Supporting Information for:

Nucleophilic strategies to construct –CF_2– linkages using borazine-CF_2Ar reagents

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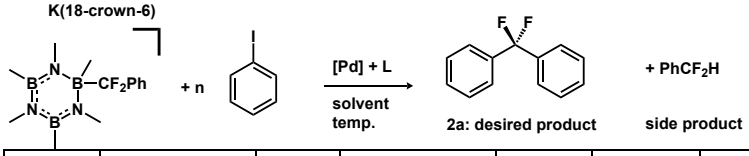
General Considerations:

Hexamethylborazine $-CF_2Ph$ **1a**; $[Me_6B_3N_3CF_2Ph]K(18\text{-c-}6)$[1] was made using previously described methods. THF was purified using a Glass Contour solvent purification system through percolation through a Cu catalyst, molecular sieves, and alumina and finally stored over activated molecular sieves for a minimum of 48 hours. (Trifluoromethoxy)benzene [$PhOCF_3$] and liquid aryl halides were dried over calcium hydride, distilled and freeze-pump-thawed. Liquid alkyl halides were dried over $MgSO_4$, distilled and freeze-pump-thawed. Low-boiling aryl halides (4-iodotoluene, 4-iodoanisole, 4-chloro-1-iodobenzene) and 4-nitrobenzotrifluoride were sublimed at 50 °C and dried under vacuum at 25 °C before further use. Toluene was dried over sodium metal, then distilled and freeze-pump-thawed. All other reagents were used from commercial sources without further purification. Unless otherwise noted, all manipulations were performed under an inert nitrogen atmosphere.

NMR spectra were recorded on a Varian Vnmrs 700, Varian Vnmrs 500, Varian MR400, Bruker Advance Neo 500 spectrometer, or Bruker Advance Neo 500 spectrometer. ^1H, ^{13}C and ^{19}F shifts are reported in parts per million (ppm) relative to TMS, with the residual solvent peak used as an internal reference. ^{19}F NMR spectra are referenced to (trifluoromethoxy)benzene or, in spectra lacking internal standard, on a unified scale, where the single primary reference is the frequency of the residual solvent peak in the ^1H NMR spectrum. Peaks not listed in the peak assignment correspond to residual solvent. Multiplicities are reported as follows: singlet (s), doublet (d), triplet (t), double triplet (dt), triple doublet (td), quartet (q), pentet (p), septet (sp), and multiplet (m). Mass spectra were obtained on an electrospray a Micromass AutoSpec Ultima Magnetic Sector Mass Spectrometer electron ionization mass spectrometer, Shimadzu QP-2010 GCMS, Agilent 1290 Infinity II UPLC with Agilent 6230 LC/TOF for ESI or an Agilent GC 8860 with an Agilent mass spectrometer 5977B GC/MSD. NMR spectra were processed using MestReNova version 14.1.1. For the purpose of labeling atoms for spectral assignments, hydrogen atoms are labeled $H_{a\text{-}z}$ and carbon atoms are labeled with numbers $C_{a\text{-}z}$. In spectra of *in-situ* reactions, (trifluoromethoxy)benzene (internal standard) appears at -57.61 ppm.

Several compounds (**4g** and **4l**) were found to be unstable to column chromatography using silica gel and thus, only in situ yields were reported for these compounds. Where appropriate, we include NMR spectra acquired before and after subjection to silica gel to illustrate these changes.

Table S1. Reaction Optimization for sp^2-sp^3 Coupling



Entry	Catalyst	mol %	Ligand	mol%	Temp. (°C)	Solvent	Conc. (M)	Time, (h)	PhI eq.	Yield %
1*	$Pd(PPh_3)_4$	10	-	-	50	THF	0.2	20	1	36
2*	$Pd(PPh_3)_4$	10	P(*o*-tol)$_3$	15	50	THF	0.2	20	1	36
3*	$Pd(PPh_3)_4$	10	DPEphos	10	50	THF	0.2	20	1	42
4*	$Pd(PPh_3)_4$	10	PAd_2Bu	15	50	THF	0.2	20	1	32
5*	$Pd(PPh_3)_4$	10	SPhos	15	50	THF	0.2	20	1	34
6*	$Pd(OAc)_2$	10	-	-	50	THF	0.2	20	1	0
7*	$Pd(OAc)_2$	10	P(*o*-tol)$_3$	15	50	THF	0.2	20	1	0
8*	$Pd(OAc)_2$	10	DPEphos	10	50	THF	0.2	20	1	22
9*	$Pd(OAc)_2$	10	PAd_2Bu	15	50	THF	0.2	20	1	15
10*	$Pd(OAc)_2$	10	SPhos	15	50	THF	0.2	20	1	3
11*	$Pd_2(dba)_3$	4.5	-	-	50	THF	0.2	20	1	0.2
12*	$Pd_2(dba)_3$	4.5	P(*o*-tol)$_3$	15	50	THF	0.2	20	1	0.2
13*	$Pd_2(dba)_3$	4.5	DPEphos	10	50	THF	0.2	20	1	10
14*	$Pd_2(dba)_3$	4.5	PAd_2Bu	15	50	THF	0.2	20	1	0.4
15*	$Pd_2(dba)_3$	4.5	SPhos	15	50	THF	0.2	20	1	0.7
16	$Pd(PPh_3)_4$	10	-	-	50	THF	0.2	20	1.03	35
17	$Pd(PPh_3)_4$	10	-	-	50	THF	0.1	20	1.03	51
18	$Pd(PPh_3)_4$	10	-	-	50	THF	0.05	20	1.03	63
19	$Pd(PPh_3)_4$	10	-	-	50	THF	0.02	20	1.03	60
20	$Pd(OAc)_2$	10	PAd_2Bu	10	50	THF	0.02	20	1	31
21	$Pd(OAc)_2$	10	PAd_2Bu	20	50	THF	0.02	20	1	41
22	$Pd(OAc)_2$	10	PAd_2Bu	30	50	THF	0.02	20	1	37
23	$Pd(OAc)_2$	10	PAd_2Bu	40	50	THF	0.02	20	1	35
24	$Pd(OAc)_2$	10	PAd_2Bu	50	50	THF	0.02	20	1	34
25	$Pd(dba)_2$	10	PAd_2Bu	20	50	THF	0.02	20	1	4
26	$(PdallylCl)_2$	5	PAd_2Bu	20	50	THF	0.02	20	1	10
27	$(IrCODCl)_2$	5	PAd_2Bu	20	50	THF	0.02	20	1	0
28[a]	$Pd(PPh_3)_4$	10	-	-	50	Toluene	0.02	20	1.03	96
29[a]	$Pd(PPh_3)_4$	10	-	-	50	DME	0.02	20	1.03	93
30[a]	$Pd(PPh_3)_4$	10	-	-	50	THF	0.02	20	1.03	84
31[a]	$Pd(PPh_3)_4$	10	-	-	50	Dioxane	0.02	20	1.03	91
32[a]	$Pd(PPh_3)_4$	10	-	-	50	DMSO	0.02	20	1.03	0
33[a]	$Pd(PPh_3)_4$	10	-	-	50	DMF	0.02	20	1.03	64
34[a]	$Pd(PPh_3)_4$	10	-	-	50	Anisole	0.02	20	1.03	90
35[b]	$Pd(PPh_3)_4$	10	-	-	50	DME	0.02	20	1.03	80
36[b]	$Pd(PPh_3)_4$	10	-	-	50	DME	0.02	20	1.03	79
37[b]	$Pd(PPh_3)_4$	10	-	-	50	DME	0.02	20	1.03	82
38	$Pd(PPh_3)_4$	5	-	-	50	DME	0.02	20	1.03	65
39	$Pd(PPh_3)_4$	2	-	-	50	DME	0.02	20	1.03	3
40	$Pd(PPh_3)_4$	1	-	-	50	DME	0.02	20	1.03	0.4
41	$Pd(PPh_3)_4$	5	-	-	50	Toluene	0.02	20	1.03	68
42	$Pd(PPh_3)_4$	5	-	-	50	DME	0.02	20	1.03	69
43	$Pd(PPh_3)_4$	5	-	-	50	THF	0.02	20	1.03	54
44	$Pd(PPh_3)_4$	5	-	-	50	Dioxane	0.02	20	1.03	72
45	$Pd(PPh_3)_4$	5	-	-	50	Anisole	0.02	20	1.03	60
46	$Pd(PPh_3)_4$	5	-	-	50	DME	0.02	20	1	55

47	$Pd(PPh_3)_4$	5	-	-	50	DME	0.02	20	1.2	66
48	$Pd(PPh_3)_4$	5	-	-	50	DME	0.02	20	1.5	57
49	$Pd(PPh_3)_4$	5	-	-	50	DME	0.02	20	2	48
50	$Pd(PPh_3)_4$	5	-	-	50	DME	0.02	20	3	28
51*	$Pd(PPh_3)_4$	5	-	-	50	Toluene	0.02	18	1.2	72
52*	$Pd(PPh_3)_4$	5	-	-	25	Toluene	0.02	18	1.2	70
53*	$Pd(PPh_3)_4$	5	-	-	25	Toluene	0.02	16	1.2	64
54*	none	-	-	-	25	Toluene	0.02	16	1.2	0

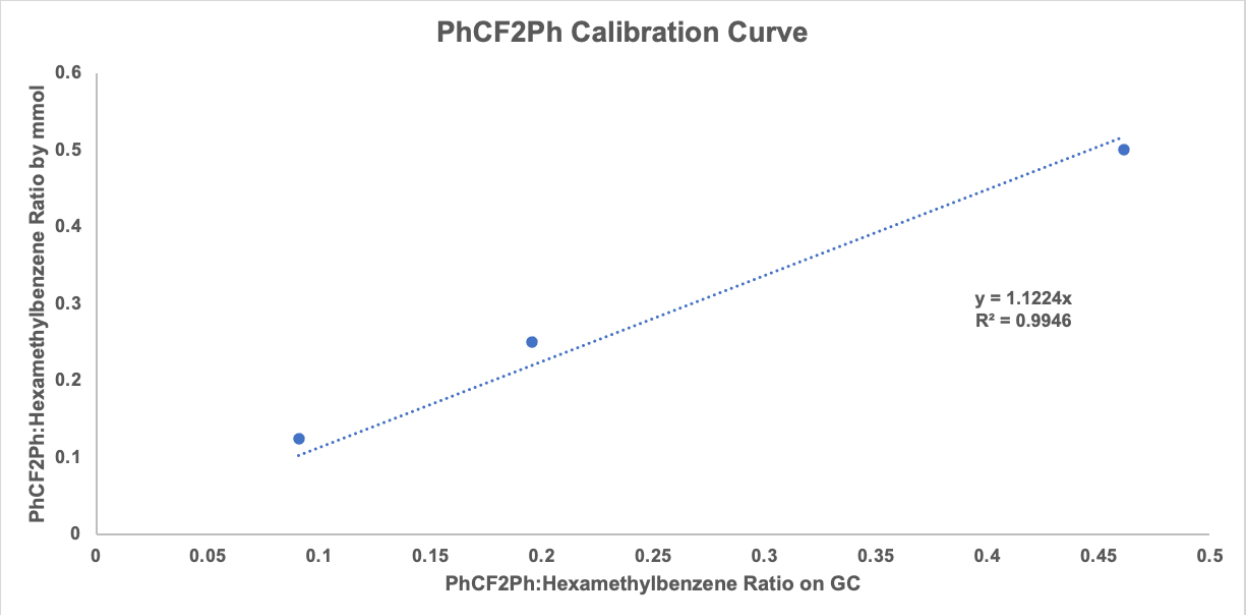
General Method: Catalyst was allowed to mix with ligand and then phenyl iodide at room temperature. **1a** and internal standard were added and the reaction was stirred (1000 rpm) in 0.5 mL of solvent in a 8 mL scintillation vial at 50 °C or 25 °C overnight. Yields were determined by GCFID with hexamethylbenzene (HMB) as internal standard, unless indicated with *, where $PhOCF_3$ as internal standard and yields were determined by ^{19}F NMR.

[a]Yields are slightly inflated due to addition of internal standard by weigh paper in the glovebox.

[b]Reaction was performed in triplicate in order to determine reproducibility.

Blue vs. black entries annotate different batches of reactions set up.
$Pd_2(dba)_3$ chloroform adduct was used

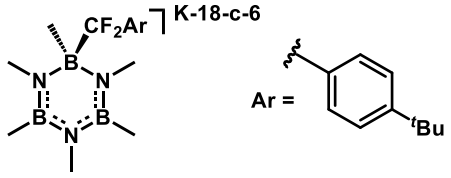
Figure S2. GCFID Calibration Curve for 2a Versus Hexamethylbenzene



2a (mmol)	HMB (mmol)	2a area	HMB area	GC ratio (2a:HMB)	mmol ratio (2a:HMB)
0.0252	0.0504	735629	1594670	0.461	0.500
0.0126	0.0504	353642	1807428	0.196	0.250
0.0063	0.0504	155019	1703266	0.091	0.125

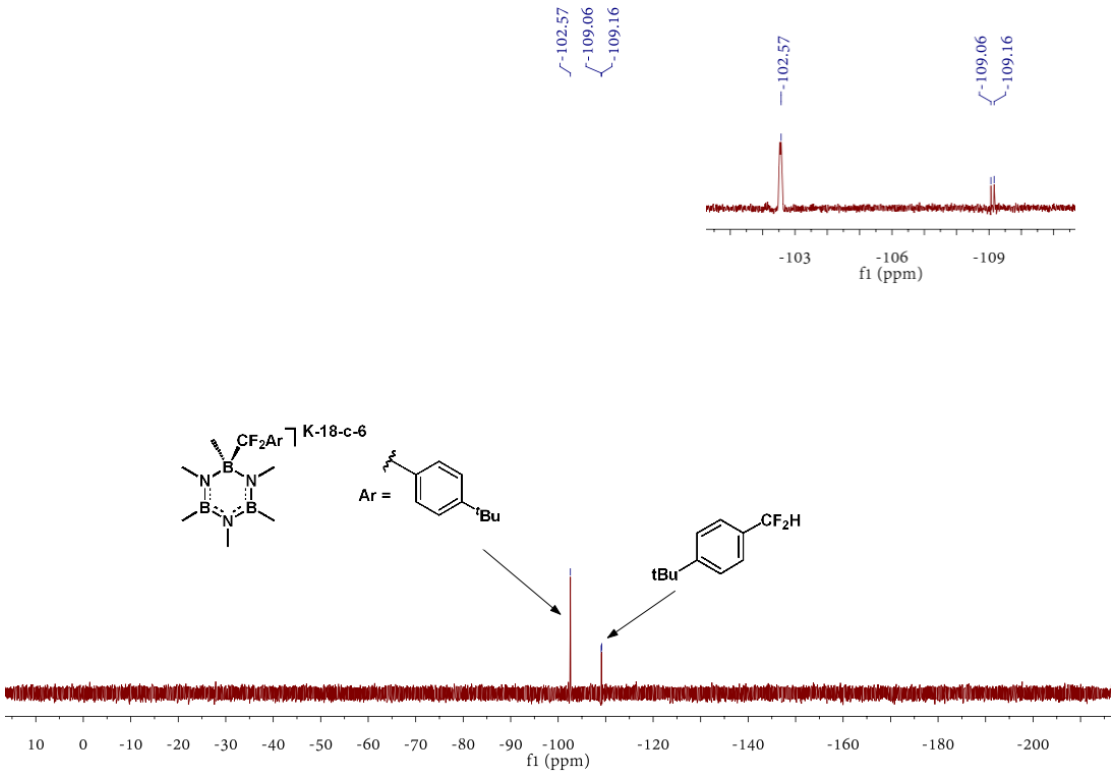
Synthesis of New Hexamethylborazine-CF_2Ar Reagents (1b-1c)

Synthesis of 1b Hexamethylborazine-CF_2(*p*-^{t}Bu-Ph) K(18-crown-6)

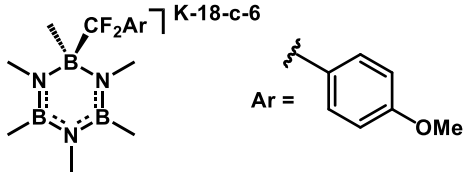


18-crown-6 (2.99 g, 11.3 mmol) and hexamethylborazine (1.87 g) were dissolved in 45 mL THF and cooled to –78 °C in a cold trap with stirring for 30 min. Solid benzyl potassium (1.48 g, 11.4 mmol) was gradually added to the solution. 5 mL THF was used to wash the vial used for weighing benzyl potassium and the solution was combined. After stirring for another 10 min, 1-(*tert*-butyl)-4-(difluoromethyl)benzene (2.08 g, 11.3 mmol) was added. The mixture was taken out of the cold trap and allowed to warm to room temperature with stirring (1 h). After the reaction, THF was removed by vacuum. Fresh THF (~3 mL) was added to the paste until all the solid was fully dissolved followed by 50-100 mL of Et_2O was added to precipitate the solid product. The mixture solid product was collected by filtration and washed with Et_2O until the eluent became colorless (~100 mL). The solid was dissolved in minimal amount of THF (~3 mL) and precipitated with Et_2O. This process was repeated for 2 additional cycles to obtain a white solid. The product was dried under vacuum for ~3 h. The obtained **1b** was kept in a -30 °C freezer for further use. Isolated yield: 52%.

Figure S3. ^{19}F NMR (565 MHz, C_6D_6, 25 °C) of 1b

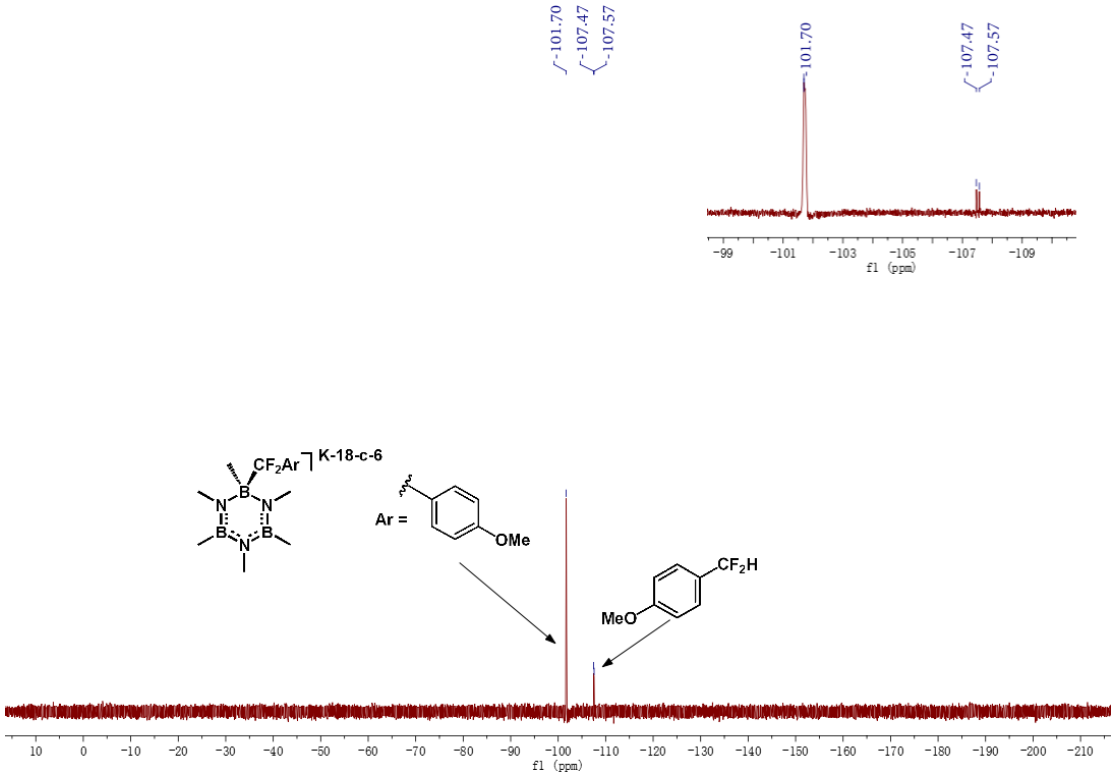


Synthesis of 1c Hexamethylborazine-CF_2(*p*-Me-Ph) K(18-crown-6)



18-crown-6 (2.99 g, 11.3 mmol) and hexamethylborazine (1.87 g) were dissolved in 45 mL THF and cooled to –78 °C in a cold trap with stirring for 30 min. Solid benzyl potassium (1.48 g, 11.4 mmol) was gradually added to the solution. 5 mL THF was used to wash the vial used for weighing benzyl potassium and the solution was combined. After stirring for another 10 min, 1-(difluoromethyl)-4-methoxybenzene (1.79 g, 11.3 mmol) was added. The mixture was taken out of the cold trap and allowed to warm to room temperature with stirring (1 h). After the reaction, THF was removed by vacuum. Fresh THF (~3 mL) was added to the paste until all the solid was fully dissolved followed by 50-100 mL of Et_2O was added to precipitate the solid product. The mixture solid product was collected by filtration and washed with Et_2O until the eluent became colorless (~100 mL). The solid was dissolved in minimal amount of THF (~3 mL) and precipitated with Et_2O. This process was repeated for 2 additional cycles to obtain a white solid. The product was dried under vacuum for ~3 h. The obtained **1c** was kept in a -30 °C freezer for further use.

Figure S4. ^{19}F NMR (565 MHz, C_6D_6, 25 °C) of 1c



Scope in sp^2-sp^3 Coupling (2a-2l)

Method A:
In a 20 mL scintillation vial charged with a magnetic stir bar, $Pd(PPh_3)_4$ (0.005 mmol) was combined with iodoarene (0.12 mmol) in 5 mL toluene. $PhOCF_3$ (0.1 mmol, 13.2 μL) was added as an inert ^{19}F NMR internal standard. $[Me_6B_3N_3CF_2Ph]K(18\text{-c-}6)$ **1a** (0.1 mmol) was added and the reaction mixture stirred (1000 rpm) for 16 hours at 25 °C.

Method A*: 0.01 mmol
Vial 1: **1a** (0.01 mmol) was directly weighed into an 8 mL scintillation vial.

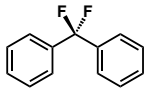
Vial 2: In a separate 20 mL scintillation vial $Pd(PPh_3)_4$ (0.004 mmol, 0.001 M) and $PhOCF_3$ (0.08 mmol, 10.6 μL, 0.02 M) were dissolved in 4 mL of toluene to generate a stock solution.

Vial 3: In a separate 20 mL vial, a 1.5 mL aliquot of vial 2 solution was allowed to mix with iodoarene (0.036 mmol, 0.024 M).

A 0.5 mL aliquot from vial 3 was transferred to vial 1, a magnetic stir bar was added and the reaction was stirred (1000 rpm) at 25 °C for 16 h. Yields were determined by ^{19}F NMR spectroscopy.

Note: Many of these compounds are volatile and their isolation required attention during rotary evaporation.

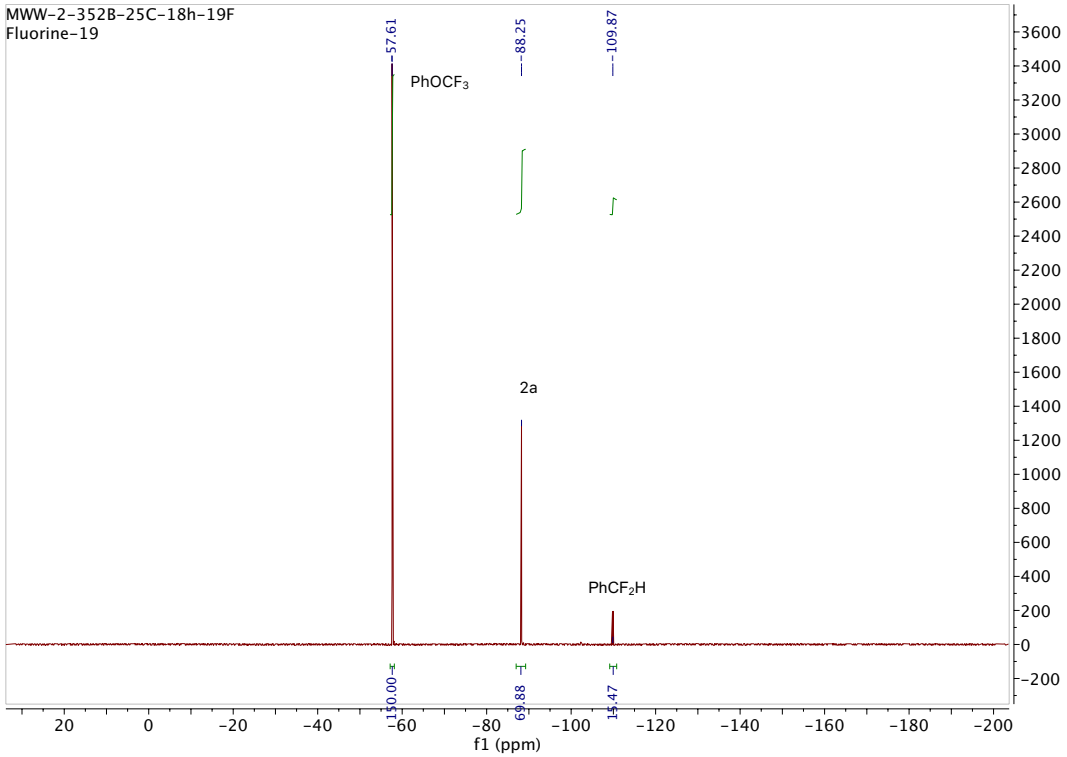
Synthesis of 2a: difluorodiphenylmethane



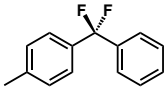
Method A* was used with **1a** (0.01 mmol, 5.8 mg) and iodobenzene (0.012 mmol). Reaction ran for 18 h. With respect to $PhOCF_3$ as ^{19}F internal standard, 70% in situ yield of **2a** was obtained. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[1]

Method A was used with **1a** (0.250 mmol, 162 mg) and iodobenzene (0.30 mmol, 33.5 µL), $Pd(PPh_3)_4$ (0.0125 mmol, 14.4 mg). Reaction ran for 16 h at 25 °C. The reaction was quenched with a saturated aqueous solution of NH_4Cl (2.0 ml). The aqueous layer was extracted with CH_2Cl_2 (8.0 ml × 3). The combined organic layers were dried over anhydrous $MgSO_4$. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (100:1), affording **2a** in 47% yield (51.4 mg) as a colorless liquid.

Figure S5. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2a in Situ Yield (70%) with Method A*



Synthesis of 2b: 1-(difluoro(phenyl)methyl)-4-methylbenzene



Method A was used with **1a** (0.101 mmol, 60.0 mg), 4-iodotoluene (0.122 mmol, 26.5 mg), $Pd(PPh_3)_4$ (0.0048 mmol, 5.6 mg). With respect to $PhOCF_3$ as ^{19}F internal standard, 84% in situ yield was obtained. The reaction mixture directly loaded onto a 100g Biotage column and eluted with 100% hexanes at the rate of 25 mL/min, 3-8 column volumes for isolation of **2b**, 17.2 mg 78% yield. After NMR analysis, **2b** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (10.0 µL). 77% purity by mass was found (compared to 17.4 mg sample).

^{1}H-NMR ($CDCl_3$): 2.38 (H_a, 3H, s), 7.22 (H_b, 2H, (d, $J_{1H\text{-}1H}$=8.1 Hz)), 7.39 (H_c, 2H, OL), 7.41 (H_d, 2H, OL), 7.42 (H_e, 1H, OL), 7.51 (H_f, 2H, (dd, $J_{1H\text{-}1H}$=6.9, 2.7 Hz)).

^{13}C-NMR: 21.41 (C_a), 121.00 (C_b, t, $J_{13C\text{-}19F}$=241.2 Hz), 125.93 (C_c, OL), 125.96 (C_d, OL), 128.48 (C_e), 129.16 (C_f), 129.90 (C_g, t, $J_{13C\text{-}19F}$=2.1 Hz), 135.00 (C_h, t, $J_{13C\text{-}19F}$=28.2 Hz), 137.99 (C_i, t, $J_{13C\text{-}19F}$=28.5 Hz), 140.04 (C_j, t, $J_{13C\text{-}19F}$=2.4 Hz).

^{19}F-NMR: -88.22.

MS EI: 218.0910 (M+).

Figure S6. ^{1}H NMR (400 MHz, $CDCl_3$, 23 °C) of 2b

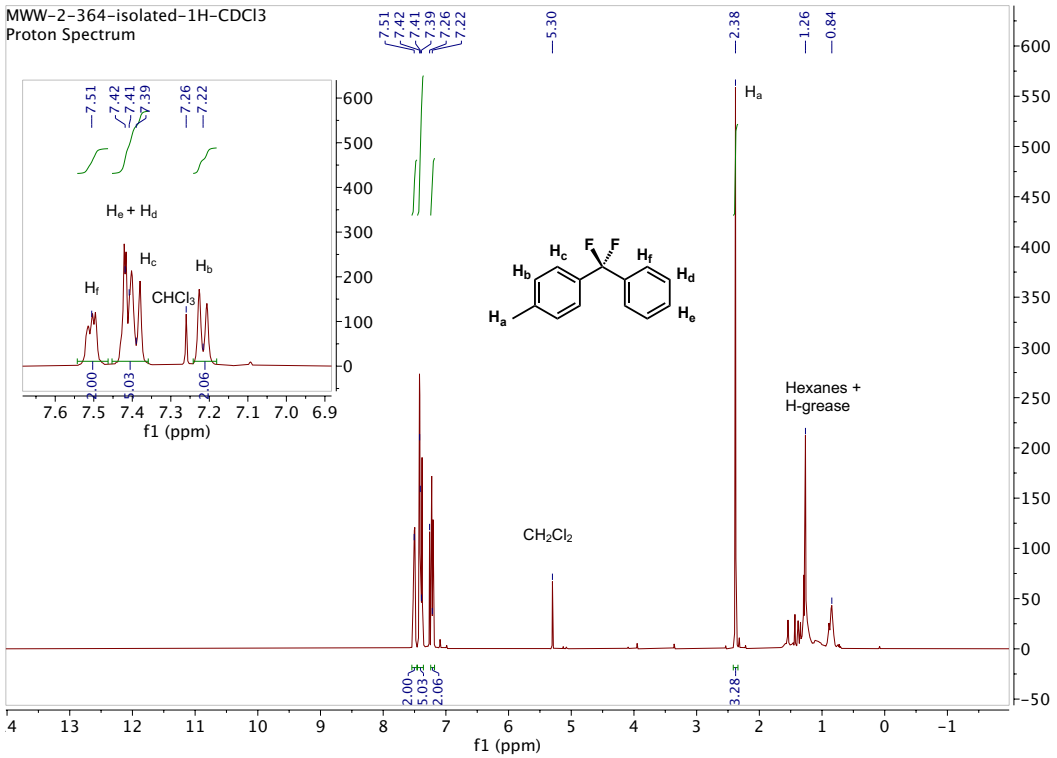


Figure S7. ^{13}C NMR (500 MHz, $CDCl_3$, 25 °C) of 2b

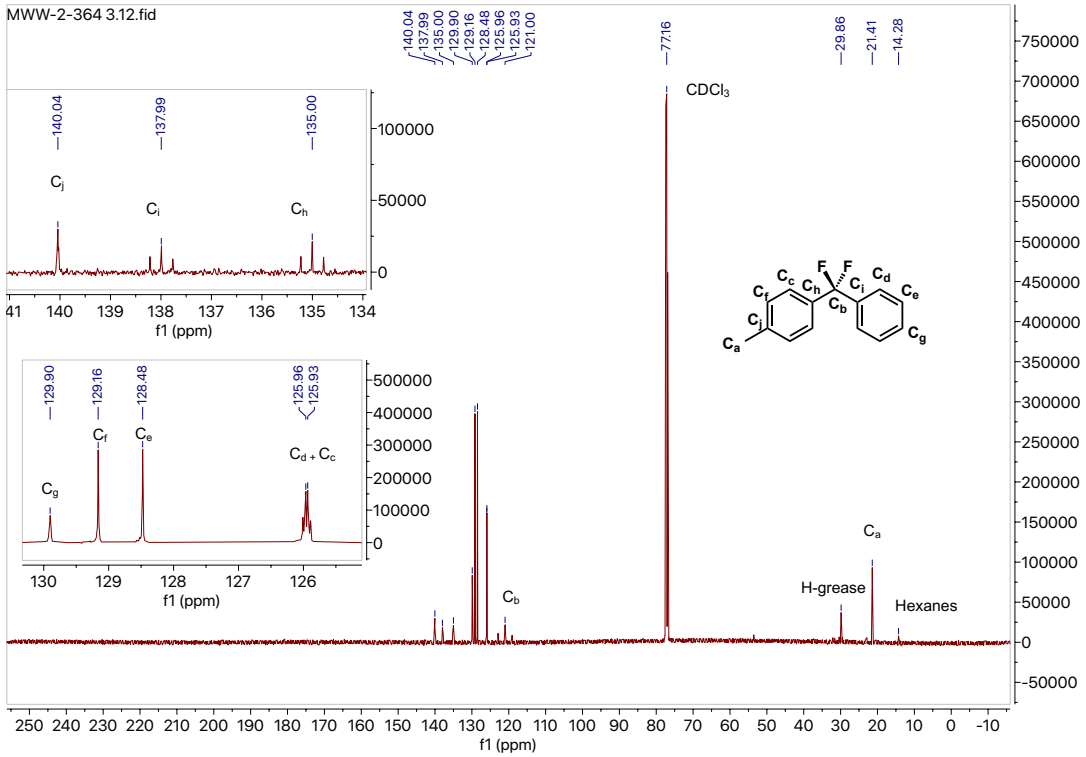


Figure S8. ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2b

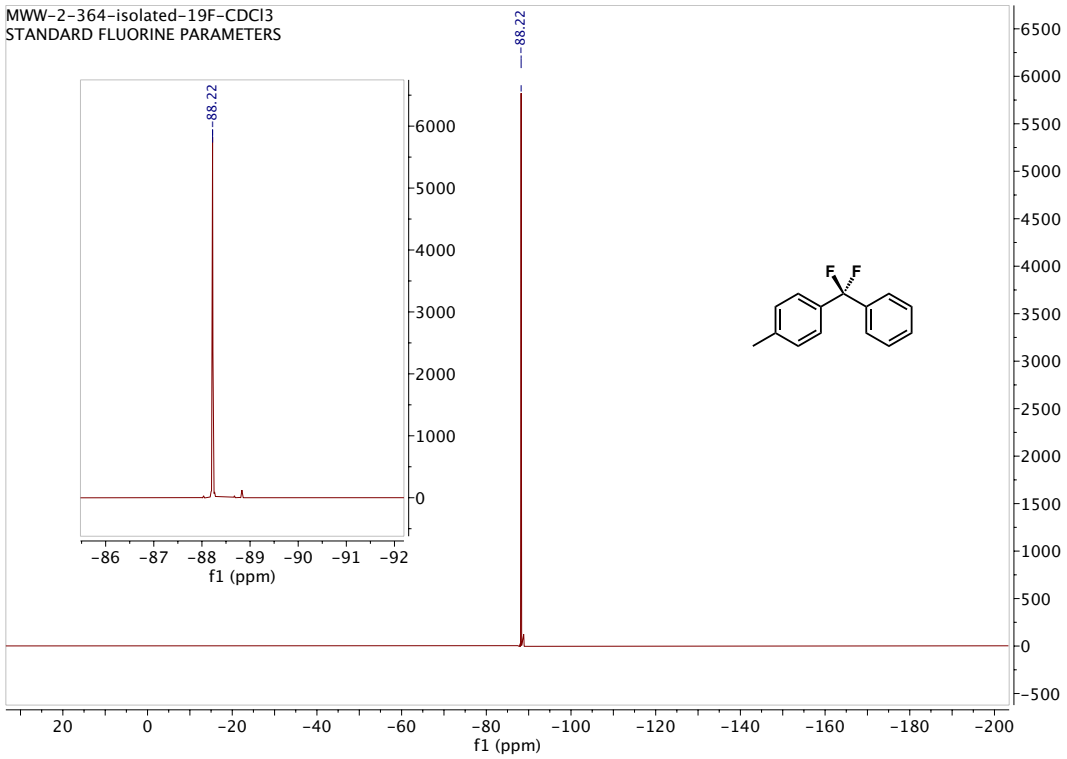


Figure S9. ^{1}H-^{1}H COSY (500 MHz, $CDCl_3$, 25 °C) of 2b

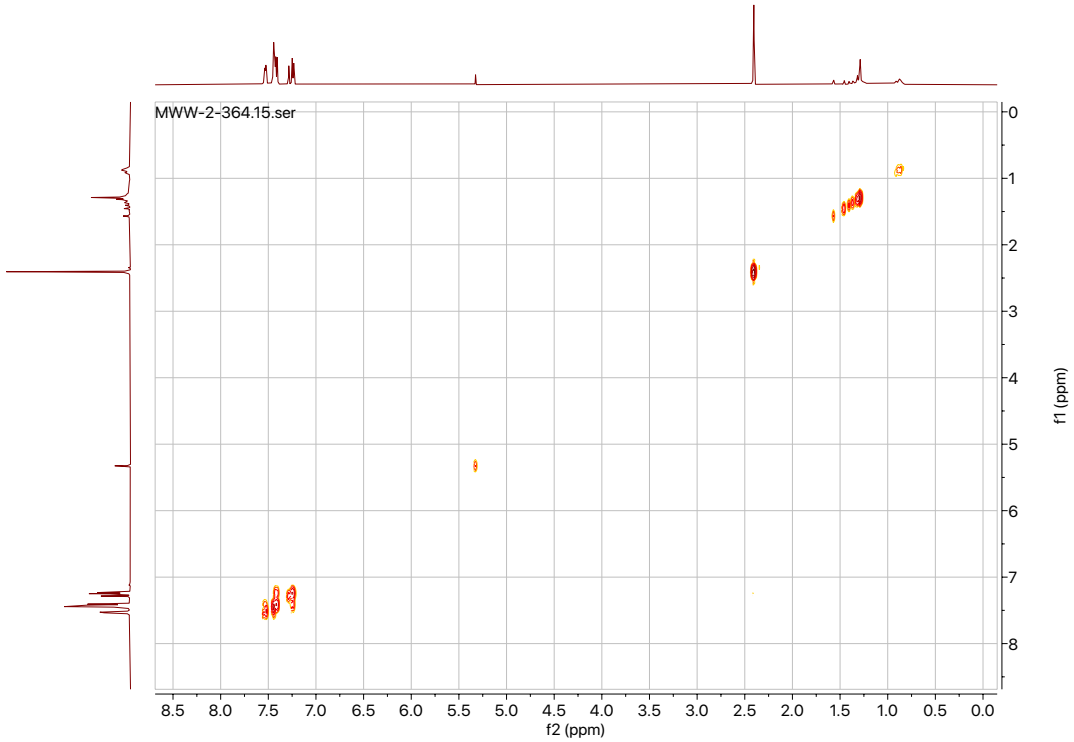


Figure S10. ^{1}H-^{13}C HSQC (500 MHz, $CDCl_3$, 25 °C) of 2b

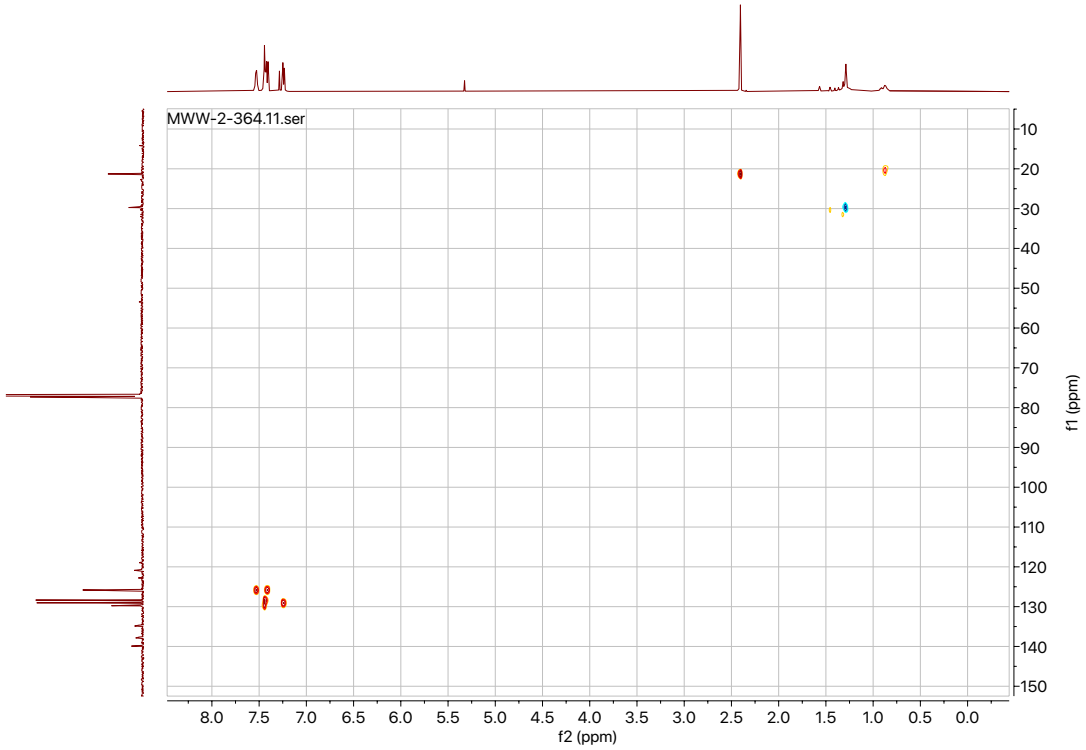


Figure S11. ^{1}H-^{13}C HMBC (500 MHz, $CDCl_3$, 25 °C) of 2b

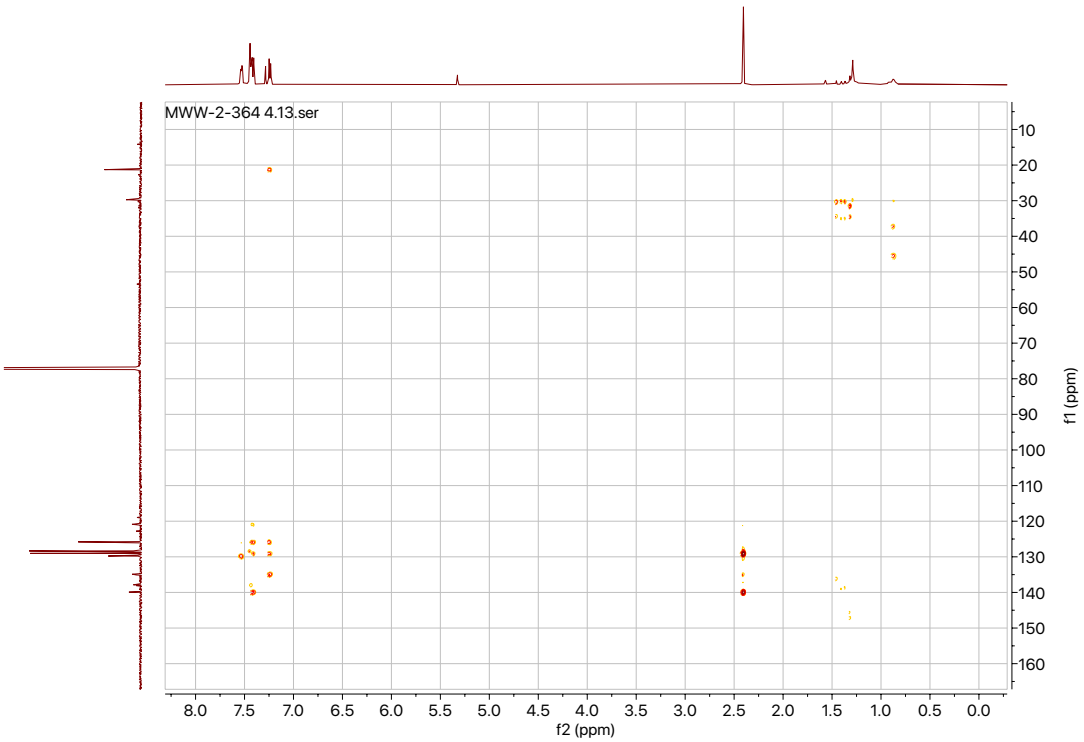


Figure S12. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2b in Situ Yield (84%) with Method A

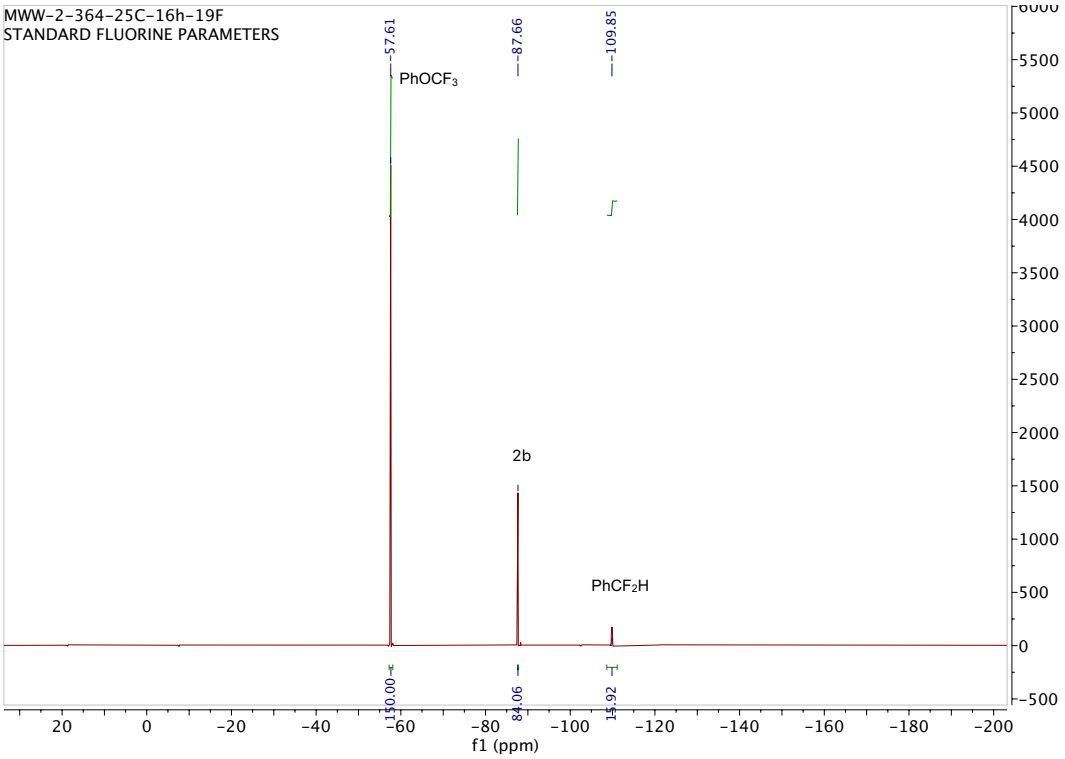
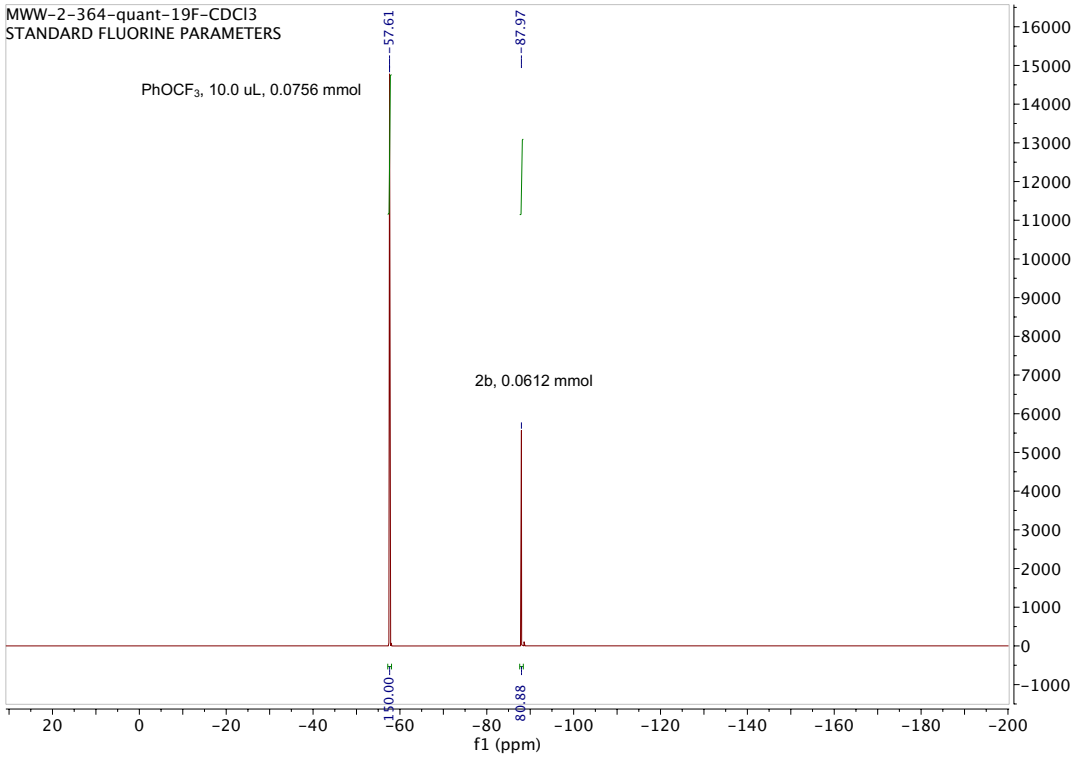
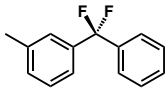


Figure S13. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2b (77% purity)



Synthesis of 2c: 1-(difluoro(phenyl)methyl)-3-methylbenzene



Method A was used with **1a** (0.101 mmol, 60.0 mg), 3-iodotoluene (0.120 mmol, 15.4 µL), $Pd(PPh_3)_4$ (0.0050 mmol, 5.8 mg). With respect to $PhOCF_3$ as ^{19}F internal standard, 70% in situ yield was obtained. The reaction mixture directly loaded onto a 100g Biotage column and eluted with 100% hexanes at the rate of 25 mL/min, 3-5 column volumes. Some of the material was subjected to a second column; (10g, 18mL/min, 3 column volumes) for isolation of **2c**, 10.8 mg 49% yield. After NMR analysis, **2c** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (10.0 µL). 83% purity by mass was found (compared to 10.7 mg sample).

^{1}H-NMR ($CDCl_3$): 2.37 (H_a, 3H, s), 7.23 (H_b, 1H, m), 7.30 (H_c, 1H, OL), 7.30 (H_d, 1H, OL), 7.32 (H_e, 1H, s), 7.41 (H_f, 2H, OL) , 7.43 (H_g, 1H, OL) 7.51 (H_h, 2H, m).

^{13}C-NMR: 21.59 (C_a), 120.89 (C_b, t, $J_{13C\text{-}19F}$=241.4 Hz), 123.06 (C_c, t, $J_{13C\text{-}19F}$=5.7 Hz), 125.95 (C_d, t, $J_{13C\text{-}19F}$=5.7 Hz), 126.48 (C_e, t, $J_{13C\text{-}19F}$=5.5 Hz), 128.42 (C_f), 128.49 (C_g), 129.93 (C_h, t, $J_{13C\text{-}19F}$=2.1 Hz), 130.72 (C_i, t, $J_{13C\text{-}19F}$=2.1 Hz), 137.74 (C_j, t, $J_{13C\text{-}19F}$=28.2 Hz), 137.94 (C_k, t, $J_{13C\text{-}19F}$=28.5 Hz), 138.35 (C_l).

^{19}F-NMR: -88.75.

MS EI: 218.0914 (M+).

Figure S14. ^{1}H NMR (400 MHz, $CDCl_3$, 23 °C) of 2c

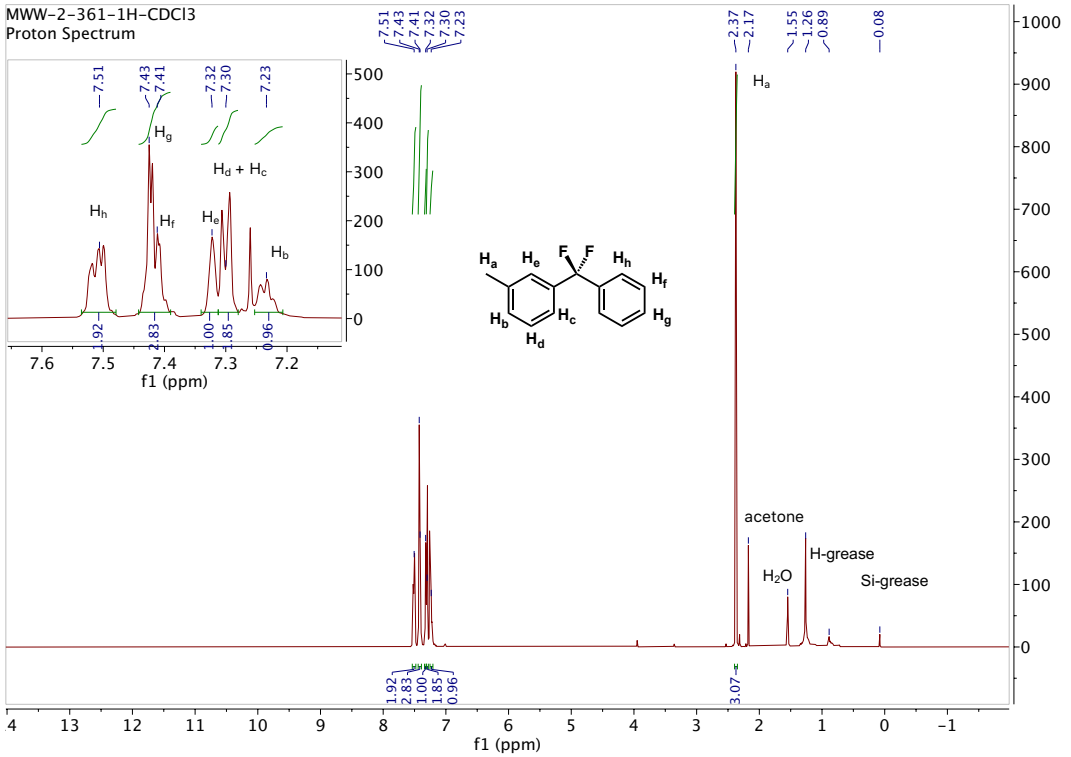


Figure S15. ^{13}C NMR (500 MHz, $CDCl_3$, 25 °C) of 2c

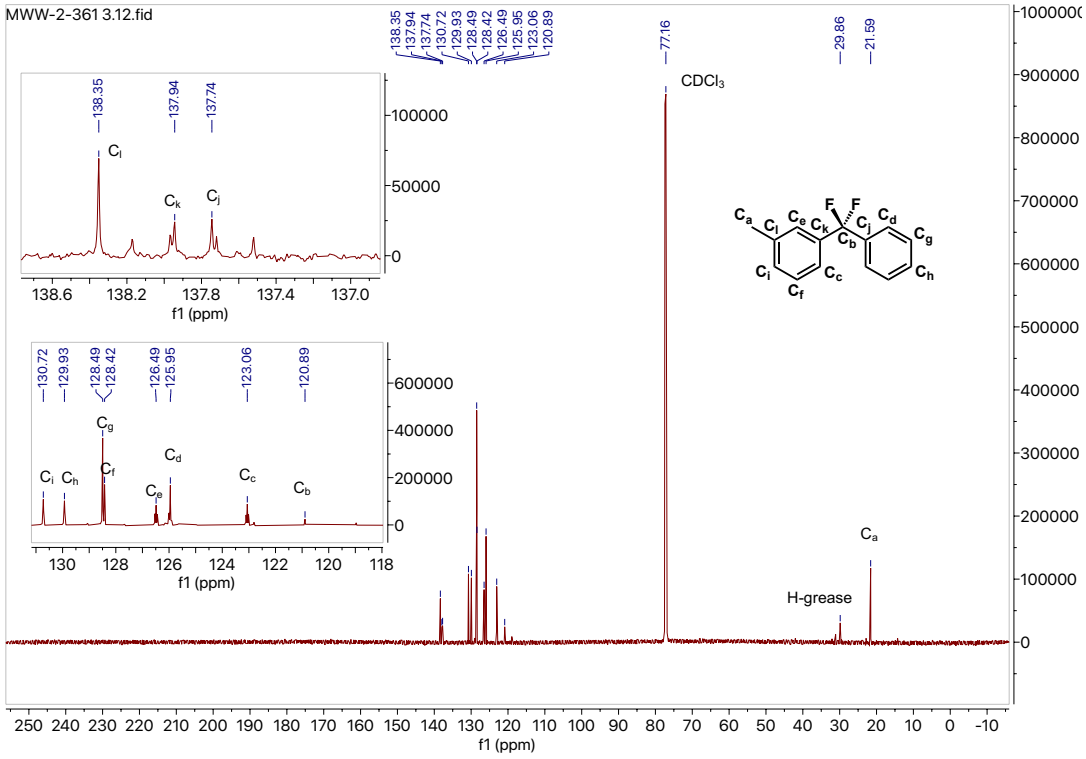


Figure S16. ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2c

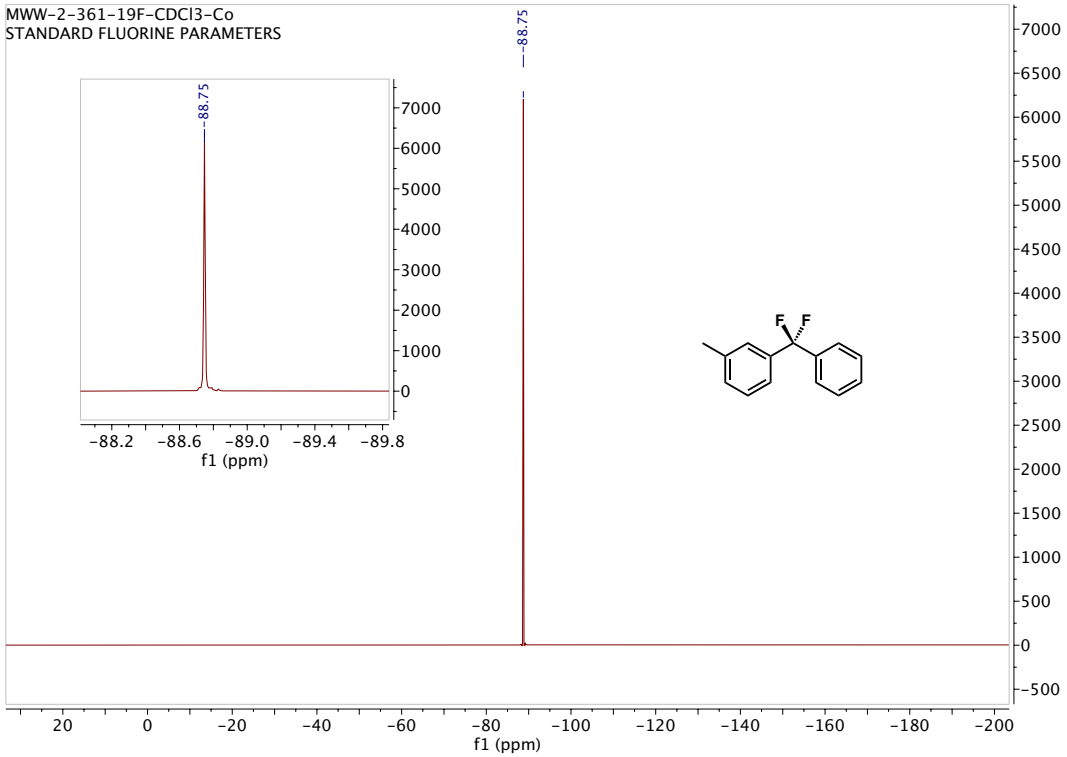


Figure S17. ^{1}H-^{1}H COSY (500 MHz, $CDCl_3$, 25 °C) of 2c

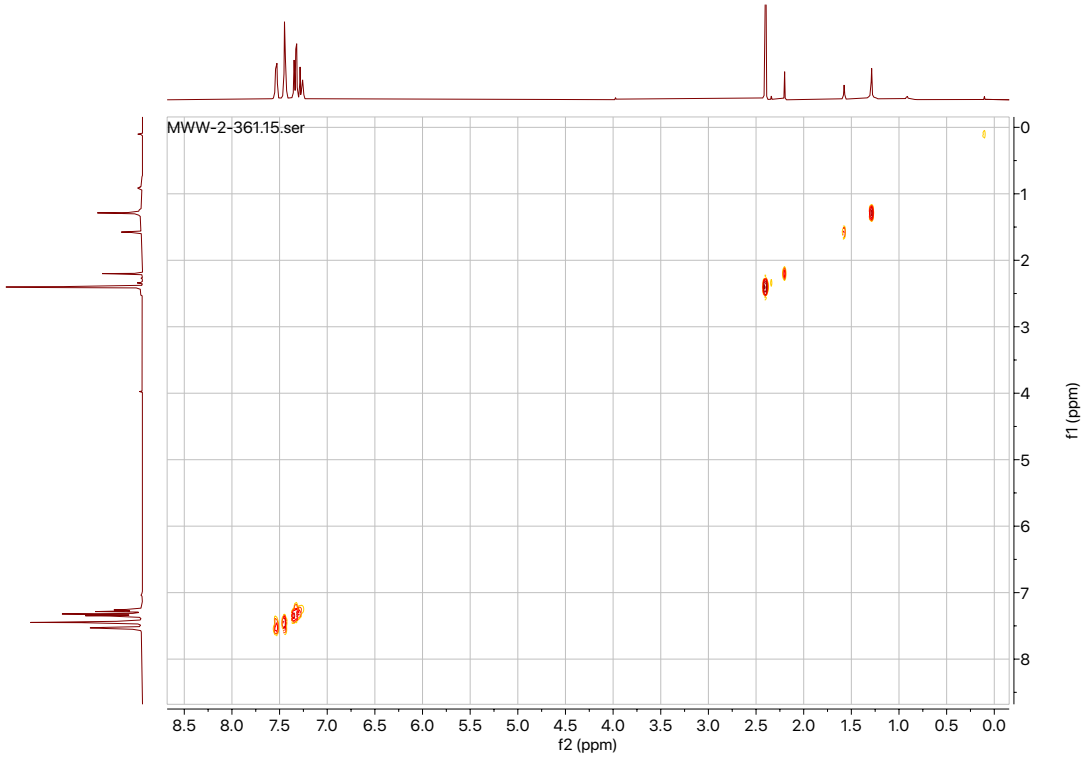


Figure S18. ^{1}H-^{13}C HSQC (500 MHz, $CDCl_3$, 25 °C) of 2c

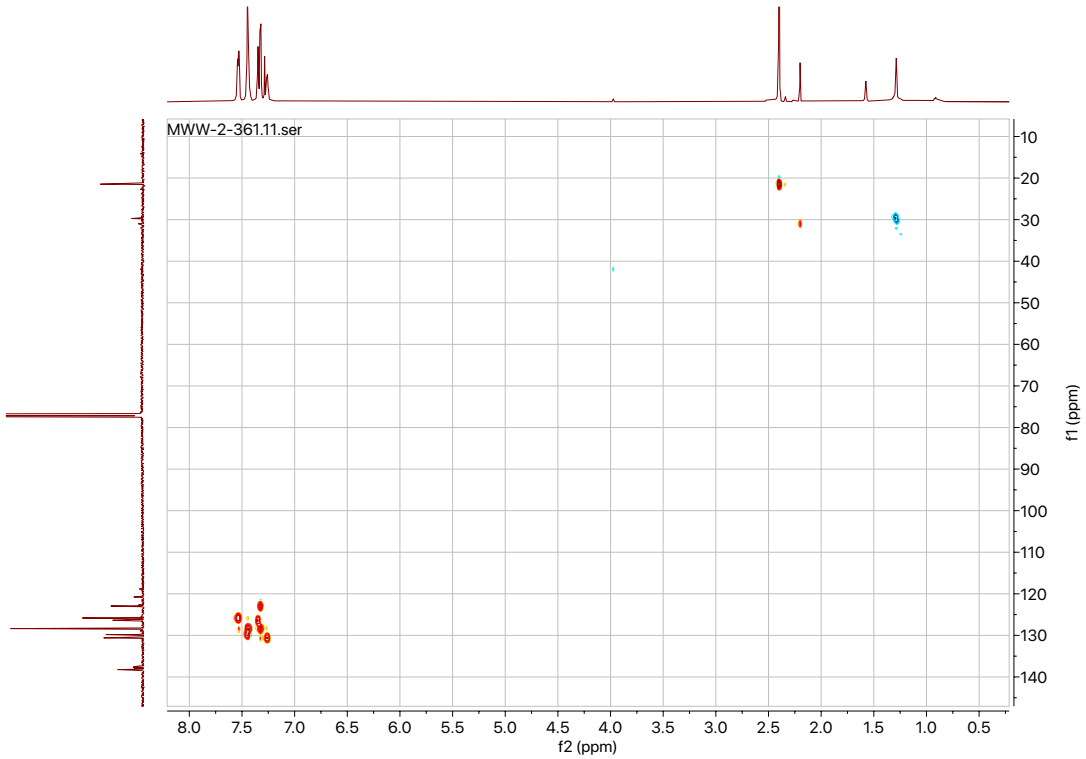


Figure S19. ^{1}H-^{13}C HMBC (500 MHz, $CDCl_3$, 25 °C) of 2c

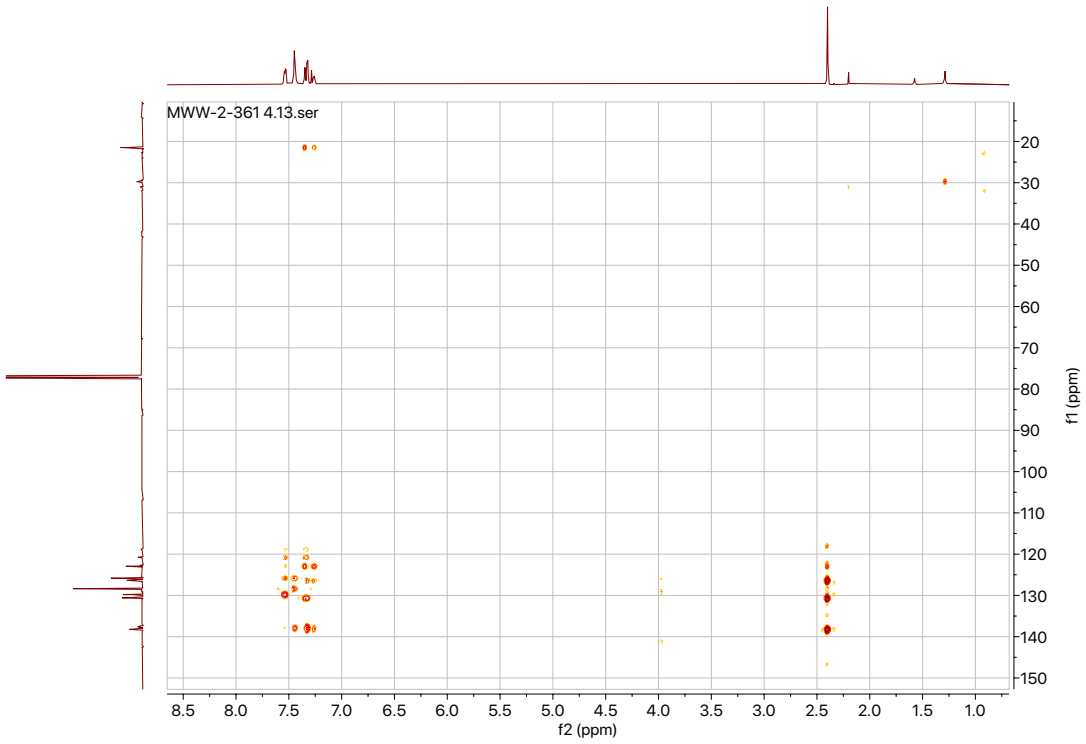


Figure S20. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2c in Situ Yield (70%) with Method A

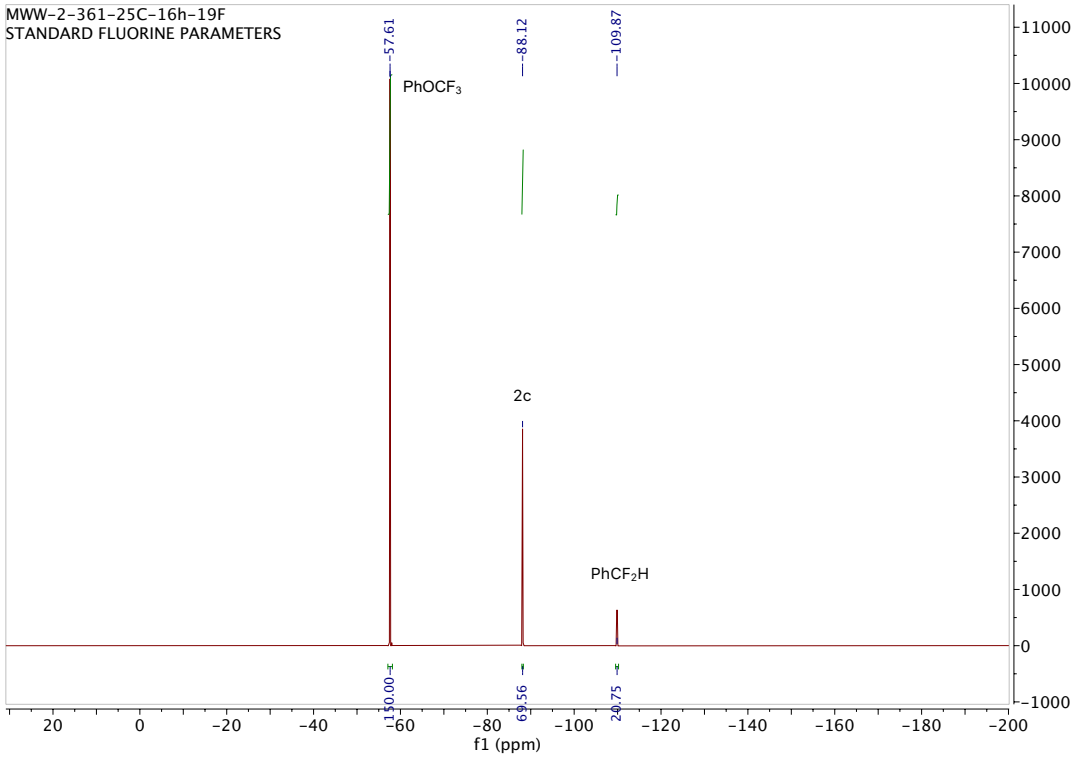
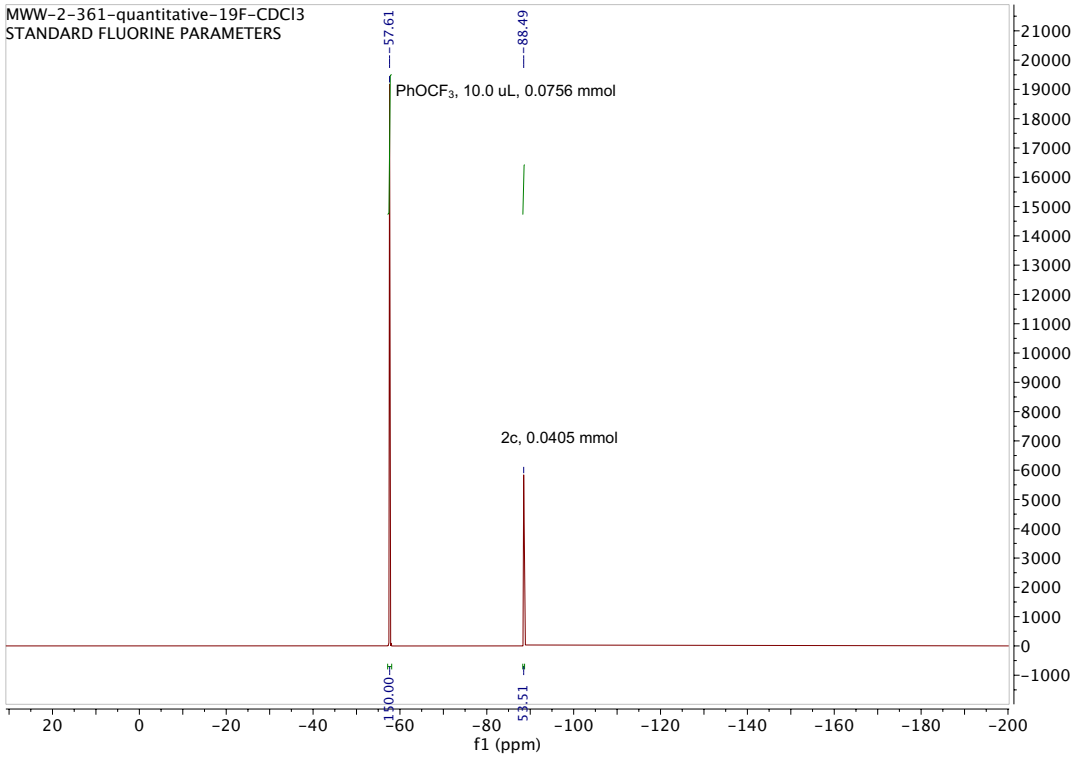
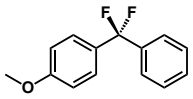


Figure S21. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2c (83% purity)



Synthesis of 2d: 1-(difluoro(phenyl)methyl)-4-methoxybenzene



Method A was used with **1a** (0.101 mmol, 59.9 mg), 4-iodoanisole (0.118 mmol, 27.7 mg), $Pd(PPh_3)_4$ (0.0050 mmol, 5.8 mg). With respect to $PhOCF_3$ as ^{19}F internal standard, 81% in situ yield was obtained. The reaction mixture directly loaded onto a 50g Biotage column and eluted with a gradient of 0-10% ethyl acetate in hexanes at the rate of 25 mL/min, 12-13 column volumes for isolation of **2d**, 10.5 mg 45% yield. After NMR analysis, **2d** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (10.0 µL). 73% purity by mass was found (compared to 11.0 mg sample).

^{1}H-NMR ($CDCl_3$): 2.83 (H_a, 3H, s), 6.91 (H_b, 2H, (d, $J_{1H\text{-}1H}$=8.9 Hz)), 7.41 (H_c, 2H, OL), 7.42 (H_d, 2H, OL), 7.42 (H_e, 1H, OL), 7.50 (H_f, 2H, (m)).

^{13}C-NMR: 55.49 (C_a), 113.79 (C_b), 121.03 (C_c, t, $J_{13C\text{-}19F}$=240.8 Hz), 126.02 (C_d, t, $J_{13C\text{-}19F}$=5.4 Hz), 127.60 (C_e, t, $J_{13C\text{-}19F}$=5.4 Hz), 128.46 (C_f), 129.90 (C_g, t, $J_{13C\text{-}19F}$=2.0 Hz), 130.14 (C_h, t, $J_{13C\text{-}19F}$=28.8 Hz), 138.01 (C_i, t, $J_{13C\text{-}19F}$=28.6 Hz), 160.81 (C_j, t, $J_{13C\text{-}19F}$=1.7 Hz).

^{19}F-NMR: -86.86.

MS EI: 234.0865 (M+).

Figure S22. ^{1}H NMR (400 MHz, $CDCl_3$, 23 °C) of 2d

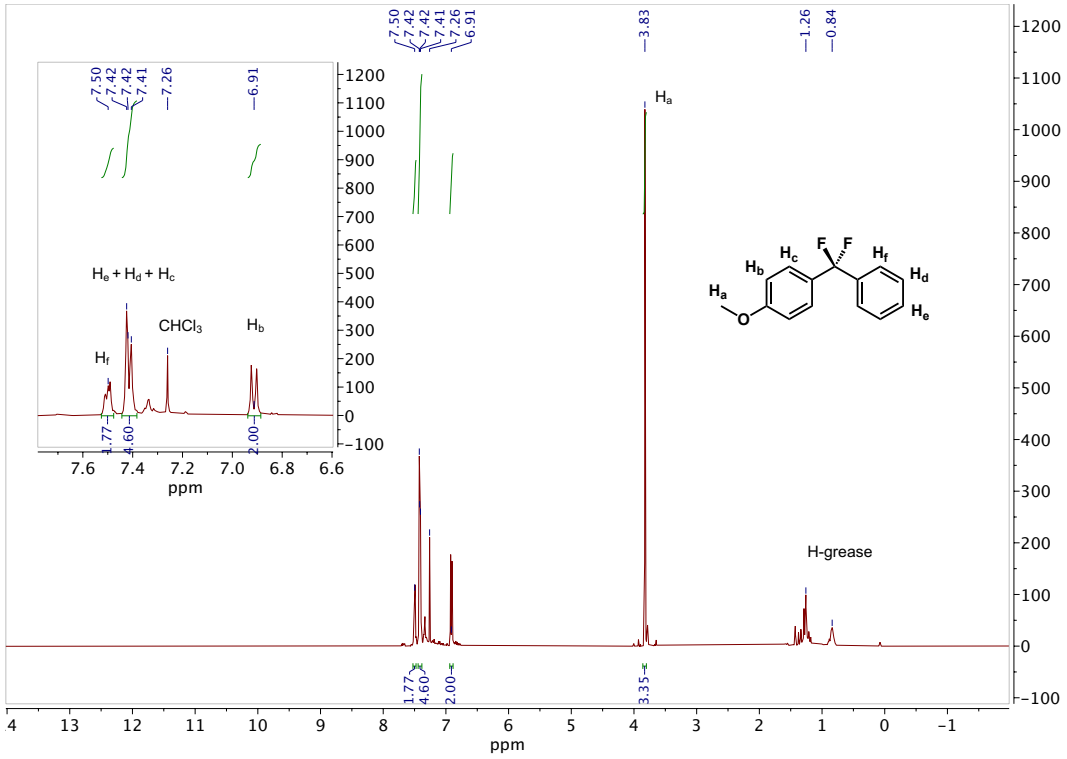


Figure S23. ^{13}C NMR (700 MHz, $CDCl_3$, 25 °C) of 2d

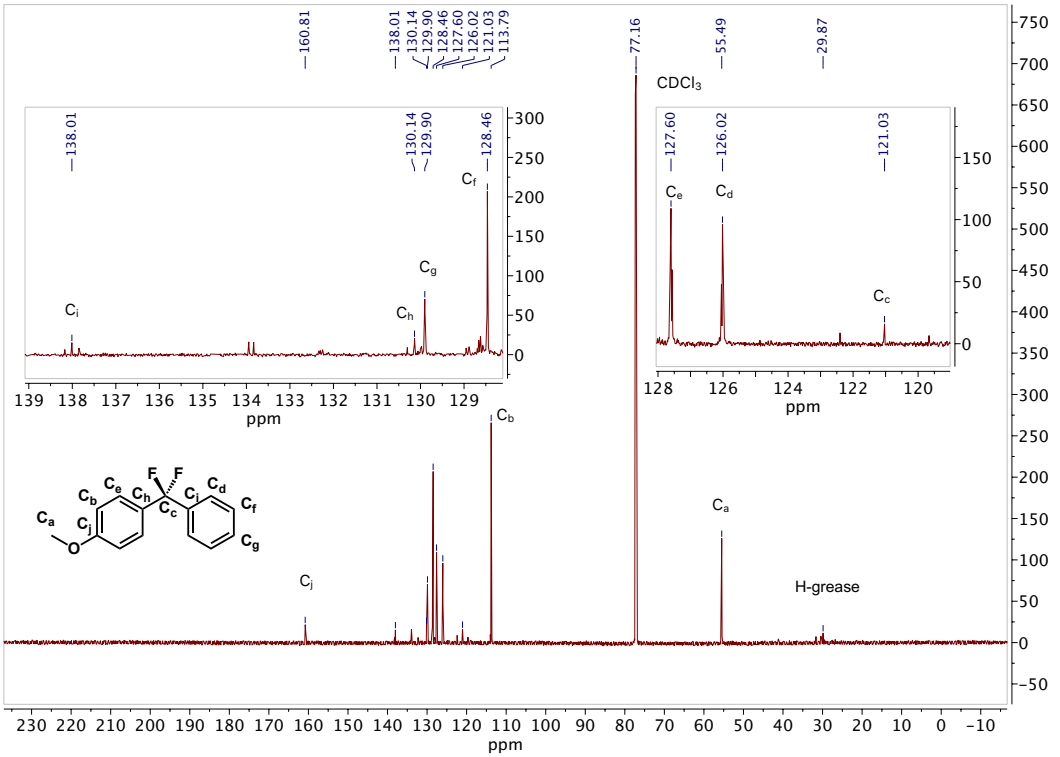


Figure S24. ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2d

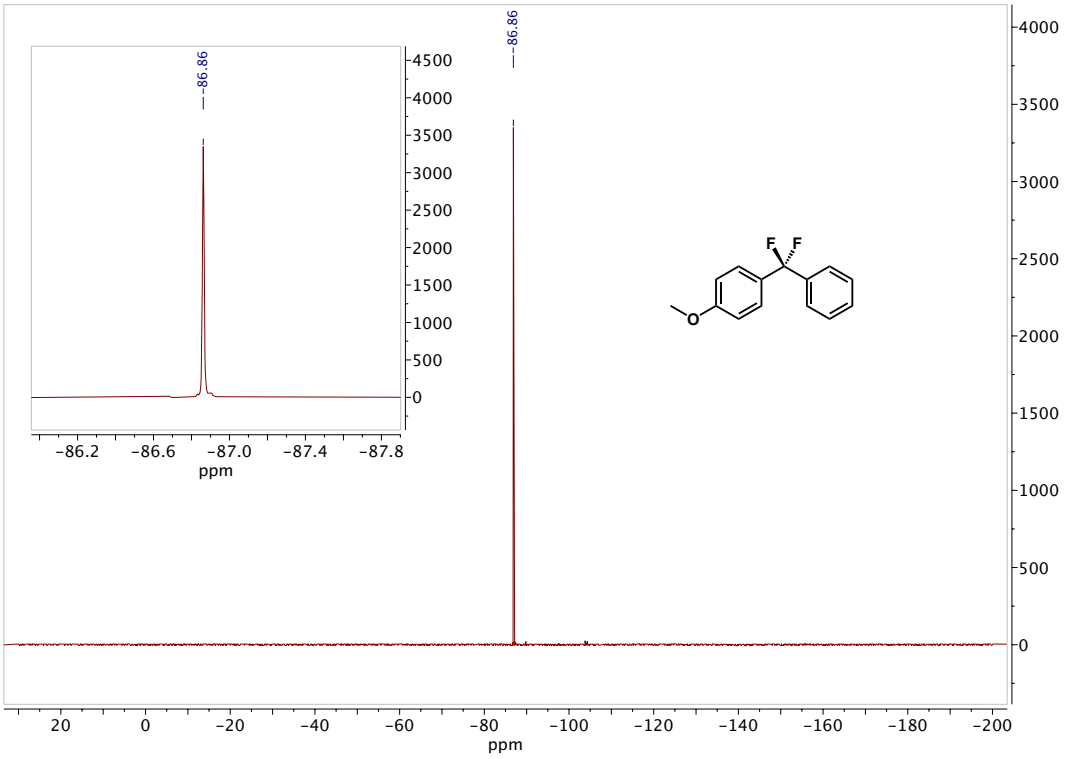


Figure S25. ^{1}H-^{1}H COSY (700 MHz, $CDCl_3$, 25 °C) of 2d

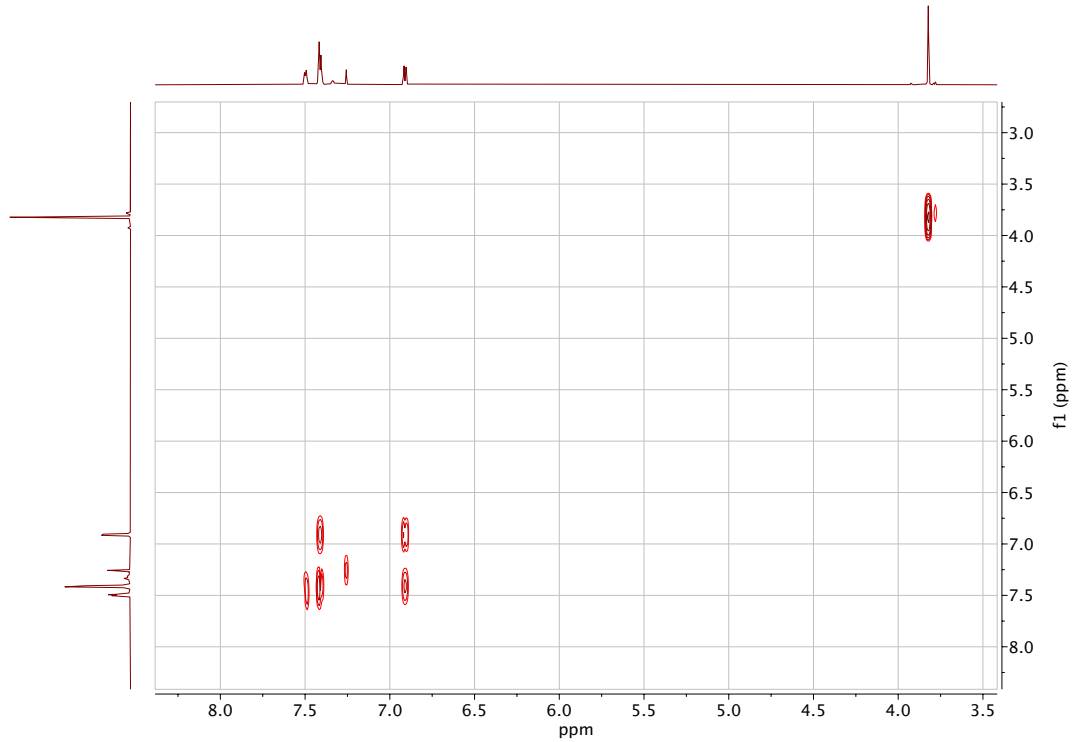


Figure S26. ^{1}H-^{13}C HSQC (700 MHz, $CDCl_3$, 25 °C) of 2d

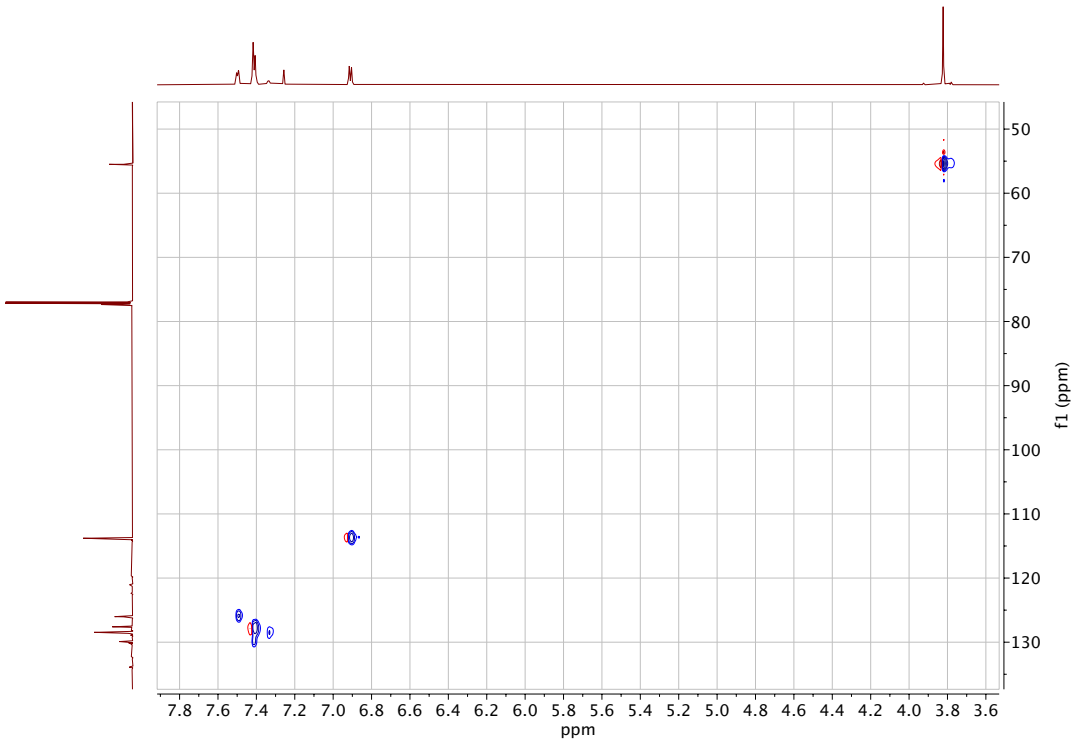


Figure S27. ^{1}H-^{13}C HMBC (700 MHz, $CDCl_3$, 25 °C) of 2d

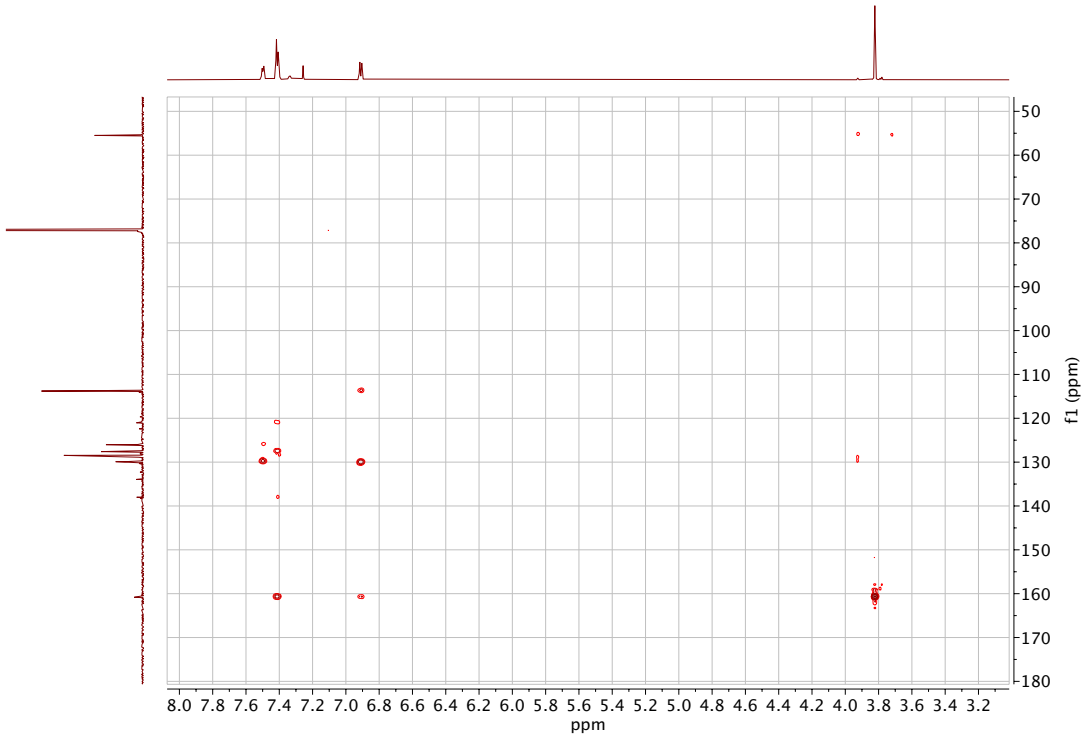


Figure S28. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2d in Situ Yield (81%) with Method A

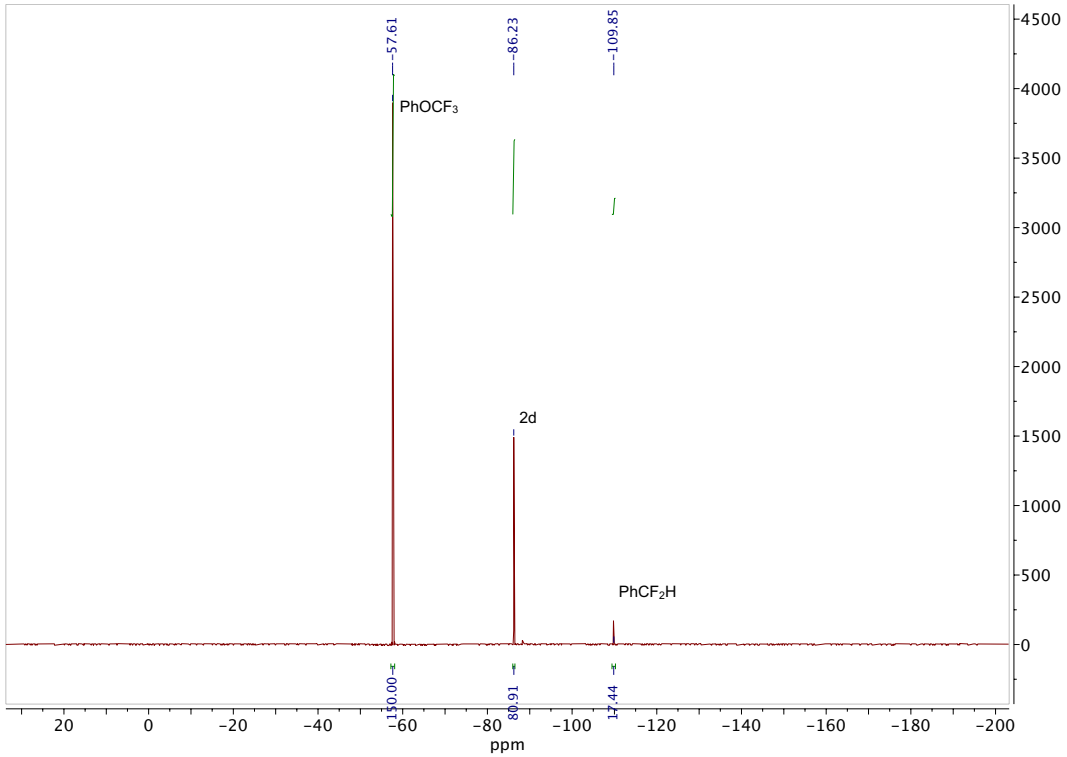
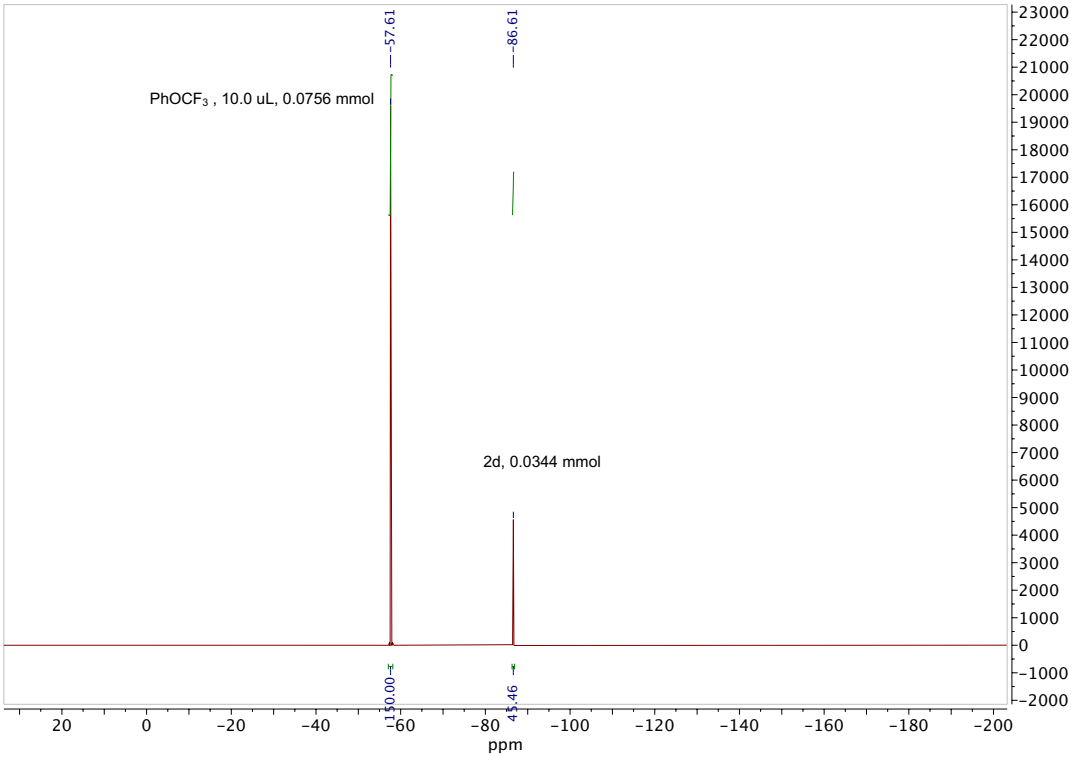
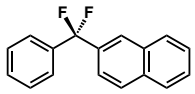


Figure S29. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2d (73% purity)



Synthesis of 2e: 2-(difluoro(phenyl)methyl)naphthalene



Method A was used with **1a** (0.100 mmol, 59.8 mg), 2-iodonapthalene (0.120 mmol, 30.4 mg), $Pd(PPh_3)_4$ (0.0051 mmol, 5.9 mg). With respect to $PhOCF_3$ as ^{19}F internal standard, 54% in situ yield was obtained. The reaction mixture dry loaded onto a 25g Biotage column (using Davisil) and eluted with a 100% HPLC grade pentane at the rate of 25 mL/min, 5-10 column volumes for isolation of **2e**, 11.1 mg 43% yield. After NMR analysis, **2e** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (10.0 µL). 88% purity by mass was found (compared to 11.1 mg sample).

^{1}H-NMR ($CO(CD_3)_2$): 7.51 (H_a, 1H, OL), 7.52 (H_b, 2H, OL), 7.60 (H_c, 1H, OL), 7.61 (H_d, 1H, OL), 7.61 (H_e, 1H, OL), 7.62 (H_f, 2H, (OL)), 7.98 (H_g, 1H, m), 8.01 (H_h, 1H, OL), 8.02 (H_i, 1H, OL), 8.13 (H_j, 1H, s).

^{13}C-NMR: 121.96 (C_a, t, $J_{13C\text{-}19F}$=241.3Hz), 123.59 (C_b, t, $J_{13C\text{-}19F}$=4.8 Hz), 126.03 (C_c, t, $J_{13C\text{-}19F}$=6.6 Hz), 126.54 (C_d, t, $J_{13C\text{-}19F}$=5.6 Hz), 127.81 (C_e), 128.33 (C_f), 128.61 (C_g), 129.53 (C_h, OL), 129.54 (C_i, OL), 129.56 (C_j, OL), 130.99 (C_k, t, $J_{13C\text{-}19F}$=1.9 Hz), 133.52 (C_l), 134.75 (C_m), 135.88 (C_n, t, $J_{13C\text{-}19F}$=28.3 Hz), 138.57 (C_o, t, $J_{13C\text{-}19F}$=28.3 Hz).

^{19}F-NMR: -89.55.

MS EI: 254.0906 (M+).

Figure S30. ^{1}H NMR (700 MHz, $CO(CD_3)_2$, 25 °C) of 2e

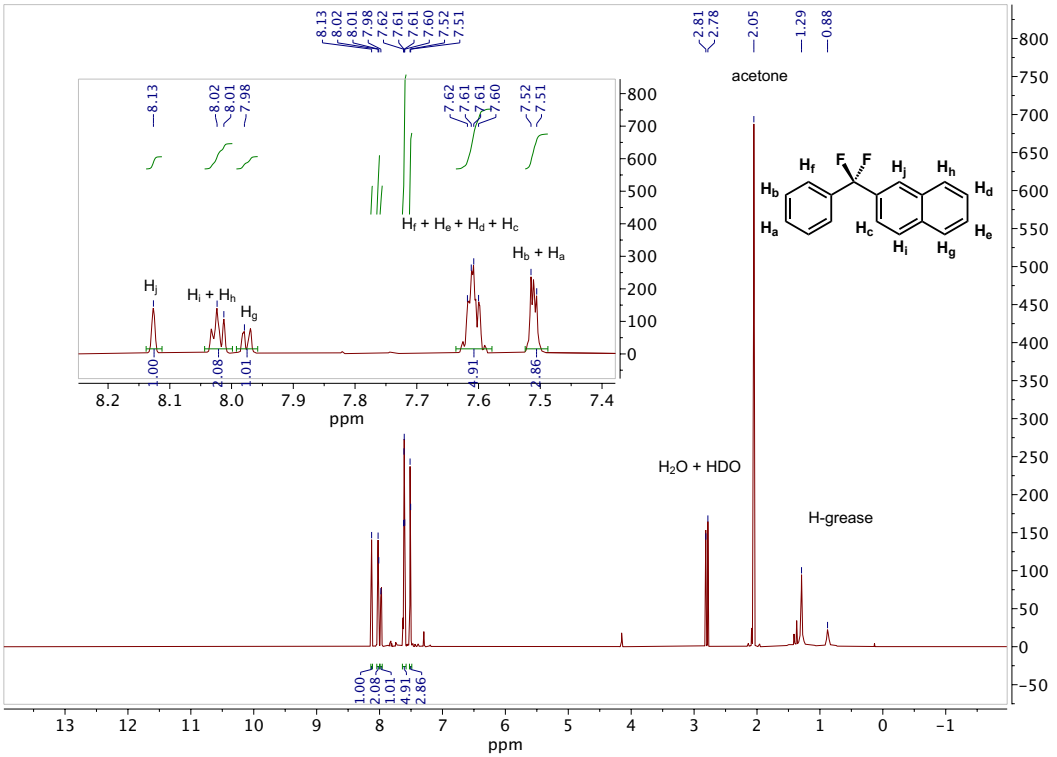


Figure S31. ^{13}C NMR (700 MHz, $CO(CD_3)_2$, 25 °C) of 2e

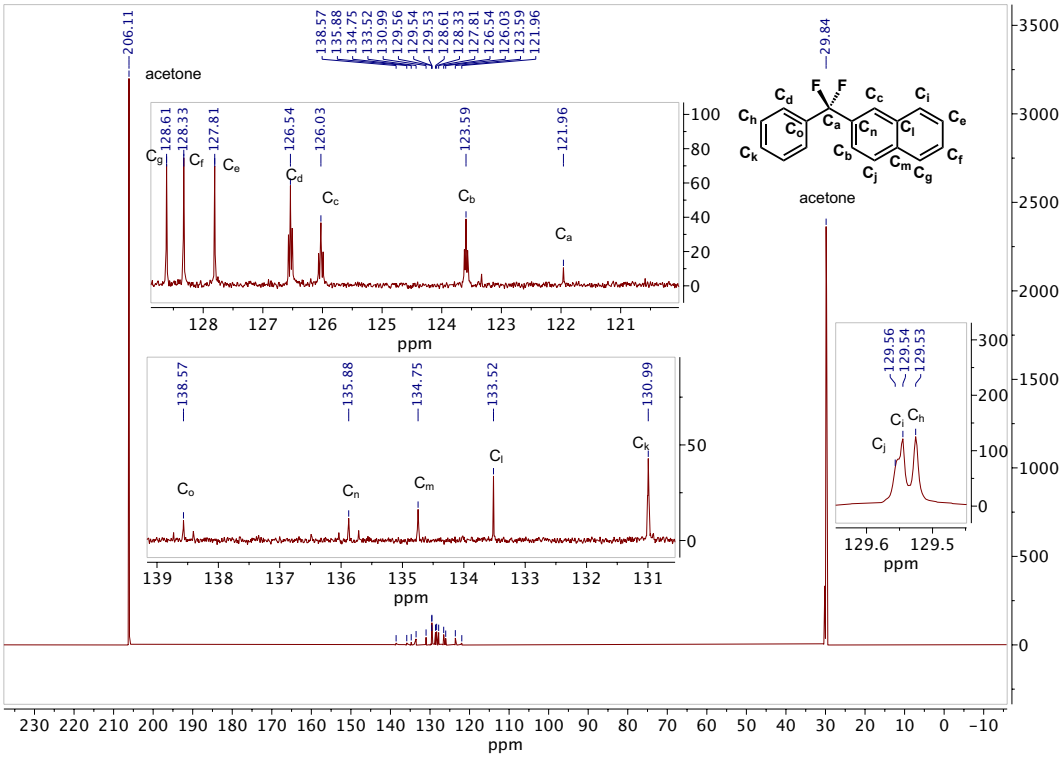


Figure S32. ^{19}F NMR (400 MHz, $CO(CD_3)_2$, 23 °C) of 2e

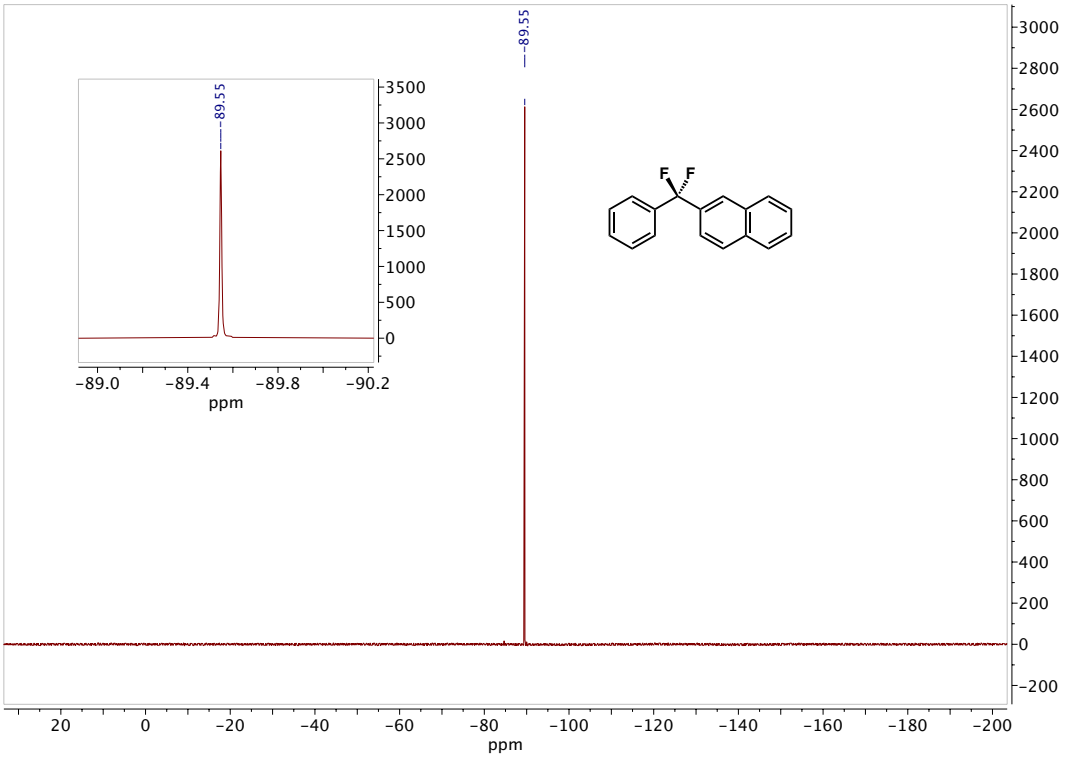


Figure S33. ^{1}H-^{1}H COSY (700 MHz, $CO(CD_3)_2$, 25 °C) of 2e

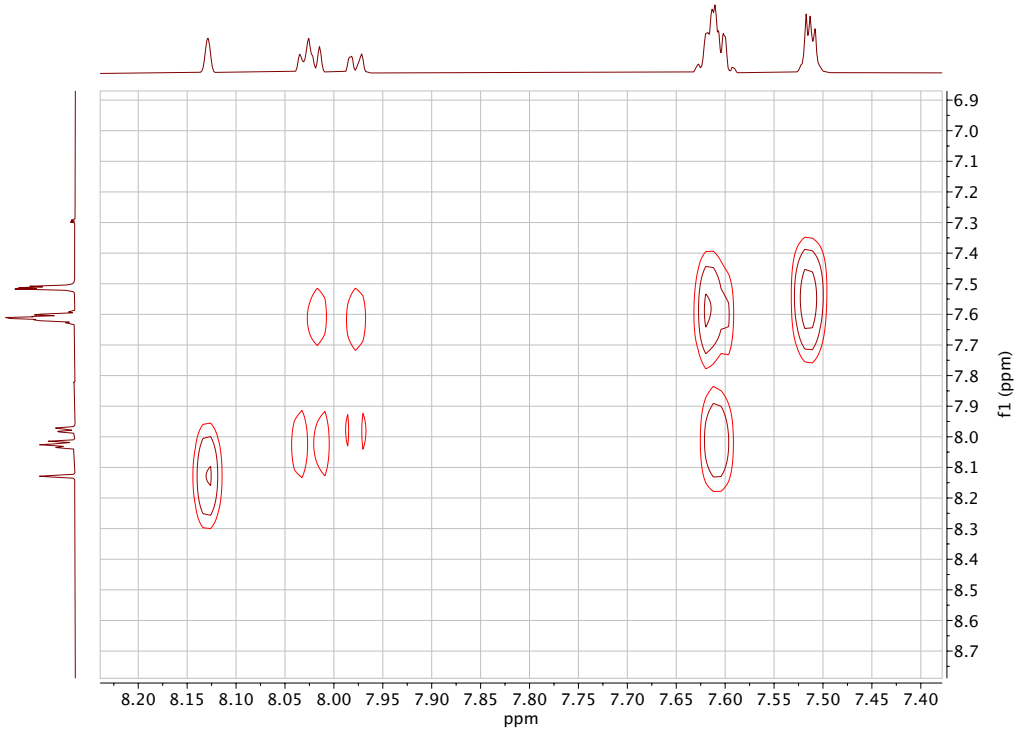


Figure S34. ^{1}H-^{13}C HSQC (700 MHz, $CO(CD_3)_2$, 25 °C) of 2e

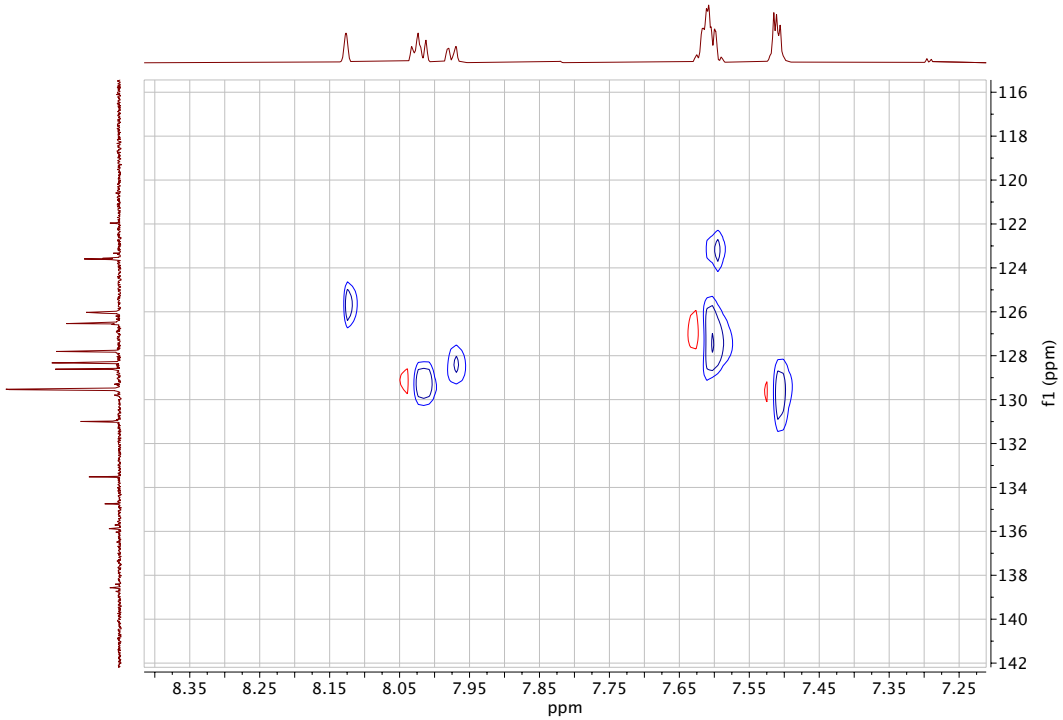


Figure S35. ^{1}H-^{13}C HSQC *small window* (700 MHz, $CO(CD_3)_2$, 25 °C) of 2e

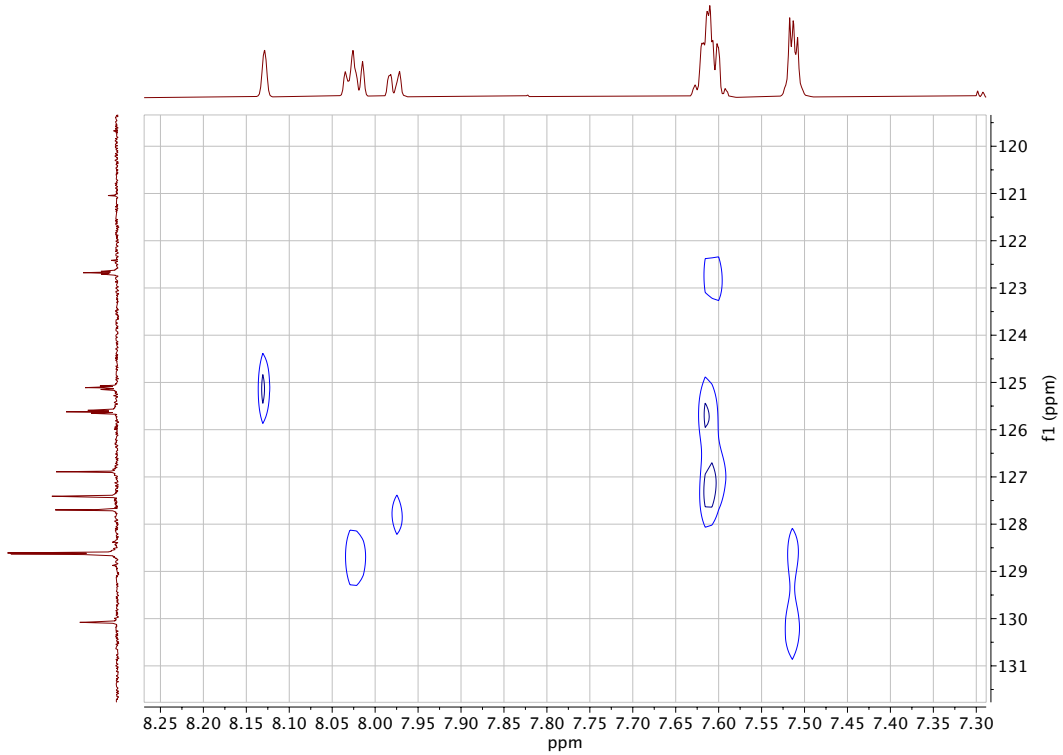


Figure S36. ^{1}H-^{13}C HMBC (700 MHz, $CO(CD_3)_2$, 25 °C) of 2e

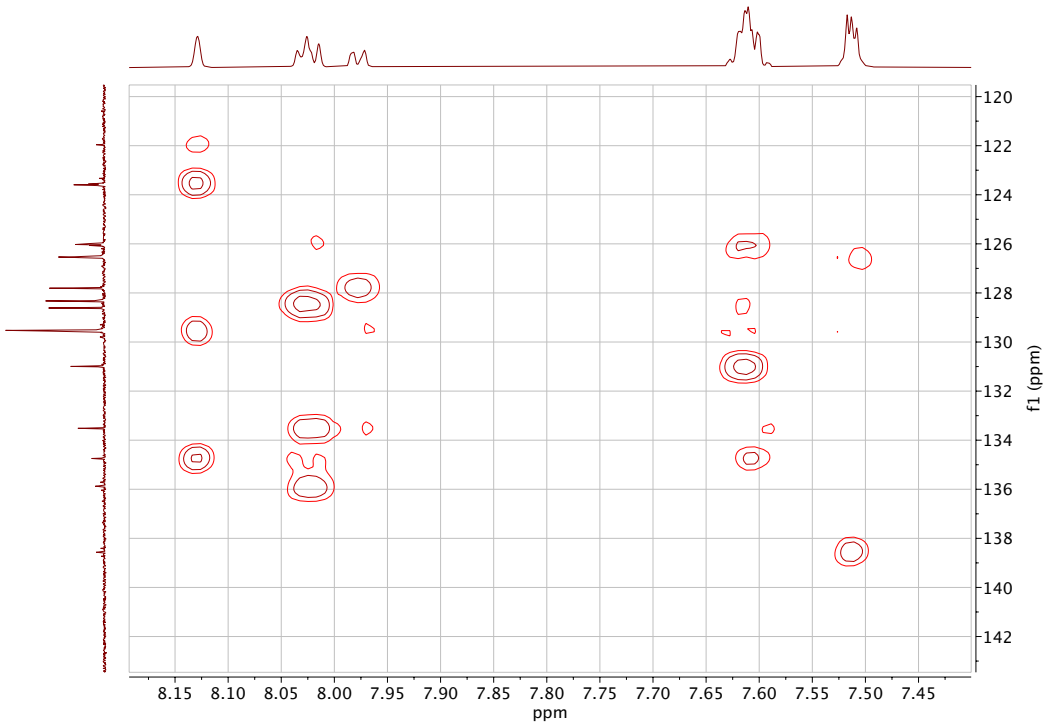


Figure S37. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2e in Situ Yield (54%) with Method A

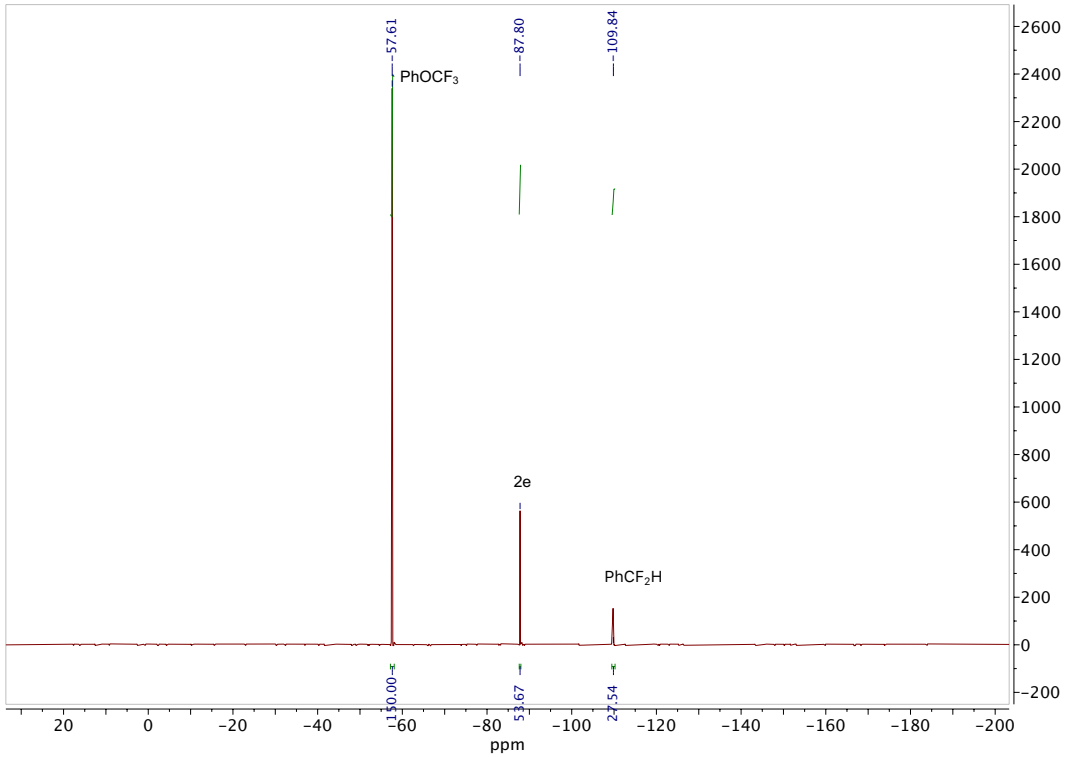
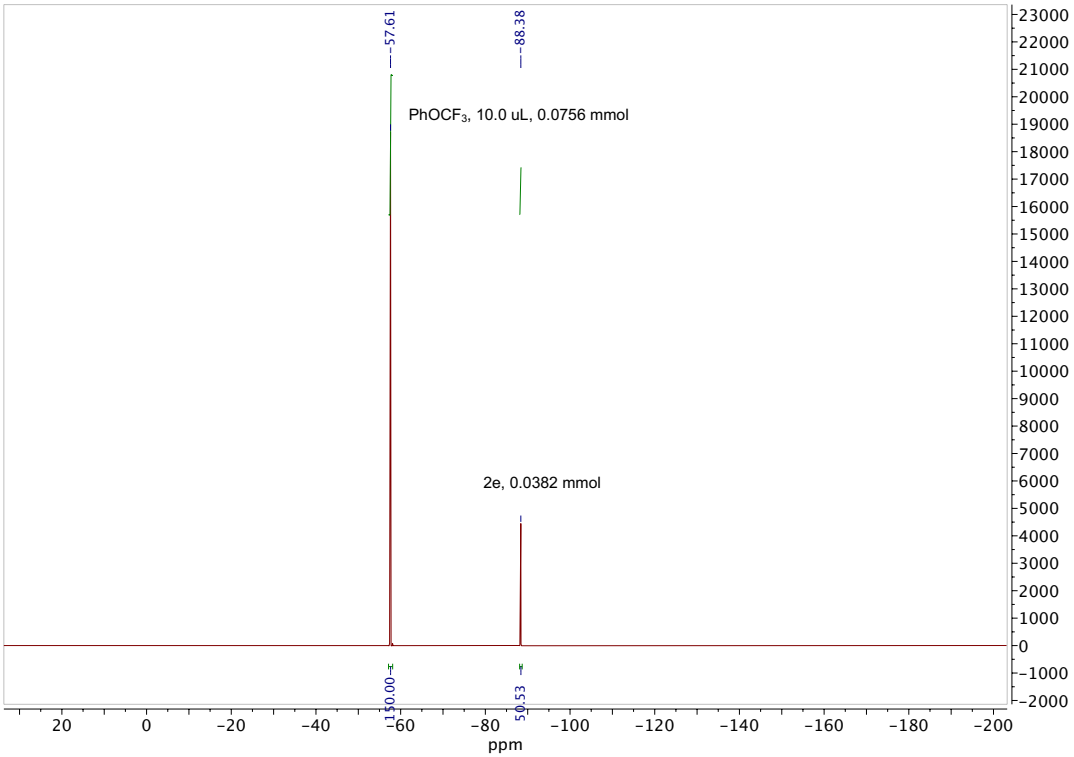
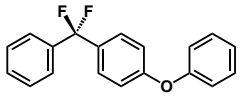


Figure S38. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2e (88% purity)



Synthesis of 2f: 1-(difluoro(phenyl)methyl)-4-phenoxybenzene



Method A was used with **1a** (0.100 mmol, 59.7 mg), 1-iodo-4-phenoxybenzene (0.120 mmol, 35.5 mg), $Pd(PPh_3)_4$ (0.0051 mmol, 5.9 mg). With respect to $PhOCF_3$ as ^{19}F internal standard, 38% in situ yield was obtained. The reaction mixture dry loaded onto a 25g Biotage column (using Davisil) and eluted with a gradient of 0-10% ethyl acetate in HPLC grade pentane at the rate of 25 mL/min, 9-18 column volumes for isolation of **2f**, 8.0 mg 27% yield. After NMR analysis, **2f** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (10.0 µL). 81% purity by mass was found (compared to 8.0 mg sample).

^{1}H-NMR ($CDCl_3$): 7.00 (H_a, 2H, (d, $J_{1H\text{-}1H}$=8.5 Hz)), 7.04 (H_b, 2H, (d, $J_{1H\text{-}1H}$=8.0 Hz)), 7.15 (H_c, 1H, (t, $J_{1H\text{-}1H}$=7.4 Hz)), 7.36 (H_d, 2H, (t, $J_{1H\text{-}1H}$=7.7 Hz)), 7.43 (H_e, 1H, OL), 7.44 (H_f, 2H, OL), 7.45 (H_g, 2H, OL), 7.52 (H_h, 2H, (dd, $J_{1H\text{-}1H}$=7.3, 2.3 Hz).

^{13}C-NMR: 118.05 (C_a), 119.74 (C_b), 120.82 (C_c, t, $J_{13C\text{-}19F}$=241.1 Hz), 124.16 (C_d), 125.97 (C_e, t, $J_{13C\text{-}19F}$=5.5 Hz), 127.78 (C_f, t, $J_{13C\text{-}19F}$=5.4 Hz), 128.53 (C_g), 130.01 (C_h, t, $J_{13C\text{-}19F}$=1.9 Hz), 130.06 (C_i), 132.35 (C_j, t, $J_{13C\text{-}19F}$=28.6 Hz), 137.77 (C_k, t, $J_{13C\text{-}19F}$=28.6 Hz) , 156.39 (C_l), 159.02 (C_m, t, $J_{13C\text{-}19F}$=1.9 Hz).

^{19}F-NMR: -87.36.

MS EI: 296.1018 (M+).

Figure S39. ^{1}H NMR (700 MHz, $CDCl_3$, 25 °C) of 2f

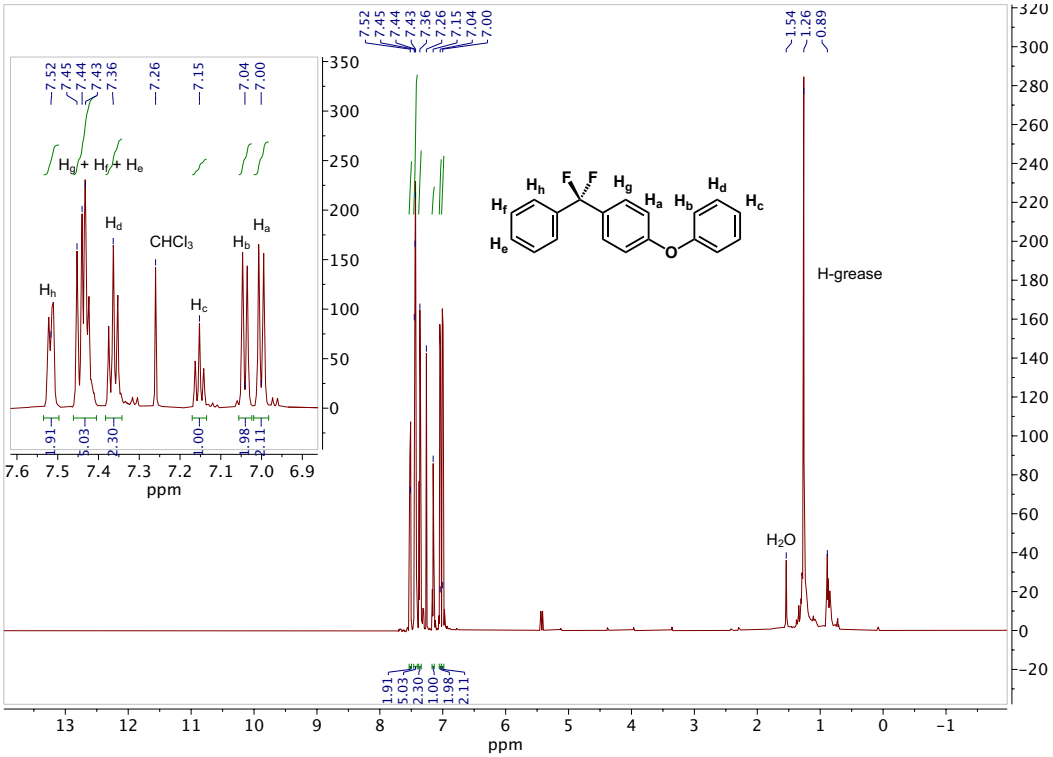


Figure S40. ^{13}C NMR (700 MHz, $CDCl_3$, 25 °C) of 2f

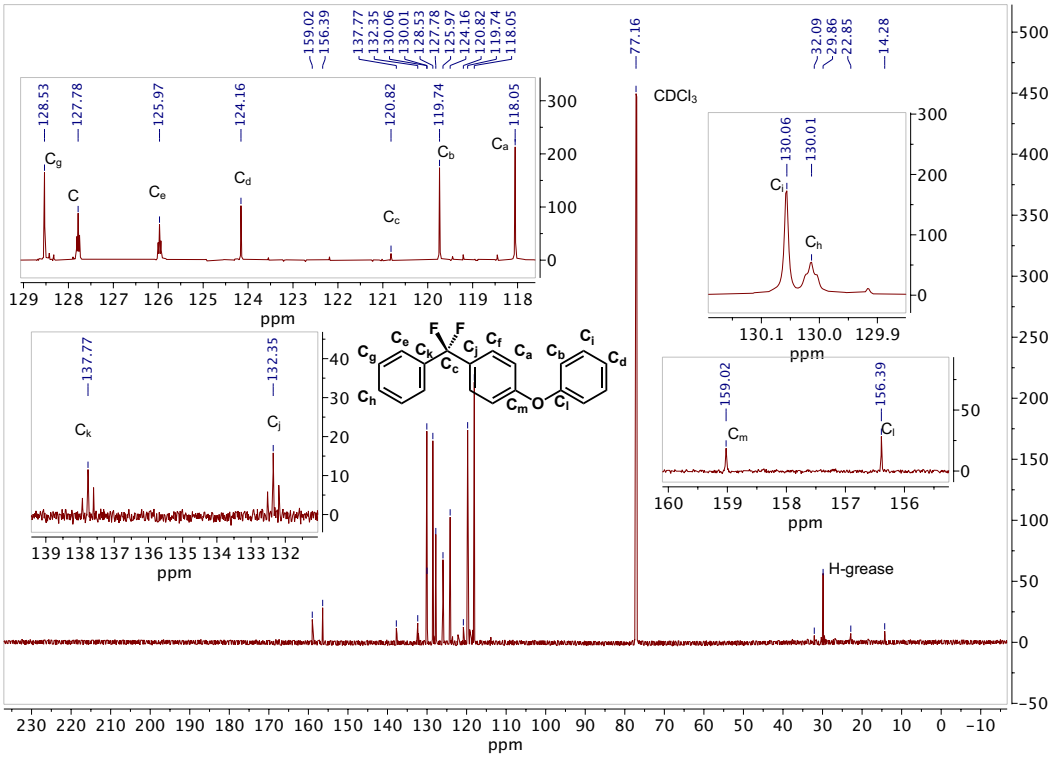


Figure S41. ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2f

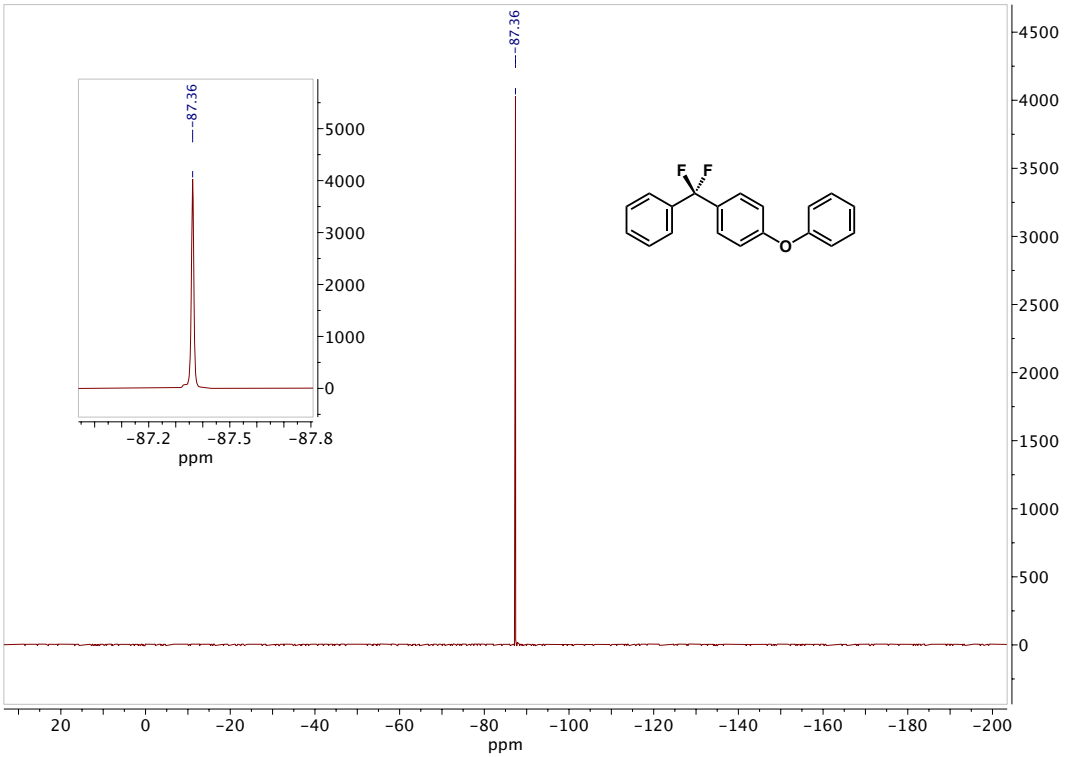


Figure S42. ^{1}H-^{1}H COSY (700 MHz, $CDCl_3$, 25 °C) of 2f

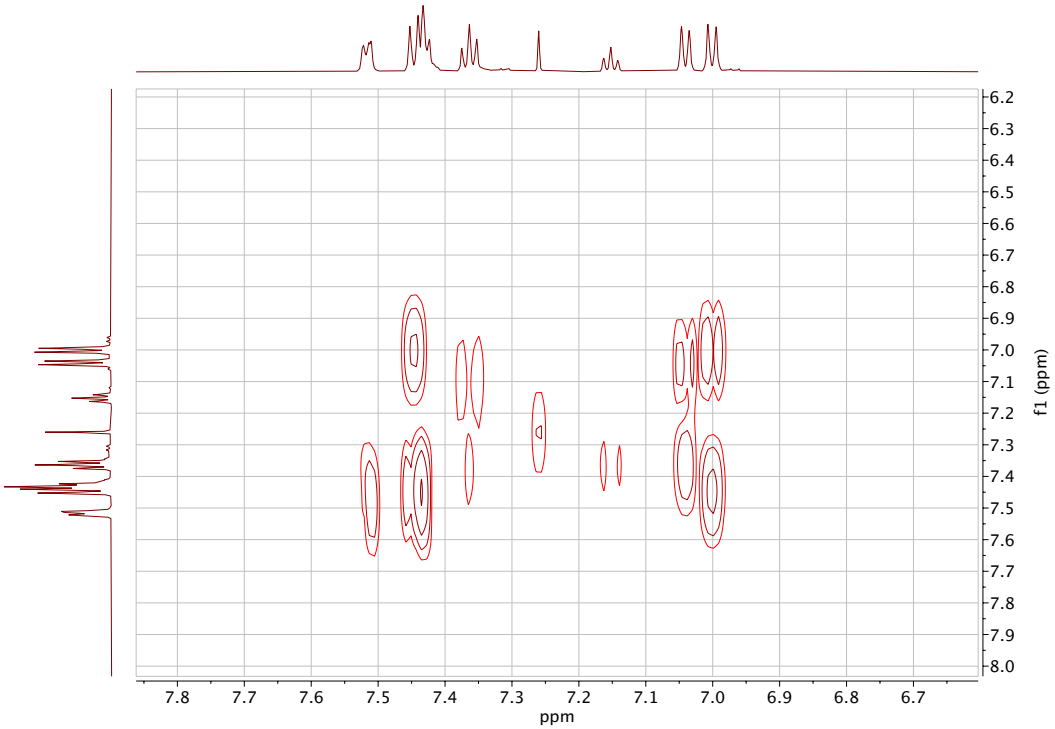


Figure S43. ^{1}H-^{13}C HSQC (700 MHz, $CDCl_3$, 25 °C) of 2f

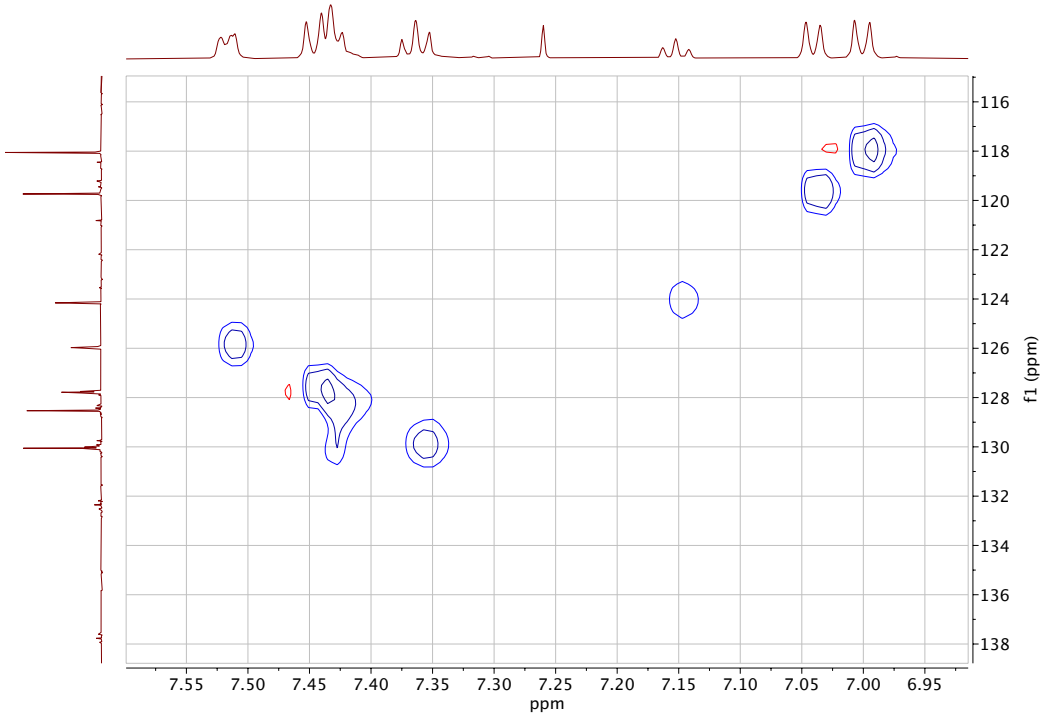


Figure S44. ^{1}H-^{13}C HMBC (700 MHz, $CDCl_3$, 25 °C) of 2f

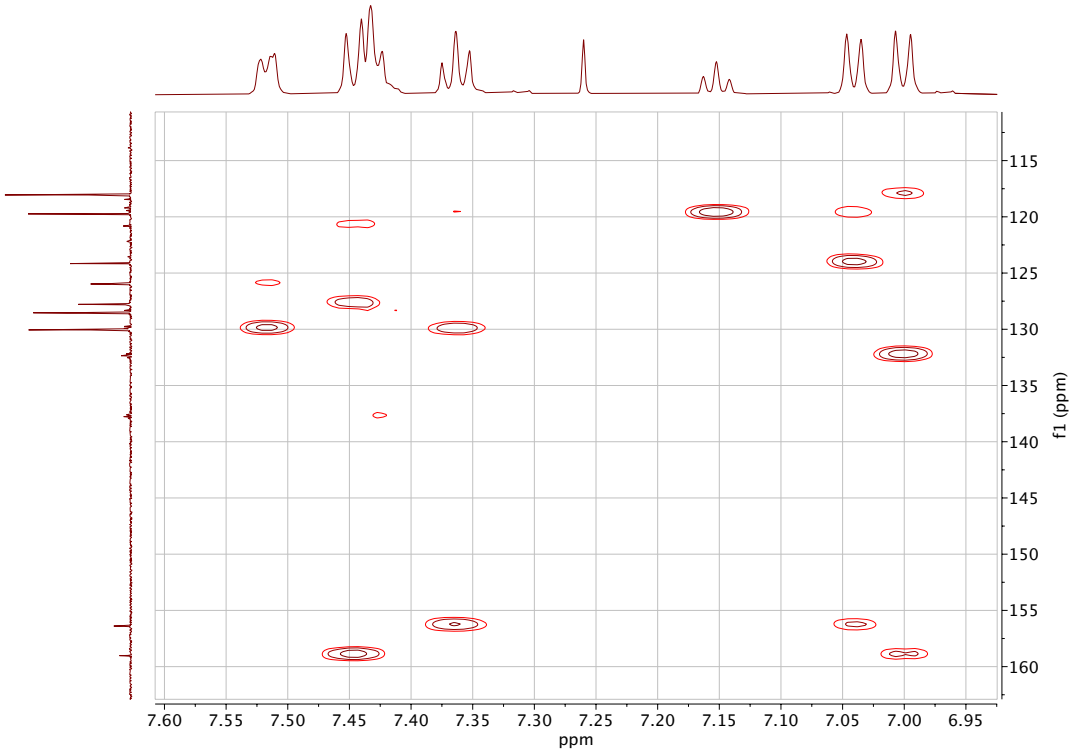


Figure S45. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2f in Situ Yield (38%) with Method A

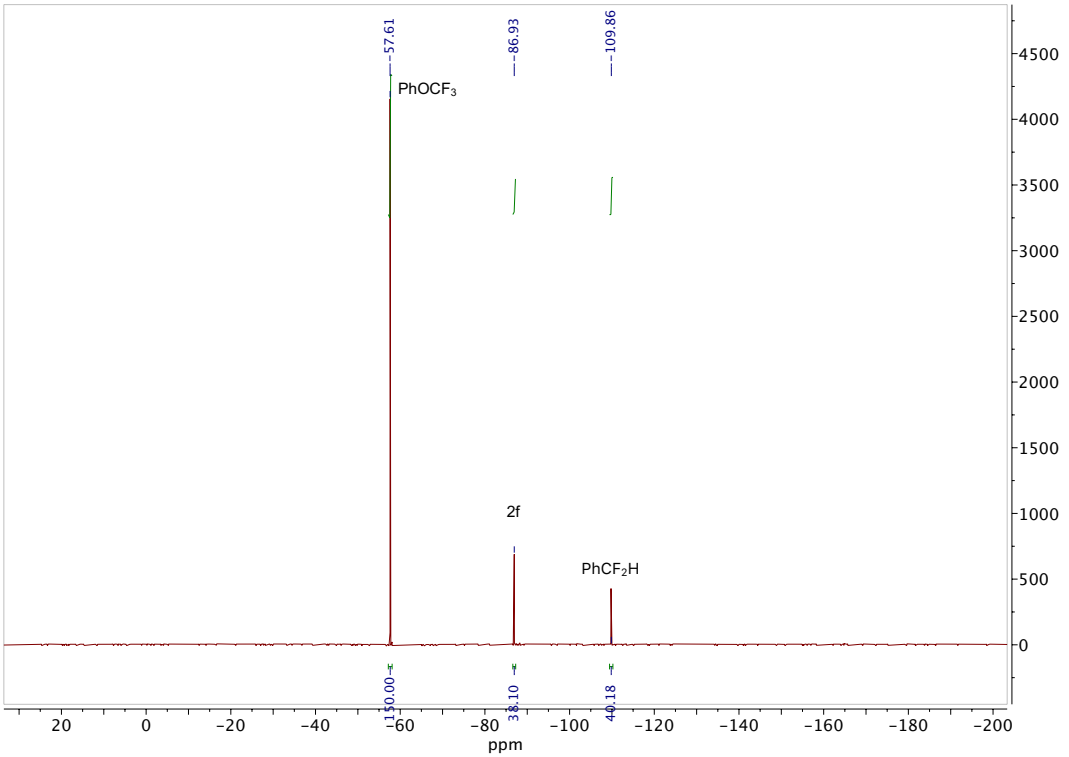
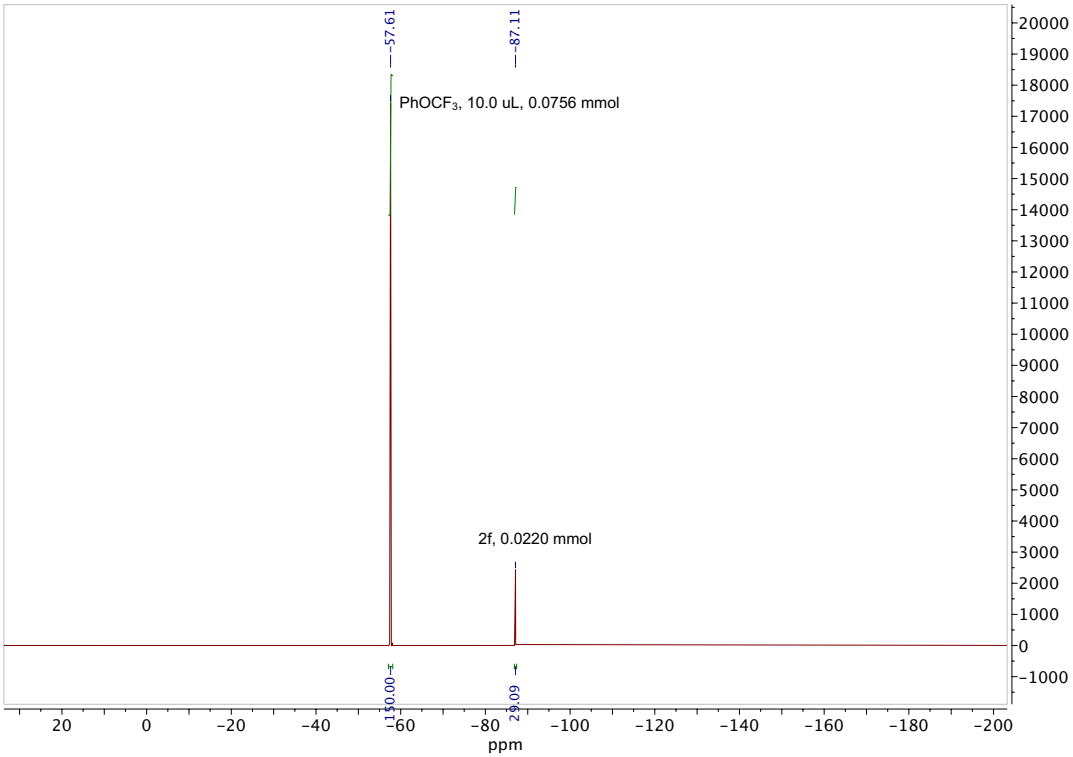
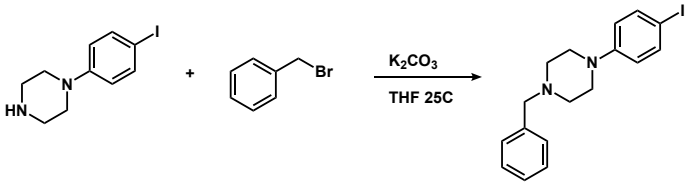


Figure S46. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 2f (81% purity)

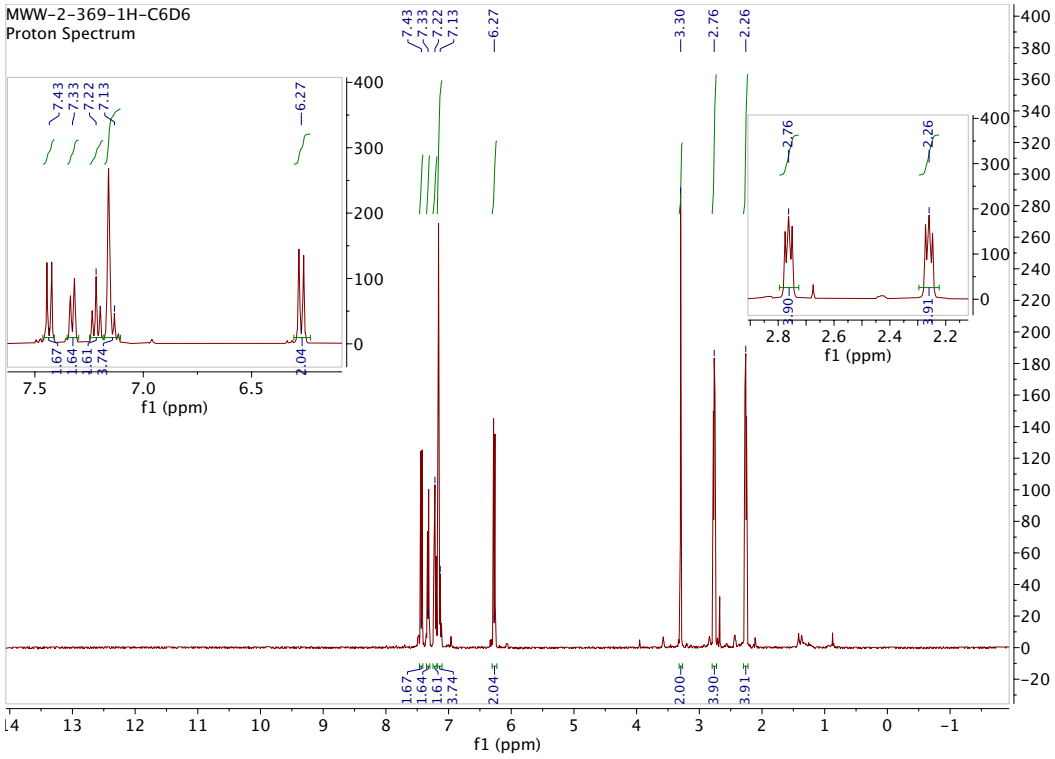


Synthesis of 1-benzyl-4-(4-iodophenyl)piperazine

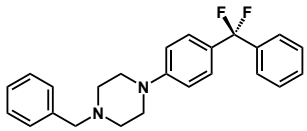


Procedure: In a 20 mL scintillation vial charged with a magnetic stir bar, benzyl bromide (2.06 mmol, 245 µL) and 1-(4- iodophenyl)piperazine (2.00 mmol, 577 mg) were dissolved in 5 mL of THF with potassium carbonate (5.00, 687 mg) suspended on the solution. Components were allowed to stir at 1200 rpm for 21 h at 25 °C. The crude reaction mixture was filtered through alumina with excess THF, and the solvent was removed under vacuum to afford 587.6 mg of 1-benzyl-4-(4-iodophenyl)piperazine 78% yield. The ^{1}H NMR in C_6D_6 was in good agreement with the previously reported spectrum in $CDCl_3$.[2]

Figure S47. ^{1}H NMR (400 MHz, C_6D_6, 25 °C) of 1-benzyl-4-(4-iodophenyl)piperazine



Synthesis of 2g: 1-benzyl-4-(4-(difluoro(phenyl)methyl)phenyl)piperazine



Method A* was used with **1a** (0.01 mmol, 6.1 mg) and 1-benzyl-4-(4-iodophenyl)piperazine (0.012 mmol). Reaction ran for 16 h. With respect to $PhOCF_3$ as ^{19}F internal standard, 67% in situ yield of **2g** was obtained. Isolation proved to be too challenging; with normal chromatography, basified silica gel and reverse phase chromatography still not affording pure product.

Figure S48. ^{1}H NMR (400 MHz, toluene, 23 °C) of 2g

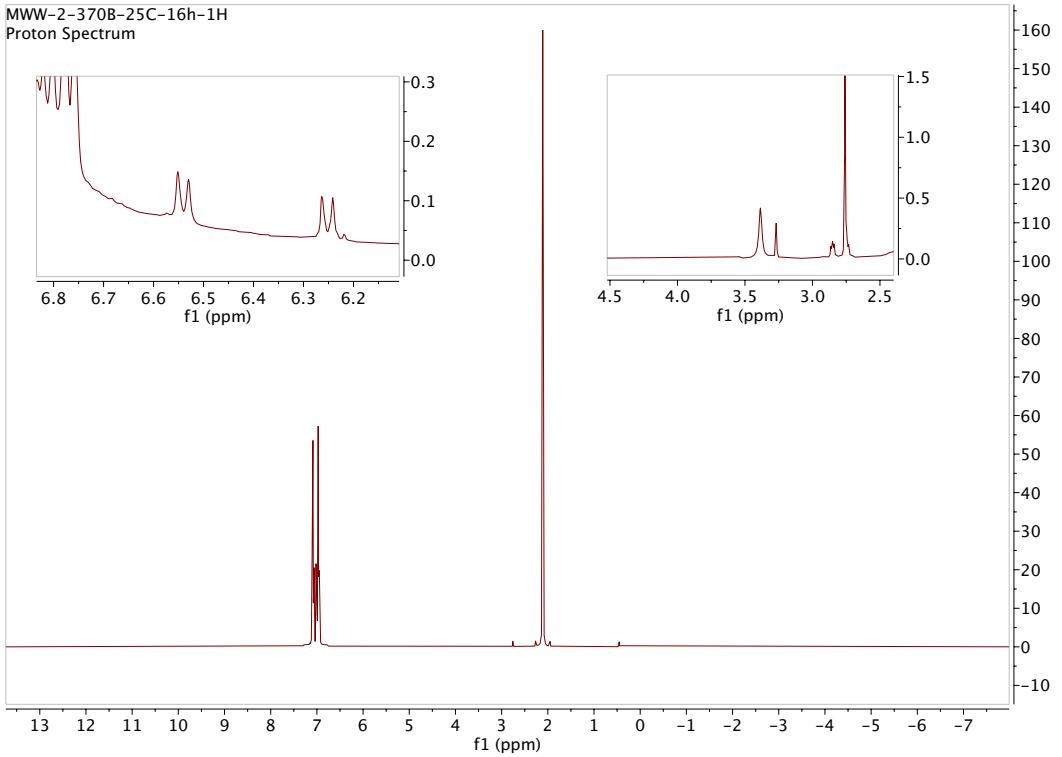
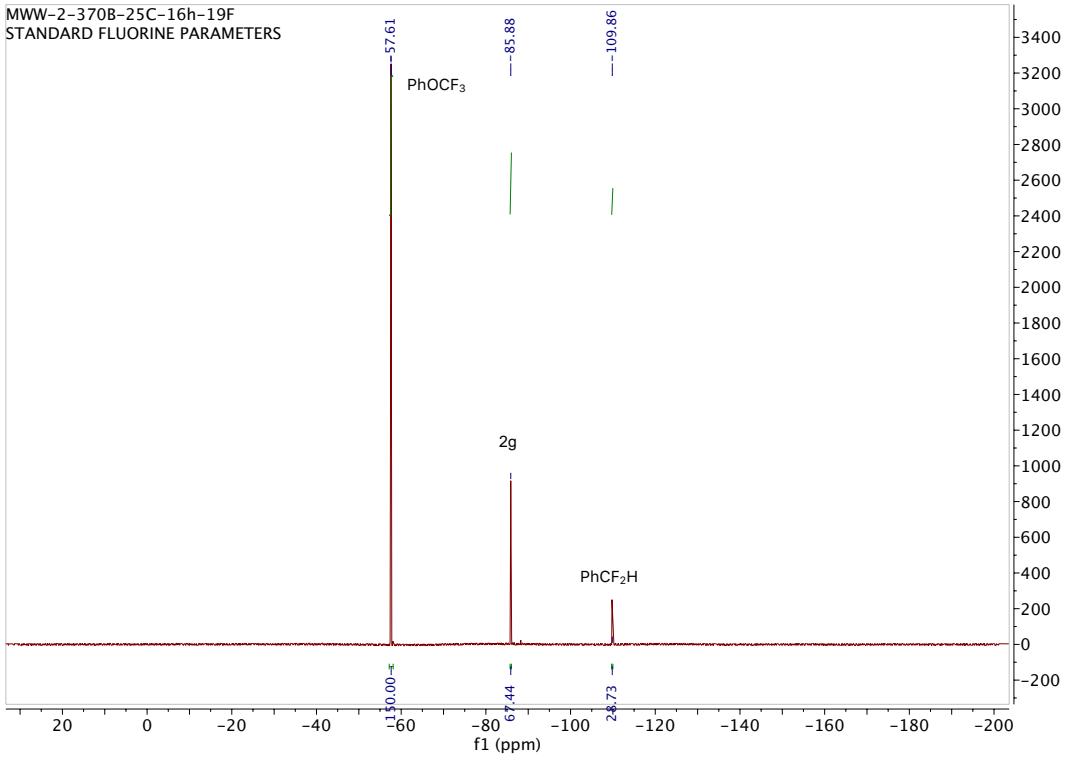
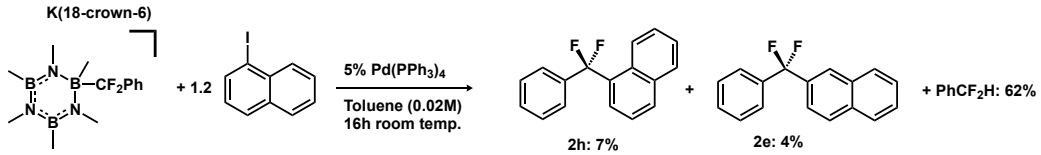


Figure S49. ^{19}F NMR (400 MHz, toluene, 23 °C) of 2g in Situ Yield (67%) with Method A*



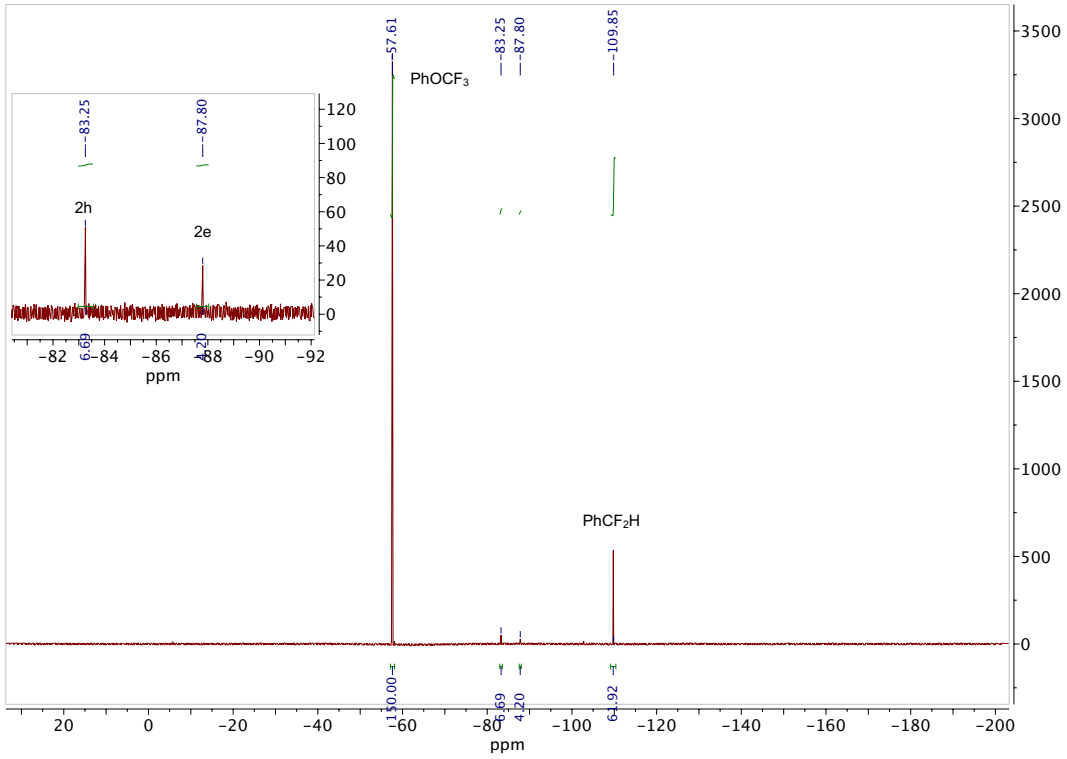
Unsuccessful Substrates for sp^2-sp^3 Coupling

Synthesis Attempt of 2h:

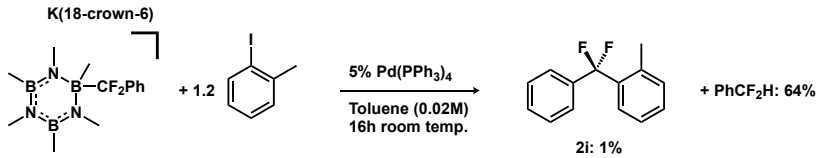


Method A* was used with **1a** (0.01 mmol, 6.1 mg) and 1-iodonaphthalene (0.012 mmol). Reaction ran for 16 h. With respect to $PhOCF_3$ as ^{19}F internal standard, 7% in situ yield of **2h** was obtained. **2e** was formed as a side product in 4% as well as difluoromethylbenzene in 62%.

Figure S50. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2h in Situ Yield (7%) with Method A*



Synthesis Attempt of 2i:



Method A* was used with **1a** (0.01 mmol) and 2-iodotoluene (0.012 mmol). Reaction ran for 16 h. With respect to $PhOCF_3$ as ^{19}F internal standard, 1% in situ yield of **2i** was obtained with difluoromethylbenzene formed as a side product in 64%. The yield was slightly improved to 5% by running the reaction at 50 °C.

Figure S51. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2i in Situ Yield (1%) with Method A*

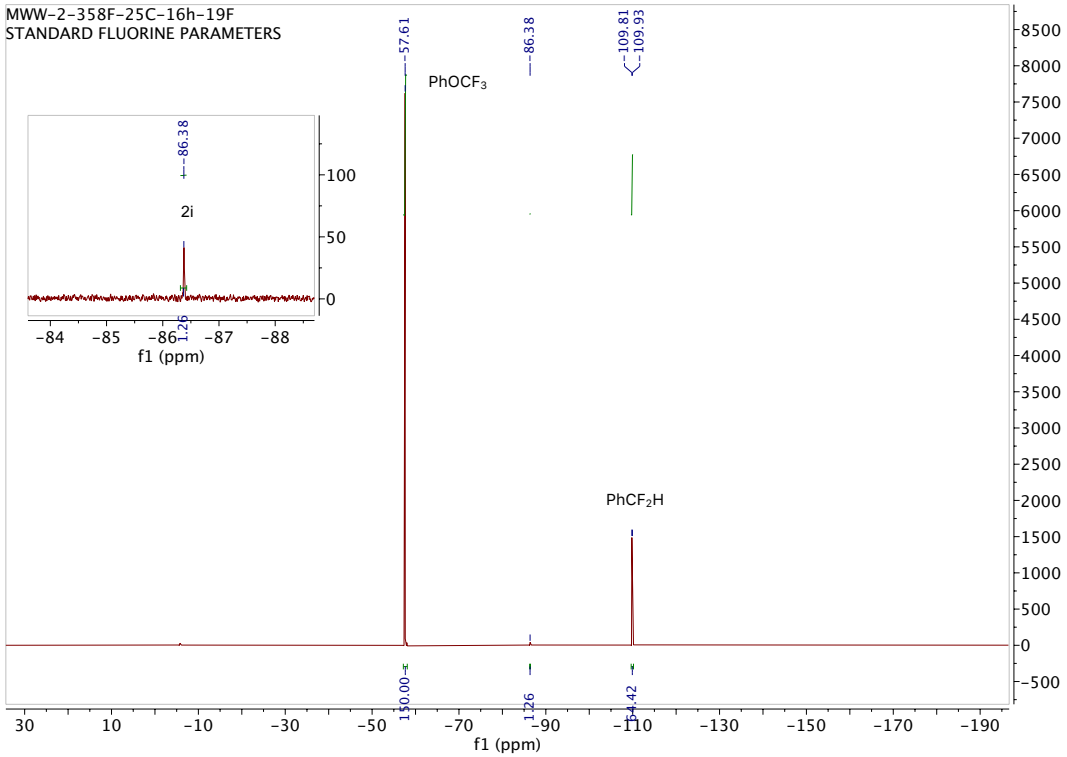
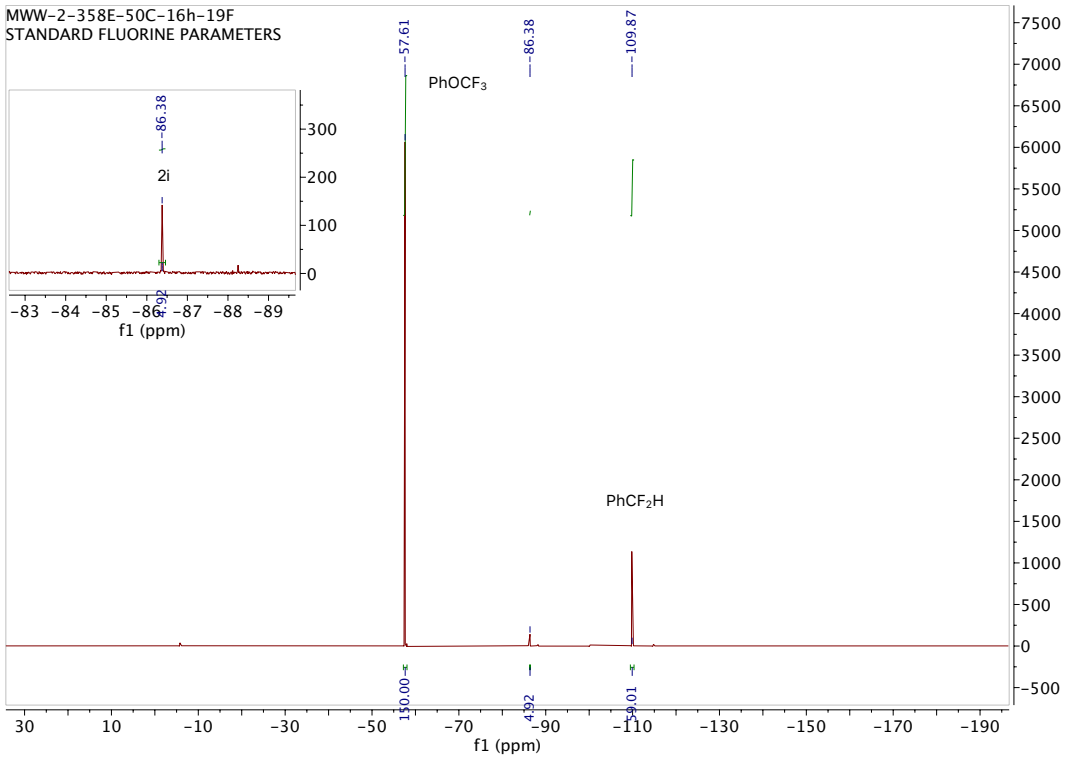
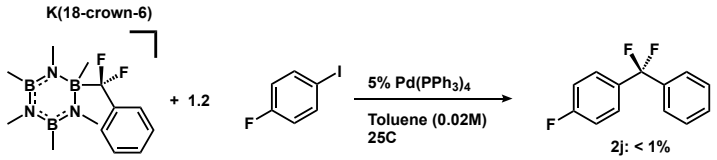


Figure S52. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2i in Situ Yield (5%) with Method A* 50 °C

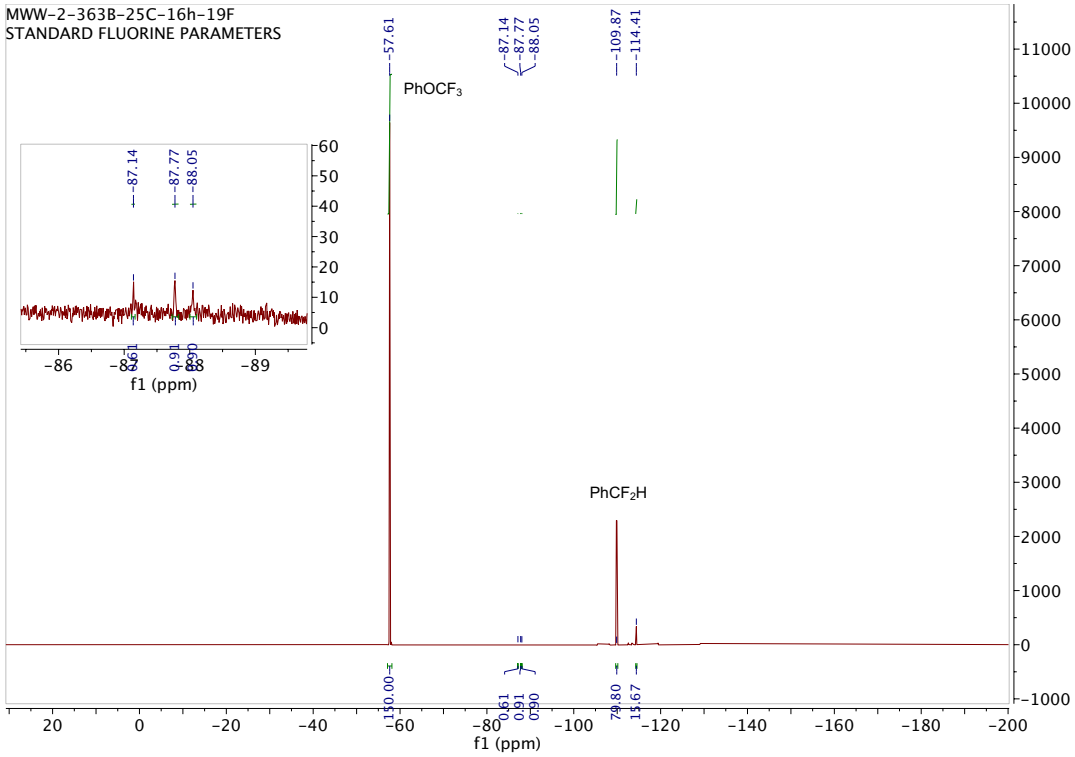


Synthesis Attempt of 2j:

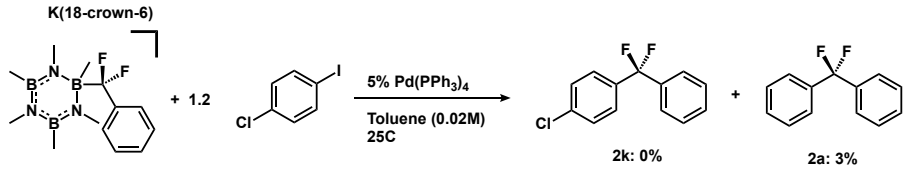


Method A* was used with **1a** (0.01 mmol) and 4-fluoroiodobenzene (0.012 mmol). Reaction ran for 16 h. With respect to $PhOCF_3$ as ^{19}F internal standard, <1% in situ yield of **2j** was obtained with difluoromethylbenzene formed as a side product in 80%.

Figure S53. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2j in Situ Yield (<1%) with Method A*

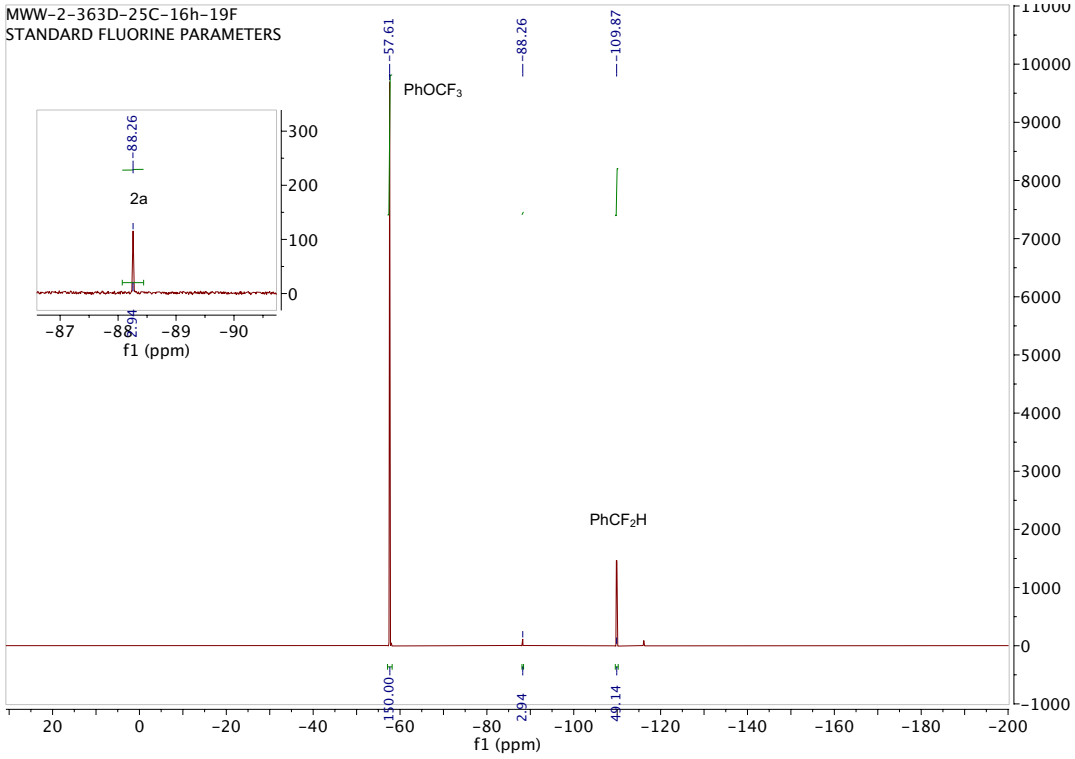


Synthesis Attempt of 2k:

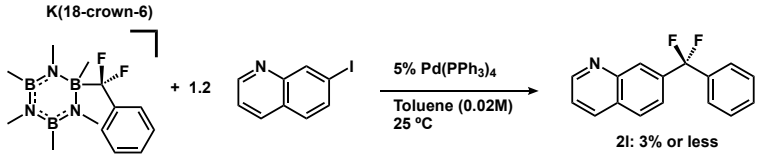


Method A* was used with **1a** (0.01 mmol, 6.1 mg) and 1-chloro-4-iodobenzene (0.012 mmol). Reaction ran for 16 h. With respect to $PhOCF_3$ as ^{19}F internal standard, 0% in situ yield of **2k** was obtained. **2a** was formed as a side product in 3% as well as difluoromethylbenzene in 49%.

Figure S54. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2k in Situ Yield (0%) with Method A*

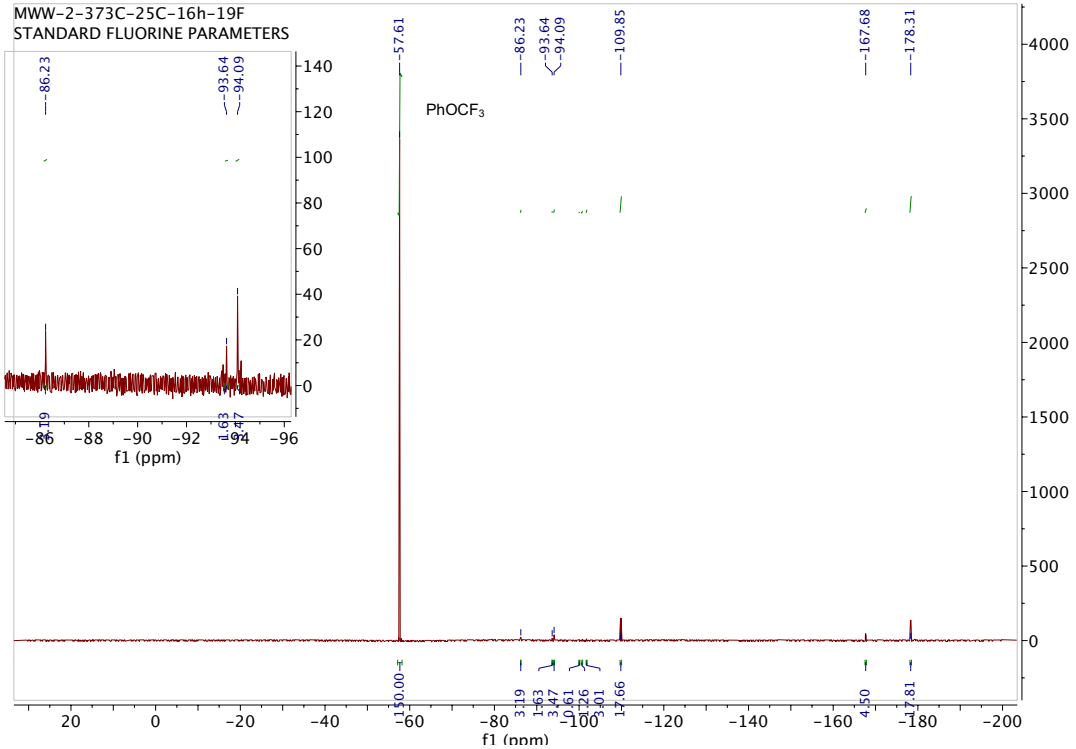


Synthesis Attempt for 2l

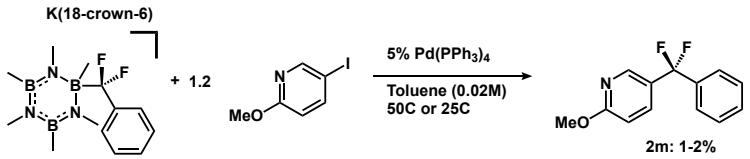


Method A* was used with **1a** (0.01 mmol, 6.1 mg) and 6-iodoquinoline (0.012 mmol). Reaction ran for 16 h. With respect to $PhOCF_3$ as ^{19}F internal standard, 3% in situ yield or less of **2l** was obtained.

Figure S55. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2l in Situ Yield (3%) with Method A*



Synthesis Attempt of 2m:



Method A* was used with **1a** (0.01 mmol) and 5-iodo-2-methoxypyridine (0.012 mmol). Reaction ran for 16.5 h. With respect to $PhOCF_3$ as ^{19}F internal standard, 1% in situ yield of **2m** was obtained with difluoromethylbenzene formed as a side product in 55%. The yield was slightly improved to 2% by running the reaction at 50 °C.

Figure S56. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2m in Situ Yield (1%) with Method A*

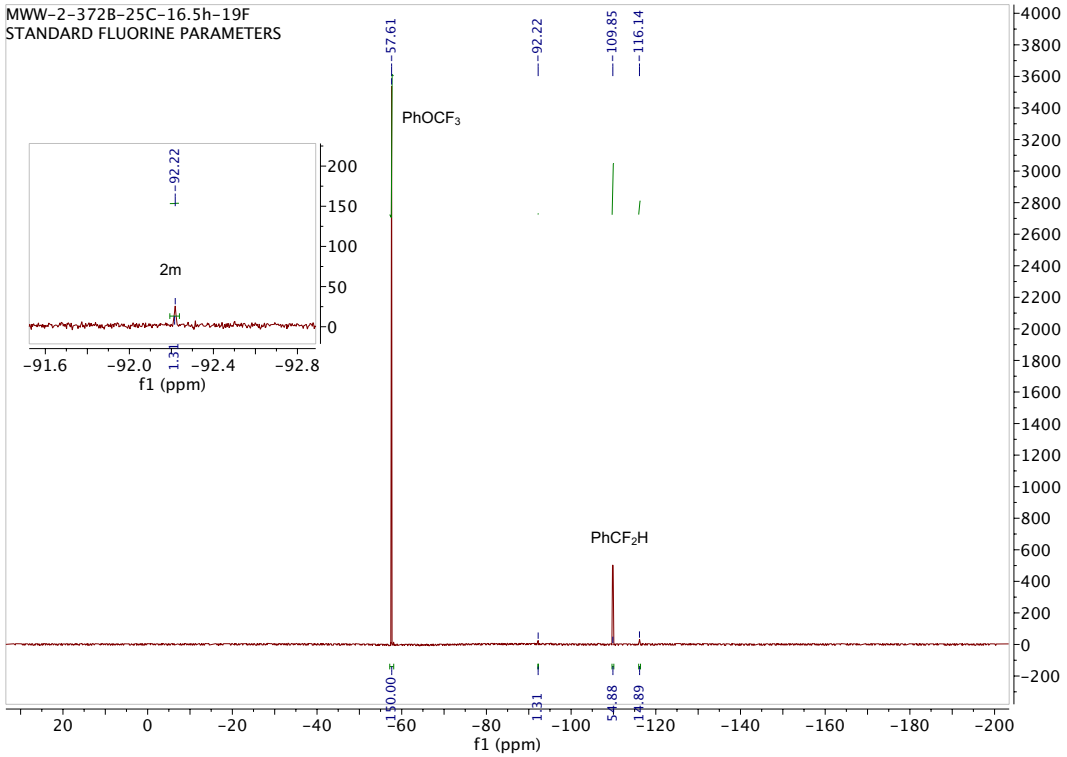
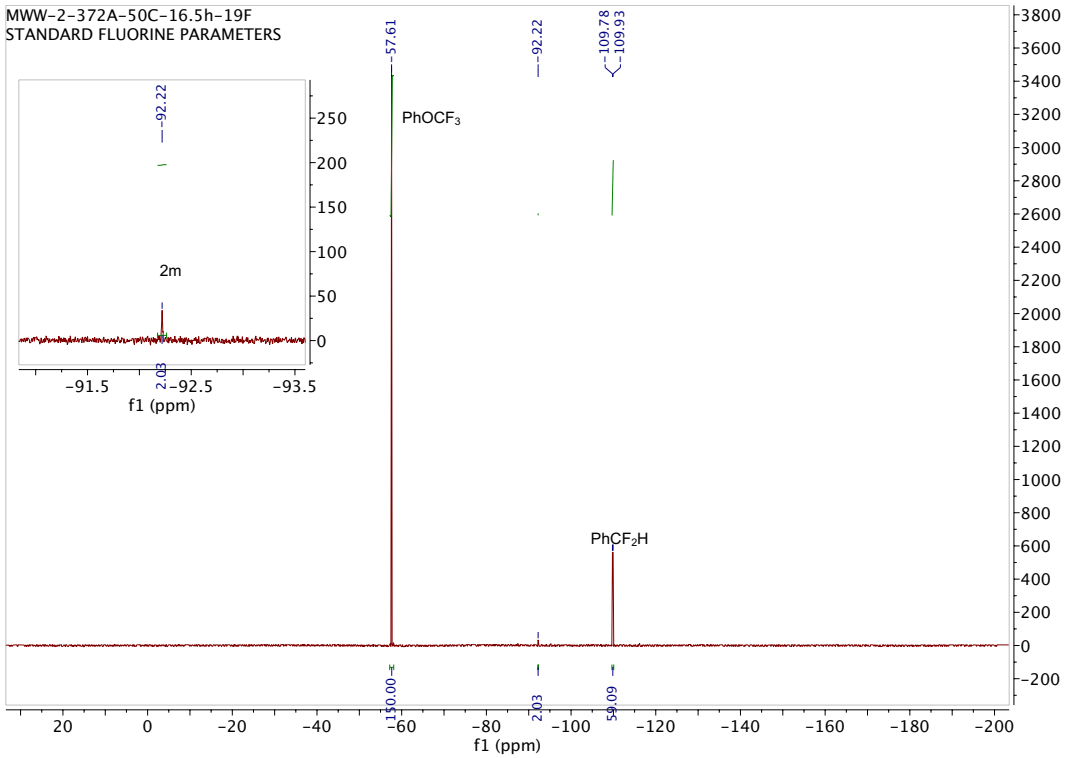
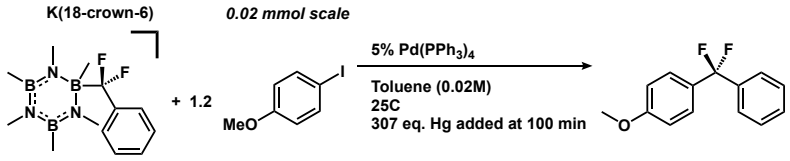


Figure S57. ^{19}F NMR (400 MHz, Toluene, 23 °C) of 2m in Situ Yield (2%) with Method A* 50 °C

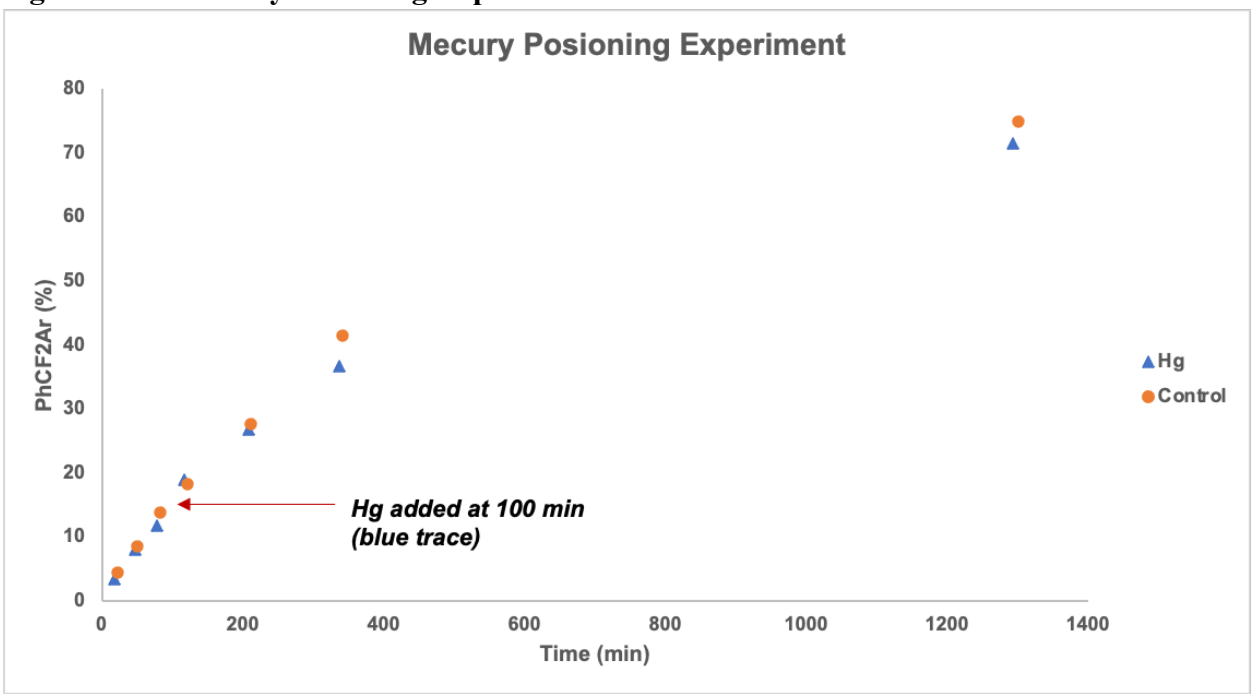


Mercury Poisoning Experiment



Procedure: A catalyst stock solution was made by dissolving $Pd(PPh_3)_4$, (0.004 mmol, 4.5 mg) in 4 mL of toluene along with 4-iodoanisole (0.095 mmol, 22.2 mg) and $PhOCF_3$ (0.080 mmol, 10.6 µL) as internal standard. **1a** (0.02 mmol, 12 mg) was directly measured into two screwcap NMR tubes. An aliquot (1mL) of the Pd solution was added to each reaction which were continuously inverted at 25 ºC. The reactions were monitored by acquiring ^{19}F NMR spectra at various time points. After 100 minutes of mercury (0.299 mmol, 60 mg, 307:1 Hg:Pd) were added to one of the two reaction tubes. No substantial difference in reaction rate was observed at later time-points. These results demonstrated an operationally homogenous catalyst.

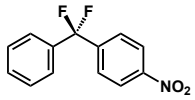
Figure S58. Mercury Poisoning Experiment



Scope in S_NAr Reactions (3a-3d)

Method B:
In a 20 mL scintillation vial, nitroarene (0.024 mmol) was dissolved in 1 mL THF along with $PhOCF_3$ (0.04 mmol, 5.3 µL) as an inert ^{19}F NMR internal standard. $[Me_6B_3N_3CF_2Ph]K(18\text{-c-}6)$ **1a** (0.02 mmol) was added and the mixture was halved and separated into sealed NMR tubes to further react at 25 °C or 80 °C. After 18.5 hours, in situ yields were analyzed by ^{19}F NMR.

Synthesis of 3a: 1-(difluoro(phenyl)methyl)-4-nitrobenzene-methane



Method B was used with **1a** (0.02 mmol, 11.9 mg) and 1,4-dinitrobenzene (0.024 mmol). Reactions ran for 18.5 h at 25 °C and 80 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 37% in situ yield at 25 °C and 39% in situ yield at 80 °C of **3a** was obtained. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[1]

^{19}F-NMR: -90.08 (s)

Figure S59. ^1H NMR (400 MHz, THF, 25 °C) of 3a [25 °C reaction]

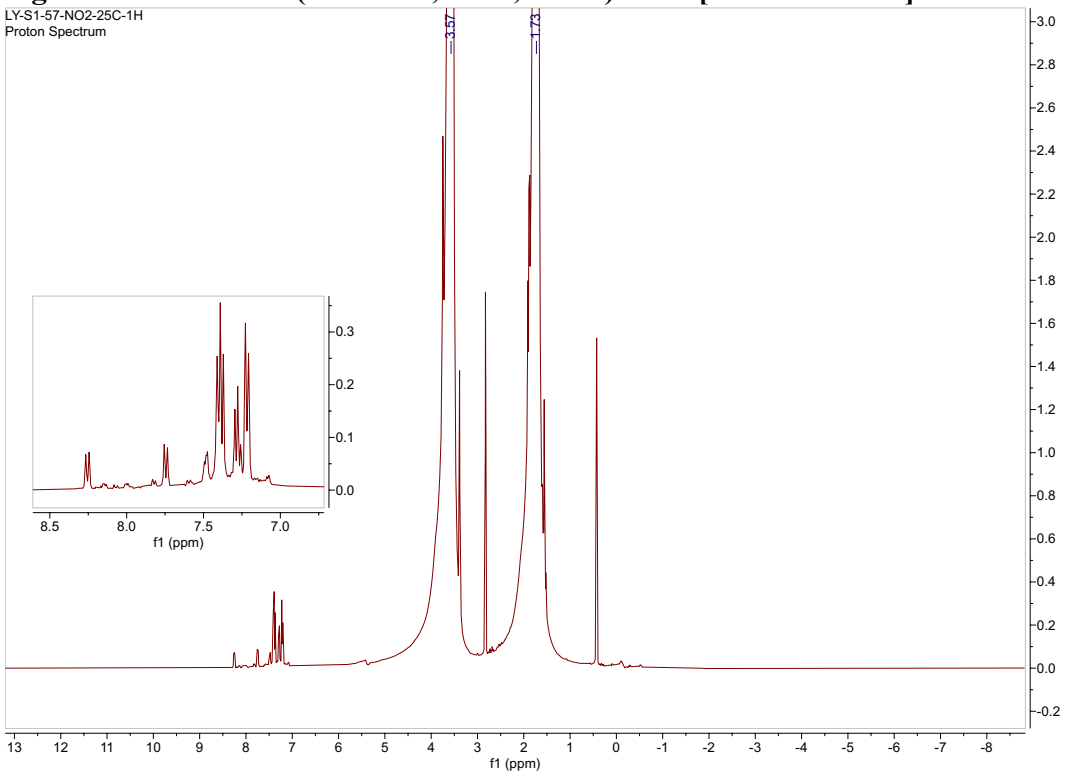


Figure S60. ^{19}F NMR (400 MHz, THF, 25 °C) of 3a in Situ Yield (37%) with Method B [25 °C reaction]

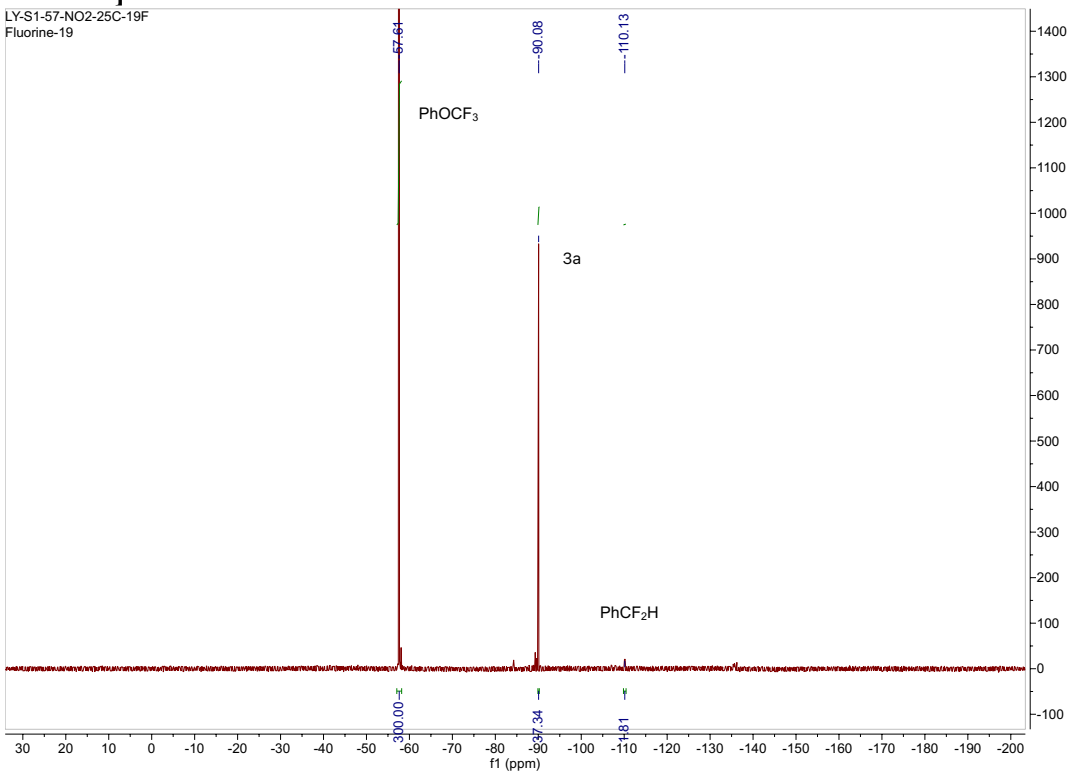


Figure S61. ^{1}H NMR (400 MHz, THF, 25 °C) of 3a [80 °C reaction]

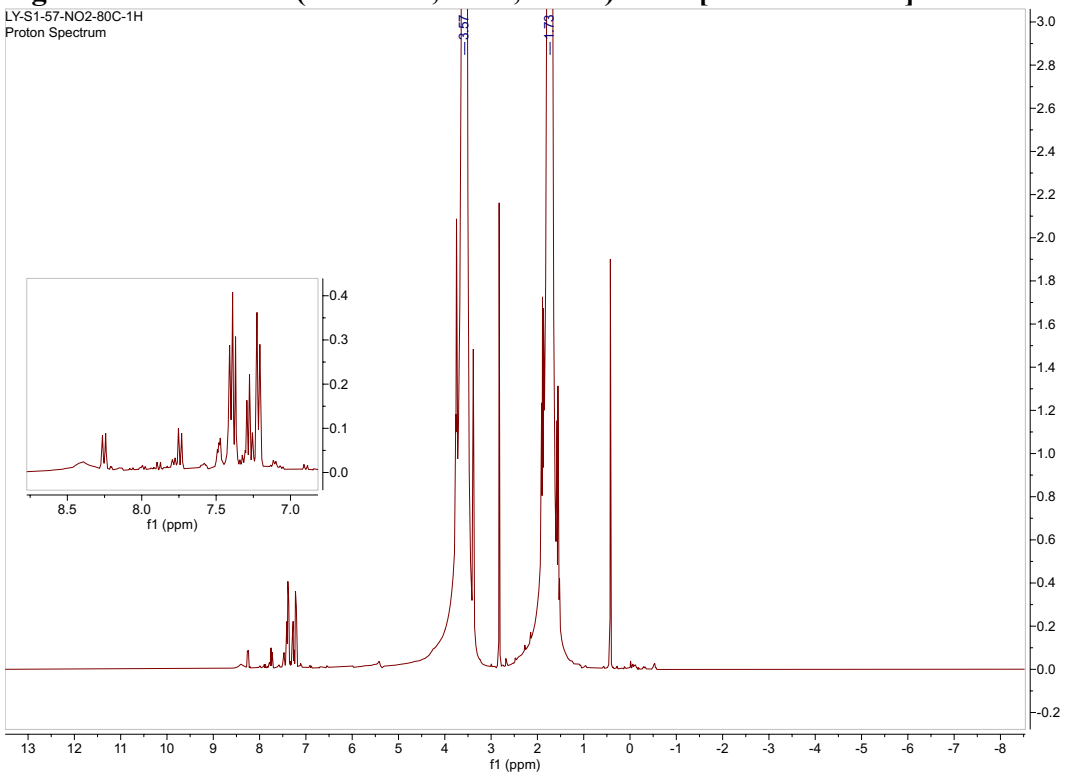
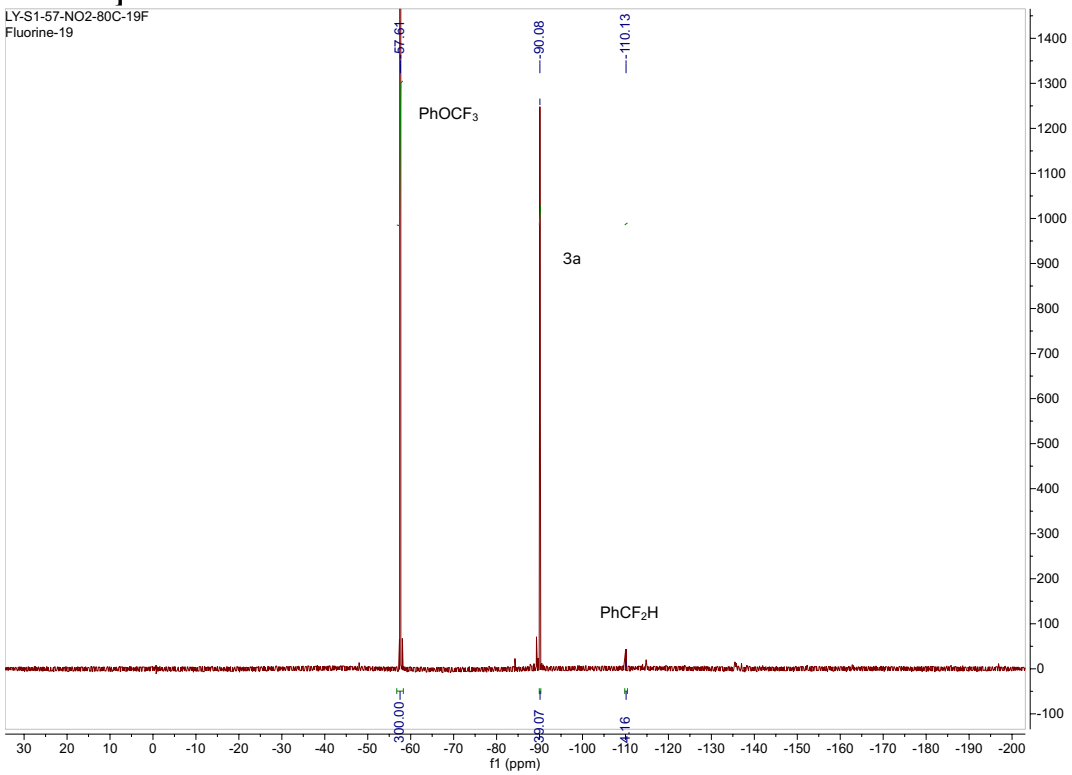
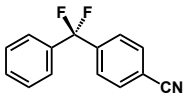


Figure S62. ^{19}F NMR (400 MHz, THF, 25 °C) of 3a in Situ Yield (39%) with Method B [80 °C reaction]



Synthesis of 3b: 4-(difluoro(phenyl)methyl)benzonitrile-methane



Method B was used with **1a** (0.02 mmol, 11.9 mg) and 4-nitrobenzonitrile (0.024 mmol). Reaction ran for 18.5 h at both 25 °C and 80 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 11% in situ yield at 25 °C and 80 °C of **3b** was obtained. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[1]

^{19}F-NMR: -90.35 (s)

Figure S63. ^{1}H NMR (400 MHz, THF, 25 °C) of 3b [25 °C reaction]

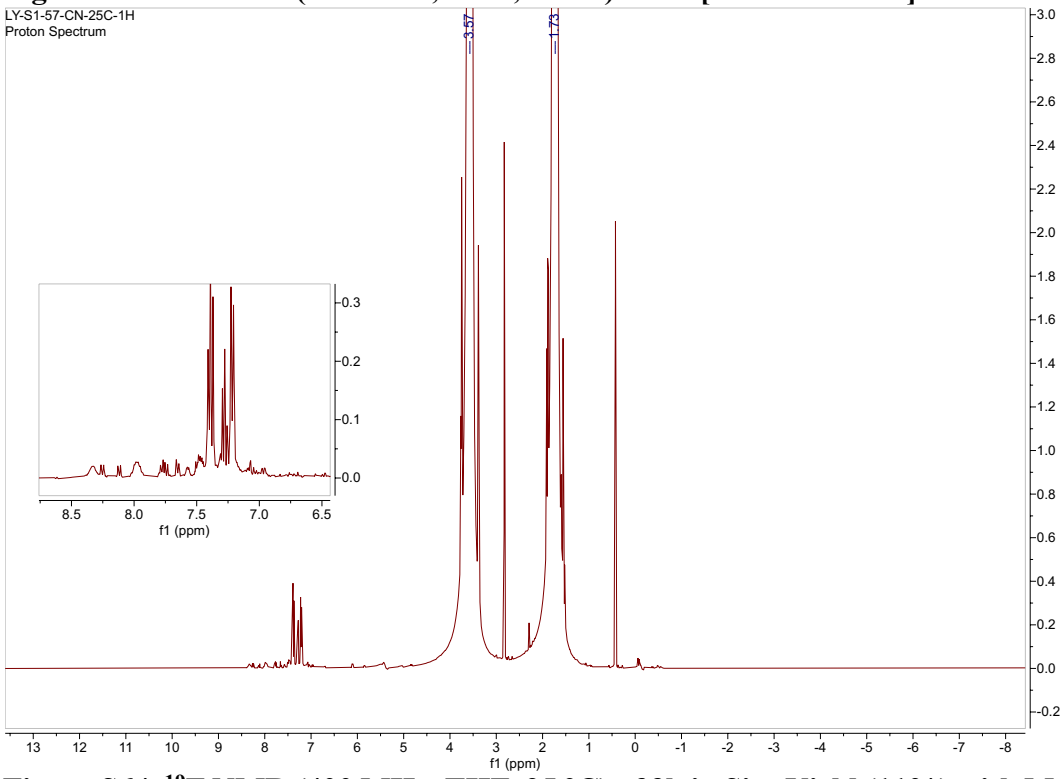


Figure S64. ^{19}F NMR (400 MHz, THF, 25 °C) of 3b in Situ Yield (11%) with Method B [25 °C reaction]

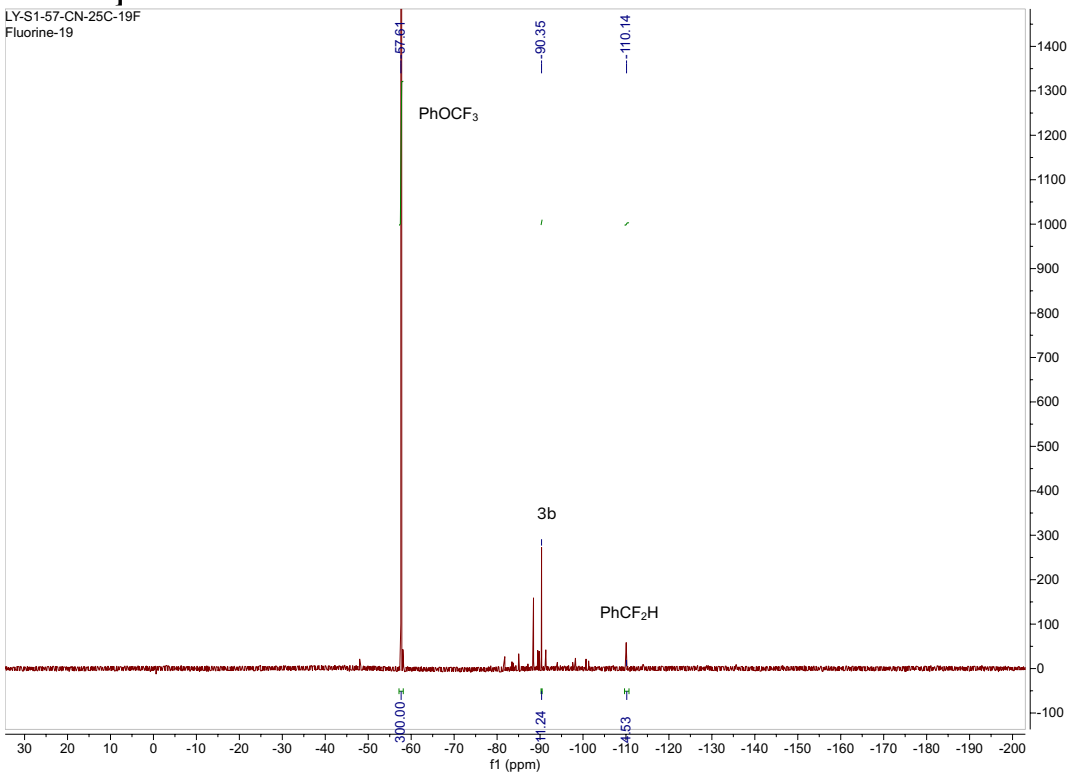


Figure S65. ^{1}H NMR (400 MHz, THF, 25 °C) of 3b [80 °C reaction]

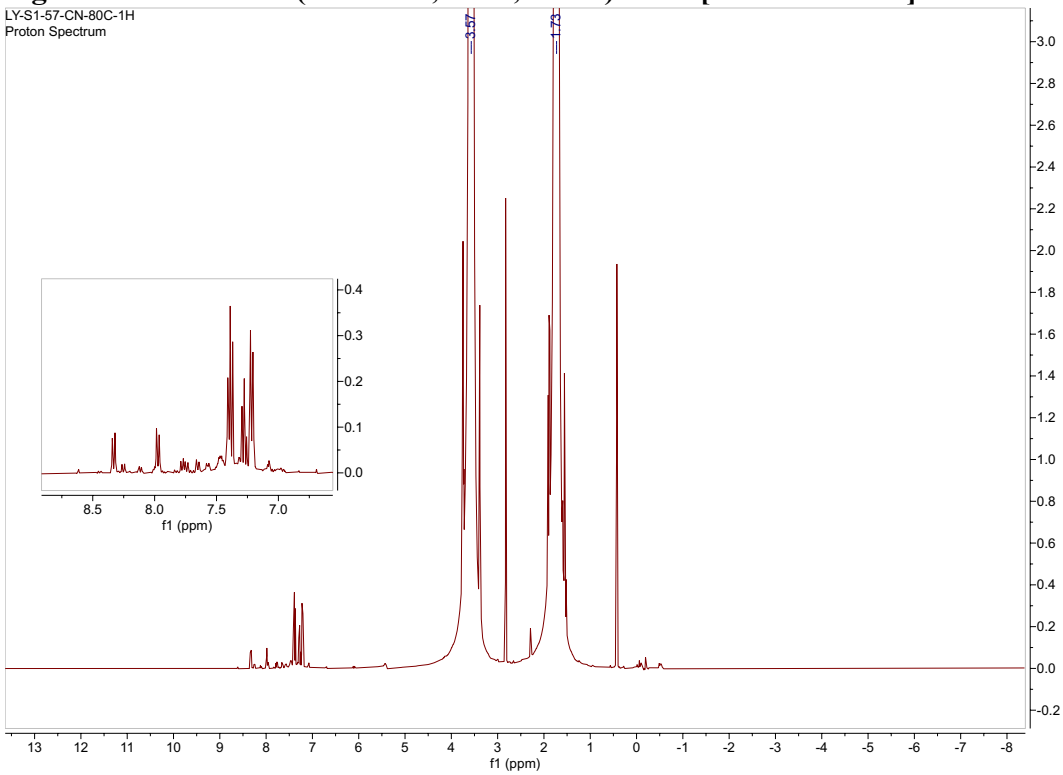
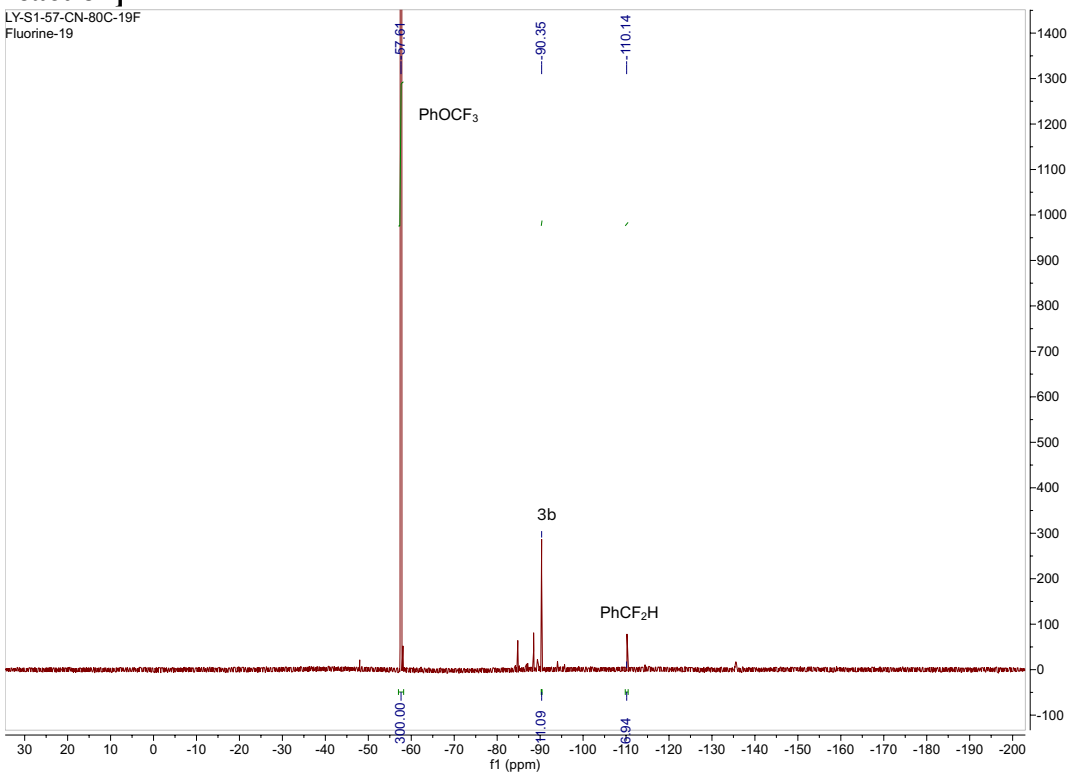
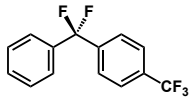


Figure S66. ^{19}F NMR (400 MHz, THF, 25 °C) of 3b in Situ Yield (11%) with Method B [80 °C reaction]



Synthesis of 3c: 1-(difluoro(phenyl)methyl)-4-(trifluoromethyl)benzene-methane



Method B was used with **1a** (0.02 mmol, 11.9 mg) and 4-nitrobenzotrifluoride (0.024 mmol). Reaction ran for 18.5 h at both 25 °C and 80 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 4% in situ yield at 25 °C and 80 °C of **3c** was obtained.

^{19}F-NMR: -89.86 (s)

Figure S67. ^{1}H NMR (400 MHz, THF, 25 °C) of 3c [25 °C reaction]

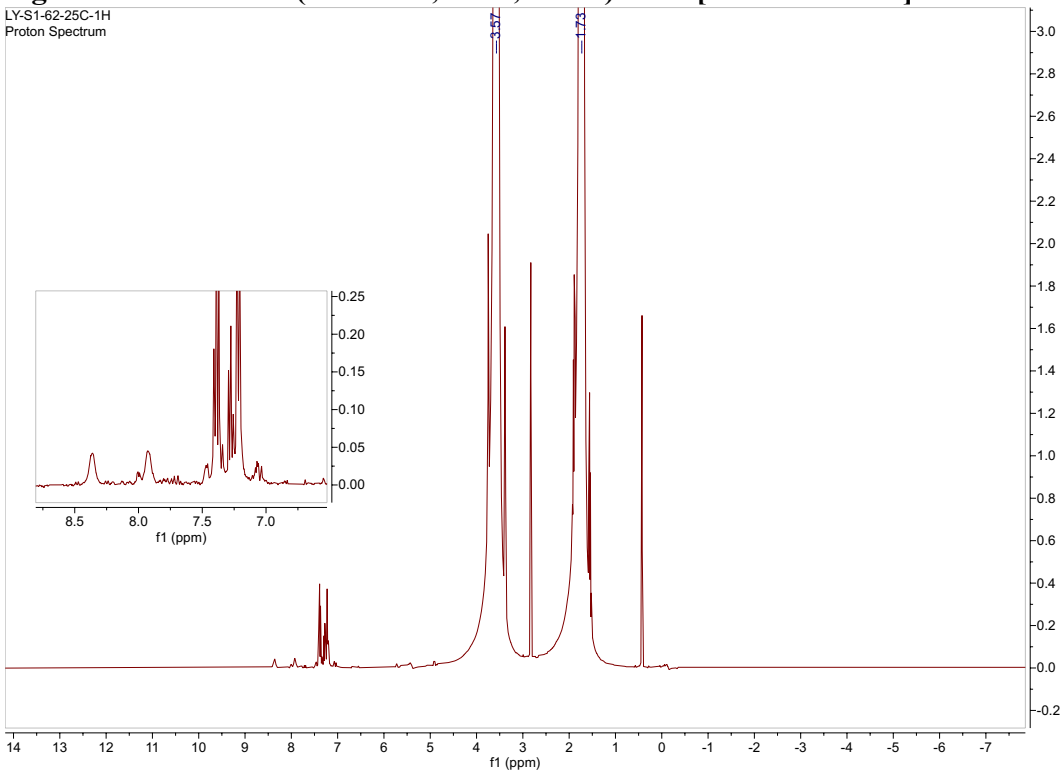


Figure S68. ^{19}F NMR (400 MHz, THF, 25 °C) of 3c in Situ Yield (4%) with Method B [25 °C reaction]

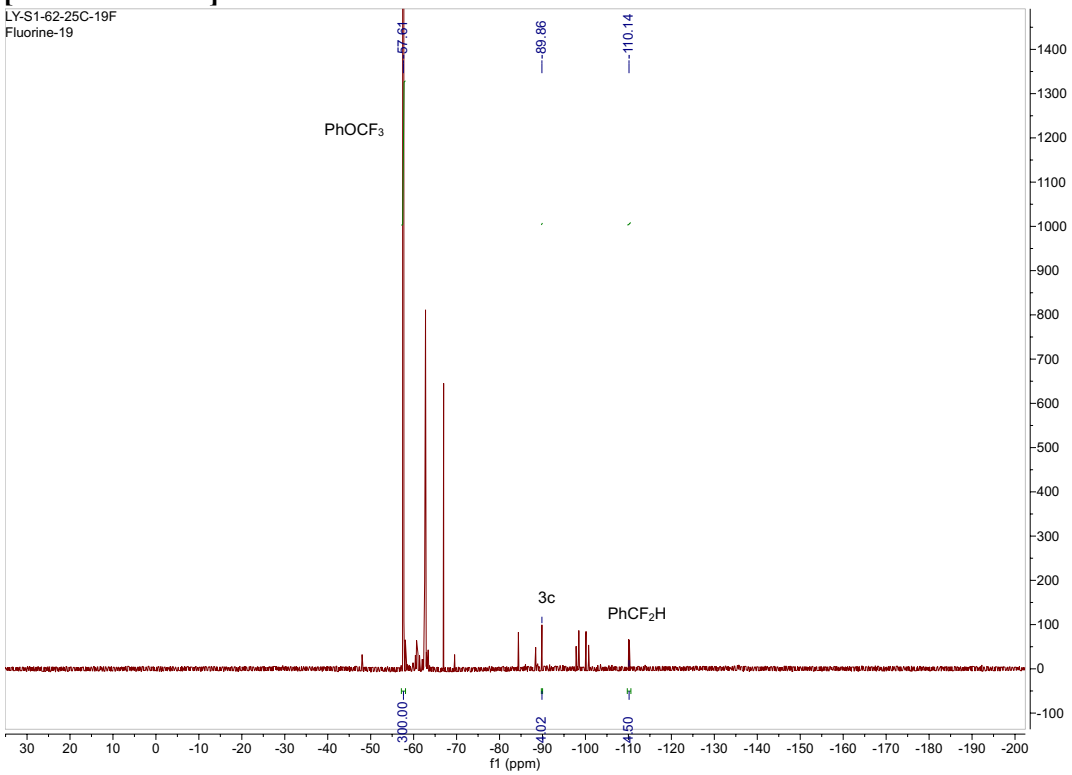


Figure S69. ^{1}H NMR (400 MHz, THF, 25 °C) of 3c [80 °C reaction]

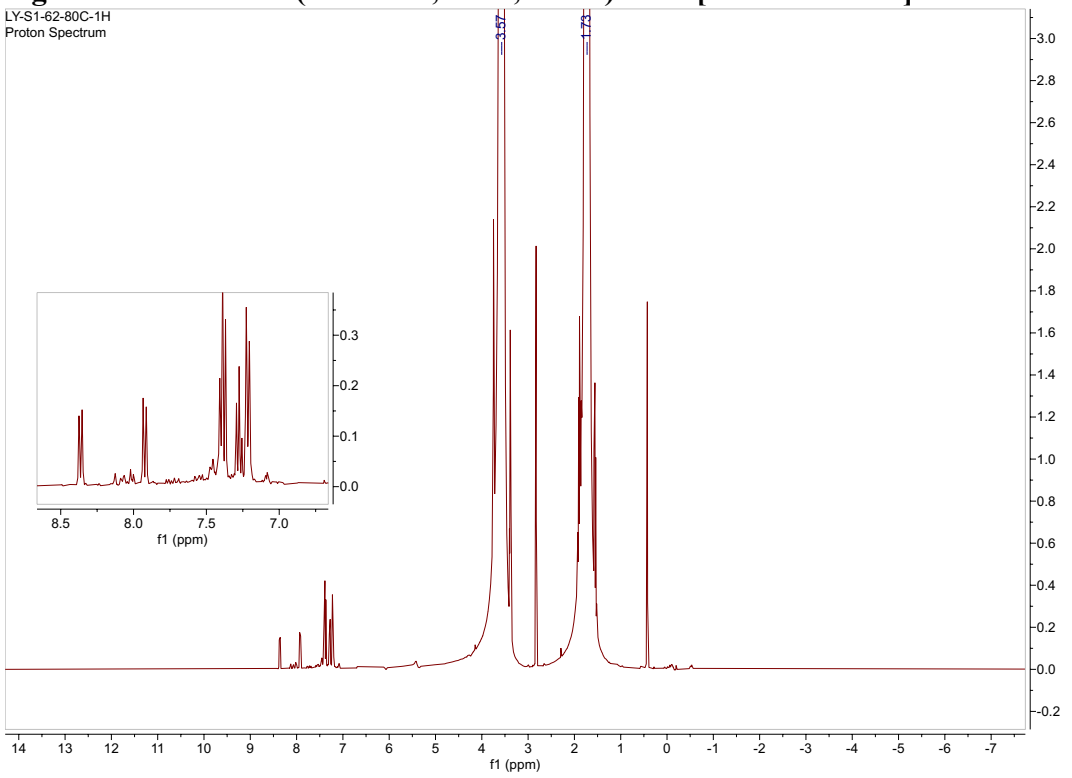
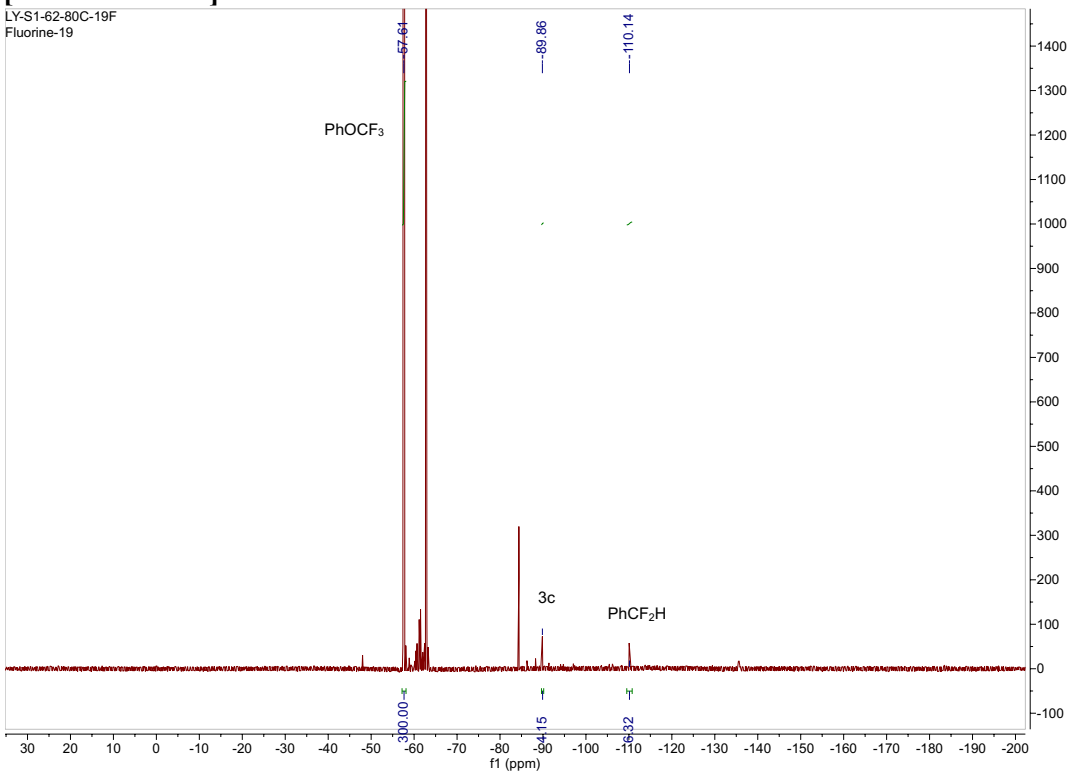
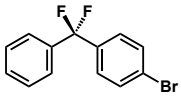


Figure S70. ^{19}F NMR (400 MHz, THF, 25 °C) of 3c in Situ Yield (4%) with Method B [80 °C reaction]



Synthesis of 3d: 1-bromo-4-(difluoro(phenyl)methyl)benzene-methane



Method B was used with **1a** (0.02 mmol, 11.9 mg) and 1-bromo-4-nitrobenzene (0.024 mmol). Reaction ran for 18.5 h at both 25 °C and 80 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 1% in situ yield at 25 °C and 2% in situ yield at 80 °C of **3d** was obtained. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[3]

Figure S71. ^{1}H NMR (400 MHz, THF, 25 °C) of 3d [25 °C reaction]

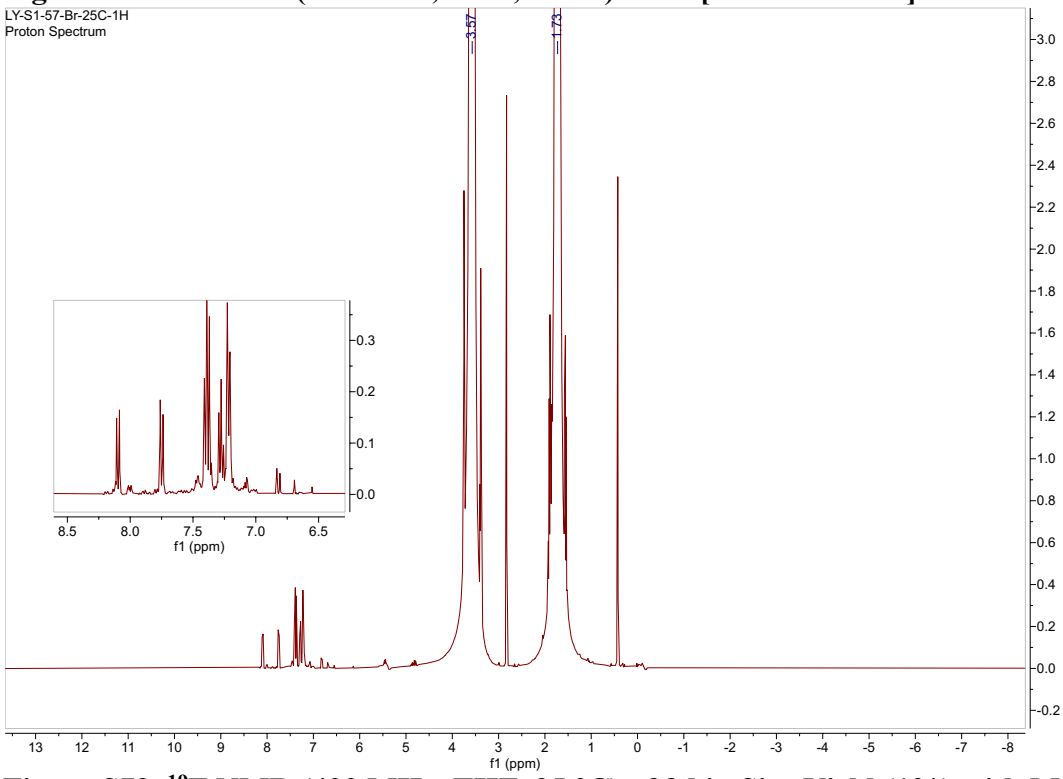


Figure S72. ^{19}F NMR (400 MHz, THF, 25 °C) of 3d in Situ Yield (1%) with Method B [25 °C reaction]

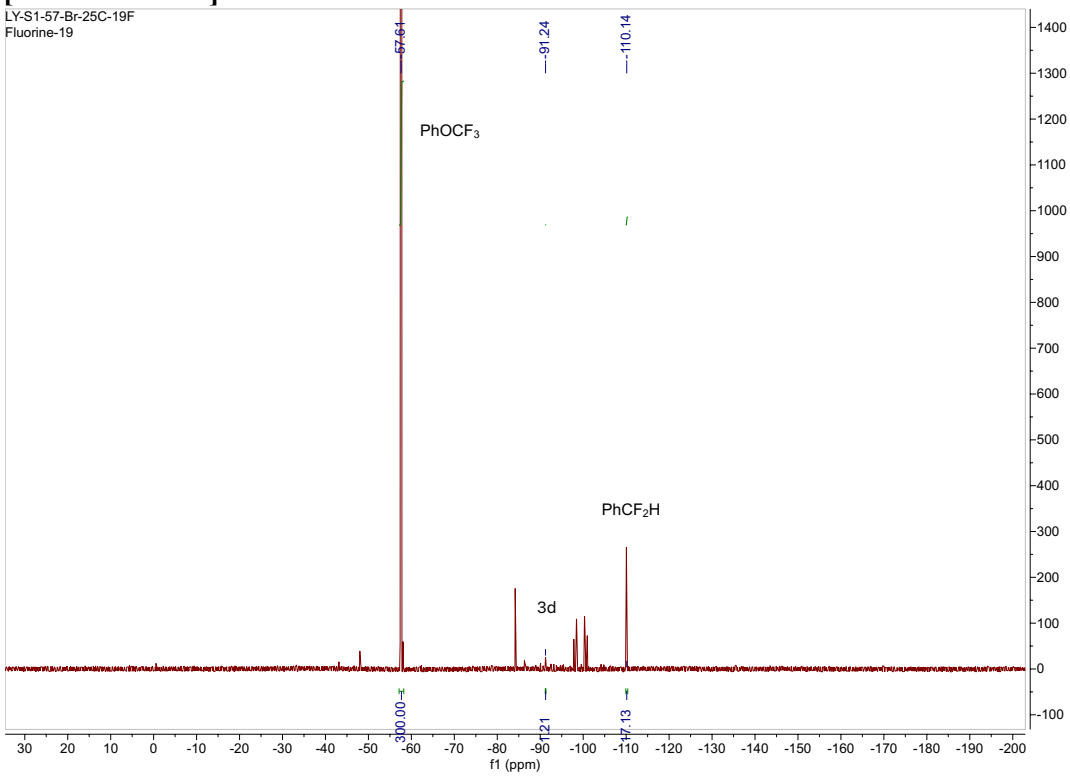


Figure S73. ^{1}H NMR (400 MHz, THF, 25 °C) of 3d [80 °C reaction]

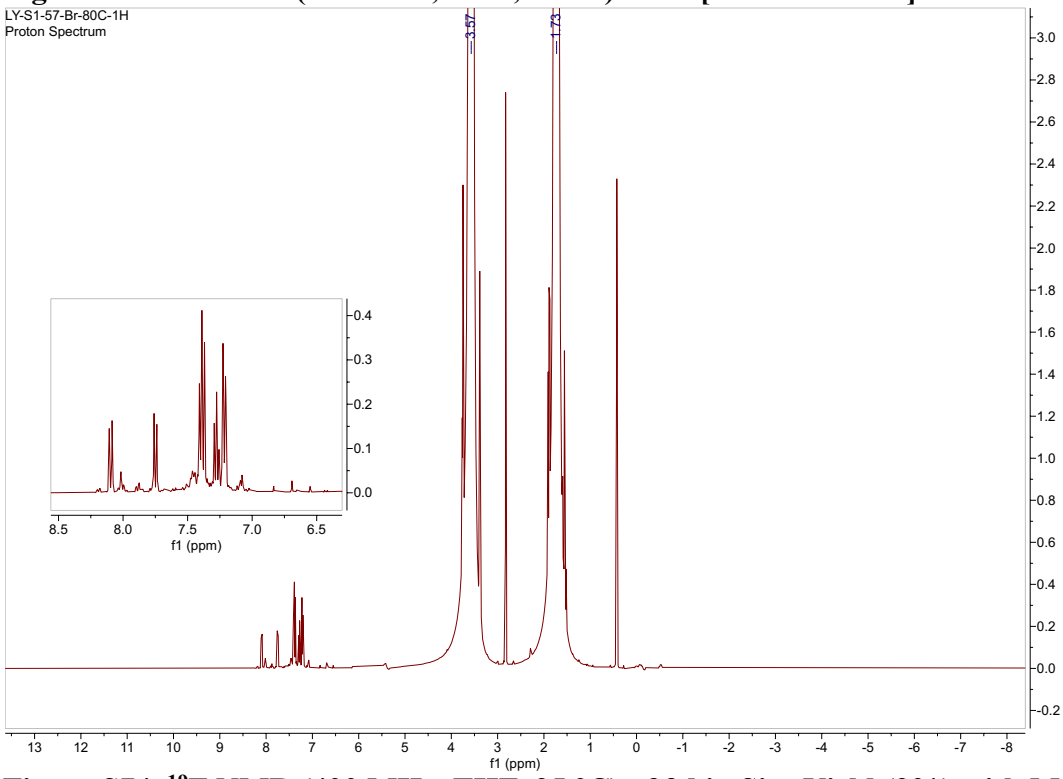
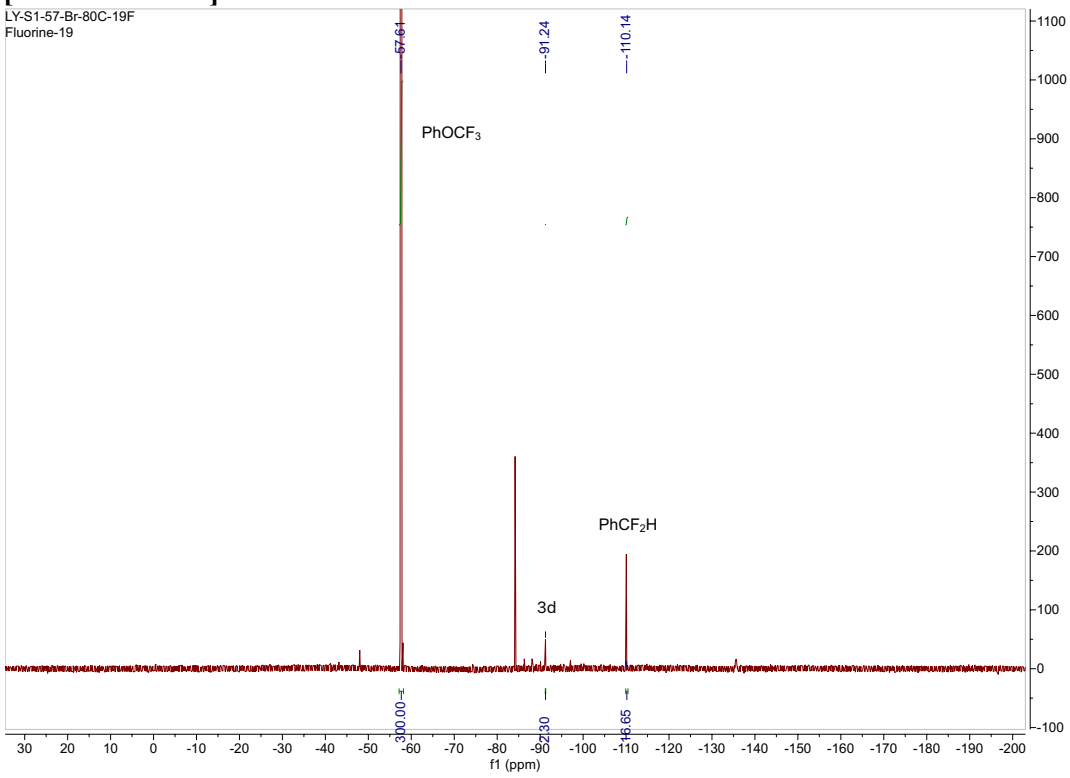
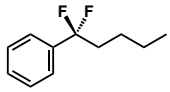


Figure S74. ^{19}F NMR (400 MHz, THF, 25 °C) of 3d in Situ Yield (2%) with Method B [80 °C reaction]



Scope in S_N2 Reactions (4a-4p)

Synthesis of 4a: (1,1-difluoropentyl)benzene



Two side-by-side reactions were performed. In two separate 8 mL scintillation vials with magnetic stir-bars, 1-bromobutane (0.024 mmol, 2.2 µL) and 1-iodobutane (0.024 mmol, 2.3 µL) were dissolved in 1 mL of toluene along with fluorobenzene (0.04 mmol, 3.8 µL) as internal standard. $[Me_6B_3N_3CF_2Ph]K$(18-c-6) **1a** (0.02 mmol) was added and the mixture, and reactions were allowed to stir at 90 °C, 1000 rpm for 30 minutes. In situ yields of 84% (bromobutane) and 83% (iodobutane) were assessed by ^{19}F NMR. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[4]

^{19}F-NMR: -95.79 (t, $J_{1H\text{-}19F}$ = 16.2 Hz).

Figure S75. ^1H NMR (400 MHz, Toluene, 25 °C) of 4a [Bromobutane]

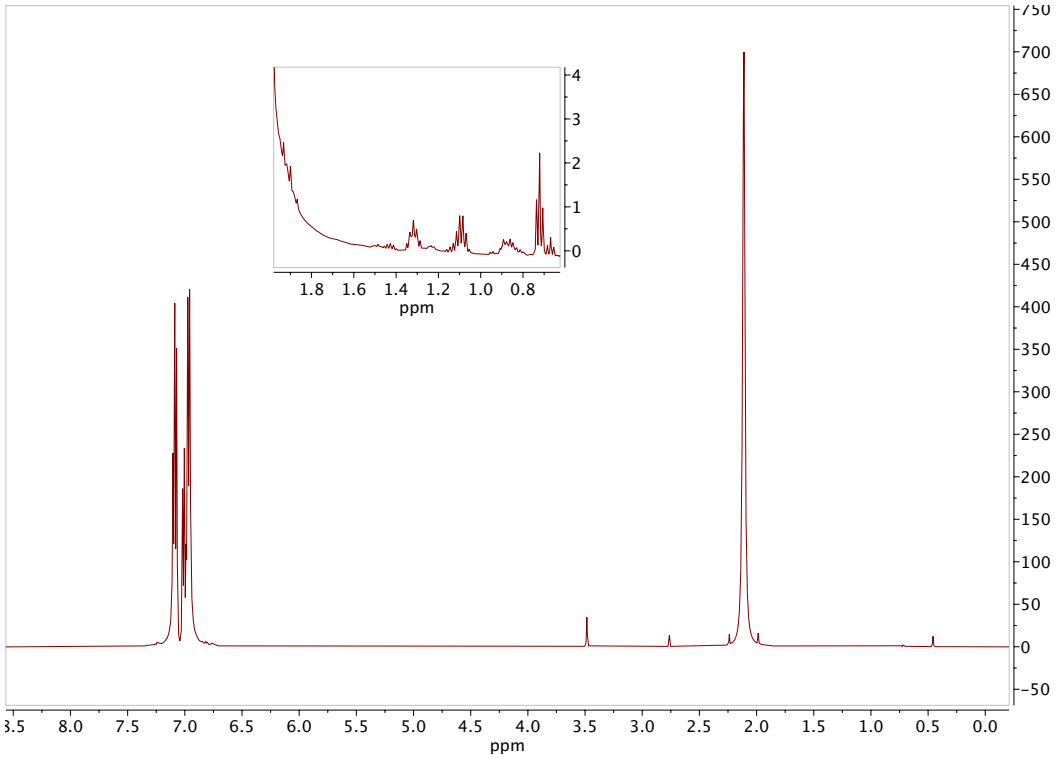


Figure S76. ^{19}F NMR (400 MHz, Toluene, 25 °C) of 4a in Situ Yield (84%) [Bromobutane]

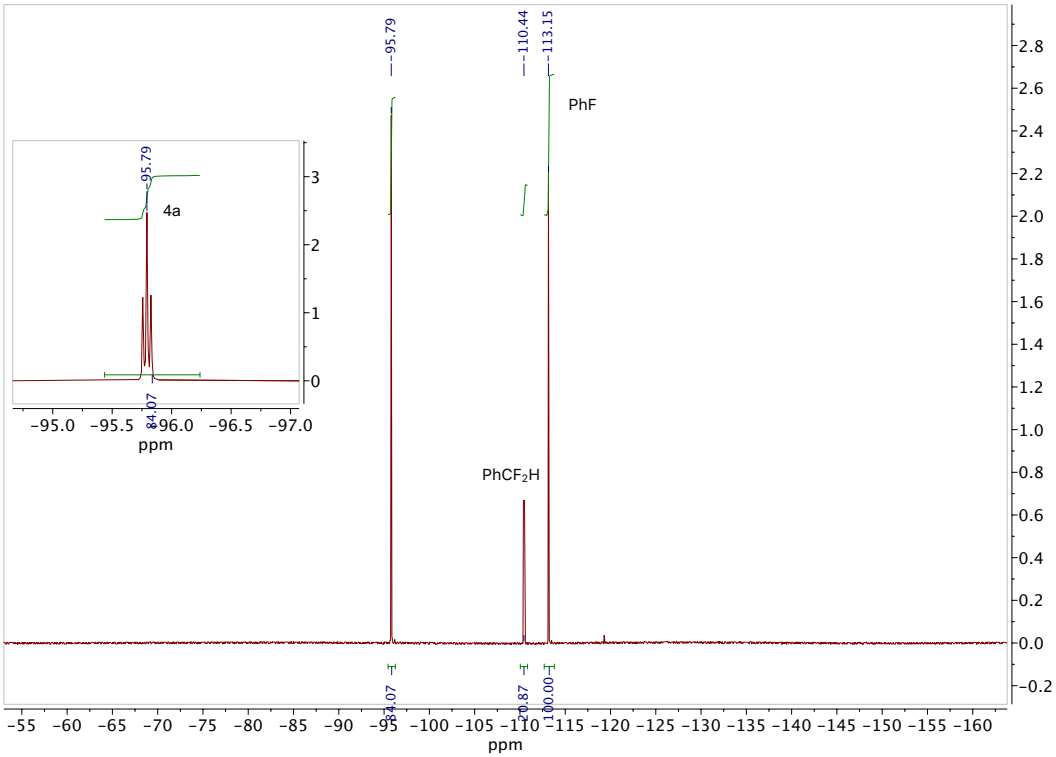


Figure S77. ^{1}H NMR (400 MHz, Toluene, 25 °C) of 4a [Iodobutane]

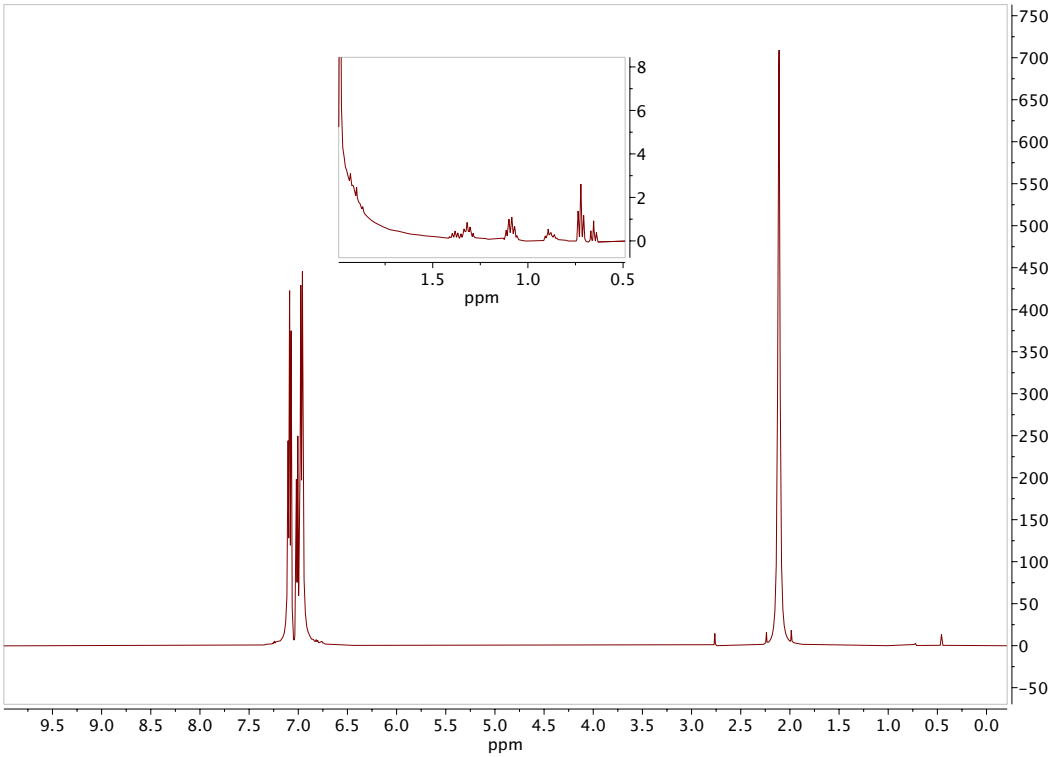
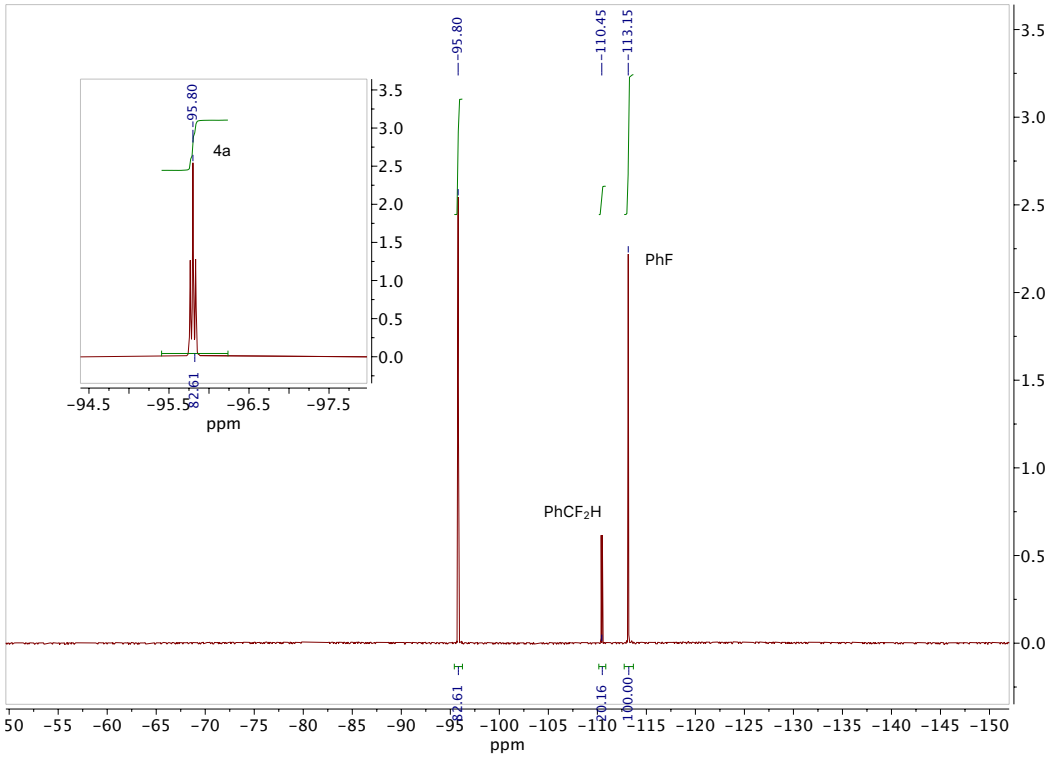


Figure S78. ^{19}F NMR (400 MHz, Toluene, 25 °C) of 4a in Situ Yield (83%) [Iodobutane]



Method C:
In a 20 mL scintillation vial, alkyl halide (0.024 mmol) was dissolved in 1 mL THF along with $PhOCF_3$ (0.04 mmol, 5.3 µL) as an inert ^{19}F NMR internal standard. $[Me_6B_3N_3CF_2Ph]K(18\text{-c-}6)$ **1a** (0.02 mmol) was added and the mixture was halved and separated into sealed NMR tubes to further react at 25 °C or 80 °C. After 18 hours, in situ yields were analyzed by ^{19}F NMR.

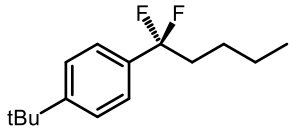
Method C*: 0.02 mmol
Vial 1: Alkyl halide (0.024 mmol) was directly weighed into an 8 mL scintillation vial.

Vial 2: In a separate 20 mL scintillation vial, **1a** (0.06 mmol, 0.02 M) and $PhOCF_3$ (0.06 mmol, 7.9 µL, 0.02 M) were dissolved in 3 mL of THF to generate a stock solution.

A 1 mL aliquot from vial 2 was transferred to vial 1. The mixture was transfered into sealed NMR tubes to further react at 25 °C. After 18 hours, in situ yields were analyzed by ^{19}F NMR.

Method D
In a glove box, to $[Me_6B_3N_3CF_2Ar]K(18\text{-crown-}6)$ **1** (0.375 mmol, 1.50 equiv.) in a 20 ml dried scintillation vial, were added alkyl halide (0.250 mmol, 1.00 equiv.) and toluene (12.5 ml), and the mixture was stirred at 90 °C for 12 h. The reaction was quenched with a saturated aqueous solution of NH_4Cl (2.0 ml). The aqueous layer was extracted with CH_2Cl_2 (8.0 ml × 3). The combined organic layers were dried over anhydrous $MgSO_4$. The filtrate was concentrated in vacuo and the residue was purified by preparative TLC or column chromatography on silica gel.

Synthesis of 4b: 1-(*tert*-butyl)-4-(1,1-difluoropentyl)benzene



Method D was used with **1b** (0.375 mmol, 234 mg) and 1-iodobutane (0.25 mmol, 28.5 µL). Reaction ran for 12 h at 90 °C. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (100:1), affording **4b** in 59% yield (35.2 mg) as a colorless liquid.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.43 (d, J = 8.3 Hz, 2H), 7.39 (d, J = 8.3 Hz, 2H), 2.19-2.04 (m, 2H), 1.49-1.38 (m, 2H), 1.38-1.34 (m, 2H), 1.33 (s, 9H), 0.89 (t, J = 7.2 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 152.76, 134.87 (t, J = 26.7 Hz), 125.39, 124.83 (t, J = 6.0 Hz), 123.44 (t, J = 241.3 Hz), 121.52, 38.91 (t, J = 27.6 Hz), 34.84, 31.40, 29.86, 24.73 (t, J = 3.9 Hz), 22.56, 13.97.

^{19}F NMR (565 MHz, $CDCl_3$) δ -94.69 (t, J = 16.2 Hz).

Figure S79. ^{1}H NMR (600 MHz, $CDCl_3$, 25 °C) of 4b

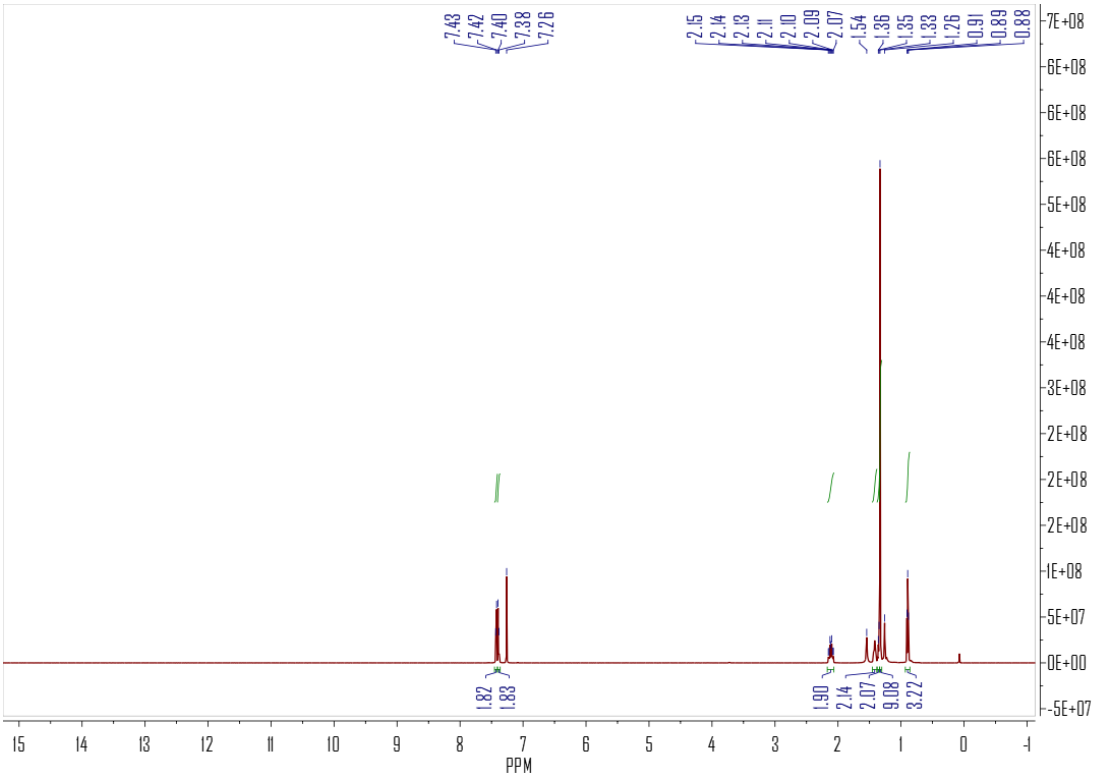


Figure S80. ^{13}C NMR (151 MHz, $CDCl_3$, 25 °C) of 4b

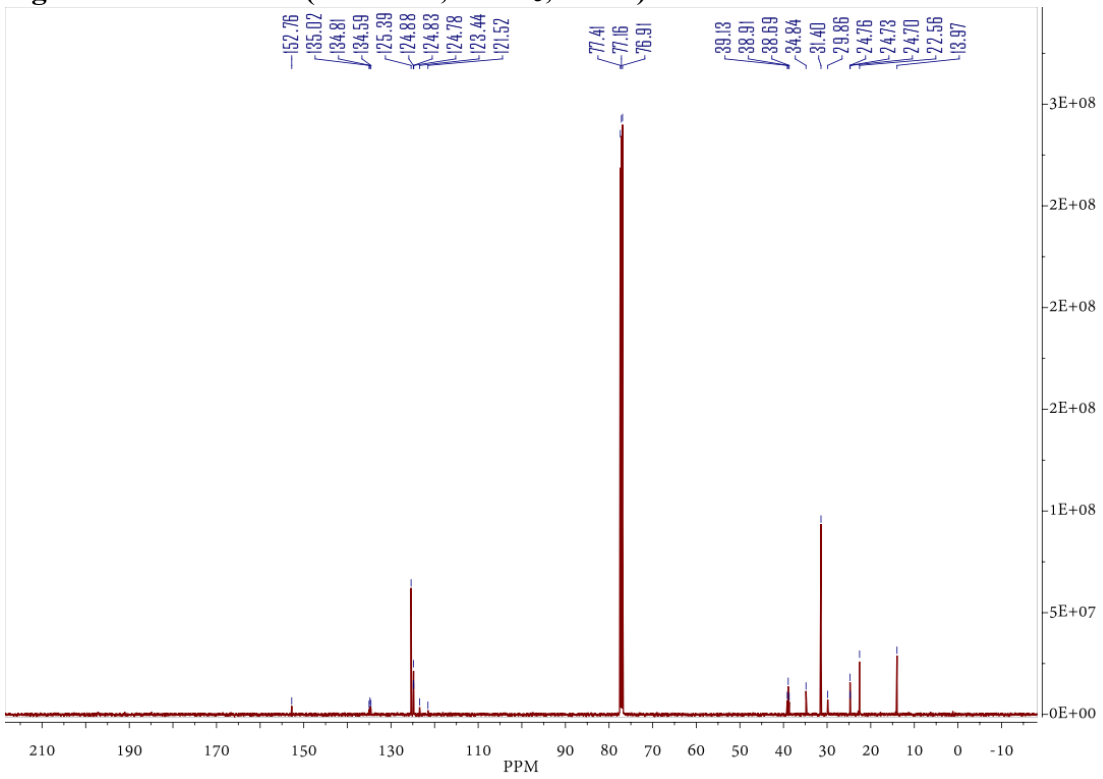
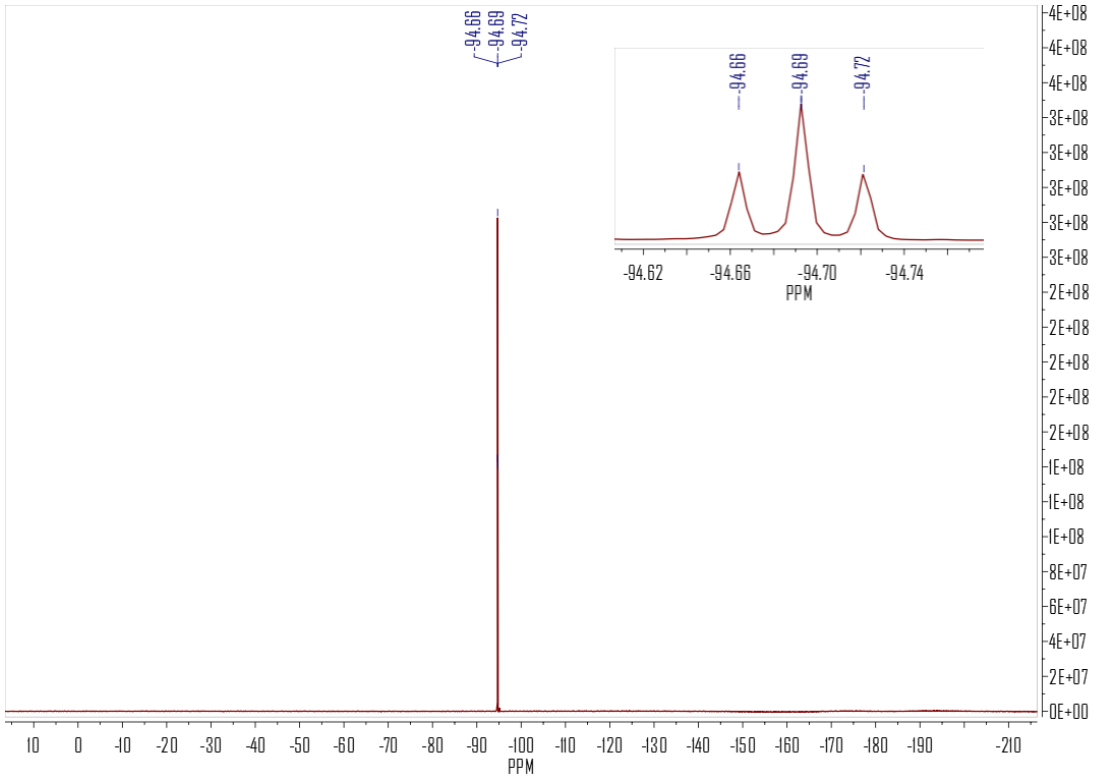
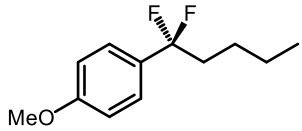


Figure S81. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4b



Synthesis of 4c: 1-(1,1-difluoropentyl)-4-methoxybenzene



Method D was used with **1c** (0.375 mmol, 234 mg) and 1-iodobutane (0.25 mmol, 28.5 µL). Reaction ran for 12 h at 90 °C. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (100:1), affording **4c** in 70% yield (37.6 mg) as a colorless liquid.

^{1}H-NMR (600 MHz, $CDCl_3$) δ 7.36 (d, J = 8.6 Hz, 2H), 6.89 (d, J = 8.6 Hz, 2H), 3.81 (s, 3H), 2.13-2.03 (m, 2H), 1.40-1.33 (m, 2H), 1.33-1.28 (m, 2H), 0.86 (t, J = 7.2 Hz, 3H).

^{13}C-NMR (151 MHz, $CDCl_3$) δ 160.58, 130.03 (t, J = 27.2 Hz), 126.57 (t, J = 6.2 Hz), 123.45 (t, J = 241.4 Hz), 113.79, 55.46, 38.95 (t, J = 28.0 Hz), 24.86 (t, J = 3.9 Hz), 22.53, 13.96.

^{19}F-NMR (565 MHz, $CDCl_3$) δ -93.54 (t, J = 16.1 Hz).

GC-MS (EI): calcd. for [M] ($C_{12}H_{16}F_2O$) = 214.12, found: 214.11.

Figure S82. ^{1}H NMR (600 MHz, $CDCl_3$, 25 °C) of 4c

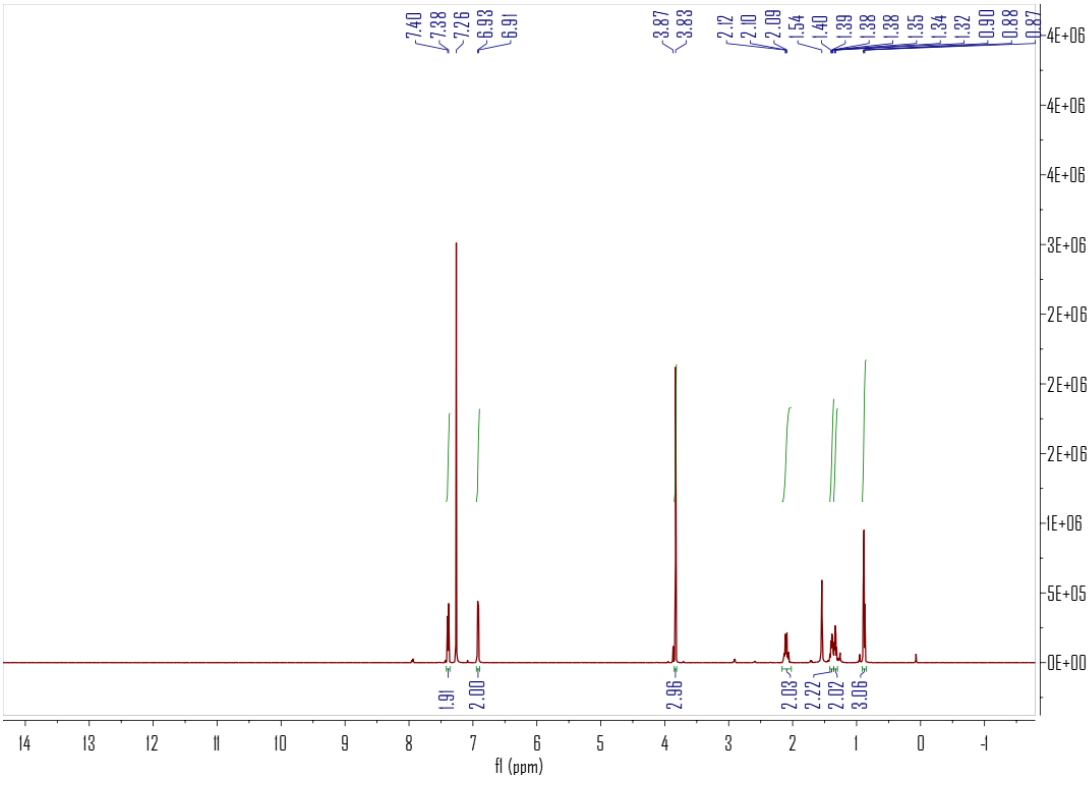


Figure S83. ^{13}C NMR (151 MHz, $CDCl_3$, 25 °C) of 4c

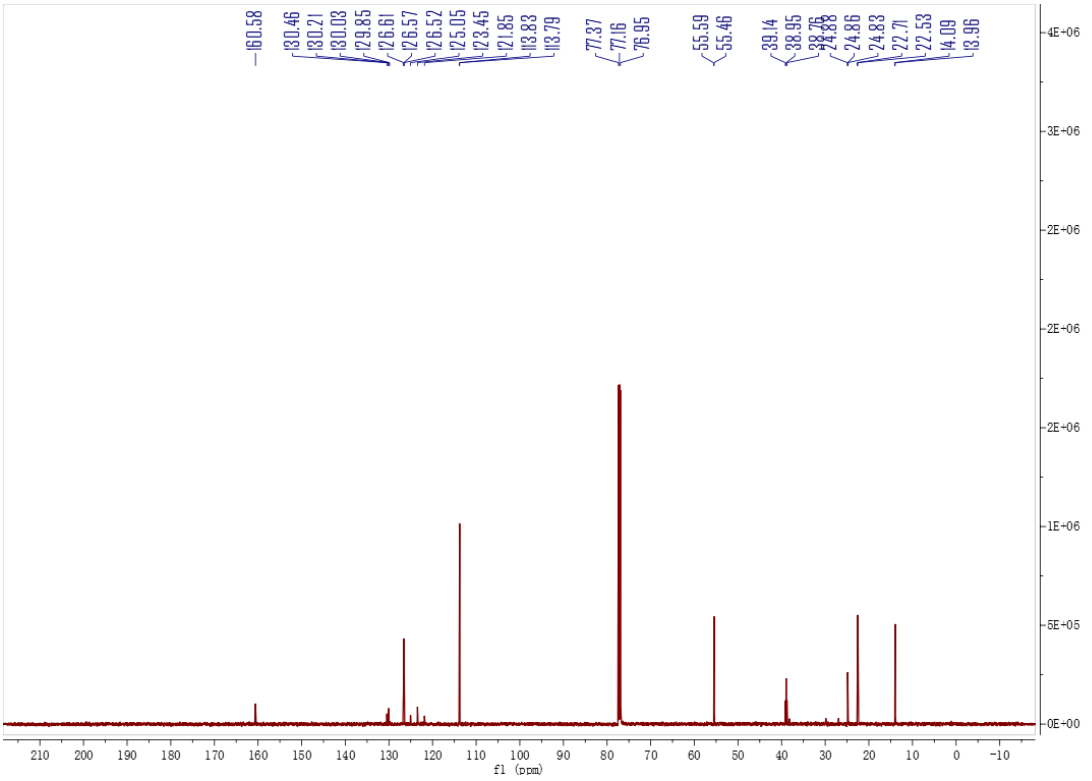
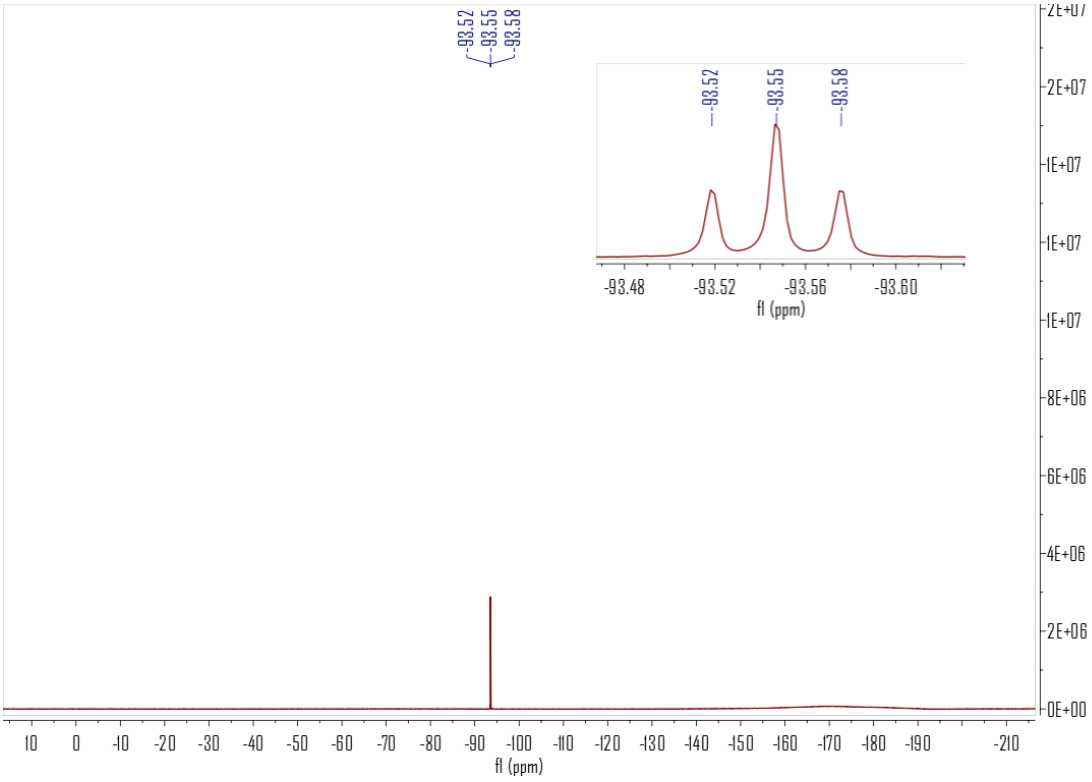
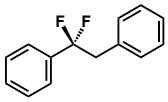


Figure S84. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4c



Synthesis of 4d: (1,1-difluoroethane-1,2-diyl)dibenzene



In a 20 mL scintillation vial with a magnetic stir bar **1a** (0.3 mmol, 179 mg), benzyl bromide (0.36 mmol, 43 µL) and $PhOCF_3$ (0.1 mmol, 13.2 µL) were dissolved in 15 mL of THF. Reaction stirred for 18 h at 80 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 52% in situ yield was obtained. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[5] The reaction mixture dry loaded onto a 25g Biotage column and eluted with a 100% hexanes at the rate of 25 mL/min, 10-12 column volumes for isolation of **4d**, 22.9 mg 35% yield. After NMR analysis, **4d** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (20.0 µL). 69% purity by mass was found (compared to 22.9 mg sample).

^{1}H-NMR ($CDCl_3$): 3.41 (H_a, 2H, t, $J_{1H\text{-}19F}$=15.9 Hz) , 7.11 (H_b, 2H), 7.25 (H_c, 2H, OL), 7.25 (H_d, 1H, OL), 7.34 (H_e, 2H, OL), 7.36 (H_f, 2H, OL), 7.40 (H_g, 1H, OL).

^{13}C-NMR: 46.01 (C_a, t, $J_{13C\text{-}19F}$=28.6 Hz), 122.07 (C_b, t, $J_{13C\text{-}19F}$=244.0 Hz), 125.34 (C_c, t, $J_{13C\text{-}19F}$=6.2 Hz), 127.39 (C_d), 128.28 (C_e), 128.30 (C_f), 129.76 (C_g, t, $J_{13C\text{-}19F}$=1.8 Hz), 130.76 (C_h), 132.79 (C_i, t, $J_{13C\text{-}19F}$=4.1 Hz), 136.98 (C_j, t, $J_{13C\text{-}19F}$=26.6 Hz).

^{19}F-NMR: -94.71 (t, $J_{1H\text{-}19F}$=15.9 Hz)

MS EI: 218.0907 (M+).

Figure S85. ^{1}H NMR (500 MHz, $CDCl_3$, 25 °C) of 4d

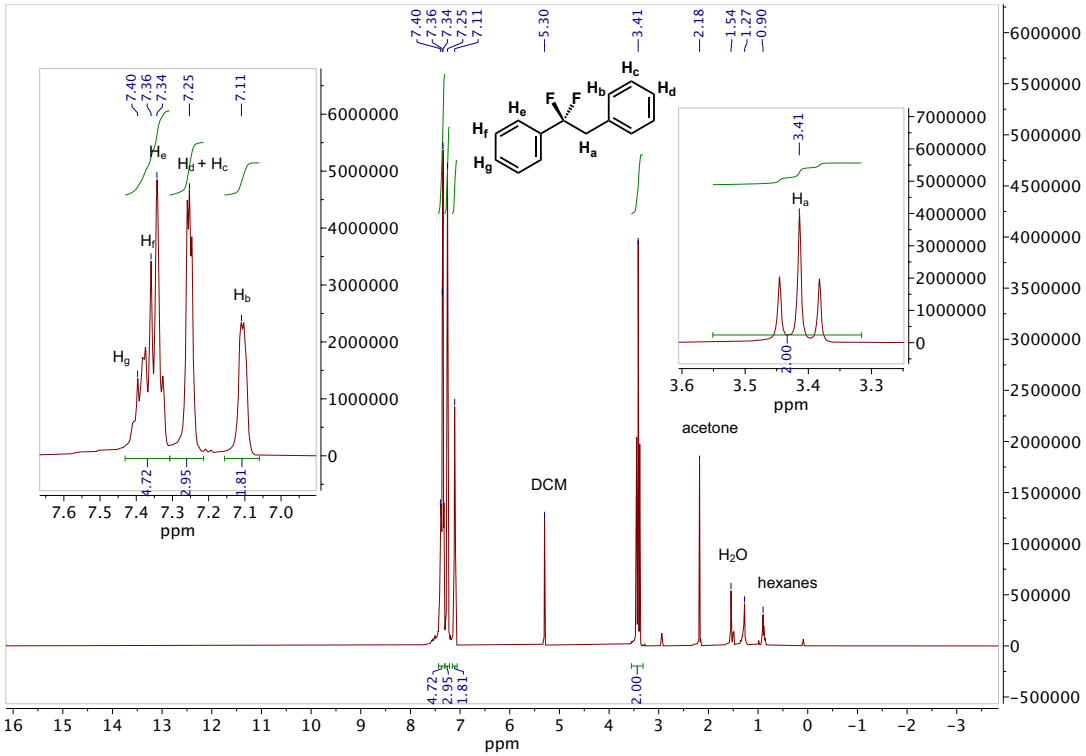


Figure S86. ^{13}C NMR (500 MHz, $CDCl_3$, 25 °C) of 4d

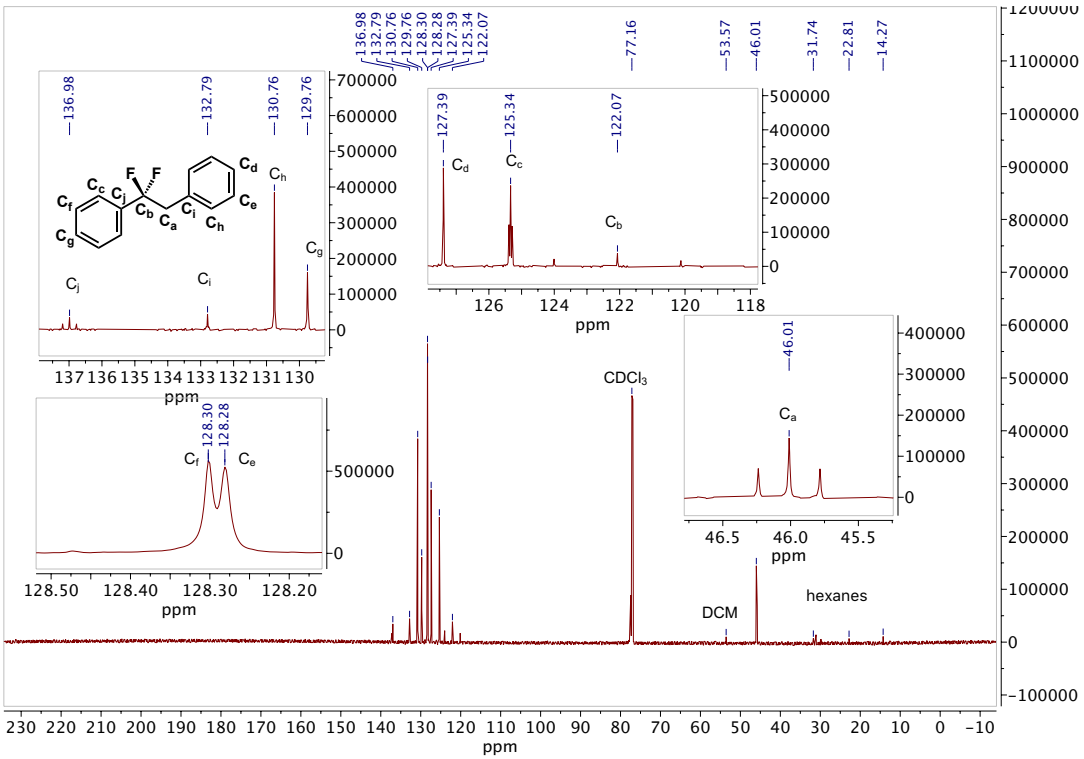


Figure S87. ^{1}H-^{1}H COSY (500 MHz, $CDCl_3$, 25 °C) of 4d

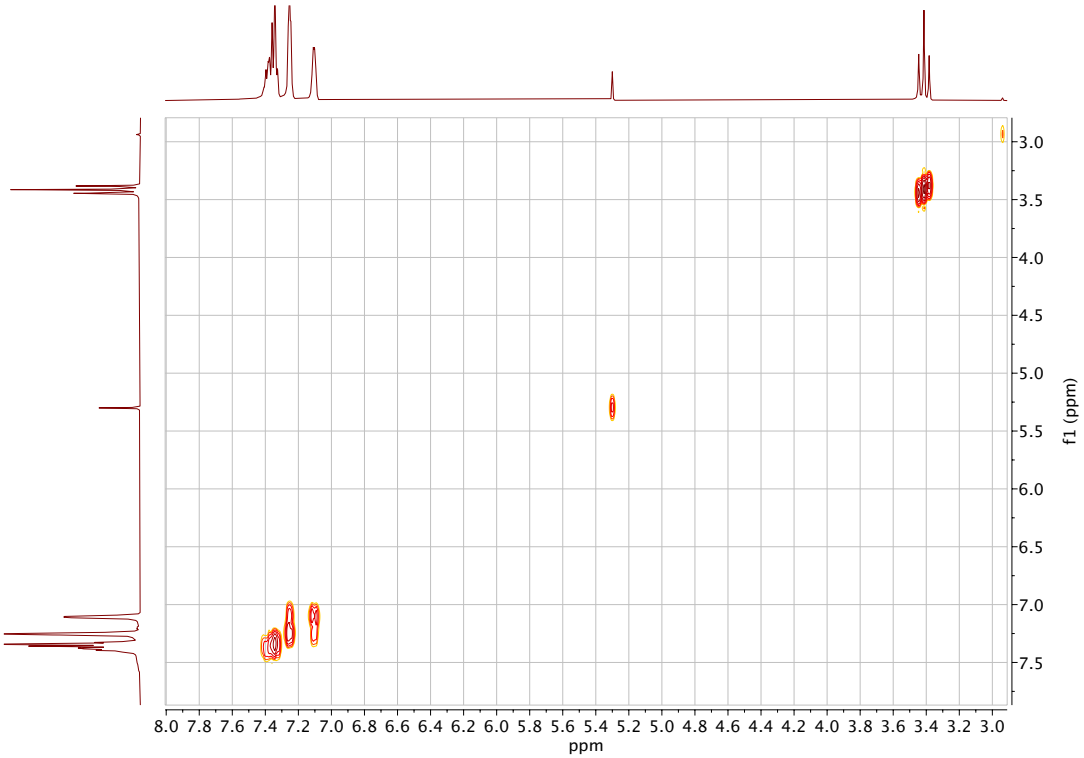


Figure S88. ^{1}H-^{13}C HSQC (500 MHz, $CDCl_3$, 25 °C) of 4d

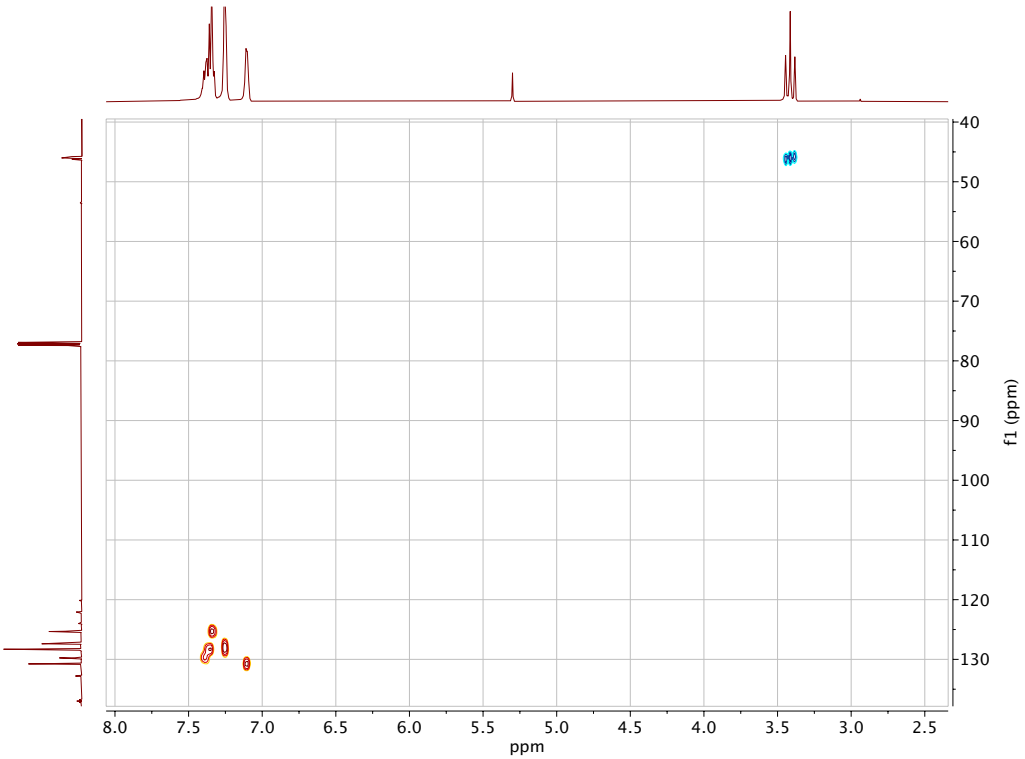


Figure S89. ^{1}H-^{13}C HMBC (500 MHz, $CDCl_3$, 25 °C) of 4d

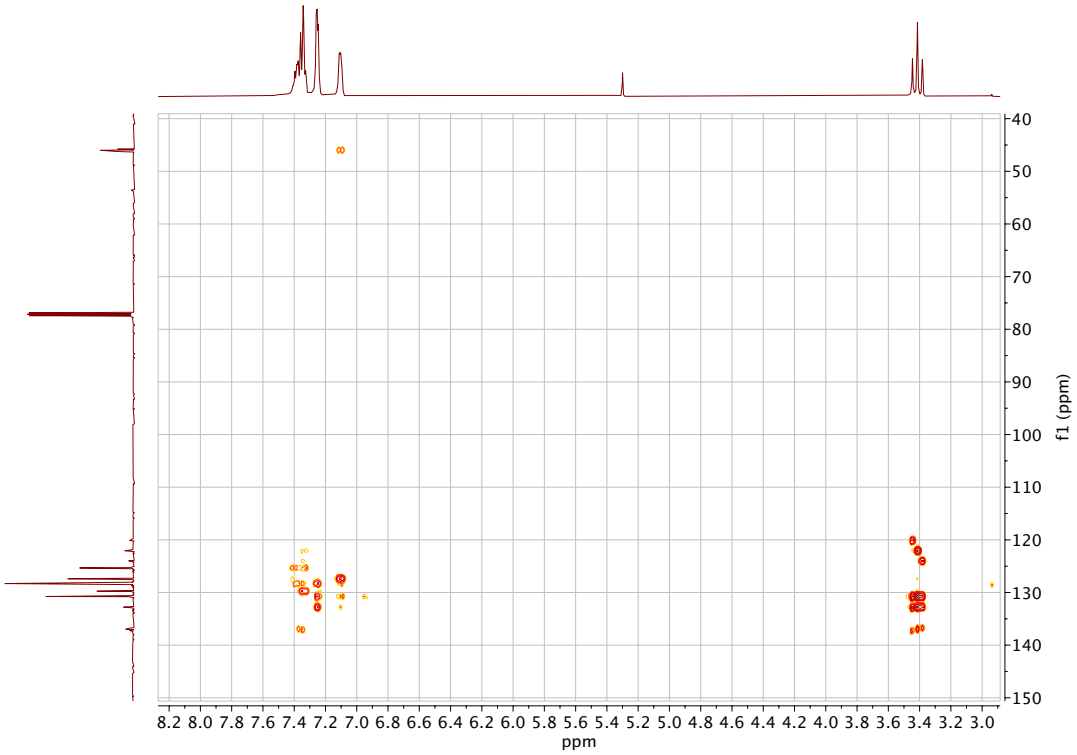


Figure S90. ^{19}F NMR (400 MHz, THF, 23 °C) of 4d in Situ Yield (52%)

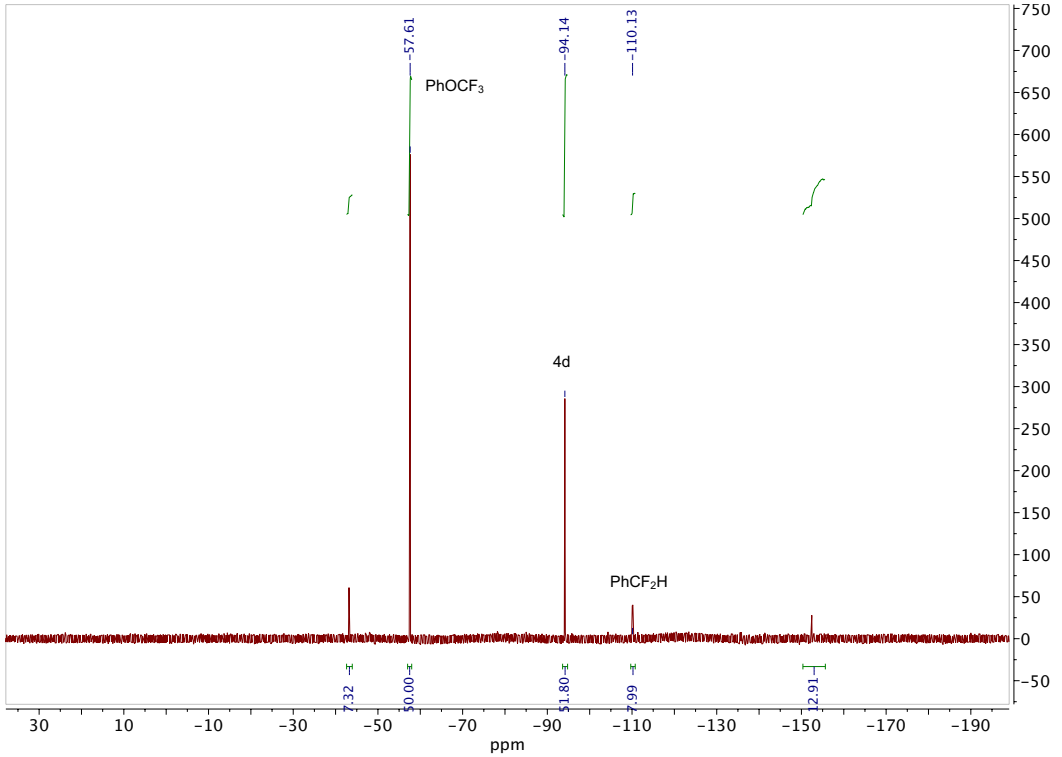
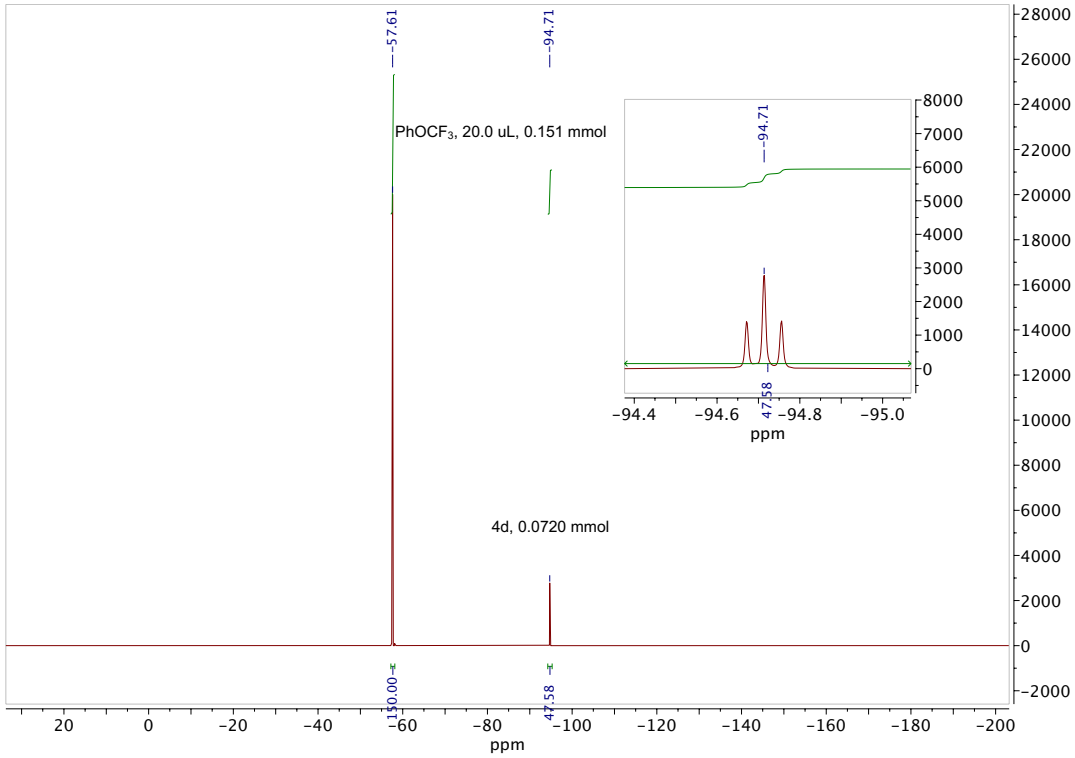
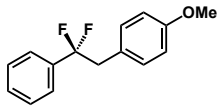


Figure S91. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 4d (69% purity)



Synthesis of 4e: 1-(2,2-difluoro-2-phenylethyl)-4-methoxybenzene



Method C was used with **1a** (0.02 mmol, 11.9 mg) and 4-methoxybenzyl bromide (0.024 mmol). Reaction ran for 18 h at both 25 °C and 80 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 9% in situ yield at 25 °C and 15% in situ yield at 80 °C of **4e** was obtained. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[6]

^{19}F-NMR: -94.33 (t, $J_{1H\text{-}19F}$ = 16.0 Hz)

Figure S92. ^{1}H NMR (400 MHz, THF, 25 °C) of 4e [25 °C reaction]

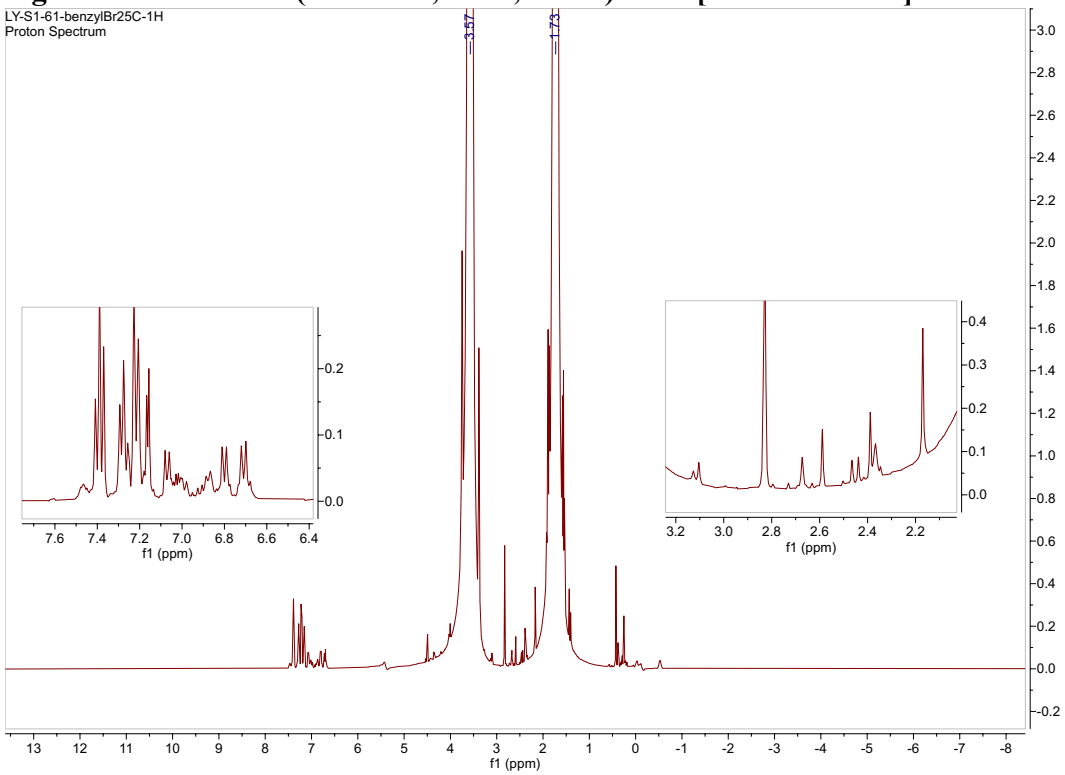


Figure S93. ^{19}F NMR (400 MHz, THF, 25 °C) of 4e in Situ Yield (9%) with Method C [25 °C reaction]

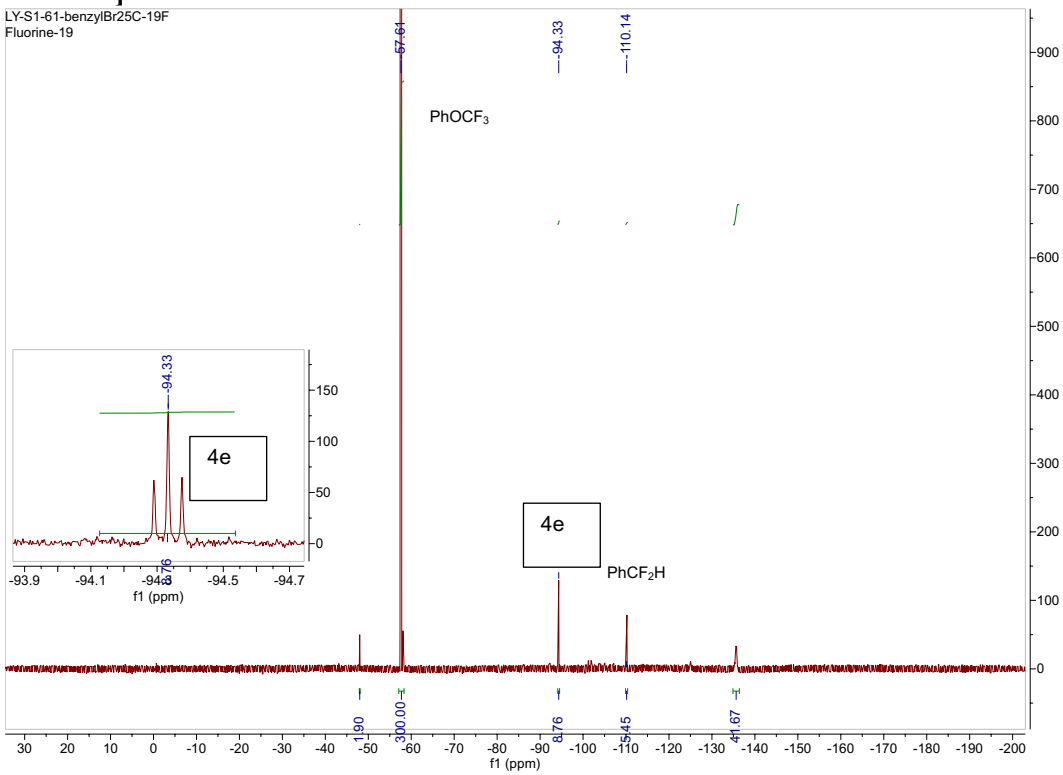


Figure S94. ^{1}H NMR (400 MHz, THF, 25 °C) of 4e [80 °C reaction]

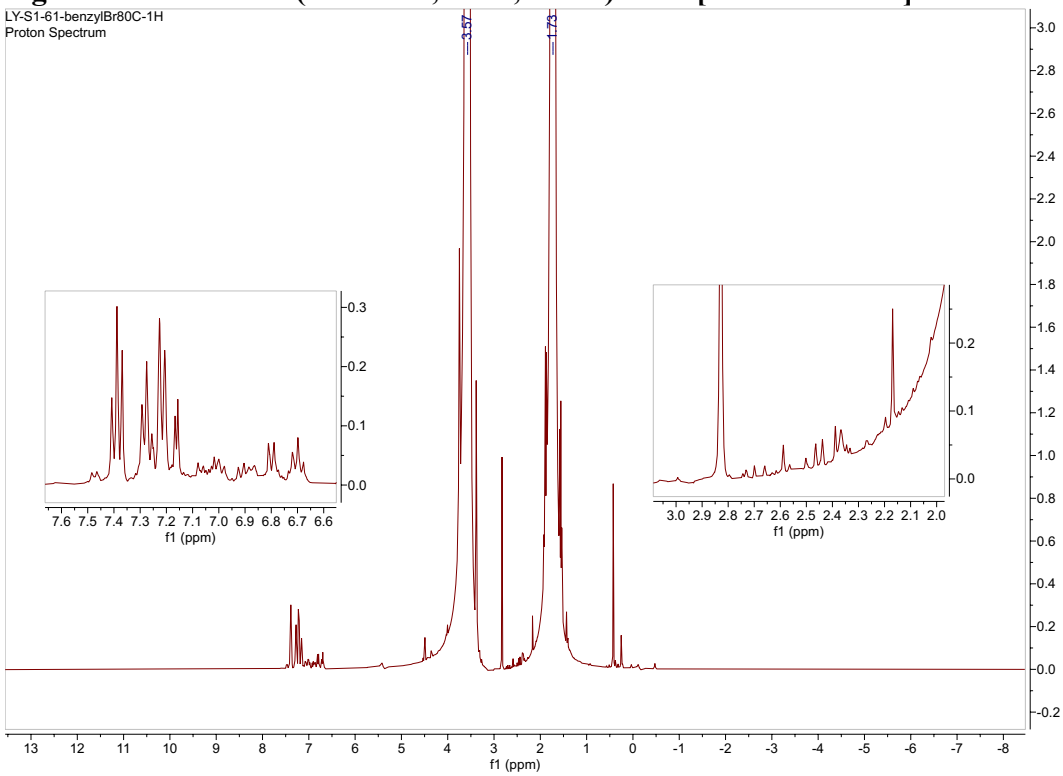
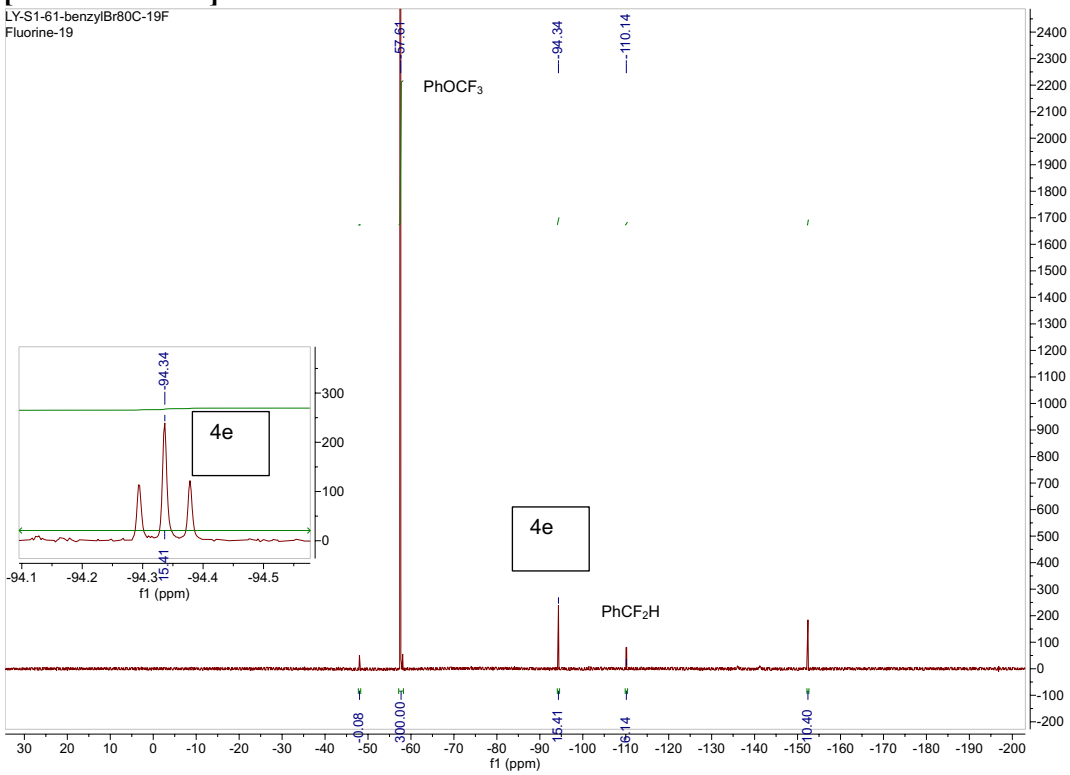
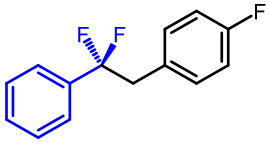


Figure S95. ^{19}F NMR (400 MHz, THF, 25 °C) of 4e in Situ Yield (15%) with Method C [80 °C reaction]



Synthesis of 4f: 1-(2,2-difluoro-2-phenylethyl)-4-fluorobenzene



Method D was used with **1a** (0.375 mmol, 234 mg) and 1-(bromomethyl)-4- fluorobenzene (0.25 mmol, 47.3 mg). Reaction ran for 12 h at 90 °C. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (100:1), affording **4f** in 19% yield (11.1 mg) as a white solid.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.41 – 7.33 (m, 3H), 7.31 (d, J = 7.5 Hz, 2H), 7.10 – 7.01 (m, 2H), 6.96 – 6.86 (m, 2H), 3.37 (t, J = 15.6 Hz, 2H).
^{13}C NMR (151 MHz, $CDCl_3$) δ 162.36 (d, J = 245.7 Hz), 136.77 (t, J = 26.5 Hz), 132.26 (d, J = 8.0 Hz), 129.86, 128.37, 125.30 (t, J = 6.2 Hz), 121.92 (t, J = 244.1 Hz), 115.27, 115.13, 45.21 (t, J = 28.9 Hz).
^{19}F NMR (565 MHz, $CDCl_3$) δ -95.37 (t, J = 15.1 Hz, 2F), -115.43 (1F).
GC-MS (EI): calcd. for [M] ($C_{14}H_{11}F_3$) = 236.08, found: 236.08.

Figure S96. ^{1}H-NMR (600 MHz, $CDCl_3$, 25 °C) of 4f

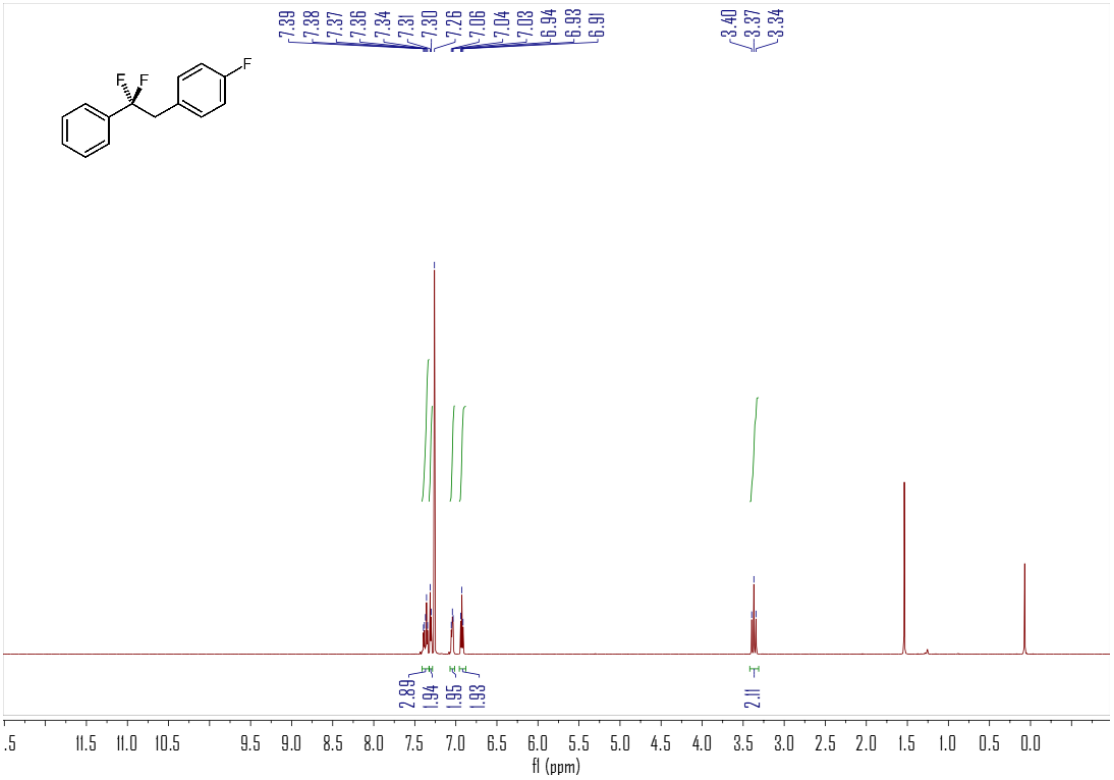


Figure S97. ^{13}C-NMR (151 MHz, $CDCl_3$, 25 °C) of 4f

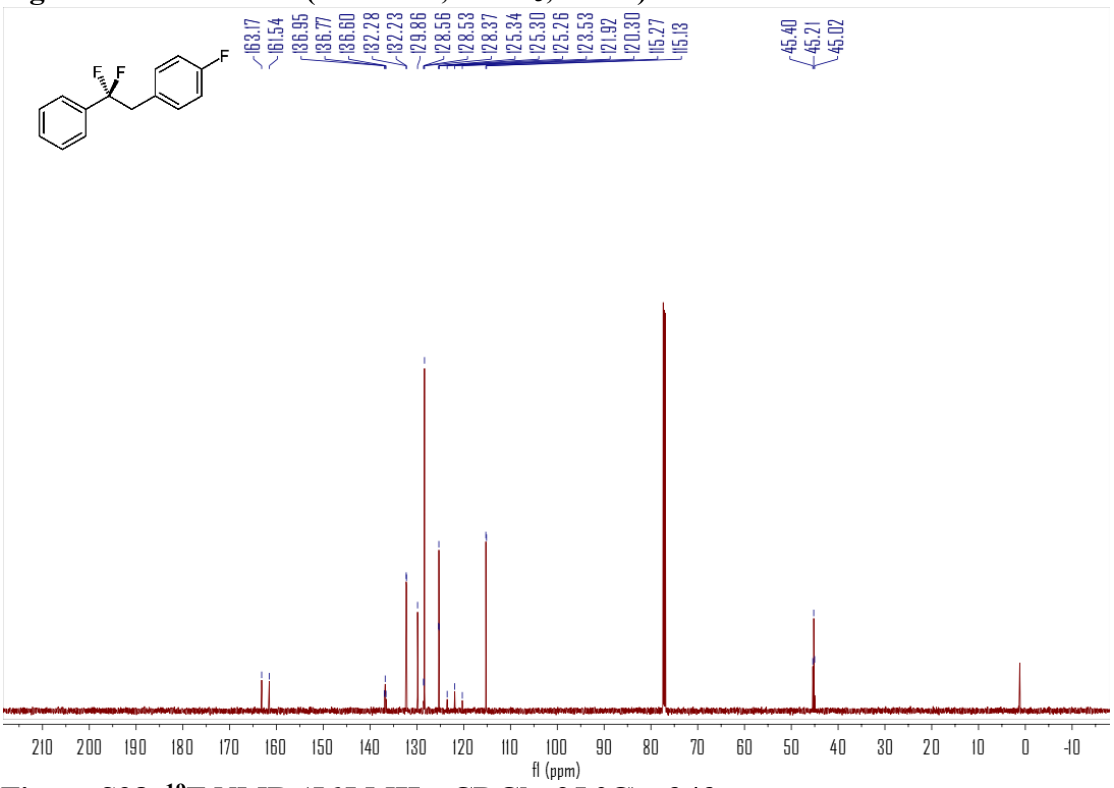
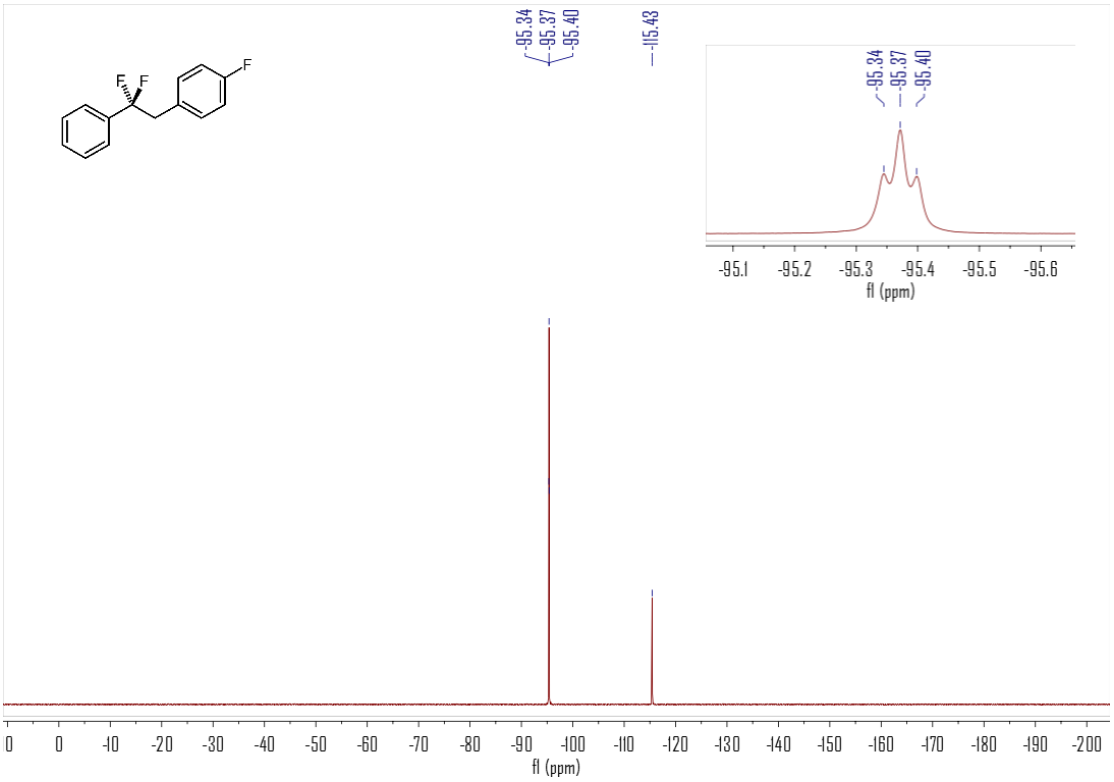
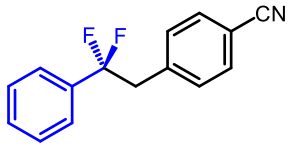


Figure S98. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4f



Synthesis of 4g: 1-(2,2-difluoro-2-phenylethyl)-4-benzonitrile



Method D was used with **1a** (0.15 mmol, 93.6 mg) and 4-(bromomethyl)benzonitrile (0.1 mmol). Reaction ran for 12 h at 90 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 25% in situ yield of **4g** was obtained.

GC-MS (EI): calcd. for [M] ($C_{15}H_{11}F_2N$) = 243.09, found: 243.08.

Figure S99. ^{19}F NMR (565 MHz, Toluene, 25 °C) of 4g

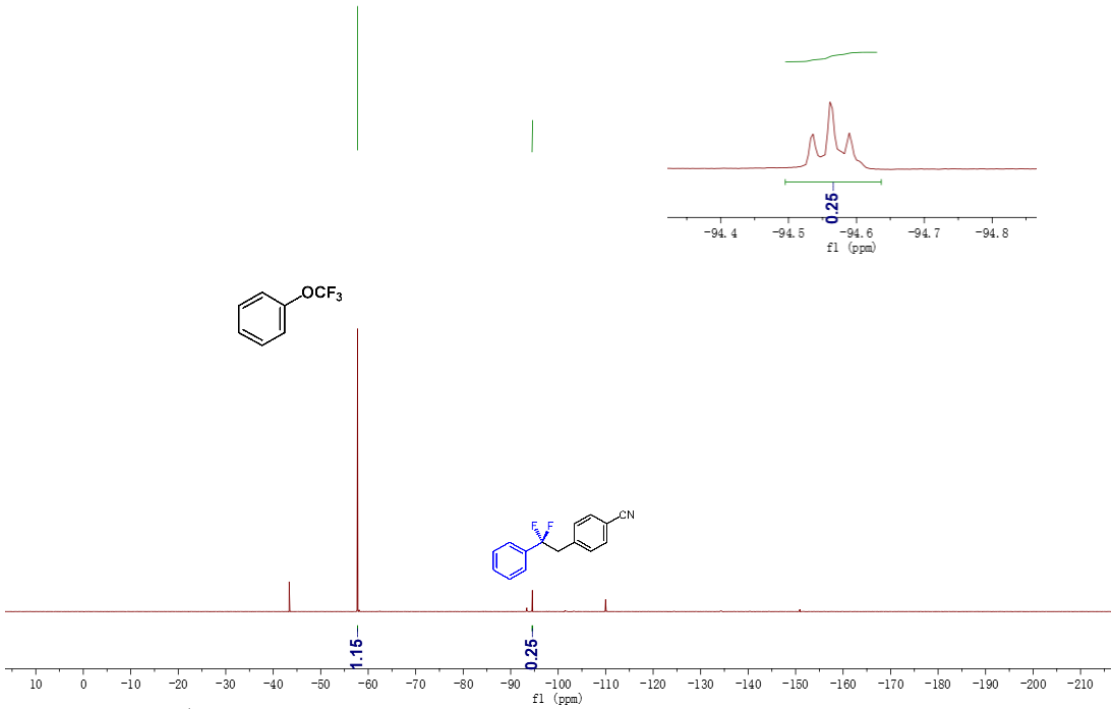


Figure S100. ^{1}H-NMR (600 MHz, $CDCl_3$, 25 °C) of 4g before purification

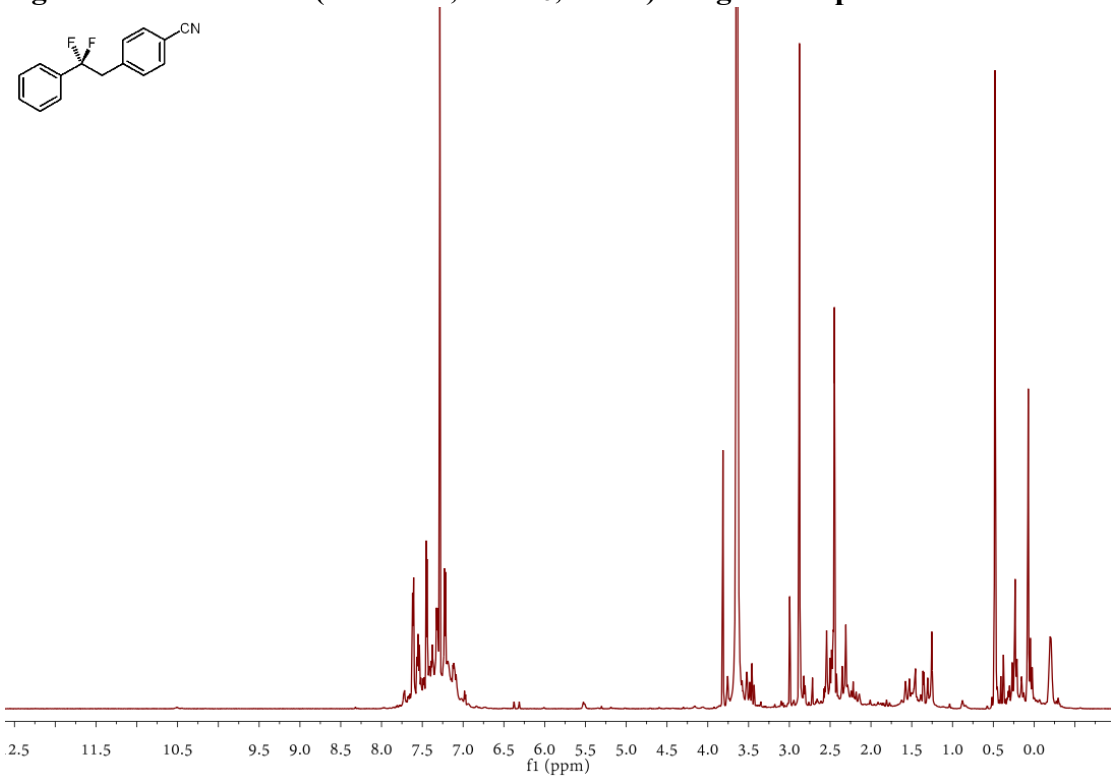


Figure S101. ^{1}H-NMR (600 MHz, $CDCl_3$, 25 °C) of 4g after purification

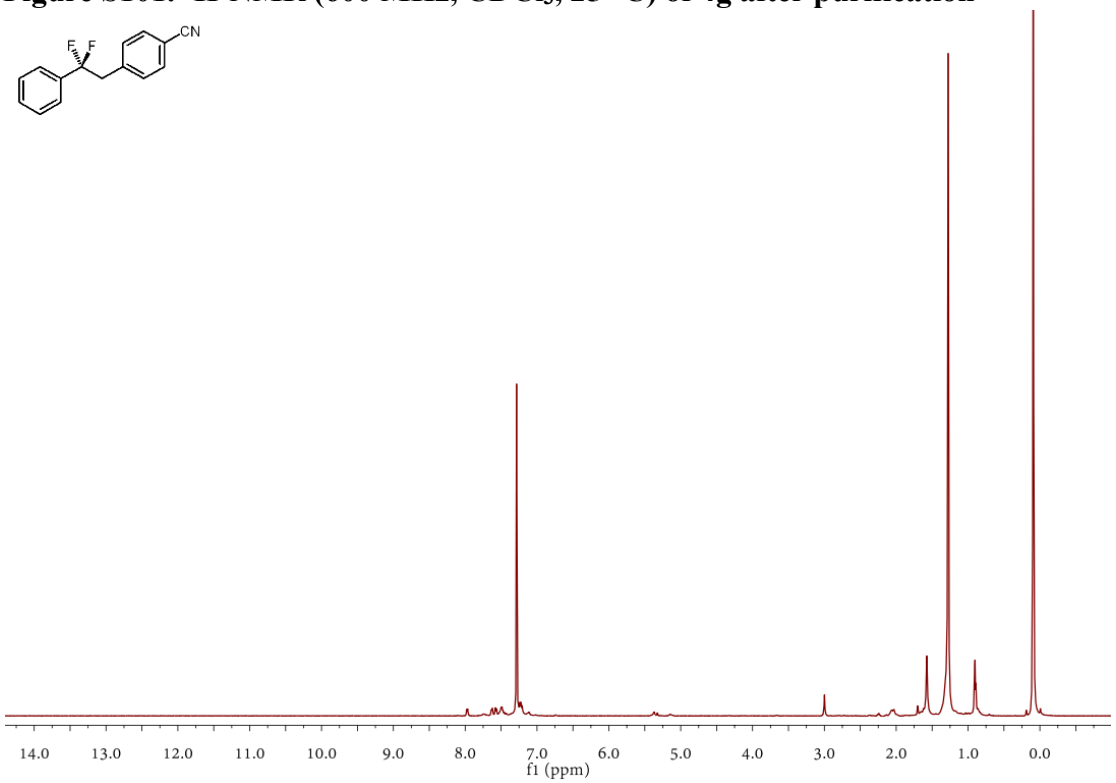


Figure S102. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4g before purification

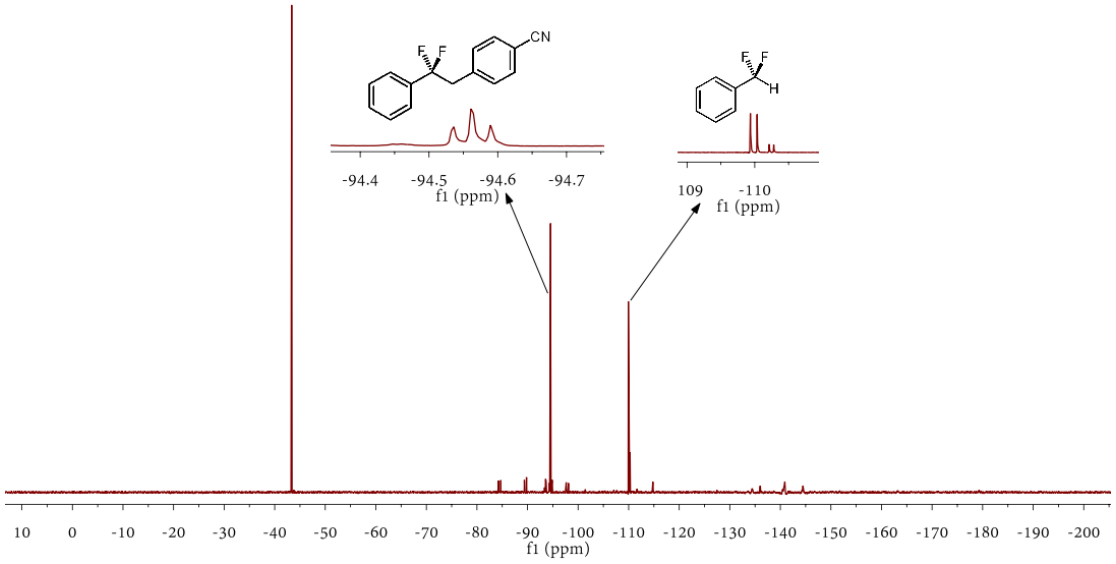


Figure S103. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4g after purification

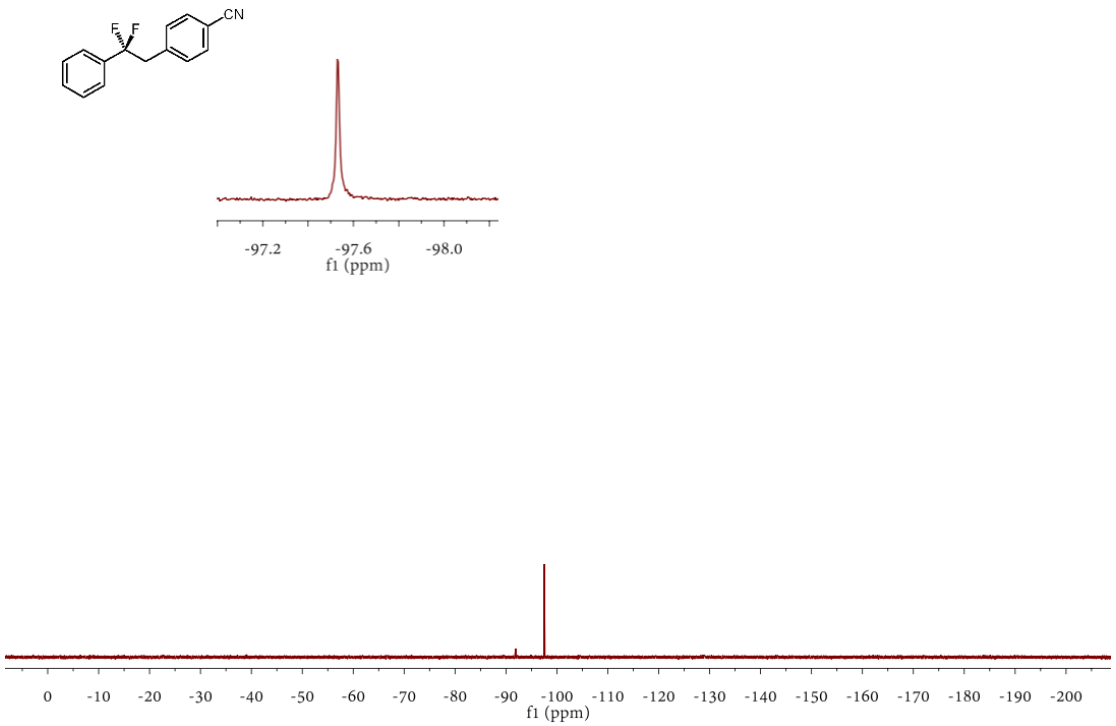
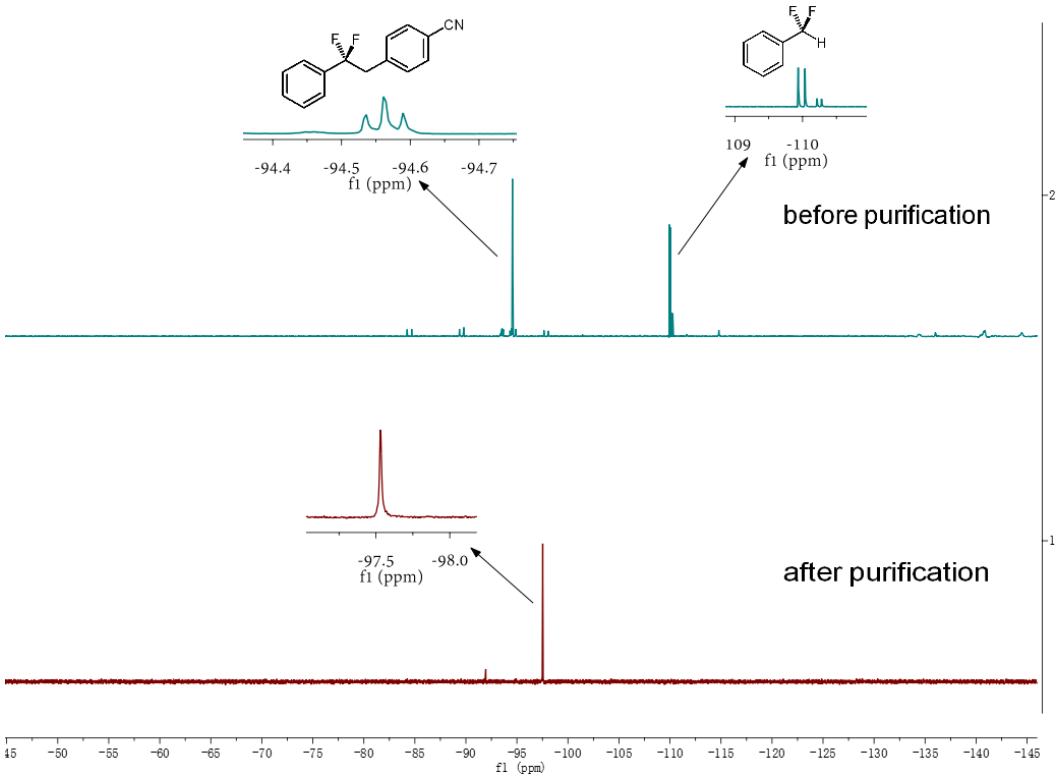
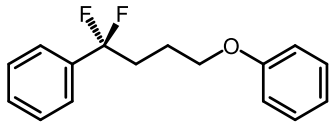


Figure S104. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4g demonstrating instability to silica



Synthesis of 4h (1,1-difluoro-4-phenoxybutyl)benzene



Method D was used with **1a** (0.375 mmol, 223 mg) and (3-bromopropoxy)benzene (0.25 mmol, 53.8 mg). Reaction ran for 12 h at 90 °C. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (50:1), affording **4h** in 72% yield (47.2 mg) as a yellow liquid.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.54-7.47 (m, 2H), 7.45-7.40 (m, 3H), 7.29-7.26 (m, 2H), 6.97-6.91 (m, 1H), 6.87 (d, J = 7.9 Hz, 2H), 3.98 (t, J = 6.2 Hz, 2H), 2.46-2.24 (m, 2H), 2.04-1.90 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 158.95, 137.39 (t, J = 26.6 Hz), 129.88, 129.60, 128.61, 125.08 (t, J = 6.2 Hz), 123.06 (t, J = 242.1 Hz), 120.94, 114.64, 67.02, 36.01 (t, J = 28.0 Hz), 22.92 (t, J = 4.0 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -95.79 (t, J = 16.5 Hz).

Figure S105. ^{1}H NMR (600 MHz, $CDCl_3$, 25 °C) of 4h

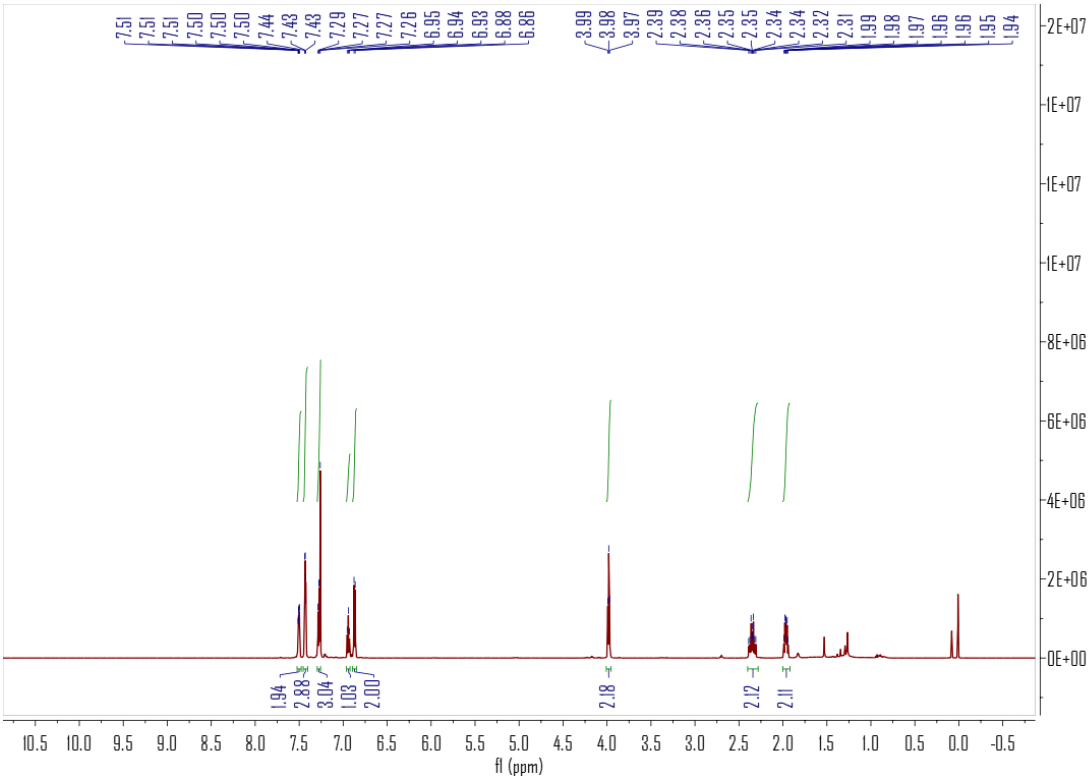


Figure S106. ^{13}C NMR (151 MHz, $CDCl_3$, 25 °C) of 4h

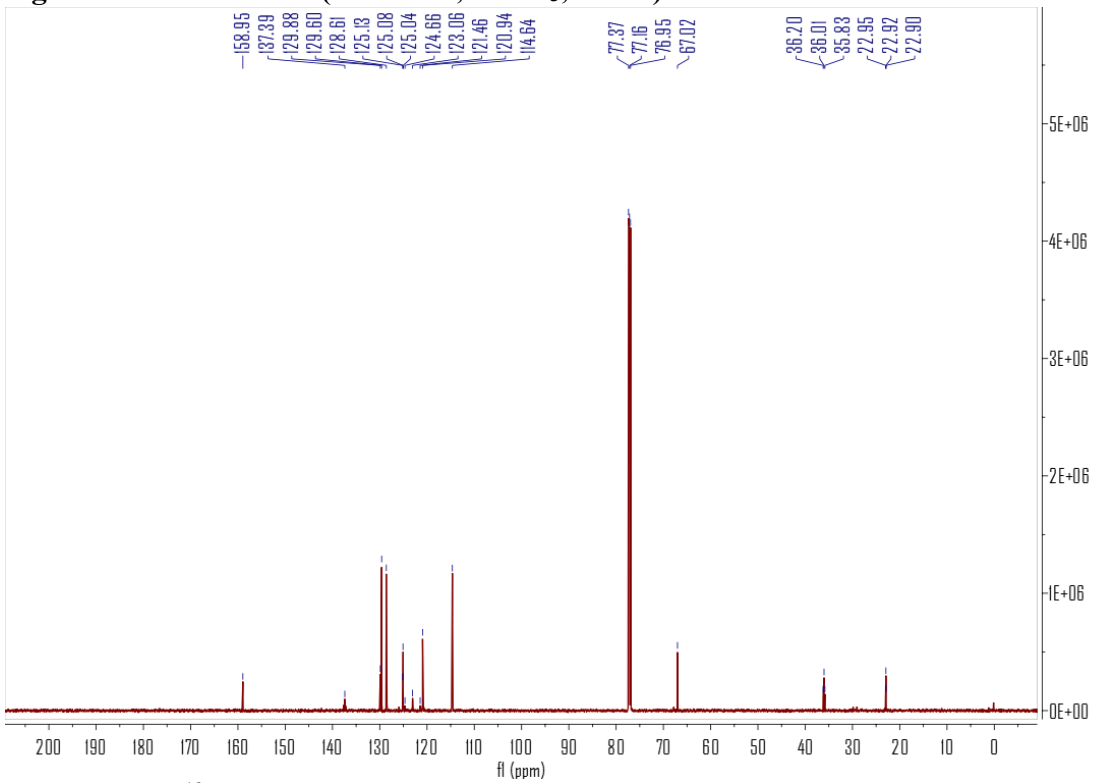
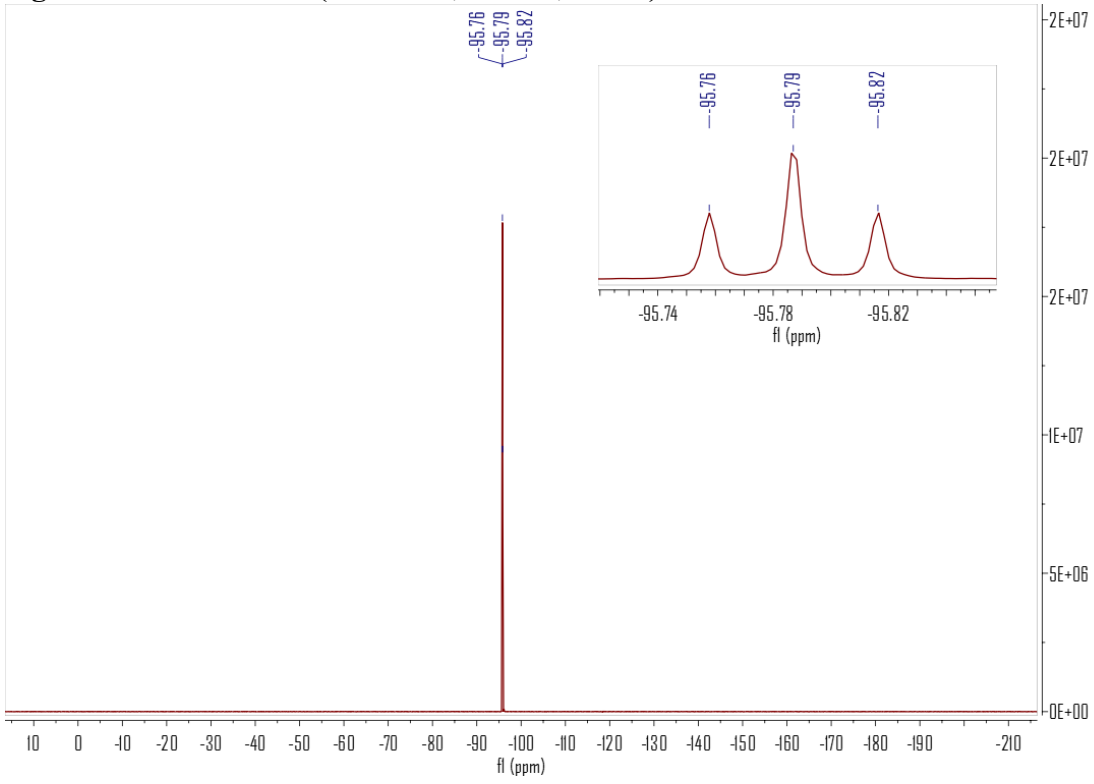
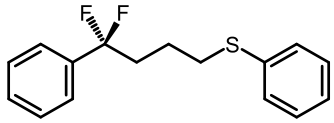


Figure S107. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4h



Synthesis of 4i (4,4-difluoro-4-phenylbutyl)(phenyl)sulfane



Method D was used with **1a** (0.375 mmol, 223 mg) and (3-bromopropyl)(phenyl)-sulfane (0.25 mmol, 57.8 mg). Reaction ran for 12 h at 90 °C. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (50:1), affording **4i** in 59% yield (41.0 mg) as a yellow liquid.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.47-7.37 (m, 5H), 7.32-7.23 (m, 4H), 7.21-7.14 (m, 1H), 2.93 (t, J = 7.1 Hz, 2H), 2.41-2.17 (m, 2H), 1.88-1.69 (m, 2H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 137.26, 136.03, 129.86, 129.84, 129.07, 128.59, 125.03 (t, J = 6.3 Hz), 122.94 (t, J = 242.1 Hz), 58.65, 37.99 (t, J = 27.8 Hz), 22.39 (t, J = 3.8 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -95.33 (t, J = 16.3 Hz).

GC-MS (EI): calcd. for [M] ($C_{16}H_{16}F_2S$) = 278.09, found: 278.10.

Figure S108. ^{1}H NMR (600 MHz, $CDCl_3$, 25 °C) of 4i

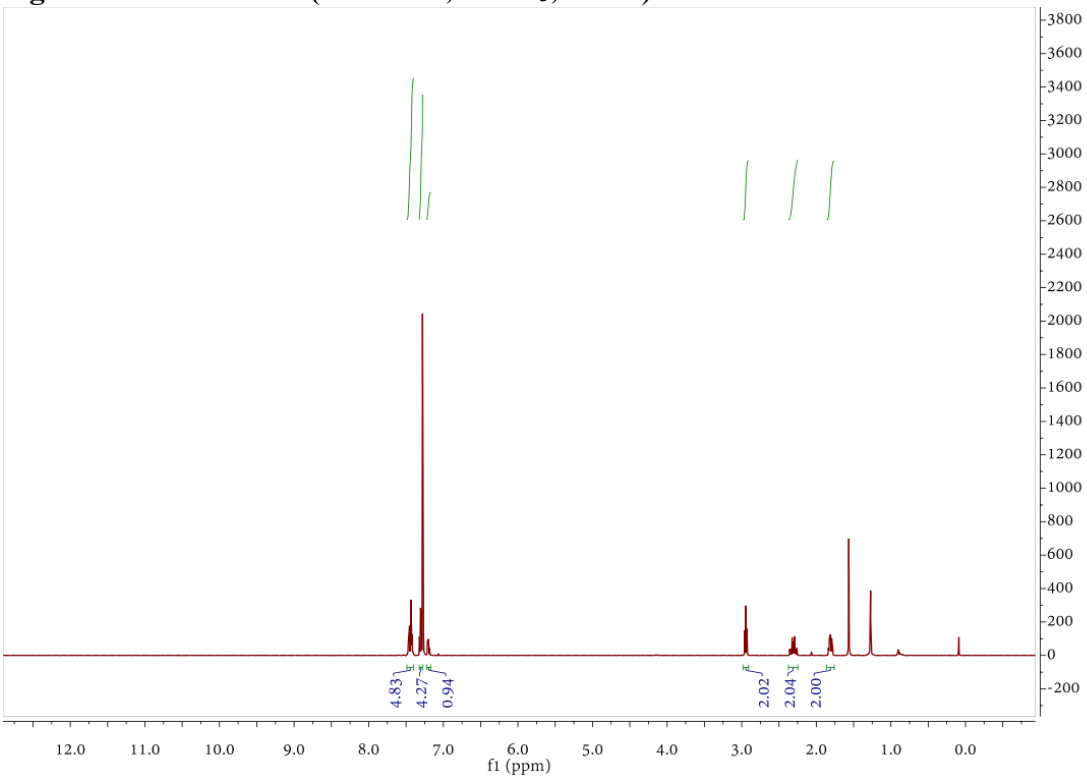


Figure S109. ^{13}C NMR (151 MHz, $CDCl_3$, 25 °C) of 4i

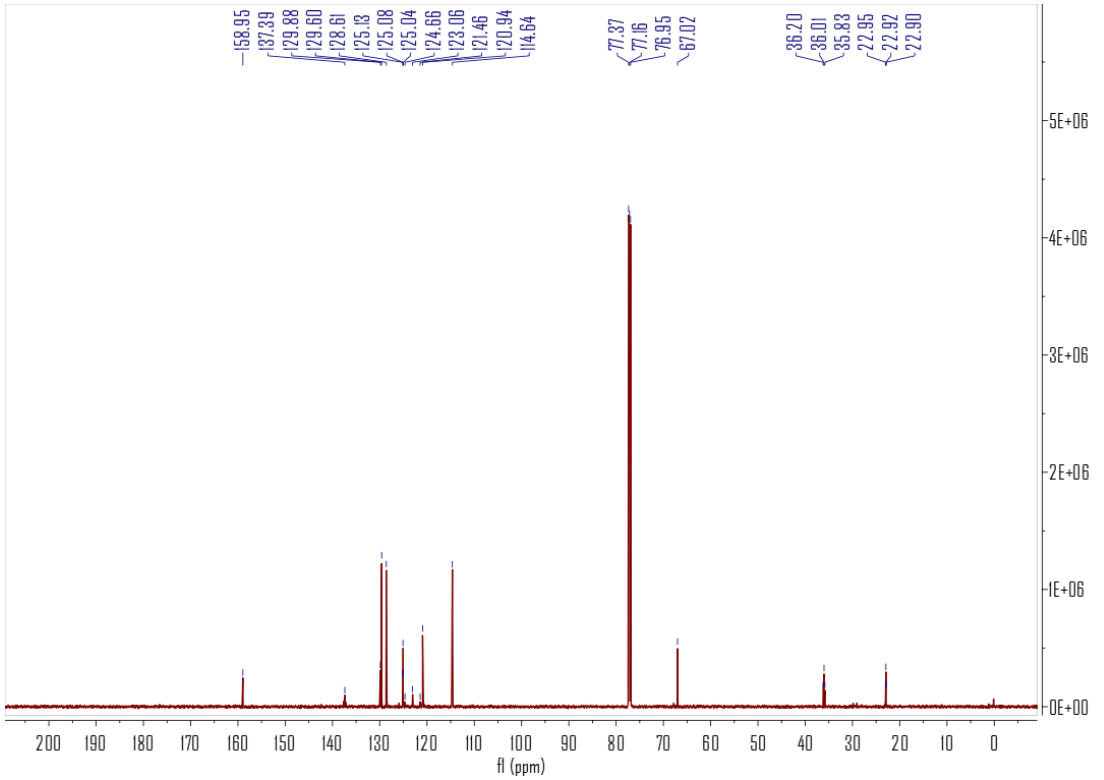
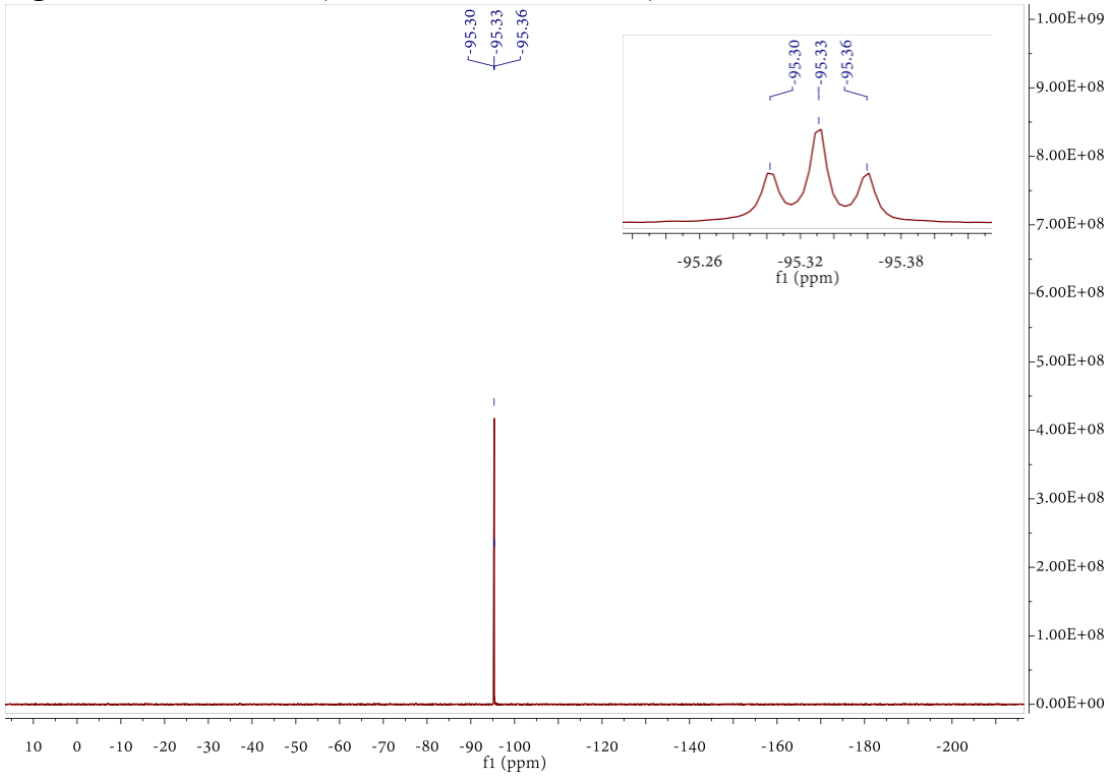
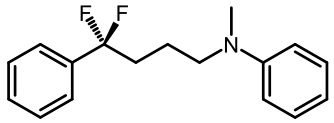


Figure S110. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4i



Synthesis of 4j *N*-(4,4-difluoro-4-phenylbutyl)-*N*-methylaniline



Method D was used with **1a** (0.375 mmol, 223 mg) and *N*-(3-bromopropyl)-*N*-methylaniline (0.25 mmol, 57.0 mg). Reaction ran for 12 h at 90 °C. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (100:1), affording **4j** in 75% yield (51.4 mg) as a yellow liquid.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.48-7.45 (m, 2H), 7.44-7.40 (m, 3H), 7.25-7.20 (m, 2H), 6.75-6.66 (m, 3H), 3.34 (t, J = 7.4 Hz, 2H), 2.90 (s, 3H), 2.28-2.06 (m, 2H), 1.84-1.68 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.25, 137.40 (t, J = 26.6 Hz), 129.86, 129.38, 128.59, 125.04 (t, J = 6.2 Hz), 123.08 (t, J = 242.2 Hz), 116.86, 112.70, 52.48, 38.44, 36.66 (t, J = 28.0 Hz), 20.27 (t, J = 3.3 Hz).

^{19}F-NMR (565 MHz, $CDCl_3$) δ -95.16 (t, J = 16.5 Hz, 2F).

Figure S111. ^{1}H NMR (600 MHz, $CDCl_3$, 25 °C) of 4j

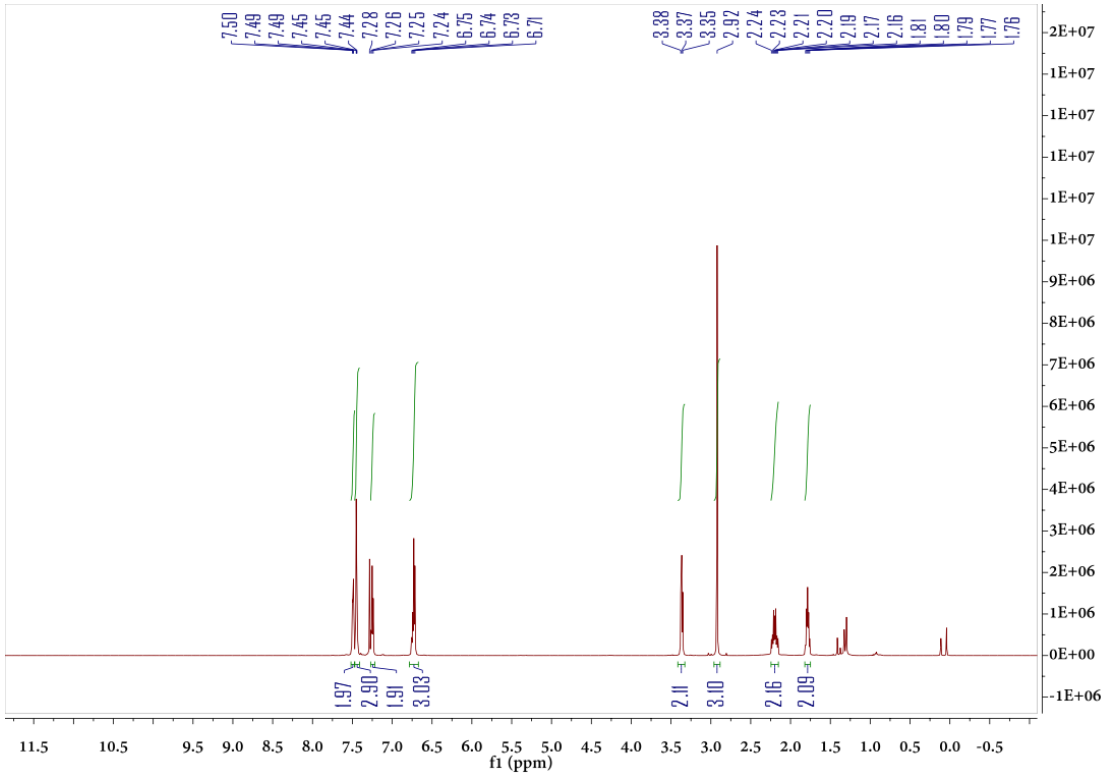


Figure S112. ^{13}C NMR (151 MHz, $CDCl_3$, 25 °C) of 4j

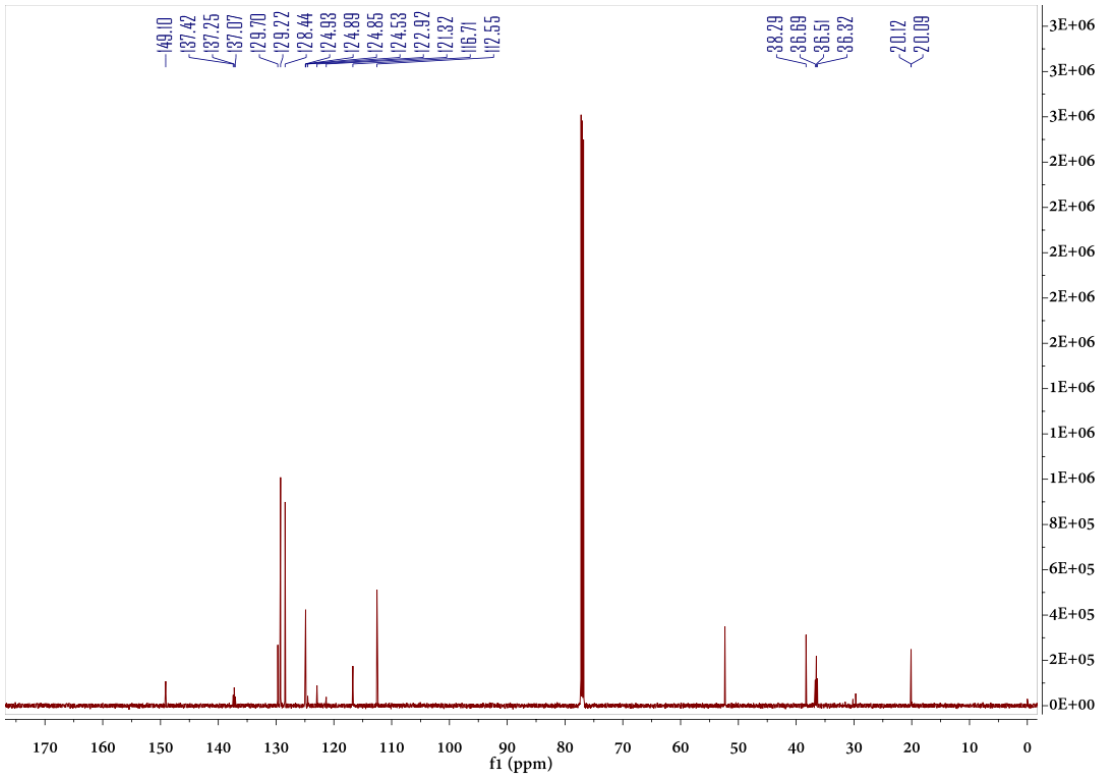
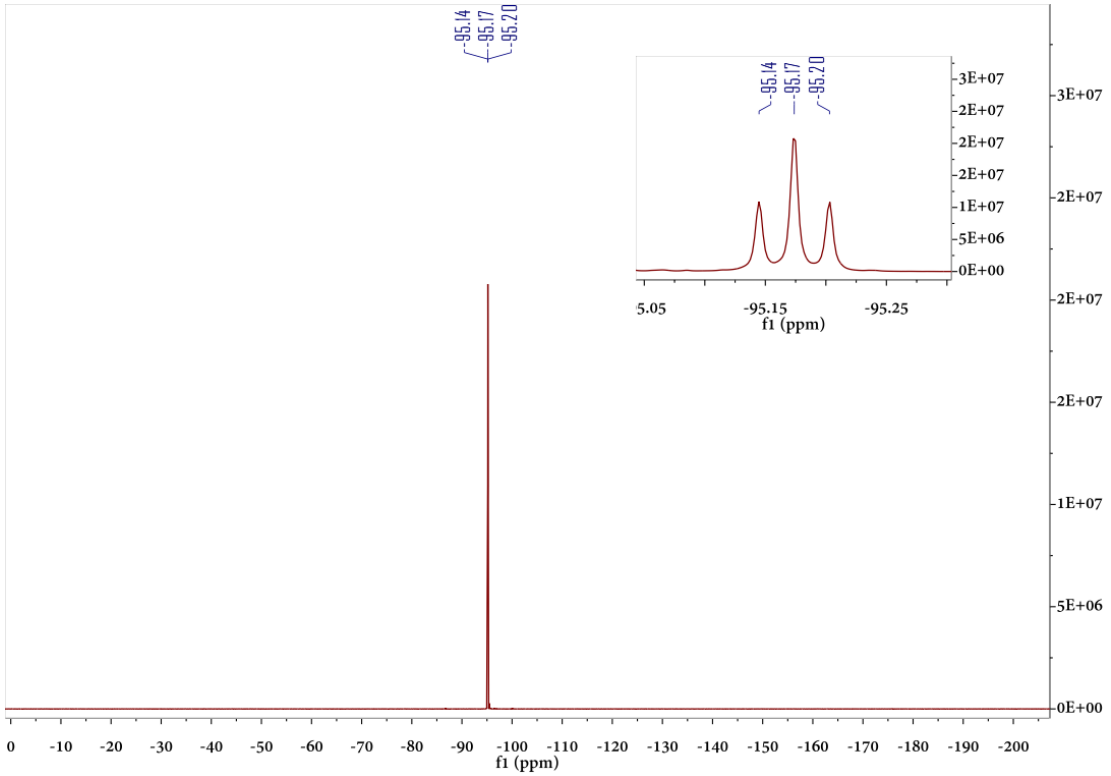
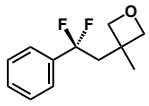


Figure S113. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4j



Synthesis of 4k: 3-(2,2-difluoro-2-phenylethyl)-3-methyloxetane



In a 20 mL scintillation vial with a magnetic stir bar **1a** (0.3 mmol, 179.6 mg), 3-bromomethyl-3-methyloxetane (0.36 mmol, 59.5 mg) and $PhOCF_3$ (0.1 mmol, 13.2 µL) were dissolved in 15 mL of THF. Reaction stirred for 18 h at 25 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 93% in situ yield was obtained. The reaction mixture dry loaded onto a 25g Biotage column and eluted with 0% to 15% ethyl acetate in hexanes at the rate of 25 mL/min, 14-16 column volumes for isolation of **4i**, 47.8 mg 75% yield.

^{1}H-NMR ($CDCl_3$): 1.54 (H_a, 3H, s), 2.52 (H_b, 2H, t, $J_{1H\text{-}19F}$=17.6 Hz), 4.26 (H_c, 2H, d, $J_{1H\text{-}1H}$=5.9 Hz), 4.46 (H_d, 2H, d, $J_{1H\text{-}1H}$=5.9 Hz), 7.43 (H_e, 2H, OL), 7.43 (H_f, 1H, OL), 7.46 (H_g, 2H, m).

^{13}C-NMR: 24.08 (C_a, t, $J_{13C\text{-}19F}$=2.5 Hz), 37.62 (C_b, t, $J_{13C\text{-}19F}$=1.6 Hz), 47.25 (C_c, t, $J_{13C\text{-}19F}$=26.5 Hz), 83.30 (C_d, t, $J_{13C\text{-}19F}$=1.4 Hz), 123.02 (C_e, t, $J_{13C\text{-}19F}$=244.1 Hz), 124.77 (C_f, t, $J_{13C\text{-}19F}$=6.3 Hz), 128.67 (C_g), 130.03 (C_h, t, $J_{13C\text{-}19F}$=1.8 Hz), 137.89 (C_i, t, $J_{13C\text{-}19F}$=26.3 Hz).

^{19}F-NMR (THF): -92.82 (t, $J_{1H\text{-}19F}$=17.8 Hz)

Figure S114. ^{1}H NMR (500 MHz, $CDCl_3$, 25 °C) of 4k

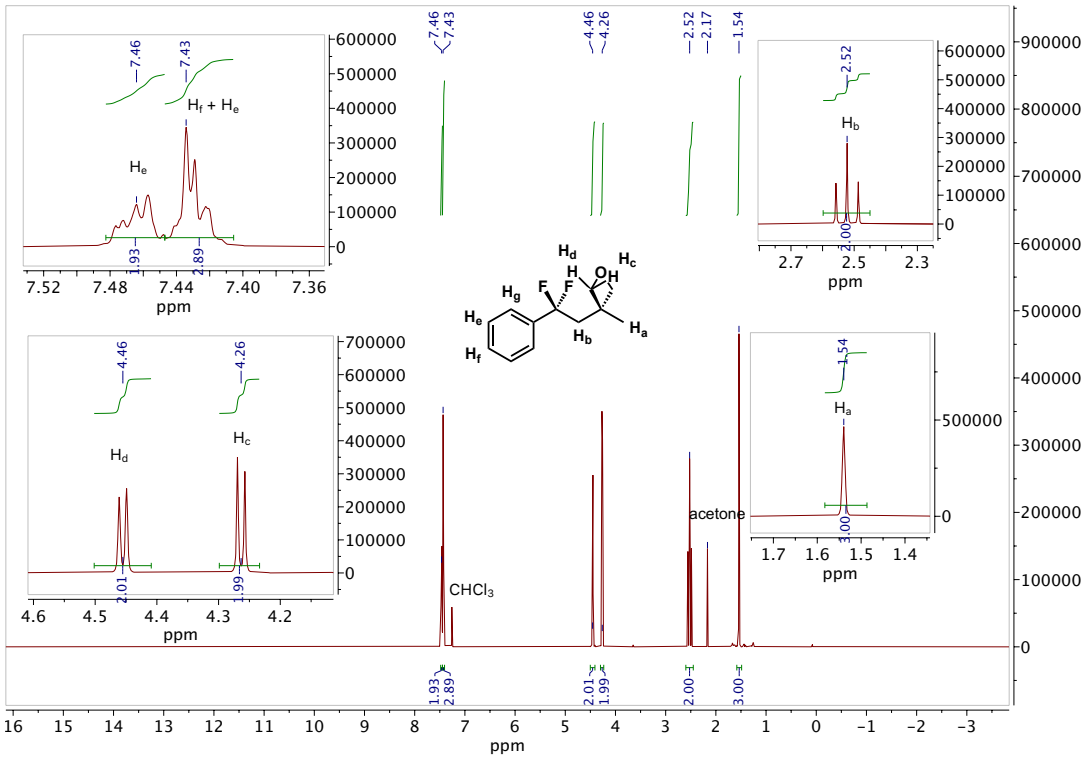


Figure S115. ^{13}C NMR (500 MHz, $CDCl_3$, 25 °C) of 4k

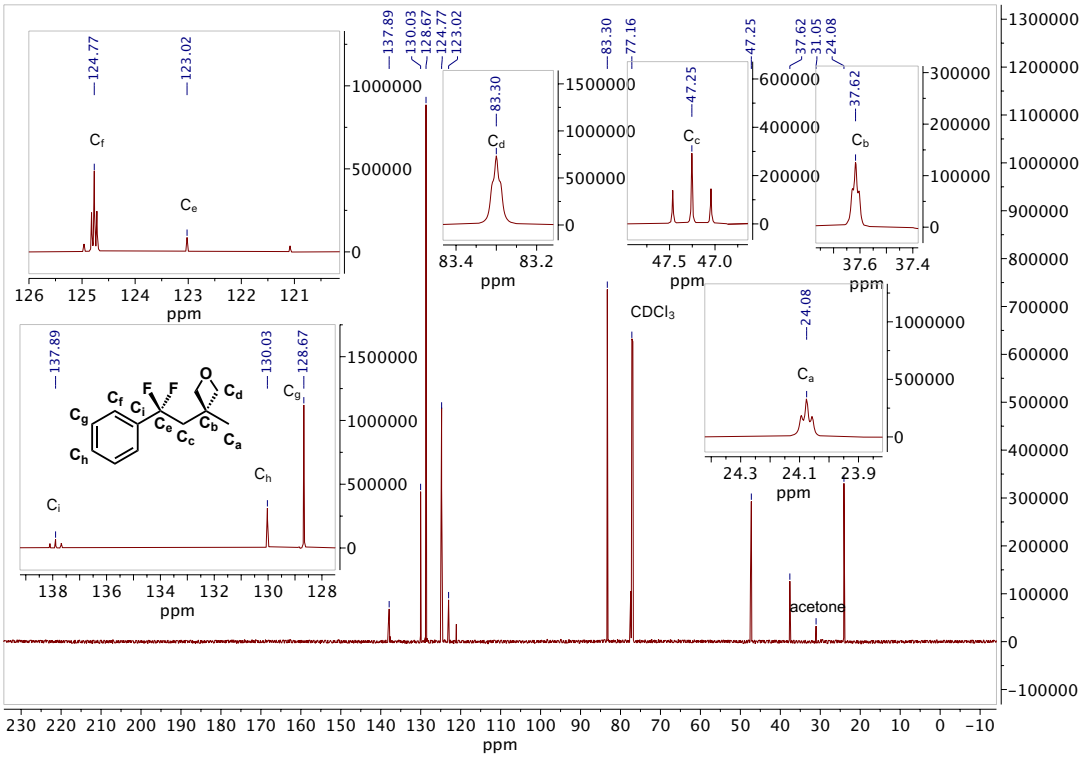


Figure S116. ^{1}H-^{1}H COSY (500 MHz, $CDCl_3$, 25 °C) of 4k

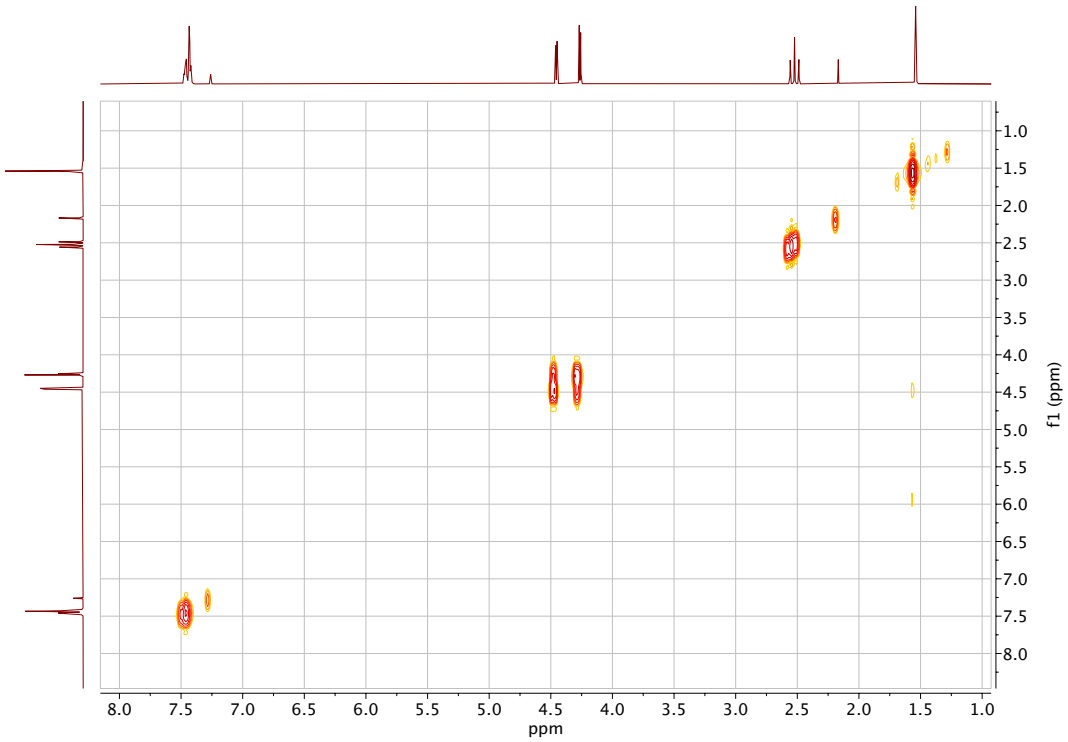


Figure S117. ^{1}H-^{13}C HSQC (500 MHz, $CDCl_3$, 25 °C) of 4k

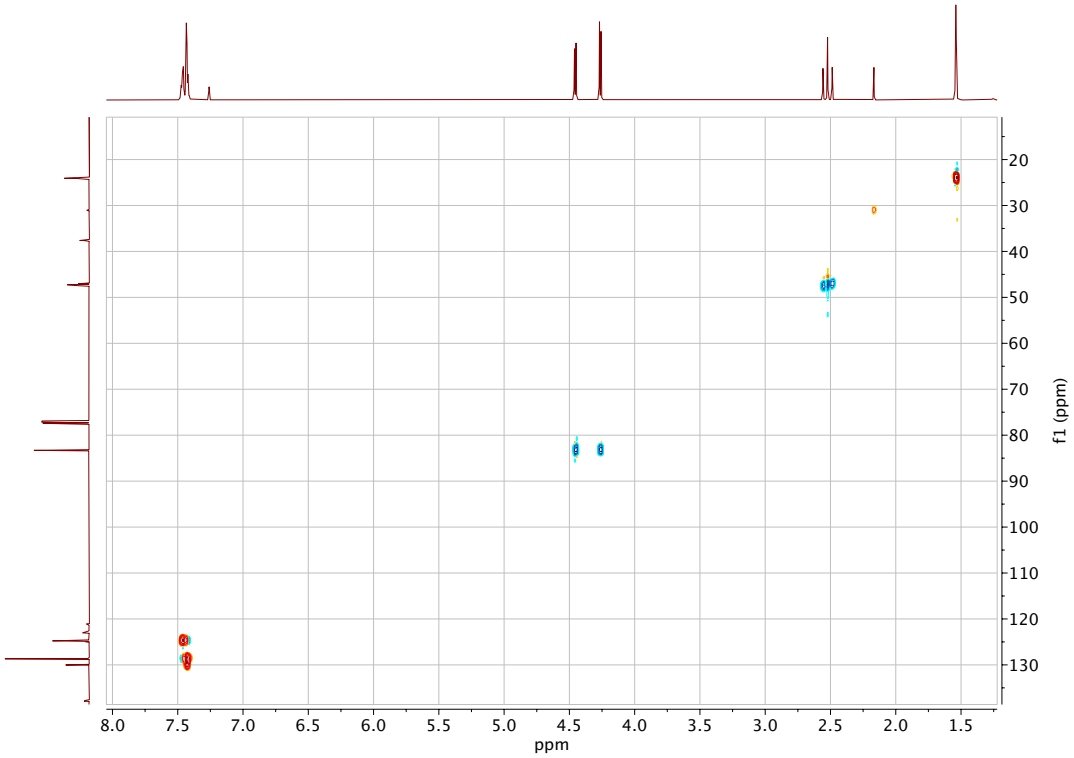


Figure S118. ^{1}H-^{13}C HMBC (500 MHz, $CDCl_3$, 25 °C) of 4k

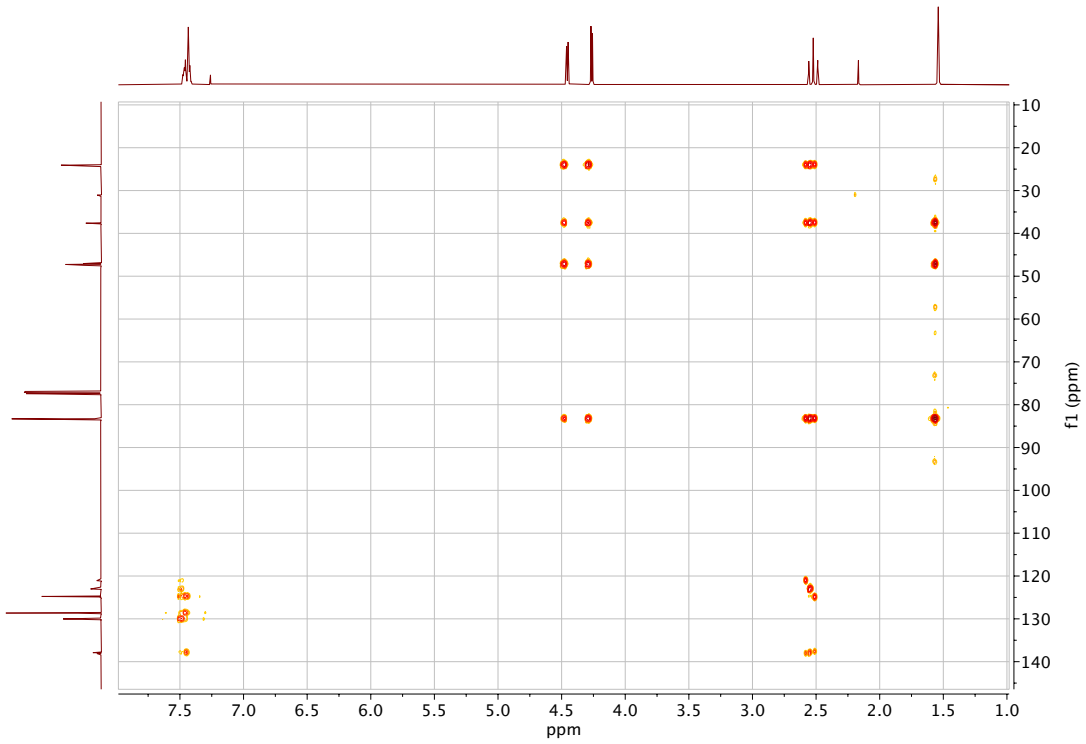
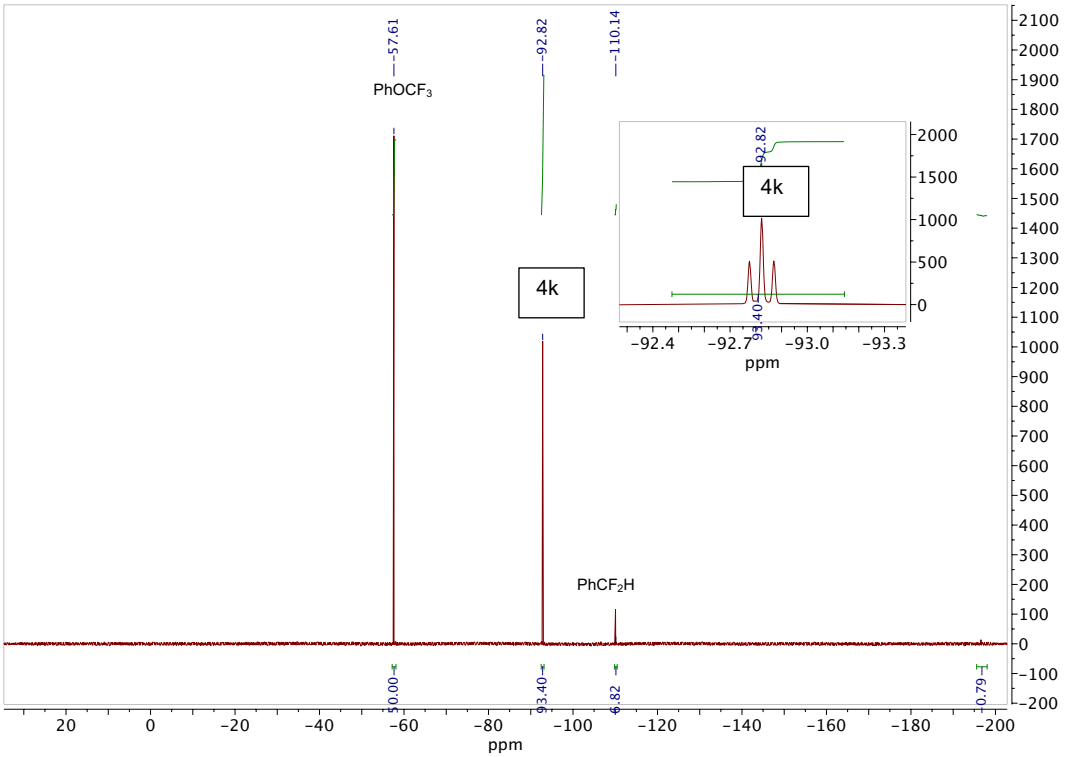
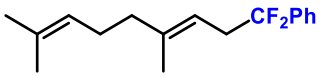


Figure S119. ^{19}F NMR (400 MHz, THF, 23 °C) of 4k in Situ Yield (93%)



Synthesis of 4l (*E*)-(1,1-difluoro-4,8-dimethylnona-3,7-dien-1-yl)benzene



1a (0.15 mmol, 93.6 mg) and geranyl bromide (0.225 mmol) were used. Reaction ran for 12 h at 23 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 55% in situ yield of **4k** was obtained.

Figure S120. ^{19}F NMR (565 MHz, Toluene, 25 °C) of 4k

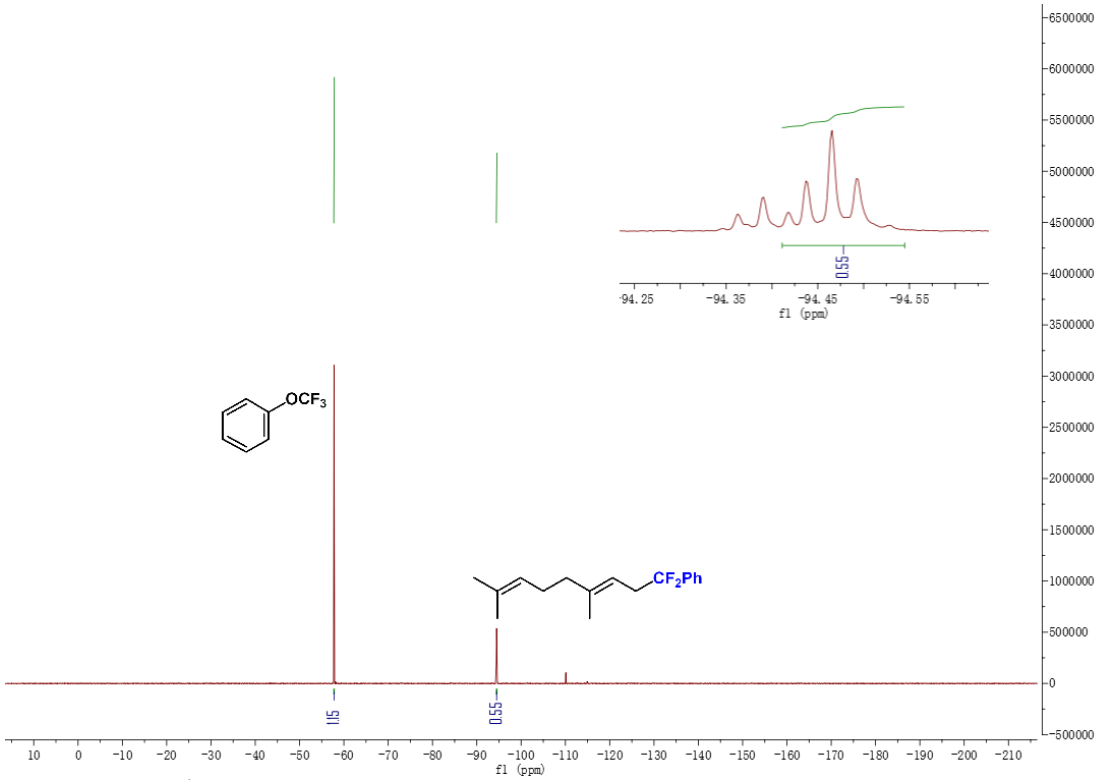


Figure S121. ^{1}H-NMR (600 MHz, $CDCl_3$, 25 °C) of 4l before purification

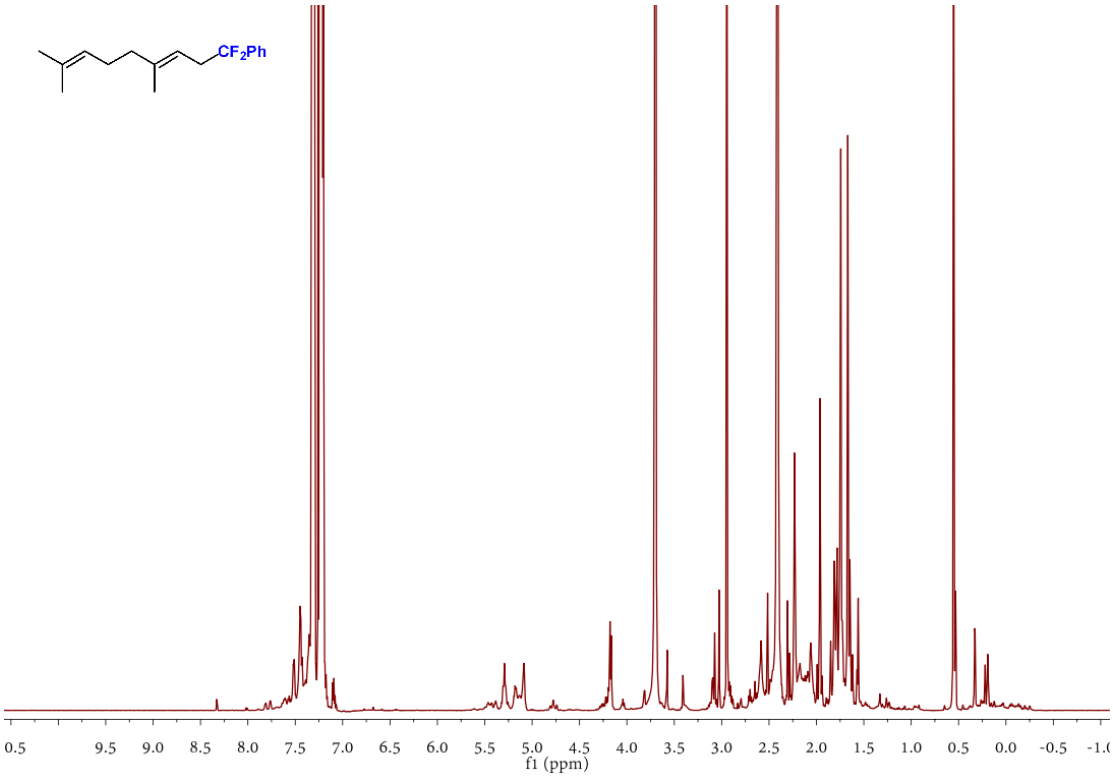


Figure S122. ^{1}H-NMR (600 MHz, $CDCl_3$, 25 °C) of 4l after purification

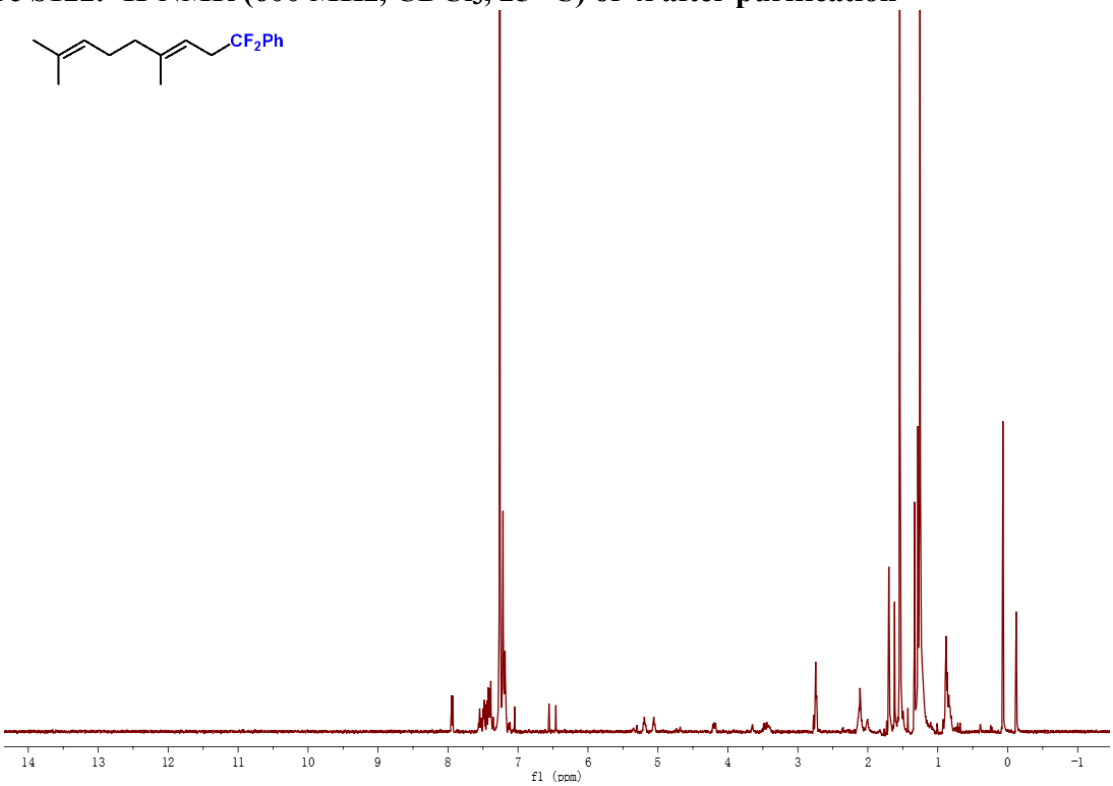


Figure S123. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4l before purification

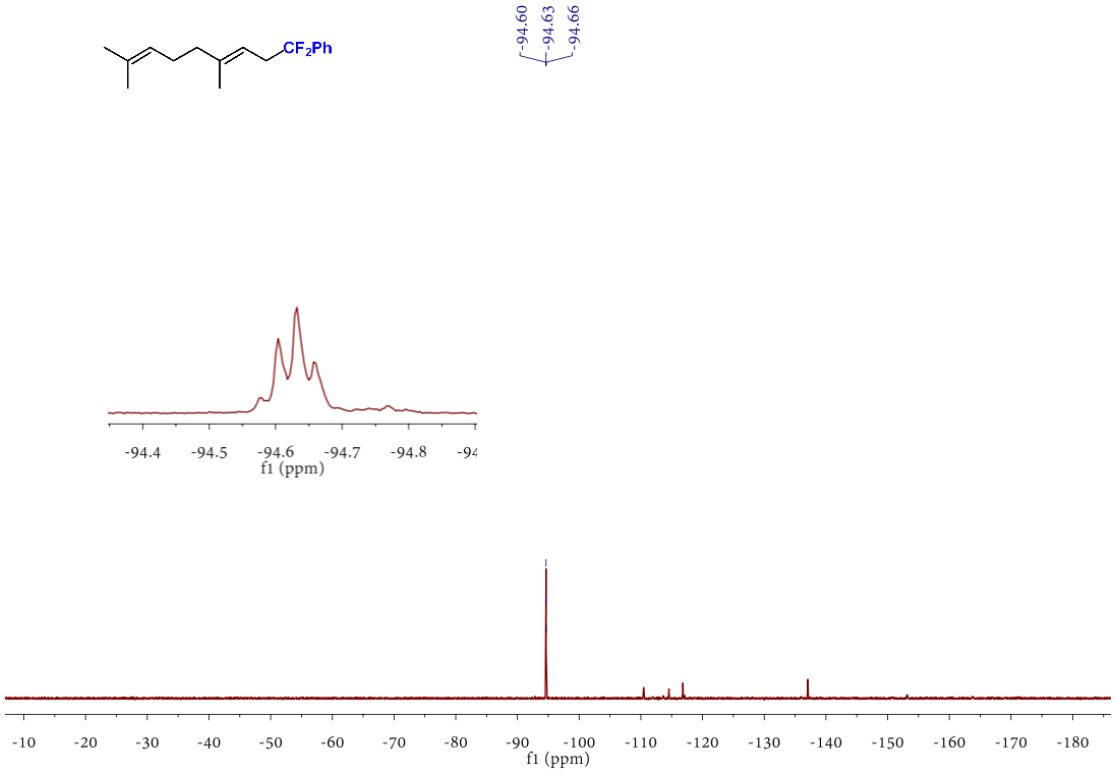
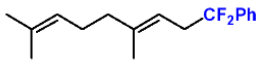


Figure S124. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4l after purification



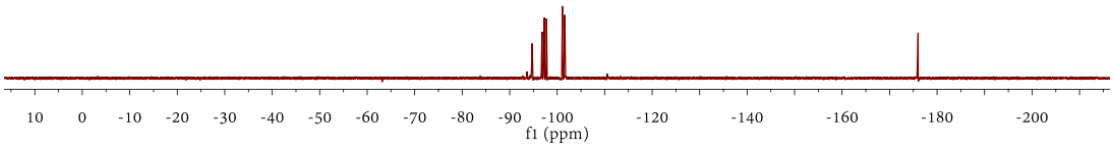


Figure S125. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4l demonstrating instability to silica

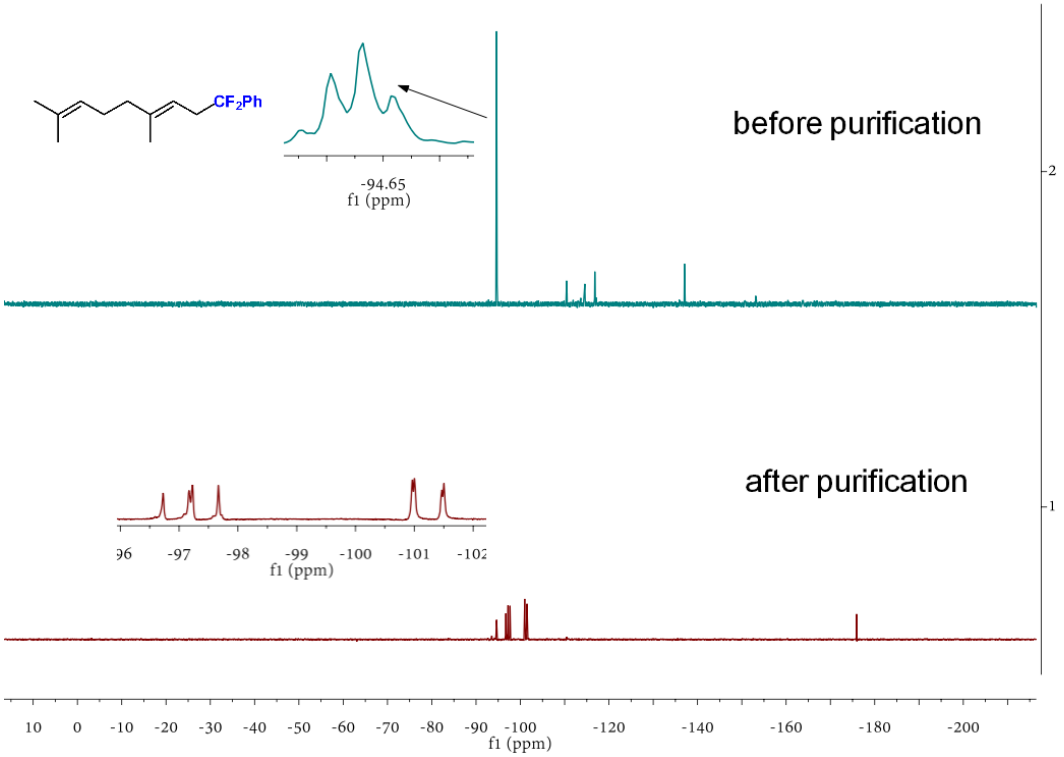
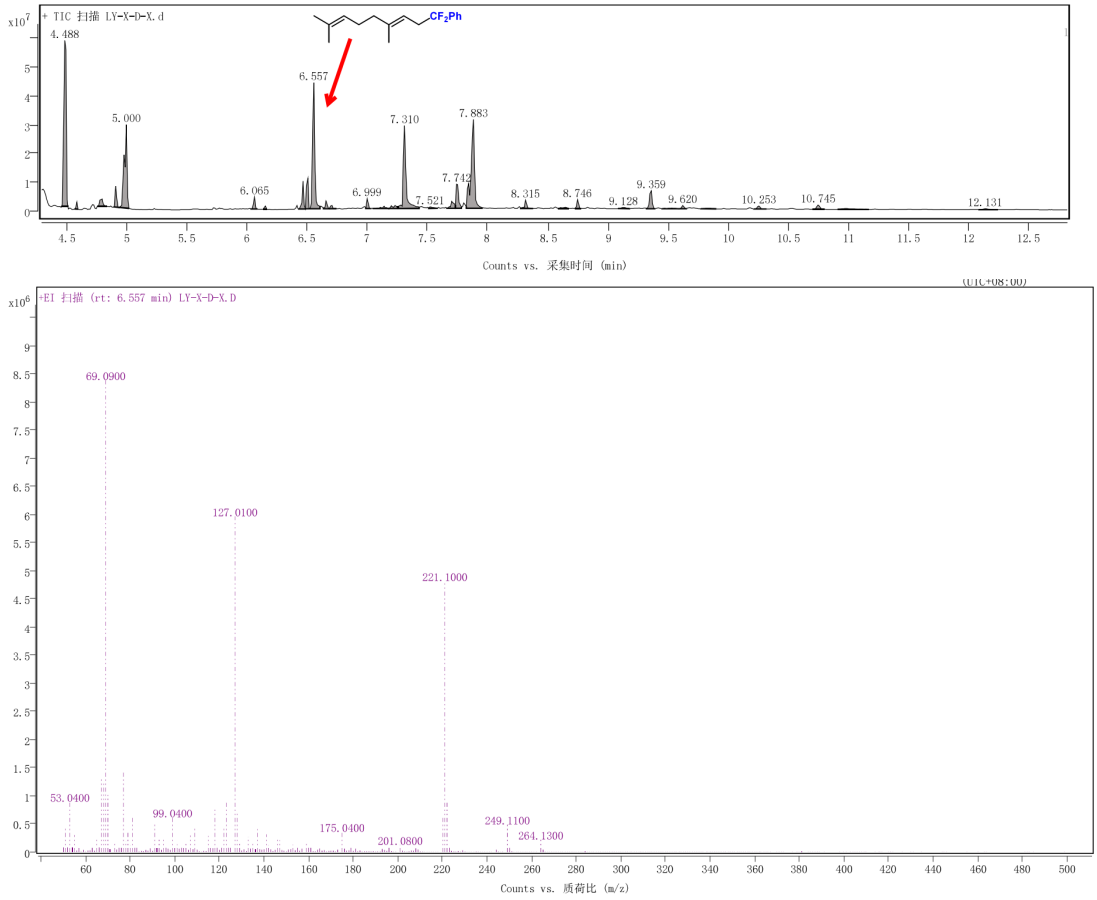
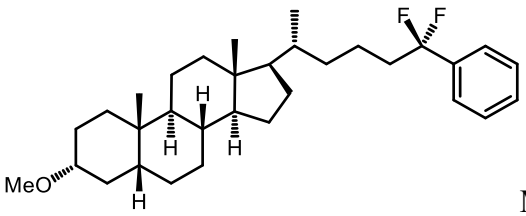


Figure S126. Mass Spectrum of 4l



Synthesis of 4m



Method D was used with **1a** (0.375 mmol, 223 mg) and bromo-substituted Lithocholic acid (0.25 mmol, 110 mg). Reaction ran for 12 h at 90 °C. The product was isolated by flash chromatography on silica gel (230-400 mesh) with hexanes-ethyl acetate (40:1), affording **4l** in 75% yield (91.0 mg) as a white solid.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.49-7.44 (m, 2H), 7.44-7.39 (m, 3H), 3.35 (s, 3H), 3.22-3.05 (m, 1H), 2.19-1.57 (m, 9H), 1.53-0.97 (m, 21H), 0.91 (s, 3H), 0.86 (d, J = 6.5 Hz, 3H), 0.61 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 137.76 (t, J = 26.8 Hz), 129.66, 128.48, 125.08 (t, J = 6.2 Hz), 123.29 (t, J = 242.0 Hz), 80.58, 56.61, 56.35, 55.69, 42.86, 42.22, 40.50, 40.33, 39.65 (t, J = 27.3 Hz), 36.00, 35.80, 35.68, 35.46, 35.05, 32.94, 28.45, 27.49, 26.94, 26.55, 24.36, 23.57, 20.96, 19.37, 18.59, 12.17.

^{19}F NMR (470 MHz, $CDCl_3$) δ -95.37 (qt, J = 243.5, 16.4 Hz).

Figure S127. ^{1}H NMR (600 MHz, $CDCl_3$, 25 °C) of 4m

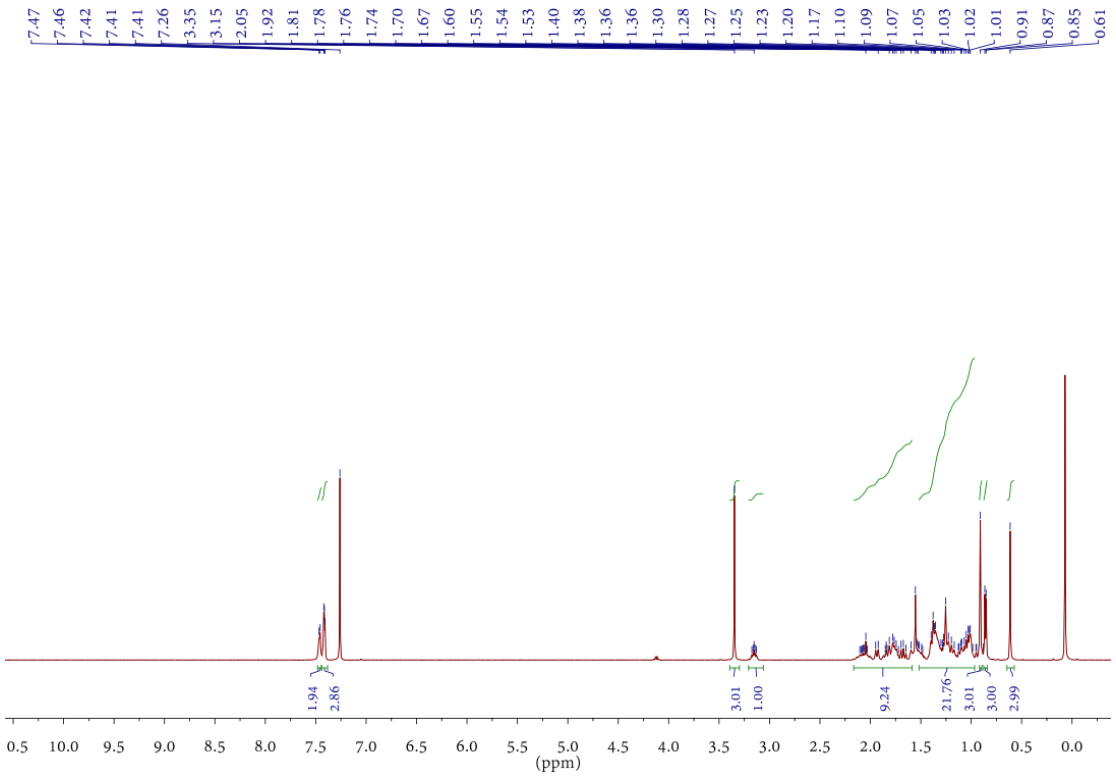


Figure S128. ^{13}C NMR (151 MHz, $CDCl_3$, 25 °C) of 4m

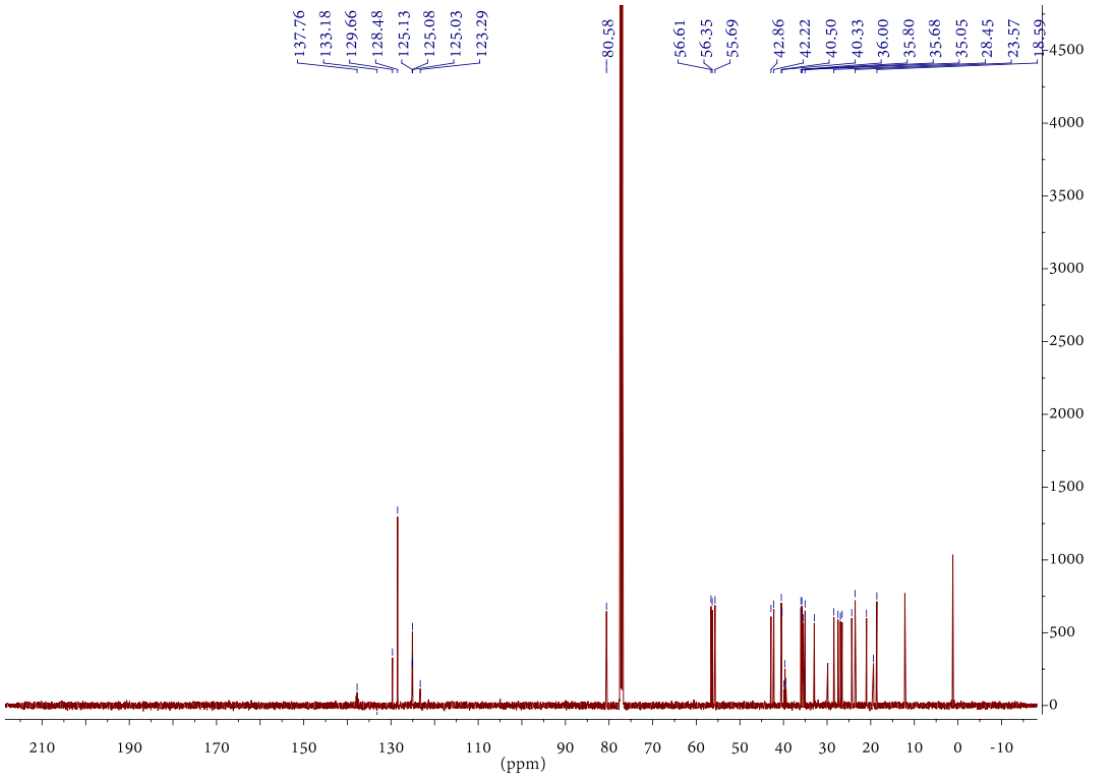
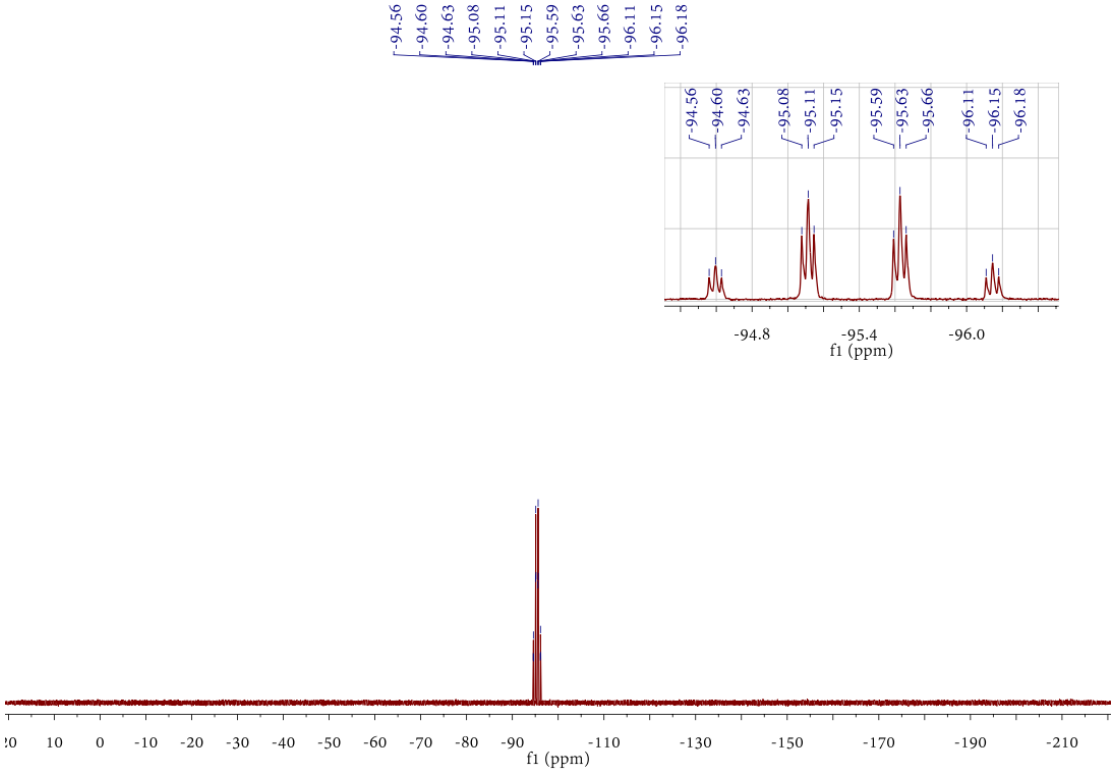
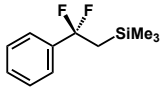


Figure S129. ^{19}F NMR (565 MHz, $CDCl_3$, 25 °C) of 4m



Synthesis of 4n: (2,2-difluoro-2-phenylethyl)trimethylsilane



In a 20 mL scintillation vial with a magnetic stir bar **1a** (0.1 mmol, 59.6 mg), iodomethyl(trimethylsilane) (0.12 mmol, 17.8 µL) and $PhOCF_3$ (0.1 mmol, 13.2 µL) were dissolved in 5 mL of THF. Reaction stirred for 18 h at 25 °C. With respect to the sole byproduct, $PhCF_2H$, ~97% in situ yield was obtained. Solvent and unreacted iodomethyl(trimethylsilane) were extracted into pentane to afford 32.2 mg of a 1:1 mixture of **4m** and hexamethylborazine. After NMR analysis, **4m** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (10.0 µL). 52% purity by mass was found (compared to 29.7 mg sample). With this purity we determined a 78% isolated yield.

^{1}H-NMR ($CDCl_3$): 0.01 (H_a, 9H, s), 1.68 (H_b, 2H, t, $J_{1H\text{-}19F}$=20.8 Hz), 7.40 (H_c, 1H, OL), 7.40 (H_d, 2H, OL), 7.49 (H_e, 2H, m).

^{13}C-NMR: 0.65 (C_a), 29.88 (C_b, t, $J_{13C\text{-}19F}$=30.8 Hz), 124.50 (C_c, t, $J_{13C\text{-}19F}$=239.9 Hz), 124.69 (C_d, t, $J_{13C\text{-}19F}$=6.0 Hz), 128.46 (C_e), 129.49 (C_f, t, $J_{13C\text{-}19F}$=2.1 Hz), 139.73 (C_g, t, $J_{13C\text{-}19F}$=28.0 Hz).

^{19}F-NMR: -80.89 (t, $J_{1H\text{-}19F}$ = 20.8 Hz)

Figure S130. ^{1}H NMR (400 MHz, $CDCl_3$, 23 °C) of 4n

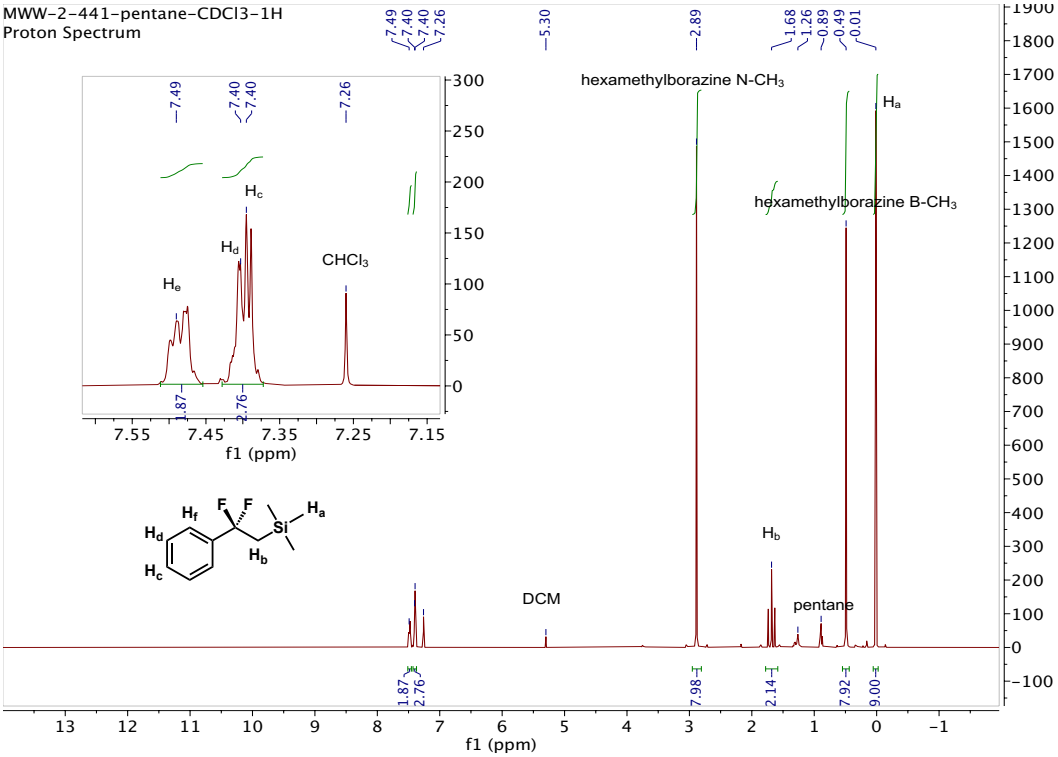


Figure S131. ^{13}C NMR (500 MHz, $CDCl_3$, 25 °C) of 4n

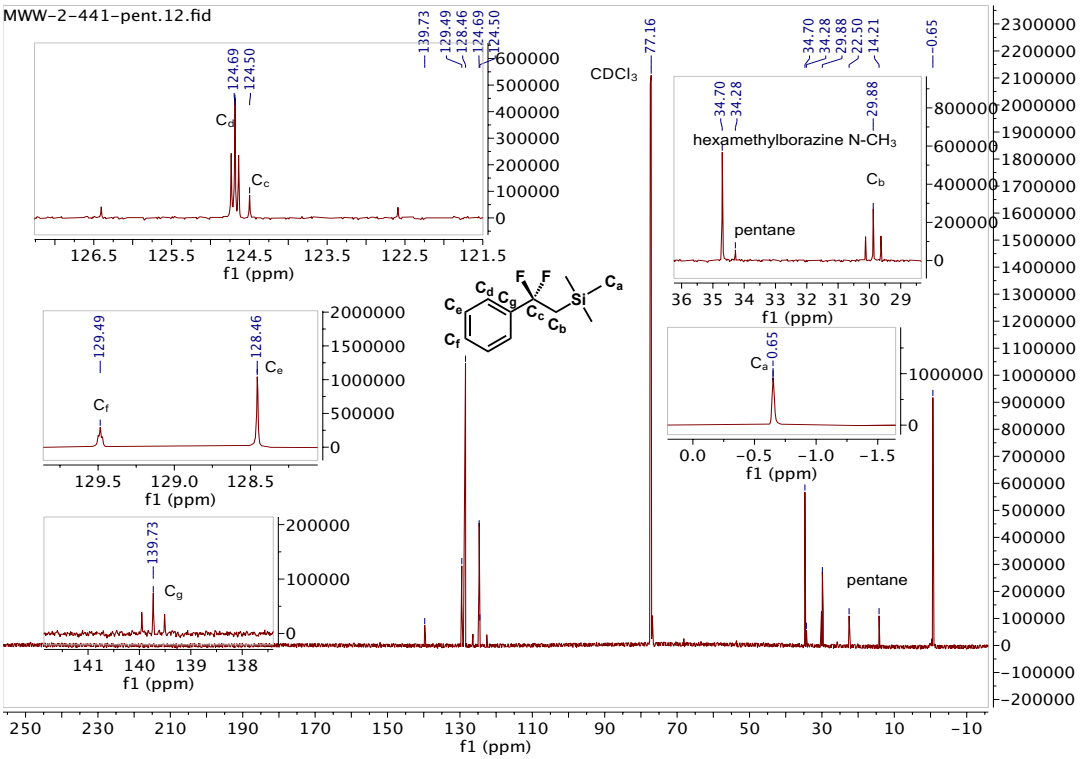


Figure S132. ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 4n

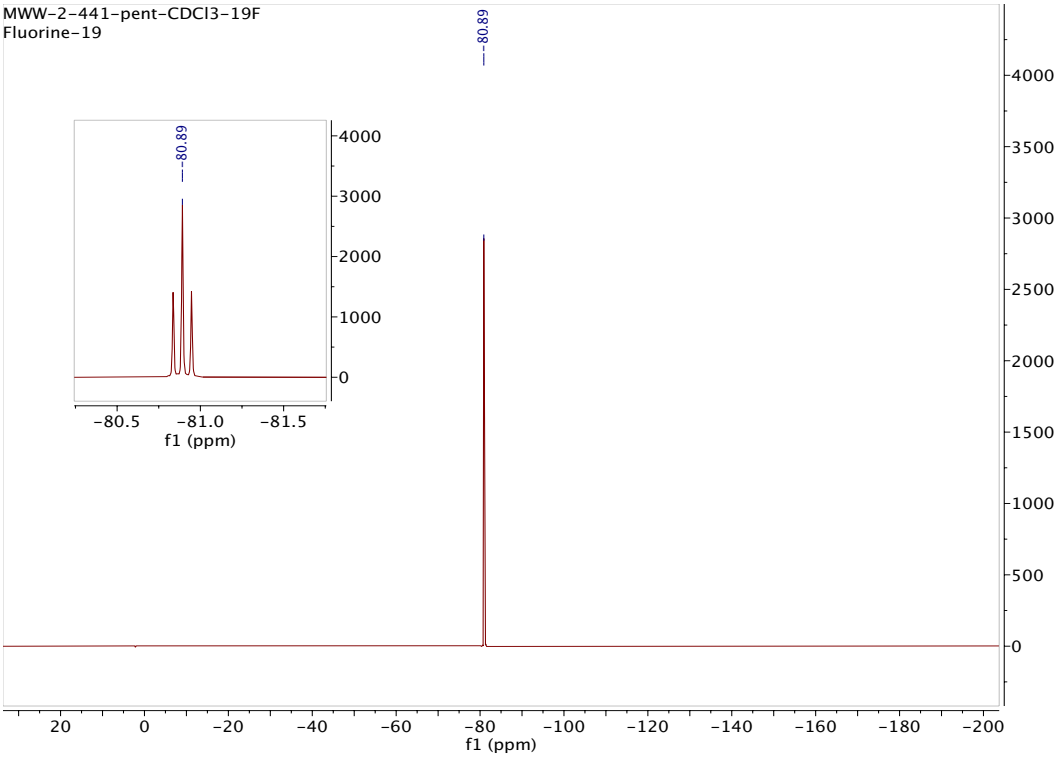


Figure S133. ^{1}H-^{1}H COSY (500 MHz, $CDCl_3$, 25 °C) of 4n

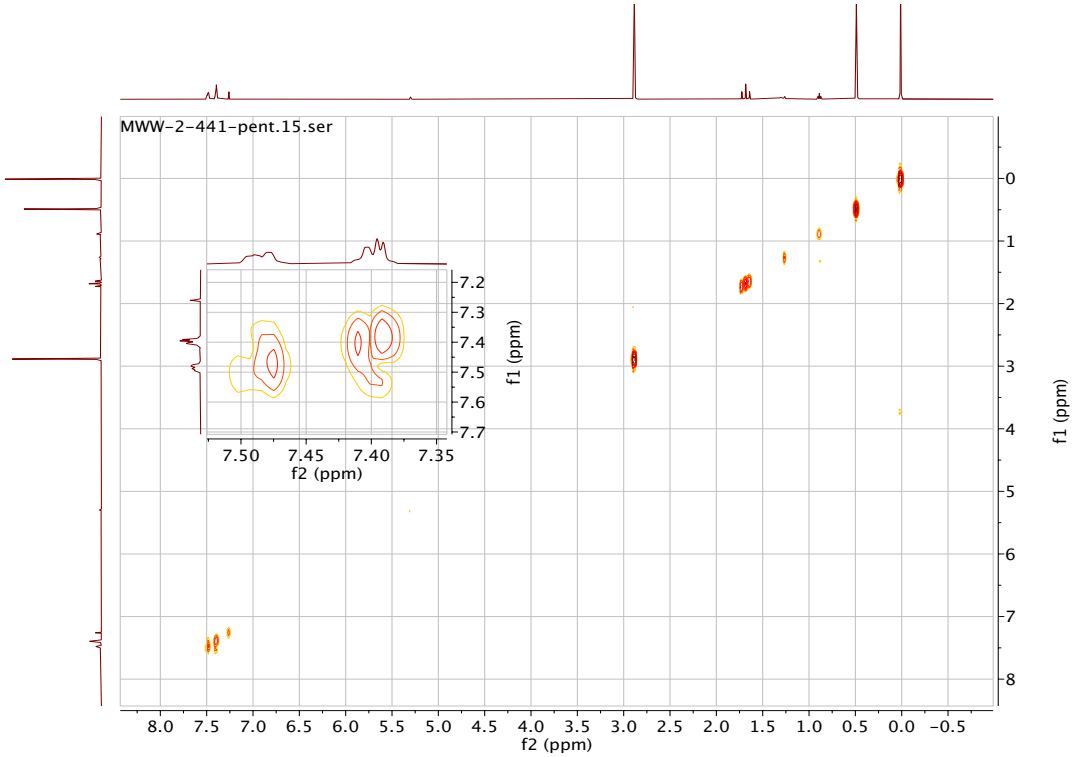


Figure S134. ^{1}H-^{13}C HSQC (500 MHz, $CDCl_3$, 25 °C) of 4n

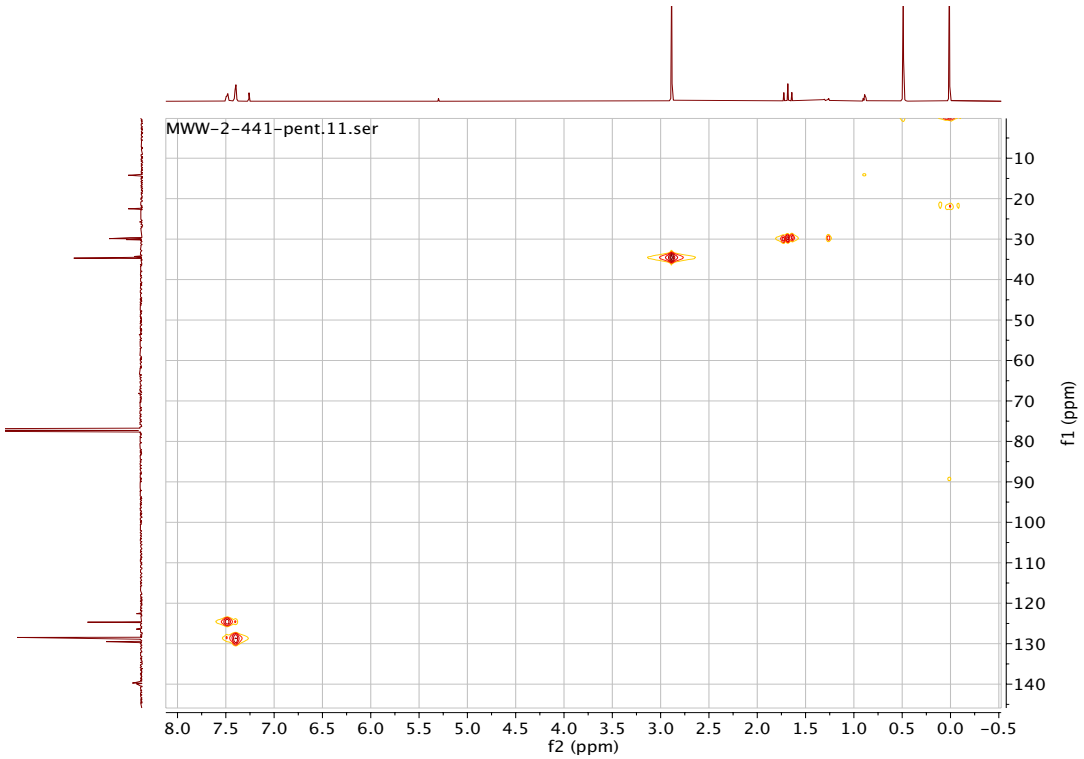


Figure S135. ^{1}H-^{13}C HMBC (500 MHz, $CDCl_3$, 25 °C) of 4n

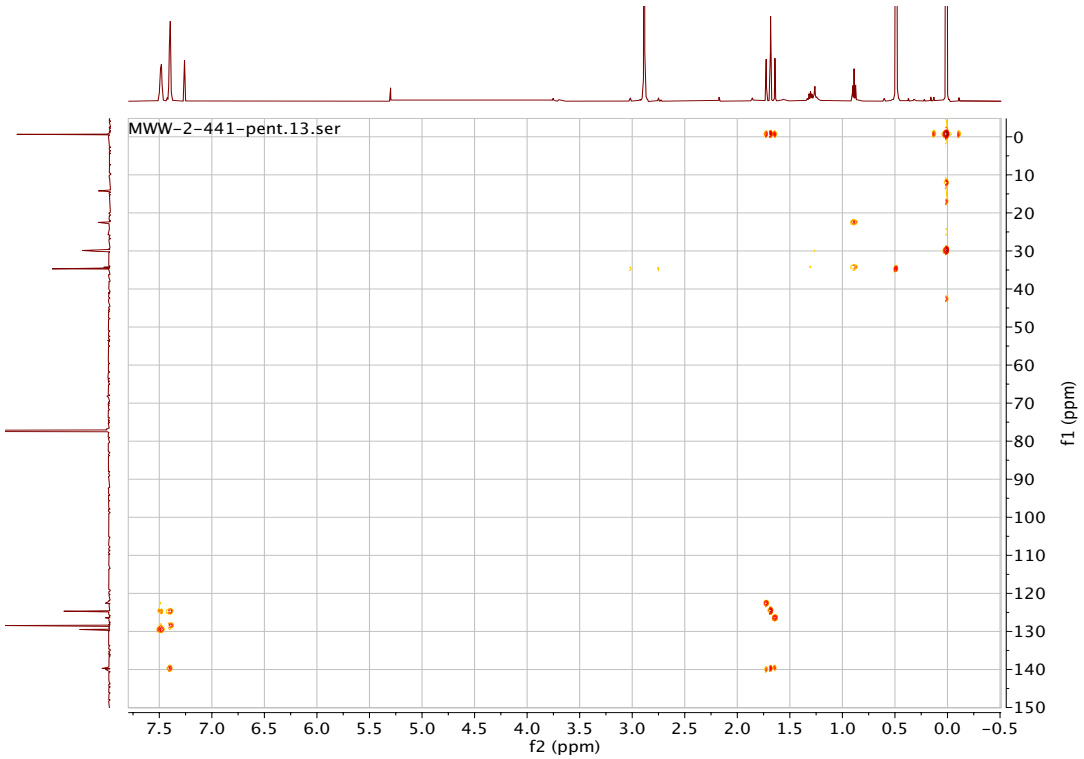


Figure S136. ^{19}F NMR (400 MHz, THF, 23 °C) of 4n in Situ Yield (~97%)

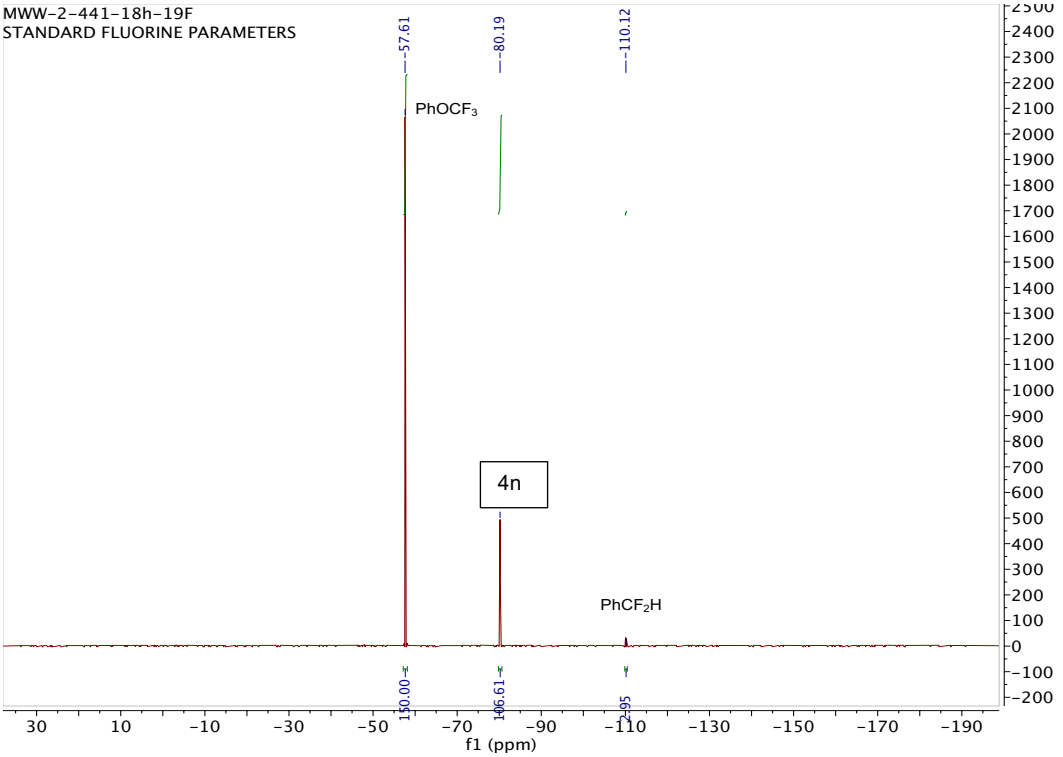
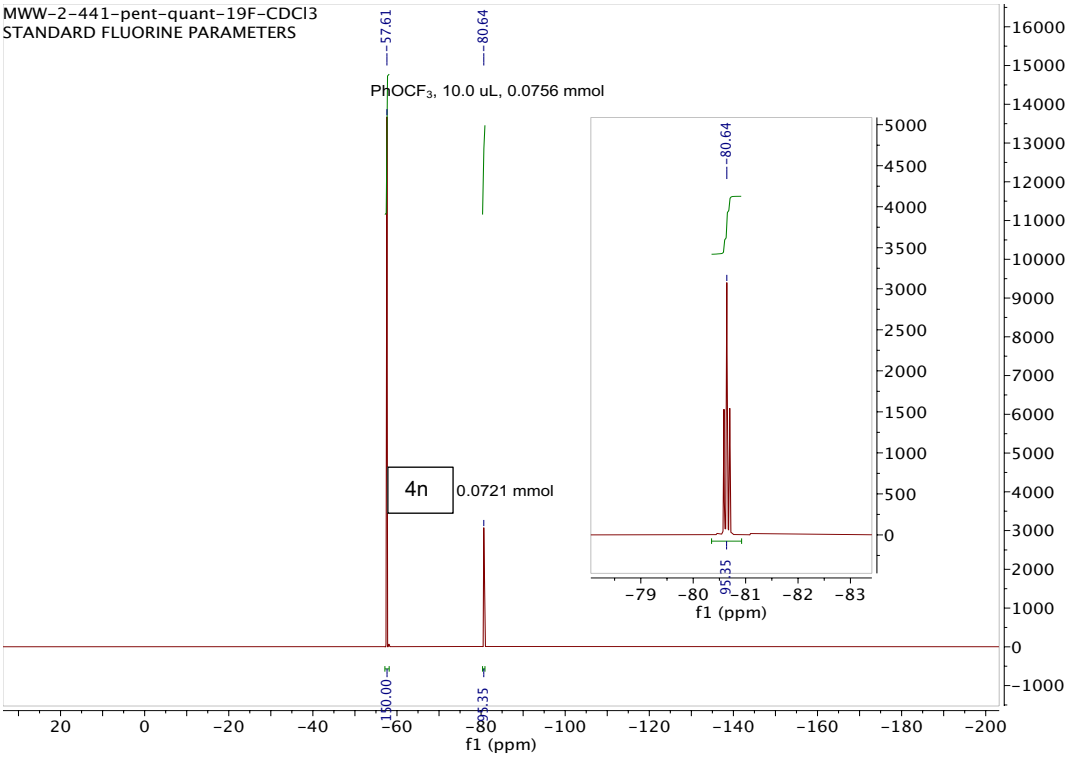
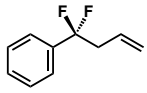


Figure S137. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 4n (52% purity)



Synthesis of 4o: (1,1-difluorobut-3-en-1-yl)benzene



In a 20 mL scintillation vial with a magnetic stir bar **1a** (0.3 mmol, 178 mg), allylbromide (0.36 mmol, 31 µL) and $PhOCF_3$ (0.1 mmol, 13.2 µL) were dissolved in 15 mL of THF. Reaction stirred for 3.5 h at 25 °C. With respect to $PhOCF_3$ as ^{19}F internal standard, 50% in situ yield at 25 °C of **4o** was obtained. Spectroscopic features were in good agreement in comparison to the compound reported in the literature.[7] The full reaction mixture was used in the synthesis of **4p**.

^{19}F-NMR: -94.44 (t, $J_{1H\text{-}19F}$ = 16.0 Hz)

GCMS: 168 m/z

Figure S138. ^{1}H NMR (400 MHz, THF, 23 °C) of 4o

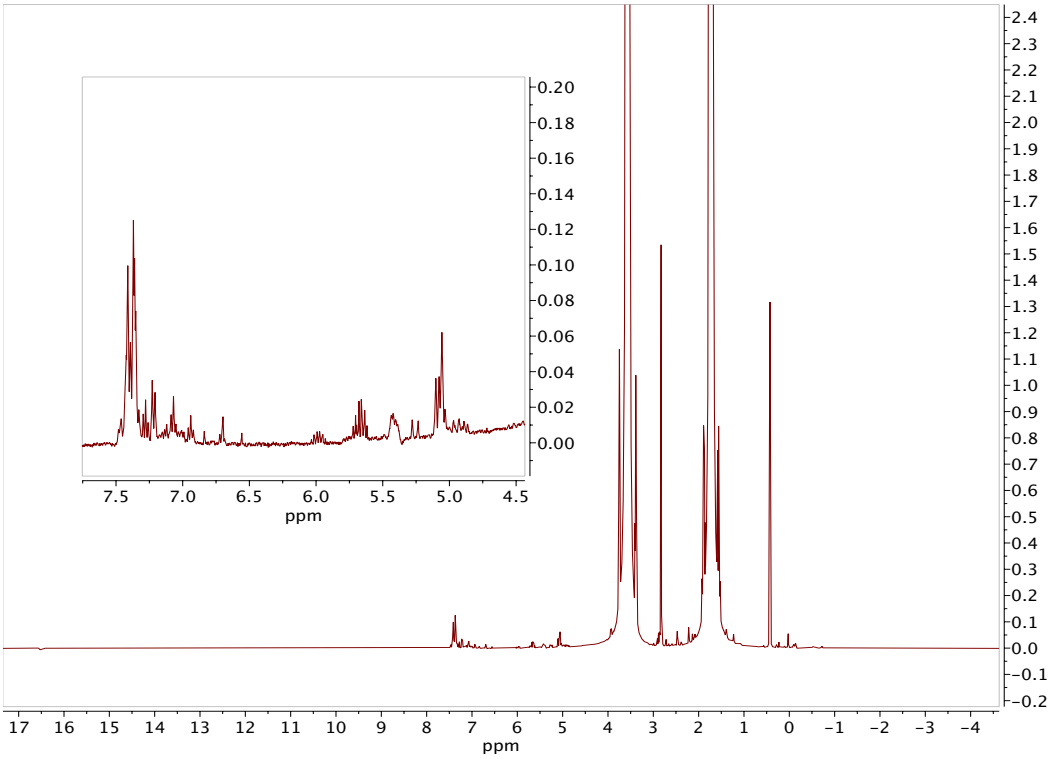


Figure S139. ^{1}H NMR (400 MHz, THF, 23 °C) of 4o Overlayed with Allyl Bromide

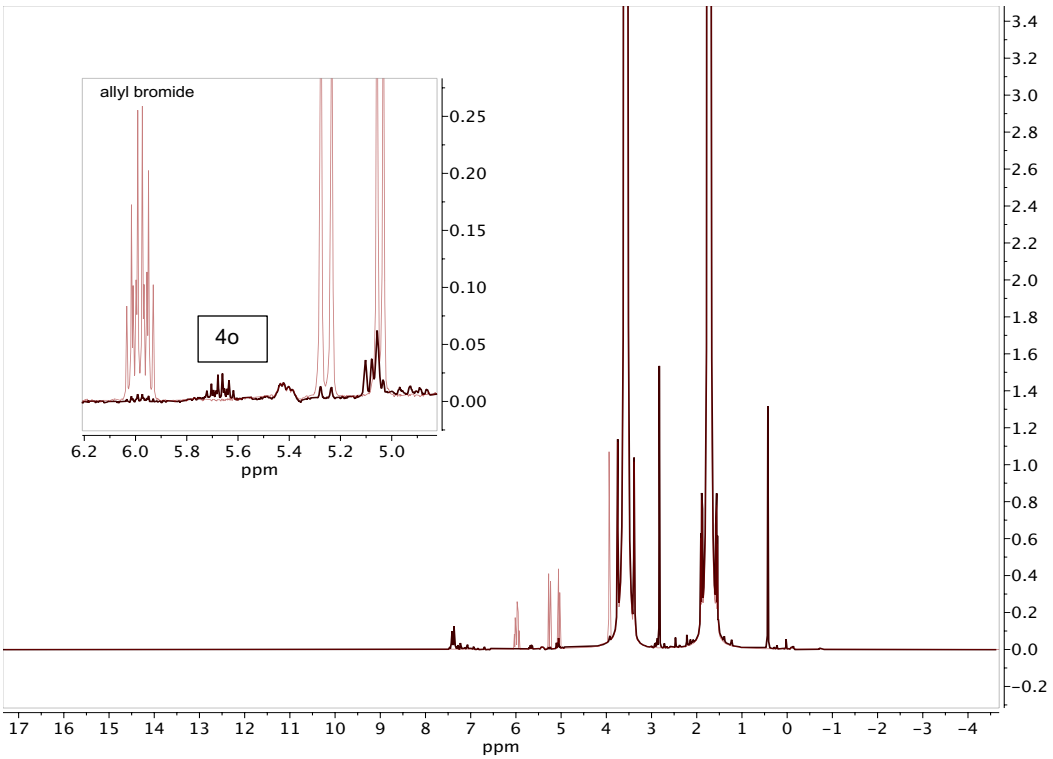
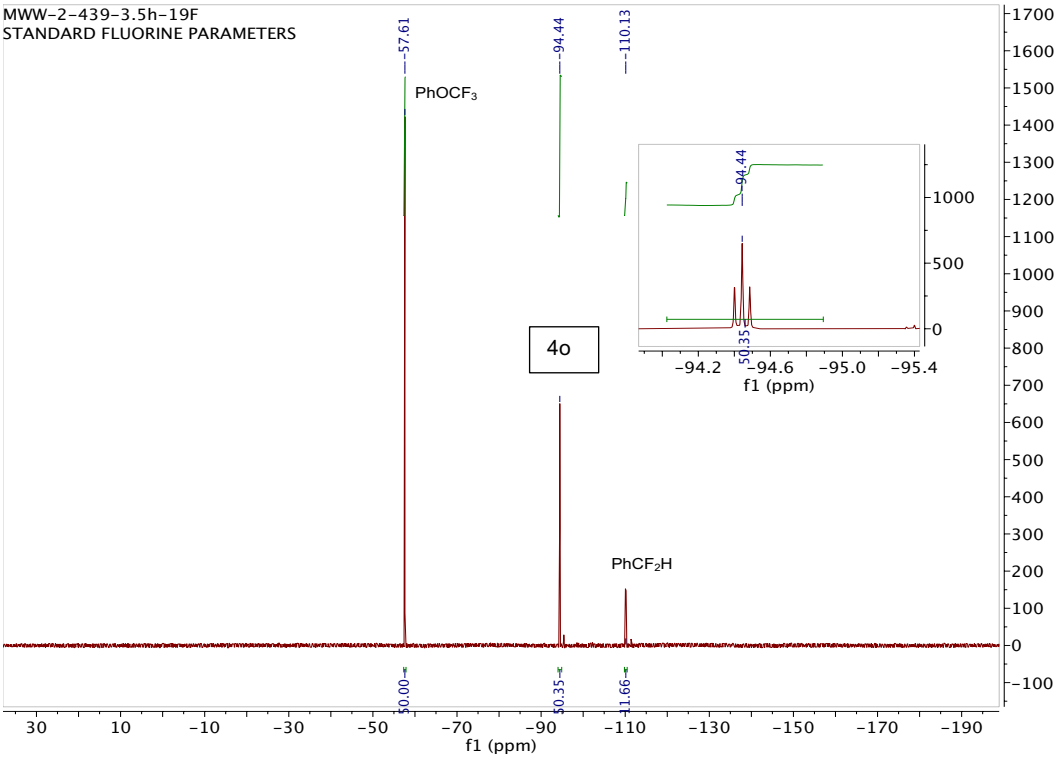
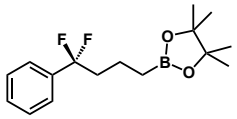


Figure S140. ^{19}F NMR (400 MHz, THF, 23 °C) of 4o in Situ Yield (50%)



Synthesis of 4p: 2-(4,4-difluoro-4-phenylbutyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane



Procedure: **4o** was formed following the above procedure. Solid particulate matter was filtered through glass filter paper into a 20 mL scintillation vial, and the resulting solution was concentrated under vacuum to remove unreacted allyl bromide. *Some of **4o** was inevitably also lost to vacuum. The solid residue was dissolved in 15mL of THF. Pinacolborane (0.6 mmol, 87 µL) was added to the reaction mixture followed by $RhCl(PPh_3)_3$ (0.003 mmol, 2.7 mg). The contents were stirred at 80 °C for 14h. After heating, fluorobenzene (0.06 mmol, 5.6 µL) was added as a new internal standard to quantify the amount of **4p** formed by ^{19}F NMR, 18% in situ yield over two steps. Three other triplet products were observed, and the selectivity for the linear hydroborated product was 53% comparatively. The reaction mixture dry loaded onto a 25g Biotage column (using Davisil) and eluted with a 0 - 20% ethyl acetate in hexanes at the rate of 25 mL/min over 10-12 column volumes. After a second column, 4.7 mg of **4p** was isolated, 5% yield. After NMR analysis, **4p** was reconstituted and assessed by quantitative ^{19}F NMR with respect to $PhOCF_3$ (10.0 µL). 51% purity by mass was found (compared to 5.0 mg sample). **Low purity was likely due to the small amount of material isolated.

^{1}H-NMR ($CDCl_3$): 0.79 (H_a, 2H, t, $J_{1H\text{-}1H}$=7.8 Hz), 1.23 (H_b, 12H, s), 1.55 (H_c, 2H, m), 2.15 (H_d, 2H, m), 7.40 (H_e, 2H, OL), 7.40 (H_f, 1H, OL), 7.47 (H_g, 2H, m).

^{13}C-NMR: 10.93 (C_a, broad), 17.27 (C_b, t, $J_{13C\text{-}19F}$=4.4 Hz), 24.95 (C_c), 41.42 (C_d, t, $J_{13C\text{-}19F}$=27.1 Hz), 83.21 (C_e), 123.17 (C_f, t, $J_{13C\text{-}19F}$=242.0 Hz), 125.15 (C_g, t, $J_{13C\text{-}19F}$=6.3 Hz), 128.45 (C_h), 129.62 (C_i), 137.67 (C_j, t, $J_{13C\text{-}19F}$=26.7 Hz).

^{19}F-NMR: -95.02 (t, $J_{1H\text{-}19F}$ = 16.2 Hz)

HRMS ESI+: 296.2126 m/z

Figure S141. ^{1}H NMR (700 MHz, $CDCl_3$, 25 °C) of 4o

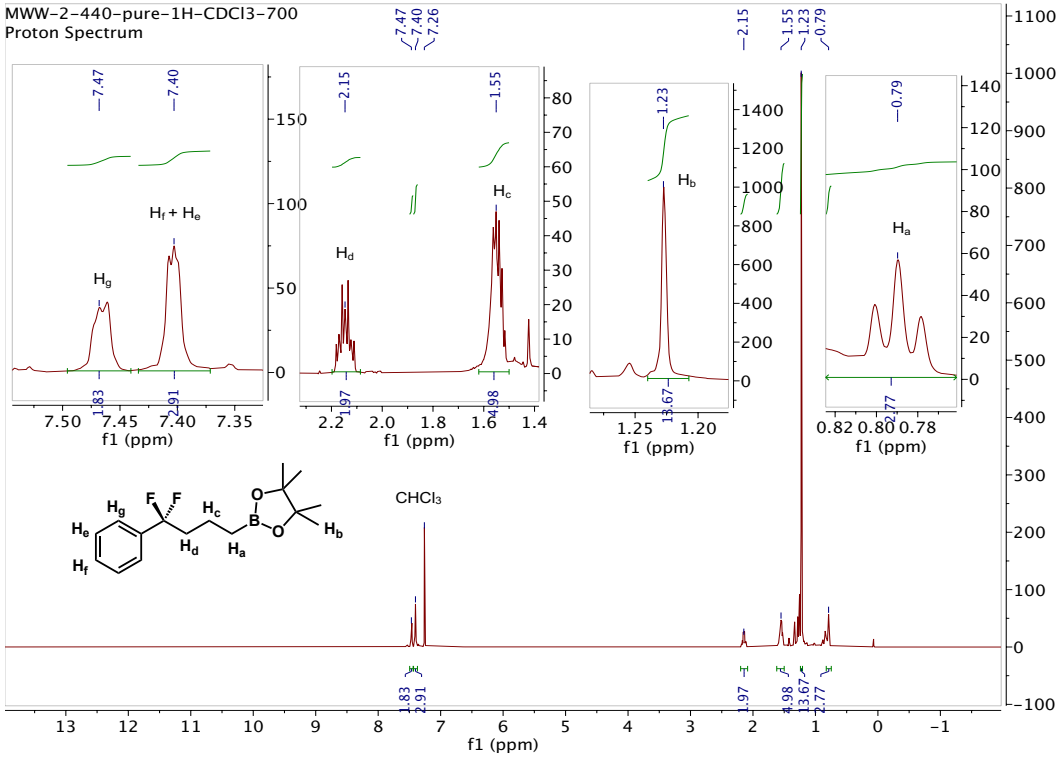


Figure S142. ^{13}C NMR (700 MHz, $CDCl_3$, 25 °C) of 4o

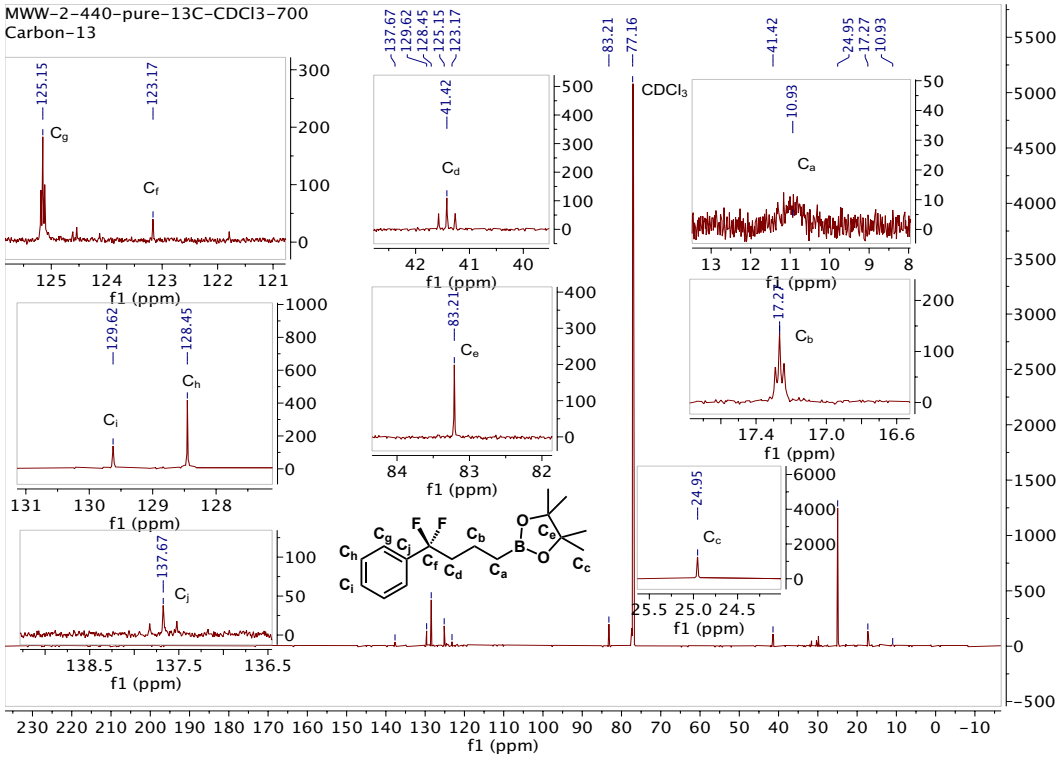


Figure S143. ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 4o

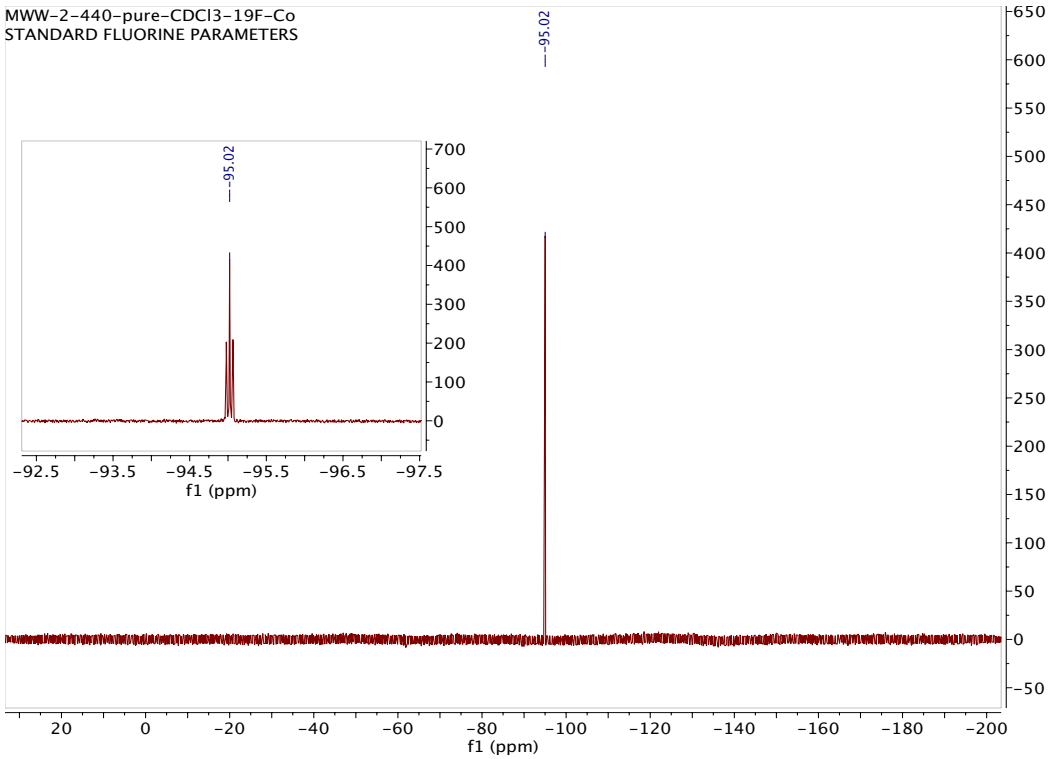


Figure S144. ^{1}H-^{1}H COSY (700 MHz, $CDCl_3$, 25 °C) of 4o

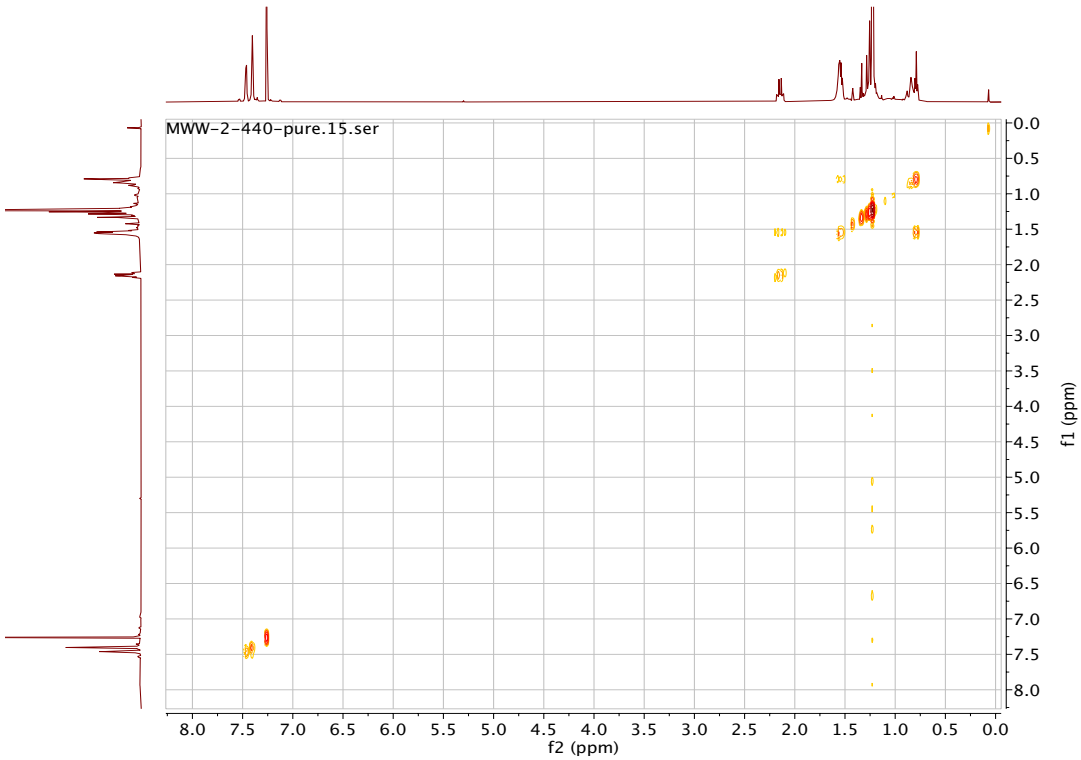


Figure S145. ^{1}H-^{13}C HSQC (500 MHz, $CDCl_3$, 25 °C) of 4o

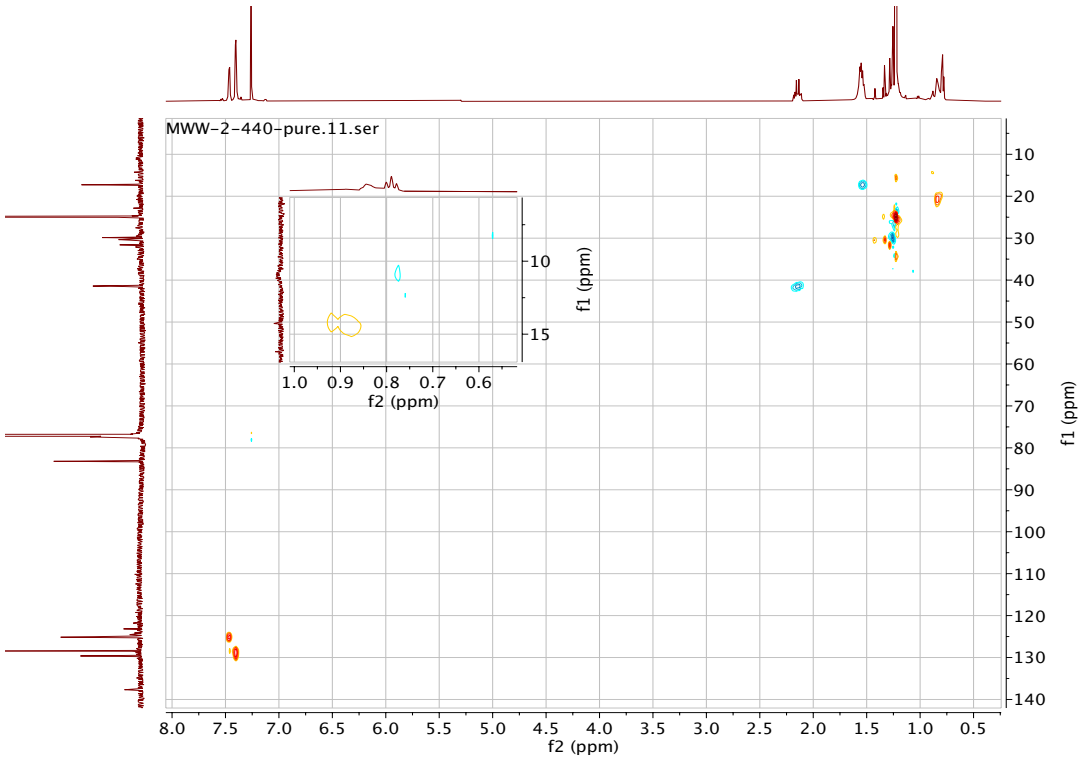


Figure S146. ^{1}H-^{13}C HMBC (500 MHz, $CDCl_3$, 25 °C) of 4o

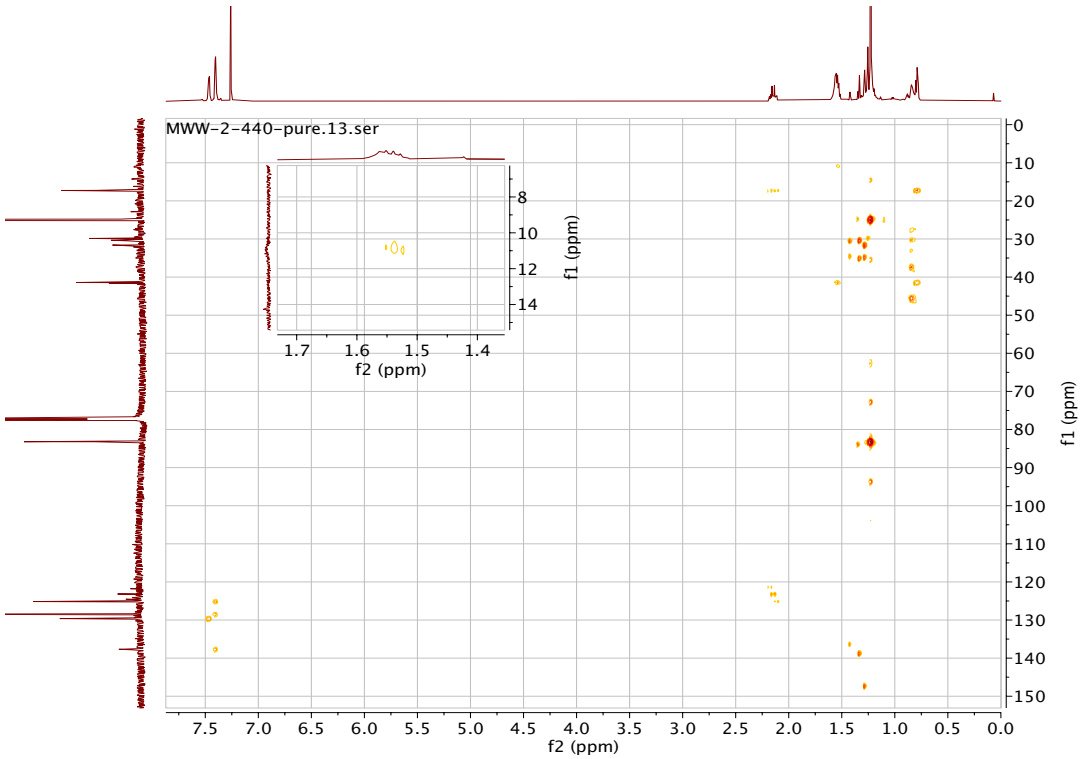


Figure S147. ^{19}F NMR (400 MHz, THF, 23 °C) of 4o in Situ Yield (18%)

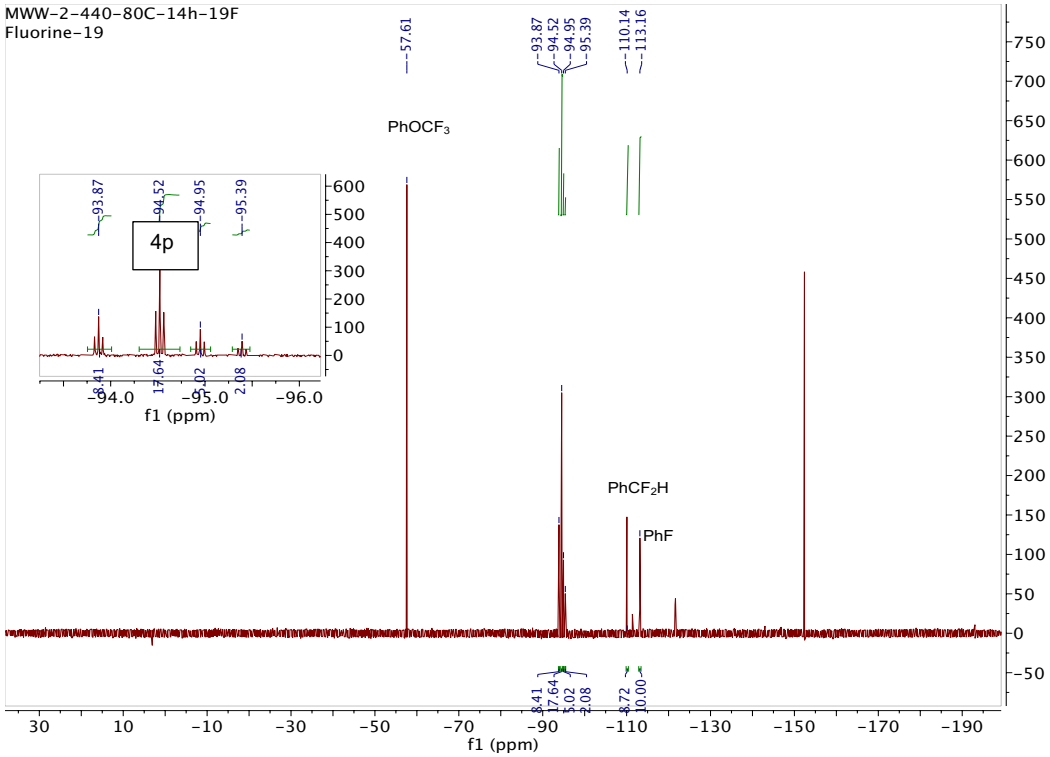
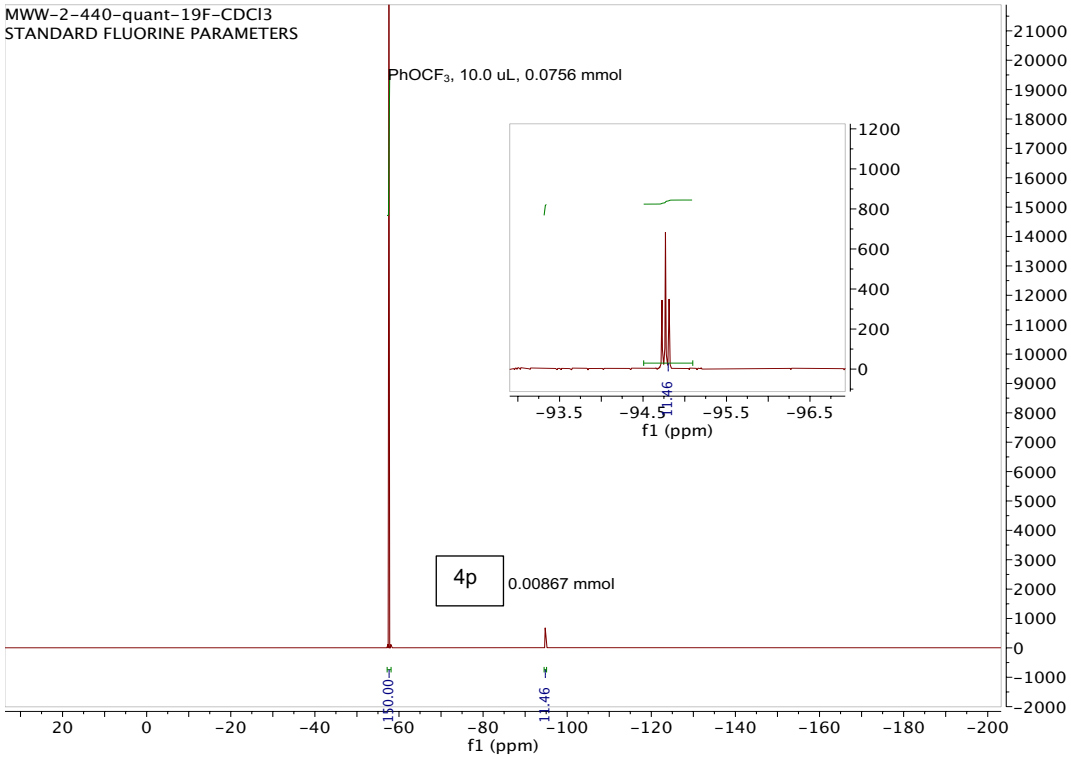


Figure S148. Quantitative ^{19}F NMR (400 MHz, $CDCl_3$, 23 °C) of 4o (51% purity)



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