Supplementary Materials for

Modular Synthesis of α-Branched Secondary Alkylamines via Visible-light-mediated Carbonyl Alkylative Amination

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1. Materials and methods

All reactions were run under an inert atmosphere (N_2) unless otherwise stated, with oven-dried glassware, using standard techniques. Dichloromethane from Acros (99.9%, Exra Dry, AcroSeal) was used for methodology reactions. Anhydrous solvents for substrate synthesis were obtained from solvent stills. Powdered 4 Å molecular sieves (MS) were activated prior to use by heating (250 °C) under high-vacuum (<1 mbar) and stored under N_2 in a round-bottomed flask. Primary amines and aldehydes were distilled prior to use and stored at 5 °C under N_2. All other commercial reagents were used as supplied unless otherwise stated.

Irradiation of the reaction mixture was achieved using a 40 W Kessil A160WE LED – Tuna blue aquarium light (max blue, max intensity). Reactions were conducted in clear hydrolytic borosilicate glass microwave vials (5 mL) from Kinesis with PTFE/silicon septum lined crimp caps.

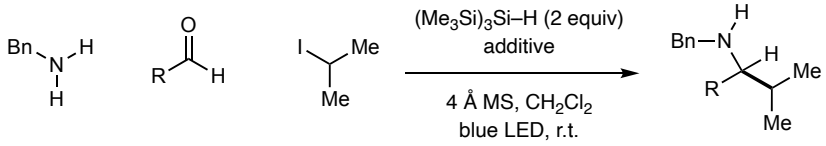
Analytical thin-layer chromatography (TLC) was performed on Merck Kieselgel 60 F254 0.20 mm precoated, glass backed silica gel plates. Visualization of the developed chromatogram was performed by UV absorbance (λ_{max} = 254 nm), and/or by aqueous $KMnO_4$ or ninhydrin stain. Flash column chromatography was performed using silica gel (Merck Geduran Si 60 [40-63 μm]) or alumina (Sigma Aldrich, activated, neutral, Brockmann I) with the indicated solvent system, or using a Teledyne Combi*Flash* NextGen 100 equipped with RediSef Rf Gold 4.0 g normal phase columns (20 – 40 μm spherical media) or RediSep Gold C18Aq 5.5 g reverse phase columns (20 – 40 μm spherical media). Strong cation exchange (SCX) chromatography was performed using HyperSep SCX cartridges (1000 mg bed weight) from Thermo Scientific.

NMR spectra were recorded at 400 MHz, 500 MHz, or 700 MHz on Bruker AM-400/500//700 instruments at 298 K unless otherwise specified. Samples were run in deuterated solvents. Chemical shifts (δ) for ^{1}H NMR spectra are reported in parts per million (ppm) relative to tetramethylsilane referenced to residual protic solvent ($CDCl_3$ = 7.26 ppm, CD_2Cl_2 = 5.32 ppm). Coupling constants (*J*) are reported in Hertz (Hz). Abbreviations for splitting patterns are as follows: s, singlet; d, doublet; t, triplet; q, quartet; p, pentet; hept, heptet; oct, octet; m, multiplet. Chemical shifts for ^{13}C NMR spectra were recorded with complete proton decoupling and are reported in ppm from tetramethylsilane referenced to the solvent resonance ($CDCl_3$ = 77.16 ppm, CD_2Cl_2 = 53.84 ppm). Chemical shifts for ^{19}F spectra were recorded with complete proton decoupling unless specified otherwise and are reported in ppm. Spectra were analysed using Mestrenova software. Where appropriate, proton and carbon assignments were deduced using 2D NMR methods (COSY, HSQC and HMBC). ^{1}H NMR yields were determined by analysis of crude reaction mixtures with reference to 1,1,2,2-tetrachloroethane as an internal standard.

IR spectra were recorded using neat samples with a Thermo Fisher Scientific Nicolet Summit PRO FTIR Spectrometer. Absorption maxima (ν_{max}) are given in wavenumbers in units of cm^{-1} with characteristic signals assigned. HRMS experiments were carried out using a Shimadzu LCMS-9030 Q-TOF mass spectrometer.

Compound names are those generated by PerkinElmer ChemDraw Professional v. 22.2.0.3348, according to IUPAC nomenclature.

2. Extended optimisation



1a **2a**, R = $(CH_2)_2Ph$ **2b**, R = *c*-C_6H_{11} **3a** **4a**, R = $(CH_2)_2Ph$ **4b**, R = *c*-C_6H_{11}

General procedure for optimization

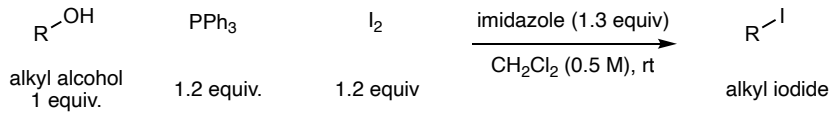
An oven-dried microwave vial was charged with a magnetic stirrer bar and 4 Å MS (100 mg, 50 mg/0.1 mmol amine). The vial was sealed and evacuate-refilled with N_2 (3 cycles). Dichloromethane (2 mL), benzylamine (22 μL, 0.2 mmol, 1.0 equiv), either hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) or cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv), isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv), tris(trimethylsilyl)silane (TTMSS, 123 μL, 0.4 mmol, 2.0 equiv), were added sequentially, followed by any additives. The reaction mixture was irradiated for 6 h with vigorous stirring. 10% aq. NaOH (2 mL) was added directly to the reaction mixture and the resulting biphasic mixture stirred vigorously for 20 min. The biphasic mixture was filtered through Celite into a separating funnel, washing the Celite pad with CH_2Cl_2 (3 × 5 mL) and water (3 × 5 mL). The organic phase was removed, the aqueous phase extracted with CH_2Cl_2 (2 × 10 mL) and the combined organic phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. The resulting crude amine was taken up in $CDCl_3$ (approx. 1.5 mL) followed by the addition of 1,1,2,2-tetrachloroethane (21 μL, 0.2 mmol, 1.0 equiv) as an internal standard and an aliquot analysed by ^1H NMR to determine the assay yield.

Entry	R	Additive	Assay yield (%)[a]
1	$(CH_2)_2Ph$	TBSOTf	0
2	$(CH_2)_2Ph$	none	11
3	$(CH_2)_2Ph$	TMSCl	37
4	$(CH_2)_2Ph$	TFA	40
5	$(CH_2)_2Ph$	propionic acid	0
6	$(CH_2)_2Ph$	$La(OTf)_3$	7
7	$(CH_2)_2Ph$	$ZnCl_2$	0
8	$(CH_2)_2Ph$	HFIP	29
9	$(CH_2)_2Ph$	HFIP + TMSCl	52 (41)
10	*c*-C_6H_{11}	TBSOTf	74
11	*c*-C_6H_{11}	none	88
12	*c*-C_6H_{11}	TMSCl	78
13	*c*-C_6H_{11}	TFA	82
14	*c*-C_6H_{11}	propionic acid	80
15	*c*-C_6H_{11}	HFIP	91
16	*c*-C_6H_{11}	HFIP + TMSCl	97 (86)
17	*c*-C_6H_{11}	None[a]	60
18	*c*-C_6H_{11}	HFIP[a]	73
19	*c*-C_6H_{11}	HFIP[b]	0

Table S1 [a]Assay yield determined by ^1H NMR using 1,1,2,2-tetrachloroethane as internal standard. Yield of isolated product shown in parentheses. HFIP: 2.5 equiv, other additives, 2 equiv. [a]Reaction conducted in the absence of molecular sieves. [b]Reaction conducted in the dark.

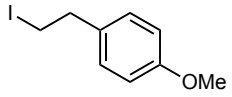
3. Synthesis of substrates

General procedure for the preparation of alkyl iodides



A 100 mL oven-dried multi-neck round-bottom flask was was charged with a magnetic stirrer bar and triphenylphosphine (1.2 equiv), imidazole (1.3 equiv), and DCM (0.5 M) were added under air. The flask was purged with nitrogen and placed in an ice-bath. The rubber septum was partly removed and iodine (1.2 equiv) was added under a stream of nitrogen, and then the alcohol was added portionwise. The reaction mixture was allowed to warm to room temperature and stirred overnight. $Na_2S_2O_3$ was added to quench the reaction. The layers were separated, the aqueous phase extracted with CH_2Cl_2 (2 × 25 mL), and the combined organic phase dried over Na_2SO_4, and filtered. The solvent was removed *in vacuo* and the crude product was purified by column chromatography.

1-(2-Iodoethyl)-4-methoxybenzene, S1



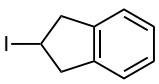
Prepared according to the general procedure, using 4-methoxyphenethyl alcohol (2.23 g, 15 mmol, 1.0 equiv), triphenylphosphine (4.72 g, 18 mmol, 1.2 equiv), imidazole (1.33 g, 19.5 mmol, 1.3 equiv), iodine (4.57 g, 18 mmol, 1.2 equiv), in DCM (30 ml) and purified by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a yellow solid (3.61 g, 13.8 mmol, 92 %).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.14 – 7.08 (m, 2H), 6.88 – 6.82 (m, 2H), 3.80 (s, 3H), 3.32 (td, *J* = 7.7, 0.8 Hz, 2H), 3.12 (t, *J* = 7.8 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 158.6, 133.0, 129.5, 114.2, 55.4, 39.7, 6.5.

S1 is a known compound and its NMR spectra are in accord with published data.[1]

2-Iodo-2,3-dihydro-1*H*-indene, S2



Prepared according to the general procedure, using 2-indanol (2.01 g, 15 mmol, 1 equiv), triphenylphosphine (4.72 g, 18 mmol, 1.2 equiv), imidazole (1.33 g, 19.5 mmol, 1.3 equiv),

iodine (4.57 g, 18 mmol, 1.2 equiv), in DCM (30 ml) and purified by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as white flakes (3.12 g, 12.8 mmol, 85%).

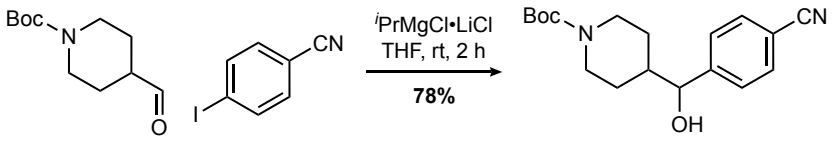
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 (td, J = 4.8, 2.3 Hz, 2H), 7.36 – 7.32 (m, 2H), 4.79 (tt, *J* = 6.4, 5.0 Hz, 1H), 3.58 (dd, *J* = 16.8, 6.4 Hz, 2H), 3.51 (dd, *J* = 16.8, 5.1 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 141.6, 127.2, 124.5, 46.8, 24.5.

S2 is a known compound and its NMR spectra are in accord with published data.[2]

Preparation of diamine starting materials

***tert*-Butyl 4-((4-cyanophenyl)(hydroxy)methyl)piperidine-1-carboxylate, S3**



To an oven-dried three-necked flask charged with a stir bar was added 4-iodobenzonitrile (2.02 g, 8.8 mmol, 1.1 equiv) and the flask evacuate-refilled with N_2 (three cycles). Anhydrous THF (11 mL) was added and the resulting solution cooled to 0 °C. A solution of isopropylmagnesium chloride lithium chloride complex (1.3 M in THF, 8 mL, 10.4 mmol, 1.3 equiv) was added dropwise and the solution allowed to warm to rt over 30 min. The solution was cooled to 0 °C and *N*-Boc-4-piperidinecarboxaldehyde (1.71 g, 8.0 mmol, 1.0 equiv) was added dropwise as a solution in anhydrous THF (4 mL). The transfer was made quantitative by washing with THF (2 mL). The reaction mixture was stirred at 0 °C for 1 h and then quenched by the addition of sat. aq. NH_4Cl (4 mL). The resulting suspension was filtered through a silica plug eluting with EtOAc and then concentrated *in vacuo*. Purification by automated flash column chromatography on silica gel (20–35% EtOAc/PE, 80 g RediSep Silver) afforded the title compound as an off-white solid (1.94 g, 78%).

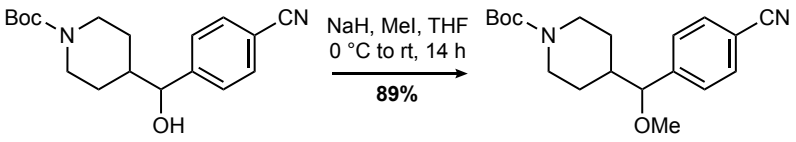
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 8.3 Hz, 2H), 7.41 (d, *J* = 8.3 Hz, 2H), 4.47 (d, *J* = 6.6 Hz, 1H), 4.07 (m, 2H), 2.69 – 2.47 (m, 3H), 1.79 (br d, *J* = 12.6 Hz, 1H), 1.70 (app dddd, *J* = 15.4, 11.7, 6.9, 3.6 Hz, 1H), 1.41 (s, 9H), 1.32 – 1.11 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 154.9, 148.6, 132.2, 127.4, 118.9, 111.4, 79.6, 77.5, 43.6 (br), 43.6, 28.5, 28.4, 27.6.

IR ν_{max}/cm^{-1} 3427 (br), 2975, 2932, 2860, 2227, 1666, 1427, 1366, 1279, 1166, 1131.

HRMS m/z (ESI) calculated for $C_{14}H_{17}N_2O_3$ $[M-{}^t\text{Bu}+H]^+$ 261.1234, found 261.1232.

***tert*-Butyl 4-((4-cyanophenyl)(methoxy)methyl)piperidine-1-carboxylate, S4**



To an oven-dried three-necked flask charged with a stir bar was added alcohol **S3** (1.27 g, 4.0 mmol, 1 equiv). Anhydrous THF (20 mL) was added and the resulting solution cooled to 0 °C followed by portionwise addition of NaH (60% dispersion in mineral oil, 320 mg, 8.0 mmol, 2 equiv). The reaction mixture was allowed to warm to rt over 1 h whereupon methyl iodide (0.50 mL, 8.0 mmol, 2 equiv) was added. The reaction was stirred for 16 h and then quenched by the addition of sat. aq. NH_4Cl (20 mL) and diluted with EtOAc (20 mL) and H_2O (10 mL). The mixture was transferred to a separating funnel, the layers separated and the aqueous phase extracted with EtOAc (2 × 20 mL). The combined organic phase was dried over Na_2SO_4, filtered and concentrated in vacuo. Purification by automated flash column chromatography on silica gel (10–20% EtOAc/PE, 80 g RediSep Silver) afforded the title compound as a pale-yellow oil (1.18 g, 89%).

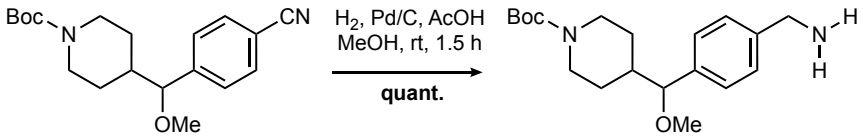
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 8.3 Hz, 2H), 7.34 (d, *J* = 8.3 Hz, 2H), 4.06 (br d, *J* = 30.4 Hz, 2H), 3.86 (d, *J* = 7.2 Hz, 1H), 3.17 (s, 3H), 2.67 – 2.42 (m, 2H), 1.92 – 1.83 (m, 1H), 1.67 (tdt, *J* = 11.3, 7.4, 3.8 Hz, 1H), 1.41 (s, 9H), 1.27 – 1.06 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 154.8, 146.2, 132.3, 128.1, 118.8, 111.7, 87.5, 79.5, 57.4, 43.7, 43.0, 28.5, 28.3.

IR ν_{max}/cm^{-1} 2976, 2932, 2856, 2227, 1686, 1422, 1365, 1166, 1097

HRMS m/z (ESI) calculated for $C_{15}H_{19}N_2O_3$ $[M-{}^t\text{Bu}+H]^+$ 275.1390, found 275.1387.

***tert*-Butyl 4-((4-(aminomethyl)phenyl)(methoxy)methyl)piperidine-1-carboxylate, S5**



To an oven-dried single-necked flask charged with a stir bar was sequentially added nitrile **S4** (1.06 g, 3.2 mmol, 1.0 equiv), methanol (LCMS grade, 32 mL) and acetic acid (1.46 mL, 25.6 mmol, 8 equiv). The flask was sealed with a fresh septum and evacuate-backfilled with N_2 (three cycles). Palladium on charcoal (10% w/w, 170 mg, 0.16 mmol, 5 mol% Pd) was added and the flask evacuate-backfilled with N_2. The flask was evacuate-backfilled with hydrogen (four cycles) and stirred vigorously (1500 rpm) at rt for 1.5 h. The atmosphere was returned to nitrogen by evacuate-backfilling three times and the reaction mixture filtered through a celite pad and concentrated *in vacuo*. The residue was stirred vigorously with CH_2Cl_2 (20 mL) and 10% aq. NaOH (20 mL) for 30 min. The layers were separated, the aqueous phase extracted with CH_2Cl_2 (2 × 10 mL) and the combined organic phase dried over Na_2SO_4, filtered and concentrated to afford the title compound as a viscous pale-yellow oil (1.07 g, quant.).

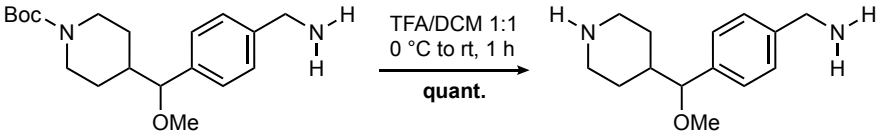
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.29 (d, *J* = 7.7 Hz, 2H), 7.19 (d, *J* = 7.7 Hz, 2H), 4.25 – 3.93 (m, 2H), 3.87 (s, 2H), 3.78 (d, *J* = 7.7 Hz, 1H), 3.17 (s, 3H), 2.72 – 2.46 (m, 2H), 2.03 – 1.93 (m, 1H), 1.70 (tdt, *J* = 11.5, 7.4, 3.7 Hz, 1H), 1.43 (s, 11H), 1.26 – 1.15 (m, 2H), 1.09 (qd, *J* = 12.6, 4.7 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 154.9, 142.9, 138.9, 127.7, 127.1, 88.0, 79.3, 57.0, 46.3, 43.8, 43.1, 28.9, 28.6, 28.5.

IR ν_{max}/cm^{-1} 2977, 2930, 2855, 2679, 1420, 1365, 1163, 1096, 909, 727.

HRMS m/z (ESI) calculated for $C_{19}H_{31}N_2O_3$ $[M+H]^+$ 335.2329, found 335.2331.

(4-(Methoxy(piperidin-4-yl)methyl)phenyl)methanamine, S6



An oven-dried microwave vial containing a stir bar was charged with *N*-Boc piperidine **S5** (83.6 mg, 0.25 mmol, 1 equiv). The vial was sealed with a septum and evacuate-backfilled with N_2 (three cycles). CH_2Cl_2 (1.25 mL) was added and the solution cooled to 0 °C. Trifluoroacetic acid (1.25 mL) was added dropwise and the solution allowed to warm to rt over 1 h. The volatiles were removed under a stream of N_2 with gentle heating and CH_2Cl_2 (2 mL) and 10% aq. NaOH (2 mL) added to the residue. The resulting biphasic mixture was stirred vigorously for 20 min and then transferred to a separating funnel The organic phase was removed, the aqueous phase extracted with CH_2Cl_2 (2 x 5 mL), and the combined organic phase dried over Na_2SO_4, filtered and concentrated *in vacuo* to afford the title compound as a yellow oil (59.6 mg, quant.)

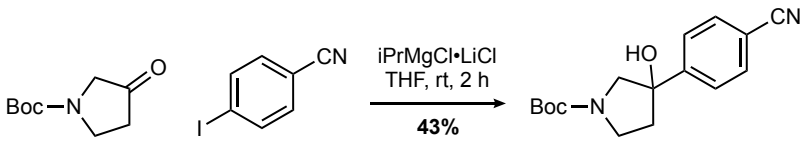
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 (d, *J* = 8.0 Hz, 2H), 7.21 (d, *J* = 8.1 Hz, 2H), 3.87 (s, 2H), 3.78 (d, *J* = 7.7 Hz, 1H), 3.18 (s, 3H), 3.09 (dt, *J* = 12.6, 3.5 Hz, 1H), 2.97 (dt, *J* = 12.4, 3.5 Hz, 1H), 2.56 (td, *J* = 12.2, 2.7 Hz, 1H), 2.46 (td, *J* = 12.1, 2.9 Hz, 1H), 2.06 – 1.95 (m, 1H), 1.77 – 1.58 (m, 4H), 1.25 – 1.16 (m, 2H), 1.09 (qd, *J* = 12.0, 4.1 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 142.7, 139.1, 127.8, 127.0, 88.6, 56.9, 46.6, 46.6, 46.3, 43.2, 30.4, 29.8.

IR ν_{max}/cm^{-1} 3357 (br), 3289 (br), 2934, 2850, 2818, 1466, 1448, 1419, 1319, 1140, 1084, 809.

HRMS m/z (ESI) calculated for $C_{14}H_{23}N_2O$ $[M+H]^+$ 235.18049, found 235.17986.

***tert*-Butyl 3-(4-cyanophenyl)-3-hydroxypyrrolidine-1-carboxylate, S7**



To an oven-dried three-necked flask charged with a stir bar was added 4-iodobenzonitrile (2.02 g, 8.8 mmol, 1.1 equiv) and the flask evacuate-refilled with N_2 (three cycles). Anhydrous THF (11 mL) was added and the resulting solution cooled to 0 °C. A solution of isopropylmagnesium chloride lithium chloride complex (1.3 M in THF, 8 mL, 10.4 mmol, 1.3 equiv) was added dropwise and the solution allowed to warm to rt over 30 min. The solution was cooled to 0 °C and *N*-Boc-3-pyrrolidinone (1.48 g, 8.0 mmol, 1.0 equiv) was added dropwise as a solution in anhydrous THF (4 mL). The transfer was made quantitative by washing with THF (2 mL). The reaction mixture was stirred at 0 °C for 1 h and then quenched by the addition of sat. aq. NH_4Cl (4 mL). The resulting suspension was filtered through a silica plug eluting with EtOAc and then concentrated *in vacuo*. Purification by automated flash column chromatography on silica gel (20–40% EtOAc/PE, 80 g RediSep Silver) afforded the title compound as an off-white solid (1.00 g, 78%).

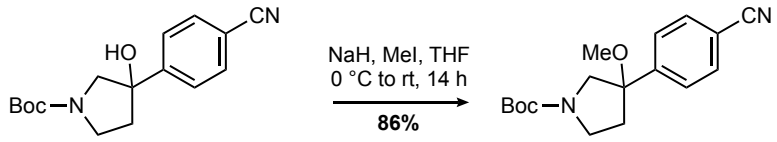
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.68 – 7.57 (m, 4H), 3.77 – 3.47 (m, 4H), 3.14 (s, 0.5H), 3.04 (s, 0.5H), 2.35 – 2.09 (m, 2H), 1.83 (s, 1H), 1.44 (s, 4.5H), 1.42 (s, 4.5H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.9, 154.7, 148.5, 148.3, 132.4, 126.3, 118.7, 111.6, 80.4, 80.1, 79.6, 59.9, 59.1, 45.2, 44.7, 40.3, 39.3, 28.6.

IR ν_{max}/cm^{-1} 3388 (br), 2976, 2228, 1663, 1404, 1366, 1169, 1135, 1116, 877, 834, 574, 554.

HRMS m/z (ESI) calculated for $C_{12}H_{13}N_2O_3$ $[M-{}^t\text{Bu}+H]^+$ 233.0921, found 233.0916.

***tert*-Butyl 3-(4-cyanophenyl)-3-methoxypyrrolidine-1-carboxylate, S8**



To an oven-dried three-necked flask charged with a stir bar was added alcohol **S7** (952 mg, 3.3 mmol, 1 equiv). Anhydrous THF (17 mL) was added and the resulting solution cooled to 0 °C followed by portionwise addition of NaH (60% dispersion in mineral oil, 264 mg, 6.6 mmol, 2 equiv). The reaction mixture was allowed to warm to rt over 1 h whereupon methyl iodide (0.50 mL, 8.0 mmol, 2 equiv) was added. The reaction was stirred for 16 h and then quenched by the addition of sat. aq. NH_4Cl (20 mL) and diluted with EtOAc (20 mL) and H_2O (10 mL). The mixture was transferred to a separating funnel, the layers separated and the aqueous phase extracted with EtOAc (2×20 mL). The combined organic phase was dried over Na_2SO_4, filtered and concentrated in vacuo. Purification by automated flash column chromatography on silica gel (10–20% EtOAc/PE, 40 g RediSep Silver) afforded the title compound as a colourless oil (860 mg, 86%).

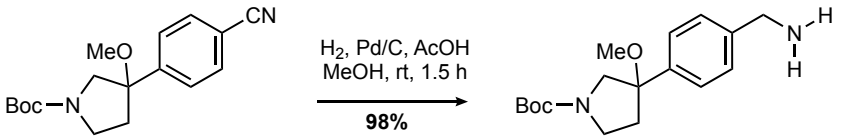
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.71 – 7.64 (m, 1H), 7.53 – 7.44 (m, 1H), 3.89 (d, *J* = 11.8 Hz, 0.5H), 3.77 (d, *J* = 11.7 Hz, 0.5H), 3.62 – 3.40 (m, 3H), 3.03 (s, 1.5H), 3.01 (s, 1.5H), 2.45 – 2.34 (m, 1H), 2.19 – 2.05 (m, 1H), 1.47 (s, 4.5H), 1.46 (s, 4.5H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.7, 154.5, 145.5, 145.4, 132.6, 127.4, 127.4, 118.6, 112.1, 85.3, 84.4, 79.8, 79.8, 55.8, 53.7, 51.7, 51.5, 44.5, 44.1, 35.9, 33.2, 28.6.

IR ν_{max}/cm^{-1} 2975, 2229, 1688, 1399, 1365, 1172, 1140, 1121, 1093, 1064, 881, 837, 770.

HRMS m/z (ESI) calculated for $C_{13}H_{15}N_2O_3$ $[M–^tBu+H]^+$ 247.1077, found 247.1072.

***tert*-Butyl 3-(4-(aminomethyl)phenyl)-3-methoxypyrrolidine-1-carboxylate, S9**



To an oven-dried single-necked flask charged with a stir bar was sequentially added nitrile **S8** (774 mg, 2.56 mmol, 1.0 equiv), methanol (LCMS grade, 26 mL) and acetic acid (1.17 mL, 20.5 mmol, 8 equiv). The flask was sealed with a fresh septum and evacuate-backfilled with N_2 (three cycles). Palladium on charcoal (10% w/w, 136 mg, 0.128 mmol, 5 mol% Pd) was added and the flask evacuate-backfilled with N_2. The flask was evacuate-backfilled with hydrogen (four cycles) and stirred vigorously (1500 rpm) at rt for 1.5 h. The atmosphere was returned to nitrogen by evacuate-backfilling three times and the reaction mixture filtered through a celite pad and concentrated *in vacuo*. The residue was stirred vigorously with CH_2Cl_2 (20 mL) and 10% aq. NaOH (20 mL) for 30 min. The layers were separated, the aqueous phase extracted with CH_2Cl_2 (2 × 10 mL) and the combined organic phase dried over Na_2SO_4, filtered and concentrated to afford the title compound as a viscous colourless oil (771 mg, 98%).

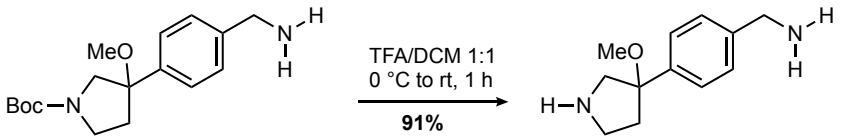
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 – 7.29 (m, 4H), 3.91 (d, *J* = 11.7 Hz, 0.5H), 3.87 (s, 2H), 3.79 (d, *J* = 11.6 Hz, 0.5H), 3.61 – 3.42 (m, 3H), 3.00 (s, 1.5H), 2.99 (s, 1.5H), 2.43 – 2.33 (m, 1H), 2.20 – 2.06 (m, 1H), 1.60 (br s, 2H), 1.47 (s, 4.5H), 1.46 (s, 4.5H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 154.7, 154.6, 143.0, 143.0, 138.2, 138.1, 127.2, 127.2, 126.8, 126.7, 85.3, 84.4, 79.3, 79.3, 56.0, 53.6, 51.1, 51.0, 46.0, 44.5, 44.1, 35.5, 32.8, 28.5.

IR ν_{max}/cm^{-1} 2975, 2932, 2889, 1689, 1402, 1365, 1173, 1141, 1120, 1093, 1067, 881.

HRMS m/z (ESI) calculated for $C_{17}H_{27}N_2O_3$ $[M+H]^+$ 307.2016, found 307.2015.

(4-(3-Methoxypyrrolidin-3-yl)phenyl)methanamine, S10



An oven-dried microwave vial containing a stir bar was charged with *N*-Boc pyrrolidine **S9** (83.6 mg, 0.25 mmol, 1 equiv). The vial was sealed with a septum and evacuate-backfilled with N_2 (three cycles). CH_2Cl_2 (1.25 mL) was added and the solution cooled to 0 °C. Trifluoroacetic acid (1.25 mL) was added dropwise and the solution allowed to warm to rt over 1 h. The volatiles were removed under a stream of N_2 with gentle heating and CH_2Cl_2 (2 mL) and 10% aq. NaOH (2 mL) added to the residue. The resulting biphasic mixture was stirred vigorously for 20 min and then transferred to a separating funnel The organic phase was removed, the aqueous phase extracted with CH_2Cl_2 (2 x 5 mL), and the combined organic phase dried over Na_2SO_4, filtered and concentrated *in vacuo* to afford the title compound as a yellow oil (47.1 mg, 91%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (d, *J* = 8.1 Hz, 2H), 7.29 (d, *J* = 8.2 Hz, 2H), 3.86 (s, 2H), 3.34 (d, *J* = 12.1 Hz, 1H), 3.23 (dt, *J* = 11.2, 7.8 Hz, 1H), 3.05 (ddd, *J* = 11.1, 9.3, 4.3 Hz, 1H), 2.99 (s, 3H), 2.88 (d, *J* = 12.2 Hz, 1H), 2.34 – 2.24 (m, 1H), 2.08 (dt, *J* = 13.5, 8.5 Hz, 1H), 1.88 (br s, 3H).

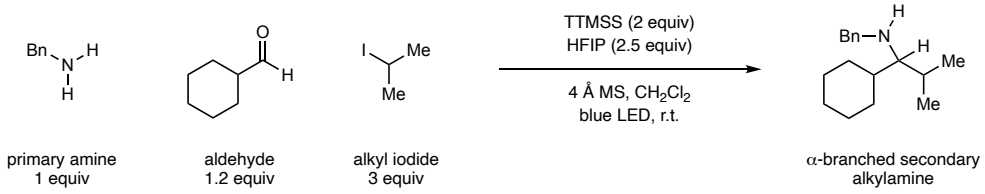
^{13}C NMR (101 MHz, $CDCl_3$) δ 142.6, 139.5, 127.1, 87.9, 57.4, 50.9, 46.1, 45.9, 35.6.

IR ν_{max}/cm^{-1} 3347 (br), 3291 (br), 2971, 2935, 2876, 1514, 1410, 1066, 880, 814.

HRMS m/z (ESI) $C_{12}H_{19}N_2O$ $[M+H]^+$ 207.1491, found 207.1490.

4. General procedures

General procedure for the multicomponent synthesis of α-branched secondary amines



primary amine 1 equiv | aldehyde 1.2 equiv | alkyl iodide 3 equiv | α-branched secondary alkylamine

An oven-dried microwave vial was charged with a magnetic stirrer bar and 4 Å MS (100 mg, 50 mg/0.1 mmol amine). The vial was sealed and evacuate-refilled with N_2 (3 cycles). Dichloromethane (2 mL), amine (0.2 mmol, 1.0 equiv), aldehyde (0.24 mmol, 1.2 equiv), alkyl iodide (0.6 mol, 3.0 equiv), tris(trimethylsilyl)silane (TTMSS, 123 μL, 0.4 mmol, 2.0 equiv), 1,1,1,3,3,3-hexafluoroisopropanol (HFIP, 54 μL, 0.5 mmol, 2.5 equiv) were added sequentially. The reaction mixture was irradiated for the specified time with vigorous stirring.

Two common modifications were used for certain substrates:

Modification 1
The reaction solvent was HFIP (0.4 mL) and CH_2Cl_2 (1.6 mL) (HFIP used as co-solvent rather than additive). The reagents were added in the same order as above (HFIP after TTMSS).

Modification 2
Chlorotrimethylsilane (TMSCl, 52 μL, 0.4 mmol, 2.0 equiv) was used as an additive (added to the reaction mixture last).

Following irradiation, the reaction mixture was worked up in one of two ways:

Workup A
The reaction mixture was filtered through Celite and concentrated *in vacuo*. The residue was triturated with hexane* (3 × 2 mL) and then dissolved in CH_2Cl_2 (10 mL) followed by the addition of 10% aq. NaOH (10 mL). The resulting biphasic mixture was stirred vigorously for 20 min. The mixture was transferred to a separating funnel and the organic phase removed. The aqueous phase was extracted with CH_2Cl_2 (2 × 10 mL) and the combined organic phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. The resulting crude amine was taken up in $CDCl_3$ (approx. 1.5 mL) followed by the addition of 1,1,2,2-tetrachloroethane (21 μL, 0.2 mmol, 1.0 equiv) as an internal standard and an aliquot analysed by ^1H NMR to determine the assay yield.
*If the hexane contained suspended solid, the washes were filtered through a plug of celite to catch the solid, which was subsequently returned to the bulk crude by washing the celite plug with CH_2Cl_2 (2 × 2 mL).

Workup B
10% aq. NaOH (2 mL) was added directly to the reaction mixture and the resulting biphasic mixture stirred vigorously for 20 min. The biphasic mixture was filtered through Celite into a separating funnel, washing the Celite pad with CH_2Cl_2 (3 × 5 mL) and water (3 × 5 mL). The organic phase was removed, the aqueous phase extracted with CH_2Cl_2 (2 × 10 mL) and the combined organic phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. The resulting crude amine was taken up in $CDCl_3$ (approx. 1.5 mL) followed by the addition of 1,1,2,2-

tetrachloroethane (21 μL, 0.2 mmol, 1.0 equiv) as an internal standard and an aliquot analysed by ^{1}H NMR to determine the assay yield.

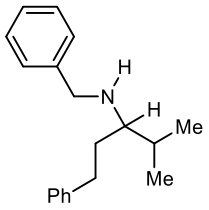
Procedure for strong cation exchange (SCX) chromatography

An SCX cartridge (1000 mg bed weight) was primed by washing with MeOH (3 × 5 mL), followed by loading of the crude sample onto the cartridge as a solution in MeOH. The cartridge was washed with MeOH (3 × 5 mL) and then the retained basic material eluted with 7 N NH_3 in MeOH (3 × 4 mL for mono-amines, 3 × 7 mL for diamines). The combined eluent was concentrated in vacuo.

5. Synthesis of α-branched secondary amines

Amine Scope

***N*-benzyl-4-methyl-1-phenylpentan-3-amine, 4a**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 µL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 µL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4a** in an assay yield of 52%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0 – 100% MeCN/H_2O) afforded the title compound as a yellow oil (22.0 mg, 0.08 mmol, 41%).

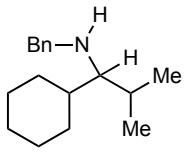
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 – 7.30 (m, 4H), 7.30 – 7.23 (m, 4H), 7.18 (m, 3H), 3.78 (d, *J* = 13.1 Hz, 1H), 3.77 (d, *J* = 13.1 Hz, 1H), 2.74 (ddd, *J* = 13.6, 10.2, 5.5 Hz, 1H), 2.61 (ddd, *J* = 13.7, 10.2, 6.1 Hz, 1H), 2.39 (dt, *J* = 7.8, 4.5 Hz, 1H), 1.91 (pd, *J* = 6.8, 4.7 Hz, 1H), 1.76 (dddd, *J* = 14.4, 10.5, 6.2, 4.4 Hz, 1H), 1.62 (dddd, *J* = 13.7, 10.2, 7.8, 5.6 Hz, 1H), 1.40 – 1.10 (br s, 1H), 0.91 (d, *J* = 6.8 Hz, 3H), 0.90 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.0, 129.2, 128.5, 128.5, 128.5, 128.4, 126.9, 125.8, 62.1, 51.9, 33.0, 32.6, 29.9, 18.9, 18.1.

IR ν_{max}/cm^{-1} 3025, 2955, 2869, 1603, 1495, 1453, 1385, 1367,745, 698.

HRMS m/z (ESI) calculated for $C_{19}H_{26}N$ $[M+H]^+$ 268.2060, found: 268.2060.

(*S*)-*N*-Benzyl-1-cyclohexyl-2-methylpropan-1-amine, 4b



Prepared according to the general procedure (employing modification 2), using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4b** in an assay yield of 97%. Purification by reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a colourless oil (42.2 mg, 0.172 mmol, 86%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.35 (m, 2H), 7.35 – 7.29 (m, 2H), 7.27 – 7.22 (m, 1H), 3.83 (d, *J* = 12.6 Hz, 1H), 3.79 (d, *J* = 12.6 Hz, 1H), 2.05 (t, *J* = 5.6 Hz, 1H), 1.91 – 1.81 (m, 1H), 1.91 – 1.60 (m, 5H), 1.48 – 1.36 (m, 1H), 1.31 – 1.03 (m, 5H), 0.99 (br s, 1H, NH), 0.95 (d, *J* = 6.8 Hz, 3H), 0.91 (d, *J* = 6.7 Hz, 3H).

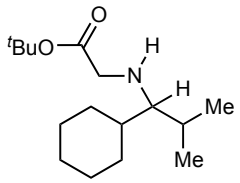
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.7, 128.4, 128.4, 126.9, 68.4, 56.3, 41.6, 31.4, 30.3, 29.1, 26.9, 26.9, 26.8, 21.1, 18.0.

IR ν_{max}/cm^{-1} 2921, 2850, 1450, 738, 698

HRMS m/z (ESI) calculated for $C_{17}H_{28}N$ $[M+H]^+$ 246.2216, found 246.2224.

4b is a known compound and its NMR spectra are in accord with published data.[3]

***tert*-Butyl (1-cyclohexyl-2-methylpropyl)glycinate, 4c**



Prepared according to the general procedure (employing modification 2), using glycine tert-butyl ester (26.23 mg, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), isopropyl iodide (60.0 µL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4f** in an assay yield of 84%. Purification by SCX followed by reverse phase flash column chromatography on C18 (0 – 100% MeCN/H_2O) afforded the title compound as a pale-yellow oil (36.8 mg, 0.137 mmol, 69%).

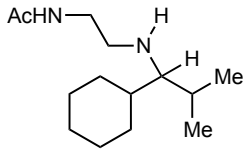
^{1}H NMR (400 MHz, $CDCl_3$) δ 3.35 (s, 2H), 1.88 (t, *J* = 5.4 Hz, 1H), 1.83 – 1.79 (m, 1H), 1.78 – 1.69 (m, 3H), 1.67 – 1.58 (m, 2H), 1.55 – 1.47 (m, 2H), 1.46 (s, 9H), 1.41 – 1.33 (m, 1H), 1.23 – 1.17 (m, 2H), 1.16 – 1.06 (m, 2H), 1.05 – 0.97 (m, 1H), 0.92 (d, *J* = 6.8 Hz, 3H), 0.89 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 172.1, 81.1, 69.6, 54.0, 41.4, 31.3, 30.2, 29.1, 28.3, 26.9, 26.8, 26.8, 21.0, 18.1.

IR ν_{max}/cm^{-1} 2924, 2852, 1734, 1449, 1392, 1367, 1229, 1156, 849

HRMS m/z (ESI) calculated for $C_{16}H_{32}NO_2$ $[M+H]^+$ 270.2428, found 270.2428

***N*-(2-((1-Cyclohexyl-2-methylpropyl)amino)ethyl)acetamide, 4d**



Prepared according to the general procedure, using glycine tert-butyl ester (19 µL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60.0 µL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4d** in an assay yield of 82%. Purification by SCX followed by reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a pale-yellow oil (34.1 mg, 0.137 mmol, 71%).

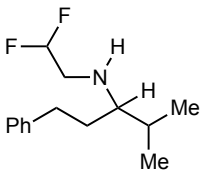
^{1}H NMR (400 MHz, $CDCl_3$) δ 6.18 (br s, 1H), 3.26 (m, 2H), 2.79 (m, 2H), 1.98 (s, 3H), 1.89 (t, J = 5.6 Hz, 1H), 1.83 – 1.70 (m, 4H), 1.69 – 1.58 (m, 2H), 1.37 (tdd, J = 11.5, 5.9, 3.0 Hz, 1H), 1.22 – 1.26 (m, 1H), 1.21 – 1.15 (m, 2H), 1.15 – 1.10 (m, 1H), 1.09 – 1.03 (m, 1H), 1.03 – 0.97 (m, 1H), 0.91 (d, J = 6.7 Hz, 3H), 0.86 (d, J = 6.7 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 170.0, 68.4, 50.2, 41.3, 40.0, 31.3, 30.0, 28.9 (2 C), 26.7, 26.5, 23.3, 21.0, 17.8.

IR ν_{max}/cm^{-1} 3286, 3088, 2923, 2851, 1651, 1558, 1448, 1372, 1295, 1112

HRMS m/z (ESI) calculated for $C_{14}H_{29}N_2O$ $[M+H]^+$ 241.2274, found 241.2271

***N*-(2,2-Difluoroethyl)-4-methyl-1-phenylpentan-3-amine, 4e**



Prepared according to the general procedure, using 2,2-difluoroethylamine (16 µL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 µL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 µL, 0.6 mmol, 3.0 equiv). The reaction mixture was worked up using method A to give crude **4e** in an assay yield of 85%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a pale-yellow oil (31.3 mg, 0.130 mmol, 65%). Although pure **4e** was not volatile (no mass change overnight on high-vacuum line), **4e** distilled together with water on a rotary evaporator (40 °C, 50 mbar). Therefore, after reverse phase flash column chromatography, the required fractions were extracted with DCM, dried with anhydrous sodium sulfate, and the solvent removed under reduced pressure (40 °C, 100 mbar).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 – 7.26 (m, 2H), 7.21 – 7.16 (m, 3H), 5.78 (tt, J = 56.7, 4.5 Hz, 1H), 3.03 – 2.84 (m, 2H), 2.74 (ddd, J = 13.7, 10.2, 5.5 Hz, 1H), 2.61 (ddd, J = 13.7, 10.0, 6.3 Hz, 1H), 2.33 (dt, J = 8.5, 4.5 Hz, 1H), 1.85 – 1.68 (m, 2H), 1.58 – 1.50 (m, 2H), 0.89 (d, J = 2.6 Hz, 3H), 0.88 (d, J = 2.6 Hz, 3H).

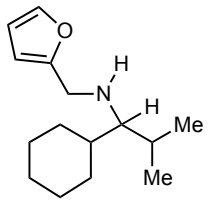
^{13}C NMR (101 MHz, $CDCl_3$) δ 142.6, 128.5, 128.5, 125.9, 116.6 (t, J_{CF} = 240 Hz), 62.8, 49.9 (t, J_{CF} = 25 Hz), 32.9, 32.8, 30.3, 18.6, 18.0.

^{19}F NMR (376 MHz, $CDCl_3$) δ –122.8.

IR ν_{max}/cm^{-1} 2922, 2850, 1670, 1602, 1495, 1453, 1374, 1119, 1060, 748,700.

HRMS m/z (ESI) calculated for $C_{14}H_{22}F_2$ $[M+H]^+$ 242.1742, found: 242.1741.

1-Cyclohexyl-*N*-(furan-2-ylmethyl)-2-methylpropan-1-amine, 4f



Prepared according to the general procedure (employing modification 2), using furfurylamine (18 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv), isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4c** in an assay yield of 71%. Purification by SCX followed by reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) with extraction using dichloromethane afforded the title compound as a pale-yellow oil (26.3 mg, 0.112 mmol, 56%).

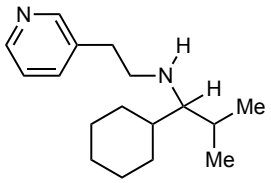
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (dd, *J* = 1.9, 0.9 Hz, 1H), 6.29 (dd, *J* = 3.2, 1.9 Hz, 1H), 6.15 (dd, *J* = 3.2, 0.9 Hz, 1H), 3.83 – 3.73 (m, 2H), 1.98 (t, *J* = 5.7 Hz, 1H), 1.85 – 1.81 (m, 1H), 1.80 – 1.77 (m, 1H), 1.77 – 1.69 (m, 2H), 1.65 (ddd, *J* = 8.8, 3.1, 1.5 Hz, 1H), 1.61 – 1.55 (m, 1H), 1.44 – 1.32 (m, 2H), 1.24 – 1.14 (m, 2H), 1.10 (dd, *J* = 11.9, 3.0 Hz, 1H), 1.07 – 0.96 (m, 2H), 0.88 (d, *J* = 6.8 Hz, 3H), 0.86 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 154.9, 141.6, 110.1, 106.7, 67.6, 48.1, 41.5, 31.1, 30.1, 28.9, 26.9, 26.8, 26.8, 20.8, 17.9.

IR ν_{max}/cm^{-1} 2924, 2851, 1669, 1579, 1449, 1170, 732.

HRMS m/z (ESI) calculated for $C_{15}H_{26}NO$ $[M+H]^+$ 236.2009, found 236.2011.

1-Cyclohexyl-2-methyl-*N*-(2-(pyridin-3-yl)ethyl)propan-1-amine, 4g



Prepared according to the general procedure, using 3-(2-aminoethyl)pyridine (24 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 4.5 h. The reaction mixture was worked up using method A to give crude **4g** in an assay yield of 50%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a pale-yellow oil (18.3 mg, 0.070 mmol, 35%).

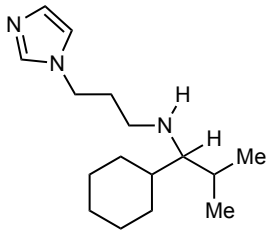
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.48 (d, *J* = 2.3 Hz, 1H), 8.45 (dd, *J* = 4.8, 1.7 Hz, 1H), 7.54 (dt, *J* = 7.8, 2.0 Hz, 1H), 7.20 (ddd, *J* = 7.8, 4.9, 0.9 Hz, 1H), 2.95 – 2.83 (m, 2H), 2.74 (t, *J* = 7.1 Hz, 2H), 1.86 (t, *J* = 5.7 Hz, 1H), 1.79 – 1.74 (m, 1H), 1.74 – 1.72 (m, 1H), 1.71 – 1.66 (m, 2H), 1.63 (ddq, *J* = 12.4, 3.5, 1.7 Hz, 1H), 1.56 (ddt, *J* = 12.5, 3.5, 1.8 Hz, 1H), 1.33 (dddt, *J* = 11.9, 9.0, 6.1, 3.0 Hz, 1H), 1.24 – 1.12 (m, 3H), 1.09 (dt, *J* = 12.6, 3.2 Hz, 1H), 1.02 – 0.91 (m, 2H), 0.84 (d, *J* = 6.8 Hz, 3H), 0.81 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 150.4, 147.7, 136.3, 136.0, 123.3, 69.0, 53.1, 41.5, 34.7, 31.3, 30.2, 29.0, 26.8, 26.8, 26.7, 21.0, 18.0.

IR ν_{max}/cm^{-1} 2925, 2851, 1477, 1449, 1422, 1107, 799, 714.

HRMS m/z (ESI) calculated for $C_{17}H_{29}N_2$ $[M+H]^+$ 261.2325, found 261.2330.

***N*-(3-(1*H*-Imidazol-1-yl)propyl)-4-methyl-1-phenylpentan-3-amine, 4h**



An oven-dried microwave vial was charged with a magnetic stirrer bar and 4 Å MS (100 mg). The vial was sealed and evacuate-refilled with N_2 (3 cycles). Dichloromethane (1.6 mL), 1-(3-aminopropyl)imidazole (24 μL, 0.2 mmol, 1.0 equiv) and cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) were added and the resulting mixture stirred at rt for 15 min. Isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv), TTMSS (123 μL, 0.4 mmol, 2.0 equiv), HFIP (0.4 mL) and TMSCl (52 μL, 0.4 mmol, 2.0 equiv) were added sequentially and the resulting mixture irradiated for 6 h. The reaction mixture was worked up using method B to give crude **4h** in quantitative assay yield. Purification by SCX chromatography afforded the title compound as a pale-yellow oil (51.7 mg, 0.196 mmol, 98%)

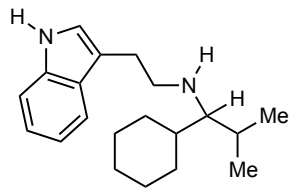
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 (s, 1H), 7.03 (br s, 1H), 6.90 (br s, 1H), 4.04 (t, *J* = 7.0 Hz, 2H), 2.68 – 2.56 (m, 2H), 1.91 – 1.80 (m, 3H), 1.80 – 1.68 (m, 4H), 1.67 – 1.55 (m, 2H), 1.38 – 1.28 (m, 1H), 1.27 – 0.92 (m, 6H), 0.88 (d, *J* = 6.7 Hz, 3H), 0.84 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 137.3, 129.5, 118.9, 68.8, 48.2, 45.0, 41.5, 32.6, 31.4, 30.1, 29.1, 26.8, 26.8, 26.7, 21.1, 18.0.

IR ν_{max}/cm^{-1} 2921, 2849, 1507, 1448, 1228, 1109, 1076, 811, 730, 663

HRMS m/z (ESI) calculated for $C_{16}H_{30}N_3$ $[M+H]^+$ 264.2434, found 264.2438.

***N*-(2-(1*H*-Indol-3-yl)ethyl)-1-cyclohexyl-2-methylpropan-1-amine, 4i**



Prepared according to the general procedure, using tryptamine (32.1 mg, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29.1 μL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4i** in an assay yield of 94%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a yellow oil (48.4 mg, 0.162 mmol, 81%).

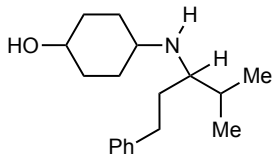
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (br s, 1H), 7.63 (dt, *J* = 7.8, 1.0 Hz, 1H), 7.36 (dt, *J* = 8.2, 1.0 Hz, 1H), 7.19 (ddd, *J* = 8.2, 7.0, 1.2 Hz, 1H), 7.11 (ddd, *J* = 8.0, 7.0, 1.0 Hz, 1H), 7.07 (d, *J* = 1.7 Hz, 1H), 3.02 – 2.91 (m, 4H), 1.90 (t, *J* = 5.7 Hz, 1H), 1.82 – 1.77 (m, 1H), 1.76 – 1.58 (m, 5H), 1.54 (ddt, *J* = 12.7, 3.5, 2.0 Hz, 1H), 1.36 (tdt, *J* = 11.9, 6.3, 3.2 Hz, 1H), 1.23 – 1.12 (m, 2H), 1.10 – 1.02 (m, 1H), 1.02 – 0.89 (m, 2H), 0.84 (d, *J* = 6.8 Hz, 3H), 0.82 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 136.5, 127.7, 122.1, 122.0, 119.3, 119.1, 114.6, 111.2, 69.2, 52.3, 41.4, 31.2, 30.1, 29.0, 26.8, 26.8, 26.7, 26.6, 20.9, 18.1.

IR ν_{max}/cm^{-1} 3416, 3056, 2921, 2849, 1455, 1353, 1104, 738.

HRMS m/z (ESI) calculated for $C_{20}H_{31}N_2$ $[M+H]^+$ 299.2482, found 299.2484.

4-((4-Methyl-1-phenylpentan-3-yl)amino)cyclohexan-1-ol, 4j



Prepared according to the general procedure, using *trans*-4-aminocyclohexanol (23.0 mg, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv). The reaction mixture was worked up using method A to give crude **4j** in an assay yield of 85%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a colorless oil (35.3 mg, 0.128 mmol, 64%).

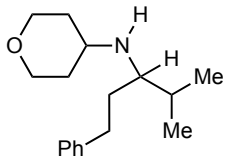
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 – 7.26 (m, 2H), 7.19 (m, 3H), 3.61 (tt, *J* = 10.5, 4.3 Hz, 1H), 2.71 (ddd, *J* = 13.6, 10.4, 5.7 Hz, 1H), 2.59 (ddd, *J* = 13.7, 10.3, 6.0 Hz, 1H), 2.45 (ddt, *J* = 10.6, 6.8, 3.8 Hz, 1H), 2.39 (dt, *J* = 7.5, 4.3 Hz, 1H), 1.96 (dtt, *J* = 11.6, 3.5, 1.6 Hz, 2H), 1.92 – 1.77 (m, 3H), 1.71 (dddd, *J* = 13.6, 10.5, 6.0, 4.6 Hz, 1H), 1.57 – 1.47 (m, 3H), 1.28 (m, *J* = 11.7, 10.1, 4.1, 2.4 Hz, 2H), 1.19 – 1.06 (m, 2H), 0.87 (d, *J* = 6.9 Hz, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 142.9, 128.5, 128.5, 125.8, 70.7, 59.7, 53.9, 34.3, 34.3, 33.4, 33.1, 32.1, 32.0, 30.4, 18.7, 18.0.

IR ν_{max}/cm^{-1} 3337, 3025, 2928, 2855, 1495, 1453, 1368, 1109, 1057, 749, 699.

HRMS m/z (ESI) calculated for $C_{18}H_{30}NO$ $[M+H]^+$ 276.2322, found 276.2322.

***N*-(4-Methyl-1-phenylpentan-3-yl)tetrahydro-2*H*-pyran-4-amine, 4k**



Prepared according to the general procedure using 4-aminotetrahydropyran (21 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4k** in an assay yield of 95%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a colourless oil (39.2 mg, 0.150 mmol, 75%).

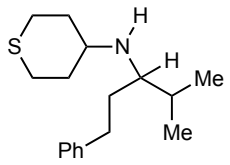
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32 – 7.26 (m, 2H), 7.23 – 7.15 (m, 3H), 4.00 – 3.91 (m, 2H), 3.38 (tt, *J* = 11.4, 2.5 Hz, 2H), 2.77 – 2.56 (m, 3H), 2.44 (dt, *J* = 7.4, 4.5 Hz, 1H), 1.86 – 1.68 (m, 4H), 1.54 (dddd, *J* = 13.5, 10.2, 7.4, 5.8 Hz, 1H), 1.35 (dddd, *J* = 13.1, 11.3, 10.2, 4.4 Hz, 2H), 0.89 (d, *J* = 1.9 Hz, 3H), 0.88 (d, *J* = 1.9 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 142.9, 128.5, 128.5, 125.8, 67.0, 67.0, 58.8, 51.6, 34.7, 34.6, 33.3, 33.0, 30.3, 18.7, 18.0.

IR ν_{max}/cm^{-1} 2952, 2932, 2841, 1465,1452, 1367, 1141, 1111, 1088, 749, 699

HRMS m/z (ESI) calculated for $C_{17}H_{28}NO$ $[M+H]^+$ 262.2165, found 262.2174.

***N*-(4-Methyl-1-phenylpentan-3-yl)tetrahydro-2*H*-thiopyran-4-amine, 4l**



Prepared according to the general procedure using tetrahydro-2*H*-thiopyran-4-amine (21 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4l** in quantitative assay yield. Purification by SCX chromatography afforded the title compound as a yellow oil (47.6 mg, 0.172 mmol, 86%).

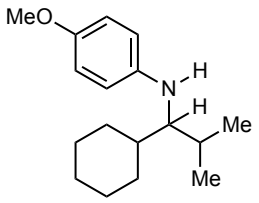
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 – 7.26 (m, 2H), 7.22 – 7.15 (m, 3H), 2.77 – 2.53 (m, 6H), 2.47 (tt, *J* = 9.9, 3.5 Hz, 1H), 2.41 (dt, *J* = 7.4, 4.4 Hz, 1H), 2.14 – 2.02 (m, 2H), 1.84 – 1.66 (m, 2H), 1.56 – 1.42 (m, 3H), 0.88 (app s, 3H), 0.87 (app s, 3H), 0.67 (br s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 142.9, 128.5, 128.5, 125.8, 58.9, 53.3, 35.4, 35.3, 33.3, 33.0, 30.3, 27.6, 27.6, 18.7, 18.0.

IR ν_{max}/cm^{-1} 2925, 1495, 1453, 1427, 1268, 1104, 748, 698

HRMS m/z (ESI) calculated for $C_{17}H_{28}NS$ $[M+H]^+$ 278.1937, found 278.1943.

4-Methoxy-*N*-(4-methyl-1-phenylpentan-3-yl)aniline, 4m



Prepared according to the general procedure (employing modification 2), using p-anisidine (24.63 mg, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60.0 µL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4m** in an assay yield of 67%. Purification by SCX followed by reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a pale-yellow oil (31.8 mg, 0.122 mmol, 61%).

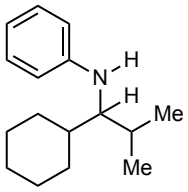
^{1}H NMR (400 MHz, $CDCl_3$) δ 6.75 – 6.69 (m, 2H), 6.56 – 6.49 (m, 2H), 3.73 (s, 3H), 2.84 (t, J = 6.1 Hz, 1H), 1.88 (m, 1H), 1.84 – 1.77 (m, 1H), 1.78 – 1.49 (m, 5H), 1.49 – 1.38 (m, 1H), 1.28 – 1.06 (m, 4H), 1.01 – 0.94 (m, 1H), 0.93 (d, J = 6.8 Hz, 3H), 0.87 (d, J = 6.7 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 150.9, 145.0, 115.0, 113.4, 64.5, 56.0, 41.8, 31.4, 30.6, 28.8, 26.7, 26.6, 26.6, 21.0, 17.8.

IR ν_{max}/cm^{-1} 2850, 2924, 1511, 1465, 1448, 1232, 1042, 813

HRMS m/z (ESI) calculated for $C_{17}H_{28}NO$ $[M+H]^+$ 262.2165, found 262.2163

***N*-(1-cyclohexyl-2-methylpropyl)aniline, 4m'**



Prepared according to the general procedure (employing modification 2), using aniline (18 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60.0 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4m'** in an assay yield of 67%. Purification by SCX chromatography followed by reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a colourless oil that darkened upon standing (24.6 mg, 0.106 mmol, 53%).

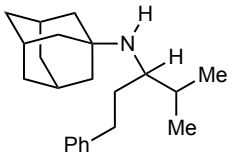
^{1}H NMR (700 MHz, CDCl3) δ 7.13 – 7.08 (m, 2H), 6.59 – 6.55 (m, 3H), 3.37 (br, 1H), 2.98 (t, *J* = 6.1 Hz, 1H), 1.90 (pd, *J* = 6.8, 5.7 Hz, 1H), 1.83 – 1.78 (m, 1H), 1.75 – 1.70 (m, 2H), 1.69 – 1.61 (m, 2H), 1.47 (tdt, *J* = 11.5, 6.5, 3.3 Hz, 1H), 1.25 – 1.08 (m, 5H), 0.94 (d, *J* = 6.7 Hz, 3H), 0.88 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (176 MHz, $CDCl_3$) 150.2, 129.2, 115.8, 112.2, 63.1, 41.5, 31.1, 30.3, 28.6, 26.5, 26.4, 26.4, 20.8, 17.5.

IR ν_{max}/cm^{-1} 2925, 2851, 1599, 1507, 1489

Data consistent with that reported in the literature: Yao, Z.; Yang, J.; Luo, Z.; Wang, H.; Zhang, X.; Ye, J.; Xu, L.; Shi, Q. *Green Chem.* **2022**, *24*, 7968.

(3s,5s,7s)-*N*-(4-Methyl-1-phenylpentan-3-yl)adamantan-1-amine, 4n



Prepared according to the general procedure (employing modification 2), using 1-adamantylamine (30.3 mg, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv), isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4n** in a quantitative assay yield. Purification by SCX chromatography afforded the title compound as a yellow oil (51.7 mg, 0.166 mmol, 83%).

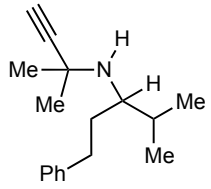
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 (tt, *J* = 7.4, 1.4 Hz, 2H), 7.22 – 7.14 (m, 3H), 2.73 – 2.57 (m, 2H), 2.56 (dd, *J* = 6.1, 3.7 Hz, 1H), 2.04 (p, *J* = 3.1 Hz, 3H), 1.82 – 1.69 (m, 2H), 1.68 – 1.47 (m, 13H), 0.89 (d, *J* = 6.8 Hz, 3H), 0.87 (d, *J* = 6.8 Hz, 3H) 0.57 (br s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.2, 128.5, 128.4, 125.7, 54.3, 50.7, 44.5, 36.9, 35.8, 33.4, 32.1, 29.9, 18.5, 18.4.

IR ν_{max}/cm^{-1} 2901, 2847, 1495, 1452, 1380, 1356, 1343, 1310, 1143, 1097, 1030, 748, 698.

HRMS m/z (ESI) calculated for $C_{22}H_{34}N$ $[M+H]^+$ 312.2686, found 312.2682.

4-Methyl-*N*-(2-methylbut-3-yn-2-yl)-1-phenylpentan-3-amine, 4o



Prepared according to the general procedure using 1,1-dimethyl-prop-2-ynylamine (21 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4o** in an assay yield of 85%. Purification by SCX chromatography afforded the title compound as a colourless oil (37.2 mg, 0.152 mmol, 76%).

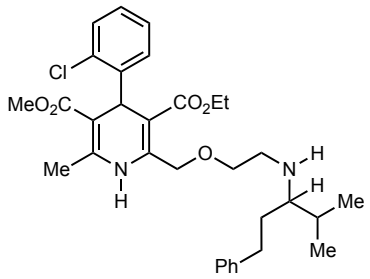
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 – 7.26 (m, 2H), 7.23 – 7.15 (m, 3H), 2.79 – 2.58 (m, 3H), 2.25 – 2.22 (s, 1H), 1.96 (heptd, *J* = 6.8, 3.9 Hz, 1H), 1.87 – 1.63 (m, 2H), 1.36 (br s, 6H), 1.06 (br s, 1H), 0.91 (d, *J* = 6.6 Hz, 3H), 0.89 (d, *J* = 6.6 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.2, 128.5, 128.4, 125.7, 90.8, 69.4, 58.5, 49.5, 34.5, 33.2, 31.3, 31.2, 31.2, 18.5, 18.1.

IR ν_{max}/cm^{-1} 2956, 1454, 1194, 749, 698, 635.

HRMS m/z (ESI) calculated for $C_{17}H_{26}N$ $[M+H]^+$ 244.2060, found 244.2067.

3-Ethyl 5-methyl 4-(2-chlorophenyl)-6-methyl-2-((2-((4-methyl-1-phenylpentan-3-yl)amino)ethoxy)methyl)-1,4-dihydropyridine-3,5-dicarboxylate, 4p



Prepared according to the general procedure using amlodipine base (81.8 mg, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4p** in an assay yield of 58%. Purification by flash column chromatography on neutral alumina (0–20% EtOAc/PE) afforded the title compound as a yellow oil (40.1 mg, 0.07 mmol, 35%) as a 1:1 mixture of diastereomers.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.35 (m, 2H), 7.32 – 7.26 (m, 2H), 7.25 – 7.16 (m, 4H), 7.10 (tdd, *J* = 7.1, 5.2, 1.5 Hz, 1H), 7.03 (tt, *J* = 7.4, 1.8 Hz, 1H), 5.41 (s, 1H), 4.78 (d, *J* = 16.4 Hz, 1H), 4.69 (d, *J* = 16.5 Hz, 1H), 4.11 – 3.98 (m, 2H), 3.67 – 3.60 (m, 2H), 3.61 (s, 3H), 2.91 – 2.81 (m, 2H), 2.76 (dddd, *J* = 13.0, 10.2, 5.7, 2.5 Hz, 1H), 2.70 – 2.58 (m, 1H), 2.37 – 2.29 (m, 1H), 2.32 (s, 3H), 1.91 – 1.73 (m, 2H), 1.68 – 1.55 (m, 2H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.97 – 0.88 (m, 6H).

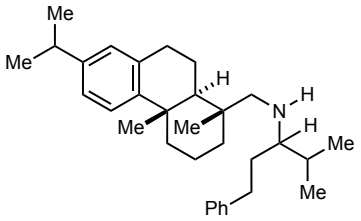
^{13}C NMR (101 MHz, $CDCl_3$) δ 168.2, 167.3, 145.9, 145.8*, 144.1*, 142.6*, 132.5*, 131.6, 129.4, 128.5, 128.4*, 127.5, 127.0*, 125.9*, 104.1, 101.5*, 71.7*, 68.0, 63.0*, 59.9, 50.9, 46.9*, 37.4, 33.1*, 32.7*, 30.3*, 19.6, 19.0*, 18.4*, 14.4.

* Peak split due to presence of two diastereomers.

IR ν_{max}/cm^{-1}: 2975, 2932, 2889, 1689, 1402, 1365, 1173, 1141, 1120, 1093, 1067, 881.

HRMS m/z (ESI) calculated for $C_{32}H_{42}N_2O_5Cl$ $[M+H]^+$ 569.2777, found 569.2754.

***N*-(((1R,4aS,10aR)-7-Isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)methyl)-4-methyl-1-phenylpentan-3-amine, 4q**



Prepared according to the general procedure (employing modification 2), using leelamine (57.1 mg, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4q** in an assay yield of 91%. SCX chromatography afforded the title compound as a pale-yellow oil (63.1 mg, 0.142 mmol, 71%) as a 1:1 mixture of diastereomers.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 – 7.27 (m, 2H), 7.24 – 7.16 (m, 4H), 7.02 (br d, *J* = 8.1 Hz, 1H), 6.91 (s, 1H), 2.97 – 2.88 (m, 2H), 2.85 (dt, *J* = 13.7, 7.8 Hz, 1H), 2.80 – 2.68 (m, 1H), 2.68 – 2.51 (m, 2H), 2.38 – 2.10 (m, 3H), 1.93 – 1.62 (m, 7H), 1.60 – 1.48 (m, 2H), 1.47 – 1.32 (m, 2H), 1.32 – 1.19 (m, 10H), 0.93 (s, 3H), 0.91 – 0.84 (m, 6H).

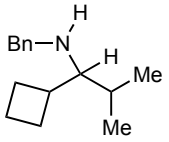
^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 147.8, 145.5, 145.5, 143.3, 143.2, 135.1, 135.0, 128.6, 128.5, 128.4, 128.4, 127.0, 126.9, 125.7, 125.7, 124.5, 124.5, 123.9, 63.6, 63.5, 59.6, 59.5, 45.1, 45.0, 38.7, 37.6, 37.4, 37.4, 36.3, 36.2, 33.6, 33.1, 33.0, 32.7, 32.7, 30.6, 30.6, 30.2, 30.0, 25.7, 25.6, 24.1, 19.8, 19.7, 19.1, 19.1, 19.1, 19.0, 18.9, 18.1, 17.9.

IR ν_{max}/cm^{-1}: 2954, 2927, 2867, 1496, 1453, 822, 697, 648

HRMS m/z (ESI) calculated for $C_{32}H_{48}N$ $[M+H]^+$ 446.3781, found 446.3779.

Aldehyde scope

***N*-Benzyl-1-cyclobutyl-2-methylpropan-1-amine, 4r**



Prepared according to the general procedure, using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), cyclobutanecarboxaldehyde (22 μL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4r** in an assay yield of 93%. Purification by SCX chromatography afforded the title compound as a pale-yellow oil (38.8 mg, 0.179 mmol, 88%).

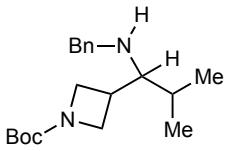
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.30 (m, 4H), 7.26 – 7.21 (m, 1H), 3.80 (d, *J* = 13.0 Hz, 1H), 3.76 (d, *J* = 13.0 Hz, 1H), 2.41 (td, *J* = 8.7, 7.0 Hz, 1H), 2.35 (dd, *J* = 9.0, 3.3 Hz, 1H), 2.07 – 1.99 (m, 1H), 1.95 – 1.89 (m, 1H), 1.84 – 1.67 (m, 5H), 1.16 – 0.95 (br s, 1H), 0.92 (d, *J* = 6.9 Hz, 3H), 0.86 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 141.7, 128.4, 128.3, 126.9, 67.9, 53.4, 39.7, 29.6, 27.9, 27.7, 19.3, 18.9, 18.2.

IR ν_{max}/cm^{-1} 2956, 2868, 1495, 1453, 1383, 1364, 1102, 1072, 1028, 738, 698.

HRMS m/z (ESI) calculated for $C_{15}H_{24}N$ $[M+H]^+$ 218.1903, found 218.1912.

***tert*-Butyl 3-(1-(benzylamino)-2-methylpropyl)azetidine-1-carboxylate, 4s**



Prepared according to the general procedure, using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), 1-Boc-azetidine-3-carboxaldehyde (44.5 mg, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4s** in an assay yield of 84%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a pale-yellow oil (52.0 mg, 0.149 mmol, 75%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 – 7.30 (m, 4H), 7.27 – 7.22 (m, 1H), 3.91 (dt, *J* = 12.8, 8.3 Hz, 2H), 3.85 (d, *J* = 12.9 Hz, 1H), 3.81 (dd, *J* = 8.4, 6.3 Hz, 1H), 3.74 (d, *J* = 12.9 Hz, 1H), 3.70 (dd, *J* = 8.4, 6.4 Hz, 1H), 2.65 (qt, *J* = 8.1, 6.3 Hz, 1H), 2.57 (dd, *J* = 8.3, 3.8 Hz, 1H), 1.86 (pd, *J* = 6.9, 3.8 Hz, 1H), 1.44 (s, 9H), 1.20 (br s, 1H), 0.90 (d, *J* = 6.9 Hz, 3H), 0.88 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.5, 141.1, 128.5, 128.3, 127.1, 79.3, 64.6, 53.1, 31.9, 30.2, 28.6, 18.8, 18.6.

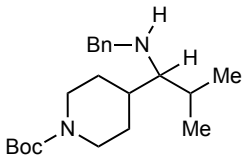
^{13}C NMR (101 MHz, $CDCl_3$, 323 K) δ 156.6, 141.2, 128.5, 128.3, 127.2, 79.3, 64.8, 53.3, 53.1*, 52.9*, 32.2, 30.4, 28.6, 18.9, 18.6.

* Peak not visible in the ^{13}C spectrum at 298 K due to peak broadening.

IR ν_{max}/cm^{-1} 2961, 2877, 1698, 1403, 1365, 1133, 699.

HRMS m/z (ESI) calculated for $C_{19}H_{31}N_2O_2$ $[M+H]^+$ 319.2380, found 319.2380.

***tert*-Butyl 4-(1-(benzylamino)-2-methylpropyl)piperidine-1-carboxylate, 4t**



Prepared according to the general procedure, using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), *N*-Boc-4-piperidinecarboxaldehyde (51 mg, 0.24 mmol, 1.2 equiv), and iodopropane (60 µL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4t** in an assay yield of 82%. Purification SCX chromatography followed by flash column chromatography on neutral alumina (0–5% EtOAc/PE) afforded the title compound as a colorless oil (51.2 mg, 0.148 mmol, 74%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38-7.28 (m, 4H), 7.24 (tt, *J* = 5.2, 2.6 Hz, 1H), 4.13 (m, 2H), 3.82 (d, *J* = 12.5 Hz, 1H), 3.76 (d, *J* = 12.5 Hz, 1H), 2.65 (t, *J* = 12.9 Hz, 2H), 2.09 (dd, *J* = 6.1, 5.1 Hz, 1H), 1.84 (m, 2H), 1.60 – 1.50 (m, 2H), 1.46 (s, 9H), 1.40 – 1.20 (m, 2H), 1.12 (br s, 1H), 0.97 (d, *J* = 6.7 Hz, 3 H), 0.90 (d, *J* = 6.7 Hz, 3 H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.0, 141.3, 128.5, 128.3, 127.1, 79.3, 67.5, 56.2, 44.1* (2C), 40.3, 30.1, 28.6, 21.0, 17.6.

* Peak not visible in the ^{13}C spectrum at 298 K but unambiguously identified by HSQC.

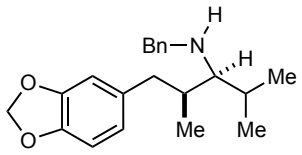
^{13}C NMR (101 MHz, $CDCl_3$, 323 K) δ 155.1, 141.5, 128.5, 128.3, 127.0, 79.3, 67.7, 56.0, 44.5† (2C), 40.4, 30.4†, 30.3, 28.7, 28.6†, 21.0, 17.8.

† Peak not visible in the ^{13}C spectrum at 298 K due to peak broadening.

IR ν_{max}/cm^{-1} 2957, 2930, 1690, 1452, 1422, 1364, 1278, 1233, 1171, 700.

HRMS m/z (ESI) calculated for $C_{21}H_{35}N_2O_2$ $[M+H]^+$ 347.2693, found 347.2683.

1-(Benzo[d][1,3]dioxol-5-yl)-N-benzyl-2,4-dimethylpentan-3-amine, 4u



Prepared according to the general procedure, using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), 2-methyl-3-(3,4-methylenedioxyphenyl)propionaldehyde (40 μL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv), and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4u** in an assay yield of 84%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a pale-yellow oil (45.5 mg, 0.140 mmol, 70%) as a 3:1 mixture of diastereomers.

Major diastereomer (*syn*-**4u**):

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.30 (m, 4H), 7.26 (m, 1H), 6.71(d, *J* = 7.9 Hz, 1H), 6.63(d, *J* = 1.2 Hz, 1H), 6.57(d, *J* = 7.9 Hz, 1H), 5.92 (br m, 2H), 3.88 (d, *J* = 12.7 Hz, 1H), 3.79 (d, *J* = 12.8 Hz, 1H), 2.70 (dd, *J* = 13.5, 6.0 Hz, 1H), 2.41 (dd, *J* = 13.4, 8.6 Hz, 1H), 2.23 – 2.15 (m, 1 H), 2.01 – 1.84 (m, 1 H), 1.80 (h, *J* = 6.7 Hz, 1H), 1.07 (br s, 1 H), 0.98 (d, *J* = 6.7 Hz, 3H), 0.93 (d, *J* = 6.7 Hz, 3H), 0.84 (d, *J* = 6.7 Hz, 3H).

Minor diastereomer (*anti*-**4u**):

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.30 (m, 4H), 7.26 (m, 1H), 6.73 (d, *J* = 7.8 Hz, 1H), 6.67 (d, *J* = 1.2 Hz, 1H), 6.61 (d, *J* = 7.8 Hz, 1H), 5.92 (br m, 2H), 3.85 (s, 2H), 2.95 (dd, *J* = 13.4, 3.8 Hz, 1H), 2.23 – 2.15 (m, 2H), 2.01 – 1.84 (m, 2H), 1.07 (br s, 1H), 1.02 (d, *J* = 6.7 Hz, 3H), 0.96 (d, *J* = 6.7 Hz, 3H), 0.85 (d, *J* = 6.7 Hz, 3H).

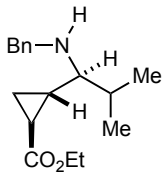
^{13}C NMR (101 MHz, $CDCl_3$) δ 147.4, 147.4, 145.4, 141.6, 141.4, 136.0, 135.7, 128.3, 128.3, 128.2, 128.2, 126.9, 126.8, 121.9, 121.9, 109.4, 109.4, 107.9, 107.9, 100.7 (br), 67.9, 66.3, 55.7, 55.2, 41.3, 38.9, 38.7, 37.5, 31.4, 30.4, 21.3, 20.5, 19.7, 18.2, 16.9, 14.2.

Assignment of relative configuration made computationally by comparing experimental spectra to those predicted using the gauge-independent atomic orbital method (GIAO) using the CP3 parameter (97.6% match in ^{1}H data; 99.6% match in ^{13}C data; 100.0% confidence overall).[8,9]

IR ν_{max}/cm^{-1} 2957, 2872, 1502, 1488, 1441, 1244, 1187, 1040, 931, 808, 700.

HRMS m/z (ESI) calculated for $C_{21}H_{28}NO_2$ $[M+H]^+$ 326.2115, found 326.2119.

Ethyl 2-(1-(benzylamino)-2-methylpropyl)cyclopropane-1-carboxylate, 4v



Prepared according to the general procedure, using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), ethyl 2-formyl-1-cyclopropanecarboxylate (32 μL, 0.24 mmol, 1.2 equiv), and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B. Purification by SCX afforded the title compound as a yellow oil (44.7 mg, 0.162 mmol, 81%) as a 1:1 mixture of diastereomers.

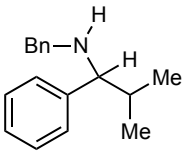
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.29 (m, 4H), 7.26 – 7.21 (m, 1H), 4.13 (m, 2H), 3.87 (dd, *J* = 13.2, 5.1 Hz, 1H), 3.79 (dd, *J* = 13.2, 5.1 Hz, 1H), 1.96 – 1.79 (m, 2H), 1.49 – 1.42 (m, 1H), 1.42–1.37 (m, 1H), 1.34 (br s, 1H), 1.26 (q, 4H, *J* = 6.8 Hz) 1.23 – 1.17 (m, 1H), 1.04 – 0.93 (m, 6H), 0.77 (dddd, *J* = 15.1, 8.3, 6.5, 4.1 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.2, 174.2, 140.9, 140.8, 128.4, 128.3, 128.0 (br), 126.9, 126.8, 65.1, 65.0, 60.4, 60.4, 51.9, 51.7, 32.1, 32.0, 25.3, 24.5, 19.0, 18.9, 18.8, 18.5, 18.5, 18.3, 14.3, 14.3, 13.5, 13.0.

IR ν_{max}/cm^{-1} 2691, 2877, 1698, 1402, 1365, 1133, 699.

HRMS m/z (ESI) calculated for $C_{17}H_{26}NO_2$ $[M+H]^+$ 276.1958, found 276.1965.

***N*-Benzyl-2-methyl-1-phenylpropan-1-amine, 4w**



Prepared according to the general procedure using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), benzaldehyde (25 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4w** in quantitative assay yield. Purification by SCX chromatography afforded the title compound as a colourless oil (46.1 mg, 0.192 mmol, 96%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.21 (m, 10H), 3.66 (d, *J* = 13.3 Hz, 1H), 3.49 (d, *J* = 13.7 Hz, 1H), 3.36 (d, *J* = 6.9 Hz, 1H), 1.89 (oct, *J* = 6.8 Hz, 1H), 1.66 (br s, 1H), 0.99 (d, *J* = 6.7 Hz, 3H), 0.77 (d, *J* = 6.8 Hz, 3H).

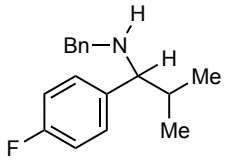
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.0, 141.1, 128.4, 128.3 (2C), 128.1, 126.9, 126.9, 68.9, 51.9, 34.6, 19.8, 19.6.

IR ν_{max}/cm^{-1} 2956, 1492, 1452, 742, 698

HRMS m/z (ESI) calculated for $C_{17}H_{22}N$ $[M+H]^+$ 240.1747, found 240.1753.

Data consistent with that reported in the literature.[3]

***N*-Benzyl-1-(4-fluorophenyl)-2-methylpropan-1-amine, 4x**



Prepared according to the general procedure using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), 4-fluorobenzaldehyde (26 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4x** in an assay yield of 90%. Purification by SCX chromatography afforded the title compound as a pale-yellow oil (43.5 mg, 0.17 mmol, 85%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.21 (m, 7H), 7.07 – 6.97 (m, 2H), 3.63 (d, *J* = 13.3 Hz, 1H), 3.45 (d, *J* = 13.3 Hz, 1H), 3.34 (d, *J* = 6.9 Hz, 1H), 1.83 (oct, *J* = 6.8 Hz, 1H), 1.65 (br s, 1H), 0.95 (d, *J* = 6.7 Hz, 3H), 0.73 (d, *J* = 6.8 Hz, 3H).

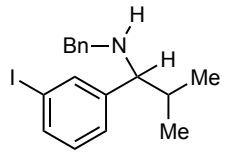
^{13}C NMR (101 MHz, $CDCl_3$) δ 162.0 (d, $^{1}J_{CF}$ = 244.1 Hz), 140.9, 138.5 (d, $^{4}J_{CF}$ = 3.0 Hz), 129.6 (d, $^{3}J_{CF}$ = 7.7 Hz), 128.5, 128.2, 127.0, 114.9 (d, $^{2}J_{CF}$ = 21.1 Hz), 68.1, 51.8, 34.6†, 19.8, 19.4.

^{19}F NMR (376 MHz, $CDCl_3$) δ –117.4.

IR ν_{max}/cm^{-1} 2958, 1602, 1506, 1454, 1220, 1155, 847, 828, 738, 698, 544

HRMS m/z (ESI) calculated for $C_{17}H_{21}NF$ $[M+H]^+$ 258.1653, found 258.1656.

***N*-Benzyl-1-(3-iodophenyl)-2-methylpropan-1-amine, 4y**



Prepared according to the general procedure using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), 3-iodobenzaldehyde (55.7 mg, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method A to give crude **4y** in an assay yield of 78%. Purification by automated flash column chromatography on silica gel (100% CH_2Cl_2) followed by SCX chromatography afforded the title compound as a pale-yellow oil (48.0 mg, 0.132 mmol, 66%).

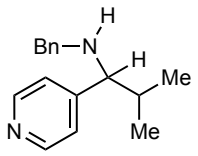
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 (t, *J* = 1.6 Hz, 1H), 7.59 (ddd, *J* = 7.8, 1.9, 1.1 Hz, 1H), 7.35 – 7.21 (m, 6H), 7.07 (t, *J* = 7.7 Hz, 1H), 3.64 (d, *J* = 13.3 Hz, 1H), 3.46 (d, *J* = 13.3 Hz, 1H), 3.29 (d, *J* = 6.9 Hz, 1H), 1.84 (oct, *J* = 6.7 Hz, 1H), 1.59 (br s, 1H), 0.96 (d, *J* = 6.7 Hz, 3H), 0.76 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 145.8, 140.8, 137.2, 136.0, 130.0, 128.5, 128.2, 127.6, 127.0, 94.5, 68.4, 51.9, 34.6, 19.6, 19.6.

IR ν_{max}/cm^{-1} 2957, 1563, 1453, 780, 734, 697

HRMS m/z (ESI) calculated for $C_{17}H_{21}NI$ $[M+H]^+$ 366.0713, found 366.0715.

***N*-Benzyl-2-methyl-1-(pyridin-4-yl)propan-1-amine, 4z**



Prepared according to the general procedure (employing modification 1) using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), 4-pyridinecarboxaldehyde (24 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 15 h. The reaction mixture was worked up using method B to give crude **4z** in an assay yield of 56%. Purification by SCX chromatography followed by flash column chromatography on neutral alumina (10–15% EtOAc/PE) afforded the title compound as a pale-yellow oil (16.8 mg, 0.070 mmol, 35%).

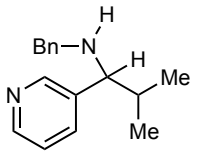
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 – 8.53 (m, 2H), 7.33 – 7.27 (m, 2H), 7.27 – 7.20 (m, 5H), 3.62 (d, *J* = 13.2 Hz, 1H), 3.45 (d, *J* = 13.3 Hz, 1H), 3.37 (d, *J* = 6.5 Hz, 1H), 1.86 (oct, *J* = 6.8 Hz, 1H), 1.78 (br s, 1H), 0.93 (d, *J* = 6.7 Hz, 3H), 0.76 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 152.2, 149.7, 140.5, 128.5, 128.2, 127.1, 123.6, 67.9, 51.9, 34.2, 19.3, 19.3.

IR ν_{max}/cm^{-1} 2958, 1597, 1453, 1411, 815, 738, 698, 562.

HRMS m/z (ESI) calculated for $C_{16}H_{21}N_2$ $[M+H]^+$ 241.1699, found 241.1703.

***N*-Benzyl-2-methyl-1-(pyridin-3-yl)propan-1-amine, 4aa**



Prepared according to the general procedure (employing modification 1) using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), nicotinaldehyde (23 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4aa** in an assay yield of 92%. Purification by flash column chromatography on neutral alumina (0–4% EtOAc/PE) followed by SCX chromatography afforded the title compound as a colourless oil (29.6 mg, 0.124 mmol, 62%).

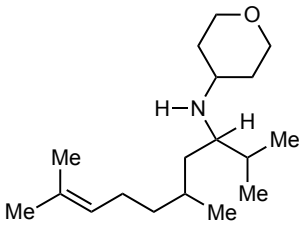
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 – 8.48 (m, 2H), 7.67 (dt, *J* = 7.8, 1.9 Hz, 1H), 7.33 – 7.21 (m, 6H), 3.62 (d, *J* = 13.3 Hz, 1H), 3.46 (d, *J* = 13.3 Hz, 1H), 3.41 (d, *J* = 6.7 Hz, 1H), 1.89 (oct, *J* = 6.8 Hz, 1H), 1.78 (br s, 1H), 0.95 (d, *J* = 6.7 Hz, 3H), 0.76 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 150.3, 148.6, 140.5, 138.1, 135.6, 128.5, 128.2, 127.1, 123.4, 66.4, 51.9, 34.4, 19.6, 19.2.

IR ν_{max}/cm^{-1} 2957, 2917, 2871, 2849, 1466, 1454, 1424, 719, 699.

HRMS m/z (ESI) calculated for $C_{16}H_{21}N_2$ $[M+H]^+$ 241.1699, found 241.1701.

***N*-(2,5,9-Trimethyldec-8-en-3-yl)tetrahydro-2*H*-pyran-4-amine, 4ab**



Prepared according to the general procedure using 4-aminotetrahydropyran (21 μL, 0.2 mmol, 1.0 equiv), (±)-citronellal (43 μL, 0.24 mmol, 1.2 equiv) isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h.The reaction mixture was worked up using method B to give crude **4ab** in 97% assay yield. Purification by SCX chromatography afforded the title compound as a colourless oil (54.3 mg, 0.192 mmol, 96%) as a 1:1 mixture of diastereomers.

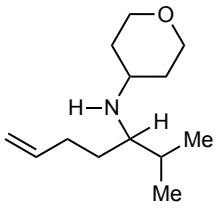
^{1}H NMR (400 MHz, $CDCl_3$) δ 5.08 (app. tdq, *J* = 7.1, 2.9, 1.5 Hz, 1H), 3.94 (app. dt, *J* = 11.5, 3.7 Hz, 2H), 3.43 – 3.32 (m, 2H), 2.66 (tt, *J* = 10.3, 4.1 Hz, 1H), 2.53 – 2.45 (m, 1H), 2.07 – 1.86 (m, 2H), 1.85 – 1.70 (m, 3H), 1.67 (s, 3H), 1.59 (s, 3H), 1.54 – 1.43 (m, 1H), 1.41 – 1.23 (m, 4H), 1.22 – 1.10 (m, 1H), 1.10 – 0.97 (m, 1H), 0.93 – 0.77 (m, 9H), 0.69 (br s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 131.3, 131.3, 125.0, 125.0, 67.2, 67.1, 67.1, 67.0, 56.3, 56.2, 51.6, 51.5, 39.4, 38.7, 38.1, 37.0, 35.1, 34.9, 34.5, 34.4, 30.4, 29.9, 29.4, 29.4, 25.9, 25.9, 25.7, 25.5, 20.6, 19.8, 18.6, 18.0, 17.9, 17.8, 17.8, 17.2.

IR ν_{max}/cm^{-1} 2954, 2925, 2869, 2843, 1464, 1376, 1169, 1142, 1115, 1088, 1009, 870, 819.

HRMS m/z (ESI) calculated for $C_{13}H_{26}NO$ $[M+H]^+$ 282.2791, found 282.2797.

***N*-(2-Methylhept-6-en-3-yl)tetrahydro-2*H*-pyran-4-amine, 4ac**



Prepared according to the general procedure using 4-aminotetrahydropyran (21 μL, 0.2 mmol, 1.0 equiv), 4-pentenal (24 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 16 h. The reaction mixture was worked up using method B to give crude **4ac** in an assay yield of 90%. Purification by automated flash column chromatography on silica gel (0–8% MeOH/CH_2Cl_2) afforded the title compound as a pale-yellow oil (29.6 mg, 0.14 mmol, 70%).

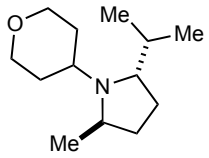
^{1}H NMR (400 MHz, $CDCl_3$) δ 5.80 (ddt, *J* = 16.9, 10.1, 6.6 Hz, 1H), 5.01 (dq, *J* = 17.1, 1.7 Hz, 1H), 4.94 (ddt, *J* = 10.2, 2.3, 1.3 Hz, 1H), 3.94 (dt, *J* = 11.9, 3.7 Hz, 2H), 3.37 (tt, *J* = 11.6, 2.3 Hz, 2H), 2.67 (tt, *J* = 10.3, 4.0 Hz, 1H), 2.39 (dt, *J* = 7.7, 4.4 Hz, 1H), 2.19 – 1.97 (m, 2H), 1.84 – 1.66 (m, 3H), 1.46 (dddd, *J* = 14.0, 9.5, 6.4, 4.6 Hz, 1H), 1.40 – 1.22 (m, 3H), 0.86 (d, *J* = 1.6 Hz, 3H), 0.84 (d, *J* = 1.5 Hz, 3H), 0.82 (br s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 139.2, 114.5, 67.0, 67.0, 58.6, 51.7, 34.7, 34.6, 30.9, 30.7, 30.4, 18.6, 18.0.

IR ν_{max}/cm^{-1} 2953, 2932, 2841, 1466, 1366, 1141, 1088, 1010, 909.

HRMS m/z (ESI) calculated for $C_{13}H_{26}NO$ $[M+H]^+$ 212.2009, found 212.2012.

***trans*-2-Isopropyl-5-methyl-1-(tetrahydro-2*H*-pyran-4-yl)pyrrolidine, 4ac'**



Prepared according to the general procedure (employing modification 2), using 4-aminotetrahydropyran (21 μL, 0.2 mmol, 1.0 equiv), 4-pentenal (24 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 16 h. The reaction mixture was worked up using method B to give the crude mixture. Purification by automated flash column chromatography on silica gel (0–8% MeOH/CH_2Cl_2) afforded first **4ac** (9.8 mg, 23%) followed by the title compound as a pale-yellow oil (1.6 mg, 0.008 mmol, 4%) as a single diastereomer.

^{1}H NMR (700 MHz, $CDCl_3$) δ 4.01 (td, *J* = 11.1, 4.5 Hz, 2H), 3.33 (qd, *J* = 11.9, 2.4 Hz, 2H), 3.07 (h, *J* = 6.3 Hz, 1H), 2.78 (q, *J* = 6.4 Hz, 1H), 2.69 (tt, *J* = 11.4, 4.1 Hz, 1H), 1.71 – 1.57 (m, 6H), 1.57 – 1.52 (m, 2H), 1.36 – 1.31 (m, 1H), 1.00 (d, *J* = 6.2 Hz, 3H), 0.86 (d, *J* = 6.9 Hz, 3H), 0.83 (d, *J* = 6.8 Hz, 3H).

Relative configuration confirmed by NOESY NMR.

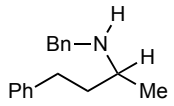
^{13}C NMR (176 MHz, $CDCl_3$) δ 68.7, 68.4, 66.3, 56.9, 54.2, 33.6, 32.2, 32.0, 29.1, 25.4, 24.0, 20.5, 16.9.

IR ν_{max}/cm^{-1} 2954, 2868, 2840, 1467, 1382, 1371, 1166, 1142, 1085, 1009.

HRMS m/z (ESI) calculated for $C_{13}H_{26}NO$ $[M+H]^+$ 212.2009, found 212.2013.

Iodide Scope

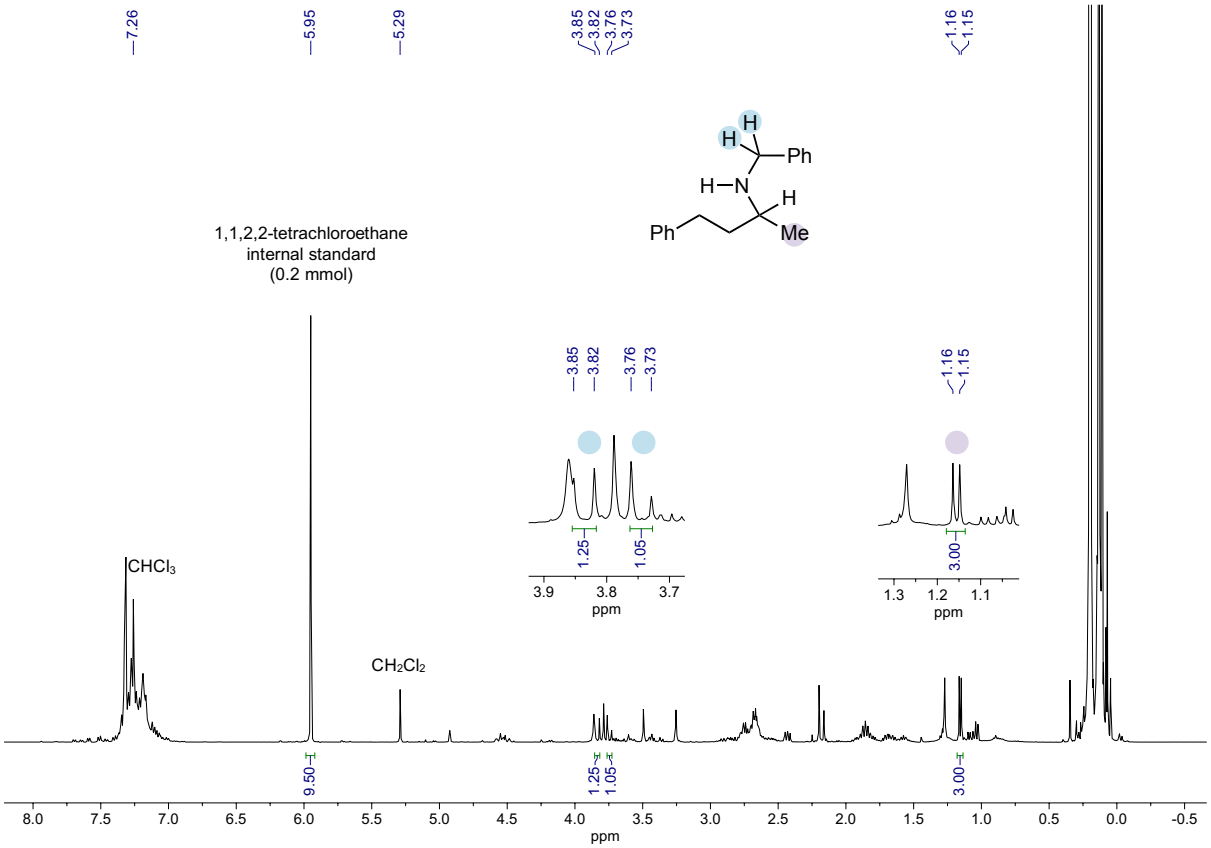
(*S*)-*N*-Benzyl-4-phenylbutan-2-amine, 4ad



Prepared according to the general procedure (employing modification 2), using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and methyl iodide (62 μL, 1.0 mmol, 5.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4ad** in an assay yield of 21%.

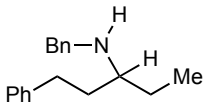
HRMS m/z (ESI) calculated for $C_{17}H_{22}N$ $[M+H]^+$ 240.1747, found 240.1478

Crude ^{1}H NMR



The observation of two diastereotopic 1H doublets at 3.84 and 3.75 ppm, and a 3H methyl doublet at 1.16 ppm, together are diagnostic for the formation of **4ad**. Comparison of the 3H methyl peak to the 2H internal standard peak gives an assay yield of 21%.

***N*-Benzyl-1-phenylpentan-3-amine, 4ae**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and iodoethane (48 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4ae** in an assay yield of 52%. Purification by SCX chromatography followed by automated flash column chromatography on silica gel (0–100% [10% Et_2O/PE + 3% NEt_3]/PE) afforded the title compound as a pale-yellow oil (20.6 mg, 0.082 mmol, 41%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 – 7.26 (m, 6H), 7.21 – 7.16 (m, 4H), 3.77 (AB q, *J* = 12.9 Hz, 2H), 2.67 (td, *J* = 8.1, 1.9 Hz, 2H), 2.57 (p, *J* = 5.9 Hz, 1H), 1.79 – 1.72 (m, 2H), 1.54 (qd, *J* = 7.4, 6.3 Hz, 2H), 1.46 (s, 1H), 0.92 (t, *J* = 7.4 Hz, 3H).

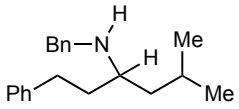
^{13}C NMR (101 MHz, $CDCl_3$) δ 142.9, 141.2, 128.5, 128.5, 128.3, 127.0, 125.8, 57.8, 51.2, 35.5, 32.2, 26.4, 9.9.

IR ν_{max}/cm^{-1} 2958, 2925, 1495, 1453, 743, 698

HRMS m/z (ESI) calculated for $C_{18}H_{24}N$ $[M+H]^+$ 254.1903, found 254.1902.

Data consistent with that reported in the literature.[4]

***N*-Benzyl-5-methyl-1-phenylhexan-3-amine, 4af**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and 1-iodo-2-methylpropane (69 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4af** in an assay yield of 55%. Purification by automated flash column chromatography on silica gel (0–100% [10% Et_2O/PE + 3% NEt_3]/PE) afforded the title compound as a pale-yellow oil (26.6 mg, 0.094 mmol, 47%).

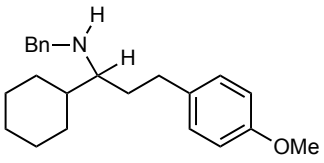
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 – 7.23 (m, 7H), 7.22 – 7.16 (m, 3H), 3.77 (AB q, *J* = 12.9 Hz, 2H), 2.72 – 2.62 (m, 3H), 1.77 (dtd, J = 10.2, 6.0, 2.1 Hz, 2H), 1.73 – 1.64 (m, 1H), 1.69 (br s, 1H, NH), 1.42 (dt, *J* = 13.8, 6.9 Hz, 1H), 1.30 (ddd, *J* = 13.7, 7.6, 6.0 Hz, 1H), 0.89 (d, *J* = 6.6 Hz, 2H), 0.86 (d, *J* = 6.6 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 142.9, 140.9, 128.5, 128.5, 128.5, 128.4, 127.0, 125.8, 54.3, 51.1, 44.0, 36.2, 32.0, 25.1, 23.3, 22.9.

IR ν_{max}/cm^{-1} 2952, 2923, 1495, 1453, 743, 698

HRMS m/z (ESI) calculated for $C_{20}H_{28}N$ $[M+H]^+$ 282.2216, found 282.2216.

***N*-Benzyl-1-cyclohexyl-3-(4-methoxyphenyl)propan-1-amine, 4ag**



Prepared according to the general procedure using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), and 1-(2-iodoethyl)-4-methoxybenzene (157 mg, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4ag** in an assay yield of 58%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a colourless oil (33.7 mg, 0.0998 mmol, 50%).

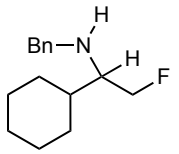
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 – 7.29 (m, 4H), 7.26 – 7.22 (m, 1H), 7.11 – 7.05 (m, 2H), 6.85 – 6.79 (m, 2H), 3.79 (s, 3H), 3.76 (s, 2H), 2.67 (ddd, *J* = 13.8, 10.3, 5.6 Hz, 1H), 2.55 (ddd, *J* = 13.8, 10.1, 6.2 Hz, 1H), 2.37 (dt, *J* = 7.6, 4.7 Hz, 1H), 1.80 – 1.72 (m, 3H), 1.71 – 1.65 (m, 3H), 1.64 – 1.56 (m, 1H), 1.51 (dddd, *J* = 11.7, 8.4, 6.7, 2.6 Hz, 1H), 1.32 (s, 1H), 1.31 – 1.24 (m, 1H), 1.24 – 1.13 (m, 2H), 1.12 – 1.06 (m, 1H), 1.06 – 1.01 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 157.8, 141.4, 135.1, 129.4, 128.4, 128.4, 126.9, 113.9, 61.6, 55.4, 52.0, 40.7, 33.2, 32.0, 29.5, 28.9, 27.0, 26.9, 26.9.

IR ν_{max}/cm^{-1} 2920, 2849, 1611, 1510, 1450, 1300, 1243, 1176, 1038, 821, 739, 698.

HRMS m/z (ESI) calculated for $C_{23}H_{32}NO$ $[M+H]^+$ 338.2478, found 338.2477

***N*-Benzyl-1-cyclohexyl-2-fluoroethan-1-amine, 4ah**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv), and fluoroiodomethane (42 μL, 0.6 mmol, 3.0 equiv) and irradiating for 16 h. The reaction mixture was worked up using method B to give crude **4ah** in an assay yield of 40%. Purification by SCX chromatography afforded the title compound as a colourless oil (16.6 mg, 0.070 mmol, 35%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.29 (m, 4H), 7.28 – 7.22 (m, 1H), 4.54 (ddd, *J* = 47.6, 9.4, 4.2 Hz, 1H), 4.44 (ddd, *J* = 47.7, 9.4, 5.4 Hz, 1H), 3.89 (d, *J* = 13.1 Hz, 1H), 3.80 (d, *J* = 13.1 Hz, 1H), 2.61 (dtd, *J* = 22.4, 5.5, 4.1 Hz, 1H), 1.88 – 1.63 (m, 5H), 1.53 (tddd, *J* = 11.9, 5.2, 3.1, 1.9 Hz, 1H), 1.44 (br s, 1H), 1.30 – 1.14 (m, 3H), 1.14 – 0.98 (m, 2H).

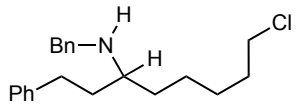
^{13}C NMR (101 MHz, $CDCl_3$) δ 140.8, 128.5, 128.3, 127.1, 84.0 (d, $^{1}J_{CF}$ = 168.3 Hz), 61.6 (d, $^{2}J_{CF}$ = 17.8 Hz), 52.2 (d, $^{4}J_{CF}$ = 0.6 Hz), 39.5 (d, $^{3}J_{CF}$ = 4.8 Hz), 29.7, 29.4 (d, $^{4}J_{CF}$ = 0.6 Hz), 26.7(2), 26.6(7), 26.6(6).

IR ν_{max}/cm^{-1} 2923, 2851, 1451, 1027, 993, 733, 678.

^{19}F NMR (471 MHz, $CDCl_3$) δ –228.0.

HRMS m/z (ESI) calculated for $C_{15}H_{23}FN$ $[M+H]^+$ 236.1809, found 236.1813.

***N*-Benzyl-8-chloro-1-phenyloctan-3-amine, 4ai**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and 1-chloro-5-iodopentane (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4ai** in an assay yield of 68%. Purification by flash column chromatography on neutral alumina (0–100% EtOAc/PE) afforded the title compound as a pale-yellow oil (32.4 mg, 0.098 mmol, 49%).

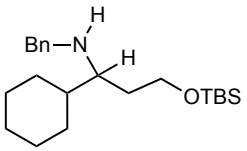
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.24 (m, 7H), 7.22 – 7.17 (m, 3H), 3.77 (s, 2H), 3.53 (t, *J* = 6.7 Hz, 2H), 2.67 (dd, *J* = 9.6, 6.6 Hz, 2H), 2.62 (p, *J* = 5.9 Hz, 1H), 1.82 – 1.72 (m, 4H), 1.54 – 1.31 (m, 7H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 142.7, 141.1, 128.5, 128.5, 128.3, 127.0, 125.9, 56.3, 51.2, 45.2, 35.9, 33.9, 32.7, 32.2, 27.3, 25.1.

IR ν_{max}/cm^{-1} 2928, 2855, 1494, 1453, 1028, 742, 697.

HRMS m/z (ESI) calculated for $C_{21}H_{29}NCl$ $[M+H]^+$ 330.1983, found 330.1982.

***N*-Benzyl-3-((*tert*-butyldimethylsilyl)oxy)-1-cyclohexylpropan-1-amine, 4aj**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), *tert*-butyl(2-iodoethoxy)dimethylsilane (146 mg, 0.6 mmol, 3.0 equiv), and ethyl 2-methyl-2-iodopropionate (3.9 µL, 0.026 equiv ,13 mol%) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4aj** in an assay yield of 61%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a pale-yellow oil (25.2 mg, 0.070 mmol, 35%).

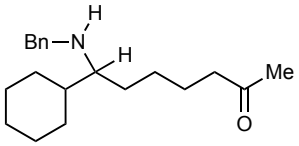
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.28 (m, 4H), 7.25 – 7.20 (m, 1H), 3.78 (d, *J* = 13.0 Hz, 1H), 3.75 (d, *J* = 13.0 Hz, 1H), 3.73 – 3.71 (m, 1H), 3.71 – 3.66 (m, 1H), 2.48 (dt, *J* = 8.3, 4.2 Hz, 1H), 1.79 – 1.75 (m, 1H), 1.75 – 1.73 (m, 1H), 1.72 – 1.60 (m, 4H), 1.56 – 1.51 (m, 1H), 1.51 – 1.43 (m, 2H), 1.25 – 1.20 (m, 1H), 1.20 – 1.16 (m, 1H), 1.15 – 1.08 (m, 1H), 1.07 – 0.97 (m, 2H), 0.88 (s, 9H), 0.04 (s, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 141.5, 128.4, 128.3, 126.8, 61.9, 60.0, 52.1, 40.8, 34.2, 29.6, 28.6, 27.0, 26.9, 26.9, 26.1, 18.4, -5.2, -5.1.

IR ν_{max}/cm^{-1} 2925, 2853, 1471, 1462, 1451, 1254, 1093, 835, 810, 775, 736, 697

HRMS m/z (ESI) calculated for $C_{22}H_{40}NOSi$ $[M+H]^+$ 362.2874, found 362.2865

7-(Benzylamino)-7-cyclohexylheptan-2-one, 4ak

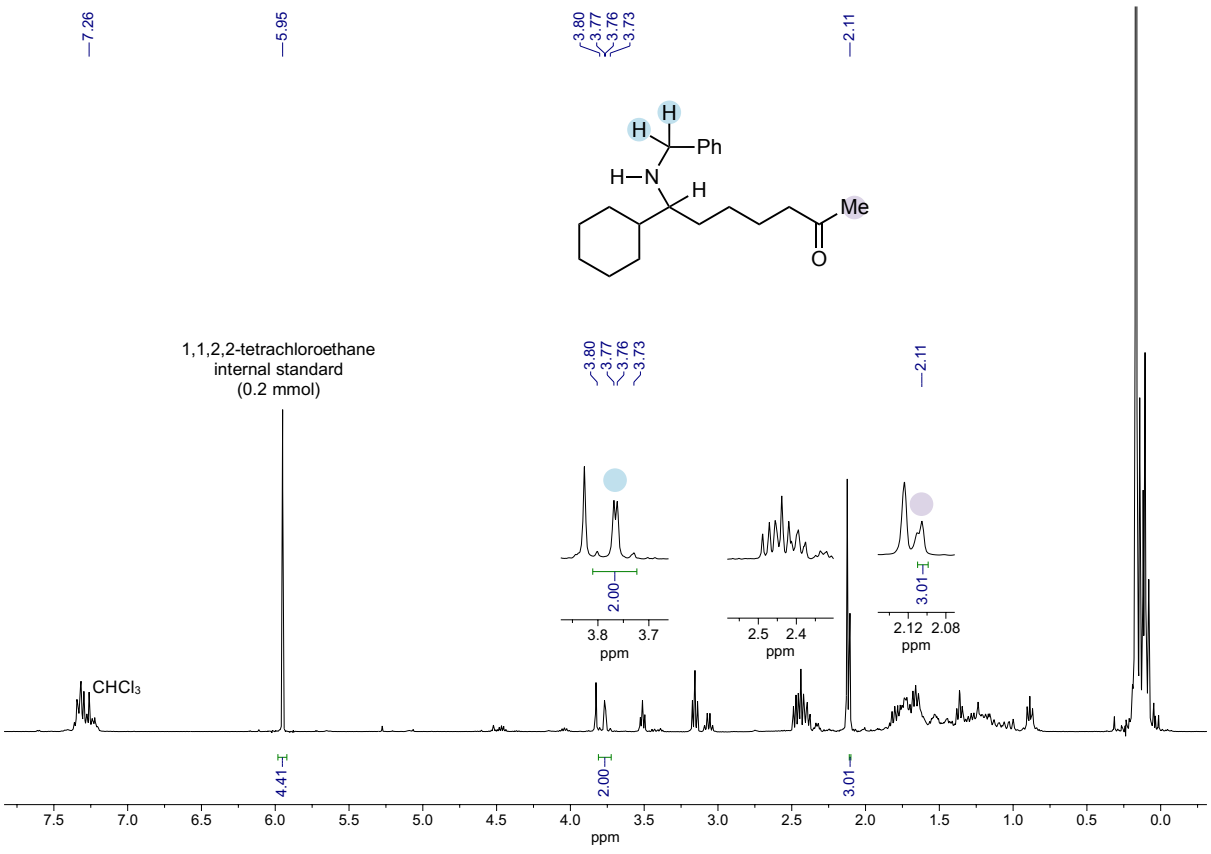


Prepared according to the general procedure (employing modification 2), using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), and 6-iodohexan-2-one (110 µL, 0.6 mmol, 3.0 equiv) and irradiating for 14 h. The reaction mixture was worked up using method B to give crude **4ak** in an assay yield of 45%. Purification by SCX chromatography afforded a sample of **4ak** of greater purity, but further purification by column chromatography on silica gel was unsuccessful.

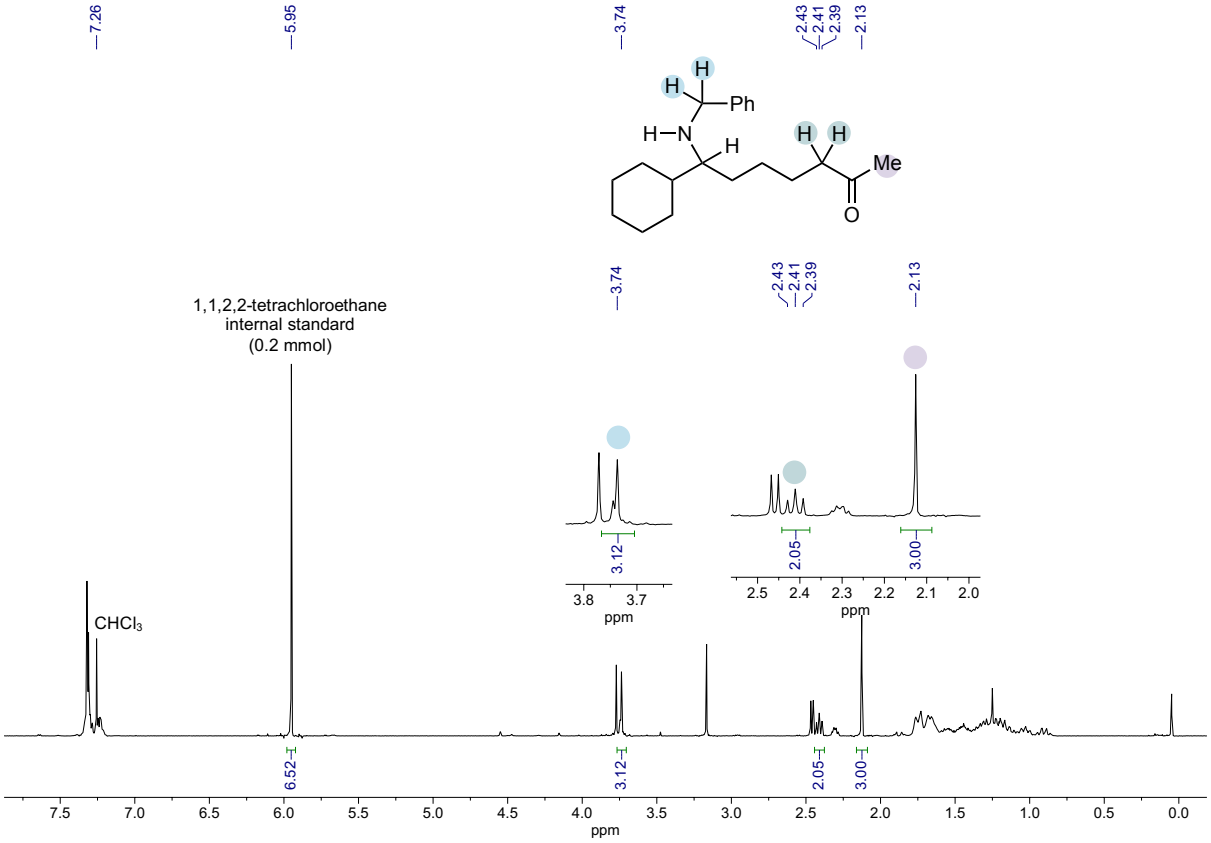
IR ν_{max}/cm^{-1} 2923, 2851, 1716, 1451, 1362, 1161, 1114, 735, 698.

HRMS m/z (ESI) calculated for $C_{20}H_{32}NO$ $[M+H]^+$ 302.2478, found 302.2478

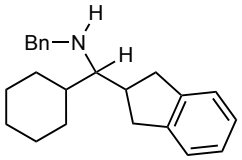
Crude ^{1}H NMR



^{1}H NMR after SCX chromatography:



***N*-Benzyl-1-cyclohexyl-1-(2,3-dihydro-1*H*-inden-2-yl)methanamine, 4al**



Prepared according to the general procedure (employing modification 2),using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), and 2-iodo-2,3-dihydro-1H-indene (146 mg, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4al** in an assay yield of 72%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a colourless oil (41.3 mg, 0.129 mmol, 65%).

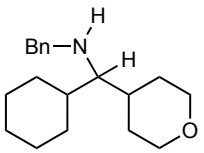
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 – 7.29 (m, 4H), 7.26 – 7.21 (m, 1H), 7.21 – 7.16 (m, 2H), 7.14 – 7.10 (m, 2H), 3.90 (d, *J* = 12.7 Hz, 1H), 3.84 (d, *J* = 12.7 Hz, 1H), 3.03 (dd, *J* = 15.4, 7.8 Hz, 1H), 2.91 (dd, *J* = 15.1, 7.8 Hz, 1H), 2.86 – 2.72 (m, 2H), 2.71 – 2.59 (m, 1H), 2.47 (dd, *J* = 7.3, 4.1 Hz, 1H), 1.84 – 1.74 (m, 3H), 1.73 – 1.64 (m, 2H), 1.60 – 1.50 (m, 1H), 1.36 – 1.11 (m, 7H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.8, 143.6, 141.5, 128.4, 128.4, 127.0, 126.2, 126.1, 124.5, 124.3, 66.6, 55.2, 44.1, 42.5, 37.6, 36.6, 31.1, 28.4, 27.1, 27.0, 27.0.

IR ν_{max}/cm^{-1} 3063, 3023, 2922, 2849, 1494, 1483, 1450, 1125, 1027, 742, 698.

HRMS m/z (ESI) calculated for $C_{23}H_{40}N$ $[M+H]^+$ 320.2373, found 320.2373

***N*-Benzyl-1-cyclohexyl-1-(tetrahydro-2*H*-pyran-4-yl)methanamine, 4am**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), 4-iodotetrahydro-2H-pyran (72 µL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4am** in an assay yield of 61%. Purification by SCX chromatography followed by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a colourless oil (28.8 mg, 0.100 mmol, 50%).

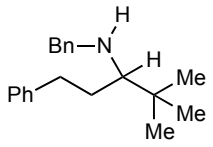
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.28 (m, 4H), 7.26 – 7.21 (m, 1H), 3.99 (td, *J* = 10.3, 3.6 Hz, 2H), 3.83 (d, *J* = 12.5 Hz, 1H), 3.76 (d, *J* = 12.5 Hz, 1H), 3.36 (td, *J* = 11.7, 2.1 Hz, 2H), 2.09 (t, *J* = 5.6 Hz, 1H), 1.83 – 1.61 (m, 7H), 1.60 – 1.52 (m, 1H), 1.52 – 1.42 (m, 3H), 1.29 – 1.14 (m, 4H), 1.13 – 0.73 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 141.4, 128.4, 128.4, 127.0, 68.6, 68.4, 67.3, 56.3, 31.4, 31.1, 29.4, 28.2, 26.9, 26.8, 26.7.

IR ν_{max}/cm^{-1} 2921, 2847, 1494, 1451, 1386, 1240, 1111, 1096, 1018, 982, 743, 699

HRMS m/z (ESI) calculated for $C_{19}H_{30}NO$ $[M+H]^+$ 288.2322, found 288.2321

***N*-Benzyl-4,4-dimethyl-1-phenylpentan-3-amine, 4an**



Prepared according to the general procedure (employing modification 2), using benzylamine (22 μL, 0.2 mmol, 1.0 equiv), hydrocinnamaldehyde (32 μL, 0.24 mmol, 1.2 equiv) and *tert*-butyl iodide (72 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4an** in an assay yield of 52%. Purification by flash column chromatography on neutral alumina (0–4% EtOAc/PE) afforded the title compound as a yellow oil (24.4 mg, 0.086 mmol, 43%).

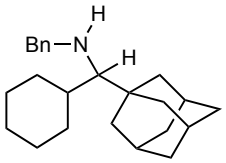
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.23 (m, 7H), 7.22 – 7.17 (m, 3H), 3.92 (d, *J* = 12.7 Hz, 1H), 3.83 (d, *J* = 12.7 Hz, 1H), 2.87 (ddd, *J* = 13.6, 10.8, 5.2 Hz, 1H), 2.62 (ddd, *J* = 13.6, 10.5, 6.1 Hz, 1H), 2.21 (dd, *J* = 9.0, 2.9 Hz, 1H), 1.95 (dddd, *J* = 13.8, 10.8, 6.2, 2.9 Hz, 1H), 1.51 (dddd, *J* = 14.1, 10.6, 9.0, 5.3 Hz, 1H), 1.34 (br s, 1H), 0.94 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.0, 141.5, 128.5, 128.5, 128.5, 128.4, 127.0, 125.9, 66.9, 55.6, 36.1, 34.7, 34.4, 27.1.

IR ν_{max}/cm^{-1} 2949, 2864, 1495, 1453, 1115, 744, 698.

HRMS m/z (ESI) calculated for $C_{20}H_{28}N$ $[M+H]^+$ 282.2216, found 282.2220.

1-((3r,5r,7r)-Adamantan-1-yl)-*N*-benzyl-1-cyclohexylmethanamine, 4ao



Prepared according to the general procedure using benzylamine (22 µL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 µL, 0.24 mmol, 1.2 equiv), and 1-iodoadamantane (157 mg, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B to give crude **4ao** in an assay yield of 92%. Purification by SCX chromatography (note that **4ao** was loaded in DCM onto the SCX column due to lack of solubility in methanol) followed by automated reverse phase flash column chromatography on C18 (0 – 100% water in acetonitrile) afforded the title compound as a colourless oil which solidified to a white solid upon standing (47.9 mg, 0.142 mmol, 71%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.38 (m, 2H), 7.35 – 7.29 (m, 2H), 7.26 – 7.21 (m, 1H), 3.93 (d, *J* = 12.9 Hz, 1H), 3.77 (d, *J* = 12.9 Hz, 1H), 1.96 (br m, 3H), 1.81 (br m, 1H), 1.76 – 1.63 (m, 13H), 1.63 – 1.60 (m, 1H), 1.58 – 1.49 (m, 4H), 1.42 – 1.35 (m, 2.8 Hz, 1H), 1.34 – 1.29 (m, 1H), 1.29 – 1.17 (m, 3H), 1.17 – 1.08 (m, 1H).

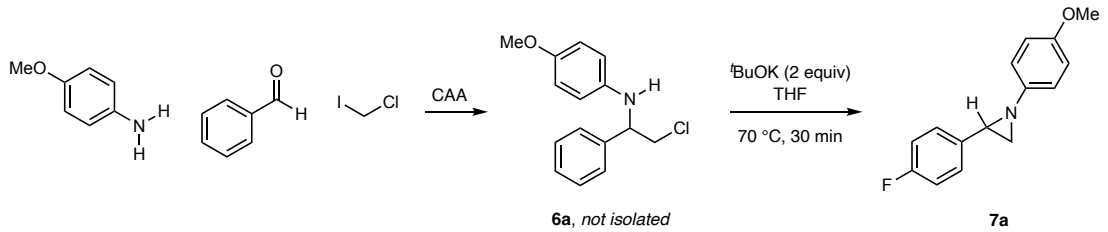
^{13}C NMR (101 MHz, $CDCl_3$) δ 142.2, 128.3, 128.3, 126.8, 72.6, 56.8, 39.8, 38.8, 38.5, 37.5, 36.2, 29.2, 28.9, 27.7, 26.9, 26.8.

IR ν_{max}/cm^{-1} 2899, 2845, 1494, 1449, 1358, 1343, 1122, 1104, 1028, 987, 733, 696, 599

HRMS m/z (ESI) calculated for $C_{24}H_{36}N$ $[M+H]^+$ 338.2842, found 338.2841

6. Synthesis of N-heterocycles

2-(4-Fluorophenyl)-1-(4-methoxyphenyl)aziridine, 7a



Prepared according to the general procedure (employing modification 2), using *p*-anisidine (24.6 mg, 0.2 mmol, 1.0 equiv), 4-fluorobenzaldehyde (26 μL, 0.24 mmol, 1.2 equiv) and chloroiodomethane (42 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B† which gave the crude β-chloroamine **6a** in an assay yield of 74%.

†The crude solution was stirred with 10% aq. NaOH for 60 min.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 – 7.35 (m, 2H), 7.09 – 7.00 (m, 2H), 6.75 – 6.68 (m, 2H), 6.54 – 6.48 (m, 2H), 4.53 (dd, *J* = 7.8, 4.2 Hz, 1H), 3.83 (dd, *J* = 11.3, 4.2 Hz, 1H), 3.71 (s, 3H), 3.68 (dd, *J* = 11.3, 7.8 Hz, 1H).

^{19}F NMR (471 MHz, $CDCl_3$) δ –114.2.

Data consistent with that reported in the literature.[5]

The residue containing **6a** was purified by SCX chromatography and then transferred to a microwave vial. ^{t}BuOK (44.7 mg. 0.4 mmol) was added whereupon the vial was sealed with a PTFE-lined septum and evacuate-refilled with N_2 (3 cycles). Anhydrous THF (2 mL) was added and the resulting mixture heated at 70 °C for 30 min. The mixture was allowed to cool to rt, filtered through celite and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (mesitylene internal standard, 27.8 μL, 0.2 mmol) showed the formation of **7a** in 88% yield from **6a** (65% over two steps). Purification by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a pale-yellow oil (21.4 mg, 0.088 mmol, 44%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 – 7.30 (m, 2H), 7.08 – 7.00 (m, 2H), 6.99 – 6.94 (m, 2H), 6.84 – 6.78 (m, 2H), 3.77 (s, 3H), 3.01 (dd, *J* = 6.4, 3.4 Hz, 1H), 2.40 (dd, *J* = 6.5, 1.1 Hz, 1H), 2.33 (dd, *J* = 3.4, 1.1 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 162.3 (d, $^1J_{CF}$ = 245.1 Hz), 155.4, 147.8, 135.4 (d, $^4J_{CF}$ = 3.0 Hz), 127.8 (d, $^3J_{CF}$ = 8.1 Hz), 121.4, 115.4 (d, $^2J_{CF}$ = 21.5 Hz), 114.5, 55.7, 41.4 (d, $^5J_{CF}$ = 0.5 Hz), 37.9.

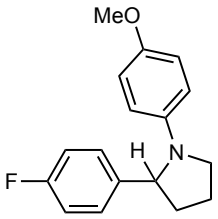
^{19}F NMR (471 MHz, $CDCl_3$) δ –115.5.

IR ν_{max}/cm^{-1} 1504, 1463, 1236, 1179, 1155, 1034, 828, 536.

HRMS m/z (ESI) calculated for $C_{15}H_{15}NOF$ $[M+H]^+$ 244.1132, found 244.1132.

Data consistent with that reported in the literature.[5]

2-(4-Fluorophenyl)-1-(4-methoxyphenyl)pyrrolidine, 7b



Prepared according to the general procedure (employing modification 2), using *p*-anisidine (24.6 mg, 0.2 mmol, 1.0 equiv), 4-fluorobenzaldehyde (26 μL, 0.24 mmol, 1.2 equiv) and 1-chloro-3-iodopropane (64 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B† which gave crude **7b** in an assay yield of 70%. Purification by SCX chromatography followed by automated flash column chromatography on silica gel (1–2% {10% MeOH in CH_2Cl_2}/PE) afforded the title compound as a colourless oil which turned brown upon standing (32.6 mg, 0.112 mmol, 56%).

†The crude solution was stirred with 10% aq. NaOH for 60 min.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 – 7.15 (m, 2H), 7.02 – 6.93 (m, 2H), 6.80 – 6.72 (m, 2H), 6.45 – 6.38 (m, 2H), 4.60 (dd, *J* = 8.3, 2.6 Hz, 1H), 3.72 (s, 3H), 3.71 – 3.66 (m, 1H), 3.34 (td, *J* = 8.8, 6.9 Hz, 1H), 2.37 (ddt, *J* = 11.9, 10.3, 7.8 Hz, 1H), 2.08 – 1.93 (m, 2H), 1.87 (ddt, *J* = 12.2, 6.2, 3.0 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 161.8 (d, $^1J_{CF}$ = 244.1 Hz), 151.1, 142.1, 140.8 (d, $^1J_{CF}$ = 3.0 Hz), 127.5 (d, $^3J_{CF}$ = 7.9 Hz), 115.38 (d, $^2J_{CF}$ = 21.3 Hz), 115.0, 113.2, 62.9, 56.0, 49.8, 36.5*, 23.4.

^{19}F NMR (471 MHz, $CDCl_3$) δ –116.8.

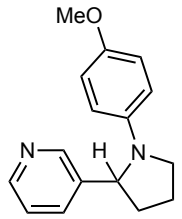
IR ν_{max}/cm^{-1} 2966, 2945, 2830, 1511, 1239, 1219, 812

HRMS m/z (ESI) calculated for $C_{17}H_{19}NOF$ $[M+H]^+$ 272.1445, found 272.1449.

*Note: Signal split by 1.07 Hz.

Data consistent with that reported in the literature.[6]

3-(1-(4-Methoxyphenyl)pyrrolidin-2-yl)pyridine, 7c



Prepared according to the general procedure (employing modifications 1 and 2) using *p*-anisidine (24.6 mg, 0.2 mmol, 1.0 equiv), nicotinaldehyde (23 μL, 0.24 mmol, 1.2 equiv) and 1-chloro-3-iodopropane (64 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B[†] which gave crude **7c** in an assay yield of 44%. Purification by SCX chromatography followed by automated flash column chromatography on silica gel (5–20% {40% Et_2O + 4% MeOH in CH_2Cl_2}/CH_2Cl_2) afforded the title compound as a yellow oil (10.1 mg, 0.040 mmol, 20%).

[†]The crude solution was stirred with 10% aq. NaOH for 60 min.

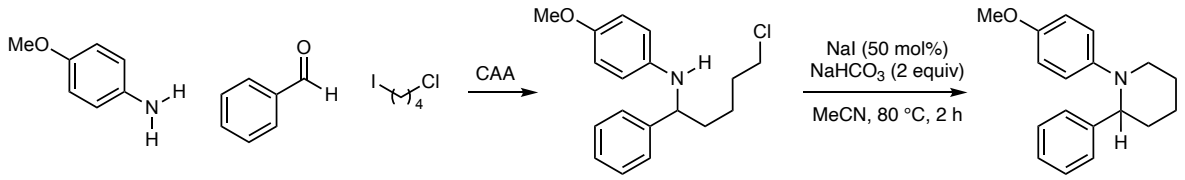
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.55 (d, *J* = 2.3 Hz, 1H), 8.47 (dd, *J* = 4.8, 1.6 Hz, 1H), 7.51 (dt, *J* = 7.8, 2.0 Hz, 1H), 7.20 (dd, *J* = 7.8, 4.8 Hz, 1H), 6.79 – 6.72 (m, 2H), 6.46 – 6.38 (m, 2H), 4.67 (dd, *J* = 8.4, 2.7 Hz, 1H), 3.74 – 3.68 (m, 1H), 3.71 (s, 3H), 3.36 (app q, *J* = 8.2 Hz, 1H), 2.44 (dq, *J* = 12.0, 8.6 Hz, 1H), 2.07 – 1.97 (m, 2H), 1.96 – 1.87 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 151.3, 148.4, 148.3, 141.9, 140.5, 133.8, 123.6, 115.0, 113.3, 61.3, 56.0, 49.9, 36.2, 23.4.

IR ν_{max}/cm^{-1} 2964, 2943, 1512, 1239, 1041, 812

HRMS m/z (ESI) calculated for $C_{16}H_{19}N_2O$ $[M+H]^+$ 255.1492, found 255.1492.

1-(4-Methoxyphenyl)-2-phenylpiperidine, 7d



6d, *not isolated* **7d**

Prepared according to the general procedure (employing modification 2), using *p*-anisidine (24.6 mg, 0.2 mmol, 1.0 equiv), benzaldehyde (24 μL, 0.24 mmol, 1.2 equiv) and 1-chloro-4-iodobutane (73 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude ε-chloroamine **6d** in an assay yield of 80%.

The residue containing **6d** was purified by SCX chromatography and then transferred to a microwave vial. A stirrer bar, sodium iodide (14.9 mg, 0.1 mmol, 50 mol%) and sodium bicarbonate (33.6 mg, 0.4 mmol, 2.0 equiv) were added sequentially whereupon the vial was sealed with a PTFE-lined septum and evacuate-refilled with N_2 (3 cycles). Anhydrous MeCN (2 mL) was added and the resulting mixture heated at 80 °C for 2 h. The mixture was allowed to cool to rt, filtered through celite and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) showed quantitative formation of piperidine **7d** from **6d** (80% over two steps). Purification by automated flash column chromatography on silica gel (0–10% {10% MeOH in CH_2Cl_2}/PE afforded the title compound as a pale-yellow oil (27.6 mg, 0.104 mmol, 52%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 – 7.23 (m, 2H), 7.20 – 7.14 (m, 2H), 7.10 – 7.05 (m, 1H), 6.92 – 6.87 (m, 2H), 6.69 – 6.63 (m, 2H), 4.03 (dd, *J* = 9.4, 3.3 Hz, 1H), 3.68 (s, 3H), 3.37 (dtd, *J* = 12.0, 3.9, 1.5 Hz, 1H), 2.88 (ddd, *J* = 12.0, 10.2, 3.5 Hz, 1H), 1.97 – 1.89 (m, 1H), 1.88 – 1.69 (m, 4H), 1.58 – 1.45 (m, 1H).

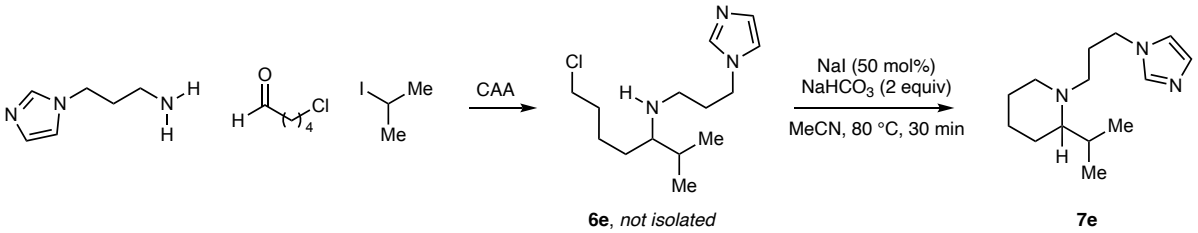
^{13}C NMR (101 MHz, $CDCl_3$) δ 154.7, 146.4, 144.8, 128.2, 127.6, 126.3, 123.9, 113.9, 64.6, 56.5, 55.4, 36.3, 26.6, 24.3.

IR ν_{max}/cm^{-1} 2932, 1507, 1451, 1237, 1211, 1038, 827, 756, 700

HRMS m/z (ESI) calculated for $C_{18}H_{22}NO$ $[M+H]^+$ 268.1696, found 268.1693.

Data consistent with that reported in the literature.[7]

1-(3-(1*H*-imidazol-1-yl)propyl)-2-Isopropylpiperidine, 7e



6e, *not isolated* **7e**

An oven-dried microwave vial was charged with a magnetic stirrer bar and 4 Å MS (100 mg, 50 mg/0.1 mmol amine). The vial was sealed and evacuate-refilled with N_2 (3 cycles). Dichloromethane (1.6 mL), 1-(3-aminopropyl)imidazole (24 μL, 0.2 mmol, 1.0 equiv) and 5-chloropentanal (29 μL, 0.24 mmol, 1.2 equiv) were added and the resulting mixture stirred at rt for 15 min. Isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv), TTMSS (123 μL, 0.4 mmol, 2.0 equiv), HFIP (0.4 mL) and TMSCl (52 μL, 0.4 mmol, 2.0 equiv) were added sequentially and the resulting mixture irradiated for 6 h. The reaction mixture was worked up using method B which gave the crude ε-chloroamine **6e** in an assay yield of 92%.

The residue containing **6e** was purified by SCX chromatography and then transferred to a microwave vial. A stirrer bar, sodium iodide (14.9 mg, 0.1 mmol, 50 mol%) and sodium bicarbonate (33.6 mg, 0.4 mmol, 2.0 equiv) were added sequentially whereupon the vial was sealed with a PTFE-lined septum and evacuate-refilled with N_2 (3 cycles). Anhydrous MeCN (2 mL) was added and the resulting mixture heated at 80 °C for 30 min. The mixture was allowed to cool to rt, filtered through celite and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) showed the formation of **7e** in 87% yield from **6e** (80% over two steps). Purification by automated reverse phase flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a pale-yellow oil (30.0 mg, 0.128 mmol, 64%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (s, 1H), 7.03 (s, 1H), 6.89 (s, 1H), 3.98 (app. dd, *J* = 13.8, 7.2 Hz, 1H), 3.91 (app. dd, J = 13.8, 7.2 Hz), 2.89 (dt, *J* = 12.0, 4.1 Hz, 1H), 2.69 (ddd, *J* = 13.1, 8.4, 6.4 Hz, 1H), 2.31 (ddd, *J* = 13.5, 8.1, 5.7 Hz, 1H), 2.15 (ddd, *J* = 11.7, 10.3, 3.0 Hz, 1H), 2.03 – 1.79 (m, 4H), 1.74 – 1.65 (m, 1H), 1.58 – 1.48 (m, 2H), 1.45 – 1.32 (m, 1H), 1.28 – 1.13 (m, 2H), 0.86 (d, *J* = 6.6 Hz, 3H), 0.79 (d, *J* = 6.6 Hz, 3H).

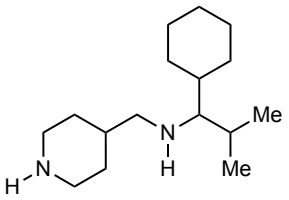
^{13}C NMR (101 MHz, $CDCl_3$) δ 137.2, 129.6, 118.8, 65.9, 52.3, 49.3, 45.3, 27.7, 27.3, 24.7, 24.0, 23.2, 20.4, 16.5.

IR ν_{max}/cm^{-1} 2930, 1507, 1445, 1384, 1228, 1109, 1077, 1034, 729, 664.

HRMS m/z (ESI) calculated for $C_{14}H_{27}N_3$ $[M+H]^+$ 236.2121, found 236.2122.

7. Primary-selective CAA of alkyl diamines

1-Cyclohexyl-2-methyl-N-(piperidin-4-ylmethyl)propan-1-amine, 9a



Prepared according to the general procedure (employing modification 2), using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave crude **9a** in an assay yield of 87%. Purification by SCX chromatography followed by reverse phase flash column chromatography on C18 (0–100% MeOH/H_2O) afforded the title compound as a pale-yellow oil (18.1 mg, 0.072 mmol, 36%).

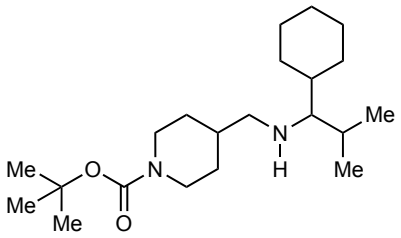
^{1}H NMR (400 MHz, $CDCl_3$) δ 3.08 (br d, *J* = 12.0 Hz, 2H), 2.59 (td, *J* = 12.2, 2.7 Hz, 2H), 2.50 (dd, *J* = 11.3, 6.6 Hz, 1H), 2.45 (dd, *J* = 11.2, 6.7 Hz, 1H), 1.80 (t, *J* = 5.7 Hz, 1H), 1.80 – 1.68 (m, 6H), 1.67 – 1.55 (m, 2H), 1.50 (ttt, *J* = 11.0, 6.7, 3.4 Hz, 1H), 1.34 (tdt, *J* = 11.7, 6.1, 3.1 Hz, 1H), 1.27 – 0.94 (m, 9H), 0.88 (d, *J* = 6.6 Hz, 3H), 0.84 (d, *J* = 6.6 Hz, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 68.9, 58.8, 46.3, 41.6, 37.7, 31.6, 31.3, 30.3, 29.1, 26.9, 26.8, 21.0, 17.9

IR ν_{max}/cm^{-1} 2919, 2849, 1447, 1384, 1106.

HRMS m/z (ESI) calculated for $C_{16}H_{33}N_2$ $[M+H]^+$ 253.2638, found 253.2639.

***tert*-Butyl 4-(((1-cyclohexyl-2-methylpropyl)amino)methyl)piperidine-1-carboxylate, Boc-9a**



Prepared according to the general procedure (employing modification 2), using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 87%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 3 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed the formation of **Boc-9a** in 98% yield from the diamine (85% over two steps). Purification by flash column chromatography on alumina (0–3% EtOAc/PE) afforded the title compound as a colourless oil (46.4 mg, 0.132 mmol, 66%).

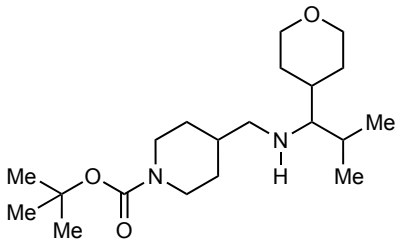
^{1}H NMR (500 MHz, $CDCl_3$) δ 4.07 (m, 2H), 2.78 – 2.59 (m, 2H), 2.51 (dd, *J* = 11.2, 6.5 Hz, 1H), 2.46 (dd, *J* = 11.2, 6.7 Hz, 1H), 1.81 (t, *J* = 5.7 Hz, 1H), 1.79 – 1.68 (m, 6H), 1.67 – 1.56 (m, 2H), 1.51 (ttt, *J* = 11.9, 7.0, 3.4 Hz, 1H), 1.44 (s, 9H), 1.34 (tdt, *J* = 11.9, 6.5, 3.2 Hz, 1H), 1.26 – 0.93 (m, 8H), 0.88 (d, *J* = 6.7 Hz, 3H), 0.84 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 155.0, 79.3, 68.9, 58.3, 44.4 (br), 43.7 (br), 41.7, 37.8, 31.4, 30.7 (br), 30.3, 29.1, 28.6, 26.9, 26.9, 26.8, 21.0, 17.9.

IR ν_{max}/cm^{-1} 2920, 2849, 1690, 1420, 1364, 1244, 1157, 1129.

HRMS m/z (ESI) calculated for $C_{21}H_{41}N_2O_2$ $[M+H]^+$ 353.3163, found 353.3158.

***tert*-Butyl 4-(((2-methyl-1-(tetrahydro-2H-pyran-4-yl)propyl)amino)methyl)piperidine-1-carboxylate, Boc-9b**



Prepared according to the general procedure (employing modification 2), using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), tetrahydro-2*H*-pyran-4-carboxaldehyde (26 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 83%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 2 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed quantitative formation of **Boc-9b** from the diamine (83% over two steps). Purification by flash column chromatography on alumina (0–5% EtOAc/PE) afforded the title compound as a colourless oil (44.5 mg, 0.126 mmol, 63%).

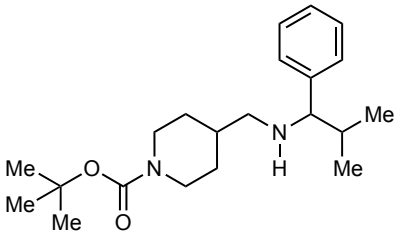
^{1}H NMR (500 MHz, $CDCl_3$) δ 4.08 (s, 2H), 4.02 – 3.93 (m, 2H), 3.39 – 3.29 (m, 2H), 2.74 – 2.61 (m, 2H), 2.53 (dd, *J* = 11.3, 6.7 Hz, 1H), 2.48 (dd, *J* = 11.3, 6.5 Hz, 1H), 1.87 (dd, *J* = 6.6, 4.9 Hz, 1H), 1.82 – 1.76 (m, 1H), 1.76 – 1.64 (m, 3H), 1.60 – 1.47 (m, 2H), 1.47 – 1.43 (m, 1H), 1.44 (s, 9H), 1.38 (qd, *J* = 12.3, 4.5 Hz, 2H), 1.10 (qd, *J* = 12.3, 4.3 Hz, 2H), 0.92 (d, *J* = 6.8 Hz, 3H), 0.85 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 155.0, 79.3, 68.5, 68.3, 58.3, 44.3, 43.7, 39.3, 37.8, 31.1, 30.6, 29.8, 29.6, 28.6, 21.0, 17.3.

IR ν_{max}/cm^{-1} 2950, 2928, 2843, 1688, 1421, 1364, 1243, 1158, 1122, 1095.

HRMS m/z (ESI) calculated for $C_{20}H_{39}N_2O_3$ $[M+H]^+$ 355.2955, found 355.2939.

***tert*-Butyl 4-(((2-methyl-1-phenylpropyl)amino)methyl)piperidine-1-carboxylate, Boc-9c**



Prepared according to the general procedure (employing modification 2), using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), benzaldehyde (24 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 65%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 2 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed quantitative formation of **Boc-9c** from the diamine (65% over two steps). Purification by flash column chromatography on alumina (0–4% EtOAc/PE) afforded the title compound as a pale-yellow oil (29.9 mg, 0.086 mmol, 43%).

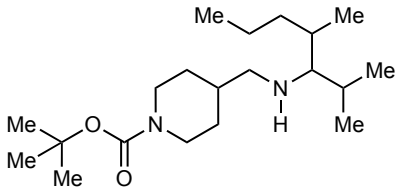
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.32 – 7.25 (m, 2H), 7.24 – 7.18 (m, 3H), 4.20 – 3.85 (m, 2H), 3.25 (d, *J* = 6.8 Hz, 1H), 2.73 – 2.59 (m, 2H), 2.29 (dd, *J* = 11.7, 6.2 Hz, 1H), 2.23 (dd, *J* = 11.7, 7.2 Hz, 1H), 1.82 (oct, *J* = 6.8 Hz, 1H), 1.70 (br d, *J* = 13.2 Hz, 1H), 1.61 (br d, *J* = 13.3 Hz, 1H), 1.56 – 1.45 (m, 1H), 1.43 (s, 9H), 1.43 (br s, 1H), 1.05 (qd, *J* = 12.2, 4.0 Hz, 1H), 1.02 (qd, *J* = 12.2, 4.0 Hz, 1H), 0.95 (d, *J* = 6.7 Hz, 3H), 0.73 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 155.0, 143.3, 128.0, 126.8, 79.3, 69.8, 53.8, 44.3 (br), 43.6 (br), 36.8, 34.6, 30.5 (br), 28.6, 19.8, 19.5.

IR ν_{max}/cm^{-1} 2924, 1686, 1451, 1420, 1364, 1274, 1244, 1168, 1148, 761, 702.

HRMS m/z (ESI) calculated for $C_{21}H_{35}N_2O_2$ $[M+H]^+$ 347.2693, found 347.2684.

***tert*-Butyl 4-(((1-cyclohexylpropyl)amino)methyl)piperidine-1-carboxylate, Boc-9d**



Prepared according to the general procedure using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), 2-methylpentanal (30 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 81%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 3 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed formation of **Boc-9d** in 95% yield from the diamine (77% over two steps). Purification by flash column chromatography on alumina (0–3% EtOAc/PE) afforded the title compound as a colourless oil (39.5 mg, 0.116 mmol, 58%) as a 2:1 mixture of diastereomers

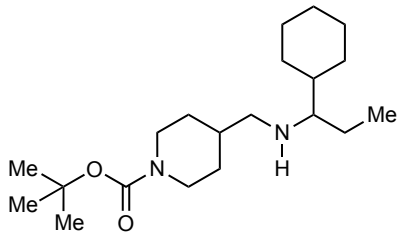
^{1}H NMR (500 MHz, $CDCl_3$) δ 4.07 (m, 2H), 2.77 – 2.59 (m, 2H), 2.52 (dd, *J* = 11.4, 6.5 Hz, 1H), 2.47 (dd, *J* = 11.6, 6.7 Hz, 1H), 1.91 (dd, *J* = 6.8, 4.1 Hz, 0.66H), 1.87 (t, *J* = 5.5 Hz, 0.33H), 1.79 – 1.64 (m, 3H), 1.64 – 1.48 (m, 2H), 1.48 – 1.35 (m, 1H), 1.44 (s, 9H), 1.35 – 0.98 (m, 6H), 0.91 – 0.84 (m, 10H), 0.80 (d, *J* = 6.8 Hz, 2H)

^{13}C NMR (126 MHz, $CDCl_3$) major diastereomer: δ 155.0, 79.3, 67.8, 57.8(8), [44.4, 43.8], 37.8, 37.5, 35.1, 31.5, 30.7, 28.6, 20.8(1), 20.7, 19.5, 14.7, 14.5; minor diastereomer: δ 155.0, 79.3, 68.9, 57.9(1), [44.4, 43.8], 37.7, 35.9, 34.6, 30.7, 30.6, 28.6, 21.4, 20.8(3), 18.4, 17.4, 14.6.

IR ν_{max}/cm^{-1} 2955, 2925, 2870, 1691, 1420, 1364, 1244, 1158, 1120.

HRMS m/z (ESI) calculated for $C_{20}H_{41}N_2O_2$ $[M+H]^+$ 341.3163, found 341.3150.

***tert*-Butyl 4-(((2,4-dimethylheptan-3-yl)amino)methyl)piperidine-1-carboxylate, Boc-9e**



Prepared according to the general procedure using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and iodoethane (48 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 73%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 3 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed quantitative formation of **Boc-9e** from the diamine (73% over two steps). Purification by flash column chromatography on alumina (0–3% EtOAc/PE) afforded the title compound as a colourless oil (27.5 mg, 0.082 mmol, 41%).

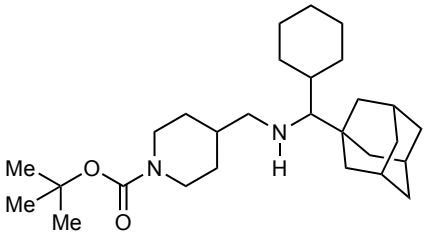
^{1}H NMR (500 MHz, $CDCl_3$) δ 4.19 – 3.96 (m, 2H), 2.78 – 2.57 (m, 2H), 2.45 (dd, *J* = 11.6, 6.6 Hz, 1H), 2.40 (dd, *J* = 11.6, 6.7 Hz, 1H), 2.09 (dt, *J* = 7.1, 5.1 Hz, 1H), 1.77 – 1.58 (m, 7H), 1.56 – 1.47 (m, 1H), 1.47 – 1.41 (m, 1H), 1.44 (s, 9H), 1.38 – 1.05 (m, 8H), 0.99 (qd, *J* = 12.0, 2.6 Hz, 1H), 0.97 (qd, *J* = 12.0, 2.6 Hz, 1H), 0.86 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 155.0, 79.3, 64.3, 54.0, 44.3, 43.7, 40.7, 37.1, 30.7, 29.4, 28.6, 26.9, 26.8, 23.5, 10.8.

IR ν_{max}/cm^{-1} 2922, 2851, 1681, 1422, 1365, 1245, 1158, 908, 730.

HRMS m/z (ESI) calculated for $C_{20}H_{39}N_2O_2$ $[M+H]^+$ 339.3006, found 339.2999.

***tert*-Butyl 4-((((-adamantan-1-yl)(cyclohexyl)methyl)amino)methyl)piperidine-1-carboxylate, Boc-9f**



Prepared according to the general procedure using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and iodoethane (48 μL, 0.6 mmol, 3.0 equiv) and irradiating for 23 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 80%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol, 10 mol%) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 3 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Purification by flash column chromatography on silica gel (5–10% Et_2O/CH_2Cl_2) afforded the title compound as a colourless oil (56.6 mg, 0.128 mmol, 64%).

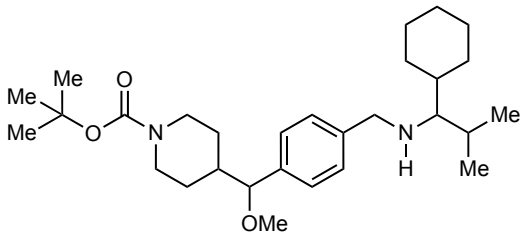
^{1}H NMR (700 MHz, $CDCl_3$) δ 4.20 – 3.98 (m, 2H), 2.76 – 2.65 (m, 2H), 2.63 (dd, *J* = 11.2, 6.5 Hz, 1H), 2.42 (dd, *J* = 11.1, 6.7 Hz, 1H), 1.96 – 1.91 (m, 3H), 1.79 – 1.65 (m, 8H), 1.64 – 1.56 (m, 10H), 1.52 – 1.47 (m, 5H), 1.45 (s, 9H), 1.32 – 1.21 (m, 3H), 1.15 – 1.06 (m, 4H).

^{13}C NMR (176 MHz, $CDCl_3$) δ 155.1, 79.3, 73.2, 59.0, 44.5, 43.7, 39.8, 38.8, 38.5, 37.9, 37.5, 36.2, 30.7, 29.1, 28.8, 28.6, 27.7, 26.9, 26.8.

IR ν_{max}/cm^{-1} 2903, 2846, 1695, 1448, 1421, 1364, 1244, 1171.

HRMS m/z (ESI) calculated for $C_{28}H_{49}N_2O_2$ $[M+H]^+$ 445.3789, found 445.3793.

***tert*-Butyl 4-((4-(((1-cyclohexyl-2-methylpropyl)amino)methyl)phenyl)(methoxy)methyl)piperidine-1-carboxylate, Boc-9g**



Prepared according to the general procedure using freshly prepared diamine **S6** (46.9 mg, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and iodoethane (48 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 64%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 2 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed quantitative formation of **Boc-9g** from the diamine (64% over two steps). Purification by flash column chromatography on silica gel (0–2% MeOH/CH_2Cl_2) afforded the title compound as a colourless oil (59.7 mg, 0.126 mmol, 63%) as a mixture of diastereomers. Diastereomeric ratio could not be determined by crude ^{1}H NMR; qualitative inspection of ^{13}C spectrum gives approx. 1:1 dr.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (d, *J* = 8.0 Hz, 2H), 7.16 (d, *J* = 7.9 Hz, 2H), 4.22 – 3.93 (m, 2H), 3.83 – 3.74 (m, 2H), 3.77 (d, *J* = 7.8 Hz, 1H) 3.16 (s, 3H), 2.70 – 2.45 (m, 2H), 2.02 (t, *J* = 5.7 Hz, 1H), 2.00 – 1.95 (m, 1H), 1.89 – 1.78 (m, 2H), 1.78 – 1.56 (m, 5H), 1.43 (br s, 10H), 1.30 – 0.99 (m, 9H), 0.93 (d, *J* = 6.8 Hz, 3H), 0.90 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 154.9, 141.1, 138.9, 128.3, 127.4, 88.1, 79.3, 68.4, 57.0, 56.0, 43.8†, 43.1, 41.6, 31.3, [30.2(8), 30.2(7)*], [29.0(9), 29.0(8)*], 29.0 (br), 28.6, 28.5, 26.9, 26.9, 26.8, 21.0, 18.0.

IR (film) ν_{max}/cm^{-1} 2930, 1687 (C=O), 1420, 1362, 1244, 1156, 1127.

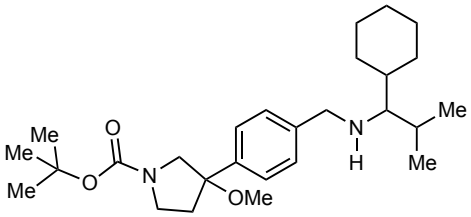
† Signal indistinguishable from baseline in the ^{13}C spectrum but unambiguously identified by HSQC.

* Denotes a duplicated resonance arising from the second diastereomer. Other diastereomeric resonances are coincident.

IR ν_{max}/cm^{-1} 2930, 1687, 1420, 1362, 1244, 1156, 1127.

HRMS m/z (ESI) calculated for $C_{29}H_{49}N_2O_3$ $[M+H]^+$ 473.3738, found 473.3735.

***tert*-Butyl 3-(4-(((1-cyclohexyl-2-methylpropyl)amino)methyl)phenyl)-3-methoxypyrrolidine-1-carboxylate, Boc-9h**



Prepared according to the general procedure using freshly prepared diamine **S10** (41.2 mg, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and iodoethane (48 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine in an assay yield of 57%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar was added, the vial sealed and evacuate-refilled with N_2 (3 cycles). CH_2Cl_2 (1 mL), triethylamine (31 μL, 0.22 mmol), Boc_2O (48 mg, 0.22 mmol) and 4-dimethylaminopyridine (2.4 mg, 0.02 mmol) were added sequentially and the reaction mixture stirred at rt until LCMS analysis indicated full consumption of the unprotected diamine. After 2 h the reaction mixture was diluted with CH_2Cl_2 (1 mL), 10% aq. NaOH (2 mL) was added and the resulting biphasic mixture stirred vigorously for 5 min. The mixture was transferred to a separating funnel, the organic layer removed and the aqueous layer extracted with CH_2Cl_2 (2 × 5 mL). The combined organic was phase dried over Na_2SO_4, filtered and concentrated *in vacuo*. Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed formation of **Boc-9h** in 65% from the diamine (37% over two steps). Purification by reverse phase automated flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a colourless oil (19.8 mg, 0.044 mmol, 22%) as an assumed mixture of diastereomers. Diastereomeric ratio could not be determined by crude ^{1}H NMR.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.41 – 7.34 (m, 2H), 7.34 – 7.28 (m, 2H), 3.92 (d, *J* = 11.7 Hz, 0.5H), 3.85 – 3.74 (m, 2.5H), 3.62 – 3.41 (m, 3H), 3.01 (s, 1.5H), 2.99 (s, 1.5H), 2.44 – 2.35 (m, 1H), 2.20 – 2.07 (m, 1H), 2.03 (br t, *J* = 5.8 Hz, 1H), 1.88 – 1.79 (m, 2H), 1.79 – 1.70 (m, 2H), 1.69 – 1.59 (m, 2H), 1.48 (s, 4.5H), 1.47 (s, 4.5H), 1.44 – 1.37 (m, 1H), 1.28 – 1.00 (m, 6H), 0.93 (d, *J* = 6.8 Hz, 3H), 0.90 (d, *J* = 6.8 Hz, 3H).

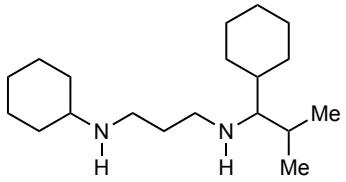
^{13}C NMR (126 MHz, $CDCl_3$) δ 154.9, 154.8, 141.6, 141.5, 138.2, 138.2, 128.5, 126.7, 126.6, 85.5, 84.6, 79.5, 79.4, 68.5, 56.2, 55.8 (2 C), 53.7, 51.3, 51.1, 44.7, 44.2, 41.6, 35.8, 32.9, 31.4, 30.3, 29.1, 28.7, 26.9, 26.9, 26.8, 21.1, 18.0.

Note: More signals than expected in the ^{13}C spectrum due to the presence of conformational isomers. The presence of conformational isomers was confirmed by observation of exchange peaks in the NOESY spectrum and coalescence of key resonances in the ^{13}C spectrum at 60 °C in C_6D_6.

IR ν_{max}/cm^{-1} 2924, 1694, 1400, 1364, 1174, 1139, 1120, 1094, 1068.

HRMS m/z (ESI) calculated for $C_{27}H_{45}N_2O_3$ $[M+H]^+$ 445.3425, found 445.3423.

***N*^{1}-Cyclohexyl-*N*^{3}-(1-cyclohexyl-2-methylpropyl)propane-1,3-diamine, 9i**



Prepared according to the general procedure using *N*-(3-aminopropyl)cyclohexylamine (35 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and iodoethane (48 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave the crude diamine **9i** in an assay yield of 71%. Purification by SCX chromatography followed by reverse phase automated flash column chromatography on C18 (0–100% MeCN/H_2O) afforded the title compound as a yellow oil (14.5 mg, 0.050 mmol, 25%).

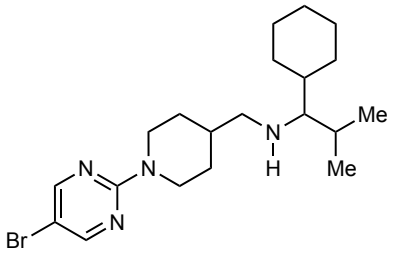
^{1}H NMR (500 MHz, $CDCl_3$) δ 2.73 – 2.62 (m, 4H), 2.39 (tt, *J* = 10.6, 3.8 Hz, 1H), 1.90 – 1.85 (m, 2H), 1.83 (t, *J* = 5.7 Hz, 1H), 1.80 – 1.56 (m, 12H), 1.35 (tdt, *J* = 12.0, 6.3, 3.2 Hz, 1H), 1.30 – 1.10 (m, 7H), 1.10 – 0.95 (m, 4H), 0.90 (d, *J* = 6.7 Hz, 3H), 0.85 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 69.0, 57.2, 51.2, 46.1, 41.5, 33.8, 31.5, 31.3, 30.2, 29.0, 26.9, 26.9, 26.8, 26.4, 25.3, 21.0, 18.0.

IR ν_{max}/cm^{-1} 2920, 2850, 1448, 1129.

HRMS m/z (ESI) calculated for $C_{19}H_{39}N_2$ $[M+H]^+$ 295.3108, found 295.3111.

***N*-((1-(5-bromopyrimidin-2-yl)piperidin-4-yl)methyl)-1-Cyclohexyl-2-methylpropan-1-amine, 9j**



Prepared according to the general procedure (employing modification 2), using 4-(aminomethyl)piperidine (24 μL, 0.2 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (29 μL, 0.24 mmol, 1.2 equiv) and isopropyl iodide (60 μL, 0.6 mmol, 3.0 equiv) and irradiating for 6 h. The reaction mixture was worked up using method B which gave crude **9a** in an assay yield of 87%.

The residue was purified by SCX chromatography and transferred to a microwave vial. A stirrer bar and 5-bromo-2-chloropyrimidine (38.7 mg, 0.2 mmol) were added, the vial sealed and evacuate-refilled with N_2 (3 cycles). DMF (2 mL) and *N*,*N*-diisopropylethylamine (38 μL, 0.22 mmol) were added and the reaction mixture heated at 100 °C for 14 h. The reaction mixture was allowed cool to room temperature then diluted with CH_2Cl_2 (10 mL) and 10% aq. NaOH (10 mL). The layers were separated and the aqueous phase extracted with CH_2Cl_2 (2 × 5 mL). The combined organic phase was washed with 10% aq. LiCl (15 mL) and brine (15 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo.* Quantitative ^{1}H NMR assay (TCE internal standard, 21 μL, 0.2 mmol) of the residue showed quantitative formation of **9j** from the diamine (87% over two steps). Purification by flash column chromatography on alumina (0–3% EtOAc/PE) afforded the title compound as a yellow oil (56.2 mg, 0.138 mmol, 69%).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (s, 2H), 4.70 – 4.62 (m, 2H), 2.86 (td, *J* = 13.1, 2.8 Hz, 2H), 2.54 (dd, *J* = 11.3, 6.5 Hz, 1H), 2.49 (dd, *J* = 11.3, 6.7 Hz, 1H), 1.87 – 1.68 (m, 7H), 1.68 – 1.56 (m, 3H), 1.34 (tdt, *J* = 11.8, 6.1, 3.1 Hz, 1H), 1.27 – 1.09 (m, 5H), 1.09 – 0.93 (m, 2H), 0.89 (d, *J* = 6.6 Hz, 3H), 0.85 (d, *J* = 6.6 Hz, 3H), 0.82 – 0.67 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.0, 158.0, 105.0, 68.9, 58.3, 44.4, 41.7, 38.0, 31.4, 30.5, 30.5, 30.3, 29.1, 26.9, 26.9, 26.8, 21.1, 18.0.

IR ν_{max}/cm^{-1} 2918, 2848, 1574, 1520, 1504, 1446, 1394, 1360, 1299, 1258, 785.

HRMS m/z (ESI) calculated for $C_{20}H_{34}N_4Br$ $[M+H]^+$ 409.1961 {^{79}Br}, found 409.1948 {^{79}Br}.

8. Unsuccessful alkyl iodides

Failed and low-yielding reactions typically produced varying quantities of reductive amination and protodeiodination of the alkyl iodide as by-products. Quoted ^{1}H NMR yields are obtained from the putative diastereotopic benzyl doublets derived from the use of benzylamine as the amine component. It is worth noting that, in several of the below cases, LCMS analysis of the crude reaction mixture returned a reasonably high total ion count corresponding to the product $[M+H]^+$, but analysis by ^{1}H NMR showed no diagnostic benzyl peaks, indicating only trace product formation. The misleading LCMS data is ascribed to the strong ionisation properties of the secondary amine products.

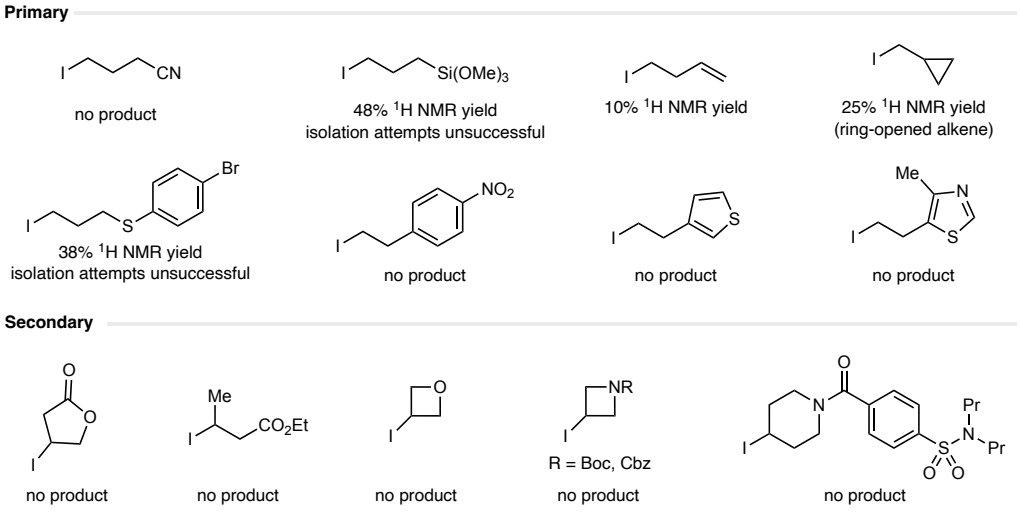
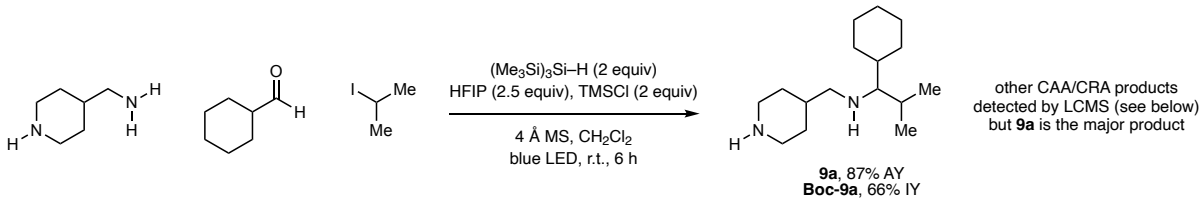


Figure S1. Unsuccessful alkyl iodides.

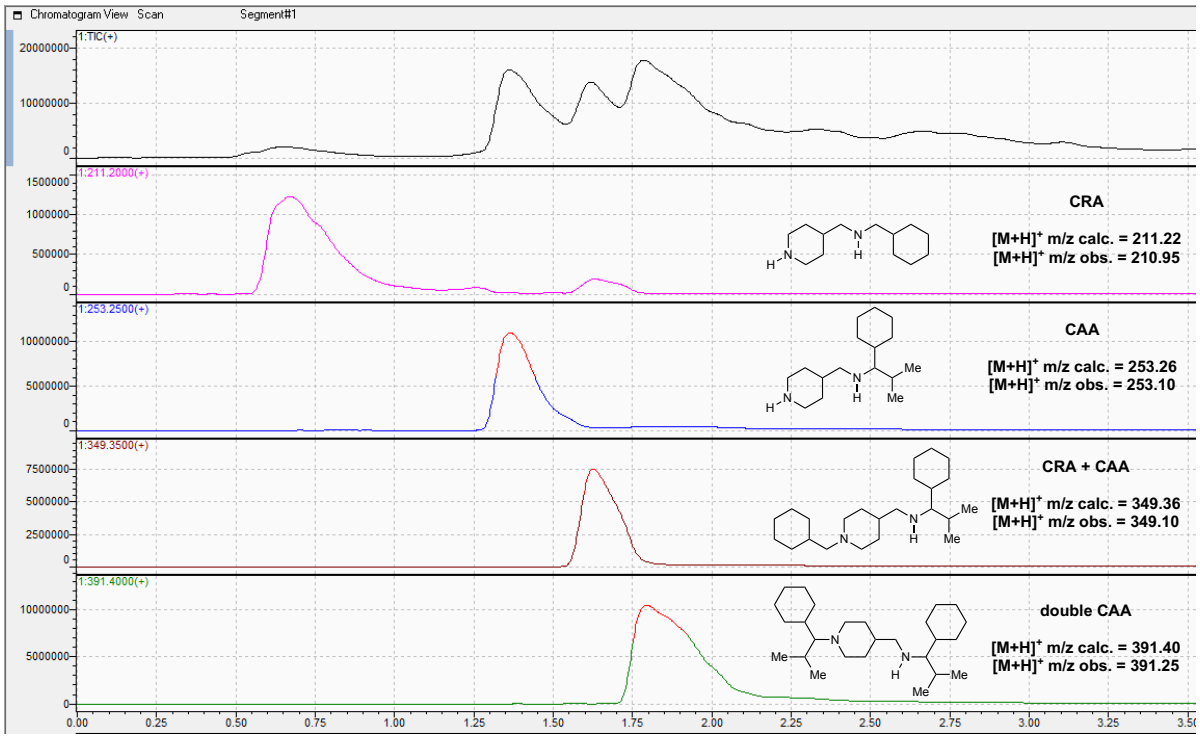
9. Supplementary data for reactions of diamines

Data for a selective reaction: formation of **9a**



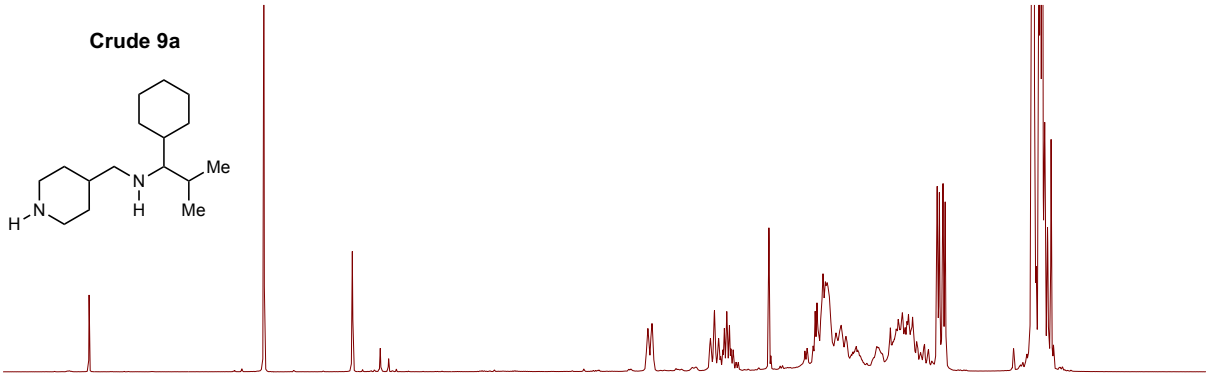
Abbreviations: CRA, carbonyl reductive amination; CAA, carbonyl alkylative amination

Crude LCMS data:



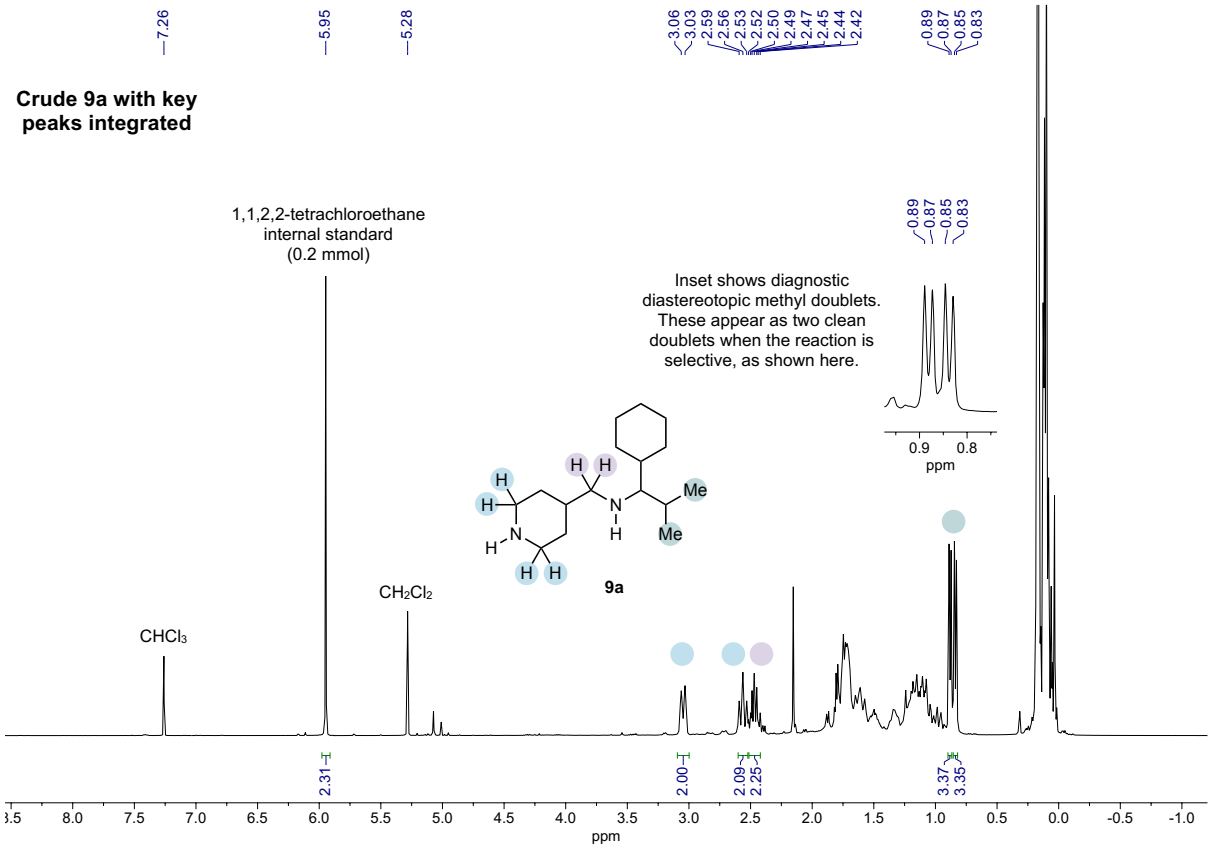
^{1}H NMR data:

Crude 9a

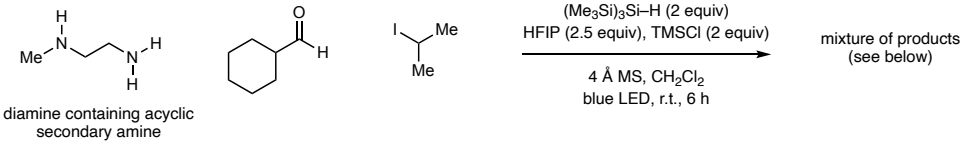


Purified 9a

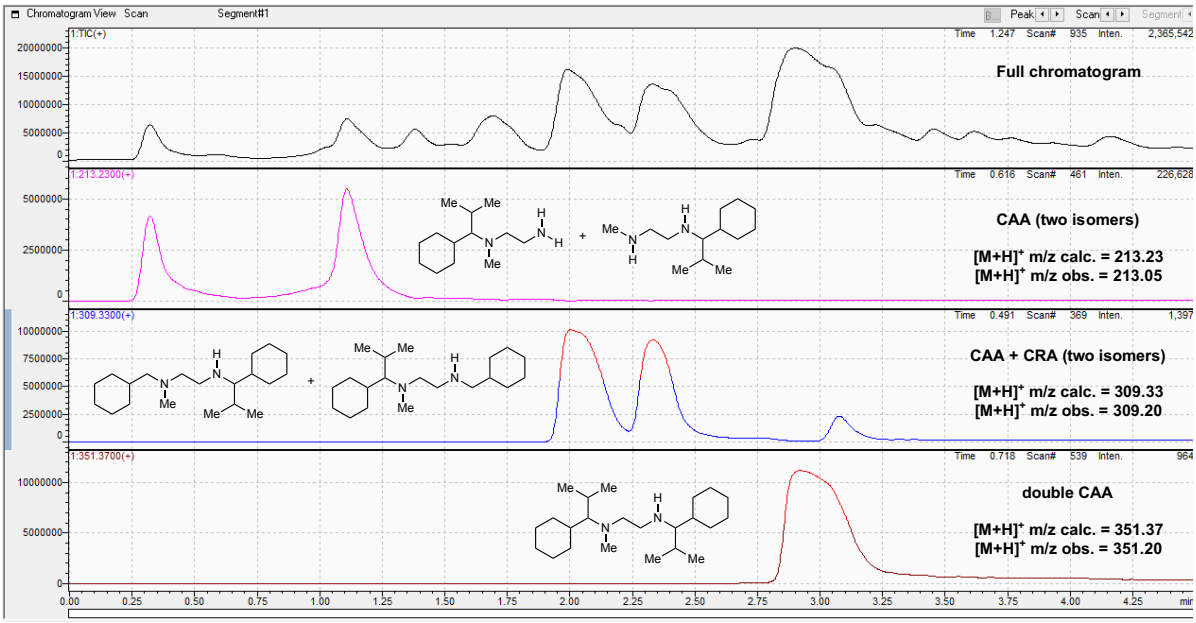
Crude 9a with key peaks integrated



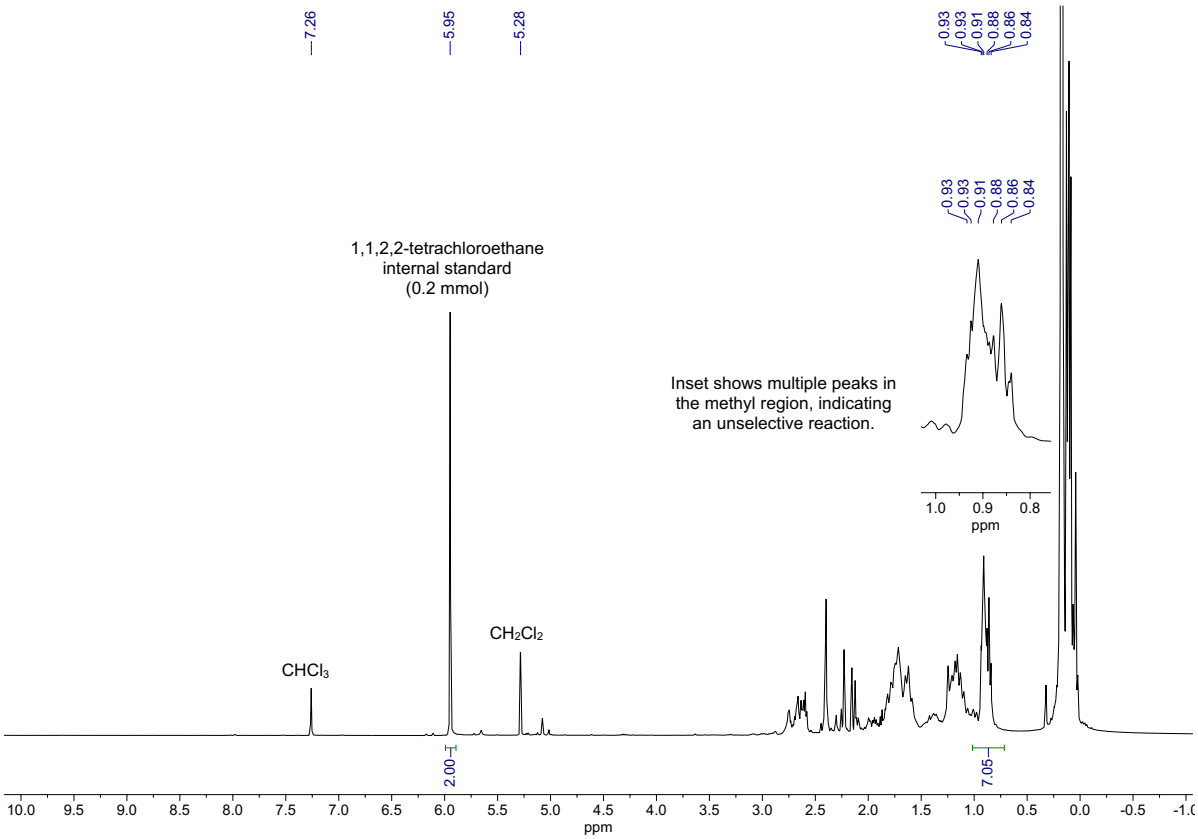
Data for an unselective reaction: diamine contains an acyclic secondary amine



Crude LCMS data



Crude ^{1}H NMR data



10. Mechanistic discussion

Proposed mechanism

The initiation mechanism of alkyl iodides in the presence of TTMSS and visible light has previously been studied by our group in multiple contexts.[10] Although these studies have ultimately been inconclusive, we have obtained tentative evidence for a ternary EDA complex between enamine, TTMSS and alkyl iodide.[10a] In a separate process, we have shown that visible light irradiation of TTMSS and alkyl iodide alone is sufficient for the formation of alkyl radicals.[10d] The precise initiation mechanism of the present reaction is beyond the scope of this study, and we do not present any new data in this regard.

We propose a mechanism in which imine ***Int-i*** (formed from condensation of the amine and aldehyde components) undergoes carbon-carbon bond-forming radical addition with alkyl radical ***Int-ii*** (derived from the alkyl iodide) to afford aminyl radical ***Int-iii*** (Figure S2). Aminyl radical ***Int-iii*** undergoes rapid, polarity matched hydrogen atom transfer from TTMSS to generate product **4b** and silyl radical ***Int-iv***, which propagates the radical chain by undergoing halogen atom transfer with a second molecule of alkyl iodide. Product **4b** is protonated by HFIP *in situ* to form **4b•HFIP**. This is expected based on known pK_a values (pK_a(HFIP) = 9.3; pK_{BH+}(piperidine) = 11.1)[11,12] and our experimental observations: the crude reaction mixture (after filtration and concentration but before basic workup) can be washed with hexane with <5% loss of product, and the residue is a solid (in contrast to the free amine which is an oil) ^{1}H NMR analysis of which is consistent with the salt (ammonium NH_2 protons visible and amine fragment integrates with HFIP counterion C–H in the expected 1:1 ratio).

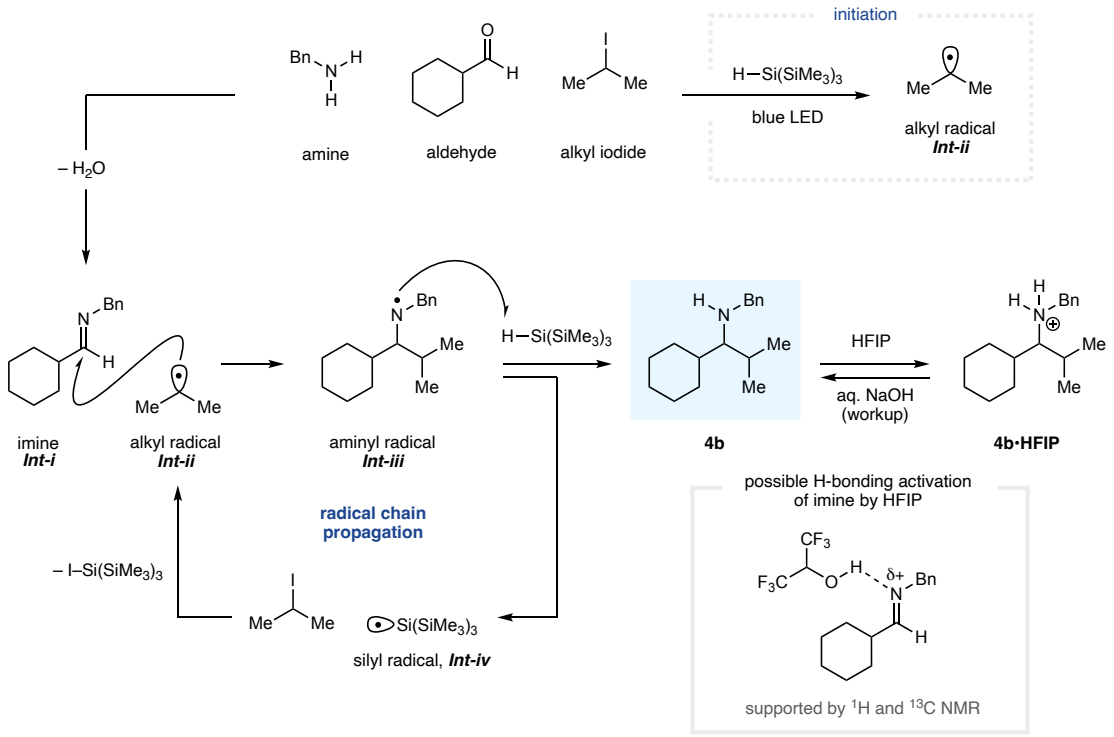


Figure S2. Proposed mechanism.

Role of HFIP

^{1}H and ^{13}C NMR studies (see Supplementary Information section 11) suggest that imine ***Int-i*** is able to hydrogen bond to HFIP, and this may accelerate 1,2-additon to the C=N bond. That the resulting species is neutral aminyl radical ***Int-iii*** and not a cationic aminium radical cation is supported by our studies described in Figure 4 of the main manuscript. Additionally, protonation of the product secondary amine could help to prevent degradation, for example via a second CAA reaction. However, HFIP is not essential for the reaction to proceed (entry 6, Table 1). While the use of HFIP afforded only marginal benefit with some substrates, with others, the improvement was stark. For example, the yields of ethylenediamine- and tryptamine-derived products **4d** and **4i** both increased drastically upon addition of 2.5 equiv HFIP (Figure S3).

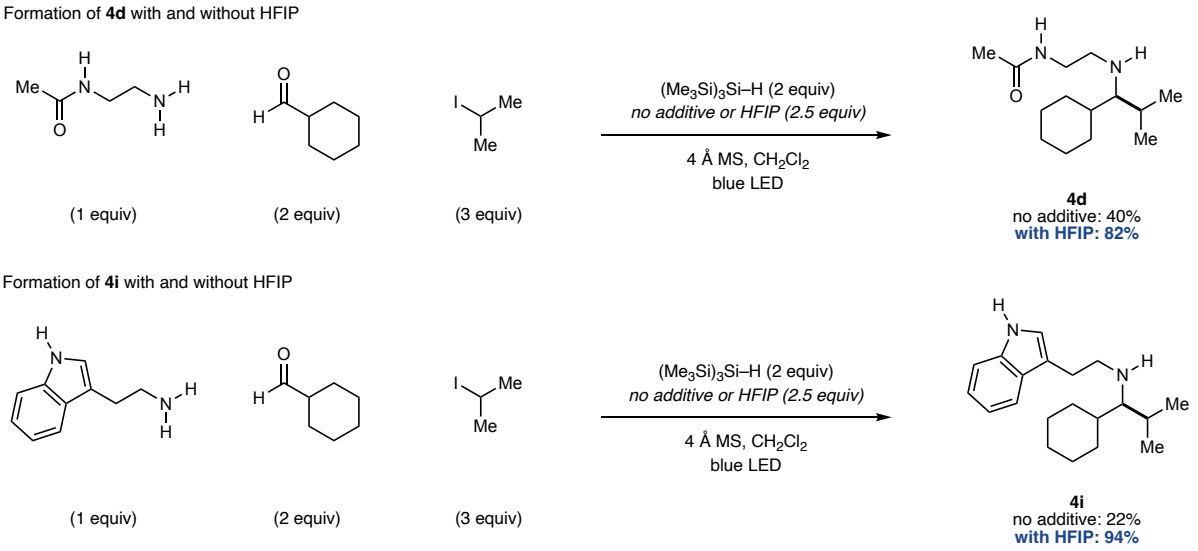


Figure S3. Examples in which the use of HFIP is essential for high yields.

Additionally, a solvent quantity of HFIP was often helpful when basic heterocycles were present (e.g. **4z**, **4aa**). Here, in solvent mode, HFIP could be assisting a more challenging condensation step with these substrates by stabilising cationic intermediates, or reducing deleterious reactivity/interactions of the basic heterocycles by forming strongly hydrogen-bonded complexes.[13]

Role of TMSCl

^{1}H and ^{13}C NMR studies (see Supplementary Information section 11) show formation of an N-H iminium ion ***Int-v*** upon addition of 2 equiv TMSCl to a mixture containing all the other reaction components. Addition of a carbon centred radical to this species, to generate aminium radical cation ***Int-vi***, should be faster than addition to the neutral C=N bond on the basis of polarity matching (the iminium ion is more electrophilic than the imine) (Figure S4). Subsequent hydrogen atom transfer from TTMSS to ***Int-vi*** furnishes **4b•HCl**. We obtained evidence for the intermediacy of an aminium radical cation when using TMSCl by observation of pyrrolidine **4ac'** (Figure 4, main manuscript). It is plausible that, with less nucleophilic radicals such as those derived from primary iodides, the increased electrophilicity of the iminium ion relative to the imine is important to offset the reduced nucleophilicity of the radical and allow productive addition to out-compete degradation of the radical. A possible explanation for the cooperative effect of TMSCl with solvent quantities of HFIP observed for certain substrates could involve stabilisation of the intermediate radical cations by HFIP, for which there is precedent.[11,13]

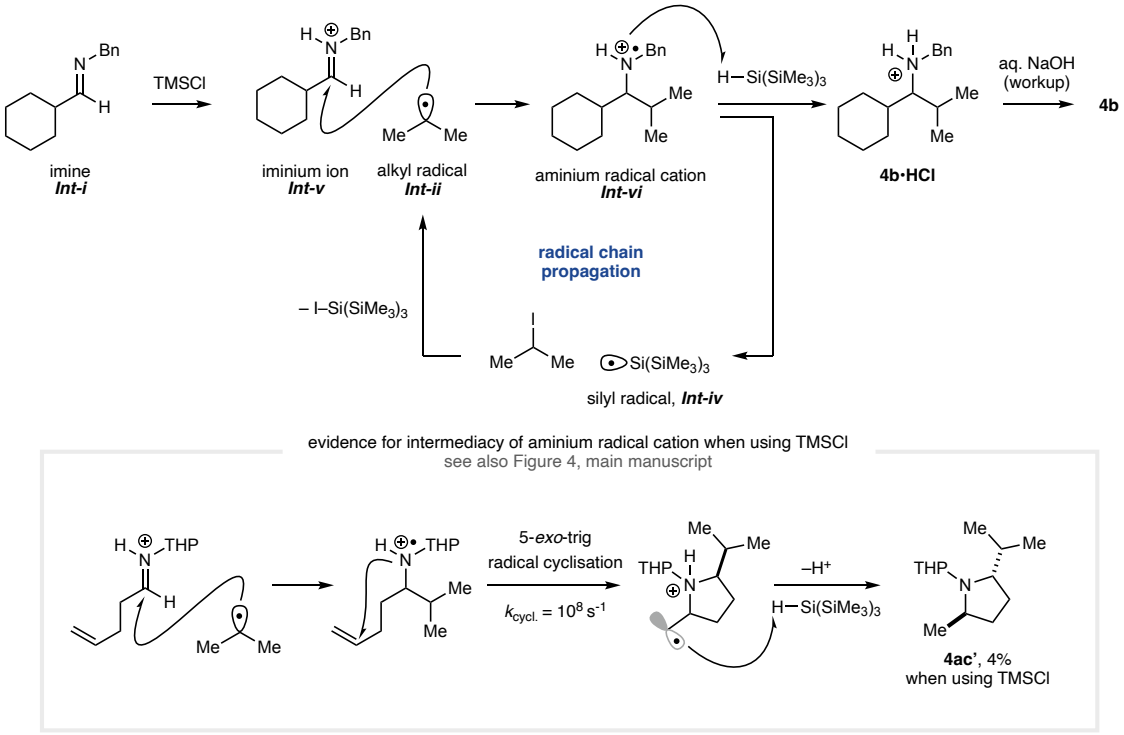


Figure S4. Proposed mechanism when using TMSCl in addition to HFIP.

Possible mechanisms for the formation of reductive amination by-products

With low-yielding reactions, particularly in the case of poorly-performing alkyl iodides, by products that correspond to a formal carbonyl reductive amination (CRA) were observed. We cannot be certain of the mechanistic origin of these by-products, but here we present three possible scenarios (Figure S5).

The TTMSS radical (***Int-iv***) is an excellent nucleophile for π-electrophiles, and can add to C=N bonds at either terminus.[14] Addition to nitrogen is usually preferred in uncharged C=N substrates, and such addition to imine ***Int-i*** would give *N*-silyl α-amino radical (***Int-vii***). This species could undergo HAT with TTMSS to give *N*-silyl amine ***Int-viii***, which would afford the CRA product upon protodesilylation. Alternatively, addition at the carbon atom of imine ***Int-i*** would afford α-silyl aminyl radical ***Int-ix***, which could undergo radical aza-Brook rearrangement to the more thermodynamically favourable *N*-silyl α-amino radical ***Int-vii***. When using TMSCl, silyl radical addition at the carbon terminus of iminium ion ***Int-v*** gives α-silyl aminium radical cation ***Int-x***. The mesolytic cleavage of α-silyl aminium radical cations to give α-amino radicals has been well-studied,[15–17] and the decomposition of ***Int-x*** via this pathway provides the α-amino radical ***Int-vii***, which can proceed to the CRA product as previously described.

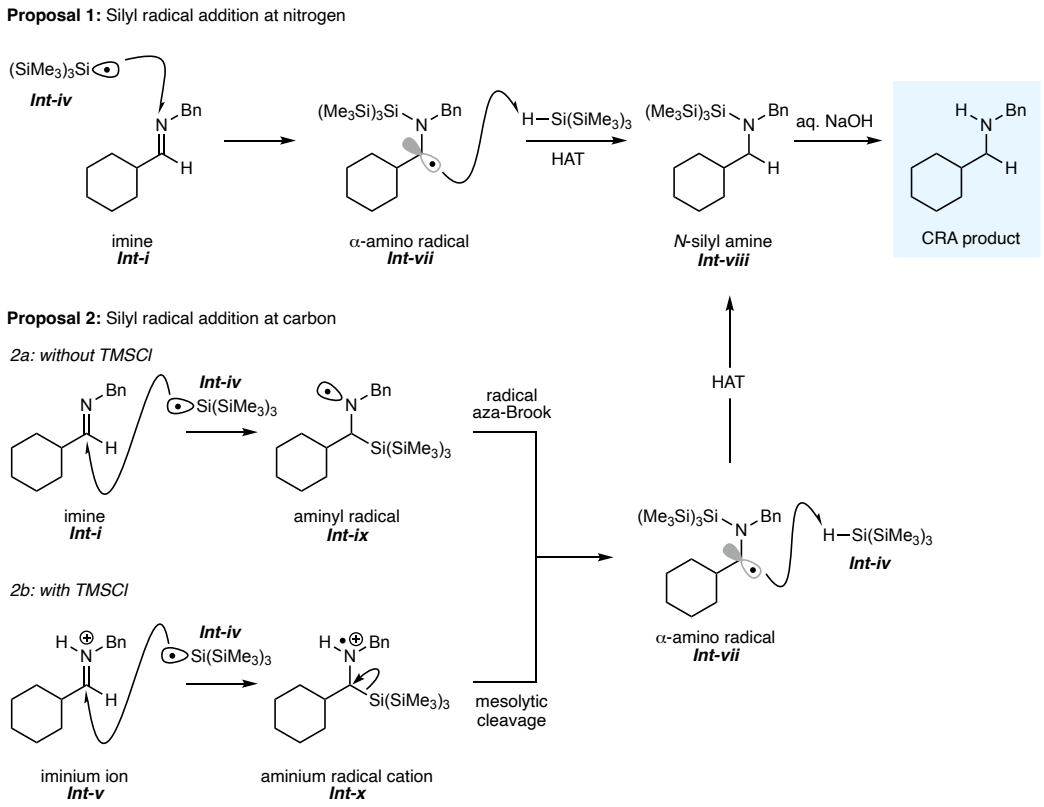


Figure S5. Possible mechanisms for the formation of reductive amination by-products.

Plausible mechanistic rationale for the selective CAA of diamines

TMSCl plays a crucial role in enabling the efficient and selective alkylation of the primary amine moiety in alkyl diamines containing a primary amine and a cyclic secondary amine. At present, the mechanistic origin of that role is unclear, but here we discuss some possibilities.

Perhaps the simplest rationale for this effect would involve in situ TMS protection of the (more nucleophilic) piperidine nitrogen amine to form **S11**, leaving only the primary amine free to undergo the CAA reaction (Figure S6). We find this explanation unlikely because TMSCl is the final reagent to be added to the reaction mixture, whereas the amine is added first and the aldehyde second. Since the reaction between the secondary amine and *aldehyde* is extremely fast, we expect that by the time the TMSCl is added, all of the amine has been consumed in the formation of the corresponding enamine, **S12**. Instead, we expect that the most likely ultimate fate of TMSCl is *O*-silylation of HFIP (driven by the strong Si–O bond), resulting in the formation of two equivalents of $(F_3C)_2HCOTMS$ and HCl and a residual 0.5 equiv HFIP.

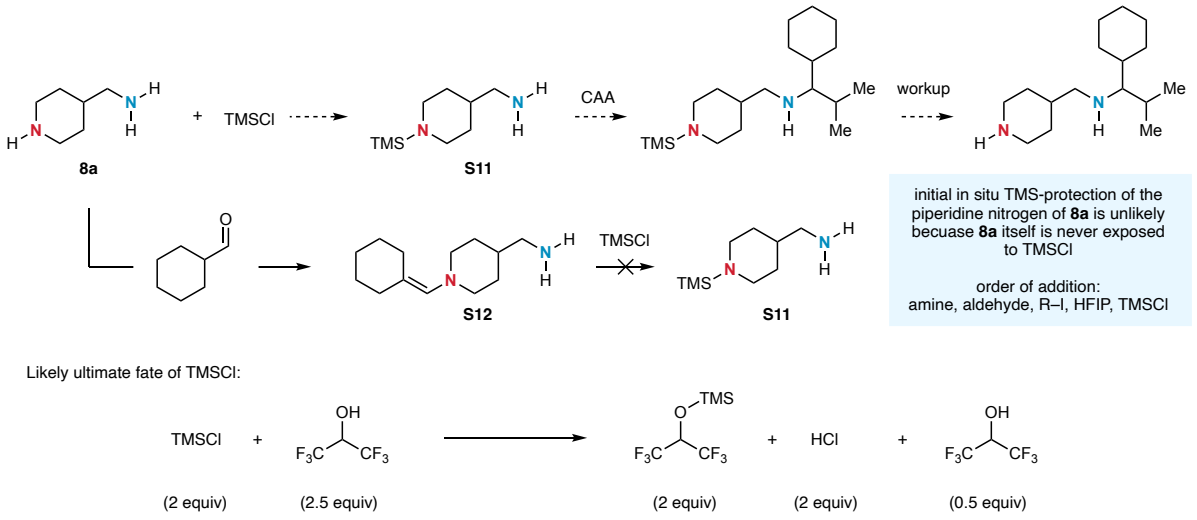


Figure S6. TMS protection of the piperidine nitrogen of diamine **8a** is unlikely.

From enamine **S12**, there are several possible explanations as to why the CAA reaction would proceed unselectively in the absence of TMSCl (Figure S7): (1) Enamine **S12** is unable to form iminium **S13** and therefore cannot isomerise to reactive imine **S14**; (2) Enamine **S12** and imine **S14** are both present and able to interconvert via **S13**, but the concentration of both **S13** and **S14** are low, leading to low conversion and unselective reaction; (3) Imine **S14** can readily form from enamine **S12**, but **S14** is able to oligomerise by attack of the secondary amine of one molecule onto the imine of another, resulting in the formation of unreactive oligomeric aminals **S15**.

In any of the above scenarios, addition of TMSCl (a soft source of HCl) may enable conversion of **S12**–**S15** to dication **S16** (pK_{BH+}(N-methylethylenediamine) = 10.4, 7.56;[18] pK_a(HCl) ≈ –7) in which the more basic piperidine nitrogen is protonated and the primary amine displays an N–H iminium ion derived from the aldehyde. The isomeric dication **S17**, featuring the iminium ion of the piperidine nitrogen and the protonated primary amine, should be disfavoured due to the $A^{1,3}$-strain present in the iminium ion of the secondary amine. CAA reaction of **S16** would result in selective reaction at the primary amine.

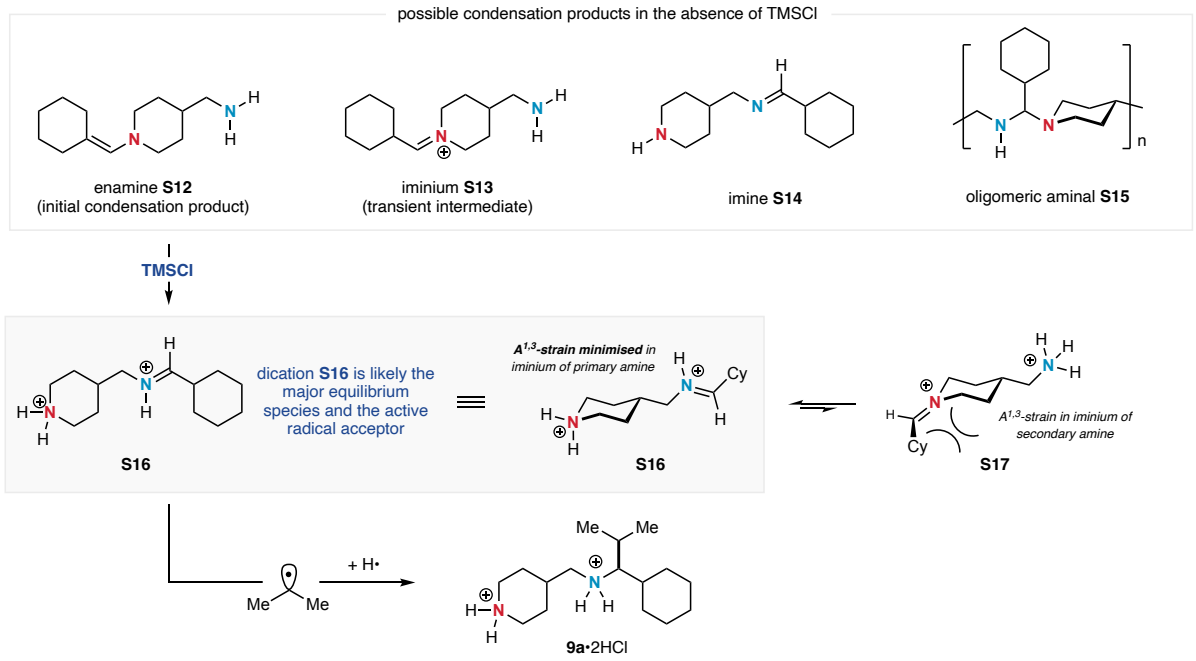


Figure S7. Possible roles of TMSCl in enabling the selective CAA of diamines.

11. NMR studies

Summary of findings

- Full conversion of the amine to the imine is observed when the amine and aldehyde are stirred together for 1 h (Study 1A).
- HFIP hydrogen-bonds to the imine (Study 1B)
- TMSCl forms an N–H iminium ion, presumably by generation of HCl in situ (Study 1C)
- TTMSS does not interact with the other reaction components prior to irradiation (Study 1D)

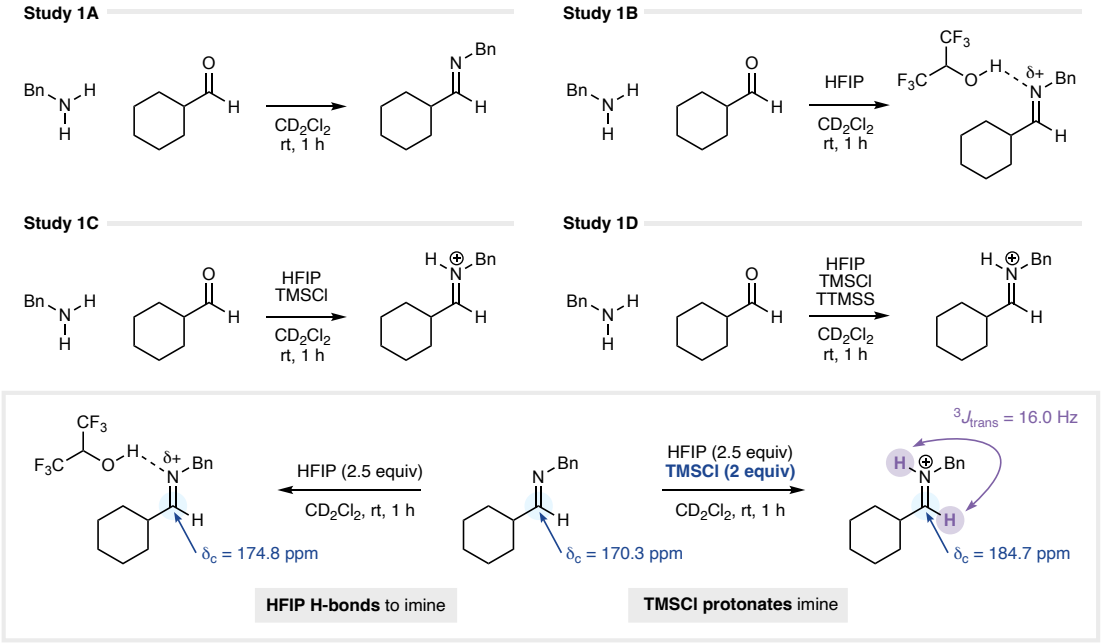


Figure S8. Summary of findings from NMR studies.

Procedure for NMR studies

An oven-dried microwave vial was charged with a magnetic stirrer bar, 4 Å MS (50 mg). The vial was sealed and evacuate-refilled with N_2 (3 cycles). Deuterated dichloromethane (1 mL) benzylamine (11 μL, 0.1 mmol, 1.0 equiv), cyclohexanecarboxaldehyde (14.5 μL, 0.24 mmol, 1.2 equiv), and

A: no additive

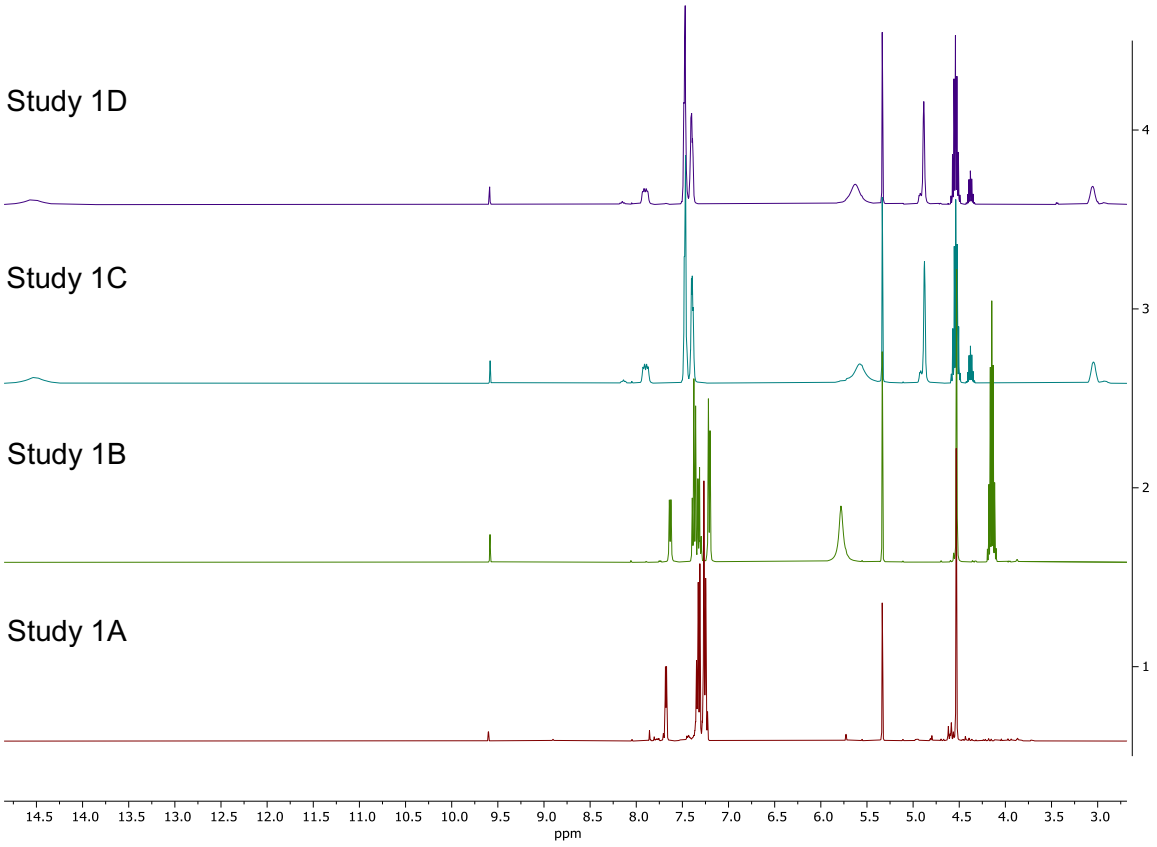
B: HFIP (26 μL, 0.25 mmol, 2.5 equiv)

C: HFIP (26 μL, 0.25 mmol, 2.5 equiv), TMSCl (26 μL, 0.2 mmol, 2.0 equiv)

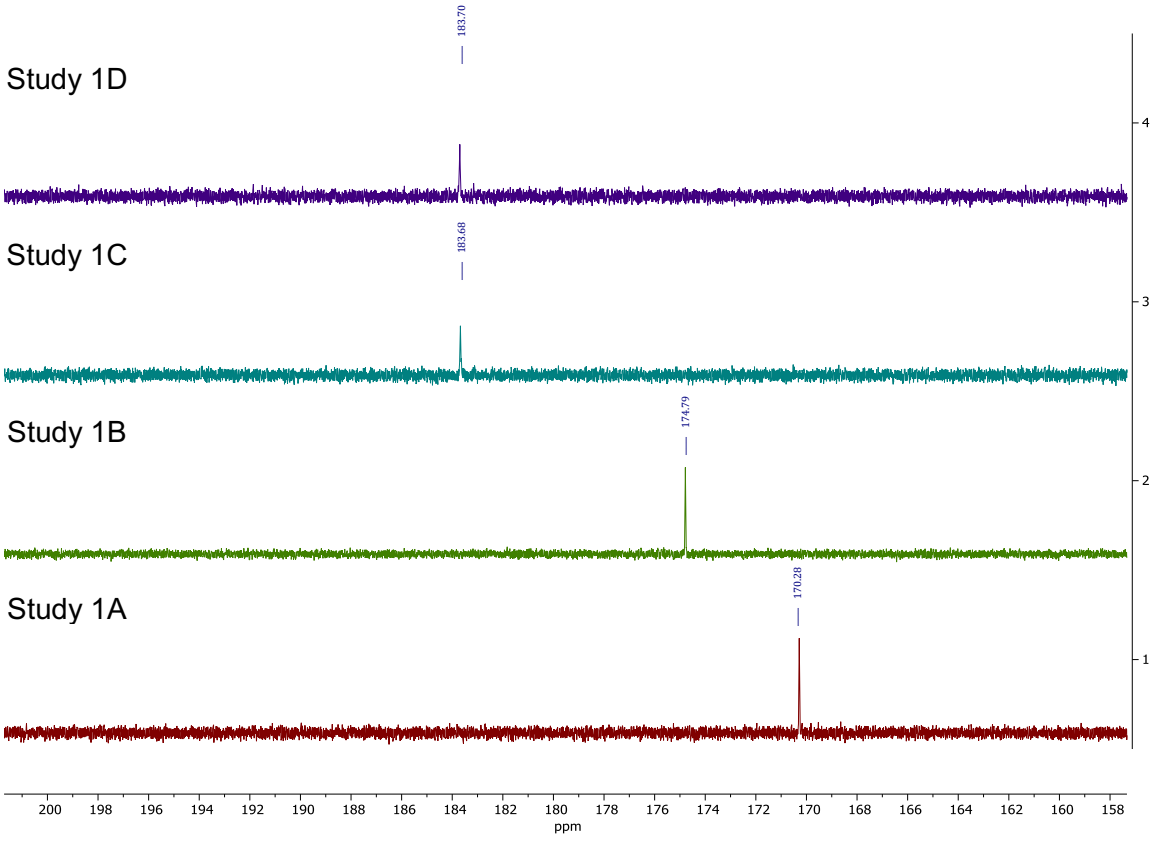
D: HFIP (26 μL, 0.25 mmol, 2.5 equiv), TMSCl (26 μL, 0.2 mmol, 2.0 equiv), TTMSS (62 μL, 0.4 mmol, 2.5 equiv)

were added. The reaction mixture was stirred in the dark for 1 h, whereupon it was filtered direftly into an NMR tube through a glass pipette-celite plug, and the filtrate analysed by ^{1}H and ^{13}C NMR.

^{1}H NMR

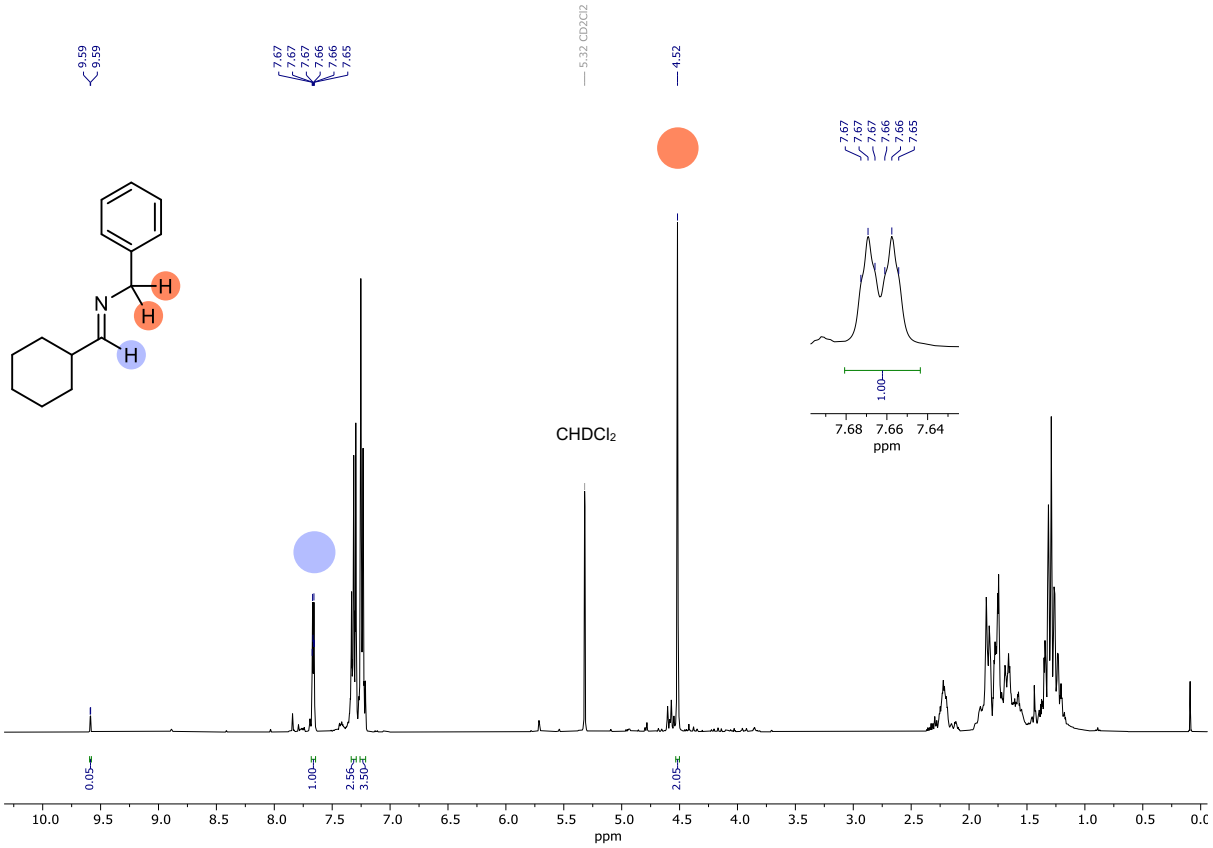


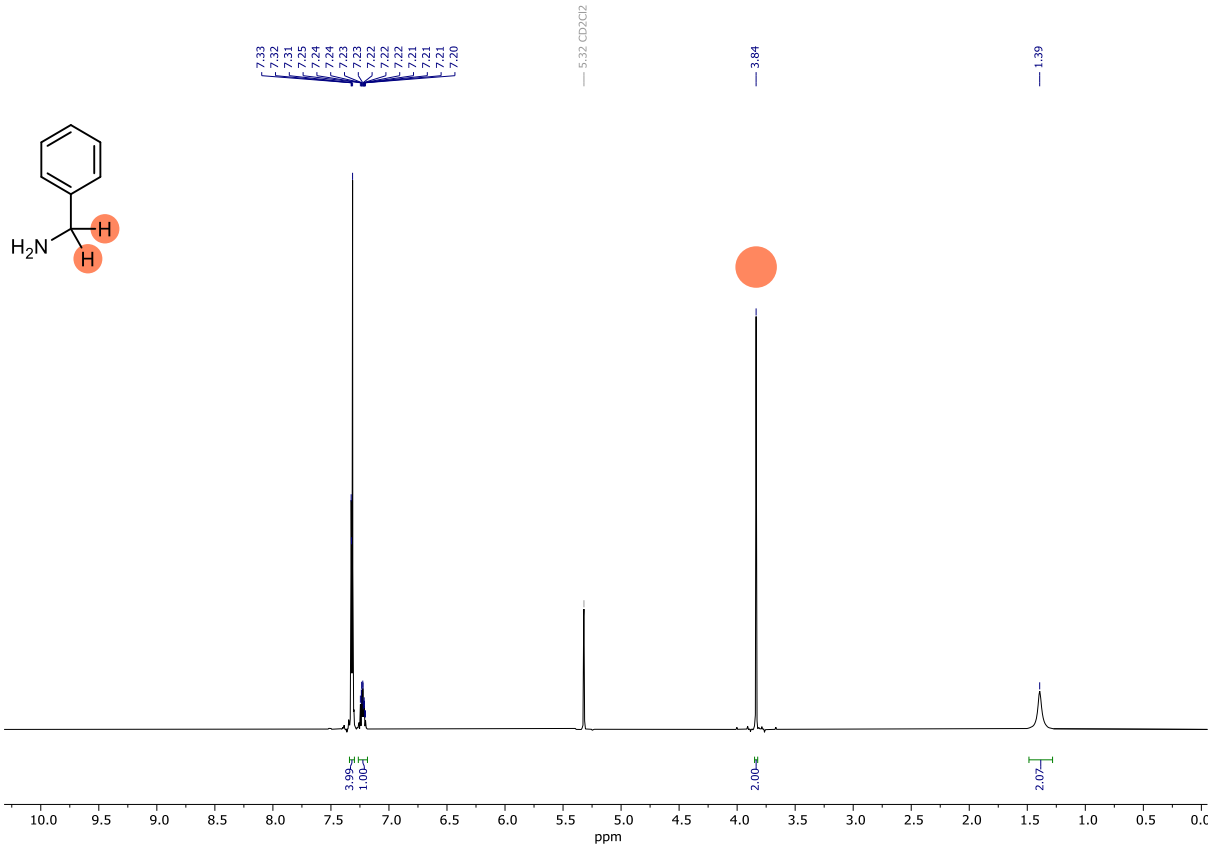
^{13}C NMR



Study 1A – amine + aldehyde

Full conversion of the amine to the imine is observed by ^{1}H NMR: disappearance of diagnostic benzyl signal at δ 3.84 ppm (s, 2H); appearance of diagnostic imine signal at δ 7.66 (dt, *J* = 4.7, 1.4 Hz, 1H).

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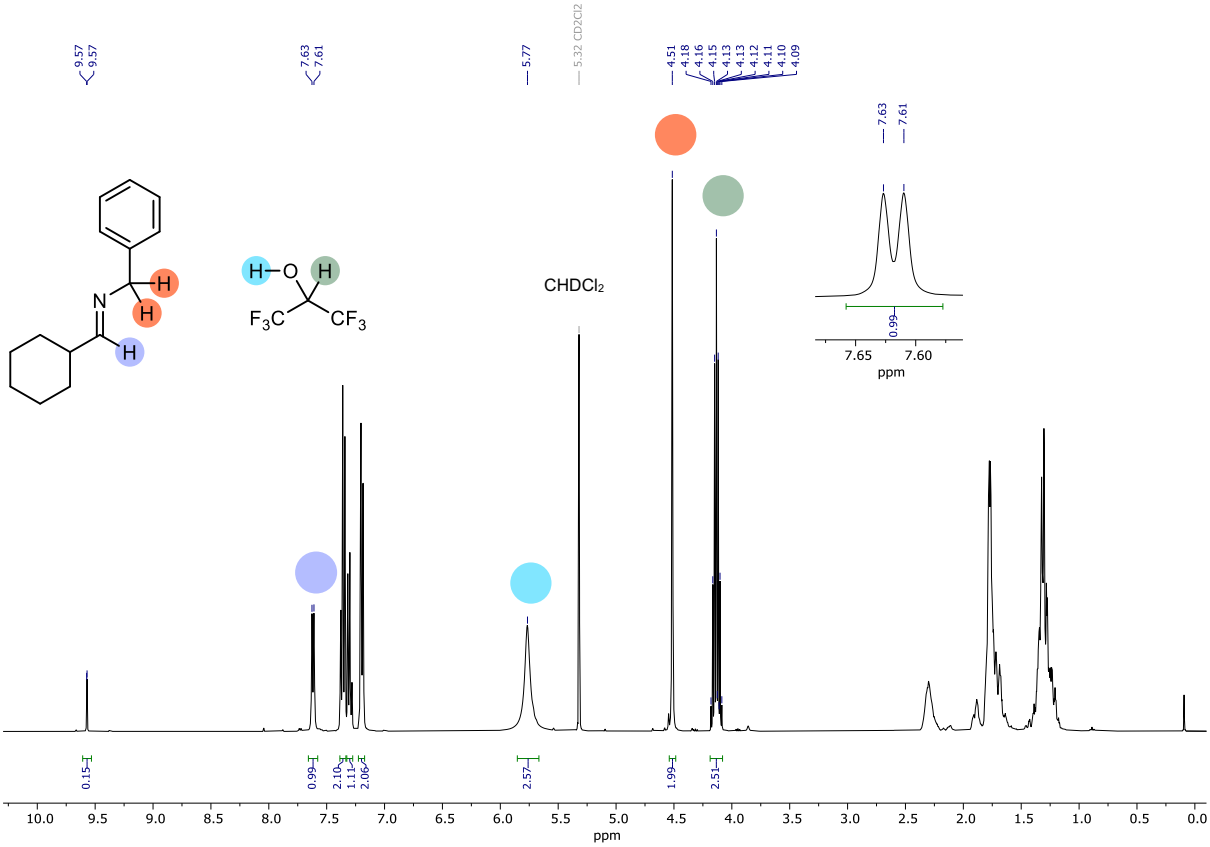
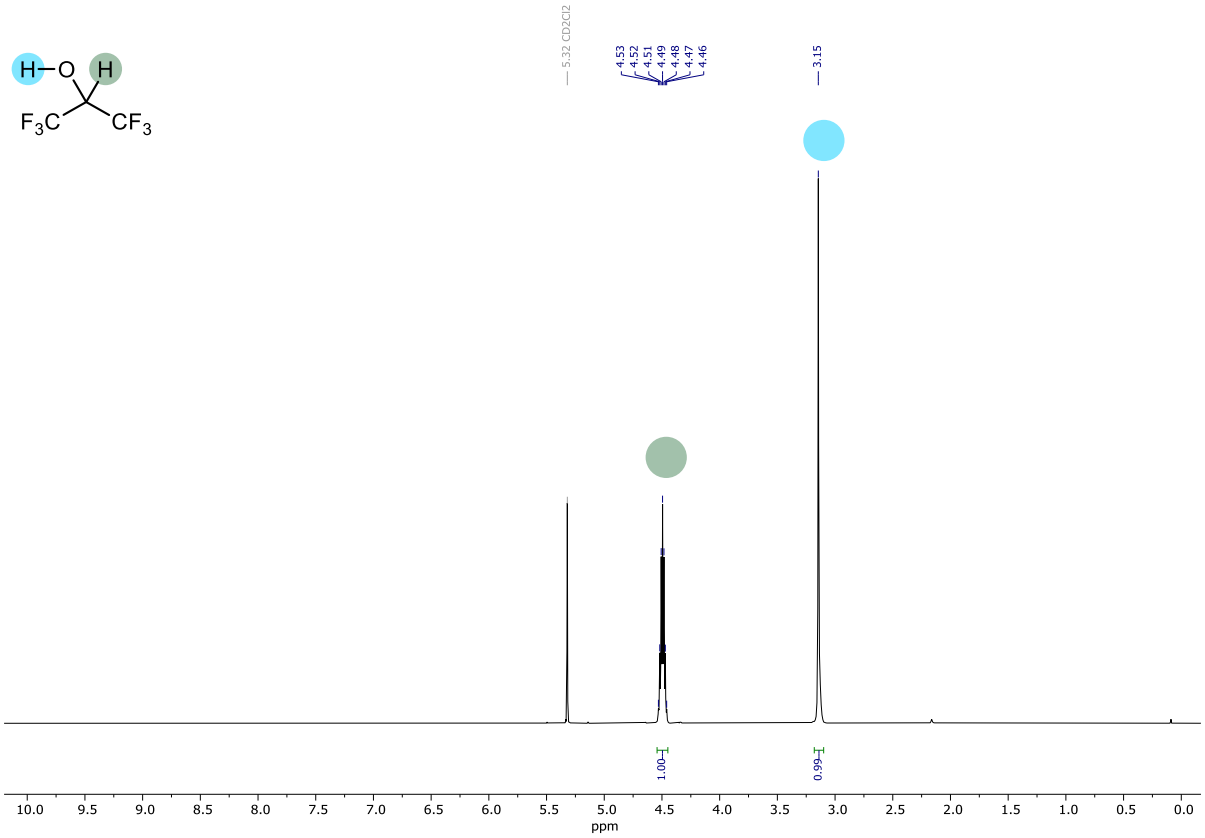
7.21
7.20
5.32 CD2Cl2
3.84
1.39
H2N
H
H
3.99
1.00
2.00
2.07
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

Study 1B – amine + aldehyde + HFIP

Full conversion of the amine is observed by ^{1}H NMR, and the resulting imine interacts with HFIP, as indicated by changes in key signals of the imine and HFIP in the mixture compared to the separate components. Most significantly, the labile O-H proton (blue) moves considerably downfield (δ 3.15 ppm in free HFIP; δ 5.77 ppm in the mixture), and the HFIP C–H proton (green) moves upfield (δ 4.49 ppm in free HFIP; δ 4.13 ppm in the mixture). The imine proton (lilac) undergoes only a slight upfield shift and the benzylic protons do not move.

In the ^{13}C NMR spectrum, the carbonyl peak shifts downfield from 170.3 ppm in the imine (Study 1A) to 174.8 ppm when HFIP is added (Study 1B), which is consistent with hydrogen-bonding activation of the imine.

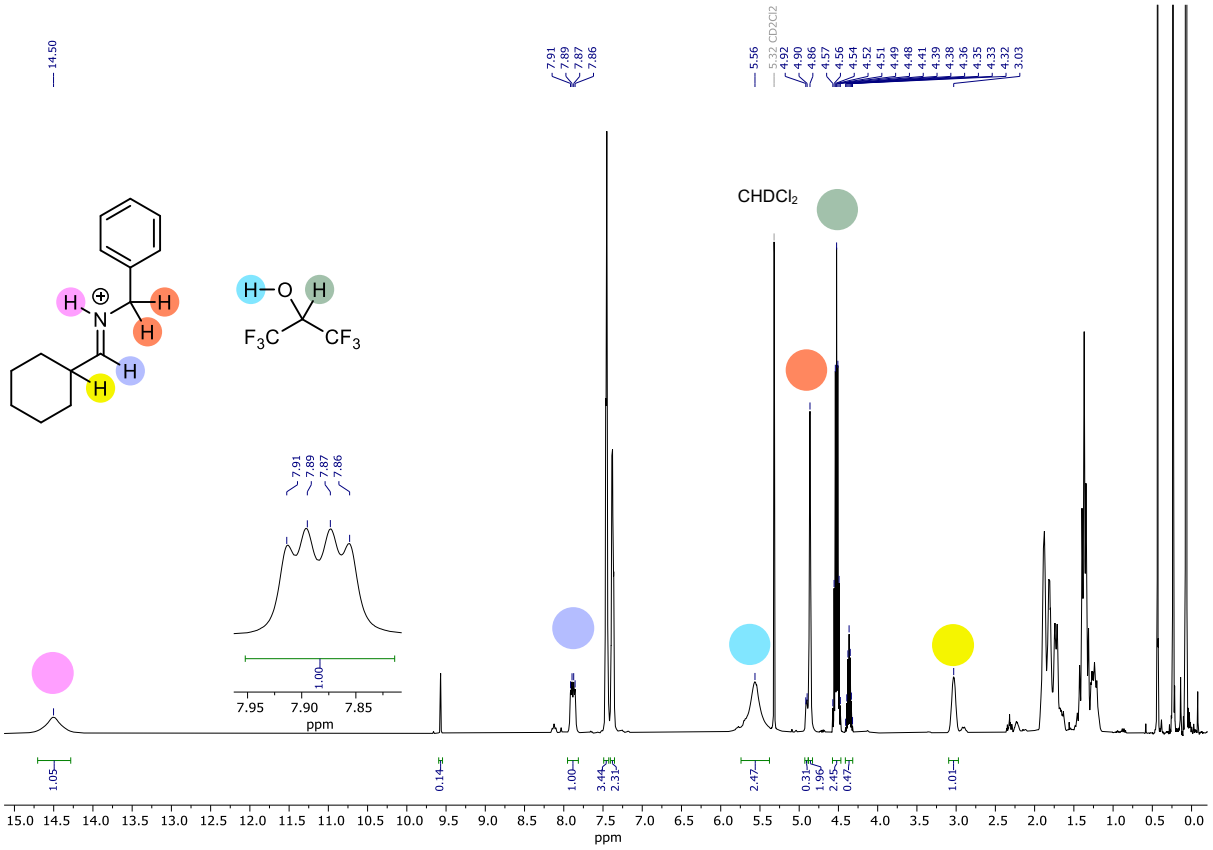



H
O
H
F3C
CF3
5.32 CD2Cl2
4.53
4.52
4.51
4.49
4.48
4.47
4.46
3.15
1.00
0.99
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm

Study 1C – Amine + aldehyde + HFIP + TMSCl

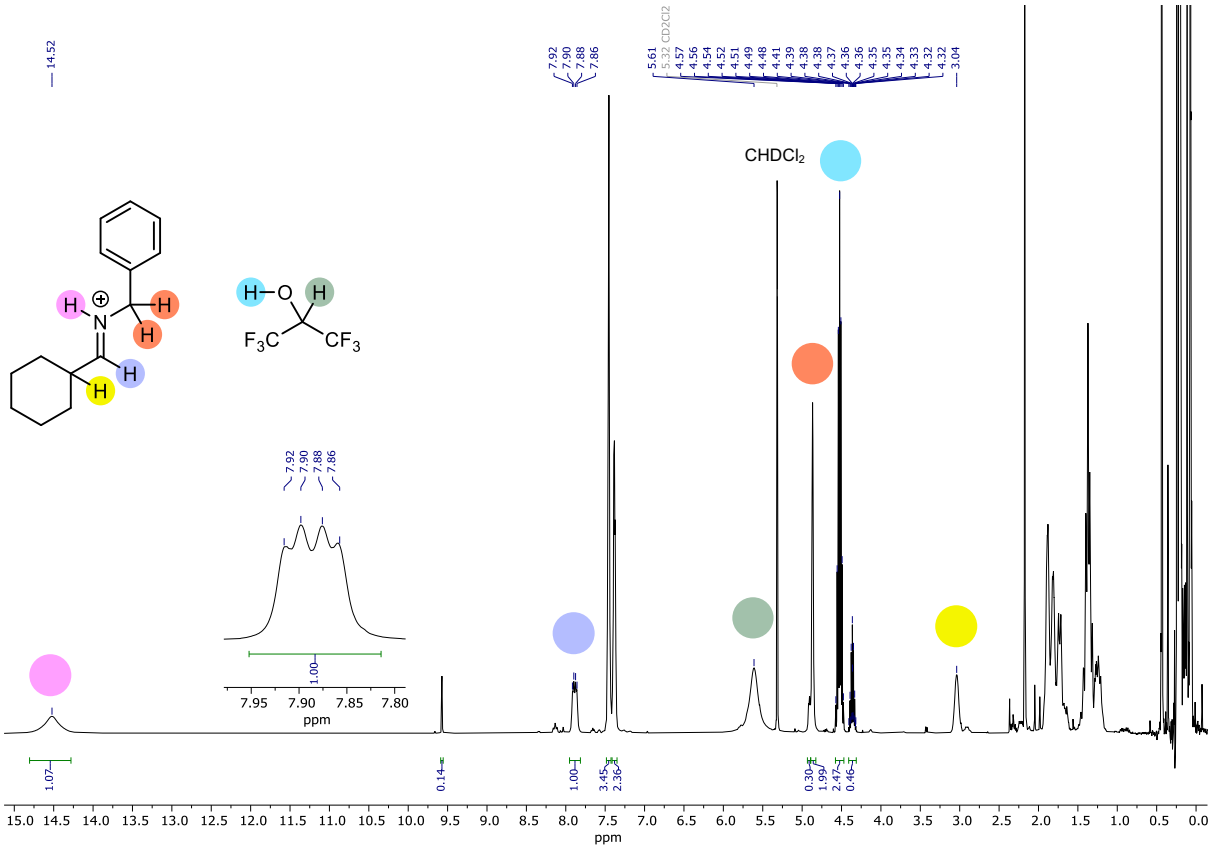
Full conversion of the amine is observed in the ^{1}H NMR spectrum, this time to a new imine-derived species, which we assign as the corresponding N–H iminium ion. Key data supporting this assignment are the appearance of a highly deshielded broad singlet at δ 14.50 ppm (pink, iminium N–H proton) and a change in the chemical shift (δ 7.62 to 7.88 ppm) and multiplicity (d, J = 6.8 Hz in study 1B; to dd, J = 16.0, 7.7 Hz) of the imine C–H proton. The 16.0 Hz coupling constant is characterisic of a ^{3}J coupling across an sp^{2} system, which we assign to the *trans*-disposed N–H proton (pink) and the imine C–H proton (lilac). Additional signals surrounding the imine also undergo a downfield shift, namely the benzylic protons (orange, δ 4.51 to 4.86 ppm) and the imine α-C–H proton (yellow, δ 2.30 to 3.03 ppm).

In the ^{13}C NMR spectrum, the carbonyl peak shifts downfield from 170.3 ppm in the imine (Study 1A) to 183.7 ppm when TMSCl is added (Study 1C) which is consistent with protonation of the imine.



Study 1D – Amine + aldehyde + HFIP + TMSCl + TTMSS

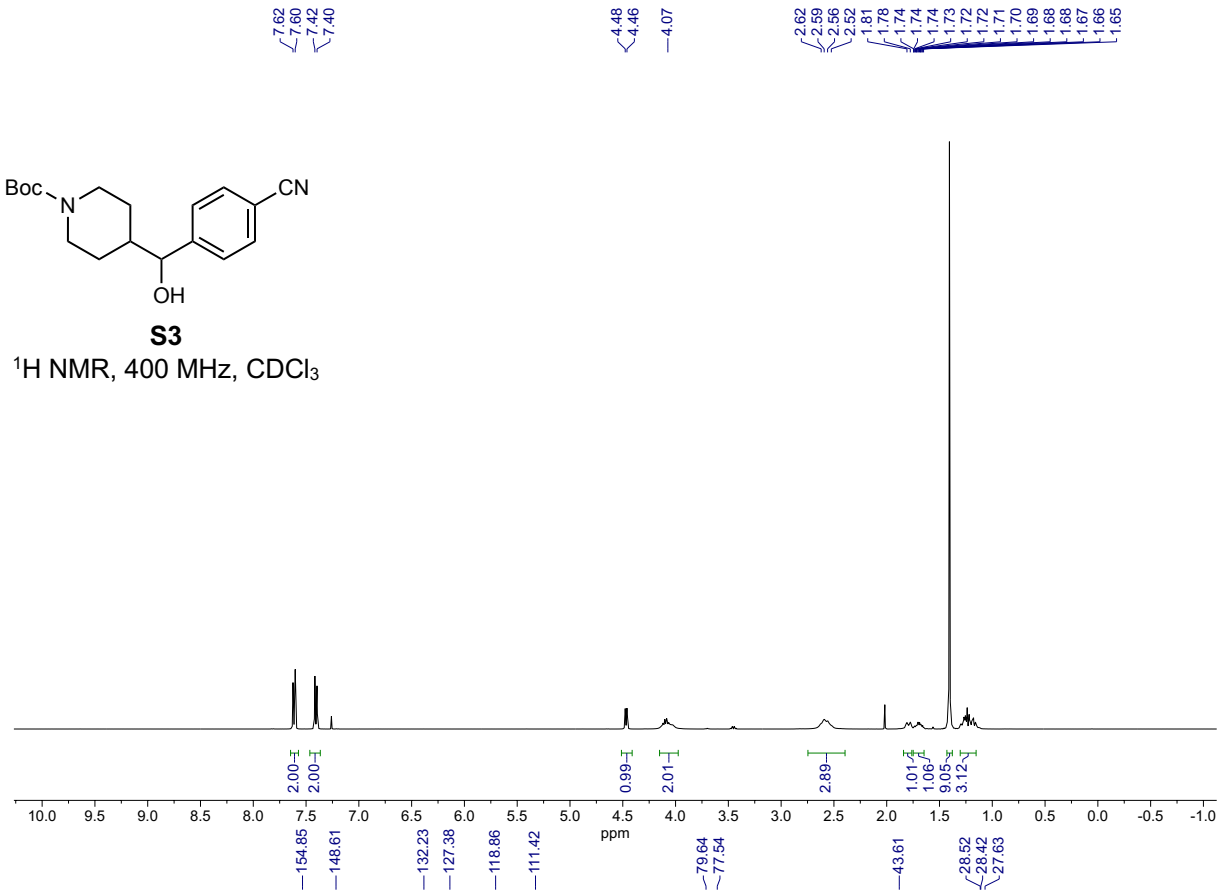
There is no meaningful difference between the spectra of Study 1C and Study 1D which suggests that TTMSS does not interact with the iminium ion or HFIP prior to irradiation.



12. Spectra

Synthesis of Substrates

S3

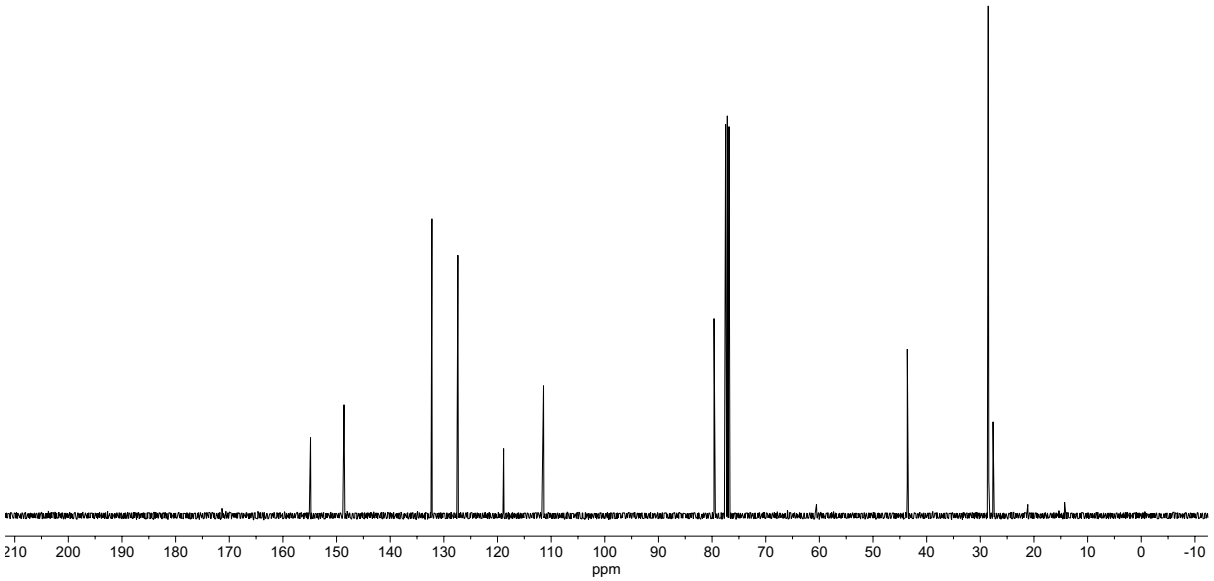


S3

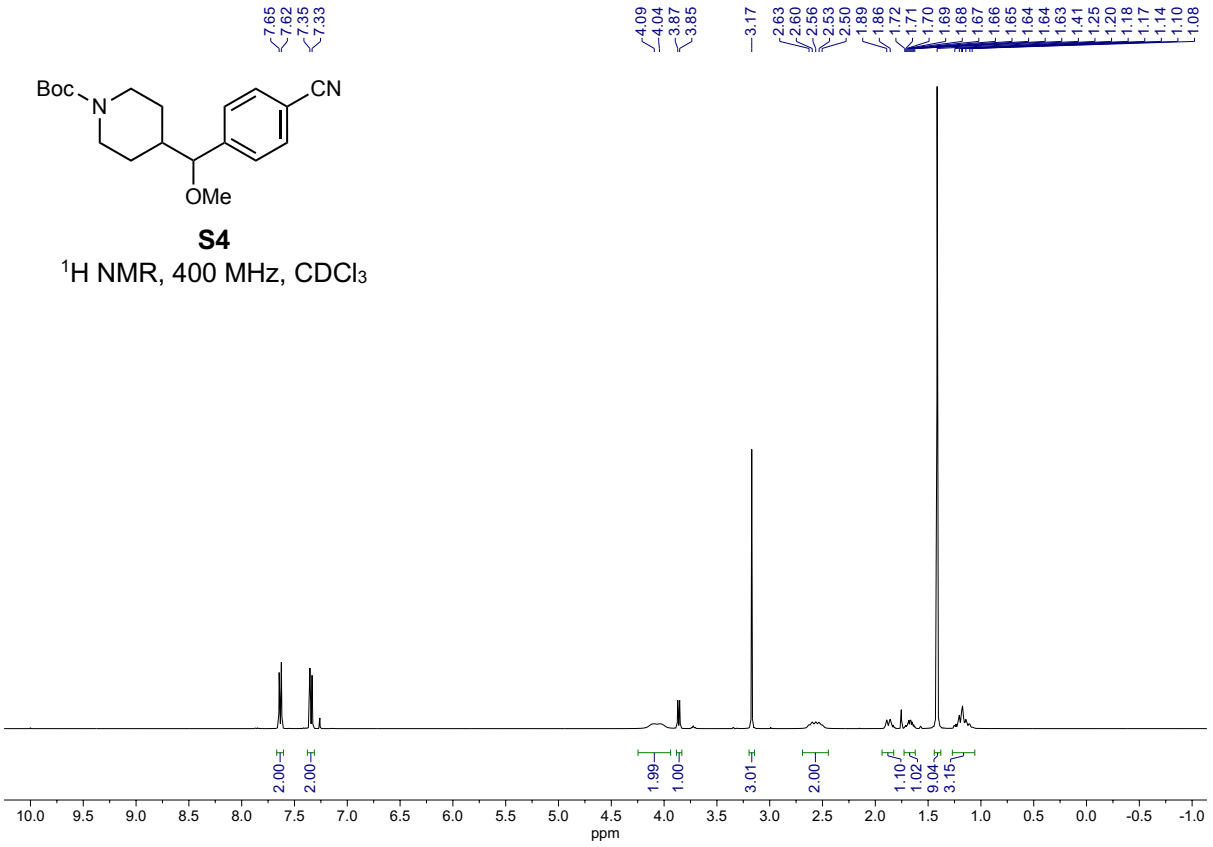
^{1}H NMR, 400 MHz, $CDCl_3$

S3

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

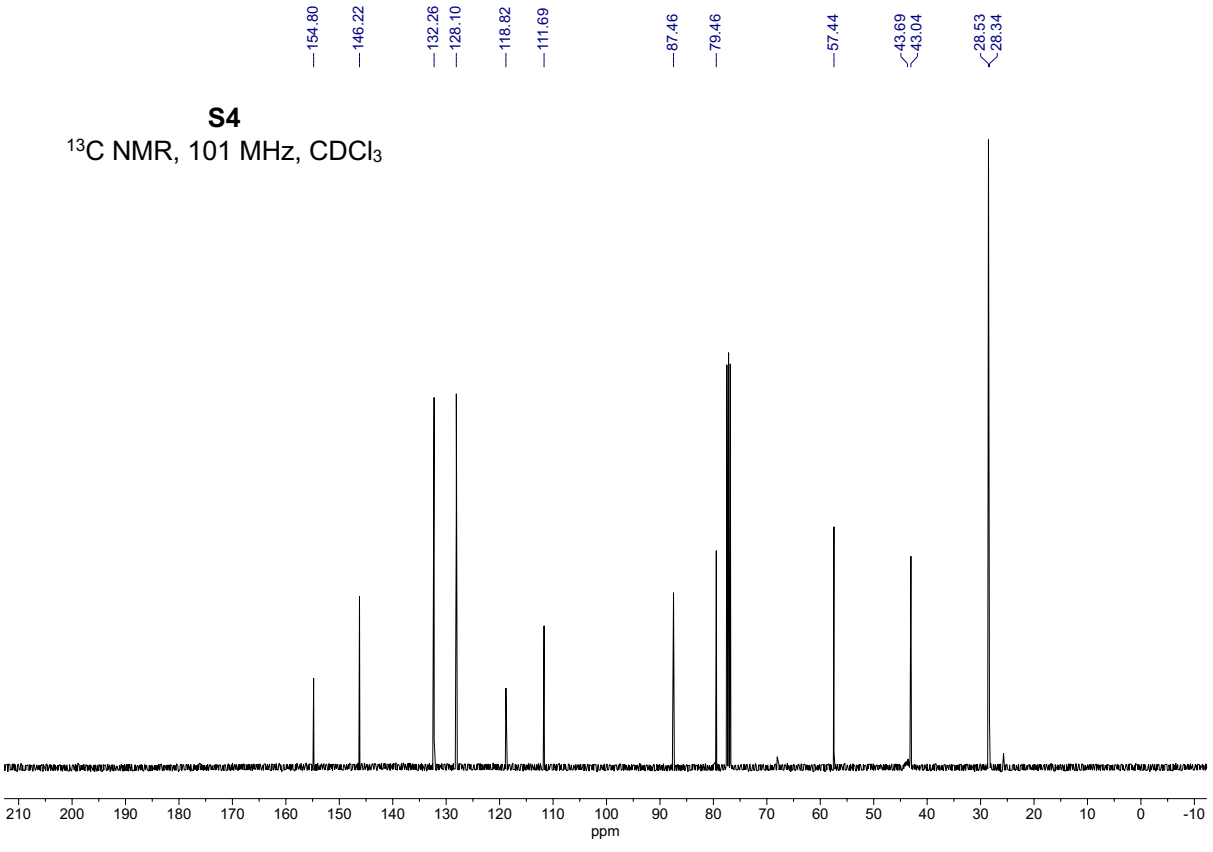


S4



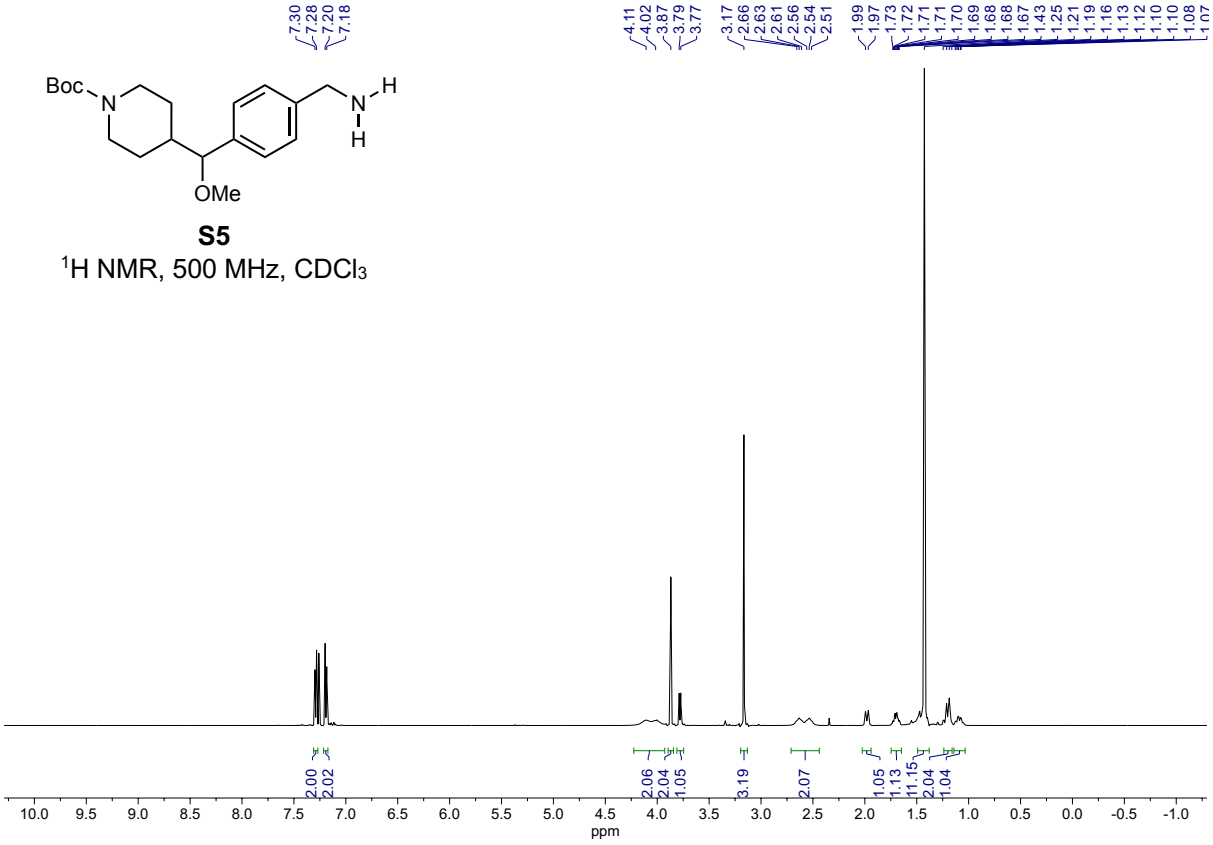
S4

^{1}H NMR, 400 MHz, $CDCl_3$



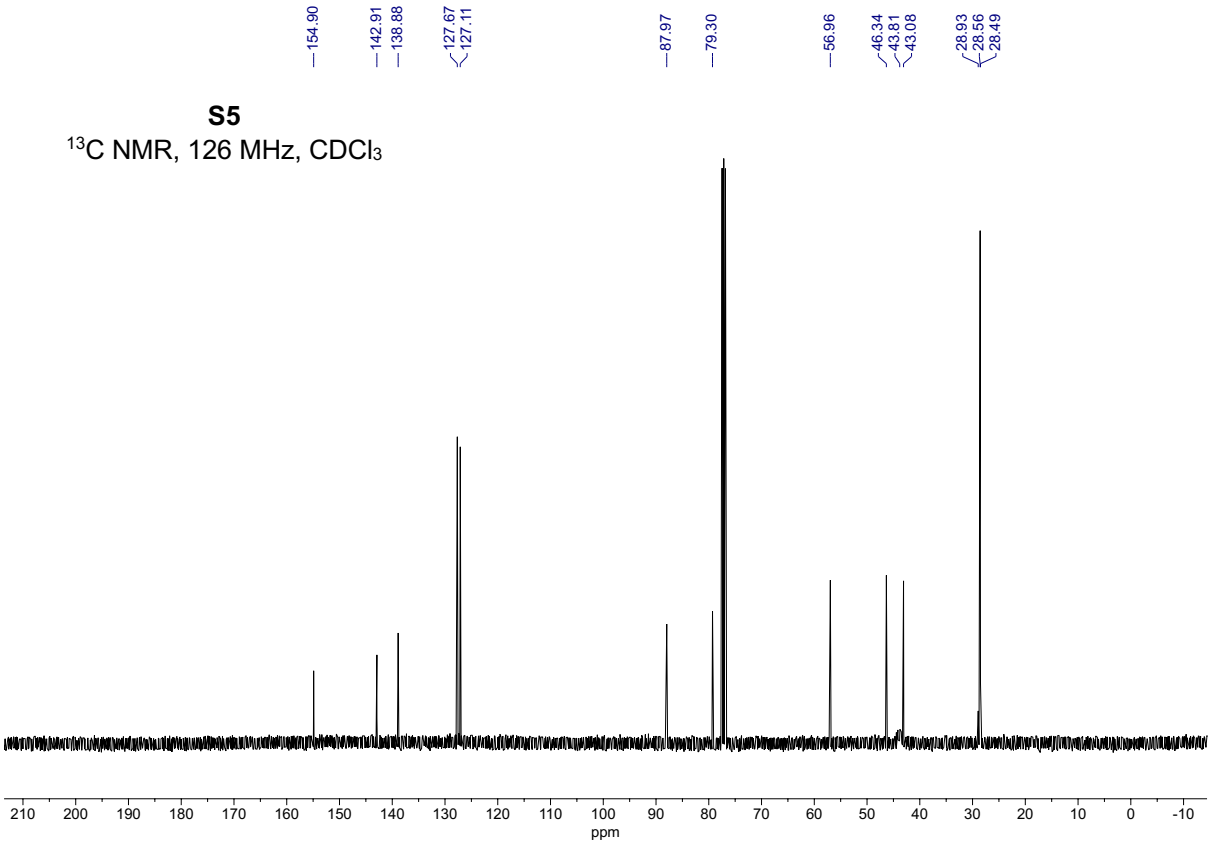
S4

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



S5

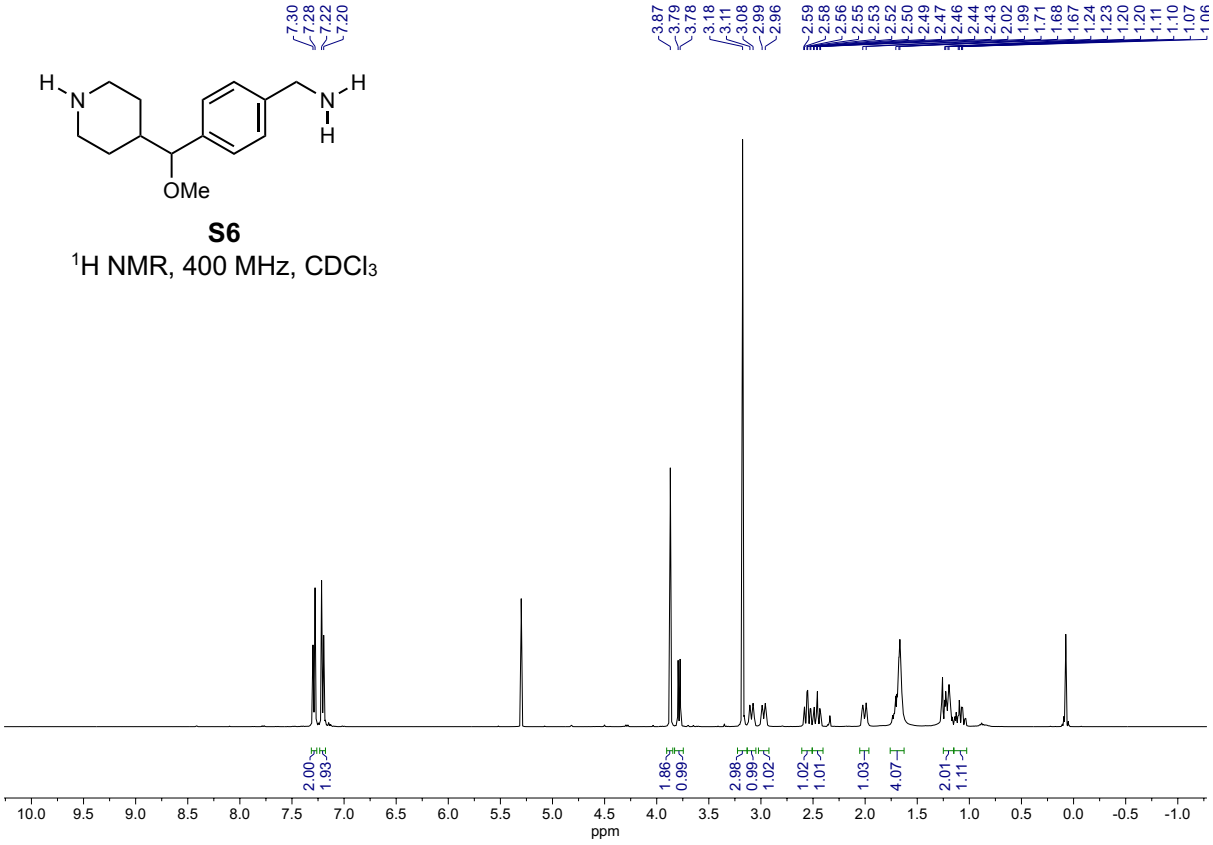
^{1}H NMR, 500 MHz, $CDCl_3$



S5

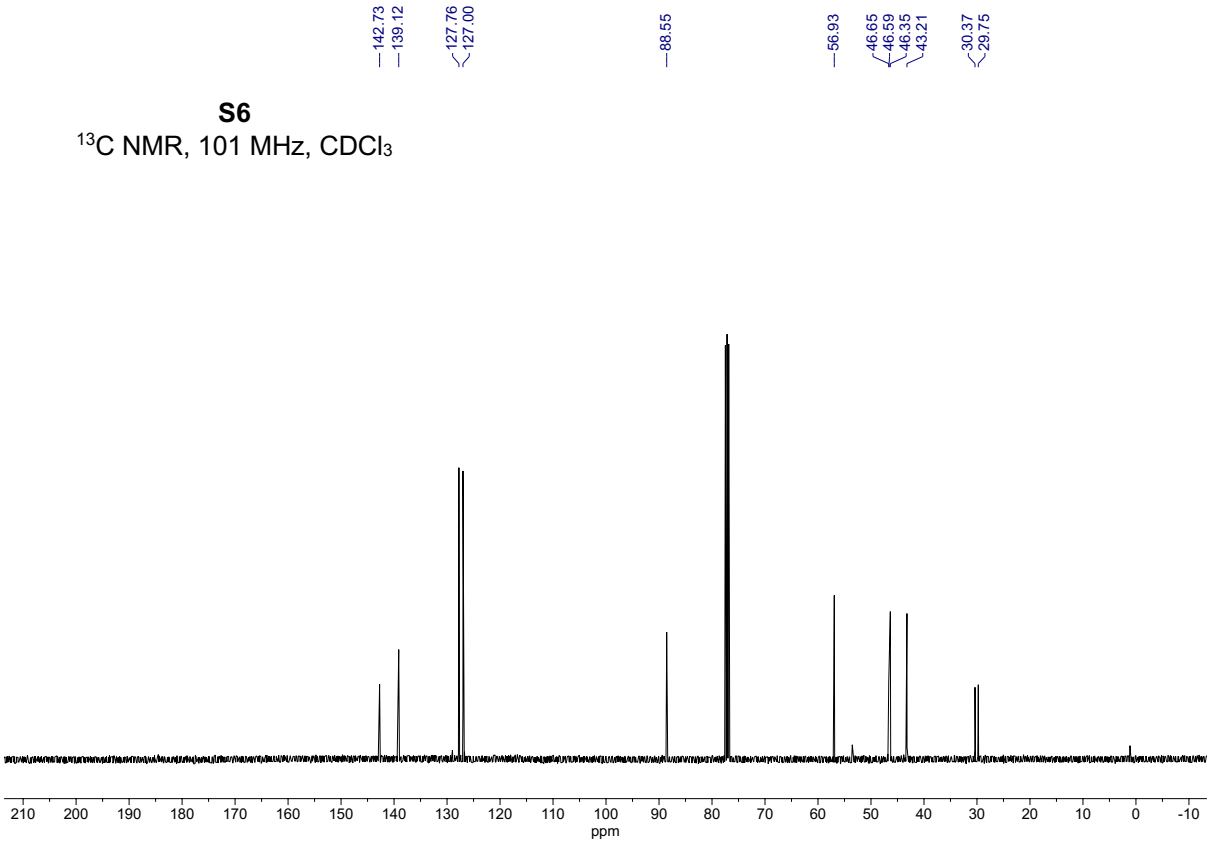
^{13}C NMR, 126 MHz, $CDCl_3$

S6



S6

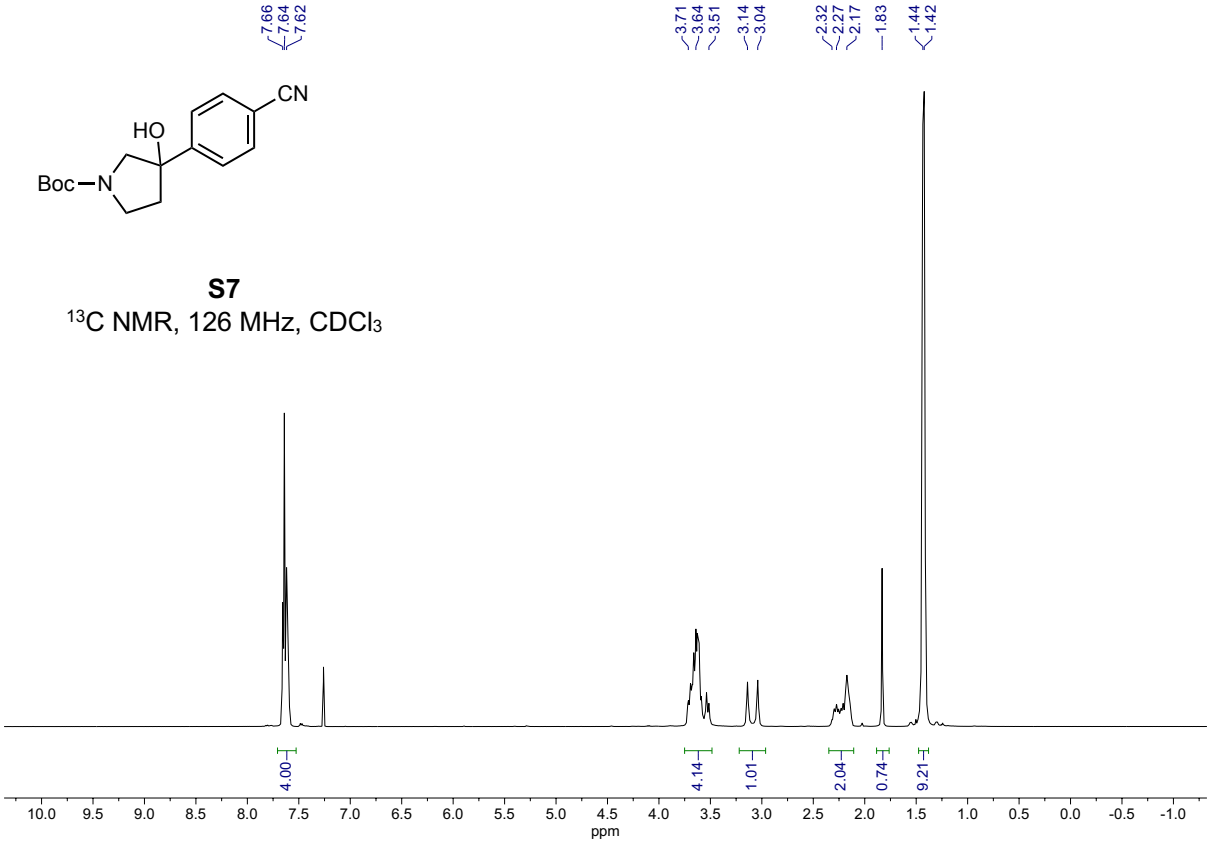
^{1}H NMR, 400 MHz, $CDCl_3$



S6

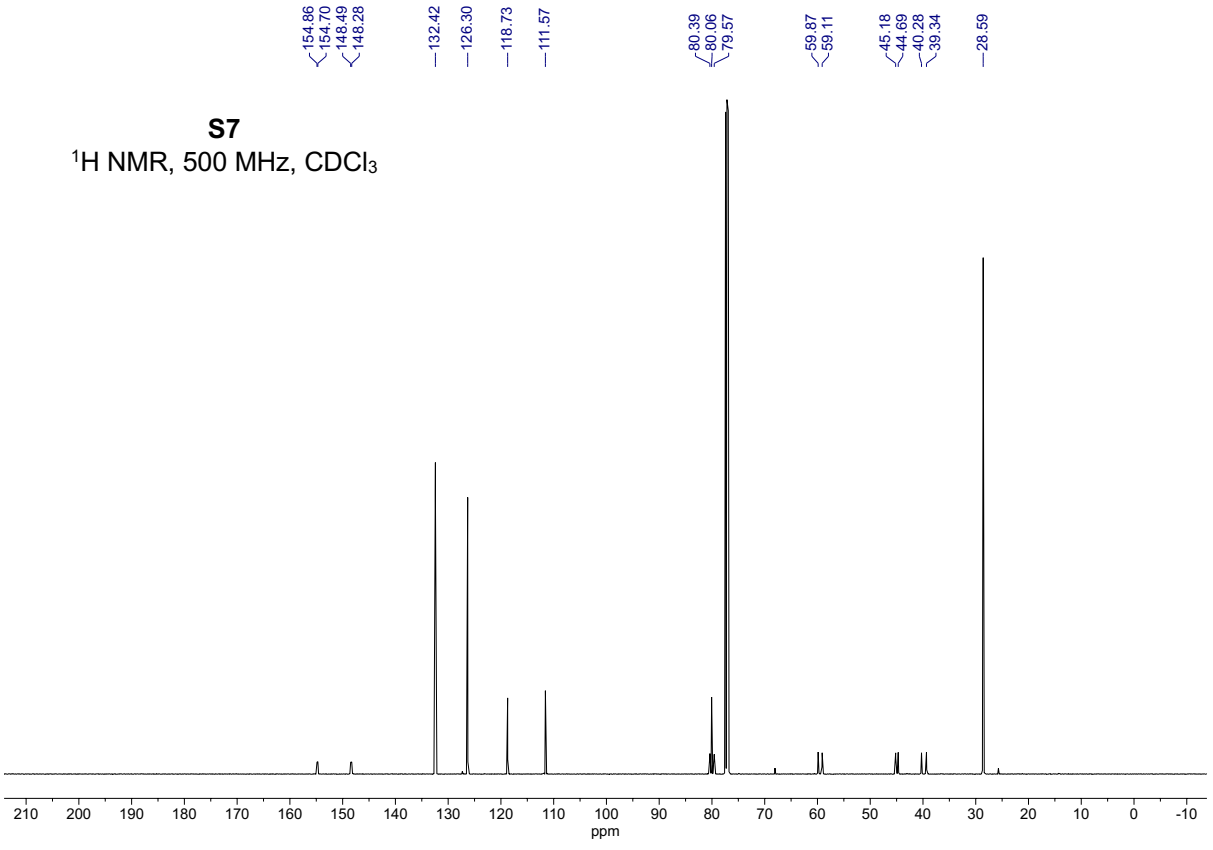
^{13}C NMR, 101 MHz, $CDCl_3$

S7



S7

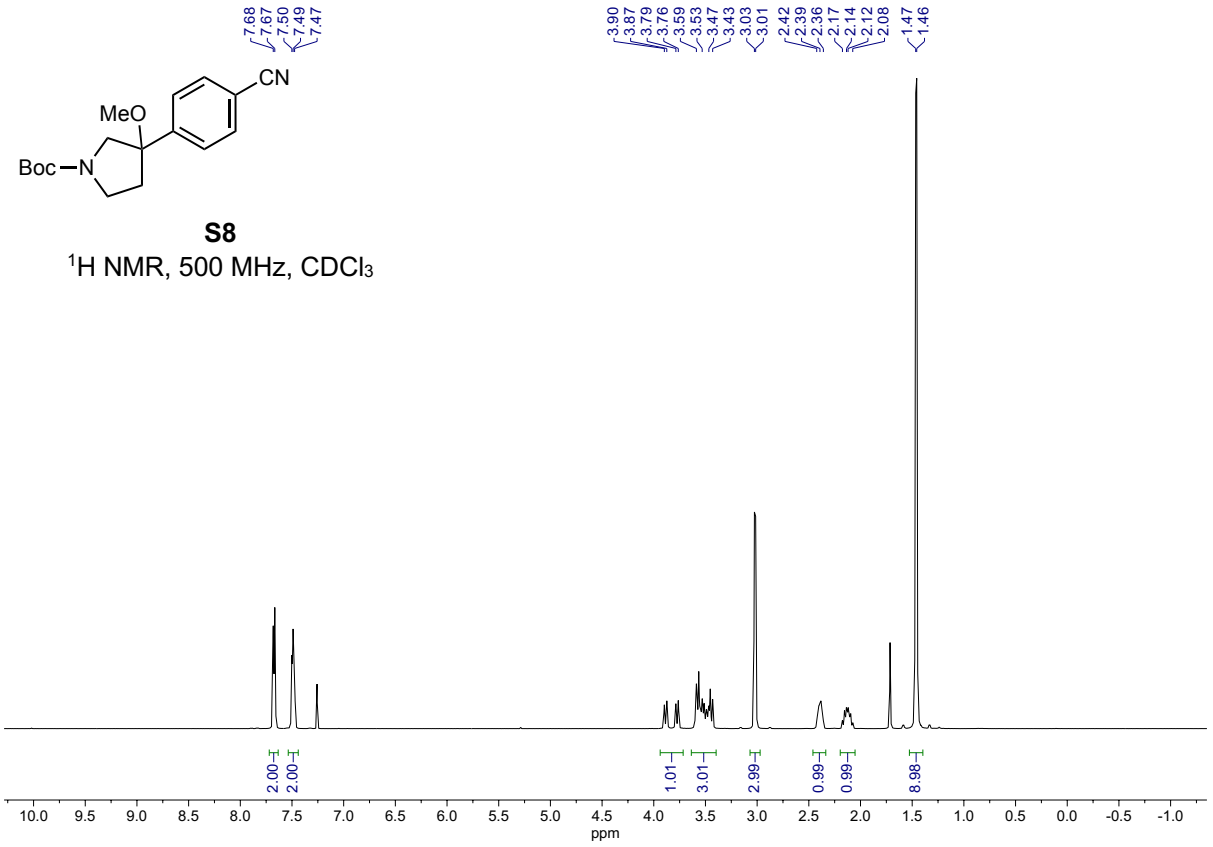
^{13}C NMR, 126 MHz, $CDCl_3$



S7

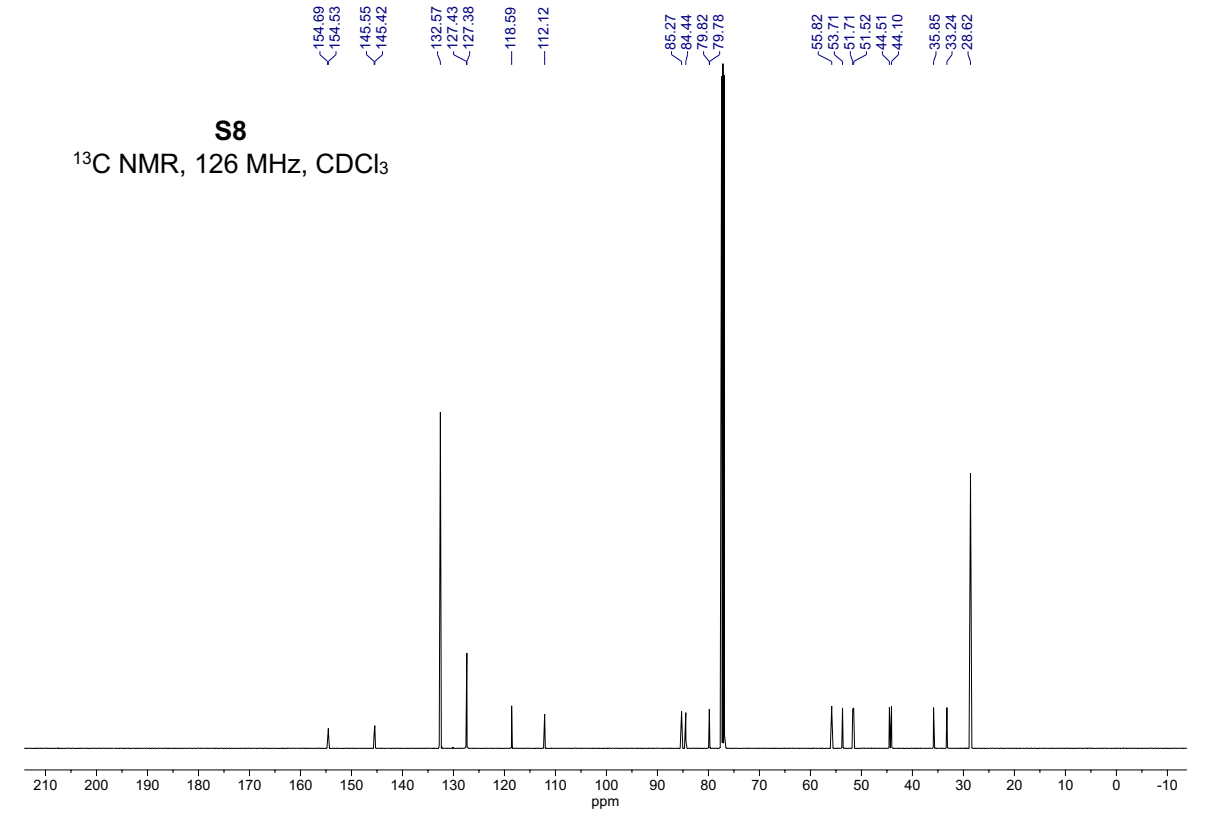
^{1}H NMR, 500 MHz, $CDCl_3$

S8



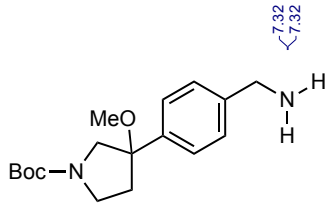
S8

^{1}H NMR, 500 MHz, $CDCl_3$



S8

^{13}C NMR, 126 MHz, $CDCl_3$

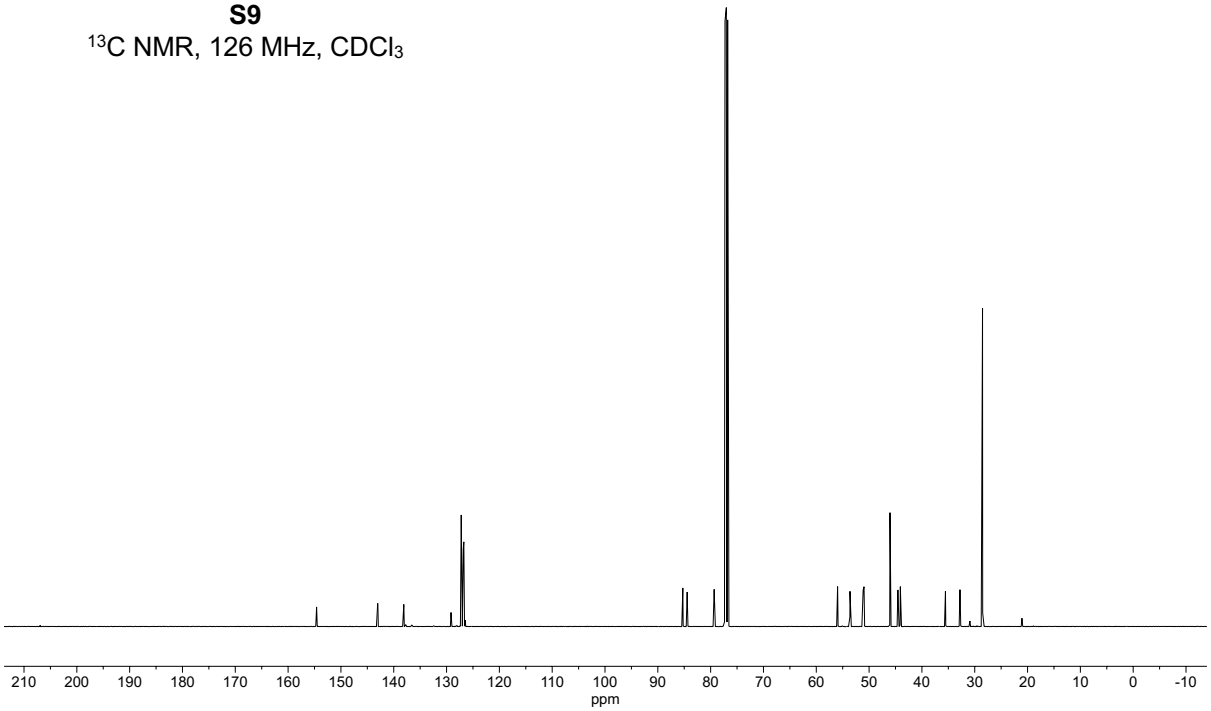


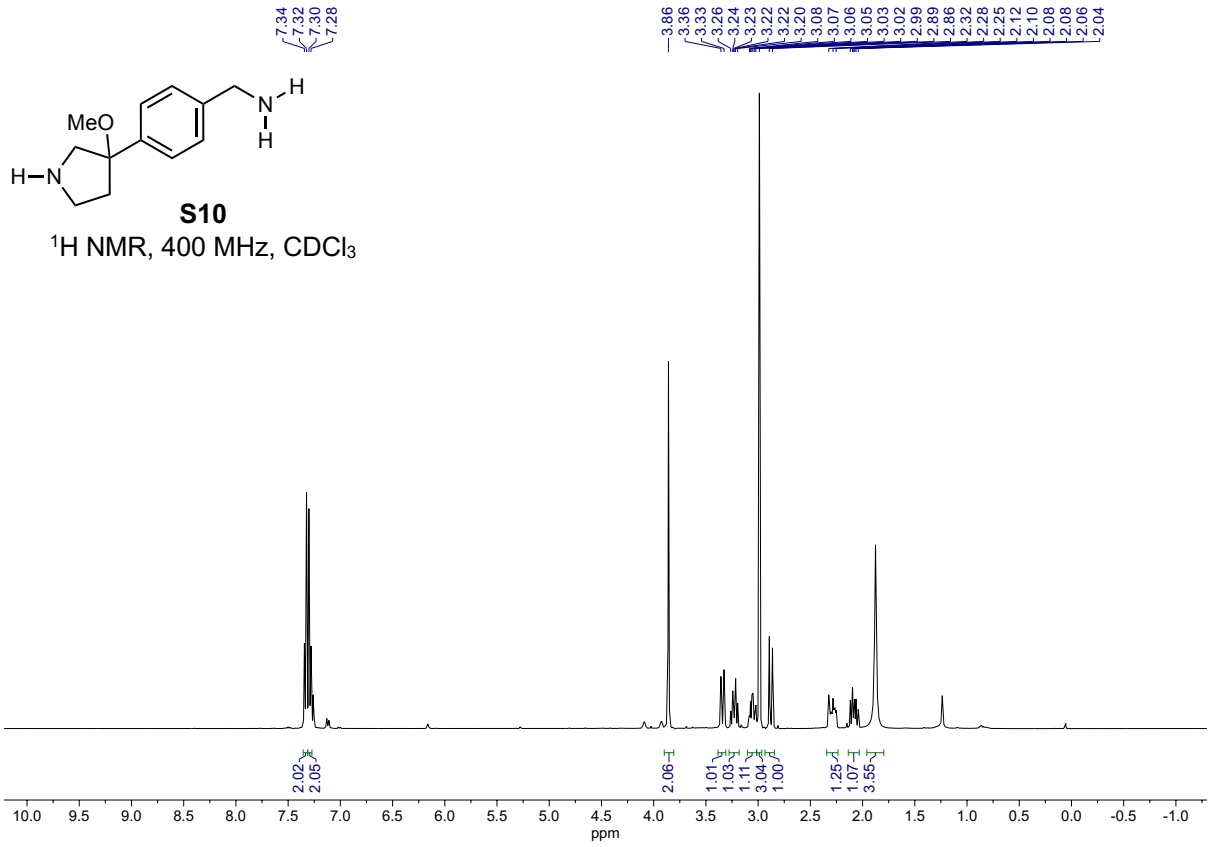
S9

^{1}H NMR, 500 MHz, $CDCl_3$

S9

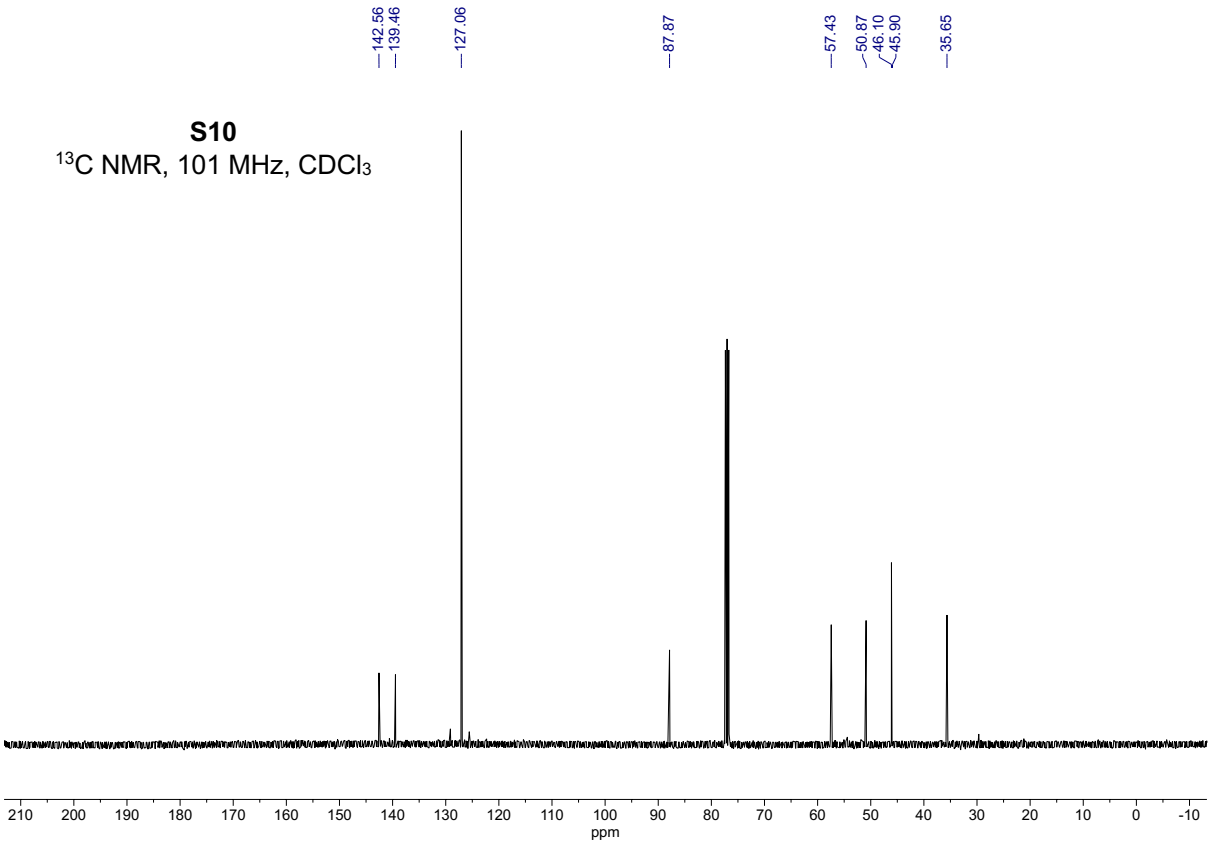
^{13}C NMR, 126 MHz, $CDCl_3$





S10

^{1}H NMR, 400 MHz, $CDCl_3$

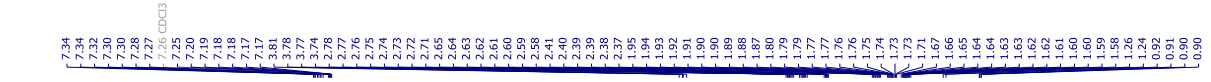


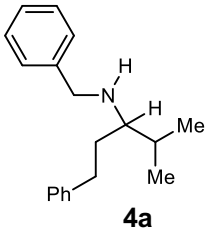
S10

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

Synthesis of α-branched secondary amines

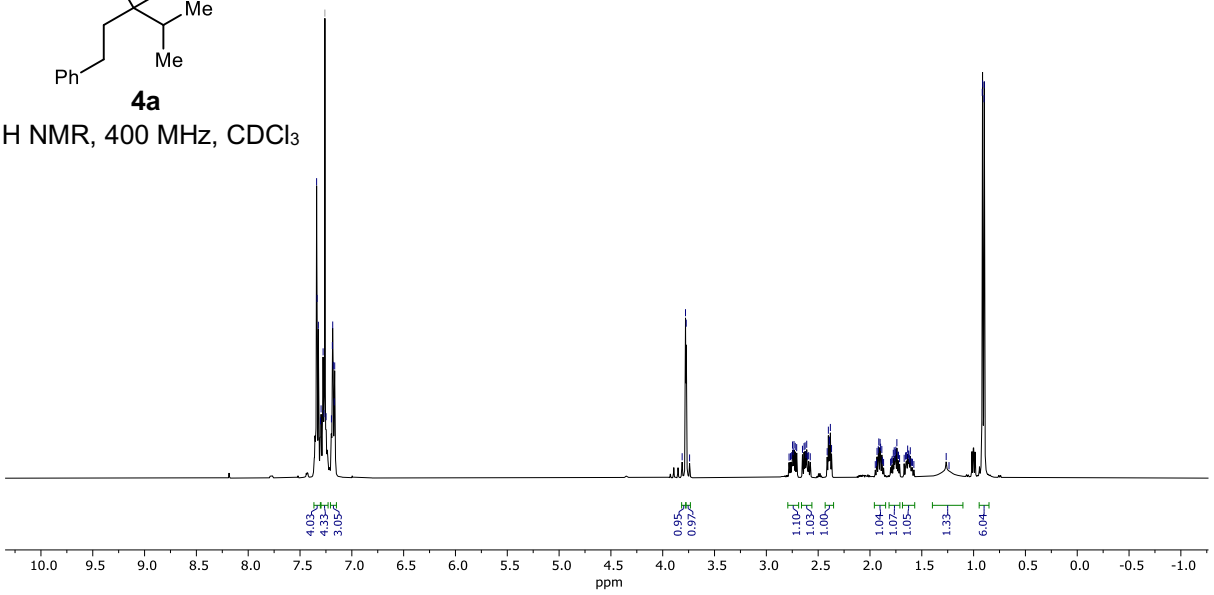
4a





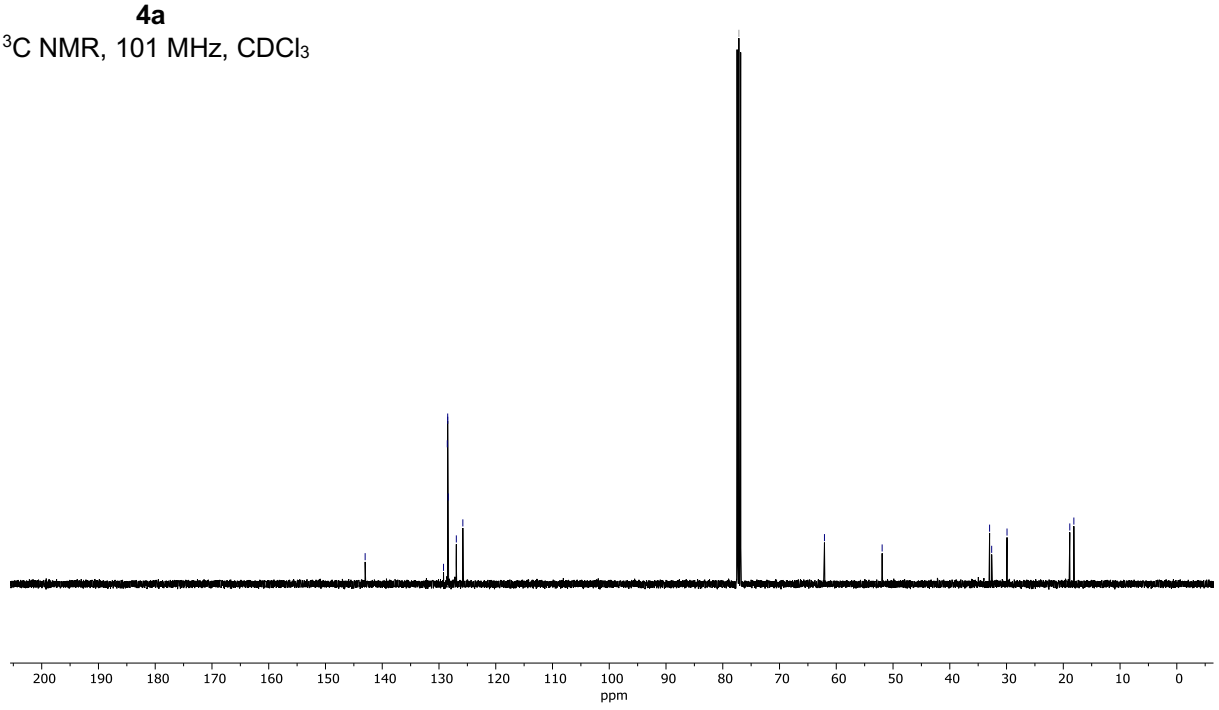
4a

^{1}H NMR, 400 MHz, $CDCl_3$

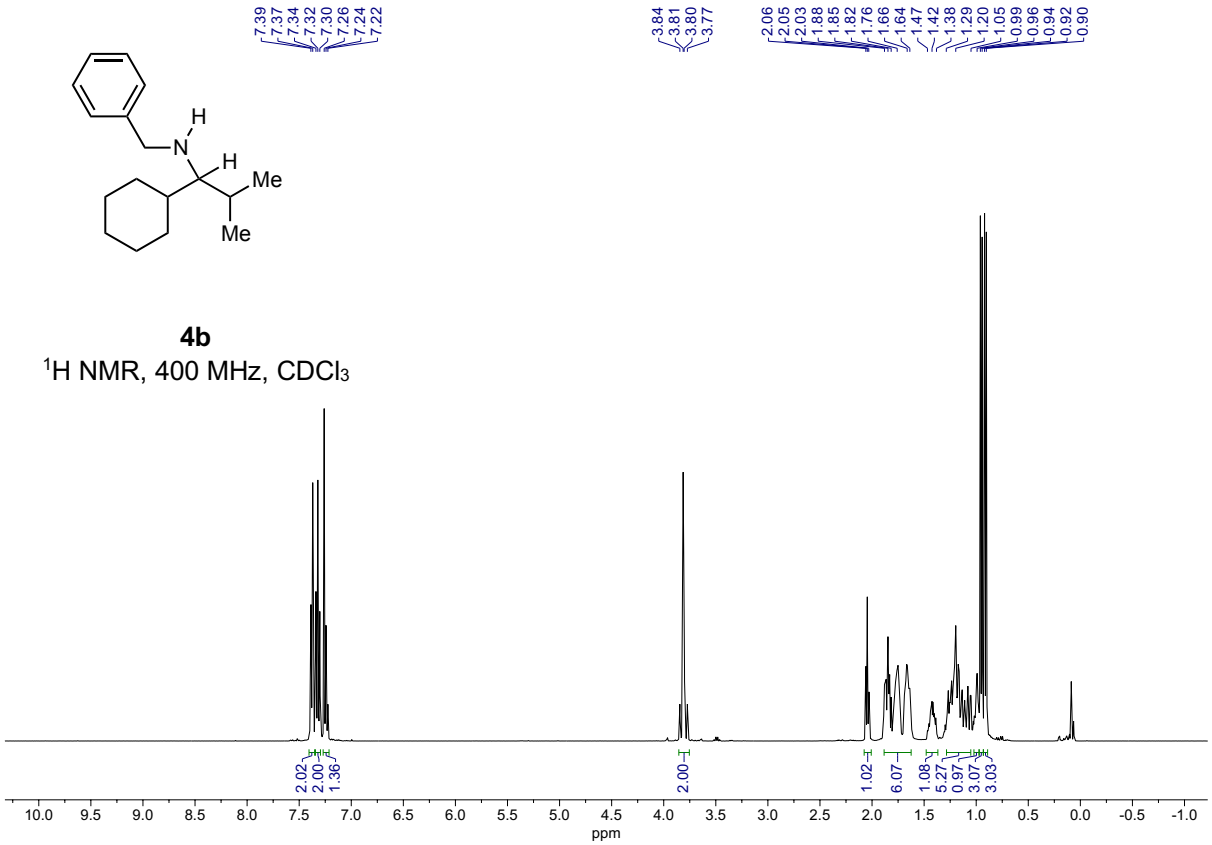


4a

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

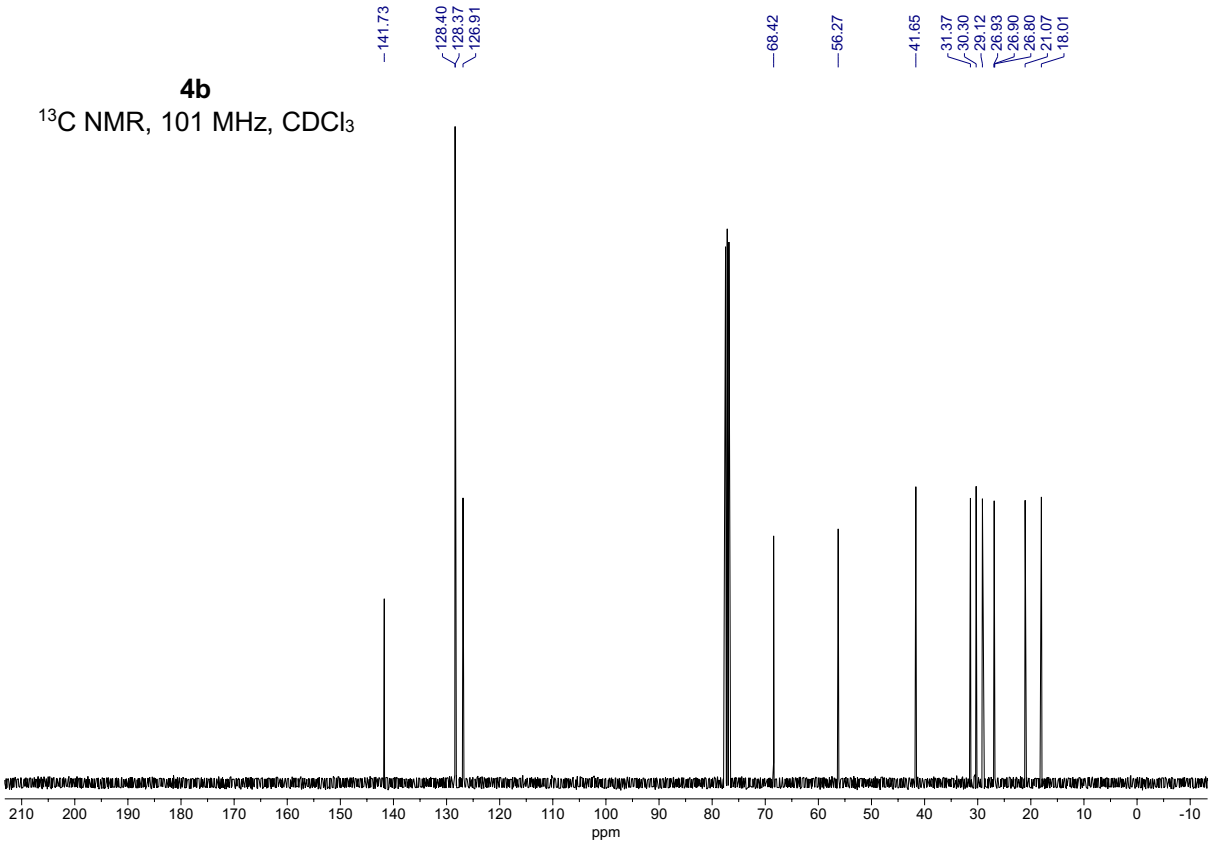


4b



4b

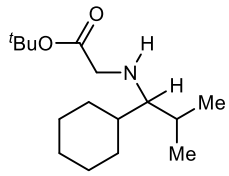
^{1}H NMR, 400 MHz, $CDCl_3$



4b

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

4c

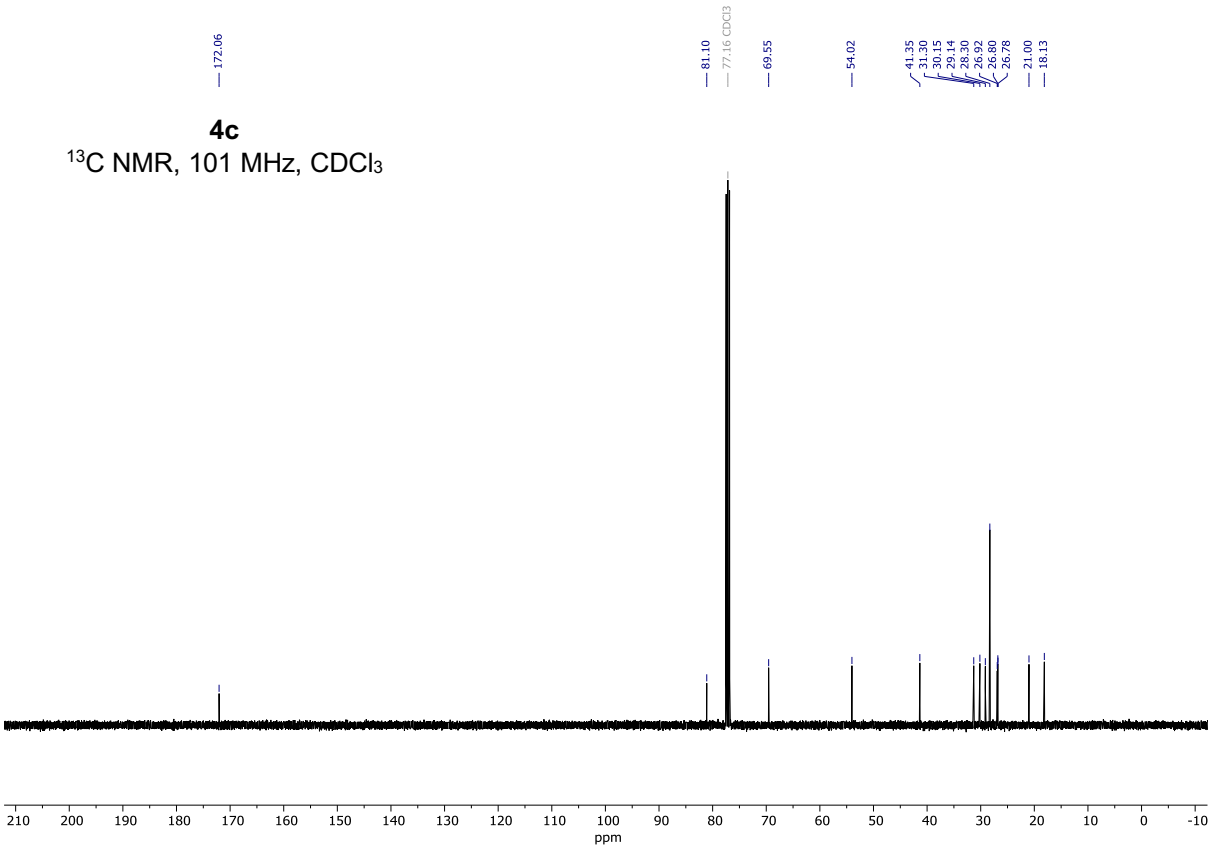


4c

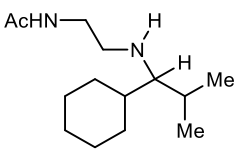
^{1}H NMR, 400 MHz, $CDCl_3$

4c

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

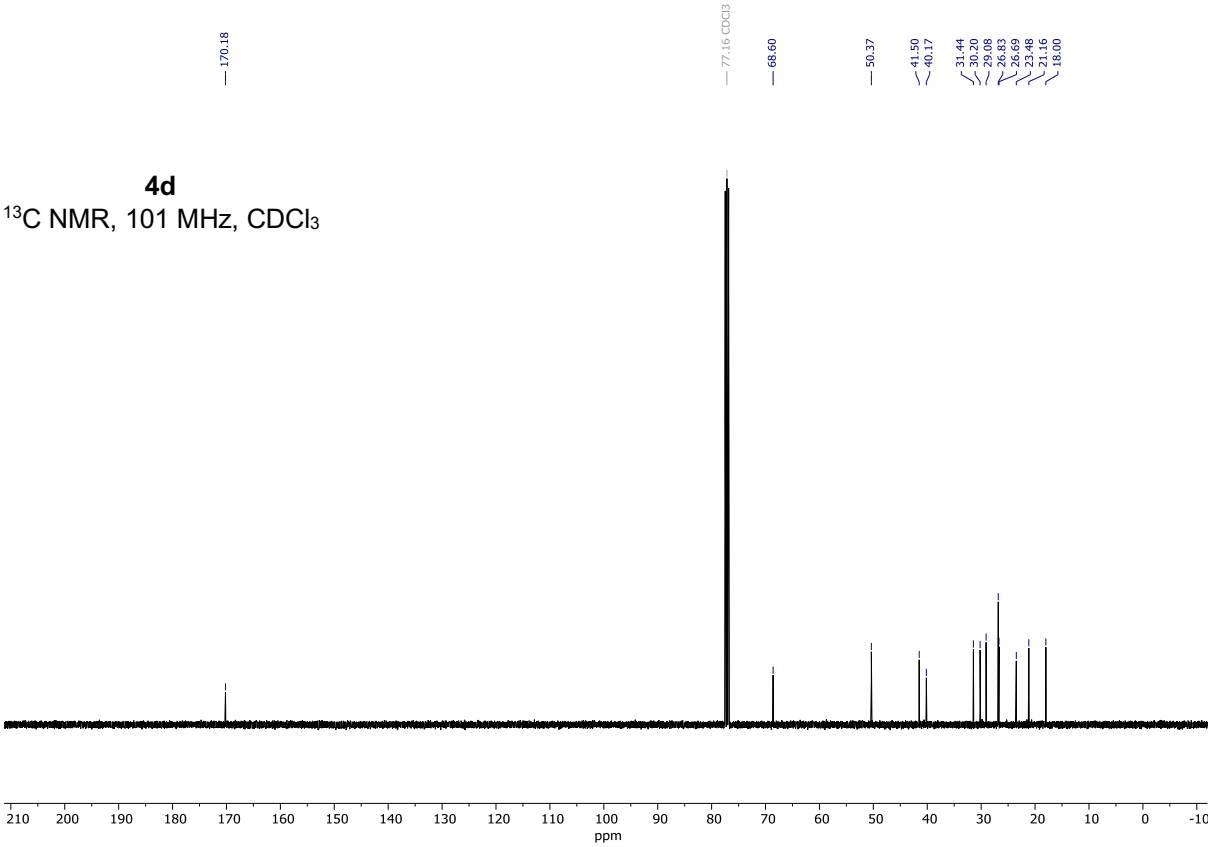


4d



4d

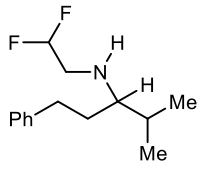
^{1}H NMR, 400 MHz, $CDCl_3$



4d

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

4e

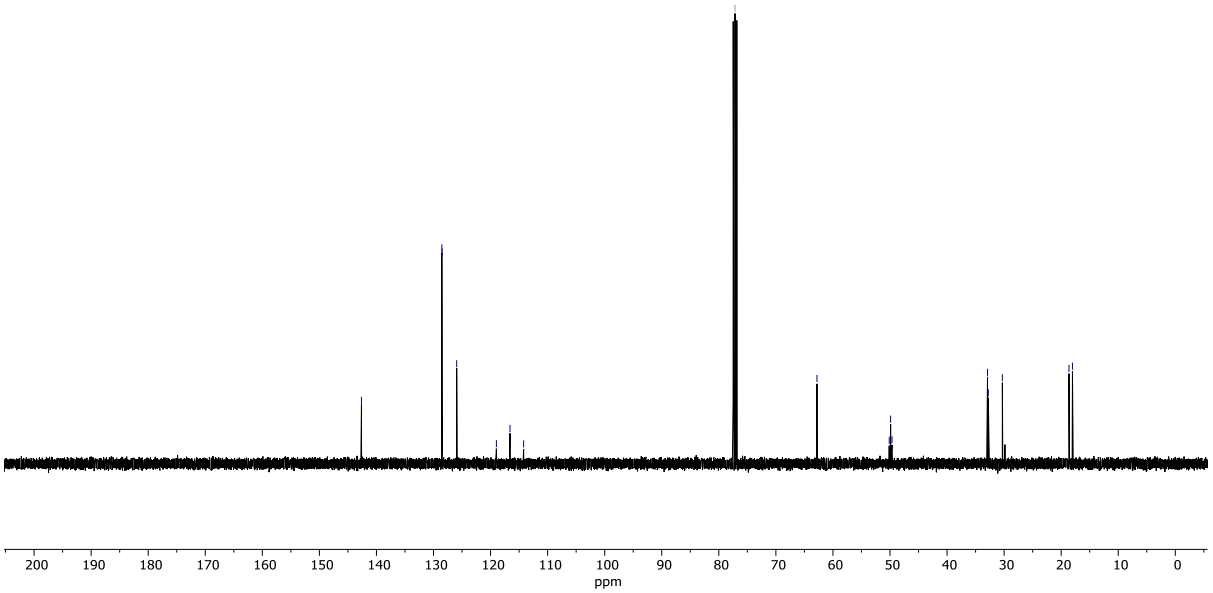


4e

^{1}H NMR, 400 MHz, $CDCl_3$

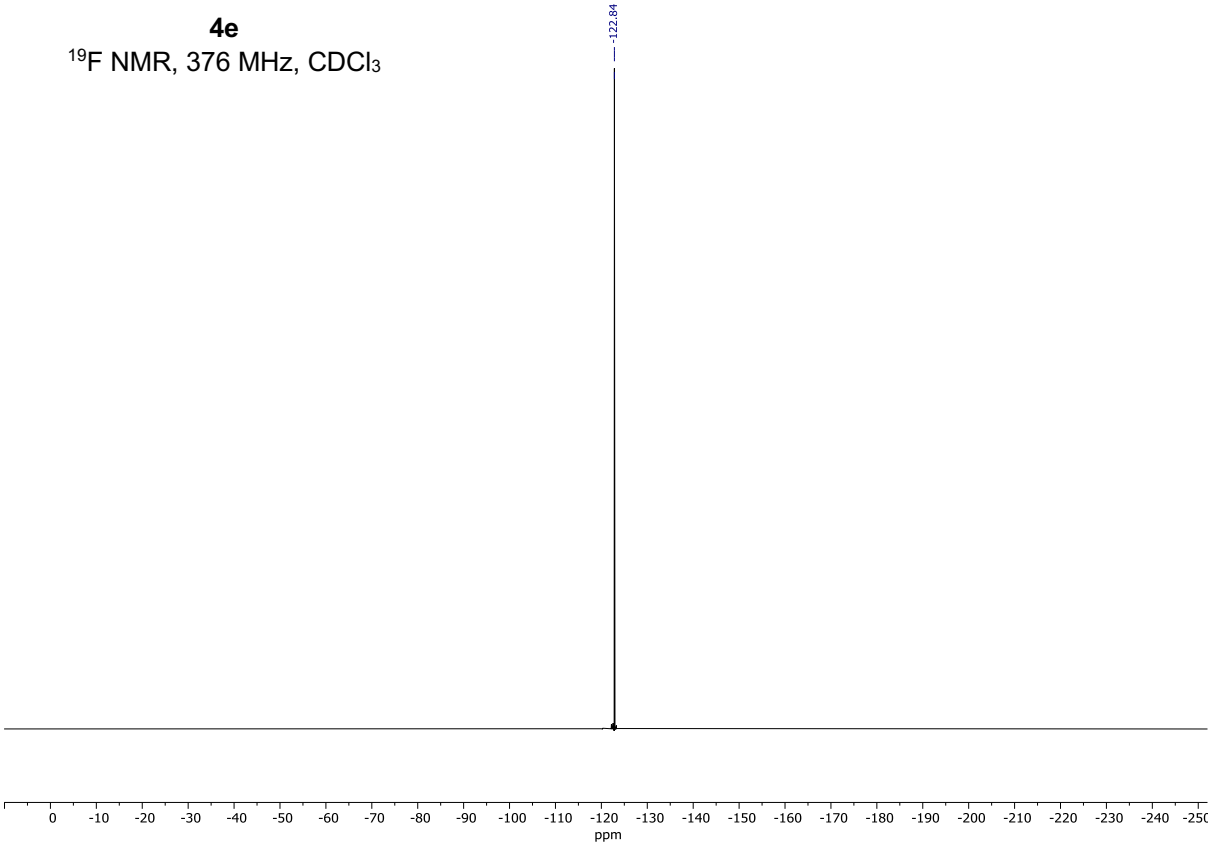
4e

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

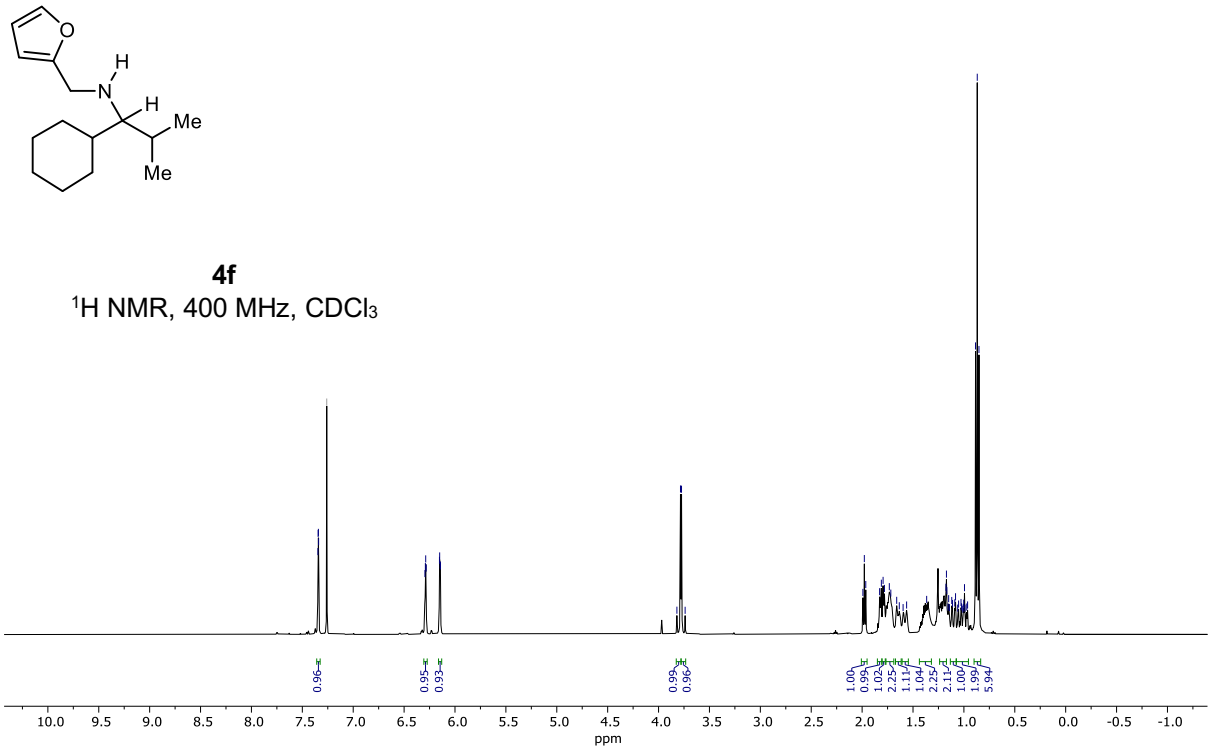


4e

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



4f

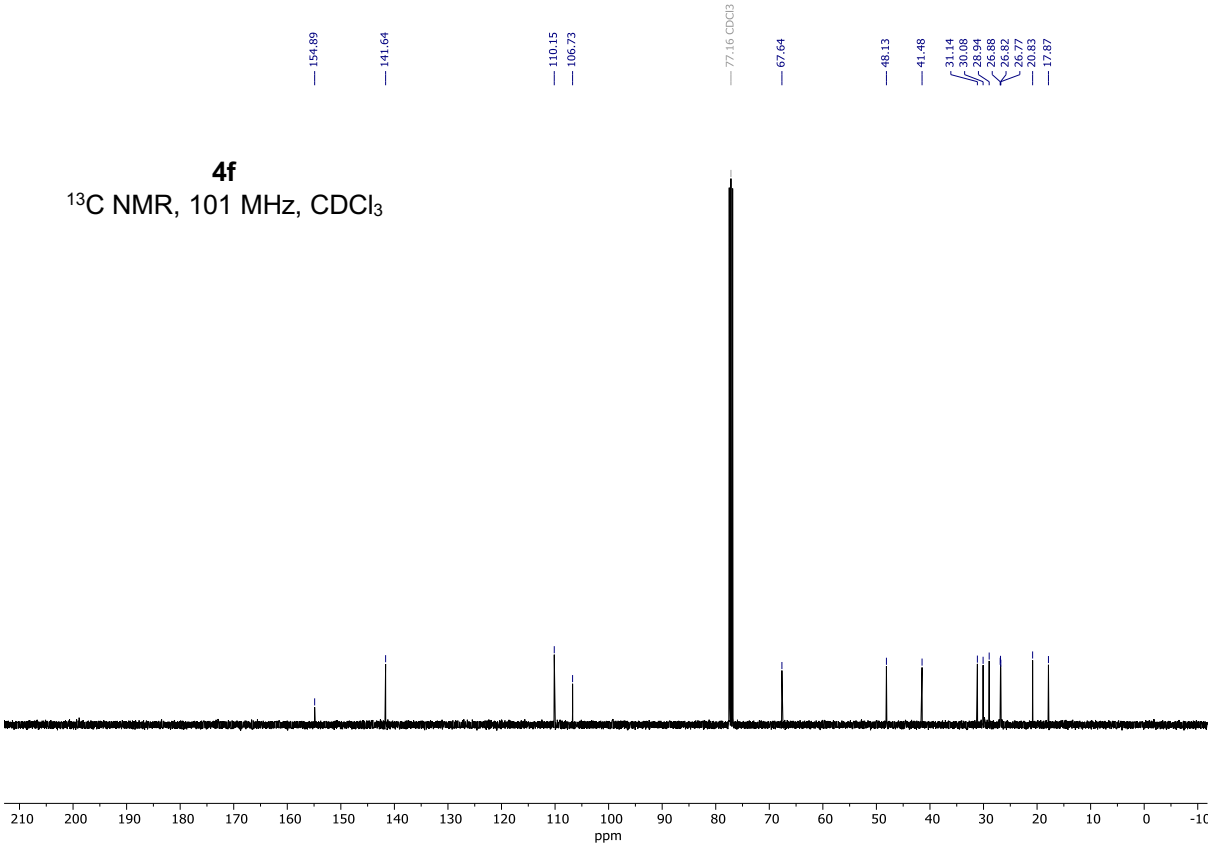


4f

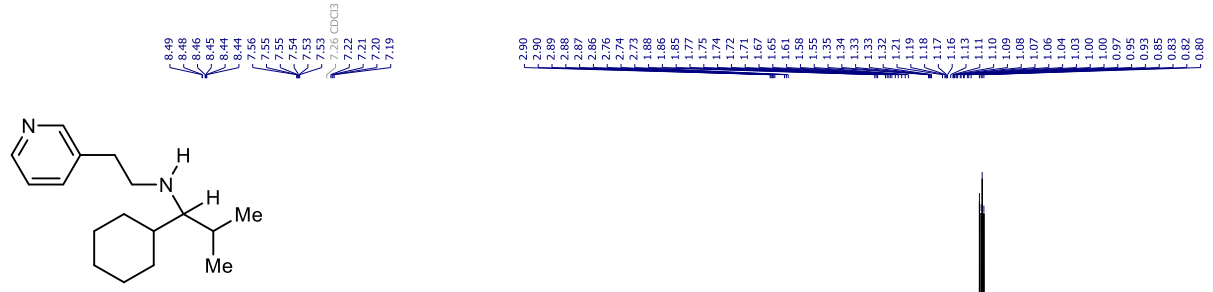
^{1}H NMR, 400 MHz, $CDCl_3$

4f

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



4g

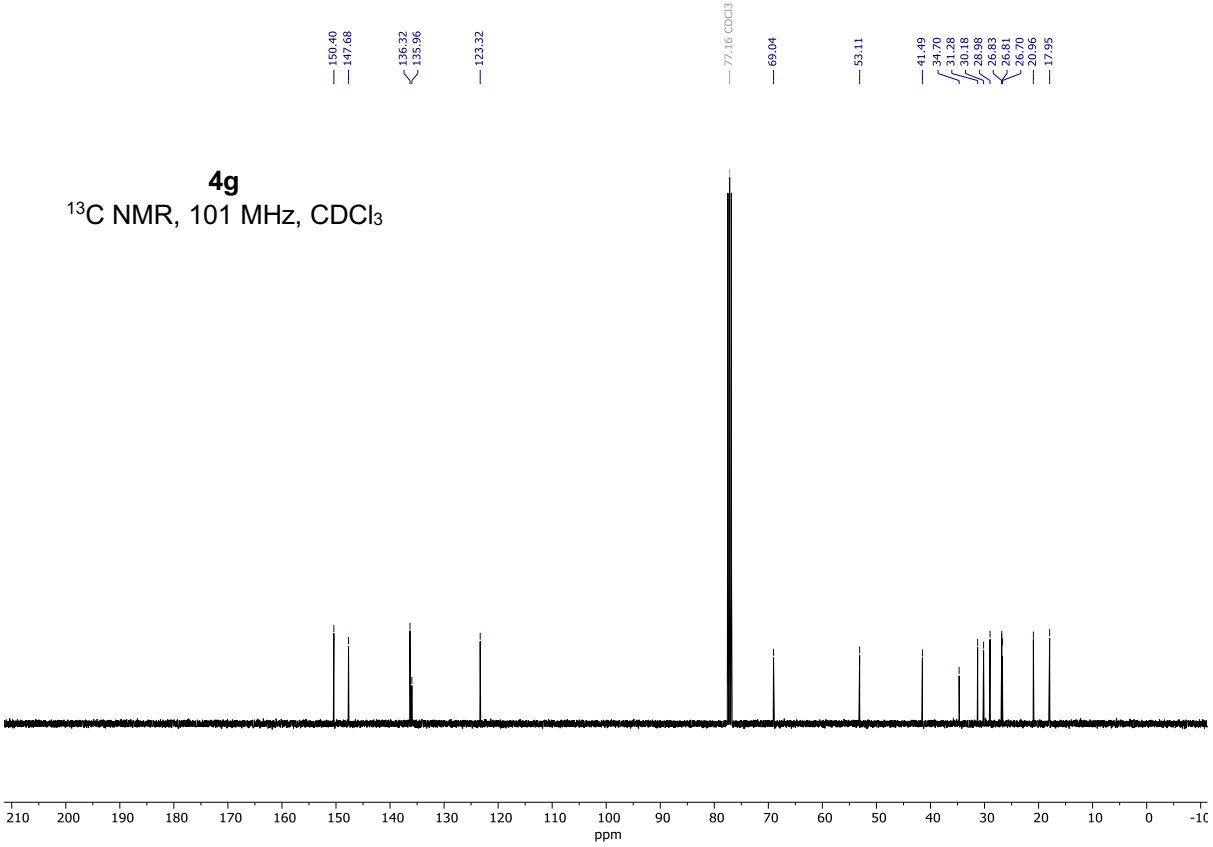


4g

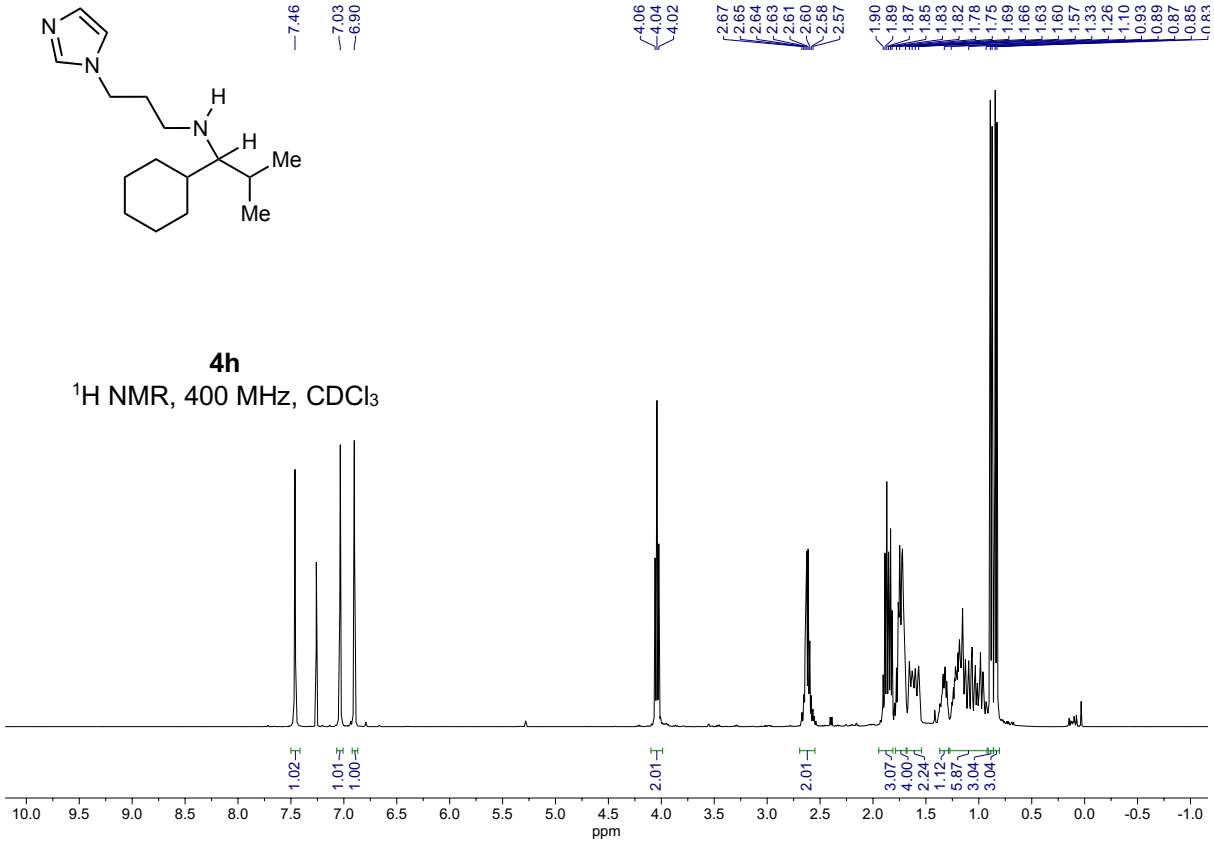
^{1}H NMR, 400 MHz, $CDCl_3$

4g

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

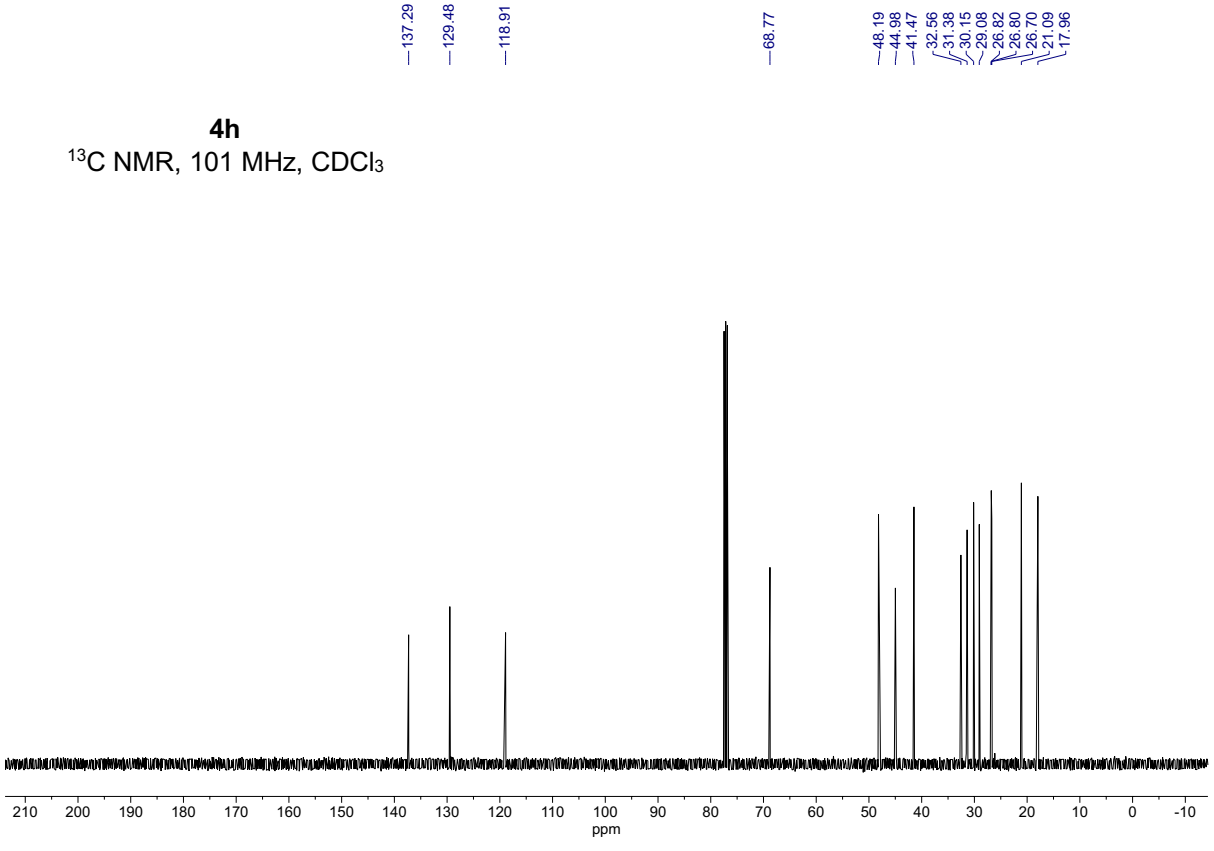


4h



4h

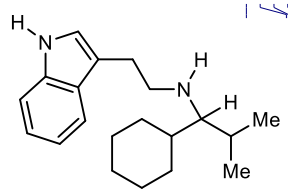
^{1}H NMR, 400 MHz, $CDCl_3$



4h

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

4i

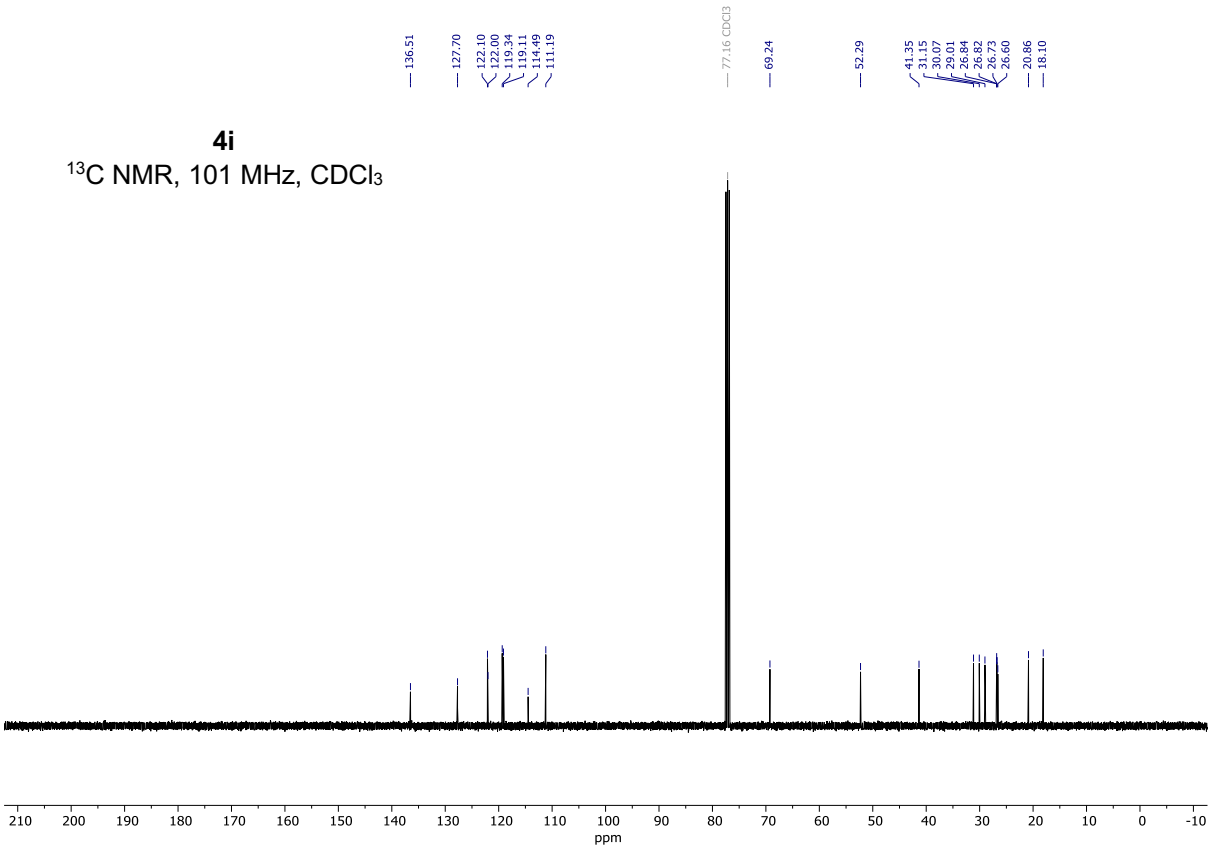


4i

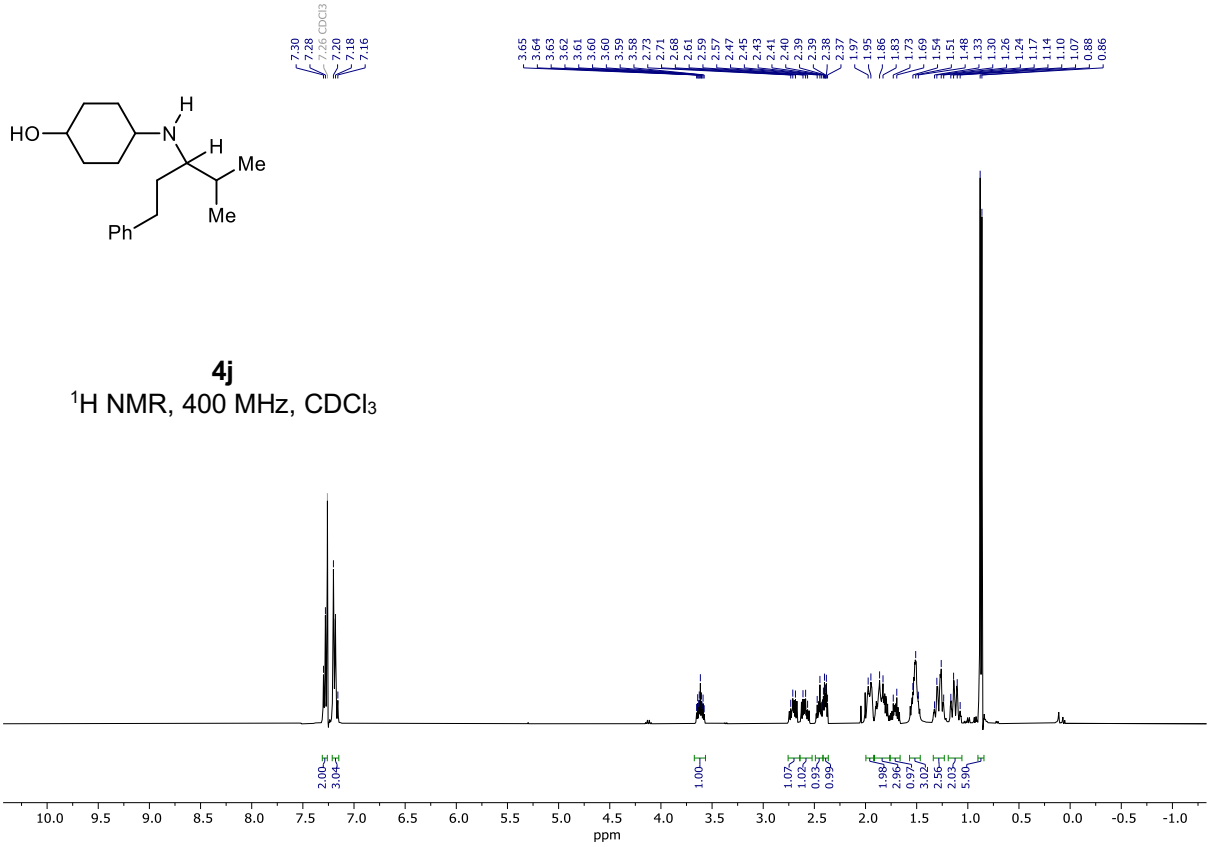
^{1}H NMR, 400 MHz, $CDCl_3$

4i

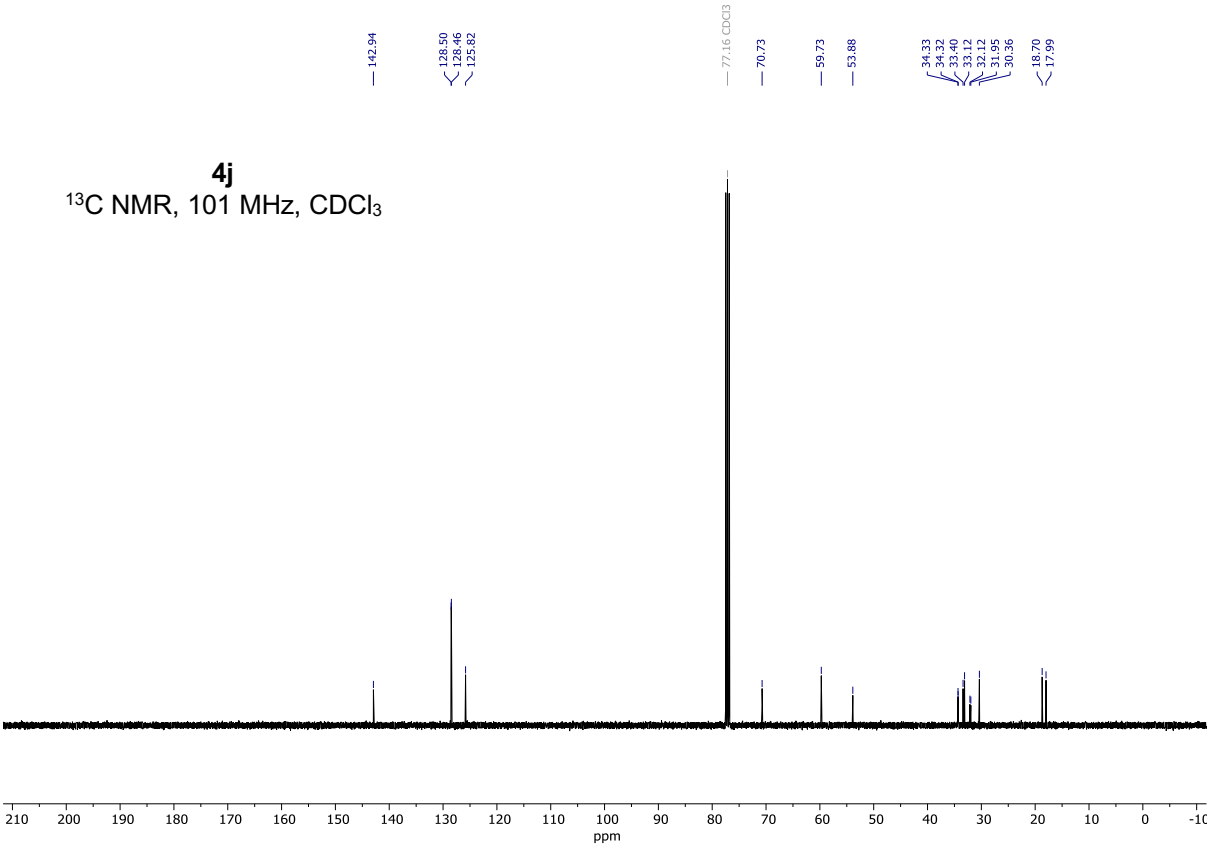
^{13}C NMR, 101 MHz, $CDCl_3$



4j

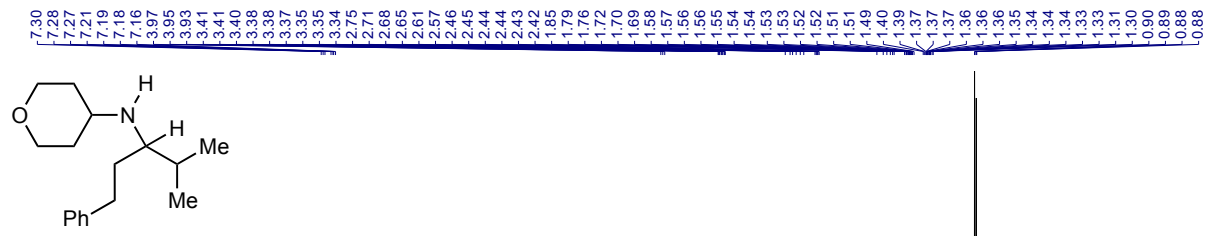


4j
^{1}H NMR, 400 MHz, $CDCl_3$



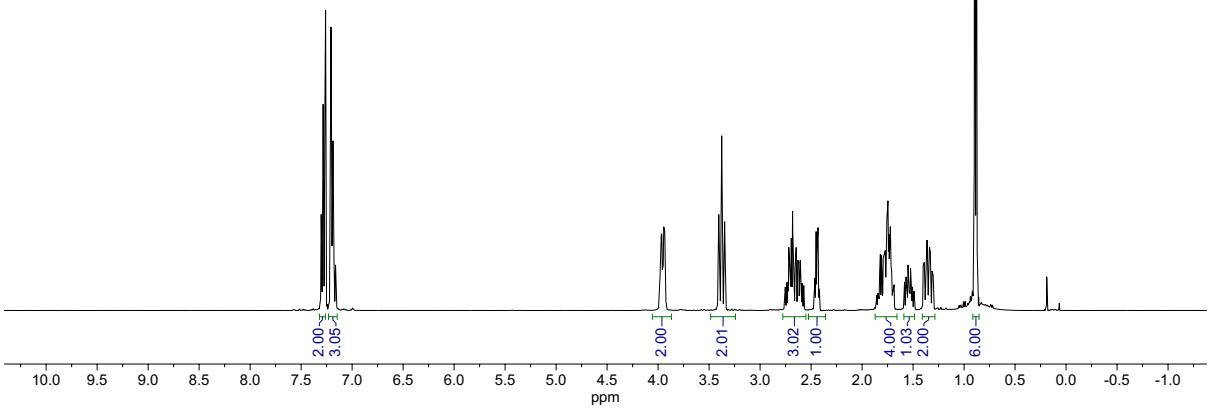
4j
^{13}C NMR, 101 MHz, $CDCl_3$

4k



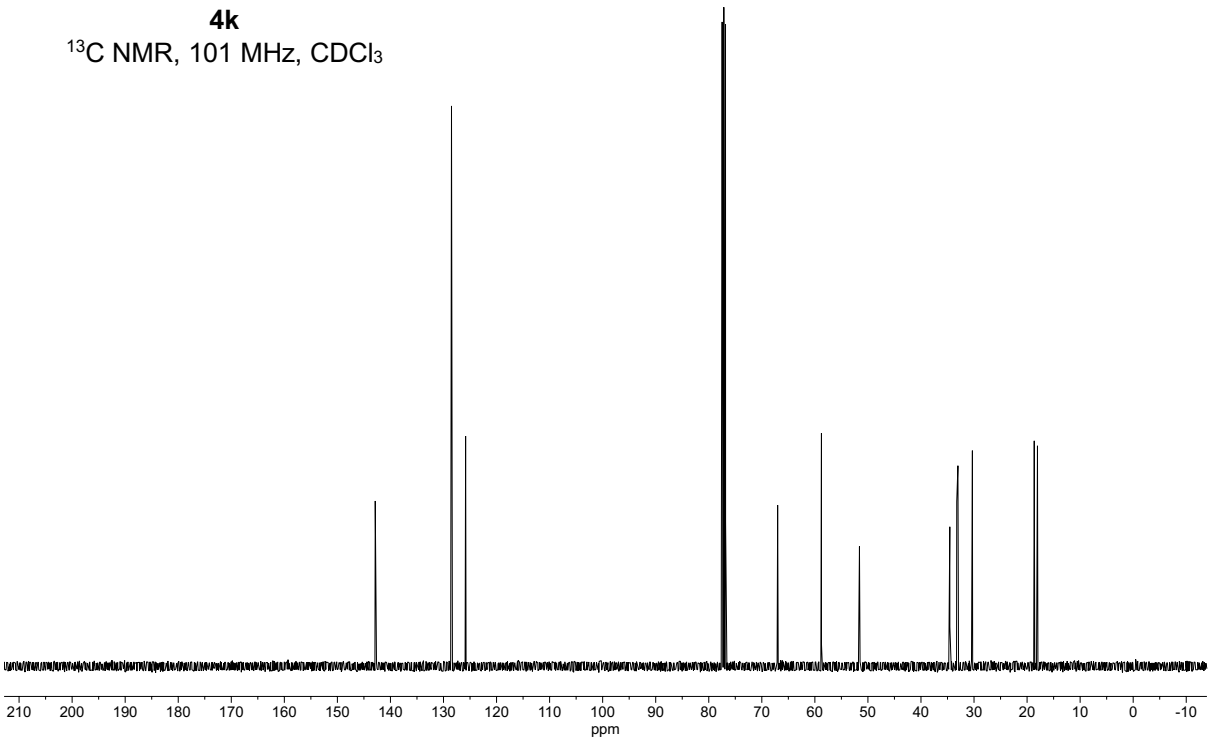
4k

^{1}H NMR, 400 MHz, $CDCl_3$

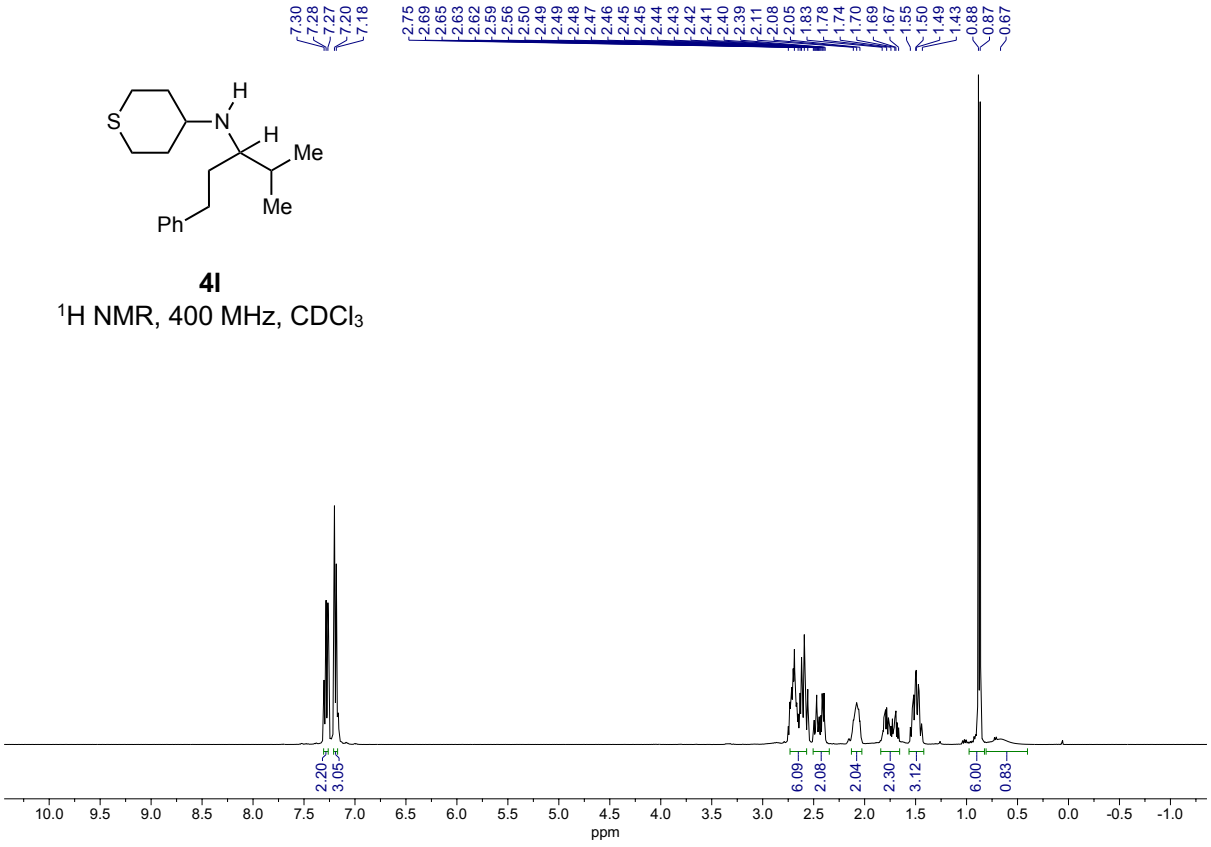


4k

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

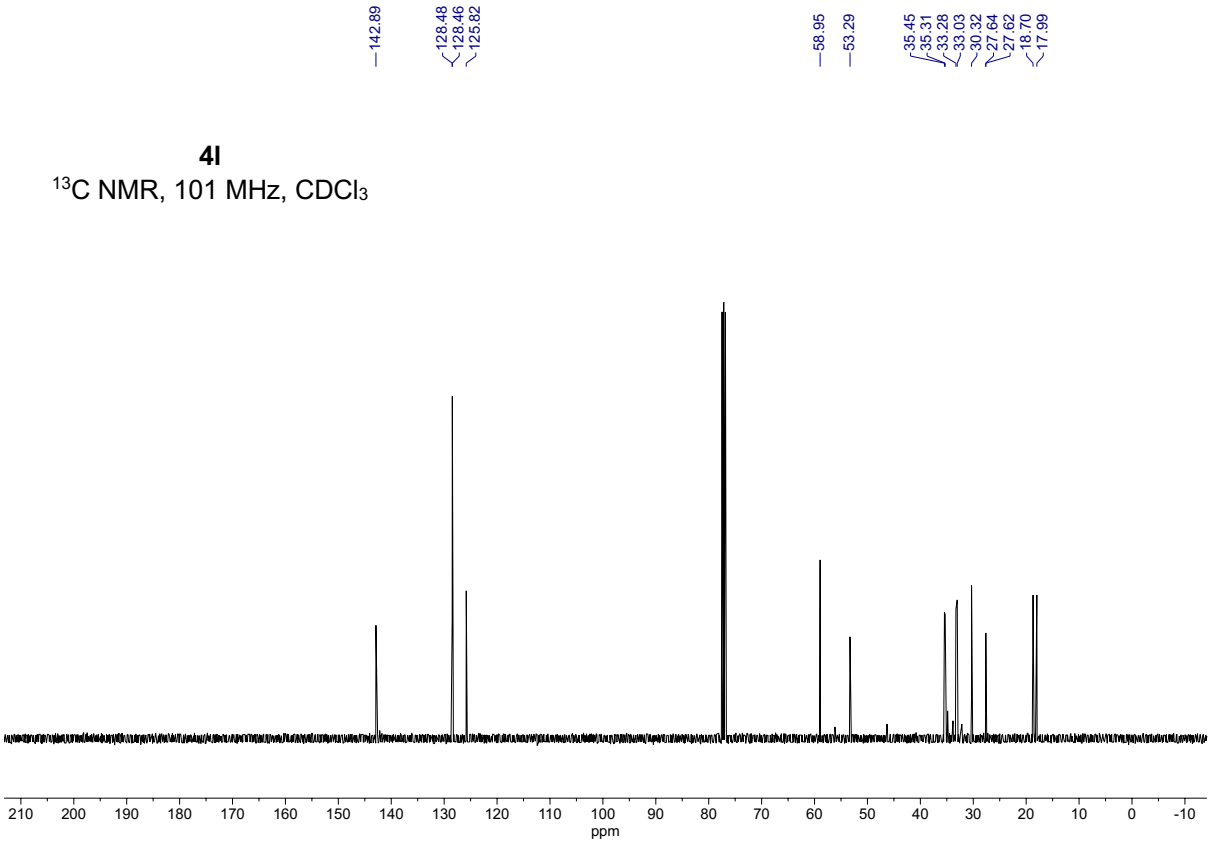


4l



4l

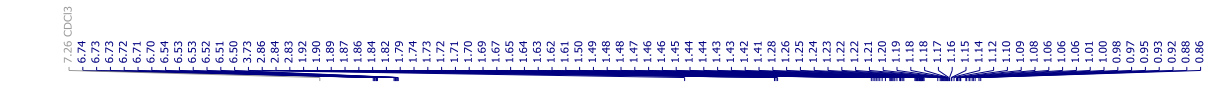
^{1}H NMR, 400 MHz, $CDCl_3$

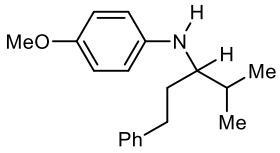


4l

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

4m



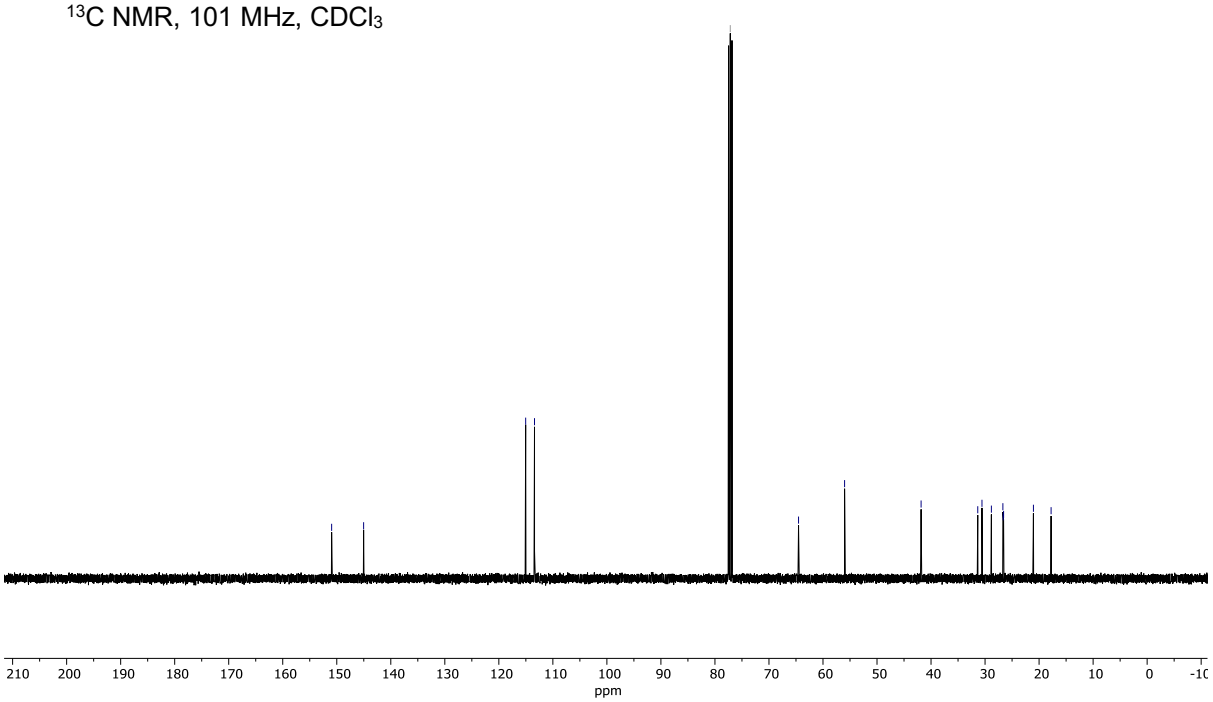


4m

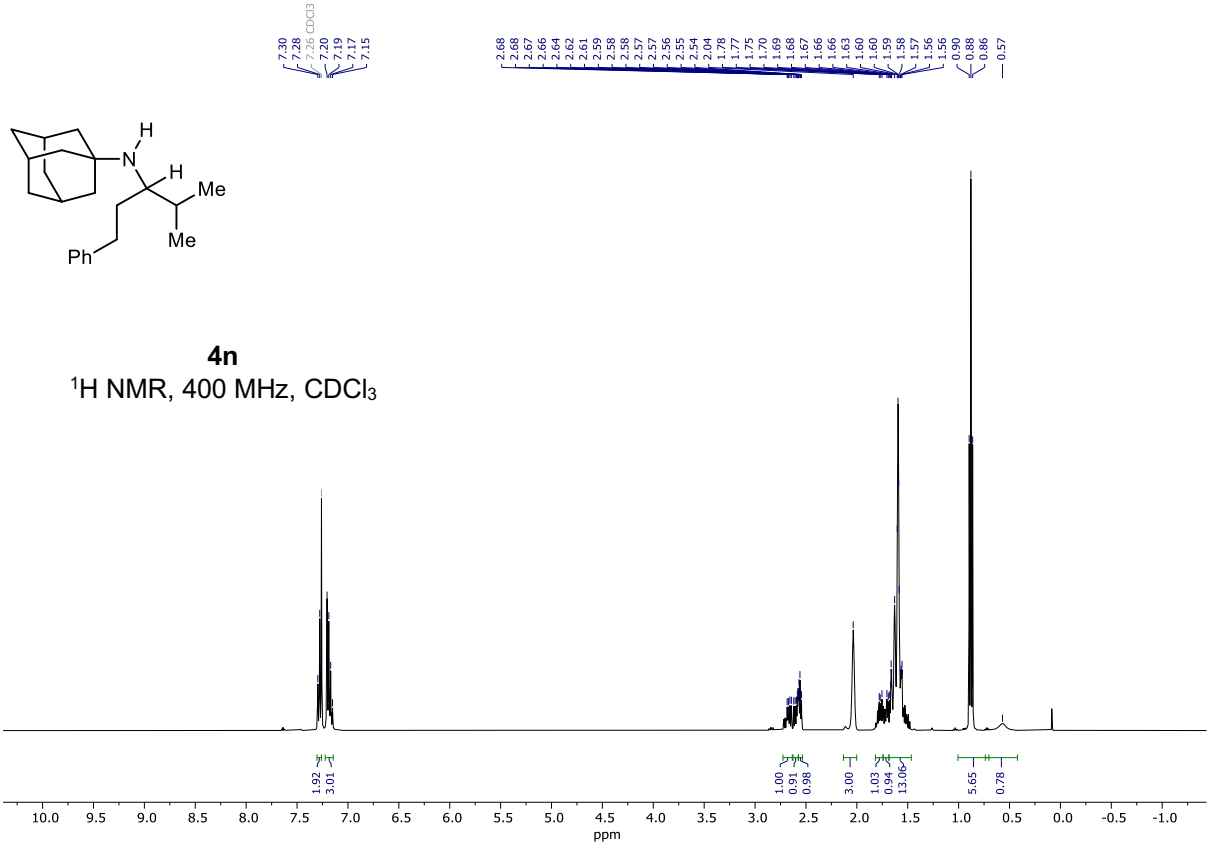
^{1}H NMR, 400 MHz, $CDCl_3$

4m

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

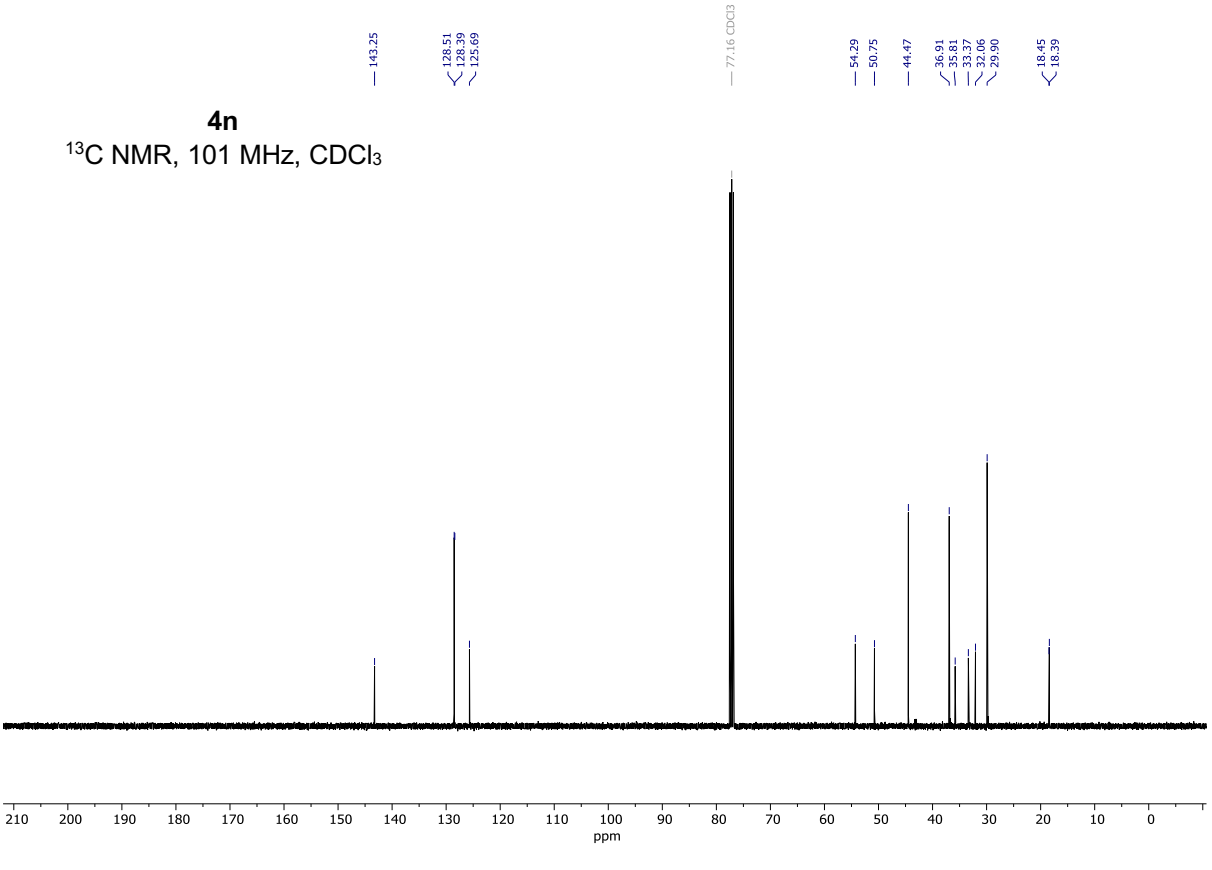


4n



4n

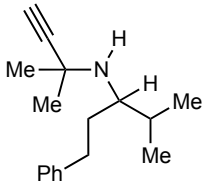
^{1}H NMR, 400 MHz, $CDCl_3$



4n

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

4o

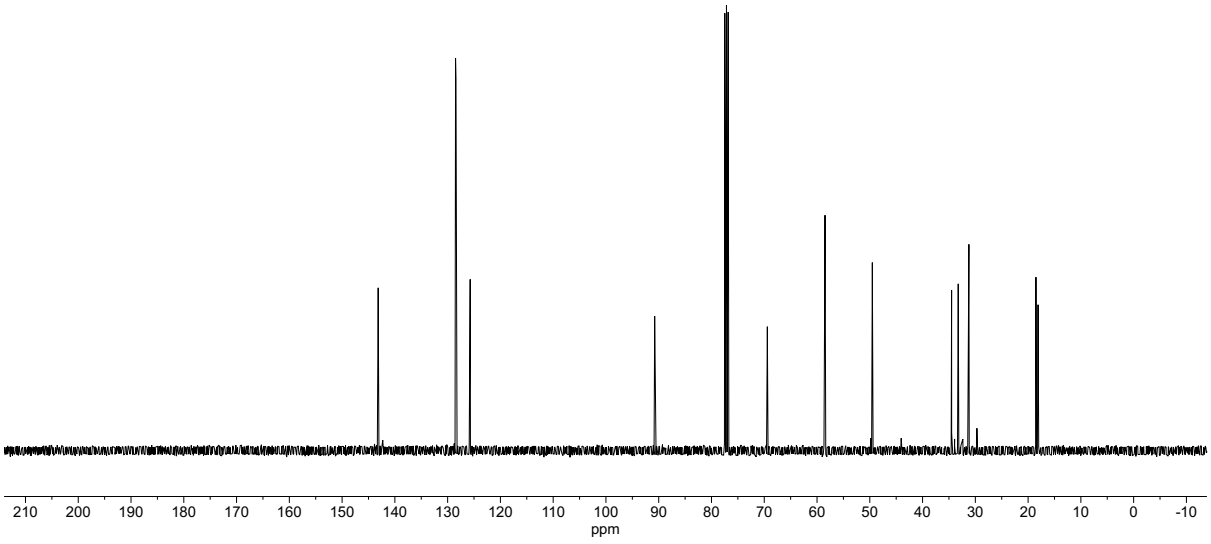


4o

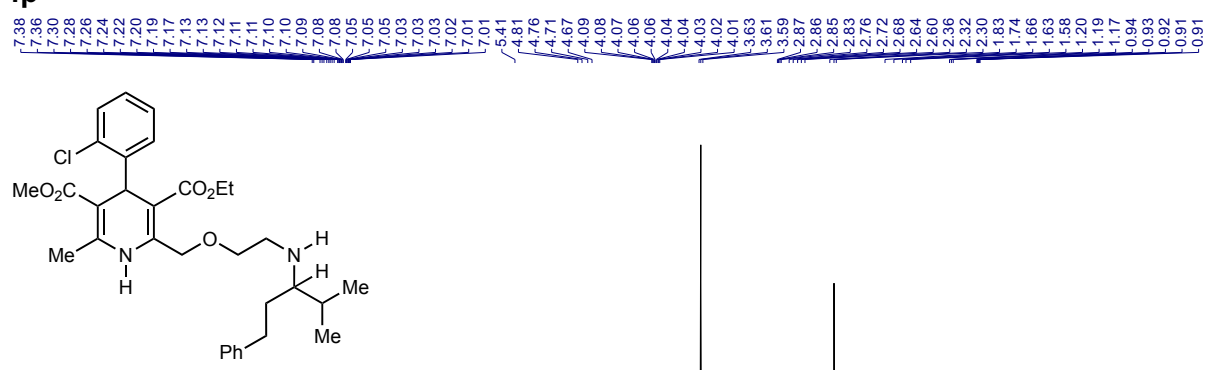
^{1}H NMR, 400 MHz, $CDCl_3$

4o

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



4p

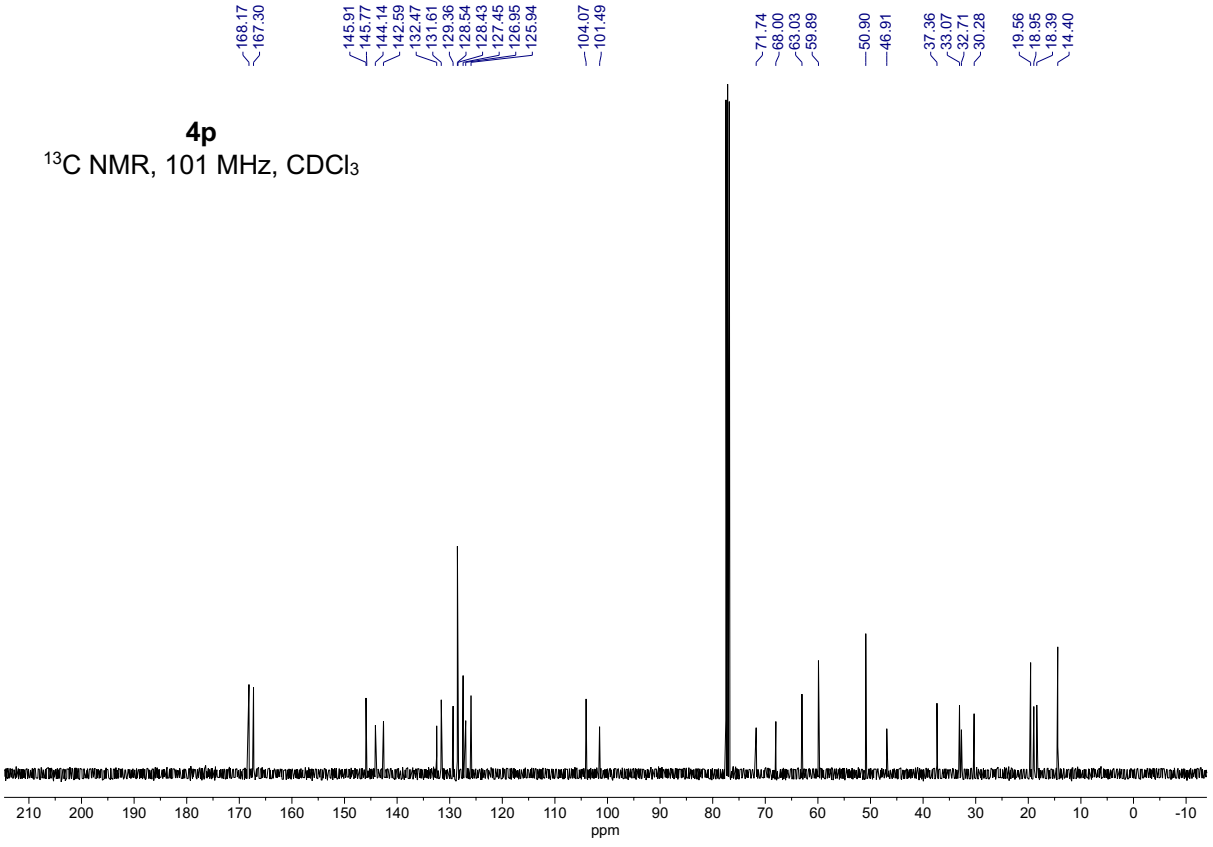


4p

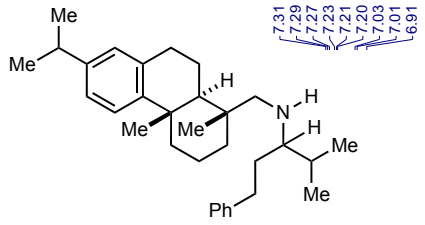
^{1}H NMR, 400 MHz, $CDCl_3$

4p

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



4q

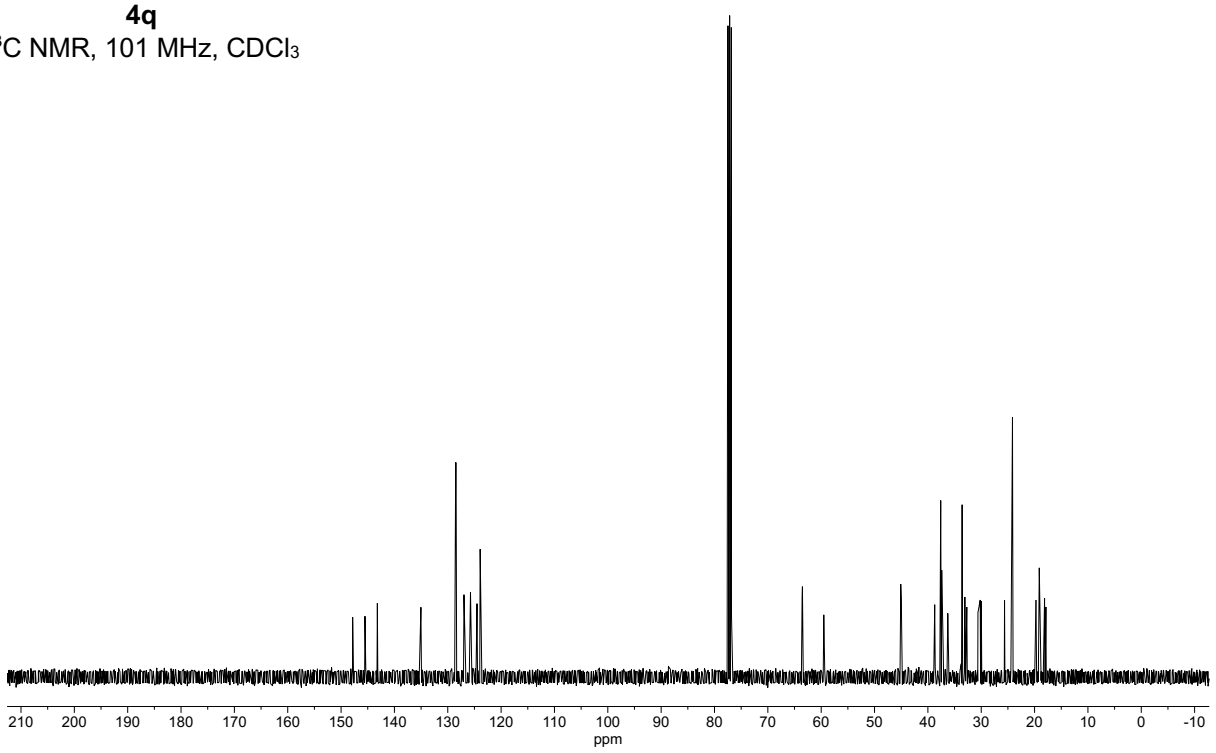


4q

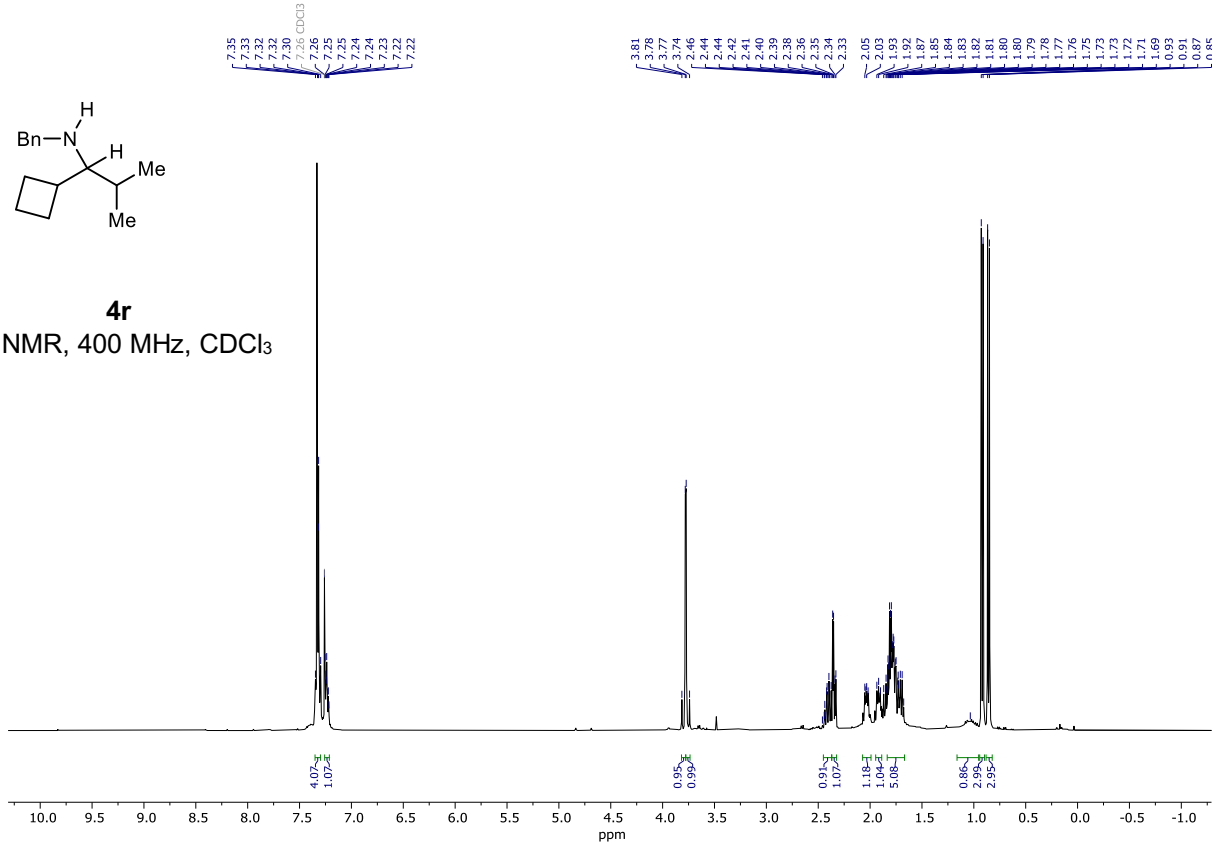
^{1}H NMR, 400 MHz, $CDCl_3$

4q

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



4r

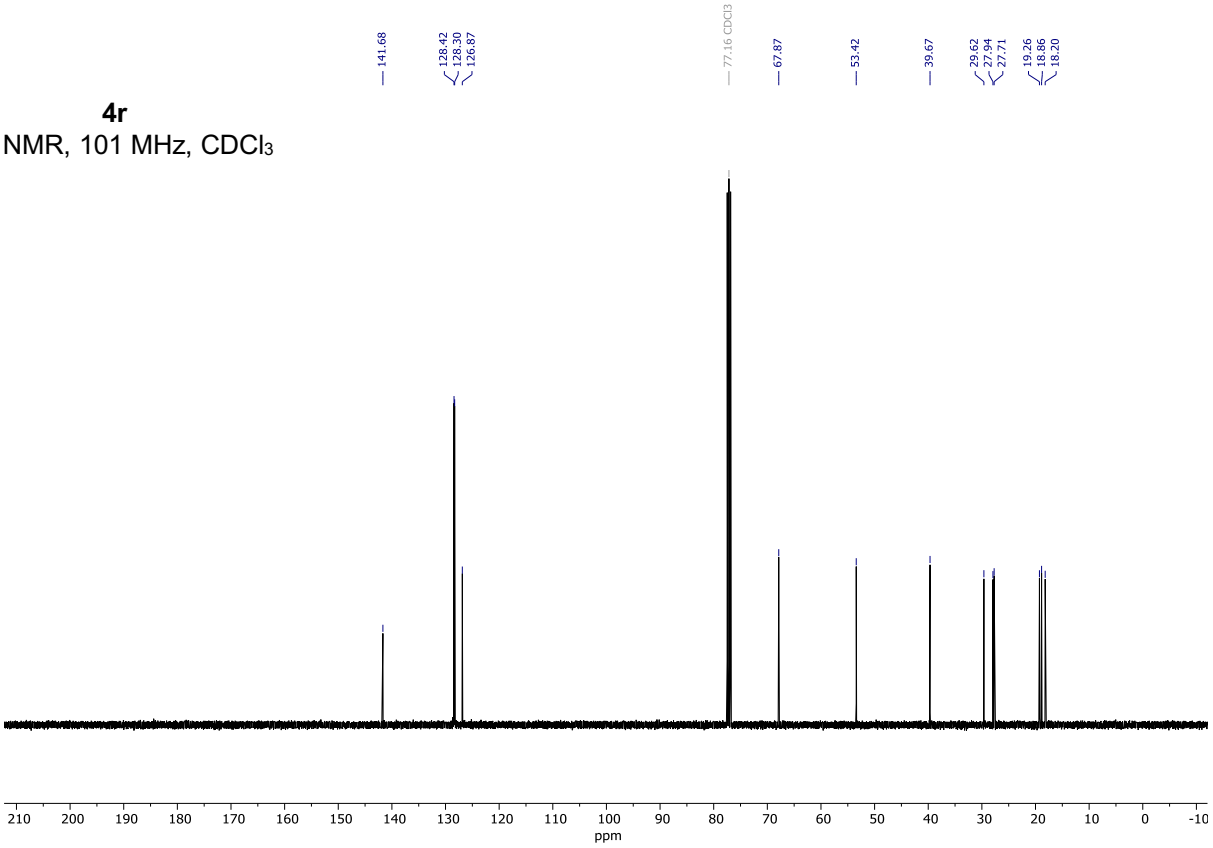


4r

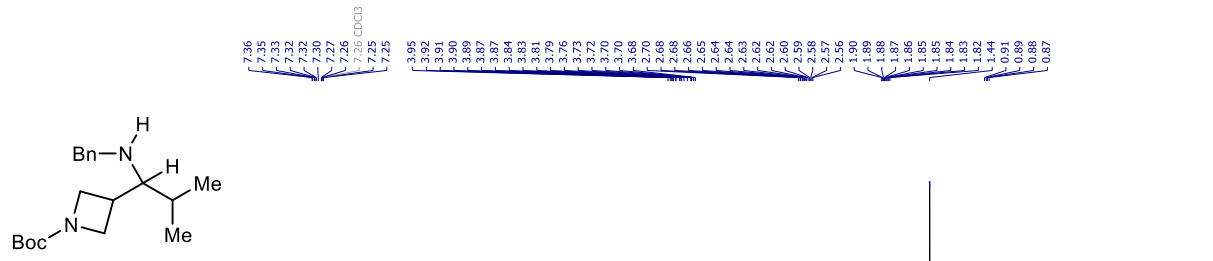
^{1}H NMR, 400 MHz, $CDCl_3$

4r

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



4s

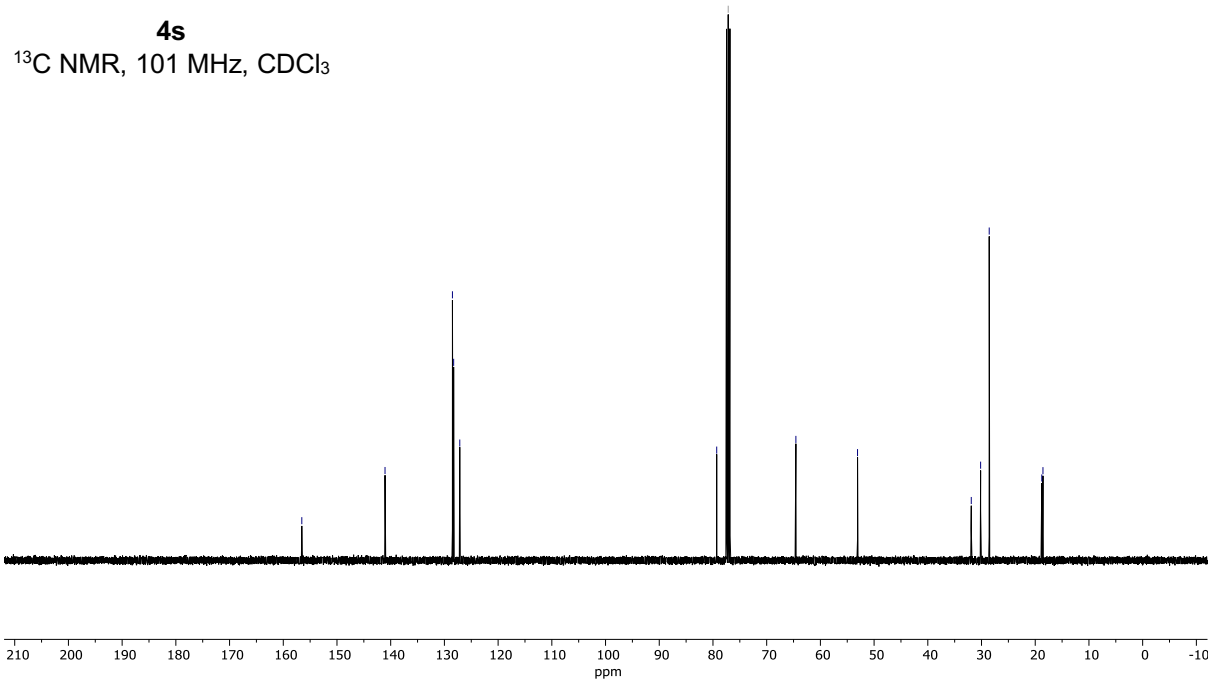


4s

^{1}H NMR, 400 MHz, $CDCl_3$

4s

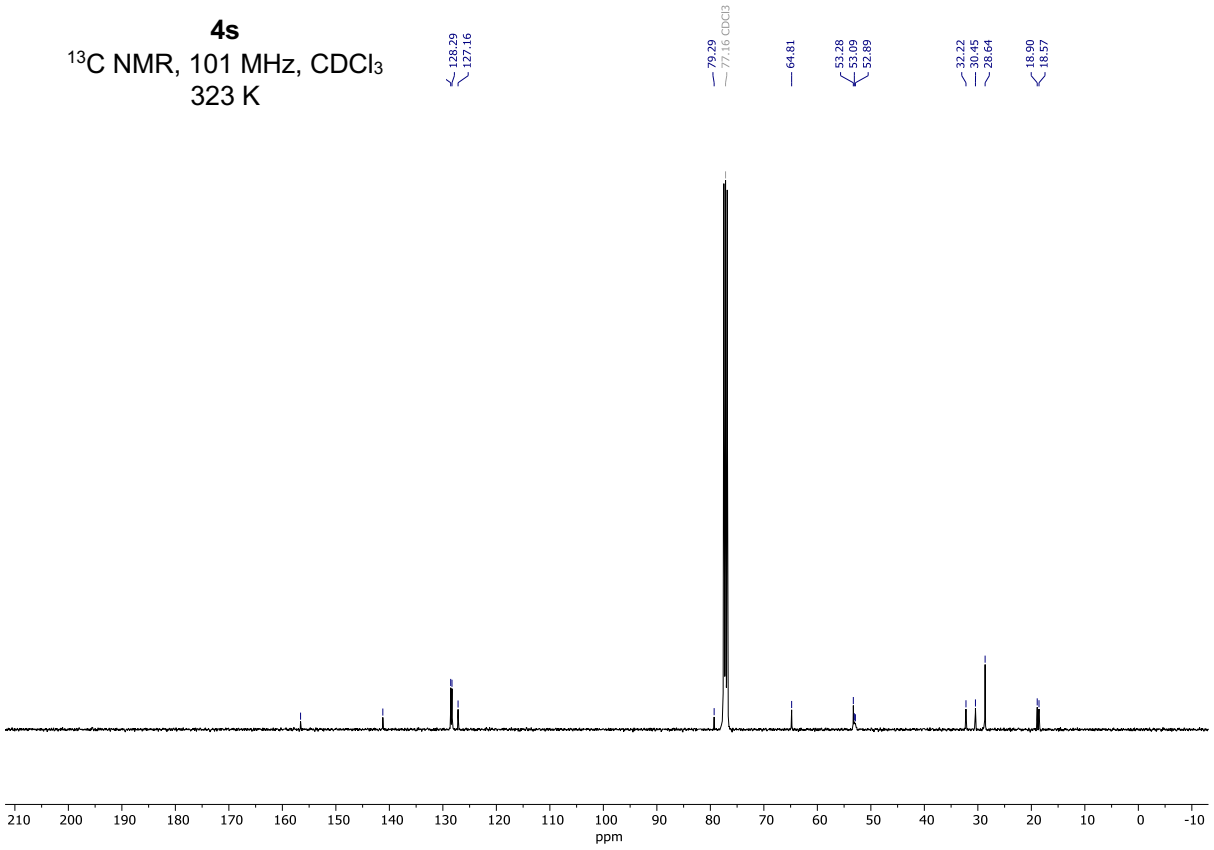
^{13}C NMR, 101 MHz, $CDCl_3$



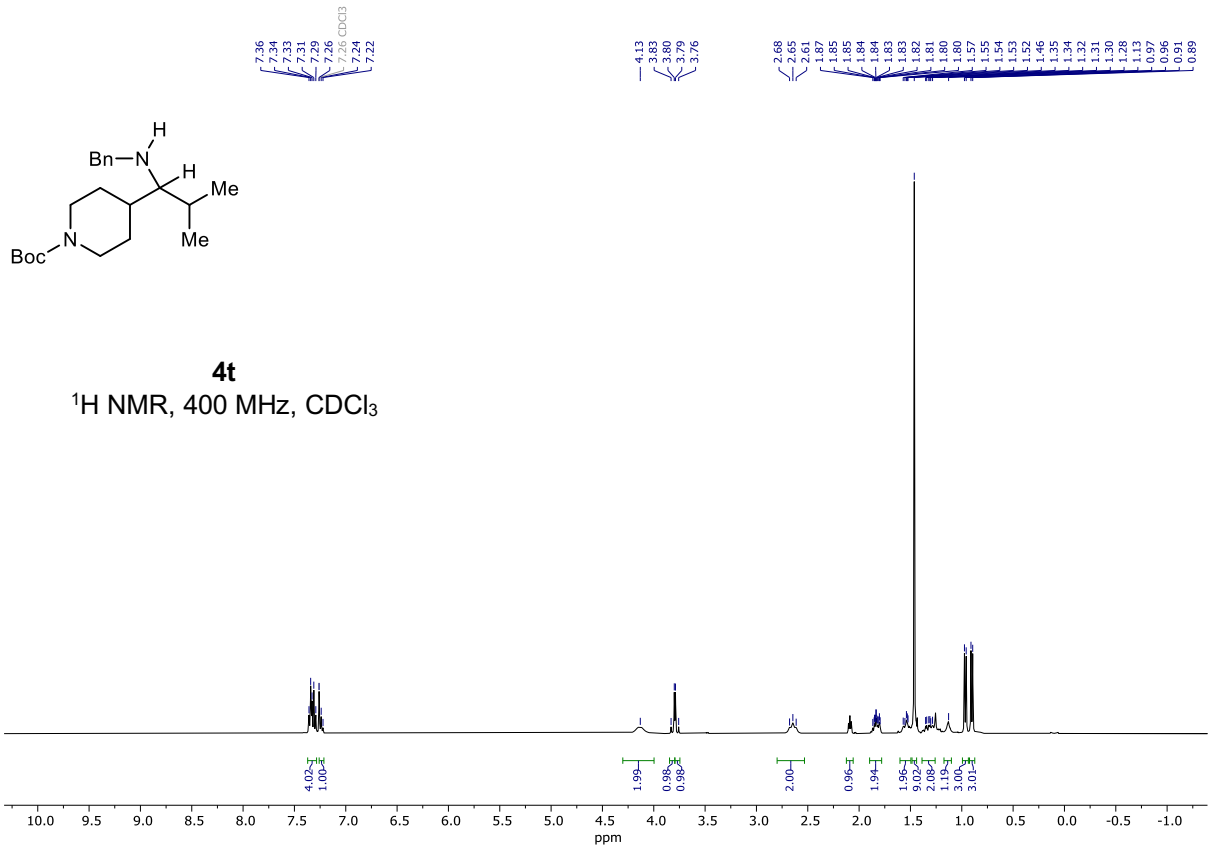
4s

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

323 K

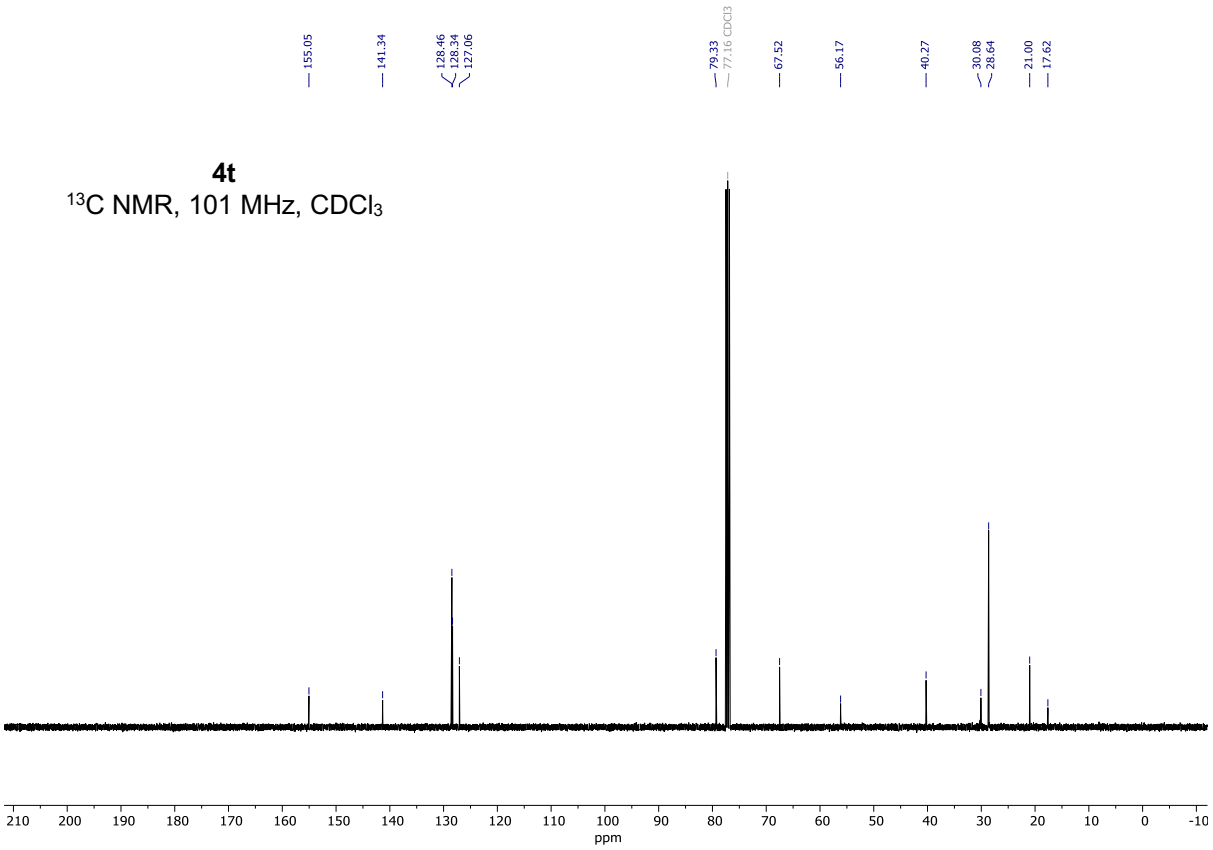


4t



4t

^{1}H NMR, 400 MHz, $CDCl_3$



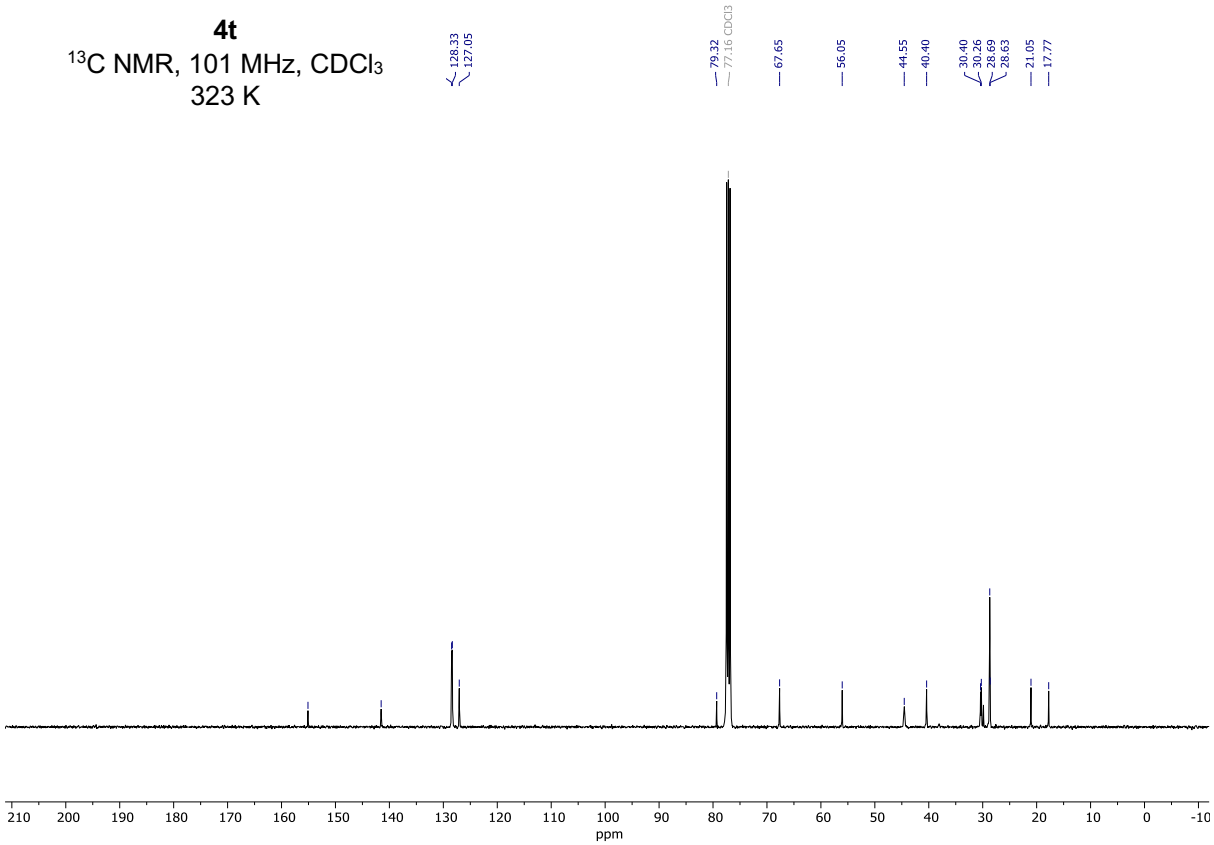
4t

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

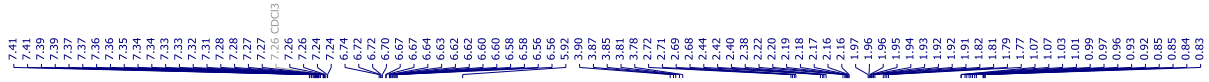
4t

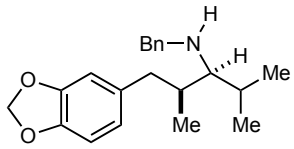
^{13}C NMR, 101 MHz, $CDCl_3$

323 K



4u



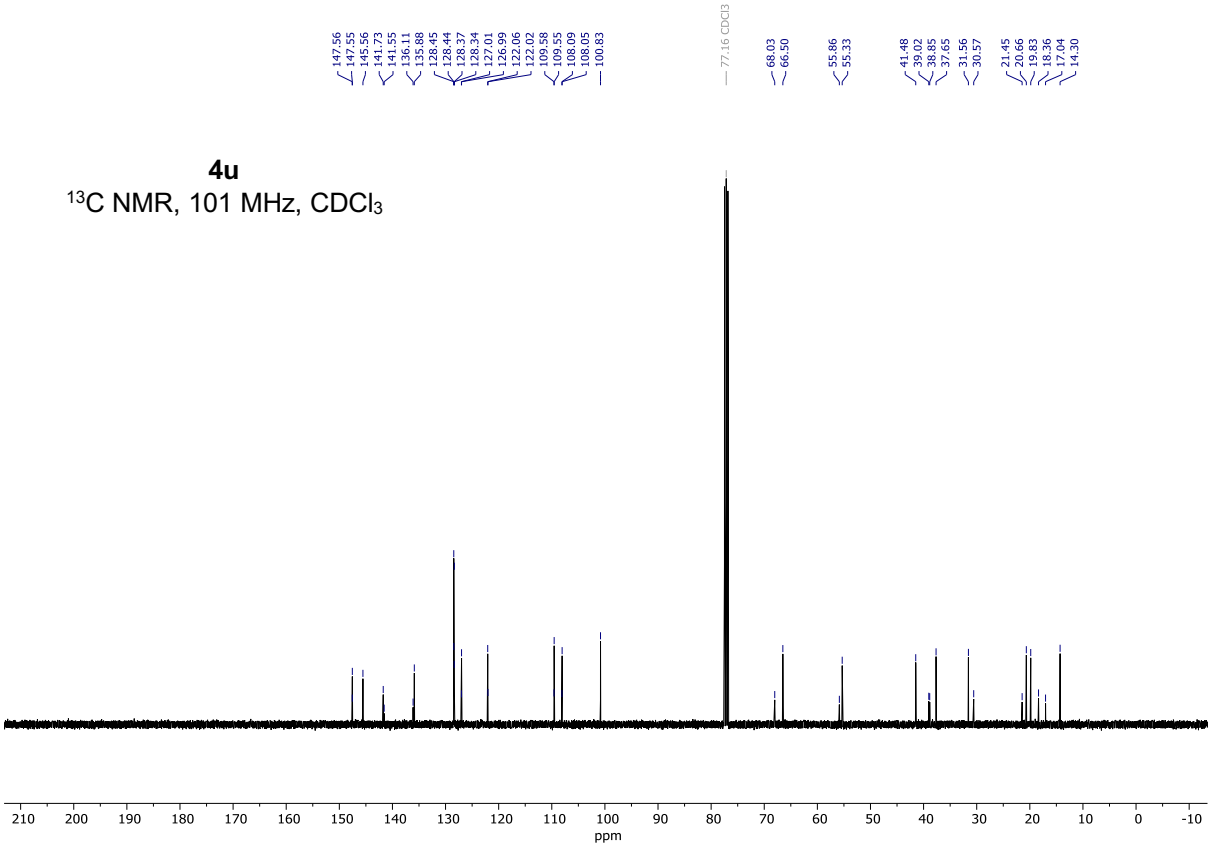


4u

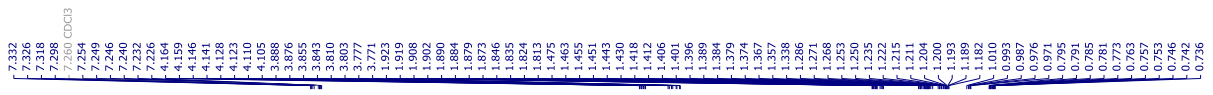
^{1}H NMR, 400 MHz, $CDCl_3$

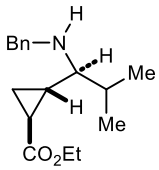
4u

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



4v



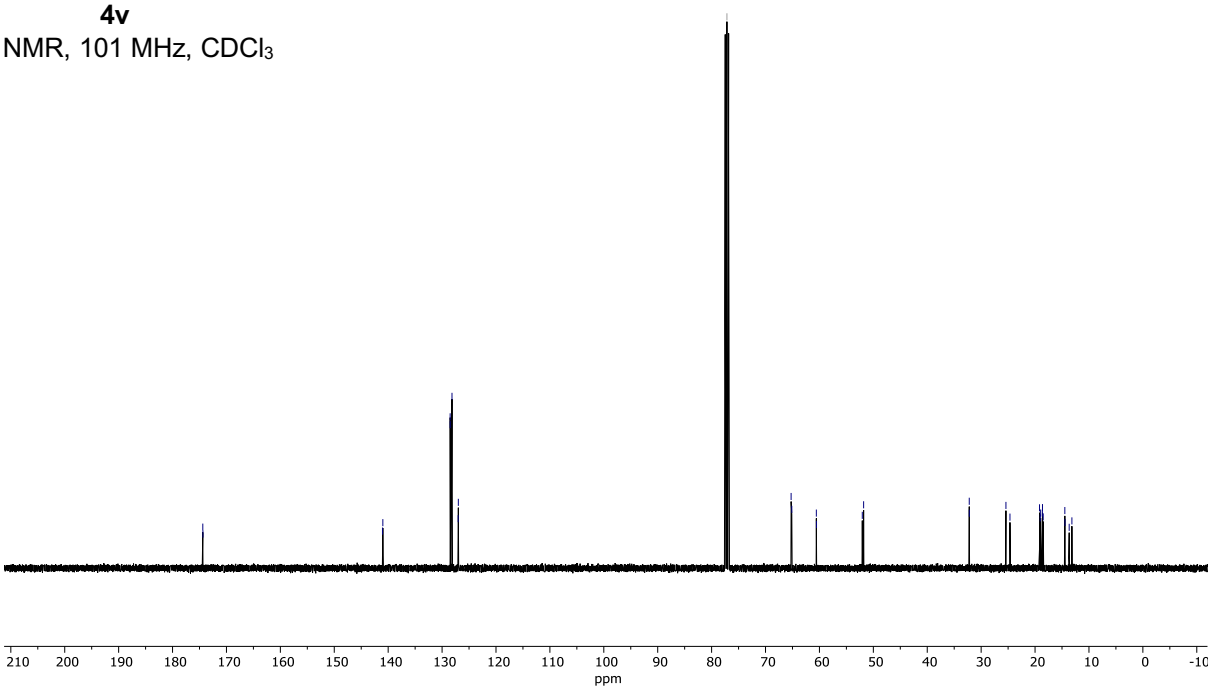


4v

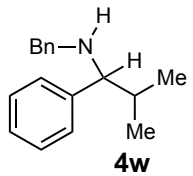
^{1}H NMR, 400 MHz, $CDCl_3$

4v

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



4w

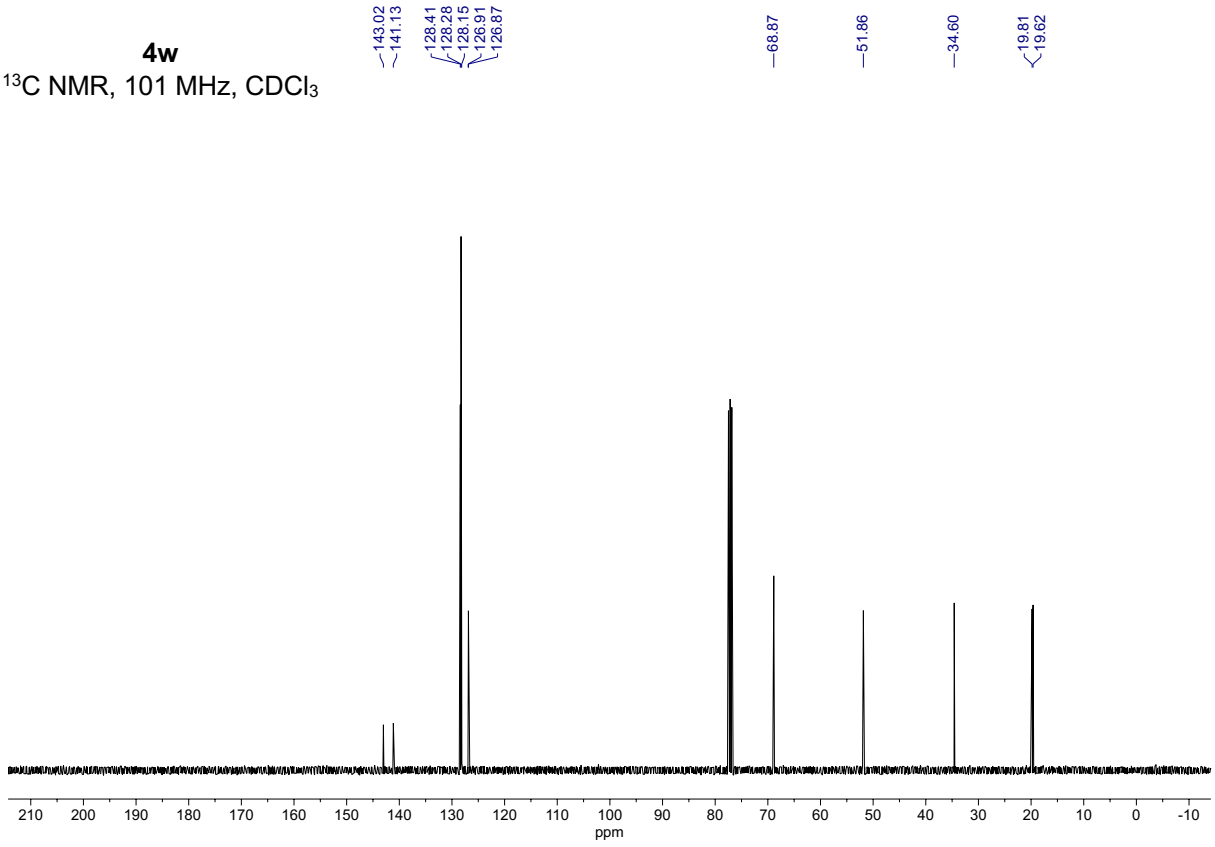


4w

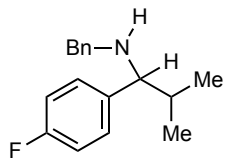
^{1}H NMR, 400 MHz, $CDCl_3$

4w

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

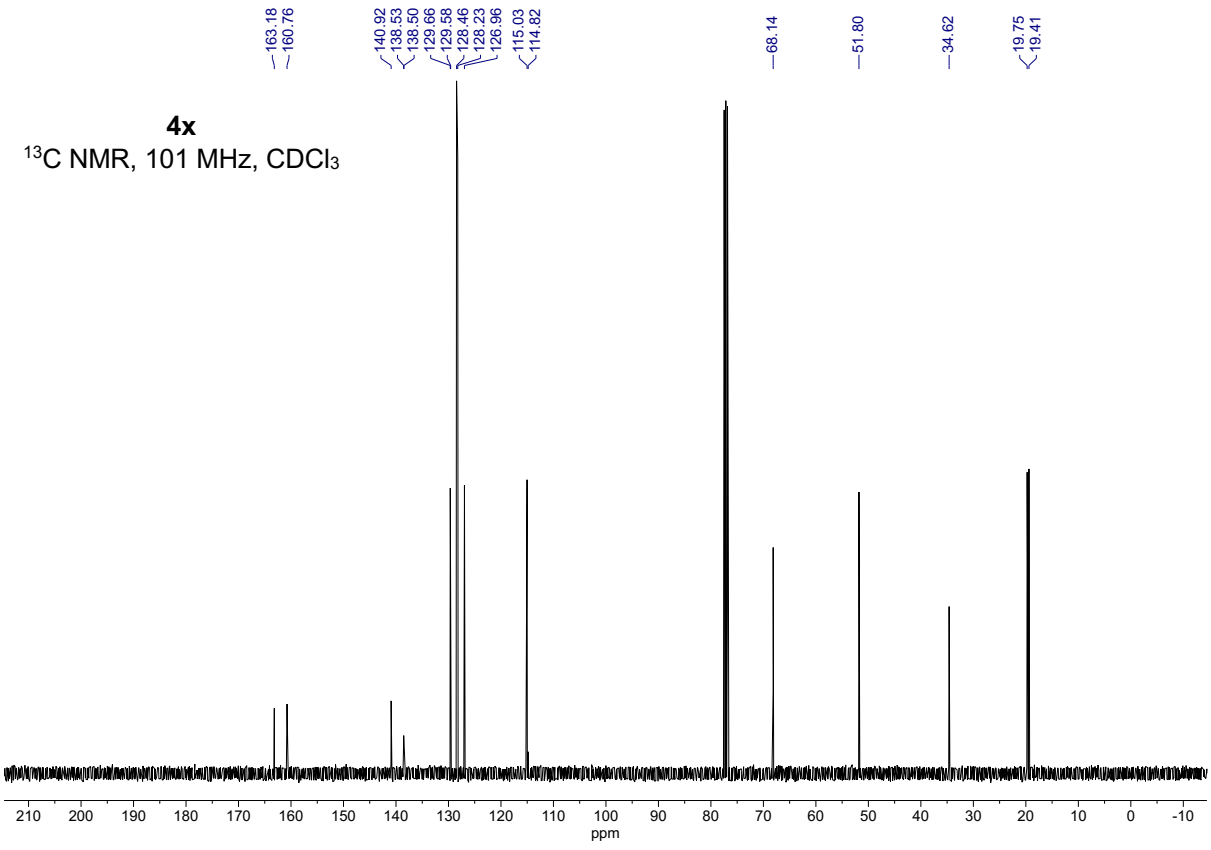


4x



4x

^{1}H NMR, 400 MHz, $CDCl_3$

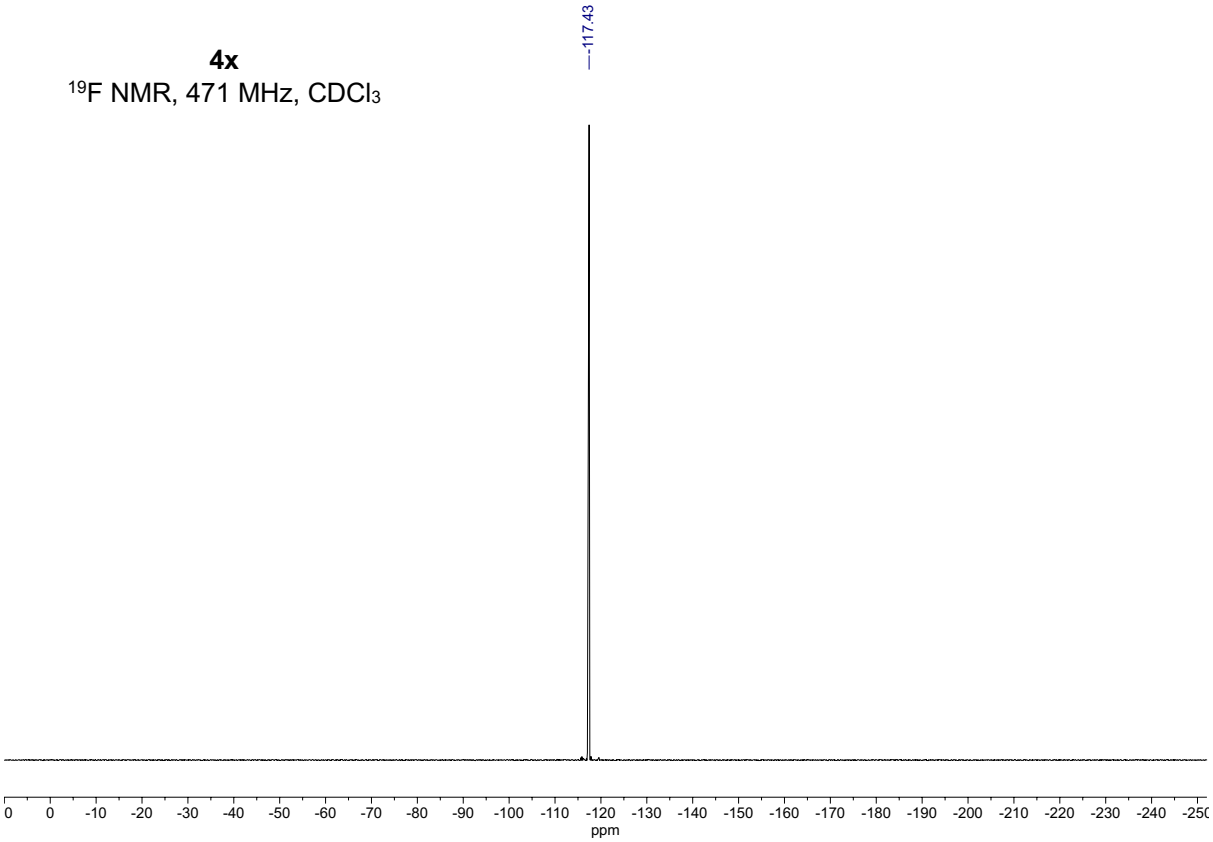


4x

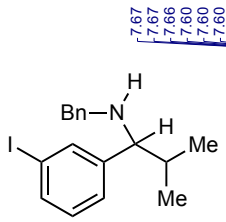
^{13}C NMR, 101 MHz, $CDCl_3$

4x

^{19}F NMR, 471 MHz, $CDCl_3$



4y

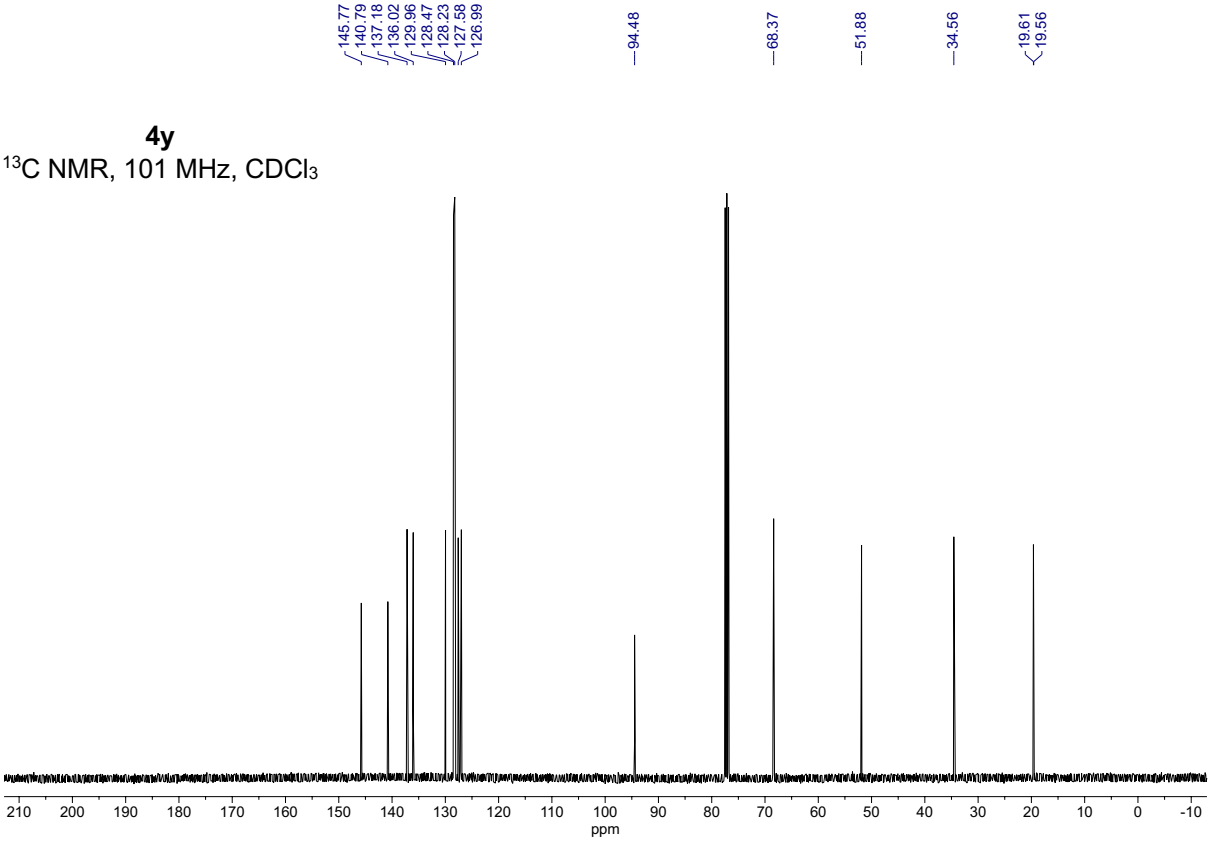


4y

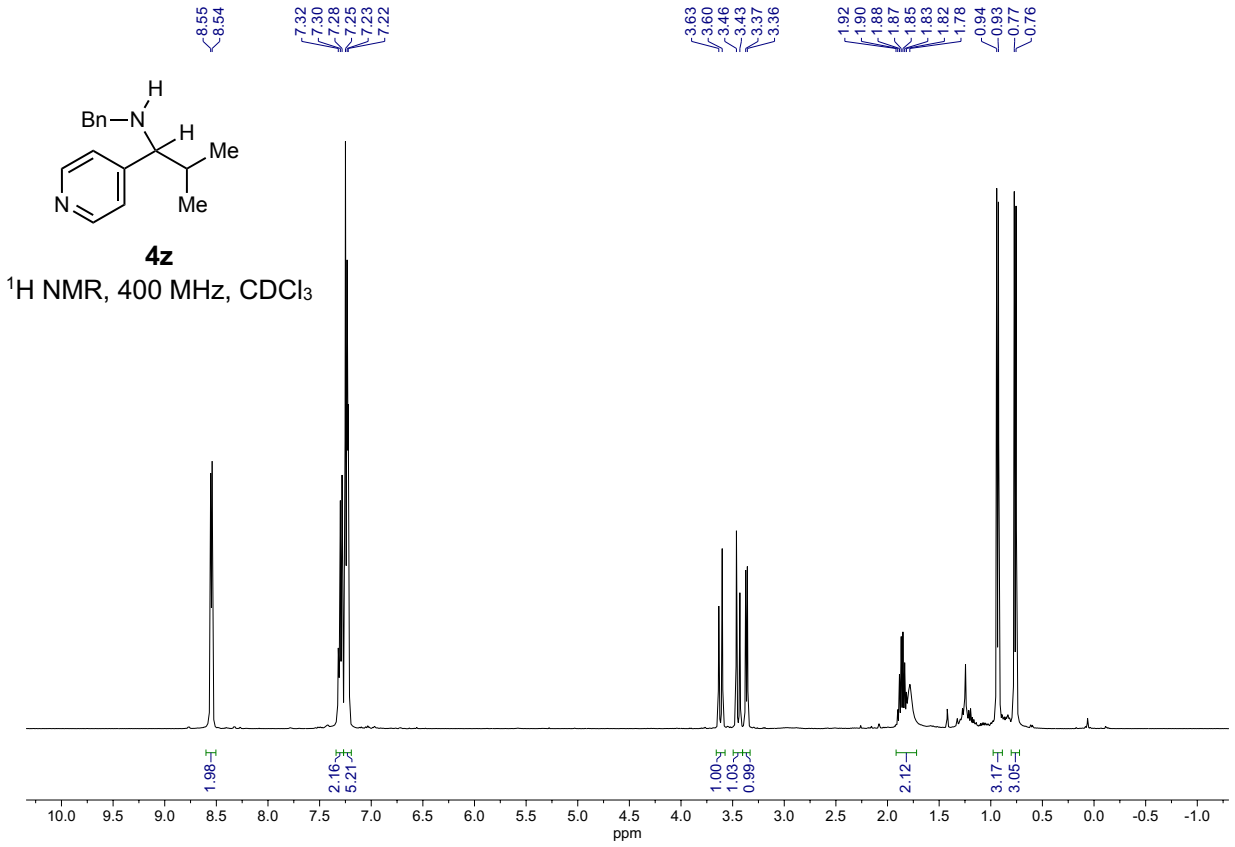
^{1}H NMR, 400 MHz, $CDCl_3$

4y

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

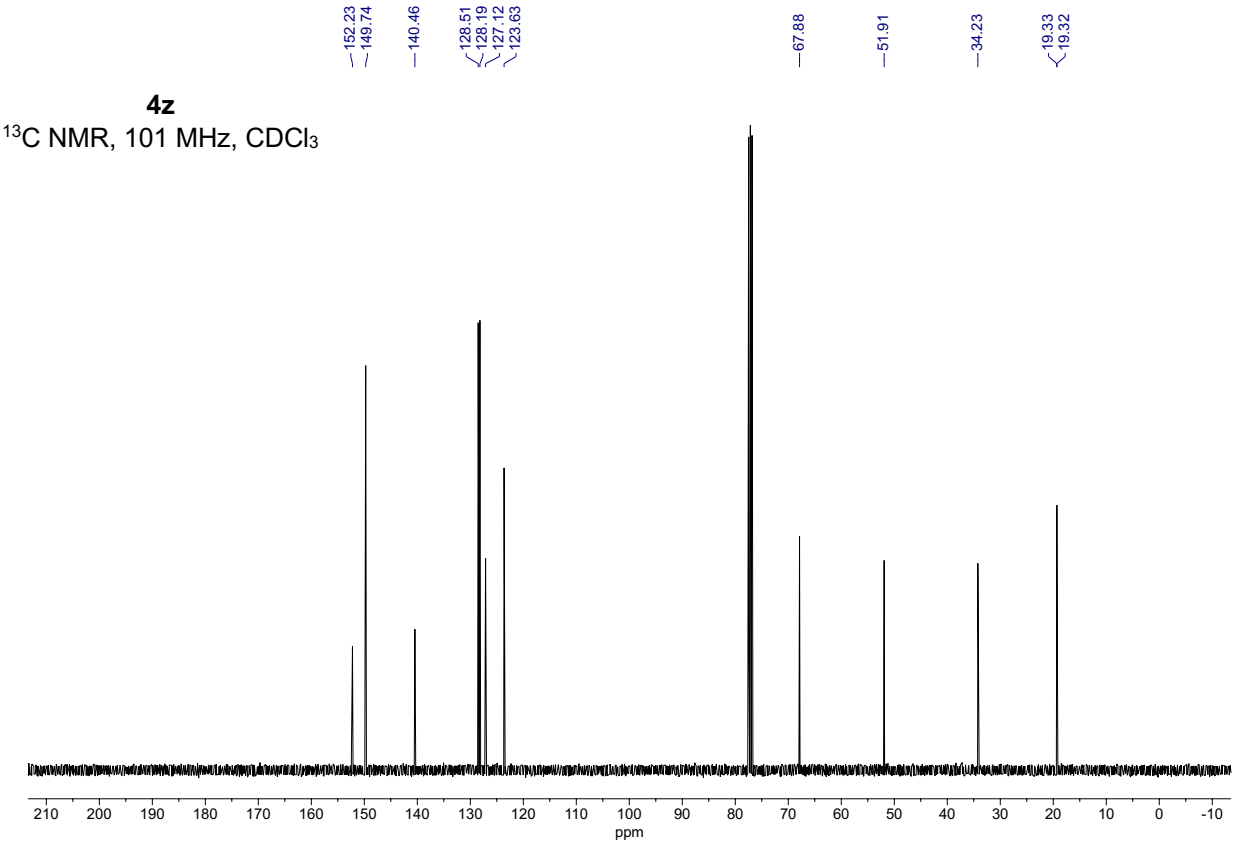


4z



4z

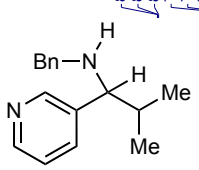
^{1}H NMR, 400 MHz, $CDCl_3$



4z

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

4aa

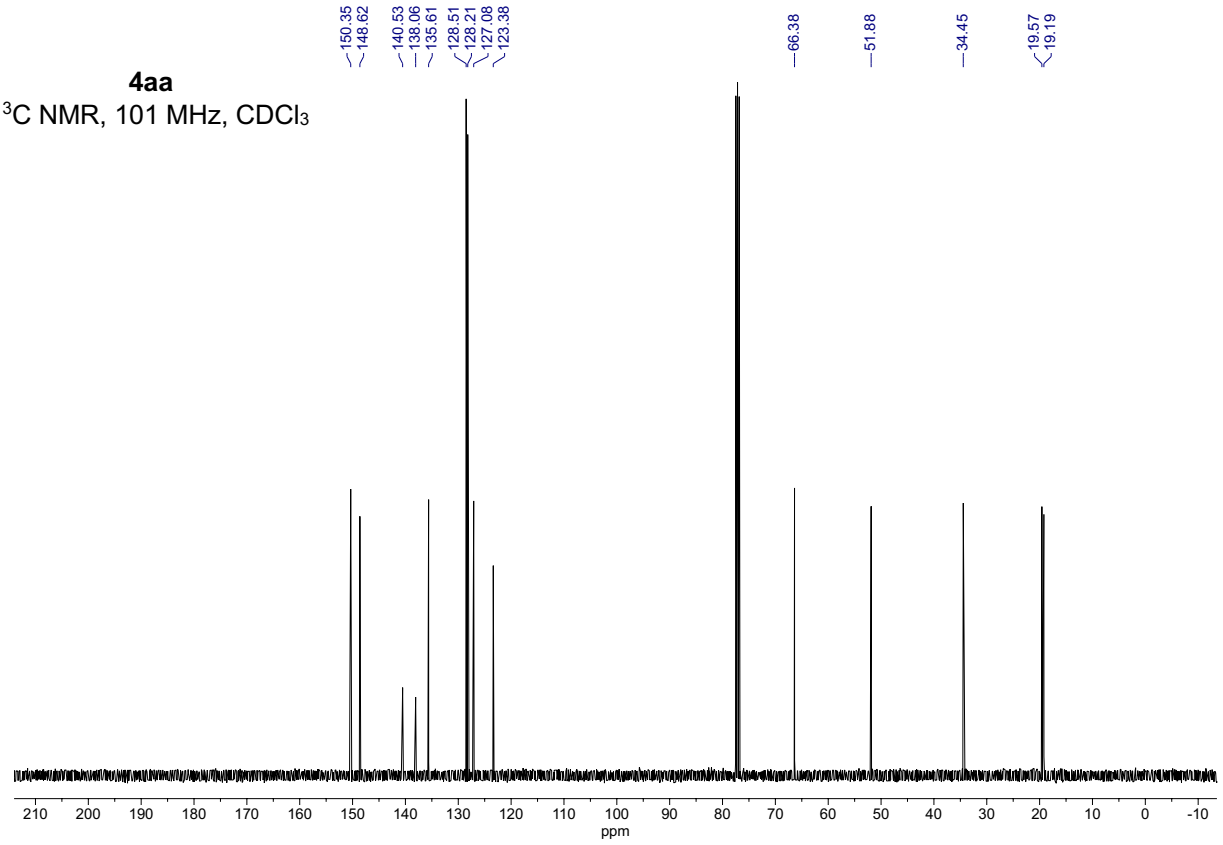


4aa

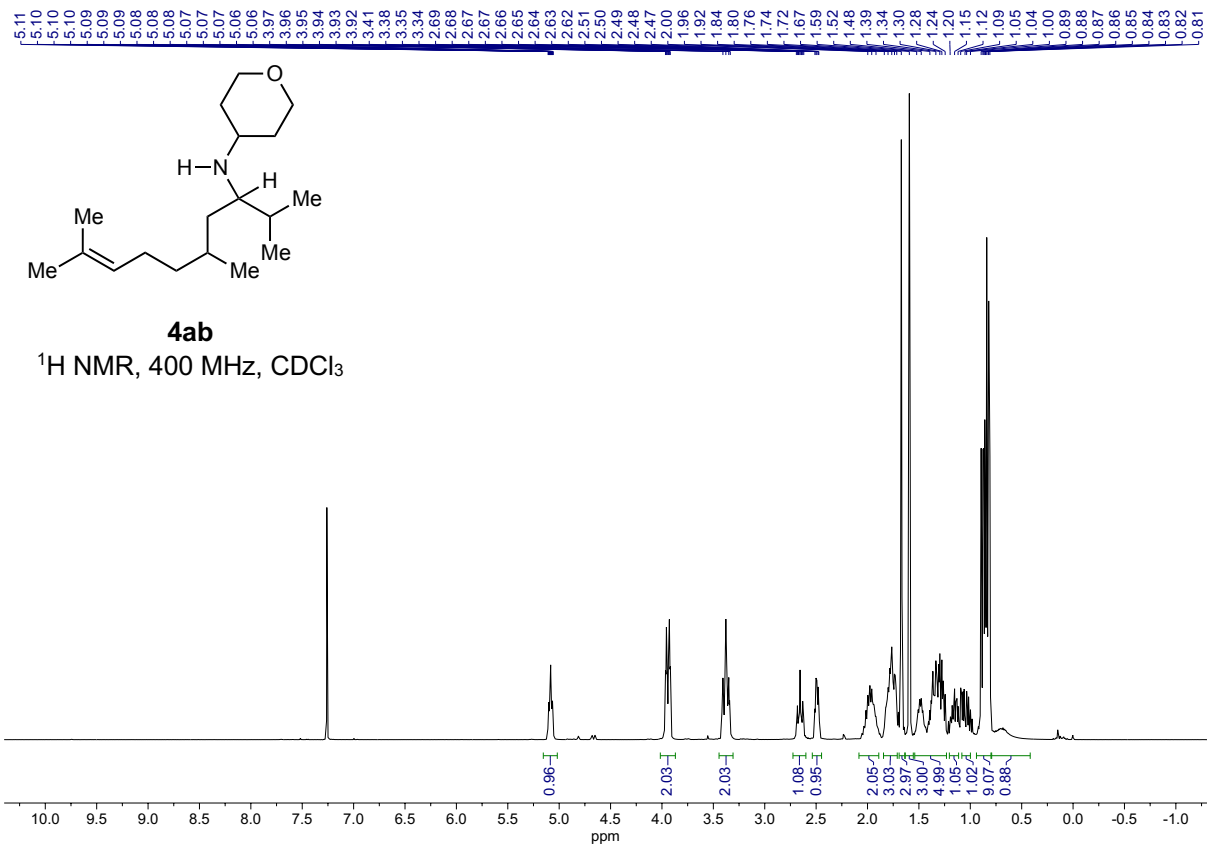
^{1}H NMR, 400 MHz, $CDCl_3$

4aa

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

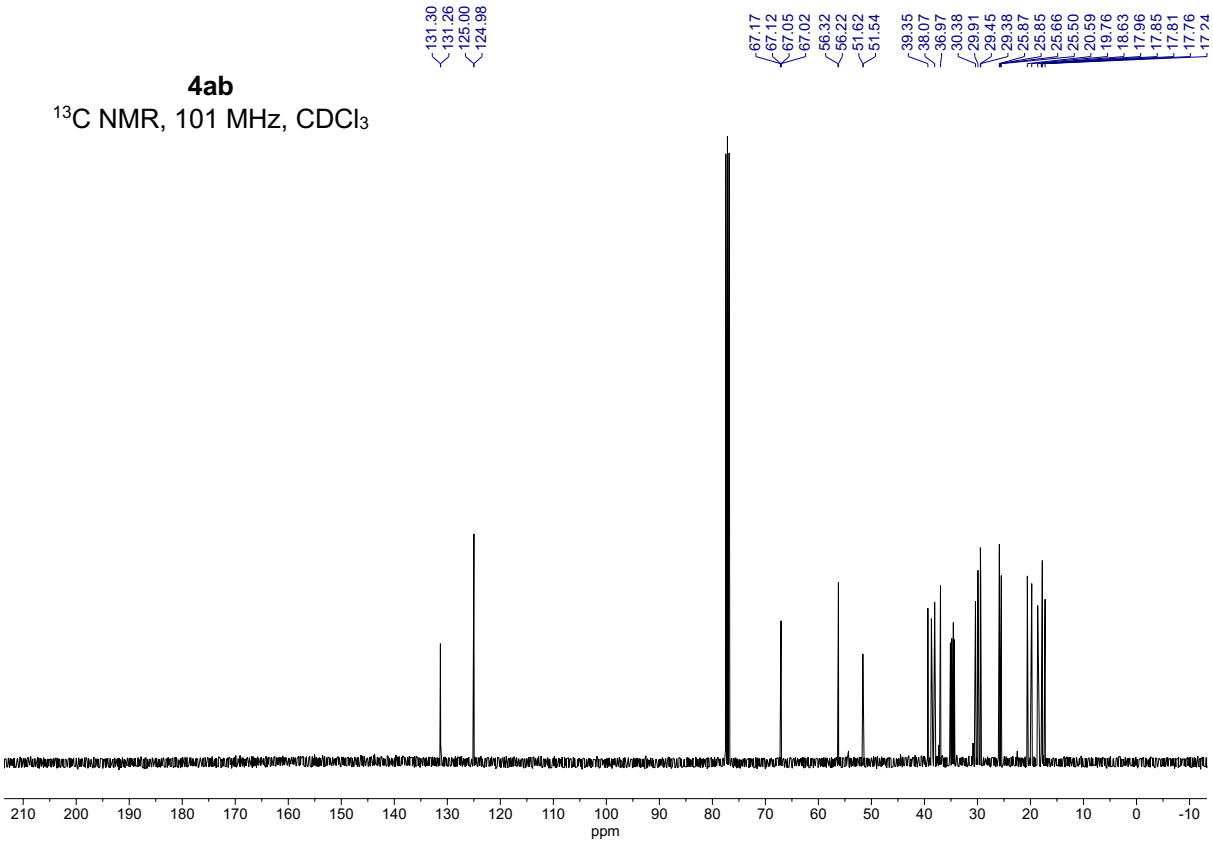


4ab



4ab

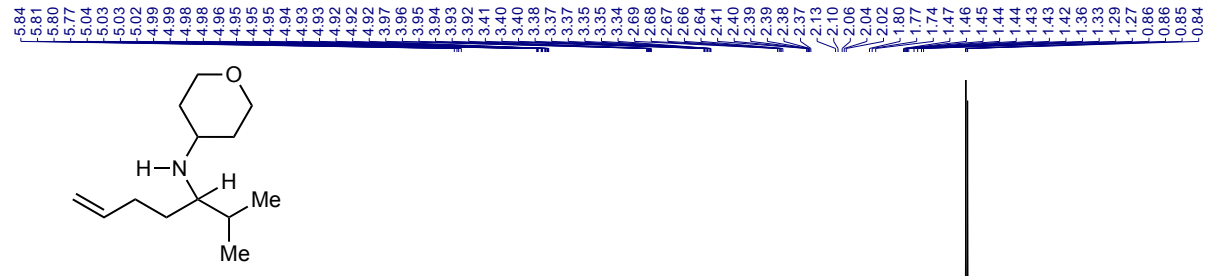
^{1}H NMR, 400 MHz, $CDCl_3$



4ab

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

4ac

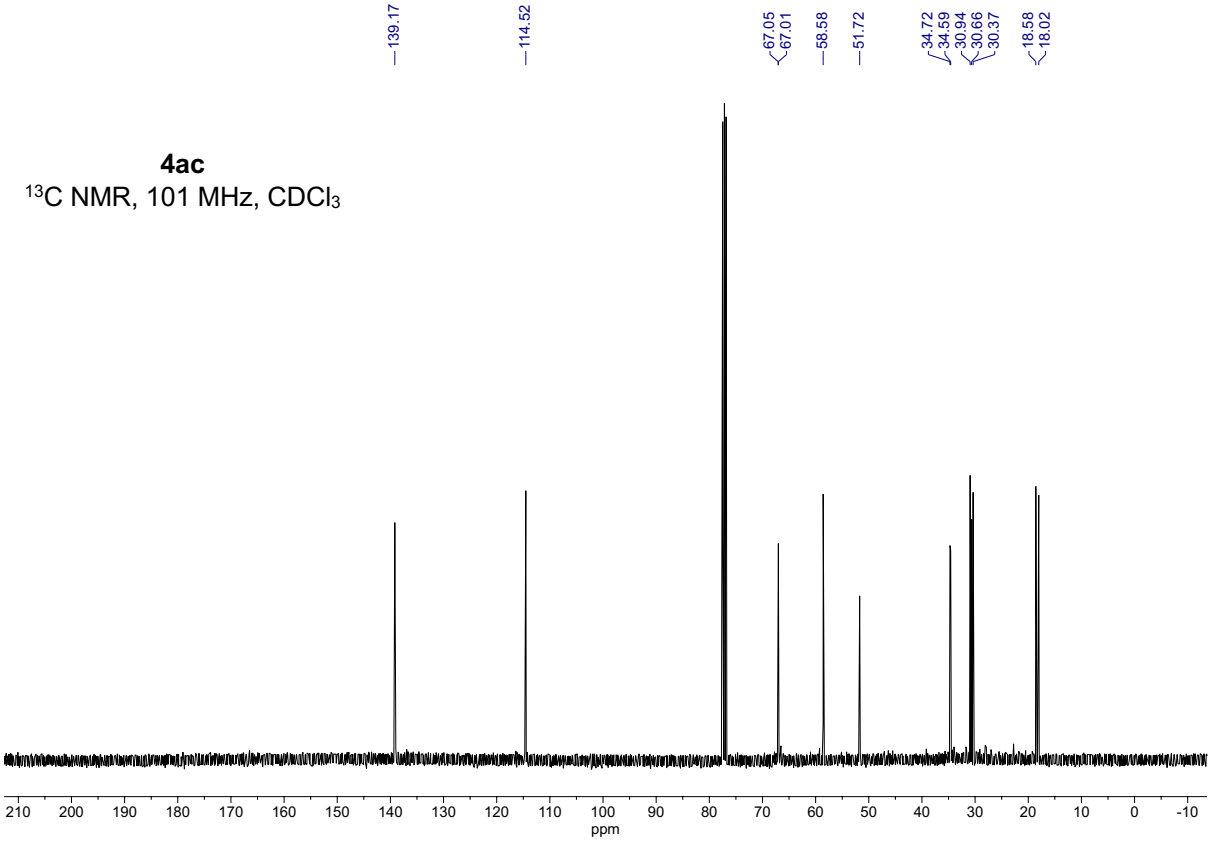


4ac

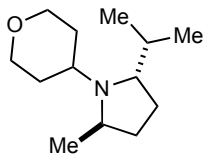
^{1}H NMR, 400 MHz, $CDCl_3$

4ac

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



4ac’

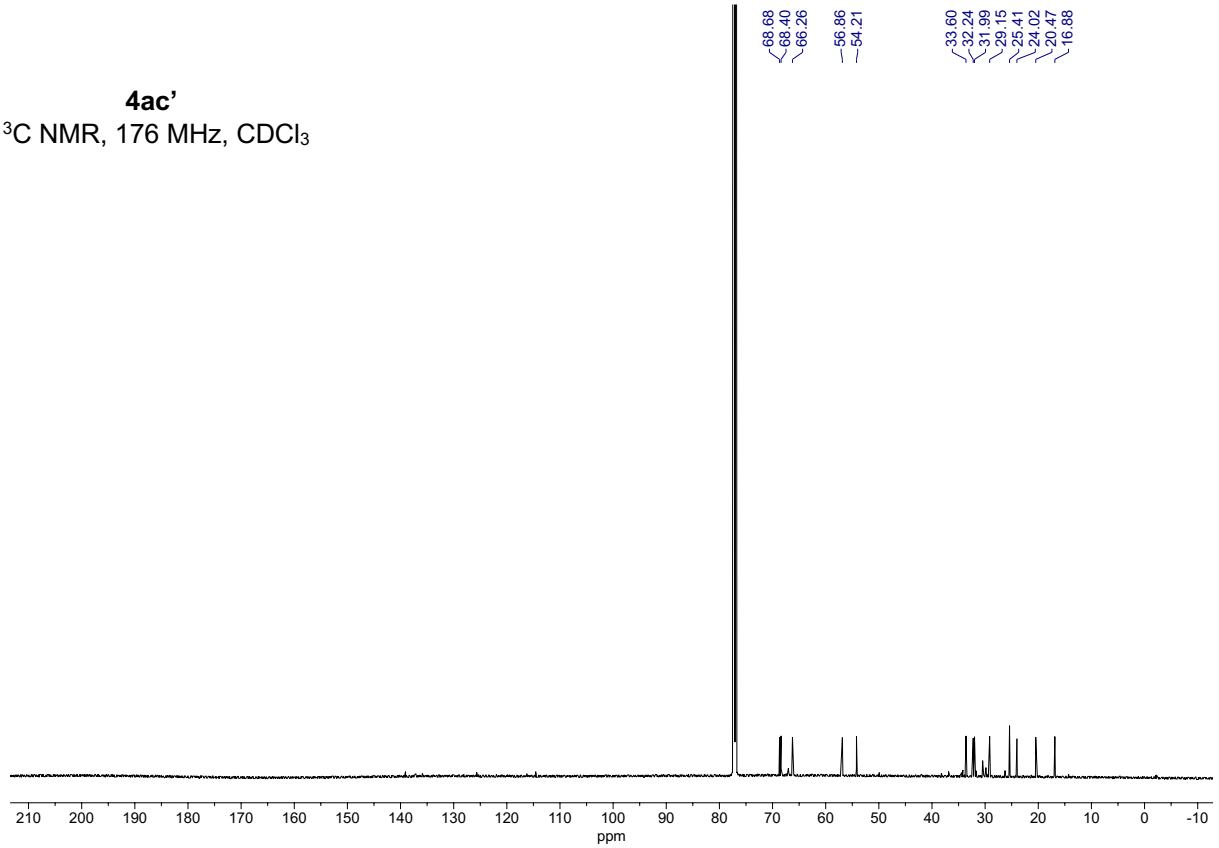


4ac’

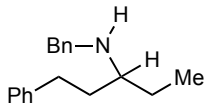
^{1}H NMR, 700 MHz, $CDCl_3$

4ac’

^{13}C NMR, 176 MHz, $CDCl_3$



4ae

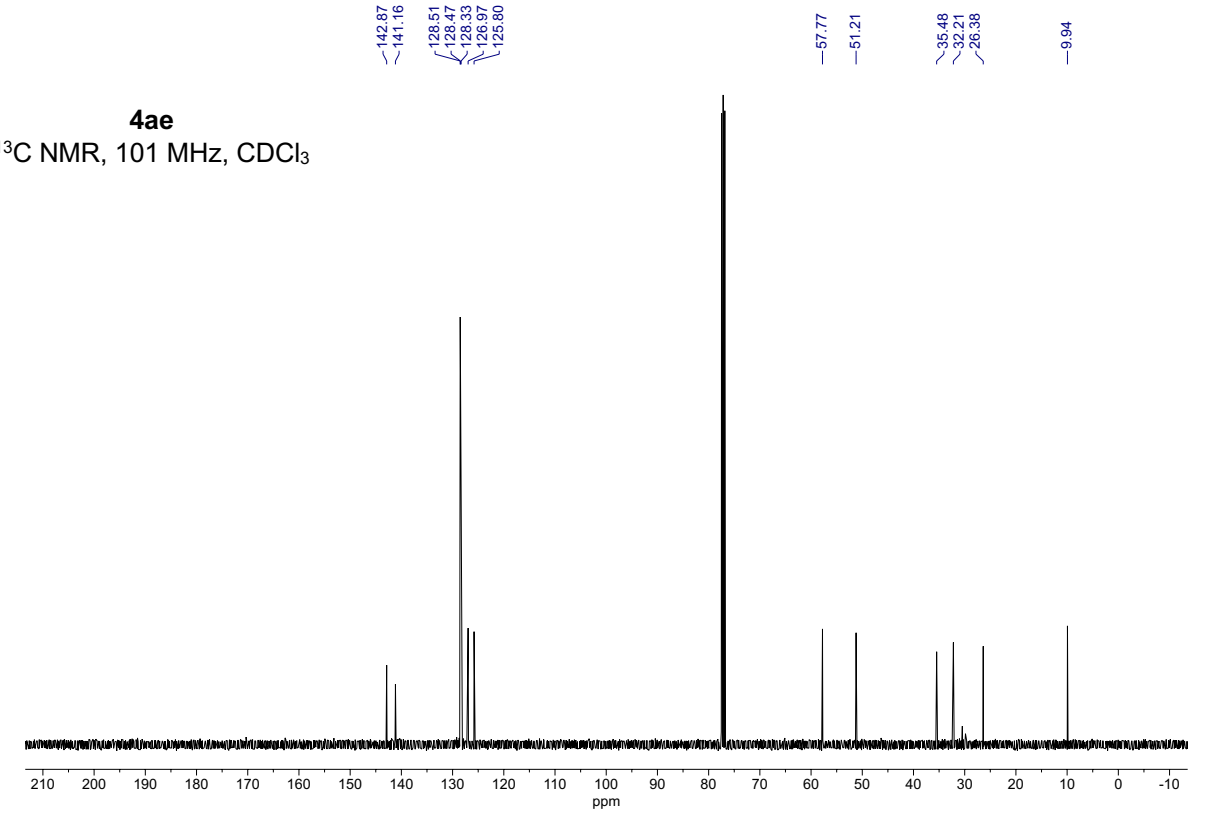


4ae

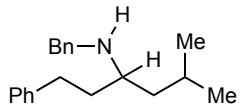
^{1}H NMR, 400 MHz, $CDCl_3$

4ae

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



4af

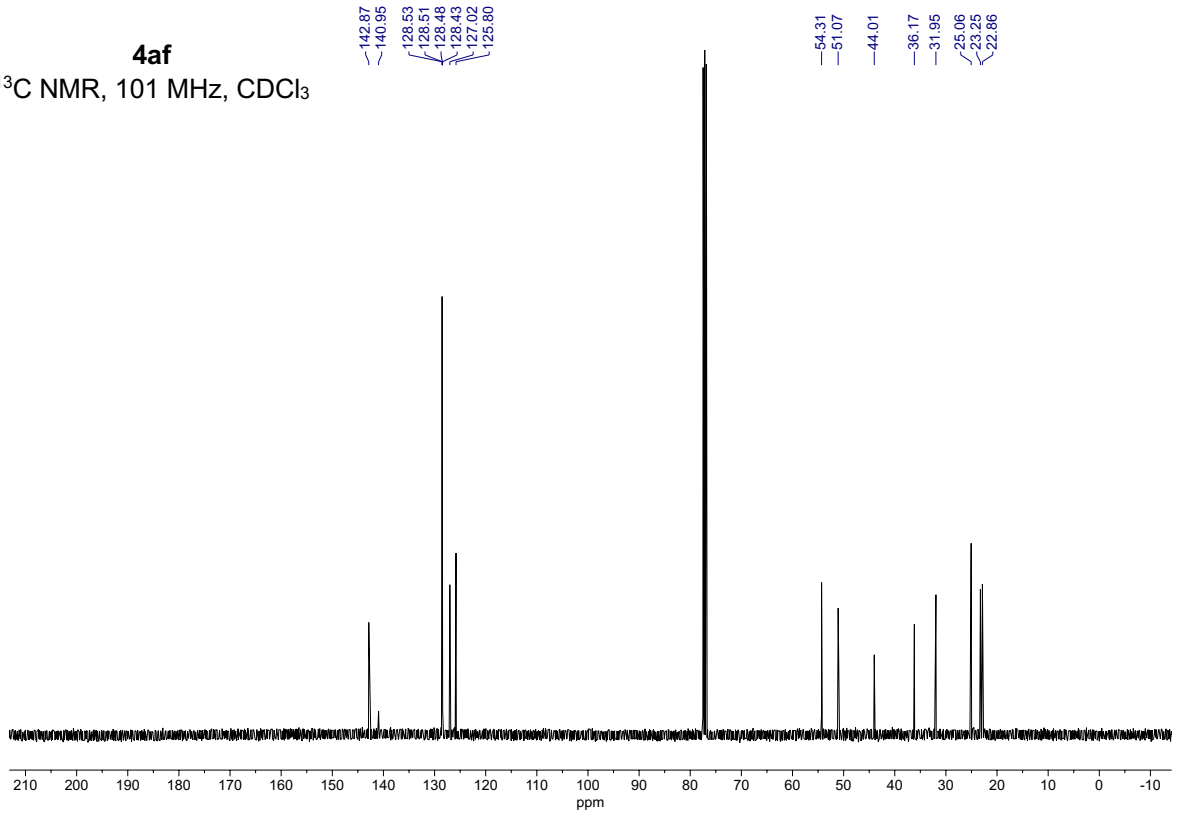


4af

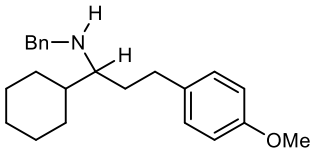
^{1}H NMR, 400 MHz, $CDCl_3$

4af

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



4ag

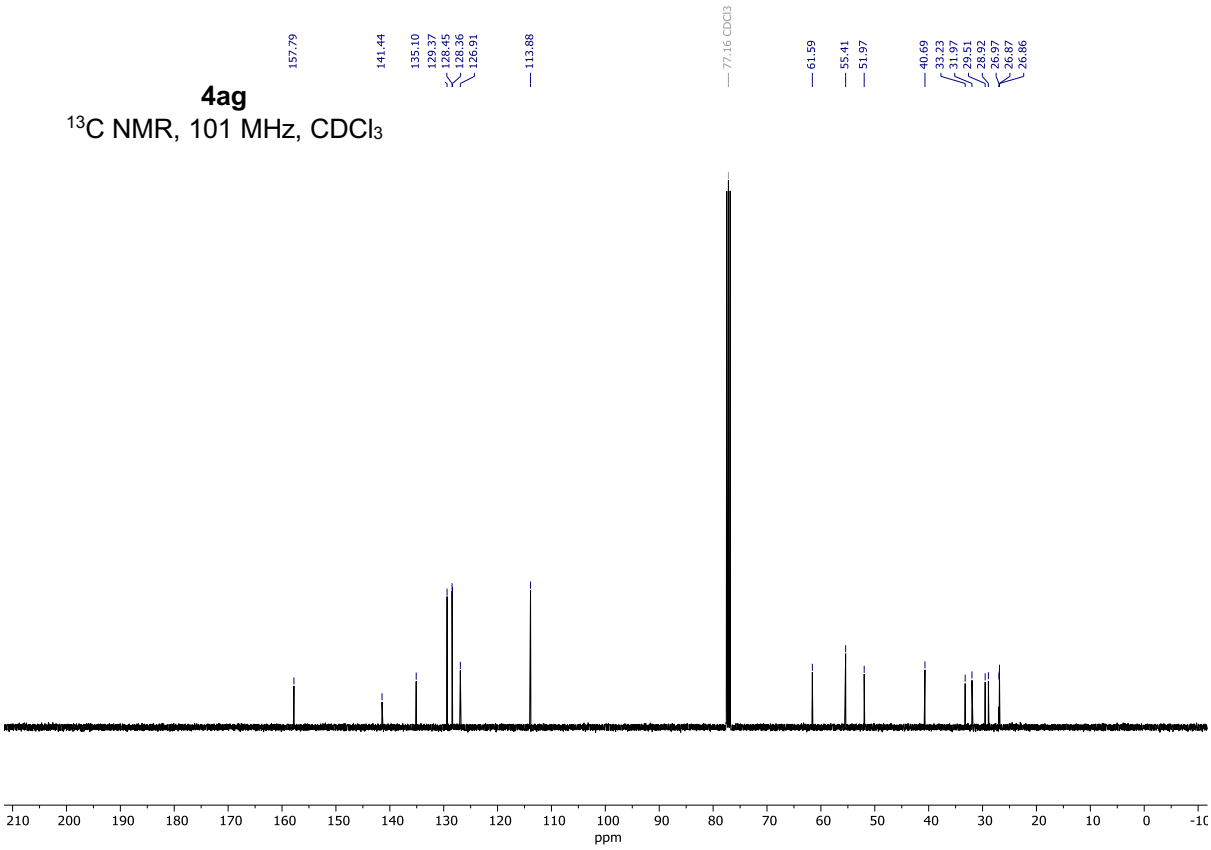


4ag

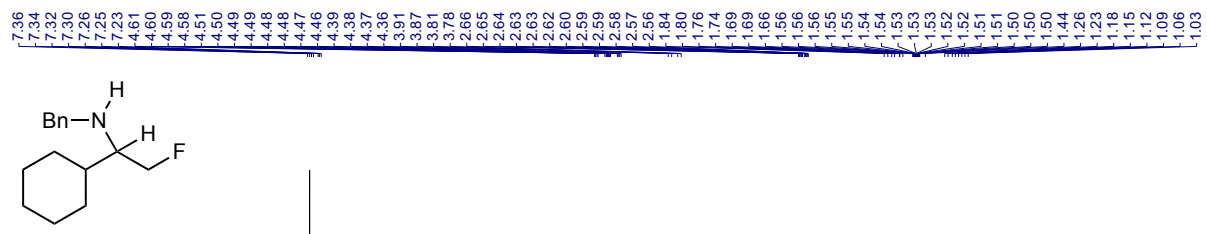
^{1}H NMR, 400 MHz, $CDCl_3$

4ag

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

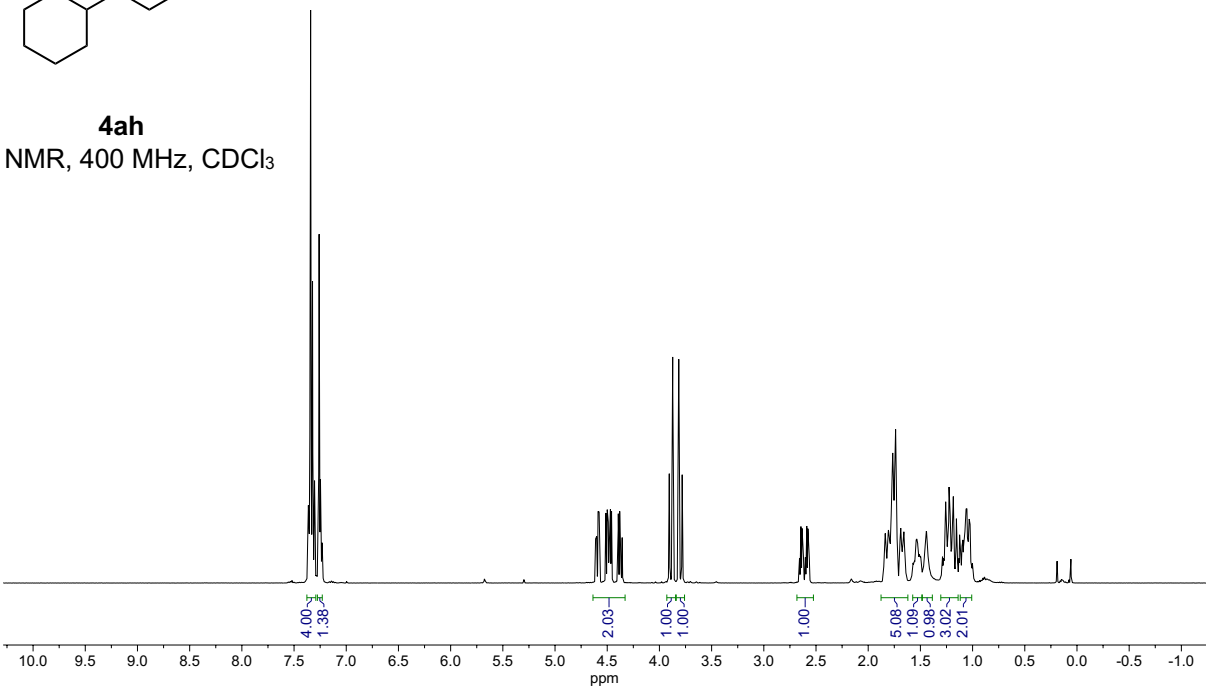


4ah



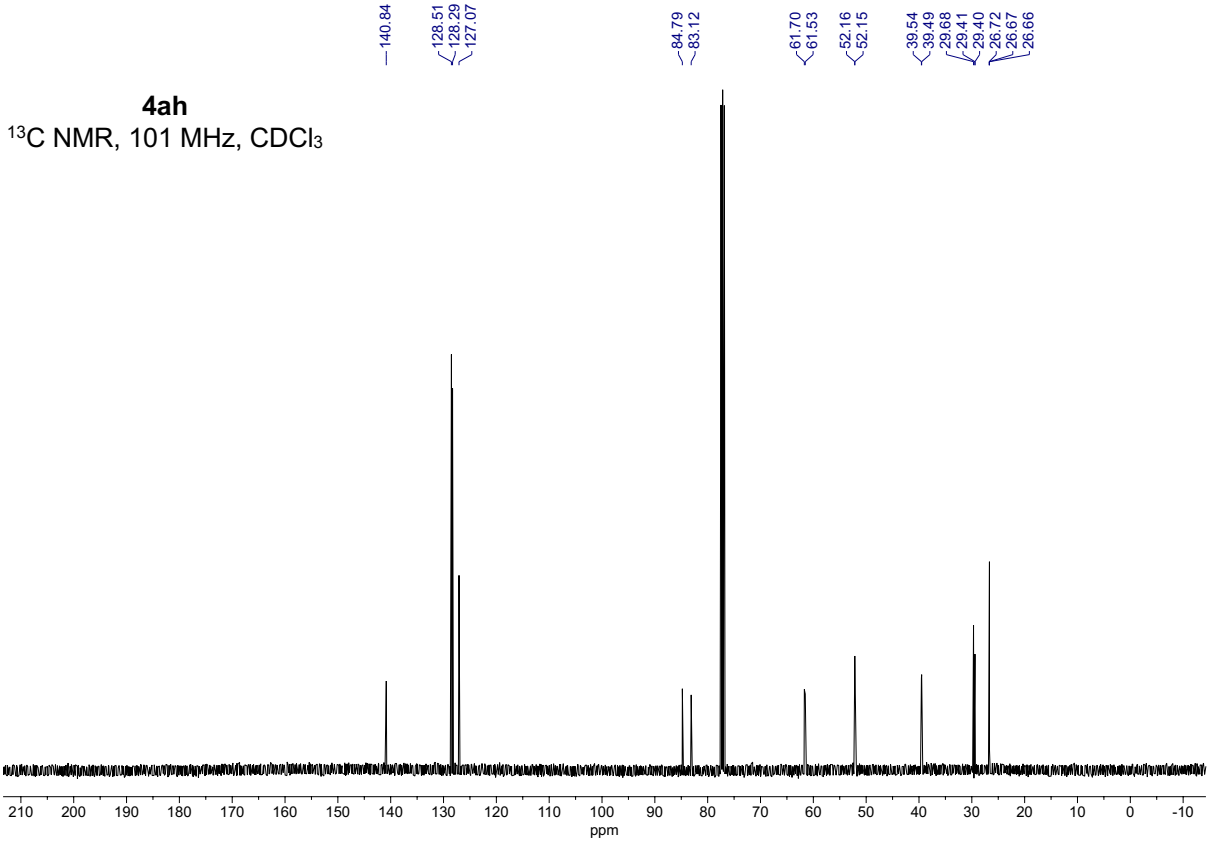
4ah

^{1}H NMR, 400 MHz, $CDCl_3$



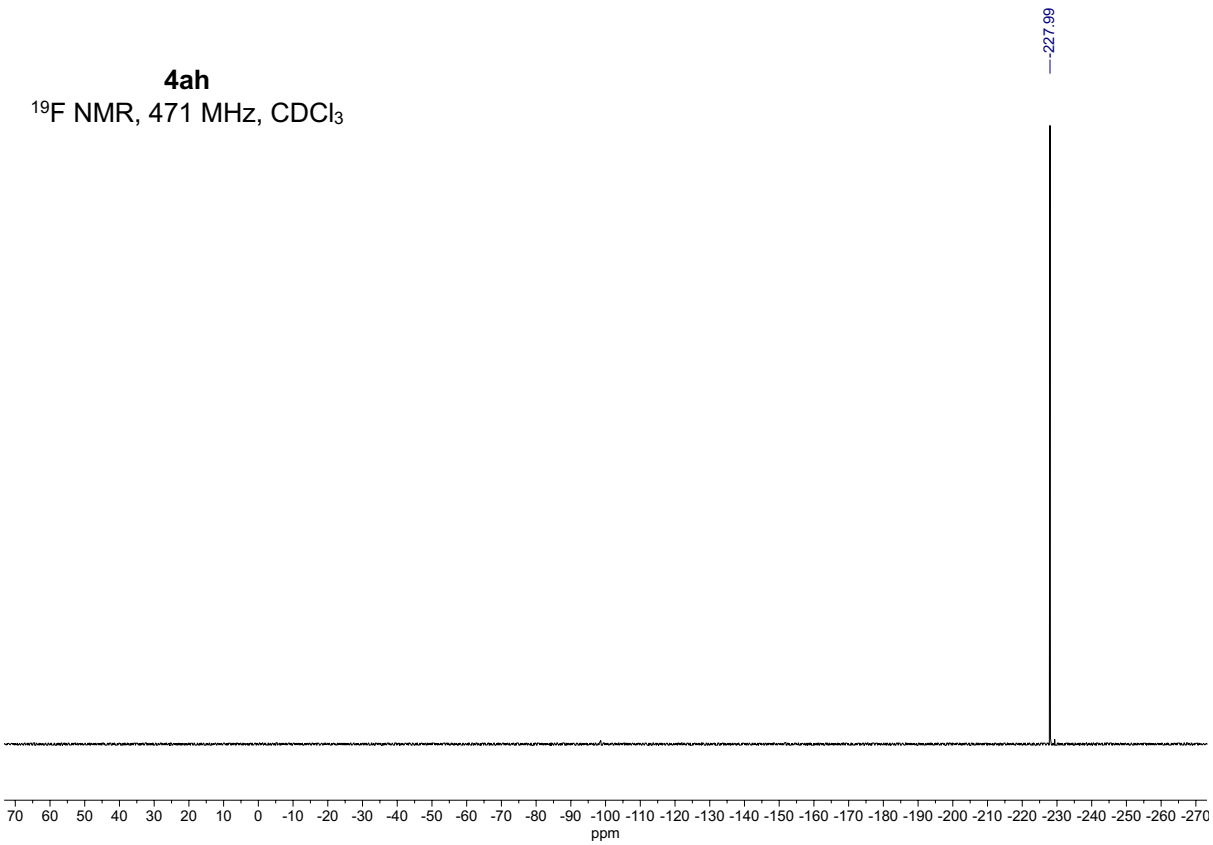
4ah

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

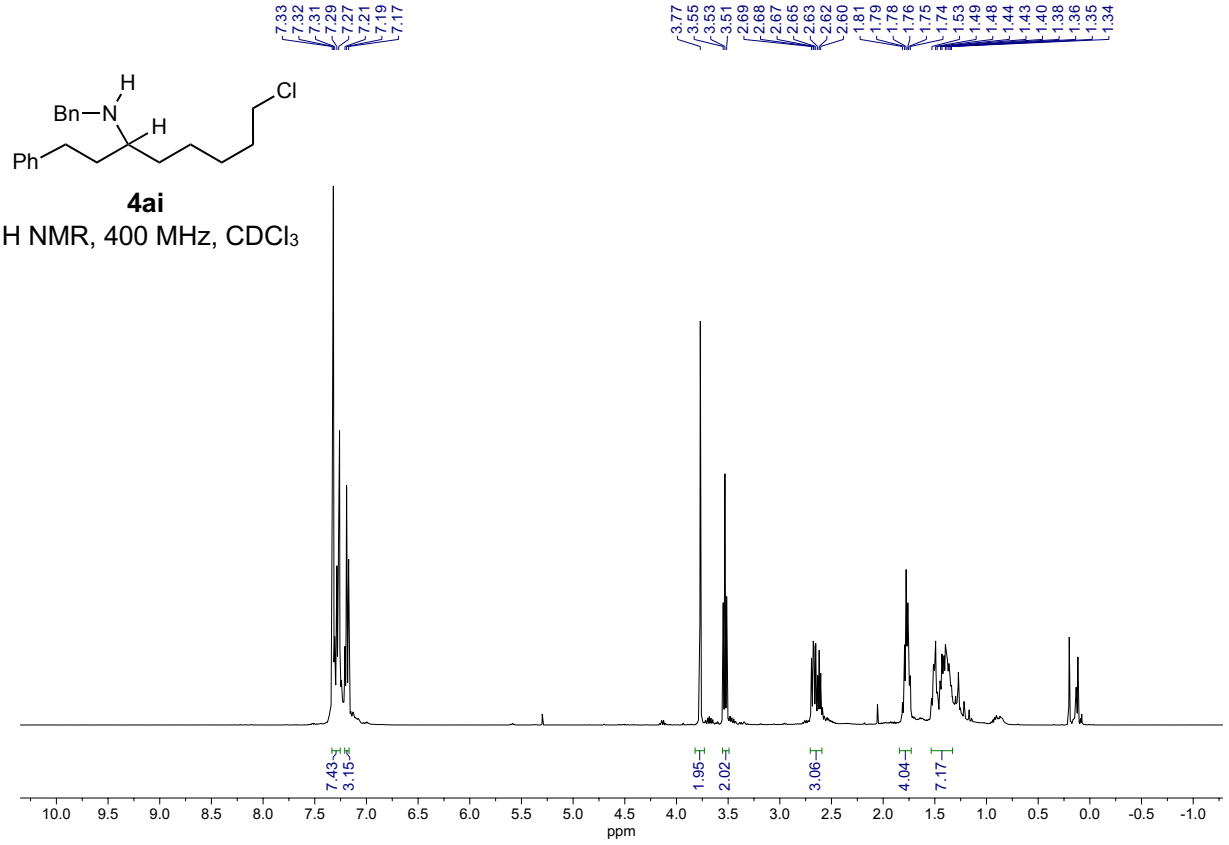


4ah

^{19}F NMR, 471 MHz, $CDCl_3$

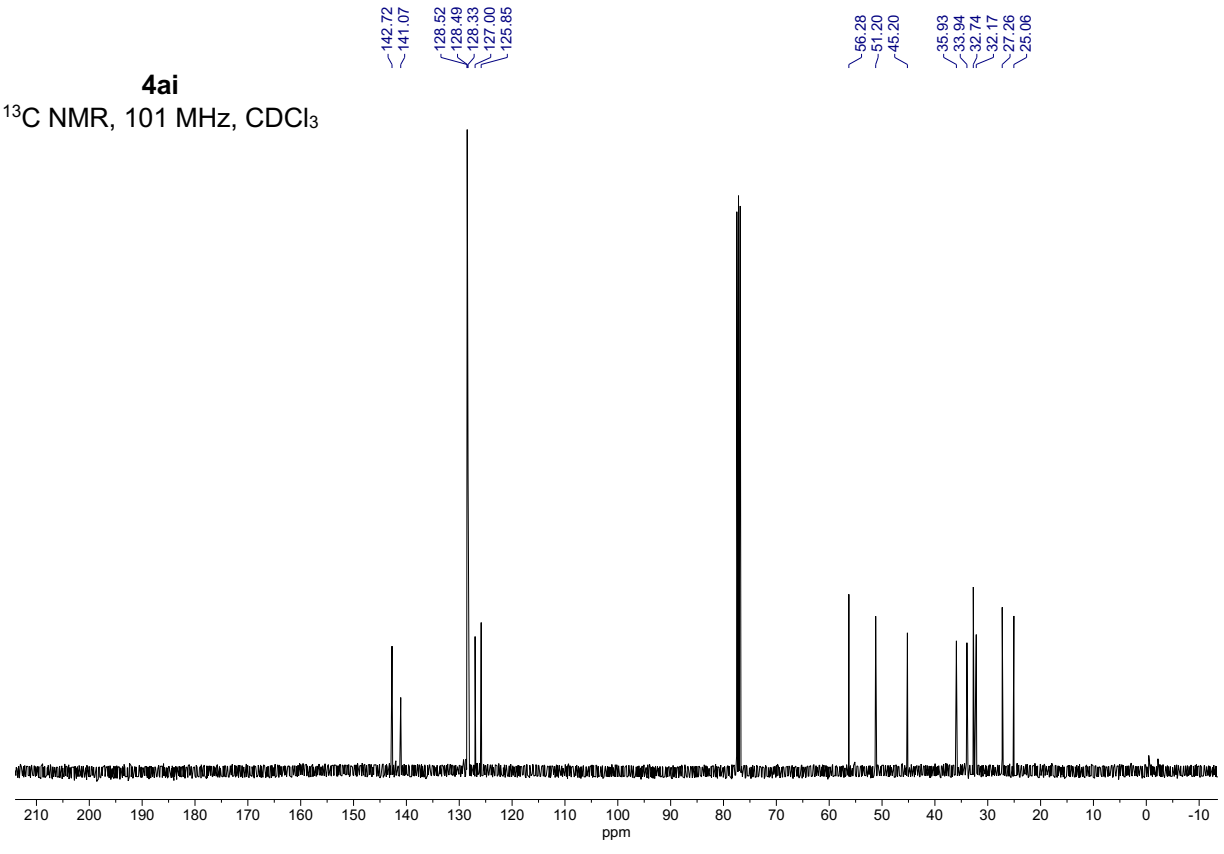


4ai



4ai

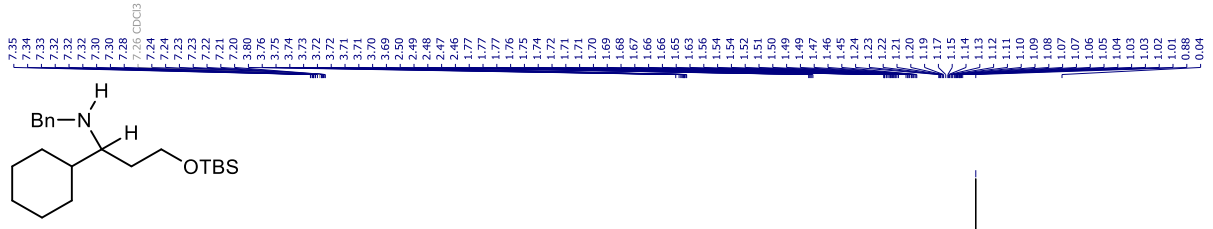
^{1}H NMR, 400 MHz, $CDCl_3$



4ai

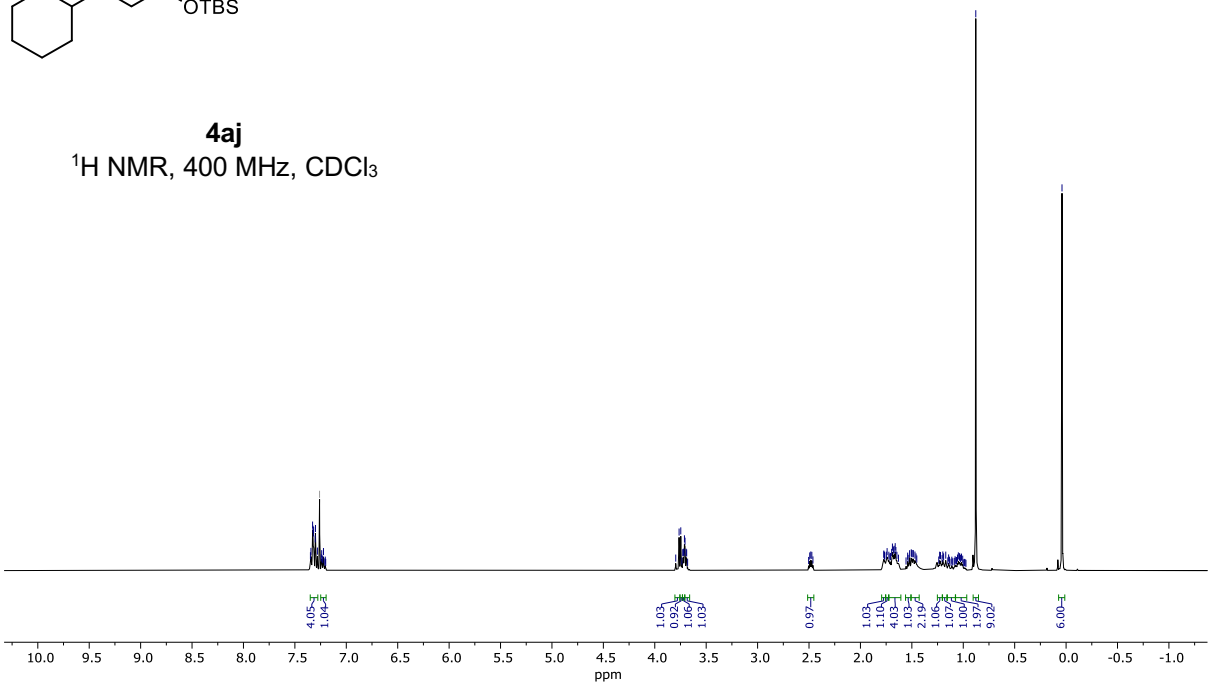
^{13}C NMR, 101 MHz, $CDCl_3$

4aj



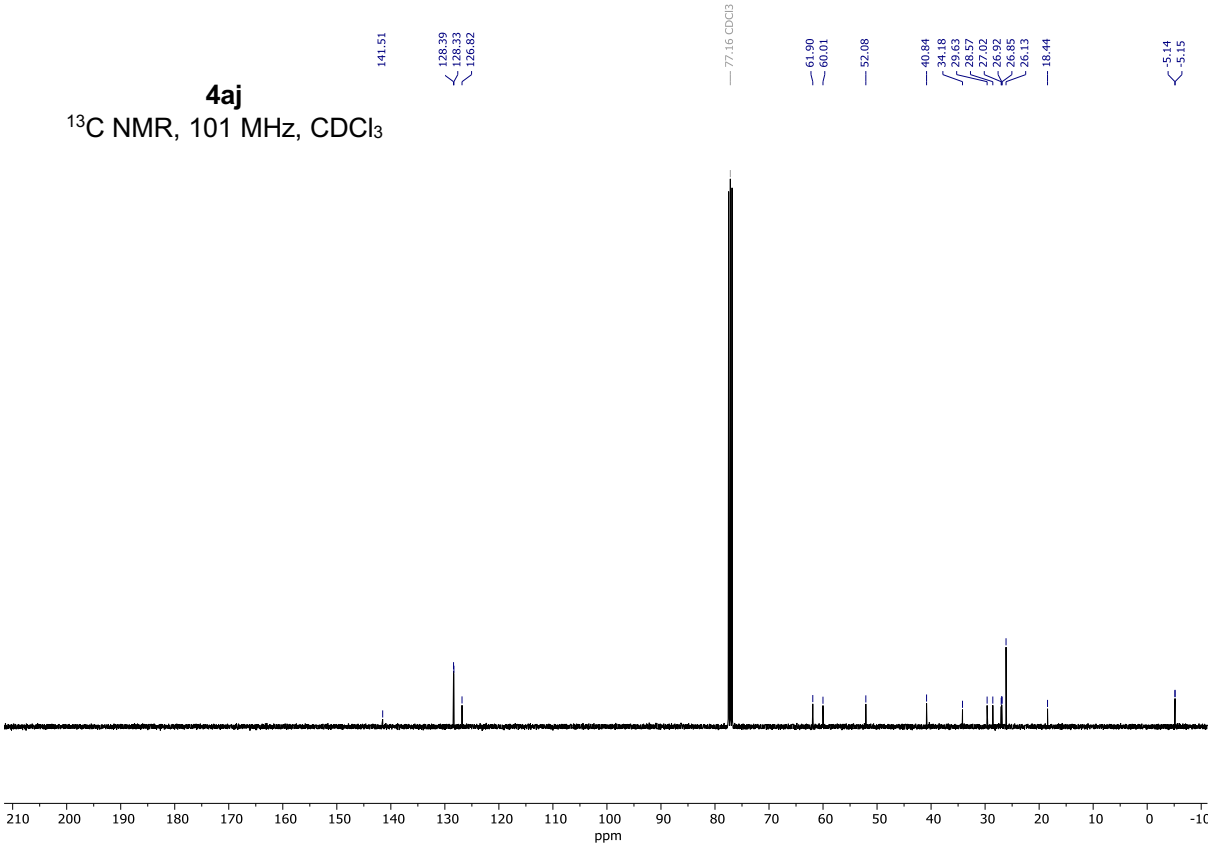
4aj

^{1}H NMR, 400 MHz, $CDCl_3$

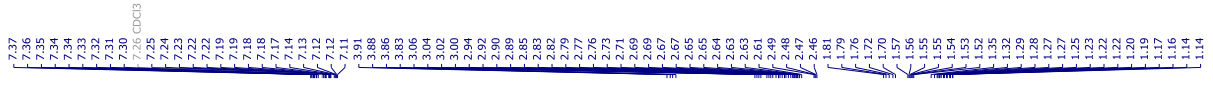


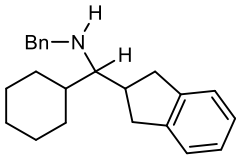
4aj

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



4al



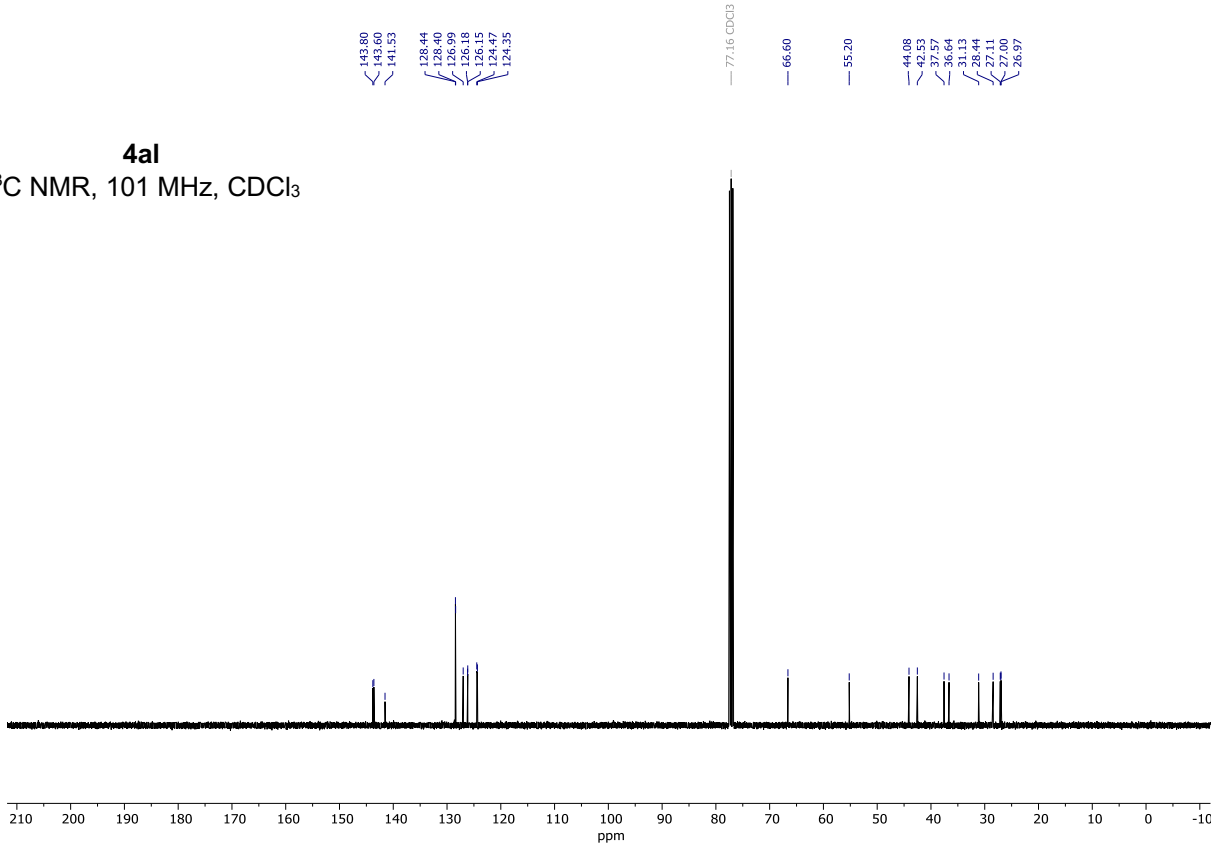


4al

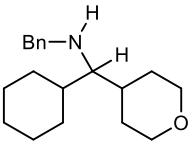
^{1}H NMR, 400 MHz, $CDCl_3$

4al

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



4am

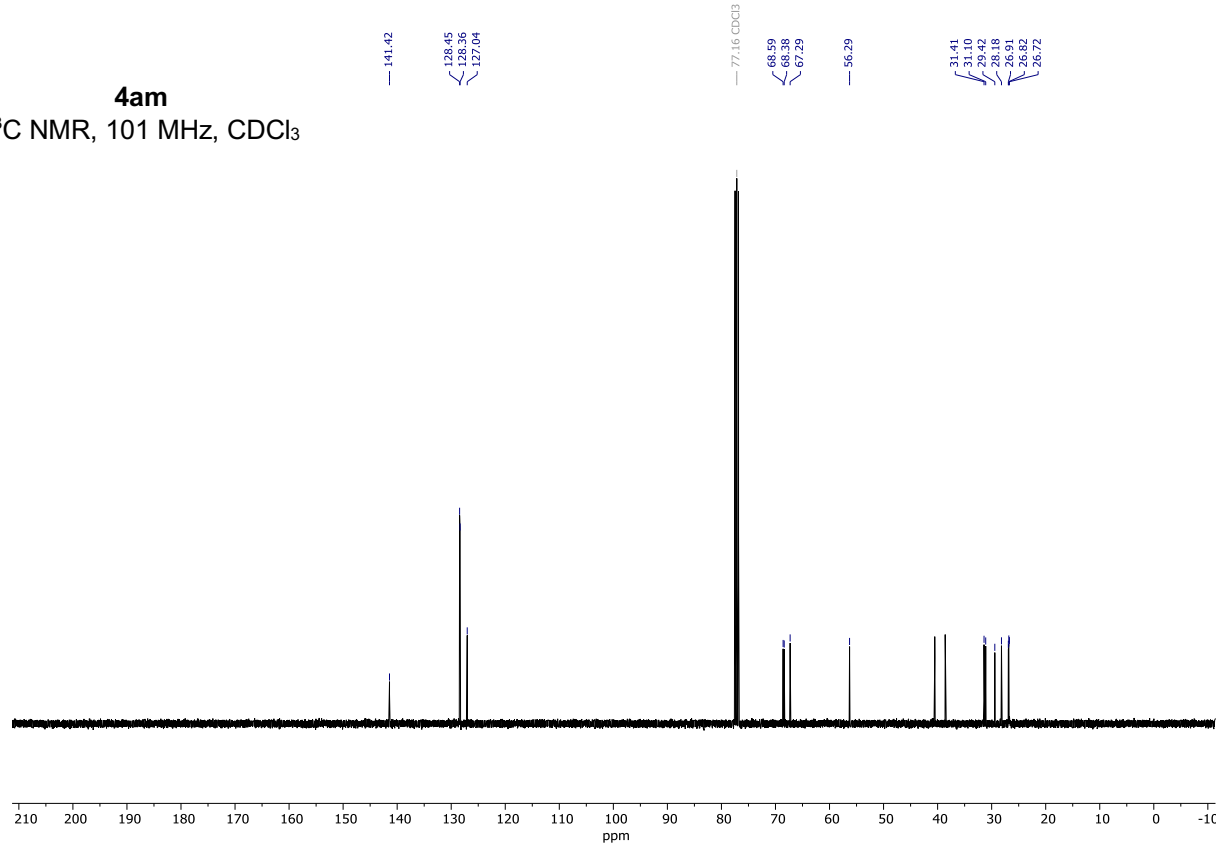


4am

^{1}H NMR, 400 MHz, $CDCl_3$

4am

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



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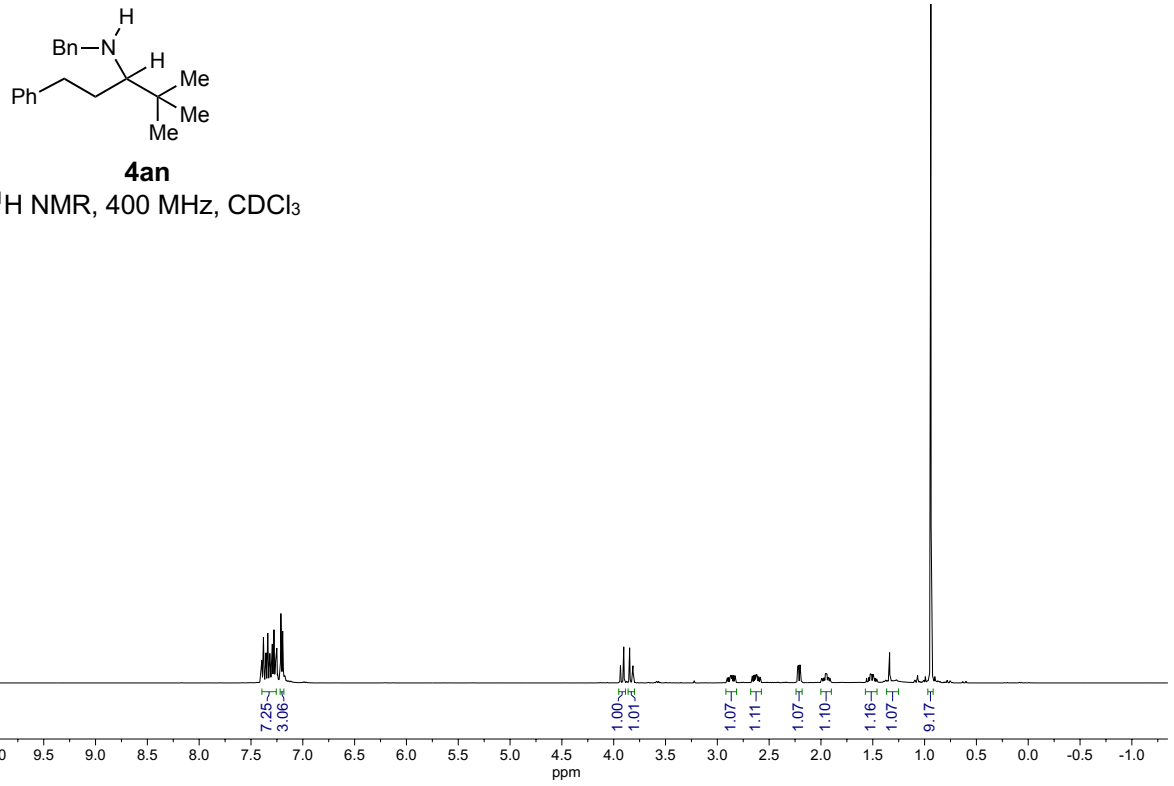
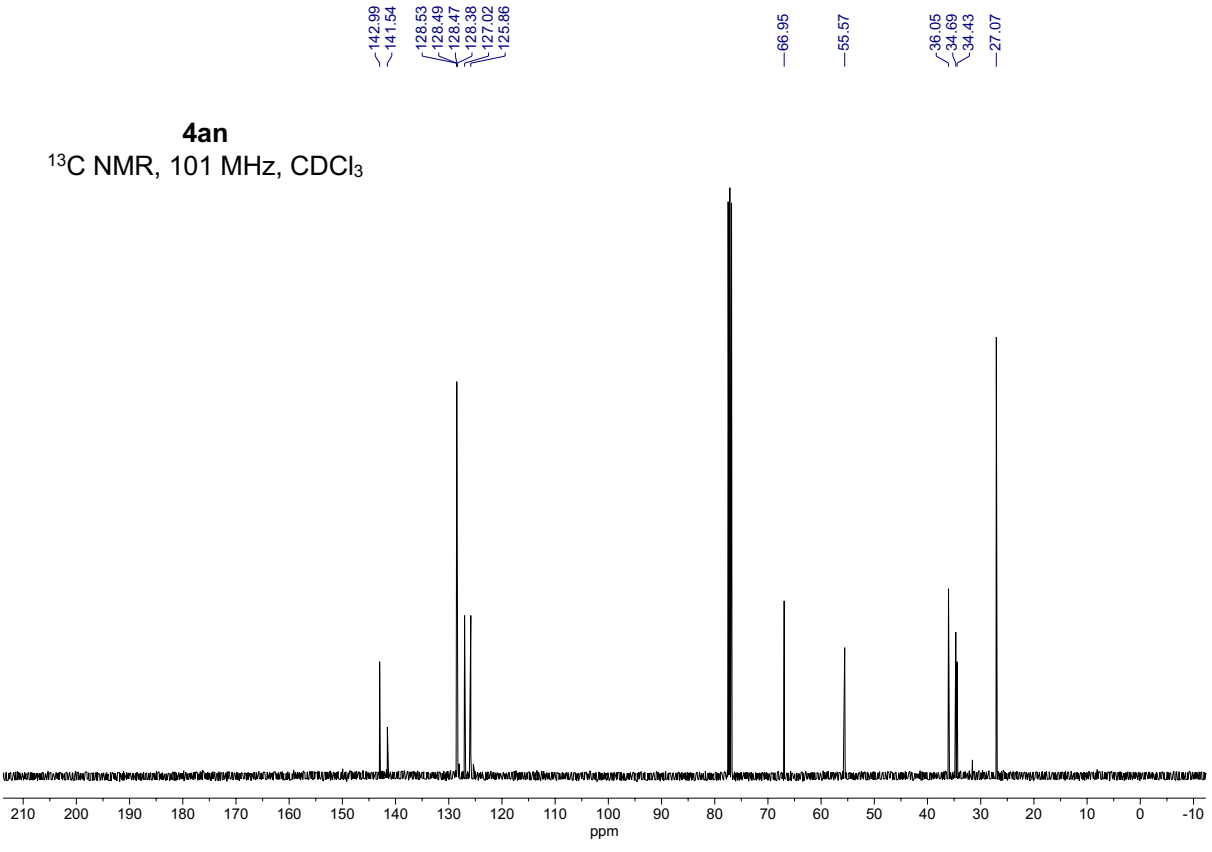


4an

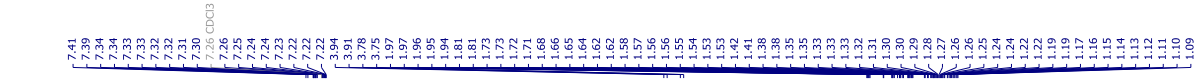
^{1}H NMR, 400 MHz, $CDCl_3$

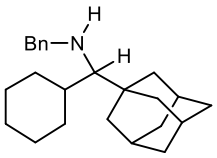


4an

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

4ao



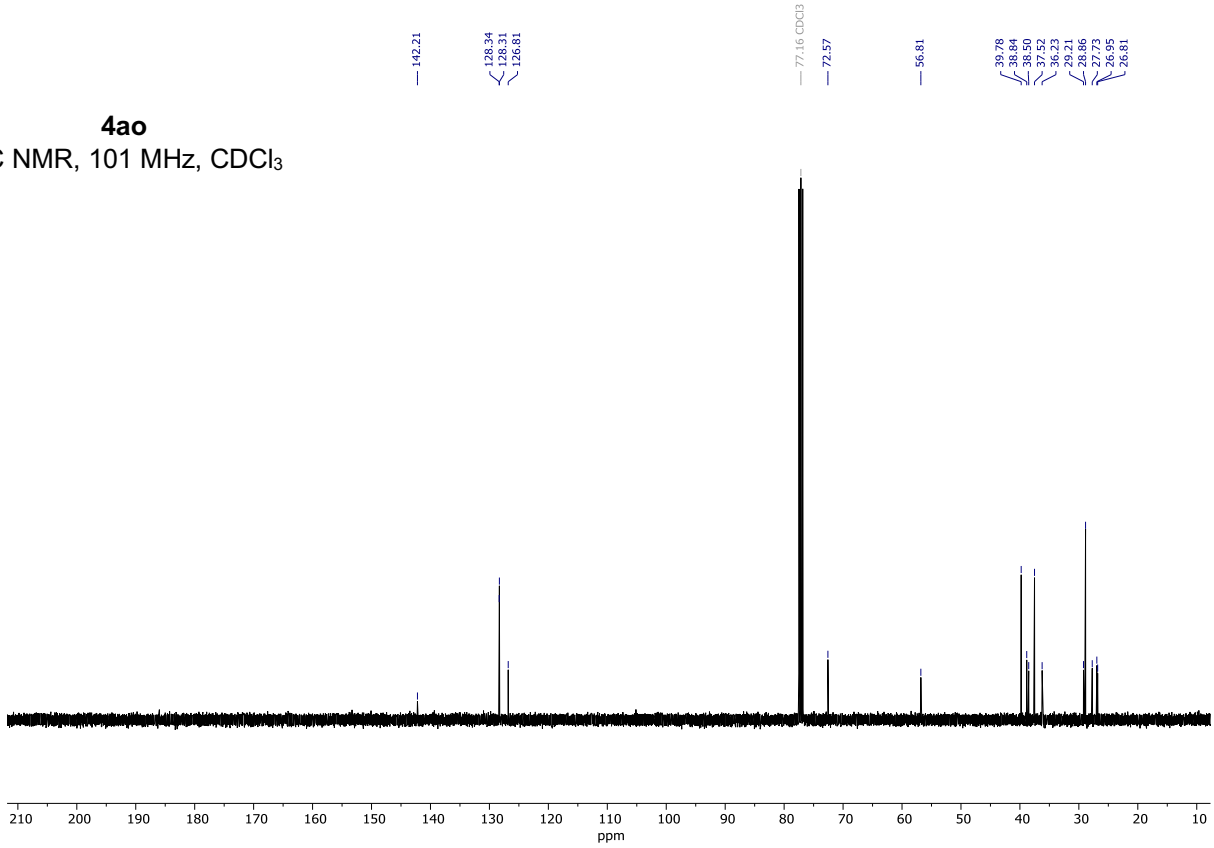


4ao

^{1}H NMR, 400 MHz, $CDCl_3$

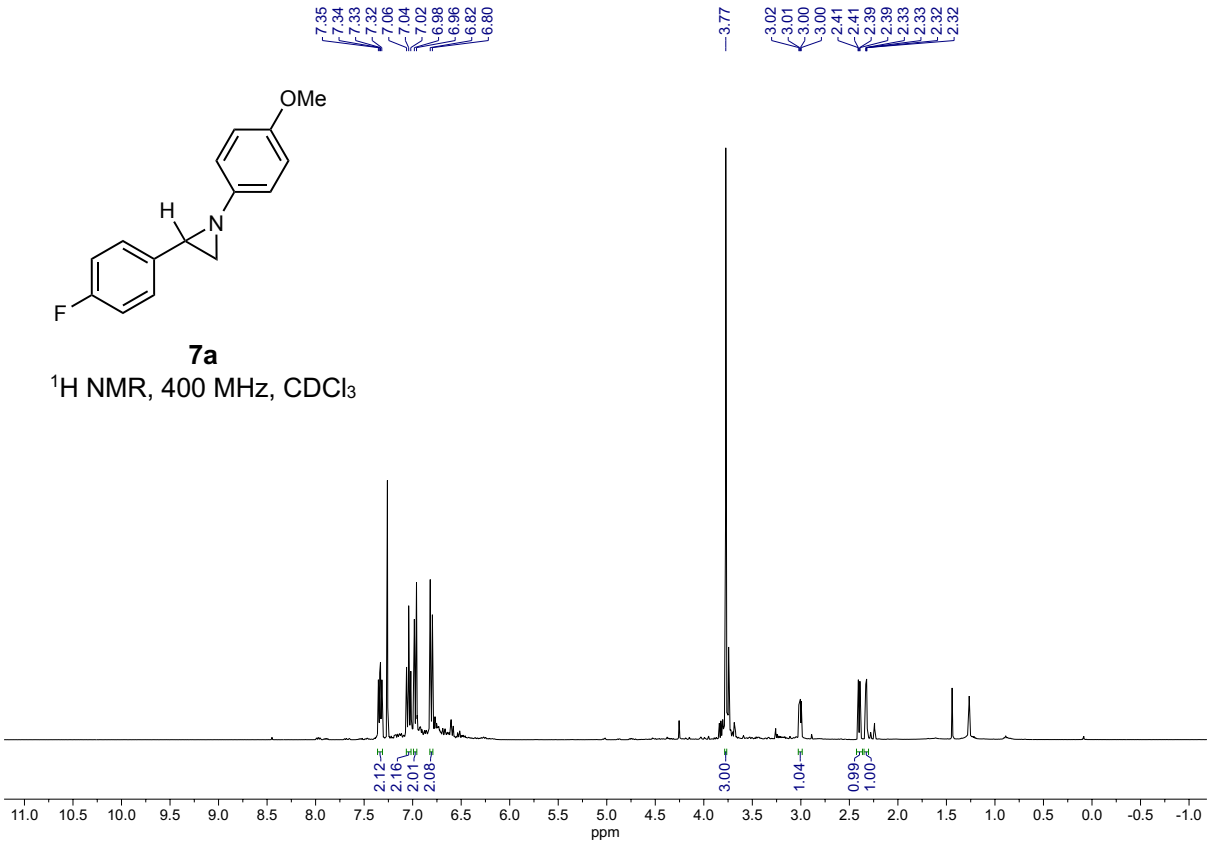
4ao

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



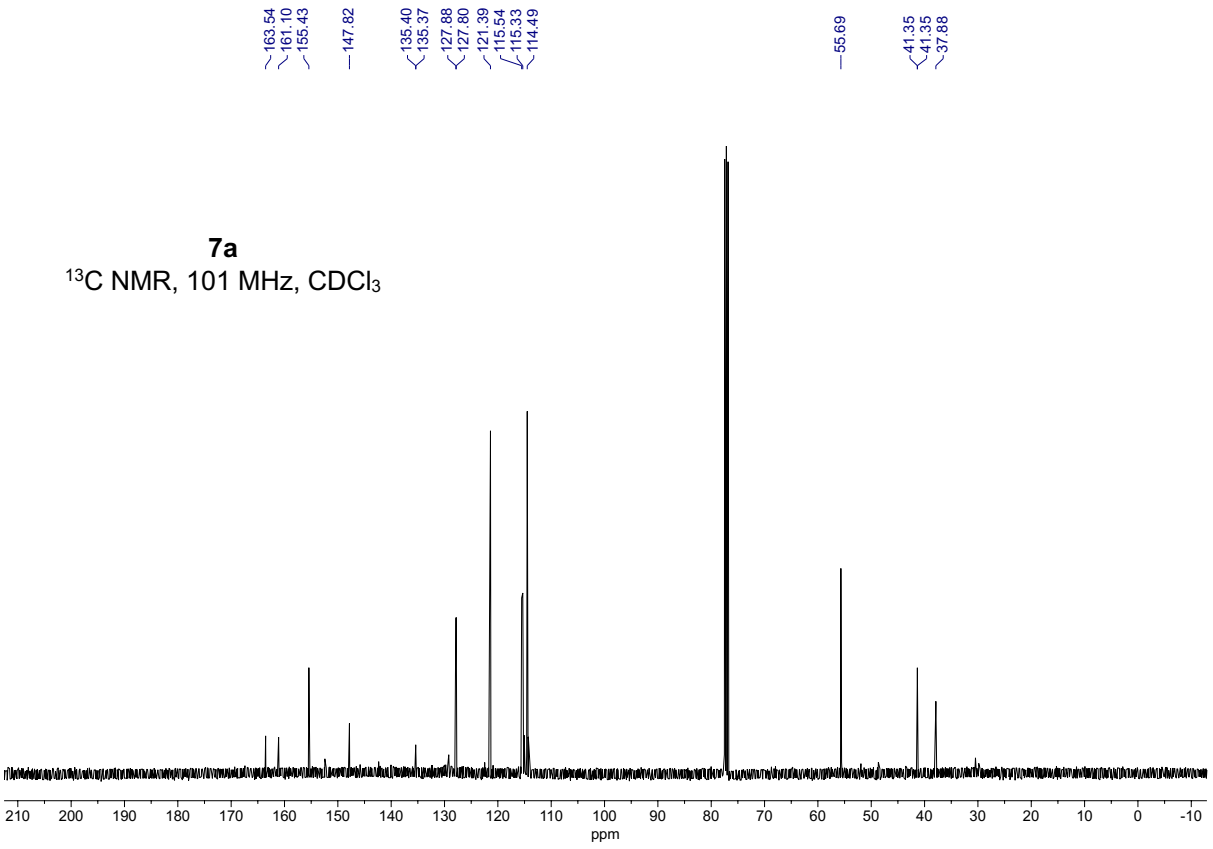
Synthesis of N-heterocycles

7a



7a

^{1}H NMR, 400 MHz, $CDCl_3$

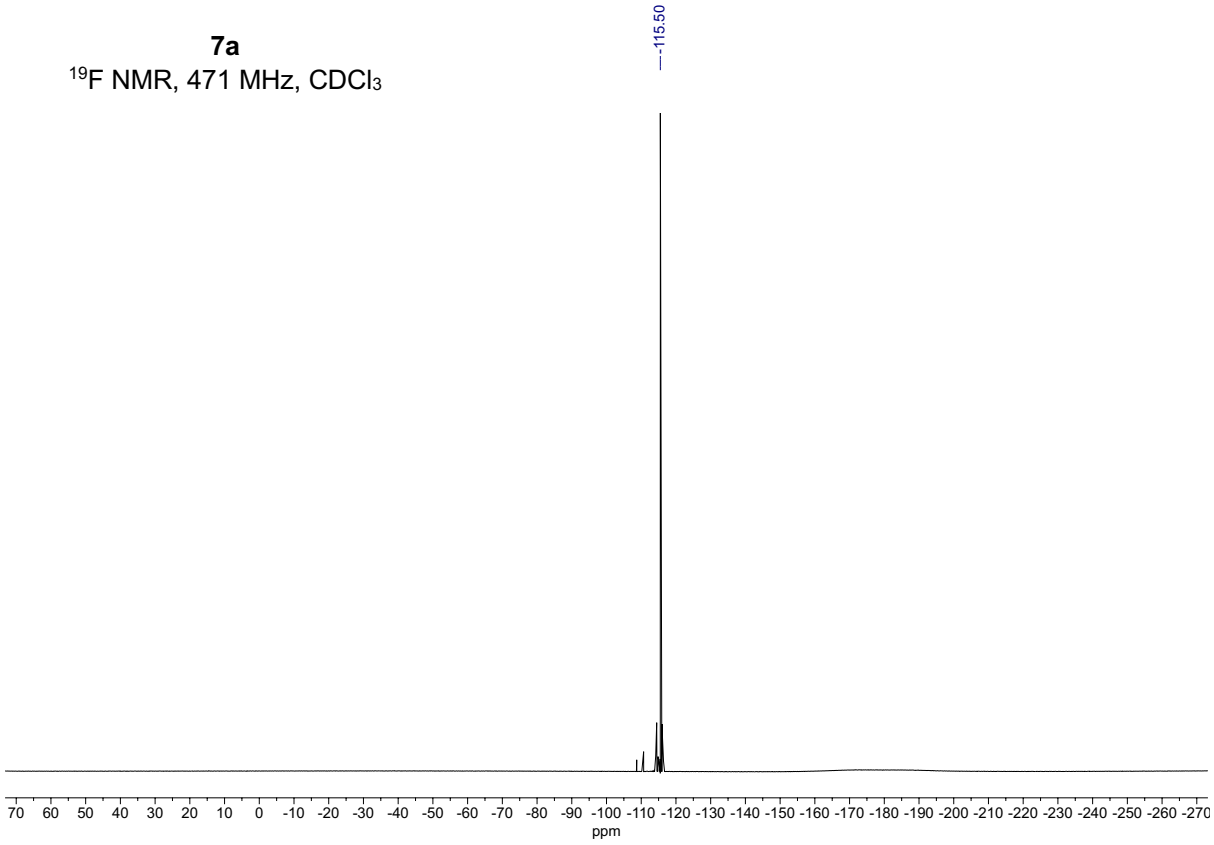


7a

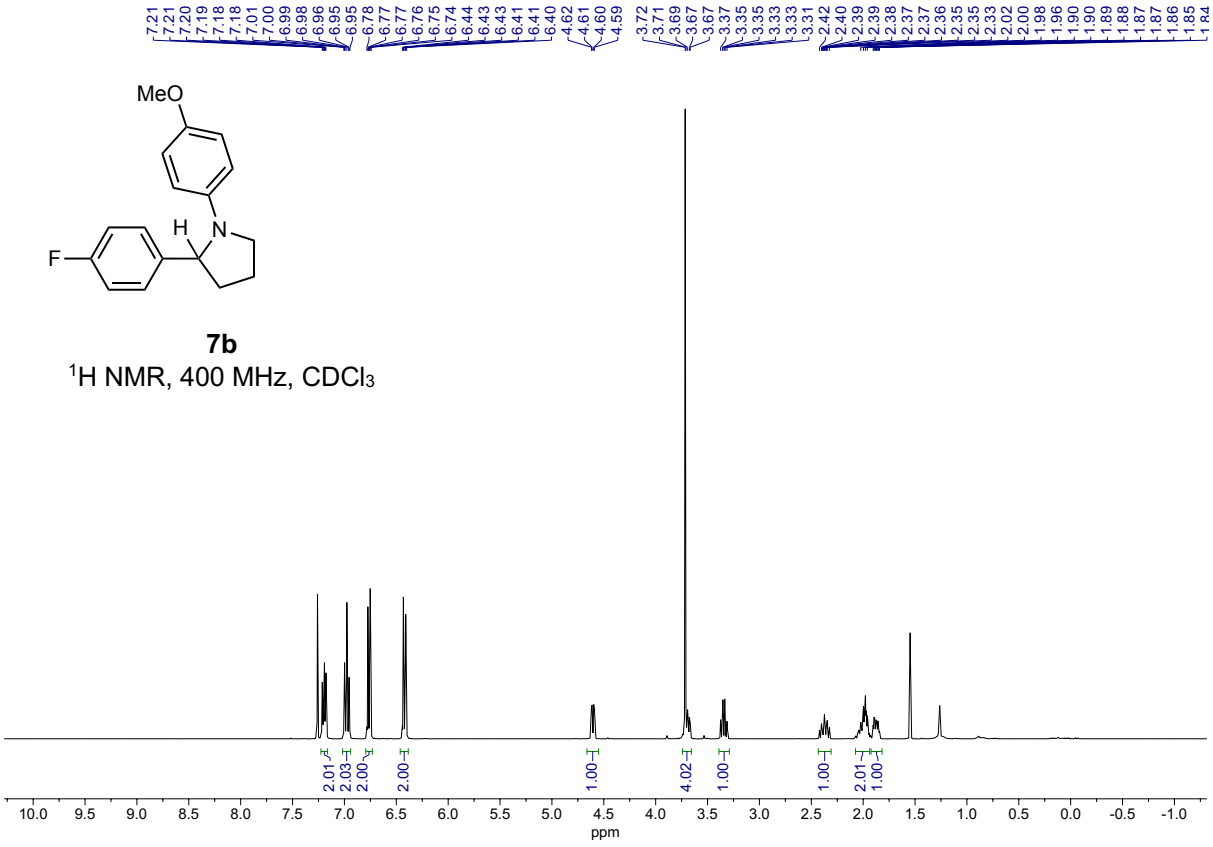
^{13}C NMR, 101 MHz, $CDCl_3$

7a

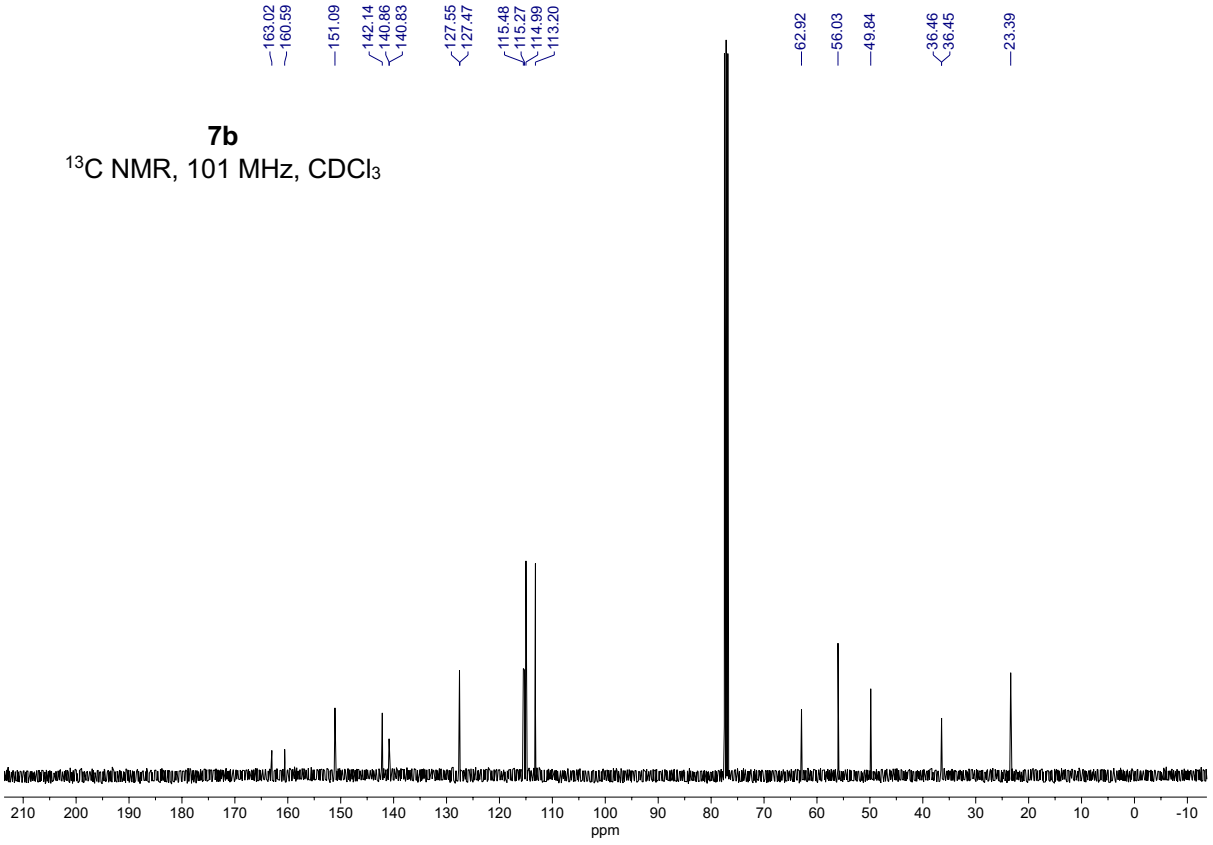
^{19}F NMR, 471 MHz, $CDCl_3$



7b



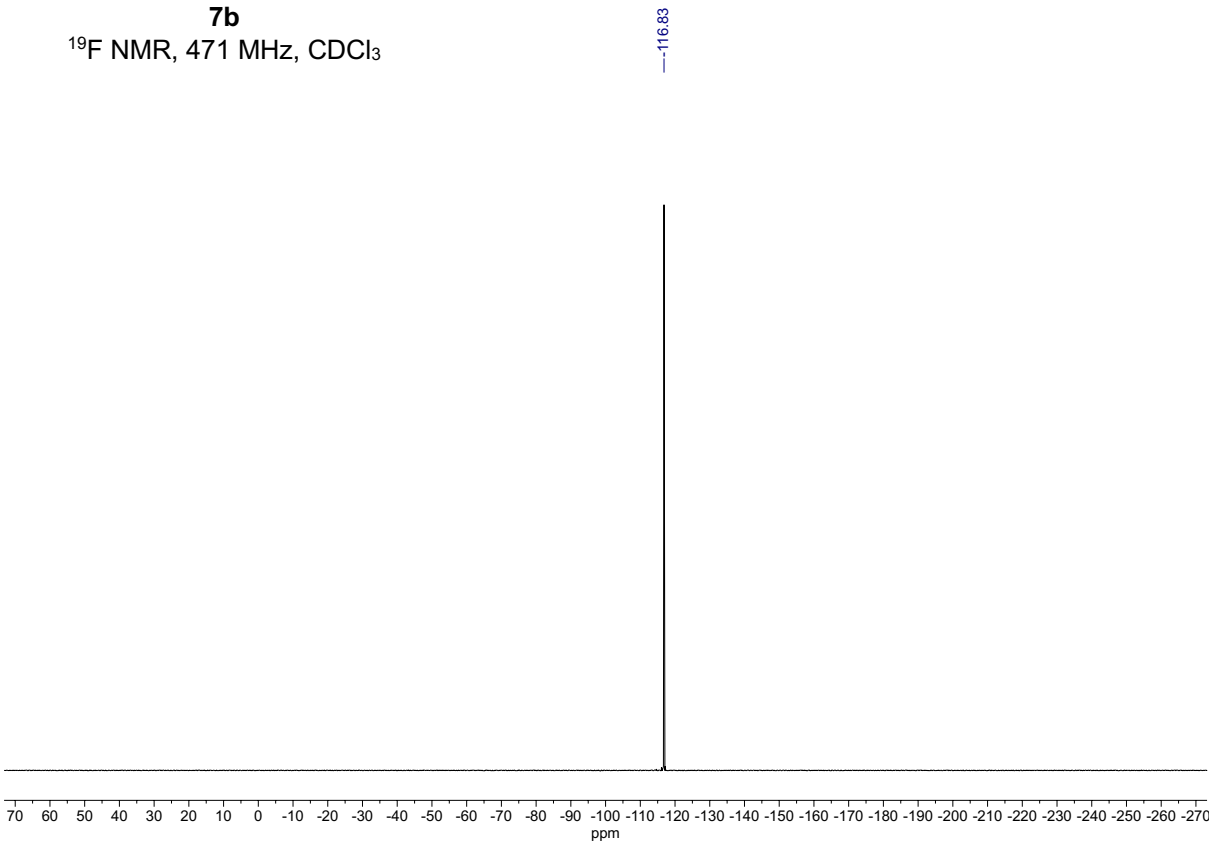
7b
^{1}H NMR, 400 MHz, $CDCl_3$



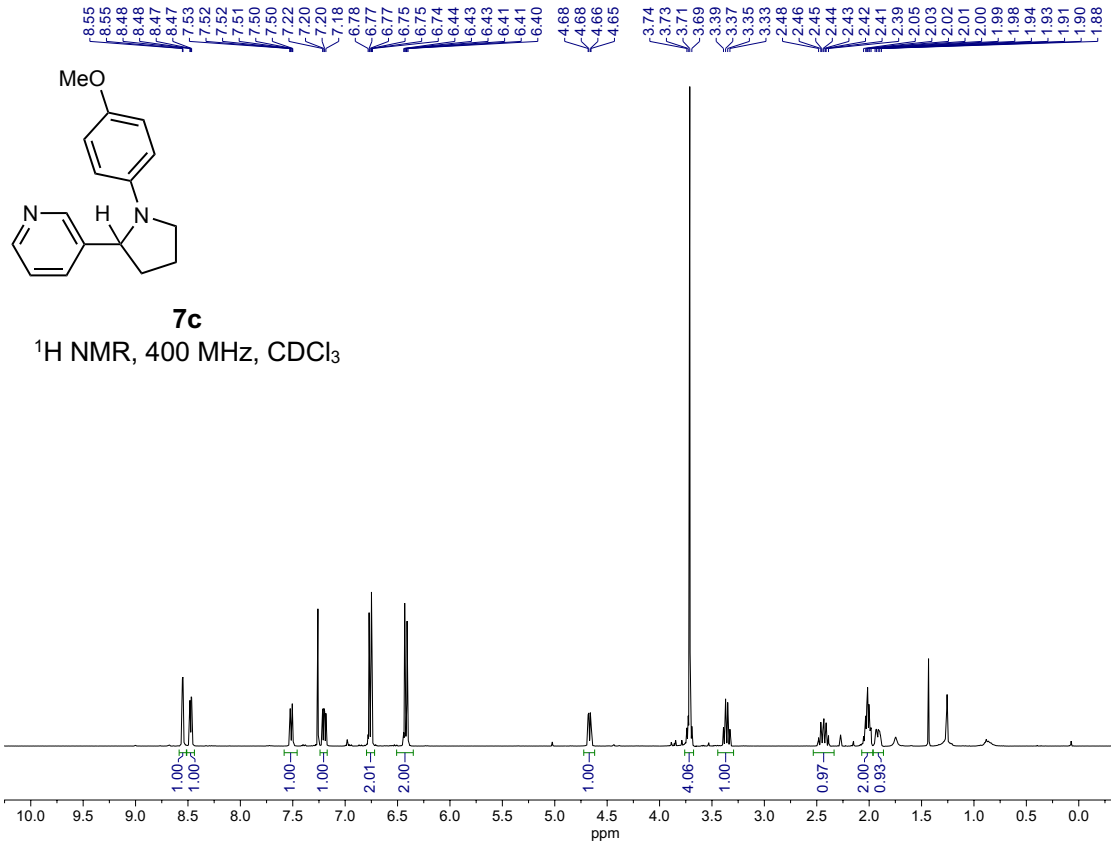
7b
^{13}C NMR, 101 MHz, $CDCl_3$

7b

^{19}F NMR, 471 MHz, $CDCl_3$

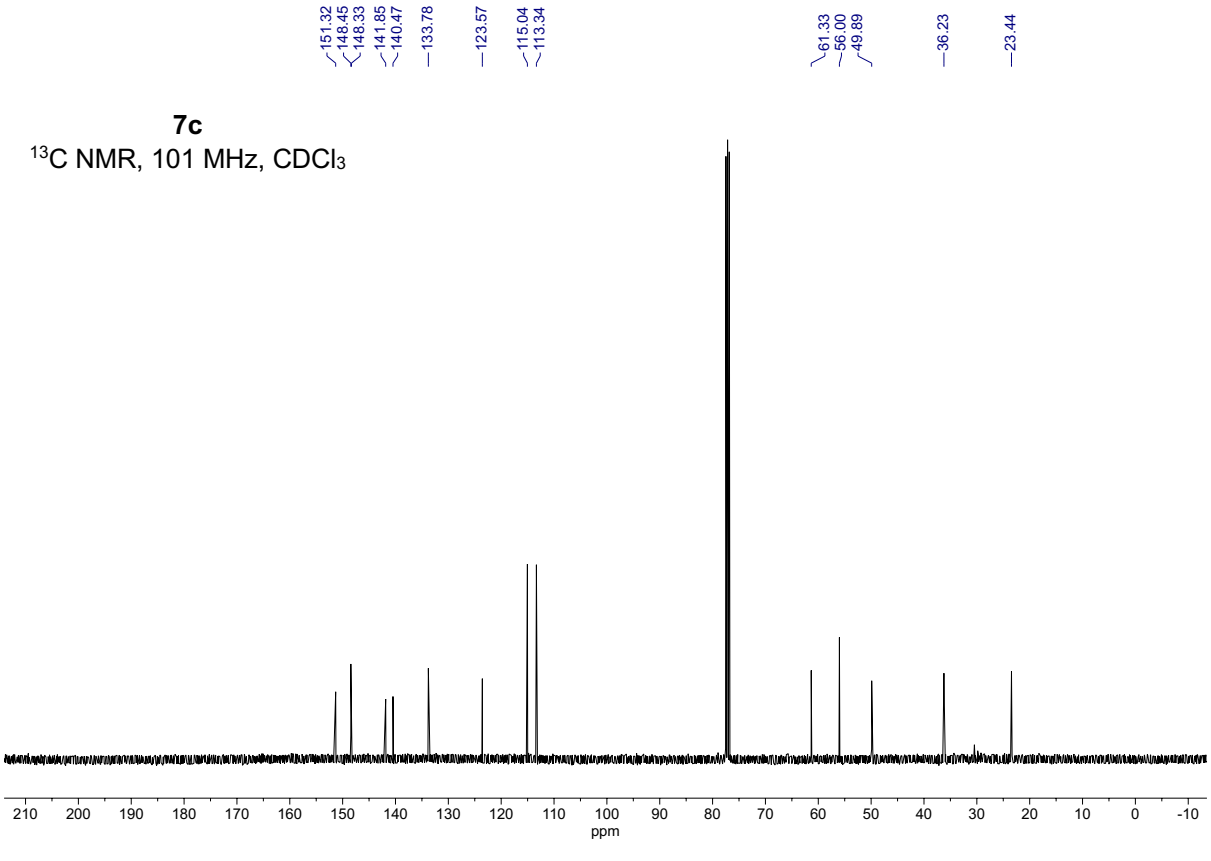


7c



7c

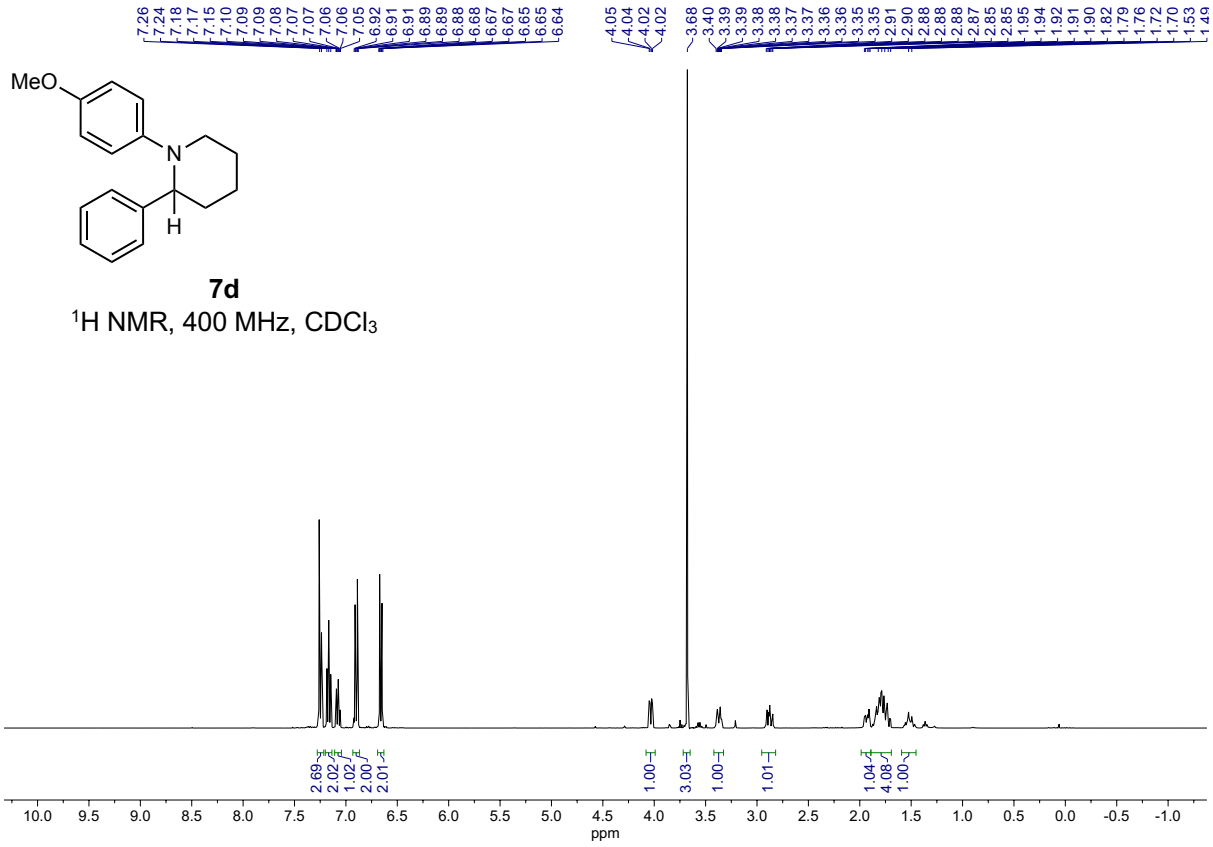
^{1}H NMR, 400 MHz, $CDCl_3$



7c

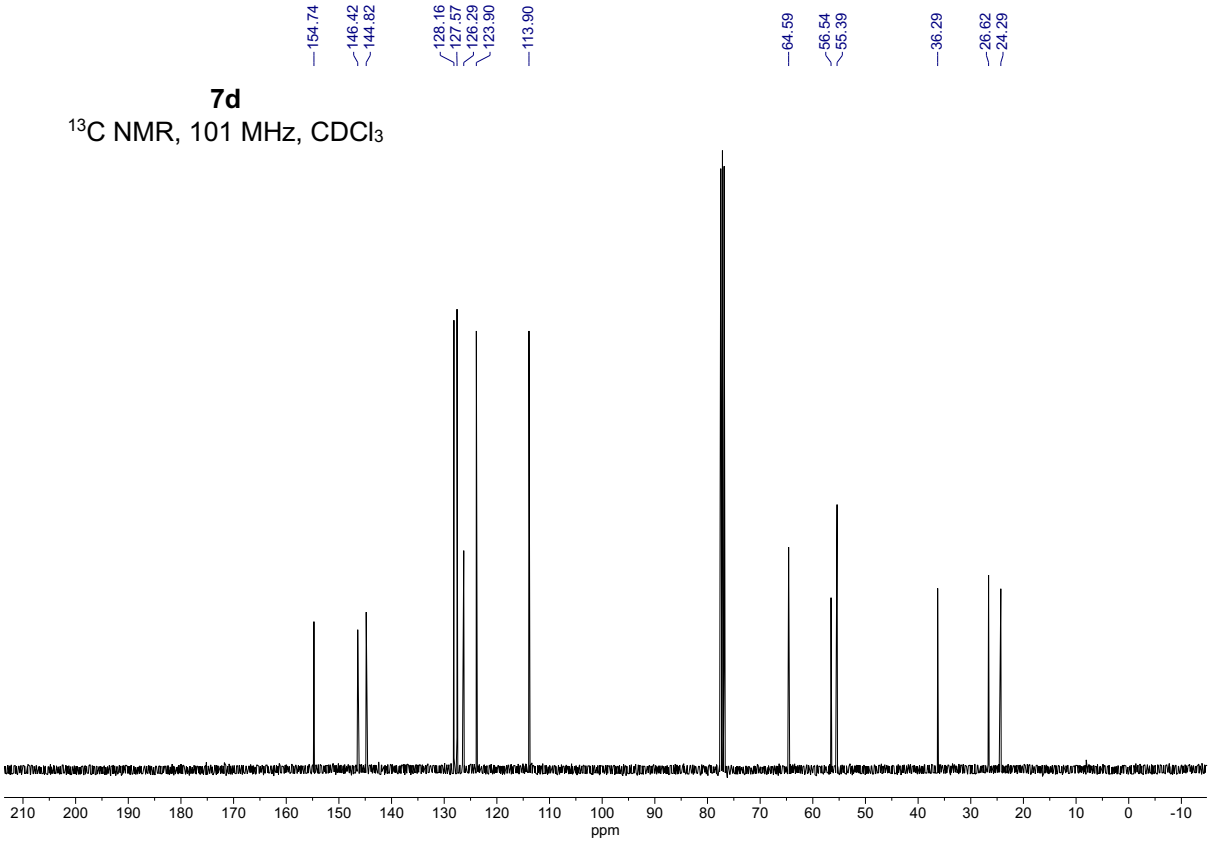
^{13}C NMR, 101 MHz, $CDCl_3$

7d



7d

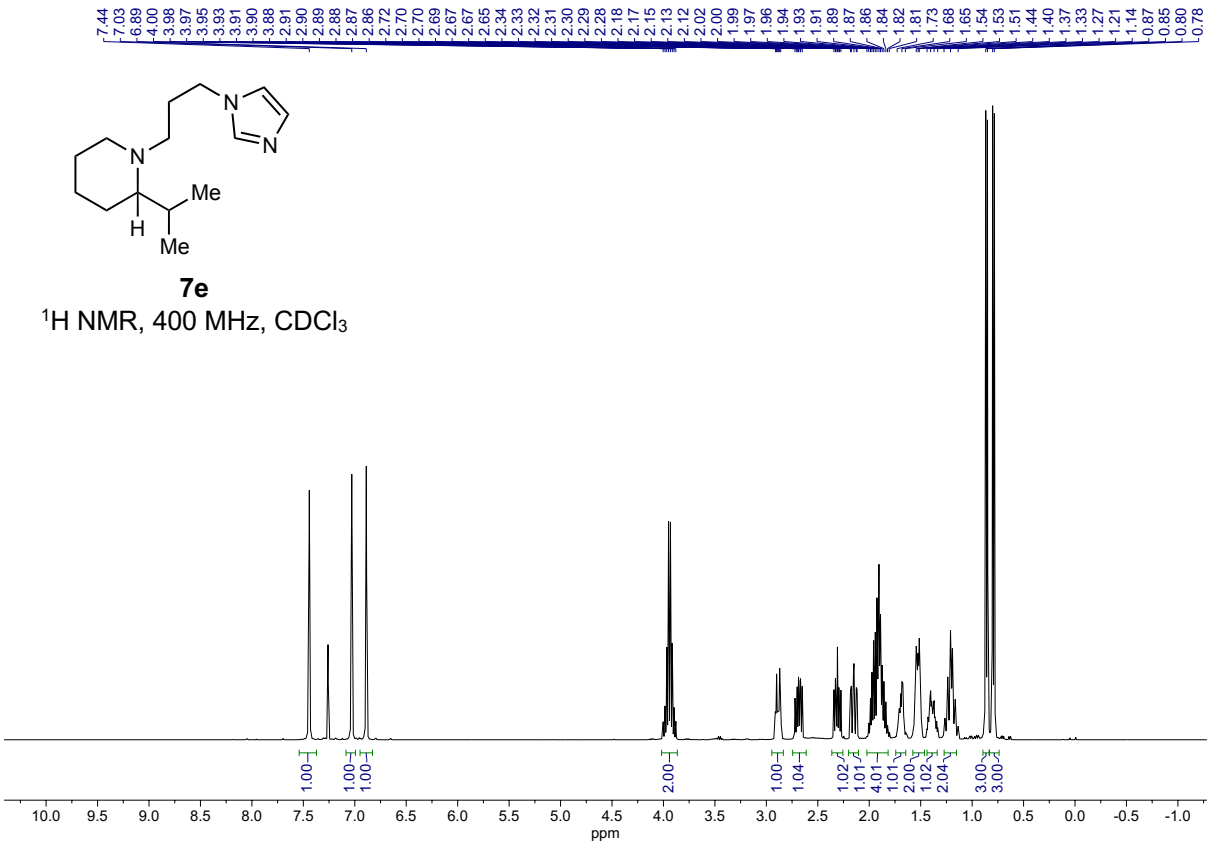
^{1}H NMR, 400 MHz, $CDCl_3$



7d

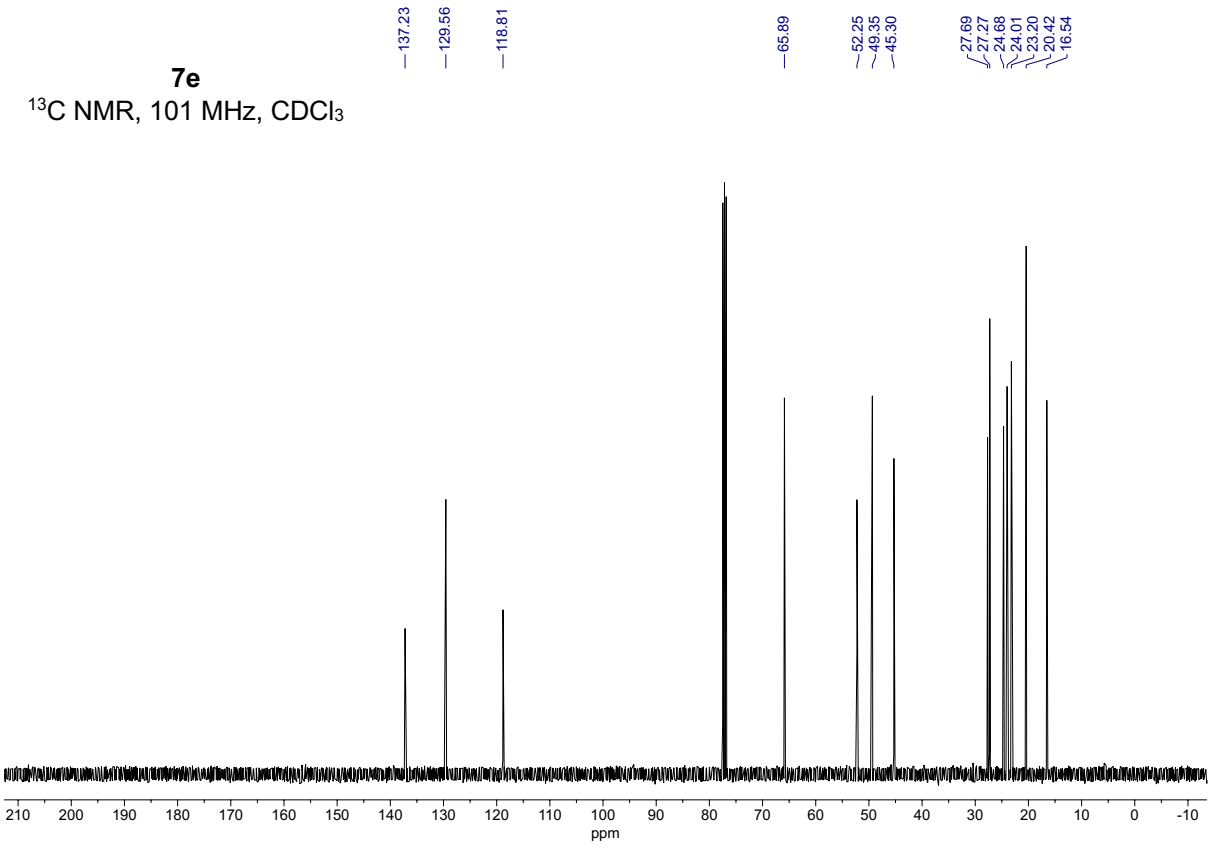
^{13}C NMR, 101 MHz, $CDCl_3$

7e



7e

^{1}H NMR, 400 MHz, $CDCl_3$

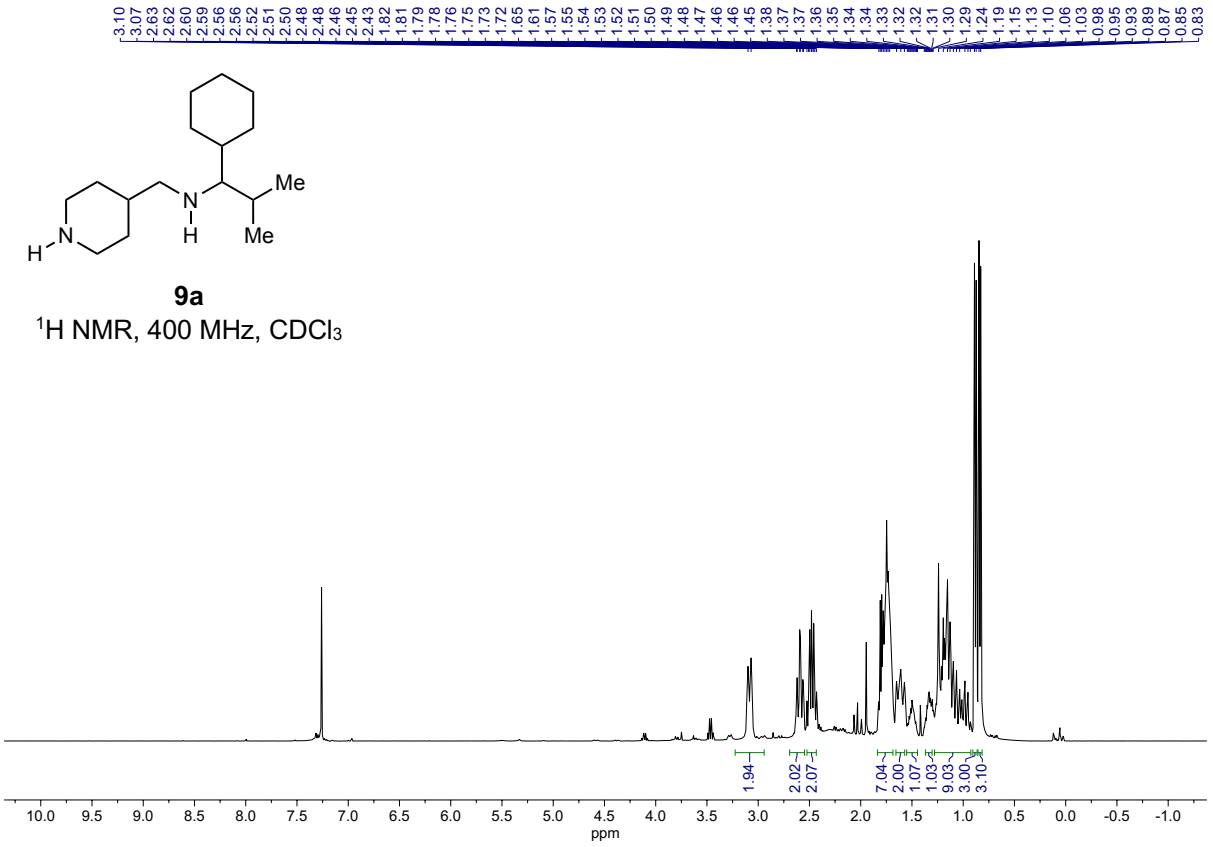


7e

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

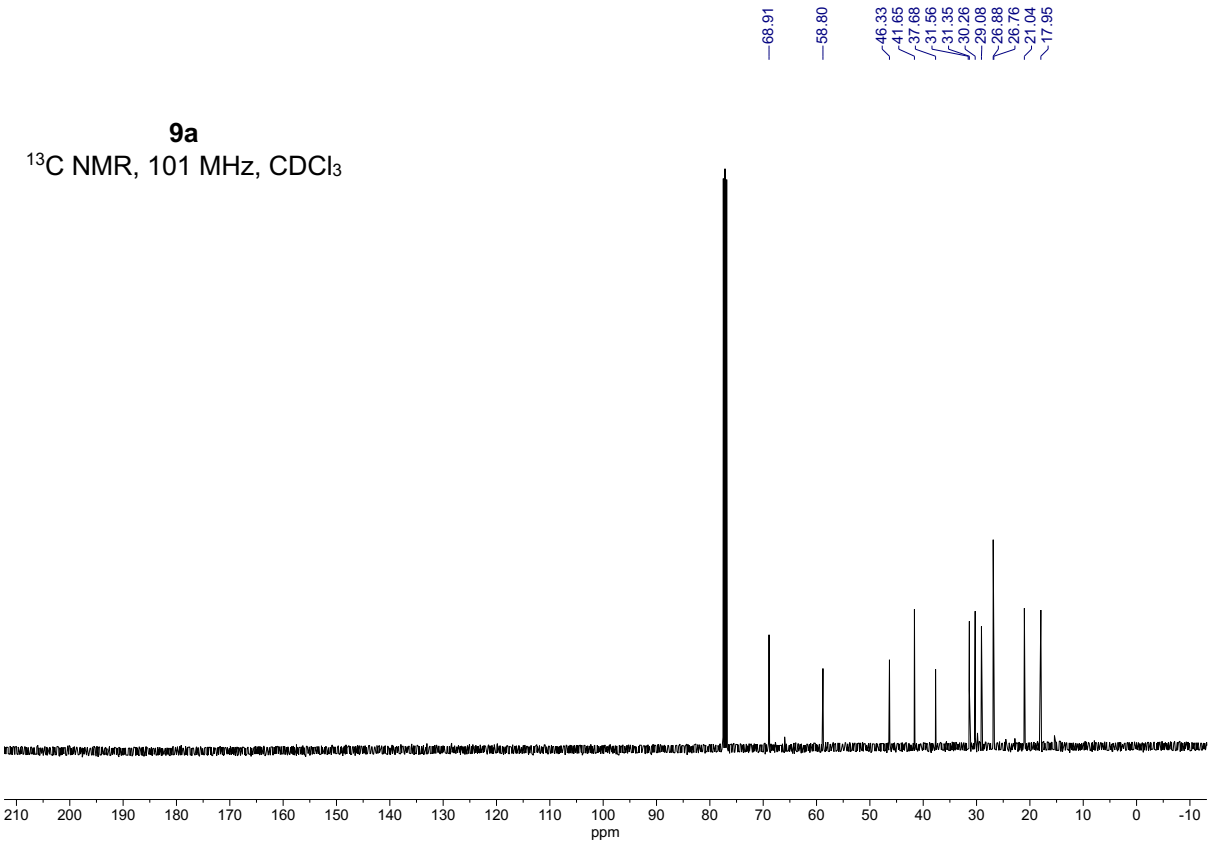
Synthesis of diamines

9a



9a

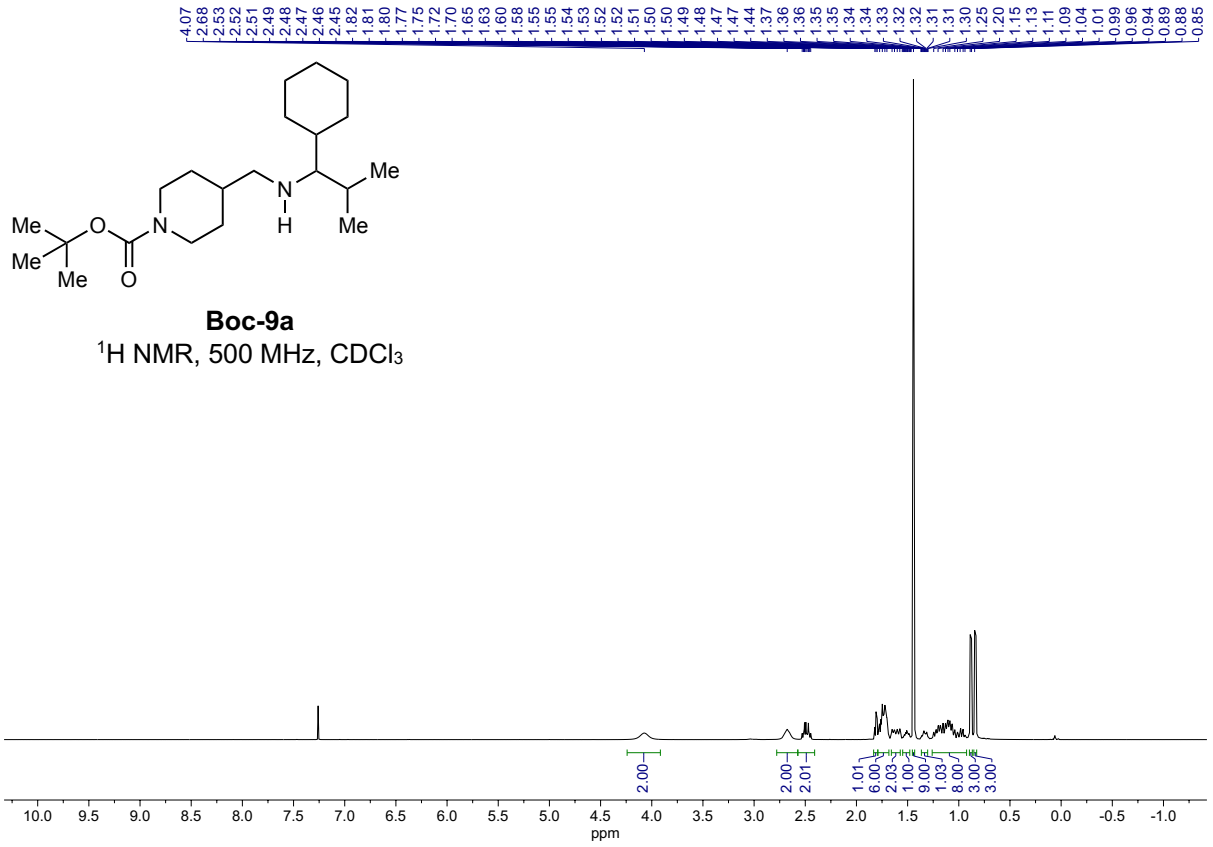
^{1}H NMR, 400 MHz, $CDCl_3$



9a

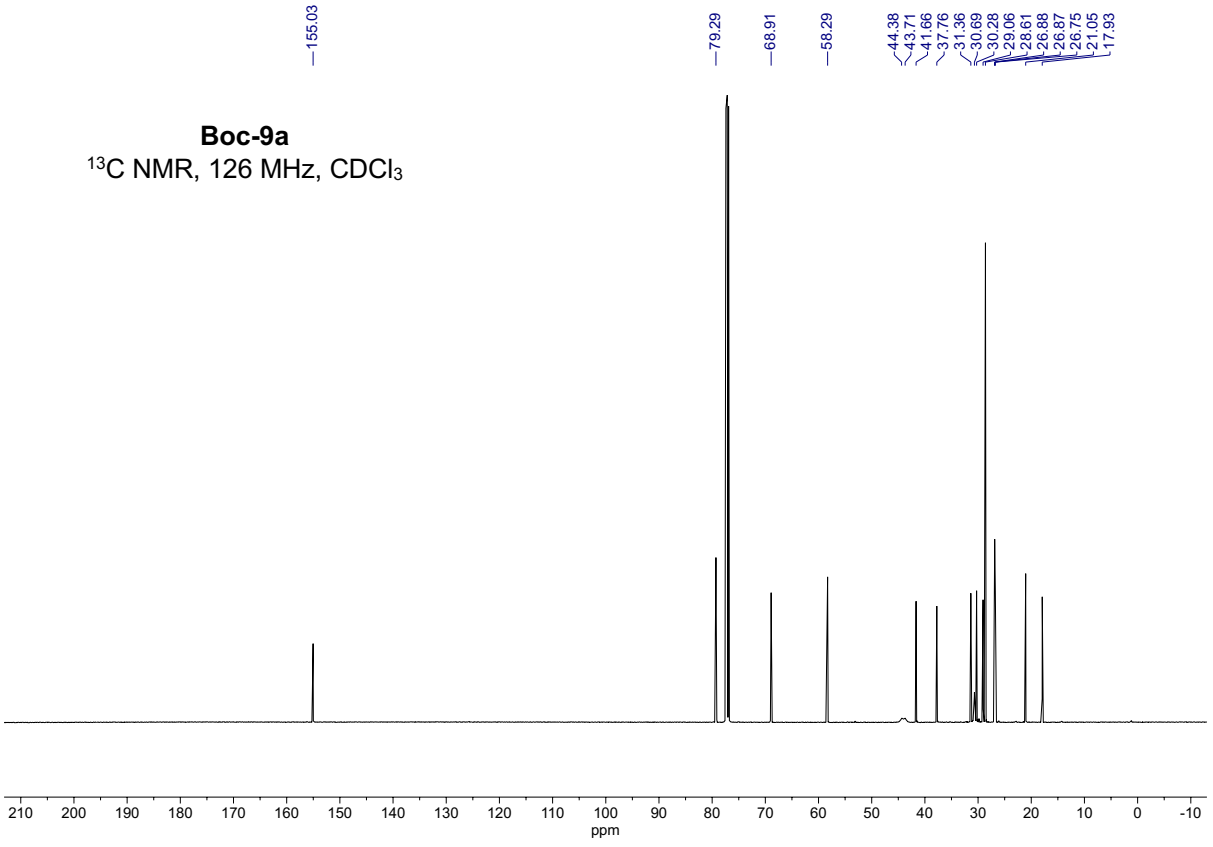
^{13}C NMR, 101 MHz, $CDCl_3$

Boc-9a



Boc-9a

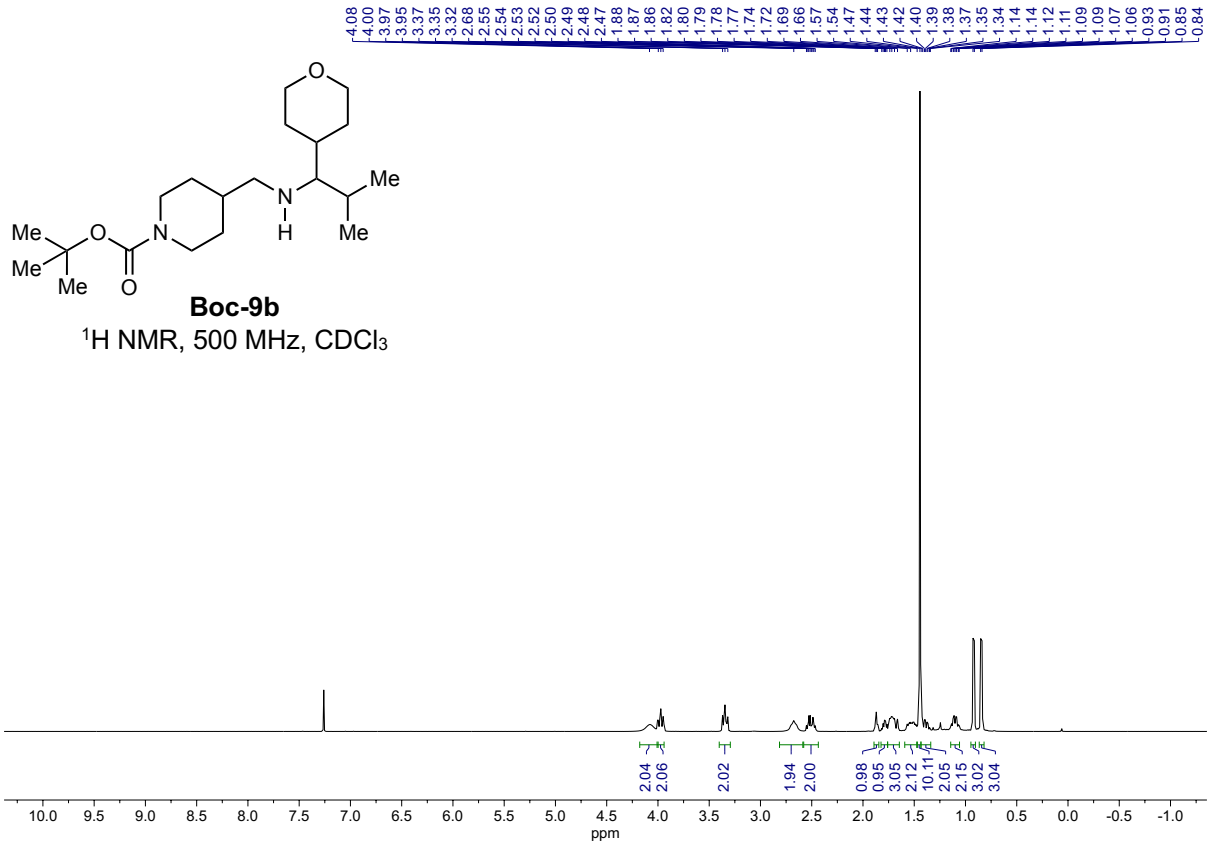
^{1}H NMR, 500 MHz, $CDCl_3$



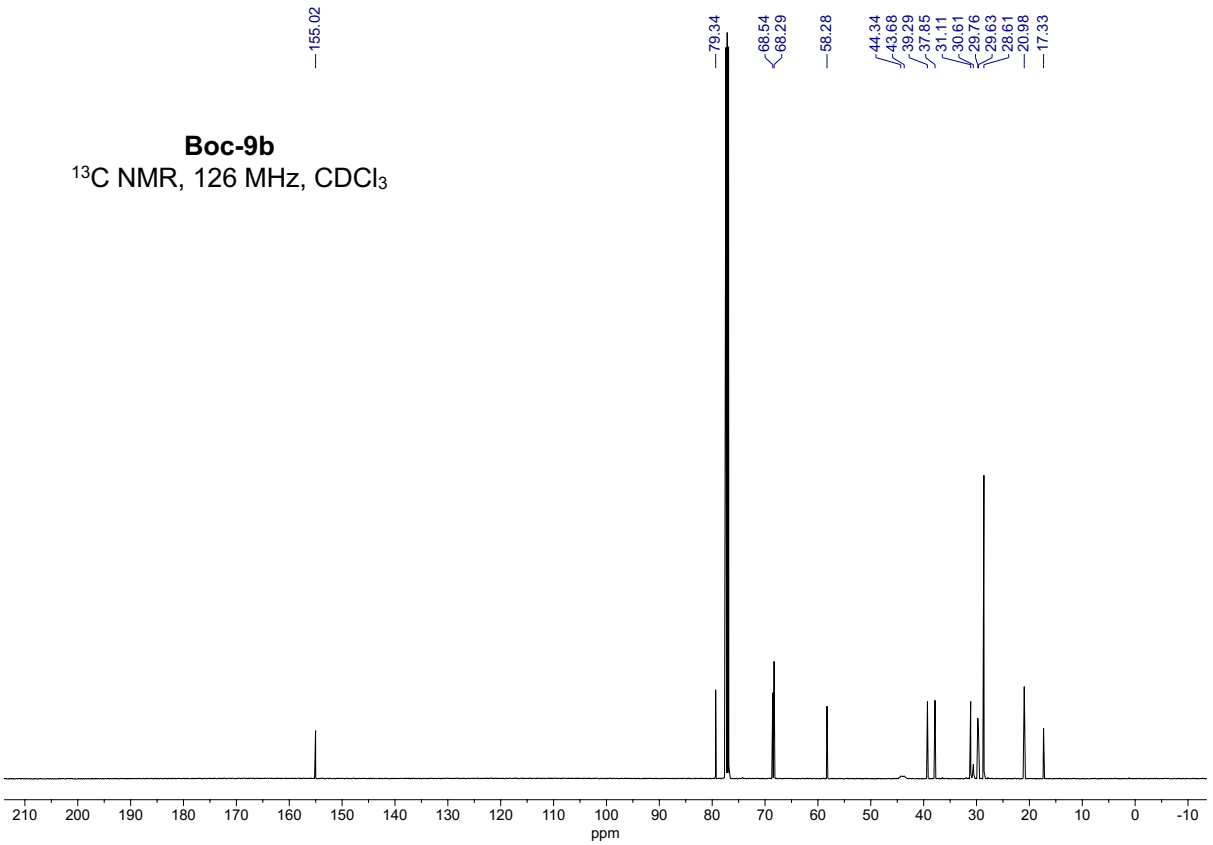
Boc-9a

^{13}C NMR, 126 MHz, $CDCl_3$

Boc-9b

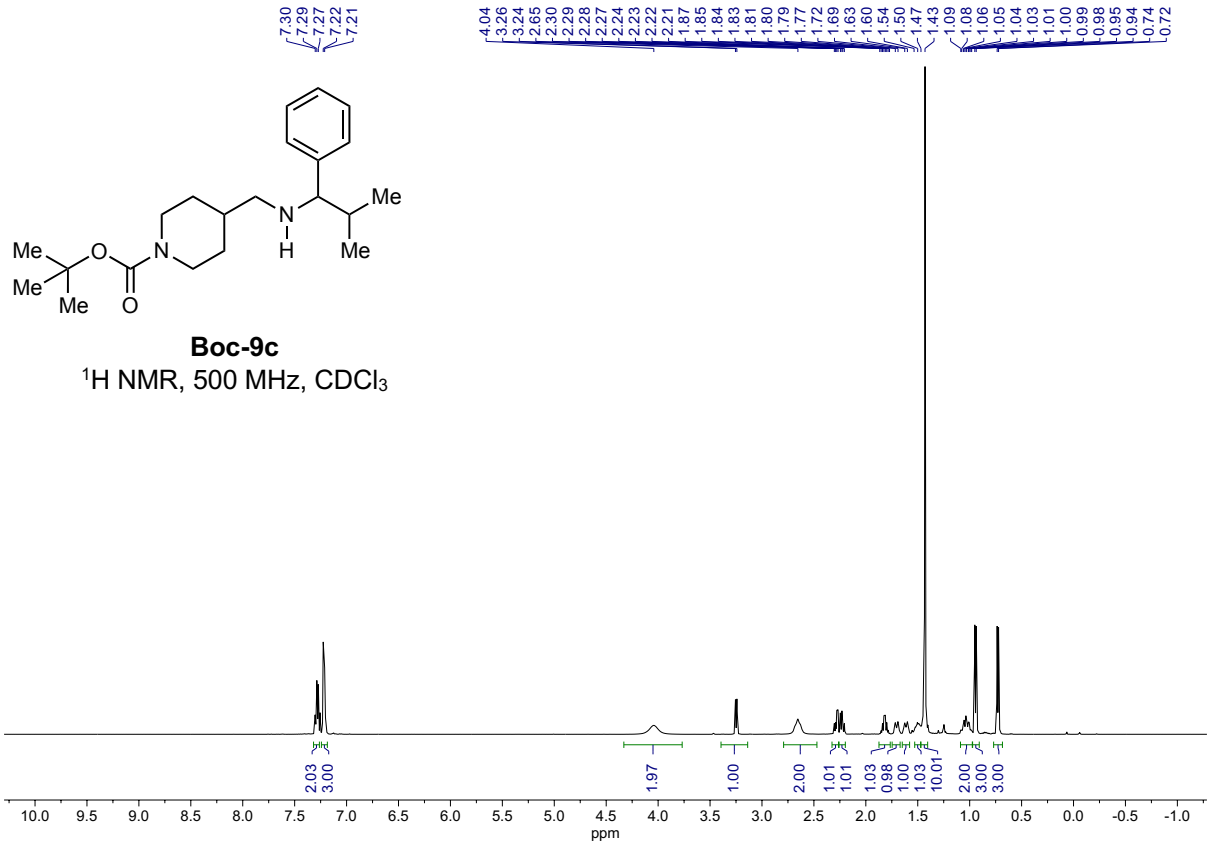


Boc-9b
^{1}H NMR, 500 MHz, $CDCl_3$



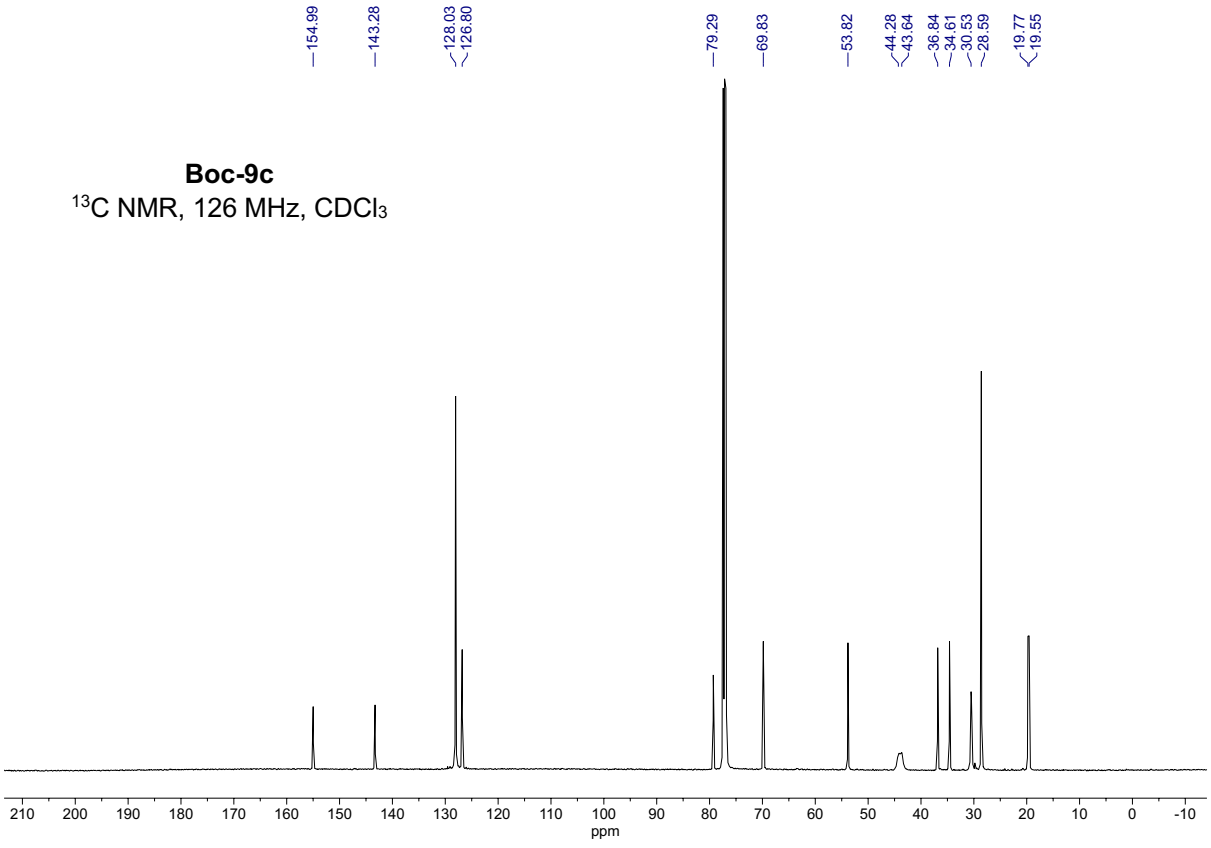
Boc-9b
^{13}C NMR, 126 MHz, $CDCl_3$

Boc-9c



Boc-9c

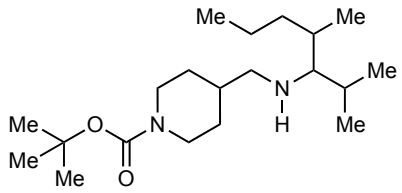
^{1}H NMR, 500 MHz, $CDCl_3$



Boc-9c

^{13}C NMR, 126 MHz, $CDCl_3$

Boc-9d

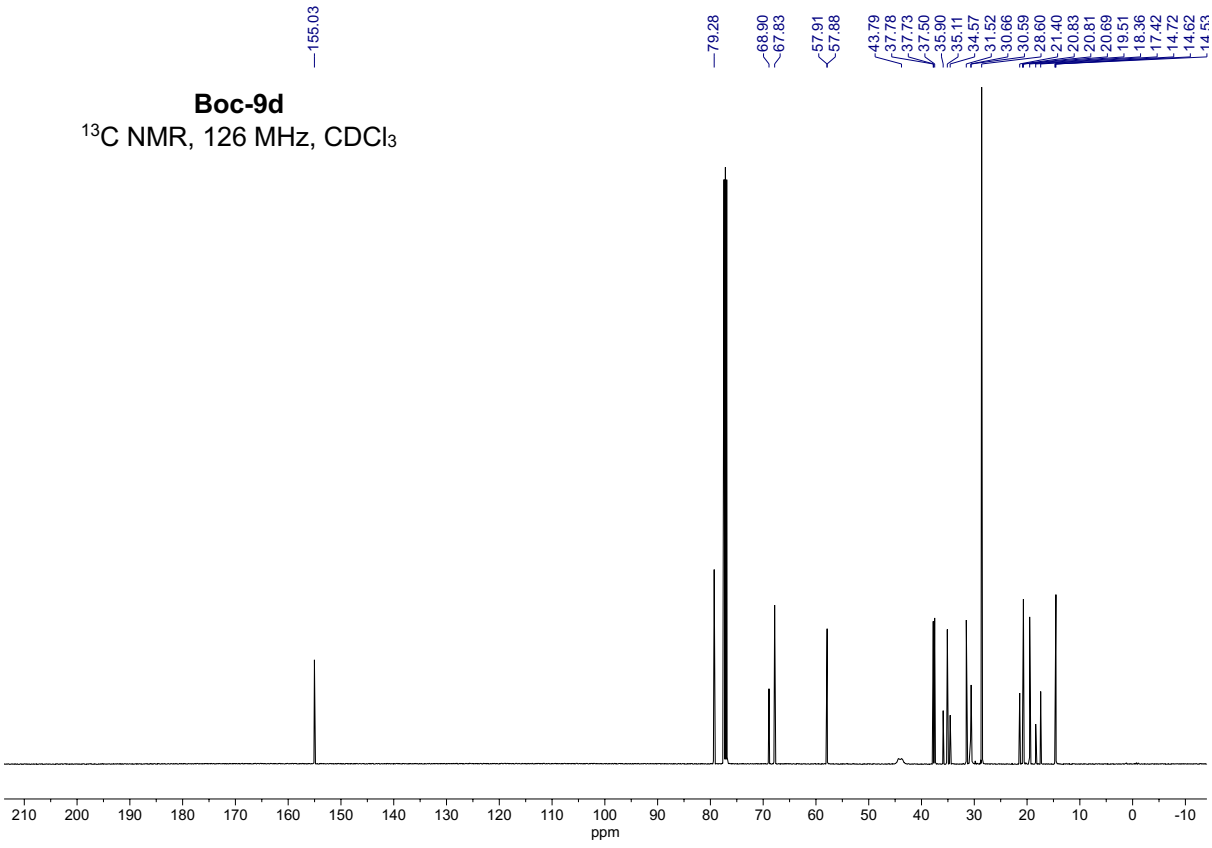


Boc-9d

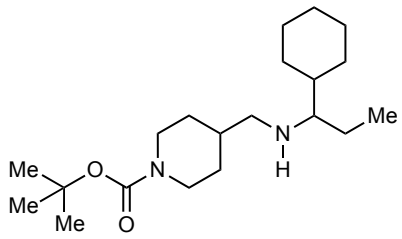
^{1}H NMR, 500 MHz, $CDCl_3$

Boc-9d

^{13}C NMR, 126 MHz, $CDCl_3$



Boc-9e

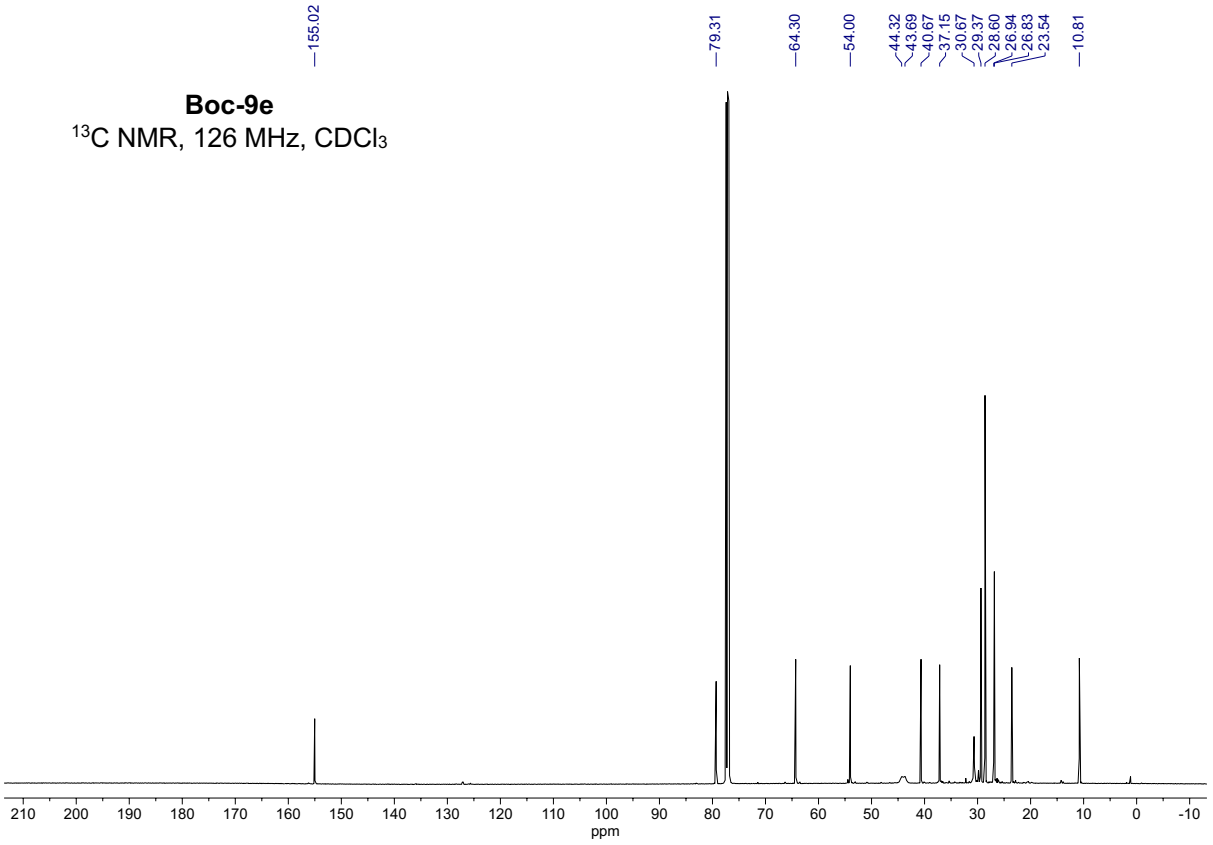


Boc-9e

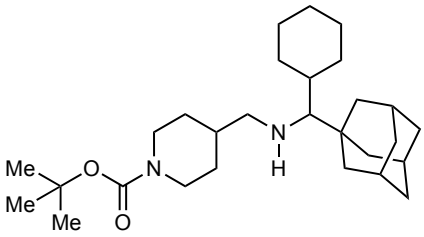
^{1}H NMR, 500 MHz, $CDCl_3$

Boc-9e

^{13}C NMR, 126 MHz, $CDCl_3$

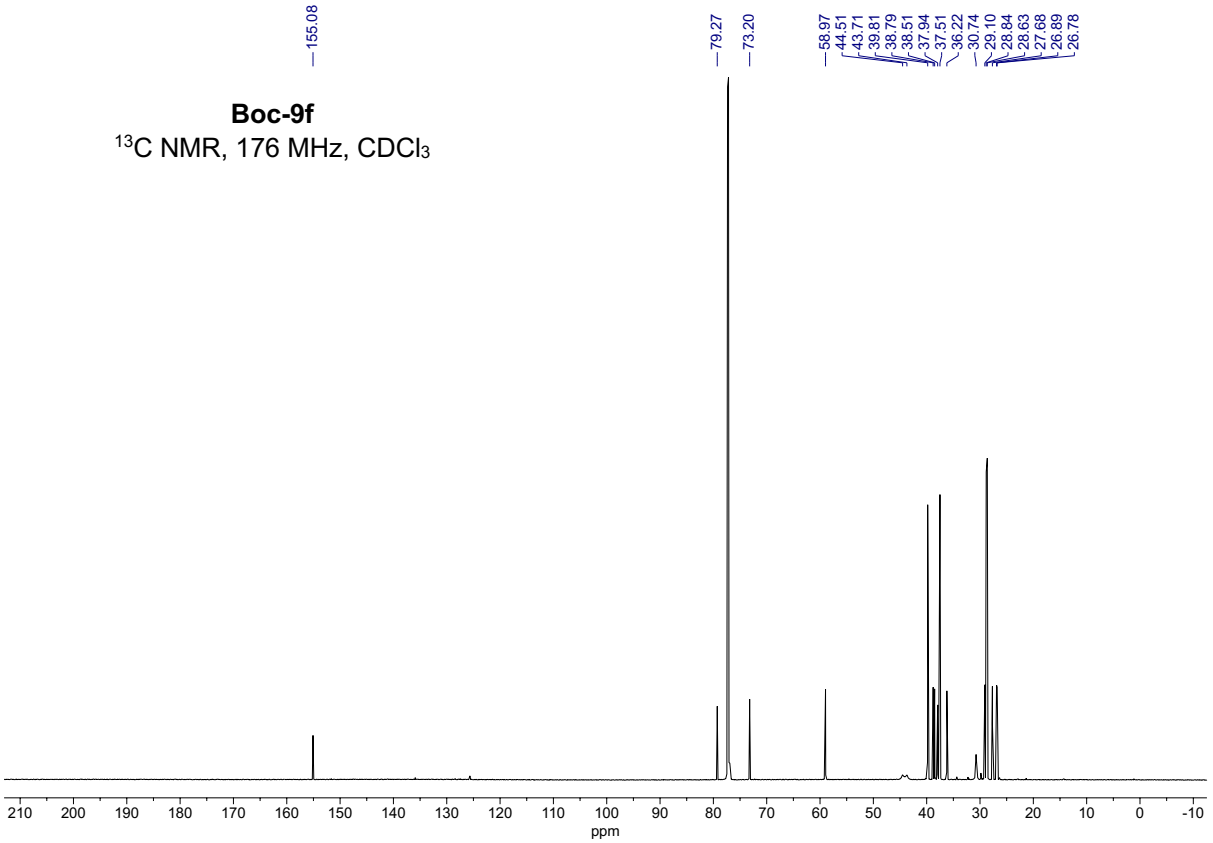


Boc-9f

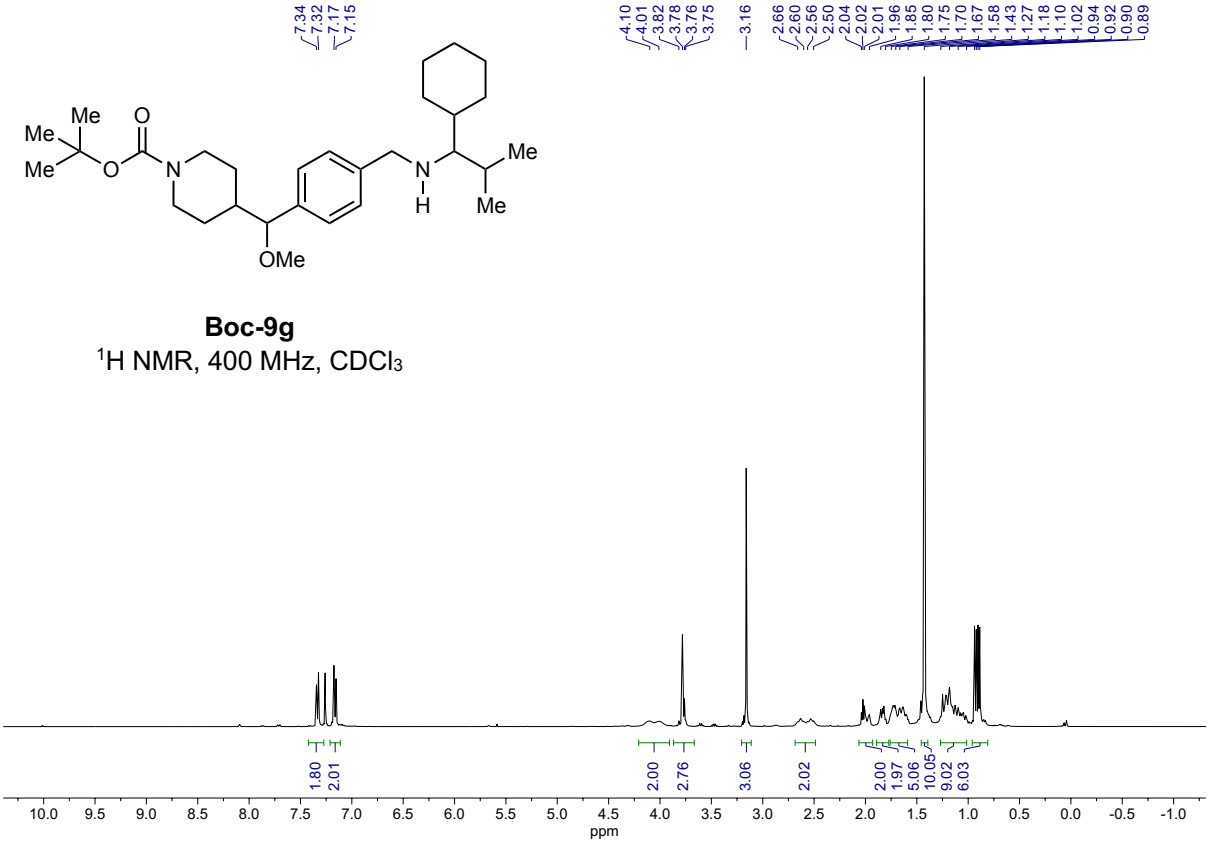


Boc-9f
^{1}H NMR, 700 MHz, $CDCl_3$

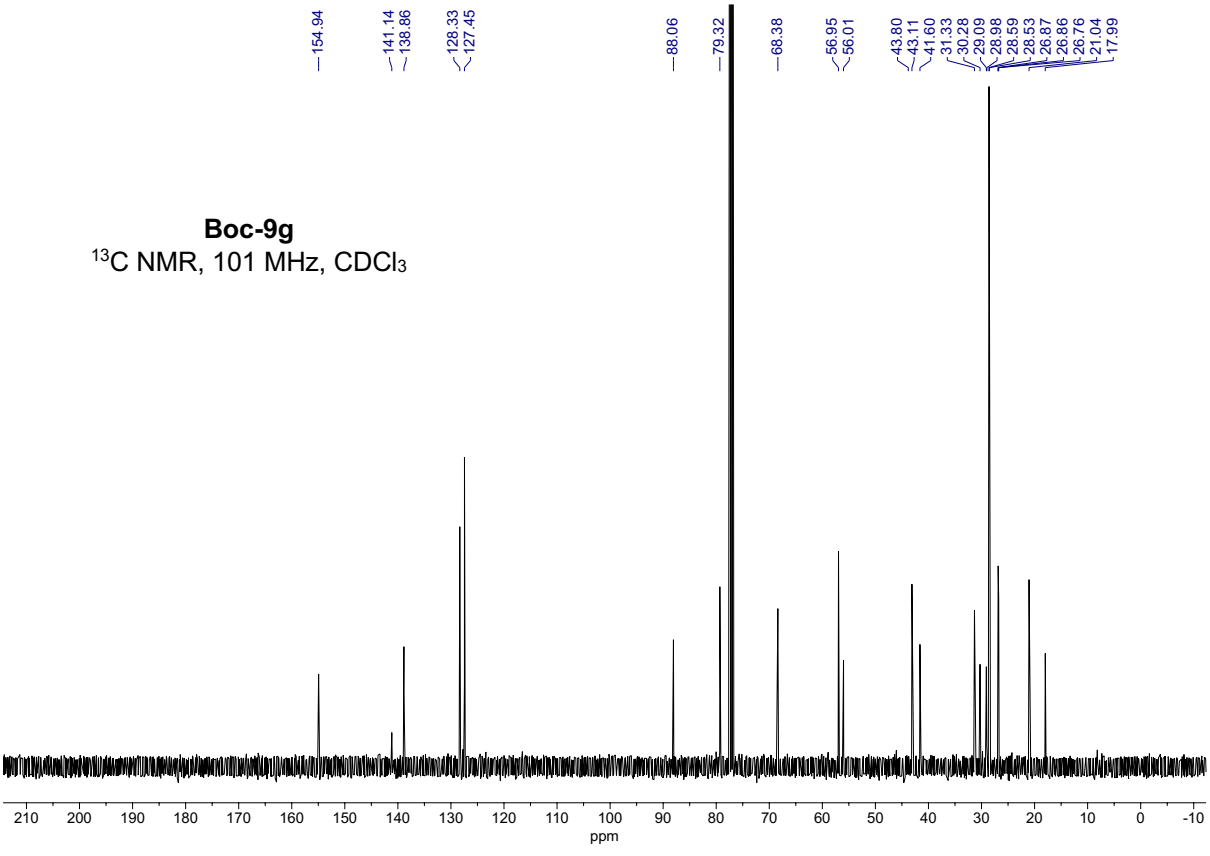
Boc-9f
^{13}C NMR, 176 MHz, $CDCl_3$



Boc-9g

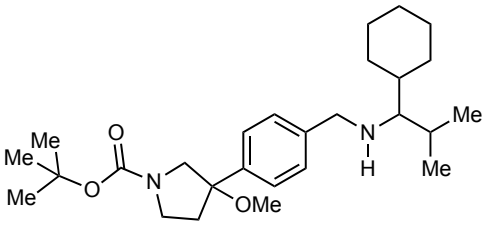


Boc-9g
^{1}H NMR, 400 MHz, $CDCl_3$



Boc-9g
^{13}C NMR, 101 MHz, $CDCl_3$

Boc-9h

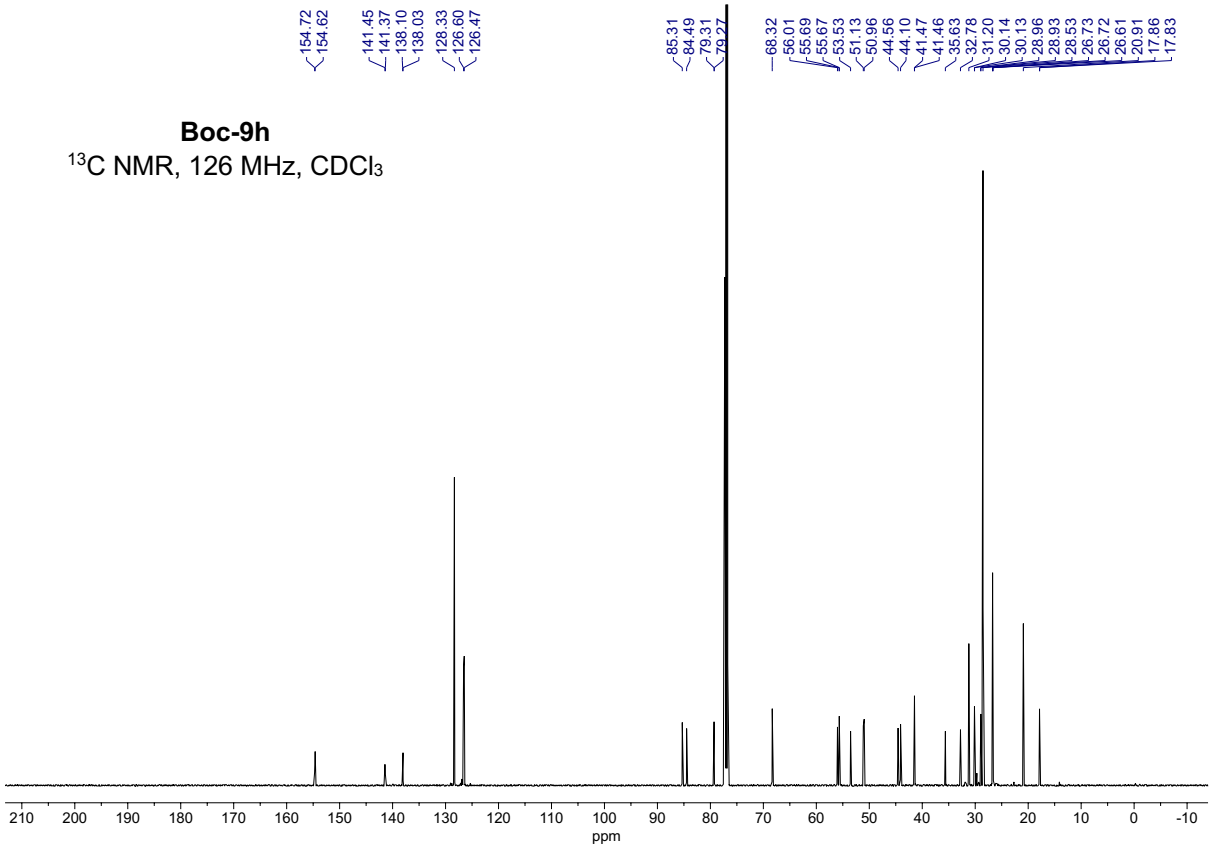


Boc-9h

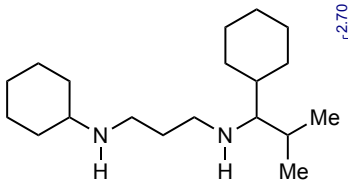
^{1}H NMR, 500 MHz, $CDCl_3$

Boc-9h

^{13}C NMR, 126 MHz, $CDCl_3$



9i

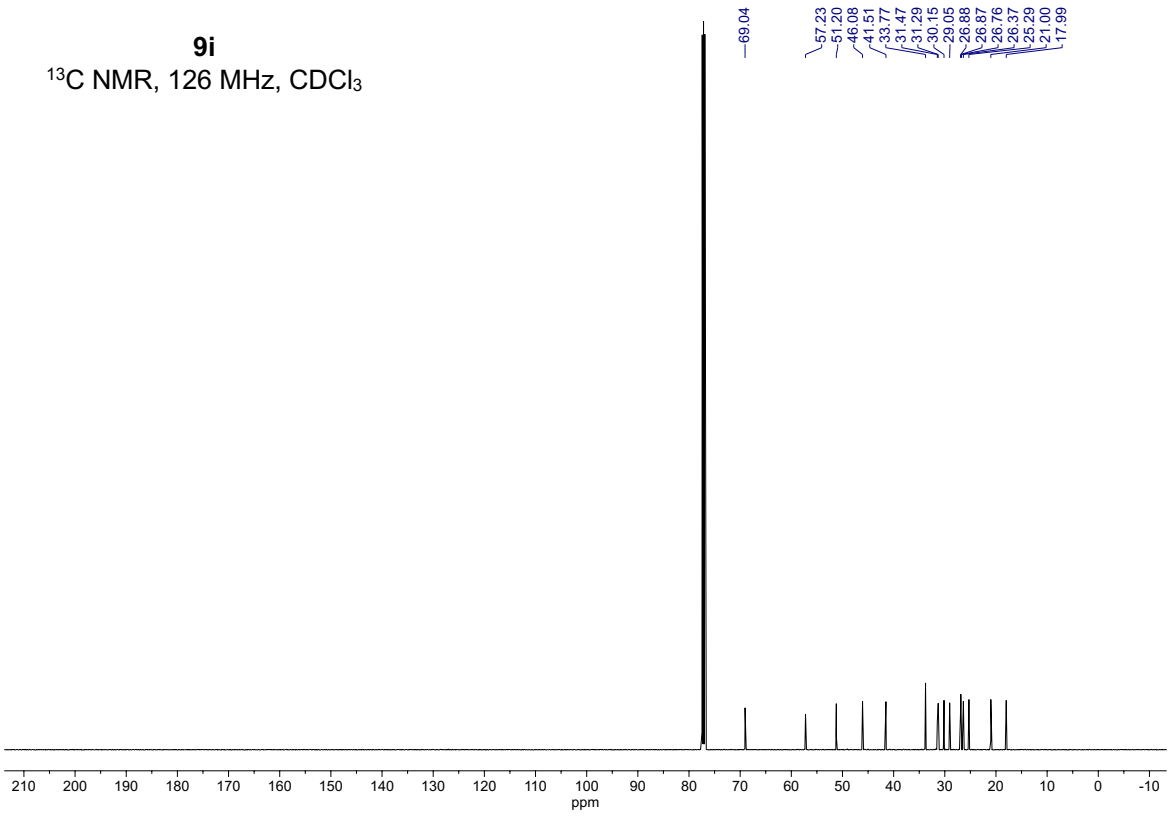


9i

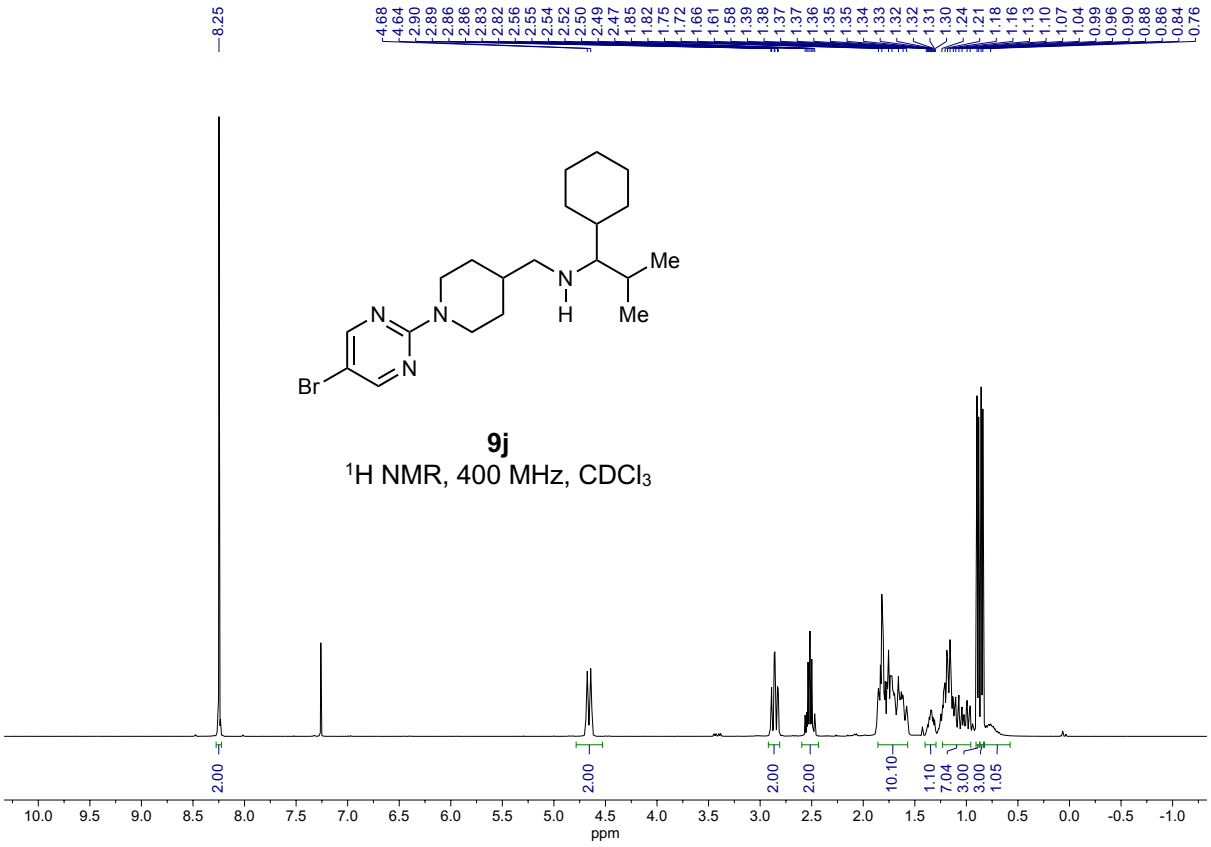
^{1}H NMR, 500 MHz, $CDCl_3$

9i

^{13}C NMR, 126 MHz, $CDCl_3$

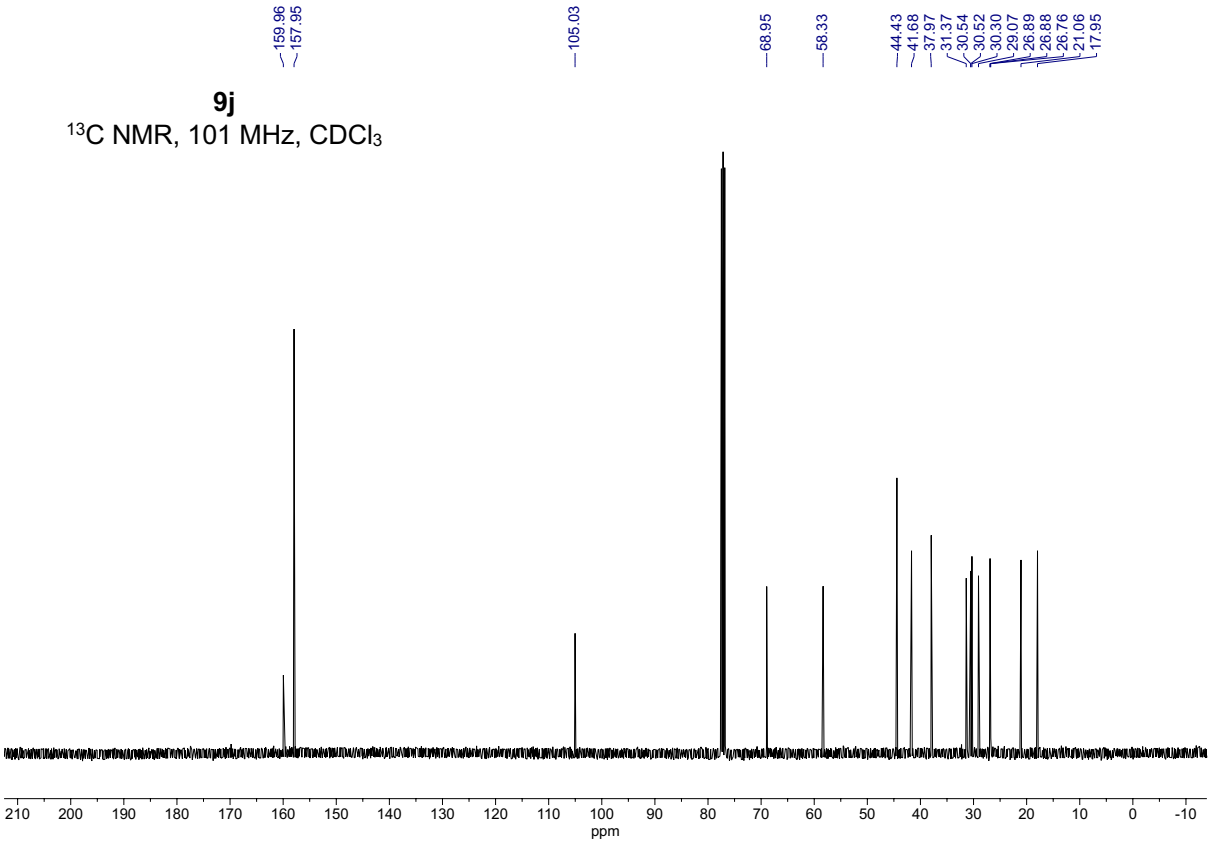


9j



9j

^{1}H NMR, 400 MHz, $CDCl_3$



9j

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

13. References

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