Supporting Information for

Deaminative coupling of benzylamines and arylboronic acids

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1. General experimental details

Materials: Unless otherwise stated, reagents were used as supplied from commercial sources without any further purification. Isoamyl nitrite was purchased from Acros, phenylboronic acid from Fluorochem, benzylamine from Sigma-Aldrich, and sodium carbonate from VWR. Extra-dry chloroform was purchased from Acros and stored over 4 Å molecular sieves under N_2 atmosphere. Commercially available benzylamine hydrochloride salts (4-nitrobenzylamine hydrochloride from Sigma Aldrich, 3-nitrobenzylamine hydrochloride from ABCR, methyl 4-(aminomethyl)benzoate hydrochloride from Fluorochem and methyl 3-(aminomethyl)benzoate hydrochloride from Fluorochem) were dissolved in dichloromethane, washed with 1M NaOH and brine, dried over $MgSO_4$ and concentrated under reduced pressure to obtain the corresponding salt-free benzylamines. All reactions were carried out in 16 mL oven-dried vials under N_2 atmosphere unless stated otherwise.

NMR: ^{1}H-, ^{2}H-, ^{13}C- and ^{19}F-NMR spectra were recorded on a Bruker AVIII 400 MHz, a Bruker Neo 400 MHz, a Bruker Neo 500 MHz or a Bruker AVIII 600 MHz spectrometer and are reported in parts per million (ppm). ^{1}H-NMR spectra are calibrated with respect to the corresponding solvent residual peak ($CHCl_3$: 7.26 ppm; DMSO: 2.50 ppm, acetone: 2.05 ppm). ^{13}C-NMR spectra are calibrated with respect to the corresponding solvent residual peak ($CHCl_3$: 77.16 ppm; DMSO: 39.52 ppm, acetone: 206.26 ppm). ^{19}F-{^{1}H} NMR spectra are calibrated with respect to hexafluorobenzene as an external standard (C_6F_6: -161.64 ppm). Multiplet signals are reported as follows: s = singlet, d = doublet, t = triplet, q = quartet, p = pentet, h = heptet, m = multiplet, or combinations thereof. ^{13}C signals are acquired with proton decoupling and are singlets unless otherwise stated. The isomer ratios using ^{13}C NMR were determined by integrating the signals for the carbons at the benzylic position in all different isomeric products. The isomer ratios using ^{19}F NMR were determined using zg ig pulse sequence with relaxation delay (d1) of 30 s and acquisition time of 2.3 s.

Gas chromatography (GC) was recorded on a Shimadzu GC-2025 (capillary column: Macherey-Nagel OPTIMA 5, 30.0 m × 0.25 × 0.25 µm; carrier gas: H_2). Calibration curves using *n*-dodecane as an internal standard were generated to determine GC yields.

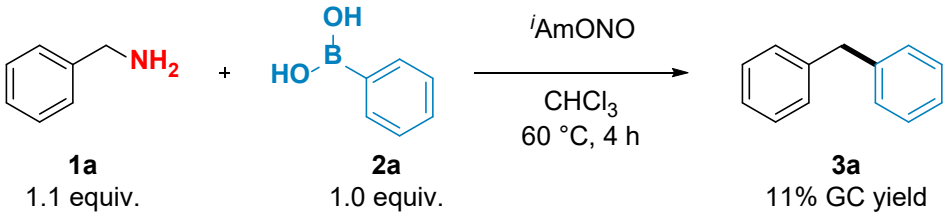
Analytical thin-layer chromatography (TLC) was performed using silica gel 60 F254 coated aluminum sheets (Merck). Visualization was achieved by ultraviolet fluorescence (λ = 254 nm) and/or staining with phosphomolybdic acid (Note: the diarylmethane products are only weakly fluorescent at λ = 254 nm and staining using phosphomolybdic acid is required to visualize the compounds).

Flash column chromatography was performed with silica gel 60 (pore size = 60 Å, mesh: 40-63 µm from Sigma-Aldrich or SiliCycle) using Biotage Isolera One system with Sfär columns (collection wavelength λ = 220 nm).

High resolution mass spectrometry (HRMS): HRMS data were obtained by the mass spectrometry service in the Laboratorium für Organische Chemie at ETH Zürich on VG-TRIBRIB for electron impact ionization (EI), a Varian IonSpec Spectrometer for electrospray ionization (ESI) or an IonSpec Ultima. Fourier transform mass spectrometer for matrix-assisted laser desorption/ionization (MALDI) are reported as (m/z).

2. Optimisation of reaction conditions

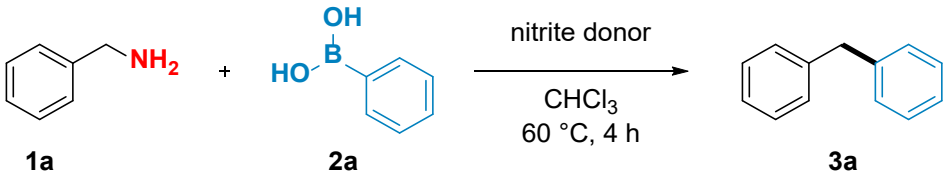
Initial hit



1a 1.1 equiv. **2a** 1.0 equiv. **3a** 11% GC yield

A 4 mL glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.250 mmol, 1.00 equiv.). Chloroform (1.0 mL) was then added followed by benzylamine (27.3 µL, 0.275 mmol, 1.10 equiv.) and isoamyl nitrite (36.9 µL, 0.275 mmol, 1.10 equiv.). The vial was sealed under air and the reaction was heated at 60°C for 4 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as an internal standard.

Nitrite donor screen

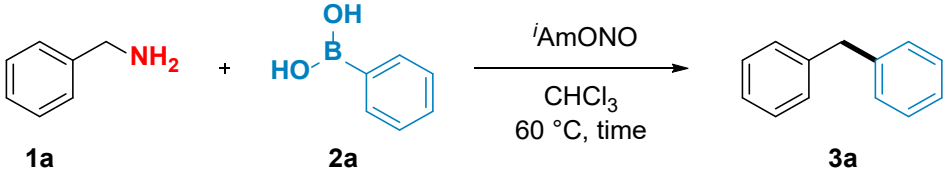


1a **2a** **3a**

A 4 mL glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.250 mmol, 1.00 equiv.). Chloroform (1.0 mL) was then added followed by benzylamine (27.3 µL, 0.275 mmol, 1.10 equiv.) and nitrite donor (0.275 mmol, 1.10 equiv.). The vial was sealed under air and the reaction was heated at 60°C for 4 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as an internal standard.

Entry	Nitrite donor	Solvent	Time, h	GC yield of 3a [%]
1	Tert-butyl nitrite	Chloroform	4	3
2	$NOBF_4$	Chloroform	4	0
3	**Isoamyl nitrite**	**Chloroform**	**4**	**15**

Time and equivalent screen



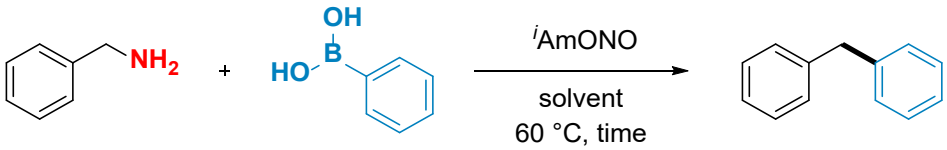
1a **2a** **3a**

A 4 mL glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.250 mmol, 1.00 equiv.). Chloroform (1.0 mL) was then added followed by benzylamine (x equiv.) and

isoamyl nitrite (y equiv.). The reaction was sealed under air and heated at 60°C for the indicated time. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as an internal standard.

Entry	Benzylamine equiv.	Phenylboronic acid equiv.	^{i}AmONO equiv.	Time, h	GC yield of 3a [%]
1	1.1	1.0	1.1	4	10
2	1.1	1.0	1.1	6	12
3	1.1	1.0	1.1	8	14
4	1.1	1.0	1.1	24	15
5	1.5	1.0	1.5	4	15
6	1.5	1.0	1.5	6	19
7	1.5	1.0	1.5	8	21
8	1.5	1.0	1.5	24	23
9	2.0	1.0	2.0	4	21
10	2.0	1.0	2.0	6	25
11	2.0	1.0	2.0	8	26
12	2.0	1.0	2.0	24	28
13	4.0	1.0	4.0	4	31
14	4.0	1.0	4.0	6	40
15	4.0	1.0	4.0	8	44
16	**4.0**	**1.0**	**4.0**	**24**	**51**

Solvent and temperature screen



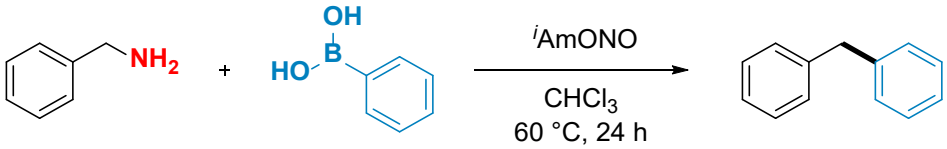
1a **2a** **3a**

A 4 mL glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.250 mmol, 1.00 equiv.). The indicated solvent (1.0 mL) was then added followed by benzylamine (109 µL, 1.00 mmol, 4.00 equiv.) and isoamyl nitrite (134 µL, 1.00 mmol, 4.00 equiv.). The reaction was sealed under air and heated at 60°C for 24 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as an internal standard.

Entry	Solvent	Temperature	GC yield of 3a [%]
1	Chloroform	60	51
2	MeCN	60	29
3	PhCl	60	42
4	DMF	60	10
5	DMSO	60	8
6	Dioxane	60	27
7	EtOAc	60	33
8	1,2-Dichloroethane	60	37
9	THF	60	16
10	Toluene	60	40

11	Xylene	60	42
12	DME	60	26
13	**Anhydrous chloroform**	**60**	**61**
14	Anhydrous MeCN	80	40
15	Anhydrous PhCl	80	11
16	Anhydrous dioxane	80	29
17	Anhydrous EtOAc	80	32
18	Anhydrous 1,2-dichloroethane	80	37
19	Anhydrous toluene	80	37
20	Anhydrous xylene	80	36
21	Anhydrous DME	80	23
22	Anhydrous PhCl	100	34
23	Anhydrous dioxane	100	31
24	Anhydrous toluene	100	35
25	Anhydrous xylene	100	36
26	Anhydrous chloroform	40	31
27	Anhydrous chloroform	rt	11

Concentration screen

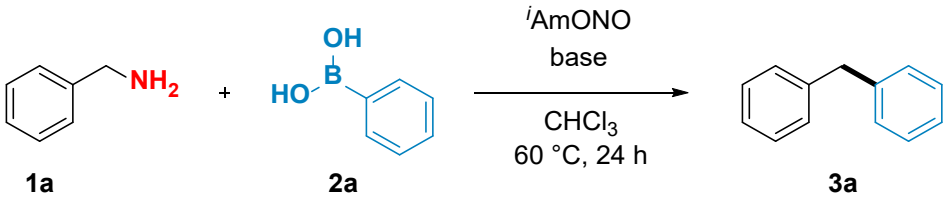


1a **2a** **3a**

A 4 mL oven-dried glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.25 mmol, 1.00 equiv.). The vial was sealed with a septum cap and evacuated and refilled with N_2 three times. Anhydrous chloroform (x mL) was then added followed by benzylamine (109 µL, 1.00 mmol, 4.00 equiv.) and isoamyl nitrite (134 µL, 1.00 mmol, 4.00 equiv.). The reaction was heated at 60°C for 24 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as a standard.

Entry	Concentration	GC yield of 3a [%]
1	1.0 M	69
2	0.8 M	71
3	0.67 M	72
4	0.5 M	71
5	**0.4 M**	**72**
6	0.2 M	72
7	0.1 M	61

Base screening

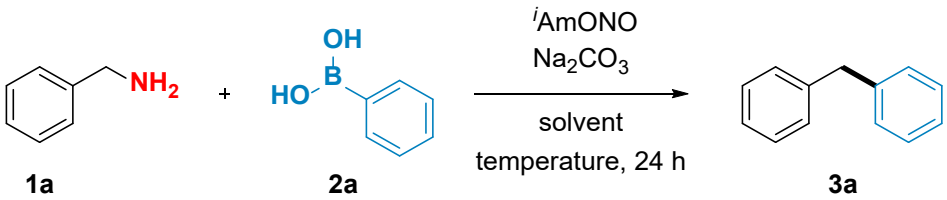


1a **2a** **3a**

A 4 mL oven-dried glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.250 mmol, 1.00 equiv.) and a base (0.25 mmol, 1.00 equiv.). The vial was sealed with a septum cap and evacuated and refilled with N_2 three times. Anhydrous chloroform (0.60 mL) was then added followed by benzylamine (109 µL, 1.00 mmol, 4.00 equiv.) and isoamyl nitrite (134 µL, 1.00 mmol, 4.00 equiv.). The reaction was heated at 60°C for 24 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as a standard.

Entry	Base	GC yield of 3a [%]
1	**Na_2CO_3**	**82**
2	Li_2CO_3	66
3	$CaCO_3$	62
4	Cs_2CO_3	8
5	$BaCO_3$	59
6	K_2CO_3	67
7	K_3PO_4	33
8	Na_3PO_4	82
9	$CaCl_2$	63
10	$CaSO_4$	68
11	CaO	68
12	BaO	34

Solvent and temperature screen

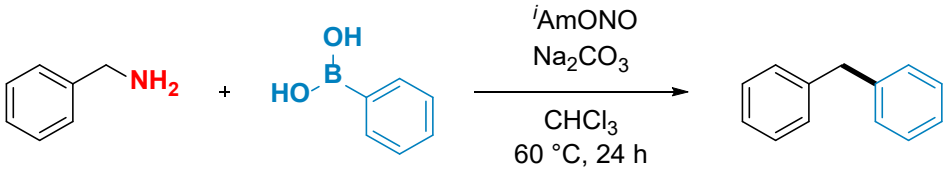


1a **2a** **3a**

A 4 mL oven-dried glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.250 mmol, 1.00 equiv.) and sodium carbonate (26.5 mg, 0.500 mmol, 1.00 equiv.). The vial was sealed with a septum cap, then evacuated and refilled with N_2 three times. The indicated anhydrous solvent (0.60 mL) was then added followed by benzylamine (109 µL, 1.00 mmol, 4.00 equiv.) and isoamyl nitrite (134 µL, 1.00 mmol, 4.00 equiv.). The reaction was heated at the indicated temperature for 24 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as an internal standard.

Entry	Solvent	Temperature	GC yield of 3a [%]
1	**Chloroform**	**60**	**72**
2	MeCN	60	41
3	PhCl	60	64
4	Dioxane	60	43
5	EtOAc	60	65
6	1,2-Dichloroethane	60	61
7	THF	60	20
8	Toluene	60	62
9	Xylene	60	61
10	DME	60	35
11	MeCN	80	64
12	PhCl	80	70
13	Dioxane	80	59
14	EtOAc	80	78
15	1,2-Dichloroethane	80	63
16	Toluene	80	67
17	Xylene	80	66
18	DME	80	49
19	PhCl	100	52
20	Dioxane	100	52
21	Toluene	100	51
22	Xylene	100	54

Equivalent screen

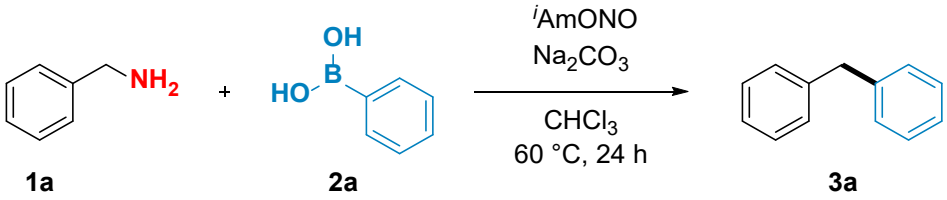


1a **2a** **3a**

A 4 mL oven-dried glass vial equipped with a stirring bar was charged with phenylboronic acid (30.5 mg, 0.250 mmol, 1.00 equiv.) and base (0.500 mmol, 1.00 equiv.). The vial was sealed with a septum cap, then evacuated and refilled with N_2 three times. Anhydrous chloroform (0.60 mL) was then added followed by benzylamine (x equiv.) and isoamyl nitrite (y equiv.). The reaction was heated at 60°C for 24 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (25 µL) as an internal standard.

Entry	Benzylamine equiv.	^{i}AmONO equiv.	Base	GC yield of 3a [%]
1	4.0	4.0	Na_2CO_3	82
2	**4.0**	**5.0**	**Na_2CO_3**	**81**
3	4.0	6.0	Na_2CO_3	86
4	3.0	3.75	Na_2CO_3	72
5	3.0	4.5	Na_2CO_3	70
6	4.0	5.0	Na_3PO_4	79
7	4.0	6.0	Na_3PO_4	79
8	3.0	3.75	Na_3PO_4	69
9	3.0	4.5	Na_3PO_4	70

Control experiments



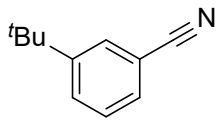
1a **2a** **3a**

A 16 mL oven-dried glass vial equipped with a stirring bar was charged with phenylboronic acid (61 mg, 0.50 mmol, 1.00 equiv.) and sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.). The vial was sealed with a septum cap, then evacuated and refilled with N_2 three times. Anhydrous chloroform (1.25 mL) was then added followed by benzylamine (218 µL, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 2.50 mmol, 5.00 equiv.). The reaction was heated at 60°C for 24 h. The crude reaction mixture was allowed to cool down to room temperature and analysed with GC using *n*-dodecane (50 µL) as an internal standard.

Entry	Deviation from the standard conditions	GC yield of 3a [%]
1	**No deviation**	**80**
2	No ^{i}AmONO	0
3	No base	72
4	2 equiv. of benzylamine instead of 4 equiv.	58
5	^{t}BuONO instead of ^{i}AmONO	23
6	Na_3PO_4 instead of Na_2CO_3	79
7	Addition of 1 equiv. $B(OH)_3$	70
8	Pinacol ester instead of phenylboronic acid	0

3. Preparation of starting materials

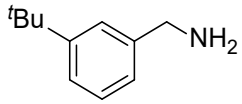
3-(*Tert*-butyl)benzonitrile



3-(*Tert*-butyl)benzonitrile was synthesised according to the modified procedure[1]. To a mixture of 1-bromo-3-*tert*-butylbenzene (3.41 mL, 20.0 mmol, 1.00 equiv.) and CuCN (3.58 mg, 40.0 mmol, 2.00 equiv.) in a 100 mL Schlenk flask was added *N*-methylpyrrolidone (30 mL). The mixture was heated to reflux under nitrogen atmosphere until full conversion was indicated by TLC analysis. The mixture was cooled to room temperature and aqueous NH_4OH was added at 0 °C. The reaction mixture was extracted with ethyl acetate (3 x 100 mL). The combined organic phases were washed with brine, dried over anhydrous $MgSO_4$, filtered, and evaporated under reduced pressure. The residue was purified by flash column chromatography (0 – 5% ethyl acetate in hexanes) to give 3-(*tert*-butyl)benzonitrile as a colourless oil (2.55 g, 16.0 mmol, 80% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.67 (m, 1H), 7.65 (ddd, *J* = 7.9, 2.1, 1.3 Hz, 1H), 7.53 – 7.45 (m, 1H), 7.42 (td, *J* = 7.8, 0.6 Hz, 1H), 1.35 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 152.60, 130.16, 129.36, 129.31, 129.01, 119.51, 112.22, 35.01, 31.16.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{11}H_{13}N^+$ 159.1043; Found 159.1041.

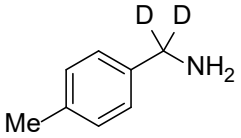
3-(*Tert*-butyl)benzylamine



To 3-(*tert*-butyl)benzonitrile (2.55 g, 16.0 mmol, 1.00 equiv.) in anhydrous THF (40 mL) at 0 °C was added lithium aluminum hydride (1.21 g, 32.0 mmol, 2.00 equiv.) in one portion. The reaction mixture was allowed to warm to room temperature and stirred for 2 h at room temperature. The reaction was quenched with an aqueous 10% potassium hydroxide solution (1.2 mL) and water (2.4 mL). The white precipitate was filtered through celite, and the filter cake was washed with diethyl ether (3 x 40 mL). The combined filtrate was concentrated to give a pale yellow oil. The residue was purified by flash column chromatography (ethyl acetate) to give 3-*tert*-butylbenzylamine as a pale yellow oil (1.97 g, 12.0 mmol, 75% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.33 (m, 1H), 7.34 – 7.27 (m, 2H), 7.22 – 7.12 (m, 1H), 3.90 (s, 2H), 1.52 (s, 2H), 1.36 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 151.58, 143.06, 128.40, 124.31, 124.18, 123.94, 46.96, 34.81, 31.51.
HRMS (ESI) m/z: $[M-H]^+$ Calculated for $C_{11}H_{16}N^+$ 162.1777; Found 162.1277.

***p*-Tolylmethan-d_2-amine**

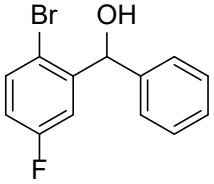


1b-d_2

p-Tolylmethan-d_2-amine was synthesised according to the modified procedure[2]. A 16 mL oven-dried vial was charged with lithium aluminum deuteride (98 atom % D, 523 mg, 12.5 mmol, 2.50 equiv.) and the vial was evacuated and refilled with N_2 three times. Anhydrous diethyl ether (6 mL) was added and the reaction mixture was cooled in an ice bath to 0 °C. 4-Methylbenzonitrile (600 µL, 5.00 mmol, 1.00 equiv.) was added dropwise over 10 min. After vigorous H_2 gas evolution ceased, the mixture was allowed to warm to room temperature and stirred for 48 h at room temperature. The solution was diluted with 5 mL of diethyl ether, cooled to 0 °C, and quenched by the successive dropwise addition of 0.4 mL of 10% NaOH solution and 1.2 mL of water. The colourless precipitate was filtered through celite, and the filter cake was washed with diethyl ether (3 x 20 mL). The combined filtrate was concentrated to give a pale yellow oil. The resulting oil was purified by flash column chromatography (ethyl acetate) to give *p*-tolylmethan-d_2-amine as a pale yellow oil (377 mg, 3.10 mmol, 61% yield, 98.5% deuterium incorporation).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.23 – 7.17 (m, 2H), 7.17 – 7.10 (m, 2H), 3.85 – 3.76 (m, 0.025H), 2.34 (s, 3H), 1.47 (s, 2H).
^{2}H NMR (92 MHz, $CDCl_3$) δ 3.79.
^{13}C NMR (151 MHz, $CDCl_3$) δ 140.48, 136.49, 129.34, 127.17, 45.71 (p, *J* = 20.4 Hz), 21.18.
HRMS (ESI) m/z: $[M+H]^+$ Calculated for $C_8H_{10}D_2N^+$ 124.1090; Found 124.1089.

(2-Bromo-5-fluorophenyl)(phenyl)methanol

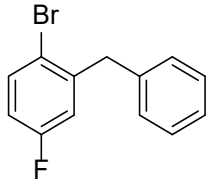


(2-Bromo-5-fluorophenyl)(phenyl)methanol was synthesised according to the modified procedure[3]. A solution of PhMgBr (3.0 M in diethyl ether, 5.5 mL, 16.5 mmol, 1.10 equiv.) was added dropwise to a solution of 2-bromo-5-fluorobenzaldehyde (3.04 g, 15.0 mmol, 1.00 equiv.) in anhydrous THF (37.5 mL) at 0 °C. The reaction mixture was warmed to room temperature and stirred until completion indicated by TLC (10% ethyl acetate in hexanes). The reaction mixture was quenched with saturated aqueous NH_4Cl solution. The aqueous phase was extracted with diethyl ether three times. The combined organic phases were washed with brine, dried over anhydrous $MgSO_4$, filtered and evaporated under reduced pressure. The residue was purified by flash column chromatography (0 – 10% ethyl acetate in hexanes) to give (2-bromo-5-fluorophenyl)(phenyl)methanol as a colourless oil (3.68 g, 13.1 mmol, 87% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (dd, *J* = 8.7, 5.2 Hz, 1H), 7.44 – 7.29 (m, 6H), 6.91 (ddd, *J* = 8.8, 7.7, 3.1 Hz, 1H), 6.11 (s, 1H), 2.63 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41 (d, *J* = 247.2 Hz), 144.81 (d, *J* = 6.8 Hz), 141.56, 134.12 (d, *J* = 7.8 Hz), 128.73, 128.22, 127.25, 116.55 (d, *J* = 3.2 Hz), 116.36 (d, *J* = 22.7 Hz), 115.67 (d, *J* = 24.1 Hz), 74.71 (d, *J* = 1.3 Hz).
^{19}F NMR (377 MHz, $CDCl_3$) δ -113.57.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{10}BrFO^+$ 279.9894; Found 279.9890.

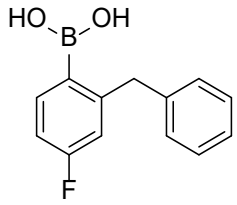
2-Benzyl-1-bromo-4-flurobenzene



2-Benzyl-1-bromo-4-flurobenzene was synthesised according to the modified procedure[4]. (2-Bromo-5-fluorophenyl)(phenyl)methanol (3.68 g, 13.1 mmol, 1.00 equiv.) was dissolved in dichloromethane (52 mL) under nitrogen atmosphere. Trifluoroacetic acid (4.00 ml, 52.4 mmol, 4.00 equiv.) was added dropwise to the reaction mixture at 0 °C. The reaction mixture was stirred for 10 min at 0 °C, and then triethylsilane (4.20 mL, 26.2 mmol, 2.00 equiv.) was added. The resulting mixture was stirred at room temperature overnight. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (hexanes) to yield 2-benzyl-1-bromo-4-flurobenzene as a colourless oil (2.31 g, 8.73 mmol, 67% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 – 7.49 (m, 1H), 7.38 – 7.32 (m, 2H), 7.32 – 7.23 (m, 1H), 7.25 – 7.19 (m, 2H), 6.90 – 6.78 (m, 2H), 4.11 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 162.15 (d, *J* = 246.6 Hz), 142.78 (d, *J* = 7.3 Hz), 138.76, 133.98 (d, *J* = 8.1 Hz), 129.19, 128.79, 126.73, 118.94 (d, *J* = 3.2 Hz), 118.02 (d, *J* = 23.0 Hz), 115.17 (d, *J* = 22.4 Hz), 41.95 (d, *J* = 1.4 Hz).
^{19}F NMR (377 MHz, $CDCl_3$) δ -114.81.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{10}BrF^+$ 263.9944; Found 263.9942.

(2-Benzyl-4-fluorophenyl)boronic acid



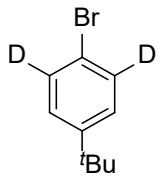
9

(2-Benzyl-4-fluorophenyl)boronic acid was synthesised according to the modified procedure[5]. *n*-BuLi (1.6 M in hexanes, 3.50 mL, 5.60 mmol, 1.10 equiv.) was added dropwise to a solution of 2-benzyl-1-bromo-4-flurobenzene (1.36 g, 5.10 mmol, 1.00 equiv.) in anhydrous THF (128 mL) at -78 °C under nitrogen atmosphere. The reaction mixture was stirred for 45 minutes, while the temperature was allowed to slowly rise to -50 °C. The reaction mixture was then cooled again to -78 °C and trimethyl borate (5.40 mL, 48.6 mmol, 9.50 equiv.) was added. The resulting solution was allowed to warm slowly to room temperature and stirred overnight. Distilled water was added to the reaction mixture and the resulting solution was acidified with 1M HCl solution. The aqueous phase was extracted with

ethyl acetate three times. The combined organic phases were washed with brine, dried over anhydrous $MgSO_4$, filtered, and concentrated under reduced pressure. The residue was purified by recrystallisation from pentane to give (2-benzyl-4-fluorophenyl)boronic acid as a white solid (0.74 g, 3.20 mmol, 63% yield).

^{1}H NMR (400 MHz, Acetone) δ 7.67 (dd, *J* = 8.3, 6.8 Hz, 1H), 7.28 – 7.18 (m, 4H), 7.18 – 7.08 (m, 1H), 6.87 (td, *J* = 8.6, 2.6 Hz, 1H), 6.80 (dd, *J* = 10.9, 2.6 Hz, 1H), 4.29 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 164.42 (d, *J* = 245.7 Hz), 150.28 (d, *J* = 6.9 Hz), 142.62, 137.39 (d, *J* = 8.0 Hz), 129.69, 129.05, 126.56, 116.53 (d, *J* = 20.1 Hz), 112.46 (d, *J* = 19.7 Hz), 41.18 (d, *J* = 1.8 Hz).
^{19}F NMR (377 MHz, Acetone) δ -113.74.
HRMS data could not be obtained due to the instability of the compound.

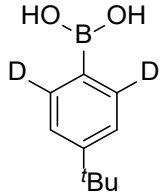
1-Bromo-4-(*tert*-butyl)benzene-2,6-d_2



1-Bromo-4-(*tert*-butyl)benzene-2,6-d_2 was synthesised according to the previously reported procedure[6]. 1-Bromo-4-(*tert*-butyl)benzene (1.73 mL, 10.00 mmol, 1.00 equiv.) was added to a vigorously stirred solution of silver carbonate (551 mg, 2.00 mmol, 0.20 equiv.), cyclohexyldiphenylphosphine (1.3 g, 5.0 mmol, 0.50 equiv.), potassium carbonate (1.87 g, 10.0 mmol, 1.00 equiv.), and D_2O (3.60 mL, 200 mmol, 20.0 equiv.) in toluene (1 mL) under nitrogen atmosphere. The reaction mixture was stirred at 120 °C for 24 h. After allowing the reaction to cool to room temperature, the reaction was quenched with saturated aqueous NH_4Cl solution and the aqueous phase was extracted with dichloromethane three times. The combined organic phases were washed with brine, dried over anhydrous $MgSO_4$, filtered and concentrated under reduced pressure. The residue was purified by flash column chromatography (hexanes) to give 1-bromo-4-(*tert*-butyl)benzene-2,6-d_2 as a colourless oil (1.83 g, 8.50 mmol, 85% yield).

^{1}H NMR (600 MHz, DMSO) δ 7.48 – 7.44 (m, 0.22H, 89% deuterium incorporation), 7.36 – 7.32 (m, 1.66H, 12% deuterium incorporation), 1.25 (s, 9H).
^{2}H NMR (92 MHz, DMSO) δ 7.48, 7.36.
^{13}C NMR (151 MHz, DMSO) δ 150.03, 149.96 (minor), 130.79 (minor), 130.73 – 130.27 (m), 127.56 (minor), 127.44, 118.40 (minor), 118.29, 34.28, 30.90.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{10}H_{11}D_2Br^+$ 214.0321; Found 214.0322.

(4-(*Tert*-butyl)phenyl-2,6-d_2)boronic acid



10

(4-(*Tert*-butyl)phenyl-2,6-d_2)boronic acid was synthesised according to the modified procedure[5]. *n*-BuLi (1.6 M in hexanes, 5.8 mL, 9.4 mmol, 1.1 equiv.) was added dropwise to a solution of 1-bromo-4-(*tert*-butyl)benzene-2,6-d_2 (1.83 g, 8.50 mmol, 1.00 equiv.) in dry THF (85 mL) at -78 °C under nitrogen atmosphere. The reaction mixture was stirred for 45 minutes, while the temperature was allowed to slowly rise to -50 °C. Then the reaction mixture was cooled down to -78 °C and trimethyl borate (2.80 mL, 25.5 mmol, 3.00 equiv.) was added. The resulting solution was allowed to warm slowly to room temperature and was stirred at room temperature overnight. Distilled water was added to the reaction mixture and the resulting solution was acidified with 1M HCl solution. The aqueous phase was extracted with ethyl acetate three times. The combined organic phases were washed with brine, dried over anhydrous $MgSO_4$, filtered and concentrated under reduced pressure. The residue was purified by recrystallisation from pentane to give (4-(*tert*-butyl)phenyl-2,6-d_2)boronic acid as a white solid (0.89 g, 4.9 mmol, 58% yield).

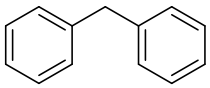
^{1}H NMR (600 MHz, Acetone) δ 7.78 – 7.75 (m, 0.24H, 88% deuterium incorporation), 7.36 – 7.34 (m, 1.78H, 11% deuterium incorporation), 1.26 (s, 9H).
^{2}H NMR (92 MHz, Acetone) δ 7.78, 7.36.
^{13}C NMR (151 MHz, Acetone) δ 150.54, 150.47 (minor), 131.57 (minor), 131.49 – 130.92 (m), 127.52, 121.73 (minor), 121.61, 31.71, 28.08.
HRMS (ESI) m/z: $[M+Na]^+$ Calculated for $C_{10}H_{13}D_2BNaO_2^+$ 203.1183; Found 203.1185.

4. Benzylamine substrate scope

General procedure A for benzylamine scope

A 16 mL oven-dried glass vial equipped with a stirring bar was charged with phenylboronic acid (61 mg, 0.50 mmol, 1.00 equiv.), sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.) and the corresponding benzylamine (if solid, 2.00 mmol, 4.00 equiv). The vial was sealed with a septum cap and evacuated and refilled with N_2 three times. Anhydrous chloroform (1.25 mL) was then added followed by the corresponding benzylamine (if liquid, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 2.50 mmol, 5.00 equiv.). The reaction was heated at 60°C for 24 h. The crude reaction mixture was allowed to cool down to room temperature, concentrated and purified by flash column chromatography.

Diphenylmethane



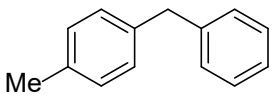
3a

Diphenylmethane was prepared according to the general procedure A using benzylamine (219 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (59 mg, 0.35 mmol, 70% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 – 7.29 (m, 4H), 7.29 – 7.23 (m, 6H), 4.08 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.26, 129.08, 128.60, 126.21, 42.09.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{12}^+$ 168.0934; Found 168.0931.

The spectral data are consistent with those reported in the literature[7].

1-Benzyl-4-methylbenzene



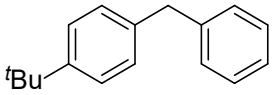
3b

1-Benzyl-4-methylbenzene was prepared according to the general procedure A using 4-methylbenzylamine (255 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (54 mg, 0.30 mmol, 59% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.31 (m, 2H), 7.31 – 7.22 (m, 3H), 7.21 – 7.15 (m, 4H), 4.03 (s, 2H), 2.40 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.55, 138.21, 135.66, 129.28, 129.01, 128.95, 128.56, 126.11, 41.65, 21.14.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{14}^+$ 182.1090; Found 182.1086.

The spectral data are consistent with those reported in the literature[8].

1-Benzyl-4-(*tert*-butyl)benzene



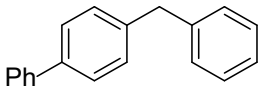
3c

1-Benzyl-4-(*tert*-butyl)benzene was prepared according to the general procedure A using 4-*tert*-butylbenzylamine (352 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (57 mg, 0.25 mmol, 51% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.32 (m, 4H), 7.31 – 7.24 (m, 3H), 7.22 – 7.17 (m, 2H), 4.02 (s, 2H), 1.37 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 148.97, 141.43, 138.22, 129.11, 128.65, 128.57, 126.14, 125.49, 41.58, 34.51, 31.54.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{17}H_{20}^+$ 224.1560; Found 224.1558.

The spectral data are consistent with those reported in the literature[8].

4-Benzyl-1,1'-biphenyl



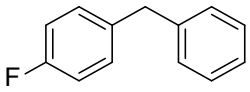
3d

4-Benzyl-1,1'-biphenyl was prepared according to the general procedure A using [1,1'-biphenyl]-4-ylmethanamine (367 mg, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a white solid (72 mg, 0.30 mmol, 60% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.60 (m, 2H), 7.59 – 7.53 (m, 2H), 7.52 – 7.21 (m, 10H), 4.07 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.15, 141.15, 140.39, 139.19, 129.46, 129.11, 128.86, 128.66, 127.35, 127.22, 127.15, 126.29, 41.73.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{19}H_{16}^+$ 244.1247; Found 244.1242.

The spectral data are consistent with those reported in the literature[9].

1-Benzyl-4-fluorobenzene



3e

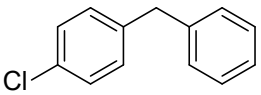
1-Benzyl-4-fluorobenzene was prepared according to the general procedure A using 4-fluorobenzylamine (229 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (47 mg, 0.25 mmol, 51% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.31 (m, 2H), 7.30 – 7.25 (m, 1H), 7.25 – 7.14 (m, 4H), 7.08 – 6.97 (m, 2H), 4.01 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 161.56 (d, *J* = 244.0 Hz), 141.08 (d, *J* = 0.9 Hz), 136.91 (d, *J* = 3.2 Hz), 130.42 (d, *J* = 7.8 Hz), 128.97, 128.67, 126.34, 115.34 (d, *J* = 21.2 Hz), 41.21.
^{19}F NMR (377 MHz, $CDCl_3$) δ -117.31.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}F^+$ 186.0839; Found 186.0835.

The spectral data are consistent with those reported in the literature[8].

1-Benzyl-4-chlorobenzene



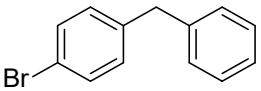
3f

1-Benzyl-4-chlorobenzene was prepared according to the general procedure A using 4-chlorobenzylamine (243 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (77 mg, 0.38 mmol, 76% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.34 (m, 2H), 7.34 – 7.26 (m, 3H), 7.26 – 7.22 (m, 2H), 7.21 – 7.15 (m, 2H), 4.02 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 140.68, 139.71, 132.02, 130.38, 128.99, 128.70, 128.69, 126.42, 41.36.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}Cl^+$ 202.0544; Found 202.0542.

The spectral data are consistent with those reported in the literature[8].

1-Benzyl-4-bromobenzene



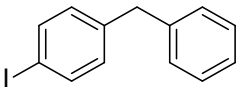
3g

1-Benzyl-4-bromobenzene was prepared according to the general procedure A using 4-bromobenzylamine (253 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (105 mg, 0.43 mmol, 85% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 7.44 (m, 2H), 7.42 – 7.34 (m, 2H), 7.34 – 7.27 (m, 1H), 7.26 – 7.21 (m, 2H), 7.17 – 7.07 (m, 2H), 4.00 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 140.55, 140.21, 131.63, 130.78, 128.98, 128.69, 126.42, 120.06, 41.41.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}Br^+$ 246.0039; Found 246.0035.

The spectral data are consistent with those reported in the literature[8].

1-Benzyl-4-iodobenzene



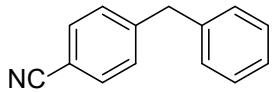
3h

1-Benzyl-4-iodobenzene was prepared according to the general procedure A using 4-iodobenzylamine (466 mg, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a light-sensitive colourless oil that turns light purple upon light exposure (131 mg, 0.44 mmol, 89% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.65 (m, 2H), 7.42 – 7.33 (m, 2H), 7.33 – 7.27 (m, 1H), 7.28 – 7.19 (m, 2H), 7.07 – 6.98 (m, 2H), 3.99 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 140.86, 140.47, 137.58, 131.11, 128.96, 128.67, 126.40, 91.45, 41.50.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}I^+$ 293.9900; Found 293.9895.

The spectral data are consistent with those reported in the literature[10].

4-Benzylbenzonitrile



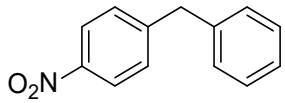
3i

4-Benzylbenzonitrile was prepared according to the general procedure A using 4-(aminomethyl)benzonitrile (238 µL, 2.00 mmol). Flash column chromatography (0−60% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as a colourless oil (88 mg, 0.46 mmol, 91% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.56 (m, 2H), 7.43 – 7.25 (m, 5H), 7.25 – 7.16 (m, 2H), 4.07 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 146.76, 139.37, 132.28, 129.65, 128.98, 128.78, 126.68, 119.01, 110.01, 41.96.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}N^+$ 193.0886; Found 193.0882.

The spectral data are consistent with those reported in the literature[11].

1-Benzyl-4-nitrobenzene



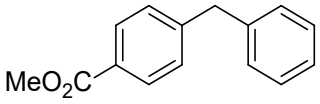
3j

1-Benzyl-4-nitrobenzene was prepared according to the general procedure A using 4-nitrobezylamine (304 mg, 2.00 mmol). Flash column chromatography (0−40% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as a colourless oil (61 mg, 0.29 mmol, 57% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 – 8.12 (m, 2H), 7.42 – 7.32 (m, 4H), 7.32 – 7.25 (m, 1H), 7.25 – 7.17 (m, 2H), 4.11 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 148.99, 146.61, 139.30, 129.75, 129.06, 128.92, 126.85, 123.84, 41.82.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}NO_2^+$ 213.0784; Found 213.0781.

The spectral data are consistent with those reported in the literature[12].

Methyl 4-benzylbenzoate



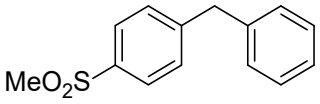
3k

Methyl 4-benzylbenzoate was prepared according to the general procedure A using methyl 4-(aminomethyl)benzoate (330 mg, 2.00 mmol). Flash column chromatography (0−50% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as a colourless oil (99 mg, 0.44 mmol, 88% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 – 7.99 (m, 2H), 7.39 – 7.20 (m, 7H), 4.07 (s, 2H), 3.94 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 167.10, 146.60, 140.19, 129.90, 129.02, 129.02, 128.68, 128.18, 126.45, 52.05, 41.98.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{15}H_{14}O_2^+$ 226.0988; Found 226.0987.

The spectral data are consistent with those reported in the literature[12].

1-Benzyl-4-(methylsulfonyl)benzene



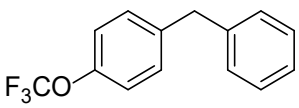
3l

1-Benzyl-4-(methylsulfonyl)benzene was prepared according to the general procedure A using methyl 4-(methylsulfonyl)benzylamine (371 mg, 2.00 mmol). Flash column chromatography (0−100% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as a white solid (115 mg, 0.47 mmol, 93% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 – 7.78 (m, 2H), 7.44 – 7.38 (m, 2H), 7.37 – 7.31 (m, 2H), 7.30 – 7.24 (m, 1H), 7.23 – 7.17 (m, 2H), 4.09 (s, 2H), 3.05 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 147.73, 139.44, 138.40, 129.82, 128.99, 128.79, 127.64, 126.70, 44.59, 41.83.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}O_2S^+$ 246.0709; Found 246.0705.

The spectral data are consistent with those reported in the literature[13].

1-Benzyl-4-(trifluoromethoxy)benzene



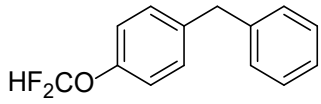
3m

1-Benzyl-4-(trifluoromethoxy)benzene was prepared according to the general procedure A using 4-trifluoromethoxybenzylamine (305 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (85 mg, 0.34 mmol, 68% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.34 (m, 2H), 7.33 – 7.23 (m, 5H), 7.22 – 7.17 (m, 2H), 4.05 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 147.75, 140.58, 140.04, 130.27, 129.05, 128.76, 126.51, 121.16, 120.68 (q, *J* = 256.9 Hz), 41.34.
^{19}F NMR (377 MHz, $CDCl_3$) δ -57.77.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}F_3O^+$ 252.0757; Found 252.0752.

The spectral data are consistent with those reported in the literature[8].

1-Benzyl-4-(difluoromethoxy)benzene



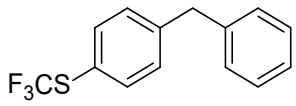
3n

1-Benzyl-4-(difluoromethoxy)benzene was prepared according to the general procedure A using 4-difluoromethoxybenzylamine (281 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (66 mg, 0.28 mmol, 56% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.32 (m, 2H), 7.32 – 7.27 (m, 1H), 7.27 – 7.20 (m, 4H), 7.15 – 7.03 (m, 2H), 6.52 (t, *J* = 74.2 Hz, 1H), 4.03 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 149.69 (t, *J* = 2.8 Hz), 140.85, 138.57, 130.32, 129.00, 128.71, 126.41, 119.76 (d, *J* = 0.9 Hz), 116.19 (t, *J* = 259.3 Hz), 41.29.
^{19}F NMR (377 MHz, $CDCl_3$) δ -80.39.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{12}F_2O^+$ 234.0851; Found 234.0846.

The spectral data are consistent with those reported in the literature[14].

(4-Benzylphenyl)(trifluoromethyl)sulfane

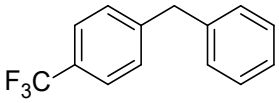


3o

(4-Benzylphenyl)(trifluoromethyl)sulfane was prepared according to the general procedure A using 4-(trifluoromethylthio)benzylamine (316 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (114 mg, 0.43 mmol, 85% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.62 (m, 2H), 7.42 – 7.36 (m, 2H), 7.34 – 7.28 (m, 3H), 7.28 – 7.23 (m, 2H), 4.08 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 144.62, 140.09, 136.68, 130.17, 129.81 (q, *J* = 308.0 Hz), 129.13, 128.81, 126.62, 121.90 (q, *J* = 2.1 Hz), 41.76.
^{19}F NMR (377 MHz, $CDCl_3$) δ -42.83.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}F_3S^+$ 268.0528; Found 268.0524.

1-Benzyl-4-(trifluoromethyl)benzene



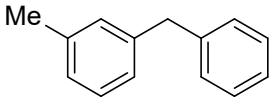
3p

1-Benzyl-4-(trifluoromethyl)benzene was prepared according to the general procedure A using 4-trifluoromethylbenzylamine (285 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (103 mg, 0.44 mmol, 87% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 8.1 Hz, 2H), 7.45 – 7.36 (m, 4H), 7.36 – 7.30 (m, 1H), 7.30 – 7.25 (m, 2H), 4.12 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 145.73 – 145.09 (m), 140.14, 129.34, 129.09, 128.82, 128.63 (q, *J* = 32.3 Hz) 126.63, 125.54 (q, *J* = 3.8 Hz), 124.50 (q, *J* = 271.9 Hz), 41.85.
^{19}F NMR (377 MHz, $CDCl_3$) δ -62.16.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}F_3^+$ 236.0807; Found 236.0804.

The spectral data are consistent with those reported in the literature[8].

1-Benzyl-3-methylbenzene



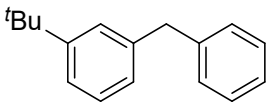
3q

1-Benzyl-3-methylbenzene was prepared according to the general procedure A using 3-methylbenzylamine (251 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (56 mg, 0.31 mmol, 62% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.32 (m, 2H), 7.33 – 7.22 (m, 4H), 7.15 – 7.03 (m, 3H), 4.03 (s, 2H), 2.40 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.39, 141.16, 138.16, 129.85, 129.06, 128.57, 128.48, 126.96, 126.15, 126.12, 42.03, 21.54.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{14}^+$ 182.1090; Found 182.1086.

The spectral data are consistent with those reported in the literature[10].

1-Benzyl-3-(*tert*-butyl)benzene



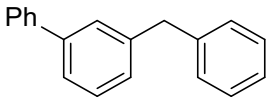
3r

1-Benzyl-3-(*tert*-butyl)benzene was prepared according to the general procedure A using 3-(*tert*-butyl)benzylamine (327 mg, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (79.4 mg, 0.35 mmol, 71% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 – 7.27 (m, 8H), 7.13 – 7.05 (m, 1H), 4.11 (s, 2H), 1.43 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 151.39, 141.43, 140.75, 129.05, 128.55, 128.28, 126.18, 126.16, 126.11, 123.16, 42.33, 34.75, 31.53.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{17}H_{20}^+$ 224.1560; Found 224.1558.

The spectral data are consistent with those reported in the literature[15].

3-Benzyl-1,1'-biphenyl



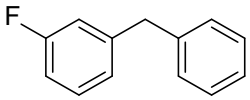
3s

3-Benzyl-1,1'-biphenyl was prepared according to the general procedure A using [1,1'-biphenyl]-3-ylmethanamine (367 mg, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (92 mg, 0.38 mmol, 75% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.52 (m, 2H), 7.45 – 7.36 (m, 4H), 7.35 – 7.24 (m, 4H), 7.24 – 7.10 (m, 4H), 4.02 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.71, 141.54, 141.34, 141.10, 129.07, 129.01, 128.83, 128.63, 128.03, 127.95, 127.34, 127.31, 126.26, 125.12, 42.15.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{19}H_{16}^+$ 244.1247; Found 224.1243.

The spectral data are consistent with those reported in the literature[16].

1-Benzyl-3-fluorobenzene



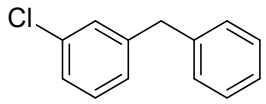
3t

1-Benzyl-3-fluorobenzene was prepared according to the general procedure A using 3-fluorobenzylamine (228 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (73 mg, 0.39 mmol, 79% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.35 (m, 2H), 7.35 – 7.23 (m, 4H), 7.10 – 7.02 (m, 1H), 7.02 – 6.93 (m, 2H), 4.05 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 163.11 (d, *J* = 245.6 Hz), 143.82 (d, *J* = 7.2 Hz), 140.42, 129.96 (d, *J* = 8.3 Hz), 129.06, 128.72, 126.48, 124.67 (d, *J* = 2.8 Hz), 115.91 (d, *J* = 21.2 Hz), 113.11 (d, *J* = 21.1 Hz), 41.76.
^{19}F NMR (377 MHz, $CDCl_3$) δ -113.41.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}F^+$ 186.0839; Found 186.0835.

The spectral data are consistent with those reported in the literature[10].

1-Benzyl-3-chlorobenzene



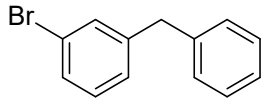
3u

1-Benzyl-3-chlorobenzene was prepared according to the general procedure A using 3-chlorobenzylamine (244 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (91 mg, 0.45 mmol, 89% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.33 (m, 2H), 7.33 – 7.21 (m, 6H), 7.18 – 7.10 (m, 1H), 4.02 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.28, 140.31, 134.38, 129.81, 129.14, 129.05, 128.73, 127.23, 126.50, 126.43, 41.69.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}Cl^+$ 202.0544; Found 202.0544.

The spectral data are consistent with those reported in the literature[10].

1-Benzyl-3-bromobenzene



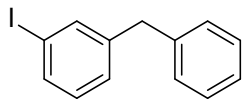
3v

1-Benzyl-3-bromobenzene was prepared according to the general procedure A using 3-bromobenzylamine (251 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (99 mg, 0.40 mmol, 80% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.33 (m, 4H), 7.33 – 7.14 (m, 5H), 4.01 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.57, 140.28, 132.04, 130.12, 129.35, 129.04, 128.73, 127.69, 126.50, 122.69, 41.65.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}Br^+$ 246.0039; Found 246.0035.

The spectral data are consistent with those reported in the literature[10].

1-Benzyl-3-iodobenzene



3w

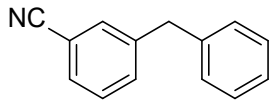
1-Benzyl-3-iodobenzene was prepared according to the general procedure A using 3-iodobenzylamine (266 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (127 mg, 0.43 mmol, 87% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.52 (m, 2H), 7.42 – 7.32 (m, 2H), 7.31 – 7.26 (m, 1H), 7.26 – 7.17 (m, 3H), 7.07 (t, *J* = 7.7 Hz, 1H), 3.98 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.63, 140.29, 137.96, 135.31, 130.30, 129.01, 128.71, 128.33, 126.47, 94.74, 41.54.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}I^+$ 293.9900; Found 293.9894.

The spectral data are consistent with those reported in the literature[17].

3-Benzylbenzonitrile



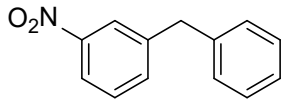
3x

3-Benzylbenzonitrile was prepared according to the general procedure A using 3-(aminomethyl)benzonitrile (264 µL, 2.00 mmol). Flash column chromatography (0−45% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as an orange oil (84 mg, 0.44 mmol, 87% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 – 7.45 (m, 3H), 7.44 – 7.39 (m, 1H), 7.39 – 7.33 (m, 2H), 7.32 – 7.26 (m, 1H), 7.25 – 7.17 (m, 2H), 4.05 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 142.66, 139.47, 133.46, 132.37, 129.94, 129.28, 128.96, 128.82, 126.71, 118.96, 112.52, 41.42.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}N^+$ 193.0886; Found 193.0883.

The spectral data are consistent with those reported in the literature[18].

1-Benzyl-3-nitrobenzene



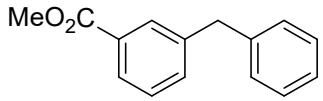
3y

1-Benzyl-3-nitrobenzene was prepared according to the general procedure A using 3-nitrobenzylamine (249 µL, 2.00 mmol). Flash column chromatography (0−40% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as a colourless oil (95 mg, 0.44 mmol, 89% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 – 8.04 (m, 2H), 7.61 – 7.52 (m, 1H), 7.52 – 7.43 (m, 1H), 7.41 – 7.33 (m, 2H), 7.33 – 7.24 (m, 1H), 7.28 – 7.19 (m, 2H), 4.12 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 148.49, 143.29, 139.47, 135.18, 129.43, 128.99, 128.91, 126.82, 123.77, 121.41, 41.58.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}NO_2^+$ 213.0784; Found 213.0783.

The spectral data are consistent with those reported in the literature[19].

Methyl 3-benzylbenzoate



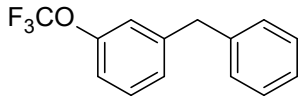
3z

Methyl 3-benzylbenzoate was prepared according to the general procedure A using methyl 4-(aminomethyl)benzoate (330 mg, 2.00 mmol). Flash column chromatography (0–40% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as a colourless oil (98 mg, 0.43 mmol, 86% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 – 7.89 (m, 2H), 7.46 – 7.30 (m, 4H), 7.30 – 7.21 (m, 3H), 4.07 (s, 2H), 3.94 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 167.21, 141.56, 140.57, 133.62, 130.44, 130.12, 128.96, 128.67, 128.63, 127.53, 126.39, 52.14, 41.80.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{15}H_{14}O_2^+$ 226.0988; Found 226.0986.

The spectral data are consistent with those reported in the literature[20].

1-Benzyl-3-(trifluoromethoxy)benzene

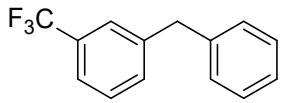


3aa

1-Benzyl-3-(trifluoromethoxy)benzene was prepared according to the general procedure A using 3-trifluoromethoxybenzylamine (301 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (96 mg, 0.38 mmol, 76% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 – 7.28 (m, 4H), 7.28 – 7.24 (m, 2H), 7.22 – 7.17 (m, 1H), 7.17 – 7.12 (m, 2H), 4.07 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 149.59 (q, *J* = 1.9 Hz), 143.62, 140.19, 129.84, 129.07, 128.79, 127.44, 126.59, 121.59 (q, *J* = 1.0 Hz), 120.67 (q, *J* = 256.8 Hz), 118.62 (q, *J* = 1.1 Hz), 41.72.
^{19}F NMR (377 MHz, $CDCl_3$) δ -57.58.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}F_3O^+$ 252.0757; Found 252.0752.

1-Benzyl-3-(trifluoromethyl)benzene



3ab

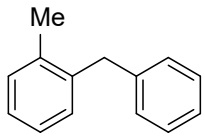
1-Benzyl-3-(trifluoromethyl)benzene was prepared according to the general procedure A using 3-trifluoromethylbenzylamine (287 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (92 mg, 0.39 mmol, 78% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.51 (m, 2H), 7.50 – 7.35 (m, 4H), 7.34 – 7.27 (m, 1H), 7.28 – 7.21 (m, 2H), 4.10 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 142.18, 140.17, 132.62 – 132.32 (m), 130.92 (q, *J* = 32.0 Hz), 129.05, 129.04, 128.82, 126.62, 125.73 (q, *J* = 3.8 Hz), 124.38 (q, *J* = 272.3 Hz), 123.18 (q, *J* = 3.8 Hz), 41.82.
^{19}F NMR (377 MHz, $CDCl_3$) δ -62.39.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}F_3^+$ 236.0807; Found 236.0803.

The spectral data are consistent with those reported in the literature[19].

1-Benzyl-2-methylbenzene



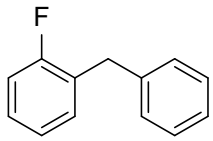
3ac

1-Benzyl-2-methylbenzene was prepared according to the general procedure A using 2-methylbenzylamine (248 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (39 mg, 0.22 mmol, 43% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.32 (m, 2H), 7.30 – 7.16 (m, 7H), 4.07 (s, 2H), 2.33 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 140.53, 139.06, 136.77, 130.42, 130.08, 128.88, 128.52, 126.59, 126.12, 126.05, 39.59, 19.81.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{14}^+$ 182.1090; Found 182.1088.

The spectral data are consistent with those reported in the literature[10].

1-Benzyl-2-fluorobenzene



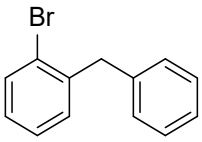
3ad

1-Benzyl-2-fluorobenzene was prepared according to the general procedure A using 2-fluorobenzylamine (229 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (65 mg, 0.35 mmol, 70% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.32 (m, 2H), 7.32 – 7.17 (m, 5H), 7.14 – 7.06 (m, 2H), 4.08 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 161.11 (d, *J* = 245.3 Hz), 139.99, 131.16 (d, *J* = 4.6 Hz), 128.94, 128.64, 128.21 (d, *J* = 16.1 Hz), 128.07 (d, *J* = 8.0 Hz), 126.36, 124.19 (d, *J* = 3.6 Hz), 115.45 (d, *J* = 22.1 Hz), 34.94 (d, *J* = 3.0 Hz).
^{19}F NMR (377 MHz, $CDCl_3$) δ -117.77.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}F^+$ 186.0839; Found 186.0834.

The spectral data are consistent with those reported in the literature[10].

1-Benzyl-2-bromobenzene



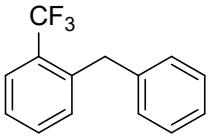
3ae

1-Benzyl-2-bromobenzene was prepared according to the general procedure A using 2-bromobenzylamine (250 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (81 mg, 0.33 mmol, 66% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.36 – 7.30 (m, 2H), 7.29 – 7.20 (m, 4H), 7.18 – 7.15 (m, 1H), 7.11 (ddd, *J* = 7.9, 7.3, 1.8 Hz, 1H), 4.16 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 140.52, 139.63, 133.00, 131.24, 129.14, 128.62, 128.03, 127.61, 126.40, 125.05, 41.87.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{11}Br^+$ 246.0039; Found 246.0037.

The spectral data are consistent with those reported in the literature[10].

1-Benzyl-2-(trifluoromethyl)benzene



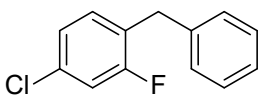
3af

1-Benzyl-2-(trifluoromethyl)benzene was prepared according to the general procedure A using 2-trifluoromethylbenzylamine (281 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (74 mg, 0.31 mmol, 63% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.48 (td, *J* = 7.6, 1.4 Hz, 1H), 7.42 – 7.32 (m, 3H), 7.32 – 7.26 (m, 1H), 7.27 – 7.19 (m, 3H), 4.26 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 140.02, 139.66 (q, *J* = 2.0 Hz), 131.91 (q, *J* = 1.0 Hz), 131.87, 129.29, 128.86 (q, *J* = 30.3 Hz), 128.66, 126.47, 126.35, 126.01 (q, *J* = 5.8 Hz), 124.76 (q, *J* = 273.9 Hz), 37.94.
^{19}F NMR (377 MHz, $CDCl_3$) δ -59.51.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{11}F_3^+$ 236.0807; Found 236.0807.

The spectral data are consistent with those reported in the literature[21].

1-Benzyl-4-chloro-2-fluorobenzene

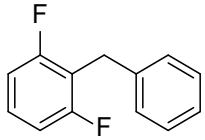


3ag

1-Benzyl-4-chloro-2-fluorobenzene was prepared according to the general procedure A using 4-chloro-2-fluorobenzylamine (251 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (92 mg, 0.42 mmol, 83% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.34 (m, 2H), 7.34 – 7.25 (m, 3H), 7.20 – 7.07 (m, 3H), 4.04 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 160.78 (d, *J* = 249.0 Hz), 139.34 – 139.32 (m), 132.83 (d, *J* = 10.2 Hz), 131.79 (d, *J* = 5.5 Hz), 128.91 – 128.82 (m), 128.74, 126.94 (d, *J* = 16.1 Hz), 126.57, 124.55 (d, *J* = 3.7 Hz), 116.24 (d, *J* = 25.7 Hz), 34.46.
^{19}F NMR (377 MHz, $CDCl_3$) δ -114.97.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{10}ClF^+$ 220.0450; Found 220.0449.

2-Benzyl-1,3-difluorobenzene



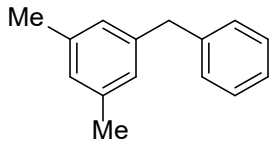
3ah

2-Benzyl-1,3-difluorobenzene was prepared according to the general procedure A using 2,6-difluorobenzylamine (239 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (87 mg, 0.42 mmol, 85% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.34 (m, 4H), 7.31 – 7.15 (m, 2H), 6.94 (ddd, *J* = 8.0, 6.5, 1.1 Hz, 2H), 4.10 (t, *J* = 1.5 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 161.54 (dd, *J* = 247.1, 8.6 Hz), 139.32, 128.63, 128.58, 127.99 (t, *J* = 10.2 Hz), 126.45, 117.01 (t, *J* = 20.3 Hz), 111.69 – 110.84 (m), 28.30.
^{19}F NMR (377 MHz, $CDCl_3$) δ -114.89.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{13}H_{10}F_2^+$ 204.0745; Found 204.0746.

The spectral data are consistent with those reported in the literature[22].

1-Benzyl-3,5-dimethylbenzene



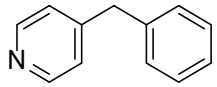
3ai

1-Benzyl-3,5-dimethylbenzene was prepared according to the general procedure A using 3,5-dimethylbenzylamine (284 µL, 2.00 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the product as a colourless oil (60 mg, 0.31 mmol, 62% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 – 7.34 (m, 2H), 7.34 – 7.25 (m, 3H), 6.99 – 6.88 (m, 3H), 4.01 (s, 2H), 2.38 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.49, 141.10, 138.04, 129.04, 128.54, 127.86, 126.91, 126.09, 41.97, 21.40.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{15}H_{16}^+$ 196.1247; Found 196.1244.

The spectral data are consistent with those reported in the literature[23].

4-Benzylpyridine



3aj

4-Benzylpyridine was prepared according to the general procedure using pyridine-4-ylmethanamine (203 µL, 2.00 mmol). Flash column chromatography (0−50% CH_2Cl_2 in hexanes) of the crude reaction mixture afforded the product as a colourless oil (52 mg, 0.31 mmol, 62% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 – 8.40 (m, 2H), 7.39 – 7.31 (m, 2H), 7.31 – 7.23 (m, 1H), 7.23 – 7.17 (m, 2H), 7.16 – 7.08 (m, 2H), 3.99 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 150.21, 149.91, 138.97, 129.17, 128.87, 126.82, 124.33, 41.38.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{12}H_{11}N^+$ 169.0886; Found 169.0883.

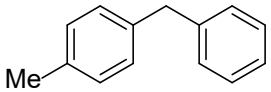
The spectral data are consistent with those reported in the literature[24].

5. Arylboronic acid substrate scope

General procedure B for arylboronic acid scope

A 16 mL oven-dried glass vial equipped with a stirring bar was charged with arylboronic acid (0.50 mmol, 1.00 equiv.) and sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.) The vial was evacuated and refilled with N_2 three times. Anhydrous chloroform (1.25 mL) was then added followed by benzylamine (218 µL, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 2.50 mmol, 5.00 equiv). The reaction was heated at 60˚C for 24 h. The crude reaction mixture was allowed to cool down to room temperature, concentrated and purified by flash column chromatography.

1-Benzyl-4-methylbenzene

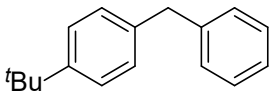


4a

1-Benzyl-4-methylbenzene was prepared according to the general procedure B using 4-methylphenylboronic acid (68 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-4-methylbenzene and 1-benzyl-3-methylbenzene as a colourless oil (53 mg, 0.29 mmol, 58% yield, *para:meta* = 92:8).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.33 (m, 2H), 7.33 – 7.24 (m, 3H), 7.24 – 7.07 (m, 4H), 4.10 – 4.02 (m, 2H), 2.47 – 2.37 (m, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.54, 141.38 (meta), 141.16 (meta), 138.21, 138.15 (meta), 135.65, 129.85 (meta), 129.28, 129.05 (meta), 129.00, 128.95, 128.56, 128.48 (meta), 126.95 (meta), 126.14 (meta), 126.11, 42.03 (meta), 41.65, 21.54 (meta), 21.14.

1-Benzyl-4-(*tert*-butyl)benzene

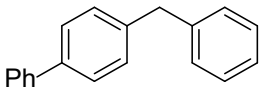


4b

1-Benzyl-4-(*tert*-butyl)benzene was prepared according to the general procedure B using 4-*tert*-butylphenylboronic acid (89 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-4-(*tert*-butyl)benzene and 1-benzyl-3-(*tert*-butyl)benzene as a colourless oil (47 mg, 0.21 mmol, 42% yield, *para:meta* = 91:9).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.33 (m, 4H), 7.33 – 7.24 (m, 3H), 7.24 – 7.16 (m, 2H), 7.12 – 6.99 (m, 1H, meta), 4.07 (s, 2H, meta), 4.04 (s, 2H), 1.39 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 151.39 (meta), 148.96, 141.42, 140.75 (meta), 138.22, 129.11, 129.05 (meta), 128.65, 128.56, 128.55 (meta), 128.28 (meta), 126.17 (meta), 126.16 (meta), 126.13, 126.11 (meta), 125.48, 123.15 (meta), 42.33 (meta), 41.58, 34.75 (meta), 34.50, 31.54.

4-Benzyl-1,1'-biphenyl

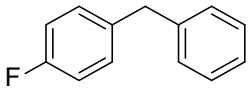


4c

4-Benzyl-1,1'-biphenyl was prepared according to the general procedure B using 4-biphenylboronic acid (99 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 4-benzyl-1,1'-biphenyl and 3-benzyl-1,1'-biphenyl as a white solid (90 mg, 0.37 mmol, 74% yield, *para:meta* = 93:7).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.60 (m, 2H), 7.59 – 7.54 (m, 2H), 7.51 – 7.43 (m, 2H), 7.40 – 7.20 (m, 8H), 4.10 (s, 2H, meta), 4.07 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.71 (meta), 141.55 (meta), 141.35 (meta), 141.13, 141.12, 140.37, 139.16, 129.45, 129.10, 129.01 (meta), 128.85, 128.65, 128.03 (meta), 127.96 (meta), 127.34, 127.20, 127.13, 126.28, 125.12 (meta), 42.16 (meta), 41.71.

1-Benzyl-4-fluorobenzene

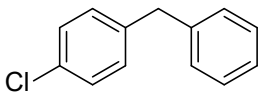


4d

1-Benzyl-4-fluorobenzene was prepared according to the general procedure B using 4-fluorophenylboronic acid (70 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-4-fluorobenzene and 1-benzyl-3-fluorobenzene as a colourless oil (62 mg, 0.33 mmol, 67% yield, *para:meta* = 93:7).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.32 (m, 2H), 7.32 – 7.15 (m, 5H), 7.03 (td, *J* = 8.8, 2.0 Hz, 2H), 6.97 – 6.91 (m, 2H, meta), 4.04 (s, 2H, meta), 4.02 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 161.56 (d, *J* = 243.9 Hz), 141.08, 140.42 (meta), 136.90 (d, *J* = 3.2 Hz), 130.42 (d, *J* = 7.8 Hz), 129.96 (d, *J* = 8.3 Hz, meta), 129.06 (meta), 128.97, 128.72 (meta), 128.67, 126.48 (meta), 126.34, 124.68 (meta), 115.91 (d, *J* = 21.4 Hz, meta), 115.34 (d, *J* = 21.2 Hz), 113.11 (d, *J* = 21.1 Hz, meta), 41.76 (d, *J* = 1.7 Hz, meta), 41.21.
^{19}F NMR (376 MHz, $CDCl_3$) δ -113.40 (meta), -117.26.

1-Benzyl-4-chlorobenzene

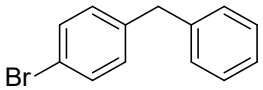


4e

1-Benzyl-4-chlorobenzene was prepared according to the general procedure B using 4-chlorophenylboronic acid (78 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-4-chlorobenzene and 1-benzyl-3-chlorobenzene as a colourless oil (76 mg, 0.37 mmol, 75% yield, *para:meta* = 94:6).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.34 (m, 2H), 7.34 – 7.21 (m, 5H), 7.21 – 7.12 (m, 2H), 4.01 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.28 (meta), 140.67, 140.31 (meta), 139.71, 134.37 (meta), 132.02, 130.38, 129.81 (meta), 129.14 (meta), 129.05 (meta), 128.99, 128.73 (meta), 128.69, 128.69, 127.23 (meta), 126.50 (meta), 126.42, 41.69 (meta), 41.36.

1-Benzyl-4-bromobenzene

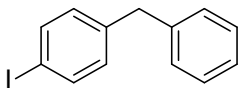


4f

1-Benzyl-4-bromobenzene was prepared according to the general procedure B using 4-bromophenylboronic acid (100 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-4-bromobenzene and 1-benzyl-3-bromobenzene as a colourless oil (81 mg, 0.33 mmol, 65% yield, *para:meta* = 95:5).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 – 7.43 (m, 2H), 7.42 – 7.32 (m, 2H), 7.31 – 7.26 (m, 1H), 7.25 – 7.20 (m, 2H), 7.20 – 7.15 (m, 2H, meta), 7.15 – 7.09 (m, 2H), 4.01 (s, 2H, meta), 3.99 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.57 (meta), 140.56, 140.28 (meta), 140.22, 132.04 (meta), 131.63, 130.79, 130.12 (meta), 129.35 (meta), 129.04 (meta), 128.98, 128.73 (meta), 128.70, 127.69 (meta), 126.50 (meta), 126.43, 122.69 (meta), 120.06, 41.65 (meta), 41.42.

1-Benzyl-4-iodobenzene

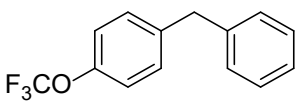


4g

1-Benzyl-4-iodobenzene was prepared according to the general procedure B using 4-iodophenylboronic acid (124 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-4-iodobenzene and 1-benzyl-3-iodobenzene as a colourless oil (116 mg, 0.39 mmol, 79% yield, *para:meta* = 96:4).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.65 (m, 2H), 7.64 – 7.57 (m, 2H, meta), 7.40 – 7.33 (m, 2H), 7.32 – 7.26 (m, 1H), 7.26 – 7.19 (m, 2H), 7.08 (t, *J* = 7.7 Hz, 1H, meta), 7.04 – 6.93 (m, 2H), 3.99 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.63 (meta), 140.87, 140.48, 140.28 (meta), 137.95 (meta), 137.59, 135.30 (meta), 131.12, 130.29 (meta), 129.00 (meta), 128.97, 128.71 (meta), 128.68, 128.32 (meta), 126.47 (meta), 126.41, 94.74 (meta), 91.45, 41.53 (meta), 41.51.

1-Benzyl-4-(trifluoromethoxy)benzene



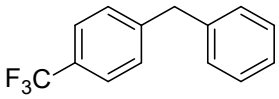
4h

1-Benzyl-4-(trifluoromethoxy)benzene was prepared according to the general procedure B using 4-trifluoromethoxyphenylboronic acid (103 mg, 0.50 mmol). Flash column chromatography (hexanes)

of the crude reaction mixture afforded the products 1-benzyl-4-(trifluoromethoxy)benzene and 1-benzyl-3-(trifluoromethoxy)benzene as a colourless oil (80 mg, 0.32 mmol, 63% yield, *para:meta* = 94:6).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.33 (m, 2H), 7.32 – 7.22 (m, 5H), 7.19 (d, *J* = 8.3 Hz, 2H), 7.12 (d, *J* = 8.3 Hz, 2H, meta), 4.05 (s, 2H, meta), 4.04 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 147.76 (d, *J* = 1.9 Hz), 143.60 (meta), 140.58, 140.18 (meta), 140.04, 130.27, 129.84 (meta), 129.05, 128.76, 127.43 (meta), 126.58 (meta), 126.51, 121.58 (meta), 121.16 (q, *J* = 1.0 Hz), 120.68 (q, *J* = 256.7 Hz), 118.62 (meta), 41.72 (meta), 41.34.
^{19}F NMR (377 MHz, $CDCl_3$) δ -57.58 (meta), -57.78.

1-Benzyl-4-(trifluoromethyl)benzene

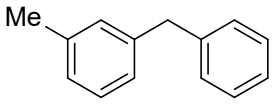


4i

1-Benzyl-4-(trifluoromethyl)benzene was prepared according to the general procedure B using 4-trifluoromethylphenylboronic acid (95 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-4-(trifluoromethyl)benzene and 1-benzyl-3-(trifluoromethyl)benzene as a colourless oil (76 mg, 0.32 mmol, 65% yield, *para:meta* = 92:8).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.56 (m, 2H), 7.55 – 7.41 (m, 6H, meta), 7.41 – 7.34 (m, 4H), 7.33 – 7.27 (m, 1H), 7.27 – 7.20 (m, 2H), 4.09 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 145.73 – 145.09 (m), 142.17 (meta), 140.16 (meta), 140.13, 132.46 (q, *J* = 1.0 Hz, meta), 129.34, 129.08, 129.05 (meta), 129.04 (meta), 128.81, 128.63 (q, *J* = 32.3 Hz), 126.62, 125.72 (q, *J* = 3.8 Hz, meta), 125.54 (q, *J* = 3.8 Hz), 124.50 (q, *J* = 271.9 Hz), 123.17 (q, *J* = 3.9 Hz, meta), 41.85, 41.82 (meta).
^{19}F NMR (377 MHz, $CDCl_3$) δ -62.18, -62.37 (meta).

1-Benzyl-3-methylbenzene

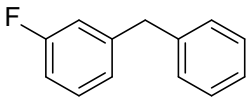


4j

1-Benzyl-3-methylbenzene was prepared according to the general procedure B using 3-methylphenylboronic acid (68 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-3-methylbenzene, 1-benzyl-4-methylbenzene and 1-benzyl-2-methylbenzene as a colourless oil (64 mg, 0.35 mmol, 70% yield, *meta:para:ortho* = 94:3:3).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.33 (m, 2H), 7.33 – 7.22 (m, 4H), 7.23 – 7.17 (m, 4H, minor isomer), 7.15 – 7.05 (m, 3H), 4.08 (s, 2H, minor isomer), 4.04 (s, 2H), 2.41 (s, 3H), 2.34 (s, 3H, minor isomer).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.38, 141.16, 140.52 (ortho), 138.15, 130.41 (ortho), 130.08 (ortho), 129.85, 129.28 (para), 129.05, 129.04 (para), 128.95 (para), 128.87 (ortho), 128.56, 128.51 (ortho), 128.48, 126.96, 126.59 (ortho), 126.14, 126.12, 126.05 (ortho), 42.03, 41.65 (para), 39.58 (ortho), 21.54, 21.14 (para), 19.80 (ortho).

1-Benzyl-3-fluorobenzene

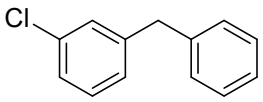


4k

1-Benzyl-3-fluorobenzene was prepared according to the general procedure B using 3-fluorophenylboronic acid (70 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-3-fluorobenzene, 1-benzyl-4-fluorobenzene and 1-benzyl-2-fluorobenzene as a colourless oil (63 mg, 0.34 mmol, 67% yield, *meta:para:ortho* = 96:2:2).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.33 (m, 2H), 7.33 – 7.20 (m, 4H), 7.08 – 7.01 (m, 1H), 7.01 – 6.90 (m, 2H), 4.07 (s, 2H, minor isomer), 4.03 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 163.11 (d, *J* = 245.6 Hz), 143.82 (d, *J* = 7.1 Hz), 140.42, 129.96 (d, *J* = 8.3 Hz), 129.07, 128.97 (para), 128.93 (ortho), 128.72, 126.48, 126.36 (ortho), 124.67 (d, *J* = 2.8 Hz), 115.92 (d, *J* = 21.2 Hz), 115.34 (d, *J* = 21.1 Hz, para), 113.11 (d, *J* = 21.0 Hz), 41.76 (d, *J* = 1.8 Hz), 41.21 (para).
^{19}F NMR (377 MHz, $CDCl_3$) δ -113.45, -117.30 (para), -117.78 (ortho).

1-Benzyl-3-chlorobenzene



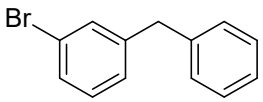
4l

1-Benzyl-3-chlorobenzene was prepared according to the general procedure B using 3-chlorophenylboronic acid (78 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-3-chlorobenzene, 1-benzyl-4-chlorobenzene and 1-benzyl-2-chlorobenzene as a colourless oil (71 mg, 0.35 mmol, 70% yield, *meta:para:ortho* = 94:4:2).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.42 (m, 2H, minor isomer), 7.43 – 7.34 (m, 2H), 7.34 – 7.22 (m, 6H), 7.21 – 7.17 (m, 3H, minor isomer), 7.17 – 7.12 (m, 1H), 4.19 (s, 2H, minor isomer), 4.02 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.28, 140.31, 139.71 (para), 134.37, 132.02 (para), 131.15 (ortho), 130.38 (para), 129.81, 129.66 (ortho), 129.14, 129.05, 128.99 (para), 128.91 (ortho), 128.73, 128.69 (para), 128.60 (ortho), 127.78 (ortho), 127.23, 126.95 (ortho), 126.50, 126.43, 126.37 (ortho), 41.69, 41.36 (para), 39.31 (ortho).

The spectral data for the ortho isomer are consistent with those reported in the literature[25].

1-Benzyl-3-bromobenzene

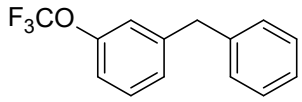


4m

1-Benzyl-3-bromobenzene was prepared according to the general procedure B using 3-bromophenylboronic acid (100 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-3-bromobenzene, 1-benzyl-4-bromobenzene and 1-benzyl-2-bromobenzene as a colourless oil (83 mg, 0.34 mmol, 67% yield, *meta:para:ortho* = 89:7:4).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (dd, *J* = 8.0, 1.3 Hz, 1H, minor isomer), 7.50 – 7.45 (m, 2H, minor isomer), 7.44 – 7.33 (m, 4H), 7.33 – 7.15 (m, 5H), 7.13 (d, *J* = 8.3 Hz, 2H, minor isomer), 4.20 (s, 2H, minor isomer), 4.01 (s, 2H), 4.00 (s, 2H, minor isomer).
^{13}C NMR (101 MHz, $CDCl_3$) δ 143.57, 140.55 (para), 140.28, 140.22 (para), 139.60 (ortho), 132.97 (ortho), 132.03, 131.63 (para), 131.21 (ortho), 130.78 (para), 130.12, 129.35, 129.12 (ortho), 129.03, 128.98 (para), 128.73, 128.70 (para), 128.60 (ortho), 128.01 (ortho), 127.69, 127.58 (ortho), 126.50, 126.43 (para), 122.68, 120.06 (para), 41.85 (ortho), 41.65, 41.42 (para).

1-Benzyl-3-(trifluoromethoxy)benzene

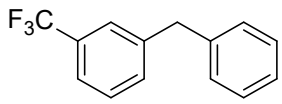


4n

1-Benzyl-3-(trifluoromethoxy)benzene was prepared according to the general procedure B using 3-trifluoromethoxyphenylboronic acid (103 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-3-(trifluoromethoxy)benzene and 1-benzyl-4-(trifluoromethoxy)benzene as a colourless oil (65 mg, 0.26 mmol, 52% yield, *meta:para* = 98:2).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.30 (m, 3H), 7.31 – 7.25 (m, 1H), 7.27 – 7.19 (m, 2H), 7.20 – 7.12 (m, 1H), 7.13 – 7.08 (m, 2H), 4.04 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 149.57 (q, *J* = 1.8 Hz), 143.60, 140.18, 130.27 (para), 129.84, 129.06, 128.79, 127.43, 126.58, 121.58 (q, *J* = 1.0 Hz), 121.16 (para), 120.65 (d, *J* = 256.8 Hz), 118.62 (q, *J* = 1.2 Hz), 41.72, 41.35 (para).
^{19}F NMR (377 MHz, $CDCl_3$) δ -57.60, -57.80 (para).

1-Benzyl-3-(trifluoromethyl)benzene

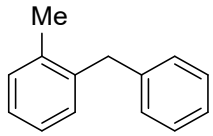


4o

1-Benzyl-3-(trifluoromethyl)benzene was prepared according to the general procedure B using 3-trifluoromethylphenylboronic acid (95 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-3-(trifluoromethyl)benzene, 1-benzyl-4-(trifluoromethyl)benzene and 1-benzyl-2-(trifluoromethyl)benzene as a colourless oil (82 mg, 0.35 mmol, 70% yield, *meta:para* = 96:4).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 – 7.58 (m, 2H, para), 7.56 – 7.48 (m, 2H), 7.48 – 7.34 (m, 4H), 7.33 – 7.27 (m, 1H), 7.27 – 7.21 (m, 2H), 4.10 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 142.18, 140.17, 132.46 (q, *J* = 1.4 Hz), 130.92 (q, *J* = 32.0 Hz), 129.34 (para), 129.05, 129.04, 128.82, 128.61 (q, *J* = 32.2 Hz, para), 126.62, 125.73 (q, *J* = 3.9 Hz), 125.54 (q, *J* = 3.8 Hz, para), 124.38 (q, *J* = 273.3 Hz), 123.18 (q, *J* = 3.8 Hz), 41.82.
^{19}F NMR (377 MHz, $CDCl_3$) δ -62.22 (para), -62.41.

1-Benzyl-2-methylbenzene

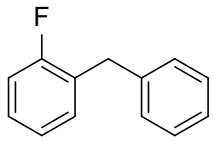


4p

1-Benzyl-2-methylbenzene was prepared according to the general procedure B using 2-methylphenylboronic acid (68 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-2-methylbenzene and 1-benzyl-3-methylbenzene as a colourless oil (46 mg, 0.25 mmol, 51% yield, *ortho:meta* = 94:6).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.30 (m, 2H), 7.30 – 7.13 (m, 7H), 7.15 – 7.03 (m, 3H, meta), 4.06 (s, 2H), 4.01 (s, 2H, meta), 2.38 (s, 3H, meta), 2.31 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.38 (meta), 141.17 (meta), 140.53, 139.06, 138.17 (meta), 136.77, 130.42, 130.08, 129.86 (meta), 129.06 (meta), 128.88, 128.57 (meta), 128.52, 128.48 (meta), 126.96 (meta), 126.59, 126.15 (meta), 126.12, 126.05, 42.03 (meta), 39.59, 21.54 (meta), 19.81.

1-Benzyl-2-fluorobenzene

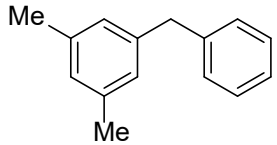


4q

1-Benzyl-2-fluorobenzene was prepared according to the general procedure B using 2-fluorophenylboronic acid (70 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude reaction mixture afforded the products 1-benzyl-2-fluorobenzene and 1-benzyl-3-fluorobenzene as a colourless oil (34 mg, 0.18 mmol, 36% yield, *ortho:meta* = 96:4).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.30 (m, 2H), 7.30 – 7.15 (m, 5H), 7.14 – 7.05 (m, 2H), 7.04 – 6.81 (m, 4H, meta), 4.05 (s, 2H), 4.02 (s, 2H, meta).
^{13}C NMR (101 MHz, $CDCl_3$) δ 161.11 (d, *J* = 245.4 Hz), 140.00, 131.17 (d, *J* = 4.7 Hz), 129.97 (d, *J* = 8.2 Hz, meta), 129.07 (meta), 128.94 (d, *J* = 0.8 Hz), 128.72 (meta), 128.64, 128.21 (d, *J* = 16.2 Hz), 128.07 (d, *J* = 8.0 Hz), 126.48 (meta), 126.36, 124.67 (d, *J* = 2.7 Hz, meta), 124.20 (d, *J* = 3.6 Hz), 115.45 (d, *J* = 22.1 Hz), 113.11 (d, *J* = 21.5 Hz, meta), 34.94 (d, *J* = 3.0 Hz).
^{19}F NMR (377 MHz, $CDCl_3$) δ -113.48 (meta), -117.80.

1-Benzyl-3,5-dimethylbenzene



4r

1-Benzyl-3,5-dimethylbenzene was prepared according to the general procedure B using 3,5-dimethylphenylboronic acid (75 mg, 0.50 mmol). Flash column chromatography (hexanes) of the crude

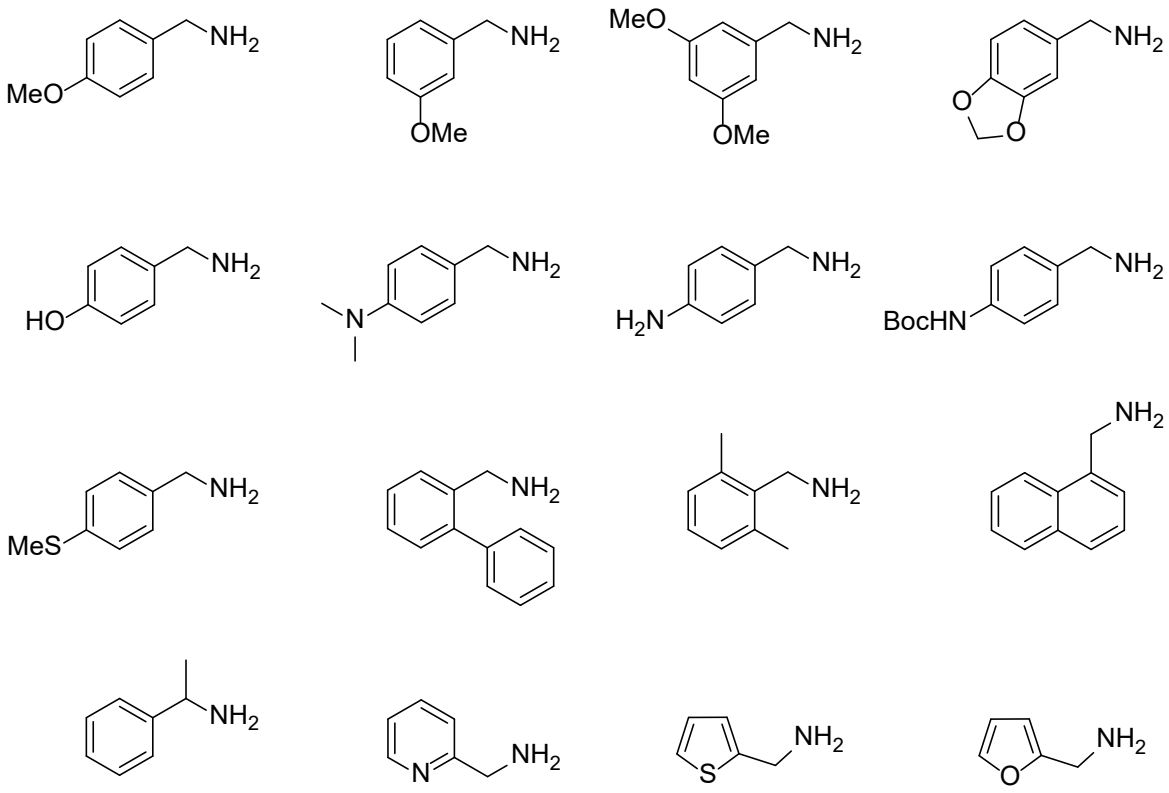
reaction mixture afforded the products 1-benzyl-3,5-dimethylbenzene and 1-benzyl-2,4-dimethylbenzene as a colourless oil (56 mg, 0.28 mmol, 57% yield, *major:minor* = 99:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.31 (m, 2H), 7.31 – 7.23 (m, 3H), 6.95 – 6.86 (m, 3H), 3.99 (s, 2H), 2.36 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.50, 141.11, 138.06, 131.26 (minor), 130.04 (minor), 129.05, 128.83 (minor), 128.55, 128.49 (minor), 127.86, 126.92, 126.73 (minor), 126.10, 125.96 (minor), 41.97, 39.18 (minor), 21.41, 21.08 (minor), 19.73 (minor).

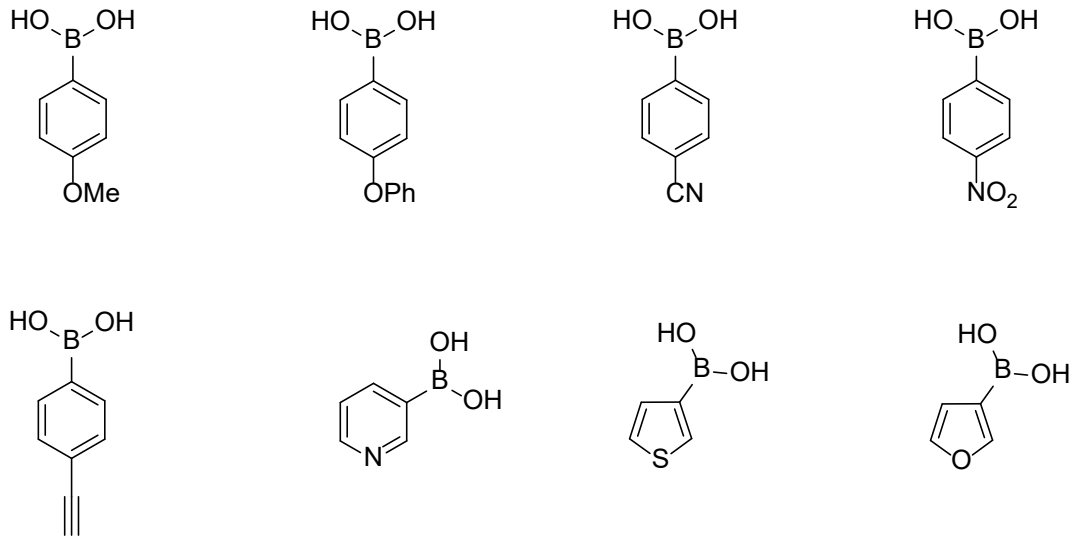
The spectral data for the major and minor isomer are consistent with those reported in the literature[23].

6. Unsuccessful substrates

Benzylamines

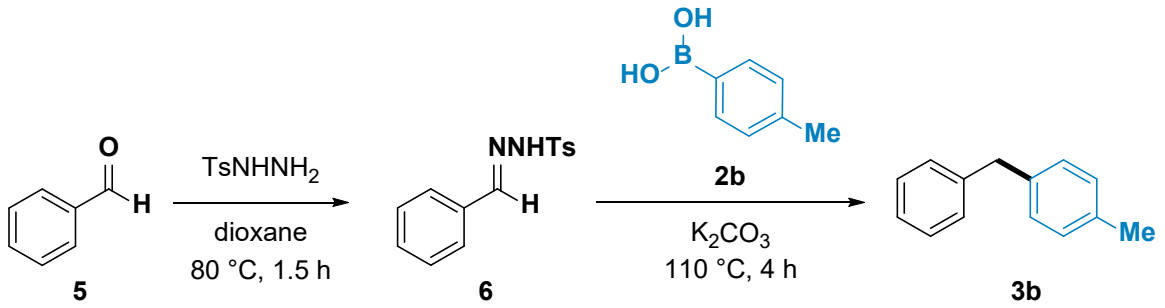


Arylboronic acids

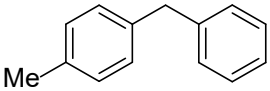


7. Mechanistic experiments

7.1. Probing the isomer formation in the diazo pathway



1-Benzyl-4-methylbenzene

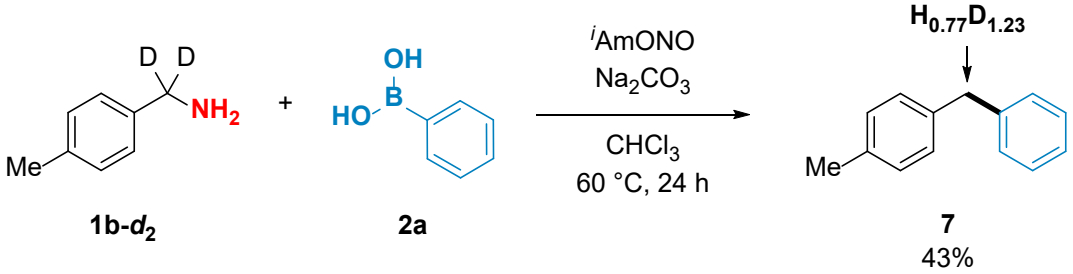


3b

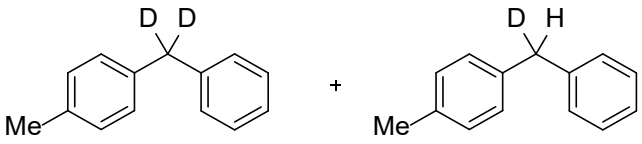
1-Benzyl-4-methylbenzene was synthesised according to the previously reported procedure[26]. A 16 mL oven-dried glass vial equipped with a stirring bar was charged with dry dioxane (4 mL), benzaldehyde (102 µL, 1.00 mmol, 1.00 equiv.) and tosylhydrazide (187 mg, 1.00 mmol, 1.00 equiv.) and the reaction mixture was stirred at 80 °C for 90 min. Potassium carbonate (207 mg, 1.50 mmol, 1.50 equiv.) and 4-methylphenylboronic acid (204 mg, 1.50 mmol, 1.50 equiv.) were then added. The reaction mixture was stirred at 110 °C for 4 h. The crude reaction mixture was allowed to cool down to room temperature and a saturated aqueous solution of $NaHCO_3$ and dichloromethane were added. The layers were separated and the aqueous phase was extracted with dichloromethane three times. The combined organic layers were washed with brine, dried over $MgSO_4$ and filtered. The solvent was removed under reduced pressure and the residue purified by flash column chromatography (hexanes) to yield 1-benzyl-4-methylbenzene as a colourless oil (110 mg, 0.60 mmol, 60% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 – 7.29 (m, 2H), 7.27 – 7.20 (m, 3H), 7.17 – 7.10 (m, 4H), 3.99 (s, 2H), 2.36 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.56, 138.22, 135.68, 129.29, 129.01, 128.95, 128.57, 126.11, 41.66, 21.15.

7.2. Deuterium-hydrogen scrambling



1-Methyl-4-(phenylmethyl-d_2)benzene and 1-methyl-4-(phenylmethyl-d)benzene

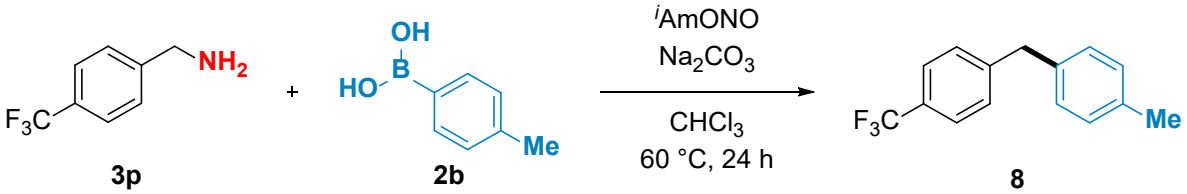


7

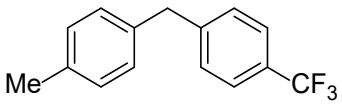
A 16 mL oven-dried glass vial equipped with a stirring bar was charged with phenylboronic acid (61 mg, 0.50 mmol, 1.00 equiv.) and sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.). The vial was sealed with a septum cap and evacuated and refilled with N_2 three times. Dry chloroform (1.25 mL) was then added followed by *p*-tolylmethan-d_2-amine (246 mg, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 2.50 mmol, 5.00 equiv.). The reaction was heated at 60 °C for 24 h. The crude reaction mixture was concentrated and purified by flash column chromatography (hexanes) to yield a mixture of 1-methyl-4-(phenylmethyl-d_2)benzene and 1-methyl-4-(phenylmethyl-d)benzene as a colourless oil (40 mg, 0.22 mmol, 43% yield, 0.77H incorporation per benzylic position).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.32 (m, 2H), 7.31 – 7.24 (m, 3H), 7.21 – 7.11 (m, 4H), 4.02 – 3.99 (m, 0.77H), 2.40 (s, 3H).
^{2}H NMR (92 MHz, $CDCl_3$) δ 3.94, 3.92, 3.87.
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.52, 138.18, 135.68, 129.28, 129.00, 128.94, 128.57, 126.12, 41.71 – 40.85 (m), 21.15.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{14}H_{13}D^+$ 183.1153; Found 183.1151.

7.3. Probing the isomer ratio using an electron-deficient benzylamine



1-Methyl-4-(4-(trifluoromethyl)benzyl)benzene

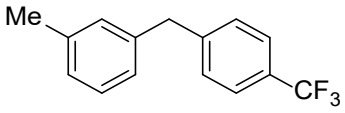


8

A 16 mL oven-dried glass vial equipped with a stirring bar was charged with 4-methylphenylboronic acid (68 mg, 0.50 mmol, 1.00 equiv.) and sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.). The vial was sealed with a septum cap and evacuated and refilled with N_2 three times. Dry chloroform (1.25 mL) was then added followed by 4-trifluoromethylbenzylamine (285 mg, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 2.50 mmol, 5.00 equiv.). The reaction was heated at 60 °C for 24 h. The crude reaction mixture was concentrated and purified by flash column chromatography (hexanes) to yield products 1-methyl-4-(4-(trifluoromethyl)benzyl)benzene and 1-methyl-3-(4-trifluoromethyl) benzyl)benzene as a colourless oil (102 mg, 0.41 mmol, 81% yield, 95:5 *p:m* isomer ratio).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 – 7.57 (m, 2H), 7.42 – 7.34 (m, 2H), 7.33 – 7.25 (m, 1H, minor isomer), 7.24 – 7.19 (m, 2H), 7.17 (d, *J* = 8.2 Hz, 2H), 7.14 – 7.05 (m, 1H, minor isomer), 4.08 (s, 2H), 2.42 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 145.70 (q, *J* = 1.4 Hz), 145.52 (meta), 140.06 (meta), 138.46 (meta), 137.10, 136.18, 129.86 (meta), 129.51, 129.31 (meta), 129.26, 128.96, 128.70 (meta), 127.38 (meta), 126.12 (meta), 125.51 (q, *J* = 3.8 Hz), 124.51 (q, *J* = 271.8 Hz), 41.81 (meta), 41.44, 21.49 (meta), 21.11. (signal of the aromatic quaternary carbon *ipso* to CF_3 is missing due to overlap)
^{19}F NMR (377 MHz, $CDCl_3$) δ -62.24.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{15}H_{13}F_3^+$ 250.0964; Found 250.0963.

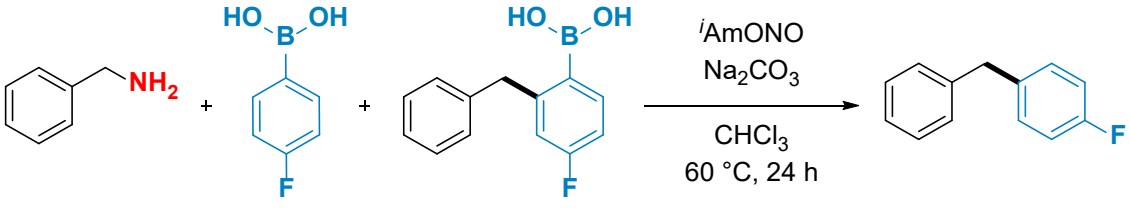
1-Methyl-3-(4-trifluoromethyl)benzyl)benzene (synthesis of the minor isomer)



A 16 mL oven-dried glass vial equipped with a stirring bar was charged with 3-methylphenylboronic acid (68 mg, 0.50 mmol, 1.0 equiv.) and sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.). The vial was sealed with an septum cap and evacuated and refilled with N_2 three times. Dry chloroform (1.25 mL) was then added followed by 4-trifluoromethylbenzylamine (285 mg, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 2.50 mmol, 5.00 equiv.). The reaction was heated at 60 °C for 24 h. The crude reaction mixture was concentrated and purified by flash column chromatography (hexanes) to yield 1-methyl-3-(4-(trifluoromethyl)benzyl)benzene as a colourless oil (108 mg, 0.43 mmol, 86% yield).

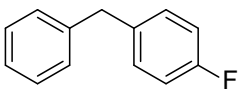
^{1}H NMR (400 MHz, $CDCl_3$) (major isomer) δ 7.65 – 7.57 (m, 2H), 7.40 – 7.34 (m, 2H), 7.31 – 7.25 (m, 1H), 7.17 – 7.09 (m, 1H), 7.10 – 7.04 (m, 2H), 4.07 (s, 2H), 2.41 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) (major isomer) δ 145.52 (q, *J* = 1.5 Hz), 140.06, 138.46, 129.86, 129.32, 128.70, 127.38, 126.12, 125.52 (q, *J* = 3.8 Hz), 124.51 (q, *J* = 271.8 Hz), 41.81, 21.50. (signal of the aromatic quaternary carbon *ipso* to CF_3 is missing due to overlap)
^{19}F NMR (377 MHz, $CDCl_3$) δ -62.26.
HRMS (ESI) m/z: $[M]^+$ Calculated for $C_{15}H_{13}F_3^+$ 250.0964; Found 250.0961.

7.4. Probing pathway 1 for the minor isomer formation



1a **2d** **9** 10 mol% **4d** 55% *p:m* 94:6

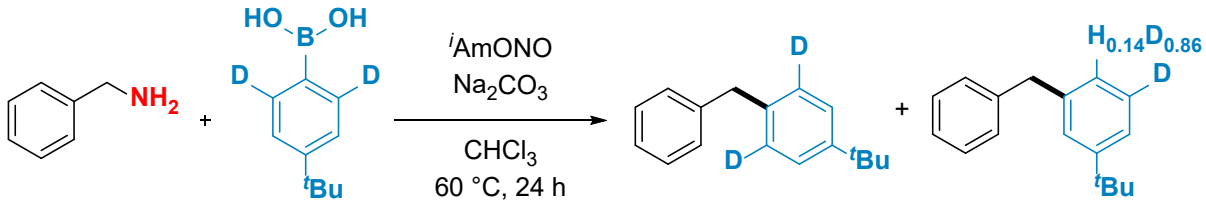
1-Benzyl-4-fluorobenzene



4d

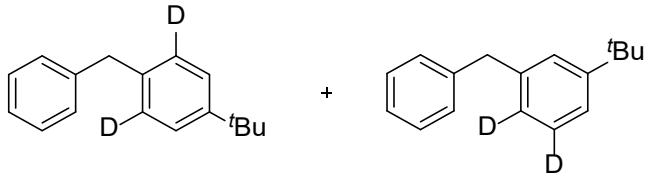
A 16 mL oven-dried glass vial equipped with a stirring bar was charged with 4-fluorophenylboronic acid (70 mg, 0.50 mmol, 1.0 equiv.), (2-benzyl-4-fluorophenyl)boronic acid (12 mg, 0.05 mmol, 0.10 equiv.) and sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.). The vial was sealed with a septum cap and evacuated and refilled with N_2 three times. Dry chloroform (1.25 mL) was then added followed by benzylamine (218 µL, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 2.50 mmol, 5.00 equiv.). The reaction was heated at 60 °C for 24 h. The crude reaction mixture was concentrated and purified by flash column chromatography (hexanes) to yield products 1-benzyl-4-fluorobenzene and 1-benzyl-3-fluorobenzene as a colourless oil (52 mg, 0.28 mmol, 55% yield, 94:6 *p:m* isomer ratio).

7.5. Probing pathway 2 for the minor isomer formation



1a **10** 88% *D* **11** 55% *p:m* 92:8

1-Benzyl-(4-(*tert*-butyl)benzene-2,6-d_2 and 1-benzyl-3-(*tert*-butyl)benzene-5,6-d_2



major **11** minor

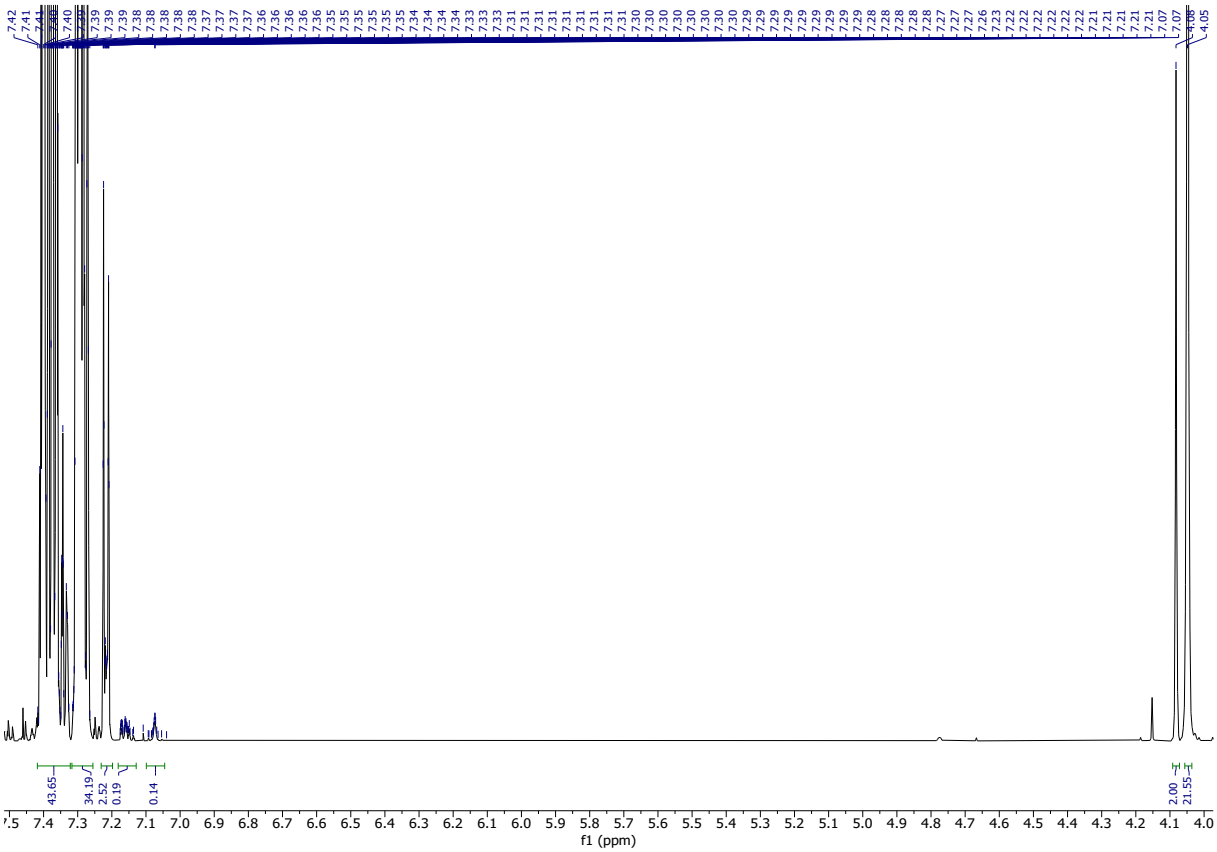
A 16 mL oven-dried glass vial equipped with a stirring bar was charged with (4-(*tert*-butyl)phenyl-2,6-d_2)boronic acid (90 mg, 0.50 mmol, 1.0 equiv.) and sodium carbonate (53 mg, 0.50 mmol, 1.00 equiv.). The vial was sealed with a septum cap and evacuated and refilled with N_2 three times. Anhydrous chloroform (1.25 mL) was then added followed by benzylamine (218 µL, 2.00 mmol, 4.00 equiv.) and isoamyl nitrite (335 µL, 3.00 mmol, 5.00 equiv.). The reaction was heated at 60 °C for 24 h. The crude reaction mixture was concentrated and purified by flash column chromatography (hexanes) to yield a mixture of 1-benzyl-4-(*tert*-butyl)benzene-2,6-d_2 and 1-benzyl-3-(*tert*-butyl)benzene-5,6-d_2 as a colourless oil (62 mg, 0.28 mmol, 55% yield, *para:meta* = 92:8).

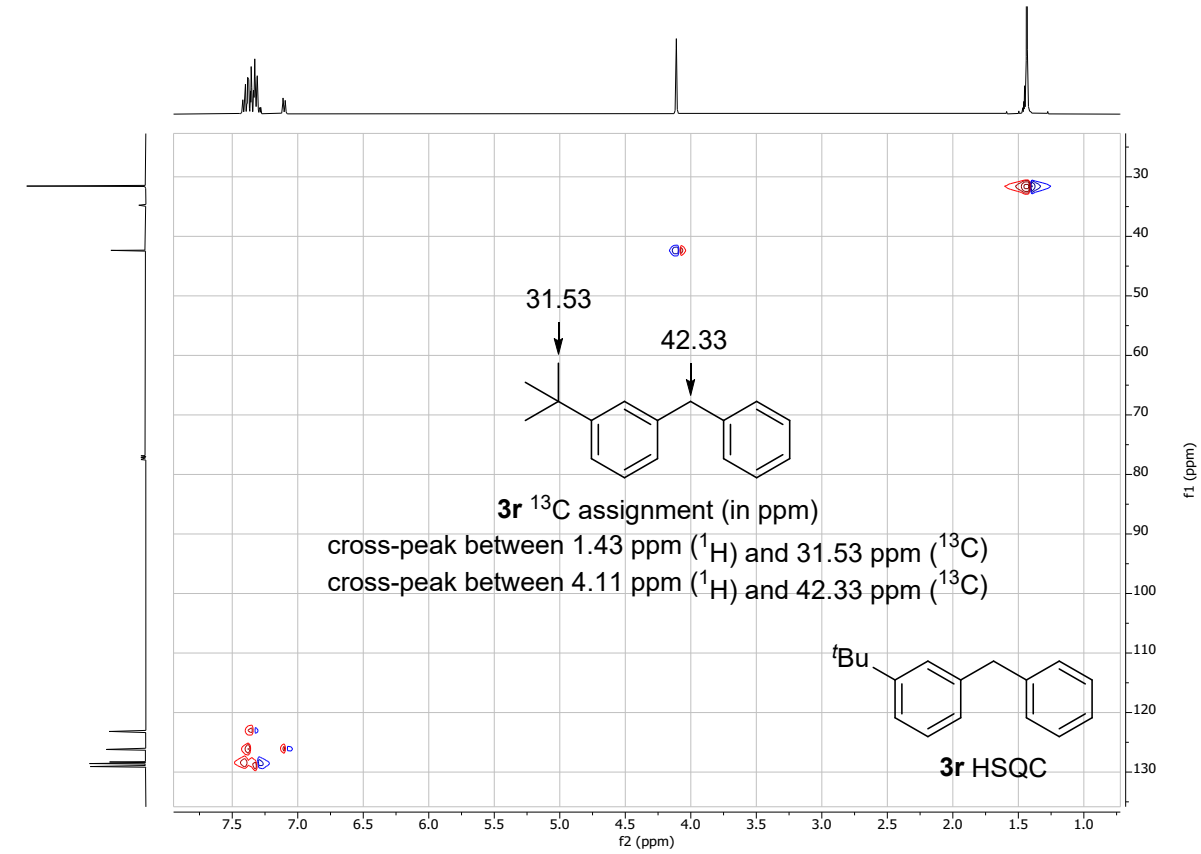
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.42 – 7.32 (m, 4H), 7.32 – 7.26 (m, 3H, major), 7.24 – 7.19 (m, 3H, minor), 4.08 (s, 2H, minor), 4.05 (s, 2H, major), 1.40 (s, 9H, minor), 1.40 (s, 9H, major).
^{2}H NMR (92 MHz, $CDCl_3$) δ 7.35, 7.17, 7.03.
^{13}C NMR (151 MHz, $CDCl_3$) δ 151.39 (minor), 148.95, 148.88 (minor), 141.42, 140.66 (minor), 138.13 (minor), 138.05, 129.11, 129.05 (minor), 128.65 (minor), 128.57, 128.50 – 128.13 (m), 126.13, 125.48 (minor), 125.37, 123.04 (minor), 41.53 (minor), 41.48, 34.75 (minor), 34.50, 31.55.
HRMS (ESI) m/z: $[M+Na]^+$ Calculated for $C_{17}H_{18}D_2^+$ 226.1685; Found 226.1683.

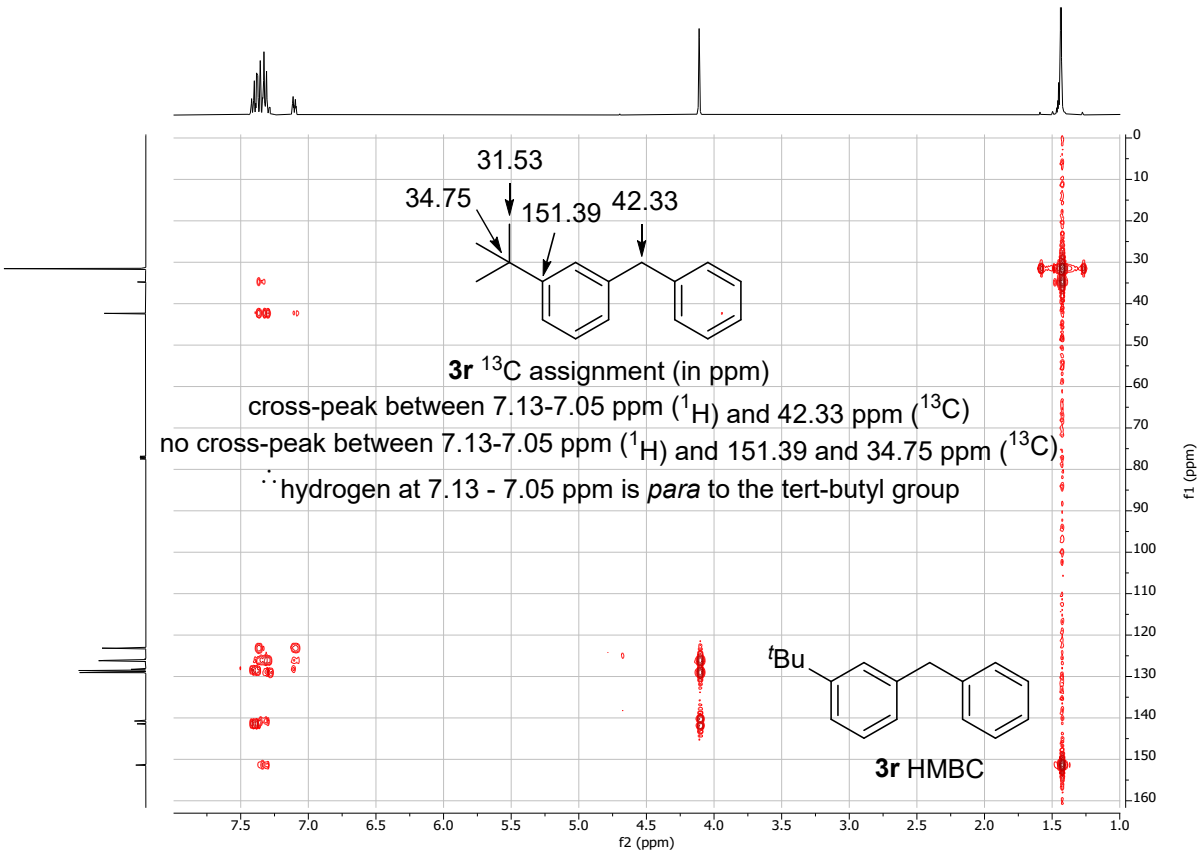
Incorporation of the deuterium in the *para* position to the *tert*-butyl isomer was calculated as follows: The integral of the two hydrogens at the benzylic position (4.08 ppm) for the minor isomer was set to

2.00 and compared to the integral in the range of 7.13 – 7.05 ppm (area ratio 0.14). Deuterium incorporation in this position was hence calculated to be ((2/1)-0.14)*100% = 86%.

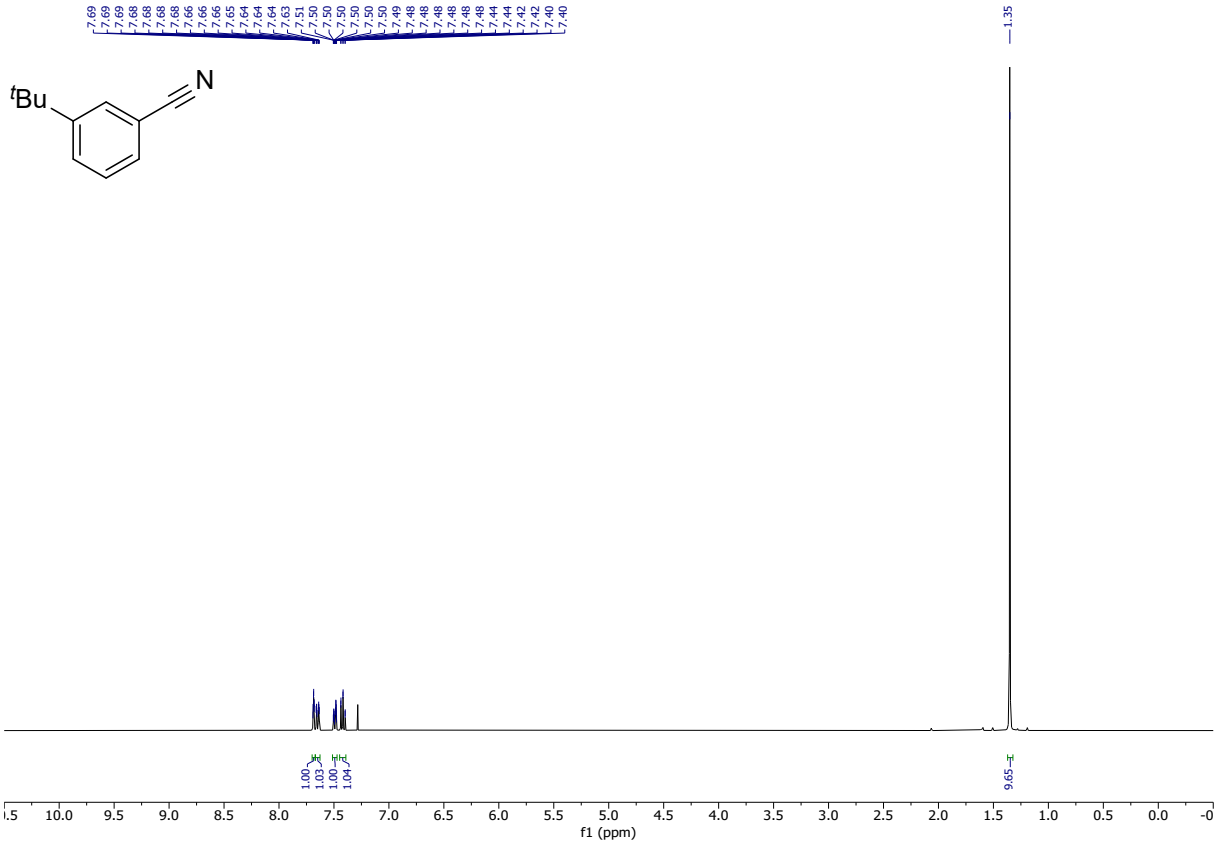
In the HMBC spectrum, coupling was observed between the hydrogen at 7.13 – 7.05 ppm with the benzylic carbon (42.33 ppm) but not with the quaternary carbon of the *tert*-butyl group (34.75 ppm) or the quaternary aromatic carbon with *tert*-butyl group attached (151.39 ppm), therefore the peak at 7.13 – 7.05 ppm has been assigned to the hydrogen *para* instead of *ortho* to the *tert*-butyl group.

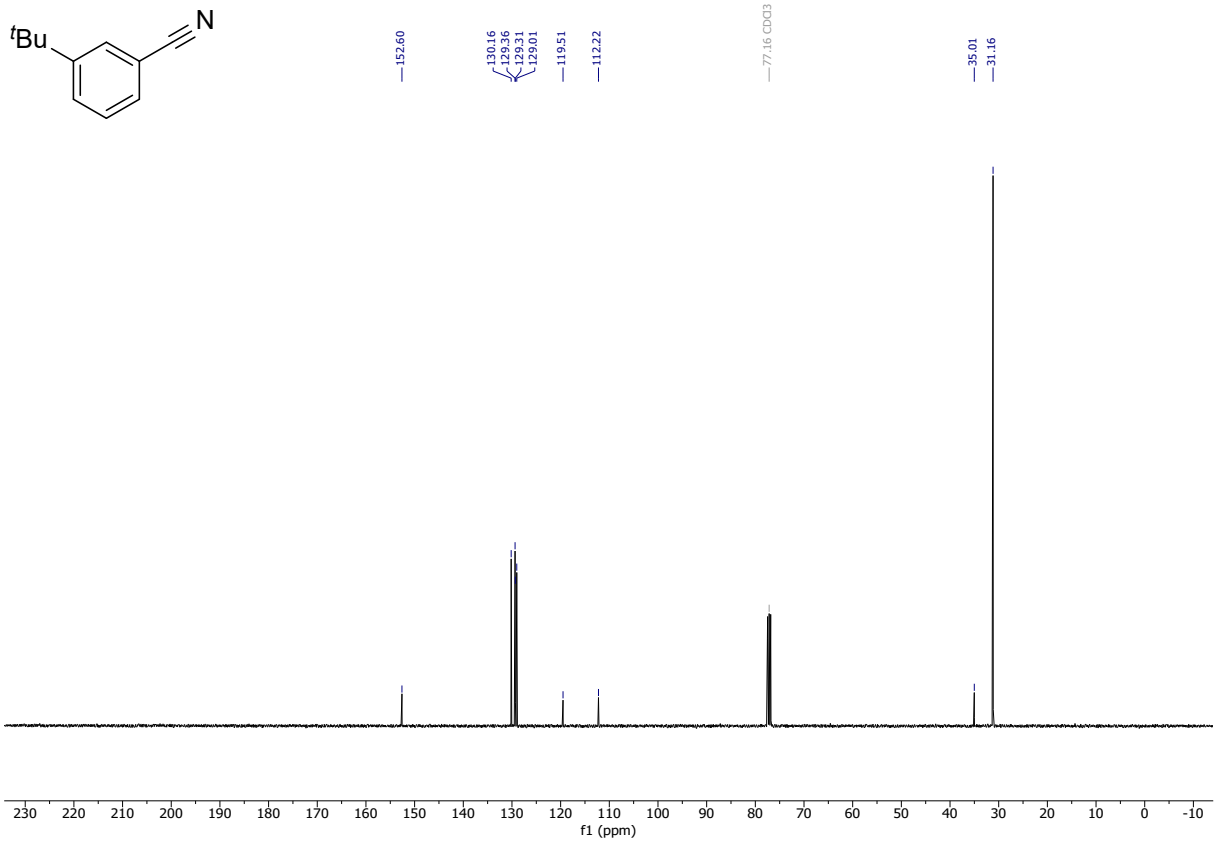


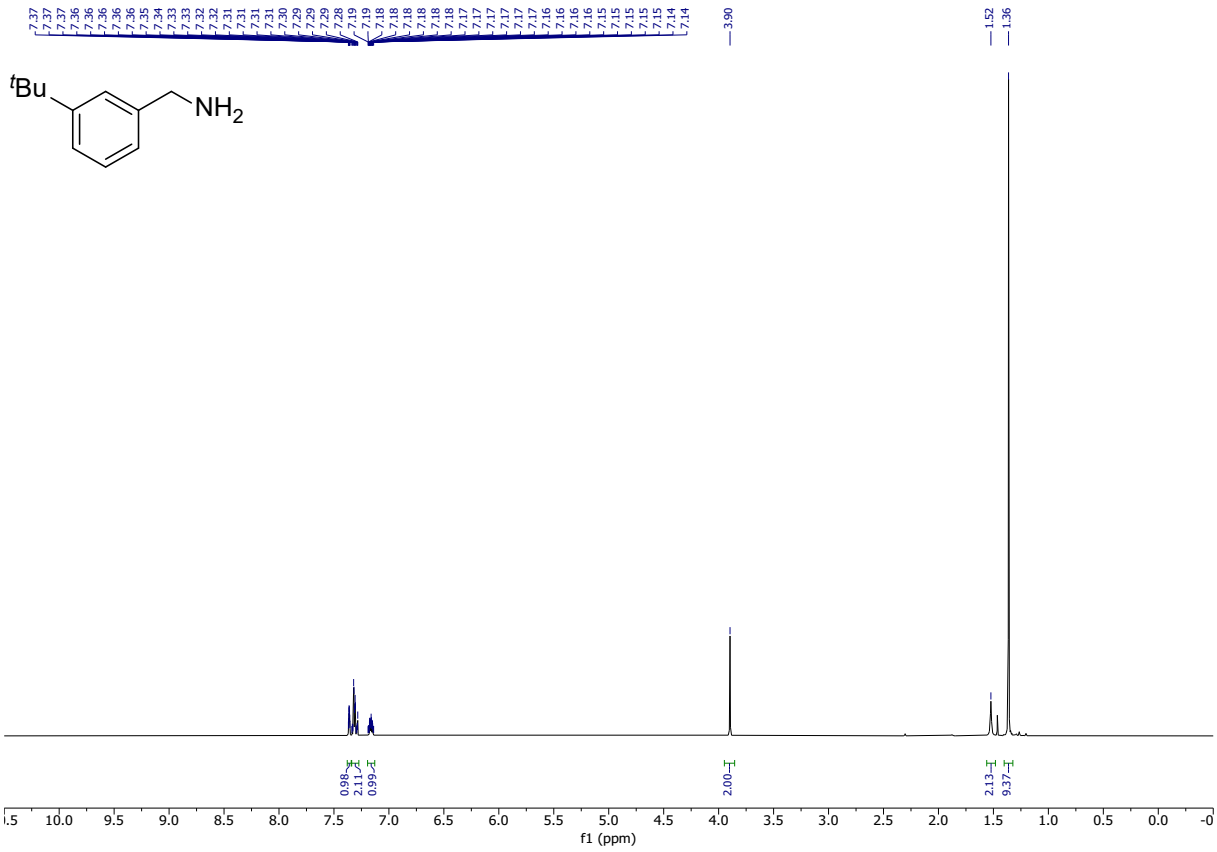

31.53
42.33
3r 13C assignment (in ppm)
cross-peak between 1.43 ppm (1H) and 31.53 ppm (13C)
cross-peak between 4.11 ppm (1H) and 42.33 ppm (13C)
tBu
3r HSQC
f2 (ppm)
f1 (ppm)

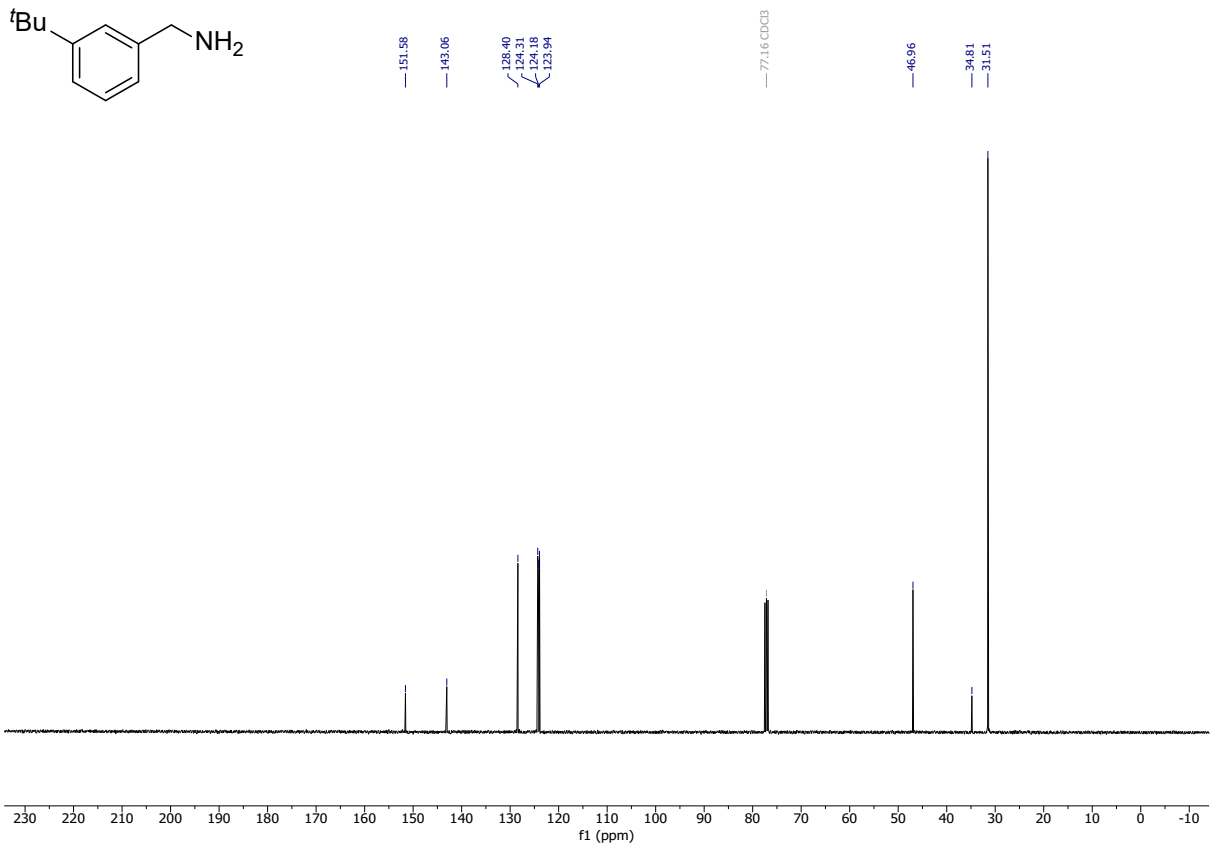

31.53
34.75
151.39
42.33
3r 13C assignment (in ppm)
cross-peak between 7.13-7.05 ppm (1H) and 42.33 ppm (13C)
no cross-peak between 7.13-7.05 ppm (1H) and 151.39 and 34.75 ppm (13C)
∴ hydrogen at 7.13 - 7.05 ppm is para to the tert-butyl group
tBu
3r HMBC
f2 (ppm)
f1 (ppm)

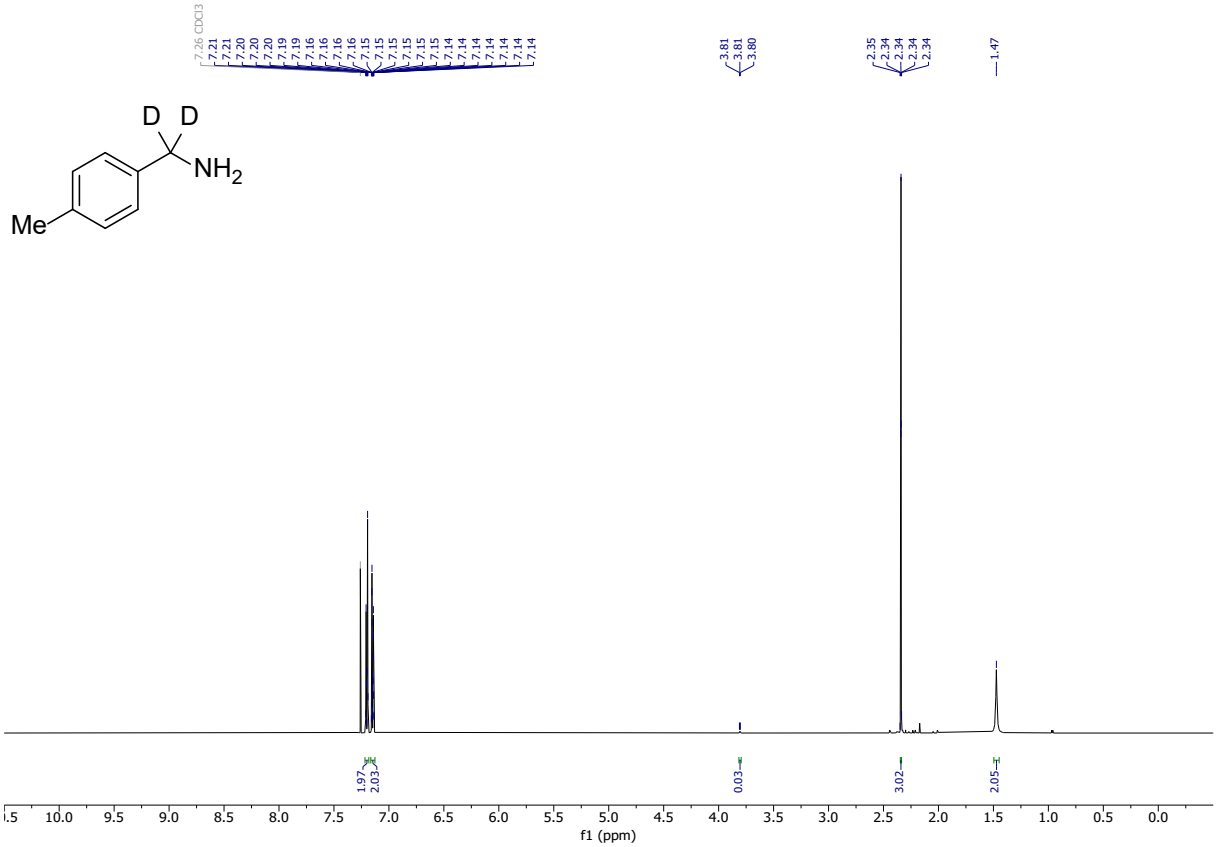
8. NMR spectra

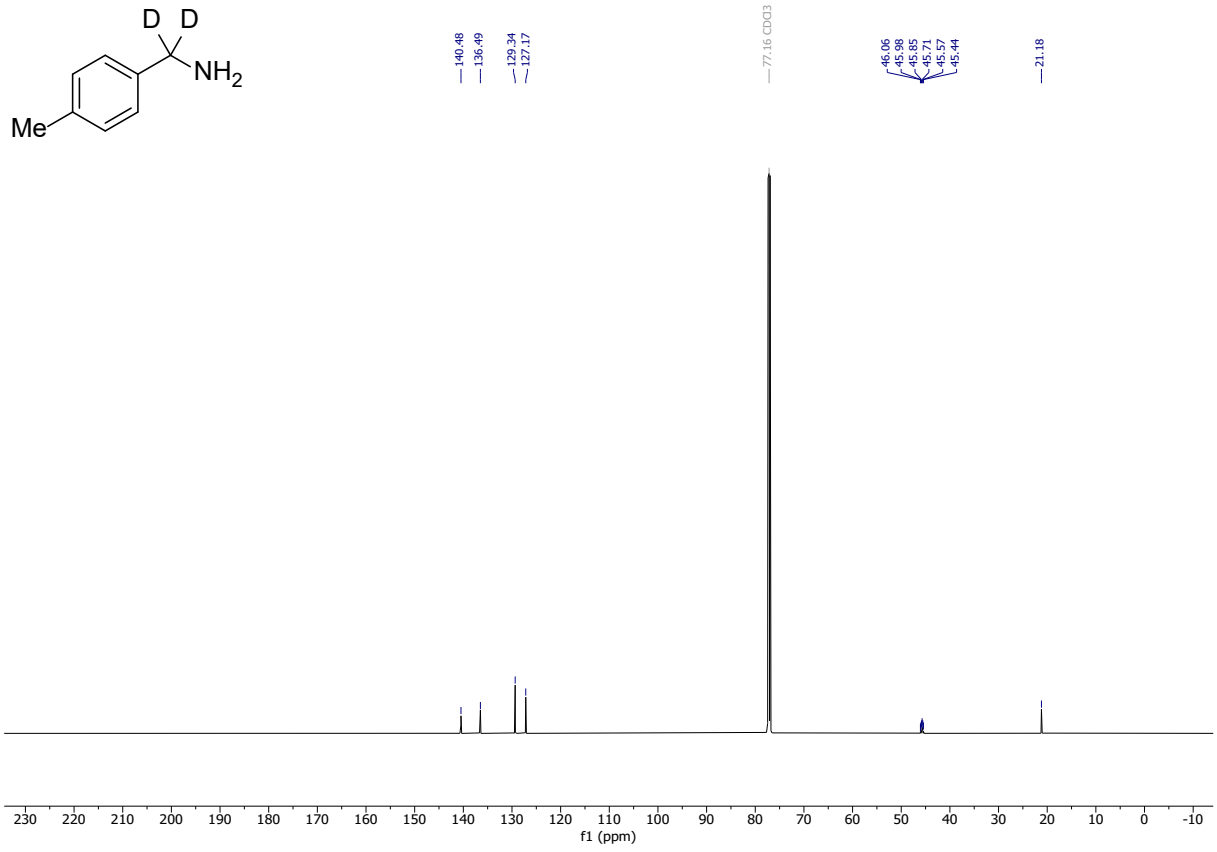


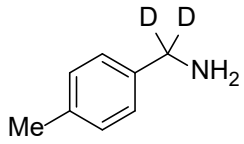



tBu
NH2
7.37 7.37 7.37 7.36 7.36 7.36 7.36 7.35 7.34 7.33 7.32 7.32 7.31 7.31 7.31 7.30 7.29 7.29 7.29 7.28 7.19 7.19 7.18 7.18 7.18 7.18 7.18 7.17 7.17 7.17 7.17 7.17 7.16 7.16 7.16 7.16 7.15 7.15 7.15 7.15 7.15 7.14 7.14
3.90
1.52 1.36
0.98 2.11 0.99 2.00 2.13 9.37
f1 (ppm)


tBu
NH2
151.58
143.06
128.40
124.31
124.18
123.94
77.16 CDCl3
46.96
34.81
31.51
f1 (ppm)

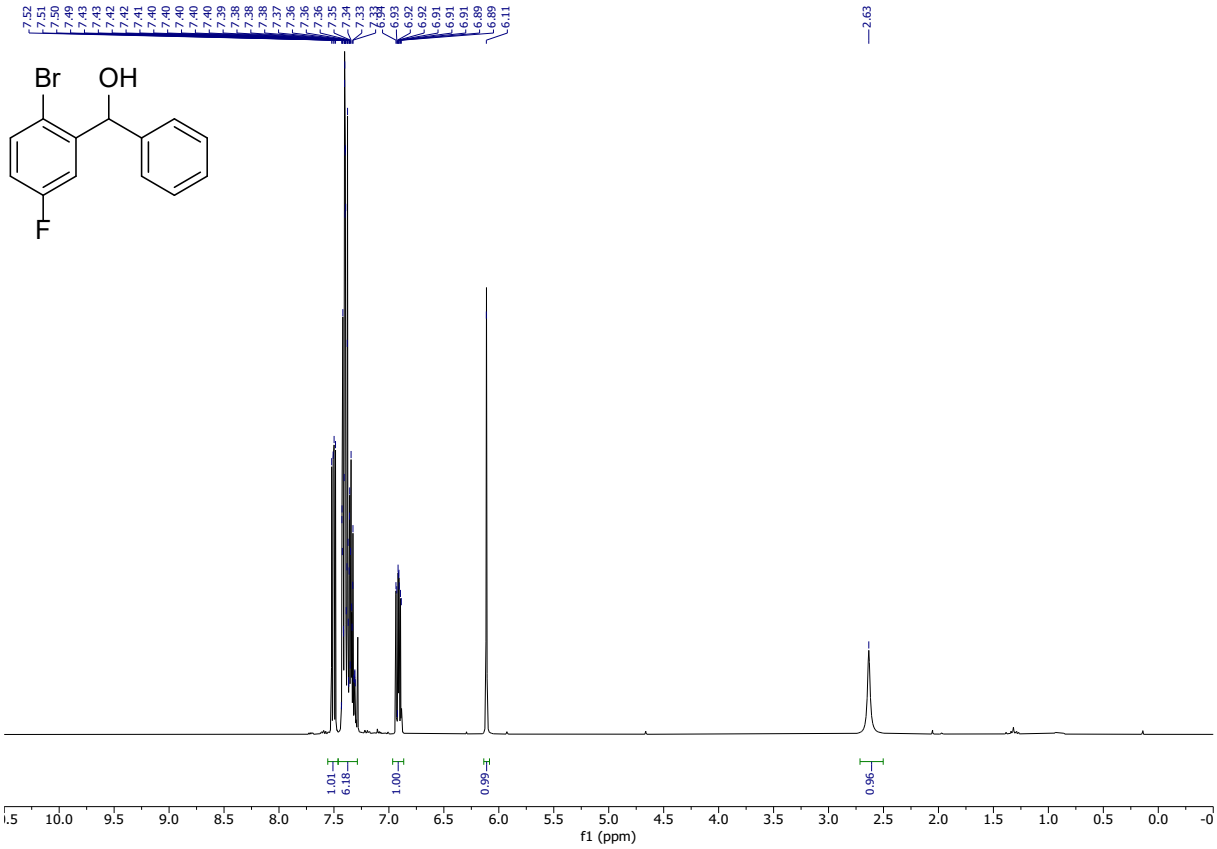

7.26 CDCl3
7.21
7.21
7.20
7.20
7.20
7.19
7.16
7.16
7.16
7.16
7.15
7.15
7.15
7.15
7.15
7.15
7.14
7.14
7.14
7.14
7.14
7.14
3.81
3.81
3.80
2.35
2.34
2.34
2.34
2.34
1.47
D D
NH2
Me
1.97
2.03
0.03
3.02
2.05
f1 (ppm)

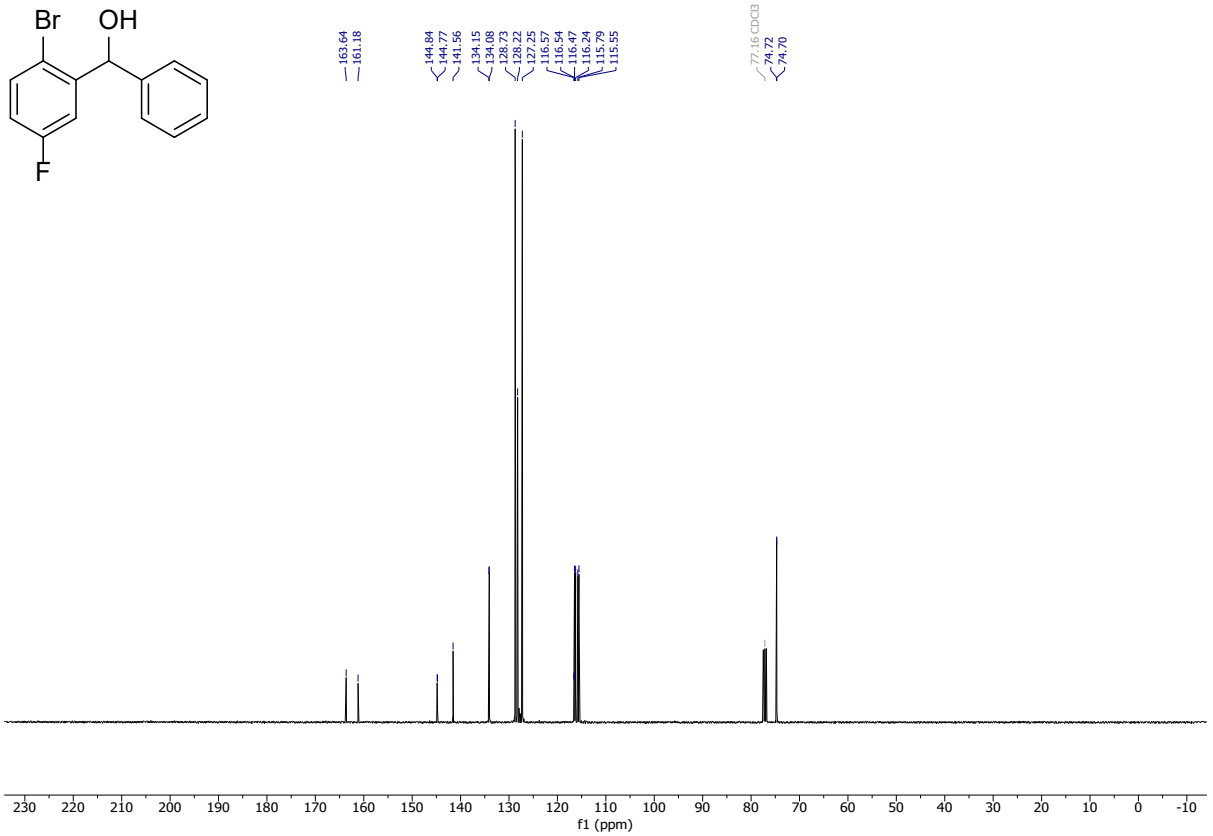

D D
NH2
Me
140.48
136.49
129.34
127.17
77.16 CDCl3
46.06
45.98
45.85
45.71
45.57
45.44
21.18
f1 (ppm)

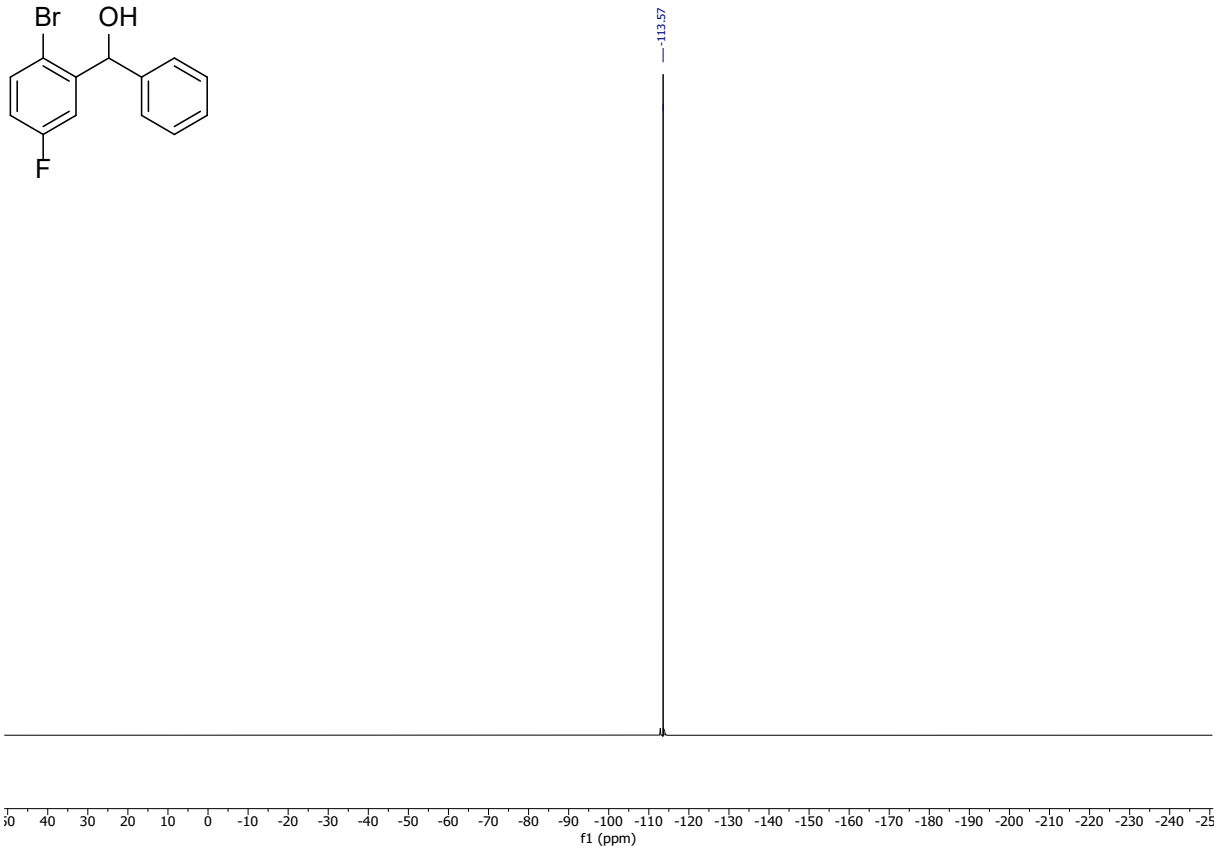

D D
NH2
Me

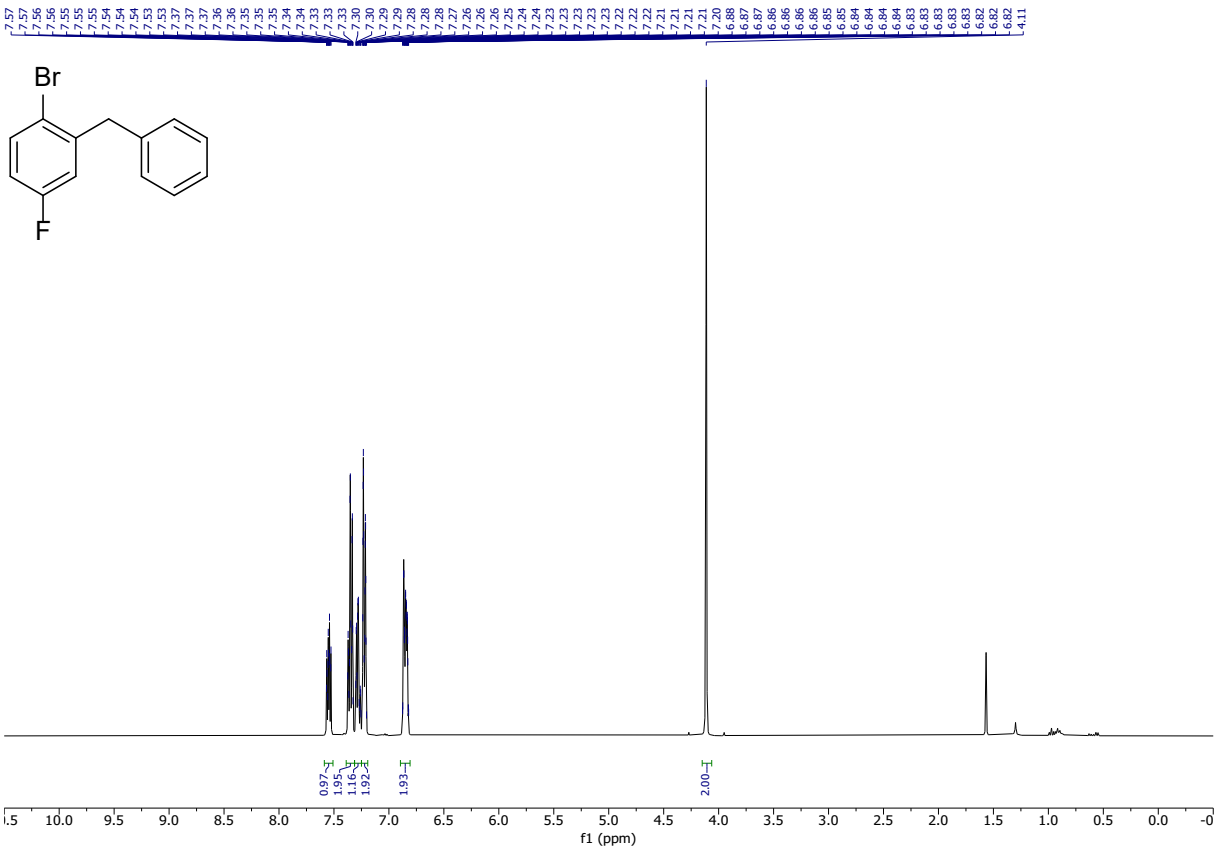
^{2}H NMR

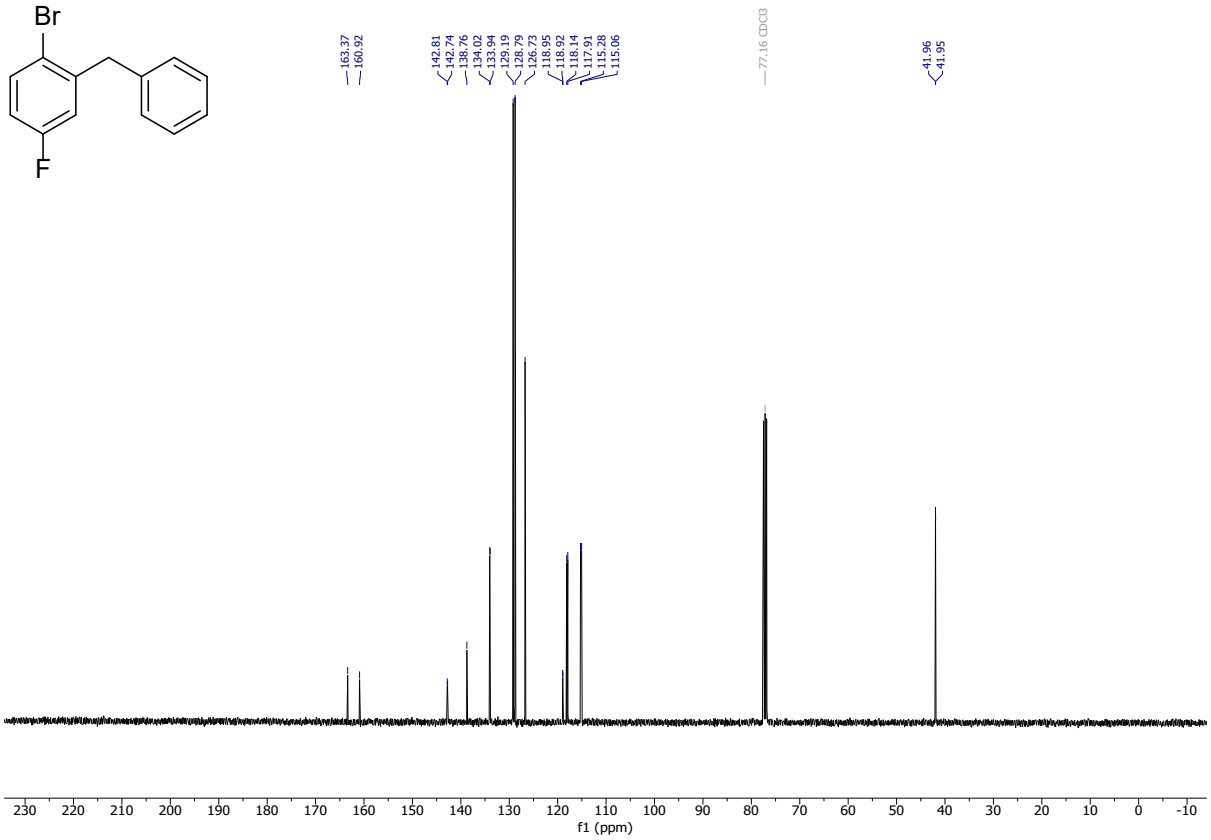
3.79
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

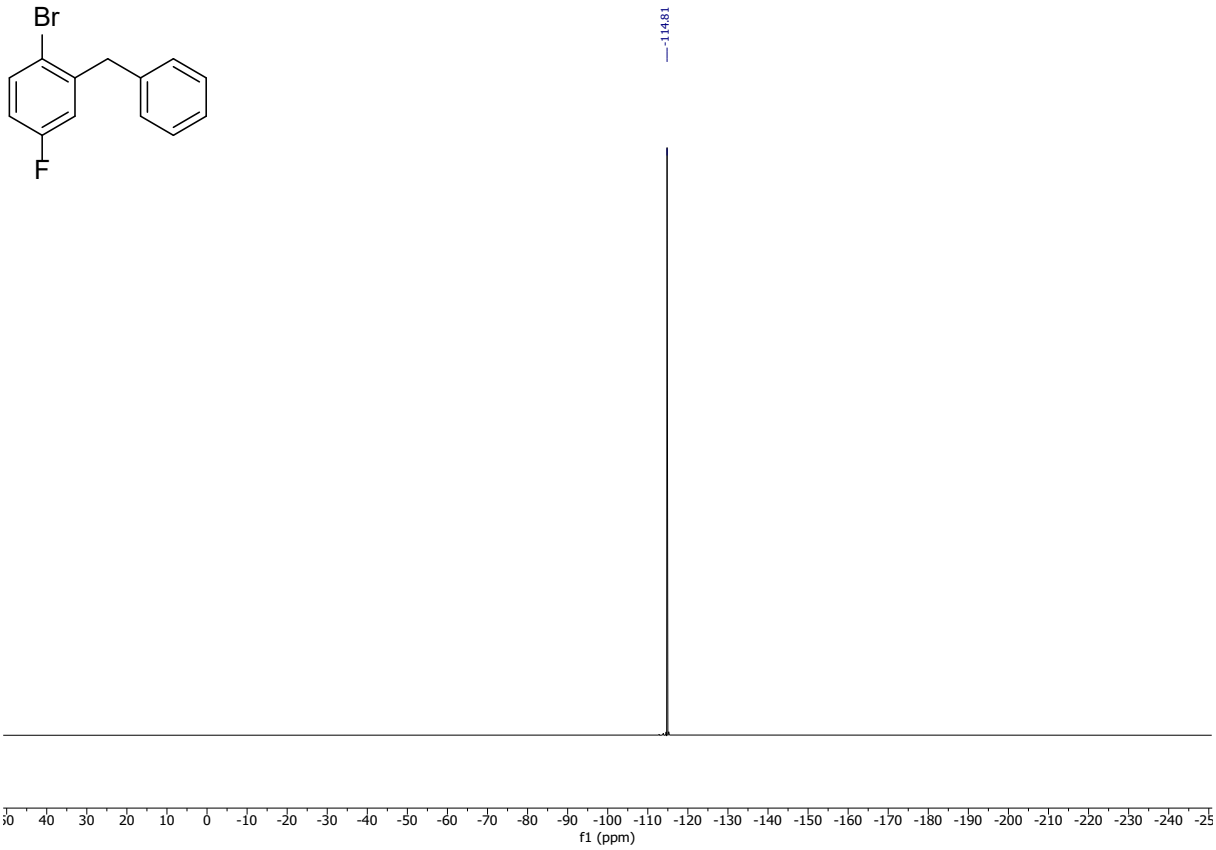

7.52
7.51
7.50
7.49
7.43
7.42
7.42
7.41
7.40
7.40
7.40
7.40
7.40
7.39
7.38
7.38
7.37
7.36
7.36
7.36
7.35
7.34
7.33
6.93
6.92
6.92
6.91
6.91
6.91
6.89
6.89
6.11
2.63
Br
OH
F
1.01
6.18
1.00
0.99
0.96
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

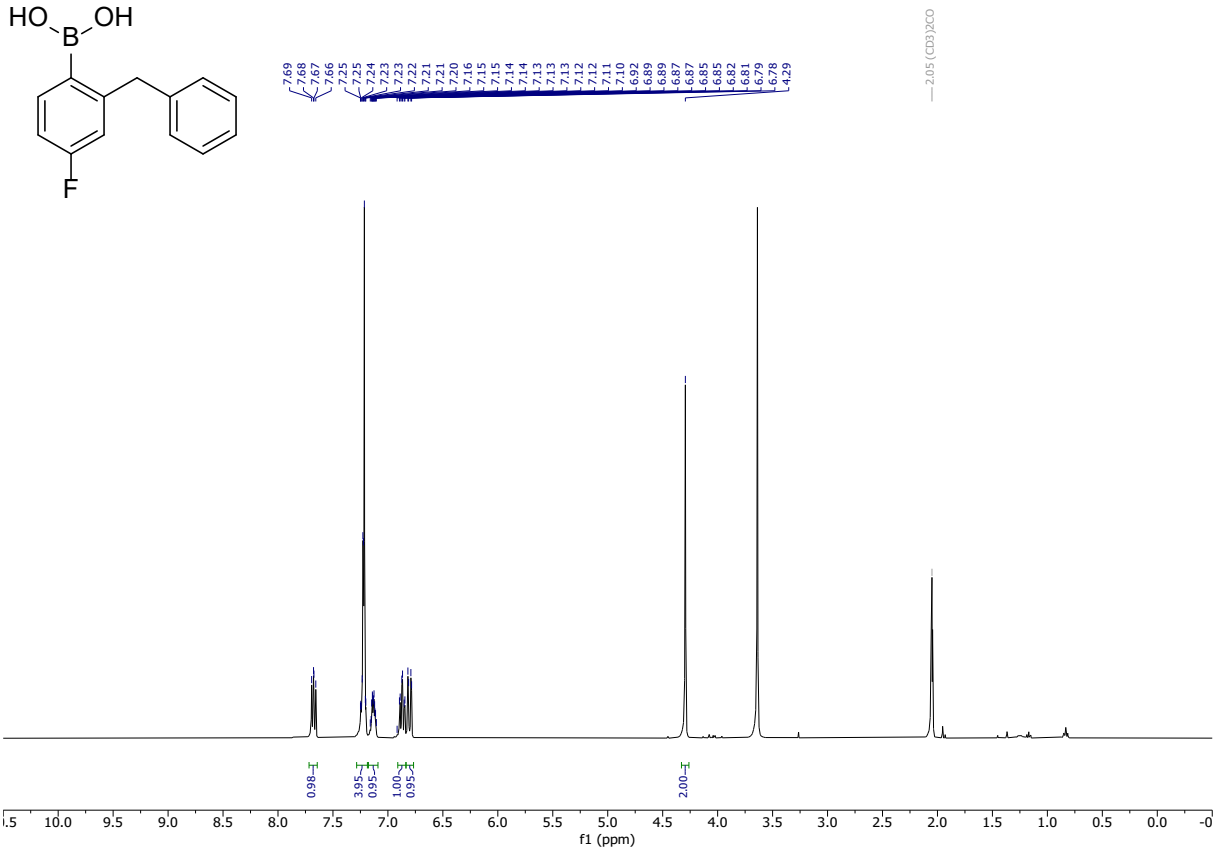

Br
OH
F
163.64
161.18
144.84
144.77
141.56
134.15
134.08
128.73
128.22
127.25
116.57
116.54
116.47
116.24
115.79
115.55
77.16 CDCl3
74.72
74.70
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

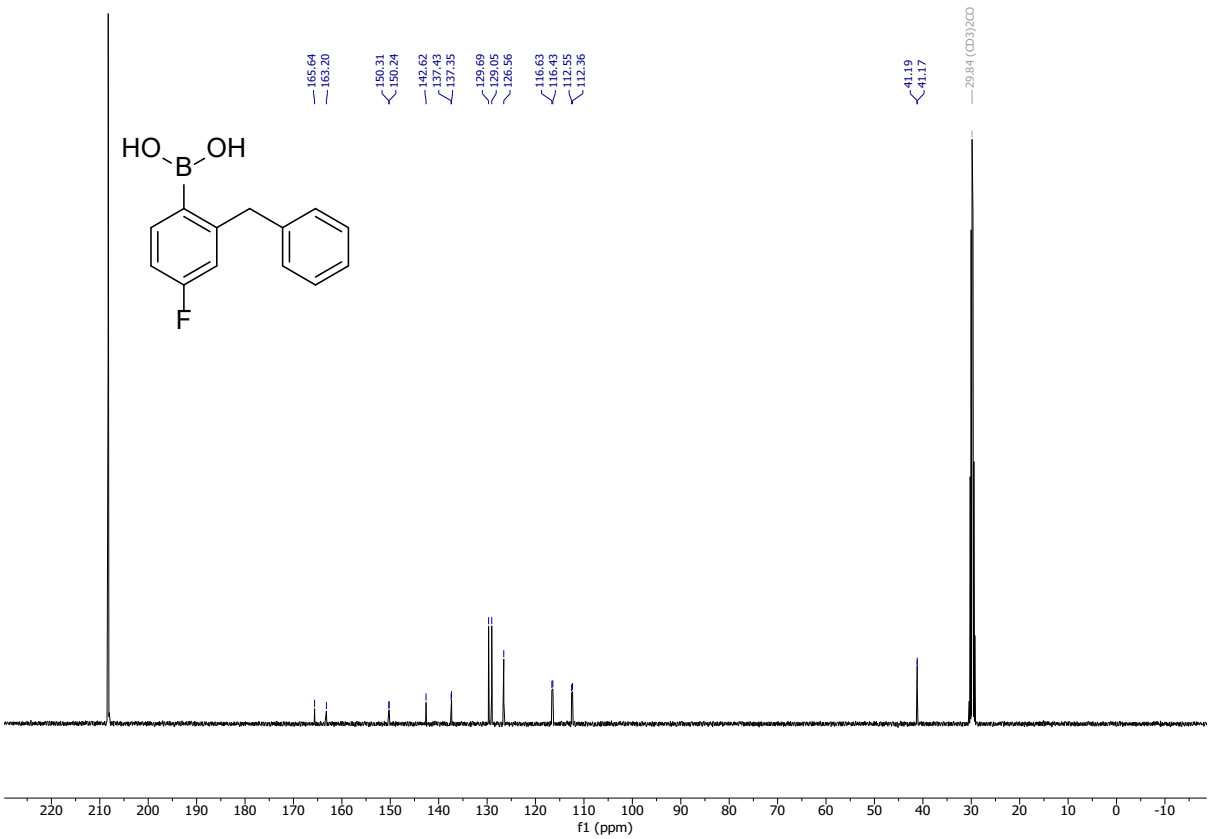

Br
OH
F
-113.57
50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -25
f1 (ppm)

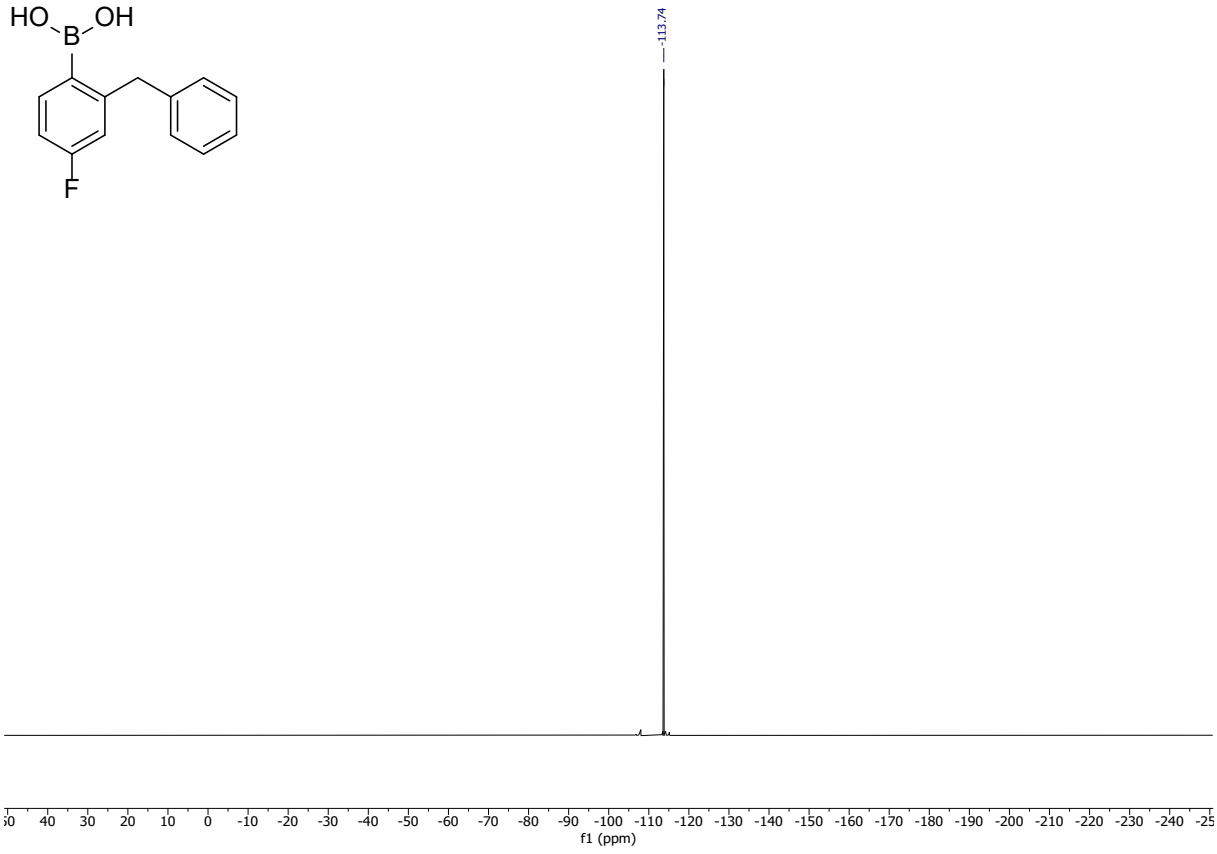

Br
F
f1 (ppm)

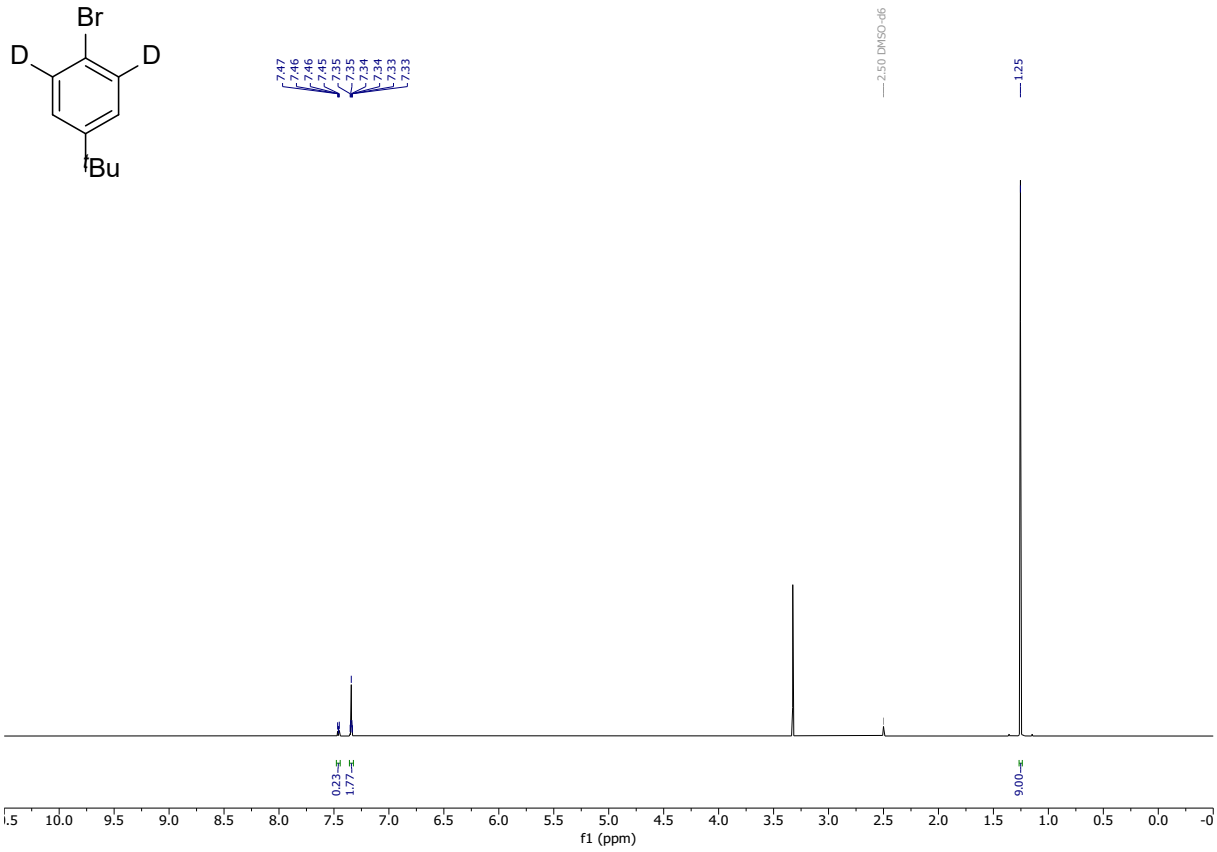

Br
F
f1 (ppm)

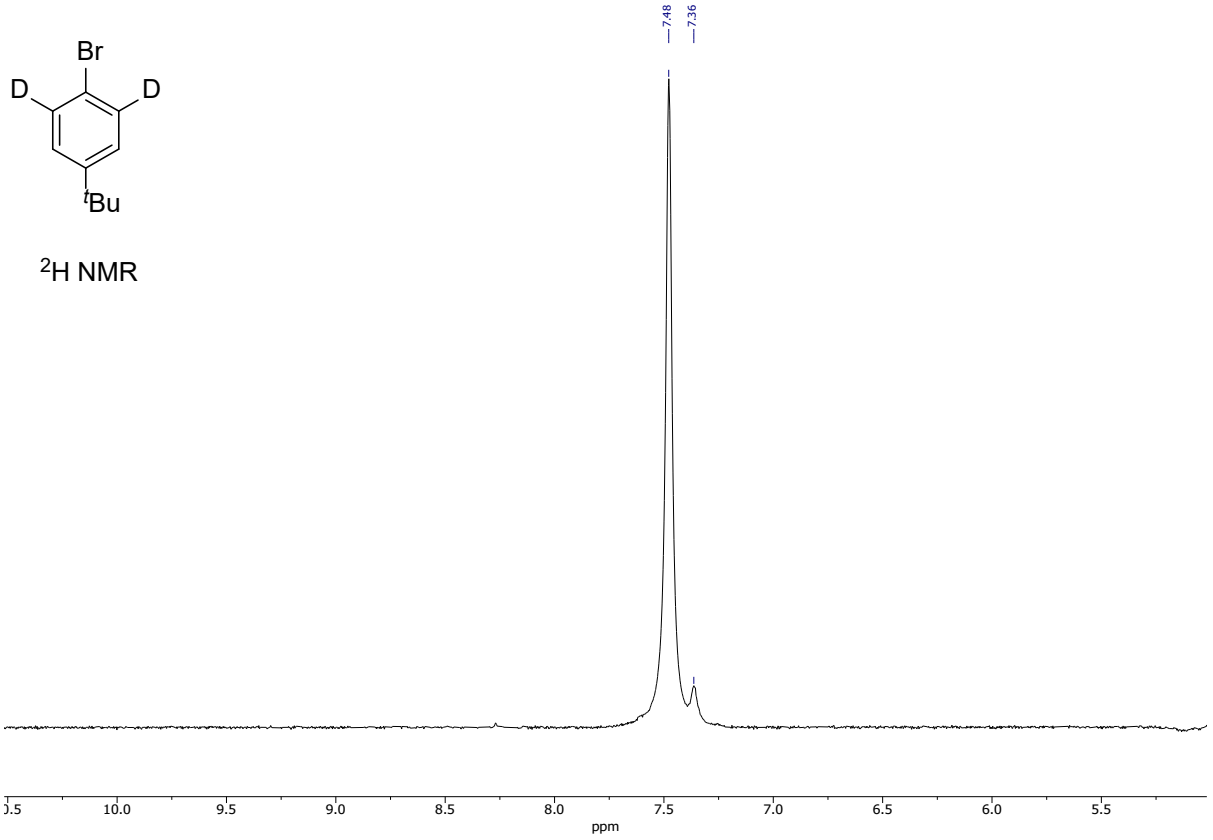

Br
F
-114.81
f1 (ppm)


HO
B
OH
F
7.69
7.68
7.67
7.66
7.25
7.24
7.23
7.22
7.21
7.20
7.16
7.15
7.14
7.13
7.12
7.11
7.10
6.92
6.89
6.87
6.85
6.82
6.81
6.79
6.78
4.29
2.05 (CD3)2CO
0.98
3.95
0.95
1.00
0.95
2.00
f1 (ppm)

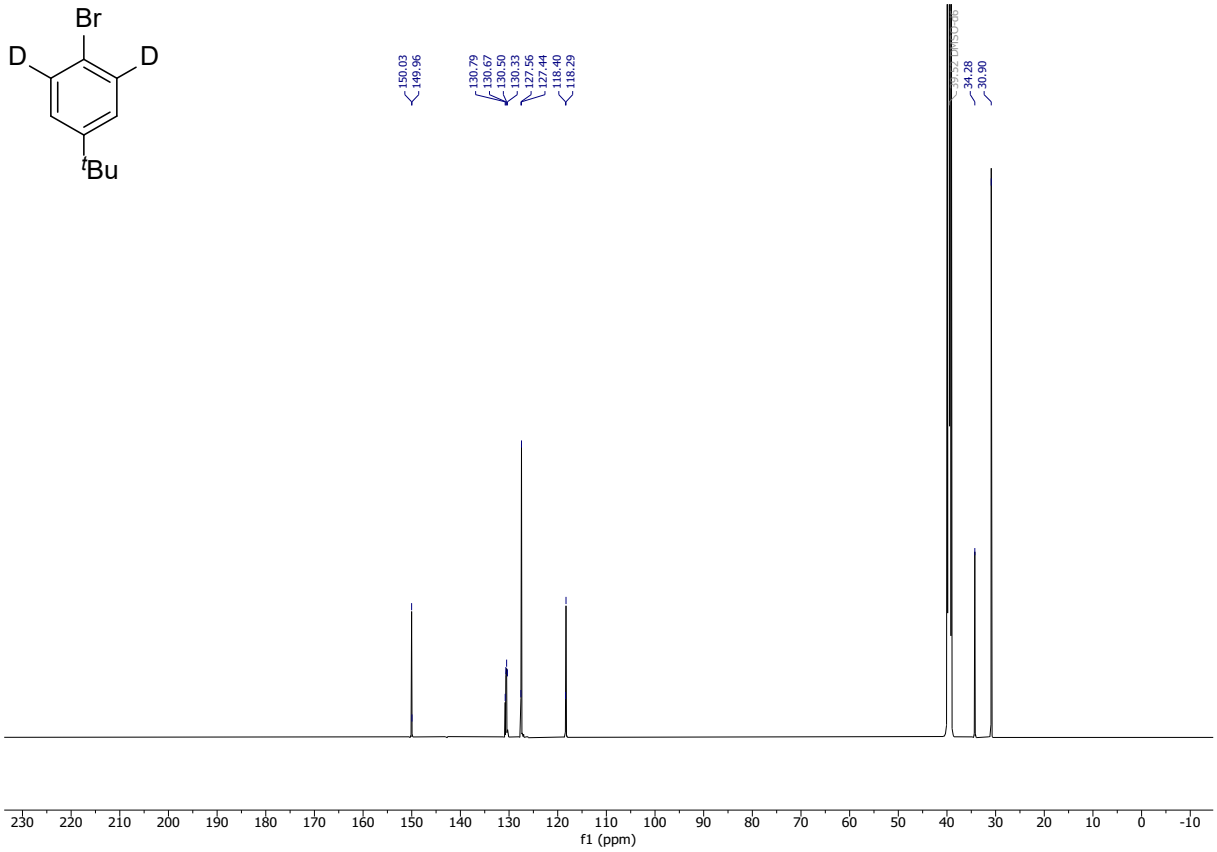

165.64
163.20
150.31
150.24
142.62
137.43
137.35
129.69
129.05
126.56
116.63
116.43
112.55
112.36
41.19
41.17
29.84 (CD3)2CO
HO
B
OH
F
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

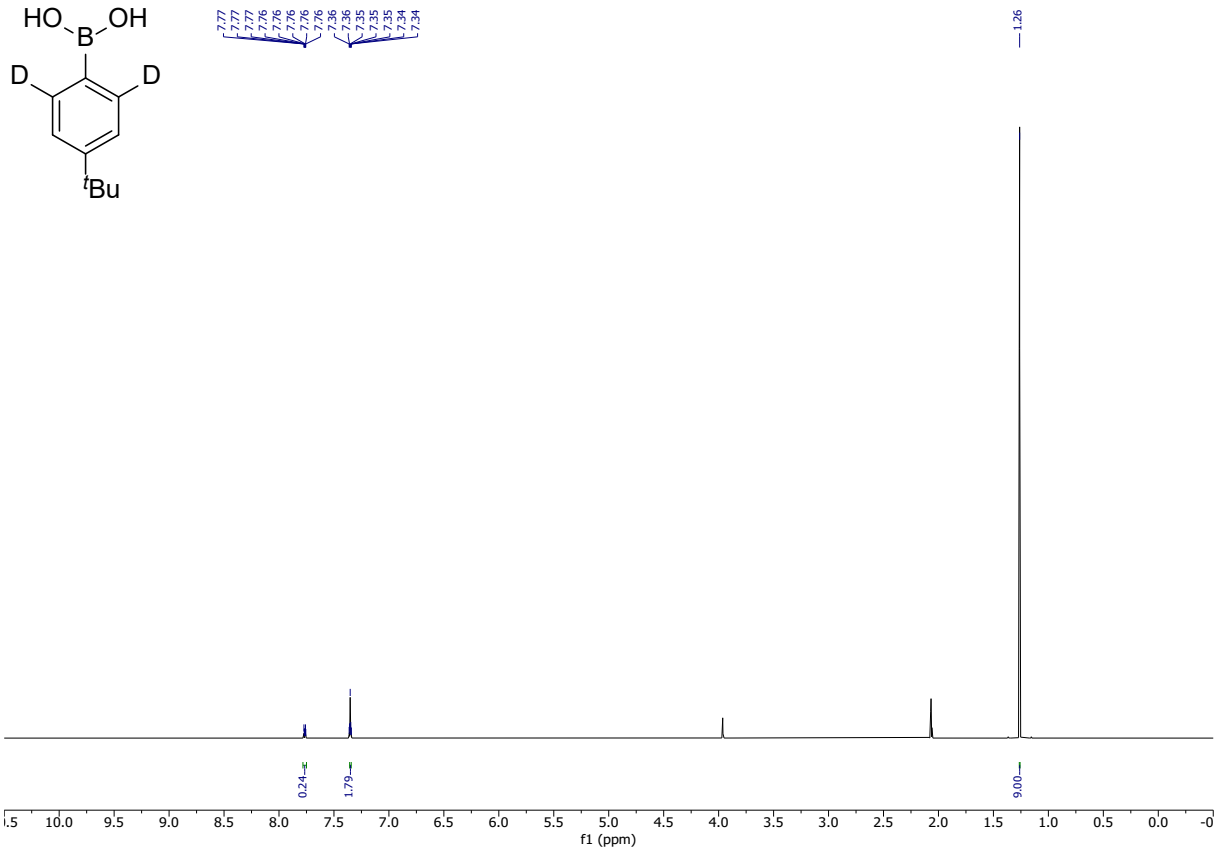

-113.74
HO
B
OH
F
50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -25
f1 (ppm)

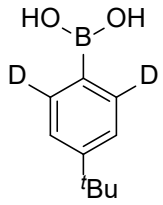

Br
D
D
tBu
7.47
7.46
7.46
7.45
7.35
7.35
7.34
7.34
7.33
7.33
2.50 DMSO-d6
1.25
0.23
1.77
9.00
f1 (ppm)


Br
D
D
tBu
7.48
7.36
ppm

^{2}H NMR

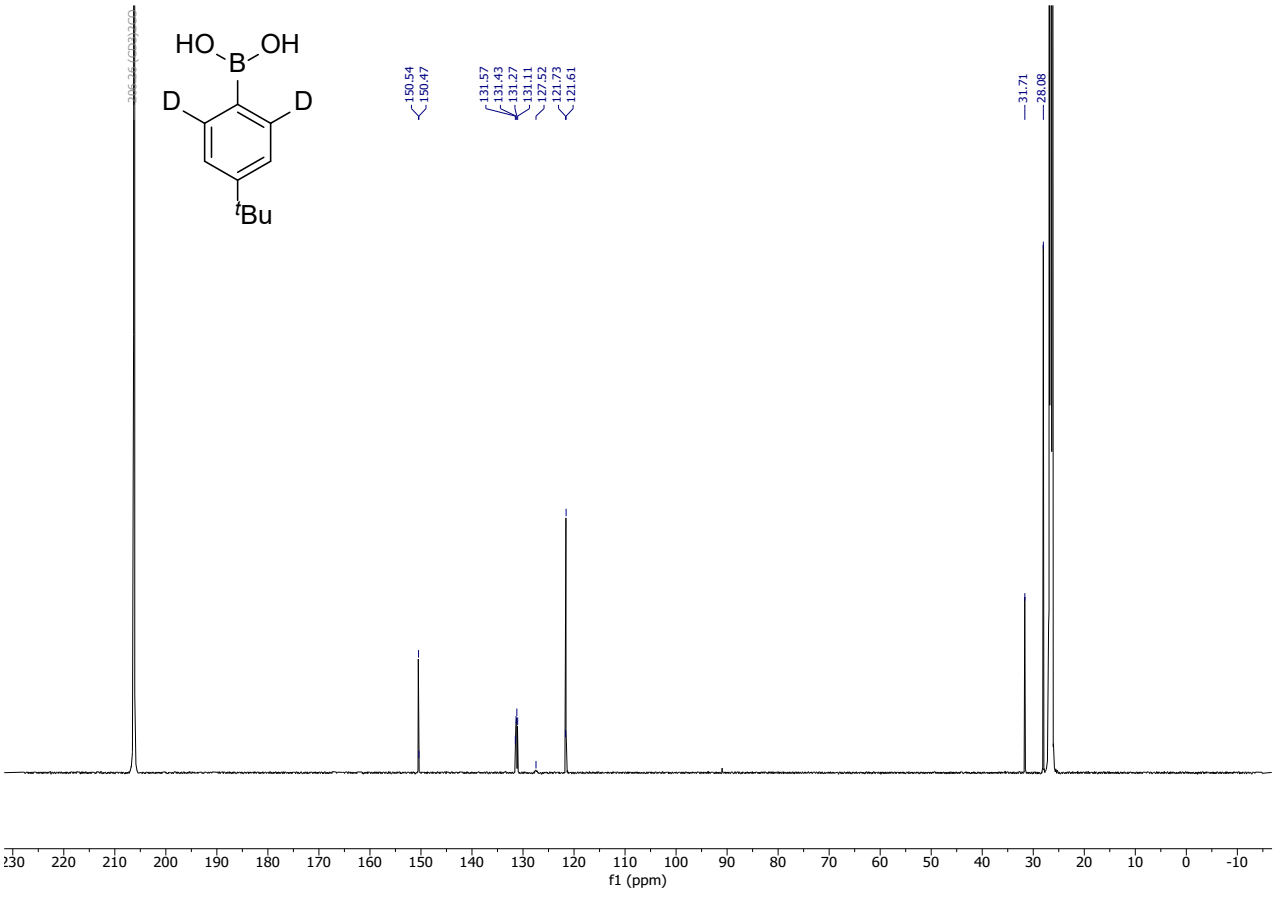

Br
D
D
tBu
150.03
149.96
130.79
130.67
130.50
130.33
127.56
127.44
118.40
118.29
34.28
30.90
f1 (ppm)

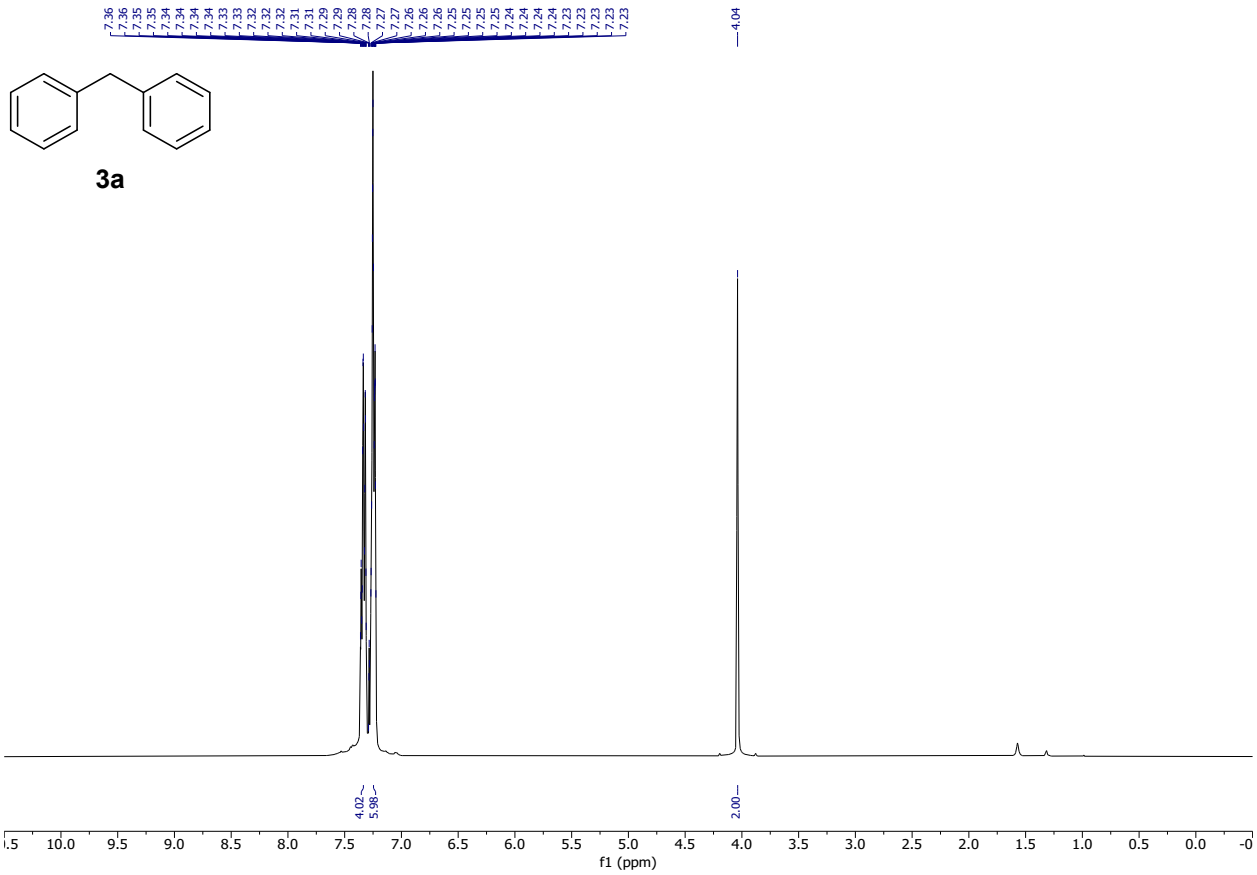

HO
B
OH
D
D
tBu
7.77
7.77
7.77
7.76
7.76
7.76
7.76
7.76
7.36
7.36
7.35
7.35
7.35
7.34
7.34
1.26
0.24
1.79
9.00
f1 (ppm)

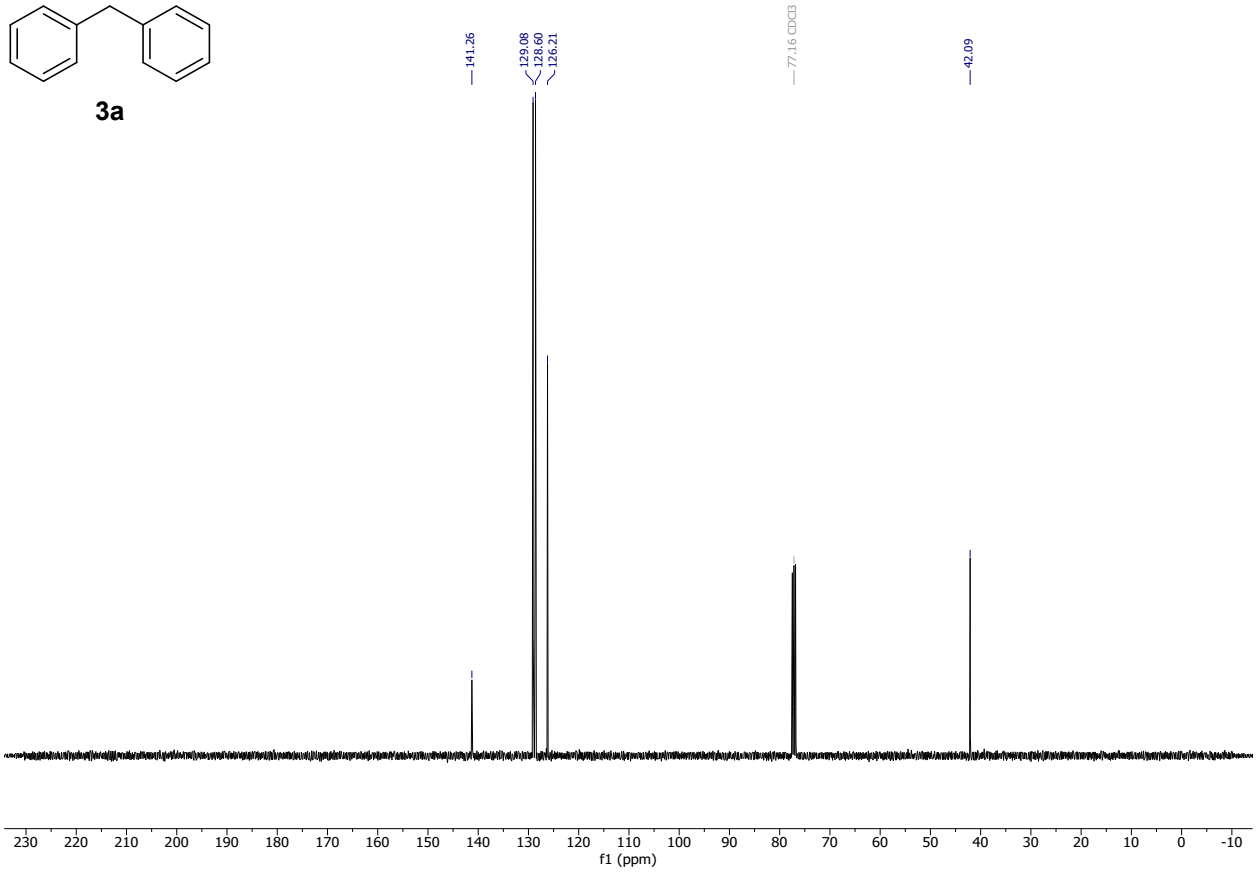

HO
B
OH
D
D
tBu

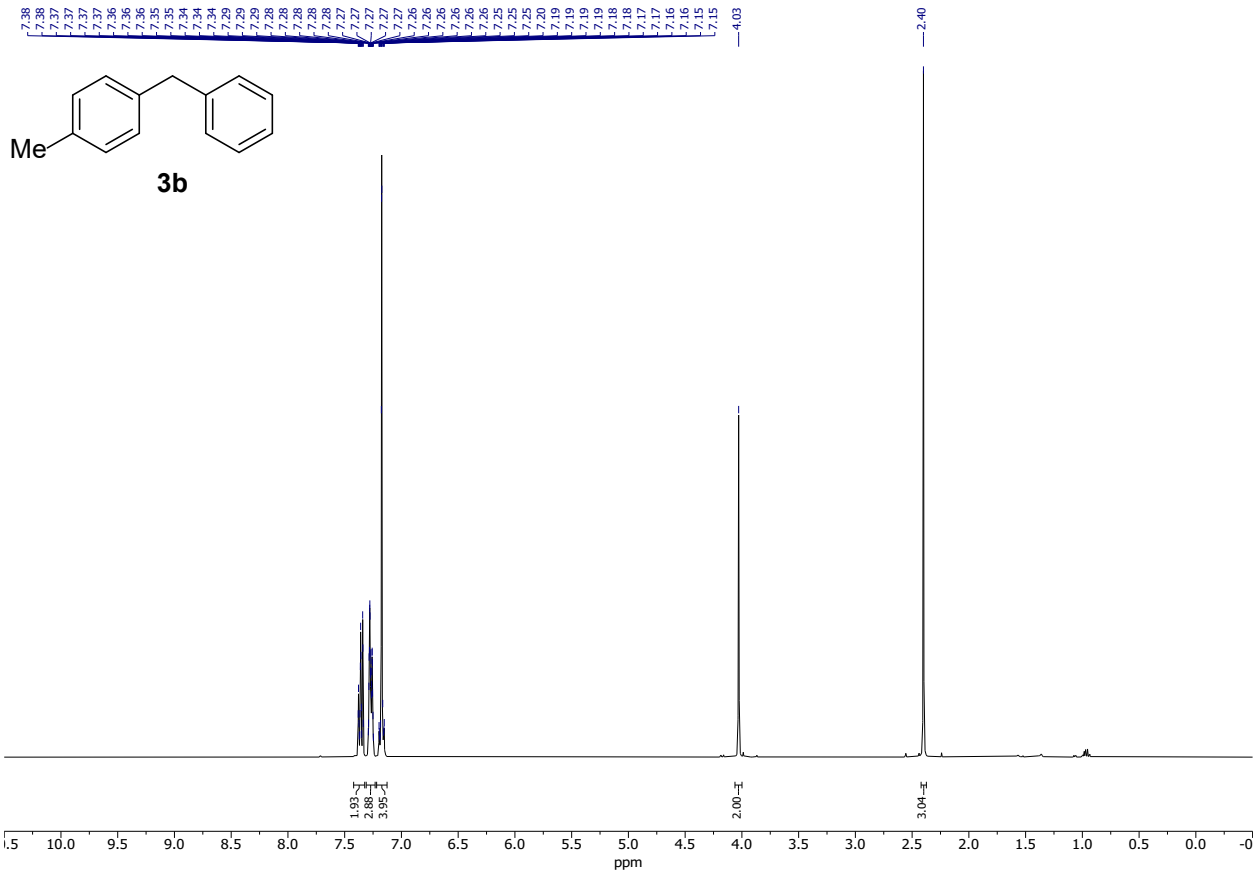
^{2}H NMR

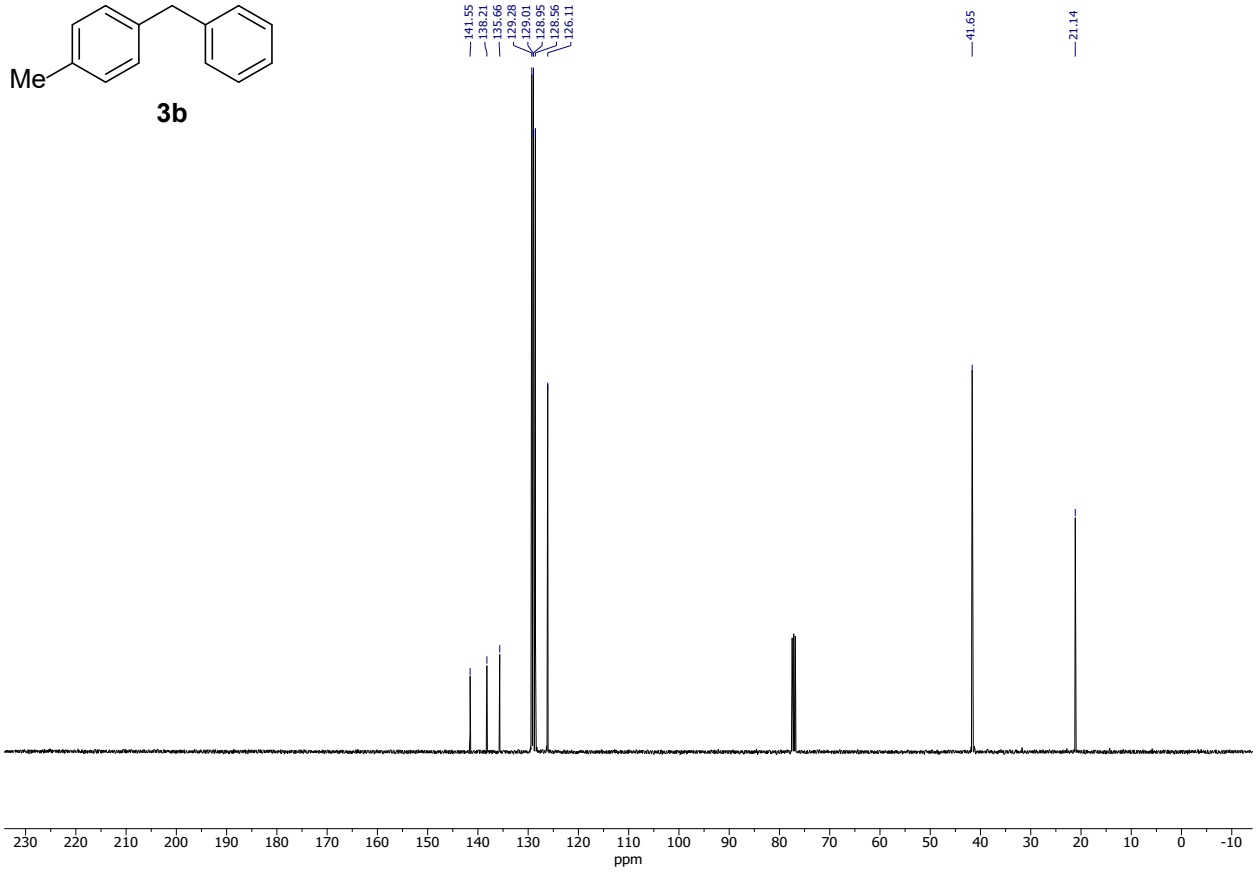
7.78
7.36
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
ppm

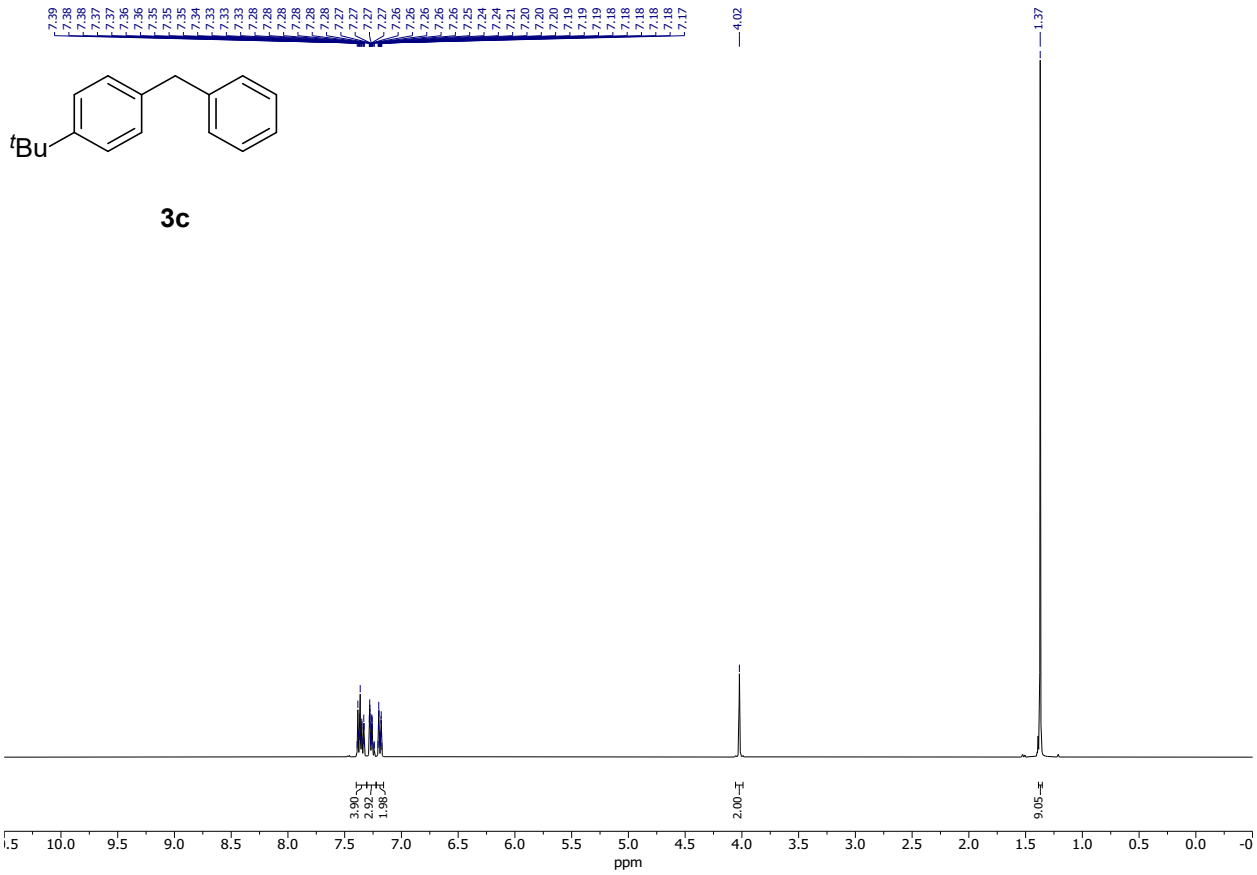

HO
B
OH
D
D
tBu
150.54
150.47
131.57
131.43
131.27
131.11
127.52
121.73
121.61
31.71
28.08
f1 (ppm)

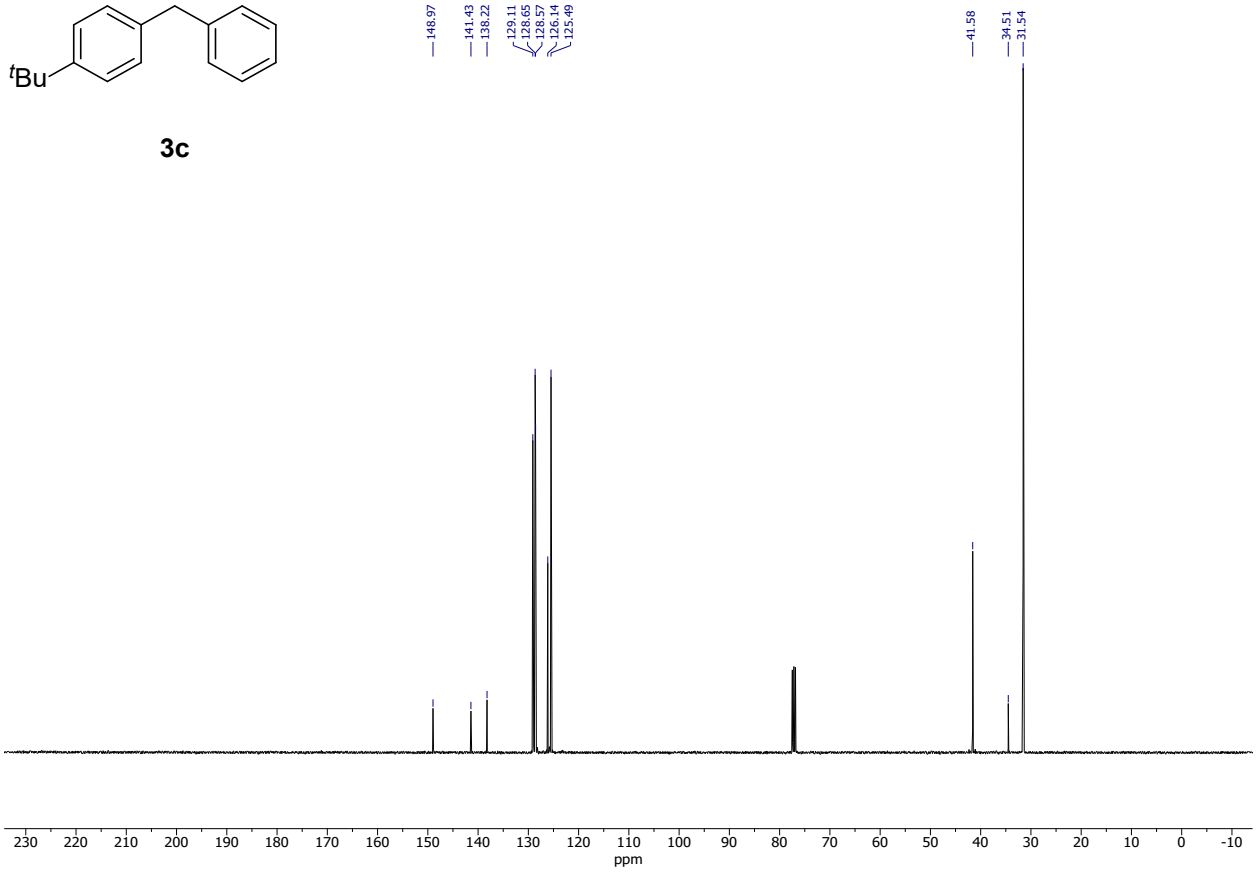

7.36
7.36
7.35
7.35
7.34
7.34
7.34
7.34
7.33
7.33
7.32
7.32
7.32
7.31
7.31
7.29
7.29
7.28
7.28
7.27
7.27
7.26
7.26
7.26
7.25
7.25
7.25
7.24
7.24
7.24
7.23
7.23
7.23
7.23
7.23
4.04
3a
4.02
5.98
2.00
f1 (ppm)

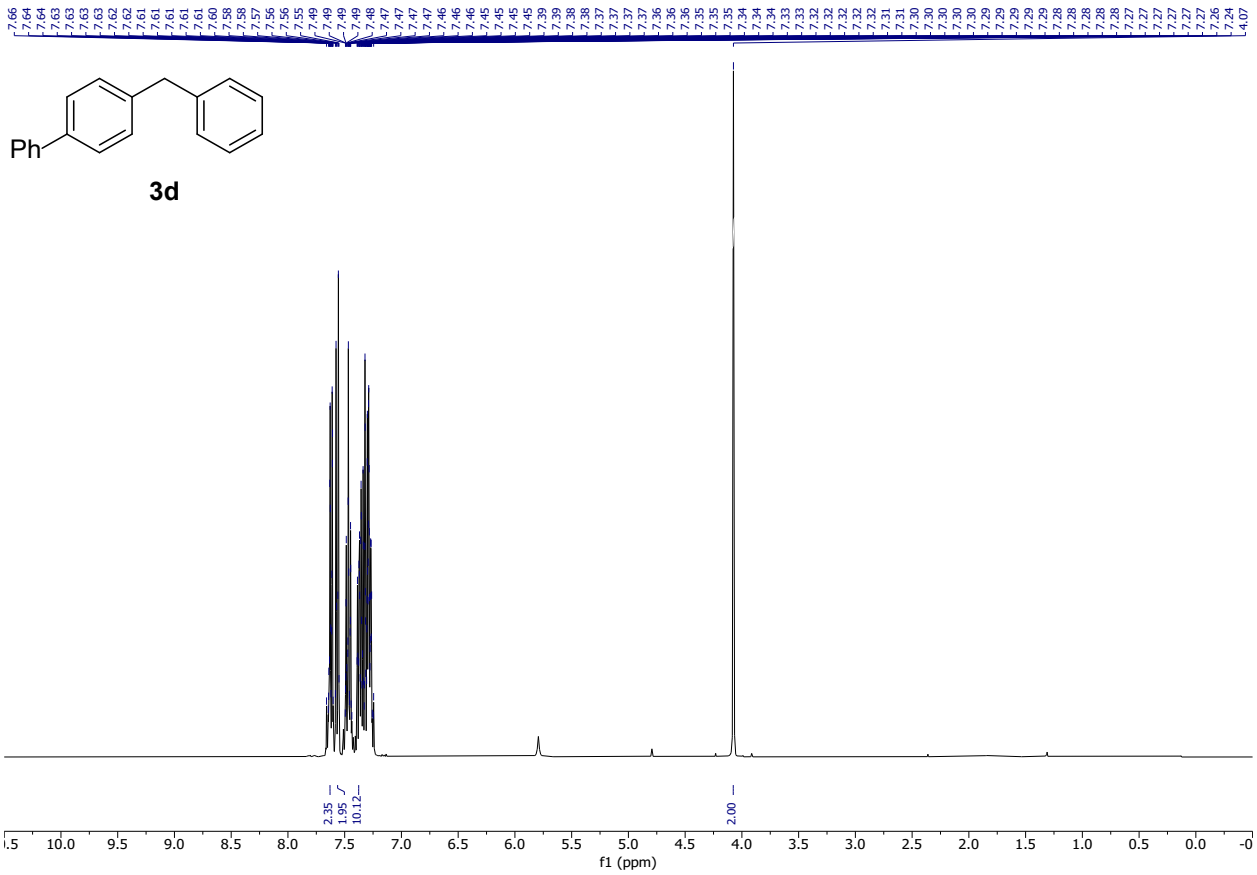

141.26
129.08
128.60
126.21
77.16 CDCl3
42.09
3a
f1 (ppm)

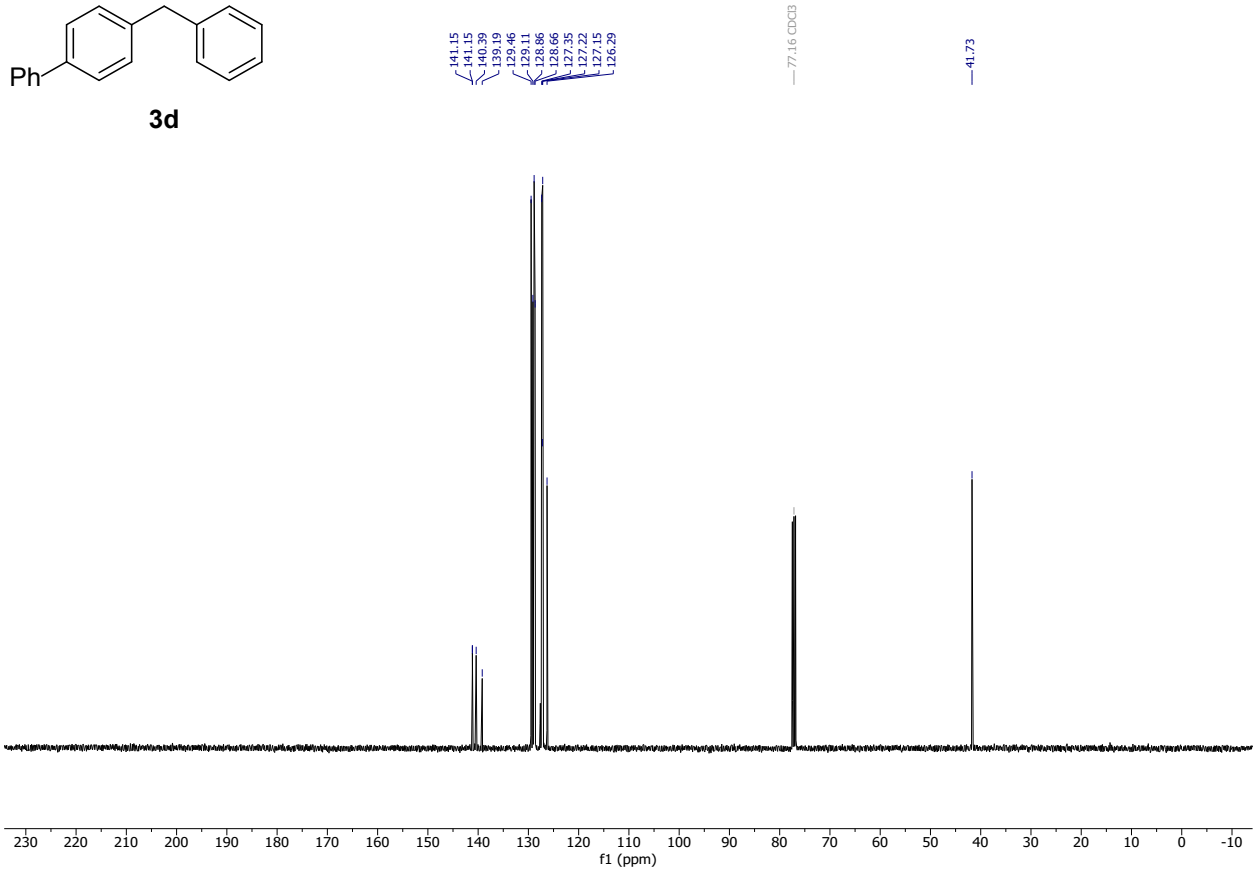

Me
3b
ppm

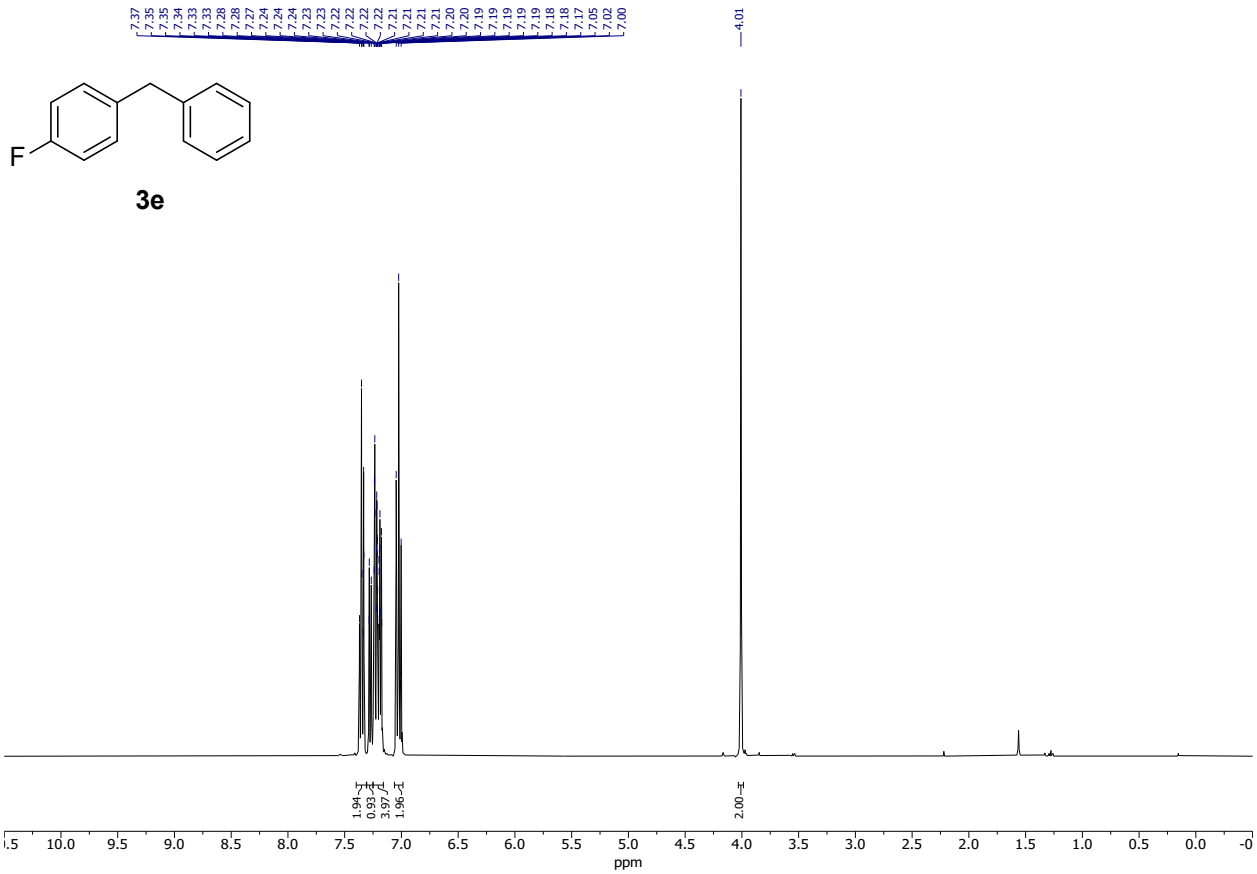

Me
3b
ppm


7.39 7.38 7.38 7.37 7.37 7.36 7.36 7.35 7.35 7.34 7.33 7.33 7.28 7.28 7.28 7.28 7.27 7.27 7.27 7.27 7.26 7.26 7.26 7.26 7.25 7.24 7.24 7.21 7.20 7.20 7.20 7.19 7.19 7.19 7.18 7.18 7.18 7.18 7.18 7.17
4.02
1.37
tBu
3c
3.90
2.92
1.98
2.00
9.05
ppm


148.97
141.43
138.22
129.11
128.65
128.57
126.14
125.49
41.58
34.51
31.54
tBu
3c
ppm


Ph
3d
2.35
1.95
10.12
2.00
f1 (ppm)


Ph
3d
141.15
141.15
140.39
139.19
129.46
129.11
128.86
128.66
127.35
127.22
127.15
126.29
77.16 CDCl3
41.73
f1 (ppm)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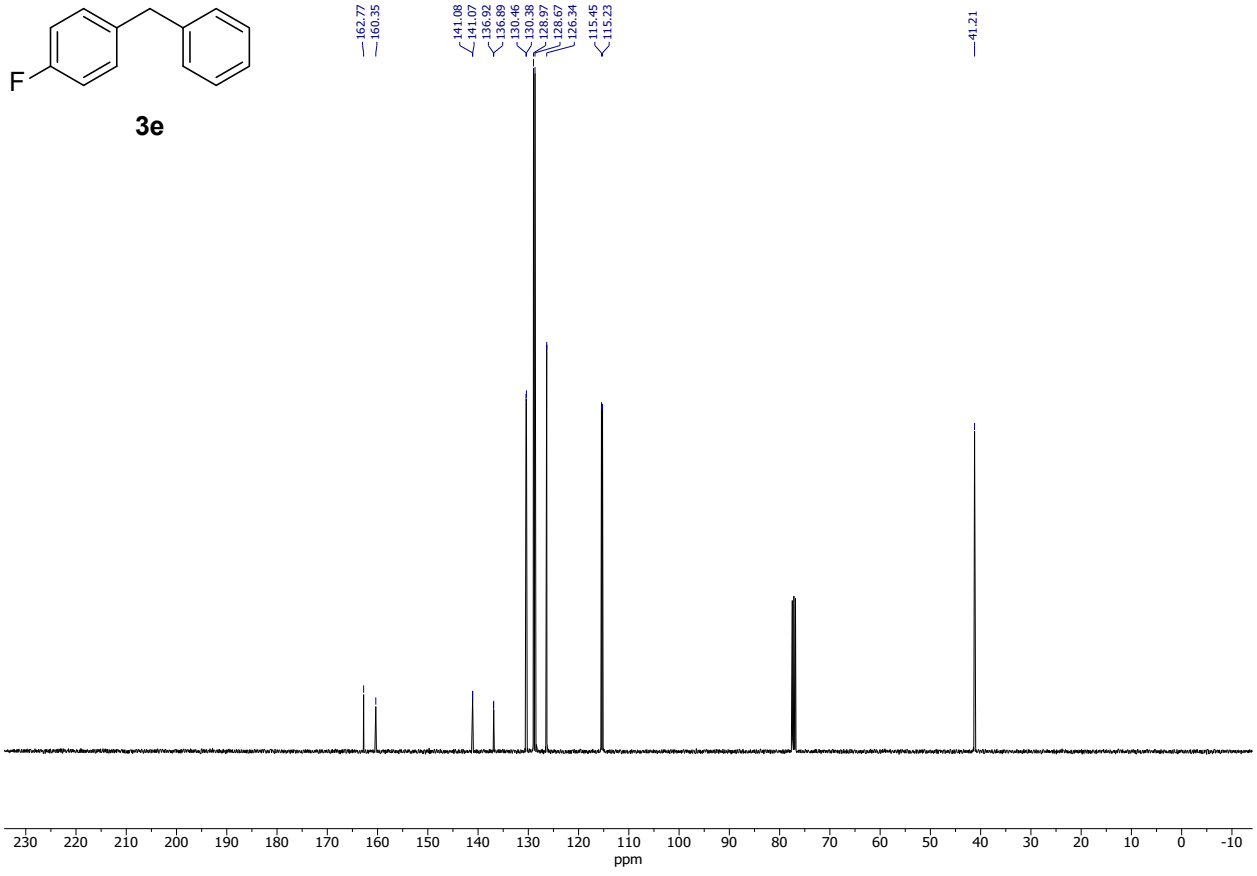
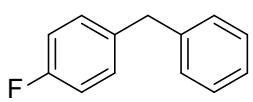
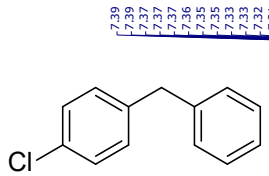
7.35
7.35
7.34
7.33
7.28
7.28
7.27
7.24
7.24
7.23
7.23
7.22
7.22
7.22
7.22
7.21
7.21
7.21
7.20
7.20
7.19
7.19
7.19
7.19
7.18
7.18
7.17
7.05
7.02
7.00
4.01
F
3e
1.94
0.93
3.97
1.96
2.00
ppm

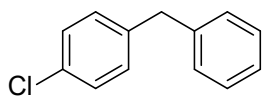

162.77
160.35
141.08
141.07
136.92
136.89
130.46
130.38
128.97
128.67
126.34
115.45
115.23
41.21
F
3e
ppm



3e

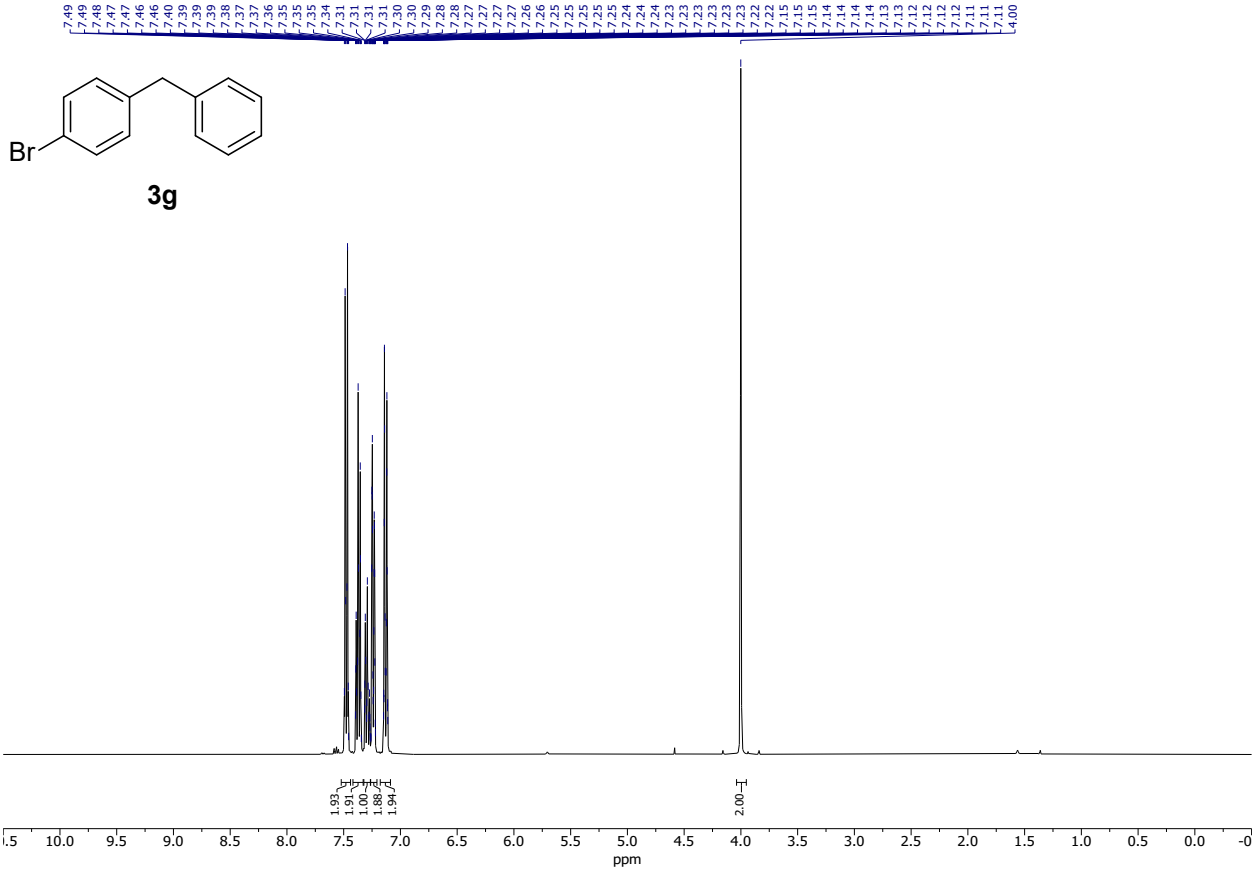


3f


Cl

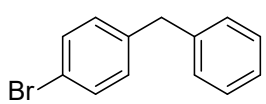
3f

140.68
139.71
132.02
130.38
128.99
128.70
128.69
126.42
41.36
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
ppm


7.49 7.49 7.48 7.47 7.47 7.46 7.46 7.40 7.39 7.39 7.39 7.38 7.37 7.37 7.36 7.35 7.35 7.34 7.31 7.31 7.31 7.30 7.30 7.29 7.28 7.28 7.27 7.27 7.27 7.27 7.26 7.26 7.25 7.25 7.25 7.25 7.24 7.24 7.24 7.23 7.23 7.23 7.23 7.23 7.22 7.22 7.15 7.15 7.15 7.14 7.14 7.14 7.14 7.13 7.13 7.12 7.12 7.12 7.12 7.11 7.11 7.11 4.00
1.93
1.91
1.00
1.88
1.94
2.00
.5 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 -0
ppm

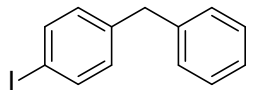
Br

3g


Br

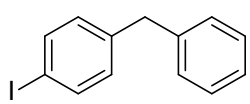
3g

140.55
140.21
131.63
130.78
128.98
128.69
126.42
120.06
41.41
ppm


I

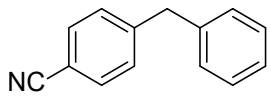
3h

1.98
1.96
1.01
1.92
2.00
2.00
ppm



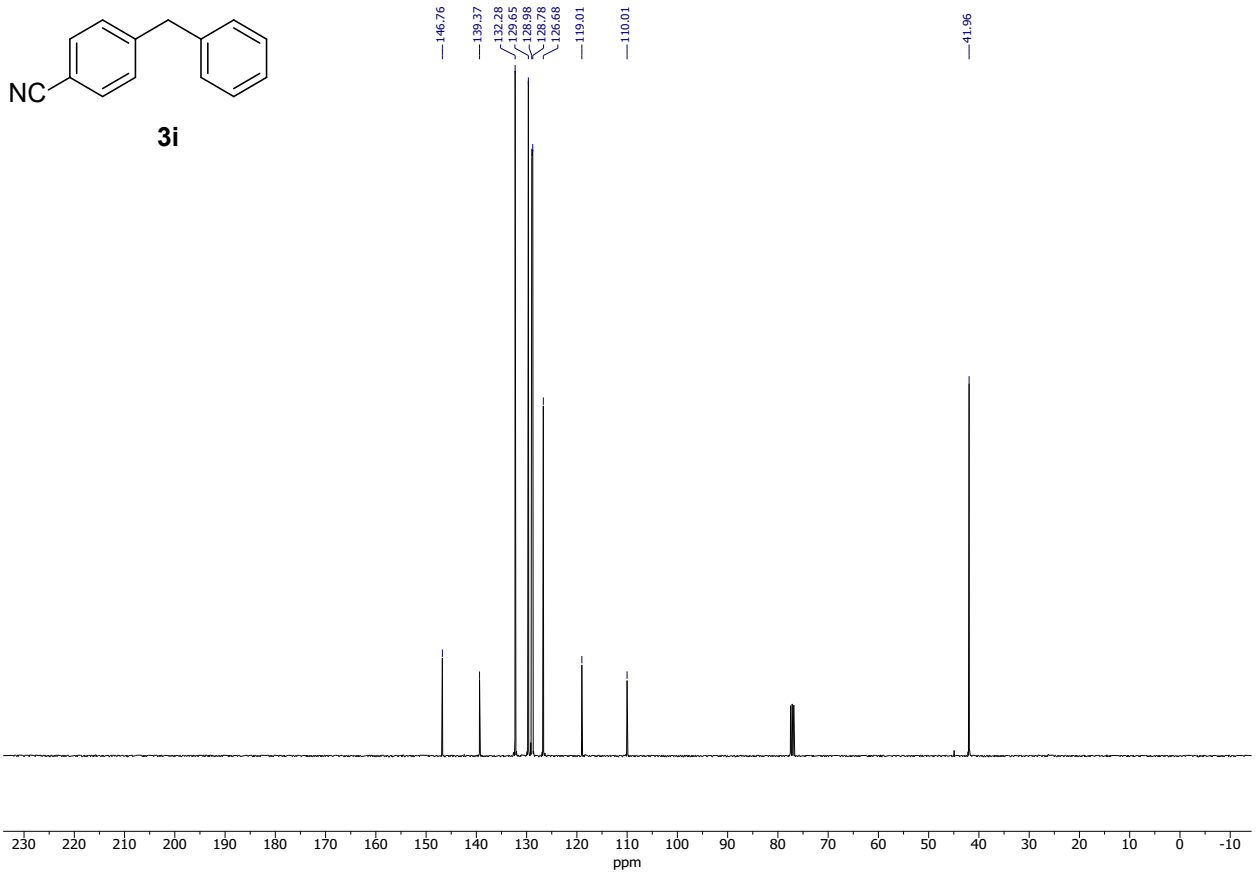
3h

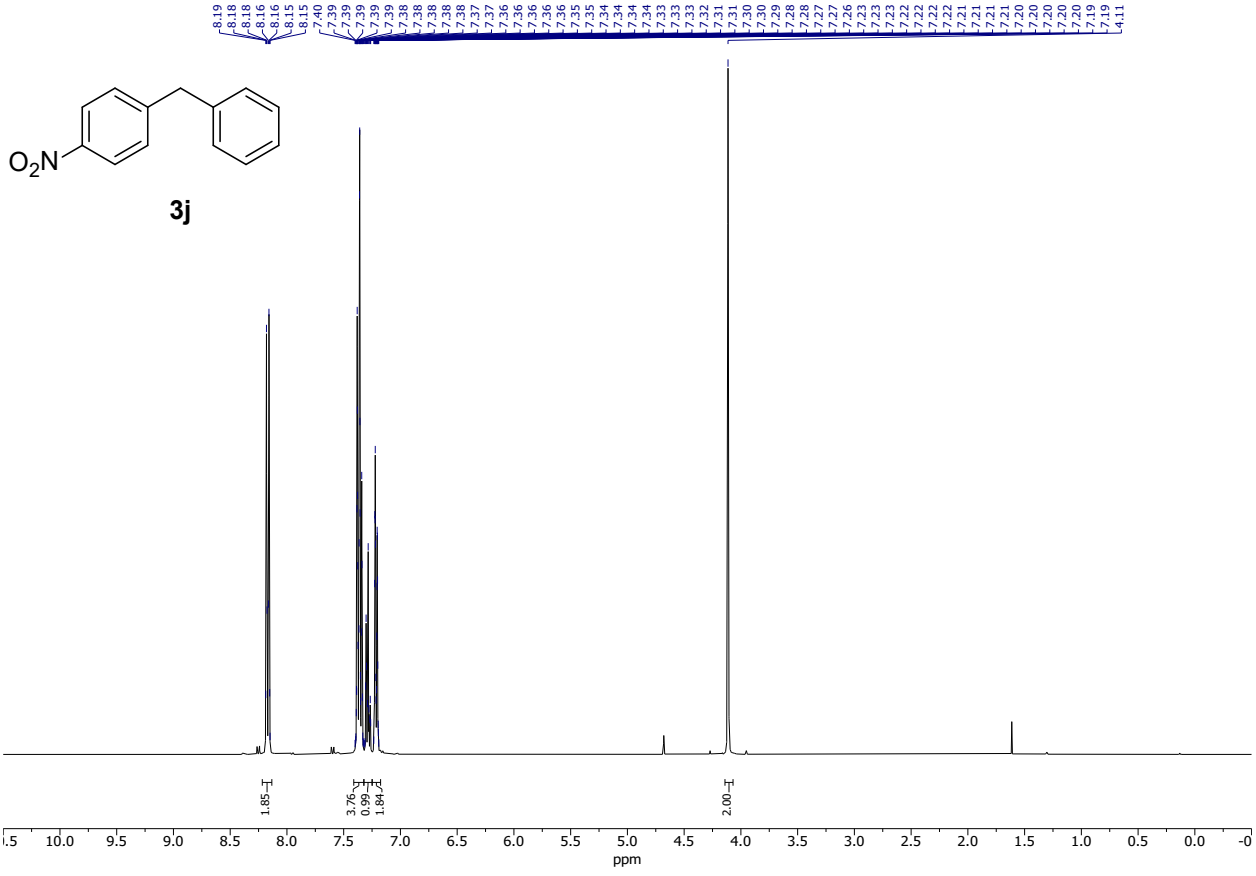
140.86
140.47
137.58
131.11
128.96
128.67
126.40
91.45
41.50
ppm

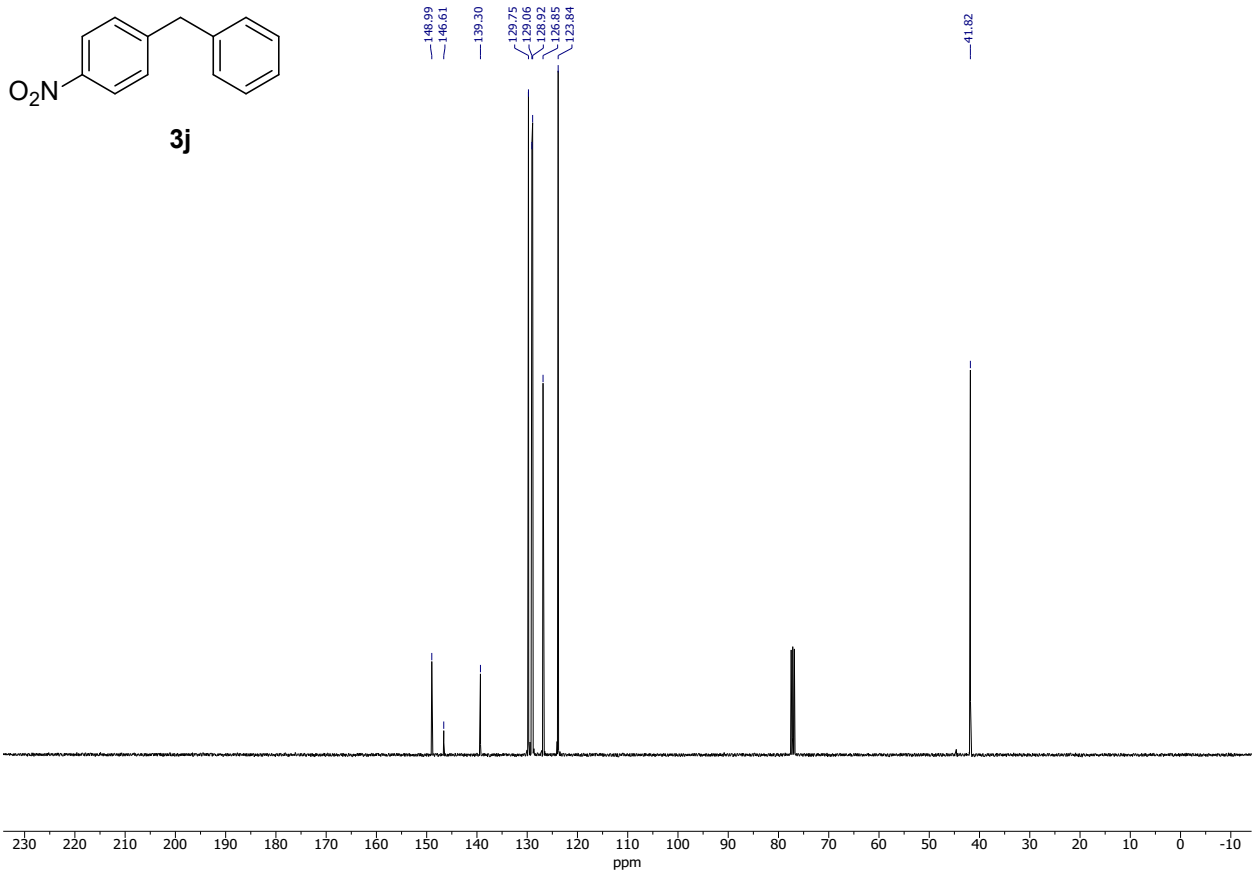


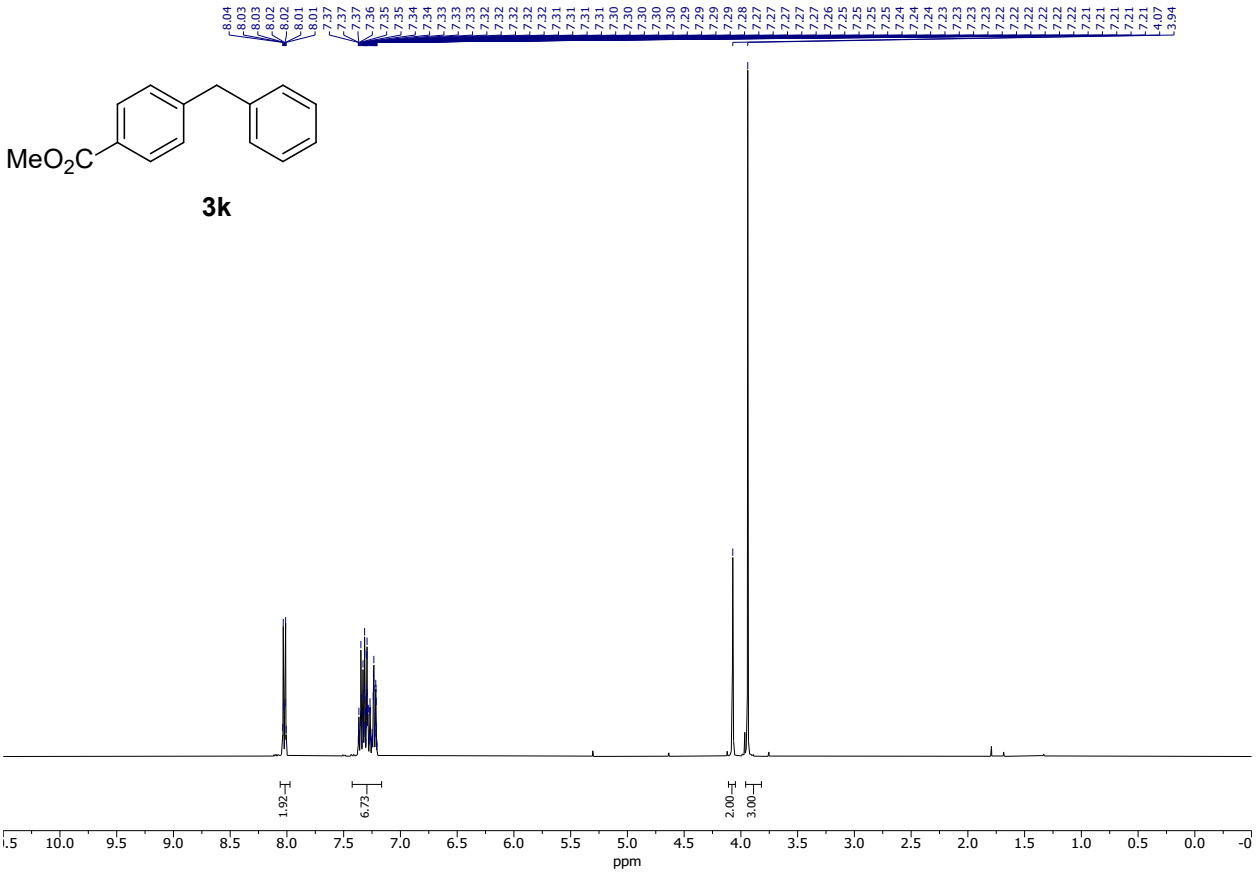
3i

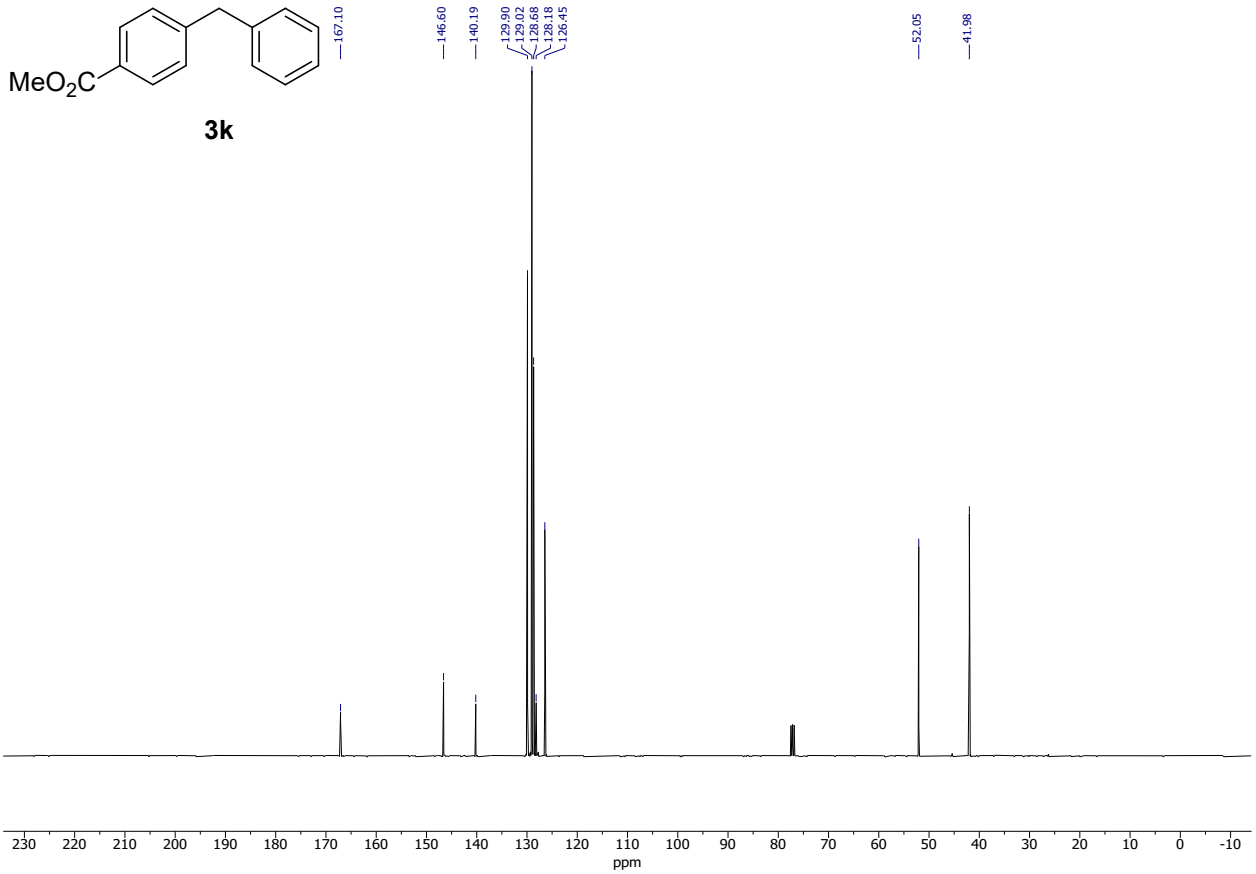
1.91
4.81
1.91
2.00
ppm

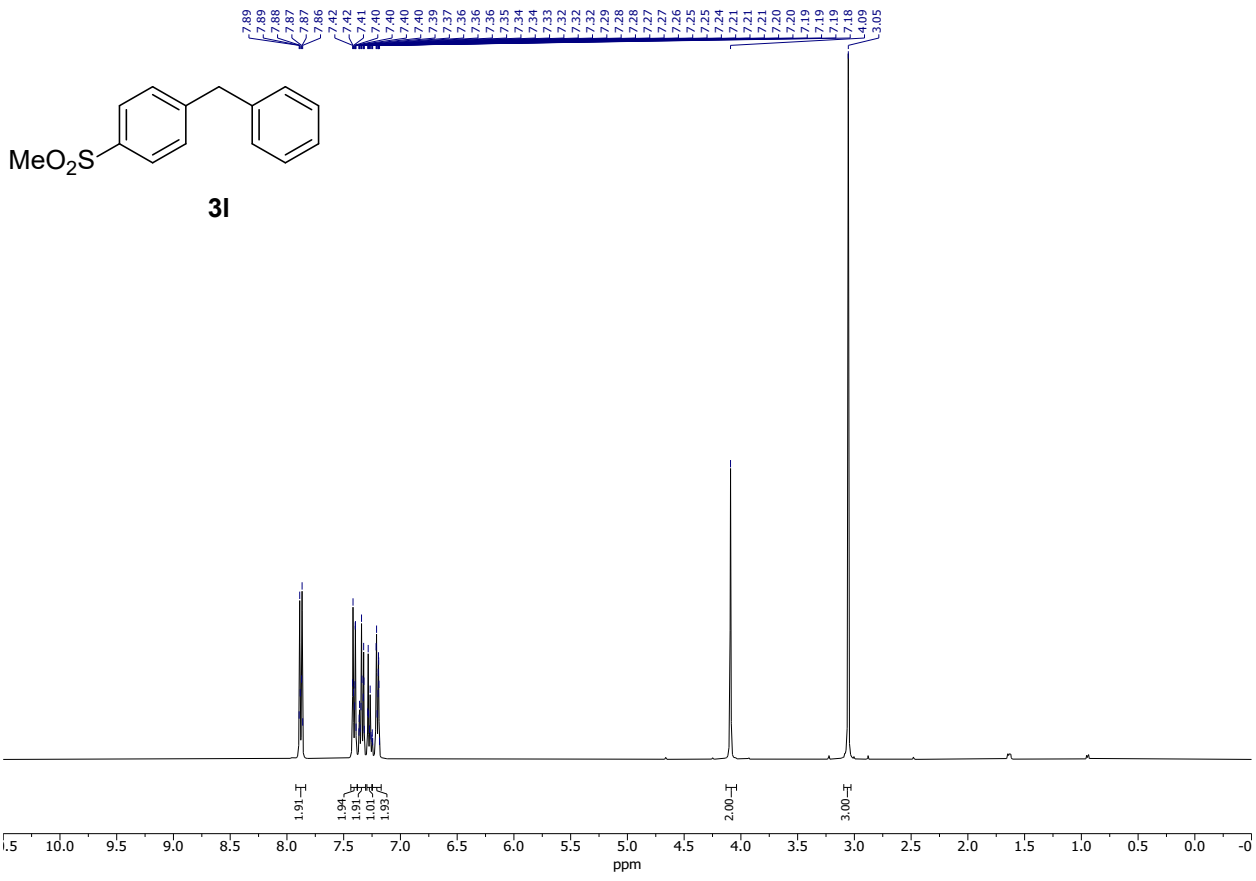

NC
3i
146.76
139.37
132.28
129.65
128.98
128.78
126.68
119.01
110.01
41.96
ppm

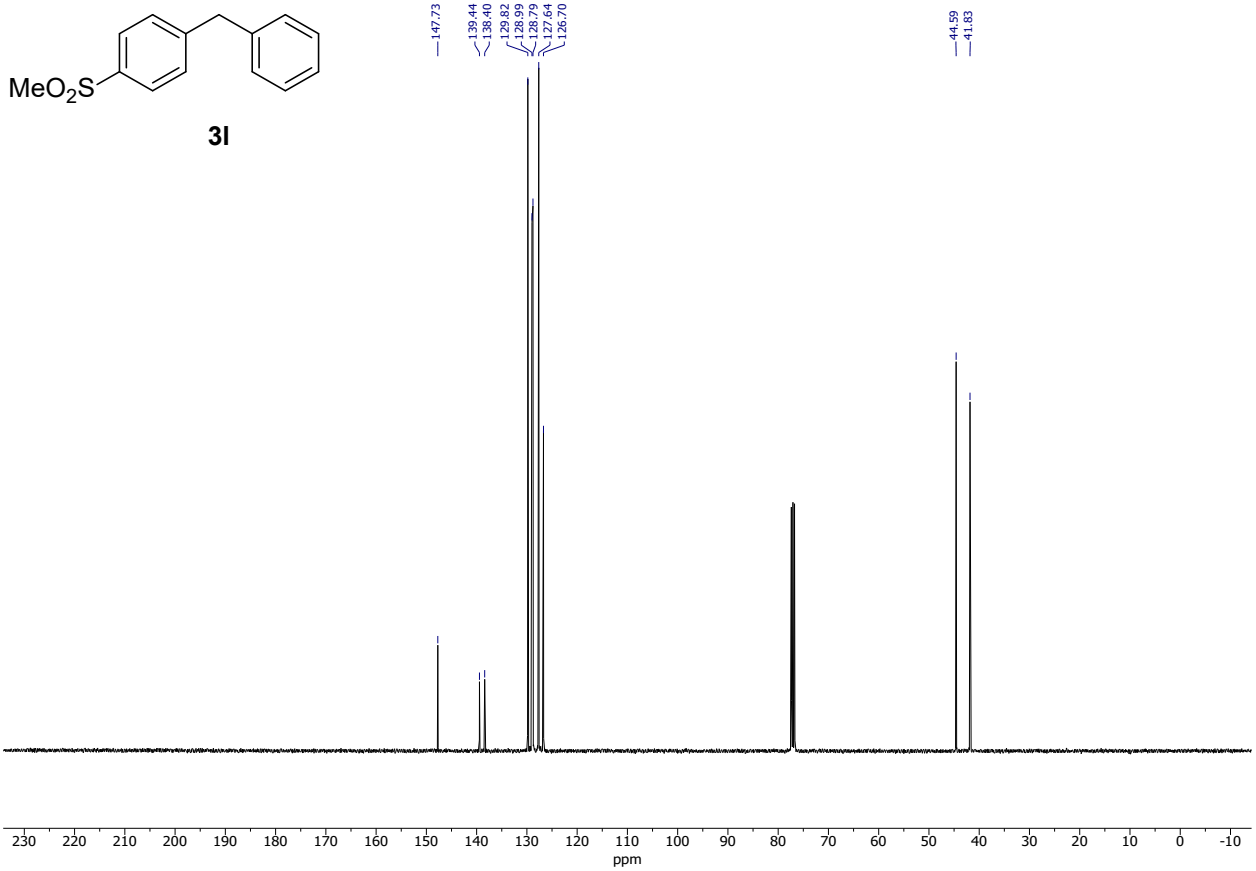

O2N
3j
1.85
3.76
0.99
1.84
2.00
ppm

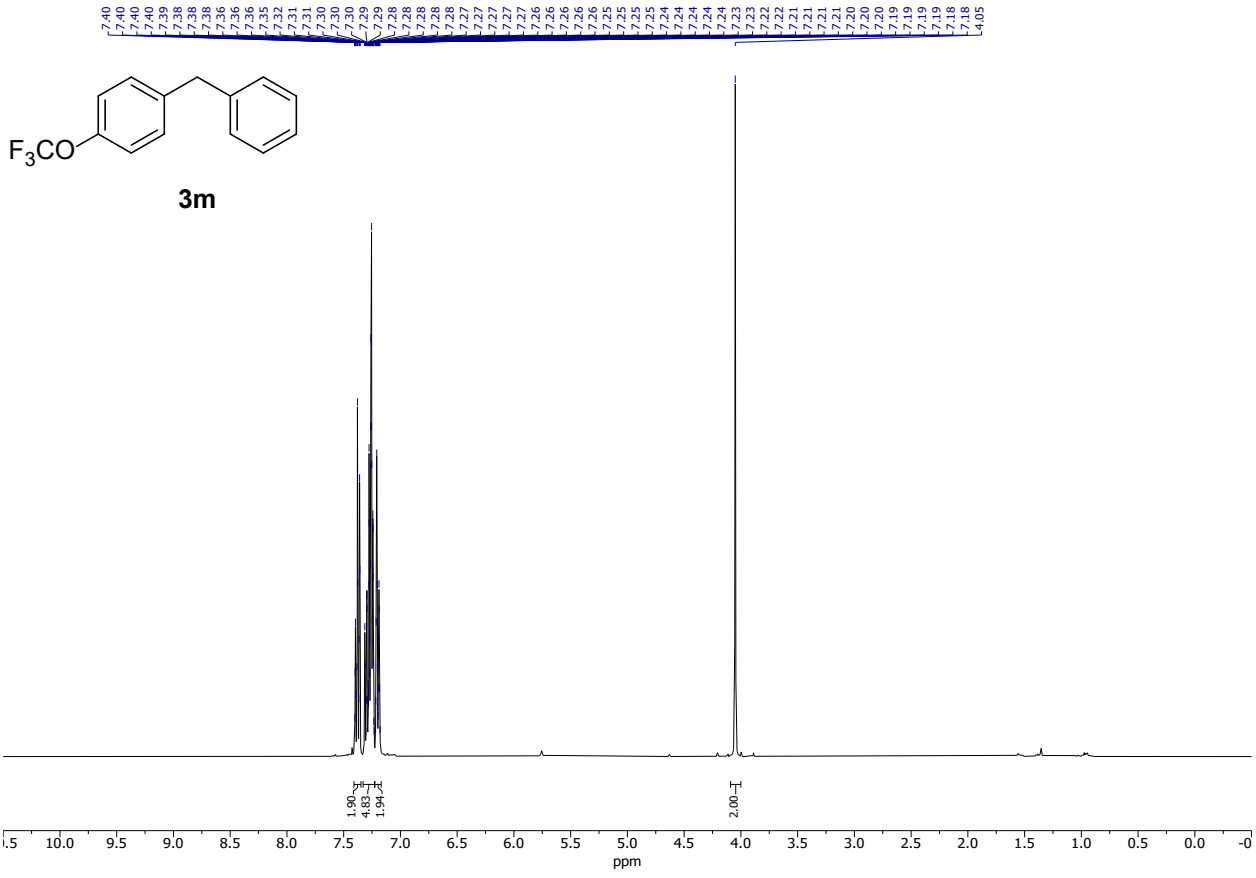

148.99
146.61
139.30
129.75
129.06
128.92
126.85
123.84
41.82
O2N
3j
ppm

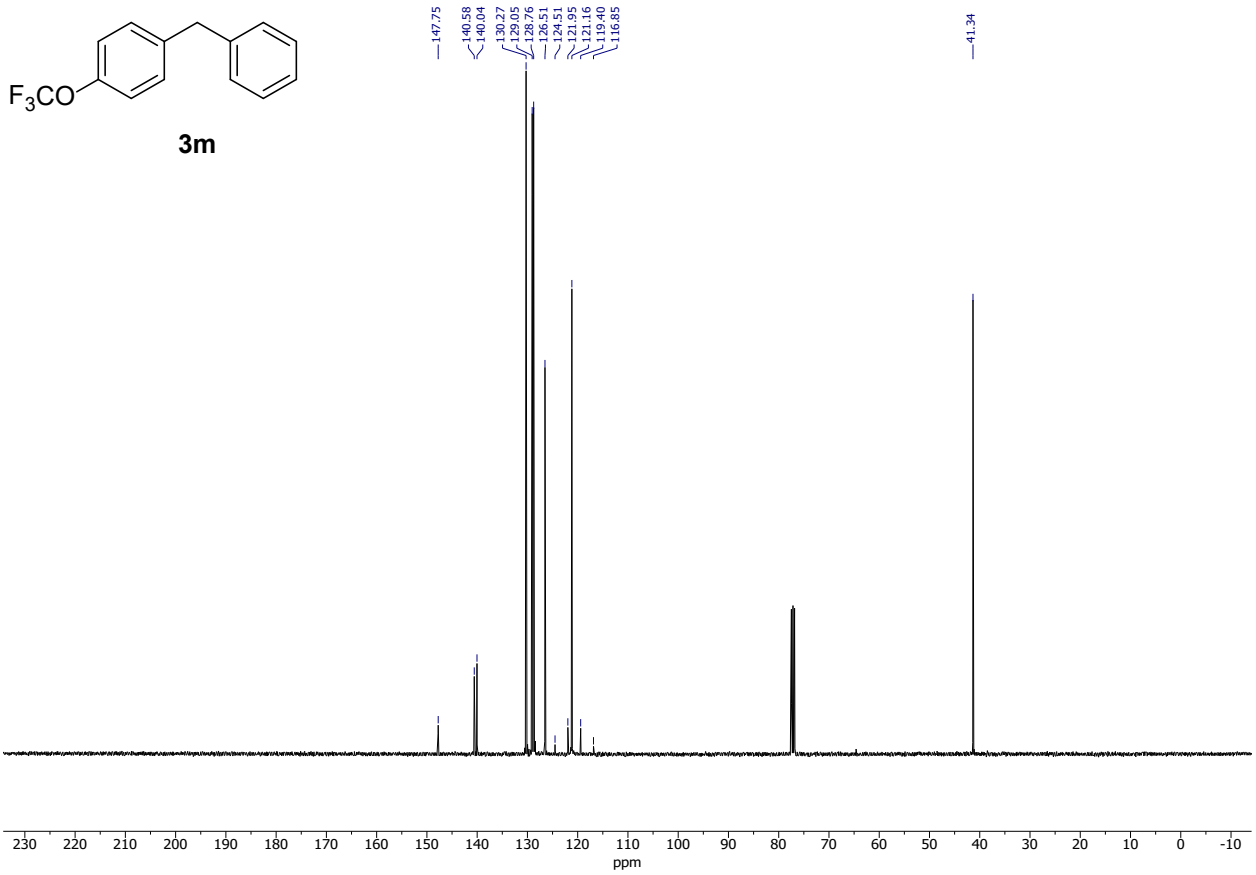

MeO2C
3k
1.92
6.73
2.00
3.00
ppm


MeO2C
3k
167.10
146.60
140.19
129.90
129.02
128.68
128.18
126.45
52.05
41.98
ppm

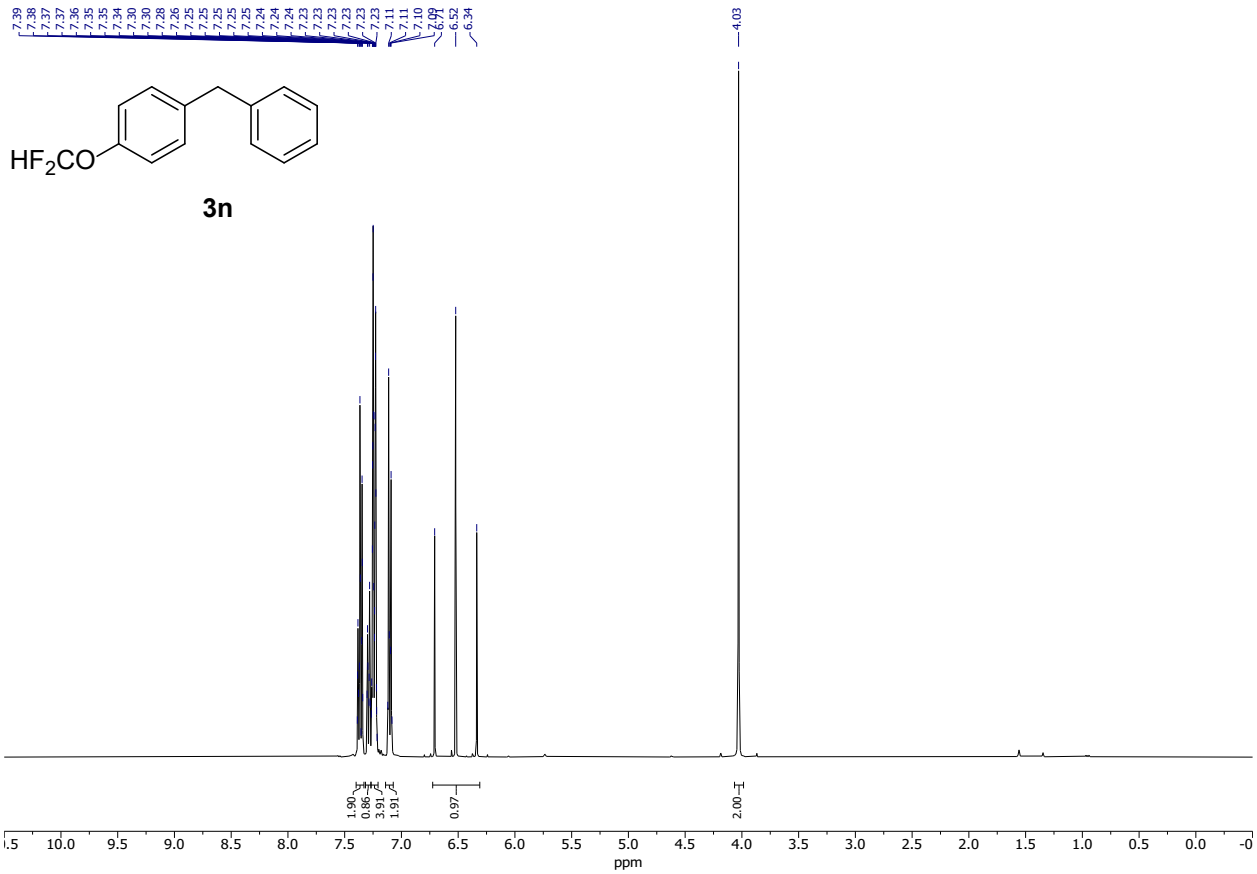

MeO2S
3l
7.89
7.88
7.87
7.86
7.42
7.41
7.40
7.39
7.37
7.36
7.35
7.34
7.33
7.32
7.29
7.28
7.27
7.26
7.25
7.24
7.21
7.20
7.19
7.18
4.09
3.05
1.91
1.94
1.93
2.00
3.00
ppm

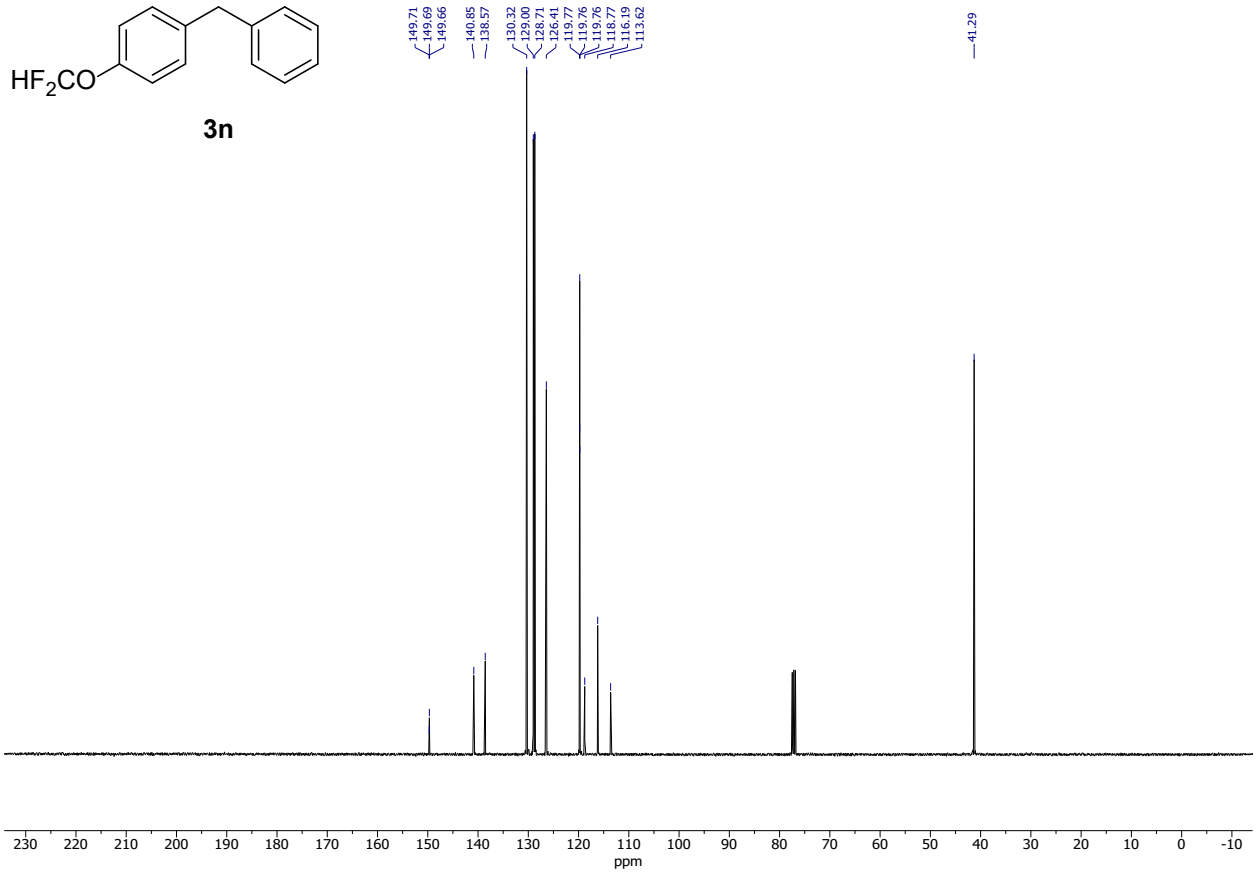

MeO2S
3l
147.73
139.44
138.40
129.82
128.99
128.79
127.64
126.70
44.59
41.83
ppm

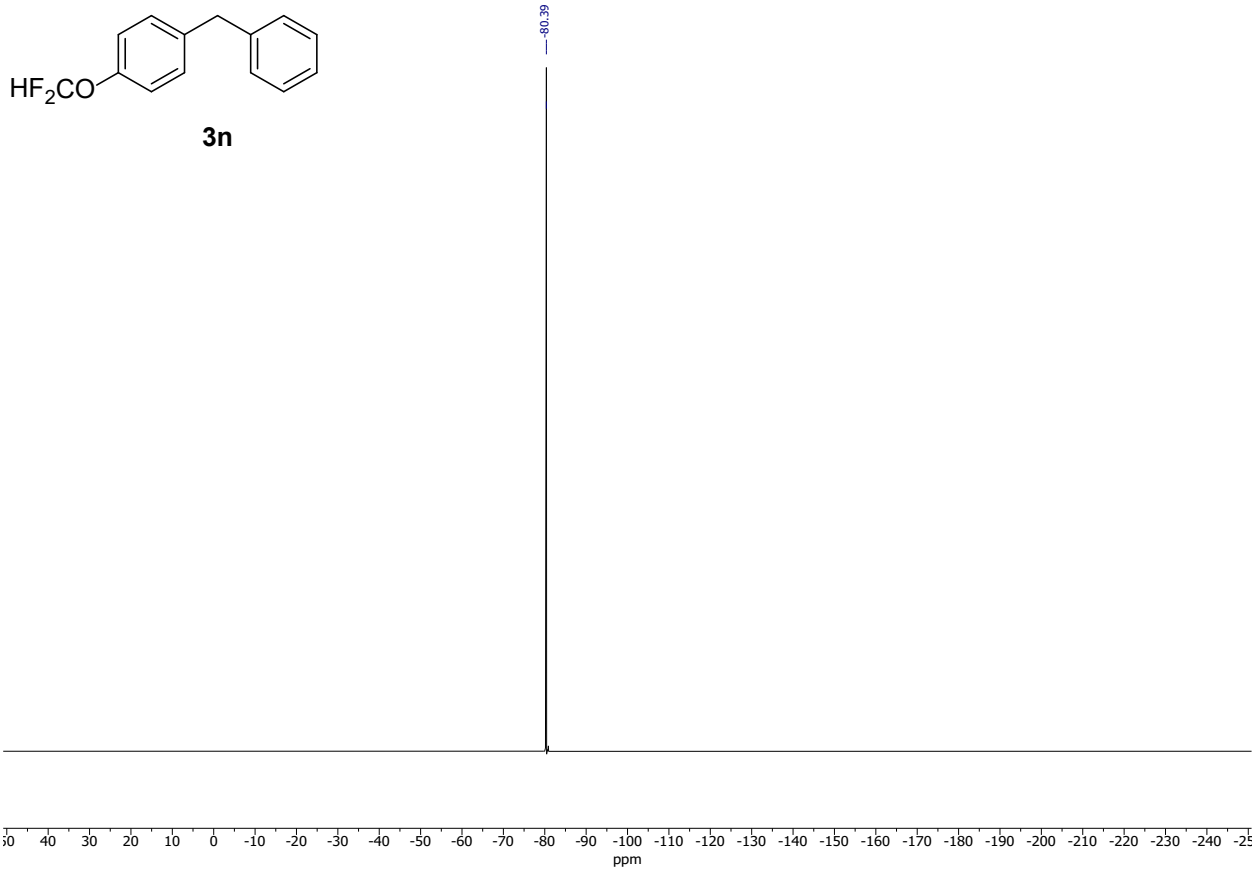

F3CO
3m
1.90
4.83
1.94
2.00
ppm


F3CO
3m
147.75
140.58
140.04
130.27
129.05
128.76
126.51
124.51
121.95
121.16
119.40
116.85
41.34
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
ppm

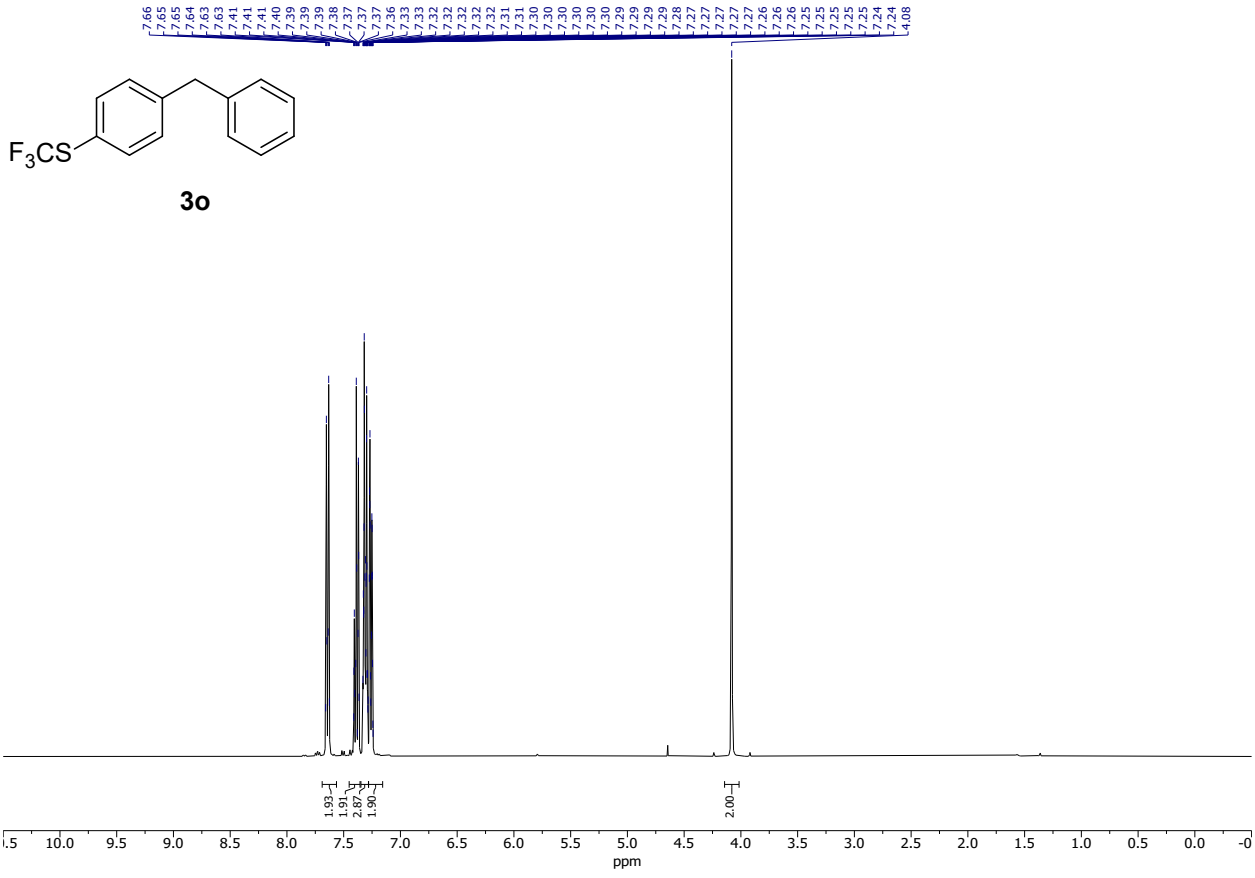

F3CO
3m
-57.77
40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240
ppm


7.39
7.38
7.37
7.37
7.36
7.35
7.35
7.34
7.30
7.30
7.28
7.26
7.25
7.25
7.25
7.25
7.25
7.24
7.24
7.24
7.23
7.23
7.23
7.23
7.23
7.23
7.11
7.11
7.10
6.52
6.34
4.03
HF2CO
3n
1.90
0.86
3.91
1.91
0.97
2.00
ppm

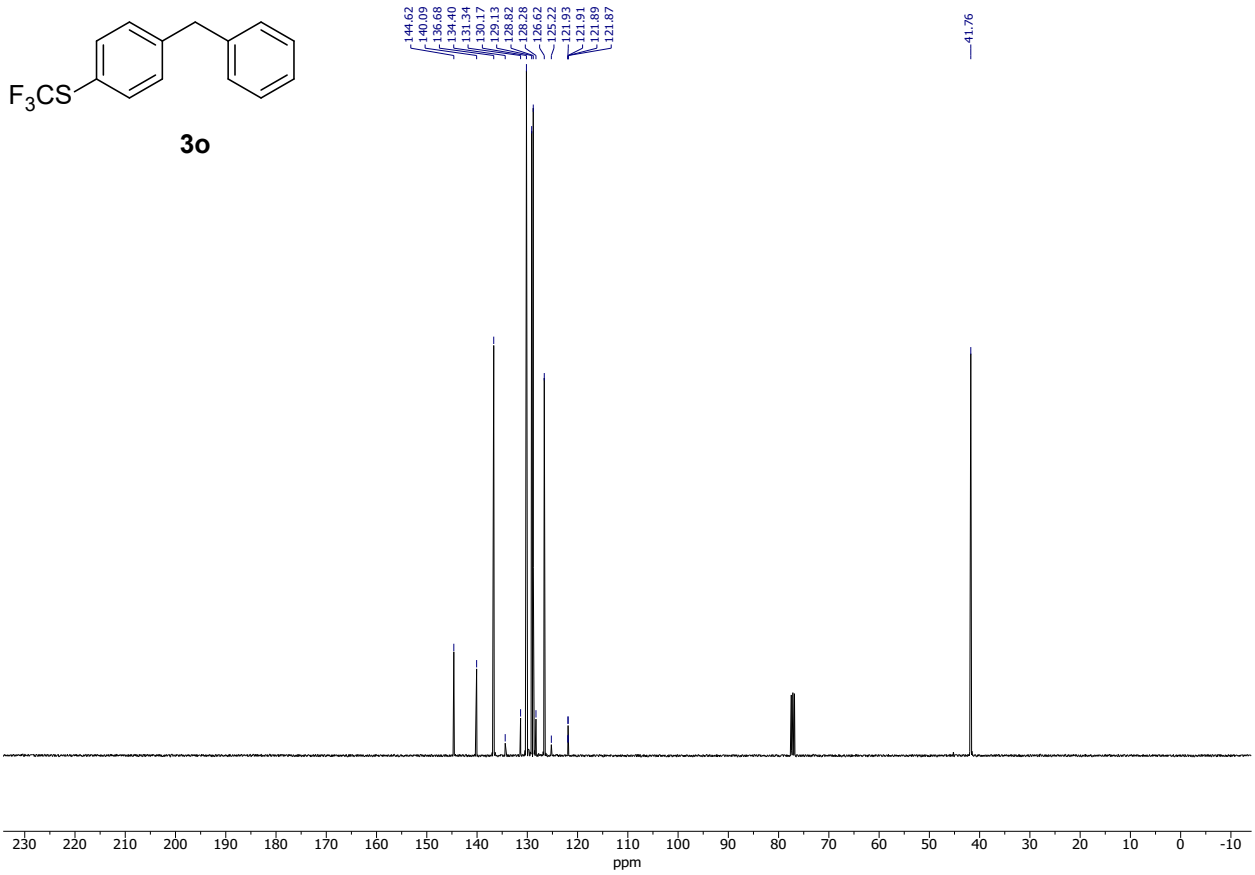

149.71
149.69
149.66
140.85
138.57
130.32
129.00
128.71
126.41
119.77
119.76
119.76
118.77
116.19
113.62
41.29
HF2CO
3n
ppm

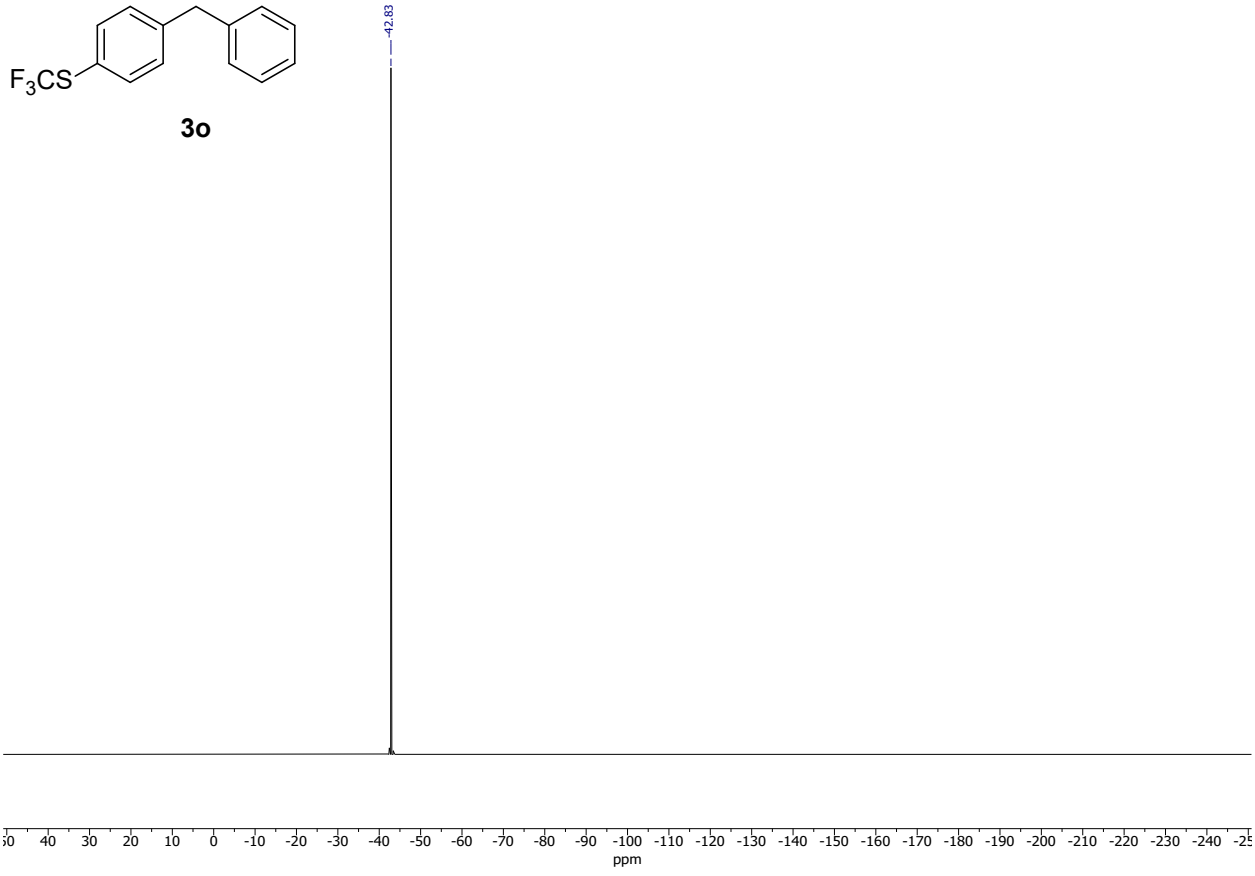


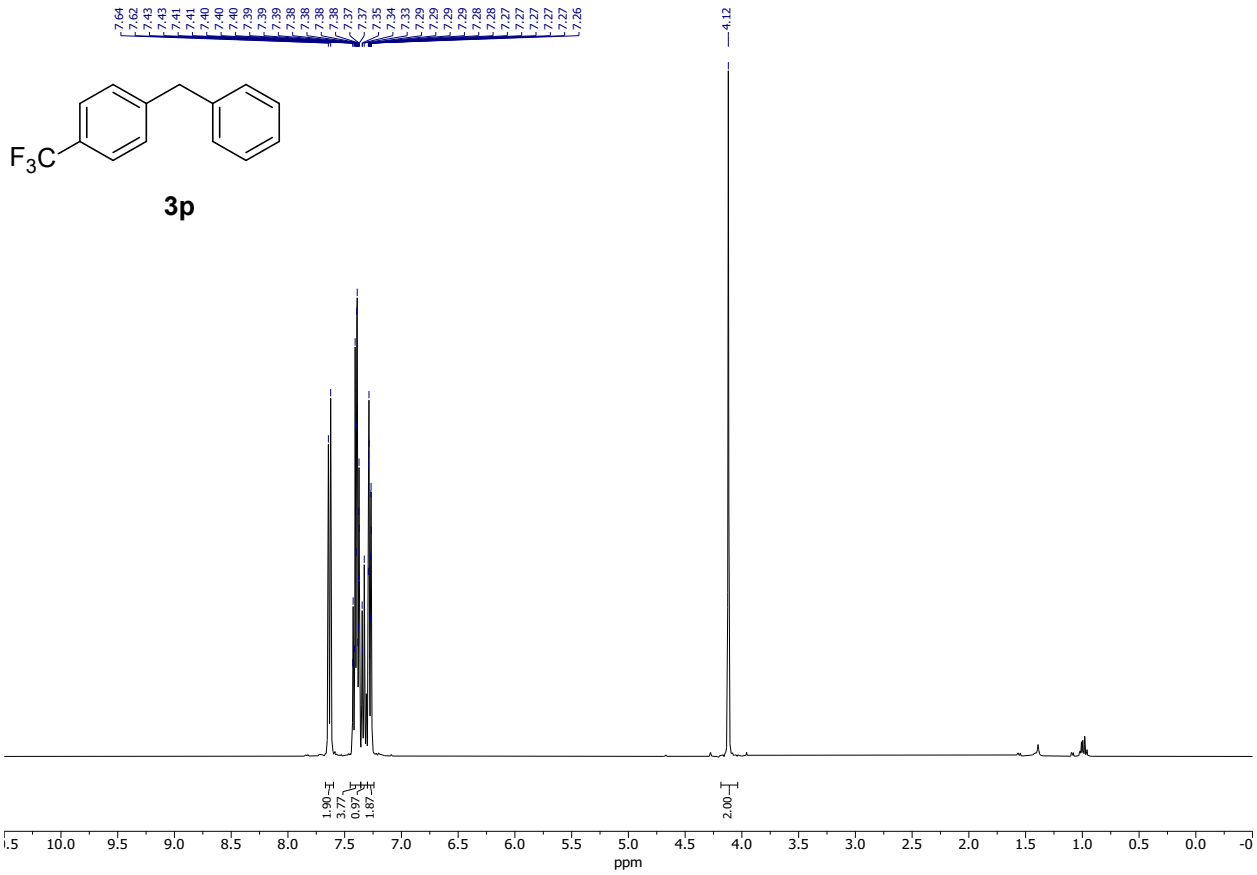
3n

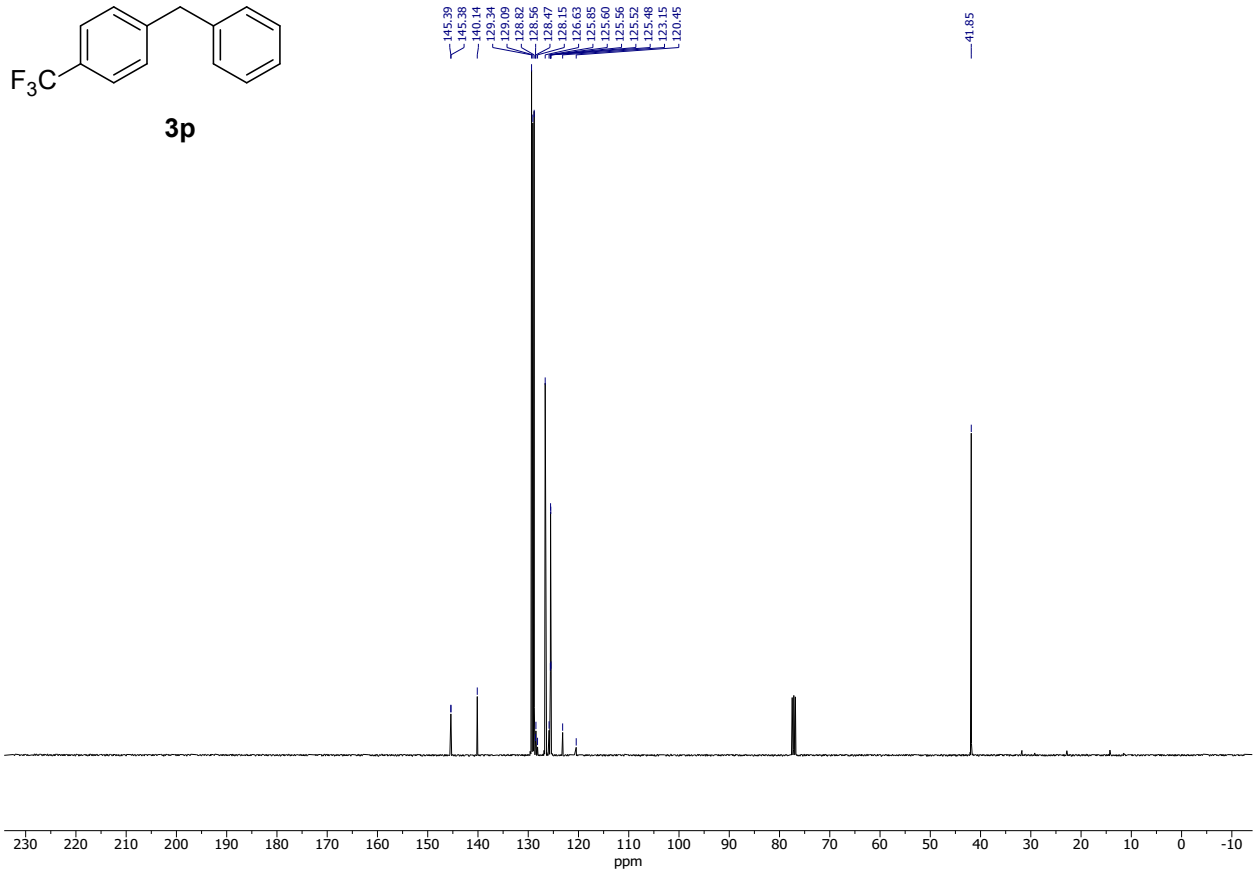


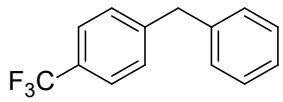
3o


144.62
140.09
136.68
134.40
131.34
130.17
129.13
128.82
128.28
126.62
125.22
121.93
121.91
121.89
121.87
41.76
F3CS
3o
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
ppm


-42.83
F3CS
3o
40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240
ppm

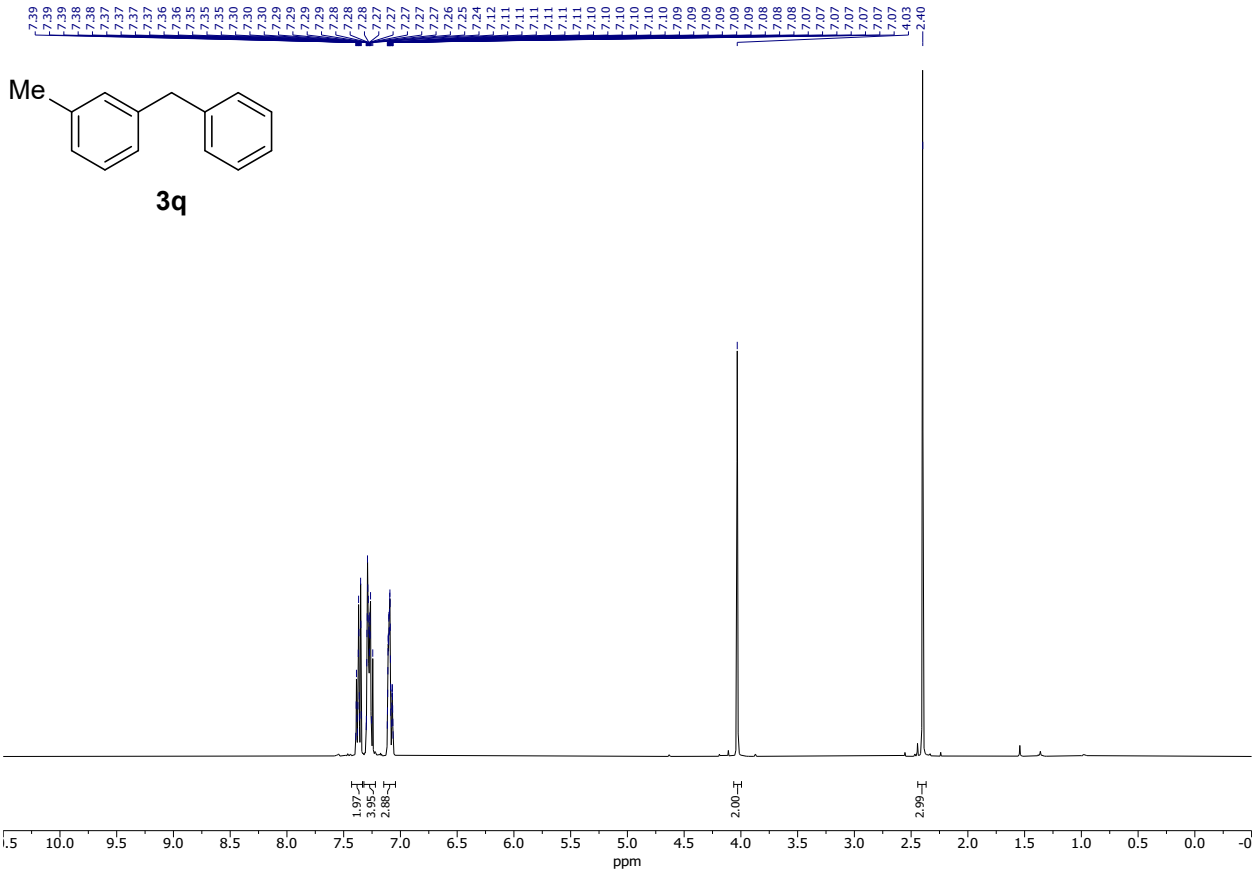

7.64
7.62
7.43
7.43
7.41
7.41
7.40
7.40
7.40
7.39
7.39
7.38
7.38
7.38
7.37
7.37
7.35
7.34
7.33
7.29
7.29
7.29
7.28
7.27
7.27
7.27
7.27
7.27
7.26
4.12
F3C
3p
1.90
3.77
0.97
1.87
2.00
ppm


F3C
3p
145.39
145.38
140.14
129.34
129.09
128.82
128.56
128.47
128.15
126.63
125.85
125.60
125.56
125.52
125.48
123.15
120.45
41.85
ppm

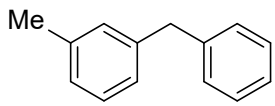


3p

-62.16
ppm

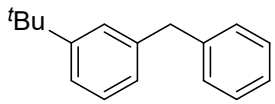

7.39
7.38
7.37
7.36
7.35
7.30
7.29
7.28
7.27
7.26
7.25
7.24
7.12
7.11
7.10
7.09
7.08
7.07
4.03
2.40
1.97
3.95
2.88
2.00
2.99
ppm

3q


Me

3q

141.39
141.16
138.16
129.85
129.06
128.57
128.48
126.96
126.15
126.12
42.03
21.54
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
ppm


tBu

3r

7.42
7.42
7.42
7.41
7.40
7.40
7.40
7.39
7.38
7.38
7.38
7.38
7.37
7.37
7.37
7.36
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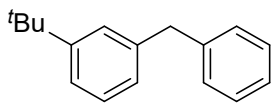
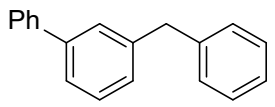
7.12
7.11
7.11
7.11
7.11
7.11
7.11
7.10
7.10
7.10
7.09
7.09
7.09
4.11
1.43
7.78
0.98
2.00
9.20
.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
ppm


tBu

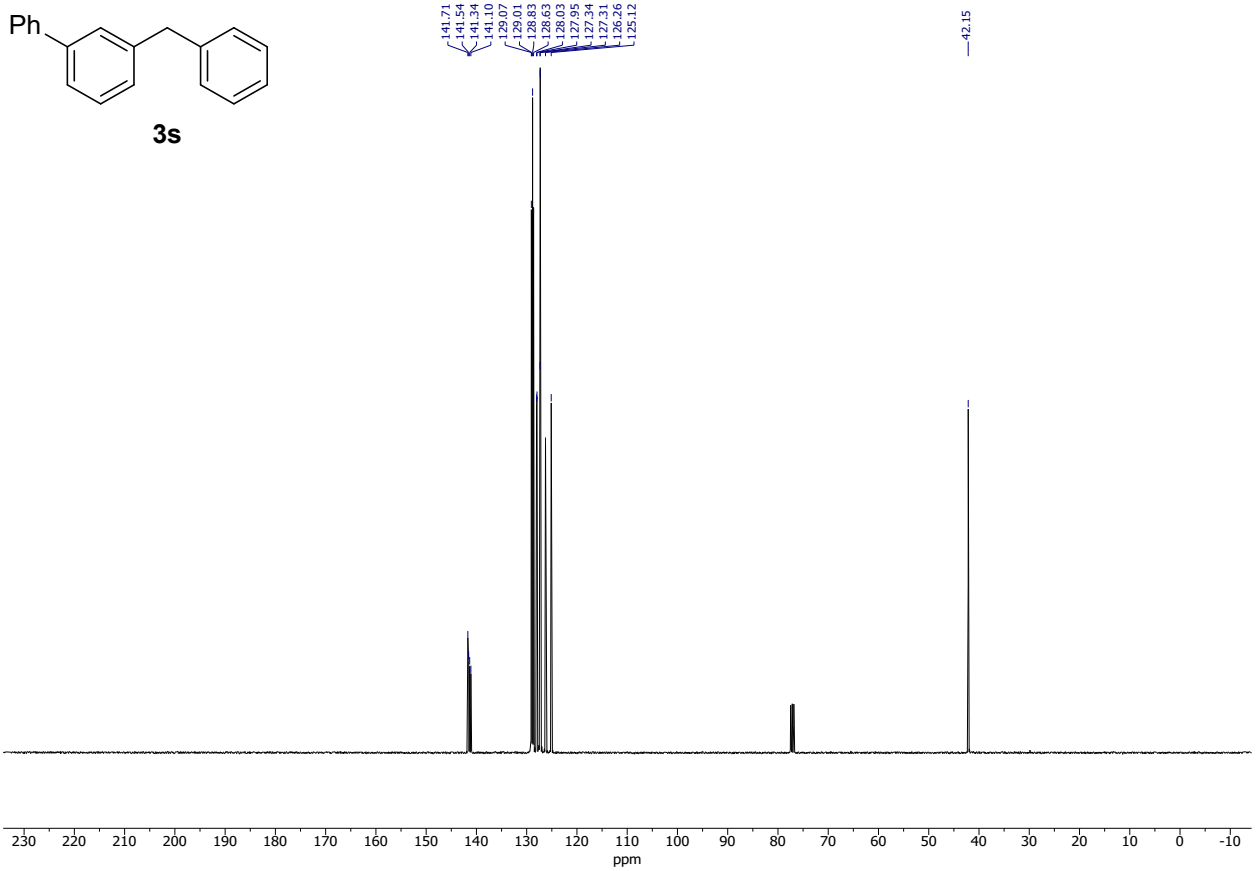
3r

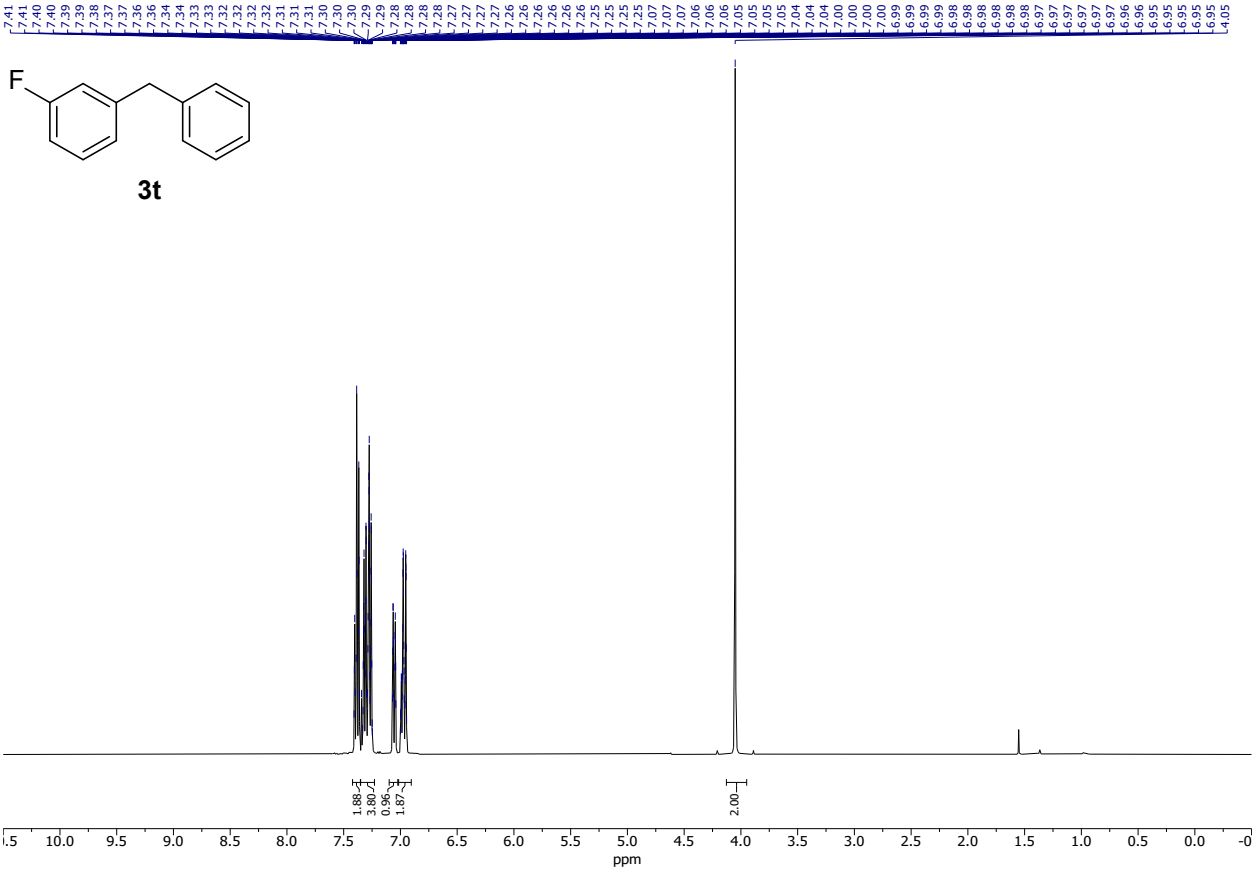
151.39
141.43
140.75
129.05
128.55
128.28
126.18
126.16
126.11
123.16
42.33
34.75
31.53
ppm

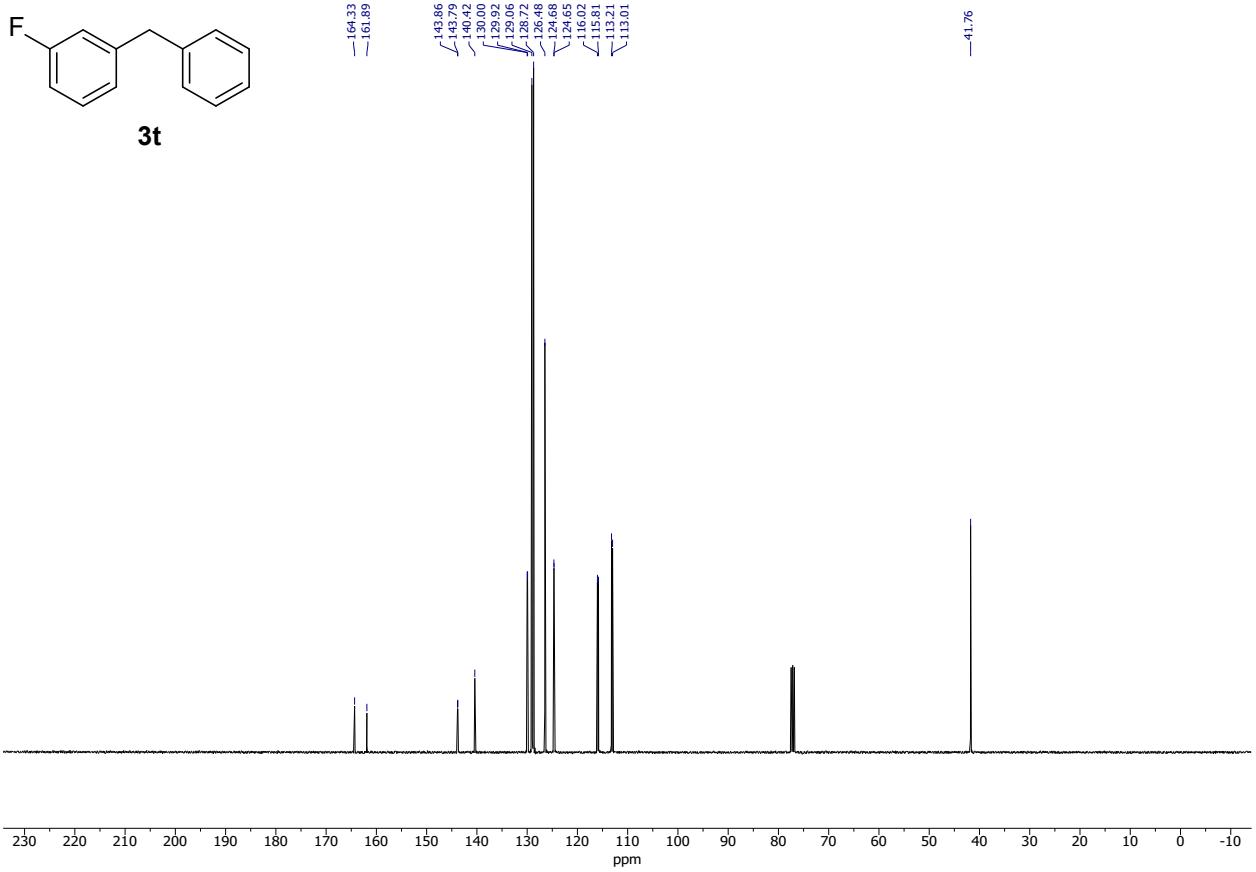

Ph

3s

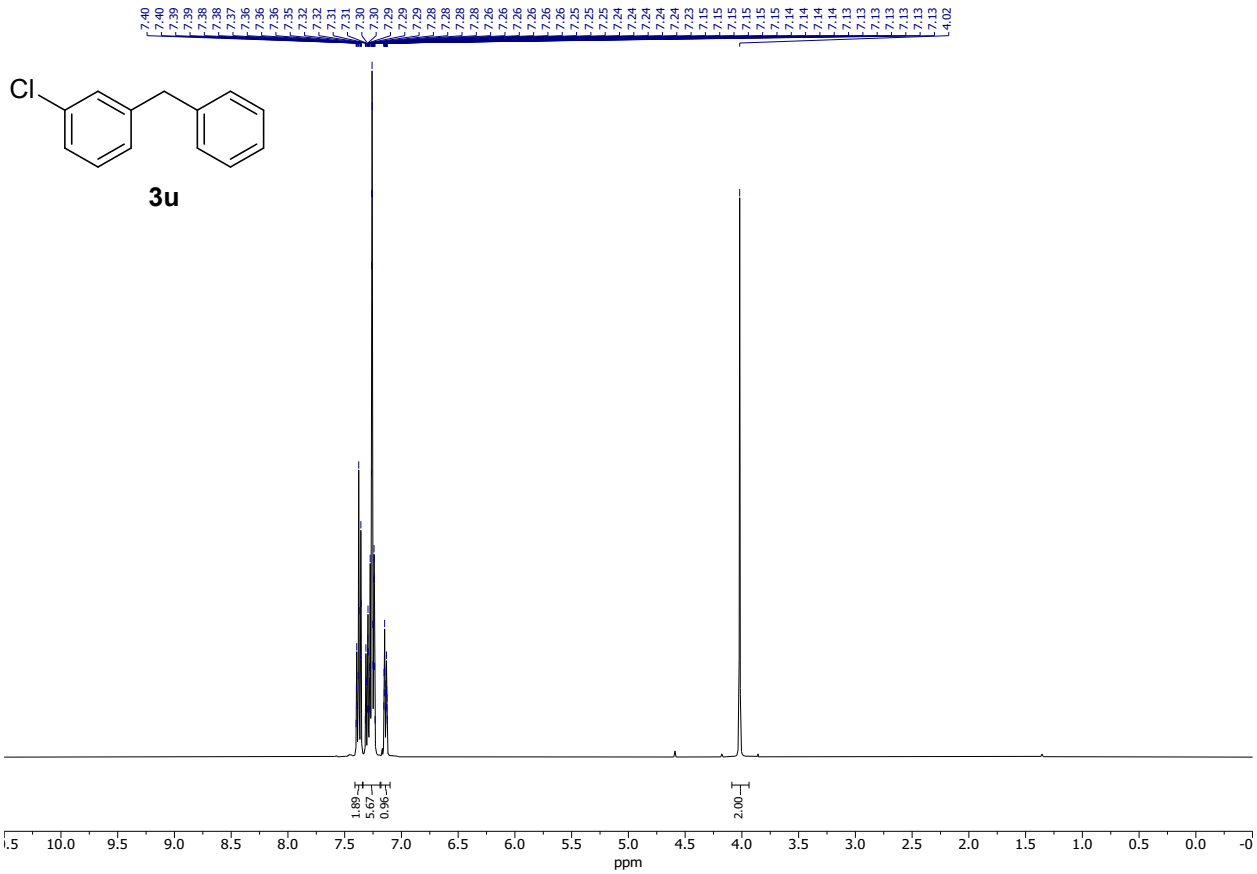
2.02
4.04
4.00
3.92
2.02
ppm

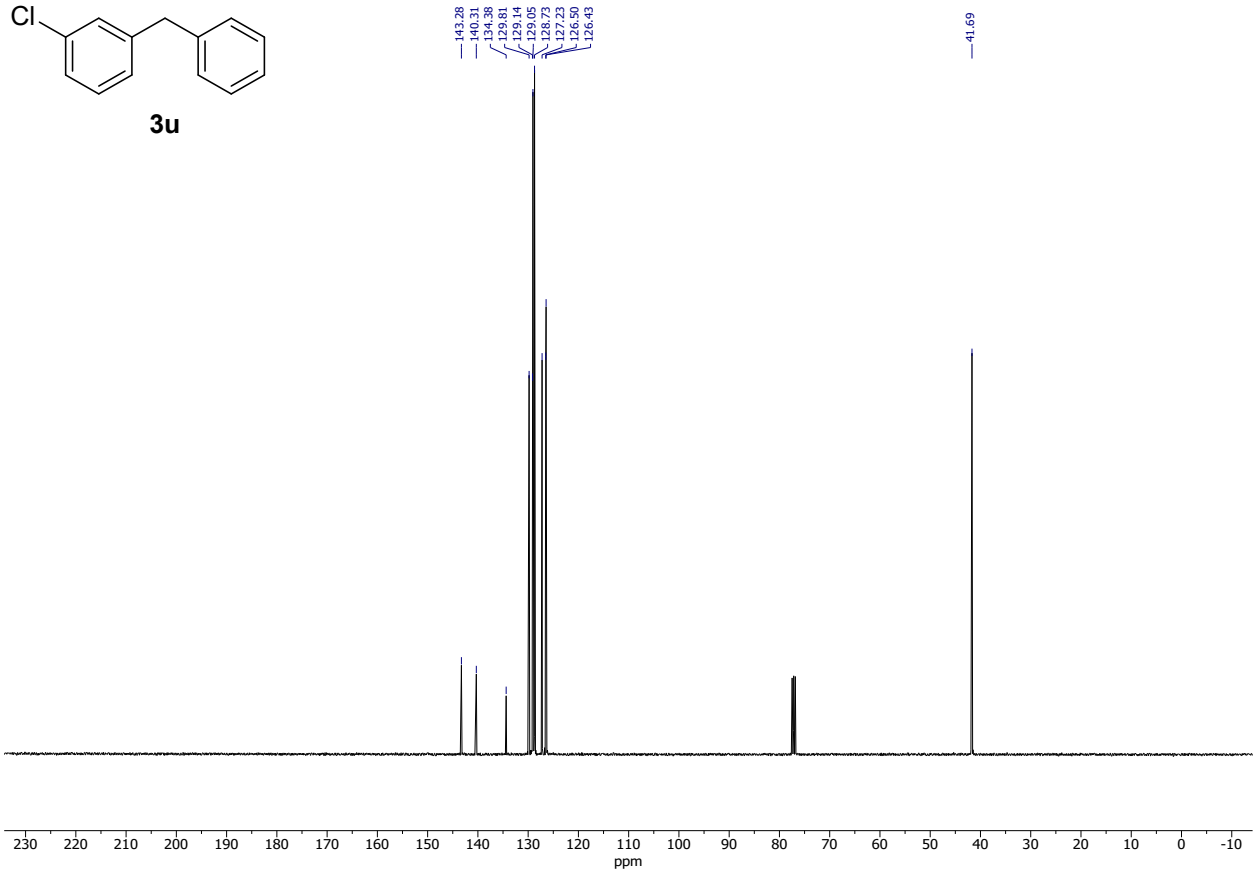

Ph
3s
141.71
141.54
141.34
141.10
129.07
129.01
128.83
128.63
128.03
127.95
127.34
127.31
126.26
125.12
42.15
ppm

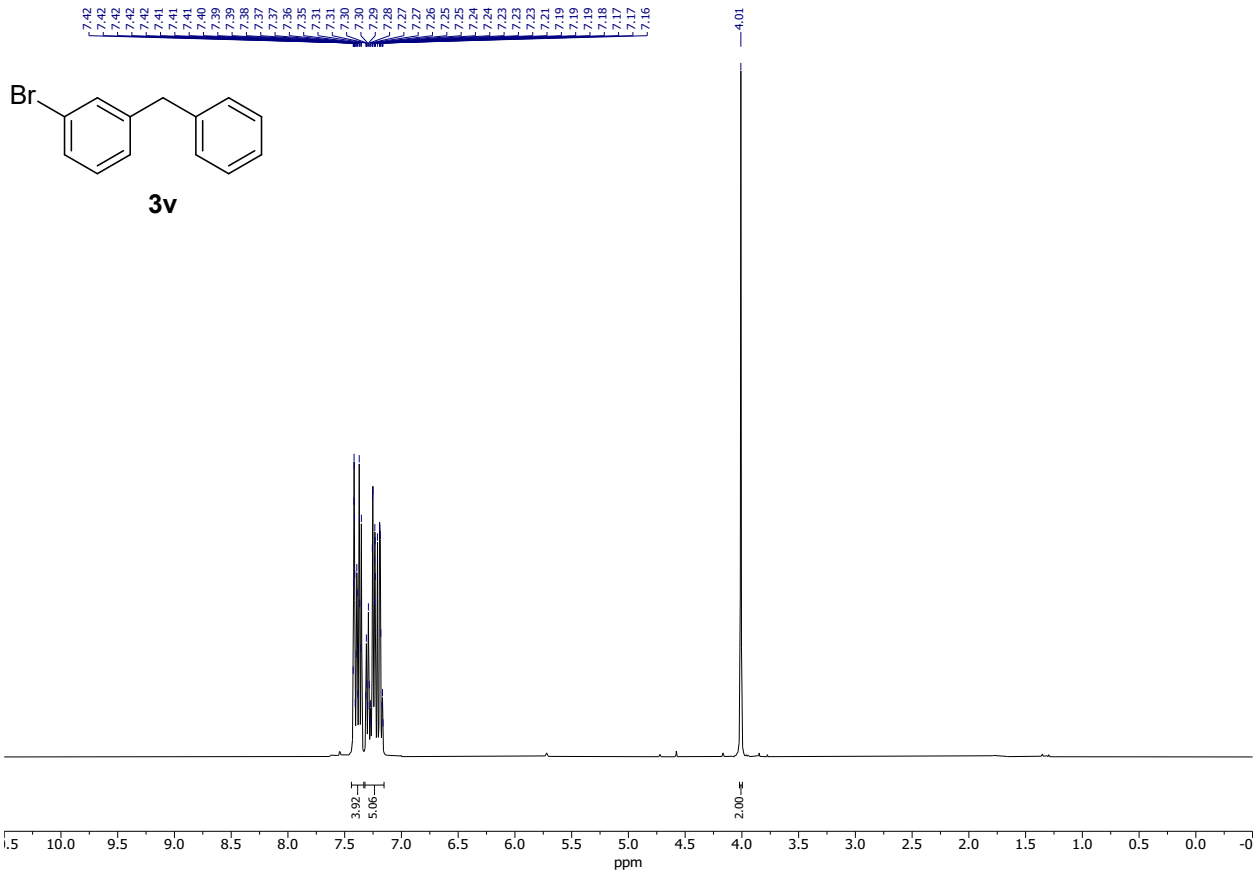

F
3t
1.88
3.80
0.96
1.87
2.00
ppm

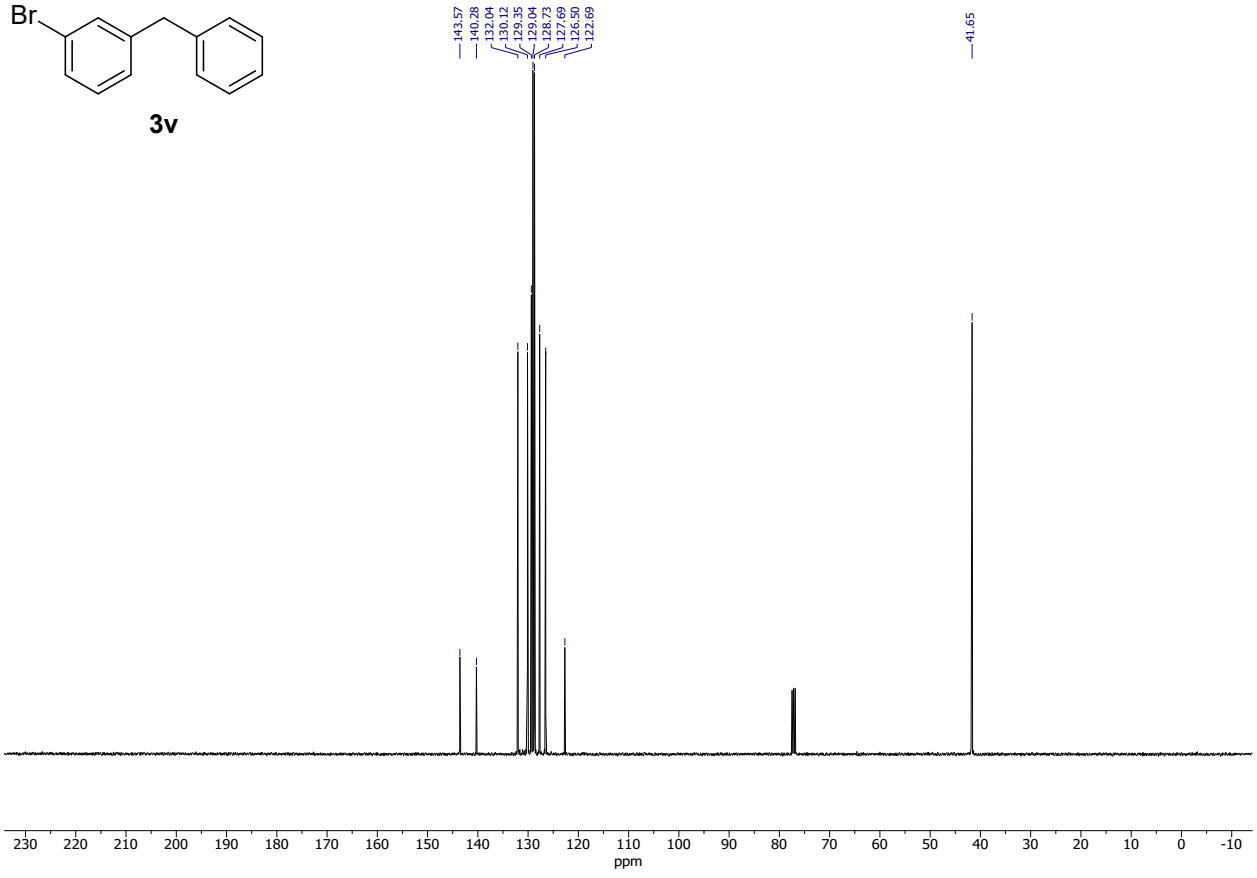

F
3t
164.33
161.89
143.86
143.79
140.42
130.00
129.92
129.06
128.72
126.48
124.68
124.65
116.02
115.81
113.21
113.01
41.76
ppm

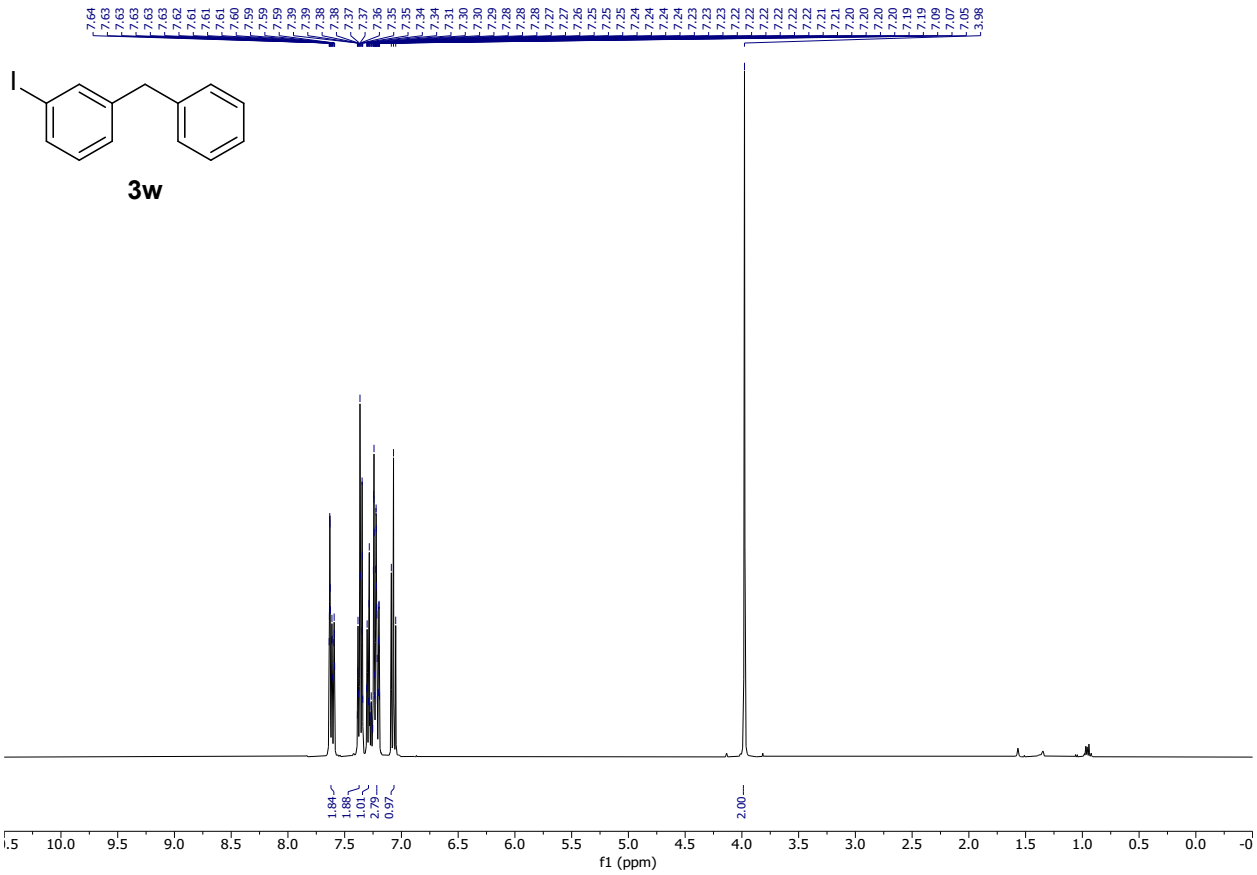

F
3t
-113.41
ppm

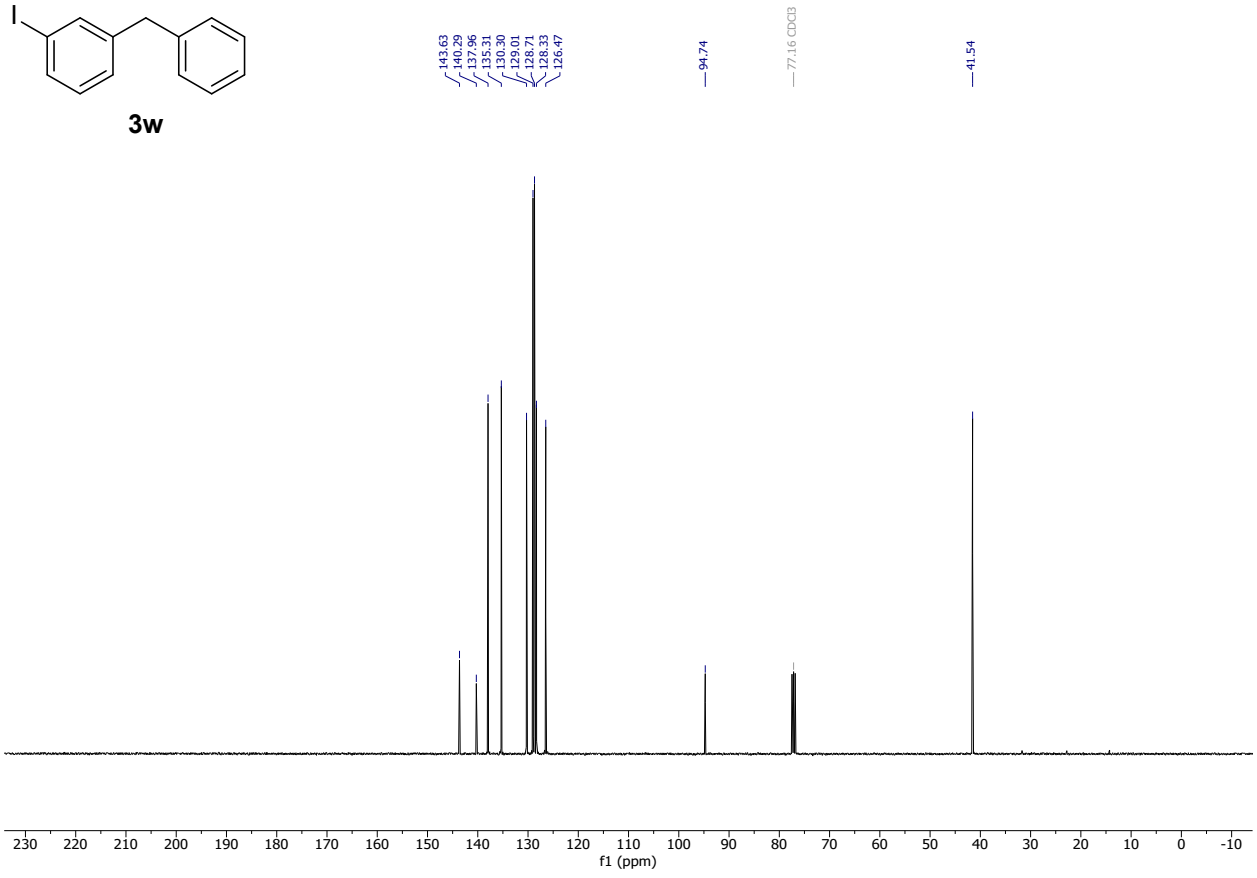

Cl
3u
1.89
5.67
0.96
2.00
ppm

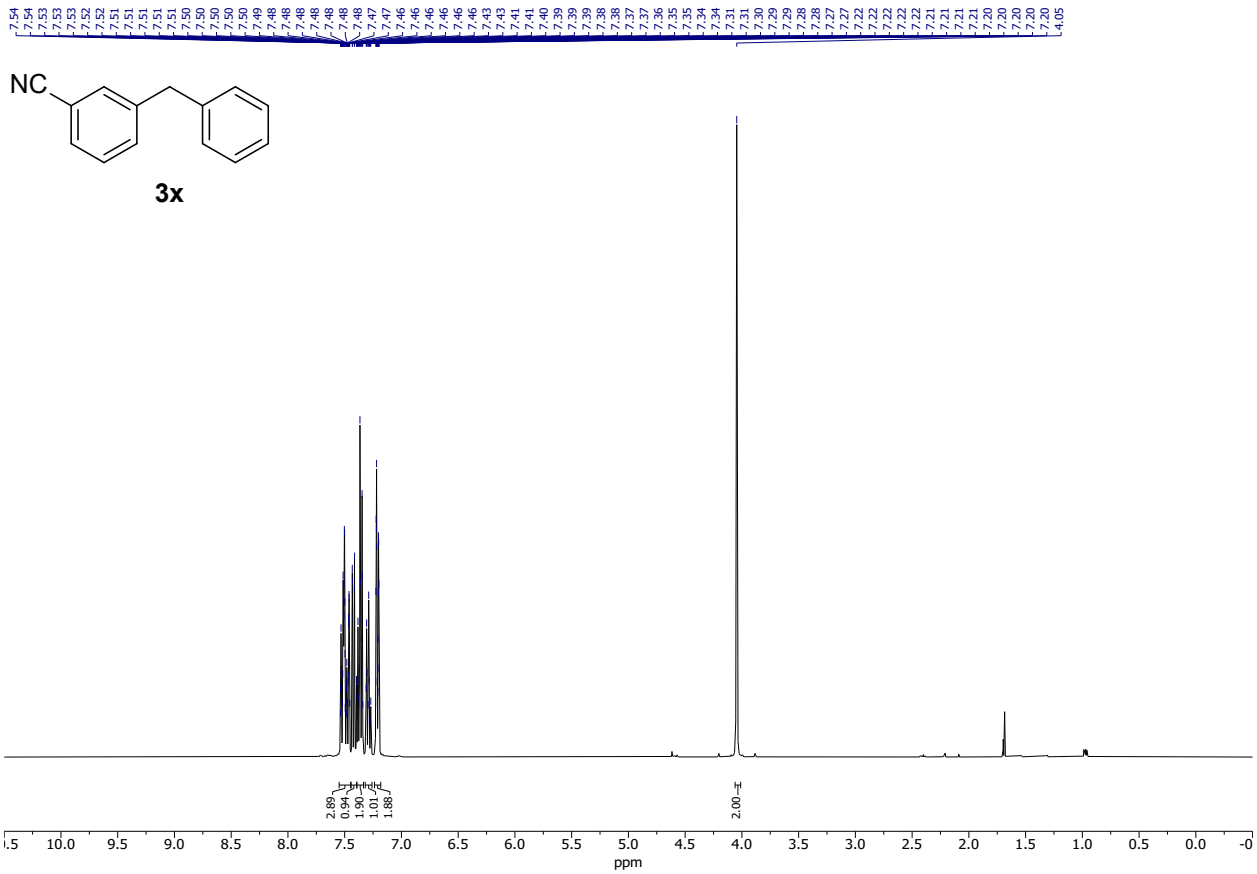

Cl
3u
143.28
140.31
134.38
129.81
129.14
129.05
128.73
127.23
126.50
126.43
41.69
ppm

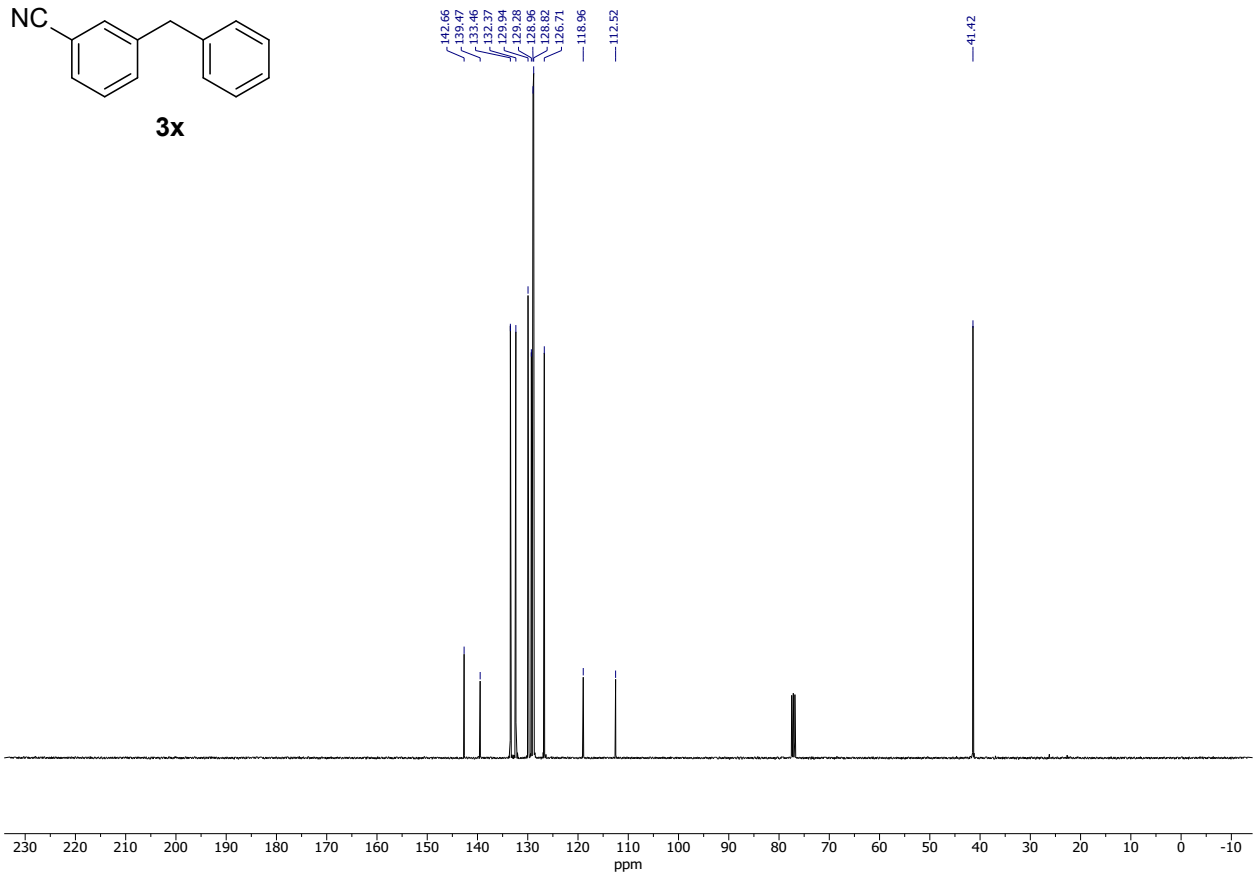

Br
3v
7.42
7.42
7.42
7.42
7.42
7.41
7.41
7.41
7.40
7.39
7.39
7.38
7.37
7.37
7.36
7.35
7.31
7.31
7.30
7.30
7.29
7.28
7.27
7.27
7.26
7.25
7.25
7.24
7.24
7.23
7.23
7.23
7.21
7.19
7.19
7.19
7.18
7.17
7.17
7.16
4.01
3.92
5.06
2.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm

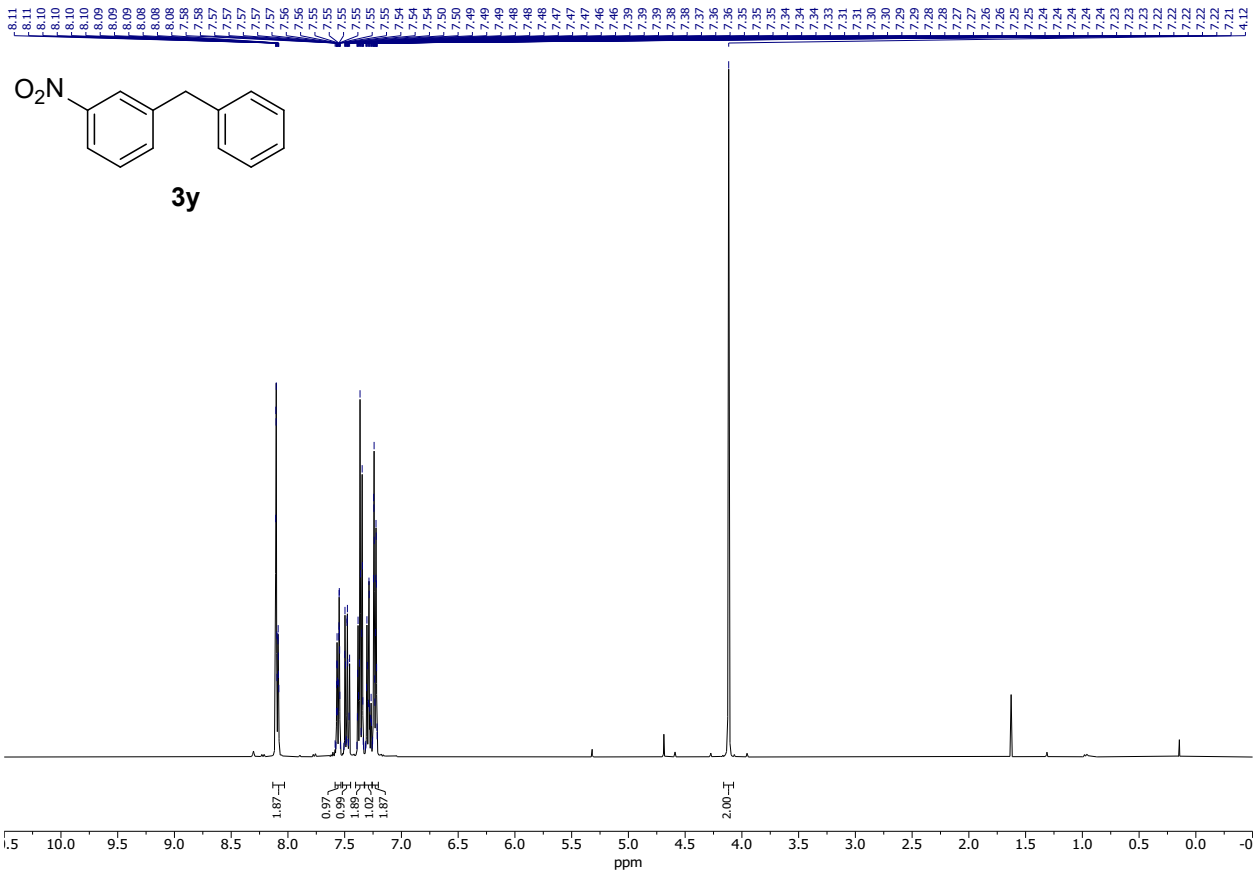

Br
3v
143.57
140.28
132.04
130.12
129.35
129.04
128.73
127.69
126.50
122.69
41.65
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
ppm

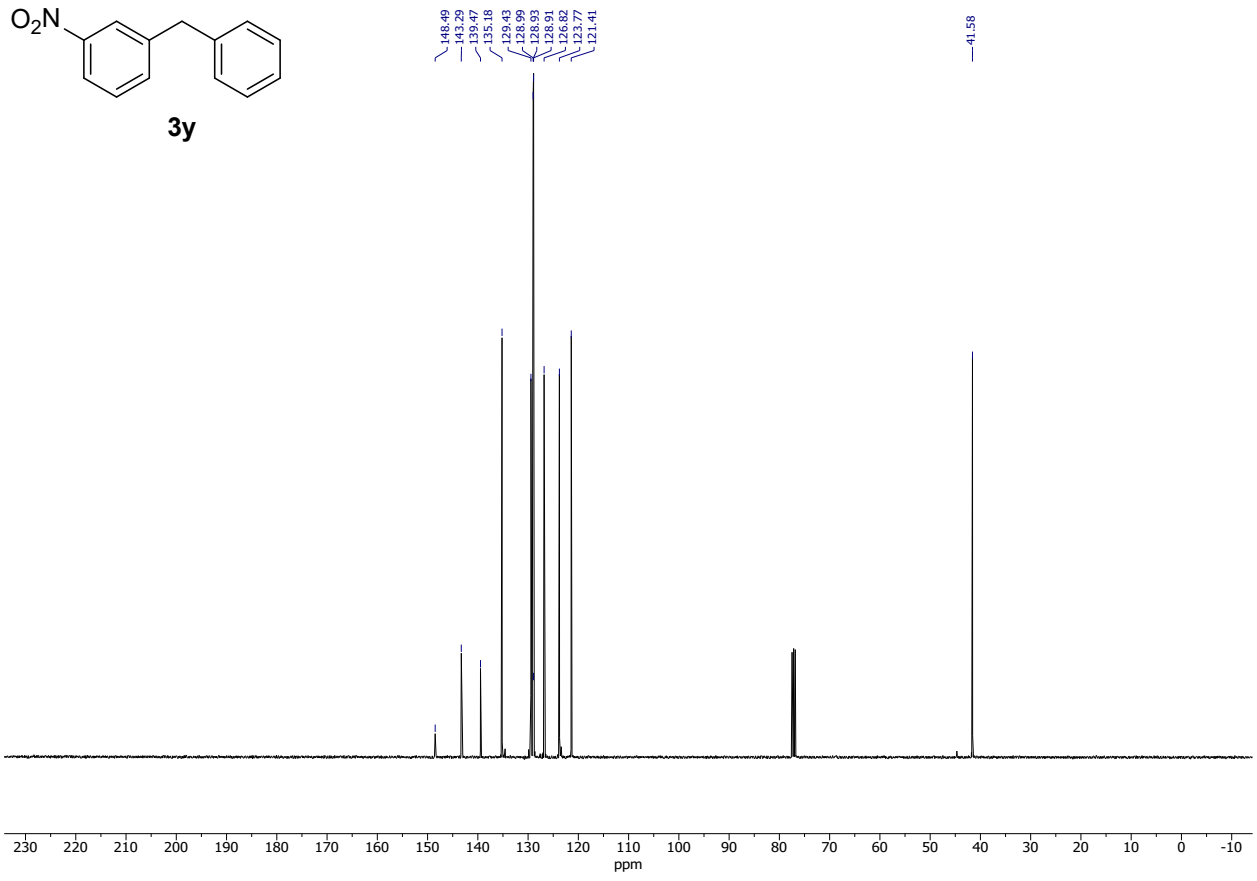

I
3w
1.84
1.88
1.01
2.79
0.97
2.00
f1 (ppm)

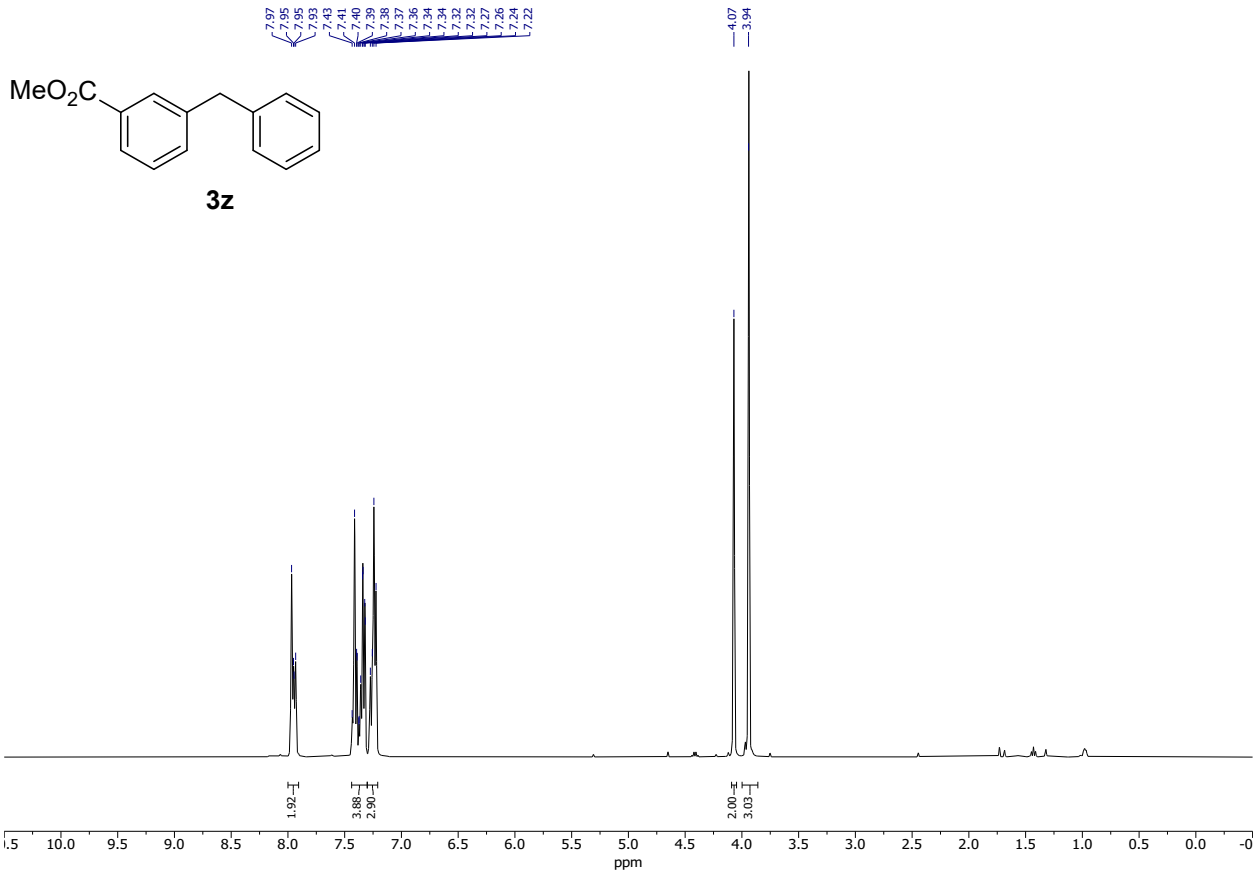

I
3w
143.63
140.29
137.96
135.31
130.30
129.01
128.71
128.33
126.47
94.74
77.16 CDCl3
41.54
f1 (ppm)

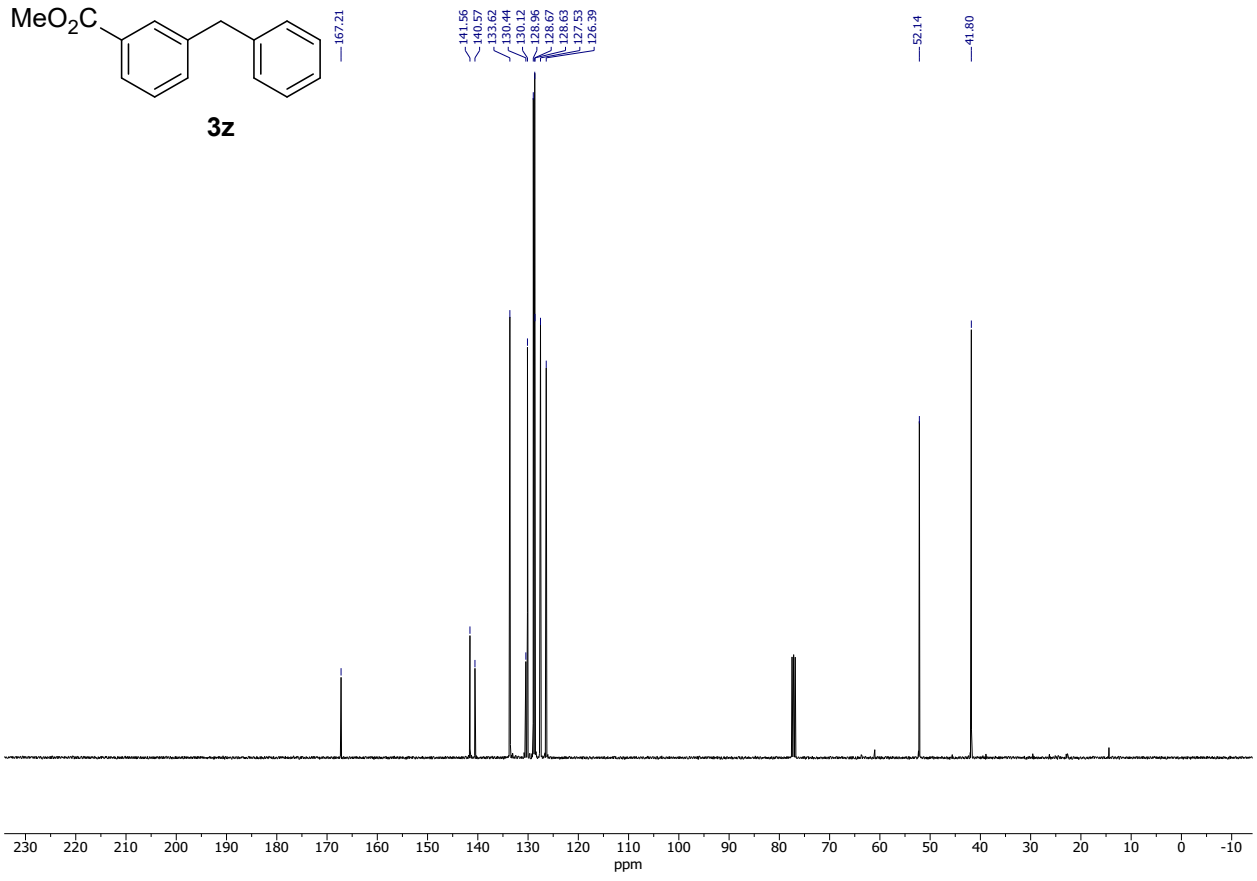

NC
3x
ppm

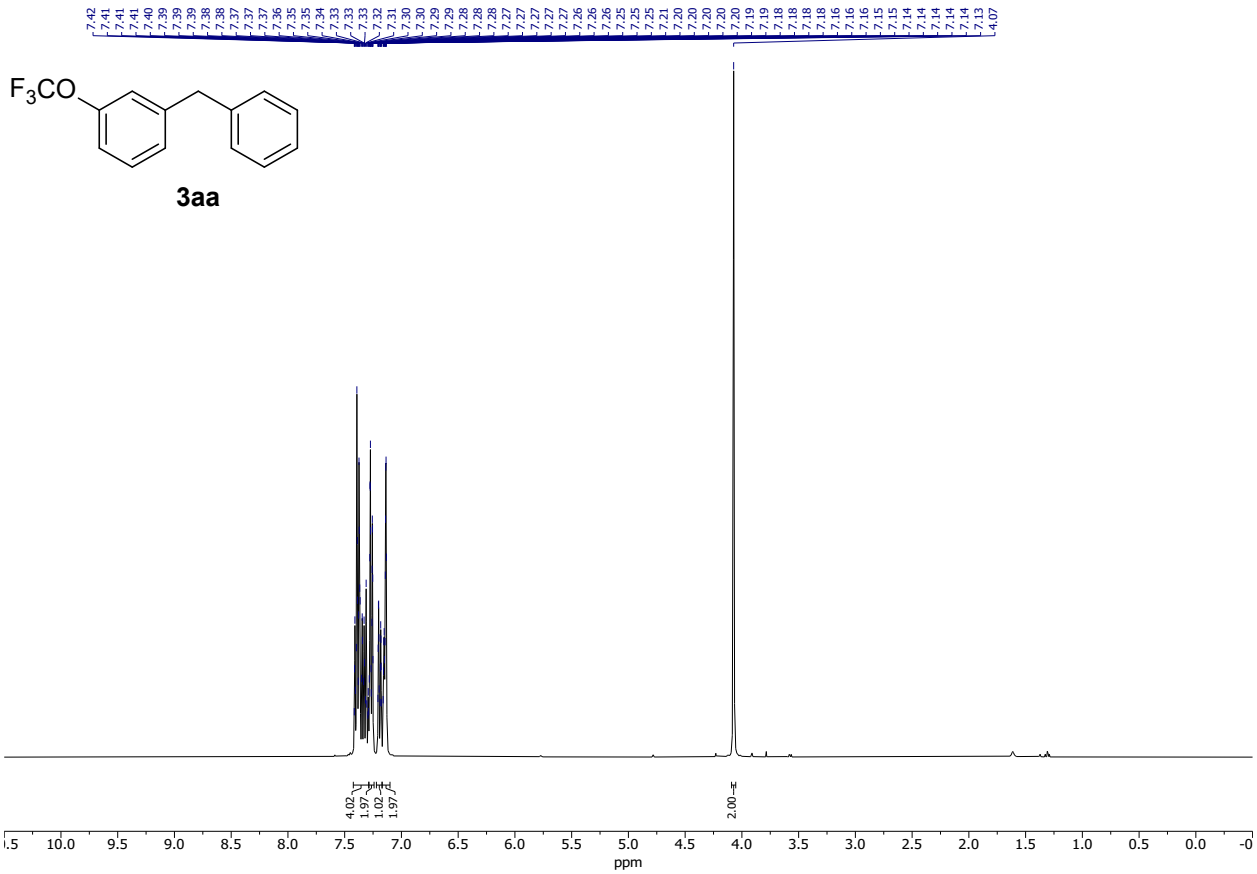

NC
3x
ppm

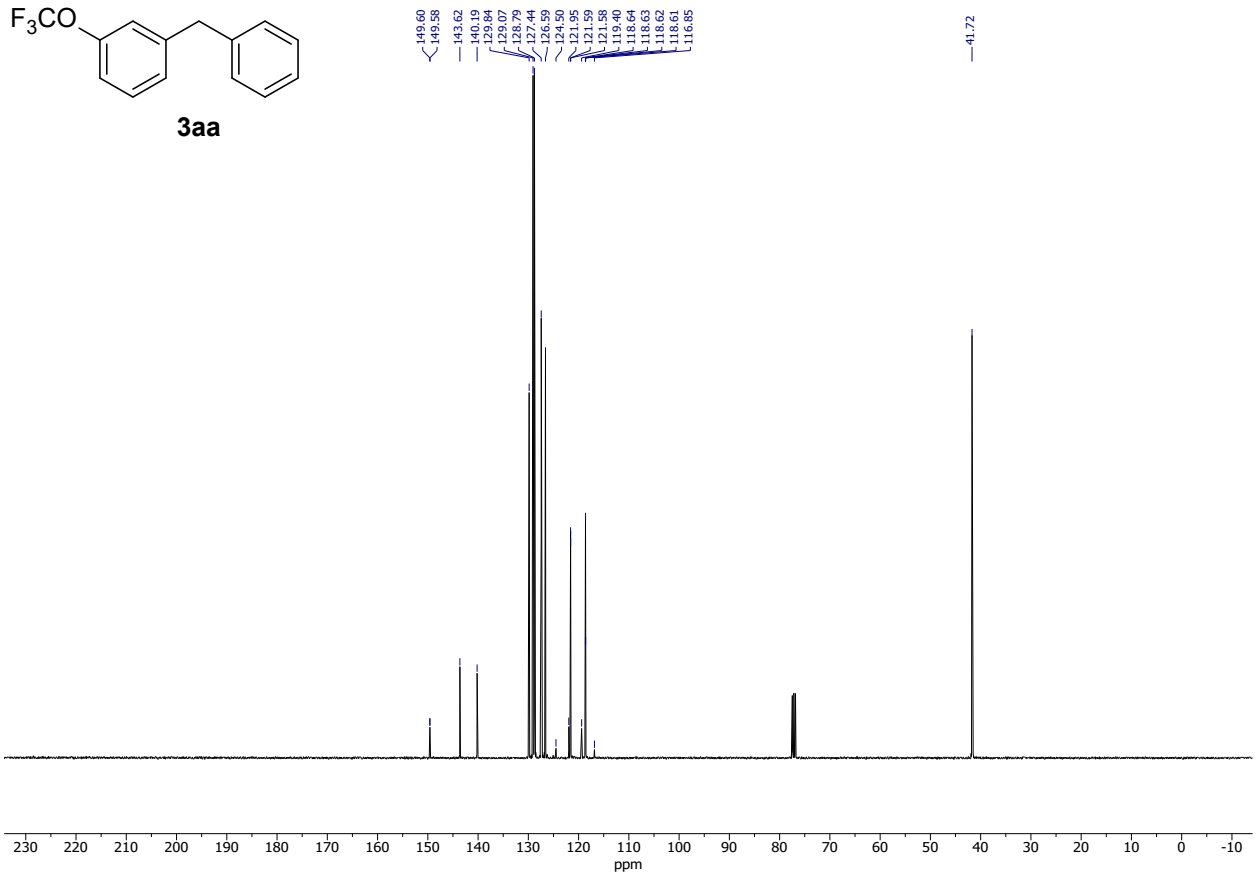

O2N
3y
1.87
0.97
0.99
1.89
1.02
1.87
2.00
ppm

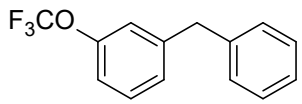

O2N
3y
148.49
143.29
139.47
135.18
129.43
128.99
128.93
128.91
126.82
123.77
121.41
41.58
ppm


MeO2C
3z
7.97
7.95
7.95
7.93
7.43
7.41
7.40
7.39
7.38
7.37
7.36
7.34
7.34
7.34
7.32
7.32
7.27
7.26
7.24
7.22
4.07
3.94
1.92
3.88
2.90
2.00
3.03
ppm

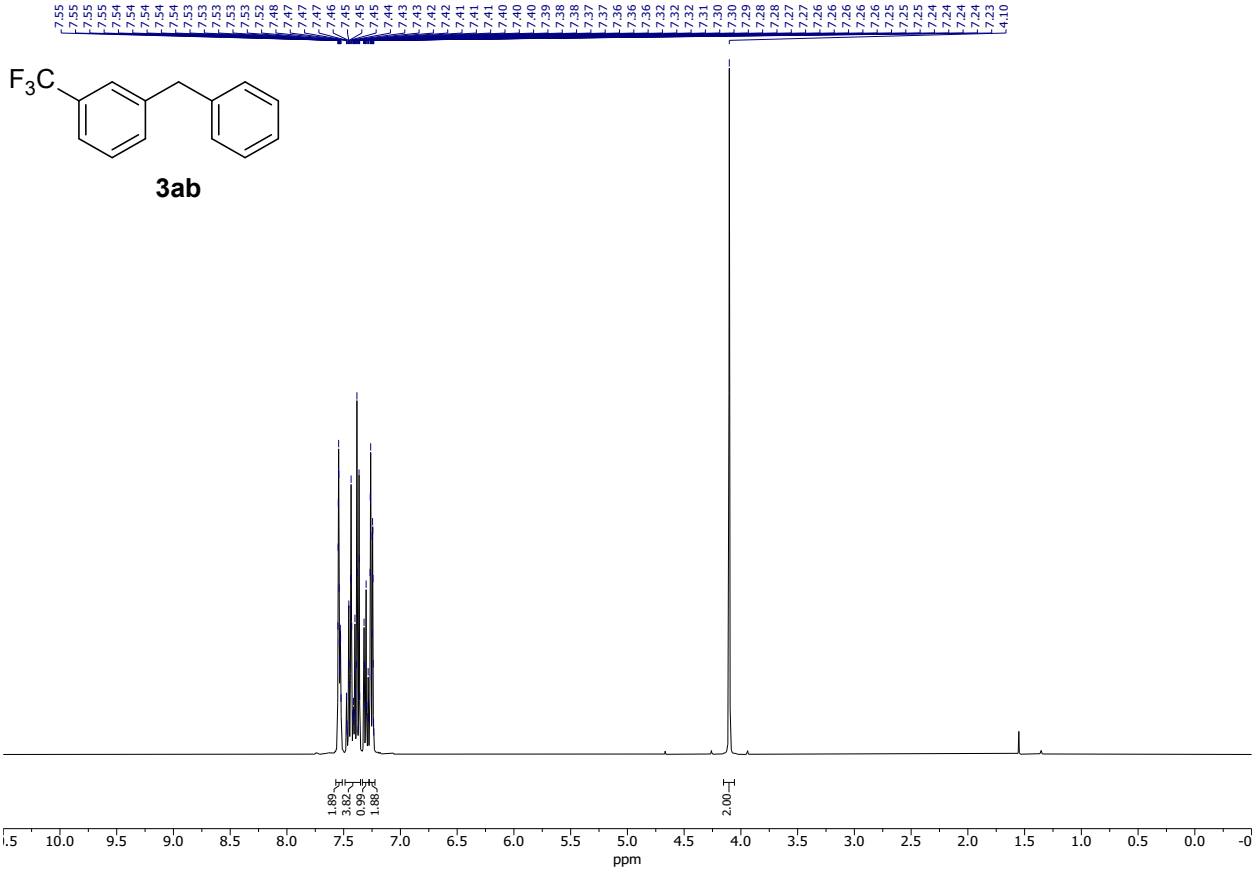

MeO2C
3z
167.21
141.56
140.57
133.62
130.44
130.12
128.96
128.67
128.63
127.53
126.39
52.14
41.80
ppm


F3CO
3aa
4.02
1.97
1.02
1.97
2.00
ppm

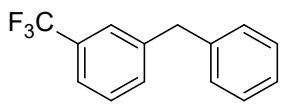

F3CO
3aa
149.60
149.58
143.62
140.19
129.84
129.07
128.79
127.44
126.59
124.50
121.95
121.59
121.58
119.40
118.64
118.63
118.62
118.61
116.85
41.72
ppm



3aa

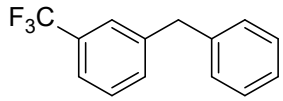


3ab



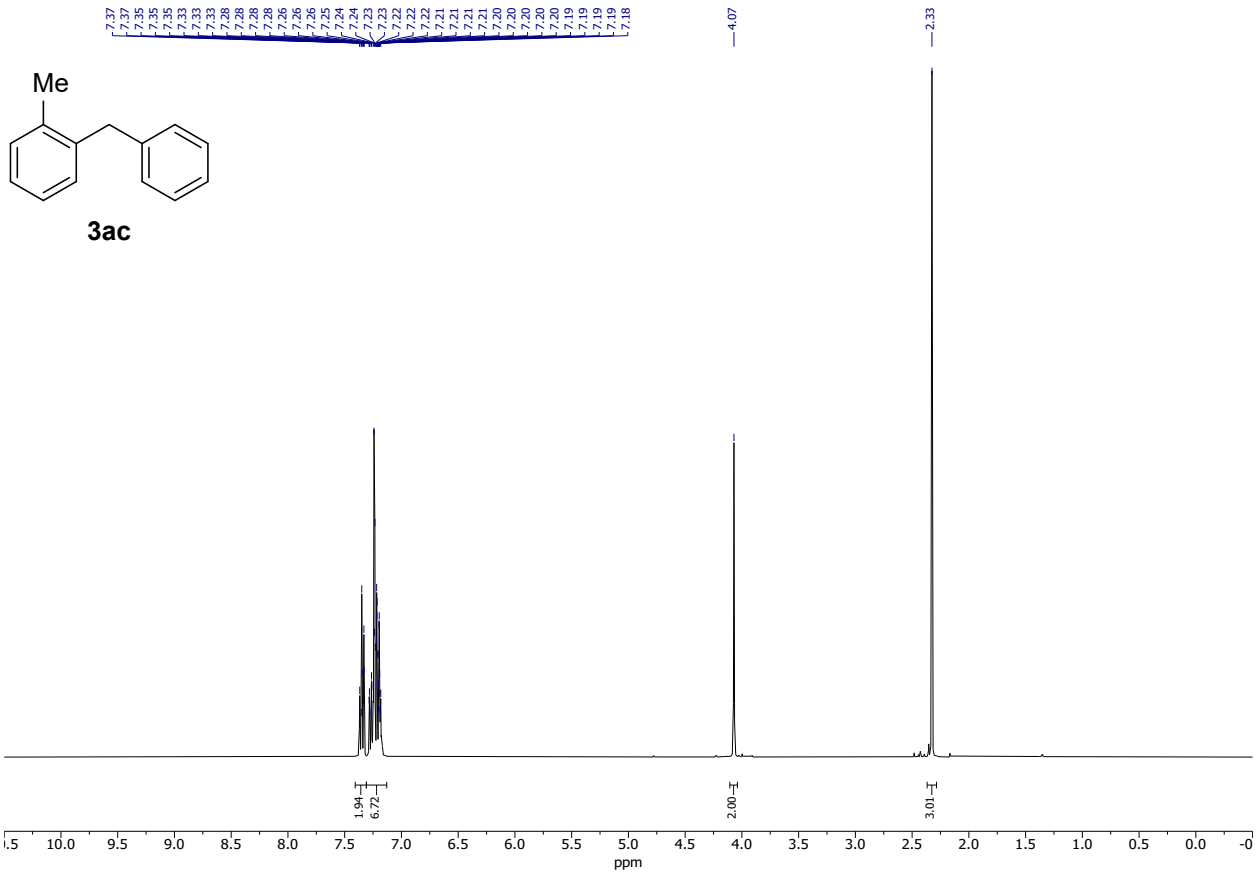
3ab

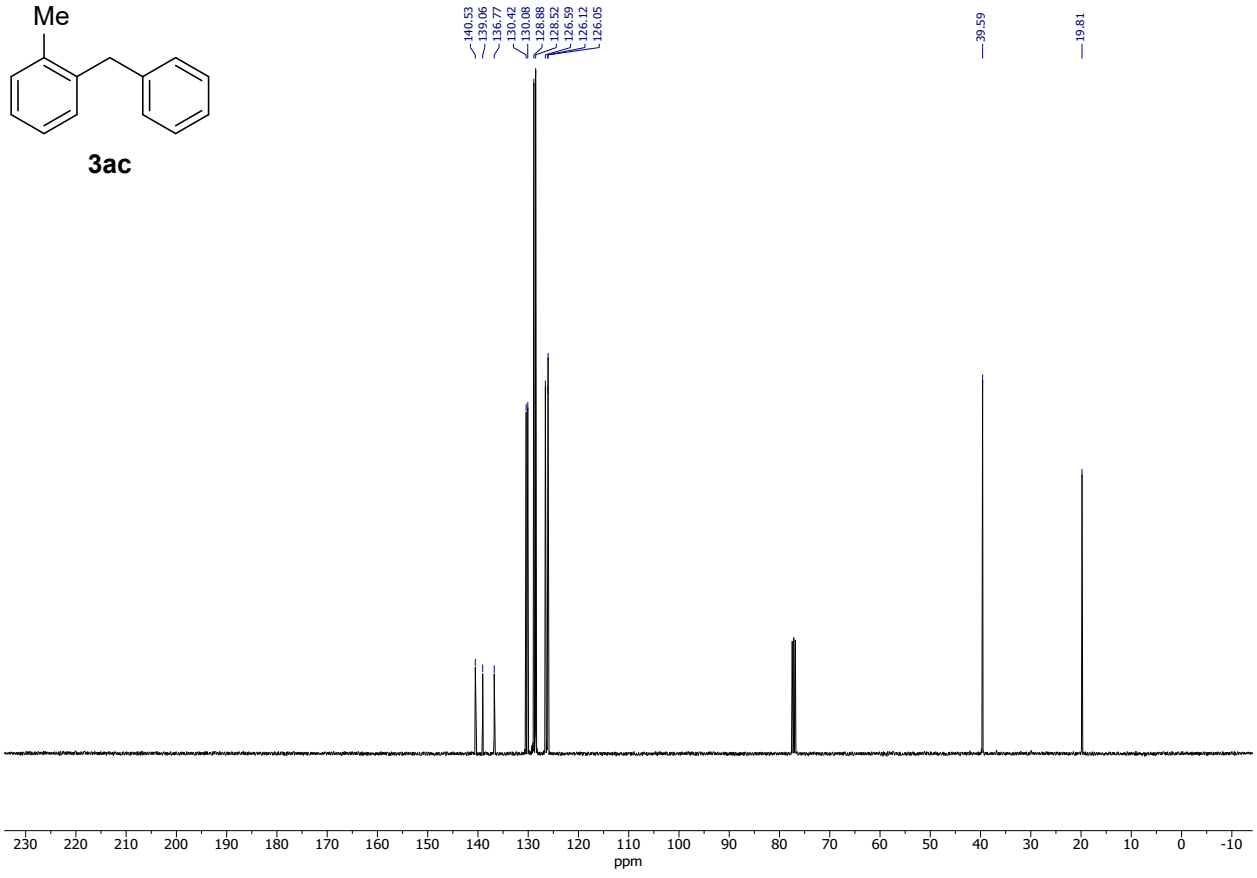
142.18
140.17
132.46
132.45
131.40
131.08
130.76
130.45
129.05
129.04
128.82
128.43
126.62
125.78
125.74
125.71
125.67
123.23
123.19
123.16
123.12
123.02
120.31
41.82
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
ppm

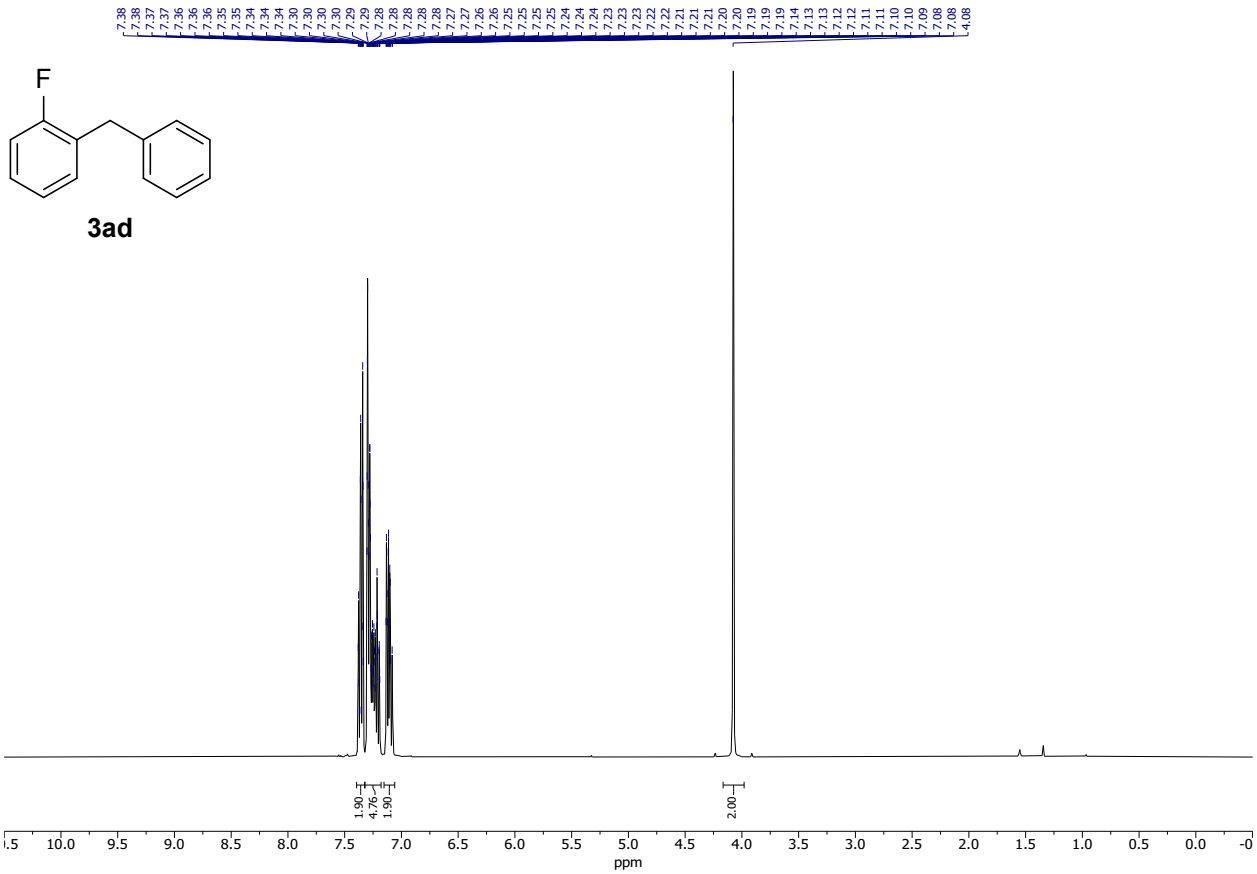


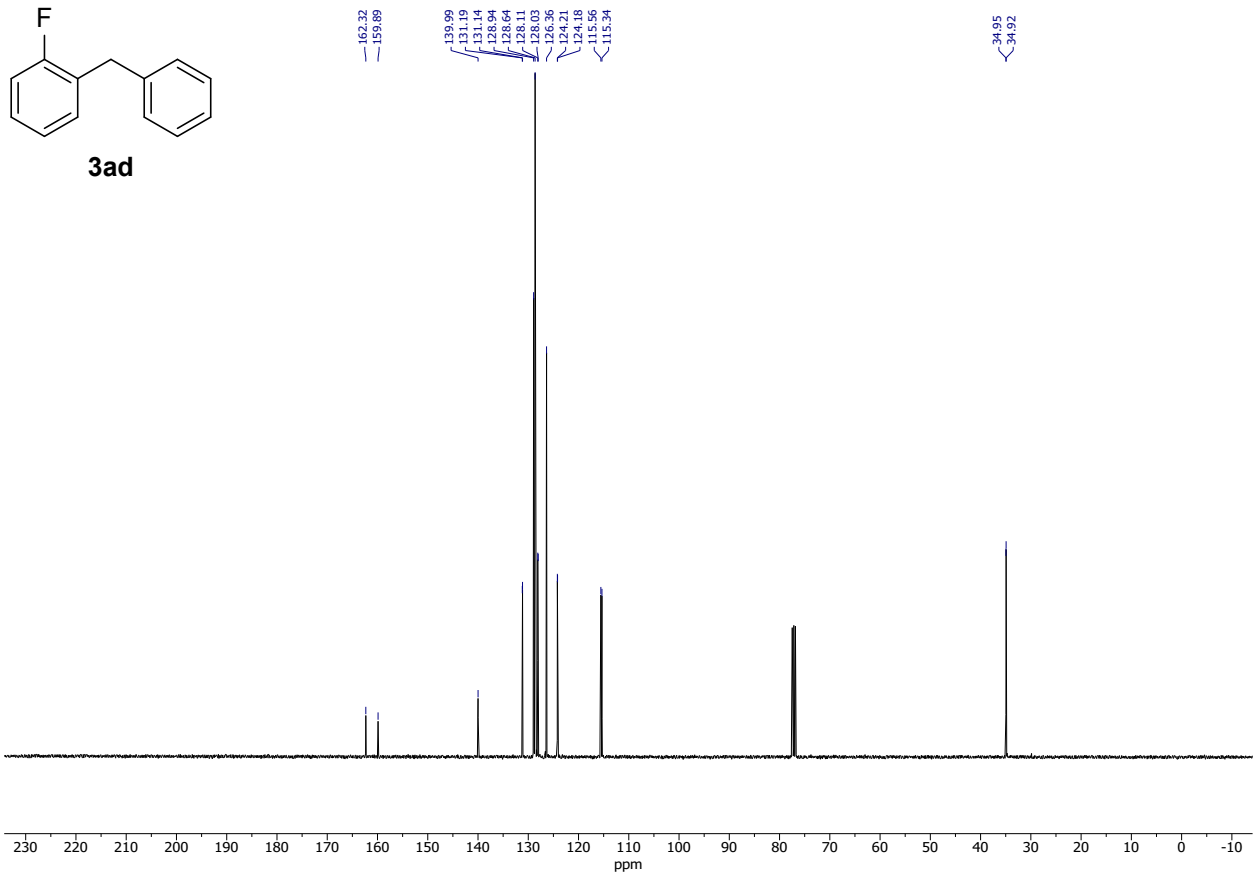
3ab

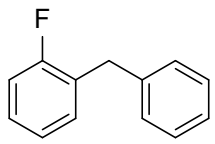
-62.39
50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240
ppm


Me
3ac
7.37
7.37
7.35
7.35
7.35
7.33
7.33
7.28
7.28
7.28
7.26
7.26
7.26
7.25
7.24
7.24
7.23
7.23
7.22
7.22
7.22
7.21
7.21
7.21
7.20
7.20
7.20
7.20
7.19
7.19
7.19
7.19
7.18
4.07
2.33
1.94
6.72
2.00
3.01
ppm

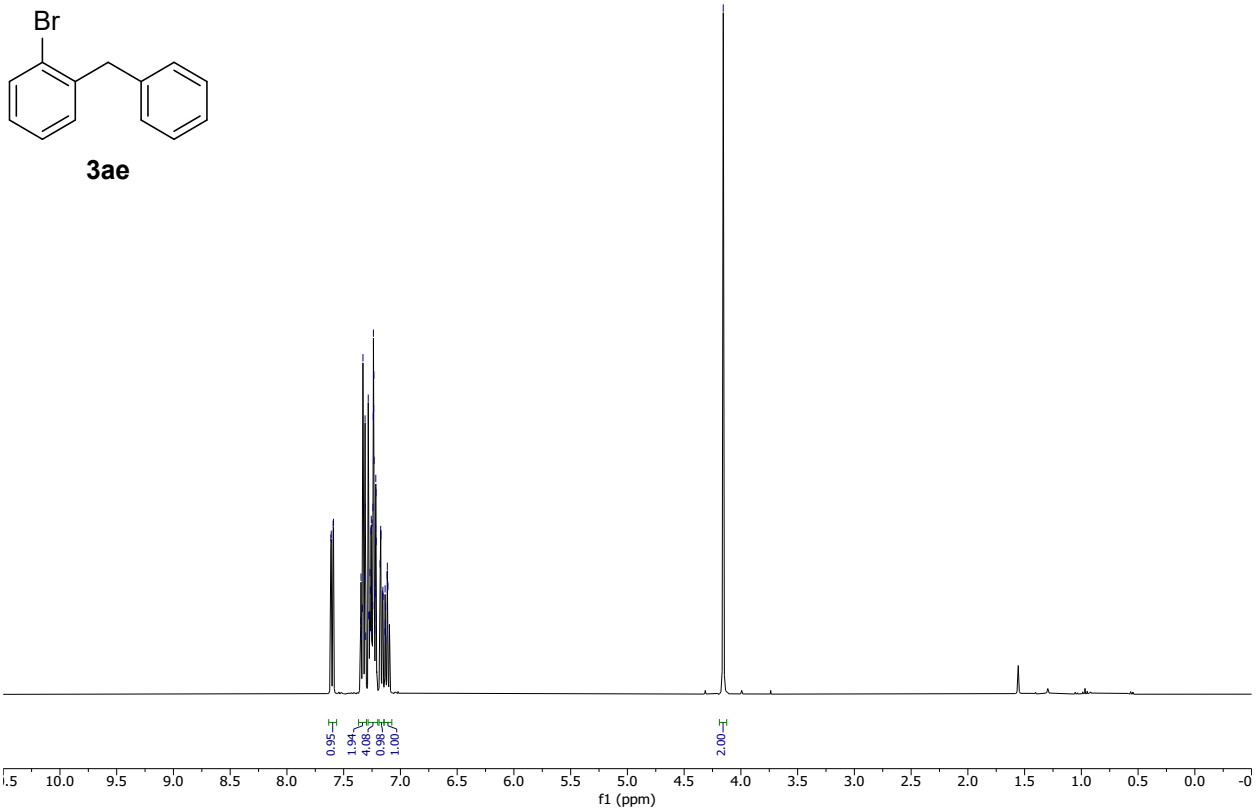

Me
3ac
140.53
139.06
136.77
130.42
130.08
128.88
128.52
126.59
126.12
126.05
39.59
19.81
ppm


F
3ad
1.90
4.76
1.90
2.00
ppm

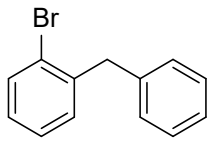

F
3ad
162.32
159.89
139.99
131.19
131.14
128.94
128.64
128.11
128.03
126.36
124.21
124.18
115.56
115.34
34.95
34.92
ppm



3ad

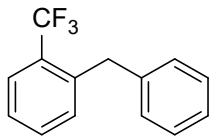


3ae


Br

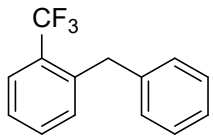
3ae

140.52
139.63
133.00
131.24
129.14
128.62
128.03
127.61
126.40
125.05
77.16 CDCl3
41.87
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


CF3

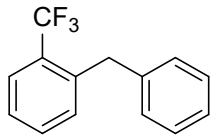
3af

7.75 7.74 7.73 7.72 7.50 7.50 7.50 7.48 7.48 7.46 7.46 7.46 7.46 7.39 7.38 7.38 7.37 7.37 7.36 7.36 7.35 7.35 7.35 7.34 7.34 7.31 7.31 7.30 7.30 7.29 7.28 7.28 7.27 7.27 7.25 7.25 7.25 7.25 7.24 7.23 7.23 7.23 7.23 7.23 7.22 7.22 7.22 7.21 7.21 7.21 7.21 7.21 7.20 4.26
0.97
0.99
2.89
1.03
2.83
2.00
.5 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 -0
ppm



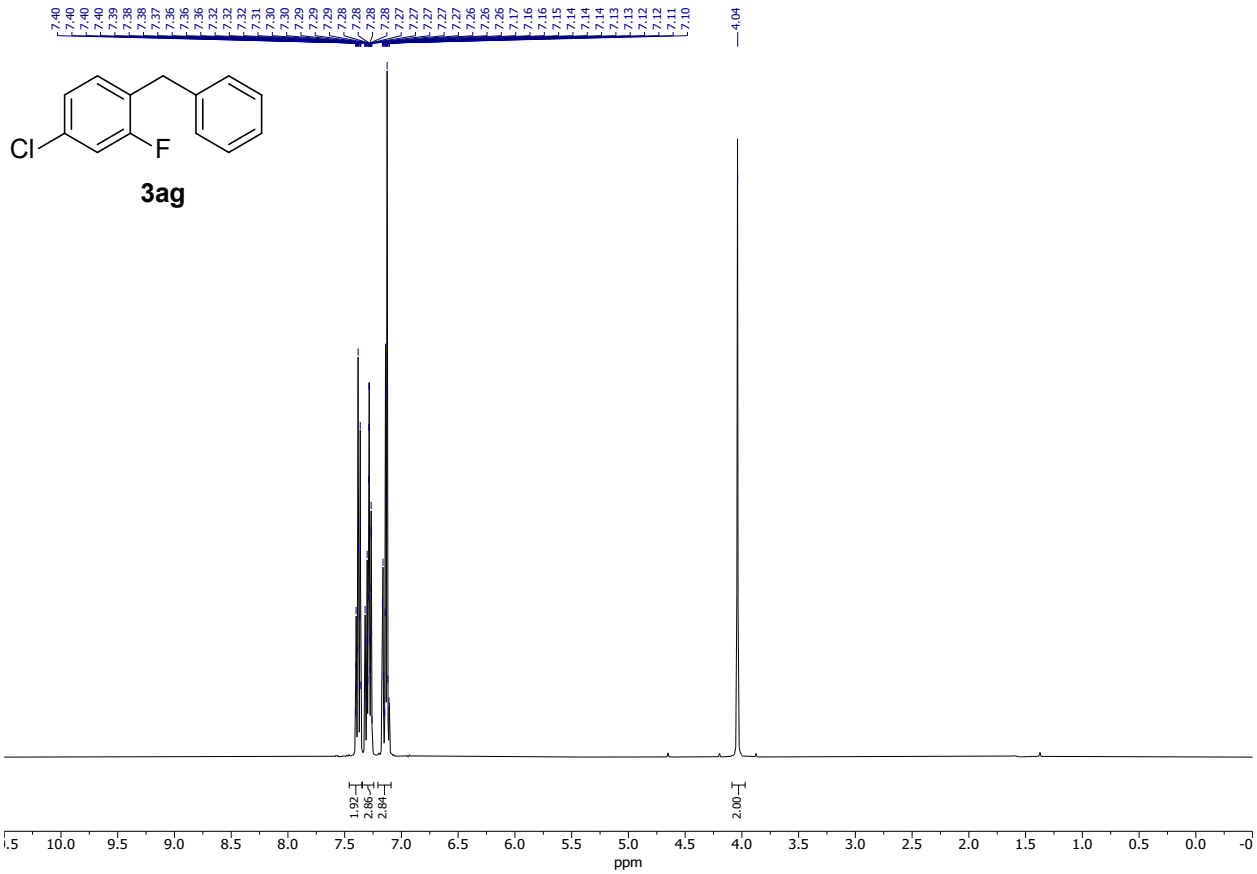
3af

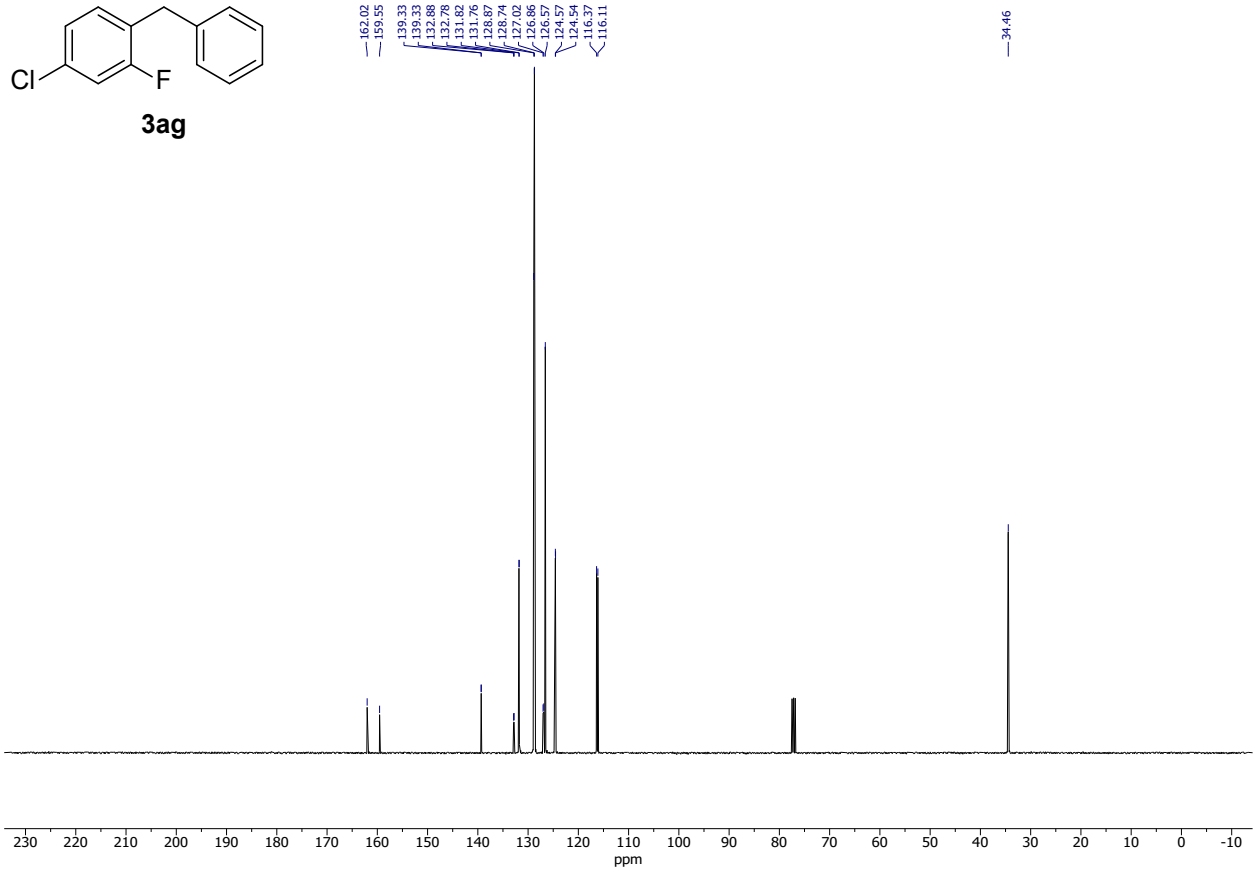
140.02
139.67
139.65
139.64
131.91
131.90
131.87
129.29
129.01
128.83
128.71
128.66
126.47
126.35
126.11
126.09
126.04
125.98
125.92
123.39
120.66
37.94
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
ppm

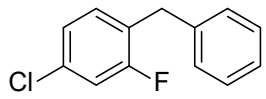


3af

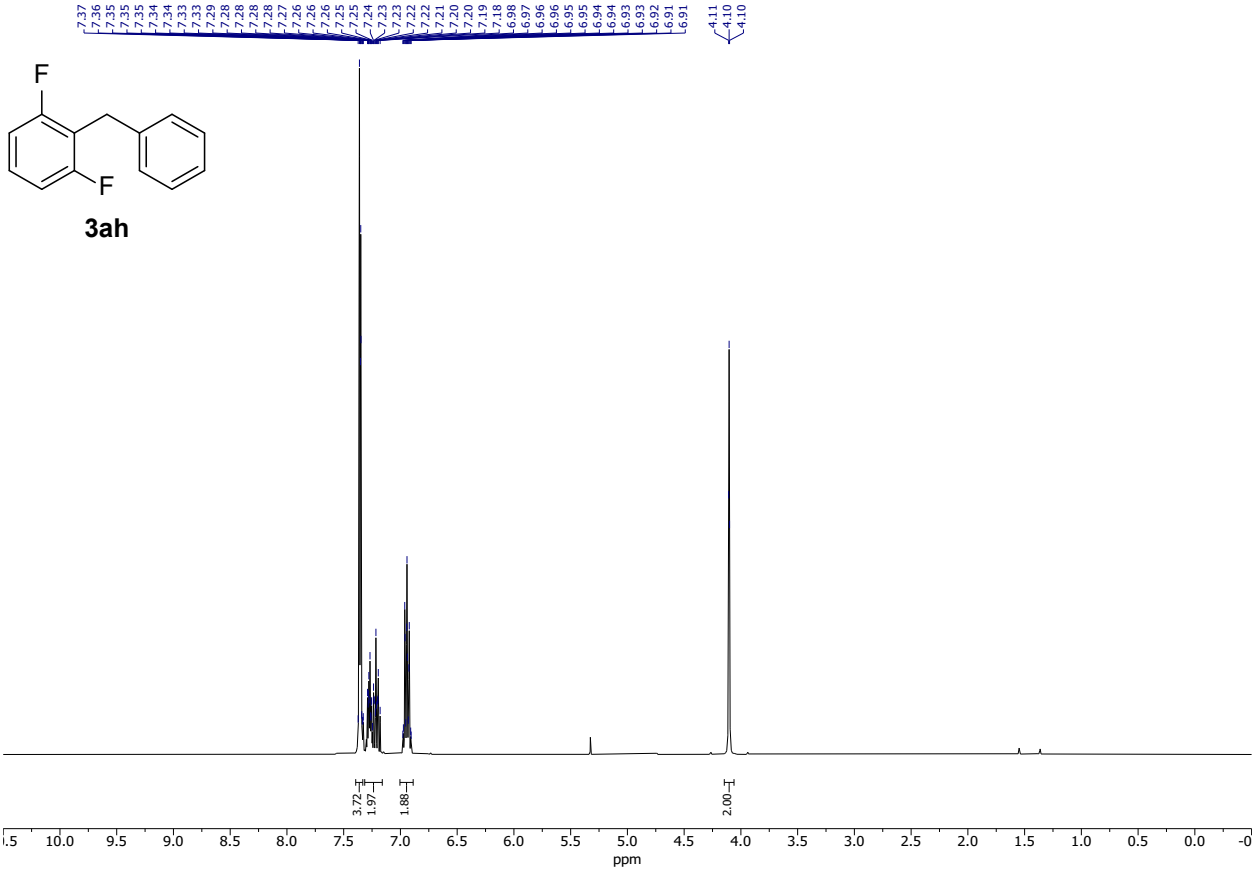
-59.51
50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240
ppm


Cl
F
3ag
ppm

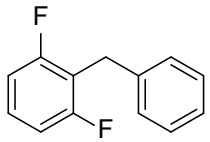

Cl
F
3ag
ppm



3ag

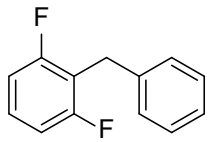


3ah



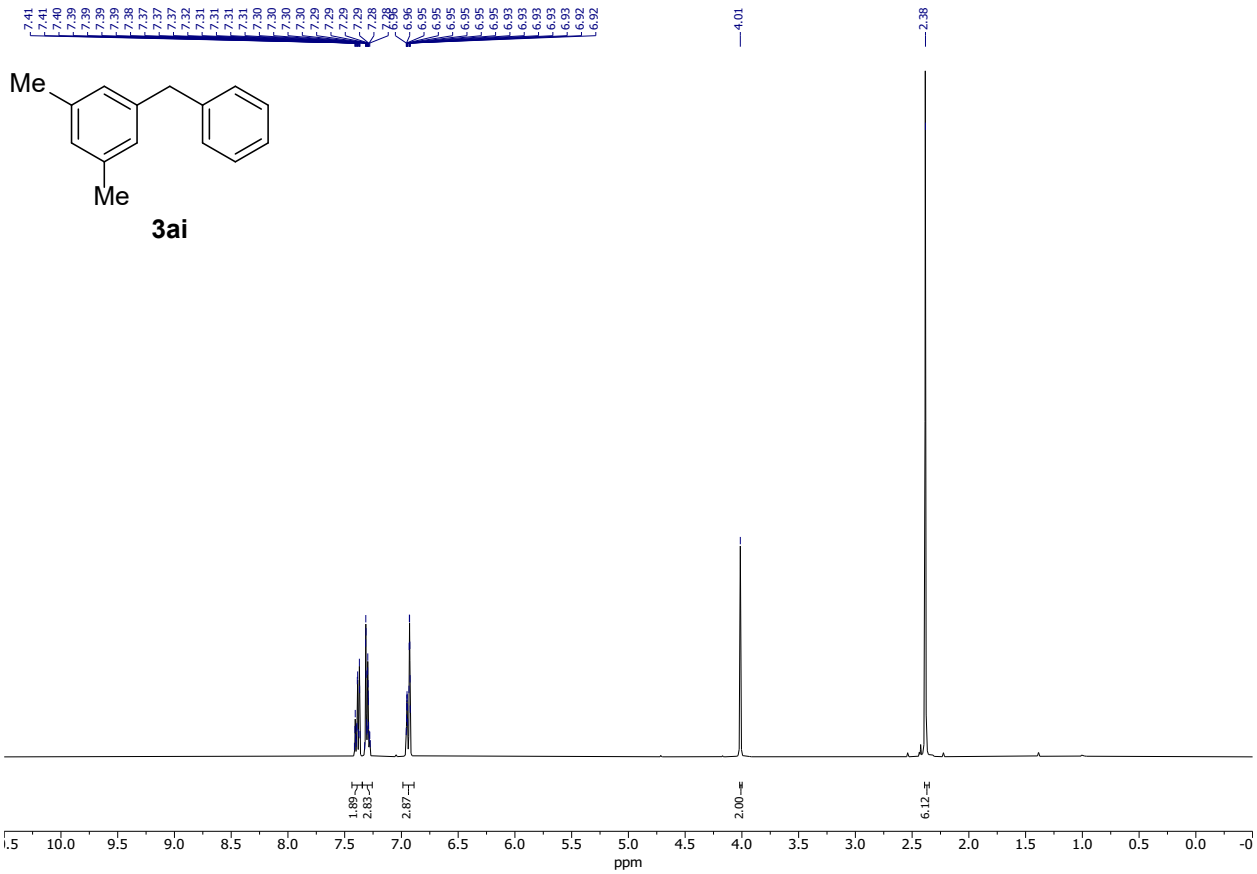
3ah

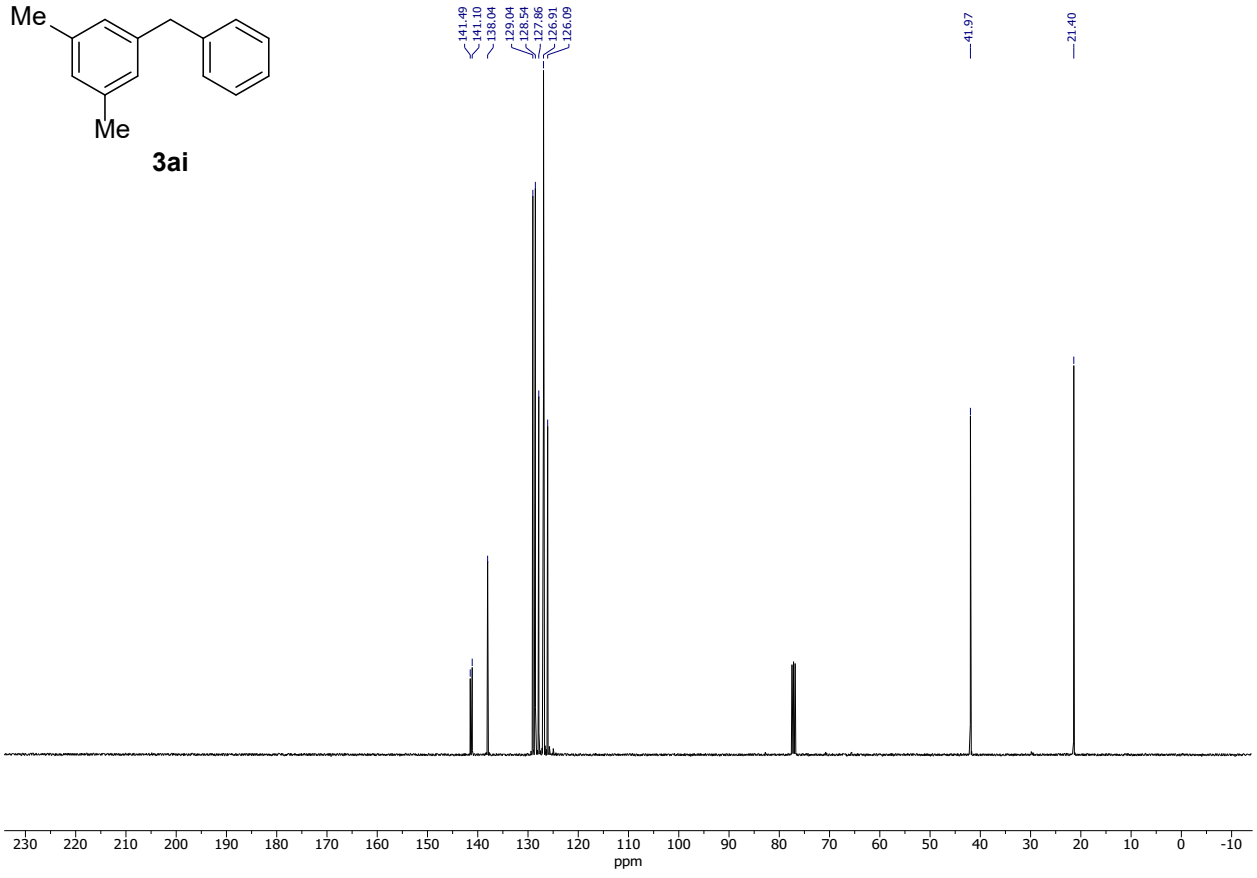
162.81
162.72
160.35
160.27
139.32
128.63
128.58
128.10
127.99
127.89
126.45
117.21
117.01
116.81
111.46
111.39
111.27
111.20
28.30
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
ppm

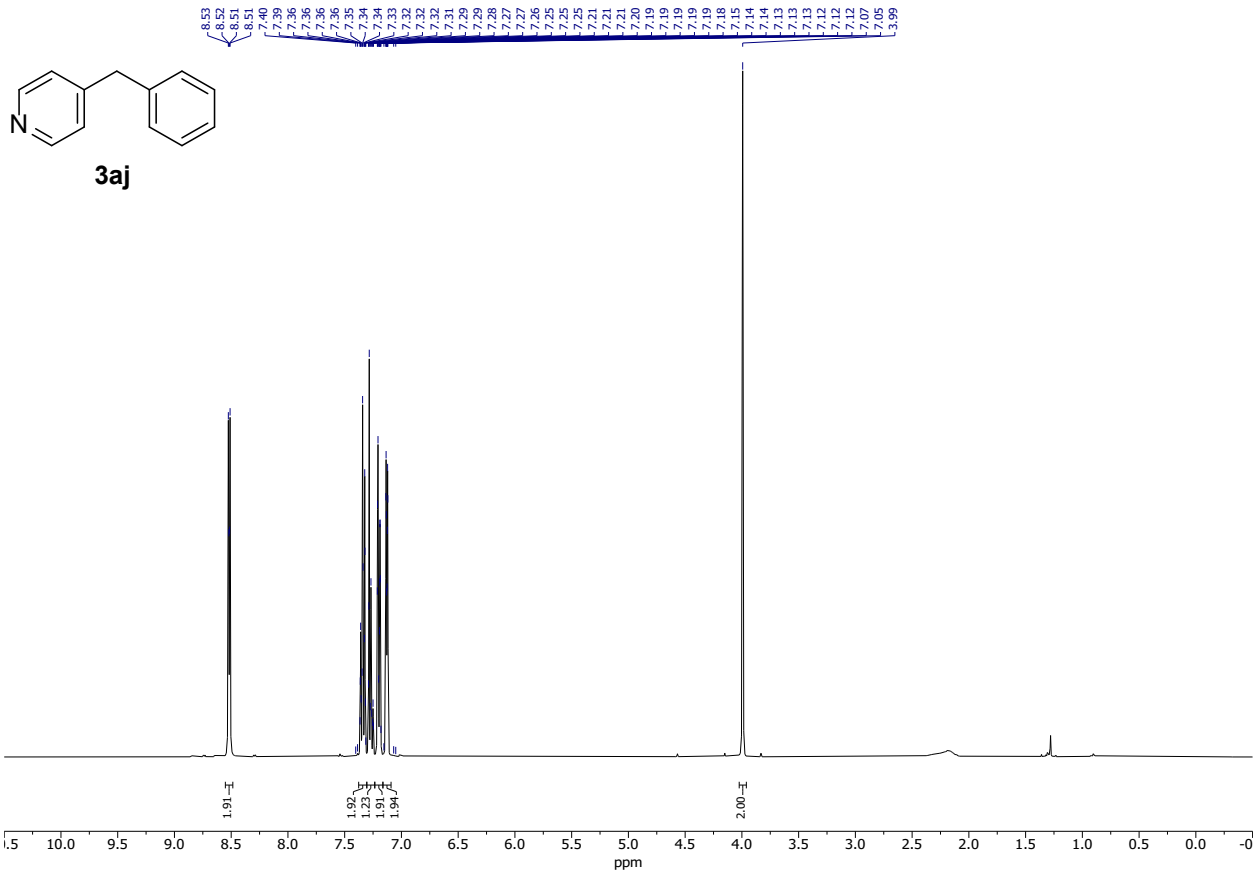


3ah

-114.89
50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -25
ppm


Me
Me
3ai
4.01
2.38
1.89
2.83
2.87
2.00
6.12
ppm


Me
Me
3ai
141.49
141.10
138.04
129.04
128.54
127.86
126.91
126.09
41.97
21.40
ppm


8.53
8.52
8.51
8.51
7.40
7.39
7.36
7.36
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7.34
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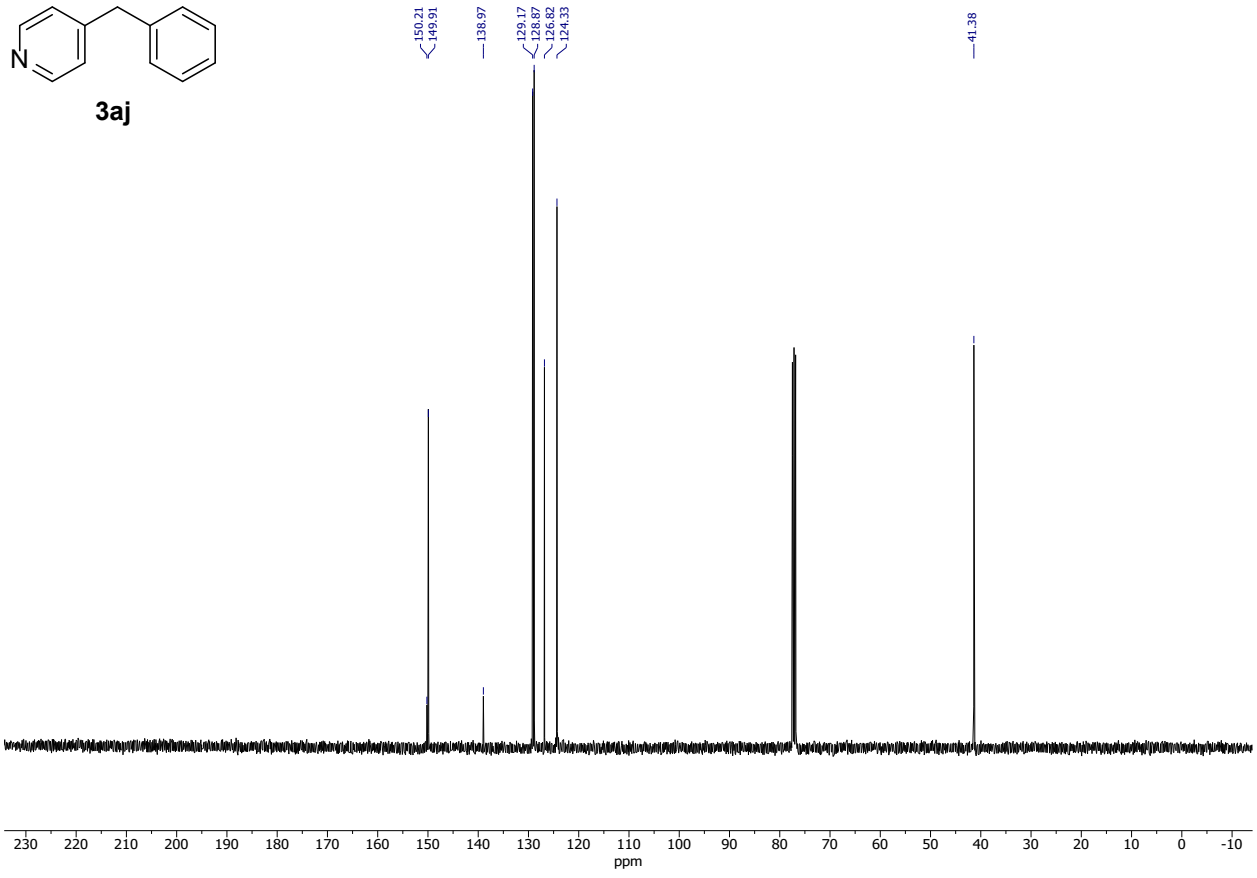
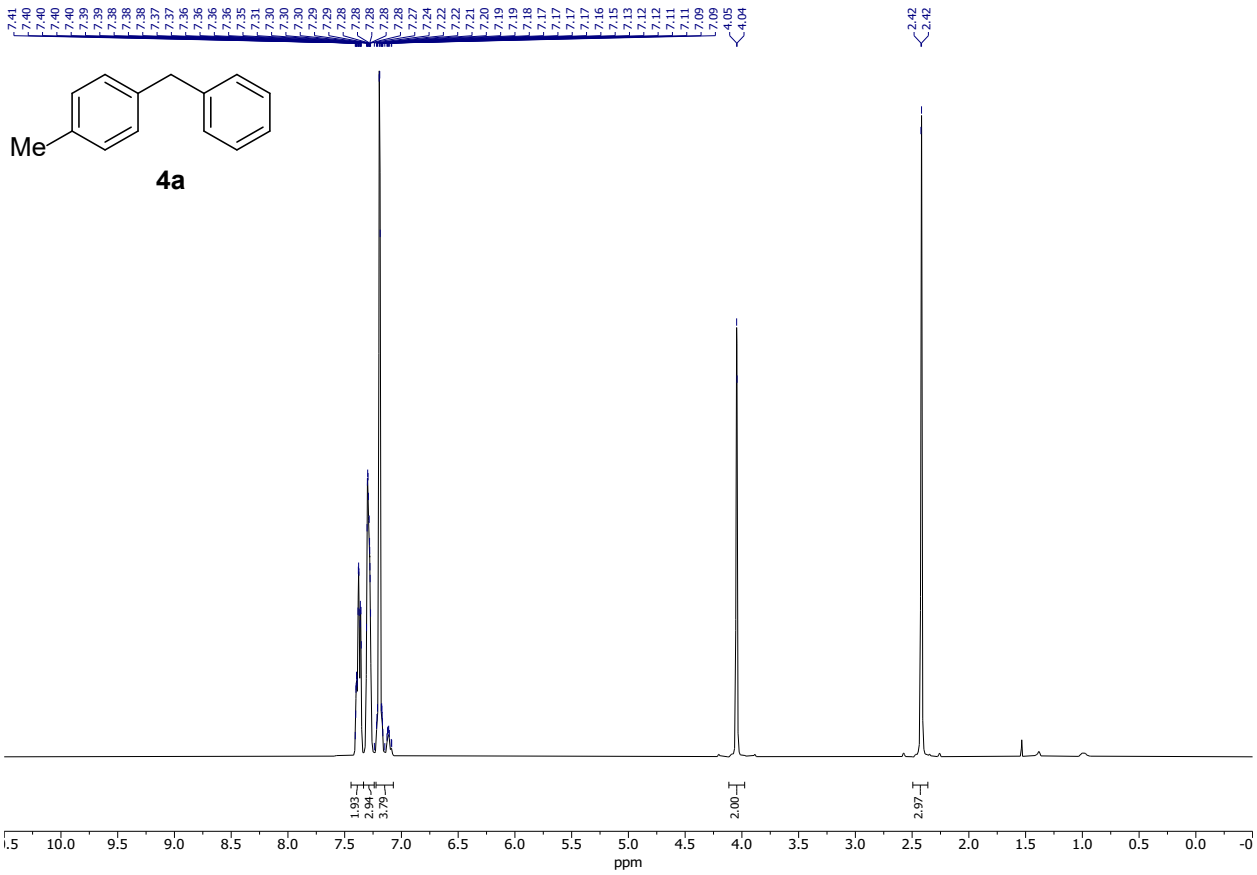
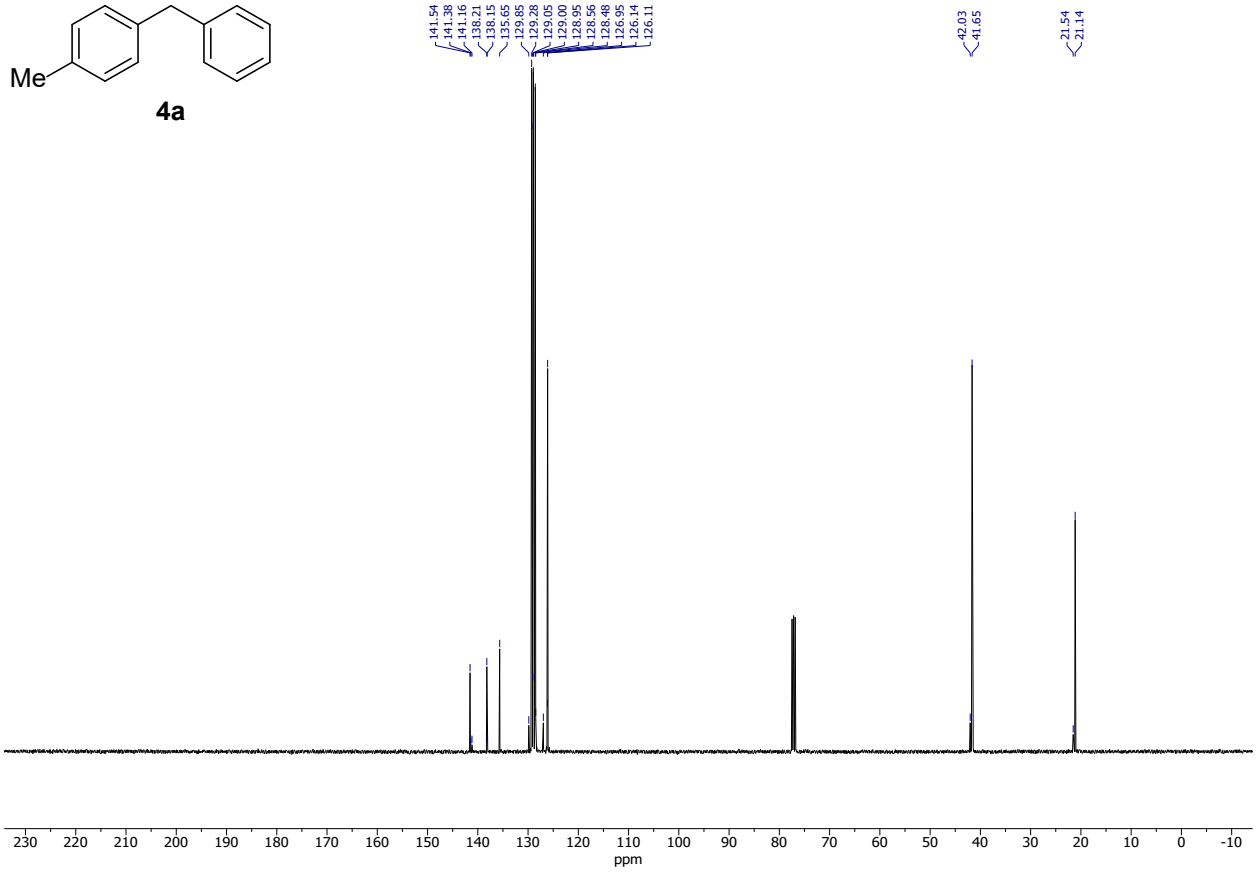
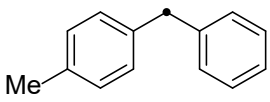
7.33
7.32
7.32
7.32
7.31
7.29
7.29
7.28
7.27
7.27
7.26
7.25
7.25
7.25
7.21
7.21
7.21
7.20
7.19
7.19
7.19
7.19
7.19
7.18
7.15
7.14
7.14
7.13
7.13
7.13
7.12
7.12
7.12
7.07
7.05
3.99
N
3aj
1.91
1.92
1.23
1.91
1.94
2.00
ppm


N
3aj
150.21
149.91
138.97
129.17
128.87
126.82
124.33
41.38
ppm

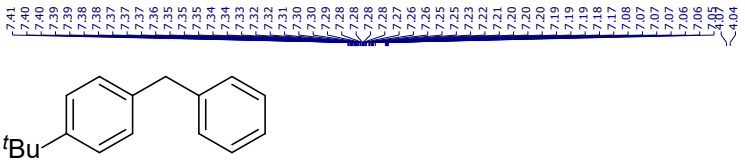

Me
4a
ppm


Me
4a
ppm

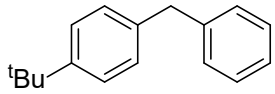


4a

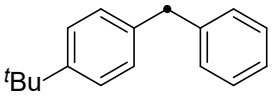
determination of *p:m* isomer ratio by ^{13}C NMR



4b

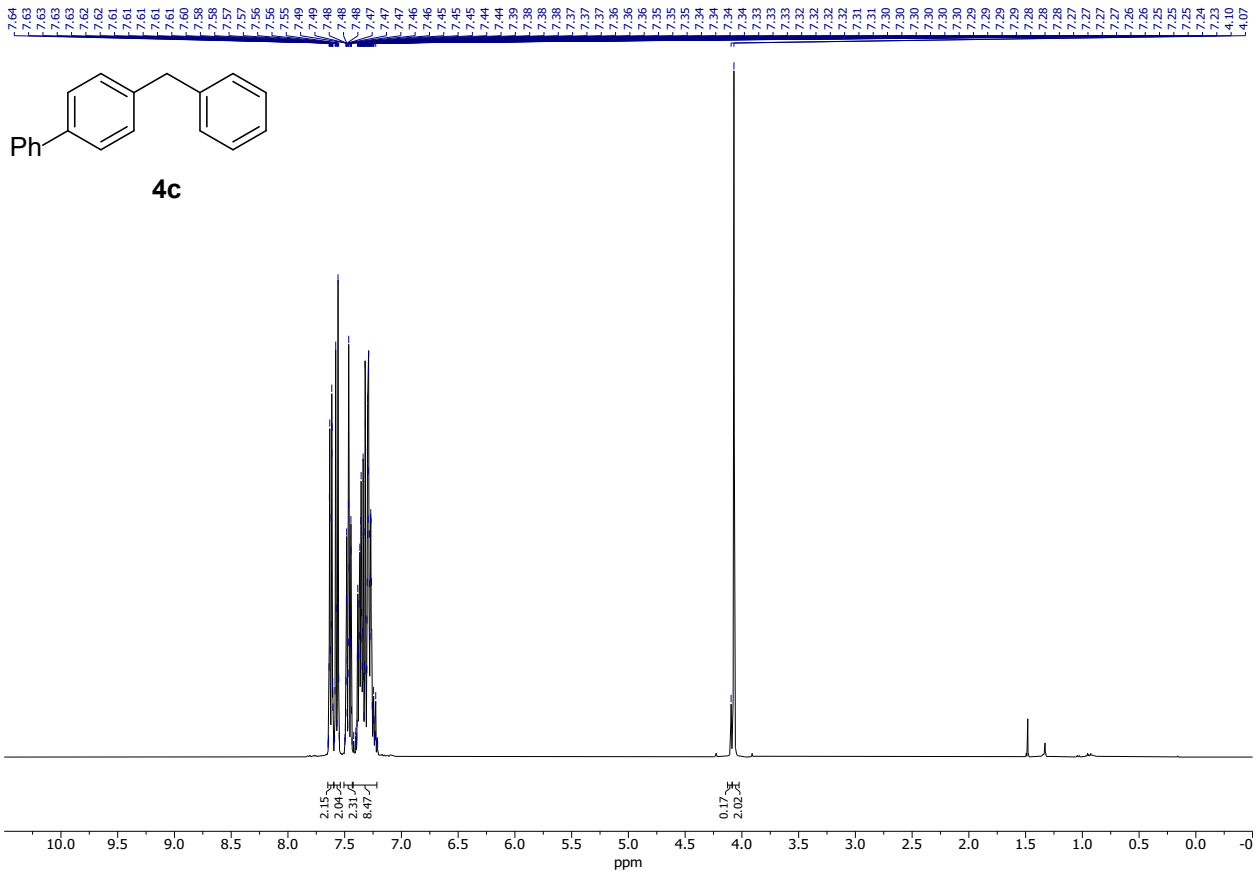


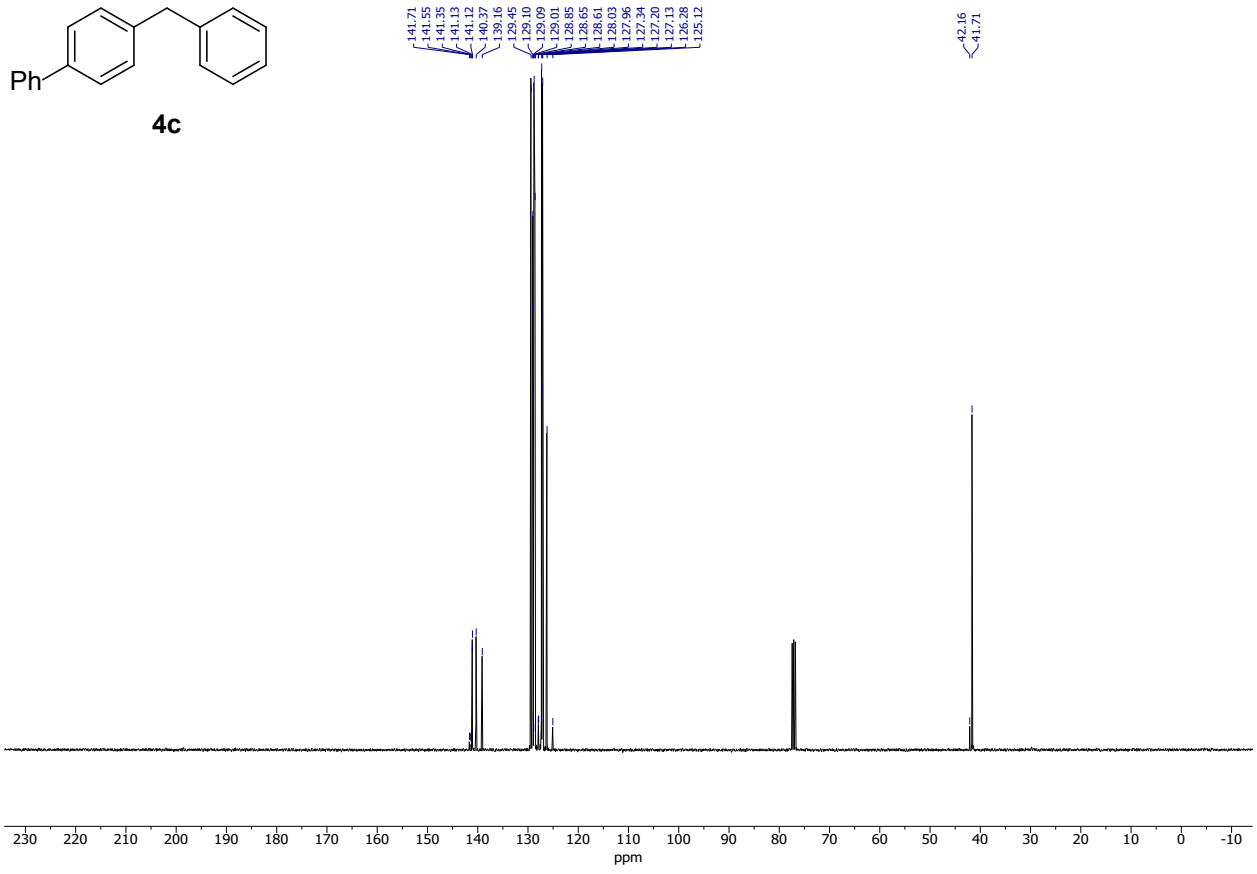
4b

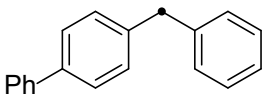


4b

determination of *p:m* isomer ratio by ^{13}C NMR

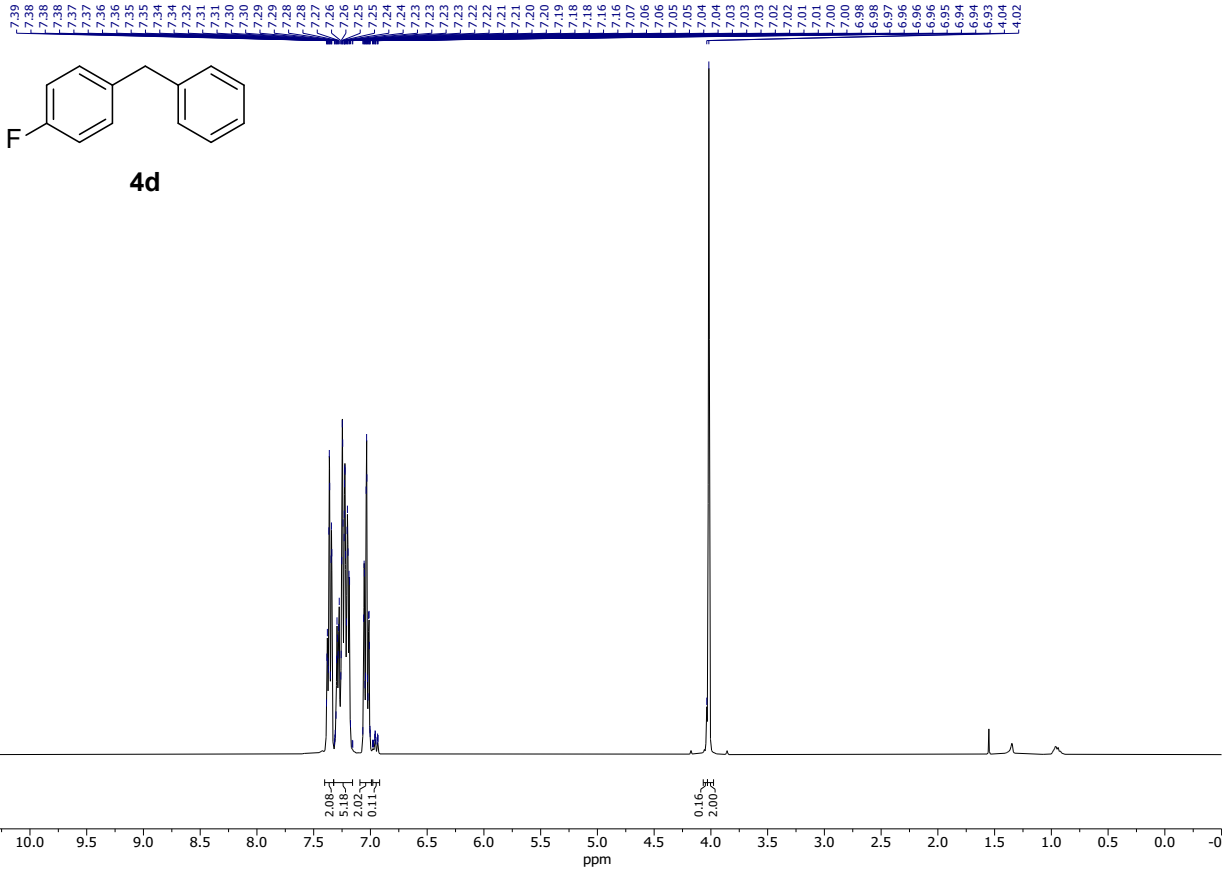

Ph
4c
ppm


Ph
4c
ppm

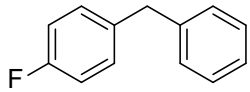


4c

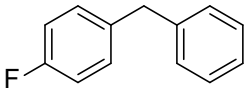
determination of *p:m* isomer ratio by ^{13}C NMR



4d

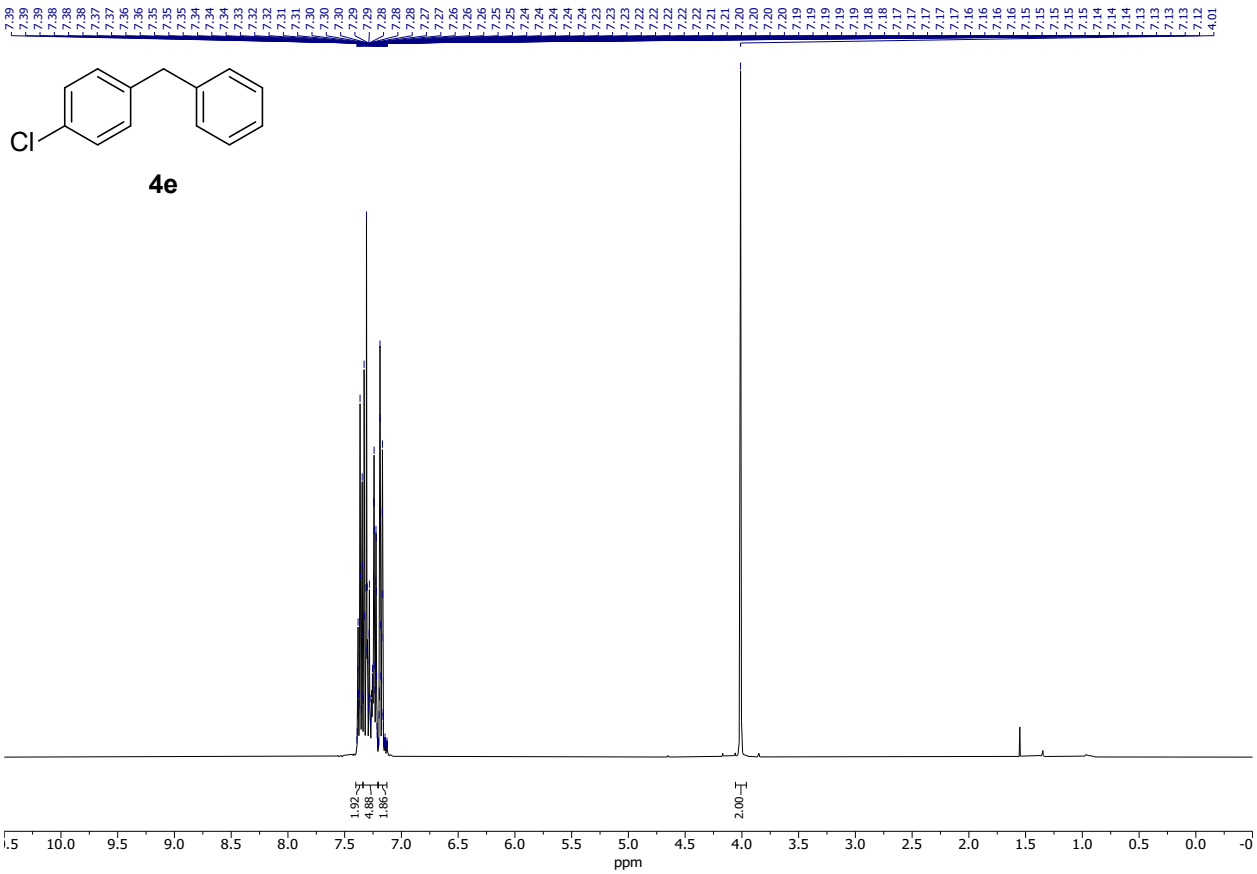


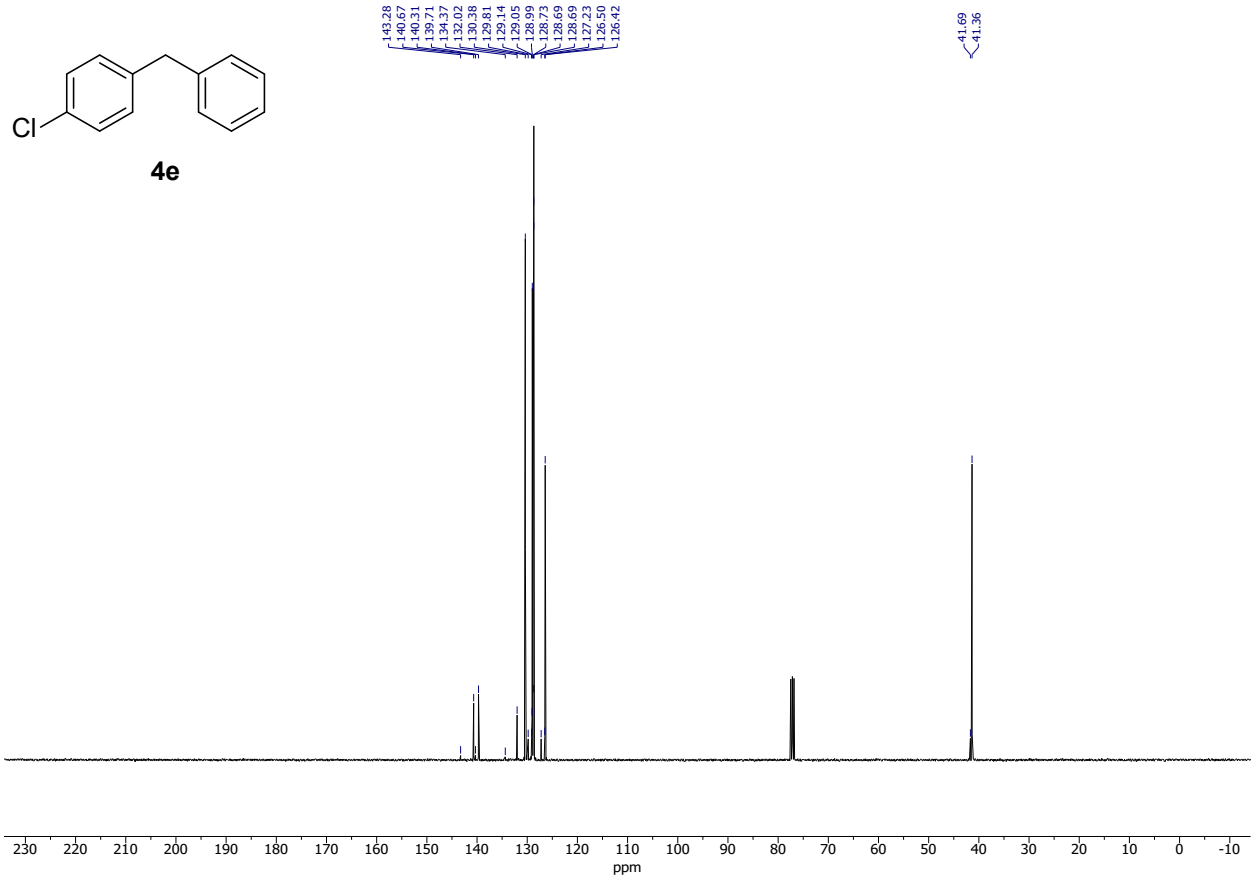
4d

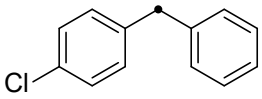


4d

determination of *p:m* isomer ratio
by ^{19}F NMR

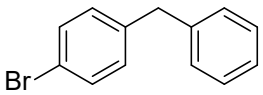

Cl
4e
1.92
4.88
1.86
2.00
ppm


Cl
4e
143.28
140.67
140.31
139.71
134.37
132.02
130.38
129.81
129.14
129.05
128.99
128.73
128.69
128.69
127.23
126.50
126.42
41.69
41.36
ppm

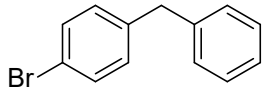


4e

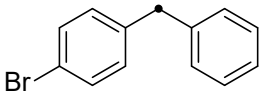
determination of *p:m* isomer ratio by ^{13}C NMR



4f

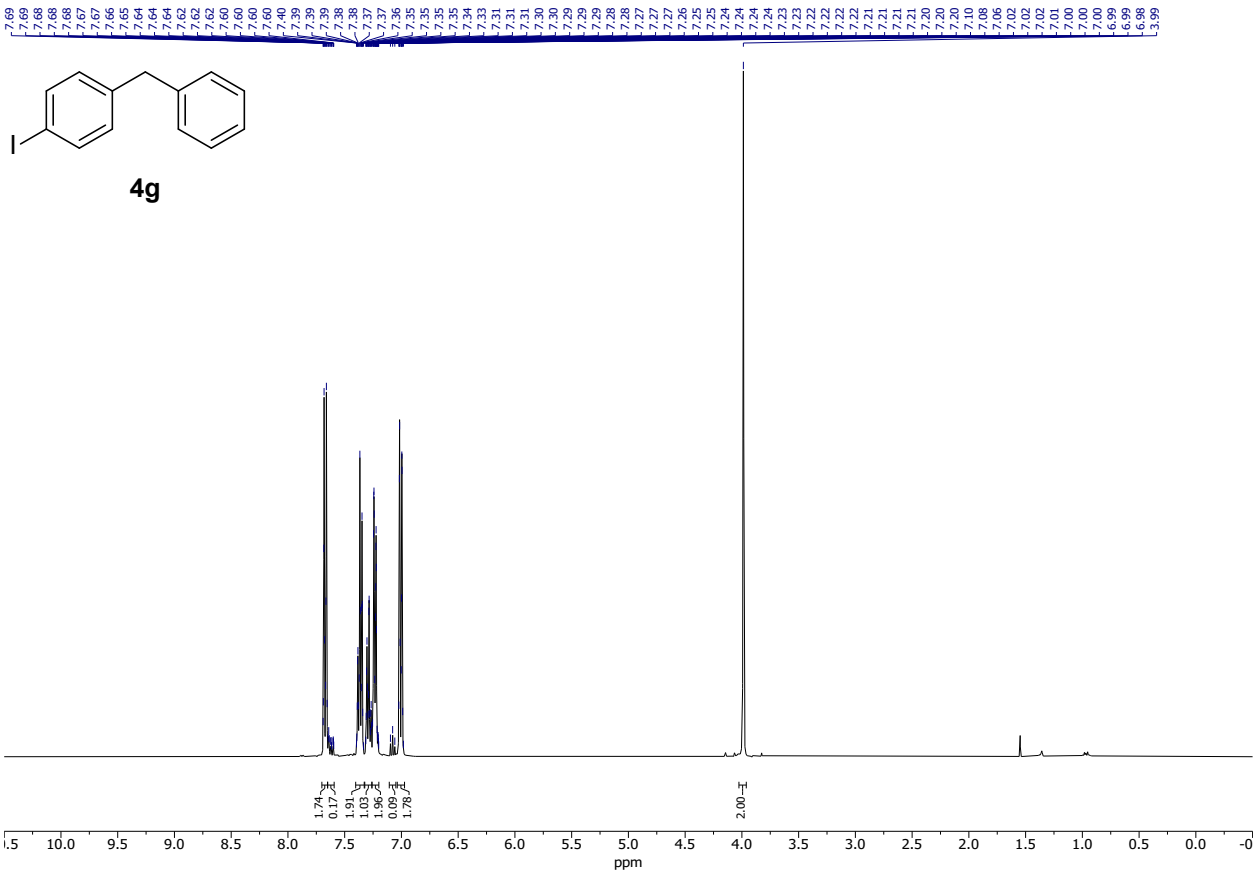


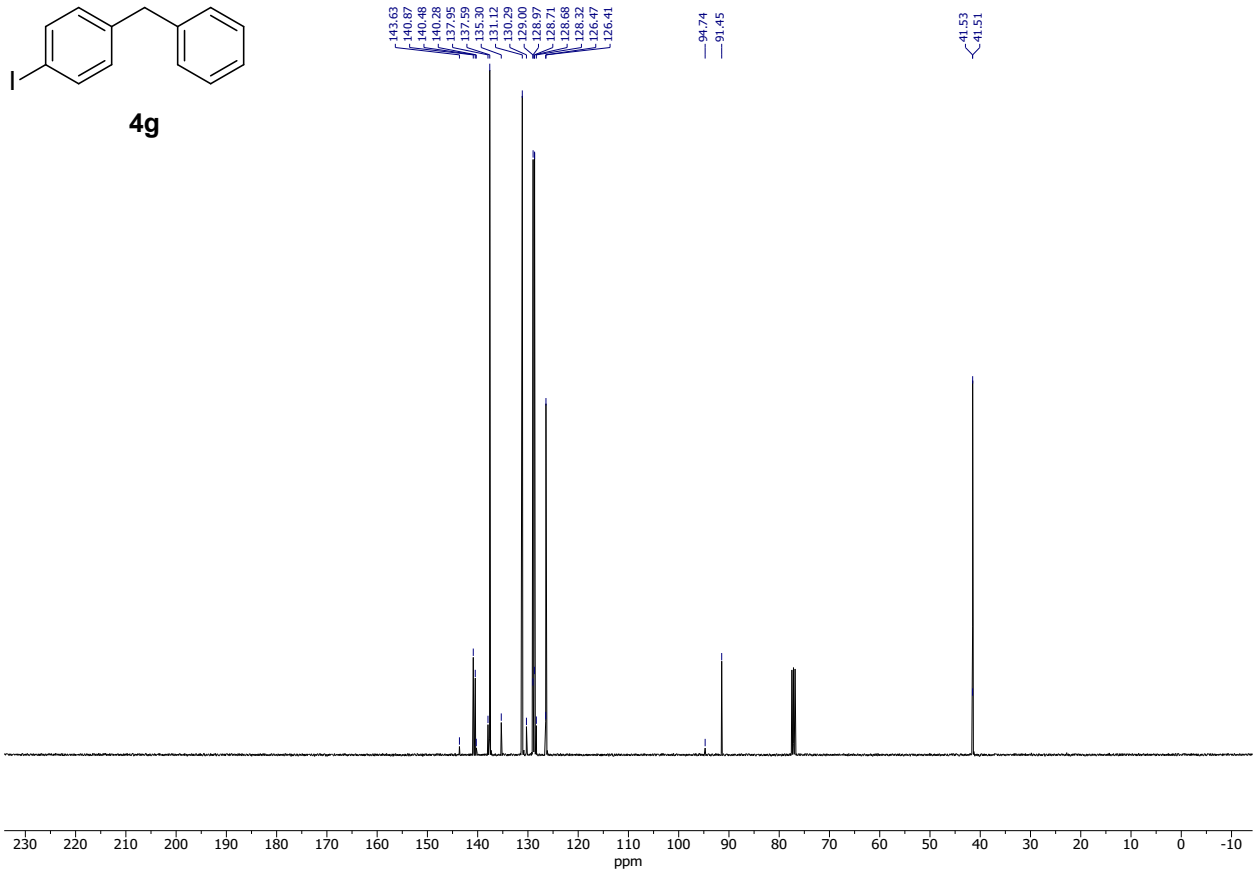
4f

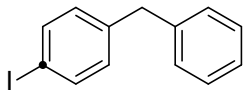


4f

determination of *p:m* isomer ratio
by ^{13}C NMR

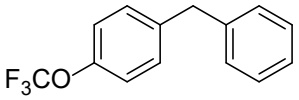

4g
ppm


4g
ppm

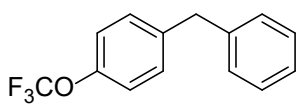


4g

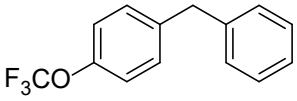
determination of *p:m* isomer ratio by ^{13}C NMR



4h

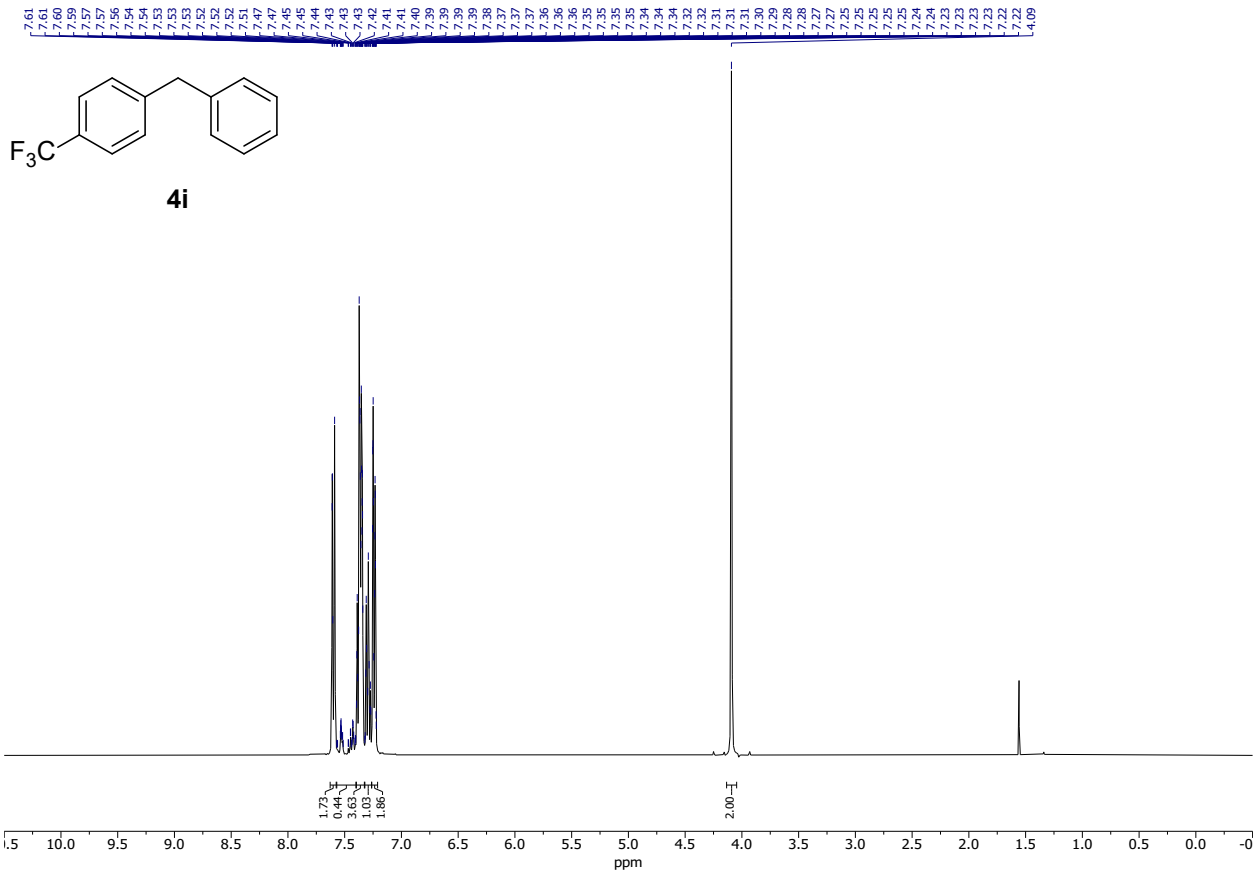


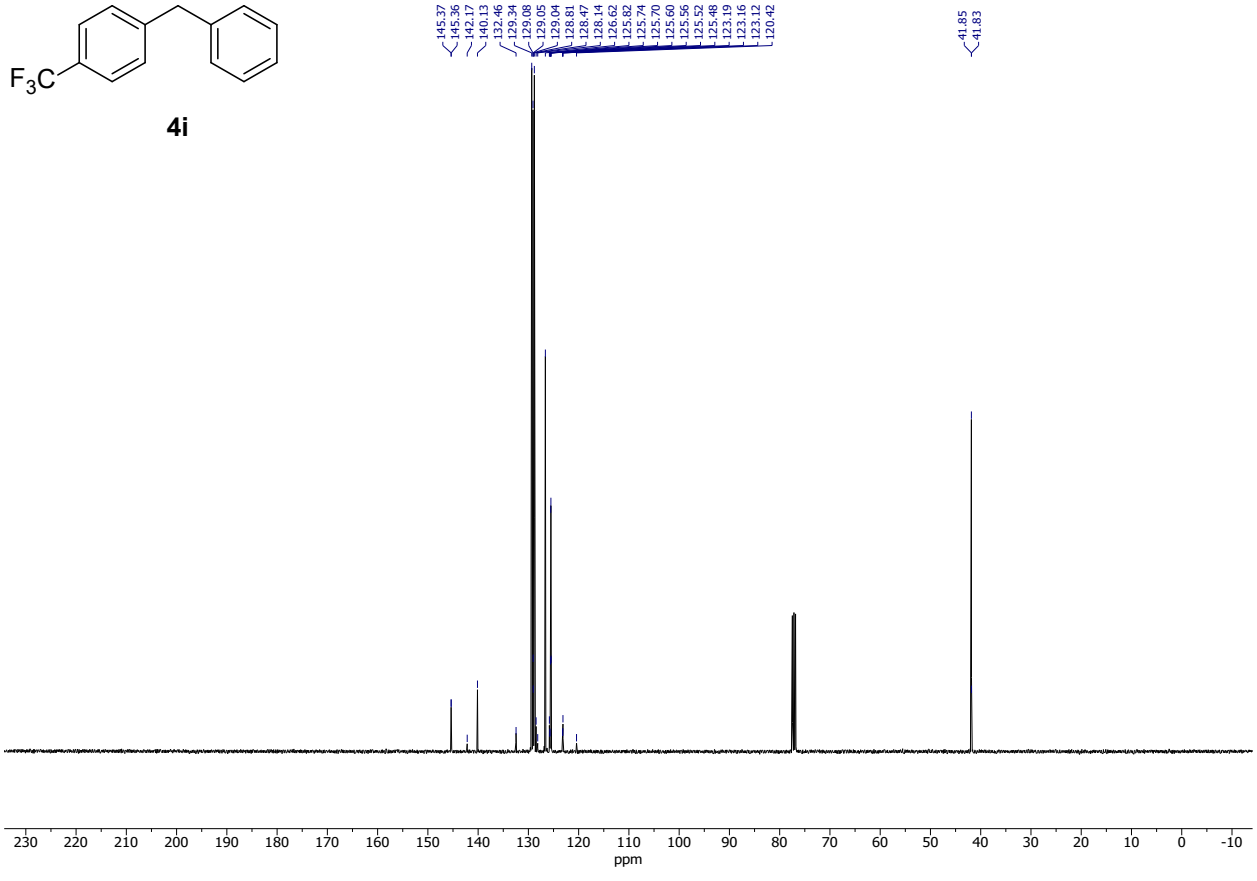
4h

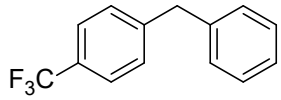


4h

determination of *p:m* isomer ratio by ^{19}F NMR

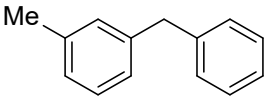

F3C
4i
ppm


F3C
4i
ppm

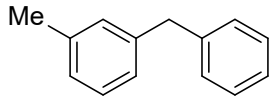


4i

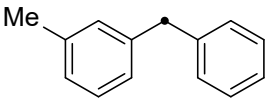
determination of *p:m* isomer ratio by ^{19}F NMR



4j

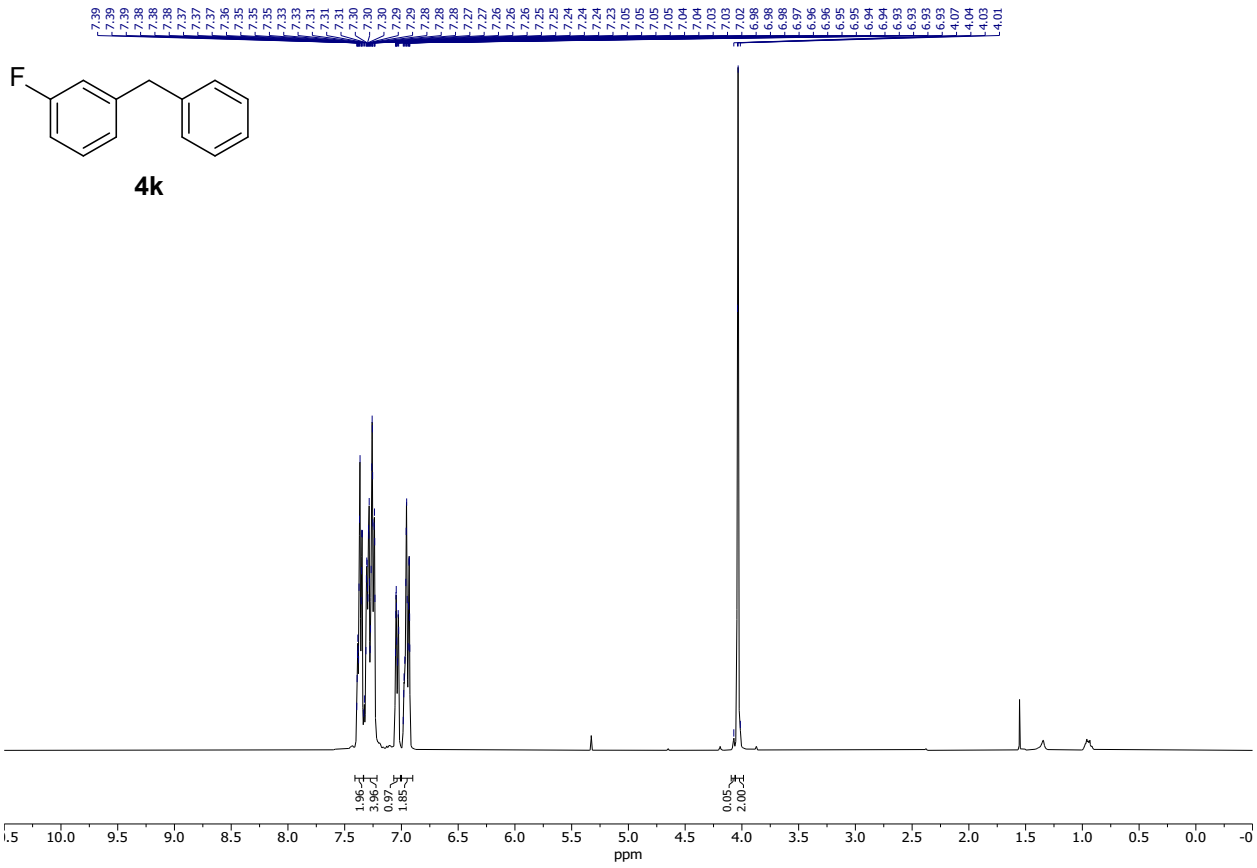


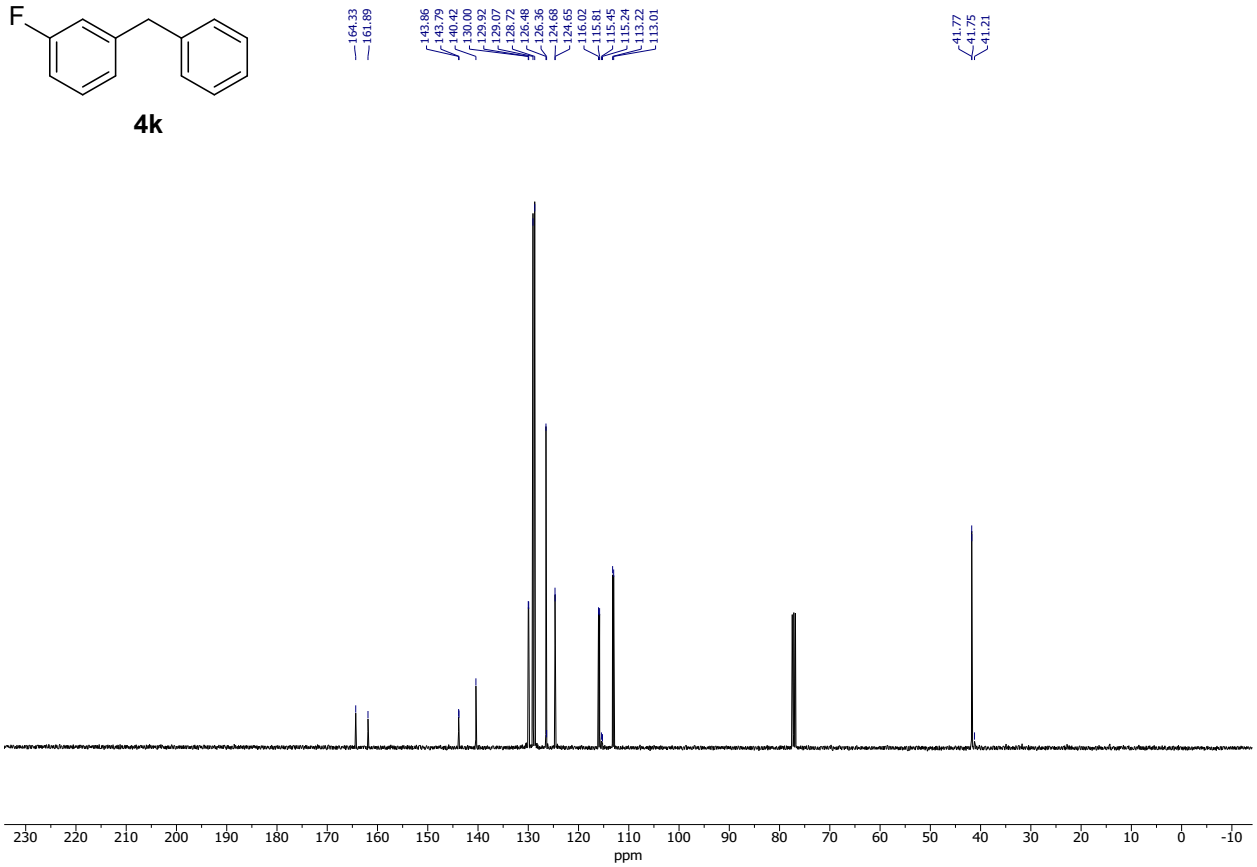
4j

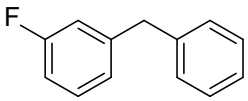


4j

determination of *m:p:o* isomer ratio by ^{13}C NMR

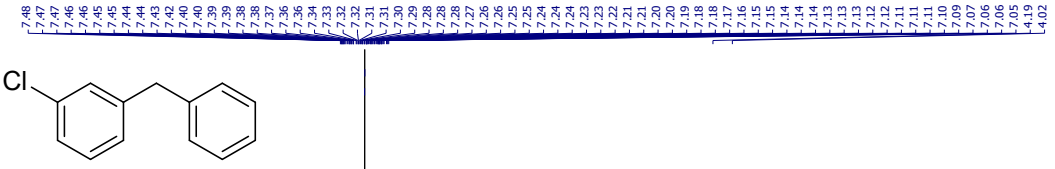

F
4k
7.39 7.39 7.38 7.38 7.38 7.37 7.37 7.37 7.36 7.35 7.35 7.33 7.31 7.31 7.31 7.30 7.30 7.30 7.29 7.28 7.28 7.28 7.27 7.27 7.26 7.26 7.25 7.25 7.24 7.24 7.24 7.23 7.05 7.05 7.05 7.05 7.04 7.04 7.03 7.03 7.02 6.98 6.98 6.98 6.97 6.96 6.96 6.95 6.95 6.94 6.94 6.93 6.93 6.93 6.93 4.07 4.04 4.03 4.01
1.96
3.96
0.97
1.85
0.05
2.00
ppm


F
4k
164.33
161.89
143.86
143.79
140.42
130.00
129.92
129.07
128.72
126.48
126.36
124.68
124.65
116.02
115.81
115.45
115.24
113.22
113.01
41.77
41.75
41.21
ppm

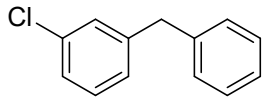


4k

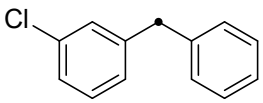
determination of *m:p:o* ratio by ^{19}F NMR



4l

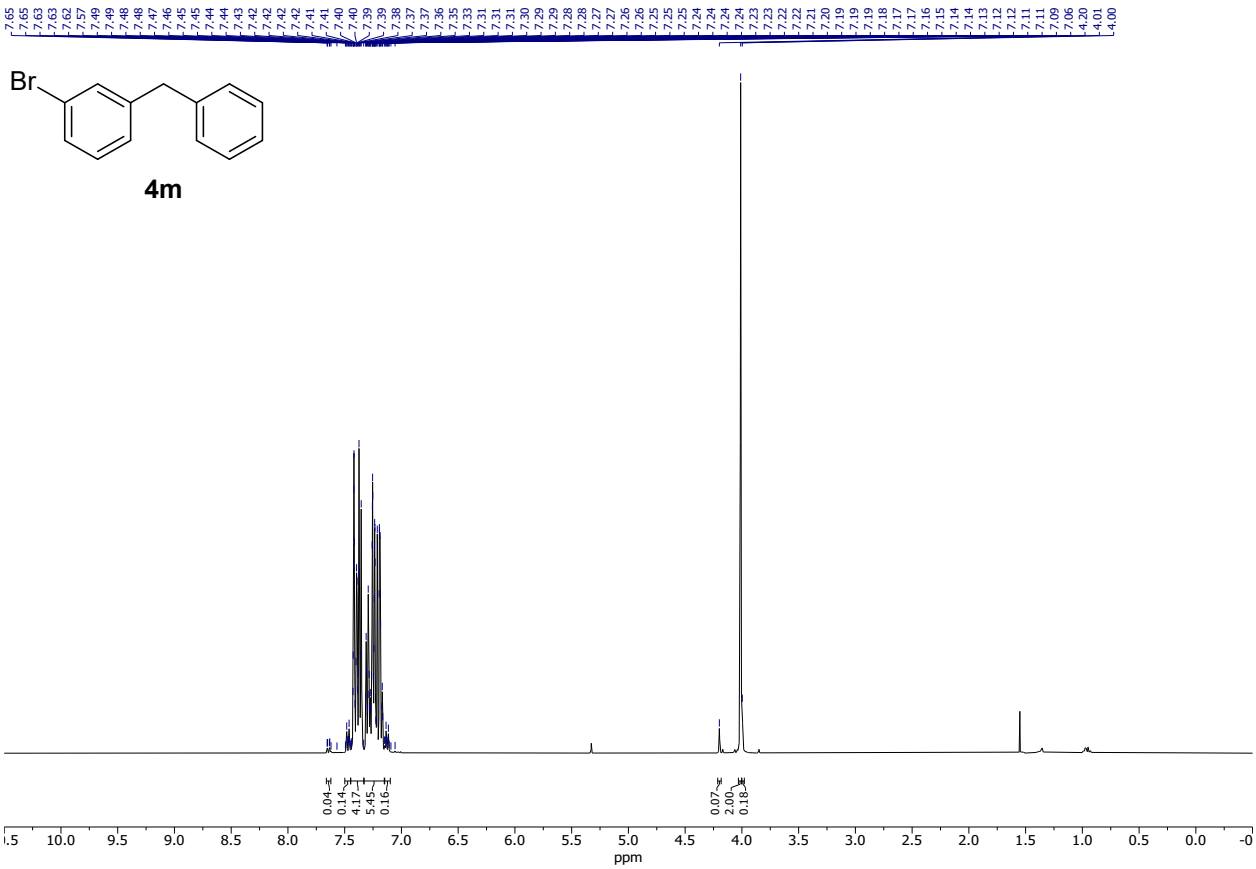


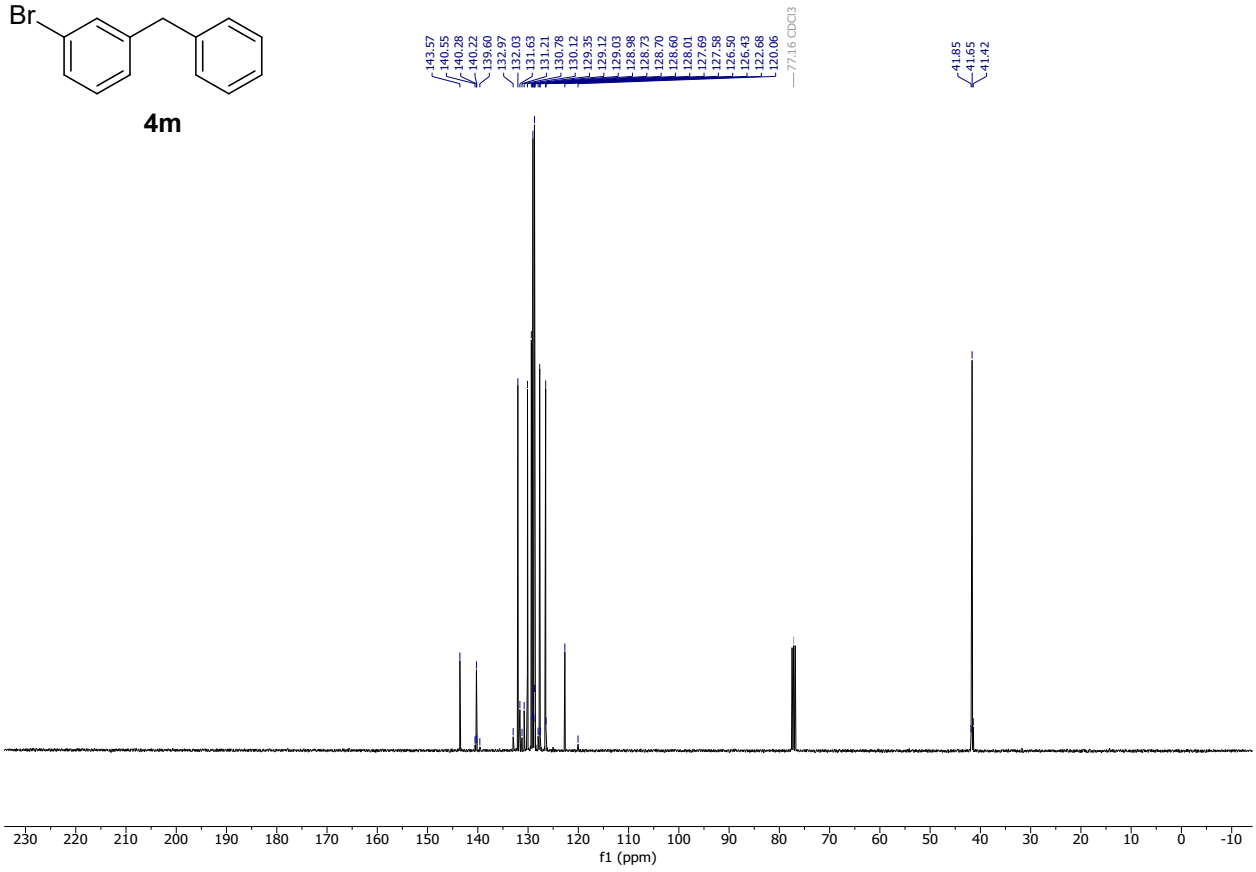
4l

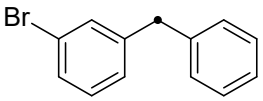


4l

determination of *m:p:o* isomer ratio by ^{13}C NMR

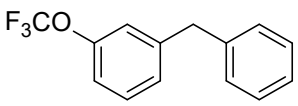

Br
4m
ppm


Br
4m
f1 (ppm)

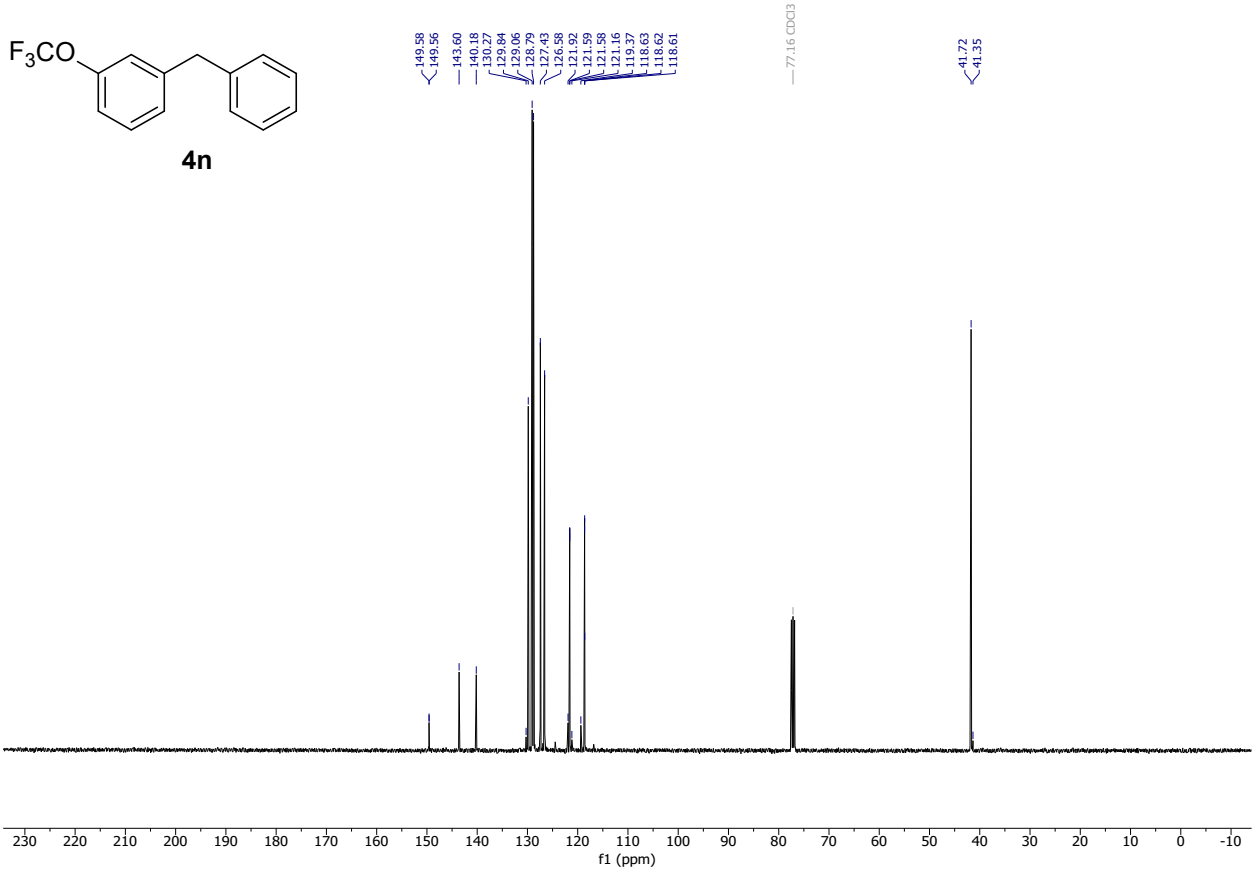


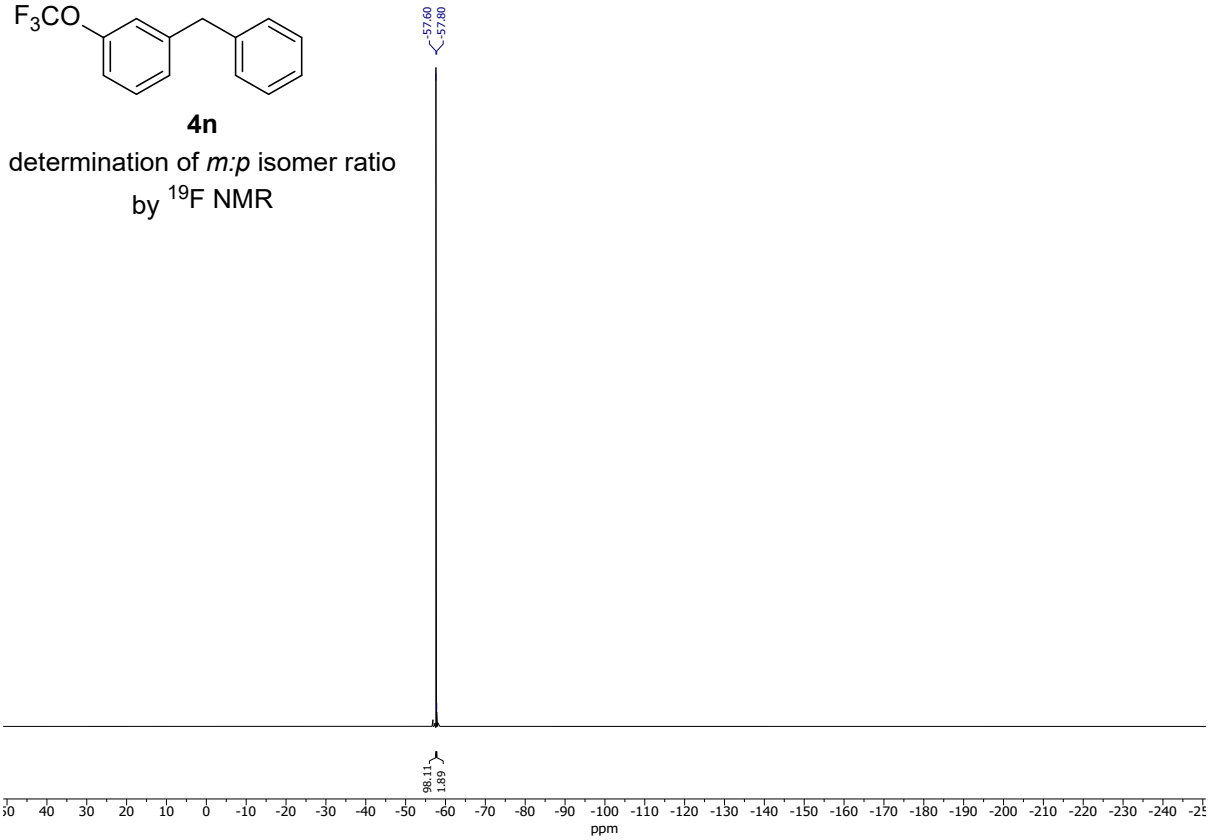
4m

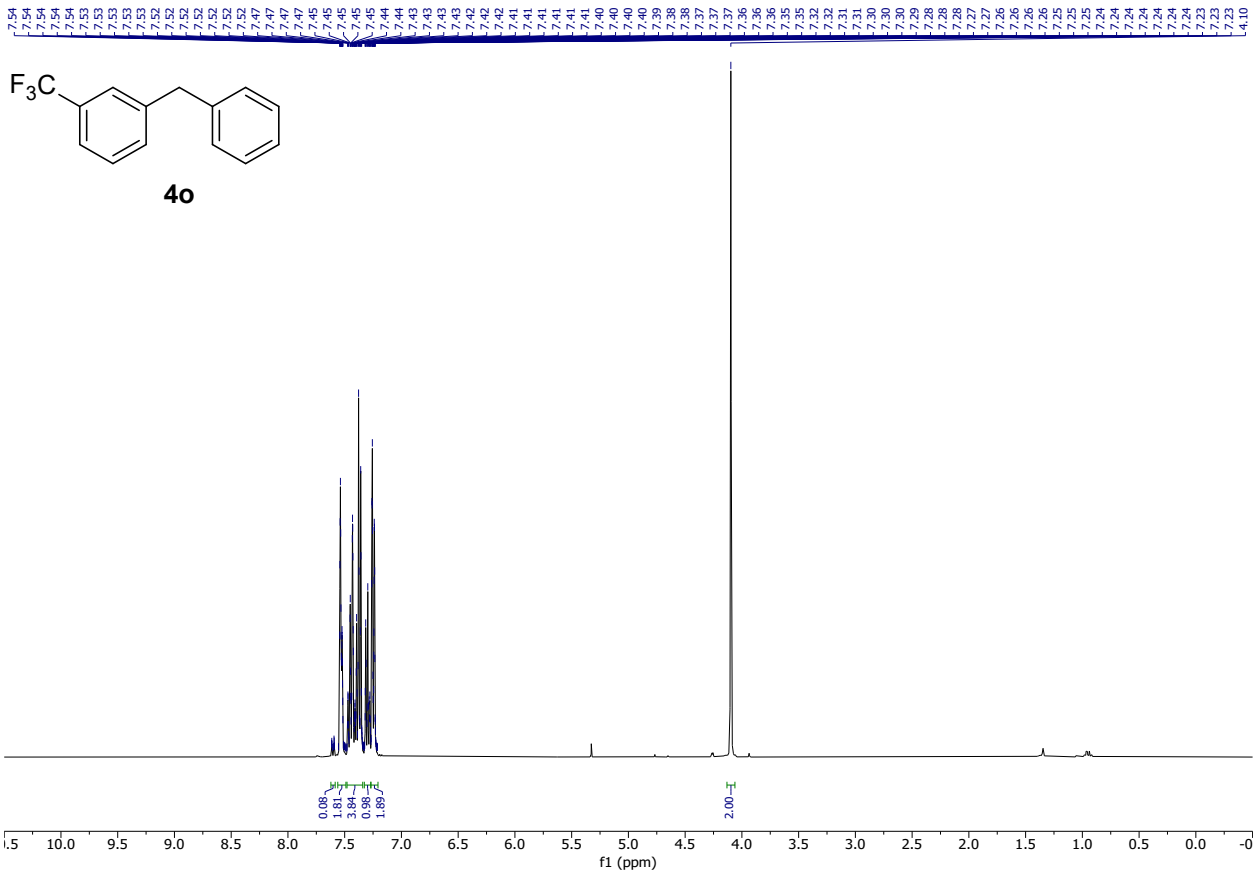
determination of *m:p:o* isomer ratio by ^{13}C NMR

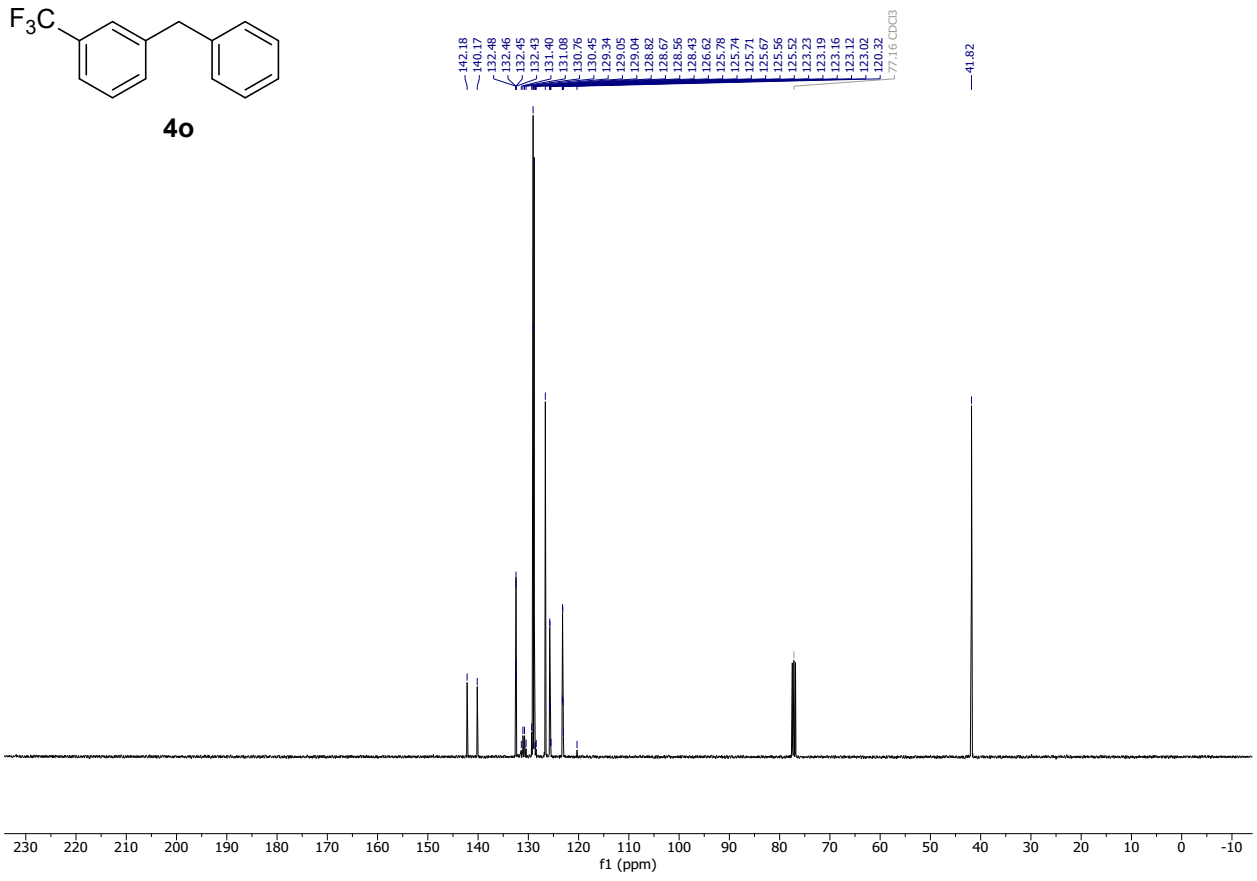


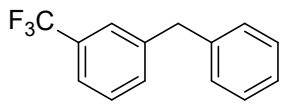
4n


F3CO
4n
149.58
149.56
143.60
140.18
130.27
129.84
129.06
128.79
127.43
126.58
121.92
121.59
121.58
121.16
119.37
118.63
118.62
118.61
77.16 CDCl3
41.72
41.35
f1 (ppm)


F3CO
4n
determination of m:p isomer ratio
by 19F NMR
57.60
57.80
98.11
1.89
ppm

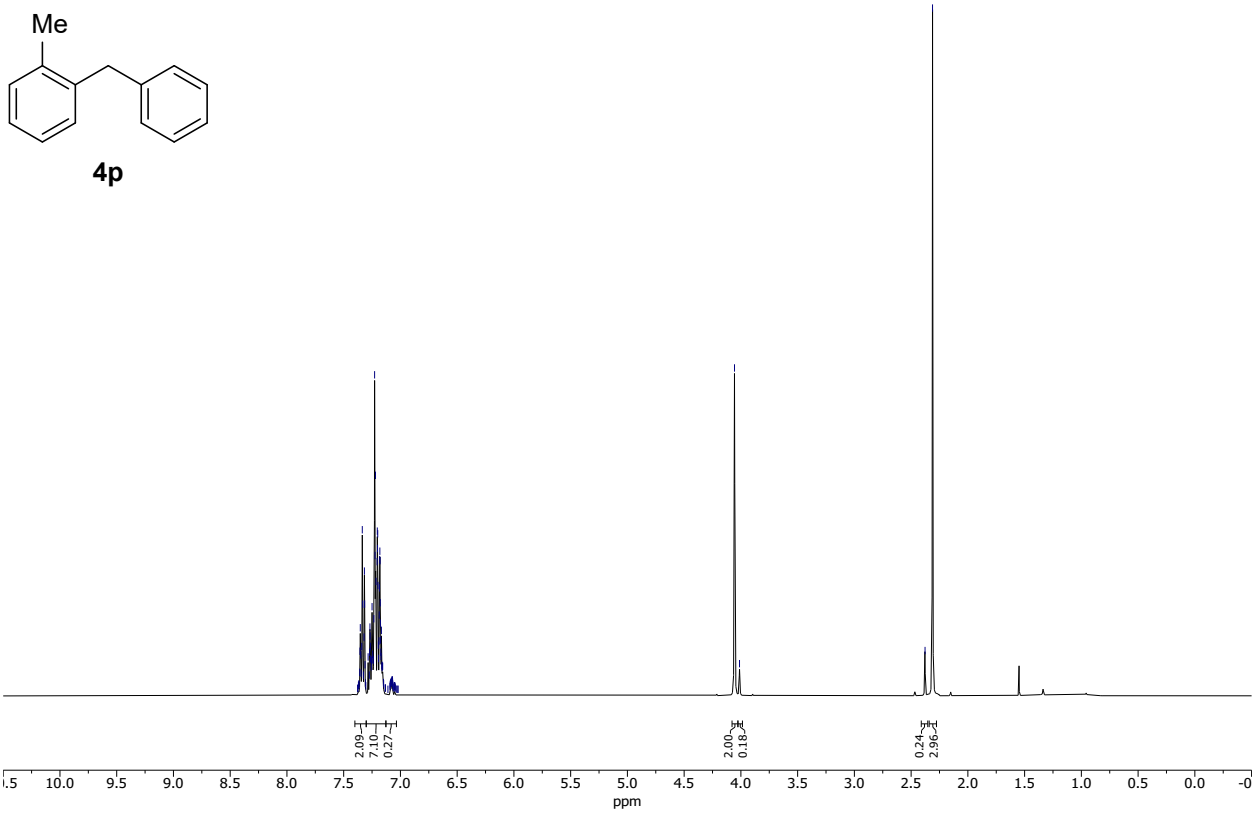

F3C
4o
0.08
1.81
3.84
0.98
1.89
2.00
f1 (ppm)


F3C
4o
142.18
140.17
132.48
132.46
132.45
132.43
131.40
131.08
130.76
130.45
129.34
129.05
129.04
128.82
128.67
128.56
128.43
126.62
125.78
125.74
125.71
125.67
125.56
125.52
123.23
123.19
123.16
123.12
123.02
120.32
77.16 CDCl3
41.82
f1 (ppm)

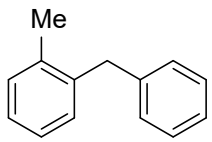


4o

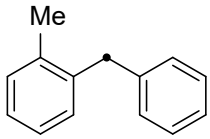
determination of *m:p* isomer ratio by ^{19}F NMR



4p

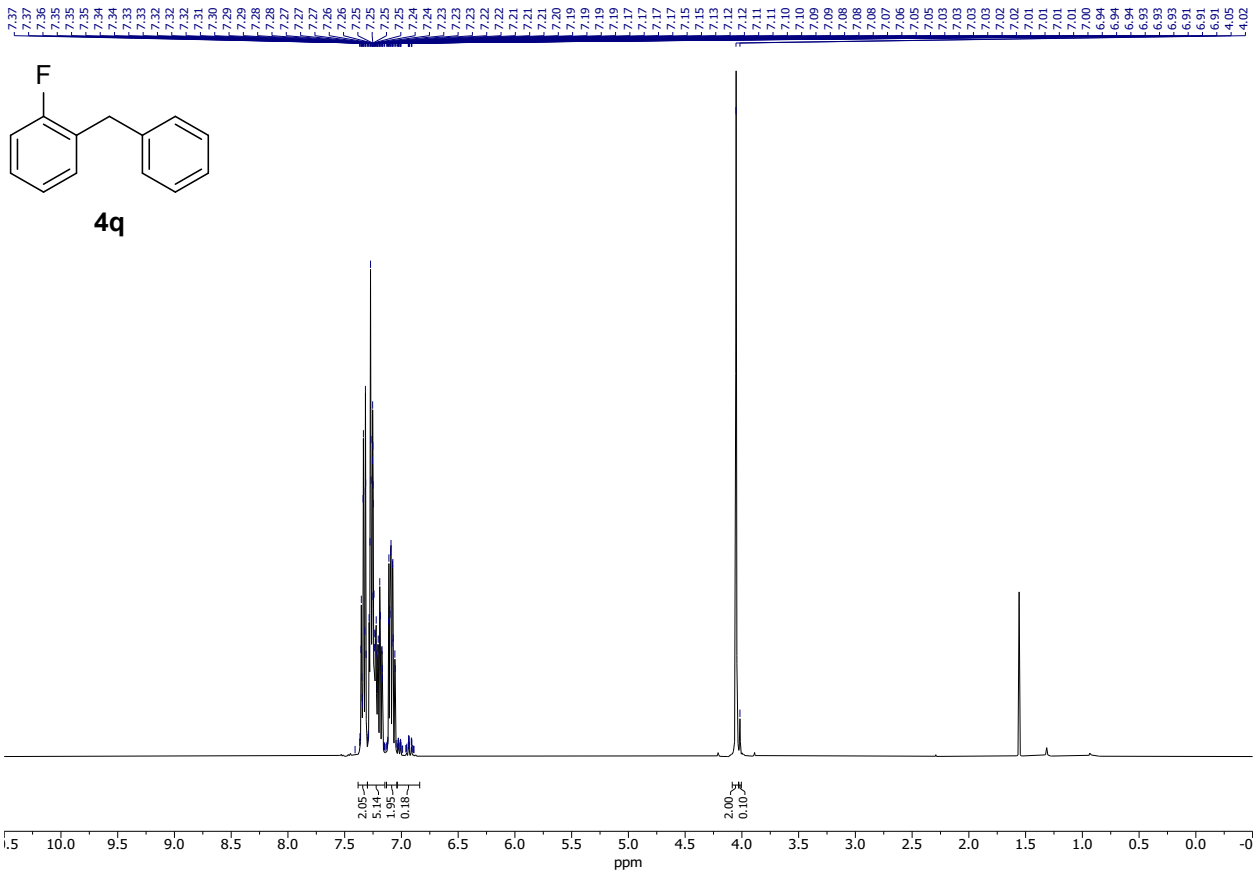


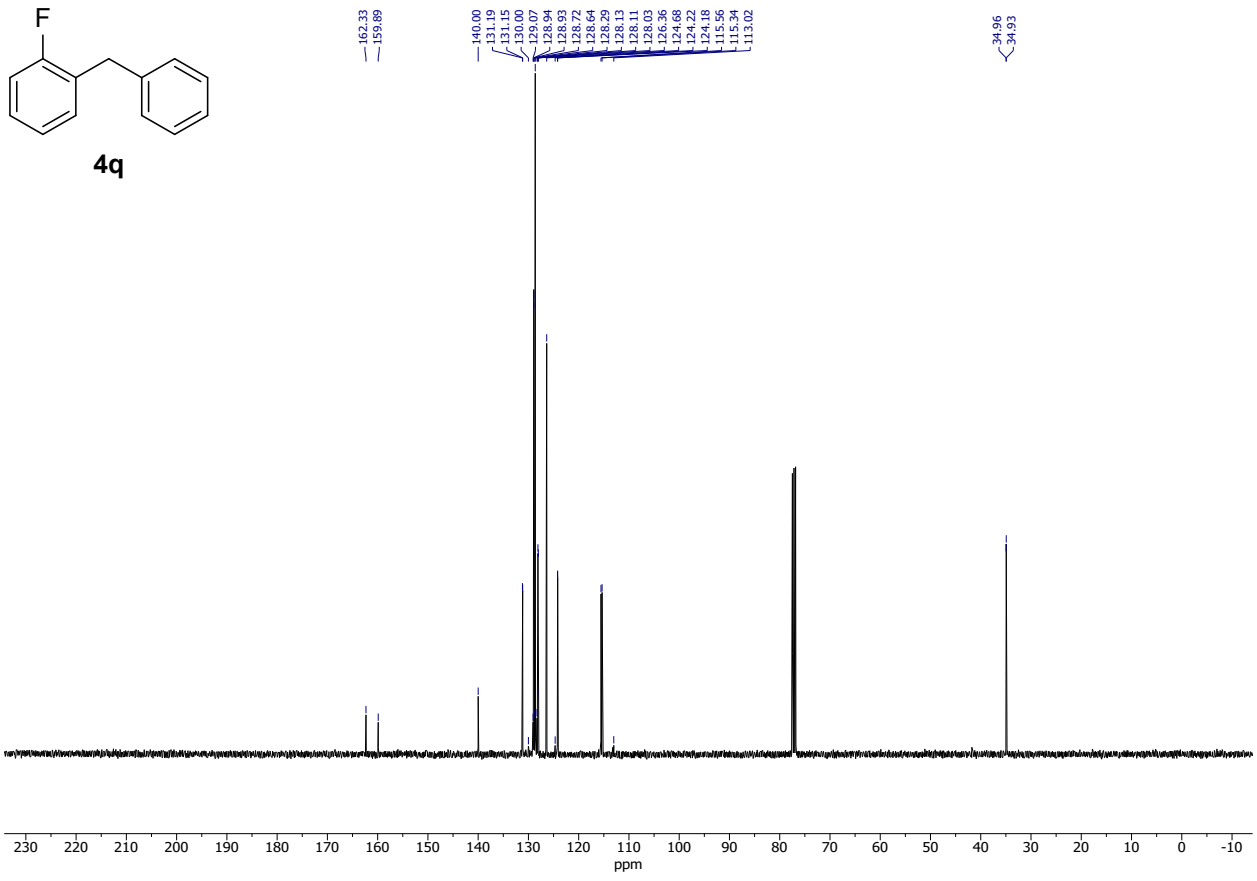
4p

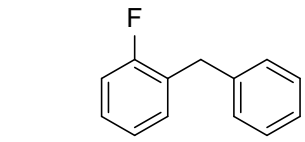


4p

determination of *o:m* isomer ratio by ^{13}C NMR

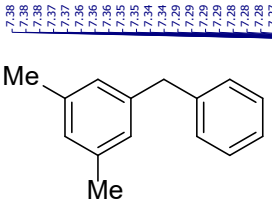

F
4q
2.05
5.14
1.95
0.18
2.00
0.10
ppm


F
4q
162.33
159.89
140.00
131.19
131.15
130.00
129.07
128.94
128.93
128.72
128.64
128.29
128.13
128.11
128.03
126.36
124.68
124.22
124.18
115.56
115.34
113.02
34.96
34.93
ppm

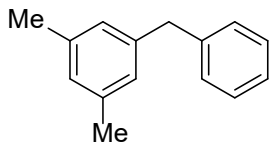


4q

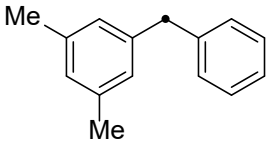
determination of *o:m* isomer ratio by ^{19}F NMR



4r

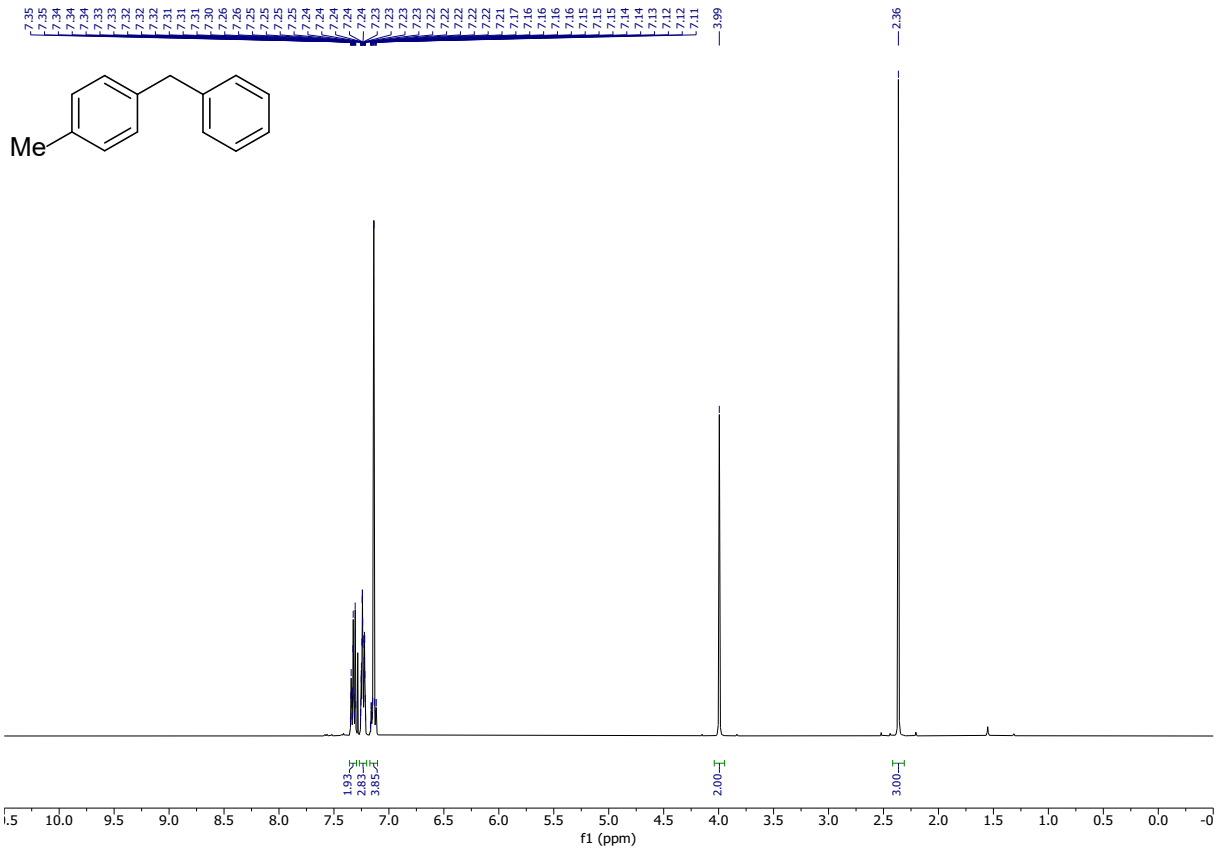


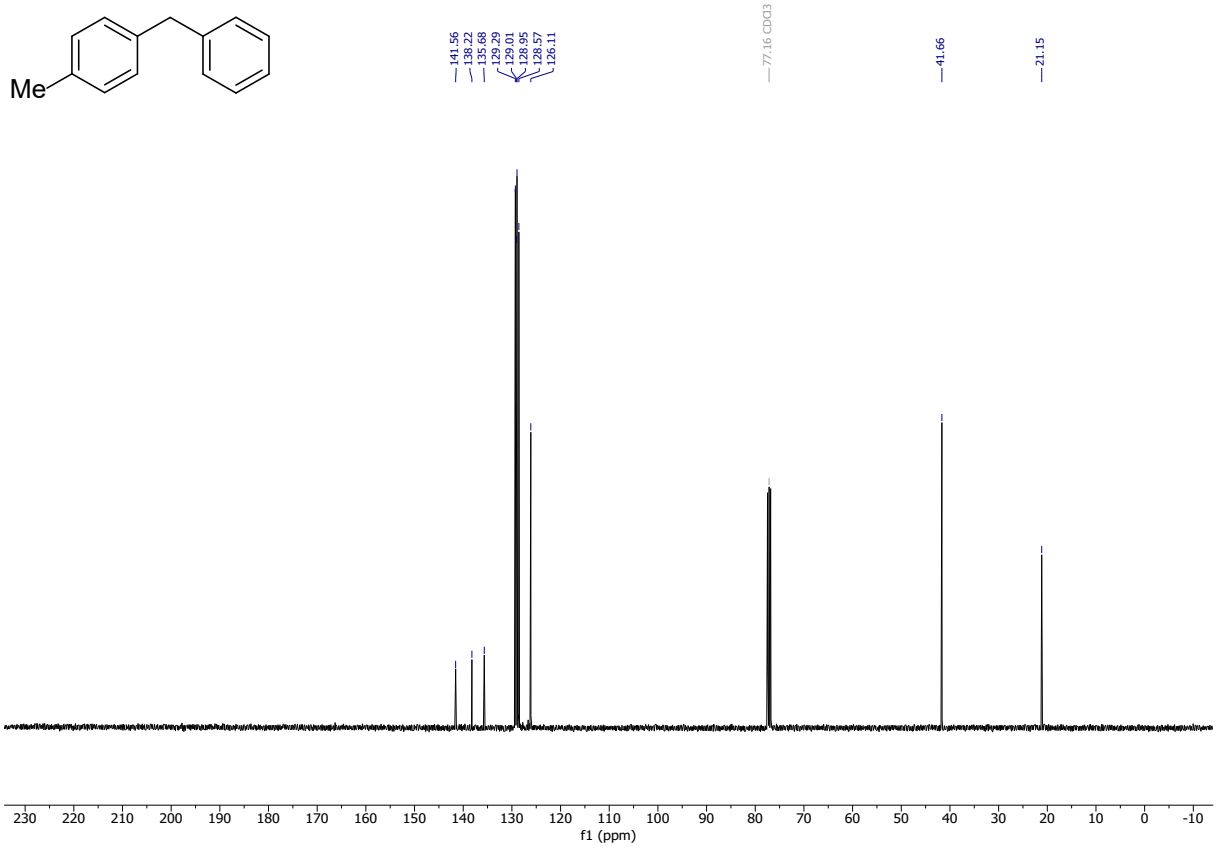
4r

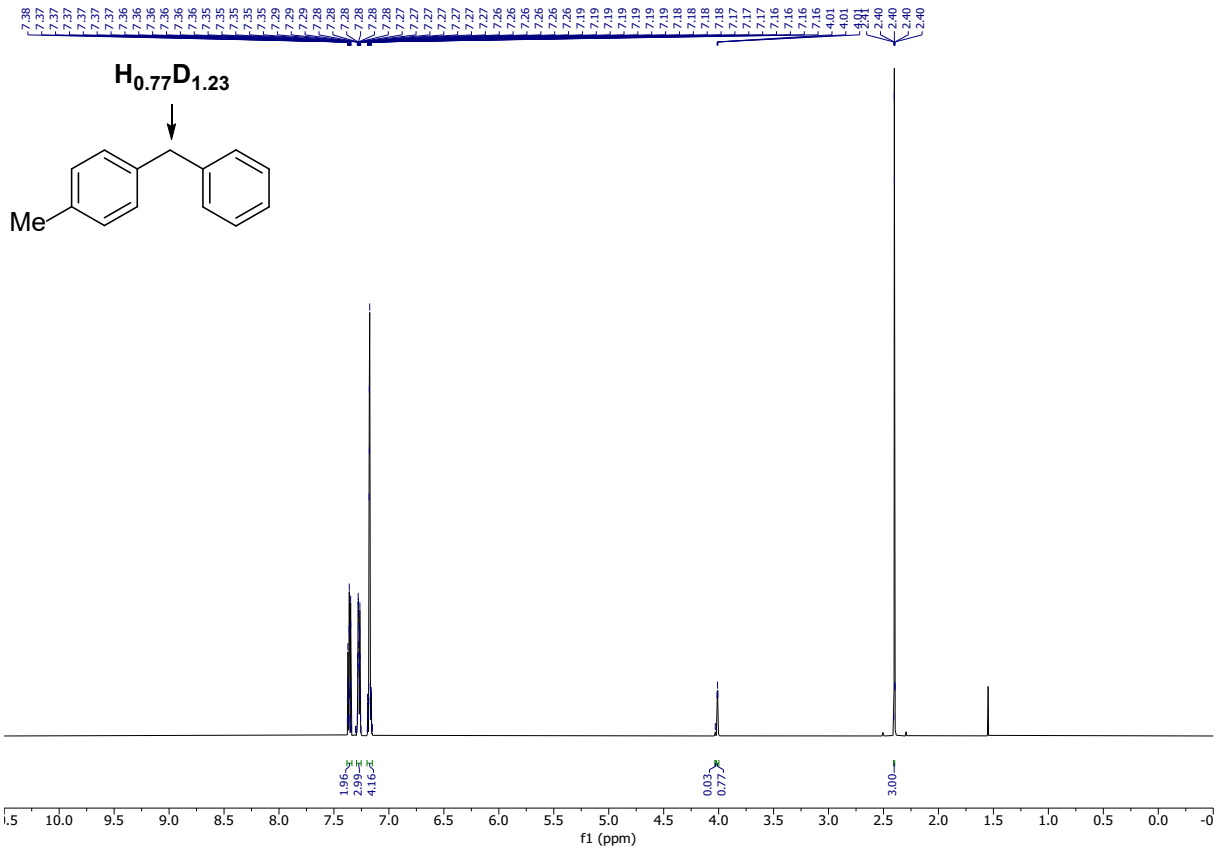


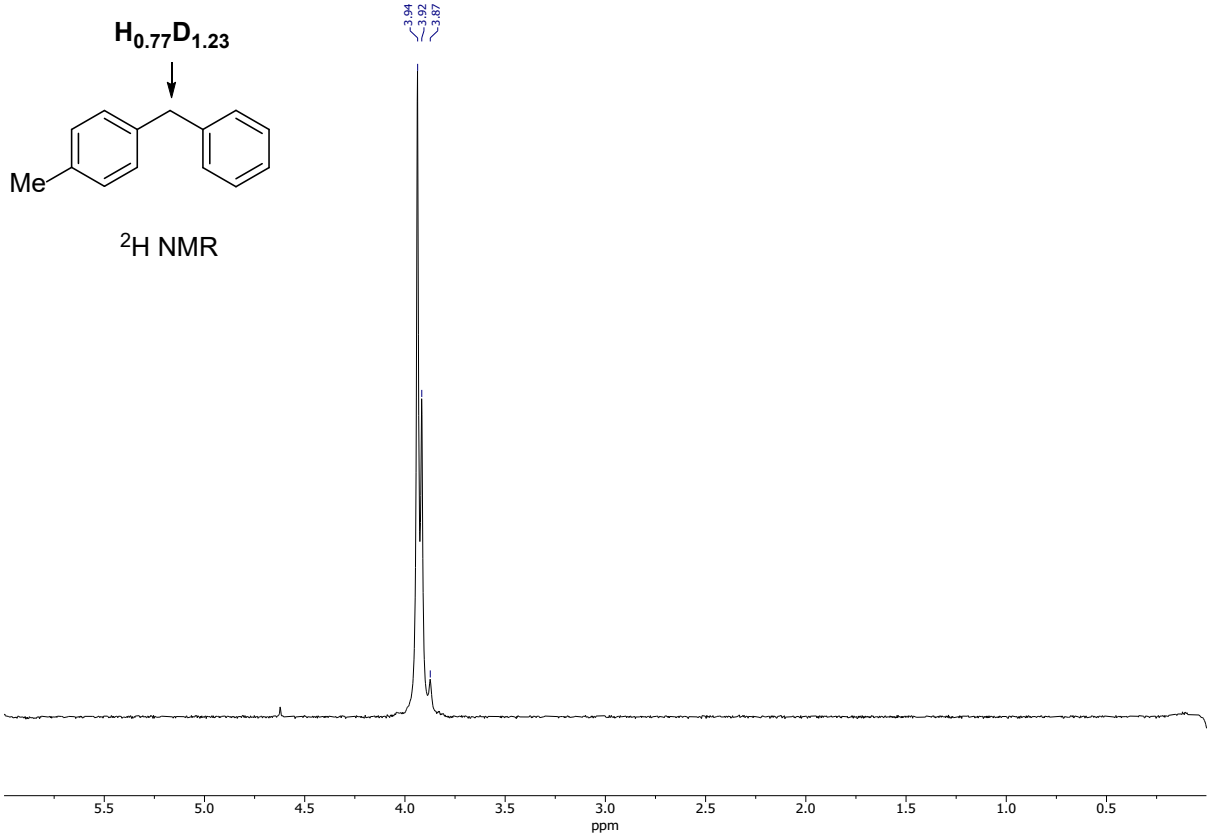
4r

determination of isomer ratio
by ^{13}C NMR

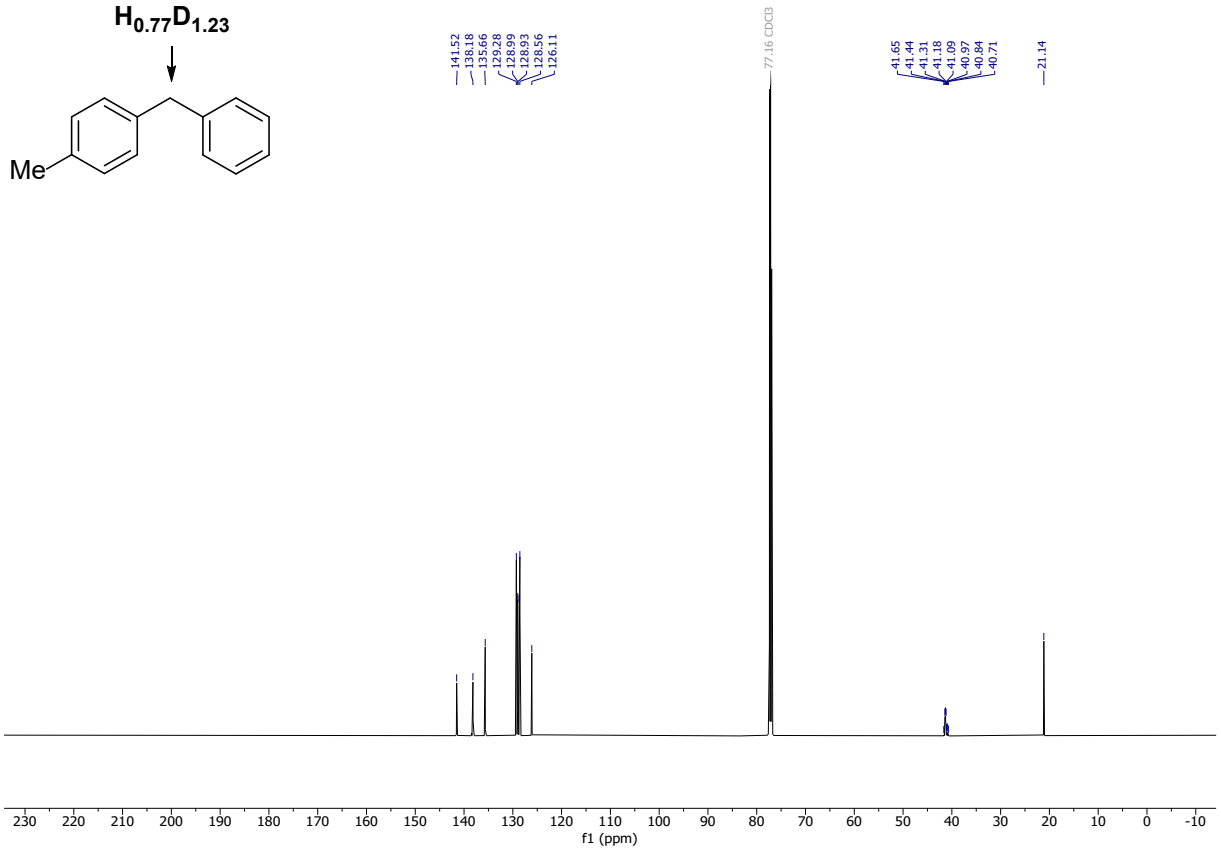

Me
f1 (ppm)

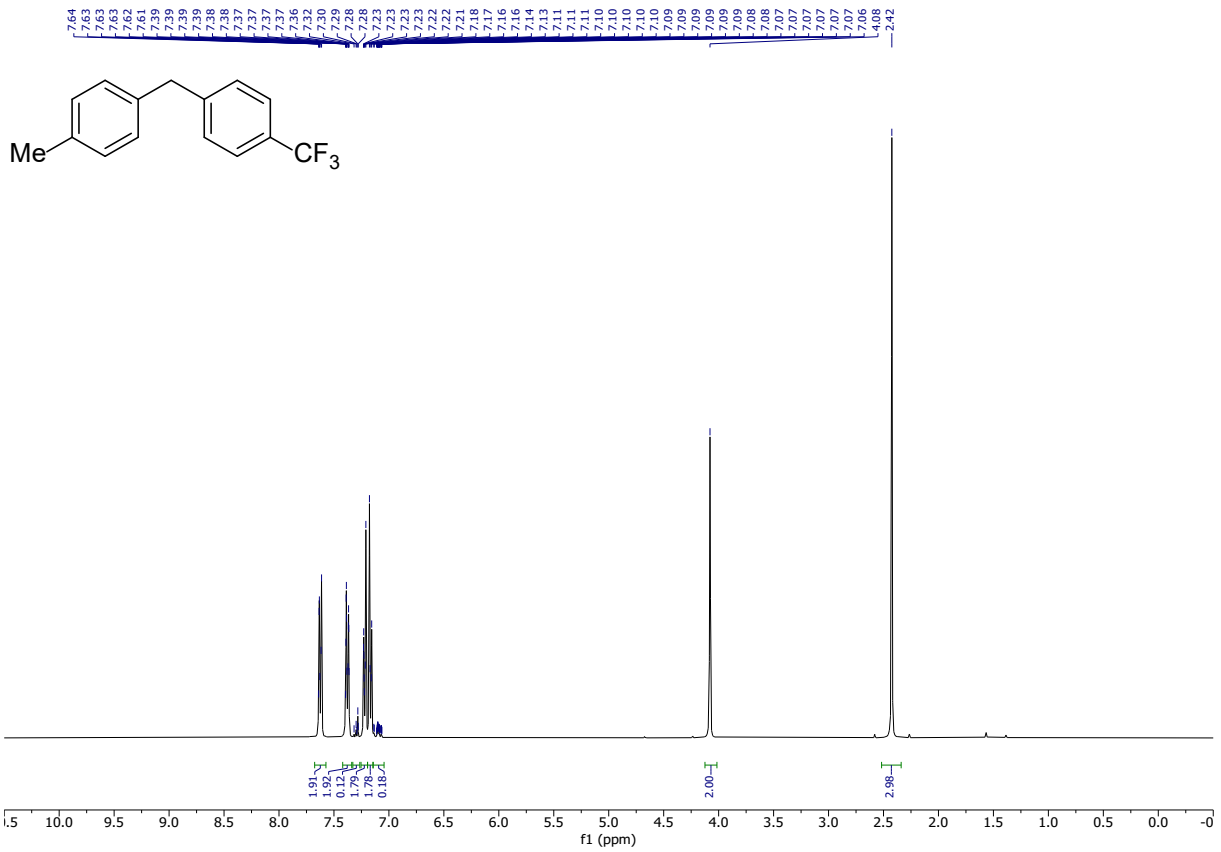

Me
f1 (ppm)

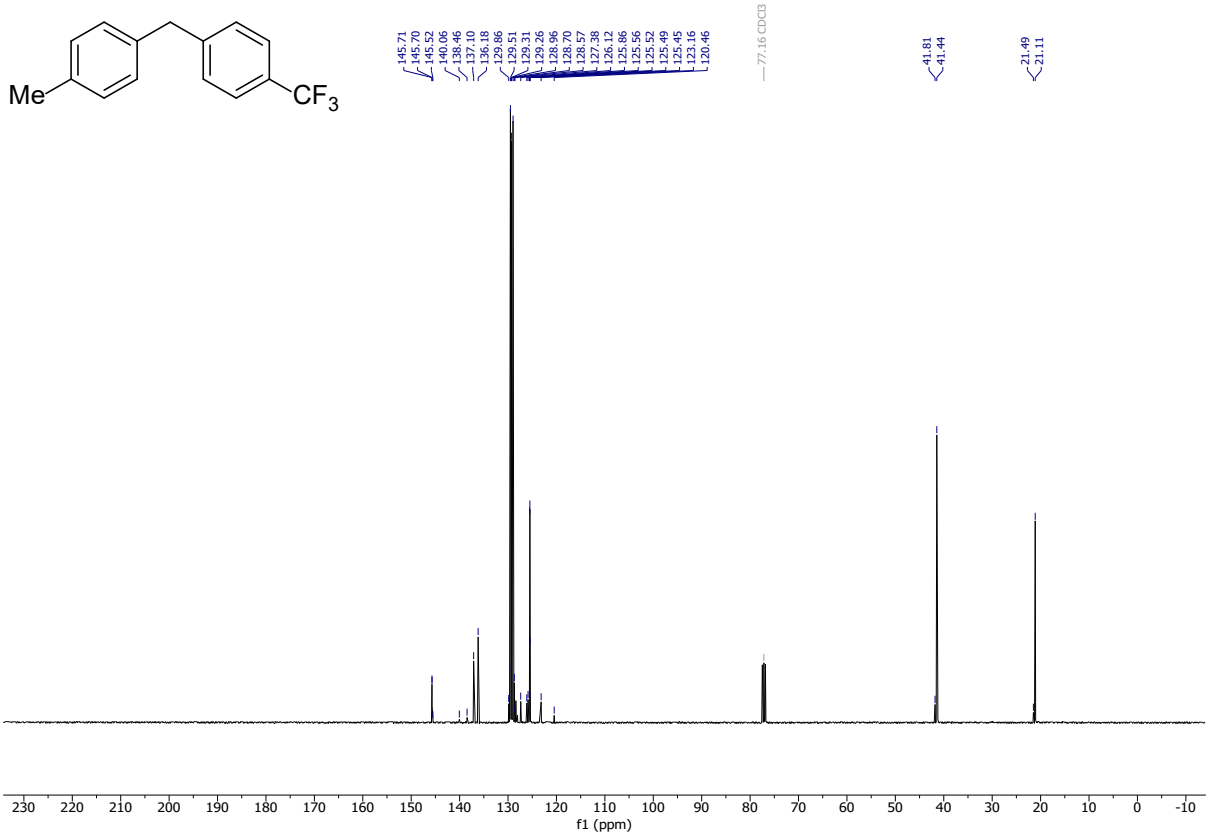

H0.77D1.23
Me
1.96
2.99
4.16
0.03
0.77
3.00
f1 (ppm)

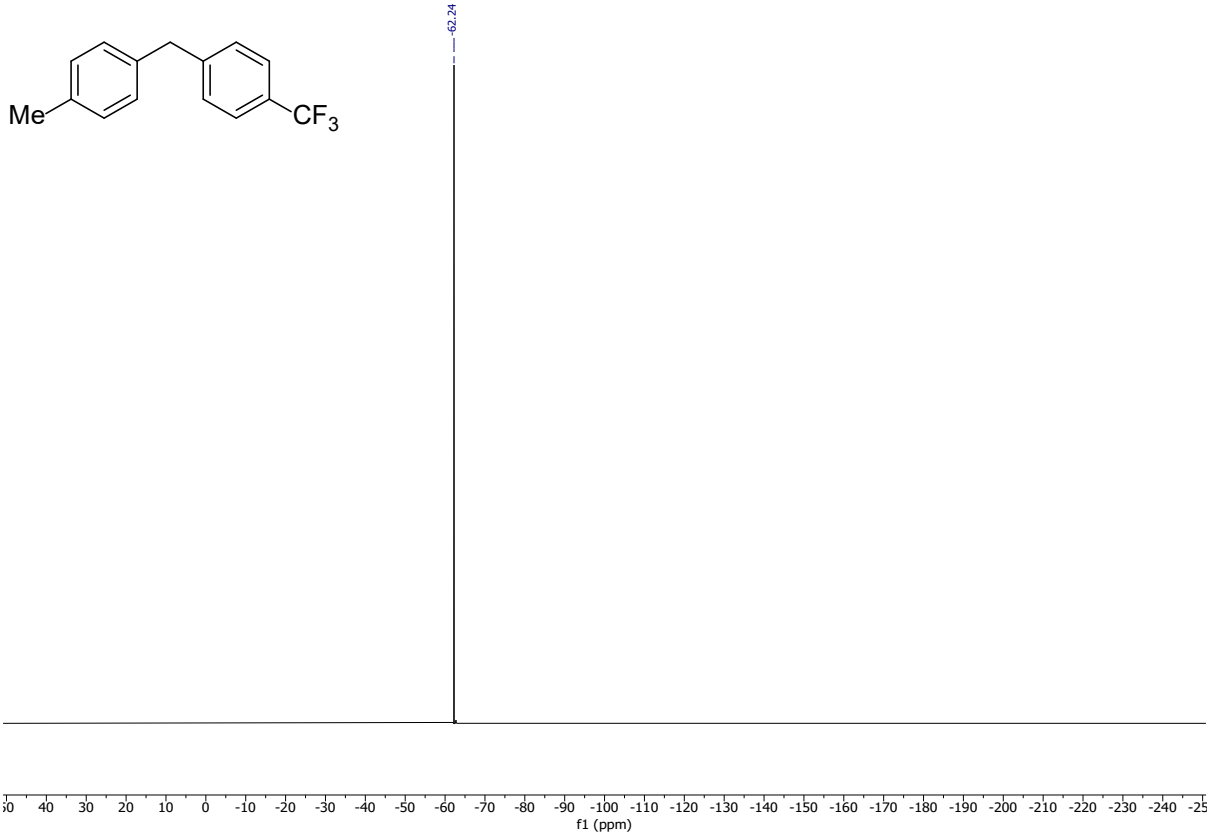

H0.77D1.23
Me
3.94
3.92
3.87
ppm

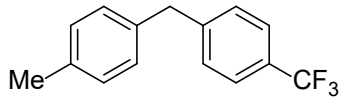
^{2}H NMR


$H_{0.77}D_{1.23}$
Me
141.52
138.18
135.66
129.28
128.99
128.93
128.56
126.11
77.16 CDCl3
41.65
41.44
41.31
41.18
41.09
40.97
40.84
40.71
21.14
f1 (ppm)

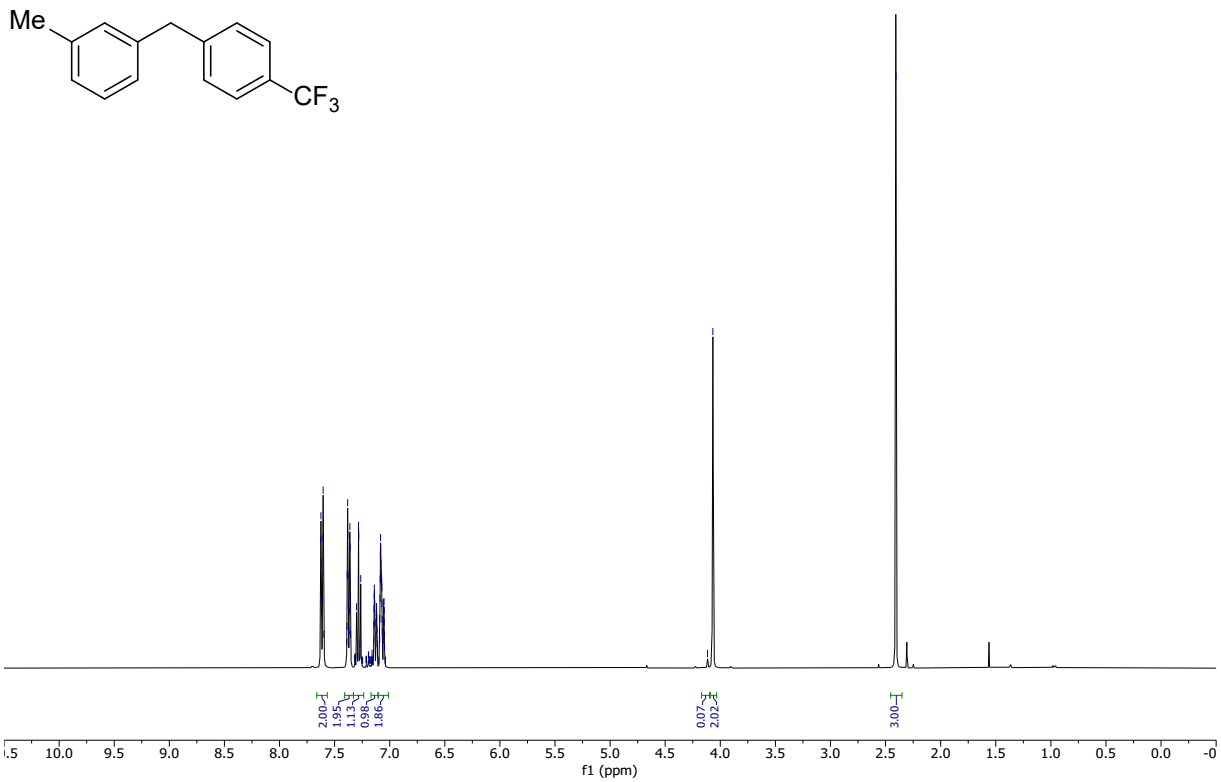

Me
CF_3
2.42
1.91
1.92
0.12
1.79
1.78
0.18
2.00
2.98
f1 (ppm)

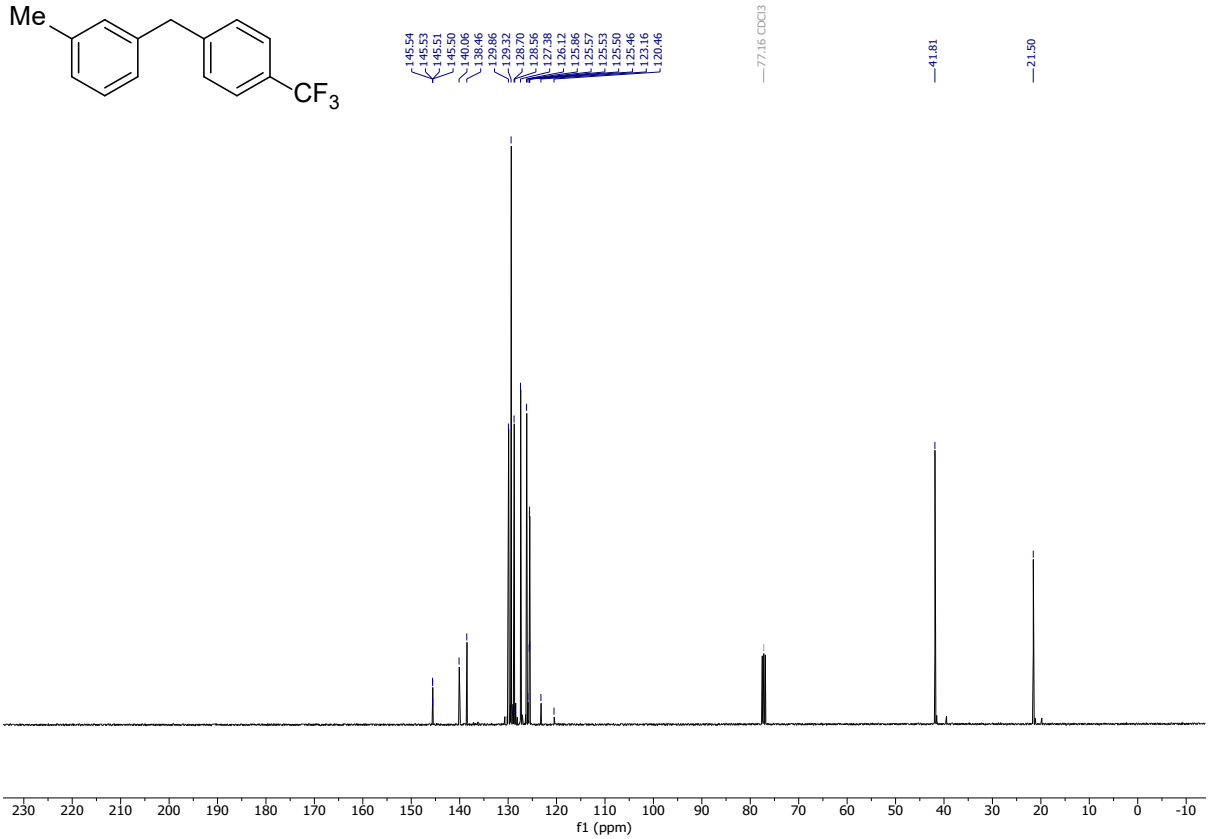

Me
CF3
145.71
145.70
145.52
140.06
138.46
137.10
136.18
129.86
129.51
129.31
129.26
128.96
128.70
128.57
127.38
127.12
125.86
125.56
125.52
125.49
125.45
123.16
120.46
77.16 CDCl3
41.81
41.44
21.49
21.11
f1 (ppm)

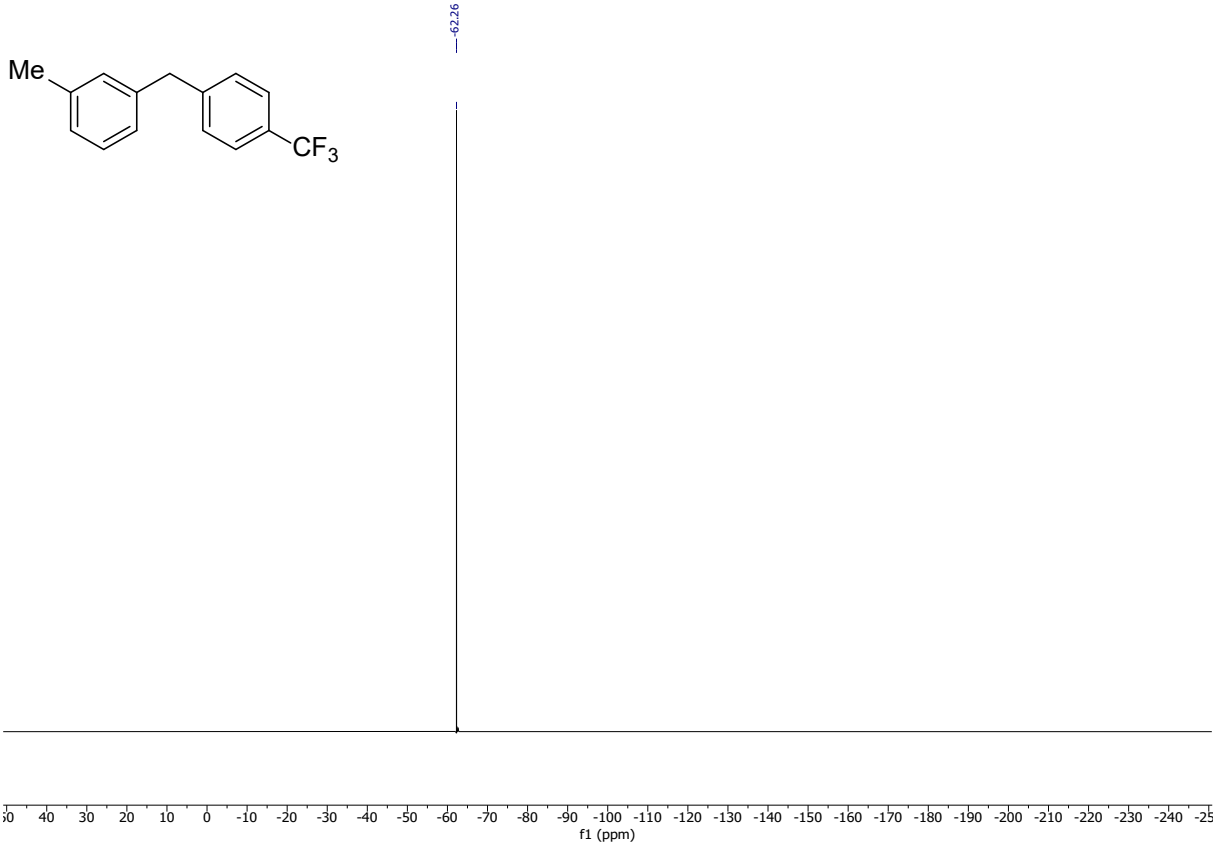

Me
CF3
-62.24
f1 (ppm)

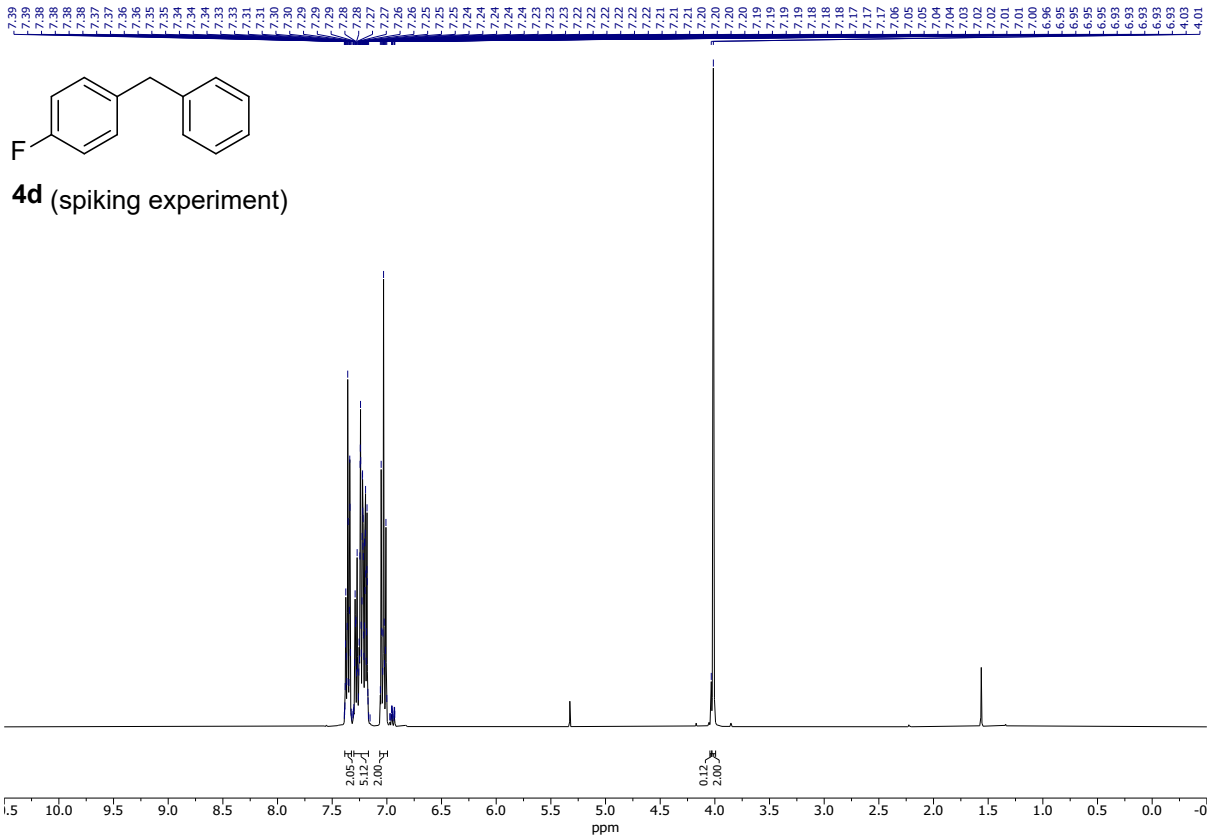


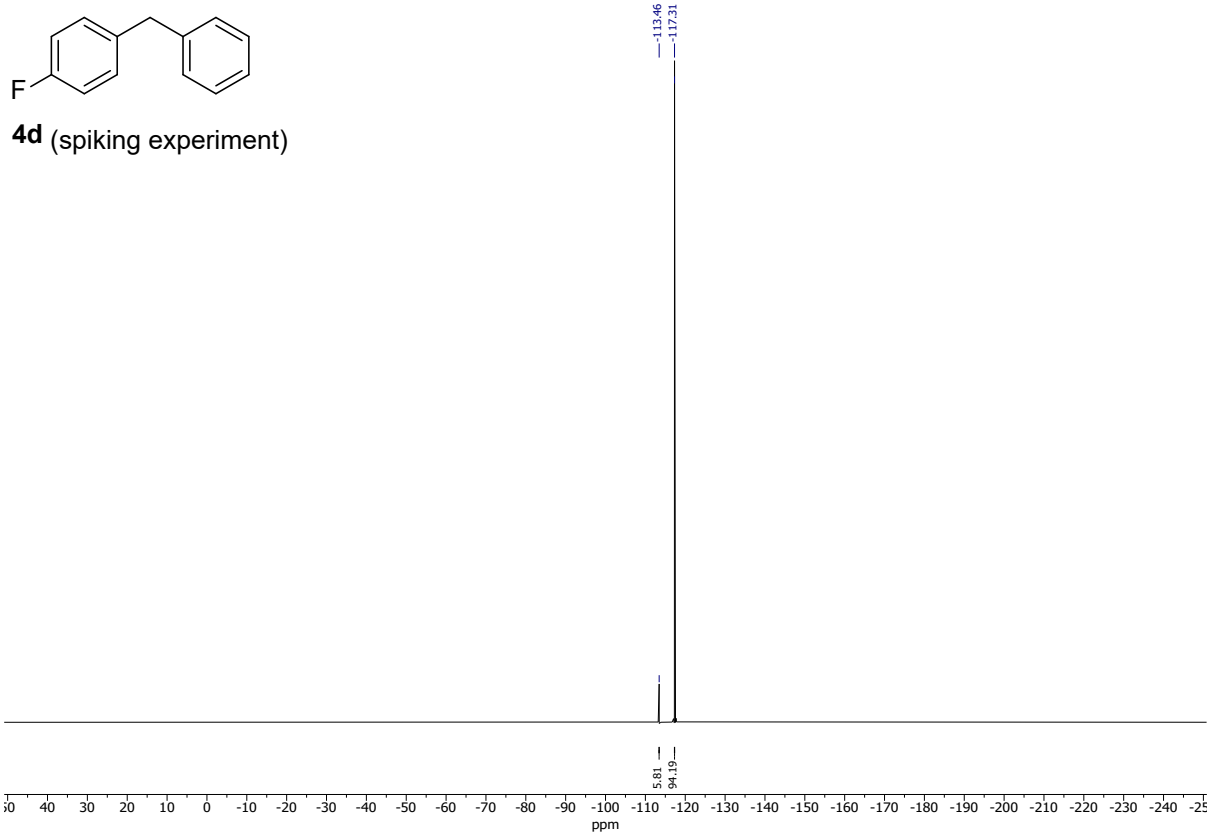
determination of *p:m* isomer ratio

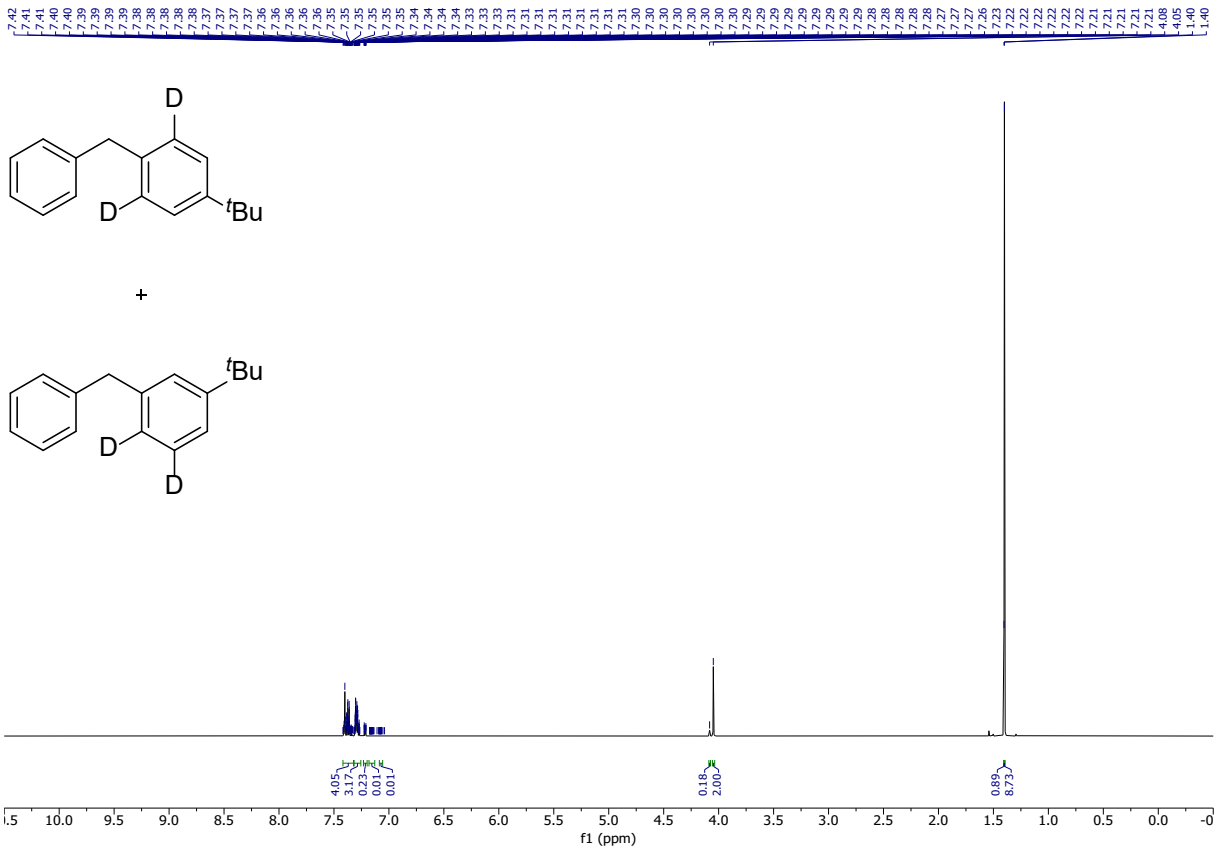


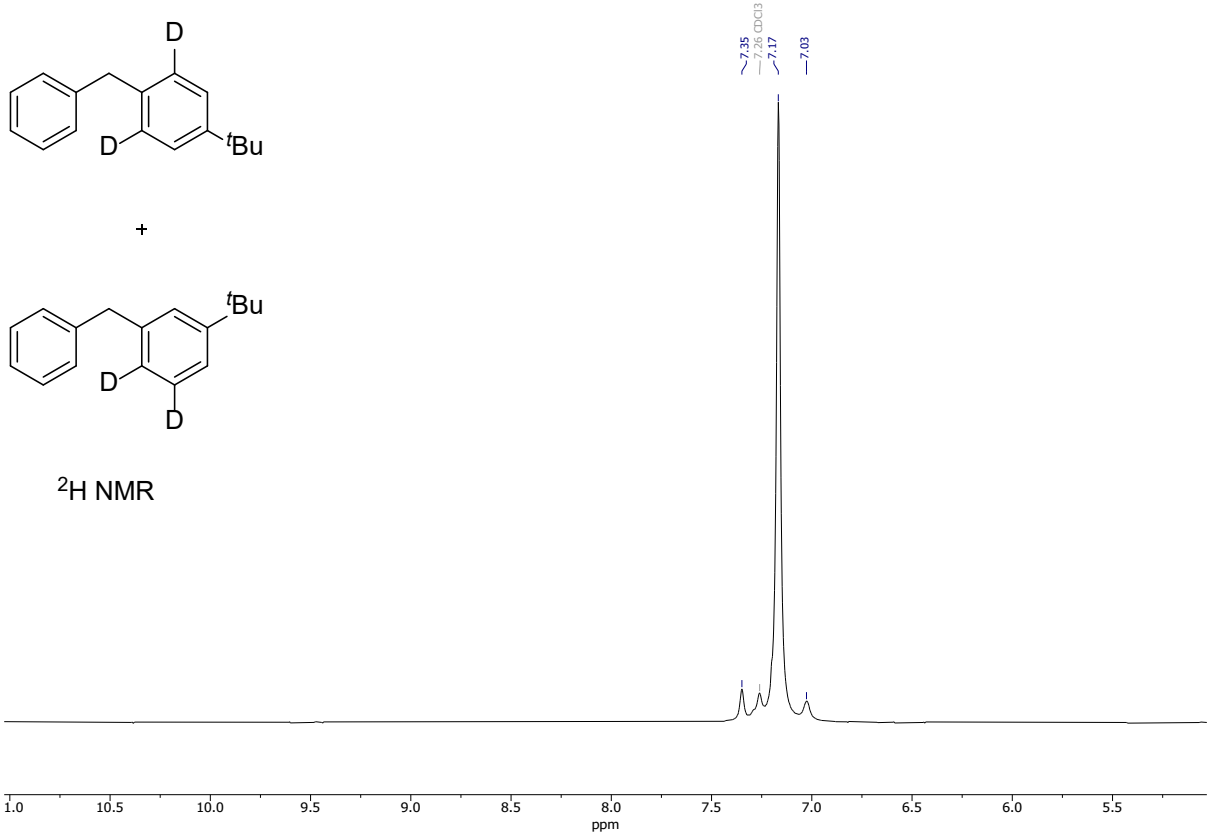

Me
CF3
145.54
145.53
145.51
145.50
140.06
138.46
129.86
129.32
128.70
128.56
127.38
126.12
125.86
125.57
125.53
125.50
125.46
123.16
120.46
77.16 CDCl3
41.81
21.50
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Me
CF3
-62.26
50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -25
f1 (ppm)

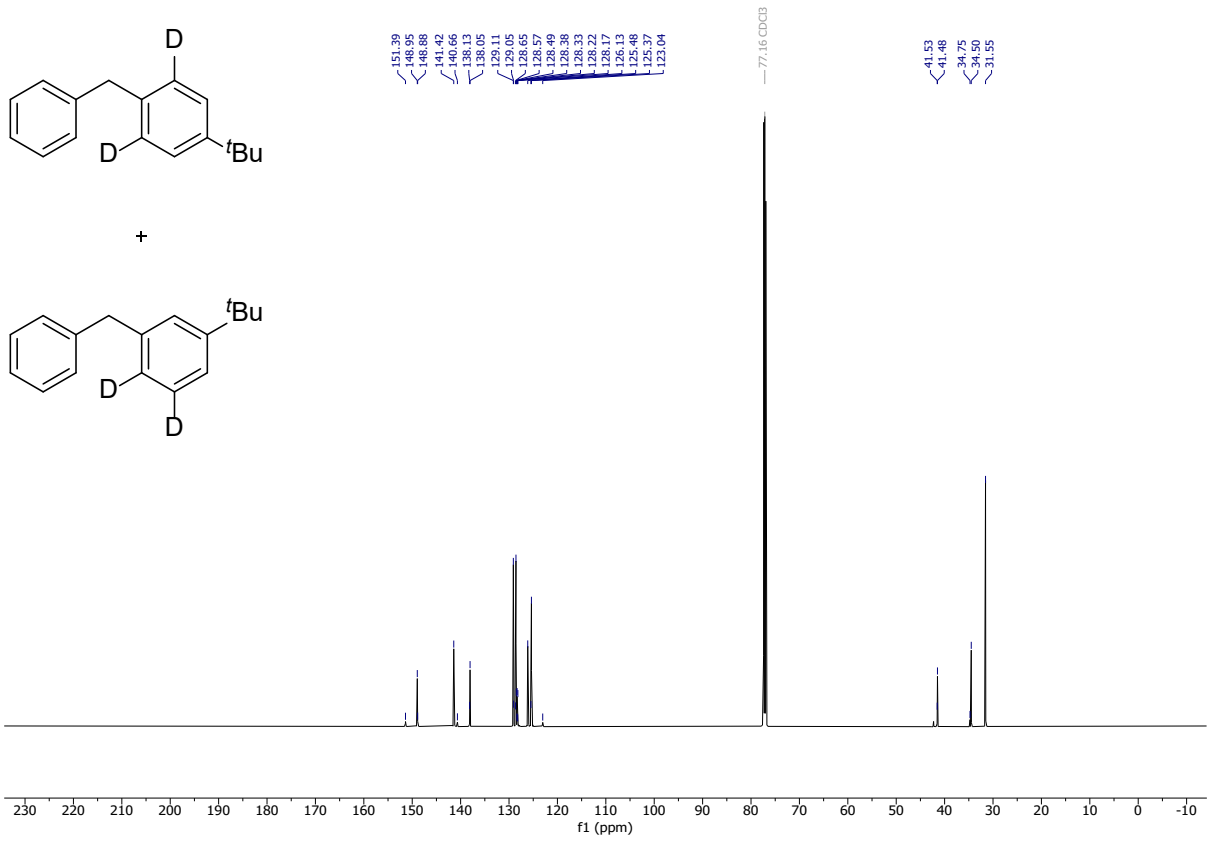

F
4d (spiking experiment)
2.05
5.12
2.00
0.12
2.00
ppm


F
4d (spiking experiment)
-113.46
-117.31
5.81
94.19
ppm


D
D
tBu
+
tBu
D
D
4.05
3.17
0.23
0.01
0.01
0.18
2.00
0.89
8.73
f1 (ppm)


D
D
tBu
+
tBu
D
D
7.35
7.26 CDCl3
7.17
7.03
ppm

^{2}H NMR


D
D
tBu
+
tBu
D
D
151.39
148.95
148.88
141.42
140.66
138.13
138.05
129.11
129.05
128.65
128.57
128.49
128.38
128.33
128.22
128.17
126.13
125.48
125.37
123.04
77.16 CDCl3
41.53
41.48
34.75
34.50
31.55
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

9. References

1. X.-C. Wang, W. Gong, L.-Z. Fang, R.-Y. Zhu, S. Li, K. M. Engle and J.-Q. Yu, *Nature*, 2015, **519**, 334-338.
2. S. Kim, J. W. Ginsbach, J. Y. Lee, R. L. Peterson, J. J. Liu, M. A. Siegler, A. A. Sarjeant, E. I. Solomon and K. D. Karlin, *J. Am. Chem. Soc.*, 2015, **137**, 2867-2874.
3. M. Winters, J. B. DuHadaway, K. N. Pham, A. Lewis-Ballester, S. Badir, J. Wai, E. Sheikh, S. R. Yeh, G. C. Prendergast, A. J. Muller and W. P. Malachowski, *Eur. J. Med. Chem.*, 2019, **162**, 455-464.
4. D.-M. Yan, Q.-Q. Zhao, L. Rao, J.-R. Chen and W.-J. Xiao, *Chem. Eur. J.*, 2018, **24**, 16895-16901.
5. T. Mohy El Dine, W. Erb, Y. Berhault, J. Rouden and J. Blanchet, *J. Org. Chem.*, 2015, **80**, 4532-4544.
6. G.-Q. Hu, J.-W. Bai, E.-C. Li, K.-H. Liu, F.-F. Sheng and H.-H. Zhang, *Org. Lett.*, 2021, **23**, 1554-1560.
7. M. A. Tandiary, Y. Masui and M. Onaka, *Tetrahedron Lett.*, 2014, **55**, 4160-4162.
8. G. Toupalas, G. Thomann, L. Schlemper, M. A. Rivero-Crespo, H. L. Schmitt and B. Morandi, *ACS Catal.*, 2022, **12**, 8147-8154.
9. J. R. Schmink and N. E. Leadbeater, *Org. Lett.*, 2009, **11**, 2575-2578.
10. T. He, H. F. T. Klare and M. Oestreich, *ACS Catal.*, 2021, **11**, 12186-12193.
11. X. Li, Y. Feng, L. Lin and G. Zou, *J. Org. Chem.*, 2012, **77**, 10991-10995.
12. Z. Guan, B. Li, G. Hai, X. Yang, T. Li and B. Tan, *RSC Adv.*, 2014, **4**, 36437-36443.
13. P. Maity, D. M. Shacklady-McAtee, G. P. A. Yap, E. R. Sirianni and M. P. Watson, *J. Am. Chem. Soc.*, 2013, **135**, 280-285.
14. D. R. Willcox, G. S. Nichol and S. P. Thomas, *ACS Catal.*, 2021, **11**, 3190-3197.
15. G. Wu, S. Xu, Y. Deng, C. Wu, X. Zhao, W. Ji, Y. Zhang and J. Wang, *Tetrahedron*, 2016, **72**, 8022-8030.
16. Y.-Y. Sun, J. Yi, X. Lu, Z.-Q. Zhang, B. Xiao and Y. Fu, *Chem. Commun.*, 2014, **50**, 11060-11062.
17. J. Zhu, M. Pérez, C. B. Caputo and D. W. Stephan, *Angew. Chem. Int. Ed.*, 2016, **55**, 1417-1421.
18. H.-S. Jung and S.-H. Kim, *Synlett*, 2015, **26**, 666-670.
19. P. Zhang, J. Xu, Y. Gao, X. Li, G. Tang and Y. Zhao, *Synlett*, 2014, **25**, 2928-2932.
20. J. C. Tellis, D. N. Primer and G. A. Molander, *Science*, 2014, **345**, 433-436.
21. J. Zhu, M. Pérez and D. W. Stephan, *Angew. Chem. Int. Ed.*, 2016, **55**, 8448-8451.
22. Y. Makida, Y. Matsumoto and R. Kuwano, *Synlett*, 2017, **28**, 2573-2576.
23. T. Wang, J. Guo, X. Wang, H. Guo, D. Jia, H. Wang and L. Liu, *RSC Adv.*, 2019, **9**, 5738-5741.
24. N. Henry, C. Enguehard-Gueiffier, I. Thery and A. Gueiffier, *Eur. J. Org. Chem.*, 2008, **2008**, 4824-4827.
25. J. Tang, L. Lv, X.-J. Dai, C.-C. Li, L. Li and C.-J. Li, *Chem. Commun.*, 2018, **54**, 1750-1753.
26. J. Barluenga, M. Tomás-Gamasa, F. Aznar and C. Valdés, *Nat. Chem.*, 2009, **1**, 494-499.