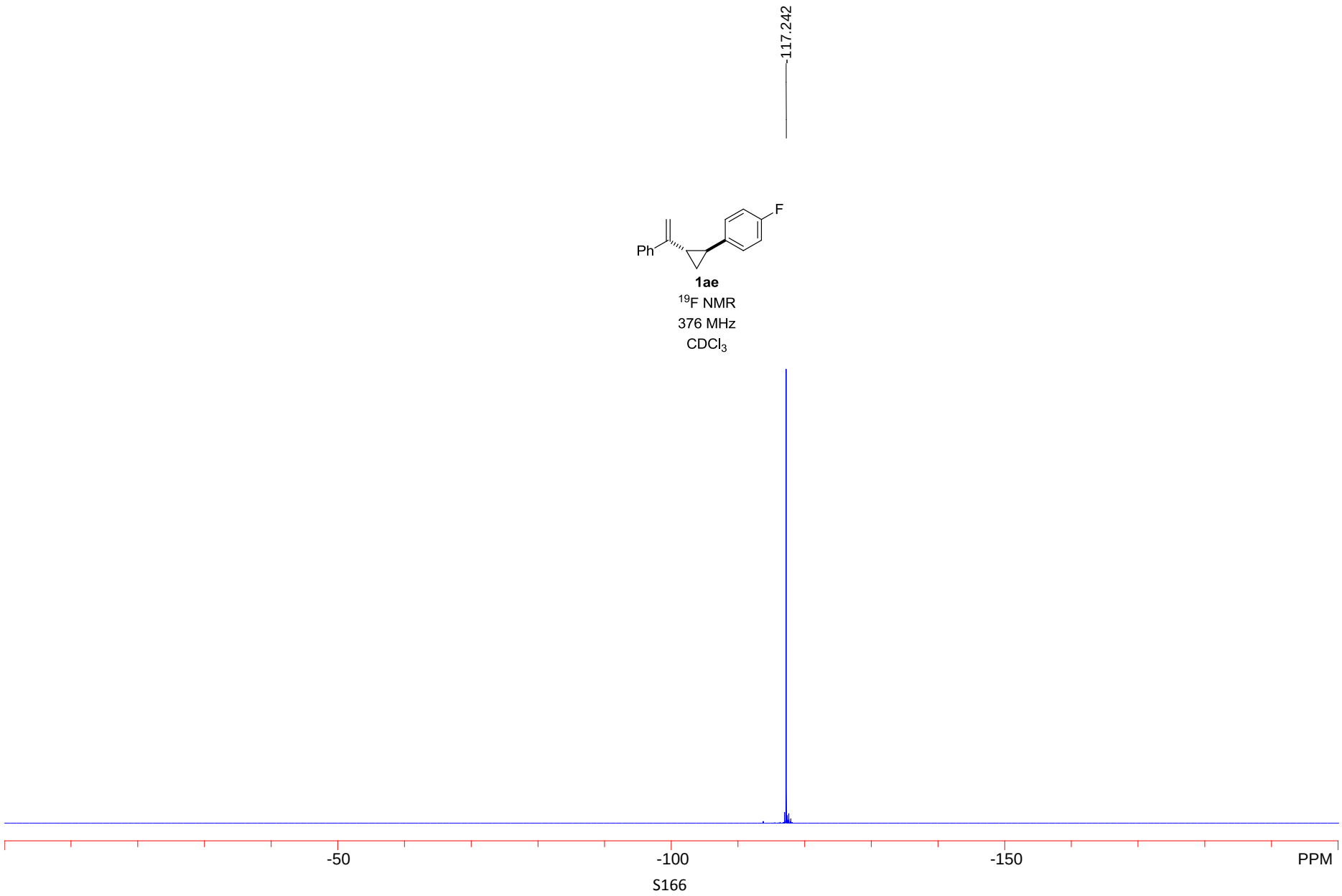
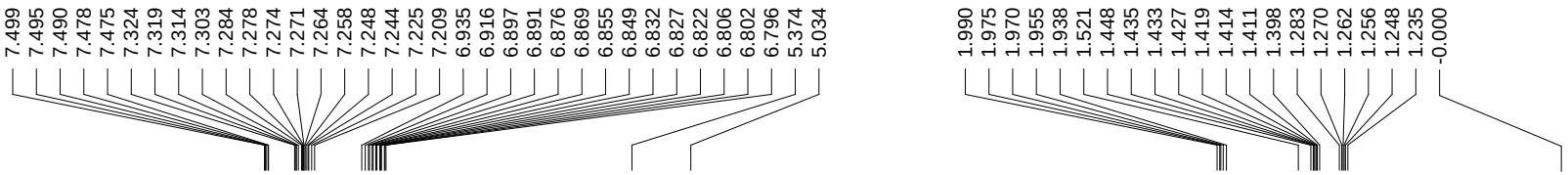
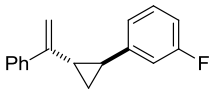
148.041
140.903
138.052
138.023
128.245
127.588
127.114
127.042
125.999
115.280
115.069
109.396
77.314
77.000
76.679
27.739
25.551
15.671
F
Ph
1ae
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


-117.242
F
Ph
1ae
19F NMR
376 MHz
CDCl3
-50
-100
-150
PPM



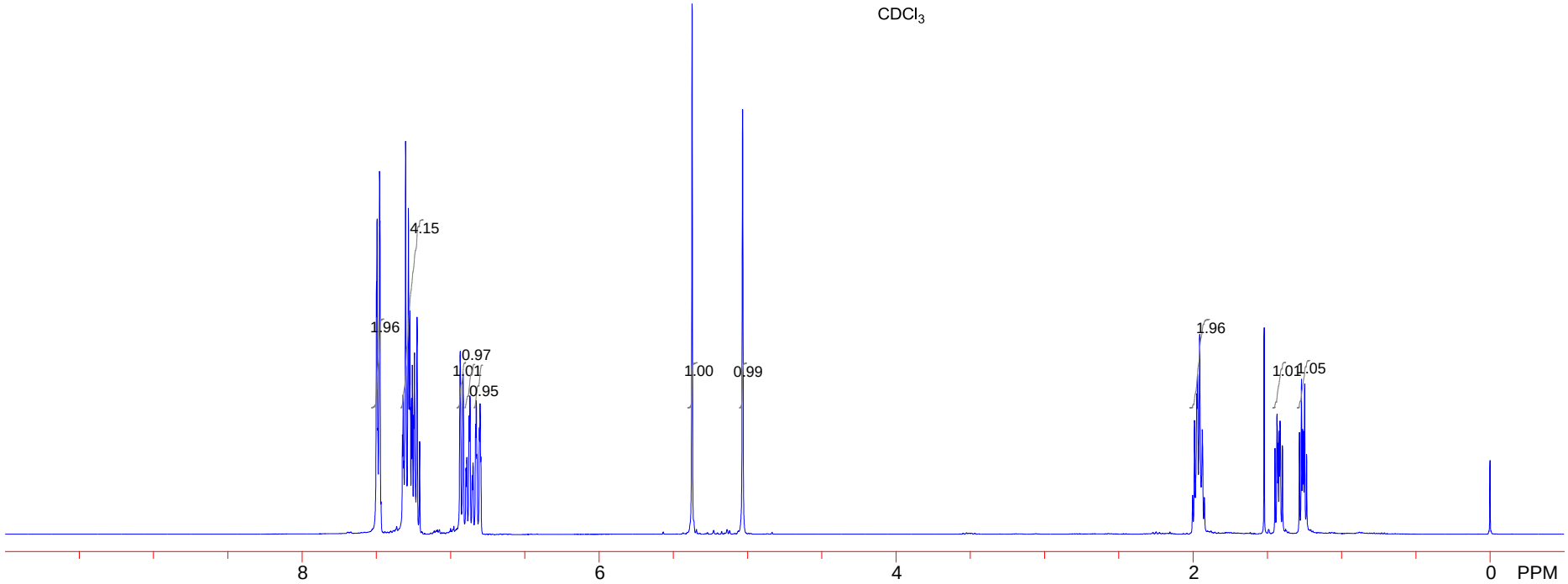


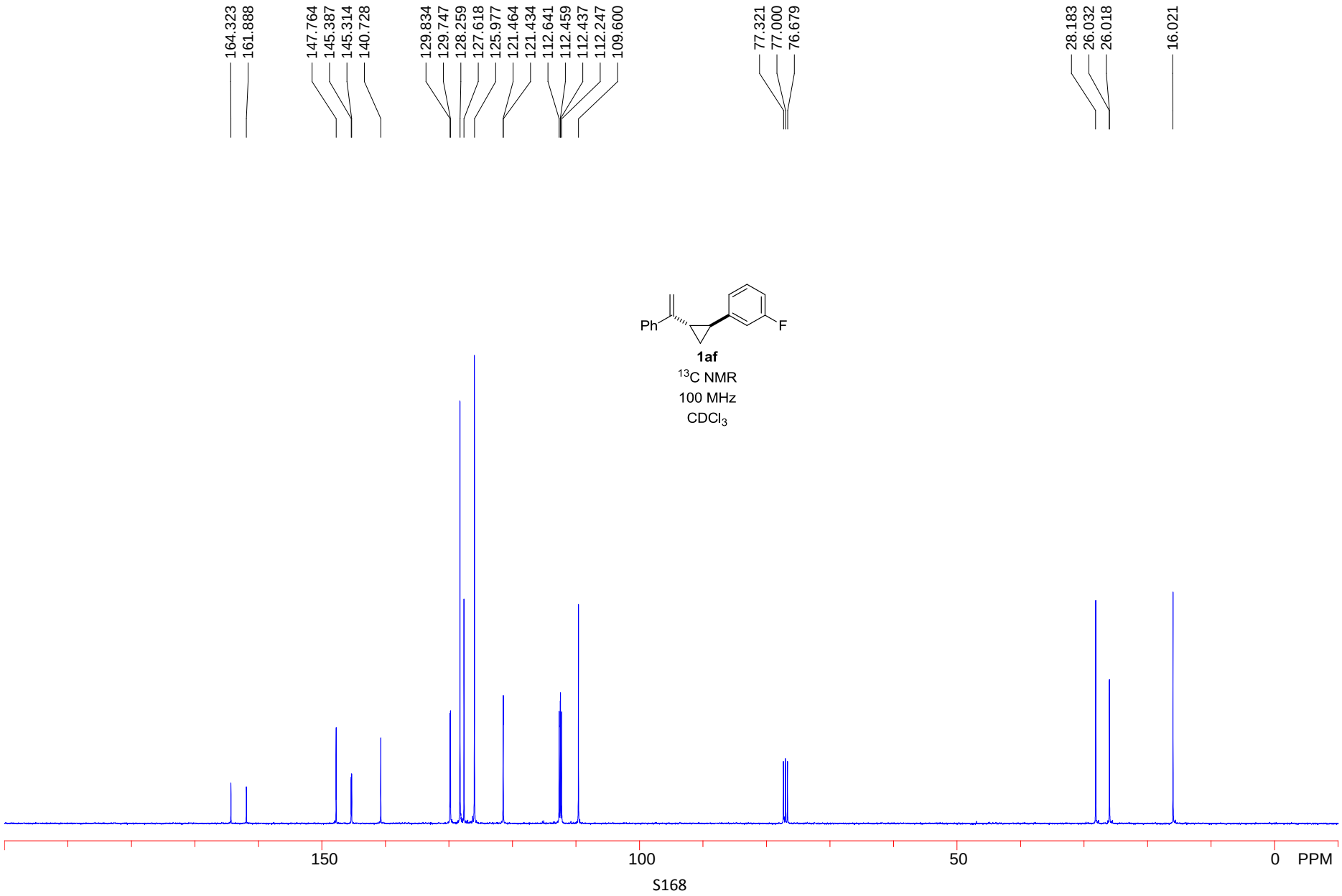
1af

^{1}H NMR

400 MHz

$CDCl_3$

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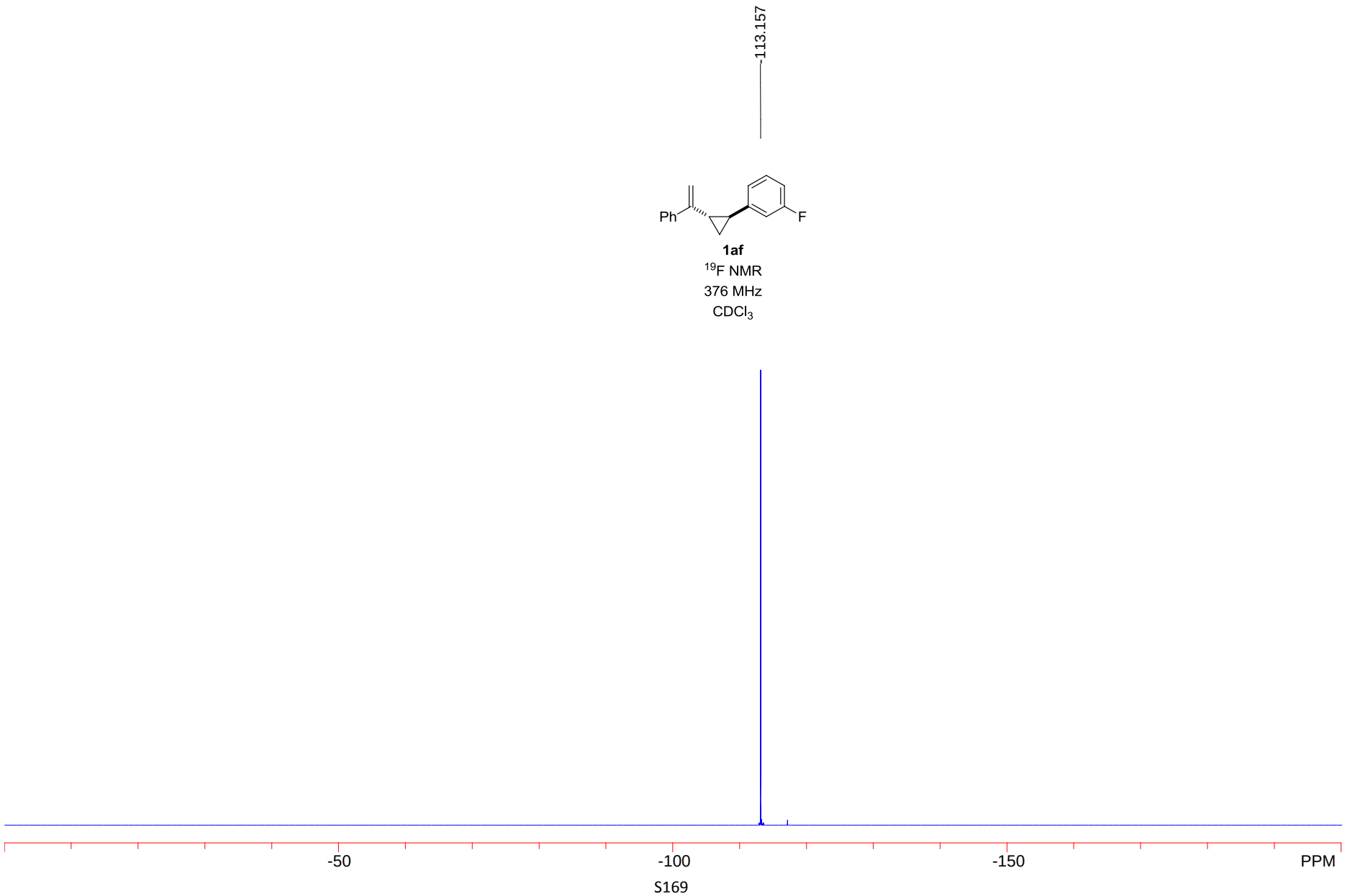
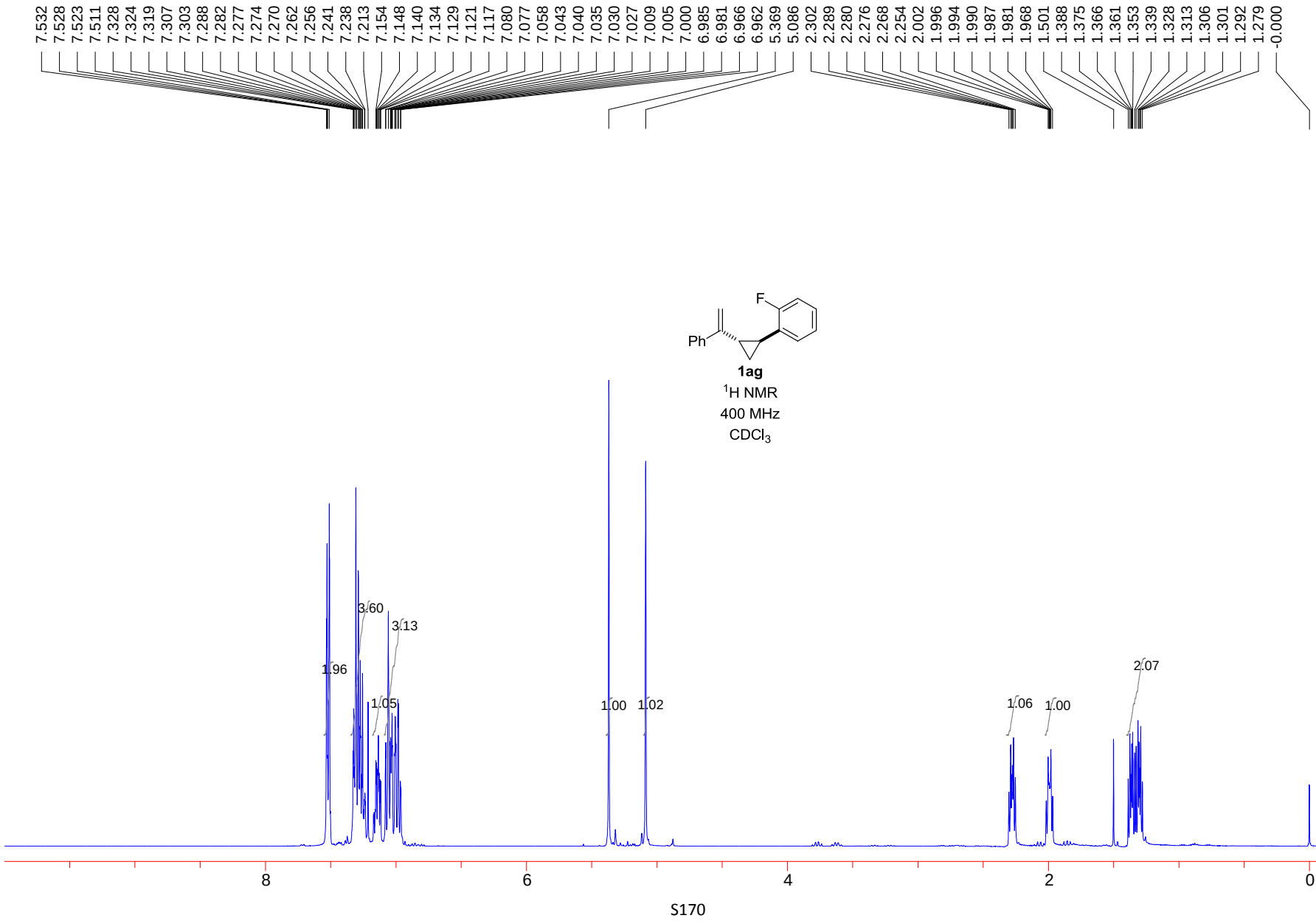
161.888
147.764
145.387
145.314
140.728
129.834
129.747
128.259
127.618
125.977
121.464
121.434
112.641
112.459
112.437
112.247
109.600
77.321
77.000
76.679
28.183
26.032
26.018
16.021
Ph
F
1af
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


-113.157
Ph
F
1af
19F NMR
376 MHz
CDCl3
-50
-100
-150
PPM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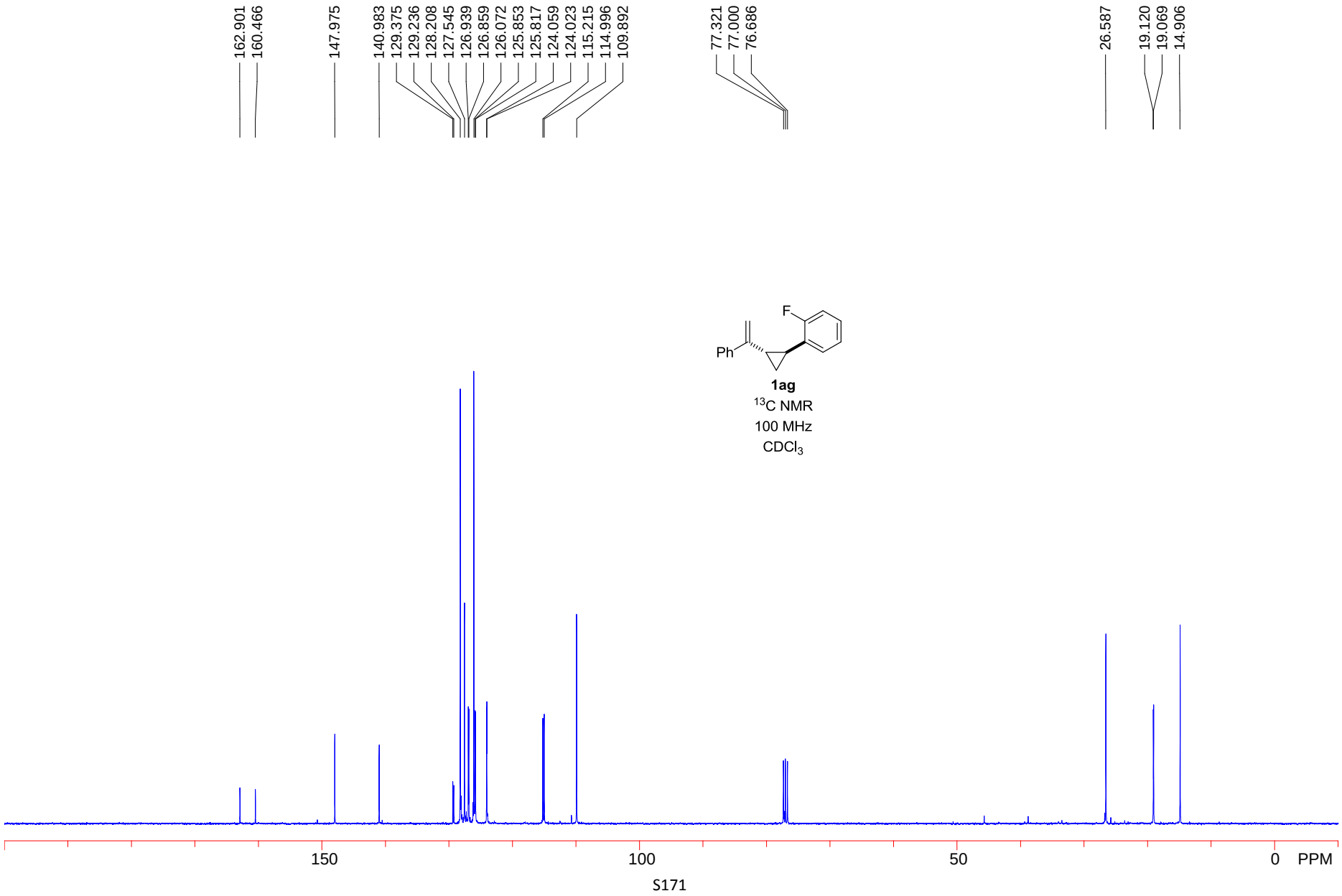
7.528
7.523
7.511
7.328
7.324
7.319
7.307
7.303
7.288
7.282
7.277
7.274
7.270
7.262
7.256
7.241
7.238
7.213
7.154
7.148
7.140
7.134
7.129
7.121
7.117
7.080
7.077
7.058
7.043
7.040
7.035
7.030
7.027
7.009
7.005
7.000
6.985
6.981
6.966
6.962
5.369
5.086
2.302
2.289
2.280
2.276
2.268
2.254
2.002
1.996
1.994
1.990
1.987
1.981
1.968
1.501
1.388
1.375
1.366
1.361
1.353
1.339
1.328
1.313
1.306
1.301
1.292
1.279
-0.000
F
Ph
1ag
1H NMR
400 MHz
CDCl3
3.60
3.13
1.96
1.05
1.00
1.02
1.06
1.00
2.07
8
6
4
2
0
PPM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129.375
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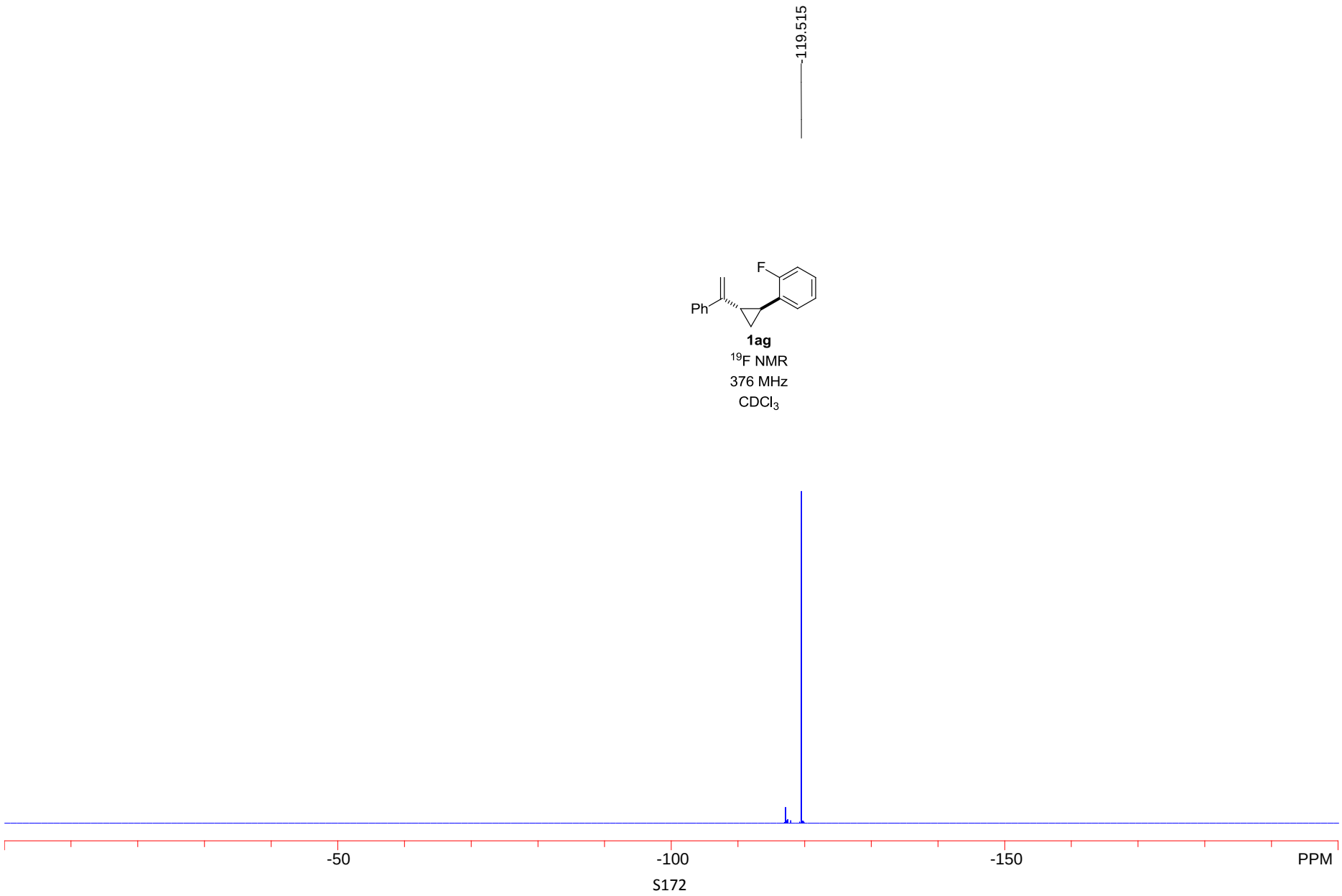
128.208
127.545
126.939
126.859
126.072
125.853
125.817
124.059
124.023
115.215
114.996
109.892
77.321
77.000
76.686
26.587
19.120
19.069
14.906
F
Ph
1ag
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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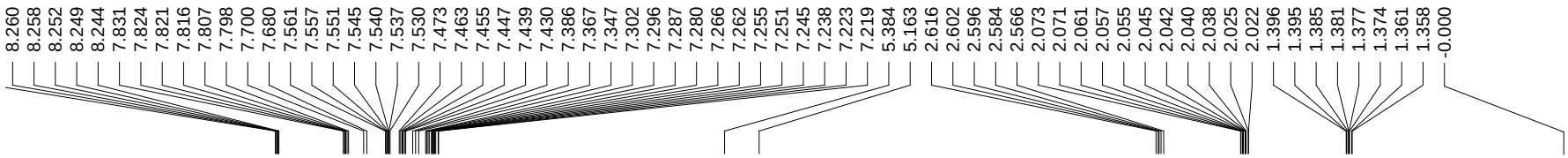
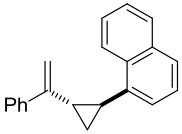
F
Ph
1ag
19F NMR
376 MHz
CDCl3
-50
-100
-150
PPM



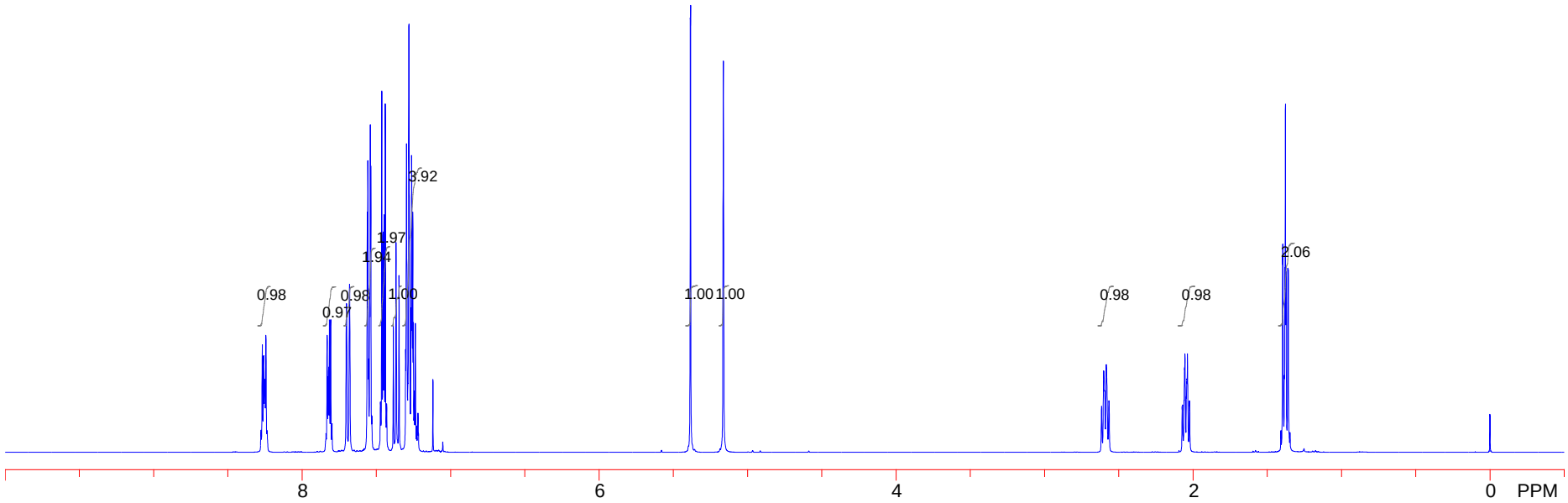


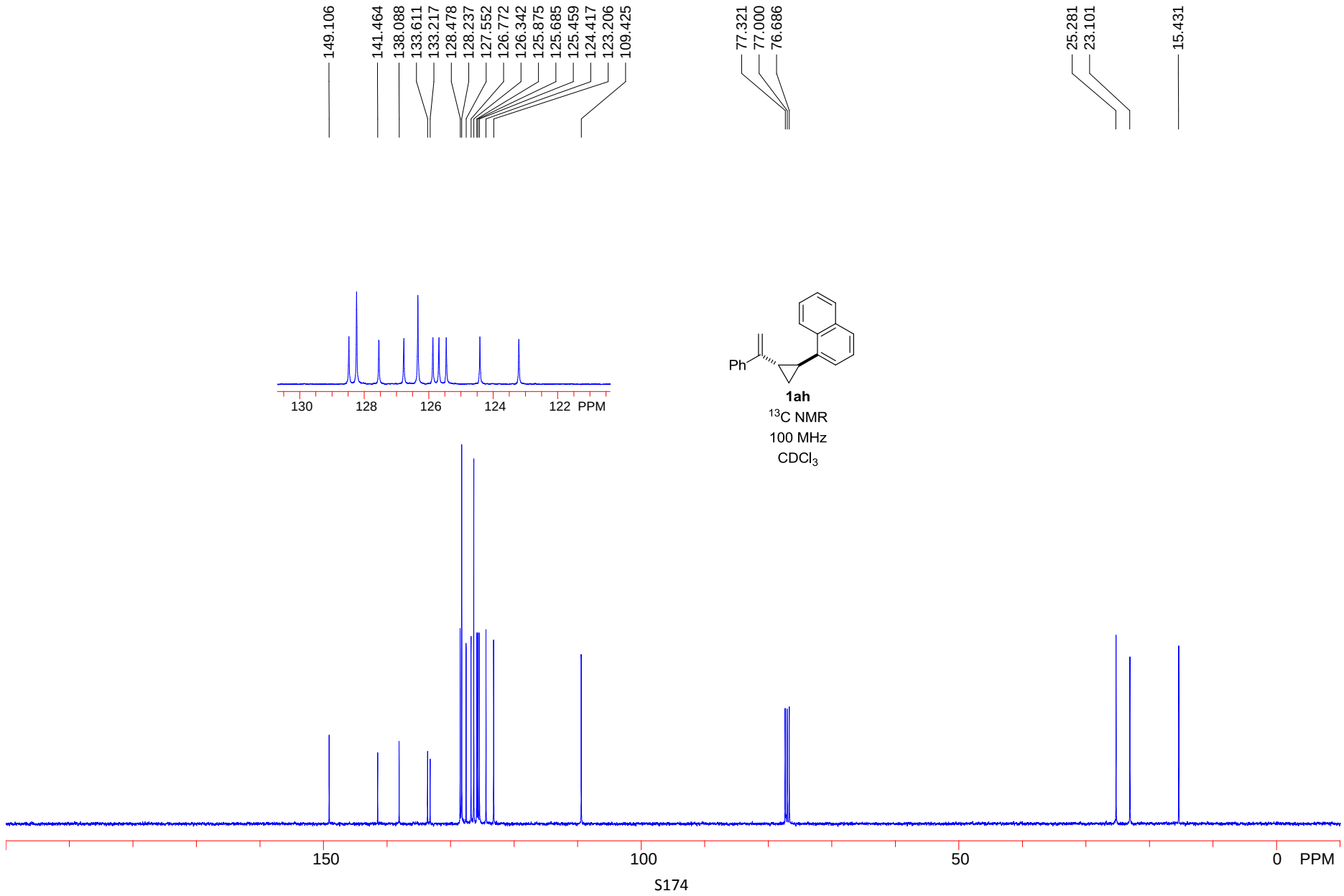
1ah

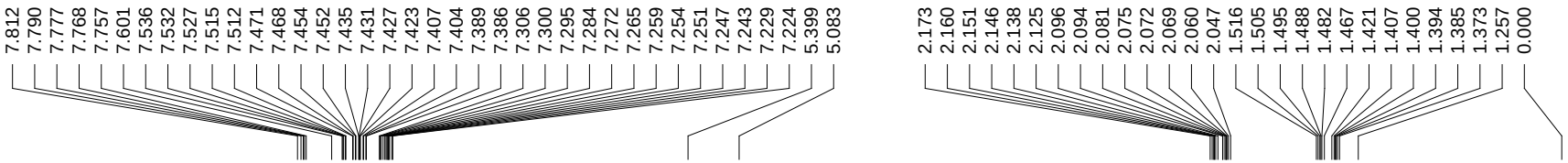
^{1}H NMR

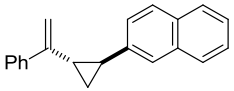
400 MHz

$CDCl_3$




149.106
141.464
138.088
133.611
133.217
128.478
128.237
127.552
126.772
126.342
125.875
125.685
125.459
124.417
123.206
109.425
77.321
77.000
76.686
25.281
23.101
15.431
130
128
126
124
122 PPM
Ph
1ah
13C NMR
100 MHz
CDCl3
150
100
50
0 PPM



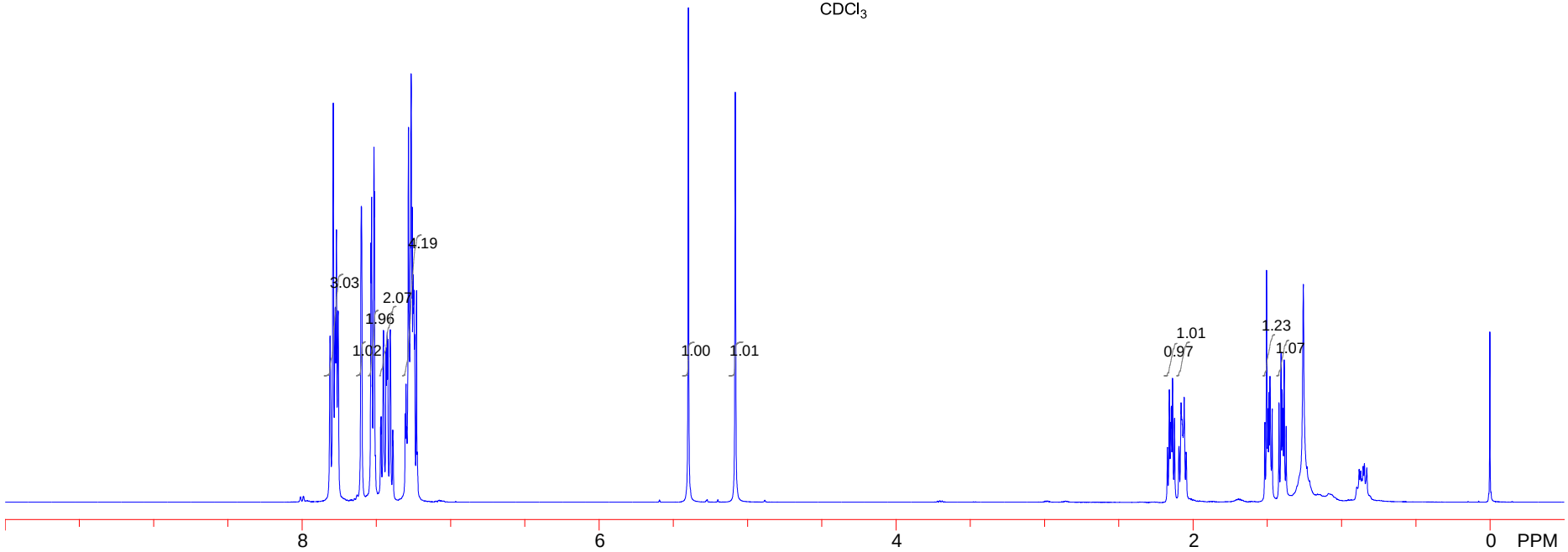


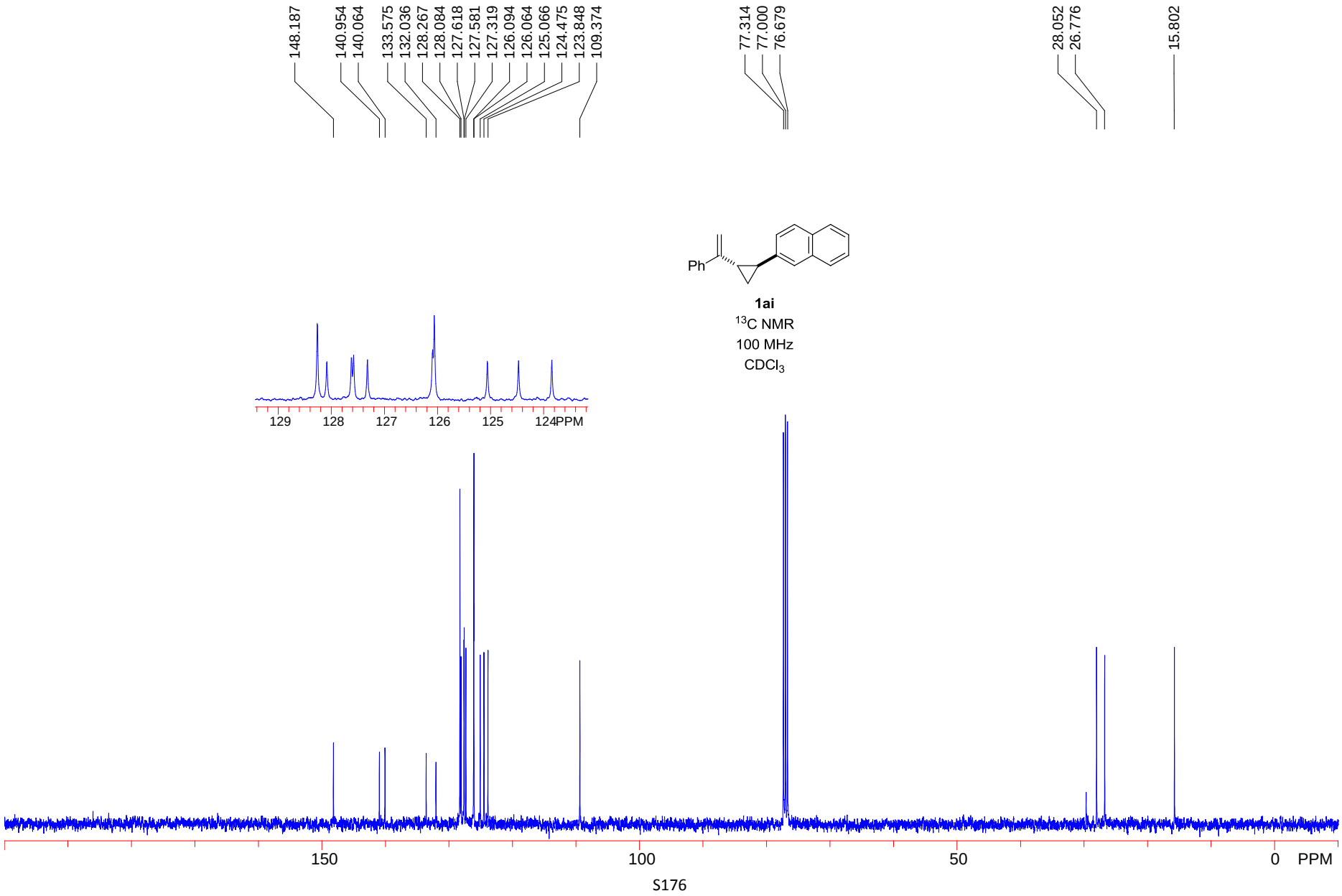
1ai

^{1}H NMR

400 MHz

$CDCl_3$

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140.064
133.575
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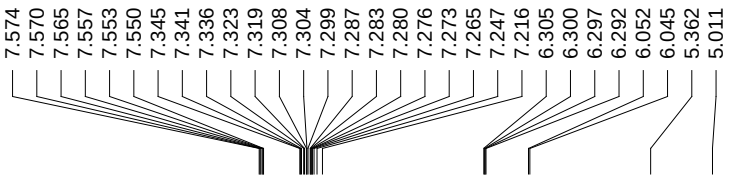
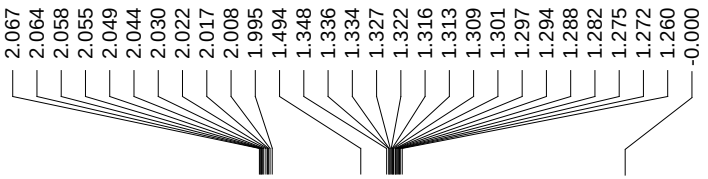
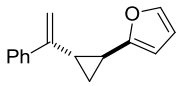
128.267
128.084
127.618
127.581
127.319
126.094
126.064
125.066
124.475
123.848
109.374
77.314
77.000
76.679
28.052
26.776
15.802
Ph
1ai
13C NMR
100 MHz
CDCl3
129
128
127
126
125
124
PPM
150
100
50
0
PPM





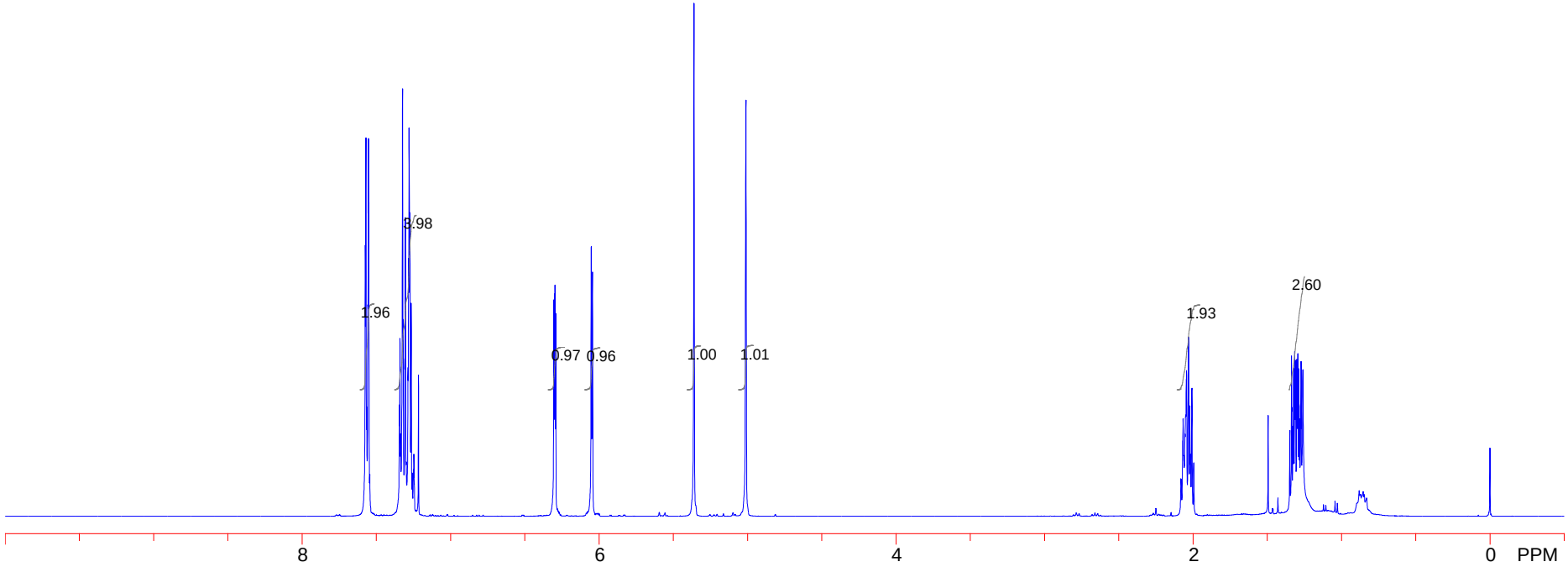


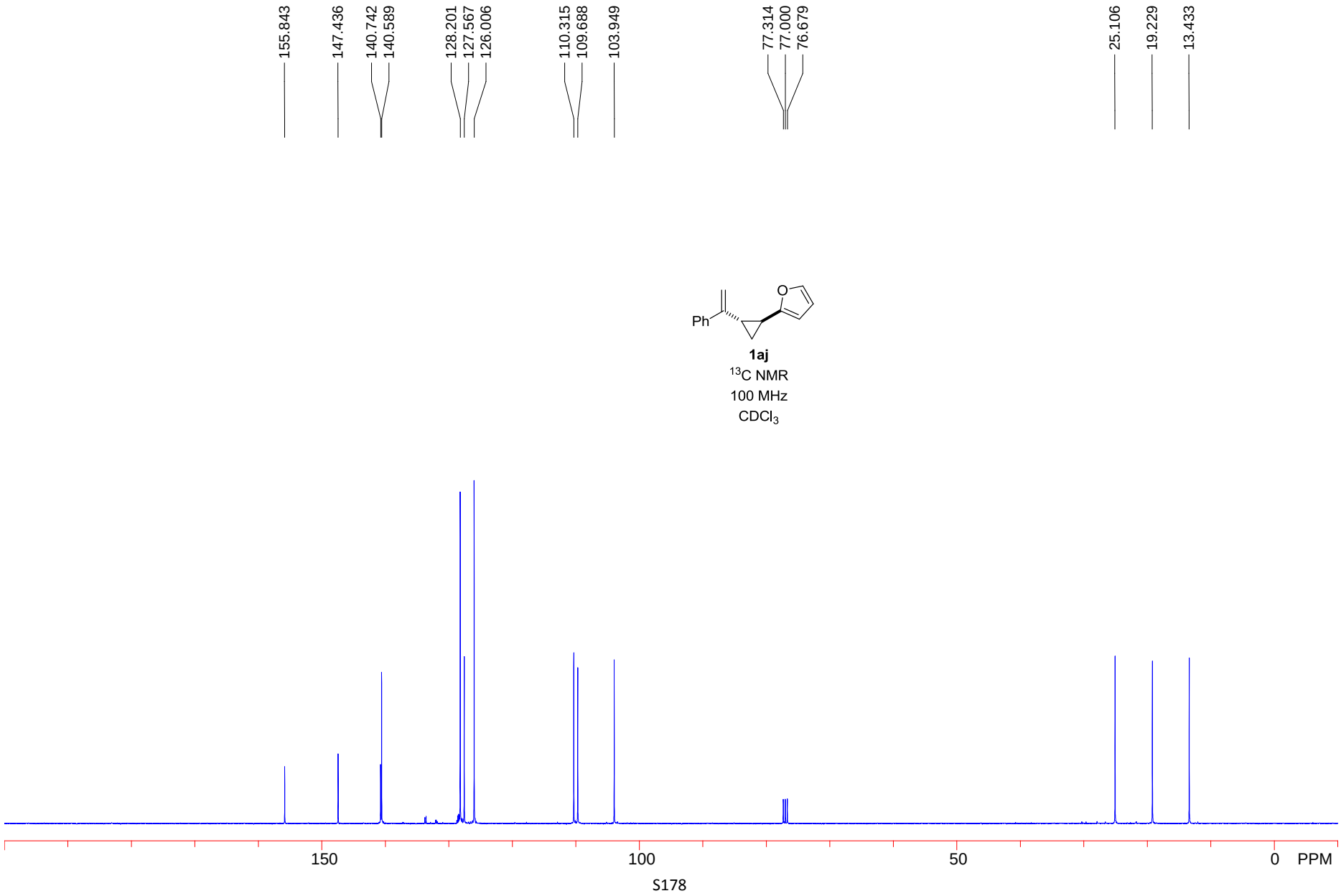
1aj

^{1}H NMR

400 MHz

$CDCl_3$

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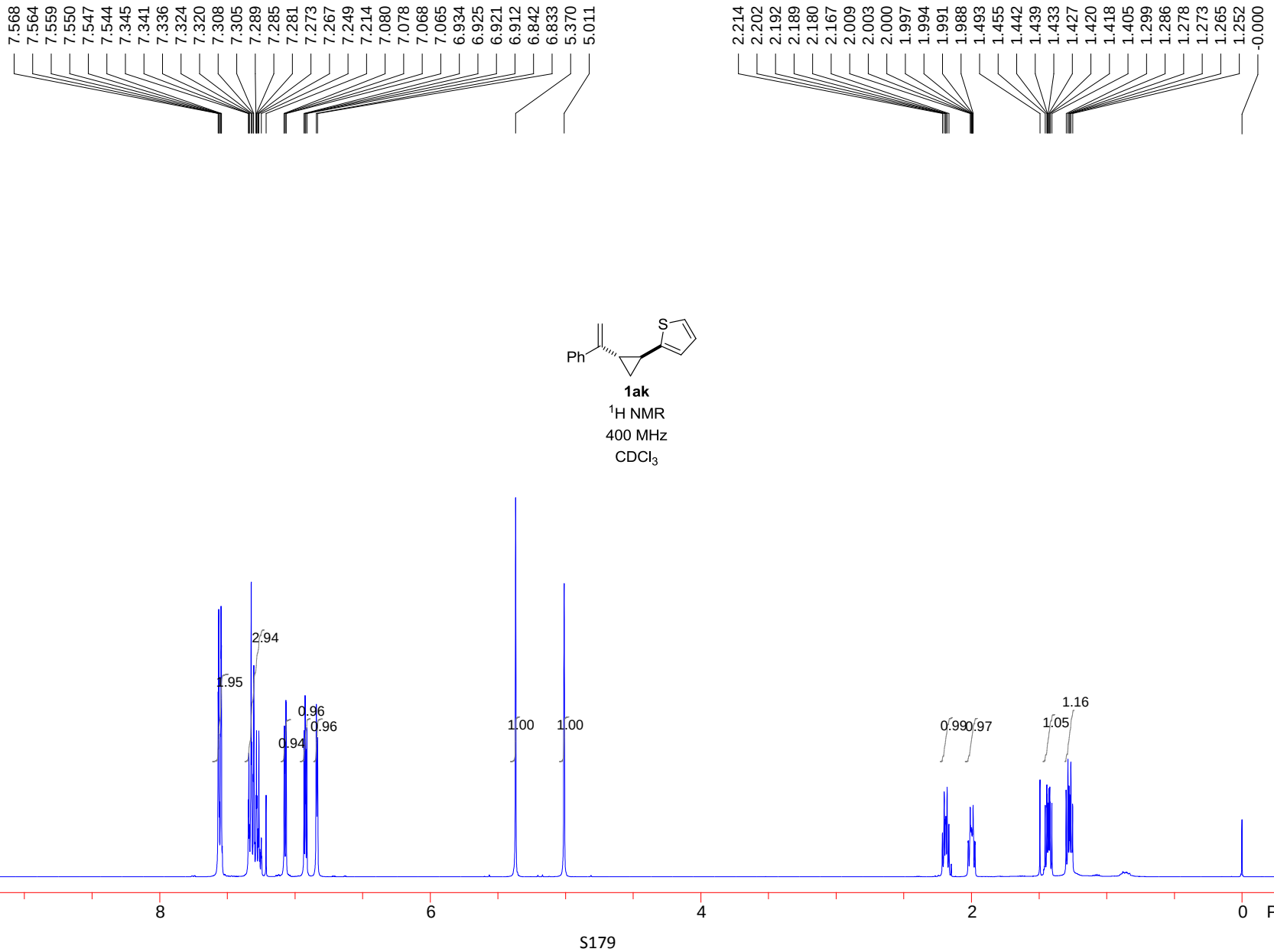
140.589
128.201
127.567
126.006
110.315
109.688
103.949
77.314
77.000
76.679
25.106
19.229
13.433
O
Ph
1aj
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.305
7.289
7.285
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7.078
7.068
7.065
6.934
6.925
6.921
6.912
6.842
6.833
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5.011
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2.000
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1.994
1.991
1.988
1.493
1.455
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1.439
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1.420
1.418
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1.286
1.278
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1.265
1.252
-0.000
Ph
S
1ak
1H NMR
400 MHz
CDCl3
1.95
2.94
0.96
0.96
0.94
1.00
1.00
0.99
0.97
1.05
1.16
8
6
4
2
0
PPM

147.560
146.933
140.684
128.223
127.596
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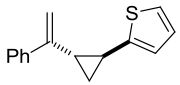
28.541
21.665
16.670

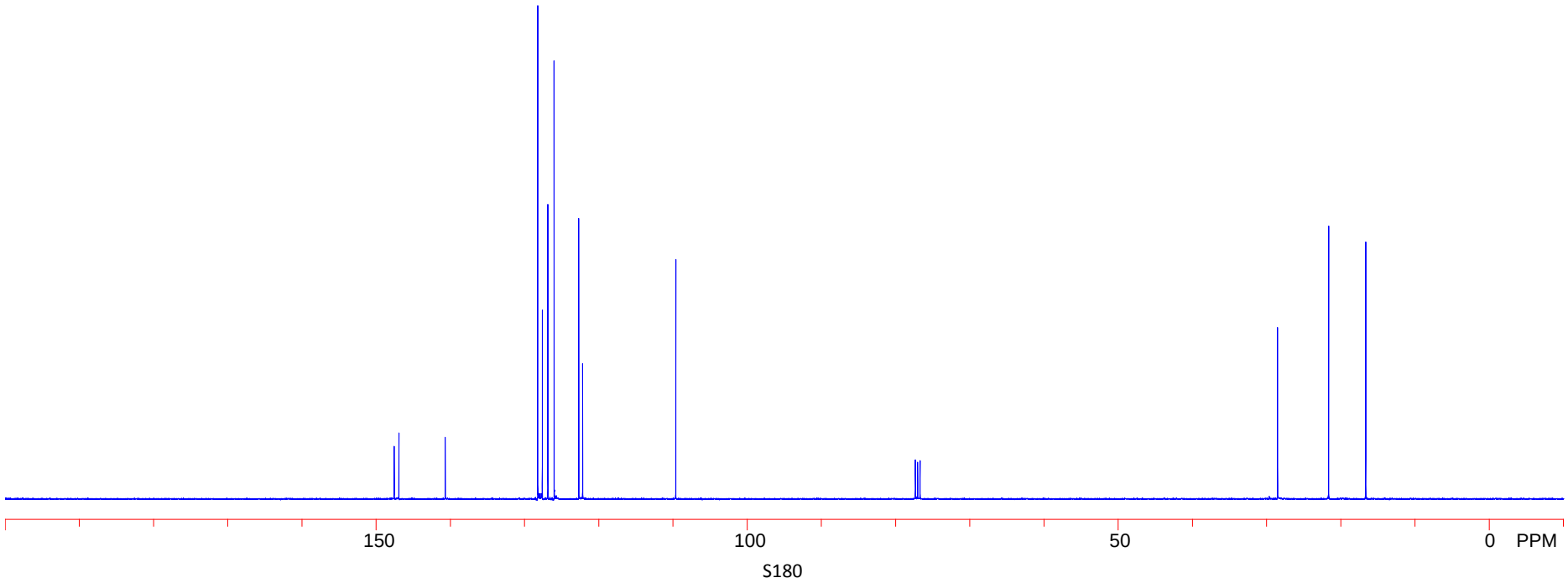


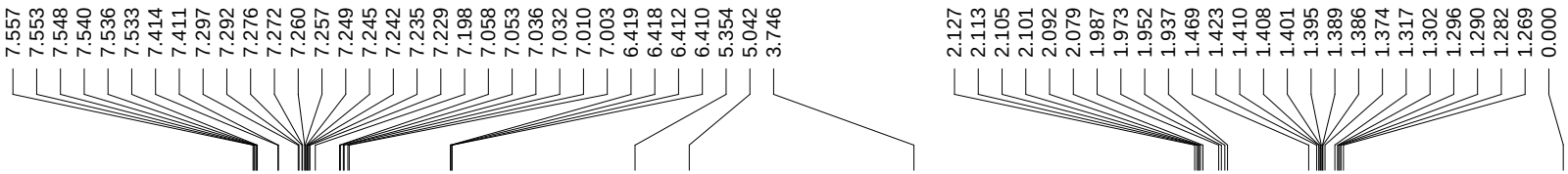
1ak

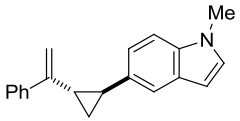
^{13}C NMR

100 MHz

$CDCl_3$





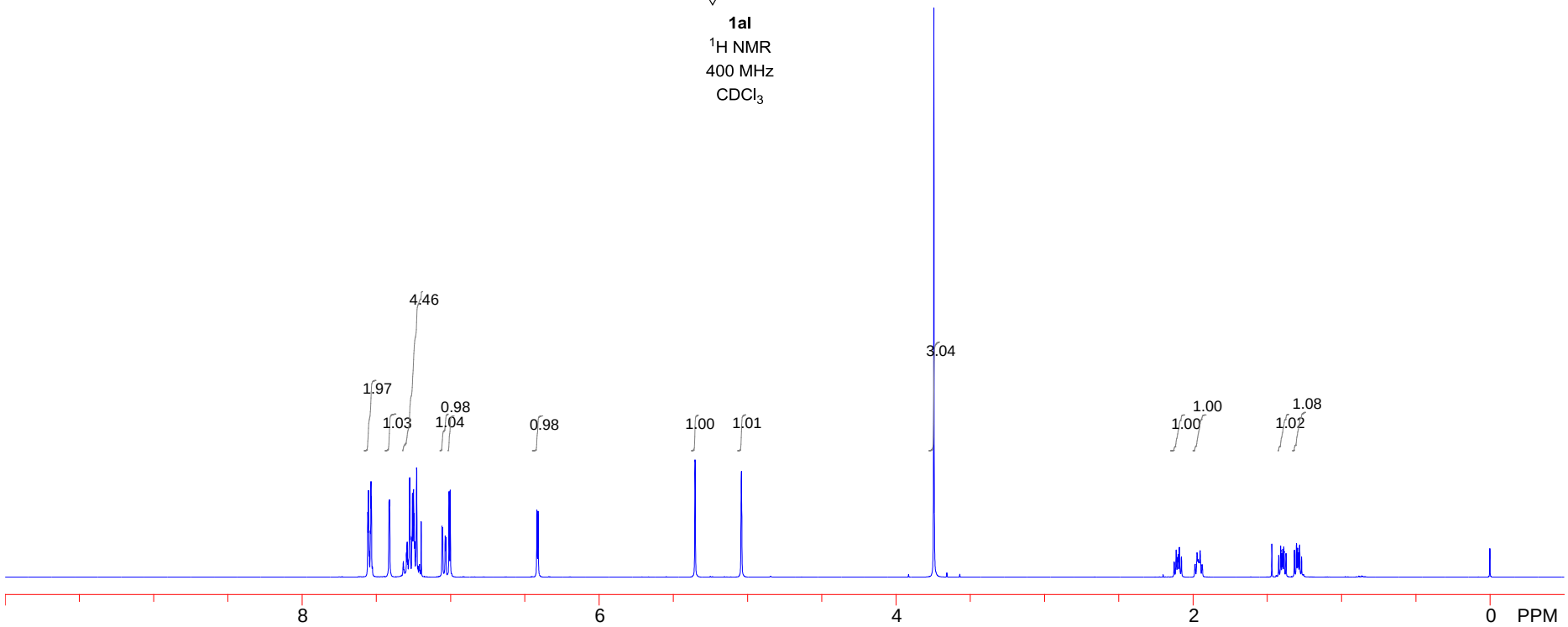


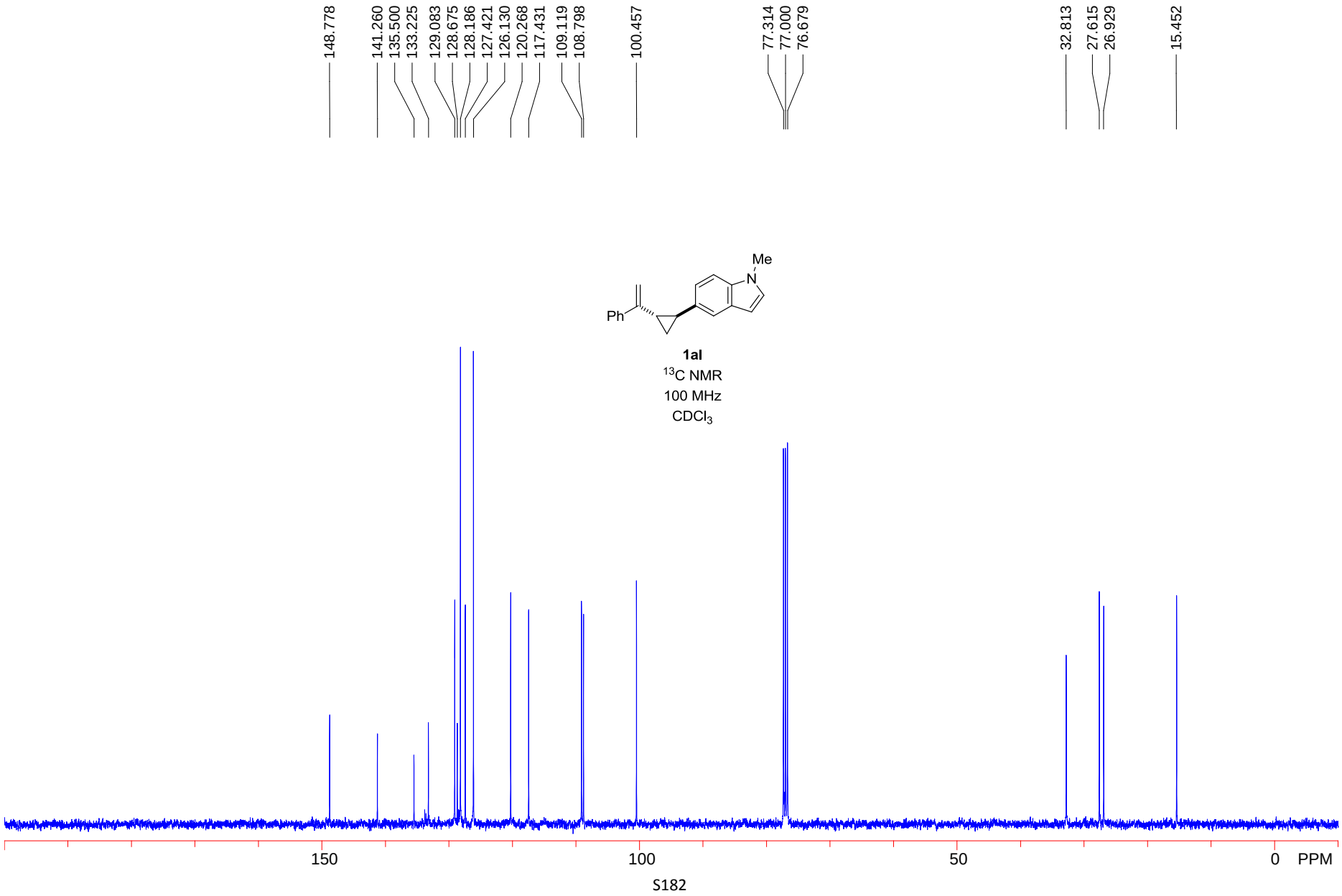
1al

^{1}H NMR

400 MHz

$CDCl_3$




148.778
141.260
135.500
133.225
129.083
128.675
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117.431
109.119
108.798
100.457
77.314
77.000
76.679
32.813
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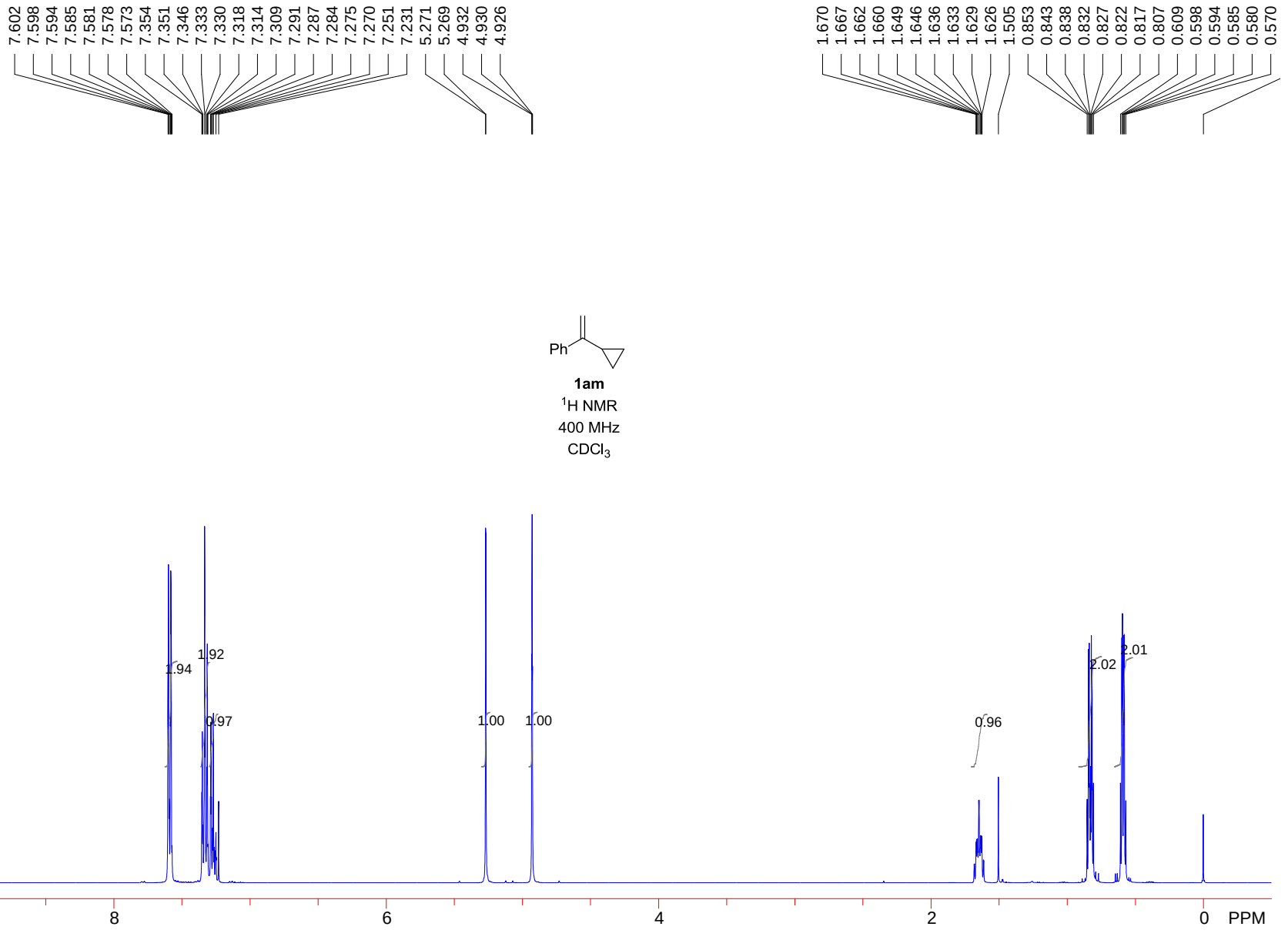
15.452
Me
N
Ph
1al
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.291
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7.275
7.270
7.251
7.231
5.271
5.269
4.932
4.930
4.926
1.670
1.667
1.662
1.660
1.649
1.646
1.636
1.633
1.629
1.626
1.505
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0.843
0.838
0.832
0.827
0.822
0.817
0.807
0.609
0.598
0.594
0.585
0.580
0.570
Ph
1am
1H NMR
400 MHz
CDCl3
1.94
1.92
0.97
1.00
1.00
0.96
2.02
2.01
8
6
4
2
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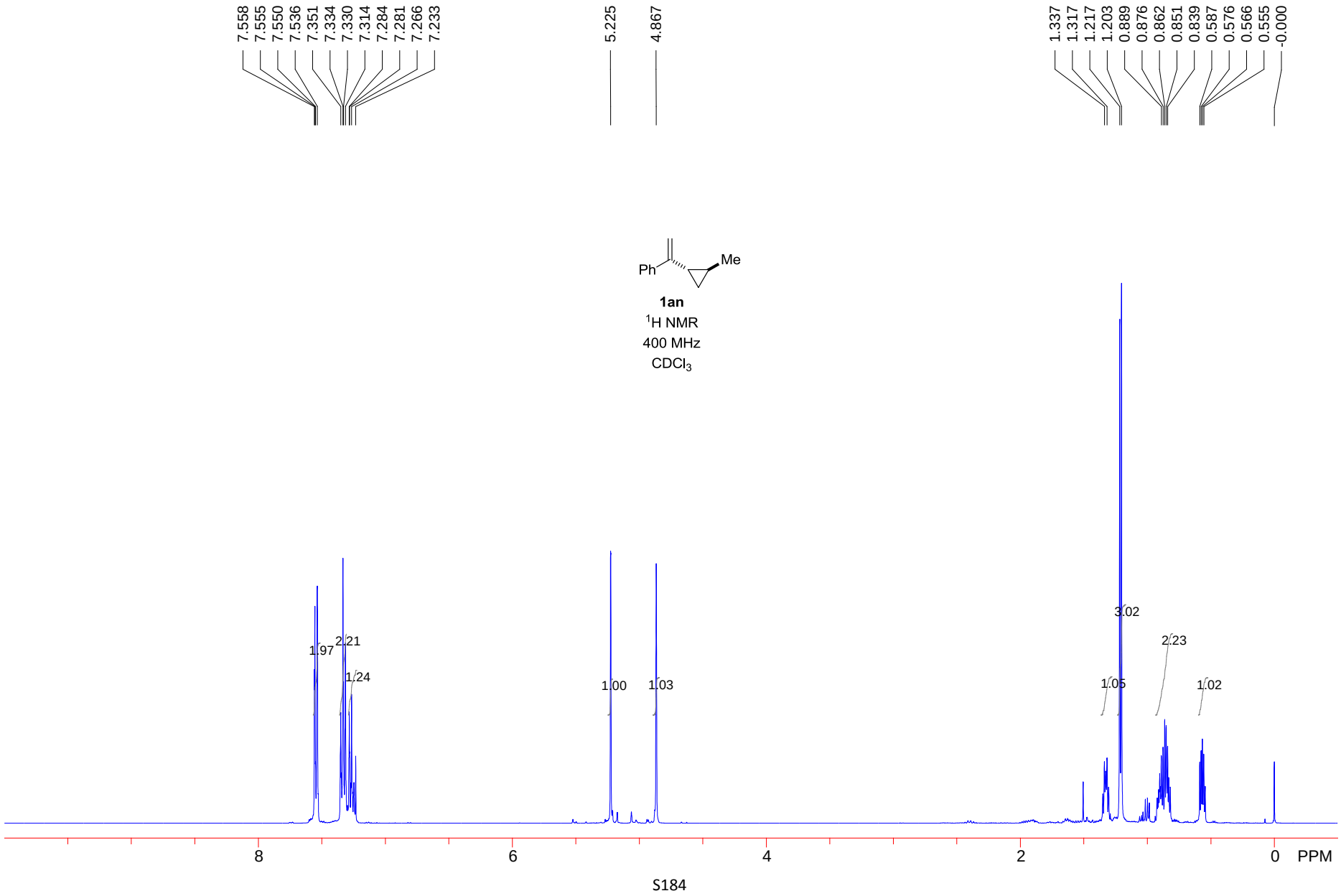
PPM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7.233
5.225
4.867
1.337
1.317
1.217
1.203
0.889
0.876
0.862
0.851
0.839
0.587
0.576
0.566
0.555
-0.000
Ph
Me
1an
1H NMR
400 MHz
CDCl3
1.97
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1.24
1.00
1.03
3.02
1.05
2.23
1.02
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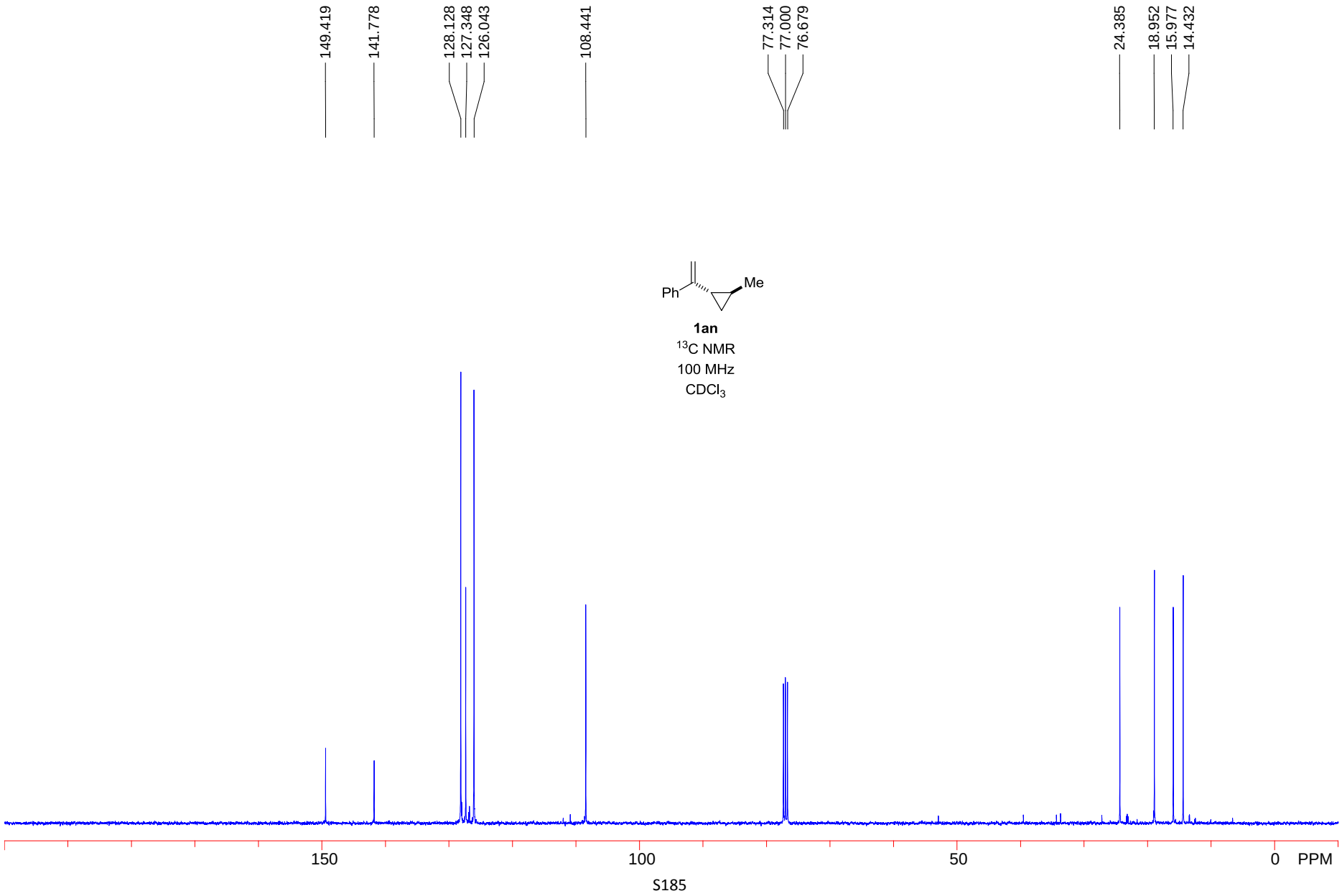
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77.314
77.000
76.679
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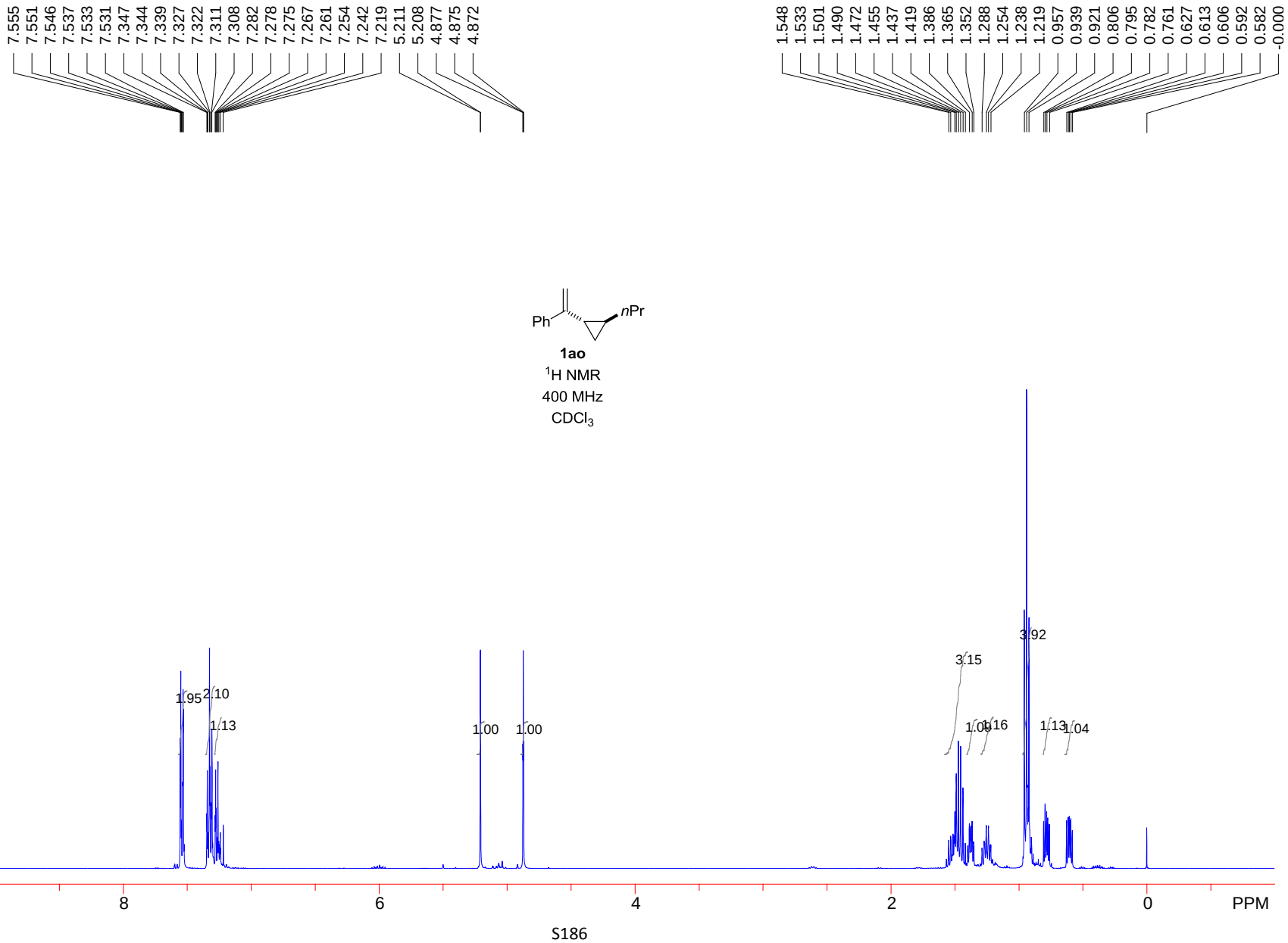
14.432
Ph
Me
1an
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.308
7.282
7.278
7.275
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7.261
7.254
7.242
7.219
5.211
5.208
4.877
4.875
4.872
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1.533
1.501
1.490
1.472
1.455
1.437
1.419
1.386
1.365
1.352
1.288
1.254
1.238
1.219
0.957
0.939
0.921
0.806
0.795
0.782
0.761
0.627
0.613
0.606
0.592
0.582
-0.000
Ph
nPr
1ao
1H NMR
400 MHz
CDCl3
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2.10
1.13
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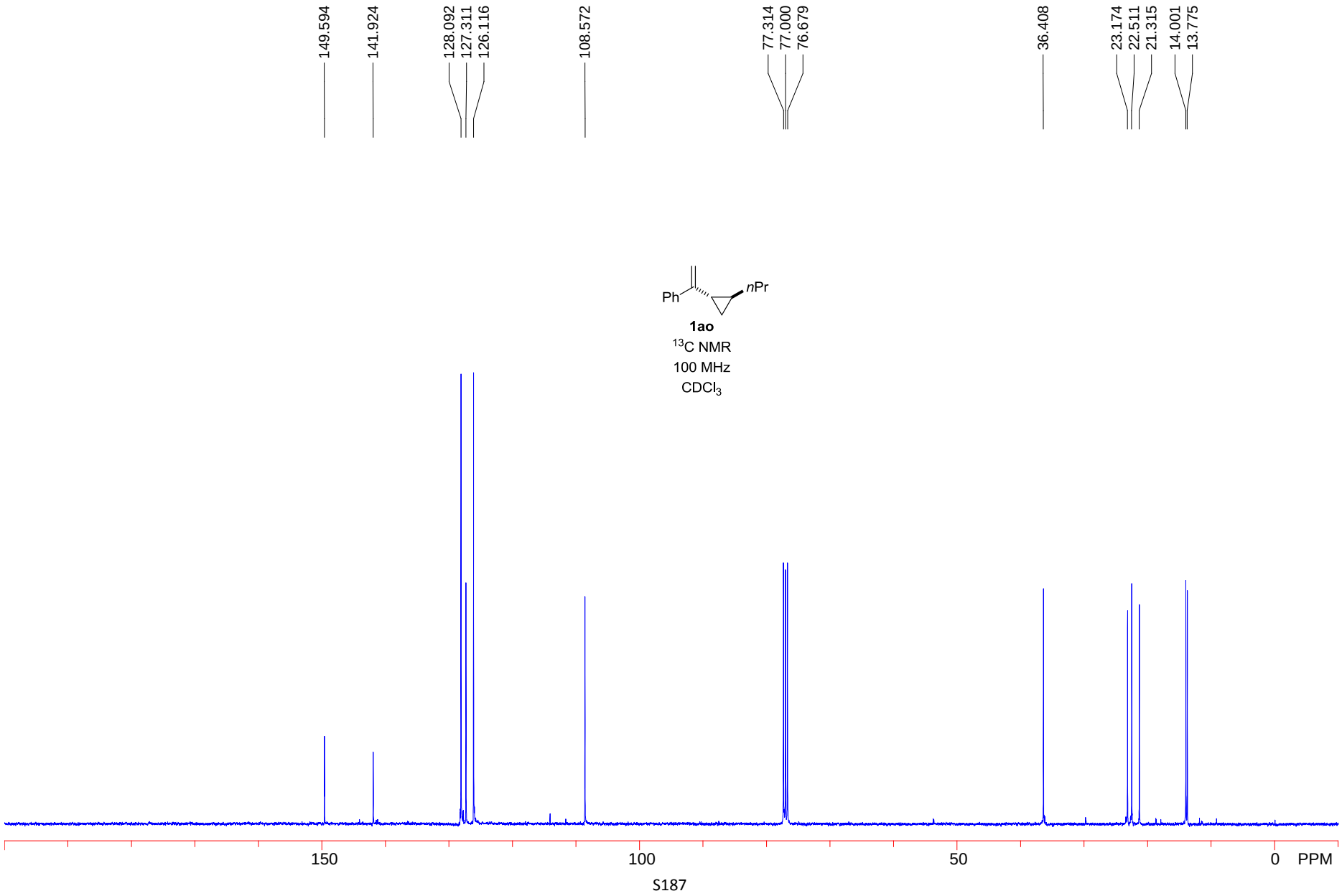
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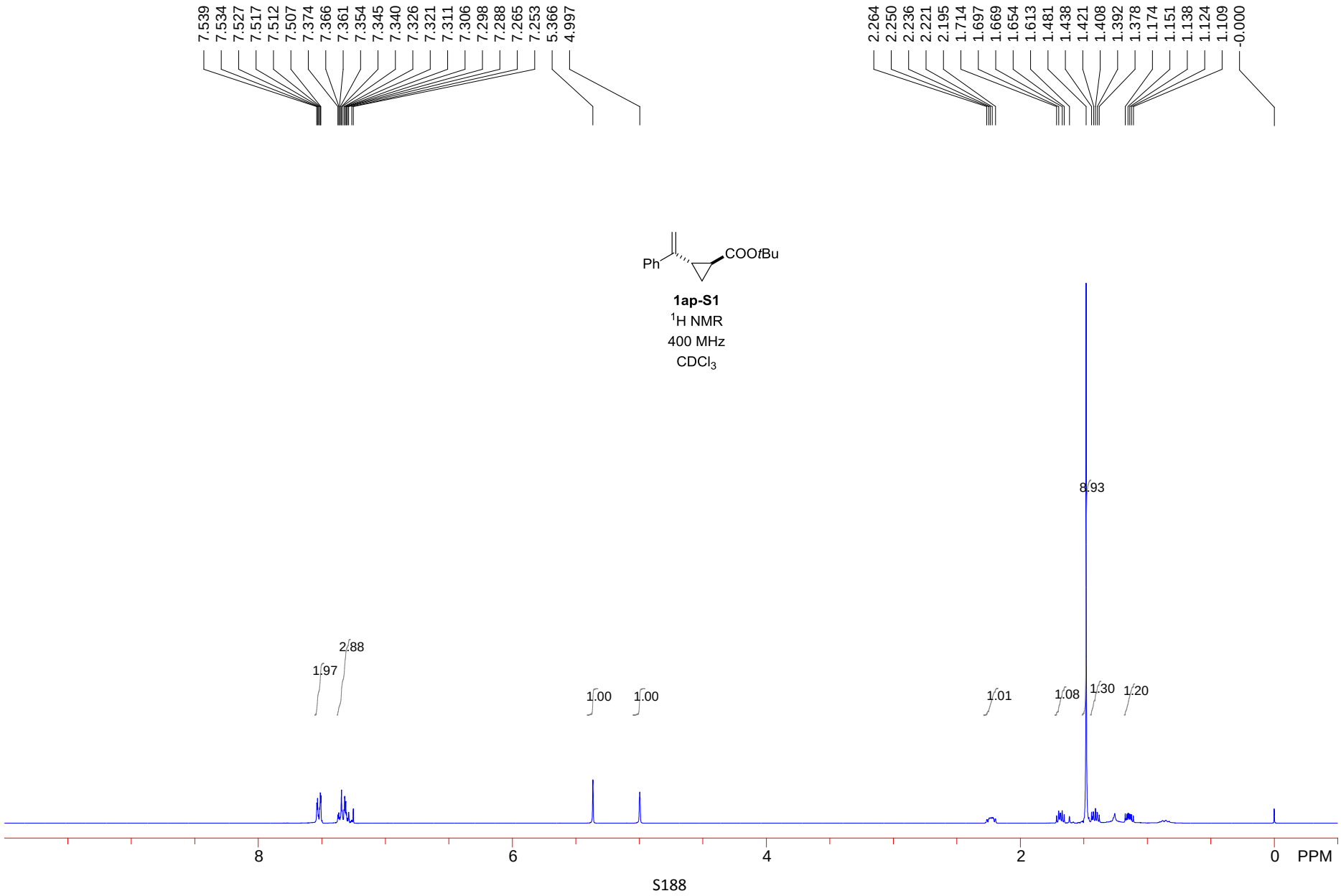
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7.311
7.306
7.298
7.288
7.265
7.253
5.366
4.997
2.264
2.250
2.236
2.221
2.195
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1.697
1.669
1.654
1.613
1.481
1.438
1.421
1.408
1.392
1.378
1.174
1.151
1.138
1.124
1.109
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Ph
COOtBu
1ap-S1
1H NMR
400 MHz
CDCl3
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1.01
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1.20
8
6
4
2
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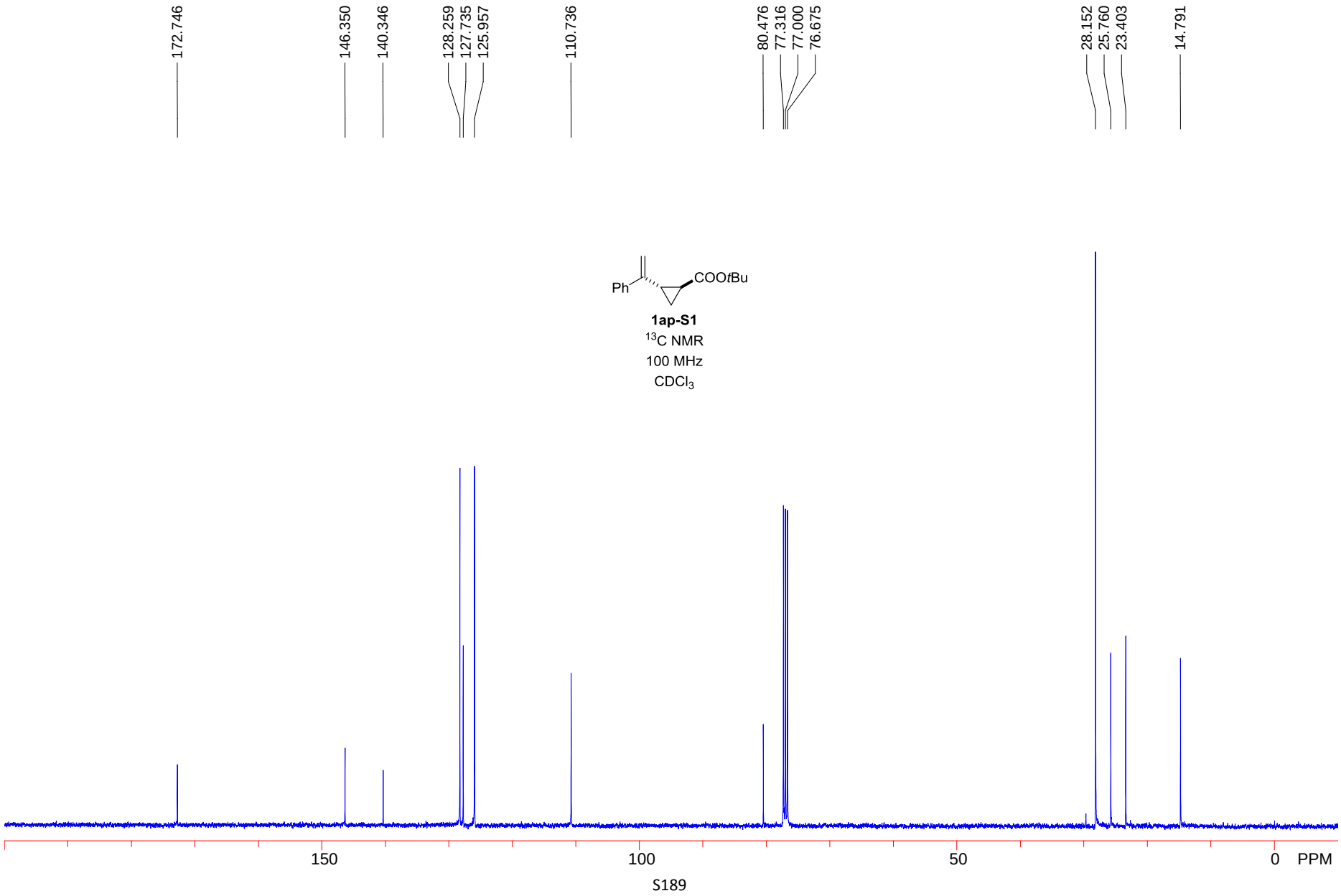
PPM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140.346
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110.736
80.476
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77.000
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28.152
25.760
23.403
14.791
Ph
COOtBu
1ap-S1
13C NMR
100 MHz
CDCl3
150
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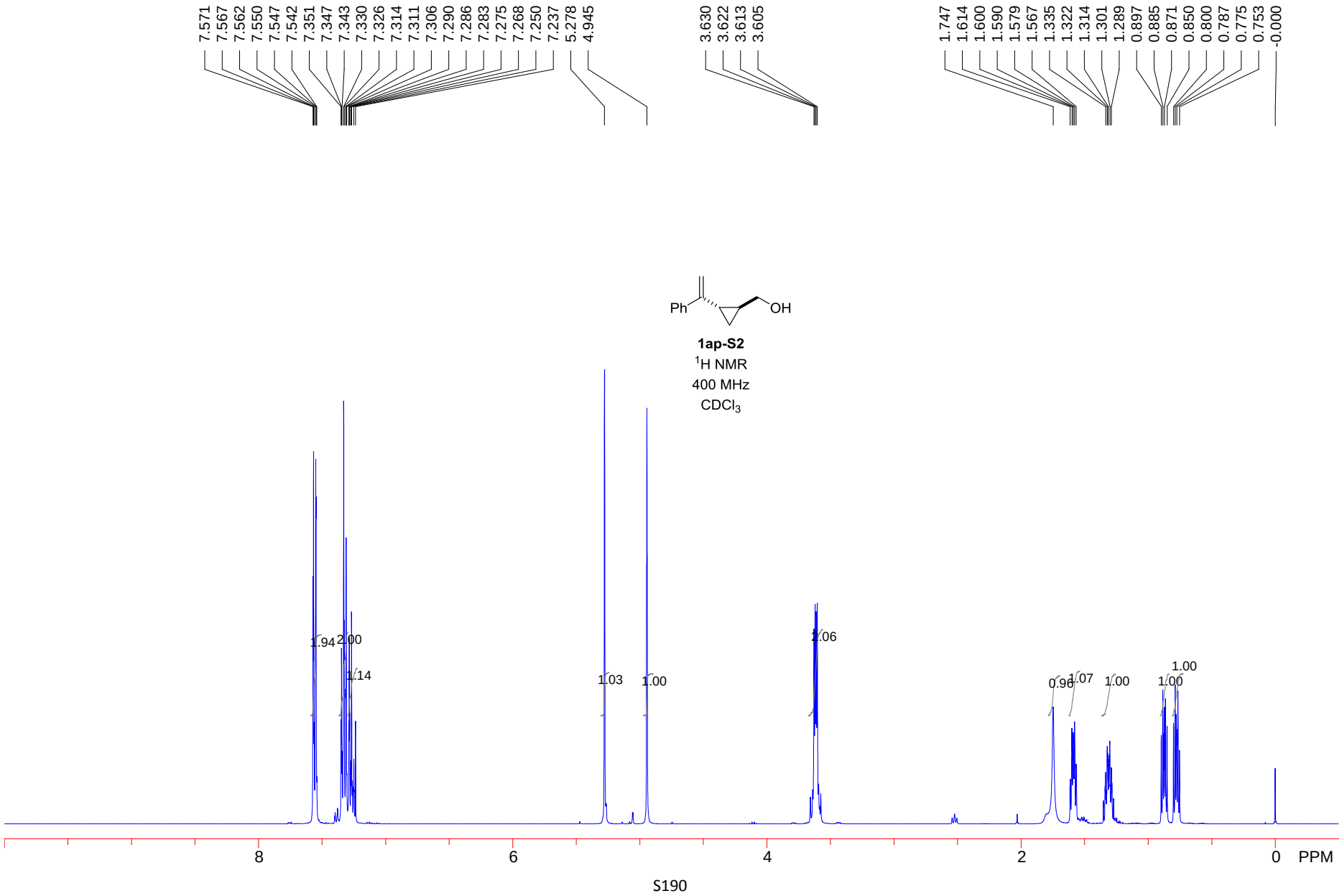
50
0
PPM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7.347
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7.330
7.326
7.314
7.311
7.306
7.290
7.286
7.283
7.275
7.268
7.250
7.237
5.278
4.945
3.630
3.622
3.613
3.605
1.747
1.614
1.600
1.590
1.579
1.567
1.335
1.322
1.314
1.301
1.289
0.897
0.885
0.871
0.850
0.800
0.787
0.775
0.753
-0.000
Ph
OH
1ap-S2
1H NMR
400 MHz
CDCl3
1.94
2.00
1.14
1.03
1.00
2.06
0.98
1.07
1.00
1.00
1.00
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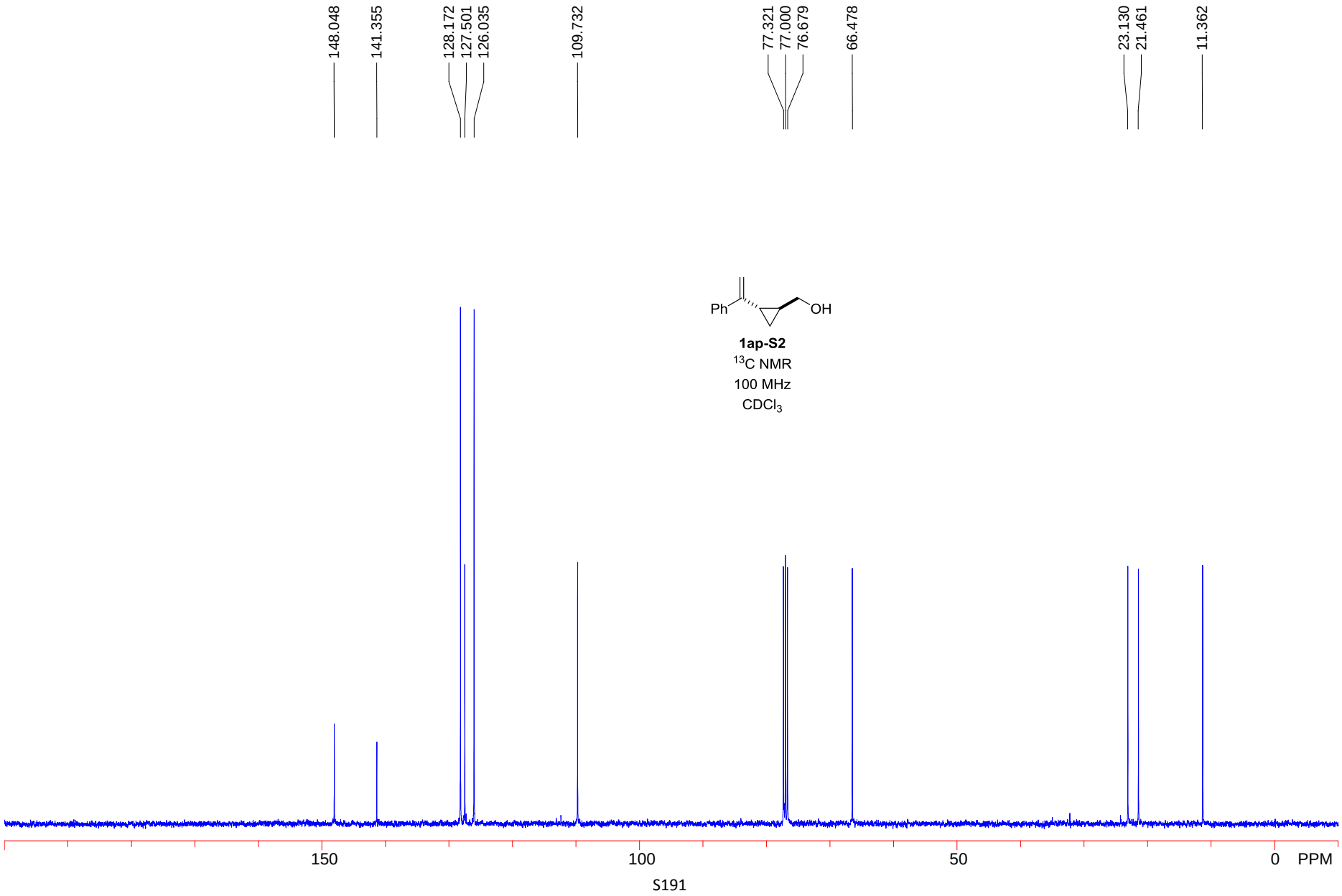
6
4
2
0
PPM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126.035
109.732
77.321
77.000
76.679
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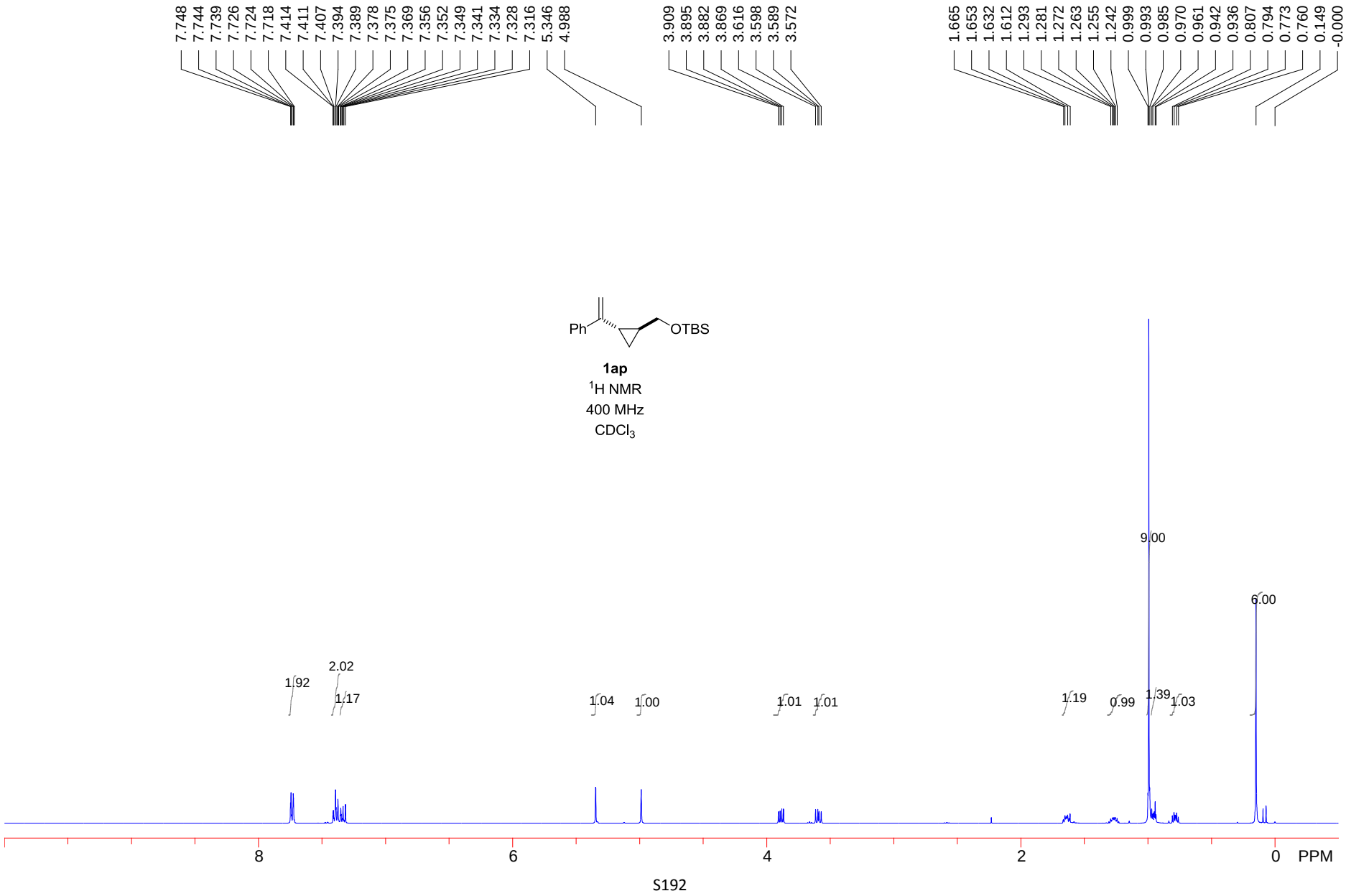
11.362
Ph
OH
1ap-S2
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.718
7.414
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7.394
7.389
7.378
7.375
7.369
7.356
7.352
7.349
7.341
7.334
7.328
7.316
5.346
4.988
3.909
3.895
3.882
3.869
3.616
3.598
3.589
3.572
1.665
1.653
1.632
1.612
1.293
1.281
1.272
1.263
1.255
1.242
0.999
0.993
0.985
0.970
0.961
0.942
0.936
0.807
0.794
0.773
0.760
0.149
-0.000
Ph
OTBS
1ap
1H NMR
400 MHz
CDCl3
1.92
2.02
1.17
1.04
1.00
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1.19
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1.03
6.00
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6
4
2
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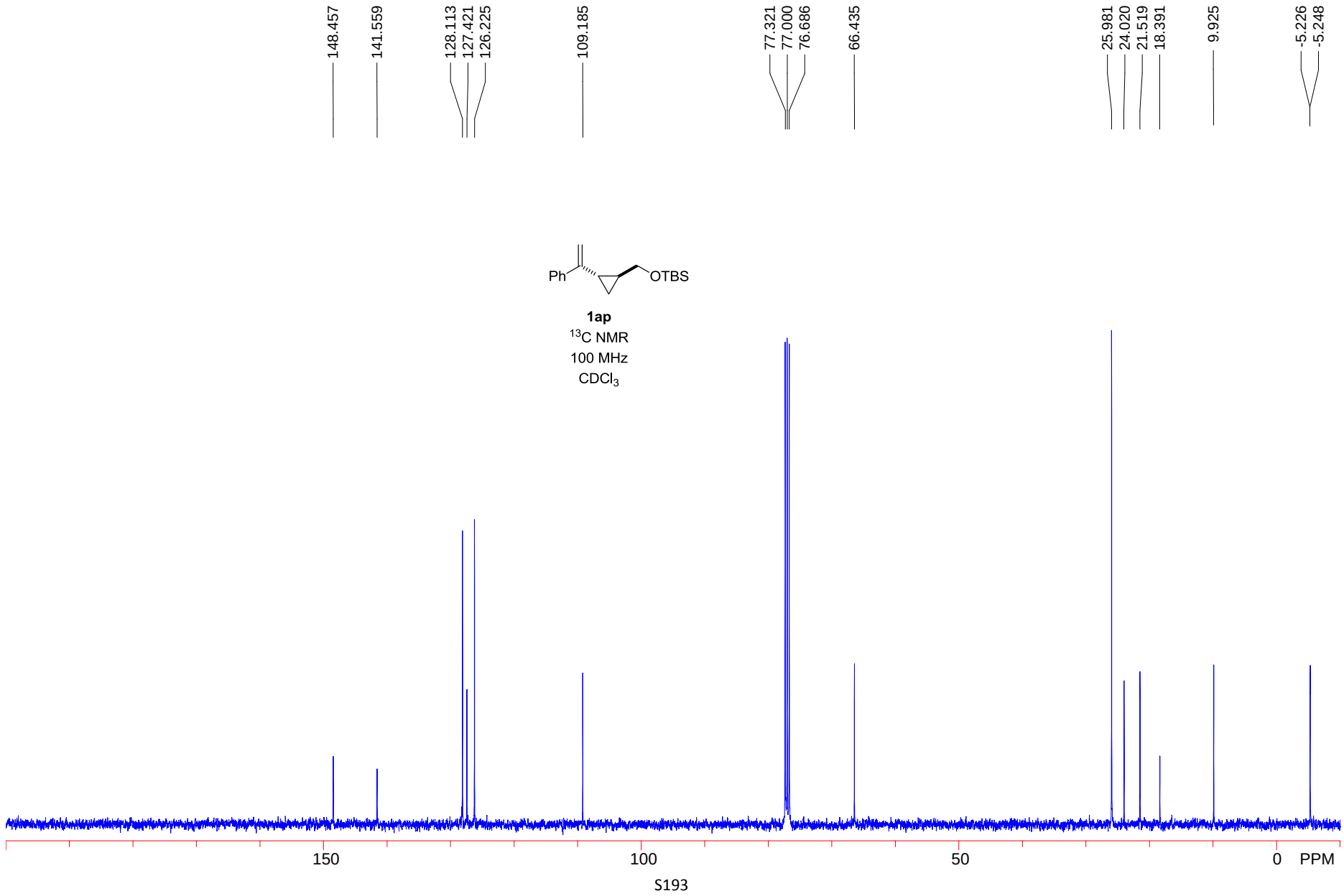
PPM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77.000
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25.981
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21.519
18.391
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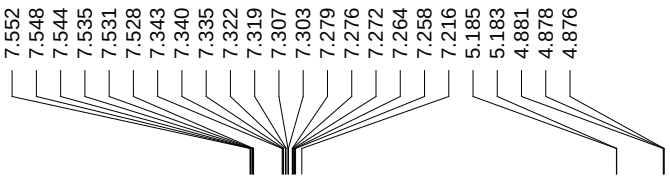
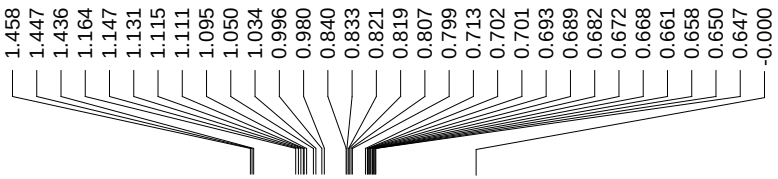
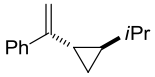
-5.248
Ph
OTBS
1ap
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM





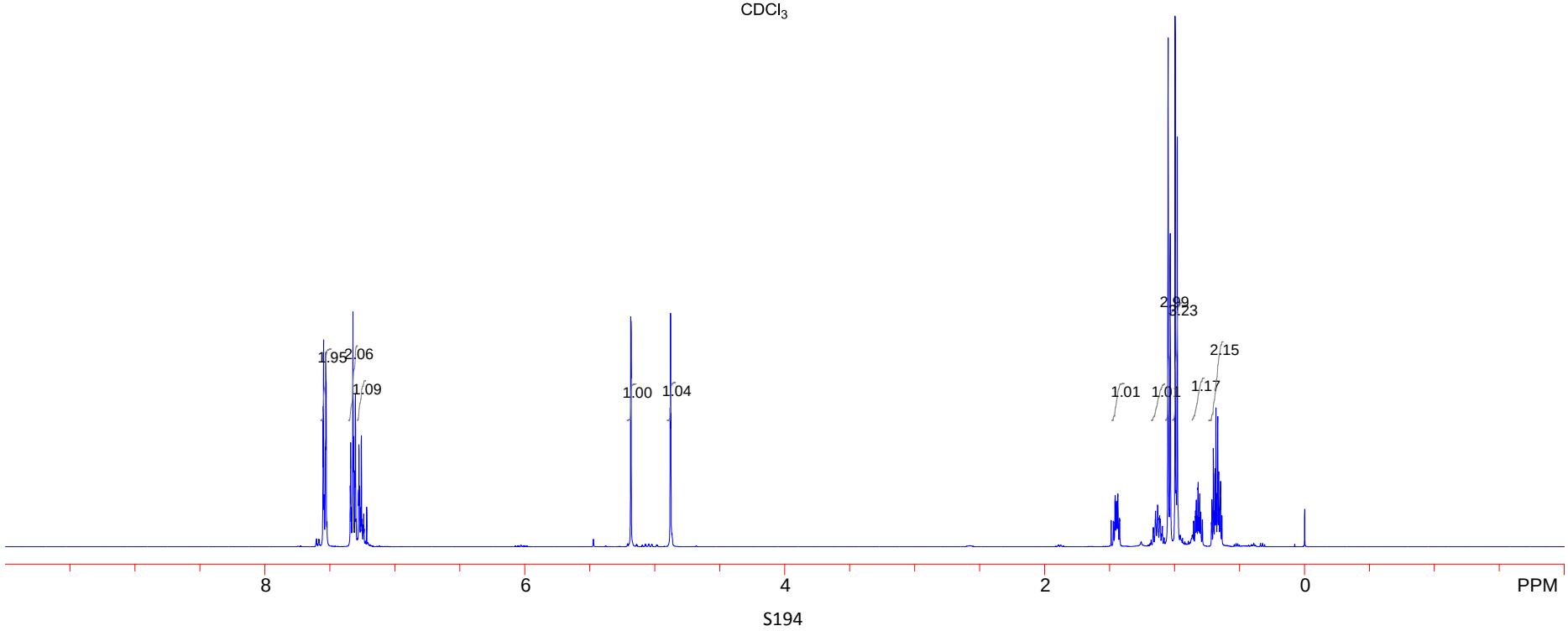


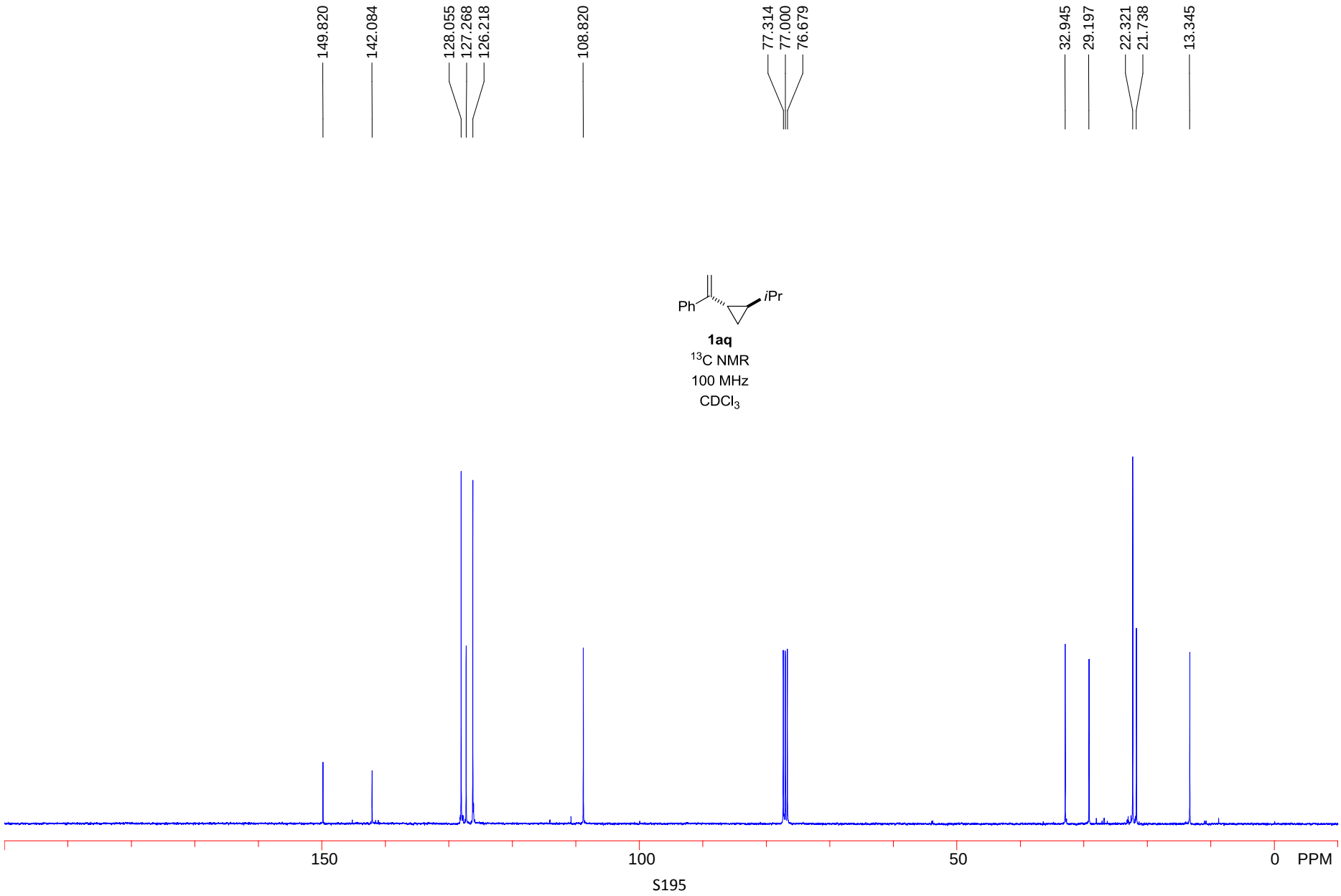
1aq

^{1}H NMR

400 MHz

$CDCl_3$

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127.268
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77.000
76.679
32.945
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13.345
Ph
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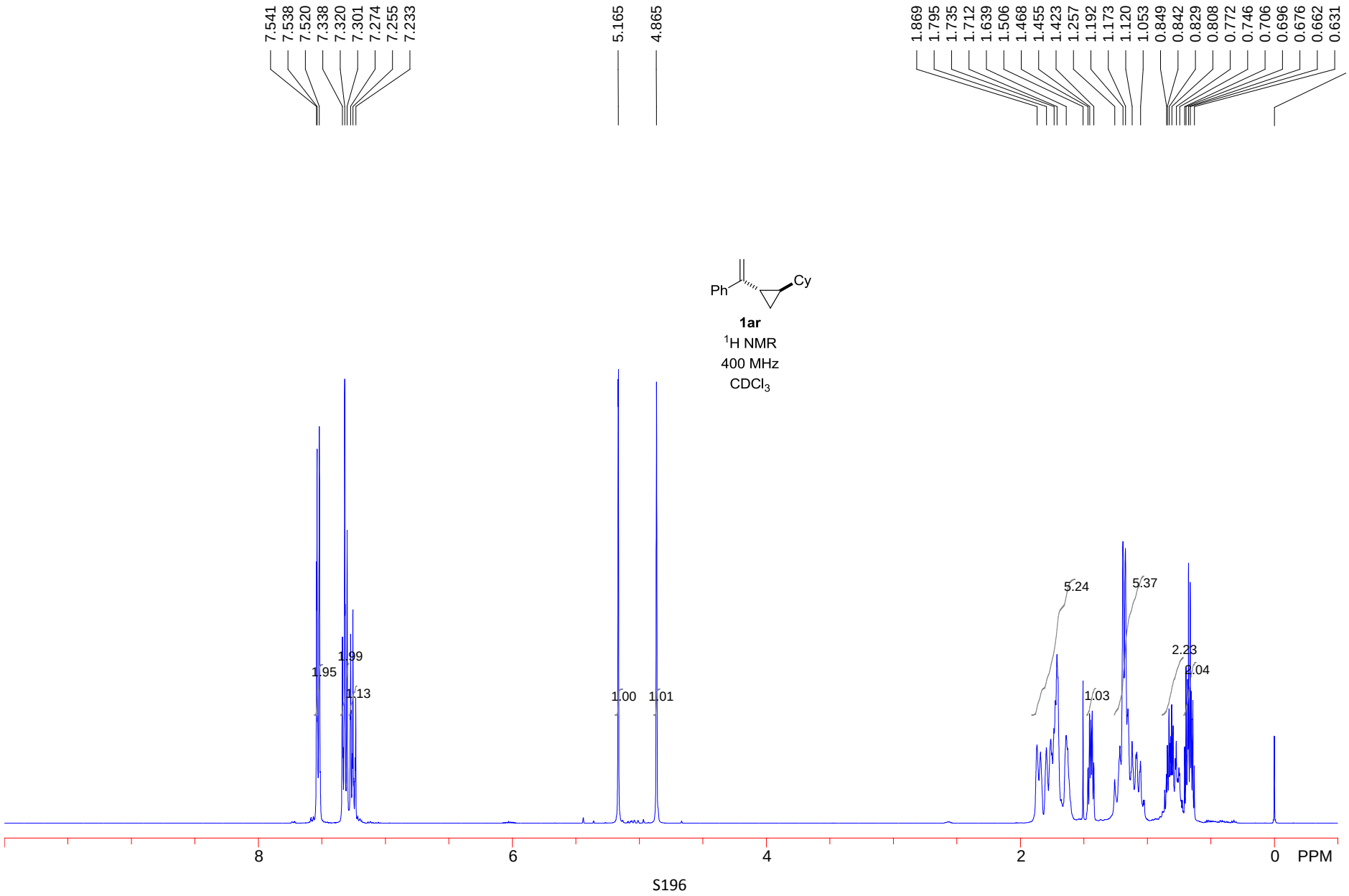
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.255
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5.165
4.865
1.869
1.795
1.735
1.712
1.639
1.506
1.468
1.455
1.423
1.257
1.192
1.173
1.120
1.053
0.849
0.842
0.829
0.808
0.772
0.746
0.706
0.696
0.676
0.662
0.631
Ph
Cy
1ar
1H NMR
400 MHz
CDCl3
1.95
1.99
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1.01
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2.04
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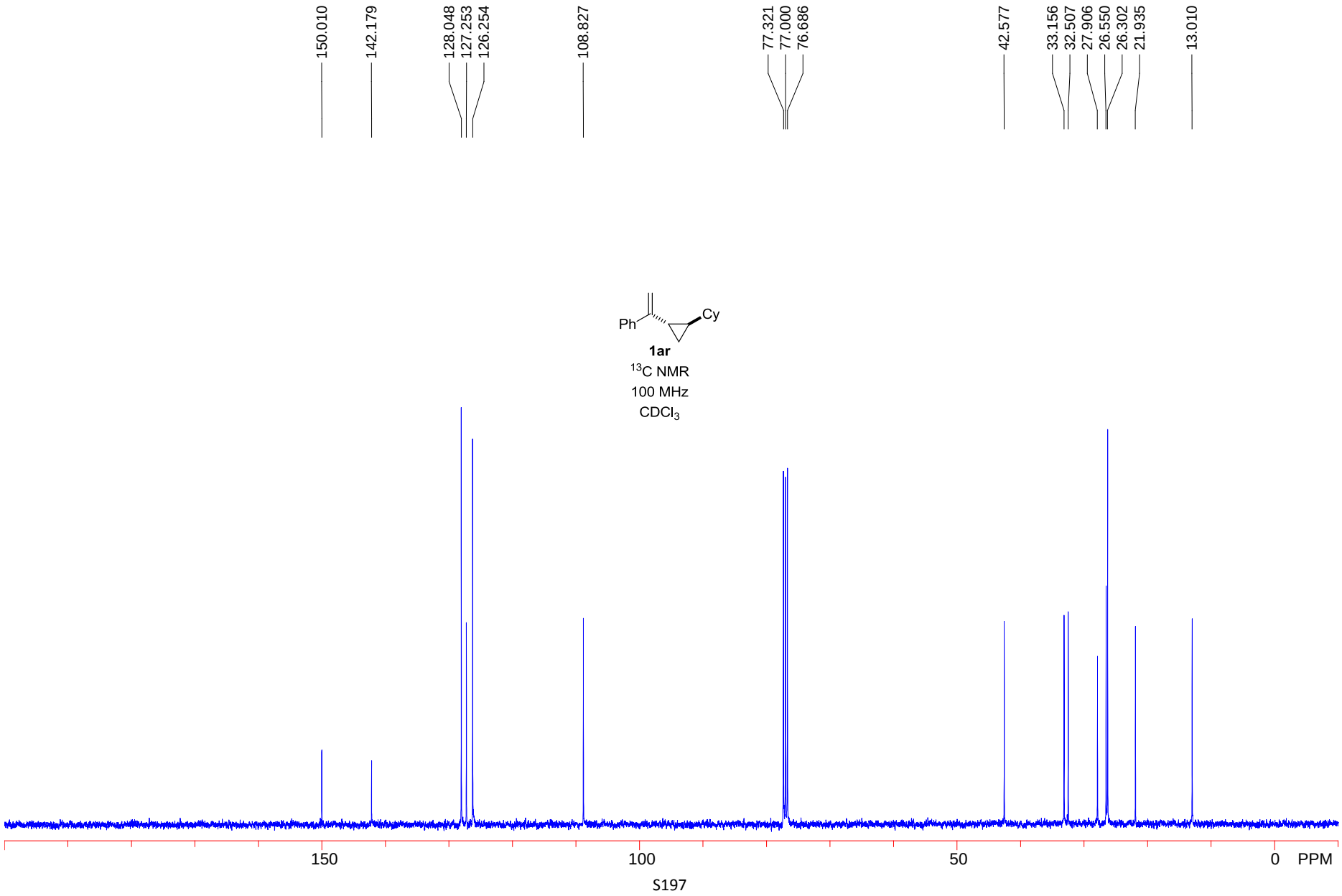
PPM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77.000
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42.577
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27.906
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13.010
Ph
Cy
1ar
13C NMR
100 MHz
CDCl3
150
100
50
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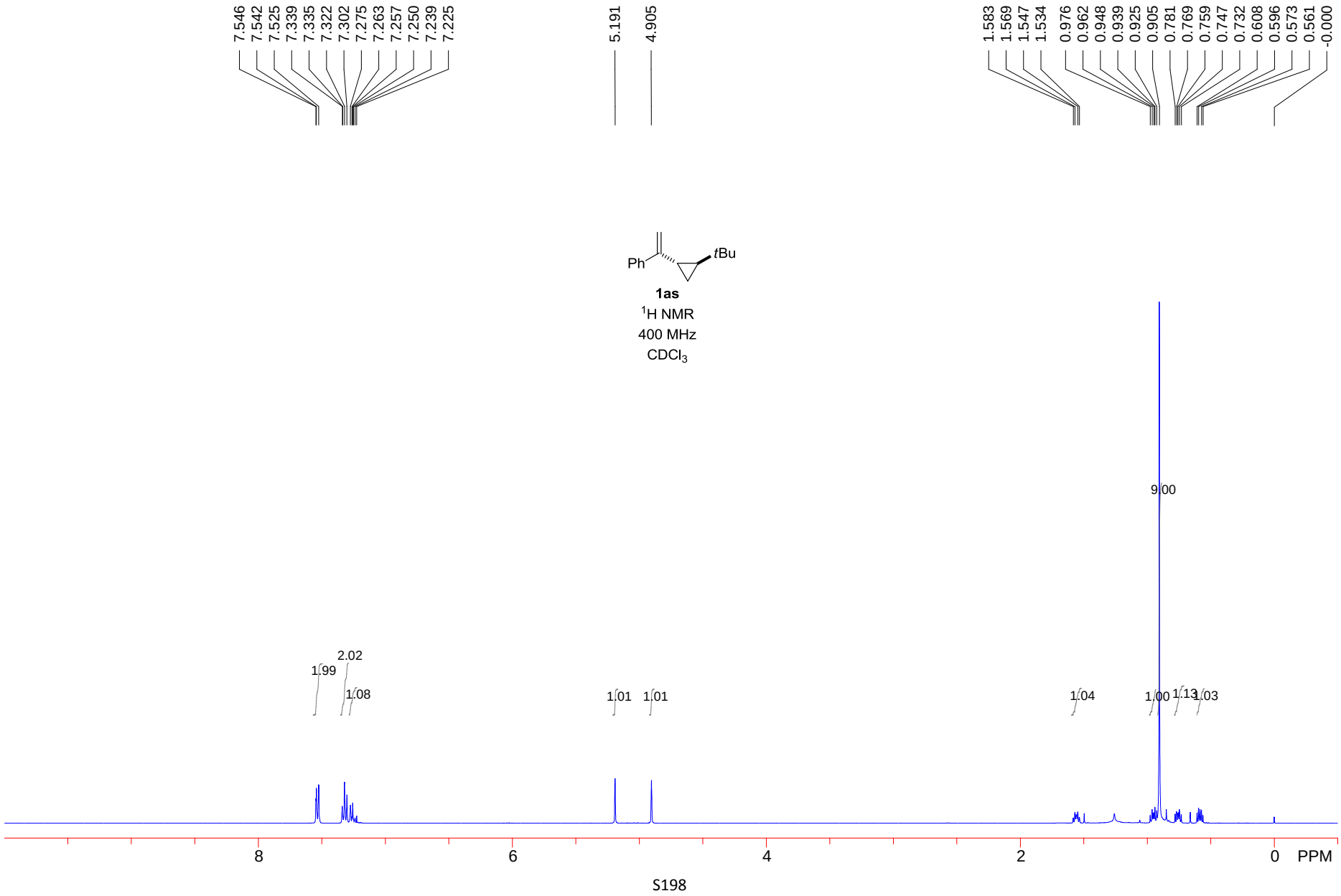
PPM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7.250
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7.225
5.191
4.905
1.583
1.569
1.547
1.534
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0.962
0.948
0.939
0.925
0.905
0.781
0.769
0.759
0.747
0.732
0.608
0.596
0.573
0.561
-0.000
Ph
tBu
1as
1H NMR
400 MHz
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2.02
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1.03
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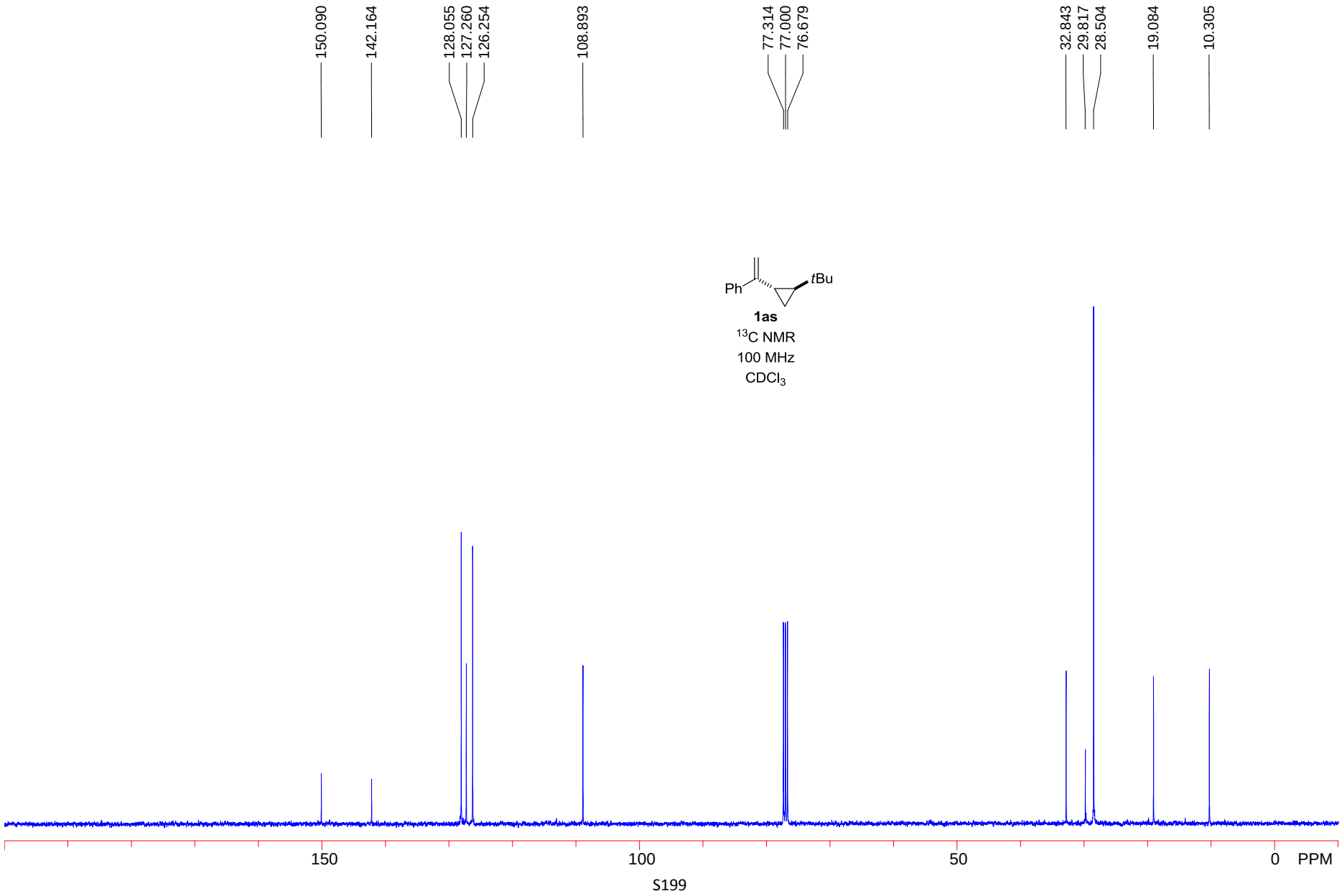
PPM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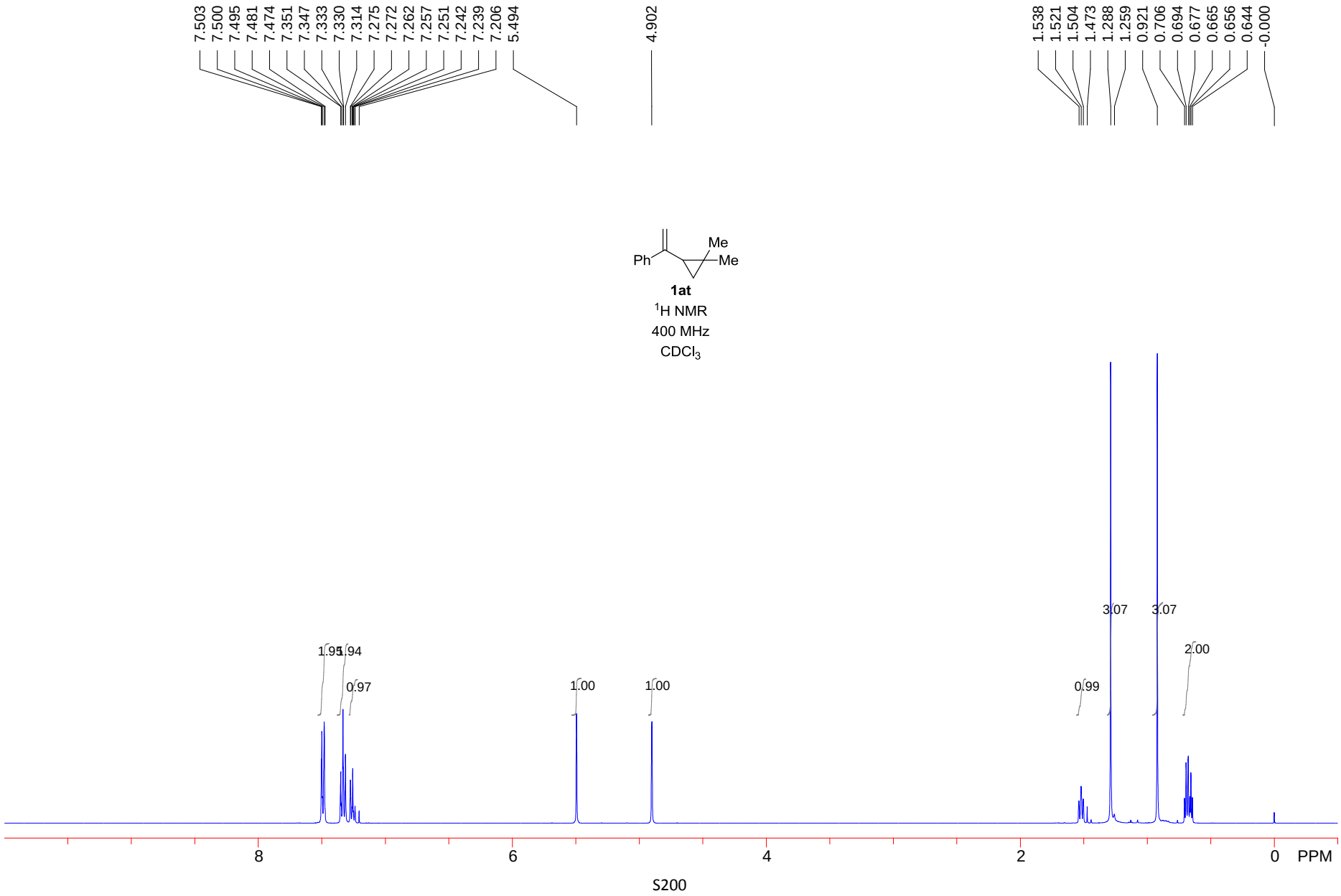
PPM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7.275
7.272
7.262
7.257
7.251
7.242
7.239
7.206
5.494
4.902
1.538
1.521
1.504
1.473
1.288
1.259
0.921
0.706
0.694
0.677
0.665
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Ph
Me
Me
1at
1H NMR
400 MHz
CDCl3
1.95
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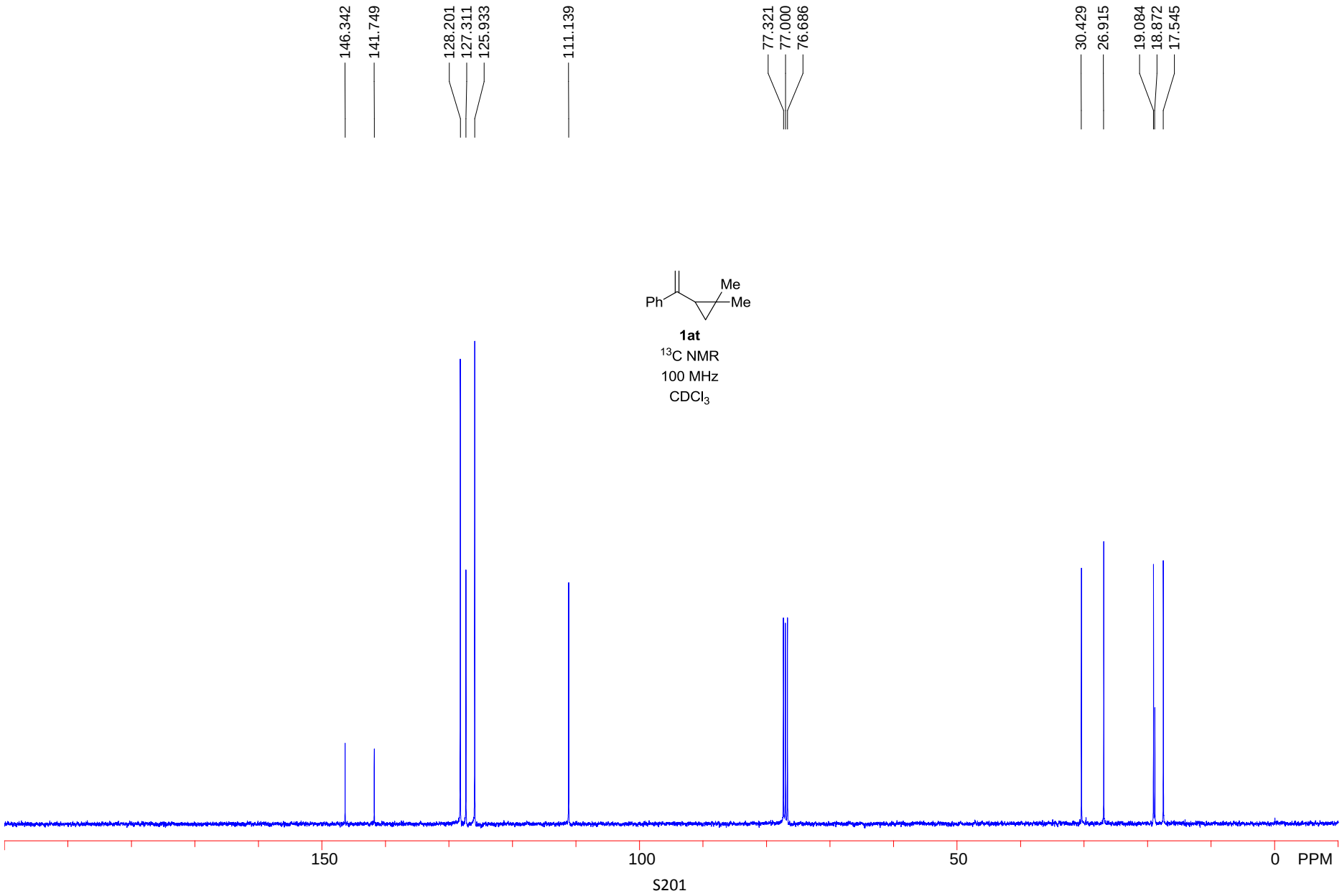
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77.000
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26.915
19.084
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Me
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1at
13C NMR
100 MHz
CDCl3
150
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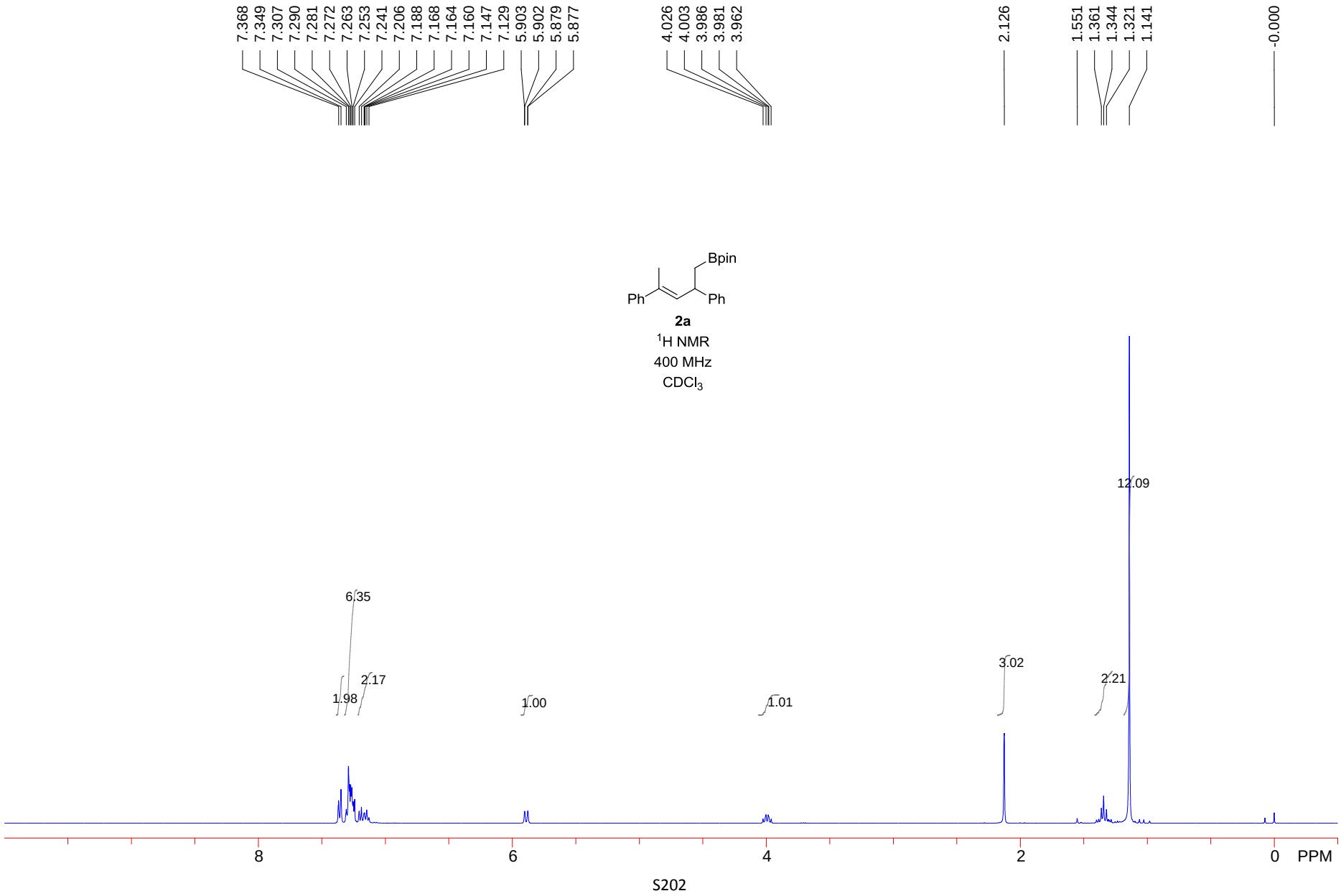
PPM

S201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7.188
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7.164
7.160
7.147
7.129
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5.902
5.879
5.877
4.026
4.003
3.986
3.981
3.962
2.126
1.551
1.361
1.344
1.321
1.141
-0.000
Bpin
Ph
Ph
2a
1H NMR
400 MHz
CDCl3
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1.01
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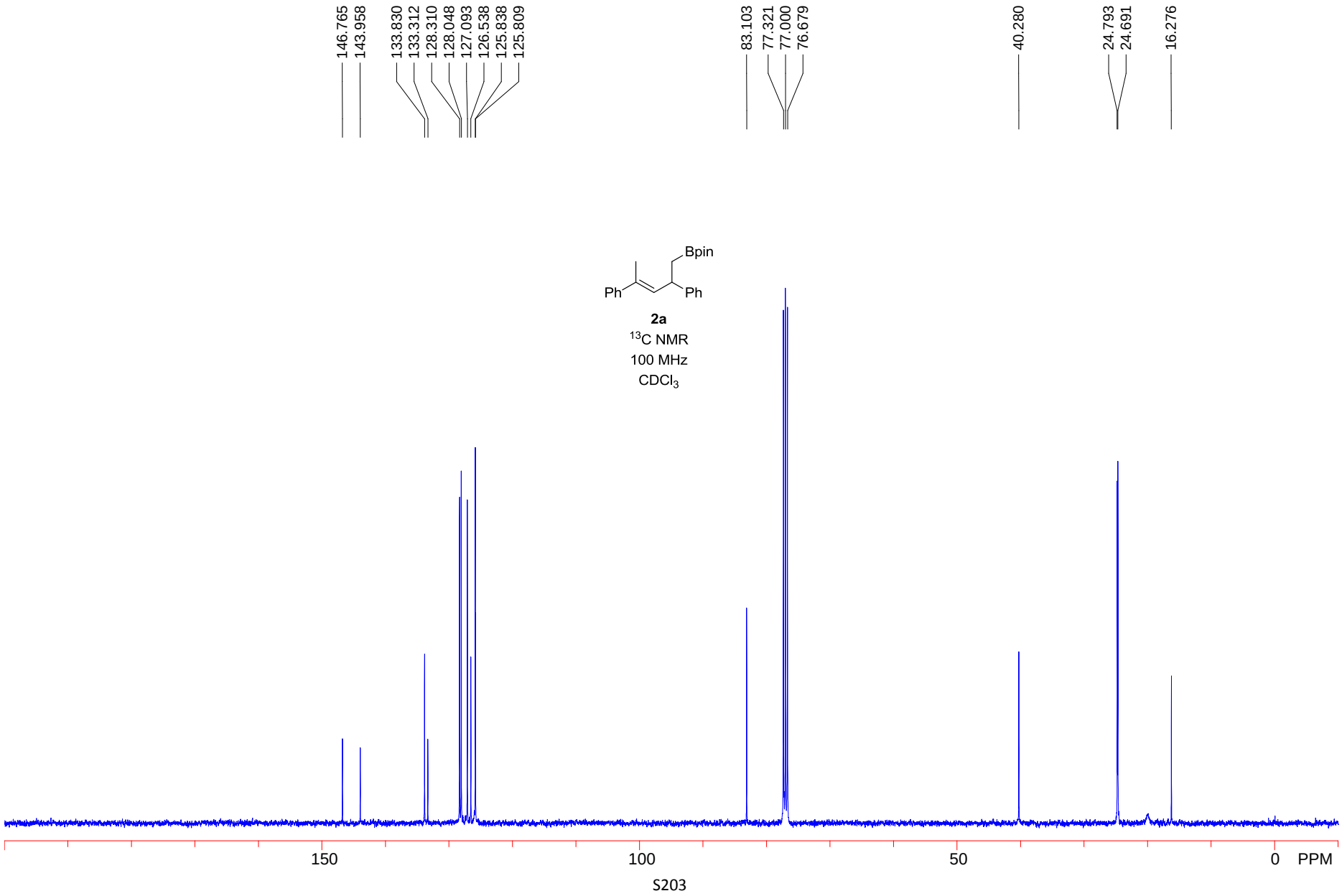
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125.809
83.103
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77.000
76.679
40.280
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16.276
Bpin
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Ph
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13C NMR
100 MHz
CDCl3
150
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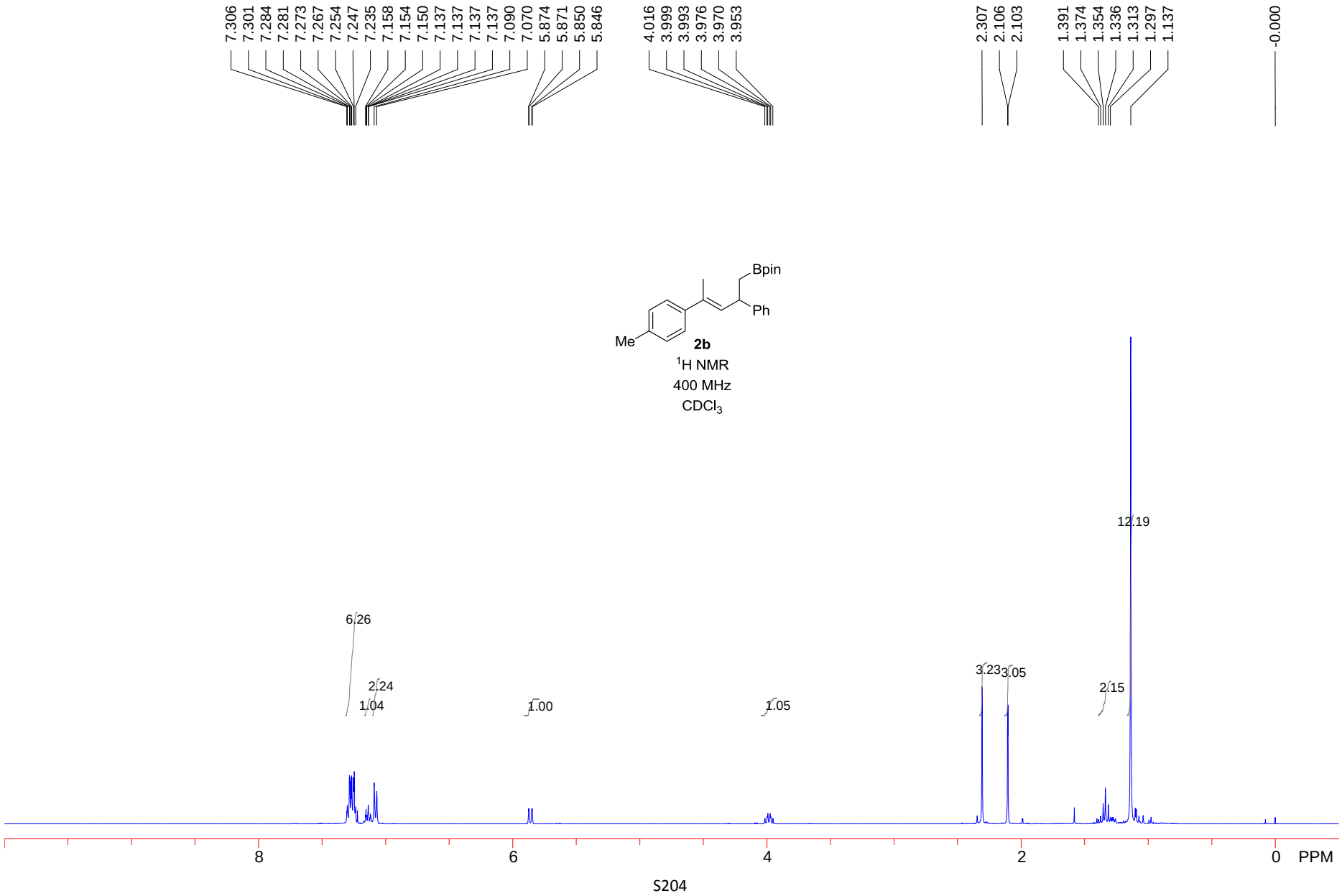
PPM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7.137
7.137
7.137
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5.850
5.846
4.016
3.999
3.993
3.976
3.970
3.953
2.307
2.106
2.103
1.391
1.374
1.354
1.336
1.313
1.297
1.137
-0.000
Bpin
Ph
Me
2b
1H NMR
400 MHz
CDCl3
6.26
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1.00
1.05
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12.19
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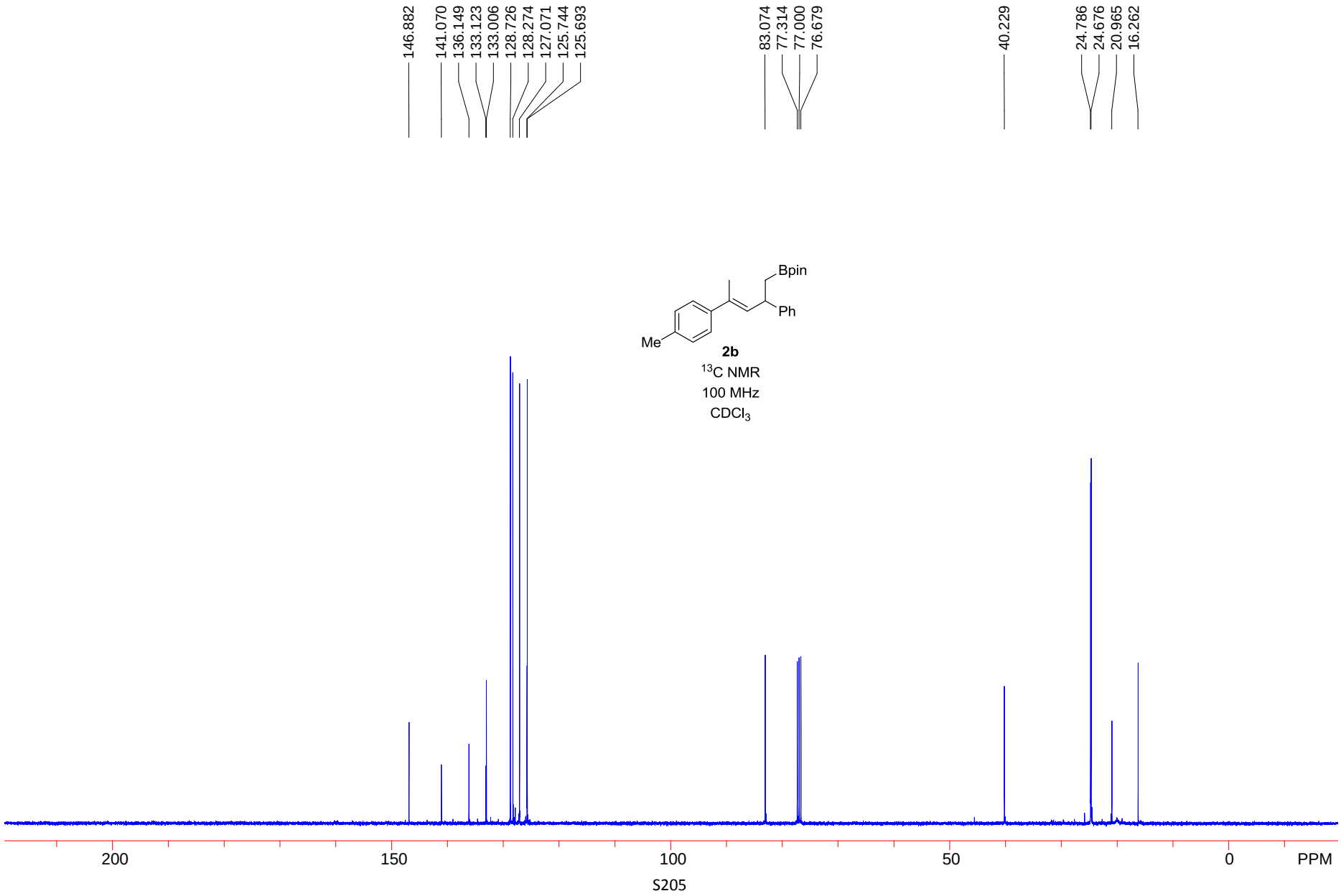
PPM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77.000
76.679
40.229
24.786
24.676
20.965
16.262
Bpin
Ph
Me
2b
13C NMR
100 MHz
CDCl3
200
150
100
50
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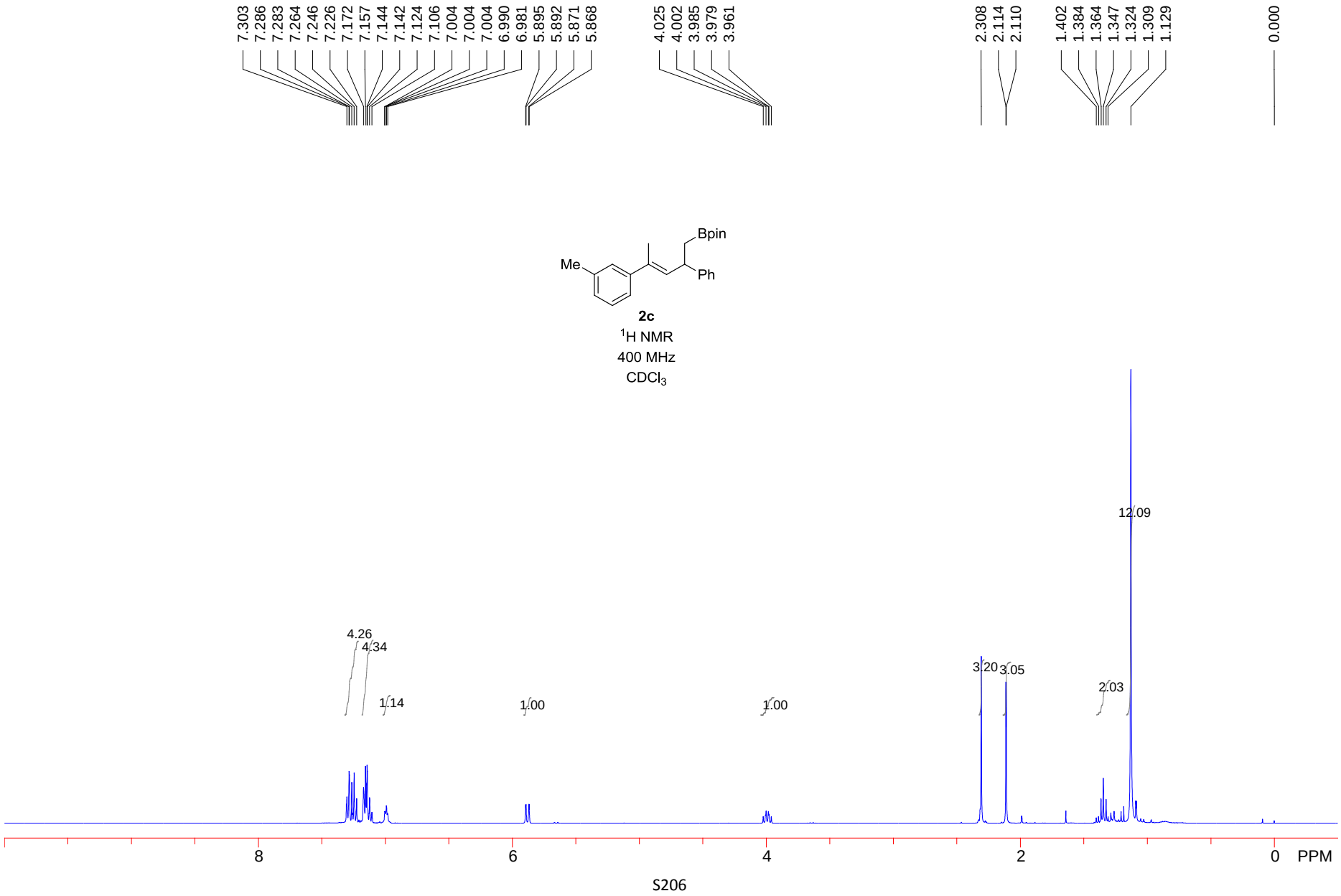
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7.004
7.004
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1.347
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1.309
1.129
0.000
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Me
Ph
2c
1H NMR
400 MHz
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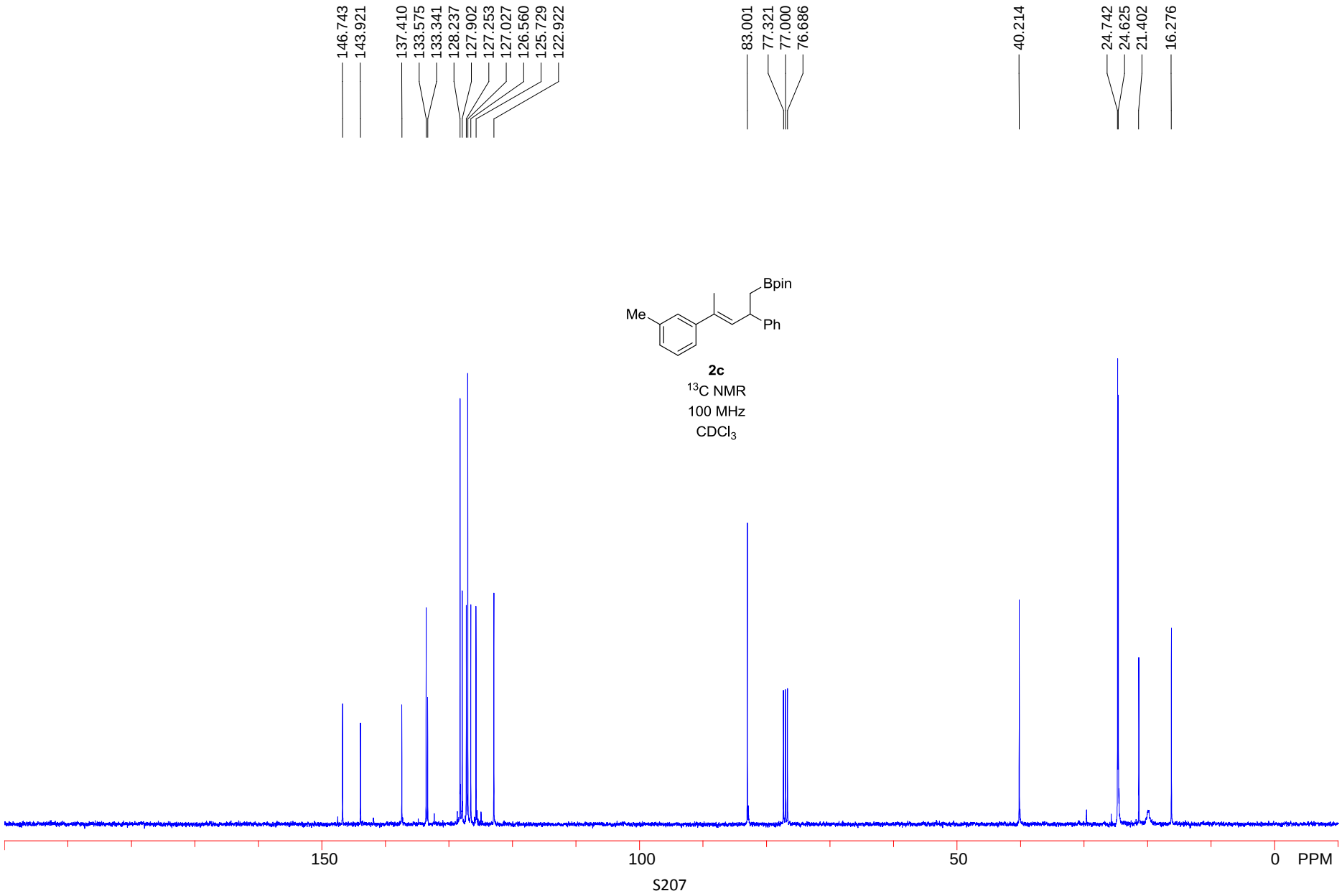
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40.214
24.742
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Ph
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100 MHz
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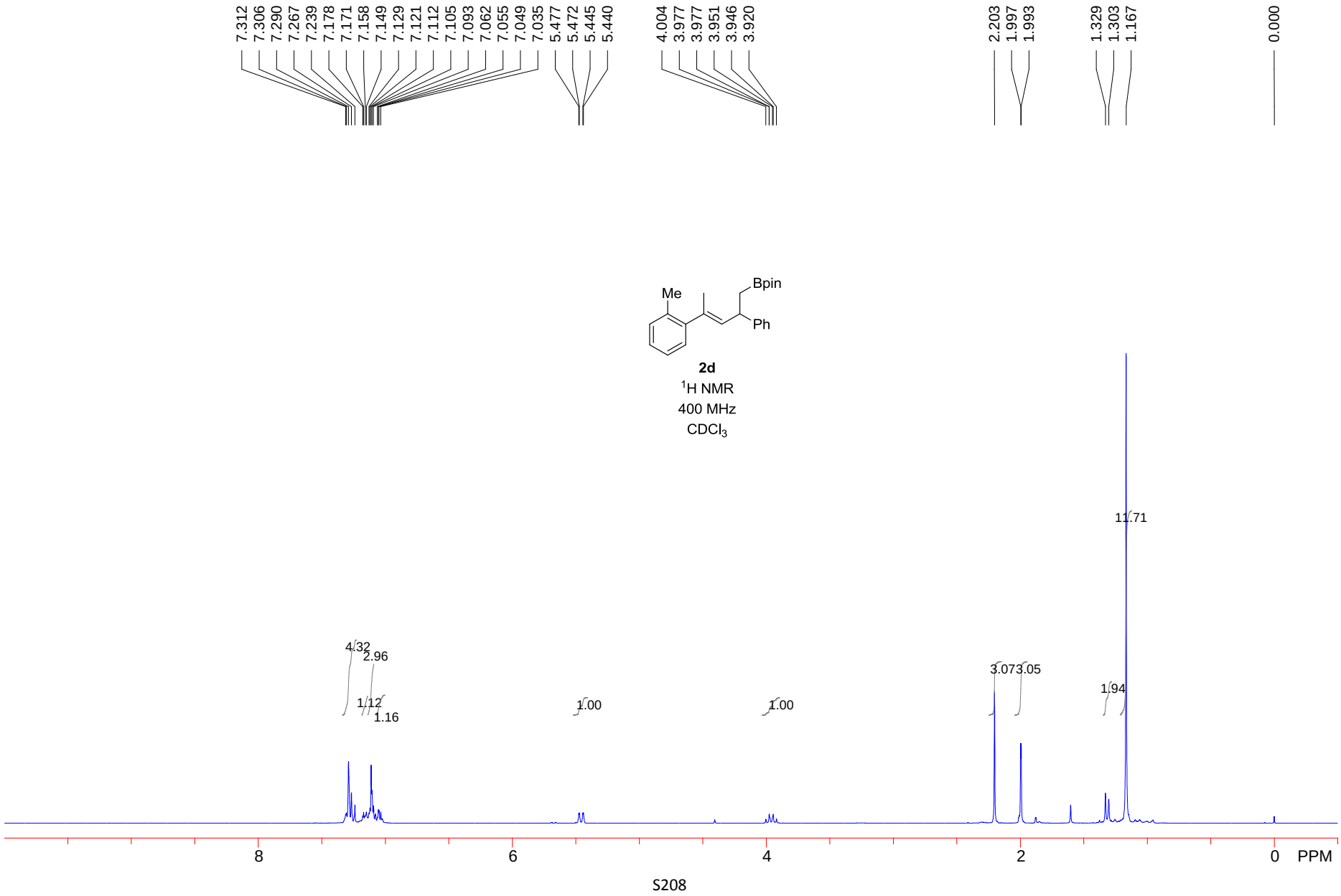
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7.093
7.062
7.055
7.049
7.035
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5.472
5.445
5.440
4.004
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3.946
3.920
2.203
1.997
1.993
1.329
1.303
1.167
0.000
Me
Bpin
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2d
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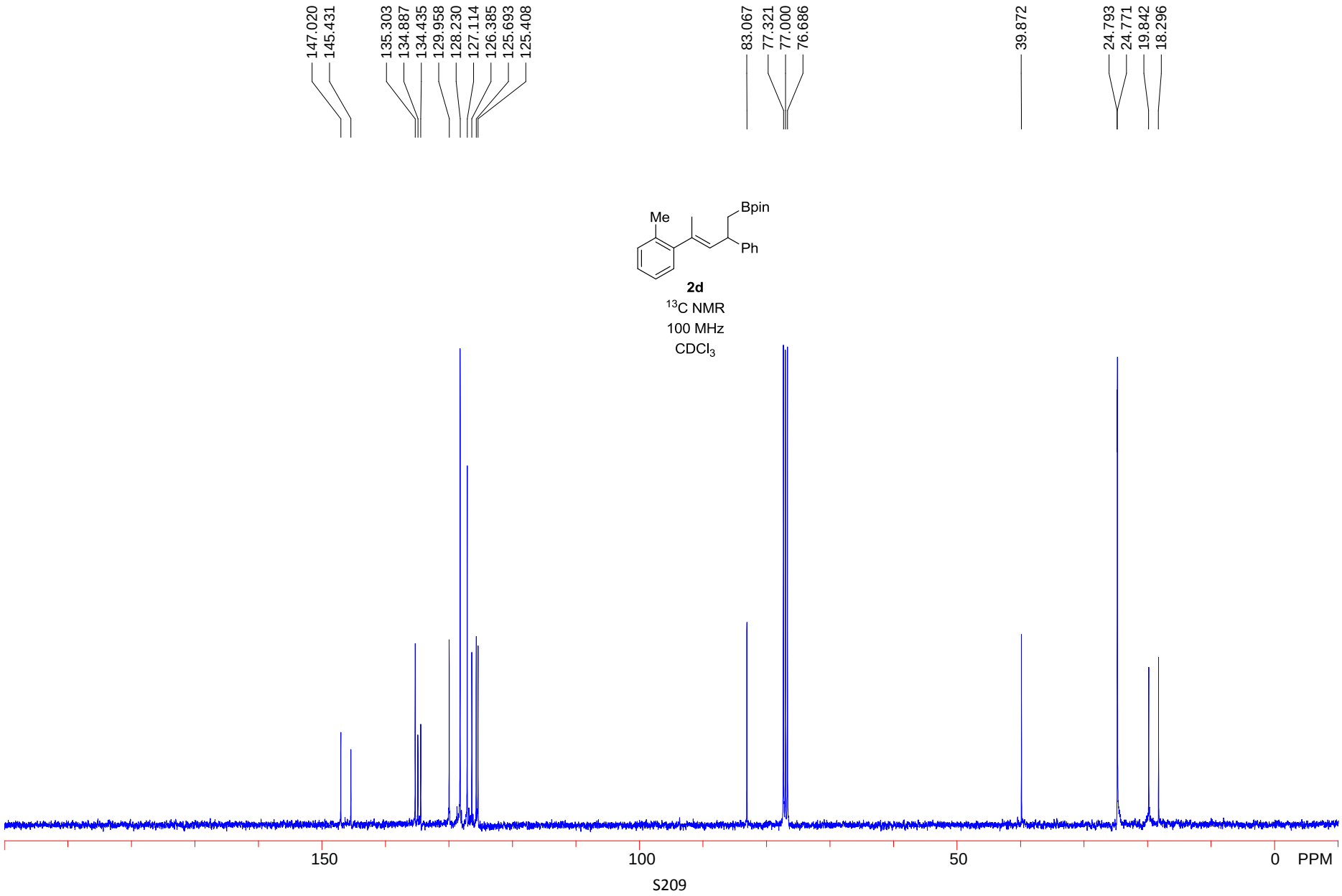
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77.000
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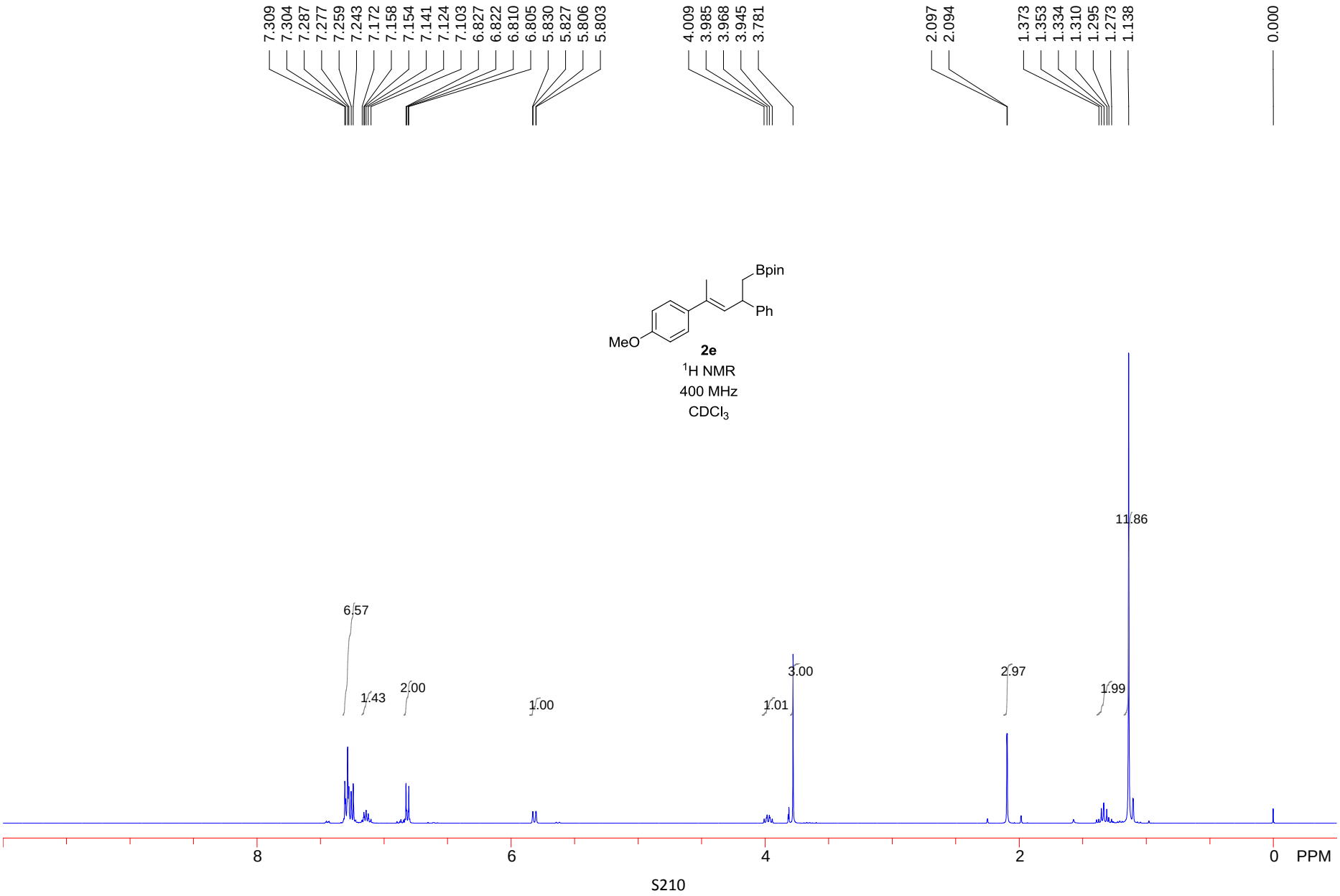
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7.103
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6.810
6.805
5.830
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5.803
4.009
3.985
3.968
3.945
3.781
2.097
2.094
1.373
1.353
1.334
1.310
1.295
1.273
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Ph
MeO
2e
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400 MHz
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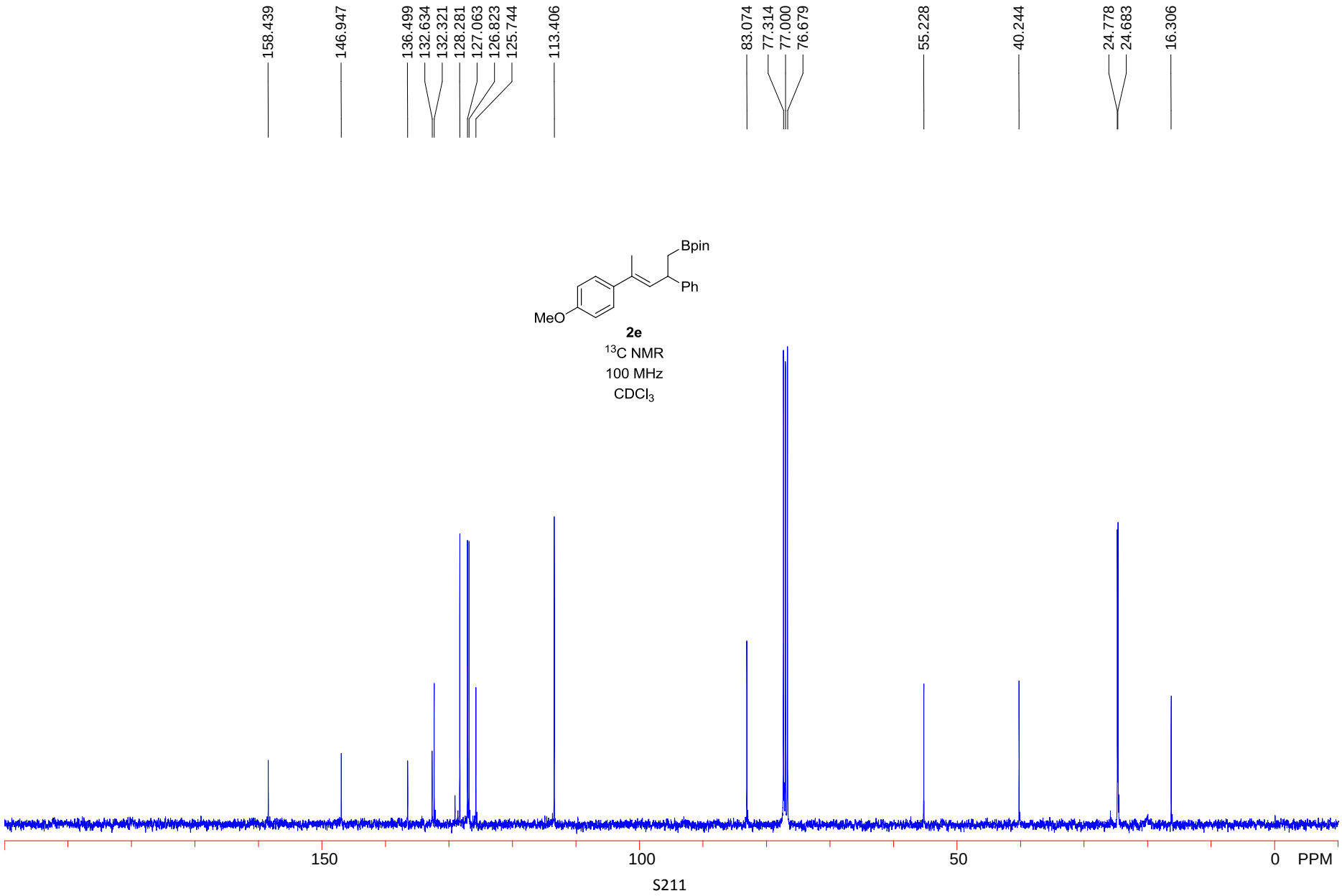
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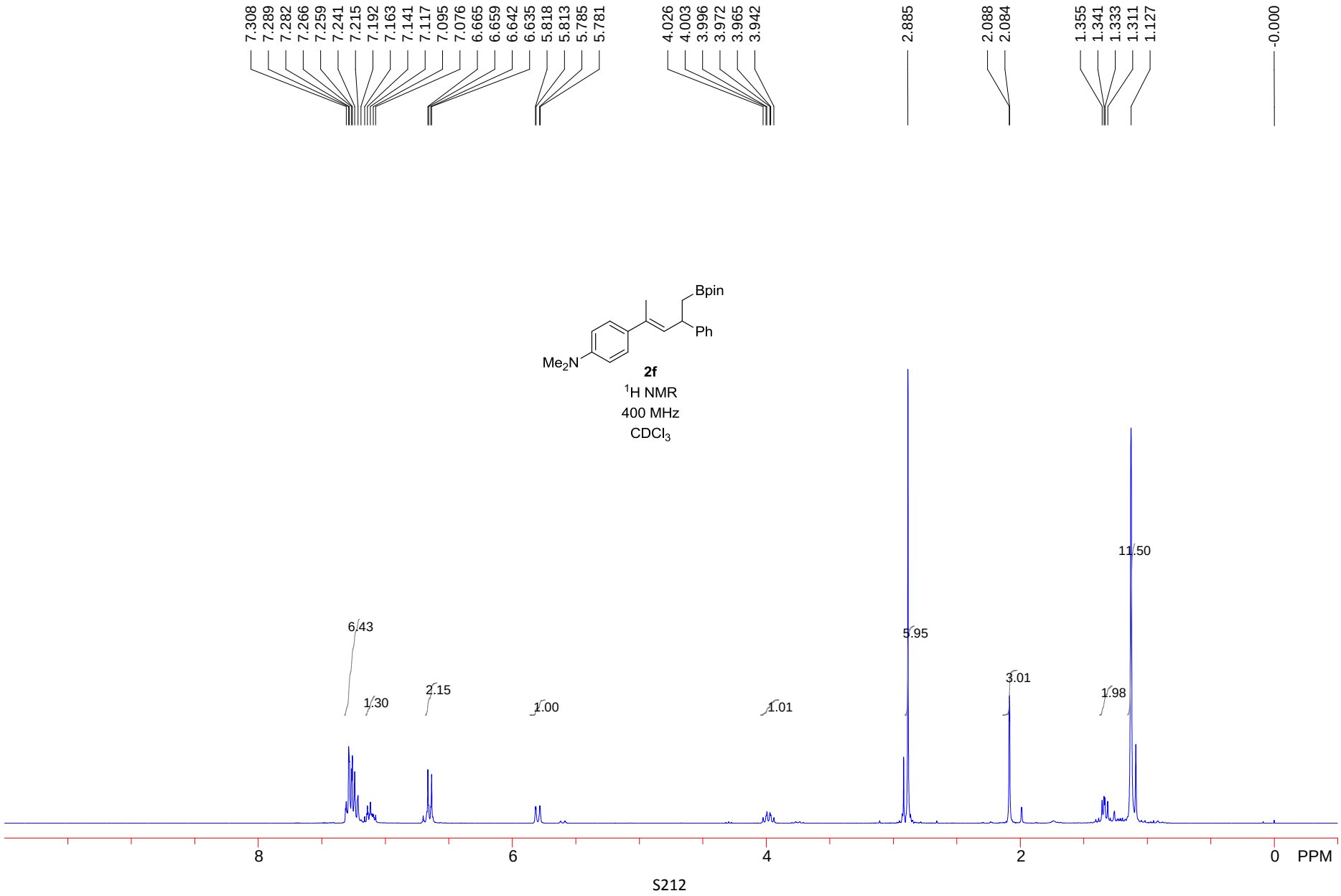
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7.076
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6.659
6.642
6.635
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5.813
5.785
5.781
4.026
4.003
3.996
3.972
3.965
3.942
2.885
2.088
2.084
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1.341
1.333
1.311
1.127
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Ph
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2f
1H NMR
400 MHz
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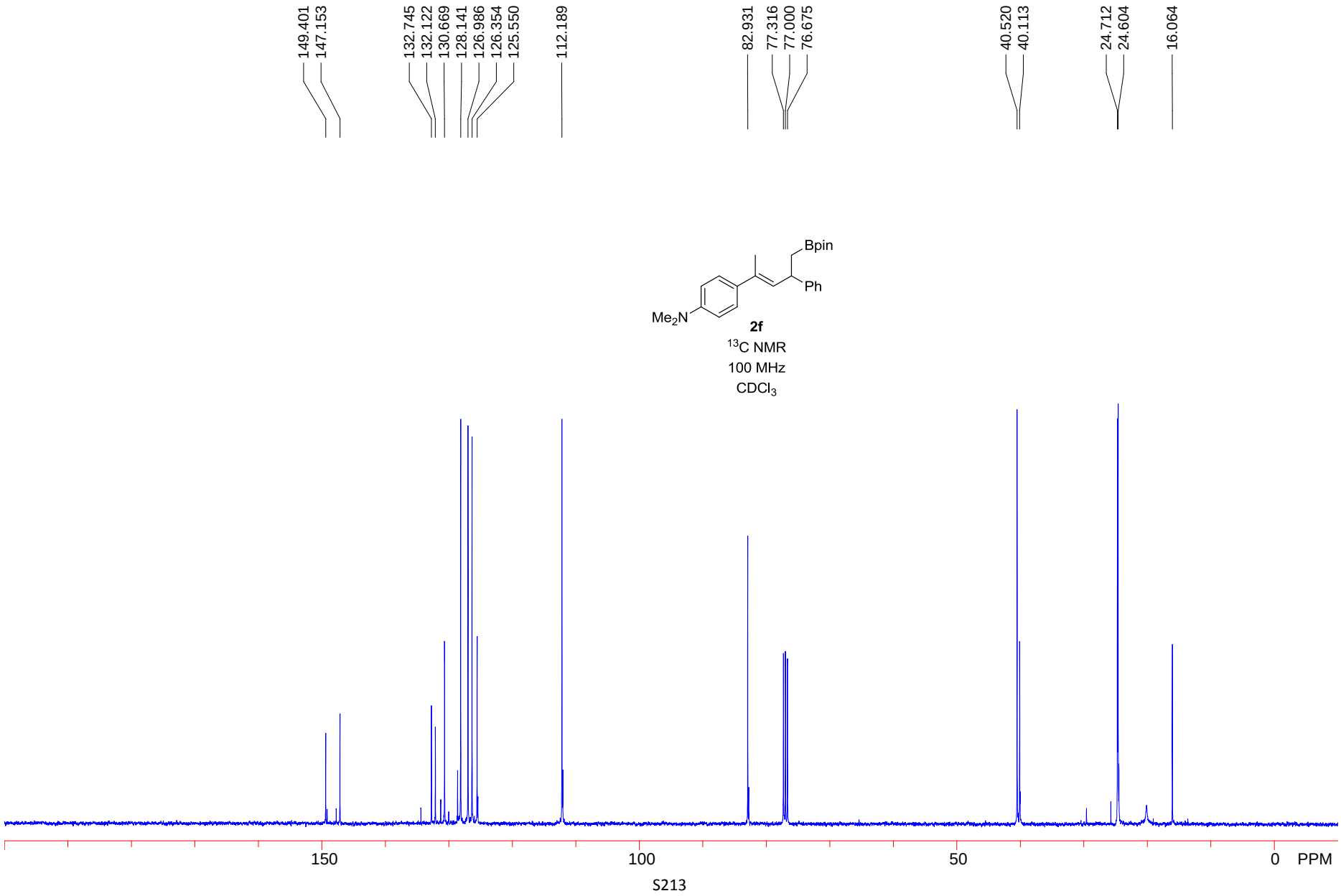
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77.000
76.675
40.520
40.113
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100 MHz
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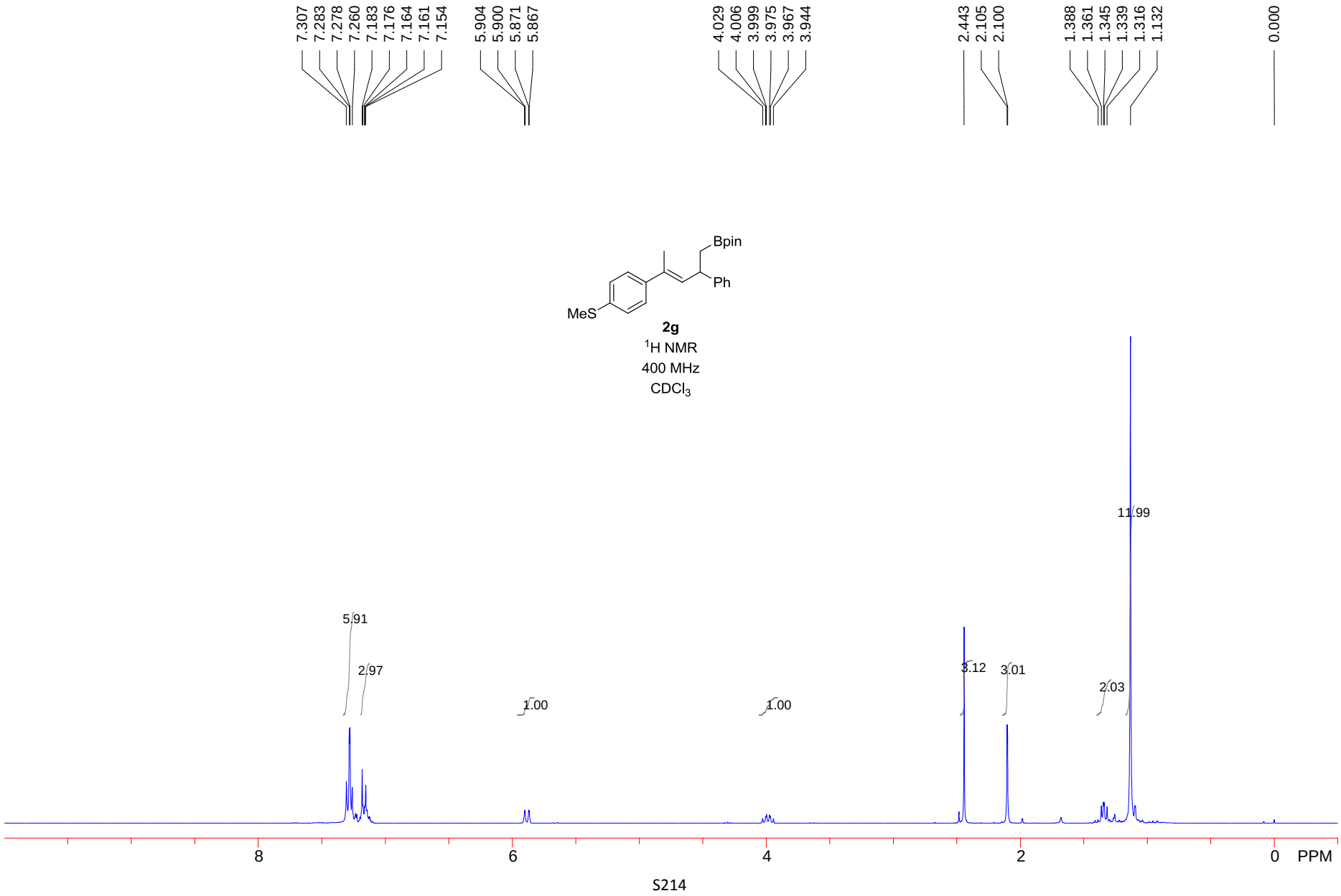
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5.867
4.029
4.006
3.999
3.975
3.967
3.944
2.443
2.105
2.100
1.388
1.361
1.345
1.339
1.316
1.132
0.000
Bpin
Ph
MeS
2g
1H NMR
400 MHz
CDCl3
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2.03
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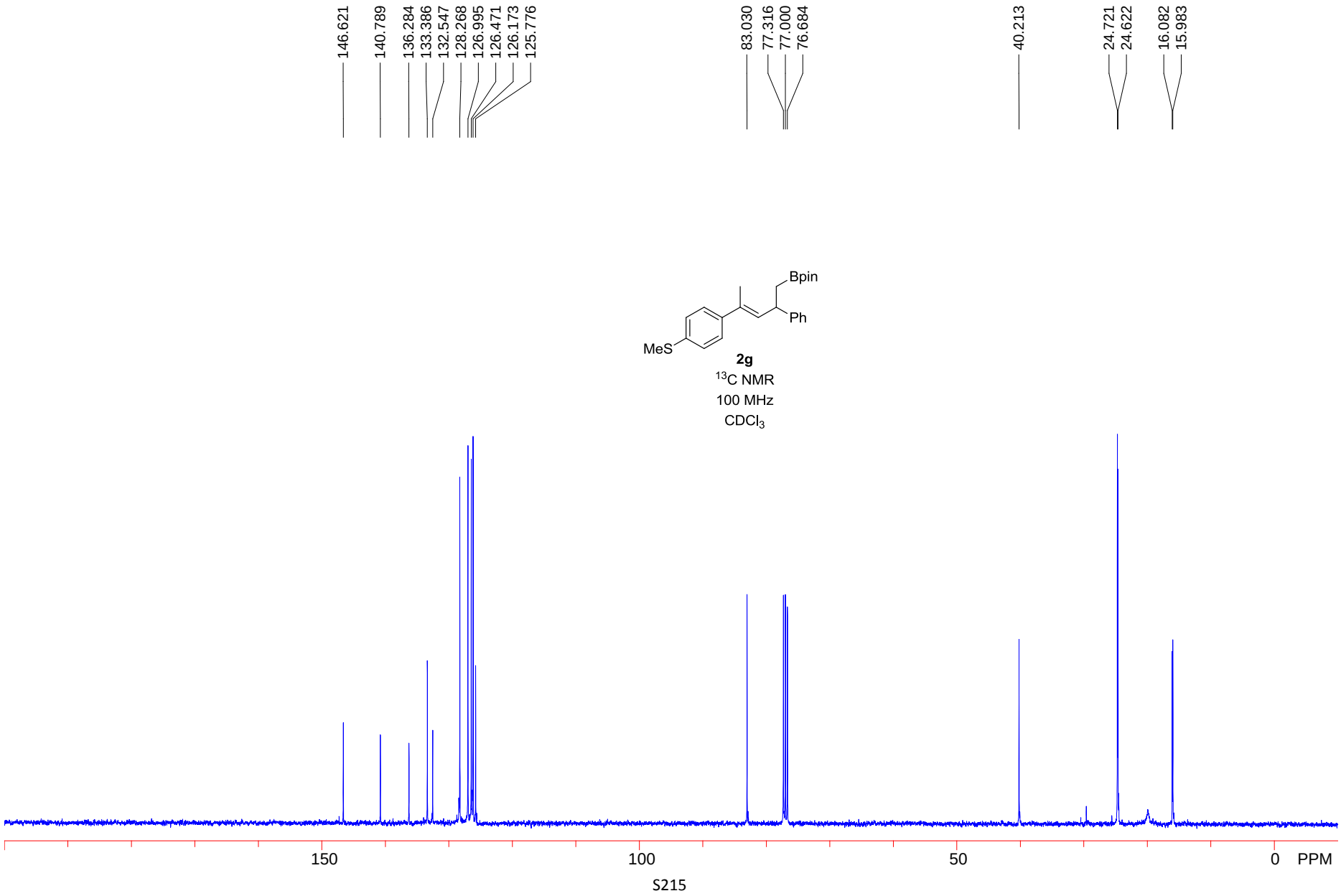
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24.721
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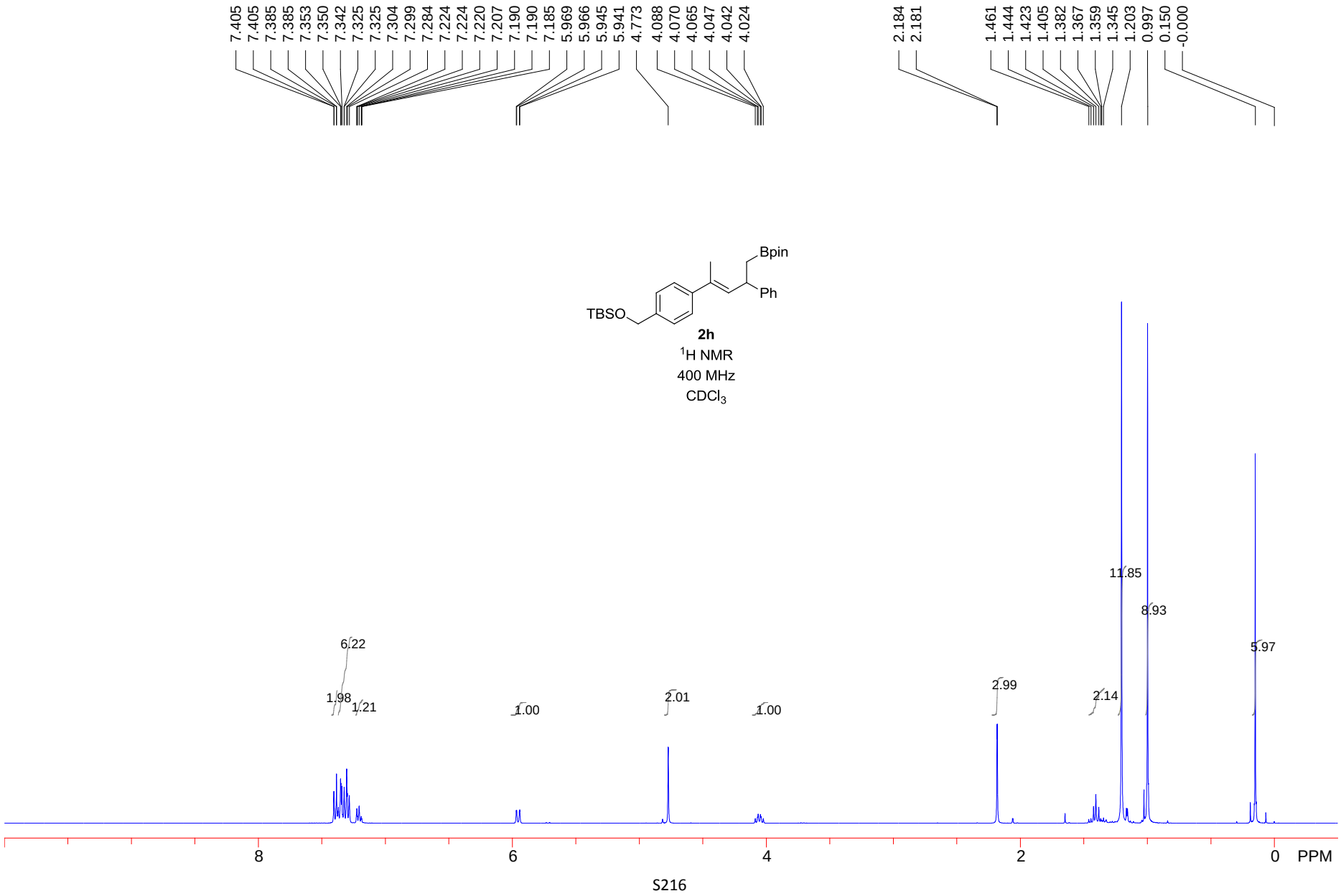
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7.224
7.220
7.207
7.190
7.190
7.185
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5.945
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4.065
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4.042
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2.181
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1.423
1.405
1.382
1.367
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Ph
TBSO
2h
1H NMR
400 MHz
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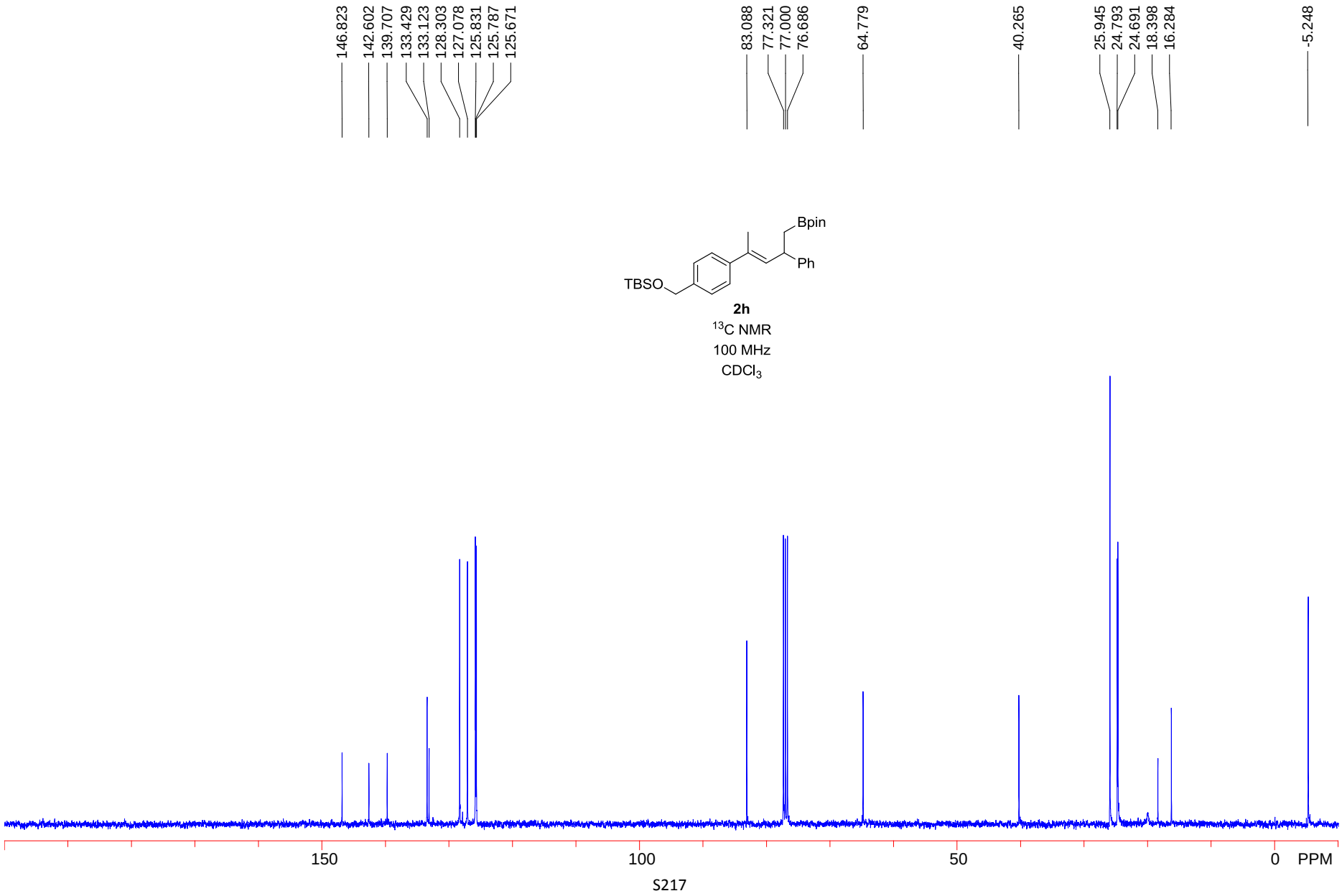
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25.945
24.793
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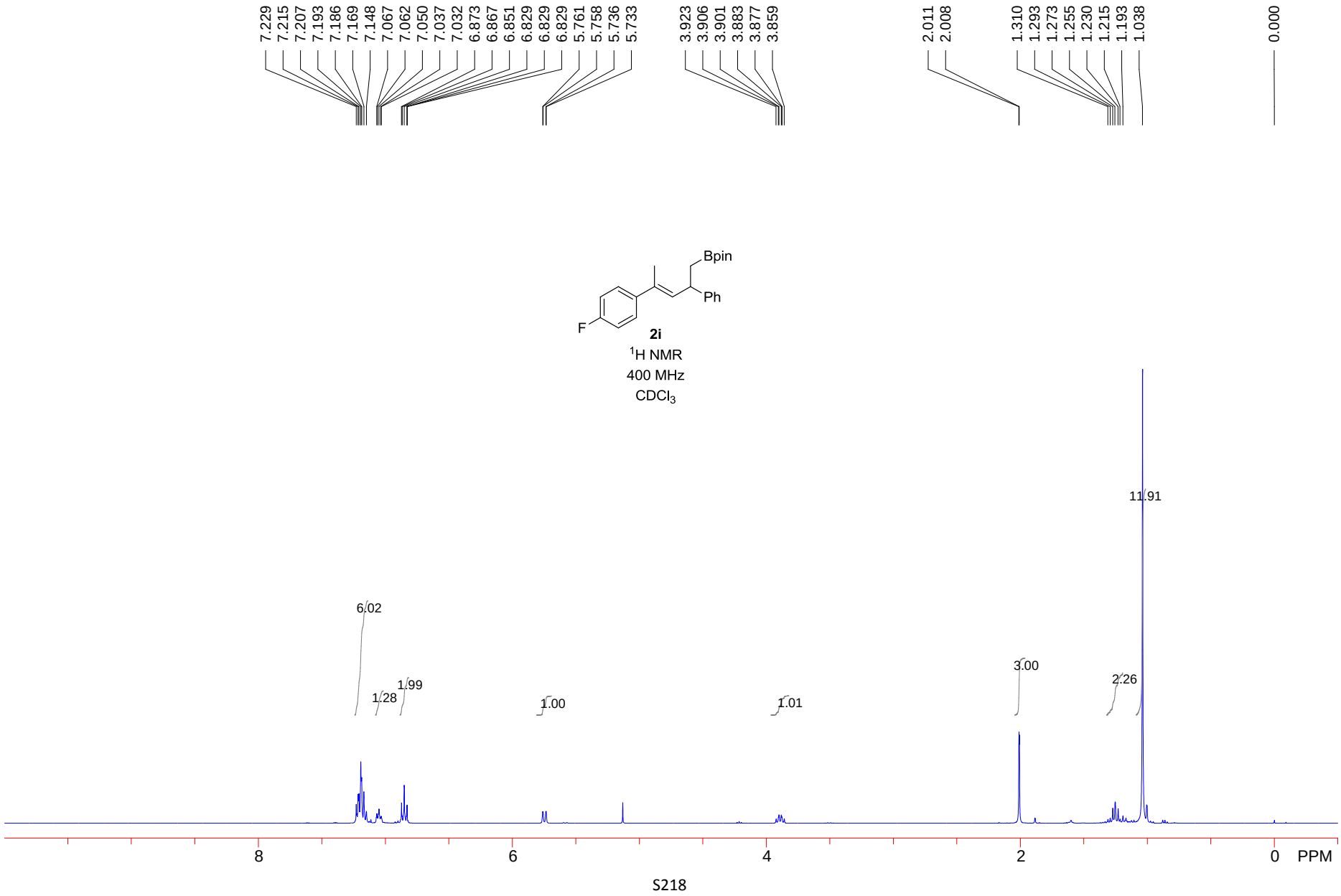
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6.851
6.829
6.829
6.829
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5.758
5.736
5.733
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3.906
3.901
3.883
3.877
3.859
2.011
2.008
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1.293
1.273
1.255
1.230
1.215
1.193
1.038
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Bpin
Ph
F
2i
1H NMR
400 MHz
CDCl3
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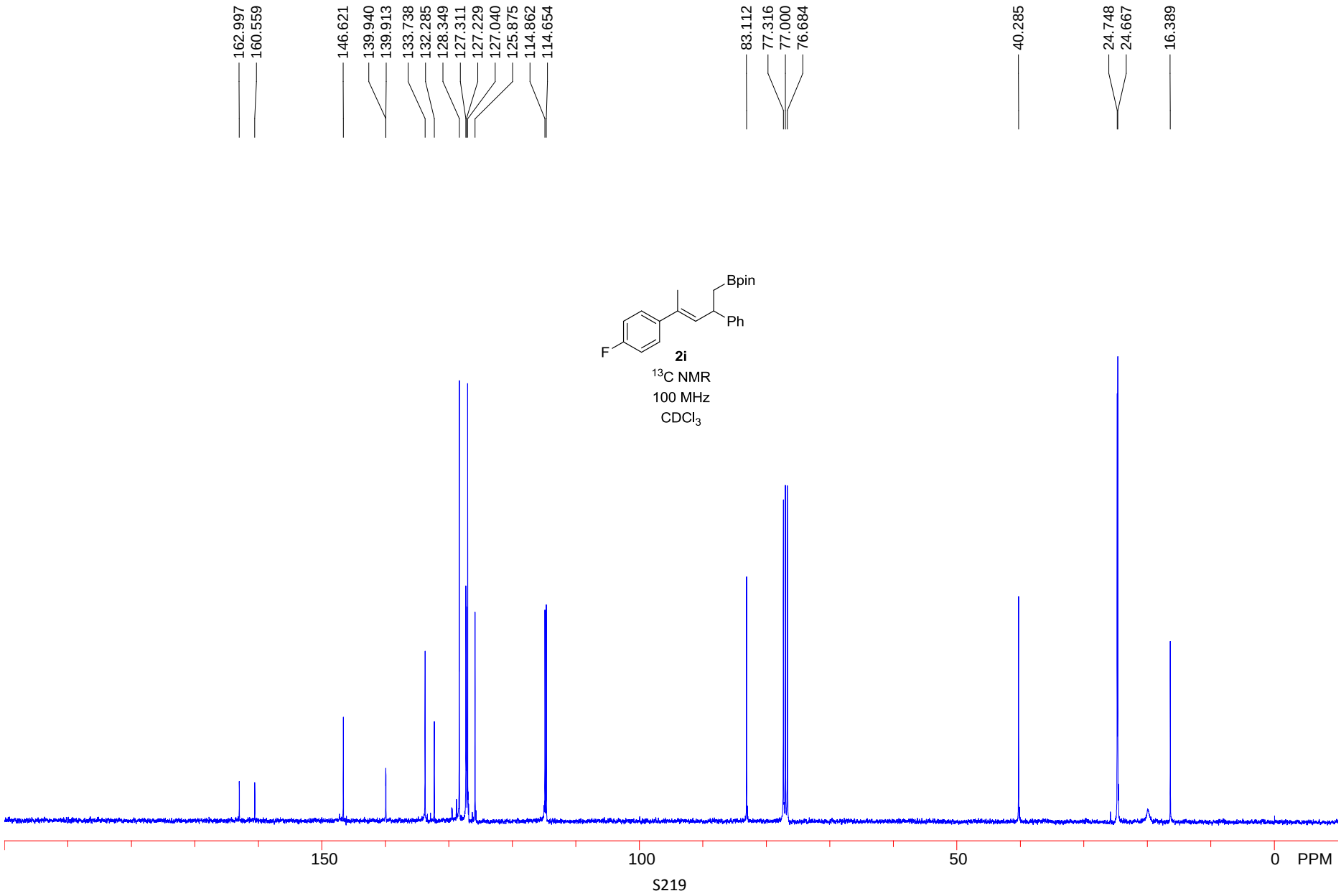
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83.112
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77.000
76.684
40.285
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Bpin
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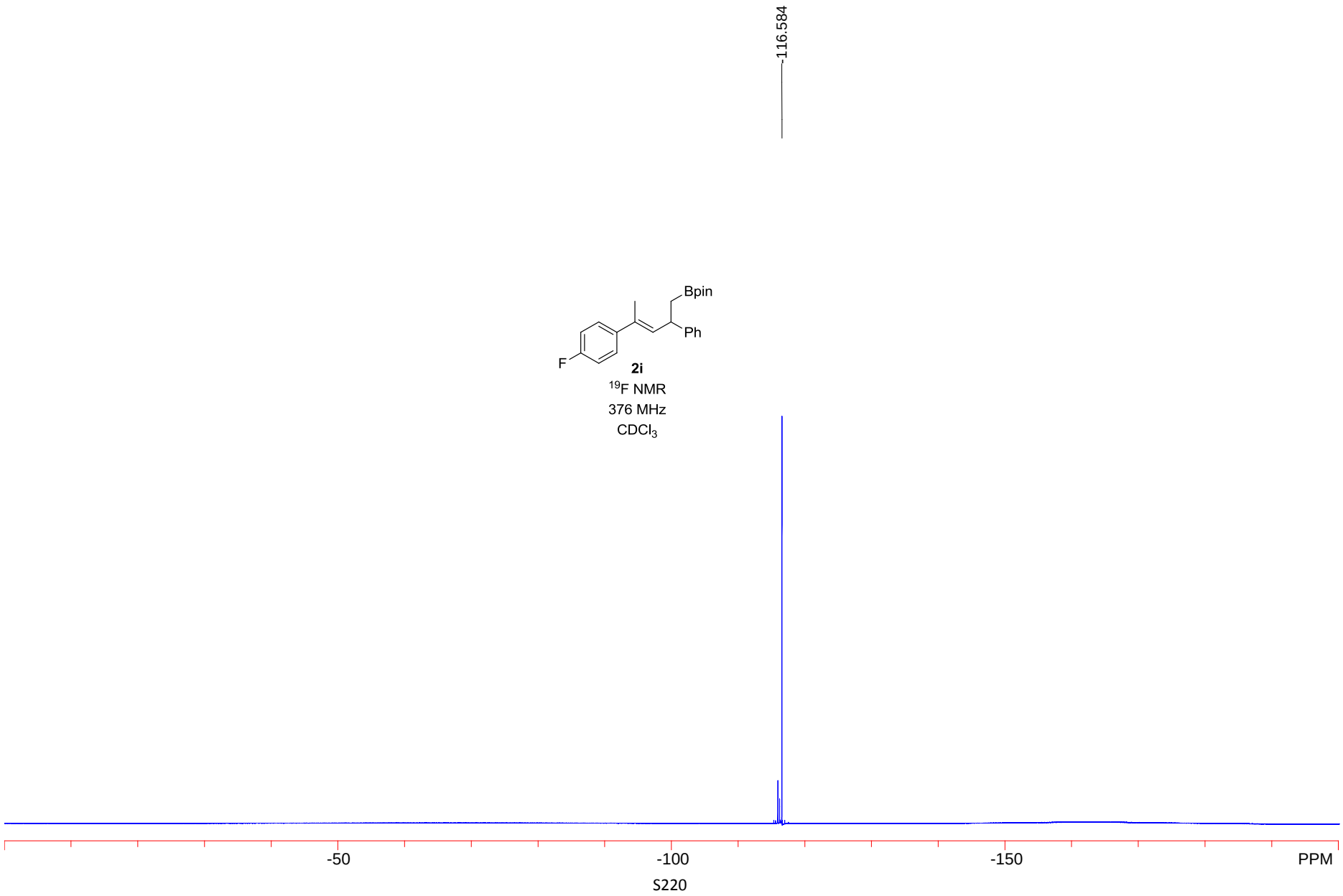
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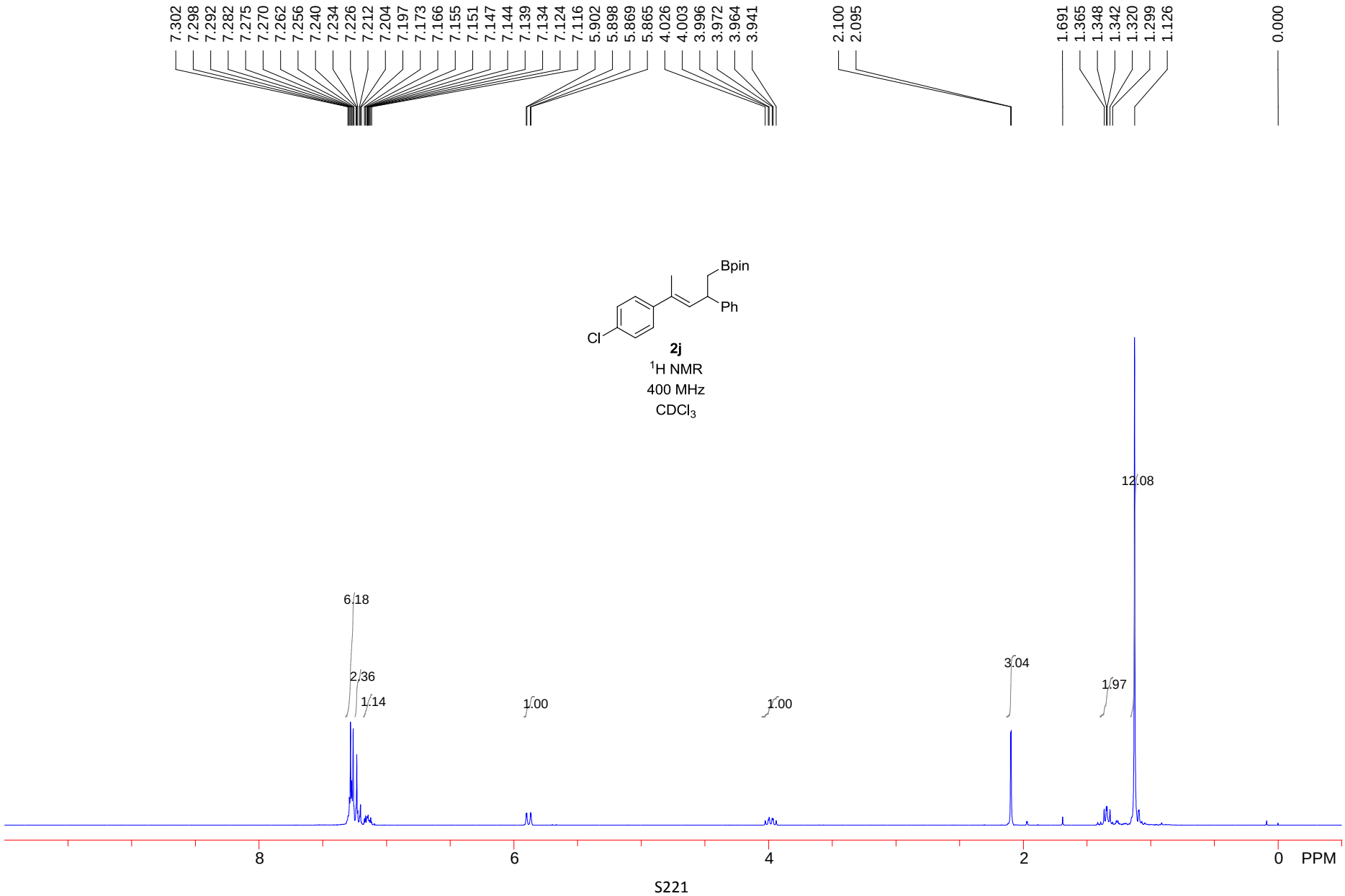
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2.095
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1.126
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Ph
Cl
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400 MHz
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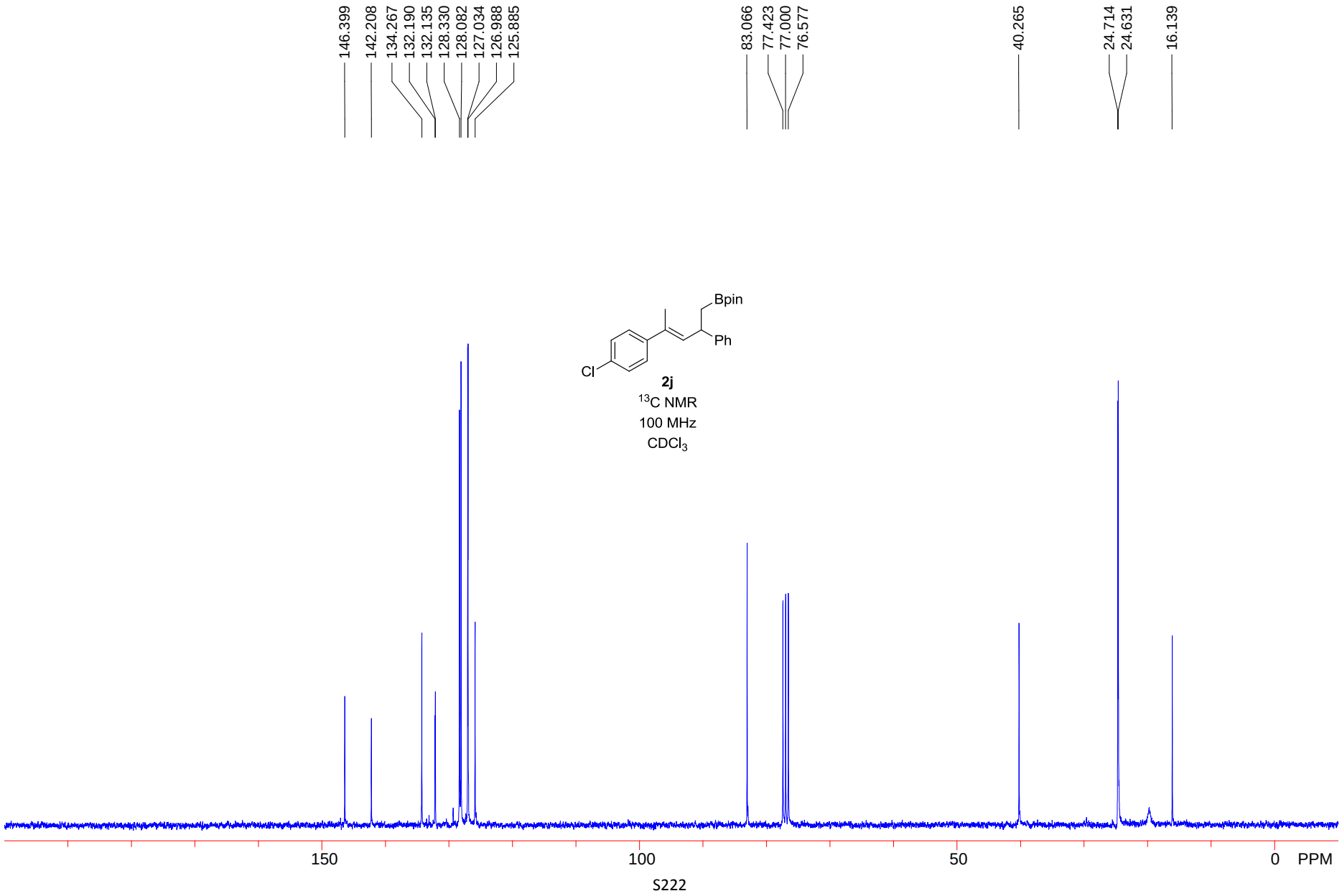
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40.265
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100 MHz
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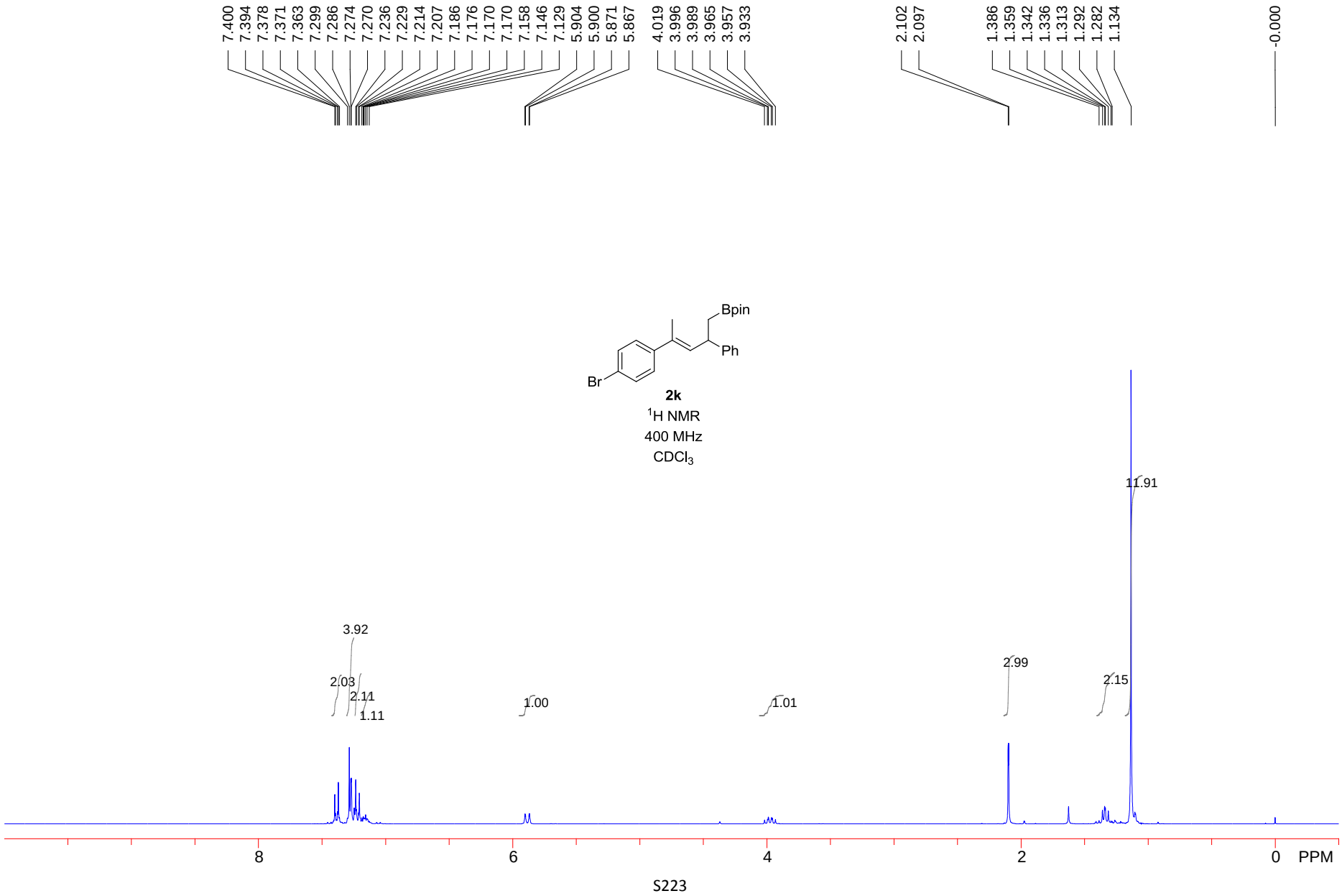
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7.186
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7.170
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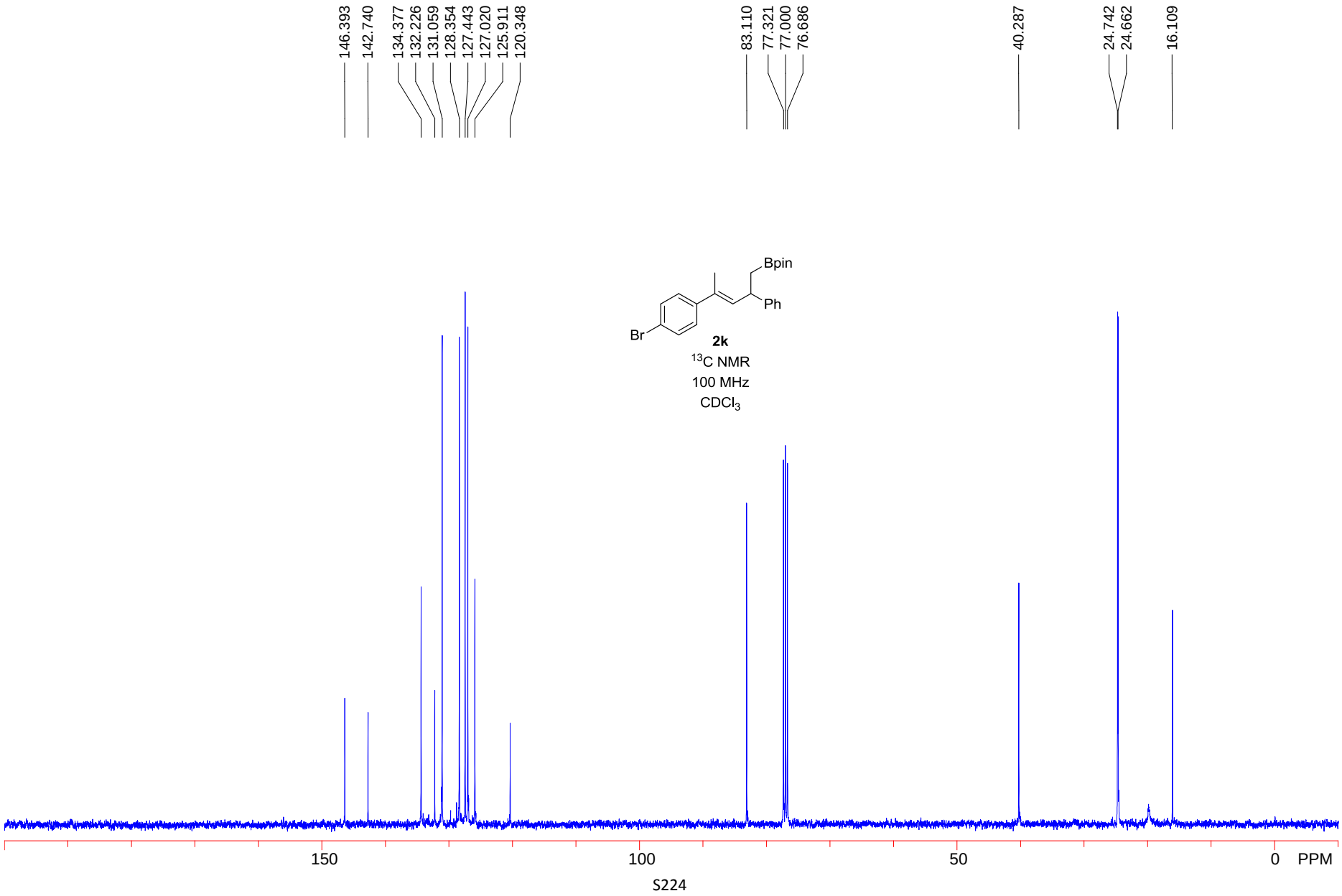
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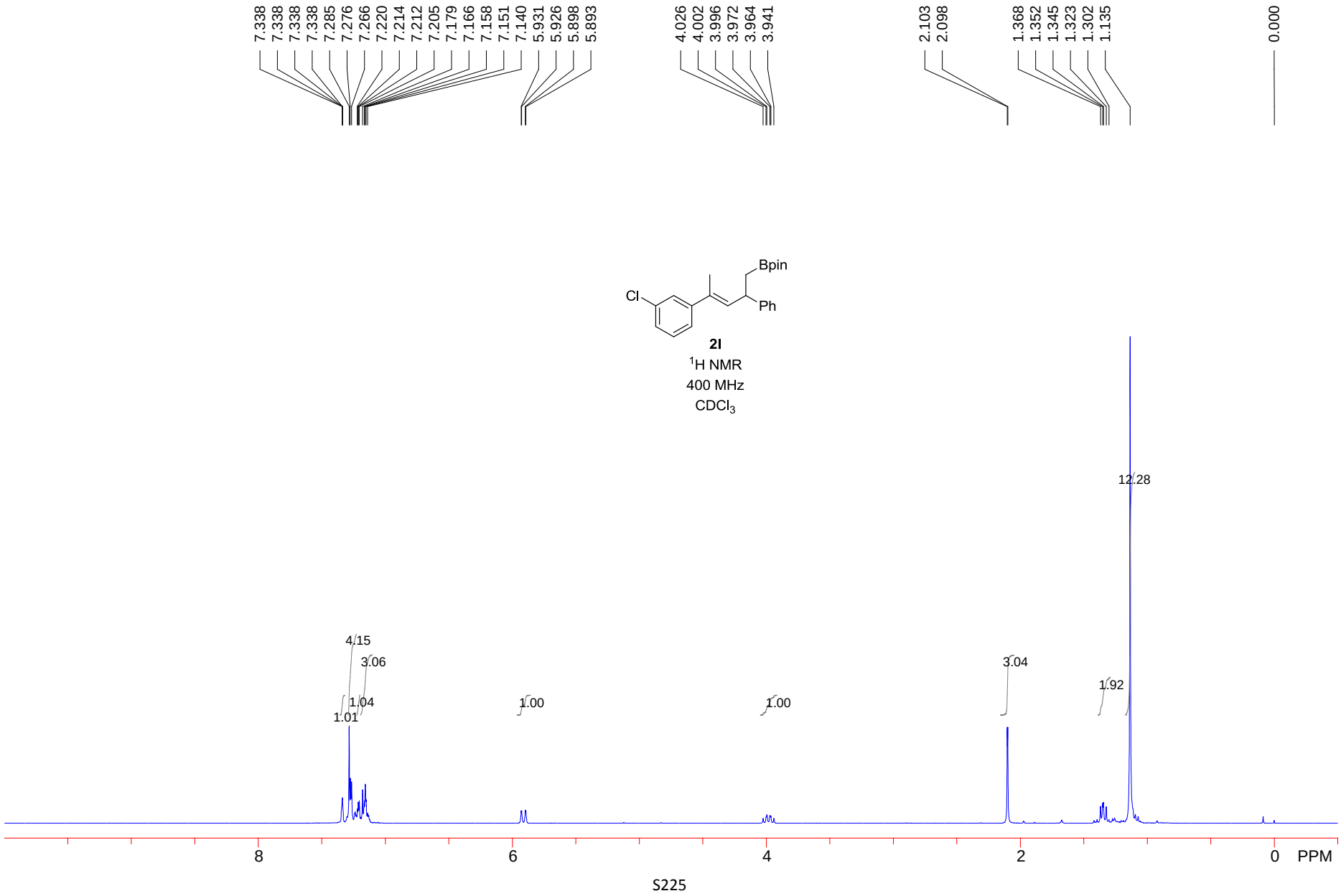
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7.158
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7.140
5.931
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5.898
5.893
4.026
4.002
3.996
3.972
3.964
3.941
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1.345
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1.302
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Cl
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400 MHz
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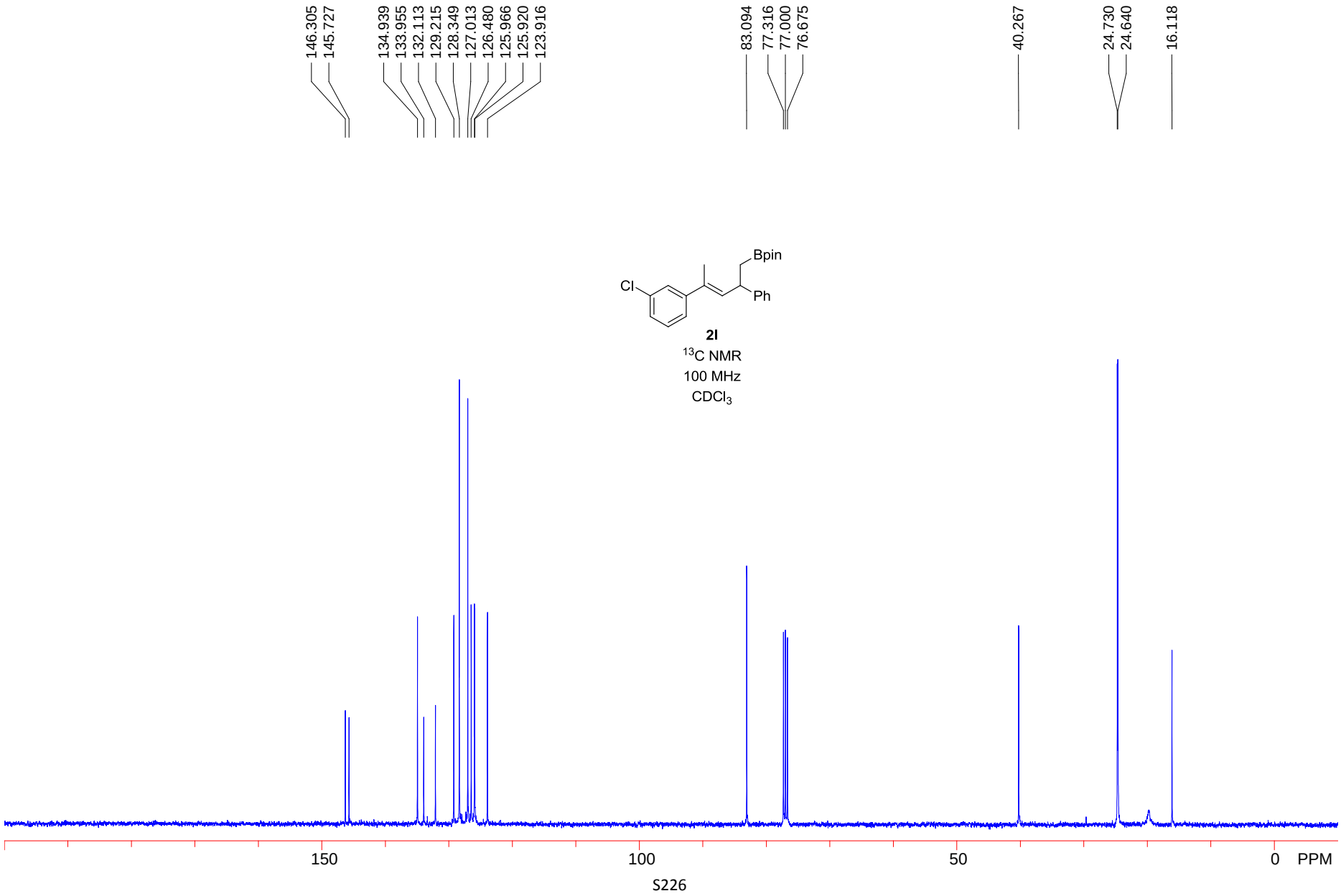
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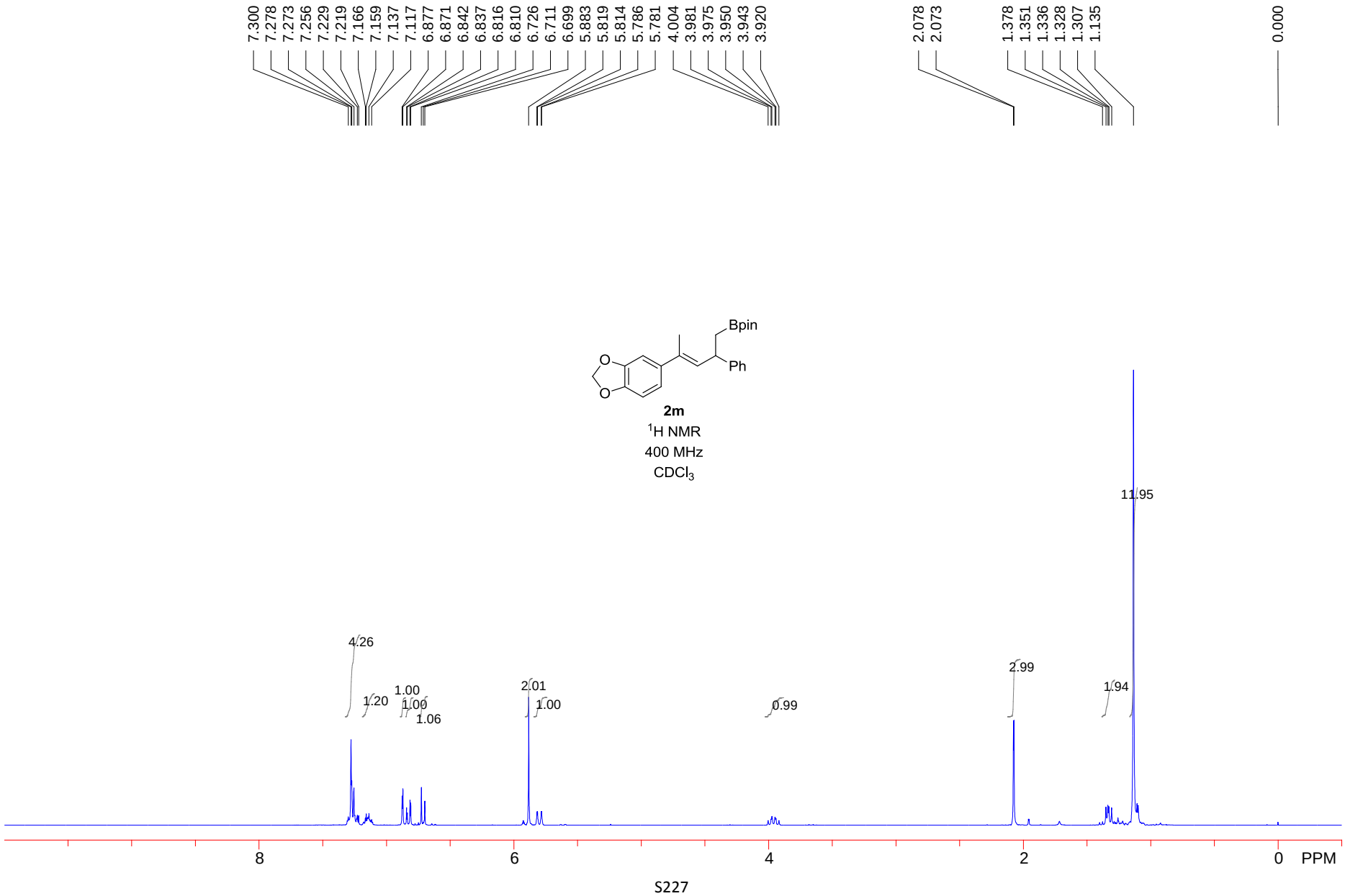
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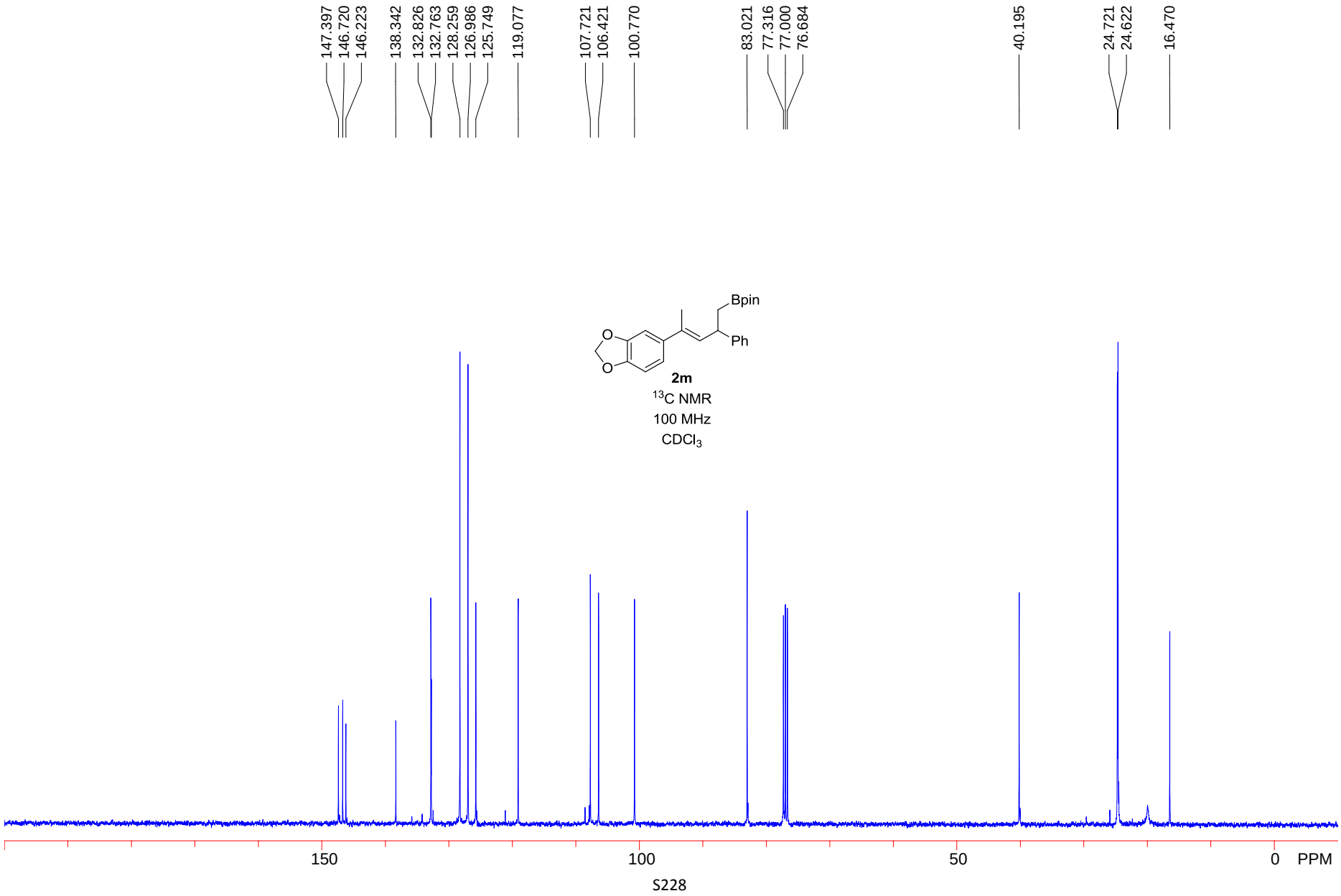
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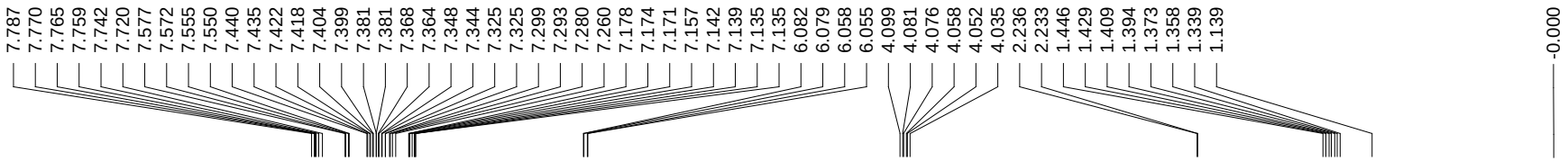
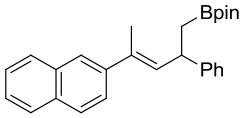
Ph
O
O
2m
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM



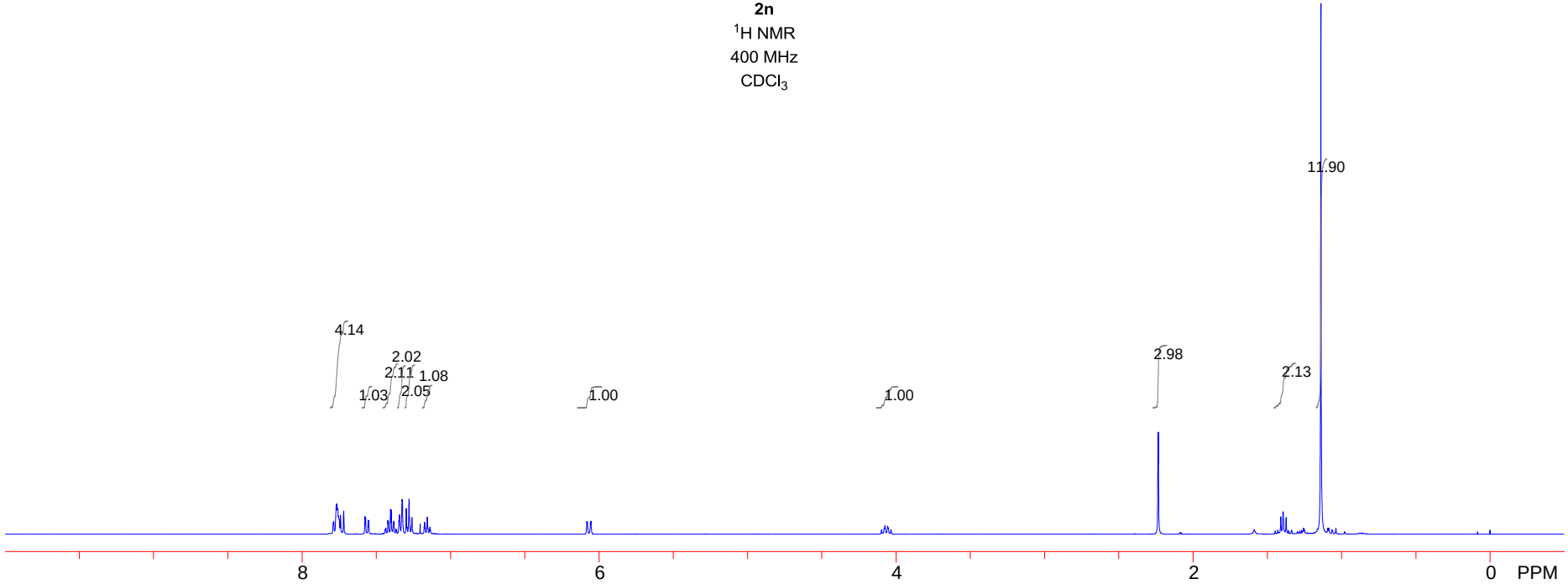


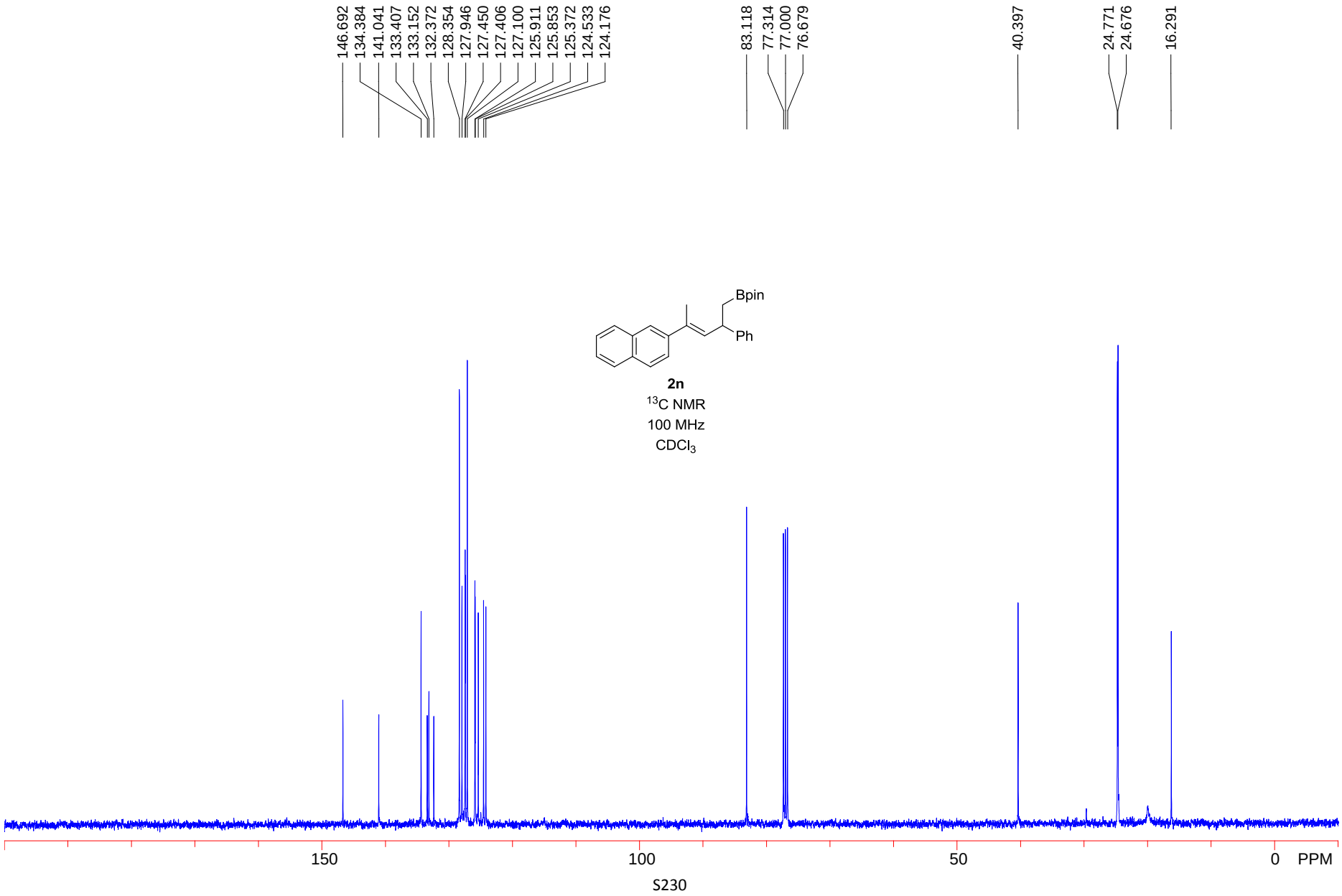
2n

^{1}H NMR

400 MHz

$CDCl_3$

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127.946
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127.406
127.100
125.911
125.853
125.372
124.533
124.176
83.118
77.314
77.000
76.679
40.397
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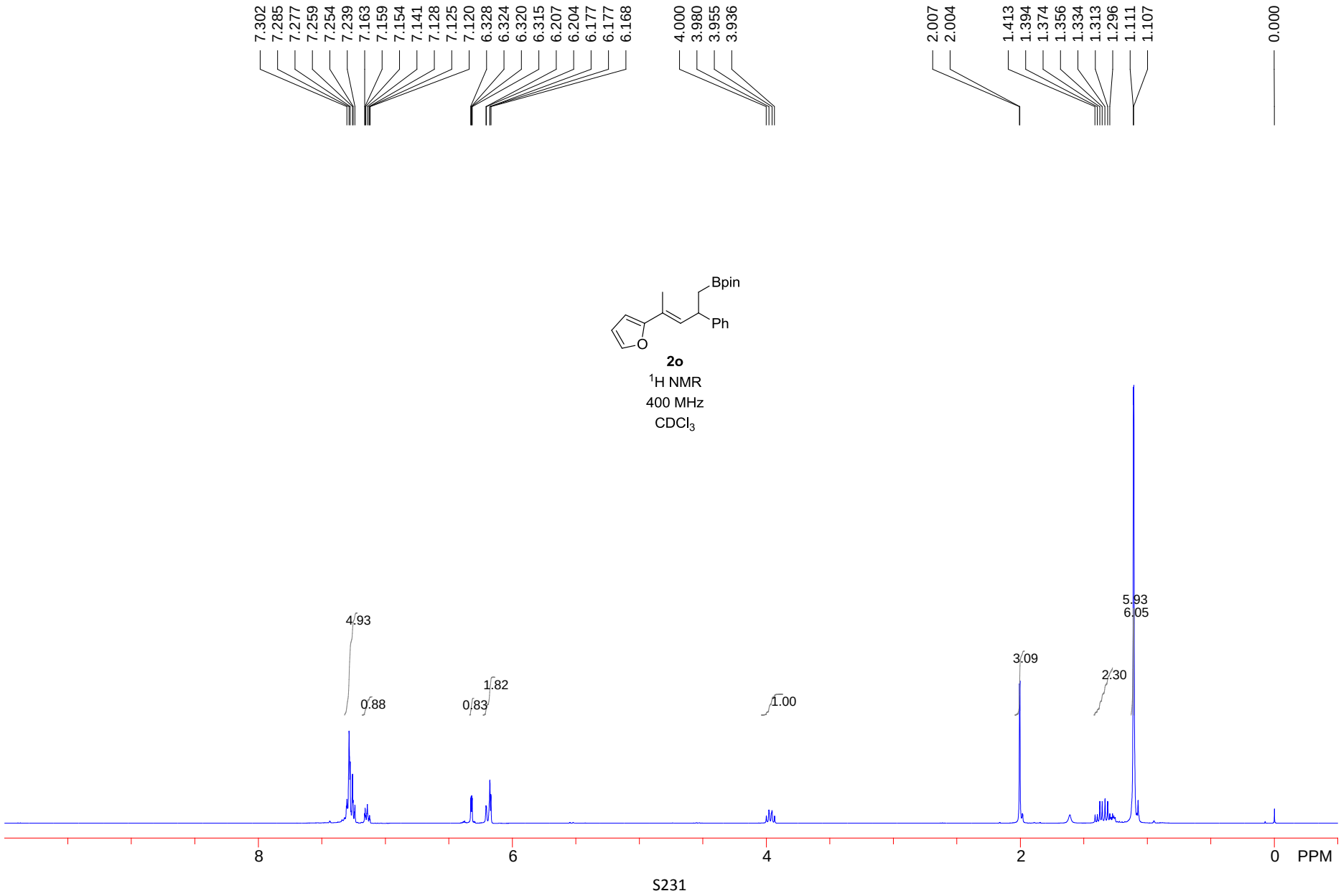
24.676
16.291
Bpin
Ph
2n
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.277
7.259
7.254
7.239
7.163
7.159
7.154
7.141
7.128
7.125
7.120
6.328
6.324
6.320
6.315
6.207
6.204
6.177
6.177
6.168
4.000
3.980
3.955
3.936
2.007
2.004
1.413
1.394
1.374
1.356
1.334
1.313
1.296
1.111
1.107
0.000
Bpin
Ph
O
2o
1H NMR
400 MHz
CDCl3
4.93
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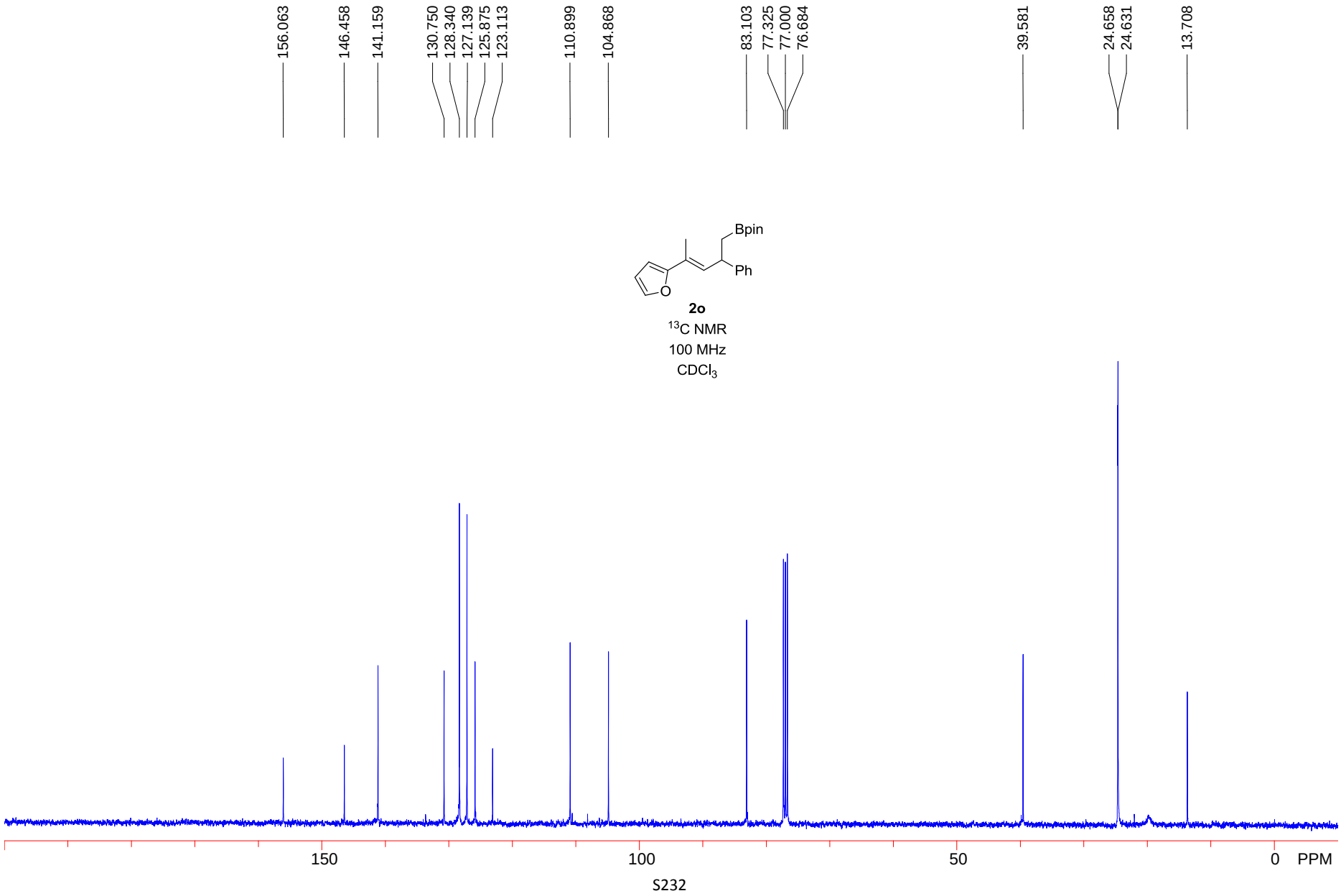
1.82
1.00
3.09
2.30
5.93
6.05
8
6
4
2
0
PPM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141.159
130.750
128.340
127.139
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123.113
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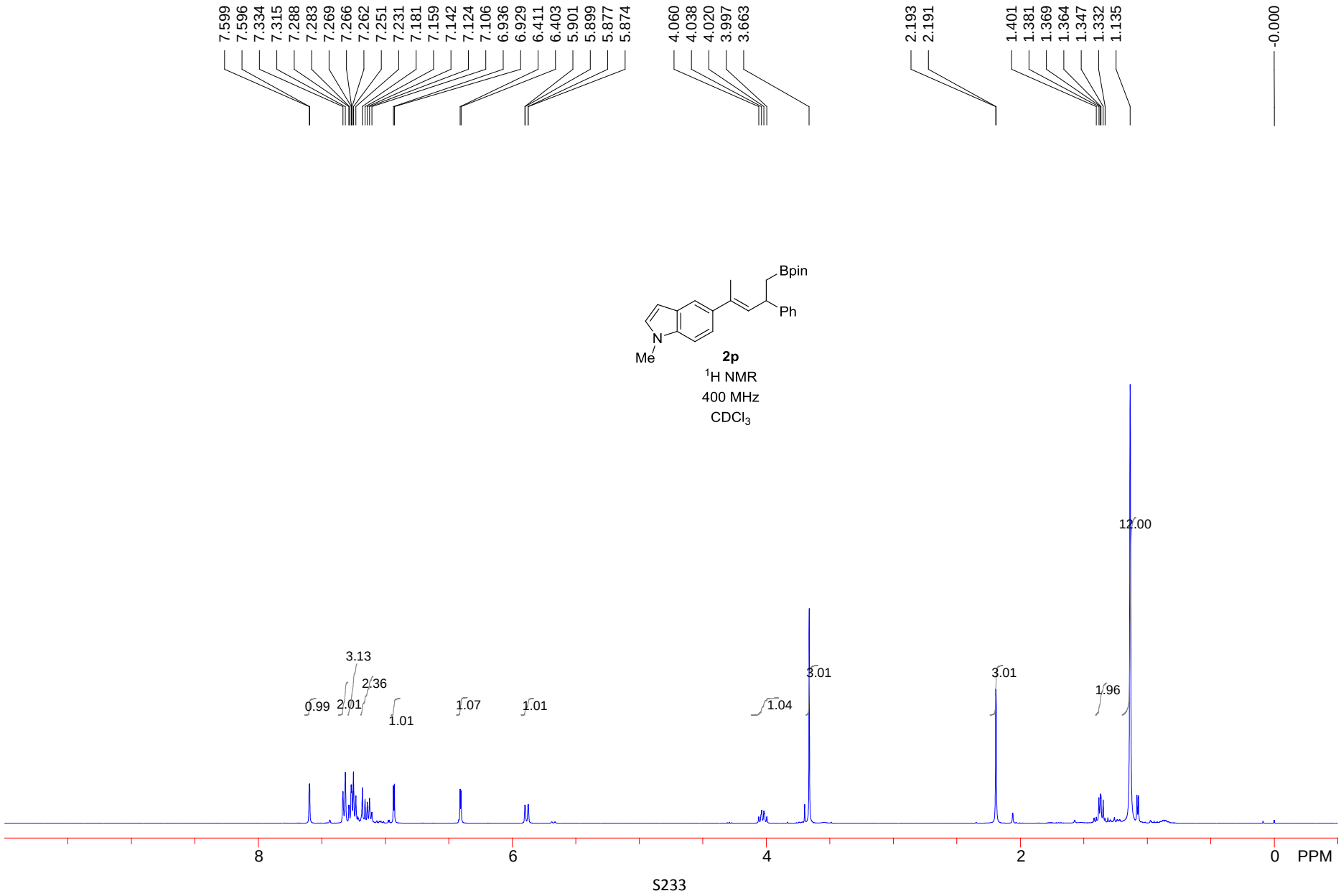
104.868
83.103
77.325
77.000
76.684
39.581
24.658
24.631
13.708
Bpin
Ph
O
2o
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.596
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7.315
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7.283
7.269
7.266
7.262
7.251
7.231
7.181
7.159
7.142
7.124
7.106
6.936
6.929
6.411
6.403
5.901
5.899
5.877
5.874
4.060
4.038
4.020
3.997
3.663
2.193
2.191
1.401
1.381
1.369
1.364
1.347
1.332
1.135
-0.000
Bpin
Ph
N
Me
2p
1H NMR
400 MHz
CDCl3
3.13
2.36
0.99
2.01
1.01
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1.01
1.04
3.01
3.01
1.96
12.00
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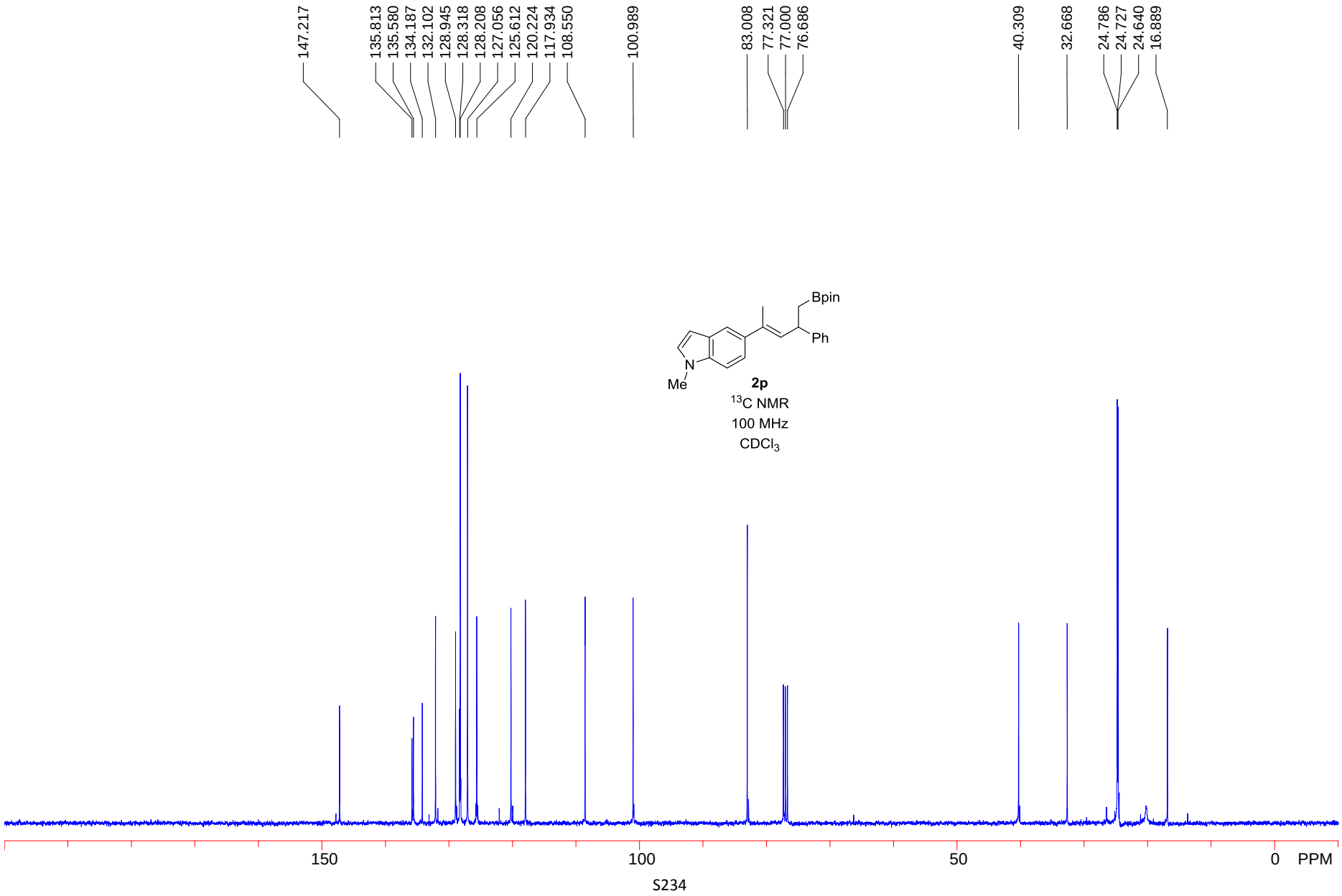
6
4
2
0
PPM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135.813
135.580
134.187
132.102
128.945
128.318
128.208
127.056
125.612
120.224
117.934
108.550
100.989
83.008
77.321
77.000
76.686
40.309
32.668
24.786
24.727
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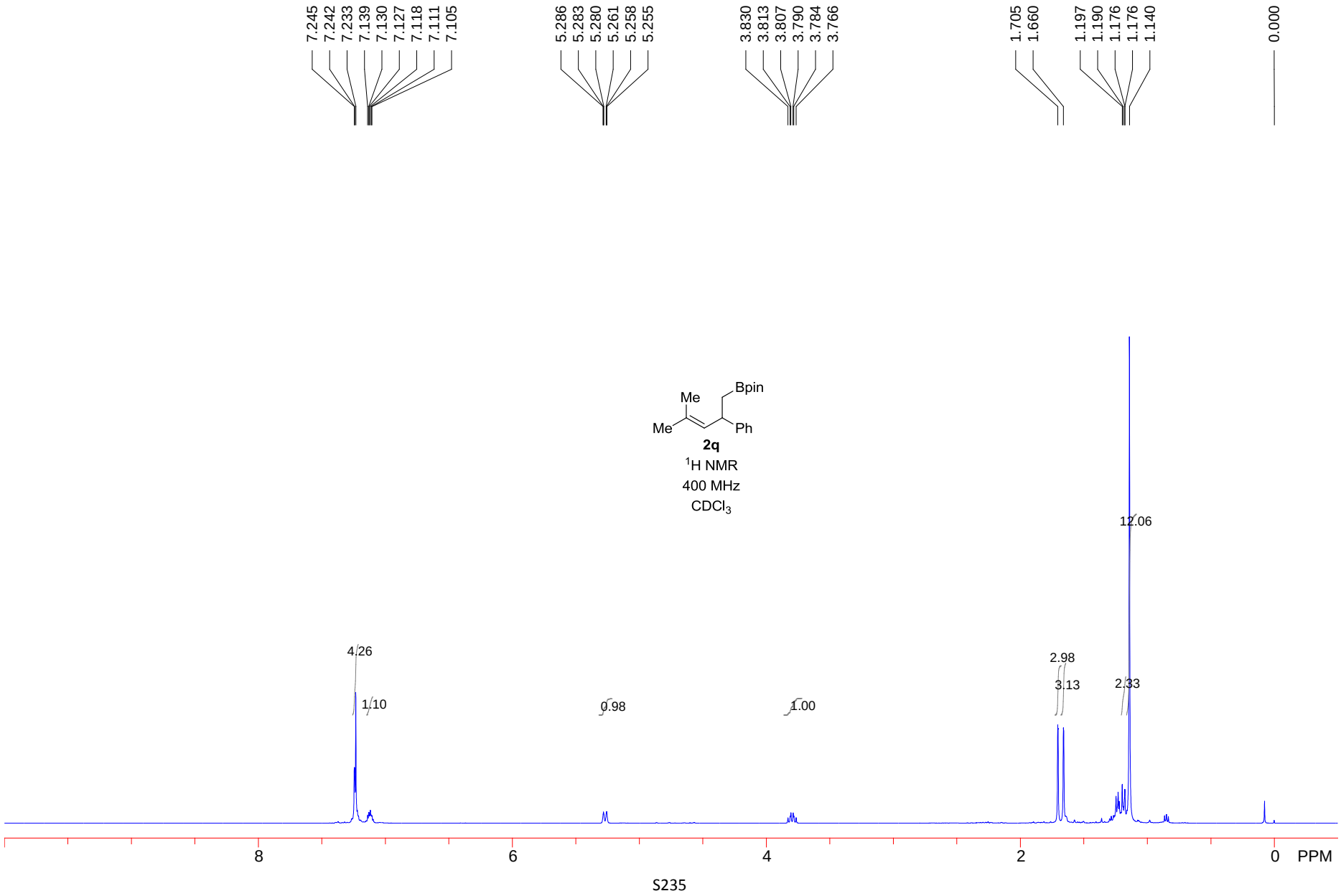
16.889
Bpin
Ph
N
Me
2p
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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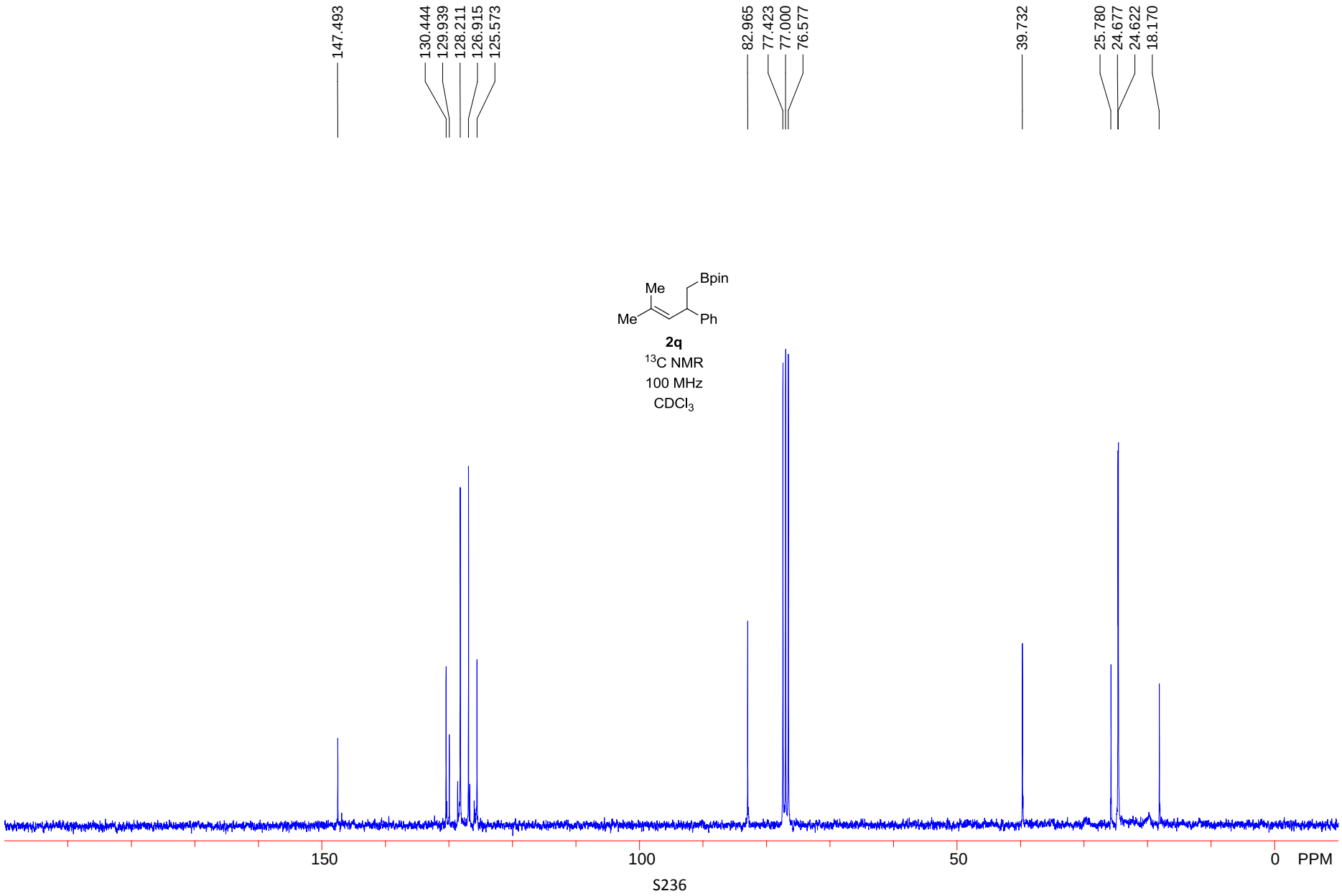
7.242
7.233
7.139
7.130
7.127
7.118
7.111
7.105
5.286
5.283
5.280
5.261
5.258
5.255
3.830
3.813
3.807
3.790
3.784
3.766
1.705
1.660
1.197
1.190
1.176
1.176
1.140
0.000
Me
Bpin
Me
Ph
2q
1H NMR
400 MHz
CDCl3
12.06
4.26
1.10
0.98
1.00
2.98
3.13
2.33
8
6
4
2
0
PPM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82.965
77.423
77.000
76.577
39.732
25.780
24.677
24.622
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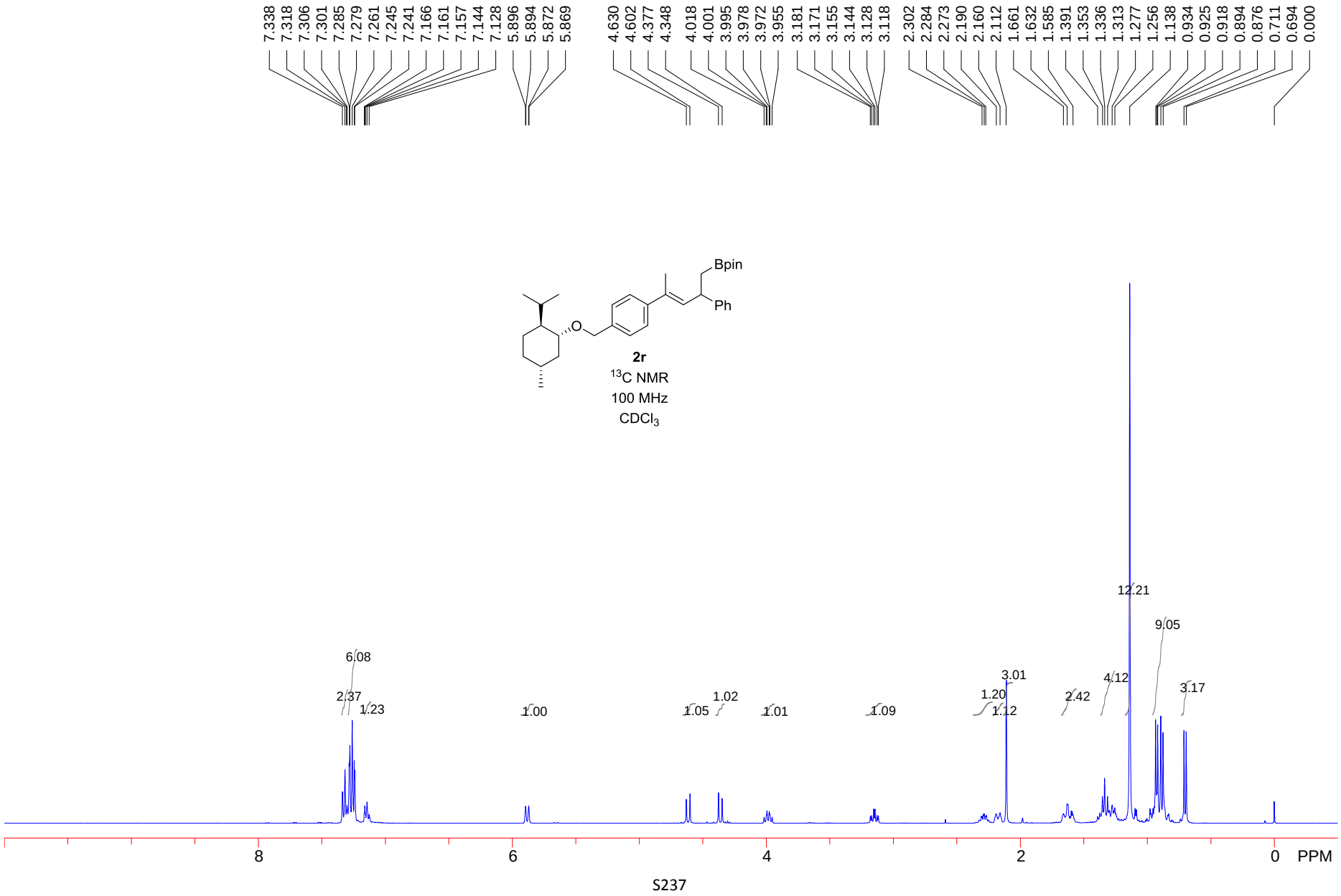
Me
Bpin
Me
Ph
2q
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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7.306
7.301
7.285
7.279
7.261
7.245
7.241
7.166
7.161
7.157
7.144
7.128
5.896
5.894
5.872
5.869
4.630
4.602
4.377
4.348
4.018
4.001
3.995
3.978
3.972
3.955
3.181
3.171
3.155
3.144
3.128
3.118
2.302
2.284
2.273
2.190
2.160
2.112
1.661
1.632
1.585
1.391
1.353
1.336
1.313
1.277
1.256
1.138
0.934
0.925
0.918
0.894
0.876
0.711
0.694
0.000
Bpin
Ph
O
2r
13C NMR
100 MHz
CDCl3
6.08
2.37
1.23
1.00
1.05
1.02
1.01
1.09
1.20
1.12
3.01
2.42
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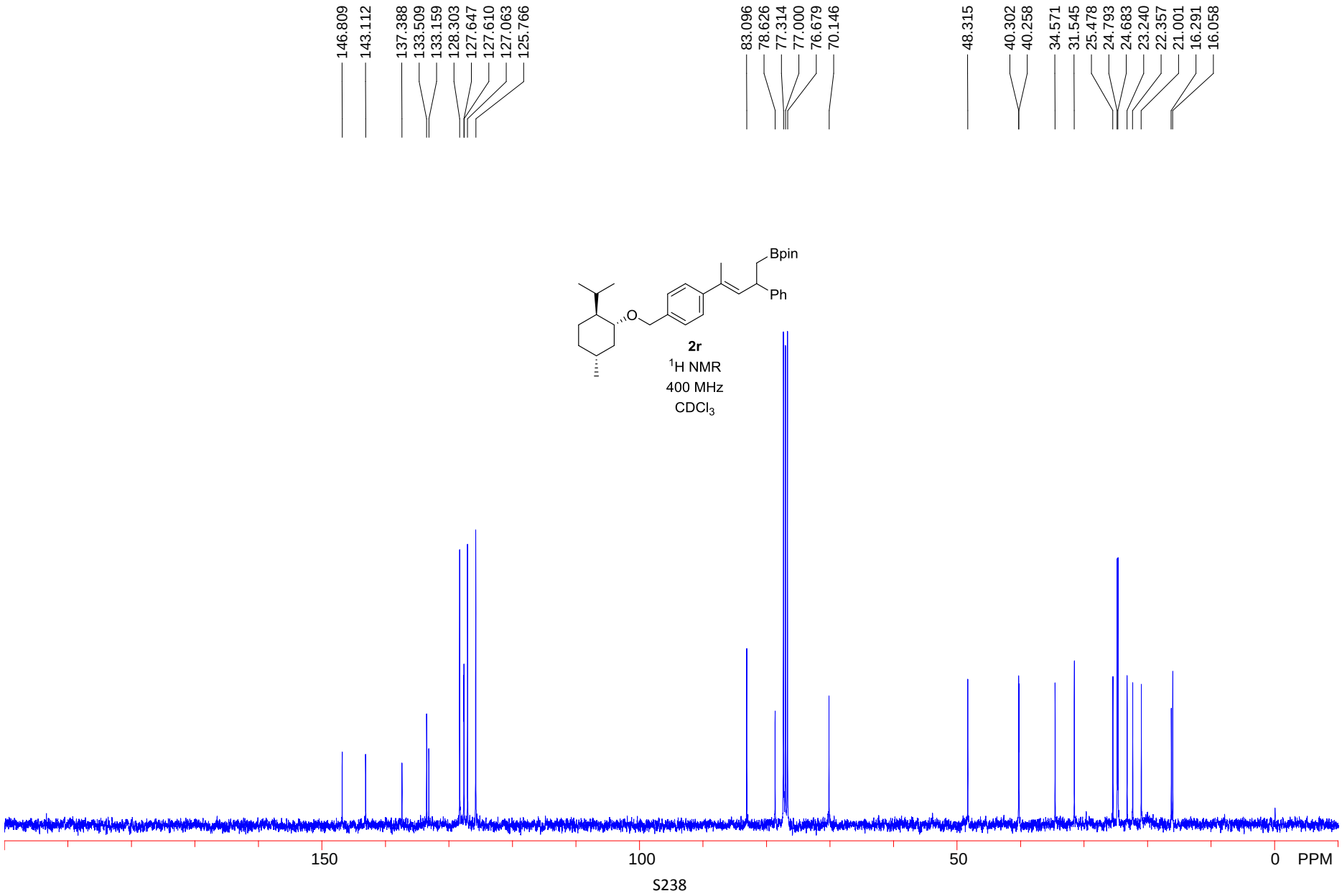
12.21
9.05
3.17
8
6
4
2
0
PPM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77.314
77.000
76.679
70.146
48.315
40.302
40.258
34.571
31.545
25.478
24.793
24.683
23.240
22.357
21.001
16.291
16.058
Bpin
Ph
O
2r
1H NMR
400 MHz
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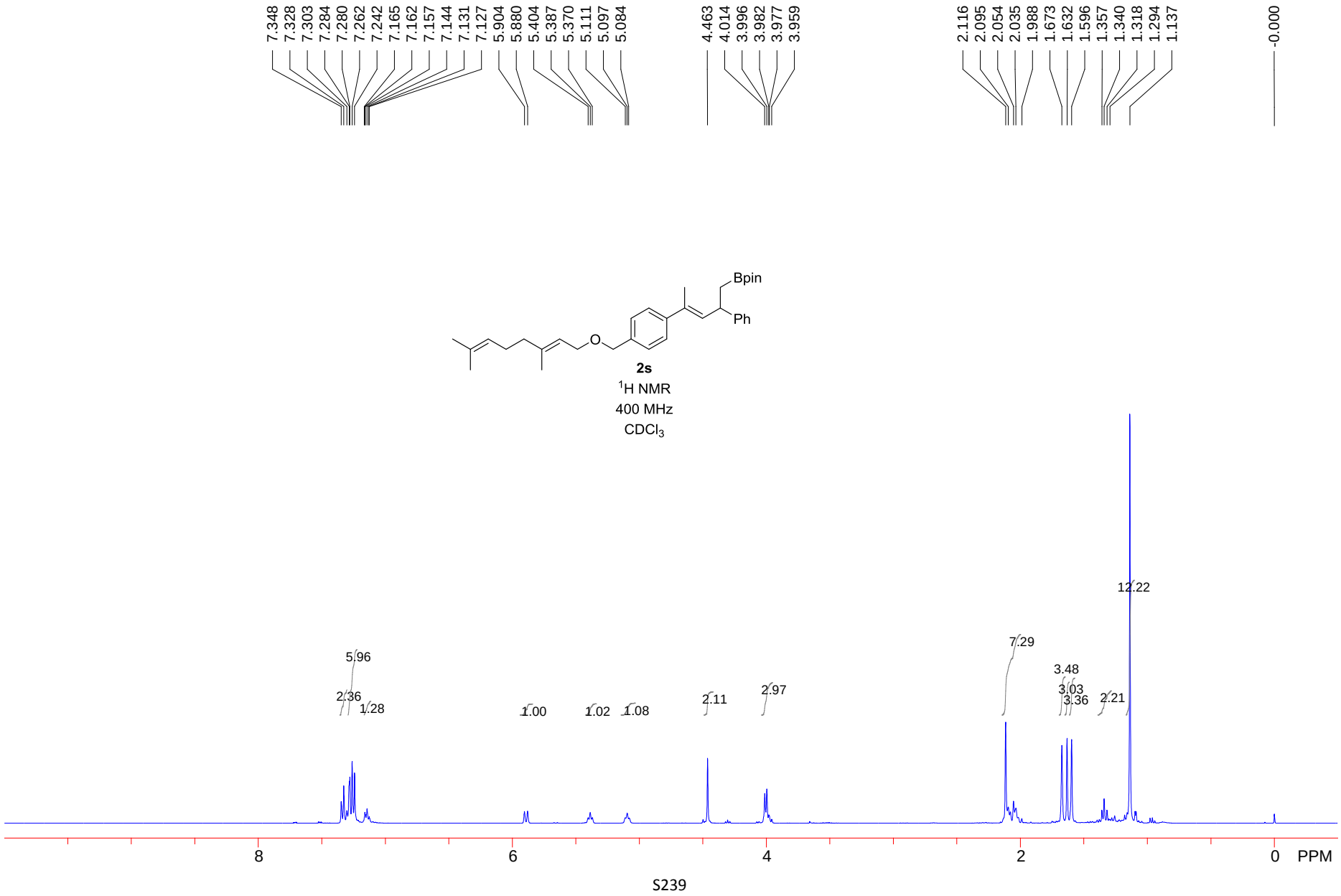
100
50
0
PPM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7.242
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7.157
7.144
7.131
7.127
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5.880
5.404
5.387
5.370
5.111
5.097
5.084
4.463
4.014
3.996
3.982
3.977
3.959
2.116
2.095
2.054
2.035
1.988
1.673
1.632
1.596
1.357
1.340
1.318
1.294
1.137
-0.000
Bpin
Ph
O
2s
1H NMR
400 MHz
CDCl3
5.96
2.36
1.28
1.00
1.02
1.08
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7.29
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3.36
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12.22
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6
4
2
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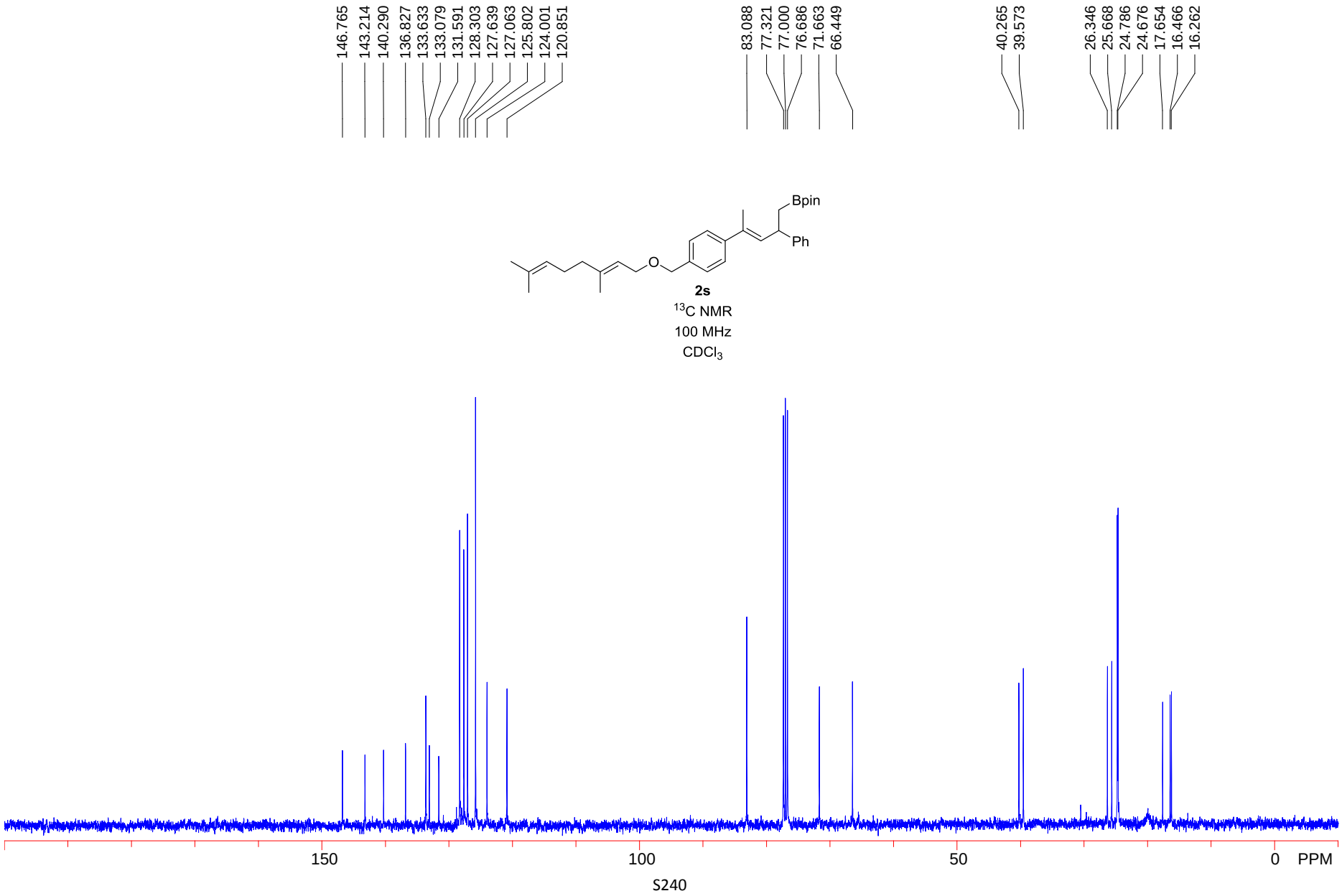
PPM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83.088
77.321
77.000
76.686
71.663
66.449
40.265
39.573
26.346
25.668
24.786
24.676
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13C NMR
100 MHz
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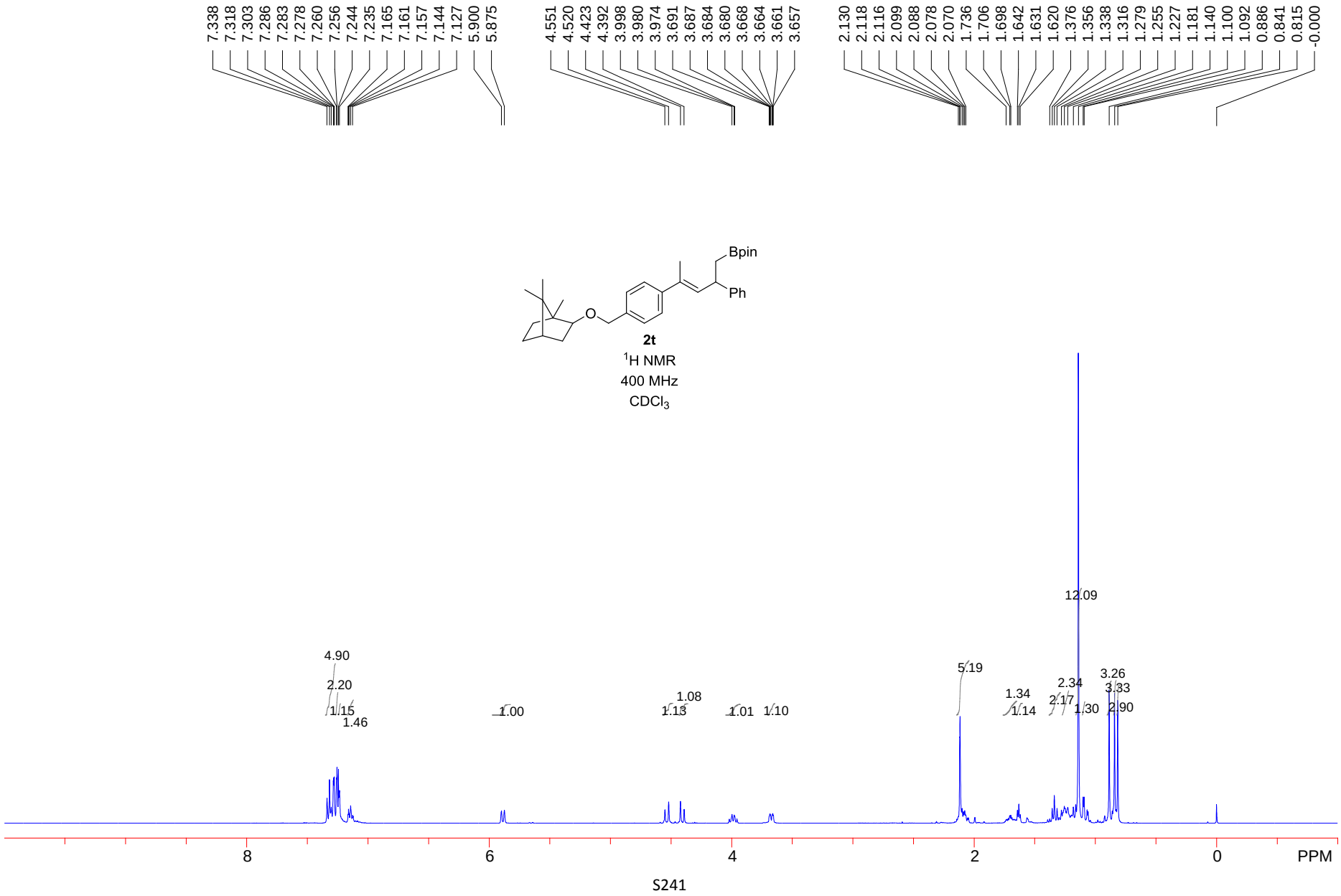
PPM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7.157
7.144
7.127
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5.875
4.551
4.520
4.423
4.392
3.998
3.980
3.974
3.691
3.687
3.684
3.680
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2.078
2.070
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1.316
1.279
1.255
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1.140
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-0.000
Bpin
Ph
O
2t
1H NMR
400 MHz
CDCl3
4.90
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1.15
1.46
1.00
1.08
1.13
1.01
1.10
5.19
12.09
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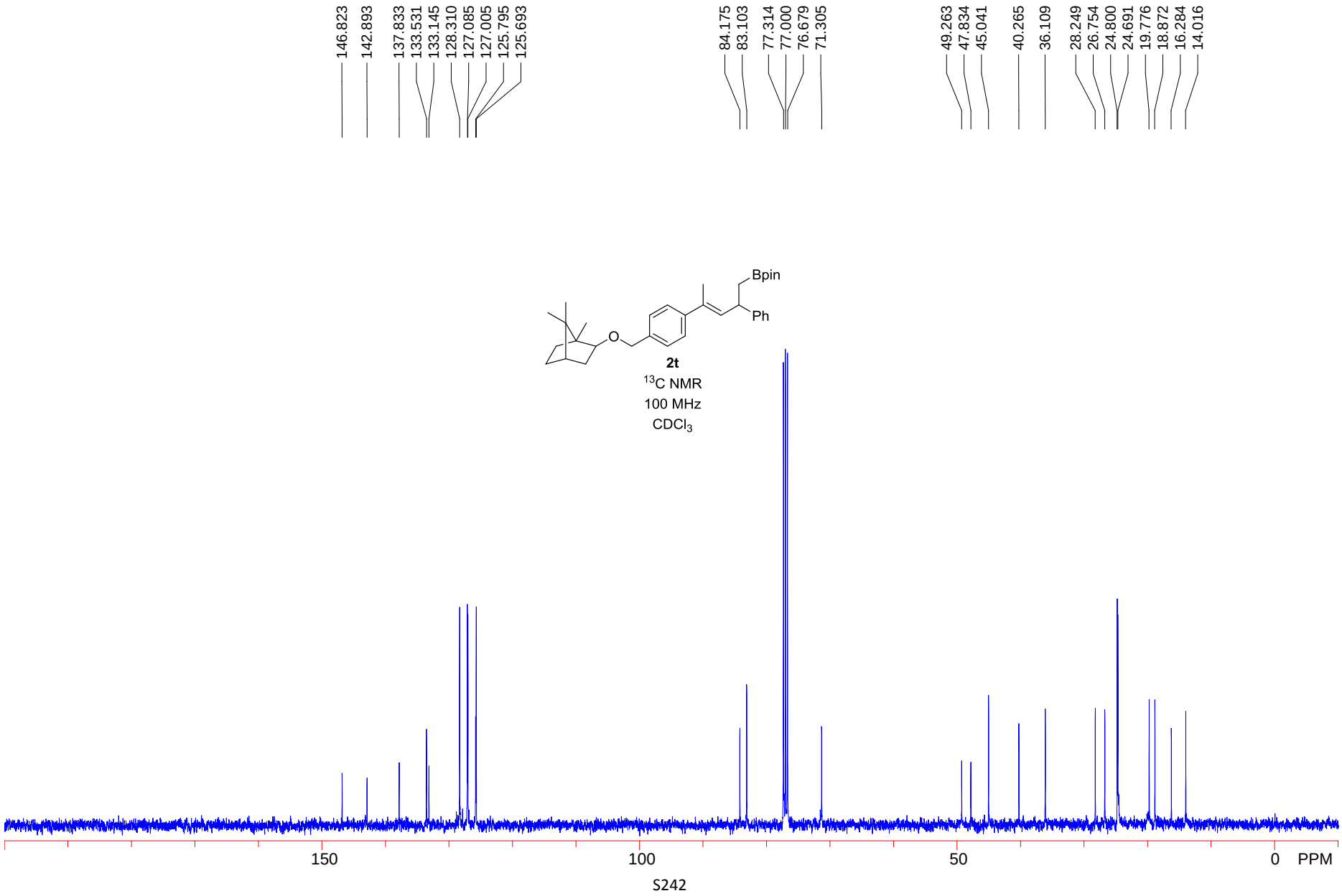
PPM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127.005
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125.693
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83.103
77.314
77.000
76.679
71.305
49.263
47.834
45.041
40.265
36.109
28.249
26.754
24.800
24.691
19.776
18.872
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14.016
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13C NMR
100 MHz
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100
50
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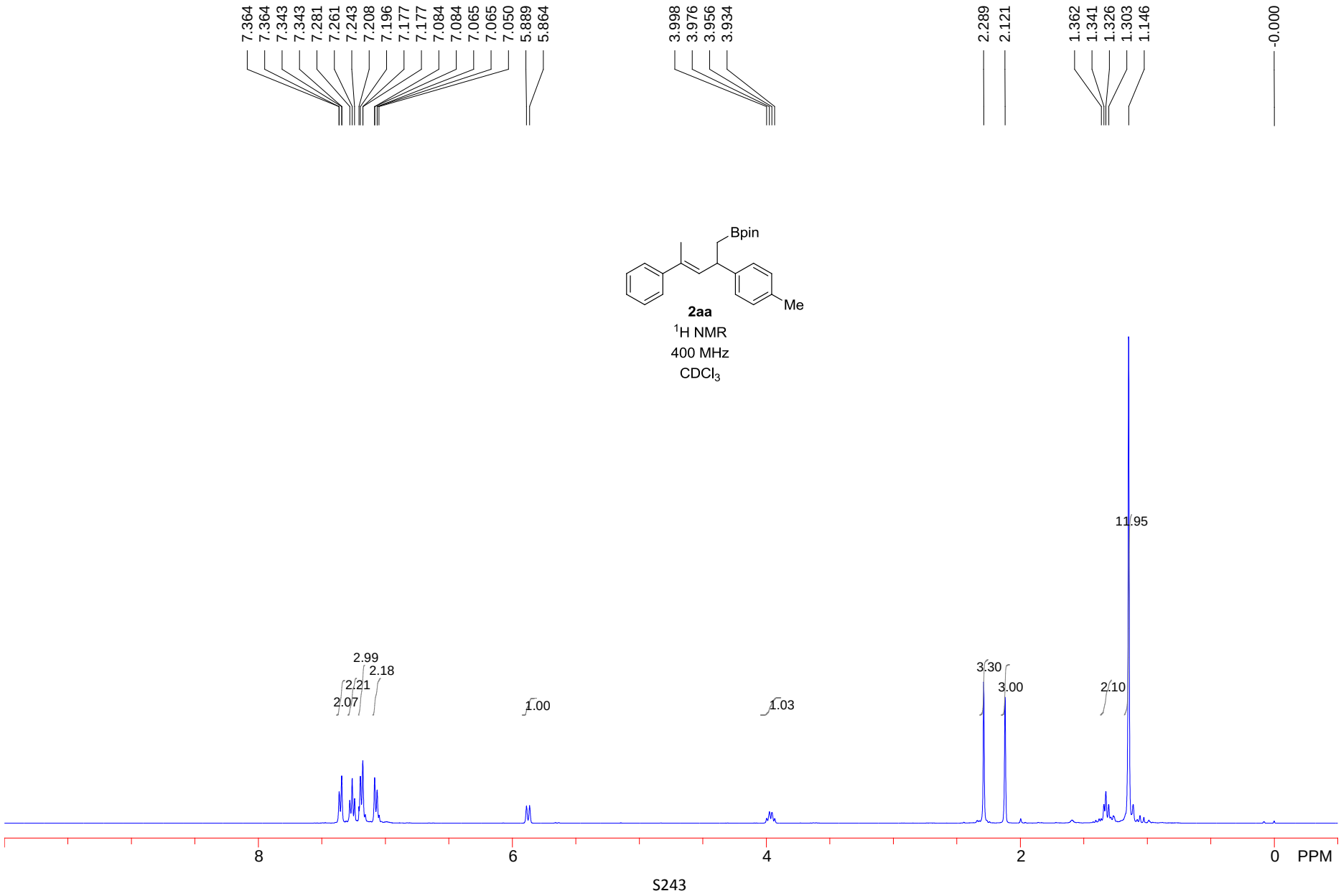
PPM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7.261
7.243
7.208
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7.177
7.177
7.084
7.084
7.065
7.065
7.050
5.889
5.864
3.998
3.976
3.956
3.934
2.289
2.121
1.362
1.341
1.326
1.303
1.146
-0.000
Bpin
Me
2aa
1H NMR
400 MHz
CDCl3
2.99
2.18
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1.03
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6
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2
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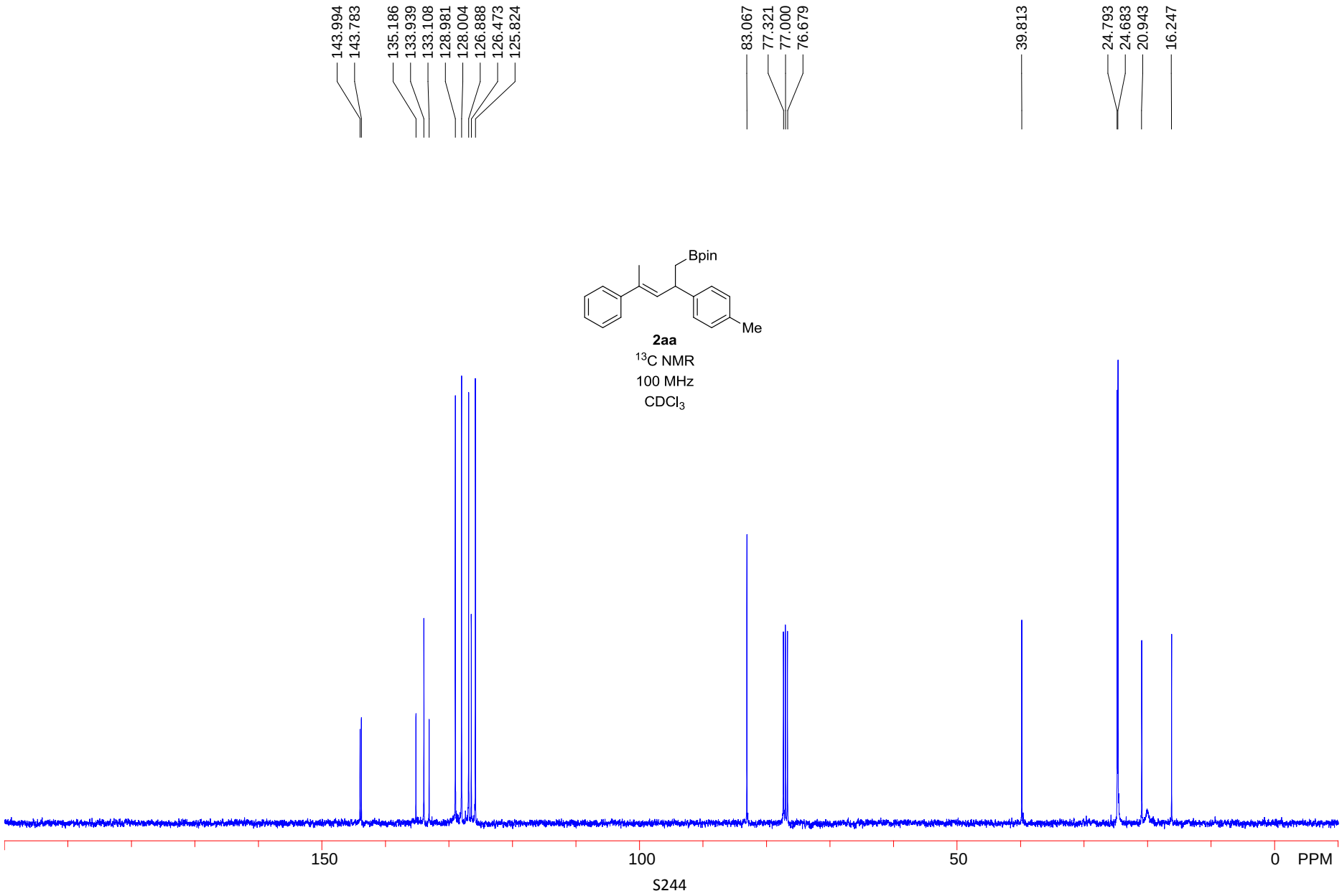
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77.000
76.679
39.813
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16.247
Bpin
Me
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13C NMR
100 MHz
CDCl3
150
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50
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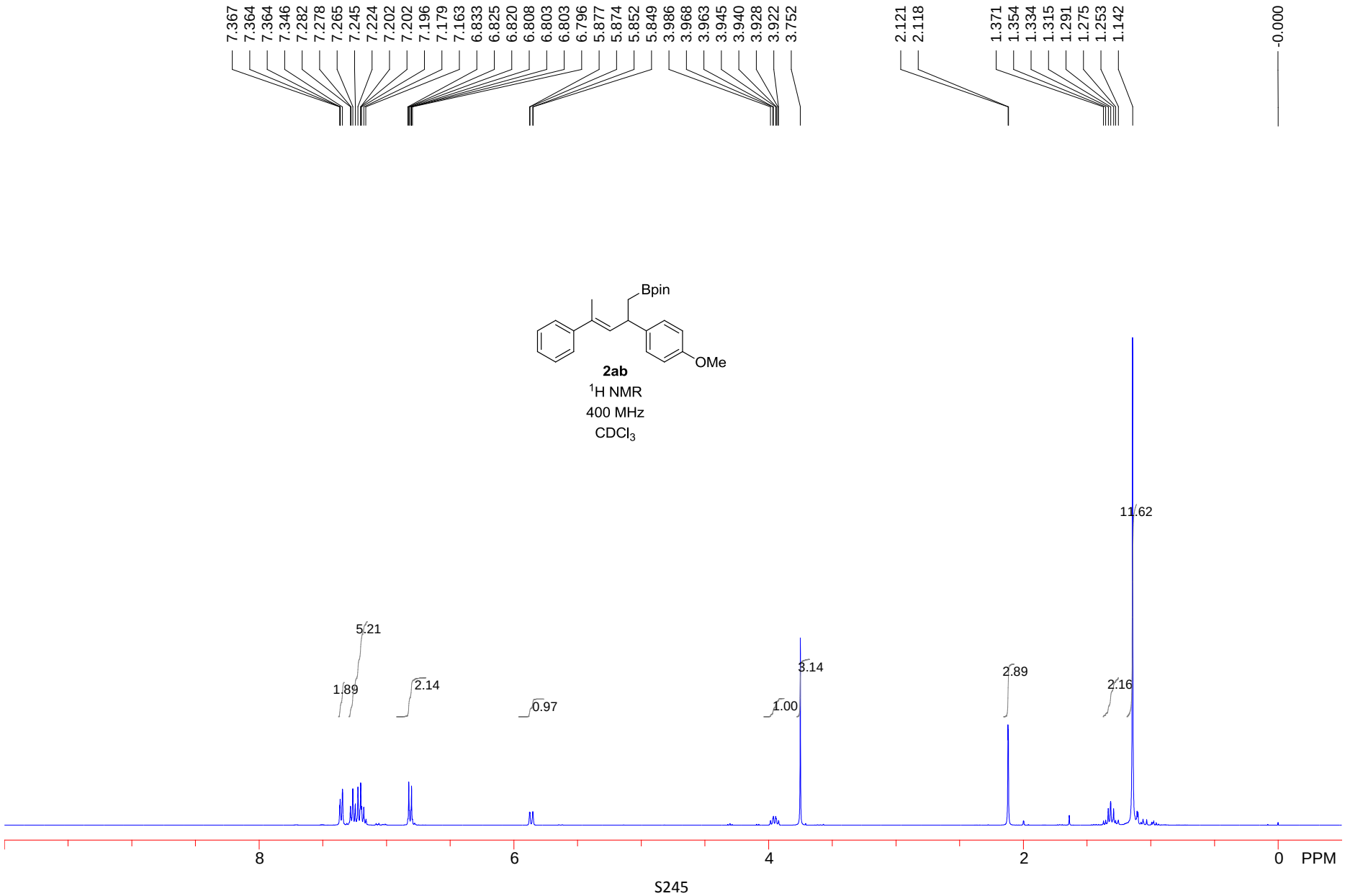
PPM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7.202
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7.179
7.163
6.833
6.825
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6.803
6.796
5.877
5.874
5.852
5.849
3.986
3.968
3.963
3.945
3.940
3.928
3.922
3.752
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2.118
1.371
1.354
1.334
1.315
1.291
1.275
1.253
1.142
-0.000
Bpin
OMe
2ab
1H NMR
400 MHz
CDCl3
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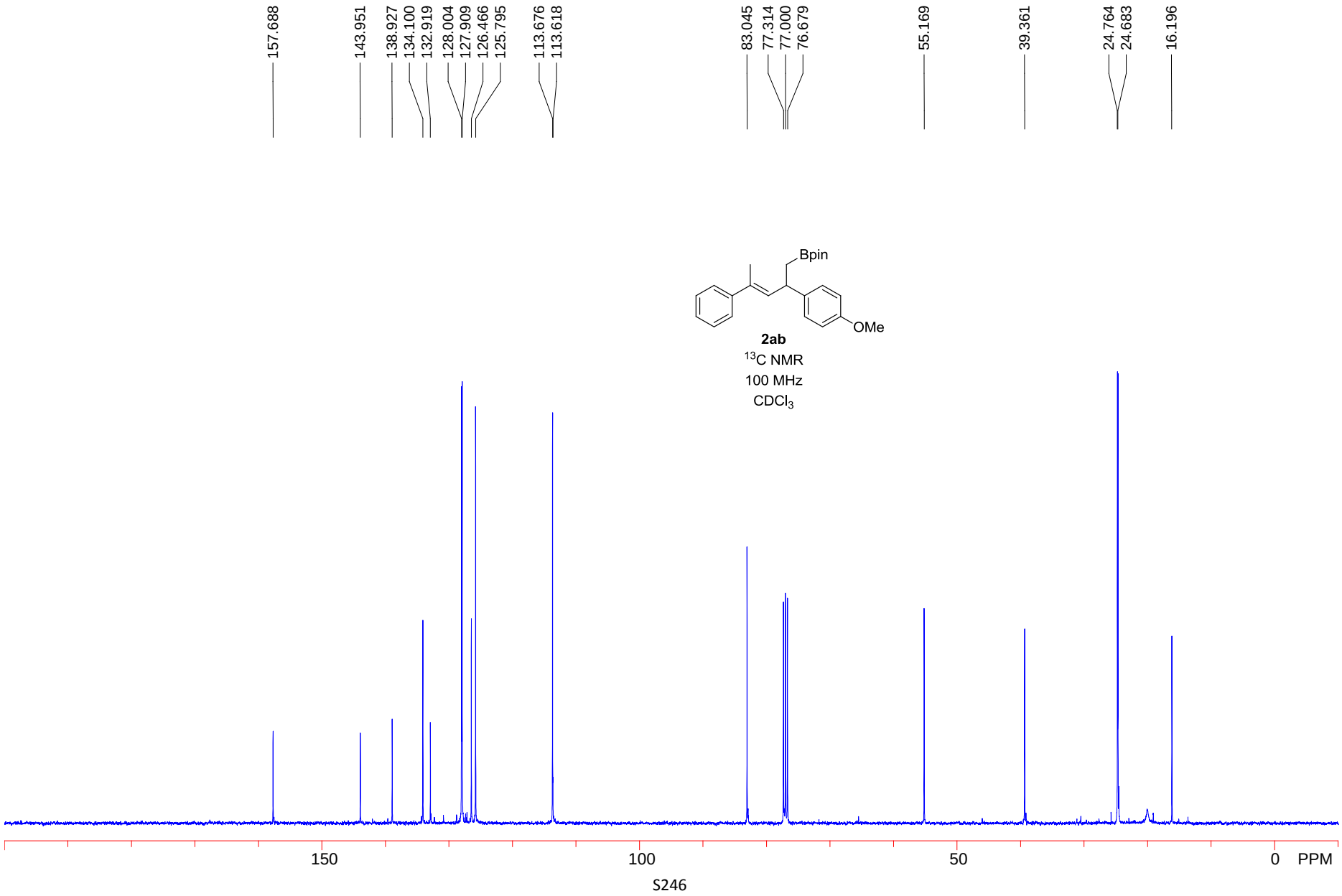
PPM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77.000
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55.169
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Bpin
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2ab
13C NMR
100 MHz
CDCl3
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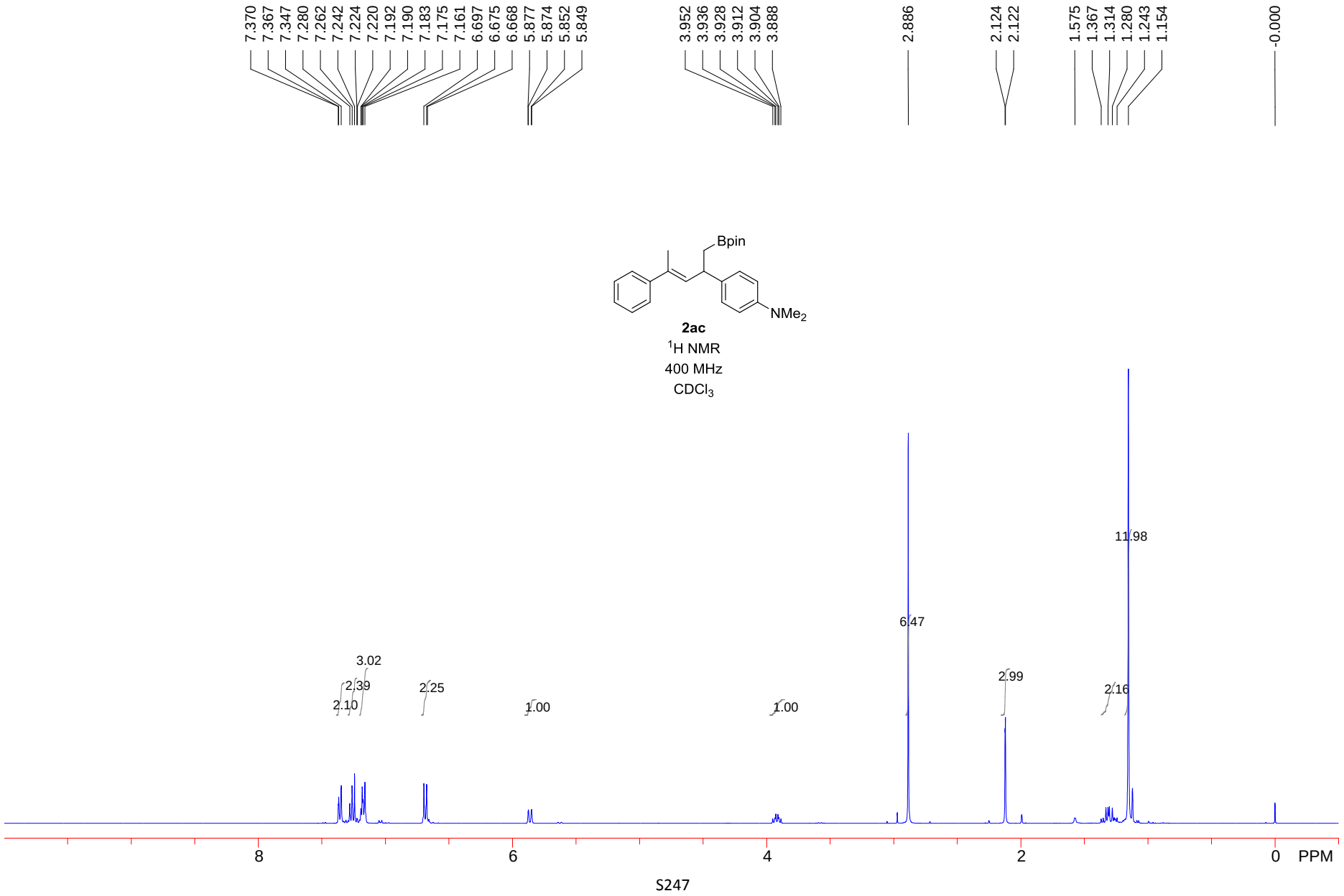
50
0
PPM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1.367
1.314
1.280
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NMe2
2ac
1H NMR
400 MHz
CDCl3
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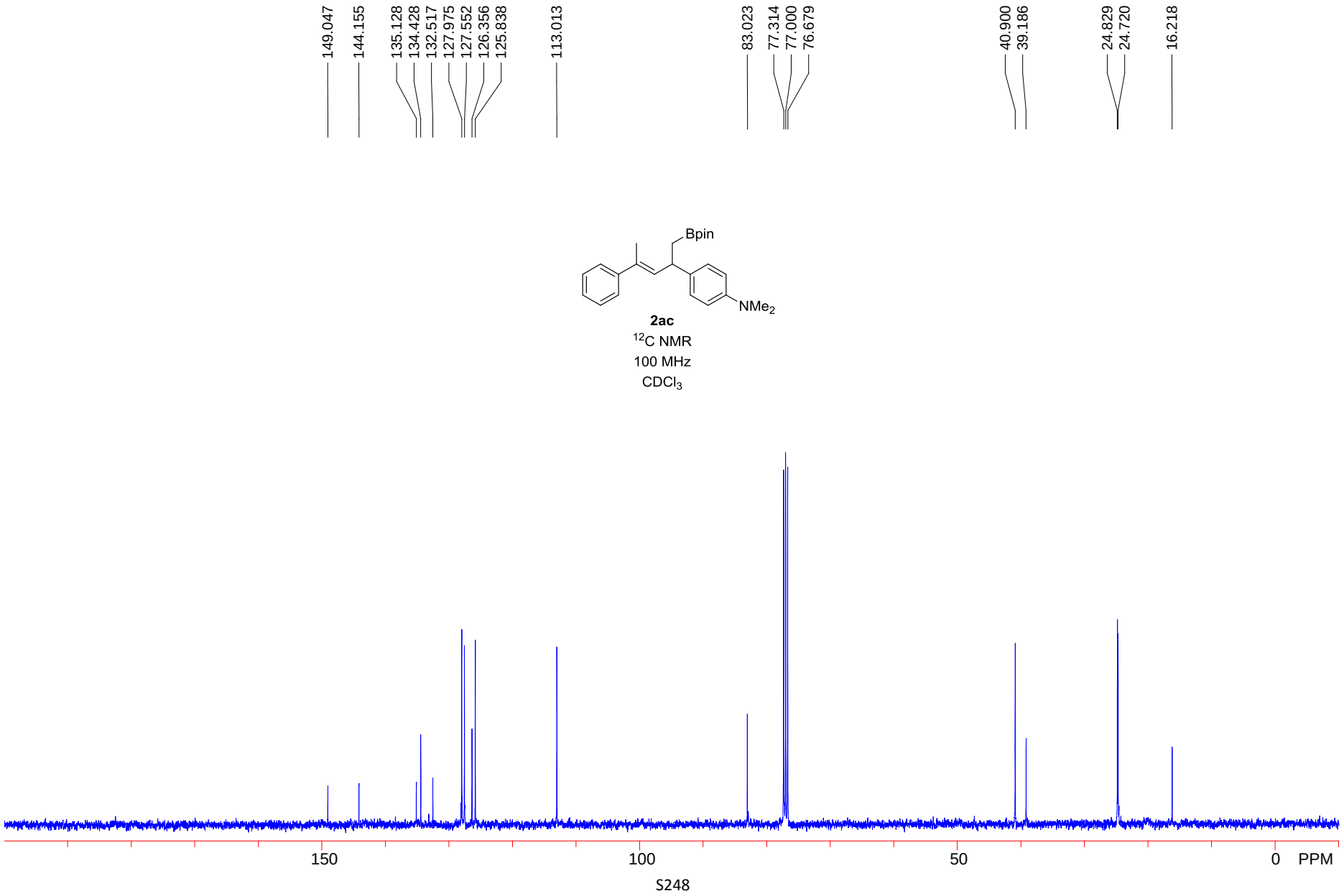
PPM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77.000
76.679
40.900
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2ac
12C NMR
100 MHz
CDCl3
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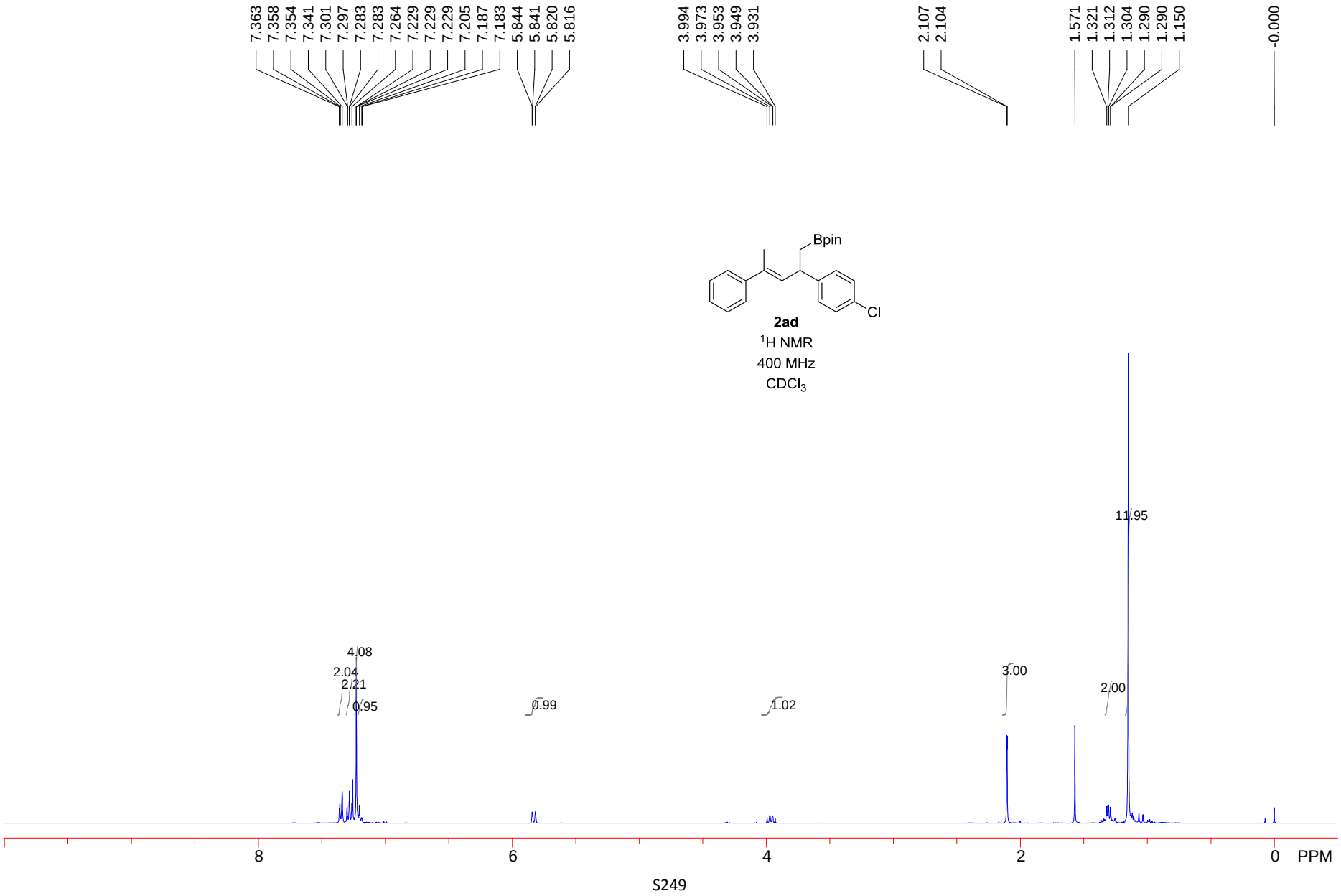
50
0
PPM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7.283
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2.107
2.104
1.571
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1.150
-0.000
Bpin
Cl
2ad
1H NMR
400 MHz
CDCl3
4.08
2.04
2.21
0.95
0.99
1.02
3.00
11.95
2.00
8
6
4
2
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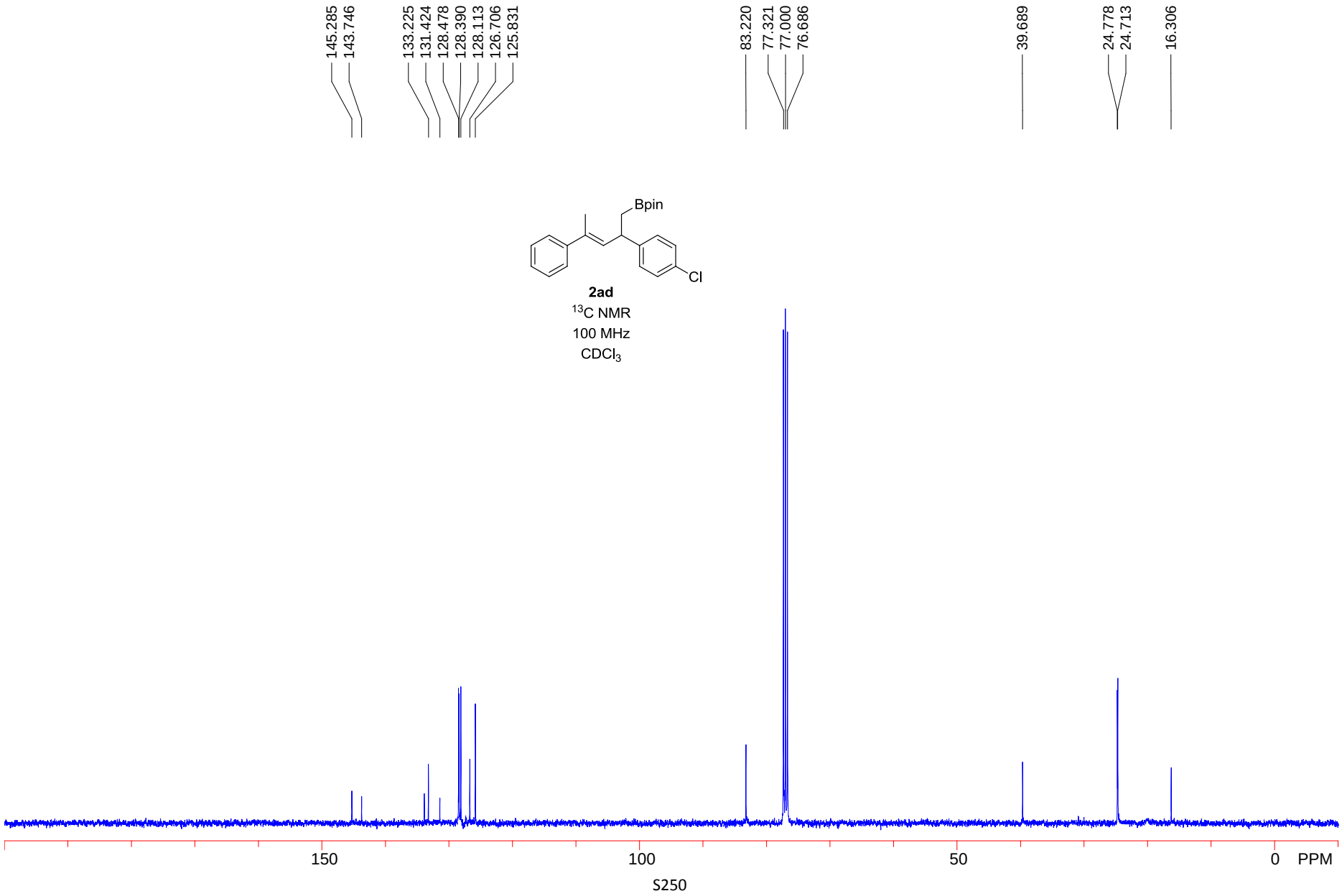
PPM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76.686
39.689
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Cl
2ad
13C NMR
100 MHz
CDCl3
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100
50
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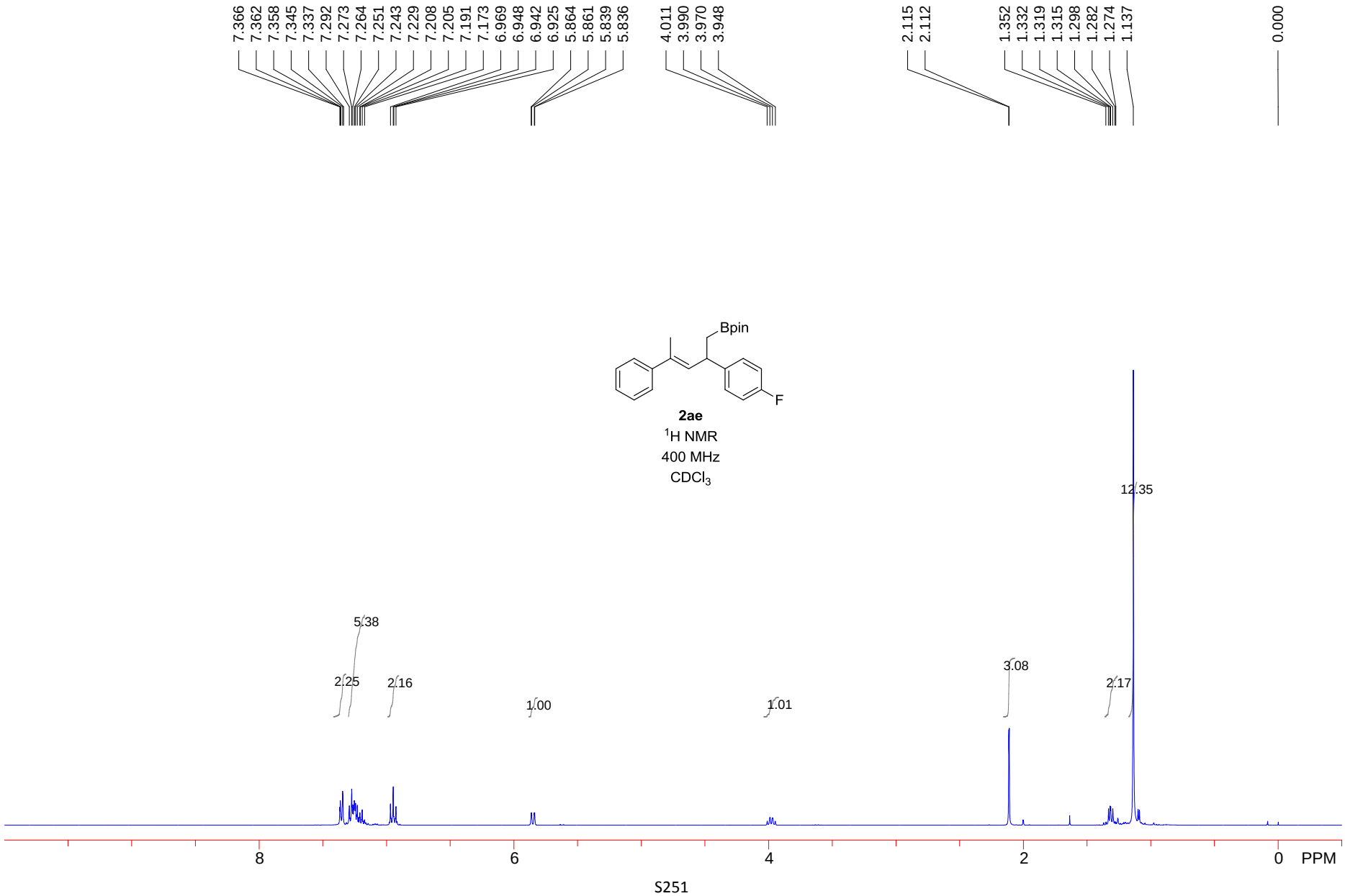
S250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7.229
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7.205
7.191
7.173
6.969
6.948
6.942
6.925
5.864
5.861
5.839
5.836
4.011
3.990
3.970
3.948
2.115
2.112
1.352
1.332
1.319
1.315
1.298
1.282
1.274
1.137
0.000
Bpin
F
2ae
1H NMR
400 MHz
CDCl3
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1.01
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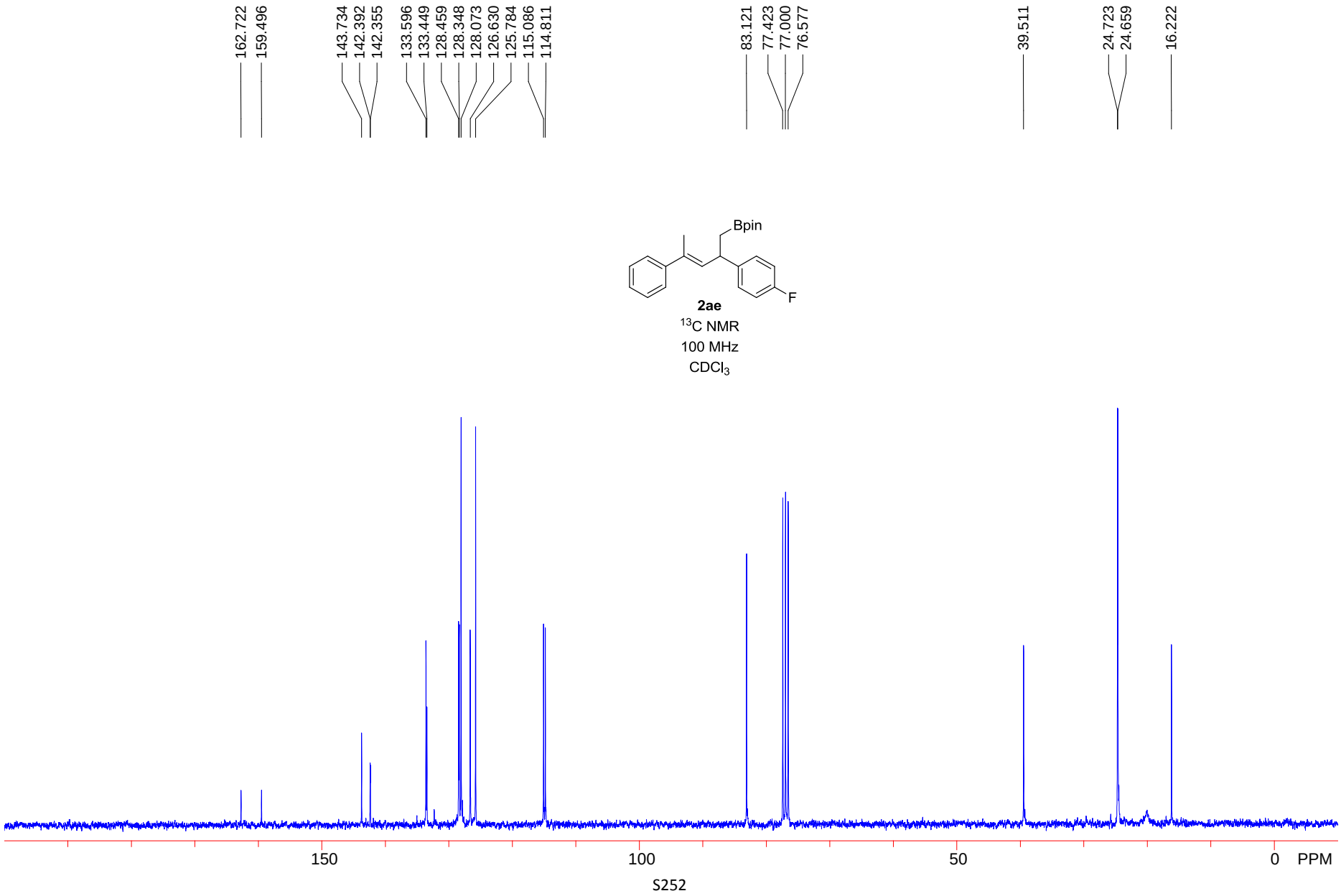
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115.086
114.811
83.121
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77.000
76.577
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13C NMR
100 MHz
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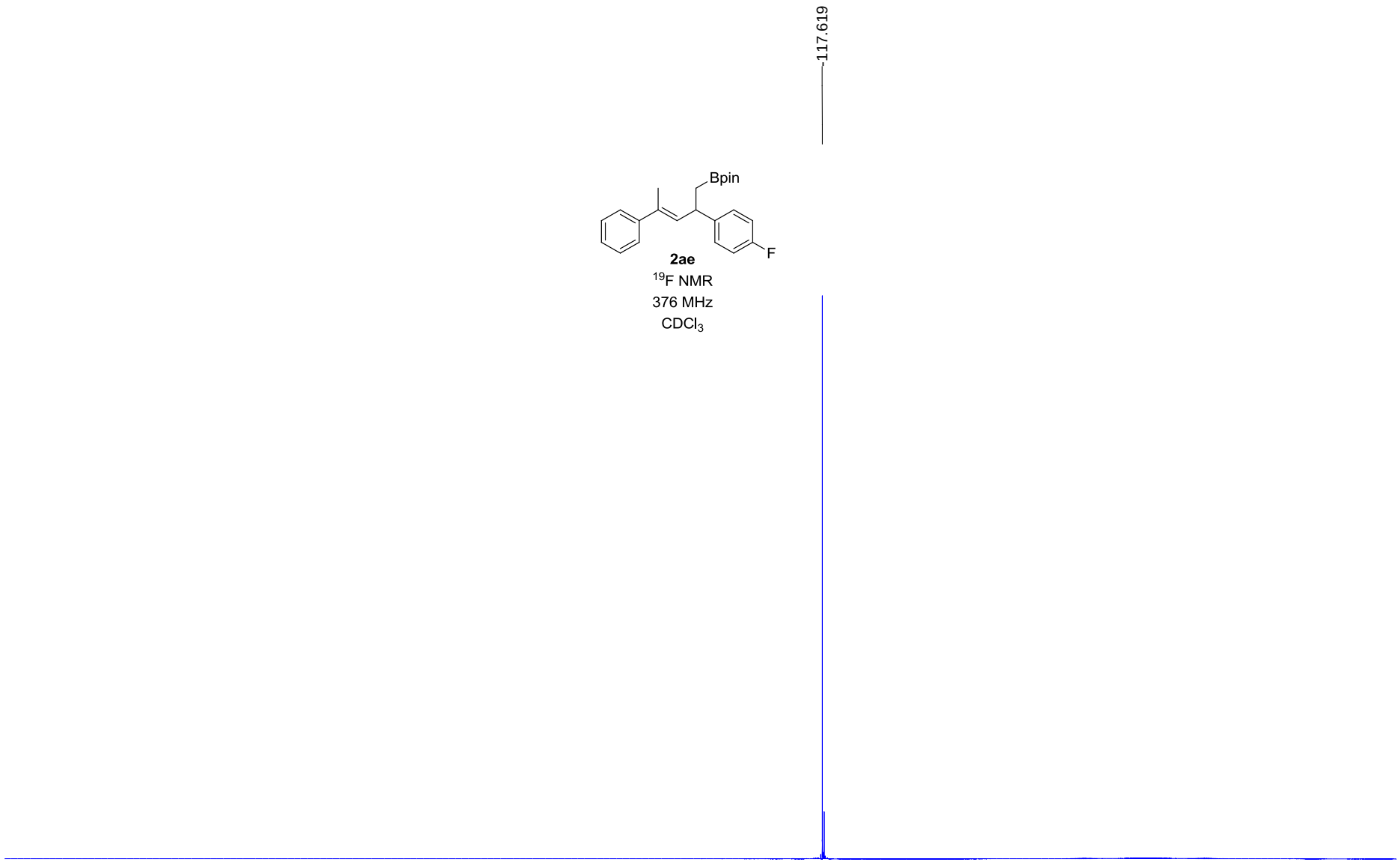
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2ae
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376 MHz
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-50
-100
-150
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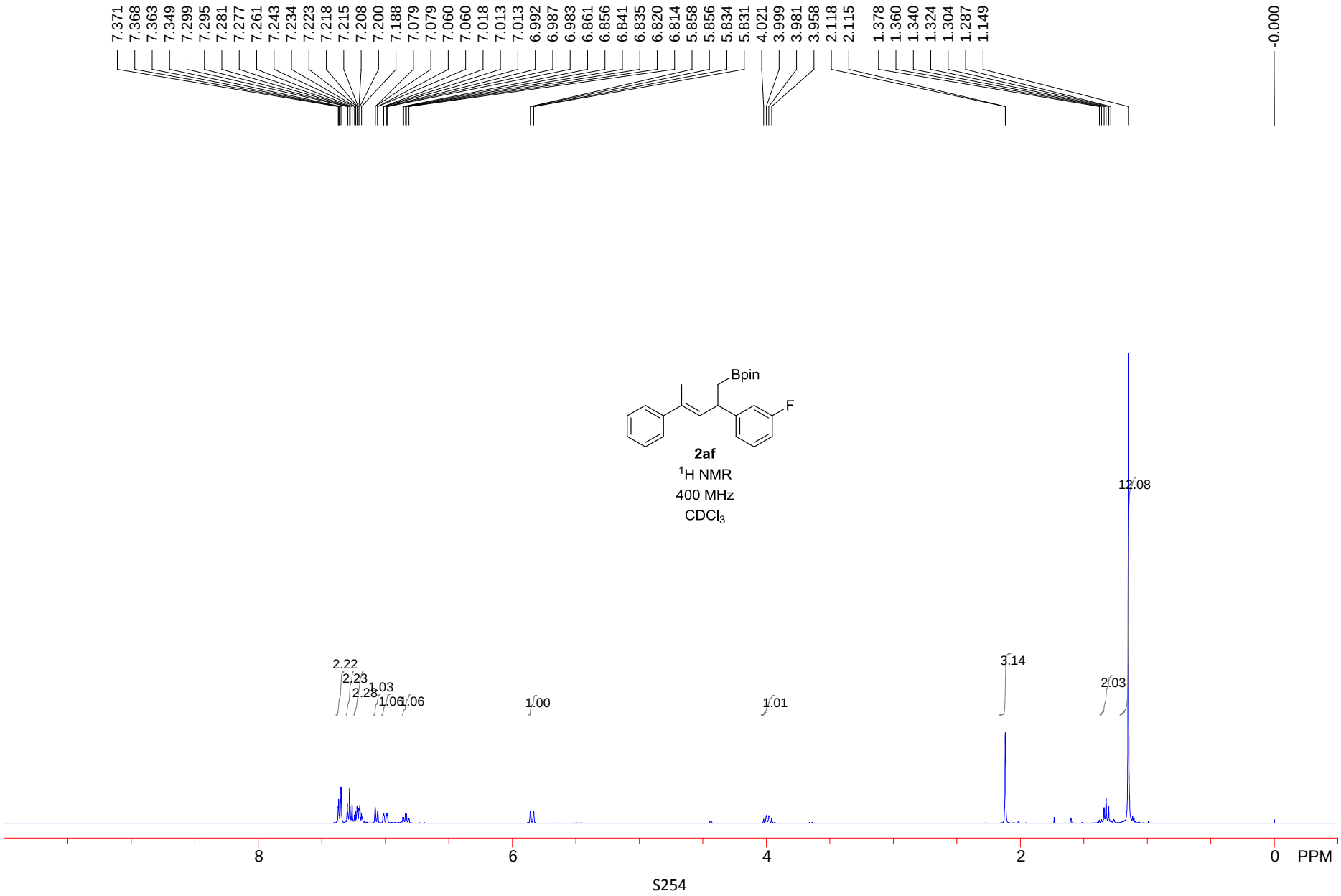
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7.218
7.215
7.208
7.200
7.188
7.079
7.079
7.060
7.060
7.018
7.013
7.013
6.992
6.987
6.983
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6.835
6.820
6.814
5.858
5.856
5.834
5.831
4.021
3.999
3.981
3.958
2.118
2.115
1.378
1.360
1.340
1.324
1.304
1.287
1.149
-0.000
Bpin
F
2af
1H NMR
400 MHz
CDCl3
12.08
3.14
2.03
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2.28
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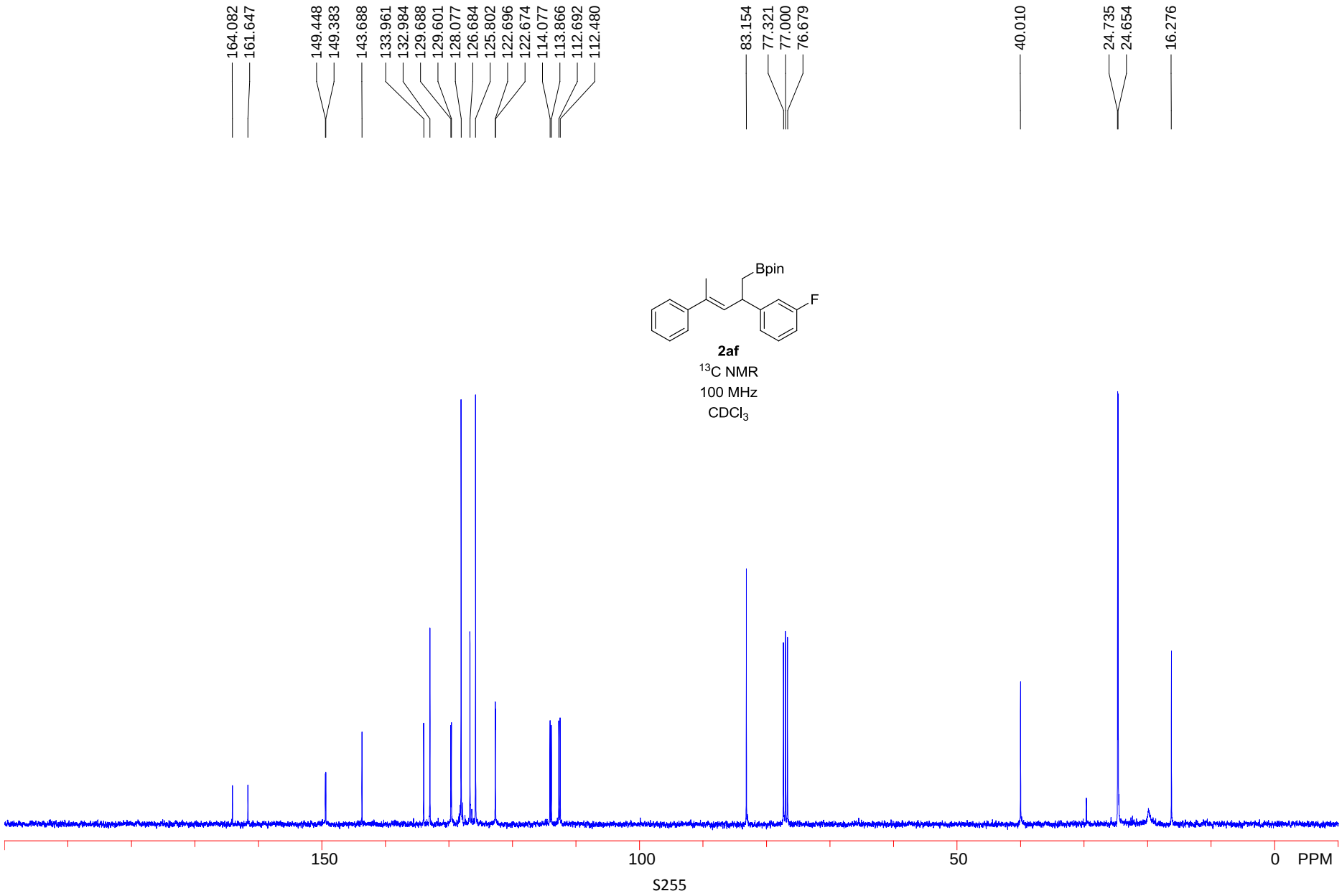
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122.696
122.674
114.077
113.866
112.692
112.480
83.154
77.321
77.000
76.679
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13C NMR
100 MHz
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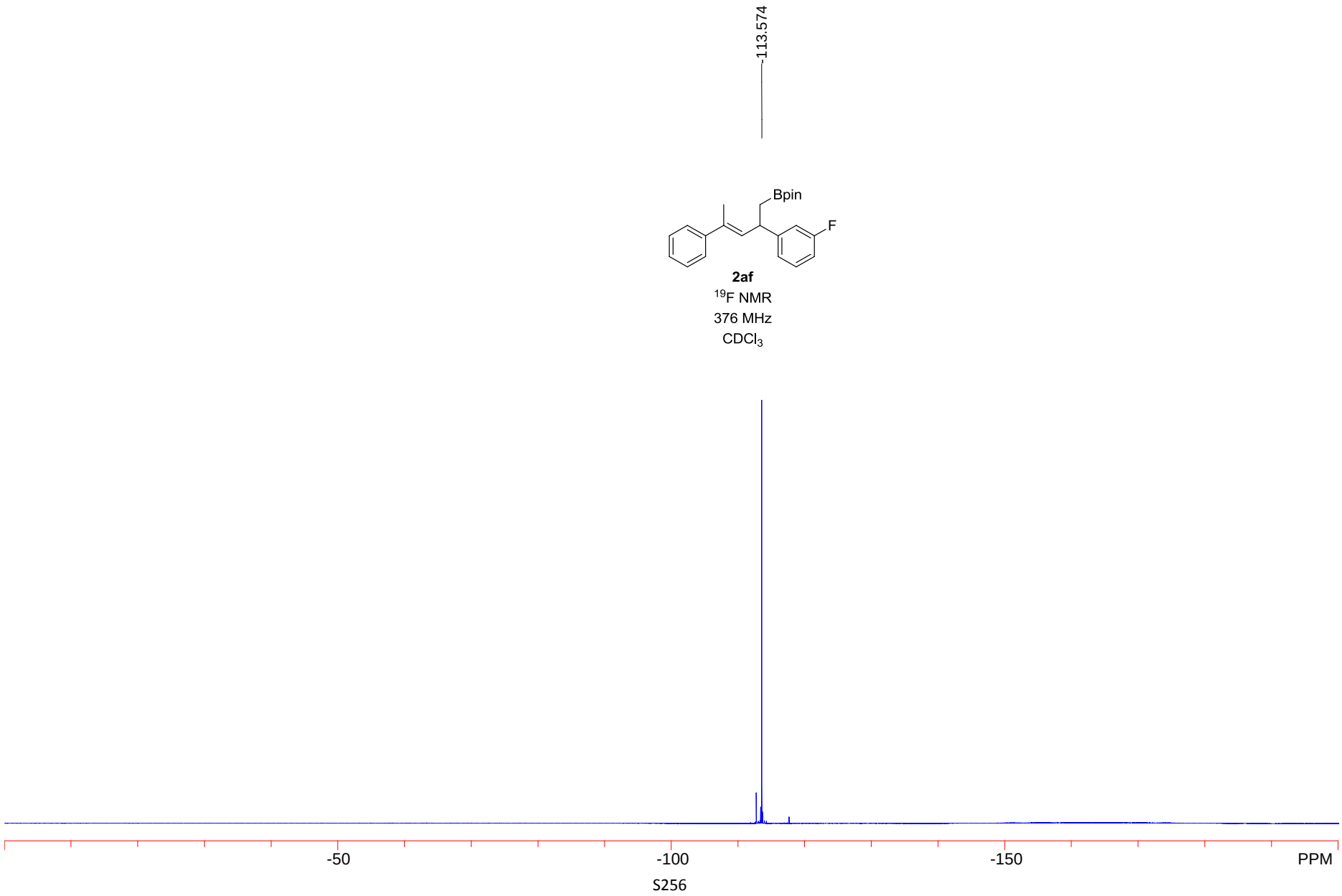
100
50
0
PPM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2af
19F NMR
376 MHz
CDCl3
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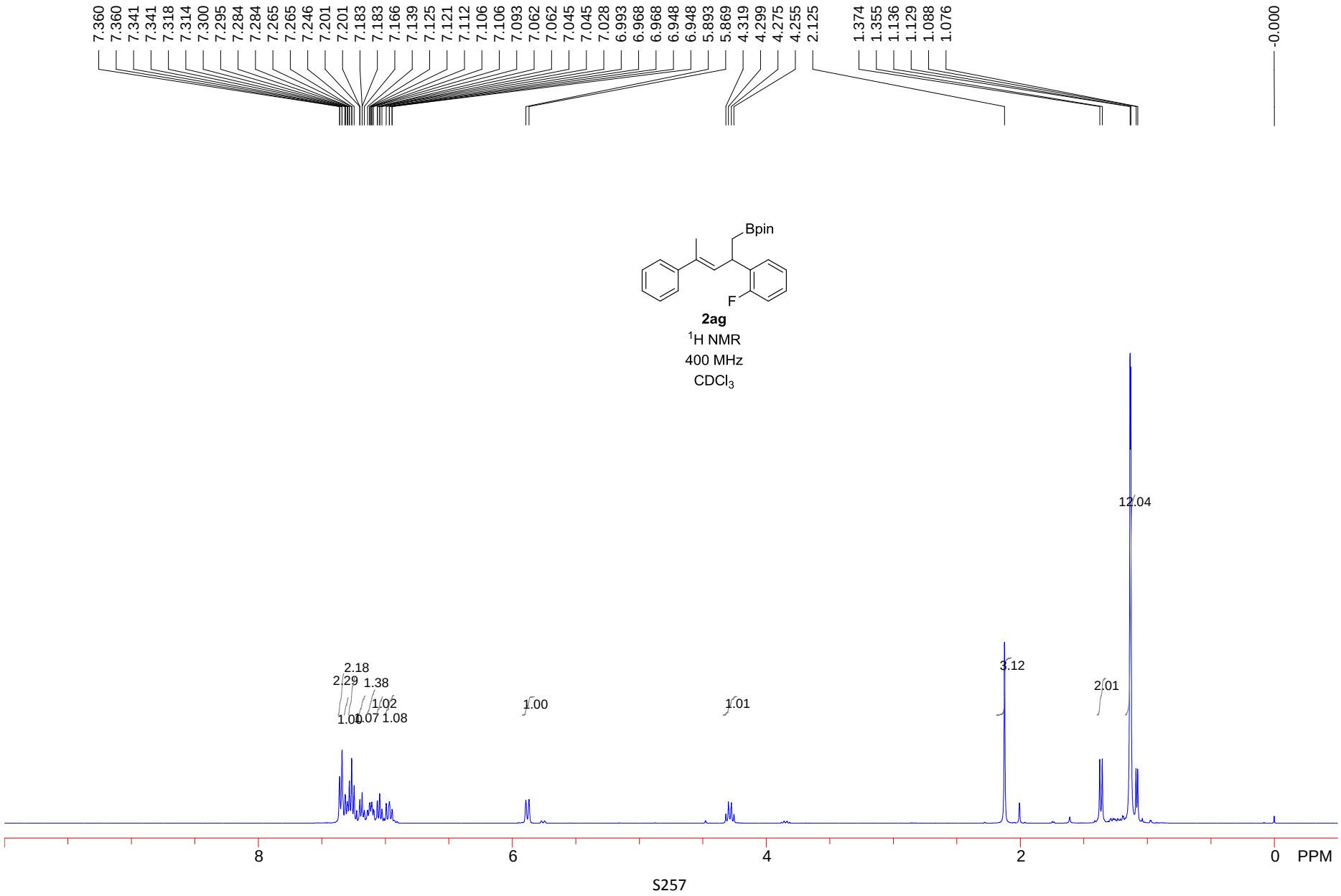
-100
-150
PPM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7.314
7.300
7.295
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7.284
7.265
7.265
7.246
7.201
7.201
7.183
7.183
7.166
7.139
7.125
7.121
7.112
7.106
7.106
7.093
7.062
7.062
7.045
7.045
7.028
6.993
6.968
6.968
6.948
6.948
5.893
5.869
4.319
4.299
4.275
4.255
2.125
1.374
1.355
1.136
1.129
1.088
1.076
-0.000
Bpin
F
2ag
1H NMR
400 MHz
CDCl3
2.18
2.29
1.38
1.02
1.00
1.07
1.08
1.00
1.01
3.12
2.01
12.04
8
6
4
2
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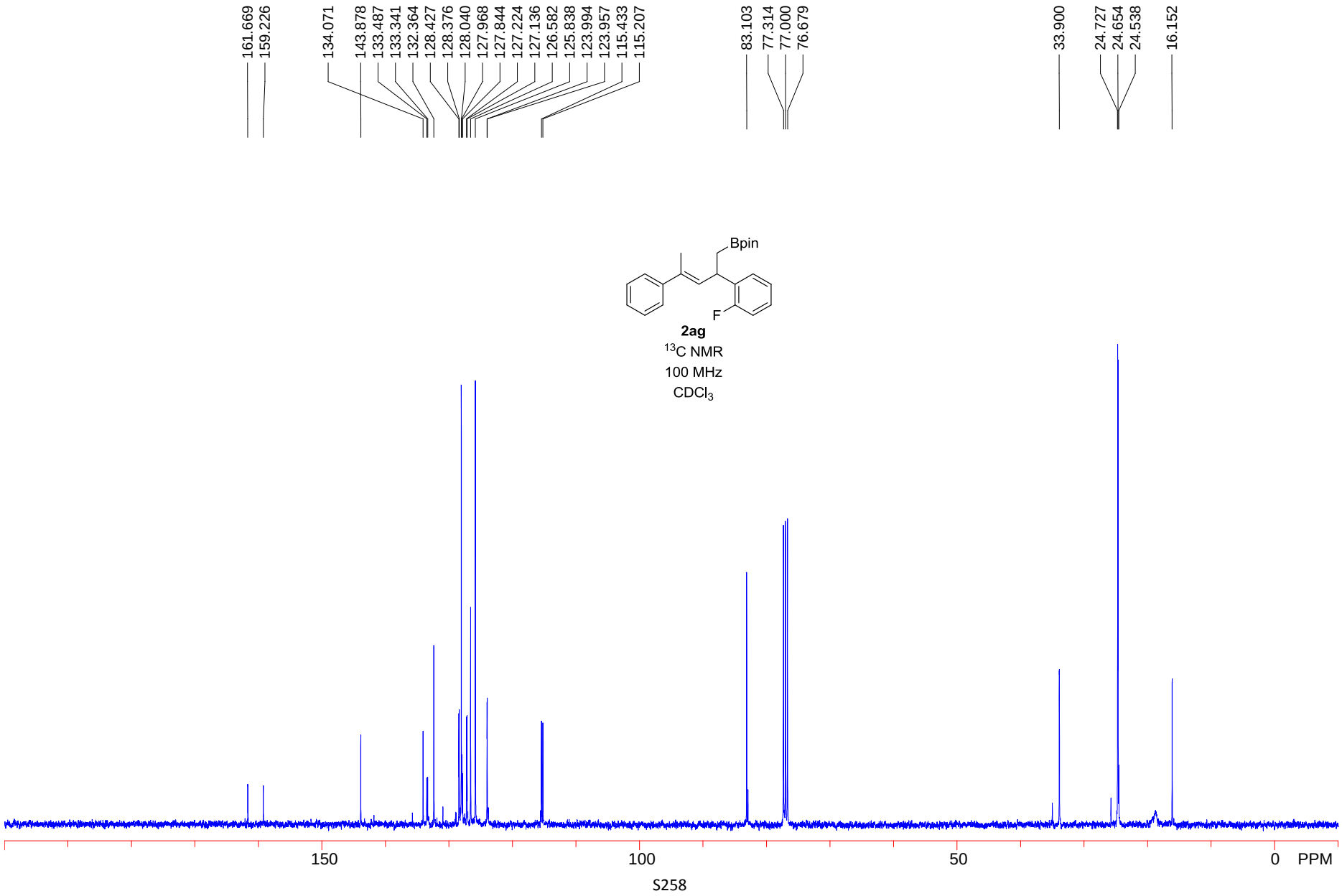
PPM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127.844
127.224
127.136
126.582
125.838
123.994
123.957
115.433
115.207
83.103
77.314
77.000
76.679
33.900
24.727
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16.152
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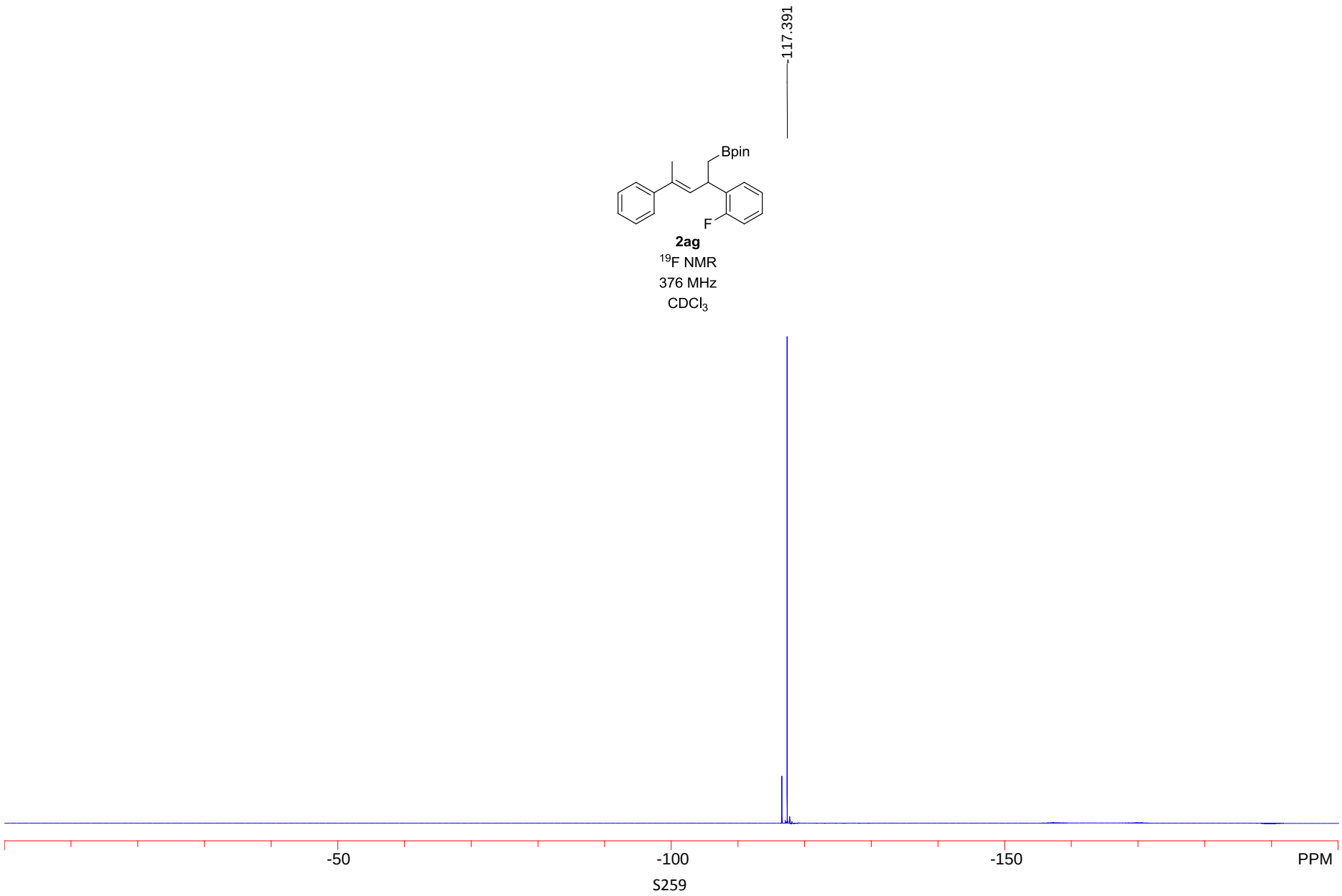
F
2ag
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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19F NMR
376 MHz
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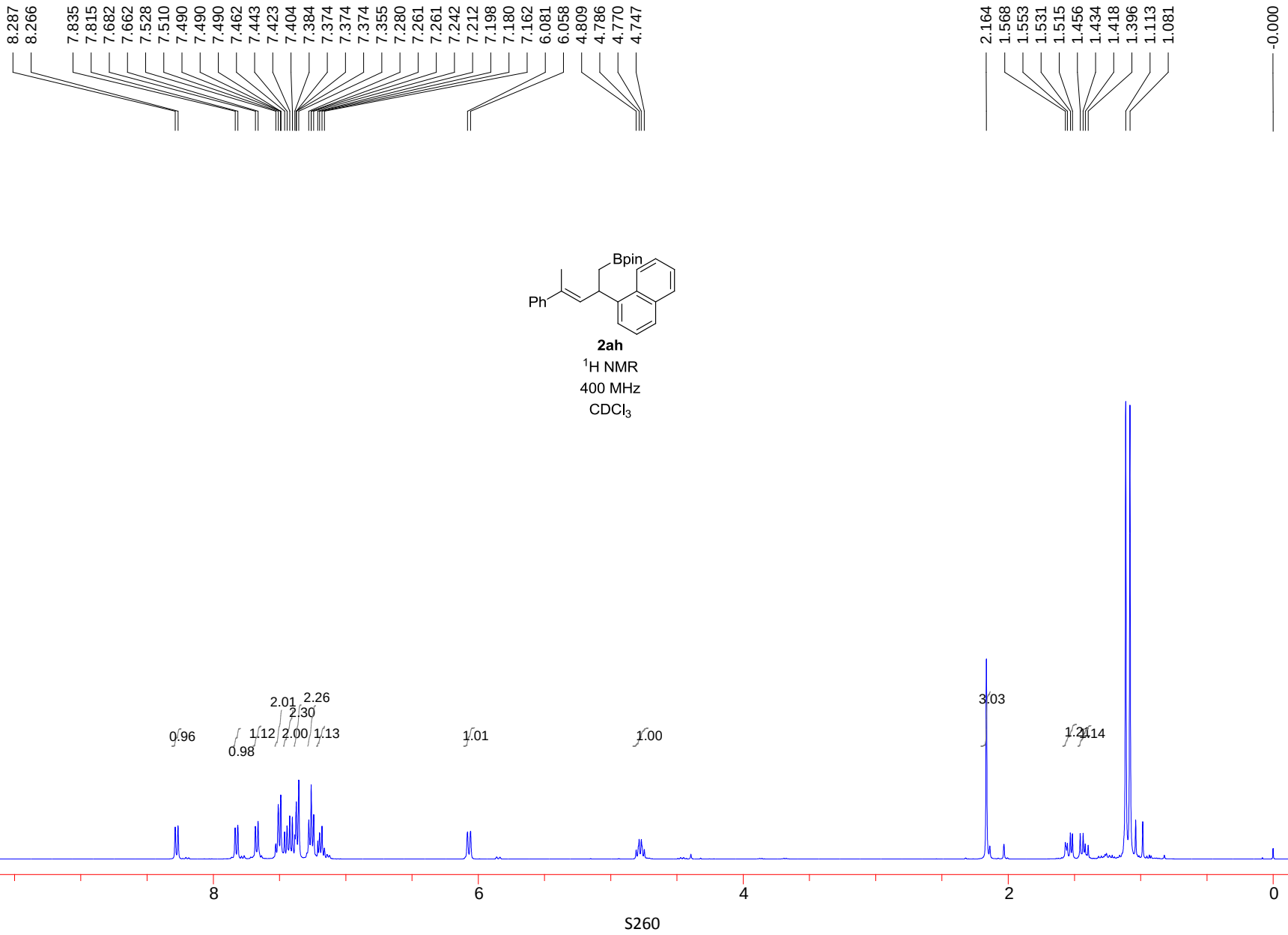
-100
-150
PPM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7.662
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7.490
7.490
7.462
7.443
7.423
7.404
7.384
7.374
7.374
7.374
7.355
7.280
7.261
7.261
7.242
7.212
7.198
7.180
7.162
6.081
6.058
4.809
4.786
4.770
4.747
2.164
1.568
1.553
1.531
1.515
1.456
1.434
1.418
1.396
1.113
1.081
-0.000
Bpin
Ph
2ah
1H NMR
400 MHz
CDCl3
0.96
0.98
1.12
2.01
2.30
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2.00
1.13
1.01
1.00
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1.14
8
6
4
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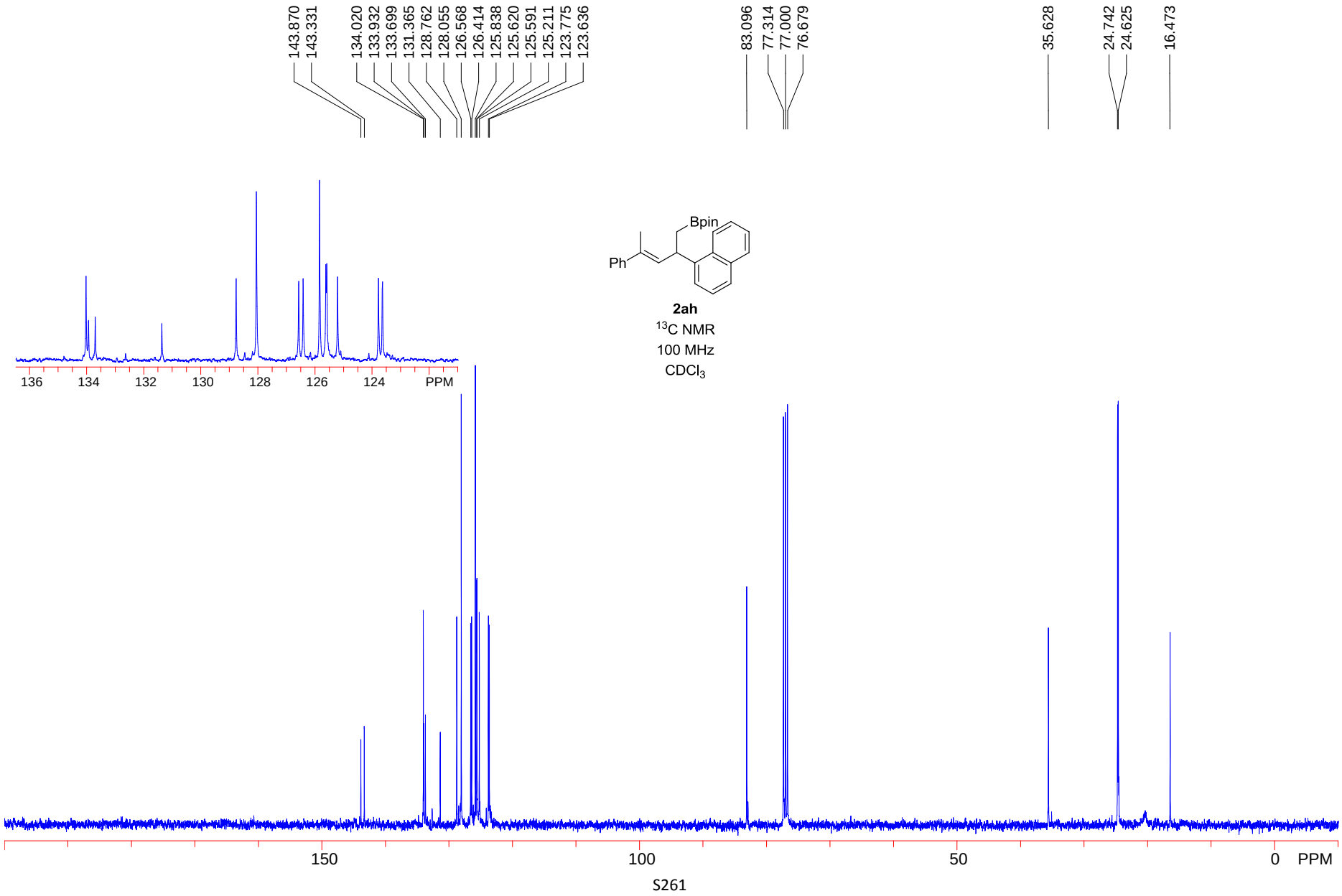
PPM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128.055
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126.414
125.838
125.620
125.591
125.211
123.775
123.636
83.096
77.314
77.000
76.679
35.628
24.742
24.625
16.473
Bpin
Ph
2ah
13C NMR
100 MHz
CDCl3
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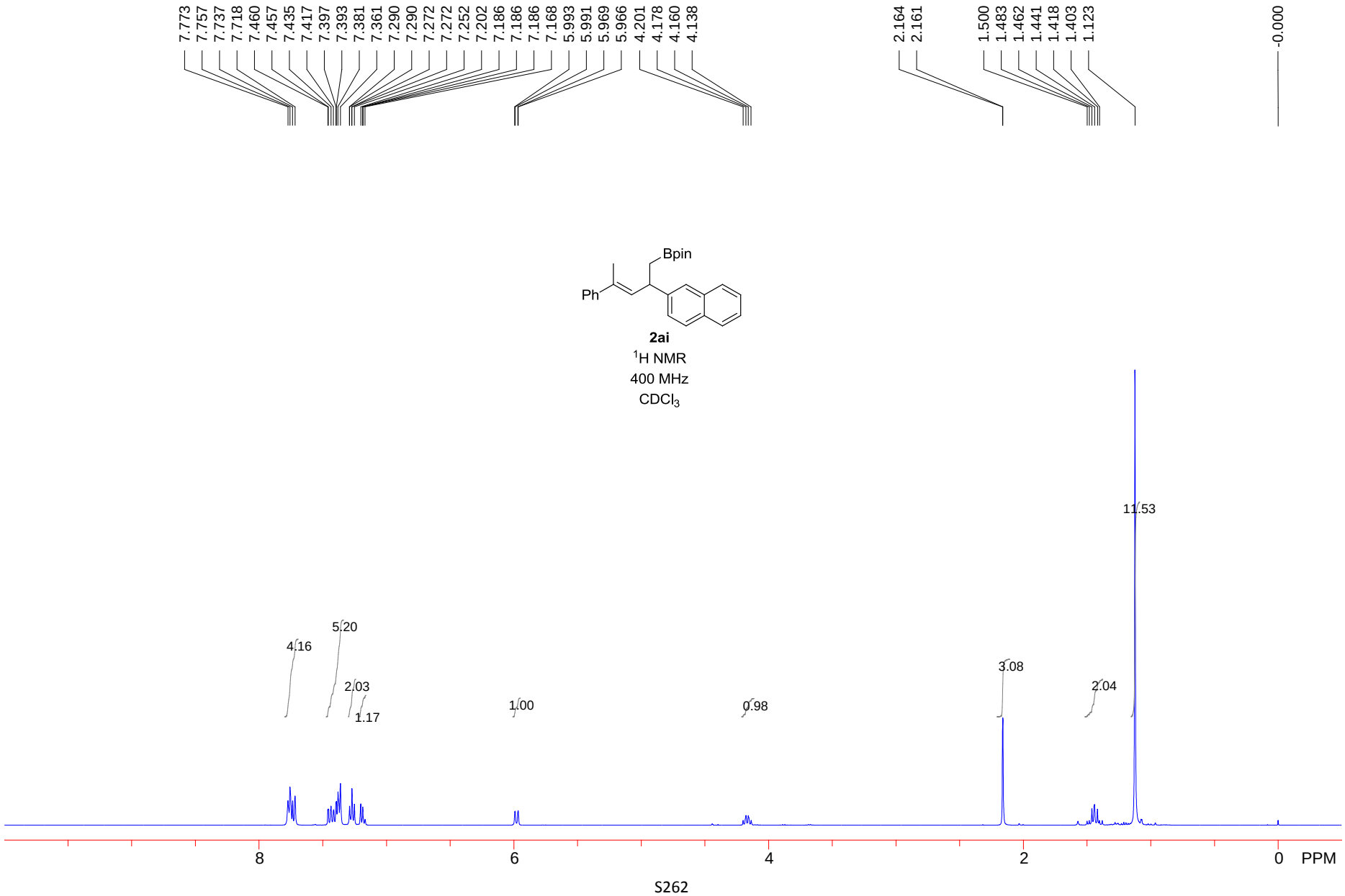
134
132
130
128
126
124
PPM
150
100
50
0
PPM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7.393
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7.290
7.290
7.272
7.272
7.252
7.202
7.186
7.186
7.168
5.993
5.991
5.969
5.966
4.201
4.178
4.160
4.138
2.164
2.161
1.500
1.483
1.462
1.441
1.418
1.403
1.123
-0.000
Bpin
Ph
2ai
1H NMR
400 MHz
CDCl3
11.53
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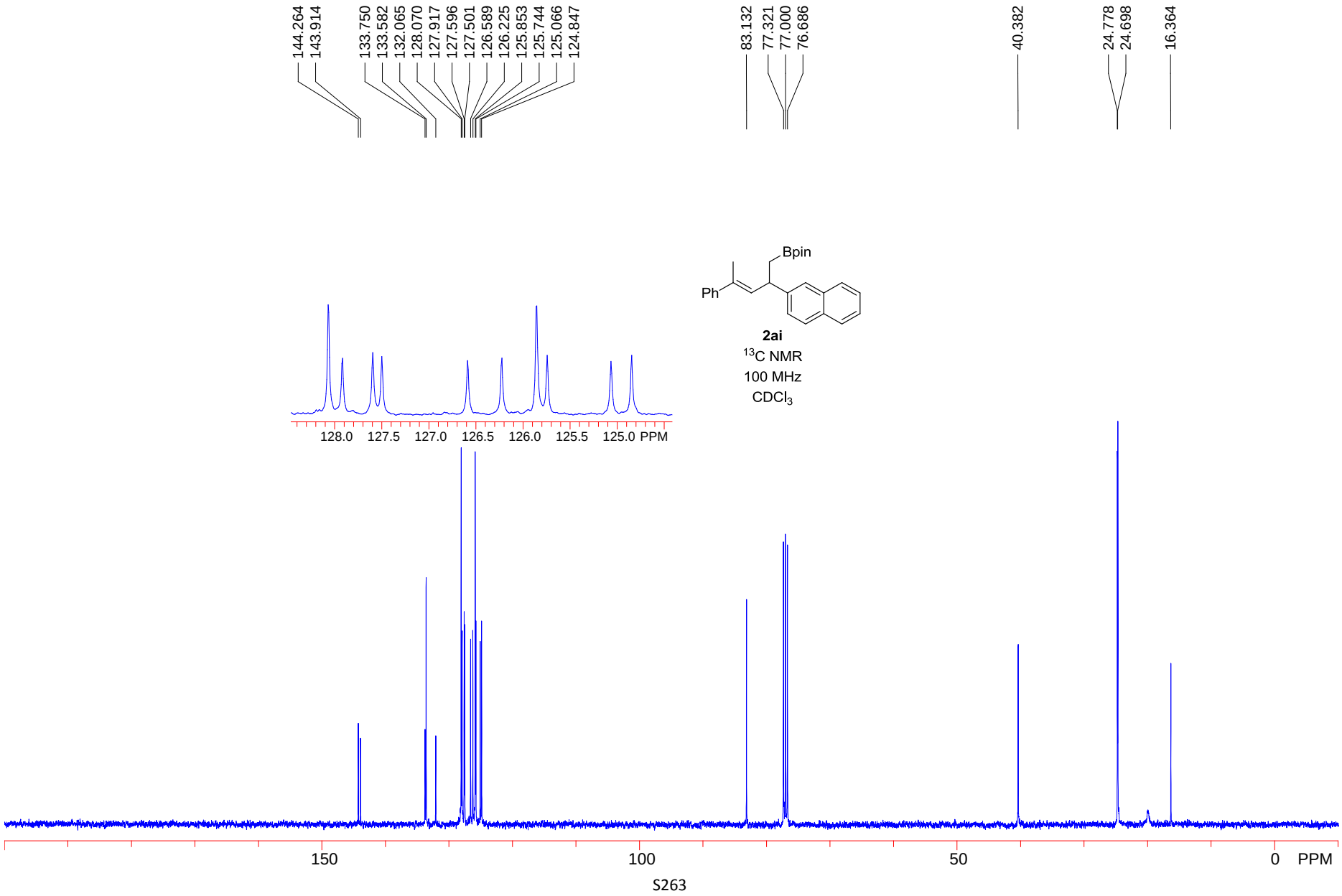
3.08
2.04
2.03
1.17
1.00
0.98
8
6
4
2
0
PPM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83.132
77.321
77.000
76.686
40.382
24.778
24.698
16.364
Bpin
Ph
2ai
13C NMR
100 MHz
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127.0
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125.0 PPM
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50
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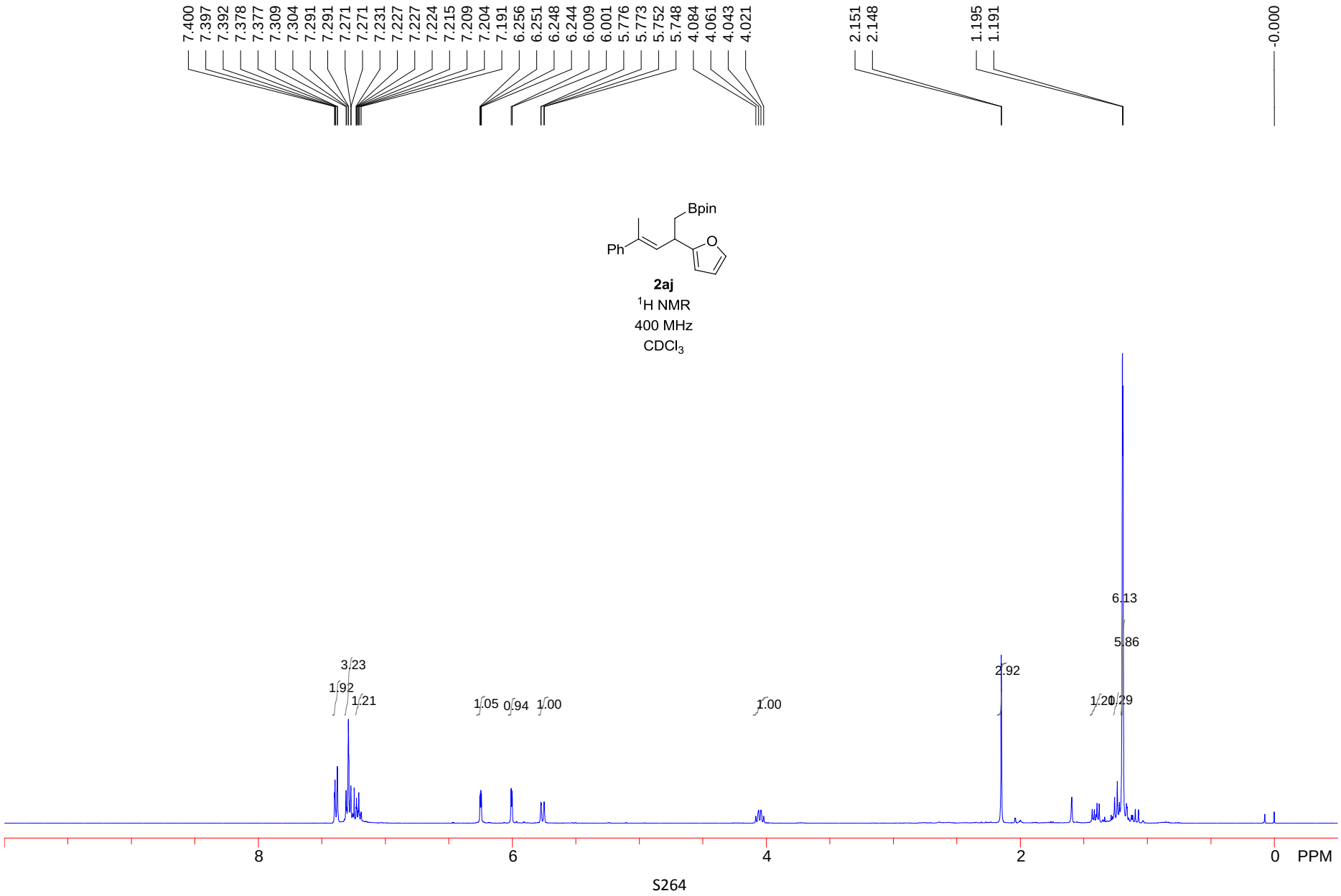
PPM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7.291
7.291
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7.271
7.231
7.227
7.227
7.224
7.215
7.209
7.204
7.191
6.256
6.251
6.248
6.244
6.009
6.001
5.776
5.773
5.752
5.748
4.084
4.061
4.043
4.021
2.151
2.148
1.195
1.191
-0.000
Bpin
Ph
O
2aj
1H NMR
400 MHz
CDCl3
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1.21
1.05
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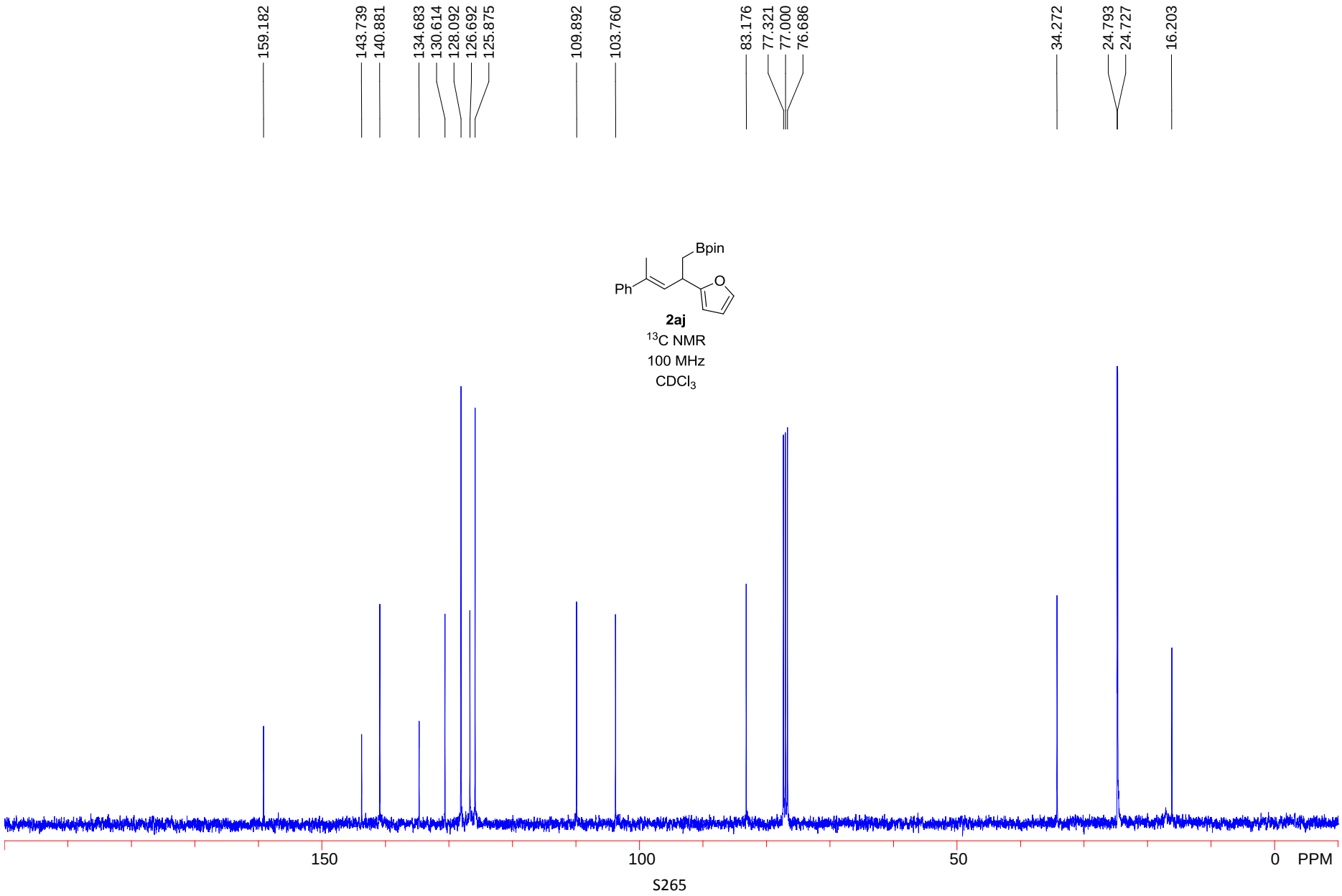
PPM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77.000
76.686
34.272
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Bpin
Ph
O
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CDCl3
150
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50
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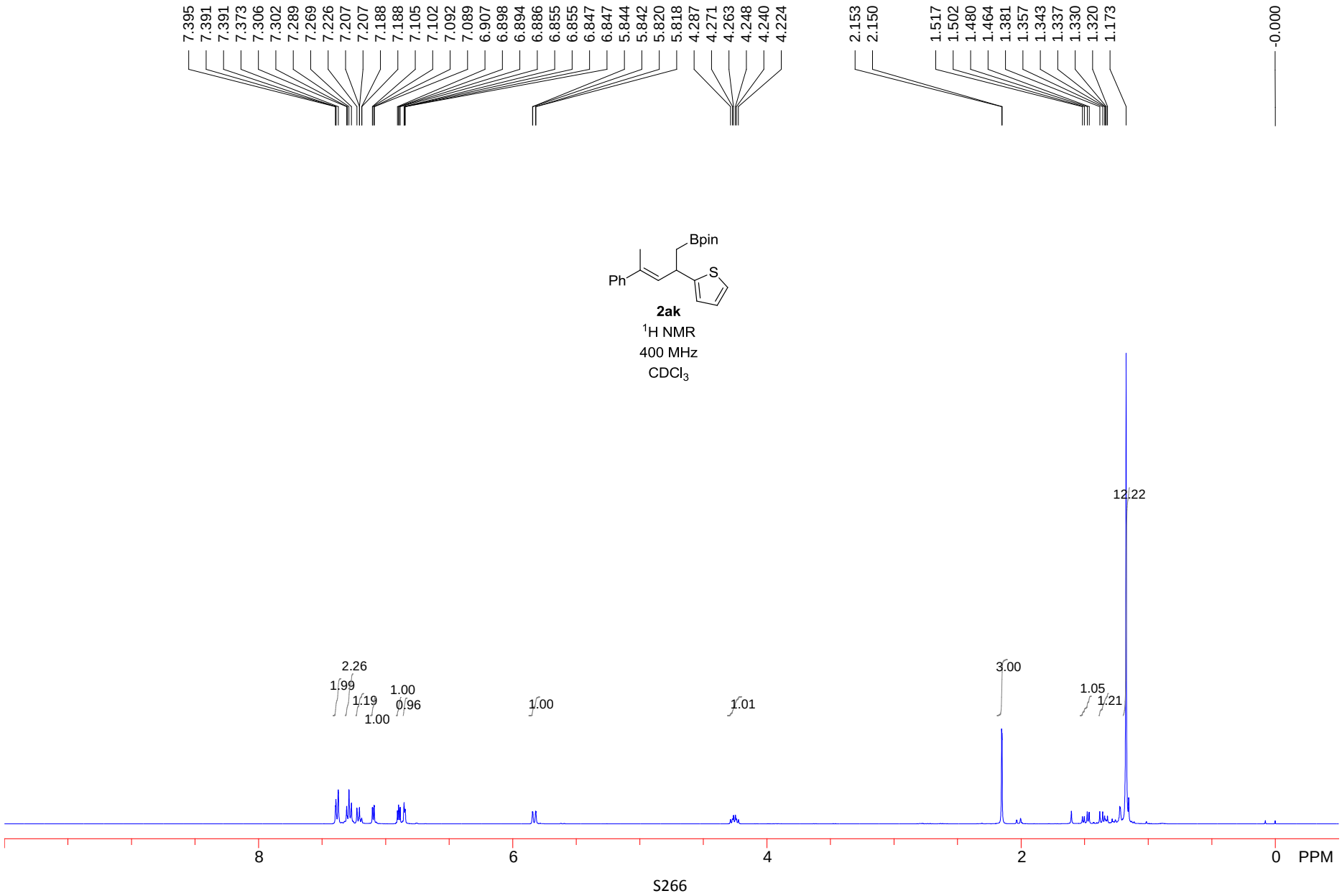
PPM
S265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6.855
6.847
6.847
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5.842
5.820
5.818
4.287
4.271
4.263
4.248
4.240
4.224
2.153
2.150
1.517
1.502
1.480
1.464
1.381
1.357
1.343
1.337
1.330
1.320
1.173
-0.000
Bpin
Ph
S
2ak
1H NMR
400 MHz
CDCl3
12.22
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1.19
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6
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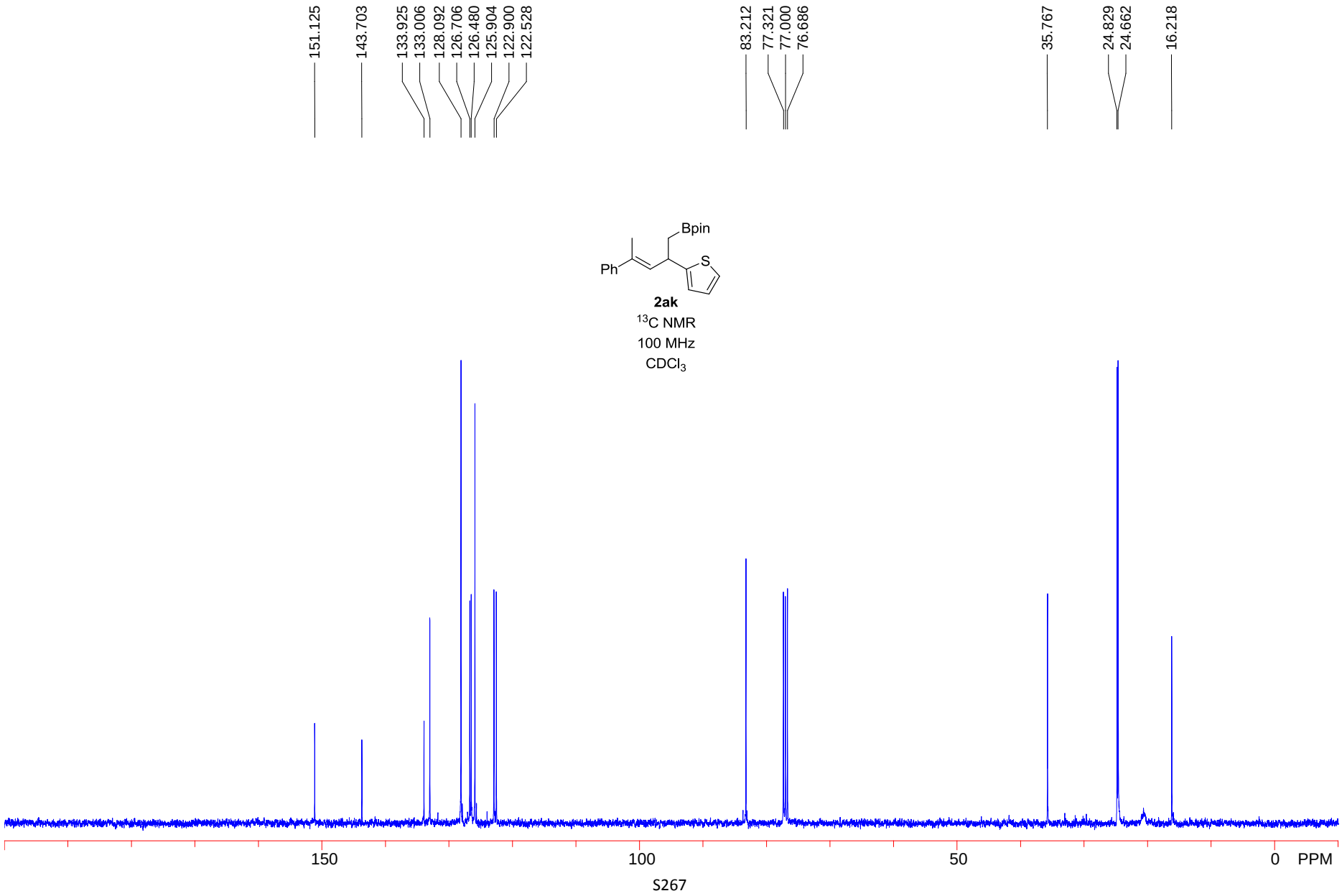
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76.686
35.767
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Bpin
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S
2ak
13C NMR
100 MHz
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150
100
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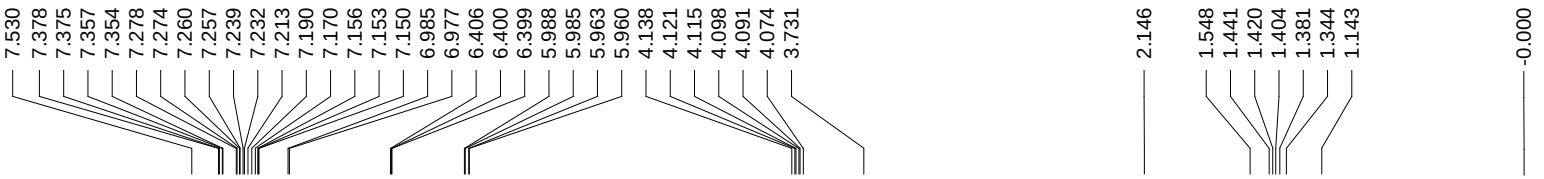
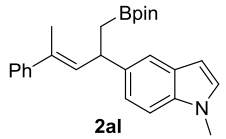
0
PPM



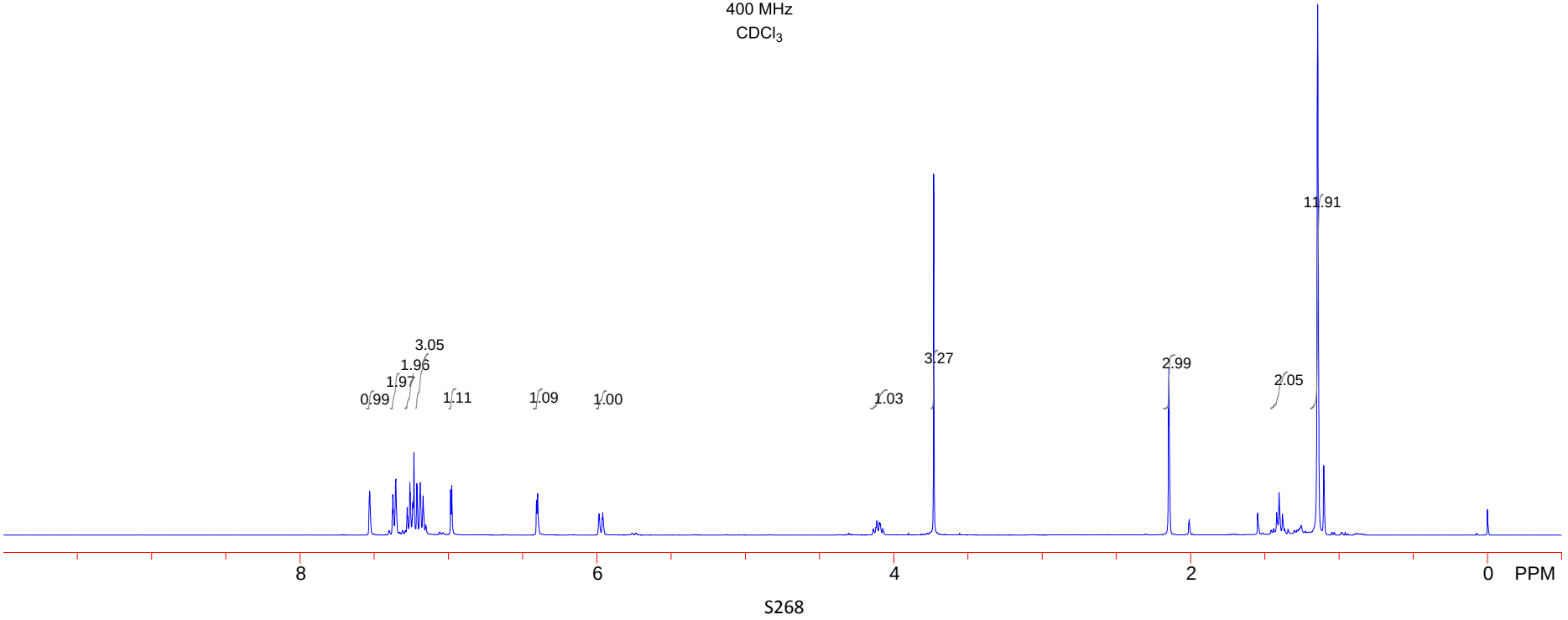


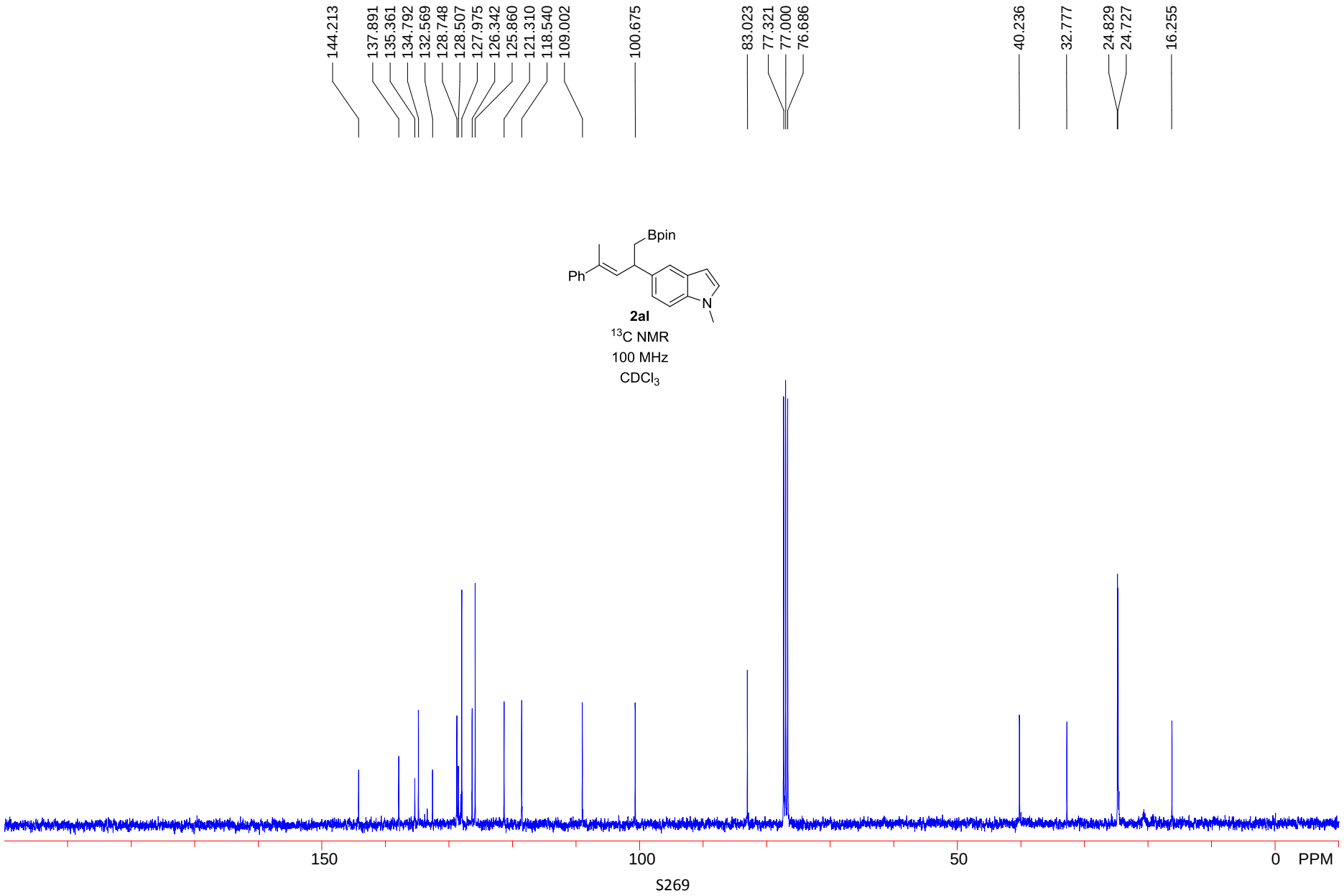
2al

^{1}H NMR

400 MHz

$CDCl_3$

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118.540
109.002
100.675
83.023
77.321
77.000
76.686
40.236
32.777
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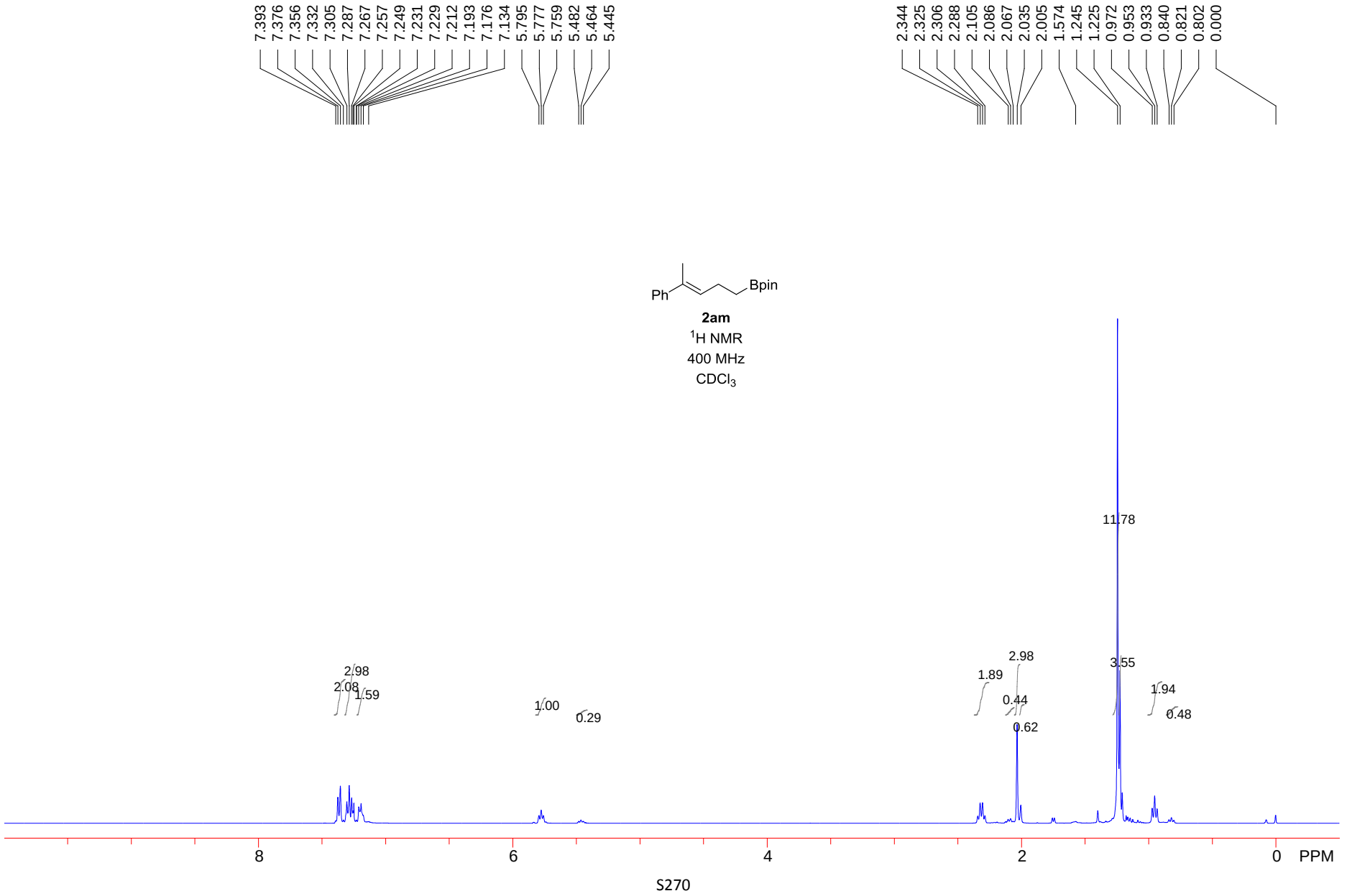
16.255
Bpin
Ph
N
2al
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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2.005
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1.245
1.225
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0.802
0.000
Ph
Bpin
2am
1H NMR
400 MHz
CDCl3
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1.00
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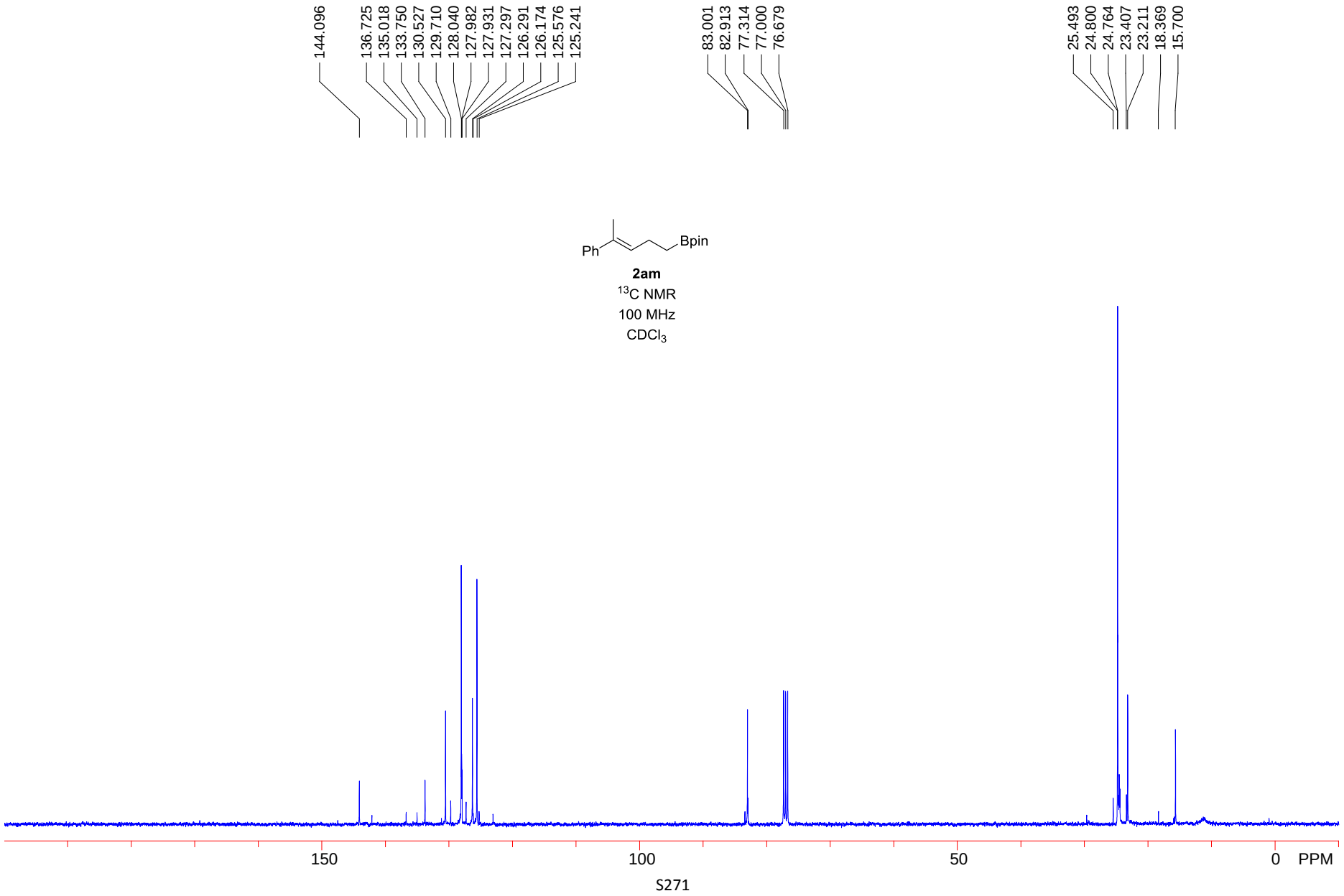
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125.241
83.001
82.913
77.314
77.000
76.679
25.493
24.800
24.764
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Ph
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2am
13C NMR
100 MHz
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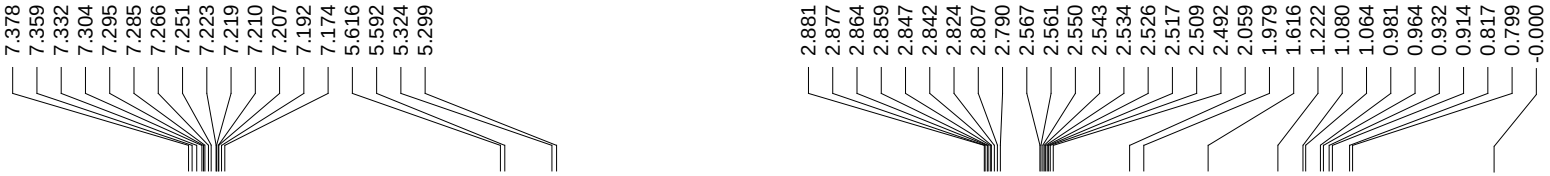
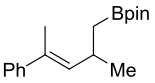
150
100
50
0
PPM



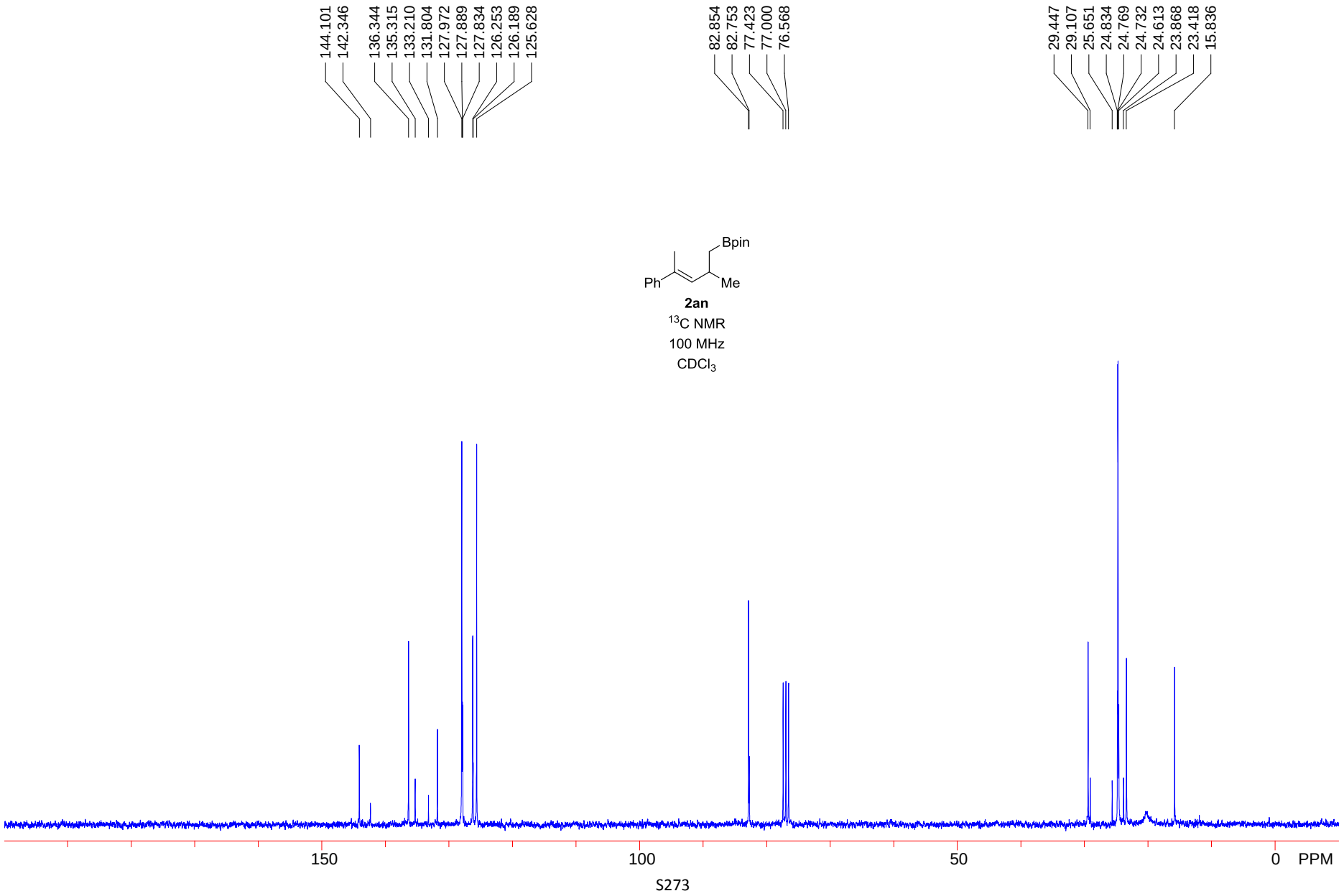


2an

^{1}H NMR

400 MHz

$CDCl_3$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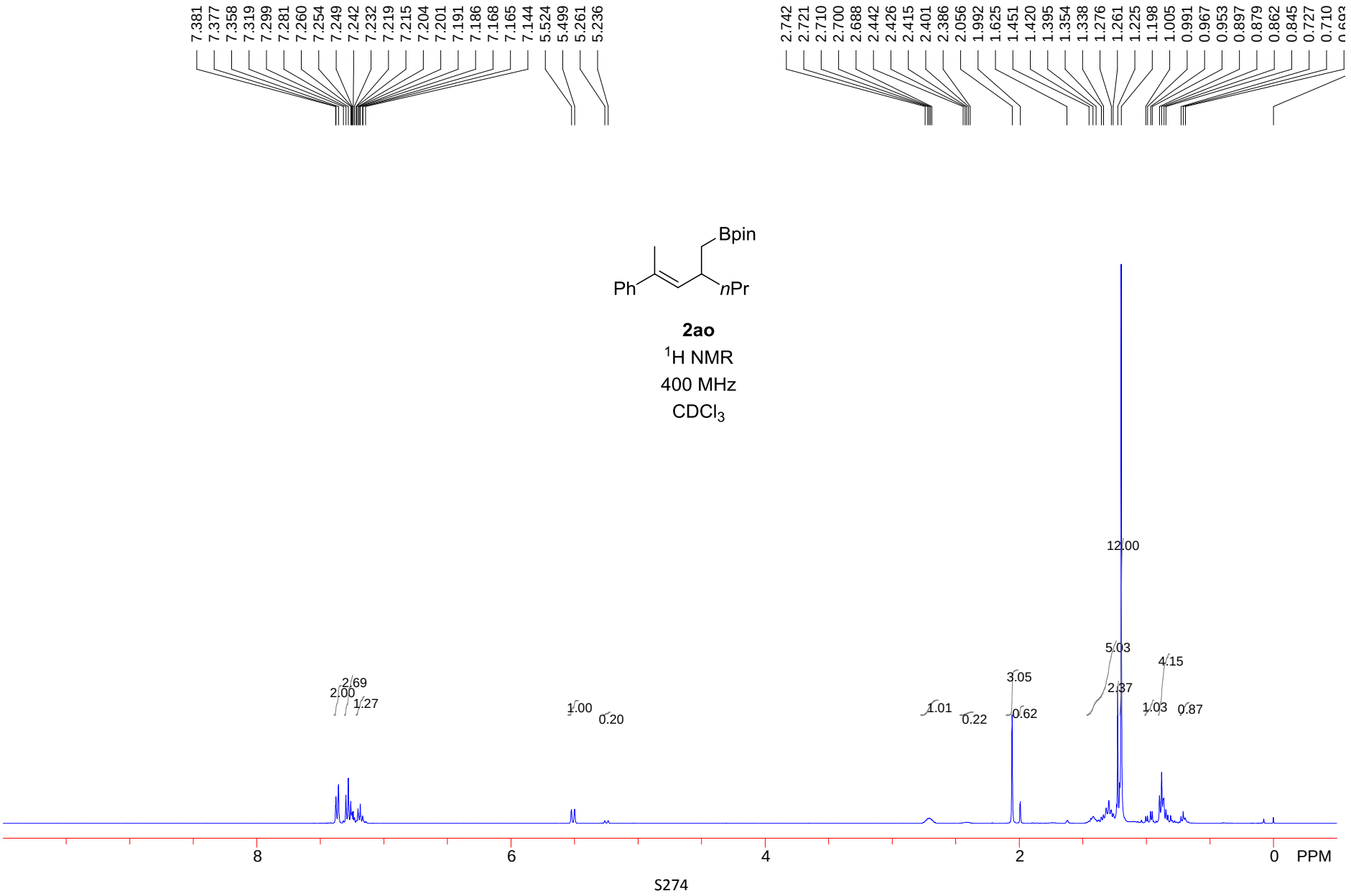
142.346
136.344
135.315
133.210
131.804
127.972
127.889
127.834
126.253
126.189
125.628
82.854
82.753
77.423
77.000
76.568
29.447
29.107
25.651
24.834
24.769
24.732
24.613
23.868
23.418
15.836
Bpin
Ph
Me
2an
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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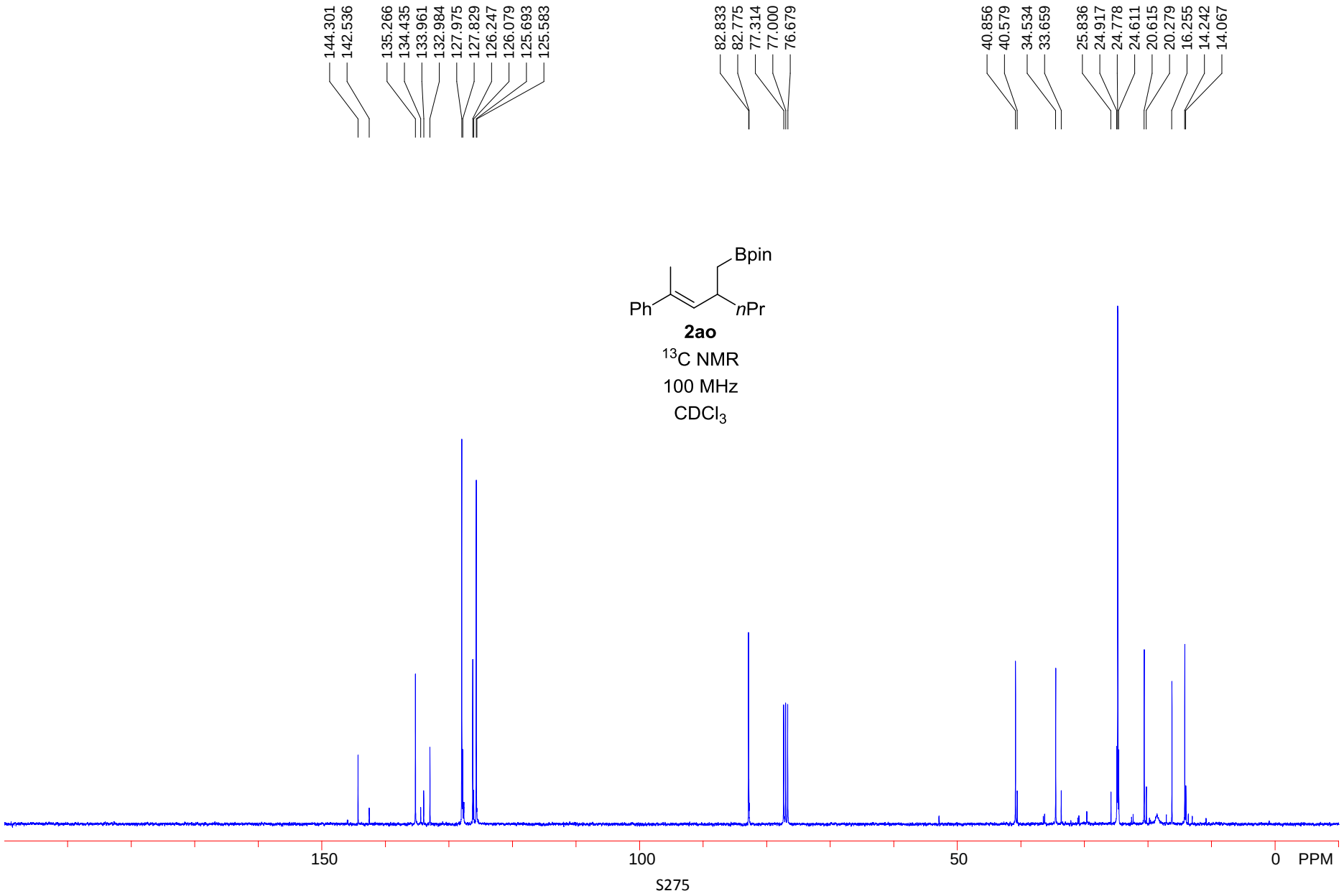
7.377
7.358
7.319
7.299
7.281
7.260
7.254
7.249
7.242
7.232
7.219
7.215
7.204
7.201
7.191
7.186
7.168
7.165
7.144
5.524
5.499
5.261
5.236
2.742
2.721
2.710
2.700
2.688
2.442
2.426
2.415
2.401
2.386
2.056
1.992
1.625
1.451
1.420
1.395
1.354
1.338
1.276
1.261
1.225
1.198
1.005
0.991
0.967
0.953
0.897
0.879
0.862
0.845
0.727
0.710
Bpin
Ph
nPr
2ao
1H NMR
400 MHz
CDCl3
12.00
5.03
4.15
3.05
2.69
2.37
2.00
1.27
1.03
1.00
0.87
1.01
0.62
0.20
0.22
8
6
4
2
0
PPM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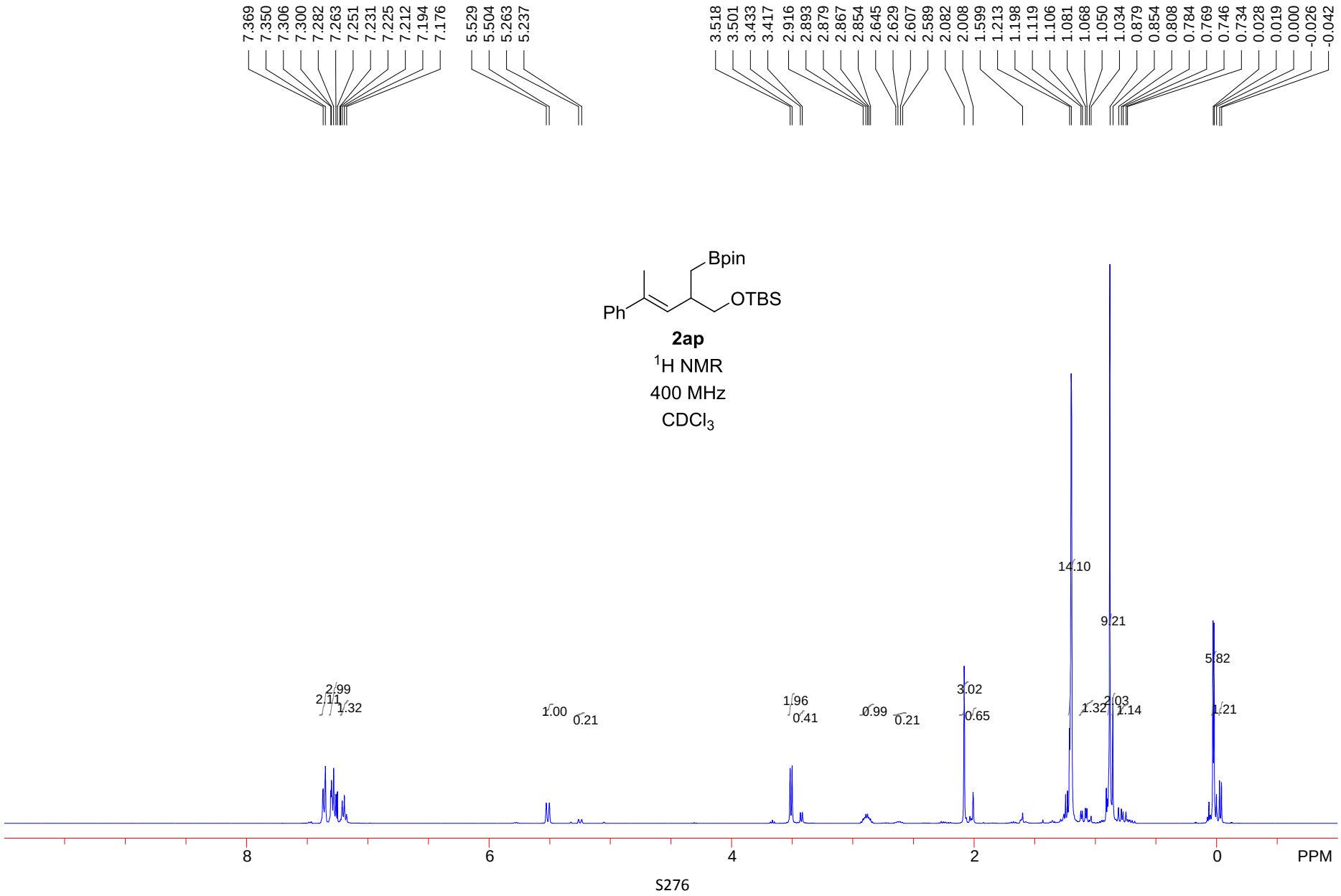
142.536
135.266
134.435
133.961
132.984
127.975
127.829
126.247
126.079
125.693
125.583
82.833
82.775
77.314
77.000
76.679
40.856
40.579
34.534
33.659
25.836
24.917
24.778
24.611
20.615
20.279
16.255
14.242
14.067
Bpin
Ph
nPr
2ao
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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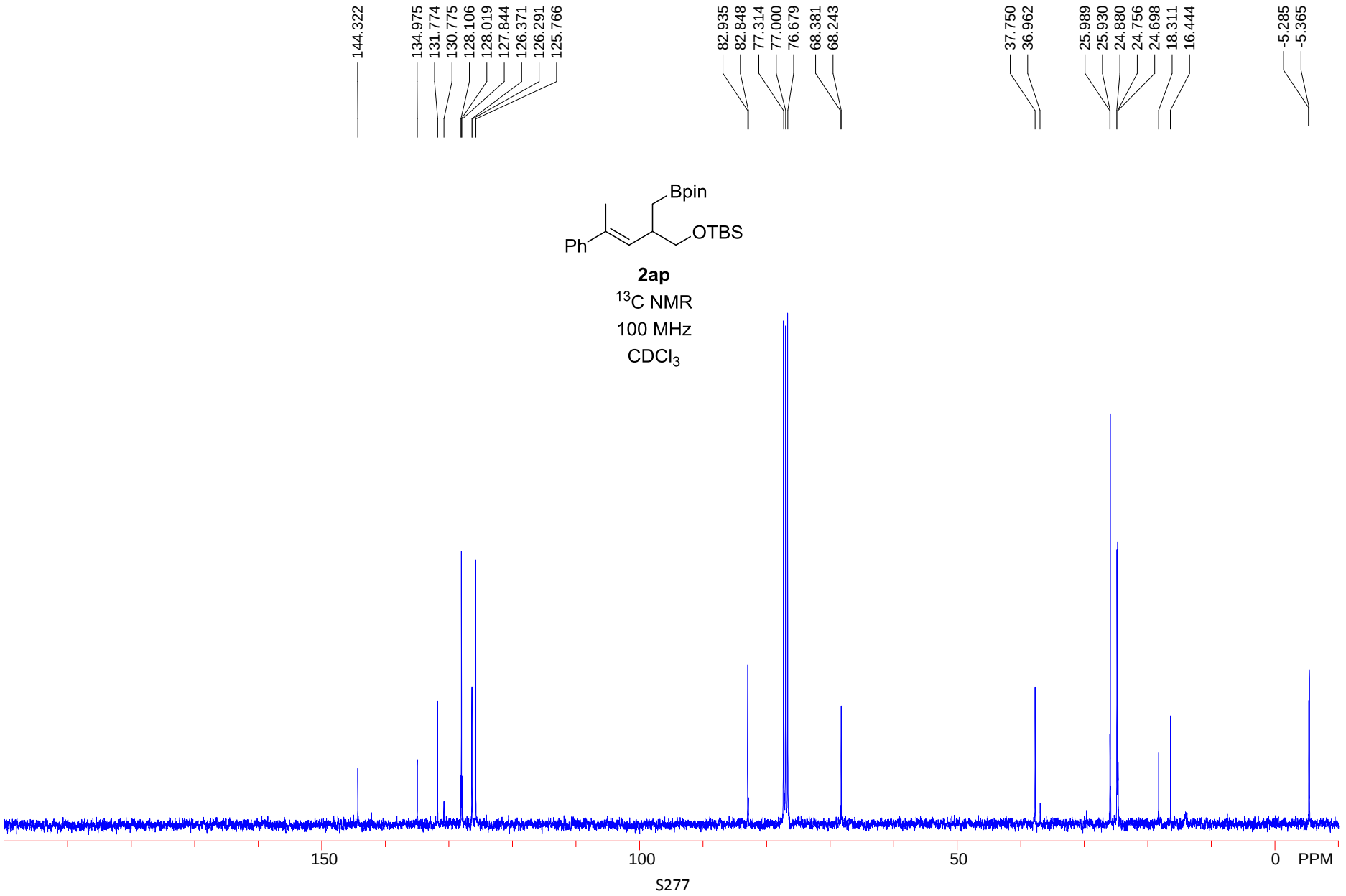
7.306
7.300
7.282
7.263
7.251
7.231
7.225
7.212
7.194
7.176
5.529
5.504
5.263
5.237
3.518
3.501
3.433
3.417
2.916
2.893
2.879
2.867
2.854
2.645
2.629
2.607
2.589
2.082
2.008
1.599
1.213
1.198
1.119
1.106
1.081
1.068
1.050
1.034
0.879
0.854
0.808
0.784
0.769
0.746
0.734
0.028
0.019
0.000
-0.026
-0.042
Bpin
OTBS
Ph
2ap
1H NMR
400 MHz
CDCl3
2.99
2.11
1.32
1.00
0.21
1.96
0.41
0.99
0.21
3.02
0.65
14.10
9.21
1.32
2.03
1.14
5.82
1.21
8
6
4
2
0
PPM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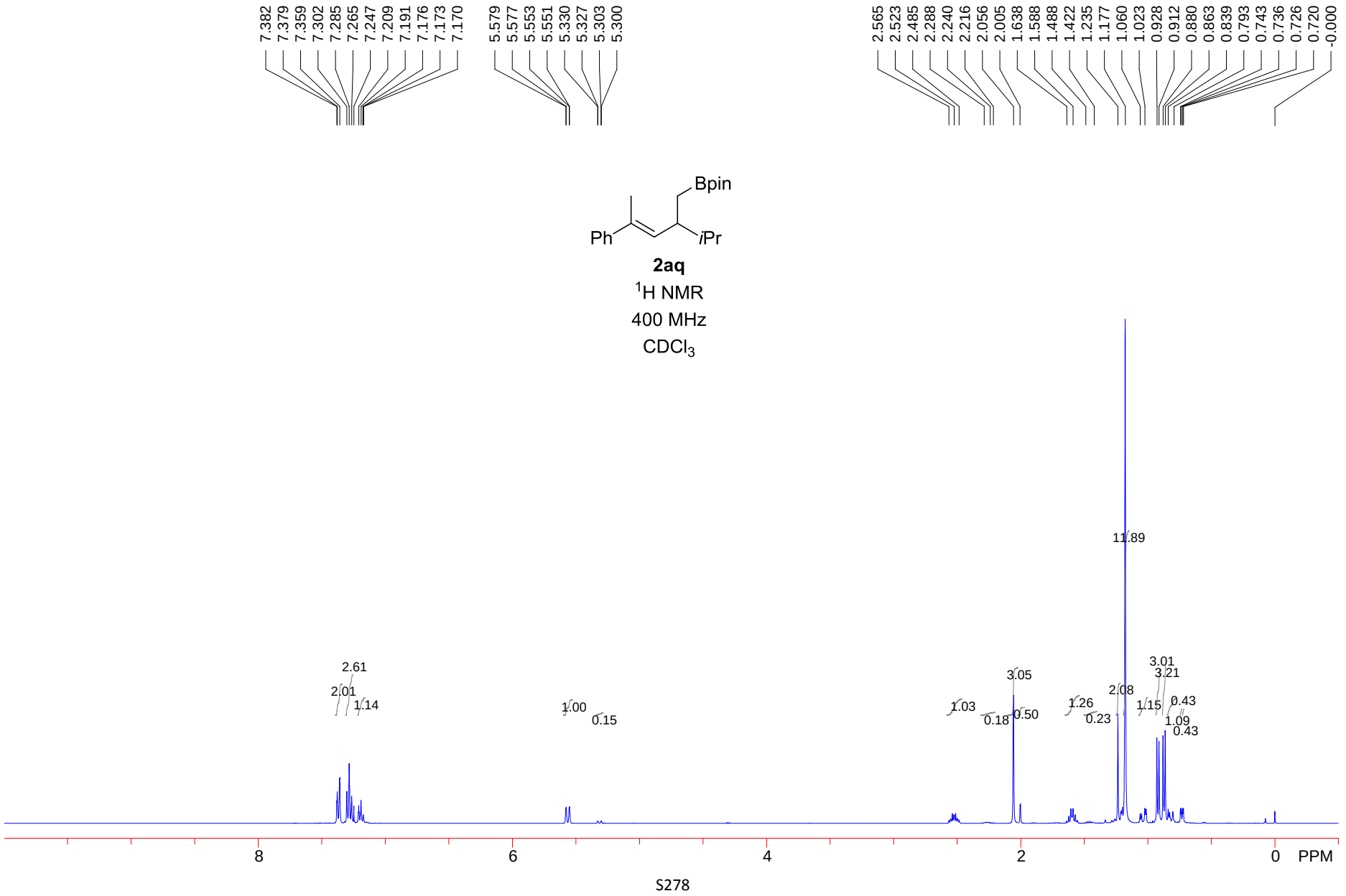
131.774
130.775
128.106
128.019
127.844
126.371
126.291
125.766
82.935
82.848
77.314
77.000
76.679
68.381
68.243
37.750
36.962
25.989
25.930
24.880
24.756
24.698
18.311
16.444
-5.285
-5.365
Bpin
OTBS
Ph
2ap
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM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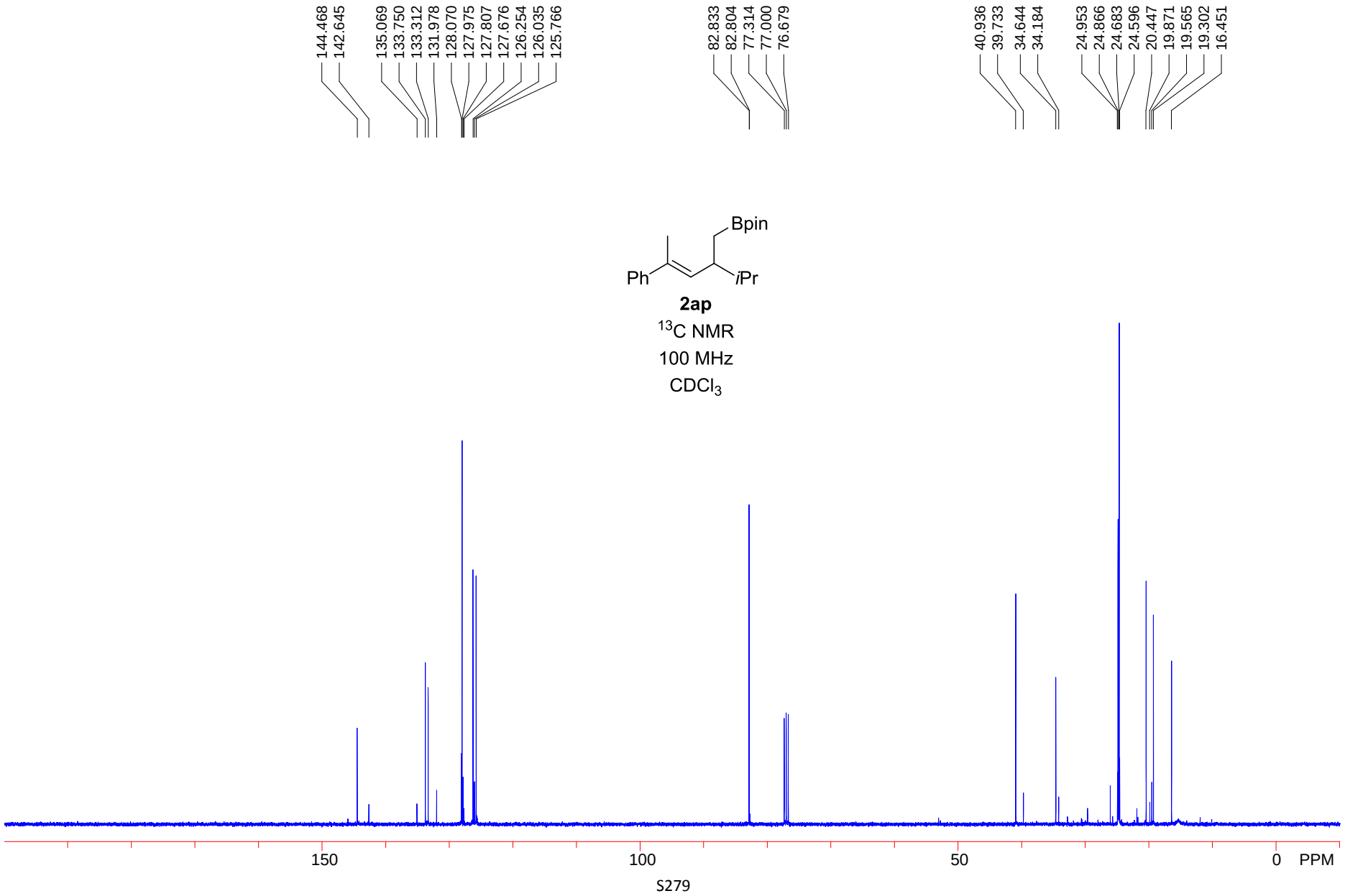
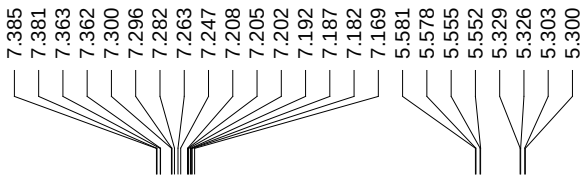
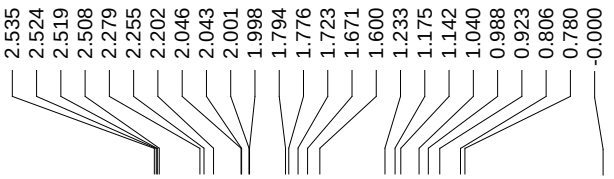
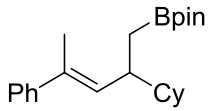
7.379
7.359
7.302
7.285
7.265
7.247
7.209
7.191
7.176
7.173
7.170
5.579
5.577
5.553
5.551
5.330
5.327
5.303
5.300
2.565
2.523
2.485
2.288
2.240
2.216
2.056
2.005
1.638
1.588
1.488
1.422
1.235
1.177
1.060
1.023
0.928
0.912
0.880
0.863
0.839
0.793
0.743
0.736
0.726
0.720
-0.000
Bpin
Ph
iPr
2aq
1H NMR
400 MHz
CDCl3
11.89
2.61
2.01
1.14
1.00
0.15
3.05
1.03
0.18
0.50
1.26
0.23
2.08
3.01
3.21
1.15
0.43
1.09
0.43
8
6
4
2
0
PPM


144.468
142.645
135.069
133.750
133.312
131.978
128.070
127.975
127.807
127.676
126.254
126.035
125.766
82.833
82.804
77.314
77.000
76.679
40.936
39.733
34.644
34.184
24.953
24.866
24.683
24.596
20.447
19.871
19.565
19.302
16.451
Bpin
Ph
iPr
2ap
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM





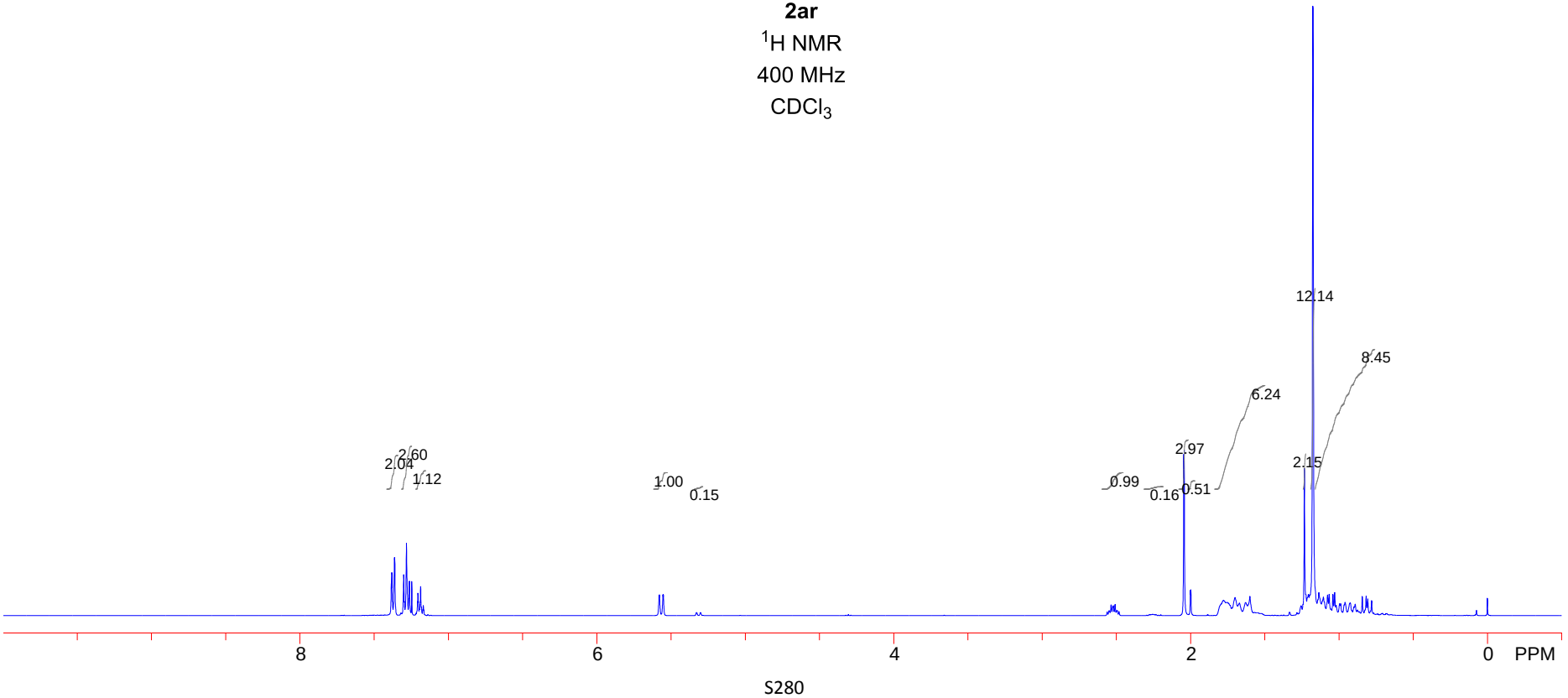


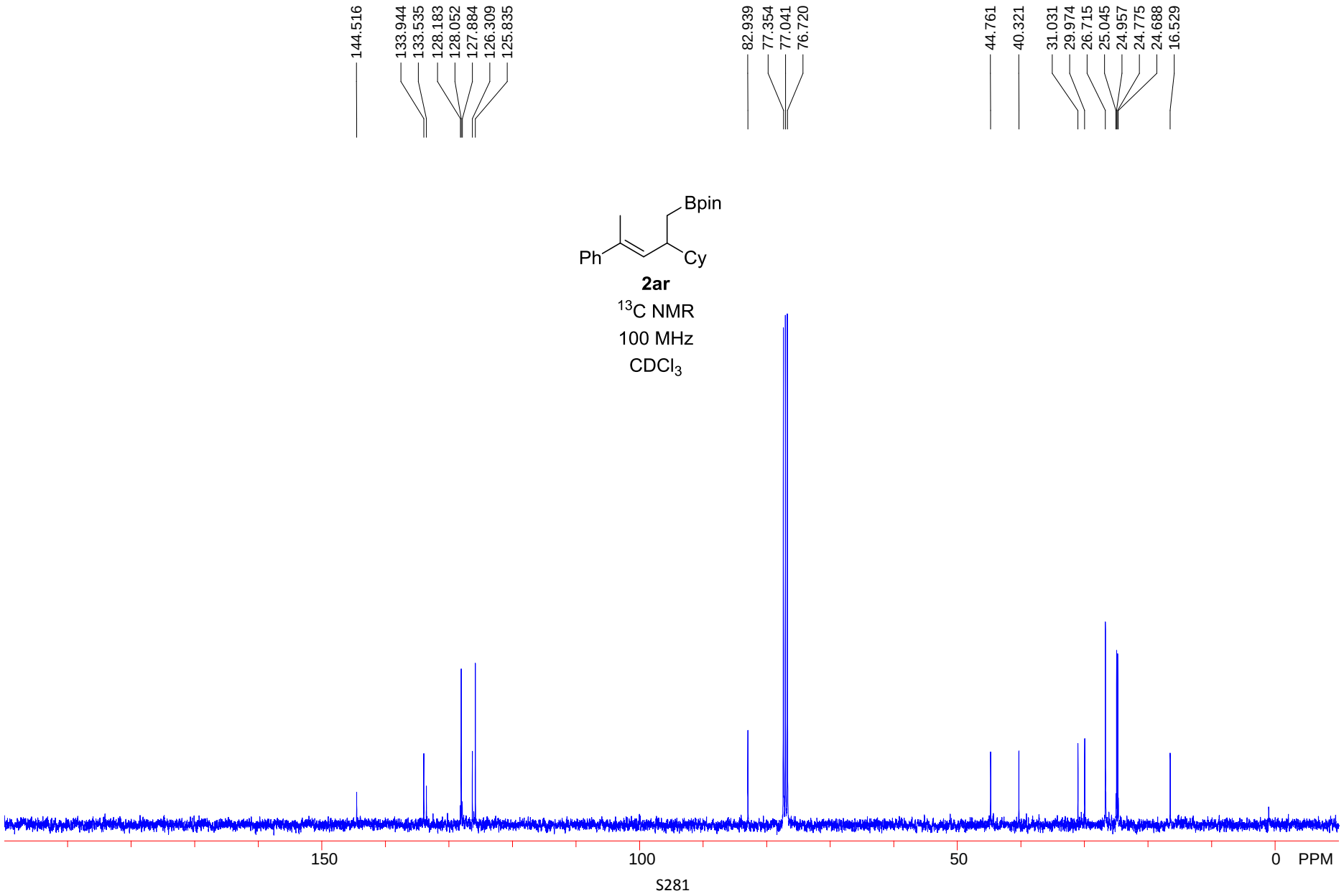
2ar

^{1}H NMR

400 MHz

$CDCl_3$

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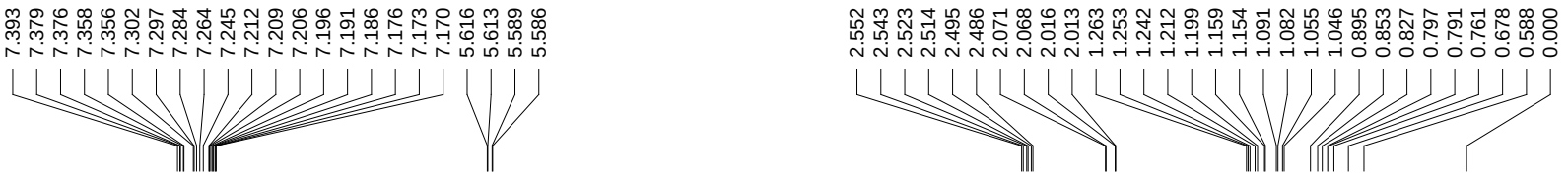
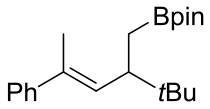
133.944
133.535
128.183
128.052
127.884
126.309
125.835
82.939
77.354
77.041
76.720
44.761
40.321
31.031
29.974
26.715
25.045
24.957
24.775
24.688
16.529
Bpin
Ph
Cy
2ar
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM



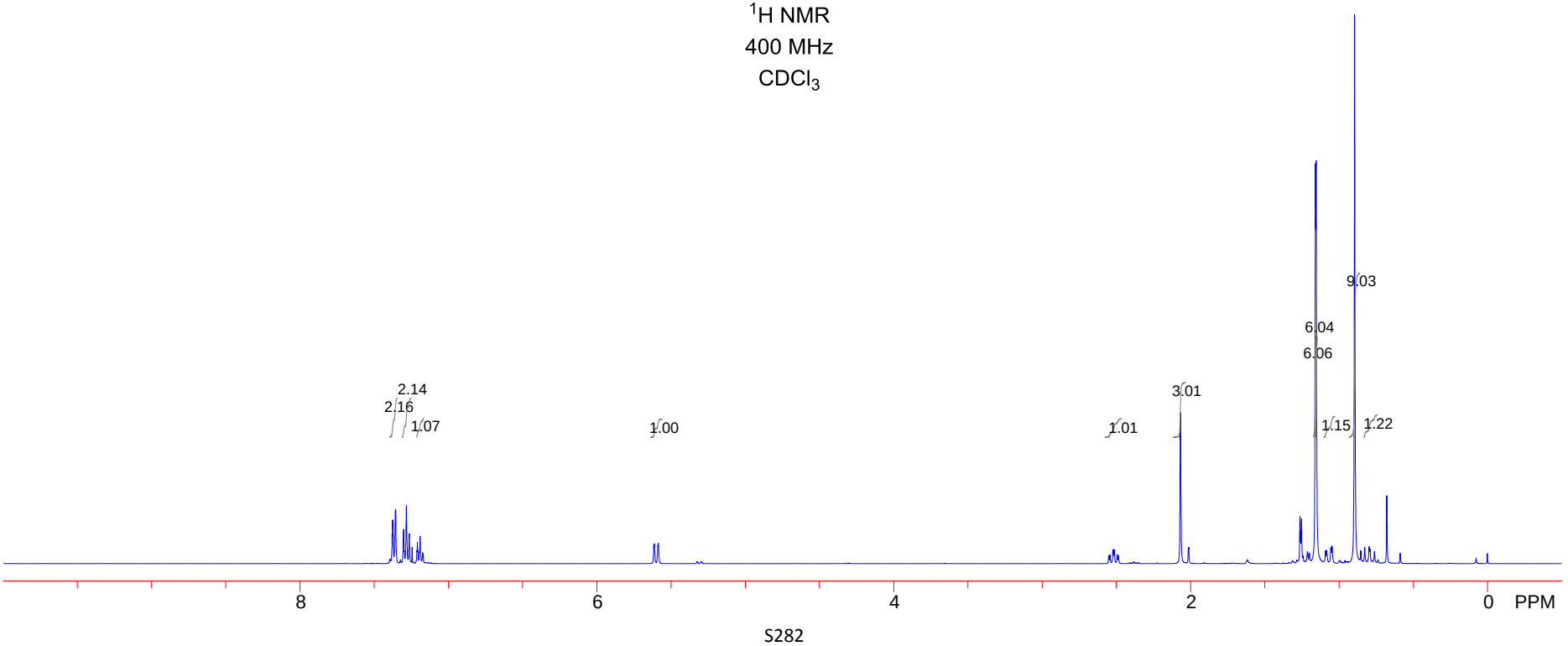


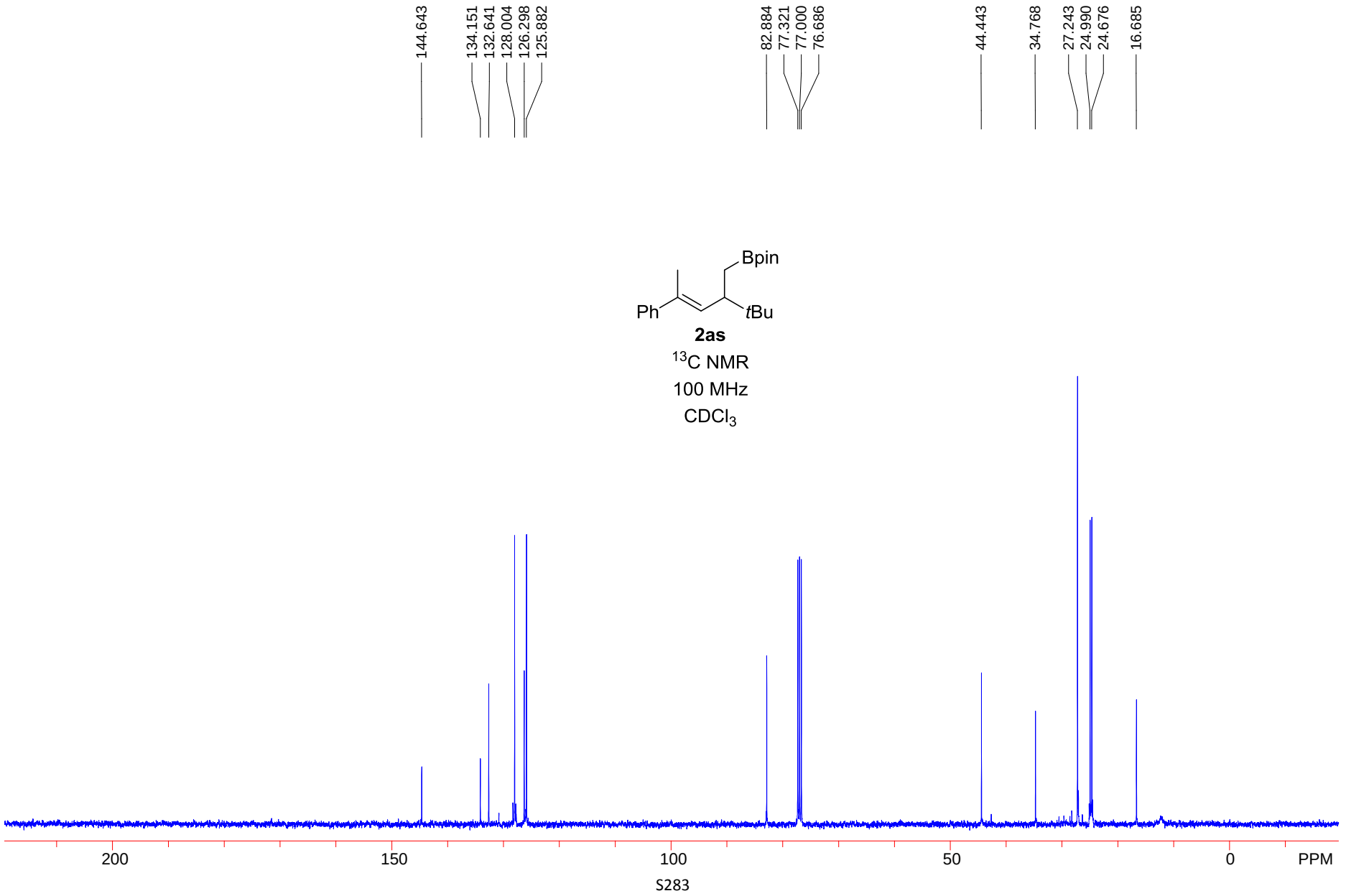
2as

^{1}H NMR

400 MHz

$CDCl_3$

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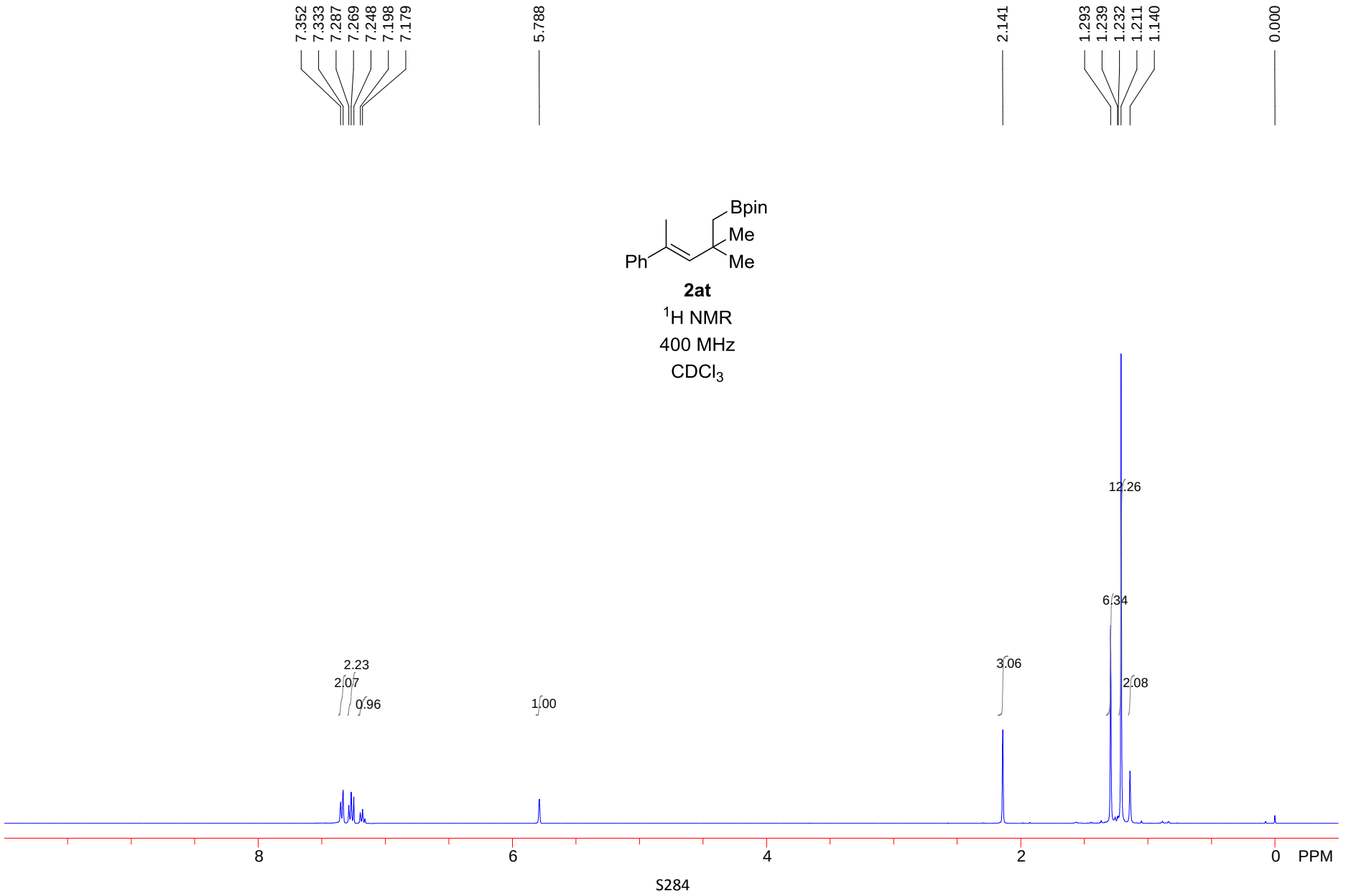
134.151
132.641
128.004
126.298
125.882
82.884
77.321
77.000
76.686
44.443
34.768
27.243
24.990
24.676
16.685
Bpin
Ph
tBu
2as
13C NMR
100 MHz
CDCl3
200
150
100
50
0
PPM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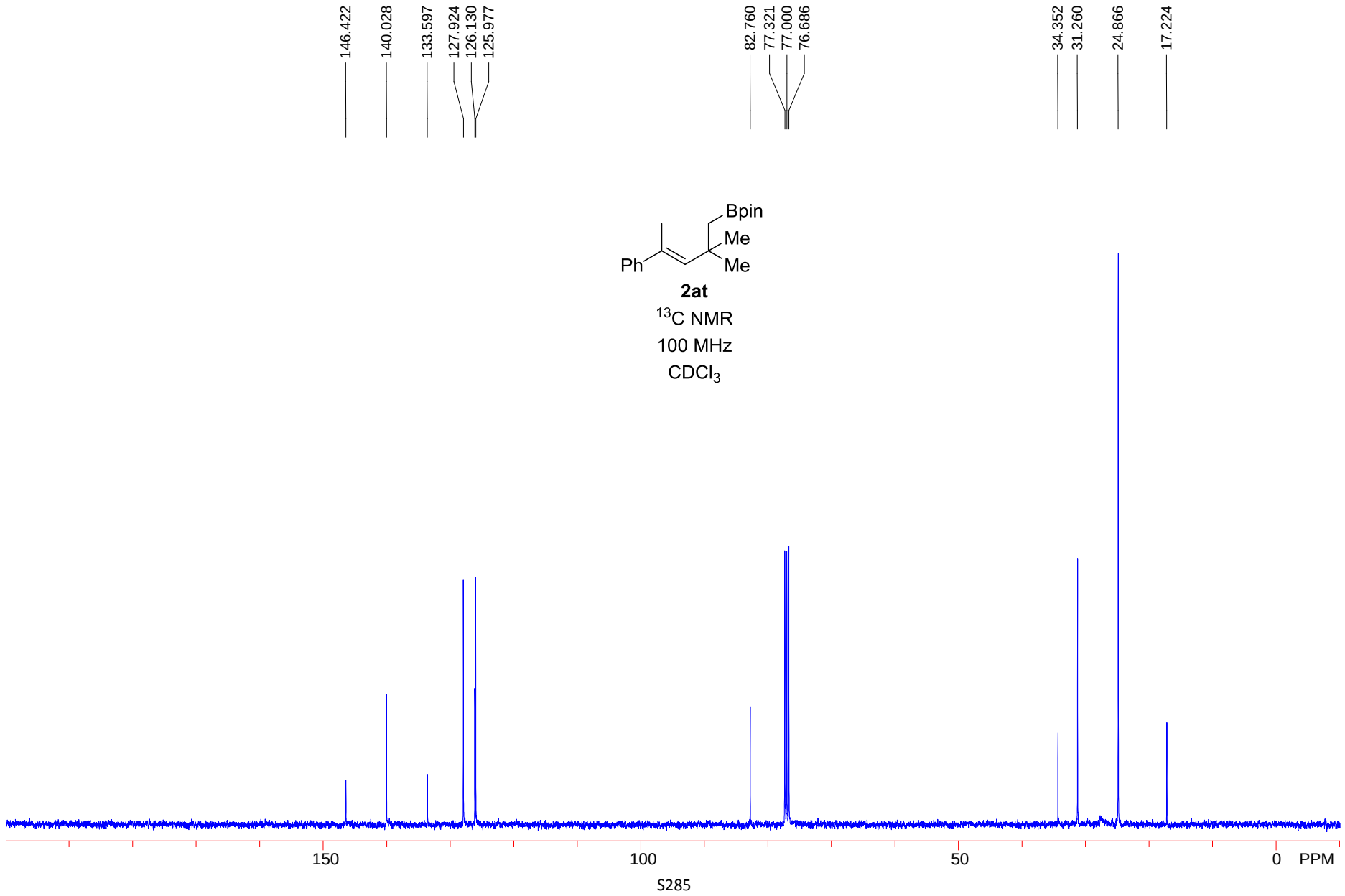
7.333
7.287
7.269
7.248
7.198
7.179
5.788
2.141
1.293
1.239
1.232
1.211
1.140
0.000
Bpin
Me
Me
Ph
2at
1H NMR
400 MHz
CDCl3
12.26
6.34
3.06
2.23
2.07
0.96
1.00
2.08
8
6
4
2
0
PPM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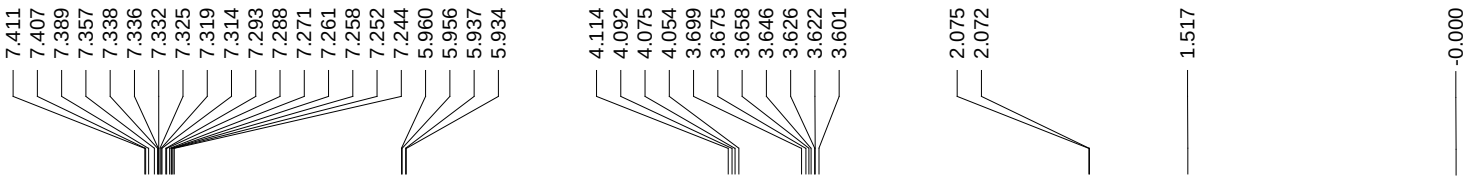
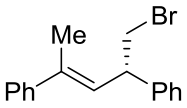
140.028
133.597
127.924
126.130
125.977
82.760
77.321
77.000
76.686
34.352
31.260
24.866
17.224
Bpin
Me
Me
Ph
2at
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM



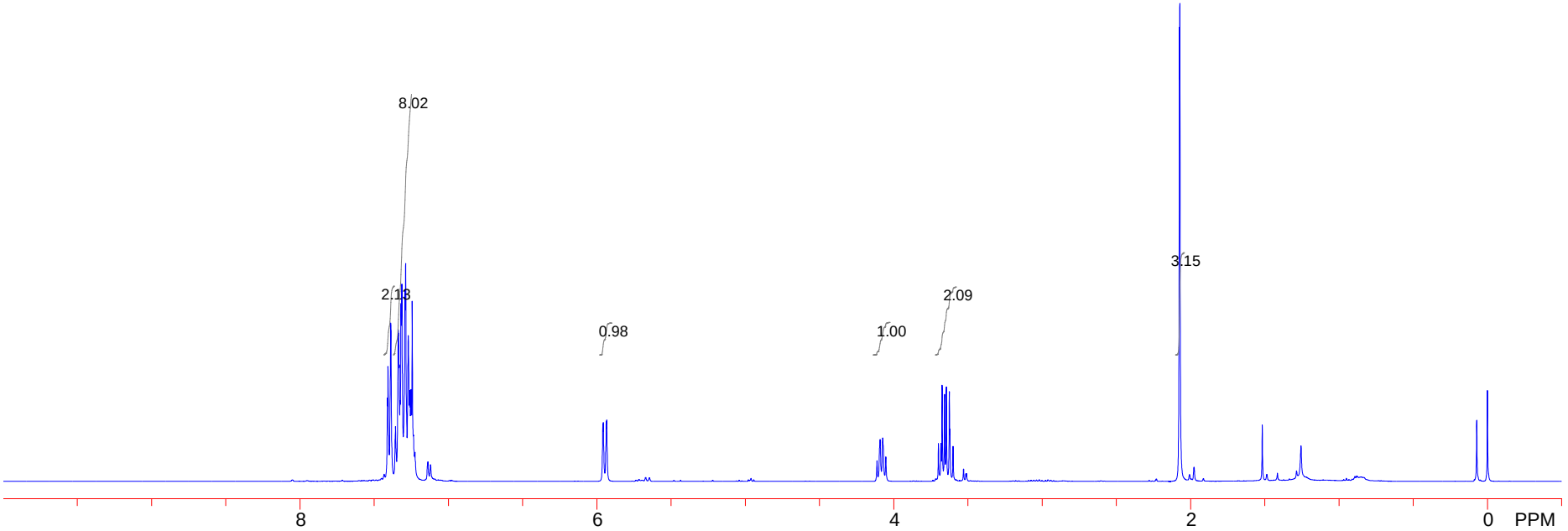


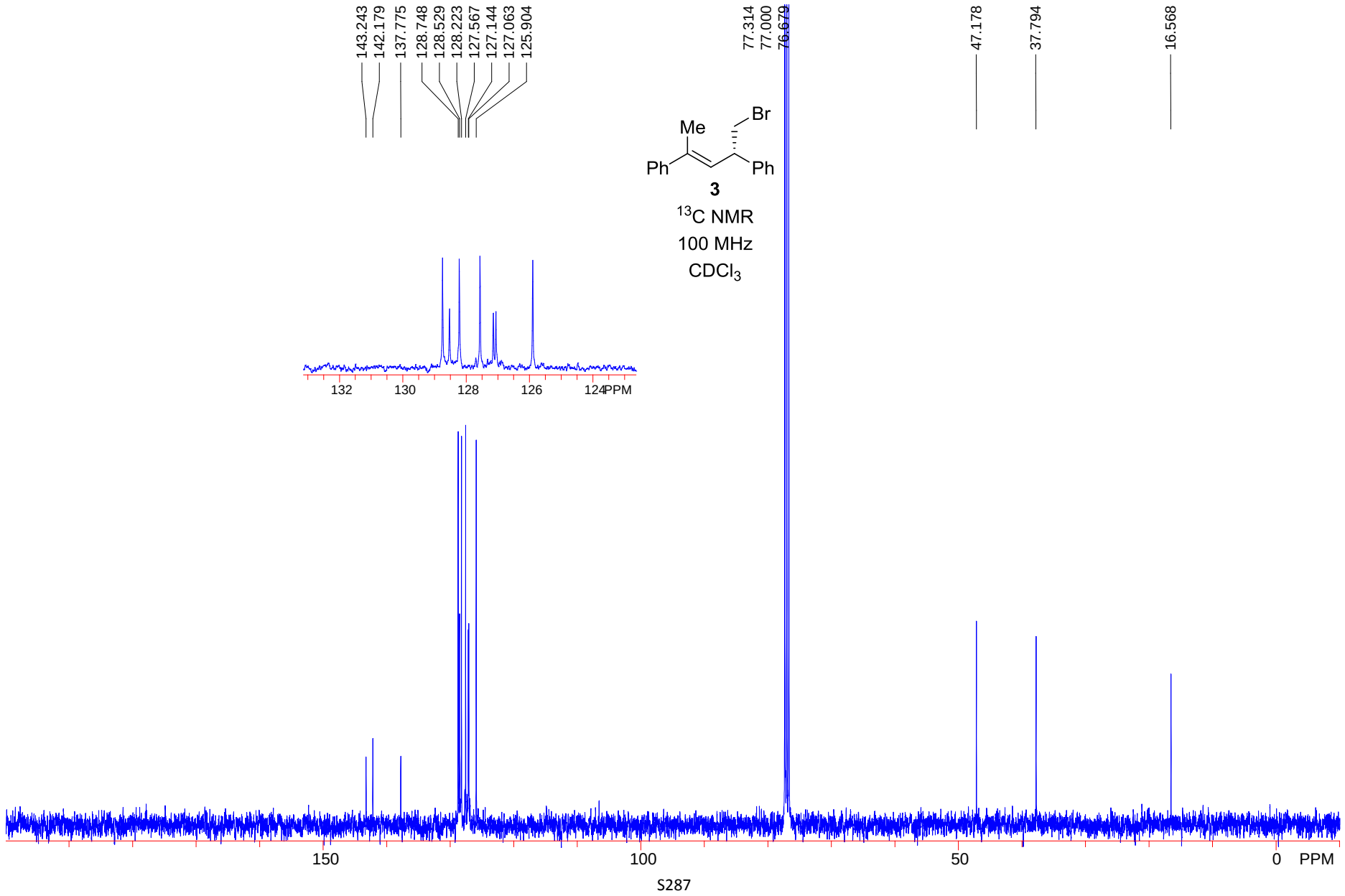
3

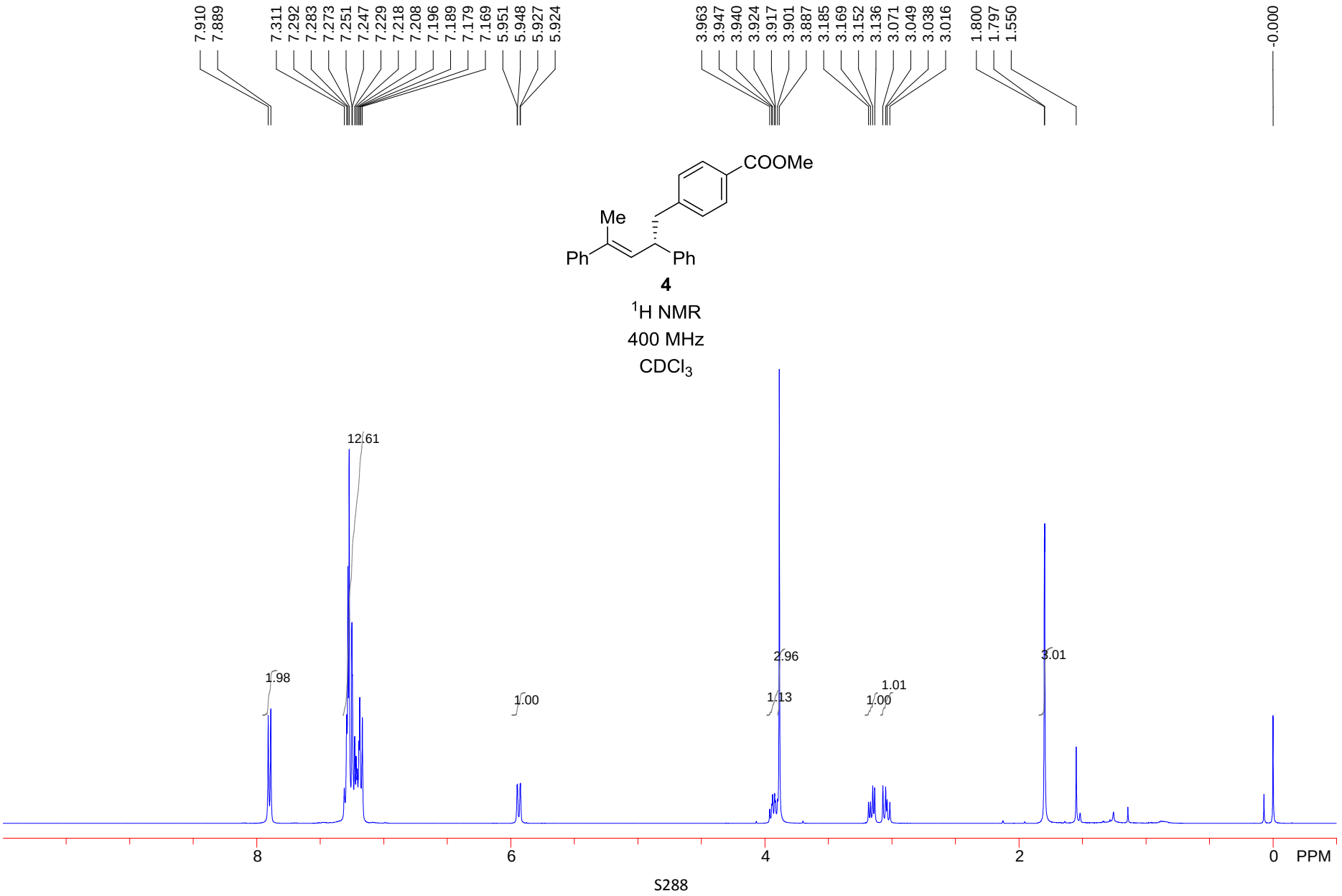
^{1}H NMR

400 MHz

$CDCl_3$




143.243
142.179
137.775
128.748
128.529
128.223
127.567
127.144
127.063
125.904
77.314
77.000
76.679
47.178
37.794
16.568
Me
Br
Ph
Ph
3
13C NMR
100 MHz
CDCl3
132
130
128
126
124PPM
150
100
50
0
PPM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7.292
7.283
7.273
7.251
7.247
7.229
7.218
7.208
7.196
7.189
7.179
7.169
5.951
5.948
5.927
5.924
3.963
3.947
3.940
3.924
3.917
3.901
3.887
3.185
3.169
3.152
3.136
3.071
3.049
3.038
3.016
1.800
1.797
1.550
-0.000
COOMe
Me
Ph
Ph
4
1H NMR
400 MHz
CDCl3
12.61
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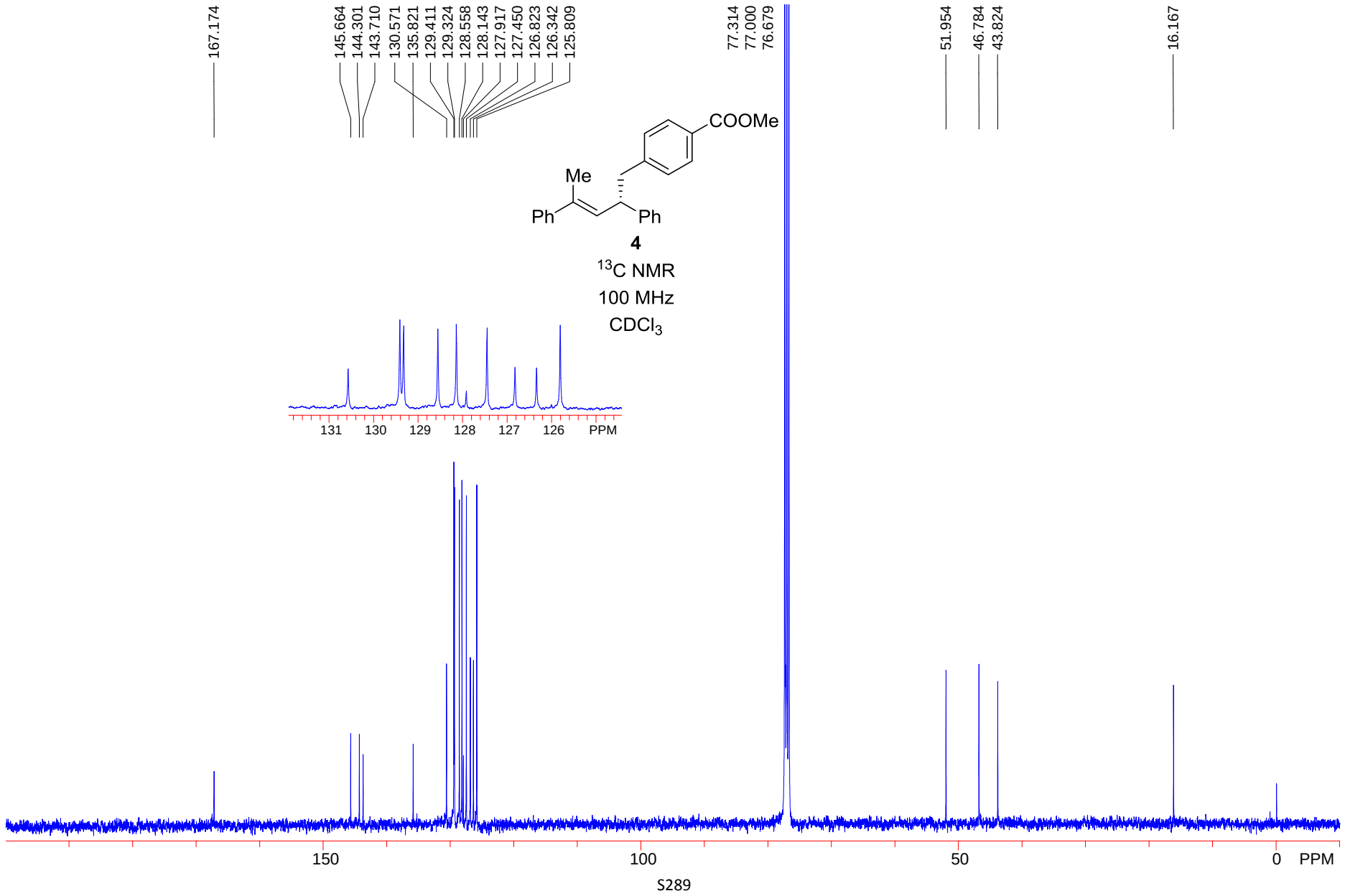
1.00
2.96
1.13
1.01
1.00
3.01
8
6
4
2
0
PPM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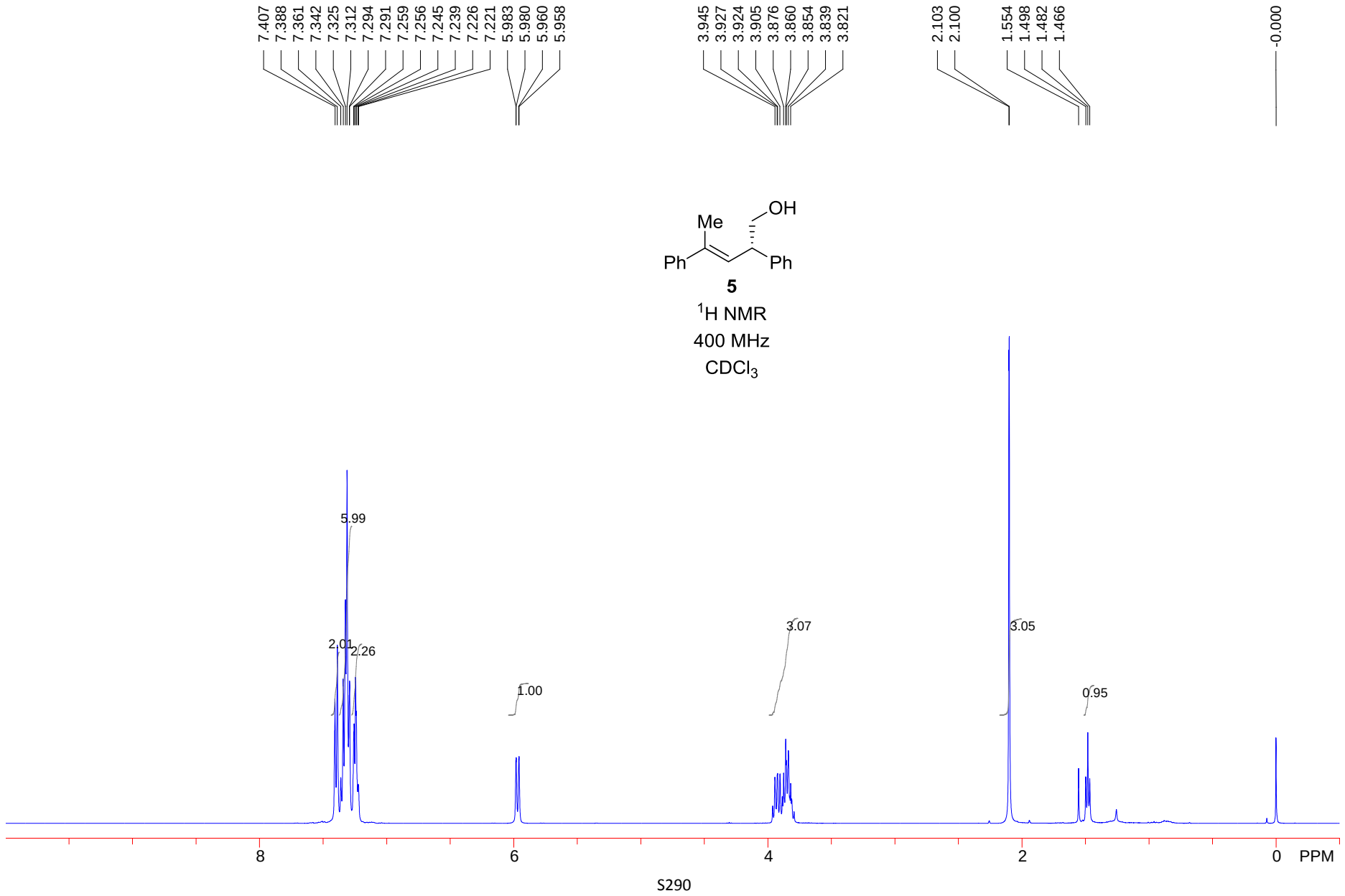
145.664
144.301
143.710
130.571
135.821
129.411
129.324
128.558
128.143
127.917
127.450
126.823
126.342
125.809
77.314
77.000
76.679
51.954
46.784
43.824
16.167
COOMe
Me
Ph
Ph
4
13C NMR
100 MHz
CDCl3
131
130
129
128
127
126
PPM
150
100
50
0
PPM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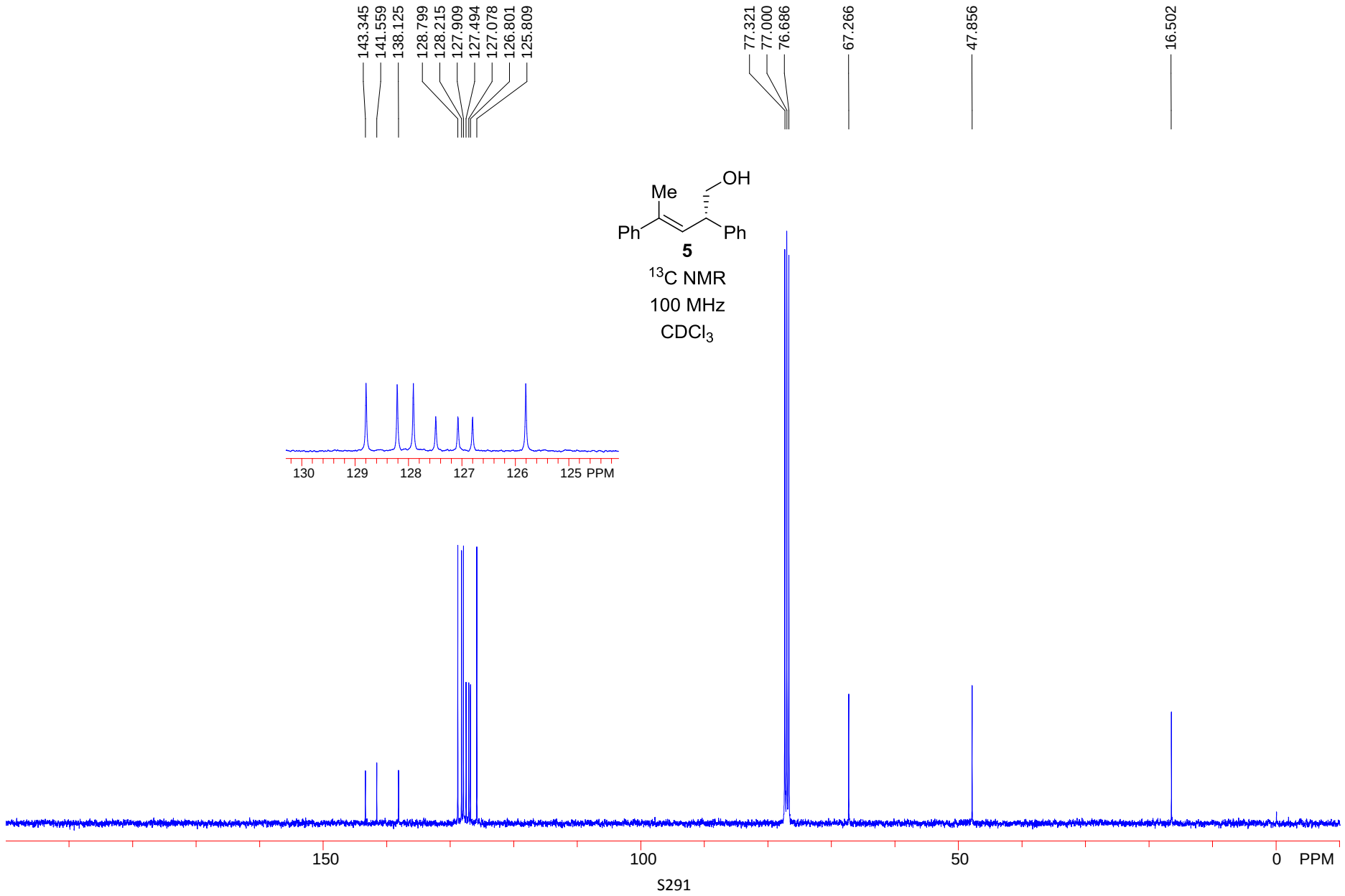
7.342
7.325
7.312
7.294
7.291
7.259
7.256
7.245
7.239
7.226
7.221
5.983
5.980
5.960
5.958
3.945
3.927
3.924
3.905
3.876
3.860
3.854
3.839
3.821
2.103
2.100
1.554
1.498
1.482
1.466
-0.000
Me
OH
Ph
Ph
5
1H NMR
400 MHz
CDCl3
5.99
2.01
2.26
1.00
3.07
3.05
0.95
8
6
4
2
0
PPM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141.559
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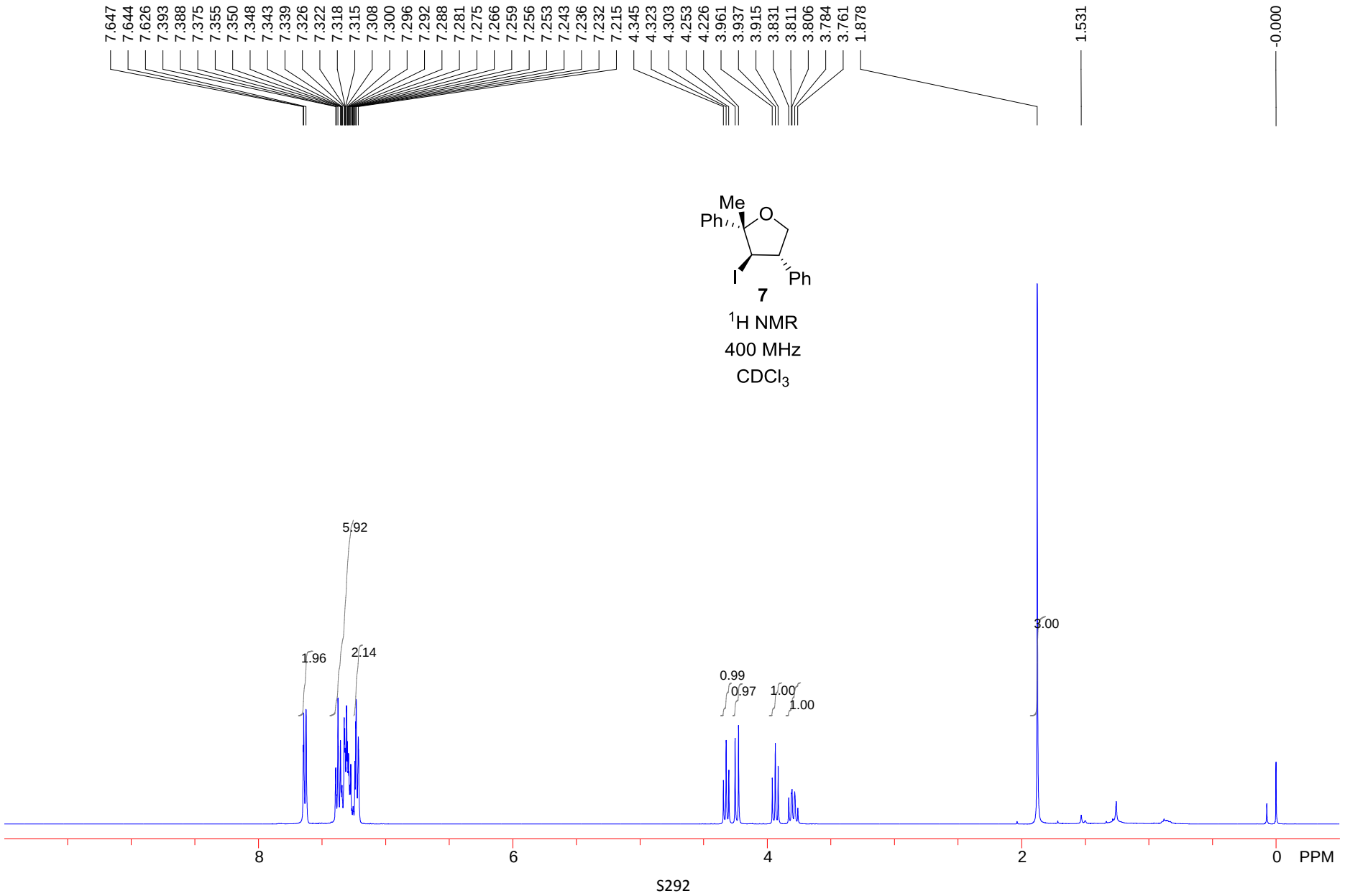
128.799
128.215
127.909
127.494
127.078
126.801
125.809
77.321
77.000
76.686
67.266
47.856
16.502
Me
OH
Ph
Ph
5
13C NMR
100 MHz
CDCl3
130
129
128
127
126
125 PPM
150
100
50
0
PPM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7.393
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7.375
7.355
7.350
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7.339
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7.322
7.318
7.315
7.308
7.300
7.296
7.292
7.288
7.281
7.275
7.266
7.259
7.256
7.253
7.243
7.236
7.232
7.215
4.345
4.323
4.303
4.253
4.226
3.961
3.937
3.915
3.831
3.811
3.806
3.784
3.761
1.878
1.531
-0.000
Me
Ph
O
I
Ph
7
1H NMR
400 MHz
CDCl3
5.92
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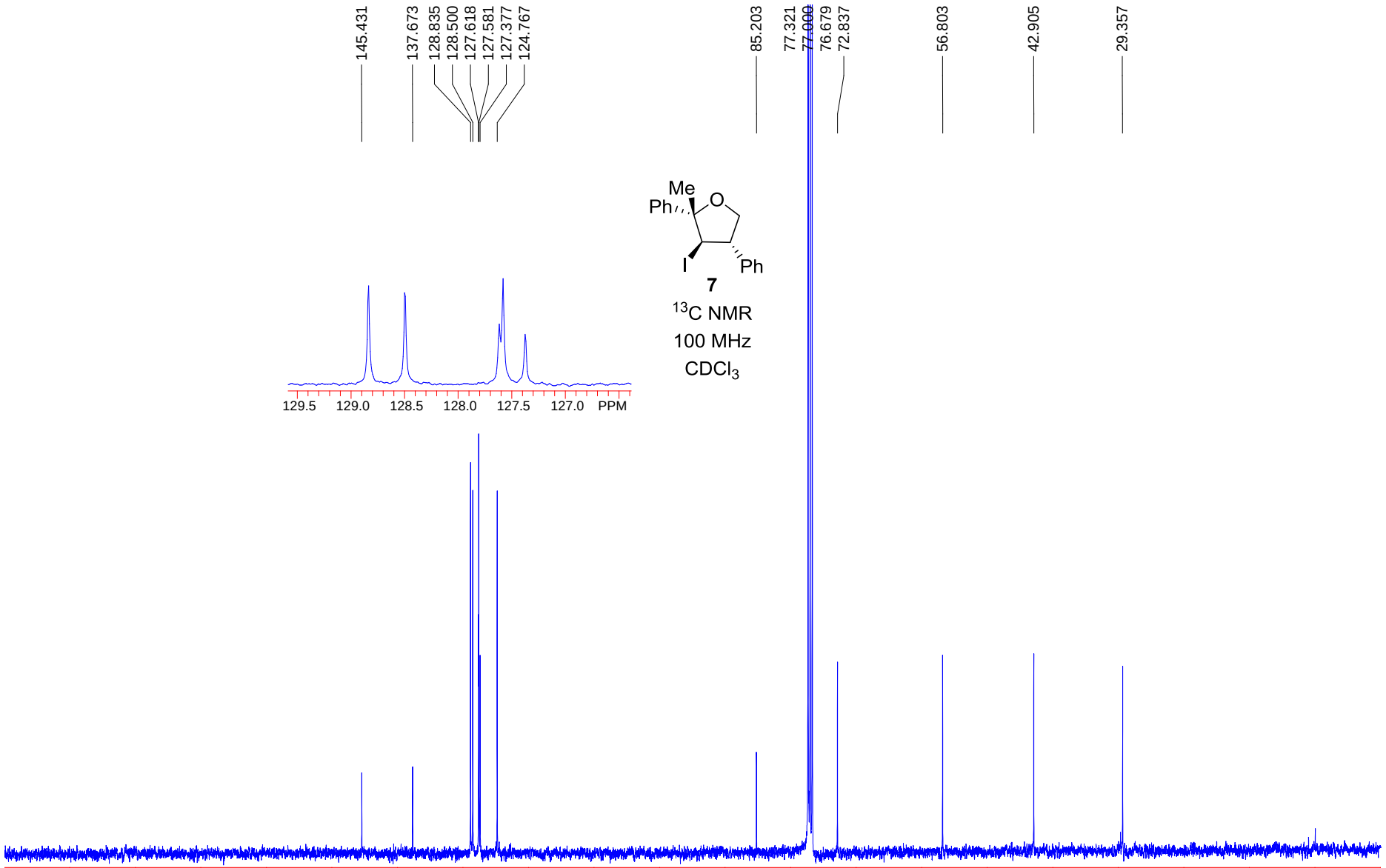
2.14
0.99
0.97
1.00
1.00
3.00
8
6
4
2
0
PPM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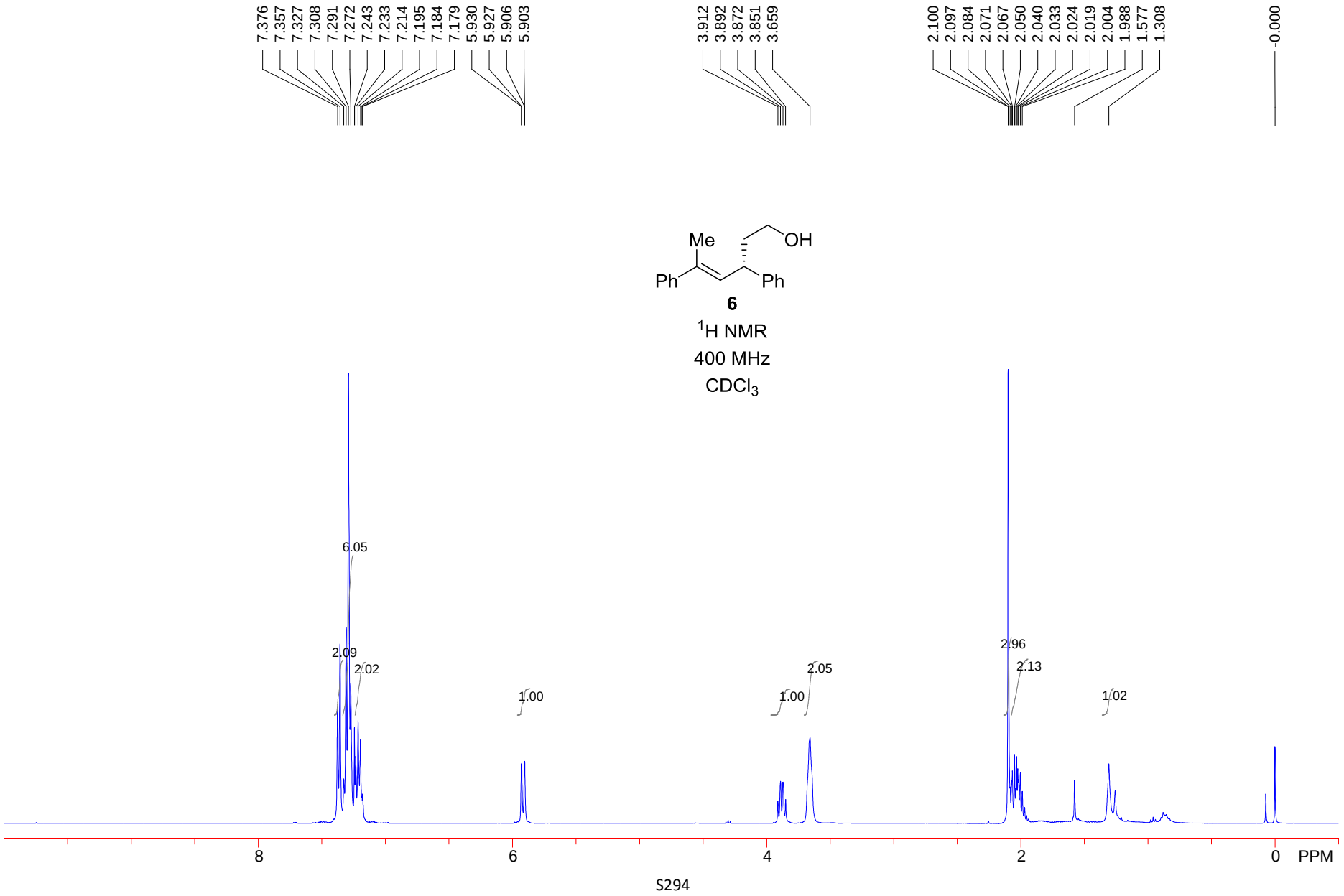
128.500
127.618
127.581
127.377
124.767
85.203
77.321
77.000
76.679
72.837
56.803
42.905
29.357
Me
Ph
O
I
Ph
7
13C NMR
100 MHz
CDCl3
129.5
129.0
128.5
128.0
127.5
127.0
PPM
150
100
50
0
PPM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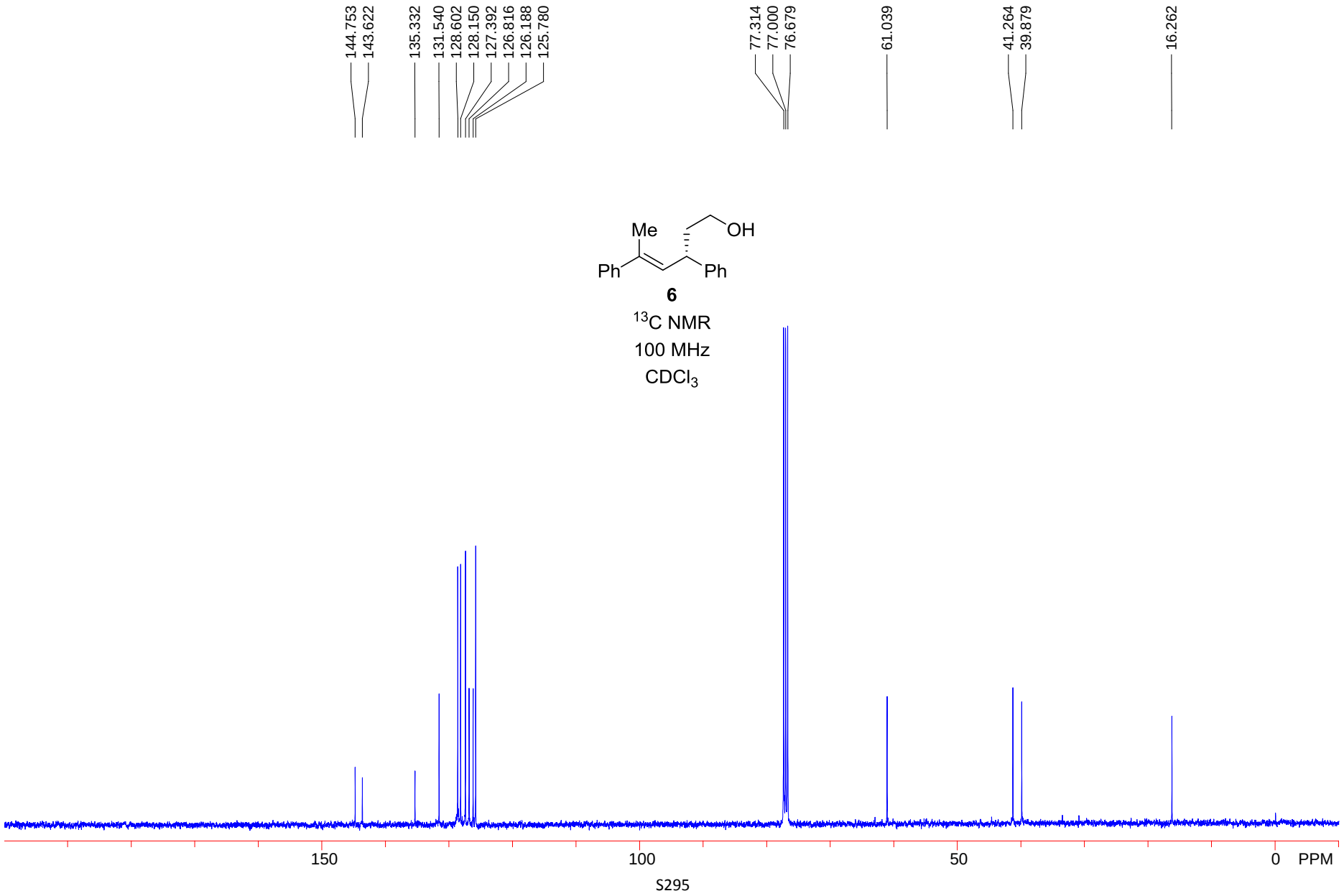
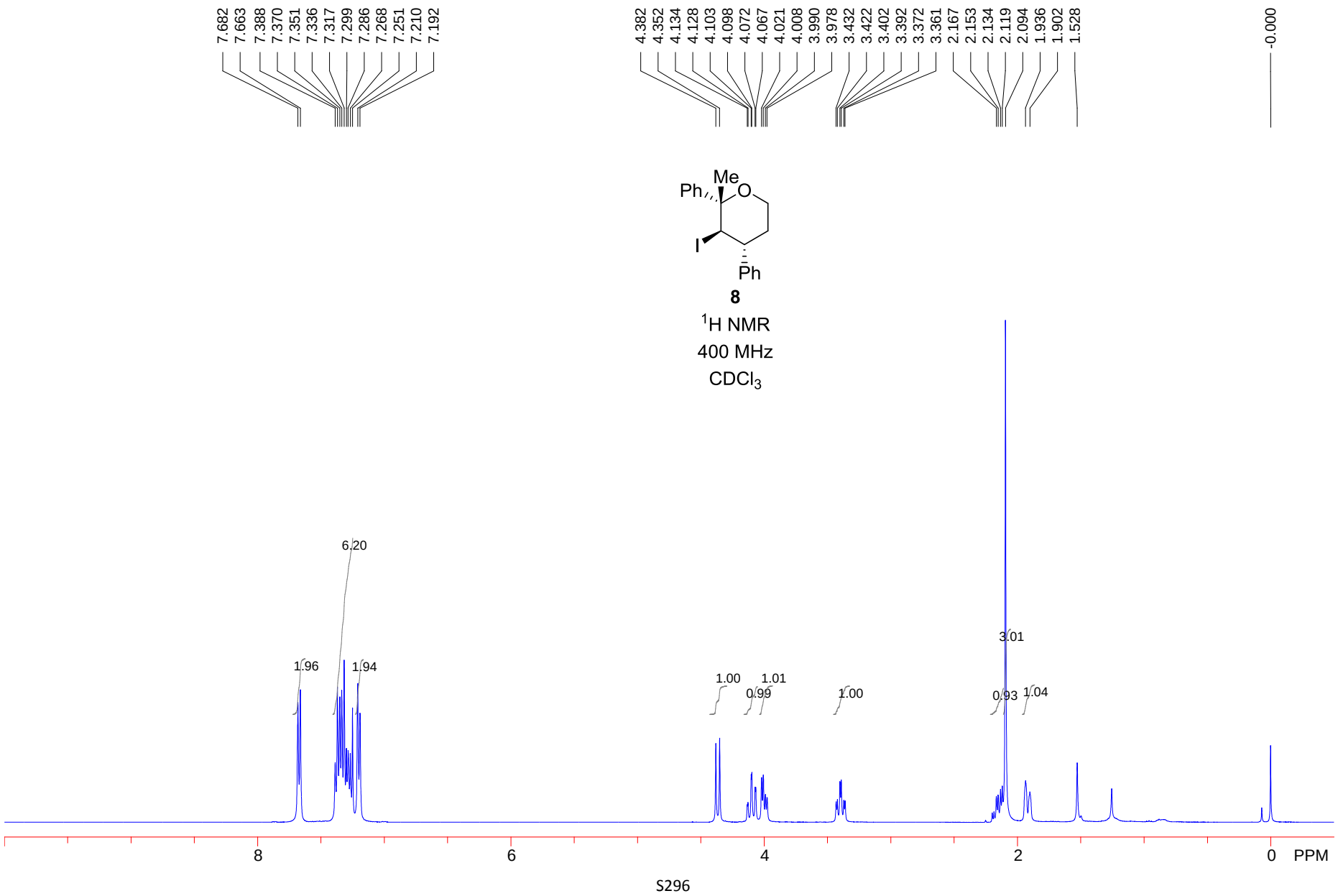
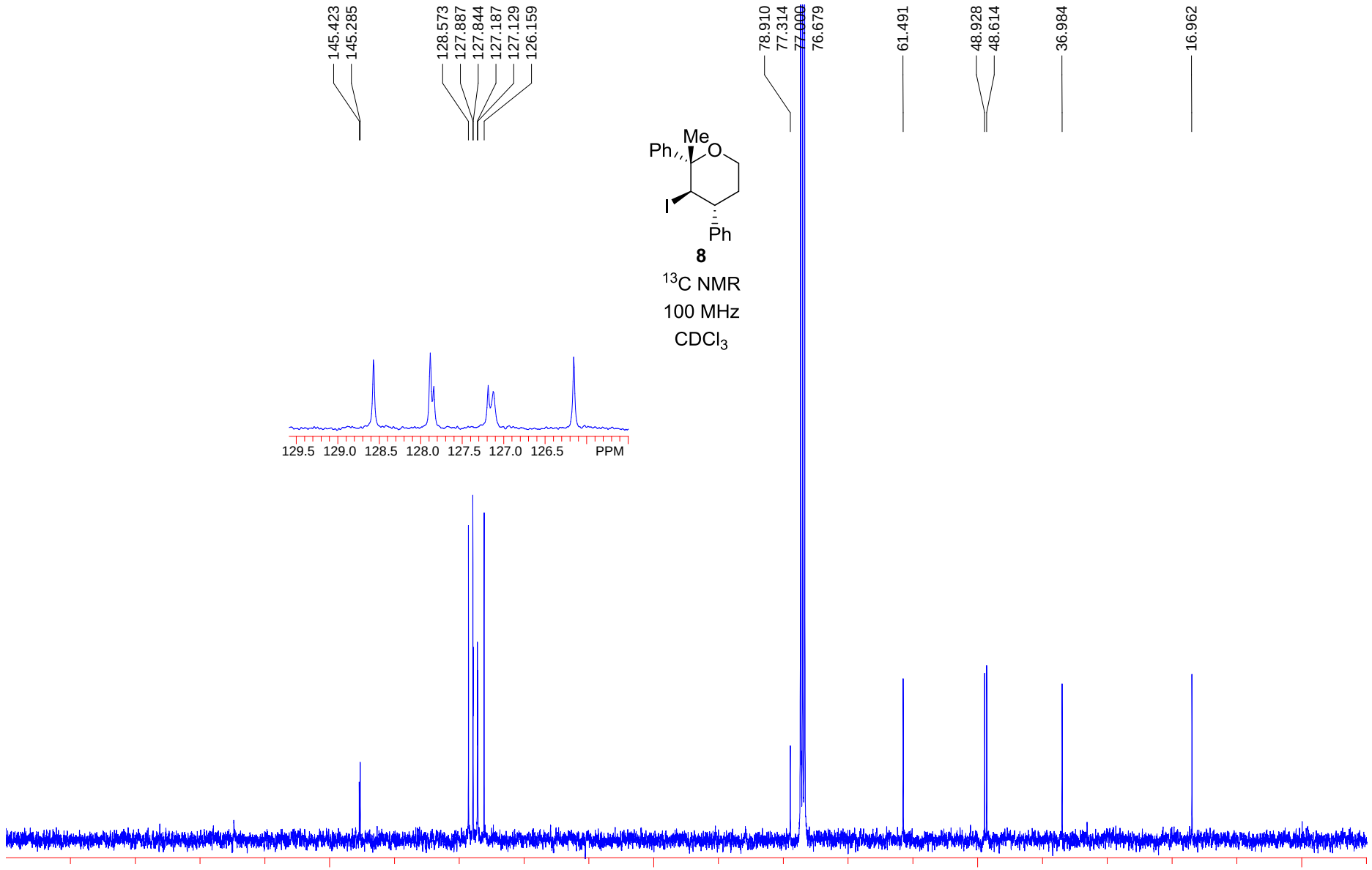
7.327
7.308
7.291
7.272
7.243
7.233
7.214
7.195
7.184
7.179
5.930
5.927
5.906
5.903
3.912
3.892
3.872
3.851
3.659
2.100
2.097
2.084
2.071
2.067
2.050
2.040
2.033
2.024
2.019
2.004
1.988
1.577
1.308
-0.000
Me
OH
Ph
Ph
6
1H NMR
400 MHz
CDCl3
6.05
2.09
2.02
1.00
1.00
2.05
2.96
2.13
1.02
8
6
4
2
0
PPM


144.753
143.622
135.332
131.540
128.602
128.150
127.392
126.816
126.188
125.780
77.314
77.000
76.679
61.039
41.264
39.879
16.262
Me
OH
Ph
Ph
6
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


7.682
7.663
7.388
7.370
7.351
7.336
7.317
7.299
7.286
7.268
7.251
7.210
7.192
4.382
4.352
4.134
4.128
4.103
4.098
4.072
4.067
4.021
4.008
3.990
3.978
3.432
3.422
3.402
3.392
3.372
3.361
2.167
2.153
2.134
2.119
2.094
1.936
1.902
1.528
-0.000
Me
Ph
O
I
Ph
8
1H NMR
400 MHz
CDCl3
6.20
1.96
1.94
1.00
1.01
0.99
1.00
3.01
0.93
1.04
8
6
4
2
0
PPM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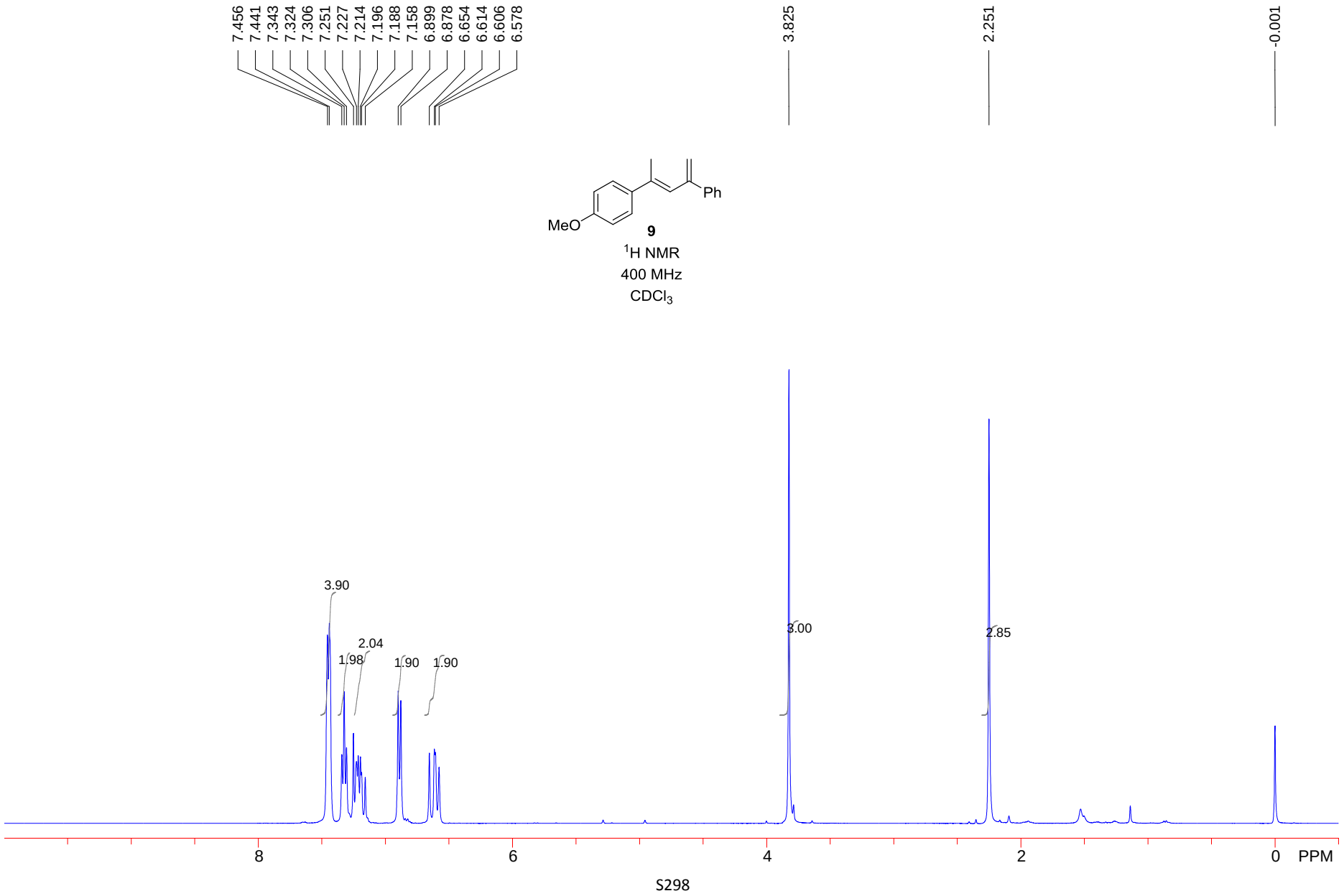
145.285
128.573
127.887
127.844
127.187
127.129
126.159
78.910
77.314
77.000
76.679
61.491
48.928
48.614
36.984
16.962
Me
O
Ph
I
Ph
8
13C NMR
100 MHz
CDCl3
129.5 129.0 128.5 128.0 127.5 127.0 126.5 PPM
150
100
50
0 PPM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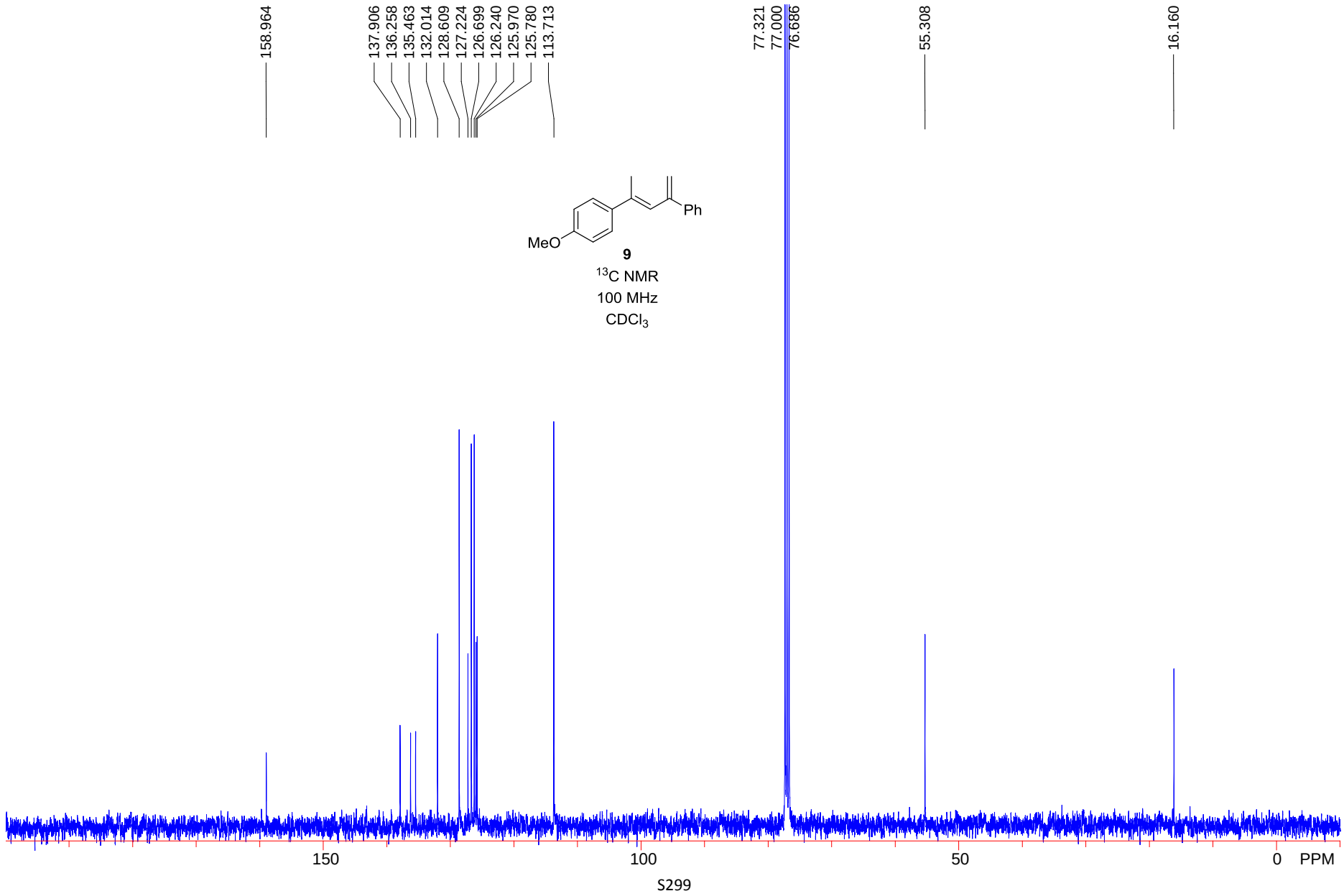
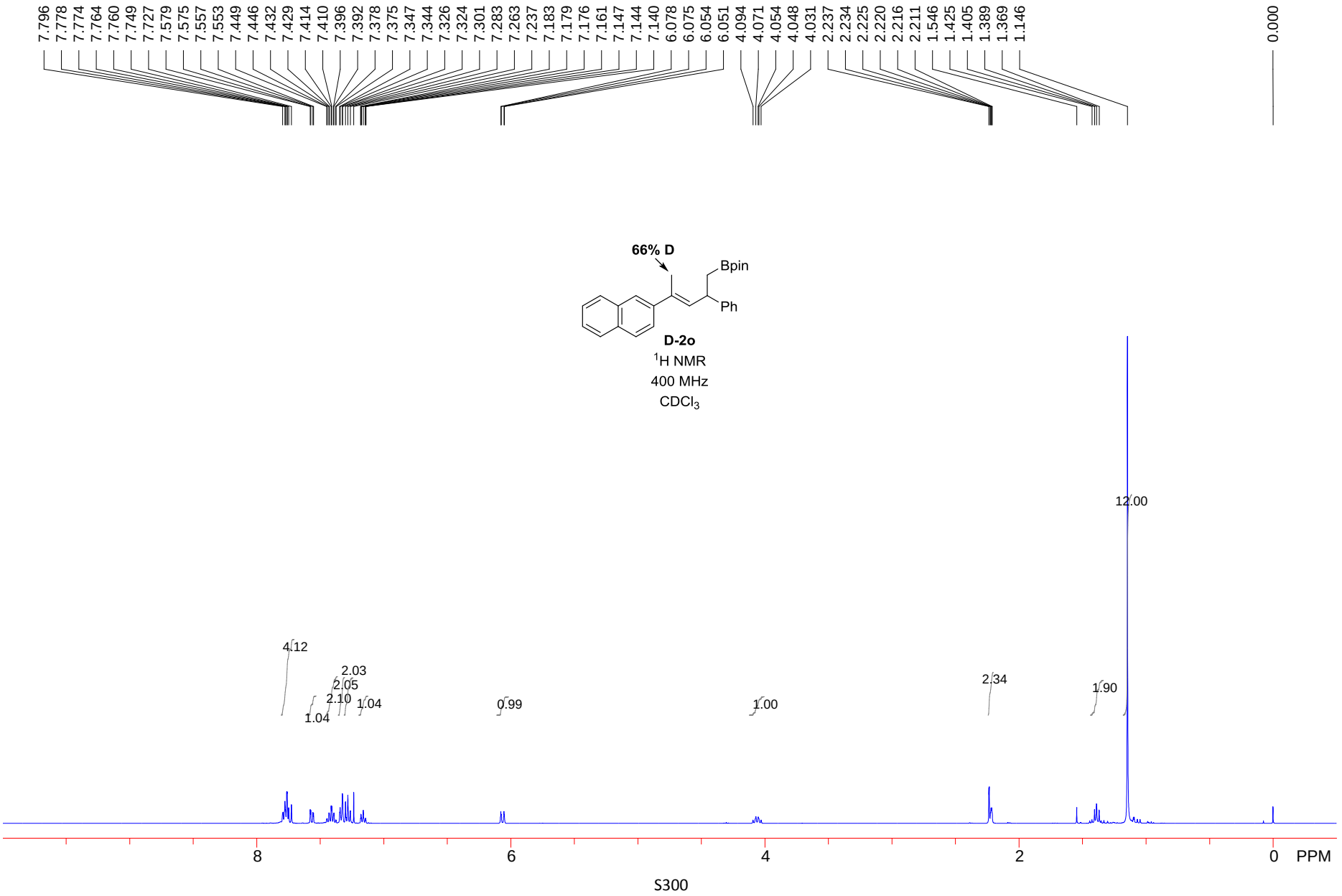
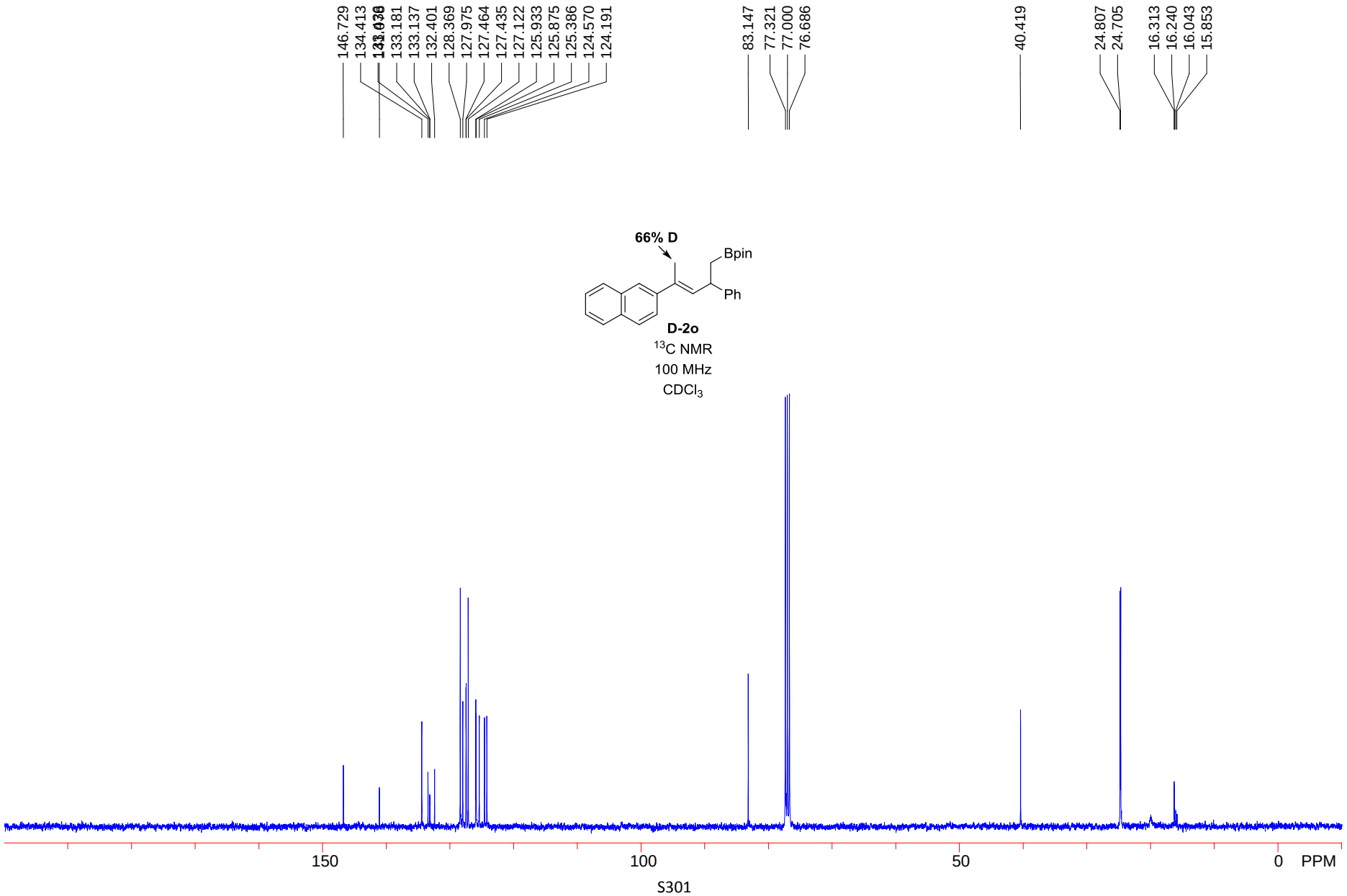
7.441
7.343
7.324
7.306
7.251
7.227
7.214
7.196
7.188
7.158
6.899
6.878
6.654
6.614
6.606
6.578
3.825
2.251
-0.001
MeO
Ph
9
1H NMR
400 MHz
CDCl3
3.90
2.04
1.98
1.90
1.90
3.00
2.85
8
6
4
2
0
PPM


158.964
137.906
136.258
135.463
132.014
128.609
127.224
126.699
126.240
125.970
125.780
113.713
77.321
77.000
76.686
55.308
16.160
MeO
Ph
9
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM
S299


7.796
7.778
7.774
7.764
7.760
7.749
7.727
7.579
7.575
7.557
7.553
7.449
7.446
7.432
7.429
7.414
7.410
7.396
7.392
7.378
7.375
7.347
7.344
7.326
7.324
7.301
7.283
7.263
7.237
7.183
7.179
7.176
7.161
7.147
7.144
7.140
6.078
6.075
6.054
6.051
4.094
4.071
4.054
4.048
4.031
2.237
2.234
2.225
2.220
2.216
2.211
1.546
1.425
1.405
1.389
1.369
1.146
0.000
66% D
Bpin
Ph
D-2o
1H NMR
400 MHz
CDCl3
12.00
4.12
2.03
2.05
2.10
1.04
1.04
0.99
1.00
2.34
1.90
8
6
4
2
0
PPM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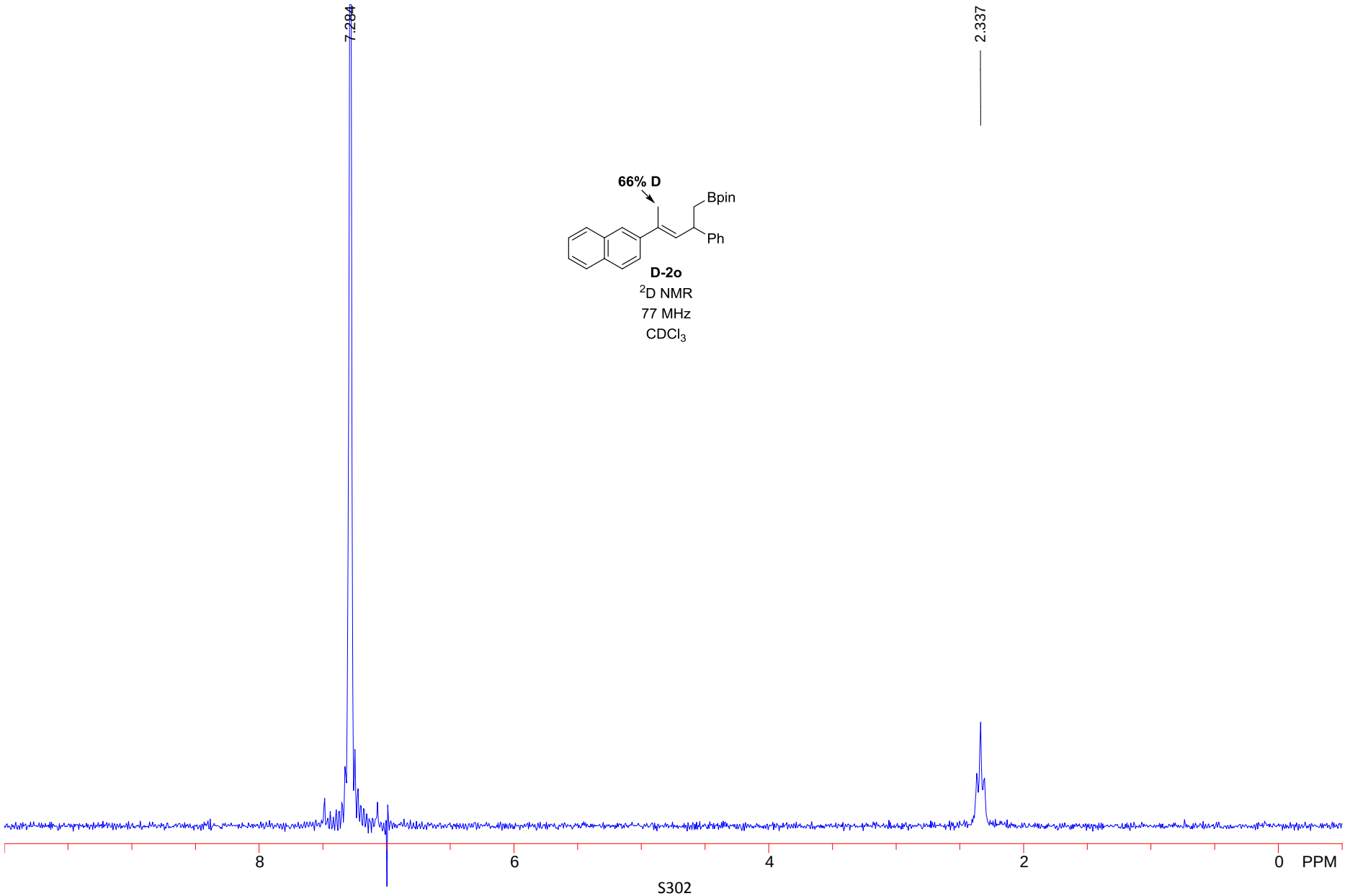
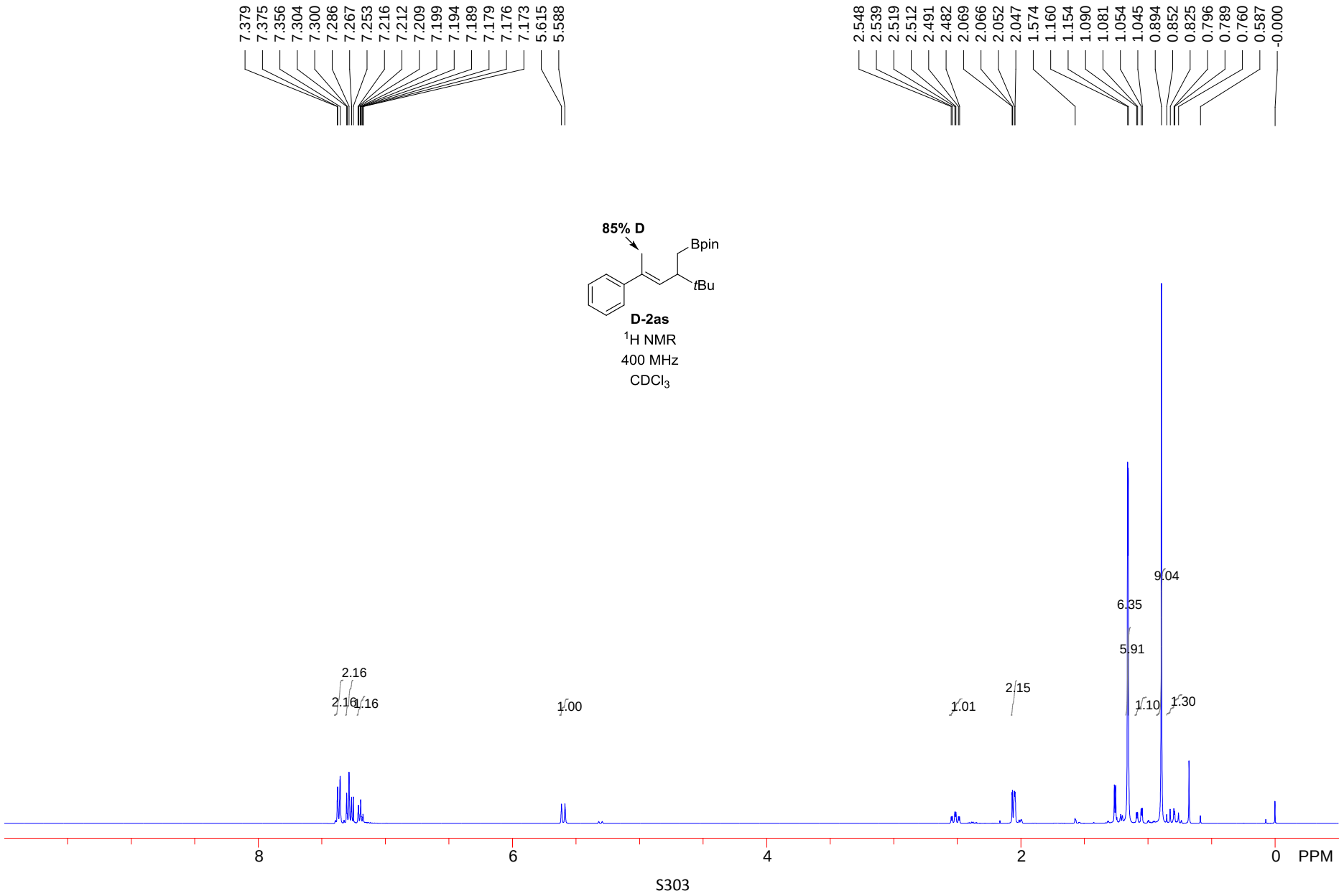
134.413
133.181
133.137
132.401
128.369
127.975
127.464
127.435
127.122
125.933
125.875
125.386
124.570
124.191
83.147
77.321
77.000
76.686
40.419
24.807
24.705
16.313
16.240
16.043
15.853
66% D
Bpin
Ph
D-2o
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


7.284
2.337
66% D
Bpin
Ph
D-2o
^{2}D NMR
77 MHz
$CDCl_3$
8
6
4
2
0
PPM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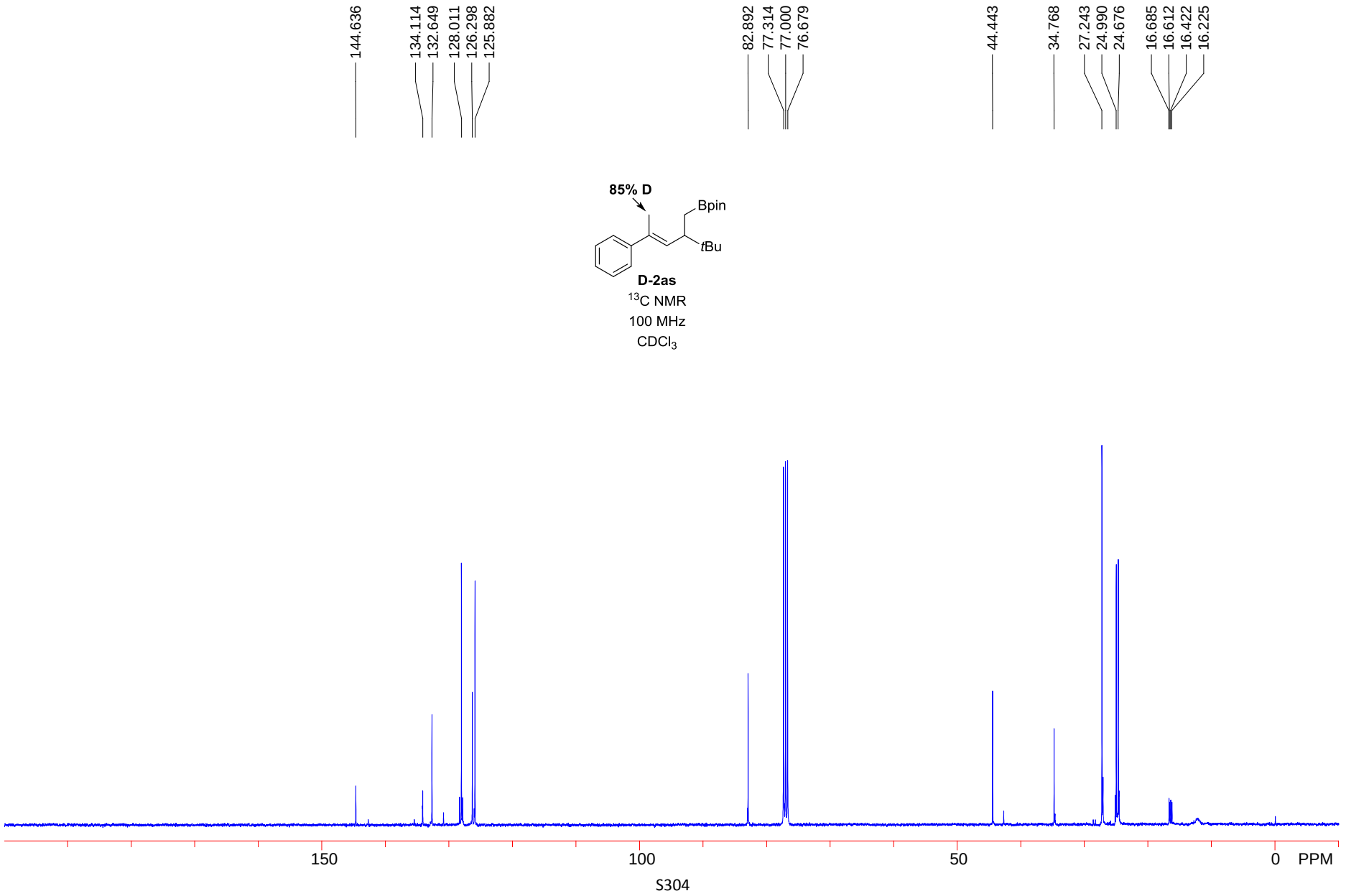
7.356
7.304
7.300
7.286
7.267
7.253
7.216
7.212
7.209
7.199
7.194
7.189
7.179
7.176
7.173
5.615
5.588
2.548
2.539
2.519
2.512
2.491
2.482
2.069
2.066
2.052
2.047
1.574
1.160
1.154
1.090
1.081
1.054
1.045
0.894
0.852
0.825
0.796
0.789
0.760
0.587
-0.000
85% D
Bpin
tBu
D-2as
1H NMR
400 MHz
CDCl3
2.16
2.16
1.16
1.00
1.01
2.15
9.04
6.35
5.91
1.10
1.30
8
6
4
2
0
PPM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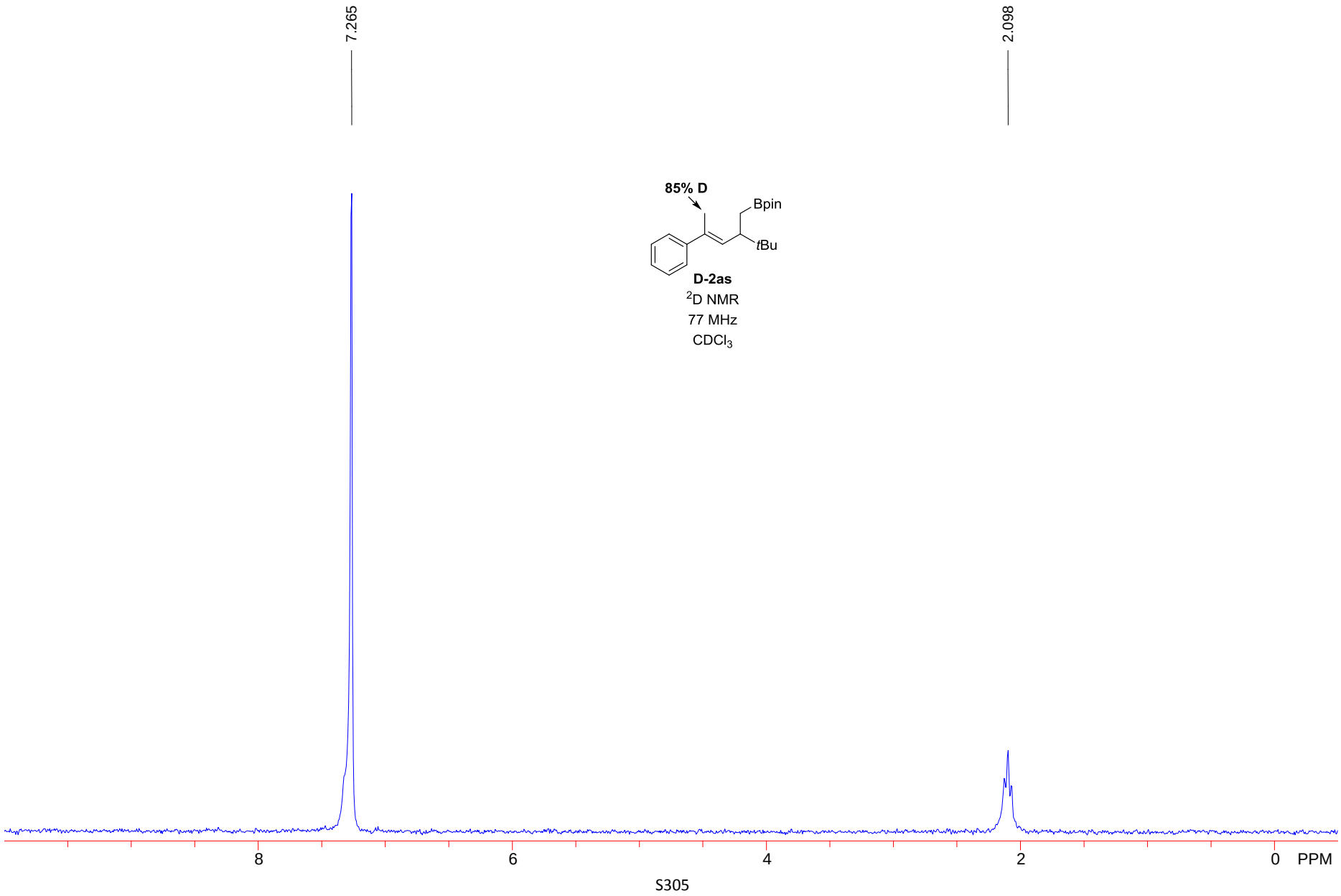
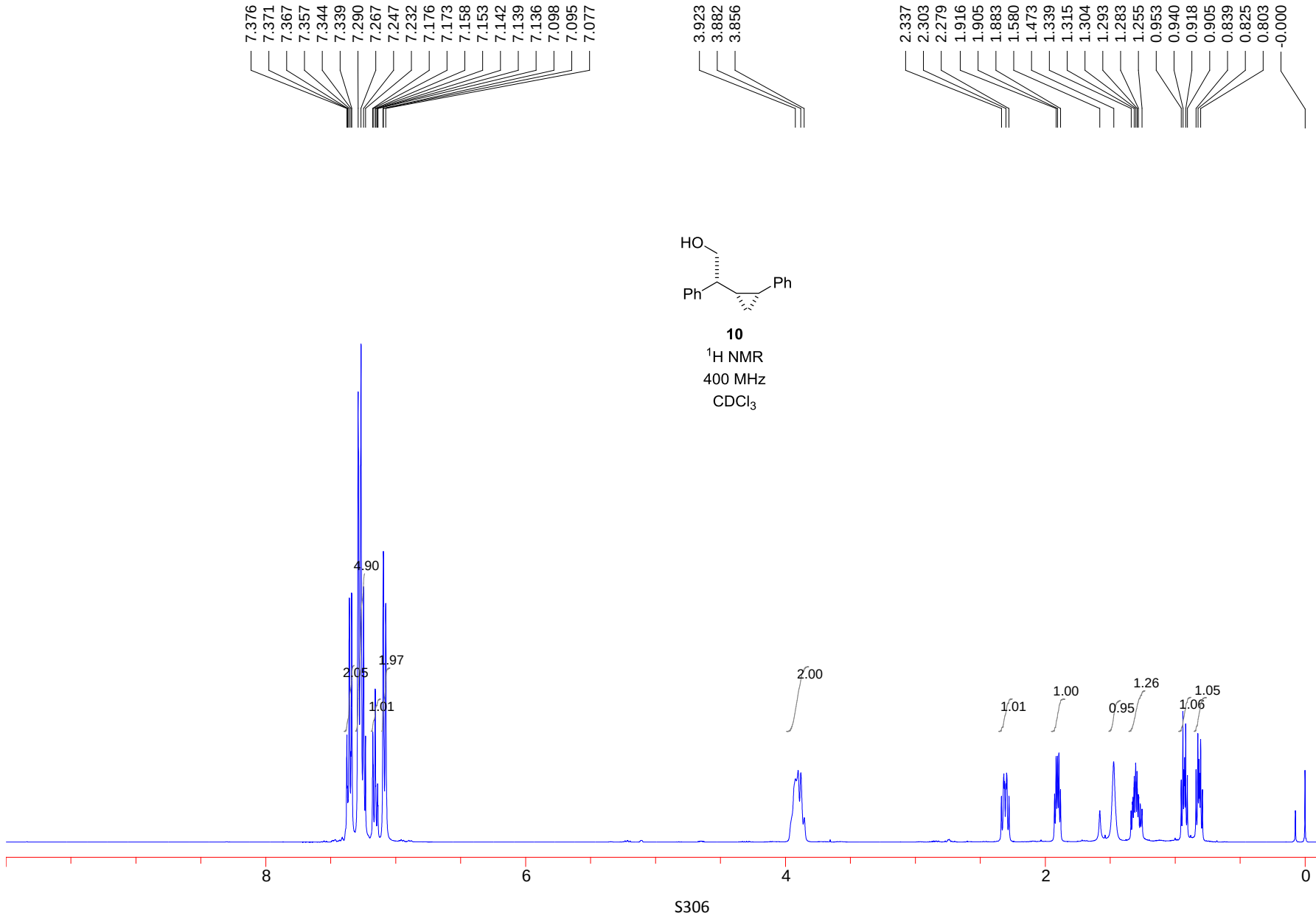
134.114
132.649
128.011
126.298
125.882
82.892
77.314
77.000
76.679
44.443
34.768
27.243
24.990
24.676
16.685
16.612
16.422
16.225
85% D
Bpin
tBu
D-2as
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM


7.265
2.098
85% D
Bpin
tBu
D-2as
2D NMR
77 MHz
CDCl3
8
6
4
2
0
PPM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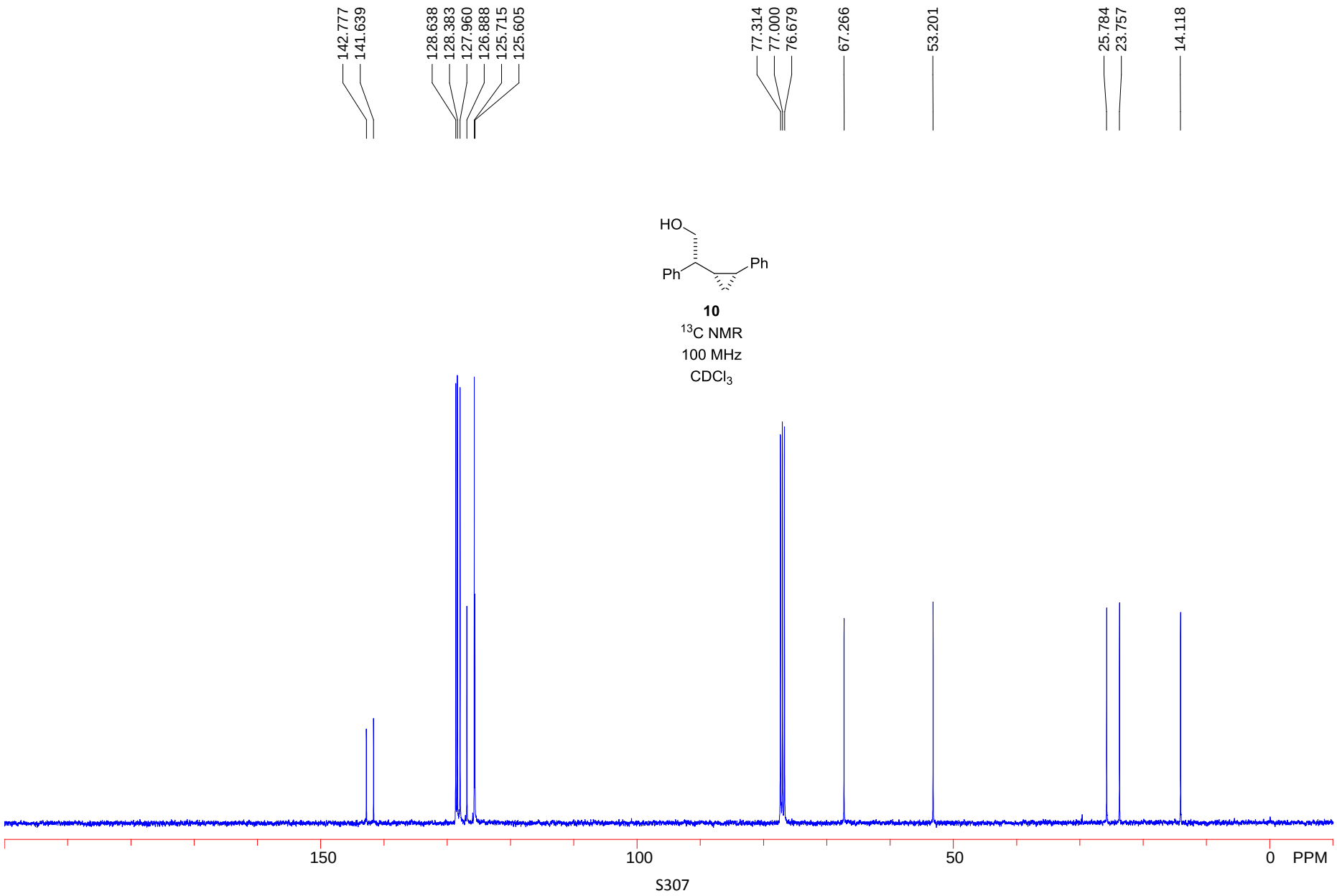
7.371
7.367
7.357
7.344
7.339
7.290
7.267
7.247
7.232
7.176
7.173
7.158
7.153
7.142
7.139
7.136
7.098
7.095
7.077
3.923
3.882
3.856
2.337
2.303
2.279
1.916
1.905
1.883
1.580
1.473
1.339
1.315
1.304
1.293
1.283
1.255
0.953
0.940
0.918
0.905
0.839
0.825
0.803
-0.000
HO
Ph
Ph
10
1H NMR
400 MHz
CDCl3
4.90
2.05
1.97
1.01
2.00
1.01
1.00
0.95
1.26
1.06
1.05
8
6
4
2
0
PPM


142.777
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127.960
126.888
125.715
125.605
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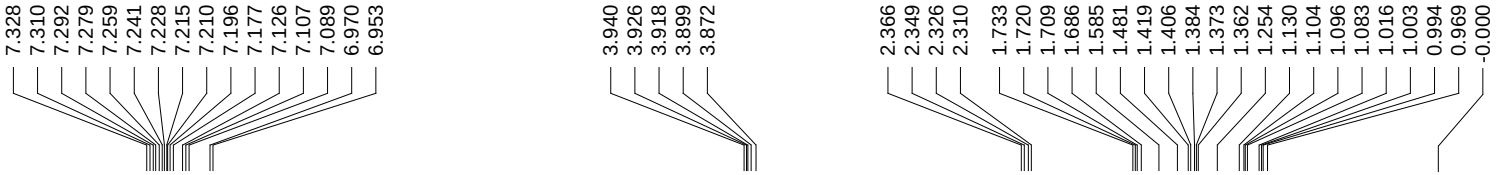
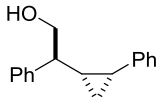
77.000
76.679
67.266
53.201
25.784
23.757
14.118
HO
Ph
Ph
10
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM



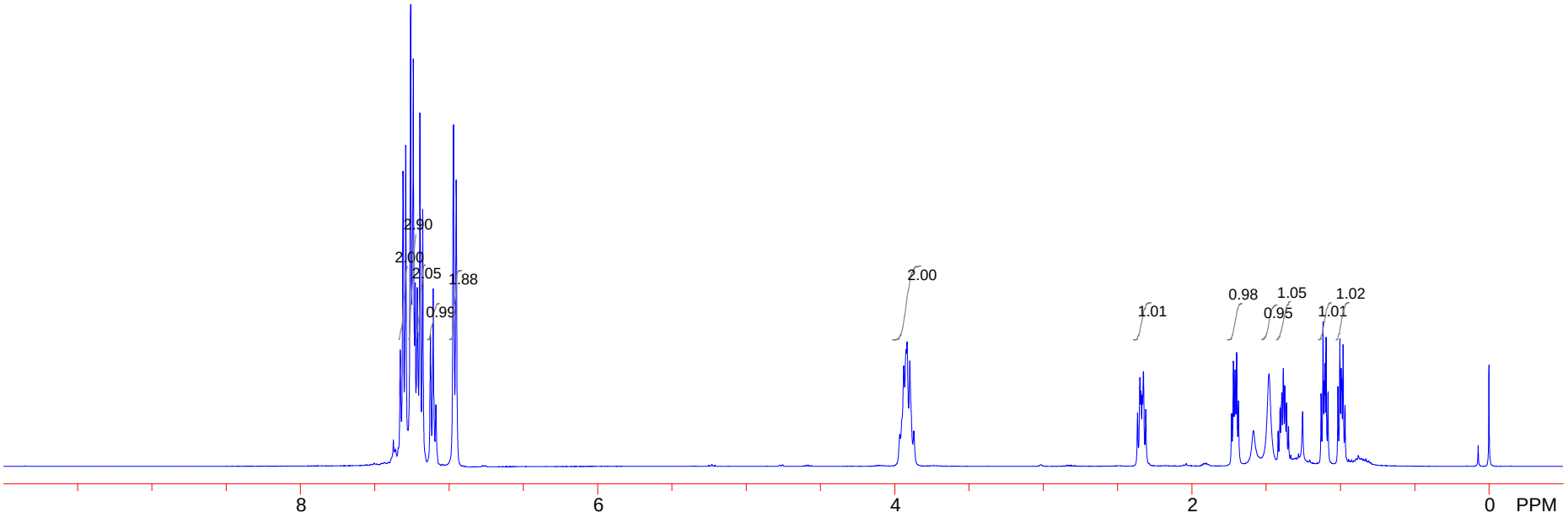


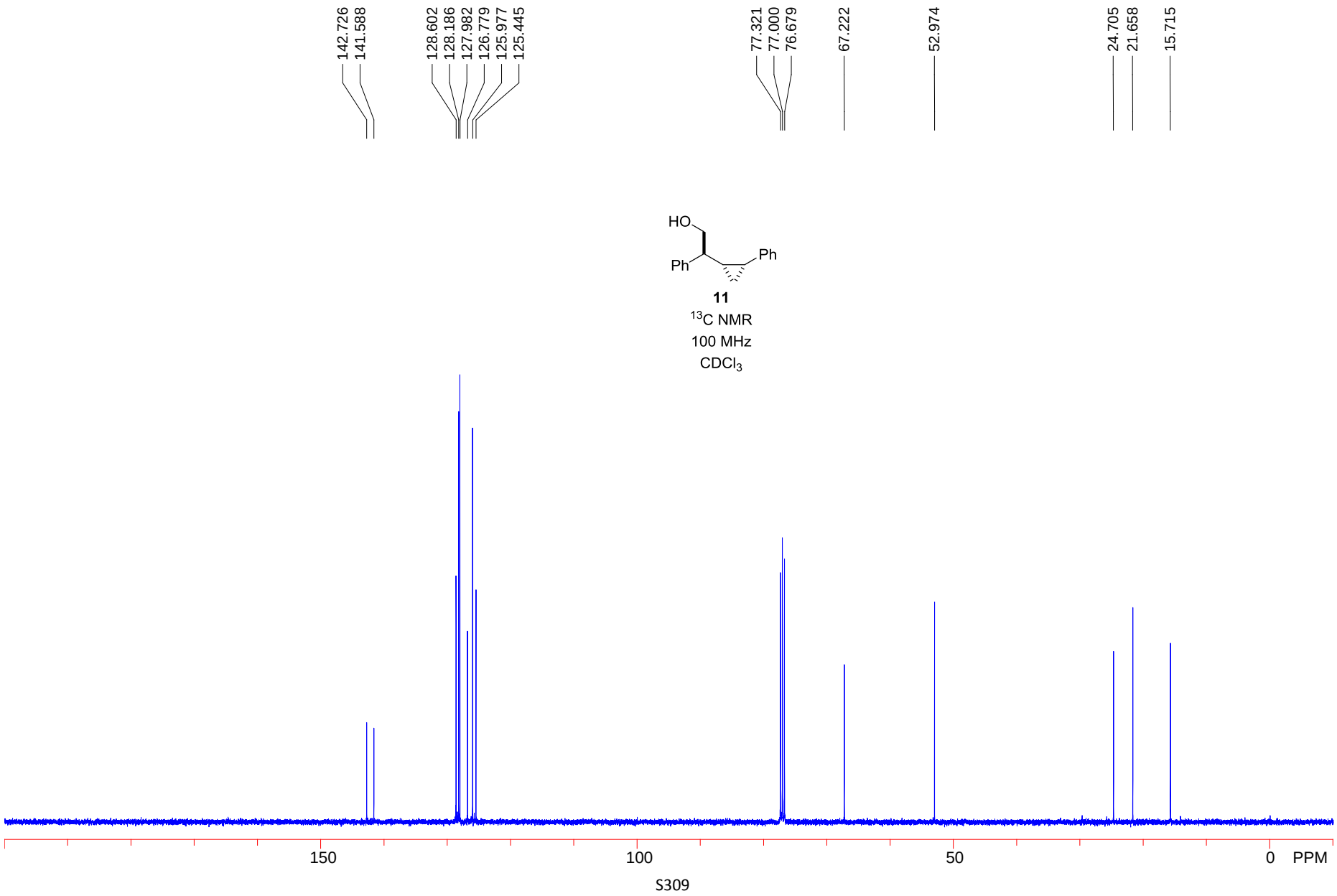
11

^{1}H NMR

400 MHz

$CDCl_3$



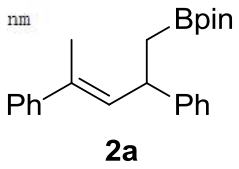

142.726
141.588
128.602
128.186
127.982
126.779
125.977
125.445
77.321
77.000
76.679
67.222
52.974
24.705
21.658
15.715
HO
Ph
Ph
11
13C NMR
100 MHz
CDCl3
150
100
50
0
PPM

XI HPLC spectra

Translation of Chinese characters in HPLC spectra to English

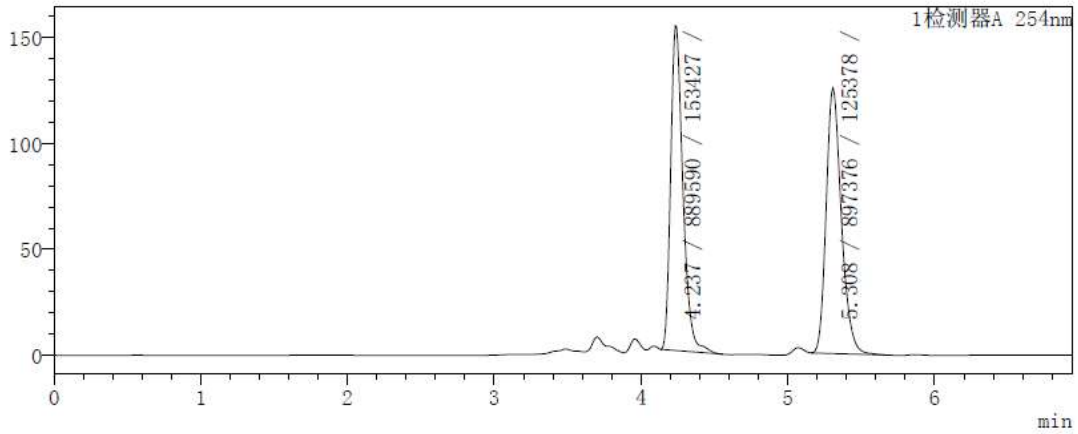
Chinese characters	English
处理日期/时间	Processing Date/Time
重复进样计数	Number of Repeat Injection
描述	HPLC Condition
色谱图	HPLC Spectra
检测器	Detector
峰表	Area Percent Report
峰号	Peak
保留时间	Remiaining Time
面积	Area
高度	Height
标记	Note
总计	Total

处理日期/时间 : 2015-11-18 12:03:12
重复进样计数 : 1
描述 : AD-H, n-hex : iPrOH= 98/2, 1.0 ml/min, 254 nm



2a

色谱图
CCH2068-R

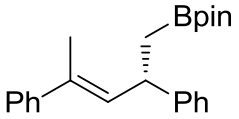


峰表

检测器A 254nm

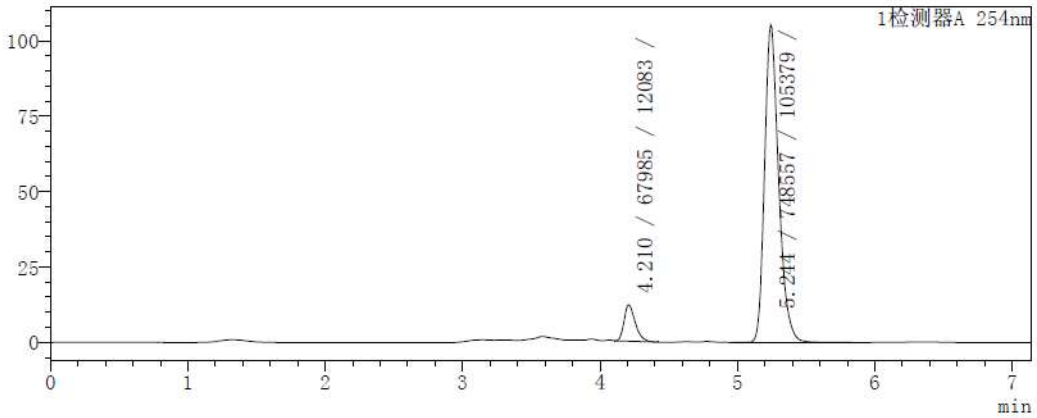
峰号	保留时间	面积	高度	标记	面积%
1	4.237	889590	153427		49.782
2	5.308	897376	125378		50.218
总计		1786965	278804		100.000

处理日期/时间 : 2016-12-29 15:32:38
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH=98/2, 1.0 ml/min, 254nm



2a

色谱图
CCH5092A-P

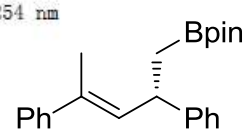


峰表

检测器A 254nm

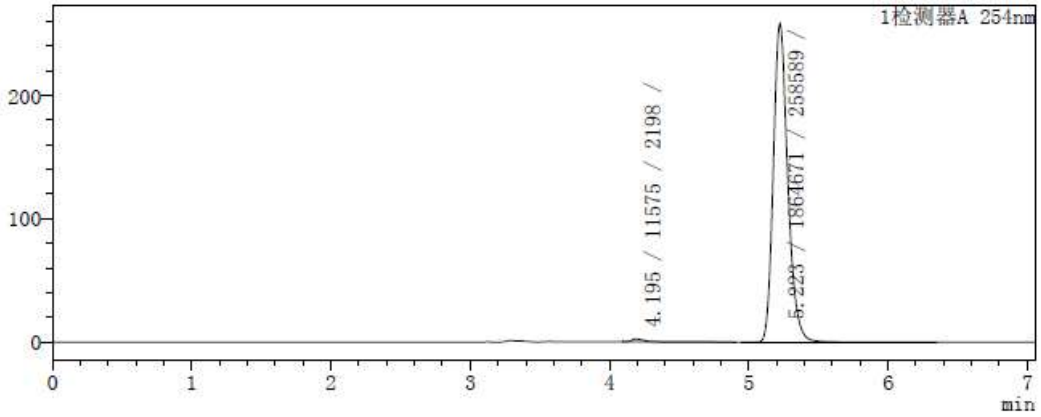
峰号	保留时间	面积	高度	标记	面积%
1	4.210	67985	12083		8.326
2	5.244	748557	105379	M	91.674
总计		816541	117461		100.000

分析日期/时间 : 2016-1-14 13:07:24
处理日期/时间 : 2016-1-14 13:14:30
重复进样计数 : 1
描述 : AD-H, n-hex : iPrOH=98/2, 1.0 ml/min, 254 nm



2a

色谱图
CCH-1-P

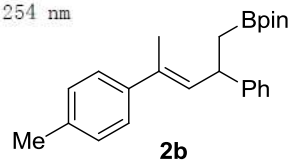


峰表

检测器A 254nm

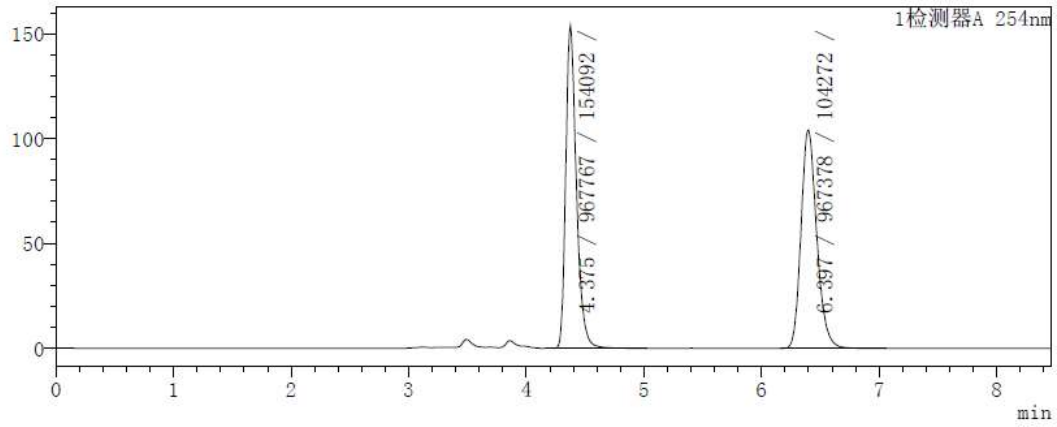
峰号	保留时间	面积	高度	标记	面积%
1	4.195	11575	2198	S	0.617
2	5.223	1864671	258589	S	99.383
总计		1876247	260787		100.000

处理日期/时间 : 2016-3-16 17:13:47
重复进样计数 : 1
描述 : AD-H, n-hex : iPrOH=98/2, 1.0 ml/min, 254 nm



2b

色谱图
CCH3045A-P

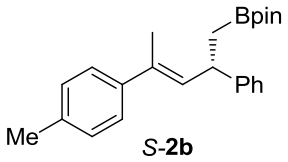


峰表

检测器A 254nm

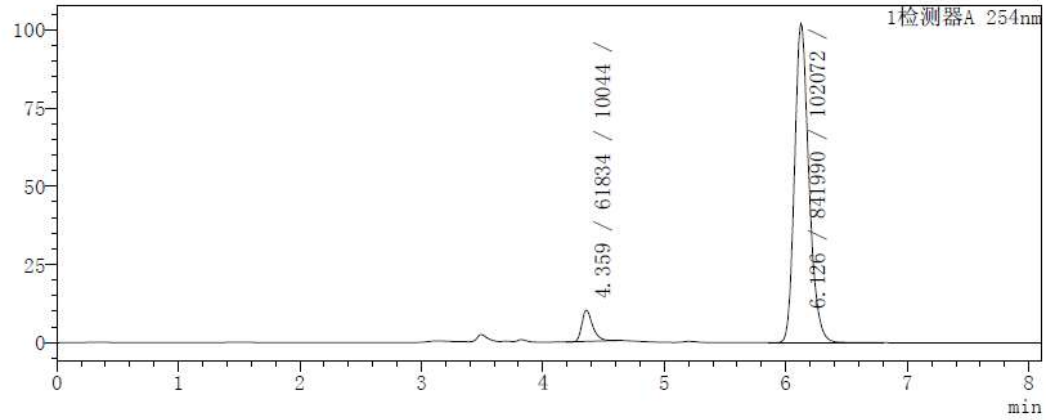
峰号	保留时间	面积	高度	标记	面积%
1	4.375	967767	154092	V	50.010
2	6.397	967378	104272		49.990
总计		1935146	258364		100.000

处理日期/时间 : 2016-12-29 15:52:07
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH=98/2, 1.0 ml/min, 254nm



***S*-2b**

色谱图
CCH5092B-P

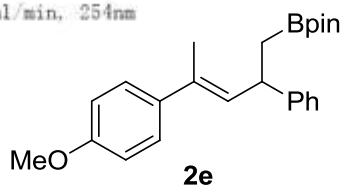


峰表

检测器A 254nm

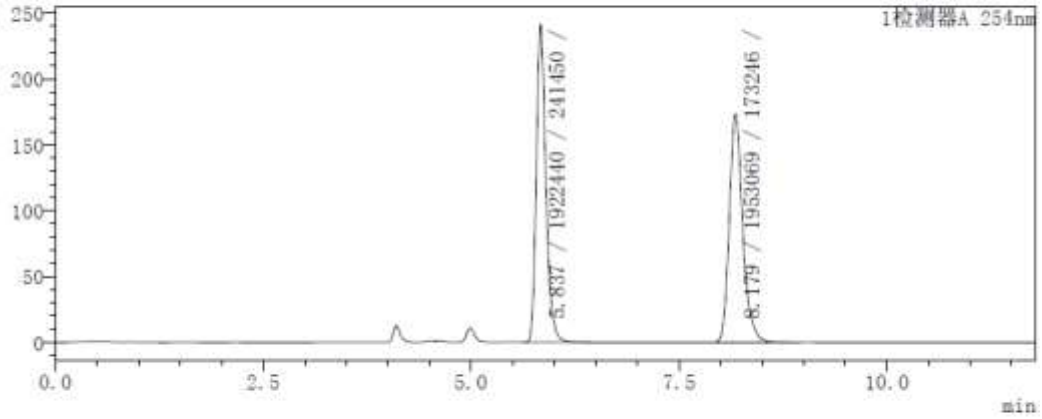
峰号	保留时间	面积	高度	标记	面积%
1	4.359	61834	10044	M	6.841
2	6.126	841990	102072		93.159
总计		903824	112116		100.000

处理日期/时间 : 2017-1-18 18:37:28
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH =98/2, 1.0 ml/min, 254nm



2e

色谱图
CCH5033-P-R

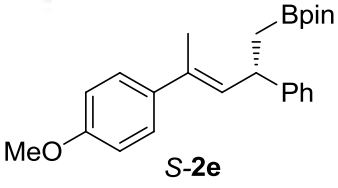


峰表

检测器A 254nm

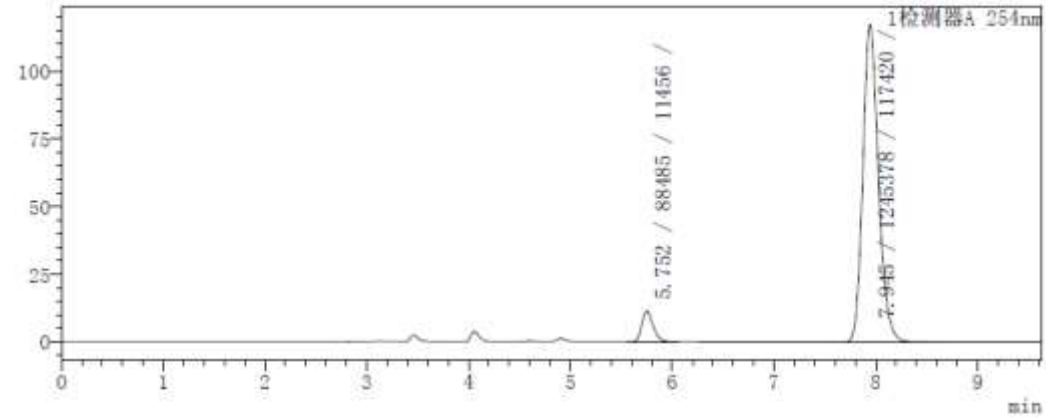
峰号	保留时间	面积	高度	标记	面积%
1	5.837	1922440	241450		49.605
2	8.179	1953069	173246		50.395
总计		3875509	414695		100.000

处理日期/时间 : 2016-12-29 16:15:02
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH=98/2, 1.0 ml/min, 254nm



***S*-2e**

色谱图
CCH5093A-P

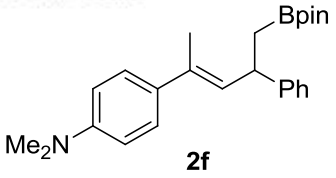


峰表

检测器A 254nm

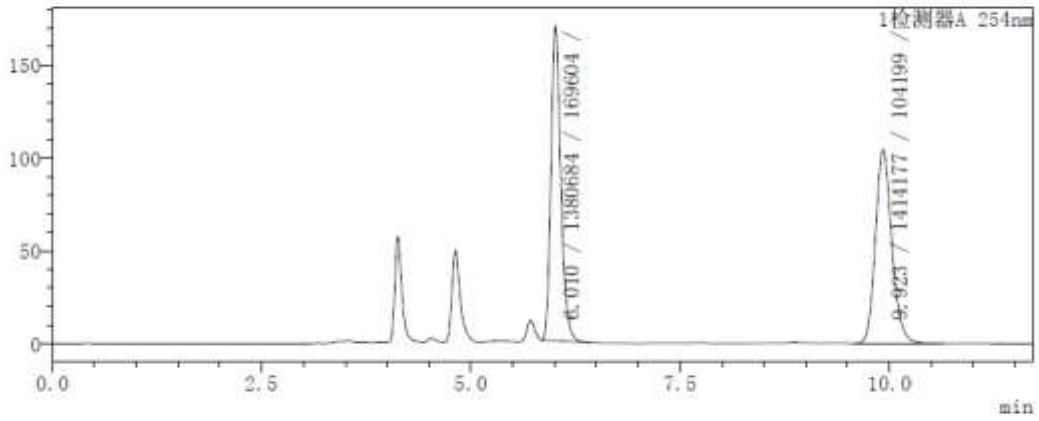
峰号	保留时间	面积	高度	标记	面积%
1	5.752	88485	11456		6.634
2	7.945	1245378	117420		93.366
总计		1333863	128876		100.000

处理日期/时间 : 2017-1-18 18:05:24
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH =98/2, 1.0 ml/min, 254nm



2f

色谱图
CCH4099A-P-R

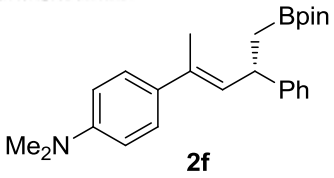


峰表

检测器A 254nm

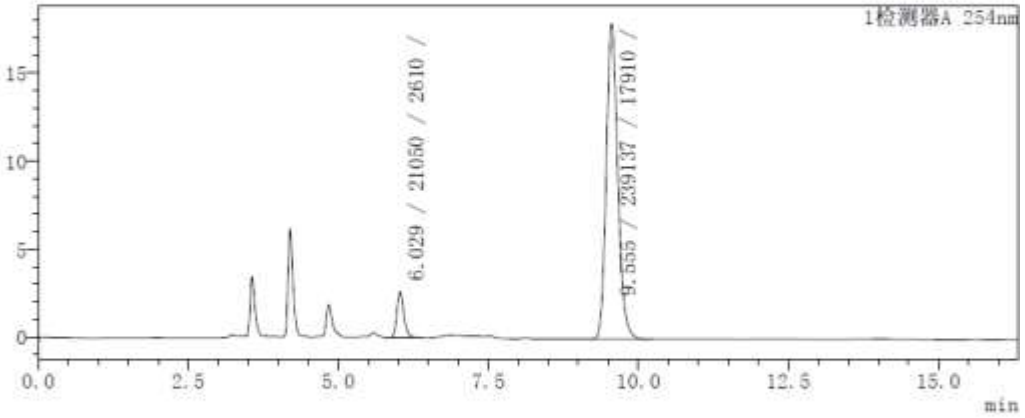
峰号	保留时间	面积	高度	标记	面积%
1	6.010	1380684	169604		49.401
2	9.923	1414177	104199		50.599
总计		2794861	273803		100.000

处理日期/时间 : 2016-12-29 17:13:51
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH=98/2, 1.0 ml/min, 254nm



2f

色谱图
CCH5094A-P

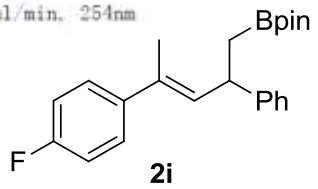


峰表

检测器A 254nm

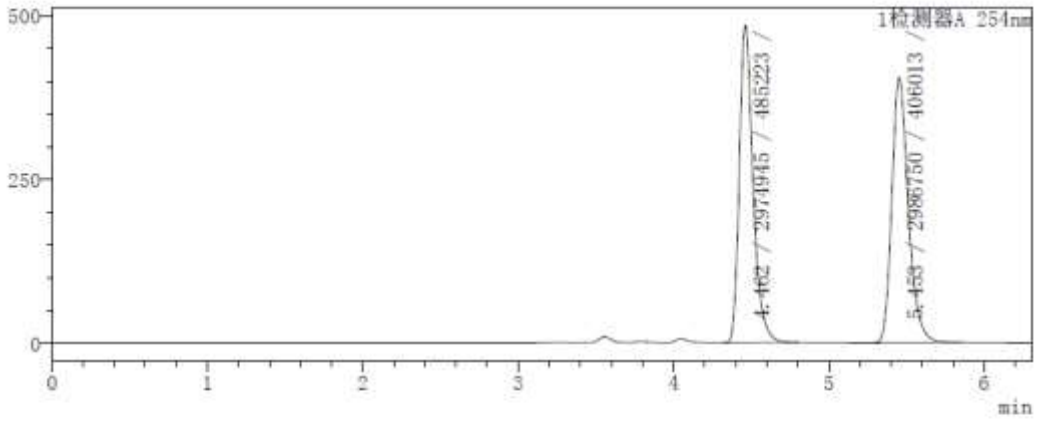
峰号	保留时间	面积	高度	标记	面积%
1	6.029	21050	2610		8.090
2	9.555	239137	17910		91.910
总计		260188	20520		100.000

处理日期/时间 : 2017-1-18 18:24:23
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH =98/2, 1.0 ml/min, 254nm



2i

色谱图
CCH4096E-P-R

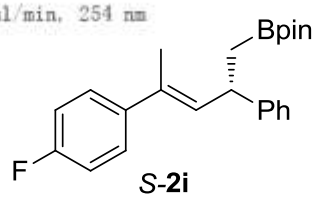


峰表

检测器A 254nm

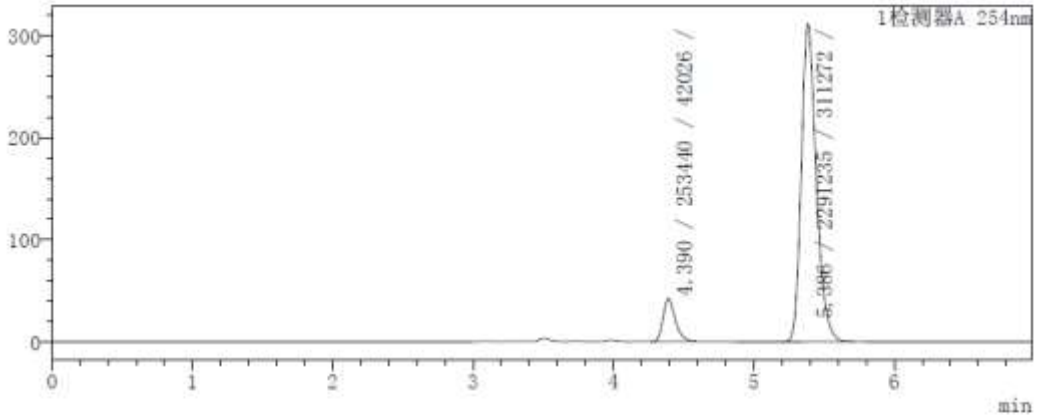
峰号	保留时间	面积	高度	标记	面积%
1	4.462	2974945	485223	M	49.901
2	5.453	2986750	406013	M	50.099
总计		5961695	891236		100.000

处理日期/时间 : 2017-1-15 00:24:45
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH = 98/2, 1.0 ml/min, 254 nm



***S*-2i**

色谱图
CCH5122A-P-C

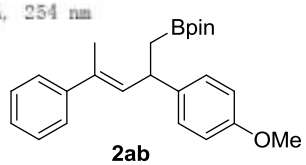


峰表

检测器A 254nm

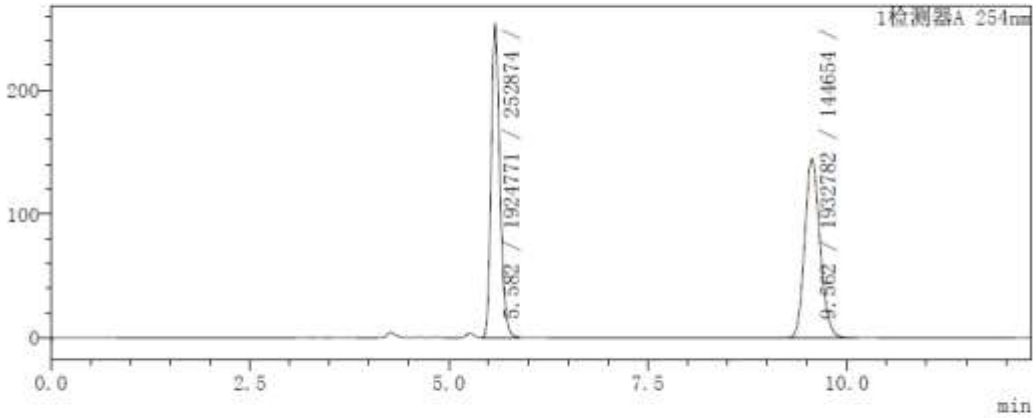
峰号	保留时间	面积	高度	标记	面积%
1	4.390	253440	42026	M	9.960
2	5.386	2291235	311272	M	90.040
总计		2544675	353298		100.000

处理日期/时间 : 2016-1-7 18:50:32
重复进样计数 : 1
描述 : AD-H, n-hex : iPrOH=98/2, 1.0 ml/min, 254 nm



2ab

色谱图
CCH2157-P

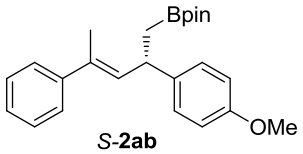


峰表

检测器A 254nm

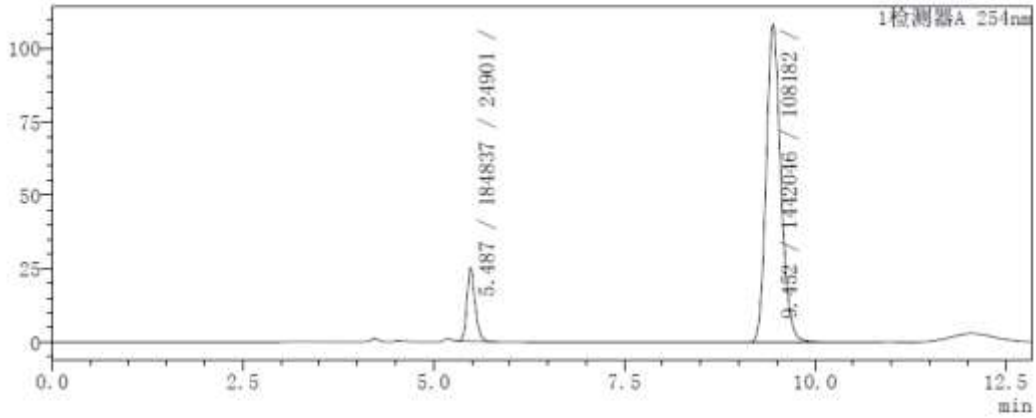
峰号	保留时间	面积	高度	标记	面积%
1	5.582	1924771	252874	M	49.896
2	9.562	1932782	144654		50.104
总计		3857553	397527		100.000

处理日期/时间 : 2017-1-14 23:28:00
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH = 98/2, 1.0 ml/min, 254 nm



***S*-2ab**

色谱图
CCH5117B-P-C

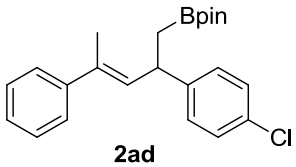


峰表

检测器A 254nm

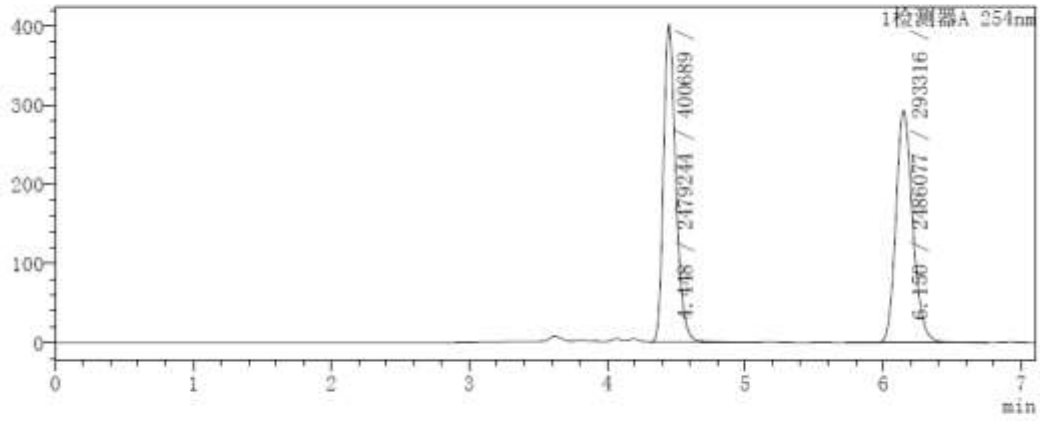
峰号	保留时间	面积	高度	标记	面积%
1	5.487	184837	24901		11.361
2	9.452	1442046	108182		88.639
总计		1626883	133083		100.000

处理日期/时间 : 2016-1-7 19:13:28
重复进样计数 : 1
描述 : AD-H, n-hex : iPrOH=98/2, 1.0 ml/min, 254 nm



2ad

色谱图
CCH2158-P

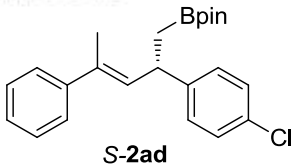


峰表

检测器A 254nm

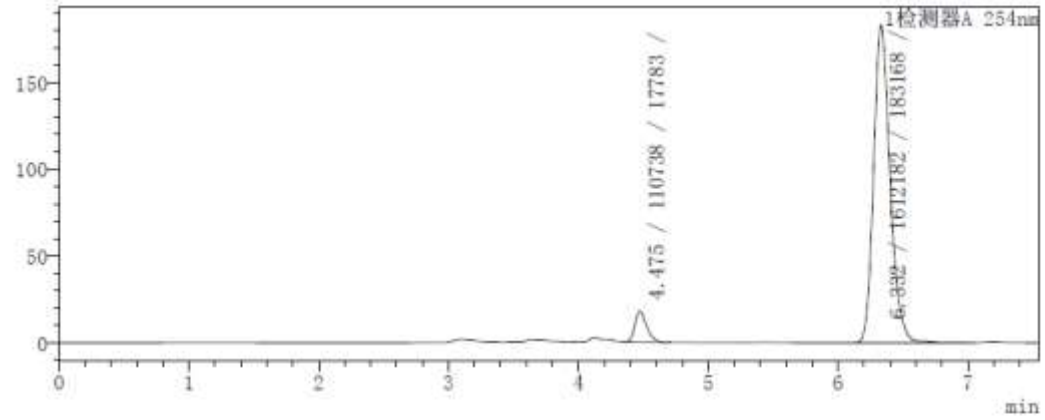
峰号	保留时间	面积	高度	标记	面积%
1	4.448	2479244	400689		49.931
2	6.150	2486077	293316		50.069
总计		4965321	694006		100.000

处理日期/时间 : 2017-1-15 00:16:03
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH = 98/2, 1.0 ml/min, 254 nm



***S*-2ad**

色谱图
CCH5121B-P-C

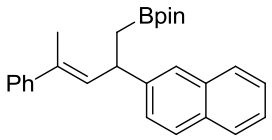


峰表

检测器A 254nm

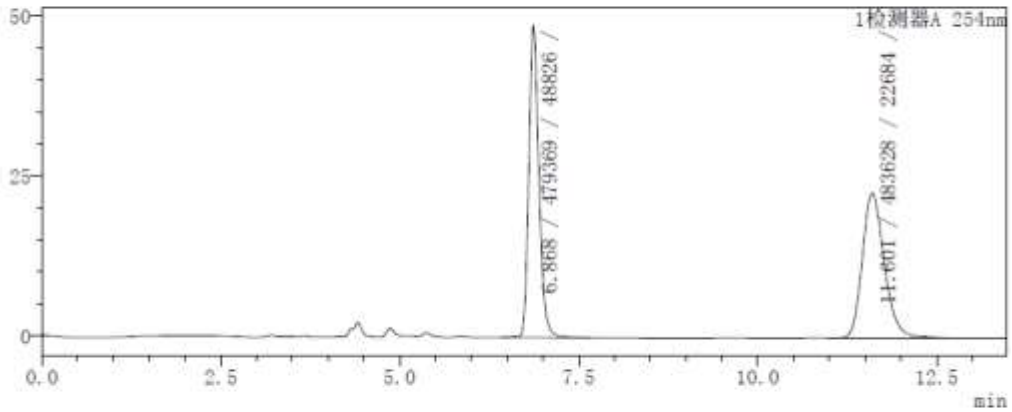
峰号	保留时间	面积	高度	标记	面积%
1	4.475	110738	17783		6.427
2	6.332	1612182	183168	SV	93.573
总计		1722920	200951		100.000

处理日期/时间 : 2017-1-18 20:07:43
重复进样计数 : 1
描述 : AD-H, n-hexane:iPrOH =99/1, 1.0 ml/min, 254nm



2ai

色谱图
CCH4186A-P-R

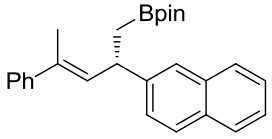


峰表

检测器A 254nm

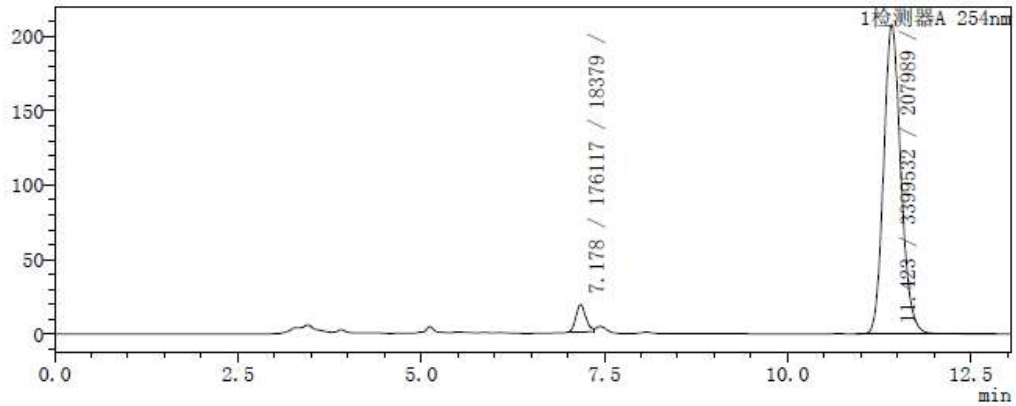
峰号	保留时间	面积	高度	标记	面积%
1	6.868	479369	48826		49.779
2	11.601	483628	22684		50.221
总计		962997	71510		100.000

分析日期/时间 : 2017-1-16 23:00:18
处理日期/时间 : 2017-1-16 23:13:22
重复进样计数 : 1
描述 : AD, n-hexane:iPrOH = 99/1, 1.0 ml/min, 254 nm



***S*-2ai**

色谱图
CCH5129B-P-C

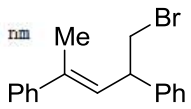


峰表

检测器A 254nm

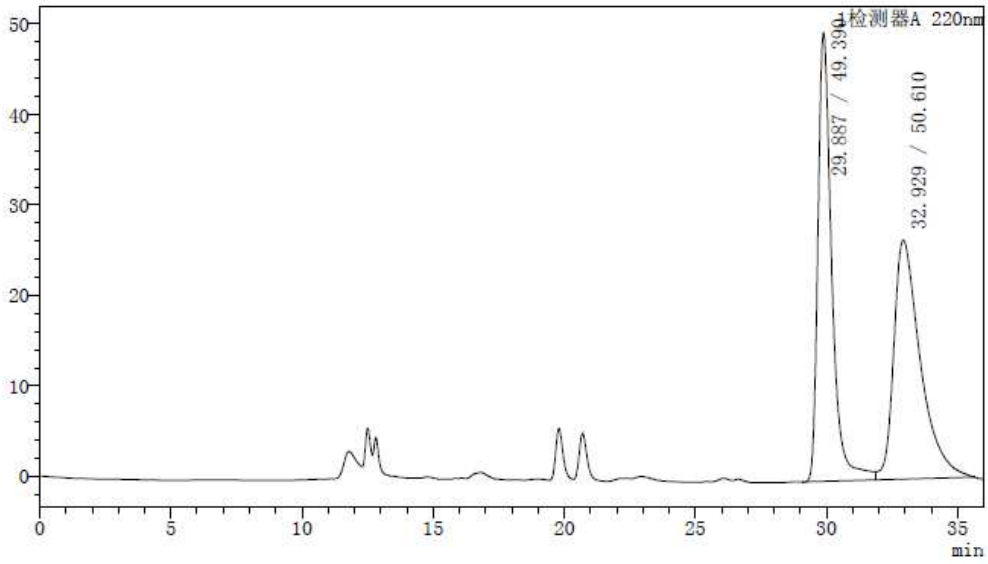
峰号	保留时间	面积	高度	标记	面积%
1	7.178	176117	18379	M	4.925
2	11.423	3399532	207989		95.075
总计		3575649	226368		100.000

处理日期/时间 : 2017/3/9 17:41:12
描述 : 2*AD-H, n-Hex:iPrOH =99.9/0.1, 0.5 mL/min, 220 nm



3

色谱图

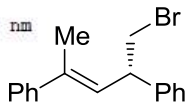


峰表

检测器A 220nm

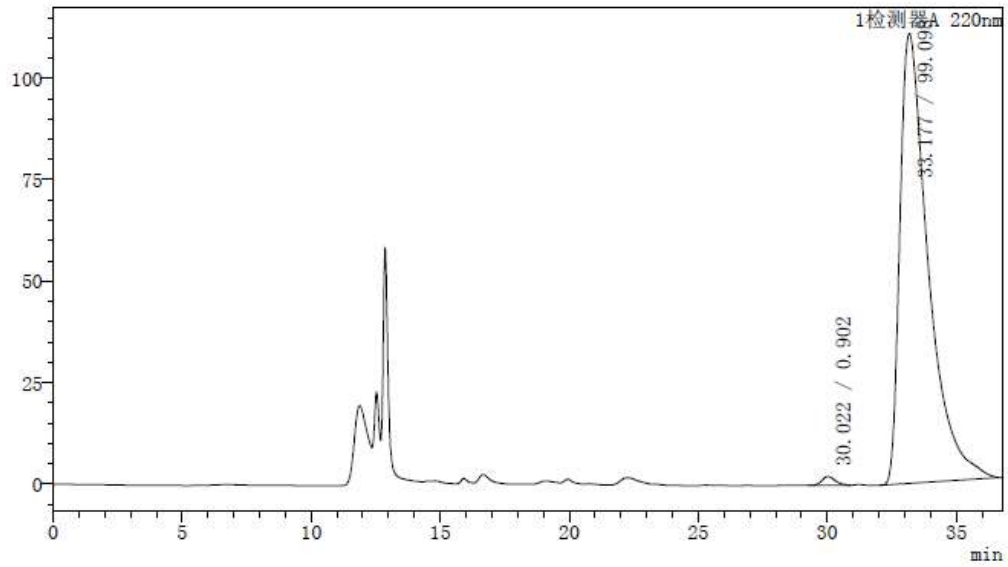
峰号	保留时间	面积	高度	标记	面积%
1	29.887	1820269	49645		49.390
2	32.929	1865203	26433	V M	50.610
总计		3685472	76078		100.000

处理日期/时间 : 2017/3/9 18:31:08
描述 : 2*AD-H, n-Hex:iPrOH =99.9/0.1, 0.5 mL/min, 220 nm



***S*-3**

色谱图

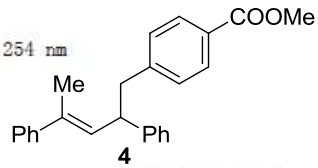


峰表

检测器A 220nm

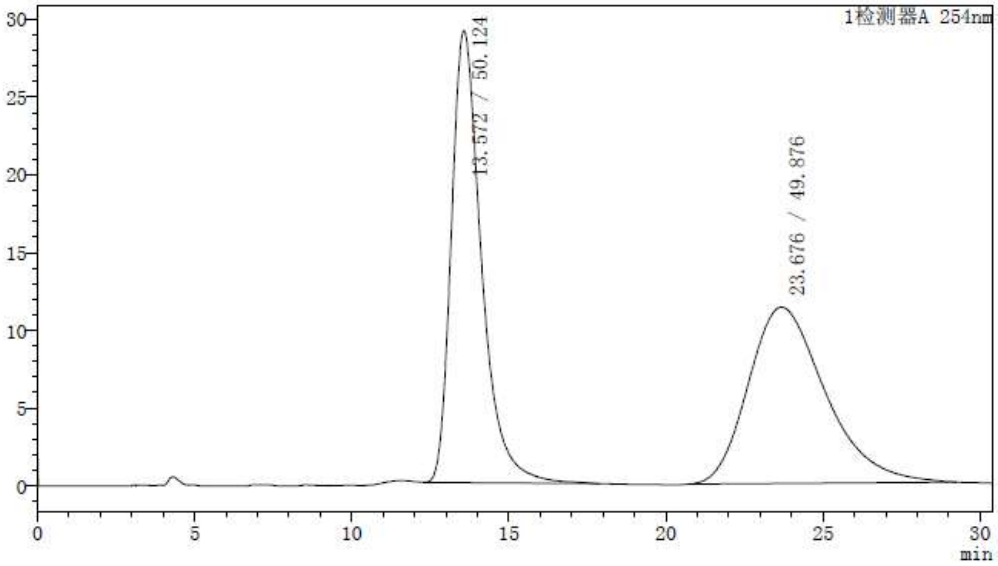
峰号	保留时间	面积	高度	标记	面积%
1	30.022	76828	2174		0.902
2	33.177	8440906	110846	M	99.098
总计		8517733	113020		100.000

处理日期/时间 : 2017/3/22 22:34:42
描述 : OJ-H, n-Hex:iPrOH =90/10, 1.0 mL/min, 254 nm



4

色谱图

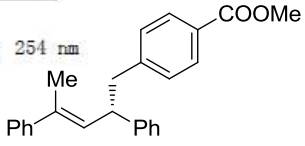


峰表

检测器A 254nm

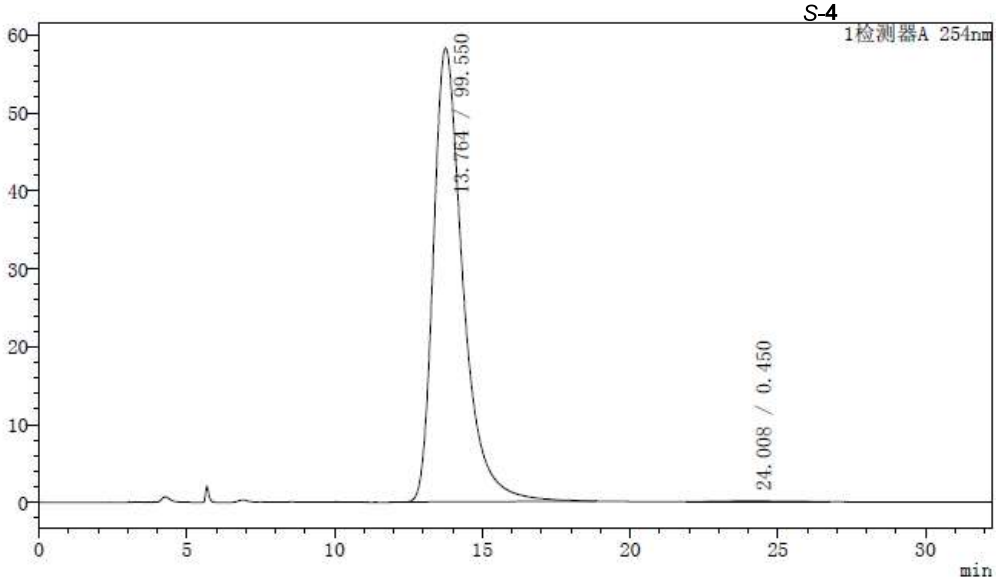
峰号	保留时间	面积	高度	标记	面积%
1	13.572	1941007	29071		50.124
2	23.676	1931387	11344		49.876
总计		3872394	40415		100.000

处理日期/时间 : 2017/3/22 23:08:57
描述 : OJ-H, n-Hex:iPrOH =90/10, 1.0 mL/min, 254 nm



***S*-4**

色谱图

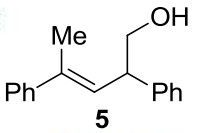


峰表

检测器A 254nm

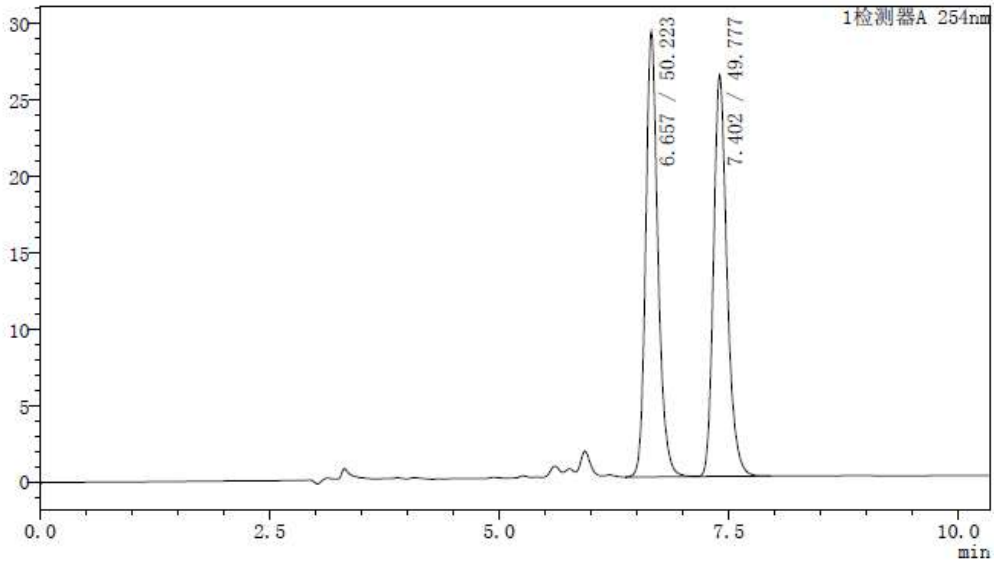
峰号	保留时间	面积	高度	标记	面积%
1	13.764	4059953	58301		99.550
2	24.008	18334	126	M	0.450
总计		4078287	58428		100.000

处理日期/时间 : 2017/2/16 16:16:45
描述 : AD-H, n-Hex:iPrOH =90/10,1.0 mL/min, 254 nm



5

色谱图

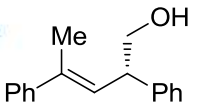


峰表

检测器A 254nm

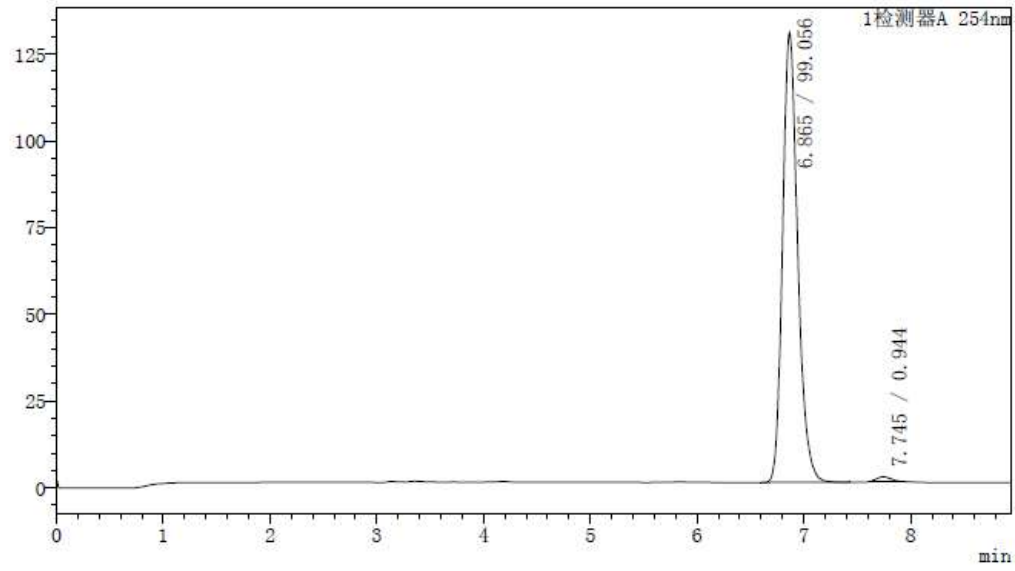
峰号	保留时间	面积	高度	标记	面积%
1	6.657	270841	29141		50.223
2	7.402	268441	26246	V	49.777
总计		539282	55387		100.000

处理日期/时间 : 2017/3/14 22:43:45
描述 : AD-H, n-Hex:iPrOH =90/10, 1.0 mL/min, 254 nm



***S*-5**

色谱图

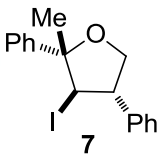


峰表

检测器A 254nm

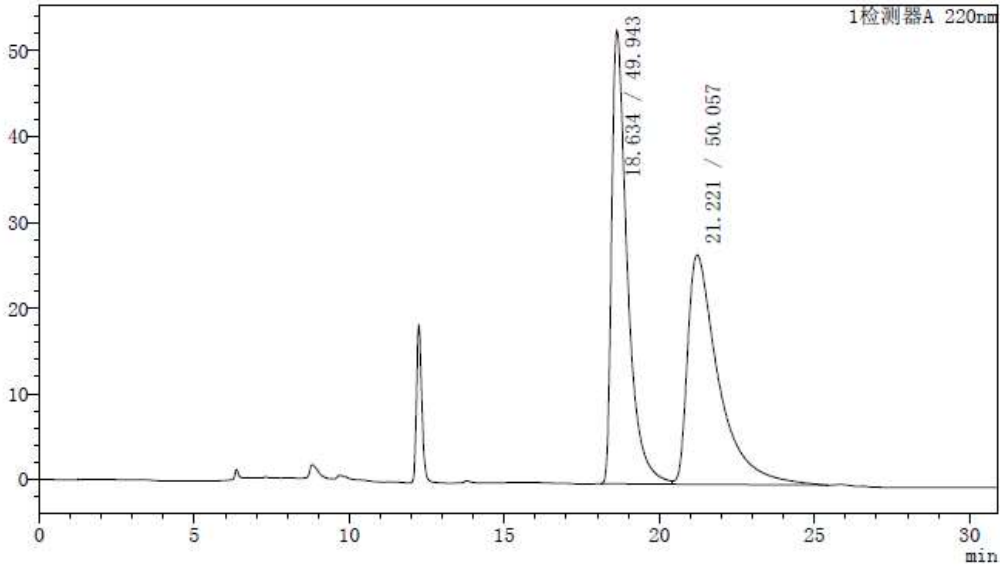
峰号	保留时间	面积	高度	标记	面积%
1	6.865	1274787	129554	M	99.056
2	7.745	12145	1349	M	0.944
总计		1286932	130903		100.000

处理日期/时间 : 2017/3/14 20:57:22
描述 : 2*AD-H, n-Hex:iPrOH =99.9/0.1, 1.0 mL/min, 220 nm



7

色谱图

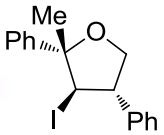


峰表

检测器A 220nm

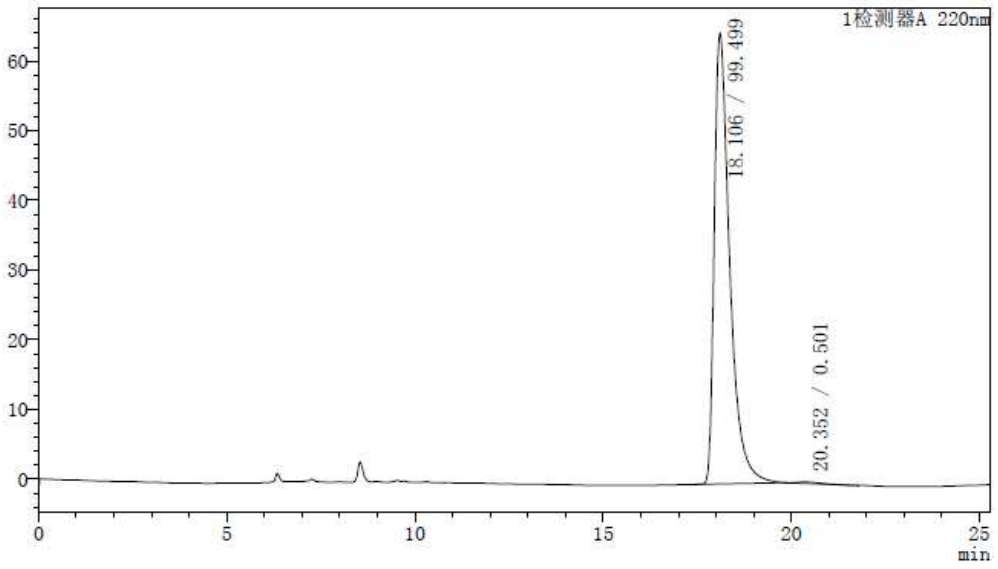
峰号	保留时间	面积	高度	标记	面积%
1	18.634	1855174	52867		49.943
2	21.221	1859420	26738	V	50.057
总计		3714594	79605		100.000

处理日期/时间 : 2017/3/14 19:31:32
描述 : 2*AD-H, n-Hex:iPrOH =99.9/0.1, 1.0 mL/min, 220 nm



(2S,3R,4S)-**7**

色谱图

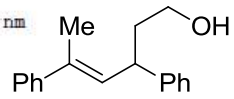


峰表

检测器A 220nm

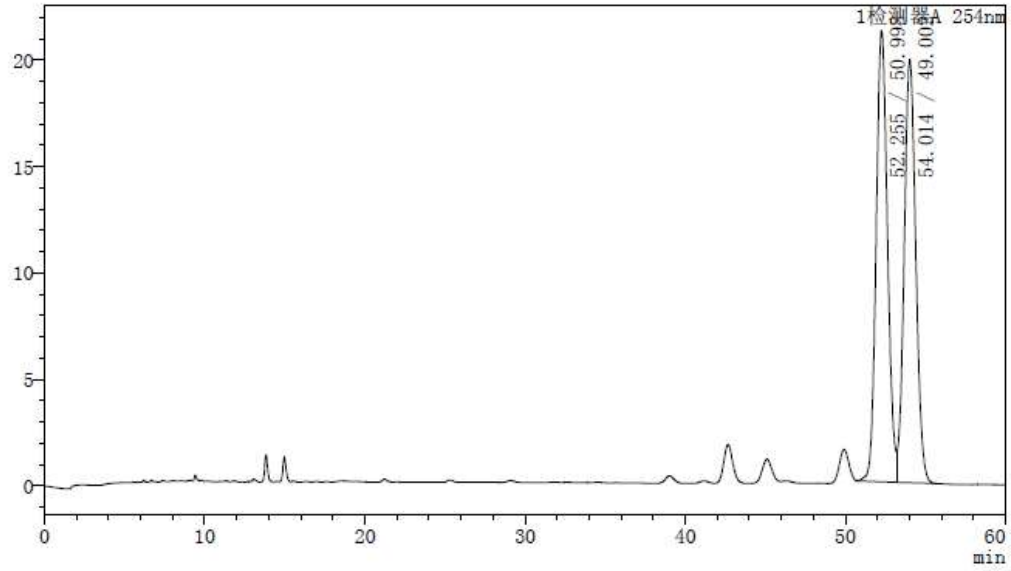
峰号	保留时间	面积	高度	标记	面积%
1	18.106	1848395	64760	M	99.499
2	20.352	9302	231	M	0.501
总计		1857697	64991		100.000

处理日期/时间 : 2017/3/9 12:35:51
描述 : 2*AD-H, n-Hex:iPrOH =98/2, 1.0 mL/min, 254 nm



6

色谱图

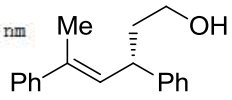


峰表

检测器A 254nm

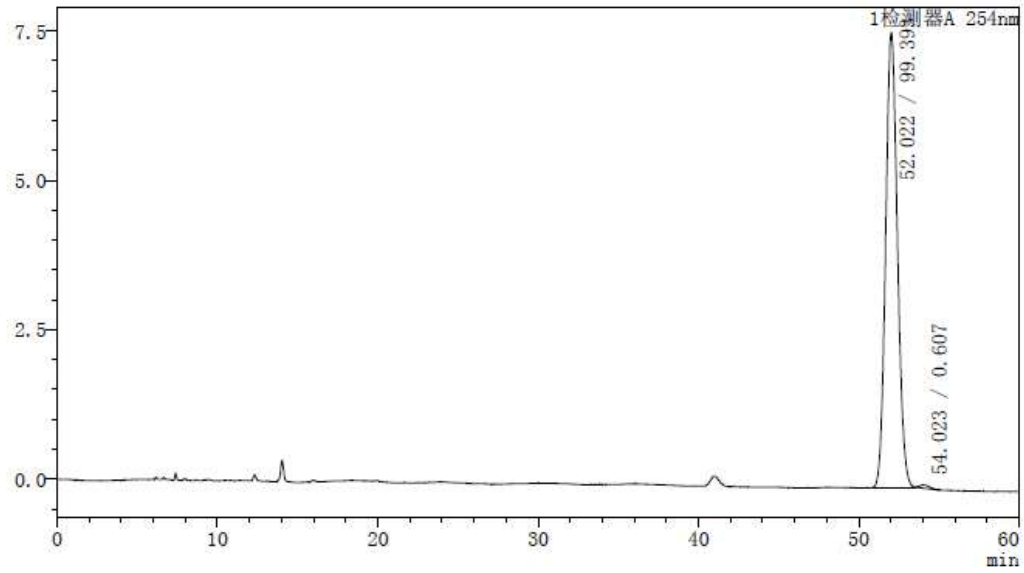
峰号	保留时间	面积	高度	标记	面积%
1	52.255	1039811	21193		50.998
2	54.014	999122	19878	V	49.002
总计		2038932	41070		100.000

处理日期/时间 : 2017/3/9 13:47:09
描述 : 2*AD-H, n-Hex:iPrOH =98/2, 1.0 mL/min, 254 nm



***S*-6**

色谱图

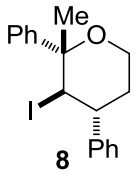


峰表

检测器A 254nm

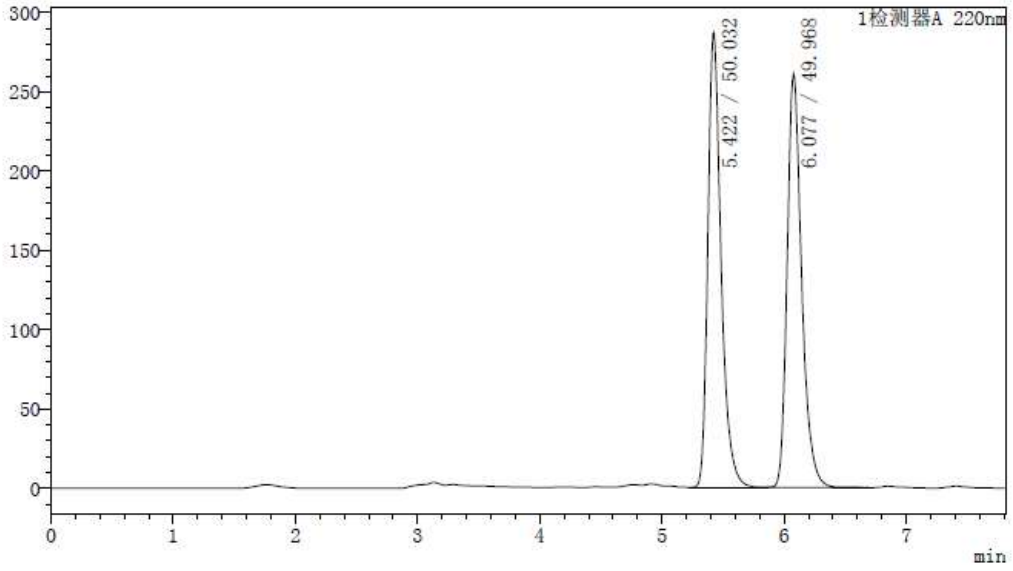
峰号	保留时间	面积	高度	标记	面积%
1	52.022	386146	7604		99.393
2	54.023	2358	56	M	0.607
总计		388504	7661		100.000

处理日期/时间 : 2017/3/21 21:40:35
描述 : AD-H, n-Hex:iPrOH =98/2, 1.0 mL/min, 220 nm



8

色谱图

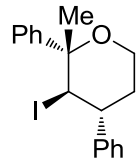


峰表

检测器A 220nm

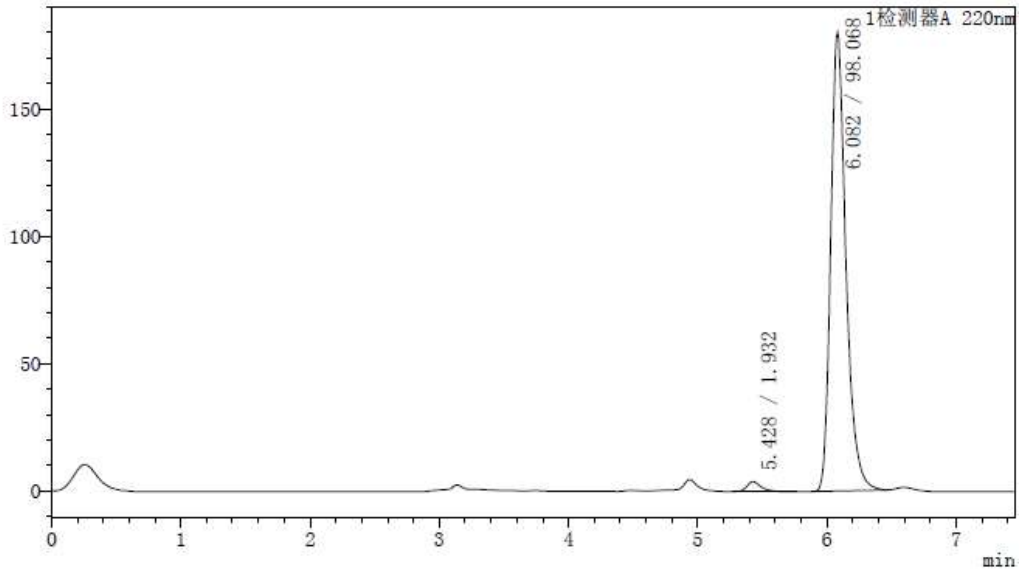
峰号	保留时间	面积	高度	标记	面积%
1	5.422	2156861	286984		50.032
2	6.077	2154122	260943	SV	49.968
总计		4310983	547927		100.000

处理日期/时间 : 2017/3/21 21:50:29
描述 : AD-H, n-Hex:iPrOH =98/2, 1.0 mL/min, 220 nm



(*2S,3R,4R*)-**8**

色谱图



峰表

检测器A 220nm

峰号	保留时间	面积	高度	标记	面积%
1	5.428	29046	3864	M	1.932
2	6.082	1474546	180051		98.068
总计		1503592	183915		100.000