Enantioselective Remote *Meta*-C–H Arylation and Alkylation *via* a Chiral Transient Mediator

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GENERAL INFORMATION

Solvents

Dry chloroform, dichloromethane (DCM), tetrahydrofuran (THF), 1,4-dioxane, and *tert*-butylmethylether (TBME) were purchased from Sigma-Aldrich. Chloroform-d_1, acetonitrile-d_3, and acetone-d_6 were purchased from Cambridge Isotope Laboratories.

Chromatography

Analytical thin layer chromatography was performed on 0.25 mm silica gel 60-F254. Visualization was carried out with UV light and Vogel's permanganate.

Spectroscopy and Instruments

^{1}H NMR was recorded on Bruker DRX-600 instrument (600 MHz). Chemical shifts were quoted in parts per million (ppm) referenced to 7.26 ppm of chloroform-*d*, the center peak of the pentet at 1.94 ppm of acetonitrile-d_3, or the center peak of a pentet at 2.05 ppm of acetone-d_6. ^{13}C NMR spectra were recorded on Bruker DRX-600 instrument (150 MHz), and were fully decoupled by broad band proton decoupling. Chemical shifts were reported in ppm referenced to the center peak of a triplet at 77.16 ppm of chloroform-*d*, the center peak of a septet at 1.32 ppm of acetonitrile-d_3, or the center peak of a septet at 29.84 ppm of acetone-d_6. ^{19}F NMR spectra were recorded on Bruker AMX-400 instrument (376 MHz), and were fully decoupled by broad band proton decoupling. The following abbreviations (or combinations thereof) were used to explain multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, p = pentet, sext = sextet, sep = septet, m = multiplet, br = broad. Coupling constants, *J*, were reported in Hertz unit (Hz). High-resolution mass spectra (HRMS) were recorded on an Agilent Mass spectrometer using ESI-TOF (electrospray ionization-time of flight). Enantiomeric ratios (er) were determined on the Agilent Technologies supercritical fluid chromatography (SFC) system using commercially available chiral columns. The single crystal X-ray diffraction studies were carried out on a Bruker Kappa APEX-II CCD diffractometer equipped with Mo Kα radiation (λ = 0.71073).

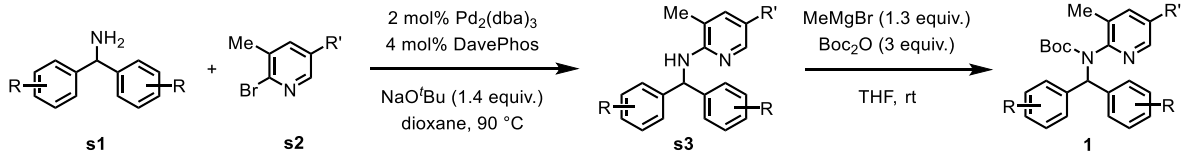
Starting materials

All substrates were used as received from commercial suppliers, unless otherwise stated. $Pd(OAc)_2$ and AgOAc were purchased from Sigma-Aldrich. Methyl (1*S*,4*R*)-bicyclo[2.2.1]hept-2-ene-2-carboxylate ((+)-NBE-CO_2Me, $[\alpha]_D^{25.5}$ = +237. (*c* = 1.0, $CHCl_3$)) was synthesized from (1*S*,2*R*,3*S*,4*R*)-3-(methoxycarbonyl)bicyclo[2.2.1]hept-5-ene-2-carboxylic acid[34] (98% ee after crystallization[35]) following literature procedures[36].

EXPERIMENTAL SECTION

I. Desymmetrization of Diarylmethyl Amines

A. Preparation of Substrates

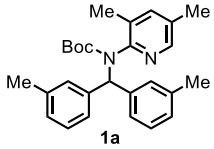


s1 s2 s3 1

Diarylmethyl amines (**s1**) were synthesized following the literature procedures[37]. 2-Bromopyridines (**S2**) are commercial available.

General procedure for synthesis of substrates: Amine **s1** (1 equiv.), $Pd_2(dba)_3$ (2 mol%), DavePhos (4 mol%) and NaO^{t}Bu (1.4 equiv.) were added to a flame-dried Schlenk tube. The Schlenk tube was evacuated and back-filled with nitrogen. 2-Bromopyridines **s2** (1 equiv.) and 1,4-dioxane (0.33 M) were added to the mixture. The Schlenk tube was immersed into a pre-heated oil bath at 90 °C. After 2 h, the oil bath was removed, and the Schlenk tube was allowed to cool to room temperature. Water was added to the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotary evaporation, the residue was purified by silica gel chromatography to afford compound **s3**.

To a solution of compound **s3** (1 equiv.) in THF (0.2 M) was added MeMgBr (1.3 equiv.) at 0 °C, and the resulting mixture was allowed to warm up to room temperature and stirred for 30 min. Then Boc_2O (3 equiv.) was added into the mixture. The resulting mixture was allowed to warm up to room temperature and stirred for 12 hours. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotary evaporation, the residue was purified by silica gel chromatography to afford compound **1**.

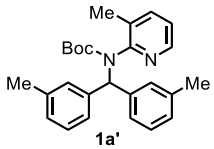


1a

***tert*-Butyl (di-*m*-tolylmethyl)(3,5-dimethylpyridin-2-yl)carbamate (1a)**

Chromatography eluent: hexane/EtOAc = 15:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.13–8.02 (m, 1H), 7.58 (s, 1H), 7.44 (s, 1H), 7.25 (s, 1H), 7.21–7.15 (m, 1H), 7.08 (s, 1H), 7.02–6.76 (m, 4H), 6.40 (s, 1H), 2.32 (s, 3H), 2.18 (s, 3H), 2.12 (s, 3H), 1.94 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 154.74, 151.62, 146.71, 143.66, 140.22, 138.41, 137.97, 133.28, 132.72, 131.86, 129.66, 128.85, 128.63, 128.26, 126.11, 80.91, 67.70, 28.33, 21.58, 21.24, 17.71, 17.67. HRMS (ESI-TOF) *m/z* calc'd for $C_{27}H_{33}N_2O_2$ $[M+H]^+$: 417.2537; found: 417.2550.



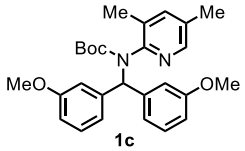
1a'

***tert*-Butyl (di-*m*-tolylmethyl)(3-methylpyridin-2-yl)carbamate (1a')**

Chromatography eluent: hexane/EtOAc = 15:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.24 (dd, J = 4.8, 1.8 Hz, 1H), 7.59 (s, 1H), 7.46 (s, 1H), 7.36 (dd, J = 7.6, 1.8 Hz, 1H), 7.25 (s, 1H), 7.14–6.73 (m, 6H), 6.43 (s, 1H), 2.32 (s, 3H), 2.12 (s, 3H), 2.00 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 154.47, 153.85, 146.45, 143.41, 139.97, 139.62, 138.26, 137.93,

133.45, 131.70, 129.55, 128.69, 128.52, 128.17, 126.00, 123.41, 80.91, 67.55, 28.18, 21.40, 21.15, 17.68. HRMS (ESI-TOF) *m/z* calc'd for $C_{26}H_{31}N_2O_2$ $[M+H]^+$: 403.2380; found: 403.2390.

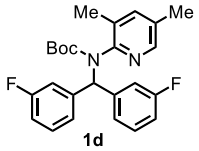


1c

***tert*-Butyl (bis(3-methoxyphenyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1c)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.09 (d, J = 2.3 Hz, 1H), 7.54 (s, 1H), 7.30–7.09 (m, 3H), 6.99 (s, 1H), 6.82 (s, 1H), 6.76–6.52 (m, 3H), 6.43 (s, 1H), 3.79 (s, 3H), 3.57 (s, 3H), 2.18 (s, 3H), 1.97 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 160.63, 159.88, 154.73, 151.48, 146.81, 145.35, 141.61, 140.34, 133.42, 132.87, 129.95, 129.47, 123.56, 121.32, 116.64, 114.91, 113.83, 112.82, 81.01, 67.48, 55.81, 55.74, 28.36, 17.74. HRMS (ESI-TOF) *m/z* calc'd for $C_{27}H_{35}N_2O_4$ $[M+H]^+$: 449.2435; found: 449.2445.

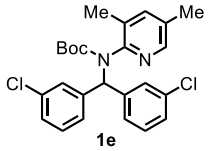


1d

***tert*-Butyl (bis(3-fluorophenyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1d)**

Chromatography eluent: hexane/EtOAc = 15:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.08 (d, J = 2.3 Hz, 1H), 7.70 (d, J = 6.4 Hz, 1H), 7.51–7.29 (m, 2H), 7.23 (d, J = 2.3 Hz, 1H), 7.12 (s, 1H), 7.04 (s, 1H), 6.96 (s, 1H), 6.91–6.73 (m, 2H), 6.51 (s, 1H), 2.19 (s, 3H), 1.99 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 163.75 (d, J = 243.5 Hz), 162.95 (d, J = 245.9 Hz), 154.52, 151.08, 146.87, 145.96, 142.43, 140.54, 133.63, 132.69, 130.86, 130.36, 127.04, 125.10, 117.74 (d, J = 22.2 Hz), 115.98 (d, J = 23.7 Hz), 115.02 (d, J = 21.5 Hz), 114.57 (d, J = 22.2 Hz), 81.47, 66.55, 28.29, 17.72, 17.64; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -115.10, -115.68. HRMS (ESI-TOF) *m/z* calc'd for $C_{25}H_{27}F_2N_2O_2$ $[M+H]^+$: 425.2035; found: 425.2043.

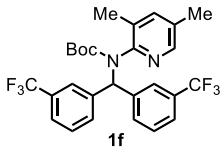


1e

***tert*-Butyl (bis(3-chlorophenyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1e)**

Chromatography eluent: hexane/EtOAc = 20:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.08 (d, J = 2.3 Hz, 1H), 7.87 (s, 1H), 7.58 (s, 1H), 7.42–7.26 (m, 2H), 7.24 (d, J = 2.3 Hz, 1H), 7.21–6.95 (m, 4H), 6.47 (s, 1H), 2.19 (s, 3H), 1.98 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 154.46, 151.06, 146.90, 145.22, 141.94, 140.57, 134.54, 133.89, 133.71, 132.64, 130.94, 130.80, 130.26, 129.53, 129.09, 128.27, 127.99, 127.70, 81.57, 66.51, 28.28, 17.72, 17.60. HRMS (ESI-TOF) *m/z* calc'd for $C_{25}H_{27}Cl_2N_2O_2$ $[M+H]^+$: 457.1444; found: 457.1452.



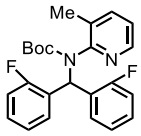
1f

***tert*-Butyl (bis(3-(trifluoromethyl)phenyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1f)**

Chromatography eluent: hexane/EtOAc = 15:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.17 (s, 1H), 8.06 (d, J = 2.4 Hz, 1H), 7.95 (s, 1H), 7.72–7.51 (m, 2H), 7.50–7.25 (m, 4H), 7.21 (d, J = 2.3 Hz, 1H), 6.67 (s, 1H), 2.17 (s, 3H), 1.96 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 154.44, 150.91, 146.98, 143.91, 140.79, 140.60, 134.86, 133.85, 133.09, 132.62,

131.12, 130.90, 130.68, 130.33, 130.06, 129.59, 127.74, 126.42, 125.95, 125.10, 124.85, 124.62, 81.71, 66.56, 28.23, 17.66, 17.48; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -63.37, -63.65. HRMS (ESI-TOF) *m/z* calc'd for $C_{27}H_{27}F_6N_2O_2$ $[M+H]^+$: 525.1971; found: 525.1972.

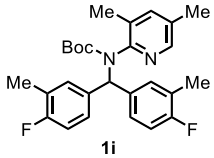


1h

***tert*-Butyl (bis(3-chlorophenyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1e)**

Chromatography eluent: hexane/EtOAc = 20:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.65 (s, 1H), 8.18 (dd, *J* = 4.9, 1.8 Hz, 1H), 7.77–6.20 (m, 10H), 2.11 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 161.10 (d, *J* = 245.2 Hz), 154.33, 152.63, 146.44, 140.00, 134.13, 133.46, 131.68, 130.41, 124.70, 123.63, 115.66 (d, *J* = 21.9 Hz), 81.67, 53.64, 28.25, 17.24; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -118.43, -119.60. HRMS (ESI-TOF) *m/z* calc'd for $C_{24}H_{25}F_2N_2O_2$ $[M+H]^+$: 411.1879; found: 411.1890.

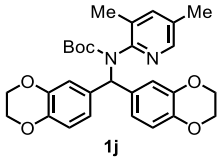


1i

***tert*-Butyl (bis(4-fluoro-3-methylphenyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1i)**

Chromatography eluent: hexane/EtOAc = 20:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.03 (d, *J* = 2.3 Hz, 1H), 7.59 (s, 1H), 7.46 (s, 1H), 7.16 (d, *J* = 2.3 Hz, 1H), 7.09–6.77 (m, 3H), 6.69 (s, 1H), 6.35 (s, 1H), 2.21 (s, 3H), 2.14 (s, 3H), 2.00 (s, 3H), 1.90 (s, 3H), 1.22 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 161.09 (d, *J* = 242.6 Hz), 154.60, 151.32, 146.77, 140.37, 139.23, 135.88, 134.38, 133.49, 132.72, 132.21, 130.25, 128.13, 125.00 (d, *J* = 15.5 Hz), 124.61 (d, *J* = 12.6 Hz), 115.20 (d, *J* = 22.8 Hz), 114.73 (d, *J* = 22.9 Hz), 81.13, 66.32, 28.34, 17.72, 17.62, 14.74, 14.33; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -121.40, -122.73. HRMS (ESI-TOF) *m/z* calc'd for $C_{27}H_{31}F_2N_2O_2$ $[M+H]^+$: 453.2348; found: 453.2361.

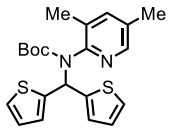


1j

***tert*-Butyl (bis(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1j)**

Chromatography eluent: hexane/EtOAc = 4:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.10 (d, *J* = 2.3 Hz, 1H), 7.38 (s, 1H), 7.25 (d, *J* = 2.3 Hz, 1H), 7.07 (s, 1H), 6.82 (s, 1H), 6.55 (s, 3H), 6.27 (s, 1H), 4.26 (s, 4H), 4.13 (s, 4H), 2.23 (s, 3H), 1.98 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 154.65, 151.53, 146.71, 144.16, 143.57, 143.35, 140.33, 137.09, 133.32, 132.76, 123.97, 121.83, 119.94, 117.82, 117.42, 116.88, 80.85, 66.49, 65.28, 65.16, 28.38, 17.76, 17.74. HRMS (ESI-TOF) *m/z* calc'd for $C_{25}H_{27}Cl_2N_2O_2$ $[M+H]^+$: 457.1444; found: 457.1452.

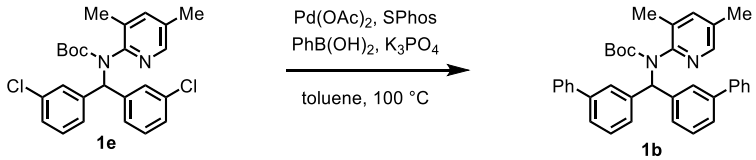


1k

***tert*-Butyl (di(thiophen-2-yl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1k)**

Chromatography eluent: hexane/EtOAc = 15:1 v/v.

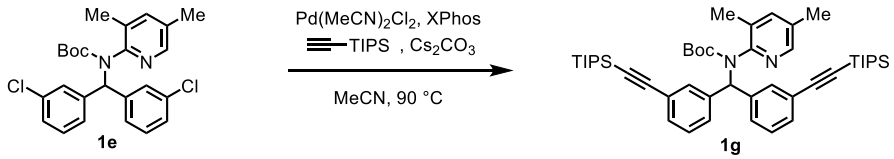
^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.11 (d, J = 2.3 Hz, 1H), 7.36 (s, 1H), 7.33 (d, J = 2.3 Hz, 1H), 7.29–7.10 (m, 2H), 6.96 (s, 1H), 6.92–6.74 (m, 3H), 2.25 (s, 3H), 1.95 (s, 3H), 1.32 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 154.00, 151.57, 147.06, 145.75, 144.49, 140.60, 133.66, 132.40, 128.27, 127.02, 126.81, 126.74, 81.77, 58.94, 28.34, 17.80, 17.63. HRMS (ESI-TOF) *m/z* calc'd for $C_{21}H_{25}N_2O_2S_2$ $[M+H]^+$: 401.1352; found: 401.1360.



***tert*-Butyl (di([1,1'-biphenyl]-3-yl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1b)**

Aryl chloride **1e** (0.23 g, 0.5 mmol, 1 equiv.), $Pd(OAc)_2$ (5.6 mg, 0.025 mmol, 5 mol%), SPhos (21 mg, 0.05 mmol, 10 mol%), $PhB(OH)_2$ (0.244 g, 2.0 mmol, 4.0 equiv.), and K_3PO_4 (0.53 g, 2.5 mmol, 5.0 equiv.) were added to a flame-dried Schlenk tube. The Schlenk tube was evacuated and back-filled with nitrogen, and then toluene (4 mL) were added to the mixture. The Schlenk tube was immersed into a pre-heated oil bath at 100 °C. After 12 h, the oil bath was removed, and the Schlenk tube was allowed to cool to room temperature. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotary evaporation, the residue was purified by silica gel chromatography (hexane/EtOAc = 12:1 v/v) to afford 0.19 g compound **1b** as a white solid (70% yield).

^{1}H NMR (600 MHz, Acetonitrile-d_3) δ 8.29–8.09 (m, 2H), 7.72–7.06 (m, 18H), 6.67 (s, 1H), 2.16 (s, 3H), 1.98 (s, 3H), 1.28 (s, 9H)**;** ^{13}C NMR (150 MHz, Acetonitrile-d_3) δ 154.83, 151.45, 146.97, 144.28, 141.98, 141.50, 141.15, 140.68, 140.42, 133.62, 132.99, 130.45, 130.07, 129.88, 129.58, 129.16, 128.11, 127.82, 127.71, 126.81, 126.19, 81.16, 67.52, 28.38, 17.71**.** HRMS (ESI-TOF) *m/z* calc'd for $C_{37}H_{37}N_2O_2$ $[M+H]^+$: 541.2850; found: 541.2854.



***tert*-Butyl (bis(3-((triisopropylsilyl)ethynyl)phenyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (1g)**

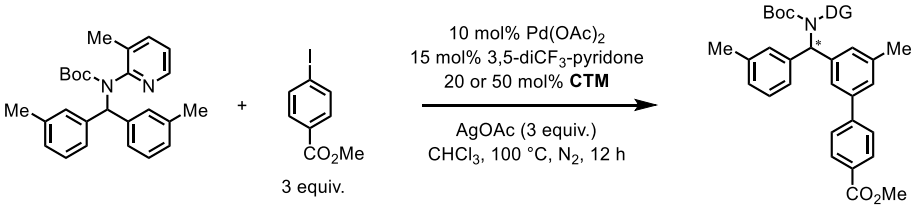
Aryl chloride **1e** (0.183 g, 0.4 mmol, 1 equiv.), $Pd(MeCN)_2Cl_2$ (10 mg, 0.04 mmol, 10 mol%), XPhos (38 mg, 0.08 mmol, 20 mol%), and Cs_2CO_3 (0.65 g, 2.0 mmol, 5.0 equiv.) were added to a flame-dried Schlenk tube. The Schlenk tube was evacuated and back-filled with nitrogen. Ethynyltriisopropylsilane (0.36 mL, 1.6 mmol, 4.0 equiv.) and MeCN (3 mL) were added to the mixture. The Schlenk tube was immersed into a pre-heated oil bath at 90 °C. After 12 h, the oil bath was removed, and the Schlenk tube was allowed to cool to room temperature. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotatory evaporation, the residue was purified by silica gel chromatography (hexane/EtOAc = 20:1 v/v) to afford 0.18 g compound **1g** as a yellow liquid (60% yield).

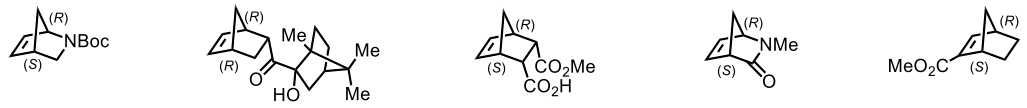
^{1}H NMR (600 MHz, Acetone-d_6) δ 8.11 (d, J = 2.2 Hz, 1H), 7.98 (s, 1H), 7.73 (s, 1H), 7.49–7.06 (m, 7H), 6.56 (s, 1H), 2.21 (s, 3H), 2.02 (s, 3H), 1.28 (s, 9H), 1.13 (s, 42H); ^{13}C NMR (150 MHz, Acetone-d_6) δ 154.12, 151.67, 146.79, 143.03, 140.79, 140.34, 134.36, 132.98, 132.13, 131.26, 131.08, 129.79, 128.99, 128.69,

123.81, 123.39, 108.63, 108.12, 90.45, 80.93, 66.85, 28.29, 19.01, 17.69, 17.63, 12.02. HRMS (ESI-TOF) *m/z* calc'd for $C_{47}H_{69}N_2O_2Si_2$ $[M+H]^+$: 749.4892; found: 749.4891.

B. Optimization of the Reaction Conditions

Table S1. Chiral transient mediator screening*

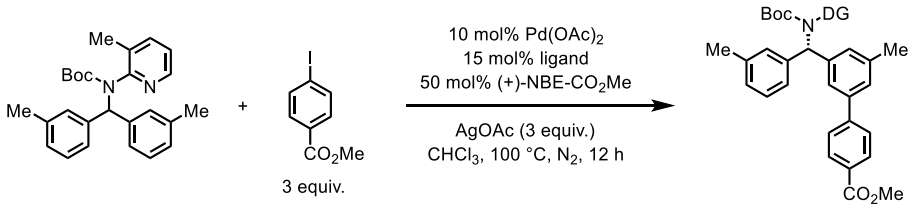


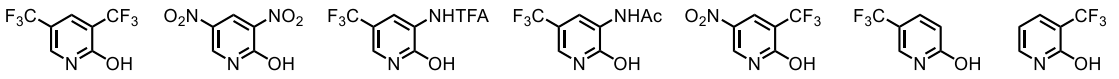


3%, -:- er 60% SM	34%, 55:45 er 49% SM	40%, 35:65 er 46% SM	18%, racemic 11% SM	58%, 88:12 er 30% SM

*The yields were determined by ^{1}H-NMR using CH_2Br_2 as the standard.

Table S2. Ligand screening*

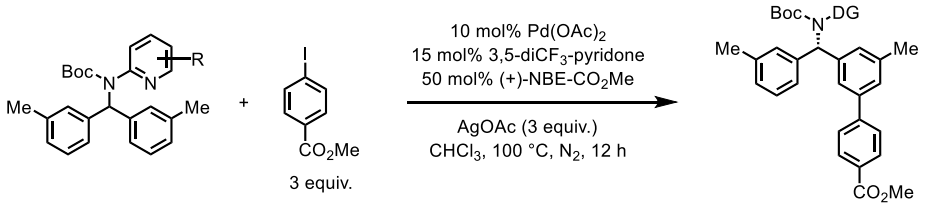


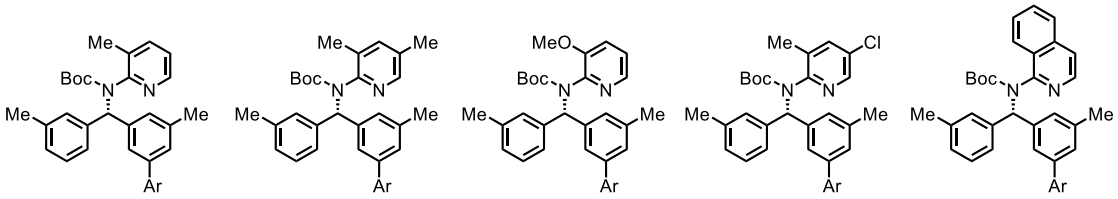


58%, 88:12 er 30% SM	55%, 89:11 er 35% SM	53%, 86:14 er 25% SM	46%, 84:16 er 40% SM	51%, 84:16 er 35% SM	43%, 82:18 er 43% SM	41%, 84:16 er 46% SM

*The yields were determined by ^{1}H-NMR using CH_2Br_2 as the standard.

Table S3. Directing group screening*

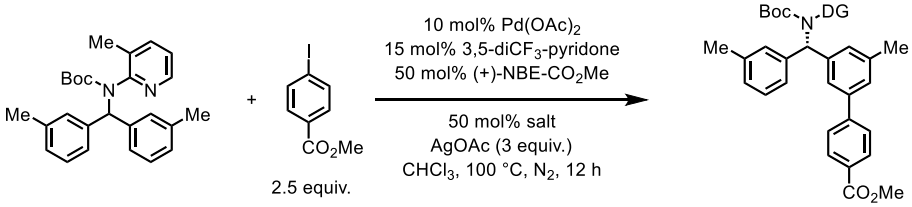




58%, 88:12 er 30% SM	61%, 91:9 er 20% SM	52%, 89:11 er† 9% SM	59%, 82:18 er 6% SM	54% 91:9 er 21% SM

*The yields were determined by ^{1}H-NMR using CH_2Br_2 as the standard. †80 °C.

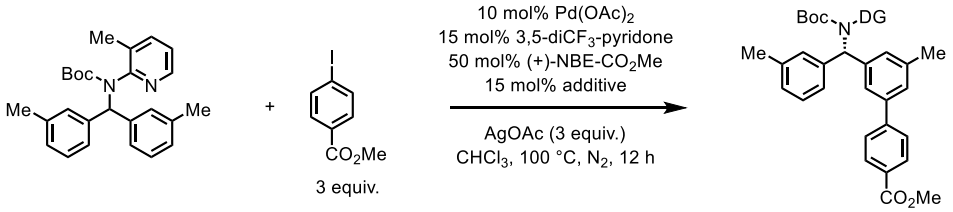
Table S4. Salt screening*



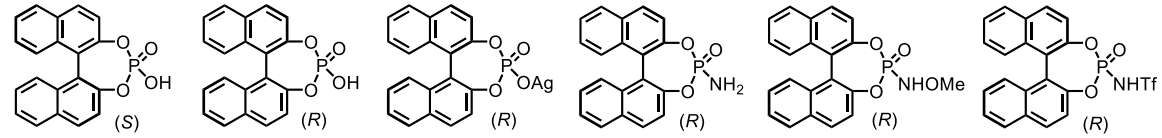
LiOAc	NaOAc	KOAc	CsOAc	LiH_2PO_4
51%, 85:15 er	49%, 84:16 er	49%, 83:17 er	44%, 80:20 er	53%, 86:14 er
NaH_2PO_4	KH_2PO_4	LiF	Li_3PO_4	Cs_2CO_3
50%, 84:16 er	51%, 84:16 er	56%, 87:13 er	55%, 86:14 er	43%, 82:18 er

*The yields were determined by ^{1}H-NMR using CH_2Br_2 as the standard.

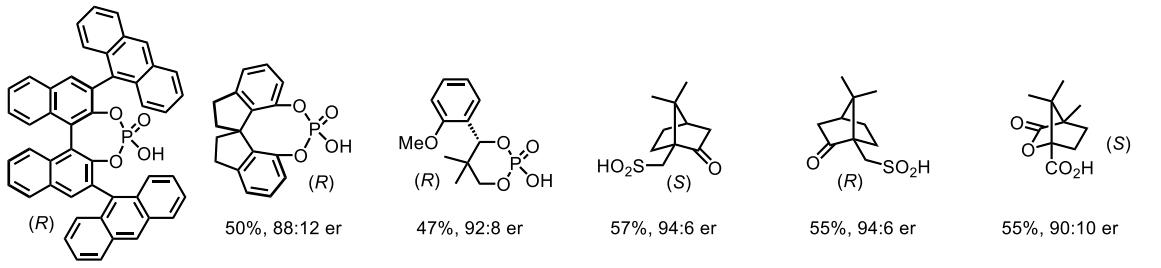
Table S5. Additive screening*



$PhOPO(OH)_2$	$(PhO)_2PO(OH)$	$Ph_2PO(OH)$	$(BuO)_2PO_2H$	$(BnO)_2PO_2H$	$(EtO)_2PO(NH_2)$
49%, 92:8 er	48%, 93:7 er	54%, 90:10 er	60%, 92:8 er	54%, 90:10 er	54%, 88:12 er
$(PhO)_2PO(NH_2)$	$PhSO_2NH_2$	Ad-CO_2H	Ac-L-Val-OH	Ac-D-Val-OH	Ag_3PO_4
53%, 88:12 er	44%, 88:12 er	55%, 89:11 er	52%, 90:10 er	54%, 90:10 er	38%, 85:15 er



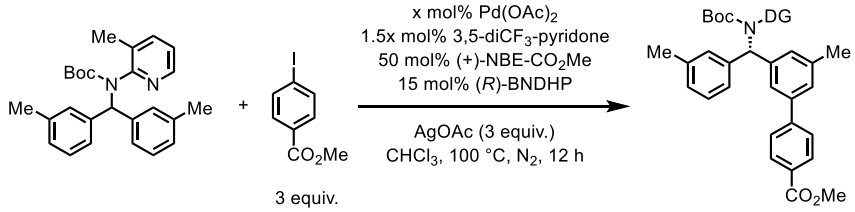
52%, 93:7 er | 70%, 97:3 er | 70%, 97:3 er | 60%, 94:6 er | 66%, 95:5 er | 43%, 92:8 er



41%, 85:15 er | 50%, 88:12 er | 47%, 92:8 er | 57%, 94:6 er | 55%, 94:6 er | 55%, 90:10 er

*The yields were determined by ^{1}H-NMR using CH_2Br_2 as the standard.

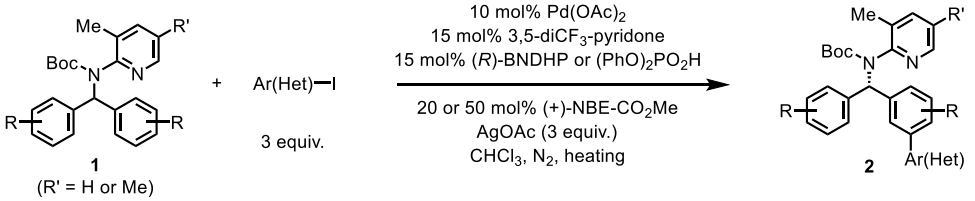
Table S6. Additive screening*



loading of $Pd(OAc)_2$	result*
10 mol%	67% yield, 97:3 er
5 mol%	60% yield, 97:3 er
2.5 mol%	45% yield, 96:4 er

*Isolated yield

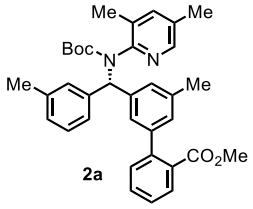
C. Pd/(+)-NBE-CO_2Me Catalyzed Desymmetrization of Diarylmethyl Amines



1 (R' = H or Me) → **2**

General procedure: Arene **1** (0.10 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 10 μmol, 10 mol%), Ligand (3.5 mg, 15 μmol, 15 mol%), hydrogenphosphate (15 μmol, 15 mol%), aryl iodide (0.3 mmol, 3.0 equiv.), and AgOAc (50 mg, 0.30 mmol, 3.0 equiv.) were added into a 2-dram reaction vial. $CHCl_3$ (0.5 mL) and (+)-NBE-CO_2Me (20 mol% or 50 mol%) were added to the mixture. The vial was flushed with N_2, and then capped. The reaction mixture was then stirred at given temperature for 12 or 18 hours. After cooling to room temperature, the mixture was filtered through Celite and eluted with EtOAc (3 × 2 mL). The filtrate was evaporated under reduced pressure. Purification by preparative TLC chromatography afforded the title compound.

In NMR spectra, the carbamate motif caused a broadening of certain peaks. After removing of *tert*-butyloxycarbonyl (Boc) group, the peaks became sharp and clear (see compound **2q**).



2a

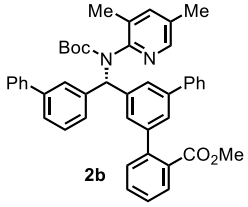
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(*m*-tolyl)methyl)-5'-methyl-[1,1'-biphenyl]-2-carboxylate (2a)

Substrate **1a** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (22 μL, 0.15 mmol, 1.5 equiv.), AgOAc (33 mg, 0.2 mmol, 2.0 equiv.), (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%), and $CHCl_3$ (1 mL) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2a** (39.1 mg) was obtained in 71% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.07 (s, 1H), 7.86–6.58 (m, 8H), 7.70 (d, *J* = 6.4 Hz, 1H), 7.54 (t, *J* = 7.0 Hz, 1H), 7.42 (t, *J* = 7.5 Hz, 1H), 7.19 (s, 1H), 6.44 (s, 1H), 3.54 (s, 3H), 2.47–2.10 (m, 6H), 2.19 (s, 3H), 1.95 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.99, 155.05, 152.02, 146.98, 143.17, 141.83, 140.46, 138.45, 133.52, 133.06, 132.66, 132.23, 131.61, 130.42, 128.67, 128.32, 127.03, 81.22, 68.10, 52.60, 28.64, 21.57, 21.55, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{39}N_2O_4$ $[M+H]^+$: 551.2904; found: 551.2906.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 4.32 min (minor), 4.83 min (major): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



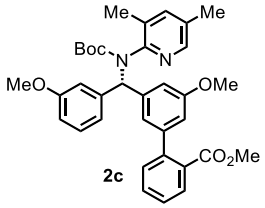
2b

Methyl (*S*)-5'-([1,1'-biphenyl]-3-yl((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)methyl)-[1,1':3',1''-terphenyl]-2-carboxylate (2b)

Substrate **1b** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2b** (43.9 mg) was obtained in 65% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.15 (br s, 1H), 8.14 (s, 1H), 7.87–6.91 (m, 18 H), 7.75 (d, *J* = 7.8 Hz, 1H), 7.56 (t, *J* = 7.6 Hz, 1H), 7.21 (s, 1H), 6.72 (s, 1H), 3.48 (s, 3H), , 2.18 (s, 3 H), 2.00 (s, 3 H), 1.31 (s, 9 H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.78, 155.11, 151.86, 147.19, 142.93, 142.61, 142.08, 141.69, 141.52, 140.65, 133.81, 133.28, 132.55, 132.39, 131.74, 130.60, 130.09, 130.01, 129.50, 128.70, 128.58, 128.53, 128.04, 128.00, 126.69, 81.45, 67.97, 52.61, 28.69, 17.92, 17.88. HRMS (ESI-TOF) *m/z* calc'd for $C_{45}H_{43}N_2O_4$ $[M+H]^+$: 675.3217; found: 675.3215.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 7.12 min (minor), 7.85 min (major): 96:4 er.
The absolute stereochemistry was assigned by analogy to compound **2ah**.



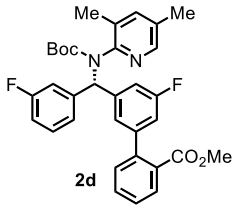
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(3-methoxyphenyl)methyl)-5'-methoxy-[1,1'-biphenyl]-2-carboxylate (2c)

Substrate **1c** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%), and $CHCl_3$ (1.0 mL) at 60 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 7:2 v/v), compound **2c** (35.1 mg) was obtained in 60% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.09 (s, 1H), 7.76–6.50 (m, 8 H), 7.70 (d, J = 7.3 Hz, 1H), 7.54 (t, J = 7.1 Hz, 1H), 7.42 (t, J = 7.4 Hz, 1H), 7.22 (s, 1H), 6.46 (s, 1H), 3.72 (br s, 6H), 3.53 (s, 3H), 2.20 (s, 3H), 1.98 (s, 3H), 1.28 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.87, 160.60, 155.03, 151.89, 147.05, 145.27, 143.15, 142.85, 140.57, 133.65, 133.18, 132.68, 132.22, 131.54, 130.39, 129.87, 128.49, 123.68, 122.24, 115.76, 113.83, 81.32, 67.92, 56.31, 56.10, 52.63, 28.66, 17.93, 17.87. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{39}N_2O_6$ $[M+H]^+$: 583.2803; found: 583.2798.

SFC Chiralpak® AD-3 column (12% isopropanol, 2.0 mL/min) t_r = 5.42 min (major), 6.91 min (minor): 95:5 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



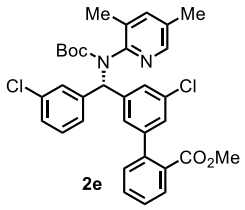
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(3-fluorophenyl)methyl)-5'-fluoro-[1,1'-biphenyl]-2-carboxylate (2d)

Substrate **1d** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2d** (30.0 mg) was obtained in 54% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.08 (s, 1H), 7.85–6.61 (m, 8 H), 7.78 (d, J = 7.4 Hz, 1H), 7.57 (t, J = 7.3 Hz, 1H), 7.47 (t, J = 7.5 Hz, 1H), 7.26 (s, 1H), 6.53 (s, 1H), 3.56 (s, 3H), 2.20 (s, 3H), 2.00 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.32, 163.61 (d, J = 247.5 Hz), 154.82, 151.48, 147.12, 144.33, 141.91, 140.79, 133.00, 132.55, 132.25, 131.62, 130.81, 129.02, 127.10, 126.00, 116.42, 115.01 (d, J = 14.6 Hz), 81.78, 67.02, 52.68, 28.59, 17.87, 17.84; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -115.02, -115.65, -115.77, -116.51. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{33}F_2N_2O_4$ $[M+H]^+$: 559.2403; found: 559.2403.

SFC Chiralpak® AD-3 column (10% isopropanol, 2.0 mL/min) t_r = 3.78 min (major), 4.77 min (minor): 90:10 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



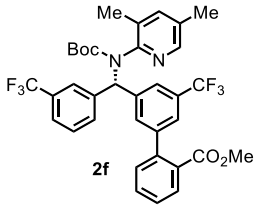
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(3-chlorophenyl)methyl)-5'-chloro-[1,1'-biphenyl]-2-carboxylate (2e)

Substrate **1e** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2e** (37.8 mg) was obtained in 64% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.08 (s, 1H), 8.01–6.66 (m, 8 H), 7.79 (d, J = 7.4 Hz, 1H), 7.57 (t, J = 7.3 Hz, 1H), 7.47 (t, J = 7.5 Hz, 1H), 7.26 (s, 1H), 6.50 (s, 1H), 3.57 (s, 3H), 2.20 (s, 3H), 1.99 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.19, 154.75, 151.43, 147.14, 144.12, 141.77, 140.80, 134.50, 133.94, 132.95, 132.62, 132.10, 131.65, 130.89, 130.62, 129.56, 129.09, 128.37, 128.11, 81.86, 66.94, 52.72, 28.59, 17.88, 17.80. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{33}Cl_2N_2O_4$ $[M+H]^+$: 559.2403; found: 559.2403.

SFC Chiralpak® AD-3 column (15% isopropanol, 2.0 mL/min) t_r = 3.63 min (major), 4.31 min (minor): 92:8 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



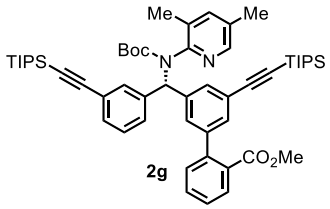
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(3-(trifluoromethyl)phenyl)methyl)-5'-(trifluoromethyl)-[1,1'-biphenyl]-2-carboxylate (2f)

Substrate **1f** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/DCM/Et_2O = 3:3:1 v/v/v), compound **2f** (46.0 mg) was obtained in 70% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.06 (s, 1H), 8.36–6.93 (m, 10 H), 7.84 (d, J = 7.6 Hz, 1H), 7.24 (s, 1H), 6.71 (s, 1H), 3.54 (s, 3H), 2.19 (s, 3H), 1.98 (s, 3H), 1.28 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.07, 154.74, 151.27, 147.21, 143.44, 141.73, 140.87, 134.94, 134.10, 133.67, 132.96, 132.80, 132.02, 131.78, 131.08, 129.98, 129.29, 126.44, 125.19, 82.01, 66.99, 52.63, 28.54, 17.82, 17.69; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -63.10, -63.28, -63.39, -63.50. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{33}F_6N_2O_4$ $[M+H]^+$: 659.2339; found: 659.2336.

SFC Chiralpak® OD-3 column (1% isopropanol, 3.0 mL/min) t_r = 7.52 min (major), 12.33 min (minor): 90:10 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



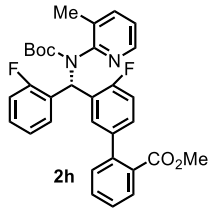
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(3-((triisopropylsilyl)ethynyl)phenyl)methyl)-5'-((triisopropylsilyl)ethynyl)-[1,1'-biphenyl]-2-carboxylate (2g)

Substrate **1g** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 6:1 v/v), compound **2g** (35.3 mg) was obtained in 40% yield as a yellow oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.11–6.83 (m, 9H), 8.06 (s, 1H), 7.77 (d, *J* = 7.7 Hz, 1H), 7.56 (t, *J* = 7.7 Hz, 1H), 7.46 (t, *J* = 7.7 Hz, 1H), 6.49 (s, 1H), 3.56 (s, 3H), 2.20 (s, 3H), 1.98 (s, 3H), 1.28 (s, 9H), 1.14 (d, *J* = 7.2 Hz, 42H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.44, 154.84, 151.71, 147.12, 142.56, 142.12, 140.74, 133.79, 132.91, 132.53, 132.30, 131.61, 131.47, 131.19, 130.76, 129.27, 128.88, 123.90, 108.32, 91.87, 91.62, 81.73, 67.20, 52.67, 28.62, 19.22, 17.93, 17.81, 12.41. HRMS (ESI-TOF) *m/z* calc'd for $C_{55}H_{75}N_2O_4Si_2$ $[M+H]^+$: 883.5260; found: 883.5265.

SFC Chiralpak® OD-3 column (10% isopropanol, 2.0 mL/min) t_r = 18.12 min (major), 20.46 min (minor): 93:7 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



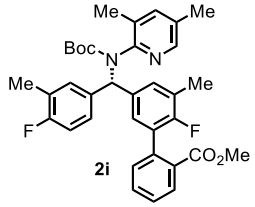
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3-methylpyridin-2-yl)amino)(2-fluorophenyl)methyl)-4'-fluoro-[1,1'-biphenyl]-2-carboxylate (2h)

Substrate **1h** was arylated following the general procedure by using $Pd(OAc)_2$ (4.4 mg, 20 μmol, 20 mol%), Ligand (6.9 mg, 30 μmol, 30 mol%), (*R*)-BNDHP (10.4 mg, 30 μmol, 30 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2h** (22.8 mg) was obtained in 42% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.16 (d, *J* = 5.5 Hz, 1H), 7.92–6.64 (m, 10 H), 7.77 (d, *J* = 8.0 Hz, 1H), 7.56 (t, *J* = 7.6 Hz, 1H), 7.45 (t, *J* = 7.8 Hz, 1H), 7.40 (d, *J* = 7.6 Hz, 1H), 3.58 (s, 3H), 2.13 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.59, 161.52 (d, *J* = 245.6 Hz), 160.88 (d, *J* = 246.0 Hz), 154.60, 152.94, 146.64, 142.33, 140.24, 138.30, 134.47, 133.06, 132.50, 132.35, 131.75, 130.81, 130.72, 130.31, 128.64, 124.82, 123.82, 115.91 (d, *J* = 22.1 Hz), 115.59 (d, *J* = 22.6 Hz), 81.95, 53.89, 52.70, 28.54, 17.44; ^{19}F NMR (376 MHz, Acetonitrile-d_3, 60 °C) δ -118.31, -119.65, -120.95, -122.80. HRMS (ESI-TOF) *m/z* calc'd for $C_{32}H_{31}F_2N_2O_4$ $[M+H]^+$: 545.2246; found: 545.2244.

SFC Chiralpak® IC column (5% isopropanol, 2.0 mL/min) t_r = 12.54 min (minor), 13.87 min (major): 91:9 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



Methyl (*S*)-5'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(4-fluoro-3-methylphenyl)methyl)-2'-fluoro-3'-methyl-[1,1'-biphenyl]-2-carboxylate (2i)

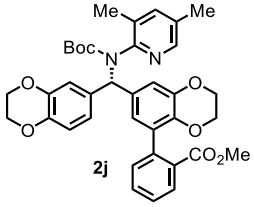
Substrate **1i** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at

100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2i** (42.1 mg) was obtained in 72% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.07 (s, 1H), 7.87 (d, J = 7.8 Hz, 1H), 7.77–6.55 (m, 6H), 7.59 (t, J = 7.7 Hz, 1H), 7.48 (t, J = 7.6 Hz, 1H), 7.24 (s, 1H), 6.44 (s, 1H), 3.60 (s, 3H), 2.36–2.07 (m, 9H), 1.97 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 168.80, 161.41 (d, J = 242.7 Hz), 158.02 (d, J = 242.7 Hz), 157.22, 154.92, 151.76, 147.03, 140.64, 137.60, 134.49, 133.72, 133.09, 132.86, 132.38, 130.91, 129.13, 125.07, 124.94, 124.80, 124.72, 115.15 (d, J = 18.5 Hz), 81.42, 66.76, 52.59, 28.65, 17.87, 17.84, 14.70. ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -121.40, -122.73, -124.84, -126.36. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{37}F_2N_2O_4$ $[M+H]^+$: 587.2716; found: 587.2715.

SFC Chiralpak® AD-3 column (20% isopropanol, 2.0 mL/min) t_r = 2.09 min (major), 2.57 min (minor): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



2j

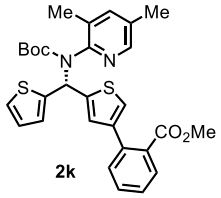
Methyl (*S*)-2-(7-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)methyl)-2,3-dihydrobenzo[*b*][1,4]dioxin-5-yl)benzoate (2j)

Substrate **1j** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 1:1 v/v), compound **2j** (33.1 mg) was obtained in 52% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.09 (s, 1H), 7.77 (d, J = 7.7 Hz, 1H), 7.54 (t, J = 7.5 Hz, 1H), 7.47–6.35 (m, 6H), 7.41 (t, J = 7.6 Hz, 1H), 7.25 (s, 1H), 6.30 (s, 1H), 4.30–4.00 (m, 8H), 3.64 (s, 3H), 2.22 (s, 3H), 1.99 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.20, 154.98, 152.00, 147.00, 144.23, 143.81, 140.60, 138.96, 133.55, 133.16, 132.57, 132.28, 130.88, 130.29, 128.49, 123.75, 117.34, 81.15, 66.97, 65.56, 65.44, 65.37, 52.50, 28.70, 17.96, 17.92. HRMS (ESI-TOF) *m/z* calc'd for $C_{37}H_{39}N_2O_8$ $[M+H]^+$: 639.2701; found: 639.2698.

SFC Chiralpak® AD-3 column (15% isopropanol, 2.0 mL/min) t_r = 8.55 min (major), 10.37 min (minor): 94:6 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



2k

Methyl (*S*)-2-(5-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(thiophen-2-yl)methyl)thiophen-3-yl)benzoate (2k)

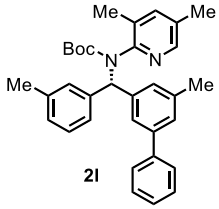
Substrate **1k** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), methyl 2-iodobenzoate (22 μL, 0.15 mmol, 1.5 equiv.), AgOAc (33 mg, 0.2 mmol, 2.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2k** (23.5 mg) was obtained in 44% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.13 (s, 1H), 7.64 (d, J = 7.7 Hz, 1H), 7.52 (t, J = 7.6 Hz, 1H), 7.48–6.88 (m, 6H), 7.40 (t, J = 7.5 Hz, 1H), 7.35 (s, 1H), 6.84 (s, 1H), 3.66 (s, 3H), 2.27 (s, 3H), 2.02 (s, 3H),

1.36 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 170.29, 154.34, 151.91, 147.28, 145.17, 141.16, 140.82, 137.02, 133.89, 132.76, 132.72, 132.21, 131.22, 130.12, 129.64, 128.67, 128.43, 127.22, 126.98, 123.79, 82.13, 59.31, 52.86, 28.67, 17.94, 17.90. HRMS (ESI-TOF) *m/z* calc'd for $C_{29}H_{31}N_2O_2S_2$ $[M+H]^+$: 535.1720; found: 535.1721.

SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 4.13 min (major), 5.24 min (minor): 70:30 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



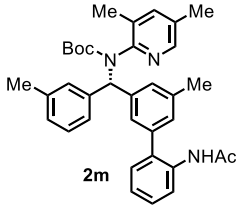
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)carbamate (2l)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), iodobenzene (33.6 μL, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 20:1 v/v), compound **2l** (30.6 mg) was obtained in 62% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.12 (s, 1H), 7.98–6.72 (m, 11H), 7.33 (t, *J* = 7.5 Hz, 1H), 7.19 (s, 1H), 6.49 (s, 1H), 2.41–2.12 (m, 6H), 2.19 (s, 3H), 1.97 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.10, 152.06, 147.03, 142.30, 141.58, 140.46, 139.11, 138.47, 133.56, 133.07, 129.97, 128.76, 128.65, 128.42, 127.97, 127.28, 81.23, 68.10, 28.65, 21.61, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{37}N_2O_2$ $[M+H]^+$: 493.2850; found: 493.2848.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 3.85 min (minor), 4.59 min (major): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



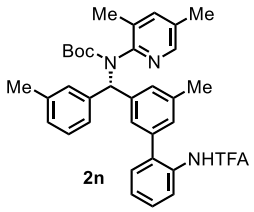
***tert*-Butyl (*S*)-((2'-acetamido-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2m)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (78.3 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 1:1 v/v), compound **2m** (41.3 mg) was obtained in 62% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.07 (s, 1H), 7.90 (s, 1H), 7.83–6.67 (m, 11H), 7.32 (t, *J* = 8.0 Hz, 1H), 6.48 (s, 1H), 2.53–2.11 (m, 6H), 2.20 (s, 3H), 1.96 (s, 3H), 1.84 (s, 3H), 1.28 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 169.63, 155.05, 151.99, 147.00, 140.49, 139.24, 138.51, 136.34, 135.56, 133.59, 133.09, 131.16, 129.31, 128.92, 128.80, 125.91, 124.89, 81.27, 68.04, 28.65, 24.29, 21.61, 17.88. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{40}N_3O_3$ $[M+H]^+$: 550.3064; found: 550.3068.

SFC Chiralpak® AD-3 column (15% isopropanol, 1.0 mL/min) t_r = 11.05 min (major), 12.83 min (major): 92:8 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



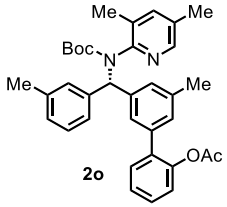
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((5-methyl-2'-(2,2,2-trifluoroacetamido)-[1,1'-biphenyl]-3-yl)(m-tolyl)methyl)carbamate (2n)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (94.4 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2n** (27.8 mg) was obtained in 46% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.56 (br s, 1H), 8.08 (s, 1H), 7.83–6.59 (m, 8H), 7.73 (s, 1H), 7.43 (t, *J* = 7.8 Hz, 1H), 7.38 (t, *J* = 7.4 Hz, 1H), 7.20 (s, 1H), 6.47 (s, 1H), 2.47–2.11 (m, 6H), 2.20 (s, 3H), 1.94 (s, 3H), 1.28 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 156.38 (q, *J* = 36.9 Hz), 151.97, 147.01, 140.49, 139.00, 138.49, 138.15, 133.58, 133.07, 133.03, 131.62, 129.41, 128.95, 128.75, 128.59, 126.19, 118.15 (q, *J* = 288.2 Hz), 81.29, 68.00, 28.63, 21.51, 17.85, 17.83. ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -76.72, -76.82. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{37}F_3N_3O_3$ $[M+H]^+$: 604.2782; found: 604.2779.

SFC Chiralpak® IC column (10% isopropanol, 2.0 mL/min) t_r = 5.15 min (minor), 5.89 min (major): 90:10 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



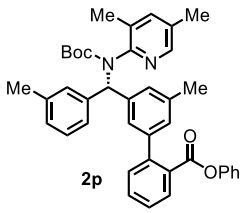
(*S*)-3'-(((*tert*-Butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(m-tolyl)methyl)-5'-methyl-[1,1'-biphenyl]-2-yl acetate (2o)

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (78.6 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2o** (23.1 mg) was obtained in 42% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.07 (s, 1H), 7.18 (s, 1H), 7.68–6.78 (m, 11H), 2.35 (d, *J* = 35.6 Hz, 3H), 2.22–2.09 (m, 6H), 1.93 (s, 3H), 1.90 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 170.31, 155.06, 152.01, 149.20, 146.98, 140.48, 138.55, 138.20, 136.03, 133.53, 133.04, 131.75, 129.59, 128.98, 128.84, 128.73, 127.45, 124.30, 81.25, 68.14, 28.65, 21.59, 21.09, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{39}N_2O_4$ $[M+H]^+$: 551.2904; found: 551.2900.

SFC Chiralpak® AD-3 column (20% isopropanol/hexane (v/v = 1/1), 2.0 mL/min) t_r = 3.68 min (major), 4.18 min (minor): 71:29 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



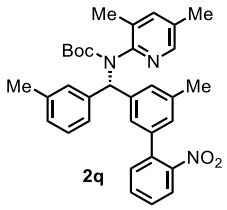
Phenyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(*m*-tolyl)methyl)-5'-methyl-[1,1'-biphenyl]-2-carboxylate (2p)

Substrate **1a** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), aryl iodide (48.6 mg, 0.15 mmol, 1.5 equiv.), AgOAc (33 mg, 0.2 mmol, 2.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2p** (39.9 mg) was obtained in 65% yield as a white solid.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.04 (s, 1H), 7.92 (d, J = 7.8 Hz, 1H), 7.79–6.66 (m, 11H), 7.62 (t, J = 7.6 Hz, 1H), 7.51 (t, J = 7.6 Hz, 1H), 7.34 (t, J = 7.7 Hz, 2H), 7.23 (t, J = 7.5 Hz, 1H), 6.48 (s, 1H), 2.48–2.08 (m, 6H), 2.15 (s, 3H), 1.92 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 168.23, 155.04, 152.13, 151.99, 146.98, 143.65, 141.85, 140.48, 138.41, 133.47, 132.98, 132.88, 131.80, 131.00, 130.49, 128.99, 128.65, 128.54, 126.96, 122.63, 81.23, 68.04, 28.64, 21.56, 17.87. HRMS (ESI-TOF) *m/z* calc'd for $C_{40}H_{41}N_2O_4$ $[M+H]^+$: 613.3061; found: 613.3055.

SFC Chiralpak® AD-3 column (20% isopropanol, 2.0 mL/min) t_r = 3.53 min (major), 5.47 min (minor): 98:2 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



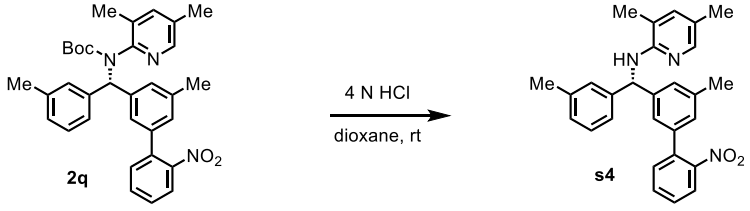
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((5-methyl-2'-nitro-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)carbamate (2q)**

Substrate **1a** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), aryl iodide (37.4 mg, 0.15 mmol, 1.5 equiv.), AgOAc (33 mg, 0.2 mmol, 2.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2q** (39.9 mg) was obtained in 62% yield as a yellow oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.08 (s, 1H), 7.96–6.69 (m, 8H), 7.84 (d, J = 8.1 Hz, 1H), 7.66 (t, J = 7.7 Hz, 1H), 7.53 (t, J = 7.8 Hz, 1H), 7.20 (s, 1H), 6.45 (s, 1H), 2.45–2.10 (m, 6H), 2.20 (s, 3H), 1.96 (s, 3H), 1.28 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.99, 151.89, 150.64, 147.00, 140.49, 139.00, 138.47, 138.26, 137.19, 133.58, 133.52, 132.98, 131.91, 130.17, 129.58, 128.74, 128.08, 126.63, 125.09, 81.29, 67.91, 28.64, 21.49, 17.88, 17.85. HRMS (ESI-TOF) *m/z* calc'd for $C_{353}H_{36}N_3O_4$ $[M+H]^+$: 538.2700; found: 538.2694.

SFC Chiralpak® IC column (15% isopropanol, 2.0 mL/min) t_r = 6.06 min (minor), 5.87 min (major): 96:4 er.

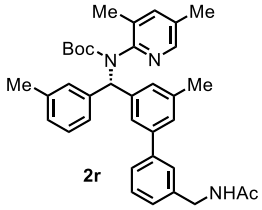
The absolute stereochemistry was assigned by analogy to compound **2ah**.



(*S*)-3,5-Dimethyl-*N*-((5-methyl-2'-nitro-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)pyridin-2-amine (s4)

To a solution of **2q** (27 mg, 0.05 mmol) was dissolved in dioxane (0.25 mL), HCl solution (4 N in dioxane) was added. The reaction mixture was stirred at room temperature for 3 hours. Aqueous $NaHCO_3$ solution was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were washed with aqueous NaCl solution, and then dried over Na_2SO_4. The organic solvent was concentrated by rotatory. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **s4** (19.1 mg) was obtained in 85% yield as a yellow liquid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.80–7.75 (m, 2H), 7.55 (td, *J* = 7.6, 1.3 Hz, 1H), 7.43 (td, *J* = 7.8, 1.4 Hz, 1H), 7.40 (dd, *J* = 7.7, 1.4 Hz, 1H), 7.20 (t, *J* = 7.5 Hz, 1H), 7.16 (s, 1H), 7.14–7.10 (m, 2H), 7.09–7.04 (m, 3H), 7.02 (s, 1H), 6.43 (d, *J* = 6.9 Hz, 1H), 4.49 (d, *J* = 6.9 Hz, 1H), 2.33 (d, *J* = 8.8 Hz, 6H), 2.13 (d, *J* = 5.8 Hz, 6H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 154.09, 149.73, 145.24, 144.43, 143.62, 138.78, 138.53, 138.44, 137.36, 136.67, 132.29, 132.12, 128.74, 128.70, 128.66, 128.14, 128.10, 127.46, 124.88, 124.33, 124.15, 121.99, 116.38, 58.64, 21.76, 17.59, 17.26. HRMS (ESI-TOF) *m/z* calc'd for $C_{28}H_{28}N_3O_2$ $[M+H]^+$: 468.2176; found: 468.2182.



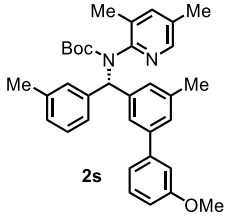
***tert*-Butyl (*S*)-((3'-(acetamidomethyl)-5-methyl-[1,1'-biphenyl]-3-yl)(m-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2r)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (82.5 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 1:6 v/v), compound **2r** (39.6 mg) was obtained in 70% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.13 (s, 1H), 8.05–6.62 (m, 9H), 7.37 (t, *J* = 7.7 Hz, 1H), 7.25 (d, *J* = 7.2 Hz, 1H), 7.19 (dd, *J* = 1.8 Hz, *J* = 0.6 Hz, 1H), 6.73 (s, 1H), 6.48 (s, 1H), 4.37 (d, *J* = 6.0 Hz, 2H), 2.47–2.13 (m, 6H), 2.19 (s, 3H), 1.97 (s, 3H), 1.92 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 170.82, 155.11, 152.03, 147.06, 142.44, 141.48, 141.39, 140.47, 139.11, 138.48, 133.56, 133.06, 130.07, 128.81, 128.67, 127.56, 127.29, 127.14, 126.64, 81.25, 68.10, 44.03, 28.67, 23.25, 21.62, 17.88. HRMS (ESI-TOF) *m/z* calc'd for $C_{36}H_{42}N_3O_3$ $[M+H]^+$: 564.3221; found: 564.3229.

SFC Chiralpak® OJ column (20% isopropanol, 2.0 mL/min) t_r = 3.17 min (minor), 3.68 min (major): 95:5 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



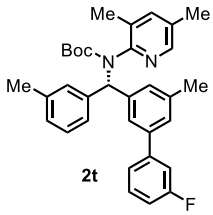
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((3'-methoxy-5-methyl-[1,1'-biphenyl]-3-yl)(m-tolyl)methyl)carbamate (2s)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (70.2 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2s** (35.1 mg) was obtained in 67% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.12 (s, 1H), 7.75–6.59 (m, 9H), 7.34 (d, *J* = 6.3 Hz, 1H), 7.19 (s, 1H), 6.90 (d, *J* = 7.6 Hz, 1H), 6.49 (s, 1H), 3.84 (s, 3H), 2.45–2.07 (m, 6H), 2.19 (s, 3H), 1.97 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 161.47, 155.09, 152.07, 147.02, 143.84, 141.42, 140.47, 139.07, 138.47, 133.56, 133.07, 131.02, 128.77, 128.66, 127.31, 120.41, 114.03, 113.77, 81.21, 68.08, 56.21, 28.66, 21.60, 17.87. HRMS (ESI-TOF) *m/z* calc'd for $C_{34}H_{39}N_2O_3$ $[M+H]^+$: 523.2955; found: 523.2956.

SFC Chiralpak® AD-3 column (10% isopropanol, 1.5 mL/min) t_r = 8.61 min (major), 9.37 min (minor): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



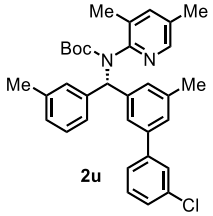
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((3'-fluoro-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)carbamate (2t)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (70.2 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 20:1 v/v), compound **2t** (35.1 mg) was obtained in 67% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.13 (s, 1H), 8.07–6.67 (m, 9H), 7.43 (d, *J* = 7.5 Hz, 1H), 7.19 (s, 1H), 7.07 (t, *J* = 7.8 Hz, 1H), 6.49 (s, 1H), 2.47–2.10 (m, 6H), 2.19 (s, 3H), 1.96 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 164.40 (d, *J* = 244.4 Hz), 155.09, 152.00, 147.04, 144.82, 140.50, 140.21, 139.33, 138.49, 133.62, 133.11, 131.78, 131.72, 128.80, 127.34, 123.87, 119.02, 114.97 (d, *J* = 21.9 Hz), 114.60 (d, *J* = 21.8 Hz), 81.27, 68.01, 28.65, 21.60, 17.85. ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -114.97. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{36}FN_2O_2$ $[M+H]^+$: 511.2755; found: 511.2747.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 3.33 min (minor), 4.13 min (major): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



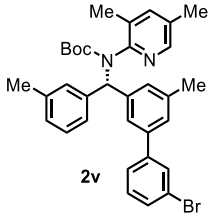
***tert*-Butyl (*S*)-((3'-chloro-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2u)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (71.8 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 20:1 v/v), compound **2u** (33.8 mg) was obtained in 64% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.13 (s, 1H), 7.80–6.66 (m, 9H), 7.40 (t, *J* = 7.4 Hz, 1H), 7.34 (d, *J* = 6.6 Hz, 1H), 7.19 (s, 1H), 6.49 (s, 1H), 2.49–2.11 (m, 6H), 2.20 (s, 3H), 1.96 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.08, 151.99, 147.03, 144.38, 140.50, 140.05, 139.36, 138.49, 135.45, 133.63, 133.12, 131.56, 129.98, 128.76, 128.26, 127.93, 127.31, 126.43, 81.28, 67.99, 28.65, 21.58, 17.87, 17.83. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{36}ClN_2O_2$ $[M+H]^+$: 527.2460; found: 527.2462.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 3.99 min (minor), 5.21 min (major): 95:5 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



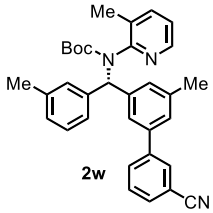
***tert*-Butyl (*S*)-((3'-bromo-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2v)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (85.0 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 20:1 v/v), compound **2v** (41.8 mg) was obtained in 73% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.13 (s, 1H), 8.05–6.64 (m, 9H), 7.49 (d, *J* = 7.9 Hz, 1H), 7.33 (t, *J* = 7.6 Hz, 1H), 7.19 (s, 1H), 6.49 (s, 1H), 2.46–2.10 (m, 6H), 2.20 (s, 3H), 1.96 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.08, 151.99, 147.02, 144.64, 140.50, 139.96, 139.36, 138.49, 133.63, 133.12, 131.81, 131.24, 130.88, 128.80, 127.32, 126.85, 123.61, 81.28, 67.98, 28.66, 21.58, 17.89, 17.83. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{36}BrN_2O_2$ $[M+H]^+$: 571.1955; found: 571.1953.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 4.42 min (minor), 5.76 min (major): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



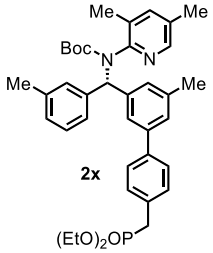
***tert*-Butyl (*S*)-((3'-cyano-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3-methylpyridin-2-yl)carbamate (2w)**

Substrate **1a'** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (91.2 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2w** (34.6 mg) was obtained in 69% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.29 (d, *J* = 3.3 Hz, 1H), 8.15–6.71 (m, 9H), 7.66 (d, *J* = 7.7 Hz, 1H), 7.57 (t, *J* = 7.8 Hz, 1H), 7.38 (d, *J* = 7.3 Hz, 1H), 7.05 (dd, *J* = 7.5, 4.7 Hz, 1H), 6.53 (s, 1H), 2.28 (br d, *J* = 53.6 Hz, 6H), 2.03 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.92, 154.34, 146.86, 143.41, 140.02, 139.57, 139.40, 138.54, 133.94, 132.45, 131.91, 131.61, 131.02, 128.81, 127.37, 123.79, 119.80, 113.95, 81.43, 67.97, 28.63, 21.58, 18.00. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{34}N_3O_2$ $[M+H]^+$: 504.2646; found: 504.2658.

SFC Chiralpak® OJ-3 column (20% isopropanol, 2.0 mL/min) t_r = 2.55 min (minor), 4.11 min (major): 90:10 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



***tert*-Butyl (*S*)-((4'-((diethoxyphosphoryl)methyl)-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2x)**

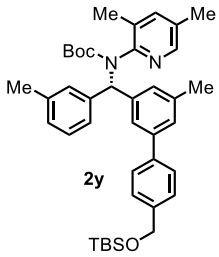
Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (106.2 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (toluene/THF = 3:2 v/v), compound **2x** (44.2 mg) was obtained in 69% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.12 (s, 1H), 7.76–6.68 (m, 11H), 7.19 (s, 1H), 6.48 (s, 1H), 4.02 (p, *J* = 7.3 Hz, 4H), 3.17 (d, *J* = 21.5 Hz, 2H), 2.41–2.14 (m, 6H), 2.19 (s, 3H), 1.97 (s, 3H), 1.29 (s, 9H),

1.24 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.11, 152.07, 147.04, 141.16, 140.71, 140.47, 139.12, 138.47, 133.56, 133.08, 132.90, 132.84, 131.50, 131.45, 128.79, 128.67, 127.90, 127.14, 81.24, 68.10, 63.03, 62.99, 34.31, 33.40, 28.66, 21.61, 17.86, 16.91, 16.87. HRMS (ESI-TOF) *m/z* calc'd for $C_{38}H_{48}N_2O_5P$ $[M+H]^+$: 634.3295; found: 634.3297.

SFC Chiralpak® AD-3 column (20% isopropanol, 2.0 mL/min) t_r = 3.66 min (major), 4.71 min (minor): 95:5 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



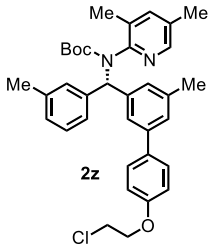
***tert*-Butyl (*S*)-((4'-(((tert-butyldimethylsilyl)oxy)methyl)-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2y)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (104 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 15:1 v/v), compound **2y** (36.2 mg) was obtained in 57% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.12 (s, 1H), 7.72–6.78 (m, 11H), 7.19 (s, 1H), 6.48 (s, 1H), 4.77 (s, 2H), 2.44–2.14 (m, 6H), 2.19 (s, 3H), 1.96 (s, 3H), 1.29 (s, 9H), 0.97 (s, 9H), 0.13 (s, 6H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.09, 152.08, 147.03, 142.01, 141.38, 140.98, 140.46, 139.07, 138.46, 133.55, 133.07, 128.78, 128.64, 128.00, 127.81, 127.20, 81.22, 68.11, 65.76, 28.66, 26.55, 21.62, 19.20, 17.86, -4.81. HRMS (ESI-TOF) *m/z* calc'd for $C_{40}H_{53}N_2O_3Si$ $[M+H]^+$: 637.3820; found: 637.3820.

SFC Chiralpak® AD-3 column (10% isopropanol, 2.0 mL/min) t_r = 4.67 min (major), 5.45 min (minor): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



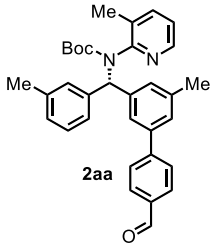
***tert*-Butyl (*S*)-((4'-(2-chloroethoxy)-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2z)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (85 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2z** (38.7 mg) was obtained in 68% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.12 (s, 1H), 7.99–6.65 (m, 11H), 7.19 (s, 1H), 6.48 (s, 1H), 4.29 (t, *J* = 5.5 Hz, 2H), 3.87 (t, *J* = 5.4 Hz, 2H), 2.44–2.08 (m, 6H), 2.19 (s, 3H), 1.96 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 159.24, 155.09, 152.07, 147.02, 141.01, 140.45, 139.02, 138.43, 135.41, 133.55, 133.07, 130.33, 129.13, 128.79, 128.64, 126.87, 116.44, 81.21, 69.70, 68.11, 43.82, 28.66, 21.62, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{40}ClN_2O_3$ $[M+H]^+$: 571.2722; found: 571.2726.

SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 3.26 min (minor), 3.92 min (major): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



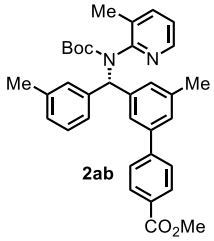
***tert*-Butyl (*S*)-((4'-formyl-5-methyl-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3-methylpyridin-2-yl)carbamate (2aa)**

Substrate **1a'** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (69.6 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2aa** (38.4 mg) was obtained in 76% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 10.03 (s, 1H), 8.29 (d, *J* = 3.4 Hz, 1H), 7.93 (d, *J* = 7.8 Hz, 2H), 7.97–6.85 (m, 9H), 7.38 (d, *J* = 7.2 Hz, 1H), 7.04 (dd, *J* = 7.5, 4.7 Hz, 1H), 6.54 (s, 1H), 2.28 (br d, *J* = 57.8 Hz, 6H), 2.04 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 193.13, 154.92, 154.36, 148.01, 146.88, 140.22, 140.01, 139.48, 138.54, 136.80, 133.89, 131.15, 128.81, 128.60, 127.58, 123.76, 81.43, 68.00, 28.63, 21.60, 18.01. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{35}N_2O_3$ $[M+H]^+$: 507.2642; found: 507.2637.

SFC Chiralpak® OJ-3 column (30% isopropanol, 2.5 mL/min) t_r = 1.74 min (minor), 2.51 min (major): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



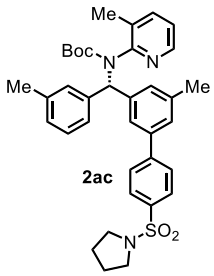
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3-methylpyridin-2-yl)amino)(*m*-tolyl)methyl)-5'-methyl-[1,1'-biphenyl]-4-carboxylate (2ab)

Substrate **1a'** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (78 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2ab** (36.0 mg) was obtained in 67% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.31 (d, *J* = 4.7 Hz, 1H), 8.07 (d, *J* = 8.0 Hz, 2H), 7.87–6.60 (m, 9H), 7.40 (d, *J* = 7.5 Hz, 1H), 7.07 (dd, *J* = 7.5, 4.7 Hz, 1H), 6.56 (s, 1H), 3.92 (s, 3H), 2.30 (br d, *J* = 53.0 Hz, 6H), 2.06 (s, 3H), 1.32 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 167.75, 154.93, 154.38, 146.89, 146.66, 140.36, 140.01, 139.42, 138.54, 133.90, 131.01, 130.38, 128.78, 128.06, 127.47, 123.77, 81.42, 68.02, 52.76, 28.63, 21.60, 18.01. HRMS (ESI-TOF) *m/z* calc'd for $C_{34}H_{37}N_2O_4$ $[M+H]^+$: 537.2748; found: 537.2752.

SFC Chiralpak® AD-3 column (15% isopropanol/hexane (v/v = 1/1), 2.0 mL/min) t_r = 8.76 min (minor), 9.38 min (major): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



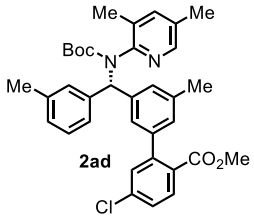
***tert*-Butyl (*S*)-((5-methyl-4'-(pyrrolidin-1-ylsulfonyl)-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3-methylpyridin-2-yl)carbamate (2ac)**

Substrate **1a'** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (101 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **2ac** (44.6 mg) was obtained in 73% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.29 (d, *J* = 4.7 Hz, 1H), 7.97–6.74 (m, 9H), 7.85 (d, *J* = 7.9 Hz, 2H), 7.38 (d, *J* = 7.6 Hz, 1H), 7.04 (dd, *J* = 7.5, 4.7 Hz, 1H), 6.54 (s, 1H), 3.28–3.14 (m, 4H), 2.28 (br d, *J* = 63.2 Hz, 6H), 2.03 (s, 3H), 1.82–1.65 (m, 4H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.91, 154.34, 146.89, 146.42, 140.02, 139.82, 139.54, 138.54, 137.19, 133.91, 130.96, 129.17, 128.82, 128.55, 127.53, 123.78, 81.44, 67.97, 49.12, 28.63, 26.09, 21.61, 21.57, 18.01. HRMS (ESI-TOF) *m/z* calc'd for $C_{36}H_{42}N_3O_4S$ $[M+H]^+$: 612.2891; found: 612.2892.

SFC Chiralpak® OJ-3 column (10% isopropanol, 3 min, then 40% isopropanol, 2.5 mL/min) t_r = 3.68 min (minor), 5.06 min (major): 92:8 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



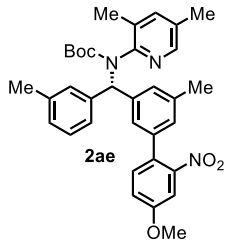
Methyl (*S*)-3'-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(*m*-tolyl)methyl)-5-chloro-5'-methyl-[1,1'-biphenyl]-2-carboxylate (2ad)

Substrate **1a** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), aryl iodide (44.6 mg, 0.15 mmol, 1.5 equiv.), AgOAc (33 mg, 0.2 mmol, 2.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2ad** (48.4 mg) was obtained in 83% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.07 (s, 1H), 7.85–6.55 (m, 8H), 7.71 (s, 1H), 7.53 (d, *J* = 8.2 Hz, 1H), 7.19 (s, 1H), 6.45 (s, 1H), 3.56 (s, 3H), 2.53–2.09 (m, 6H), 2.19 (s, 3H), 1.95 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 168.63, 155.01, 151.97, 146.97, 141.81, 140.47, 138.49, 138.45, 134.14, 133.86, 133.51, 133.28, 133.04, 128.72, 128.53, 126.98, 81.25, 68.04, 52.94, 28.65, 21.56, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{38}ClN_2O_4$ $[M+H]^+$: 585.2515; found: 585.2516.

SFC Chiralpak® IC column (25% isopropanol, 2.0 mL/min) t_r = 3.37 min (minor), 3.69 min (major): 98:2 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



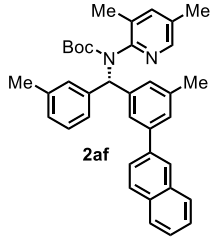
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((4'-methoxy-5-methyl-2'-nitro-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)carbamate (2ae)**

Substrate **1a** was arylated following the general procedure by using $(PhO)_2PO_2H$ (3.8 mg, 15 μmol, 15 mol%), aryl iodide (44.6 mg, 0.15 mmol, 1.5 equiv.), AgOAc (33 mg, 0.2 mmol, 2.0 equiv.), and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) at 80 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **2ae** (48.4 mg) was obtained in 83% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.11 (s, 1H), 7.90–6.54 (m, 10H), 7.41 (s, 1H), 6.46 (s, 1H), 3.92 (s, 3H), 2.51–2.14 (m, 6H), 2.23 (s, 3H), 1.98 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 160.57, 155.01, 151.91, 151.12, 147.00, 140.49, 138.94, 138.47, 138.06, 133.84, 133.52, 132.99, 129.92, 128.73, 128.21, 126.79, 119.63, 110.45, 81.29, 67.94, 57.07, 28.64, 21.56, 21.48, 17.87. HRMS (ESI-TOF) *m/z* calc'd for $C_{34}H_{38}N_3O_5$ $[M+H]^+$: 568.2806; found: 568.2805.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 4.84 min (minor), 5.48 min (major): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



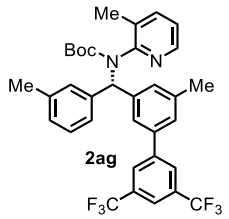
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((3-methyl-5-(naphthalen-2-yl)phenyl)(*m*-tolyl)methyl)carbamate (2af)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (76.2 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/THF = 6:1 v/v), compound **2af** (35.8 mg) was obtained in 66% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.37–6.65 (m, 12H), 8.16 (s, 1H), 7.51 (p, J = 7.0 Hz, 2H), 7.20 (s, 1H), 6.53 (s, 1H), 2.52–2.10 (m, 6H), 2.19 (s, 3H), 1.98 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.12, 152.09, 147.06, 141.38, 140.49, 139.65, 139.23, 138.48, 134.96, 133.89, 133.58, 133.11, 129.55, 129.25, 128.81, 128.71, 127.56, 127.18, 126.51, 126.46, 81.25, 68.13, 28.68, 21.67, 21.61, 17.88. HRMS (ESI-TOF) *m/z* calc'd for $C_{37}H_{39}N_2O_2$ $[M+H]^+$: 543.3006; found: 543.3004.

SFC Chiralpak® AD-3 column (20% isopropanol, 2.0 mL/min) t_r = 4.56 min (major), 6.43 min (minor): 95:5 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



***tert*-Butyl (*S*)-((5-methyl-3',5'-bis(trifluoromethyl)-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3-**

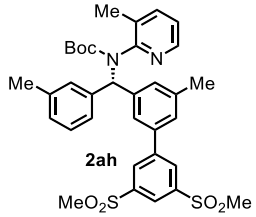
methylpyridin-2-yl)carbamate (2ag)

Substrate **1a'** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (102 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/toluene/EtOAc = 4:2:1 v/v/v), compound **2ag** (40.6 mg) was obtained in 66% yield as a white solid.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.55–6.69 (m, 9H), 8.31–8.25 (m, 1H), 7.95 (s, 1H), 7.39 (d, *J* = 7.7 Hz, 1H), 7.06 (ddd, *J* = 7.4, 4.6, 2.5 Hz, 1H), 6.55 (s, 1H), 2.29 (d, *J* = 74.2 Hz, 3H), 2.03 (s, 3H), 1.29 (d, *J* = 2.5 Hz, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.95, 154.31, 146.83, 144.70, 140.08, 139.89, 138.58, 138.49, 134.06, 133.23, 132.90 (q, *J* = 33.1 Hz), 128.87, 128.43, 127.59, 126.42, 124.88 (q, *J* = 271.9 Hz), 122.98 (hept, *J* = 3.8 Hz), , 81.49, 67.88, 28.61, 21.54, 17.97; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -63.57. HRMS (ESI-TOF) *m/z* calc'd for $C_{34}H_{33}F_6N_2O_2$ $[M+H]^+$: 615.2441; found: 615.2445.

SFC Chiralpak® IC column (5% isopropanol, 1.0 mL/min) t_r = 6.85 min (minor), 7.71 min (major): 99:1 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



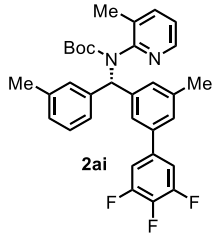
***tert*-Butyl (*S*)-((5-methyl-3',5'-bis(methylsulfonyl)-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)(3-methylpyridin-2-yl)carbamate (2ah)**

Substrate **1a'** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (108 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 1:1 v/v), compound **2ah** (51.0 mg) was obtained in 80% yield as a white solid.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.71–6.72 (m, 9H), 8.37–8.32 (m, 2H), 7.39 (dd, *J* = 7.6, 1.8 Hz, 1H), 7.07 (dd, *J* = 7.6, 4.7 Hz, 1H), 6.57 (s, 1H), 3.18 (s, 6H), 2.30 (br d, *J* = 84.6 Hz, 6H), 2.04 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.93, 154.19, 146.97, 145.28, 144.38, 140.08, 140.02, 138.58, 138.13, 134.02, 131.21, 128.87, 127.62, 125.70, 123.93, 81.52, 67.85, 44.78, 28.64, 21.55, 17.99. HRMS (ESI-TOF) *m/z* calc'd for $C_{34}H_{39}N_2O_6S_2$ $[M+H]^+$: 635.2244; found: 635.2241.

SFC Chiralpak® OJ-3 column (15% isopropanol, 2.0 mL/min) t_r = 4.87 min (minor), 5.65 min (major): 96:4 er.

The absolute stereochemistry was determined by X-ray crystallography.



***tert*-Butyl (*S*)-(3-methylpyridin-2-yl)(*m*-tolyl(3',4',5'-trifluoro-5-methyl-[1,1'-biphenyl]-3-yl)methyl)carbamate (2ai)**

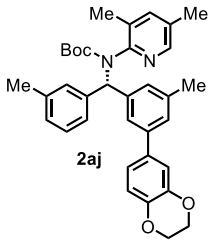
Substrate **1a'** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (77.4 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 12 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 20:1 v/v), compound **2ai** (40.1 mg) was obtained in 75% yield as a white solid.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.28 (d, *J* = 4.7 Hz, 1H), 8.13–6.62 (m, 9H), 7.38 (d, *J* = 7.5 Hz, 1H), 7.05 (dd, *J* = 7.5, 4.7 Hz, 1H), 6.52 (s, 1H), 2.27 (br d, *J* = 50.2 Hz, 6H), 2.03 (s, 3H), 1.29 (s, 9H); ^{13}C

NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.92, 154.32, 152.49 (ddd, J = 247.1, 9.3, 3.4 Hz), 146.87, 140.22 (dt, J = 249.0, 15.6 Hz), 140.04, 139.64, 138.94, 138.57, 138.57, 138.45, 138.45, 133.96, 131.32, 128.85, 127.20, 126.13, 123.82, 112.14 (dd, J = 17.5, 3.8 Hz), 81.46, 67.93, 28.63, 21.56, 17.99; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -136.70, -136.75, -165.47, -165.51. HRMS (ESI-TOF) *m/z* calc'd for $C_{32}H_{32}F_3N_2O_2$ $[M+H]^+$: 533.2410; found: 533.2407.

SFC Chiralpak® IC column (5% isopropanol, 1.0 mL/min) t_r = 20.03 min (minor), 21.74 min (major): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



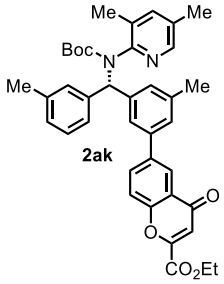
***tert*-Butyl (*S*)-((3-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-5-methylphenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2aj)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (78.6 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **2aj** (38.9 mg) was obtained in 71% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.12 (s, 1H), 7.95–6.62 (m, 9H), 7.19–7.18 (m, 1H), 6.88 (d, J = 7.8 Hz, 1H), 6.46 (s, 1H), 4.26 (s, 4H), 2.47–2.11 (m, 6H), 2.19 (s, 3H), 1.96 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.09, 152.06, 147.02, 145.21, 144.65, 140.96, 140.46, 138.99, 138.44, 135.67, 133.58, 133.09, 130.33, 128.78, 128.63, 126.88, 120.84, 118.57, 116.50, 81.20, 68.09, 65.67, 28.67, 21.61, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{39}N_2O_4$ $[M+H]^+$: 551.2904; found: 551.2909.

SFC Chiralpak® AD-3 column (20% isopropanol, 1.0 mL/min) t_r = 7.61 min (major), 8.67 min (minor): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



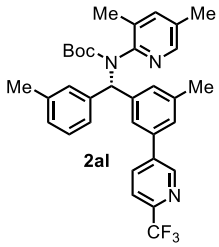
***tert*-Butyl (*S*)-((3-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-5-methylphenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2ak)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (103 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **2ak** (48.2 mg) was obtained in 76% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.49–6.63 (m, 9H), 8.18 (s, 1H), 7.63 (d, J = 8.7 Hz, 1H), 7.21–7.17 (m, 1H), 6.99 (s, 1H), 6.51 (s, 1H), 4.44 (q, J = 7.1 Hz, 2H), 2.45–2.09 (m, 6H), 2.19 (s, 3H), 1.97 (s, 3H), 1.41 (t, J = 7.1 Hz, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 178.98, 161.62, 156.56, 155.08, 153.99, 151.95, 147.12, 140.51, 140.07, 139.52, 138.50, 134.56, 133.68, 133.10, 131.73, 130.04, 128.78, 127.35, 125.79, 123.80, 120.44, 115.20, 81.31, 67.98, 64.05, 28.66, 21.59, 17.86, 14.51. HRMS (ESI-TOF) *m/z* calc'd for $C_{39}H_{41}N_2O_6$ $[M+H]^+$: 633.2959; found: 633.2962.

SFC Chiralpak® OD-3 column (30% isopropanol, 2.0 mL/min) t_r = 4.79 min (minor), 5.35 min (major): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



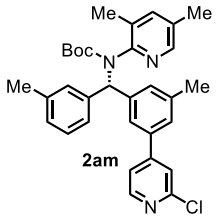
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((3-methyl-5-(6-(trifluoromethyl)pyridin-3-yl)phenyl)(*m*-tolyl)methyl)carbamate (2al)**

Substrate **1a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), ligand (6.9 mg, 23 μmol, 23 mol%), (*R*)-BNDHP (8.0 mg, 23 μmol, 23 mol%), aryl iodide (81.9 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2al** (34.9 mg) was obtained in 62% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 9.18–6.62 (m, 9H), 8.13 (s, 1H), 7.81 (d, *J* = 8.1 Hz, 1H), 7.19 (s, 1H), 6.52 (s, 1H), 2.53–2.10 (m, 6H), 2.19 (s, 3H), 1.97 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.07, 151.92, 149.44, 147.28 (q, *J* = 34.3 Hz), 147.04, 140.78, 140.52, 139.82, 138.56, 136.91, 136.79, 133.66, 133.12, 131.46, 128.84, 127.62, 123.29 (d, *J* = 272.8 Hz), 121.79, 81.35, 67.95, 28.65, 21.57, 17.85; ^{19}F NMR (376 MHz, Acetonitrile-d_3, 60 °C) δ -68.47. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{35}F_3N_3O_2$ $[M+H]^+$: 562.2676; found: 562.2675.

SFC Chiralpak® AD-3 column (10% isopropanol, 2.0 mL/min) t_r = 4.10 min (minor), 5.02 min (major): 5:95 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



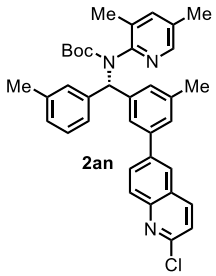
***tert*-Butyl (*S*)-((3-(2-chloropyridin-4-yl)-5-methylphenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2am)**

Substrate **1a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), ligand (6.9 mg, 23 μmol, 23 mol%), (*R*)-BNDHP (8.0 mg, 23 μmol, 23 mol%), aryl iodide (71.7 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 7:2 v/v), compound **2am** (34.9 mg) was obtained in 65% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.37 (s, 1H), 8.28–6.72 (m, 9H), 8.13 (s, 1H), 7.19 (s, 1H), 6.51 (s, 1H), 2.49–2.10 (m, 6H), 2.19 (s, 3H), 1.95 (s, 3H), 1.29 (d, *J* = 1.1 Hz, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.04, 153.02, 152.80, 151.89, 151.32, 147.03, 140.53, 139.82, 138.55, 137.25, 133.69, 133.13, 131.74, 128.84, 127.33, 122.74, 121.67, 81.36, 67.87, 28.65, 21.56, 17.87, 17.82. HRMS (ESI-TOF) *m/z* calc'd for $C_{32}H_{35}ClN_3O_2$ $[M+H]^+$: 528.2412; found: 528.2411.

SFC Chiralpak® AD-3 column (20% isopropanol, 2.0 mL/min) t_r = 2.67 min (minor), 3.18 min (major): 89:11 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



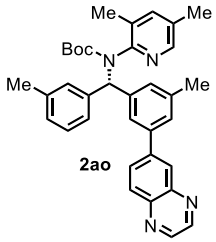
***tert*-Butyl (*S*)-((3-(2-chloroquinolin-6-yl)-5-methylphenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2an)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (87 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2an** (29.5 mg) was obtained in 51% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.38–6.84 (m, 9H), 8.26 (d, J = 8.6 Hz, 1H), 8.15 (s, 1H), 7.98 (d, J = 8.1 Hz, 1H), 7.45 (d, J = 8.6 Hz, 1H), 7.20 (s, 1H), 6.53 (s, 1H), 2.51–2.13 (m, 6H), 2.19 (s, 3H), 1.98 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.11, 152.02, 151.49, 148.36, 147.06, 140.88, 140.71, 140.51, 140.31, 139.45, 138.51, 133.62, 133.12, 131.12, 129.83, 128.81, 128.45, 127.66, 126.43, 123.85, 81.30, 68.07, 28.67, 21.63, 17.87. HRMS (ESI-TOF) *m/z* calc'd for $C_{36}H_{37}ClN_3O_2$ $[M+H]^+$: 578.2569; found: 578.2567.

SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 7.76 min (minor), 8.79 min (major): 90:10 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



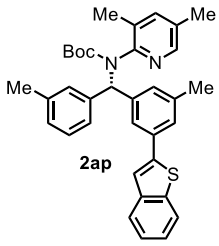
***tert*-Butyl (*S*)-((3-methyl-5-(quinoxalin-6-yl)phenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2ao)**

Substrate **1a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), Ligand (6.9 mg, 23 μmol, 23 mol%), (*R*)-BNDHP (8.0 mg, 23 μmol, 23 mol%), aryl iodide (76.8 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 1:1 v/v), compound **2ao** (25.5 mg) was obtained in 47% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.86 (d, J = 1.8 Hz, 1H), 8.83 (d, J = 1.8 Hz, 1H), 8.50–6.68 (m, 11H), 7.22–7.18 (m, 1H), 6.54 (s, 1H), 2.54–2.11 (m, 6H), 2.20 (s, 3H), 1.98 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.12, 152.02, 147.15, 147.08, 146.50, 144.41, 143.78, 143.52, 140.53, 140.06, 139.56, 138.54, 133.69, 133.15, 131.99, 130.99, 130.46, 128.83, 128.78, 127.81, 127.69, 81.31, 68.04, 28.66, 21.61, 17.87, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{37}N_4O_2$ $[M+H]^+$: 545.2911; found: 545.2919.

SFC Chiralpak® IC column (25% isopropanol, 2.0 mL/min) t_r = 7.87 min (minor), 9.29 min (major): 84:16 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



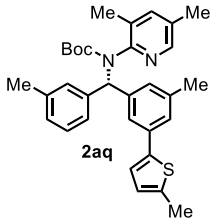
***tert*-Butyl (*S*)-((3-(benzo[b]thiophen-2-yl)-5-methylphenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2ap)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (78 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 10:1 v/v), compound **2ap** (33.4 mg) was obtained in 61% yield as a yellow solid.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.35–6.64 (m, 8H), 8.15 (s, 1H), 7.87 (d, *J* = 7.9 Hz, 1H), 7.81 (d, *J* = 7.9 Hz, 1H), 7.37 (t, *J* = 7.5 Hz, 1H), 7.33 (t, *J* = 7.5 Hz, 1H), 7.20 (s, 1H), 6.49 (s, 1H), 2.45–2.13 (m, 6H), 2.19 (s, 3H), 1.99 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.06, 151.98, 147.11, 145.43, 142.04, 140.51, 140.47, 139.54, 138.54, 134.72, 133.60, 133.02, 131.82, 130.50, 128.82, 126.51, 125.87, 125.69, 124.81, 123.39, 120.73, 81.35, 67.91, 28.66, 21.54, 17.87. HRMS (ESI-TOF) *m/z* calc'd for $C_{35}H_{37}N_2O_2S$ $[M+H]^+$: 549.2570; found: 549.2577.

SFC Chiralpak® AD-3 column (20% isopropanol, 2.0 mL/min) t_r = 5.01 min (major), 6.48 min (major): 97:3 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



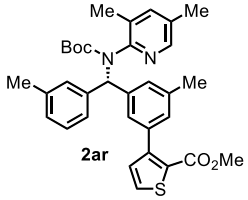
***tert*-Butyl (*S*)-(3,5-dimethylpyridin-2-yl)((3-methyl-5-(5-methylthiophen-2-yl)phenyl)(*m*-tolyl)methyl)carbamate (2aq)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (67.2 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 20:1 v/v), compound **2aq** (33.4 mg) was obtained in 65% yield as a yellow solid.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.12 (d, *J* = 2.3 Hz, 1H), 8.03–6.57 (m, 8H), 7.19 (d, *J* = 2.3 Hz, 1H), 6.73 (s, 1H), 6.43 (s, 1H), 2.47 (s, 3H), 2.38–2.10 (m, 6H), 2.19 (s, 3H), 1.97 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.05, 152.03, 147.06, 143.14, 140.72, 140.47, 139.25, 138.47, 135.21, 133.53, 132.99, 130.61, 128.72, 127.56, 125.51, 124.22, 81.26, 67.96, 28.66, 21.58, 21.52, 17.86, 15.51. HRMS (ESI-TOF) *m/z* calc'd for $C_{32}H_{37}N_2O_2S$ $[M+H]^+$: 513.2570; found: 513.2566.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 4.61 min (minor), 5.44 min (major): 96:4 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



Methyl (*S*)-3-(3-(((*tert*-butoxycarbonyl)(3,5-dimethylpyridin-2-yl)amino)(*m*-tolyl)methyl)-5-

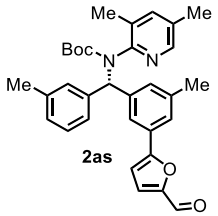
methylphenyl)thiophene-2-carboxylate (2ar)

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (80.4 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2ar** (36.8 mg) was obtained in 66% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.07 (s, 1H), 7.85–6.52 (m, 8H), 7.61 (d, *J* = 5.4 Hz, 1H), 7.19 (s, 1H), 6.44 (s, 1H), 3.67 (s, 3H), 2.40–2.13 (m, 6H), 2.19 (s, 3H), 1.95 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 163.45, 155.06, 152.04, 149.34, 146.97, 140.48, 138.46, 138.04, 136.48, 133.53, 133.08, 132.57, 131.72, 129.93, 129.51, 128.72, 128.23, 81.23, 68.08, 52.57, 28.64, 21.54, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{37}N_2O_4S$ $[M+H]^+$: 557.2469; found: 557.2467.

SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 6.26 min (minor), 7.39 min (major): 89:11 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



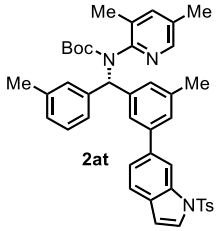
***tert*-Butyl (*S*)-((3-(5-formylfuran-2-yl)-5-methylphenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2as)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (66.6 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **2as** (20.4 mg) was obtained in 40% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 9.59 (s, 1H), 8.11 (s, 1H), 7.81–6.67 (m, 8H), 7.38 (s, 1H), 7.19 (s, 1H), 6.48 (s, 1H), 2.41–2.12 (m, 6H), 2.19 (s, 3H), 1.97 (d, *J* = 3.7 Hz, 3H), 1.29 (s, 5H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 178.42, 160.35, 155.04, 153.50, 151.92, 147.06, 140.52, 139.70, 138.58, 133.63, 133.01, 131.83, 129.91, 128.87, 125.37, 125.25, 123.64, 109.16, 81.43, 67.86, 28.64, 21.54, 17.85, 17.82. HRMS (ESI-TOF) *m/z* calc'd for $C_{32}H_{35}N_2O_4$ $[M+H]^+$: 511.2591; found: 511.2586.

SFC Chiralpak® OJ-3 column (20% isopropanol, 2.0 mL/min) t_r = 2.56 min (minor), 2.99 min (major): 99.8:0.2 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



***tert*-Butyl (*S*)-((3-methyl-5-(1-tosyl-1H-indol-6-yl)phenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2at)**

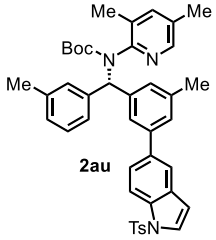
Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (119 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2at** (58.1 mg) was obtained in 70% yield as a colorless oil.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.39–6.80 (m, 9H), 8.17 (s, 1H), 7.78 (d, *J* = 8.0 Hz, 2H), 7.64 (d, *J* = 3.7 Hz, 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.23 (d, *J* = 8.1 Hz, 2H), 7.20 (d, *J* = 2.3 Hz, 1H), 6.74 (d, *J* = 3.7 Hz, 1H), 6.54 (s, 1H), 2.45–2.11 (m, 6H), 2.30 (s, 3H), 2.17 (s, 3H), 2.01 (s, 3H), 1.31 (s, 9H); ^{13}C NMR

(150 MHz, Acetonitrile-d_3, 60 °C) δ 155.10, 152.12, 147.17, 146.98, 141.59, 140.50, 139.21, 138.48, 136.61, 136.03, 133.51, 133.00, 131.40, 131.26, 128.78, 128.48, 127.95, 127.53, 124.06, 122.98, 112.67, 110.32, 81.30, 68.12, 28.70, 21.72, 21.65, 17.92, 17.89. HRMS (ESI-TOF) *m/z* calc'd for $C_{42}H_{44}N_3O_4S$ $[M+H]^+$: 686.3047; found: 686.3050.

SFC Chiralpak® OJ-3 column (15% isopropanol, 1.0 mL/min) t_r = 23.56 min (minor), 25.77 min (major): 92:8 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.



***tert*-Butyl (*S*)-((3-methyl-5-(1-tosyl-1H-indol-6-yl)phenyl)(*m*-tolyl)methyl)(3,5-dimethylpyridin-2-yl)carbamate (2au)**

Substrate **1a** was arylated following the general procedure by using (*R*)-BNDHP (5.2 mg, 15 μmol, 15 mol%), aryl iodide (119 mg, 0.3 mmol, 3.0 equiv.), and (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%) at 100 °C for 18 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **2au** (40.3 mg) was obtained in 59% yield as a colorless oil.

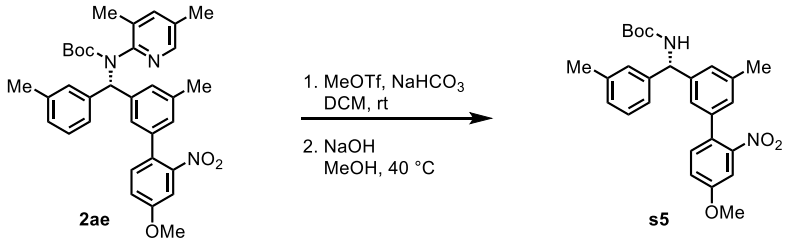
^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.39–6.69 (m, 9H), 8.12 (s, 1H), 7.99 (d, *J* = 8.6 Hz, 1H), 7.80 (d, *J* = 8.0 Hz, 2H), 7.63 (d, *J* = 3.7 Hz, 1H), 7.29 (d, *J* = 8.1 Hz, 2H), 7.17 (s, 1H), 6.76 (d, *J* = 3.7 Hz, 1H), 6.48 (s, 1H), 2.52–2.09 (m, 6H), 2.31 (s, 3H), 2.17 (s, 3H), 1.96 (s, 3H), 1.28 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 155.09, 152.05, 147.03, 141.50, 140.46, 139.10, 138.44, 138.06, 136.17, 135.38, 133.54, 133.07, 132.76, 131.23, 128.76, 128.60, 127.91, 127.51, 125.07, 120.80, 114.88, 110.72, 81.23, 68.08, 28.66, 21.71, 21.61, 17.86. HRMS (ESI-TOF) *m/z* calc'd for $C_{42}H_{44}N_3O_4S$ $[M+H]^+$: 686.3047; found: 686.3048.

SFC Chiralpak® AD-3 column (30% isopropanol, 3.0 mL/min) t_r = 2.70 min (major), 3.32 min (minor): 94:6 er.

The absolute stereochemistry was assigned by analogy to compound **2ah**.

D. Directing Group Cleavage of Desymmetrization Product 2ae

The directing group was removed following a modified known procedure[38].



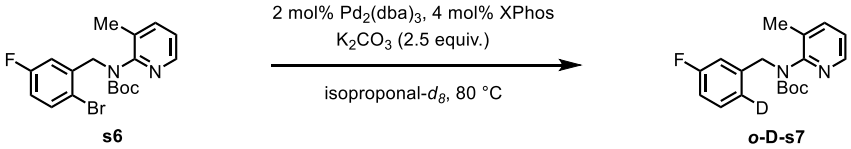
***tert*-Butyl (*S*)-((4'-methoxy-5-methyl-2'-nitro-[1,1'-biphenyl]-3-yl)(*m*-tolyl)methyl)carbamate (s5)**

To a solution of compound **2ae** (28.4 mg, 50 μmol, 1 equiv.) in dry DCM (0.5 mL), $NaHCO_3$ (6.3 mg, 75 μmol, 1.5 equiv.) and MeOTf (7.9 μL, 70 μmol, 1.4 equiv.) were added at 0 °C. The reaction mixture was stirred at room temperature for 5 hours, and then filtered through cotton. The filtrate was evaporated under reduced pressure. The residue was dissolved in MeOH (0.5 mL). Aqueous NaOH solution (6 N, 0.25 mL) was added. The reaction mixture was stirred at 40 °C for 3 hours. Aqueous NH_4Cl solution was added and extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was

concentrated by rotary evaporation, the residue was purified by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v) to afford 20.9 mg compound **s5** as a colorless oil (90 % yield).
^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.33 (d, *J* = 2.7 Hz, 1H), 7.29 (d, *J* = 8.5 Hz, 1H), 7.22 (t, *J* = 7.7 Hz, 1H), 7.11 (dd, *J* = 8.5, 2.6 Hz, 1H), 7.08–7.01 (m, 4H), 6.97 (d, *J* = 14.0 Hz, 2H), 5.85 (s, 1H), 5.13 (s, 1H), 3.88 (s, 3H), 2.33 (d, *J* = 2.8 Hz, 6H), 1.44 (s, 9H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 159.18, 155.19, 149.80, 142.65, 141.88, 138.77, 138.51, 137.55, 132.89, 128.77, 128.68, 128.32, 128.26, 127.85, 124.49, 124.09, 118.71, 109.10, 79.94, 58.41, 56.06, 28.52, 21.60, 21.59. HRMS (ESI-TOF) *m/z* calc'd for $C_{27}H_{30}NaN_2O_5$ $[M+Na]^+$: 485.2047; found: 485.2044.
SFC Chiralpak® AD-3 column (15% isopropanol, 1.5 mL/min) t_r = 9.12 min (minor), 9.74 min (major): 94:6 er.

E. Mechanistic Studies

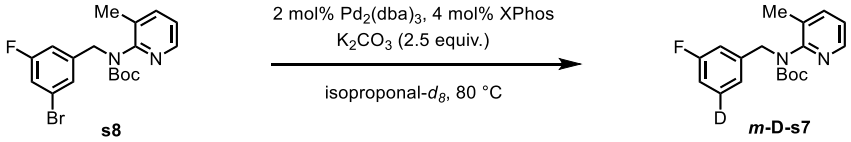
1. Preparation of substrates



Benzylamine (**s6**) was synthesized following the literature procedures[28].

***tert*-Butyl 3-fluoro-6-D-benzyl(3-methylpyridin-2-yl)carbamate (*o*-D-s7)**

Aryl bromide **s6** (1.90 g, 4.8 mmol, 1.0 equiv), $Pd_2(dba)_3$ (88 mg, 96 μmol, 2 mol%), XPhos (92 mg, 0.19 mmol, 10 mol%), and K_2CO_3 (1.66 g, 12 mmol, 2.5 equiv.) were added into a flame-dried Schlenk tube. The Schlenk tube was evacuated and back-filled with nitrogen. Isopropanol-d_8 (5 mL) was added to the mixture. The Schlenk tube was immersed into a pre-heated oil bath at 80 °C. After 12 hours, the reaction mixture was filtered through Celite and eluted with EtOAc. After the organic solvent was concentrated by rotatory evaporation, the residue was purified by silica gel chromatography (hexanes/EtOAc = 8:1 v/v) to afford 0.456 g compound ***o*-D-s7** as a white solid (30% yield).
^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.34 (d, *J* = 5.7 Hz, 1H), 7.46 (d, *J* = 8.0 Hz, 1H), 7.19 (t, *J* = 7.4 Hz, 1H), 7.09 (t, *J* = 6.9 Hz, 1H), 6.99 (d, *J* = 10.4 Hz, 1H), 6.90 (t, *J* = 8.5 Hz, 1H), 5.31–4.52 (m, 2H), 2.00 (s, 3H), 1.41 (d, *J* = 15.4 Hz, 9H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 162.81 (d, *J* = 245.9 Hz), 153.91, 153.57, 146.53, 140.87, 139.44, 131.50, 129.68 (d, *J* = 8.3 Hz), 123.87, 122.41, 115.46, 114.18 (d, *J* = 20.9 Hz), 81.03, 51.84, 28.37, 17.62; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -113.72. HRMS (ESI-TOF) *m/z* calc'd for $C_{18}H_{21}DFN_2O_2$ $[M+H]^+$: 318.1723; found: 318.1731.

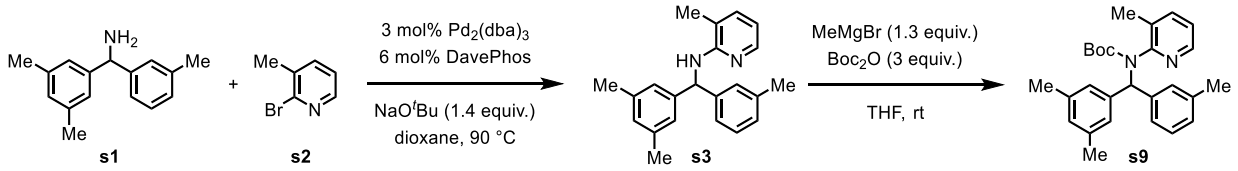


Benzylamine (**s8**) was synthesized following the literature procedures[28].

***tert*-Butyl 3-fluoro-5-D-benzyl(3-methylpyridin-2-yl)carbamate (*m*-D-s7)**

Aryl bromide **s8** (1.19 g, 3.0 mmol, 1.0 equiv), $Pd_2(dba)_3$ (55 mg, 60 μmol, 2 mol%), XPhos (57 mg, 0.12 mmol, 10 mol%), and K_2CO_3 (1.04 g, 7.5 mmol, 2.5 equiv.) were added into a flame-dried Schlenk tube. The Schlenk tube was evacuated and back-filled with nitrogen. Isopropanol-d_8 (5 mL) was added to the mixture. The Schlenk tube was immersed into a pre-heated oil bath at 80 °C. After 12 hours, the reaction mixture was filtered through Celite and eluted with EtOAc. After the organic solvent was concentrated by rotatory evaporation, the residue was purified by silica gel chromatography (hexanes/EtOAc = 8:1 v/v) to afford 0.59 g compound ***m*-D-s7** as a white solid (62% yield).

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.34 (dd, *J* = 4.8, 2.1 Hz, 1H), 7.47 (d, *J* = 7.7 Hz, 1H), 7.09 (dd, *J* = 7.6, 4.8 Hz, 1H), 7.05–6.94 (m, 2H), 6.90 (dd, *J* = 8.7, 2.6 Hz, 1H), 5.26–4.48 (m, 2H), 2.00 (s, 3H), 1.40 (s, 9H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 162.83 (d, *J* = 245.4 Hz), 153.94, 153.58, 146.54, 141.05, 139.45, 131.52, 129.53 (td, *J* = 24.8, 9.1 Hz), 124.10, 122.42, 115.51, 114.10 (d, *J* = 20.9 Hz), 81.04, 51.87, 28.38, 17.64; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -113.72. HRMS (ESI-TOF) *m/z* calc'd for $C_{18}H_{21}DFN_2O_2$ $[M+H]^+$: 318.1723; found: 318.1733.



Diarylmethyl amines (**s1**) was synthesized following the literature procedures[37].

***tert*-Butyl ((3,5-dimethylphenyl)(*m*-tolyl)methyl)(3-methylpyridin-2-yl)carbamate (s9)**

Amine **s1** (0.675 g, 3.0 mmol, 1 equiv.), $Pd_2(dba)_3$ (83 mg, 90 μmol, 3 mol%), DavePhos (72 mg, 0.18 mmol, 6 mol%) and NaO^{t}Bu (0.4 g, 4.2 mmol, 1.4 equiv.) were added to a flame-dried Schlenk tube. The Schlenk tube was evacuated and back-filled with nitrogen. 2-Bromopyridines **s2** (0.52 g, 3 mmol, 1 equiv.) and 1,4-dioxane (9 mL) were added to the mixture. The Schlenk tube was immersed into a pre-heated oil bath at 90 °C. After 2 h, the oil bath was removed, and the Schlenk tube was allowed to cool to room temperature. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotatory evaporation, the residue was purified by silica gel chromatography (hexanes/EtOAc = 20:1 v/v) to afford compound **s3**.

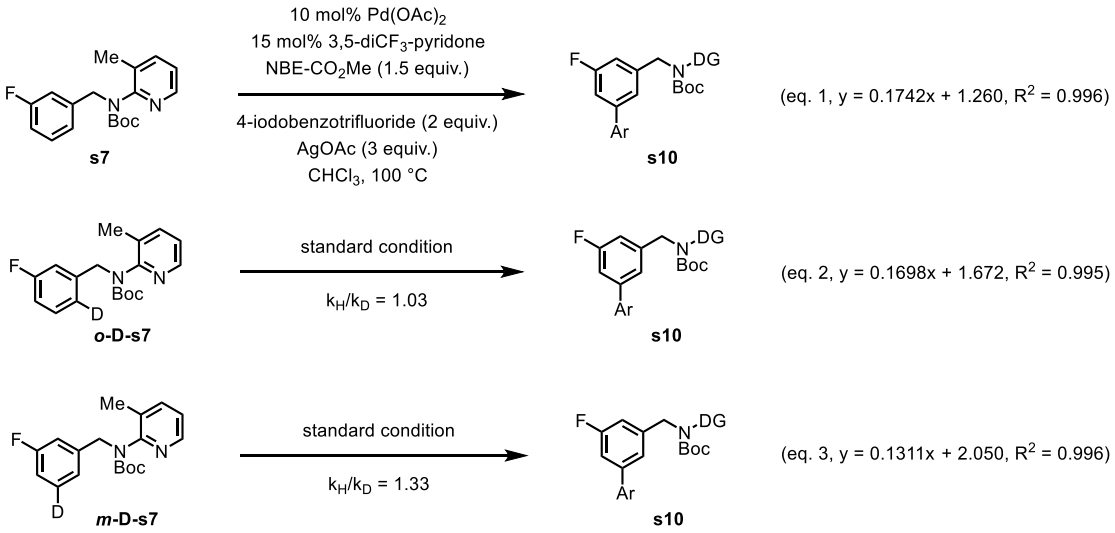
To a solution of compound **s3** in dry THF (30 mL) was added MeMgBr (3.0 M, 1.3 mL, 3.9 mmol, 1.3 equiv.) at 0 °C, and the resulting mixture was allowed to warm up to room temperature and stirred for 30 min. Then Boc_2O (1.96 g, 9 mmol, 3 equiv.) was added into the mixture. The resulting mixture was allowed to warm up to room temperature and stirred for another 12 hours. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotatory evaporation, the residue was purified by silica gel chromatography (hexanes/EtOAc = 20:1 v/v) to afford 0.456 g compound **s9** as a white solid (45% yield).

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.25 (dd, *J* = 4.8, 2.2 Hz, 1H), 7.69–6.55 (m, 7H), 7.36 (dd, *J* = 7.6, 2.2 Hz, 1H), 7.03 (dd, *J* = 7.4, 4.8 Hz, 1H), 6.38 (s, 1H), 2.39–2.02 (m, 9H), 2.00 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.61, 154.04, 146.56, 143.55, 140.18, 139.73, 138.31, 137.95, 133.57, 131.73, 129.66, 129.33, 128.98, 128.58, 128.26, 126.80, 126.11, 123.53, 81.00, 67.69, 28.33, 21.50, 21.25, 17.82. HRMS (ESI-TOF) *m/z* calc'd for $C_{27}H_{33}N_2O_2$ $[M+H]^+$: 417.2537; found: 417.2545.

2. Measurement of the kinetic isotope effect

Kinetic studies on the *meta*-arylation of **s7**, ***o*-D-s7**, and ***m*-D-s7** were conducted in separate vessels.

Arene (0.05 mmol, 1.0 equiv), $Pd(OAc)_2$ (1.1 mg, 5 μmol, 10 mol%), 3,5-diCF_3-pyridone (1.7 mg, 7.5 μmol, 15 mol%), 4-iodobenzotrifluoride (14.7 μL, 0.1 mmol, 2.0 equiv.), and AgOAc (25 mg, 0.15 mmol, 3.0 equiv.) were added into a 2-dram reaction vial. $CHCl_3$ (0.5 mL) and NBE-CO_2Me (11.4 mg, 75 μmol, 1.5 equiv.) were added to the mixture. The reaction mixture was then stirred at 100 °C for given times. After cooling to room temperature, the mixture was filtered through Celite and eluted with EtOAc (3 × 2 mL). The filtrate was evaporated under reduced pressure. The yield was determined by ^{19}F NMR analysis of the crude mixture using 1,2-difluorobenzene as an internal standard. All measurements were repeated once.



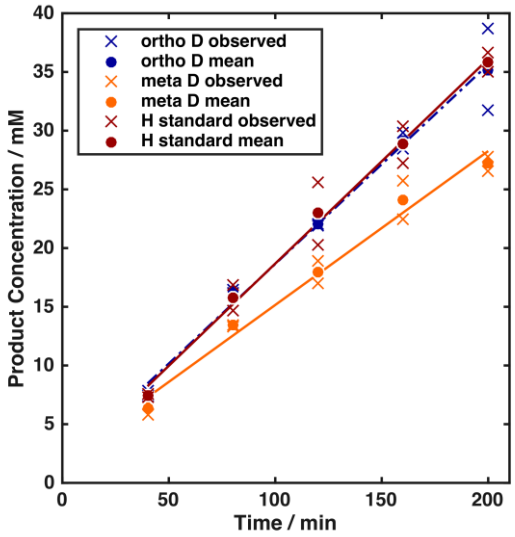


Fig. S1. Determination of the kinetic isotope effect.

3. Measurement of reaction rate dependence

Arene, $Pd(OAc)_2$, ligand (1.5 equiv. to $Pd(OAc)_2$), 4-iodobenzotrifluoride, and AgOAc were added into a 2-dram reaction vial. $CHCl_3$ and NBE-CO_2Me were added to the mixture. The reaction mixture was then stirred at 100 °C for given times. After cooling to room temperature, the mixture was filtered through Celite and eluted with EtOAc. The filtrate was evaporated under reduced pressure. The yield was determined by ^{19}F NMR analysis of the crude mixture using 1,2-difluorobenzene as an internal standard. All measurements were repeated once.

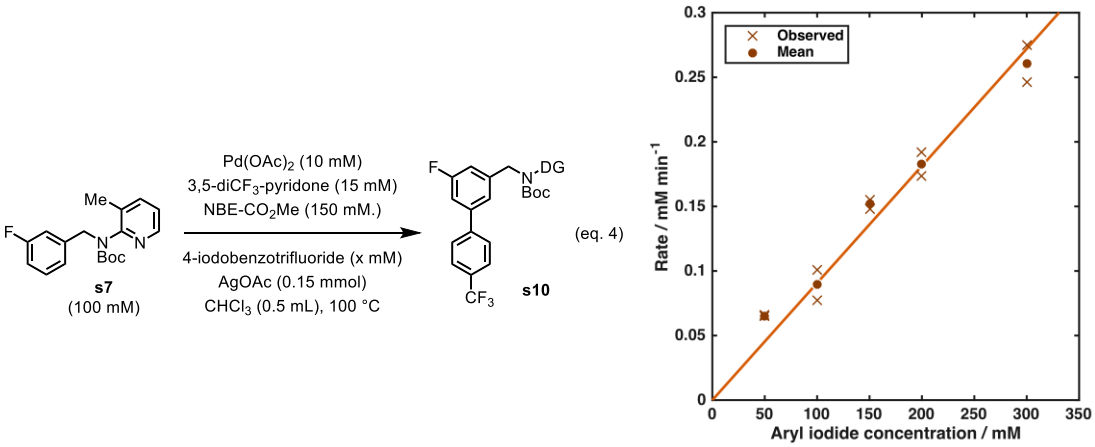


Fig. S2. Reaction rate dependence of arene **s7** on aryl iodide using super-stoichiometric NBE-CO_2Me.

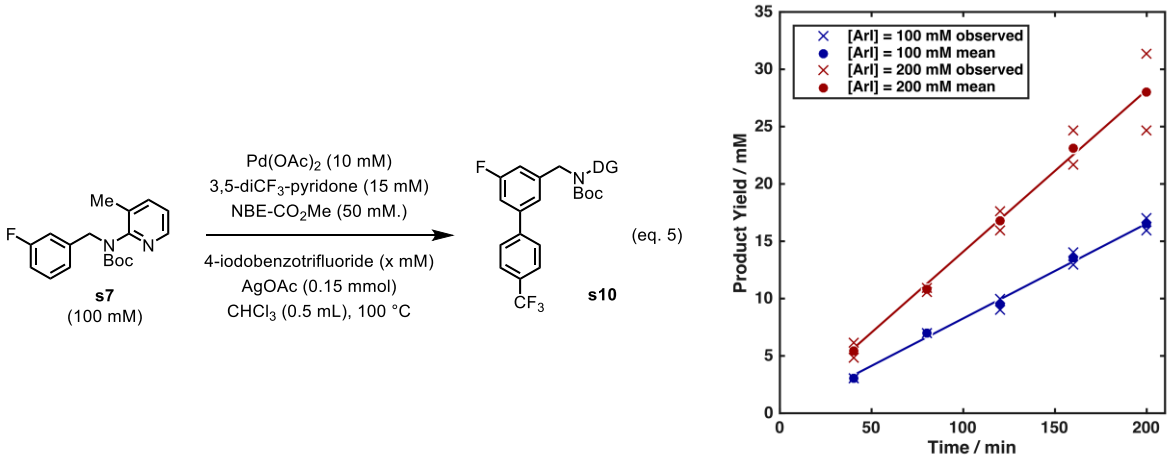


Fig. S3. Reaction rate dependence of arene **s7** on aryl iodide using catalytic NBE-CO_2Me.

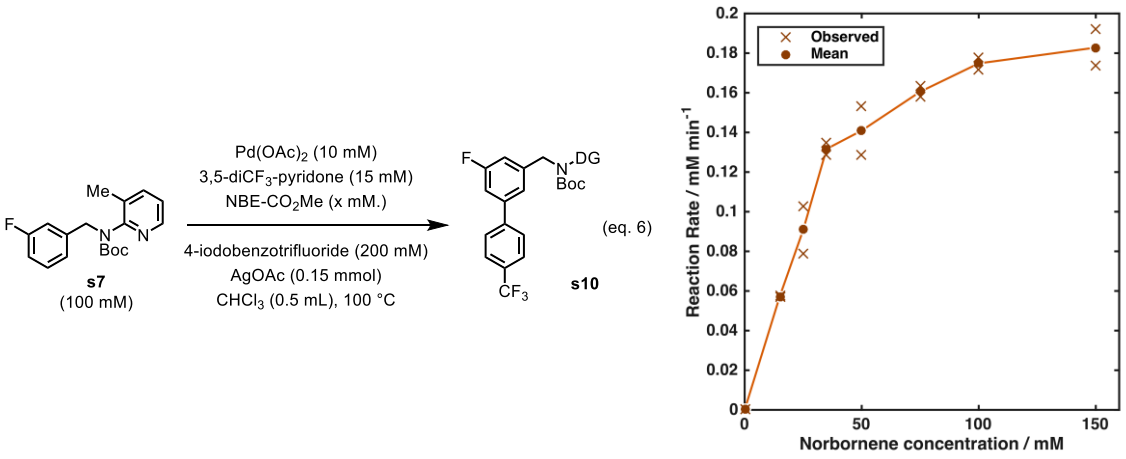


Fig. S4. Reaction rate dependence of arene **s7** on NBE-CO_2Me.

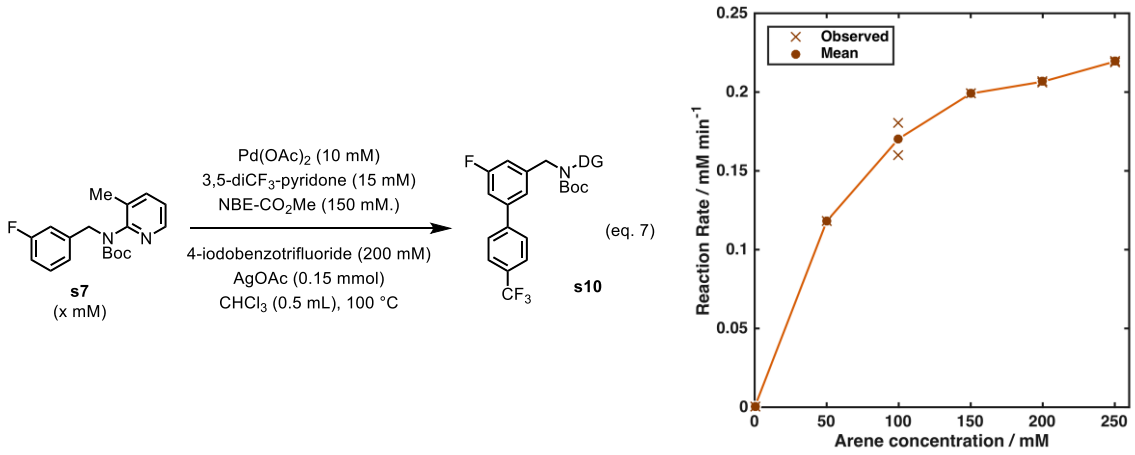


Fig. S5. Reaction rate dependence on arene **s7**.

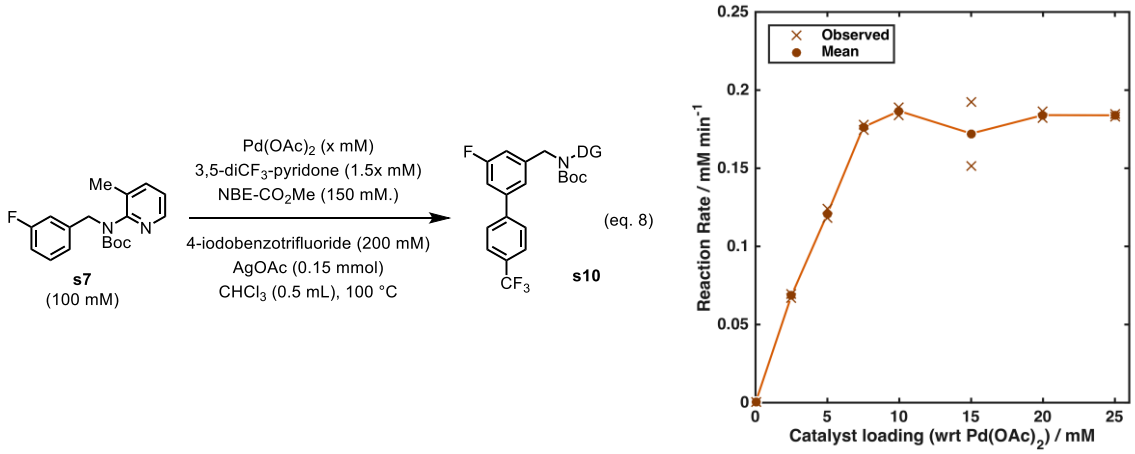


Fig. S6. Reaction rate dependence of arene **s7** on catalyst.

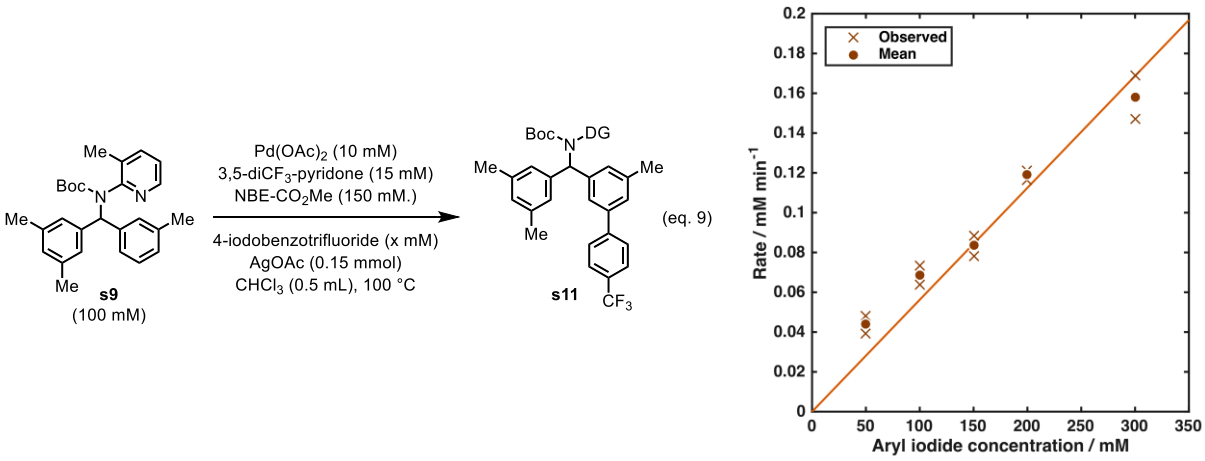


Fig. S7. Reaction rate dependence of arene **s9** on aryl iodide using super-stoichiometric NBE-CO_2Me.

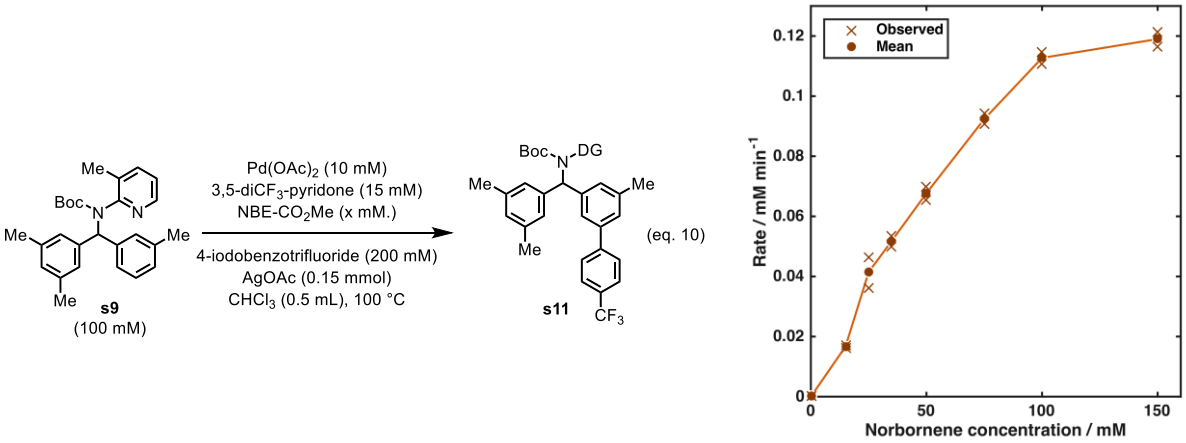


Fig. S8. Reaction rate dependence of arene **s9** on NBE-CO_2Me.

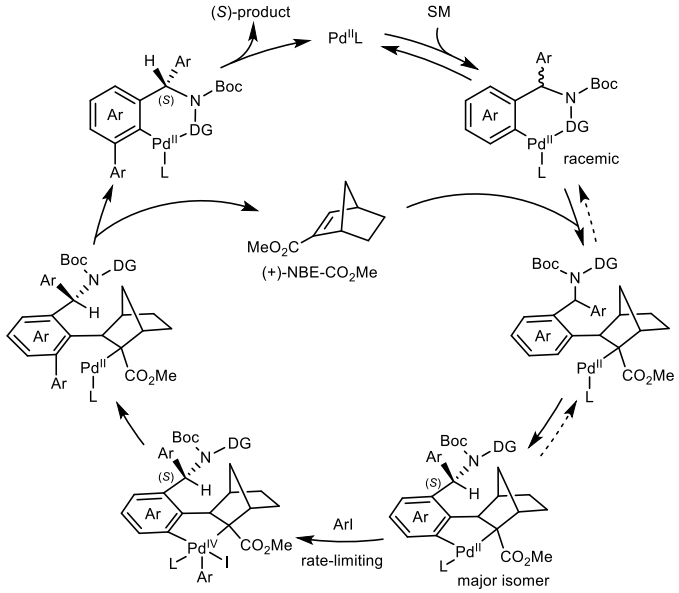
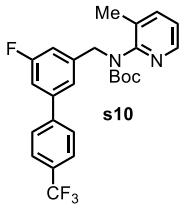


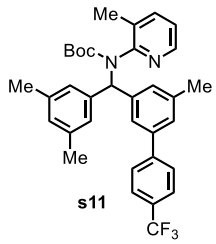
Fig. S9. Proposed catalytic cycle



***tert*-Butyl (3,5-dimethylpyridin-2-yl)((5-fluoro-4'-(trifluoromethyl)-[1,1'-biphenyl]-3-yl)methyl)carbamate (s10)**

Preparative TLC chromatography eluent: hexane/EtOAc = 10:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.36 (d, *J* = 5.1 Hz, 1H), 7.67 (d, *J* = 8.1 Hz, 2H), 7.59 (d, *J* = 8.1 Hz, 2H), 7.50 (d, *J* = 7.7 Hz, 1H), 7.30 (s, 1H), 7.15 (d, *J* = 9.5 Hz, 1H), 7.14–7.05 (m, 2H), 4.99 (br d, *J* = 106.1 Hz, 2H), 2.07 (s, 3H), 1.41 (s, 9H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ ^{13}C NMR (150 MHz, Chloroform-*d*) δ 163.21 (d, *J* = 246.5 Hz), 153.97, 153.59, 146.61, 143.43, 141.71 (d, *J* = 7.9 Hz), 139.53, 130.02 (q, *J* = 32.5 Hz), 129.70, 127.46, 125.96, 124.28 (q, *J* = 272.0 Hz), 122.51, 115.13, 113.09 (d, *J* = 22.6 Hz), 81.22, 51.93, 28.38, 17.73. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.80, -113.10. HRMS (ESI-TOF) *m/z* calc'd for $C_{25}H_{25}F_4N_2O_2[M+H]^+$: 461.1847; found: 461.1853.



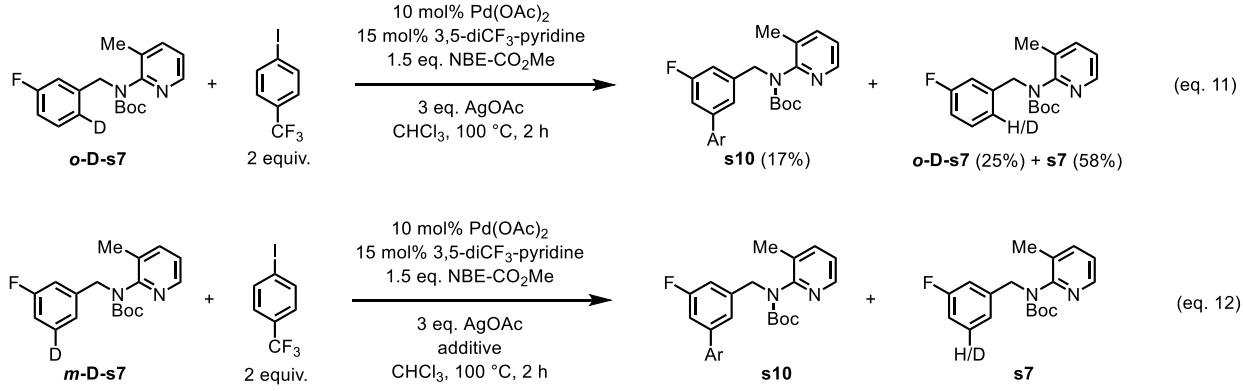
***tert*-Butyl ((3,5-dimethylphenyl)(5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-3-yl)methyl)(3-methylpyridin-2-yl)carbamate (s11)**

Preparative TLC chromatography eluent: hexane/EtOAc = 20:1 v/v.

^{1}H NMR (600 MHz, Acetonitrile-d_3, 60 °C) δ 8.29 (dd, J = 4.9, 1.7 Hz, 1H), 8.14–6. 95 (m, 9H), 7.38 (dd, J = 7.5, 2.0 Hz, 1H), 7.04 (dd, J = 7.5, 4.7 Hz, 1H), 6.82 (br s, 1H), 6.48 (s, 1H), 2.33 (br s, 3H), 2.18 (br s, 6H), 2.03 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (150 MHz, Acetonitrile-d_3, 60 °C) δ 154.99, 154.41, 146.87, 146.18, 140.01, 139.48, 138.44, 133.93, 129.88 (q, J = 32.1 Hz), 129.58, 128.77, 128.58, 127.46, 126.87, 126.84, 125.83 (q, J = 271.1 Hz), 123.78, 81.43, 68.01, 28.63, 21.62, 21.47, 17.99; ^{19}F NMR (376 MHz, Acetonitrile-d_3) δ -63.15. HRMS (ESI-TOF) *m/z* calc'd for $C_{34}H_{36}F_3N_2O_2[M+H]^+$: 561.2723; found: 561.2720.

Hydrogen/deuterium exchange experiment

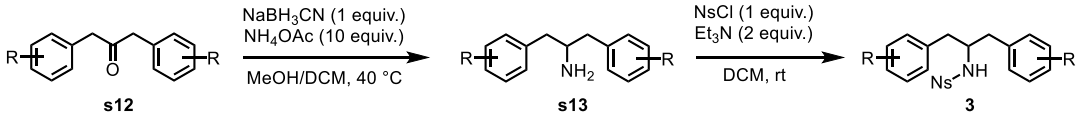
Arene (0.05 mmol, 1.0 equiv), $Pd(OAc)_2$ (1.1 mg, 5 μmol, 10 mol%), 3,5-diCF_3-pyridone (1.7 mg, 7.5 μmol, 15 mol%), 4-iodobenzotrifluoride (14.7 μL, 0.1 mmol, 2.0 equiv.), and AgOAc (25 mg, 0.15 mmol, 3.0 equiv.) were added into a 2-dram reaction vial. $CHCl_3$ (0.5 mL), additive, and NBE-CO_2Me were added to the mixture. The reaction mixture was then stirred at 100 °C for 2 hours. After cooling to room temperature, the mixture was filtered through Celite and eluted with EtOAc (3 × 2 mL). The filtrate was evaporated under reduced pressure. The yield was determined by ^{19}F NMR and ^{1}H NMR analysis of the crude product.



additive	**s10**	***m*-D-s7**	**s7**
none	17%	73%	9%
H_2O (2 equiv.)	18%	68%	9%

II. Enantioselecitve Remote C–H Activation of Homobenzylamines

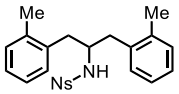
A. Preparation of Substrates



Ketones (**s12**) were synthesized following the literature procedures[39].

General procedure for synthesis of substrates: to a solution of ketone **s12** (1 equiv.) in MeOH/DCM (0.15 M, v/v = 5/1), $NaBH_3CN$ (1 equiv.) and NH_4OAc (10 equiv.) were added. The reaction flask was stirred at 40 °C overnight. Aqueous NaOH solution (10 wt%) was added into the reaction mixture, which was then extracted with DCM. The combined organic layers were washed with aqueous NaCl solution, and then dried over Na_2SO_4. The organic solvent was concentrated by rotary evaporation to afford compound **s13**.

To a solution of crude amine **s13** (1 equiv.) in DCM (0.15 M), NsCl (1.1 equiv.) was added. Then Et_3N (2.0 equiv.) was added at 0 °C. The reaction mixture was allowed to warm up to room temperature and stirred overnight. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotary evaporation, the residue was purified by silica gel chromatography to afford compound **3**.

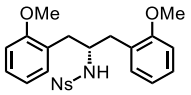


3a

***N*-(1,3-Di-*o*-tolylpropan-2-yl)-4-nitrobenzenesulfonamide (3a)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.99 (d, *J* = 8.9 Hz, 2H), 7.51 (d, *J* = 8.8 Hz, 2H), 7.10 (td, *J* = 7.4, 1.6 Hz, 2H), 7.04 (t, *J* = 7.1 Hz, 2H), 7.02–6.96 (m, 4H), 4.86 (d, *J* = 7.6 Hz, 1H), 3.57 (q, *J* = 7.2 Hz, 1H), 2.88 (d, *J* = 7.2 Hz, 4H), 2.10 (s, 6H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.47, 145.41, 136.26, 135.53, 130.82, 130.58, 127.59, 127.20, 126.19, 123.98, 55.50, 39.70, 19.25. HRMS (ESI-TOF) *m/z* calc'd for $C_{23}H_{23}N_2O_4S[M-H]^-$: 423.1384; found: 423.1383.

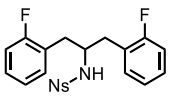


3b

***N*-(1,3-Bis(2-methoxyphenyl)propan-2-yl)-4-nitrobenzenesulfonamide (3b)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.97 (d, *J* = 8.8 Hz, 2H), 7.53 (d, *J* = 8.9 Hz, 2H), 7.17 (ddd, *J* = 8.2, 7.4, 1.8 Hz, 2H), 6.95 (dd, *J* = 7.4, 1.8 Hz, 2H), 6.81–6.74 (m, 4H), 5.37 (d, *J* = 6.6 Hz, 1H), 3.82 (s, 6H), 3.67 (dddd, *J* = 7.8, 6.5, 5.3, 2.4 Hz, 1H), 2.93 (dd, *J* = 13.7, 7.9 Hz, 2H), 2.77 (dd, *J* = 13.7, 5.9 Hz, 2H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 157.42, 149.37, 145.68, 131.44, 128.19, 127.67, 126.25, 123.78, 120.95, 110.64, 56.90, 55.54, 36.25. HRMS (ESI-TOF) *m/z* calc'd for $C_{23}H_{25}N_2O_6S[M+H]^+$: 457.1428; found: 457.1435.

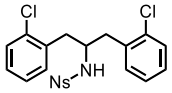


3c

***N*-(1,3-Bis(2-fluorophenyl)propan-2-yl)-4-nitrobenzenesulfonamide (3c)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 8.9 Hz, 2H), 7.59 (d, *J* = 8.9 Hz, 2H), 7.15 (tdd, *J* = 7.6, 5.3, 1.9 Hz, 2H), 7.06 (td, *J* = 7.6, 1.8 Hz, 2H), 6.98 (td, *J* = 7.5, 1.2 Hz, 2H), 6.87 (ddd, *J* = 9.7, 8.2, 1.2 Hz, 2H), 4.65 (d, *J* = 8.5 Hz, 1H), 3.77 (dtd, *J* = 13.9, 7.8, 5.9 Hz, 1H), 2.93–2.77 (m, 4H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 161.23 (d, *J* = 244.9 Hz, 1H), 149.61, 145.74, 131.87 (d, *J* = 4.0 Hz, 1H), 128.98 (d, *J* = 8.2 Hz, 1H), 127.73, 124.26 (d, *J* = 3.5 Hz, 1H), 124.07, 124.05 (d, *J* = 15.5 Hz, 1H), 115.56 (d, *J* = 22.1 Hz, 1H), 56.14, 35.28; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -117.50. HRMS (ESI-TOF) *m/z* calc'd for $C_{21}H_{17}F_2N_2O_4S[M-H]^-$: 431.0883; found: 431.0884.

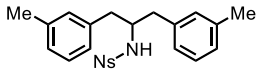


3d

***N*-(1,3-Bis(2-chlorophenyl)propan-2-yl)-4-nitrobenzenesulfonamide (3d)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 8.8 Hz, 2H), 7.60 (d, *J* = 8.9 Hz, 2H), 7.23–7.18 (m, 2H), 7.15–7.09 (m, 6H), 4.89 (d, *J* = 8.4 Hz, 1H), 3.96 (dt, *J* = 8.3, 7.2 Hz, 1H), 3.01 (d, *J* = 7.1 Hz, 4H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.54, 145.53, 135.07, 134.28, 131.88, 129.83, 128.55, 127.68, 127.09, 124.02, 55.54, 39.64. HRMS (ESI-TOF) *m/z* calc'd for $C_{21}H_{19}Cl_2N_2O_4S[M-H]^-$: 463.0292; found: 463.0285.

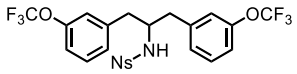


3e

***N*-(1,3-Di-*m*-tolylpropan-2-yl)-4-nitrobenzenesulfonamide (3e)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.01 (d, *J* = 8.9 Hz, 2H), 7.52 (d, *J* = 9.0 Hz, 2H), 7.08 (t, *J* = 7.5 Hz, 2H), 6.99 (d, *J* = 7.7 Hz, 3H), 6.84 (d, *J* = 7.6 Hz, 2H), 6.81 (s, 2H), 4.52 (d, *J* = 8.0 Hz, 1H), 3.61 (dt, *J* = 7.7, 5.7 Hz, 1H), 2.86 (dd, *J* = 13.8, 5.8 Hz, 2H), 2.69 (dd, *J* = 13.7, 7.3 Hz, 2H), 2.23 (s, 6H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.50, 145.73, 138.41, 136.97, 130.29, 128.70, 127.80, 127.70, 126.59, 123.90, 57.66, 41.67, 21.42. HRMS (ESI-TOF) *m/z* calc'd for $C_{23}H_{23}N_2O_4S[M-H]^-$: 423.1384; found: 423.1386.

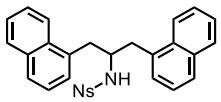


3f

***N*-(1,3-Bis(3-(trifluoromethoxy)phenyl)propan-2-yl)-4-nitrobenzenesulfonamide (3f)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.06 (d, *J* = 8.9 Hz, 2H), 7.60 (d, *J* = 8.9 Hz, 2H), 7.22 (t, *J* = 7.9 Hz, 2H), 7.05 (d, *J* = 8.3 Hz, 2H), 6.98 (d, *J* = 7.6 Hz, 2H), 6.87 (s, 2H), 4.62 (d, *J* = 8.4 Hz, 1H), 3.68 (dtd, *J* = 13.5, 7.6, 5.7 Hz, 1H), 2.92 (dd, *J* = 13.9, 5.7 Hz, 2H), 2.76 (dd, *J* = 13.9, 7.4 Hz, 2H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.81 (q, *J* = 1.7 Hz), 149.46, 145.51, 139.06, 130.21, 127.84, 127.71, 123.02, 121.32, 120.46 (d, *J* = 257.6 Hz), 119.57, 57.23, 41.42; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -58.05. HRMS (ESI-TOF) *m/z* calc'd for $C_{23}H_{17}F_6N_2O_6S[M-H]^-$: 563.0717; found: 563.0719.



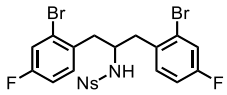
3g

***N*-(1,3-Di(naphthalen-1-yl)propan-2-yl)-4-nitrobenzenesulfonamide (3g)**

Chromatography eluent: hexane/EtOAc = 6:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.70 (d, *J* = 8.2 Hz, 3H), 7.68 (d, *J* = 8.2 Hz, 3H), 7.44 (d, *J* = 8.9 Hz, 1H), 7.41 (d, *J* = 8.5 Hz, 2H), 7.38 (ddd, *J* = 8.1, 6.8, 1.1 Hz, 2H), 7.33 (dd, *J* = 8.2, 6.9 Hz, 2H), 7.24 (dd, *J* = 7.0, 1.2 Hz, 2H), 7.21 (ddd, *J* = 8.6, 7.0, 1.5 Hz, 2H), 7.18 (d, *J* = 9.0 Hz, 1H), 4.66 (d, *J* = 6.4 Hz, 1H), 3.90 (h, *J* = 7.0 Hz, 1H), 3.34 (dd, *J* = 14.1, 7.5 Hz, 2H), 3.27 (dd, *J* = 14.1, 6.7 Hz, 2H); ^{13}C NMR (150 MHz,

Chloroform-*d*) δ 148.74, 143.66, 134.07, 133.29, 131.44, 128.88, 128.14, 128.10, 126.90, 126.31, 126.05, 125.44, 123.45, 123.09, 54.78, 39.89. HRMS (ESI-TOF) *m/z* calc'd for $C_{29}H_{23}N_2O_4S[M-H]^-$: 495.1384; found: 495.1379.



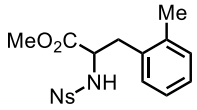
3h

***N*-(1,3-Bis(2-bromo-4-fluorophenyl)propan-2-yl)-4-nitrobenzenesulfonamide (3h)**

Chromatography eluent: hexane/EtOAc = 8:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.8 Hz, 1H), 7.62 (d, *J* = 8.8 Hz, 2H), 7.12 (dd, *J* = 8.1, 2.6 Hz, 2H), 7.09 (dd, *J* = 8.5, 5.9 Hz, 2H), 6.87 (td, *J* = 8.1, 2.6 Hz, 2H), 4.76 (d, *J* = 8.9 Hz, 1H), 3.94 (qt, *J* = 8.6, 5.8 Hz, 1H), 2.99 (dd, *J* = 14.0, 5.8 Hz, 2H), 2.93 (dd, *J* = 14.1, 8.6 Hz, 2H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 162.32 (d, *J* = 251.4 Hz), 149.66, 145.77, 132.61 (d, *J* = 3.8 Hz), 132.57 (d, *J* = 8.3 Hz), 127.81, 124.72 (d, *J* = 9.4 Hz), 124.03, 120.33 (d, *J* = 24.3 Hz), 114.93 (d, *J* = 20.9 Hz), 55.73, 41.25; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -112.74. HRMS (ESI-TOF) *m/z* calc'd for $C_{21}H_{15}Br_2F_2N_2O_4S[M-H]^-$: 586.9093; found: 586.9088.

Substrates **3i**, **3j**, **3k** and **3l** were synthesized following the literature procedures[29].

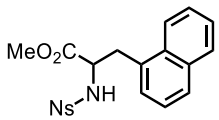


3i

Methyl 2-((4-nitrophenyl)sulfonamido)-3-(*o*-tolyl)propanoate (3i)

Chromatography eluent: hexane/EtOAc = 5:1 v/v.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.16 (d, *J* = 8.8 Hz, 2H), 7.75 (d, *J* = 8.9 Hz, 2H), 7.10 (td, *J* = 7.4, 1.4 Hz, 1H), 7.06–6.98 (m, 2H), 6.94 (dd, *J* = 7.6, 1.3 Hz, 1H), 5.41 (d, *J* = 7.9 Hz, 1H), 4.22 (td, *J* = 8.4, 5.3 Hz, 1H), 3.63 (s, 3H), 3.13 (dd, *J* = 14.2, 5.5 Hz, 1H), 2.89 (dd, *J* = 14.1, 8.8 Hz, 1H), 2.24 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.79, 149.97, 145.58, 136.58, 133.49, 130.84, 130.31, 128.19, 127.68, 126.31, 124.20, 56.53, 52.95, 36.81, 19.43. HRMS (ESI-TOF) *m/z* calc'd for $C_{17}H_{19}N_2O_6S[M+H]^+$: 379.0958; found: 379.0957.

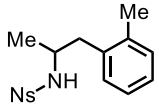


3j

Methyl 3-(naphthalen-1-yl)-2-((4-nitrophenyl)sulfonamido)propanoate (3j)

Chromatography eluent: hexane/EtOAc = 5:1 v/v.

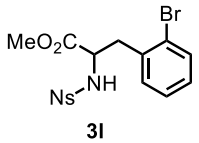
^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.80 (d, *J* = 8.4 Hz, 1H), 7.77 (d, *J* = 8.8 Hz, 2H), 7.70 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.65 (d, *J* = 8.2 Hz, 1H), 7.47 (ddd, *J* = 8.4, 6.8, 1.5 Hz, 1H), 7.43 (ddd, *J* = 8.0, 6.8, 1.2 Hz, 1H), 7.38 (d, *J* = 8.8 Hz, 2H), 7.27 (dd, *J* = 8.2, 7.0 Hz, 1H), 7.27 (d, *J* = 6.6 Hz, 1H), 5.35 (d, *J* = 9.3 Hz, 1H), 4.33 (td, *J* = 9.8, 4.5 Hz, 1H), 3.76 (s, 3H), 3.65 (dd, *J* = 14.4, 4.5 Hz, 1H), 3.12 (dd, *J* = 14.3, 10.3 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.86, 149.43, 144.48, 133.95, 131.31, 131.12, 129.06, 128.46, 128.44, 127.54, 126.76, 126.17, 125.44, 123.58, 122.85, 56.42, 53.18, 36.61. HRMS (ESI-TOF) *m/z* calc'd for $C_{20}H_{19}N_2O_6S[M+H]^+$: 415.0958; found: 415.0952.



3k

4-Nitro-*N*-(1-(*o*-tolyl)propan-2-yl)benzenesulfonamide (3k)

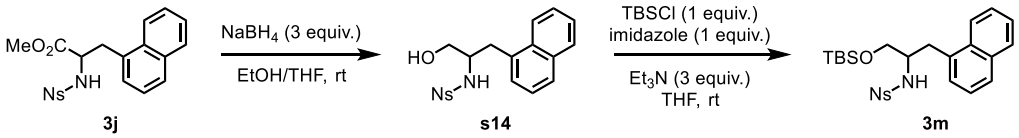
Chromatography eluent: hexane/EtOAc = 8:1 v/v.
^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.13 (d, *J* = 8.9 Hz, 2H), 7.72 (d, *J* = 8.8 Hz, 2H), 7.07 (td, *J* = 7.5, 1.4 Hz, 1H), 7.00 (t, *J* = 7.4 Hz, 1H), 6.95 (d, *J* = 7.5 Hz, 1H), 6.91 (dd, *J* = 7.5, 1.4 Hz, 1H), 4.73 (d, *J* = 7.7 Hz, 1H), 3.61–3.46 (m, 1H), 2.74 (dd, *J* = 14.1, 5.8 Hz, 1H), 2.64 (dd, *J* = 14.1, 8.7 Hz, 1H), 2.12 (s, 3H), 1.28 (d, *J* = 6.5 Hz, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.75, 146.21, 136.21, 135.49, 130.77, 130.31, 127.95, 127.21, 126.25, 124.19, 51.01, 41.19, 22.92, 19.41. HRMS (ESI-TOF) *m/z* calc'd for $C_{16}H_{19}N_2O_4S[M+H]^+$: 335.1060; found: 335.1055.



3l

Methyl 3-(2-bromophenyl)-2-((4-nitrophenyl)sulfonamido)propanoate (3l)

Chromatography eluent: hexane/EtOAc = 5:1 v/v.
^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.15 (d, *J* = 8.8 Hz, 2H), 7.78 (d, *J* = 8.8 Hz, 2H), 7.38 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.14 (td, *J* = 7.4, 1.3 Hz, 1H), 7.10 (dd, *J* = 7.6, 1.9 Hz, 1H), 7.04 (td, *J* = 7.7, 1.8 Hz, 1H), 5.50 (d, *J* = 9.8 Hz, 1H), 4.37 (td, *J* = 9.8, 5.2 Hz, 1H), 3.68 (s, 3H), 3.23 (dd, *J* = 14.0, 5.3 Hz, 1H), 2.98 (dd, *J* = 13.9, 9.8 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.56, 149.98, 145.49, 134.95, 133.17, 131.95, 129.20, 128.24, 127.76, 124.80, 124.20, 55.93, 53.13, 39.36. HRMS (ESI-TOF) *m/z* calc'd for $C_{16}H_{16}BrN_2O_6S[M+H]^+$: 442.9907; found: 442.9911.

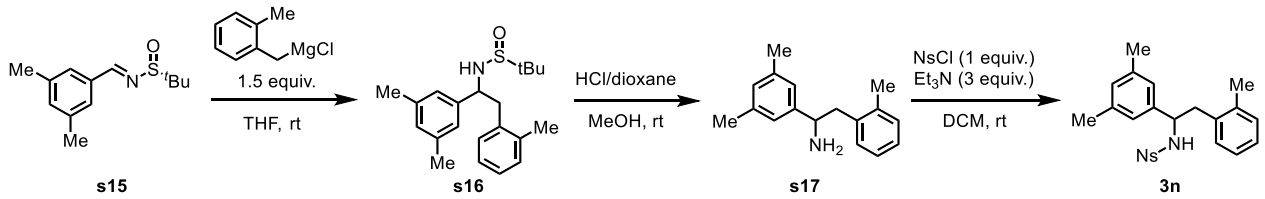


***N*-(1-((*tert*-Butyldimethylsilyl)oxy)-3-(naphthalen-1-yl)propan-2-yl)-4-nitrobenzenesulfonamide (3m)**

To a solution of ester **3j** (1.24 g, 3 mmol, 1.0 equiv.) in EtOH/THF (15 mL/15 mL), $NaBH_4$ (0.34 g, 9.0 mmol, 3.0 equiv.) was added. The reaction mixture was stirred at room temperature overnight. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were washed with aqueous NaCl solution, and then dried over Na_2SO_4. The organic solvent was concentrated by rotary evaporation to afford compound **s14**.

To a solution of crude alcohol **s14** in THF (20 mL), Et_3N (0.83 mL, 6.0 mmol, 2.0 equiv.), imidazole (0.204 g, 3.0 mmol, 1.0 equiv.) and TBSCl (0.45 g, 3.0 mmol, 1.0 equiv.) were added at 0 °C. The reaction mixture was stirred at room temperature overnight. Aqueous NH_4Cl solution was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotary evaporation, the residue was purified by silica gel chromatography (hexane/EtOAc = 8:1 v/v) to afford 0.92 g compound **3m** as a white solid (61% yield for two steps).

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.73 (d, *J* = 7.7 Hz, 1H), 7.66 (d, *J* = 8.9 Hz, 2H), 7.63 (dd, *J* = 7.5, 1.9 Hz, 1H), 7.59 (d, *J* = 8.2 Hz, 1H), 7.39 (dtd, *J* = 13.7, 6.8, 1.6 Hz, 2H), 7.32 (d, *J* = 8.8 Hz, 2H), 7.25 (dd, *J* = 8.0, 6.9 Hz, 1H), 7.11 (d, *J* = 6.8 Hz, 1H), 5.02–4.73 (m, 1H), 3.92 (dd, *J* = 9.7, 2.9 Hz, 1H), 3.68 (dd, *J* = 9.7, 6.3 Hz, 1H), 3.60 (dtt, *J* = 13.7, 7.1, 3.8 Hz, 1H), 3.54 (dd, *J* = 14.3, 4.6 Hz, 1H), 2.84 (dd, *J* = 14.3, 10.1 Hz, 1H), 0.98 (s, 9H), 0.16 (s, 3H), 0.14 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.05, 144.59, 133.95, 133.24, 131.39, 128.83, 127.93, 127.88, 127.18, 126.31, 126.03, 125.42, 123.36, 123.30, 66.08, 55.79, 35.83, 26.06, 18.45, -5.19, -5.25. HRMS (ESI-TOF) *m/z* calc'd for $C_{25}H_{33}N_2O_5SSi[M+H]^+$: 501.1874; found: 501.1864.



***N*-(1-(3,5-Dimethylphenyl)-2-(*o*-tolyl)ethyl)-4-nitrobenzenesulfonamide (3n)**

To a solution of sulfinyl imine **s15** (3.43 g, 10 mmol, 1.0 equiv.) in dry THF (30 mL), a solution of (2-methylbenzyl)magnesium chloride solution (1 M in Et_2O, 15 mL, 15 mmol, 1.5 equiv.) was added at 0 °C. The reaction mixture was stirred at room temperature overnight. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotary evaporation, the residue was purified by silica gel chromatography (hexane/EtOAc = 4:1 v/v) to afford 2.72 g compound **s16** as a colorless liquid (79% yield).

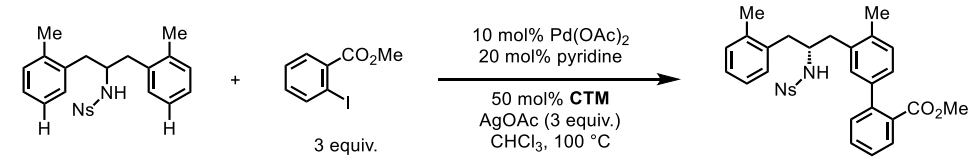
To a solution of compound **s16** (2.72 g, 7.9 mmol, 1 equiv.) in MeOH (30 mL), hydrochloric acid solution (4 M in dioxane, 7.9 mL) was added. The reaction mixture was stirred at room temperature overnight. Aqueous Na_2CO_3 solution was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. The organic solvent was concentrated by rotary evaporation to afford compound **s17**.

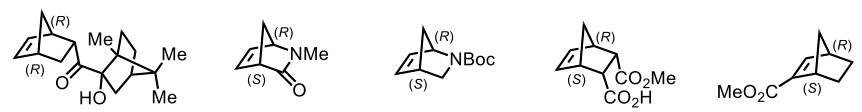
To a solution of crude amine **s17** in DCM (60 mL), NsCl (1.75 g, 7.9 mmol, 1.0 equiv.) was added. Then Et_3N (2.2 mL, 15.8 mmol, 2.0 equiv.) was added at 0 °C. The reaction mixture was allowed to warm up to room temperature and stirred overnight. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. After the organic solvent was concentrated by rotary evaporation, the residue was purified by silica gel chromatography (hexane/EtOAc = 6:1 v/v.) to afford 2.71 g compound **3n** as a white solid (81% yield for two steps).

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 8.8 Hz, 2H), 7.56 (d, *J* = 8.8 Hz, 2H), 7.11 (td, *J* = 7.4, 1.3 Hz, 1H), 7.06–7.00 (m, 2H), 6.96 (d, *J* = 7.4 Hz, 1H), 6.80 (s, 1H), 6.66 (s, 2H), 5.20 (d, *J* = 4.0 Hz, 1H), 4.51 (dt, *J* = 9.6, 4.9 Hz, 1H), 3.01 (dd, *J* = 14.4, 5.5 Hz, 1H), 2.90 (dd, *J* = 14.4, 9.3 Hz, 1H), 2.17 (s, 9H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.57, 146.05, 140.15, 138.30, 136.51, 134.80, 130.84, 130.13, 129.53, 128.12, 127.39, 126.35, 124.48, 123.64, 58.56, 41.60, 21.27, 19.49. HRMS (ESI-TOF) *m/z* calc'd for $C_{23}H_{24}N_2O_4SNa[M+Na]^+$: 447.1349; found: 447.1350.

B. Optimization of the Reaction Conditions

Table S7. Chiral transient mediator screening*

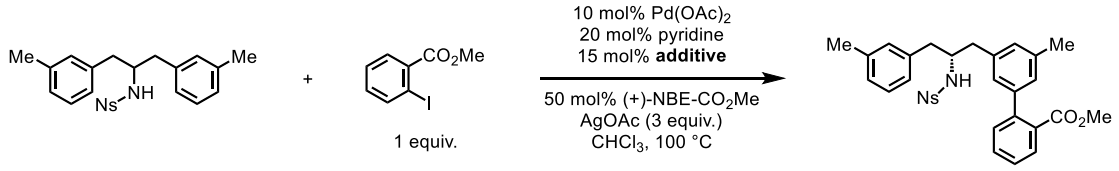




43%, 51:49 er | 6%, 56:44 er | 20%, 50:50 er | 43%, 41:59 er | 55%, 93:7 er

*The yields were determined by ^{1}H-NMR using Cl_2HC-$CHCl_2$ as the standard.

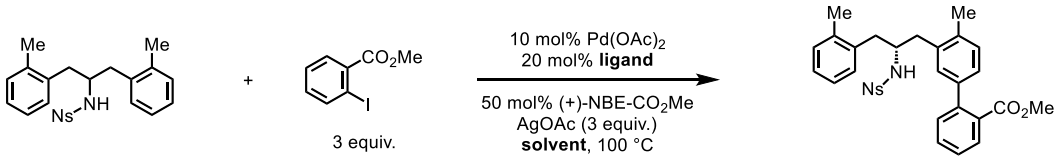
Table S8. Additive screening*



none	(*R*)-BNDHP	(*S*)-BNDHP				HDQ	$(DHQD)_2PHAL$
50%, 72:28 er	43%, 62:38 er	46%, 62:38 er	45%, 66:34	42%, 69:31 er	42%, 69:31 er	26%, 64:36 er	24%, 67:33 er

*The yields were determined by ^{1}H-NMR using Cl_2HC-$CHCl_2$ as the standard.

Table S9. Ligand and solvent screening*



Ligand screening ($CHCl_3$ as solvent)

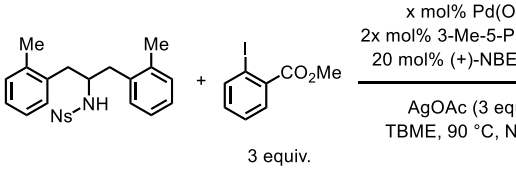
55%, 92:8 er	35%, 82:18	54%, 91:9 er	55%, 93:7 er	45%, 92:8 er	20%, 86:14 er

Solvent screening (3-Me-5-Ph-pyridine as ligand)

$CHCl_3$	55%, 93:7 er
DCE	54%, 92:8 er
toluene	46%, 90:10 er
TBME	63%, 99:1 er
TBME	72%, 97:3 er†

*The yields were determined by ^{1}H-NMR using Cl_2HC-$CHCl_2$ as the standard. †20 mol% (+)-NBE-CO_2Me, 90 °C.

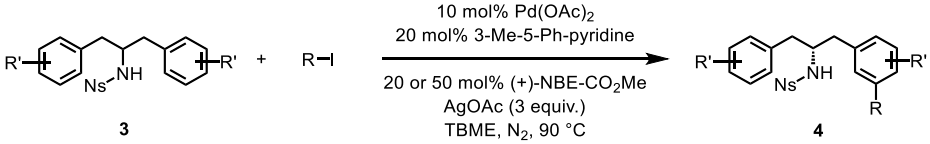
Table S10. Additive screening*



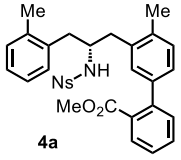
loading of $Pd(OAc)_2$	result*
10 mol%	71% yield, 97:3 er
5 mol%	70% yield, 97:3 er
2.5 mol%	65% yield, 97:3 er

*Isolated yield

C. Pd/(+)-NBE-CO_2Me Catalyzed Desymmetrization of Homobenzylamines



General procedure: Arene **3** (0.10 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 10 μmol, 10 mol%), 3-methyl-5-phenylpyridine (3.4 mg, 20 μmol, 20 mol%), iodide (0.3 mmol, 3.0 equiv.), and AgOAc (50 mg, 0.30 mmol, 3.0 equiv.) were added into a 2-dram reaction vial. TBME (1 mL) and (+)-NBE-CO_2Me (20 mol% or 50 mol%) were added to the mixture. The vial was flushed with N_2, and then capped. The reaction mixture was then stirred at 90 °C for 24 hours. After cooling to room temperature, the mixture was filtered through Celite and eluted with EtOAc (3 × 2 mL). The filtrate was evaporated under reduced pressure. Purification by preparative TLC chromatography afforded the title compound.



4a

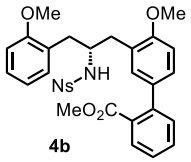
Methyl (*R*)-4'-methyl-3'-(2-((4-nitrophenyl)sulfonamido)-3-(*o*-tolyl)propyl)-[1,1'-biphenyl]-2-carboxylate (4a)

Substrate **3a** was arylated following the general procedure by using methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%), and TBME (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 3:1 v/v), compound **4a** (39.7 mg) was obtained in 71% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.99 (d, *J* = 8.8 Hz, 2H), 7.87 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.57 (d, *J* = 8.8 Hz, 2H), 7.53 (td, *J* = 7.6, 1.4 Hz, 1H), 7.41 (td, *J* = 7.6, 1.3 Hz, 1H), 7.30 (dd, *J* = 7.7, 1.2 Hz, 1H), 7.11–7.03 (m, 3H), 7.03–6.95 (m, 4H), 4.91 (d, *J* = 6.7 Hz, 1H), 3.72 (s, 3H), 3.56 (q, *J* = 7.0 Hz, 1H), 3.02–2.82 (m, 4H), 2.11 (s, 3H), 2.04 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.77, 149.51, 145.49, 142.39, 139.12, 136.29, 135.68, 135.39, 134.76, 131.71, 131.23, 130.96, 130.80, 130.70, 130.59, 130.28, 130.20, 127.98, 127.40, 127.24, 127.15, 126.17, 124.01, 54.83, 52.35, 39.76, 39.52, 19.33, 18.96. HRMS (ESI-TOF) *m/z* calc'd for $C_{31}H_{31}N_2O_6S$ $[M+H]^+$: 559.1897; found: 559.1904.

SFC Chiralpak® OJ-3 column (25% isopropanol, 2.0 mL/min) t_r = 3.09 min (minor), 4.57 min (major): 97:3 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4b

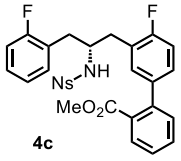
Methyl (*R*)-4'-methoxy-3'-(3-(2-methoxyphenyl)-2-((4-nitrophenyl)sulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate (4b)

Substrate **3b** was arylated following the general procedure by using methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4b** (45.0 mg) was obtained in 76% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.98 (d, *J* = 8.7 Hz, 2H), 7.81 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.58 (d, *J* = 8.7 Hz, 2H), 7.51 (td, *J* = 7.6, 1.4 Hz, 1H), 7.38 (td, *J* = 7.7, 1.3 Hz, 1H), 7.27 (dd, *J* = 7.8, 1.1 Hz, 1H), 7.16–7.09 (m, 2H), 7.01 (d, *J* = 2.3 Hz, 1H), 6.91 (dd, *J* = 7.4, 1.7 Hz, 1H), 6.77 (d, *J* = 8.3 Hz, 1H), 6.73 (t, *J* = 7.4 Hz, 1H), 6.70 (d, *J* = 8.1 Hz, 1H), 5.39 (d, *J* = 6.6 Hz, 1H), 3.80 (s, 3H), 3.76 (s, 3H), 3.75–3.70 (m, 1H), 3.68 (s, 3H), 2.97 (dd, *J* = 13.7, 7.3 Hz, 1H), 2.89–2.81 (m, 2H), 2.76 (dd, *J* = 13.8, 5.5 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 169.03, 157.37, 156.94, 149.38, 145.91, 142.01, 133.75, 131.78, 131.49, 131.43, 130.82, 130.53, 130.05, 128.16, 128.05, 127.88, 127.08, 126.24, 125.68, 123.78, 110.56, 110.23, 56.34, 55.54, 55.49, 52.18, 36.74, 35.77. HRMS (ESI-TOF) *m/z* calc'd for $C_{31}H_{31}N_2O_8S$ $[M+H]^+$: 591.1796; found: 591.1801.

SFC Chiralpak® AD-3 column (40% isopropanol, 3.0 mL/min) t_r = 2.84 min (minor), 4.41 min (major): 87:13 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4c

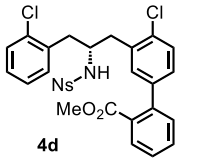
Methyl (*R*)-4'-fluoro-3'-(3-(2-fluorophenyl)-2-((4-nitrophenyl)sulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate (4c)

Substrate **3c** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), ligand (5.1 mg, 30 μmol, 30 mol%), methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4c** (33.8 mg) was obtained in 60% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.03 (d, *J* = 8.9 Hz, 2H), 7.91 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.66 (d, *J* = 8.8 Hz, 2H), 7.54 (td, *J* = 7.5, 1.4 Hz, 1H), 7.43 (td, *J* = 7.7, 1.3 Hz, 1H), 7.28 (d, *J* = 1.2 Hz, 1H), 7.16–7.09 (m, 3H), 7.07 (td, *J* = 7.5, 1.8 Hz, 1H), 6.95 (td, *J* = 7.4, 1.2 Hz, 1H), 6.89 (t, *J* = 9.4 Hz, 1H), 6.83 (ddd, *J* = 9.8, 8.2, 1.2 Hz, 1H), 4.96 (d, *J* = 8.3 Hz, 1H), 3.86–3.79 (m, 1H), 3.73 (s, 3H), 2.99–2.87 (m, 3H), 2.82 (dd, *J* = 14.0, 8.3 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.41, 161.21 (d, *J* = 244.9 Hz), 160.70 (d, *J* = 245.7 Hz), 149.60, 145.91, 141.71, 137.59 (d, *J* = 3.8 Hz), 132.45 (d, *J* = 4.8 Hz), 131.92 (d, *J* = 4.7 Hz), 131.84, 130.98, 130.46, 130.05, 128.89 (d, *J* = 3.7 Hz), 128.84 (d, *J* = 3.3 Hz), 127.92, 127.70, 124.35 (d, *J* = 3.5 Hz), 124.26 (d, *J* = 15.5 Hz), 124.08, 123.21 (d, *J* = 16.4 Hz), 115.46 (d, *J* = 22.2 Hz), 115.14 (d, *J* = 22.6 Hz), 55.63, 52.28, 35.46, 34.86; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -117.59, -119.70. HRMS (ESI-TOF) *m/z* calc'd for $C_{29}H_{25}F_2N_2O_6S$ $[M+H]^+$: 567.1396; found: 567.1398.

SFC Chiralpak® OJ-3 column (25% isopropanol, 2.0 mL/min) t_r = 3.27 min (minor), 3.54 min (major): 86:14 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4d

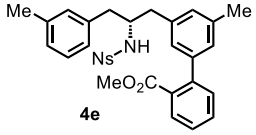
Methyl (*R*)-4'-chloro-3'-(3-(2-chlorophenyl)-2-((4-nitrophenyl)sulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate (4d)

Substrate **3d** was arylated following the general procedure by using methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (hexane/Et_2O/DCM = 4:4:3 v/v/v), compound **4d** (41.6 mg) was obtained in 69% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 8.8 Hz, 2H), 7.93 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.64 (d, *J* = 8.8 Hz, 2H), 7.55 (td, *J* = 7.6, 1.4 Hz, 1H), 7.44 (t, *J* = 7.4 Hz, 1H), 7.29 (d, *J* = 7.6 Hz, 1H), 7.20 (d, *J* = 8.2 Hz, 1H), 7.18 (d, *J* = 2.2 Hz, 1H), 7.14 (dd, *J* = 7.2, 2.0 Hz, 1H), 7.11–7.05 (m, 4H), 5.04 (d, *J* = 7.9 Hz, 1H), 4.04–3.94 (m, 1H), 3.74 (s, 3H), 3.09–2.92 (m, 4H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.33, 149.56, 145.65, 141.53, 140.32, 135.25, 134.28, 134.15, 133.38, 132.46, 131.96, 131.94, 130.94, 130.57, 129.88, 129.76, 129.44, 128.55, 128.45, 127.96, 127.90, 127.00, 124.03, 54.83, 52.38, 39.71, 39.15. HRMS (ESI-TOF) *m/z* calc'd for $C_{29}H_{25}ClN_2O_6S$ $[M+H]^+$: 599.0805; found: 599.0809.

SFC Chiralpak® AD-3 column (30% isopropanol, 3.0 mL/min) t_r = 3.34 min (minor), 5.65 min (major): 95:5 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4e

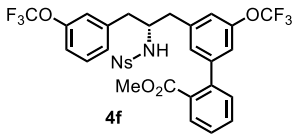
Methyl (*R*)-3'-methyl-5'-(2-((4-nitrophenyl)sulfonamido)-3-(*m*-tolyl)propyl)-[1,1'-biphenyl]-2-carboxylate (4e)

Substrate **3e** was arylated following the general procedure by using methyl 2-iodobenzoate (20.5 μL, 0.14 mmol, 1.4 equiv.), (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%), and TBME (1.5 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 3:1 v/v), compound **4e** (30.5 mg) was obtained in 55% yield as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.03 (d, *J* = 8.8 Hz, 2H), 7.87 (dd, *J* = 7.8, 1.3 Hz, 1H), 7.61 (d, *J* = 8.8 Hz, 2H), 7.54 (td, *J* = 7.6, 1.4 Hz, 1H), 7.42 (td, *J* = 7.6, 1.2 Hz, 1H), 7.31 (dd, *J* = 7.7, 1.0 Hz, 1H), 7.06 (t, *J* = 7.5 Hz, 1H), 7.00 (s, 1H), 6.97 (d, *J* = 7.6 Hz, 1H), 6.88 (s, 1H), 6.85 (d, *J* = 7.6 Hz, 1H), 6.82 (s, 1H), 6.78 (s, 1H), 4.78 (d, *J* = 7.6 Hz, 1H), 3.72 (s, 3H), 3.64 (q, *J* = 6.7, 6.0 Hz, 1H), 2.92 (dd, *J* = 13.7, 5.8 Hz, 1H), 2.84 (dd, *J* = 13.8, 5.8 Hz, 1H), 2.76 (dd, *J* = 13.7, 6.7 Hz, 1H), 2.69 (dd, *J* = 13.8, 7.6 Hz, 1H), 2.26 (s, 3H), 2.22 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.72, 149.50, 145.89, 142.64, 141.61, 138.32, 138.24, 137.23, 136.22, 131.66, 130.89, 130.28, 130.23, 129.13, 128.64, 128.04, 127.78, 127.60, 127.46, 127.42, 126.57, 123.92, 57.36, 52.27, 41.52, 41.31, 21.43, 21.40. HRMS (ESI-TOF) *m/z* calc'd for $C_{31}H_{30}NaN_2O_6S$ $[M+Na]^+$: 581.1717; found: 581.1725.

SFC Chiralpak® OD-3 column (30% isopropanol, 2.0 mL/min) t_r = 4.46 min (major), 5.78 min (minor): 88:12 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4f

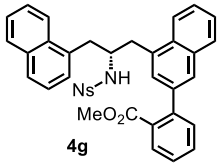
Methyl (*R*)-3'-(2-((4-nitrophenyl)sulfonamido)-3-(3-(trifluoromethoxy)phenyl)propyl)-5'-(trifluoromethoxy)-[1,1'-biphenyl]-2-carboxylate (4f)

Substrate **3f** was arylated following the general procedure by using methyl 2-iodobenzoate (44 μL, 0.30 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (hexane/Et_2O = 1:2 v/v), compound **4f** (40.0 mg) was obtained in 57% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.8 Hz, 2H), 7.98 (dd, *J* = 7.8, 1.3 Hz, 1H), 7.66 (d, *J* = 8.9 Hz, 2H), 7.58 (td, *J* = 7.5, 1.4 Hz, 1H), 7.48 (td, *J* = 7.7, 1.3 Hz, 1H), 7.30 (dd, *J* = 7.6, 1.3 Hz, 1H), 7.19 (t, *J* = 7.9 Hz, 1H), 7.07 (d, *J* = 1.6 Hz, 1H), 7.05–7.00 (m, 2H), 6.99 (d, *J* = 7.8 Hz, 1H), 6.89 (s, 1H), 6.82 (s, 1H), 4.94 (d, *J* = 8.1 Hz, 1H), 3.76 (s, 3H), 3.73 (td, *J* = 8.1, 4.1 Hz, 1H), 3.02 (dd, *J* = 13.8, 5.5 Hz, 1H), 2.90 (dd, *J* = 13.9, 5.6 Hz, 1H), 2.80 (dd, *J* = 13.9, 6.6 Hz, 1H), 2.70 (dd, *J* = 13.9, 8.0 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 167.99, 149.81, 149.38, 149.11, 145.68, 143.63, 141.31, 139.45, 137.73, 132.14, 130.90, 130.80, 130.09, 129.70, 128.98, 128.29, 127.88, 127.82, 124.15, 122.05, 120.48 (q, *J* = 258.1 Hz), 120.25 (q, *J* = 256.0 Hz), 120.44, 119.74, 119.42, 56.76, 52.38, 41.33, 40.91; ^{19}F NMR (376 MHz, $CDCl_3$) δ -58.07, -58.10. HRMS (ESI-TOF) *m/z* calc'd for $C_{31}H_{25}F_6N_2O_8S$ $[M+H]^+$: 699.1230; found: 699.1214.

SFC Chiralpak® AD-3 column (10% isopropanol, 2.0 mL/min) t_r = 4.84 min (minor), 6.02 min (major): 90:10 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4g

Methyl (*R*)-4'-chloro-3'-(3-(2-chlorophenyl)-2-((4-nitrophenyl)sulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate (4g)

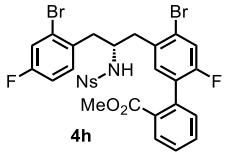
Substrate **3g** was arylated following the general procedure by using methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (toluene/DCM/Et_2O = 2:1:1 v/v/v), compound **4g** (44.5 mg) was obtained in 71% yield as a yellow liquid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.99 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.77 (d, *J* = 8.3 Hz, 2H), 7.71 (d, *J* = 8.1 Hz, 1H), 7.68 (d, *J* = 8.2 Hz, 1H), 7.65 (d, *J* = 1.7 Hz, 1H), 7.60 (td, *J* = 7.5, 1.4 Hz, 1H), 7.51–7.41 (m, 5H), 7.36 (dd, *J* = 12.5, 8.4 Hz, 4H), 7.30 (dt, *J* = 7.5, 4.2 Hz, 2H), 7.25 (d, *J* = 1.8 Hz, 1H), 7.17 (d, *J* = 8.4 Hz,

1H), 7.08 (t, *J* = 7.6 Hz, 1H), 4.99 (d, *J* = 5.1 Hz, 1H), 3.90 (q, *J* = 7.1 Hz, 1H), 3.75 (s, 3H), 3.66–3.57 (m, 1H), 3.32–3.24 (m, 2H), 3.16 (dd, *J* = 14.3, 8.6 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.49, 148.80, 143.77, 142.62, 138.57, 134.11, 134.04, 133.69, 132.12, 131.94, 131.67, 131.42, 130.68, 130.34, 130.06, 129.84, 128.99, 128.91, 128.20, 128.03, 127.79, 127.38, 126.85, 126.31, 126.29, 126.16, 126.03, 125.48, 123.79, 123.21, 54.50, 52.58, 40.32, 39.29. HRMS (ESI-TOF) *m/z* calc'd for $C_{37}H_{30}NaN_2O_6S$ $[M+Na]^+$: 653.1717; found: 653.1720.

SFC Chiralpak® AD-3 column (40% isopropanol, 2.0 mL/min) t_r = 5.37 min (minor), 8.26 min (major): 98:2 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4h

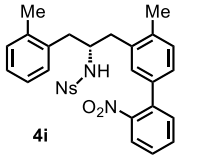
Methyl (*R*)-4'-bromo-5'-(3-(2-bromo-4-fluorophenyl)-2-((4-nitrophenyl)sulfonamido)propyl)-2'-fluoro-[1,1'-biphenyl]-2-carboxylate (4h)

Substrate **3h** was arylated following the general procedure by using methyl 2-iodobenzoate (44 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (toluene/EtOAc = 6:1 v/v), compound **4h** (43.5 mg) was obtained in 60% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.8 Hz, 2H), 8.02 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.68 (d, *J* = 8.8 Hz, 2H), 7.59 (td, *J* = 7.6, 1.5 Hz, 1H), 7.49 (td, *J* = 7.7, 1.3 Hz, 1H), 7.28 (dd, *J* = 7.6, 1.3 Hz, 1H), 7.16 (dd, *J* = 8.2, 2.0 Hz, 2H), 7.10–7.04 (m, 2H), 6.83 (td, *J* = 8.2, 2.7 Hz, 1H), 5.01 (d, *J* = 8.6 Hz, 1H), 3.99 (dt, *J* = 8.5, 5.7 Hz, 1H), 3.79 (s, 3H), 3.04 (ddd, *J* = 21.5, 14.0, 5.6 Hz, 2H), 2.98–2.89 (m, 2H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 167.52, 161.42 (d, *J* = 251.0 Hz), 158.19 (d, *J* = 250.9 Hz), 149.69, 145.76, 135.41, 133.47 (d, *J* = 4.0 Hz), 132.79 (d, *J* = 3.8 Hz), 132.62 (d, *J* = 8.1 Hz), 132.36, 132.79 (d, *J* = 3.5 Hz), 131.46, 130.65, 130.23, 128.88 (d, *J* = 15.9 Hz), 128.65, 128.06, 124.70 (d, *J* = 9.1 Hz), 124.12, 123.59 (d, *J* = 9.4 Hz), 120.21 (d, *J* = 24.2 Hz), 119.89 (d, *J* = 25.8 Hz), 114.80 (d, *J* = 20.7 Hz), 55.05, 52.42, 41.34, 40.79; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -112.99, -115.98. HRMS (ESI-TOF) *m/z* calc'd for $C_{29}H_{23}Br_2F_2N_2O_6S$ $[M+H]^+$: 722.9606; found: 722.9599.

SFC Chiralpak® OJ-3 column (30% isopropanol, 2.0 mL/min) t_r = 3.96 min (minor), 4.40 min (major): 92:8 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4i

(*R*)-*N*-(1-(4-methyl-2'-nitro-[1,1'-biphenyl]-3-yl)-3-(*o*-tolyl)propan-2-yl)-4-nitrobenzenesulfonamide (4i)

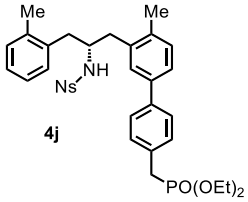
Substrate **3a** was arylated following the general procedure by using 1-iodo-2-nitrobenzene (74.5 mg, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%), and TBME (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4i** (35.5 mg) was obtained in 65% yield as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.99 (d, *J* = 8.9 Hz, 2H), 7.83 (d, *J* = 8.0 Hz, 1H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.54 (d, *J* = 8.9 Hz, 2H), 7.48 (t, *J* = 7.7 Hz, 1H), 7.39 (d, *J* = 7.6 Hz, 1H), 7.11 (d, *J* = 1.1 Hz, 2H), 7.07 (s, 1H), 7.03 (t, *J* = 7.3 Hz, 1H), 6.96 (t, *J* = 7.3 Hz, 1H), 6.92 (d, *J* = 7.5 Hz, 1H), 6.89 (d, *J* = 7.4 Hz, 1H), 4.82 (d, *J* = 7.4 Hz, 1H), 3.55 (h, *J* = 7.2 Hz, 1H), 3.06 (dd, *J* = 13.8, 6.4 Hz, 1H), 2.94–2.82 (m, 2H), 2.68 (dd, *J* = 14.1, 9.1 Hz, 1H), 2.22 (s, 3H), 1.99 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.55, 149.41, 145.33, 136.69, 136.25, 136.05, 135.79, 135.41, 135.32, 132.48, 131.87, 131.29, 130.79, 130.47, 130.20,

128.33, 127.78, 127.19, 126.69, 126.20, 124.22, 124.04, 55.34, 40.38, 38.76, 19.29, 19.11. HRMS (ESI-TOF) *m/z* calc'd for $C_{29}H_{28}N_3O_6S$ $[M+H]^+$: 546.1693; found: 546.1694.

SFC Chiralpak® OJ-3 column (10% isopropanol, 2.0 mL/min) t_r = 23.64 min (minor), 24.81 min (major): 99:1 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



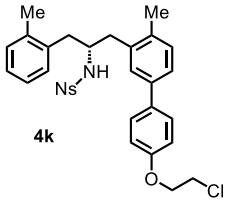
(*R*)-*N*-(1-(4'-(2-chloroethoxy)-4-methyl-[1,1'-biphenyl]-3-yl)-3-(*o*-tolyl)propan-2-yl)-4-nitrobenzenesulfonamide (4j)

Substrate **3a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), 4-acetylpyridine as ligand (3.3 μL, 30 μmol, 30 mol%), diethyl (4-iodobenzyl)phosphonate (106 mg, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.3 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 1:6 v/v), compound **4j** (39.0 mg) was obtained in 60% yield as a yellow solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.85 (d, *J* = 8.8 Hz, 2H), 7.45 (d, *J* = 8.8 Hz, 2H), 7.41 (d, *J* = 7.9 Hz, 2H), 7.35 (dd, *J* = 8.3, 2.5 Hz, 2H), 7.22 (dd, *J* = 7.9, 2.0 Hz, 1H), 7.17 (d, *J* = 2.0 Hz, 1H), 7.11–6.98 (m, 4H), 6.96 (d, *J* = 7.9 Hz, 1H), 5.57 (d, *J* = 8.1 Hz, 1H), 4.14–3.98 (m, 4H), 3.61 (q, *J* = 7.3 Hz, 1H), 3.21 (s, 1H), 3.18 (s, 1H), 2.95 (dd, *J* = 13.7, 7.2 Hz, 1H), 2.91–2.74 (m, 3H), 2.15 (s, 3H), 2.05 (s, 3H), 1.34–1.17 (m, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 149.25, 145.88, 138.96 (d, *J* = 3.8 Hz), 138.24 (d, *J* = 1.4 Hz), 136.35, 136.28, 135.72, 135.34, 131.16, 130.79, 130.74 (d, *J* = 11.4 Hz), 130.73, 130.38 (d, *J* = 6.2 Hz), 129.08, 127.36, 127.15, 126.85, 126.83, 126.14, 125.33, 123.82, 62.40 (dd, *J* = 6.8, 1.6 Hz), 55.56, 40.24, 39.47, 33.41 (d, *J* = 138.3 Hz), 19.38, 18.80, 16.55 (d, *J* = 6.0 Hz). HRMS (ESI-TOF) *m/z* calc'd for $C_{34}H_{40}N_2O_7PS$ $[M+H]^+$: 651.2288; found: 651.2285.

SFC Chiralpak® OJ-3 column (20% isopropanol, 2.0 mL/min) t_r = 6.51 min (major), 8.58 min (minor): 96:4 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



(*R*)-*N*-(1-(4'-(2-chloroethoxy)-4-methyl-[1,1'-biphenyl]-3-yl)-3-(*o*-tolyl)propan-2-yl)-4-nitrobenzenesulfonamide (4k)

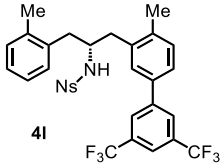
Substrate **3a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), 4-acetylpyridine as ligand (3.3 μL, 30 μmol, 30 mol%), 1-(2-chloroethoxy)-4-iodobenzene (85 mg, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **4k** (33.6 mg) was obtained in 58% yield as a yellow solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.88 (d, *J* = 8.8 Hz, 2H), 7.45 (d, *J* = 8.8 Hz, 2H), 7.41 (d, *J* = 8.9 Hz, 2H), 7.22 (dd, *J* = 7.8, 2.0 Hz, 1H), 7.15–7.08 (m, 2H), 7.08–7.01 (m, 3H), 6.95 (dd, *J* = 15.1, 8.4 Hz, 3H), 4.96 (d, *J* = 8.0 Hz, 1H), 4.26 (t, *J* = 5.8 Hz, 2H), 3.84 (t, *J* = 5.9 Hz, 2H), 3.62 (td, *J* = 7.9, 5.7 Hz, 1H), 2.99 (dd, *J* = 13.8, 7.0 Hz, 1H), 2.95–2.86 (m, 2H), 2.80 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.18 (s, 3H), 2.04 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 157.88, 149.37, 145.43, 138.24, 136.36, 136.00, 135.51, 134.75, 133.45, 131.25, 130.86, 130.69, 128.61, 127.79, 127.41, 127.26, 126.23, 125.12, 123.90, 115.23, 68.25, 55.61, 42.02,

40.33, 39.48, 19.43, 18.78. HRMS (ESI-TOF) *m/z* calc'd for $C_{31}H_{30}ClN_2O_5S$ $[M-H]^-$: 577.1569; found: 577.1561.

SFC Chiralpak® OJ-3 column (40% isopropanol, 2.5 mL/min) t_r = 6.01 min (minor), 7.36 min (major): 91:9 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



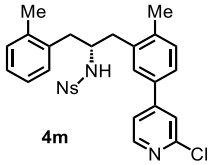
(*R*)-*N*-(1-(4-methyl-3',5'-bis(trifluoromethyl)-[1,1'-biphenyl]-3-yl)-3-(*o*-tolyl)propan-2-yl)-4-nitrobenzenesulfonamide (4l)

Substrate **3a** was arylated following the general procedure by using 1-iodo-3,5-bis(trifluoromethyl)benzene (53 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **4l** (40.0 mg) was obtained in 63% yield as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.96–7.89 (m, 4H), 7.84 (s, 1H), 7.49 (d, *J* = 8.8 Hz, 2H), 7.36 (dd, *J* = 7.8, 2.1 Hz, 1H), 7.27 (d, *J* = 2.1 Hz, 1H), 7.19 (d, *J* = 7.9 Hz, 1H), 7.07 (td, *J* = 7.4, 1.5 Hz, 1H), 7.00 (t, *J* = 7.7 Hz, 1H), 6.96–6.92 (m, 2H), 4.75 (d, *J* = 8.1 Hz, 1H), 3.69 (td, *J* = 7.8, 5.8 Hz, 1H), 3.06 (dd, *J* = 13.9, 7.3 Hz, 1H), 2.97 (dd, *J* = 13.9, 6.9 Hz, 1H), 2.90 (dd, *J* = 14.0, 5.8 Hz, 1H), 2.77 (dd, *J* = 14.0, 8.6 Hz, 1H), 2.26 (s, 3H), 2.05 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.51, 145.65, 142.60, 137.54, 136.87, 136.14, 135.97, 135.23, 132.34 (q, *J* = 33.2 Hz), 131.83, 130.93, 130.53, 129.35, 127.50, 127.40, 126.88, 126.35, 125.83, 123.48 (q, *J* = 272.9 Hz), 123.97, 121.03 (hept, *J* = 3.7 Hz), 55.49, 40.50, 39.52, 19.23; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -63.08. HRMS (ESI-TOF) *m/z* calc'd for $C_{31}H_{25}F_6N_2O_4S$ $[M-H]^-$: 635.1445; found: 635.1439.

SFC Chiralpak® OD-3 column (20% isopropanol, 2.0 mL/min) t_r = 3.17 min (minor), 4.38 min (major): 95:5 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



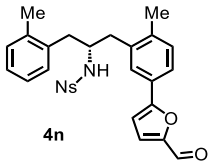
(*R*)-*N*-(1-(5-(2-chloropyridin-4-yl)-2-methylphenyl)-3-(*o*-tolyl)propan-2-yl)-4-nitrobenzenesulfonamide (4m)

Substrate **3a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), 4-acetylpyridine as ligand (3.3 μL, 30 μmol, 30 mol%), 2-chloro-4-iodopyridine (50 mg, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.5 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4m** (24.1 mg) was obtained in 45% yield as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.40 (d, *J* = 5.1 Hz, 1H), 7.92 (d, *J* = 8.8 Hz, 2H), 7.49 (d, *J* = 8.9 Hz, 2H), 7.45 (d, *J* = 1.2 Hz, 1H), 7.38–7.32 (m, 2H), 7.28 (d, *J* = 2.0 Hz, 1H), 7.14 (d, *J* = 7.8 Hz, 1H), 7.07 (t, *J* = 7.4 Hz, 1H), 7.01 (t, *J* = 7.3 Hz, 1H), 6.97 (t, *J* = 7.1 Hz, 2H), 5.13 (d, *J* = 8.2 Hz, 1H), 3.67 (h, *J* = 7.4 Hz, 1H), 3.03–2.92 (m, 2H), 2.89 (dd, *J* = 13.9, 6.2 Hz, 1H), 2.83 (dd, *J* = 13.9, 8.2 Hz, 1H), 2.21 (s, 3H), 2.08 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 152.22, 150.71, 150.08, 149.29, 145.56, 138.36, 136.74, 136.00, 135.13, 134.26, 131.59, 130.73, 130.40, 129.09, 127.27, 127.19, 126.15, 125.39, 123.80, 121.49, 119.98, 55.36, 40.02, 39.56, 19.13, 19.07. HRMS (ESI-TOF) *m/z* calc'd for $C_{28}H_{27}ClN_3O_4S$ $[M+H]^+$: 536.1405; found: 536.1408.

SFC Chiralpak® OJ-3 column (30% isopropanol, 2.0 mL/min) t_r = 4.68 min (major), 10.34 min (minor): 92:8 er.

The absolute stereochemistry was determined by X-ray crystallography.



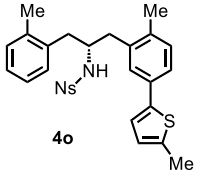
(*R*)-*N*-(1-(5-(5-formylfuran-2-yl)-2-methylphenyl)-3-(*o*-tolyl)propan-2-yl)-4-nitrobenzenesulfonamide (4n)

Substrate **3a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), 4-acetylpyridine as ligand (3.3 μL, 30 μmol, 30 mol%), 5-iodofuran-2-carbaldehyde (66.6 mg, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.3 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4n** (27.4 mg) was obtained in 53% yield as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 9.62 (s, 1H), 7.84 (d, *J* = 8.8 Hz, 2H), 7.48 (d, *J* = 8.8 Hz, 2H), 7.41 (d, *J* = 1.9 Hz, 1H), 7.37 (dd, *J* = 7.9, 1.9 Hz, 1H), 7.30 (d, *J* = 3.7 Hz, 1H), 7.13–7.09 (m, 1H), 7.08–7.05 (m, 2H), 7.04 (d, *J* = 7.7 Hz, 2H), 6.70 (d, *J* = 3.7 Hz, 1H), 5.25 (d, *J* = 8.5 Hz, 1H), 3.73–3.65 (m, 1H), 2.99 (dd, *J* = 13.7, 7.0 Hz, 1H), 2.89 (dd, *J* = 13.8, 6.4 Hz, 2H), 2.77 (dd, *J* = 14.1, 8.9 Hz, 1H), 2.19 (s, 3H), 2.08 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 177.20, 159.16, 151.82, 149.23, 146.14, 138.44, 136.95, 136.40, 135.47, 131.23, 130.88, 130.74, 127.34, 127.32, 127.28, 126.68, 126.26, 123.92, 123.83, 107.43, 55.83, 40.64, 39.10, 19.45, 19.14. HRMS (ESI-TOF) *m/z* calc'd for $C_{28}H_{27}N_2O_6S$ $[M+H]^+$: 519.1584; found: 519.1590.

SFC Chiralpak® OD-3 column (30% isopropanol, 3.0 mL/min) t_r = 3.74 min (minor), 4.41 min (major): 96:4 er.

The absolute stereochemistry was determined by X-ray crystallography.



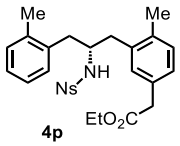
(*R*)-*N*-(1-(2-methyl-5-(5-methylthiophen-2-yl)phenyl)-3-(*o*-tolyl)propan-2-yl)-4-nitrobenzenesulfonamide (4o)

Substrate **3a** was arylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), 4-acetylpyridine as ligand (3.3 μL, 30 μmol, 30 mol%), 2-iodo-5-methylthiophene (67.2 mg, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and TBME (0.3 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4o** (22.5 mg) was obtained in 43% yield as a yellow solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.88 (d, *J* = 8.8 Hz, 2H), 7.46 (d, *J* = 8.8 Hz, 2H), 7.17 (dd, *J* = 7.8, 2.0 Hz, 1H), 7.12 (td, *J* = 7.1, 2.1 Hz, 1H), 7.10 – 7.04 (m, 3H), 7.00 (d, *J* = 2.0 Hz, 1H), 6.96 (d, *J* = 3.5 Hz, 1H), 6.89 (d, *J* = 7.9 Hz, 1H), 6.72 – 6.66 (m, 1H), 4.66 (d, *J* = 7.9 Hz, 1H), 3.65 – 3.55 (m, 1H), 3.03 (dd, *J* = 13.8, 6.7 Hz, 1H), 2.91 (dd, *J* = 13.8, 7.4 Hz, 1H), 2.86 (dd, *J* = 14.1, 5.3 Hz, 1H), 2.68 (dd, *J* = 14.1, 8.9 Hz, 1H), 2.50 (s, 3H), 2.21 (s, 3H), 2.00 (d, *J* = 2.1 Hz, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 149.40, 145.42, 141.19, 139.57, 136.47, 136.09, 135.44, 134.90, 132.63, 131.22, 130.93, 130.73, 127.41, 127.33, 127.26, 126.44, 126.26, 123.98, 123.84, 122.63, 55.79, 40.60, 39.04, 19.51, 18.85, 15.60. HRMS (ESI-TOF) *m/z* calc'd for $C_{28}H_{29}N_2O_4S_2$ $[M+H]^+$: 521.1563; found: 521.1572.

SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 5.08 min (major), 5.82 min (minor): 88:12 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4p

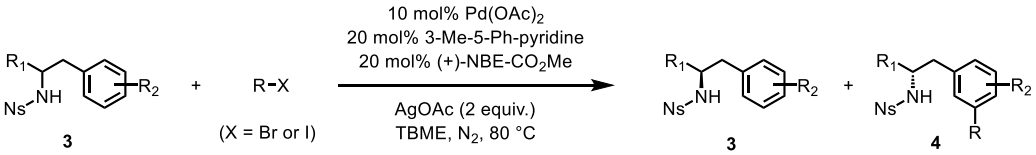
Ethyl (*R*)-2-(4-methyl-3-(2-((4-nitrophenyl)sulfonamido)-3-(*o*-tolyl)propyl)phenyl)acetate (4p)

Substrate **3a** was alkylated following the general procedure by using $Pd(OAc)_2$ (3.3 mg, 15 μmol, 15 mol%), 4-acetylpyridine as ligand (3.3 μL, 30 μmol, 30 mol%), ethyl 2-iodoacetate (35 μL, 0.3 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and DCM (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4p** (24.5 mg) was obtained in 48% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.96 (d, *J* = 8.9 Hz, 2H), 7.50 (d, *J* = 8.9 Hz, 2H), 7.08 (td, *J* = 7.4, 1.7 Hz, 1H), 7.04–6.95 (m, 4H), 6.93 (d, *J* = 1.9 Hz, 1H), 6.85 (d, *J* = 7.7 Hz, 1H), 4.89 (d, *J* = 7.5 Hz, 1H), 4.16 (q, *J* = 7.1 Hz, 2H), 3.55–3.41 (m, 3H), 2.91 (dd, *J* = 13.9, 7.3 Hz, 1H), 2.87–2.80 (m, 2H), 2.77 (dd, *J* = 13.9, 8.2 Hz, 1H), 2.10 (s, 3H), 1.96 (s, 3H), 1.26 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 171.80, 149.44, 145.26, 136.30, 135.74, 135.54, 134.94, 131.98, 131.63, 130.96, 130.81, 130.61, 128.08, 127.70, 127.18, 126.17, 123.95, 61.12, 55.19, 40.79, 39.86, 39.52, 19.29, 18.76, 14.35. HRMS (ESI-TOF) *m/z* calc'd for $C_{27}H_{31}N_2O_6S$ $[M+H]^+$: 511.1897; found: 511.1899.

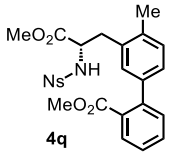
SFC Chiralpak® OJ-3 column (20% isopropanol, 2.0 mL/min) t_r = 3.87 min (minor), 4.18 min (major): 92:8 er. The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.

D. Pd/(+)-NBE-CO_2Me Catalyzed Kinetic Resolution of Homobenzylamines



3 3 4

General procedure: Arene **3** (0.10 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 10 μmol, 10 mol%), 3-methyl-5-phenylpyridine (3.4 mg, 20 μmol, 20 mol%), coupling partner, and AgOAc (33 mg, 0.20 mmol, 2.0 equiv.) were added into a 2-dram reaction vial. TBME (1 mL) and (+)-NBE-CO_2Me (3.0 mg, 20 μmol, 20 mol%) were added to the mixture. The vial was flushed with N_2, and then capped. The reaction mixture was then stirred at 80 °C for 24 hours. After cooling to room temperature, the mixture was filtered through Celite and eluted with EtOAc (3 × 2 mL). The filtrate was evaporated under reduced pressure. Purification by preparative TLC chromatography afforded product **4**.



4q

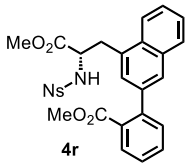
Methyl (*S*)-3'-(3-methoxy-2-((4-nitrophenyl)sulfonamido)-3-oxopropyl)-4'-methyl-[1,1'-biphenyl]-2-carboxylate (4q)

Substrate **3i** was arylated following the general procedure by using methyl 2-bromobenzoate (7.1 μL, 0.05 mmol, 0.5 equiv.) and TBME (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4q** (24.4 mg) was obtained in 47% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.17 (d, *J* = 8.8 Hz, 2H), 7.92–7.79 (m, 3H), 7.52 (td, *J* = 7.5, 1.4 Hz, 1H), 7.41 (td, *J* = 7.6, 1.3 Hz, 1H), 7.28–7.23 (m, 1H), 7.09 (dd, *J* = 7.7, 1.9 Hz, 1H), 7.06 (d, *J* = 7.8 Hz, 1H), 6.98 (d, *J* = 1.8 Hz, 1H), 5.60 (br s, 1H), 4.23 (dd, *J* = 8.4, 5.5 Hz, 1H), 3.76 (s, 3H), 3.62 (s, 3H), 3.17 (dd, *J* = 14.3, 5.5 Hz, 1H), 2.97 (dd, *J* = 14.2, 8.4 Hz, 1H), 2.20 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.68, 168.76, 149.98, 145.69, 142.25, 139.28, 135.58, 132.81, 131.68, 130.90, 130.67, 130.65, 130.25, 130.21, 128.42, 127.73, 127.44, 124.19, 56.12, 52.89, 52.41, 36.58, 19.08. HRMS (ESI-TOF) *m/z* calc'd for $C_{25}H_{25}N_2O_8S$ $[M+H]^+$: 513.1326; found: 513.1331.

SFC Chiralpak® AD-3 column (30% isopropanol, 2.0 mL/min) t_r = 4.31 min (minor), 6.64 min (major): 88:12 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4r

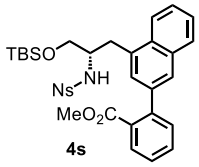
Methyl (*S*)-2-(4-(3-methoxy-2-((4-nitrophenyl)sulfonamido)-3-oxopropyl)naphthalen-2-yl)benzoate (4r)

Substrate **3j** was arylated following the general procedure by using methyl 2-bromobenzoate (7.1 µL, 0.05 mmol, 0.5 equiv.) and TBME (1 mL). After purification by preparative TLC chromatography (toluene/EtOAc = 5:1 v/v), compound **4r** (25.8 mg) was obtained in 47% yield as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.06 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.75–7.69 (m, 3H), 7.69–7.65 (m, 2H), 7.62 (td, *J* = 7.5, 1.4 Hz, 1H), 7.53 (d, *J* = 8.8 Hz, 2H), 7.50 (td, *J* = 7.7, 1.3 Hz, 1H), 7.43 (dd, *J* = 7.6, 1.2 Hz, 1H), 7.39–7.33 (m, 2H), 7.23 (d, *J* = 1.7 Hz, 1H), 5.53 (d, *J* = 6.5 Hz, 1H), 4.21 (ddd, *J* = 10.8, 6.4, 4.4 Hz, 1H), 3.88 (s, 3H), 3.78 (s, 3H), 3.71 (dd, *J* = 14.3, 4.4 Hz, 1H), 3.12 (dd, *J* = 14.4, 10.7 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.84, 168.24, 149.35, 144.20, 142.75, 138.73, 134.04, 132.36, 131.47, 130.94, 130.56, 130.06, 129.41, 129.34, 129.20, 127.96, 127.93, 127.26, 126.71, 126.32, 123.56, 122.68, 56.01, 53.07, 52.83, 35.93. HRMS (ESI-TOF) *m/z* calc'd for $C_{28}H_{25}N_2O_8S$ $[M+H]^+$: 549.1326; found: 549.1328.

SFC Chiralpak® IC column (40% isopropanol, 2.0 mL/min) t_r = 5.86 min (major), 8.90 min (minor): 93:7 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



4s

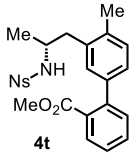
Methyl (*S*)-2-(4-(3-((*tert*-butyldimethylsilyl)oxy)-2-((4-nitrophenyl)sulfonamido)propyl)naphthalen-2-yl)benzoate (4s)

Substrate **3m** was arylated following the general procedure by using methyl 2-bromobenzoate (7.1 µL, 0.05 mmol, 0.5 equiv.) and TBME (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **4s** (29.8 mg) was obtained in 47% yield as a colorless oil.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.02 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.67–7.59 (m, 6H), 7.52–7.46 (m, 3H), 7.44 (d, *J* = 7.7 Hz, 1H), 7.34–7.27 (m, 2H), 7.17 (d, *J* = 1.7 Hz, 1H), 4.91 (d, *J* = 5.1 Hz, 1H), 4.08 (dd, *J* = 9.8, 3.2 Hz, 1H), 3.87 (s, 3H), 3.80–3.65 (m, 2H), 3.58–3.43 (m, 1H), 2.75 (dd, *J* = 14.5, 10.9 Hz, 1H), 0.98 (s, 9H), 0.16 (d, *J* = 8.3 Hz, 6H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.36, 149.05, 144.19, 142.69, 138.57, 134.08, 132.25, 131.74, 131.50, 130.78, 130.32, 130.17, 129.60, 129.00, 127.85, 127.79, 126.76, 126.32, 126.16, 123.41, 123.22, 66.62, 55.40, 52.72, 35.83, 26.08, 18.45, -5.12, -5.16. HRMS (ESI-TOF) *m/z* calc'd for $C_{33}H_{39}N_2O_7SSi$ $[M+H]^+$: 635.2242; found: 635.2242.

SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 3.05 min (major), 3.96 min (minor): 92:8 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.

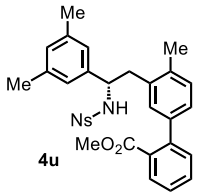


4t

Methyl (*R*)-4'-methyl-3'-(2-((4-nitrophenyl)sulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate (4t)

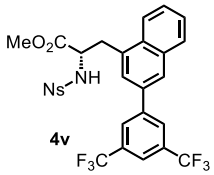
Substrate **3k** was arylated following the general procedure by using methyl 2-bromobenzoate (21.1 µL, 0.15 mmol, 1.5 equiv.) and TBME (1 mL) at 80 °C for 48 hours. After purification by preparative TLC chromatography (hexane/EtOAc = 4:1 v/v), compound **4t** (17.8 mg) was obtained in 38% yield as a colorless

oil.
^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.15 (d, *J* = 8.4 Hz, 2H), 7.89 (d, *J* = 7.8 Hz, 1H), 7.82 (d, *J* = 8.4 Hz, 2H), 7.54 (t, *J* = 7.7 Hz, 1H), 7.42 (t, *J* = 7.7 Hz, 1H), 7.28 (d, *J* = 7.7 Hz, 1H), 7.10 (d, *J* = 7.7 Hz, 1H), 6.98 (d, *J* = 7.8 Hz, 1H), 6.95 (s, 1H), 4.82 (d, *J* = 6.4 Hz, 1H), 3.78 (s, 3H), 3.52 (p, *J* = 6.6 Hz, 1H), 2.82 (dd, *J* = 14.1, 5.6 Hz, 1H), 2.65 (dd, *J* = 14.2, 8.8 Hz, 1H), 2.06 (s, 3H), 1.31 (d, *J* = 6.4 Hz, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.69, 149.78, 146.24, 142.41, 139.20, 135.38, 134.53, 131.78, 131.01, 130.98, 130.73, 130.35, 130.07, 128.40, 127.47, 127.27, 124.20, 52.48, 50.24, 41.20, 22.85, 19.06. HRMS (ESI-TOF) *m/z* calc'd for $C_{24}H_{25}N_2O_6S$ $[M+H]^+$: 469.1428; found: 469.1426.
SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 5.09 min (minor), 6.50 min (major): 93:7 er.
The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



Methyl (*S*)-3'-(2-(3,5-dimethylphenyl)-2-((4-nitrophenyl)sulfonamido)ethyl)-4'-methyl-[1,1'-biphenyl]-2-carboxylate (4u)

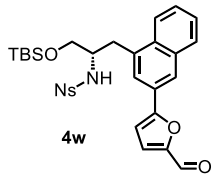
Substrate **3n** was arylated following the general procedure by using methyl 2-bromobenzoate (14.1 μL, 0.10 mmol, 1.0 equiv.) and TBME (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4u** (27.4 mg) was obtained in 49% yield as a colorless oil.
^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 8.8 Hz, 2H), 7.91 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.65 (d, *J* = 8.8 Hz, 1H), 7.53 (td, *J* = 7.6, 1.5 Hz, 1H), 7.42 (td, *J* = 7.6, 1.3 Hz, 1H), 7.24 (dd, *J* = 7.7, 1.3 Hz, 1H), 7.09 (dd, *J* = 7.7, 2.0 Hz, 1H), 7.07–6.98 (m, 2H), 6.79 (s, 1H), 6.64 (d, *J* = 1.4 Hz, 2H), 5.48 (d, *J* = 6.2 Hz, 1H), 4.57–4.46 (m, 1H), 3.81 (s, 2H), 3.08 (dd, *J* = 14.2, 5.2 Hz, 1H), 2.91 (dd, *J* = 14.3, 8.9 Hz, 1H), 2.16 (s, 6H), 2.02 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 168.81, 149.53, 146.17, 142.57, 140.24, 139.13, 138.12, 135.83, 133.89, 131.75, 131.08, 131.00, 130.54, 130.36, 129.98, 129.33, 128.41, 127.40, 127.39, 124.58, 123.58, 58.21, 52.50, 41.80, 21.26, 19.03. HRMS (ESI-TOF) *m/z* calc'd for $C_{31}H_{30}NaN_2O_6S$ $[M+Na]^+$: 581.1717; found: 581.1714.
SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 5.18 min (minor), 5.90 min (major): 90:10 er.
The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



Methyl (*S*)-3'-(2-(3,5-dimethylphenyl)-2-((4-nitrophenyl)sulfonamido)ethyl)-4'-methyl-[1,1'-biphenyl]-2-carboxylate (4v)

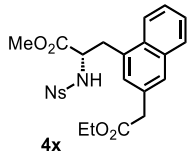
Substrate **3j** was arylated following the general procedure by using 1-iodo-3,5-bis(trifluoromethyl)benzene (53.1 μL, 0.30 mmol, 3.0 equiv.), AgOAc (50 mg, 0.30 mmol, 3.0 equiv.), and TBME (0.5 mL). After purification by preparative TLC chromatography (toluene/EtOAc = 5:1 v/v), compound **4v** (26.4 mg) was obtained in 42% yield as a white solid.
^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 (d, *J* = 1.5 Hz, 2H), 7.95–7.90 (m, 2H), 7.89 (d, *J* = 1.8 Hz, 1H), 7.85 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.82 (d, *J* = 8.8 Hz, 2H), 7.62–7.53 (m, 2H), 7.50–7.44 (m, 3H), 4.47 (dd, *J* = 9.8, 4.6 Hz, 1H), 3.81–3.69 (m, 4H), 3.30 (dd, *J* = 14.4, 9.8 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.72, 149.63, 144.96, 142.33, 134.89, 134.13, 133.04, 132.63 (q, *J* = 33.2 Hz), 131.34, 129.63, 127.83, 127.60, 127.25, 127.22, 127.05, 126.66, 123.45 (q, *J* = 272.7 Hz), 123.68, 123.05, 121.50 (hept, *J* = 3.6 Hz),

56.66, 53.26, 36.69; ^{19}F NMR (376 MHz, Chloroform-*d*) δ -63.00. HRMS (ESI-TOF) *m/z* calc'd for $C_{28}H_{21}F_6N_2O_6S$ $[M+H]^+$: 627.1019; found: 581.1048.
SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 3.17 min (major), 4.20 min (minor): 92:8 er.
The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



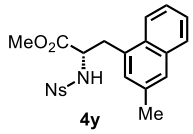
(*S*)-*N*-(1-((*tert*-butyldimethylsilyl)oxy)-3-(3-(5-formylfuran-2-yl)naphthalen-1-yl)propan-2-yl)-4-nitrobenzenesulfonamide (4w)

Substrate **3m** was arylated following the general procedure by using 5-iodofuran-2-carbaldehyde (22.2 mg, 0.10 mmol, 1.0 equiv.) and TBME (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4w** (23.4 mg) was obtained in 39% yield as an orange solid.
^{1}H NMR (600 MHz, Chloroform-*d*) δ 9.71 (s, 1H), 7.98 (s, 1H), 7.83 (d, *J* = 9.1 Hz, 1H), 7.77–7.70 (m, 1H), 7.64 (d, *J* = 8.5 Hz, 2H), 7.55–7.44 (m, 3H), 7.38 (d, *J* = 3.9 Hz, 1H), 7.33 (d, *J* = 8.5 Hz, 2H), 6.92 (d, *J* = 3.9 Hz, 1H), 5.16 (d, *J* = 7.8 Hz, 1H), 3.92 (d, *J* = 6.9 Hz, 1H), 3.70 (d, *J* = 6.2 Hz, 2H), 3.52 (dd, *J* = 14.4, 4.0 Hz, 1H), 2.95 (dd, *J* = 14.4, 9.6 Hz, 1H), 1.00 (s, 9H), 0.16 (d, *J* = 12.2 Hz, 6H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 177.38, 158.76, 152.39, 149.14, 145.38, 135.00, 133.74, 131.88, 129.50, 127.67, 127.19, 127.13, 125.84, 124.44, 124.11, 123.52, 123.43, 108.36, 66.27, 56.29, 35.74, 26.09, 18.51, -5.19, -5.24. HRMS (ESI-TOF) *m/z* calc'd for $C_{30}H_{35}N_2O_7SSi$ $[M+H]^+$: 595.1929; found: 595.1927.
SFC Chiralpak® IC column (20% isopropanol, 2.0 mL/min) t_r = 9.35 min (major), 10.69 min (minor): 90:10 er.
The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



Methyl (*S*)-3-(3-(2-ethoxy-2-oxoethyl)naphthalen-1-yl)-2-((4-nitrophenyl)sulfonamido)propanoate (4x)

Substrate **3j** was alkylated following the general procedure by using 4-acetylpyridine as ligand (2.2 μL, 20 μmol, 20 mol%), ethyl 2-iodoacetate (35.5 μL, 0.30 mmol, 3.0 equiv.), AgOAc (50 mg, 0.30 mmol, 3.0 equiv.), (+)-NBE-CO_2Me (7.5 mg, 50 μmol, 50 mol%), and DCM (1 mL) at 80 °C for 48 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 5:1 v/v), compound **4x** (20.1 mg) was obtained in 40% yield as a white solid.
^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.74 (d, *J* = 8.3 Hz, 1H), 7.70 (d, *J* = 8.8 Hz, 2H), 7.59 (dd, *J* = 8.0, 1.4 Hz, 1H), 7.50 (s, 1H), 7.42 (ddd, *J* = 8.4, 6.8, 1.5 Hz, 1H), 7.38 (td, *J* = 7.5, 7.0, 1.6 Hz, 3H), 7.15 (d, *J* = 1.7 Hz, 1H), 5.53 (d, *J* = 9.3 Hz, 1H), 4.29 (ddd, *J* = 10.7, 9.2, 4.2 Hz, 1H), 4.24 (q, *J* = 7.1 Hz, 2H), 3.80 (s, 3H), 3.71 (s, 2H), 3.63 (dd, *J* = 14.3, 4.2 Hz, 1H), 3.07 (dd, *J* = 14.3, 10.7 Hz, 1H), 1.33 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.92, 171.62, 149.25, 144.26, 133.97, 131.53, 131.38, 130.19, 130.18, 128.69, 128.47, 127.57, 126.60, 126.47, 123.43, 122.73, 61.39, 56.23, 53.23, 41.17, 36.43, 14.43. HRMS (ESI-TOF) *m/z* calc'd for $C_{24}H_{25}N_2O_8S$ $[M+H]^+$: 501.1326; found: 501.1323.
SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 6.10 min (major), 17.17 min (minor): 90:10 er.
The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



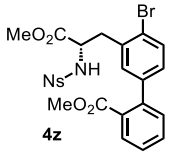
Methyl (*S*)-3-(3-methylnaphthalen-1-yl)-2-((4-nitrophenyl)sulfonamido)propanoate (4y)

Substrate **3j** was alkylated following the general procedure by using 4-acetylpyridine as ligand (2.2 μL, 20 μmol, 20 mol%), iodomethane (18.7 μL, 0.30 mmol, 3.0 equiv.), AgOAc (50 mg, 0.30 mmol, 3.0 equiv.), and DCM (1 mL). After purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v), compound **4y** (15.4 mg) was obtained in 36% yield as yellow solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.80–7.69 (m, 3H), 7.60 (d, *J* = 7.1 Hz, 1H), 7.44–7.31 (m, 5H), 6.98 (s, 1H), 5.34 (d, *J* = 9.3 Hz, 1H), 4.40–4.25 (m, 1H), 3.78 (s, 3H), 3.62 (d, *J* = 14.7 Hz, 1H), 3.12–2.98 (m, 1H), 2.40 (s, 3H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.90, 149.42, 144.55, 135.00, 134.27, 130.98, 130.69, 129.58, 128.39, 127.40, 127.30, 126.25, 125.88, 123.49, 122.64, 56.54, 53.17, 36.51, 21.54. HRMS (ESI-TOF) *m/z* calc'd for $C_{21}H_{21}N_2O_6S$ $[M+H]^+$: 429.1115; found: 429.1119.

SFC Chiralpak® IC column (40% isopropanol, 2.0 mL/min) t_r = 3.70 min (major), 6.83 min (minor): 92:8 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



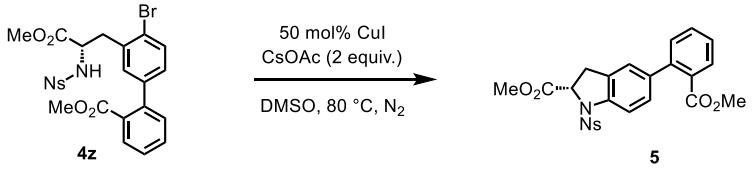
Methyl (*S*)-4'-bromo-3'-(3-methoxy-2-((4-nitrophenyl)sulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate (4z)

Substrate **3l** was arylated following the general procedure by using methyl 2-bromobenzoate (21.2 μL, 0.15 mmol, 1.5 equiv.) and TBME (1 mL) at 80 °C for 48 hours. After purification by preparative TLC chromatography (toluene/EtOAc = 5:1 v/v), compound **4z** (23.7 mg) was obtained in 41% yield as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.22 (d, *J* = 8.4 Hz, 2H), 7.96 (d, *J* = 7.8 Hz, 1H), 7.91 (d, *J* = 8.4 Hz, 2H), 7.58 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 1H), 7.42 (d, *J* = 8.1 Hz, 1H), 7.28 (d, *J* = 9.8 Hz, 1H), 7.15 (s, 1H), 7.06 (d, *J* = 8.2 Hz, 1H), 5.55 (d, *J* = 9.1 Hz, 1H), 4.42 (q, *J* = 8.6, 8.2 Hz, 1H), 3.81 (s, 3H), 3.69 (s, 3H), 3.29 (dd, *J* = 14.1, 5.3 Hz, 1H), 3.08 (dd, *J* = 14.1, 9.3 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.42, 168.22, 150.05, 145.56, 141.32, 141.17, 134.08, 132.79, 132.32, 132.00, 130.86, 130.63, 129.84, 129.31, 128.57, 128.04, 124.24, 123.57, 55.53, 53.08, 52.51, 39.13. HRMS (ESI-TOF) *m/z* calc'd for $C_{24}H_{22}BrN_2O_8S$ $[M+H]^+$: 577.0275; found: 577.0277.

SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 6.16 min (major), 8.91 min (minor): 92:8 er.

The absolute stereochemistry was assigned by analogy to compounds **4m** and **4n**.



Methyl (*S*)-5-(2-(methoxycarbonyl)phenyl)-1-((4-nitrophenyl)sulfonyl)indoline-2-carboxylate (5)

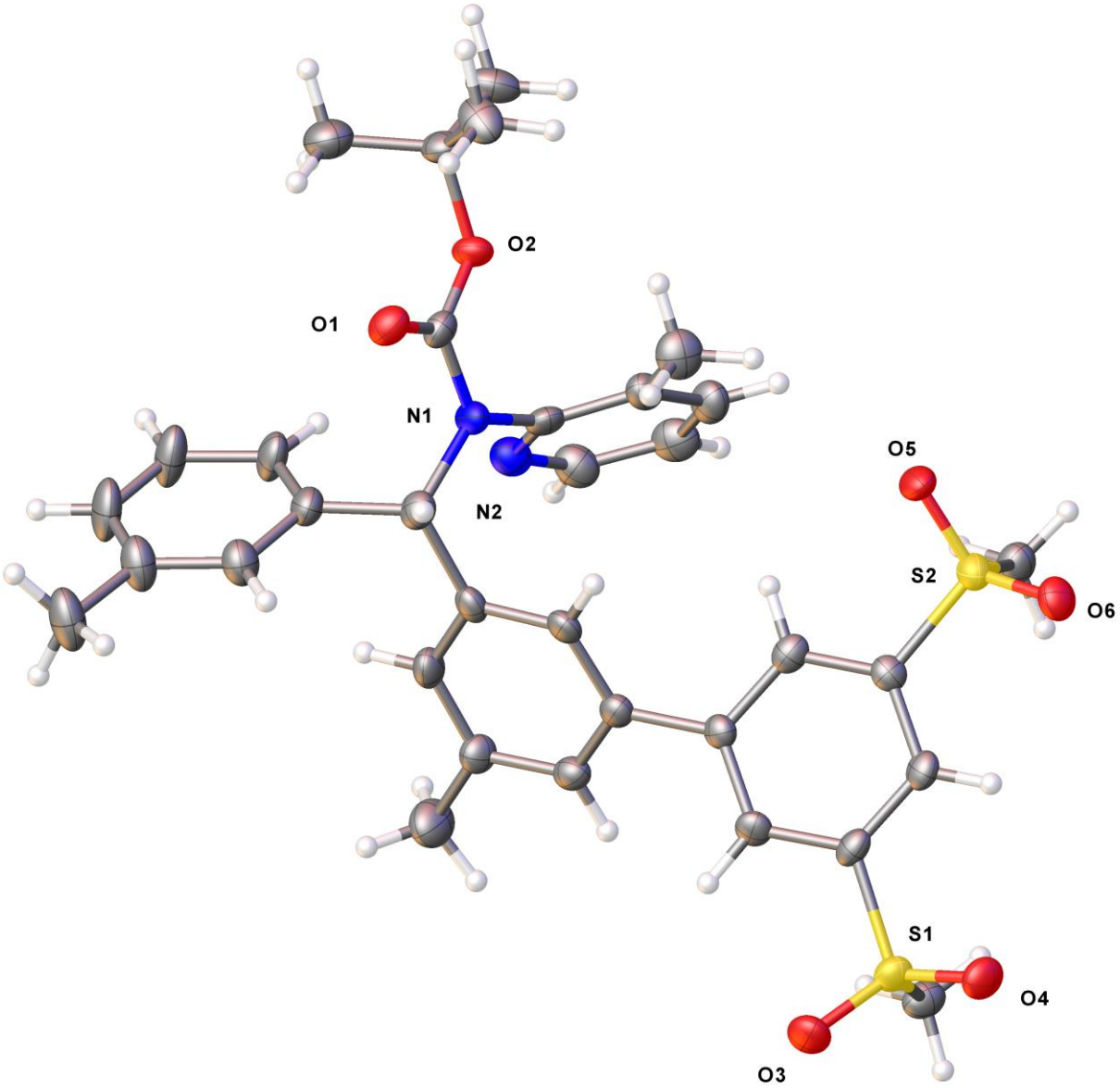
Compound **4z** (17.3 mg, 30 μmol, 1.0 equiv), CuI (2.9 mg, 15 μmol, 50 mol%) and CsOAc (11.5 mg, 60 μmol, 2.0 equiv.) were added into a flame-dried Schlenk tube. The Schlenk tube was evacuated and back-filled with nitrogen. DMSO (0.5 mL) was added to the reaction mixture. The Schlenk tube was immersed into a pre-heated oil bath at 80 °C. After 2.5 hours, the oil bath was removed, and the Schlenk tube was cooled to room temperature. Water was added into the reaction mixture, which was then extracted with EtOAc. The combined organic layers were dried with Na_2SO_4. The solvent was removed by evaporation under reduced pressure. Purification by preparative TLC chromatography (hexane/EtOAc = 2:1 v/v) afforded the 11.2 mg compound **5** as a yellow solid (75% yield).

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.33 (d, *J* = 8.9 Hz, 2H), 8.05 (d, *J* = 8.9 Hz, 2H), 7.83 (dd, *J* = 7.8, 1.6 Hz, 1H), 7.55 (d, *J* = 8.3 Hz, 1H), 7.51 (td, *J* = 7.6, 1.5 Hz, 1H), 7.40 (td, *J* = 7.6, 1.5 Hz, 1H), 7.28 (dd, *J* =

7.6, 1.5 Hz, 1H), 7.17 (dd, *J* = 8.3, 2.1 Hz, 1H), 7.05 (d, *J* = 1.7 Hz, 1H), 4.90 (dd, *J* = 10.5, 4.9 Hz, 1H), 3.82 (s, 3H), 3.68 (s, 3H), 3.27 (dd, *J* = 16.4, 10.5 Hz, 1H), 3.18 (dd, *J* = 16.6, 4.8 Hz, 1H); ^{13}C NMR (150 MHz, Chloroform-*d*) δ 171.11, 168.61, 150.68, 143.49, 141.73, 139.91, 138.74, 131.58, 130.81, 130.60, 130.17, 129.63, 128.85, 128.79, 127.58, 125.40, 124.54, 114.94, 62.70, 53.23, 52.15, 33.03. HRMS (ESI-TOF) *m/z* calc'd for $C_{24}H_{21}N_2O_8S$ $[M+H]^+$: 497.1013; found: 497.1014.
SFC Chiralpak® IC column (30% isopropanol, 2.0 mL/min) t_r = 7.72 min (major), 9.73 min (minor): 91:9 er.

X-RAY CRYSTALLOGRAPHIC DATA

X-ray structure of **2ah**:

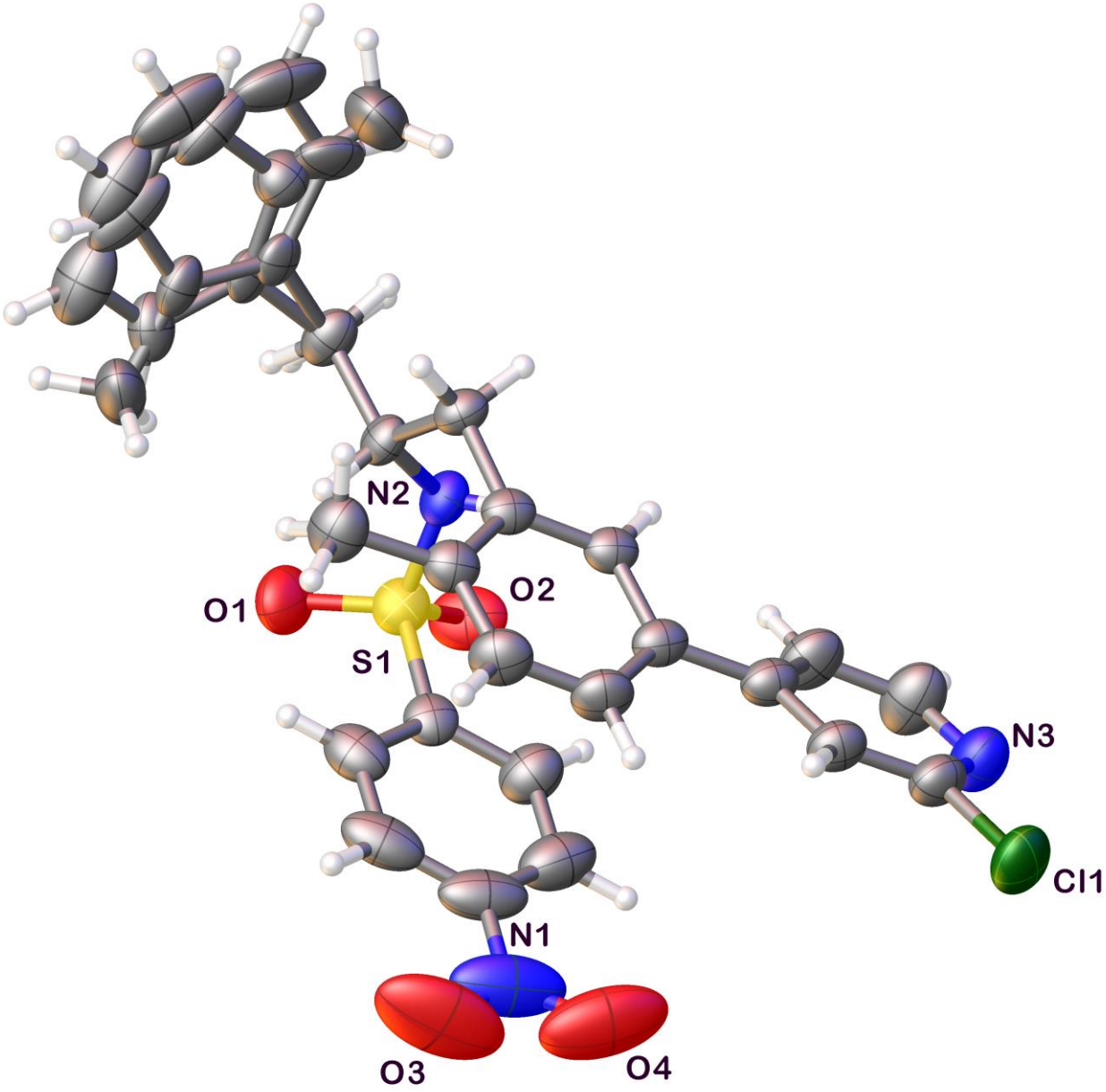


Crystal data and structure refinement for **2ah**

Report date	2017-09-22
Identification code	IV-38-5
Empirical formula	C34 H38 N2 O6 S2
Molecular formula	C34 H38 N2 O6 S2
Formula weight	634.78
Temperature	100.0 K
Wavelength	1.54178 Å
Crystal system	Monoclinic
Space group	P 1 21 1

Unit cell dimensions	a = 10.2520(4) Å	α= 90°.
	b = 7.9470(3) Å	β= 104.098(2)°.
	c = 20.6363(9) Å	γ = 90°.
Volume	1630.65(11) $Å^3$	
Z	2	
Density (calculated)	1.293 Mg/m^3	
Absorption coefficient	1.863 mm^{-1}	
F(000)	672	
Crystal size	0.075 x 0.011 x 0.004 mm^3	
Crystal color, habit	Colorless Needle	
Theta range for data collection	2.207 to 54.261°.	
Index ranges	-10<=h<=10, -8<=k<=8, -20<=l<=21	
Reflections collected	14459	
Independent reflections	3998 [R(int) = 0.0954, R(sigma) = 0.0872]	
Completeness to theta = 54.261°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.3017 and 0.2076	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3998 / 90 / 425	
Goodness-of-fit on F^2	1.014	
Final R indices [I>2sigma(I)]	R1 = 0.0459, wR2 = 0.0838	
R indices (all data)	R1 = 0.0719, wR2 = 0.0929	
Absolute structure parameter	0.03(2)	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.187 and -0.192 $e.Å^{-3}$	

X-ray structure of **4m**:

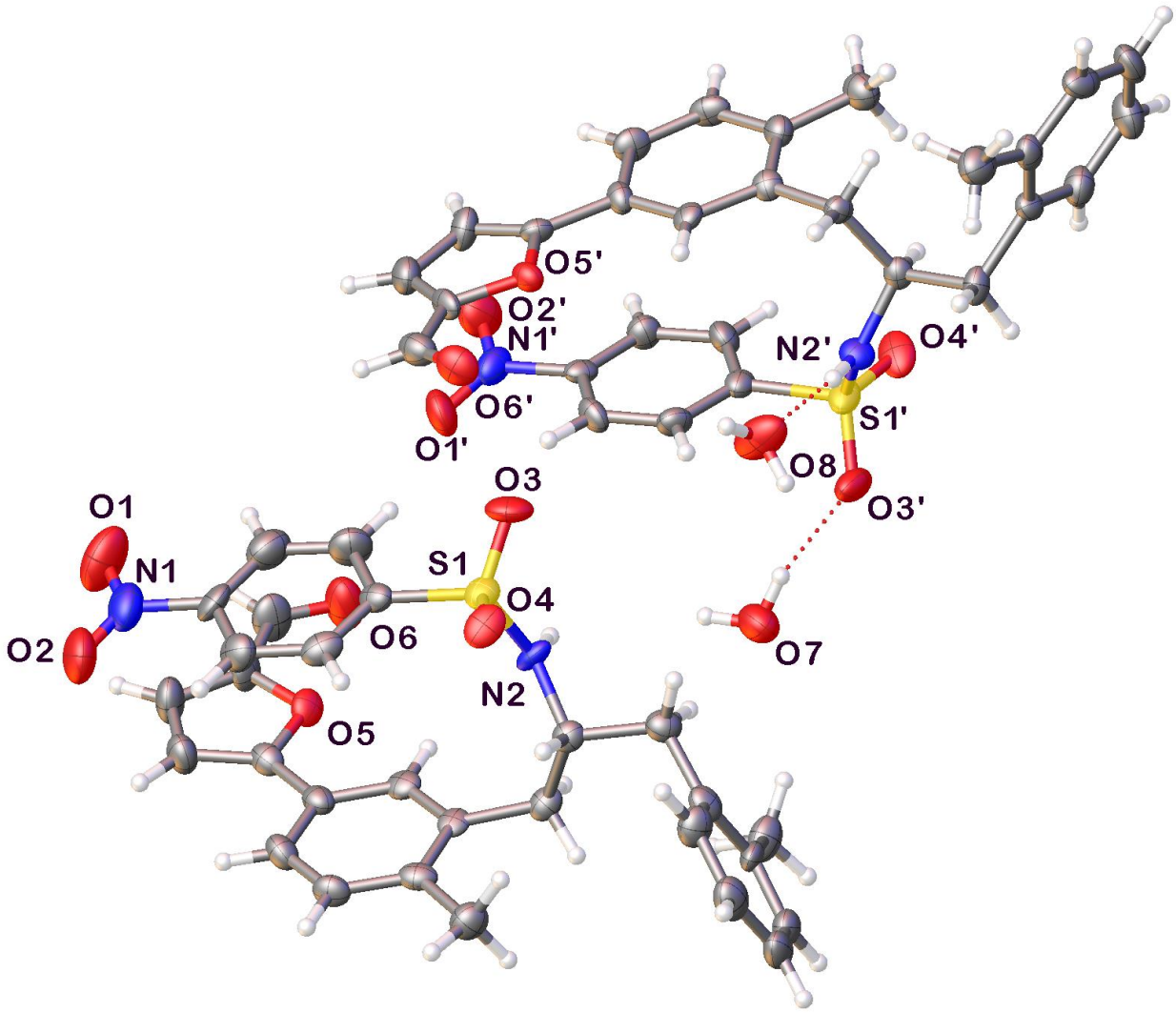


Crystal data and structure refinement for **4m**

Identification code	yu95_0m_a	
Empirical formula	C28 H26 Cl N3 O4 S	
Formula weight	536.03	
Temperature	100.0 K	
Wavelength	0.71073 Å	
Crystal system	Orthorhombic	
Space group	$P2_12_12_1$	
Unit cell dimensions	a = 7.5065(6) Å	α= 90°.
	b = 17.3919(13) Å	β= 90°.

	c = 20.3819(11) Å γ= 90°.
Volume	2660.9(3) $Å^3$
Z	4
Density (calculated)	1.338 Mg/m^3
Absorption coefficient	0.261 mm^{-1}
F(000)	1120
Crystal size	0.28 x 0.2 x 0.14 mm^3
Theta range for data collection	2.892 to 24.998°.
Index ranges	-7<=h<=8, -20<=k<=14, -24<=l<=24
Reflections collected	7623
Independent reflections	4527 [R(int) = 0.0247]
Completeness to theta = 24.998°	99.1 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.8012 and 0.7059
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	4527 / 348 / 377
Goodness-of-fit on F^2	1.037
Final R indices [I>2sigma(I)]	R1 = 0.0490, wR2 = 0.1009
R indices (all data)	R1 = 0.0772, wR2 = 0.1147
Absolute structure parameter	0.03(5) [abs stereochem determined]
Extinction coefficient	n/a
Largest diff. peak and hole	0.214 and -0.231 $e.Å^{-3}$

X-ray structure of **4n**:

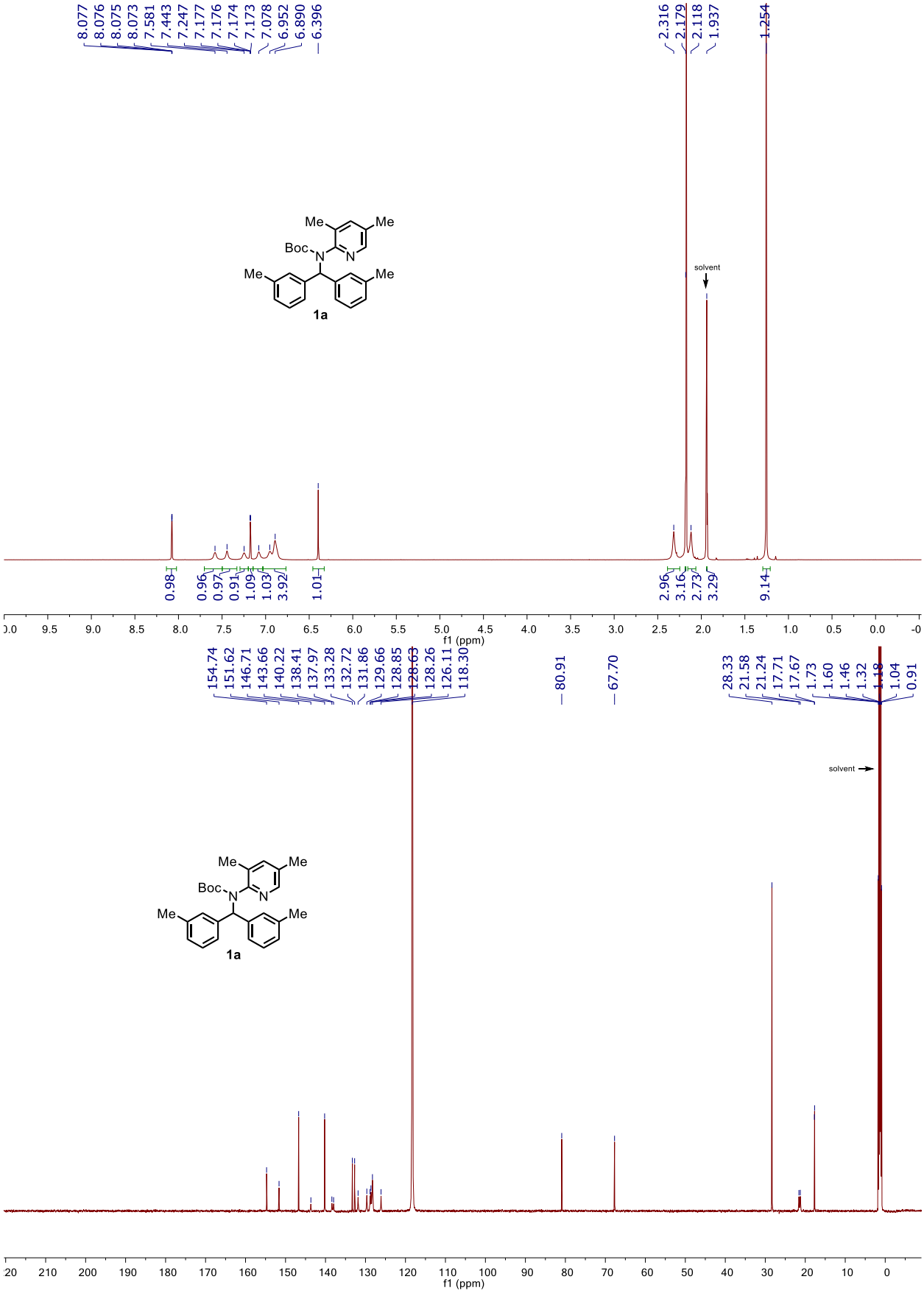


Crystal data and structure refinement for **4n**

Identification code	III-152-3	
Empirical formula	C28 H28 N2 O7 S	
Formula weight	536.58	
Temperature	100.0 K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	P 21	
Unit cell dimensions	a = 12.891(9) Å	α= 90°.
	b = 7.214(5) Å	β= 97.295(15)°.
	c = 28.37(2) Å	γ= 90°.
Volume	2617(3) $Å^3$	
Z	4	

Density (calculated)	1.362 Mg/m^3
Absorption coefficient	0.174 mm^{-1}
F(000)	1128
Crystal size	0.28 x 0.2 x 0.1 mm^3
Theta range for data collection	1.447 to 25.778°.
Index ranges	-15<=h<=15, -8<=k<=8, -34<=l<=31
Reflections collected	18746
Independent reflections	18746 [R(int) = ?]
Completeness to theta = 25.242°	91.2 %
Absorption correction	None
Max. and min. transmission	0.2589 and 0.2069
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	18746 / 3 / 702
Goodness-of-fit on F^2	1.000
Final R indices [I>2sigma(I)]	R1 = 0.0507, wR2 = 0.1279
R indices (all data)	R1 = 0.0618, wR2 = 0.1330
Absolute structure parameter	0.08(6)
Extinction coefficient	n/a
Largest diff. peak and hole	0.359 and -0.287 $e.Å^{-3}$

NMR SPECTRA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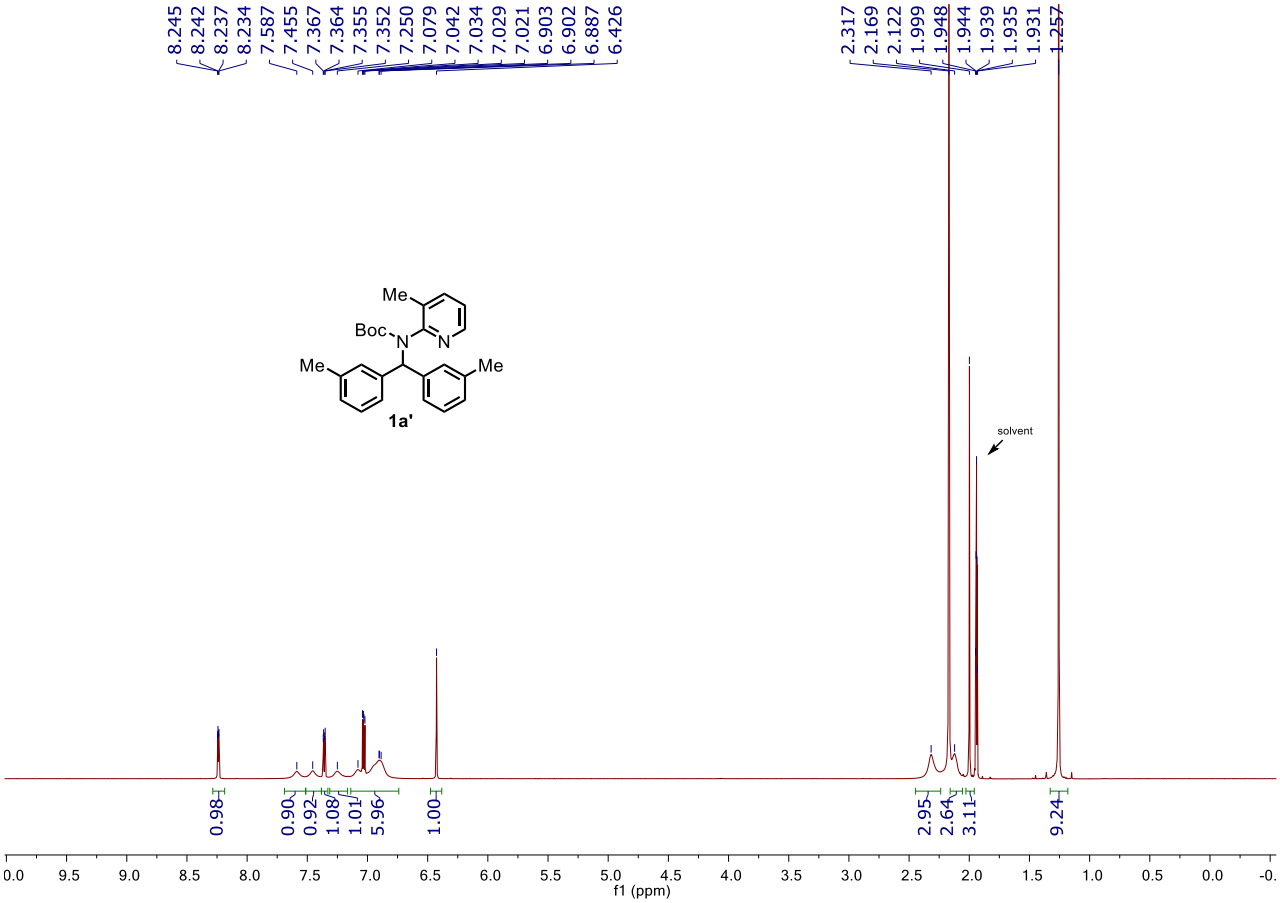
8.076
8.075
8.073
7.581
7.443
7.247
7.177
7.176
7.174
7.173
7.078
6.952
6.890
6.396
2.316
2.179
2.118
1.937
1.254
Me
Me
Boc
N
N
Me
Me
1a
solvent
0.98
0.96
0.97
0.91
1.09
1.03
3.92
1.01
2.96
3.16
2.73
3.29
9.14
f1 (ppm)
154.74
151.62
146.71
143.66
140.22
138.41
137.97
133.28
132.72
131.86
129.66
128.85
128.63
128.26
126.11
118.30
80.91
67.70
28.33
21.58
21.24
17.71
17.67
1.73
1.60
1.46
1.32
1.18
1.04
0.91
solvent
f1 (ppm)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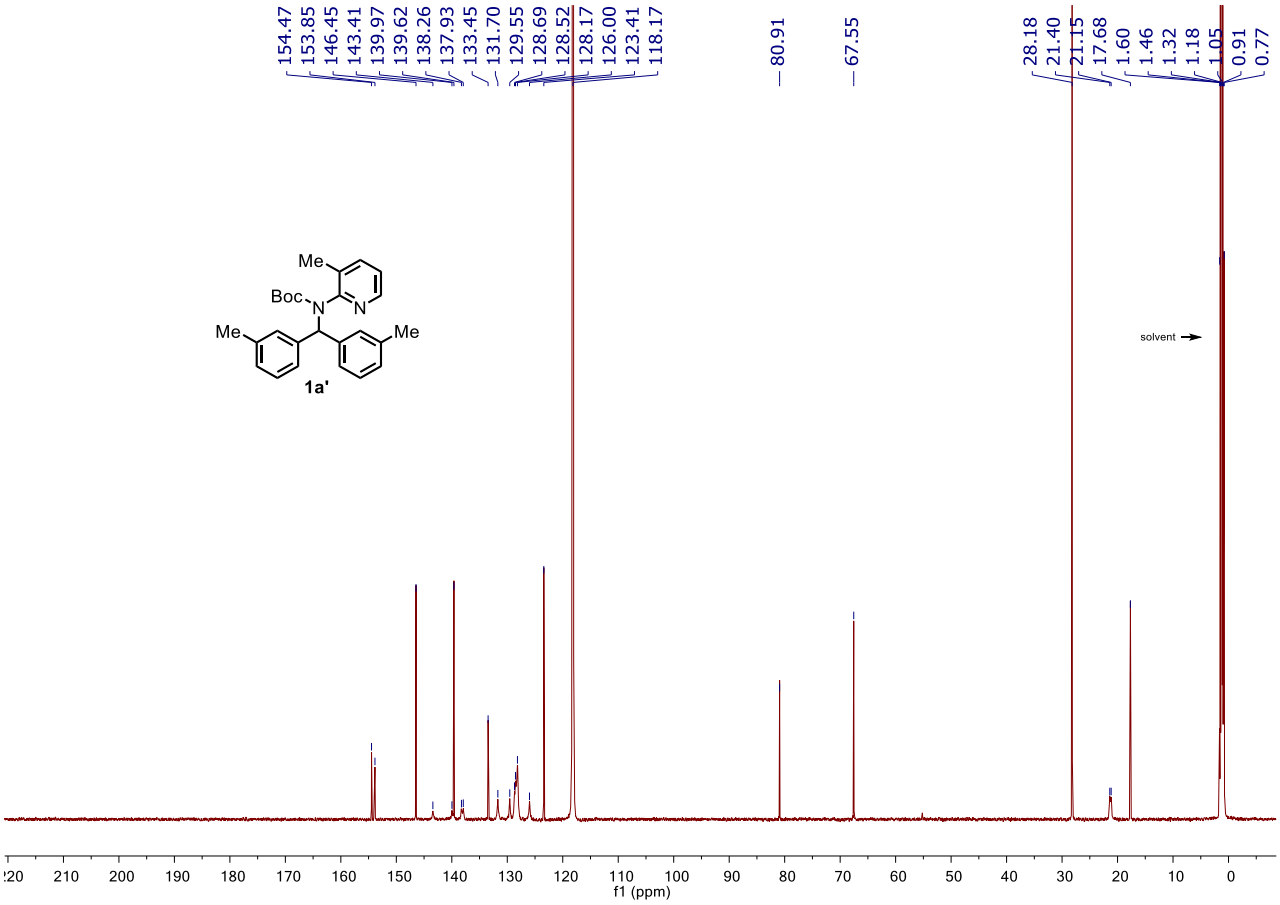
8.242
8.237
8.234
7.587
7.455
7.367
7.364
7.355
7.352
7.250
7.079
7.042
7.034
7.029
7.021
6.903
6.902
6.887
6.426
2.317
2.169
2.122
1.999
1.948
1.944
1.939
1.935
1.931
1.257
Me
Boc
N
N
Me
Me
1a'
solvent
0.98
0.90
0.92
1.08
1.01
5.96
1.00
2.95
2.64
3.11
9.24
f1 (ppm)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153.85
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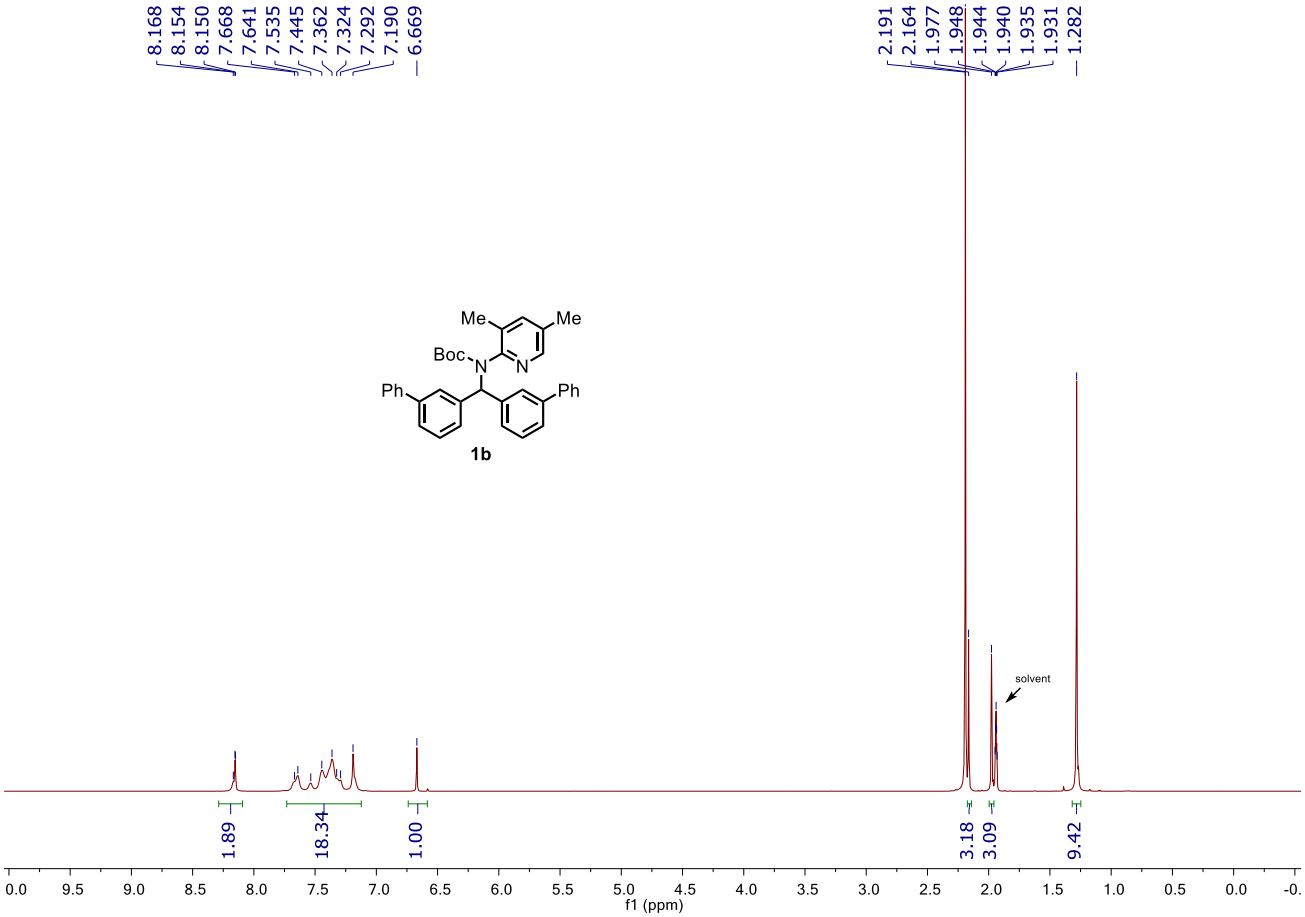
143.41
139.97
139.62
138.26
137.93
133.45
131.70
129.55
128.69
128.52
128.17
126.00
123.41
118.17
80.91
67.55
28.18
21.40
21.15
17.68
1.60
1.46
1.32
1.18
1.05
0.91
0.77
Me
Boc
N
N
Me
Me
1a'
solvent
f1 (ppm)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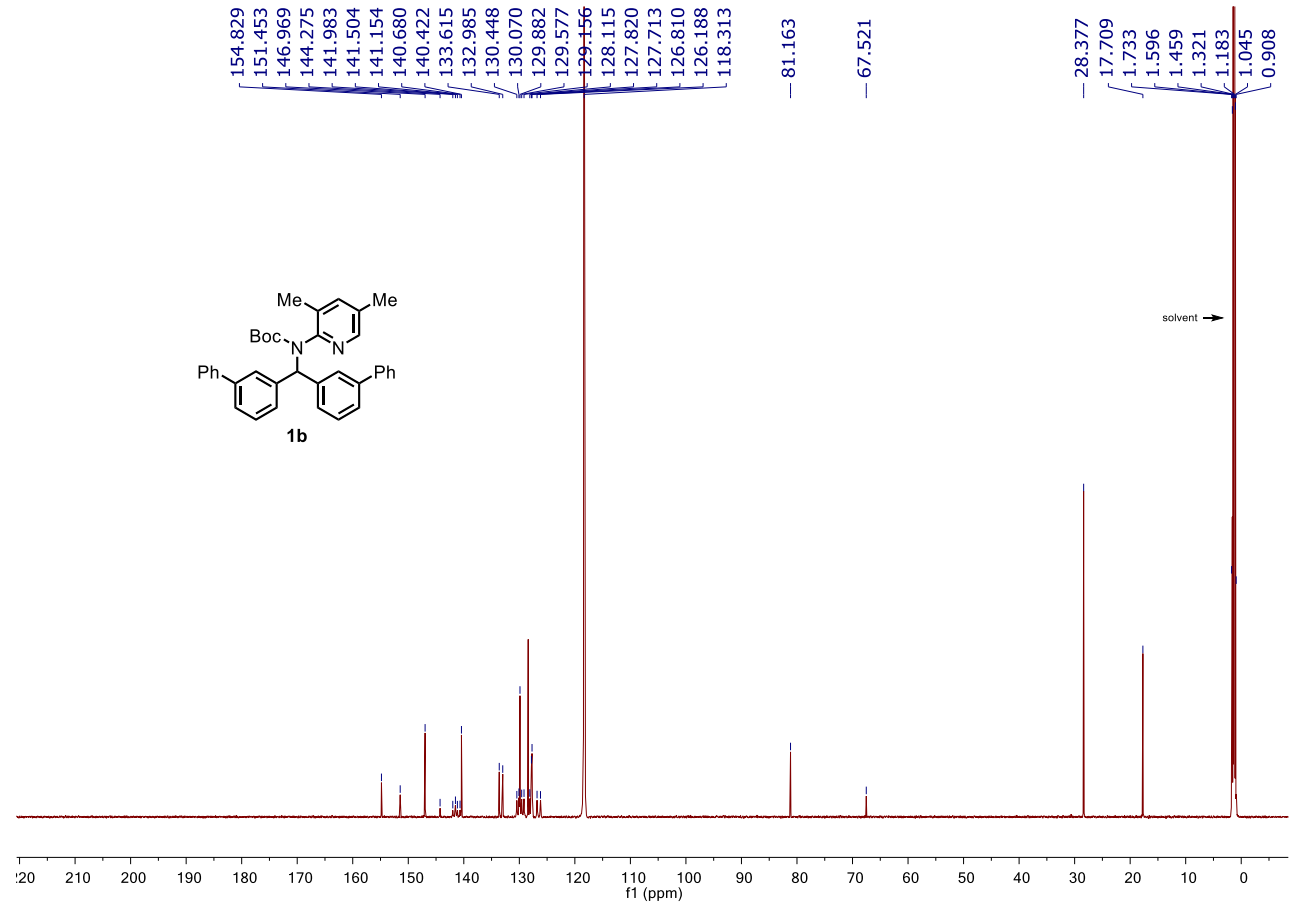
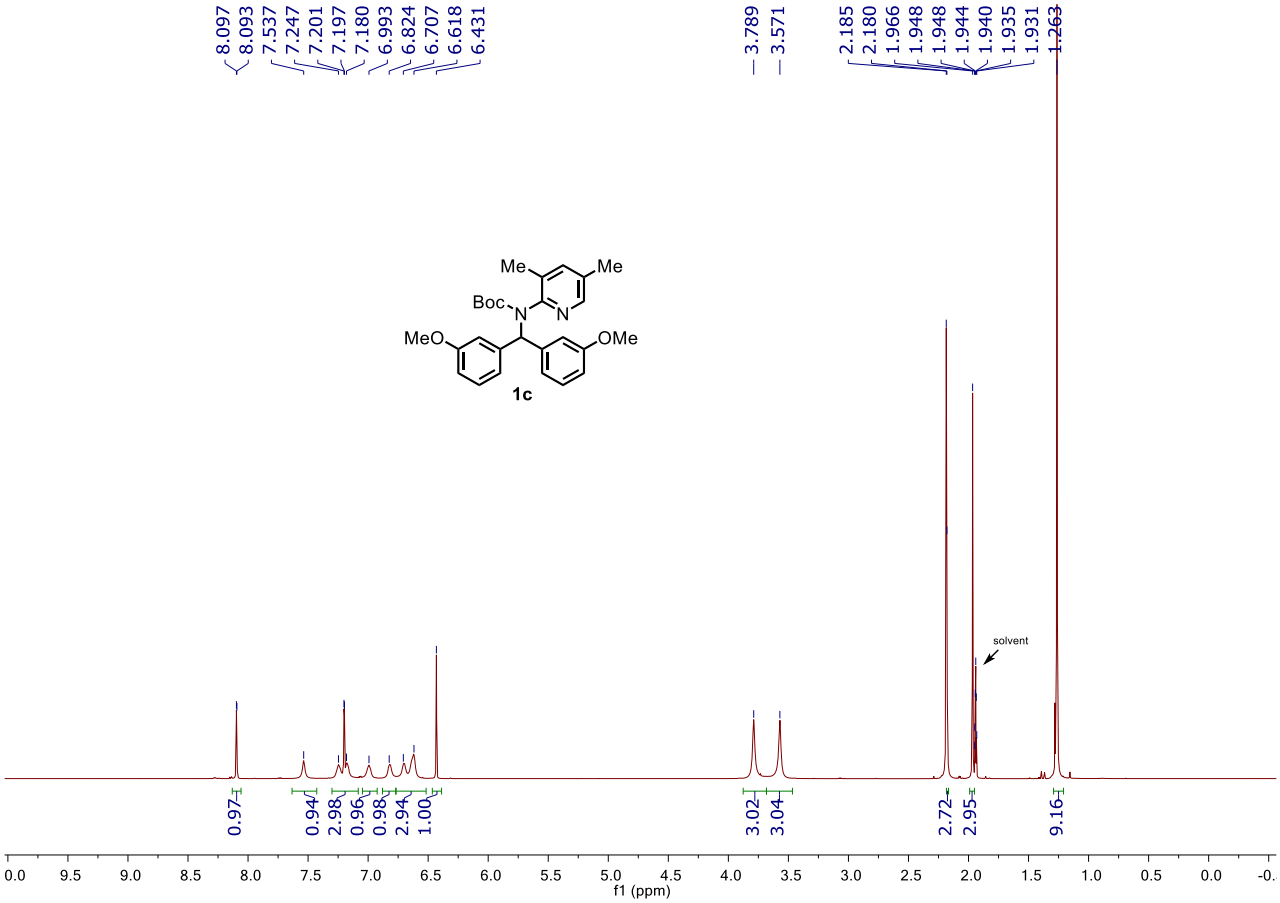
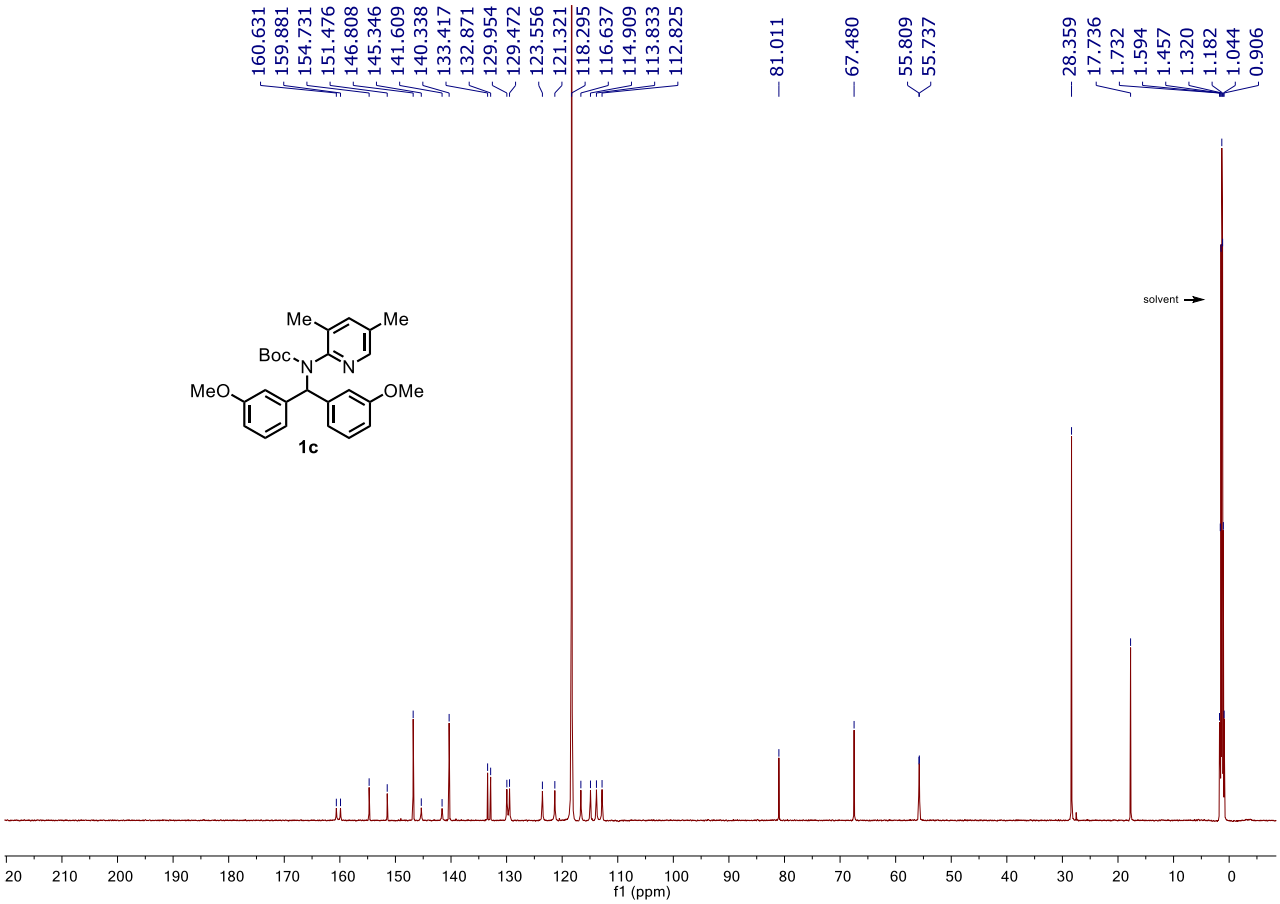
8.154
8.150
7.668
7.641
7.535
7.445
7.362
7.324
7.292
7.190
6.669
2.191
2.164
1.977
1.948
1.944
1.940
1.935
1.931
1.282
Me
Me
Boc
N
N
Ph
Ph
1b
solvent
1.89
18.34
1.00
3.18
3.09
9.42
f1 (ppm)


154.829
151.453
146.969
144.275
141.983
141.504
141.154
140.680
140.422
133.615
132.985
130.448
130.070
129.882
129.577
129.156
128.115
127.820
127.713
126.810
126.188
118.313
81.163
67.521
28.377
17.709
1.733
1.596
1.459
1.321
1.183
1.045
0.908
Me
Me
Boc
N
N
Ph
Ph
1b
solvent
f1 (ppm)


8.097
8.093
7.537
7.247
7.201
7.197
7.180
6.993
6.824
6.707
6.618
6.431
3.789
3.571
2.185
2.180
1.966
1.948
1.948
1.944
1.940
1.935
1.931
1.263
Me
Me
Boc
N
N
MeO
OMe
1c
solvent
0.97
0.94
2.98
0.96
0.98
2.94
1.00
3.02
3.04
2.72
2.95
9.16
f1 (ppm)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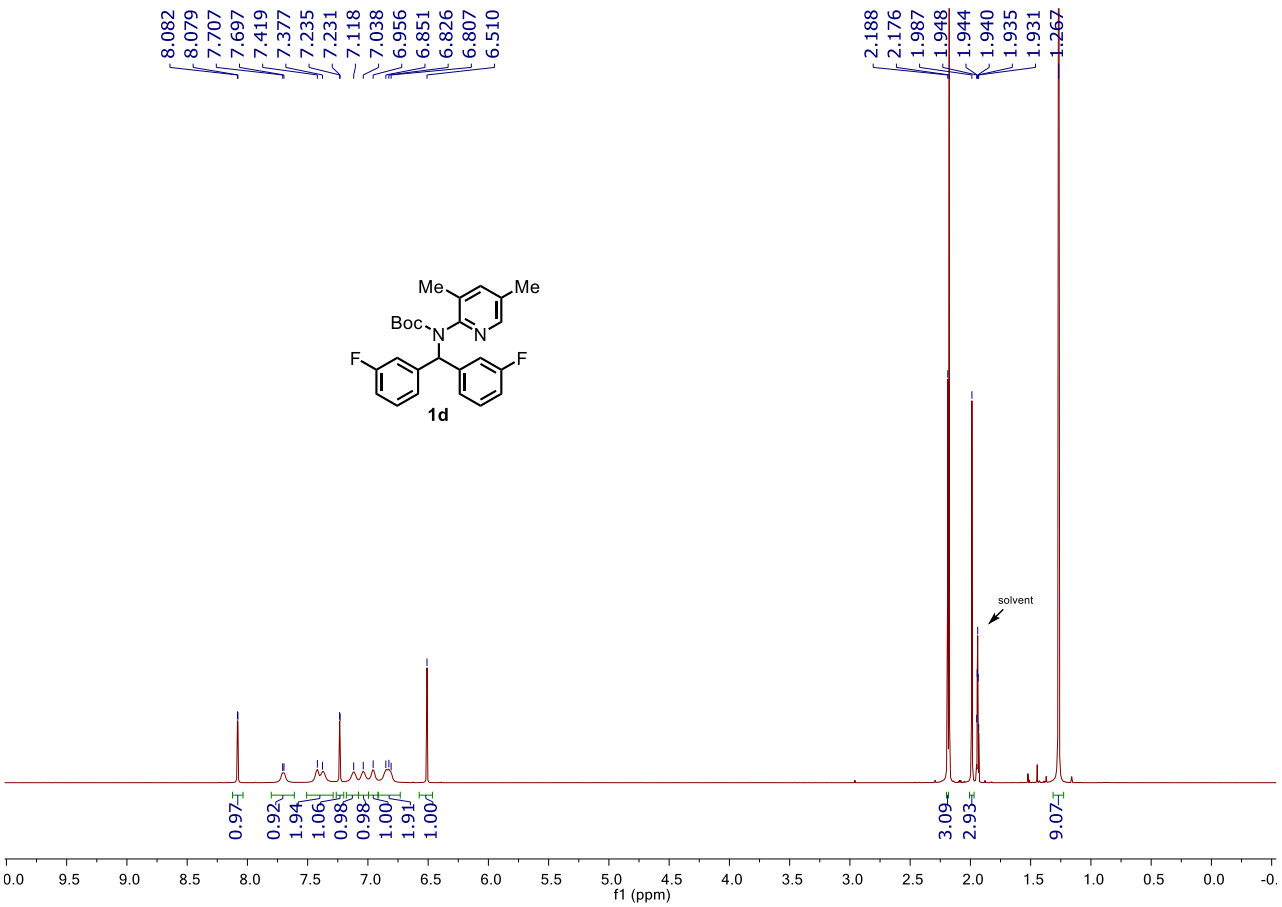
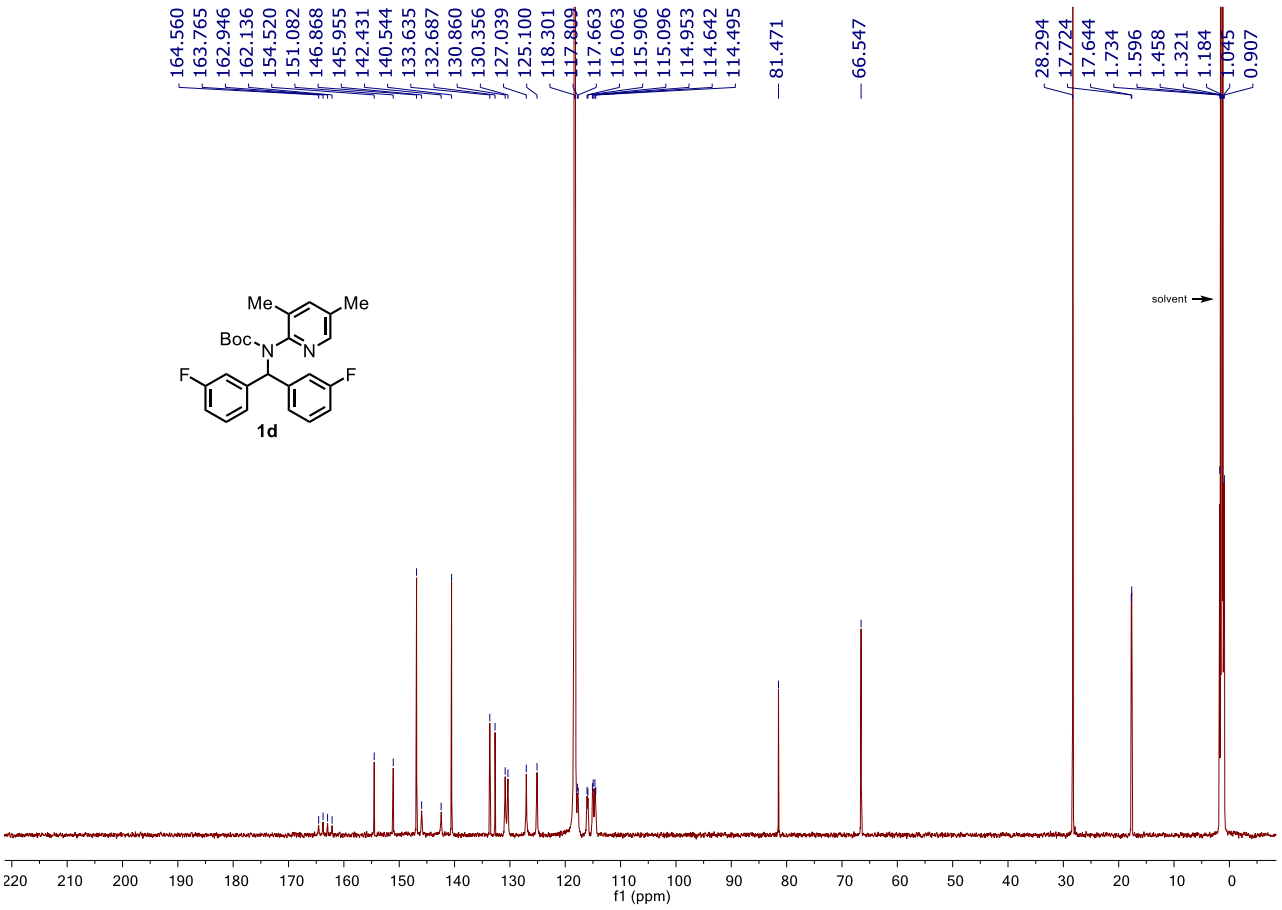
159.881
154.731
151.476
146.808
145.346
141.609
140.338
133.417
132.871
129.954
129.472
123.556
121.321
118.295
116.637
114.909
113.833
112.825
81.011
67.480
55.809
55.737
28.359
17.736
1.732
1.594
1.457
1.320
1.182
1.044
0.906
Me
Me
Boc
N
N
MeO
OMe
1c
solvent
f1 (ppm)


8.082
8.079
7.707
7.697
7.419
7.377
7.235
7.231
7.118
7.038
6.956
6.851
6.826
6.807
6.510
2.188
2.176
1.987
1.948
1.944
1.940
1.935
1.931
1.267
Me
Me
Boc
N
N
F
F
1d
solvent
0.97
0.92
1.94
1.06
0.98
0.98
1.00
1.91
1.00
3.09
2.93
9.07
f1 (ppm)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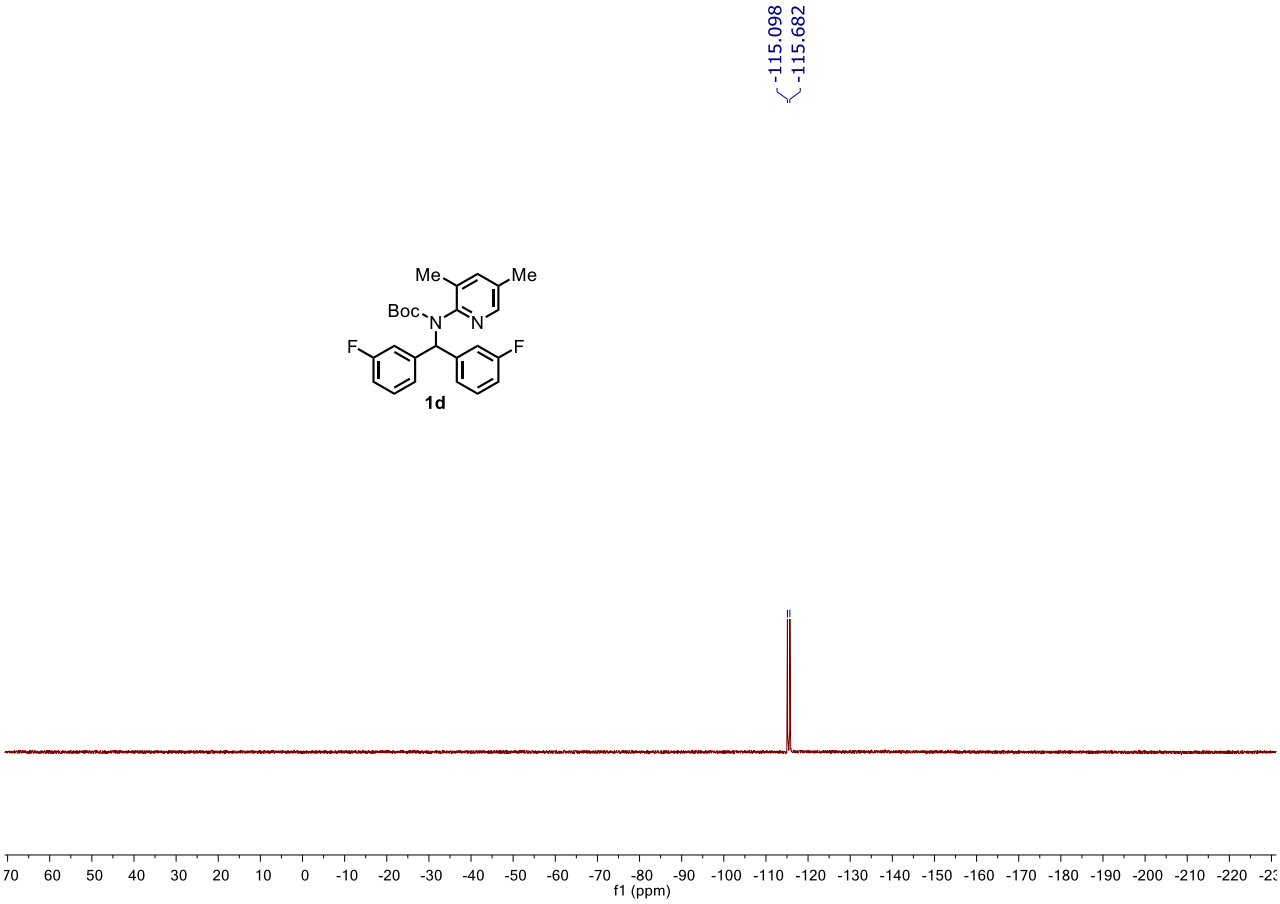
163.765
162.946
162.136
154.520
151.082
146.868
145.955
142.431
140.544
133.635
132.687
130.860
130.356
127.039
125.100
118.301
117.809
117.663
116.063
115.906
115.096
114.953
114.642
114.495
81.471
66.547
28.294
17.724
17.644
1.734
1.596
1.458
1.321
1.184
1.045
0.907
Me
Me
Boc
N
N
F
F
1d
solvent
f1 (ppm)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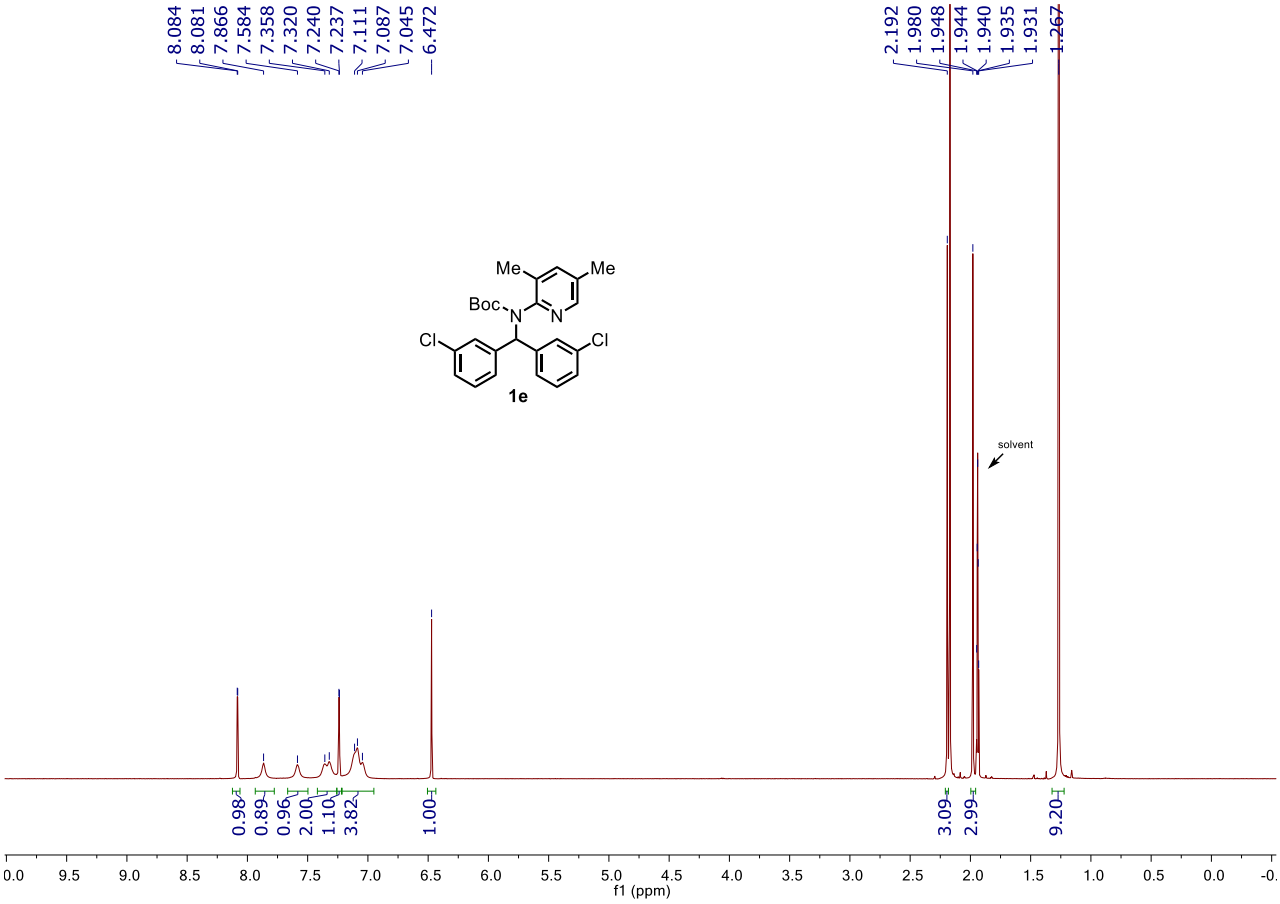
-115.682
Me
Me
Boc
N
N
F
F
1d
f1 (ppm)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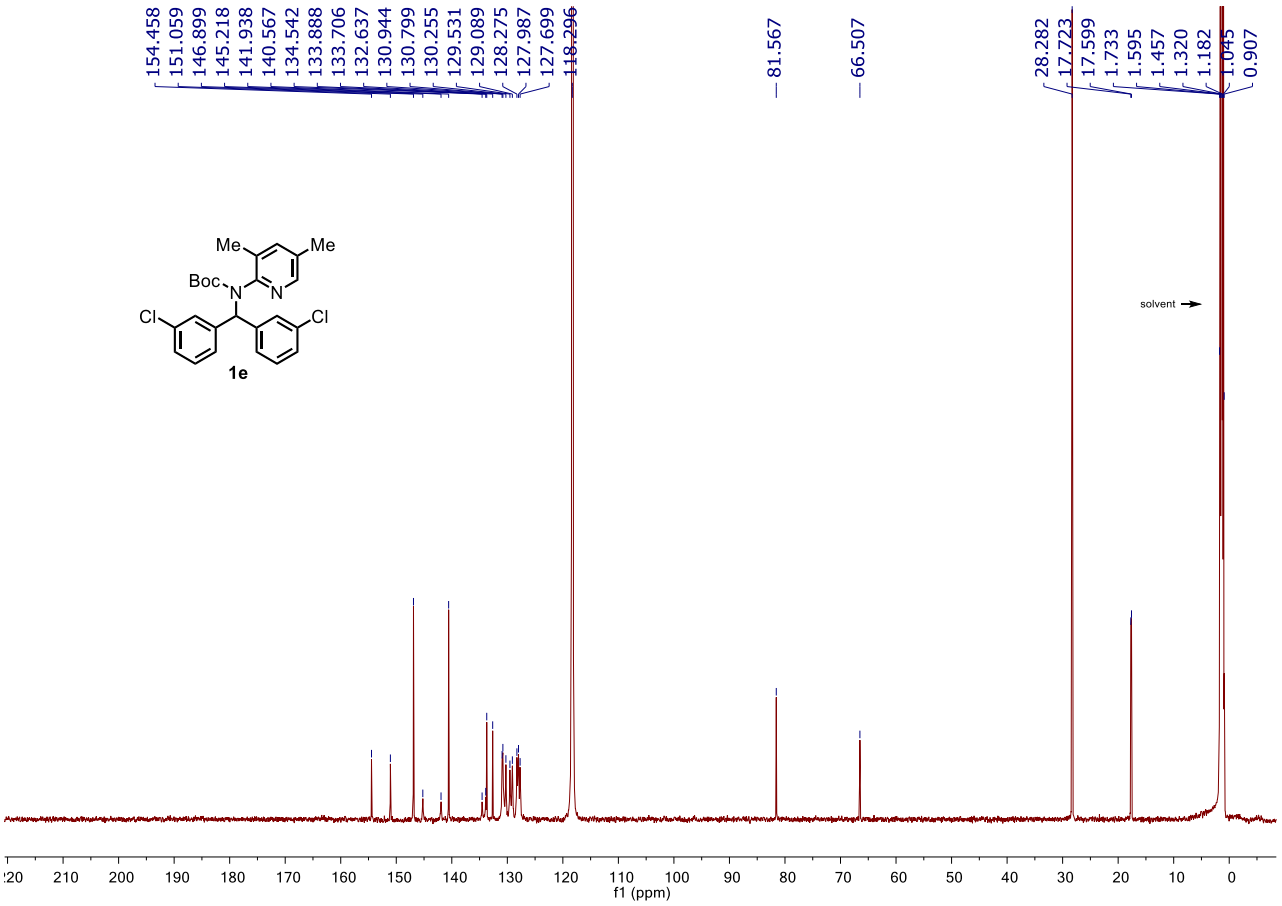
8.081
7.866
7.584
7.358
7.320
7.240
7.237
7.111
7.087
7.045
6.472
2.192
1.980
1.948
1.944
1.940
1.935
1.931
1.267
Me
Me
Boc
N
N
Cl
Cl
1e
solvent
0.98
0.89
0.96
2.00
1.10
3.82
1.00
3.09
2.99
9.20
f1 (ppm)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146.899
145.218
141.938
140.567
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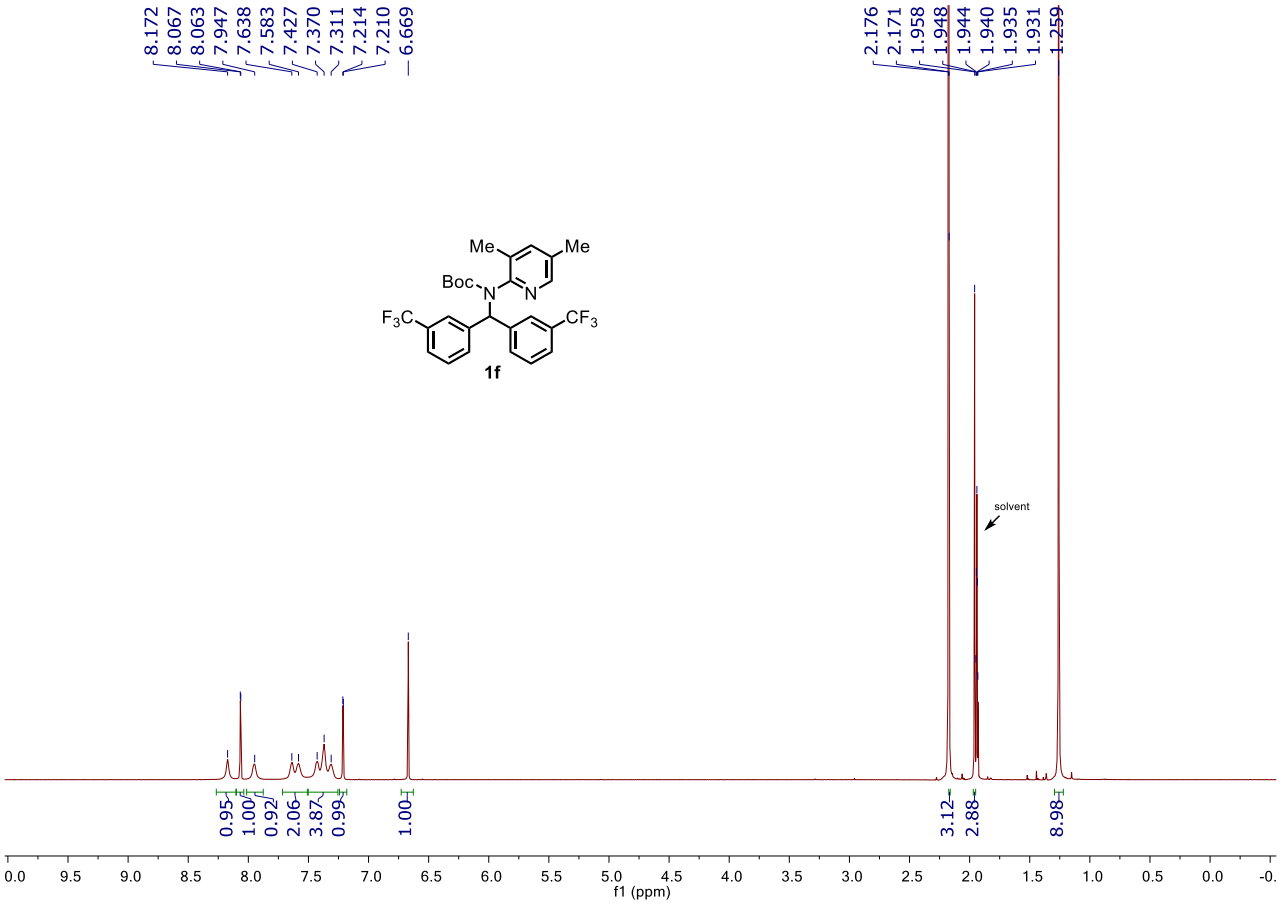
133.888
133.706
132.637
130.944
130.799
130.255
129.531
129.089
128.275
127.987
127.699
118.296
81.567
66.507
28.282
17.723
17.599
1.733
1.595
1.457
1.320
1.182
1.045
0.907
solvent
Me
Me
Boc
N
N
Cl
Cl
1e
f1 (ppm)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8.067
8.063
7.947
7.638
7.583
7.427
7.370
7.311
7.214
7.210
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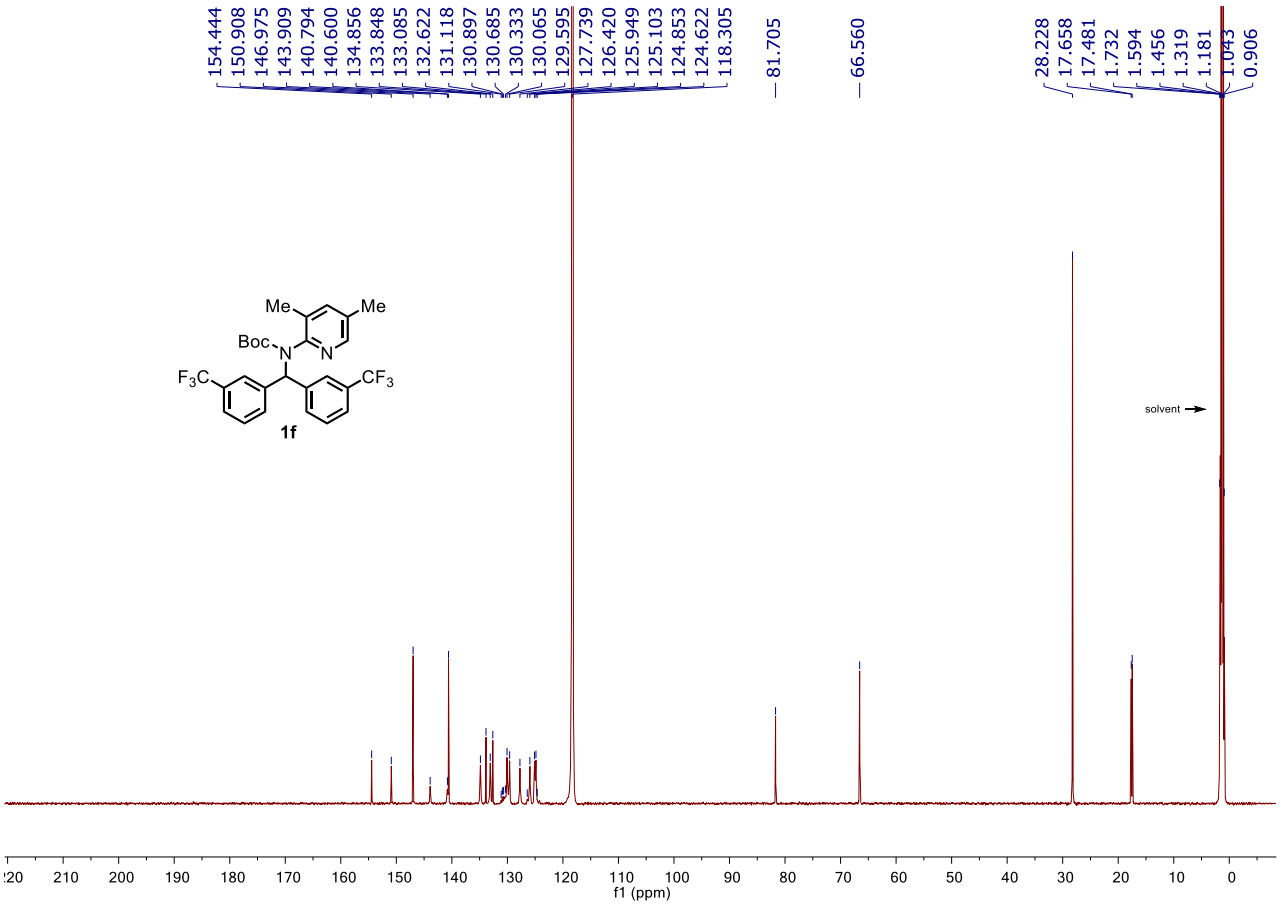
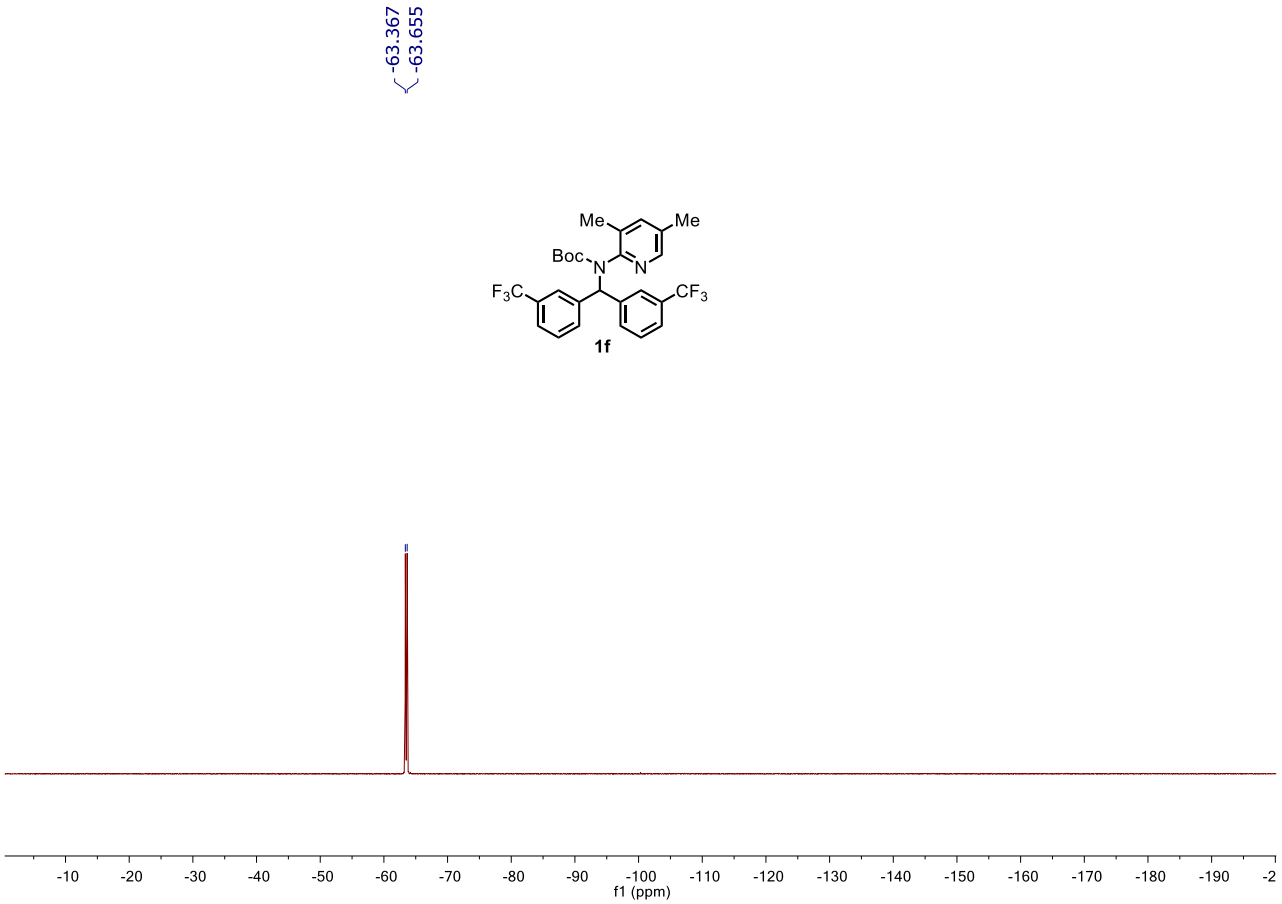
2.176
2.171
1.958
1.948
1.944
1.940
1.935
1.931
1.259
solvent
Me
Me
Boc
N
N
F3C
CF3
1f
0.95
1.00
0.92
2.06
3.87
0.99
1.00
3.12
2.88
8.98
f1 (ppm)


154.444
150.908
146.975
143.909
140.794
140.600
134.856
133.848
133.085
132.622
131.118
130.897
130.685
130.333
130.065
129.595
127.739
126.420
125.949
125.103
124.853
124.622
118.305
81.705
66.560
28.228
17.658
17.481
1.732
1.594
1.456
1.319
1.181
1.043
0.906
Me
Me
Boc
N
N
F3C
CF3
1f
solvent
f1 (ppm)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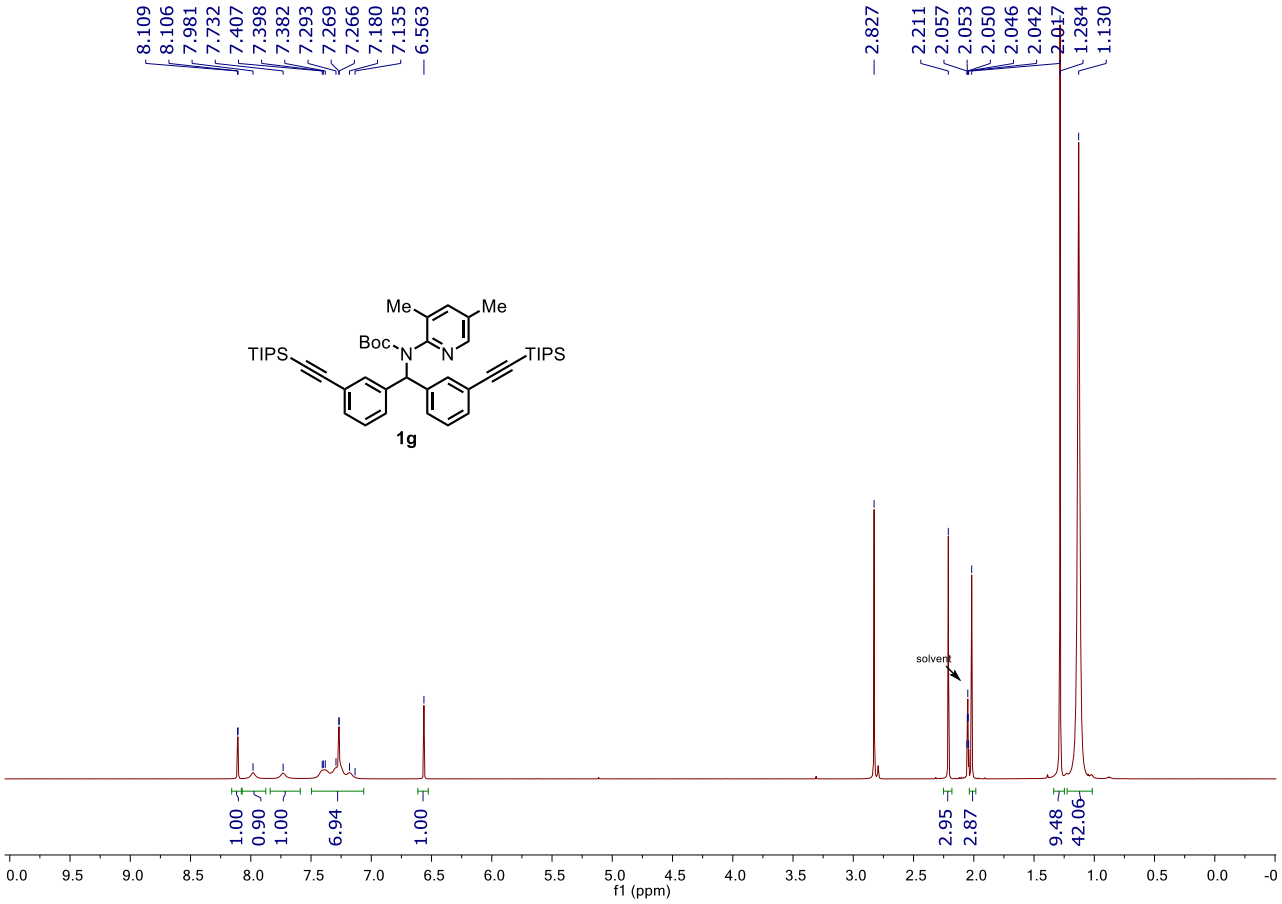
Me
Me
Boc
N
N
F3C
CF3
1f
f1 (ppm)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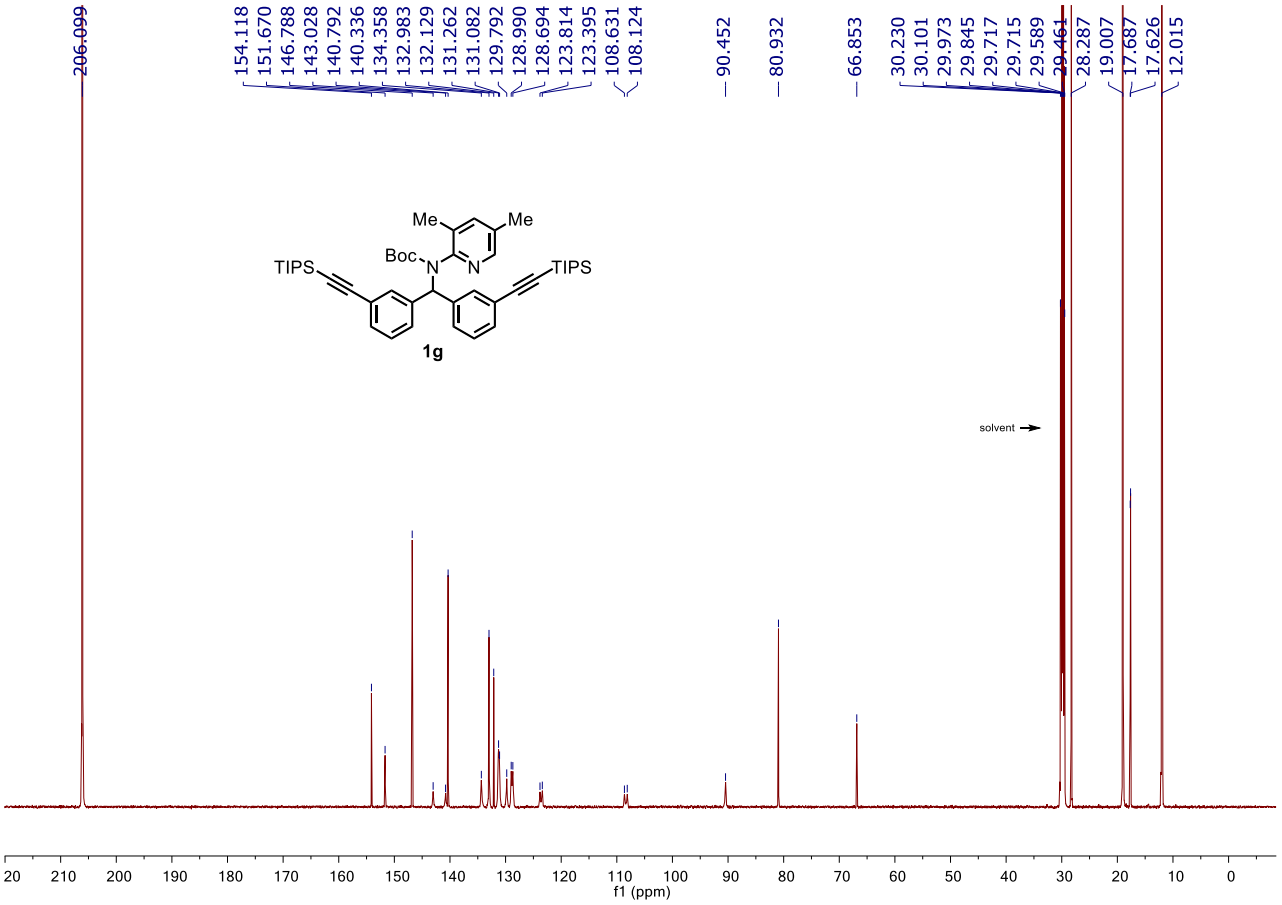
8.106
7.981
7.732
7.407
7.398
7.382
7.293
7.269
7.266
7.180
7.135
6.563
2.827
2.211
2.057
2.053
2.050
2.046
2.042
2.017
1.284
1.130
Me
Me
Boc
N
N
TIPS
TIPS
1g
solvent
1.00
0.90
1.00
6.94
1.00
2.95
2.87
9.48
42.06
f1 (ppm)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128.694
123.814
123.395
108.631
108.124
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80.932
66.853
30.230
30.101
29.973
29.845
29.717
29.715
29.589
29.461
28.287
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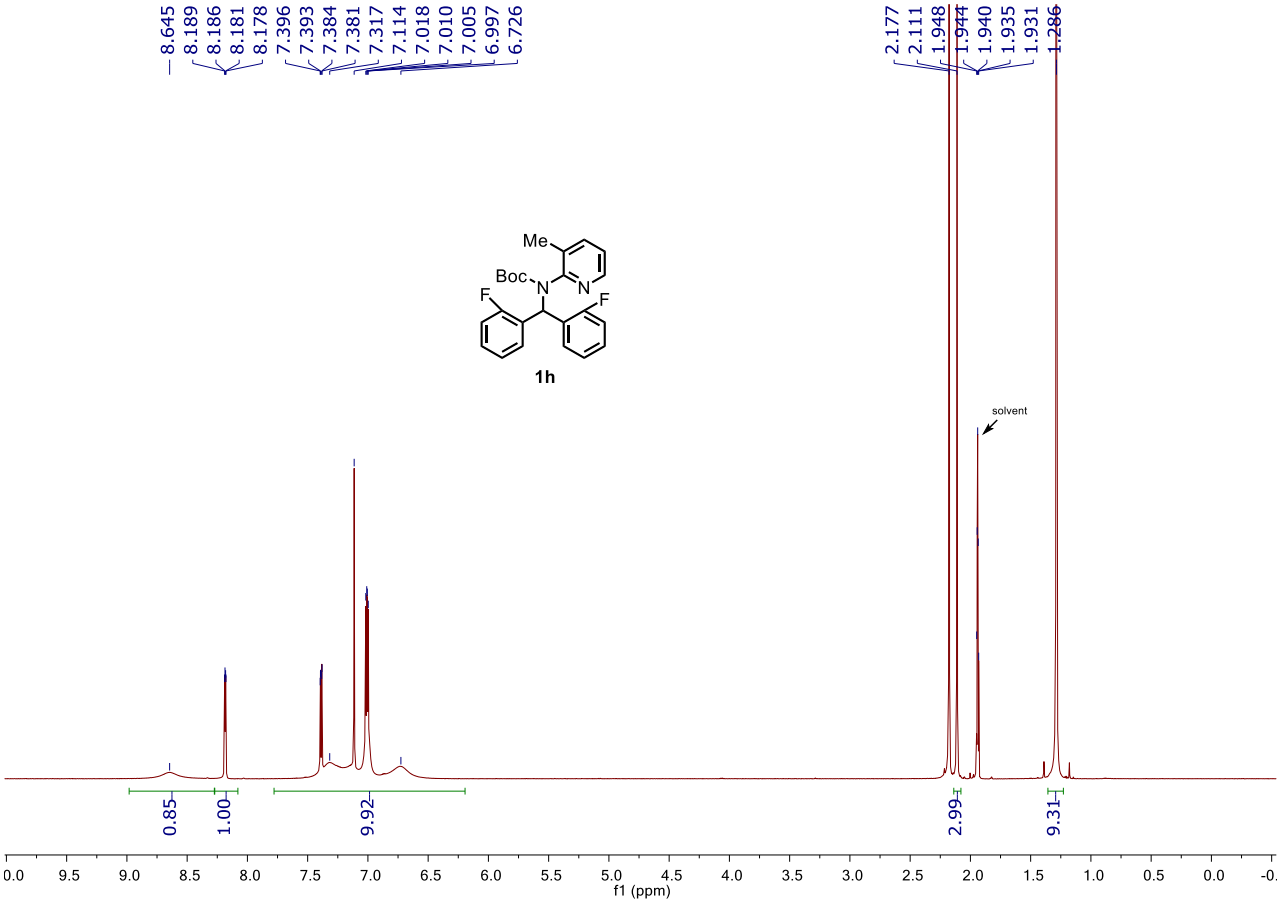
17.626
12.015
Me
Me
Boc
N
N
TIPS
TIPS
1g
solvent
f1 (ppm)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7.317
7.114
7.018
7.010
7.005
6.997
6.726
2.177
2.111
1.948
1.944
1.940
1.935
1.931
1.286
Me
Boc
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N
F
F
1h
solvent
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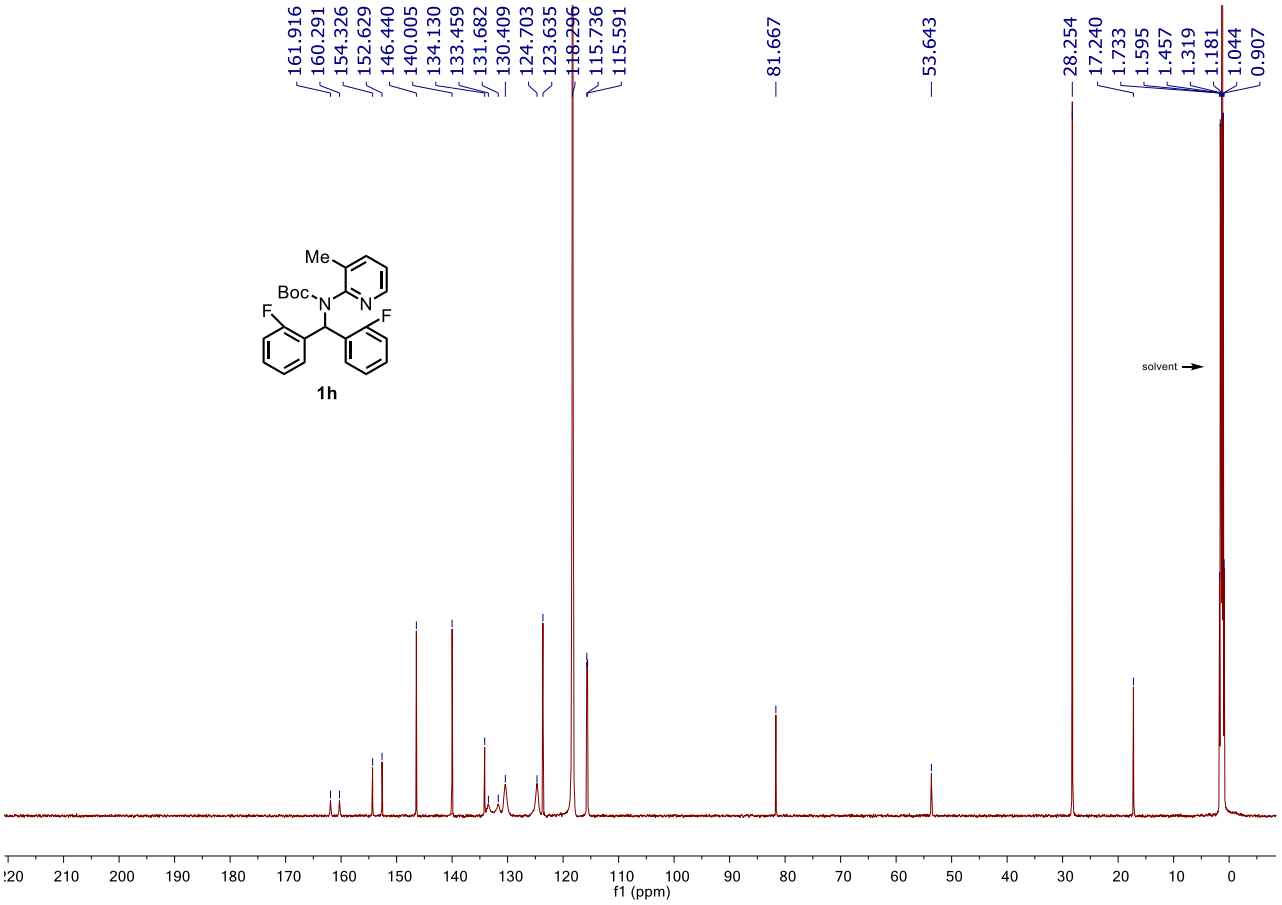
1.00
9.92
2.99
9.31
f1 (ppm)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115.736
115.591
81.667
53.643
28.254
17.240
1.733
1.595
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1.181
1.044
0.907
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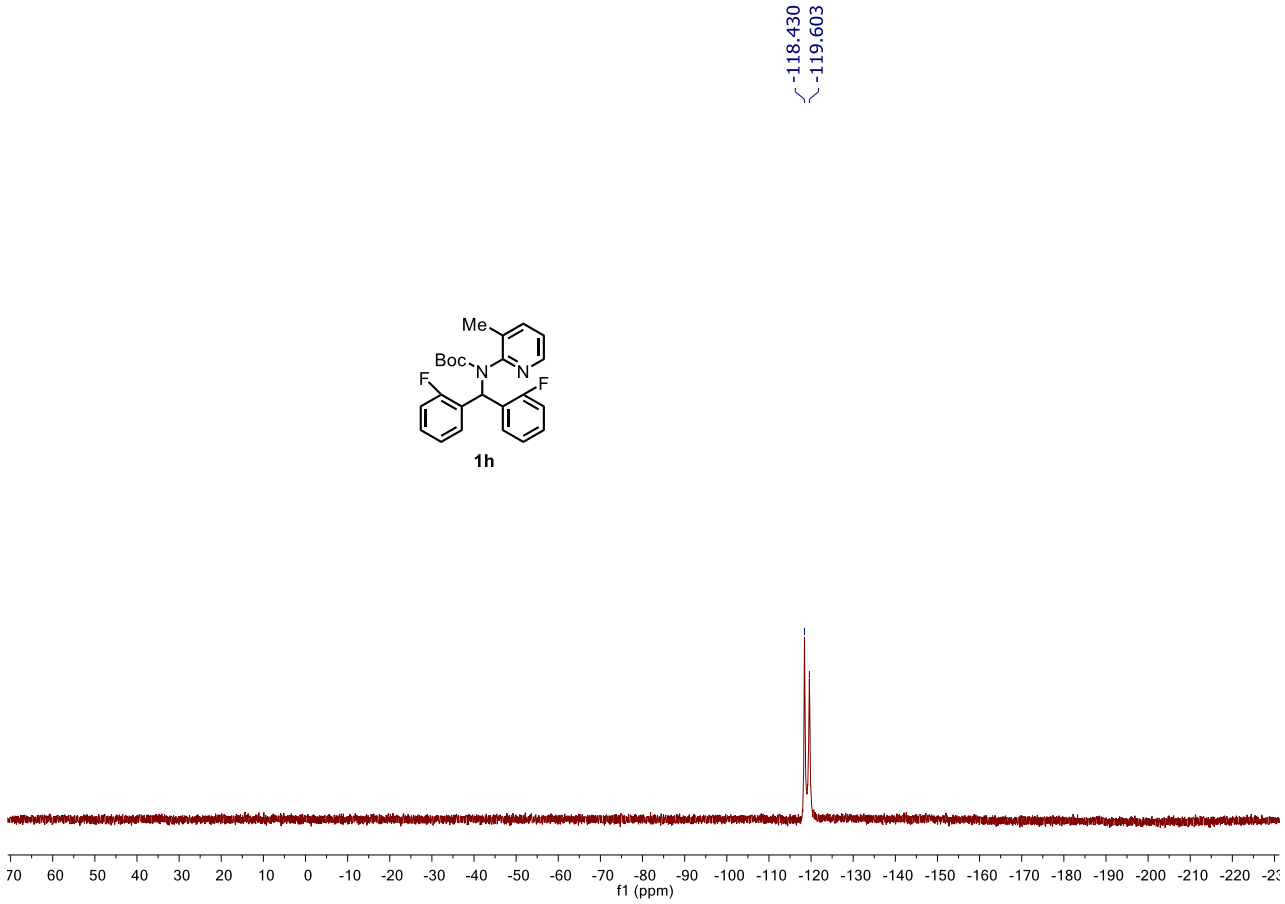
Boc
N
N
F
F
1h
solvent
f1 (ppm)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Boc
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N
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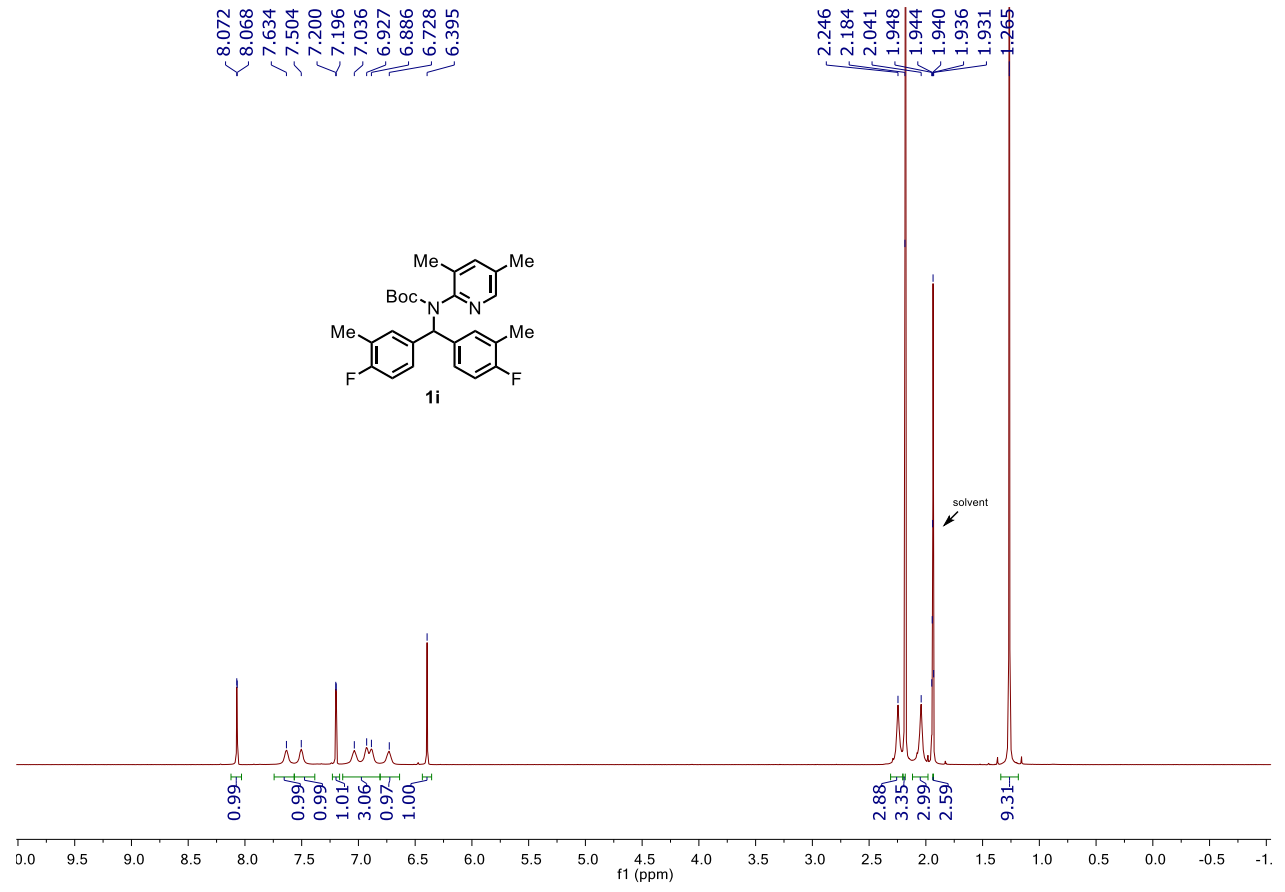
F
1h
f1 (ppm)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6.886
6.728
6.395
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2.041
1.948
1.944
1.940
1.936
1.931
1.265
Me
Me
Boc
N
N
Me
Me
F
F
1i
solvent
0.99
0.99
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3.06
0.97
1.00
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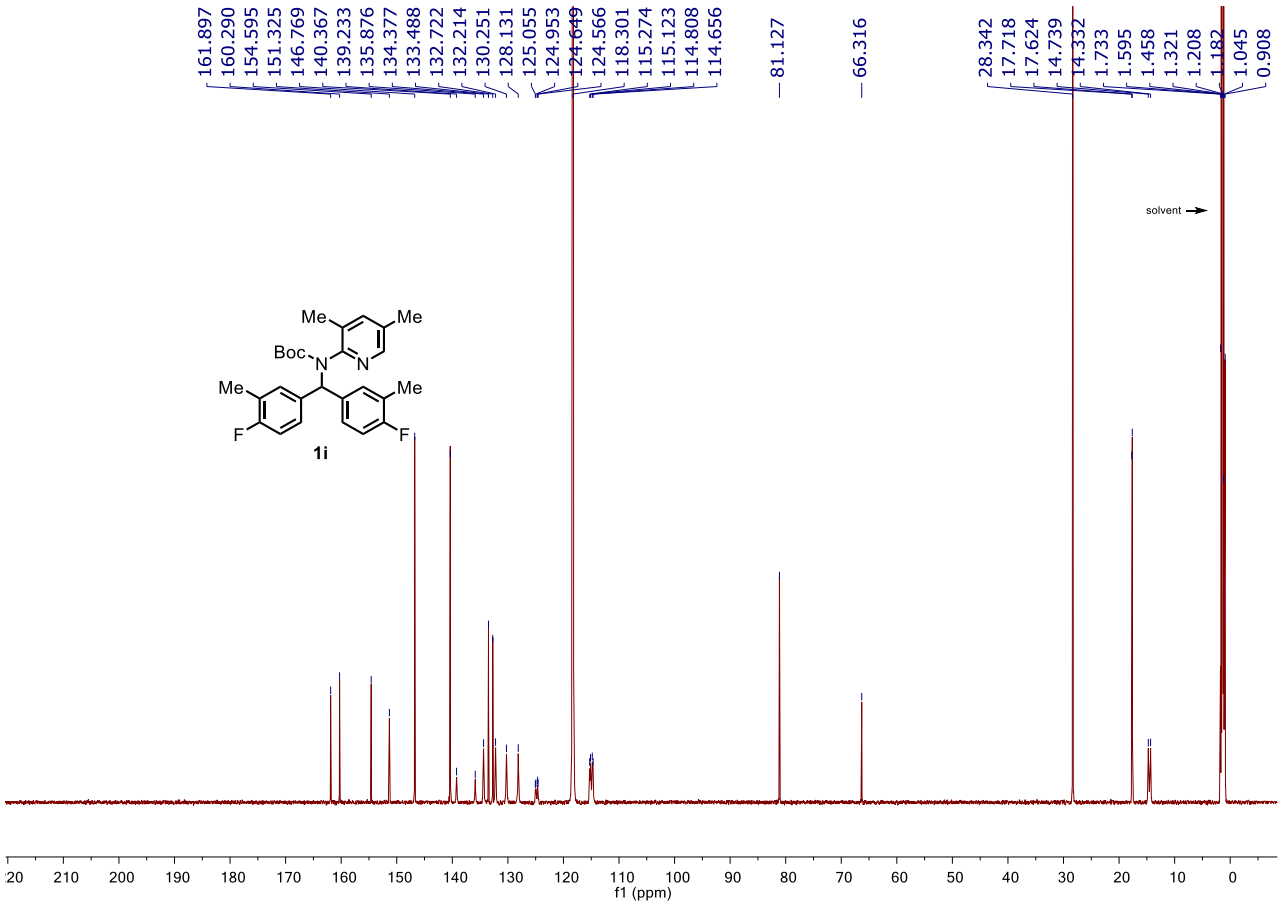
3.35
2.99
2.59
9.31
f1 (ppm)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130.251
128.131
125.055
124.953
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124.566
118.301
115.274
115.123
114.808
114.656
81.127
66.316
28.342
17.718
17.624
14.739
14.332
1.733
1.595
1.458
1.321
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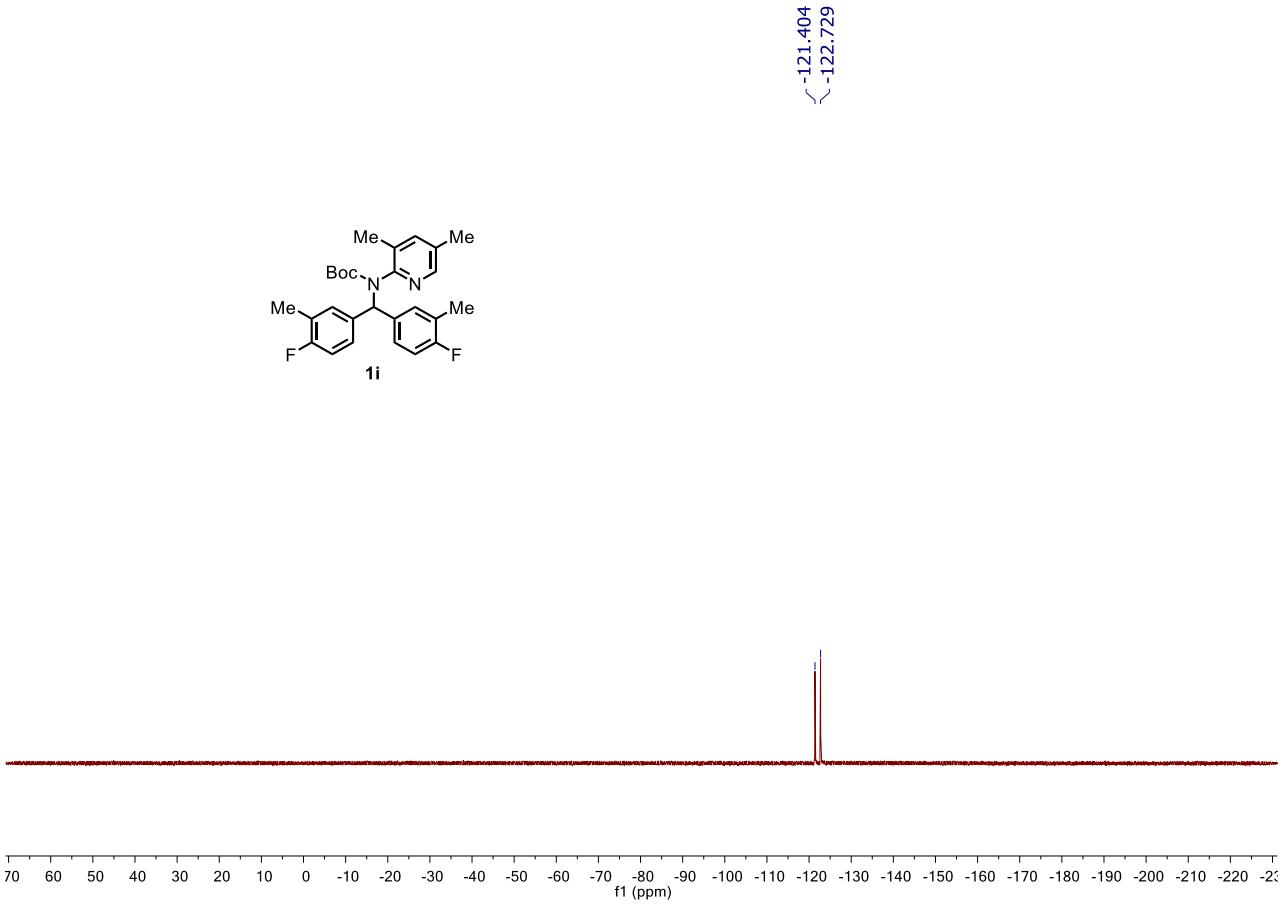
0.908
solvent
Me
Me
Boc
N
N
Me
Me
F
F
1i
f1 (ppm)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Me
Me
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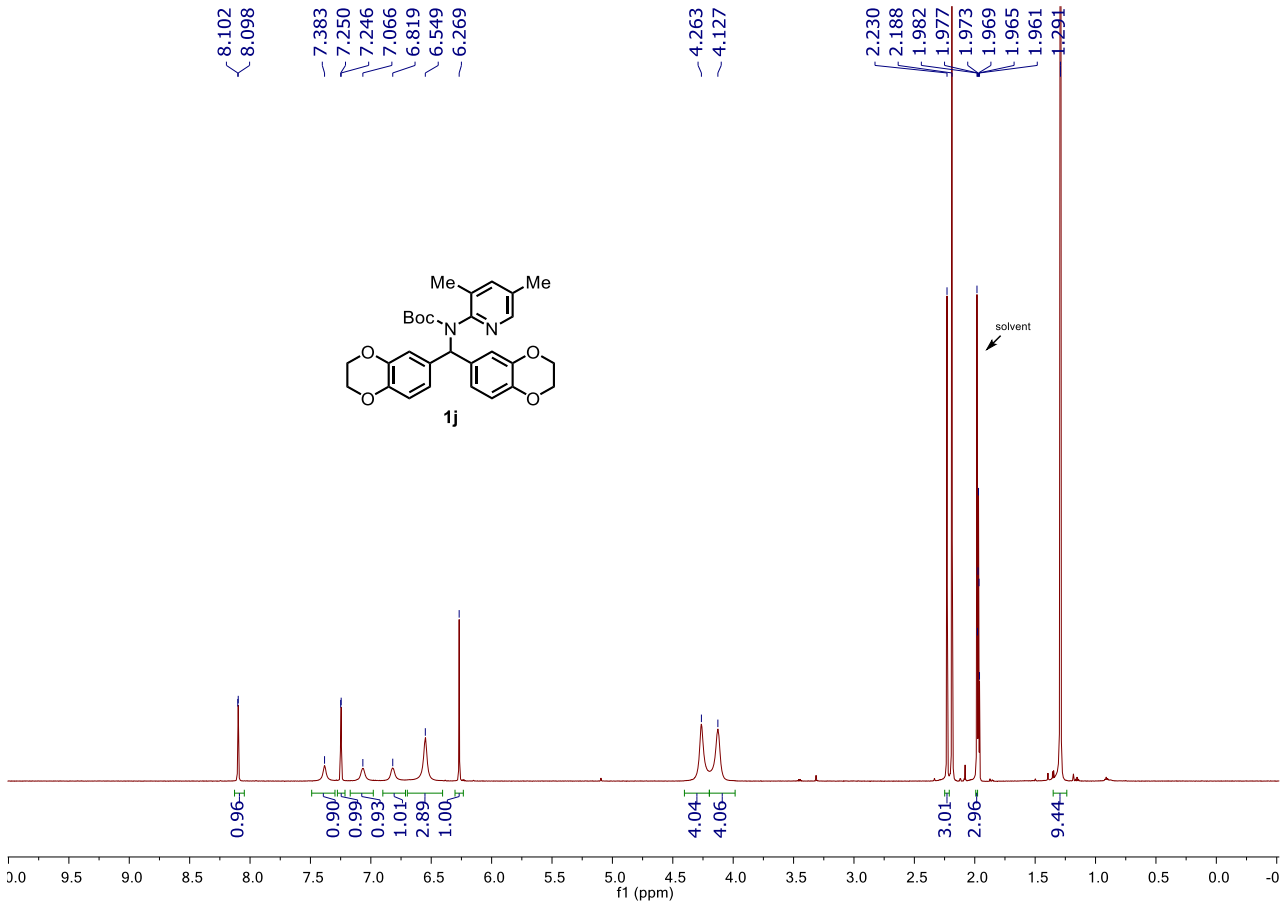
F
1i
f1 (ppm)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6.549
6.269
4.263
4.127
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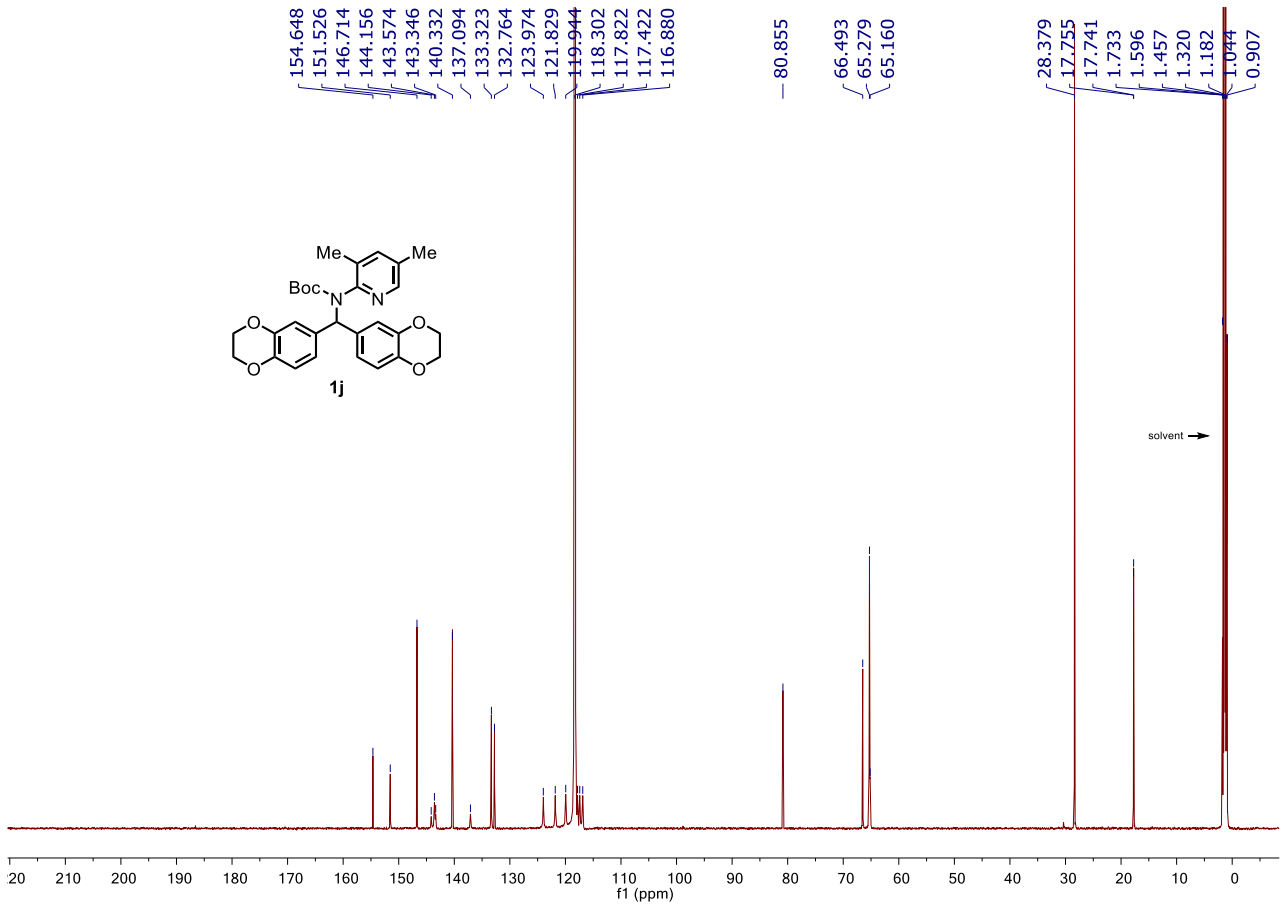
2.188
1.982
1.977
1.973
1.969
1.965
1.961
1.291
Me
Me
Boc
N
N
O
O
O
O
1j
solvent
0.96
0.90
0.99
0.93
1.01
2.89
1.00
4.04
4.06
3.01
2.96
9.44
f1 (ppm)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118.302
117.822
117.422
116.880
80.855
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65.279
65.160
28.379
17.755
17.741
1.733
1.596
1.457
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1.182
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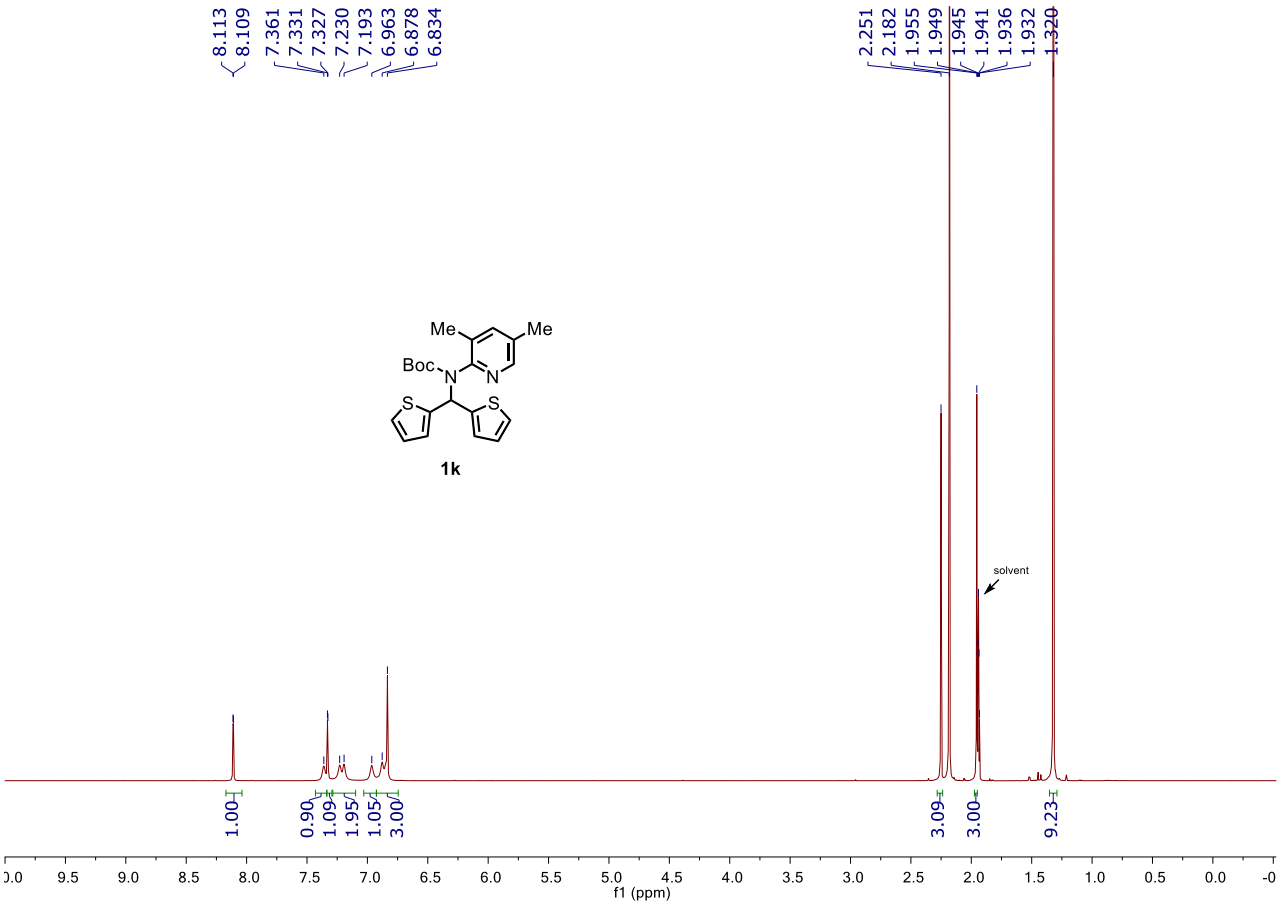
0.907
Me
Me
Boc
N
N
O
O
O
O
1j
solvent
f1 (ppm)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6.963
6.878
6.834
2.251
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1.949
1.945
1.941
1.936
1.932
1.320
Me
Me
Boc
N
N
S
S
1k
solvent
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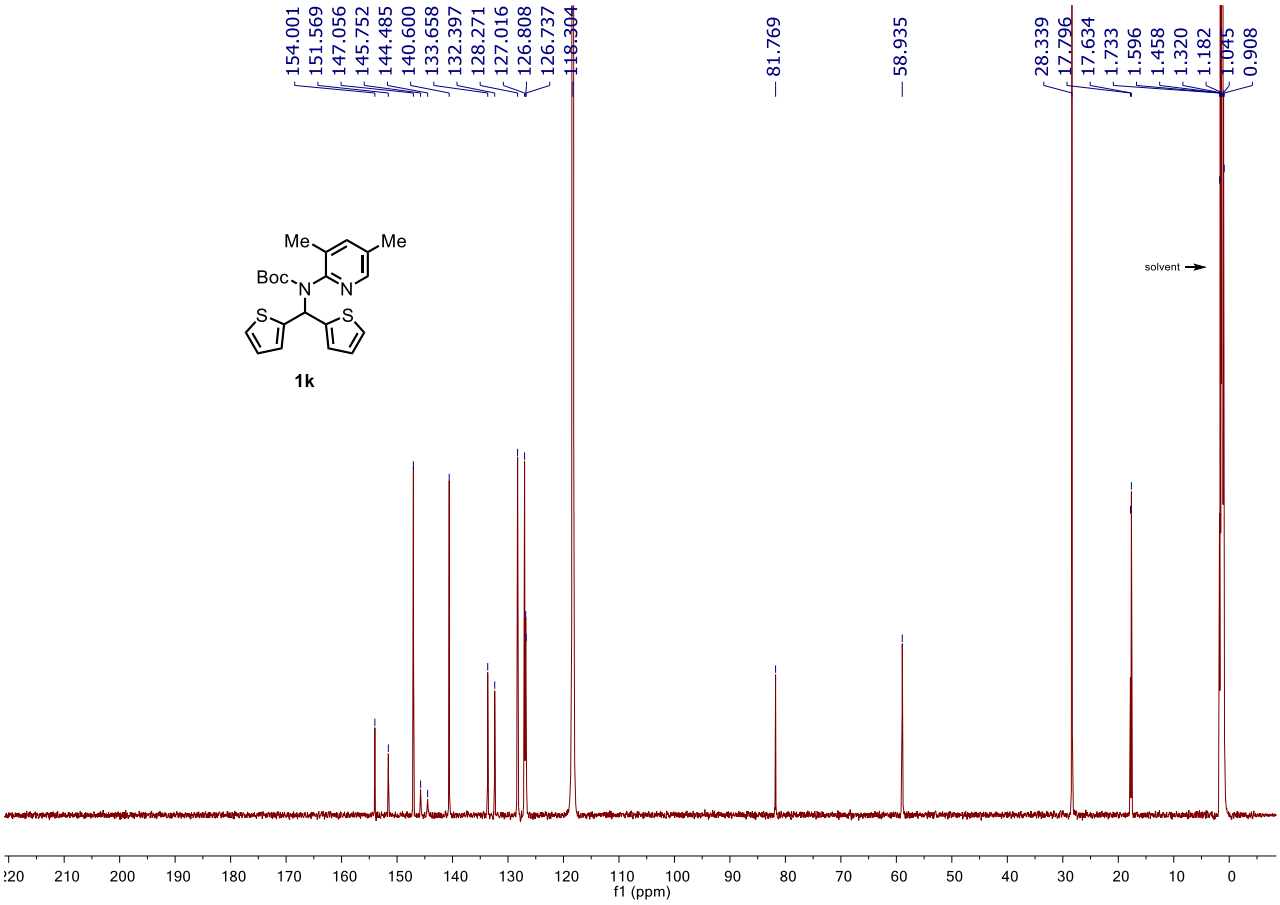
0.90
1.09
1.95
1.05
3.00
3.09
3.00
9.23
f1 (ppm)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118.304
81.769
58.935
28.339
17.796
17.634
1.733
1.596
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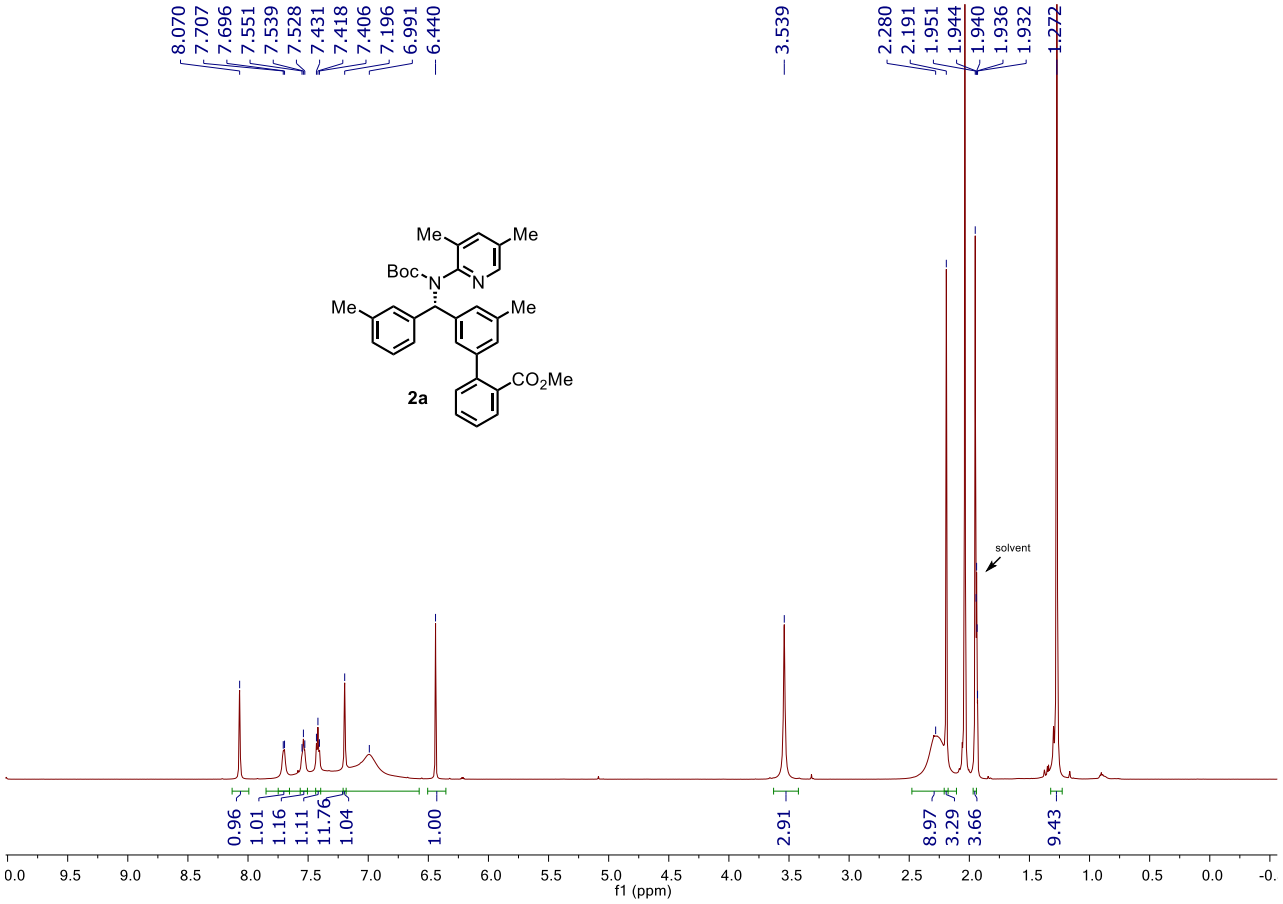
1.182
1.045
0.908
Me
Me
Boc
N
N
S
S
1k
solvent
f1 (ppm)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2.280
2.191
1.951
1.944
1.940
1.936
1.932
1.272
Me
Me
Boc
N
N
Me
Me
CO2Me
2a
solvent
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1.00
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3.29
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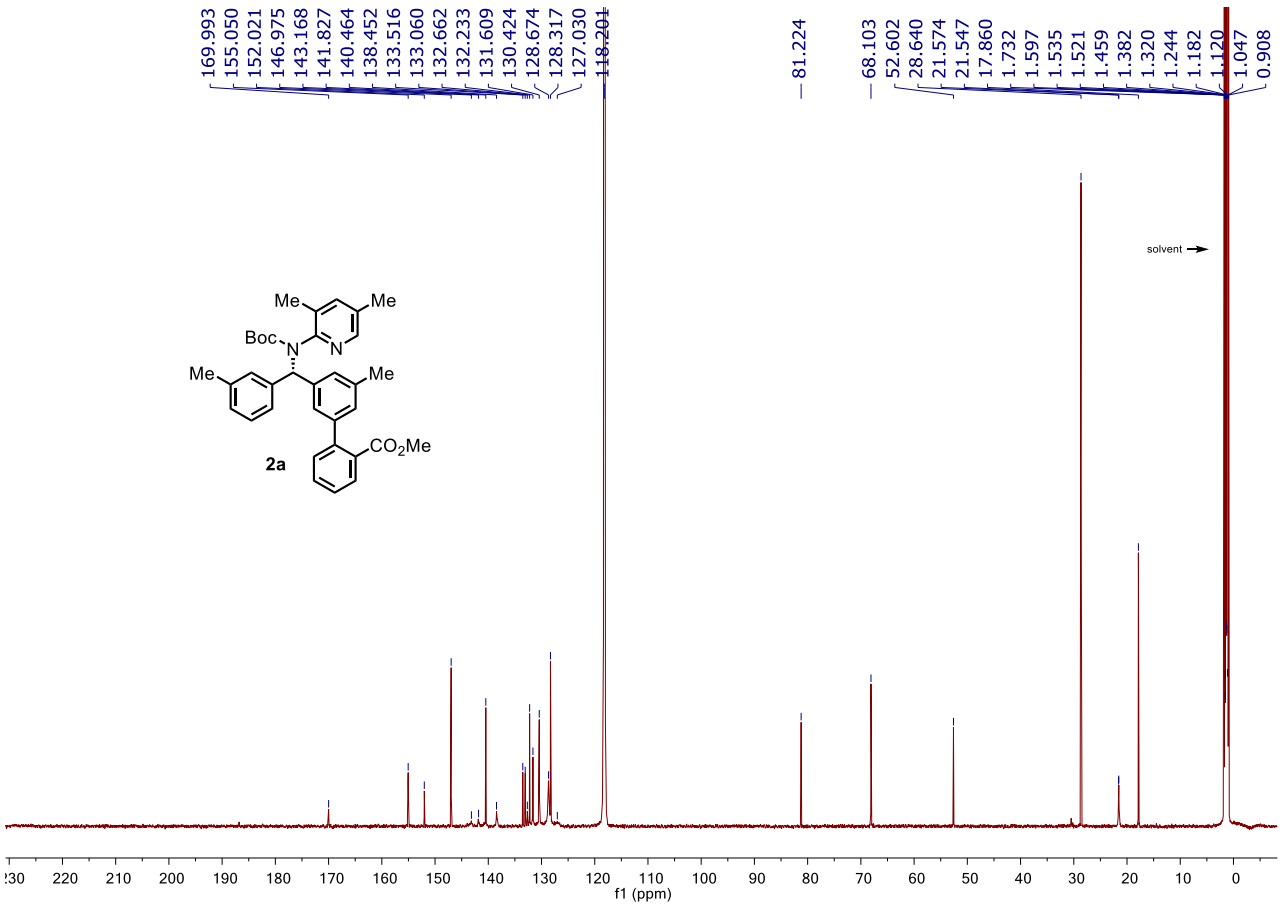
f1 (ppm)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130.424
128.674
128.317
127.030
118.291
81.224
68.103
52.602
28.640
21.574
21.547
17.860
1.732
1.597
1.535
1.521
1.459
1.382
1.320
1.244
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1.120
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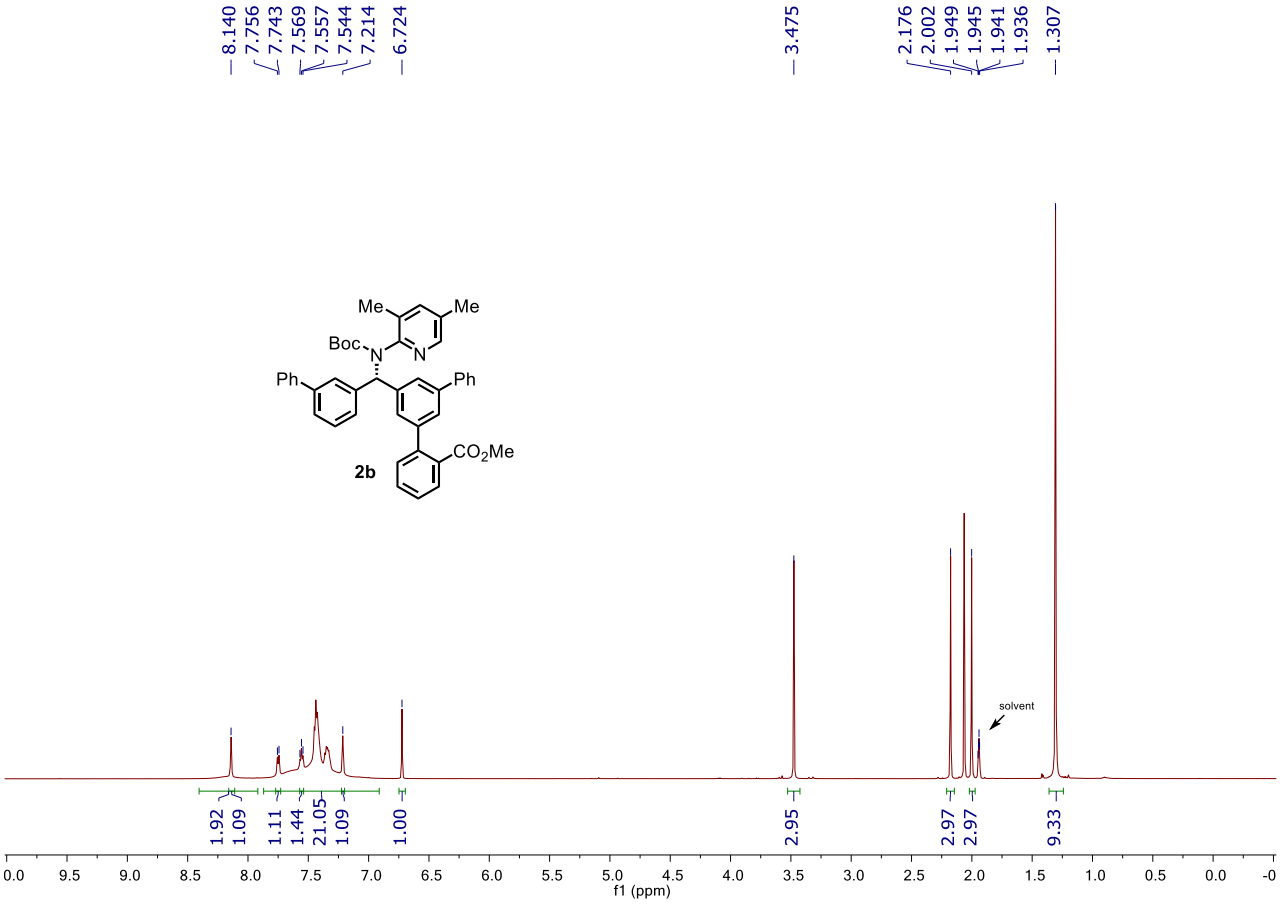
0.908
solvent
Me
Me
Boc
N
N
Me
Me
CO2Me
2a
f1 (ppm)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1.945
1.941
1.936
1.307
Me
Me
Boc
N
N
Ph
Ph
CO2Me
2b
solvent
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1.09
1.11
1.44
21.05
1.09
1.00
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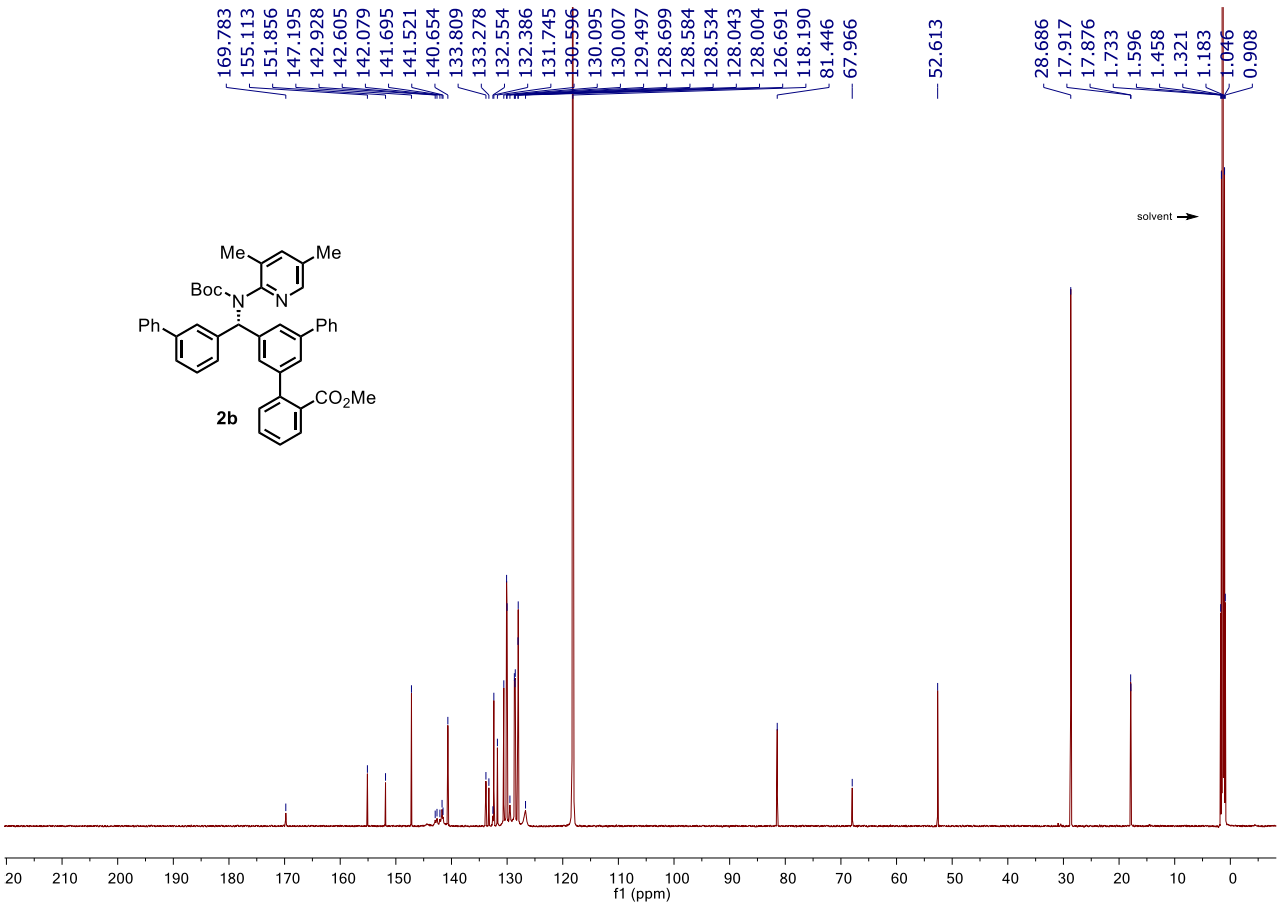
2.97
2.97
9.33
f1 (ppm)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131.745
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130.095
130.007
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128.699
128.584
128.534
128.043
128.004
126.691
118.190
81.446
67.966
52.613
28.686
17.917
17.876
1.733
1.596
1.458
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1.046
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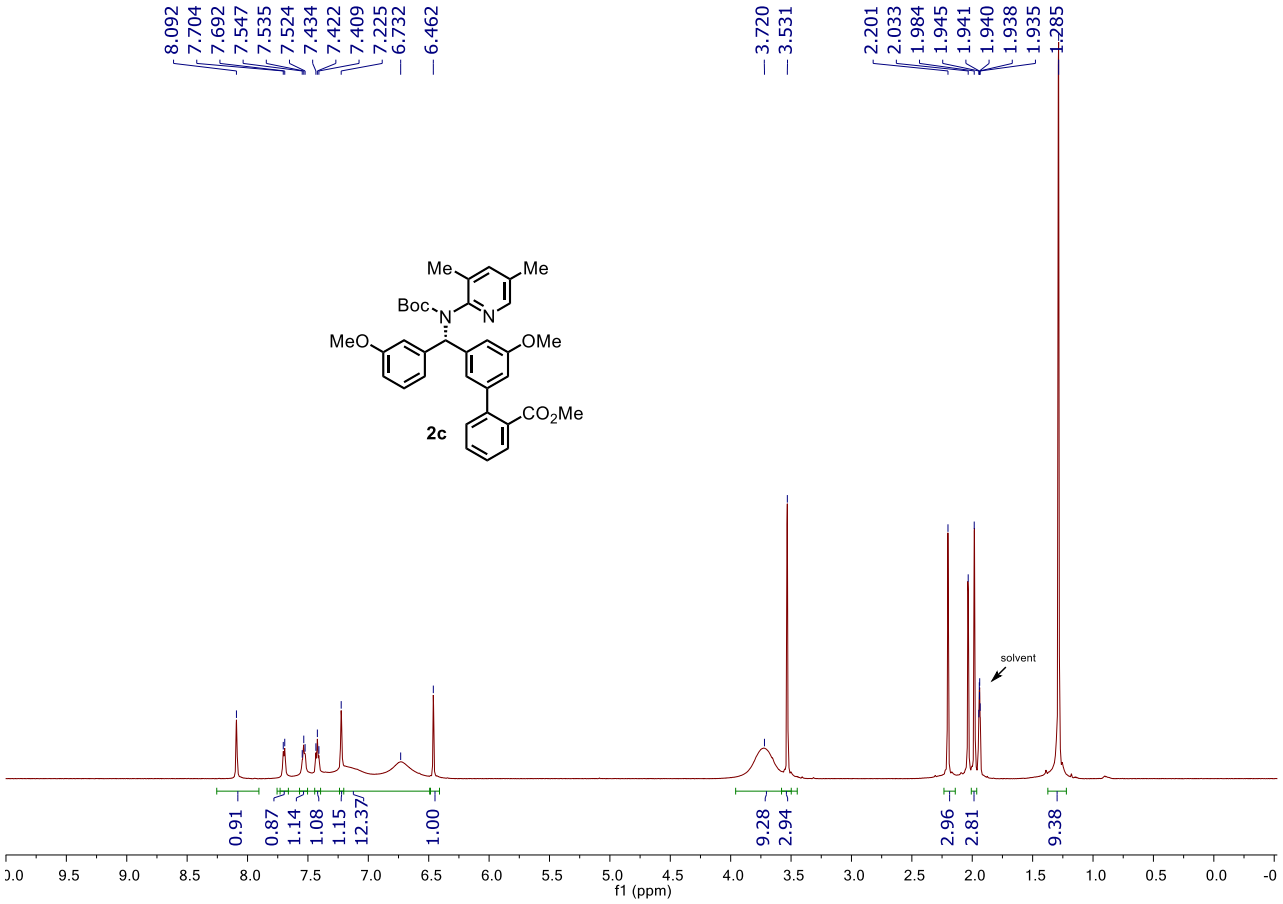
solvent
Me
Me
Boc
N
N
Ph
Ph
CO2Me
2b
f1 (ppm)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3.531
2.201
2.033
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1.945
1.941
1.940
1.938
1.935
1.285
Me
Me
Boc
N
N
MeO
OMe
CO2Me
2c
solvent
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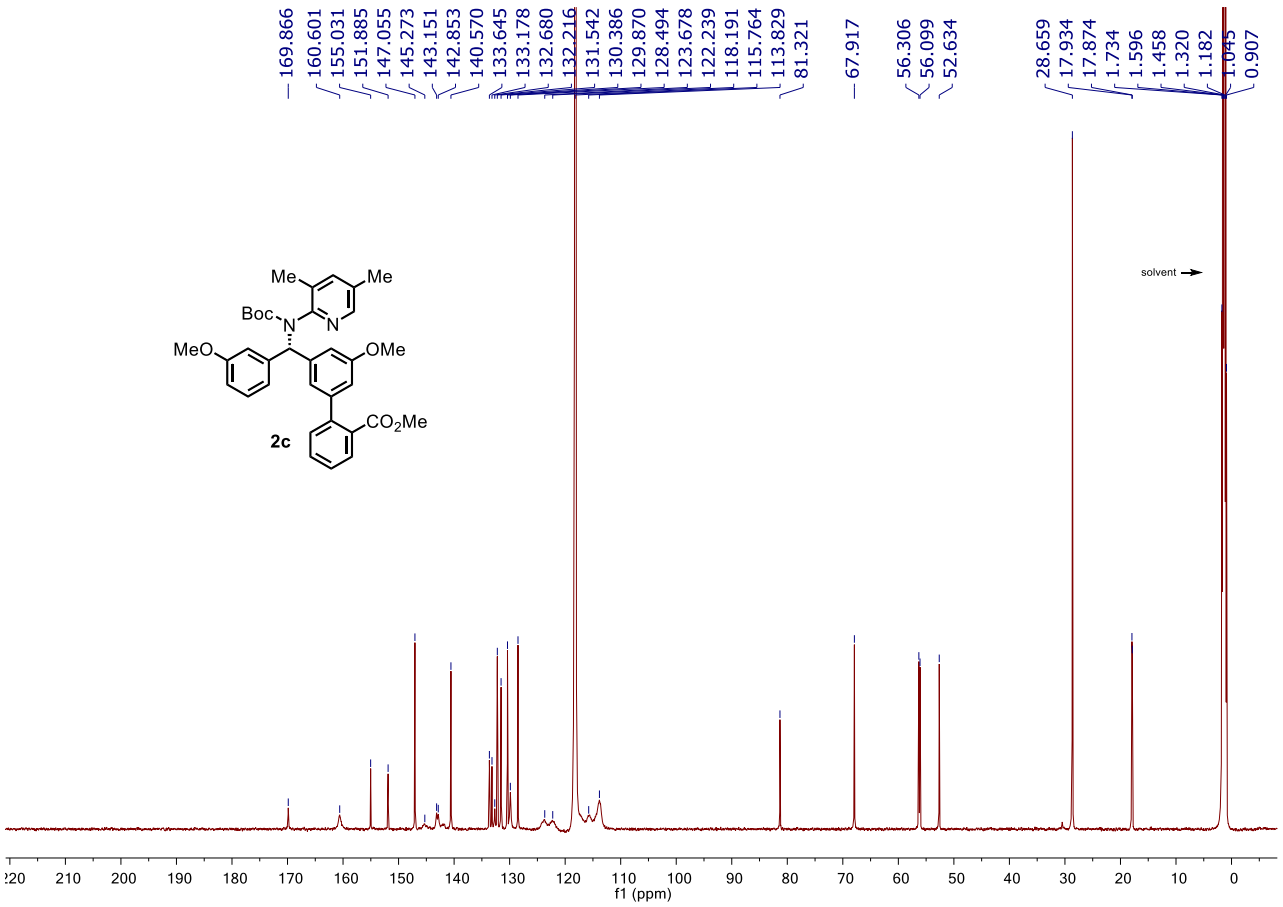
f1 (ppm)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122.239
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113.829
81.321
67.917
56.306
56.099
52.634
28.659
17.934
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1.458
1.320
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Me
Boc
N
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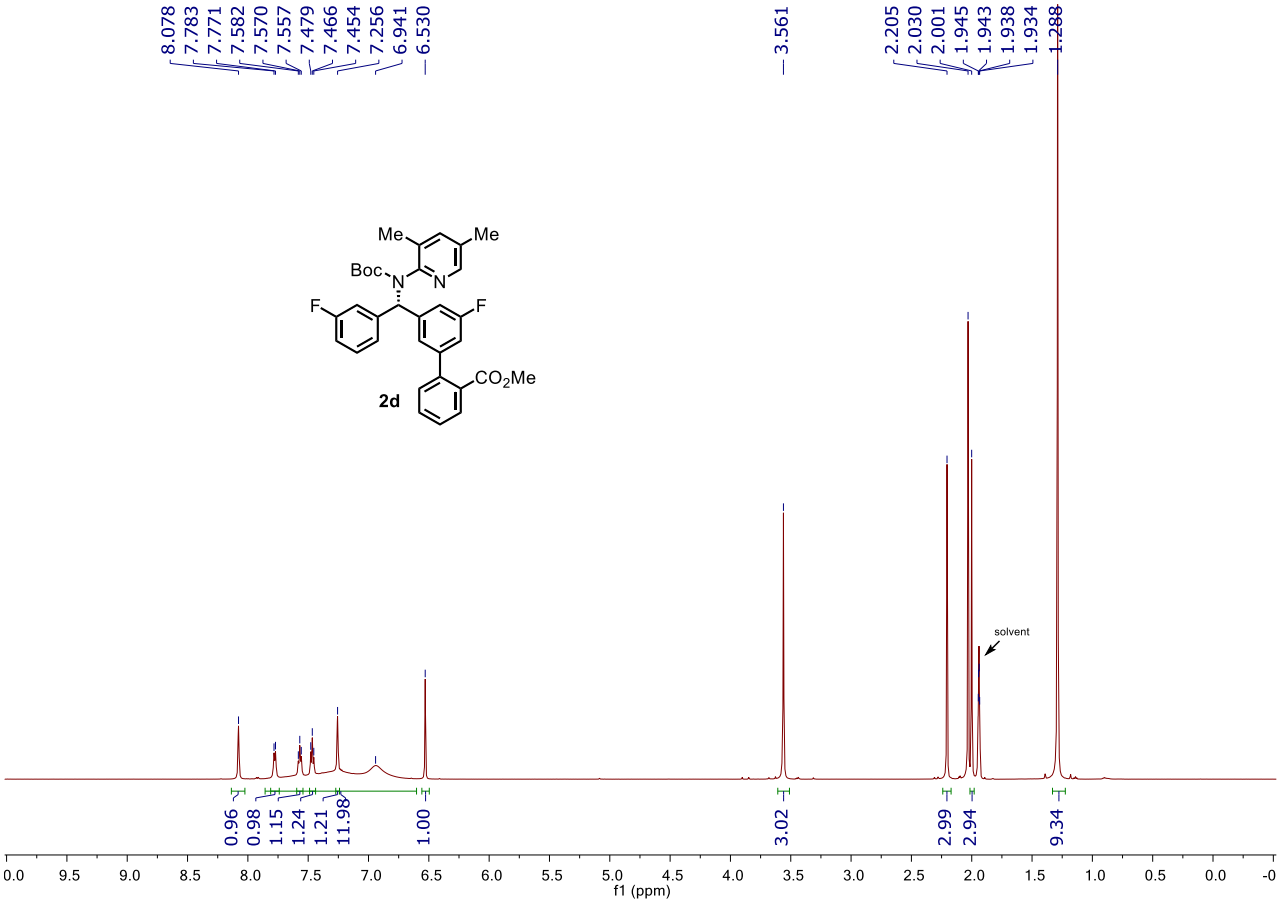
OMe
CO2Me
2c
solvent
f1 (ppm)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2.030
2.001
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1.943
1.938
1.934
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Me
Me
Boc
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F
F
CO2Me
2d
solvent
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2.99
2.94
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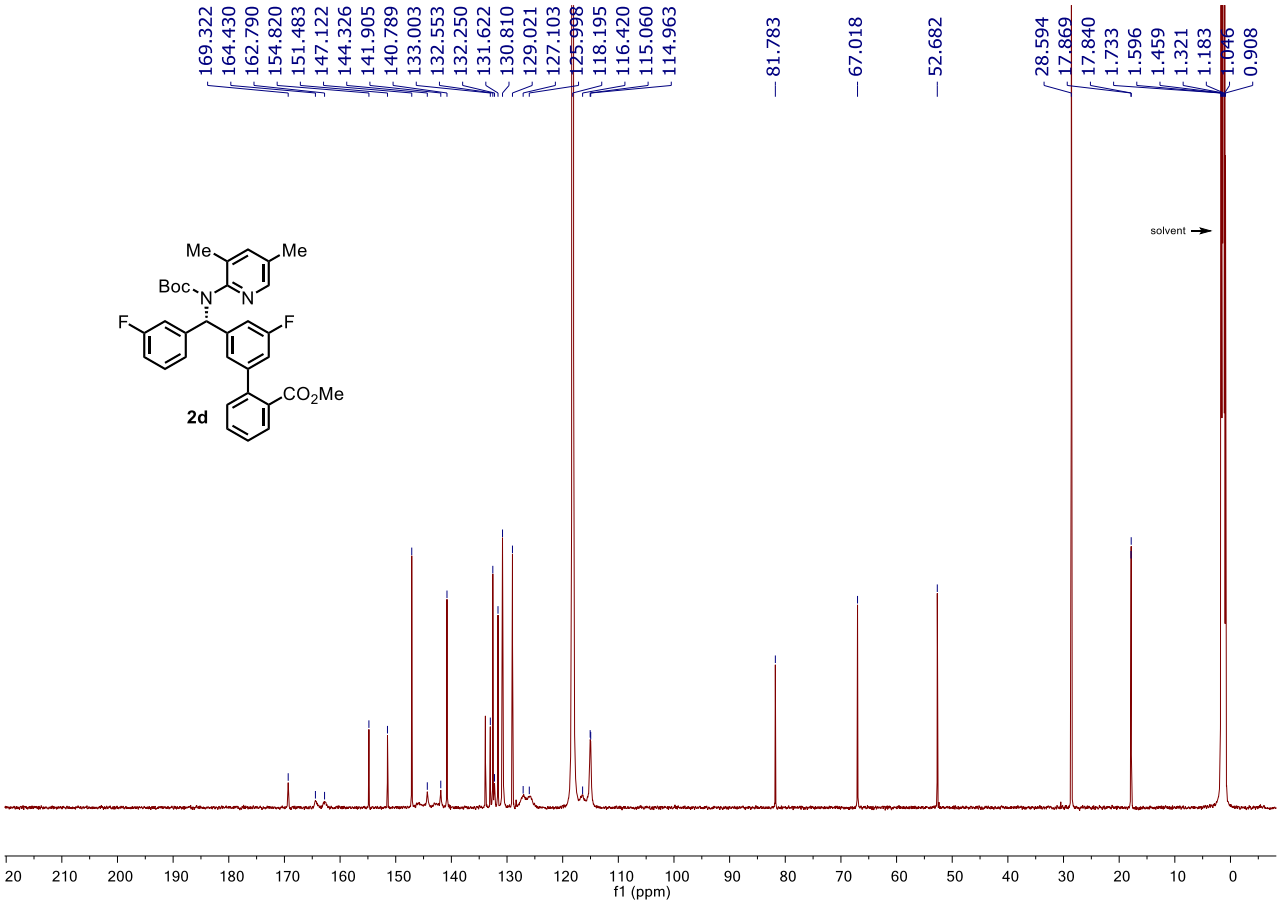
f1 (ppm)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131.622
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129.021
127.103
125.998
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114.963
81.783
67.018
52.682
28.594
17.869
17.840
1.733
1.596
1.459
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Me
Me
Boc
N
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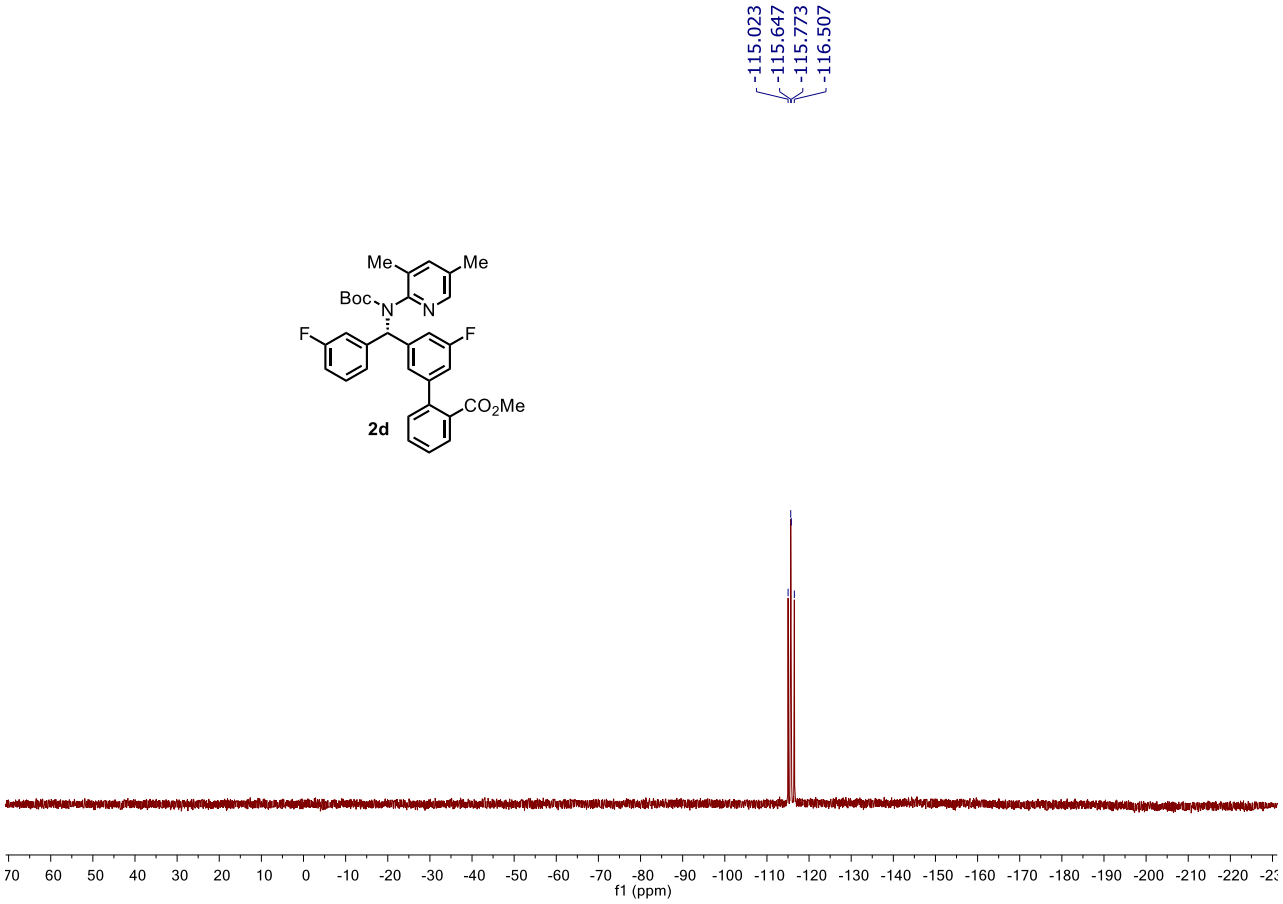
F
F
CO2Me
2d
solvent
f1 (ppm)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Me
Boc
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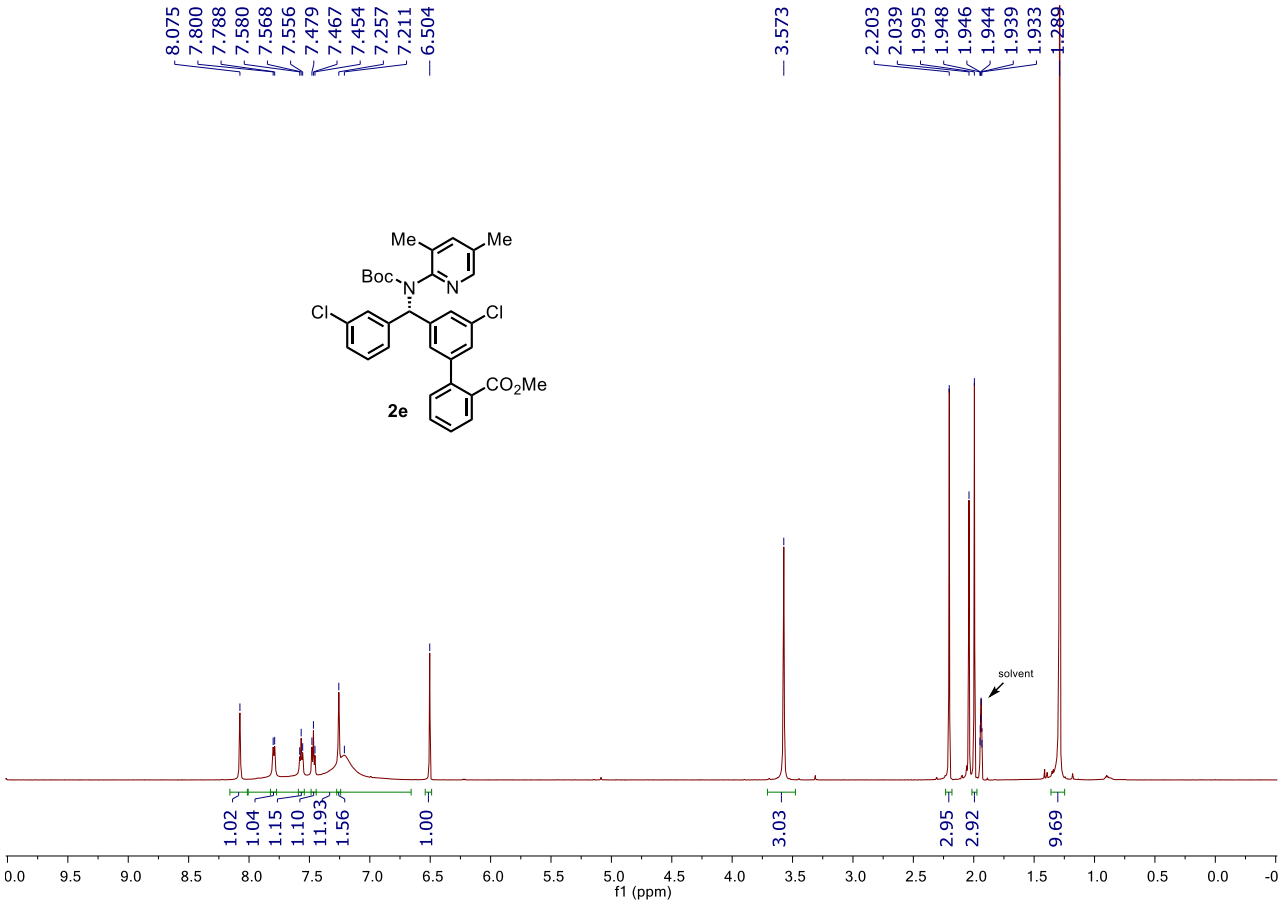
N
F
F
CO2Me
2d
f1 (ppm)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2.039
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1.946
1.944
1.939
1.933
1.289
Me
Me
Boc
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N
Cl
Cl
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solvent
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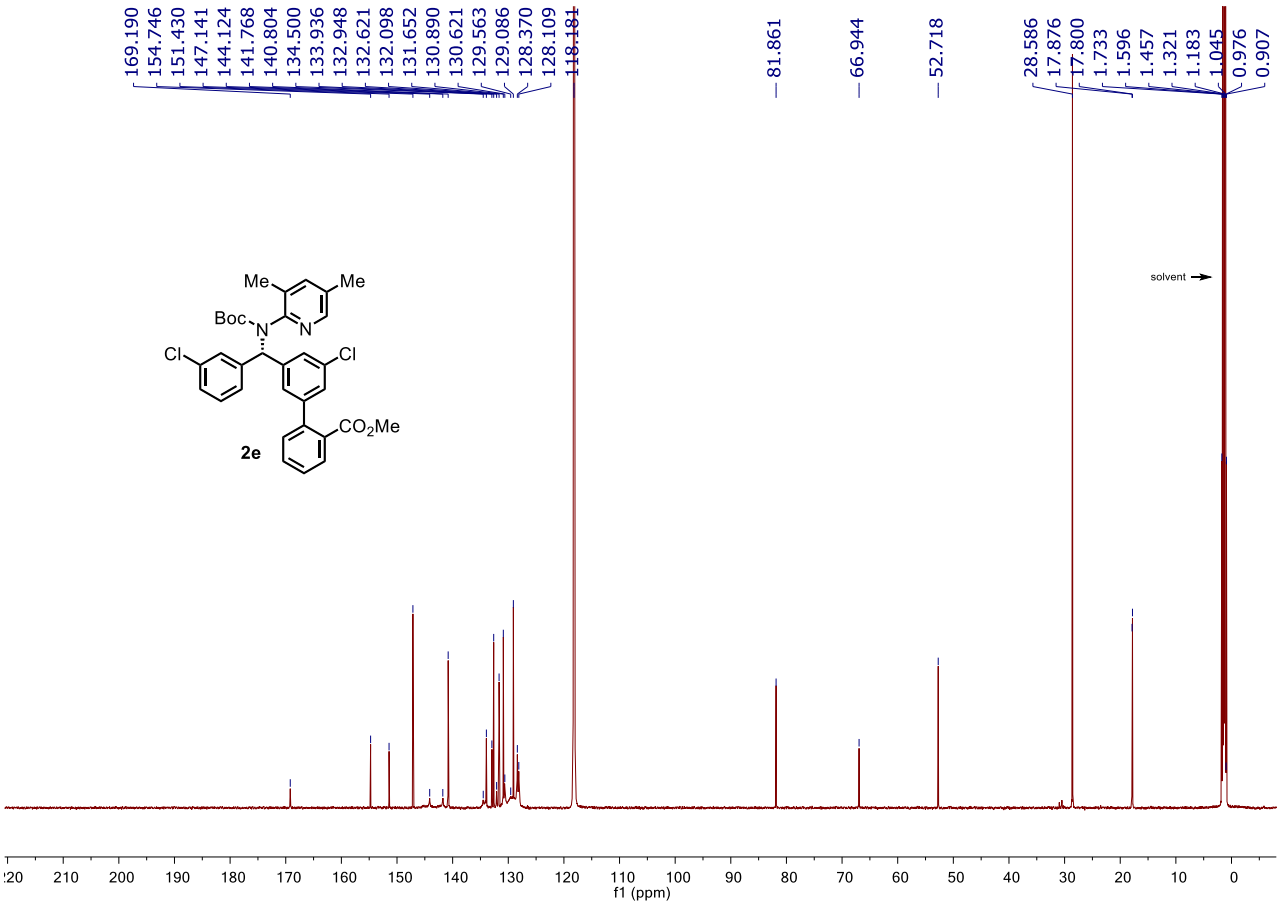
f1 (ppm)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52.718
28.586
17.876
17.800
1.733
1.596
1.457
1.321
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solvent
Me
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Cl
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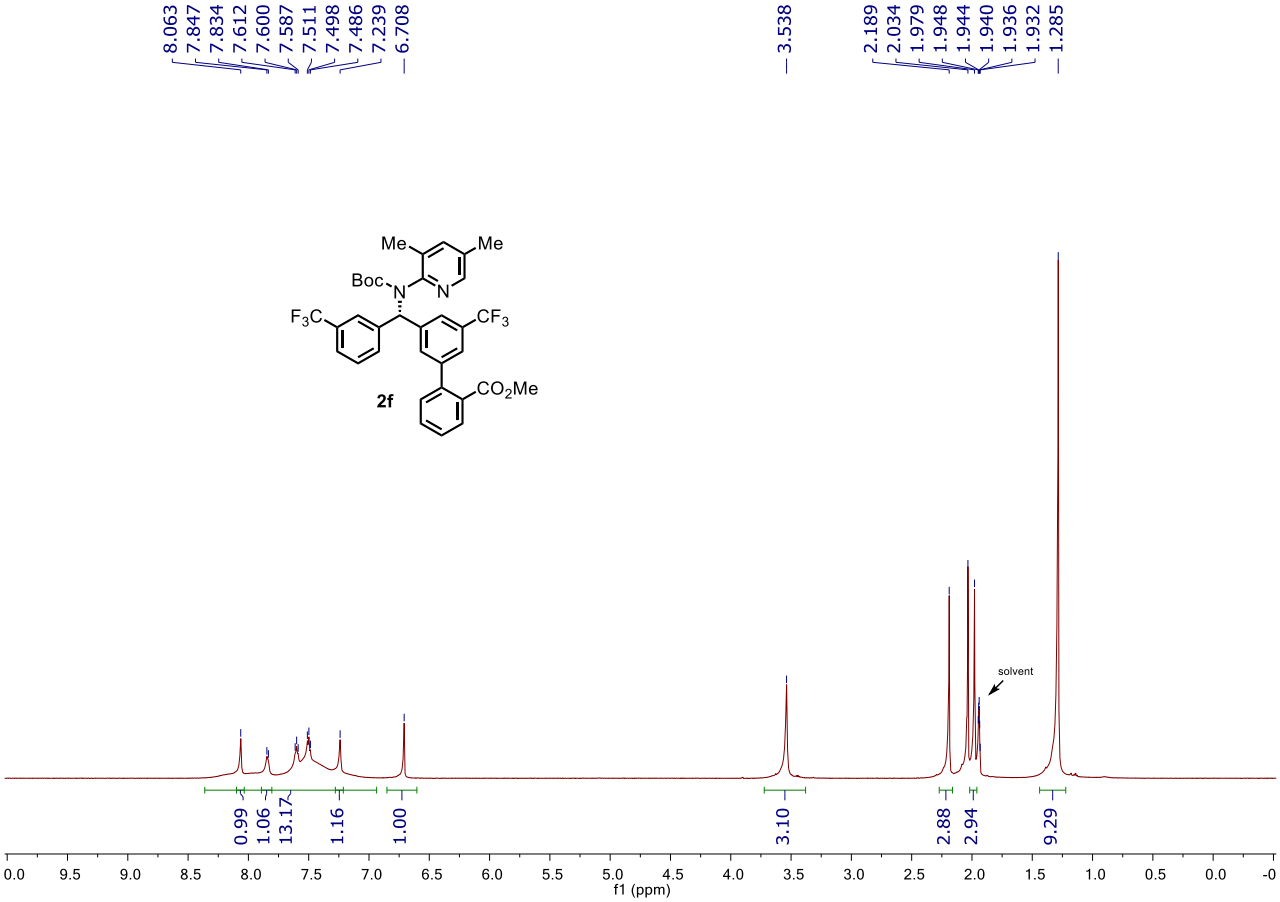
2e
f1 (ppm)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1.940
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1.932
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Me
Me
Boc
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N
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CF3
CO2Me
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9.29
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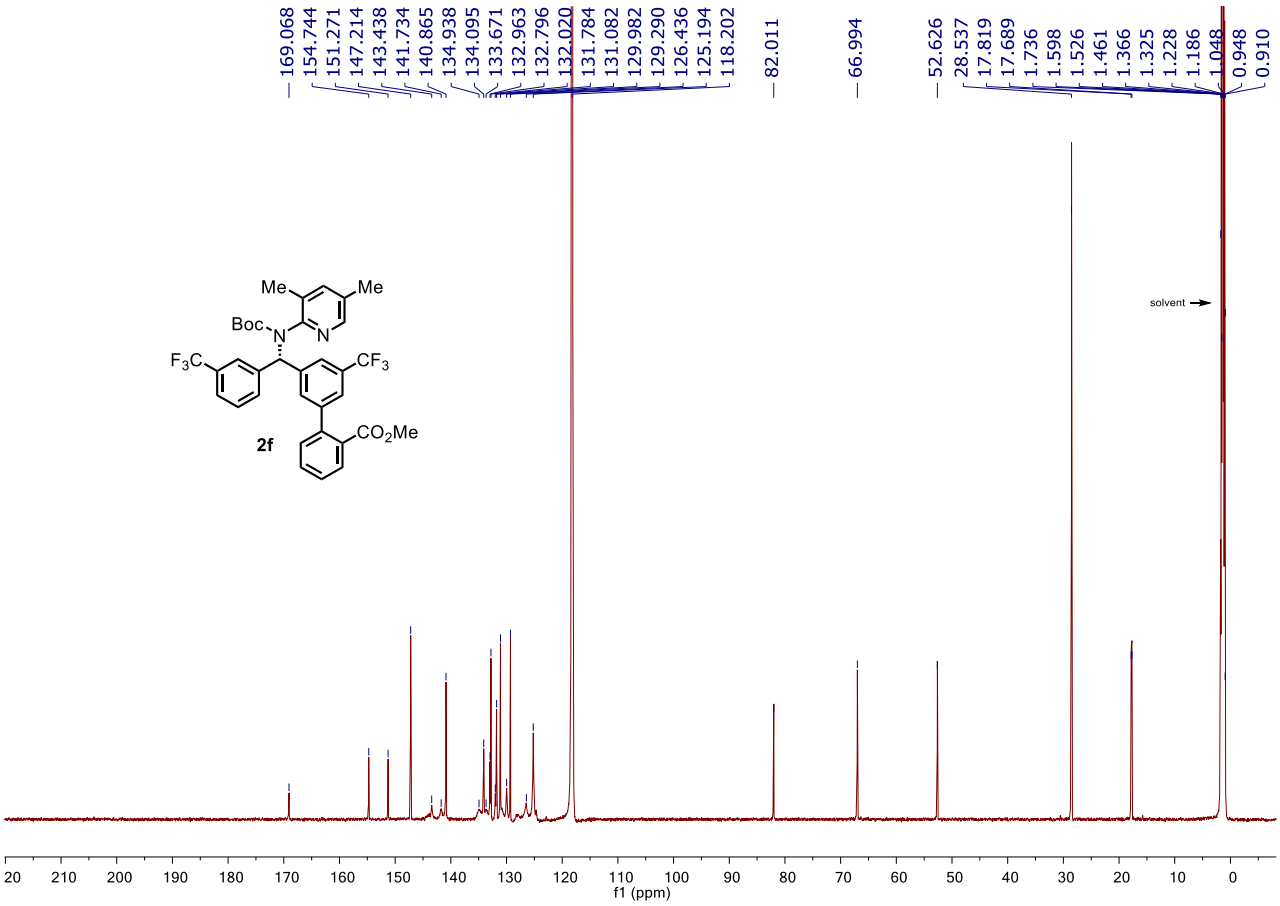
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118.202
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1.526
1.461
1.366
1.325
1.228
1.186
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solvent
Me
Me
Boc
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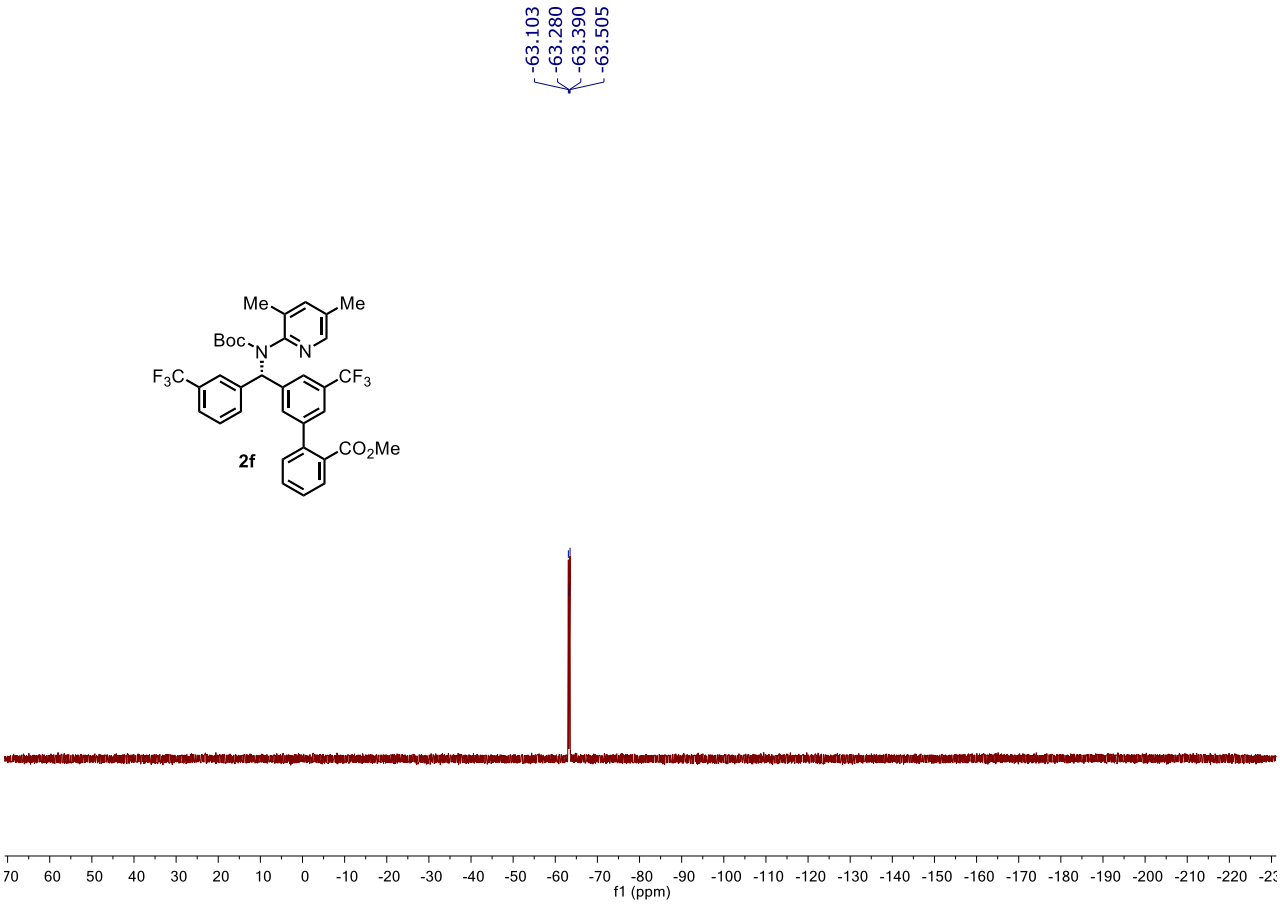
F3C
CF3
CO2Me
2f
f1 (ppm)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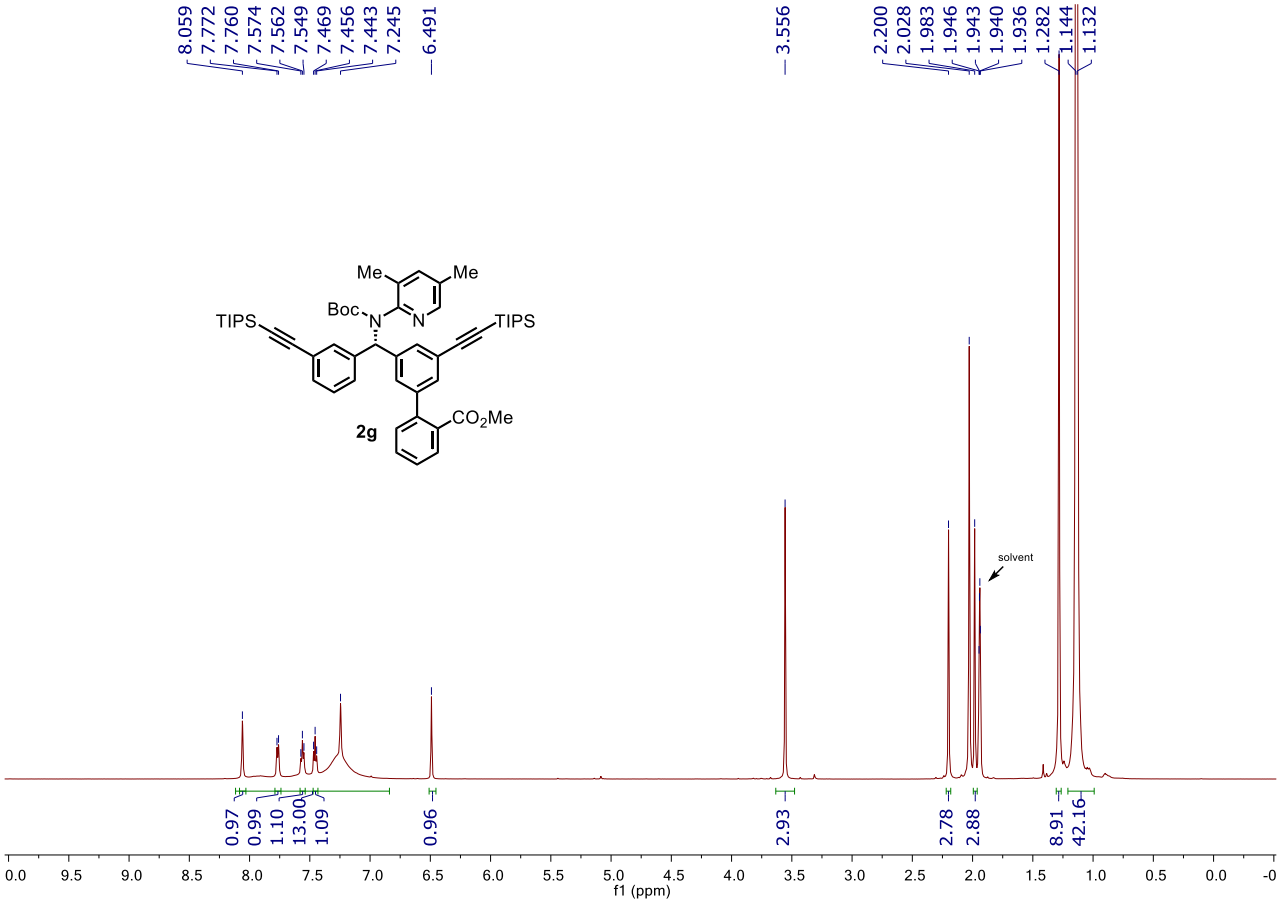
f1 (ppm)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2.028
1.983
1.946
1.943
1.940
1.936
1.282
1.144
1.132
Me
Me
Boc
N
N
TIPS
TIPS
CO2Me
2g
solvent
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2.93
2.78
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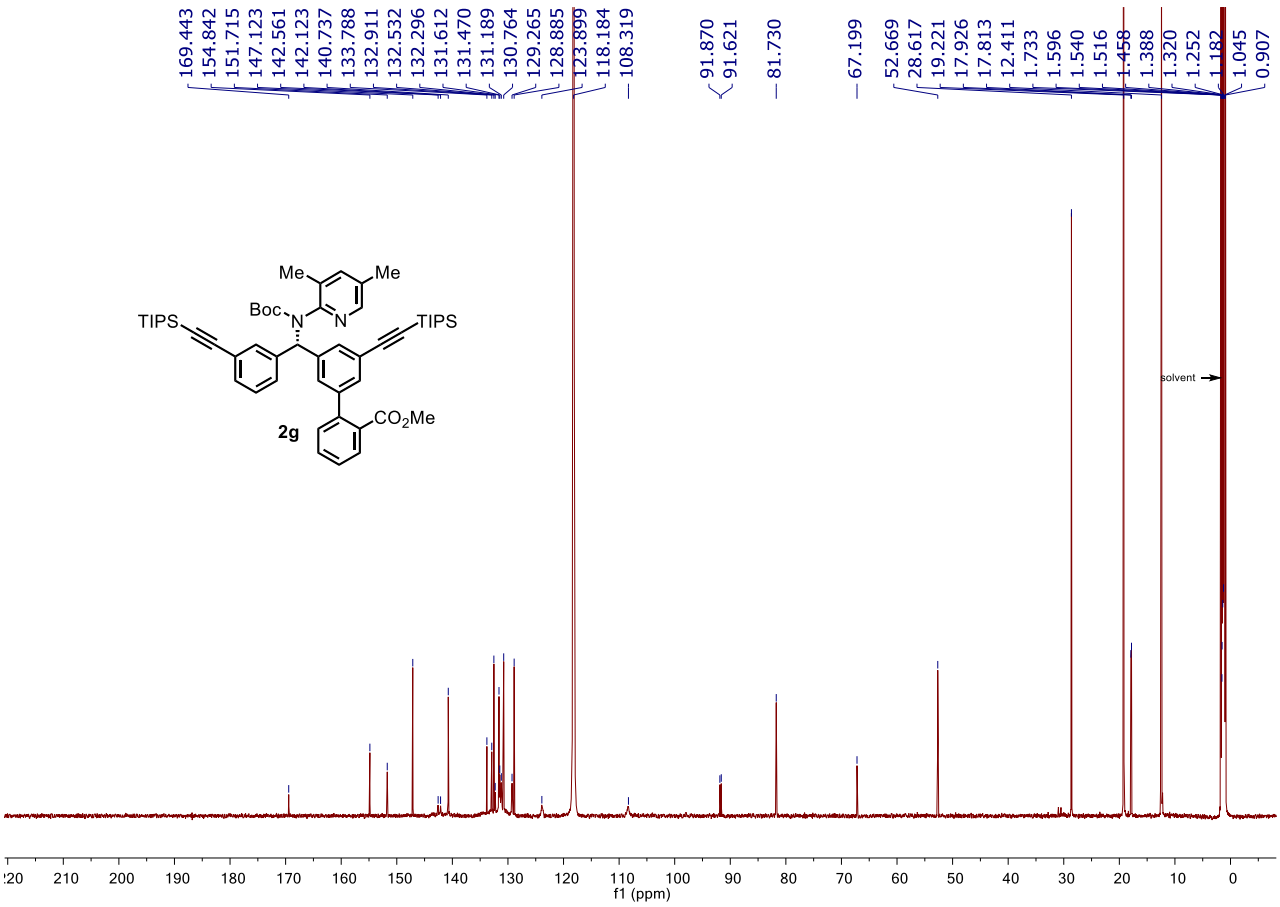
f1 (ppm)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131.189
130.764
129.265
128.885
123.899
118.184
108.319
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91.621
81.730
67.199
52.669
28.617
19.221
17.926
17.813
12.411
1.733
1.596
1.540
1.516
1.458
1.388
1.320
1.252
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0.907
Me
Me
Boc
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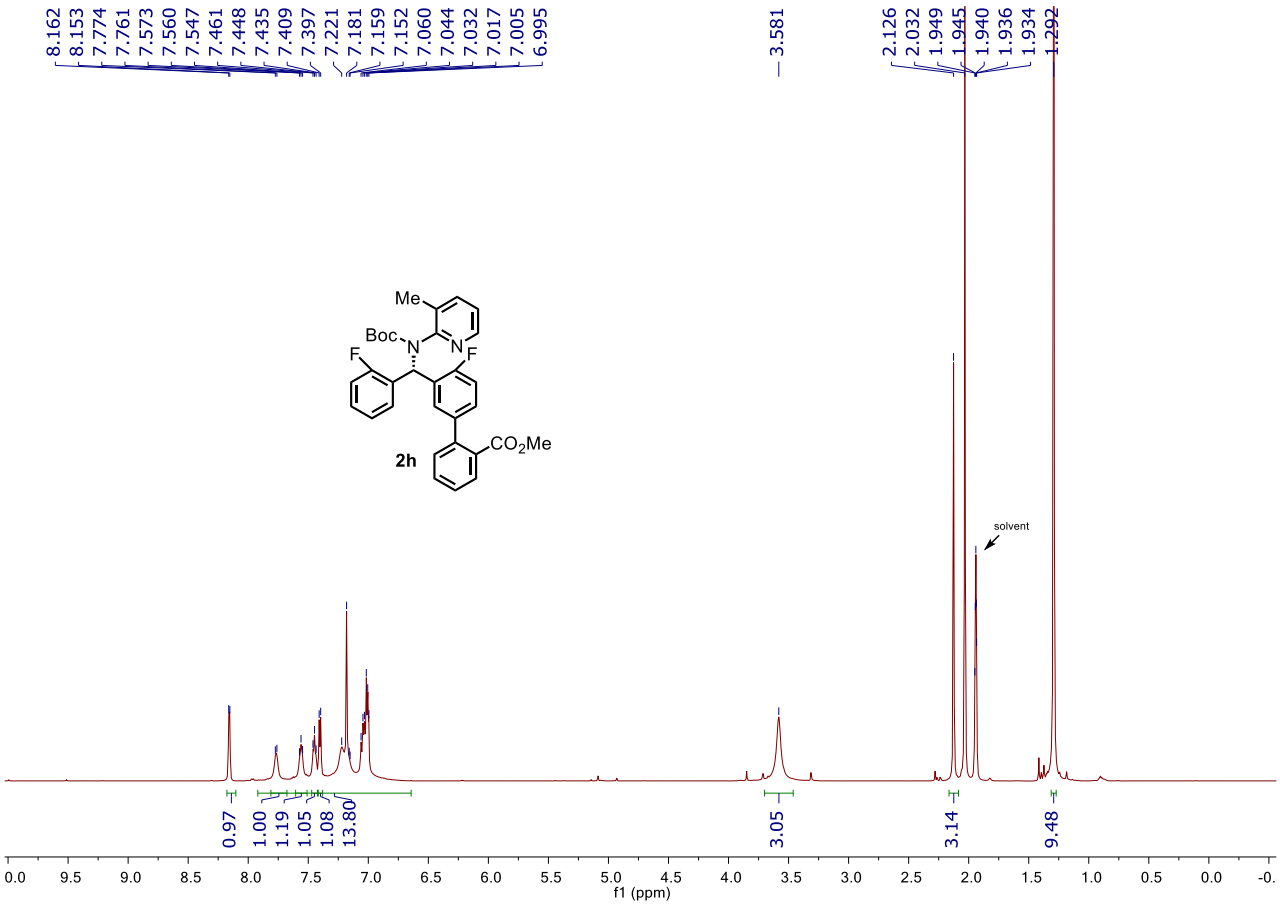
N
TIPS
TIPS
CO2Me
2g
solvent
f1 (ppm)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7.397
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7.181
7.159
7.152
7.060
7.044
7.032
7.017
7.005
6.995
3.581
2.126
2.032
1.949
1.945
1.940
1.936
1.934
1.292
Me
Boc
N
N
F
F
CO2Me
2h
solvent
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1.05
1.08
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3.05
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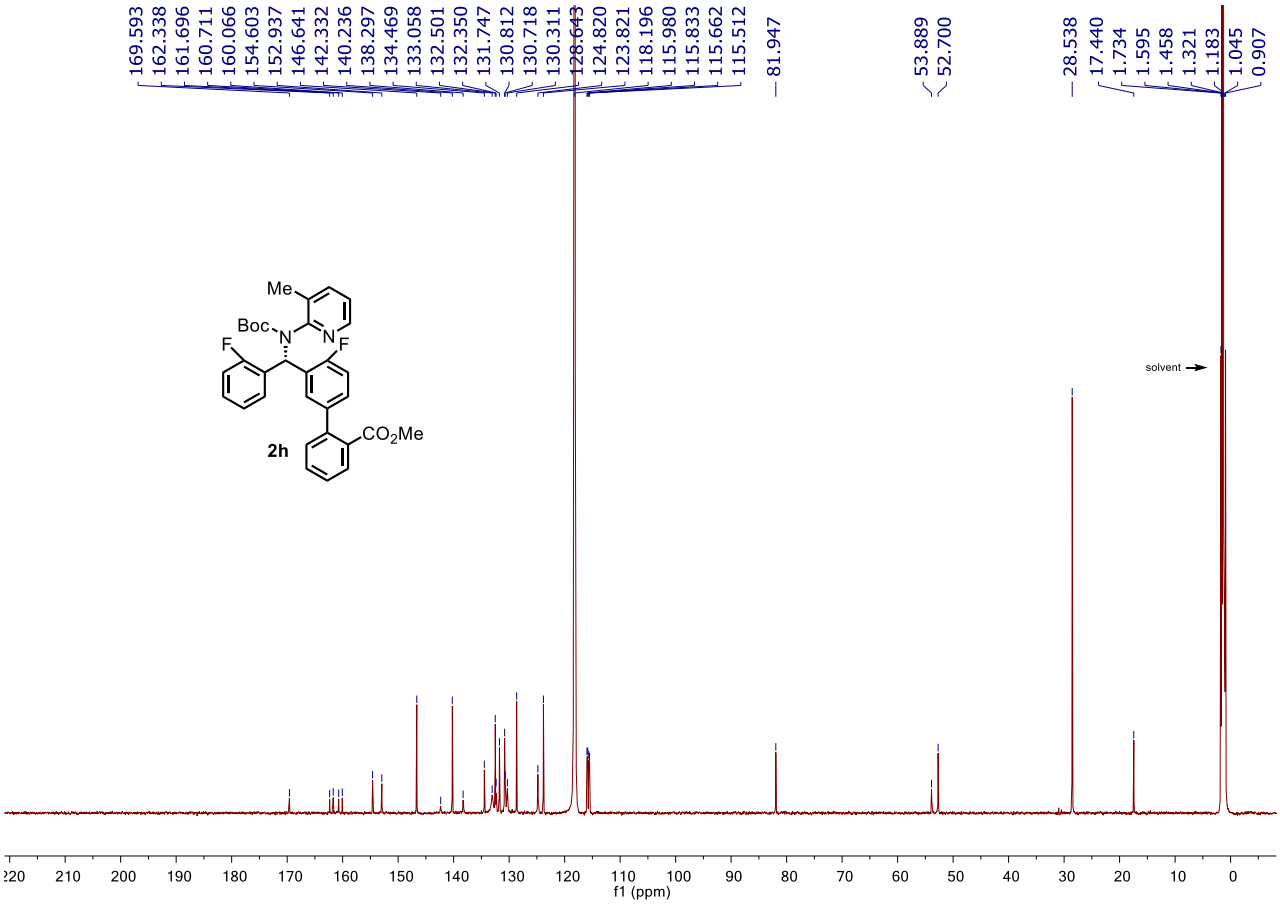
f1 (ppm)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132.350
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115.980
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53.889
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28.538
17.440
1.734
1.595
1.458
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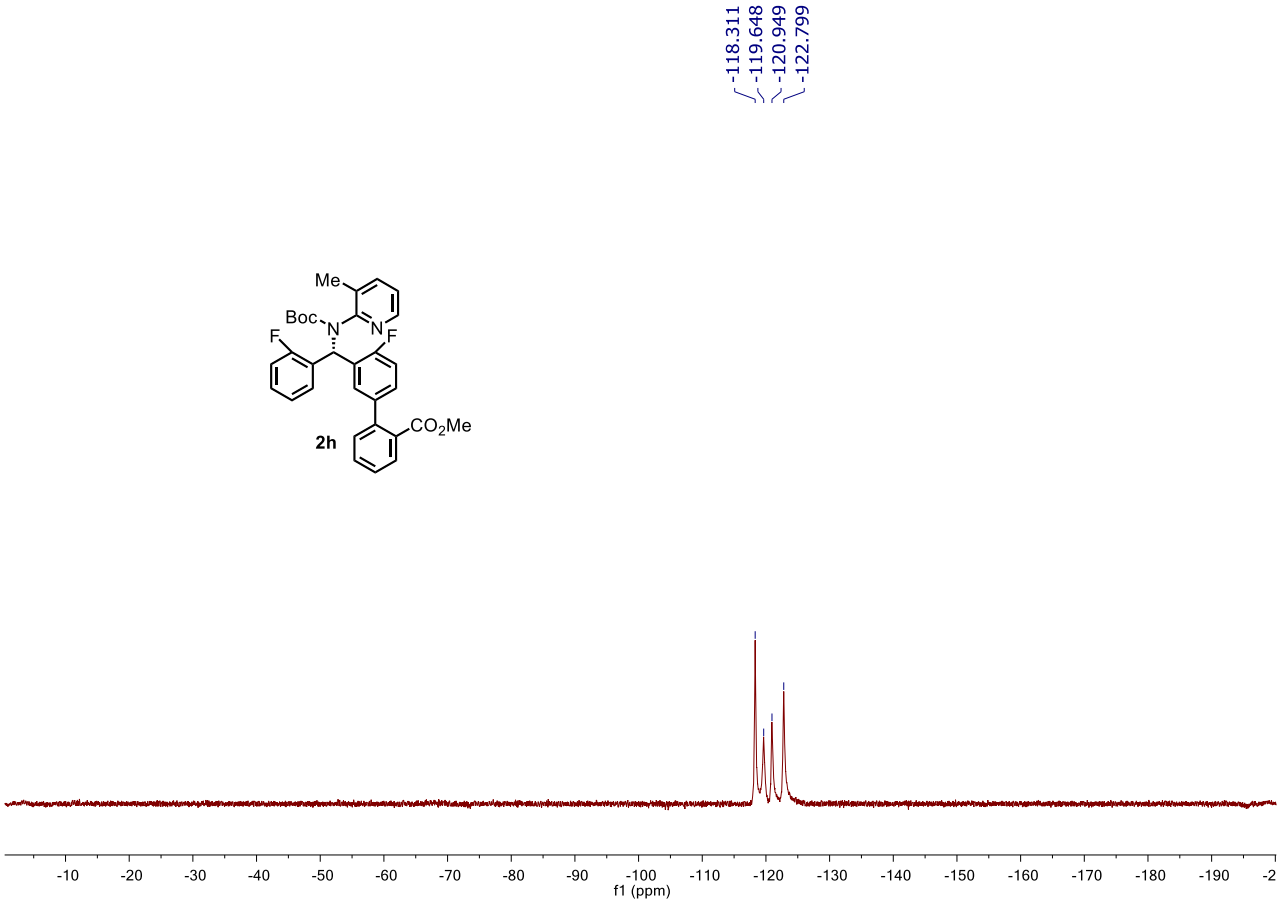
1.045
0.907
Me
Boc
N
N
F
F
CO2Me
2h
solvent
f1 (ppm)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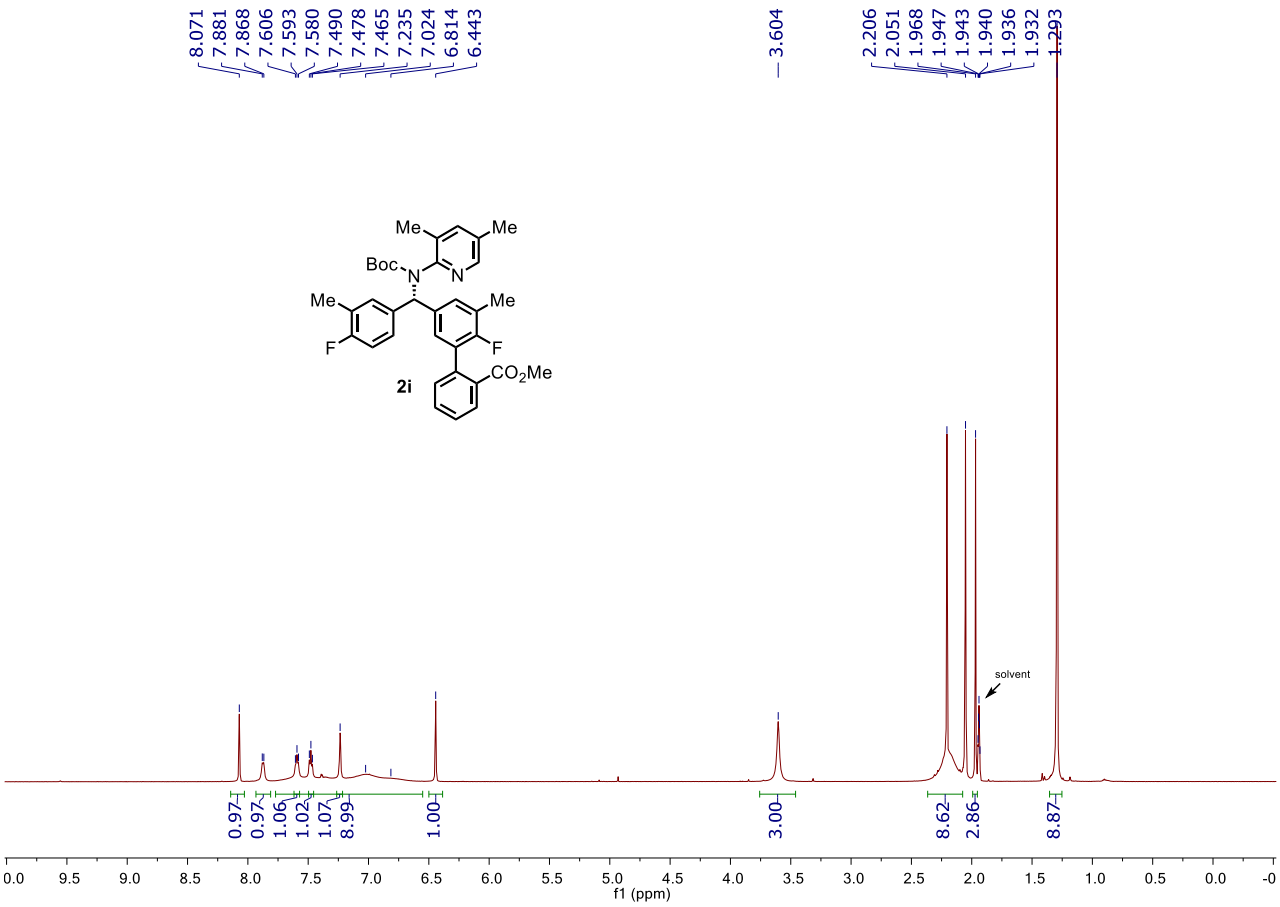
Me
Boc
N
N
F
F
CO2Me
2h
f1 (ppm)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6.443
3.604
2.206
2.051
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1.947
1.943
1.940
1.936
1.932
1.293
Me
Me
Boc
N
N
Me
Me
F
F
CO2Me
2i
solvent
0.97
0.97
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1.00
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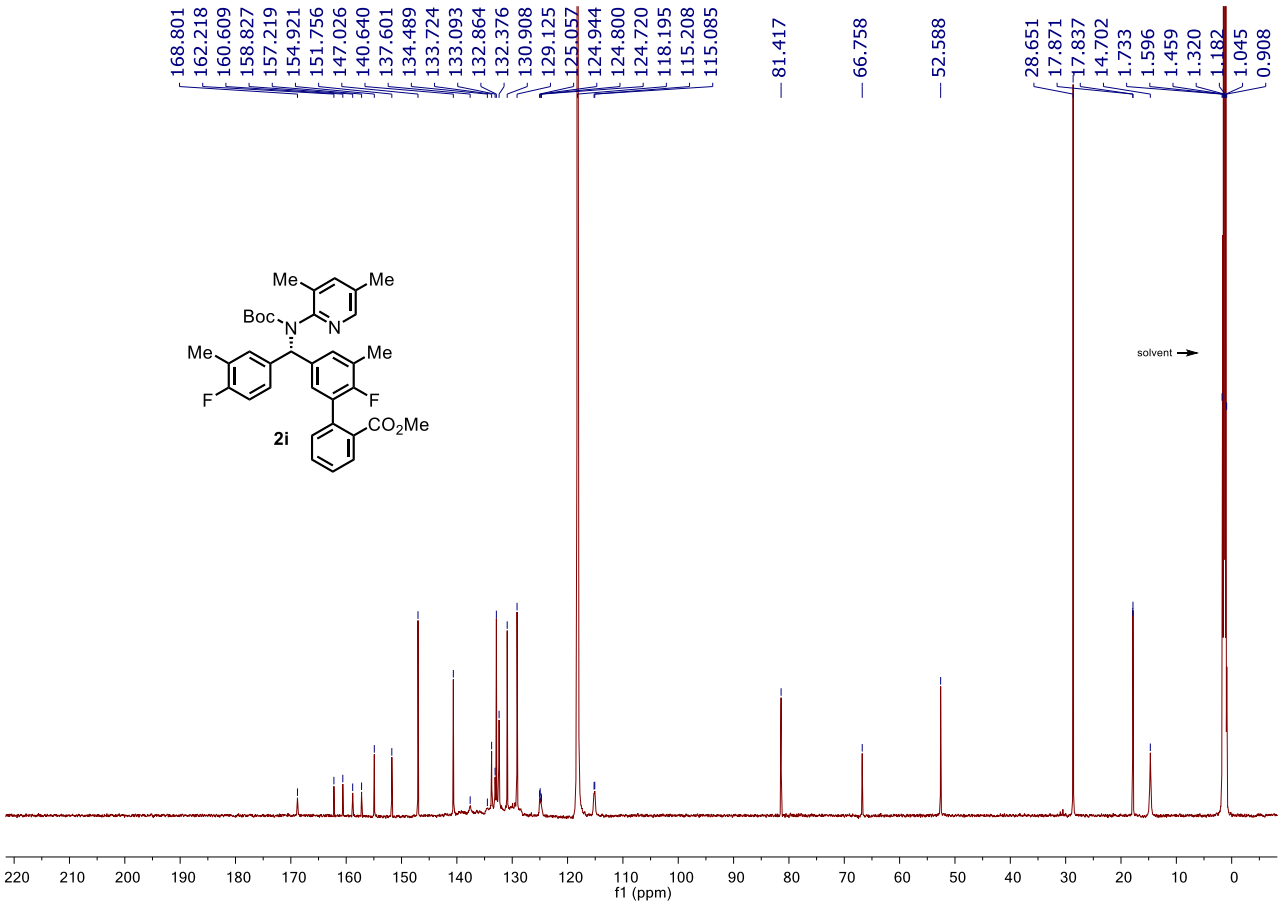
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132.864
132.376
130.908
129.125
125.057
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124.800
124.720
118.195
115.208
115.085
81.417
66.758
52.588
28.651
17.871
17.837
14.702
1.733
1.596
1.459
1.320
1.182
1.045
0.908
solvent
Me
Me
Boc
N
N
Me
Me
F
F
CO2Me
2i
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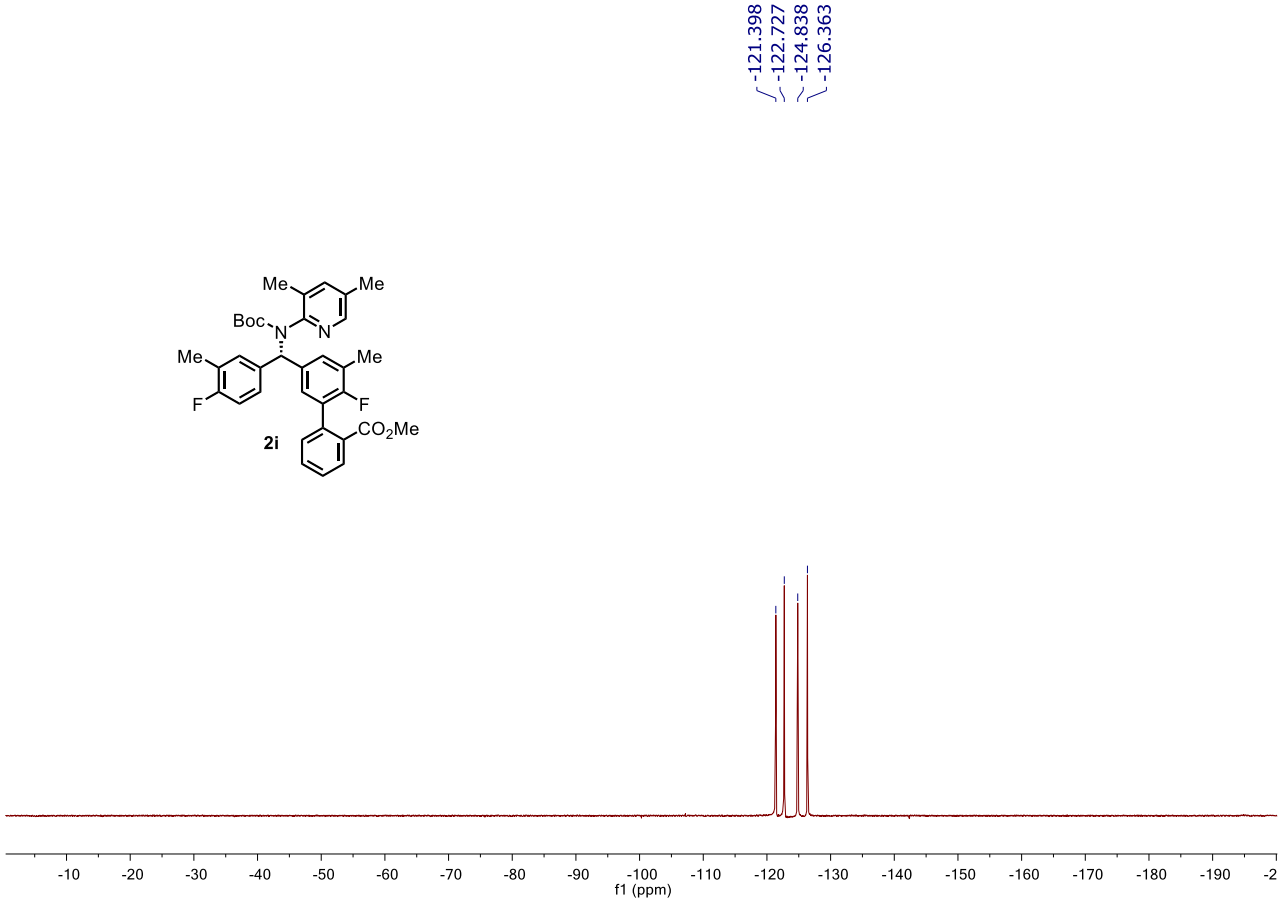
f1 (ppm)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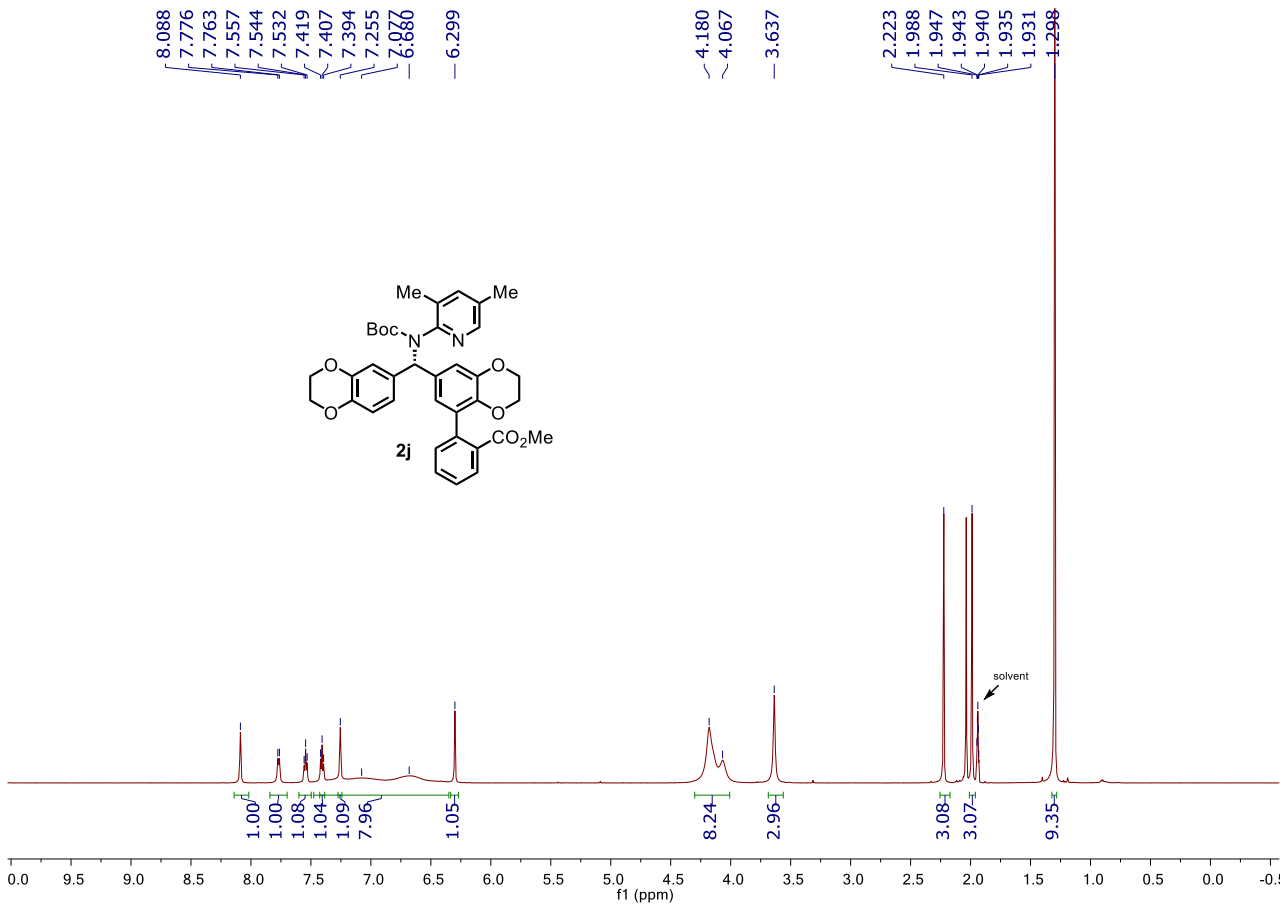
-122.727
-124.838
-126.363
Me
Me
Boc
N
N
Me
Me
F
F
CO2Me
2i
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -2
f1 (ppm)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7.407
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7.255
7.027
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4.180
4.067
3.637
2.223
1.988
1.947
1.943
1.940
1.935
1.931
1.298
Me
Me
Boc
N
N
O
O
O
O
CO2Me
2j
solvent
1.00
1.00
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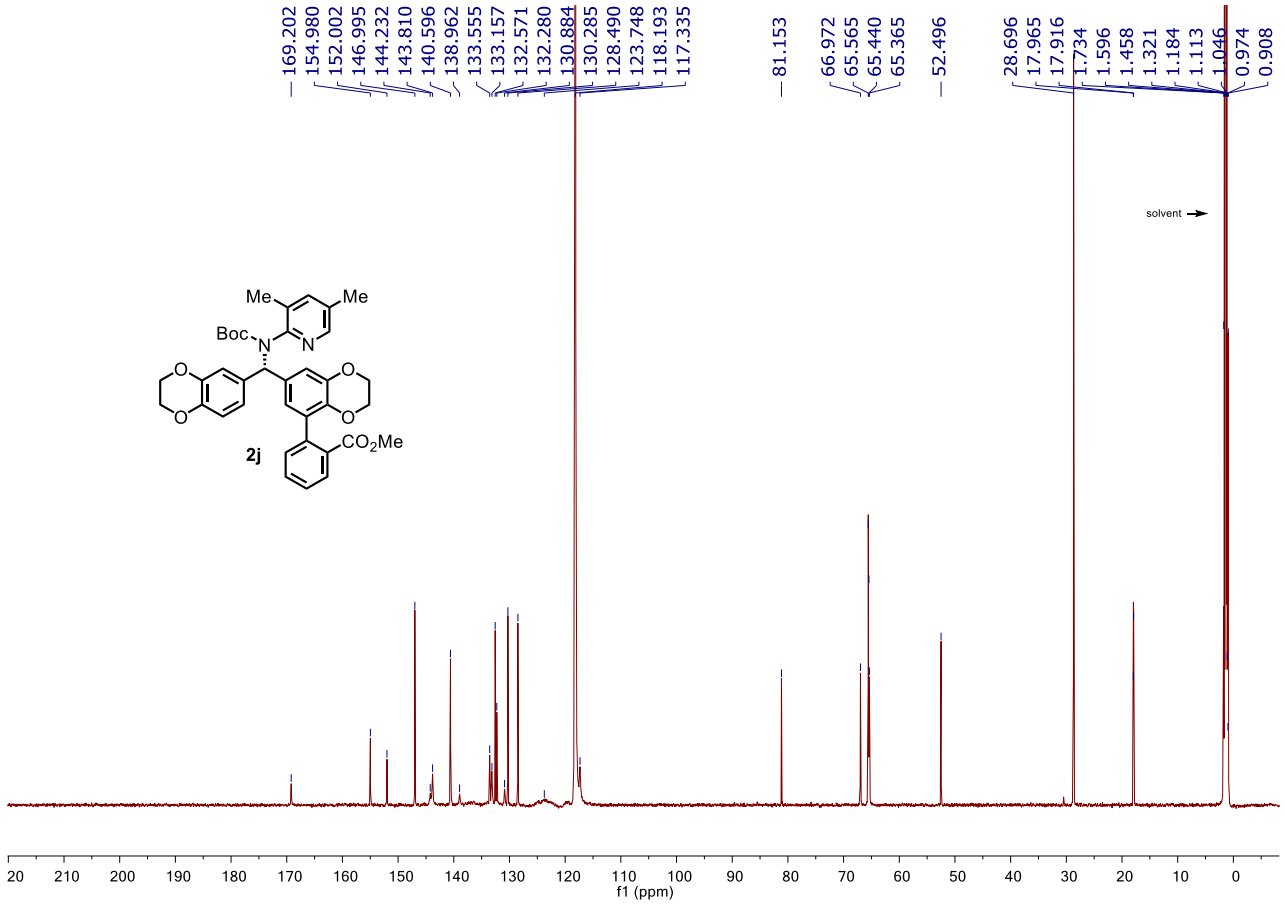
1.04
1.09
7.96
1.05
8.24
2.96
3.08
3.07
9.35
f1 (ppm)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130.285
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123.748
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117.335
81.153
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65.565
65.440
65.365
52.496
28.696
17.965
17.916
1.734
1.596
1.458
1.321
1.184
1.113
1.046
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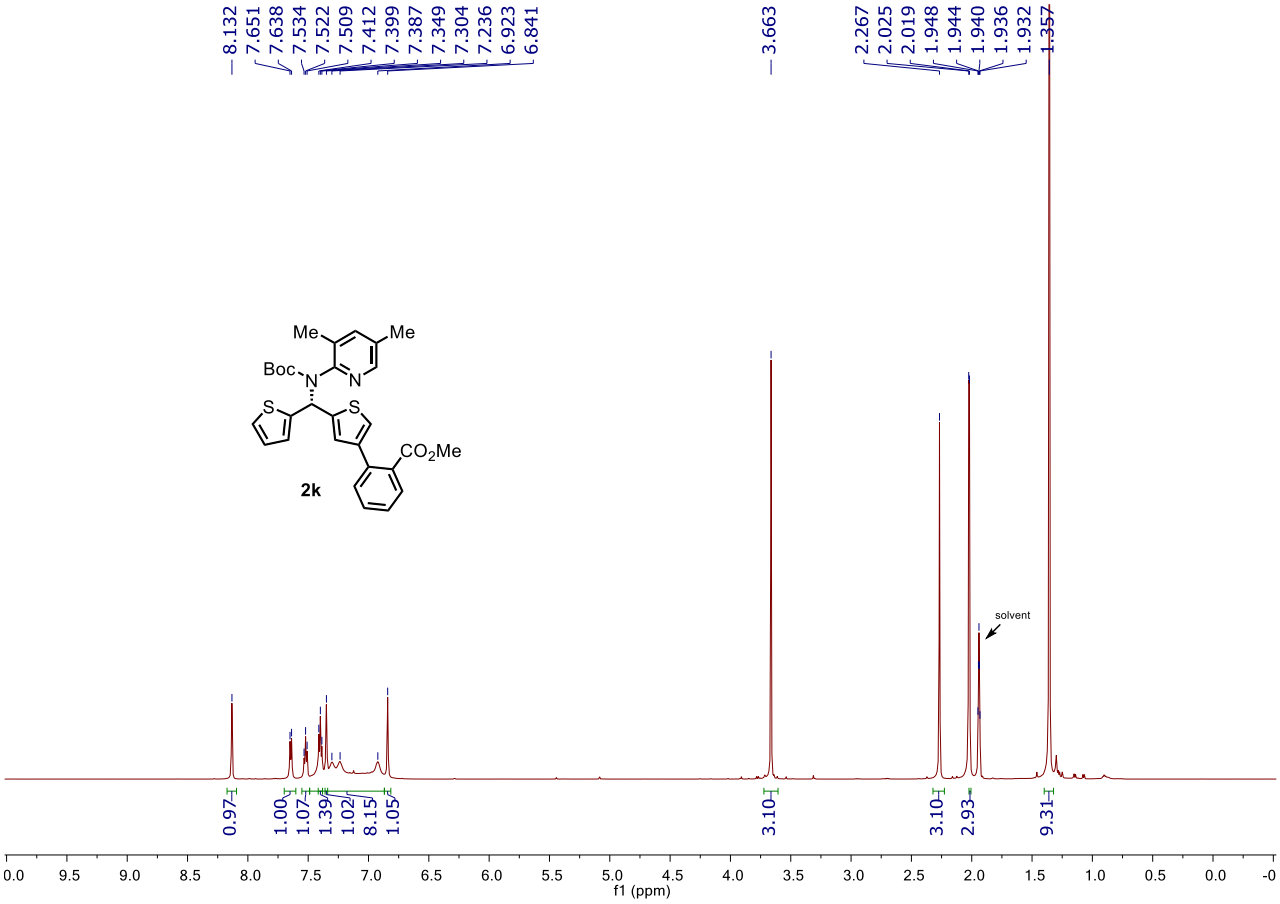
0.908
solvent
Me
Me
Boc
N
N
O
O
O
O
CO2Me
2j
f1 (ppm)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7.412
7.399
7.387
7.349
7.304
7.236
6.923
6.841
3.663
2.267
2.025
2.019
1.948
1.944
1.940
1.936
1.932
1.357
Me
Me
Boc
N
N
S
S
CO2Me
2k
solvent
0.97
1.00
1.07
1.39
1.02
8.15
1.05
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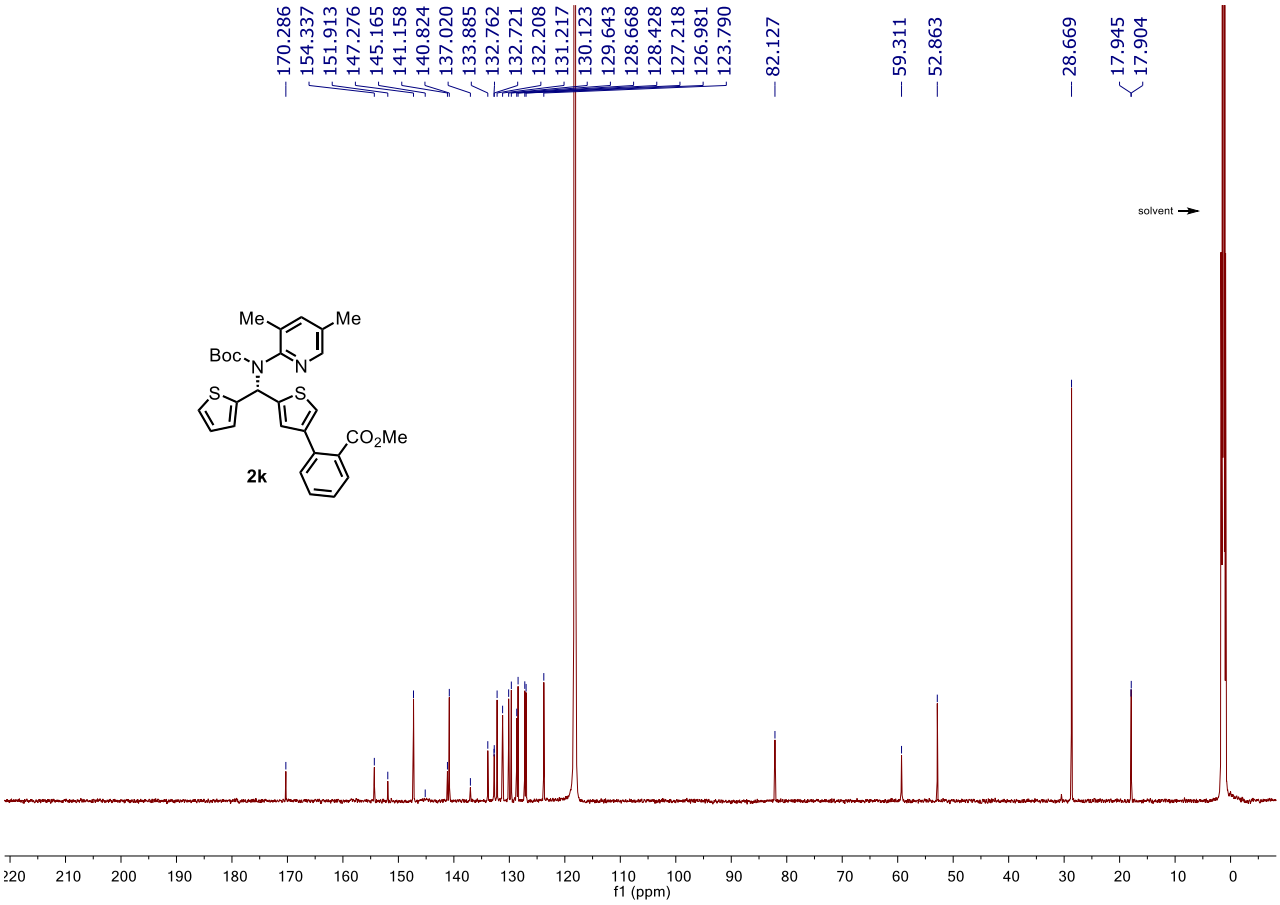
3.10
2.93
9.31
f1 (ppm)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137.020
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132.208
131.217
130.123
129.643
128.668
128.428
127.218
126.981
123.790
82.127
59.311
52.863
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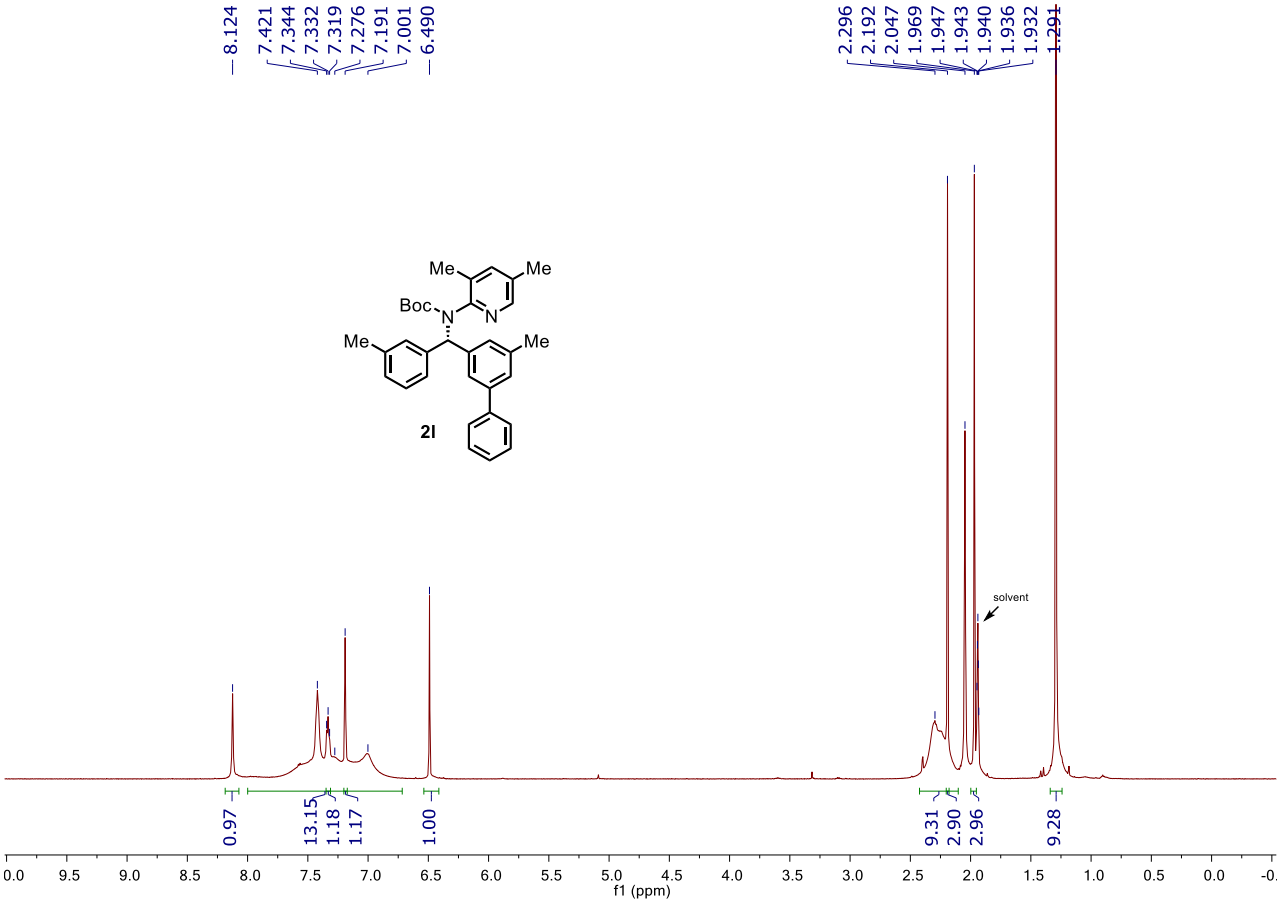
17.904
solvent
Me
Me
Boc
N
N
S
S
CO2Me
2k
f1 (ppm)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7.001
6.490
2.296
2.192
2.047
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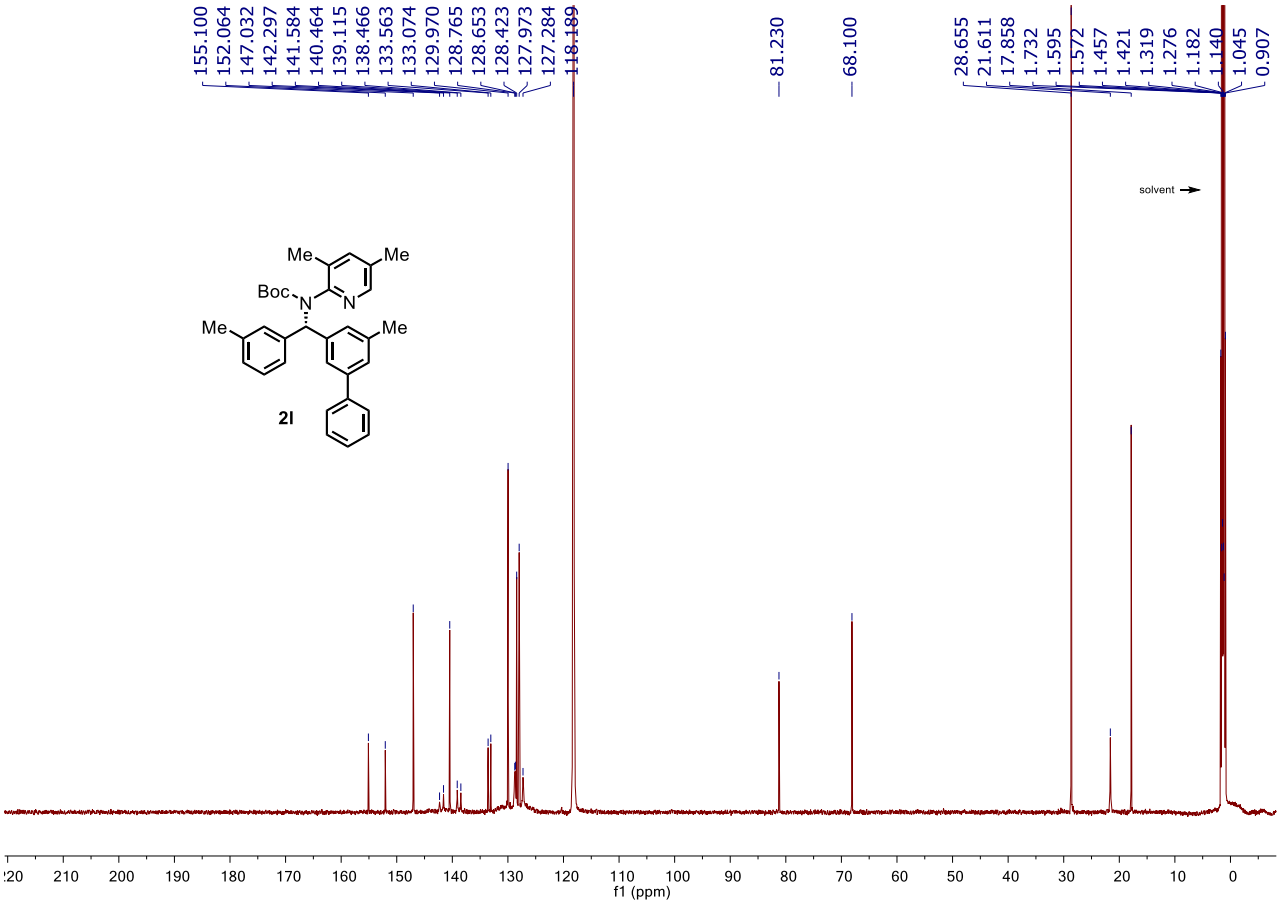
1.947
1.943
1.940
1.936
1.932
1.291
Me
Me
Boc
N
N
Me
Me
2l
solvent
0.97
13.15
1.18
1.17
1.00
9.31
2.90
2.96
9.28
f1 (ppm)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128.423
127.973
127.284
118.189
81.230
68.100
28.655
21.611
17.858
1.732
1.595
1.572
1.457
1.421
1.319
1.276
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1.045
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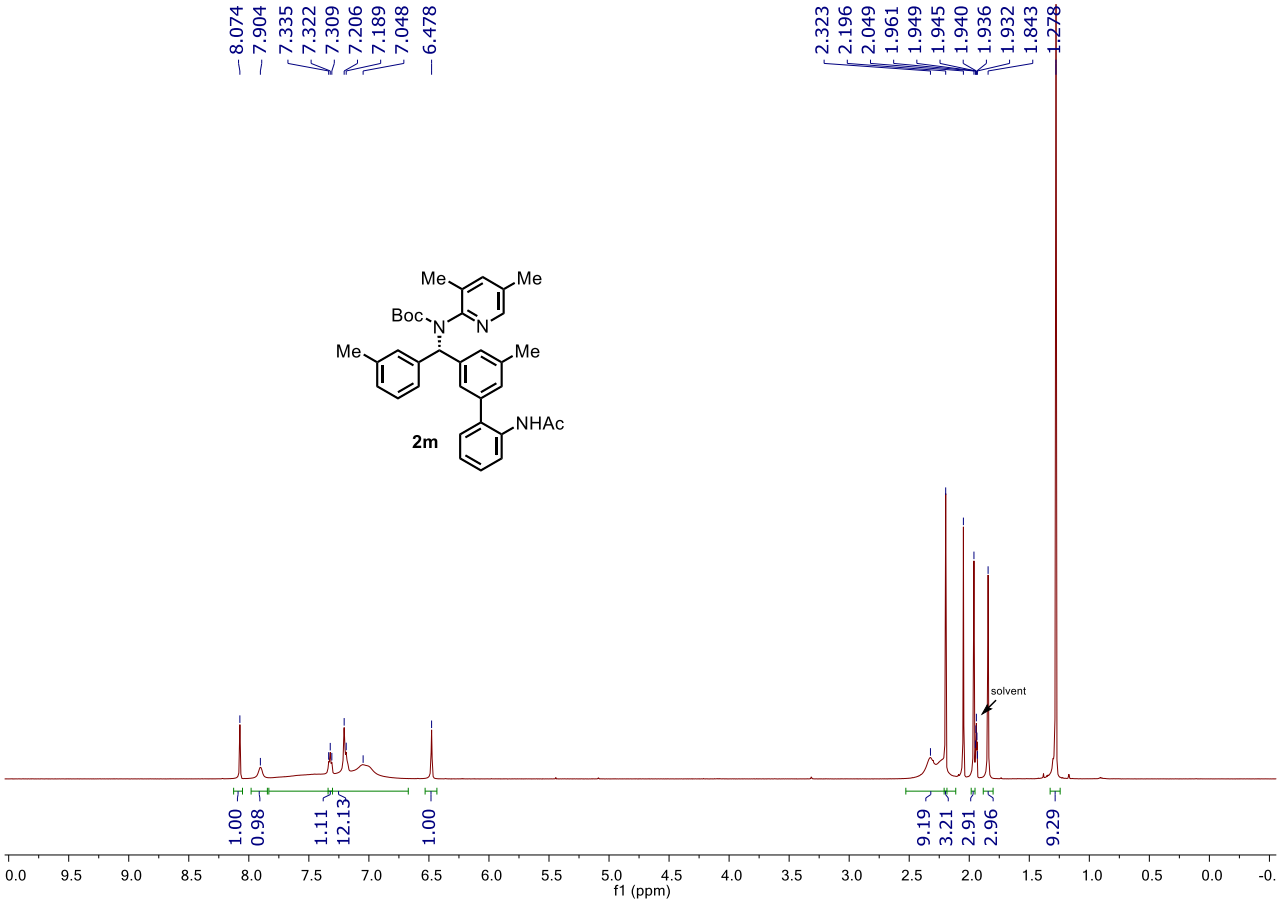
solvent
Me
Me
Boc
N
N
Me
Me
2l
f1 (ppm)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1.961
1.949
1.945
1.940
1.936
1.932
1.843
1.278
Me
Me
Boc
N
N
Me
Me
NHAc
2m
solvent
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1.00
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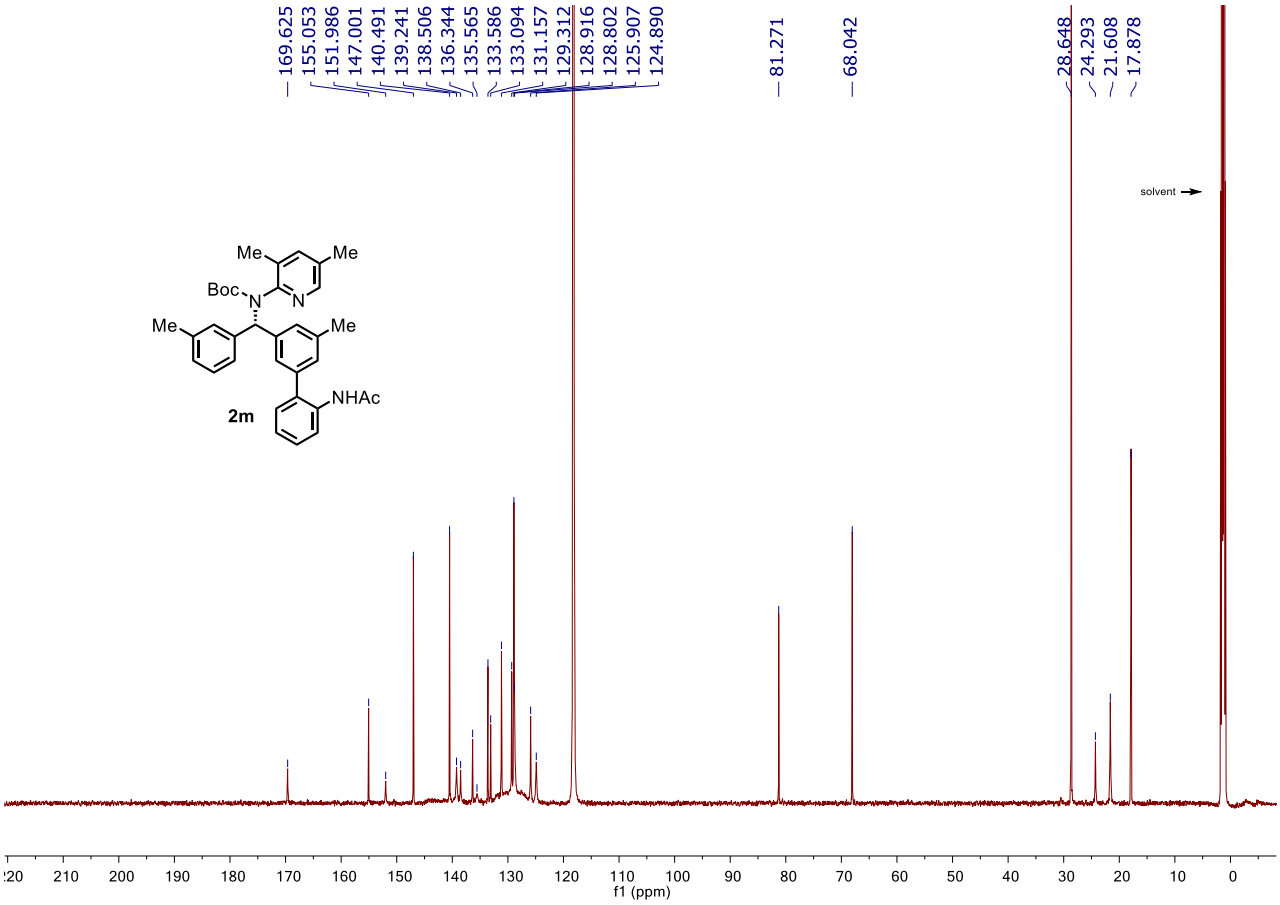
2.91
2.96
9.29
f1 (ppm)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128.802
125.907
124.890
81.271
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Boc
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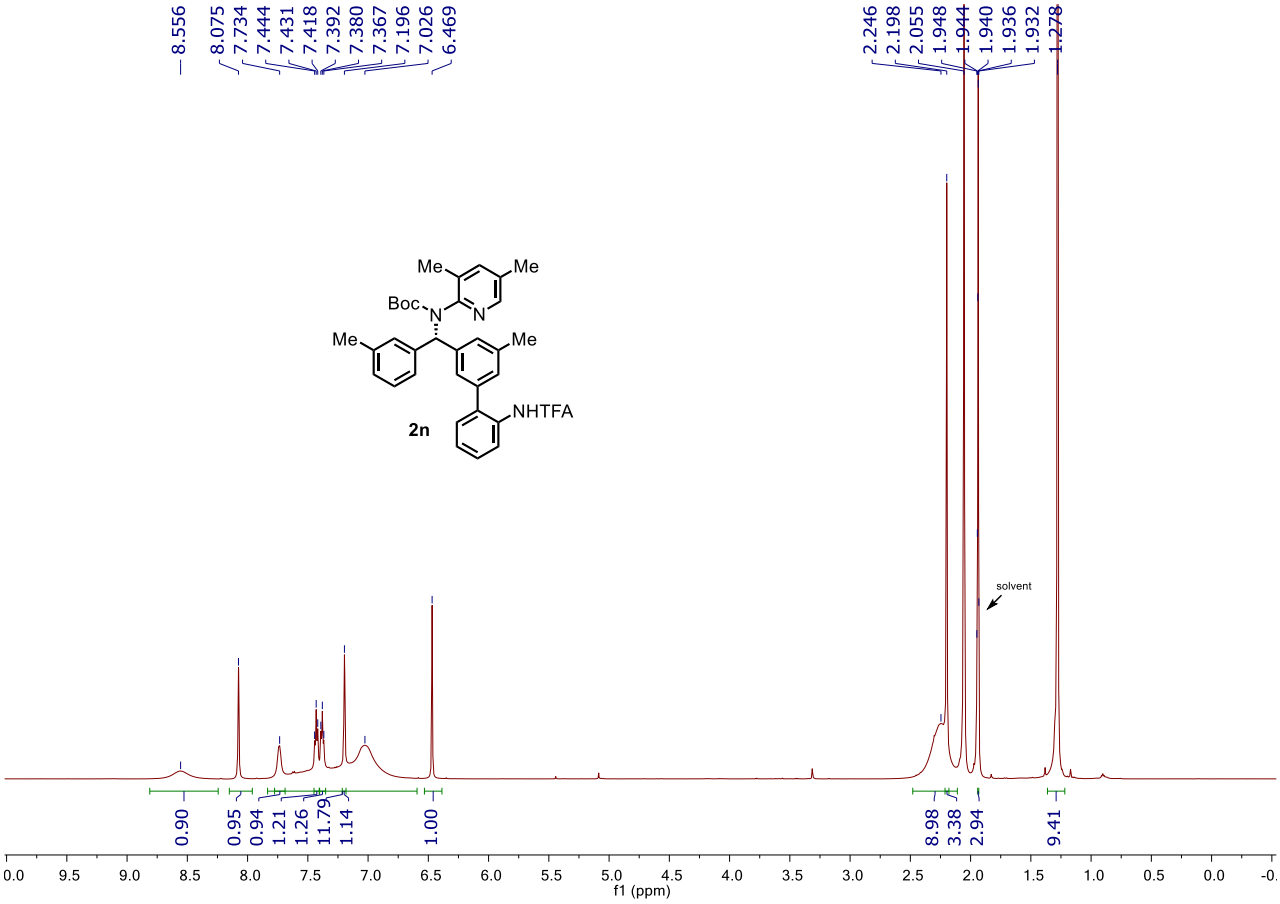
N
Me
Me
NHAc
2m
f1 (ppm)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2.198
2.055
1.948
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1.940
1.936
1.932
1.278
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Me
Boc
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N
Me
Me
NHTFA
2n
solvent
0.90
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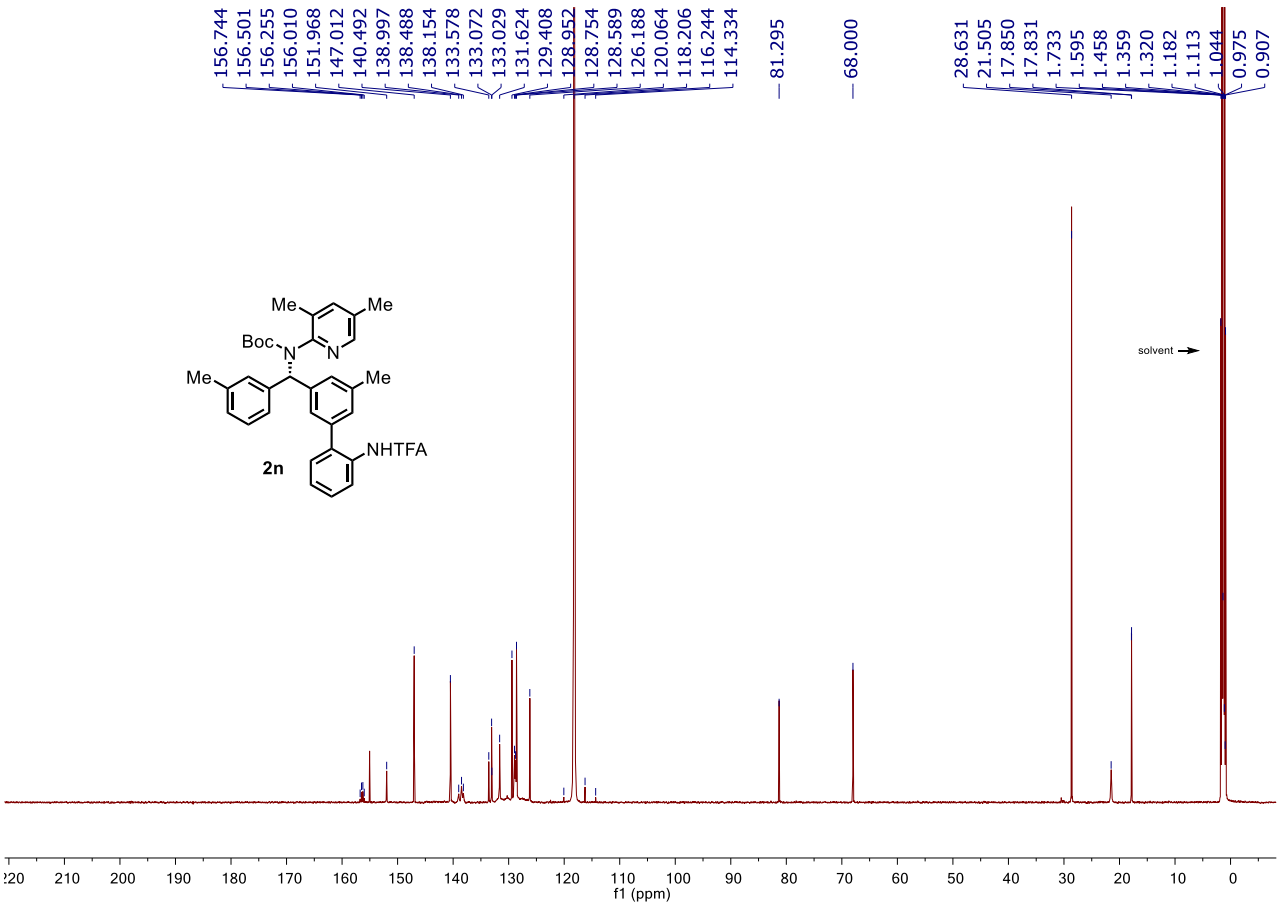
f1 (ppm)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1.595
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1.359
1.320
1.182
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Me
Boc
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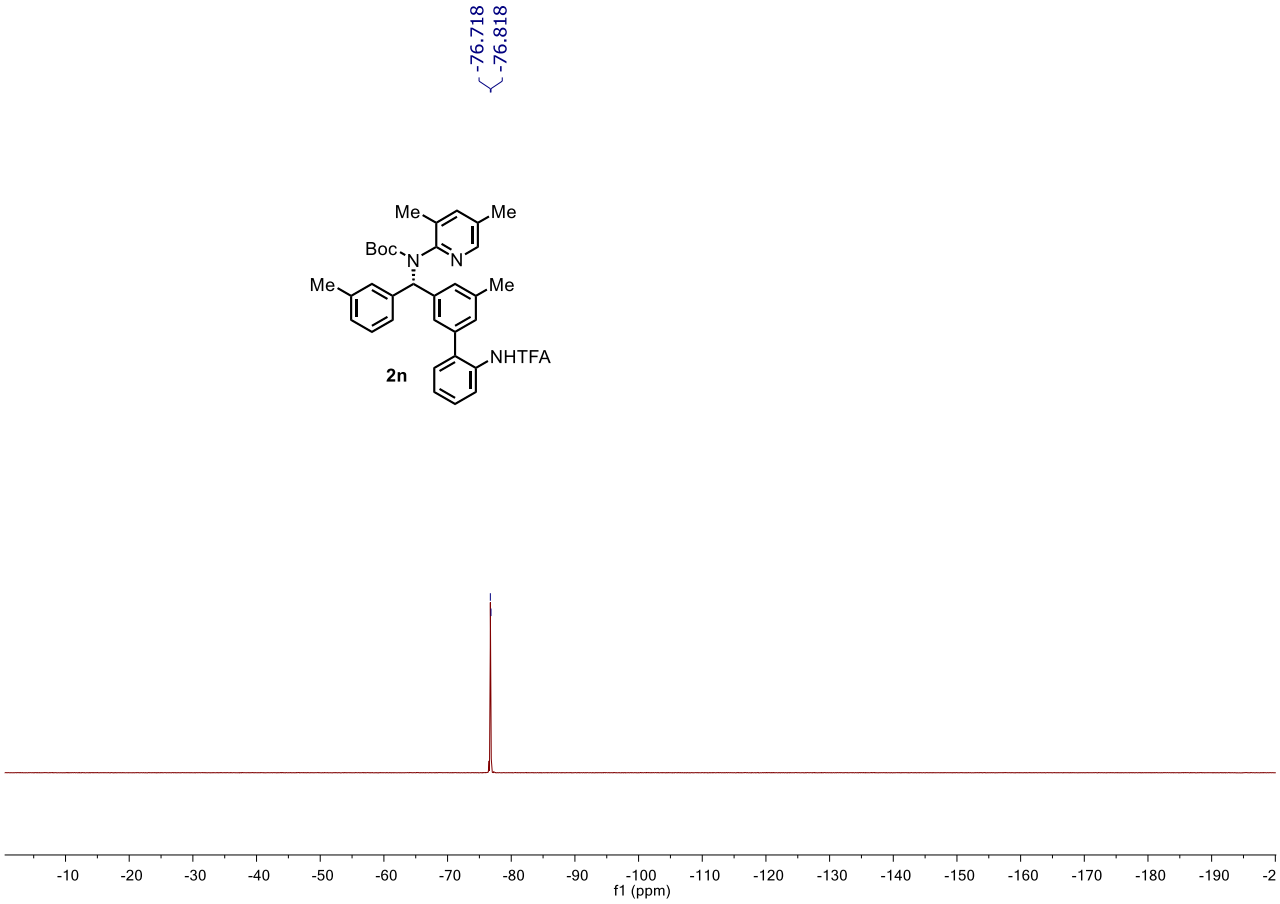
Me
Me
NHTFA
2n
solvent
f1 (ppm)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Me
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N
Me
Me
NHTFA
2n
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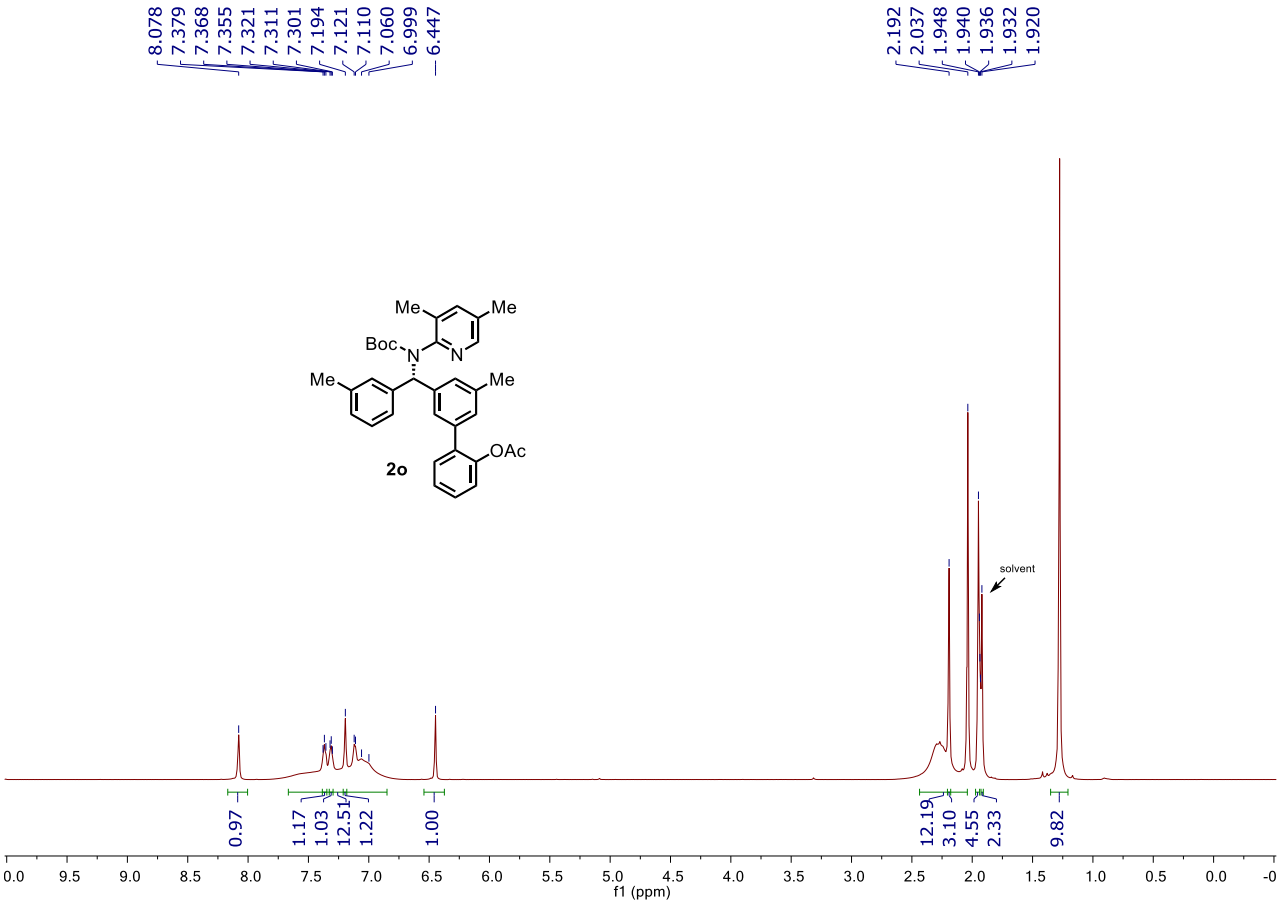
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1.936
1.932
1.920
Me
Me
Boc
N
N
Me
Me
OAc
2o
solvent
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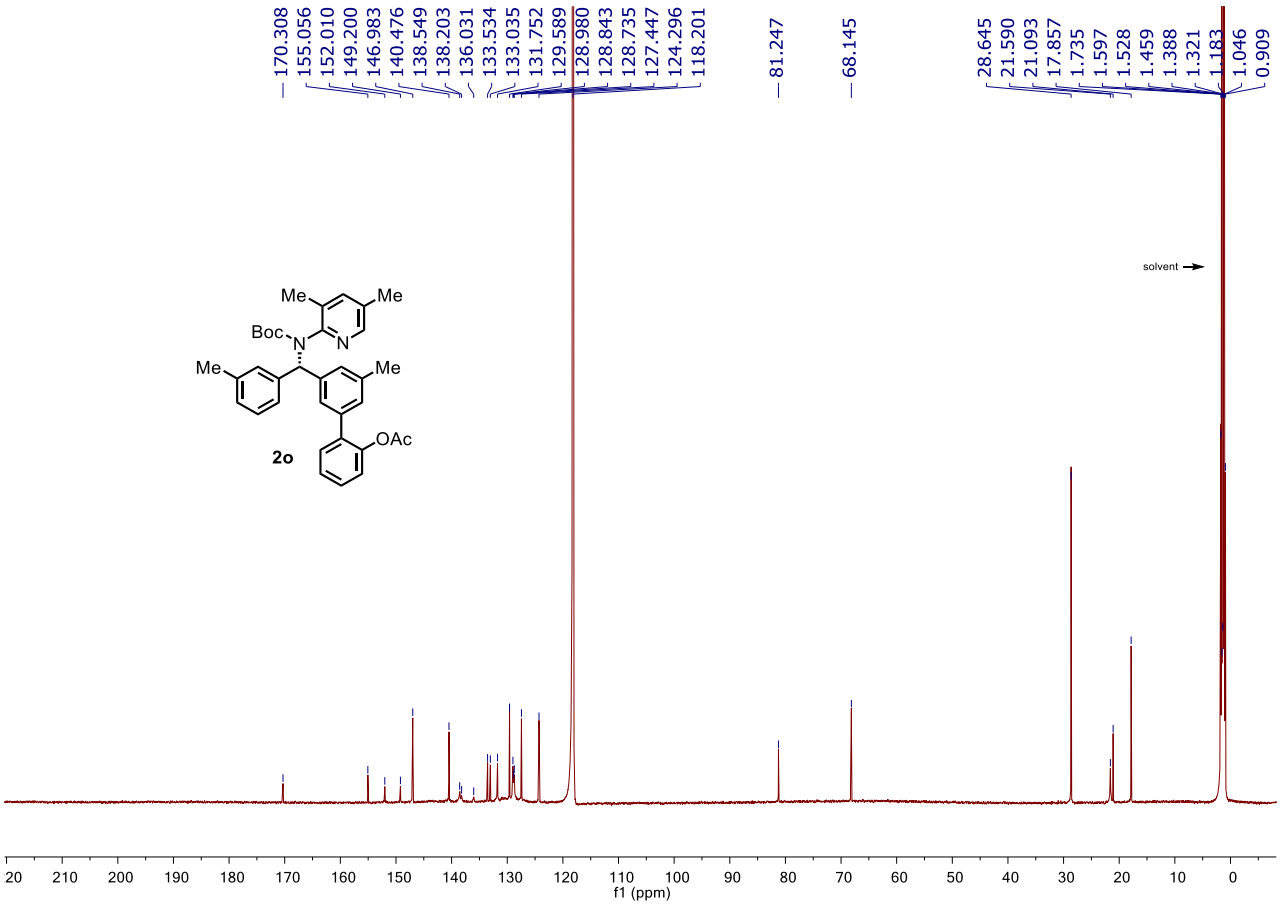
1.00
12.19
3.10
4.55
2.33
9.82
f1 (ppm)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128.980
128.843
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124.296
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68.145
28.645
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21.093
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1.597
1.528
1.459
1.388
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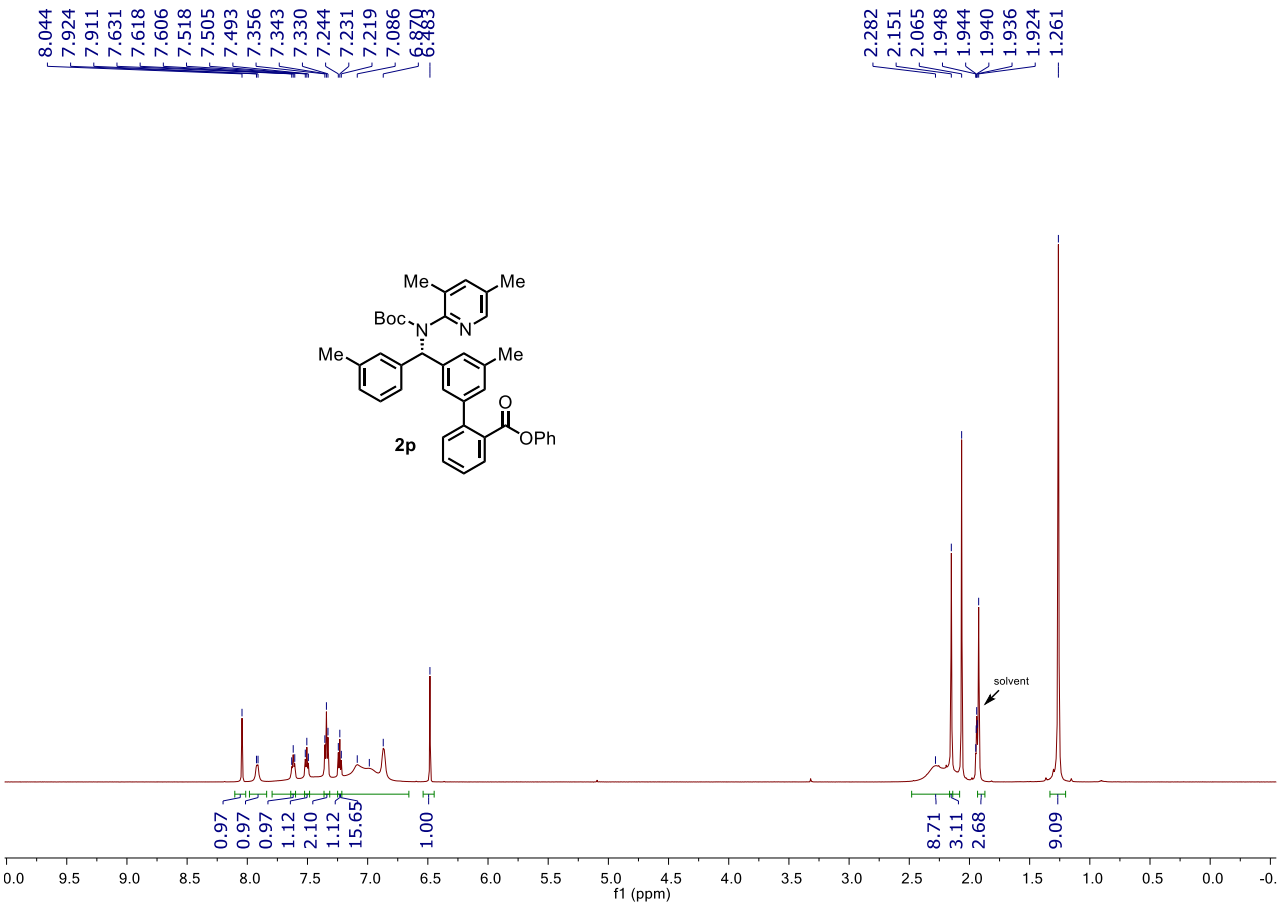
solvent
Me
Me
Boc
N
N
Me
Me
OAc
2o
f1 (ppm)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7.086
6.870
6.483
2.282
2.151
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1.944
1.940
1.936
1.924
1.261
Me
Me
Boc
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N
Me
Me
O
OPh
2p
solvent
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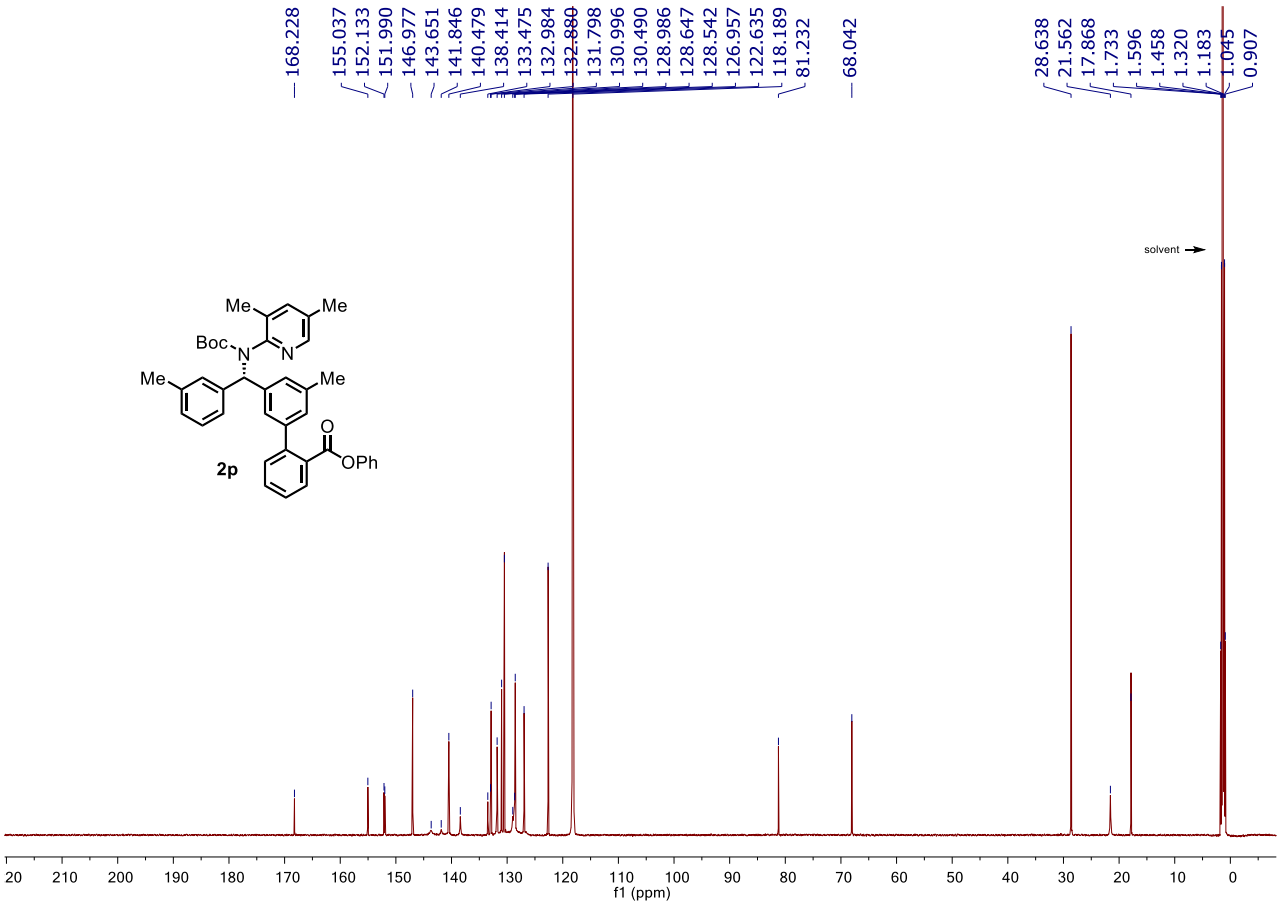
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122.635
118.189
81.232
68.042
28.638
21.562
17.868
1.733
1.596
1.458
1.320
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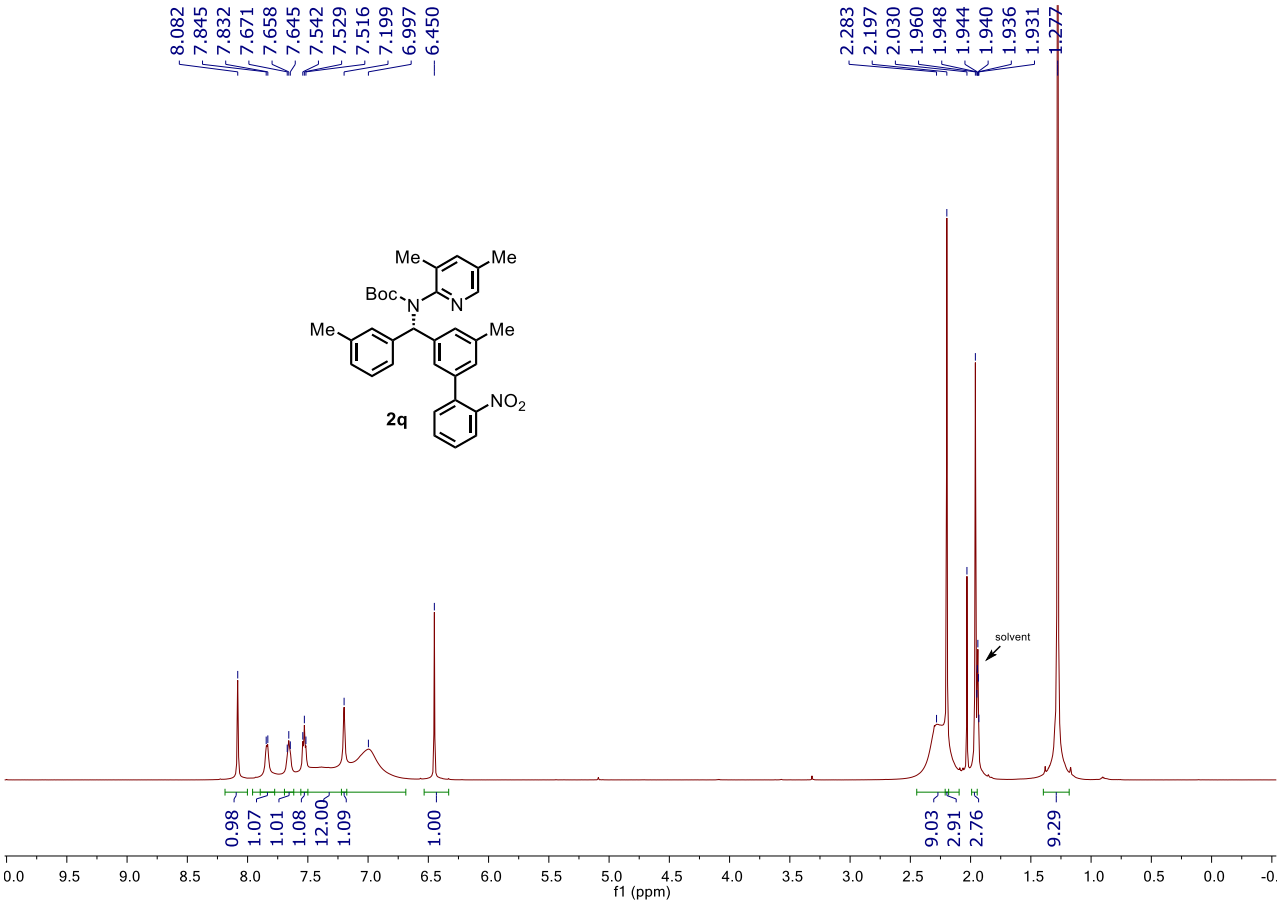
0.907
solvent
Me
Me
Boc
N
N
Me
Me
O
OPh
2p
f1 (ppm)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1.948
1.944
1.940
1.936
1.931
1.277
Me
Me
Boc
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N
Me
Me
NO2
2q
solvent
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1.09
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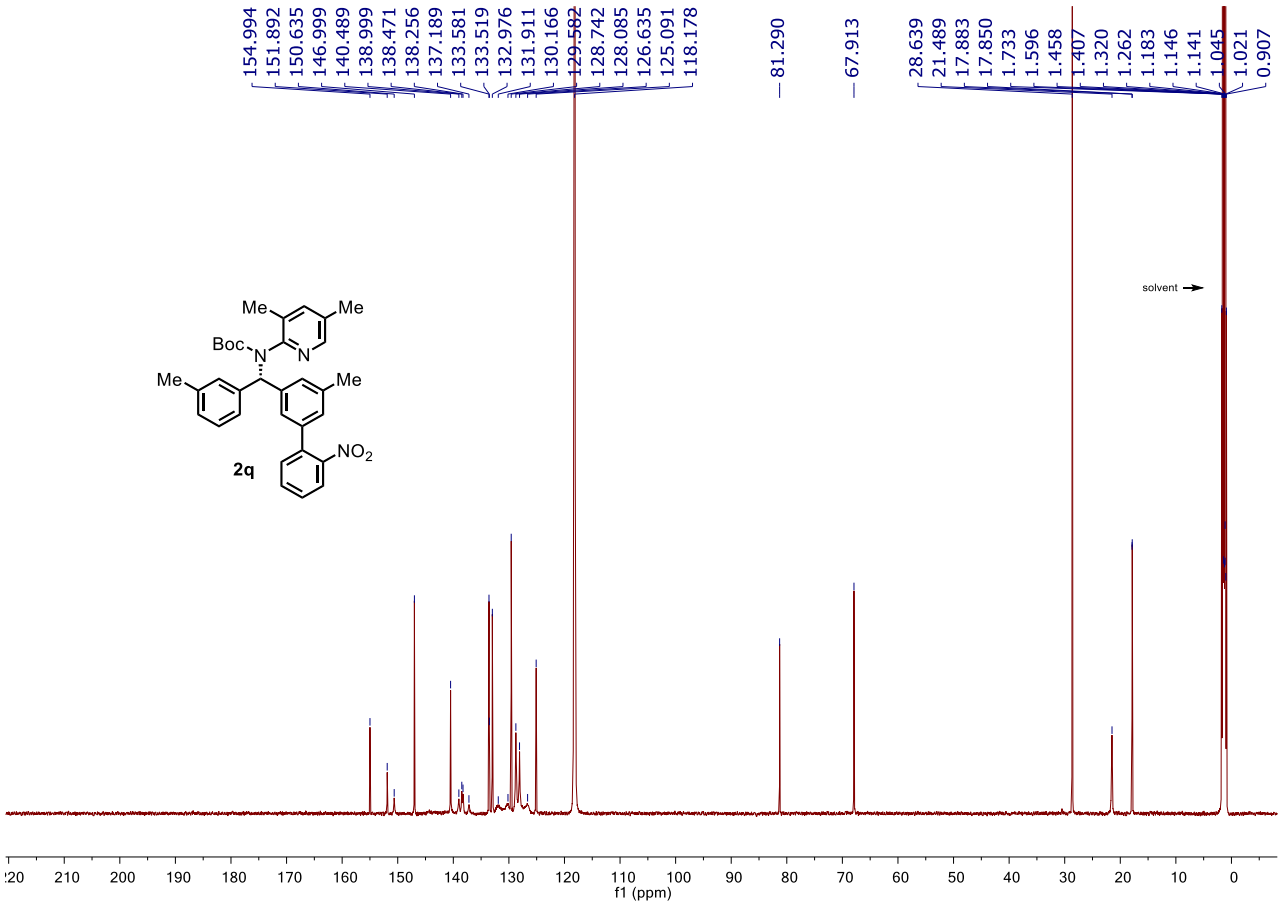
f1 (ppm)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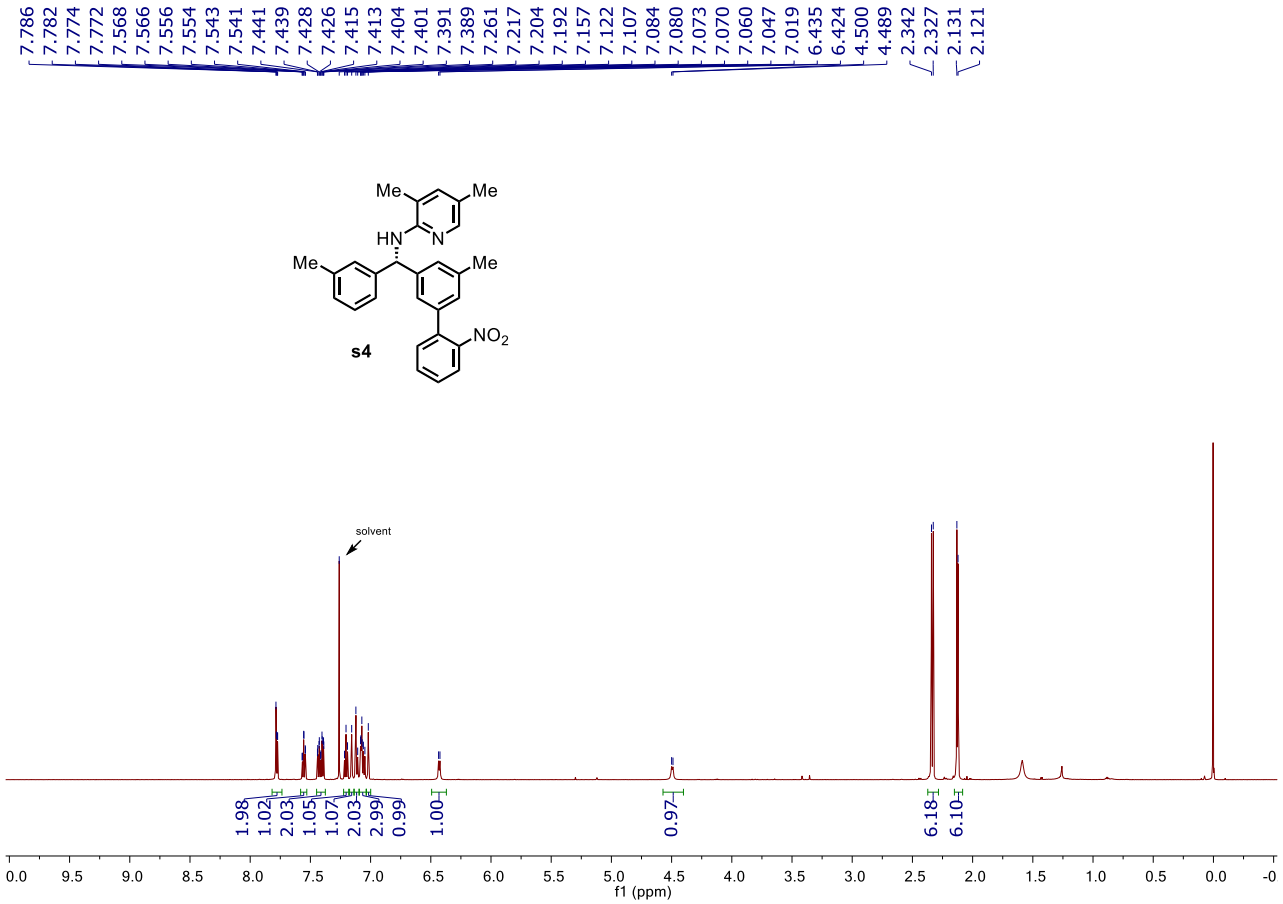
1.146
1.141
1.045
1.021
0.907
solvent
Me
Me
Boc
N
N
Me
Me
NO2
2q
f1 (ppm)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7.554
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7.441
7.439
7.428
7.426
7.415
7.413
7.404
7.401
7.391
7.389
7.261
7.217
7.204
7.192
7.157
7.122
7.107
7.084
7.080
7.073
7.070
7.060
7.047
7.019
6.435
6.424
4.500
4.489
2.342
2.327
2.131
2.121
Me
Me
HN
N
Me
Me
NO2
s4
solvent
1.98
1.02
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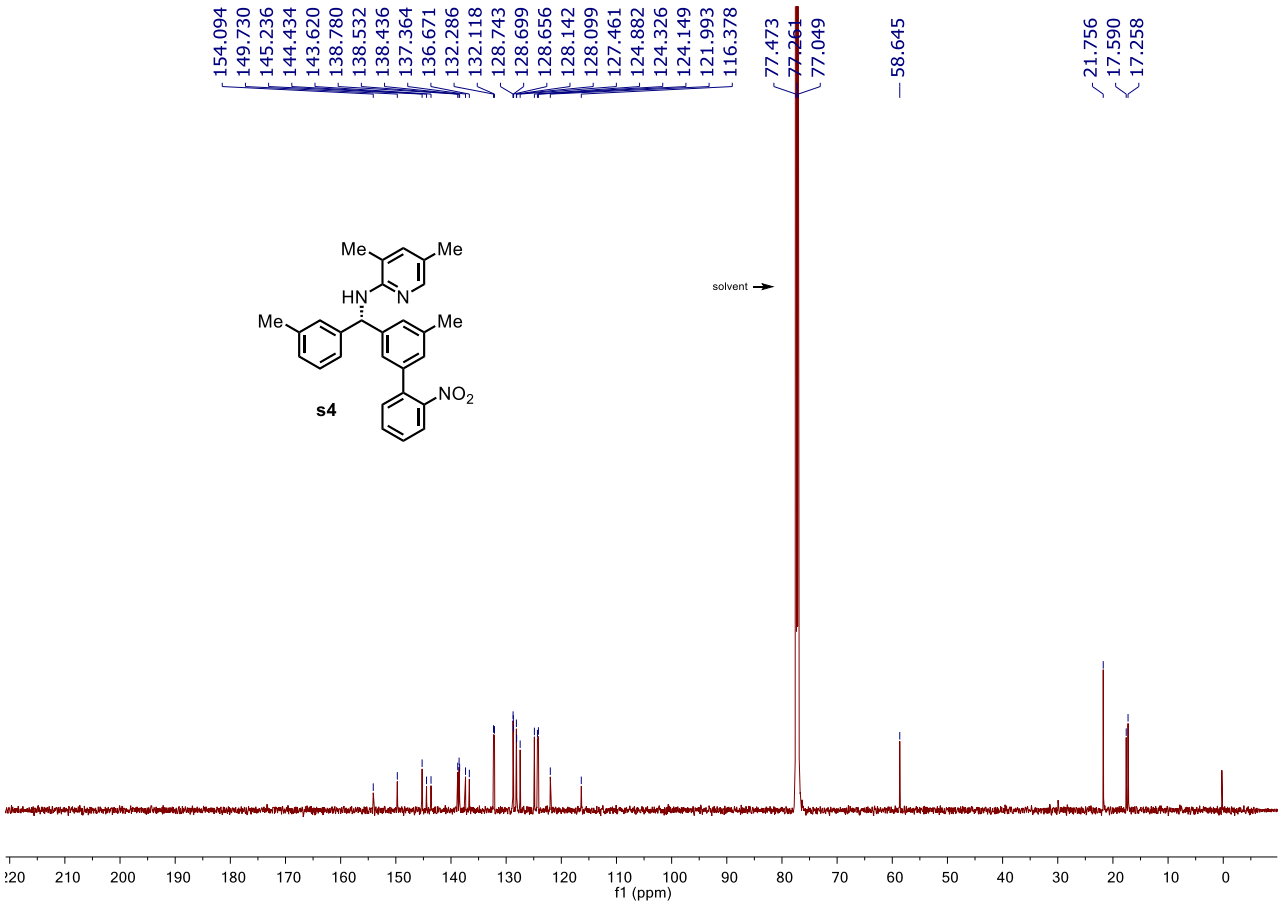
1.05
1.07
2.03
2.99
0.99
1.00
0.97
6.18
6.10
f1 (ppm)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138.436
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128.699
128.656
128.142
128.099
127.461
124.882
124.326
124.149
121.993
116.378
77.473
77.261
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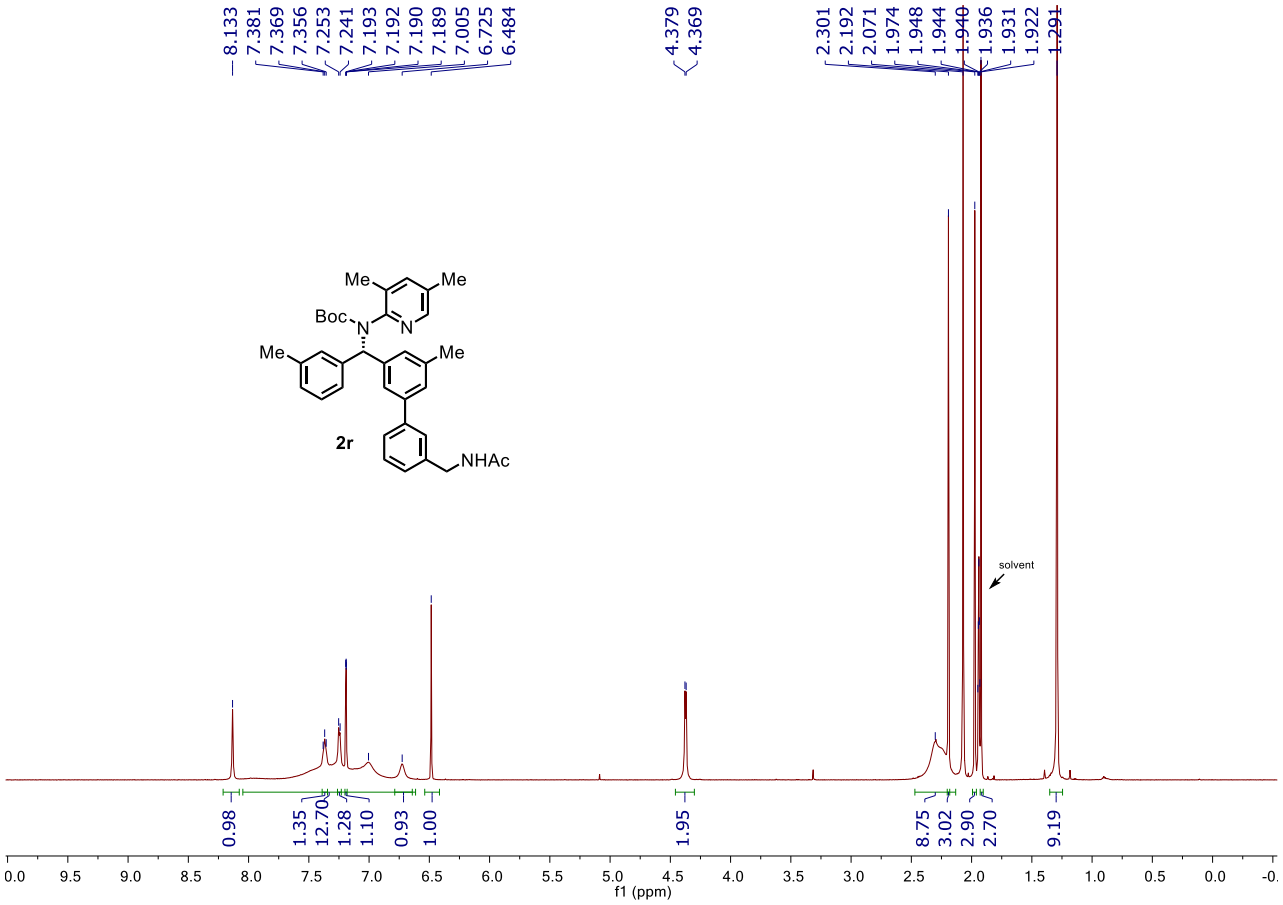
17.258
Me
Me
HN
N
Me
Me
NO2
s4
solvent
f1 (ppm)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7.190
7.189
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6.484
4.379
4.369
2.301
2.192
2.071
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1.948
1.944
1.940
1.936
1.931
1.922
1.291
Me
Me
Boc
N
N
Me
Me
2r
NHAc
solvent
0.98
1.35
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0.93
1.00
1.95
8.75
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2.90
2.70
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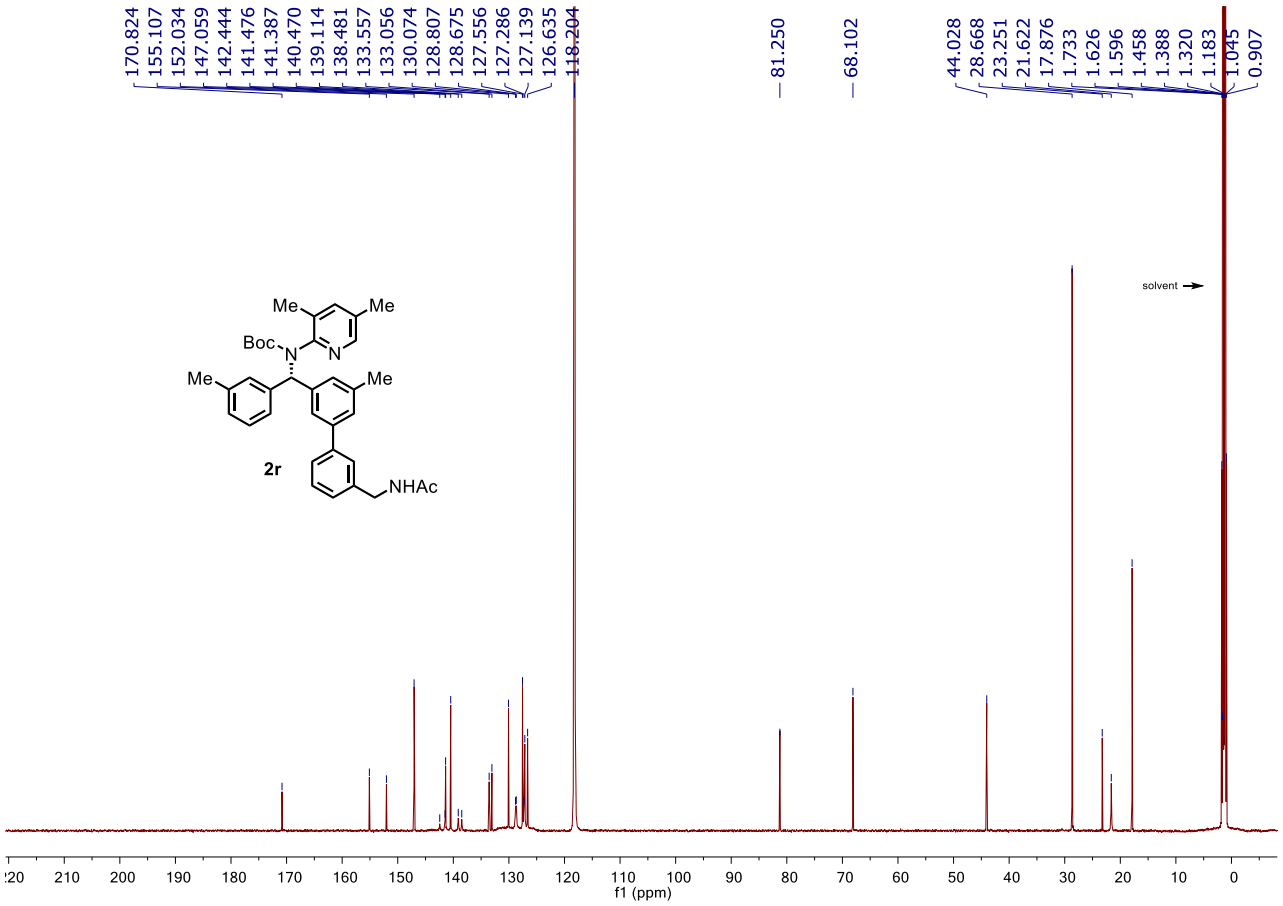
f1 (ppm)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130.074
128.807
128.675
127.556
127.286
127.139
126.635
118.204
81.250
68.102
44.028
28.668
23.251
21.622
17.876
1.733
1.626
1.596
1.458
1.388
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1.183
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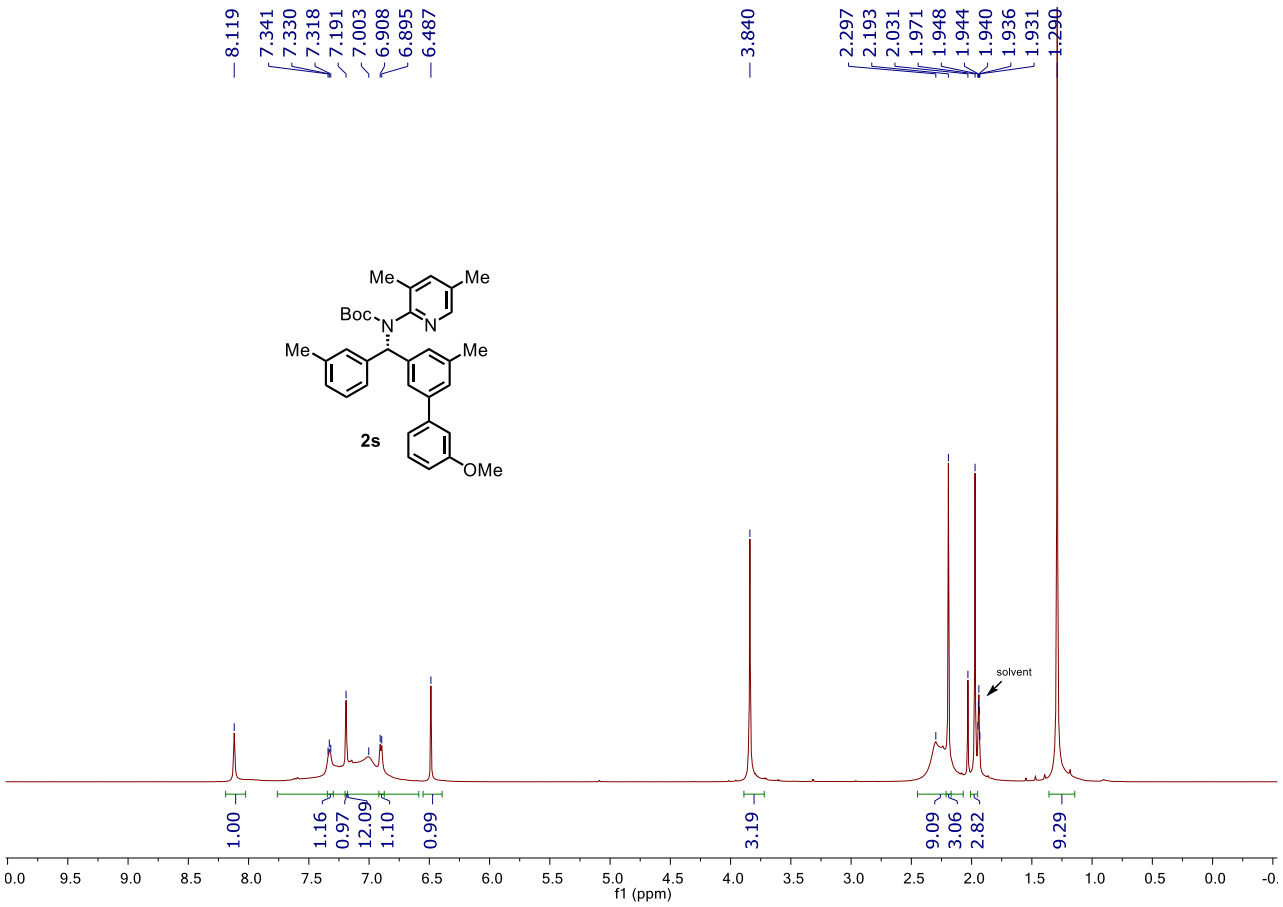
solvent
Me
Me
Boc
N
N
Me
Me
2r
NHAc
f1 (ppm)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7.318
7.191
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6.908
6.895
6.487
3.840
2.297
2.193
2.031
1.971
1.948
1.944
1.940
1.936
1.931
1.290
Me
Me
Boc
N
N
Me
Me
2s
OMe
solvent
1.00
1.16
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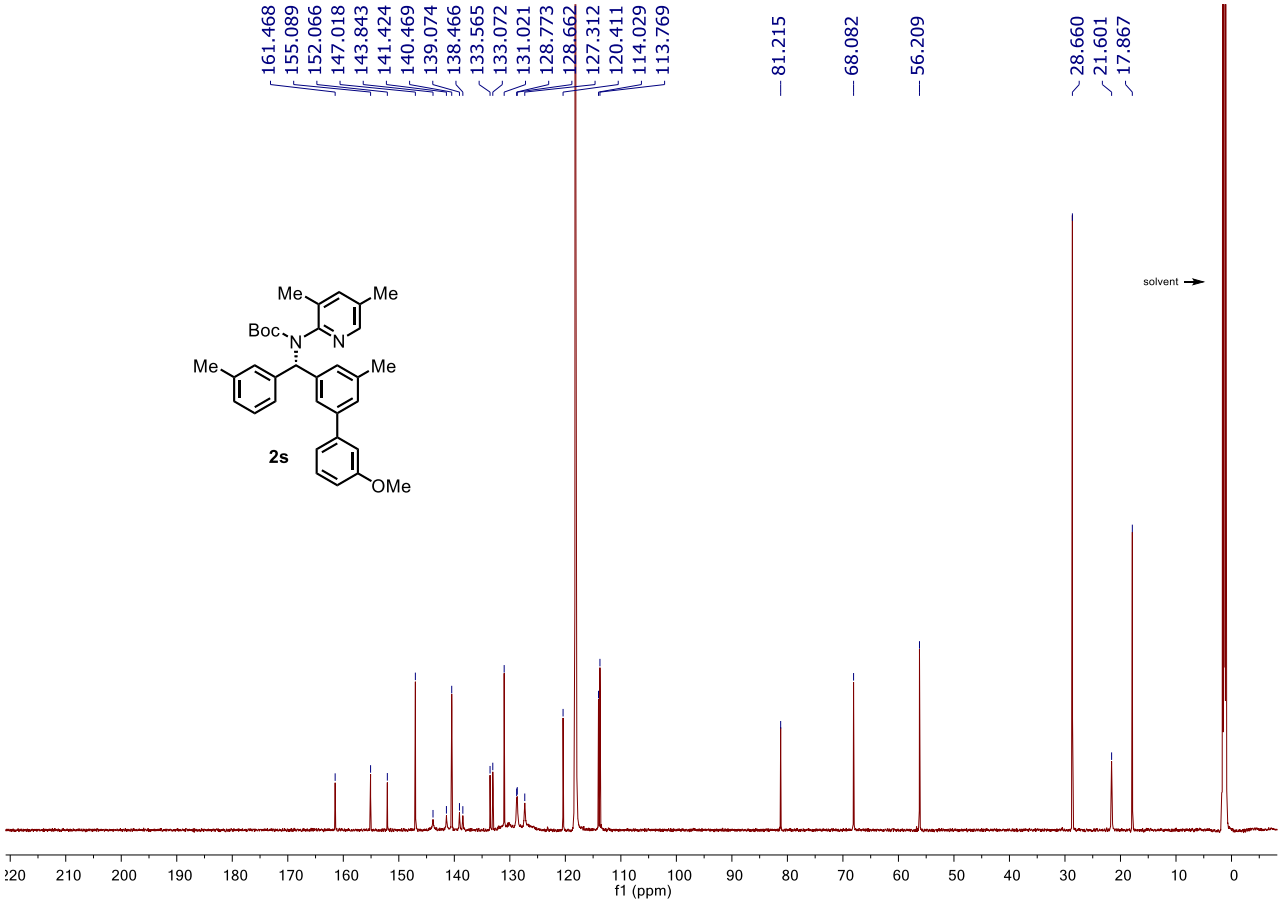
12.09
1.10
0.99
3.19
9.09
3.06
2.82
9.29
f1 (ppm)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140.469
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133.072
131.021
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128.662
127.312
120.411
114.029
113.769
81.215
68.082
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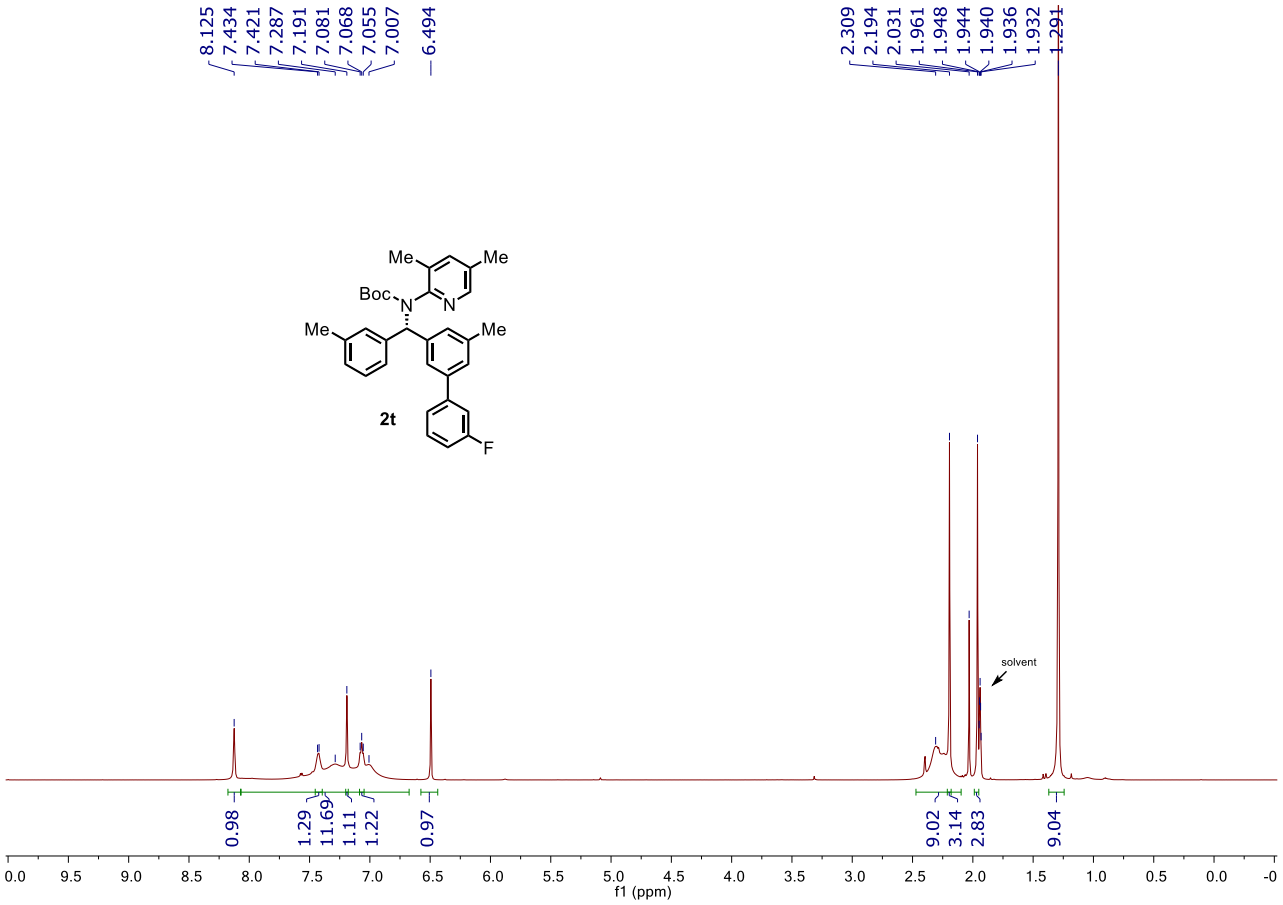
17.867
solvent
Me
Me
Boc
N
N
Me
Me
2s
OMe
f1 (ppm)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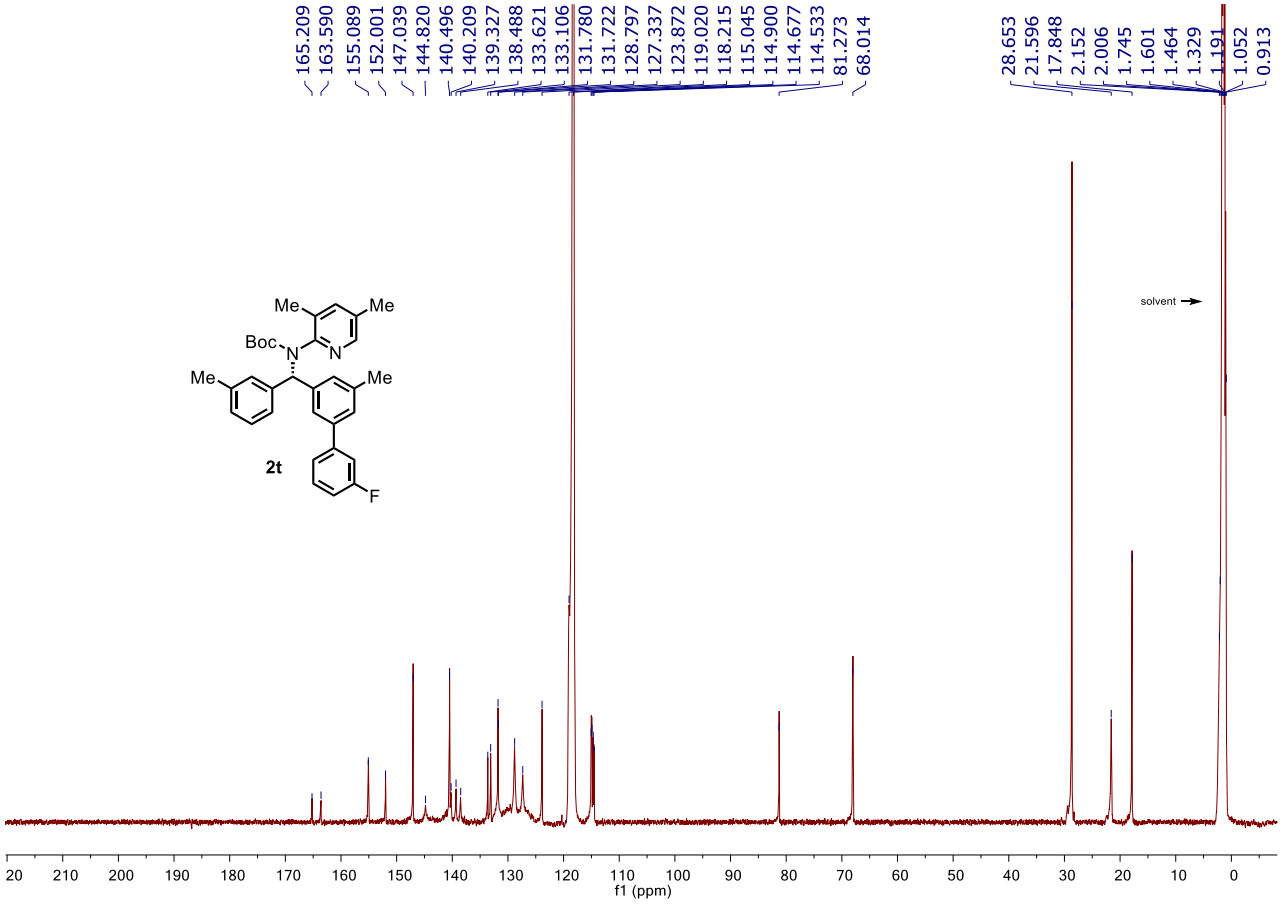
7.434
7.421
7.287
7.191
7.081
7.068
7.055
7.007
6.494
2.309
2.194
2.031
1.961
1.948
1.944
1.940
1.936
1.932
1.291
Me
Me
Boc
N
N
Me
Me
2t
F
solvent
0.98
1.29
11.69
1.11
1.22
0.97
9.02
3.14
2.83
9.04
f1 (ppm)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144.820
140.496
140.209
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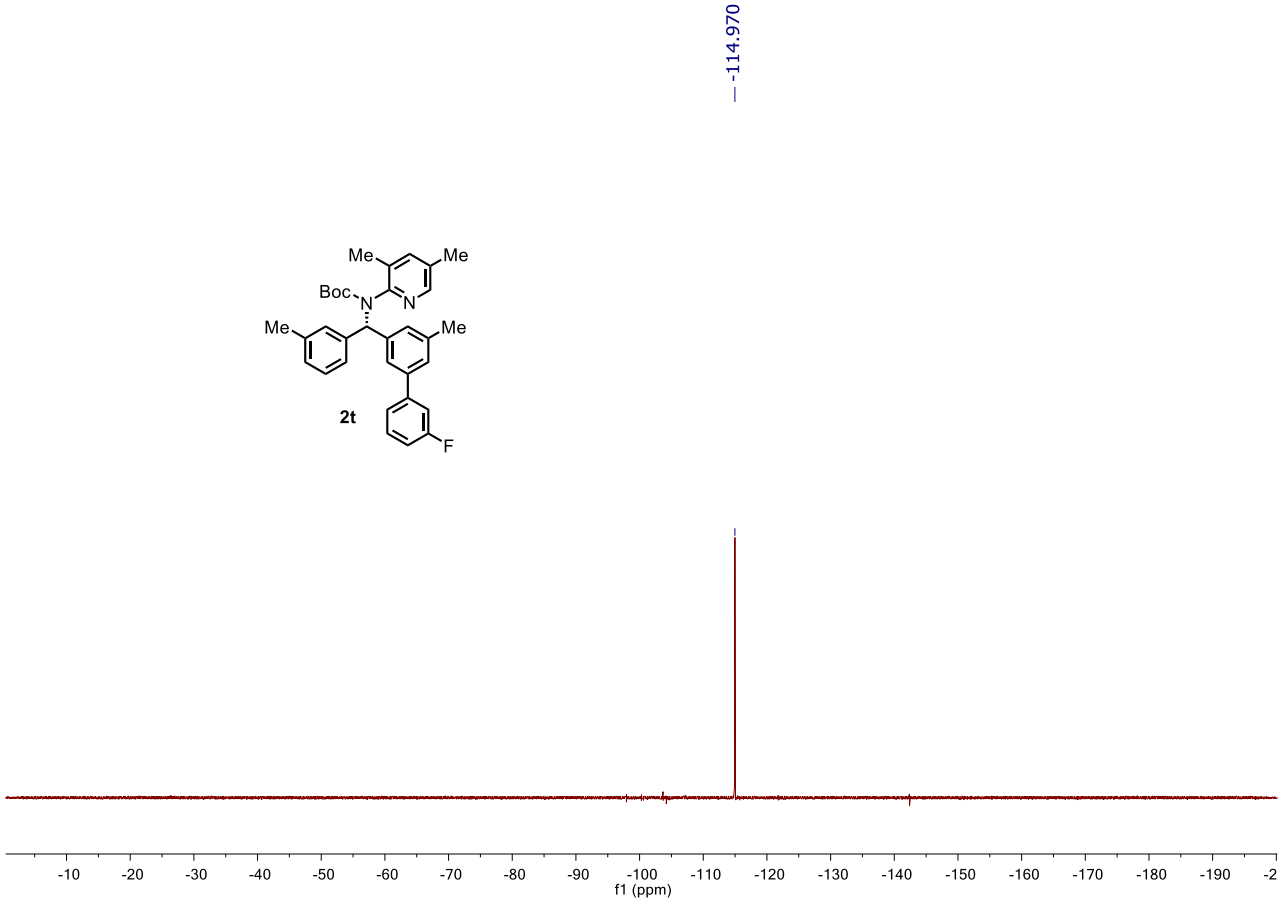
138.488
133.621
133.106
131.780
131.722
128.797
127.337
123.872
119.020
118.215
115.045
114.900
114.677
114.533
81.273
68.014
28.653
21.596
17.848
2.152
2.006
1.745
1.601
1.464
1.329
1.191
1.052
0.913
solvent
Me
Me
Boc
N
N
Me
Me
2t
F
f1 (ppm)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Boc
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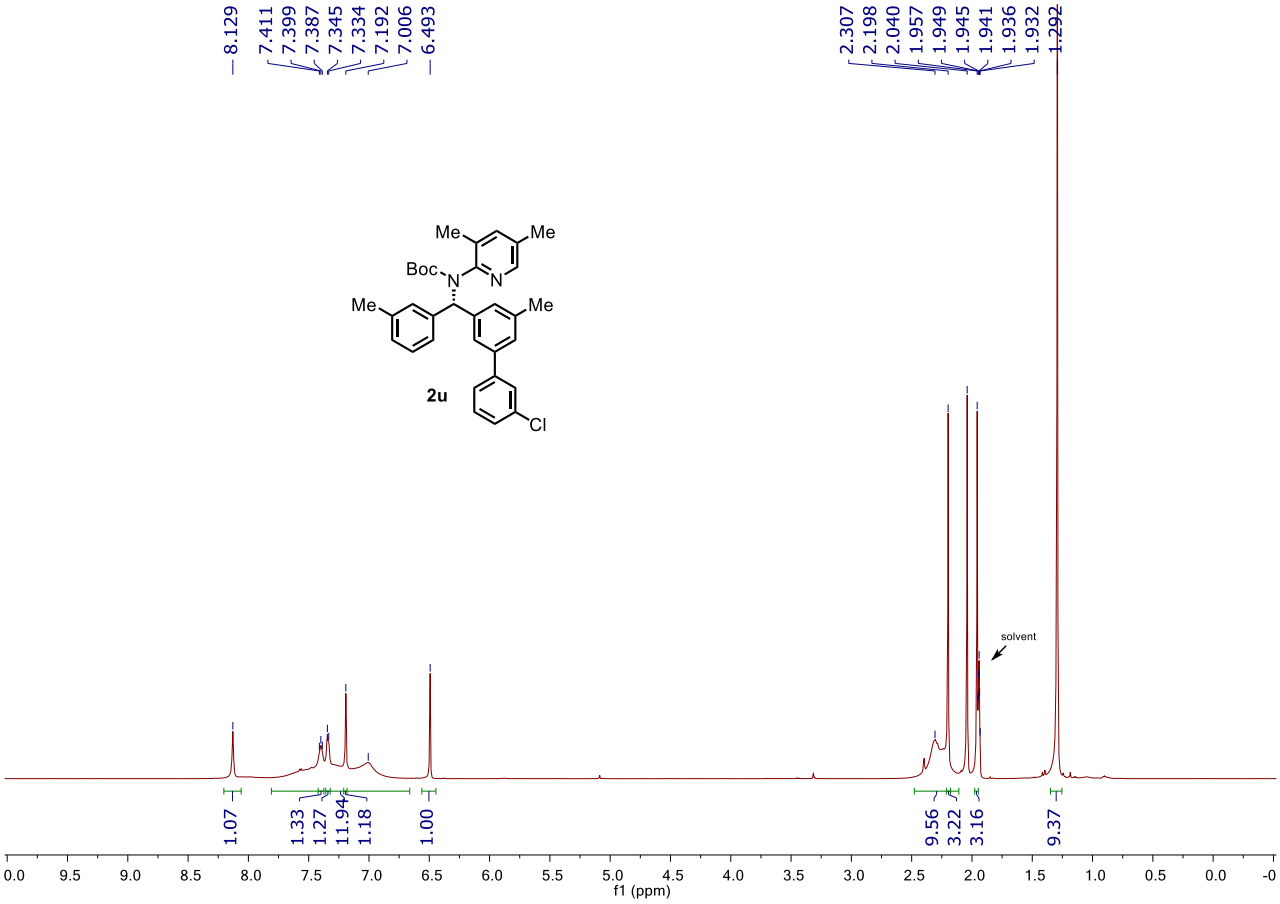
Me
Me
2t
F
f1 (ppm)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7.192
7.006
6.493
2.307
2.198
2.040
1.957
1.949
1.945
1.941
1.936
1.932
1.292
Me
Me
Boc
N
N
Me
Me
2u
Cl
solvent
1.07
1.33
1.27
11.94
1.18
1.00
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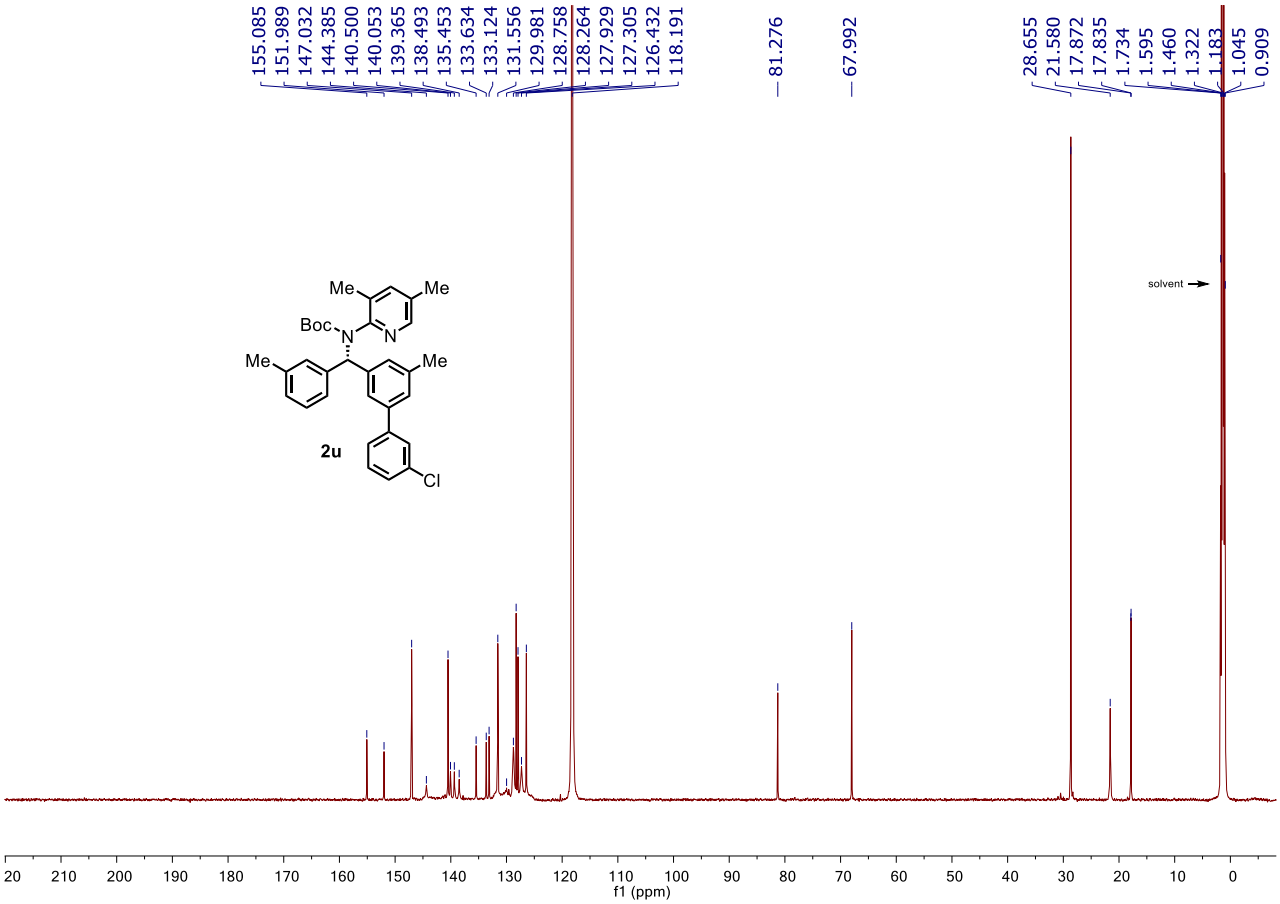
3.22
3.16
9.37
f1 (ppm)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140.053
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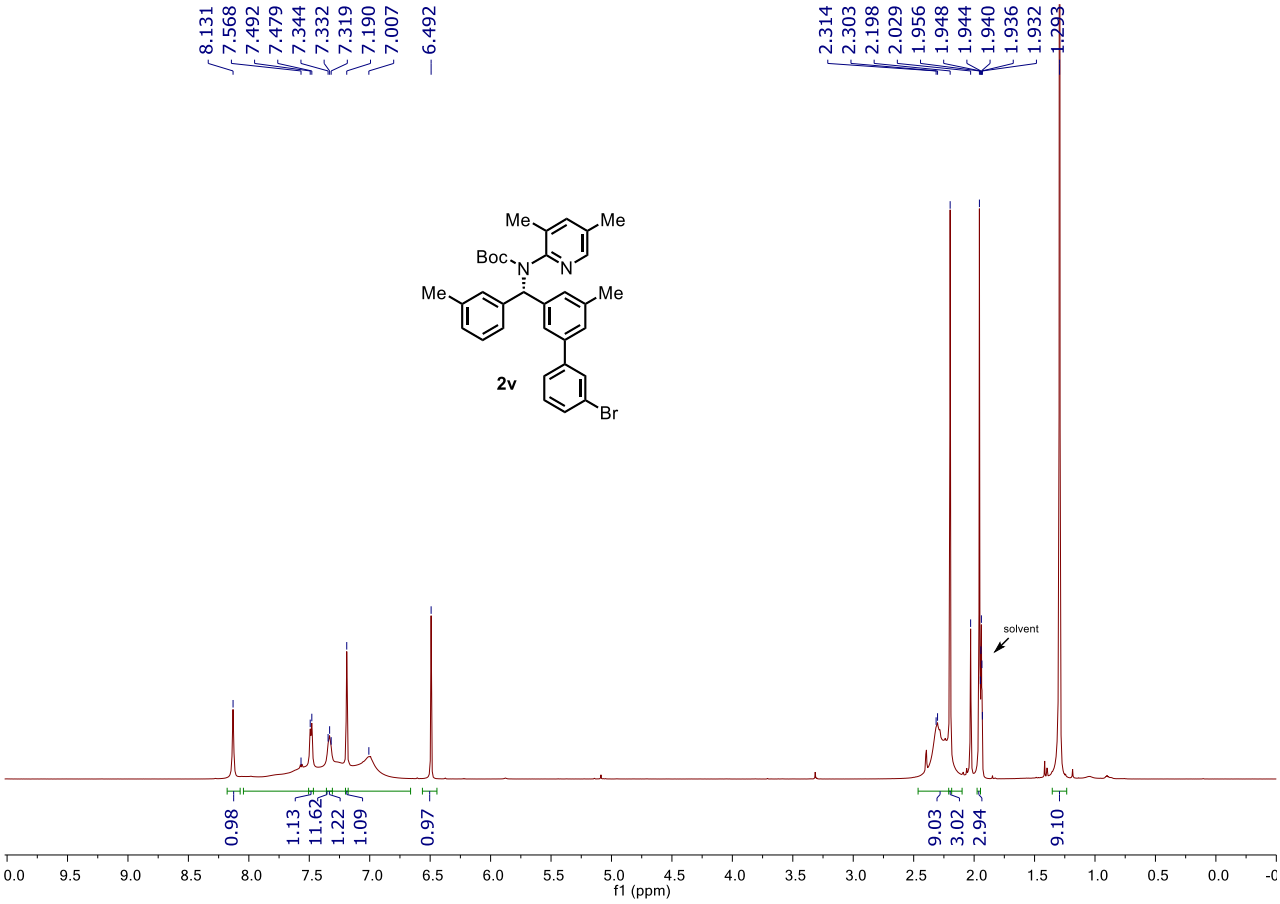
138.493
135.453
133.634
133.124
131.556
129.981
128.758
128.264
127.929
127.305
126.432
118.191
81.276
67.992
28.655
21.580
17.872
17.835
1.734
1.595
1.460
1.322
1.183
1.045
0.909
Me
Me
Boc
N
N
Me
Me
2u
Cl
solvent
f1 (ppm)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7.190
7.007
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2.314
2.303
2.198
2.029
1.956
1.948
1.944
1.940
1.936
1.932
1.293
Me
Me
Boc
N
N
Me
Me
2v
Br
solvent
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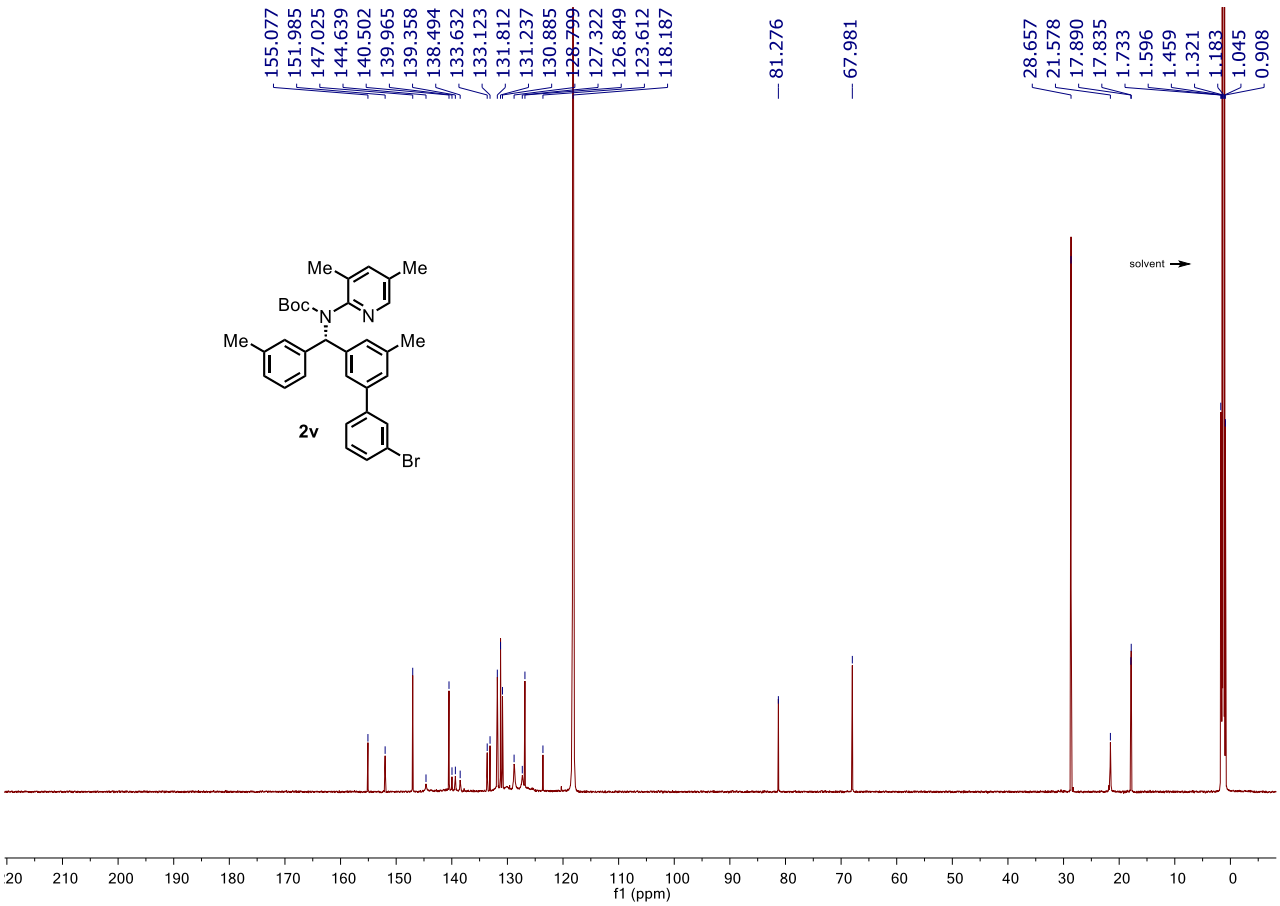
11.62
1.22
1.09
0.97
9.03
3.02
2.94
9.10
f1 (ppm)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127.322
126.849
123.612
118.187
81.276
67.981
28.657
21.578
17.890
17.835
1.733
1.596
1.459
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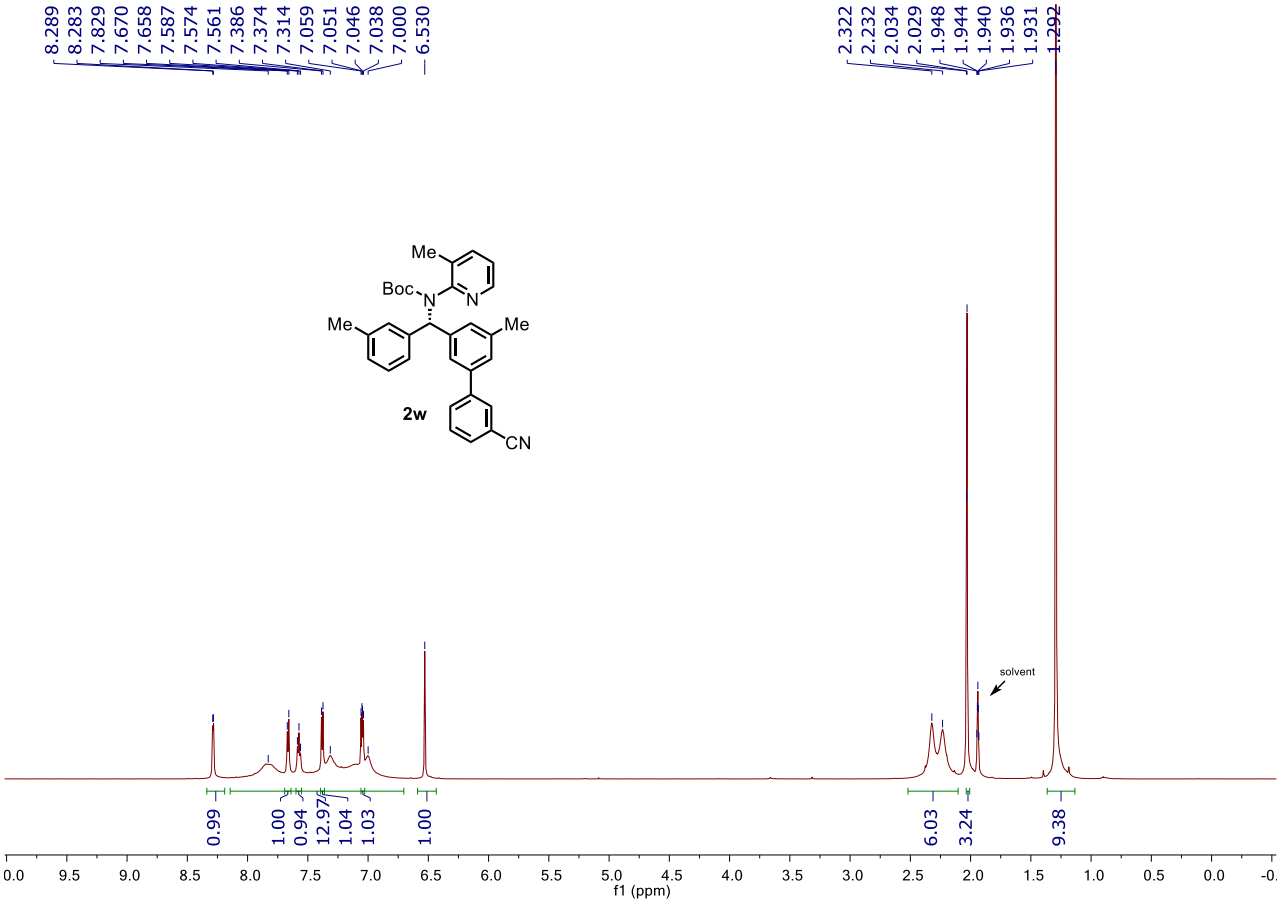
1.183
1.045
0.908
Me
Me
Boc
N
N
Me
Me
2v
Br
solvent
f1 (ppm)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7.051
7.046
7.038
7.000
6.530
2.322
2.232
2.034
2.029
1.948
1.944
1.940
1.936
1.931
1.292
Me
Boc
N
N
Me
Me
2w
CN
solvent
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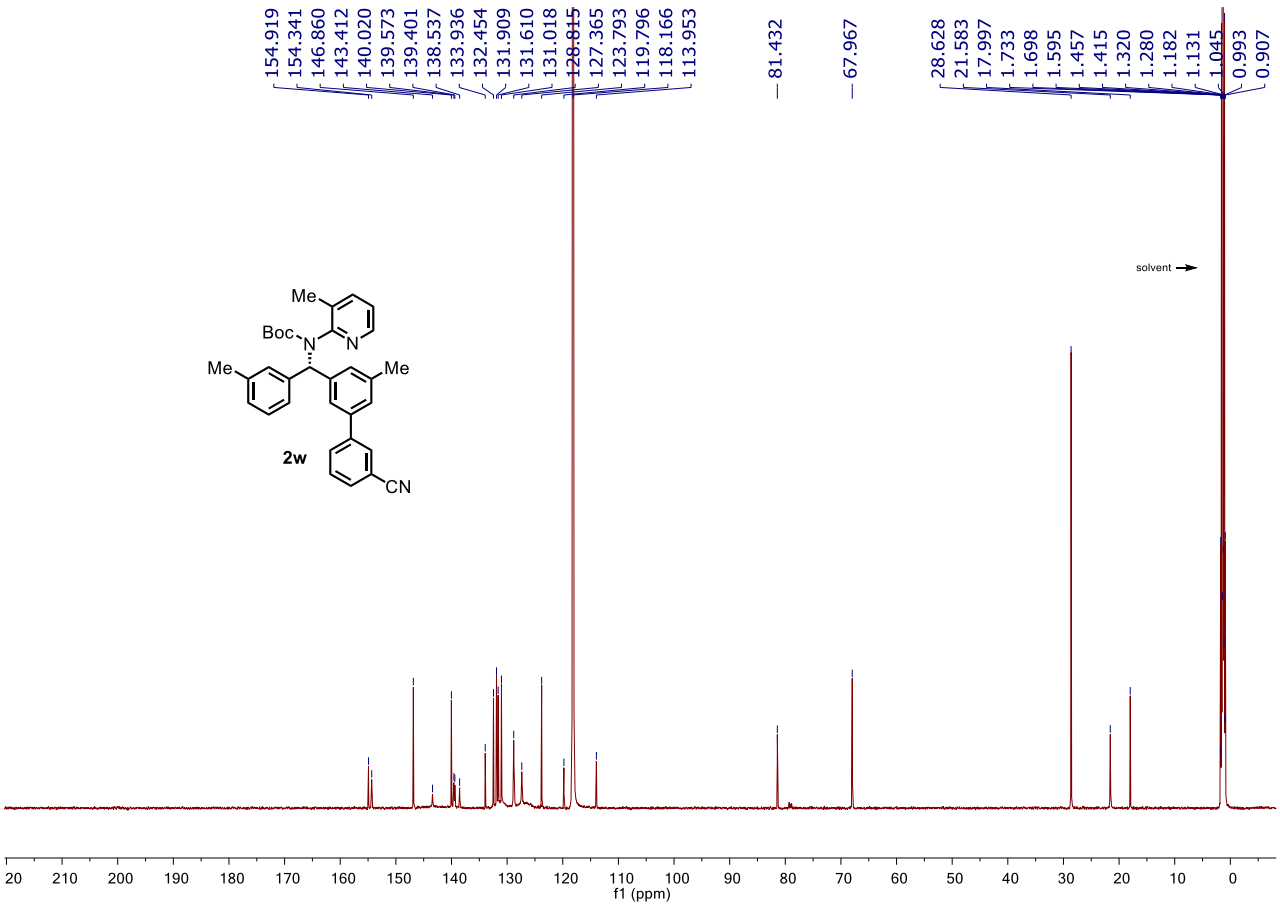
12.97
1.04
1.03
1.00
6.03
3.24
9.38
f1 (ppm)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131.018
128.815
127.365
123.793
119.796
118.166
113.953
81.432
67.967
28.628
21.583
17.997
1.733
1.698
1.595
1.457
1.415
1.320
1.280
1.182
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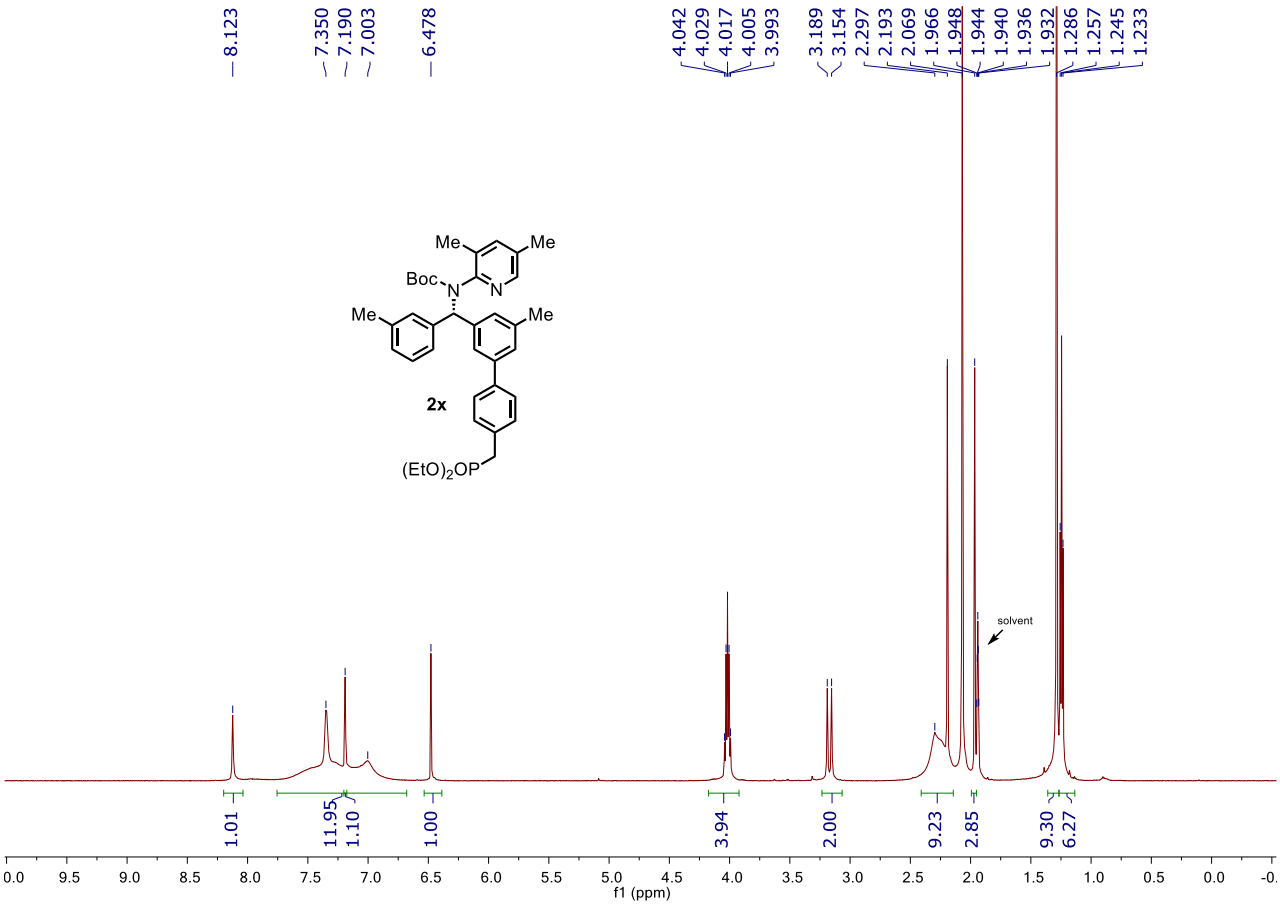
1.045
0.993
0.907
Me
Boc
N
N
Me
Me
2w
CN
solvent
f1 (ppm)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4.005
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3.189
3.154
2.297
2.193
2.069
1.966
1.948
1.944
1.940
1.936
1.932
1.286
1.257
1.245
1.233
Me
Me
Boc
N
N
Me
Me
2x
(EtO)2OP
solvent
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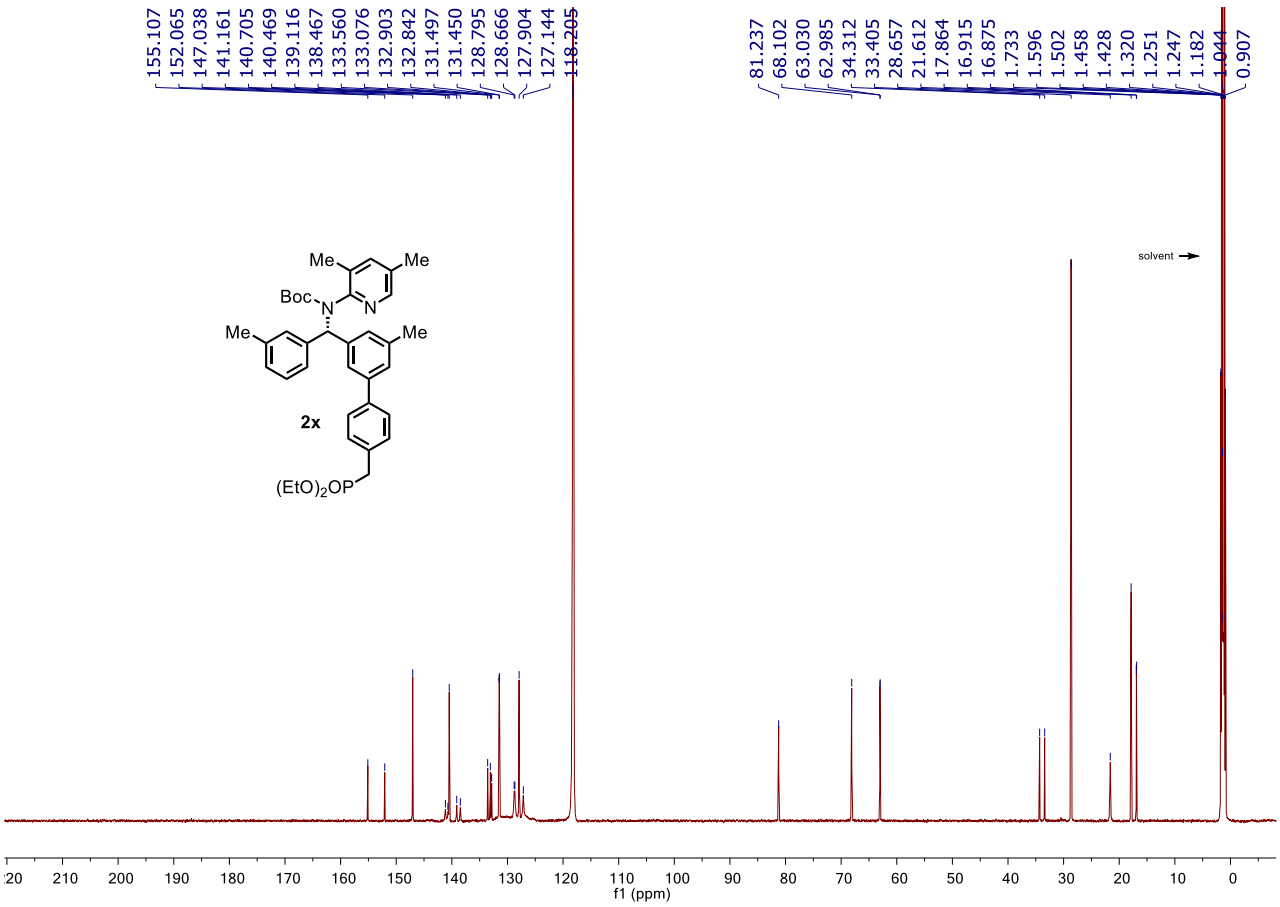
1.10
1.00
3.94
2.00
9.23
2.85
9.30
6.27
f1 (ppm)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128.666
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127.144
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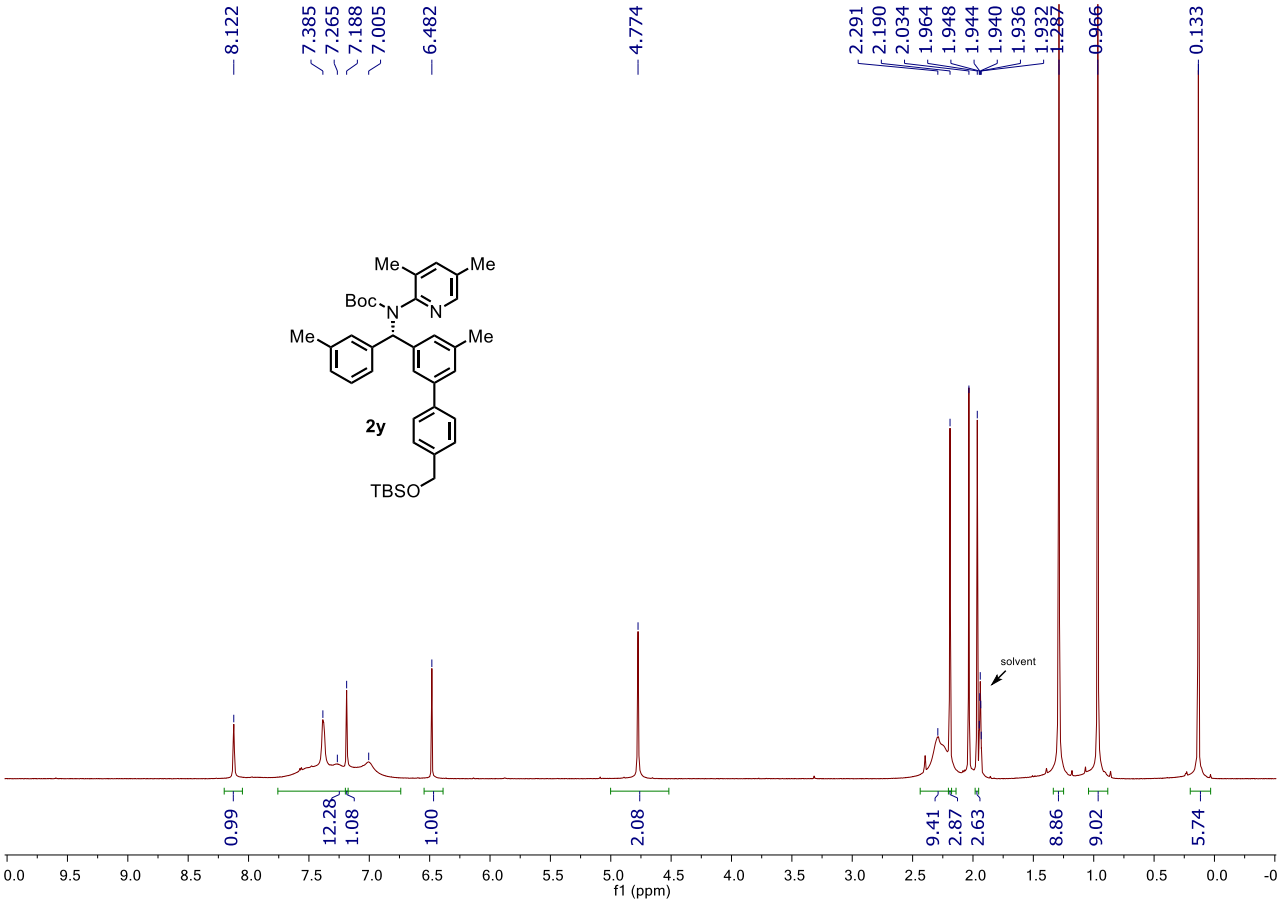
81.237
68.102
63.030
62.985
34.312
33.405
28.657
21.612
17.864
16.915
16.875
1.733
1.596
1.502
1.458
1.428
1.320
1.251
1.247
1.182
1.044
0.907
Me
Me
Boc
N
N
Me
Me
2x
(EtO)2OP
solvent
f1 (ppm)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1.944
1.940
1.936
1.932
1.287
0.966
0.133
Me
Me
Boc
N
N
Me
Me
2y
TBSO
solvent
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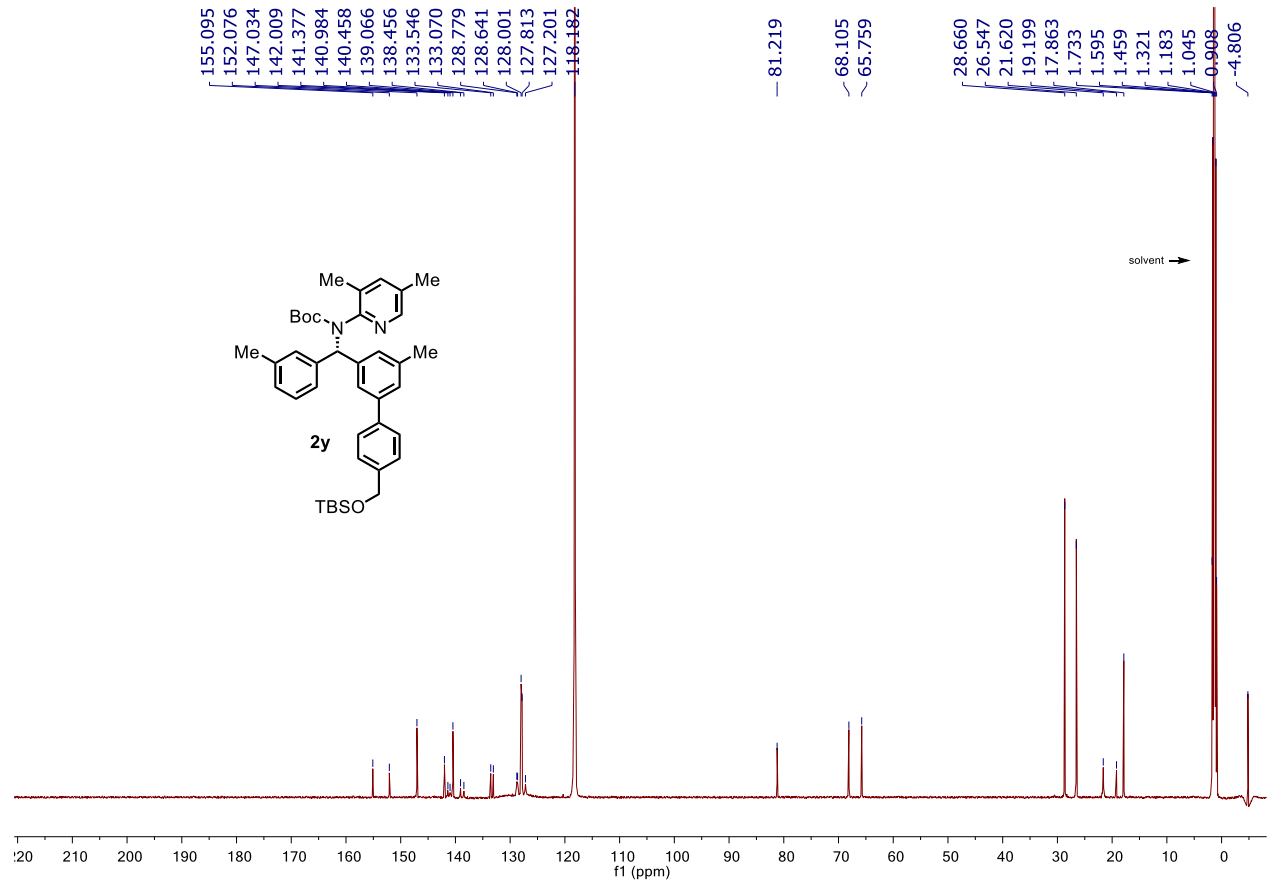
1.00
2.08
9.41
2.87
2.63
8.86
9.02
5.74
f1 (ppm)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133.546
133.070
128.779
128.641
128.001
127.813
127.201
118.182
81.219
68.105
65.759
28.660
26.547
21.620
19.199
17.863
1.733
1.595
1.459
1.321
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solvent
Me
Me
Boc
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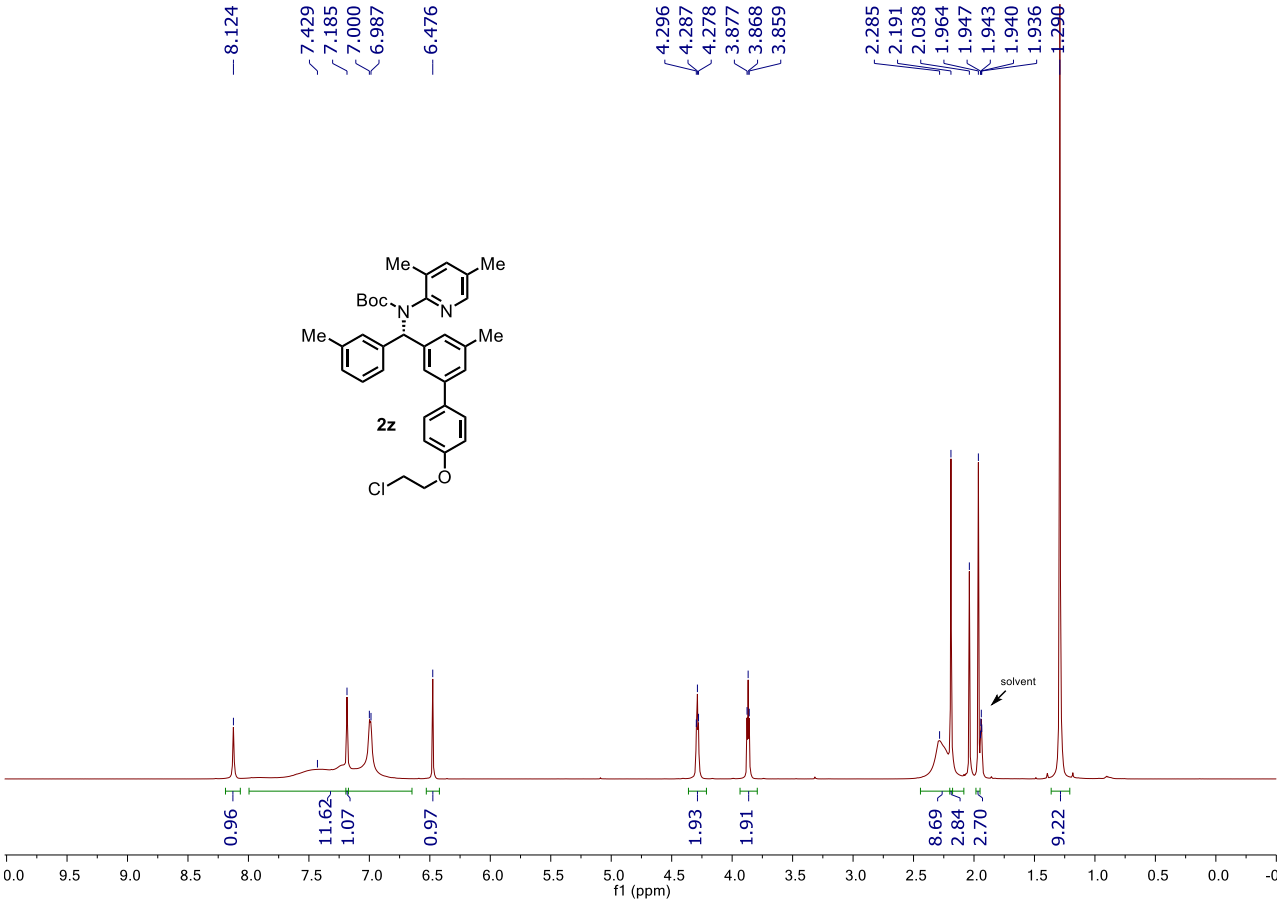
N
Me
Me
2y
TBSO
f1 (ppm)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1.943
1.940
1.936
1.290
Me
Me
Boc
N
N
Me
Me
2z
Cl
O
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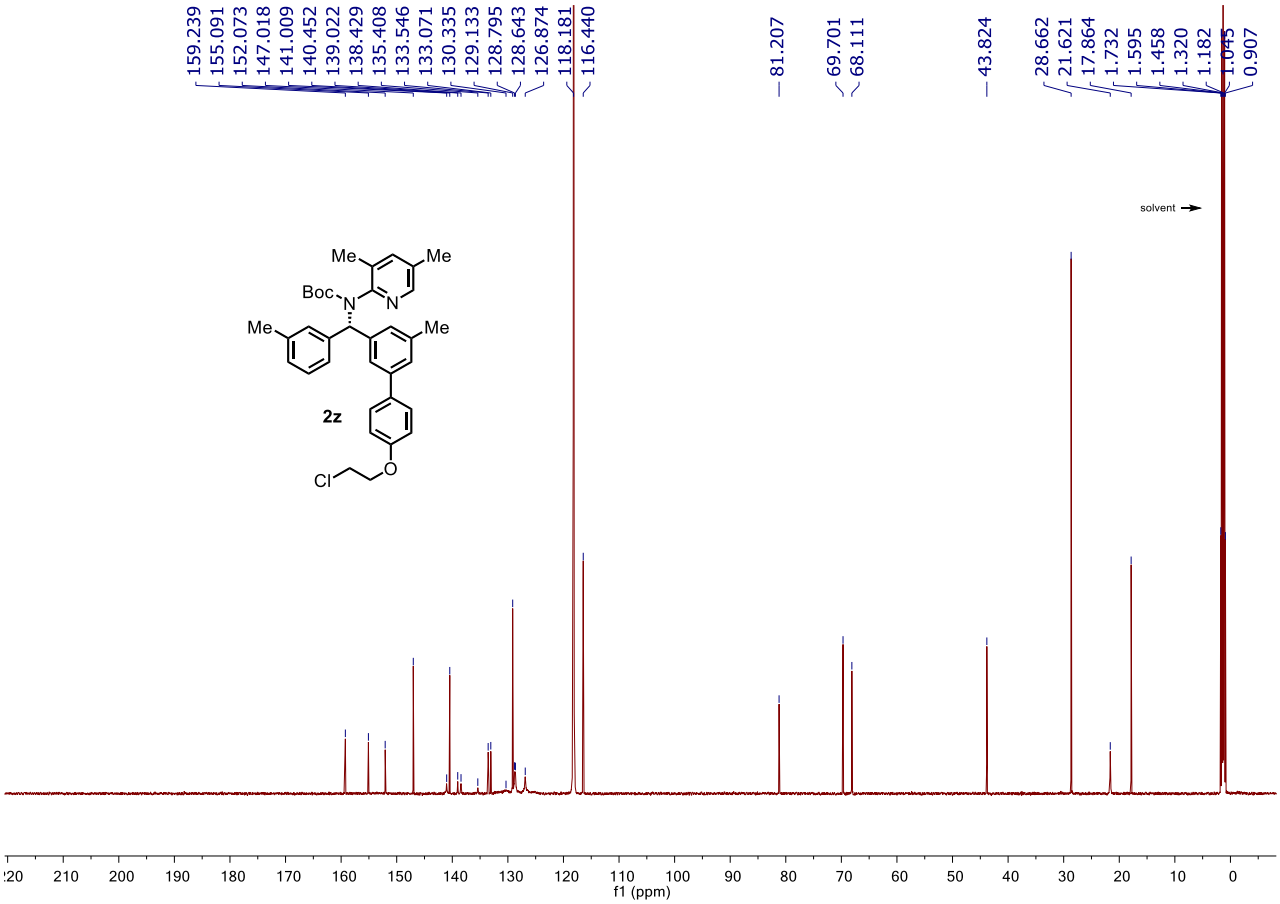
f1 (ppm)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116.440
81.207
69.701
68.111
43.824
28.662
21.621
17.864
1.732
1.595
1.458
1.320
1.182
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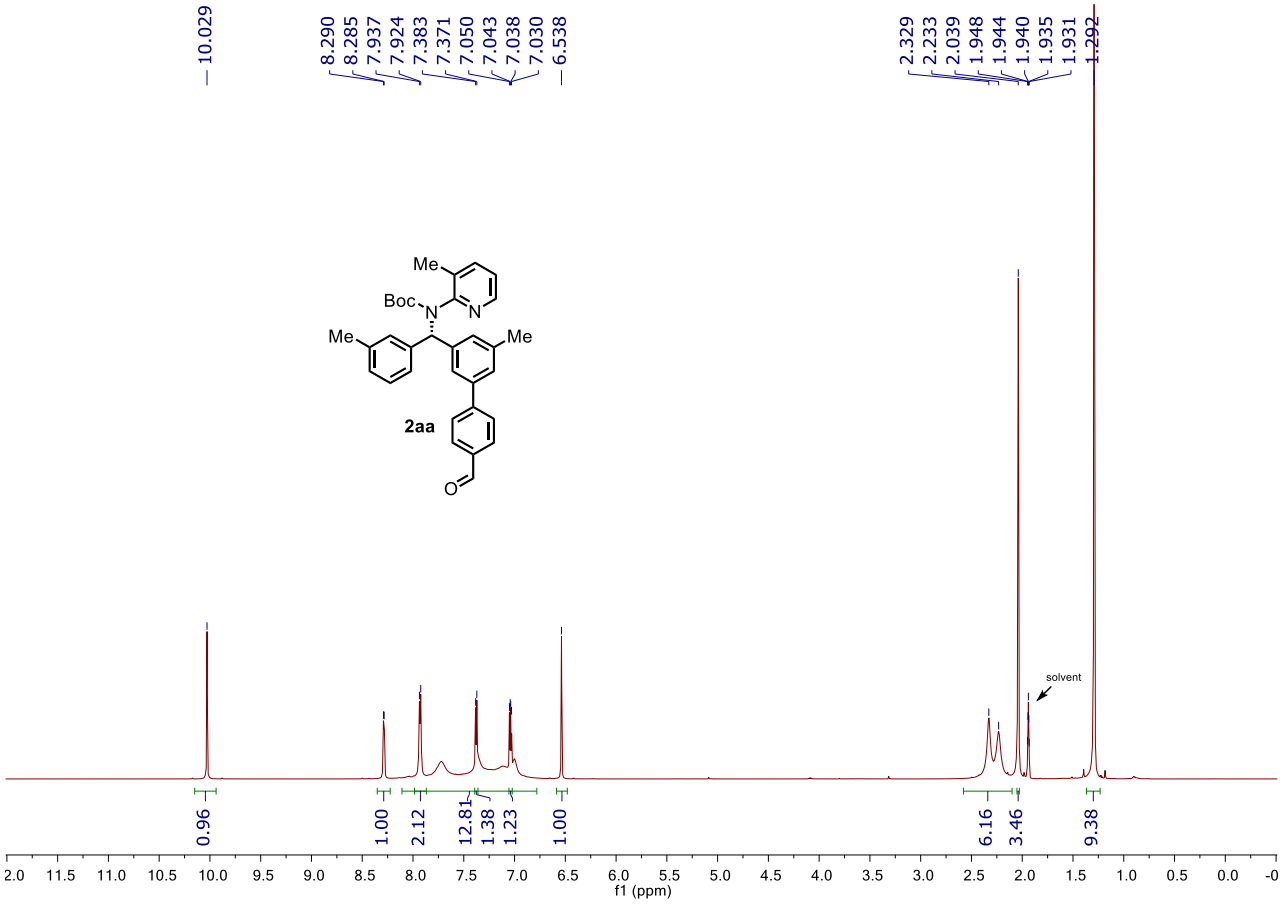
0.907
solvent
Me
Me
Boc
N
N
Me
Me
2z
Cl
O
f1 (ppm)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7.030
6.538
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2.233
2.039
1.948
1.944
1.940
1.935
1.931
1.292
Me
Boc
N
N
Me
Me
2aa
O
solvent
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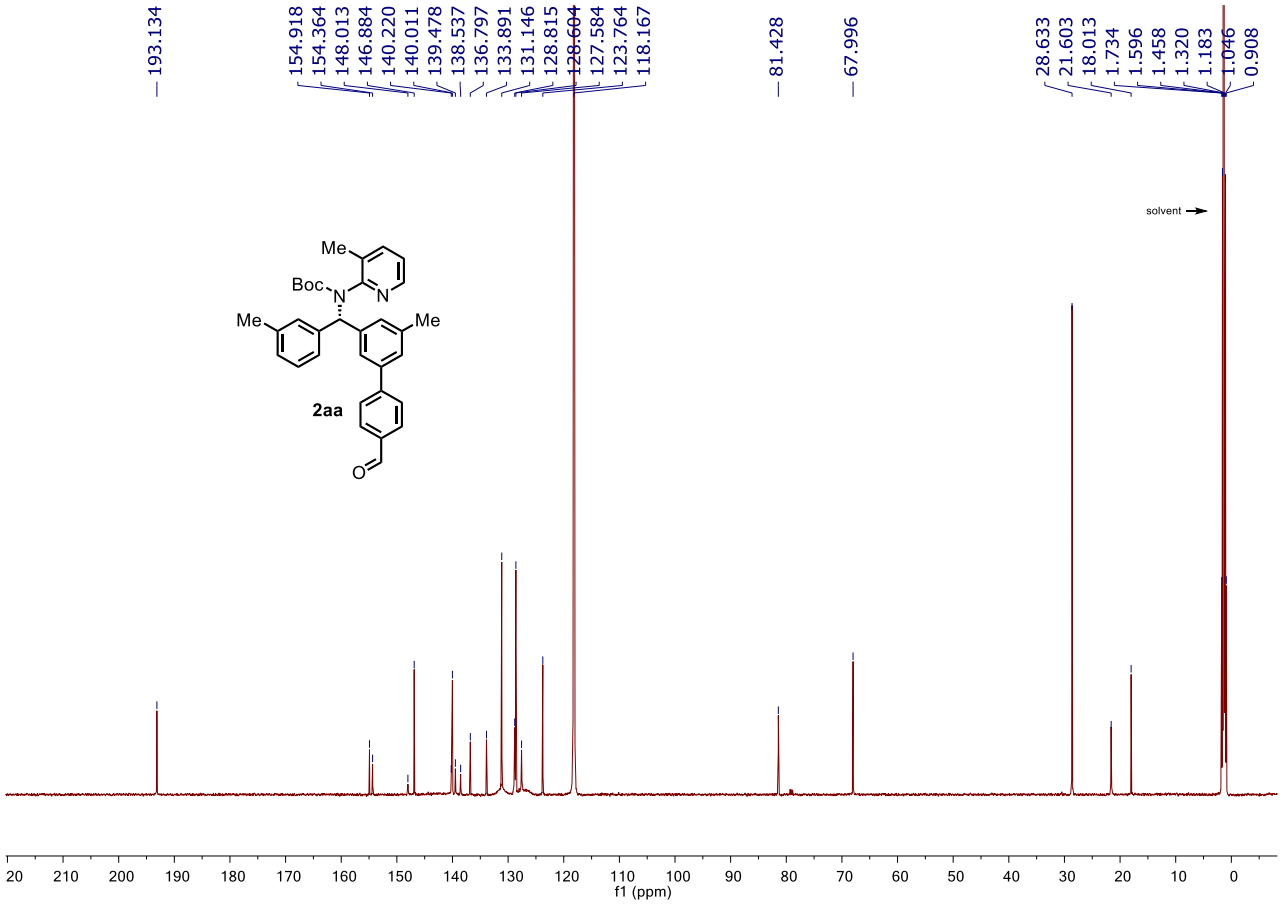
12.81
1.38
1.23
1.00
6.16
3.46
9.38
f1 (ppm)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127.584
123.764
118.167
81.428
67.996
28.633
21.603
18.013
1.734
1.596
1.458
1.320
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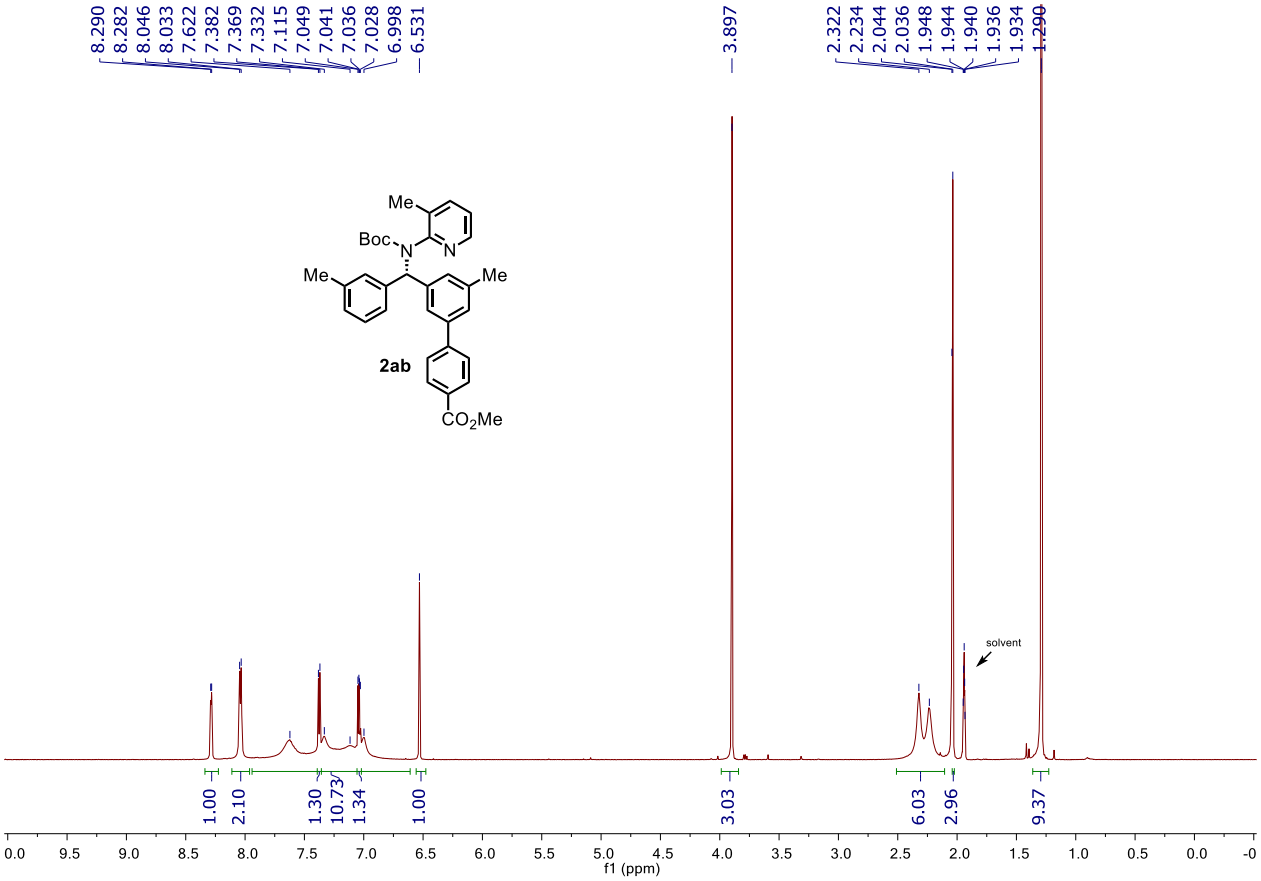
1.046
0.908
solvent
Me
Boc
N
N
Me
Me
2aa
O
f1 (ppm)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7.036
7.028
6.998
6.531
3.897
2.322
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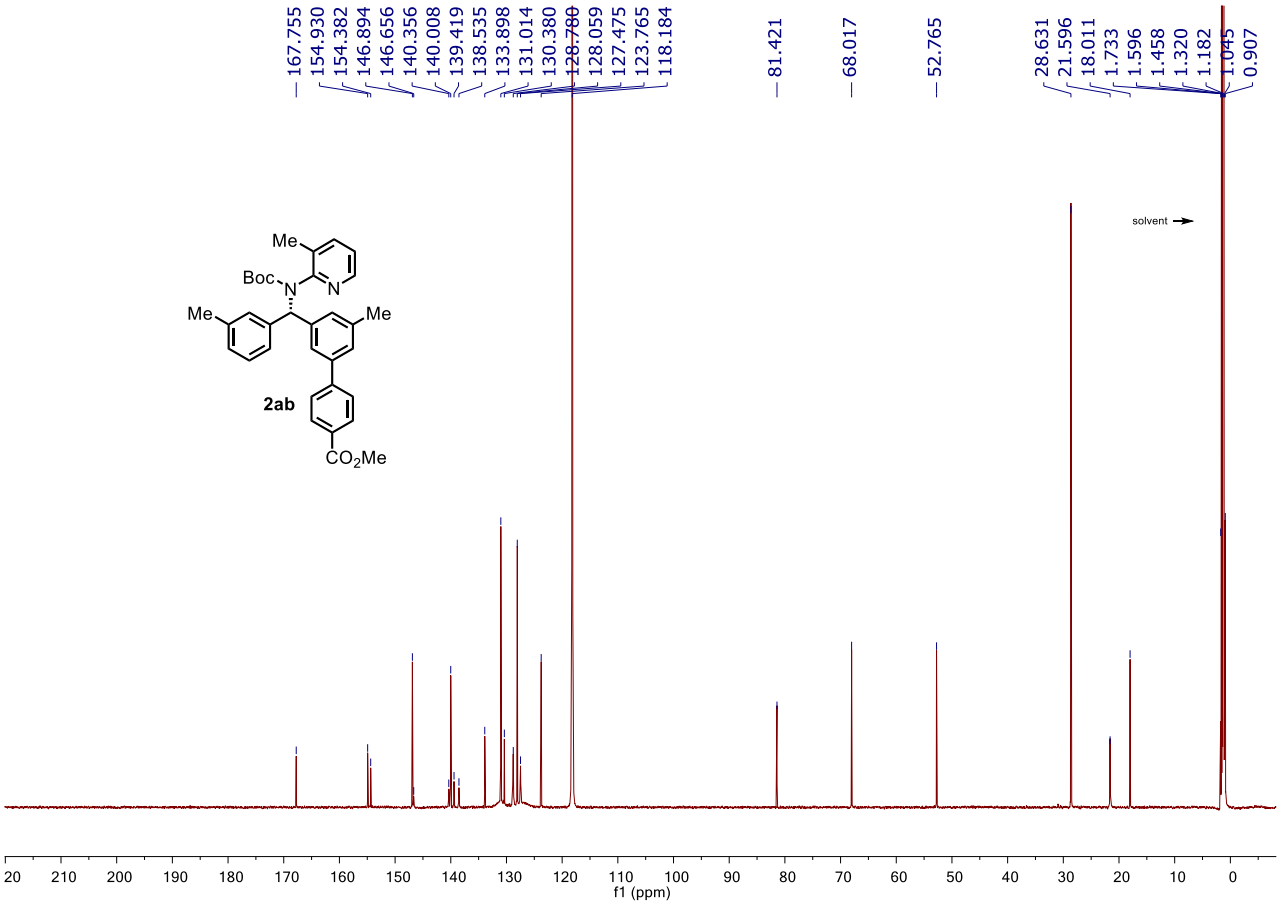
2.044
2.036
1.948
1.944
1.940
1.936
1.934
1.290
Me
Boc
N
N
Me
Me
2ab
CO2Me
solvent
1.00
2.10
1.30
10.73
1.34
1.00
3.03
6.03
2.96
9.37
f1 (ppm)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127.475
123.765
118.184
81.421
68.017
52.765
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21.596
18.011
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1.596
1.458
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1.045
0.907
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Boc
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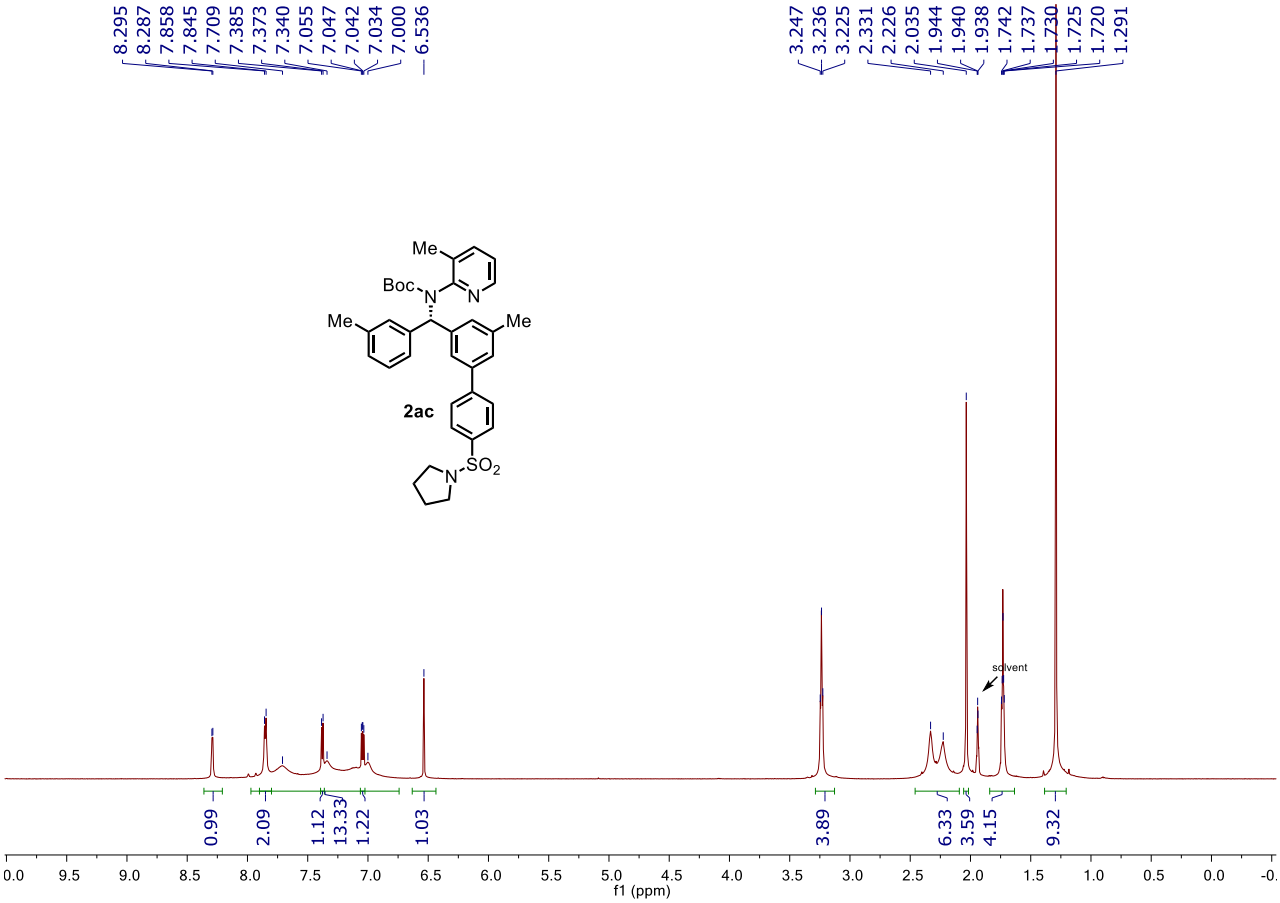
Me
Me
2ab
CO2Me
solvent
f1 (ppm)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7.000
6.536
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3.236
3.225
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2.226
2.035
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1.940
1.938
1.742
1.737
1.730
1.725
1.720
1.291
Me
Boc
N
N
Me
Me
2ac
N
SO2
solvent
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1.03
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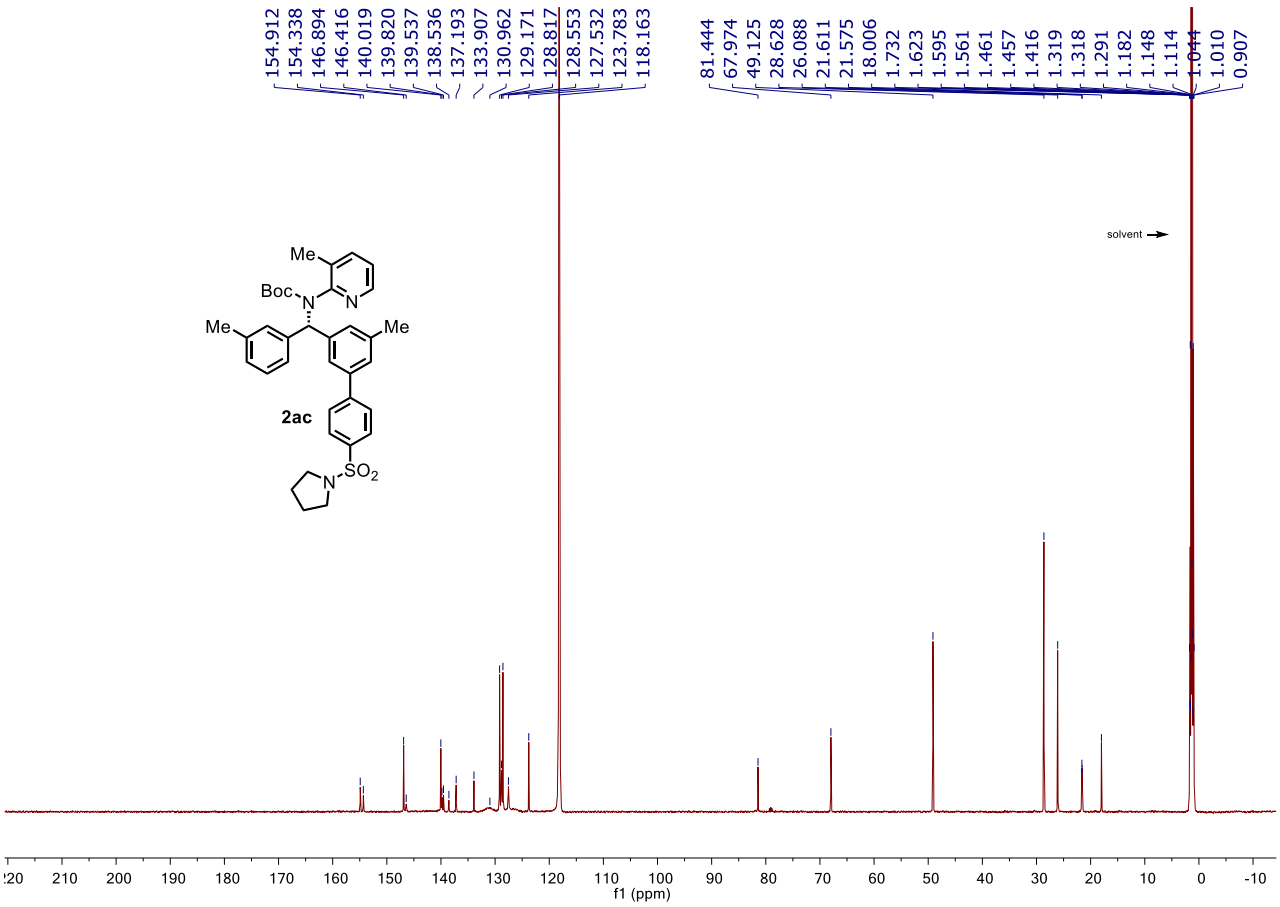
9.32
f1 (ppm)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18.006
1.732
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1.561
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1.416
1.319
1.318
1.291
1.182
1.148
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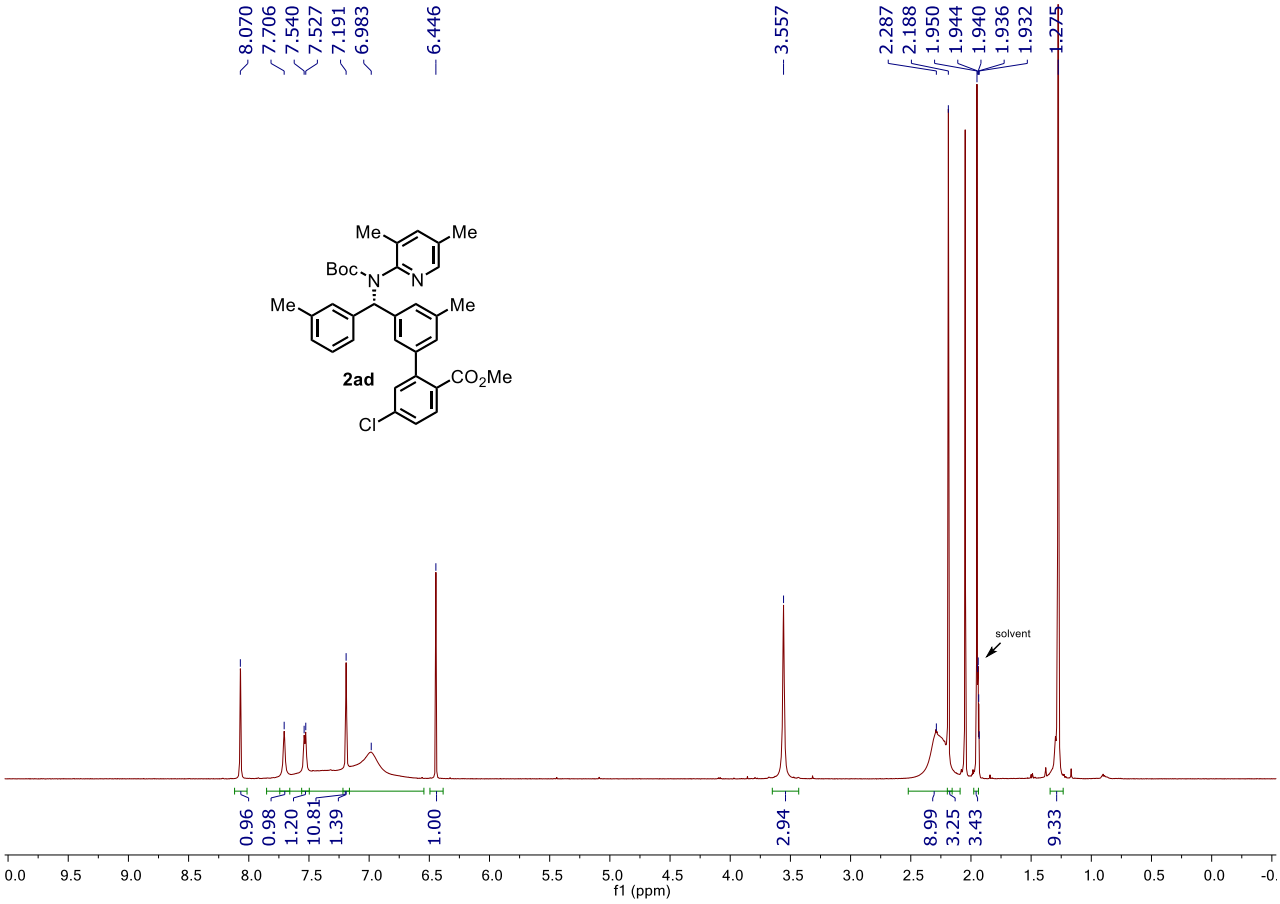
Boc
N
N
Me
Me
2ac
N
SO2
solvent
f1 (ppm)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1.940
1.936
1.932
1.275
Me
Me
Boc
N
N
Me
Me
2ad
CO2Me
Cl
solvent
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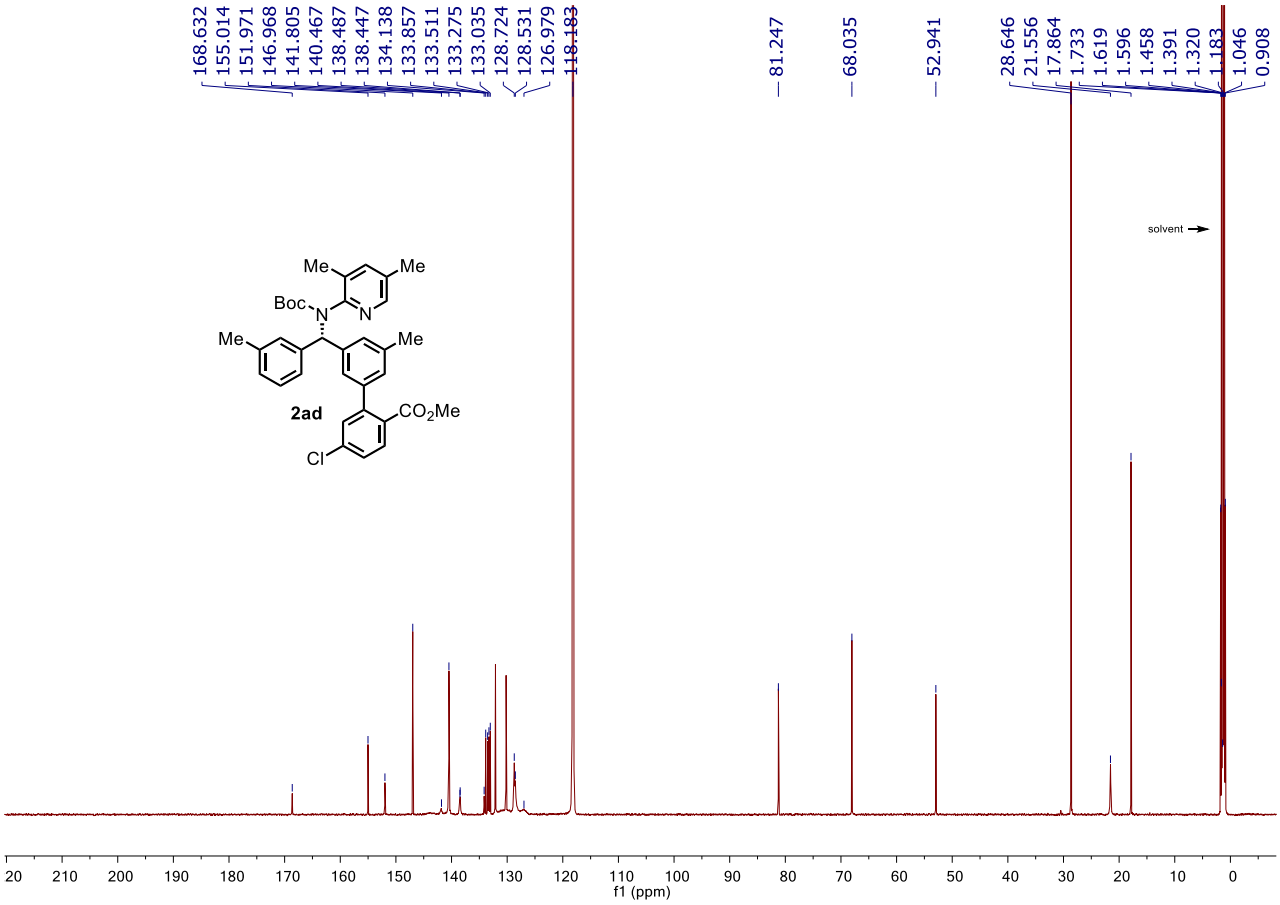
f1 (ppm)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68.035
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21.556
17.864
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1.619
1.596
1.458
1.391
1.320
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0.908
solvent
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Me
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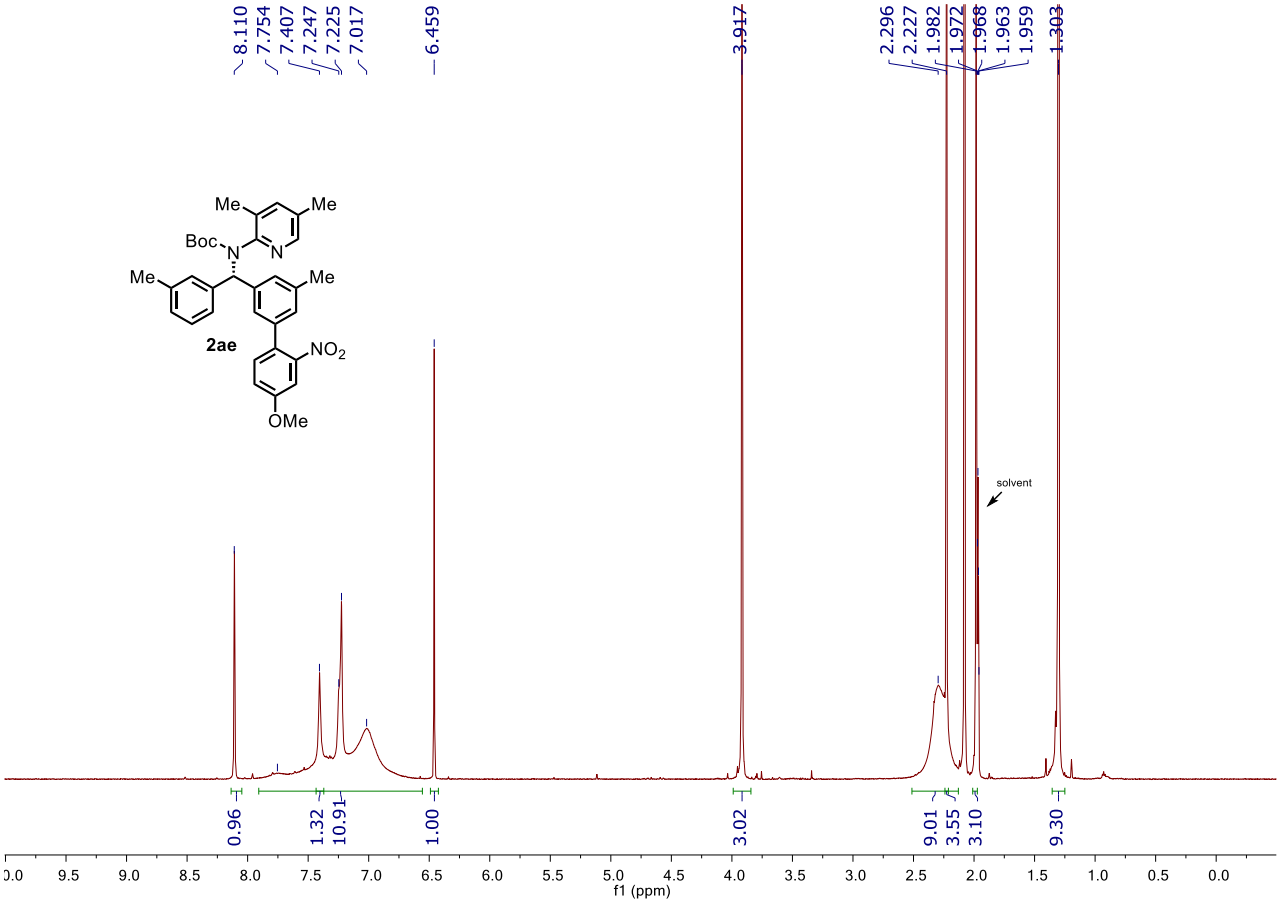
Me
Me
2ad
CO2Me
Cl
f1 (ppm)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1.968
1.963
1.959
1.303
Me
Me
Boc
N
N
Me
Me
2ae
NO2
OMe
solvent
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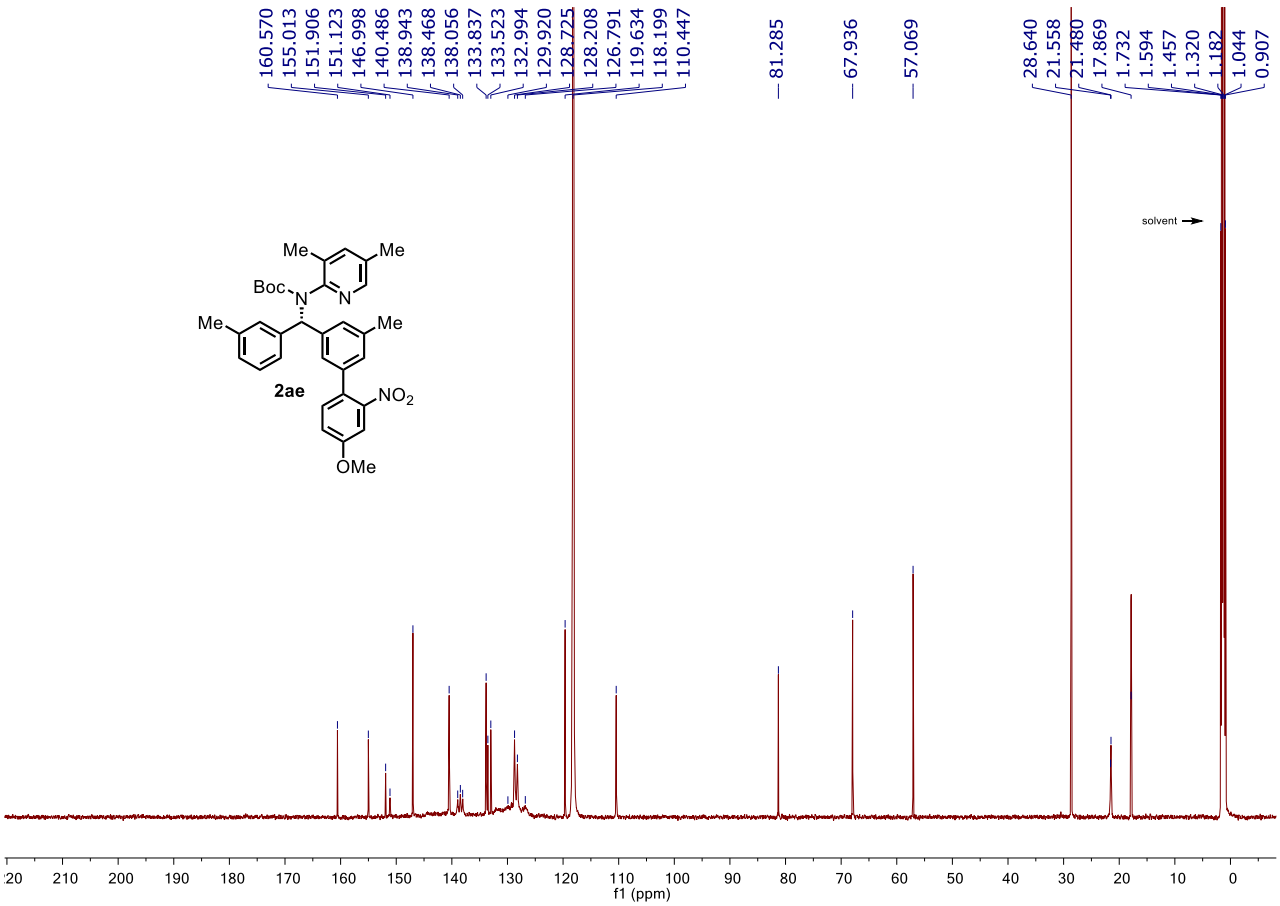
1.32
10.91
1.00
3.02
9.01
3.55
3.10
9.30
f1 (ppm)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128.725
128.208
126.791
119.634
118.199
110.447
81.285
67.936
57.069
28.640
21.558
21.480
17.869
1.732
1.594
1.457
1.320
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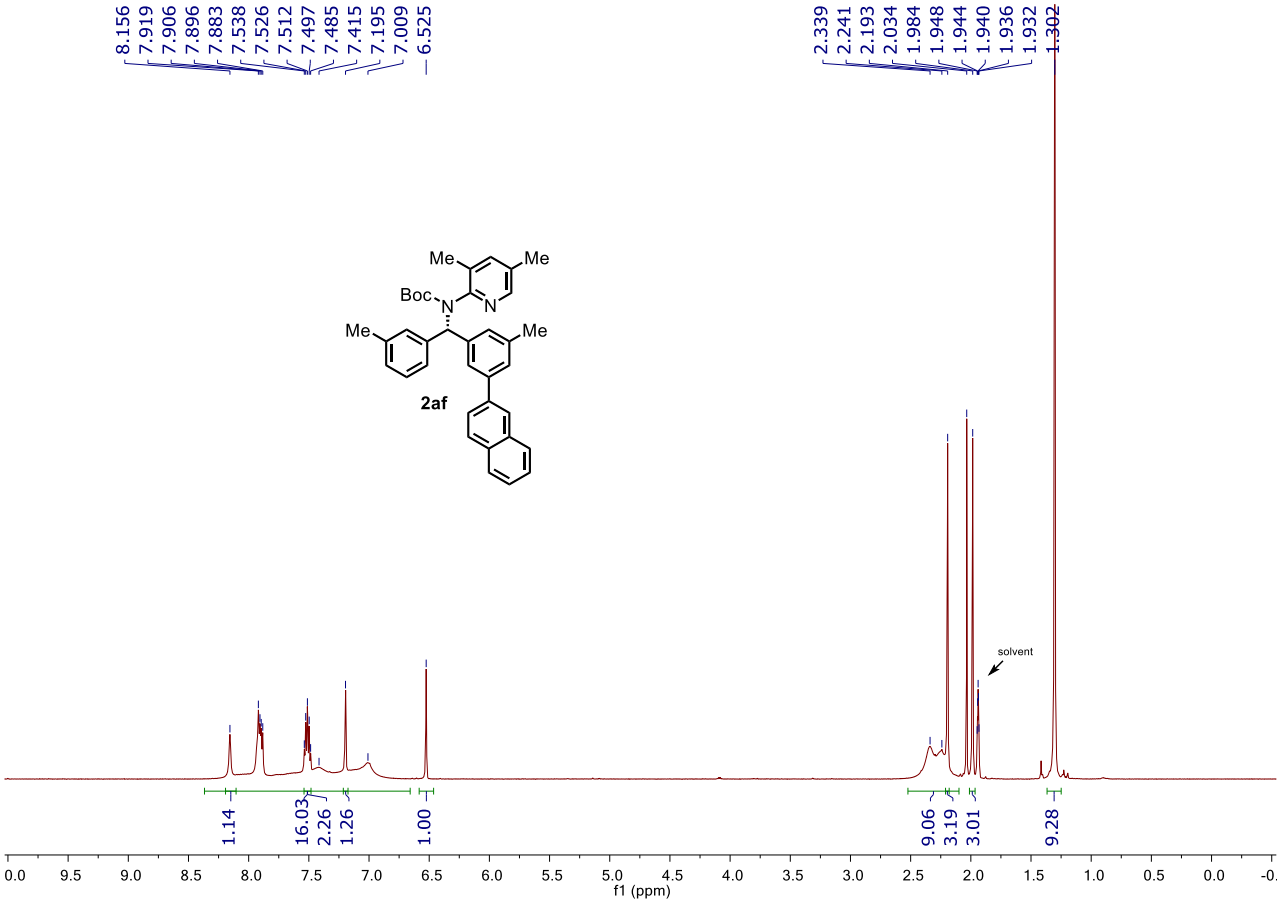
0.907
Me
Me
Boc
N
N
Me
Me
2ae
NO2
OMe
solvent
f1 (ppm)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7.195
7.009
6.525
2.339
2.241
2.193
2.034
1.984
1.948
1.944
1.940
1.936
1.932
1.302
Me
Me
Boc
N
N
Me
Me
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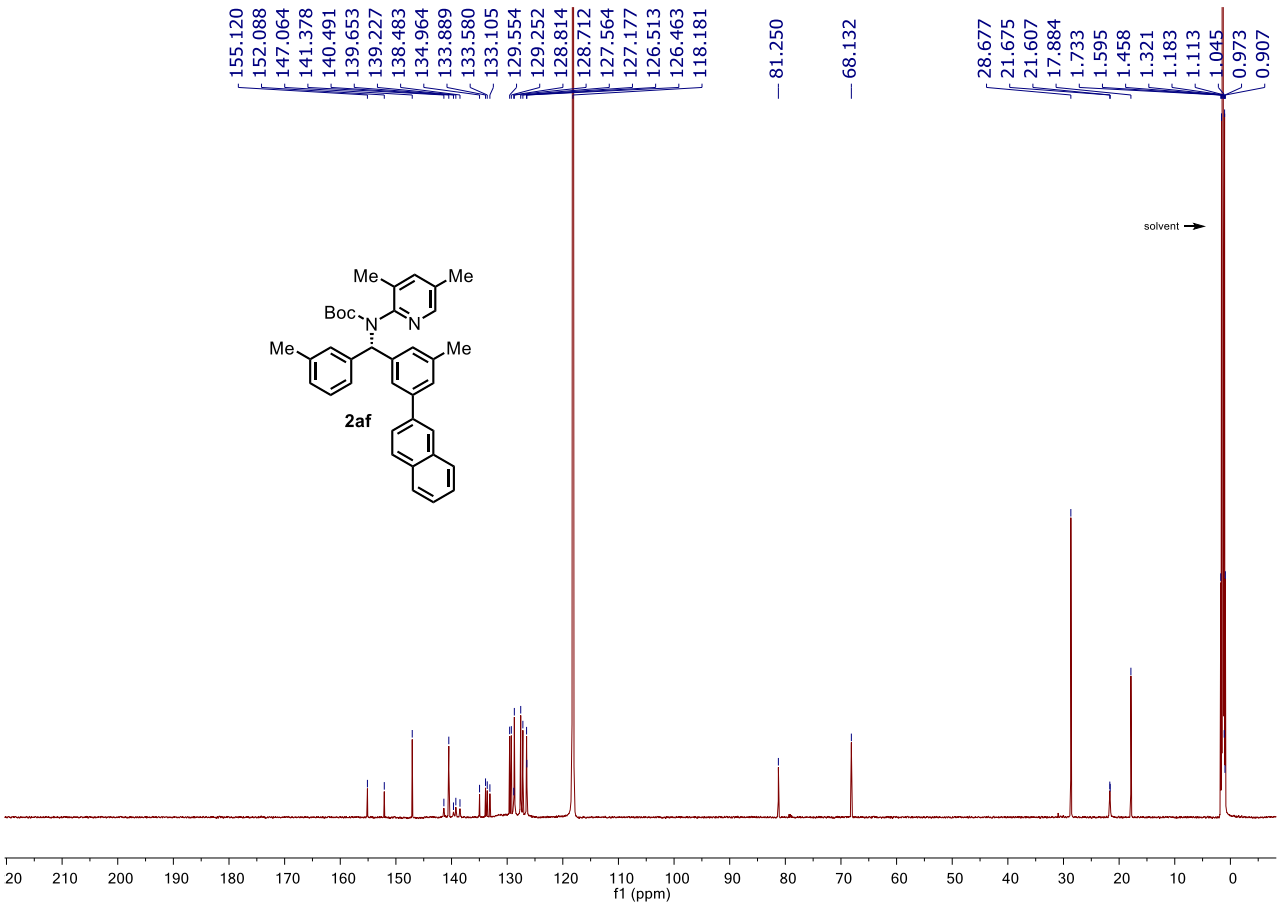
16.03
2.26
1.26
1.00
9.06
3.19
3.01
9.28
f1 (ppm)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128.712
127.564
127.177
126.513
126.463
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81.250
68.132
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21.675
21.607
17.884
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1.595
1.458
1.321
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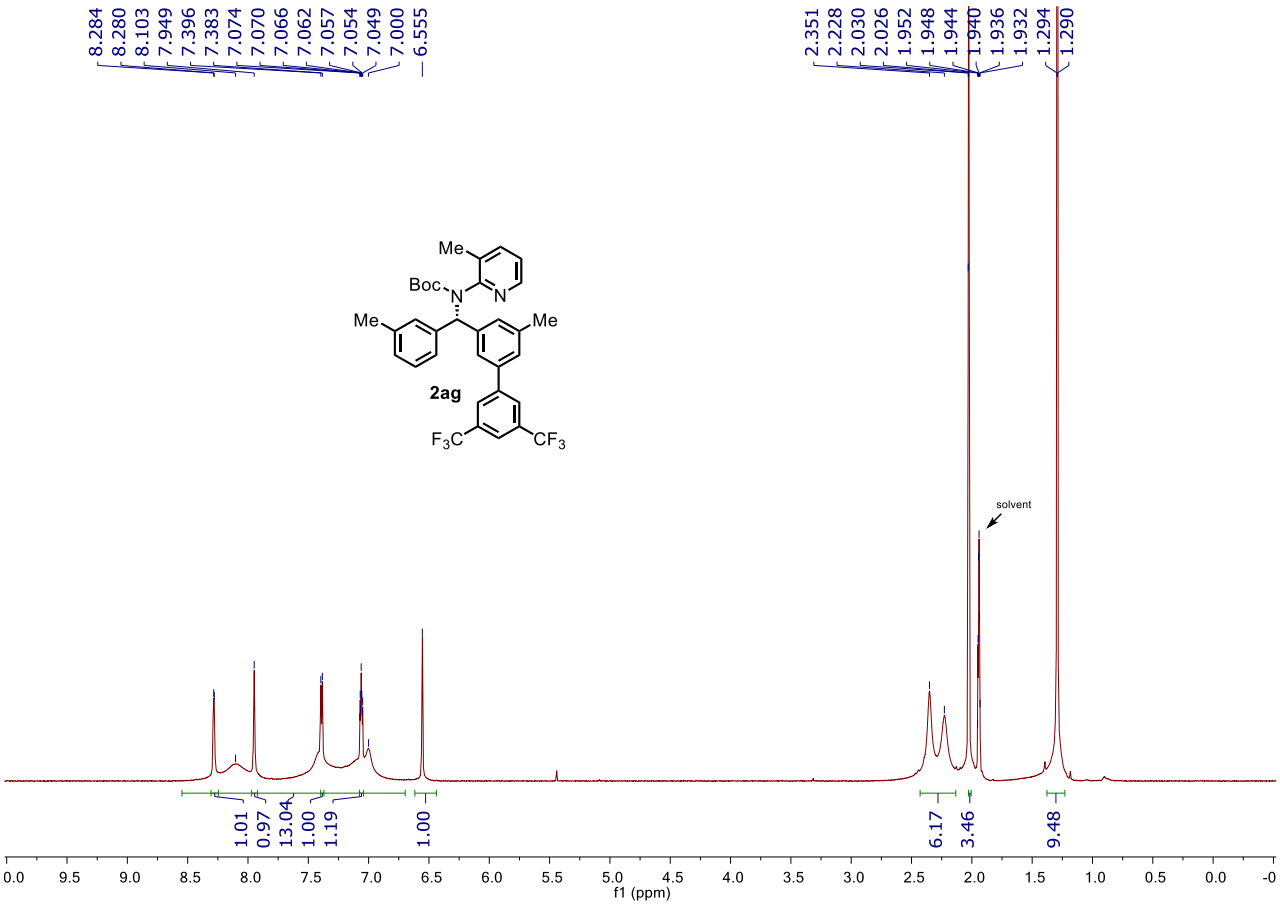
solvent
Me
Me
Boc
N
N
Me
Me
2af
f1 (ppm)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7.054
7.049
7.000
6.555
2.351
2.228
2.030
2.026
1.952
1.948
1.944
1.940
1.936
1.932
1.294
1.290
Me
Boc
N
N
Me
Me
2ag
F3C
CF3
solvent
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1.19
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6.17
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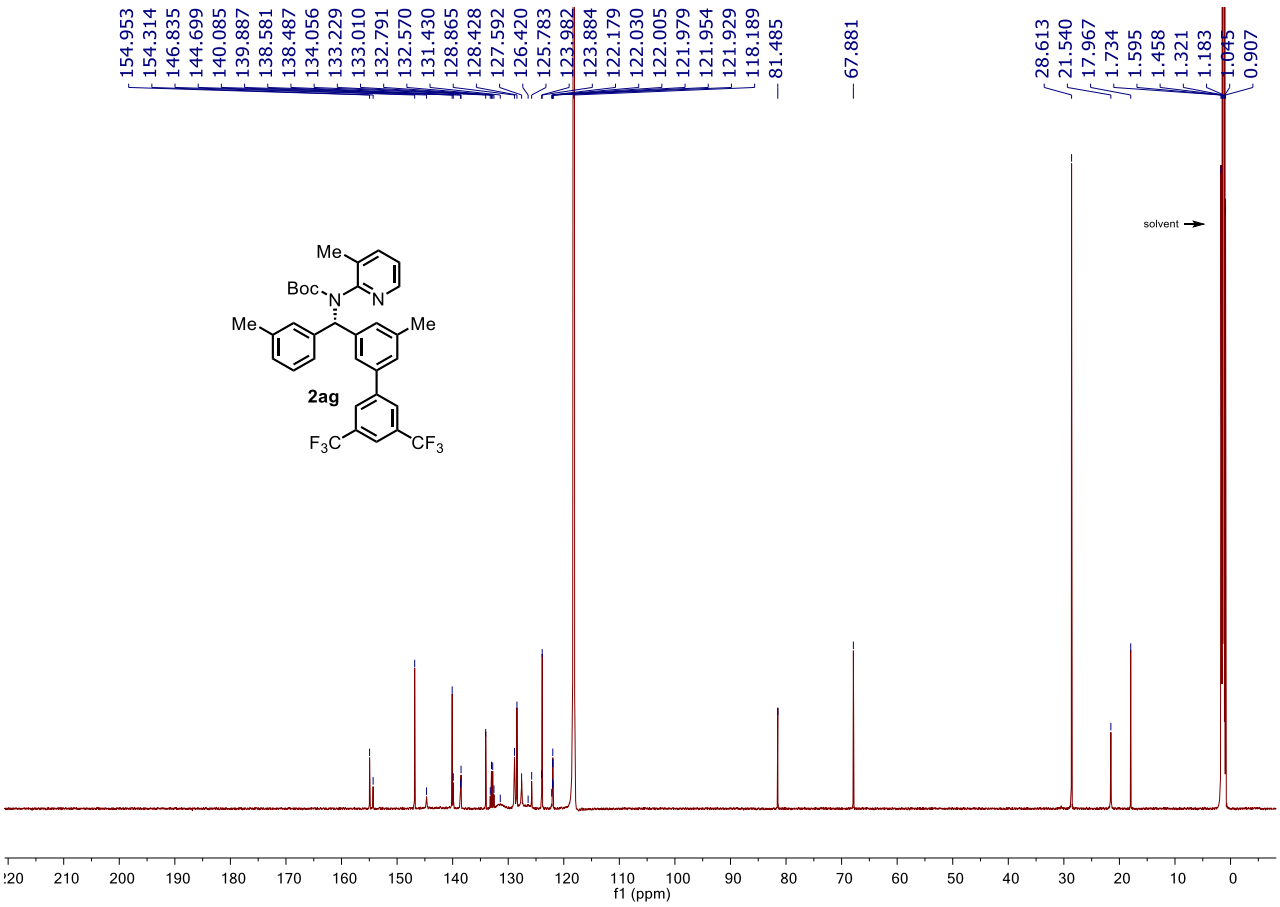
f1 (ppm)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128.865
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126.420
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81.485
67.881
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21.540
17.967
1.734
1.595
1.458
1.321
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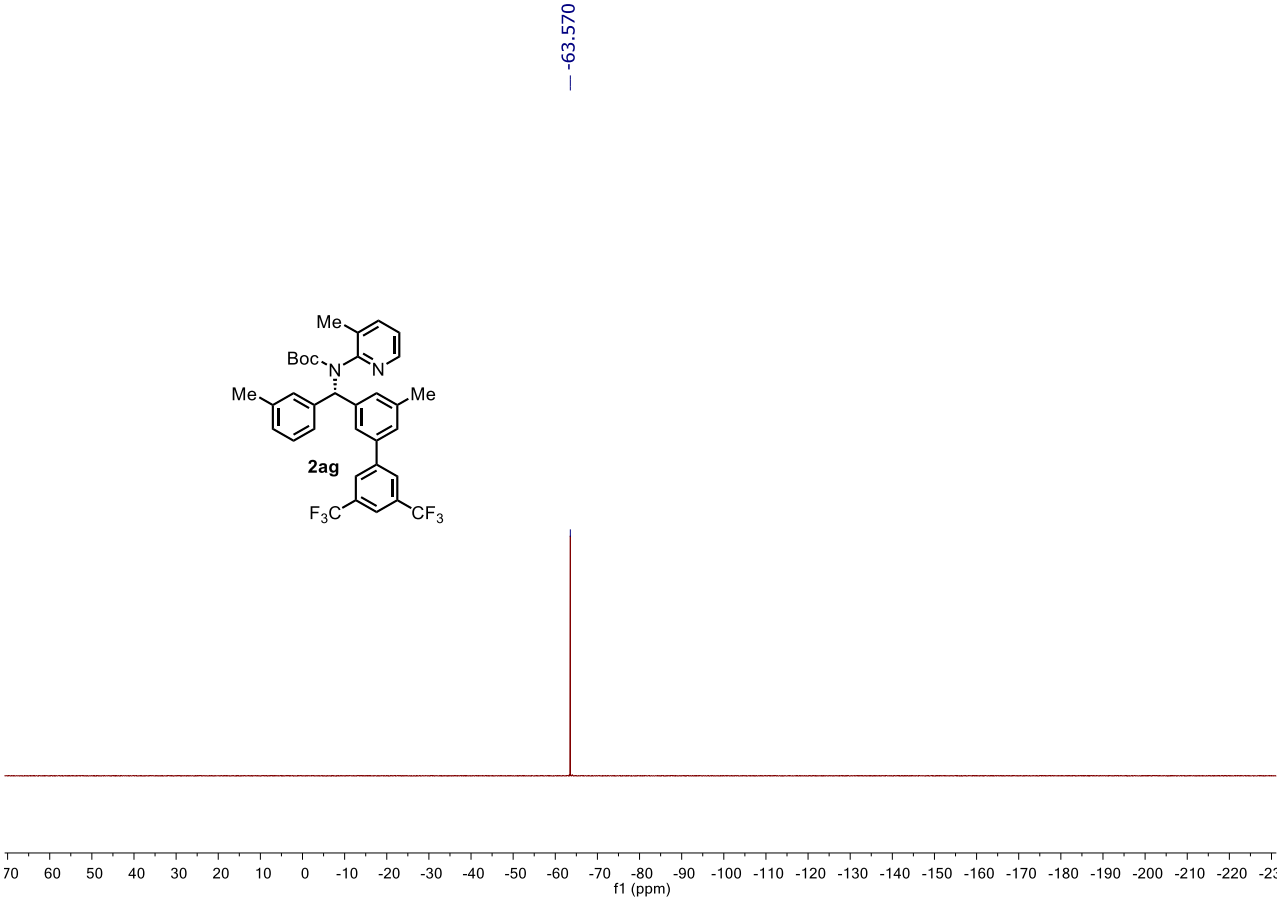
0.907
solvent
Me
Boc
N
N
Me
Me
2ag
F3C
CF3
f1 (ppm)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N
Me
Me
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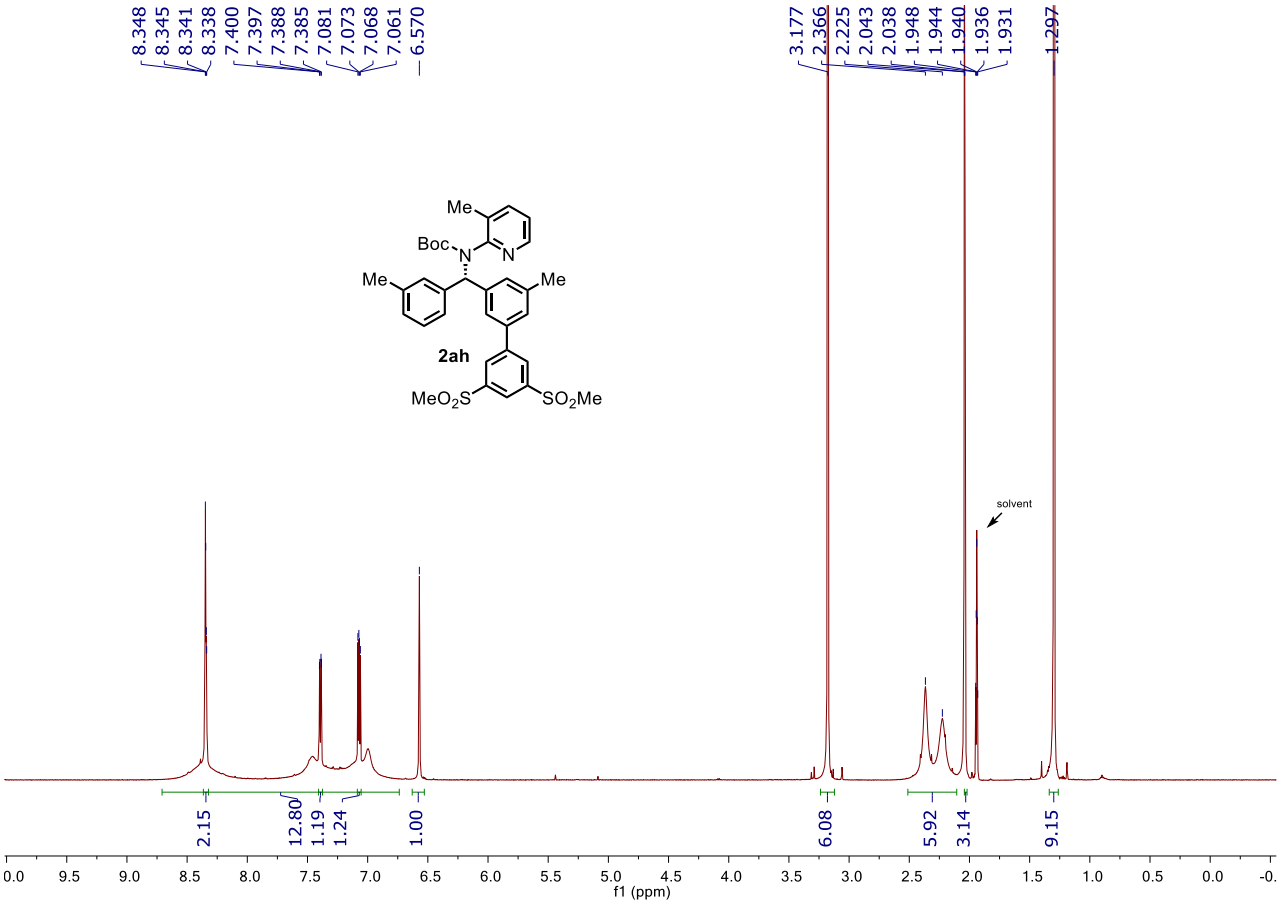
CF3
f1 (ppm)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7.068
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2.225
2.043
2.038
1.948
1.944
1.940
1.936
1.931
1.297
Me
Boc
N
N
Me
Me
2ah
MeO2S
SO2Me
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1.24
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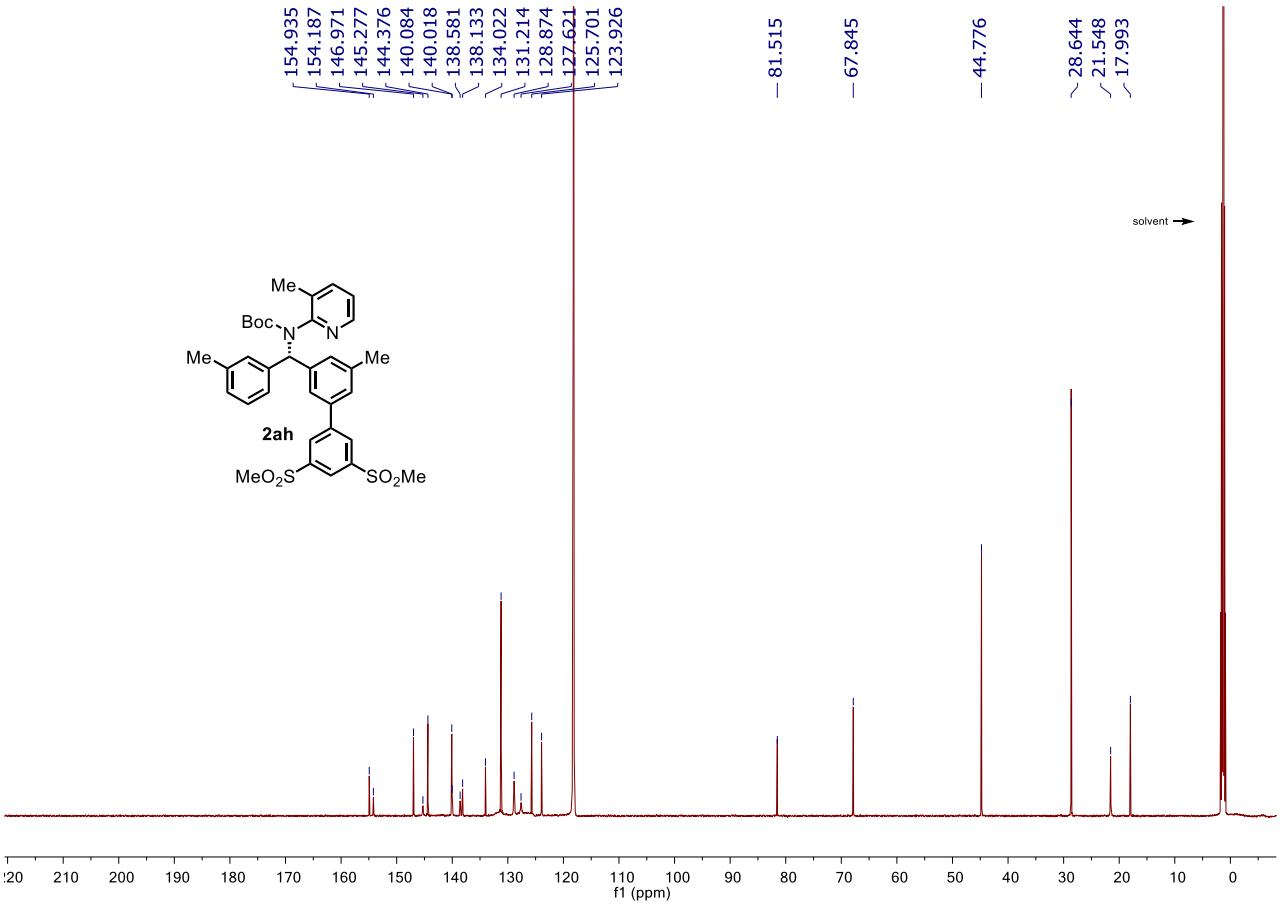
9.15
f1 (ppm)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67.845
44.776
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solvent
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Boc
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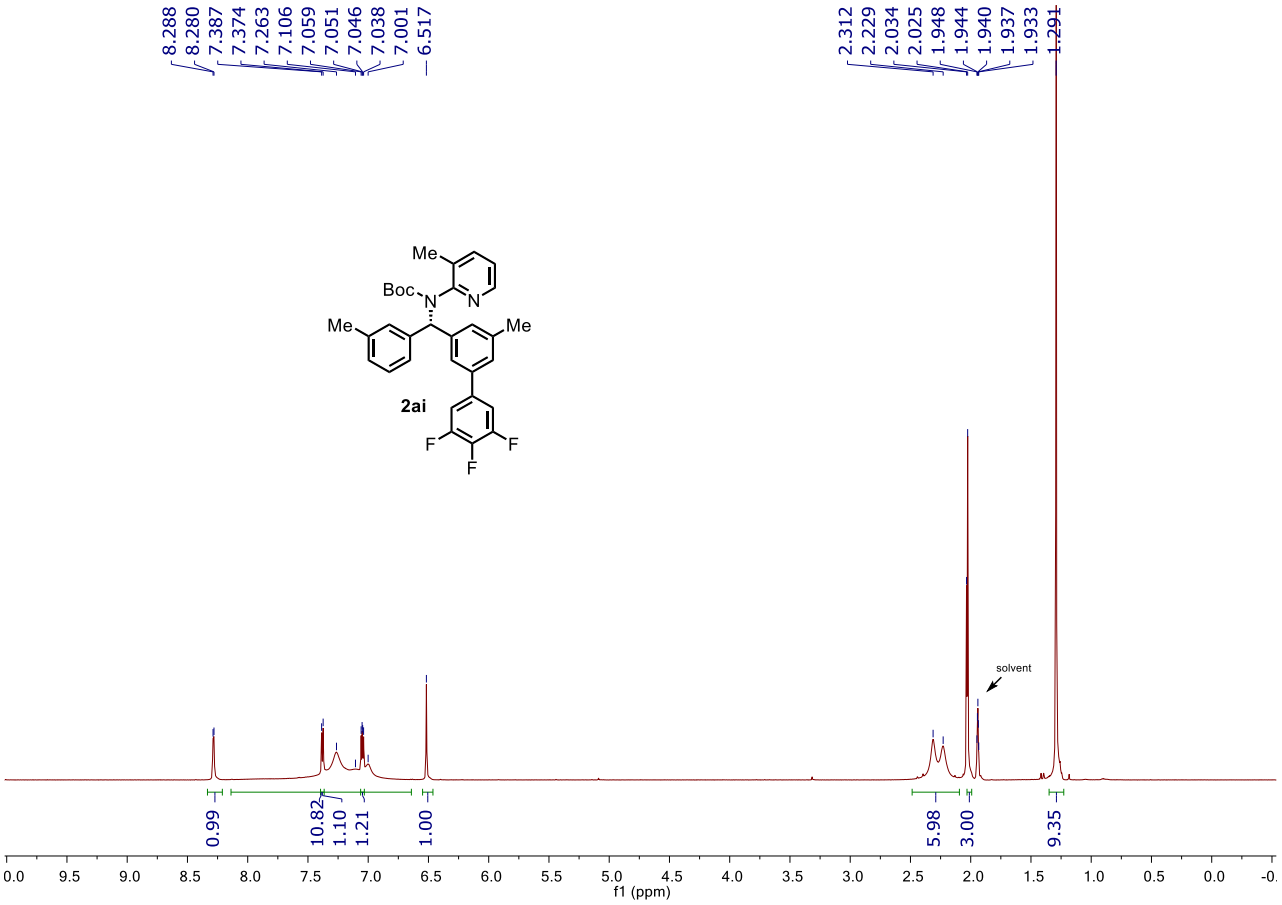
Me
2ah
MeO2S
SO2Me
f1 (ppm)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2.229
2.034
2.025
1.948
1.944
1.940
1.937
1.933
1.291
Me
Boc
N
N
Me
Me
2ai
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F
F
solvent
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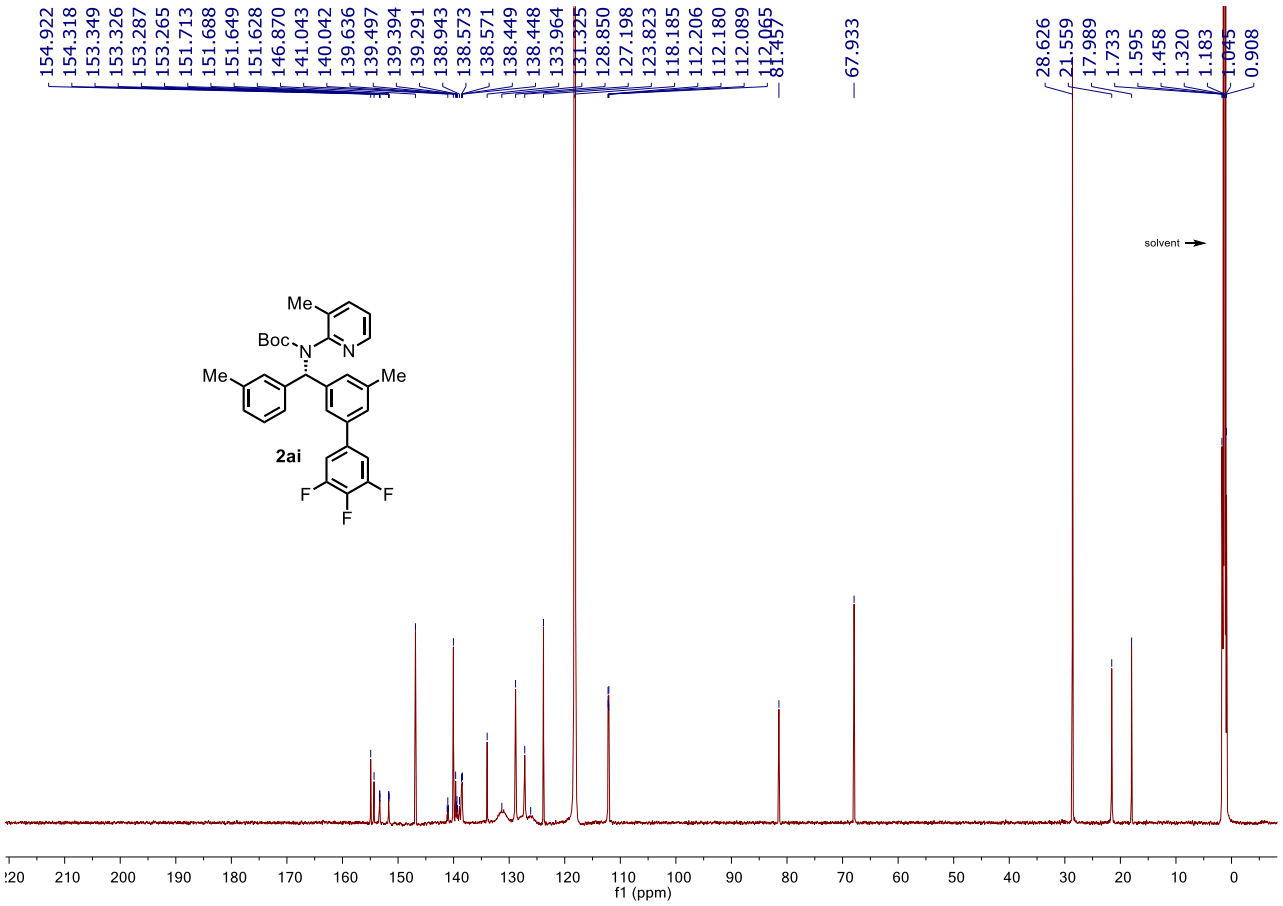
3.00
9.35
f1 (ppm)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128.850
127.198
123.823
118.185
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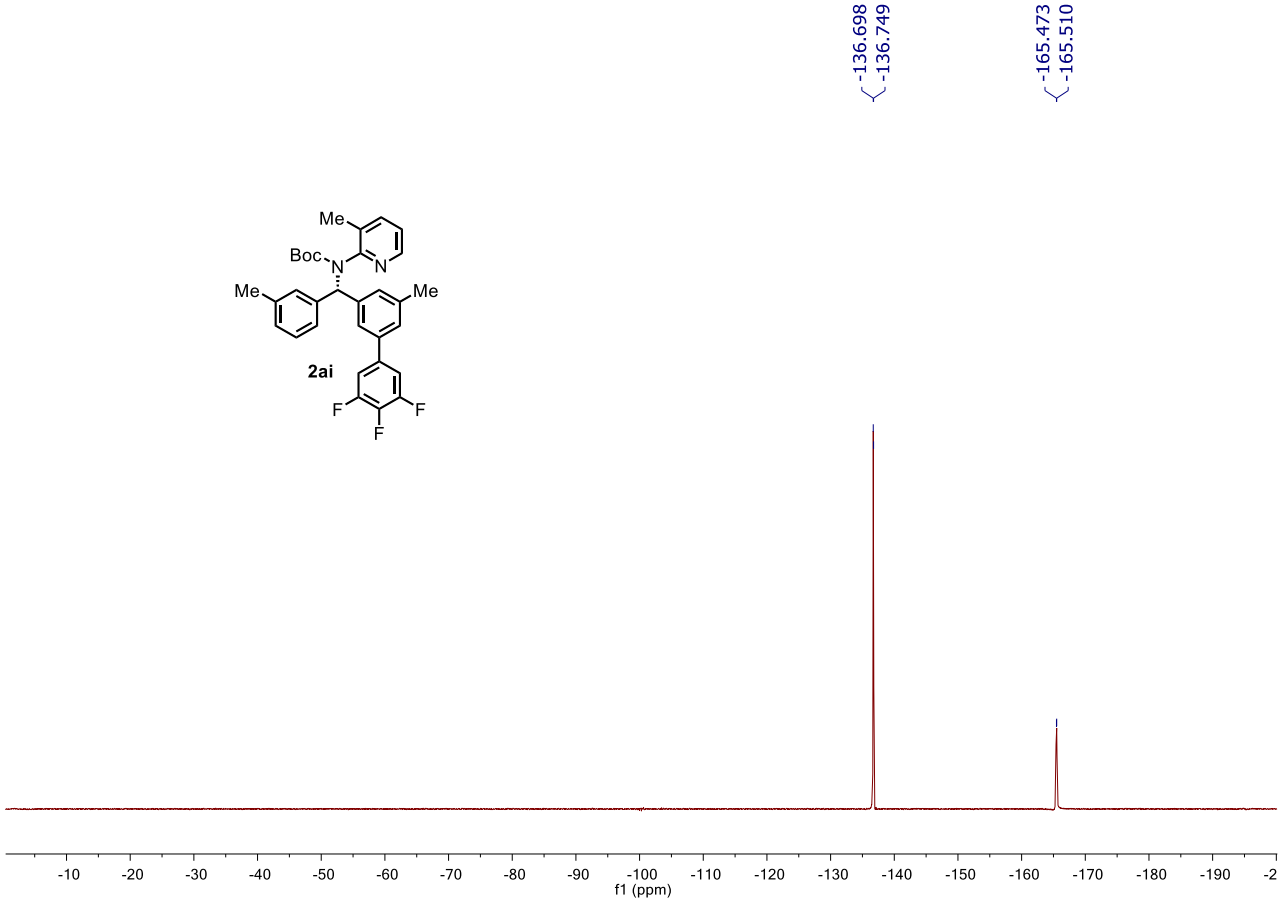
112.180
112.089
112.065
81.457
67.933
28.626
21.559
17.989
1.733
1.595
1.458
1.320
1.183
1.045
0.908
solvent
Me
Boc
N
N
Me
Me
2ai
F
F
F
f1 (ppm)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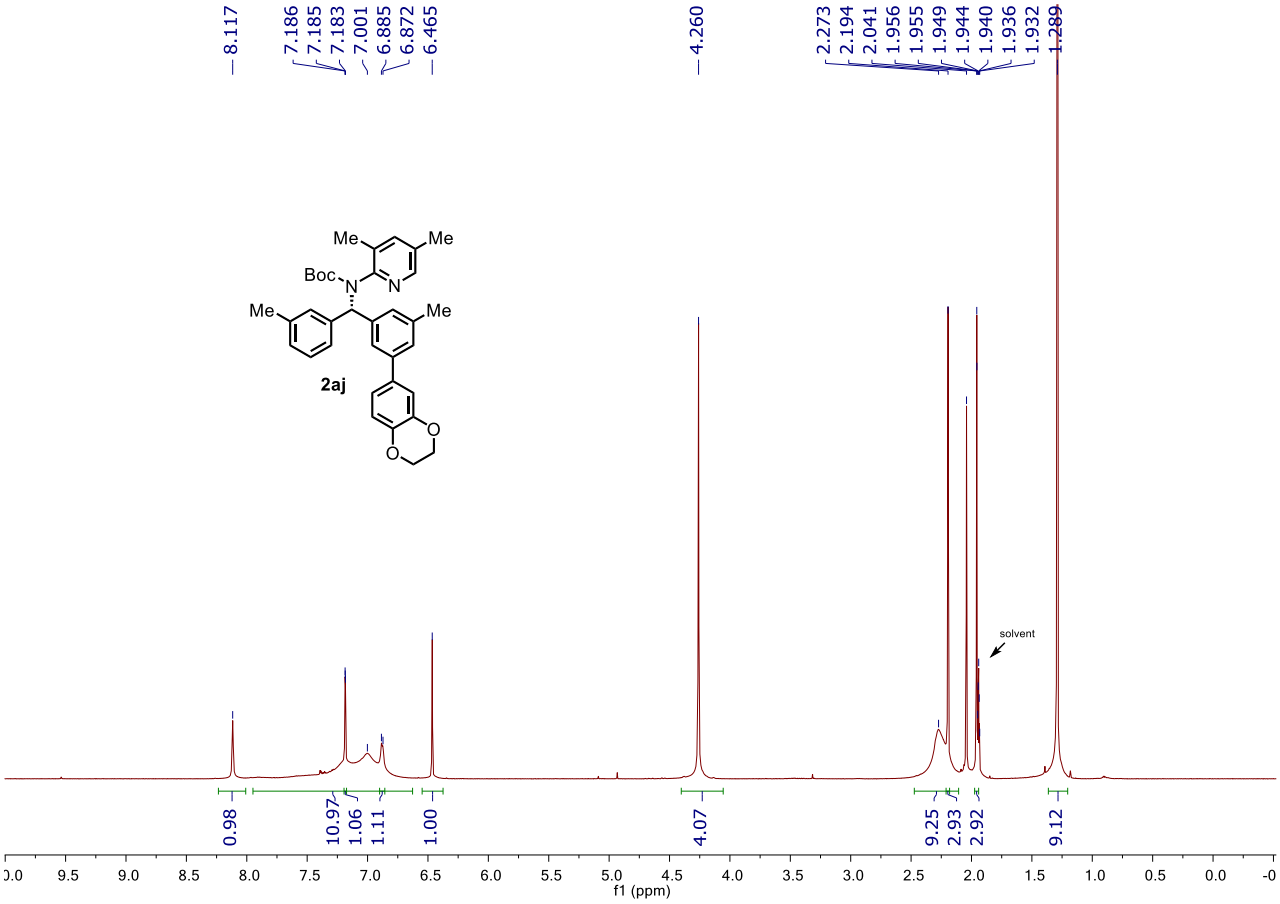
Me
Boc
N
N
Me
Me
2ai
F
F
F
f1 (ppm)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1.955
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1.944
1.940
1.936
1.932
1.289
Me
Me
Boc
N
N
Me
Me
2aj
O
O
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1.00
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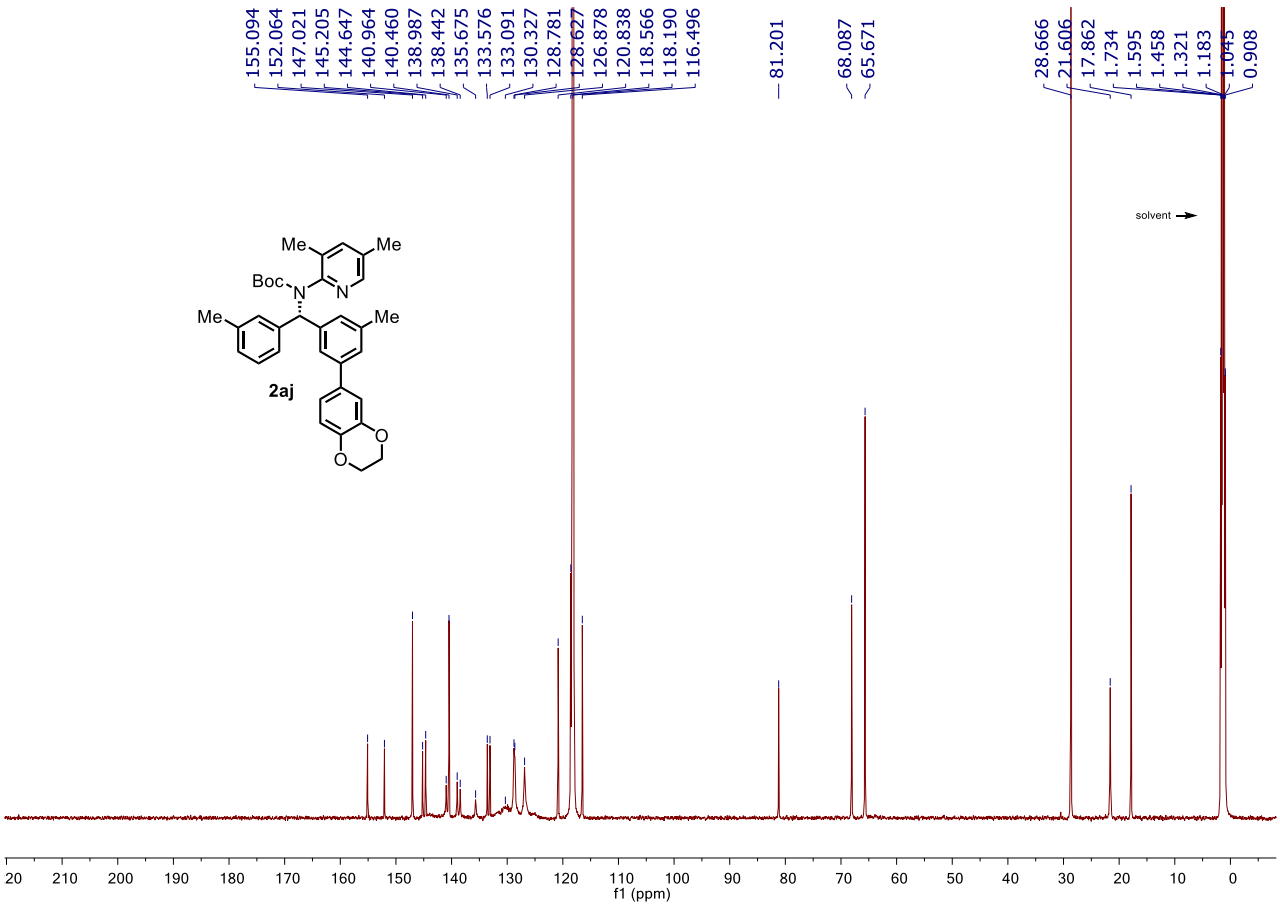
9.12
f1 (ppm)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68.087
65.671
28.666
21.606
17.862
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1.458
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Boc
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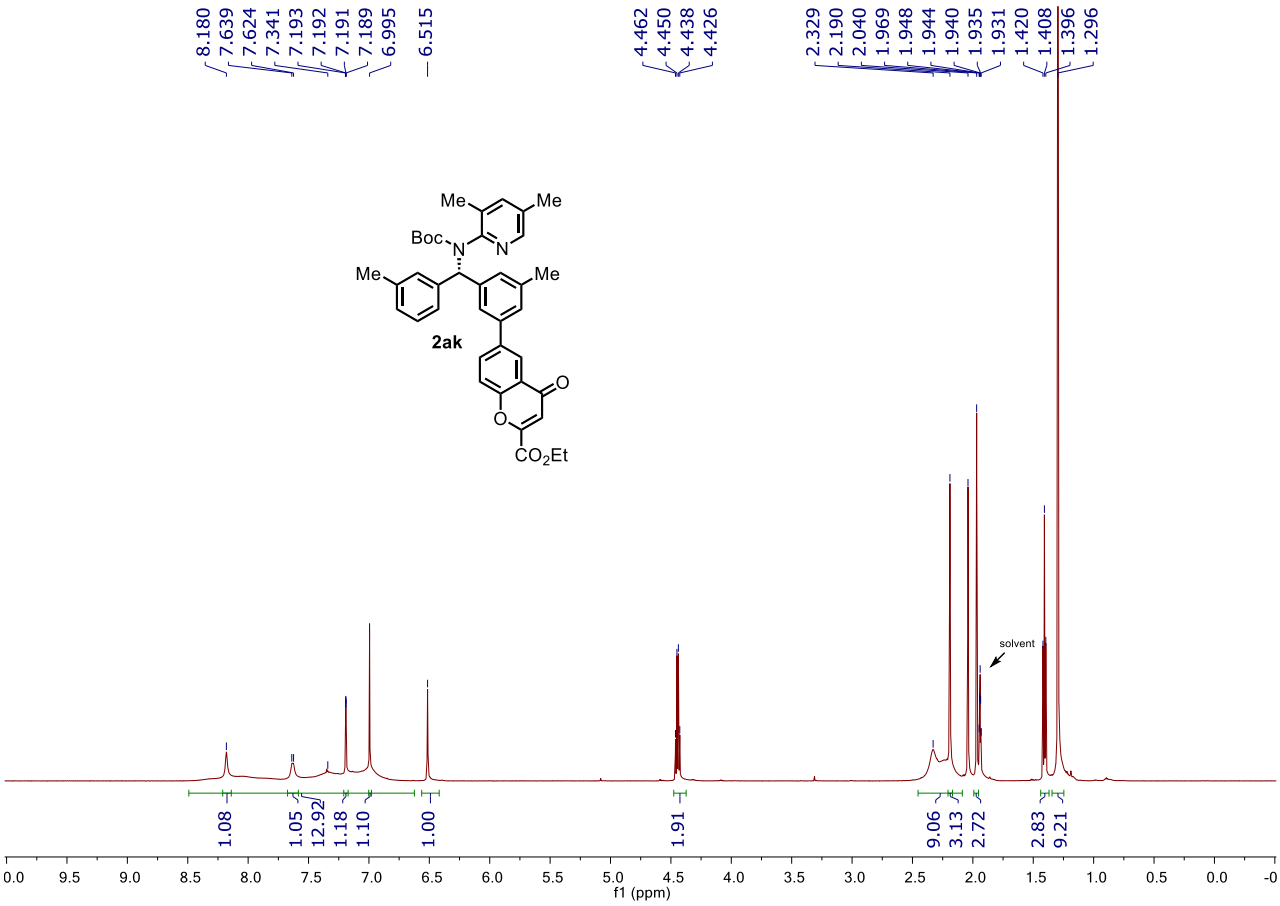
Me
2aj
O
O
solvent
f1 (ppm)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4.426
2.329
2.190
2.040
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1.948
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Boc
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Me
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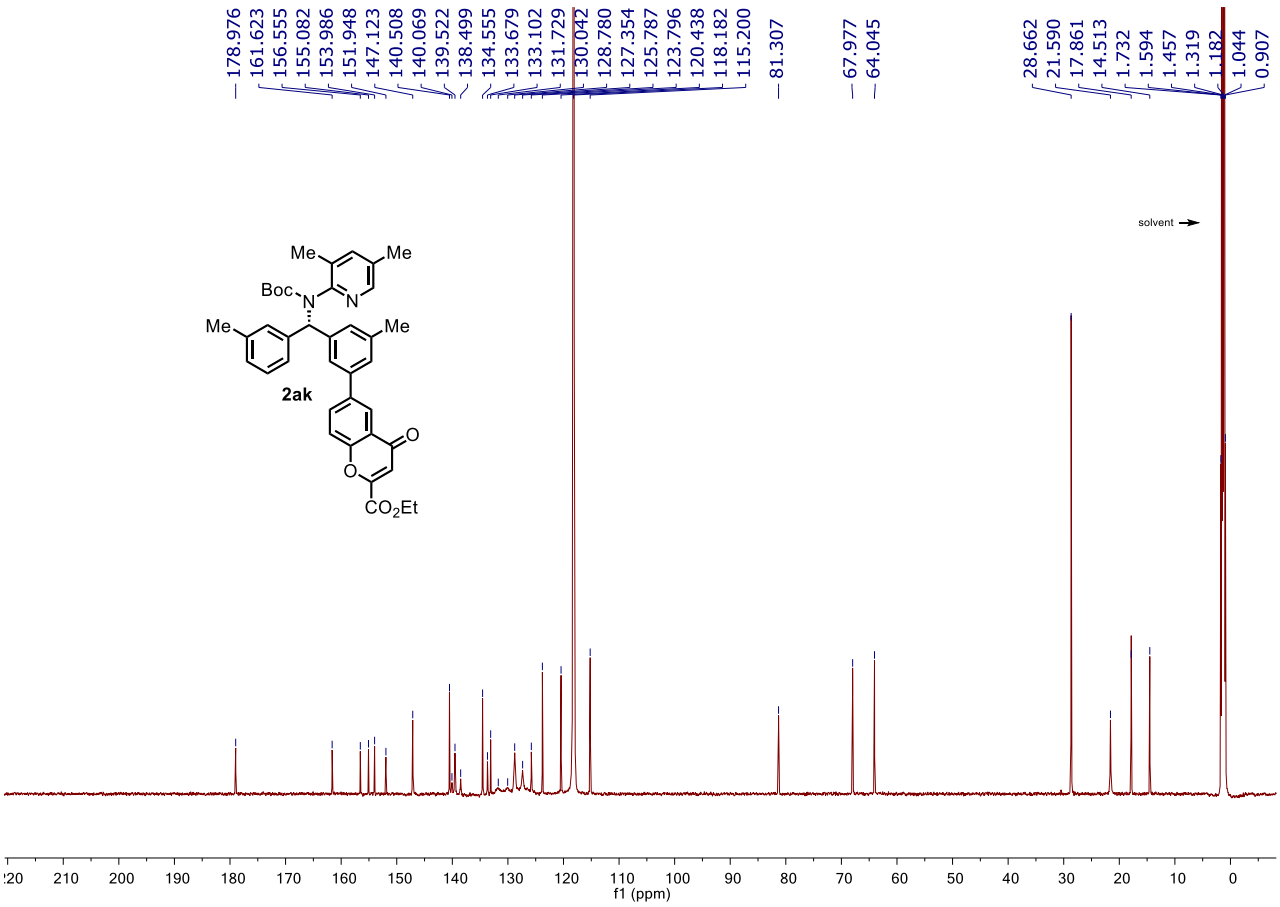
f1 (ppm)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131.729
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128.780
127.354
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123.796
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115.200
81.307
67.977
64.045
28.662
21.590
17.861
14.513
1.732
1.594
1.457
1.319
1.182
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0.907
solvent
Me
Me
Boc
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N
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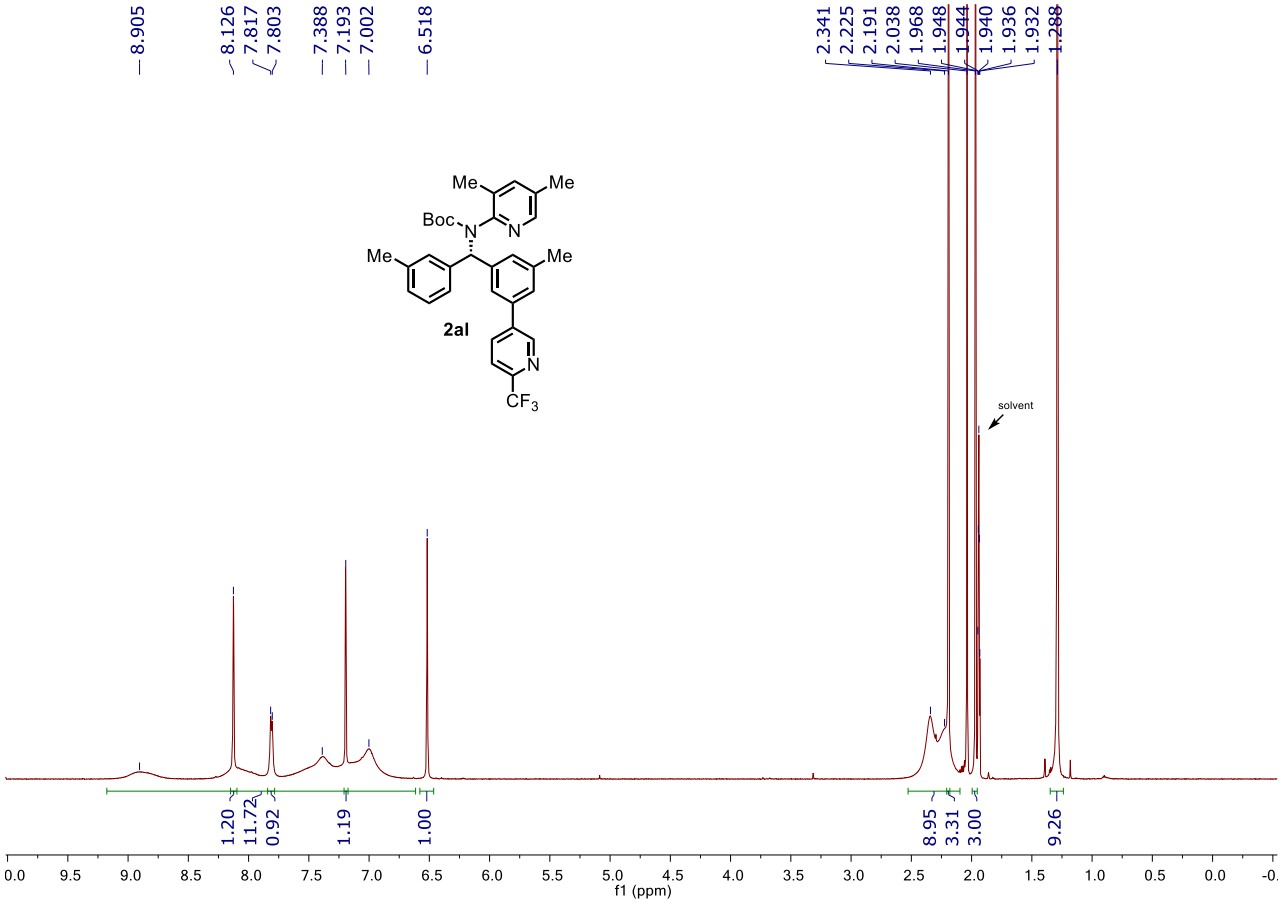
Me
2ak
O
O
CO2Et
f1 (ppm)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2.038
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1.948
1.944
1.940
1.936
1.932
1.288
Me
Me
Boc
N
N
Me
Me
2al
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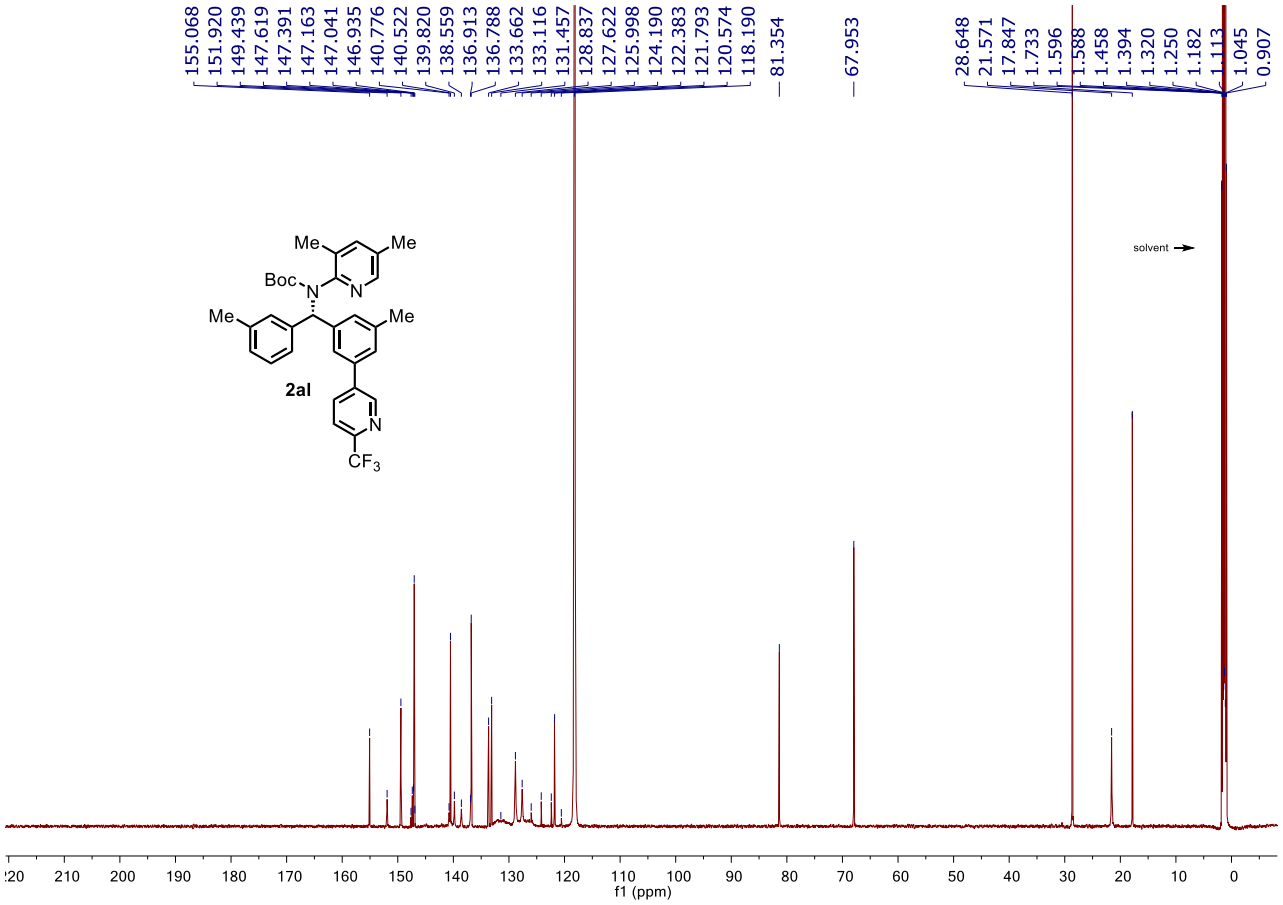
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1.596
1.588
1.458
1.394
1.320
1.250
1.182
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Me
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N
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Me
2al
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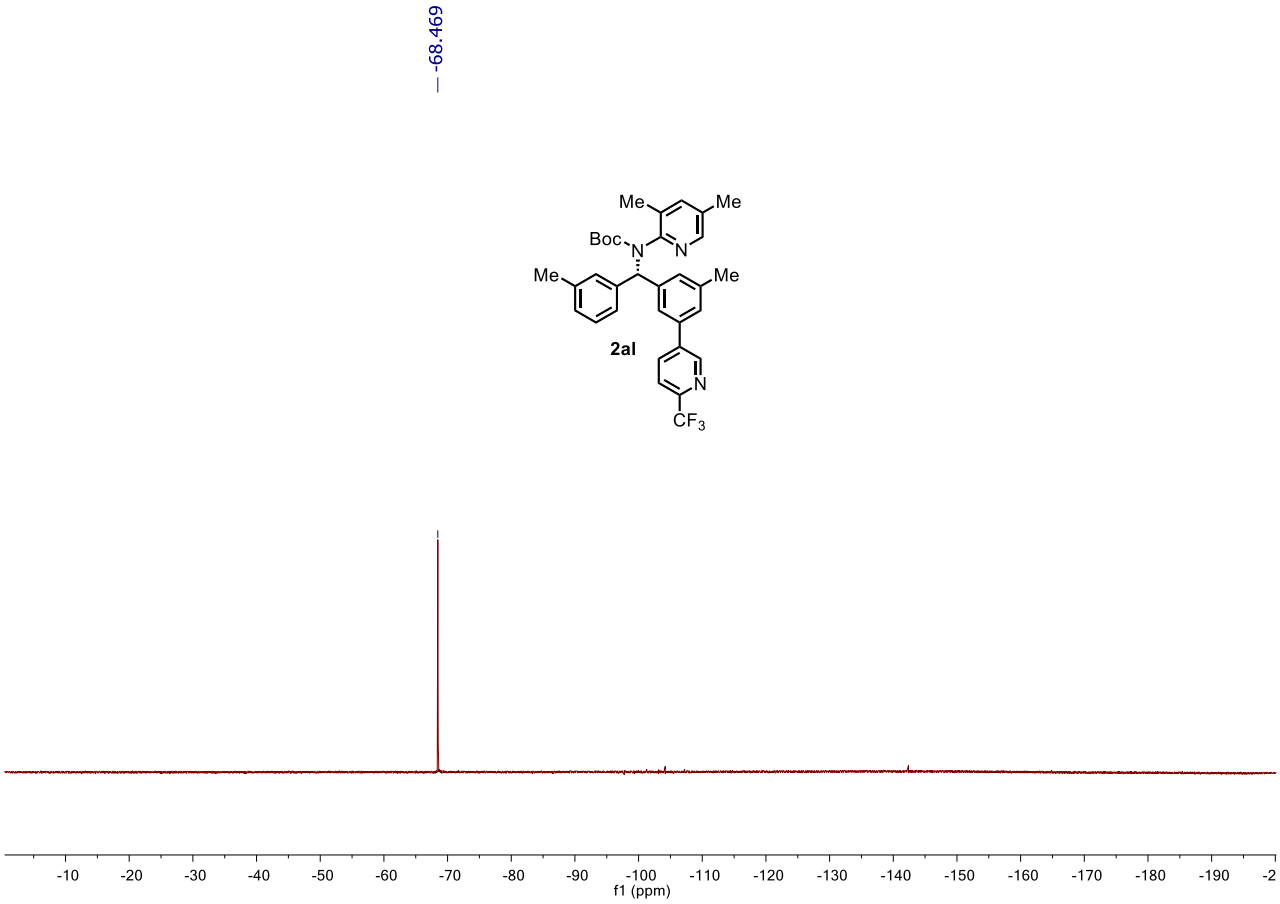
CF3
solvent
f1 (ppm)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CF3
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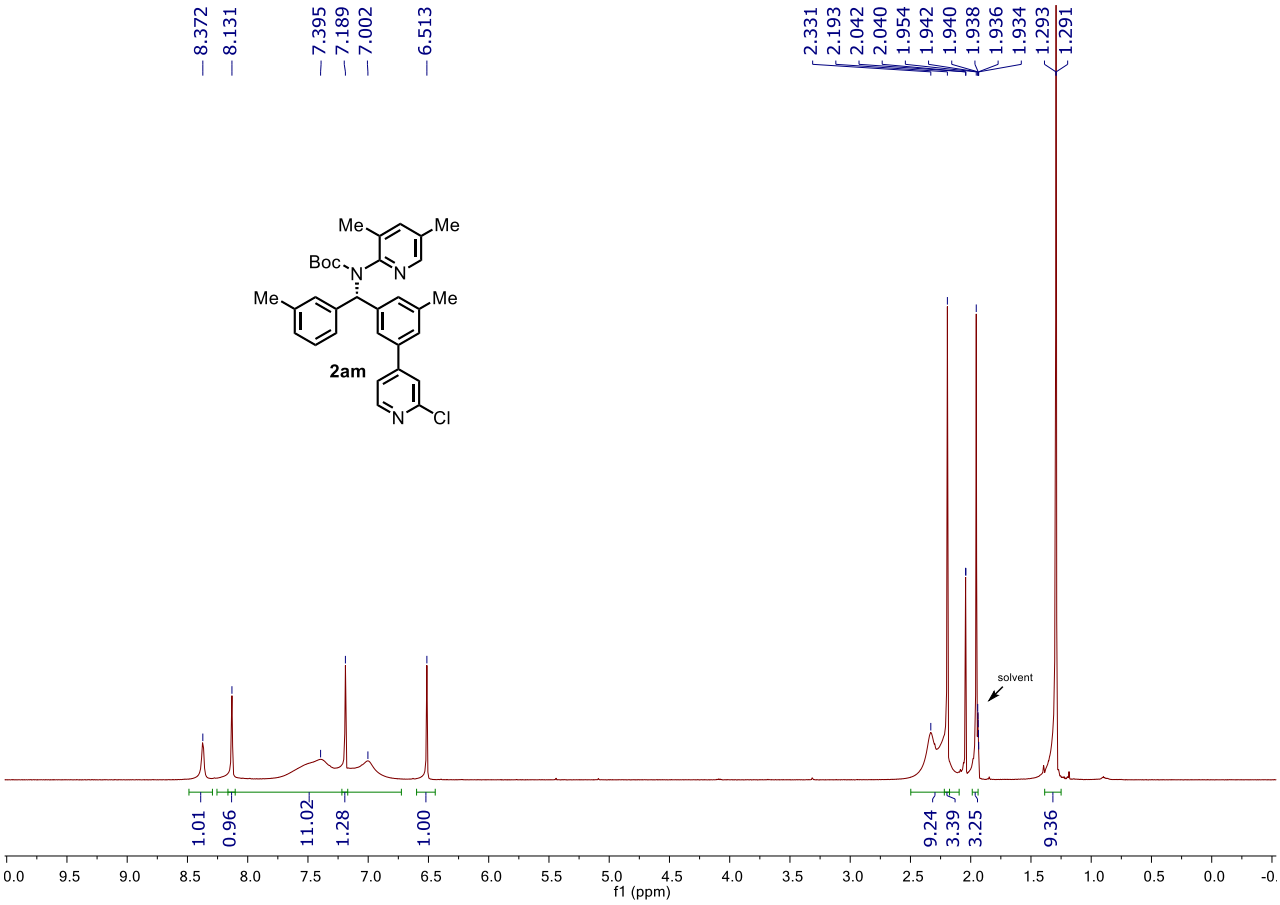
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Boc
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Me
Me
2am
N
Cl
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0.96
11.02
1.28
1.00
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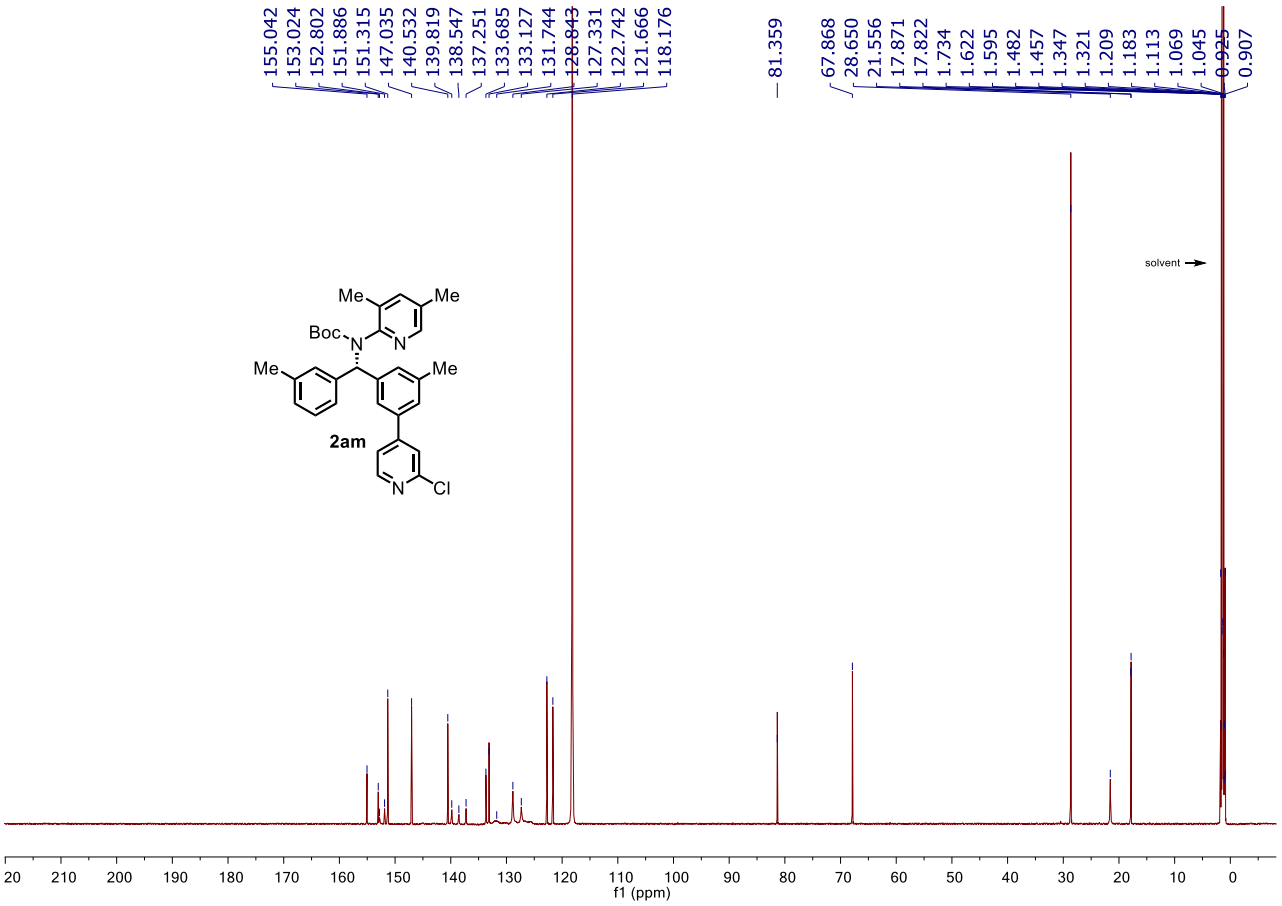
3.39
3.25
9.36
f1 (ppm)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122.742
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118.176
81.359
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28.650
21.556
17.871
17.822
1.734
1.622
1.595
1.482
1.457
1.347
1.321
1.209
1.183
1.113
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Me
Boc
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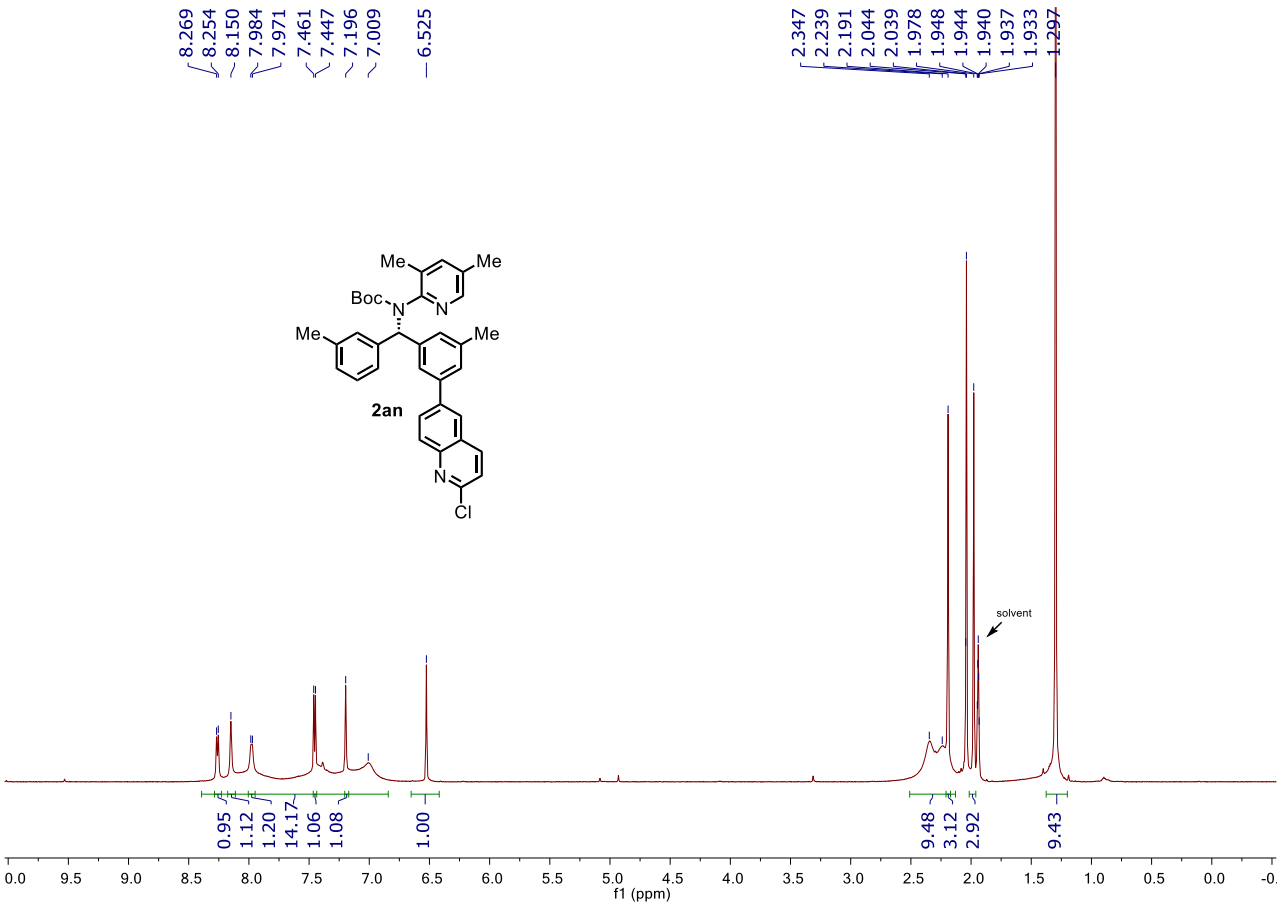
N
Me
Me
2am
N
Cl
f1 (ppm)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2.191
2.044
2.039
1.978
1.948
1.944
1.940
1.937
1.933
1.297
Me
Me
Boc
N
N
Me
Me
2an
N
Cl
solvent
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14.17
1.06
1.08
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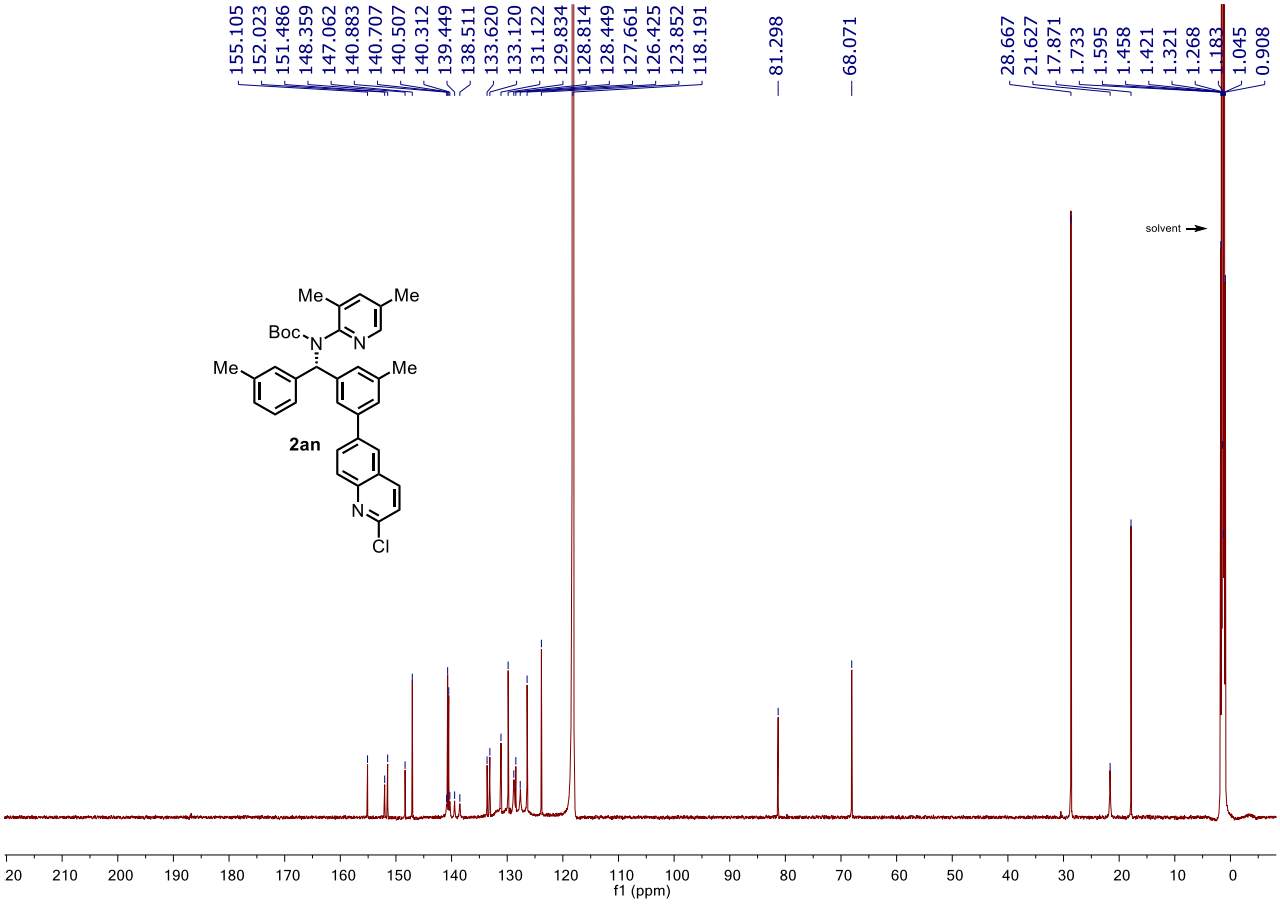
f1 (ppm)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1.595
1.458
1.421
1.321
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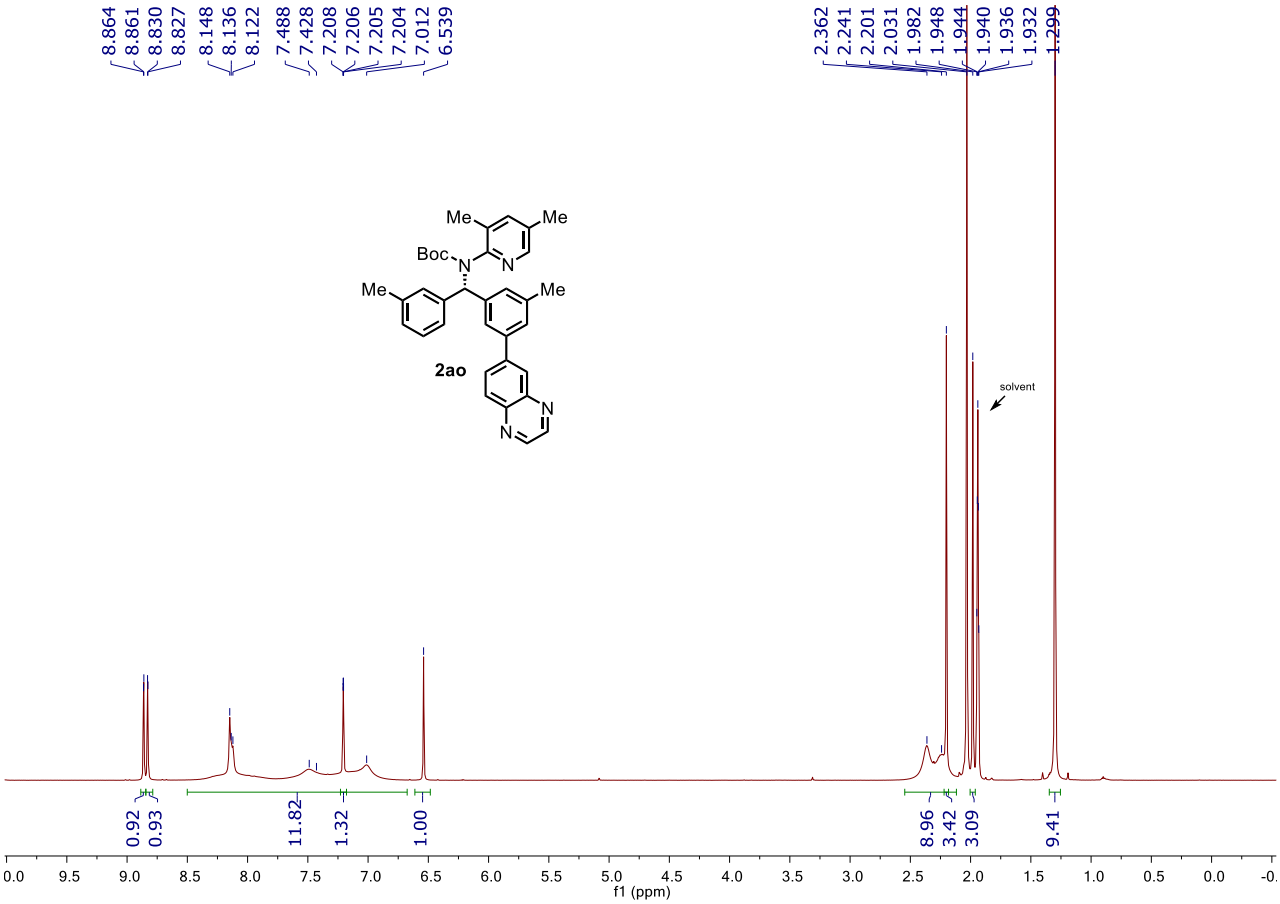
0.908
solvent
Me
Me
Boc
N
N
Me
Me
2an
N
Cl
f1 (ppm)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7.205
7.204
7.012
6.539
2.362
2.241
2.201
2.031
1.982
1.948
1.944
1.940
1.936
1.932
1.299
Me
Me
Boc
N
N
Me
Me
2ao
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N
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0.93
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1.32
1.00
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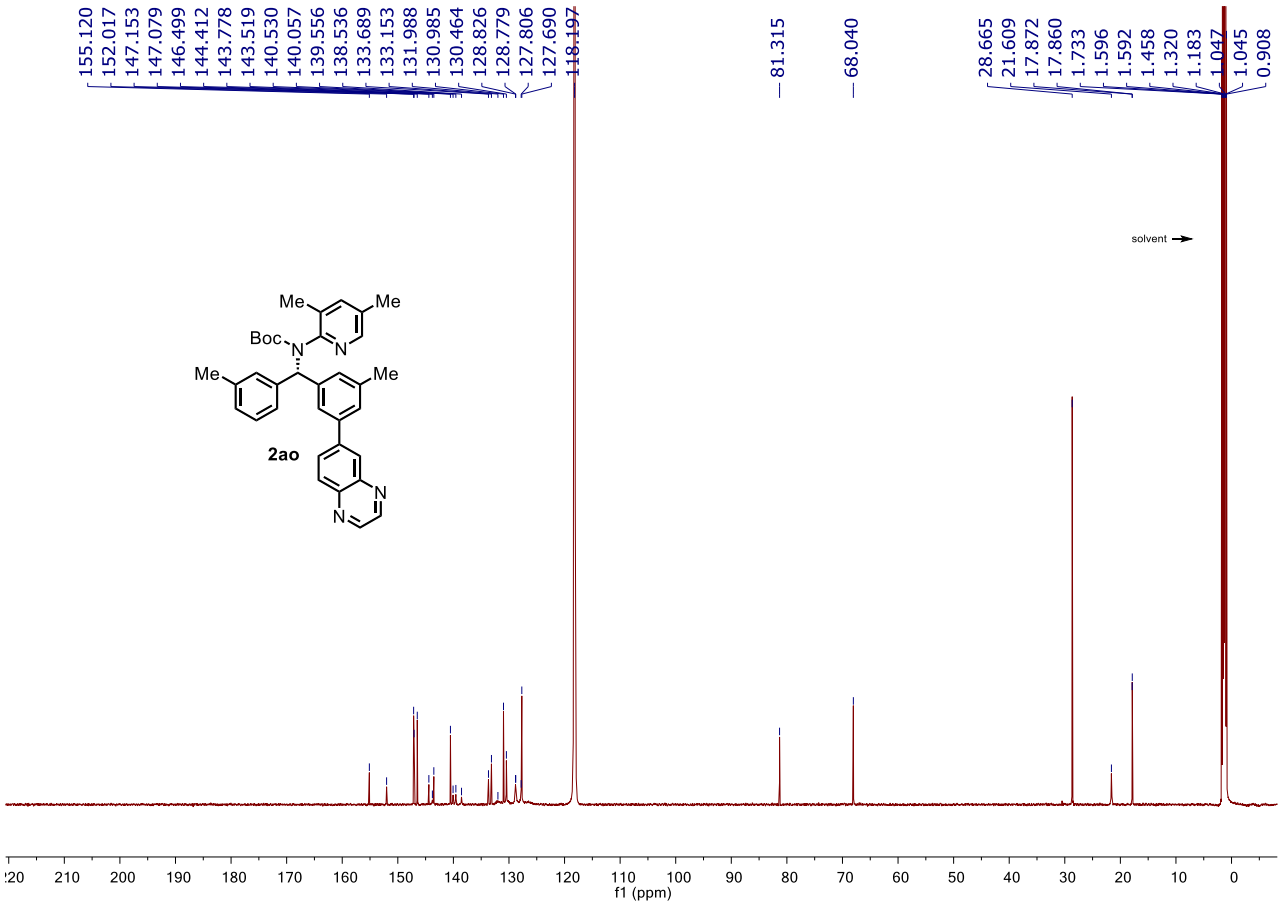
3.42
3.09
9.41
f1 (ppm)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139.556
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133.153
131.988
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130.464
128.826
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127.806
127.690
118.197
81.315
68.040
28.665
21.609
17.872
17.860
1.733
1.596
1.592
1.458
1.320
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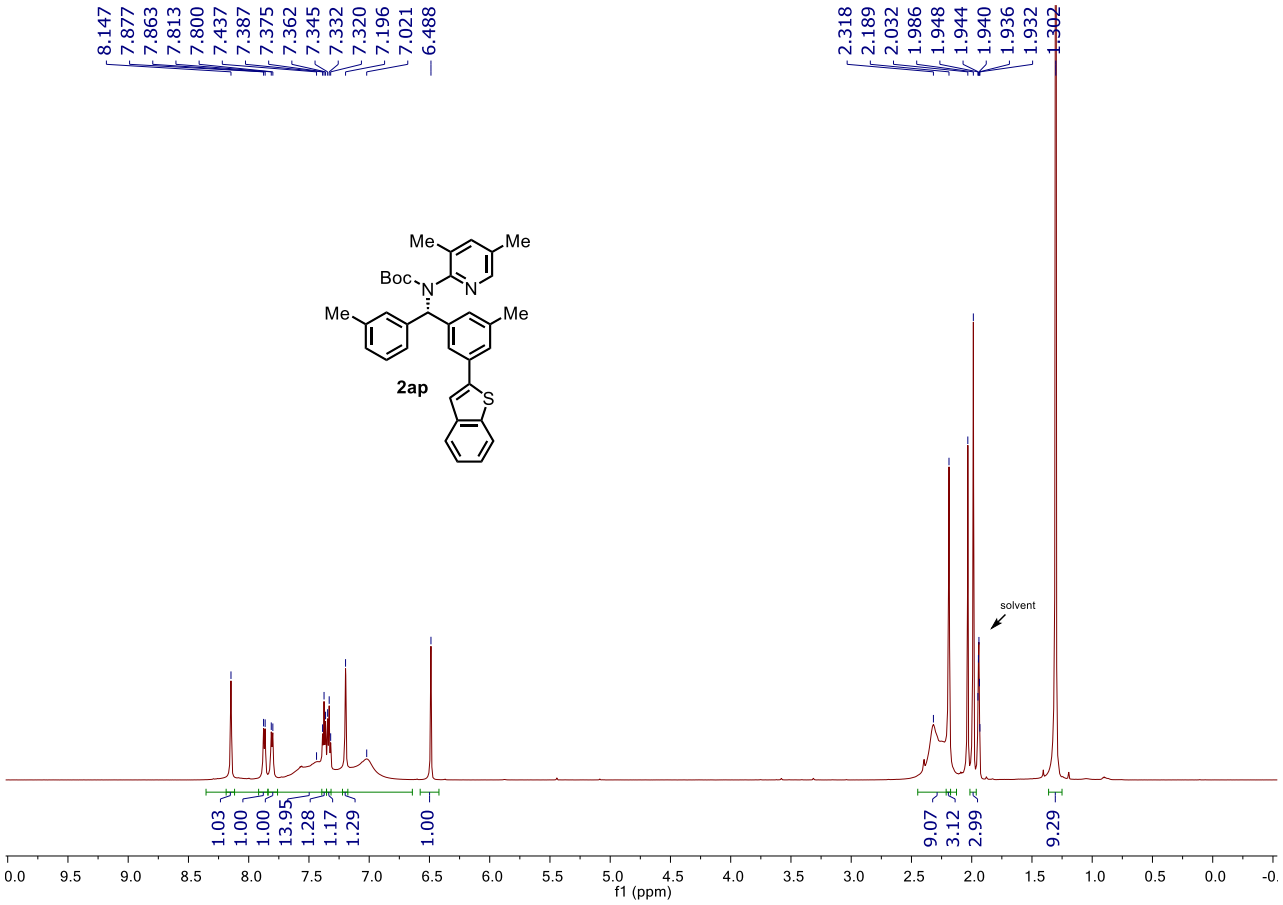
0.908
solvent
Me
Me
Boc
N
N
Me
Me
2ao
N
N
f1 (ppm)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7.437
7.387
7.375
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7.345
7.332
7.320
7.196
7.021
6.488
2.318
2.189
2.032
1.986
1.948
1.944
1.940
1.936
1.932
1.302
Me
Me
Boc
N
N
Me
Me
2ap
S
solvent
1.03
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1.00
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1.28
1.17
1.29
1.00
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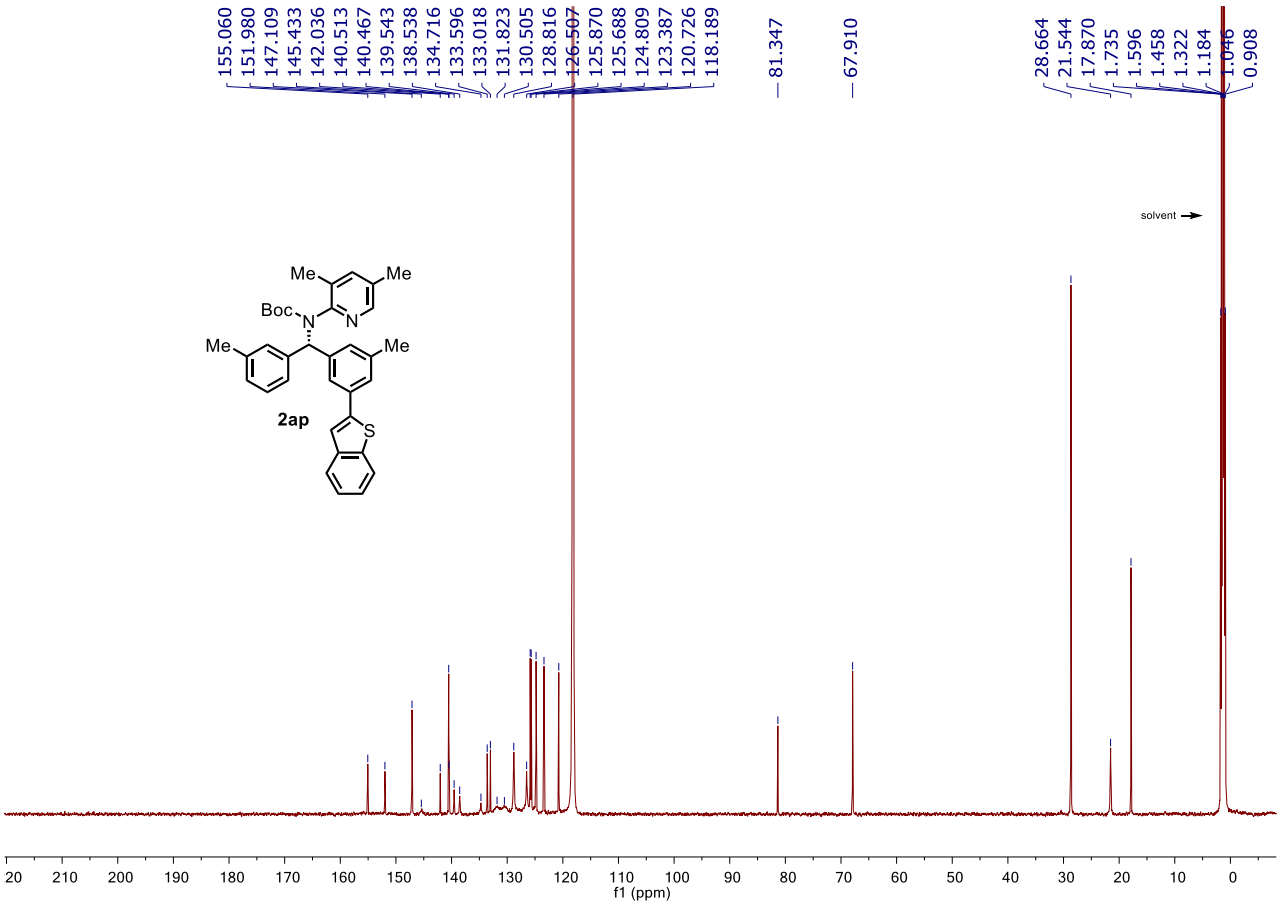
9.29
f1 (ppm)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140.467
139.543
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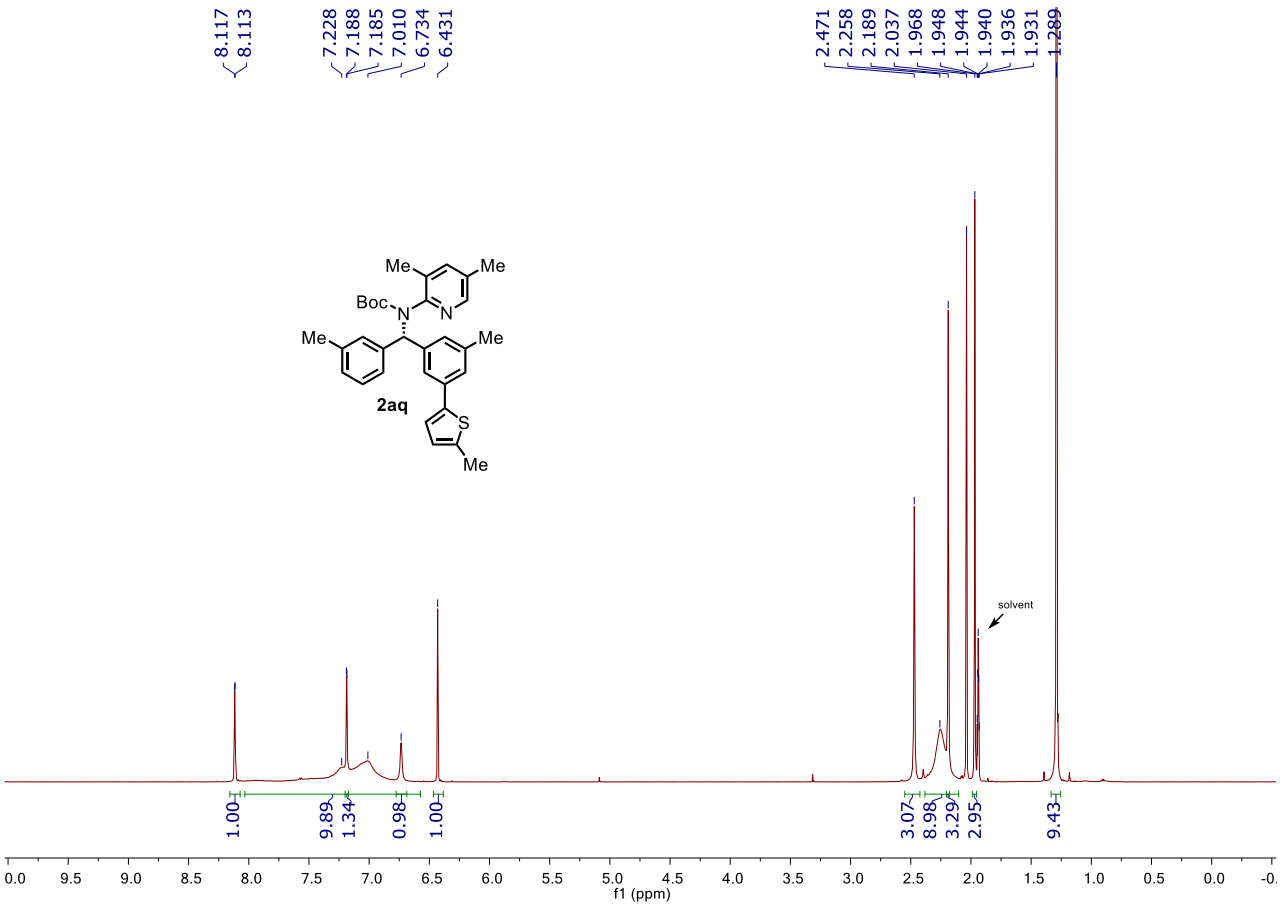
130.505
128.816
126.507
125.870
125.688
124.809
123.387
120.726
118.189
81.347
67.910
28.664
21.544
17.870
1.735
1.596
1.458
1.322
1.184
1.046
0.908
solvent
Me
Me
Boc
N
N
Me
Me
2ap
S
f1 (ppm)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8.113
7.228
7.188
7.185
7.010
6.734
6.431
2.471
2.258
2.189
2.037
1.968
1.948
1.944
1.940
1.936
1.931
1.289
Me
Me
Boc
N
N
Me
Me
2aq
S
Me
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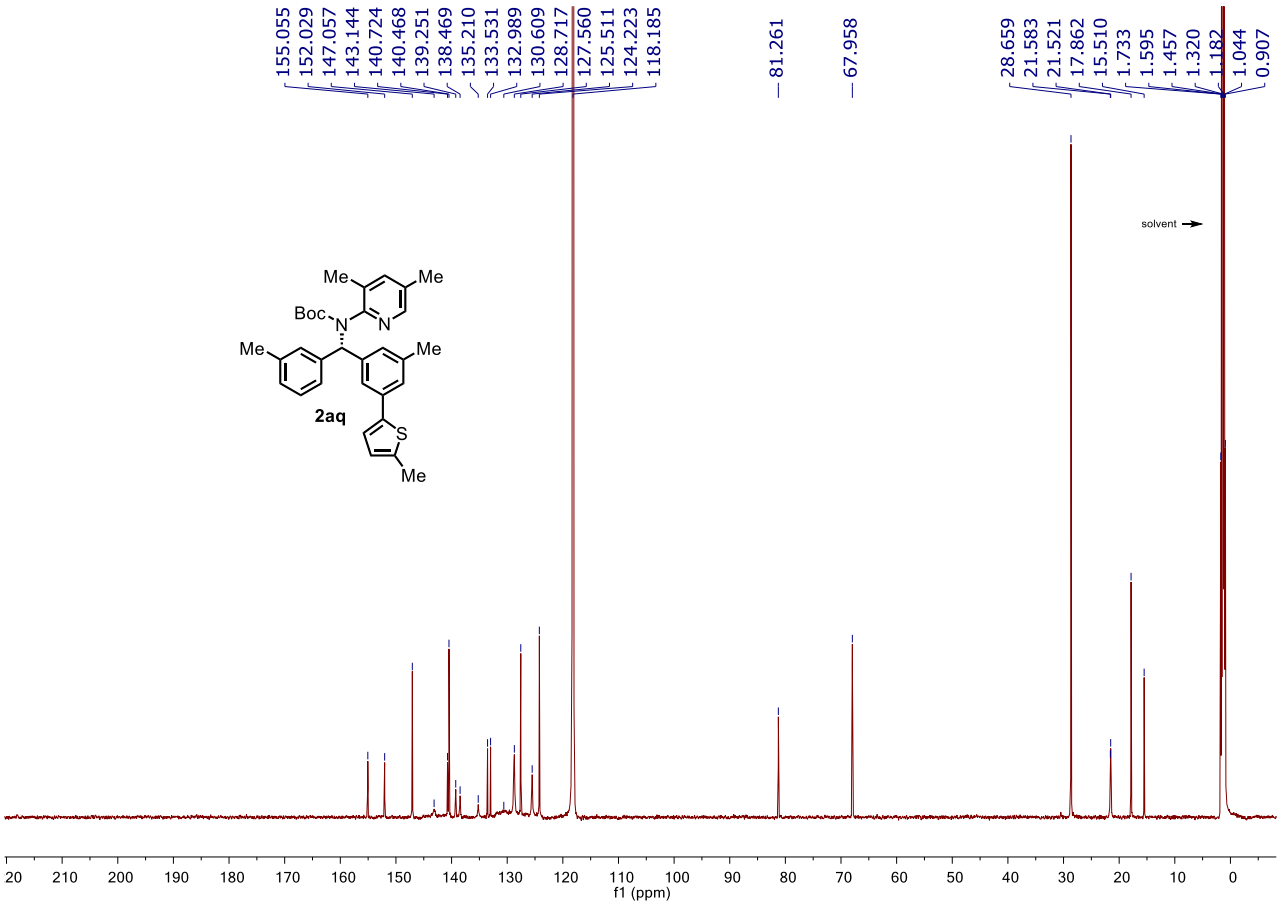
1.34
0.98
1.00
3.07
8.98
3.29
2.95
9.43
f1 (ppm)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138.469
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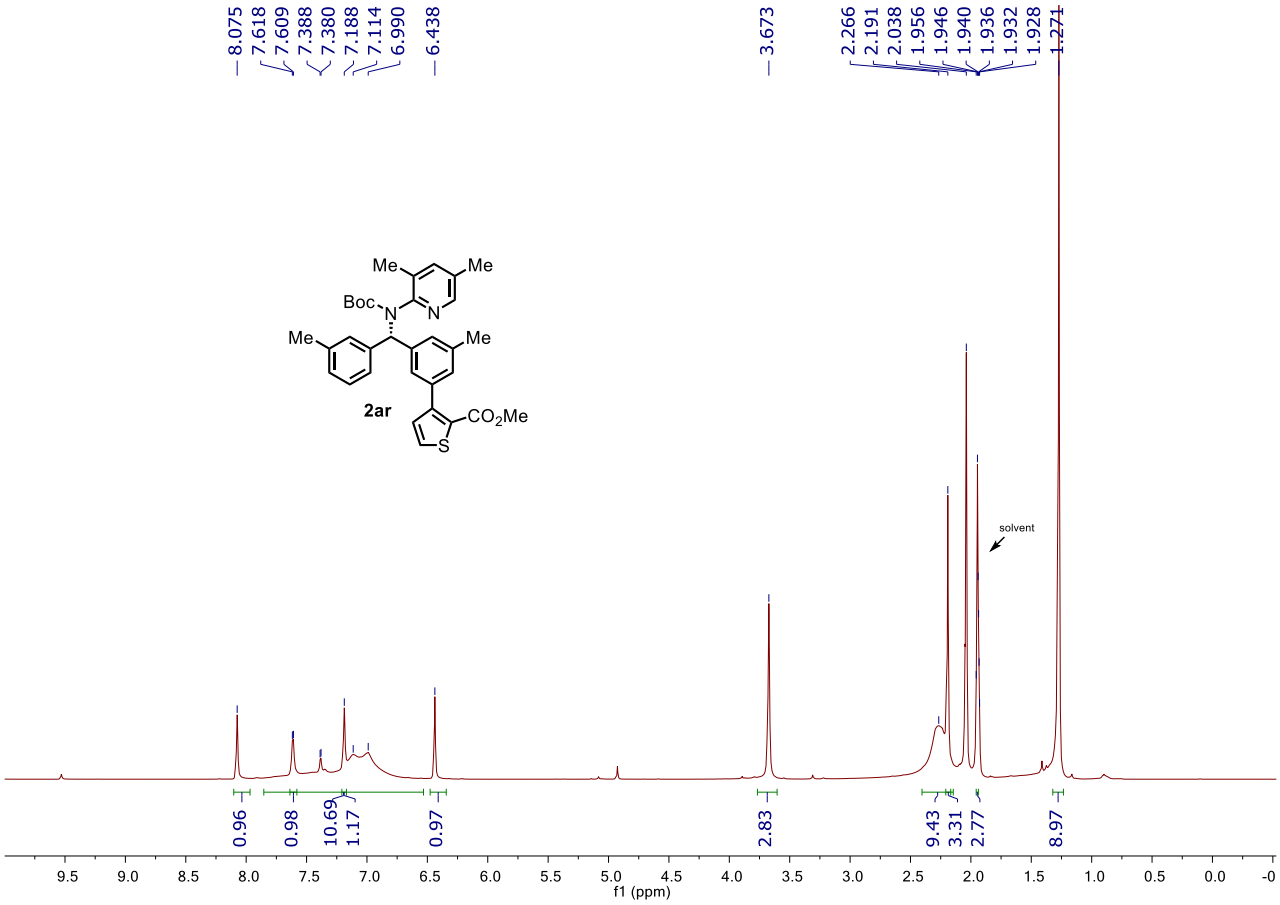
130.609
128.717
127.560
125.511
124.223
118.185
81.261
67.958
28.659
21.583
21.521
17.862
15.510
1.733
1.595
1.457
1.320
1.182
1.044
0.907
solvent
Me
Me
Boc
N
N
Me
Me
2aq
S
Me
f1 (ppm)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7.114
6.990
6.438
3.673
2.266
2.191
2.038
1.956
1.946
1.940
1.936
1.932
1.928
1.271
Me
Me
Boc
N
N
Me
Me
2ar
CO2Me
S
solvent
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10.69
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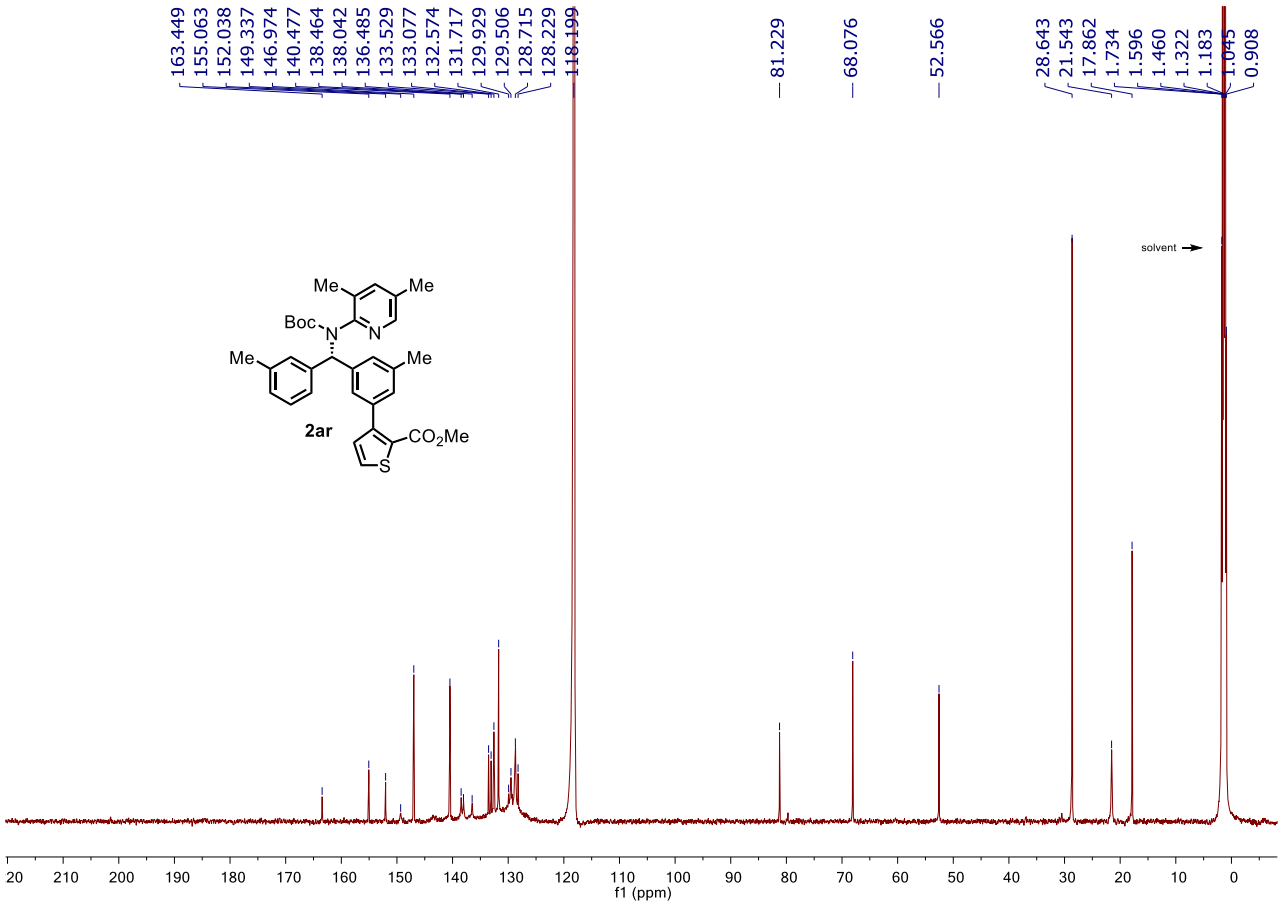
0.97
2.83
9.43
3.31
2.77
8.97
f1 (ppm)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138.042
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133.529
133.077
132.574
131.717
129.929
129.506
128.715
128.229
118.199
81.229
68.076
52.566
28.643
21.543
17.862
1.734
1.596
1.460
1.322
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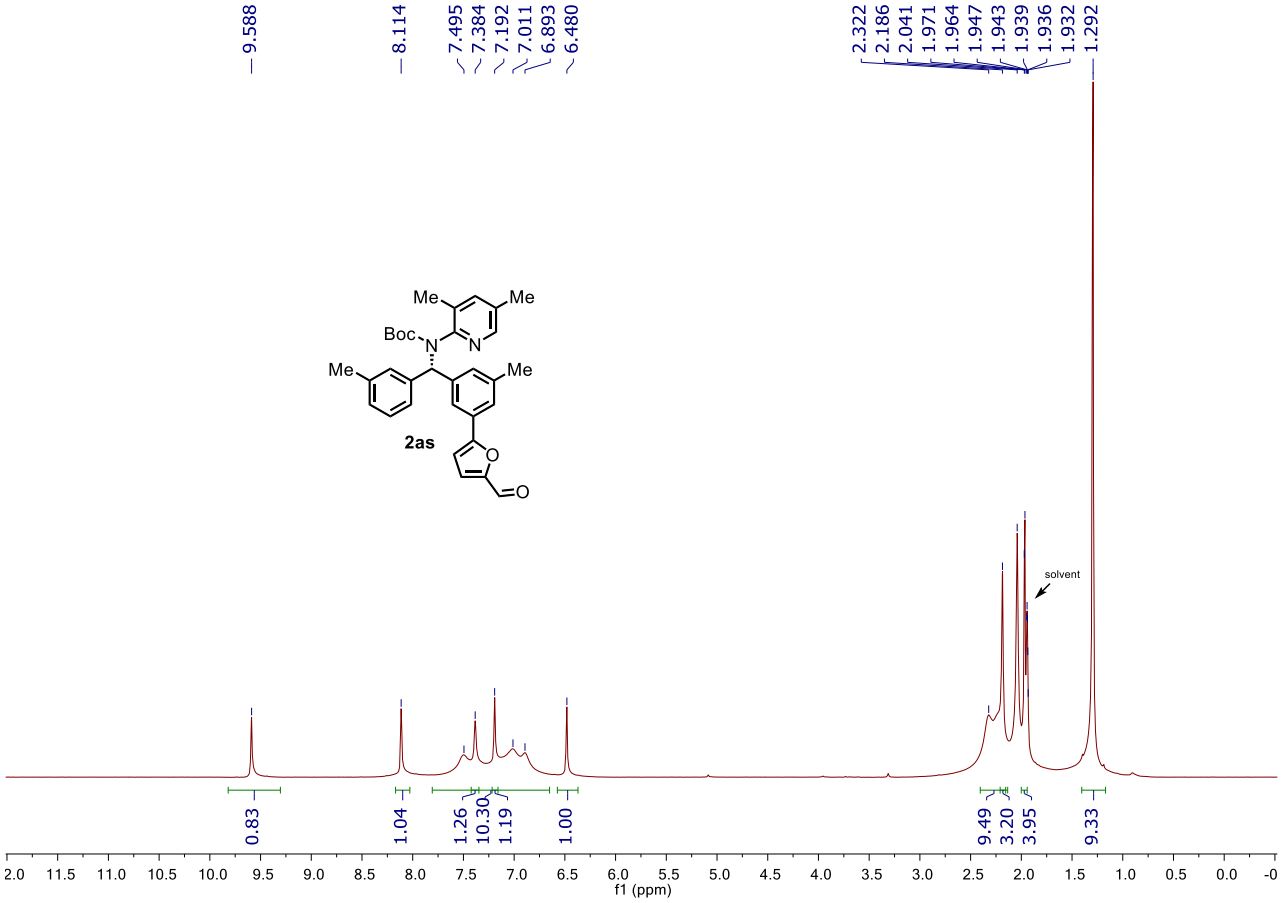
0.908
solvent
Me
Me
Boc
N
N
Me
Me
2ar
CO2Me
S
f1 (ppm)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7.384
7.192
7.011
6.893
6.480
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2.186
2.041
1.971
1.964
1.947
1.943
1.939
1.936
1.932
1.292
Me
Me
Boc
N
N
Me
Me
2as
O
O
solvent
0.83
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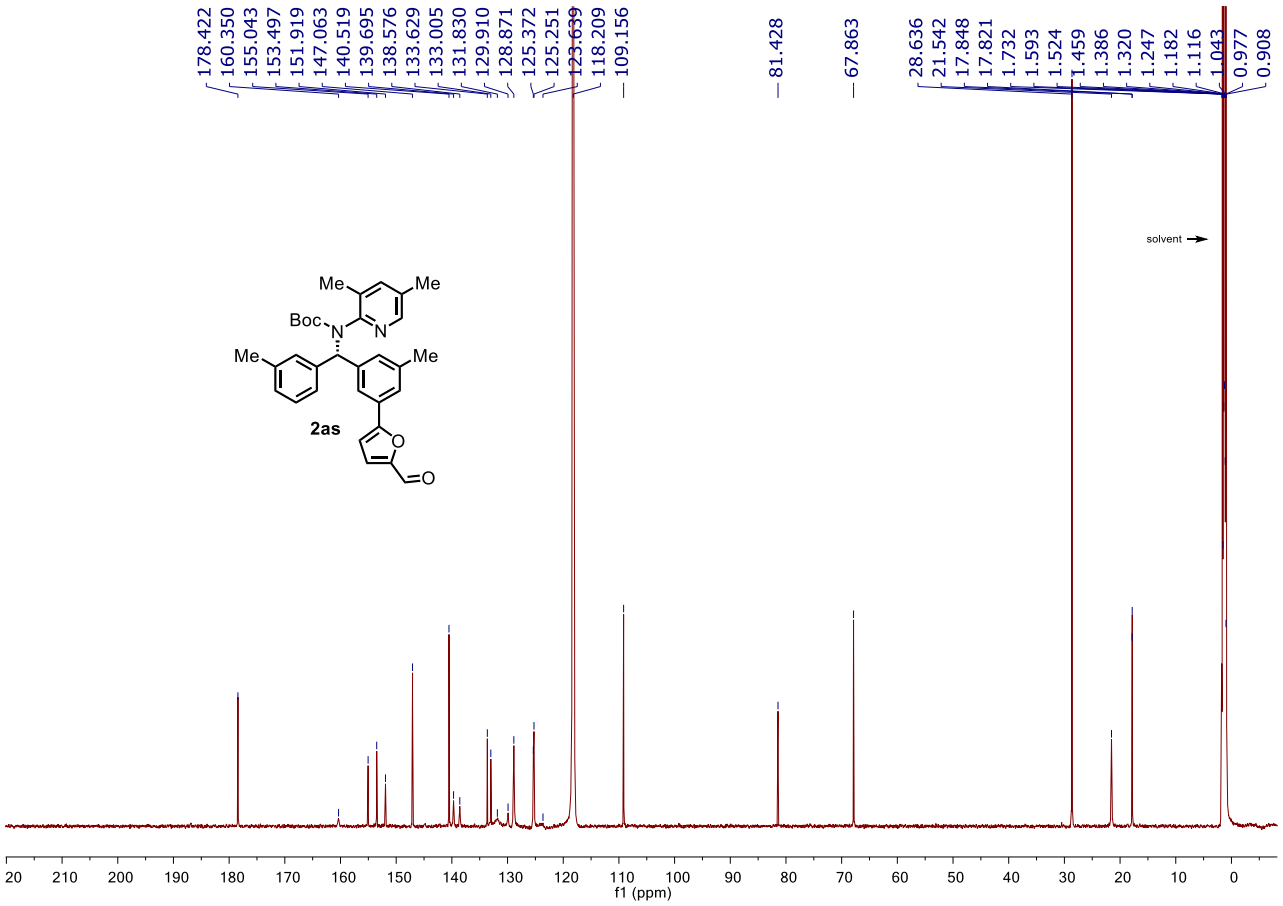
1.26
10.30
1.19
1.00
9.49
3.20
3.95
9.33
f1 (ppm)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140.519
139.695
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133.005
131.830
129.910
128.871
125.372
125.251
123.639
118.209
109.156
81.428
67.863
28.636
21.542
17.848
17.821
1.732
1.593
1.524
1.459
1.386
1.320
1.247
1.182
1.116
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0.908
solvent
Me
Me
Boc
N
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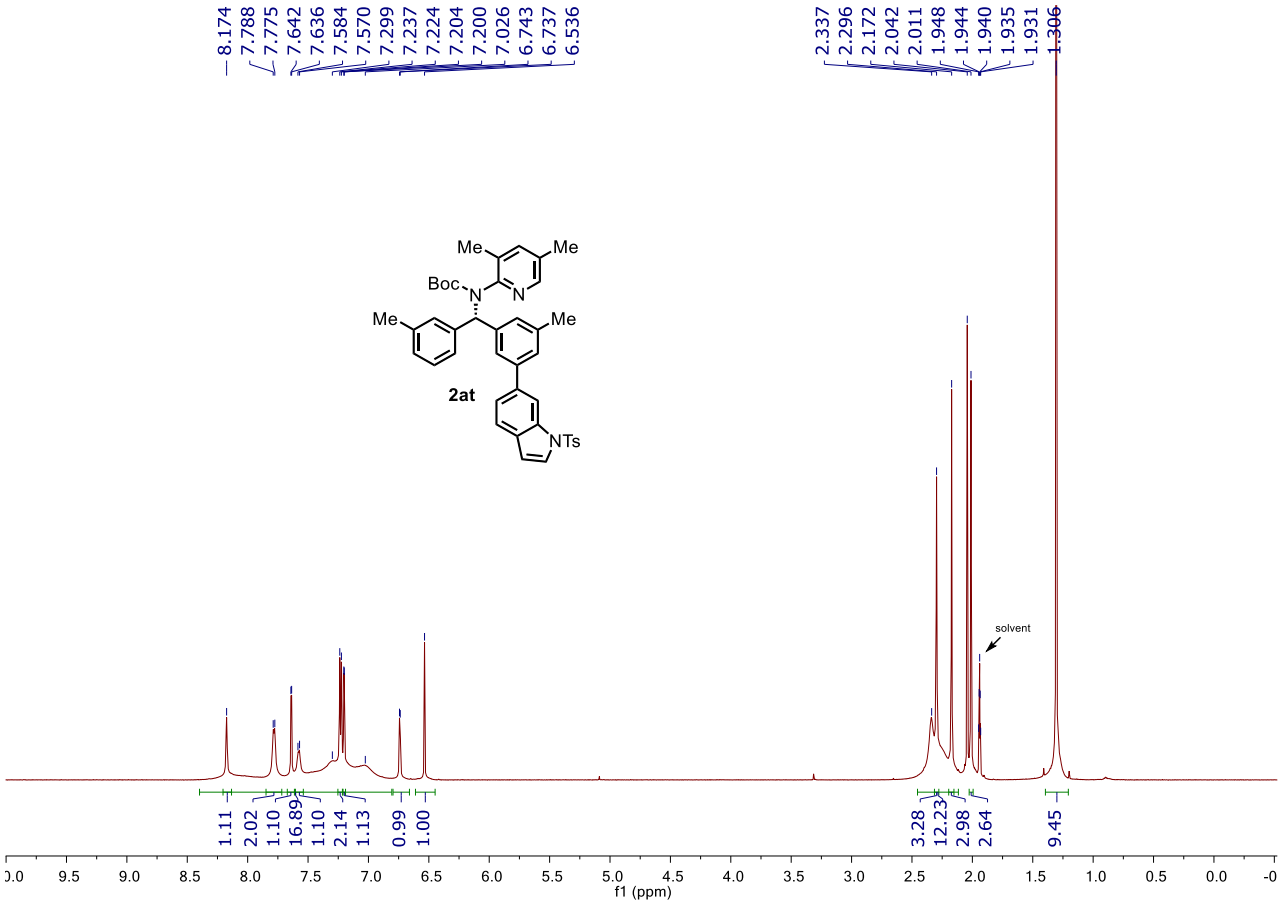
Me
Me
2as
O
O
f1 (ppm)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6.743
6.737
6.536
2.337
2.296
2.172
2.042
2.011
1.948
1.944
1.940
1.935
1.931
1.306
Me
Me
Boc
N
N
Me
Me
2at
NTs
solvent
1.11
2.02
1.10
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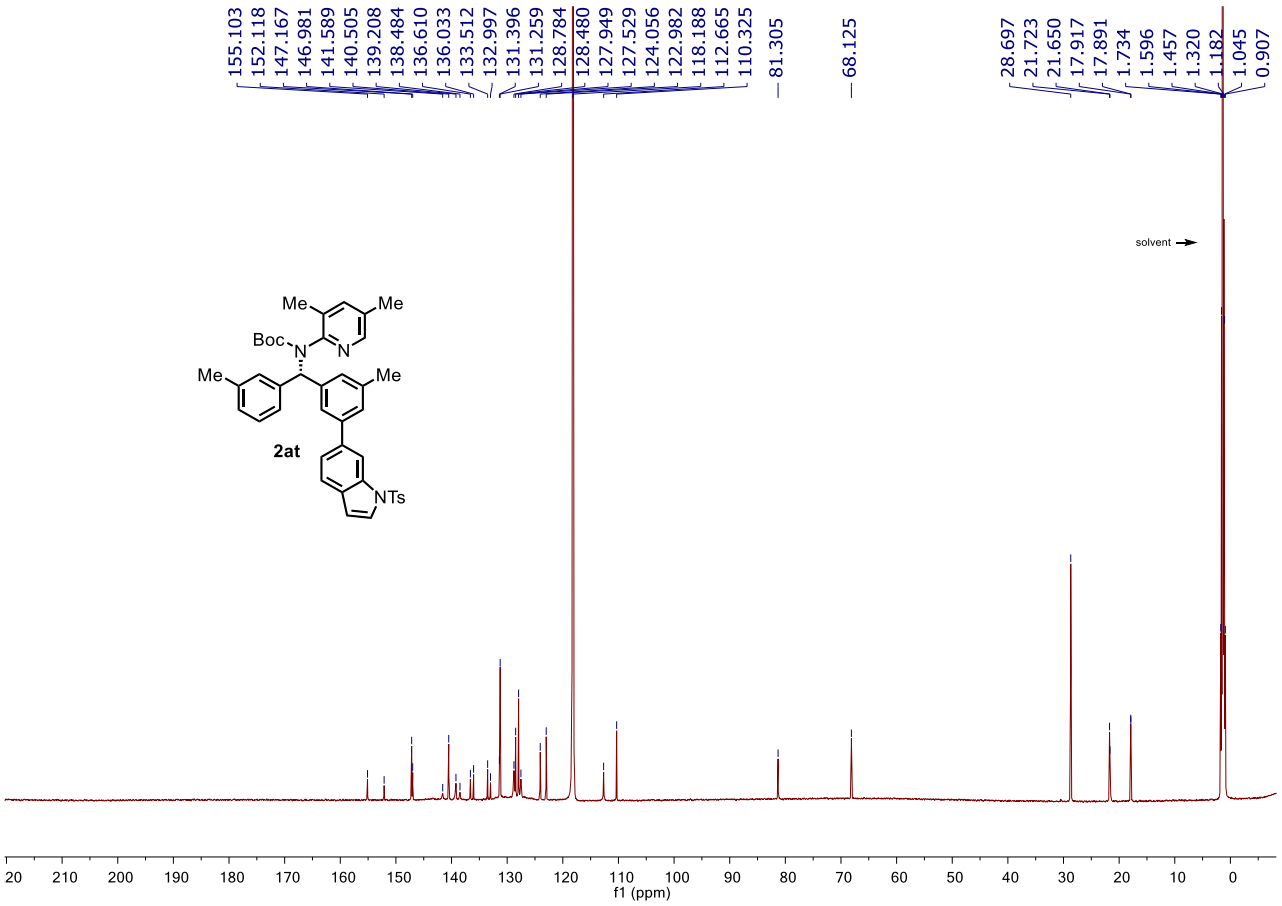
f1 (ppm)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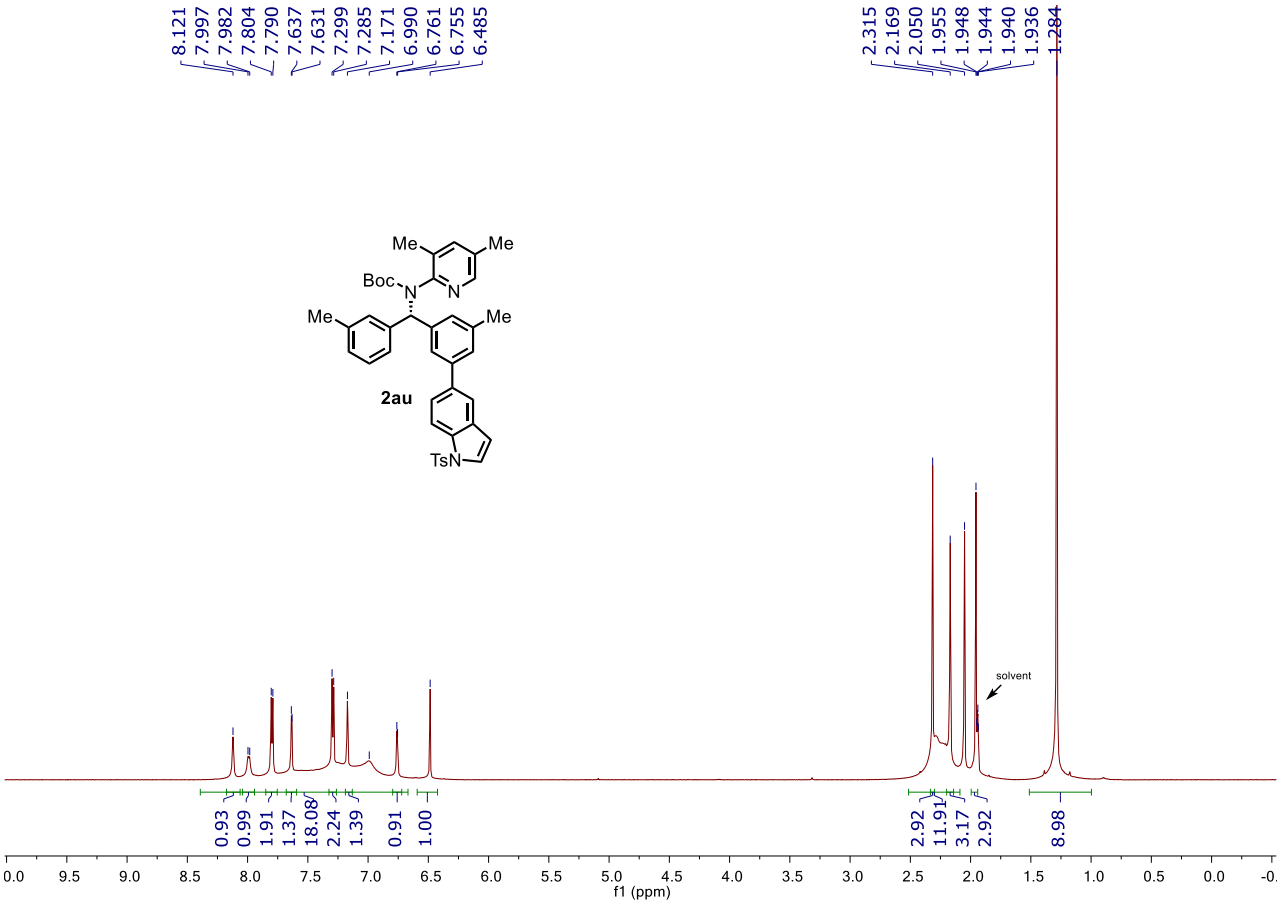
133.512
132.997
131.396
131.259
128.784
128.480
127.949
127.529
124.056
122.982
118.188
112.665
110.325
81.305
68.125
28.697
21.723
21.650
17.917
17.891
1.734
1.596
1.457
1.320
1.182
1.045
0.907
solvent
Me
Me
Boc
N
N
Me
Me
2at
NTs
f1 (ppm)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7.171
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6.755
6.485
2.315
2.169
2.050
1.955
1.948
1.944
1.940
1.936
1.284
Me
Me
Boc
N
N
Me
Me
2au
TsN
solvent
0.93
0.99
1.91
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18.08
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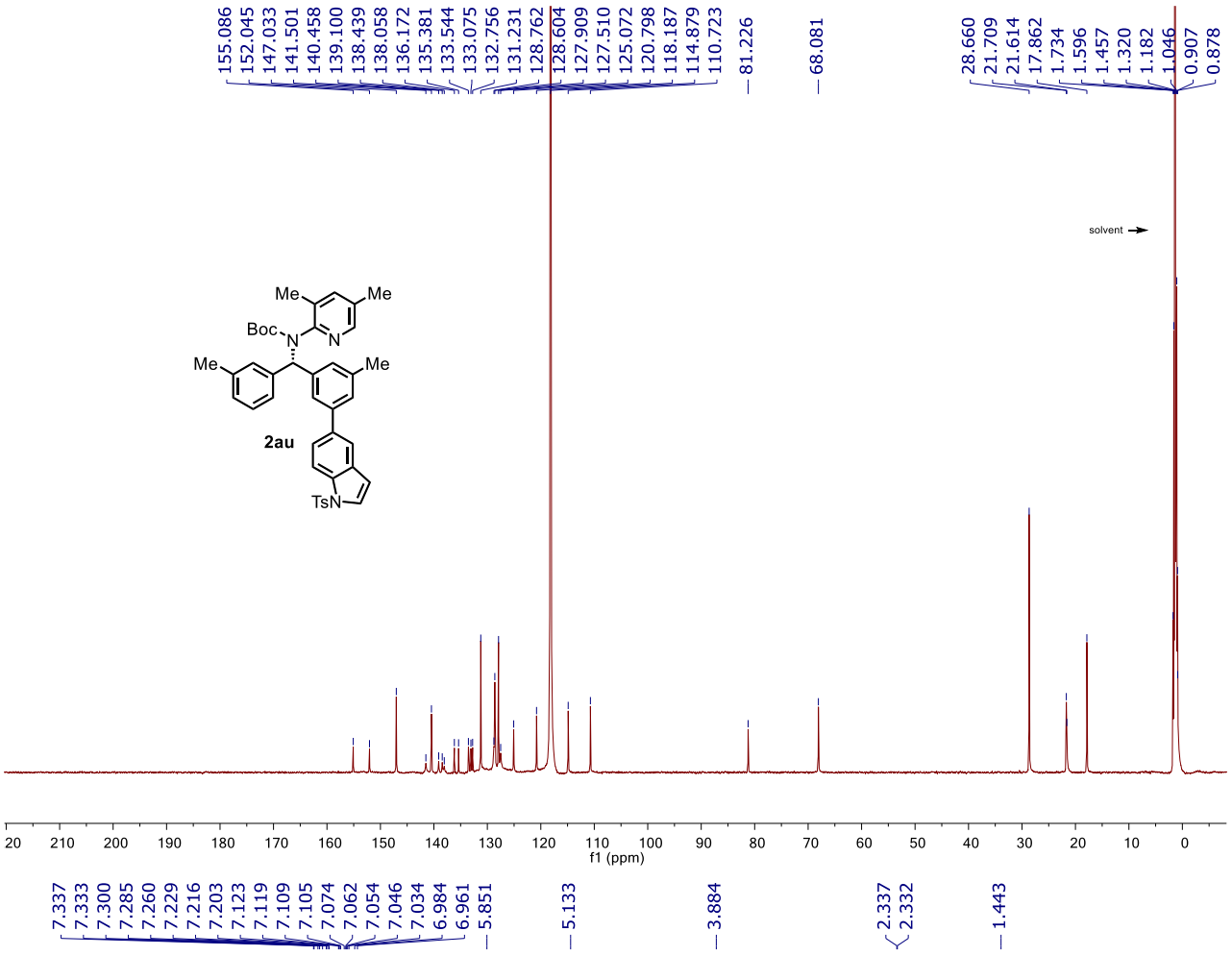
1.39
0.91
1.00
2.92
11.91
3.17
2.92
8.98
f1 (ppm)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114.879
110.723
81.226
68.081
28.660
21.709
21.614
17.862
1.734
1.596
1.457
1.320
1.182
1.046
0.907
0.878
solvent
Me
Me
Boc
N
N
Me
Me
2au
TsN
f1 (ppm)
7.337
7.333
7.300
7.285
7.260
7.229
7.216
7.203
7.123
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7.109
7.105
7.074
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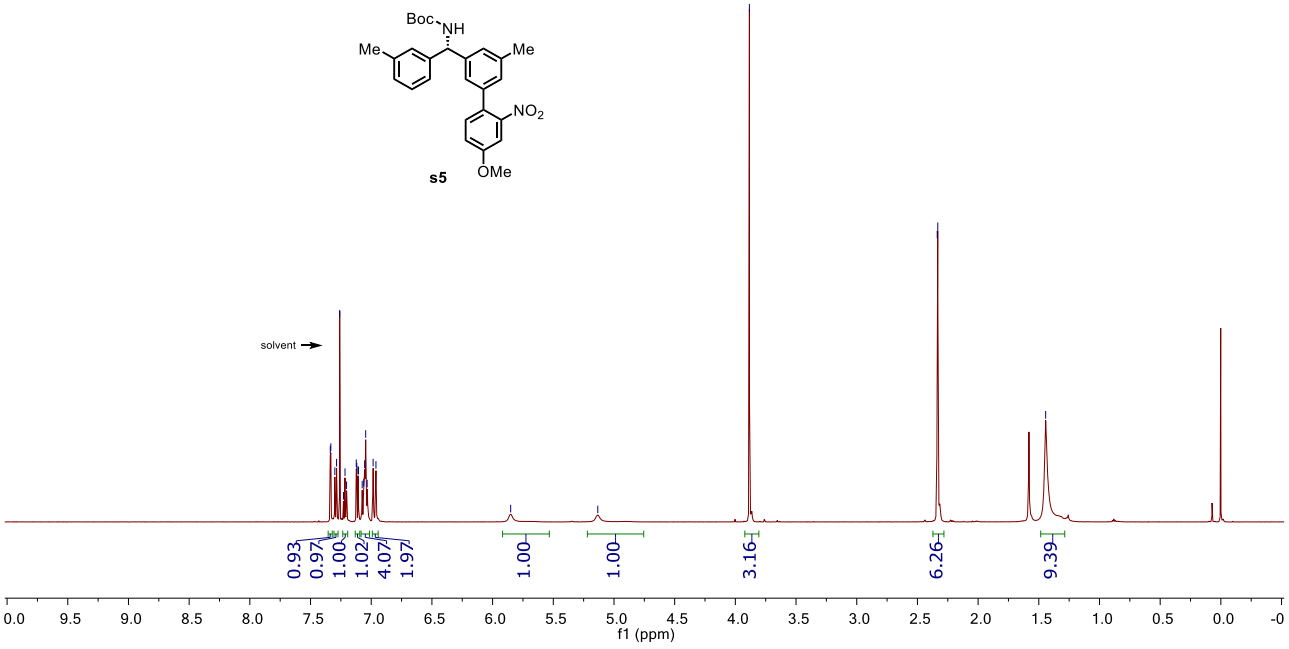
Boc
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NO2
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4.07
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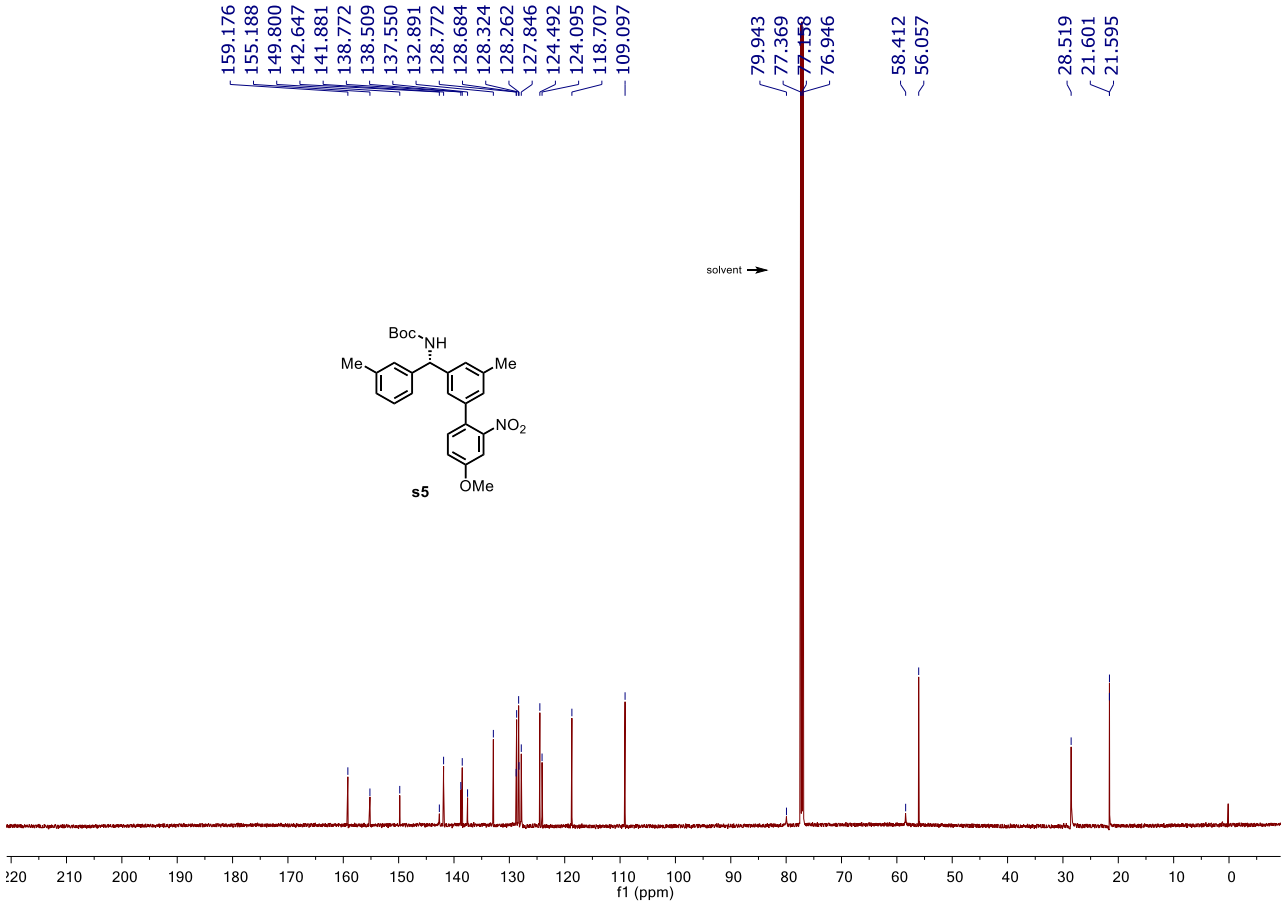
9.39
f1 (ppm)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118.707
109.097
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77.369
77.158
76.946
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solvent
Boc
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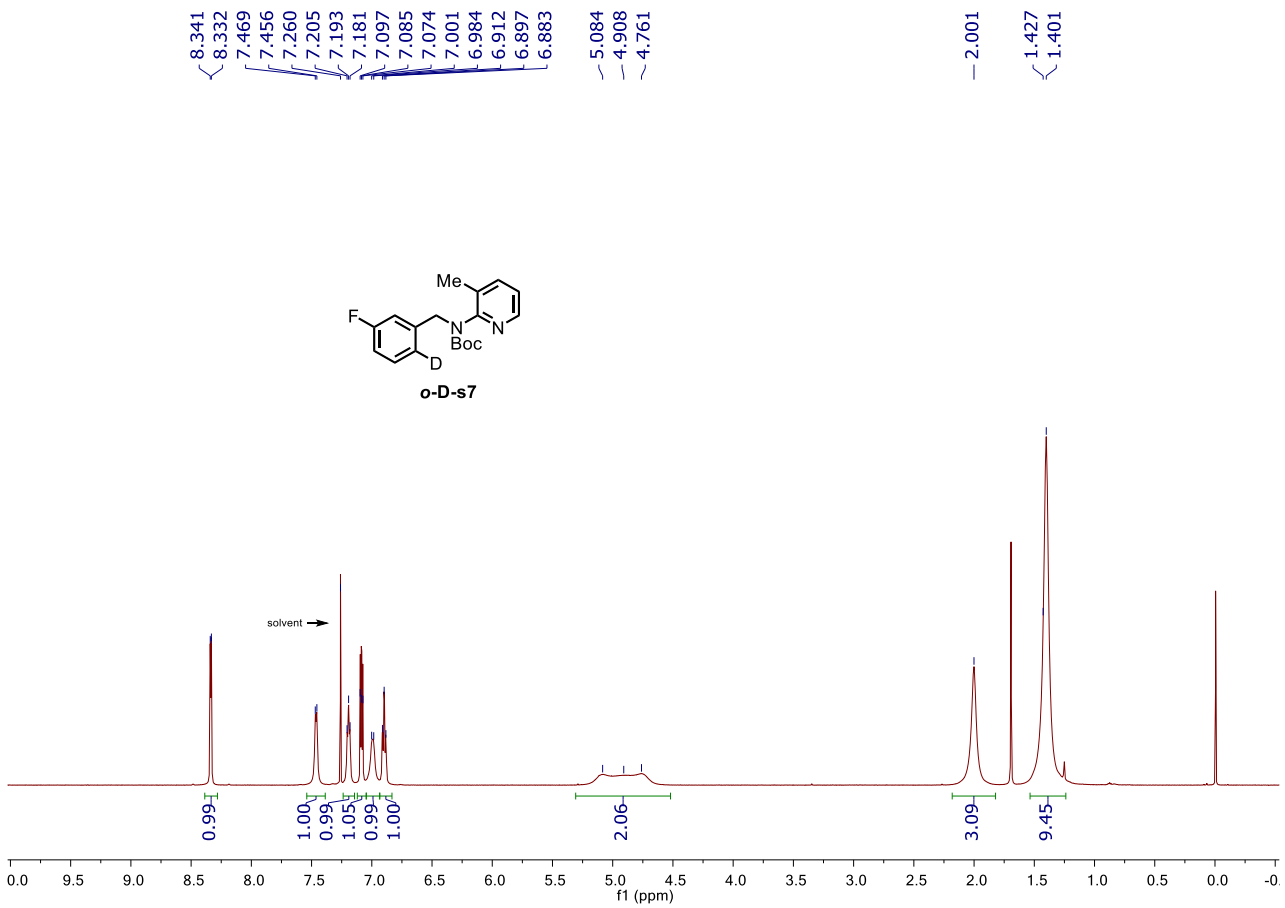
Me
Me
NO2
OMe
s5
f1 (ppm)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7.205
7.193
7.181
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7.085
7.074
7.001
6.984
6.912
6.897
6.883
5.084
4.908
4.761
2.001
1.427
1.401
Me
F
N
N
Boc
D
o-D-s7
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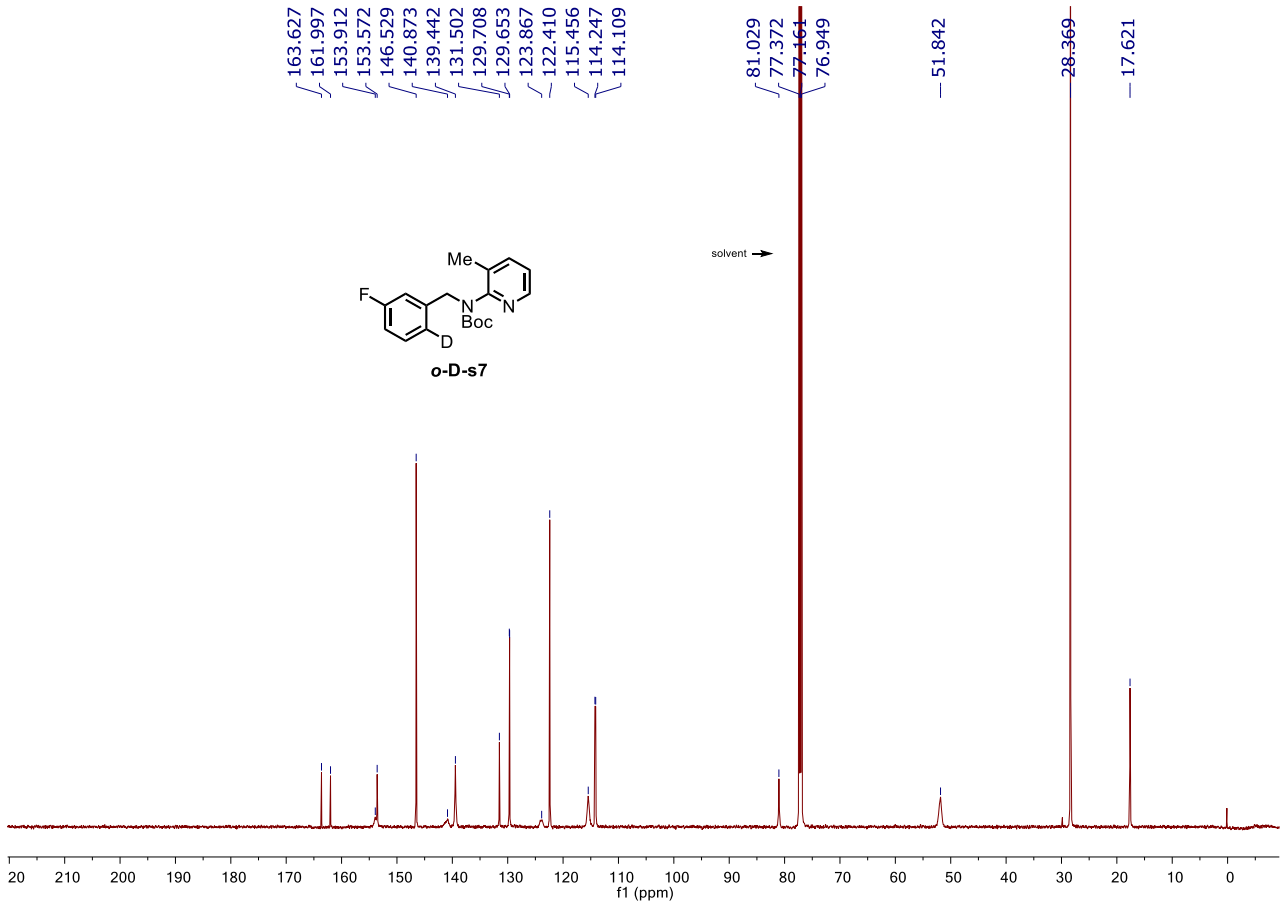
1.00
0.99
1.05
0.99
1.00
2.06
3.09
9.45
f1 (ppm)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114.247
114.109
81.029
77.372
77.161
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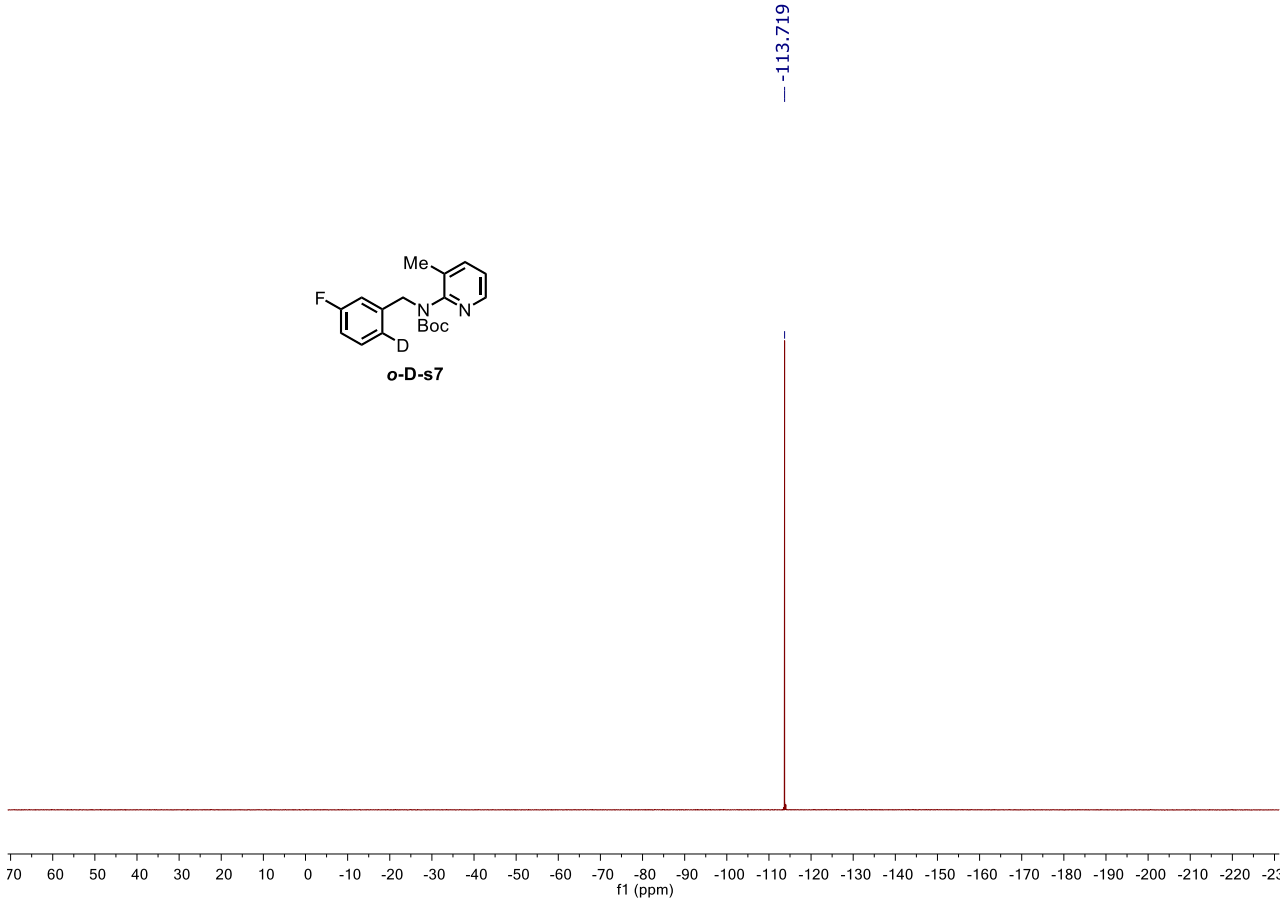
17.621
solvent
Me
F
N
N
Boc
D
o-D-s7
f1 (ppm)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F
N
N
Boc
D
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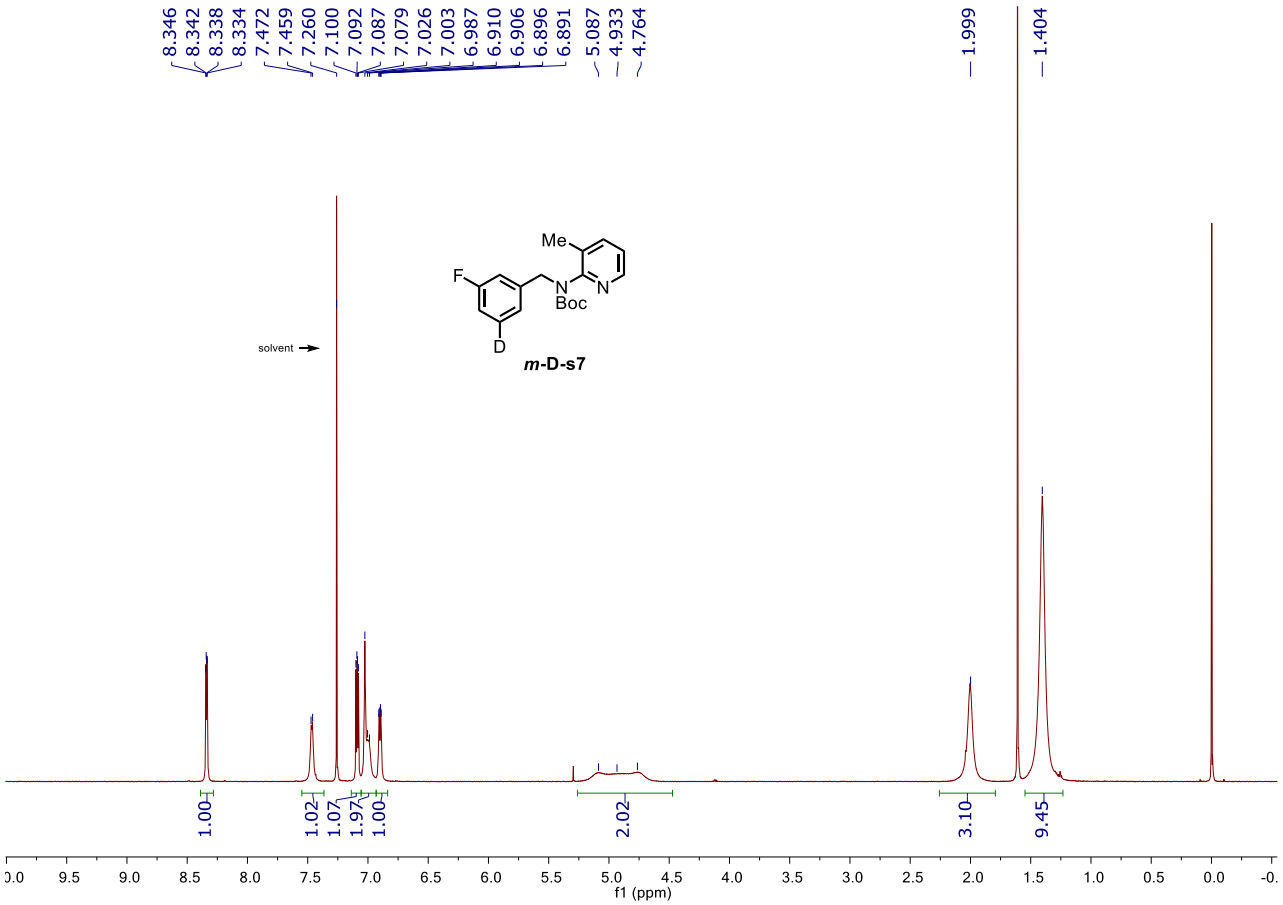
f1 (ppm)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7.026
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6.910
6.906
6.896
6.891
5.087
4.933
4.764
1.999
1.404
Me
F
N
N
Boc
D
m-D-s7
solvent
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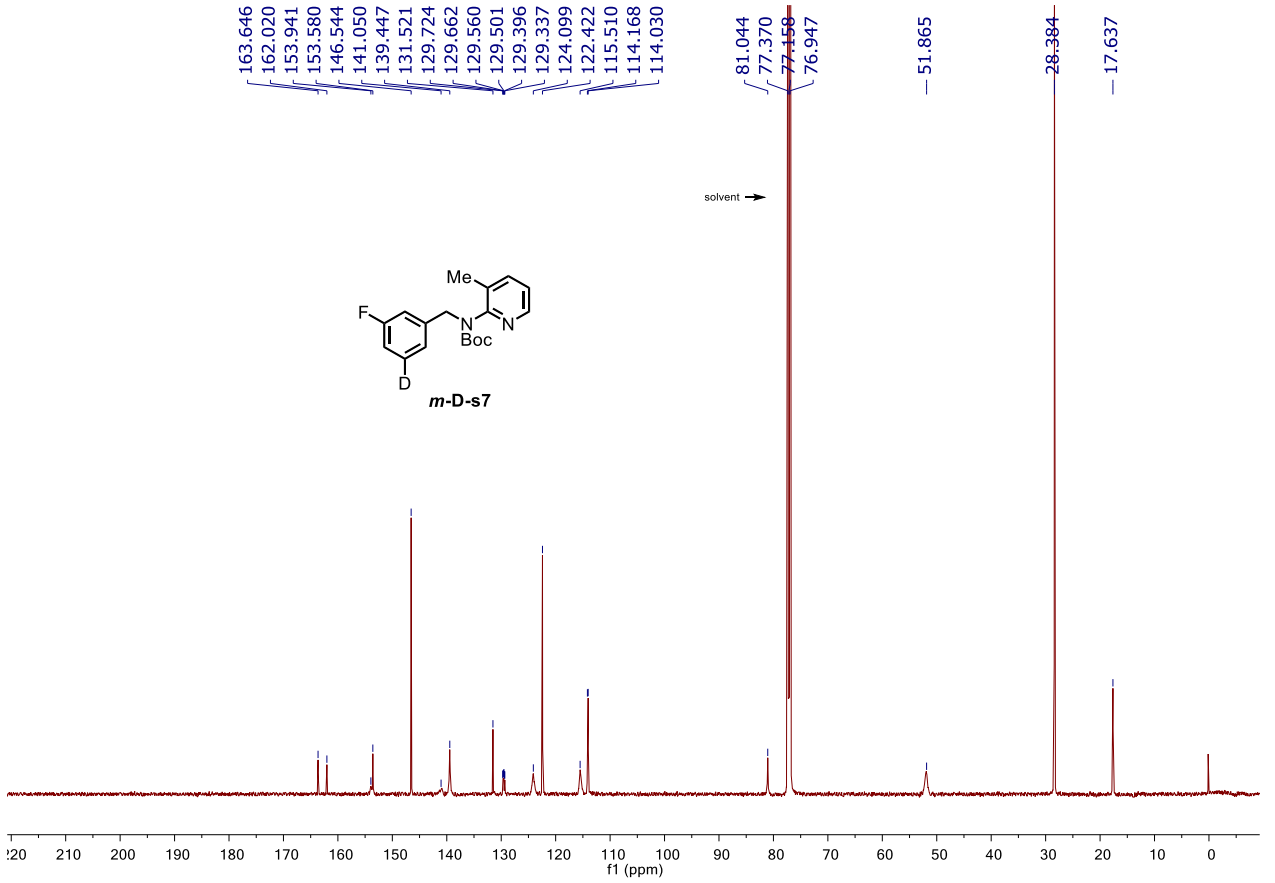
2.02
3.10
9.45
f1 (ppm)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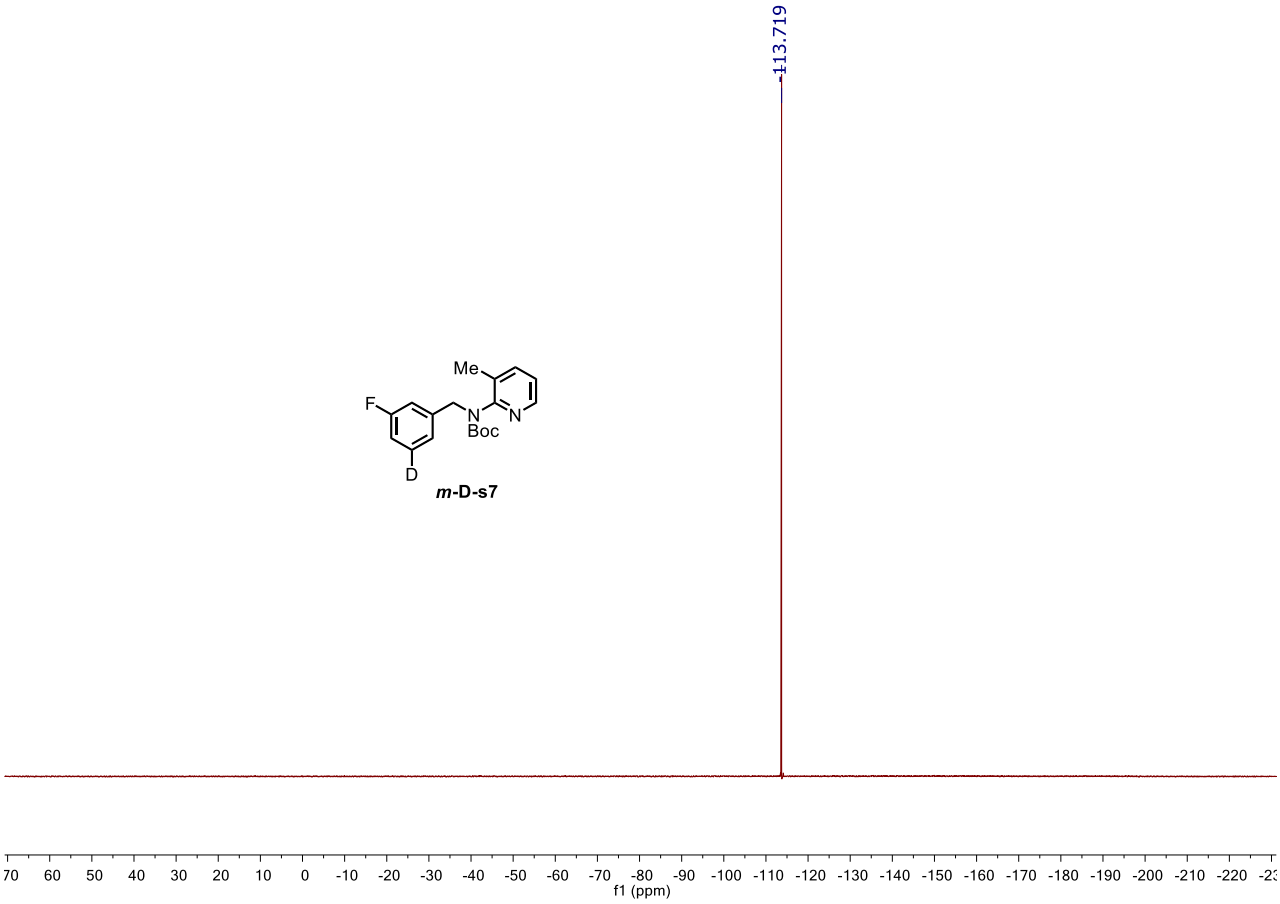
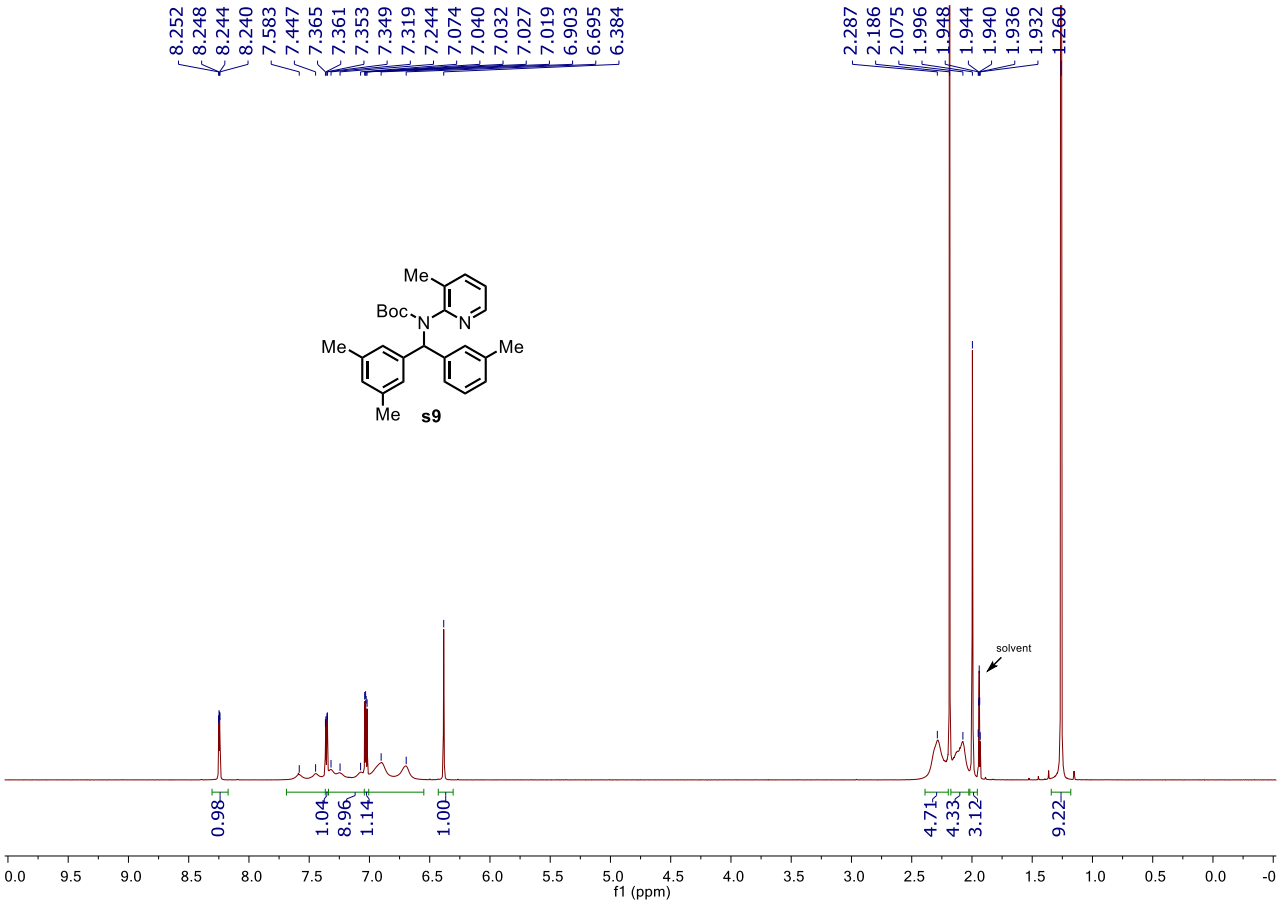
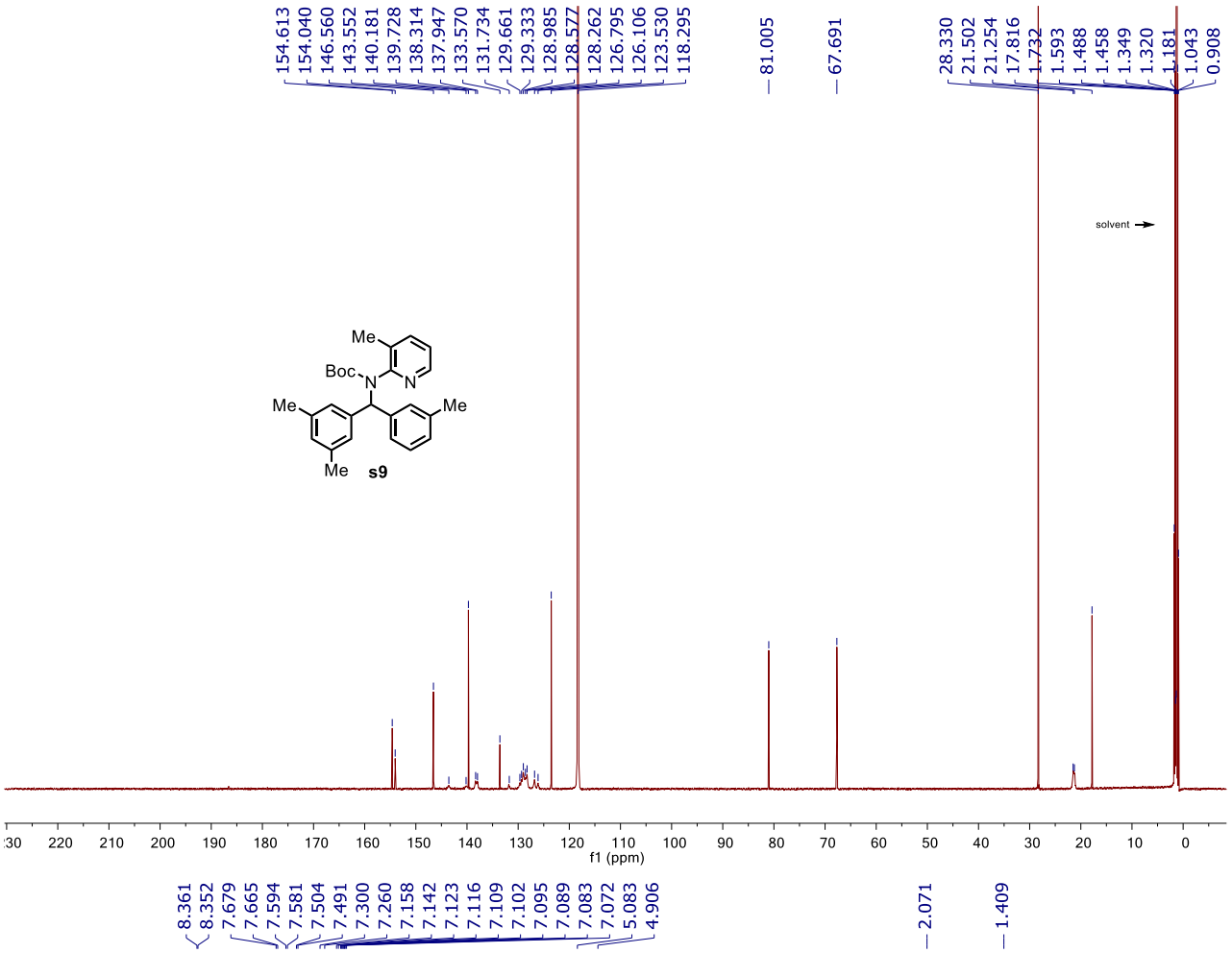
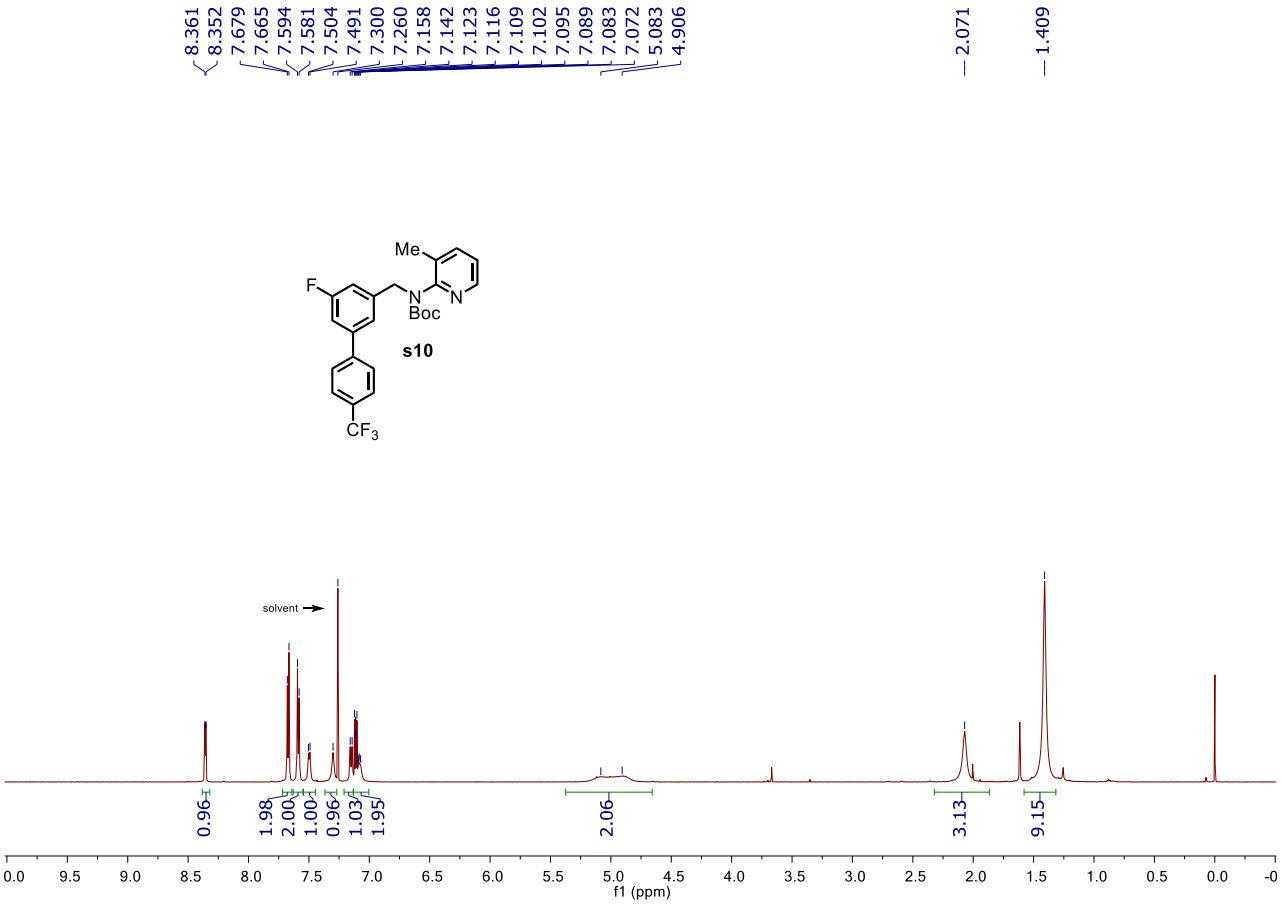
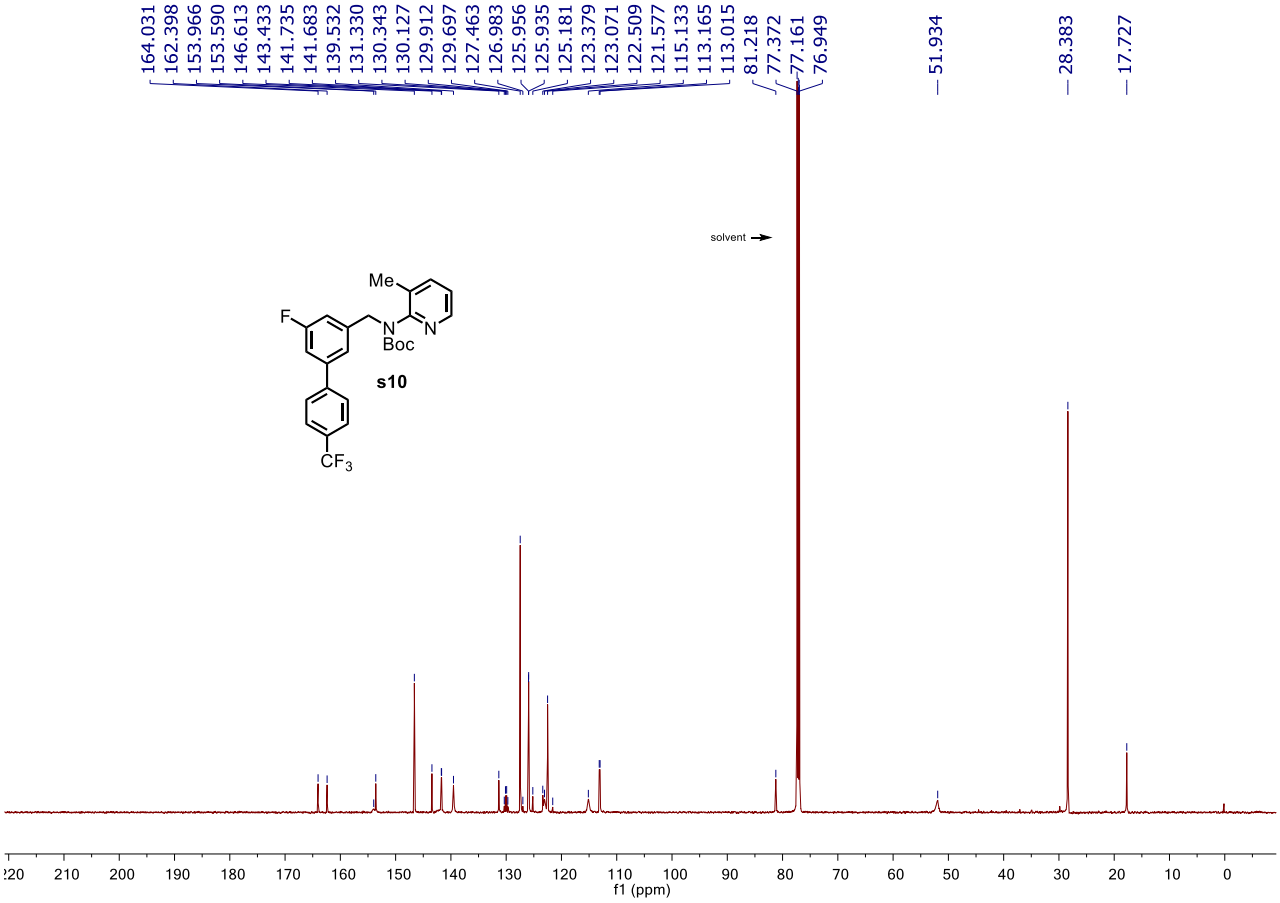
122.422
115.510
114.168
114.030
81.044
77.370
77.158
76.947
51.865
28.384
17.637
solvent
Me
F
N
N
Boc
D
m-D-s7
f1 (ppm)

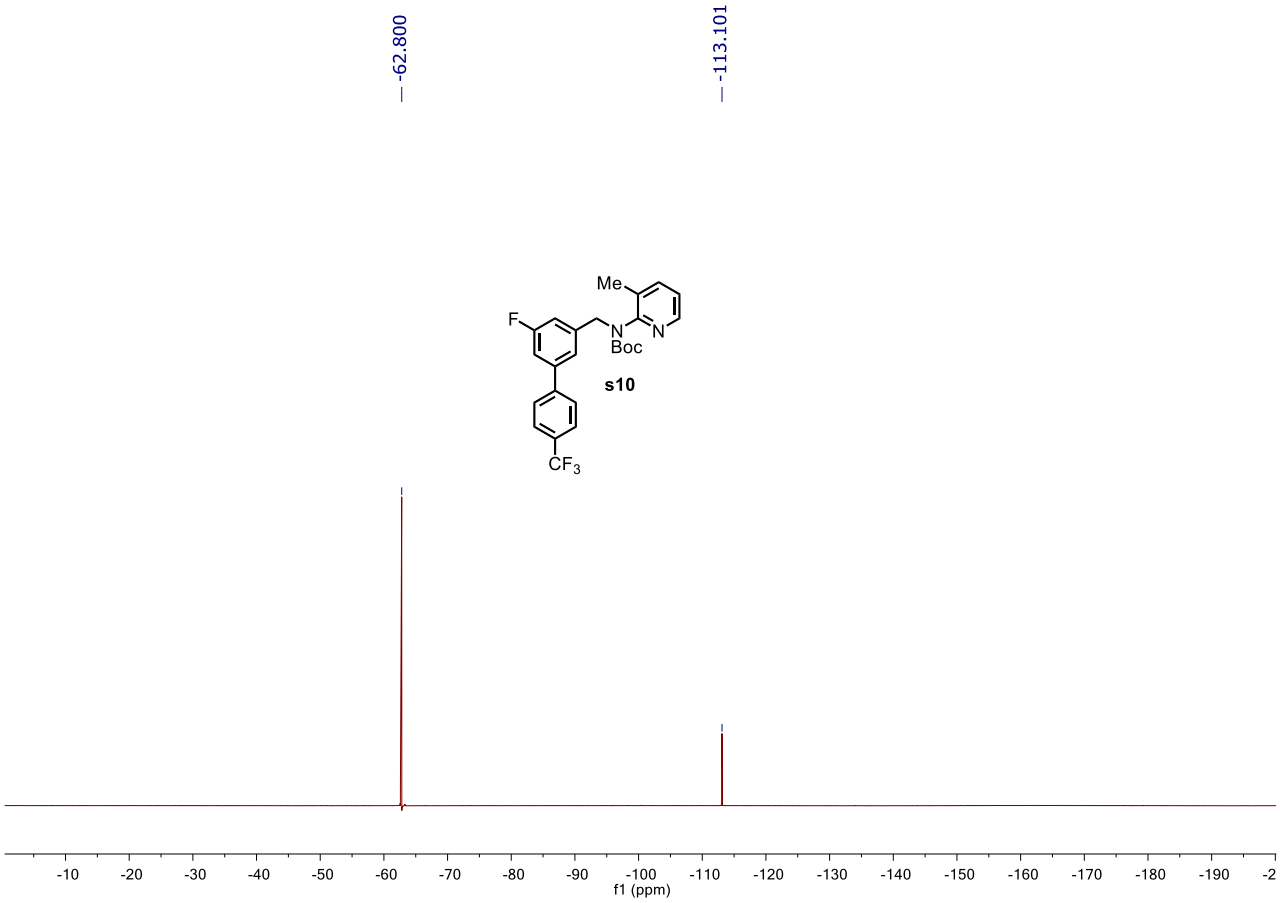

-113.719
Me
F
N
Boc
N
D
m-D-s7
f1 (ppm)


8.252
8.248
8.244
8.240
7.583
7.447
7.365
7.361
7.353
7.349
7.319
7.244
7.074
7.040
7.032
7.027
7.019
6.903
6.695
6.384
2.287
2.186
2.075
1.996
1.948
1.944
1.940
1.936
1.932
1.260
Me
Boc
N
N
Me
Me
Me
s9
solvent
0.98
1.04
8.96
1.14
1.00
4.71
4.33
3.12
9.22
f1 (ppm)


154.613
154.040
146.560
143.552
140.181
139.728
138.314
137.947
133.570
131.734
129.661
129.333
128.985
128.577
128.262
126.795
126.106
123.530
118.295
81.005
67.691
28.330
21.502
21.254
17.816
1.732
1.593
1.488
1.458
1.349
1.320
1.181
1.043
0.908
solvent
Me
Boc
N
N
Me
Me
Me
s9
f1 (ppm)


8.361
8.352
7.679
7.665
7.594
7.581
7.504
7.491
7.300
7.260
7.158
7.142
7.123
7.116
7.109
7.102
7.095
7.089
7.083
7.072
5.083
4.906
2.071
1.409
Me
F
N
N
Boc
s10
CF3
solvent
0.96
1.98
2.00
1.00
0.96
1.03
1.95
2.06
3.13
9.15
f1 (ppm)


164.031
162.398
153.966
153.590
146.613
143.433
141.735
141.683
139.532
131.330
130.343
130.127
129.912
129.697
127.463
126.983
125.956
125.935
125.181
123.379
123.071
122.509
121.577
115.133
113.165
113.015
81.218
77.372
77.161
76.949
51.934
28.383
17.727
solvent
Me
F
N
Boc
N
s10
CF3
f1 (ppm)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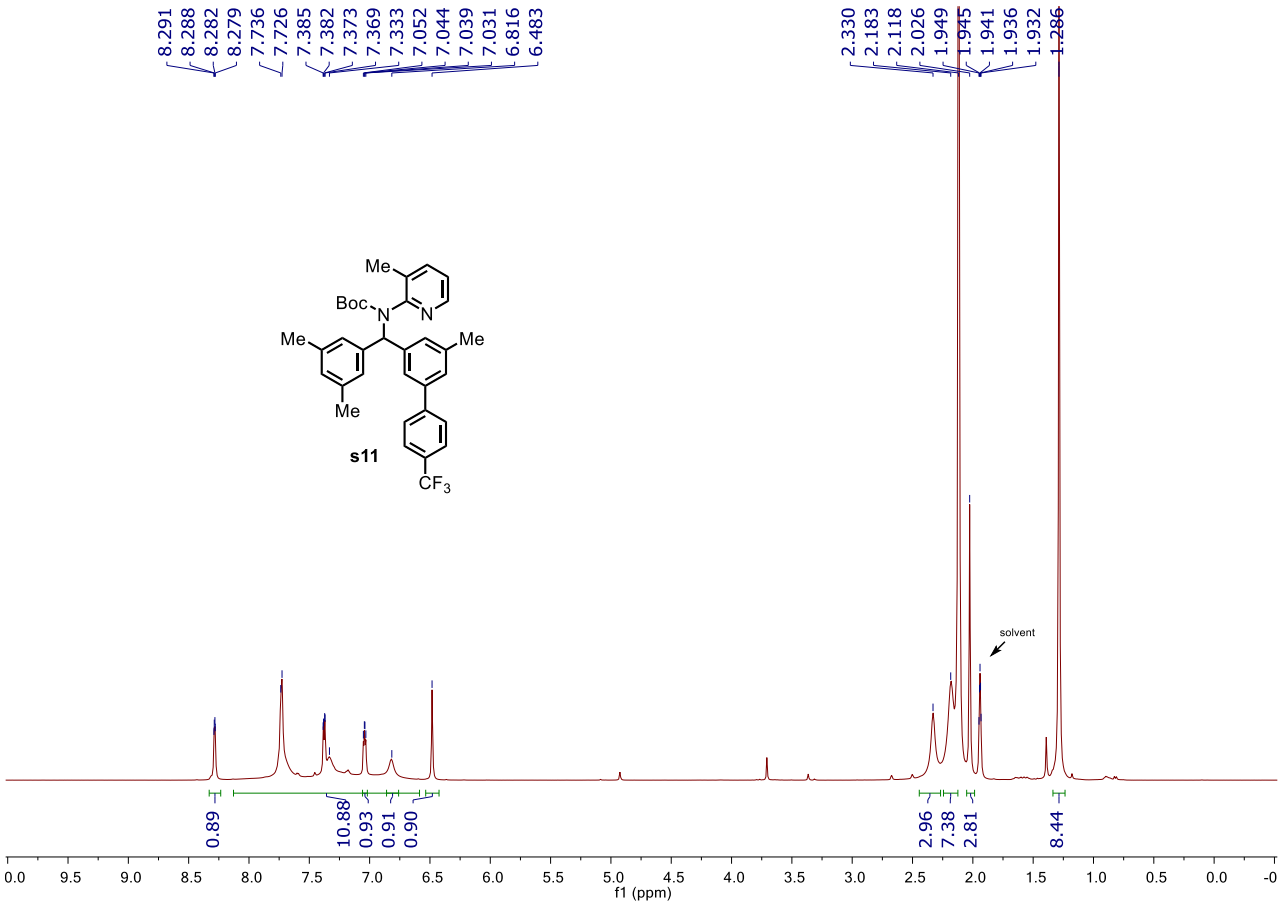
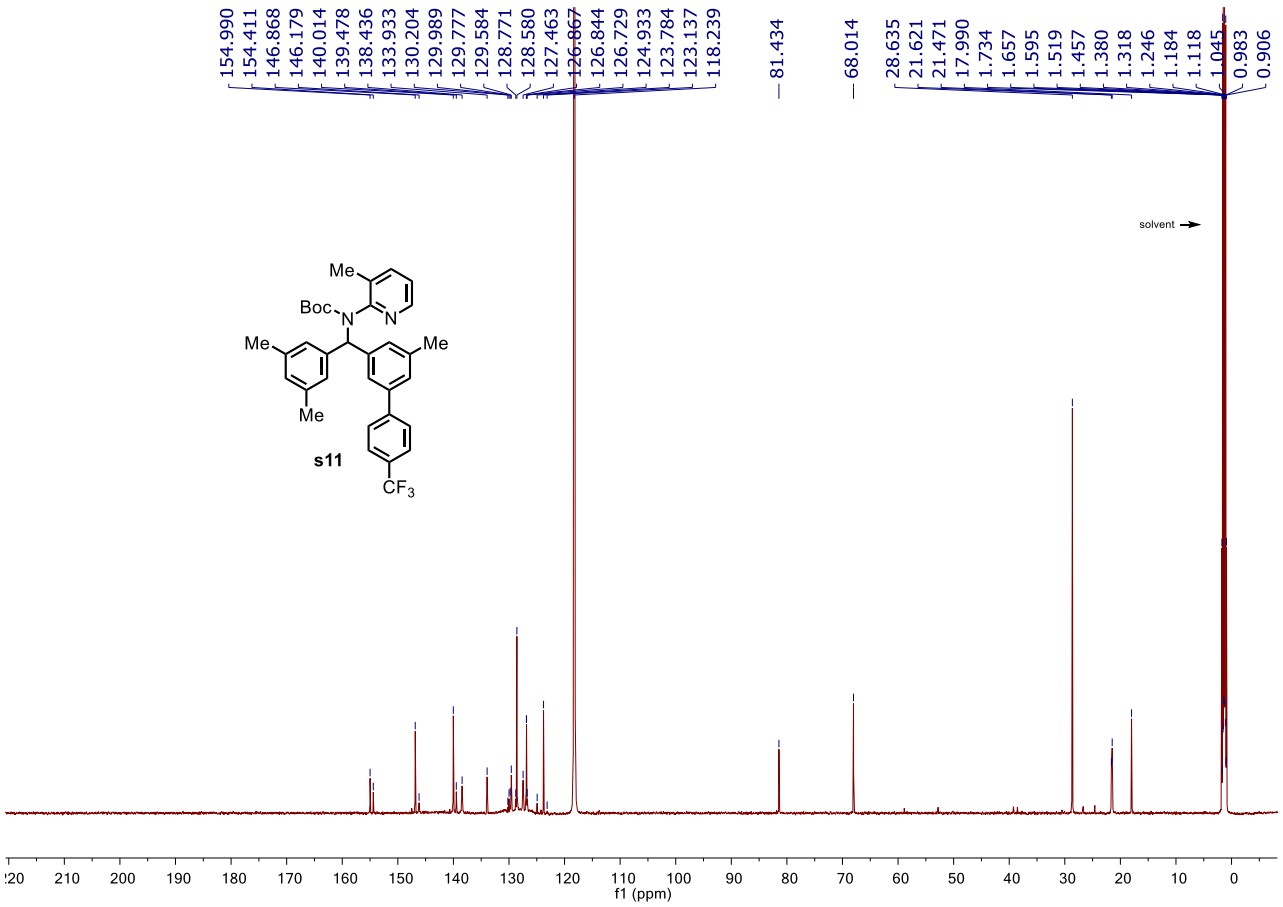
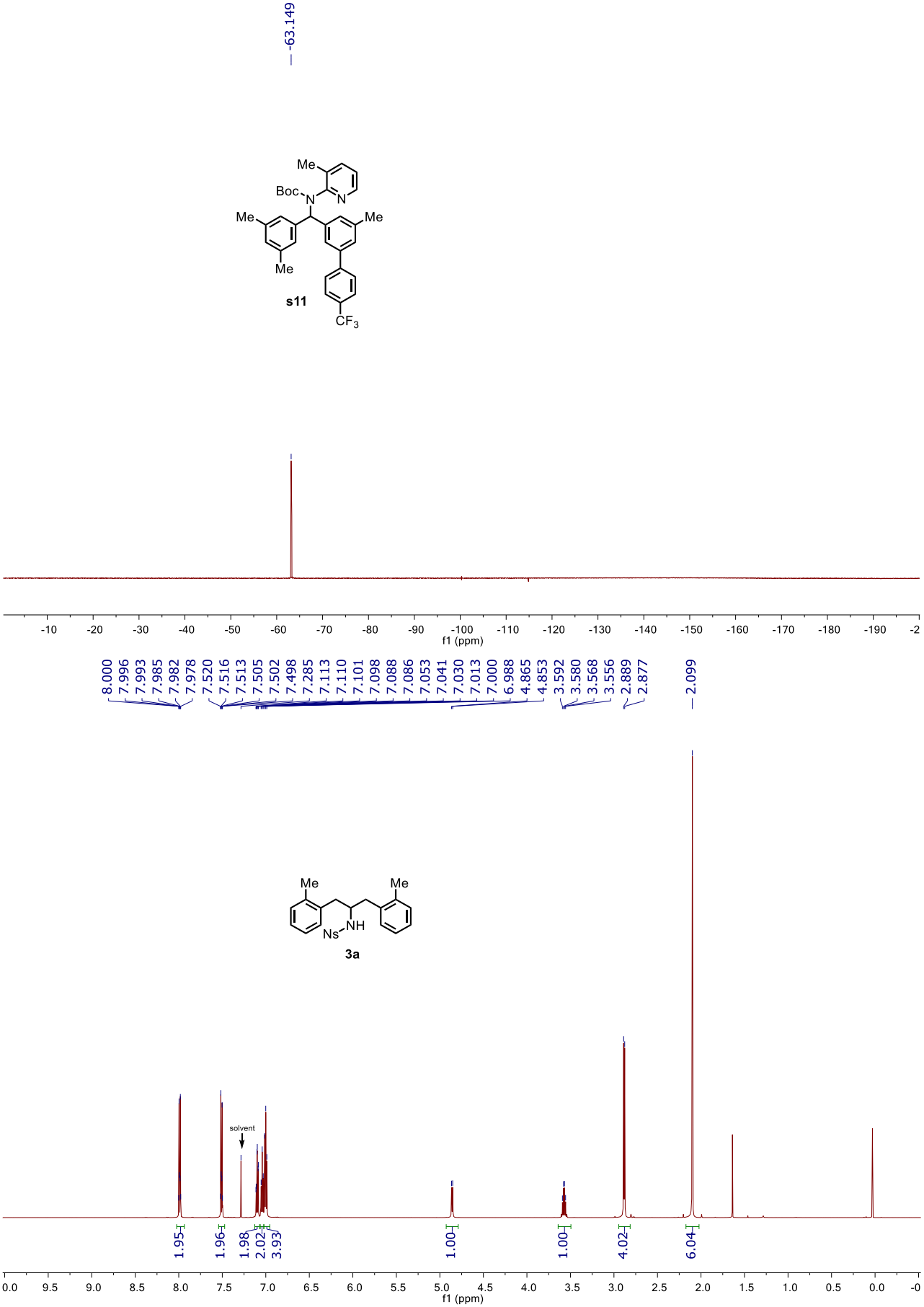
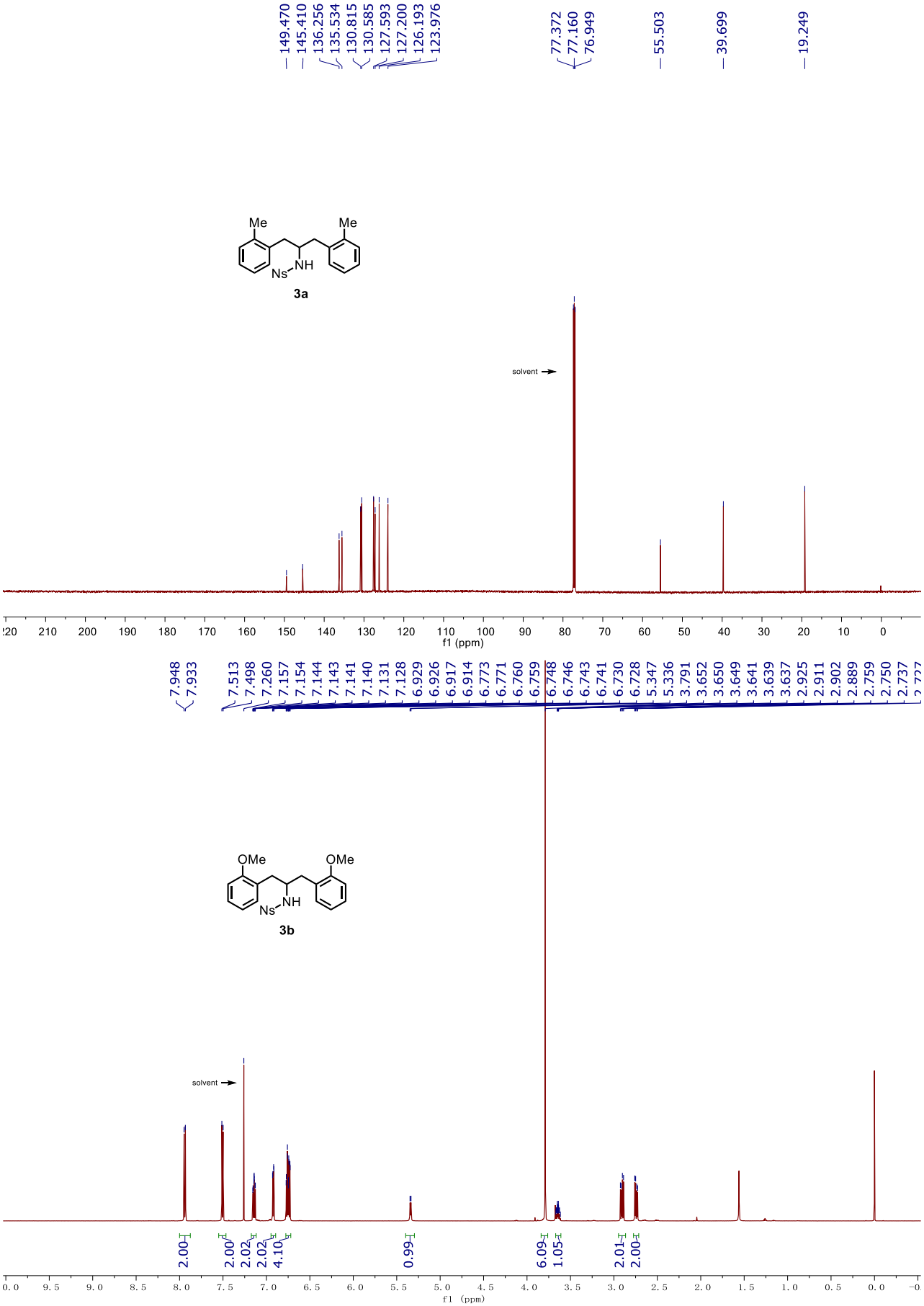
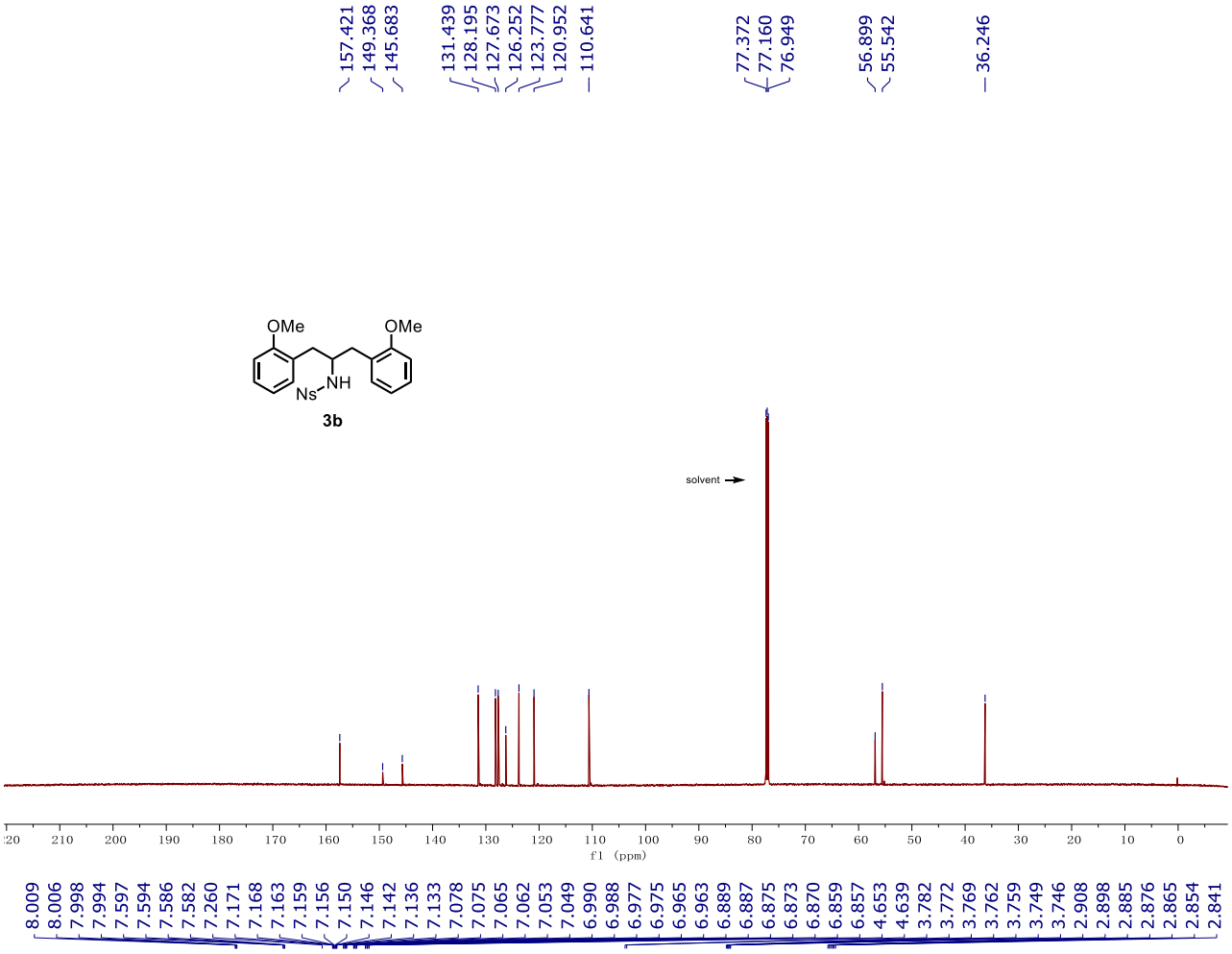
-113.101
Me
F
N
Boc
N
s10
CF3
f1 (ppm)

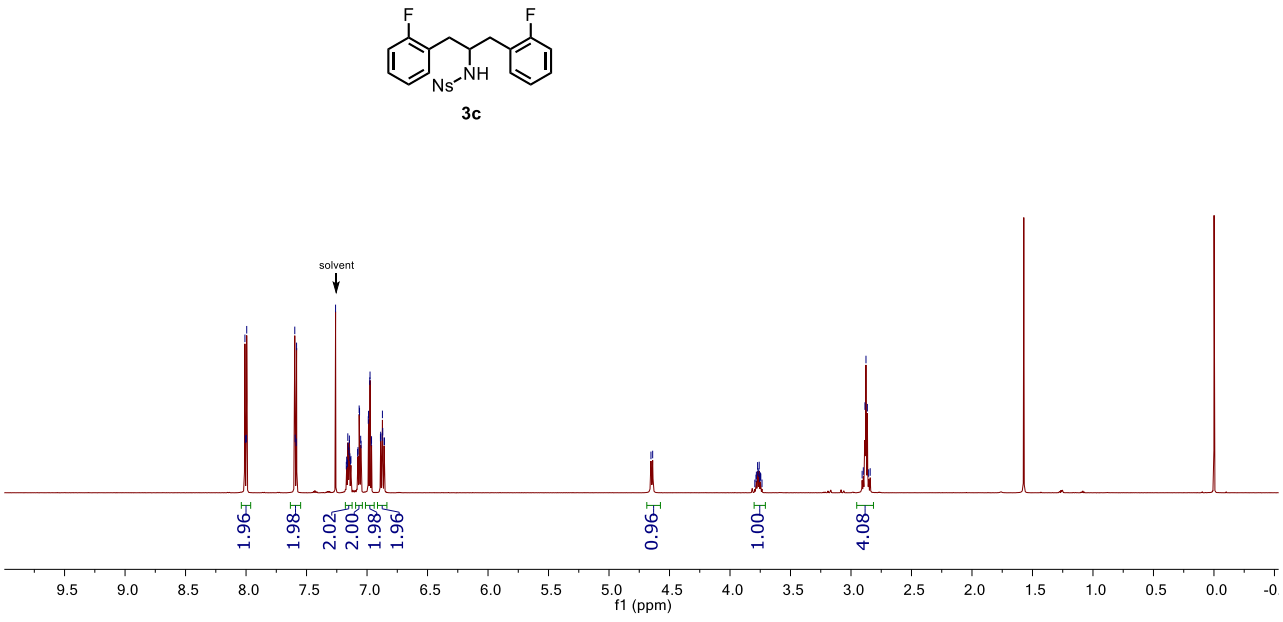

8.291
8.288
8.282
8.279
7.736
7.726
7.385
7.382
7.373
7.369
7.333
7.052
7.044
7.039
7.031
6.816
6.483
2.330
2.183
2.118
2.026
1.949
1.945
1.941
1.936
1.932
1.286
Me
Boc
N
N
Me
Me
Me
s11
CF3
solvent
0.89
10.88
0.93
0.91
0.90
2.96
7.38
2.81
8.44
f1 (ppm)

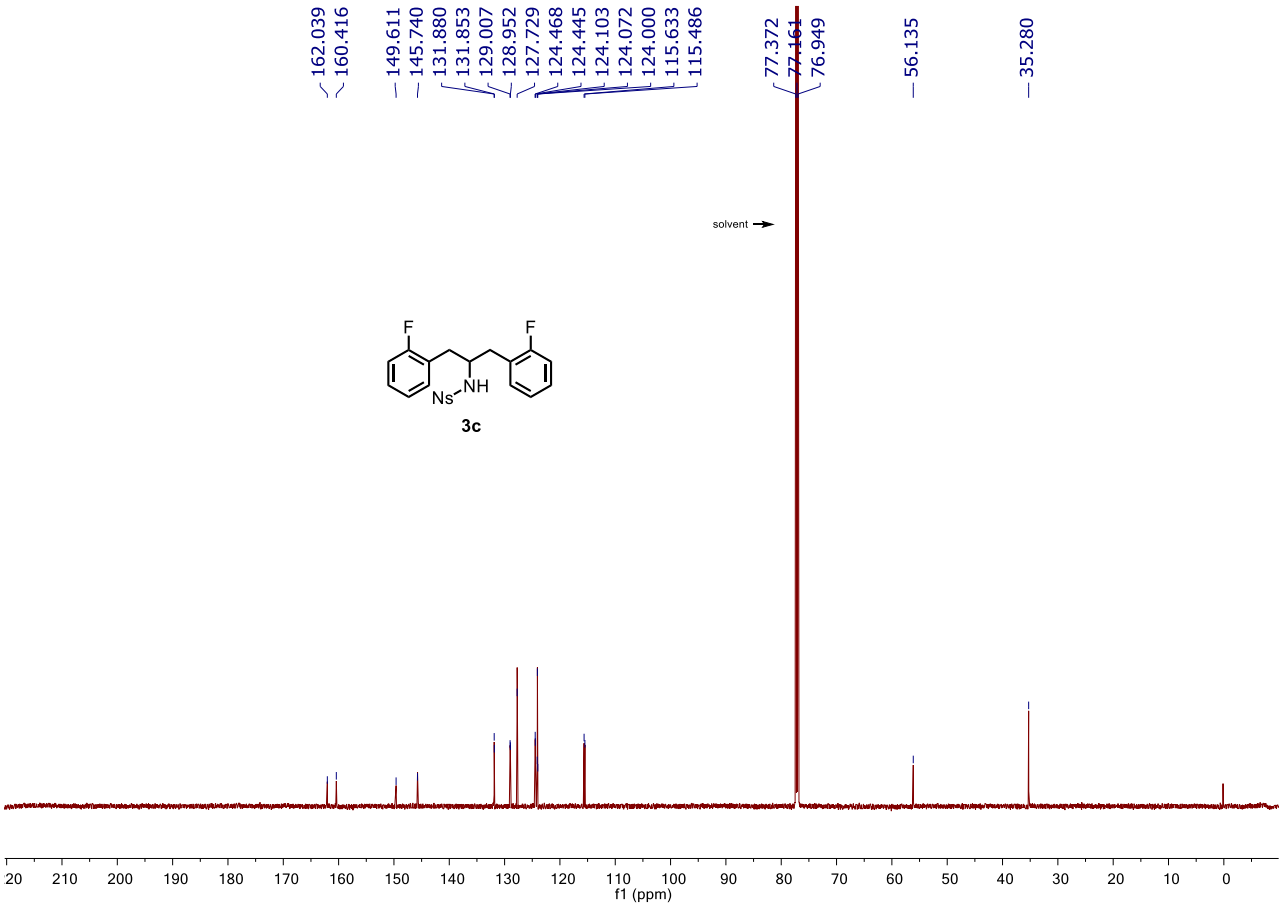

154.990
154.411
146.868
146.179
140.014
139.478
138.436
133.933
130.204
129.989
129.777
129.584
128.771
128.580
127.463
126.867
126.844
126.729
124.933
123.784
123.137
118.239
81.434
68.014
28.635
21.621
21.471
17.990
1.734
1.657
1.595
1.519
1.457
1.380
1.318
1.246
1.184
1.118
1.045
0.983
0.906
solvent
Me
Boc
N
N
Me
Me
Me
s11
CF3
f1 (ppm)

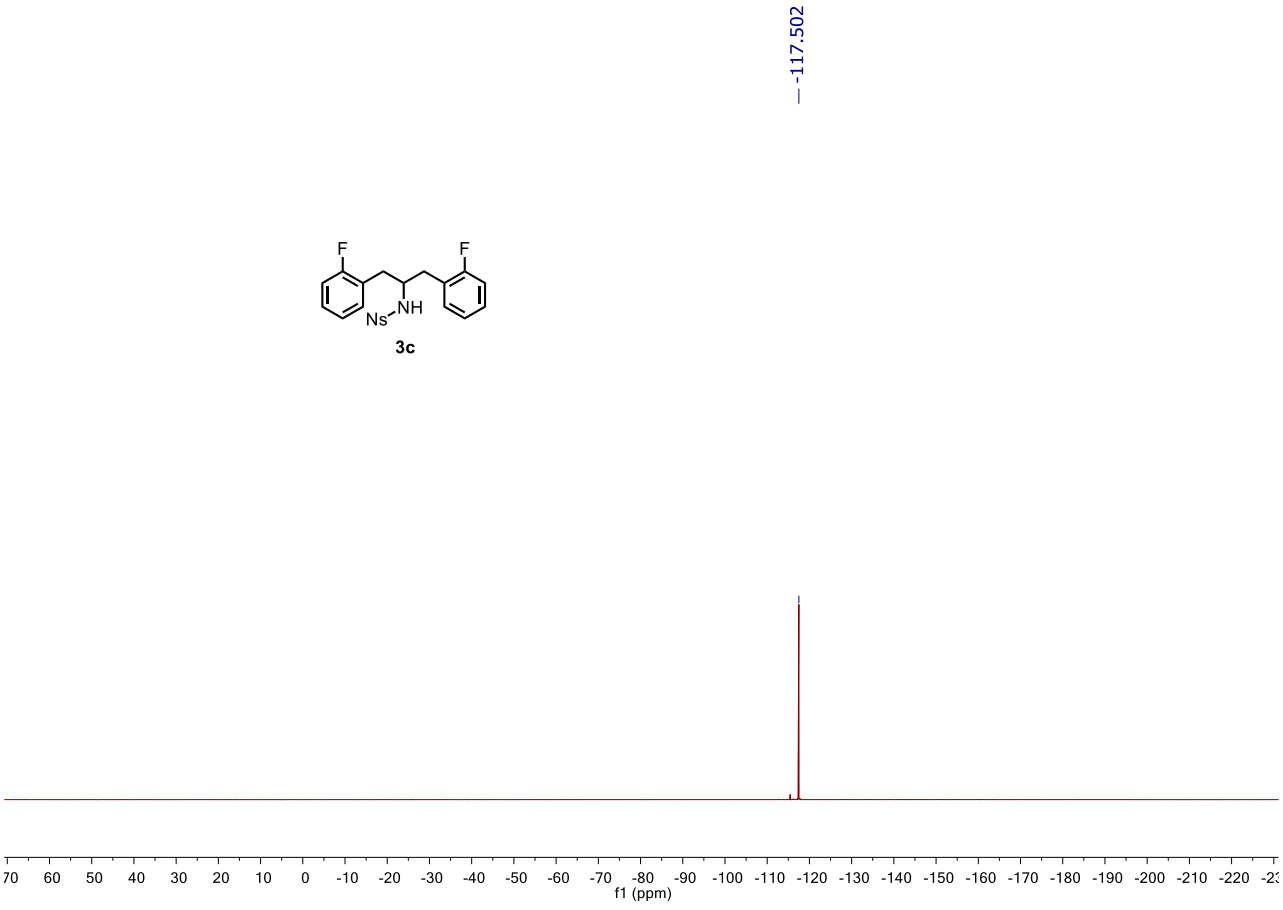

-63.149
Me
Boc
N
N
Me
Me
Me
s11
CF3
f1 (ppm)
8.000
7.996
7.993
7.985
7.982
7.978
7.520
7.516
7.513
7.505
7.502
7.498
7.285
7.113
7.110
7.101
7.098
7.088
7.086
7.053
7.041
7.030
7.013
7.000
6.988
4.865
4.853
3.592
3.580
3.568
3.556
2.889
2.877
2.099
Me
Me
Ns
NH
3a
solvent
1.95
1.96
1.98
2.02
3.93
1.00
1.00
4.02
6.04
f1 (ppm)


149.470
145.410
136.256
135.534
130.815
130.585
127.593
127.200
126.193
123.976
77.372
77.160
76.949
55.503
39.699
19.249
Me
Me
NH
Ns
3a
solvent
f1 (ppm)
7.948
7.933
7.513
7.498
7.260
7.157
7.154
7.144
7.143
7.141
7.140
7.131
7.128
6.929
6.926
6.917
6.914
6.773
6.771
6.760
6.759
6.748
6.746
6.743
6.741
6.730
6.728
5.347
5.336
3.791
3.652
3.650
3.649
3.641
3.639
3.637
2.925
2.911
2.902
2.889
2.759
2.750
2.737
OMe
OMe
NH
Ns
3b
solvent
2.00
2.00
2.02
2.02
4.10
0.99
6.09
1.05
2.01
2.00
f1 (ppm)

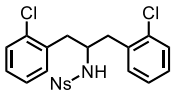

157.421
149.368
145.683
131.439
128.195
127.673
126.252
123.777
120.952
110.641
77.372
77.160
76.949
56.899
55.542
36.246
OMe
OMe
NH
Ns
3b
solvent
f1 (ppm)
8.009
8.006
7.998
7.994
7.597
7.594
7.586
7.582
7.260
7.171
7.168
7.163
7.159
7.156
7.150
7.146
7.142
7.136
7.133
7.078
7.075
7.065
7.062
7.053
7.049
6.990
6.988
6.977
6.975
6.965
6.963
6.889
6.887
6.875
6.873
6.870
6.859
6.857
4.653
4.639
3.782
3.772
3.769
3.762
3.759
3.749
3.746
2.908
2.898
2.885
2.876
2.865
2.854
2.841


F
F
NH
Ns
3c
solvent
1.96
1.98
2.02
2.00
1.98
1.96
0.96
1.00
4.08
f1 (ppm)

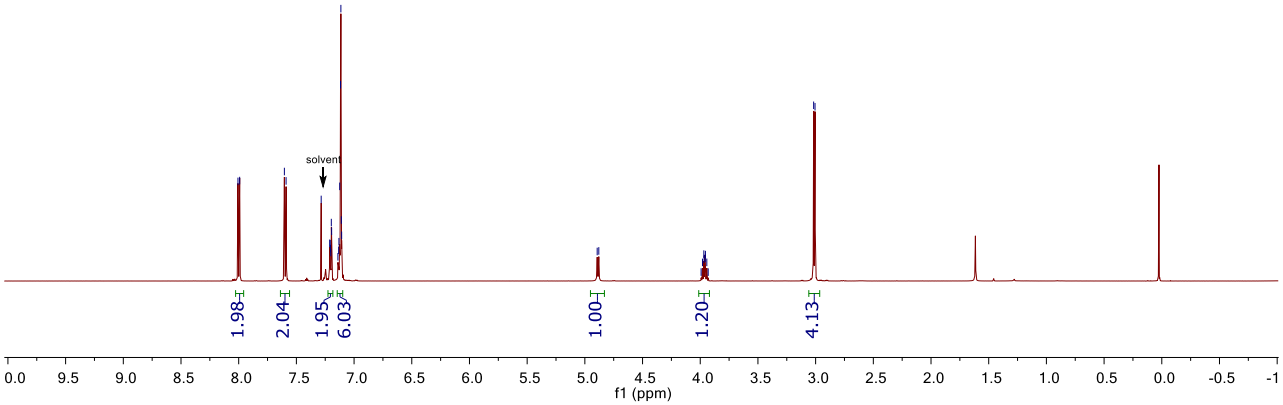

162.039
160.416
149.611
145.740
131.880
131.853
129.007
128.952
127.729
124.468
124.445
124.103
124.072
124.000
115.633
115.486
77.372
77.161
76.949
56.135
35.280
solvent
F
F
NH
Ns
3c
f1 (ppm)


-117.502
F
F
NH
Ns
3c
f1 (ppm)

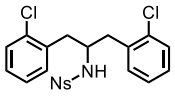

8.006
7.992
7.604
7.589
7.285
7.211
7.207
7.205
7.202
7.197
7.194
7.140
7.134
7.131
7.124
7.118
7.114
7.110
7.108
4.893
4.879
3.992
3.981
3.969
3.967
3.957
3.955
3.943
3.931
3.017
3.005


Cl
Cl
NH
Ns

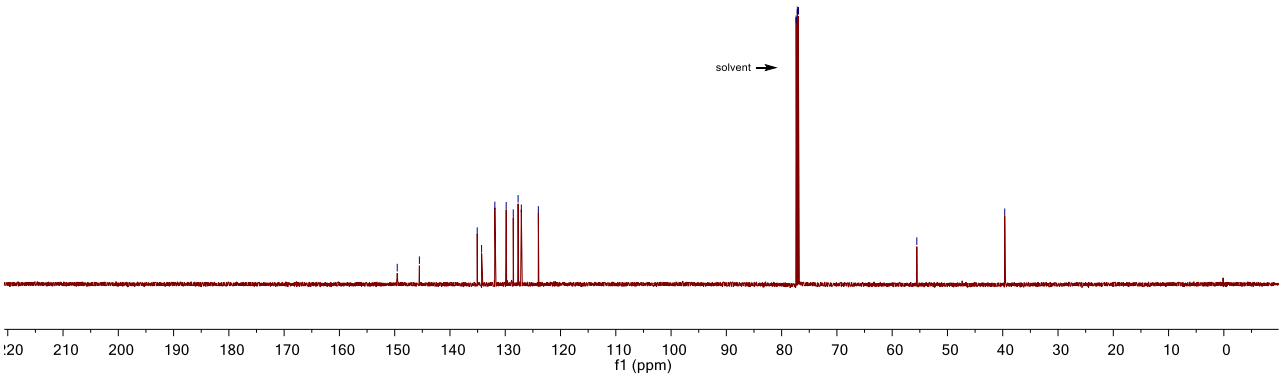
3d

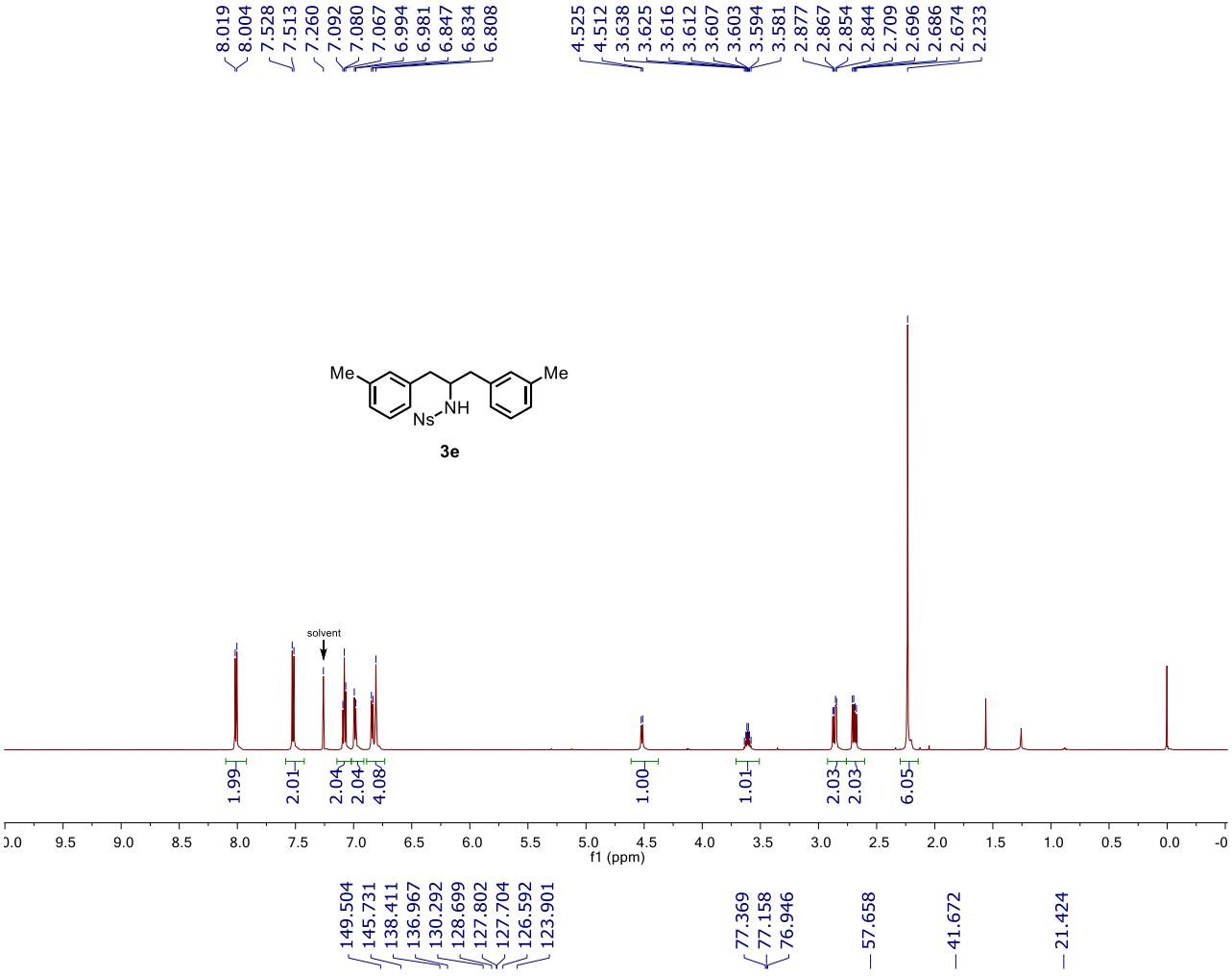

solvent
1.98
2.04
1.95
6.03
1.00
1.20
4.13
f1 (ppm)

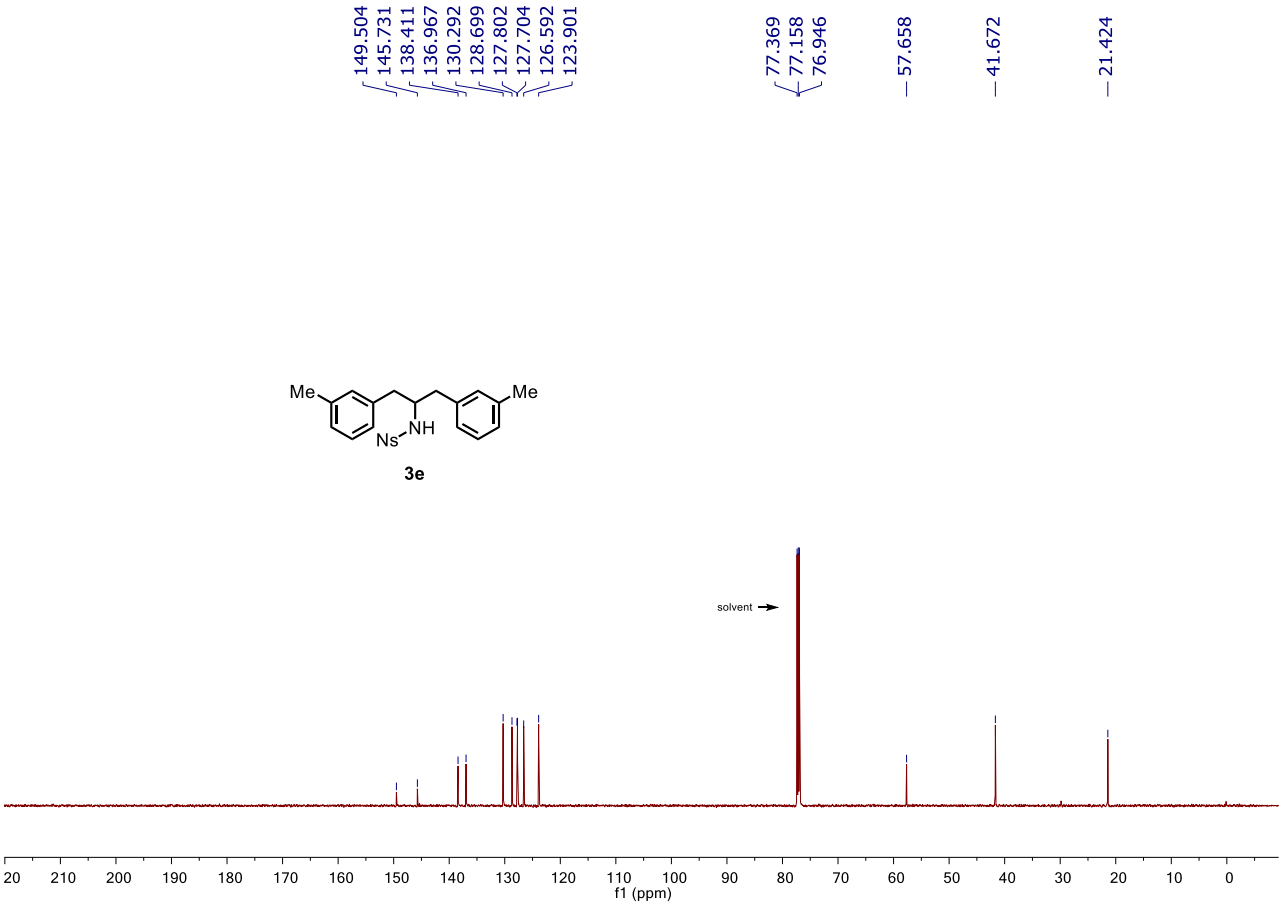

149.542
145.530
135.072
134.277
131.881
129.830
128.552
127.676
127.093
124.017
77.371
77.159
76.947
55.543
39.637


Cl
Cl
NH
Ns

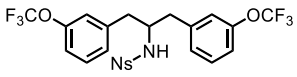
3d


solvent
f1 (ppm)

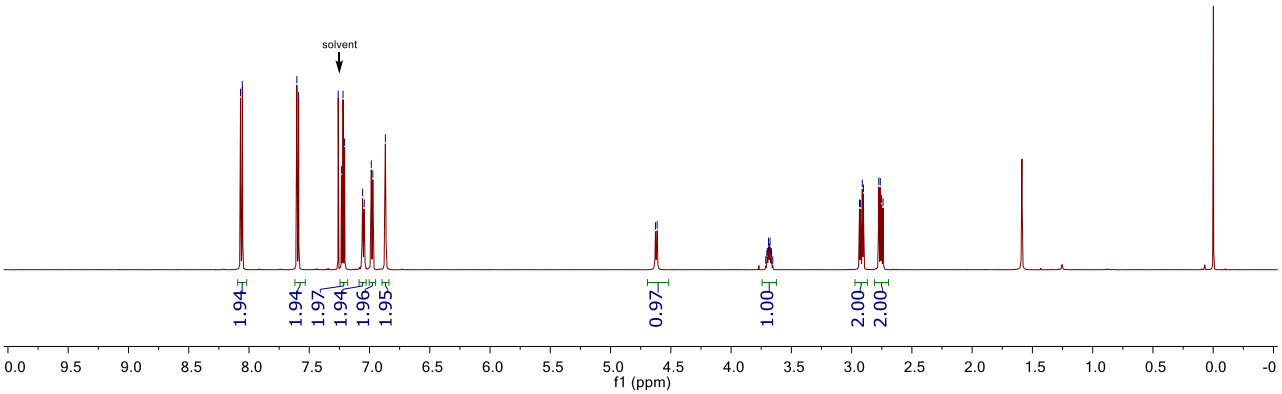

8.019
8.004
7.528
7.513
7.260
7.092
7.080
7.067
6.994
6.981
6.847
6.834
6.808
4.525
4.512
3.638
3.625
3.616
3.612
3.607
3.603
3.594
3.581
2.877
2.867
2.854
2.844
2.709
2.696
2.686
2.674
2.233
Me
Me
NH
Ns
3e
solvent
1.99
2.01
2.04
2.04
4.08
1.00
1.01
2.03
2.03
6.05
f1 (ppm)

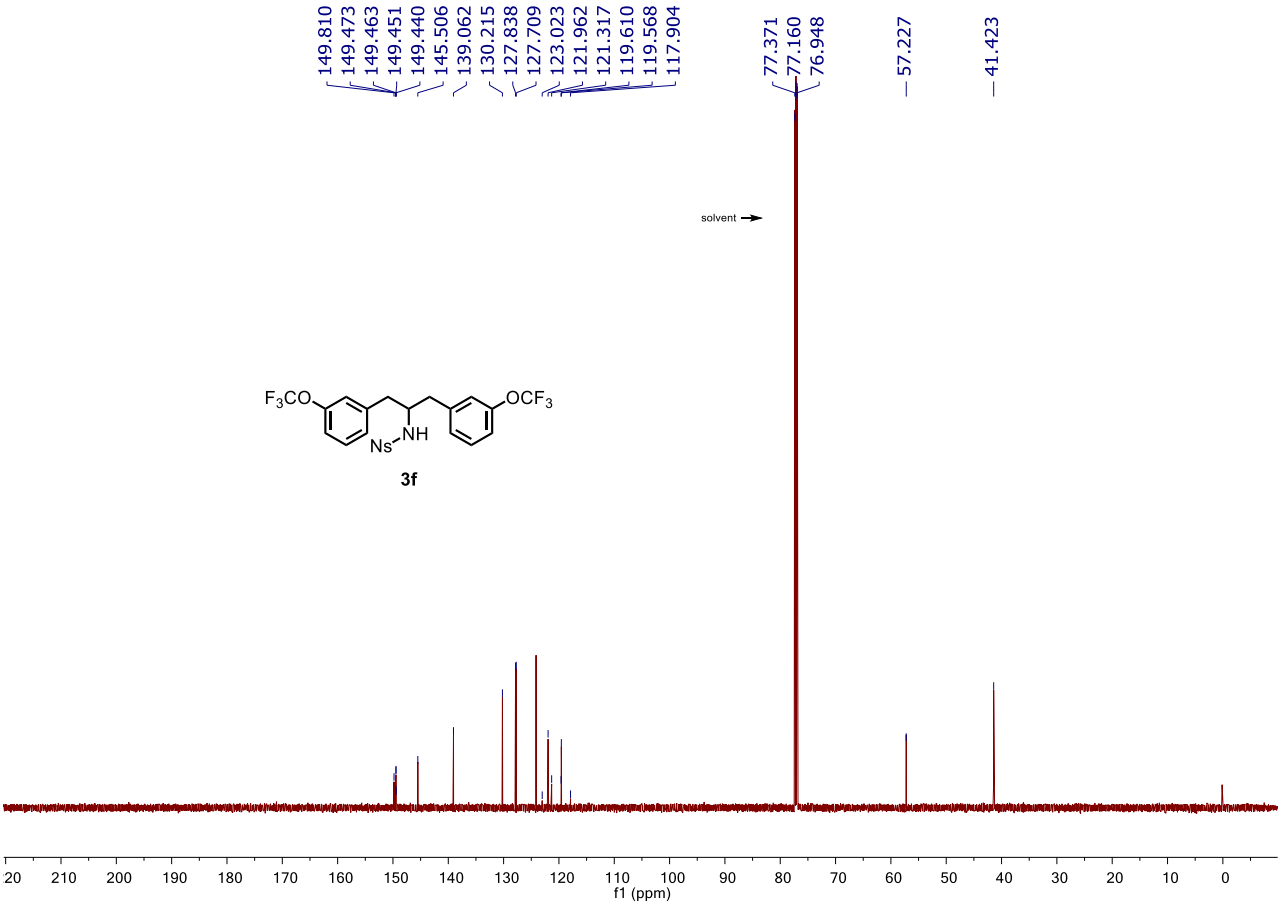

149.504
145.731
138.411
136.967
130.292
128.699
127.802
127.704
126.592
123.901
77.369
77.158
76.946
57.658
41.672
21.424
Me
Me
NH
Ns
3e
solvent
f1 (ppm)


8.070
8.055
7.603
7.588
7.260
7.233
7.220
7.207
7.058
7.044
6.985
6.973
6.868
4.628
4.614
3.712
3.703
3.700
3.690
3.687
3.681
3.677
3.667
3.664
3.654
2.935
2.925
2.912
2.902
2.775
2.762
2.751
2.739

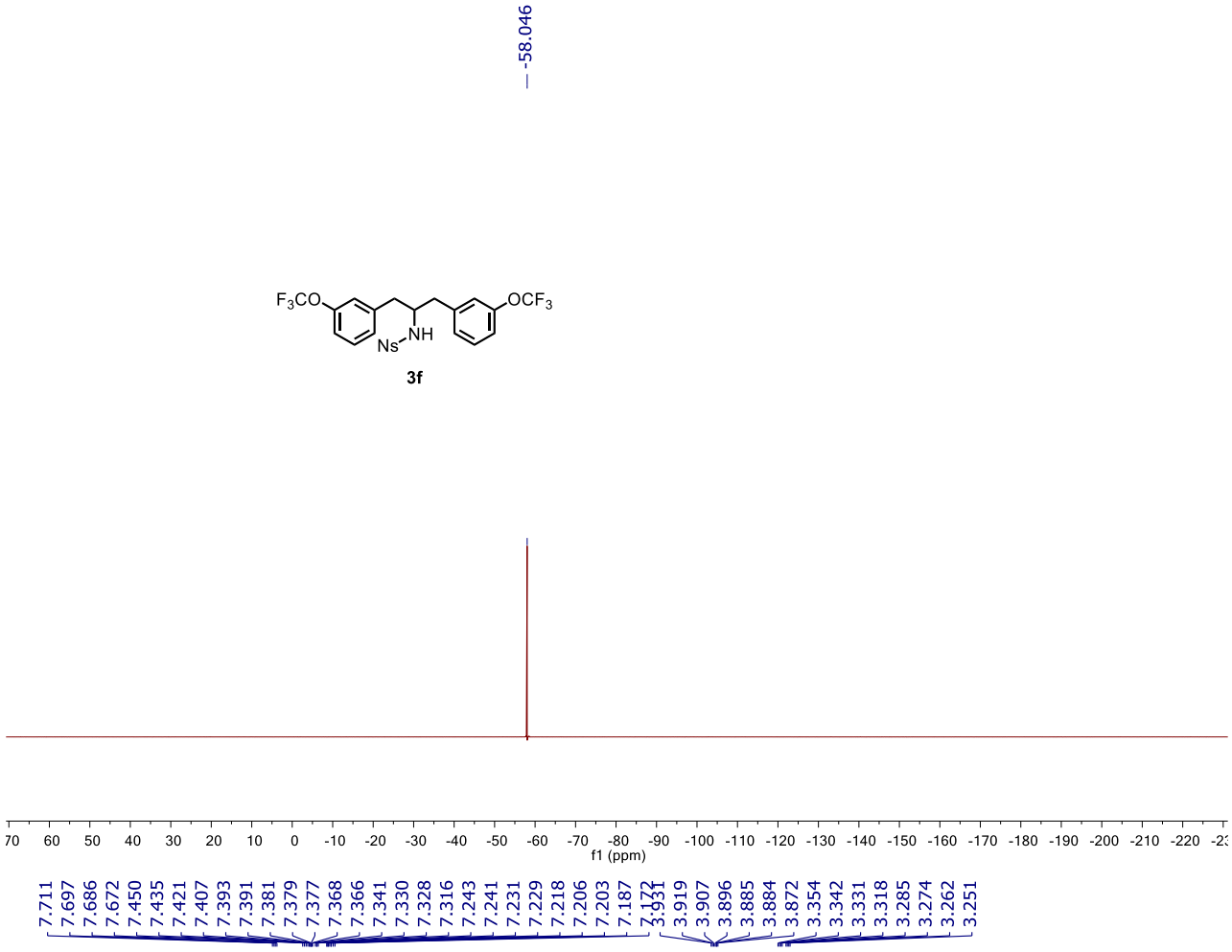

F3CO
OCF3
NH
Ns

3f


solvent
1.94
1.94
1.97
1.94
1.96
1.95
0.97
1.00
2.00
2.00
f1 (ppm)


149.810
149.473
149.463
149.451
149.440
145.506
139.062
130.215
127.838
127.709
123.023
121.962
121.317
119.610
119.568
117.904
77.371
77.160
76.948
57.227
41.423
solvent
F3CO
OCF3
NH
Ns
f1 (ppm)

3f


-58.046
F3CO
OCF3
Ns
NH
3f
f1 (ppm)
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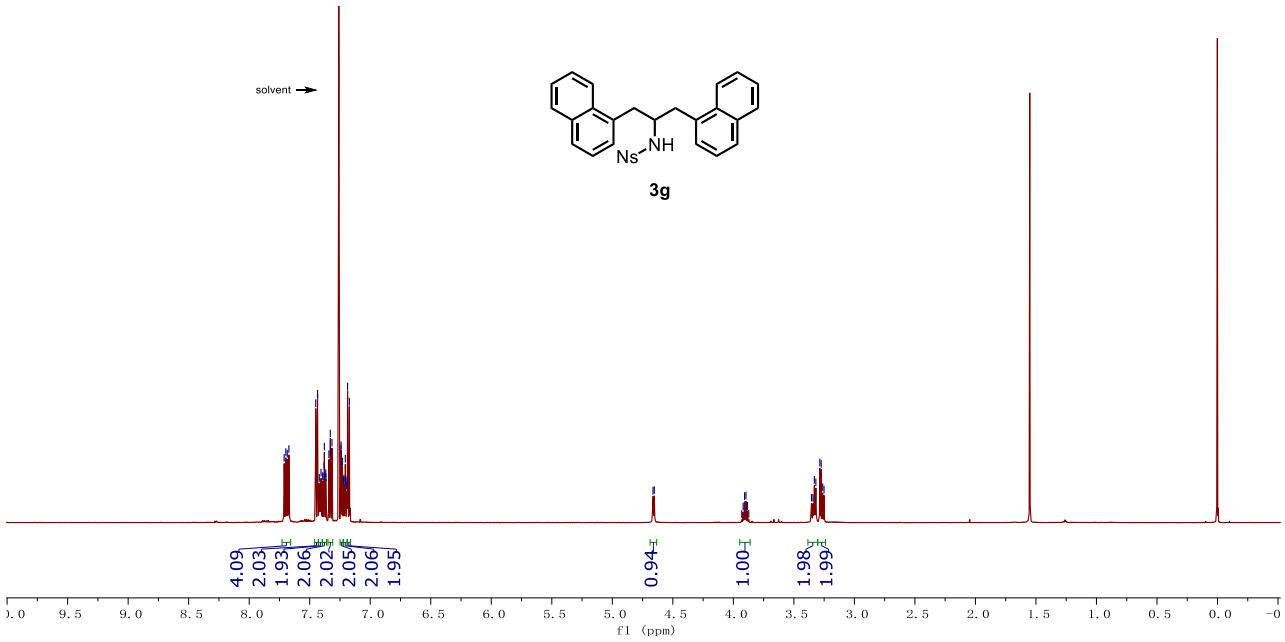
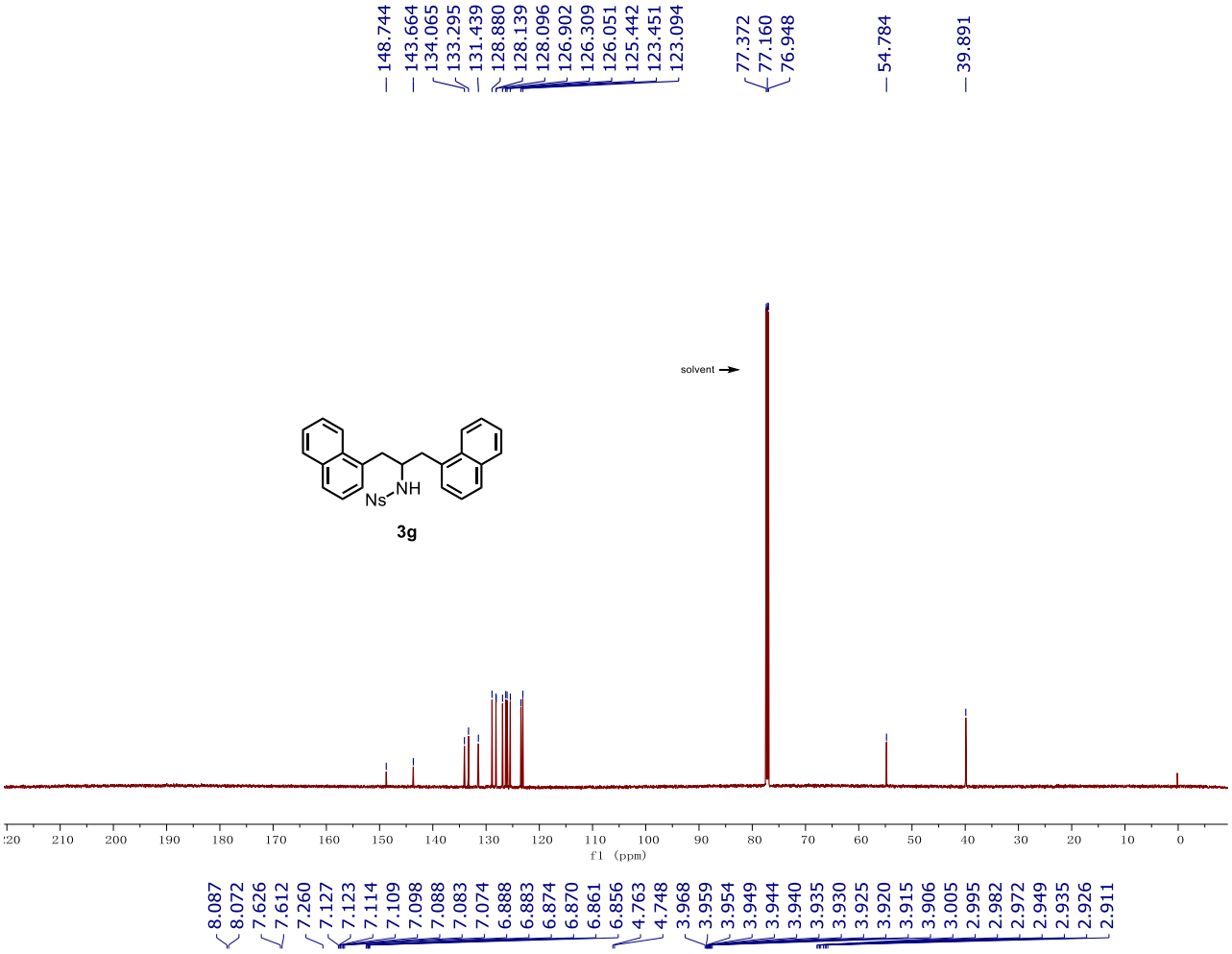
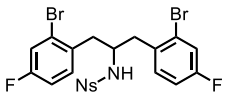
7.697
7.686
7.672
7.450
7.435
7.421
7.407
7.393
7.391
7.381
7.379
7.377
7.368
7.366
7.341
7.330
7.328
7.316
7.243
7.241
7.231
7.229
7.218
7.206
7.203
7.187
3.931
3.919
3.907
3.896
3.885
3.884
3.872
3.354
3.342
3.331
3.318
3.285
3.274
3.262
3.251

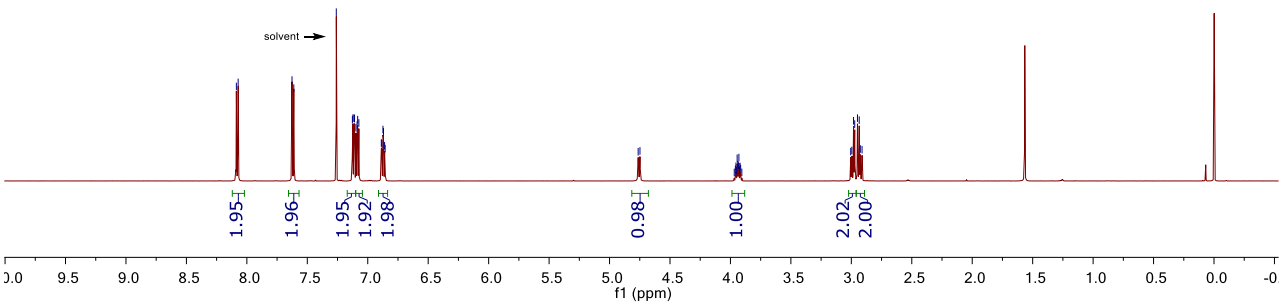

solvent
Ns
NH
3g
4.09
2.03
1.93
2.06
2.02
2.05
2.06
1.95
0.94
1.00
1.98
1.99
f1 (ppm)


148.744
143.664
134.065
133.295
131.439
128.880
128.139
128.096
126.902
126.309
126.051
125.442
123.451
123.094
77.372
77.160
76.948
54.784
39.891
solvent
Ns
NH
f1 (ppm)
8.087
8.072
7.626
7.612
7.260
7.127
7.123
7.114
7.109
7.098
7.088
7.083
7.074
6.888
6.883
6.874
6.870
6.861
6.856
4.763
4.748
3.968
3.959
3.954
3.949
3.944
3.940
3.935
3.930
3.925
3.920
3.915
3.906
3.005
2.995
2.982
2.972
2.949
2.935
2.926
2.911

3g


Br
Br
F
F
Ns
NH

3h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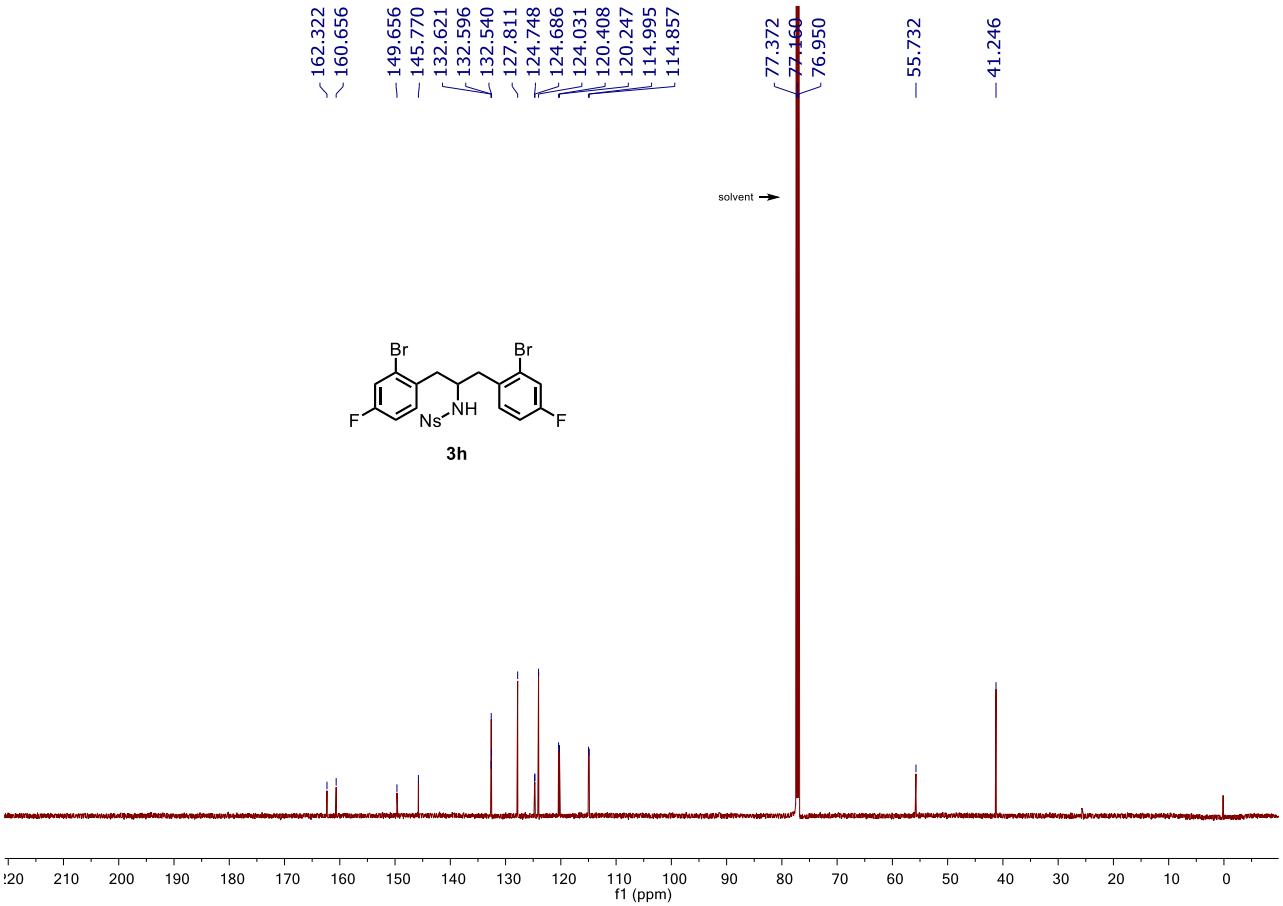
1.96
1.95
1.92
1.98
0.98
1.00
2.02
2.00
f1 (ppm)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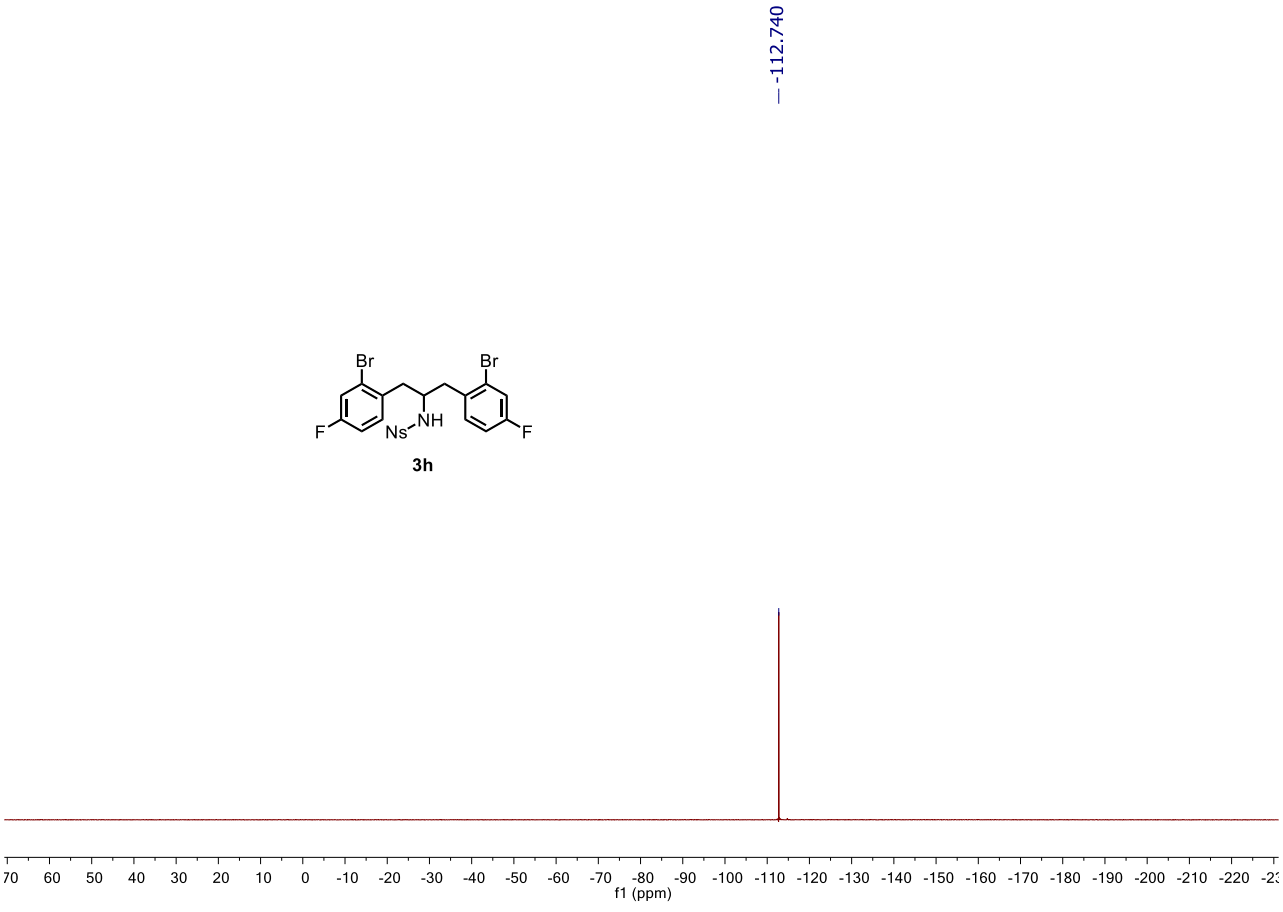
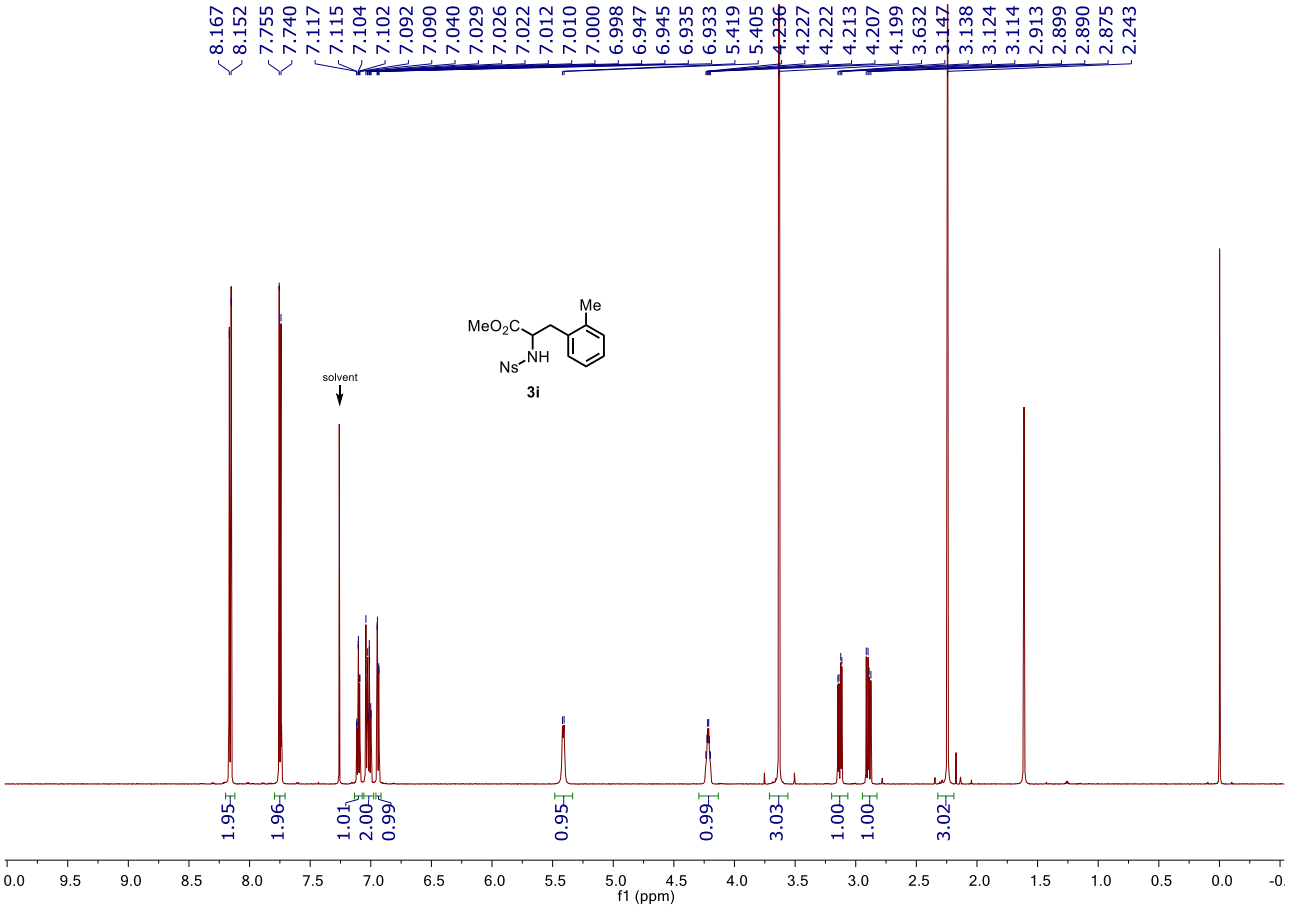
160.656
149.656
145.770
132.621
132.596
132.540
127.811
124.748
124.686
124.031
120.408
120.247
114.995
114.857
77.372
77.160
76.950
55.732
41.246
solvent
Br
Br
F
Ns
NH
F
3h
f1 (ppm)


-112.740
Br
Br
F
Ns
NH
F
3h
f1 (ppm)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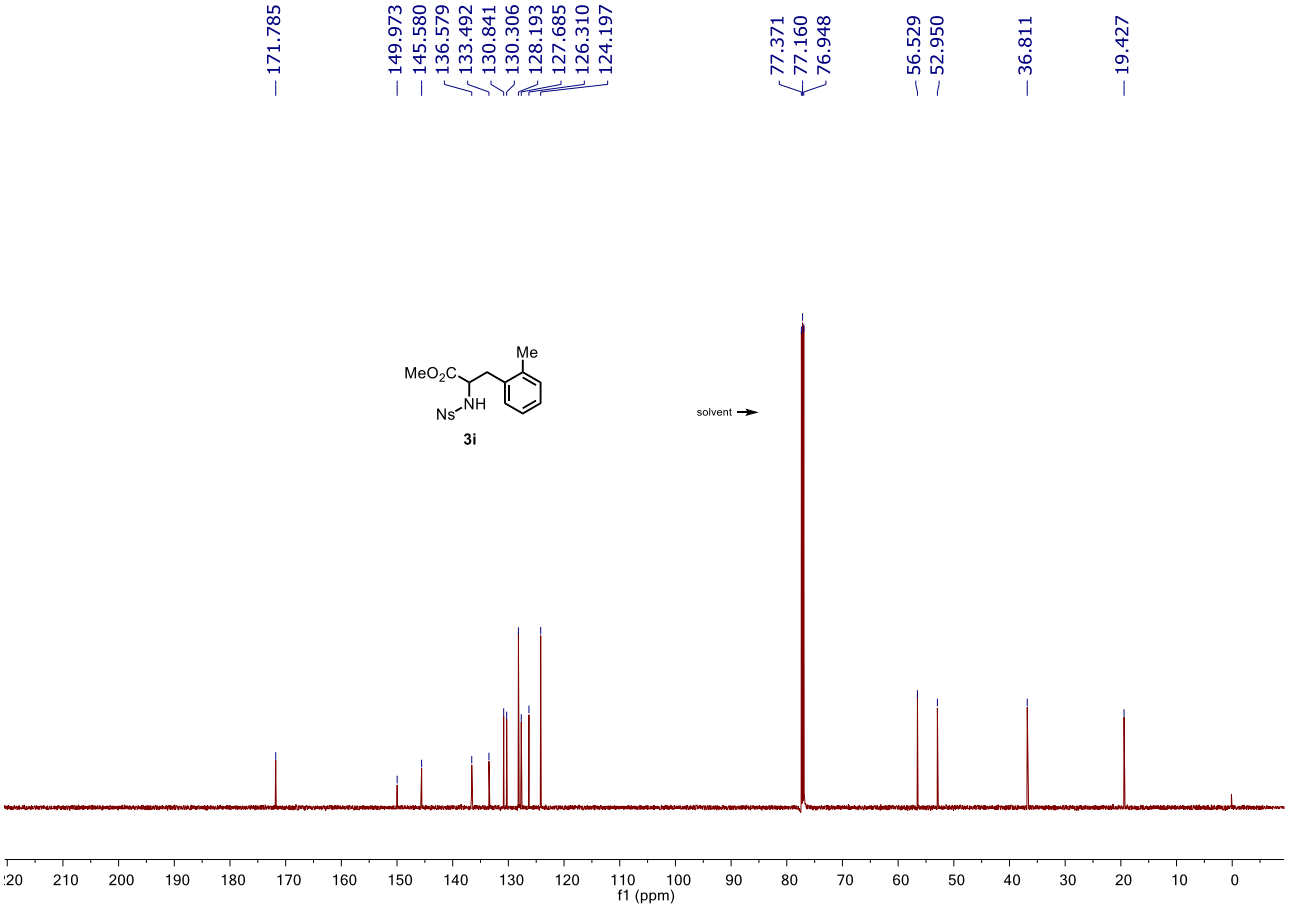
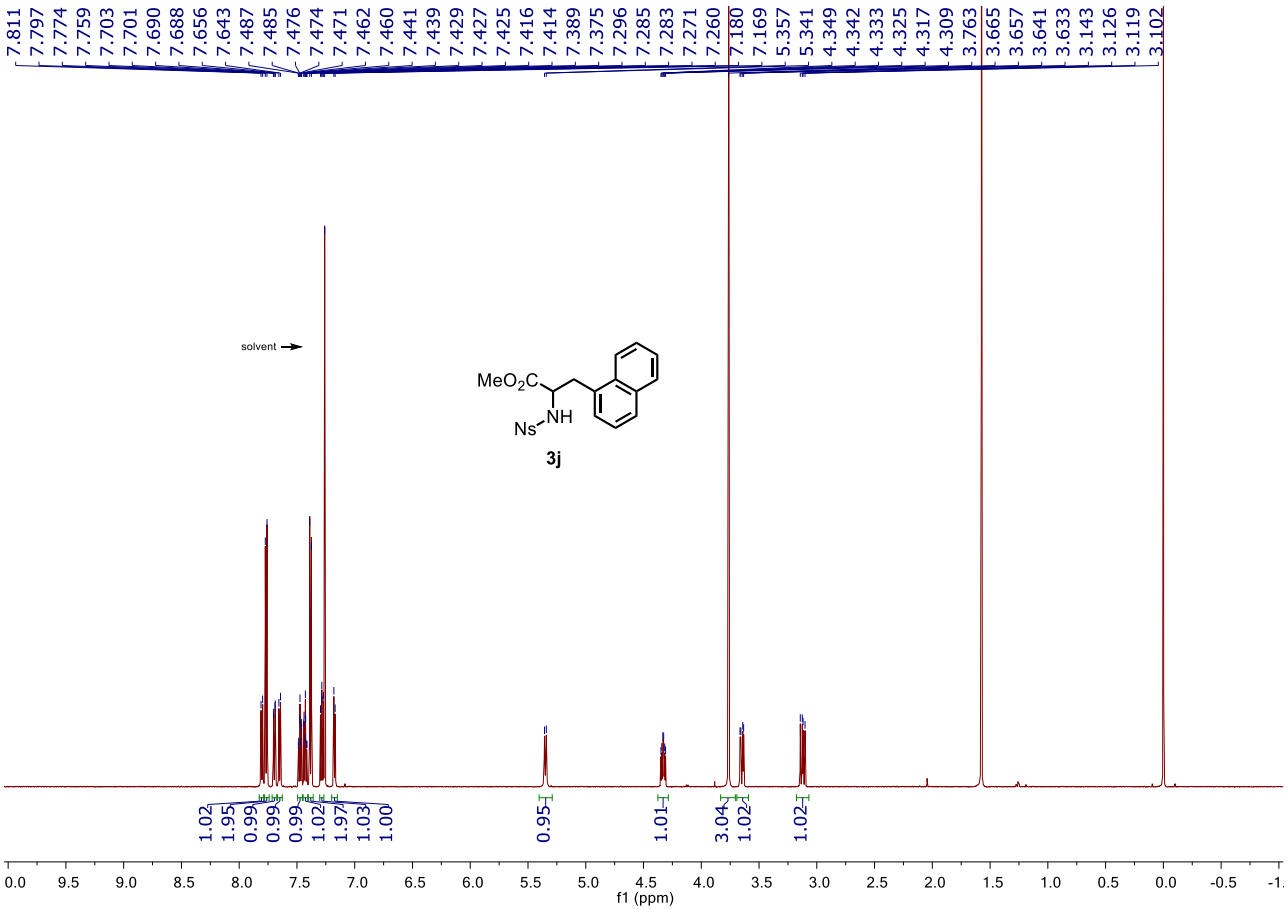
8.152
7.755
7.740
7.117
7.115
7.104
7.102
7.092
7.090
7.040
7.029
7.026
7.022
7.012
7.010
7.000
6.998
6.947
6.945
6.935
6.933
5.419
5.405
4.236
4.227
4.222
4.213
4.207
4.199
3.632
3.147
3.138
3.124
3.114
2.913
2.899
2.890
2.875
2.243
Me
MeO2C
NH
Ns
3i
solvent
1.95
1.96
1.01
2.00
0.99
0.95
0.99
3.03
1.00
1.00
3.02
f1 (ppm)


171.785
149.973
145.580
136.579
133.492
130.841
130.306
128.193
127.685
126.310
124.197
77.371
77.160
76.948
56.529
52.950
36.811
19.427
Me
MeO2C
NH
Ns
3i
solvent
f1 (ppm)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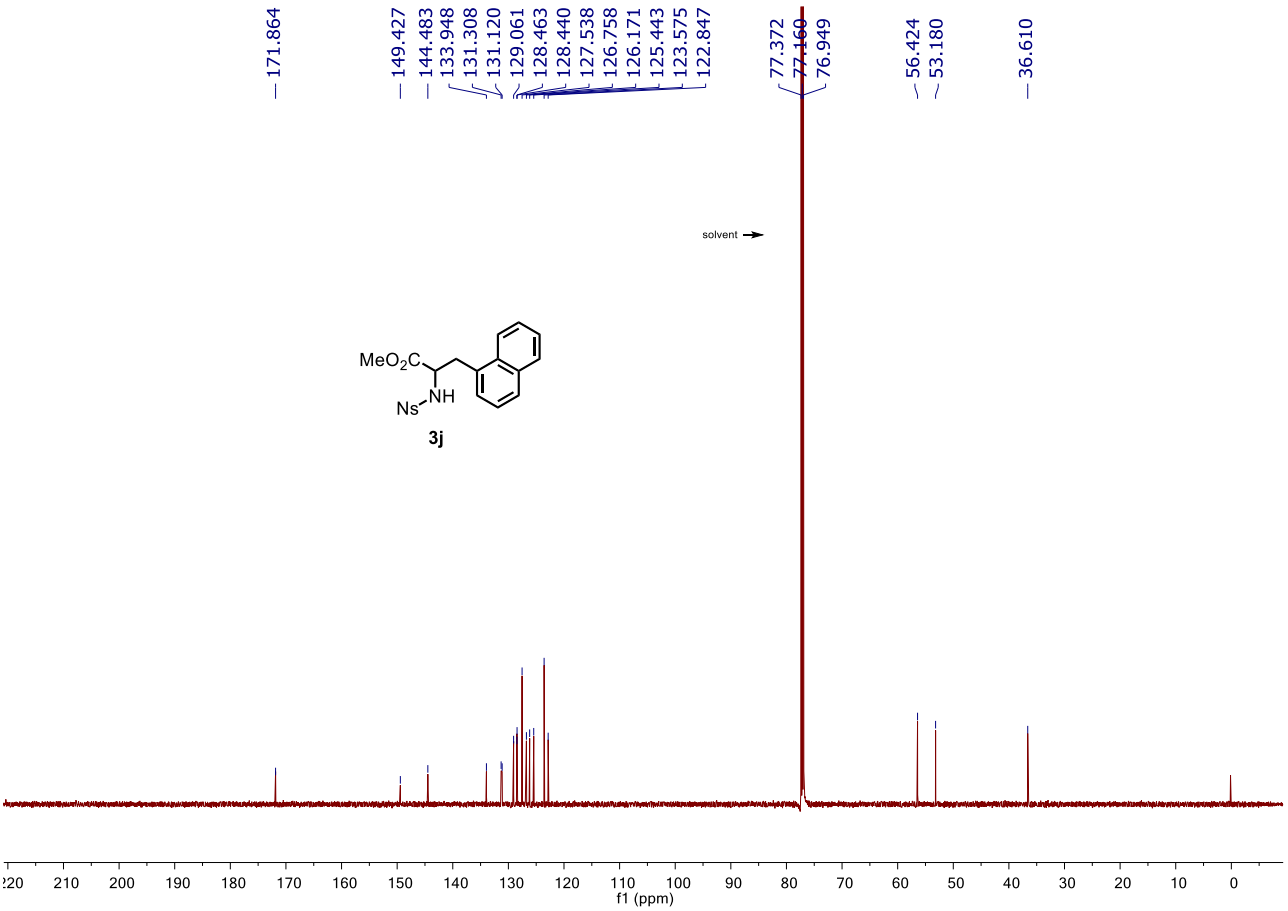
7.797
7.774
7.759
7.703
7.701
7.690
7.688
7.656
7.643
7.487
7.485
7.476
7.474
7.471
7.462
7.460
7.441
7.439
7.429
7.427
7.425
7.416
7.414
7.389
7.375
7.296
7.285
7.283
7.271
7.260
7.180
7.169
5.357
5.341
4.349
4.342
4.333
4.325
4.317
4.309
3.763
3.665
3.657
3.641
3.633
3.143
3.126
3.119
3.102
solvent
MeO2C
NH
Ns
3j
1.02
1.95
0.99
0.99
0.99
1.02
1.97
1.03
1.00
0.95
1.01
3.04
1.02
1.02
f1 (ppm)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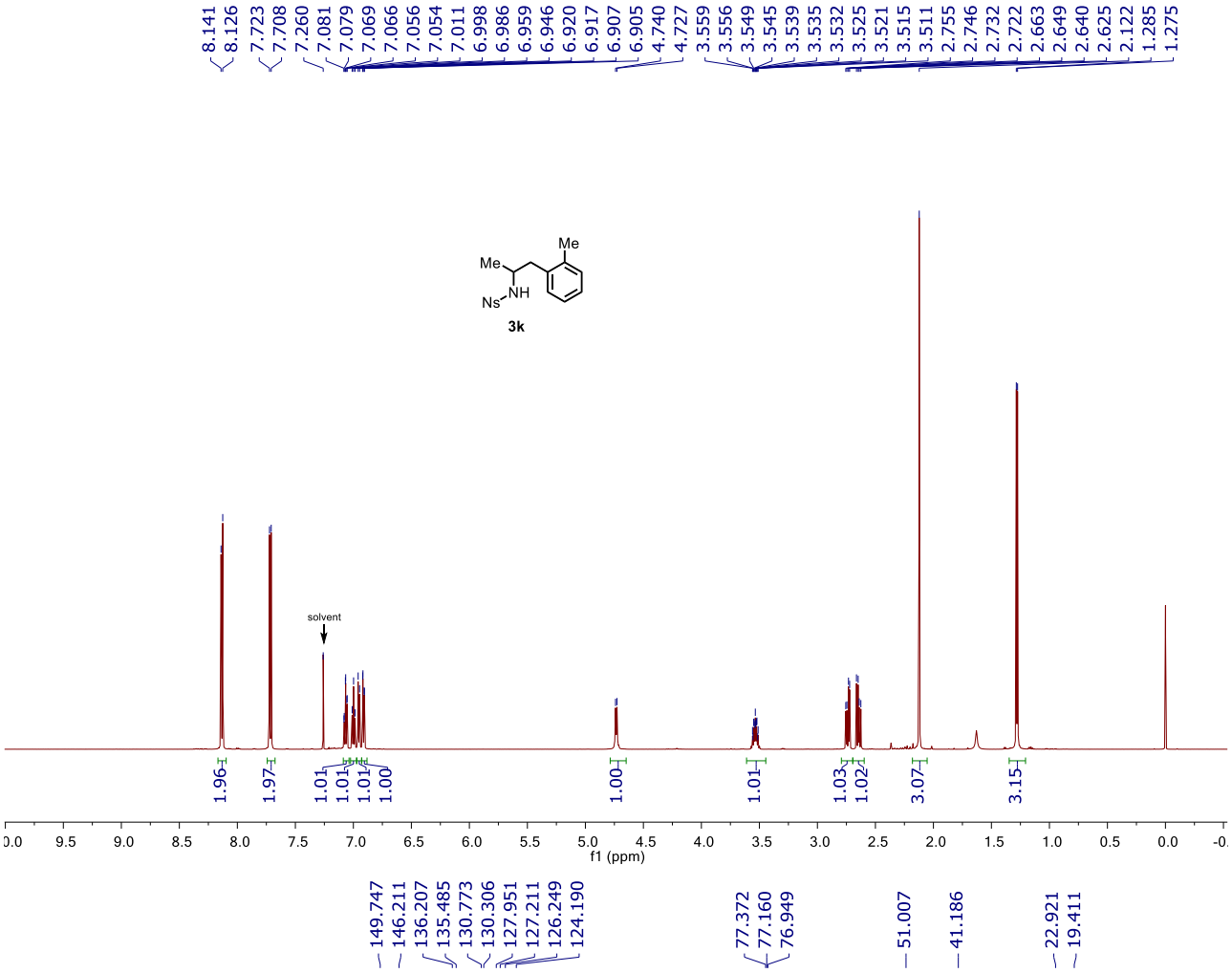
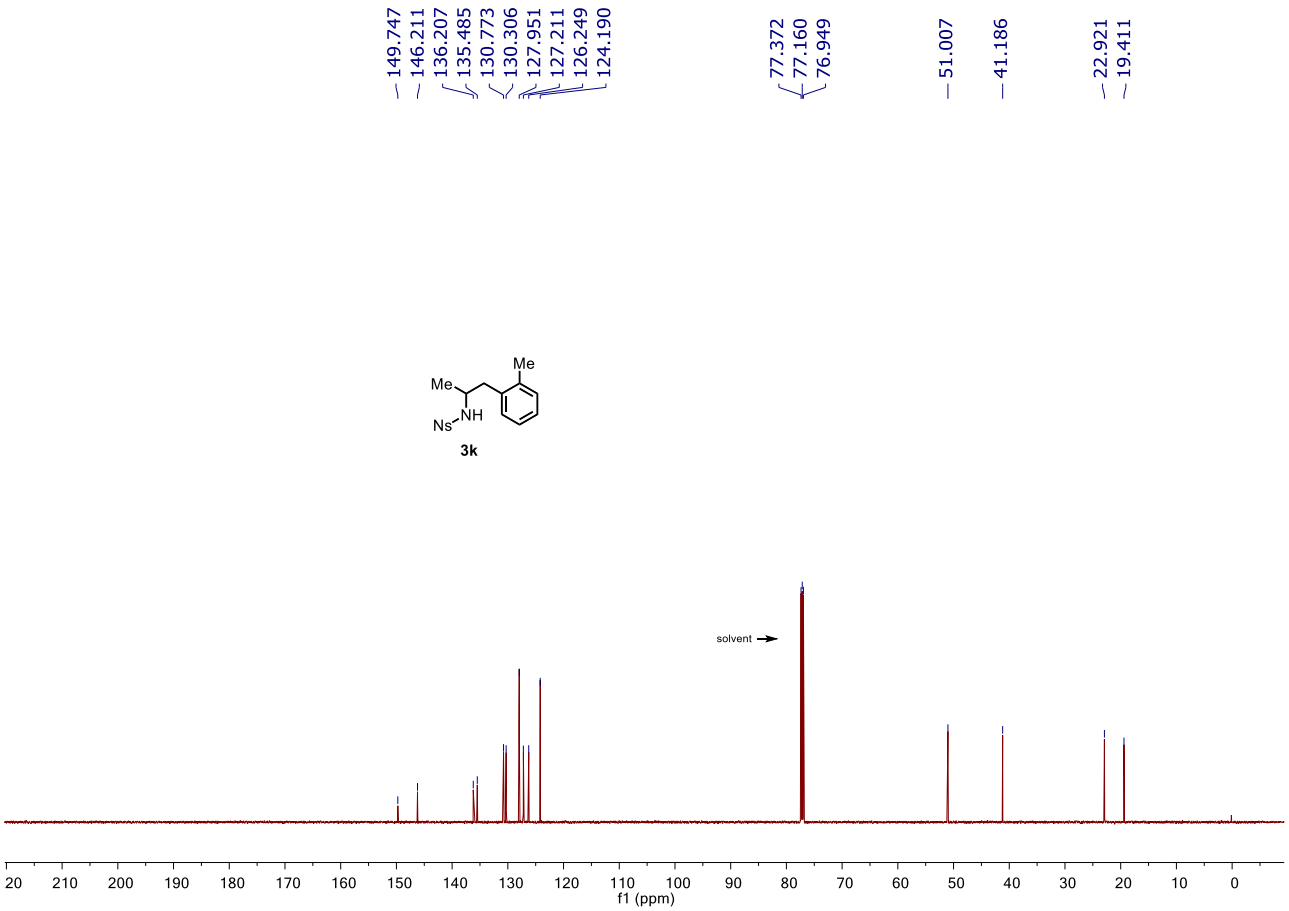
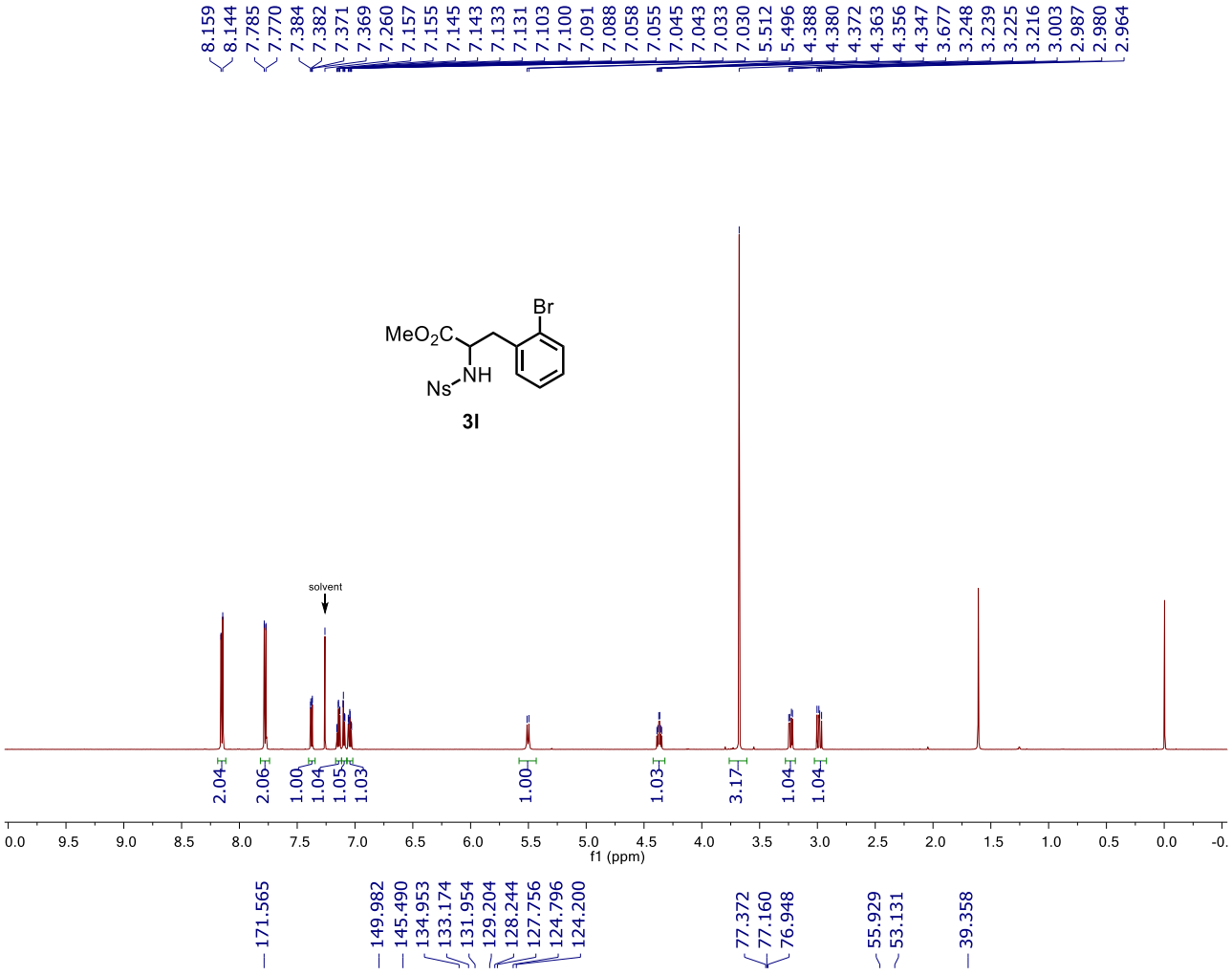
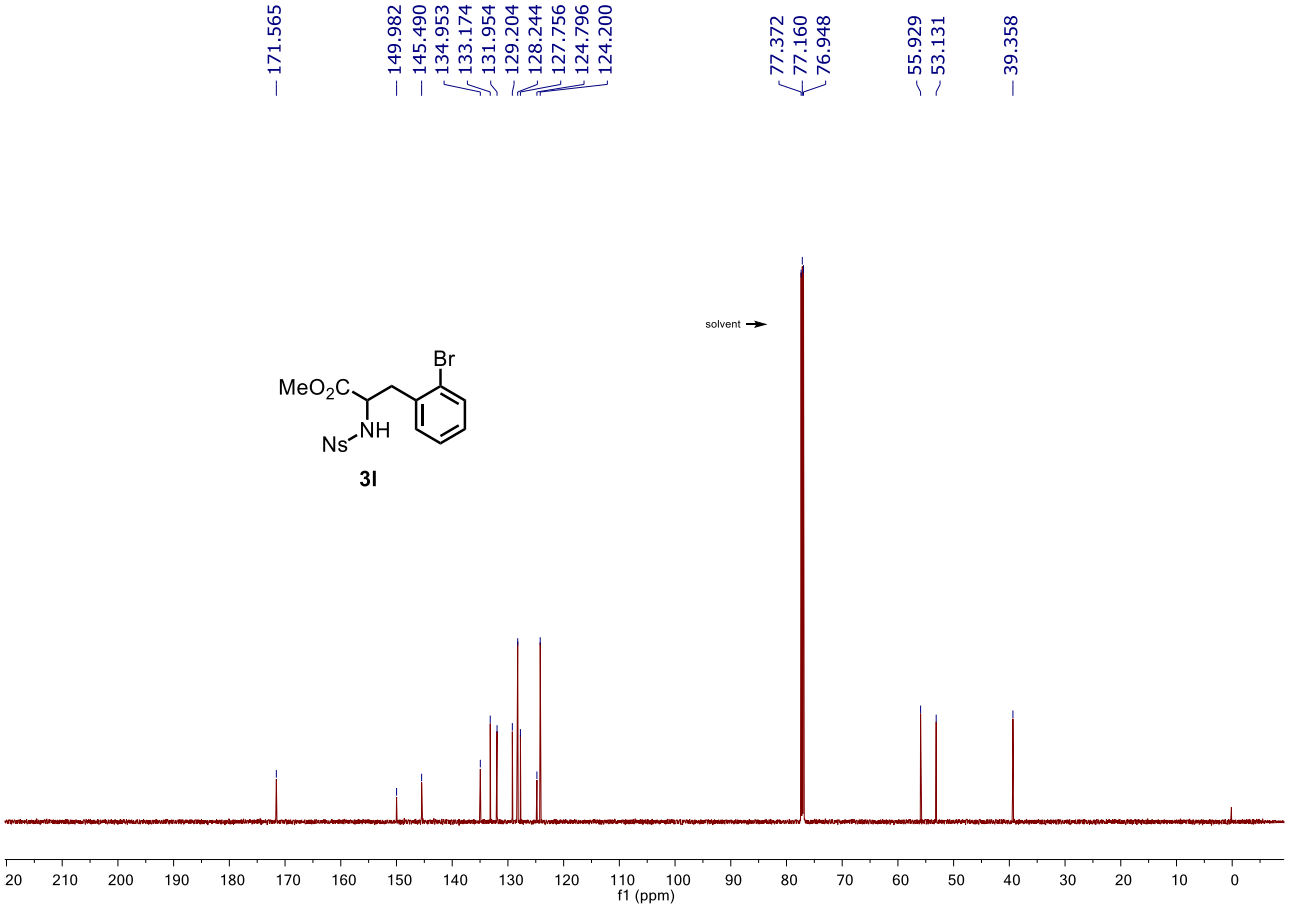
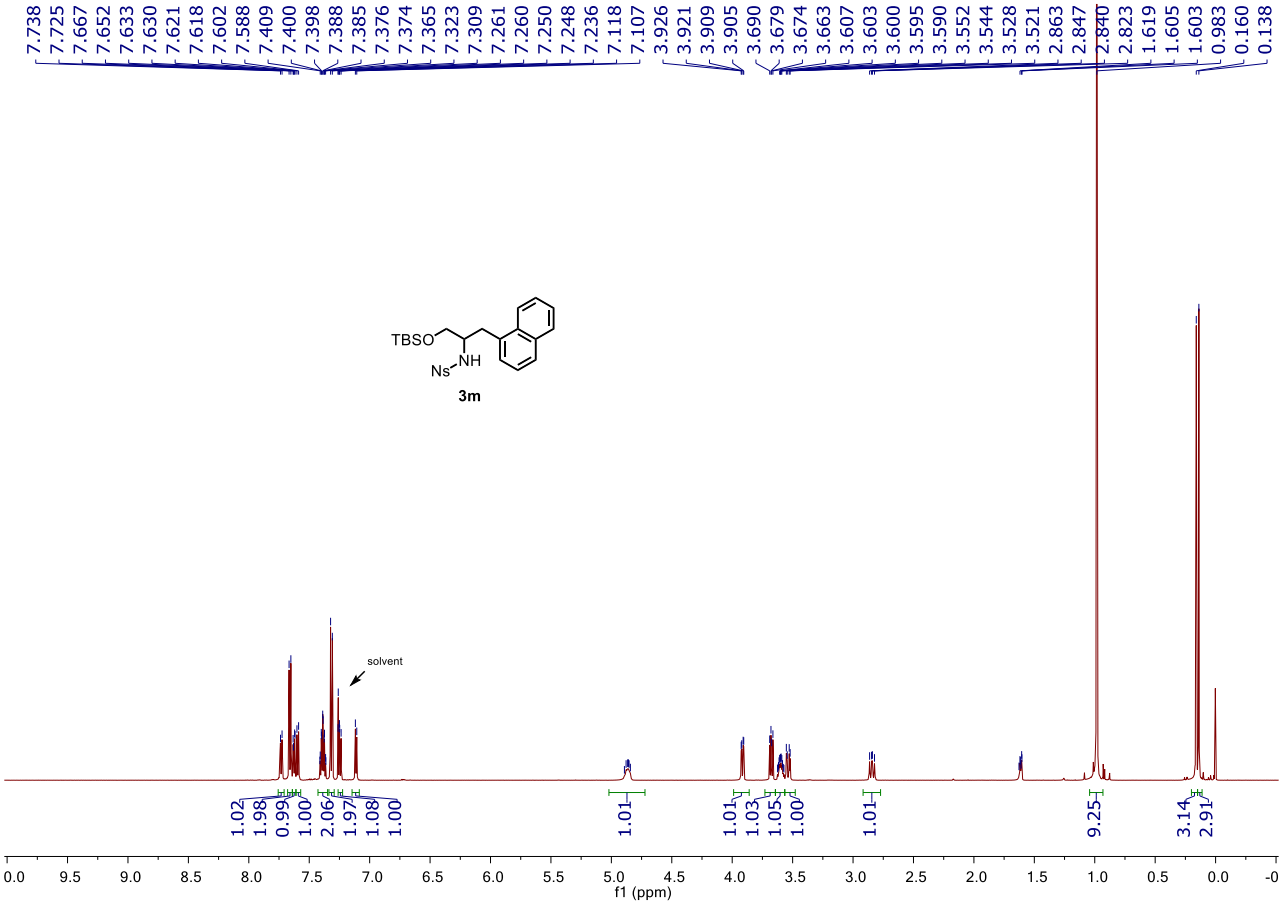
144.483
133.948
131.308
131.120
129.061
128.463
128.440
127.538
126.758
126.171
125.443
123.575
122.847
77.372
77.160
76.949
56.424
53.180
36.610
solvent
MeO2C
NH
Ns
3j
f1 (ppm)


8.141
8.126
7.723
7.708
7.260
7.081
7.079
7.069
7.066
7.056
7.054
7.011
6.998
6.986
6.959
6.946
6.920
6.917
6.907
6.905
4.740
4.727
3.559
3.556
3.549
3.545
3.539
3.535
3.532
3.525
3.521
3.515
3.511
2.755
2.746
2.732
2.722
2.663
2.649
2.640
2.625
2.122
1.285
1.275
Me
Me
NH
Ns
3k
solvent
1.96
1.97
1.01
1.01
1.01
1.00
1.00
1.01
1.03
1.02
3.07
3.15
f1 (ppm)


149.747
146.211
136.207
135.485
130.773
130.306
127.951
127.211
126.249
124.190
77.372
77.160
76.949
51.007
41.186
22.921
19.411
Me
Me
NH
Ns
3k
solvent
f1 (ppm)


8.159
8.144
7.785
7.770
7.384
7.382
7.371
7.369
7.260
7.157
7.155
7.145
7.143
7.133
7.131
7.103
7.100
7.091
7.088
7.058
7.055
7.045
7.043
7.033
7.030
5.512
5.496
4.388
4.380
4.372
4.363
4.356
4.347
3.677
3.248
3.239
3.225
3.216
3.003
2.987
2.980
2.964
Br
MeO2C
NH
Ns
3l
solvent
2.04
2.06
1.00
1.04
1.05
1.03
1.00
1.03
3.17
1.04
1.04
f1 (ppm)


171.565
149.982
145.490
134.953
133.174
131.954
129.204
128.244
127.756
124.796
124.200
77.372
77.160
76.948
55.929
53.131
39.358
Br
MeO2C
NH
Ns
3l
solvent
f1 (ppm)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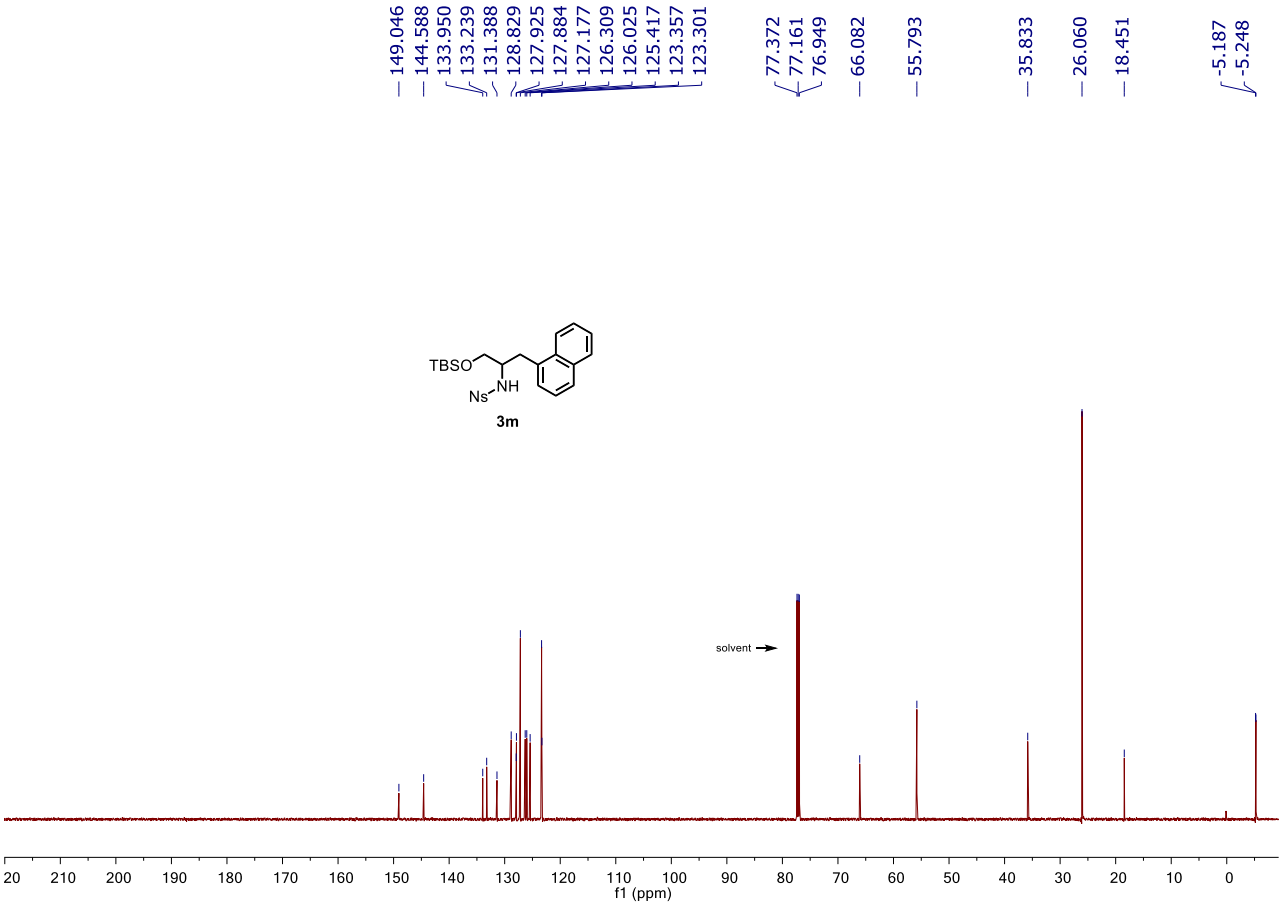
7.725
7.667
7.652
7.633
7.630
7.621
7.618
7.602
7.588
7.409
7.400
7.398
7.388
7.385
7.376
7.374
7.365
7.323
7.309
7.261
7.260
7.250
7.248
7.236
7.118
7.107
3.926
3.921
3.909
3.905
3.690
3.679
3.674
3.663
3.607
3.603
3.600
3.595
3.590
3.552
3.544
3.528
3.521
2.863
2.847
2.840
2.823
1.619
1.605
1.603
0.983
0.160
0.138
TBSO
NH
Ns
3m
solvent
1.02
1.98
0.99
1.00
2.06
1.97
1.08
1.00
1.01
1.01
1.03
1.05
1.00
1.01
9.25
3.14
2.91
f1 (ppm)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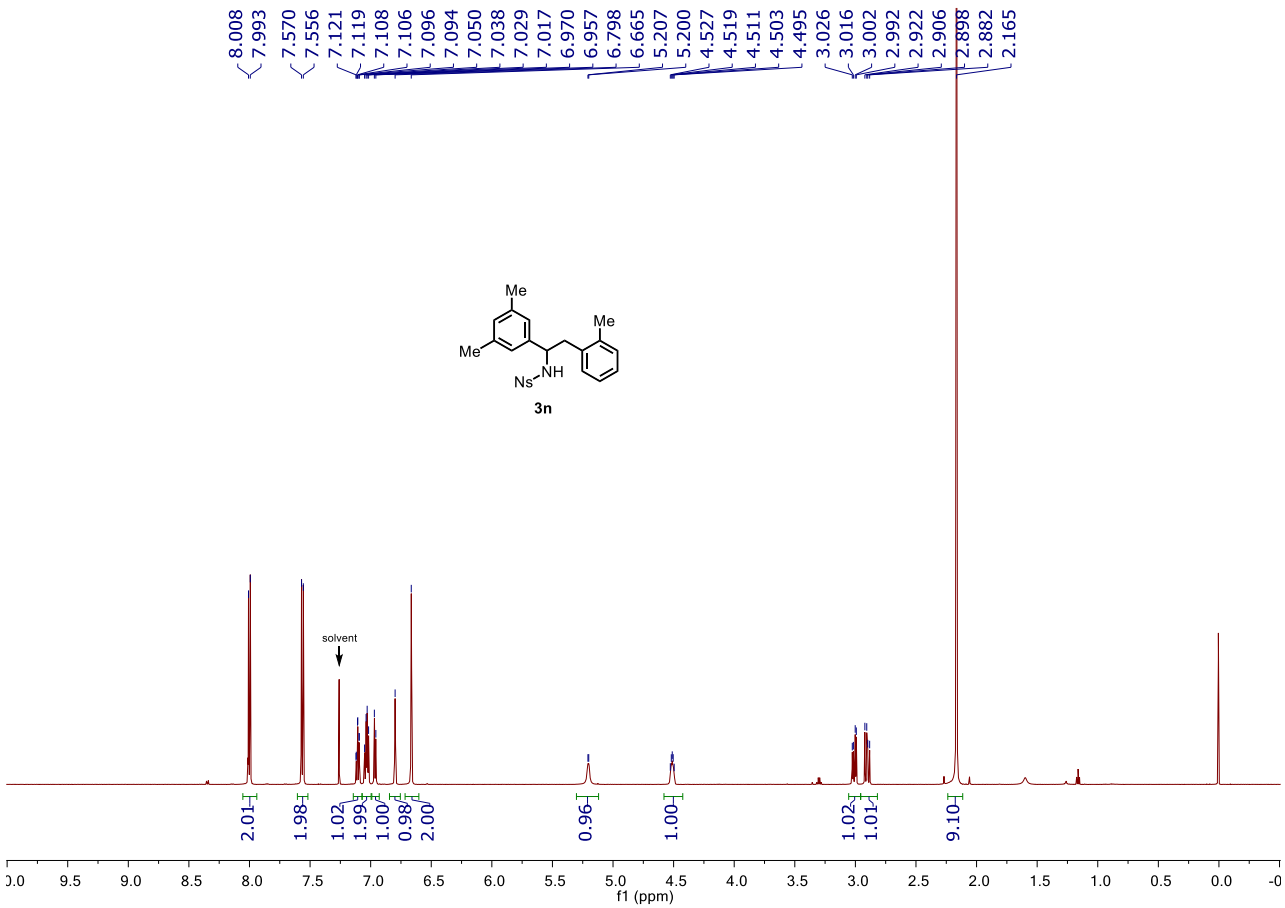
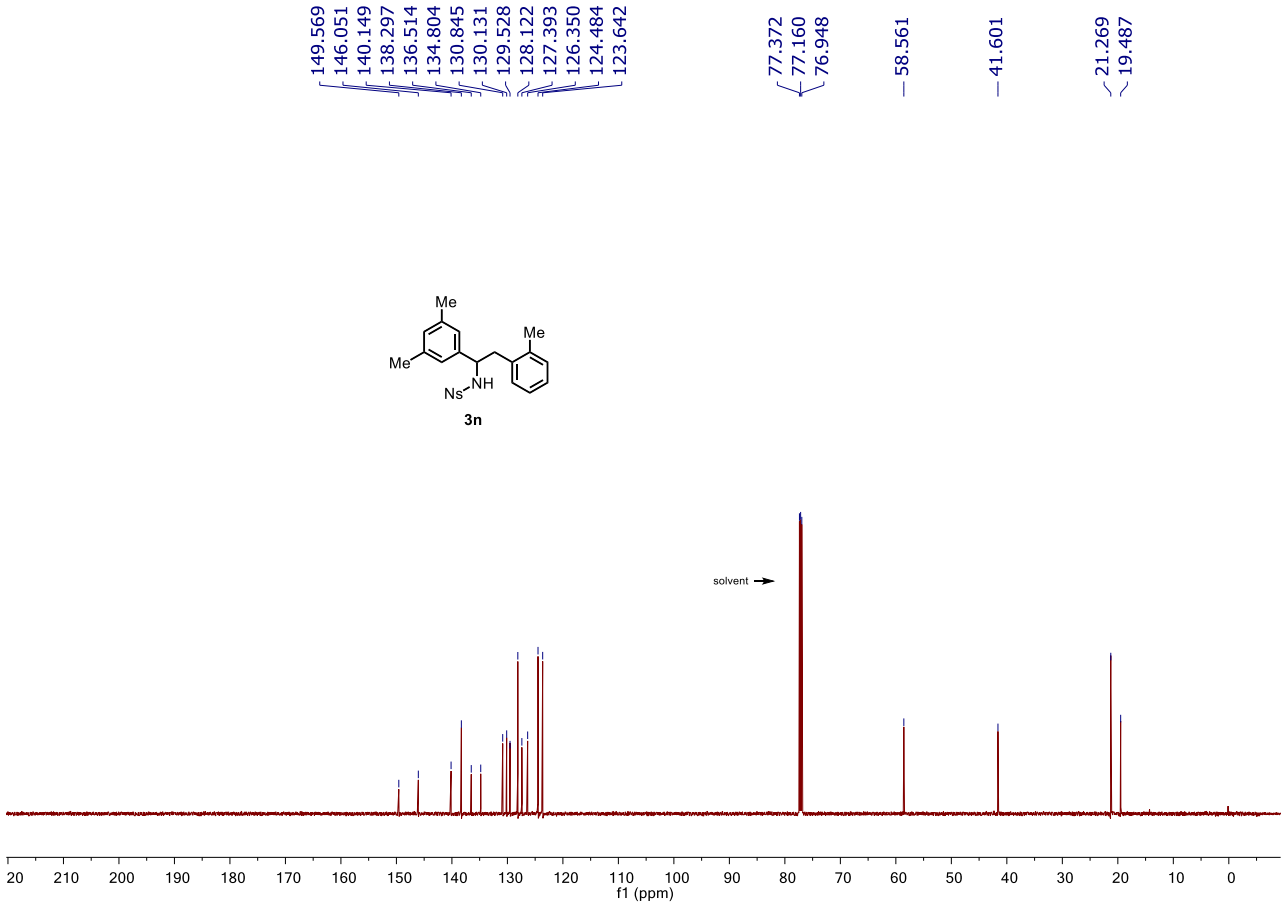
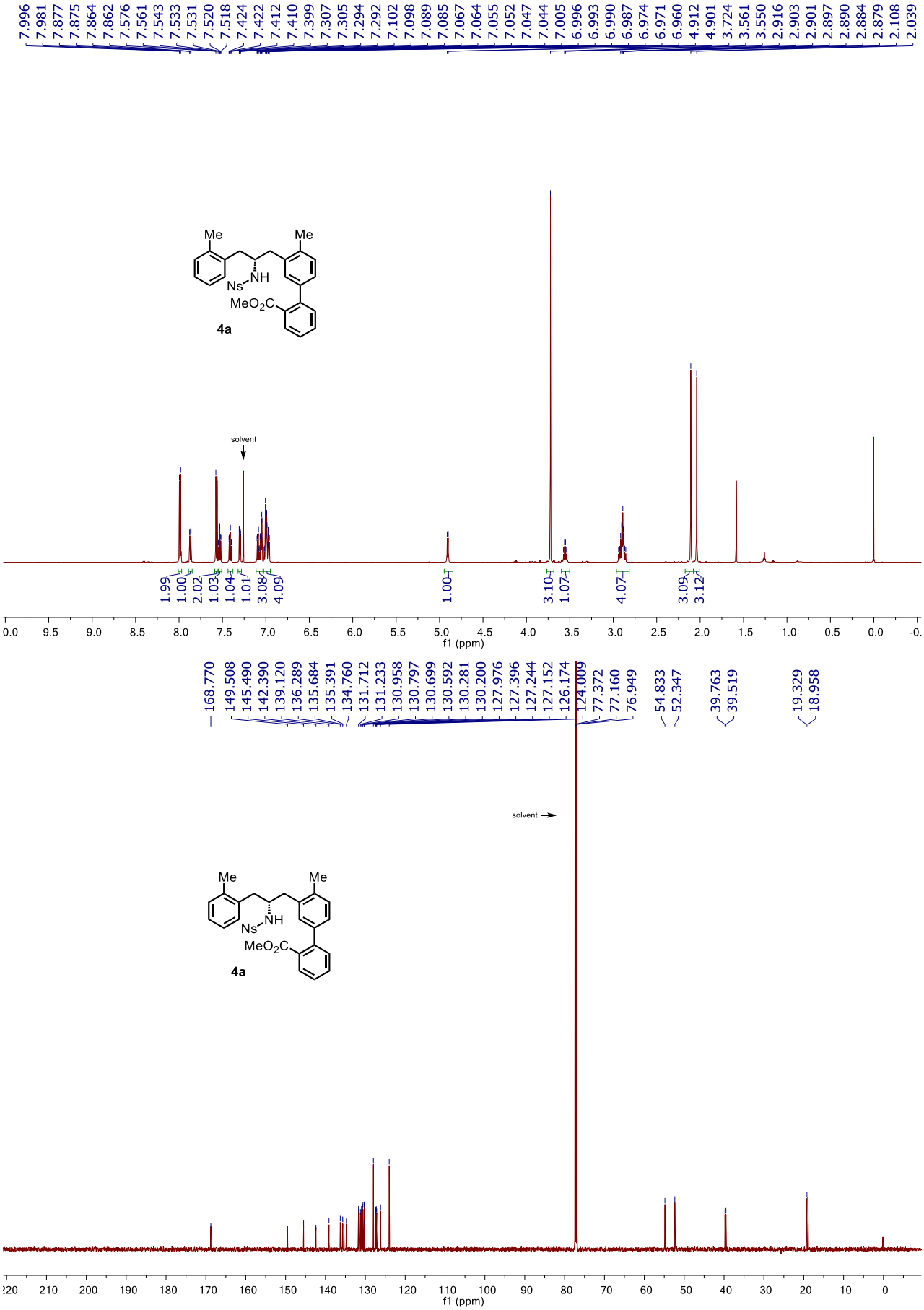
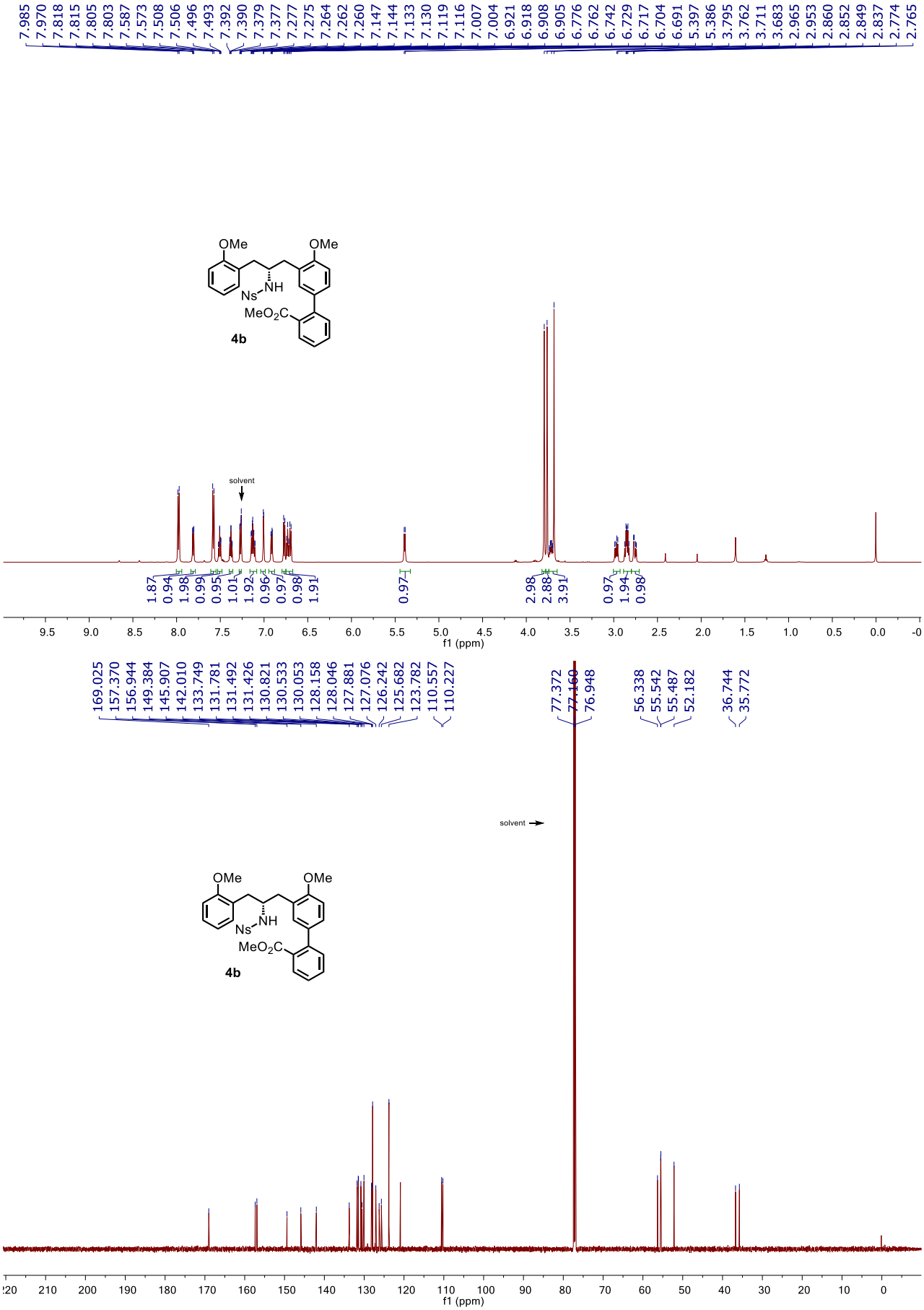
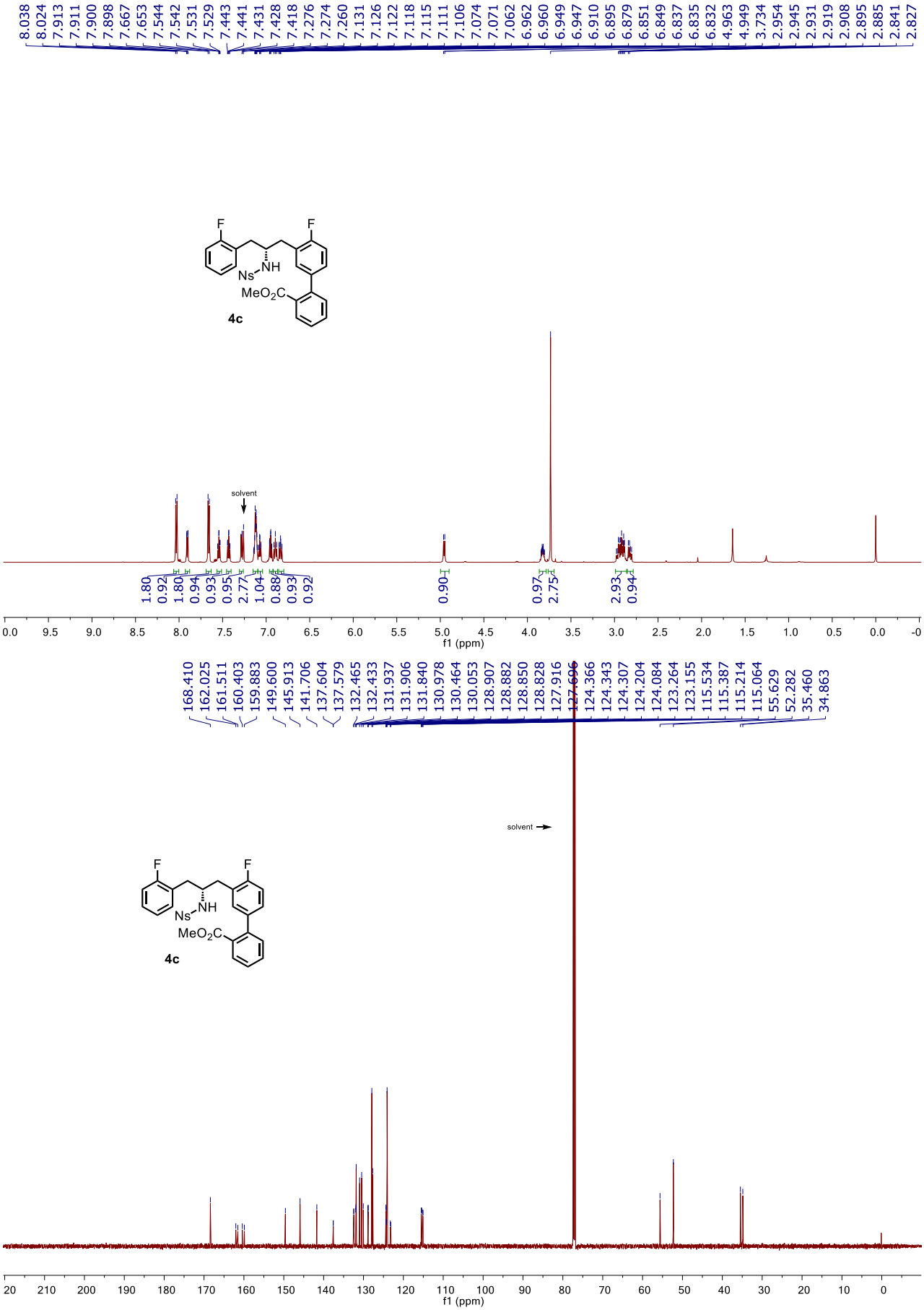
144.588
133.950
133.239
131.388
128.829
127.925
127.884
127.177
126.309
126.025
125.417
123.357
123.301
77.372
77.161
76.949
66.082
55.793
35.833
26.060
18.451
-5.187
-5.248
TBSO
NH
Ns
3m
solvent
f1 (ppm)

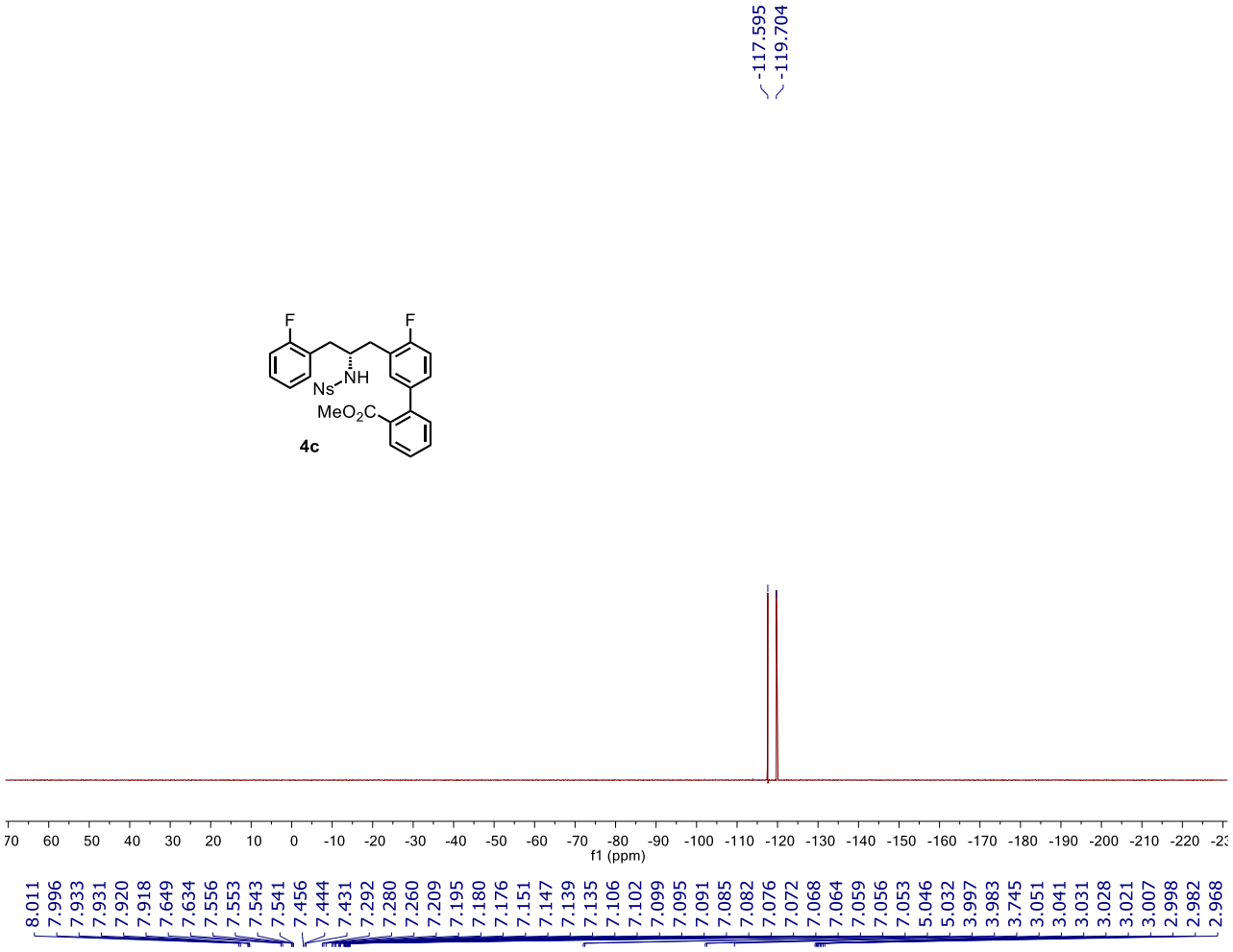

8.008
7.993
7.570
7.556
7.121
7.119
7.108
7.106
7.096
7.094
7.050
7.038
7.029
7.017
6.970
6.957
6.798
6.665
5.207
5.200
4.527
4.519
4.511
4.503
4.495
3.026
3.016
3.002
2.992
2.922
2.906
2.898
2.882
2.165
Me
Me
Me
NH
Ns
3n
solvent
2.01
1.98
1.02
1.99
1.00
0.98
2.00
0.96
1.00
1.02
1.01
9.10
f1 (ppm)


149.569
146.051
140.149
138.297
136.514
134.804
130.845
130.131
129.528
128.122
127.393
126.350
124.484
123.642
77.372
77.160
76.948
58.561
41.601
21.269
19.487
Me
Me
Me
NH
Ns
3n
solvent
f1 (ppm)


7.996
7.981
7.877
7.875
7.864
7.862
7.576
7.561
7.543
7.533
7.531
7.520
7.518
7.424
7.422
7.412
7.410
7.399
7.307
7.305
7.294
7.292
7.102
7.098
7.089
7.085
7.067
7.064
7.055
7.052
7.047
7.044
7.005
6.996
6.993
6.990
6.987
6.974
6.971
6.960
4.912
4.901
3.724
3.561
3.550
2.916
2.903
2.901
2.897
2.890
2.884
2.879
2.108
2.039
Me
Me
NH
Ns
MeO2C
4a
solvent
1.99
1.00
2.02
1.03
1.04
1.01
3.08
4.09
1.00
3.10
1.07
4.07
3.09
3.12
f1 (ppm)
168.770
149.508
145.490
142.390
139.120
136.289
135.684
135.391
134.760
131.712
131.233
130.958
130.797
130.699
130.592
130.281
130.200
127.976
127.396
127.244
127.152
126.174
124.009
77.372
77.160
76.949
54.833
52.347
39.763
39.519
19.329
18.958
solvent
Me
Me
NH
Ns
MeO2C
4a
f1 (ppm)


7.985 7.970 7.818 7.815 7.805 7.803 7.587 7.573 7.508 7.506 7.496 7.493 7.392 7.390 7.379 7.377 7.277 7.275 7.264 7.262 7.260 7.147 7.144 7.133 7.130 7.119 7.116 7.007 7.004 6.921 6.918 6.908 6.905 6.776 6.762 6.742 6.729 6.717 6.704 6.691 5.397 5.386 3.795 3.762 3.711 3.683 2.965 2.953 2.860 2.852 2.849 2.837 2.774 2.765
OMe
OMe
NH
Ns
MeO2C
4b
solvent
1.87 0.94 1.98 0.99 0.95 1.01 1.92 0.96 0.97 0.98 1.91 0.97 2.98 2.88 3.91 0.97 1.94 0.98
f1 (ppm)
169.025 157.370 156.944 149.384 145.907 142.010 133.749 131.781 131.492 131.426 130.821 130.533 130.053 128.158 128.046 127.881 127.076 126.242 125.682 123.782 110.557 110.227
77.372 77.160 76.948
56.338 55.542 55.487 52.182
36.744 35.772
solvent
OMe
OMe
NH
Ns
MeO2C
4b
f1 (ppm)


8.038
8.024
7.913
7.911
7.900
7.898
7.667
7.653
7.544
7.542
7.531
7.529
7.443
7.441
7.431
7.428
7.418
7.276
7.274
7.260
7.131
7.126
7.122
7.118
7.115
7.111
7.106
7.074
7.071
7.062
6.962
6.960
6.949
6.947
6.910
6.895
6.879
6.851
6.849
6.837
6.835
6.832
4.963
4.949
3.734
2.954
2.945
2.931
2.919
2.908
2.895
2.885
2.841
2.827
F
F
NH
Ns
MeO2C
4c
solvent
1.80
0.92
1.80
0.94
0.93
0.95
2.77
1.04
0.88
0.93
0.92
0.90
0.97
2.75
2.93
0.94
f1 (ppm)
168.410
162.025
161.511
160.403
159.883
149.600
145.913
141.706
137.604
137.579
132.465
132.433
131.937
131.906
131.840
130.978
130.464
130.053
128.907
128.882
128.850
128.828
127.916
127.696
124.366
124.343
124.307
124.204
124.084
123.264
123.155
115.534
115.387
115.214
115.064
55.629
52.282
35.460
34.863
solvent
F
F
NH
Ns
MeO2C
4c
f1 (ppm)


-117.595
-119.704
F
F
NH
Ns
MeO2C
4c
f1 (ppm)
8.011
7.996
7.933
7.931
7.920
7.918
7.649
7.634
7.556
7.553
7.543
7.541
7.456
7.444
7.431
7.292
7.280
7.260
7.209
7.195
7.180
7.176
7.151
7.147
7.139
7.135
7.106
7.102
7.099
7.095
7.091
7.085
7.082
7.076
7.072
7.068
7.064
7.059
7.056
7.053
5.046
5.032
3.997
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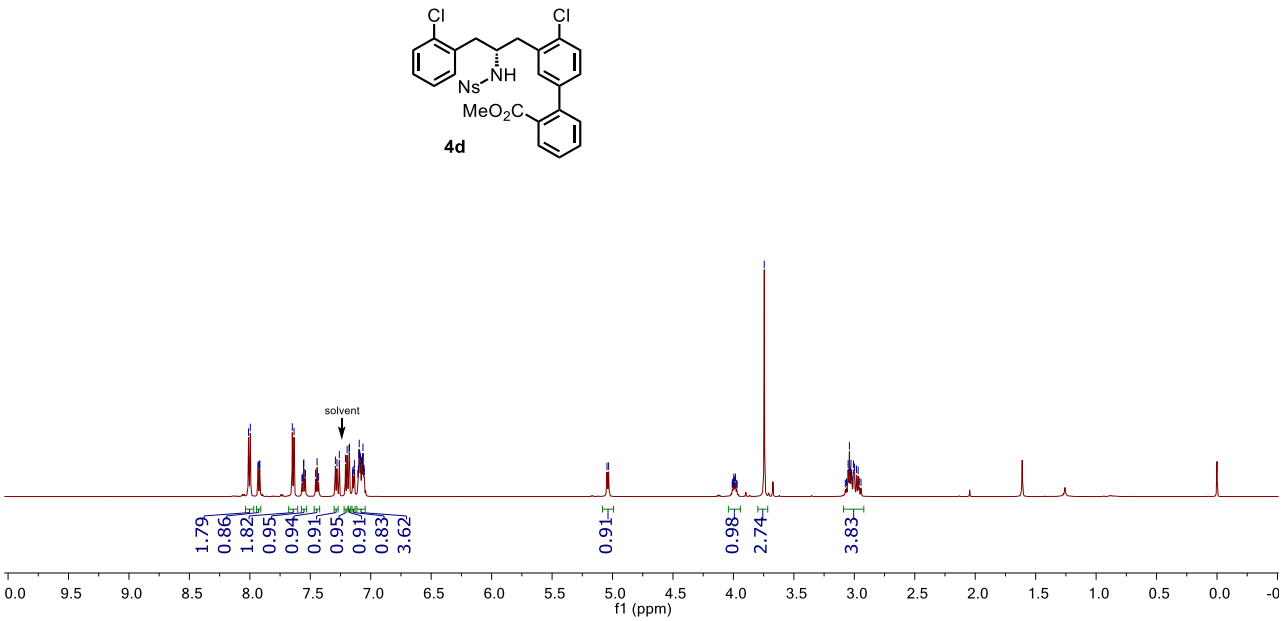
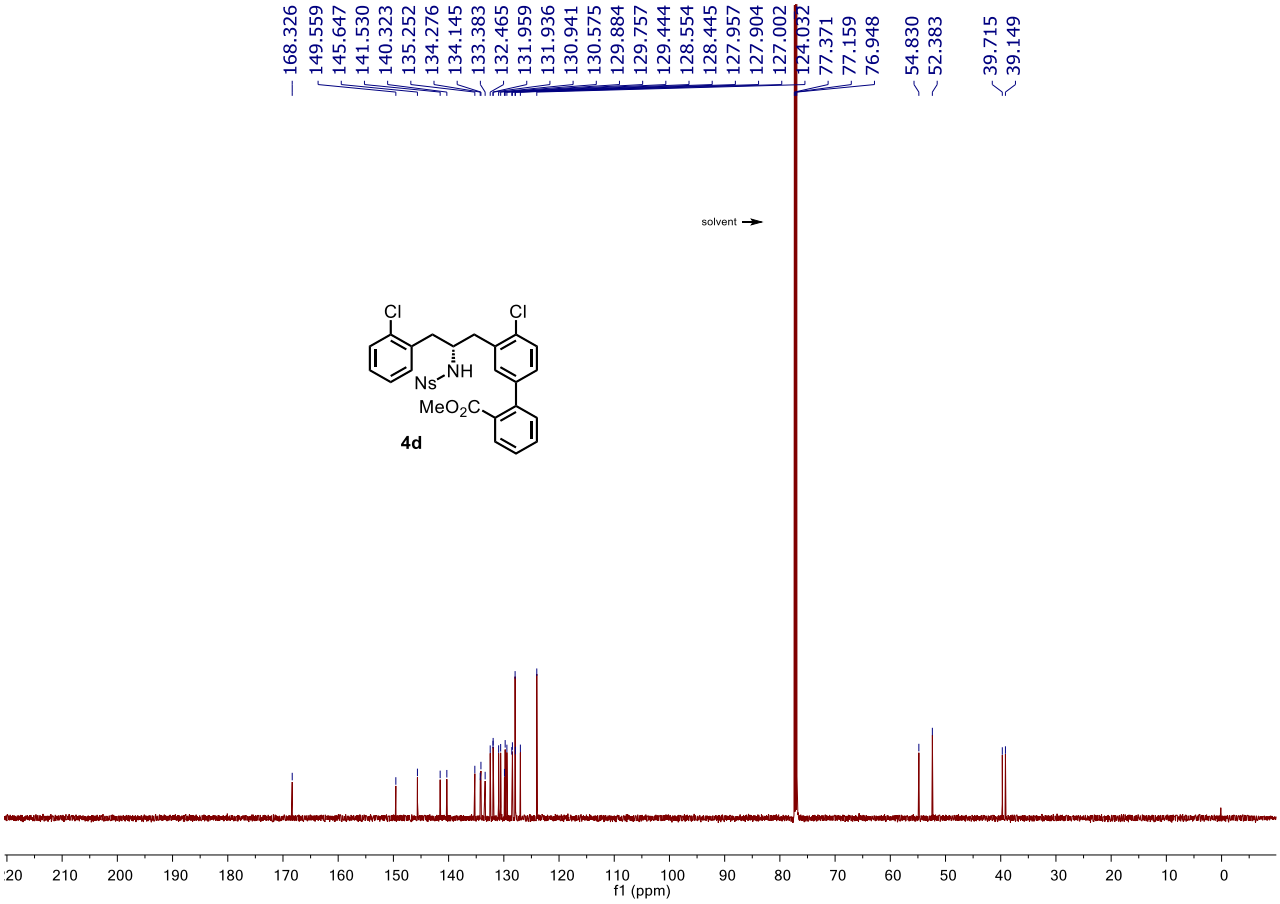
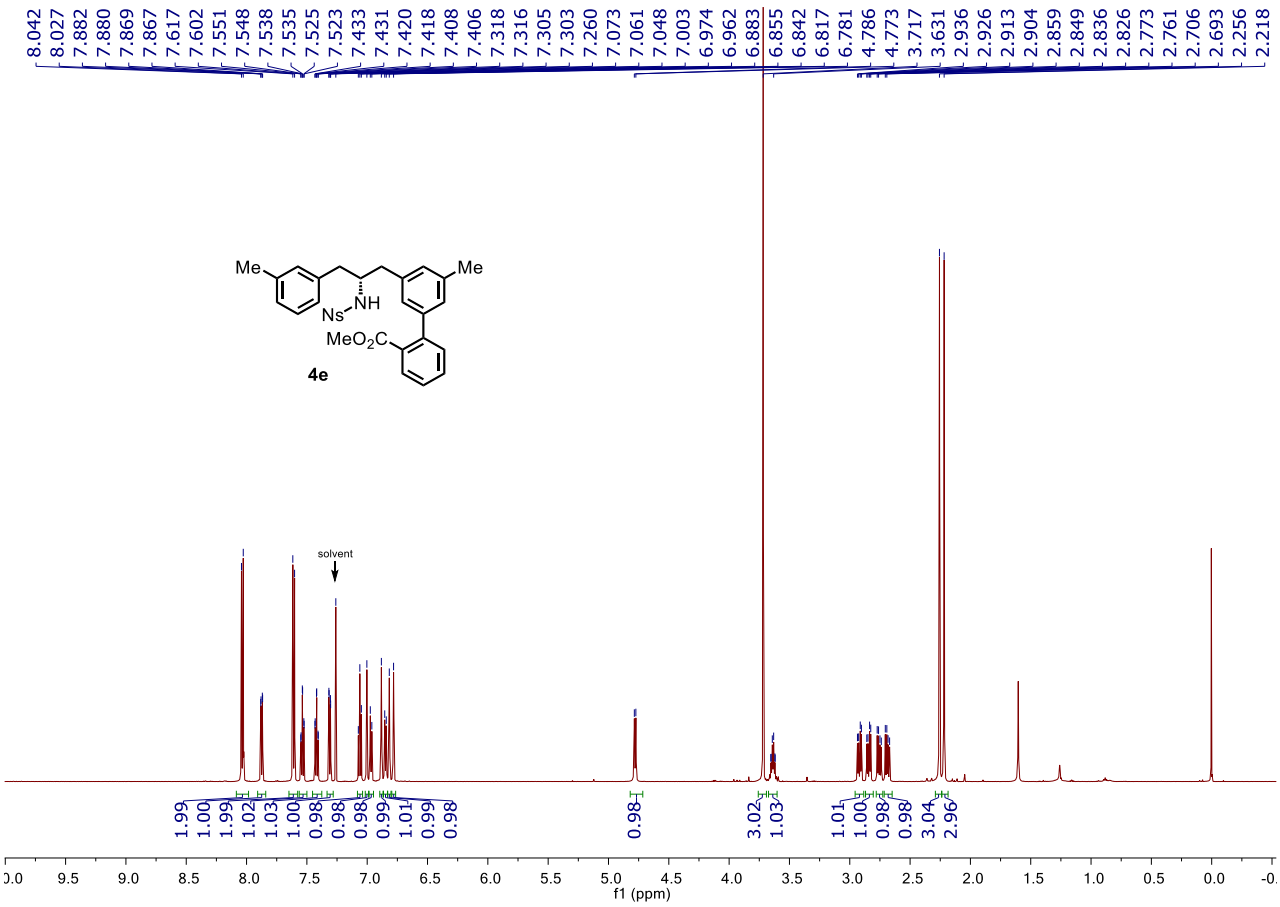
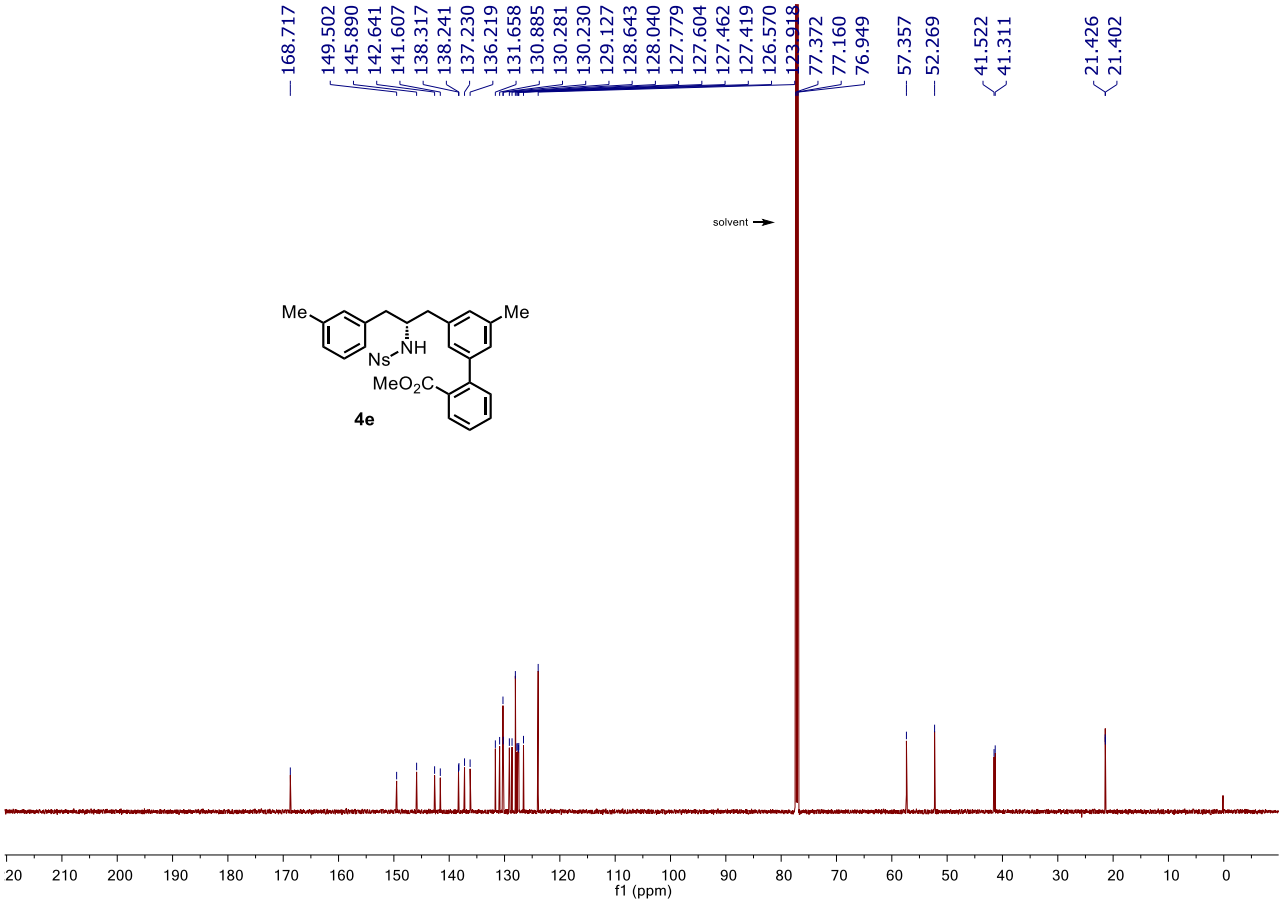
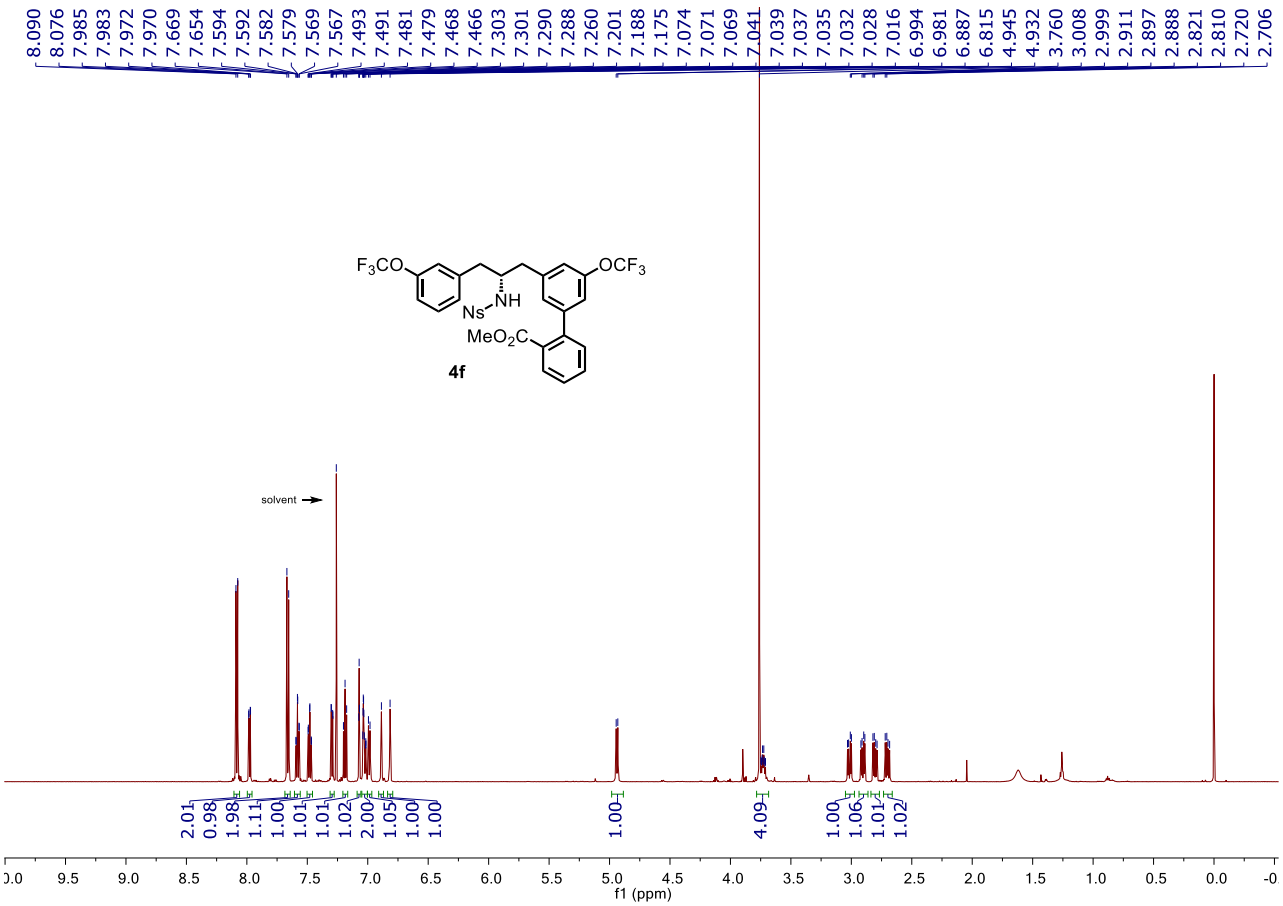
3.041
3.031
3.028
3.021
3.007
2.998
2.982
2.968

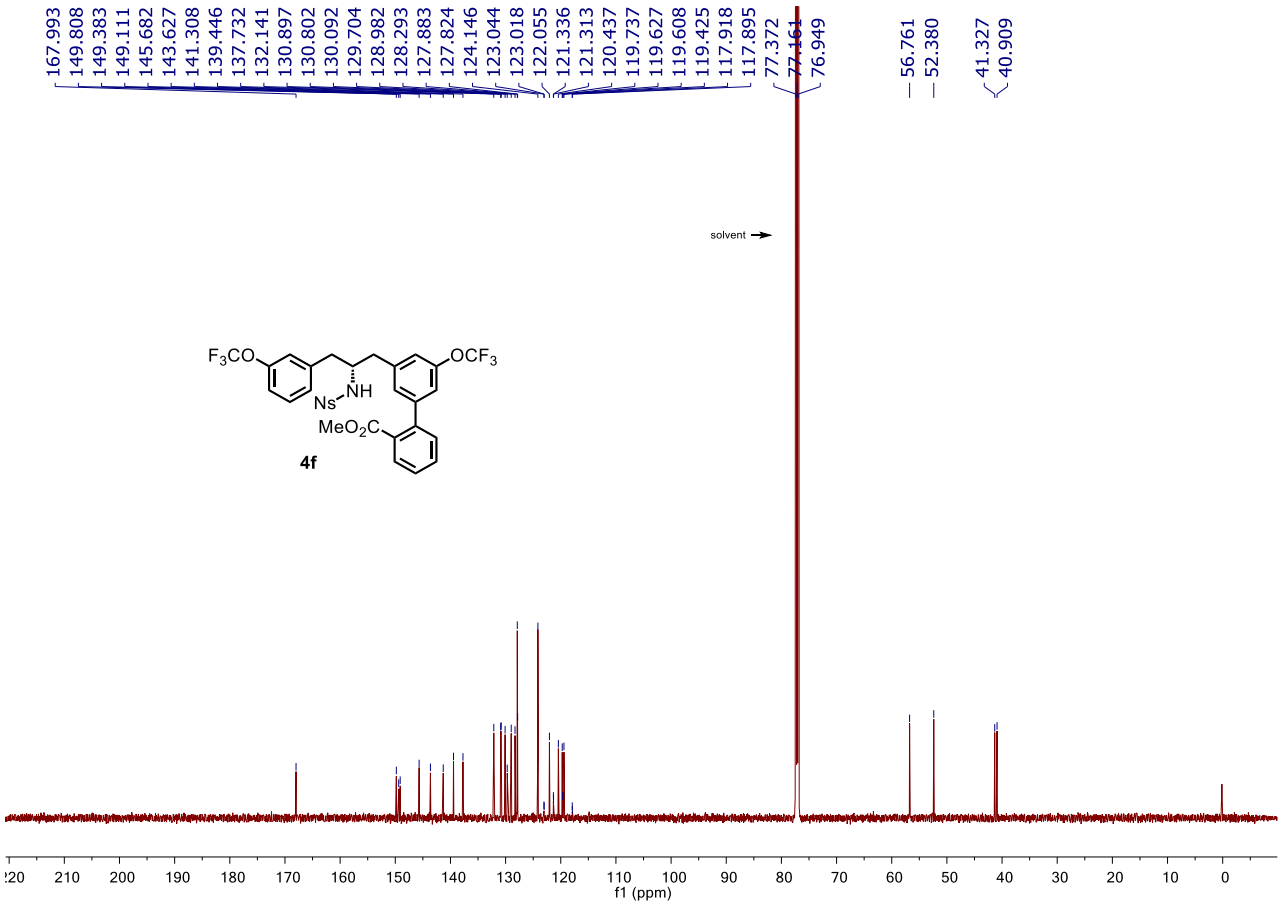

Cl
Cl
NH
Ns
MeO2C
4d
solvent
1.79
0.86
1.82
0.95
0.94
0.91
0.95
0.91
0.83
3.62
0.91
0.98
2.74
3.83
f1 (ppm)

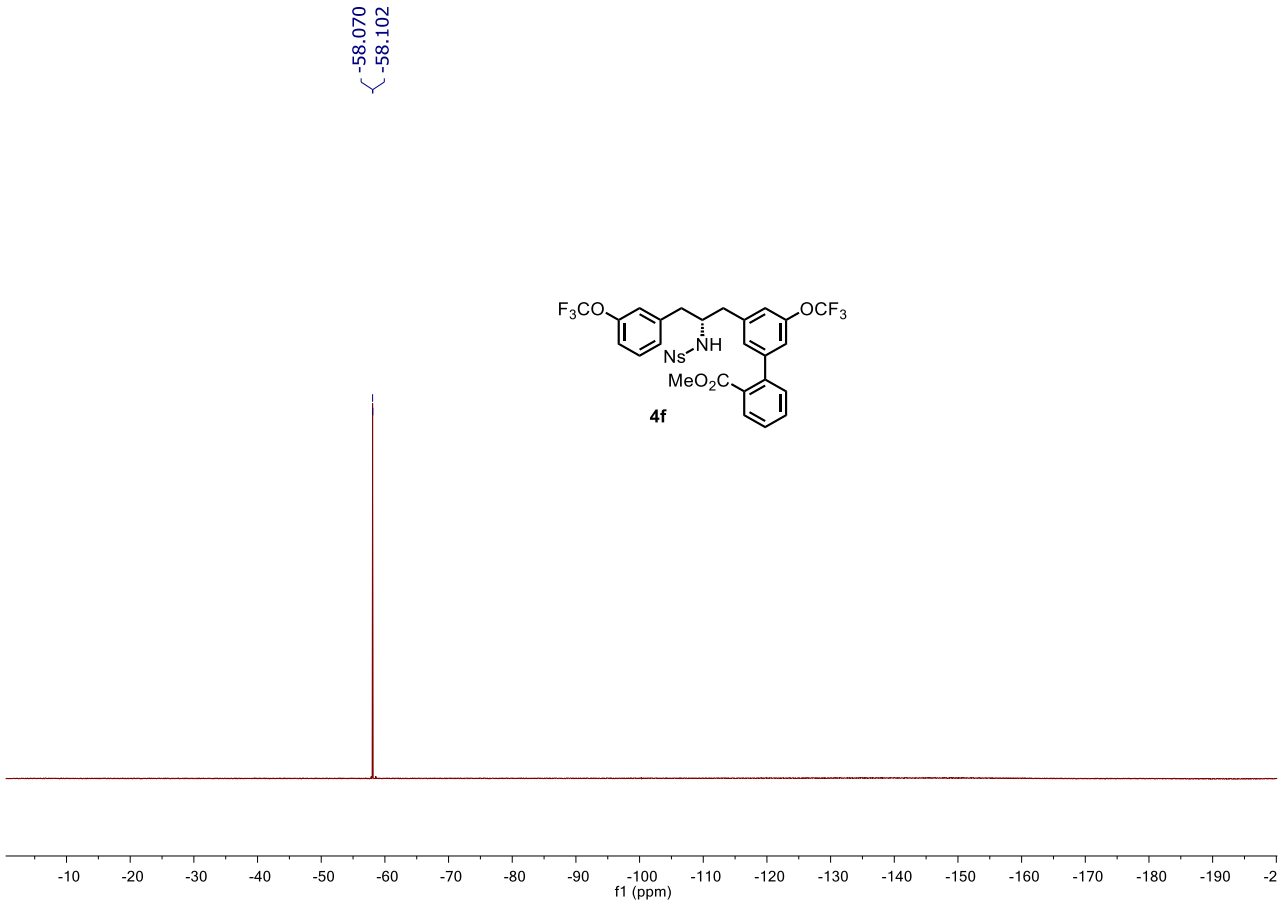

168.326
149.559
145.647
141.530
140.323
135.252
134.276
134.145
133.383
132.465
131.959
131.936
130.941
130.575
129.884
129.757
129.444
128.554
128.445
127.957
127.904
127.002
124.032
77.371
77.159
76.948
54.830
52.383
39.715
39.149
solvent
Cl
Cl
NH
Ns
MeO2C
4d
f1 (ppm)


8.042
8.027
7.882
7.880
7.869
7.867
7.617
7.602
7.551
7.548
7.538
7.535
7.525
7.523
7.433
7.431
7.420
7.418
7.408
7.406
7.318
7.316
7.305
7.303
7.260
7.073
7.061
7.048
7.003
6.974
6.962
6.883
6.855
6.842
6.817
6.781
4.786
4.773
3.717
3.631
2.936
2.926
2.913
2.904
2.859
2.849
2.836
2.826
2.773
2.761
2.706
2.693
2.256
2.218
Me
Me
NH
Ns
MeO2C
4e
solvent
1.99
1.00
1.99
1.02
1.03
1.00
0.98
0.98
0.98
0.99
1.01
0.99
0.98
0.98
3.02
1.03
1.01
1.00
0.98
0.98
3.04
2.96
f1 (ppm)


168.717
149.502
145.890
142.641
141.607
138.317
138.241
137.230
136.219
131.658
130.885
130.281
130.230
129.127
128.643
128.040
127.779
127.604
127.462
127.419
126.570
123.918
77.372
77.160
76.949
57.357
52.269
41.522
41.311
21.426
21.402
solvent
Me
Me
Ns
NH
MeO2C
4e
f1 (ppm)


8.090
8.076
7.985
7.983
7.972
7.970
7.669
7.654
7.594
7.592
7.582
7.579
7.569
7.567
7.493
7.491
7.481
7.479
7.468
7.466
7.303
7.301
7.290
7.288
7.260
7.201
7.188
7.175
7.074
7.071
7.069
7.041
7.039
7.037
7.035
7.032
7.028
7.016
6.994
6.981
6.887
6.815
4.945
4.932
3.760
3.008
2.999
2.911
2.897
2.888
2.821
2.810
2.720
2.706
F3CO
OCF3
Ns
NH
MeO2C
4f
solvent
2.01
0.98
1.98
1.11
1.00
1.01
1.01
1.02
2.00
1.05
1.00
1.00
1.00
4.09
1.00
1.06
1.01
1.02
f1 (ppm)


167.993
149.808
149.383
149.111
145.682
143.627
141.308
139.446
137.732
132.141
130.897
130.802
130.092
129.704
128.982
128.293
127.883
127.824
124.146
123.044
123.018
122.055
121.336
121.313
120.437
119.737
119.627
119.608
119.425
117.918
117.895
77.372
77.161
76.949
56.761
52.380
41.327
40.909
solvent
F3CO
OCF3
NH
Ns
MeO2C
4f
f1 (ppm)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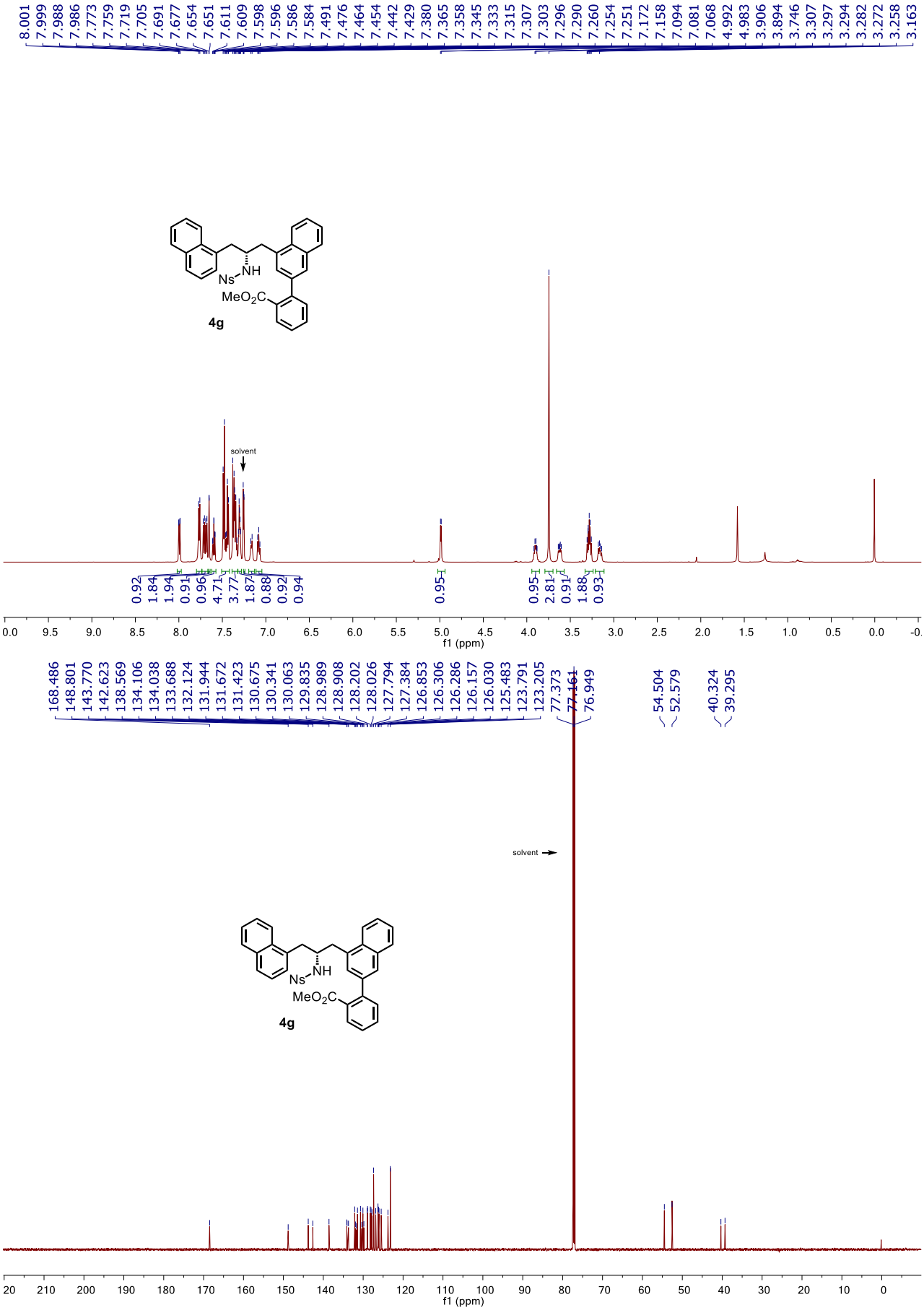
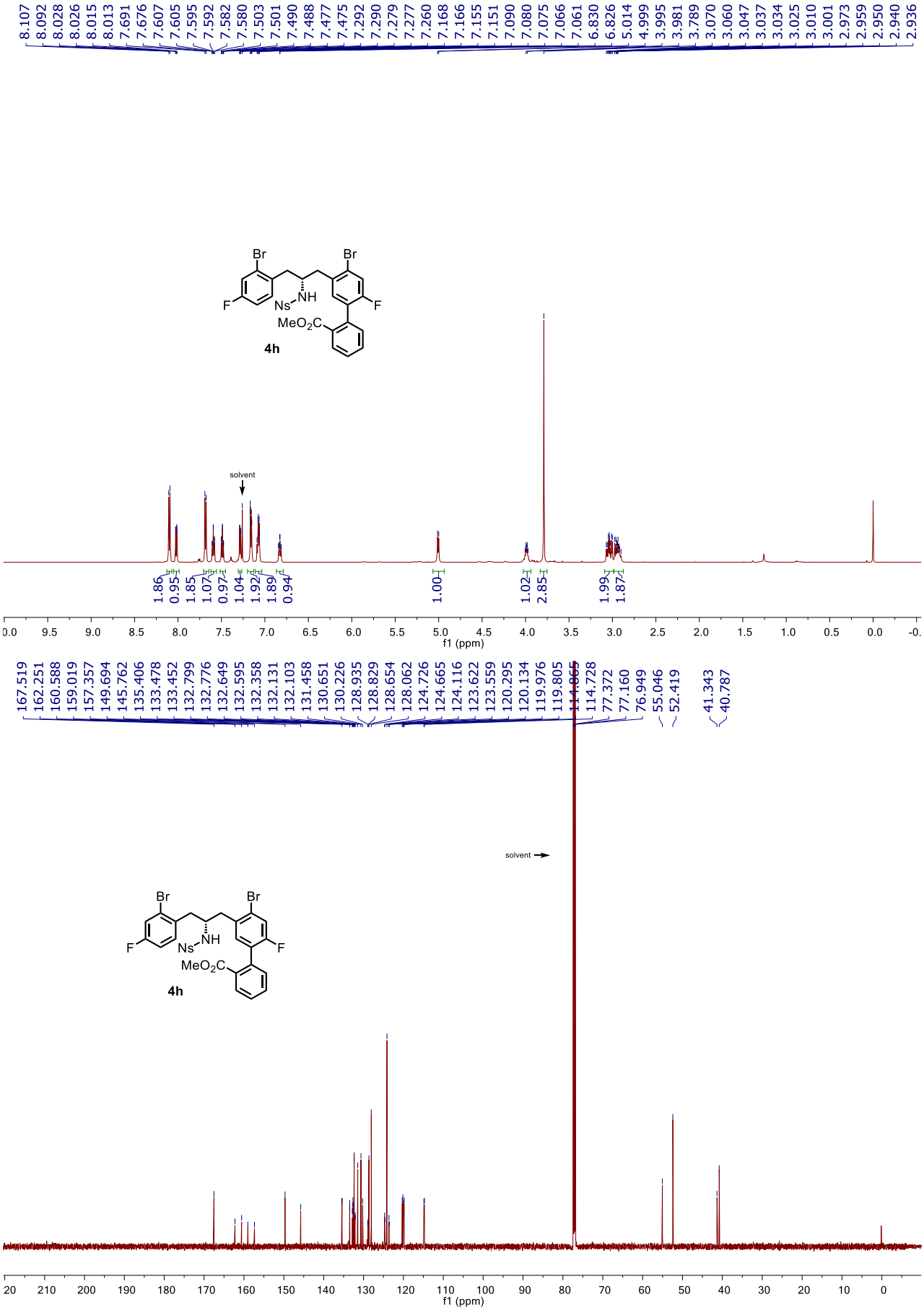
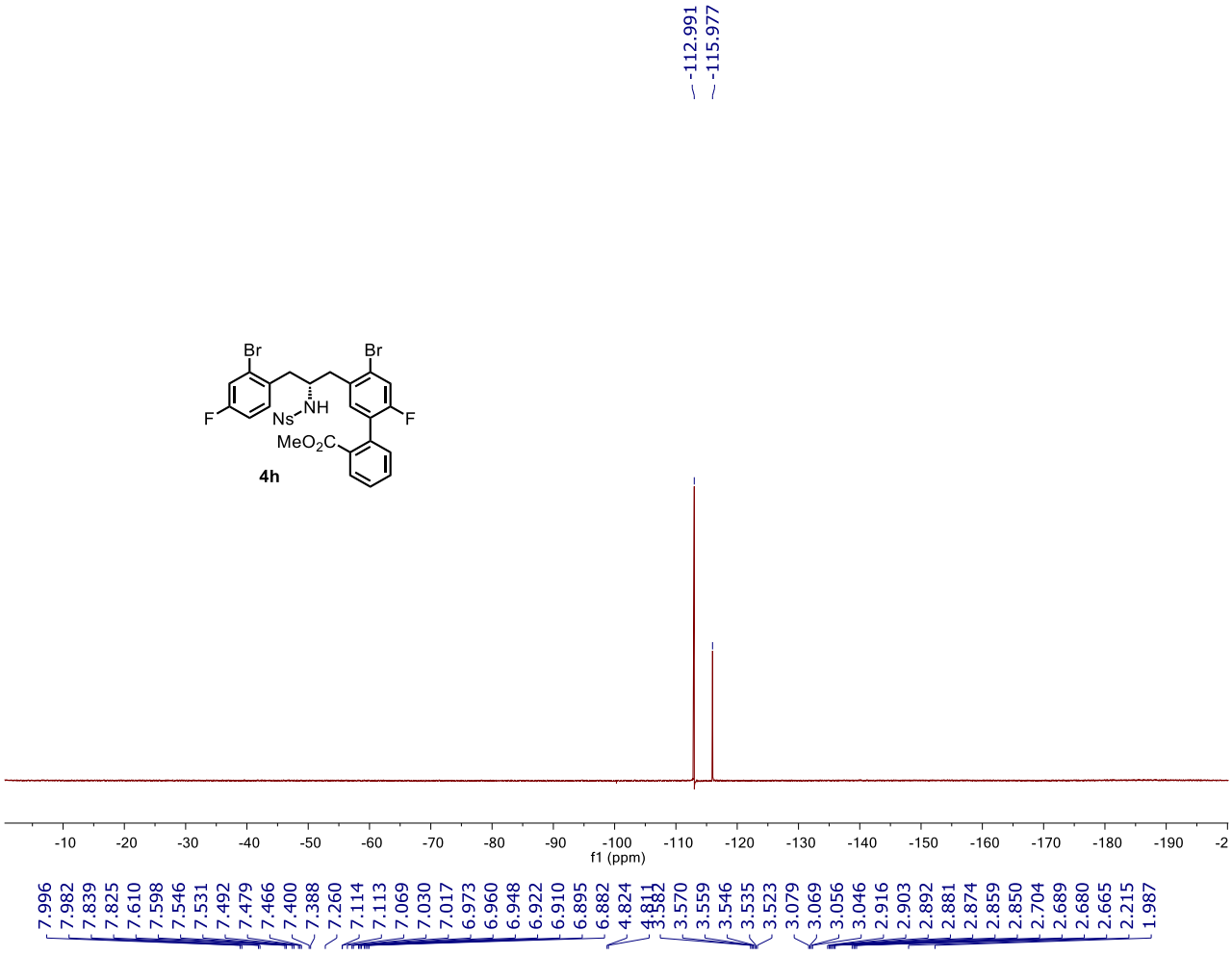
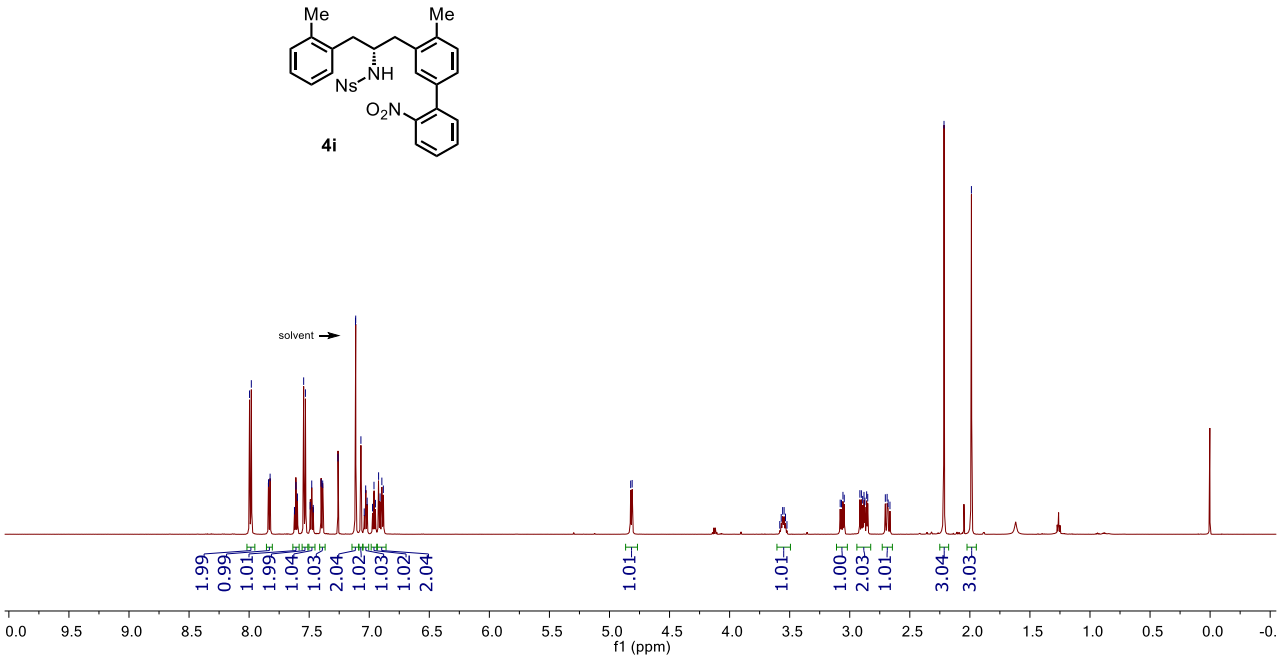
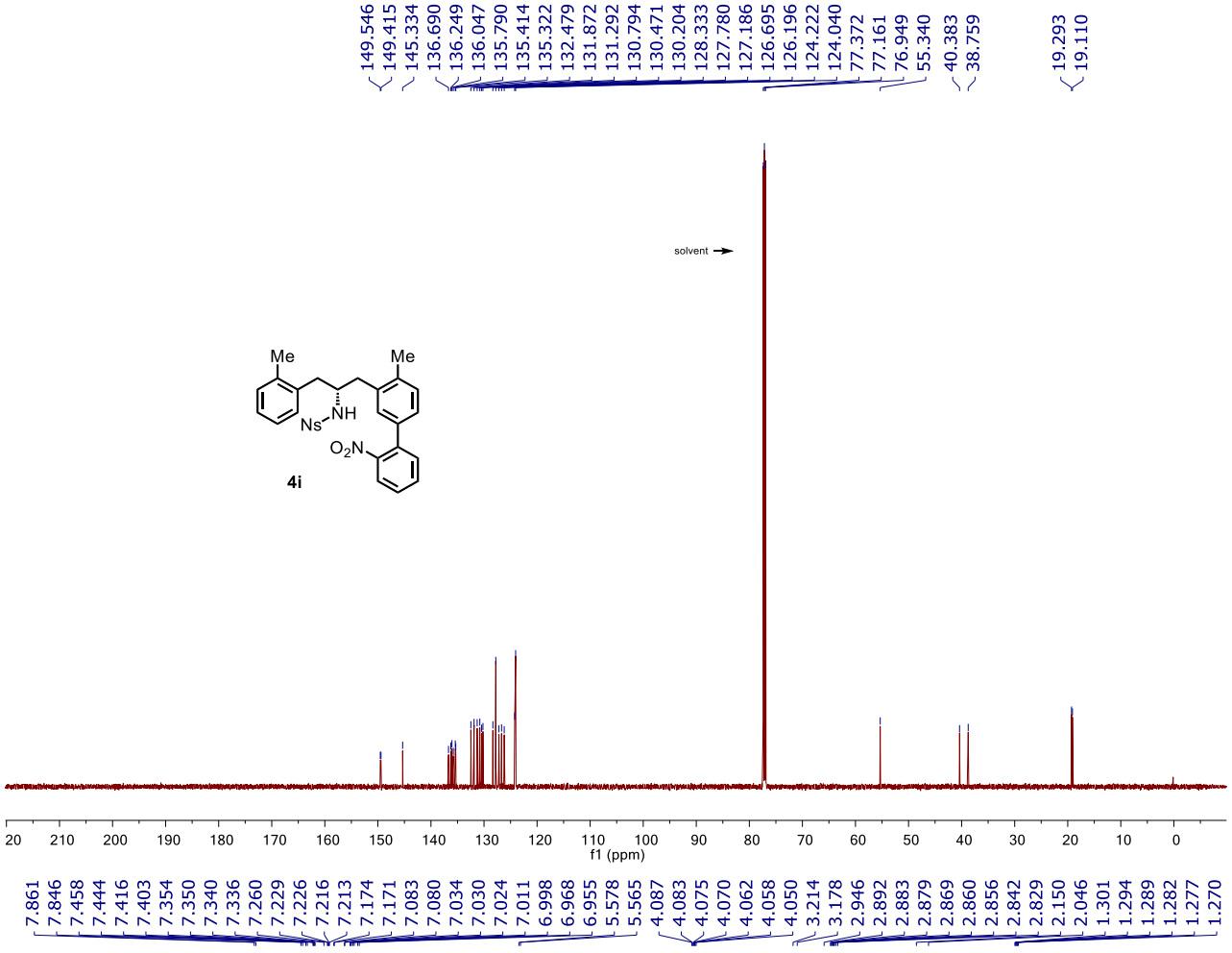
-58.102
F3CO
OCF3
NH
Ns
MeO2C
4f
f1 (ppm)

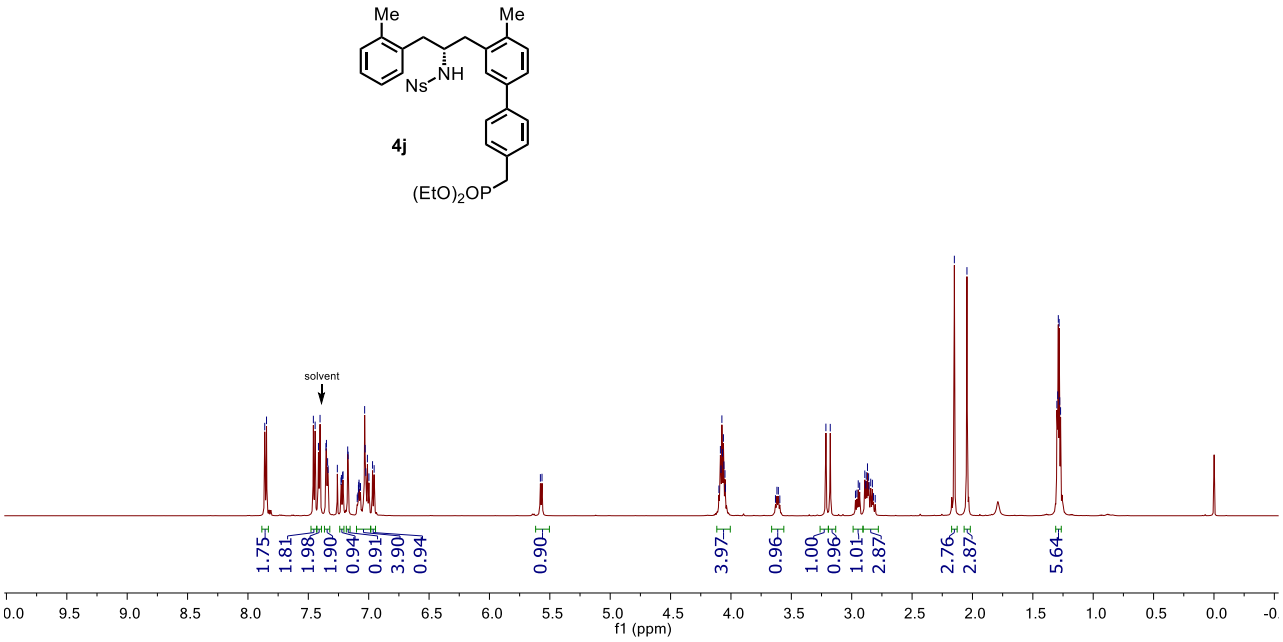

8.001
7.999
7.988
7.986
7.773
7.759
7.719
7.705
7.691
7.677
7.654
7.651
7.611
7.609
7.598
7.596
7.586
7.584
7.491
7.476
7.464
7.454
7.442
7.429
7.380
7.365
7.358
7.345
7.333
7.315
7.307
7.303
7.296
7.290
7.260
7.254
7.251
7.172
7.158
7.094
7.081
7.068
4.992
4.983
3.906
3.894
3.746
3.307
3.297
3.294
3.282
3.272
3.258
3.163
Ns
NH
MeO2C
4g
solvent
0.92
1.84
1.94
0.91
0.96
4.71
3.77
1.87
0.88
0.92
0.94
0.95
0.95
2.81
0.91
1.88
0.93
f1 (ppm)
168.486
148.801
143.770
142.623
138.569
134.106
134.038
133.688
132.124
131.944
131.672
131.423
130.675
130.341
130.063
129.835
128.989
128.908
128.202
128.026
127.794
127.384
126.853
126.306
126.286
126.157
126.030
125.483
123.791
123.205
77.373
77.161
76.949
54.504
52.579
40.324
39.295
solvent
Ns
NH
MeO2C
4g
f1 (ppm)

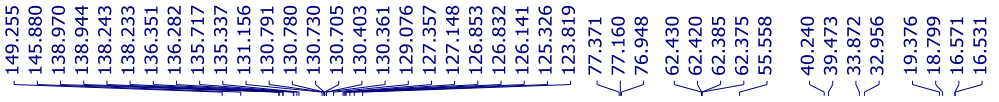

8.107
8.092
8.028
8.026
8.015
8.013
7.691
7.676
7.607
7.605
7.595
7.592
7.582
7.580
7.503
7.501
7.490
7.488
7.477
7.475
7.292
7.290
7.279
7.277
7.260
7.168
7.166
7.155
7.151
7.090
7.080
7.075
7.066
7.061
6.830
6.826
5.014
4.999
3.995
3.981
3.789
3.070
3.060
3.047
3.037
3.034
3.025
3.010
3.001
2.973
2.959
2.950
2.940
2.936
Br
Br
F
F
Ns
NH
MeO2C
4h
solvent
1.86
0.95
1.85
1.07
0.97
1.04
1.92
1.89
0.94
1.00
1.02
2.85
1.99
1.87
f1 (ppm)
167.519
162.251
160.588
159.019
157.357
149.694
145.762
135.406
133.478
133.452
132.799
132.776
132.649
132.595
132.358
132.131
132.103
131.458
130.651
130.226
128.935
128.829
128.654
128.062
124.726
124.665
124.116
123.622
123.559
120.295
120.134
119.976
119.805
114.865
114.728
77.372
77.160
76.949
55.046
52.419
41.343
40.787
solvent
f1 (ppm)

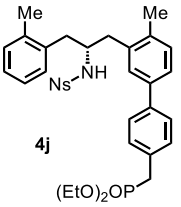

-112.991
-115.977
Br
Br
F
F
Ns
NH
MeO2C
4h
f1 (ppm)
7.996
7.982
7.839
7.825
7.610
7.598
7.546
7.531
7.492
7.479
7.466
7.400
7.388
7.260
7.114
7.113
7.069
7.030
7.017
6.973
6.960
6.948
6.922
6.910
6.895
6.882
4.824
3.582
3.570
3.559
3.546
3.535
3.523
3.079
3.069
3.056
3.046
2.916
2.903
2.892
2.881
2.874
2.859
2.850
2.704
2.689
2.680
2.665
2.215
1.987


Me
Me
Ns
NH
O2N
4i
solvent
1.99
0.99
1.01
1.99
1.04
1.03
2.04
1.02
1.03
1.02
2.04
1.01
1.01
1.00
2.03
1.01
3.04
3.03
f1 (ppm)


149.546
149.415
145.334
136.690
136.249
136.047
135.790
135.414
135.322
132.479
131.872
131.292
130.794
130.471
130.204
128.333
127.780
127.186
126.695
126.196
124.222
124.040
77.372
77.161
76.949
55.340
40.383
38.759
19.293
19.110
solvent
Me
Me
Ns
NH
O2N
4i
f1 (ppm)
7.861
7.846
7.458
7.444
7.416
7.403
7.354
7.350
7.340
7.336
7.260
7.229
7.226
7.216
7.213
7.174
7.171
7.083
7.080
7.034
7.030
7.024
7.011
6.998
6.968
6.955
5.578
5.565
4.087
4.083
4.075
4.070
4.062
4.058
4.050
3.214
3.178
2.946
2.892
2.883
2.879
2.869
2.860
2.856
2.842
2.829
2.150
2.046
1.301
1.294
1.289
1.282
1.277
1.270

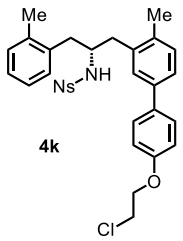

Me
Me
Ns
NH
4j
(EtO)2OP
solvent
1.75
1.81
1.98
1.90
0.94
0.91
3.90
0.94
0.90
3.97
0.96
1.00
0.96
1.01
2.87
2.76
2.87
5.64
f1 (ppm)

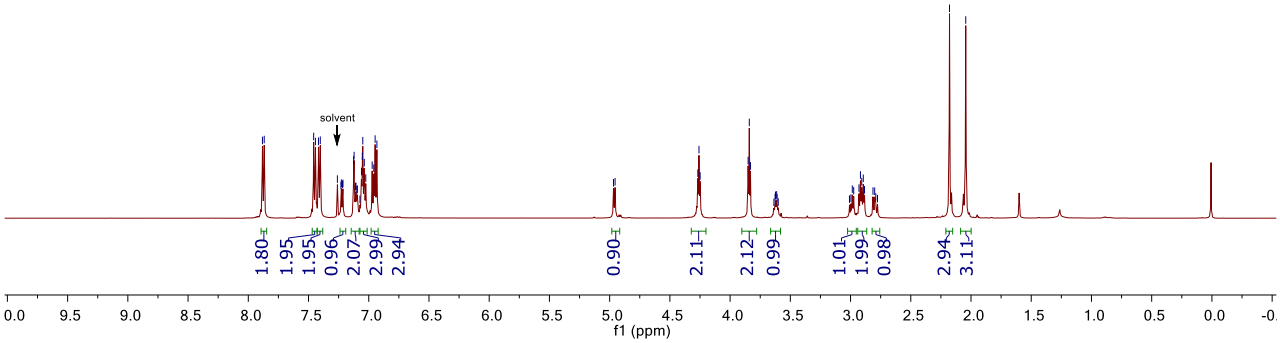

149.255
145.880
138.970
138.944
138.243
138.233
136.351
136.282
135.717
135.337
131.156
130.791
130.780
130.730
130.705
130.403
130.361
129.076
127.357
127.148
126.853
126.832
126.141
125.326
123.819
77.371
77.160
76.948
62.430
62.420
62.385
62.375
55.558
40.240
39.473
33.872
32.956
19.376
18.799
16.571
16.531

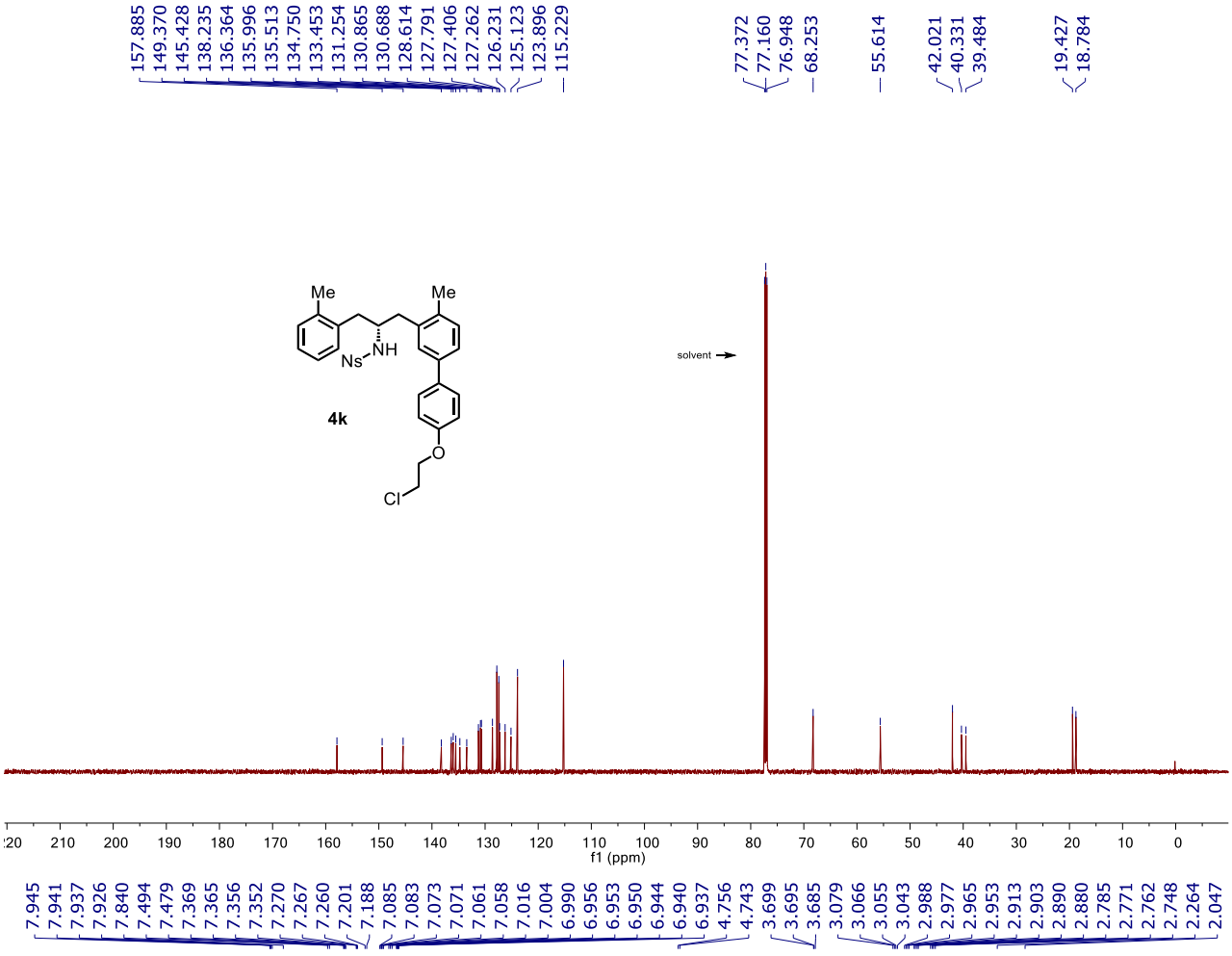

Me
Me
Ns
NH
4j
(EtO)2OP

solvent
20 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.883
7.868
7.457
7.443
7.417
7.402
7.260
7.230
7.227
7.217
7.214
7.125
7.122
7.110
7.106
7.099
7.095
7.073
7.060
7.053
7.049
7.037
7.025
6.971
6.958
6.947
6.932
4.968
4.955
4.268
4.258
4.249
3.851
3.841
3.831
3.627
3.623
3.613
3.610
3.009
2.997
2.986
2.974
2.930
2.918
2.907
2.894
2.884
2.814
2.800
2.790
2.776
2.179
2.044


Me
Me
Ns
NH
4k
O
Cl


solvent
1.80
1.95
1.95
0.96
2.07
2.99
2.94
0.90
2.11
2.12
0.99
1.01
1.99
0.98
2.94
3.11
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


157.885
149.370
145.428
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136.364
135.996
135.513
134.750
133.453
131.254
130.865
130.688
128.614
127.791
127.406
127.262
126.231
125.123
123.896
115.229
77.372
77.160
76.948
68.253
55.614
42.021
40.331
39.484
19.427
18.784
Me
Me
Ns
NH
4k
O
Cl
solvent
f1 (ppm)
7.945
7.941
7.937
7.926
7.840
7.494
7.479
7.369
7.365
7.356
7.352
7.270
7.267
7.260
7.201
7.188
7.085
7.083
7.073
7.071
7.061
7.058
7.016
7.004
6.990
6.956
6.953
6.950
6.944
6.940
6.937
4.756
4.743
3.699
3.695
3.685
3.079
3.066
3.055
3.043
2.988
2.977
2.965
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2.903
2.890
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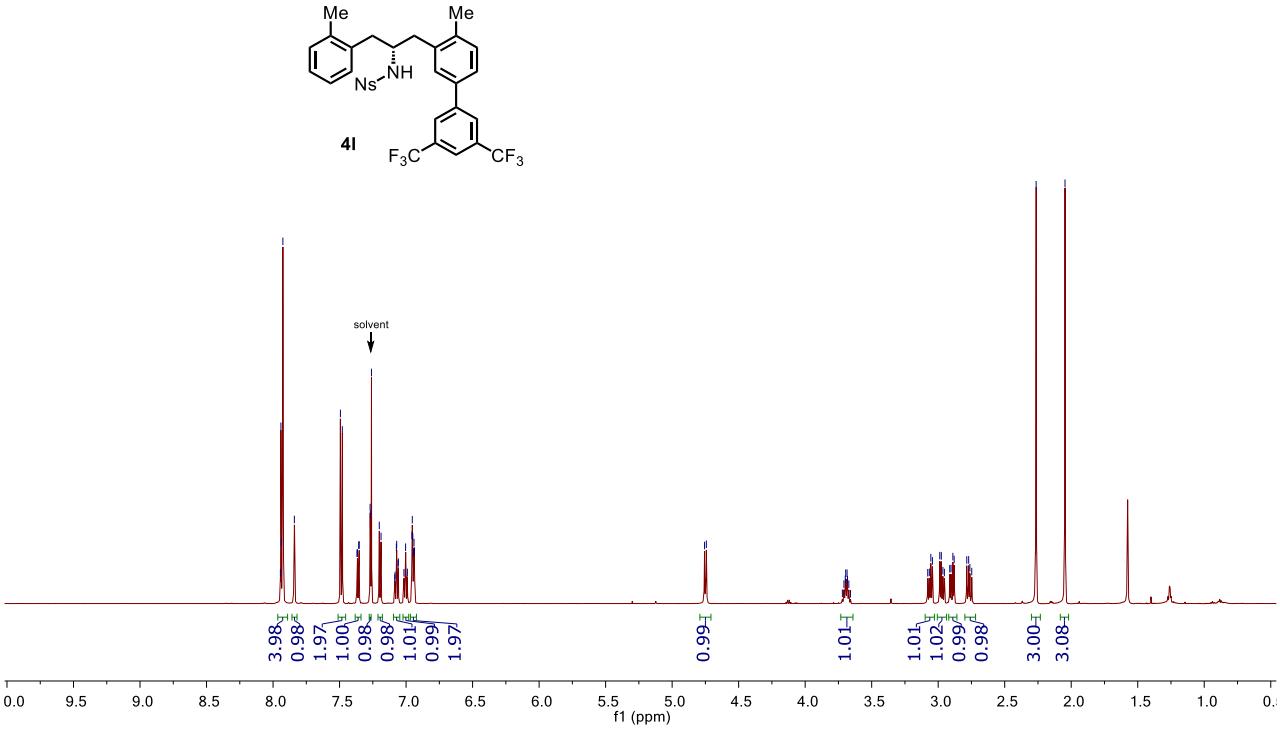
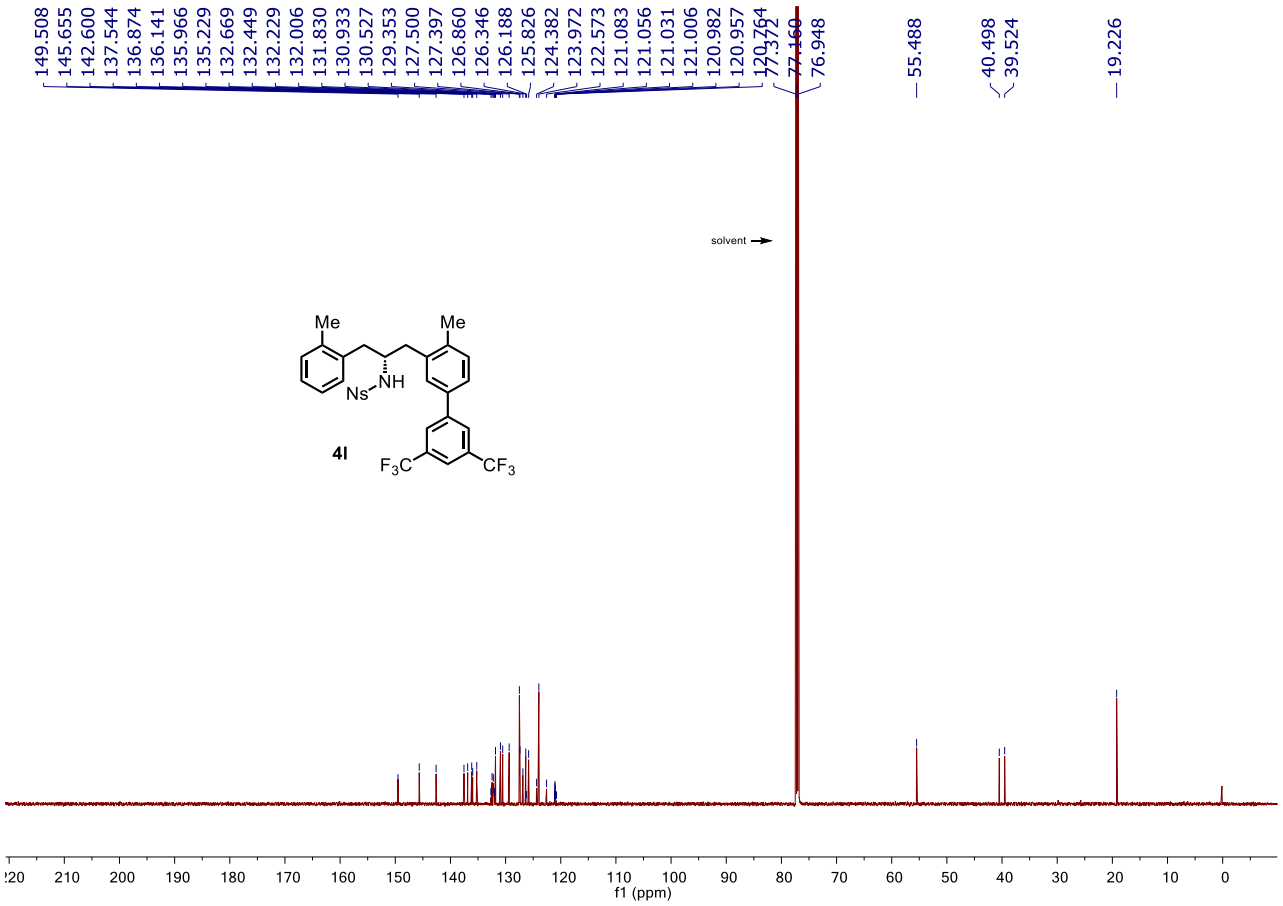
2.762
2.748
2.264
2.047


Me
Me
Ns
NH
4l
F3C
CF3
solvent
3.98
0.98
1.97
1.00
0.98
0.98
1.01
0.99
1.97
0.99
1.01
1.01
1.02
0.99
0.98
3.00
3.08
f1 (ppm)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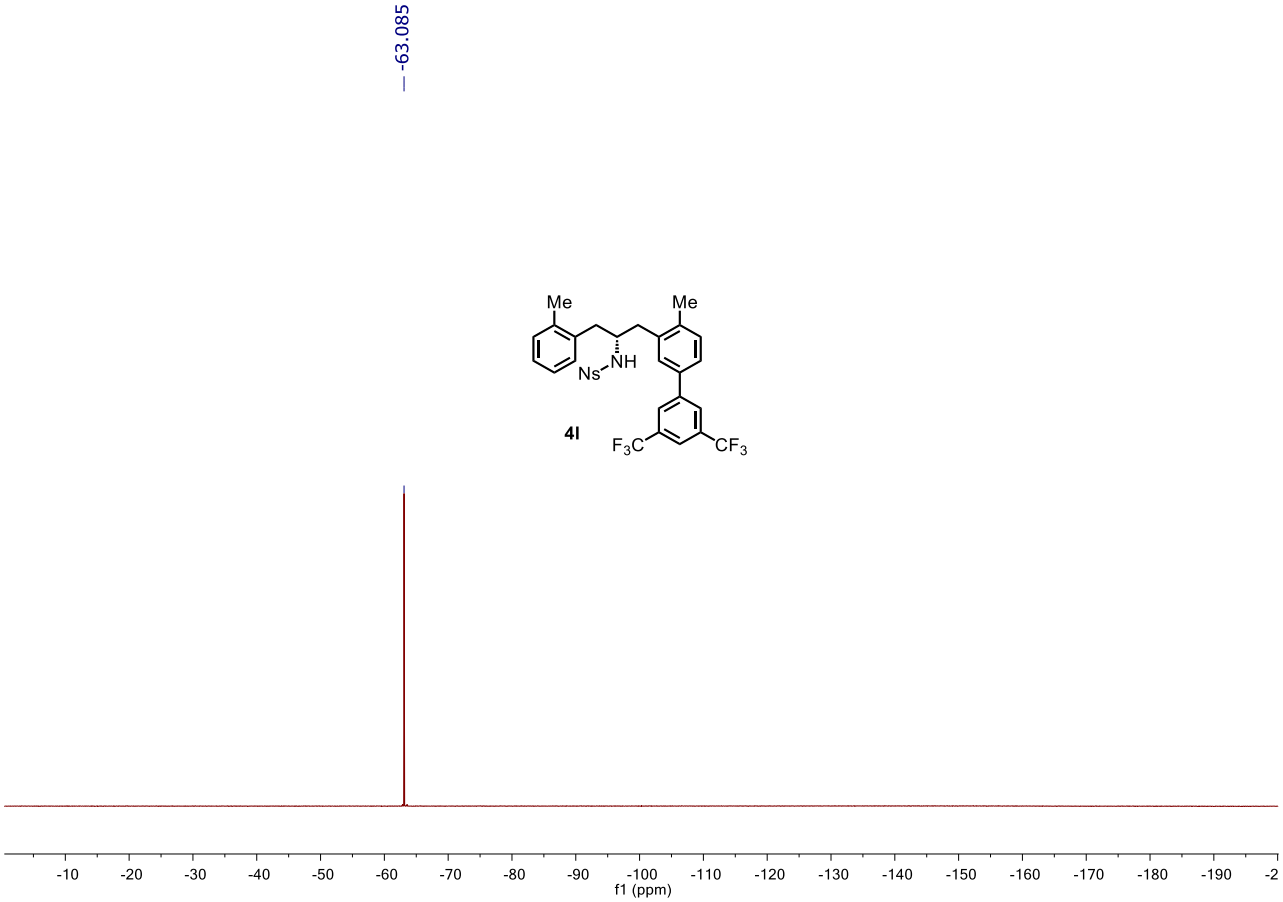
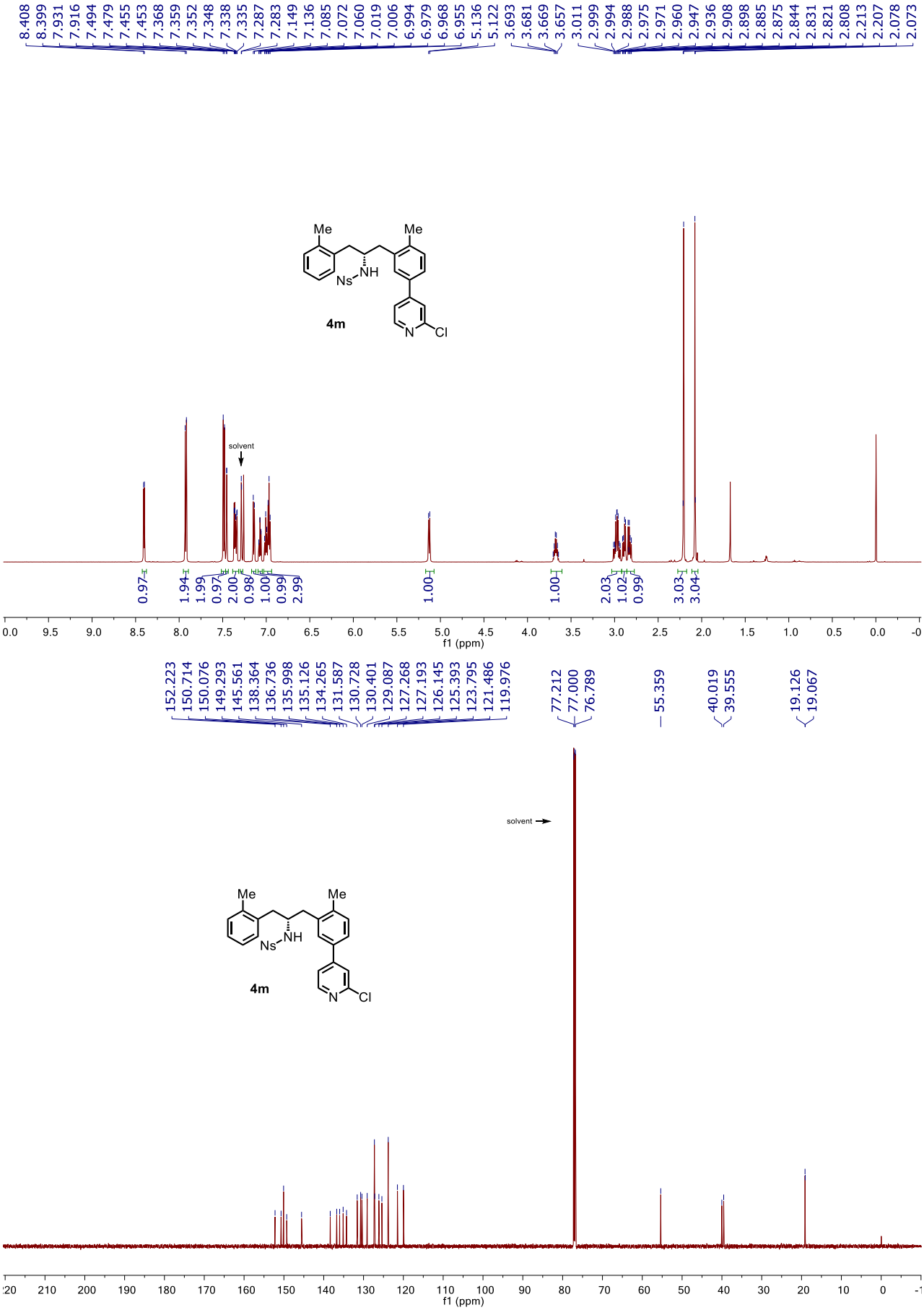
142.600
137.544
136.874
136.141
135.966
135.229
132.669
132.449
132.229
132.006
131.830
130.933
130.527
129.353
127.500
127.397
126.860
126.346
126.188
125.826
124.382
123.972
122.573
121.083
121.056
121.031
121.006
120.982
120.957
120.764
77.372
77.160
76.948
55.488
40.498
39.524
19.226
solvent
Me
Me
Ns
NH
4l
F3C
CF3
f1 (ppm)


-63.085
Me
Me
Ns
NH
4l
F3C
CF3
f1 (ppm)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7.453
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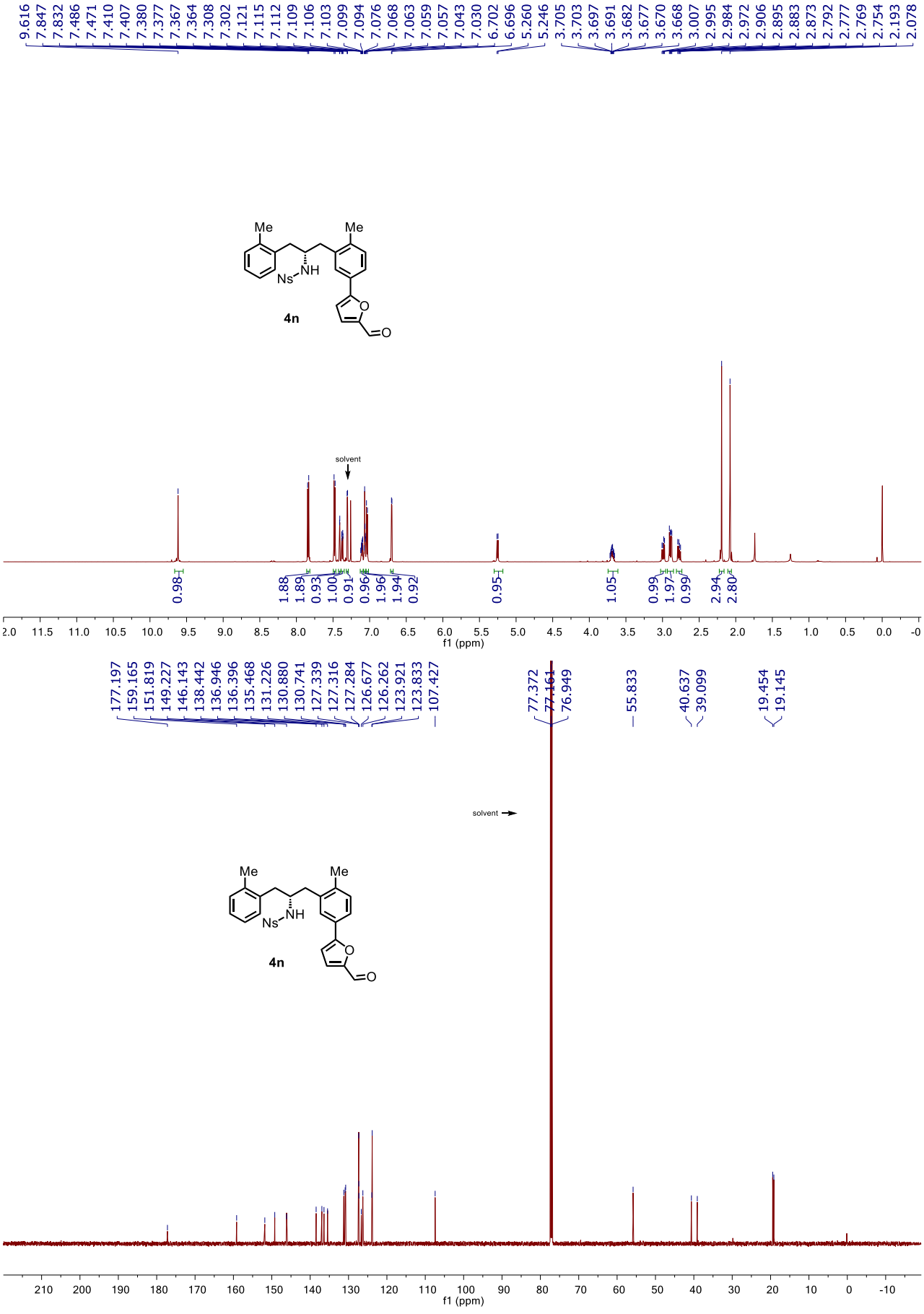
7.359
7.352
7.348
7.338
7.335
7.287
7.283
7.149
7.136
7.085
7.072
7.060
7.019
7.006
6.994
6.979
6.968
6.955
5.136
5.122
3.693
3.681
3.669
3.657
3.011
2.999
2.994
2.988
2.975
2.971
2.960
2.947
2.936
2.908
2.898
2.885
2.875
2.844
2.831
2.821
2.808
2.213
2.207
2.078
2.073
Me
Me
Ns
NH
4m
N
Cl
solvent
0.97
1.94
1.99
0.97
2.00
0.98
1.00
0.99
2.99
1.00
1.00
2.03
1.02
0.99
3.03
3.04
f1 (ppm)
152.223
150.714
150.076
149.293
145.561
138.364
136.736
135.998
135.126
134.265
131.587
130.728
130.401
129.087
127.268
127.193
126.145
125.393
123.795
121.486
119.976
77.212
77.000
76.789
55.359
40.019
39.555
19.126
19.067
solvent
Me
Me
Ns
NH
4m
N
Cl
f1 (ppm)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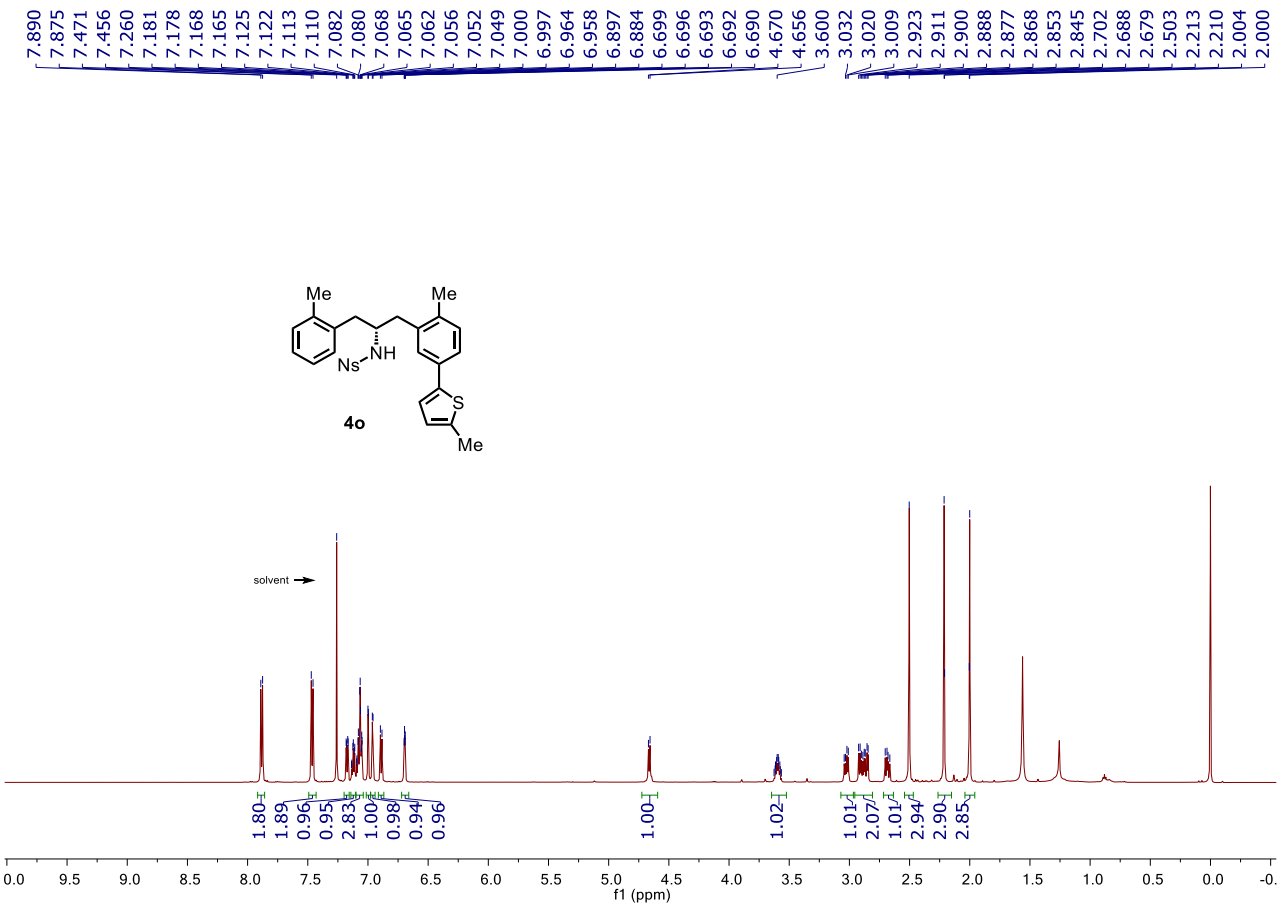
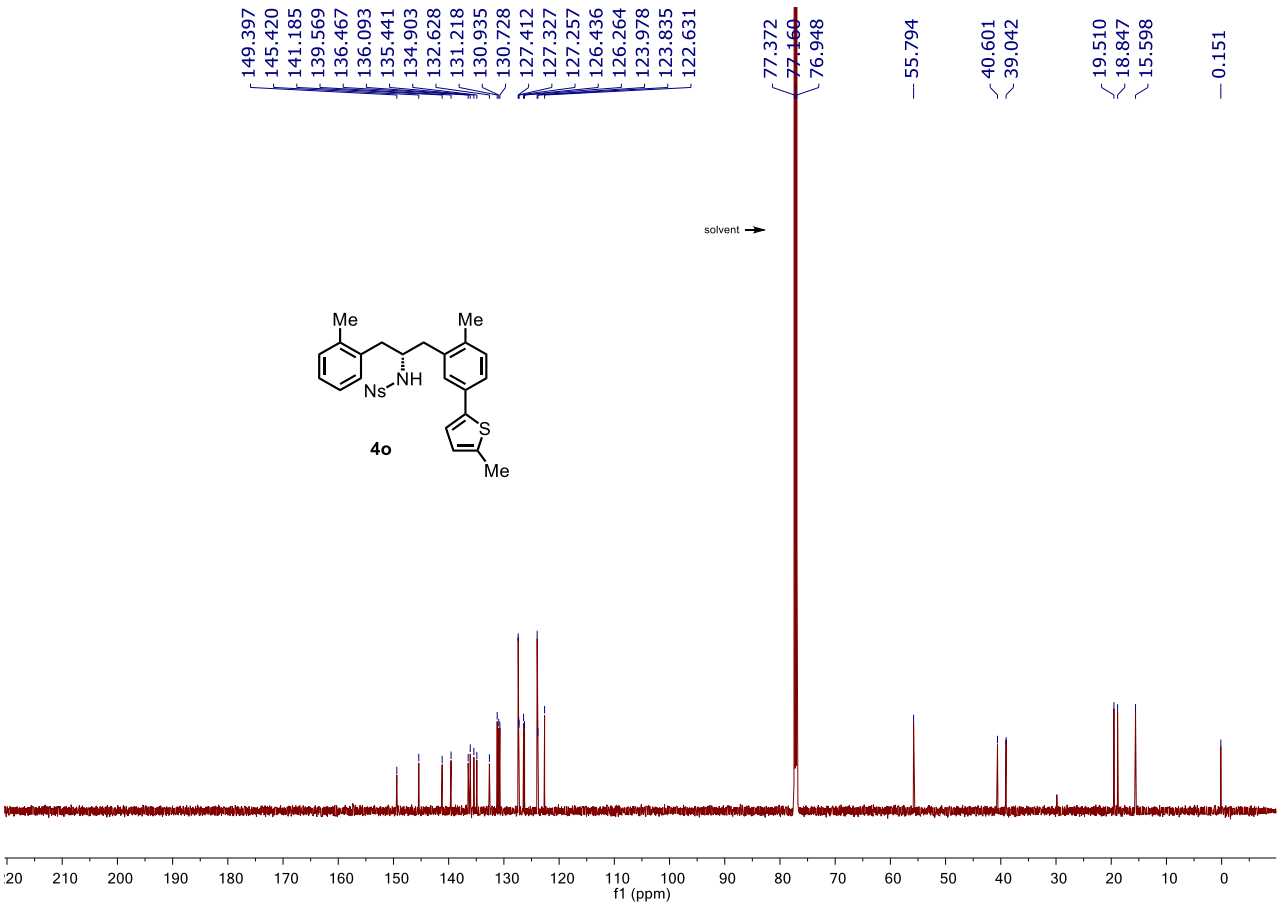
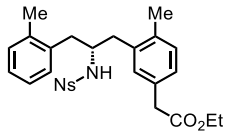
7.847
7.832
7.486
7.471
7.410
7.407
7.380
7.377
7.367
7.364
7.308
7.302
7.121
7.115
7.112
7.109
7.106
7.103
7.099
7.094
7.076
7.068
7.063
7.059
7.057
7.043
7.030
6.702
6.696
5.260
5.246
3.705
3.703
3.697
3.691
3.682
3.677
3.670
3.668
3.007
2.995
2.984
2.972
2.906
2.895
2.883
2.873
2.792
2.777
2.769
2.754
2.193
2.078
Me
Me
Ns
NH
O
O
4n
solvent
0.98
1.88
1.89
0.93
1.00
0.91
0.96
1.96
1.94
0.92
0.95
1.05
0.99
1.97
0.99
2.94
2.80
f1 (ppm)
177.197
159.165
151.819
149.227
146.143
138.442
136.946
136.396
135.468
131.226
130.880
130.741
127.339
127.316
127.284
126.677
126.262
123.921
123.833
107.427
77.372
77.161
76.949
55.833
40.637
39.099
19.454
19.145
solvent
Me
Me
Ns
NH
O
O
4n
f1 (ppm)

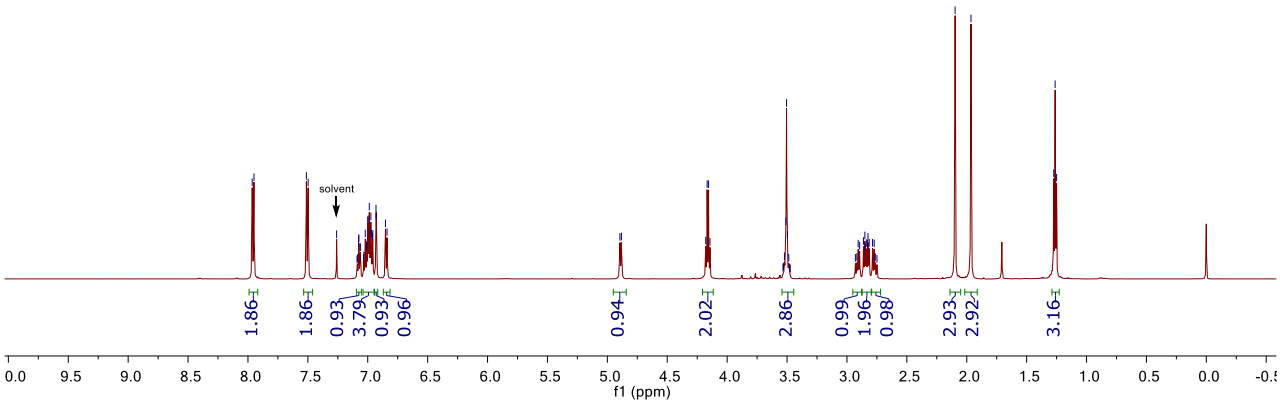

7.890
7.875
7.471
7.456
7.260
7.181
7.178
7.168
7.165
7.125
7.122
7.113
7.110
7.082
7.080
7.068
7.065
7.062
7.056
7.052
7.049
7.000
6.997
6.964
6.958
6.897
6.884
6.699
6.696
6.693
6.692
6.690
4.670
4.656
3.600
3.032
3.020
3.009
2.923
2.911
2.900
2.888
2.877
2.868
2.853
2.845
2.702
2.688
2.679
2.503
2.213
2.210
2.004
2.000
Me
Me
Ns
NH
S
Me
4o
solvent
1.80
1.89
0.96
0.95
2.83
1.00
0.98
0.94
0.96
1.00
1.02
1.01
2.07
1.01
2.94
2.90
2.85
f1 (ppm)


149.397
145.420
141.185
139.569
136.467
136.093
135.441
134.903
132.628
131.218
130.935
130.728
127.412
127.327
127.257
126.436
126.264
123.978
123.835
122.631
77.372
77.160
76.948
55.794
40.601
39.042
19.510
18.847
15.598
0.151
solvent
Me
Me
Ns
NH
S
Me
4o
f1 (ppm)

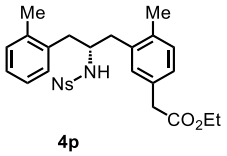

7.965
7.950
7.512
7.498
7.260
7.077
7.074
7.065
7.062
7.035
7.032
7.021
7.010
7.008
7.000
6.997
6.987
6.977
6.974
6.970
6.961
6.958
6.931
6.928
6.852
6.839
4.895
4.882
4.179
4.167
4.155
4.143
3.522
3.510
3.504
3.497
2.917
2.906
2.894
2.862
2.851
2.847
2.838
2.828
2.824
2.814
2.786
2.773
2.763
2.097
1.965
1.274
1.262
1.250


Me
Me
NH
Ns
CO2Et

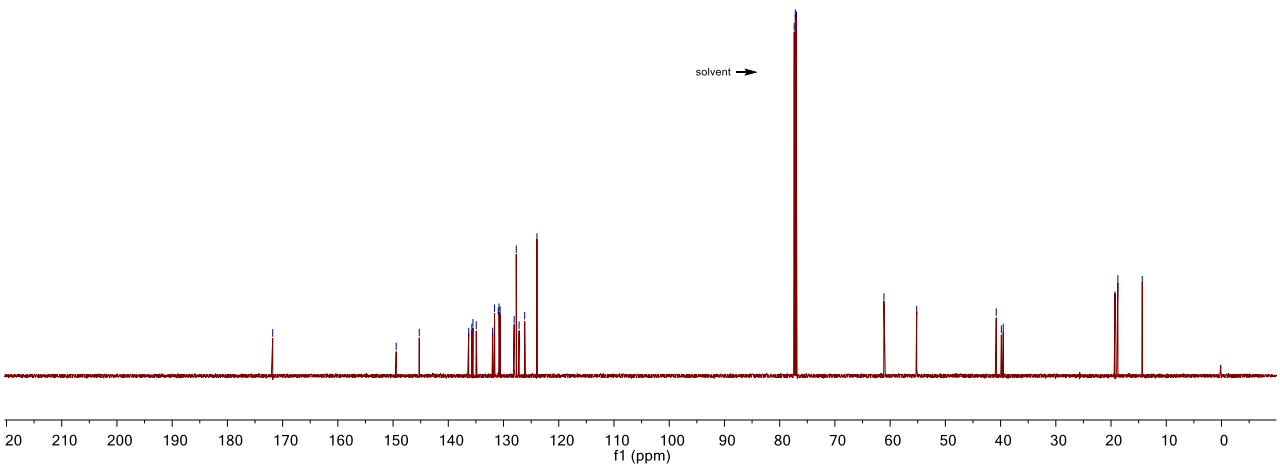
4p

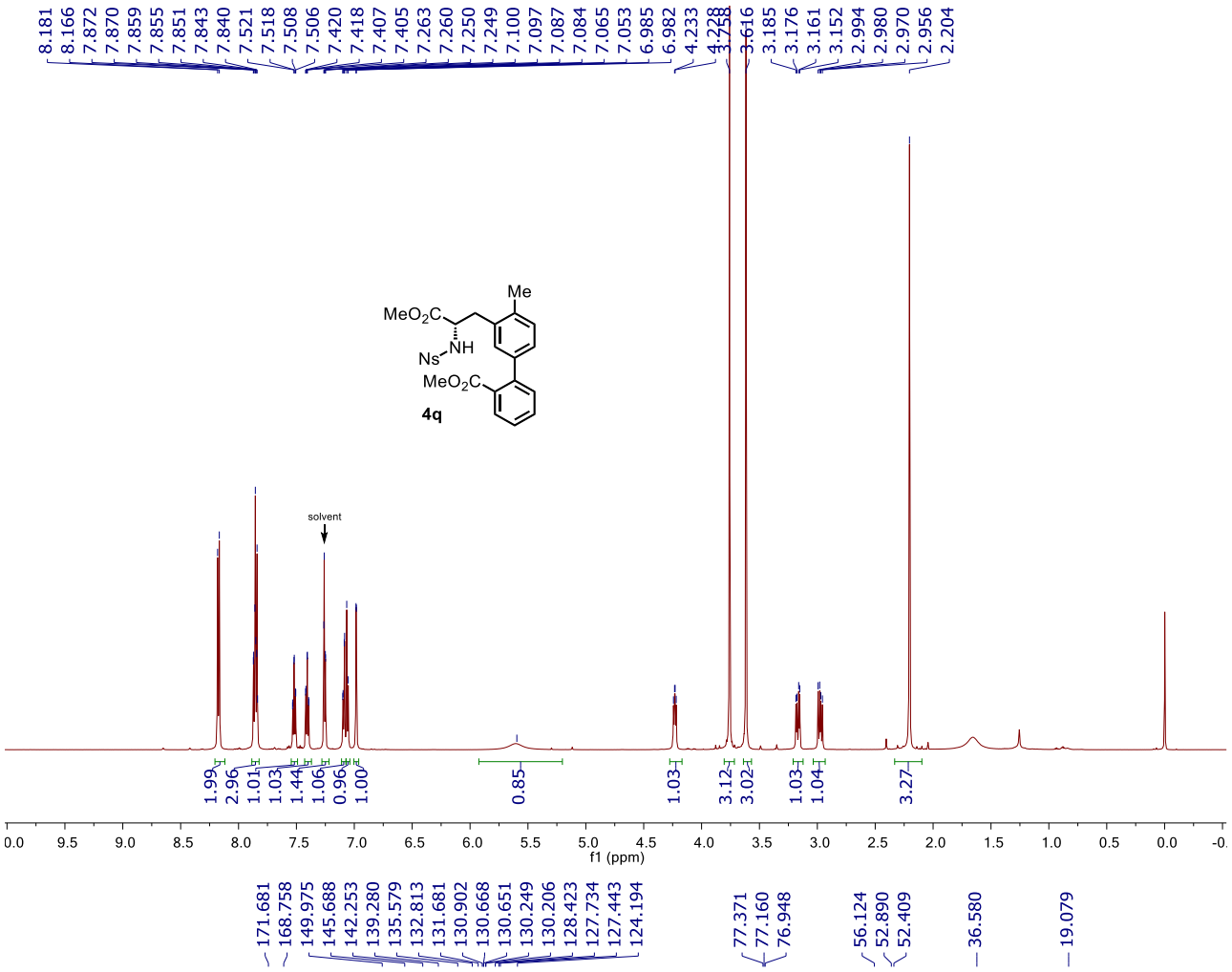

solvent
1.86
1.86
0.93
3.79
0.93
0.96
0.94
2.02
2.86
0.99
1.96
0.98
2.93
2.92
3.16
f1 (ppm)


171.796
149.436
145.260
136.303
135.736
135.538
134.937
131.978
131.626
130.955
130.812
130.615
128.076
127.699
127.184
126.171
123.947
77.371
77.160
76.948
61.123
55.189
40.788
39.858
39.517
19.286
18.761
14.351


Me
Me
NH
Ns
CO2Et

4p


solvent
f1 (ppm)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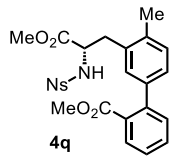
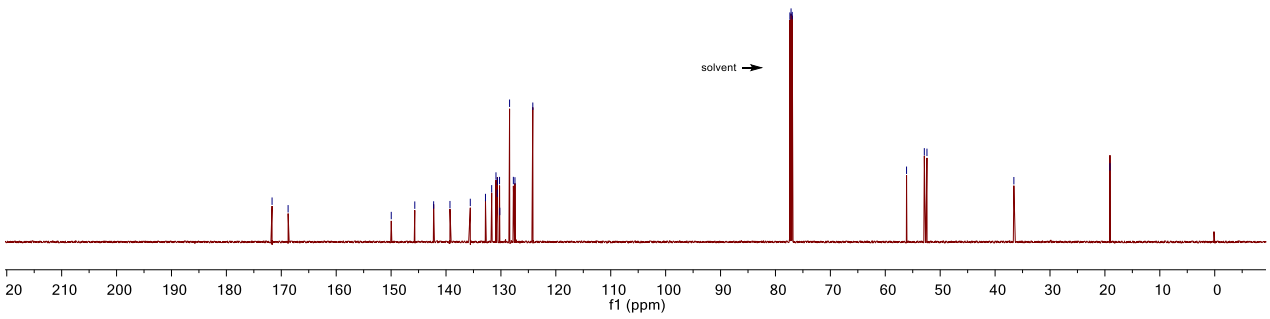
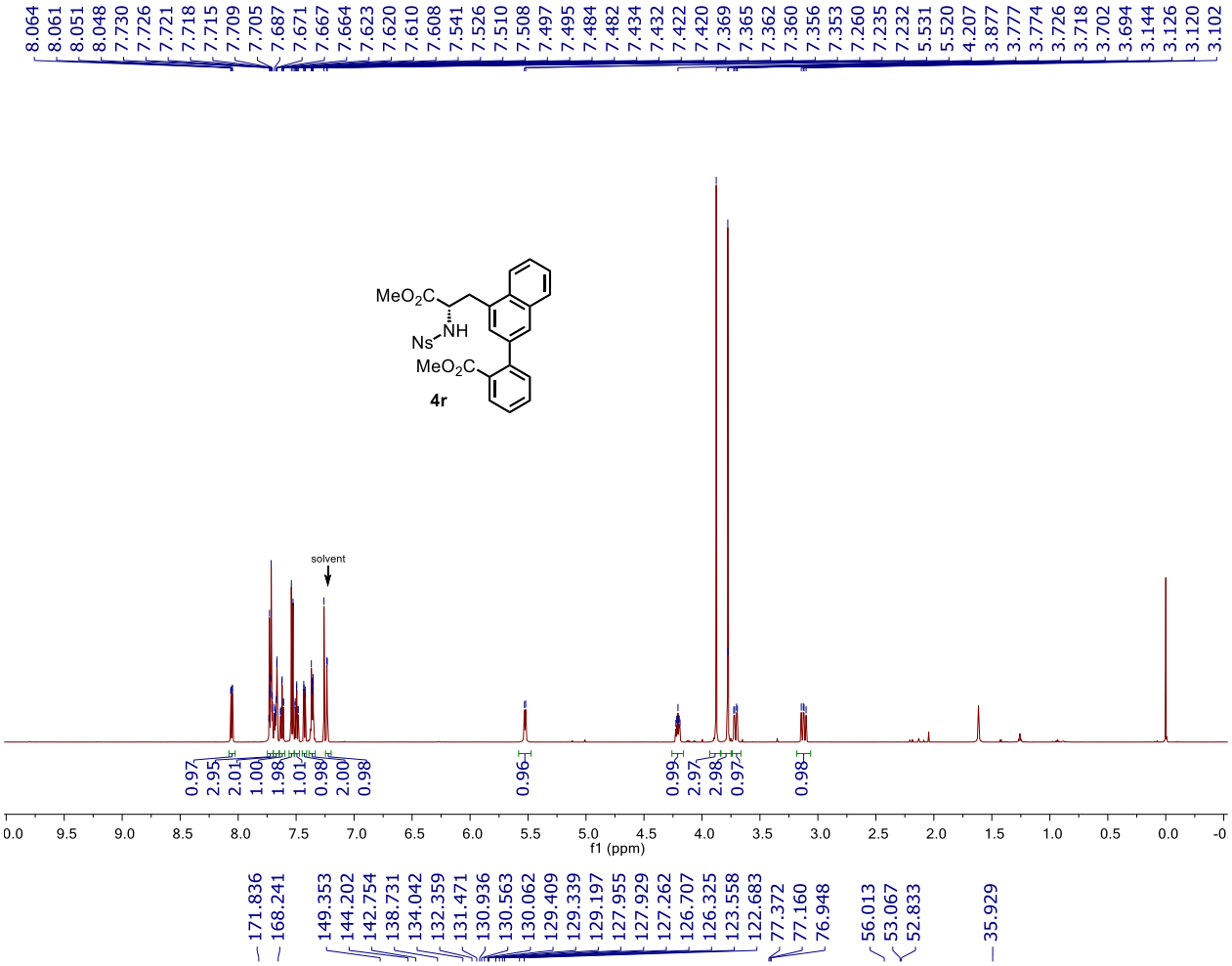
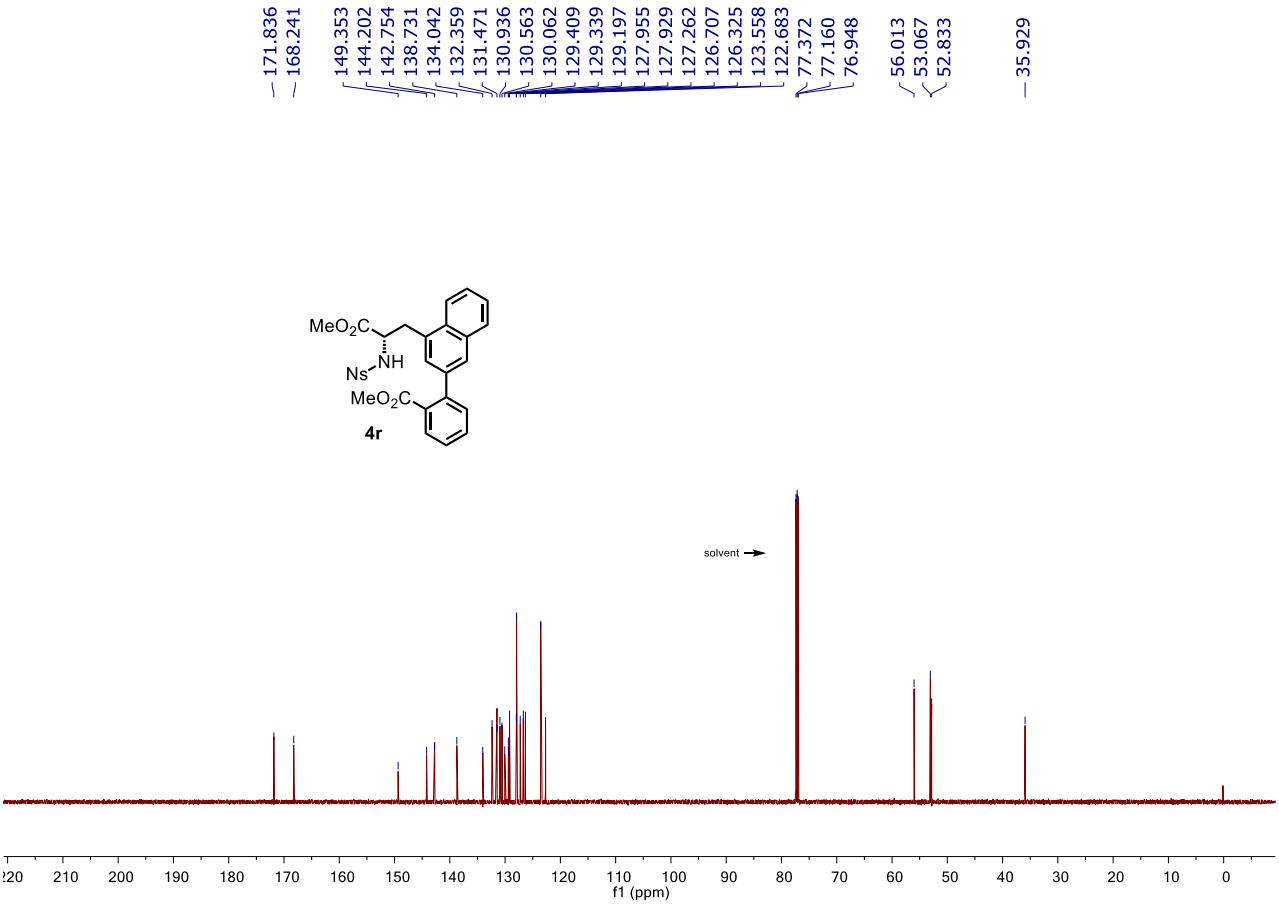
8.166
7.872
7.870
7.859
7.855
7.851
7.843
7.840
7.521
7.518
7.508
7.506
7.420
7.418
7.407
7.405
7.263
7.260
7.250
7.249
7.100
7.097
7.087
7.084
7.065
7.053
6.985
6.982
4.233
3.616
3.185
3.176
3.161
3.152
2.994
2.980
2.970
2.956
2.204
Me
MeO2C
NH
Ns
MeO2C
4q
solvent
1.99
2.96
1.01
1.03
1.44
1.06
0.96
1.00
0.85
1.03
3.12
3.02
1.03
1.04
3.27
f1 (ppm)

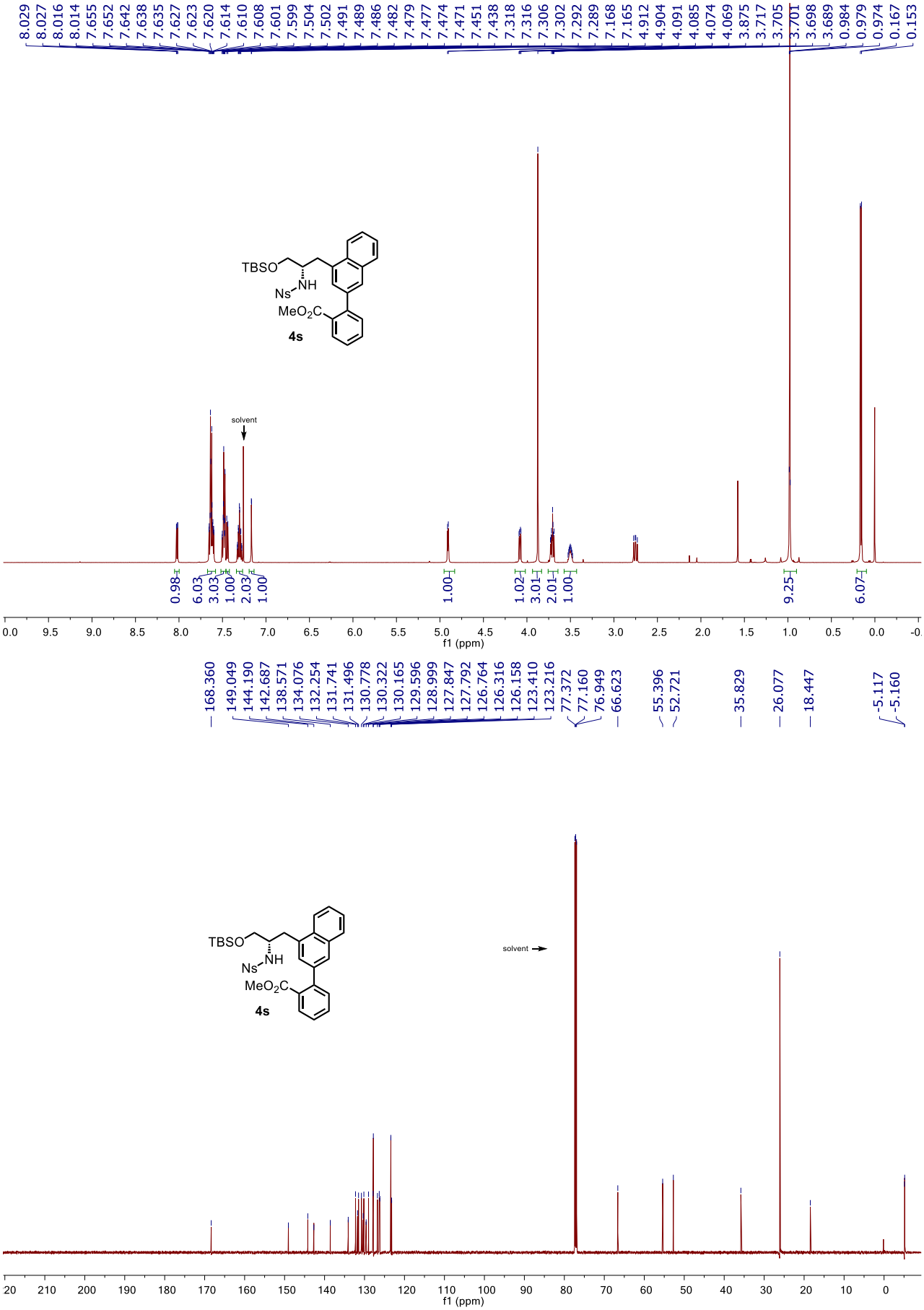
171.681
168.758
149.975
145.688
142.253
139.280
135.579
132.813
131.681
130.902
130.668
130.651
130.249
130.206
128.423
127.734
127.443
124.194
77.371
77.160
76.948
56.124
52.890
52.409
36.580
19.079

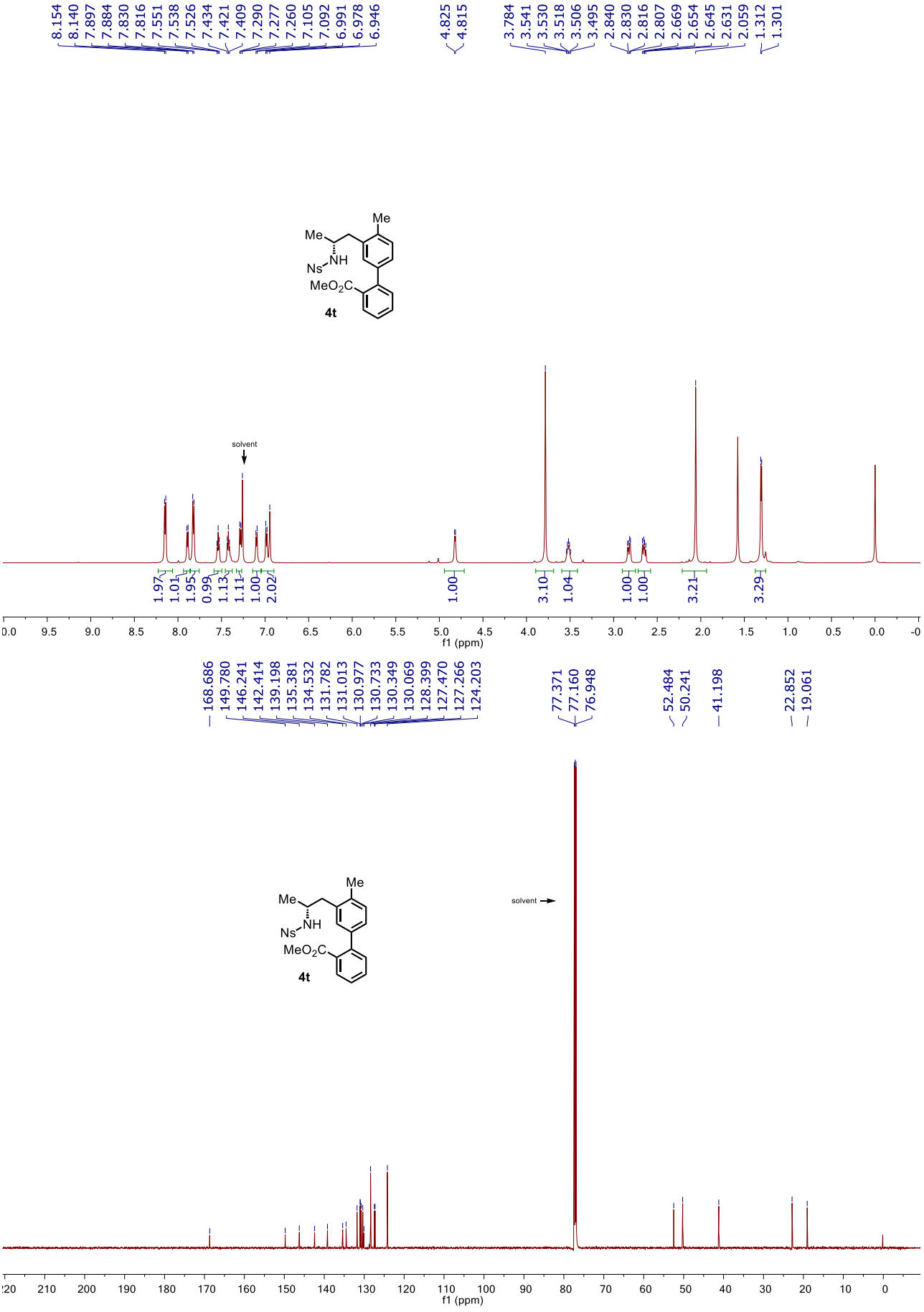

Me
MeO2C
NH
Ns
MeO2C
4q


solvent
f1 (ppm)


8.064
8.061
8.051
8.048
7.730
7.726
7.721
7.718
7.715
7.709
7.705
7.687
7.671
7.667
7.664
7.623
7.620
7.610
7.608
7.541
7.526
7.510
7.508
7.497
7.495
7.484
7.482
7.434
7.432
7.422
7.420
7.369
7.365
7.362
7.360
7.356
7.353
7.260
7.235
7.232
5.531
5.520
4.207
3.877
3.777
3.774
3.726
3.718
3.702
3.694
3.144
3.126
3.120
3.102
MeO2C
NH
Ns
MeO2C
4r
solvent
0.97
2.95
2.01
1.00
1.98
1.01
0.98
2.00
0.98
0.96
0.99
2.97
2.98
0.97
0.98
f1 (ppm)


171.836
168.241
149.353
144.202
142.754
138.731
134.042
132.359
131.471
130.936
130.563
130.062
129.409
129.339
129.197
127.955
127.929
127.262
126.707
126.325
123.558
122.683
77.372
77.160
76.948
56.013
53.067
52.833
35.929
MeO2C
NH
Ns
MeO2C
4r
solvent
f1 (ppm)


8.029
8.027
8.016
8.014
7.655
7.652
7.642
7.638
7.635
7.627
7.623
7.620
7.614
7.610
7.608
7.601
7.599
7.504
7.502
7.491
7.489
7.486
7.482
7.479
7.477
7.474
7.471
7.451
7.438
7.318
7.316
7.306
7.302
7.292
7.289
7.168
7.165
4.912
4.904
4.091
4.085
4.074
4.069
3.875
3.717
3.705
3.701
3.698
3.689
0.984
0.979
0.974
0.167
0.153
TBSO
NH
Ns
MeO2C
4s
solvent
0.98
6.03
3.03
1.00
2.03
1.00
1.00
1.02
3.01
2.01
1.00
9.25
6.07
f1 (ppm)
168.360
149.049
144.190
142.687
138.571
134.076
132.254
131.741
131.496
130.778
130.322
130.165
129.596
128.999
127.847
127.792
126.764
126.316
126.158
123.410
123.216
77.372
77.160
76.949
66.623
55.396
52.721
35.829
26.077
18.447
-5.117
-5.160
TBSO
NH
Ns
MeO2C
4s
solvent
f1 (ppm)


8.154
8.140
7.897
7.884
7.830
7.816
7.551
7.538
7.526
7.434
7.421
7.409
7.290
7.277
7.260
7.105
7.092
6.991
6.978
6.946
4.825
4.815
3.784
3.541
3.530
3.518
3.506
3.495
2.840
2.830
2.816
2.807
2.669
2.654
2.645
2.631
2.059
1.312
1.301
Me
Me
NH
Ns
MeO2C
4t
solvent
1.97
1.01
1.95
0.99
1.13
1.11
1.00
2.02
1.00
3.10
1.04
1.00
1.00
3.21
3.29
f1 (ppm)
168.686
149.780
146.241
142.414
139.198
135.381
134.532
131.782
131.013
130.977
130.733
130.349
130.069
128.399
127.470
127.266
124.203
77.371
77.160
76.948
52.484
50.241
41.198
22.852
19.061
Me
Me
NH
Ns
MeO2C
4t
solvent
f1 (ppm)


8.007
7.993
7.992
7.922
7.920
7.909
7.907
7.661
7.647
7.543
7.540
7.530
7.528
7.517
7.515
7.433
7.431
7.421
7.418
7.408
7.406
7.251
7.249
7.238
7.236
7.101
7.098
7.088
7.085
7.053
7.050
7.032
7.019
6.786
6.637
6.634
5.489
5.478
4.527
4.522
4.518
4.512
4.503
3.813
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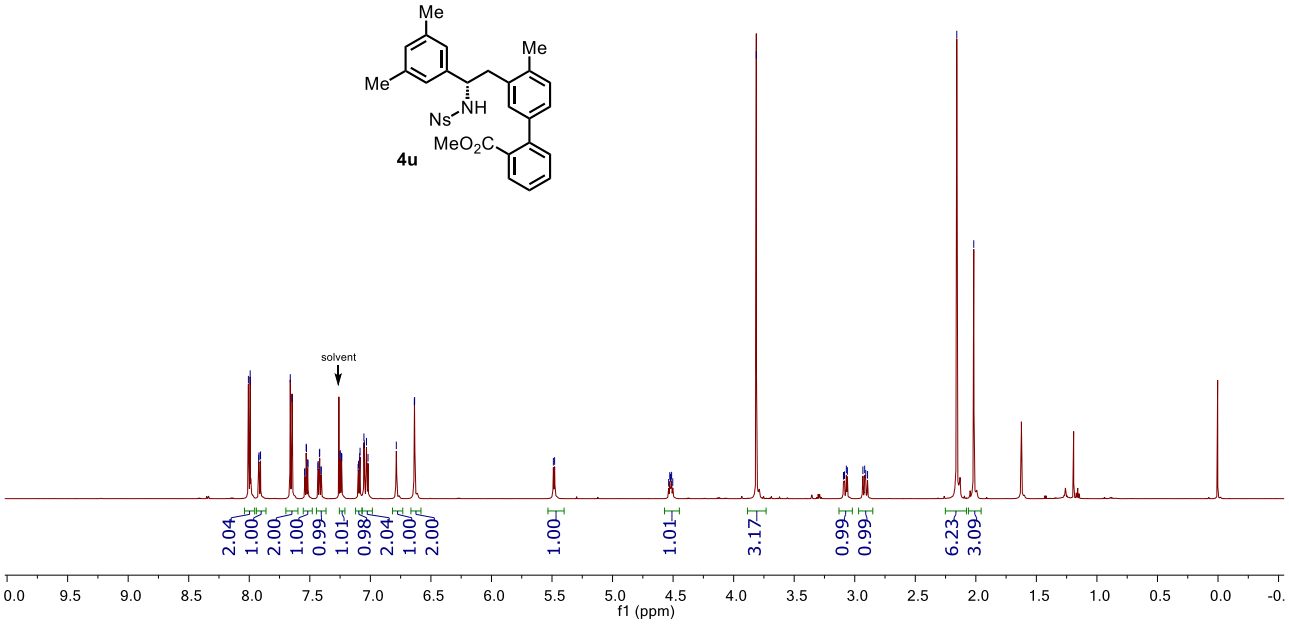
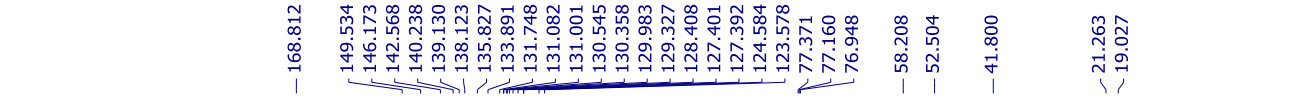
3.084
3.069
3.061
2.933
2.918
2.909
2.894
2.157
2.017


Me
Me
Me
NH
Ns
MeO2C
4u
solvent
2.04
1.00
2.00
1.00
0.99
1.01
0.98
2.04
1.00
2.00
1.00
1.01
3.17
0.99
0.99
6.23
3.09
f1 (ppm)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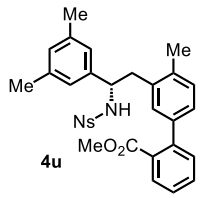
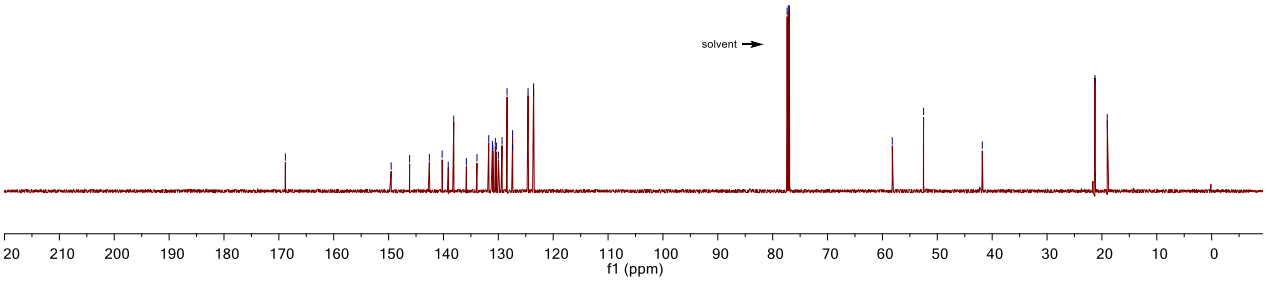
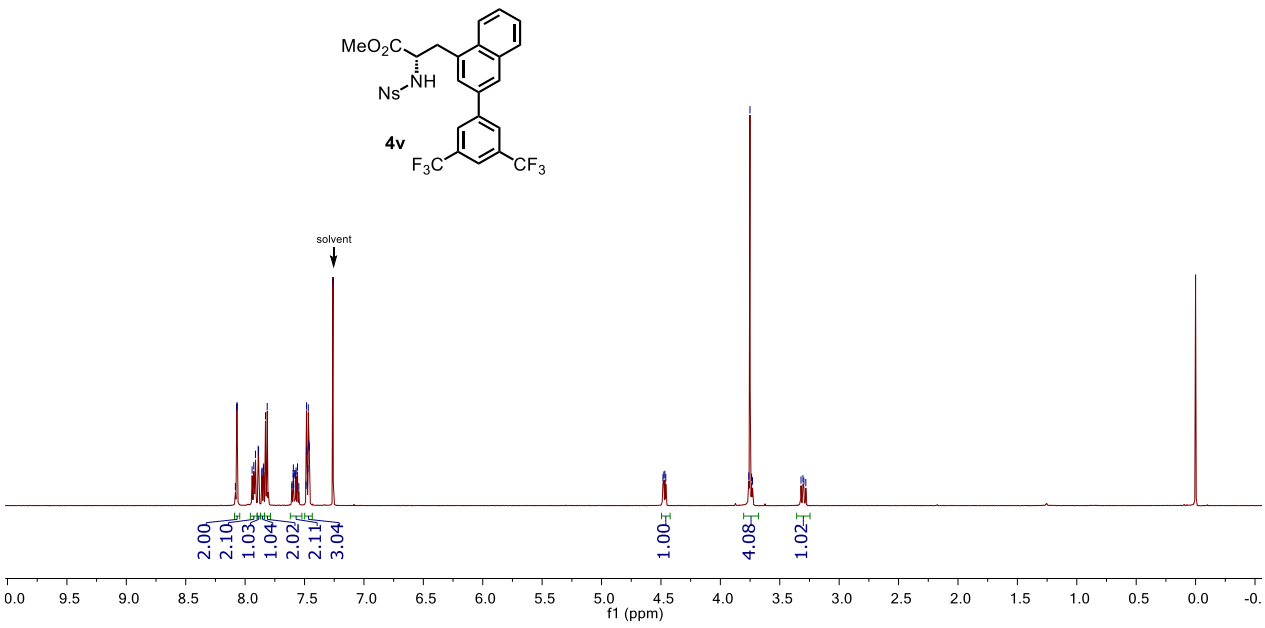
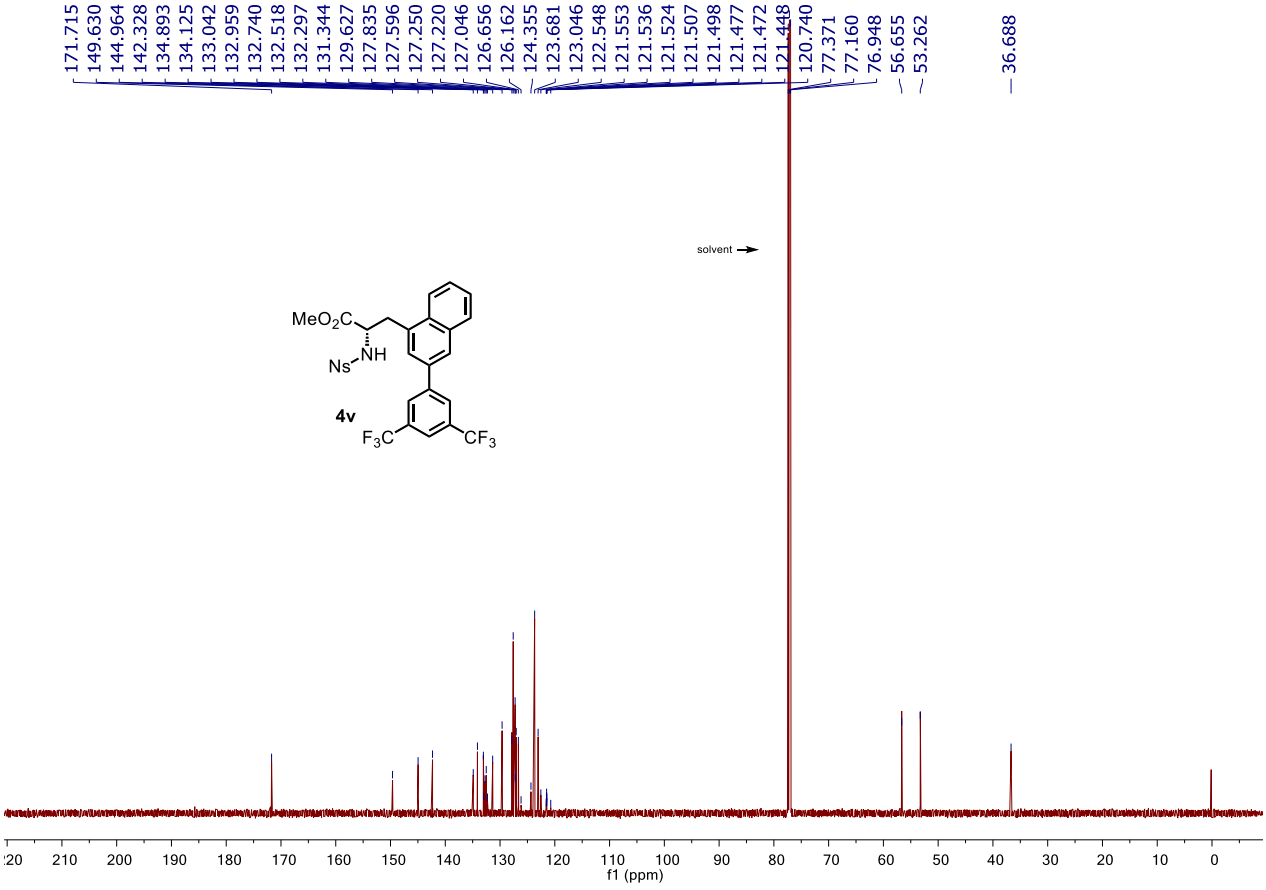
146.173
142.568
140.238
139.130
138.123
135.827
133.891
131.748
131.082
131.001
130.545
130.358
129.983
129.327
128.408
127.401
127.392
124.584
123.578
77.371
77.160
76.948
58.208
52.504
41.800
21.263
19.027

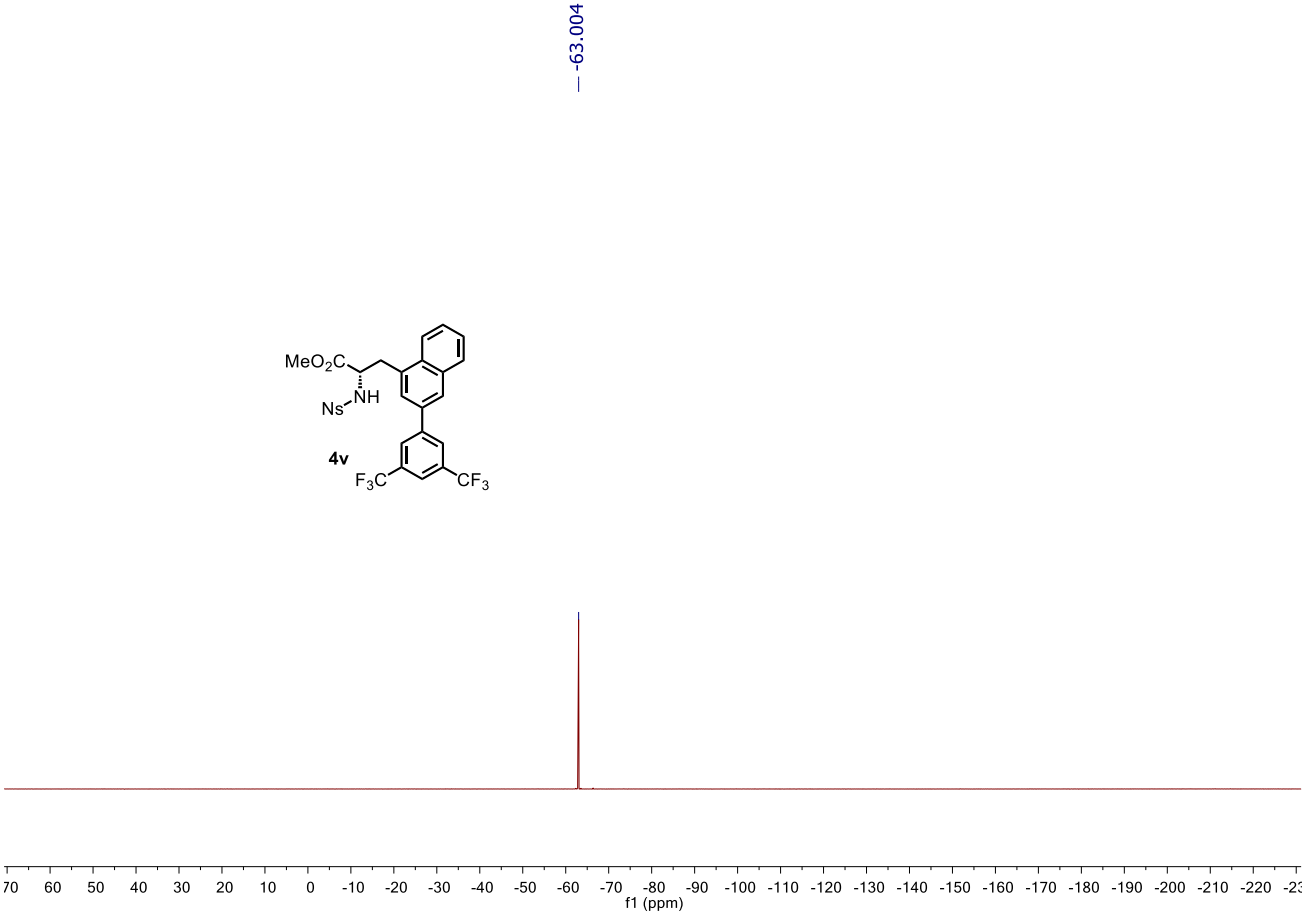

Me
Me
Me
NH
Ns
MeO2C
4u

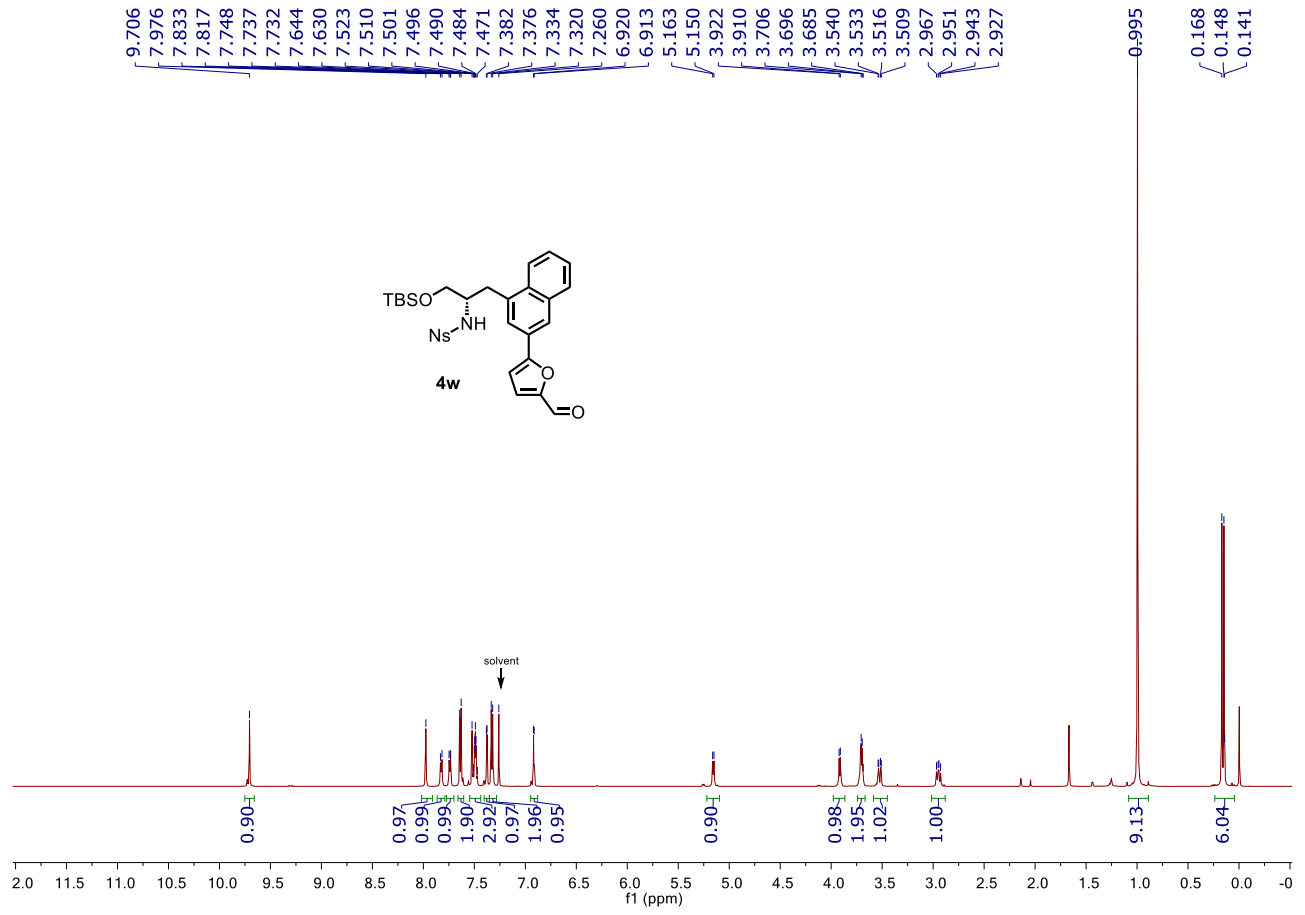

solvent
f1 (ppm)

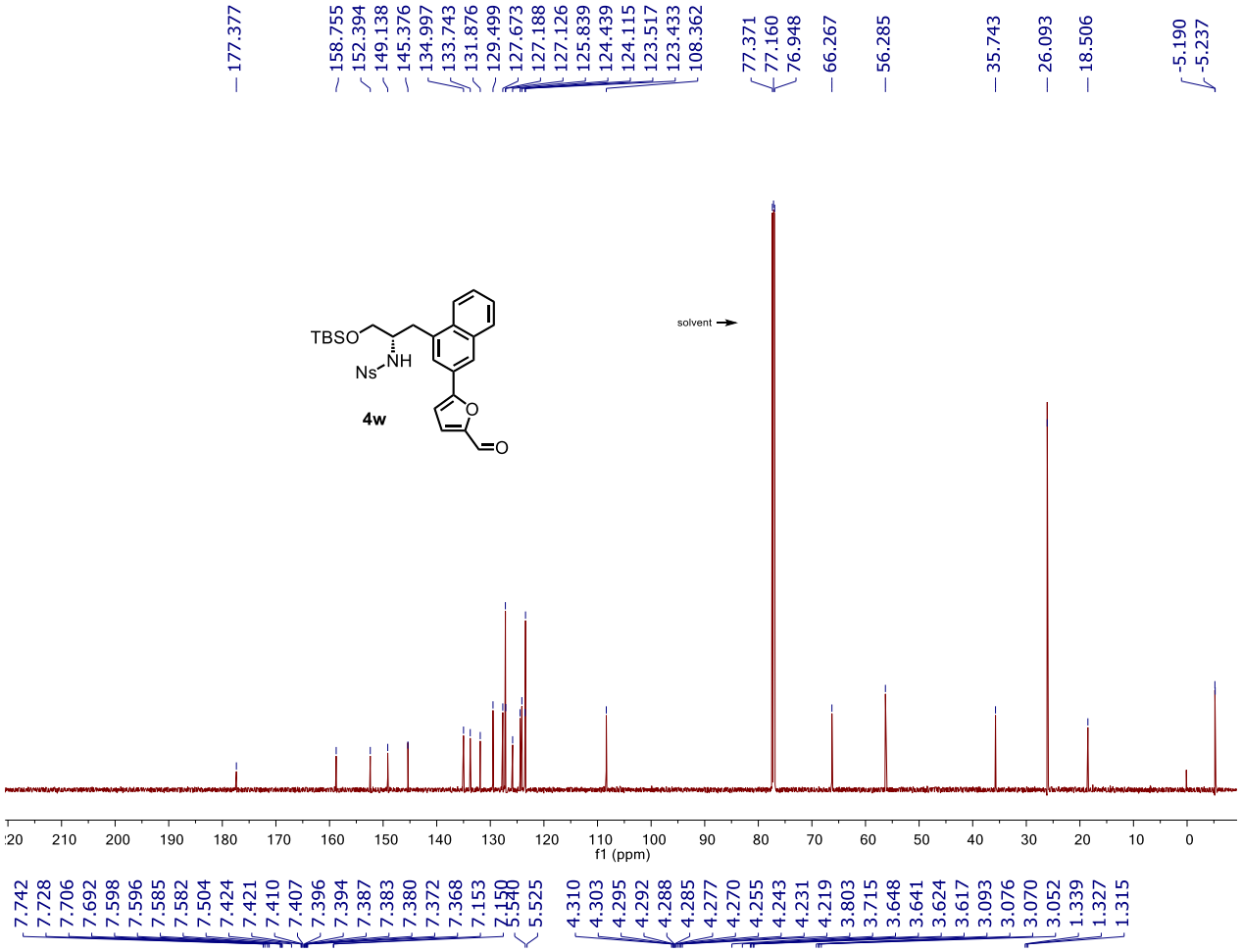

8.070
8.068
7.941
7.927
7.913
7.890
7.887
7.859
7.857
7.846
7.844
7.829
7.814
7.596
7.594
7.582
7.580
7.573
7.571
7.559
7.483
7.480
7.472
7.468
7.463
7.460
7.260
4.476
4.467
4.459
3.761
3.751
3.737
3.729
3.321
3.305
3.297
3.281

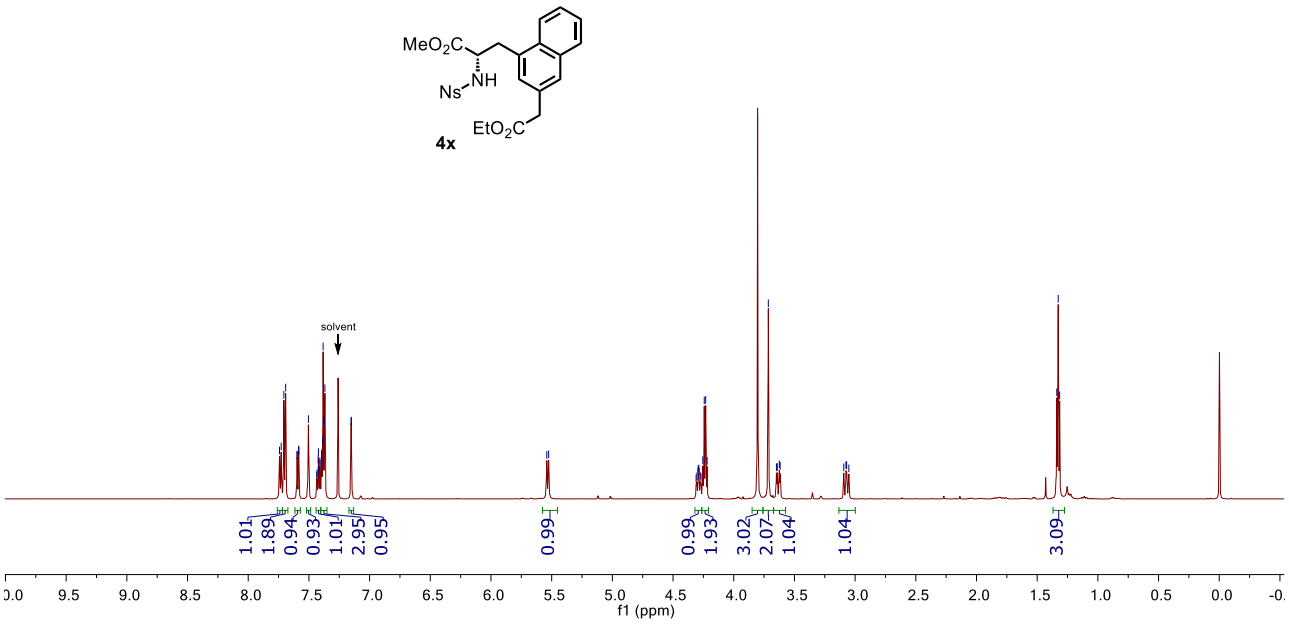

MeO2C
NH
Ns
4v
F3C
CF3
solvent
2.00
2.10
1.03
1.04
2.02
2.11
3.04
1.00
4.08
1.02
f1 (ppm)

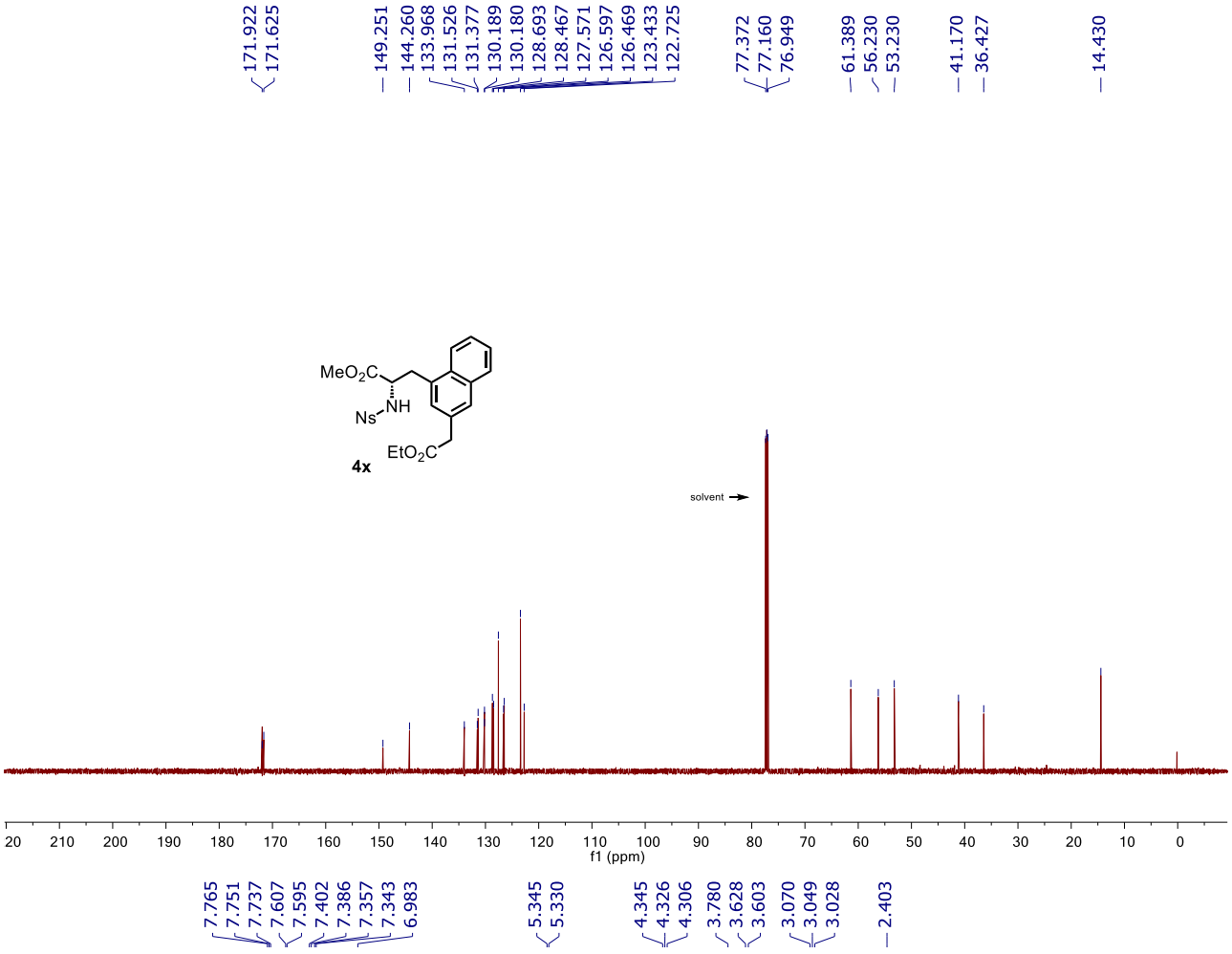

171.715
149.630
144.964
142.328
134.893
134.125
133.042
132.959
132.740
132.518
132.297
131.344
129.627
127.835
127.596
127.250
127.220
127.046
126.656
126.162
124.355
123.681
123.046
122.548
121.553
121.536
121.524
121.507
121.498
121.477
121.472
121.448
120.740
77.371
77.160
76.948
56.655
53.262
36.688
solvent
MeO2C
NH
Ns
4v
F3C
CF3
f1 (ppm)

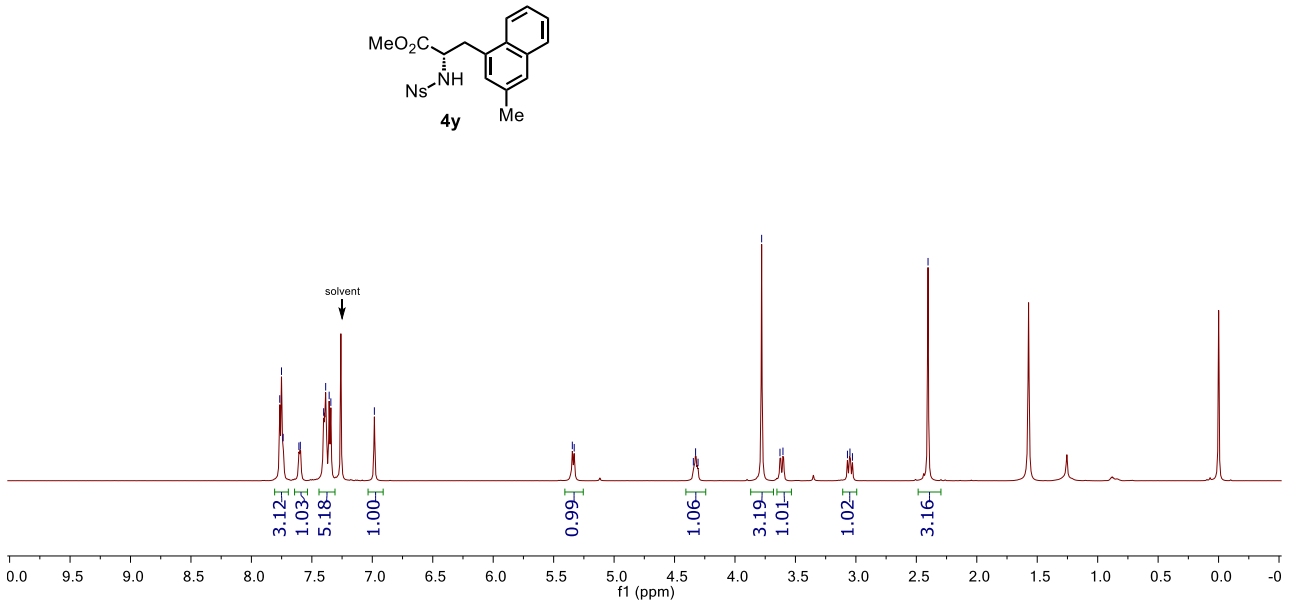

-63.004
MeO2C
NH
Ns
4v
F3C
CF3
f1 (ppm)

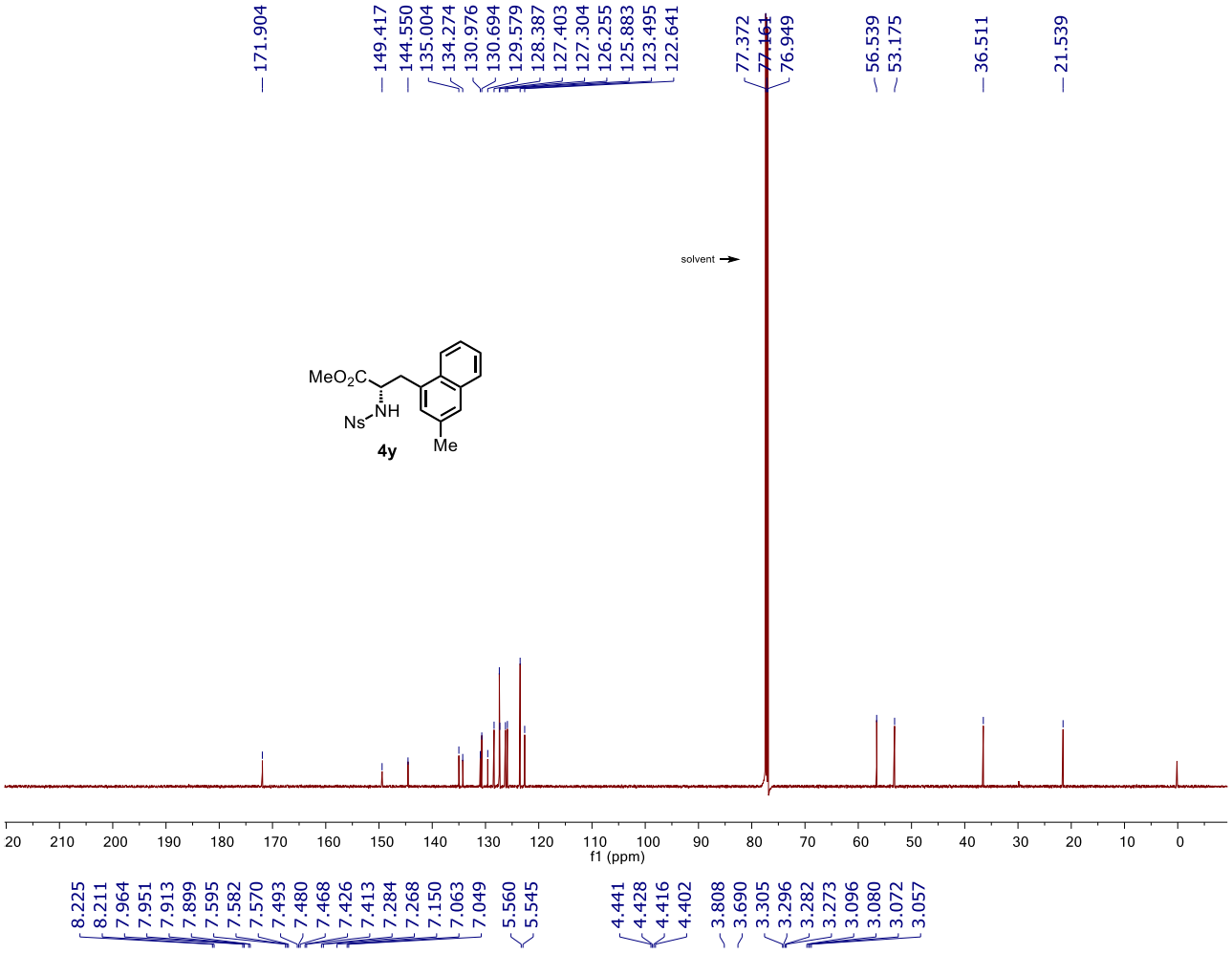

9.706
7.976
7.833
7.817
7.748
7.737
7.732
7.644
7.630
7.523
7.510
7.501
7.496
7.490
7.484
7.471
7.382
7.376
7.334
7.320
7.260
6.920
6.913
5.163
5.150
3.922
3.910
3.706
3.696
3.685
3.540
3.533
3.516
3.509
2.967
2.951
2.943
2.927
0.995
0.168
0.148
0.141
TBSO
NH
Ns
O
4w
solvent
0.90
0.97
0.99
0.99
1.90
2.92
0.97
1.96
0.95
0.90
0.98
1.95
1.02
1.00
9.13
6.04
f1 (ppm)

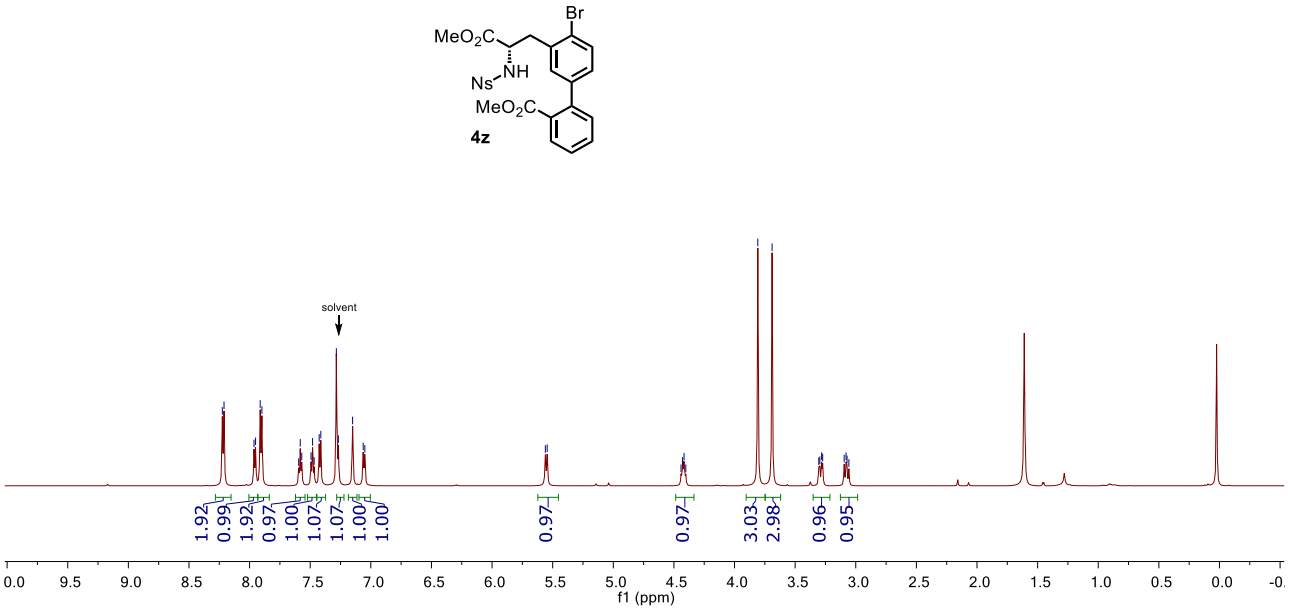

177.377
158.755
152.394
149.138
145.376
134.997
133.743
131.876
129.499
127.673
127.188
127.126
125.839
124.439
124.115
123.517
123.433
108.362
77.371
77.160
76.948
66.267
56.285
35.743
26.093
18.506
-5.190
-5.237
TBSO
NH
Ns
O
4w
solvent
f1 (ppm)
7.742
7.728
7.706
7.692
7.598
7.596
7.585
7.582
7.504
7.424
7.421
7.410
7.407
7.396
7.394
7.387
7.383
7.380
7.372
7.368
7.153
7.150
5.540
5.525
4.310
4.303
4.295
4.292
4.288
4.285
4.277
4.270
4.255
4.243
4.231
4.219
3.803
3.715
3.648
3.641
3.624
3.617
3.093
3.076
3.070
3.052
1.339
1.327
1.315

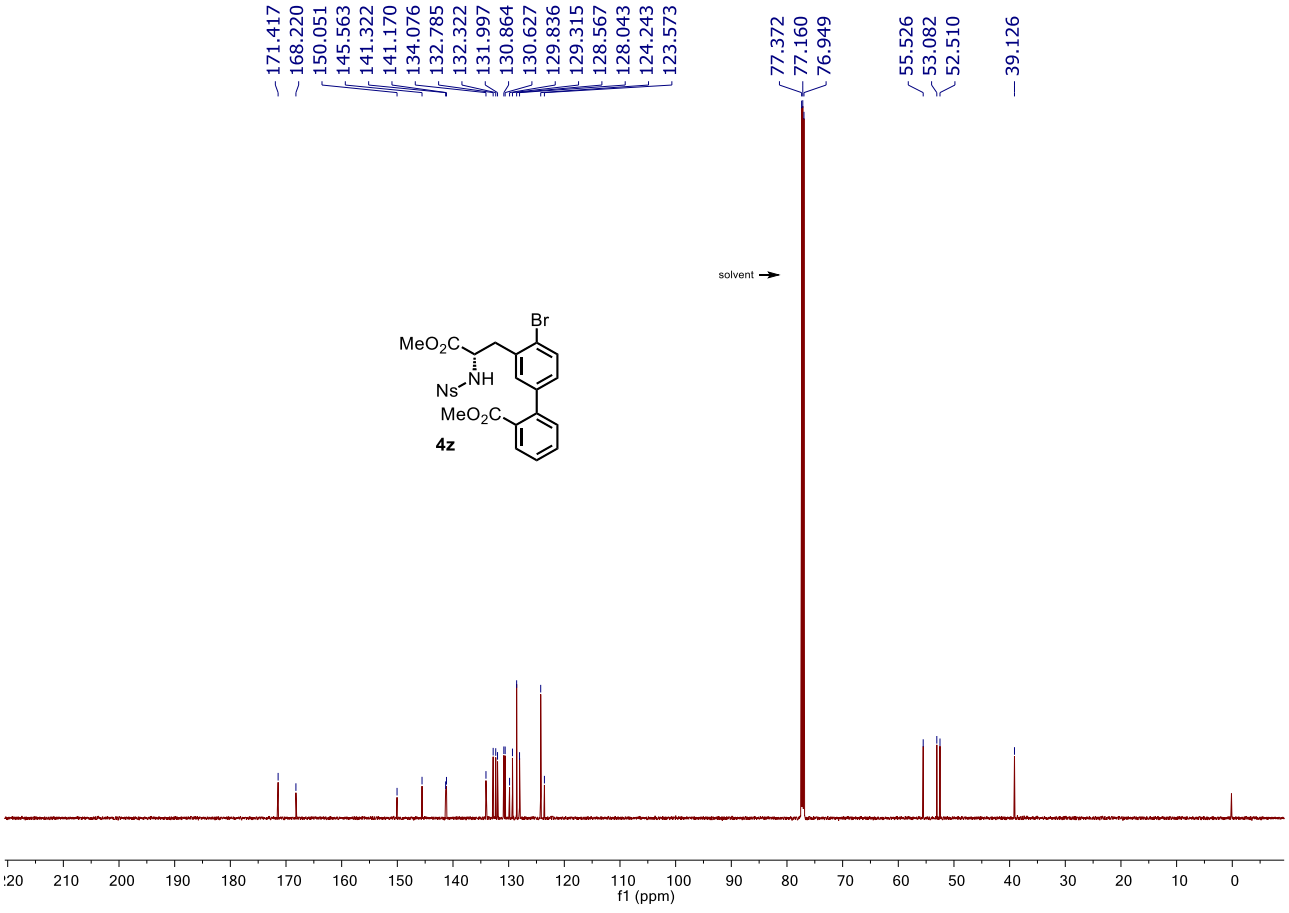

MeO2C
NH
Ns
EtO2C
4x
solvent
1.01
1.89
0.94
0.93
1.01
2.95
0.95
0.99
0.99
1.93
3.02
2.07
1.04
1.04
3.09
f1 (ppm)

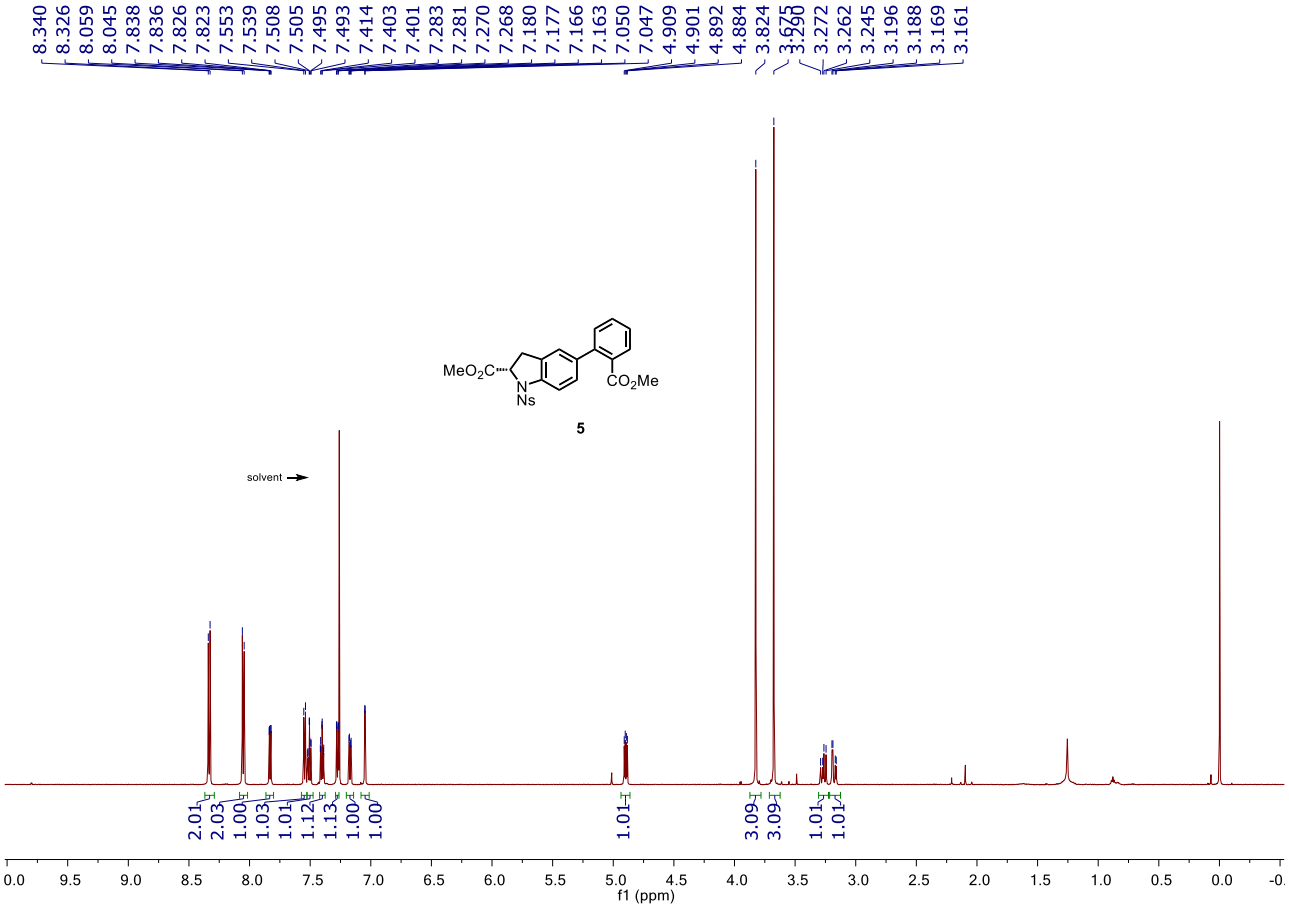

171.922
171.625
149.251
144.260
133.968
131.526
131.377
130.189
130.180
128.693
128.467
127.571
126.597
126.469
123.433
122.725
77.372
77.160
76.949
61.389
56.230
53.230
41.170
36.427
14.430
MeO2C
Ns
NH
EtO2C
4x
solvent
f1 (ppm)
7.765
7.751
7.737
7.607
7.595
7.402
7.386
7.357
7.343
6.983
5.345
5.330
4.345
4.326
4.306
3.780
3.628
3.603
3.070
3.049
3.028
2.403

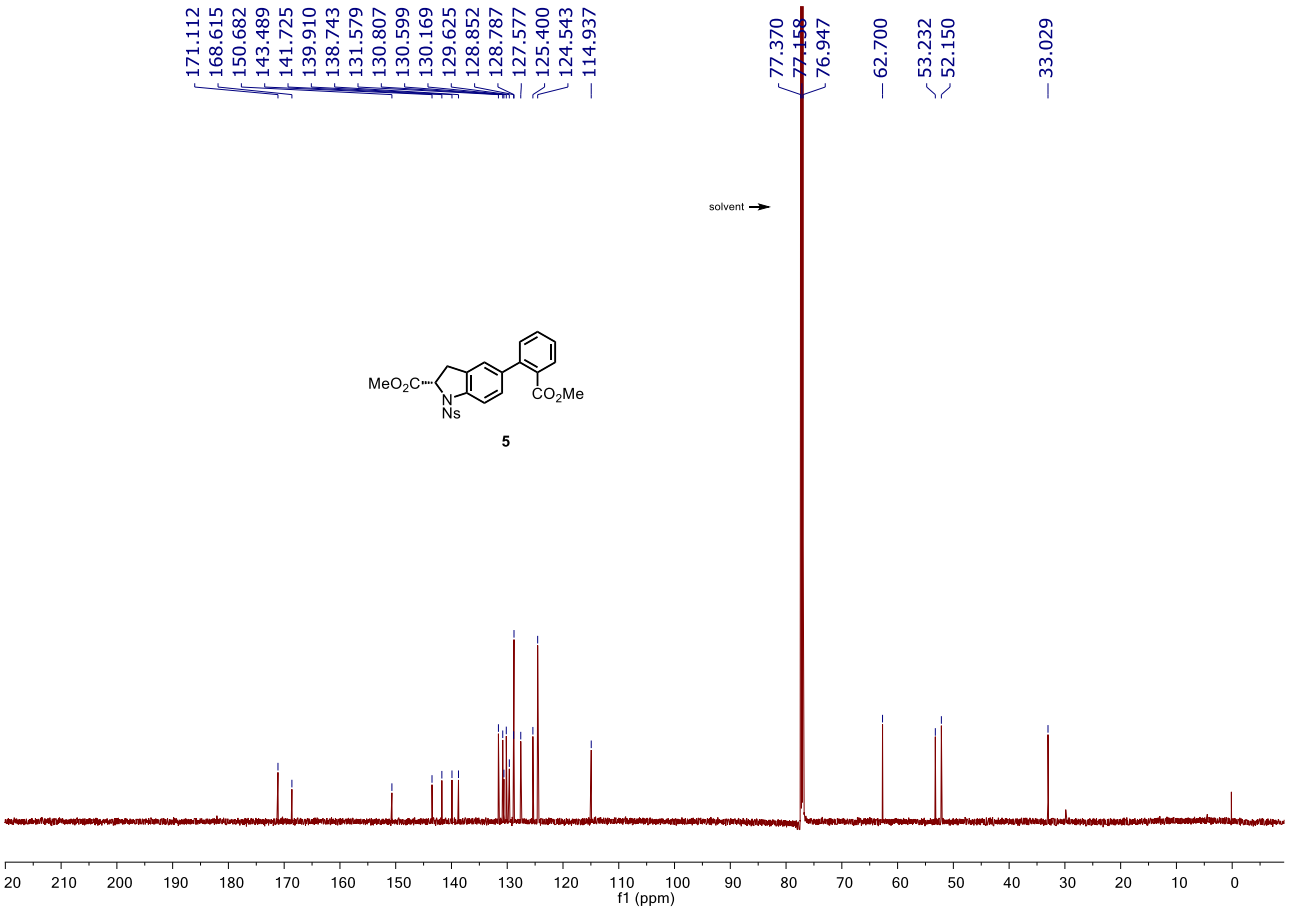

MeO2C
Ns
NH
Me
4y
solvent
3.12
1.03
5.18
1.00
0.99
1.06
3.19
1.01
1.02
3.16
f1 (ppm)


171.904
149.417
144.550
135.004
134.274
130.976
130.694
129.579
128.387
127.403
127.304
126.255
125.883
123.495
122.641
77.372
77.161
76.949
56.539
53.175
36.511
21.539
solvent
MeO2C
NH
Ns
Me
4y
f1 (ppm)
8.225
8.211
7.964
7.951
7.913
7.899
7.595
7.582
7.570
7.493
7.480
7.468
7.426
7.413
7.284
7.268
7.150
7.063
7.049
5.560
5.545
4.441
4.428
4.416
4.402
3.808
3.690
3.305
3.296
3.282
3.273
3.096
3.080
3.072
3.057

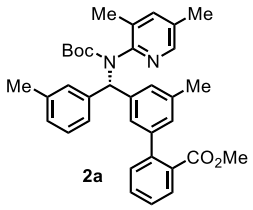

Br
MeO2C
NH
Ns
MeO2C
4z
solvent
1.92
0.99
1.92
0.97
1.00
1.07
1.07
1.00
1.00
0.97
0.97
3.03
2.98
0.96
0.95
f1 (ppm)


171.417
168.220
150.051
145.563
141.322
141.170
134.076
132.785
132.322
131.997
130.864
130.627
129.836
129.315
128.567
128.043
124.243
123.573
77.372
77.160
76.949
55.526
53.082
52.510
39.126
solvent
Br
MeO2C
NH
Ns
MeO2C
4z
f1 (ppm)

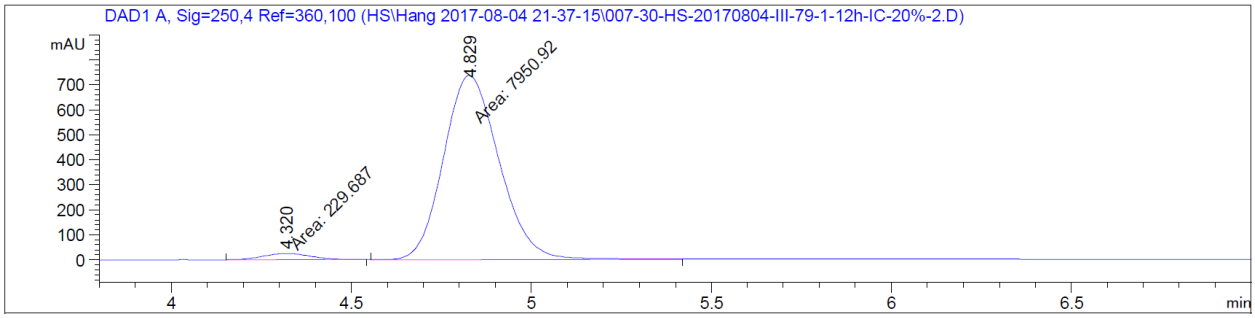

8.340
8.326
8.059
8.045
7.838
7.836
7.826
7.823
7.553
7.539
7.508
7.505
7.495
7.493
7.414
7.403
7.401
7.283
7.281
7.270
7.268
7.180
7.177
7.166
7.163
7.050
7.047
4.909
4.901
4.892
4.884
3.824
3.675
3.272
3.262
3.245
3.196
3.188
3.169
3.161
MeO2C
N
Ns
CO2Me
5
solvent
2.01
2.03
1.00
1.03
1.01
1.12
1.13
1.00
1.00
1.01
3.09
3.09
1.01
1.01
f1 (ppm)

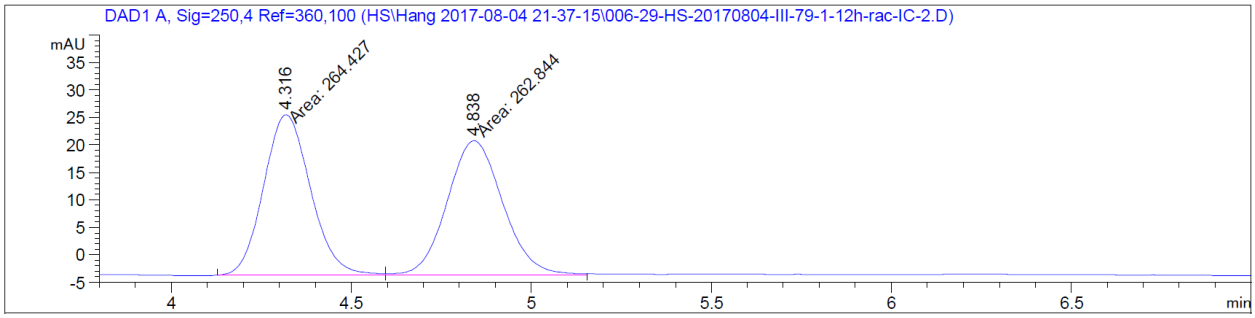

171.112
168.615
150.682
143.489
141.725
139.910
138.743
131.579
130.807
130.599
130.169
129.625
128.852
128.787
127.577
125.400
124.543
114.937
77.370
77.158
76.947
62.700
53.232
52.150
33.029
solvent
MeO2C
N
Ns
CO2Me
5
20 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

SFC TRACES



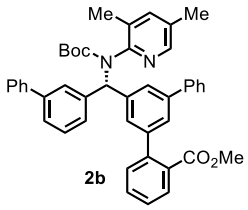
2a



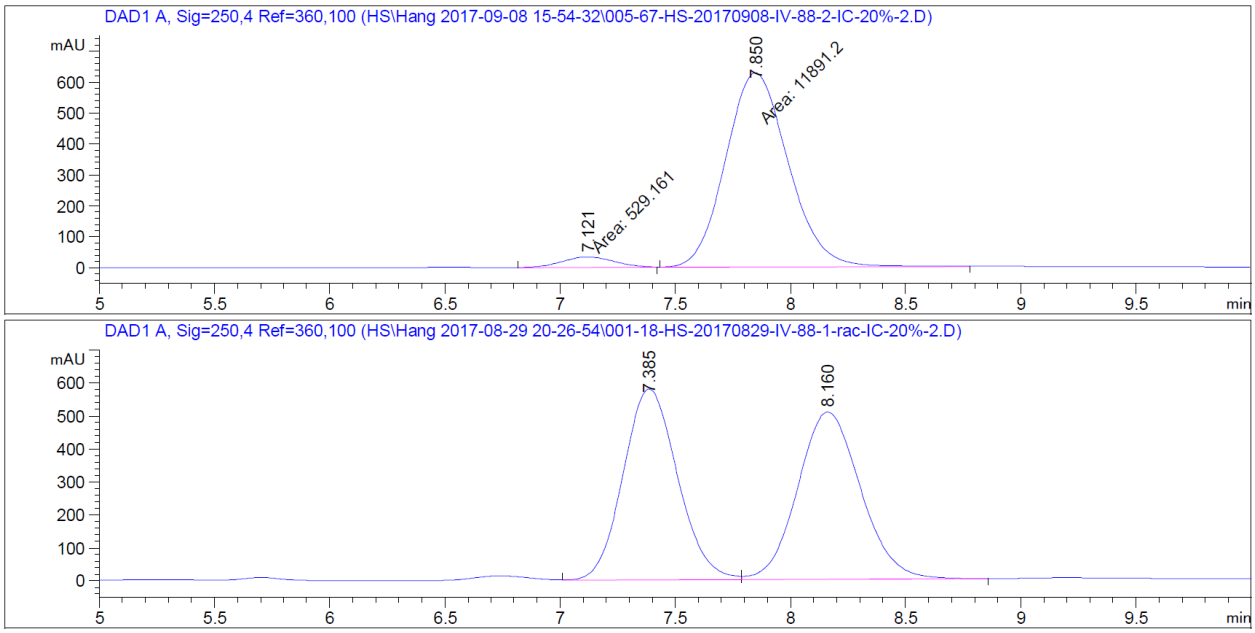


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.320	MM	0.1509	229.68727	25.37218	2.8077
2	4.829	MM	0.1797	7950.92139	737.59424	97.1923

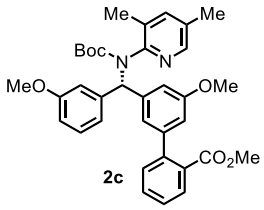


2b

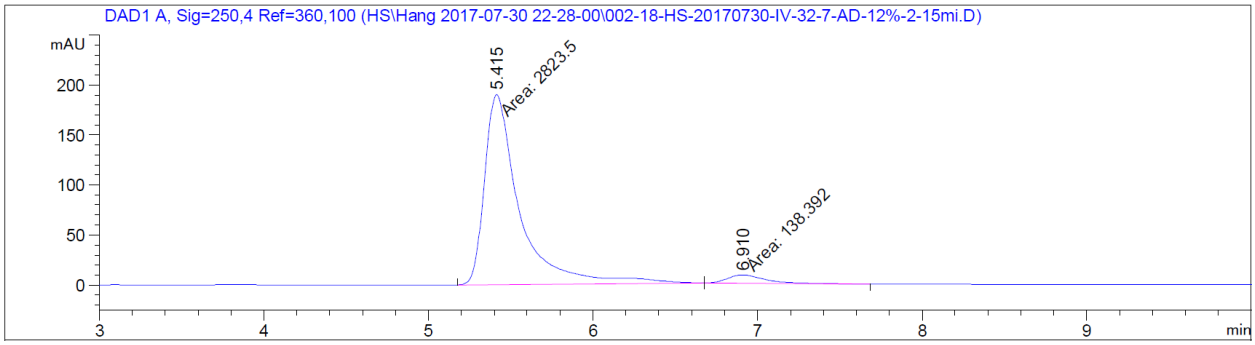


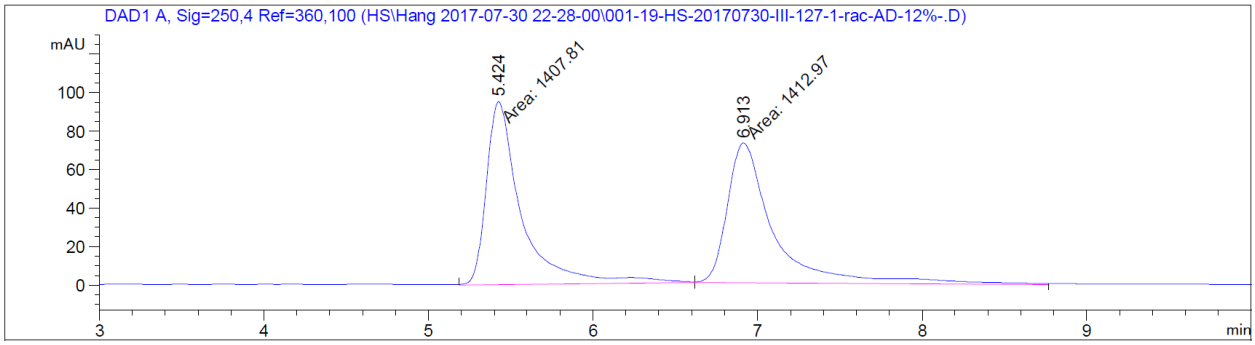
Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.121	MM	0.2614	529.16058	33.73596	4.2604
2	7.850	MM	0.3155	1.18912e4	628.12677	95.7396



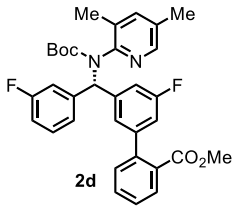
2c



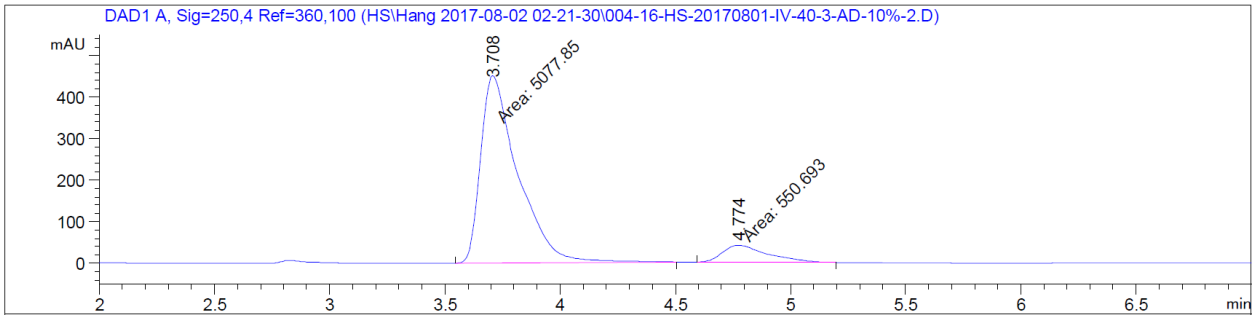


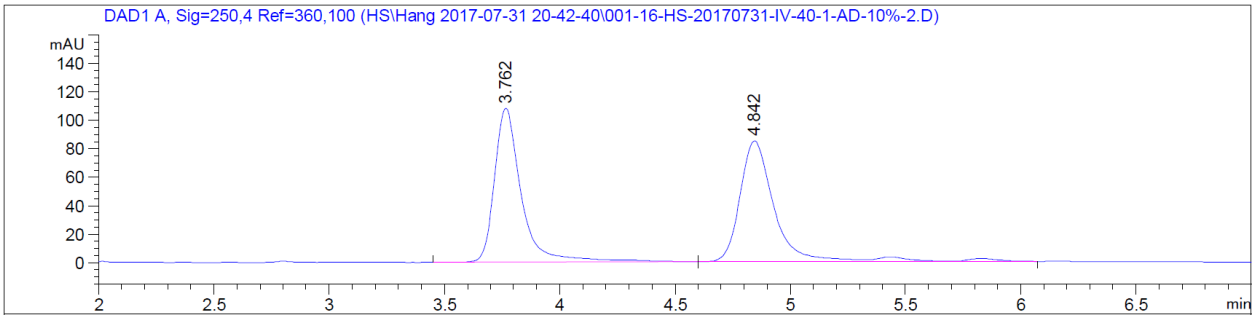
Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.415	MM	0.2476	2823.50439	190.06265	95.3276
2	6.910	MM	0.2723	138.39246	8.46927	4.6724

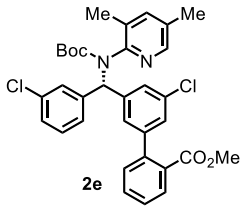


2d

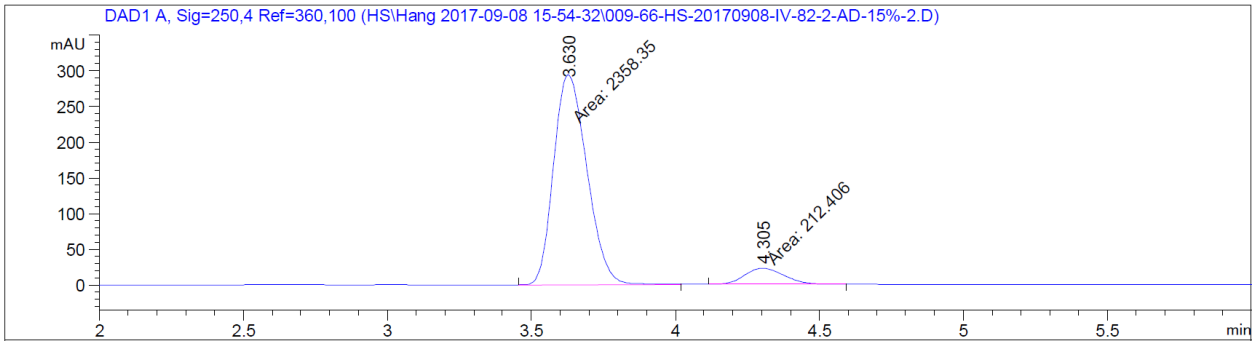


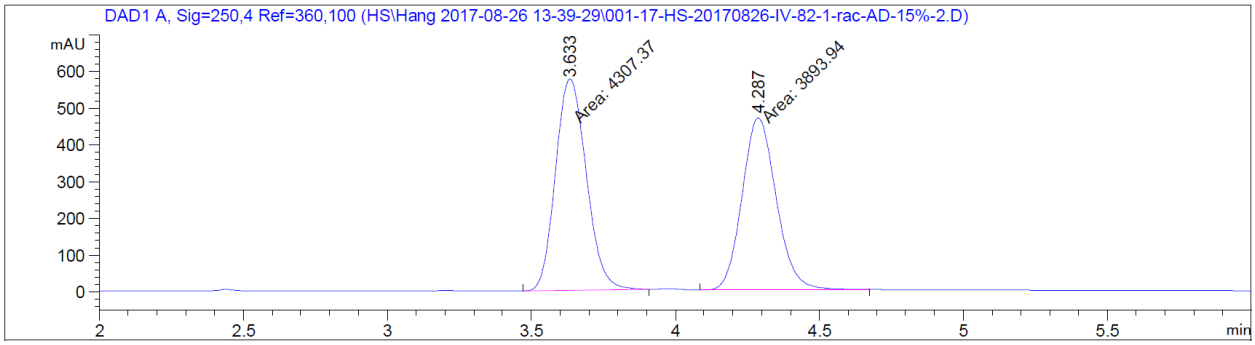


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.708	MM	0.1873	5077.84863	451.93127	90.2161
2	4.774	MM	0.2226	550.69342	41.22754	9.7839
Totals :				5628.54205	493.15881	



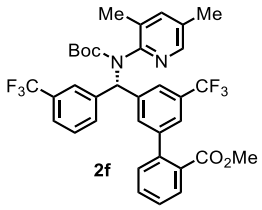
2e



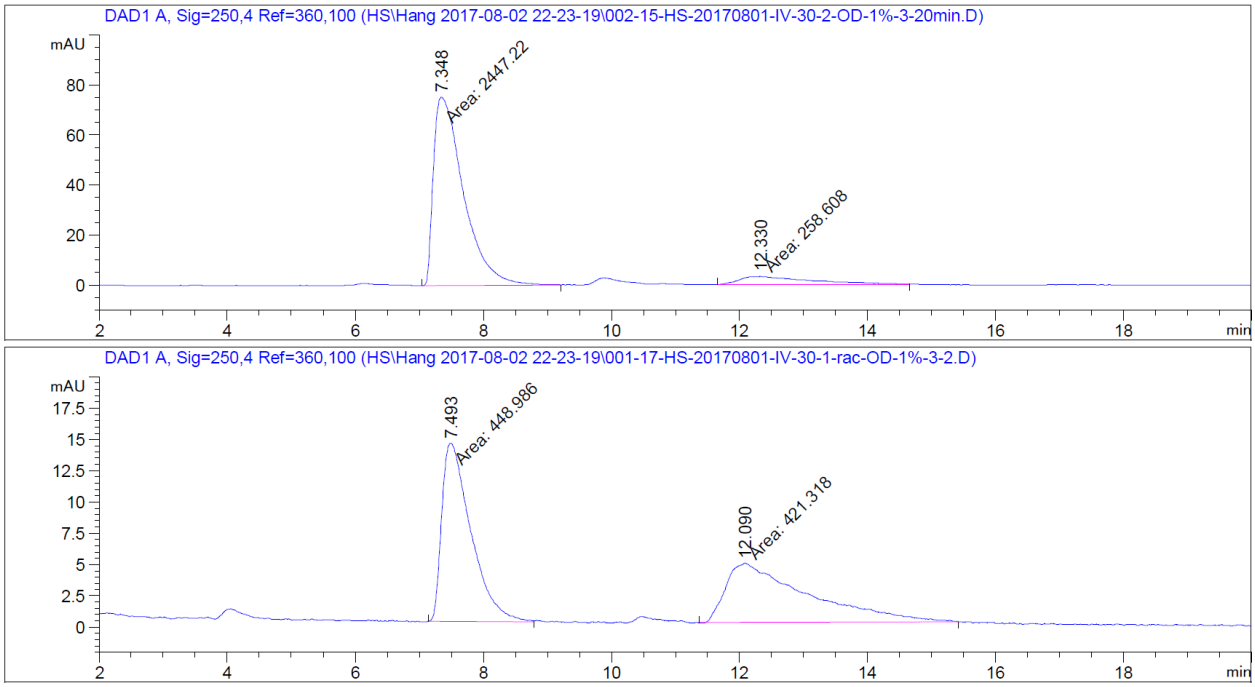


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.630	MM	0.1336	2358.35352	294.12524	91.7376
2	4.305	MM	0.1585	212.40570	22.33520	8.2624

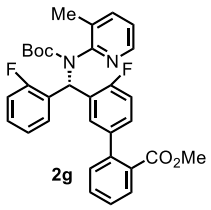


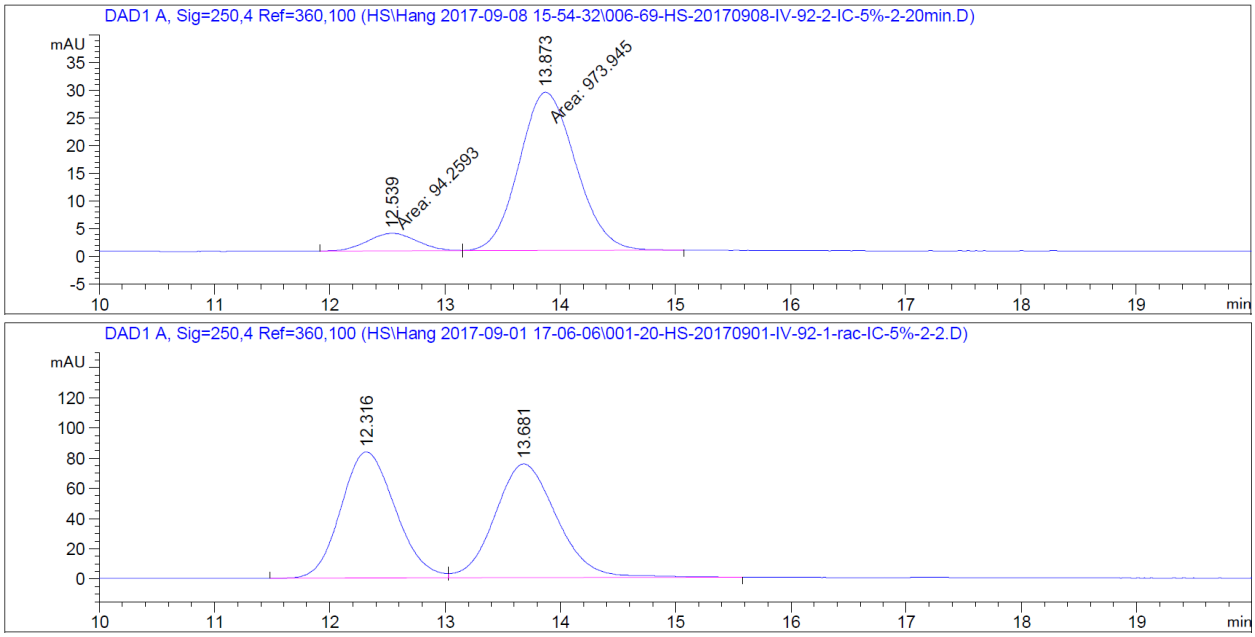
2f



Signal 1: DAD1 A, Sig=250,4 Ref=360,100

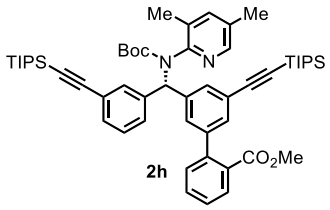
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.348	MM	0.5418	2447.21826	75.27472	90.4425
2	12.330	MM	1.3038	258.60831	3.30577	9.5575

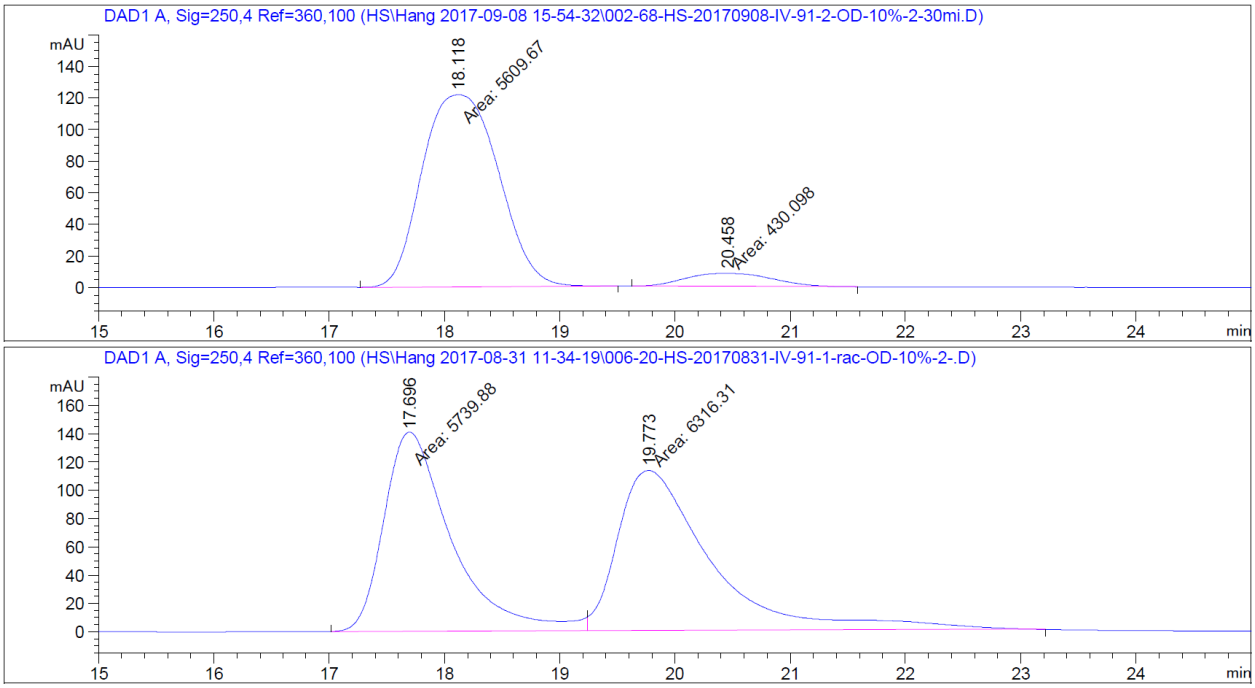




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

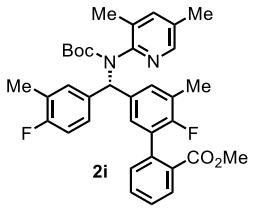
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.539	MM	0.4980	94.25928	3.15432	8.8241
2	13.873	MM	0.5678	973.94489	28.58943	91.1759



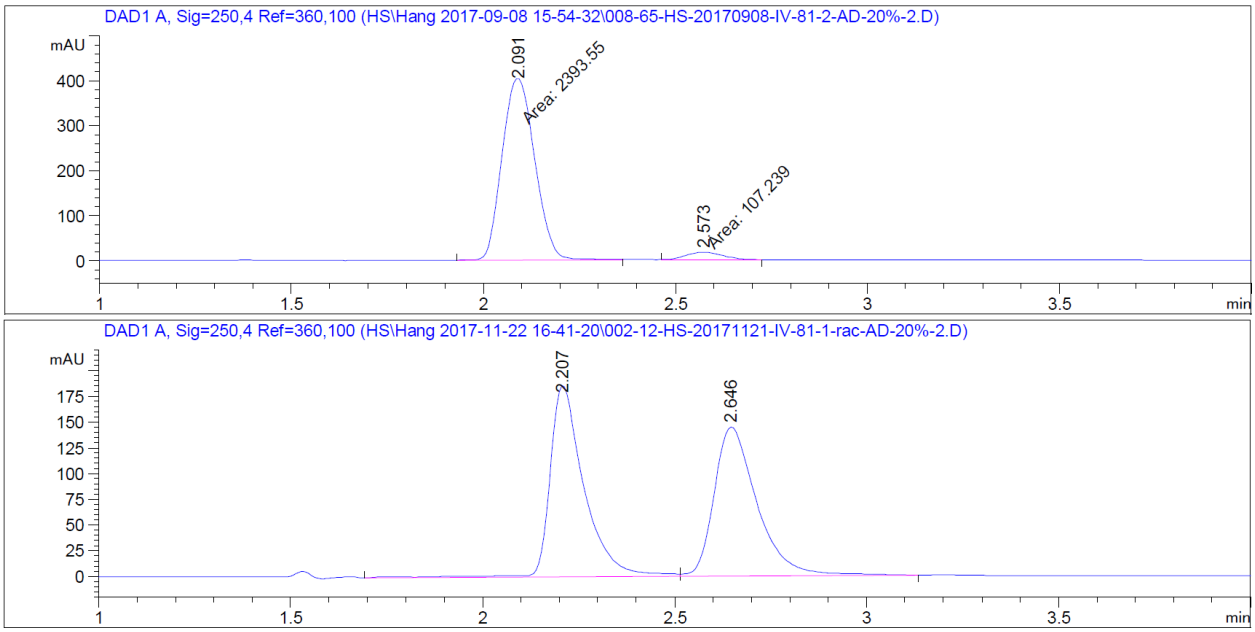


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.118	MM	0.7676	5609.67383	121.80787	92.8789
2	20.458	MM	0.8680	430.09839	8.25843	7.1211

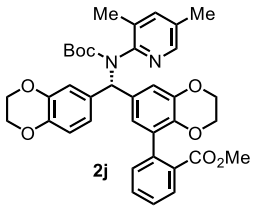


2i

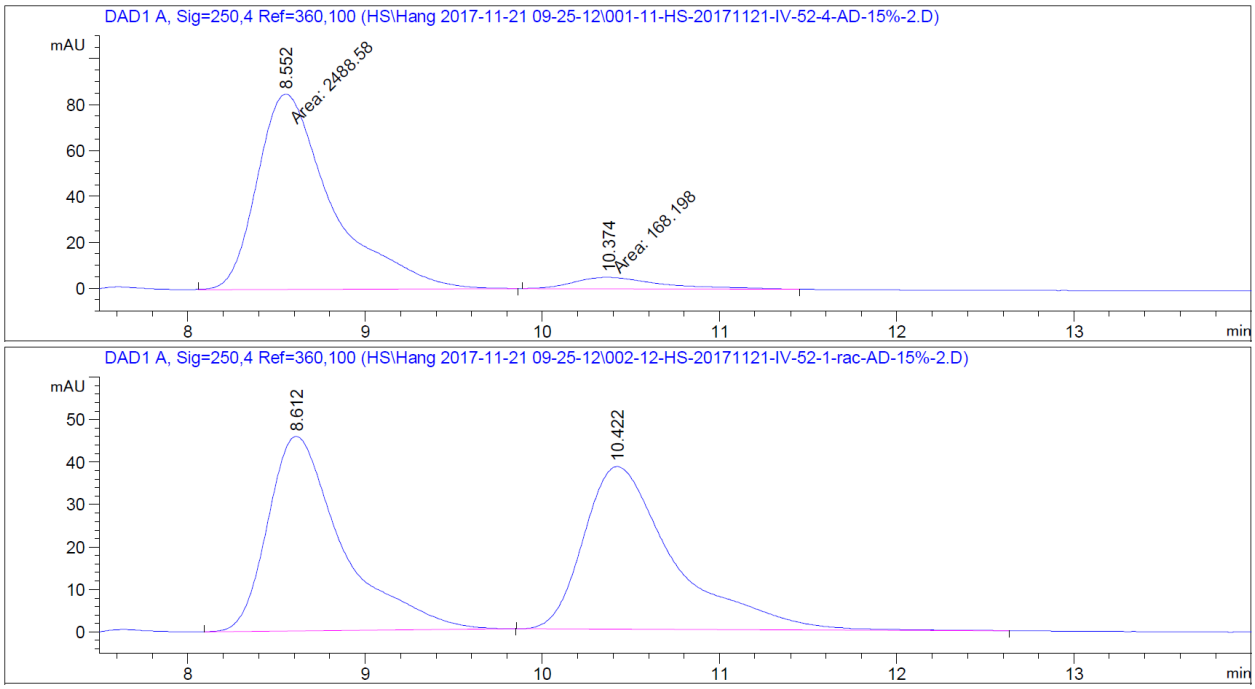


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.091	MM	0.0985	2393.55249	404.92963	95.7118
2	2.573	MM	0.1089	107.23945	16.41767	4.2882

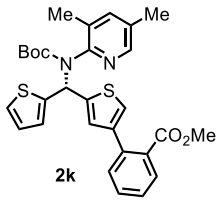


2j

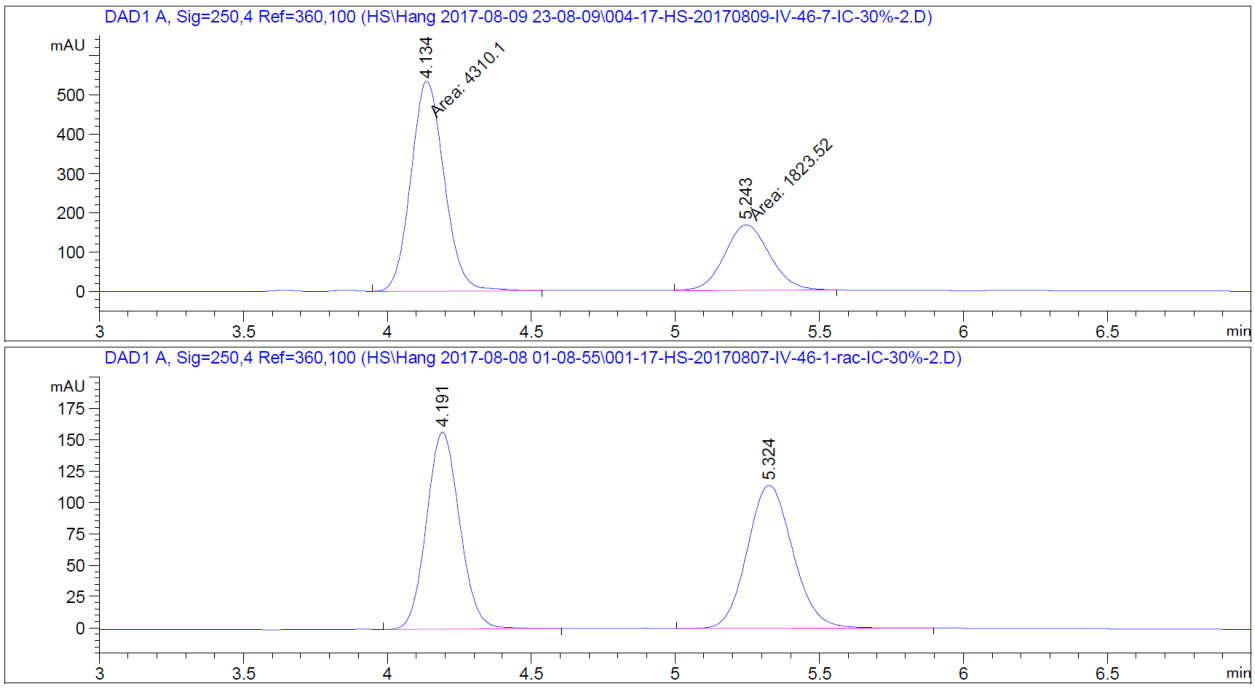


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.552	MM	0.4877	2488.58325	85.05038	93.6691
2	10.374	MM	0.5628	168.19827	4.98111	6.3309

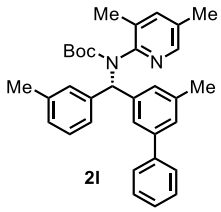


2k

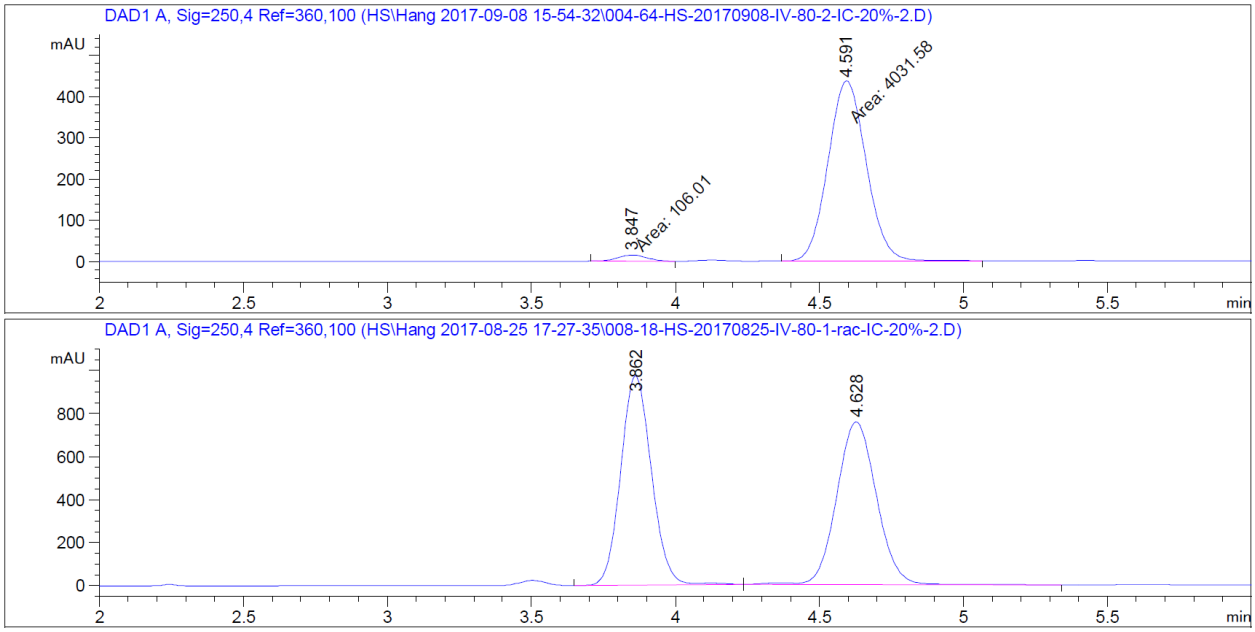


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.134	MM	0.1341	4310.09961	535.67480	70.2700
2	5.243	MM	0.1816	1823.52490	167.33965	29.7300

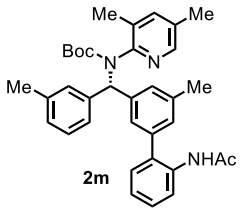


2l

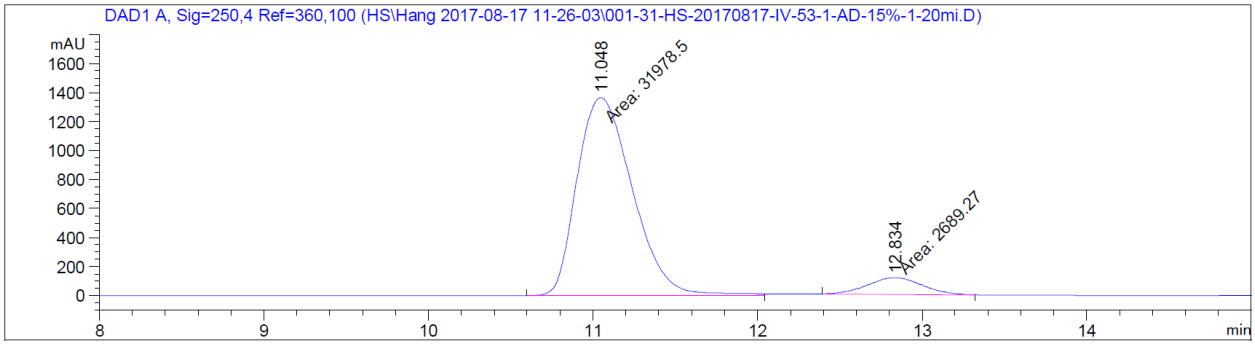


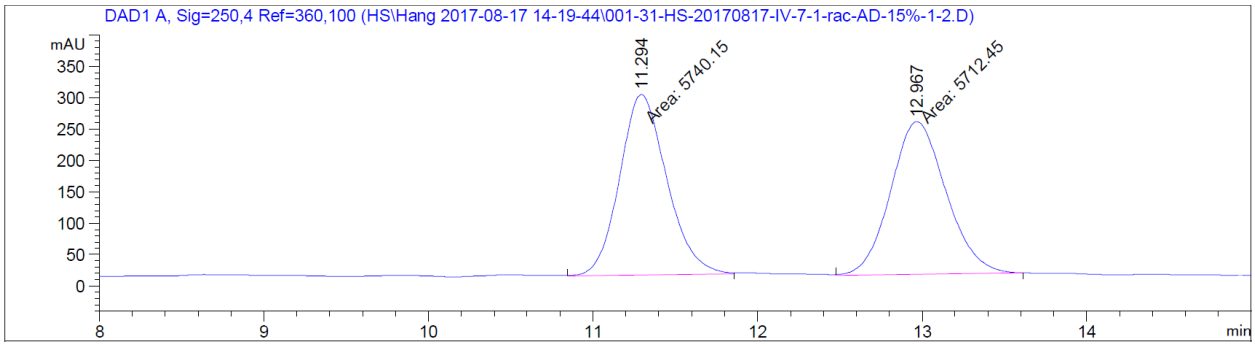
Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.847	MM	0.1168	106.01046	15.12457	2.5621
2	4.591	MM	0.1537	4031.58008	437.29309	97.4379



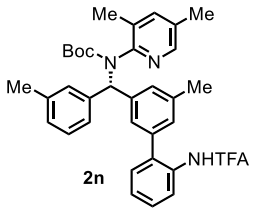
2m



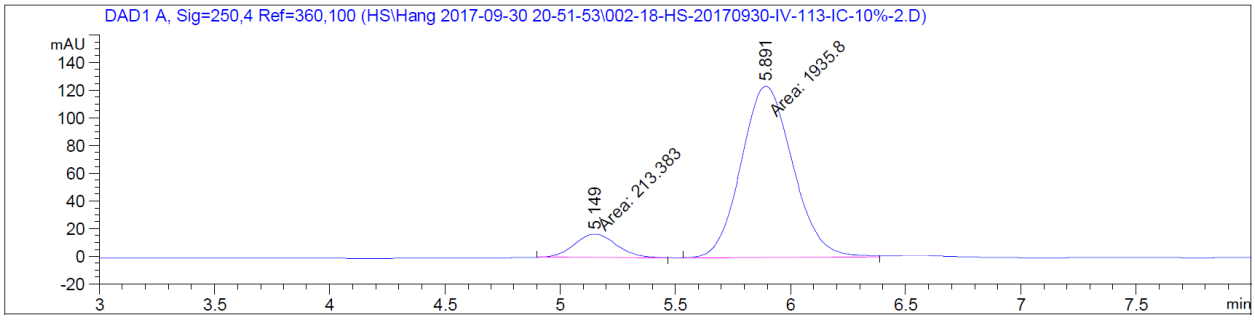


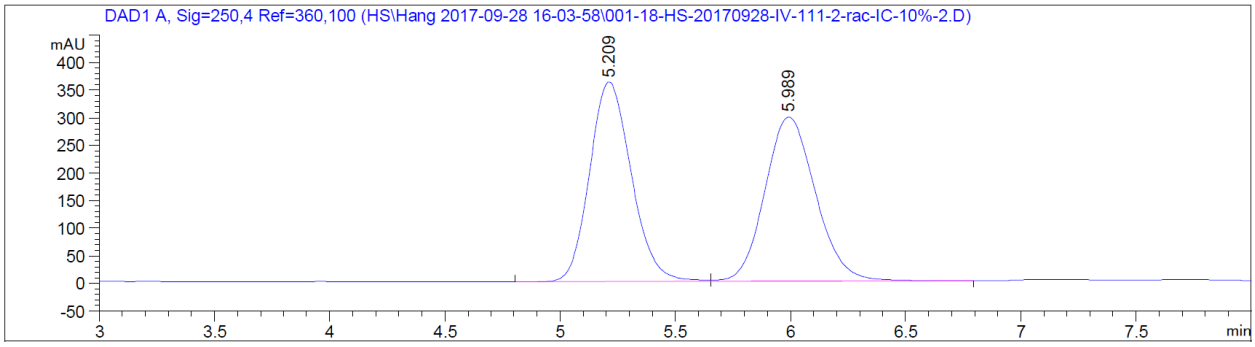
Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.048	MM	0.3901	3.19785e4	1366.14307	92.2428
2	12.834	MM	0.3848	2689.26538	116.47205	7.7572



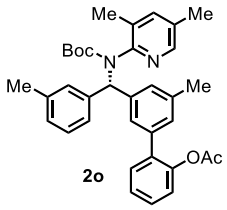
2n



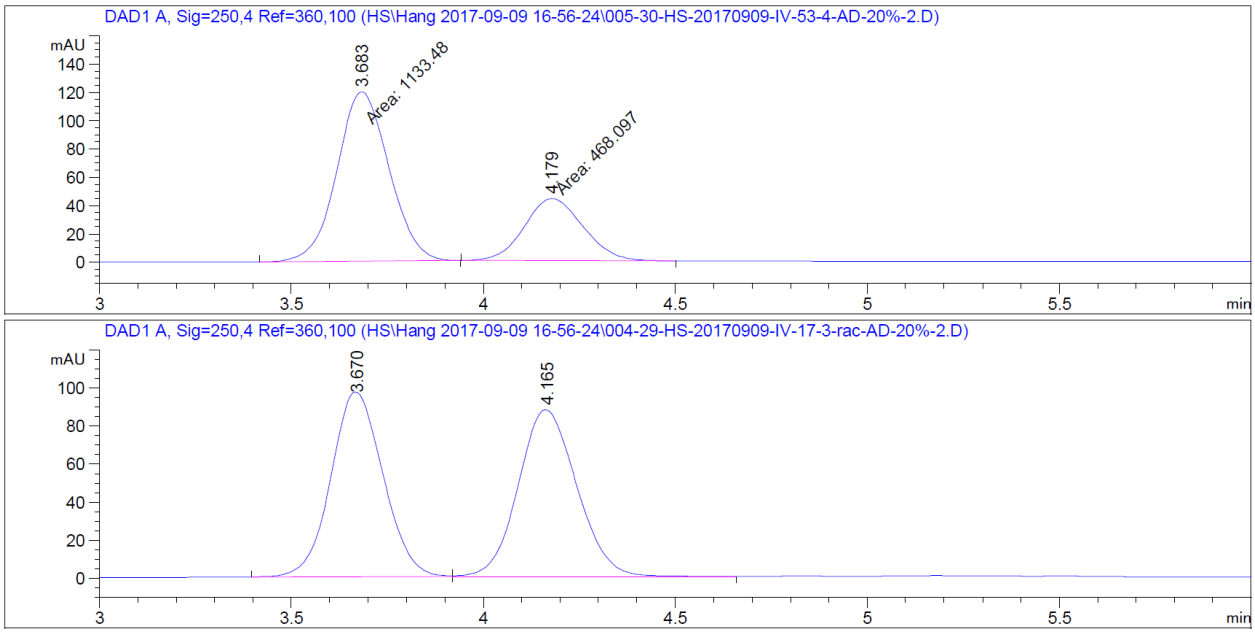


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.149	MM	0.2102	213.38335	16.92092	9.9286
2	5.891	MM	0.2604	1935.79797	123.88663	90.0714

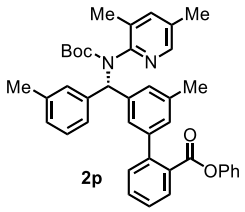


2o

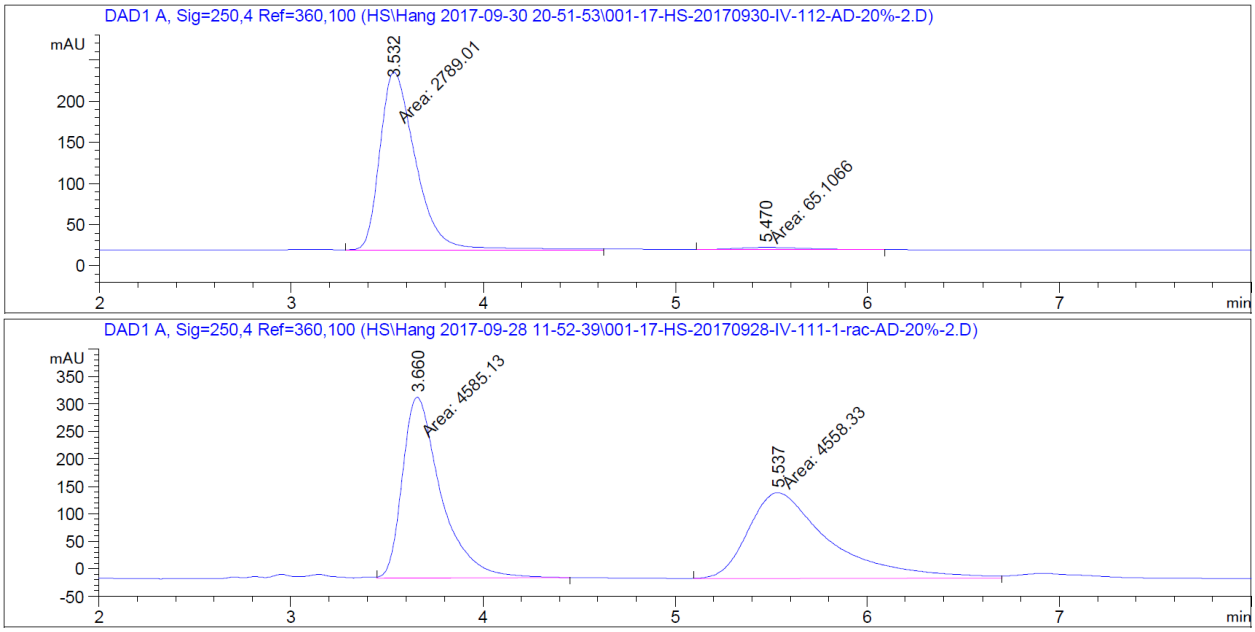


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.683	MM	0.1574	1133.48279	120.01421	70.7728
2	4.179	MM	0.1775	468.09714	43.96405	29.2272

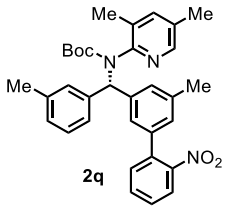


2p

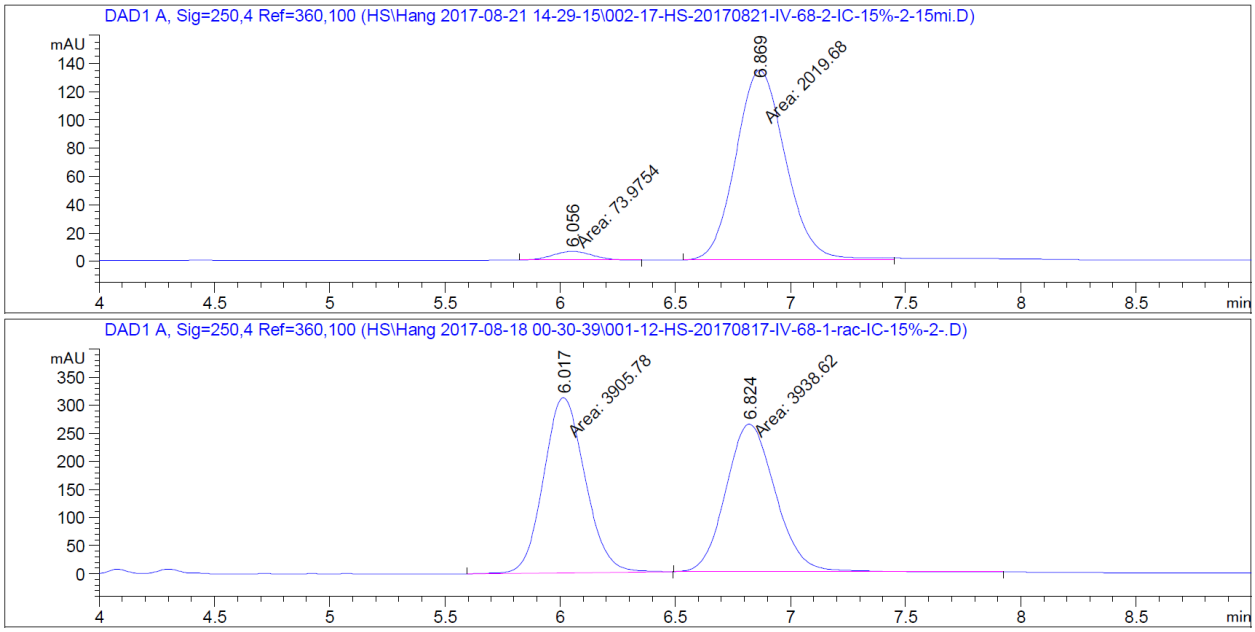


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.532	MM	0.2156	2789.01172	215.64548	97.7189
2	5.470	MM	0.4285	65.10661	2.53228	2.2811

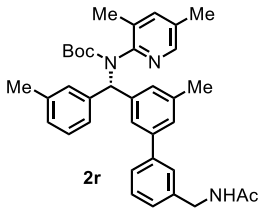


2q

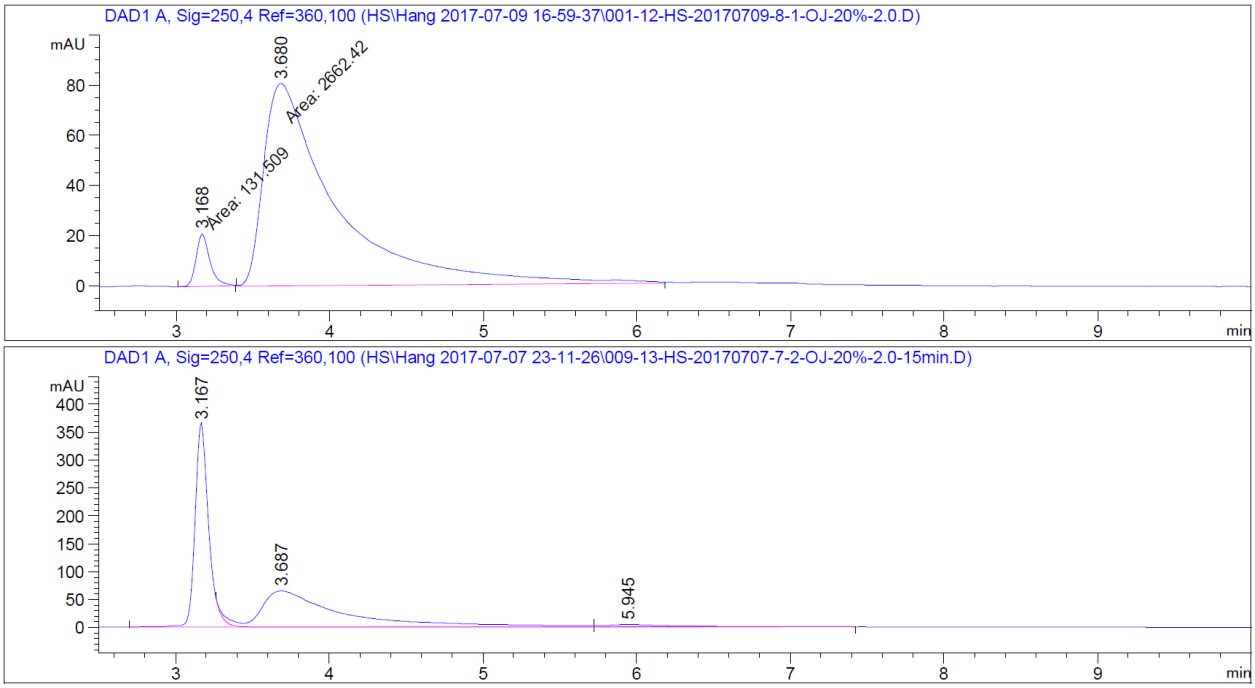


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.056	MM	0.2007	73.97545	6.14264	3.5333
2	6.869	MM	0.2503	2019.68396	134.47147	96.4667

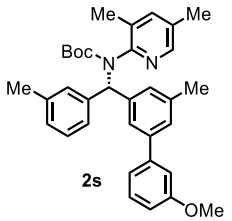


2r

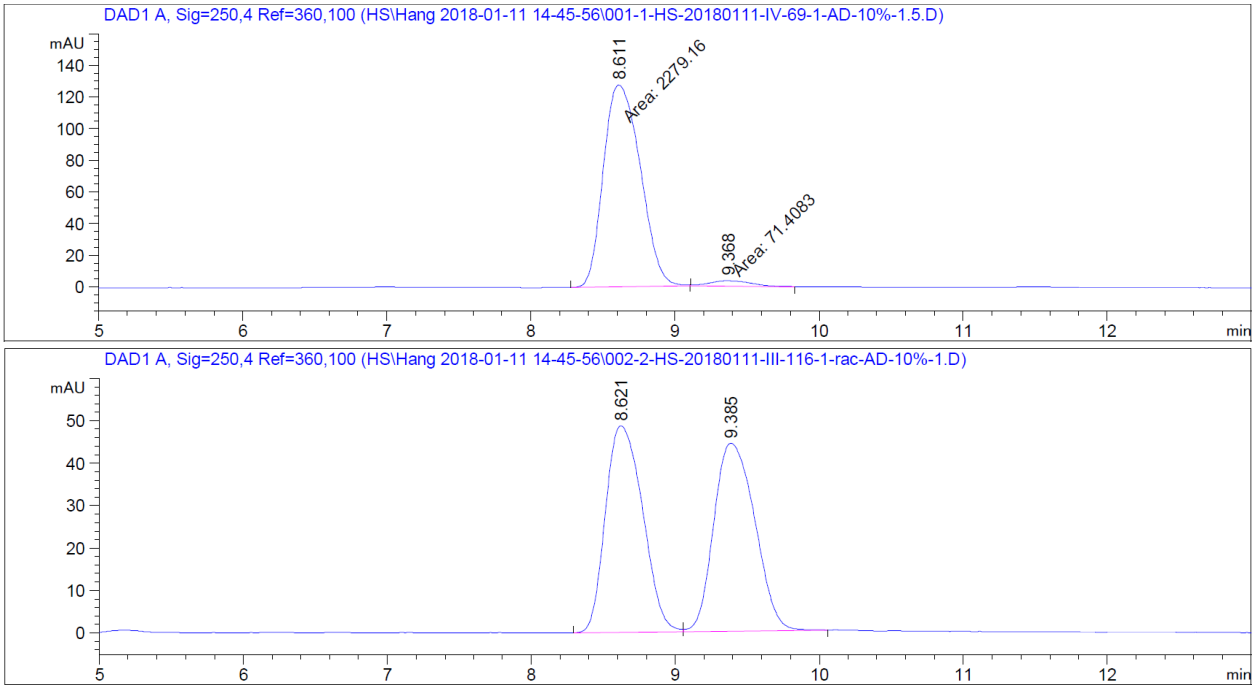


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.168	MM	0.1047	131.50948	20.93688	4.7070
2	3.680	MM	0.5499	2662.41602	80.69624	95.2930

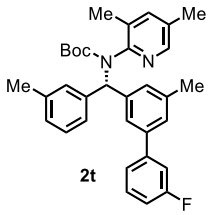


2s

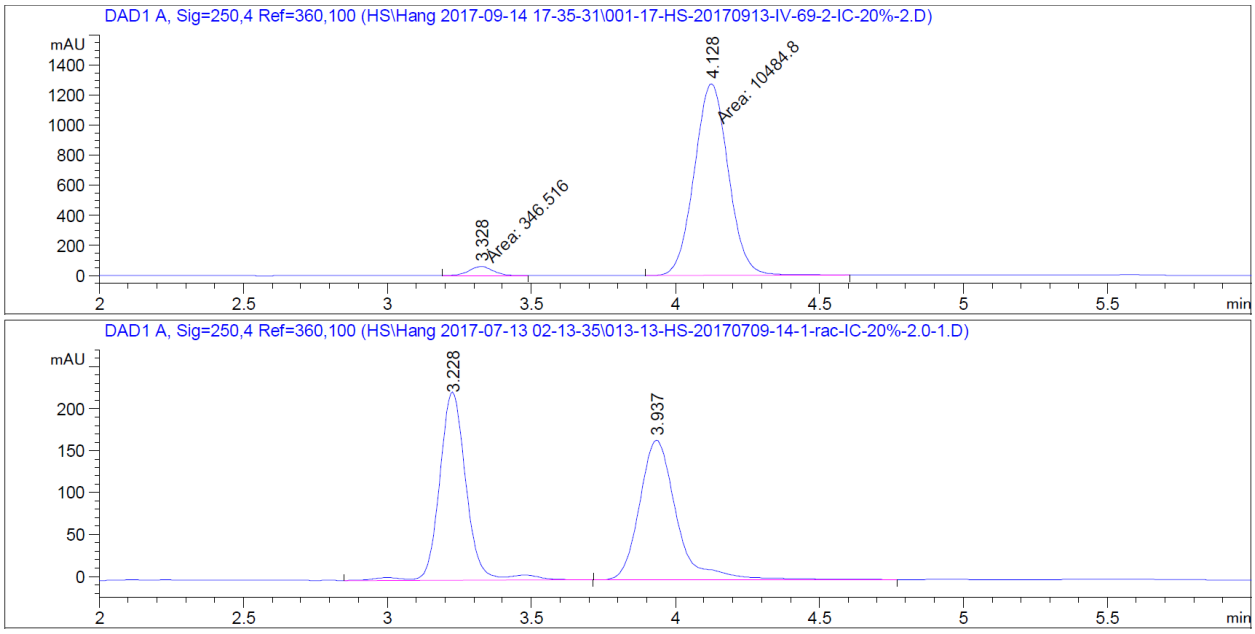


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.611	MM	0.2971	2279.16431	127.85472	96.9621
2	9.368	MM	0.3410	71.40829	3.49040	3.0379

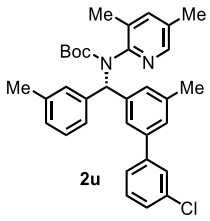


2t

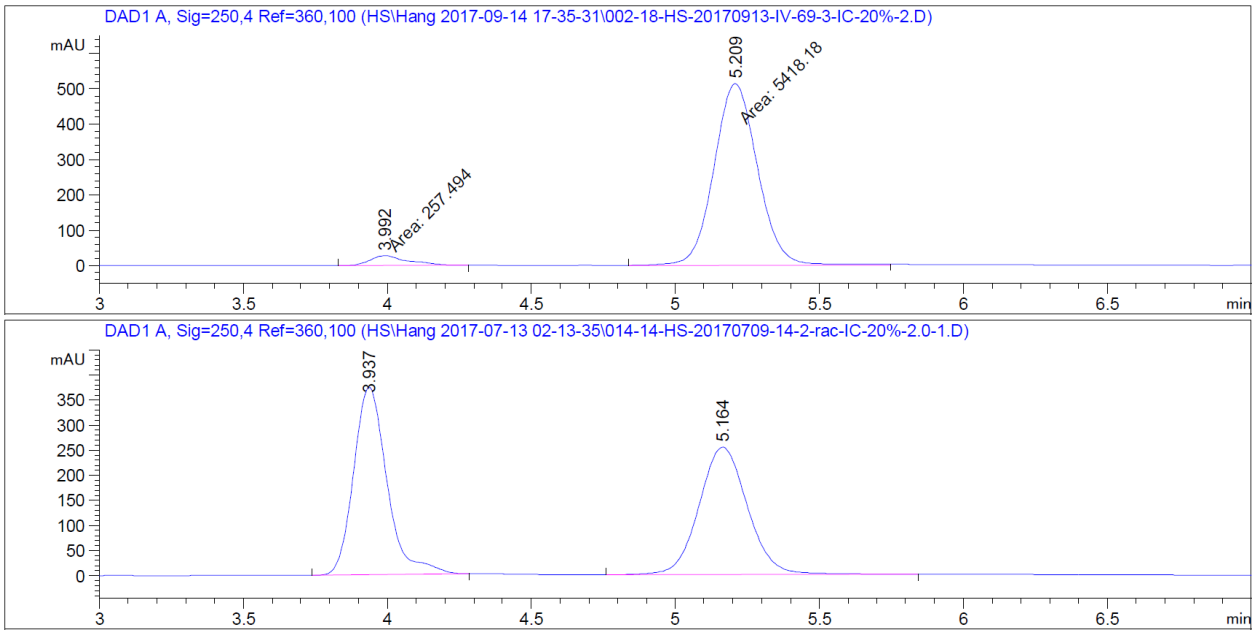


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.328	MM	0.0959	346.51639	60.22383	3.1992
2	4.128	MM	0.1368	1.04848e4	1277.26770	96.8008

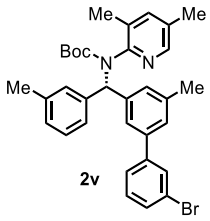


2u

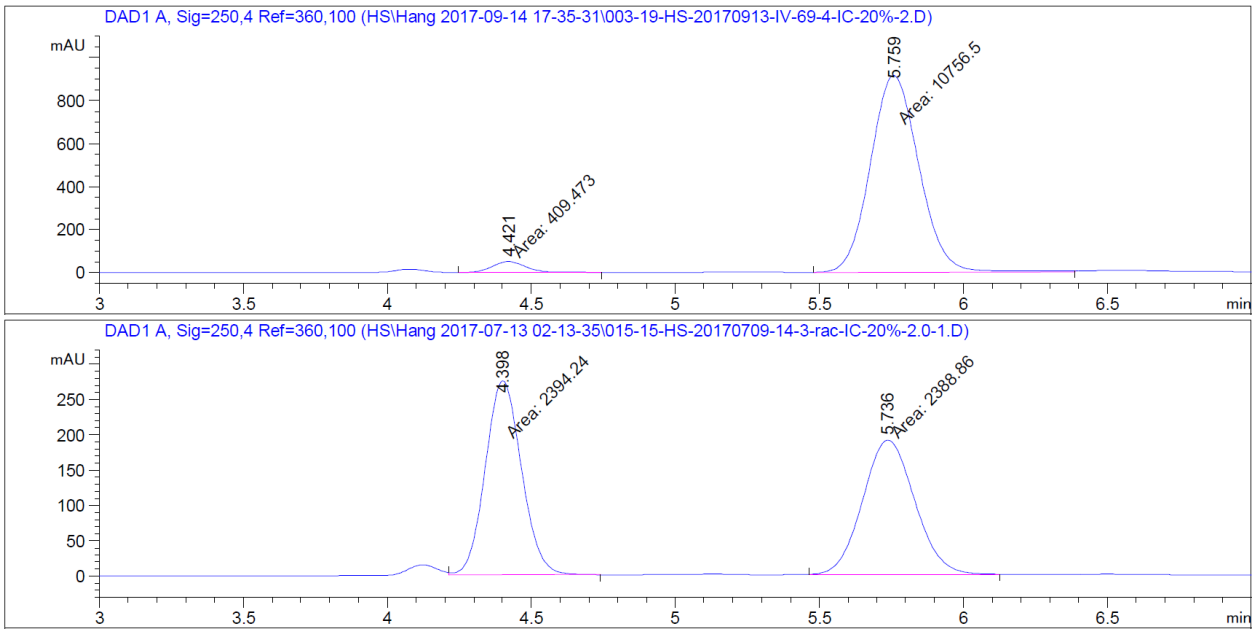


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.992	MM	0.1538	257.49399	27.90685	4.5368
2	5.209	MM	0.1756	5418.17627	514.14496	95.4632

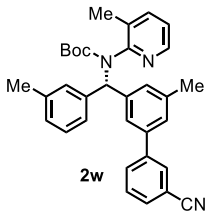


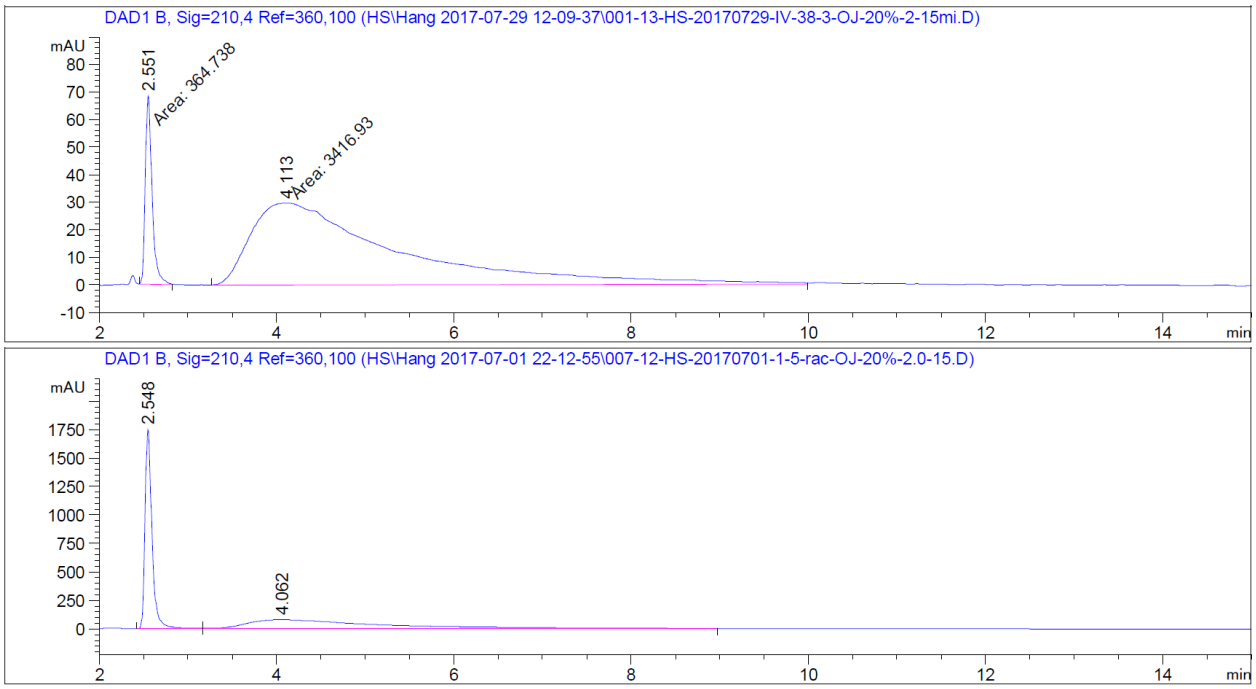
2v



Signal 1: DAD1 A, Sig=250,4 Ref=360,100

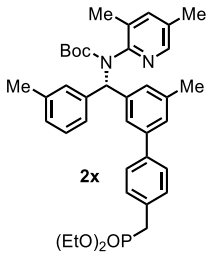
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.421	MM	0.1356	409.47339	50.32362	3.6671
2	5.759	MM	0.1956	1.07565e4	916.64673	96.3329

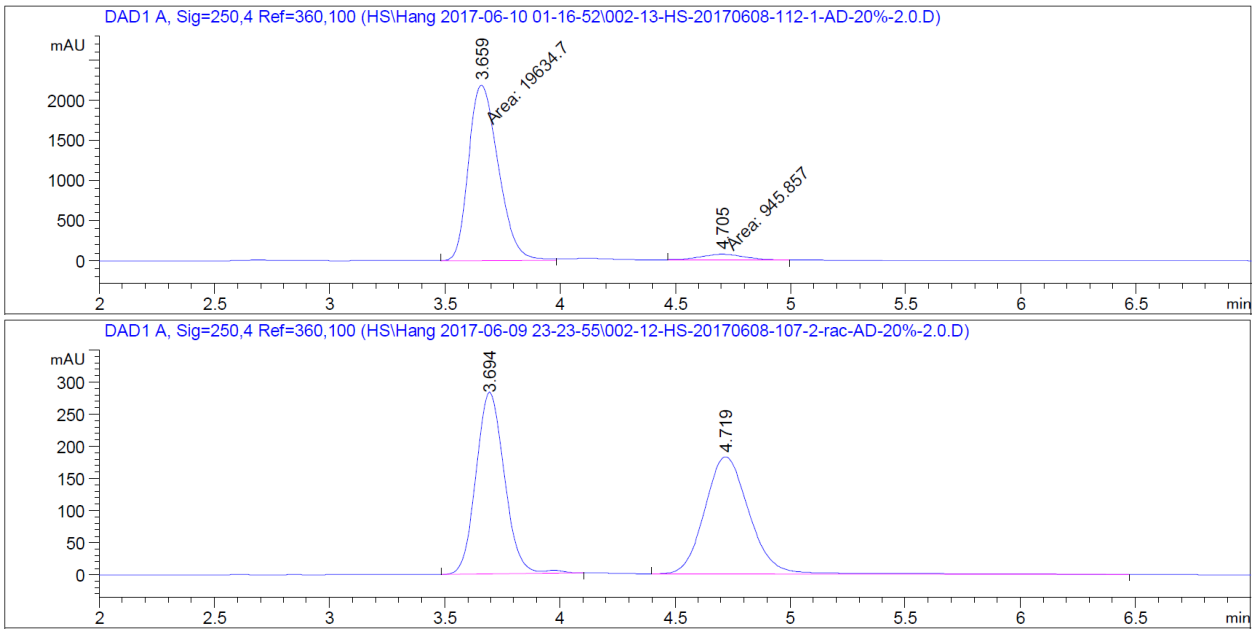




Signal 2: DAD1 B, Sig=210,4 Ref=360,100

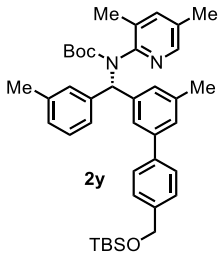
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.551	MM	0.0887	364.73767	68.51612	9.6449
2	4.113	MM	1.9086	3416.92749	29.83876	90.3551

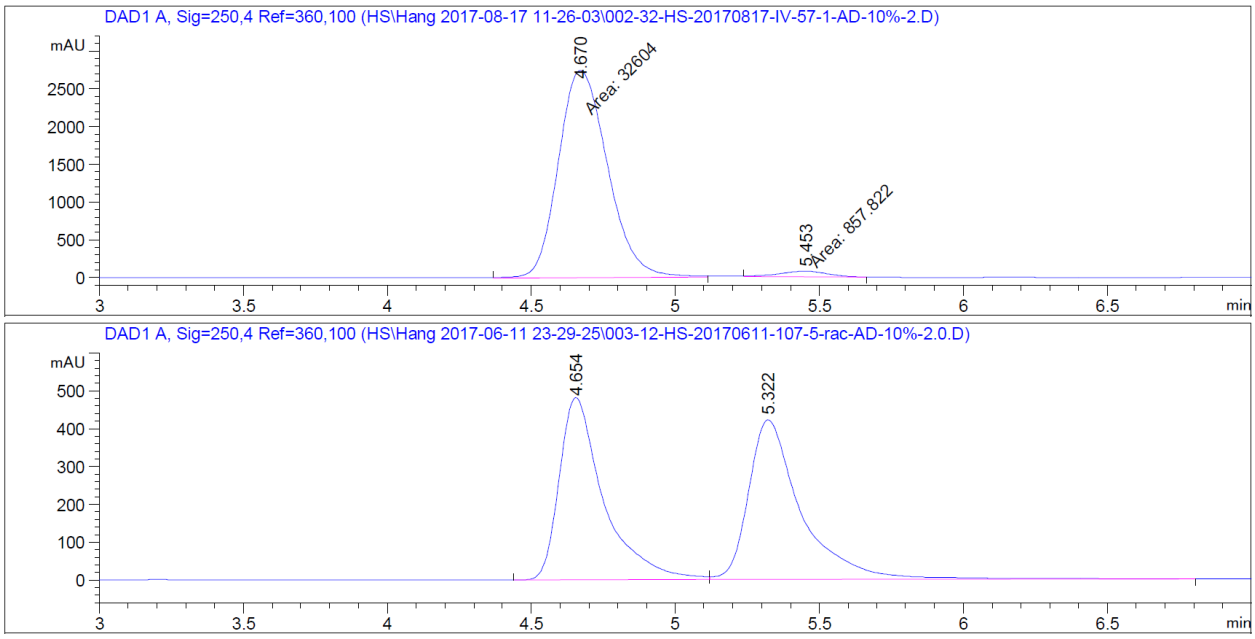




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

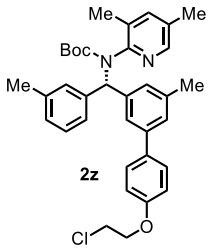
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.659	MM	0.1497	1.96347e4	2185.73682	95.4041
2	4.705	MM	0.2225	945.85706	70.85395	4.5959

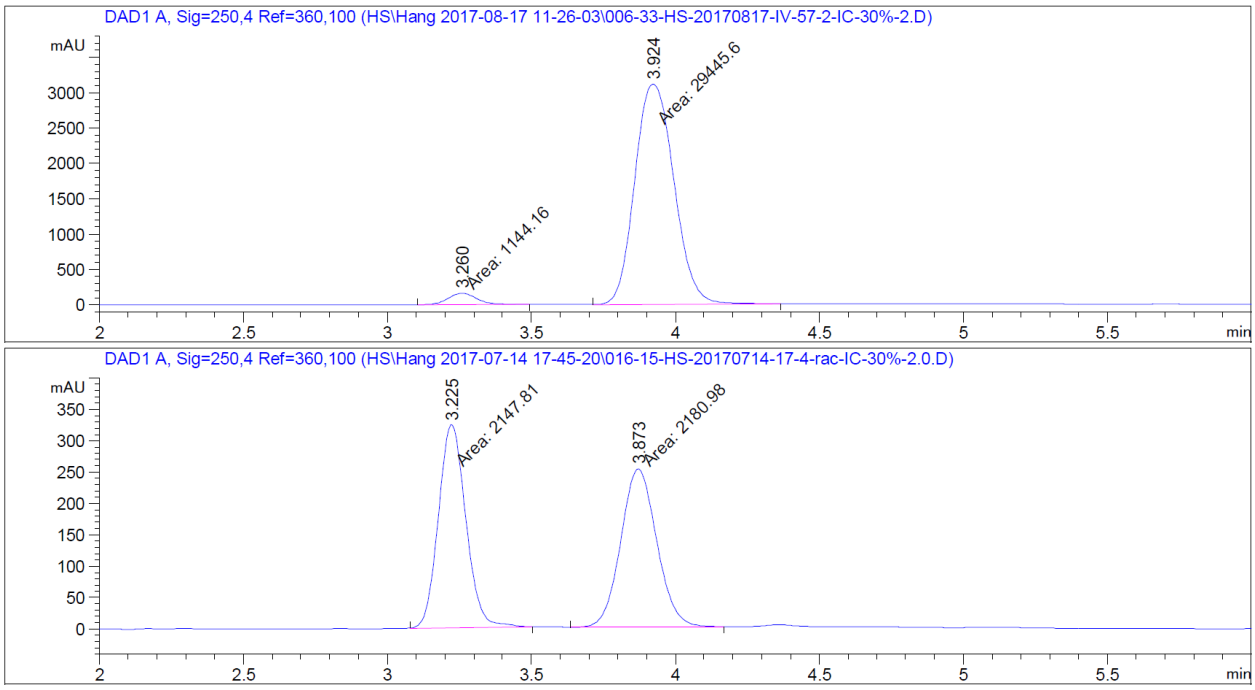




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

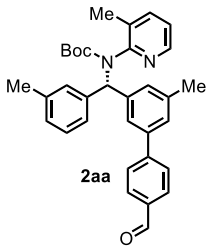
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.670	MM	0.1980	3.26040e4	2744.02490	97.4364
2	5.453	MM	0.1902	857.82245	75.18507	2.5636

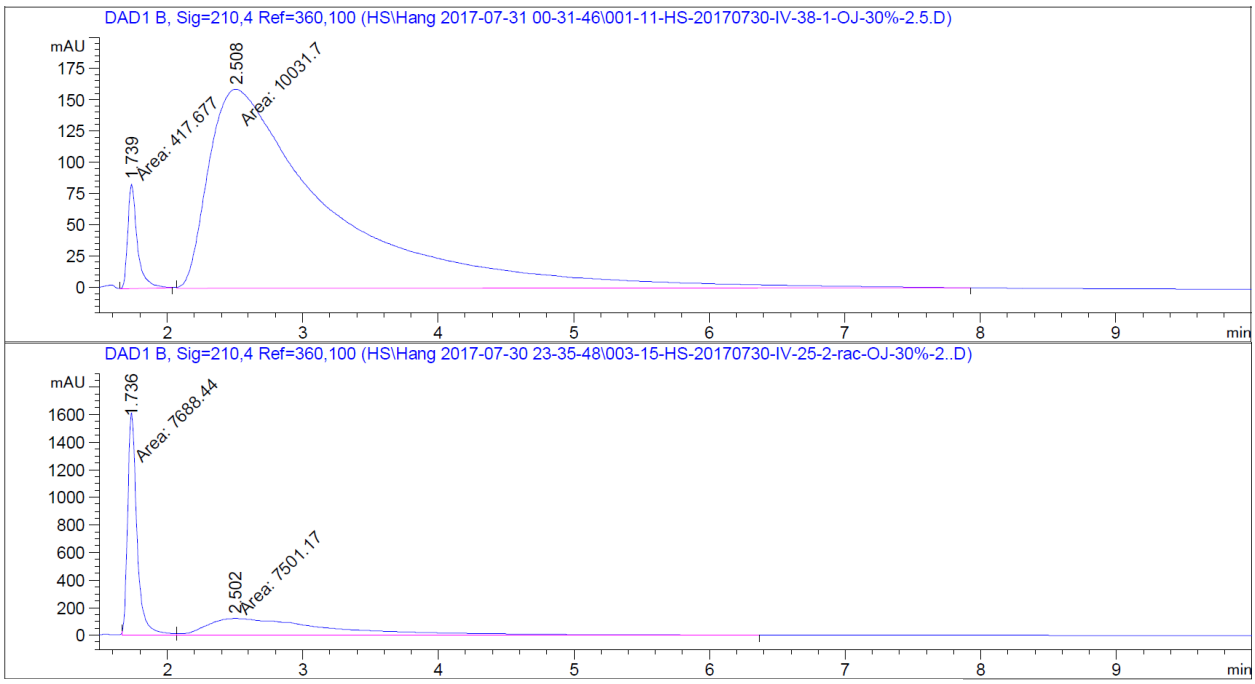




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

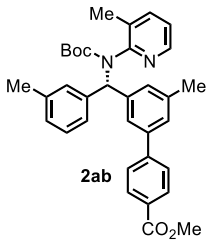
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.260	MM	0.1165	1144.15857	163.68040	3.7403
2	3.924	MM	0.1576	2.94456e4	3114.60840	96.2597

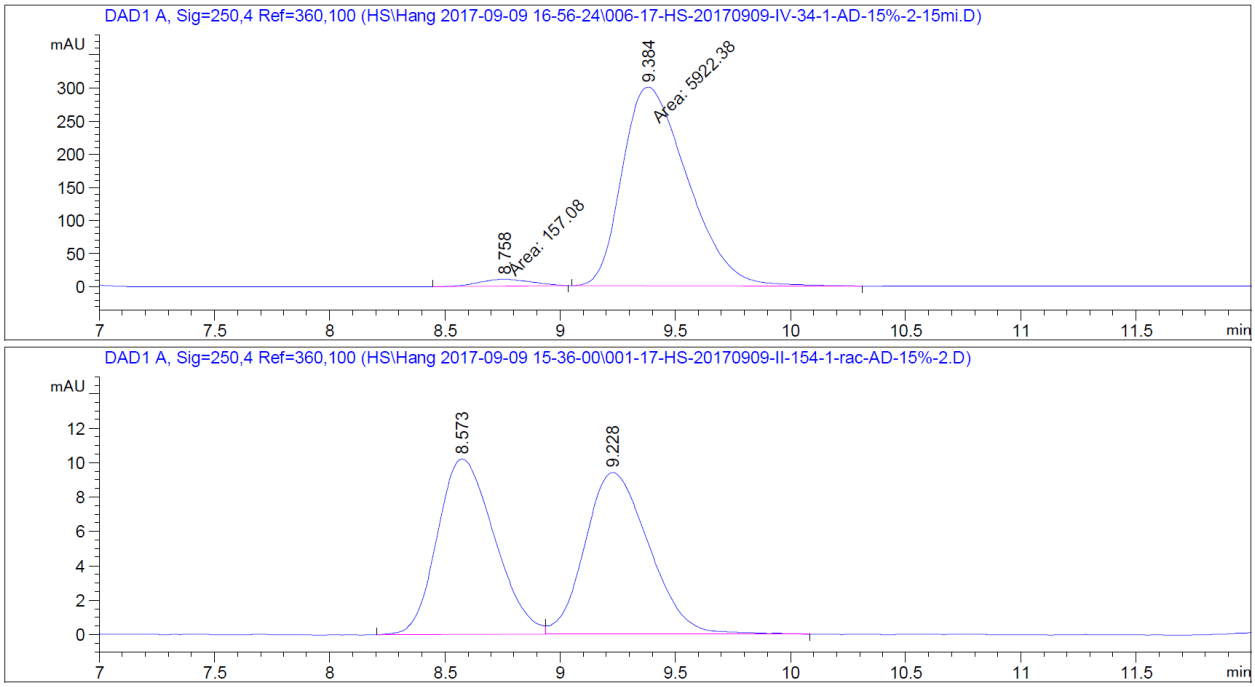




Signal 2: DAD1 B, Sig=210,4 Ref=360,100

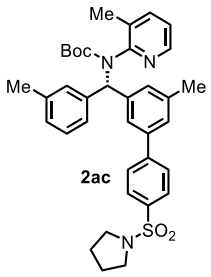
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	1.739	MM	0.0830	417.67682	83.85143	3.9971
2	2.508	MM	1.0507	1.00317e4	159.12238	96.0029

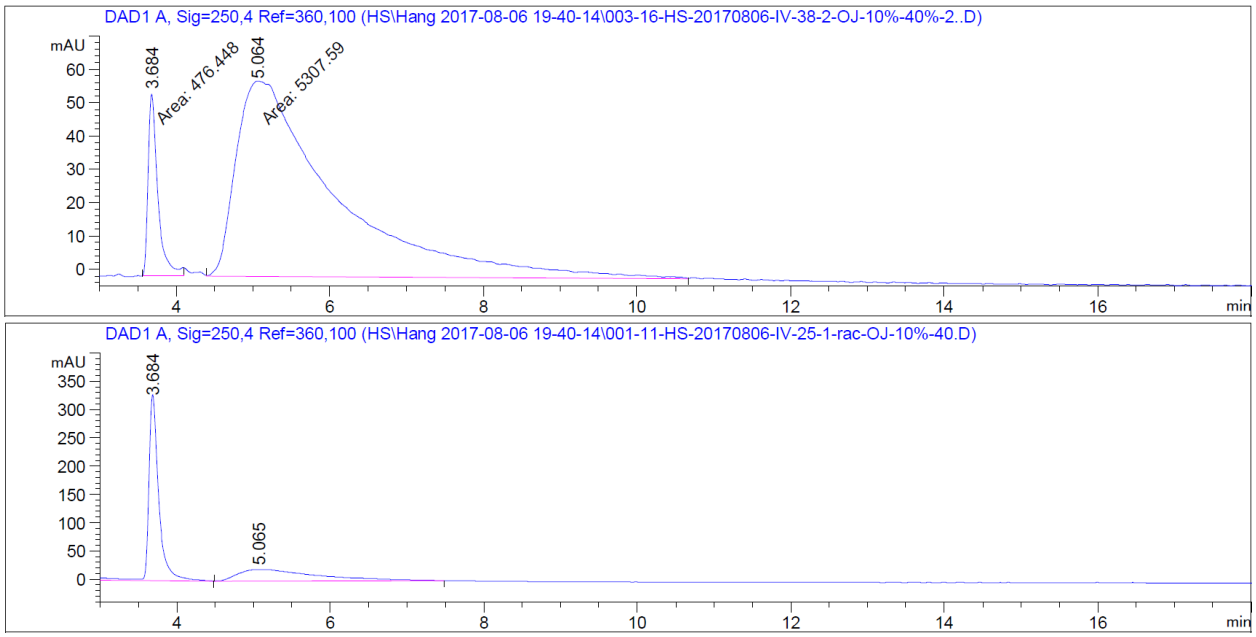




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

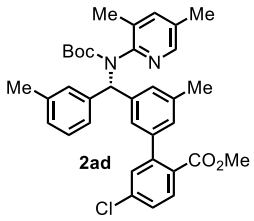
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.758	MM	0.2614	157.07967	10.01671	2.5838
2	9.384	MM	0.3292	5922.38379	299.85886	97.4162

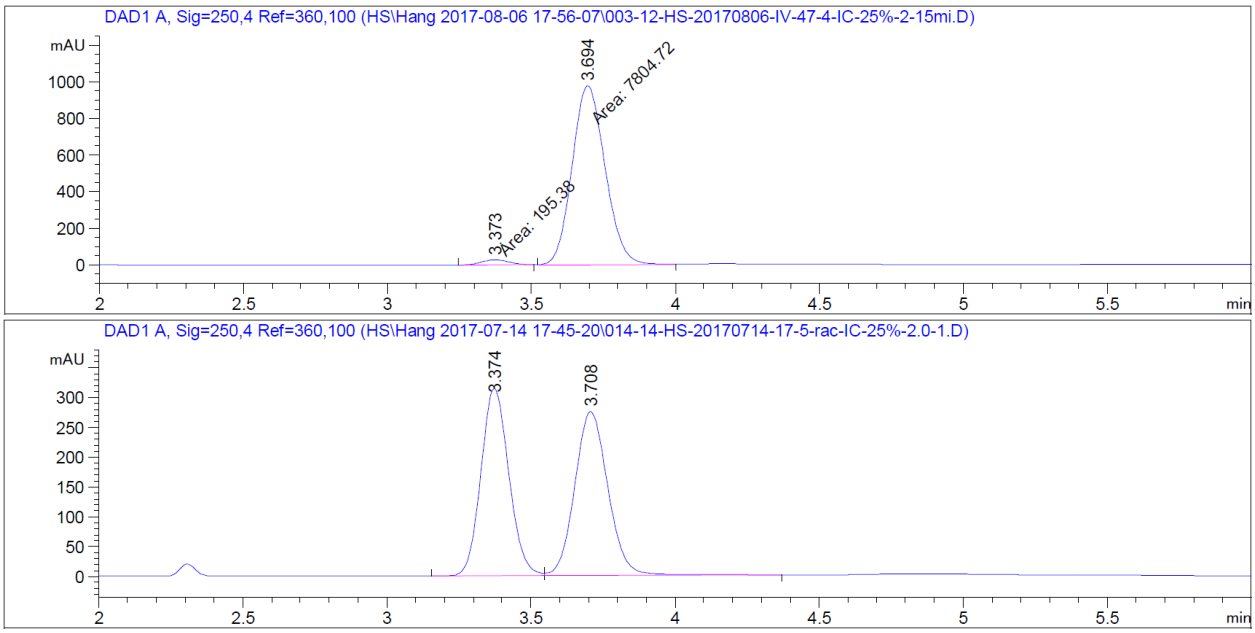




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

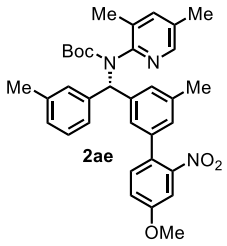
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.684	MM	0.1455	476.44806	54.58828	8.2373
2	5.064	MM	1.5084	5307.59277	58.64465	91.7627

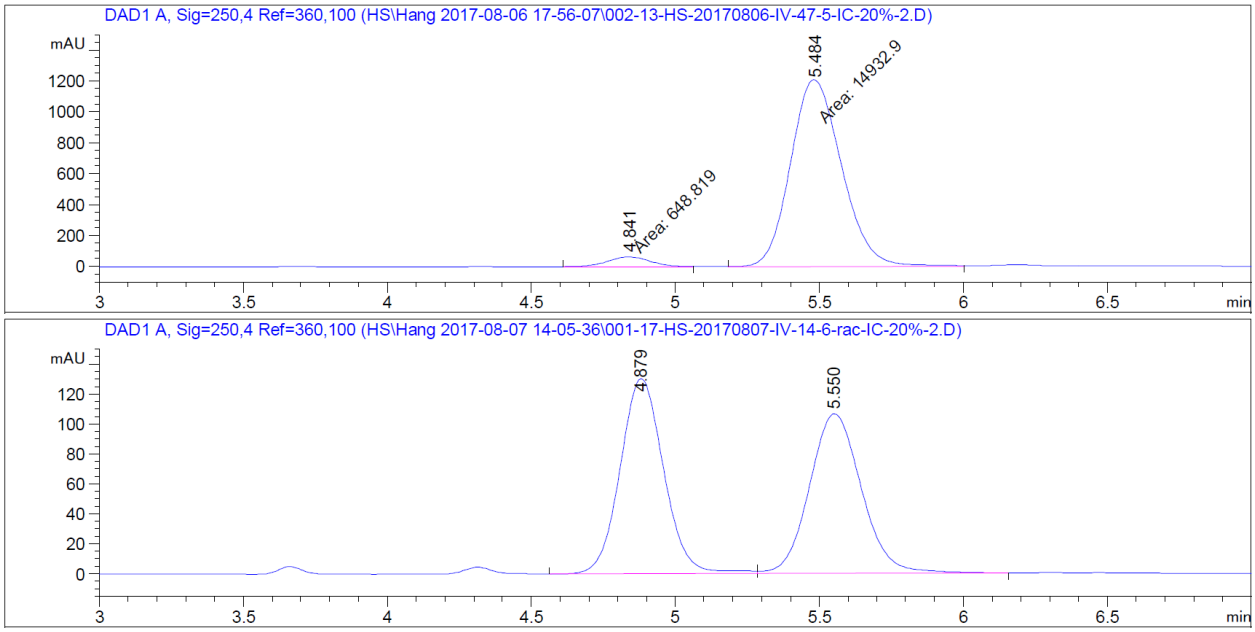




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

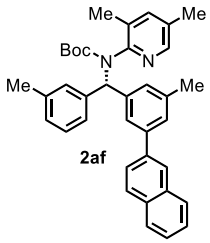
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.373	MM	0.1123	195.37979	28.99484	2.4422
2	3.694	MM	0.1328	7804.72314	979.33472	97.5578

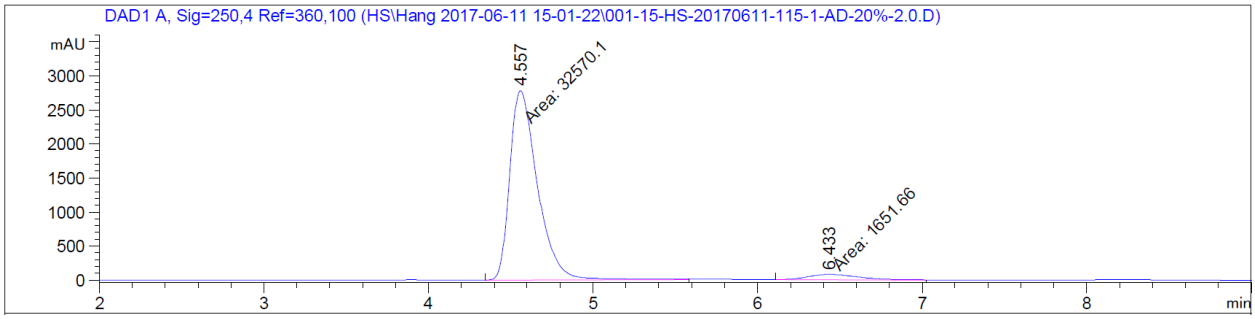


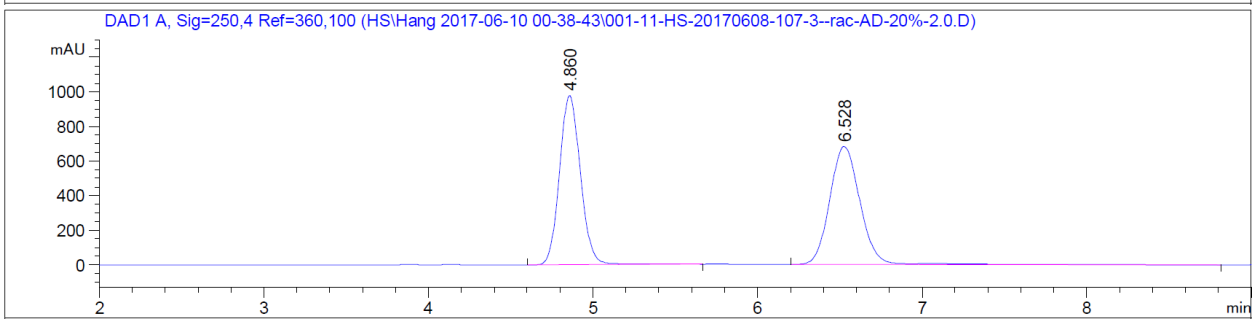


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.841	MM	0.1717	648.81927	62.96412	4.1640
2	5.484	MM	0.2056	1.49329e4	1210.25586	95.8360

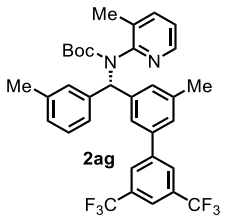


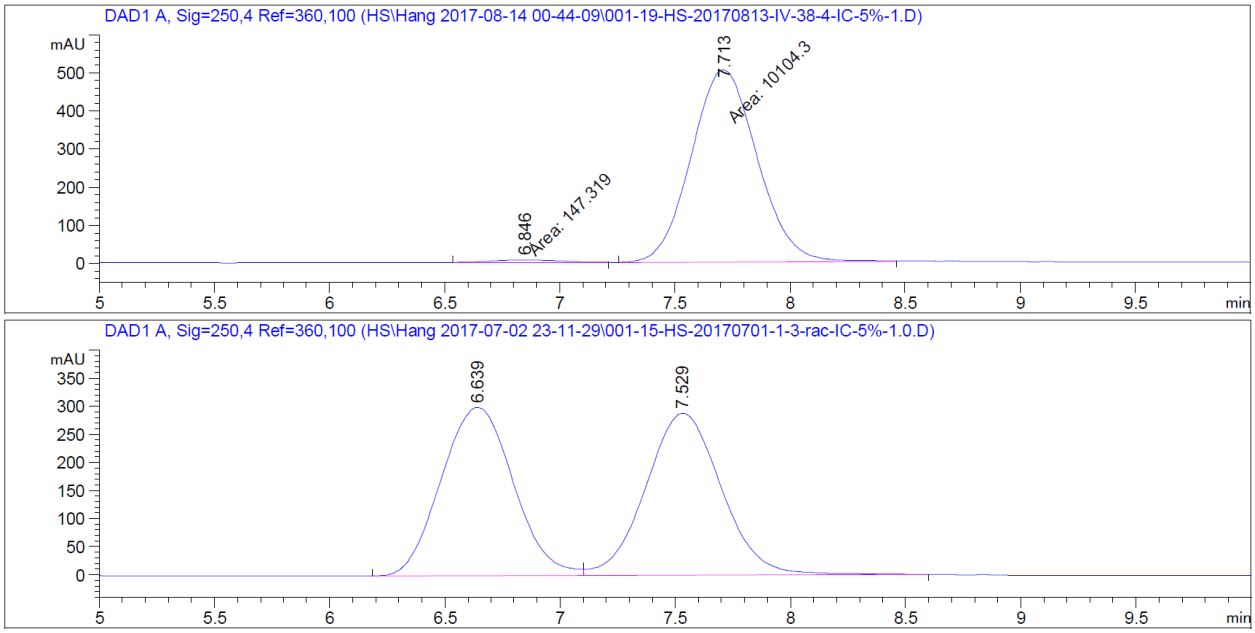




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

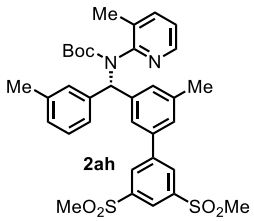
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.557	MM	0.1952	3.25701e4	2781.44775	95.1737
2	6.433	MM	0.3541	1651.65894	77.74711	4.8263

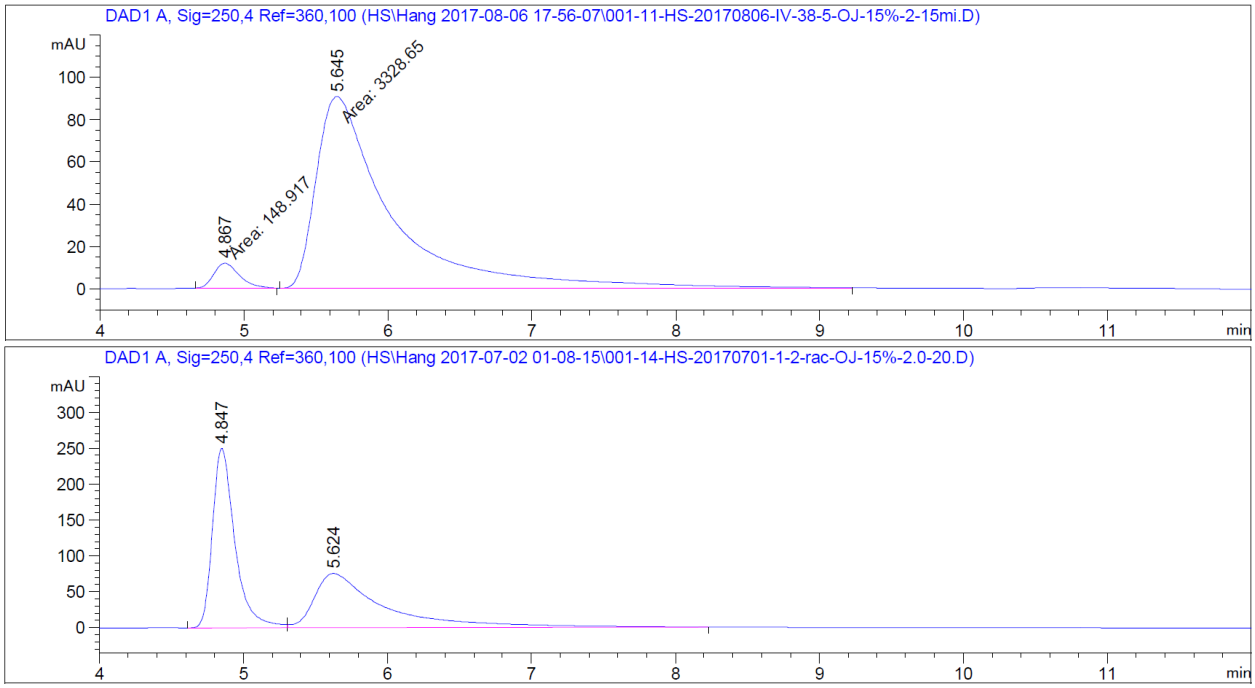




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

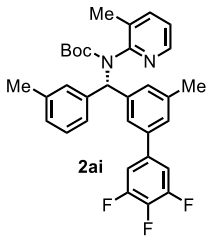
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.846	MM	0.3360	147.31938	7.30824	1.4370
2	7.713	MM	0.3329	1.01043e4	505.91608	98.5630

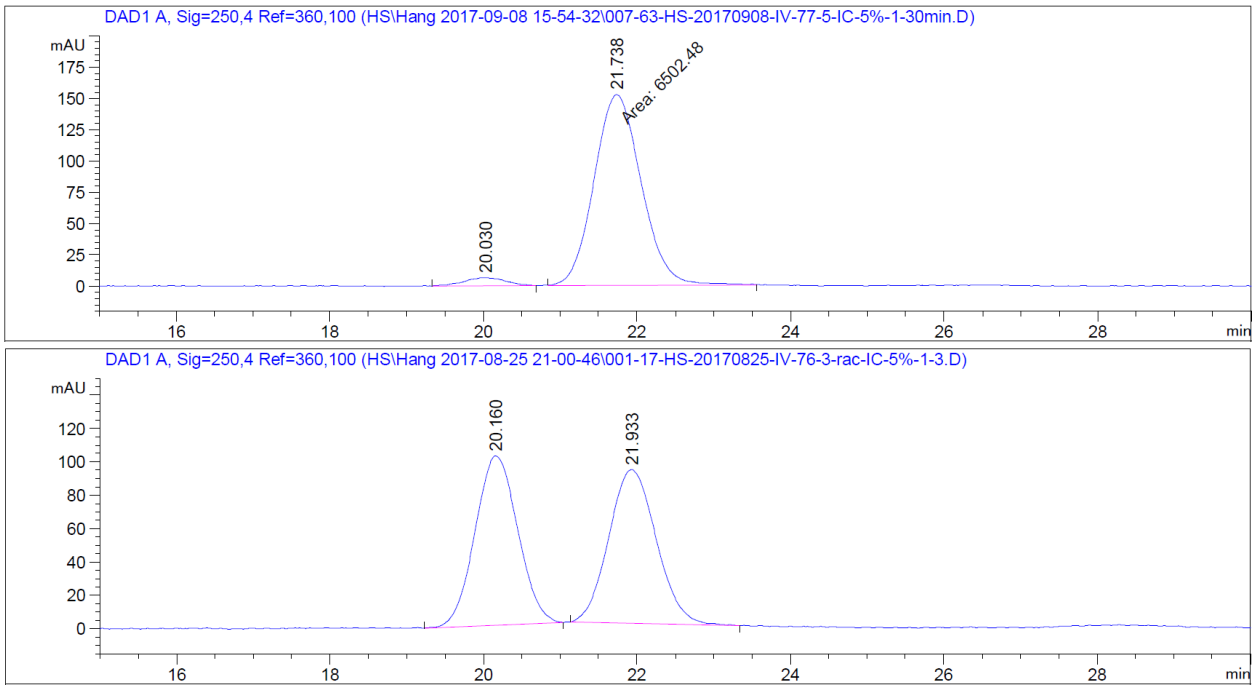




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

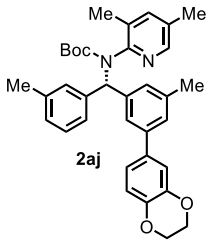
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.867	MM	0.2089	148.91724	11.88122	4.2822
2	5.645	MM	0.6124	3328.65210	90.58678	95.7178

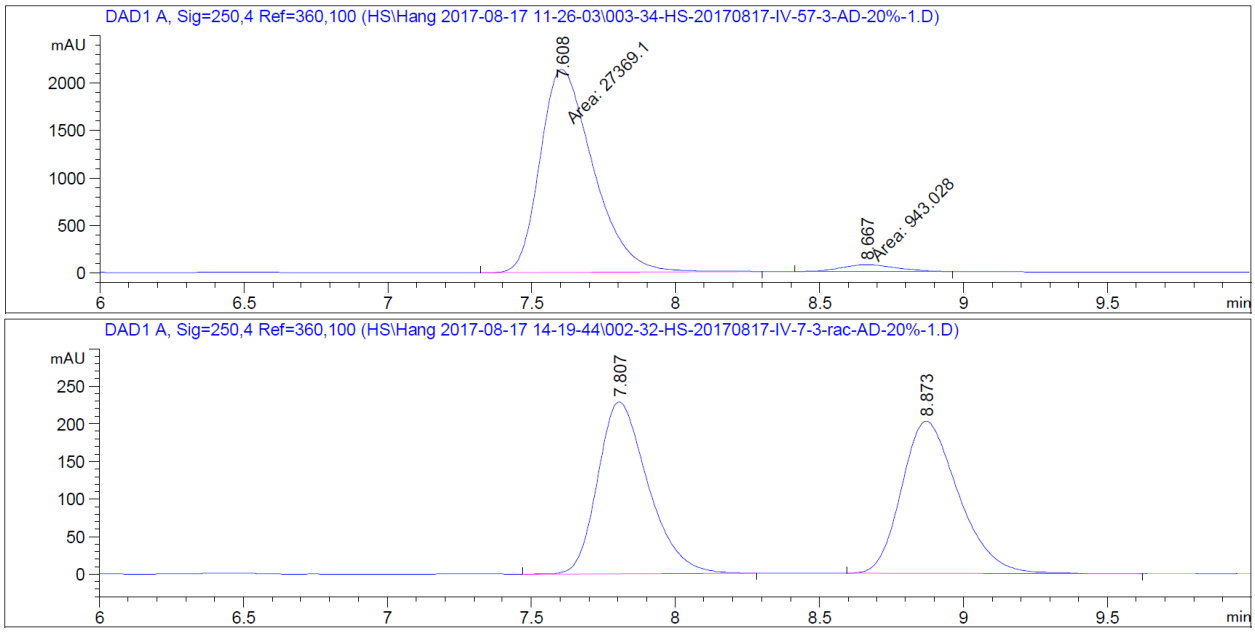




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

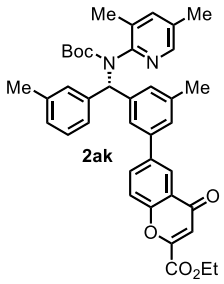
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.030	BB	0.4498	244.98763	6.61937	3.6308
2	21.738	MM	0.7111	6502.47852	152.40547	96.3692

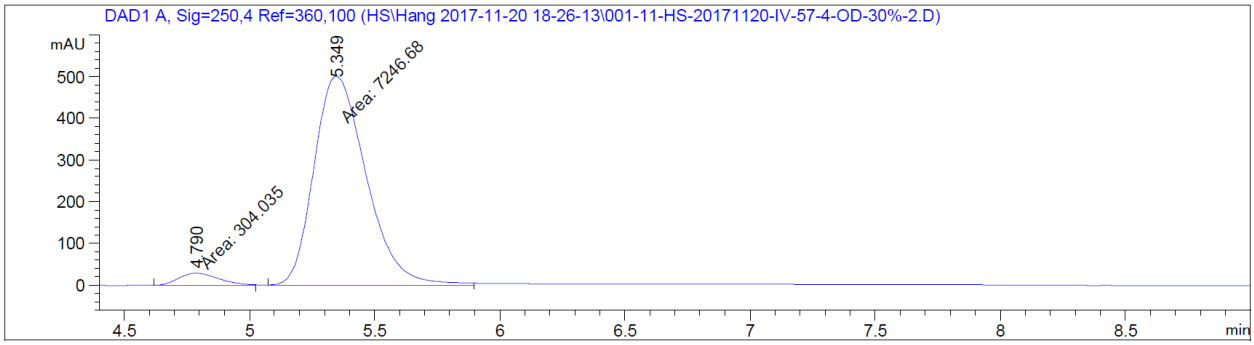


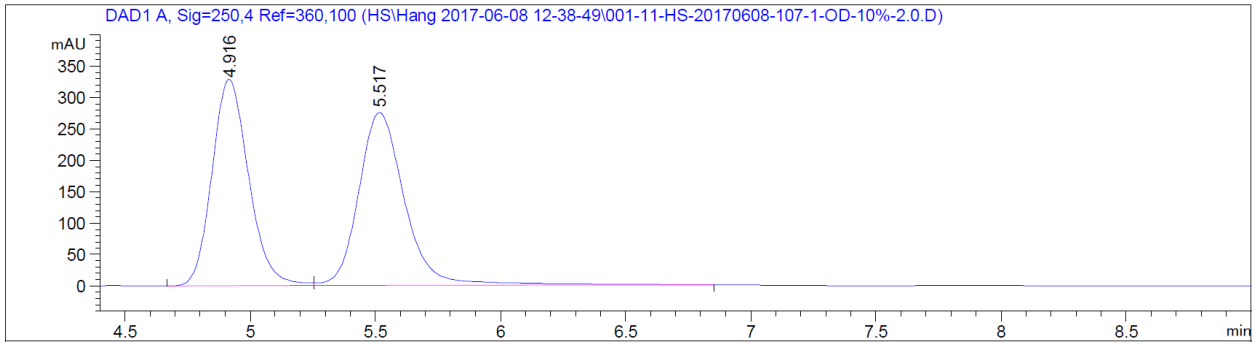


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.608	MM	0.2132	2.73691e4	2139.36987	96.6692
2	8.667	MM	0.2222	943.02783	70.74281	3.3308

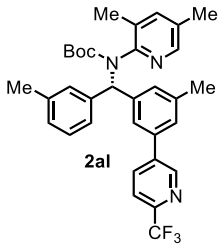


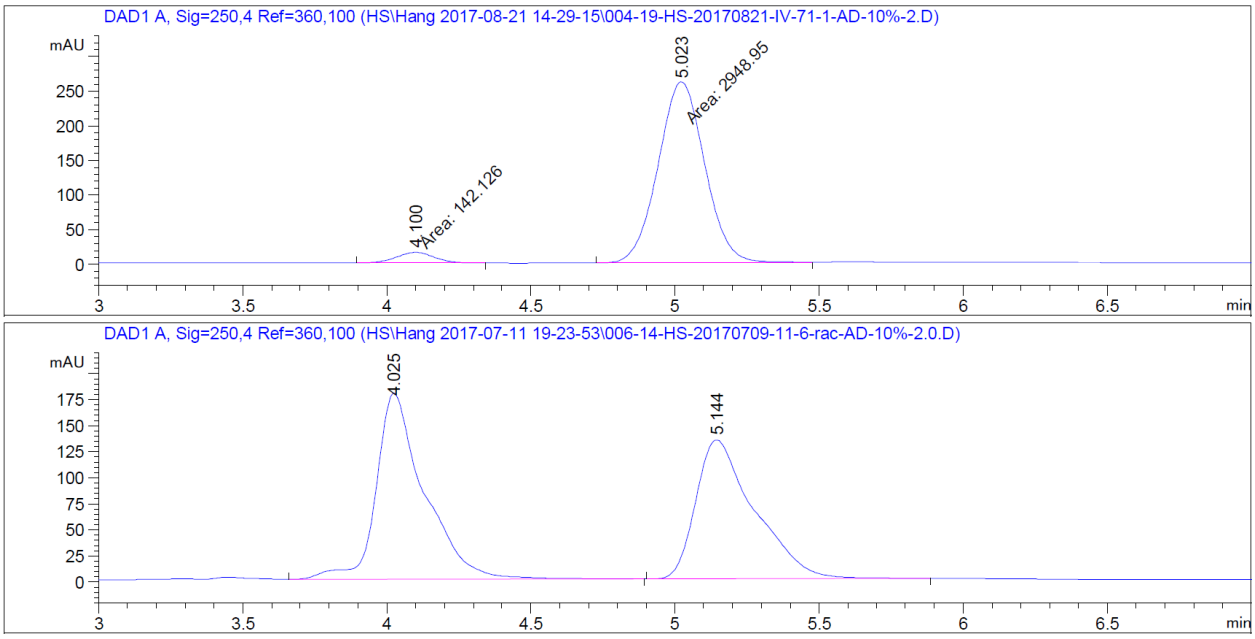




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

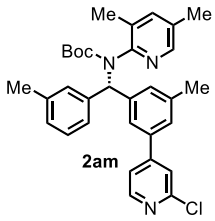
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.790	MM	0.1805	304.03473	28.07036	4.0266
2	5.349	MM	0.2411	7246.68115	500.97849	95.9734

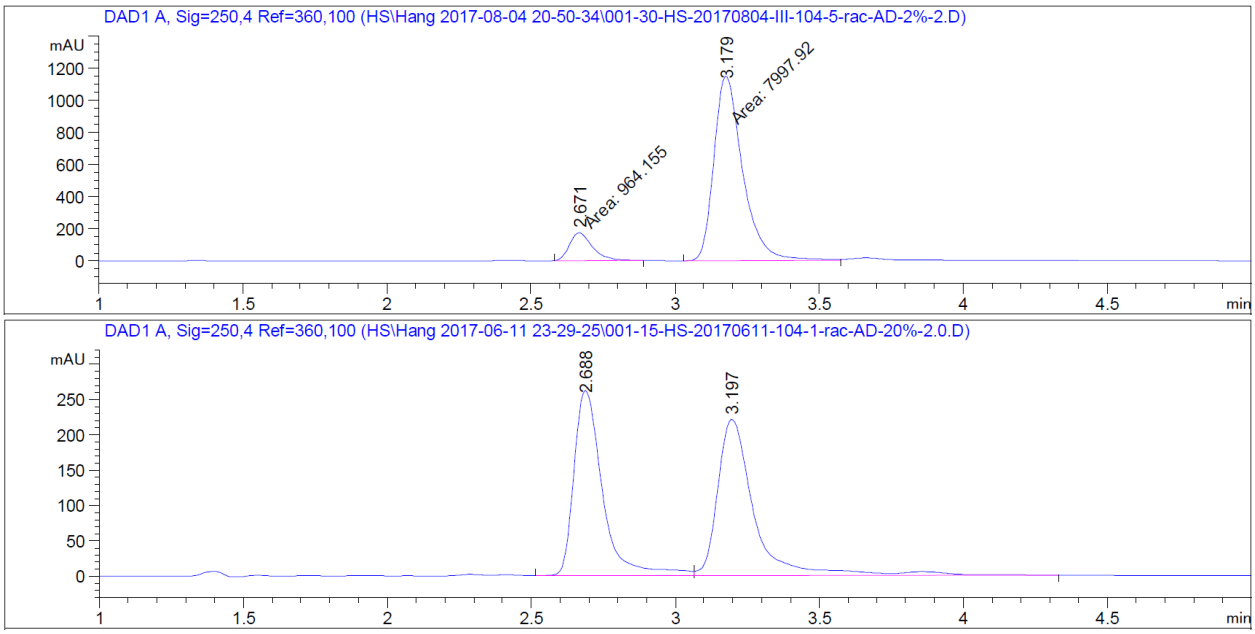




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

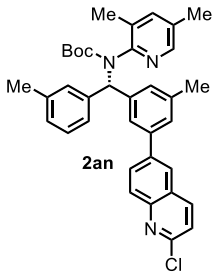
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.100	MM	0.1552	142.12622	15.26688	4.5980
2	5.023	MM	0.1878	2948.95020	261.68994	95.4020

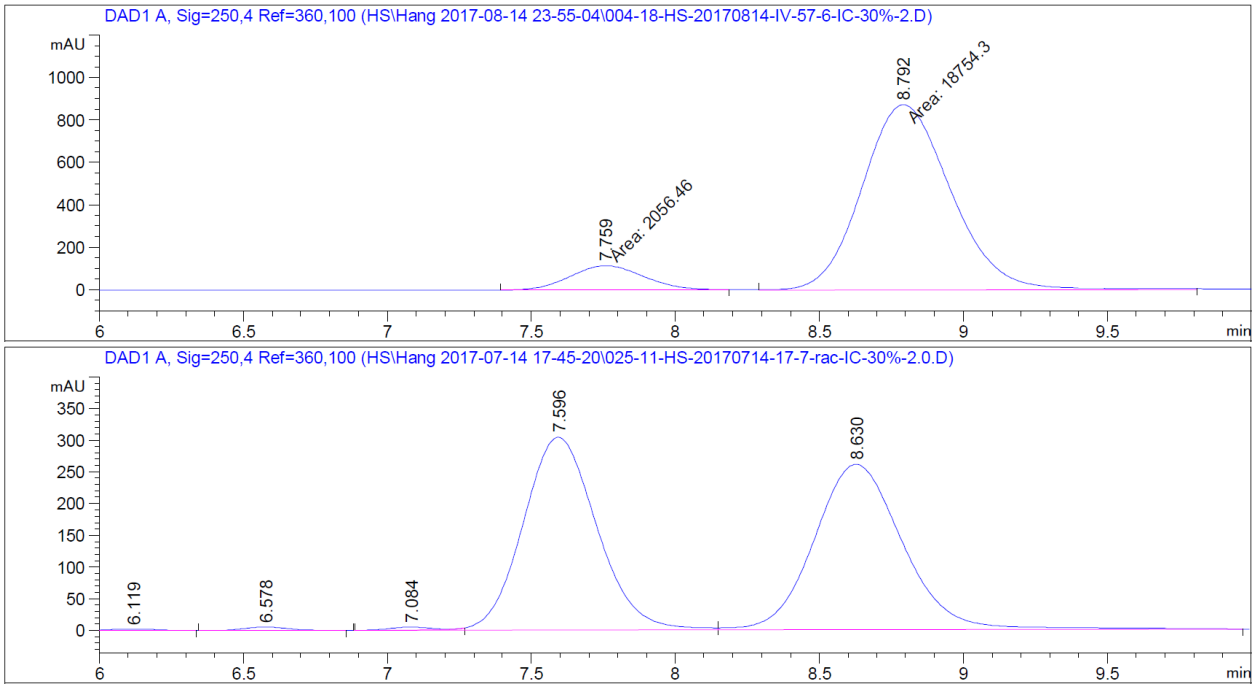




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

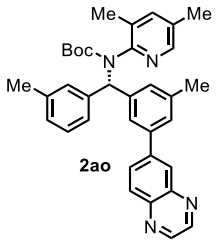
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.671	MM	0.0920	964.15527	174.58240	10.7582
2	3.179	MM	0.1155	7997.92480	1154.24976	89.2418

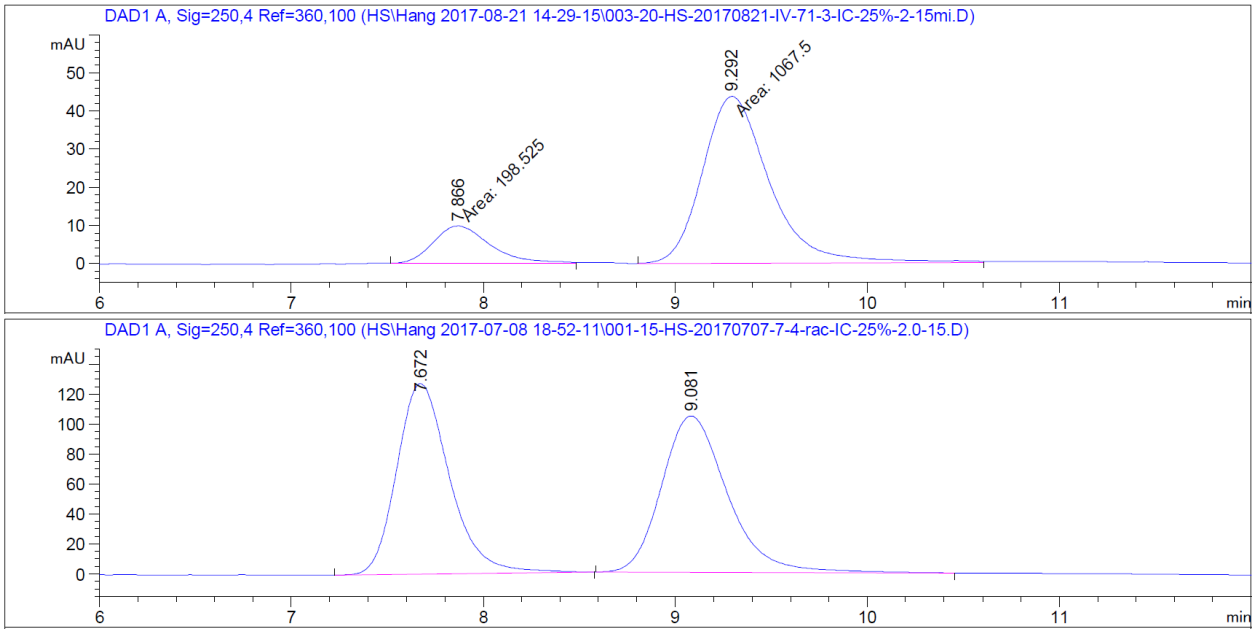




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

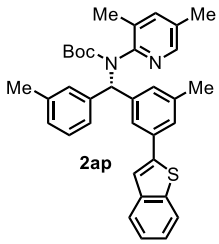
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.759	MM	0.2990	2056.45923	114.62666	9.8817
2	8.792	MM	0.3583	1.87543e4	872.31128	90.1183

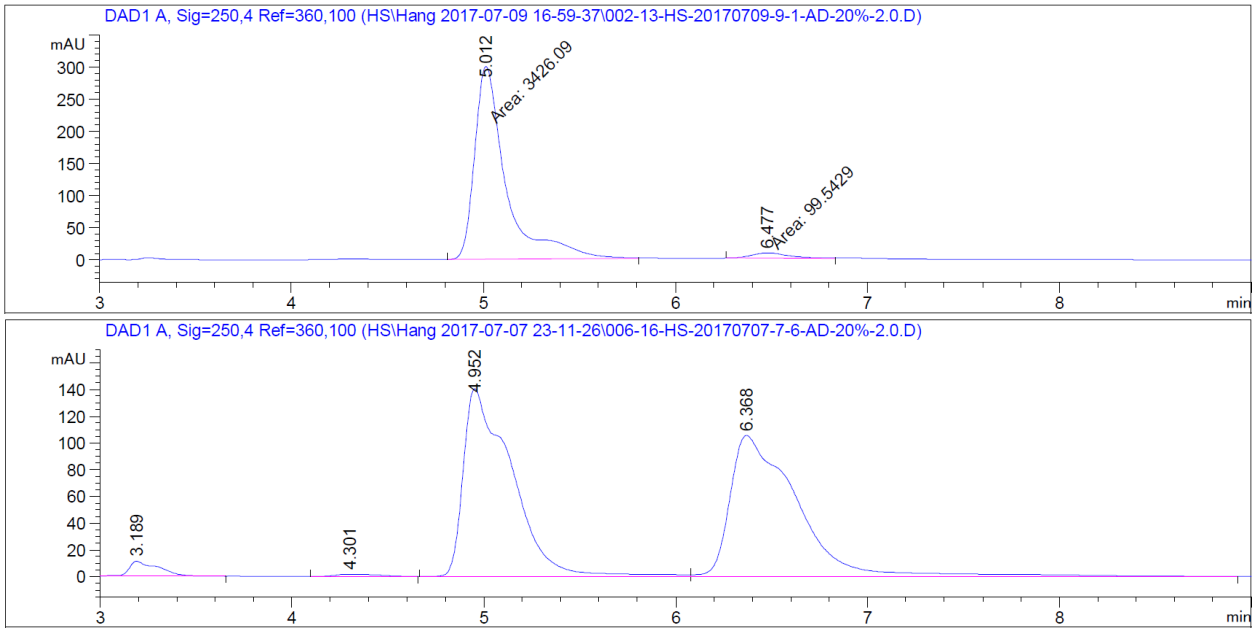




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

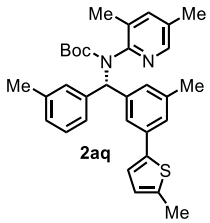
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.866	MM	0.3384	198.52547	9.77880	15.6810
2	9.292	MM	0.4059	1067.50208	43.83463	84.3190

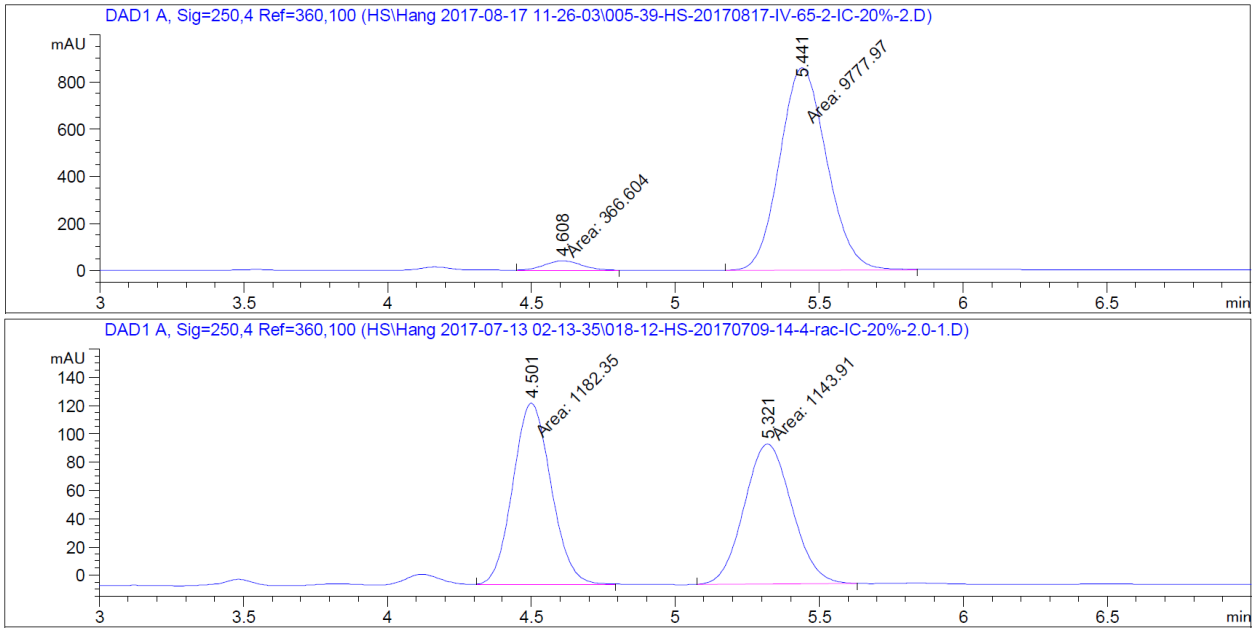




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

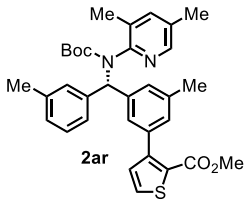
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.012	MM	0.1902	3426.08545	300.28397	97.1766
2	6.477	MM	0.2112	99.54285	7.85430	2.8234

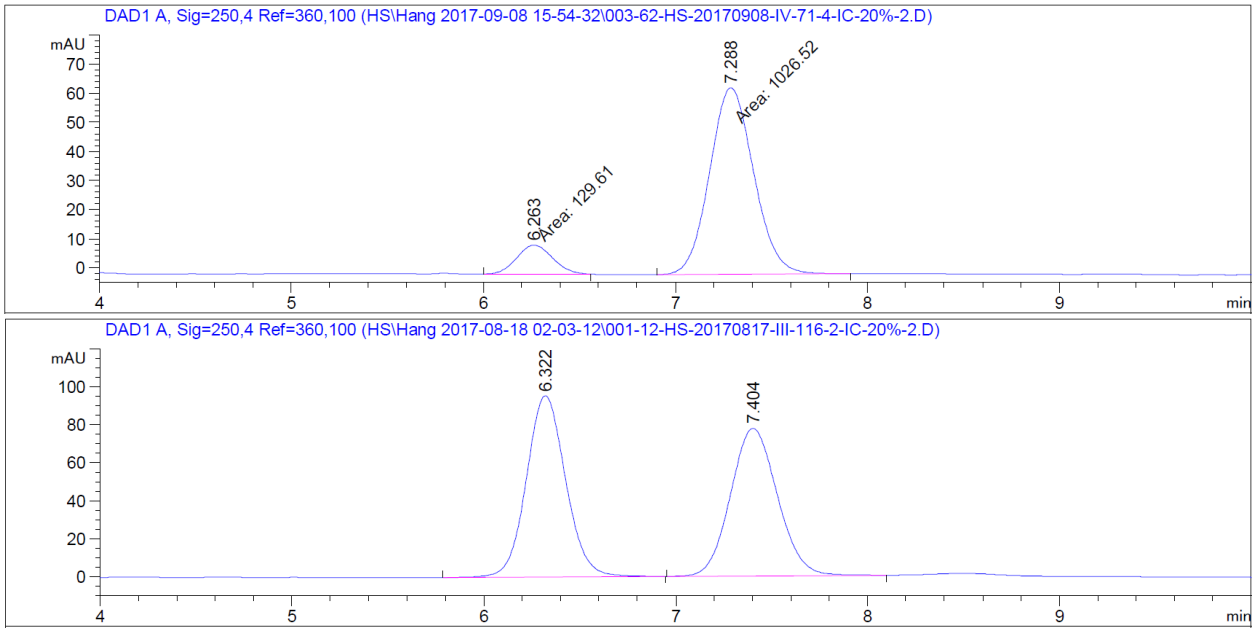




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

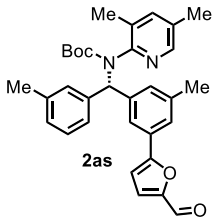
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.608	MM	0.1523	366.60370	40.11977	3.6138
2	5.441	MM	0.1896	9777.97461	859.60364	96.3862

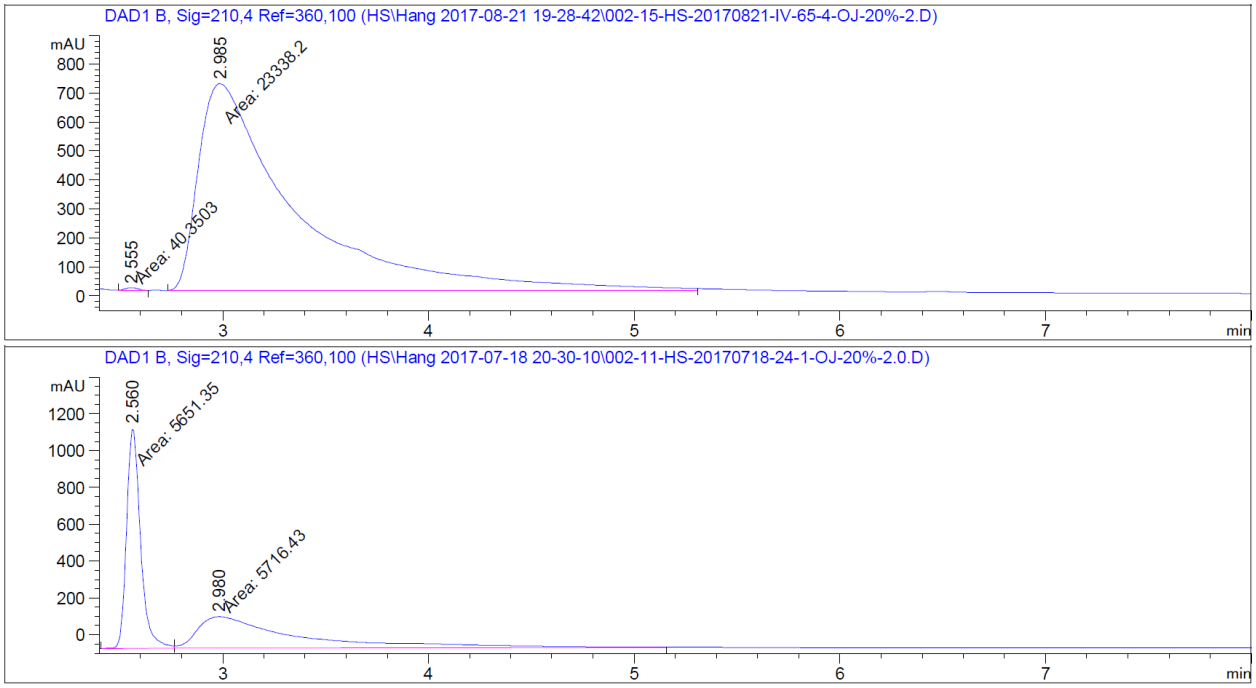




Signal 1: DAD1 A, Sig=250,4 Ref=360,100

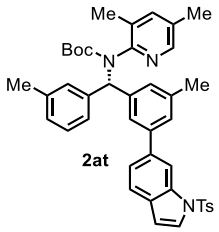
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.263	MM	0.2169	129.60992	9.95831	11.2106
2	7.288	MM	0.2665	1026.52490	64.20895	88.7894

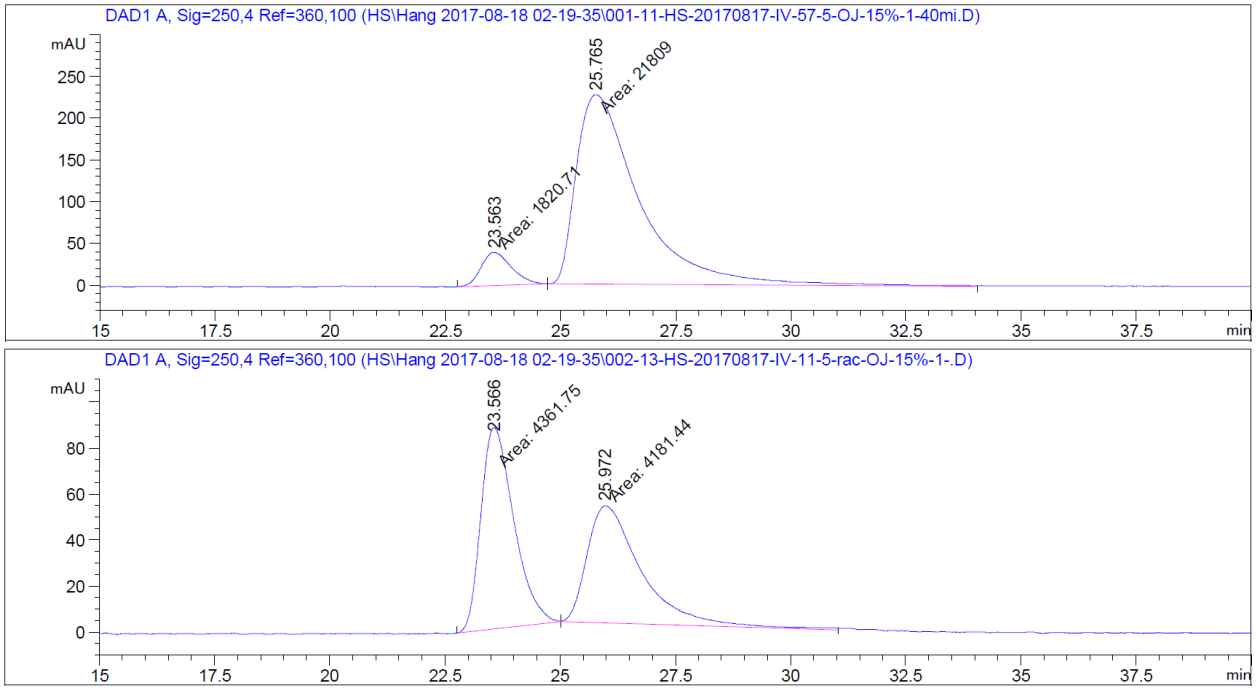




Signal 2: DAD1 B, Sig=210,4 Ref=360,100

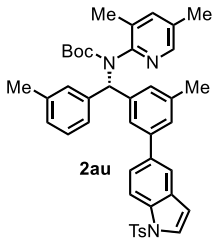
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.555	MM	0.0719	40.35028	9.35781	0.1726
2	2.985	MM	0.5451	2.33382e4	713.63544	99.8274

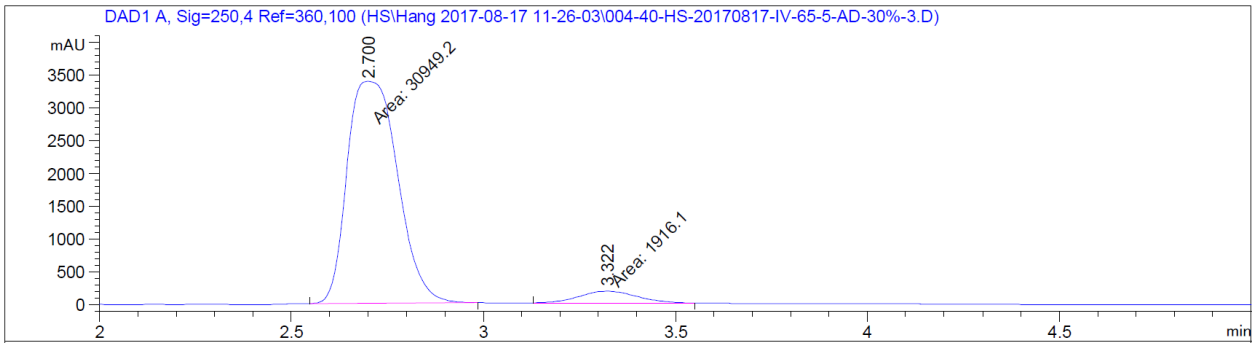


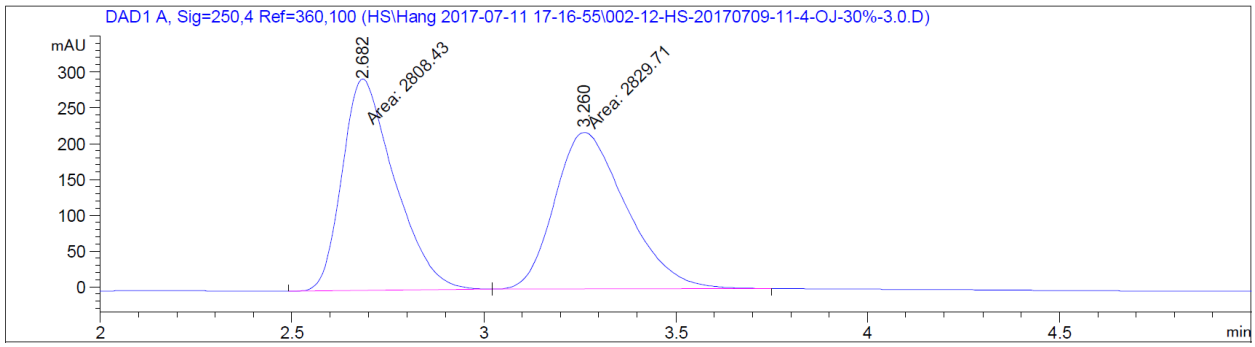


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.563	MM	0.7665	1820.70520	39.58834	7.7051
2	25.765	MM	1.6020	2.18090e4	226.88873	92.2949

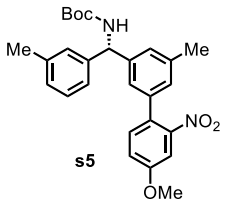




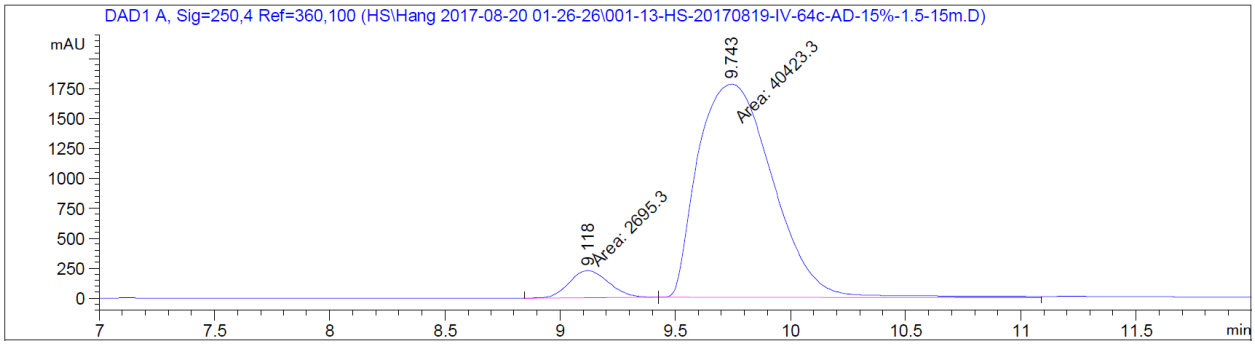


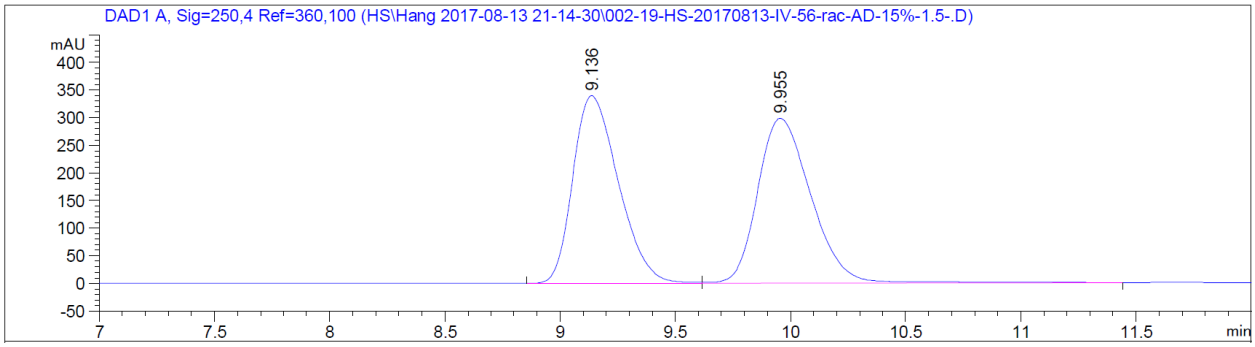
Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.700	MM	0.1525	3.09492e4	3382.94434	94.1698
2	3.322	MM	0.1762	1916.10339	181.27367	5.8302

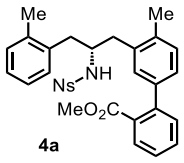


s5

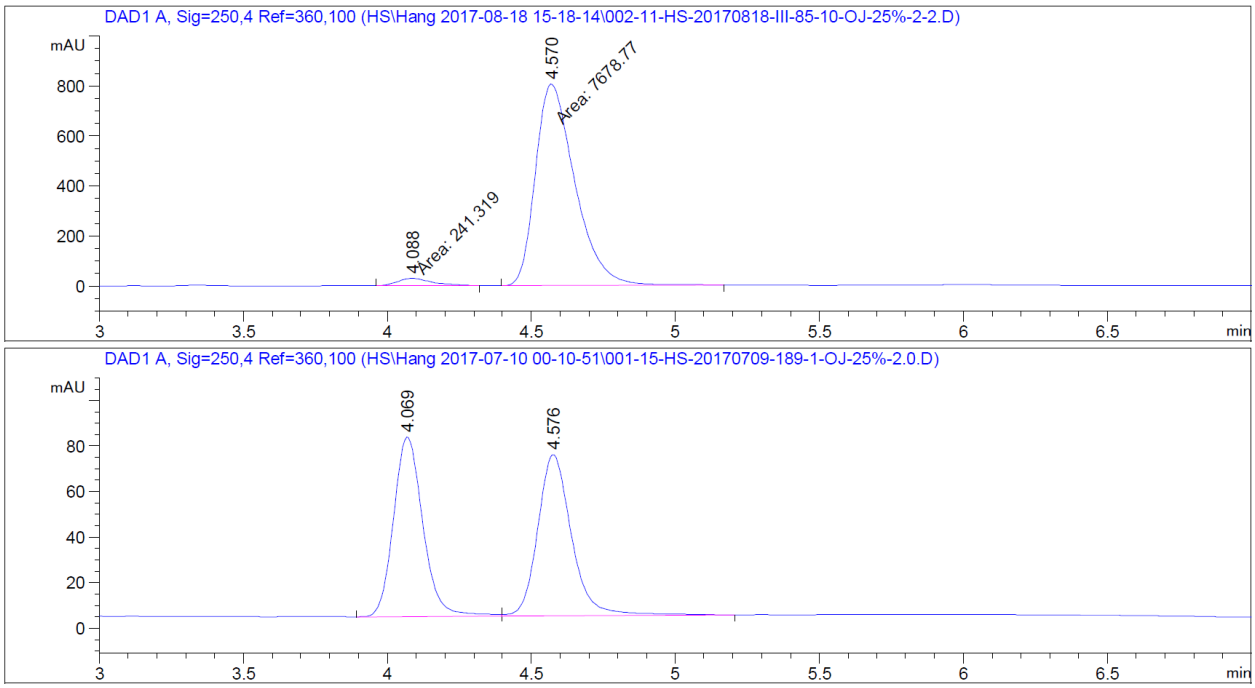




Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.118	MM	0.1984	2695.29712	226.42526	6.2509
2	9.743	MM	0.3780	4.04233e4	1782.31323	93.7491

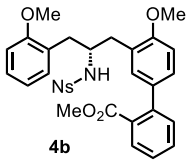


4a

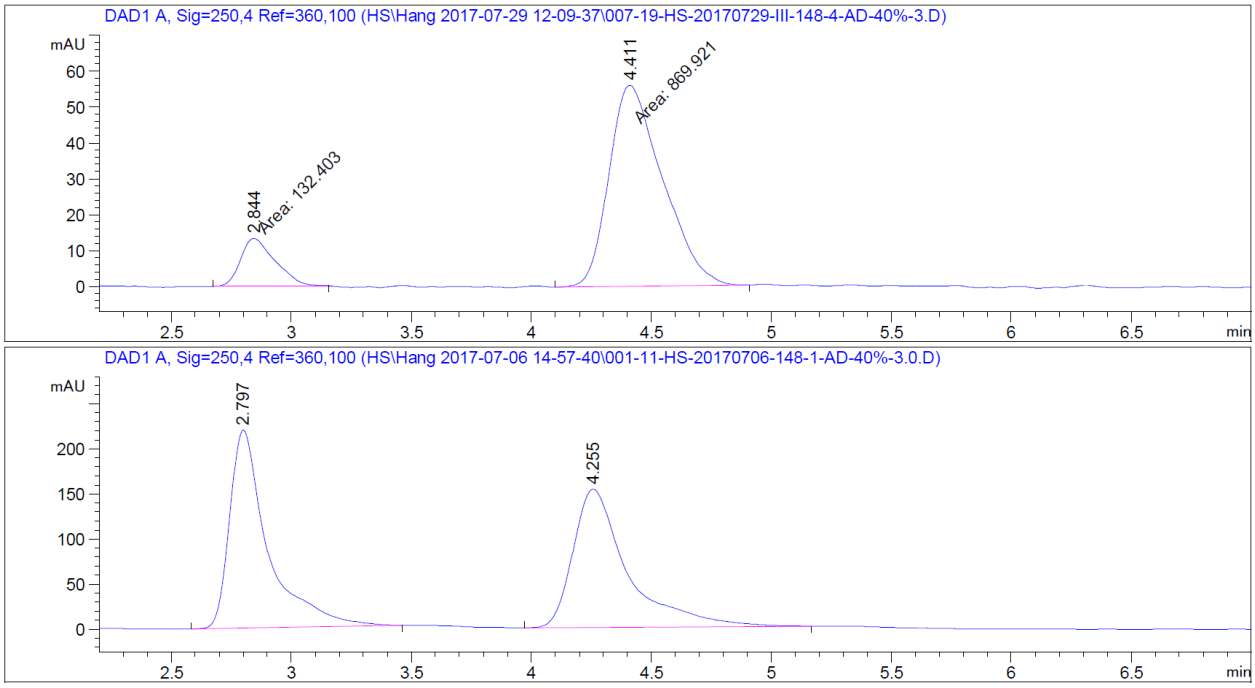


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.088	MM	0.1385	241.31932	29.04813	3.0469
2	4.570	MM	0.1587	7678.76660	806.38159	96.9531

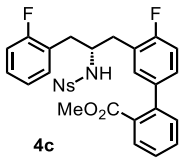


4b

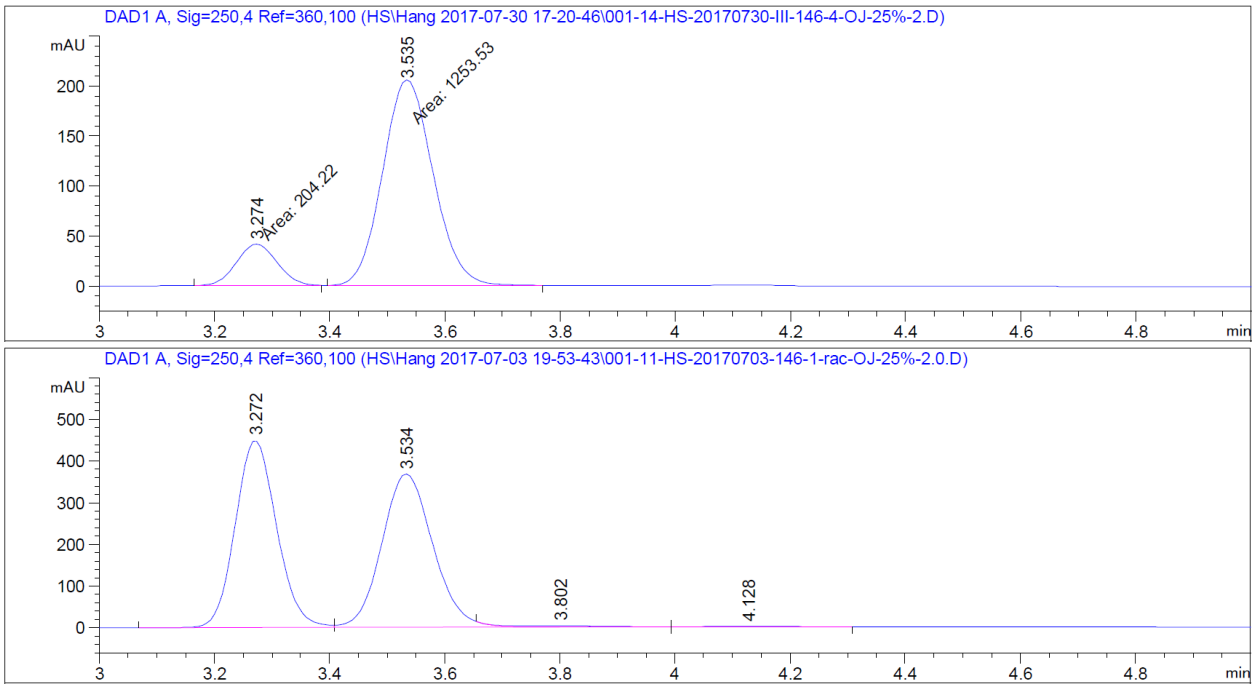


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.844	MM	0.1658	132.40337	13.30708	13.2096
2	4.411	MM	0.2586	869.92133	56.06168	86.7904

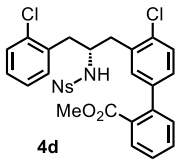


4c

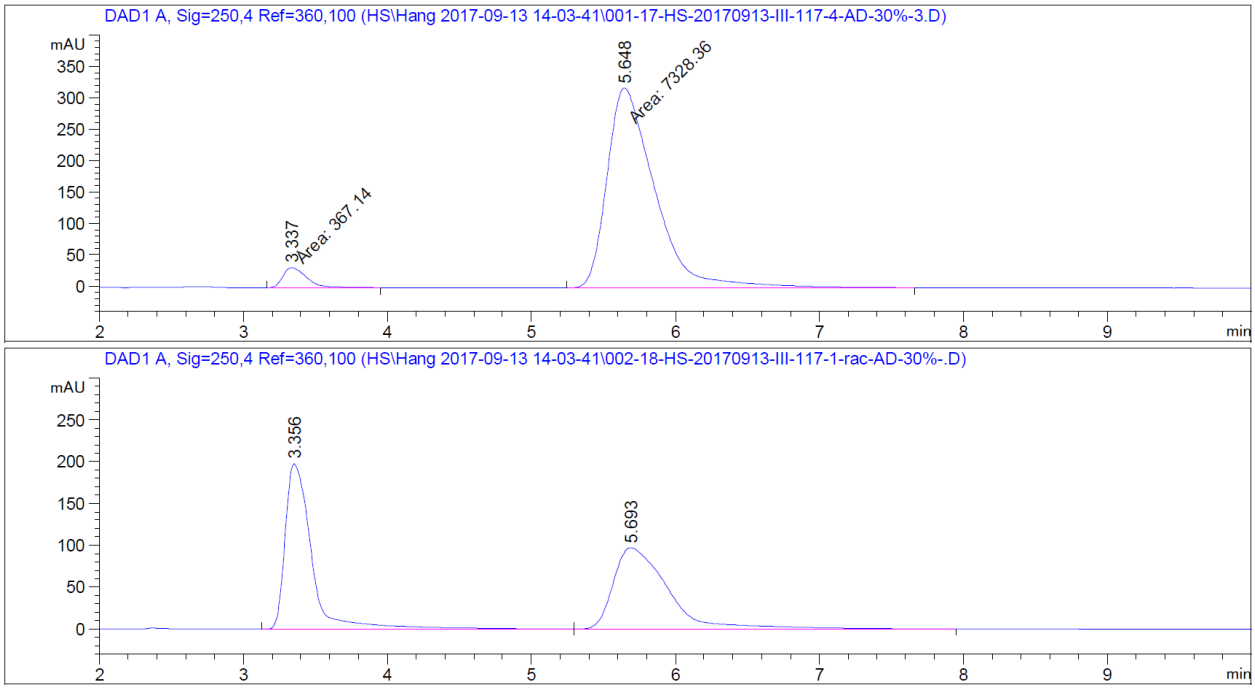


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.274	MM	0.0816	204.21960	41.70602	14.0092
2	3.535	MM	0.1014	1253.53442	206.02576	85.9908

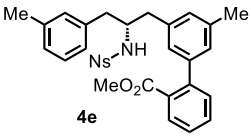


4d

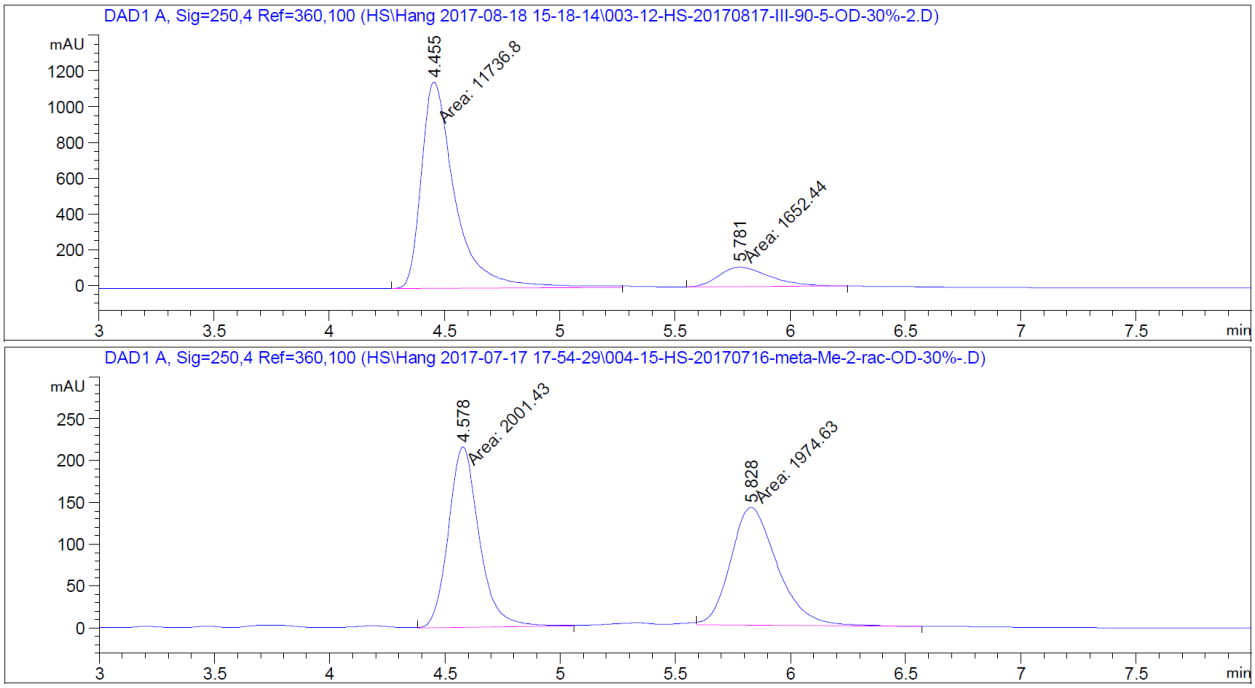


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.337	MM	0.1902	367.13989	32.17627	4.7708
2	5.648	MM	0.3832	7328.36084	318.74097	95.2292

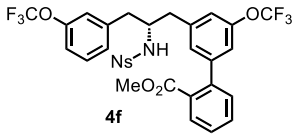


4e

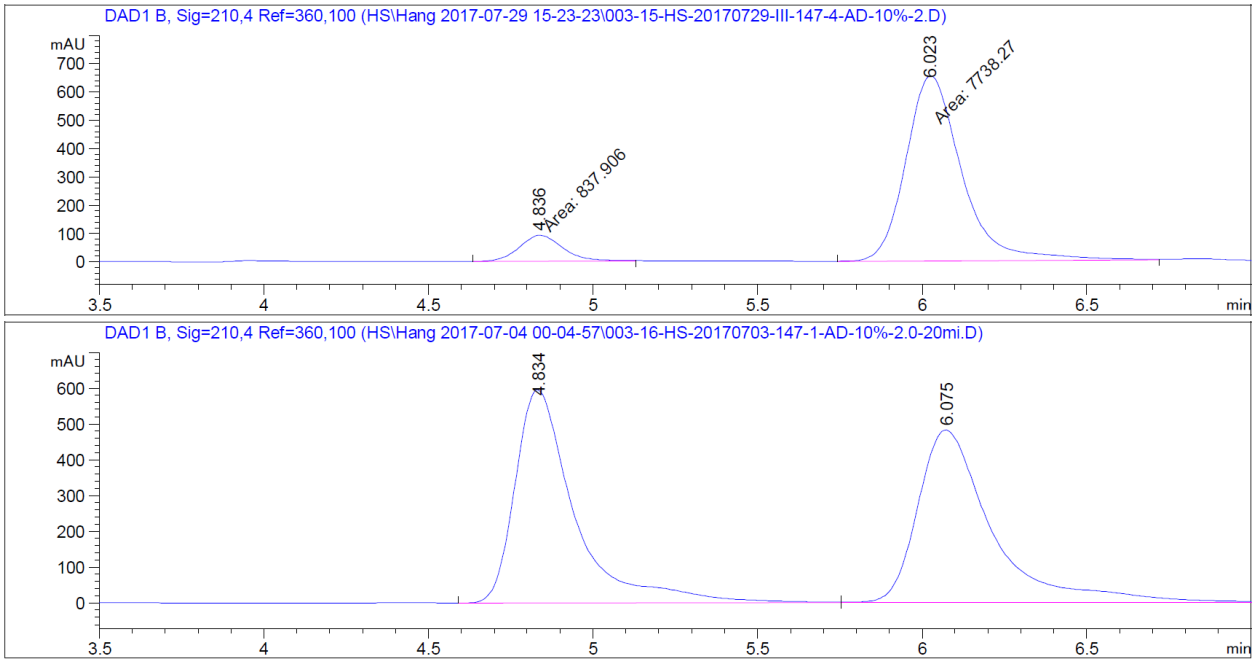


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.455	MM	0.1695	1.17368e4	1153.87244	87.6585
2	5.781	MM	0.2540	1652.43713	108.42530	12.3415

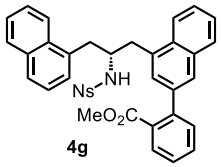


4f

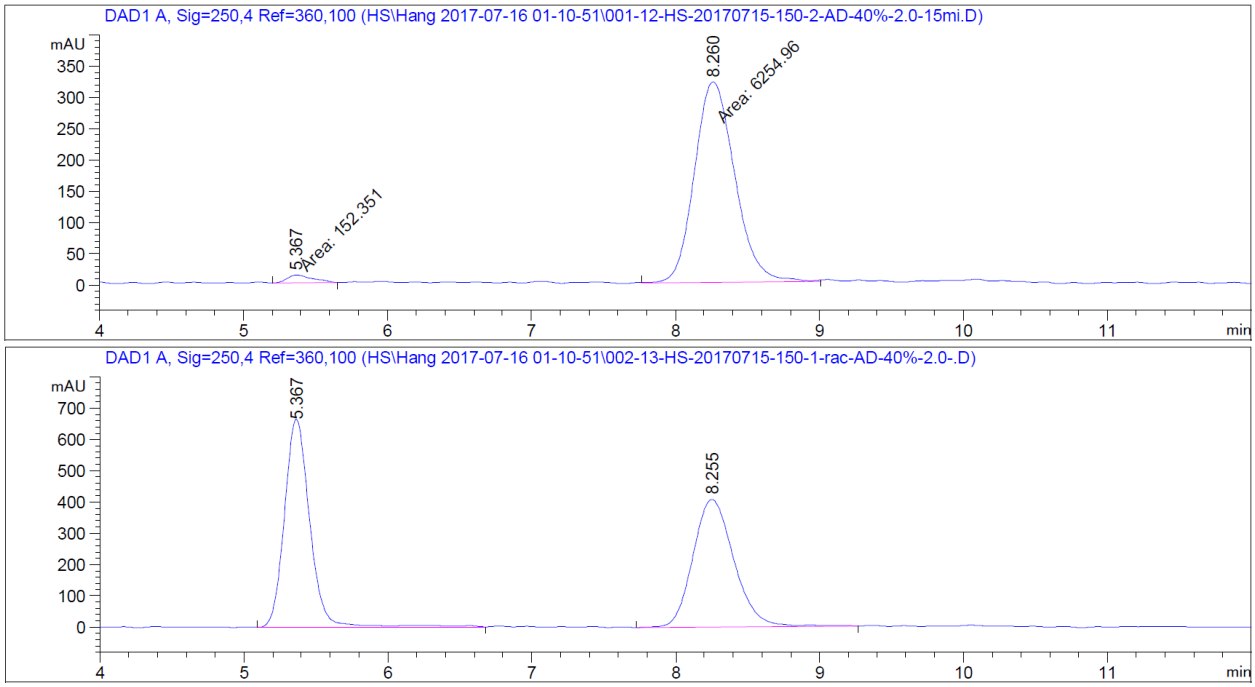


Signal 2: DAD1 B, Sig=210,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.836	MM	0.1526	837.90576	91.53378	9.7702
2	6.023	MM	0.1971	7738.27490	654.50769	90.2298

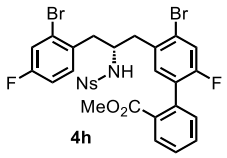


4g

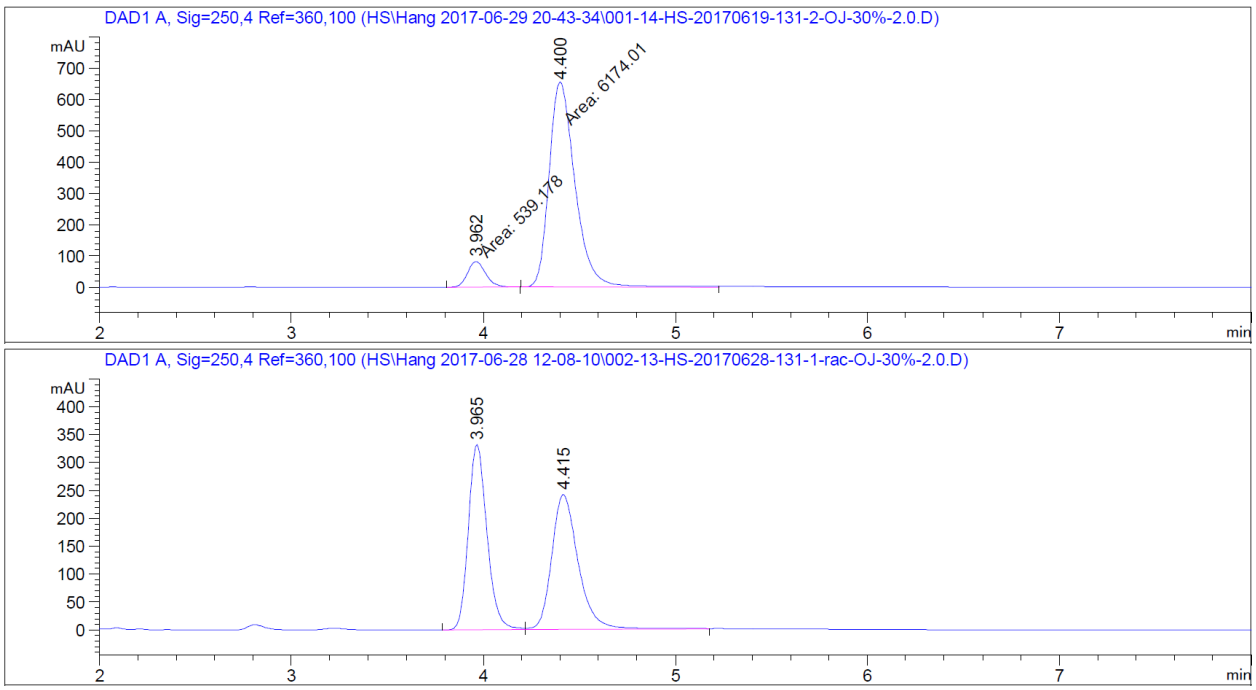


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.367	MM	0.2039	152.35146	12.45088	2.3778
2	8.260	MM	0.3247	6254.95654	321.03714	97.6222

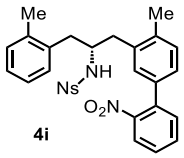


4h

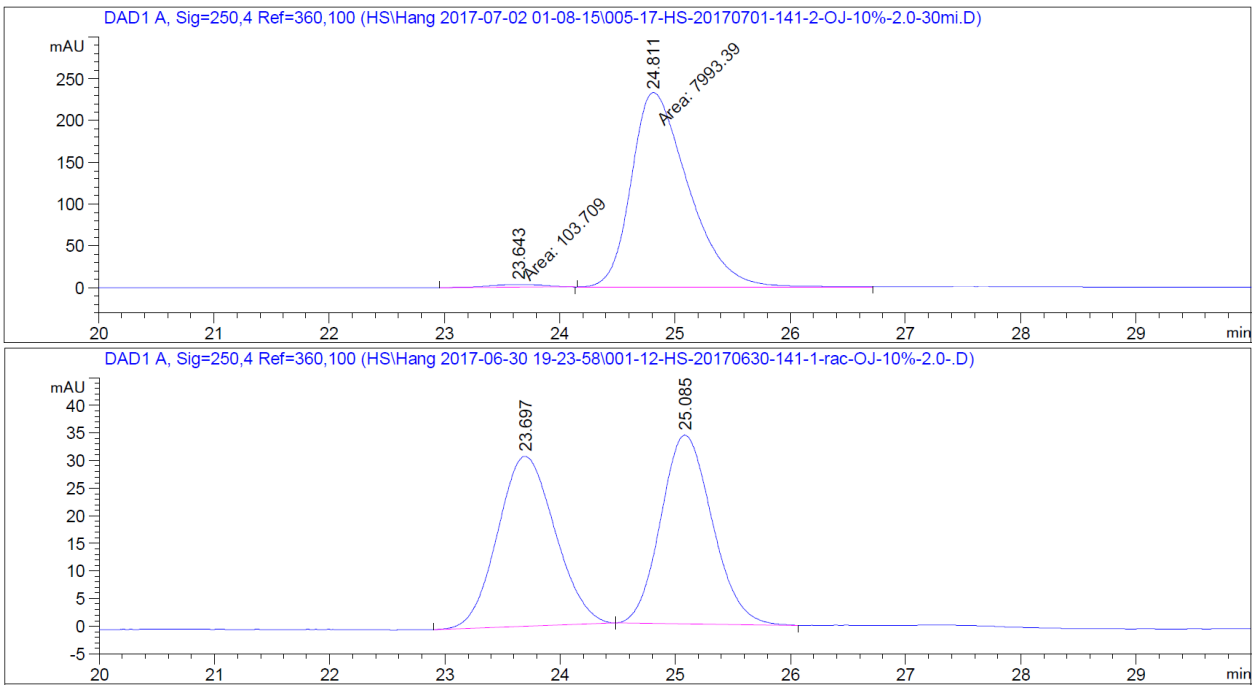


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.962	MM	0.1099	539.17792	81.76174	8.0316
2	4.400	MM	0.1569	6174.00928	656.01202	91.9684

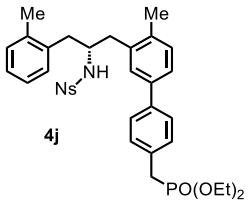


4i

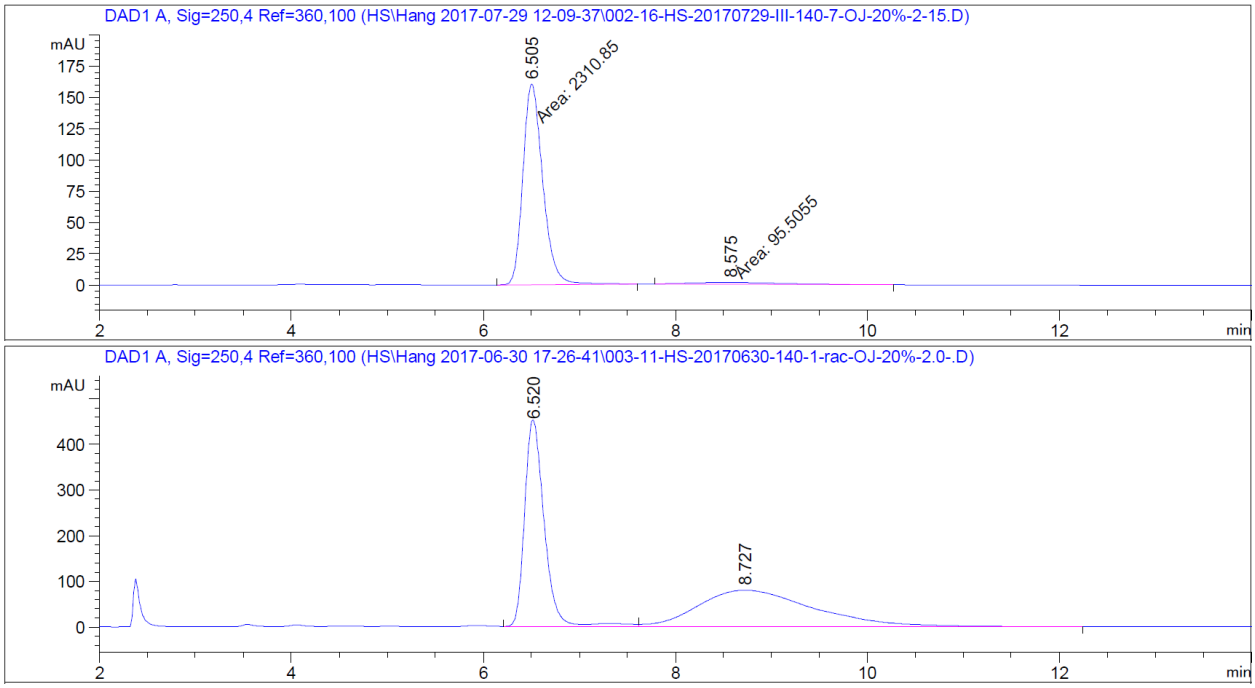


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.643	MM	0.5091	103.70914	3.39537	1.2808
2	24.811	MM	0.5724	7993.39209	232.74353	98.7192

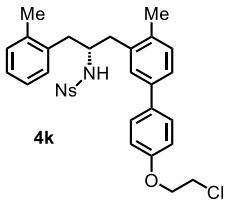


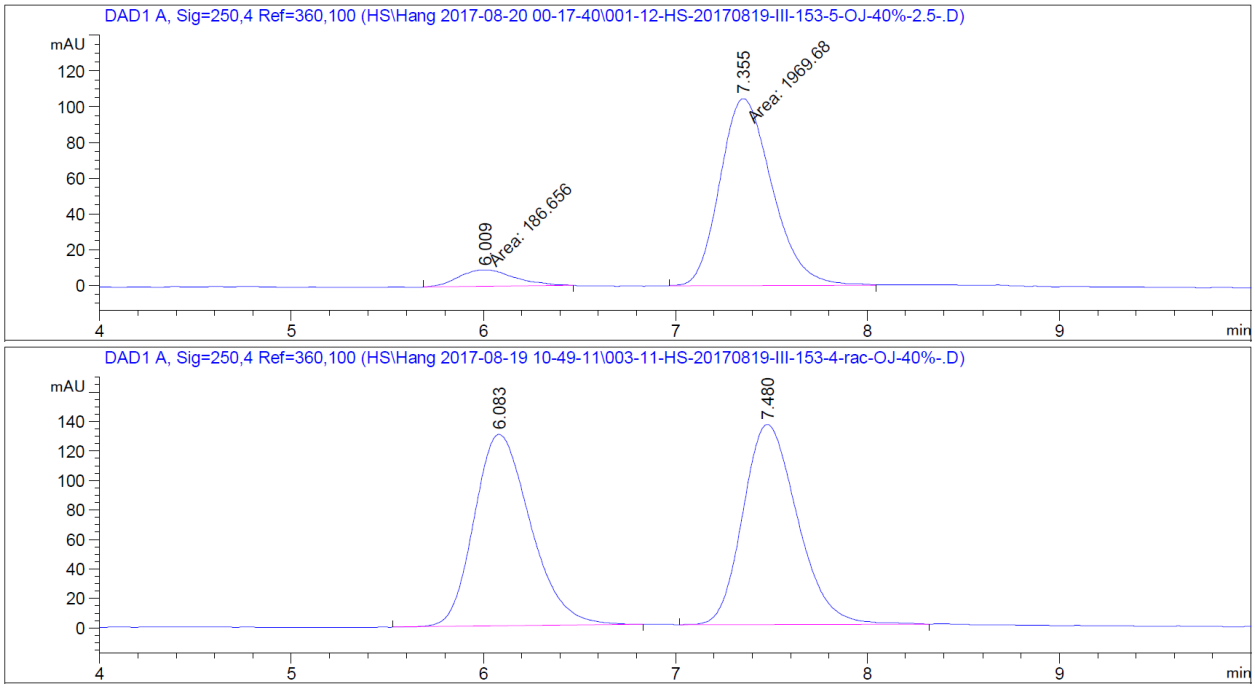
4j



Signal 1: DAD1 A, Sig=250,4 Ref=360,100

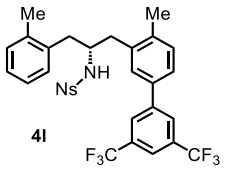
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.505	MM	0.2401	2310.84912	160.43649	96.0311
2	8.575	MM	1.1314	95.50554	1.40690	3.9689



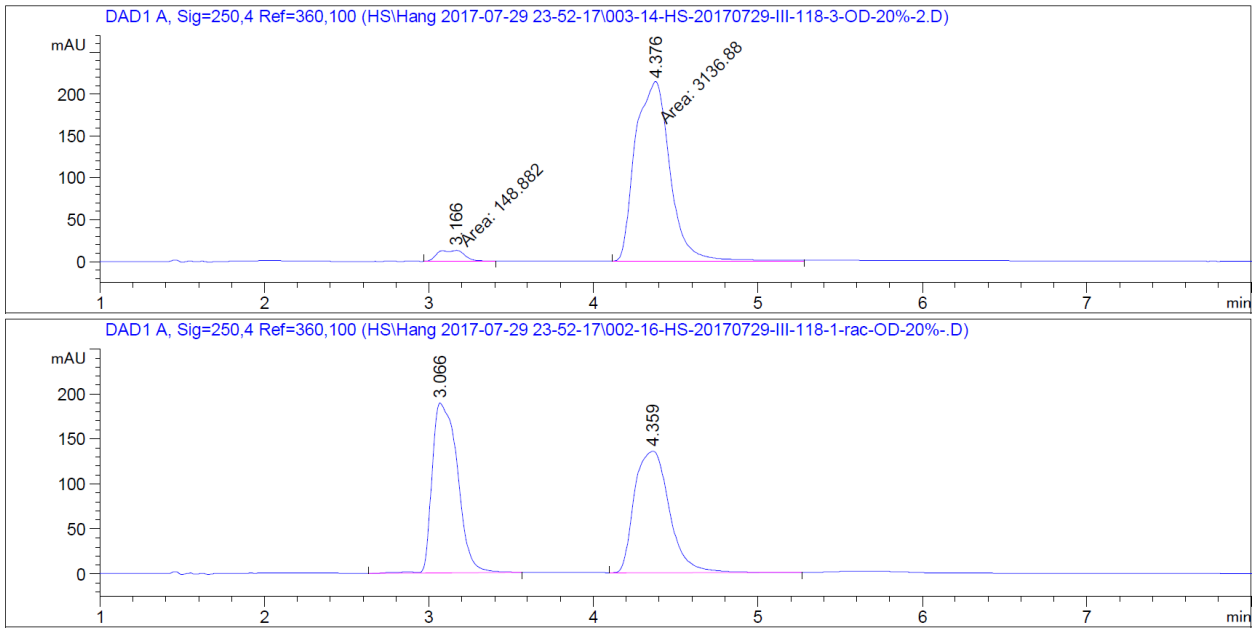


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.009	MM	0.3380	186.65569	9.20326	8.6562
2	7.355	MM	0.3139	1969.67542	104.57546	91.3438

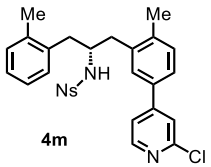


4l

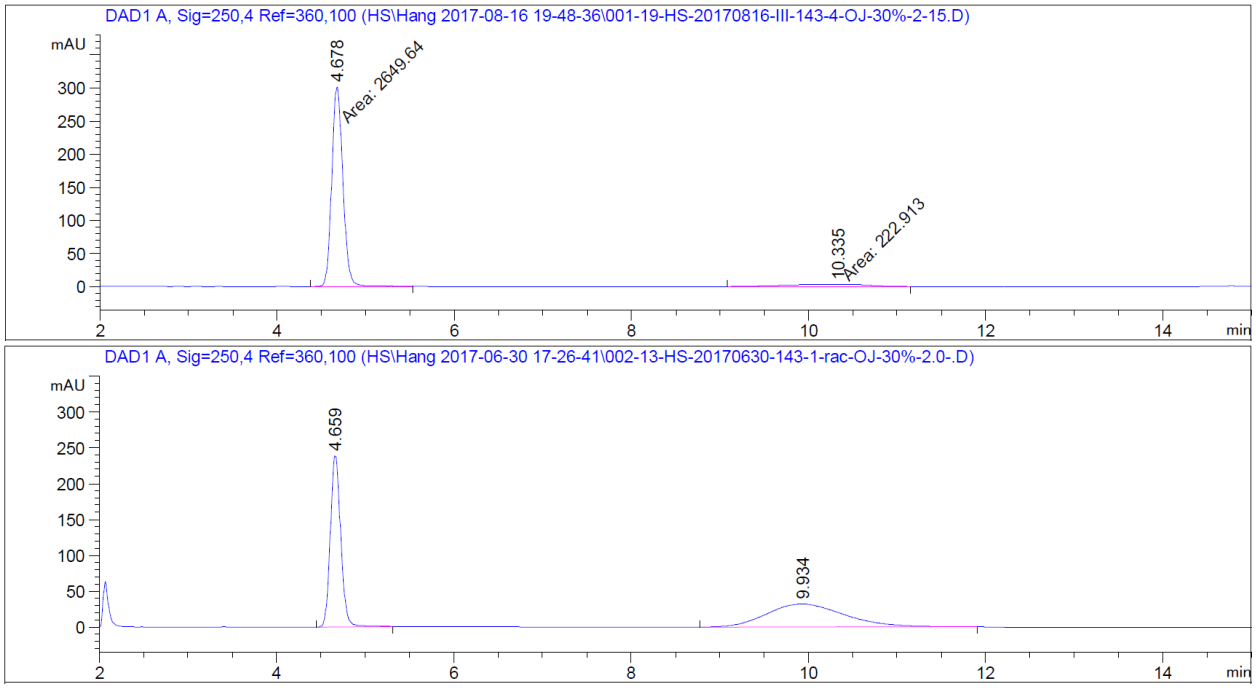


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.166	MM	0.1885	148.88176	13.16310	4.5311
2	4.376	MM	0.2433	3136.87891	214.88333	95.4689

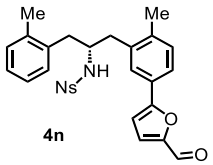


4m

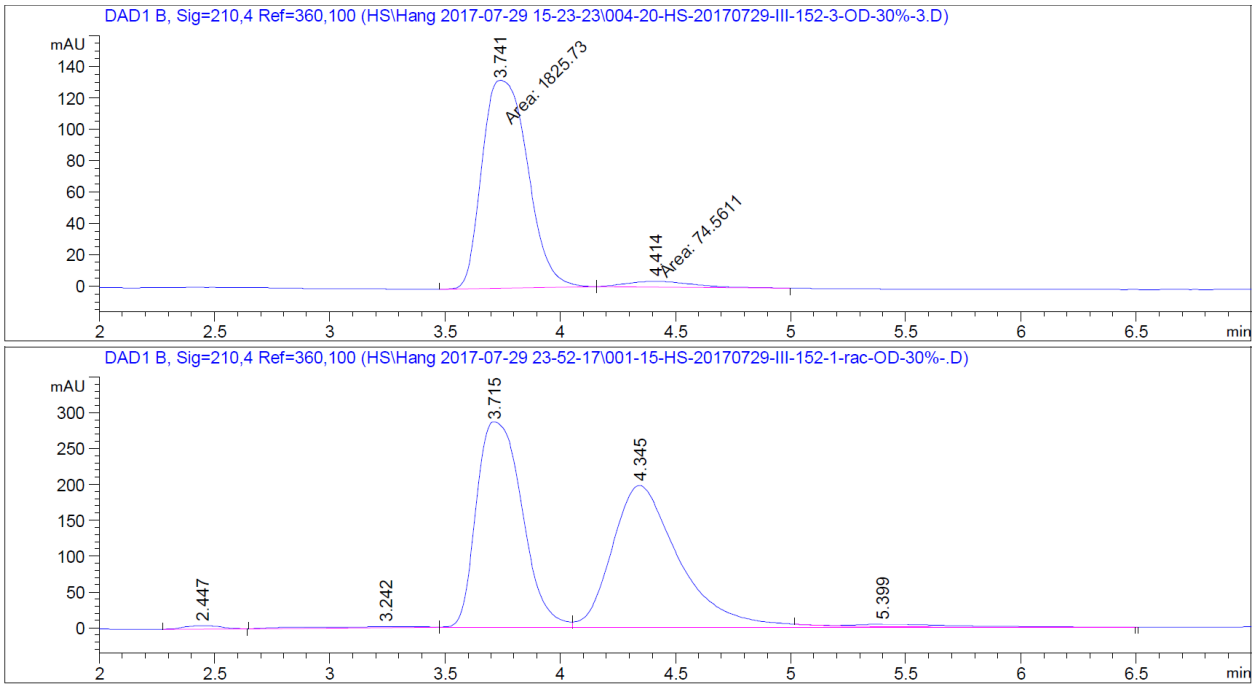


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.678	MM	0.1465	2649.63574	301.41370	92.2399
2	10.335	MM	1.1082	222.91309	3.35239	7.7601

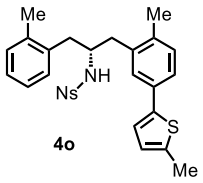


4n

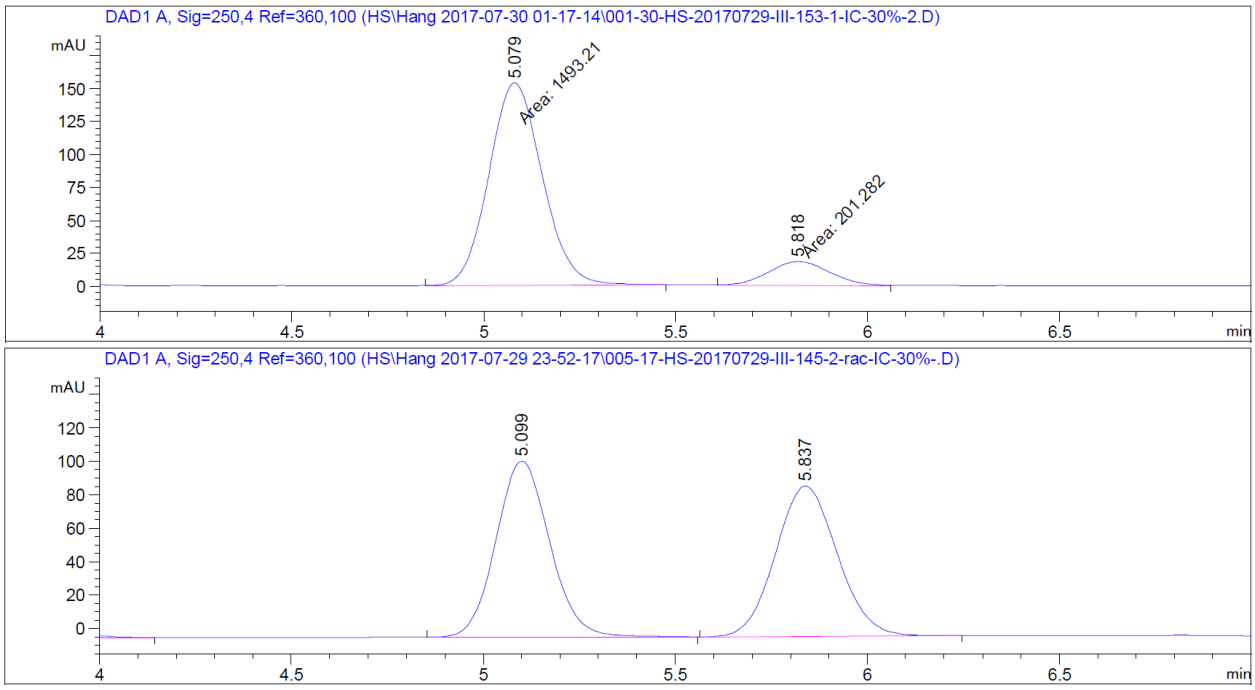


Signal 2: DAD1 B, Sig=210,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.741	MM	0.2292	1825.73450	132.75627	96.0763
2	4.414	MM	0.3333	74.56106	3.72887	3.9237

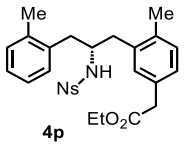


4o

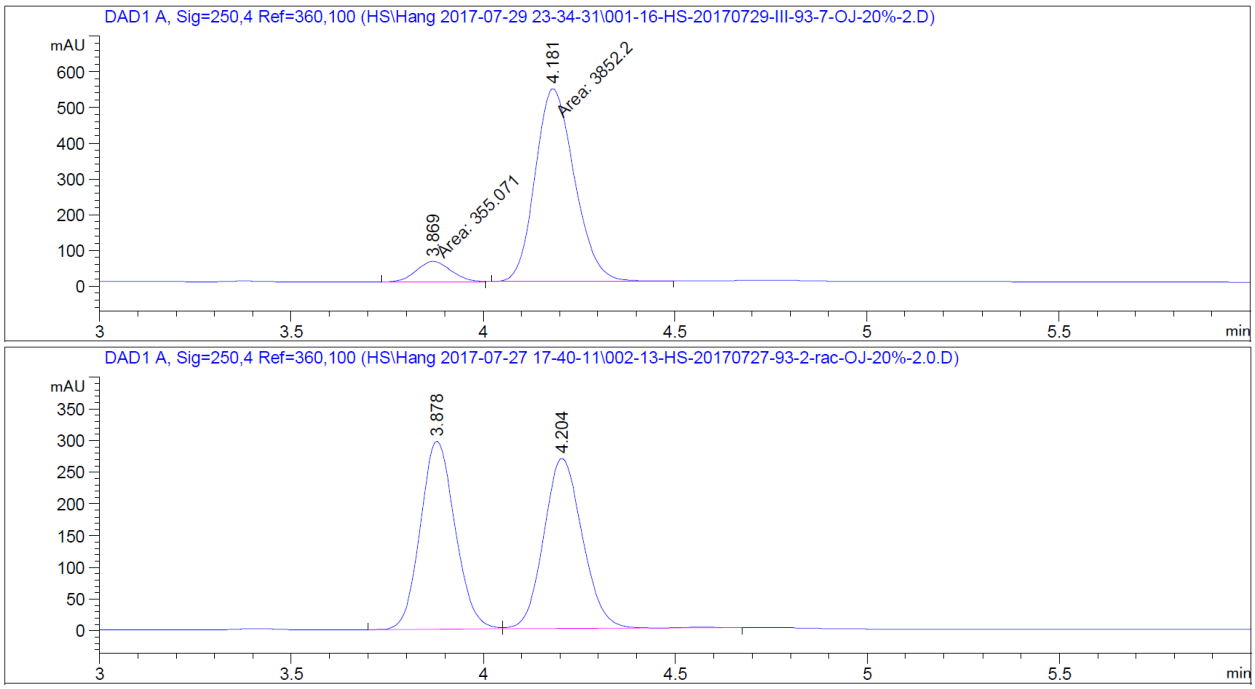


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.079	MM	0.1616	1493.21191	153.99384	88.1214
2	5.818	MM	0.1849	201.28221	18.13864	11.8786

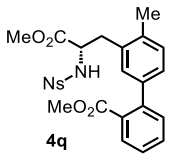


4p

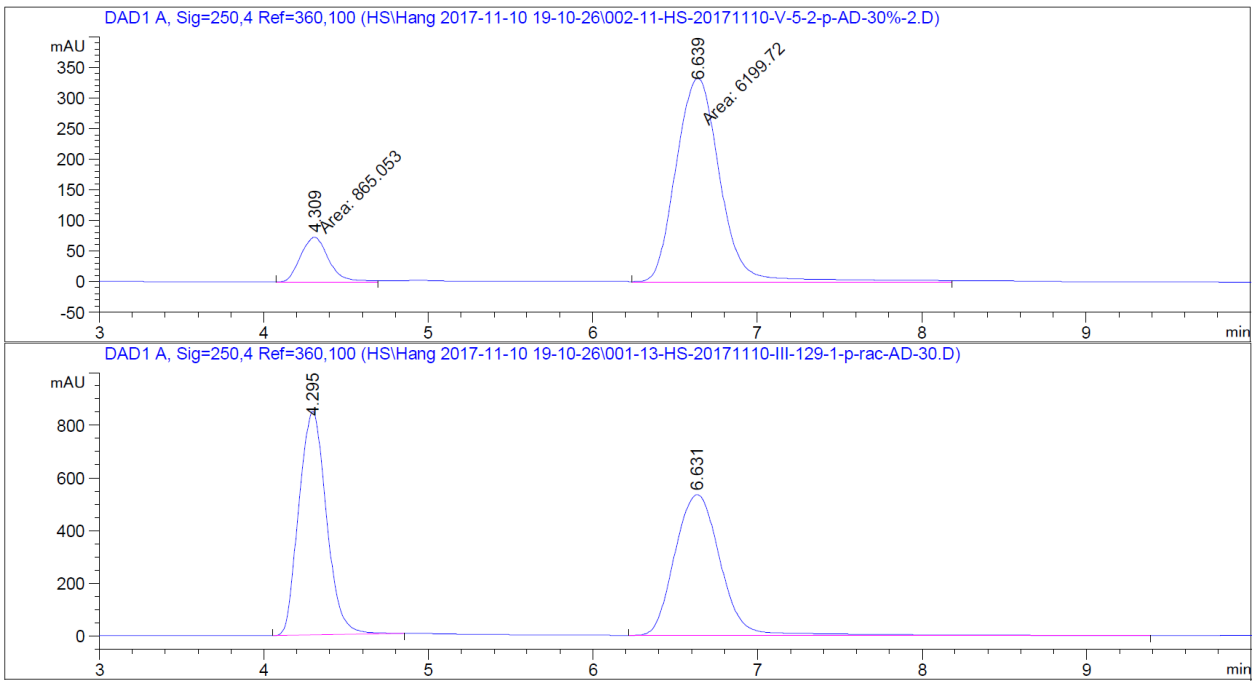


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.869	MM	0.1042	355.07101	56.79617	8.4395
2	4.181	MM	0.1187	3852.19800	541.02374	91.5605

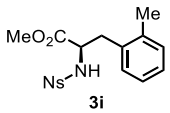


4q

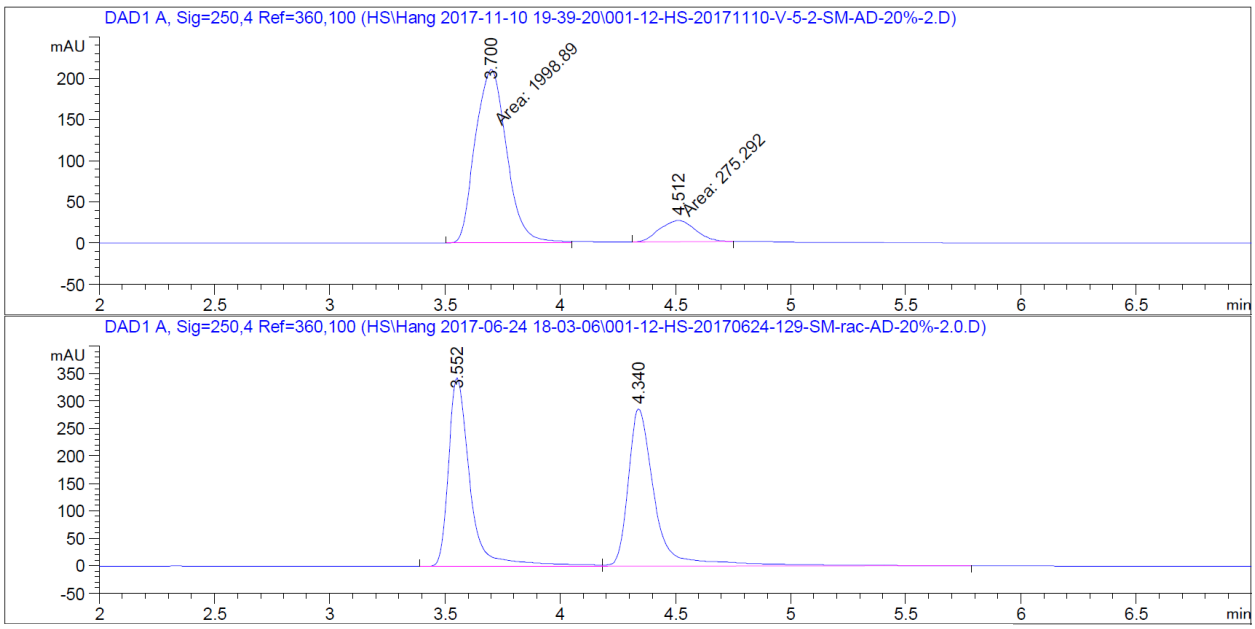


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.309	MM	0.1973	865.05347	73.09028	12.2446
2	6.639	MM	0.3105	6199.71631	332.83386	87.7554

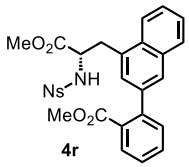


3i

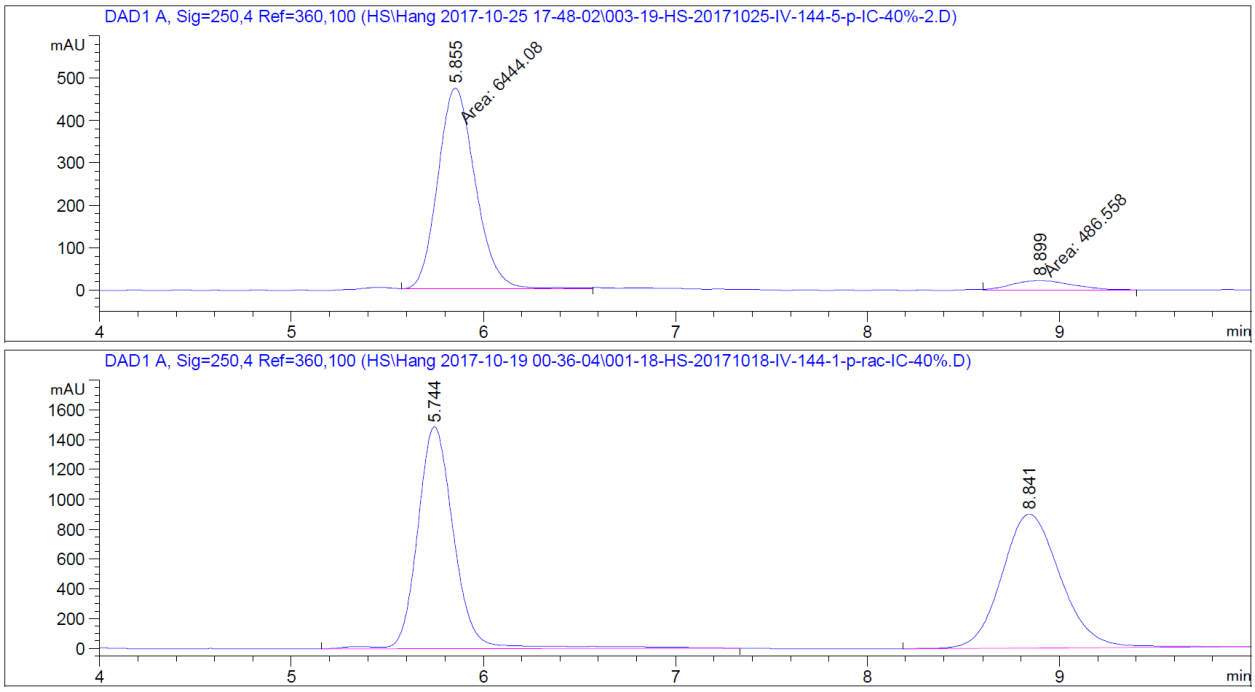


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.700	MM	0.1579	1998.88965	211.03954	87.8949
2	4.512	MM	0.1776	275.29227	25.83036	12.1051

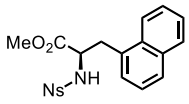


4r

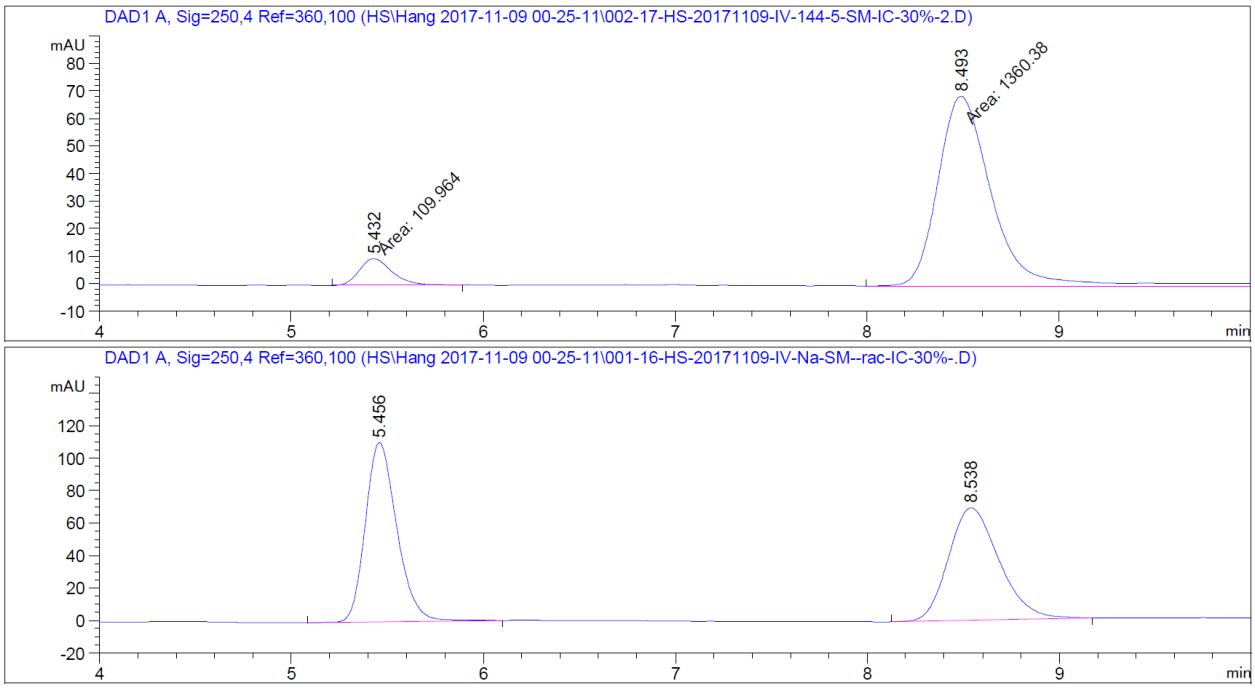


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.855	MM	0.2266	6444.08398	473.91415	92.9796
2	8.899	MM	0.3658	486.55807	22.16995	7.0204

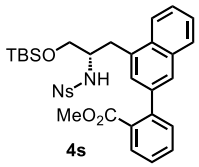


3j

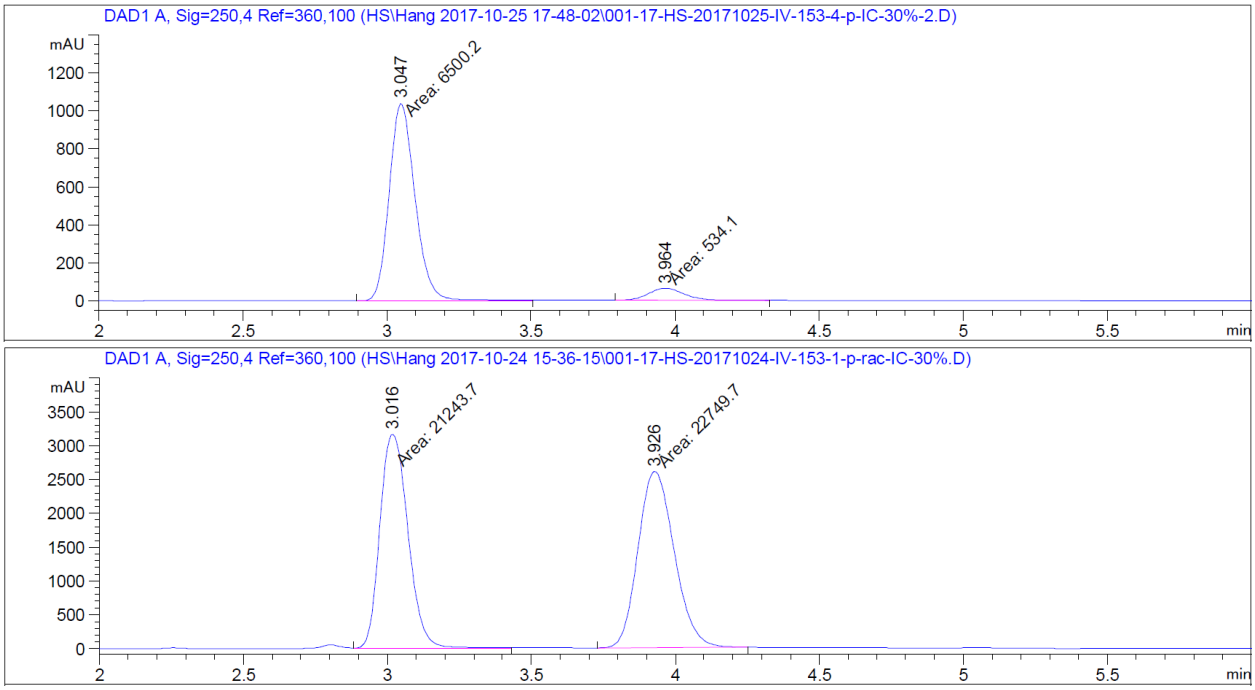


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.432	MM	0.1920	109.96355	9.54492	7.4788
2	8.493	MM	0.3289	1360.38098	68.94481	92.5212

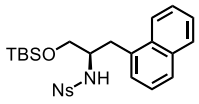


4s

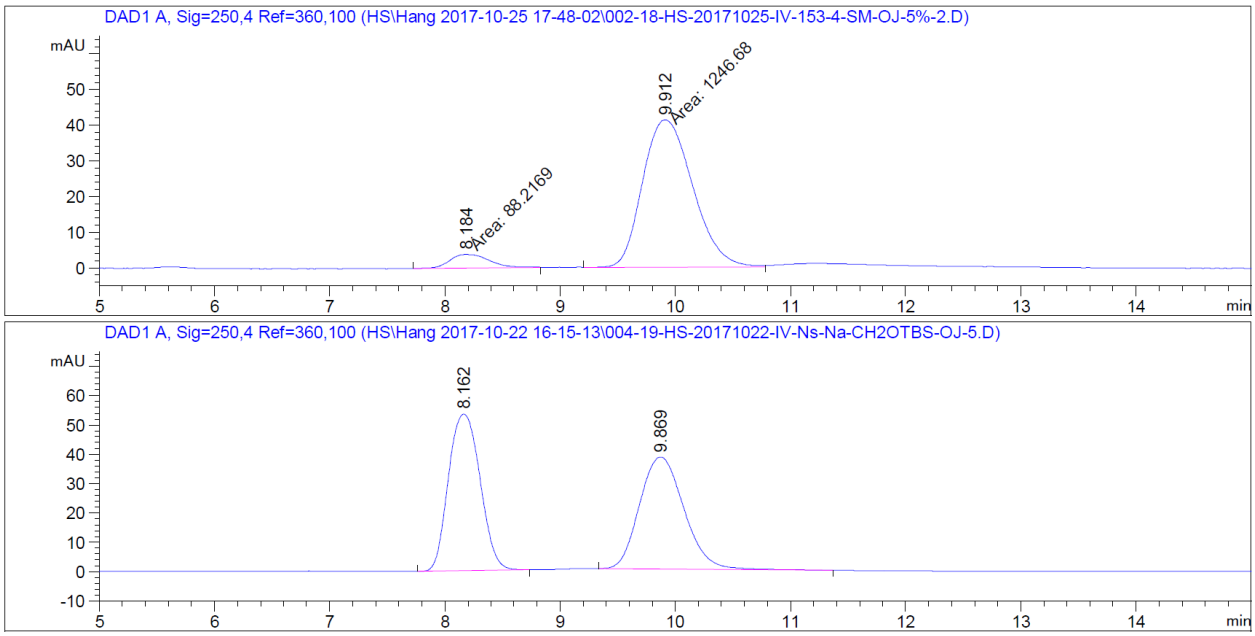


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.047	MM	0.1041	6500.20361	1040.88354	92.4072
2	3.964	MM	0.1421	534.09979	62.65053	7.5928

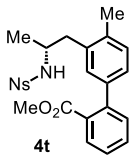


3m

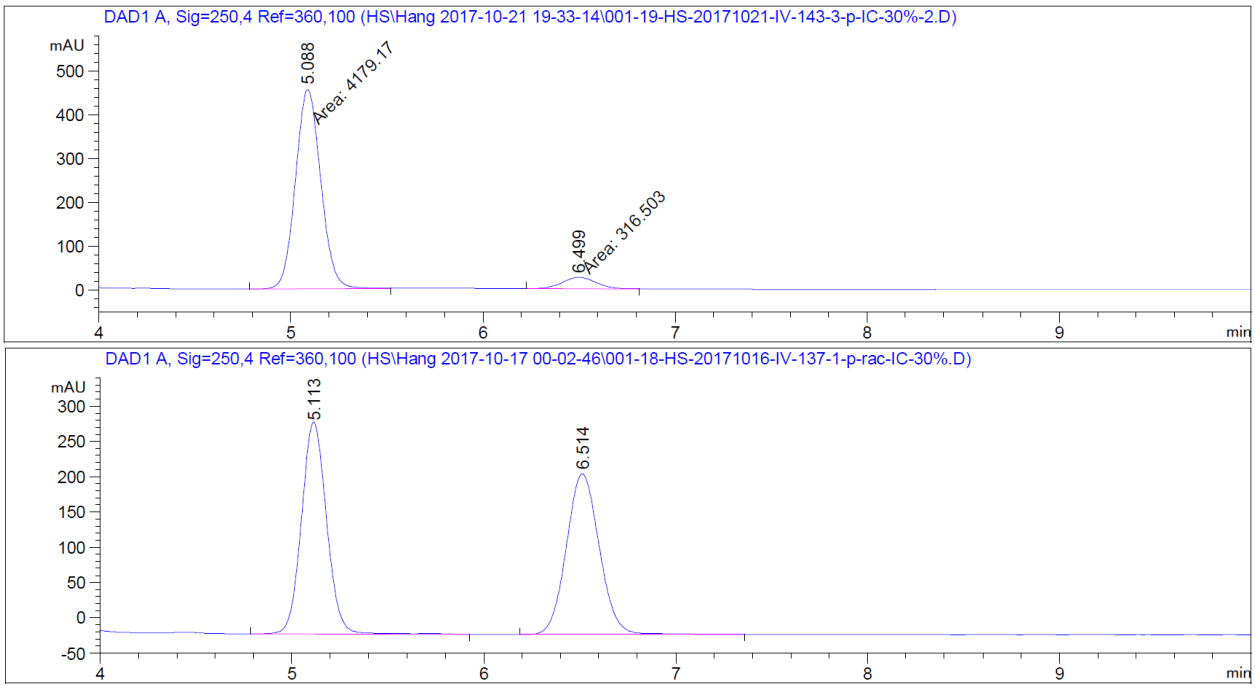


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.184	MM	0.3906	88.21686	3.76424	6.6085
2	9.912	MM	0.5032	1246.67957	41.29092	93.3915

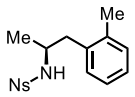


4t

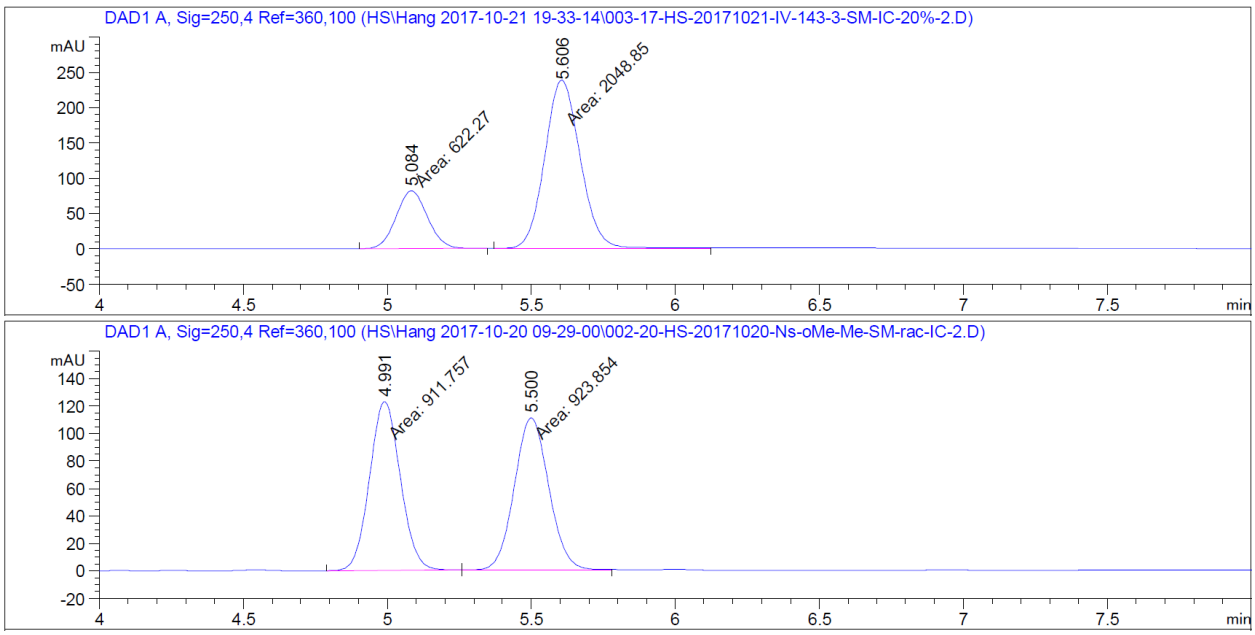


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.088	MM	0.1528	4179.16943	455.88596	92.9598
2	6.499	MM	0.2030	316.50284	25.98948	7.0402

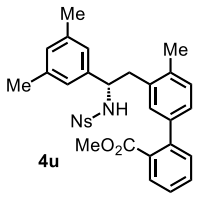


3k

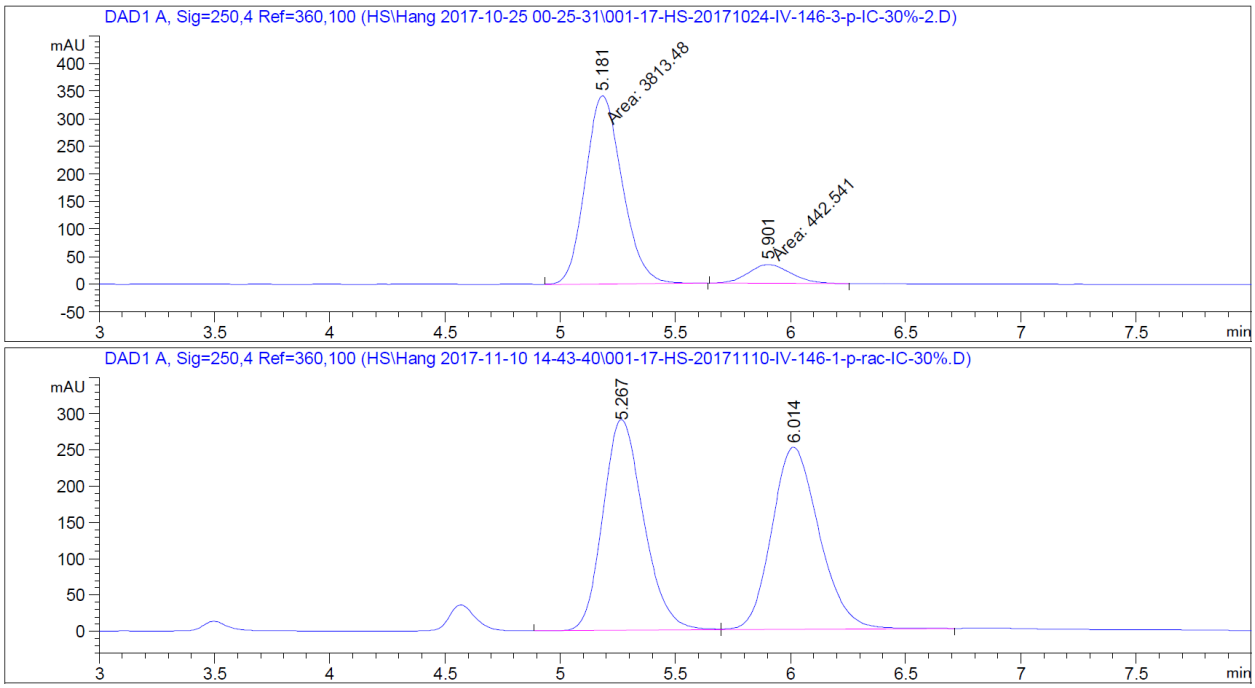


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.084	MM	0.1267	622.26953	81.83183	23.2962
2	5.606	MM	0.1432	2048.85010	238.52176	76.7038

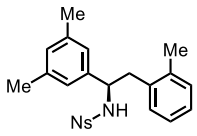


4u

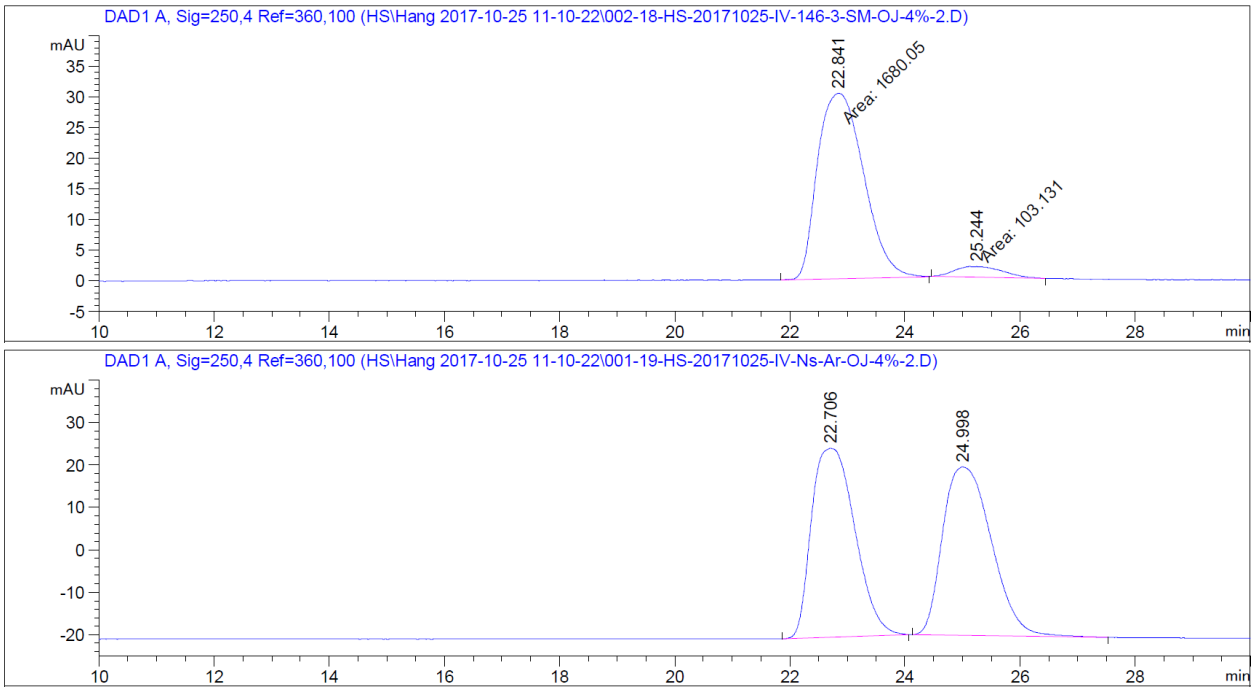


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.181	MM	0.1861	3813.48438	341.60596	89.6020
2	5.901	MM	0.2166	442.54083	34.05733	10.3980

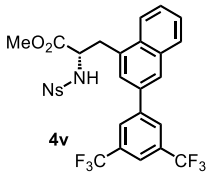


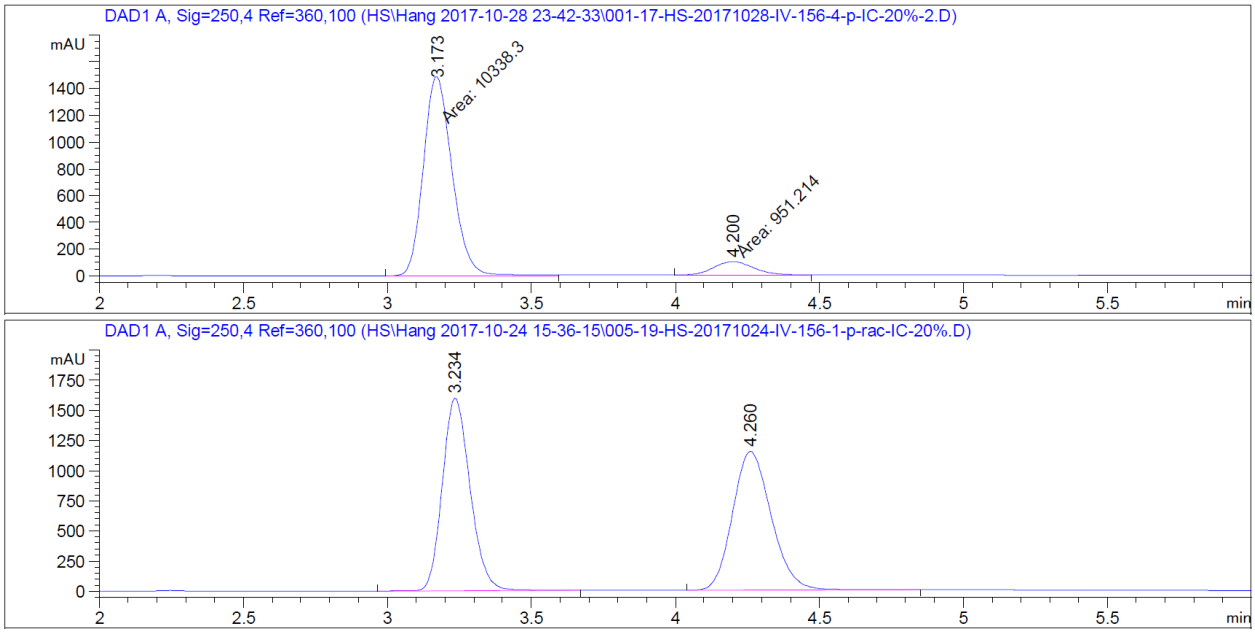
3n



Signal 1: DAD1 A, Sig=250,4 Ref=360,100

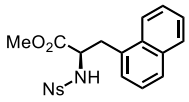
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	22.841	MM	0.9240	1680.05347	30.30535	94.2165
2	25.244	MM	0.9805	103.13062	1.75308	5.7835



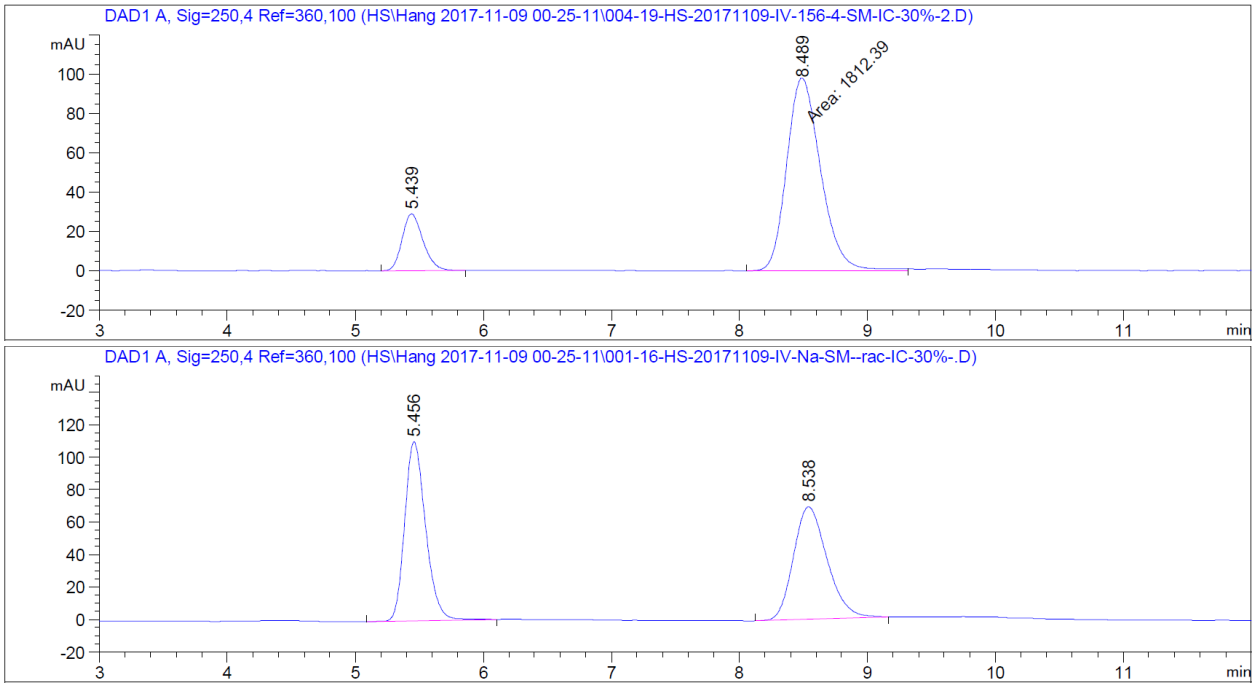


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.173	MM	0.1155	1.03383e4	1491.61975	91.5744
2	4.200	MM	0.1581	951.21368	100.26136	8.4256

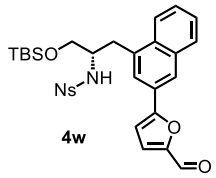


3j

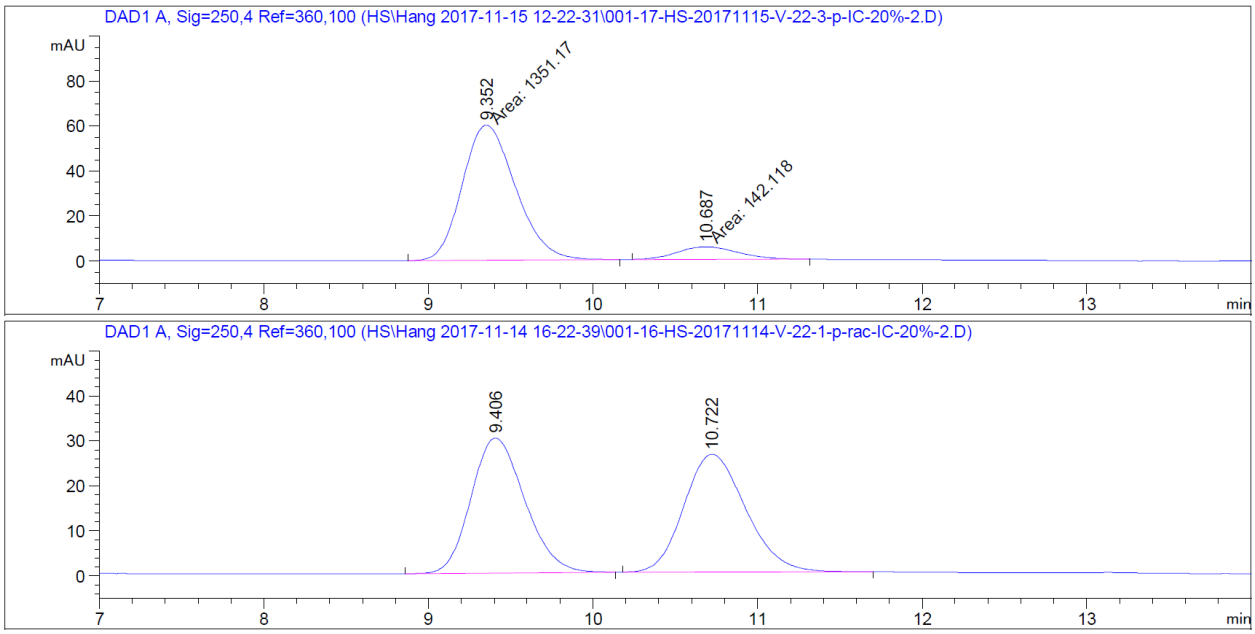


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.439	BB	0.1743	327.99240	28.92523	15.3240
2	8.489	MM	0.3077	1812.38513	98.16897	84.6760

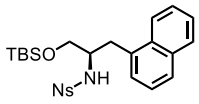


4w

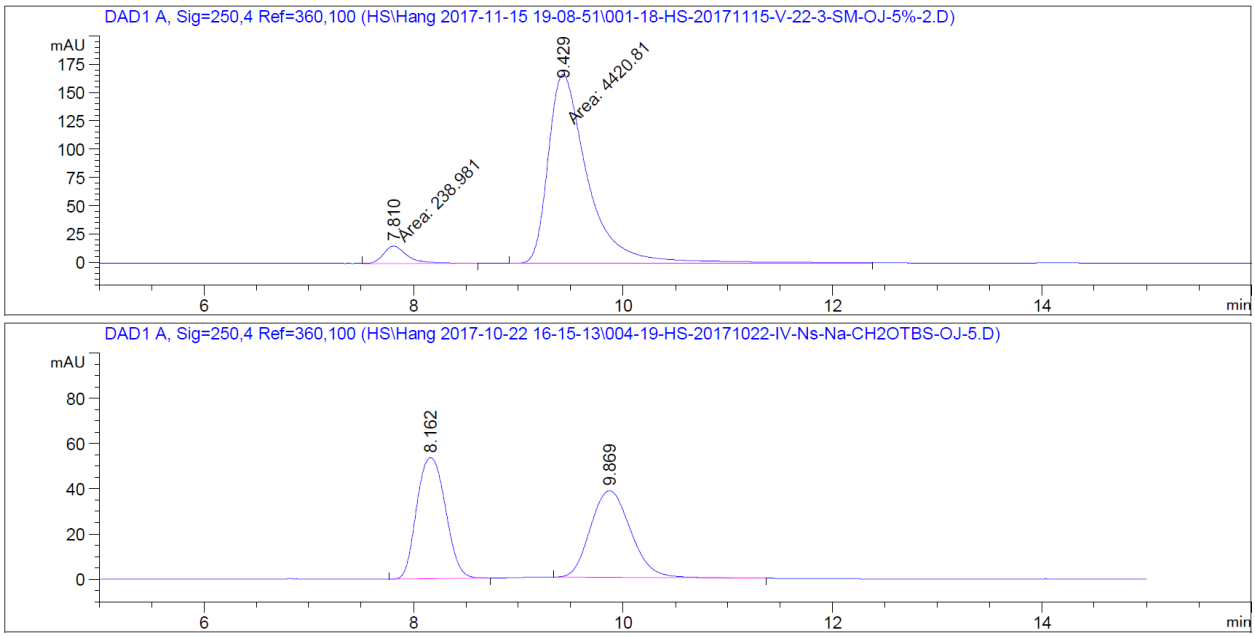


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.352	MM	0.3749	1351.17456	60.07418	90.4829
2	10.687	MM	0.4269	142.11836	5.54905	9.5171

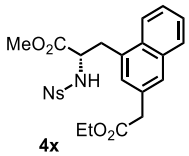


3m

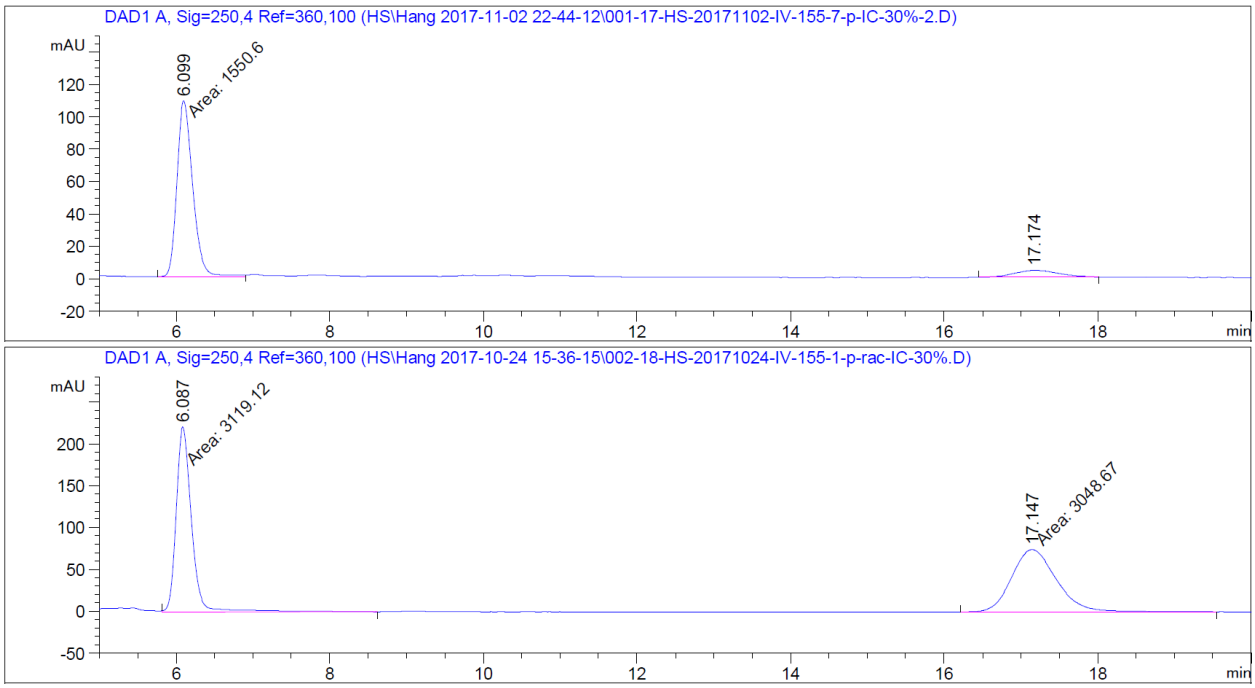


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.810	MM	0.2600	238.98119	15.32124	5.1286
2	9.429	MM	0.4416	4420.81201	166.84232	94.8714

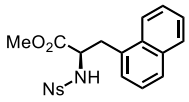


4x

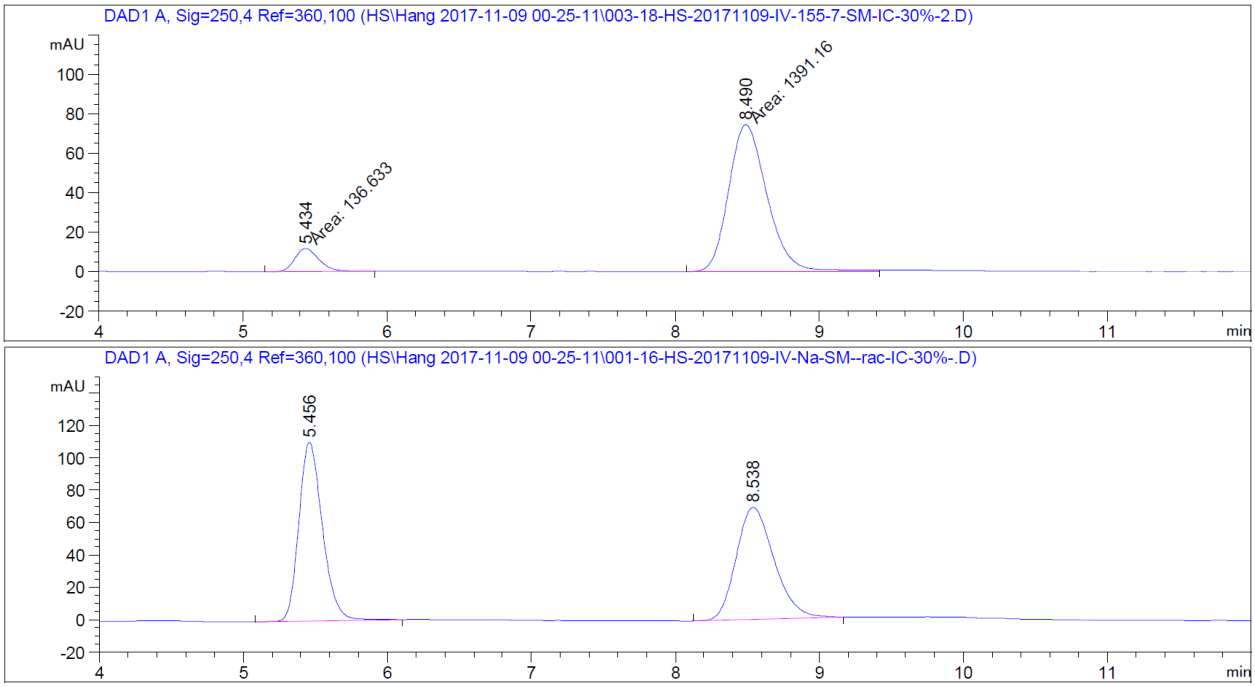


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.099	MM	0.2380	1550.60046	108.56999	90.0303
2	17.174	BB	0.4969	171.70859	4.27254	9.9697

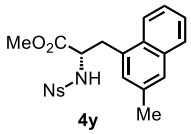


3j

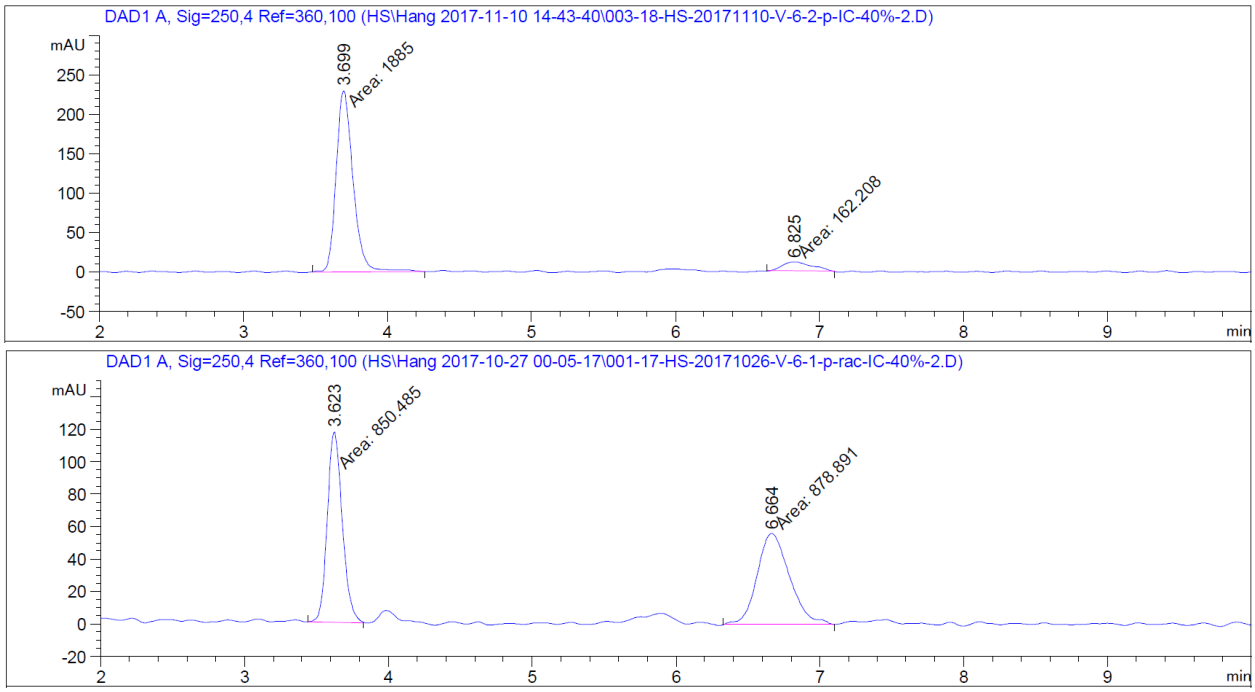


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.434	MM	0.1939	136.63313	11.74363	8.9432
2	8.490	MM	0.3110	1391.15540	74.56083	91.0568

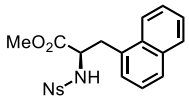


4y

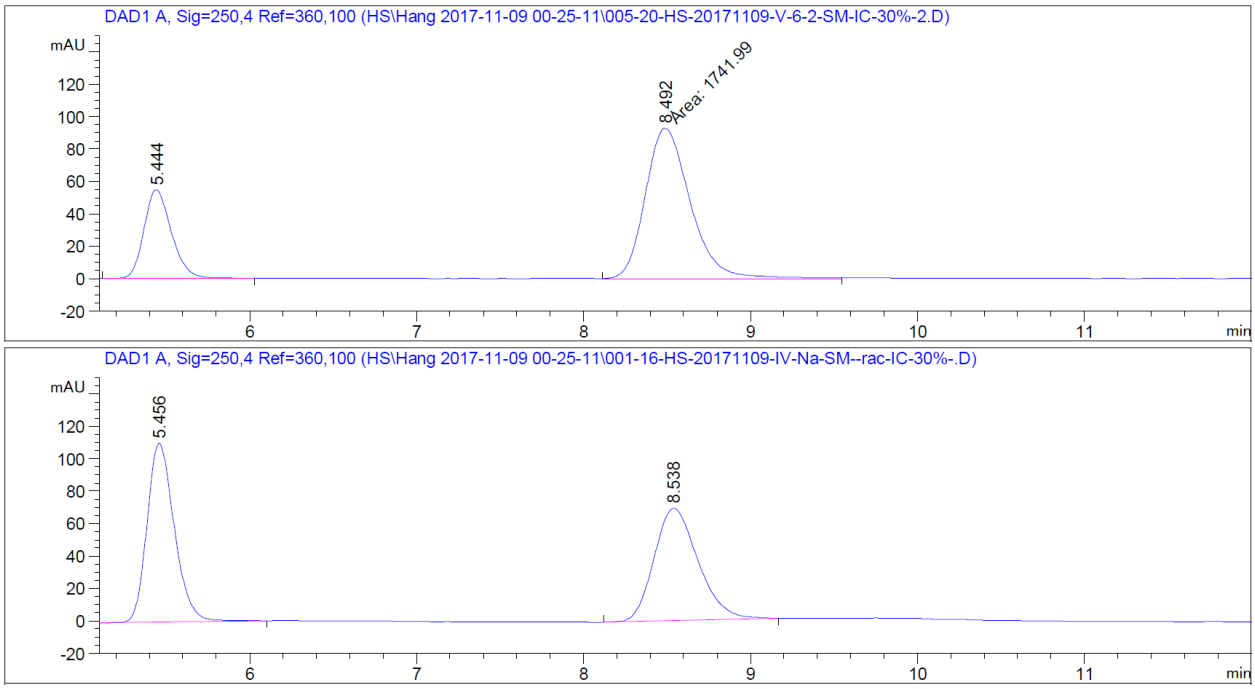


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.699	MM	0.1366	1884.99915	230.05949	92.0766
2	6.825	MM	0.2376	162.20778	11.37620	7.9234

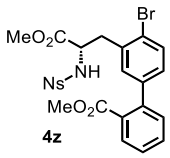


3j

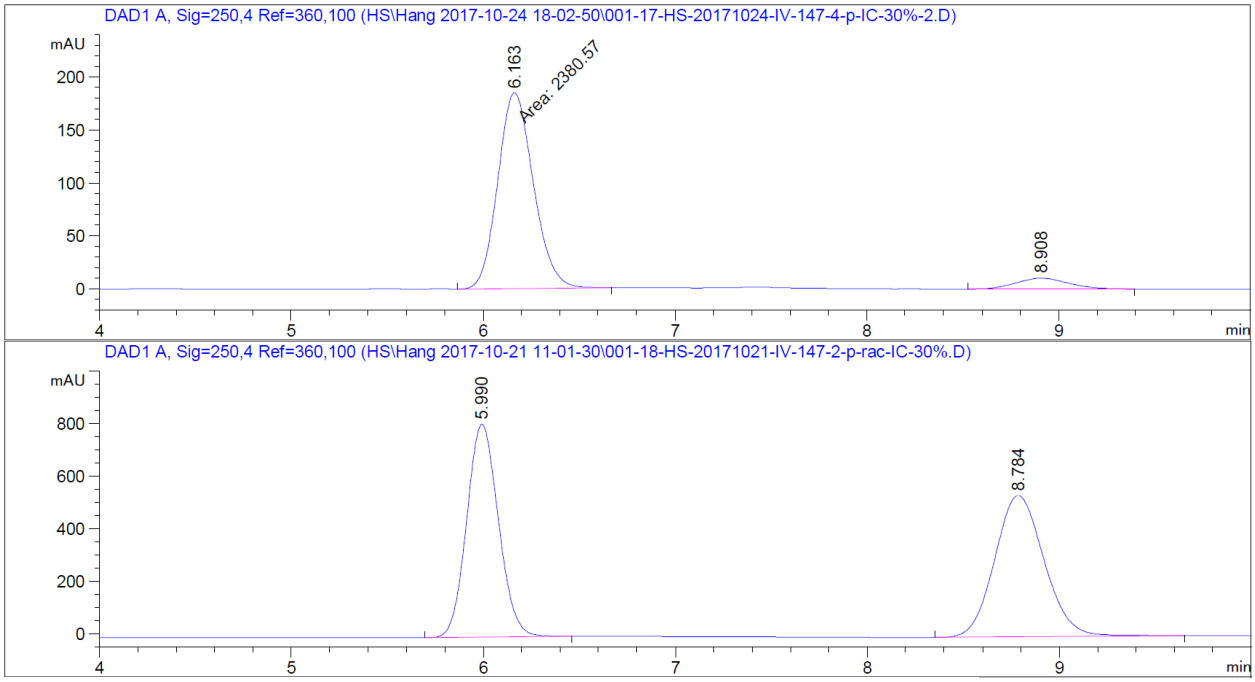


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.444	BB	0.1743	619.92261	54.67658	26.2467
2	8.492	MM	0.3125	1741.98792	92.92081	73.7533

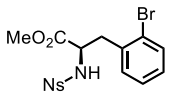


4z

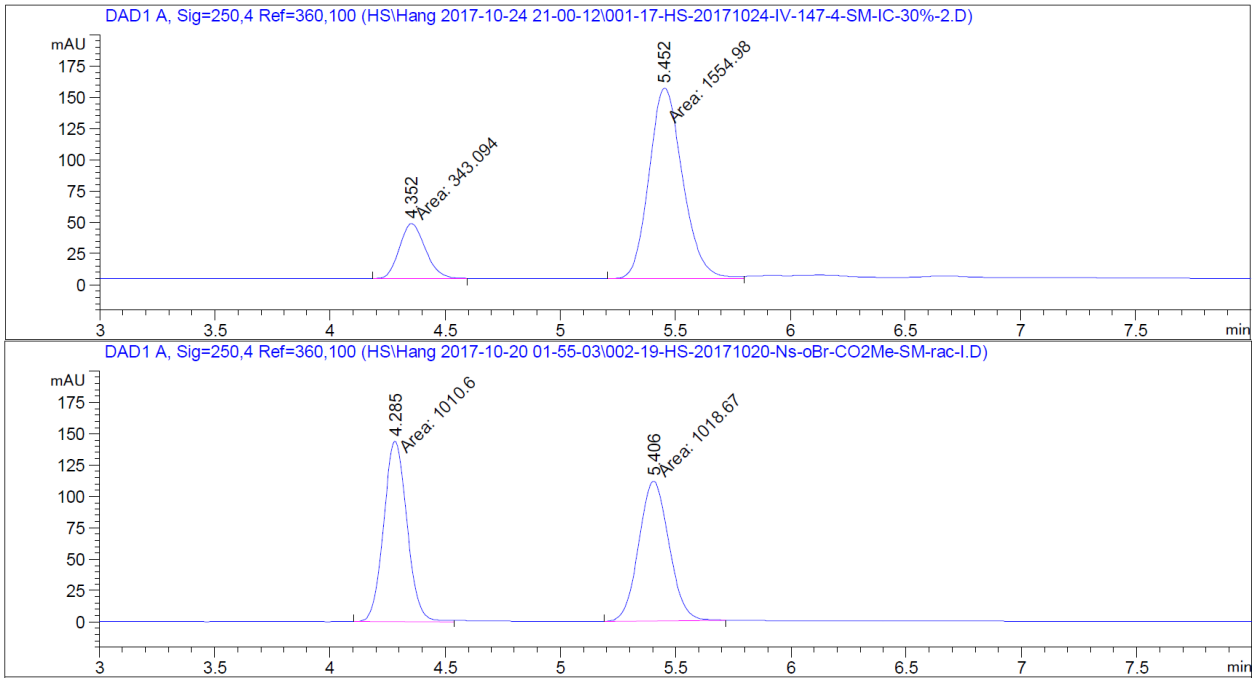


Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.163	MM	0.2145	2380.57056	184.94643	92.3810
2	8.908	BB	0.3025	196.33482	10.20089	7.6190

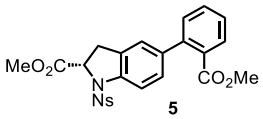


3l



Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.352	MM	0.1299	343.09421	44.03119	18.0759
2	5.452	MM	0.1697	1554.98279	152.74278	81.9241



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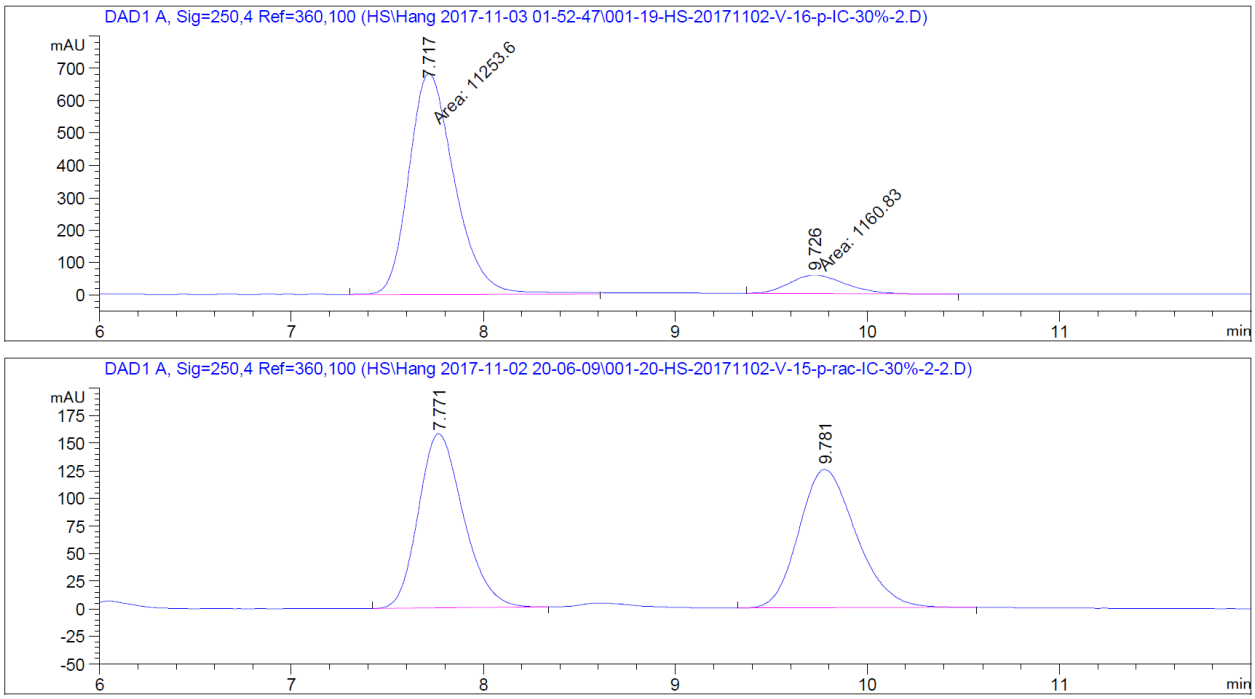

Signal 1: DAD1 A, Sig=250,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.717	MM	0.2747	1.12536e4	682.73999	90.6493
2	9.726	MM	0.3379	1160.83484	57.26508	9.3507

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