# *Supporting Information*

## Photoredox Catalyzed C–H Trifluoroethylamination of Heteroarenes

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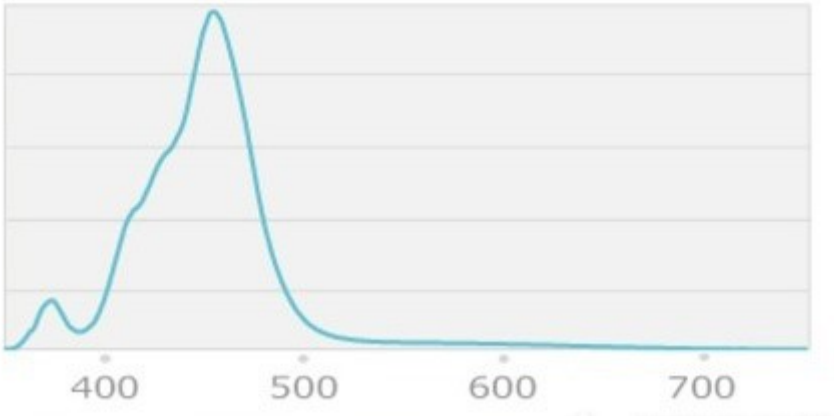
# 1. General Information

$^{1}H$ NMR (TMS as the internal standard) were recorded on a Bruker AM 400 or 600 spectrometer, $^{13}C$ NMR and $^{19}F$ NMR ($CFCl_3$ as outside standard and low field is positive) spectra were recorded on a Bruker AM 400 or 600 spectrometer. For the determination of $^{19}F$ NMR yield, $PhCF_3$ was used as an internal standard and the relaxation delay (d1) was set to 5 s. Chemical shifts (δ) were reported in per million (ppm), and coupling constants (*J*) were in Hertz (Hz). The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, m = multiplet. High resolution mass spectra (HRMS) were obtained on a GC-TOF mass spectrometer.

**Materials:** Unless otherwise noted, all reagents were obtained commercially and used without further purification. Substrates were purchased from commercial sources or prepared according to literature procedures. Reactions were performed using glassware that was flame-dried under vacuum.

All photochemical reactions were performed in 10 mL screw cap scintillation vials (unless noted otherwise) under a nitrogen atmosphere at room temperature and irradiated with a 40 W White LED (Kessil A160WE, America) from a distance of 10 cm.




**Emission spectra of the used light sources**

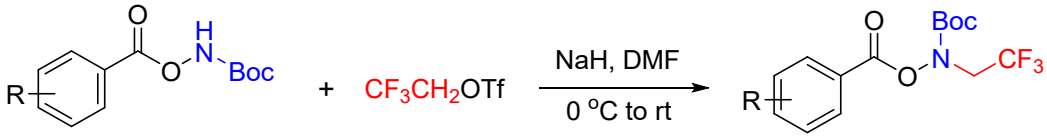
**(picture originated from** https://www.instrument.com.cn/netshow/C327600.htm**)**

## 2. Preparation of Substrates

Substrates **3a** (603-76-9), **3q** (10075-52-2), **3t** (21535-97-7), **5a** (271-89-6), **5b** (21535-97-7), **5c** (59214-70-9), **5d** (23145-07-5), **5e** (1455-18-1) were obtained commercially and used without further purification.

Substrates **1a-1d**[1], **1e**[2], **1f**[2], **3b**[3], **3c**[4], **3d**[5], **3e**[6], **3f-3k**[7], **3l**[8-10], **3m-3p**[7], **3r**[7], **3s**[3], **5f**[7] and **5h**[7] were prepared according to the reported literatures.

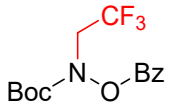
### General procedure for synthesis of 2a-2d




**1a-1d** **2a-2d**

To a solution of *tert*-butyl (benzoyloxy)carbamate (**1a-1d**) (10 mmol, 1.0 equiv.) in dry DMF (80 mL) was added portion wise NaH (15 mmol, 1.6 equiv., 60% dispersion in mineral oil) at 0 °C. The reaction mixture was stirred at 0 °C for 30 minutes and 2,2,2-trifluoroethyl trifluoromethanesulfonate (12 mmol, 1.5 equiv.) was added dropwise at 0 °C. The reaction mixture was allowed to warm to room temperature and stirred for 30 minutes. After completion of the reaction monitored by TLC, the reaction mixture was quenched by $H_2O$, extracted with $CH_2Cl_2$. The combined organic layers were washed with brine, dried over anhydrous $Na_2SO_4$, and concentrated under reduced pressure. The resulting residue was purified by flash column chromatography on silica-gel eluting with a mixture of pentane and EtOAc to give the desired product **2a-2d**.

### *t*ert-Butyl (benzoyloxy)(2,2,2-trifluoroethyl)carbamate (2a)

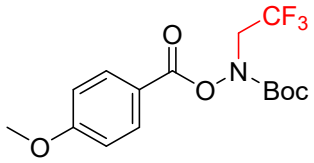



**2a**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 100:1) to afford **2a** (2.39 g, 75%) as a white solid. Mp. 48-50 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.00 (dd, *J* = 8.4, 1.4 Hz, 2H), 7.60 – 7.55 (m, 1H), 7.42 (t, *J* = 7.8 Hz, 2H), 4.21 (s, 2H), 1.40 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 164.3, 153.5, 134.3, 123.0, 128.7, 126.8, 123.5 (q, *J* = 279.7 Hz), 84.0, 51.2 (q, *J* = 33.9 Hz), 27.9; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -70.87 (t, *J* = 8.4 Hz); **IR** (thin film) ν 3013, 1768, 1719, 1607, 1599,

1451, 1266, 1143, 1013, 939, 708, 624 $cm^{-1}$; **MS** (ESI): m/z 342.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{14}H_{16}F_3NNaO_4$ $[M+Na]^+$: 342.0924; Found: 342.0922.

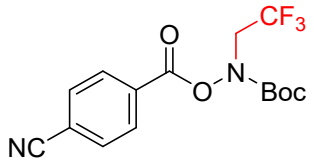
***t*ert-Butyl ((4-methoxybenzoyl)oxy)(2,2,2-trifluoroethyl)carbamate (2b)**



**2b**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **2b** (2.41 g, 69%) as a white solid. Mp. 72-74 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.03 (d, $J$ = 8.7 Hz, 2H), 6.96 (d, $J$ = 8.7 Hz, 2H), 4.27 (s, 2H), 3.88 (s, 3H), 1.47 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 164.4, 164.0, 153.6, 132.2, 123.6 (q, $J$ = 279.6 Hz), 118.9, 114.1, 83.8, 55.5, 51.3 (q, $J$ = 32.8 Hz), 27.9; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -70.88 (t, $J$ = 8.5 Hz); **IR** (thin film) ν 3018, 1762, 1723, 1607, 1509, 1372, 1250, 1143, 1045, 1027, 852, 762, 584 $cm^{-1}$; **MS** (ESI): m/z 372.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{15}H_{18}F_3NNaO_5$ $[M+ Na]^+$: 372.1029; Found: 372.1025.

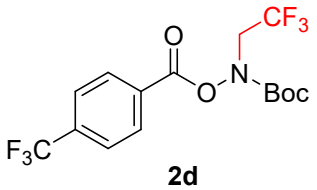
***t*ert-Butyl ((4-cyanobenzoyl)oxy)(2,2,2-trifluoroethyl)carbamate (2c)**



**2c**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 100:1) to afford **2c** (2.79 g, 81%) as a white solid. Mp. 98-100 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.20 (d, $J$ = 8.0 Hz, 2H), 7.82 (d, $J$ = 8.1 Hz, 2H), 4.31 (q, $J$ = 8.5 Hz, 2H), 1.50 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 162.8, 153.1, 132.5, 130.7, 130.4, 123.4 (q, $J$ = 279.7 Hz), 117.7, 117.5, 84.6, 51.3 (q, $J$ = 35.3 Hz), 27.9; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -70.74 (t, $J$ = 8.4 Hz); **IR** (thin film) ν 2946, 1771, 1727, 1370, 1355, 1299, 1271, 1137, 1064, 1042, 846, 755, 543 $cm^{-1}$; **MS** (ESI): m/z 367.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{15}H_{15}F_3N_2NaO_4$ $[M+Na]^+$: 367.0876; Found: 367.0880.

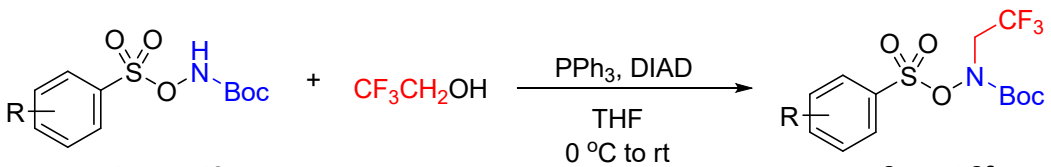
***t*ert-Butyl (2,2,2-trifluoroethyl)((4-(trifluoromethyl)benzoyl)oxy)carbamate (2d)**



**2d**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 100:1) to afford **2d** (3.06 g, 79%) as a white solid. Mp. 80-82 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.12 (d, *J* = 8.1 Hz, 2H), 7.70 (d, *J* = 8.2 Hz, 2H), 4.23 (q, *J* = 8.7 Hz, 2H), 1.41 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 163.2, 153.2, 135.6 (q, *J* = 32.9 Hz), 130.4, 130.2, 125.8 (q, *J* = 3.7 Hz), 123.4 (q, *J* = 279.7 Hz), 123.3 (q, *J* = 272.9 Hz), 84.4, 51.2 (q, *J* = 35.1 Hz), 27.9; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -63.35 (s, 3F), -70.79 (t, *J* = 8.5 Hz, 3F); **IR** (thin film) ν 3013, 1772, 1733, 1376, 1354, 1269, 1141, 1069, 1016, 861, 591 $cm^{-1}$; **MS** (ESI): m/z 410.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{15}H_{15}F_6NNaO_4$ $[M+Na]^+$: 410.0797; Found: 410.0794.

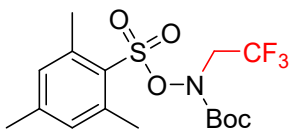
**General procedure for synthesis of 2e and 2f**.




**1e** and **1f** **2e** and **2f**

Under a nitrogen atmosphere, to a solution of $PPh_3$ (6 mmol, 1.2 equiv.) in anhydrous THF (2 M) was added drop wise diisopropyl azodicarboxylate (6 mmol, 1.2 equiv.) at 0 °C. The mixture was stirred at this temperature for 30 minutes, a solution of *tert*-butyl ((phenylsulfonyl)oxy)carbamate (6 mmol, 1.2 equiv.) and 2,2,2-trifluoroethanol (5 mmol, 1.0 equiv.) in anhydrous THF (10 mL) were added. The reaction mixture was stirred at 0 °C for 1 hour, after which it was stirred at room temperature and monitored by TLC. Upon completion, the reaction mixture was concentrated in vacuo and purification by column chromatography on silica gel eluting with a mixture of pentane and EtOAc gave **2e** and **2f**.

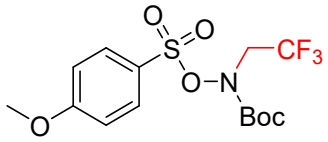
***t*ert-Butyl ((mesitylsulfonyl)oxy)(2,2,2-trifluoroethyl)carbamate (2e)**



**2e**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **2e** (1.11 g, 56%) as a white solid. Mp. 102-104 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 6.94 (s, 2H), 4.20 (s, 2H), 2.58 (s, 6H), 2.26 (s, 3H), 1.23 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.6, 144.8, 142.0, 131.8, 128.7, 123.4 (q, $J$ = 282.8 Hz), 84.8, 52.1 (q, $J$ = 33.8 Hz), 27.5, 23.3, 21.1; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -68.02 (t, $J$ = 8.2 Hz); **IR** (thin film) ν 2982, 1732, 1601, 1369, 1304, 1259, 1194, 1146, 1033, 855, 745, 670, 575 $cm^{-1}$; **MS** (ESI): m/z 420.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{22}F_3NNaO_5S$ $[M+Na]^+$: 420.1063; Found: 420.1054.

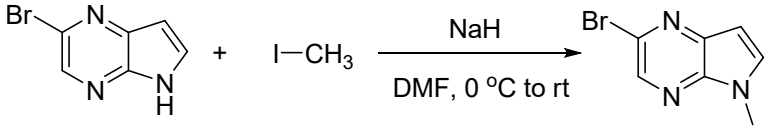
**tert-Butyl (((4-methoxyphenyl)sulfonyl)oxy)(2,2,2-trifluoroethyl)carbamate (2f)**




**2f**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 100:1) to afford **2f** (1.50 g, 78%) as a white solid. Mp. 82-84 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.84 (d, $J$ = 9.0 Hz, 2H), 6.96 (d, $J$ = 9.0 Hz, 2H), 4.22 (s, 2H), 3.83 (s, 3H), 1.20 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 164.9, 153.5, 132.0, 124.6, 123.3 (q, $J$ = 282.6 Hz), 114.4, 84.7, 55.9, 52.2 (q, $J$ = 33.9 Hz), 27.5; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -67.89 (t, $J$ = 8.0 Hz); **IR** (thin film) ν 2988, 1756, 1594, 1576, 1496, 1375, 1197, 1090, 855, 868, 769, 633 $cm^{-1}$; **MS** (ESI): m/z 408.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{14}H_{18}F_3NNaO_6S$ $[M+Na]^+$: 408.0699; Found: 408.0692.

**Preparation of 2-Bromo-5-methyl-5*H*-pyrrolo[2,3-b]pyrazine (5g)**

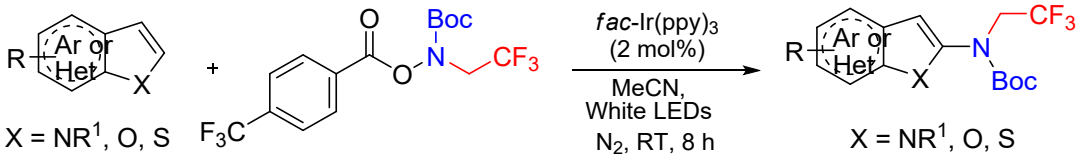



**5g**

To a solution of 2-bromo-5*H*-pyrrolo[2,3-b]pyrazine (8 mmol, 1.0 equiv.) in dry DMF (20 mL) was added portion wise NaH (12.8 mmol, 1.6 equiv., 60% dispersion in mineral oil) at 0 °C. The reaction mixture was stirred at 0 °C for 30 minutes and methyl iodide (9.6 mmol, 1.2 equiv.) was added drop wise at 0 °C. The reaction mixture was allowed to warm to room temperature and stirred for overnight. After completion of the reaction monitored by TLC, the reaction mixture was quenched by $H_2O$, extracted with $CH_2Cl_2$ (10 × 3 mL). The combined organic layers were washed with brine, dried over

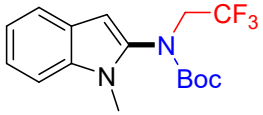
anhydrous $Na_2SO_4$, and concentrated under reduced pressure. The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 8:1) to afford **5g**. (0.911 g, 59%) as a yellow solid. Mp.102-104 $^oC$. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.31 (s, 1H), 7.47 (d, *J* = 2.7 Hz, 1H), 6.63 (s, 1H), 3.90 (s, 3H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 139.8, 139.6, 138.1, 134.4, 133.0, 100.4, 31.7; IR (thin film) ν 2968, 1718, 1459, 1367, 1248, 1152, 1057, 923, 864, 760 $cm^{-1}$; MS (ESI): m/z 212.0 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_7H_7BrN_3$ $[M+H]^+$: 211.9818; Found: 211.9821.

## 3. General Procedures for C-H Trifluoroethylamination of Heteroarenes




A 15 mL screw-cap vial was charged with a magnetic stir bar, *N*-trifluoroethylhydroxylamine **2d** (309.7 mg, 0.8 mmol, 2.0 equiv.), *fac*-Ir(ppy)$_3$ (5.2 mg, 0.008 mmol), and heteroaren **3** or **5** (0.4 mmol, 1 equiv., if it is a solid). The vial was evacuated and backfilled nitrogen three times. Then, MeCN (4 mL) was added via a syringe (If the heteroarens **3** or **5** is a liquid, it is dissolved in MeCN). The reaction mixture was irradiated by a 40 W white LED and stirred at room temperature for 8 h. The mixture was diluted with saturated $NaHCO_3$ aqueous solution and extracted by ethyl acetate. The combined organic phase were dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuum to give a residue. The residue was purified by silica-gel column chromatography to give the desired product **4** or **6**.

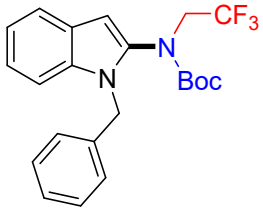
**_tert_-Butyl (1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4a)**




**4a**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4a** (116.8 mg, 89%) as a light yellow solid. Mp. 64-66 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.51 (s, 1H), 7.23 – 7.21 (m, 1H), 7.19 – 7.15 (m, 1H), 7.04 (t, *J* = 7.4 Hz, 1H), 6.24 (s, 1H), 4.53 (s, 1H), 3.92 (s, 1H), 3.49 (s, 3H), 1.31 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.3, 135.9, 133.9, 125.2, 123.2 (q, *J* = 280.4 Hz), 121.0, 119.8, 118.8, 108.5, 94.9, 81.6, 50.9, 27.7, 27.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.25 (t, *J* = 8.6 Hz); **IR** (thin film) ν 2976, 1712, 1557, 1471, 1372, 1265, 1146, 1018, 858, 748, 655 cm$^{-1}$; **MS** (ESI): m/z 351.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{19}F_3N_2NaO_2$ $[M+Na]^+$: 351.1291; Found: 351.1290.

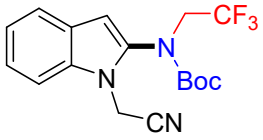
**_t_ert-Butyl (1-benzyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4b)**




**4b**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4b** (98.6 mg, 61%) as a yellow solid. Mp. 128-130 °C. **$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 7.7 Hz, 1H), 7.23 – 7.17 (m, 3H), 7.11 – 7.08 (m, 2H), 7.07–7.03 (m, 1H), 7.00 (d, J = 6.7 Hz, 2H), 6.41 (s, 1H), 5.23 – 4.97 (m, 2H), 4.06 (s, 1H), 3.46 (s, 1H), 1.28 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.2, 136.1, 135.0, 133.9, 127.7, 126.5, 125.6, 125.3, 123.1 (q, *J* = 280.7 Hz), 121.5, 120.1, 119.0, 109.3, 98.3, 81.7, 49.9, 45.2, 26.9; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -70.08 (t, *J* = 8.8 Hz); **IR** (thin film) ν 2982, 1706, 1558, 1456, 1360, 1271, 1155, 1057, 727, 697, 661 cm-1; **MS** (ESI): m/z 427.2 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{22}H_{23}F_3N_2NaO_2$ $[M+Na]^+$: 427.1604; Found: 427.1599.

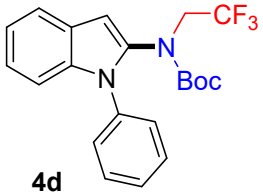
**tert-Butyl (1-(cyanomethyl)-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4c)**




**4c**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 10:1) to afford **4c** (125.7 mg, 89%) as a white solid. Mp. 99-101 °C. **$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 7.51 (d, *J* = 7.9 Hz, 1H), 7.30 – 7.23 (m, 2H), 7.12 (t, *J* = 7.4 Hz, 1H), 6.32 (s, 1H), 4.70 (d, *J* = 5.4 Hz, 2H), 4.55 (s, 1H), 3.82 (s, 1H), 1.35 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.0, 136.0, 134.0, 126.6, 123.7, 124.2 (q, *J* = 280.2 Hz), 121.6, 121.5, 114.3, 109.5, 98.8, 84.2, 52.1 (d, *J* = 35.3 Hz), 30.3, 27.9; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -70.97 (s); **IR** (thin film) ν 2971, 1718, 1584, 1566, 1462, 1364, 1152, 1054, 858, 757, 655 $cm^{-1}$; **MS** (ESI): m/z 376.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{17}H_{18}F_3N_3NaO_2$ $[M+Na]^+$: 376.1243; Found: 376.1241.

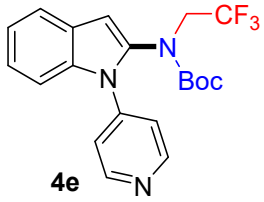
**tert-Butyl (1-phenyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4d)**




**4d**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4d** (117.0 mg, 75%) as a white solid. Mp. 116-118 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.56 (d, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.6 Hz, 2H), 7.35 (t, *J* = 7.4 Hz, 1H), 7.27 (d, *J* = 7.5 Hz, 2H), 7.13 – 7.07 (m, 3H), 6.51 (s, 1H), 4.03 (d, *J* = 246.8 Hz, 2H), 1.18 (s, 9H); **$^{13}$C NMR** (151 MHz, $CDCl_3$) δ 154.1, 136.5, 135.6, 129.6, 128.0, 127.6, 127.1, 126.5, 124.1 (q, *J* = 281.2 Hz), 122.9, 121.1, 120.7, 110.6, 100.9, 82.5, 51.0, 27.9; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -69.85 (s, 2F), -70.41 (s, 1F); **IR** (thin film) ν 2985, 1714, 1498, 1455, 1392, 1141, 1011, 930, 736, 660 $cm^{-1}$; **MS** (ESI): m/z 413.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{21}H_{21}F_3N_2NaO_2$ $[M+Na]^+$: 413.1447; Found: 413.1450.

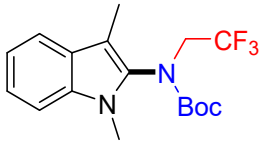
**tert-Butyl (1-(pyridin-4-yl)-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4e)**




**4e**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 15:1) to afford **4e** (109.5 mg, 70%) as a white solid. Mp. 115-117 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.80 (d, *J* = 5.2 Hz, 2H), 7.68 (d, *J* = 7.6 Hz, 1H), 7.38 (s, 3H), 7.31-7.23 (m, 2H), 6.67 (s, 1H), 4.45 (s, 1H), 3.88 (s, 1H), 1.25 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 157.0, 153.7, 151.3, 144.5, 135.6, 127.0, 123.9 (q, *J* = 279.8 Hz), 123.7, 121.6, 121.5, 120.7, 110.5, 102.2, 83.1, 51.7, 27.8; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -69.99 (s, 2F), -70.24 (s, 1F); **IR** (thin film) ν 2997, 1709, 1593, 1566, 1459, 1358, 1143, 929, 771, 587 $cm^{-1}$; **MS** (ESI): m/z 392.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{20}H_{21}F_3N_3O_2$ $[M+H]^+$: 392.1580; Found: 392.1583.

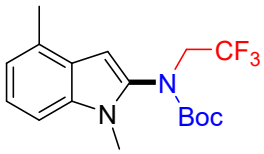
**tert-Butyl (1,3-dimethyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4f)**




**4f**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 100:1) to afford **4f** (98.6 mg, 72%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.45 (d, *J* = 7.8 Hz, 1H), 7.16 (d, *J* = 5.6 Hz, 2H), 7.03 (d, *J* = 6.3 Hz, 1H), 4.48 (s, 1H), 3.82-3.76 (m, 1H), 3.44 (s, 3H), 2.10 (s, 3H), 1.26 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.9, 134.7, 133.2, 126.7, 124.4 (q, *J* = 280.3 Hz), 122.2, 119.2, 119.1, 109.3, 104.0, 82.3, 50.3 (d, *J* = 35.2 Hz), 28.7, 28.1, 8.1; **$^{19}$F NMR** (376MHz, $CDCl_3$) δ -71.10 (t, *J* = 9.1 Hz); **IR** (thin film) ν 2979, 1717, 1470, 1437, 1355, 1138, 1016, 932, 880, 772 $cm^{-1}$; **MS** (ESI): m/z 343.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{17}H_{22}F_3N_2O_2$ $[M+H]^+$: 343.1628; Found: 343.1626.

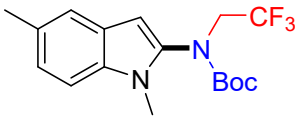
**tert-Butyl (1,4-dimethyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4g)**




**4g**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 100:1) to afford **4g** (111.8 mg, 81%) as a light yellow solid. Mp. 92-94 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.18 (d, *J* = 6.3 Hz, 2H), 6.95 (d, *J* = 6.1 Hz, 1H), 6.35 (s, 1H), 4.65 (s, 1H), 4.04 (s, 1H), 3.59 (s, 3H), 2.55 (s, 3H), 1.43 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.4, 136.5, 134.7, 130.4, 126.2, 124.2 (q, *J* = 280.5 Hz), 122.2, 120.1, 107.1, 94.6, 82.6, 52.3, 28.9, 28.1, 18.6; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.24 (t, *J* = 8.7 Hz); **IR** (thin film) ν 2983, 1706, 1569, 1471, 1358, 1263, 1144, 1016, 864, 774, 664 $cm^{-1}$; **MS** (ESI): m/z 343.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{17}H_{22}F_3N_2O_2$ $[M+H]^+$: 343.1628; Found: 343.1628.

**tert-Butyl (1,5-dimethyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4h)**

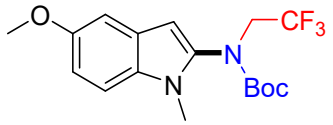



**4h**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4h** (97.2 mg, 71%) as a white solid. Mp. 114-116 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.41 (s, 1H), 7.24 (dd, *J* = 8.4, 2.6 Hz, 1H), 7.12 (d, *J* = 7.9 Hz, 1H), 6.27 (s, 1H), 4.64 (s, 1H), 4.03 (s, 1H), 3.59 (s, 3H), 2.48 (s, 3H), 1.43 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.1, 136.9, 133.3, 129.1, 126.4, 124.2 (q, *J* = 280.9 Hz),

123.6, 120.5, 109.2, 95.4, 82.5, 51.9, 28.8, 28.1, 21.5; **$^{19}$F NMR** (376MHz, $CDCl_3$) δ -71.27 (t, *J* = 8.6 Hz); **IR** (thin film) ν 2973, 1714, 1552, 1490, 1439, 1404, 1146, 1012, 800, 771, 655 $cm^{-1}$; **MS** (ESI): m/z 343.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{17}H_{22}F_3N_2O_2$ $[M+H]^+$: 343.1628; Found: 343.1628.

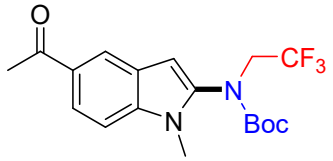
**tert-Butyl (5-methoxy-1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4i)**




**4i**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4i** (101.7 mg, 71%) as a light yellow solid. Mp. 101-103 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.22 (d, *J* = 8.9 Hz, 1H), 7.07 (d, *J* = 2.4 Hz, 1H), 6.93 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.27 (s, 1H), 4.62 (s, 1H), 4.03 (d, *J* = 13.7 Hz, 1H), 3.87 (s, 3H), 3.57 (s, 3H), 1.41 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.3, 153.4, 137.2, 130.2, 126.5, 124.2 (q, *J* = 280.3 Hz), 112.4, 110.3, 102.6, 95.6, 82.5, 55.9, 51.7, 28.8, 28.1; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.27 (t, *J* = 8.7 Hz); **IR** (thin film) ν 2928, 1704, 1558, 1488, 1464, 1455, 1148, 1077, 723, 577 $cm^{-1}$; **MS** (ESI): m/z 359.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{17}H_{22}F_3N_2O_3$ $[M+H]^+$: 359.1577; Found: 359.1576.

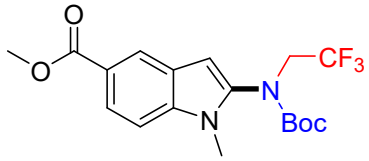
**tert-Butyl (5-acetyl-1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4j)**




**4j**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 20:1) to afford **4j** (87.3 mg, 59%) as a white solid. Mp. 121-123 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.18 (s, 1H), 7.86 (d, *J* = 8.7 Hz, 1H), 7.26 (d, *J* = 8.7 Hz, 1H), 6.38 (s, 1H), 4.57 (s, 1H), 3.93 (s, 1H), 3.54 (s, 3H), 2.59 (s, 3H), 1.32 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 198.1, 153.8, 138.4, 137.5, 130.0, 125.6, 124.1 (q, *J* = 280.3 Hz), 123.1, 122.4, 109.4, 97.9, 83.0, 52.0, 29.0, 28.0, 26.6; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.32 (t, *J* = 9.2 Hz); **IR** (thin film) ν 2994, 1723, 1667, 1560, 1366, 1298, 1143, 813, 667 $cm^{-1}$; **MS** (ESI): m/z 371.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{18}H_{22}F_3N_2O_3$ $[M+H]^+$: 371.1577; Found: 371.1577.

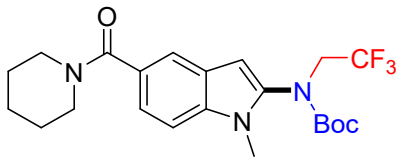
**Methyl 2-((*t*ert-Butoxycarbonyl)(2,2,2-trifluoroethyl)amino)-1-methyl-1*H*-indole-5-carboxylate (4k)**



**4k**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 30:1) to afford **4k** (123.5 mg, 80%) as a white solid. Mp. 138-140 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.26 (d, *J* = 1.5 Hz, 1H), 7.87 (dd, *J* = 8.7, 1.6 Hz, 1H), 7.22 (d, *J* = 8.7 Hz, 1H), 6.34 (s, 1H), 4.54 (s, 1H), 3.93 (s, 1H), 3.83 (s, 3H), 3.51 (s, 3H), 1.30 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 168.0, 153.9, 138.3, 137.4, 125.6, 124.1 (q, *J* = 279.6 Hz), 123.9, 123.5, 122.0, 109.2, 97.6, 82.9, 52.0, 51.9, 29.0, 28.0; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.33 (d, *J* = 9.2 Hz); **IR** (thin film) ν 2994, 1732, 1706, 1566, 1435, 1313, 1143, 1012, 774, 664 $cm^{-1}$; **MS** (ESI): m/z 387.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{18}H_{22}F_3N_2O_4$ $[M+H]^+$: 387.1526; Found: 387.1525.

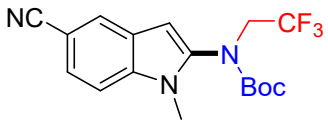
***t*ert-Butyl(1-methyl-5-(piperidine-1-carbonyl)-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4l)**



**4l**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 20:1) to afford **4l** (145.0 mg, 82%) as a yellow solid. Mp. 159-161 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.57 (s, 1H), 7.23 (s, 2H), 6.28 (s, 1H), 4.56 (s, 1H), 3.92 (s, 1H), 3.51 (brs, 7H), 1.62 – 1.54 (m, 6H), 1.31 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 171.6, 154.0, 137.9, 135.4, 128.1, 125.7, 124.1 (q, *J* = 279.7 Hz), 121.4, 120.1, 109.4, 96.7, 82.8, 51.8, 31.6, 28.9, 28.0, 26.2, 24.7, 22.7, 14.1; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.31 (t, *J* = 8.7 Hz); **IR** (thin film) ν 2920, 1712, 1614, 1557, 1464, 1452, 1147, 1006, 855, 763, 654 $cm^{-1}$; **MS** (ESI): m/z 440.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{22}H_{29}F_3N_3O_3$ $[M+H]^+$: 440.2156; Found: 440.2156.

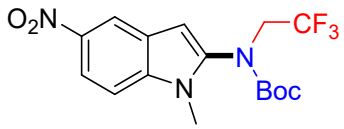
***t*ert-Butyl (5-cyano-1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4m)**



**4m**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4m** (113.0 mg, 80%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.81 (d, *J* = 1.5 Hz, 1H), 7.37 (dd, *J* = 8.5, 1.6 Hz, 1H), 7.27 (d, *J* = 8.6 Hz, 1H), 6.35 (s, 1H), 4.55 (s, 1H), 3.93 (s, 1H), 3.53 (s, 3H), 1.31 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 152.5, 138.2, 135.4, 125.3, 124.9, 124.0, 123.1 (q, *J* = 280.2 Hz), 119.5, 109.4, 102.0, 96.1, 82.3, 50.8, 28.0, 27.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.33 (t, *J* = 8.8 Hz); **IR** (thin film) ν 2979, 1720, 1615, 1560, 1484, 1434, 1144, 1096, 852, 700, 656 $cm^{-1}$; **MS** (ESI): m/z 354.1 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{17}H_{19}F_3N_3O_2$ $[M+H]^+$: 354.1424; Found: 354.1425.

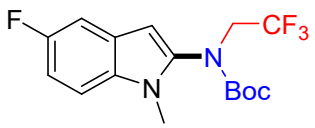
**tert-Butyl (1-methyl-5-nitro-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4n)**



**4n**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 20:1) to afford **4n** (87.0 mg, 58%) as a yellow solid. Mp. 120-122 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.45 (d, *J* = 2.1 Hz, 1H), 8.06 (dd, *J* = 9.1, 2.2 Hz, 1H), 7.26 (d, *J* = 9.1 Hz, 1H), 6.46 (s, 1H), 4.58 (s, 1H), 3.92 (s, 1H), 3.56 (s, 3H), 1.32 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.4, 141.9, 139.9, 137.8, 125.2, 124.1 (q, *J* = 280.0 Hz), 118.1, 117.8, 109.6, 98.7, 83.2, 51.7, 29.3, 28.0; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.35; **IR** (thin film) ν 2979, 1728, 1562, 1515, 1480, 1434, 1140, 1067, 853, 748, 663 $cm^{-1}$; **MS** (ESI): m/z 374.1 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{19}F_3N_3O_4$ $[M+H]^+$: 374.1322; Found: 374.1321.

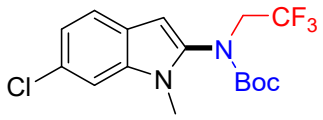
**tert-Butyl (5-fluoro-1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4o)**



**4o**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 100:1) to afford **4o** (112.1 mg, 81%) as a white solid. Mp. 86-88 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.20 – 7.08 (m, 2H), 6.91 (td, *J* = 9.2, 2.5 Hz, 1H), 6.20 (s, 1H), 4.54 (s, 1H), 3.90 (s, 1H), 3.48 (s, 3H), 1.31 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 158.0 (d, *J* = 234.5 Hz), 154.2, 138.2, 131.5, 126.3 (q, *J* = 10.4 Hz), 124.2 (q, *J* = 280.2 Hz), 110.5 (d, *J* = 26.1 Hz), 110.2 (d, *J* = 9.5 Hz), 105.7 (d, *J* = 23.7 Hz), 96.1, 82.8, 52.0, 29.0, 28.0; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.31 (t, *J* = 8.7 Hz, 3F), -124.35 – -124.53 (m, 1F); **IR** (thin film) ν 2988, 1718, 1491, 1411, 1369, 1259, 1111, 1024, 959, 768, 658 $cm^{-1}$; **MS** (ESI): m/z 347.1 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{19}F_4N_2O_2$ $[M+H]^+$: 347.1377; Found: 347.1377.

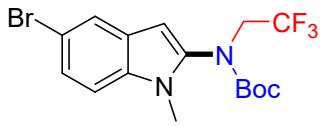
***t*ert-Butyl (6-chloro-1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4p)**




**4p**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4p** (125.6 mg, 86%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.37 (d, *J* = 8.4 Hz, 1H), 7.20 (d, *J* = 1.9 Hz, 1H), 6.98 (dd, *J* = 8.4, 1.9 Hz, 1H), 6.21 (s, 1H), 4.50 (s, 1H), 3.89 (s, 1H), 3.43 (s, 3H), 1.29 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 152.8, 136.5, 134.3, 127.0, 123.7, 123.1 (q, *J* = 280.3 Hz), 120.8, 119.6, 108.5, 95.3, 81.8, 50.8, 27.8, 27.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.29 (t, *J* = 8.7 Hz); **IR** (thin film) ν 2982, 1720, 1552, 1473, 1426, 1394, 1144, 1117, 810, 769 $cm^{-1}$; **MS** (ESI): m/z 363.1 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{19}ClF_3N_2O_2$ $[M+H]^+$: 363.1082; Found: 363.1082.

***tert*-Butyl (5-bromo-1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4q)**

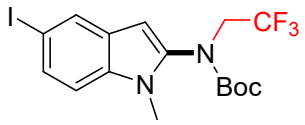



**4q**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4q** (140.0 mg, 86%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 1.9 Hz, 1H), 7.22 (dd, *J* = 8.7, 1.9 Hz, 1H), 7.07 (d, *J* = 8.7 Hz, 1H), 6.18 (s, 1H), 4.51 (s, 1H), 3.89 (s, 1H), 3.45 (s, 3H), 1.29 (s, 9H); **$^{13}$C NMR** (101 MHz,

$CDCl_3$) δ 152.8, 136.9, 132.5, 126.8, 123.9, 123.1 (q, *J* = 280.4 Hz), 122.3, 112.1, 110.0, 94.7, 81.8, 50.7, 27.8, 27.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.28 (t, *J* = 8.8 Hz); **IR** (thin film) ν 2980, 1729, 1595, 1444, 1392, 1370, 1140, 1049, 900, 797, 671 $cm^{-1}$; **MS** (ESI): m/z 407.1 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{19}BrF_3N_2O_2$ $[M+H]^+$: 407.0577; Found: 407.0577.

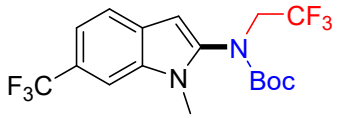
**tert-Butyl (5-iodo-1-methyl-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4r)**




**4r**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4r** (125.3 mg, 69%) as a white solid. Mp. 103-105 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.84 (d, *J* = 1.5 Hz, 1H), 7.42 (d, *J* = 8.6 Hz, 1H), 7.01 (d, *J* = 8.6 Hz, 1H), 6.18 (s, 1H), 4.53 (s, 1H), 3.90 (s, 1H), 3.47 (d, *J* = 1.2 Hz, 3H), 1.32 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.3, 137.5, 134.0, 130.4, 129.6, 128.6, 124.1 (q, *J* = 280.6 Hz), 111.5, 95.2, 83.3, 82.8, 51.7, 28.8, 28.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.31 – -71.33 (m); **IR** (thin film) ν 2977, 1703, 1569, 1471, 1403, 1355, 1141, 1010, 864, 774, 664 $cm^{-1}$; **MS** (ESI): m/z 455.0 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{19}F_3IN_2O_2$ $[M+H]^+$: 455.0438; Found: 455.0437.

**tert-Butyl(1-methyl-6-(trifluoromethyl)-1*H*-indol-2-yl)(2,2,2-trifluoroethyl)carbamate (4s)**

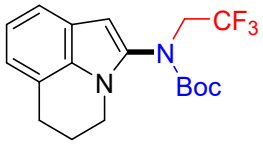



**4s**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4s** (115.3 mg, 73%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.55 (d, *J* = 8.3 Hz, 1H), 7.50 (s, 1H), 7.26 (dd, *J* = 8.4, 1.5 Hz, 1H), 6.30 (s, 1H), 4.55 (s, 1H), 3.90 (s, 1H), 3.53 (s, 3H), 1.31 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.8, 139.4, 133.9, 128.6, 125.2 (q, *J* = 270.0 Hz), 124.2 (q, *J* = 31.7 Hz), 124.1 (q, *J* = 278.3 Hz), 121.3, 116.5, 107.1 (q, *J* = 3.9 Hz), 96.4, 83.1, 51.6, 28.9, 28.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -60.65 (s, 3F), -71.37 (t, *J* = 8.7 Hz, 3F); **IR** (thin film) ν 2982, 1721, 1552, 1473, 1431, 1342, 1146, 1054, 859, 771, 656 $cm^{-1}$; **MS** (ESI): m/z 397.1 $[M+H]^+$;

**HRMS** (ESI-TOF): m/z Calculated for $C_{17}H_{19}F_6N_2O_2$ $[M+H]^+$: 397.1345; Found: 397.1343.

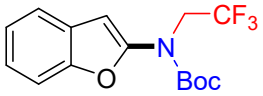
**tert-Butyl (5,6-dihydro-4*H*-pyrrolo[3,2,1-ij]quinolin-2yl)(2,2,2trifluoroethyl)carbamate (4t)**




**4t**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **4t** (72.4 mg, 51%) as a white solid. Mp. 108-110 °C.**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 7.9 Hz, 1H), 6.93 (t, *J* = 7.5 Hz, 1H), 6.85 (d, *J* = 7.0 Hz, 1H), 6.14 (s, 1H), 4.57 (s, 1H), 3.85 (s, 3H), 2.89 (t, *J* = 5.9 Hz, 2H), 2.14 – 2.09 (m, 2H), 1.30 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.3, 135.8, 132.3, 124.4, 124.3 (q, *J* = 280.6 Hz), 121.8, 119.9, 119.0, 118.1, 95.1, 82.6, 52.0, 41.4, 28.1, 24.9, 22.8; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.45 (t, *J* = 8.6 Hz); **IR** (thin film) ν 2943, 1709, 1552, 1401, 1367, 1258, 1139, 1025, 855, 775, 656 $cm^{-1}$; **MS** (ESI): m/z 355.2 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{18}H_{22}F_3N_2O_2$ $[M+H]^+$: 355.1628; Found: 355.1627.

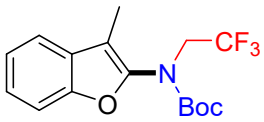
**tert-Butyl benzofuran-2-yl(2,2,2-trifluoroethyl)carbamate (6a)**




**6a**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **6a** (56.7 mg, 45%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.44 – 7.41 (m, 1H), 7.34 – 7.31 (m, 1H), 7.20 – 7.12 (m, 2H), 6.47 (s, 1H), 4.31 (q, *J* = 8.5 Hz, 2H), 1.43 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 150.2, 148.2, 127.5, 122.9 (q, *J* = 280.6 Hz), 122.9, 122.1, 119.8, 109.8, 103.3, 96.7, 82.4, 47.3 (q, *J* = 34.8 Hz), 27.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -70.90 (t, *J* = 8.6 Hz); **IR** (thin film) ν 2980, 1727, 1596, 1455, 1393, 1370, 1141, 1103, 886, 745, 657 $cm^{-1}$; **MS** (ESI): m/z 338.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{15}H_{16}F_3NNaO_3$ $[M+Na]^+$: 338.0975; Found: 338.0979.

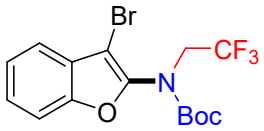
**tert-Butyl (3-methylbenzofuran-2-yl)(2,2,2-trifluoroethyl)carbamate (6b)**




**6b**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 50:1) to afford **6b** (107.9 mg, 82%) as a white solid. Mp. 60-62 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.40 (d, *J* = 7.4 Hz, 1H), 7.29 (d, *J* = 8.1 Hz, 1H), 7.23 – 7.13 (m, 2H), 4.17 (q, *J* = 8.6 Hz, 2H), 2.04 (s, 3H), 1.33 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 152.3, 150.5, 143.7, 128.4, 123.6, 123.1 (q, *J* = 280.4 Hz), 121.5, 118.6, 110.0, 108.4, 81.7, 47.3, 26.9, 6.5; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.30 (t, *J* = 8.8 Hz); **IR** (thin film) ν 2985, 1728, 1658, 1455, 1392, 1370, 1129, 1105, 858, 745, 655 $cm^{-1}$; **MS** (ESI): m/z 352.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{18}F_3NNaO_3$ $[M+Na]^+$: 352.1131; Found: 352.1130.

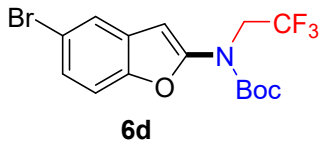
### *t*ert-Butyl (3-bromobenzofuran-2-yl)(2,2,2-trifluoroethyl)carbamate (6c)




**6c**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc =50:1) to afford **6c** (103.3 mg, 66%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.43 (dd, *J* = 7.6, 1.4 Hz, 1H), 7.35 (d, *J* = 8.1 Hz, 1H), 7.31 – 7.26 (m, 1H), 7.23 (t, *J* = 7.5 Hz, 1H), 4.19 (q, *J* = 8.6 Hz, 2H), 1.35 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 152.5, 151.2, 146.2, 127.6, 126.0, 123.8 (d, *J* = 280.1 Hz), 123.6, 112.0, 111.6, 93.1, 83.5, 48.3, 27.9; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.29 (t, *J* = 8.6 Hz); **IR** (thin film) ν 2981, 1731, 1624, 1450, 1370, 1320, 1130, 1104, 995, 744, 658 $cm^{-1}$; **MS** (ESI): m/z 416.0 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{15}H_{15}BrF_3NNaO_3$ $[M+Na]^+$: 416.0080; Found: 416.0081.

### *t*ert-Butyl (5-bromobenzofuran-2-yl)(2,2,2-trifluoroethyl)carbamate (6d)

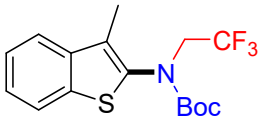



**6d**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc =50:1) to afford **6d** (117.9 mg, 75%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ

7.55 (s, 1H), 7.27 (d, $J$ = 8.7 Hz, 1H), 7.19 (d, $J$ = 7.2 Hz, 1H), 6.44 (s, 1H), 4.33 (q, $J$ = 8.4 Hz, 2H), 1.44 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 151.9, 150.3, 149.8, 130.6, 126.7, 123.8 (q, $J$ = 280.7 Hz), 123.3, 116.2, 112.3, 96.3, 83.8, 45.0 (q, $J$ = 35.0 Hz), 28.0; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -70.92 (t, $J$ = 8.4 Hz); **IR** (thin film) ν 2980, 1729, 1595, 1444, 1392, 1370, 1140, 1002, 900, 797, 671 $cm^{-1}$; **MS** (ESI): m/z 416.0 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{15}H_{15}BrF_3NNaO_3$ $[M+Na]^+$: 416.0080; Found: 416.0076

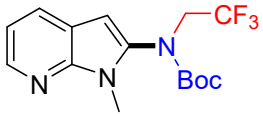
**tert-Butyl (3-methylbenzo[b]thiophen-2-yl)(2,2,2-trifluoroethyl)carbamate (6e)**




**6e**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc =100:1) to afford **6e** (70.4 mg, 51%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.65 (d, $J$ = 7.1 Hz, 1H), 7.58 (d, $J$ = 7.6 Hz, 1H), 7.32 – 7.25 (m, 2H), 4.17 (s, 2H), 2.16 (s, 3H), 1.32 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 154.1, 147.1, 138.4, 137.3, 137.0, 125.2, 124.3, 124.2 (q, $J$ = 280.8 Hz), 122.5, 122.4, 82.4, 50.7, 28.0, 11.1; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -70.57 (t, $J$ = 8.7 Hz); **IR** (thin film) ν 2979, 1716, 1437, 1368, 1305, 1138, 1021, 859, 753, 583 $cm^{-1}$; **MS** (ESI): m/z 368.1 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{16}H_{18}F_3NNaO_2S$ $[M+Na]^+$: 368.0903; Found: 368.0905.

**tert-Butyl (1-methyl-1*H*-pyrrolo[2,3-b]pyridin-2-yl)(2,2,2-trifluoroethyl)carbamate (6f)**

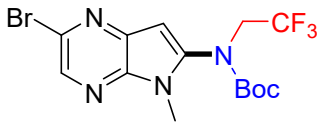



**6f**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 30:1) to afford **6f** (94.0 mg, 70%) as a yellow oil. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.27 (d, $J$ = 4.7 Hz, 1H), 7.78 (d, $J$ = 7.8 Hz, 1H), 7.01 – 6.98 (m, 1H), 6.21 (s, 1H), 4.49 (s, 1H), 3.97 (s, 1H), 3.62 (s, 3H), 1.31 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.8, 146.0, 143.4, 137.6, 128.8, 124.1 (q, $J$ = 280.4 Hz), 119.2, 116.3, 94.5, 83.0, 51.7, 28.0, 27.5; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -71.29 (t, $J$ = 8.6 Hz); **IR** (thin film) ν 2979, 1720, 1598, 1551, 1488, 1463, 1144, 1115, 908, 727, 535 $cm^{-1}$; **MS** (ESI): m/z 330.1 $[M+H]^+$;

**HRMS** (ESI-TOF): m/z Calculated for $C_{15}H_{19}F_3N_3O_2$ $[M+H]^+$: 330.1424; Found: 330.1427.

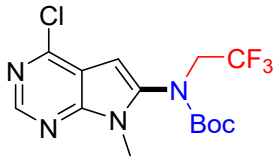
***t*ert-Butyl (2-bromo-5-methyl-5*H*-pyrrolo[2,3-b]pyrazin-6-yl)(2,2,2trifluoroethyl)carbamate (6g)**




**6g**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 40:1) to afford **6g** (81.6 mg, 50%) as a white solid. Mp. 162-164 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.35 (s, 1H), 6.48 (s, 1H), 4.30 (s, 2H), 3.71 (s, 3H), 1.46 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 152.8, 142.7, 139.1, 138.3, 133.6, 123.9 (q, $J$ = 280.3 Hz), 95.3, 83.9, 51.6, 28.0, 27.7; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.49 (s); **IR** (thin film) ν 2970, 1728, 1537, 1419, 1409, 1394, 1135, 1009, 931, 867, 762 $cm^{-1}$; MS (ESI): m/z 431.0 $[M+Na]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{14}H_{16}BrF_3N_4NaO_2$ $[M+Na]^+$: 431.0301; Found: 431.0292.

***t*ert-Butyl (4-chloro-7-methyl-4a,7a-dihydro-7*H*-pyrrolo[2,3-d]pyrimidin-6-yl)(2,2,2-trifluoroethyl)carbamate (6h)**

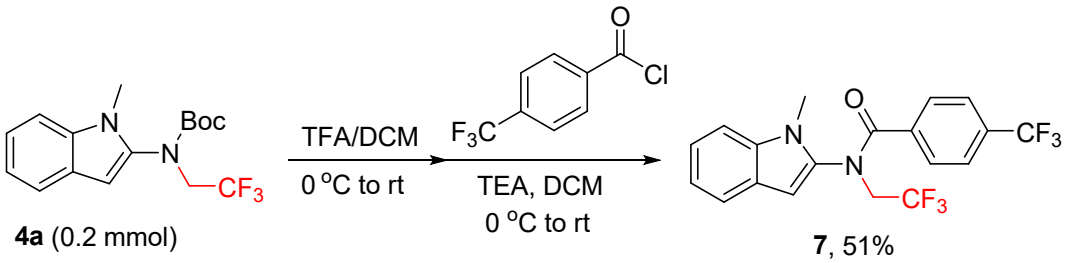



**6h**

The product mixture was purified by silica gel column chromatography (hexane/EtOAc = 20:1) to afford **6h** (69.9 mg, 48%) as a white solid. Mp. 107-109 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.59 (s, 1H), 6.38 (s, 1H), 4.03 (s, 2H), 3.62 (s, 3H), 1.38 (s, 9H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 153.0, 151.9, 151.2, 149.7, 139.0, 123.9 (q, $J$ = 280.1 Hz), 116.3, 94.2, 83.9, 51.8, 28.1, 28.0; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -71.47 (s); **IR** (thin film) ν 2973, 1724, 1595, 1538, 1487, 1150, 1110, 1012, 863, 784, 564 $cm^{-1}$; **MS** (ESI): m/z 365.1 $[M+H]^+$; **HRMS** (ESI-TOF): m/z Calculated for $C_{14}H_{17}ClF_3N_4O_2$ $[M+H]^+$: 365.0987; Found: 365.0989.

## 4. Transformation of Trifluoroethylaminated Product

***N*-(1-methyl-1*H*-indol-2-yl)-*N*-(2,2,2-trifluoroethyl)-4-(trifluoromethyl)benzamide (7)**



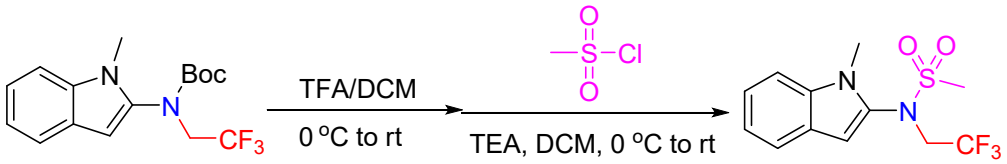

**4a** (0.2 mmol)

**7**, 51%

To a solution of **4a** (65.0 mg, 0.2 mmol) in DCM (2 mL) was added TFA (0.4 mL). The reaction mixture was stirred at room temperature for 4 h, the reaction mixture was concentrated to a residue in vacuo. To the intermediate solution in dichloromethane (2 mL) at 0 °C was added triethylamine (101.0 mg, 1.0 mmol) followed by a slow addition of methanesulfonyl chloride (23.0 mg, 0.2 mmol) under nitrogen atmosphere in a round bottomed flask. The reaction mixture was stirred at room temperature. Until completion of the reaction monitored by TLC, the reaction mixture was quenched with water, extracted with dichloromethane. Combined organic layers were dried over $MgSO_4$, filtered and evaporated under reduced pressure to afford the crude product, which was further purified by flash chromatography on silica gel with *n*-hexane/EtOAc (15:1) to

give the desired product **7** as a yellow solid (40.8 mg, 51%). Mp. 138-140 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 8.78 (s, 1H), 7.71 – 7.65 (m, 4H), 7.14 (d, *J* = 7.9 Hz, 1H), 7.10 – 7.05 (m, 1H), 6.93 – 6.89 (m, 1H), 6.65 (d, *J* = 7.9 Hz, 1H), 3.93 (q, *J* = 8.4 Hz, 2H), 3.68 (s, 3H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 190.0, 154.8, 144.5, 135.3, 132.3 (q, *J* = 32.5 Hz), 128.3, 125.4 (q, *J* = 3.8 Hz), 125.1, 124.1 (q, *J* = 279.8 Hz), 123.9 (q, *J* = 272.4 Hz), 122.3, 122.0, 119.2, 109.0, 101.1, 47.8 (q, *J* = 33.7 Hz), 31.1; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -62.68 (s, 3F), -72.43 (t, *J* = 8.6 Hz, 3F); **IR** (thin film) ν 2979, 1587, 1560, 1254, 1154, 1095, 1066, 840, 780, 557 $cm^{-1}$; **MS** (ESI): m/z 401.1 $[M+H]^+$; HRMS (ESI-TOF): m/z Calculated for $C_{19}H_{15}F_6N_2O$ $[M+H]^+$: 401.1083; Found: 401.1087.

**_N_-(1-methyl-1_H_-indol-2-yl)-_N_-(2,2,2-trifluoroethyl)methanesulfonamide (8)**




**4a** (0.2 mmol)

**8**, 59%

To a solution of **4a** (65.0 mg, 0.2 mmol) in DCM (2 mL) was added TFA (0.4 mL). The reaction mixture was stirred at room temperature for 4 h, the reaction mixture was concentrated to a residue in vacuo. To the intermediate solution in dichloromethane (2 mL) at 0 °C was added triethylamine (101.0 mg, 1.0 mmol) followed by a slow addition of methanesulfonyl chloride (23.0 mg, 0.2 mmol) under nitrogen atmosphere in a round bottomed flask. The reaction mixture was stirred at room temperature. Until completion of the reaction monitored by TLC, the reaction mixture was quenched with water, extracted with dichloromethane. Combined organic layers were dried over $MgSO_4$, filtered and evaporated under reduced pressure to afford the crude product, which was further purified by flash chromatography on silica gel with *n*-hexane/EtOAc (2:1) to give the desired product **8** as a white solid (36.1 mg, 59%). Mp. 135-137 °C. **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.78 –7.74 (m, 1H), 7.28 – 7.26 (m, 3H), 6.12 (t, *J* = 7.8 Hz, 1H), 3.83 – 3.74 (m, 2H), 3.69 (s, 3H), 3.12 (s, 3H); **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 147.4, 134.5, 124.3 (q, *J* = 280.5 Hz), 124.0, 122.8, 122.6, 118.2, 109.5, 98.1, 49.2 (q, *J* = 32.8 Hz), 45.2, 30.6; **$^{19}$F NMR** (377 MHz, $CDCl_3$) δ -72.13 (t, *J* = 8.8 Hz); **IR** (thin film) ν 3342, 1614, 1267, 1538, 1146, 1126, 1019, 955, 619, 544, 459 $cm^{-1}$; **MS** (ESI): m/z 307.1 $[M+H]^+$; HRMS (ESI-TOF): m/z Calculated for $C_{12}H_{14}F_3N_2O_2S$ $[M+H]^+$: 307.0723; Found: 307.0722.

## 5. Stern-Volmer Experiments

Stern-Volmer quenching experiments were carried by Edinburgh Fluorescence Spectrometer FS5, using a 10 μM solution of photocatalyst *fac*-Ir(ppy)$_3$ and variable concentrations (0.5, 1.0, 1.5, 2.0,2.5 mM) of **2d**, *N*-methyl indole (**3a**) in MeCN. The samples were prepared in 4 mL quartz cuvettes, equipped with PTFE stoppers, and sealed with parafilm inside nitrogen filled glove-box. The intensity of the emission peak at 532 nm (λex= 375 nm) expressed as the ratio $I_0/I$, where $I_0$ is the emission intensity of photocatalyst at 532 nm in the absence of a quencher and I is the observed intensity, as a function of the quencher concentration was measured. Stern-Volmer plots for each component are given in the Supplementary Figures below.

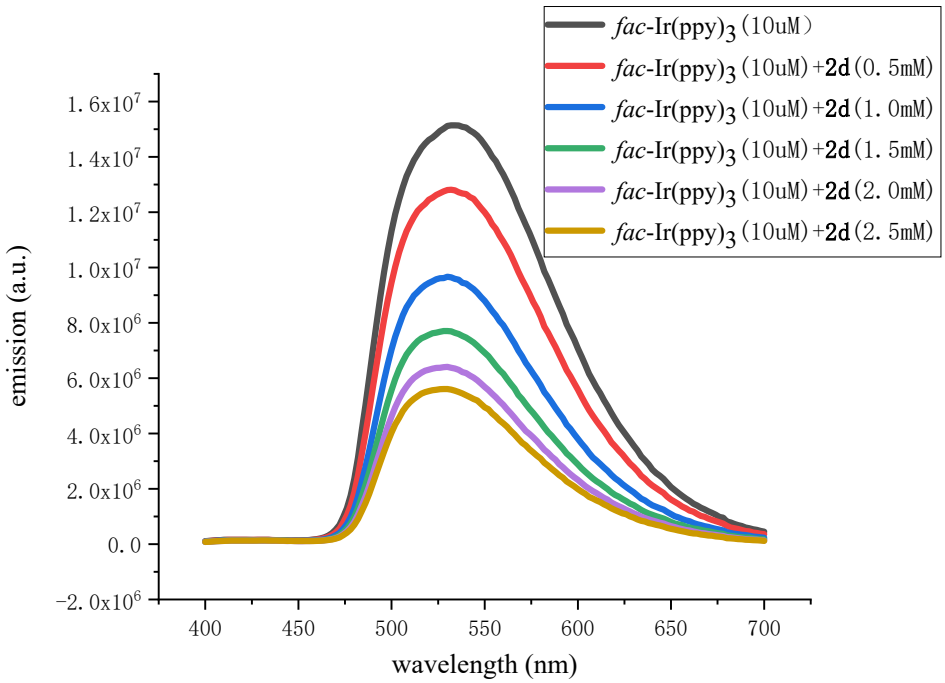



**Fig. S1** Emission profile of *fac*-Ir(ppy)$_3$ with **2d** in $CH_3CN$

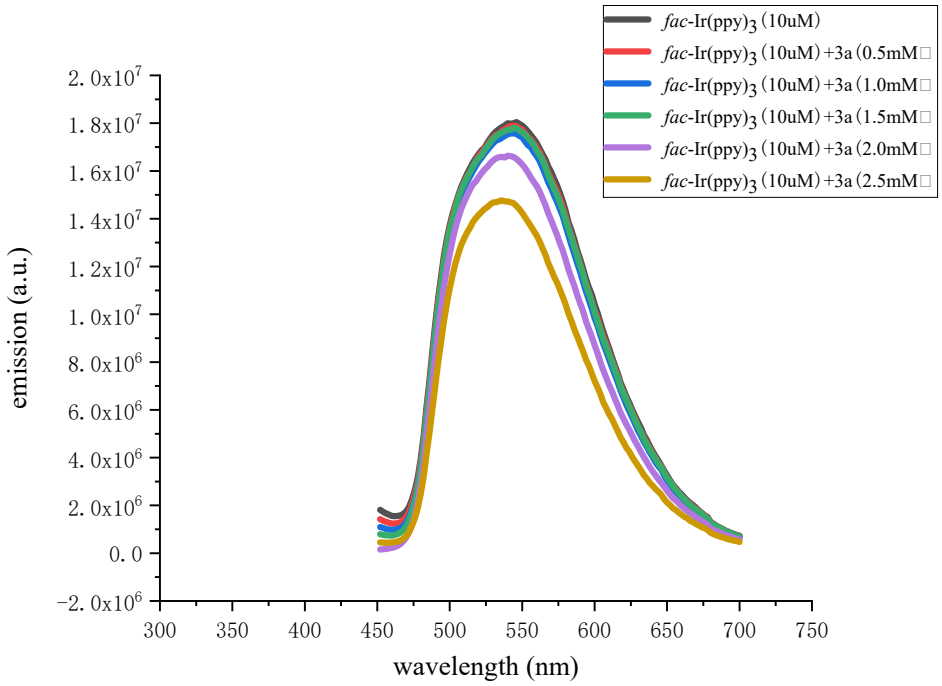



**Fig. S2** Emission profile of *fac*-Ir(ppy)$_3$ with *N*-methyl indole (**3a**) in $CH_3CN$

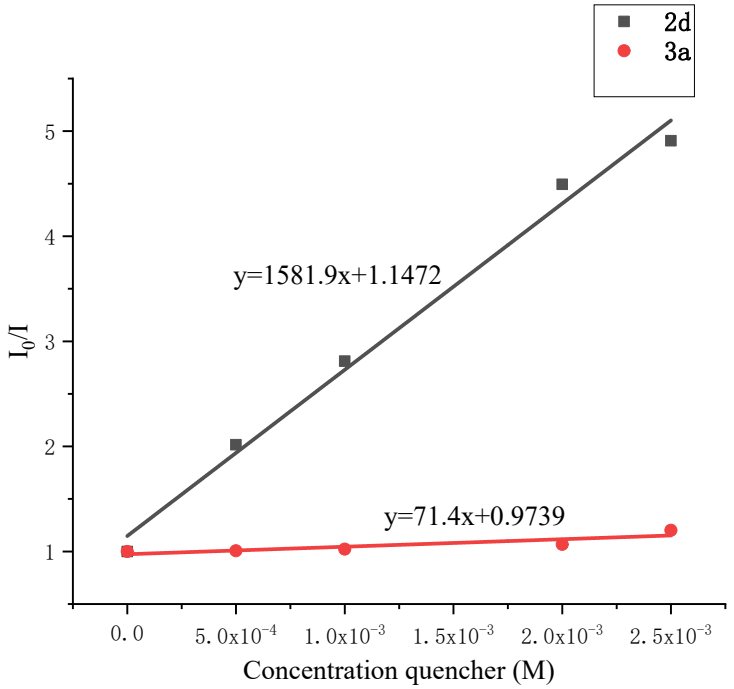
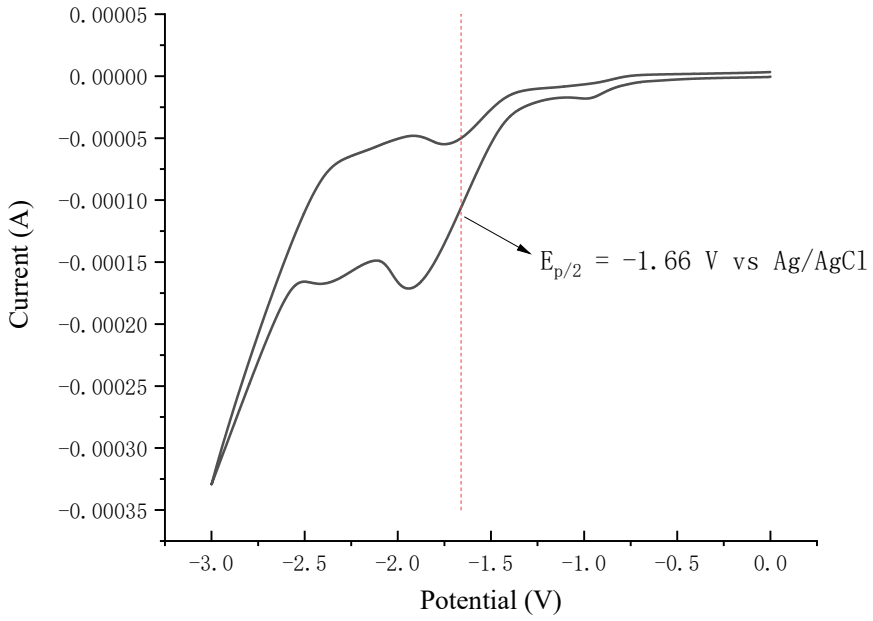



**Fig. S3** Stern-Volmer plots. $I_0$ and I are respective luminescence intensities in the absence and presence of the indicated concentrations of the corresponding quencher.

## 6. Cyclic Voltammetry Analysis

Electrochemical measurements were performed on a CHI730E electrochemical analyzer, using a standard three-electrode setup with a glassy carbon working electrode (2 mm diameter), a platinum wire counter electrode, and a non-aqueous $Ag/Ag^+$ reference electrode (degassed THF containing 0.1 M $^nBu_4NPF_6$). Samples were prepared with 0.01 mmol of substrate in 10 mL of 0.1 M $^nBu_4NPF_6$ in dry, degassed THF, with a scan rate of 0.05 V/s. Solutions were kept under positive pressure of nitrogen during the measurements. Data was analyzed using Origin. The obtained value was referenced to $Ag/Ag^+$ and converted to SCE by subtracting 0.03 V.[11]

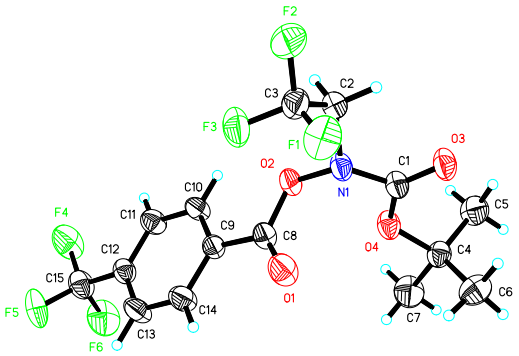


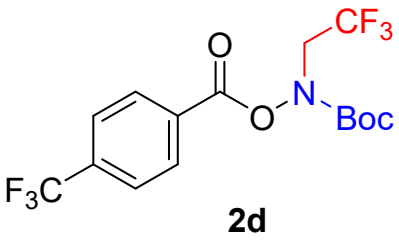

$E_{p/2}$ = -1.69 V vs (SCE)

**Figure S4** Cyclic voltammetry of **2d** in THF from 0 V to -3.0 V.

## 7. ORTEP Drawing of the X-Ray Crystallographic Structure of Compounds 2d and 4a

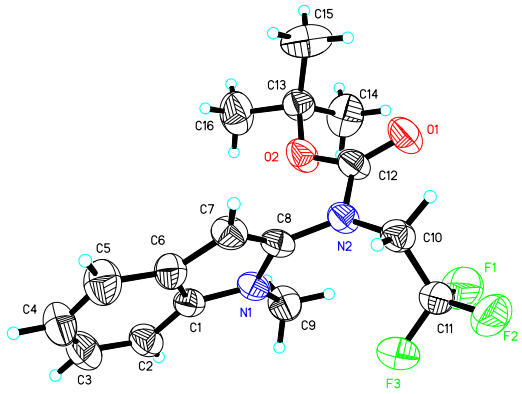
The crystals were obtained from a solution of hexane upon slow volatilization. The X-ray intensity data were measured at 293(2) K, on a Rigaku AFC7R diffractometer.

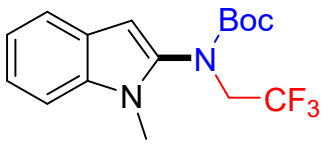



**2d**

The crystal structure has been deposited at the Cambridge Crystallographic Date Center and allocated the deposition number CCDC 2123735. The thermal ellipsoids are shown at the 30% probability level. This data can be obtained free of charge from the Cambridge Crystallographic Date Center via www.ccdc.cam.ac.uk/data_request/cif




**4a**

The crystal structure has been deposited at the Cambridge Crystallographic Date Center and allocated the deposition number CCDC 2123736. The thermal ellipsoids are shown at the 30% probability level. This data can be obtained free of charge from the Cambridge Crystallographic Date Center via www.ccdc.cam.ac.uk/data_request/cif

## Talbe S1. Crystal data and structure refinement for 2d

| | | |
|---|---|---|
| Identification code | 2d | |
| Empirical formula | C15 H15 F6 N O4 | |
| Formula weight | 387.28 | |
| Temperature | 293(2) K | |
| Wavelength | 0.71073 Å | |
| Crystal system | Monoclinic | |
| Space group | P 21/c | |
| Unit cell dimensions | a = 16.8153(11) Å | a= 90°. |
| | b = 8.7366(5) Å | b= 102.655(2)°. |
| | c = 12.2243(7) Å | g = 90°. |
| Volume | 1752.23(18) $Å^3$ | |
| Z | 4 | |
| Density (calculated) | 1.468 $Mg/m^3$ | |
| Absorption coefficient | 0.146 $mm^{-1}$ | |
| F(000) | 792 | |
| Crystal size | 0.200 x 0.150 x 0.100 $mm^3$ | |
| Theta range for data collection | 2.483 to 26.000°. | |
| Index ranges | -20<=h<=16, -10<=k<=10, -15<=l<=15 | |
| Reflections collected | 19678 | |
| Independent reflections | 3424 [R(int) = 0.0307] | |
| Completeness to theta = 25.242° | 99.2 % | |
| Absorption correction | Semi-empirical from equiv.alents | |
| Max. and min. transmission | 0.7456 and 0.6622 | |
| Refinement method | Full-matrix least-squares on $F^2$ | |
| Data / restraints / parameters | 3424 / 36 / 266 | |
| Goodness-of-fit on $F^2$ | 1.032 | |
| Final R indices [I>2sigma(I)] | R1 = 0.0430, wR2 = 0.1058 | |
| R indices (all data) | R1 = 0.0584, wR2 = 0.1192 | |
| Extinction coefficient | 0.026(5) | |
| Largest diff. peak and hole | 0.335 and -0.154 $e.Å^{-3}$ | |

## Talbe S2. Crystal data and structure refinement for 4a

| | | |
|---|---|---|
| Identification code | 4a | |
| Empirical formula | C16 H19 F3 N2 O2 | |
| Formula weight | 328.33 | |
| Temperature | 293(2) K | |
| Wavelength | 0.71073 Å | |
| Crystal system | Monoclinic | |
| Space group | P 21/c | |
| Unit cell dimensions | a = 10.5525(15) Å | a= 90°. |
| | b = 38.111(5) Å | b= 105.355(4)°. |
| | c = 9.0256(12) Å | g = 90°. |
| Volume | 3500.2(8) $Å^3$ | |
| Z | 8 | |
| Density (calculated) | 1.246 $Mg/m^3$ | |
| Absorption coefficient | 0.104 $mm^{-1}$ | |
| F(000) | 1376 | |
| Crystal size | 0.150 x 0.120 x 0.080 $mm^3$ | |
| Theta range for data collection | 2.269 to 24.998°. | |
| Index ranges | -12<=h<=12, -45<=k<=45, -10<=l<=10 | |
| Reflections collected | 51834 | |
| Independent reflections | 6155 [R(int) = 0.0781] | |
| Completeness to theta = 25.242° | 97.1 % | |
| Absorption correction | Semi-empirical from equiv.alents | |
| Max. and min. transmission | 0.7456 and 0.5390 | |
| Refinement method | Full-matrix least-squares on $F^2$ | |
| Data / restraints / parameters | 6155 / 1 / 424 | |
| Goodness-of-fit on $F^2$ | 1.414 | |
| Final R indices [I>2sigma(I)] | R1 = 0.1180, wR2 = 0.3480 | |
| R indices (all data) | R1 = 0.1664, wR2 = 0.3998 | |
| Extinction coefficient | 0.019(6) | |
| Largest diff. peak and hole | 1.041 and -0.434 $e.Å^{-3}$ | |

## 8. References

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# 9. Copies of NMR Spectra for the Products

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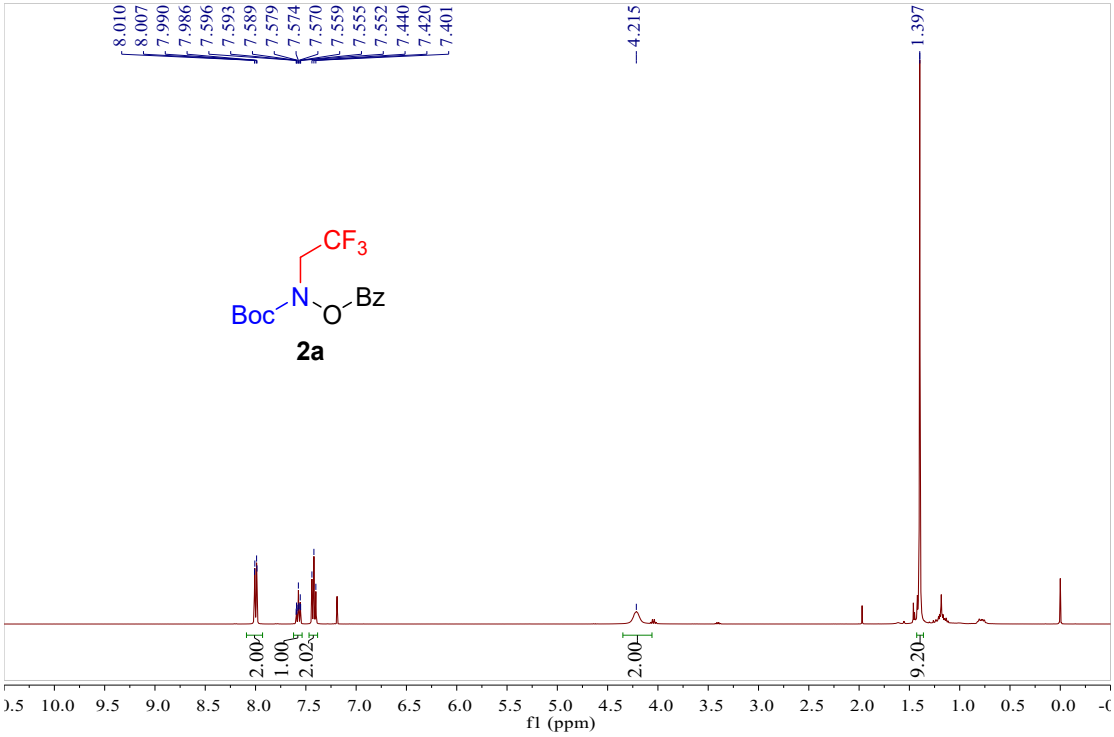


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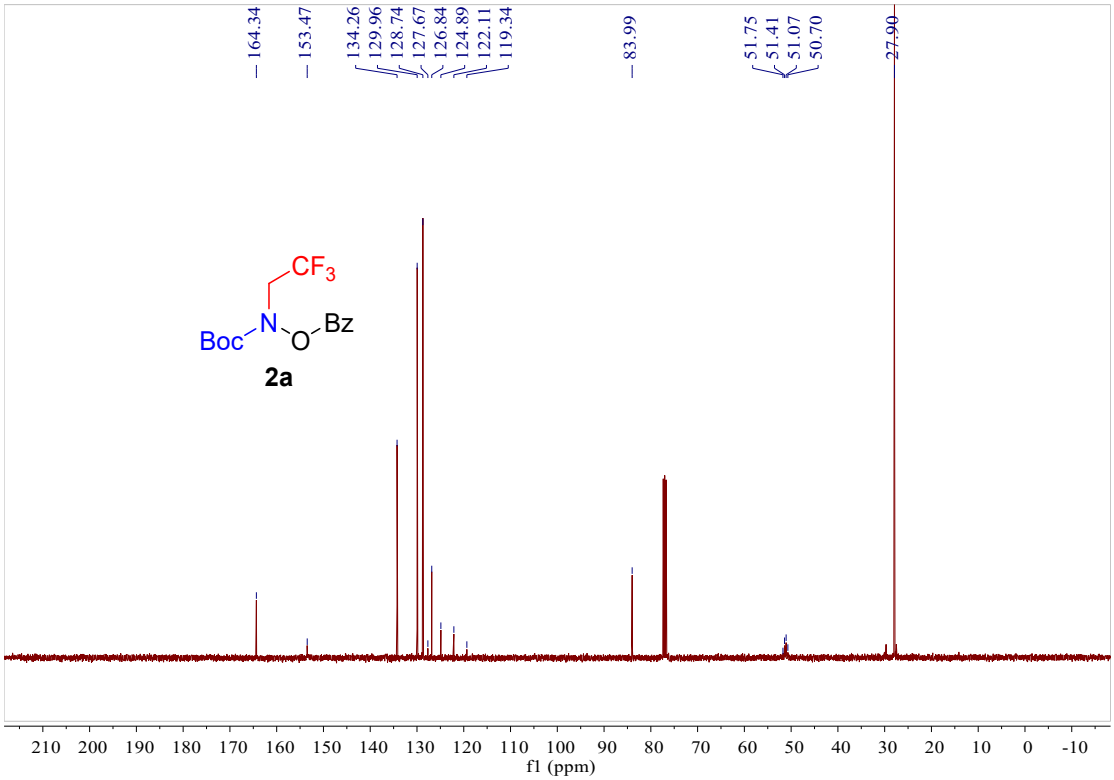
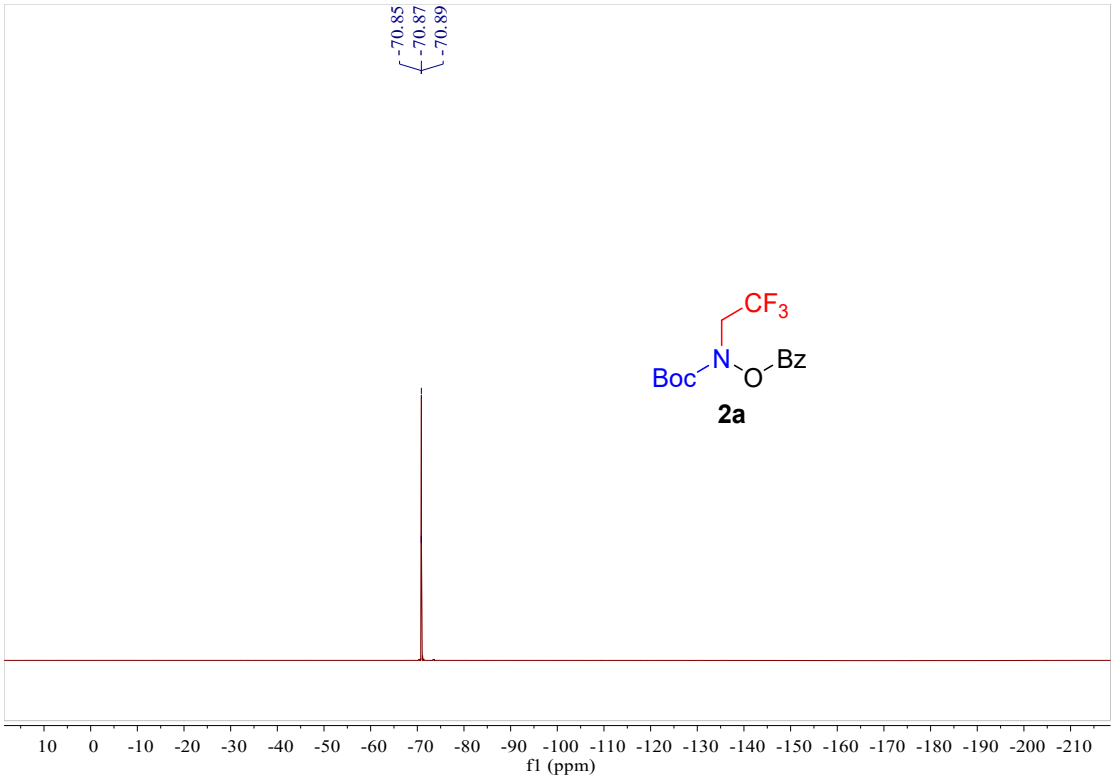


*$^{19}F$ NMR (377 MHz, $CDCl_3$)*

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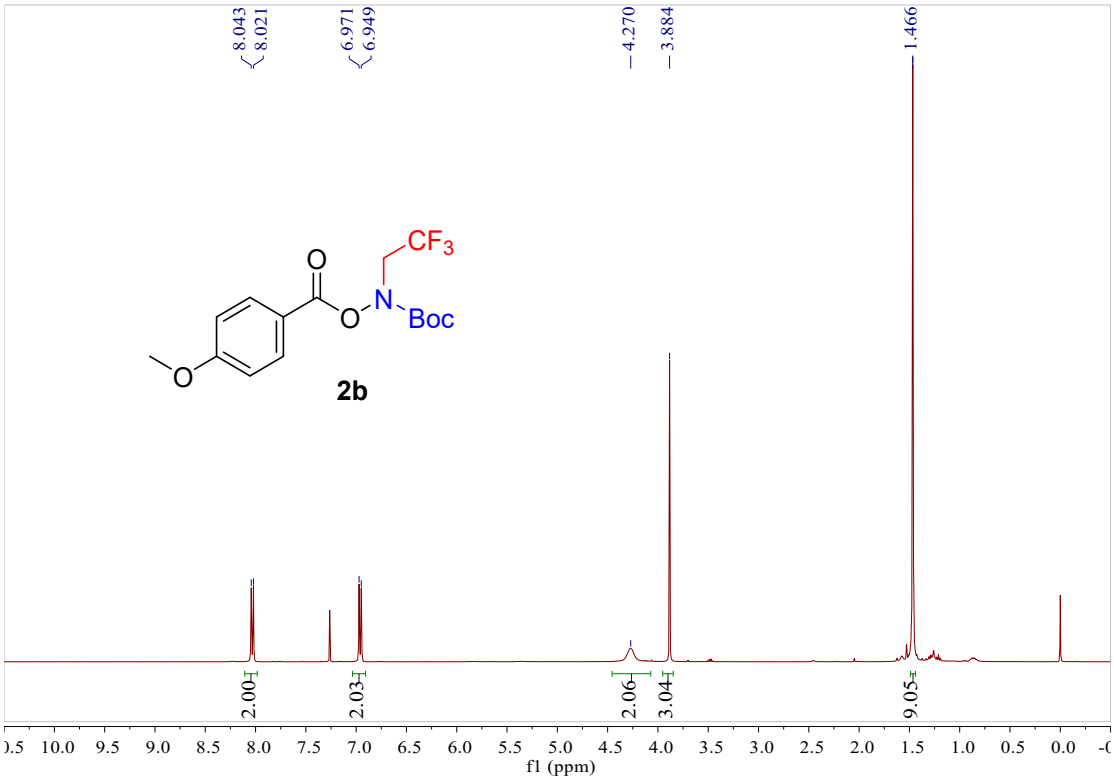


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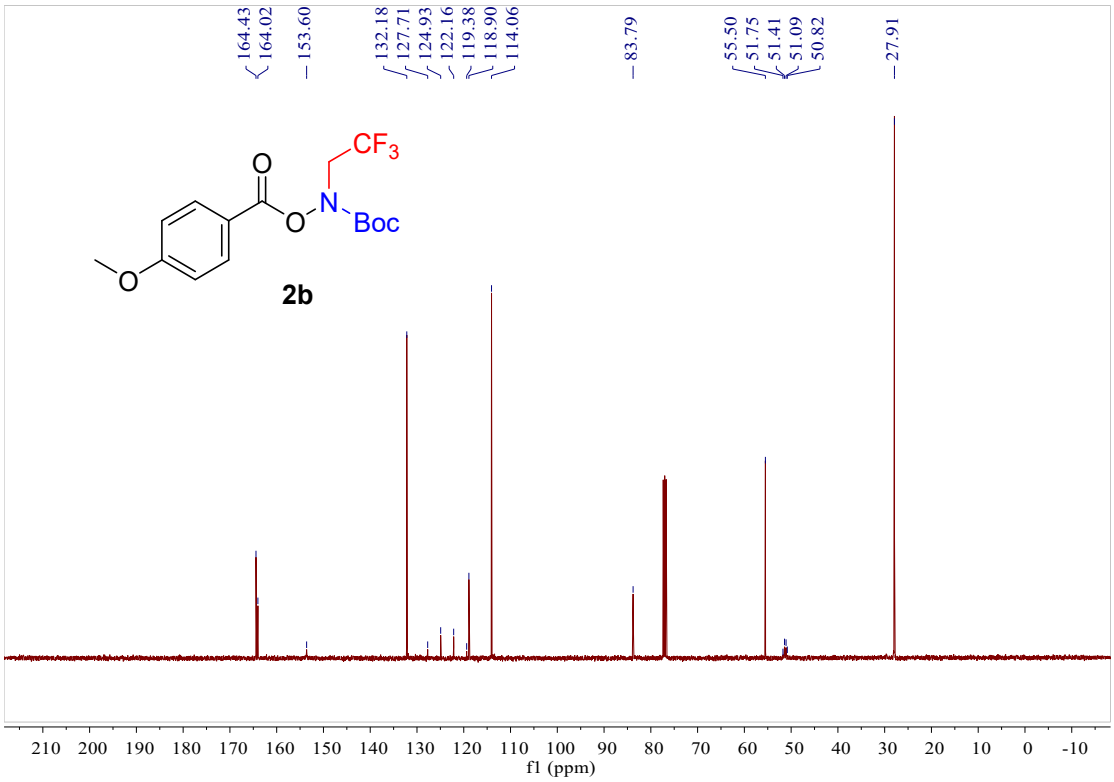


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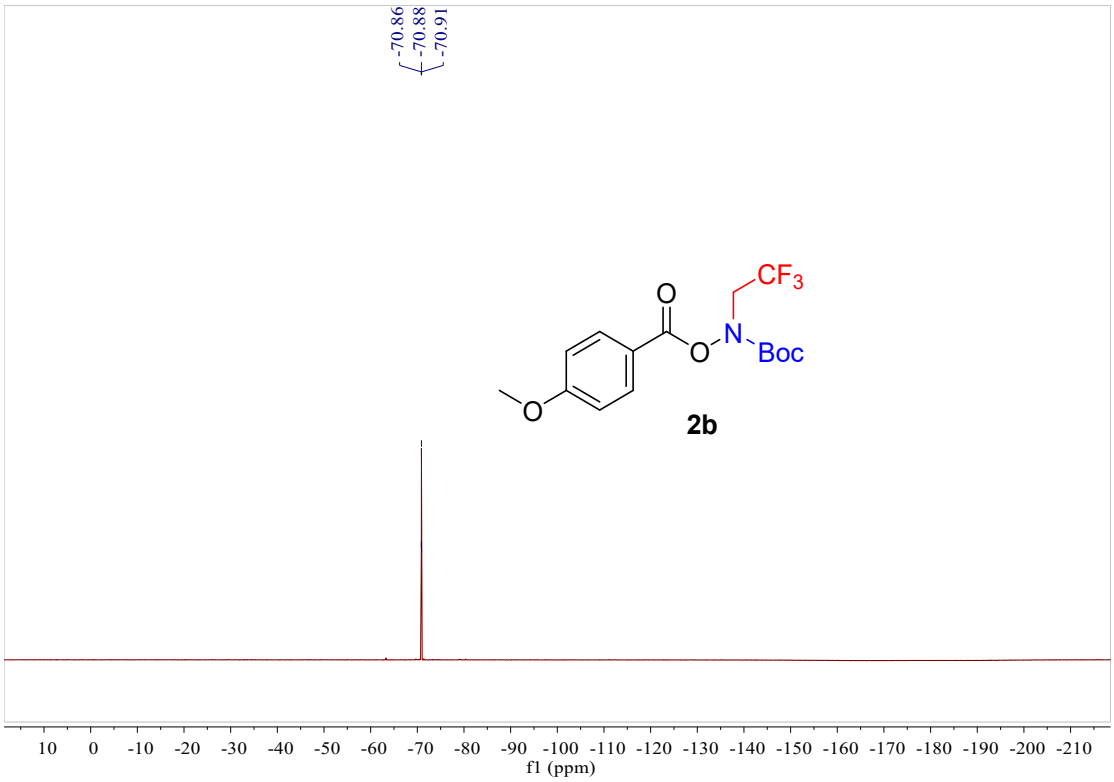


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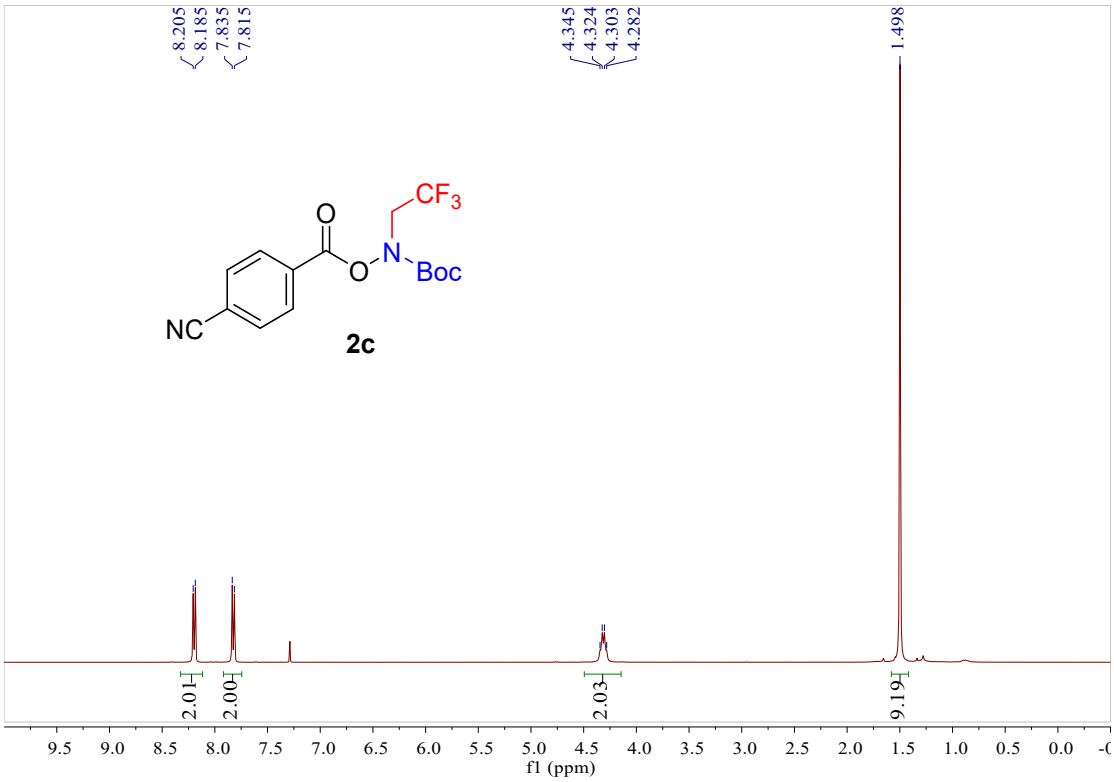


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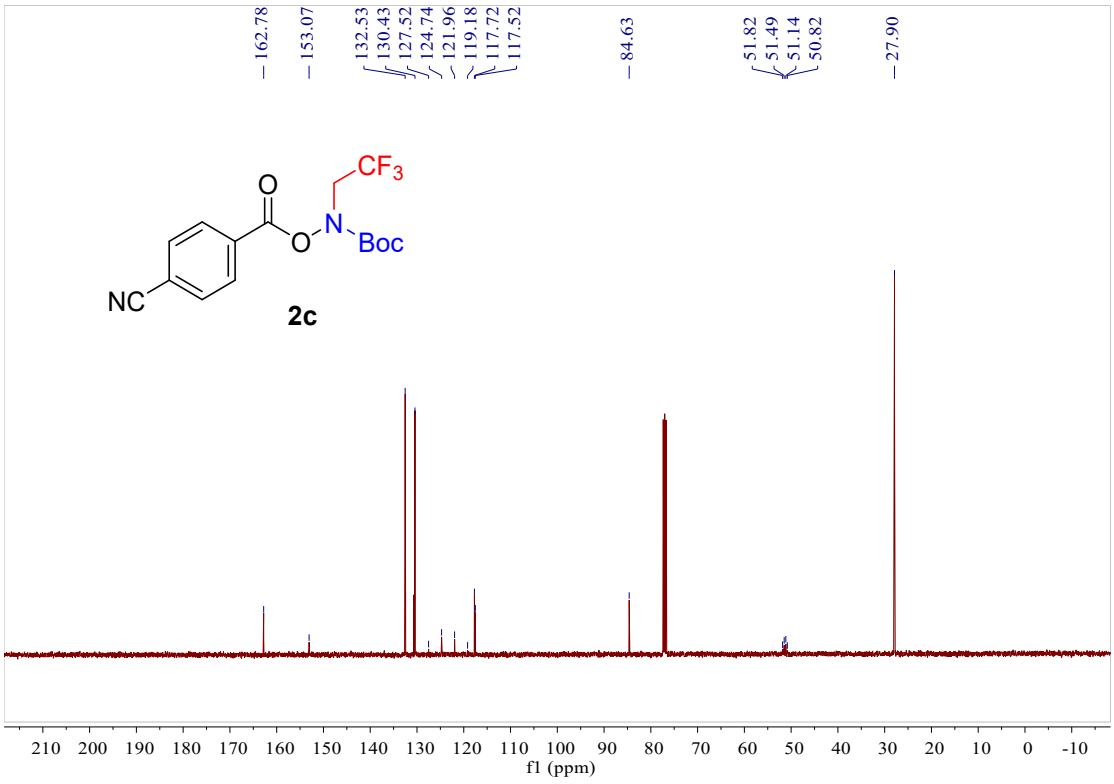


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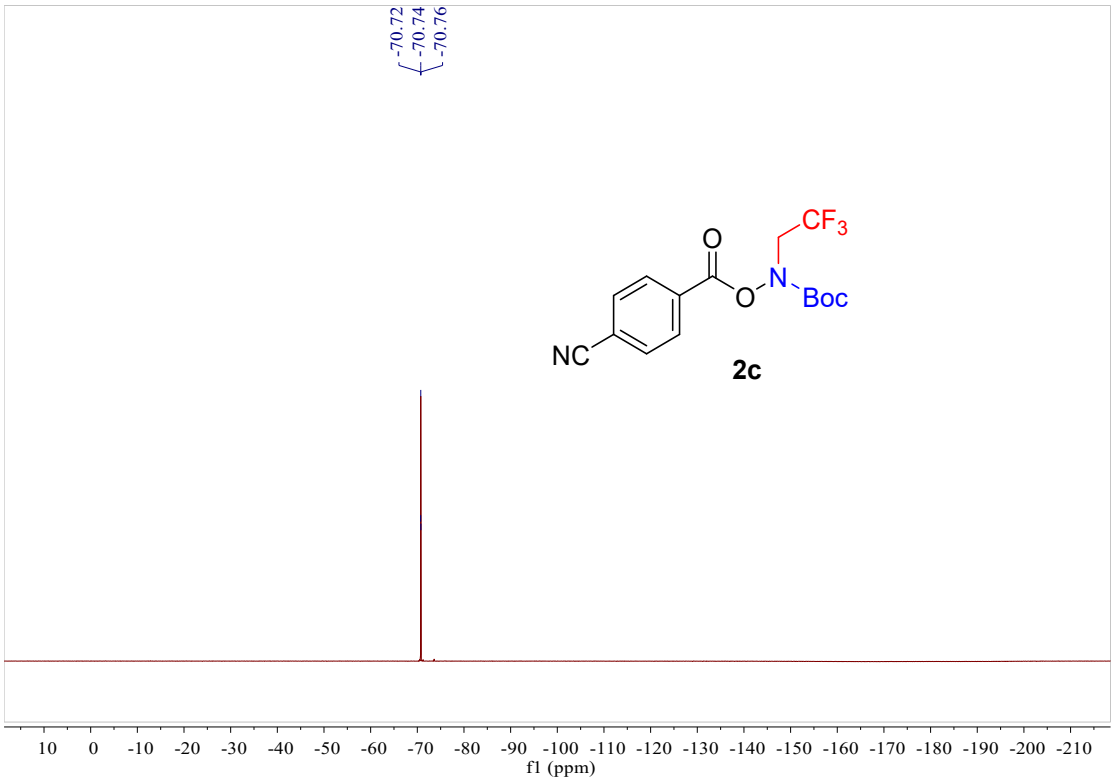


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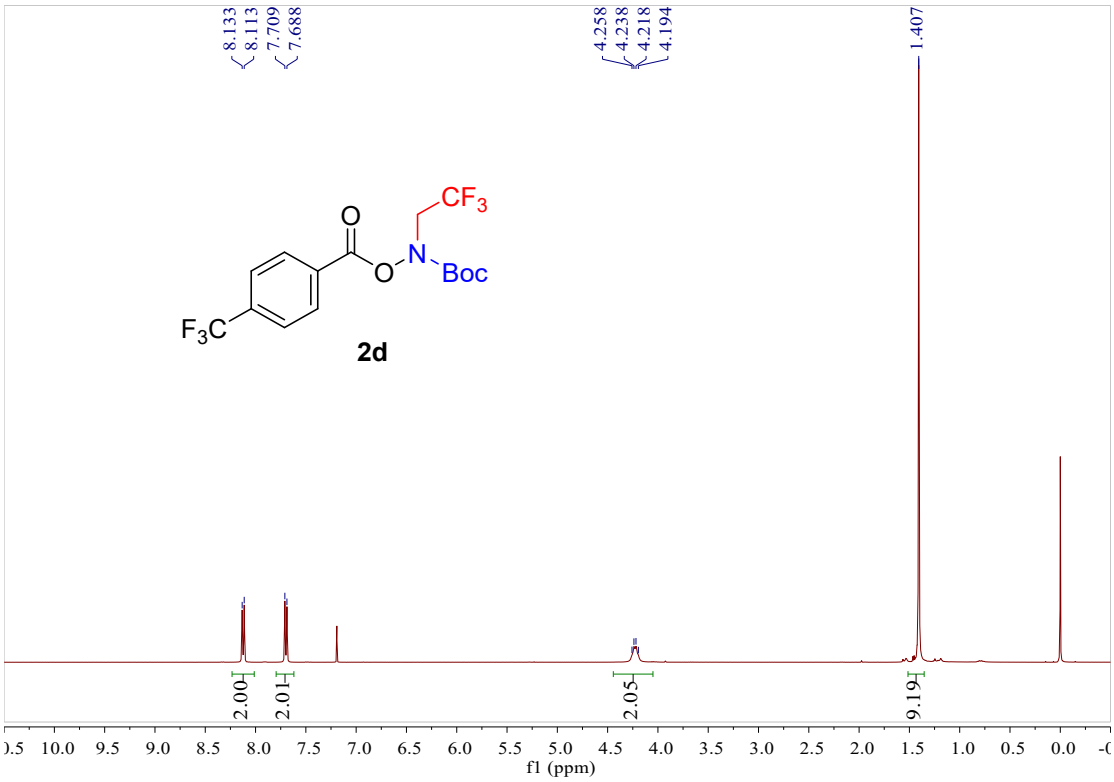


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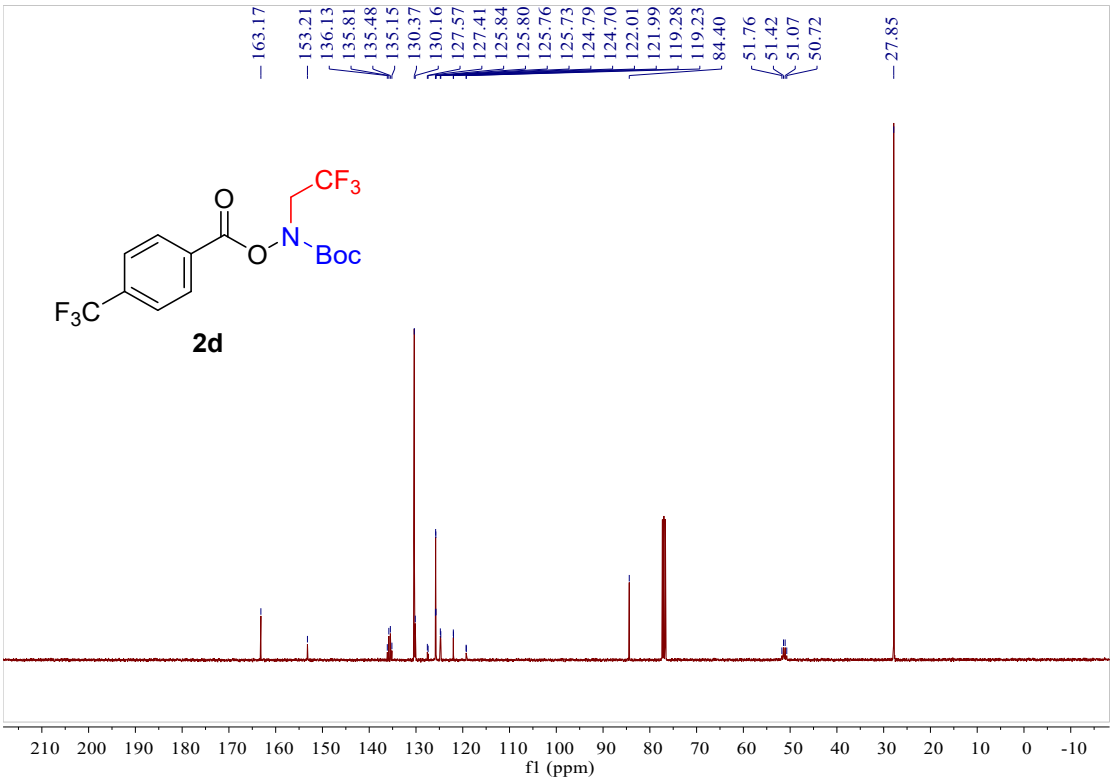


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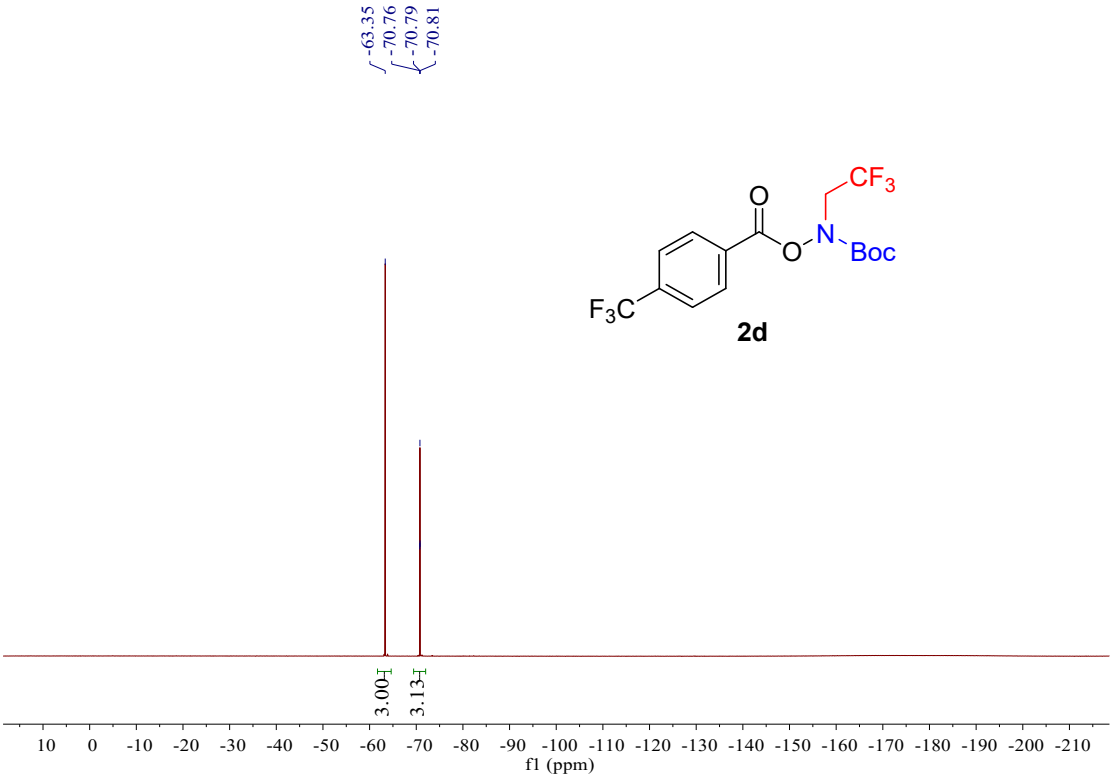


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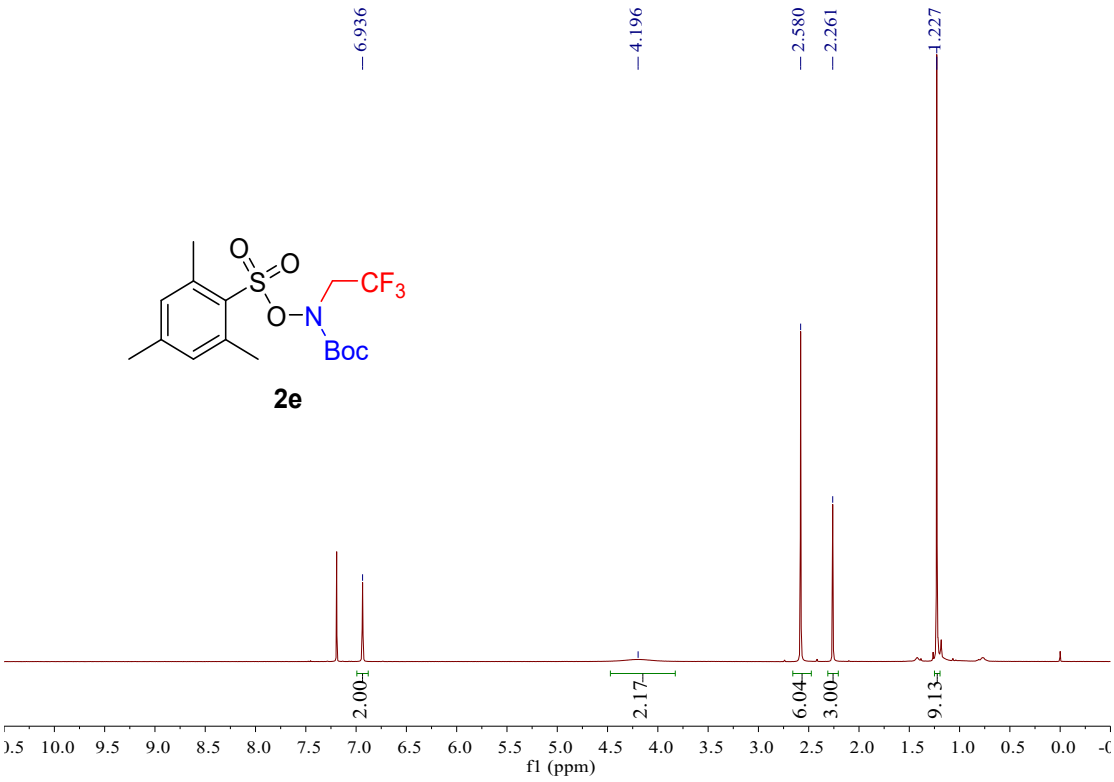


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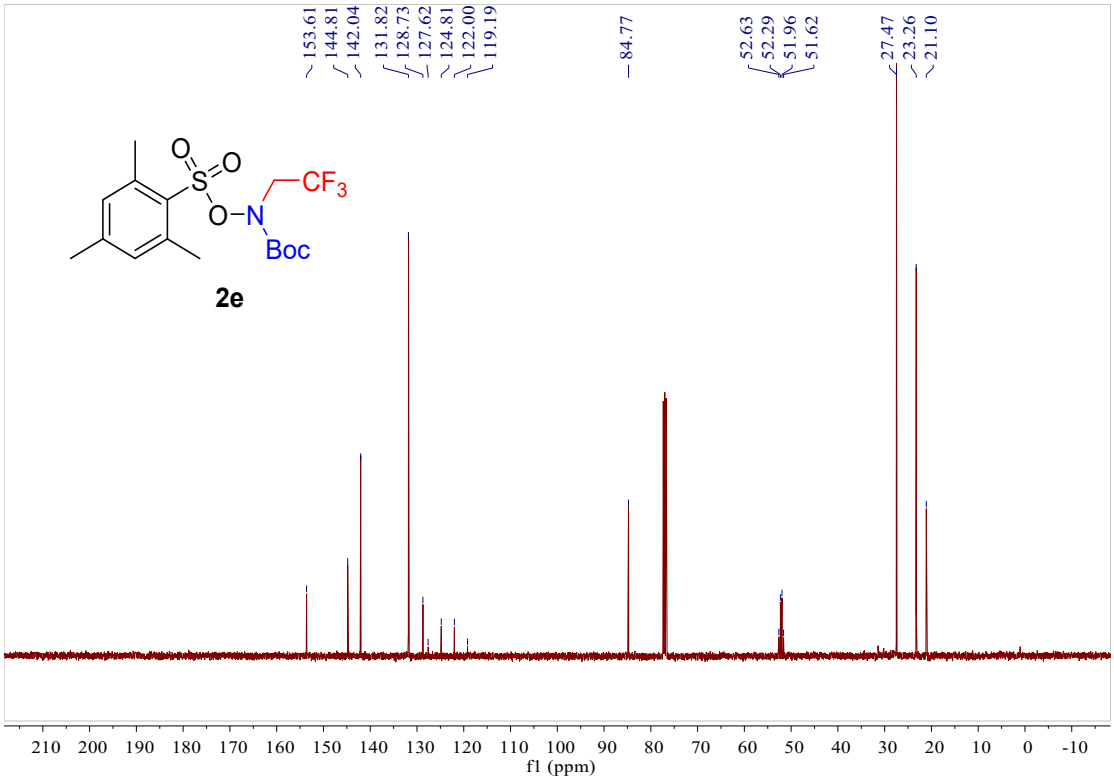


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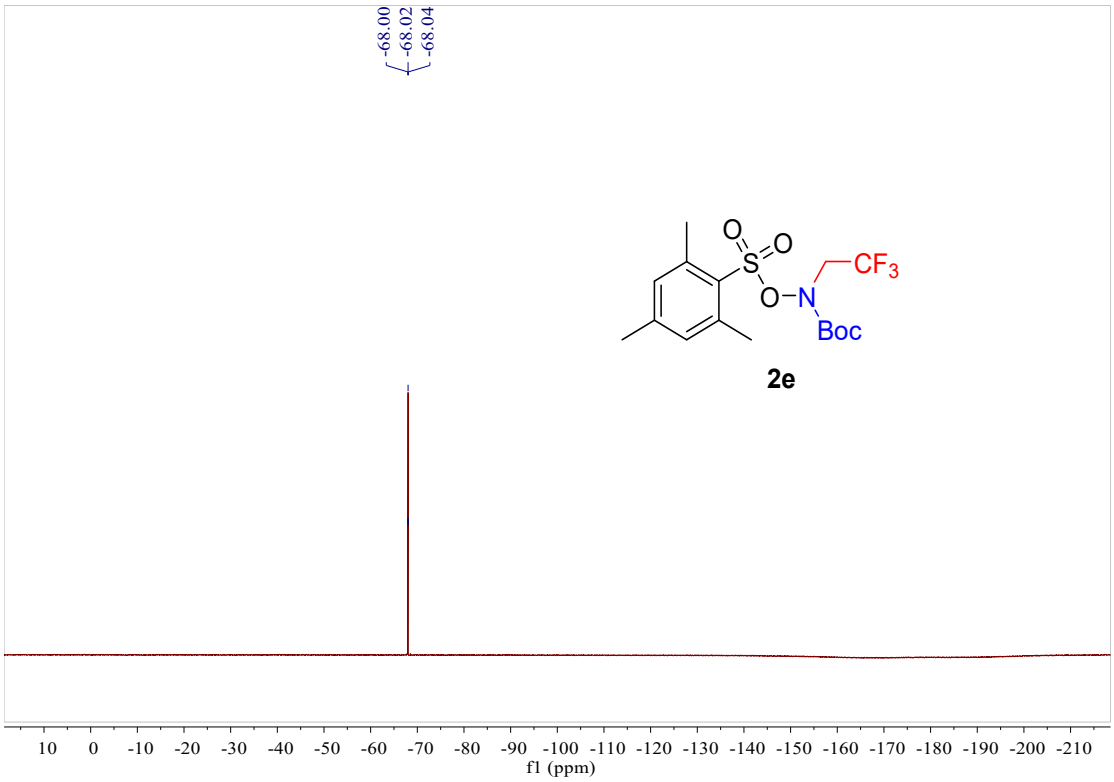


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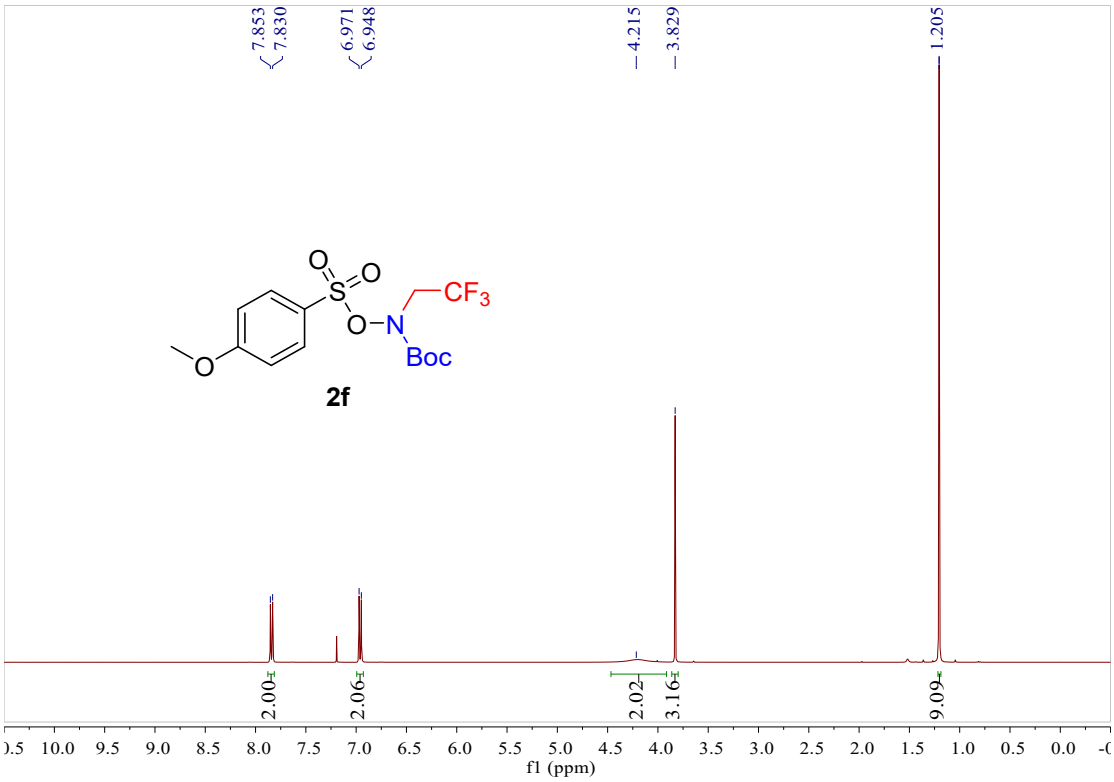


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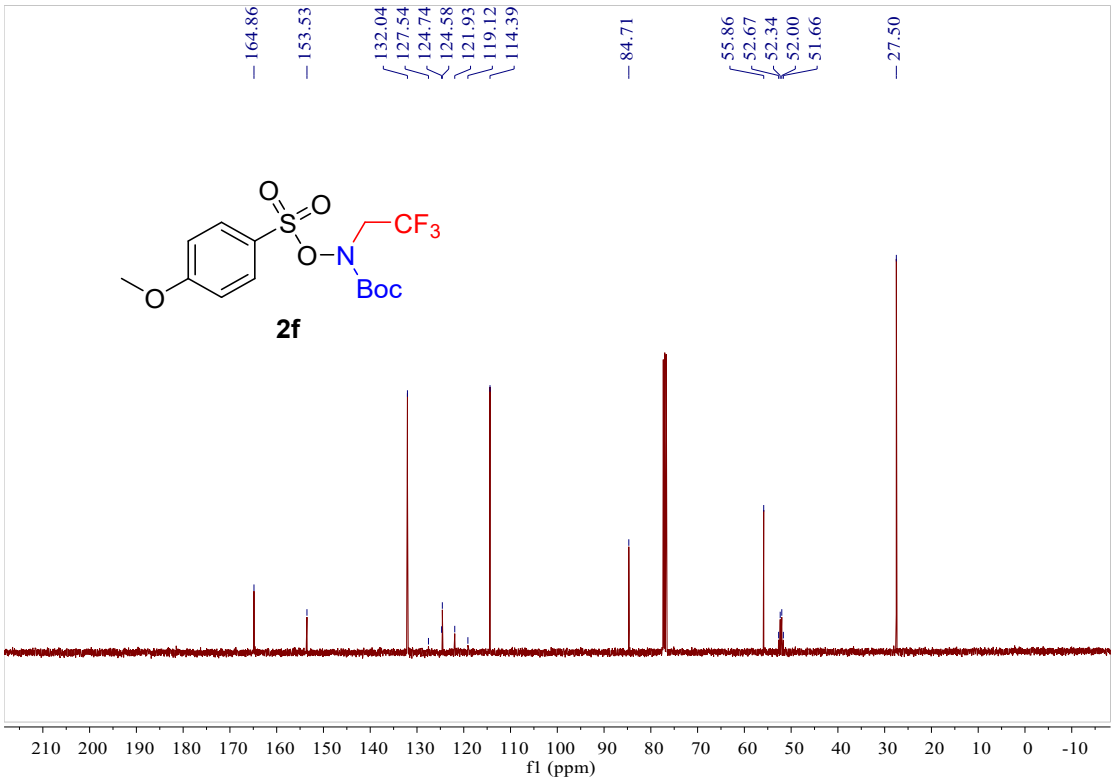


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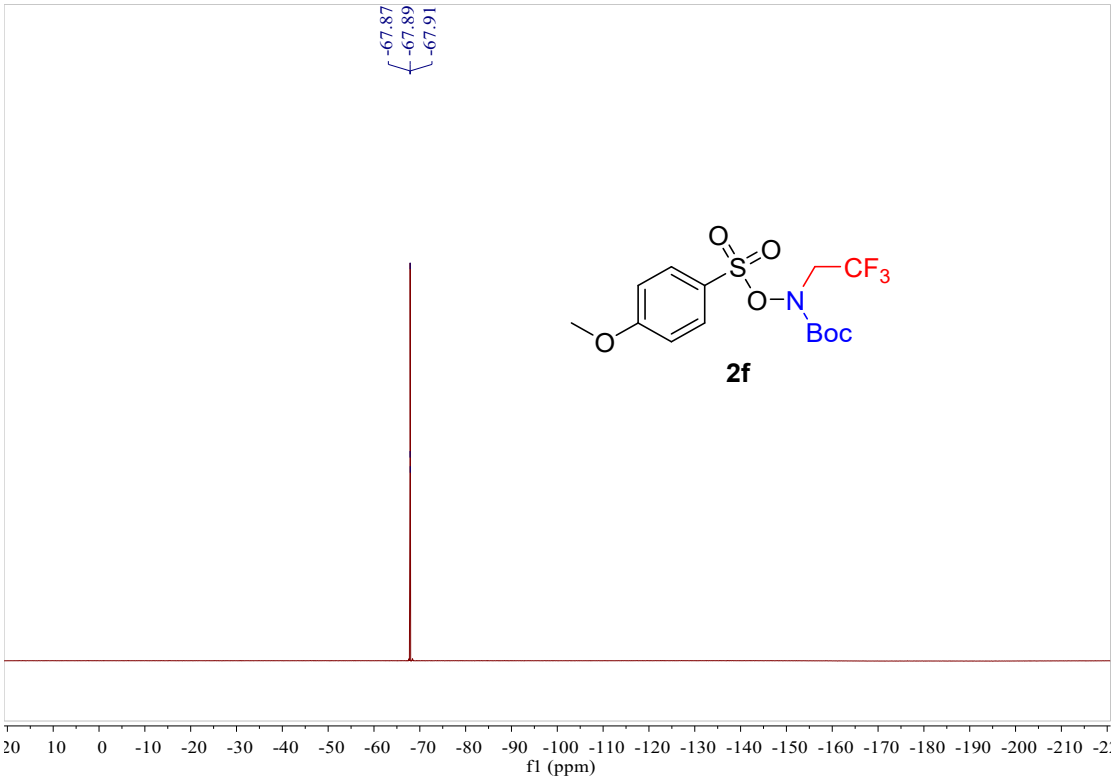


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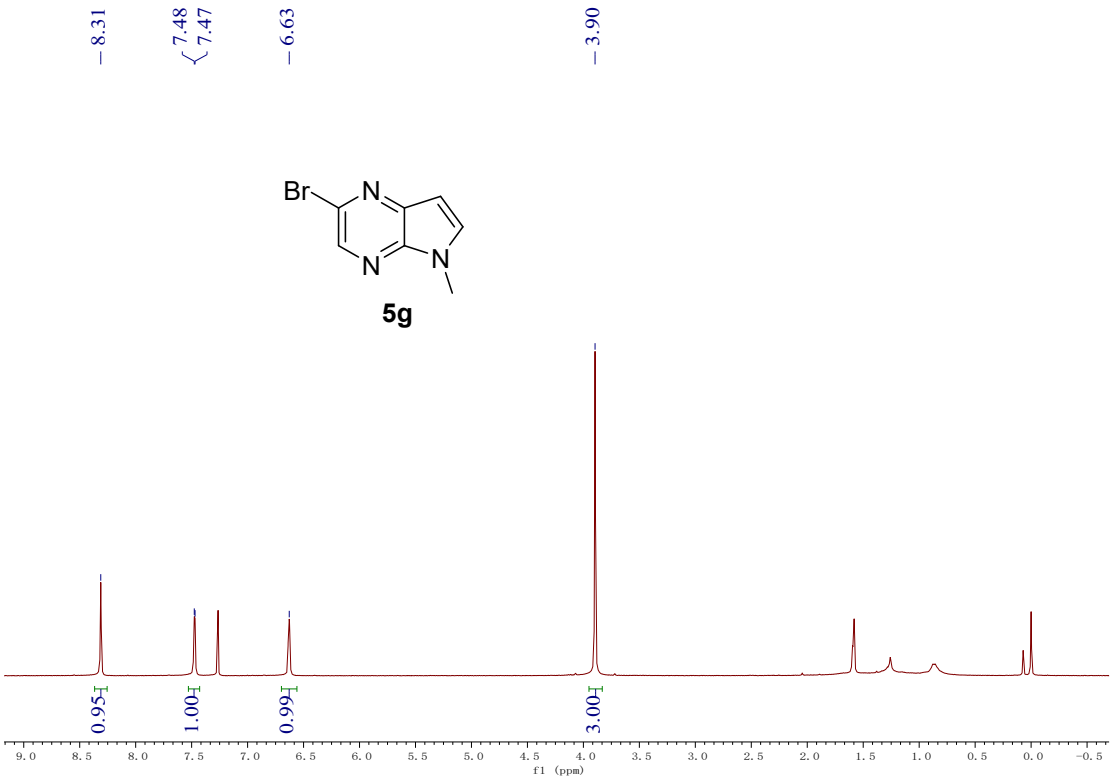


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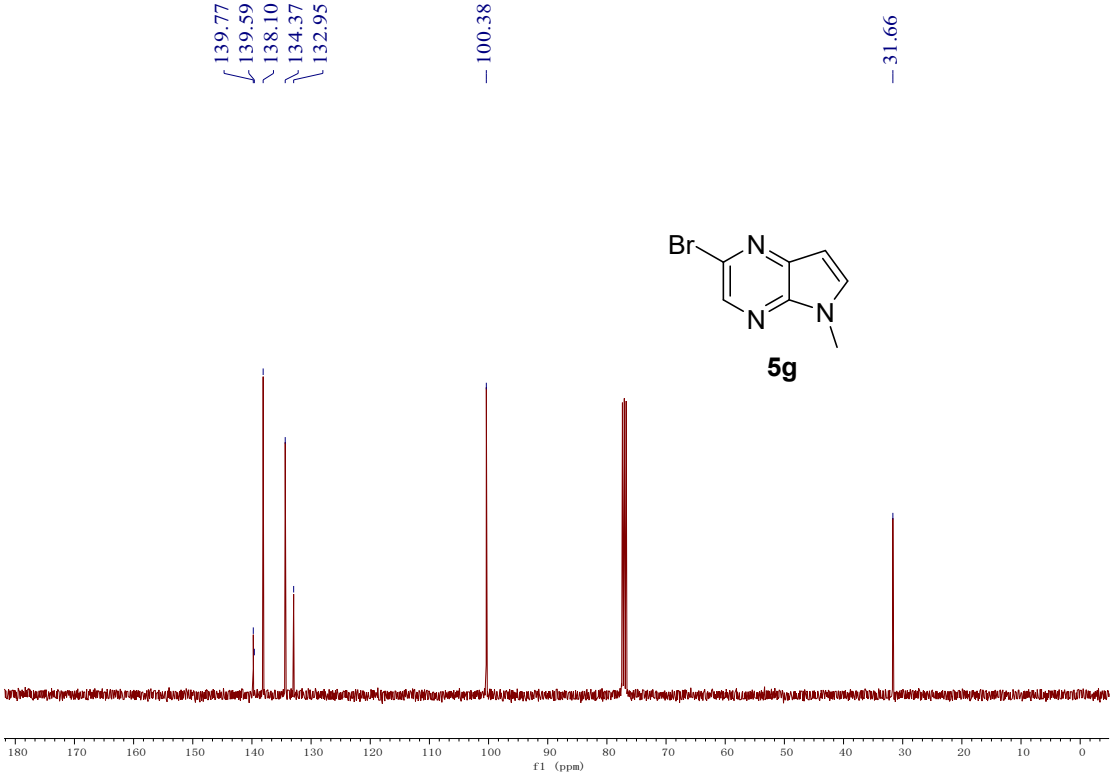


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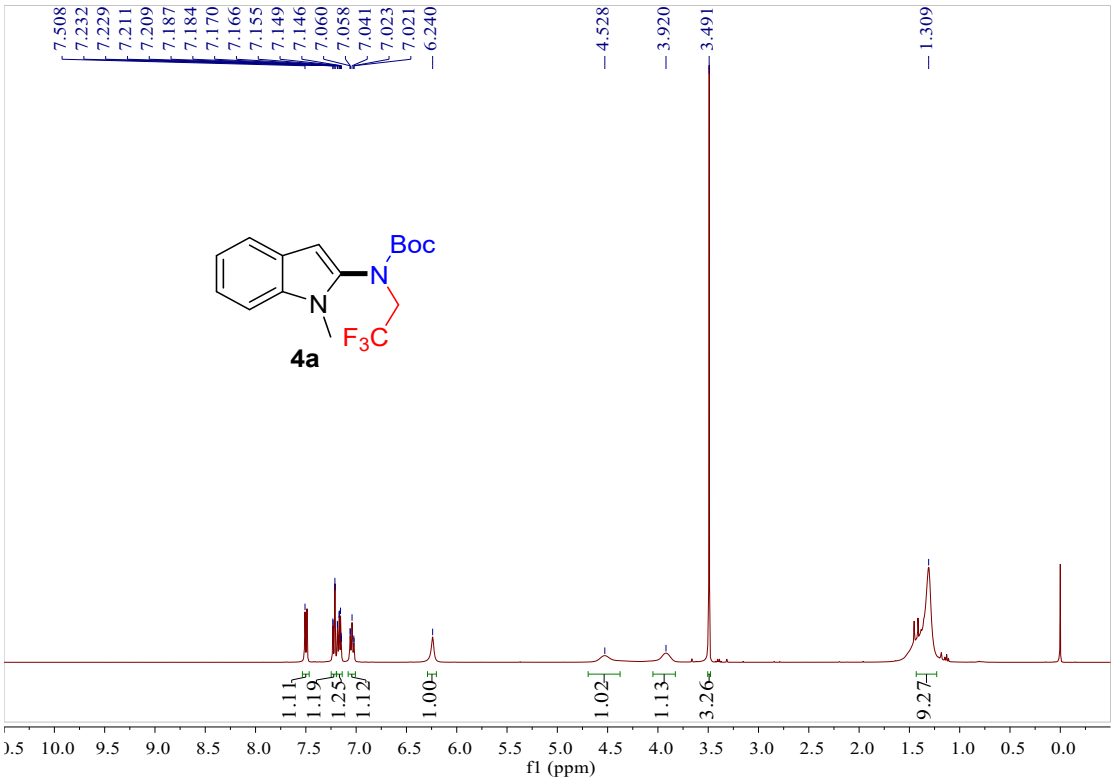


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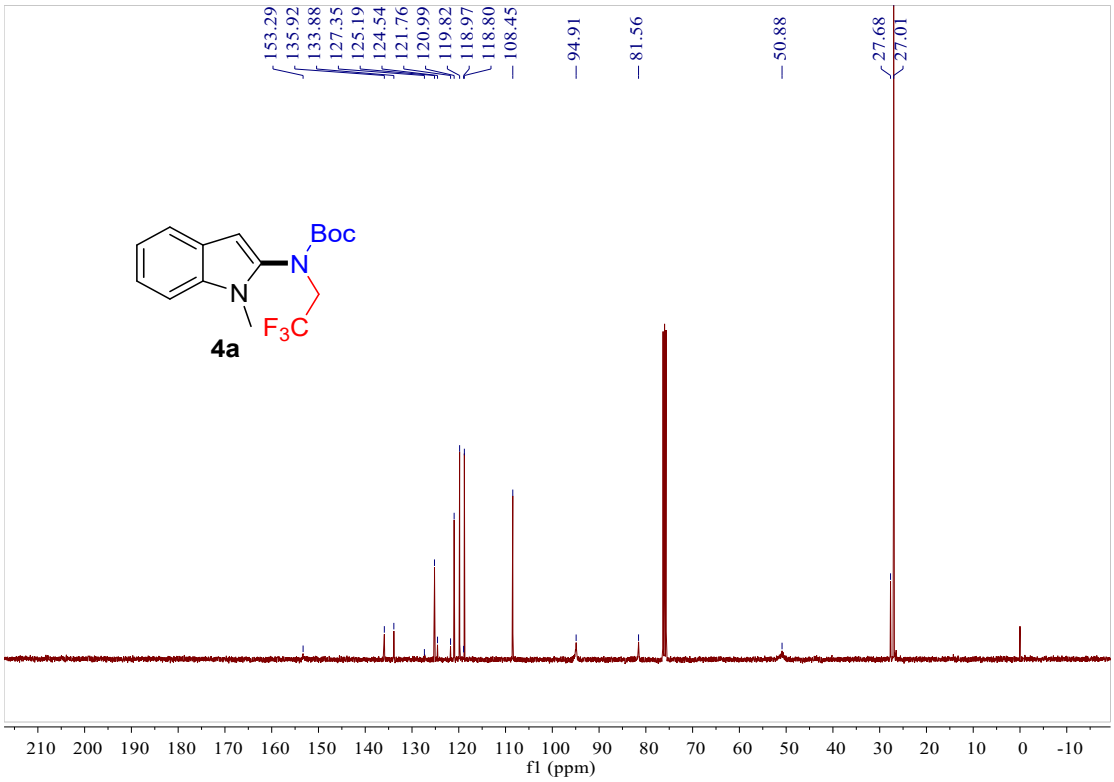


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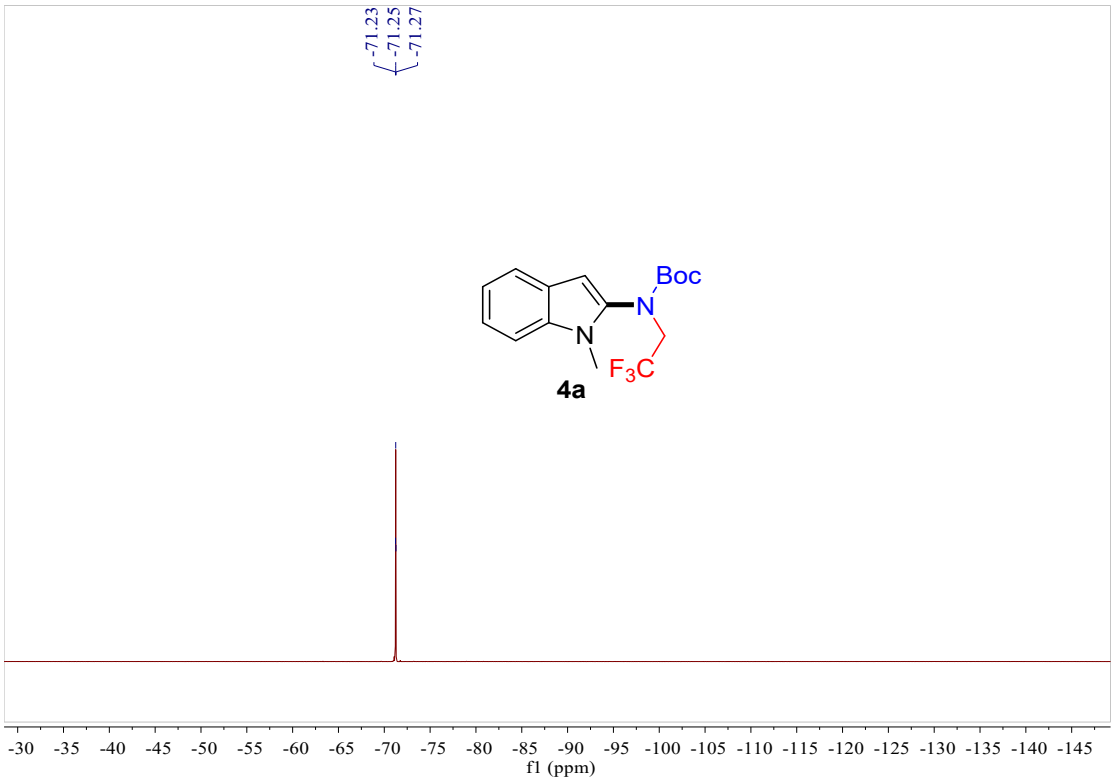


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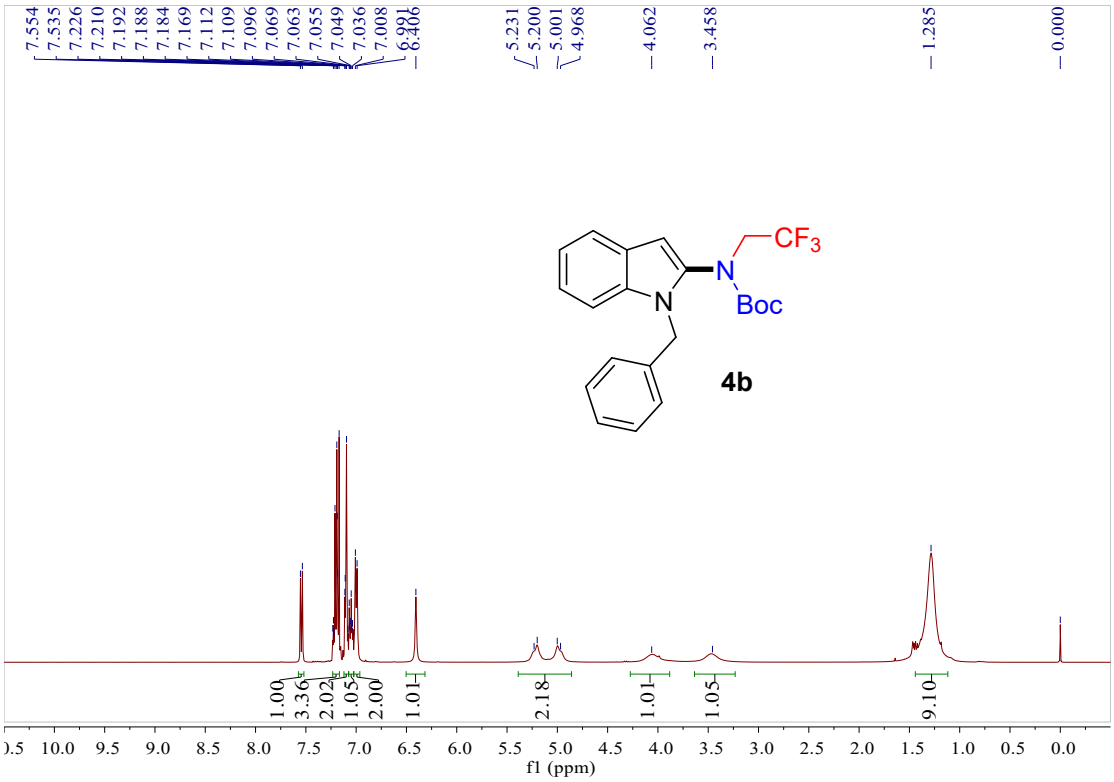
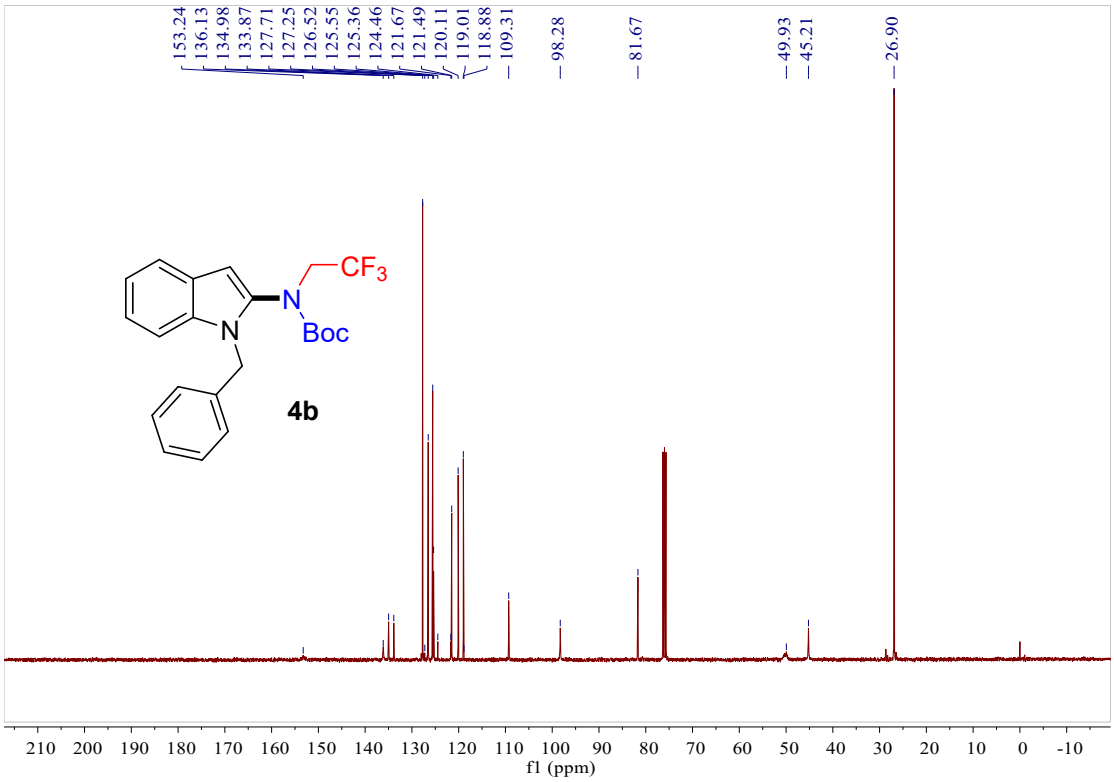



*[13]C NMR (101 MHz, CDCl3)*

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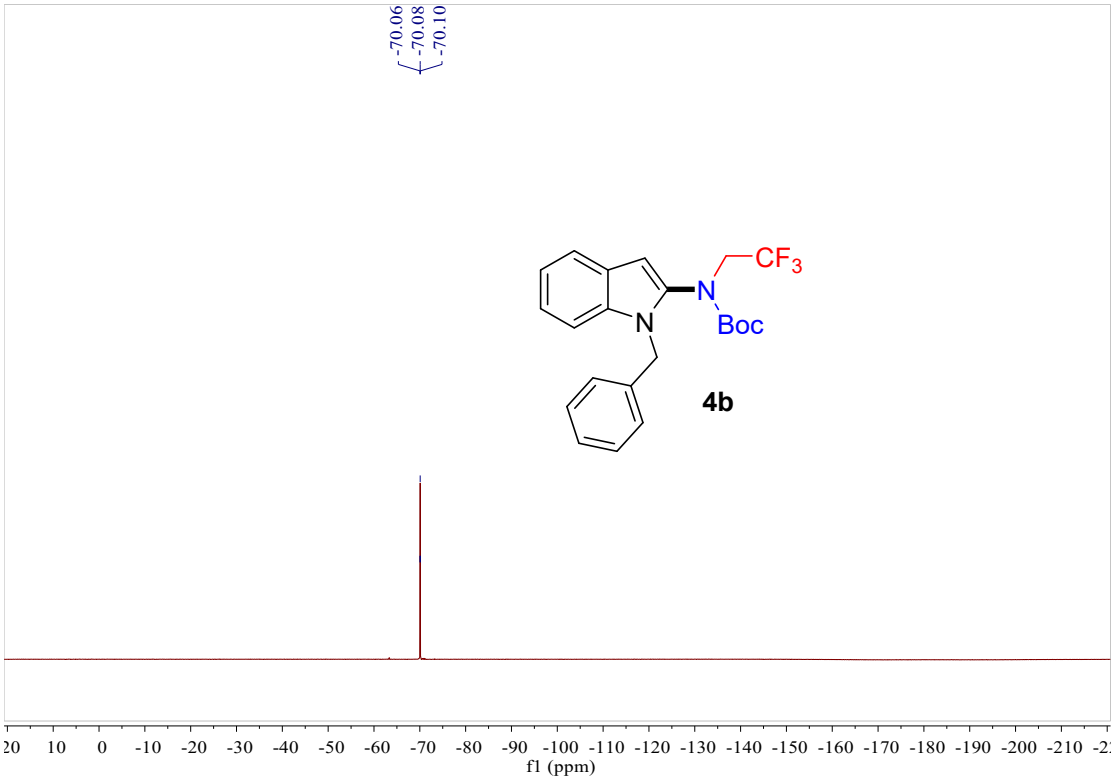


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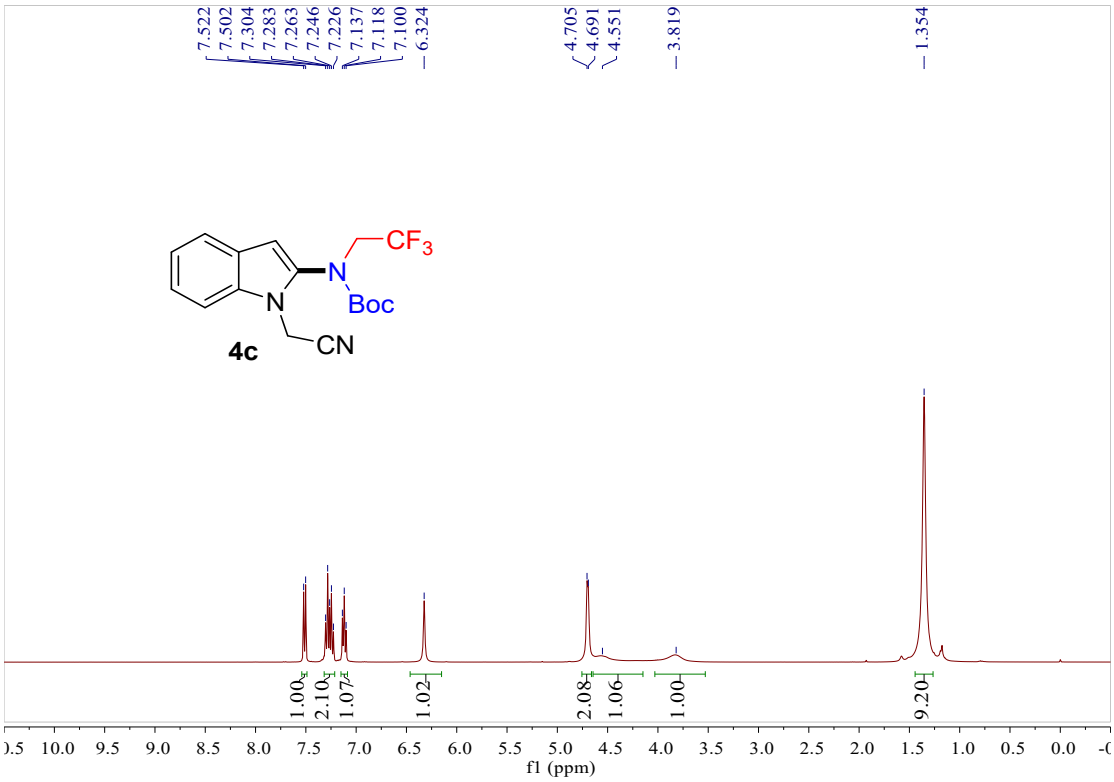
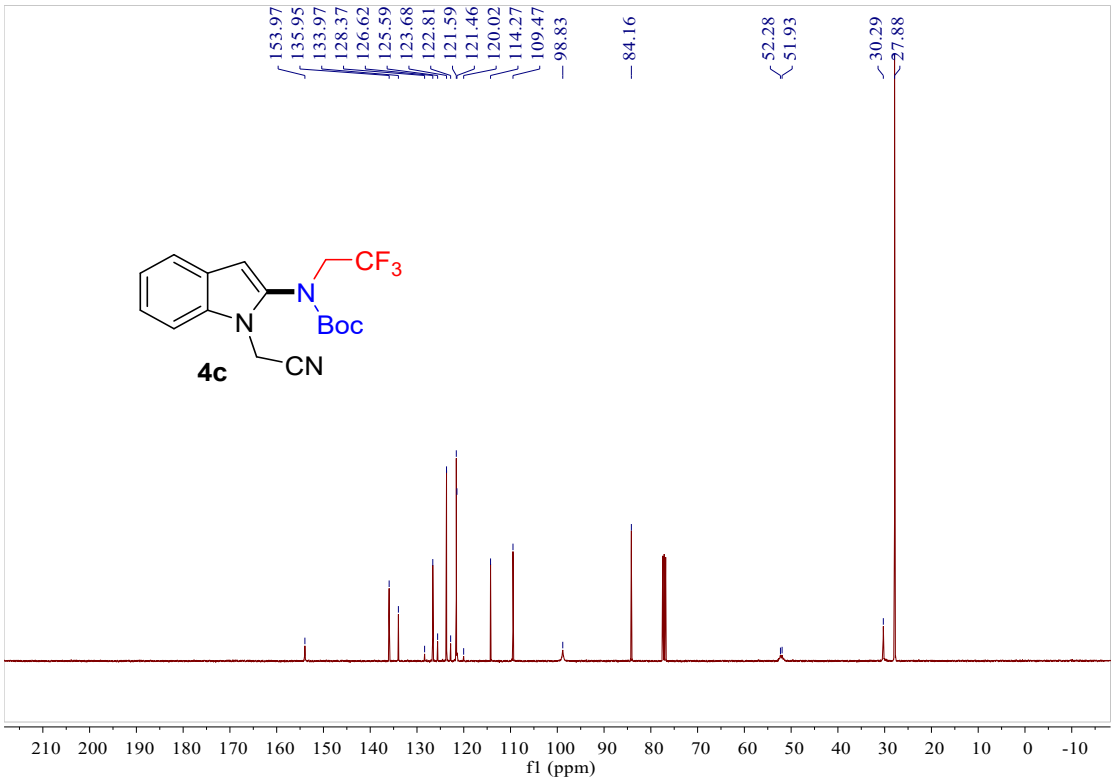
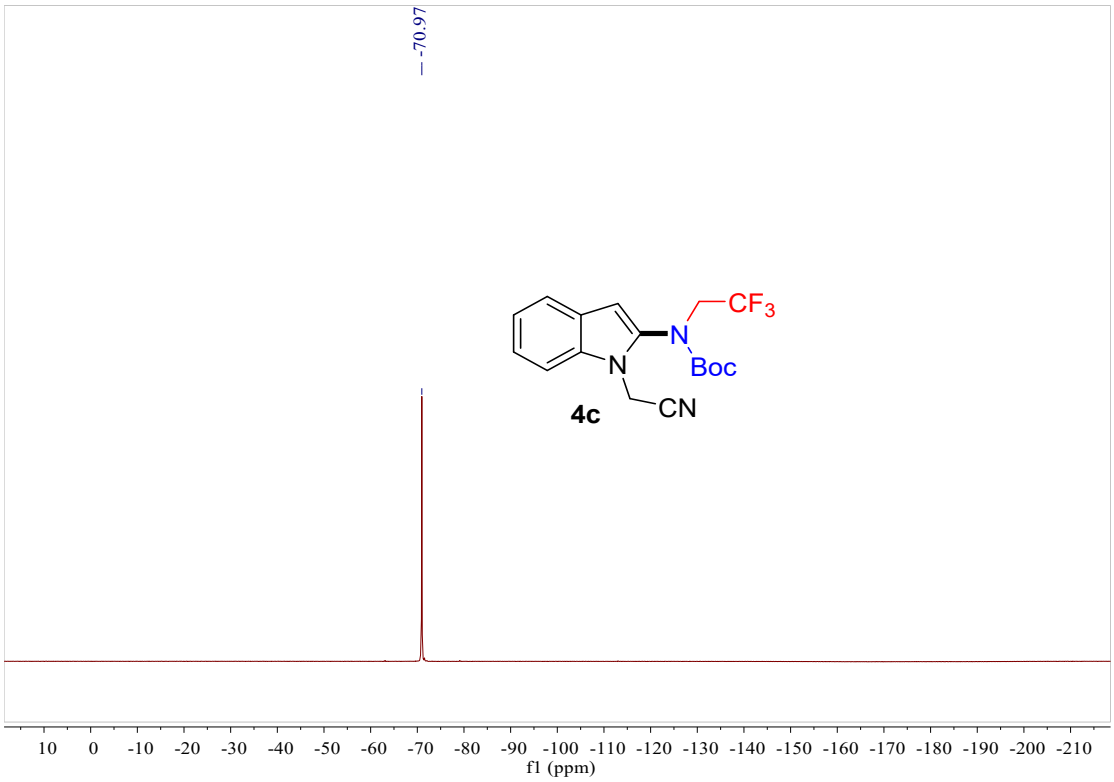


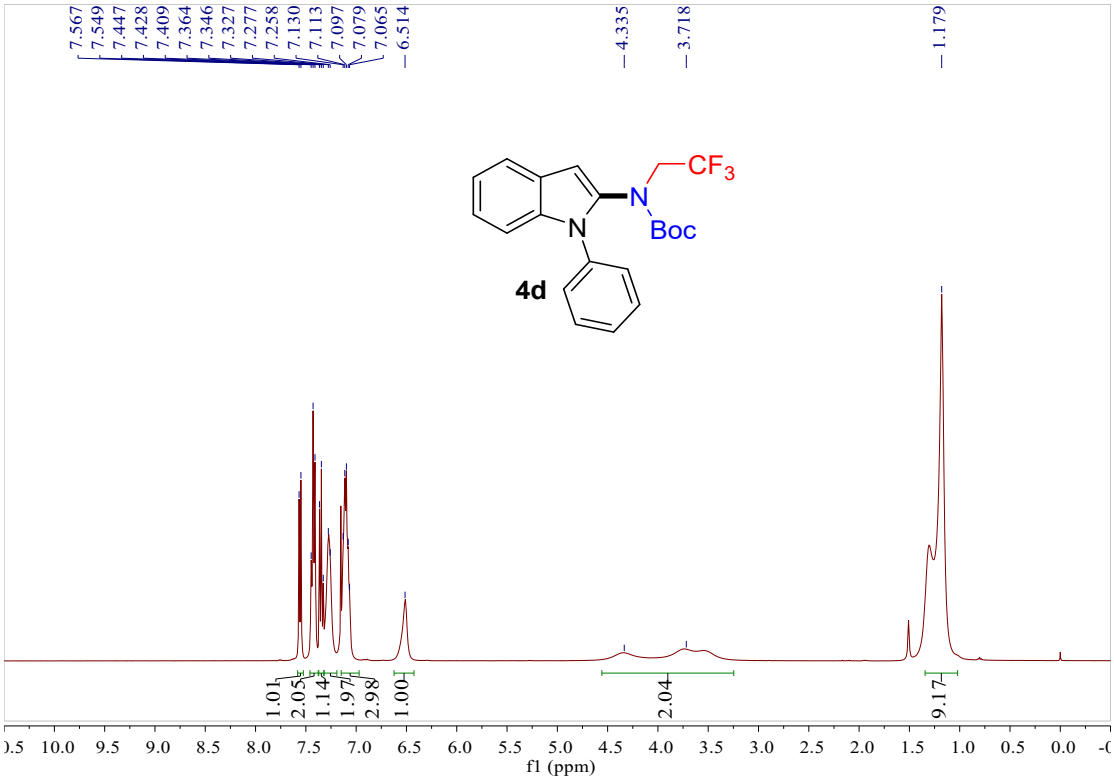

*$^{13}$C NMR (101 MHz, $CDCl_3$)*




*$^{19}$F NMR (377 MHz, $CDCl_3$)*




*[1]H NMR (400 MHz, CDCl3)*

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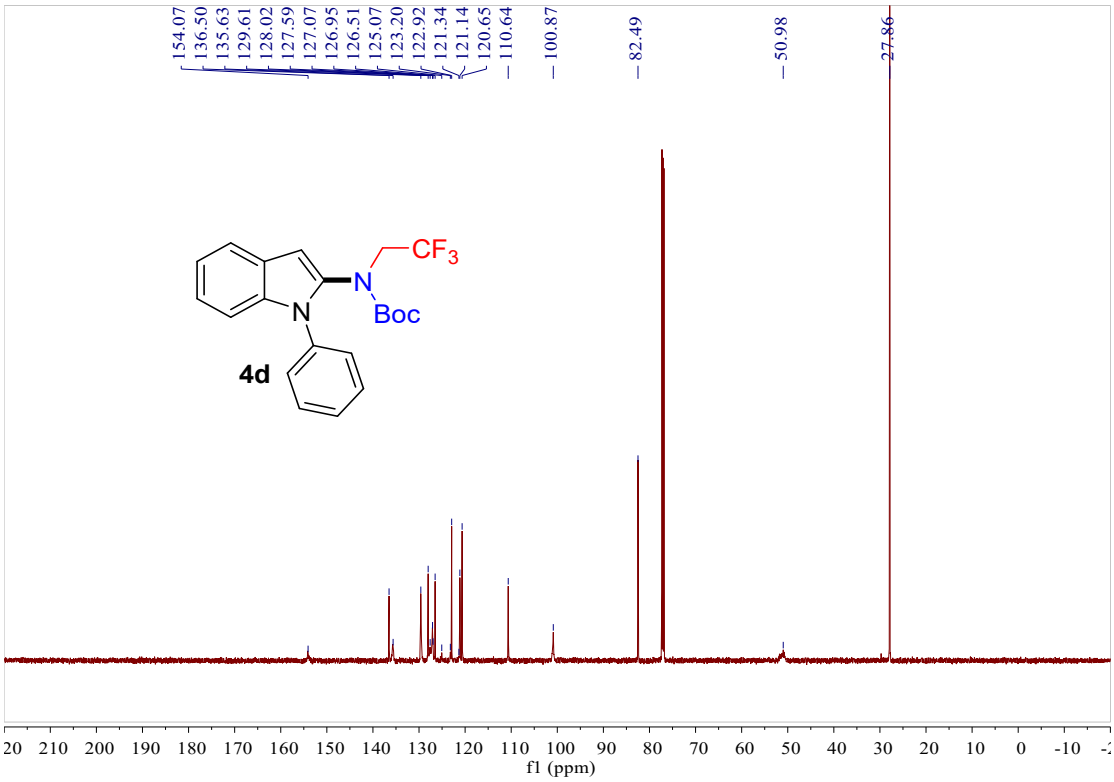
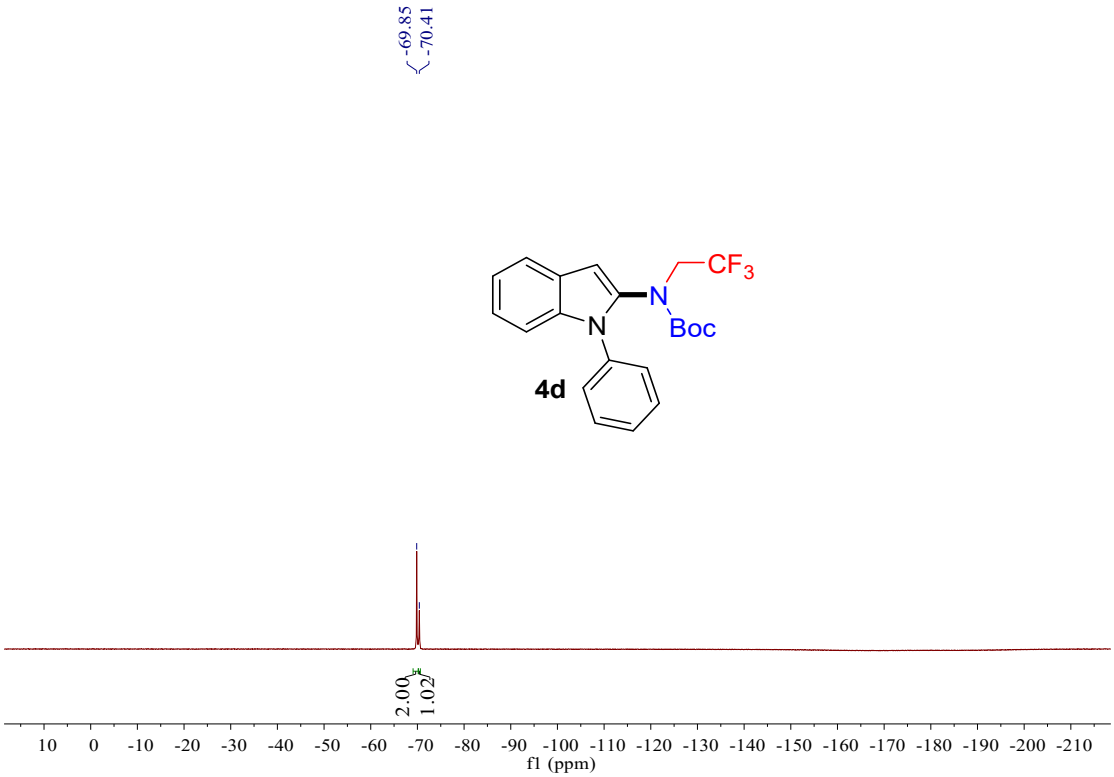



*[19]F NMR (377 MHz, $CDCl_3$)*

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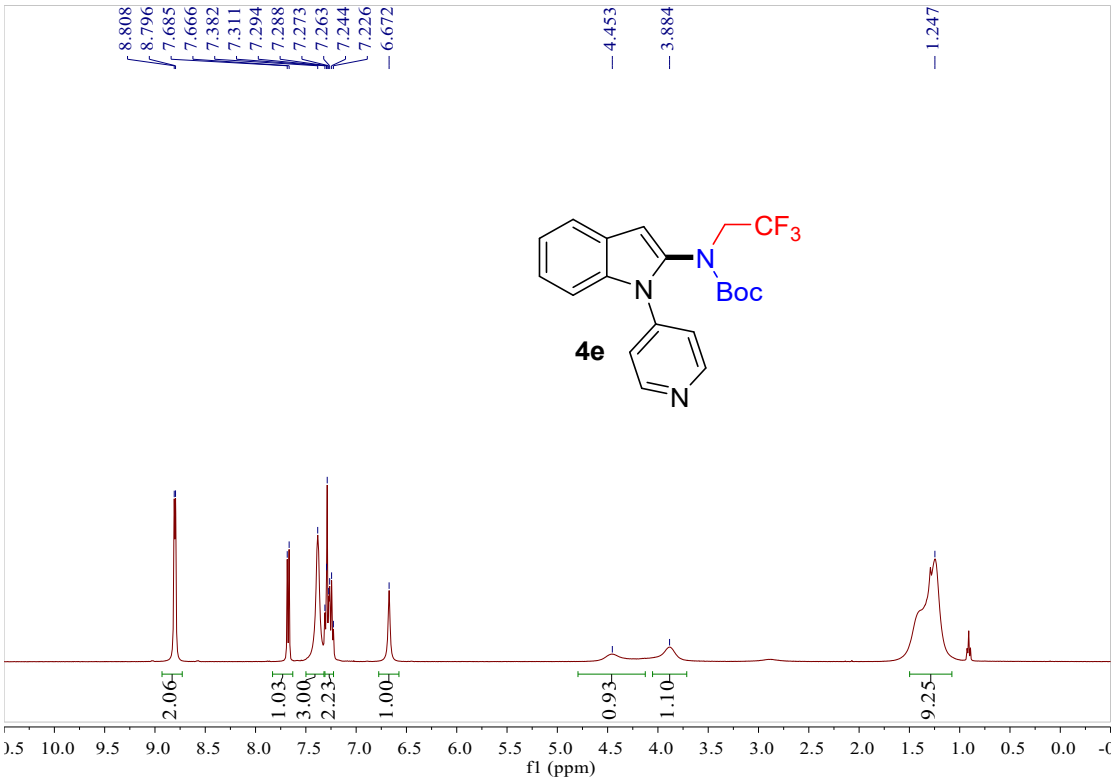


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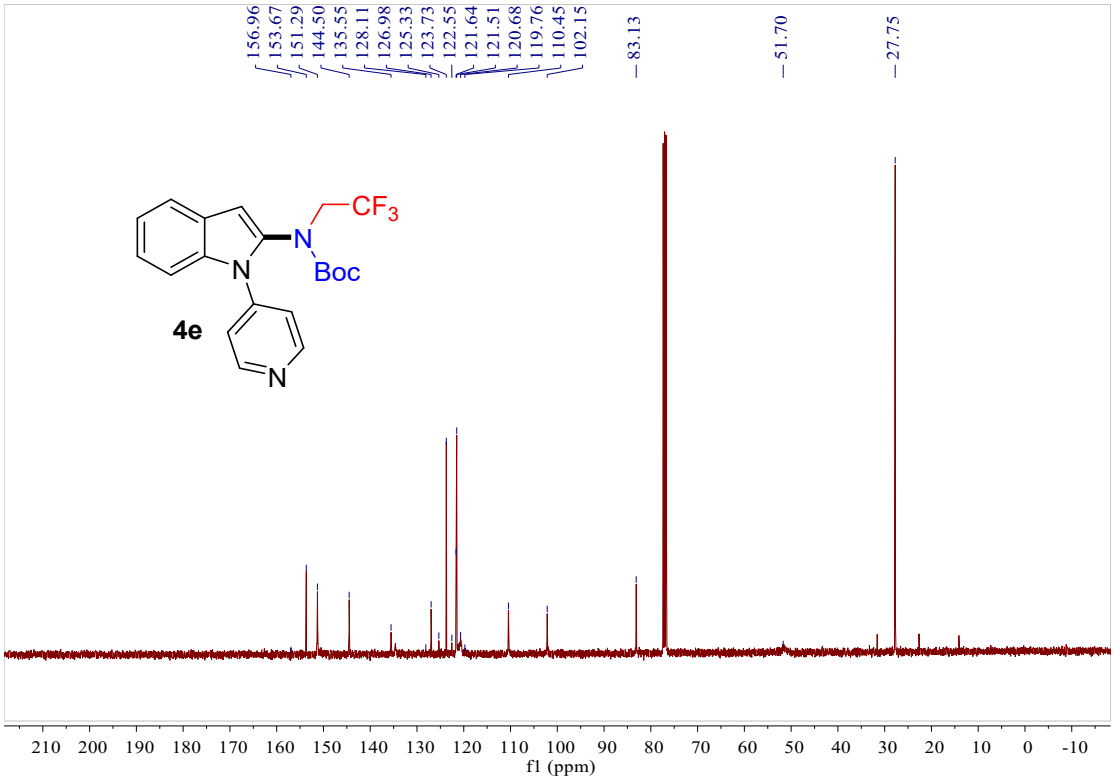


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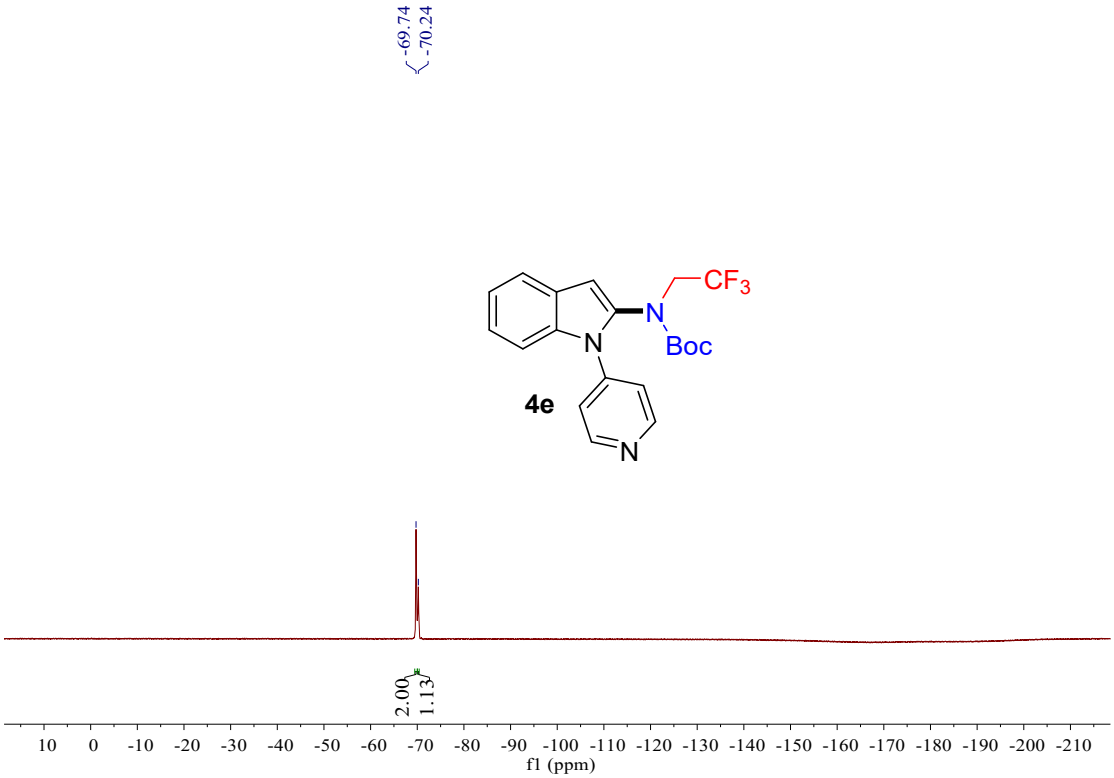


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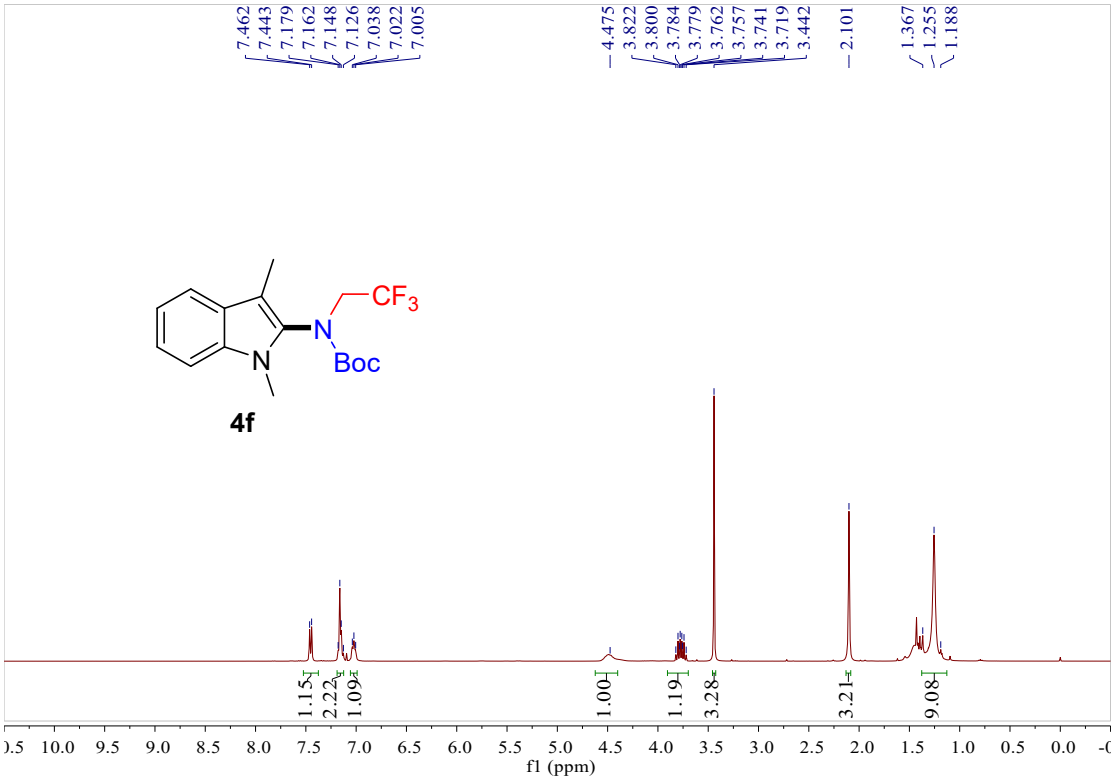


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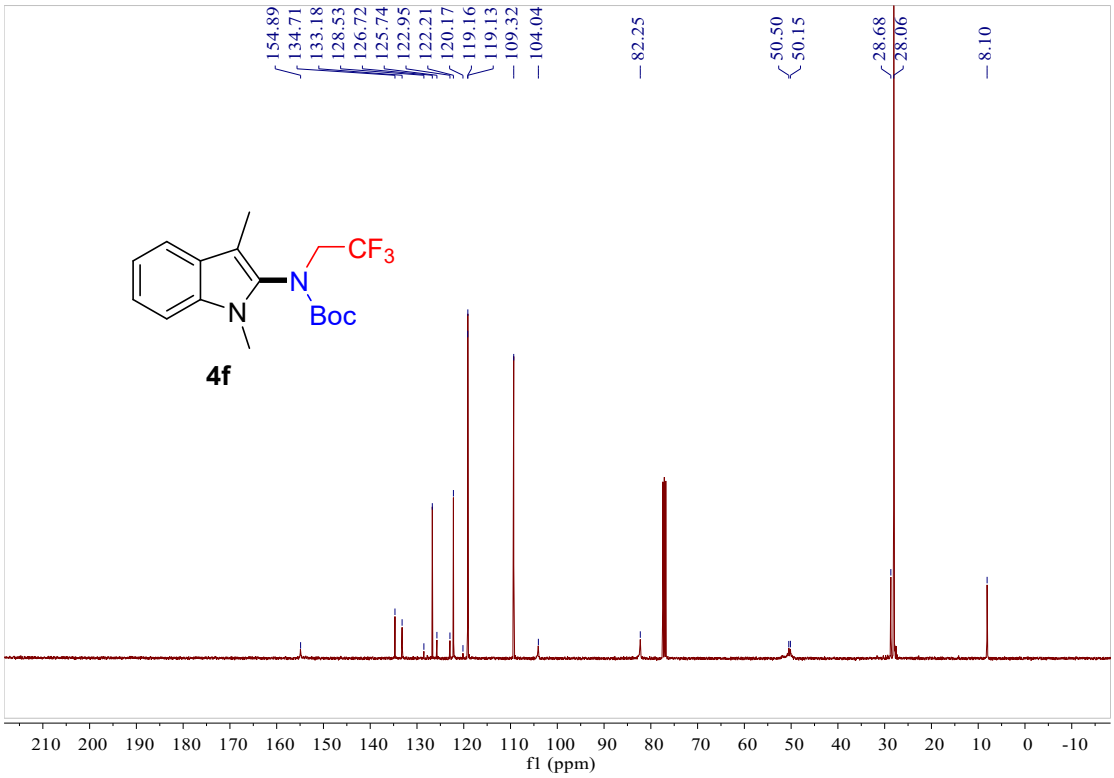
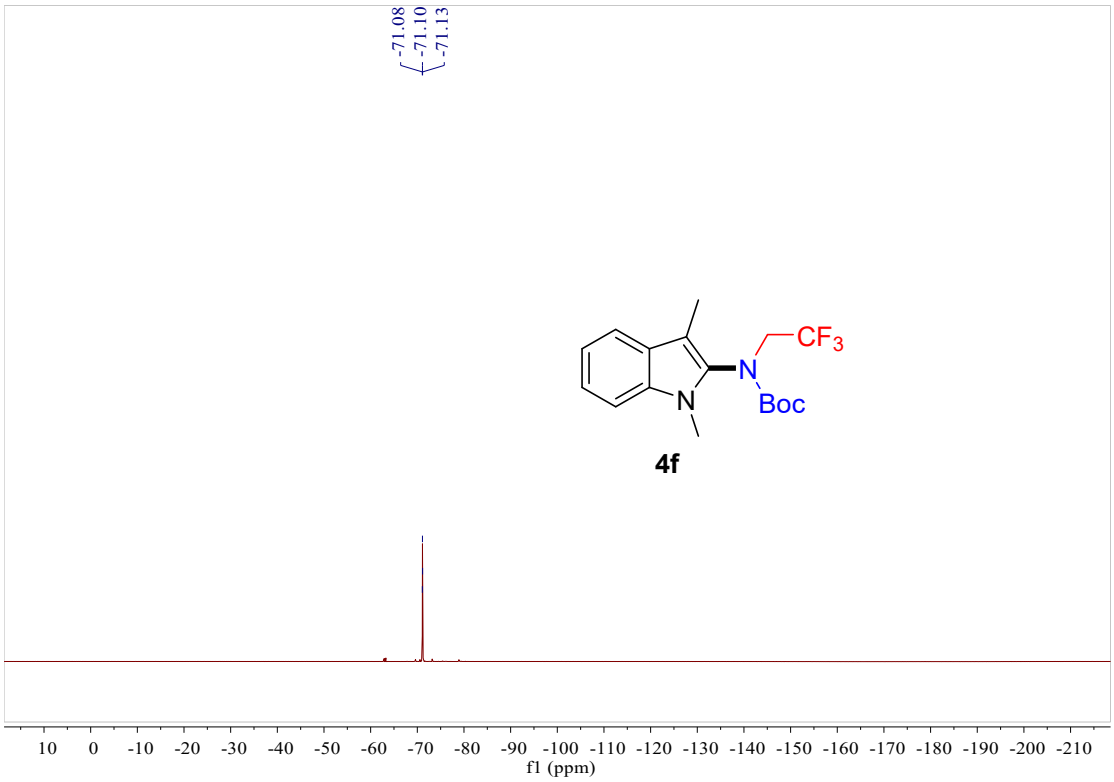



*[19]F NMR (376 MHz, $CDCl_3$)*

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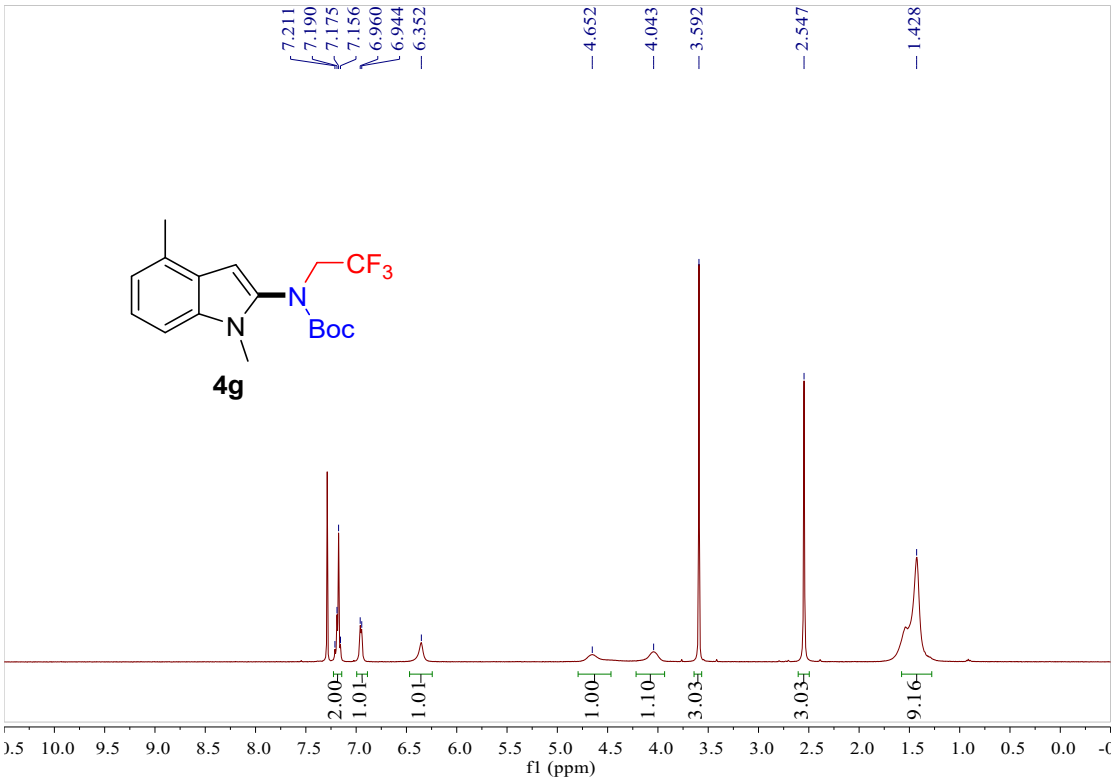


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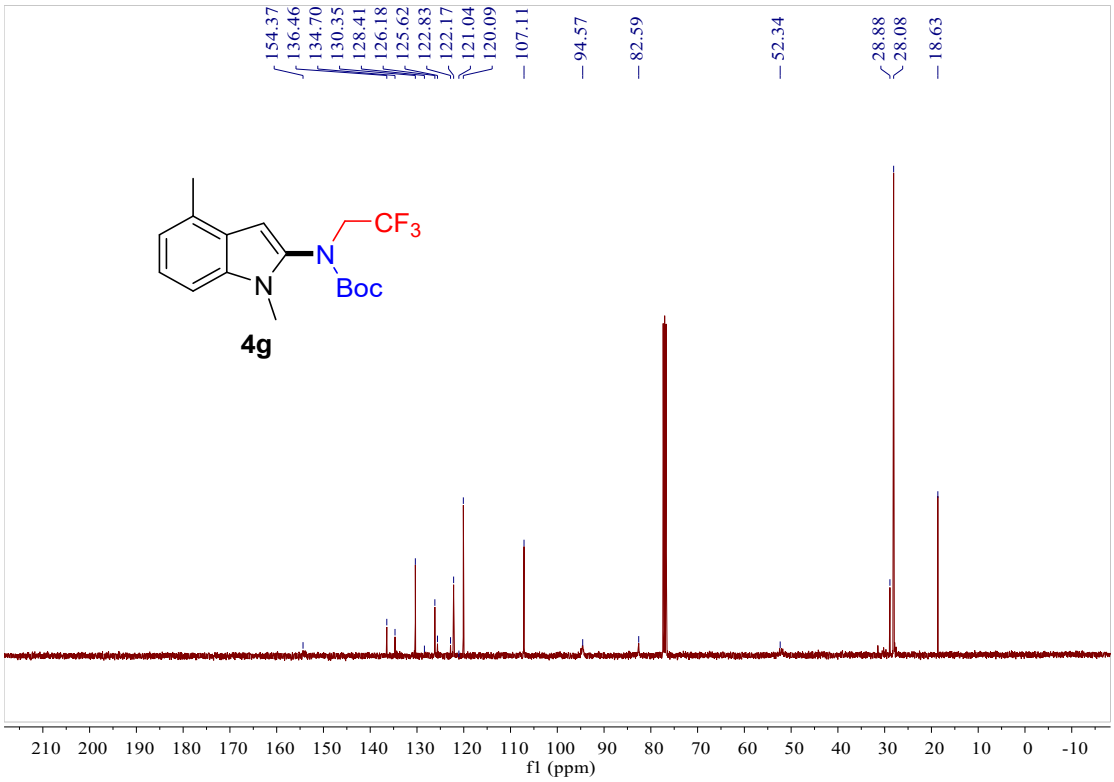


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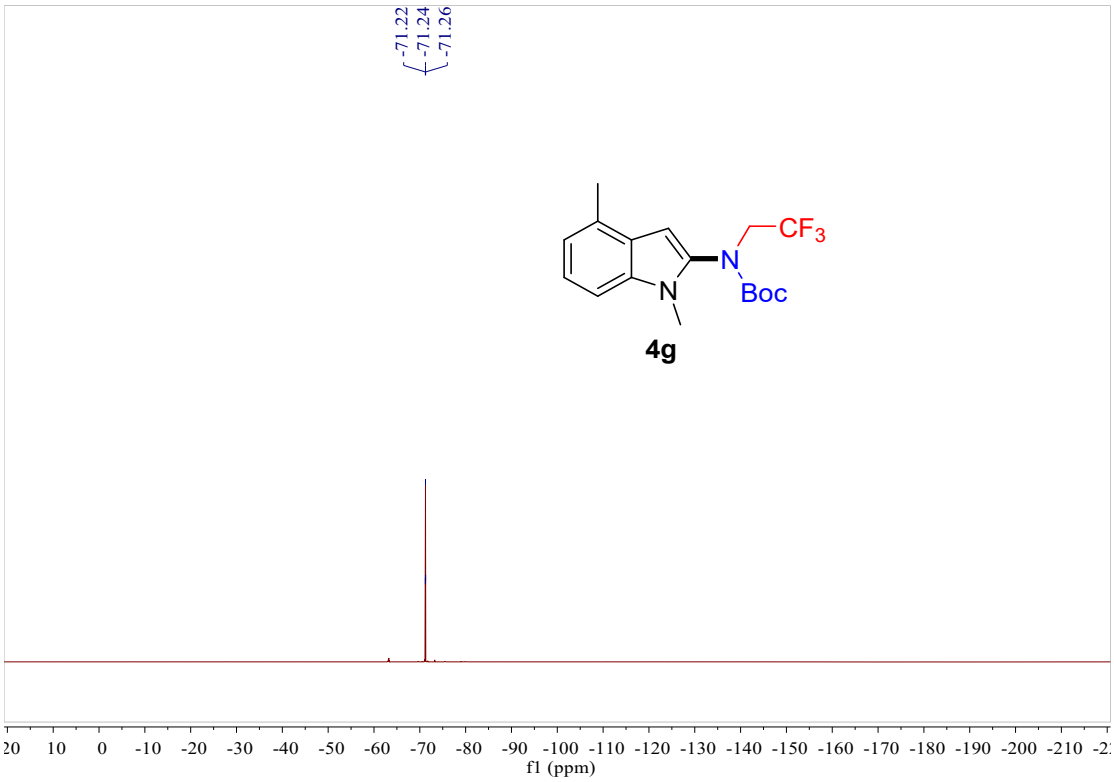


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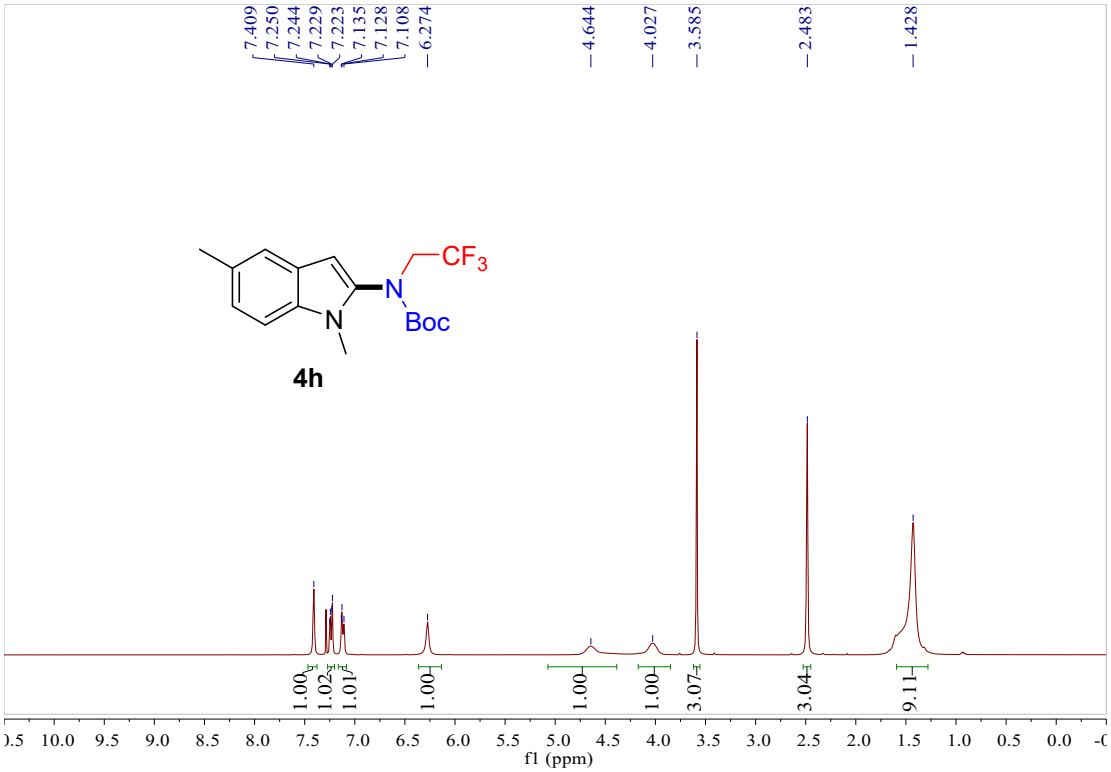


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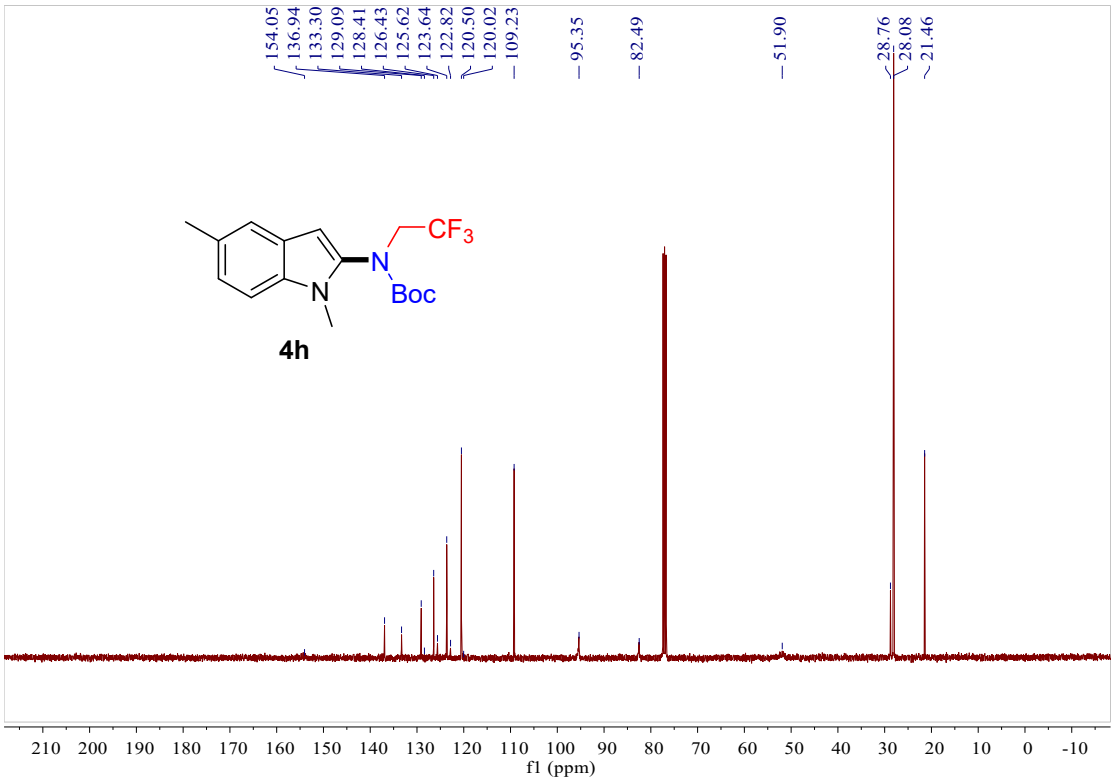


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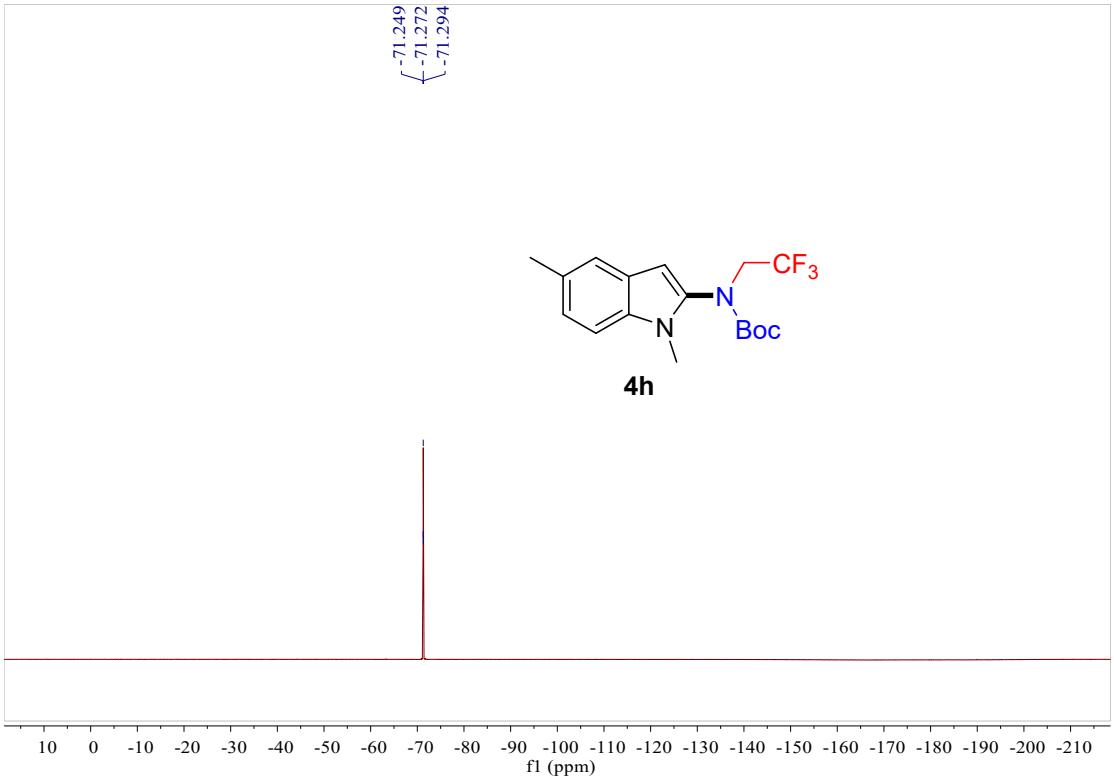


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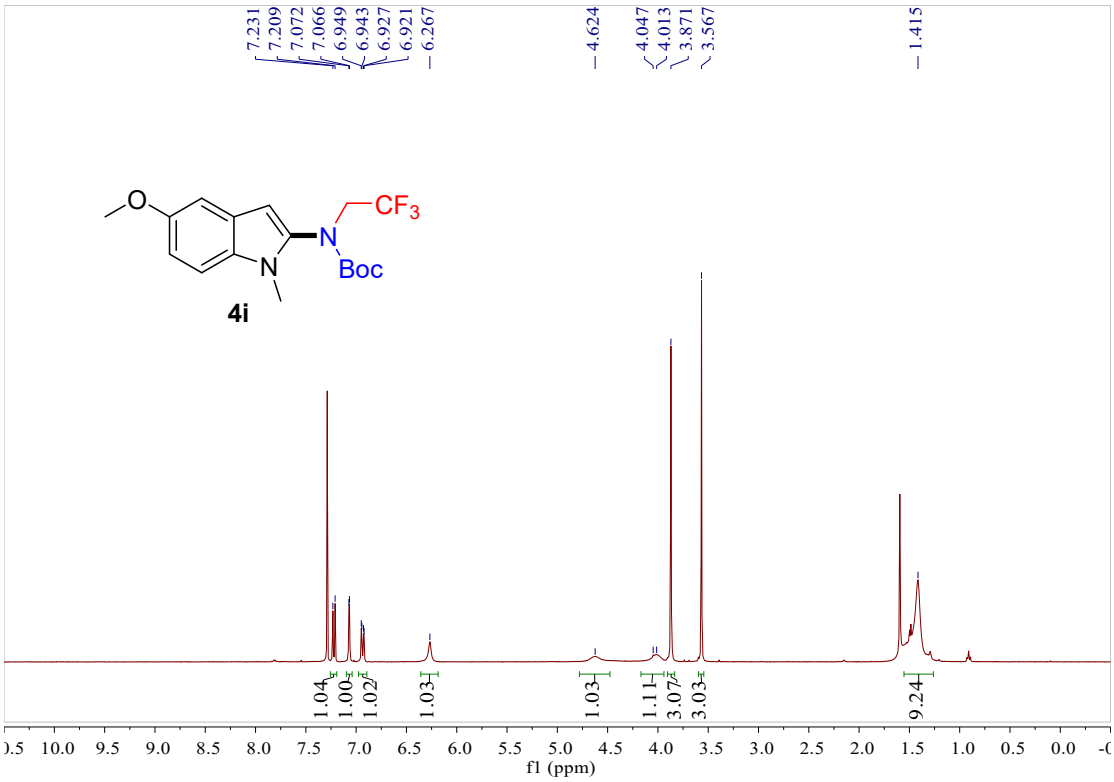


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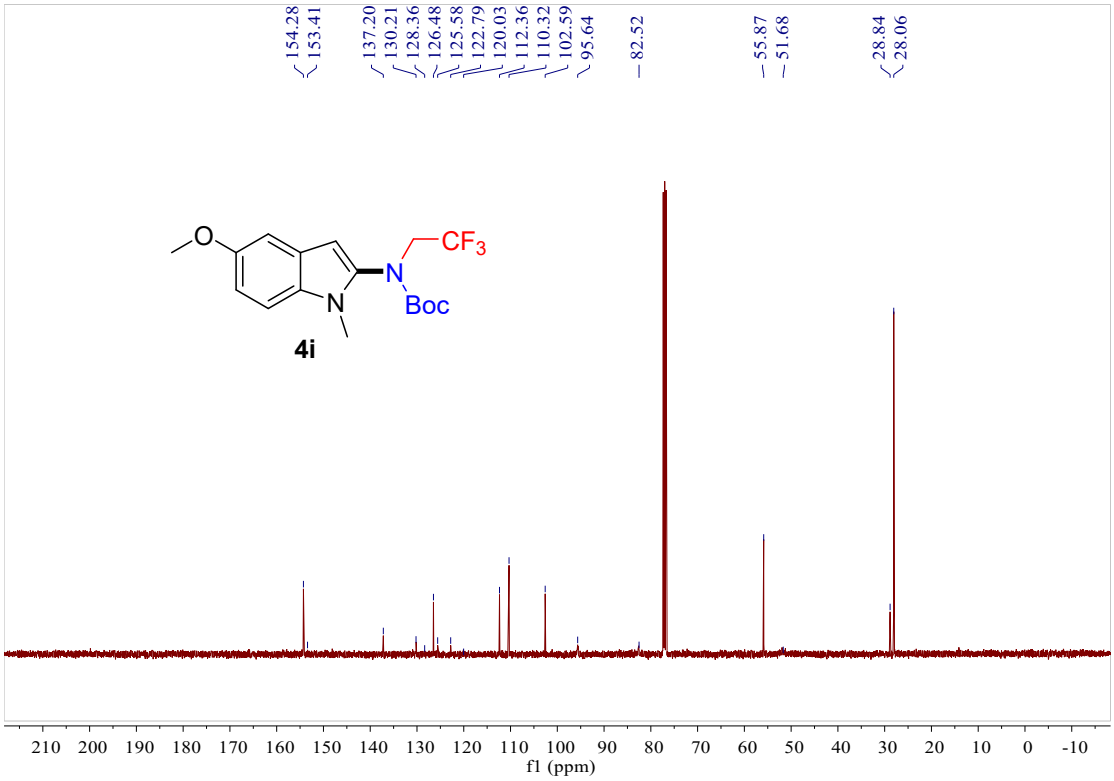


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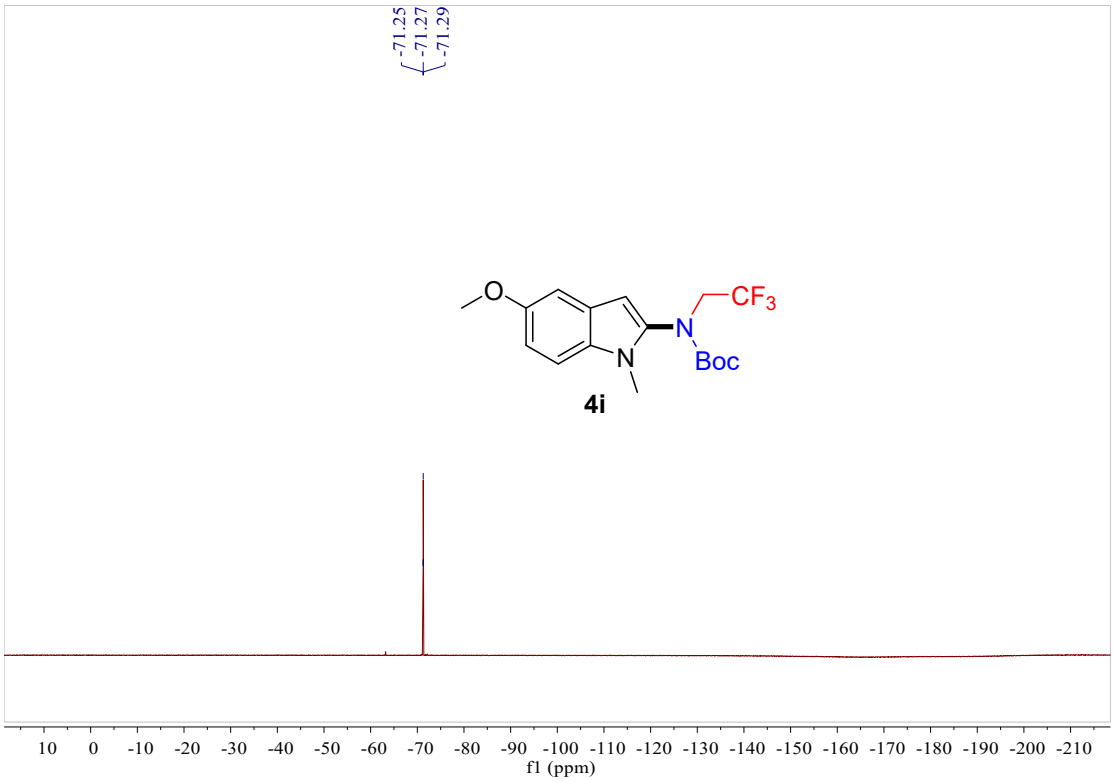


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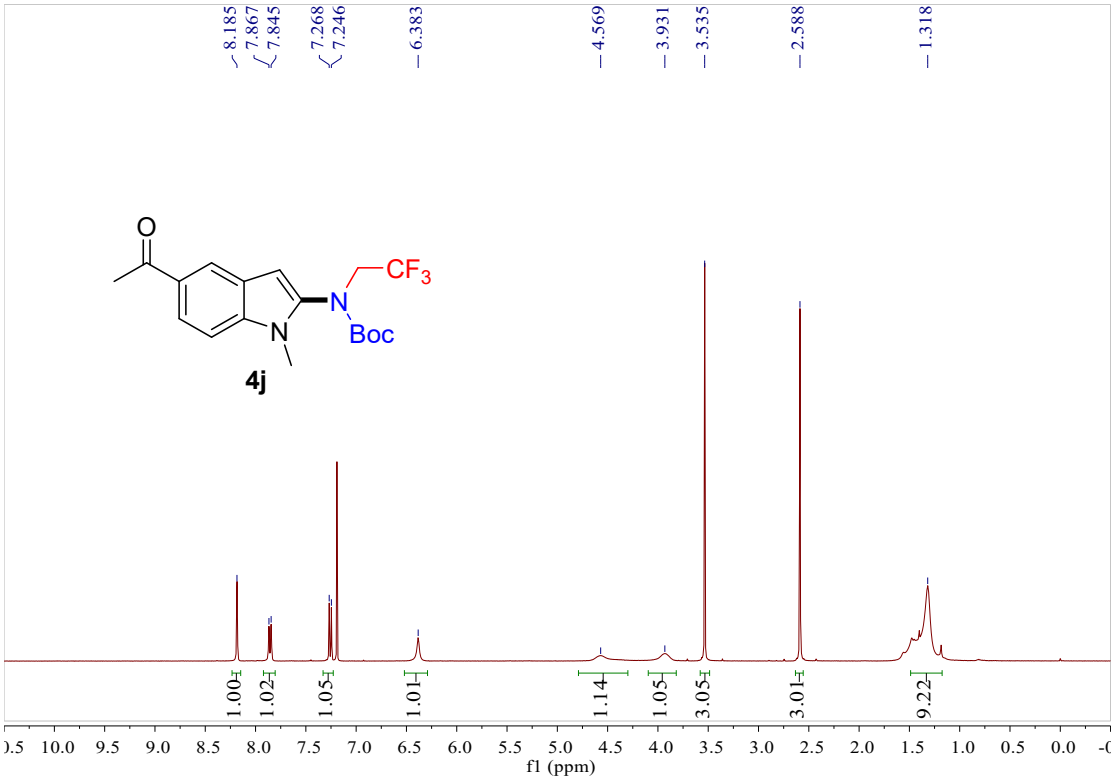


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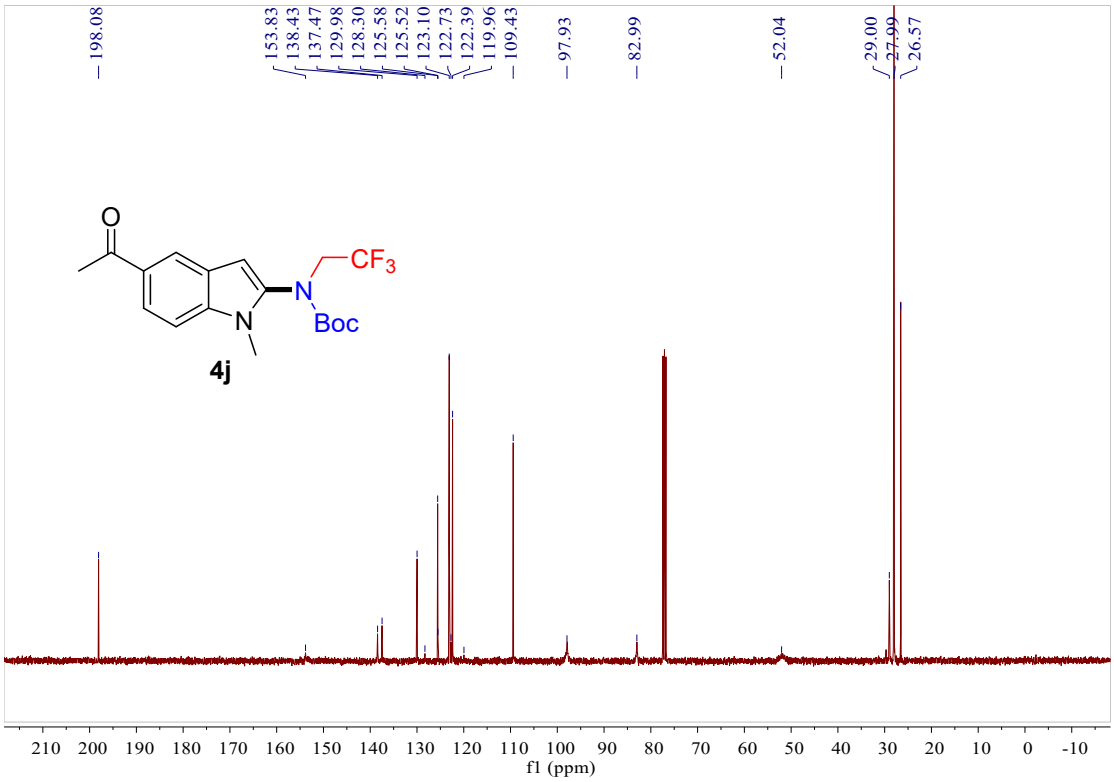


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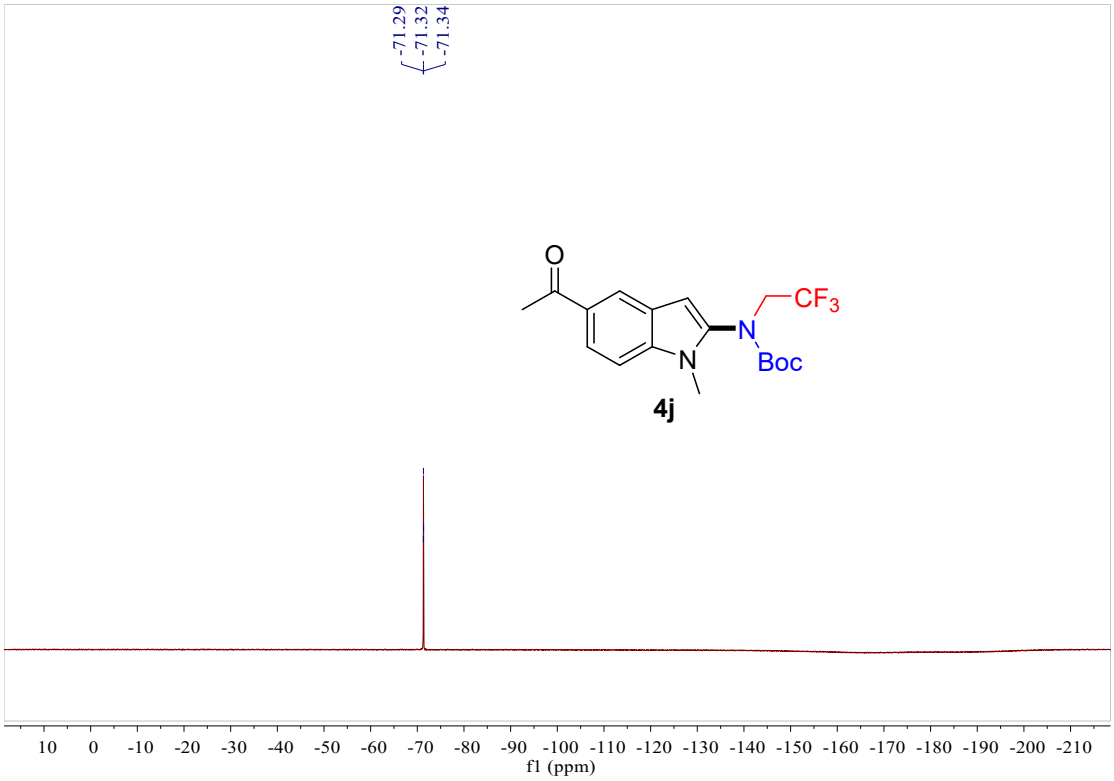


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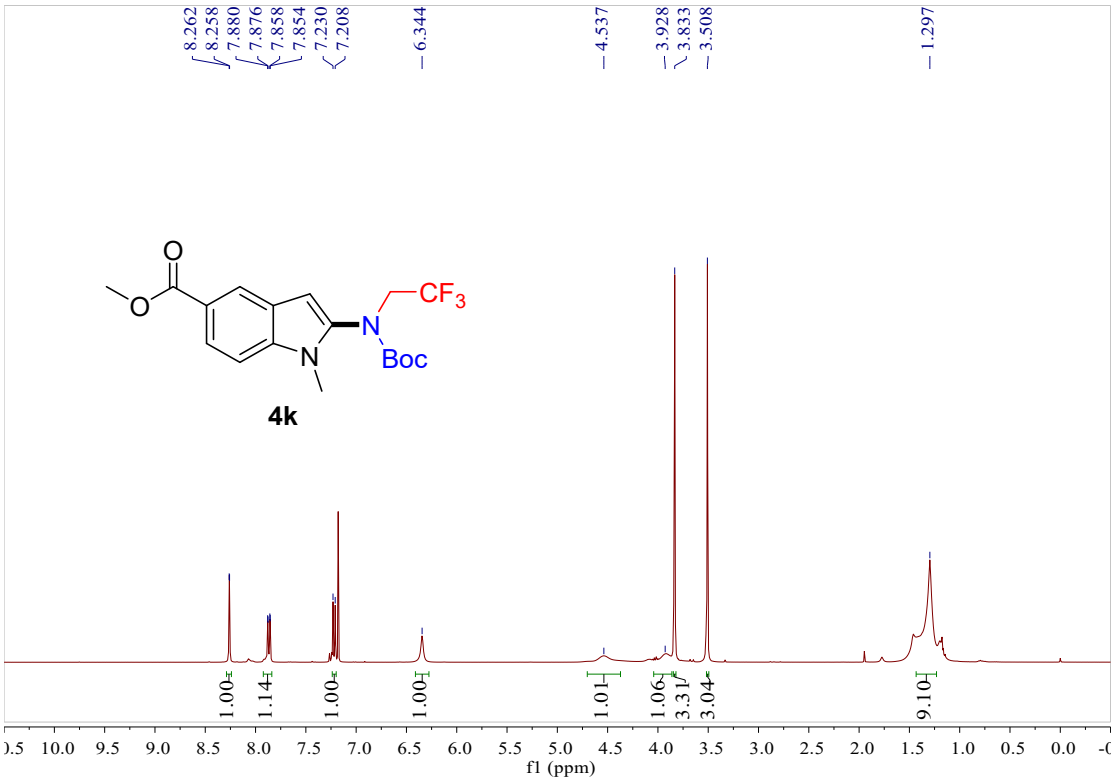


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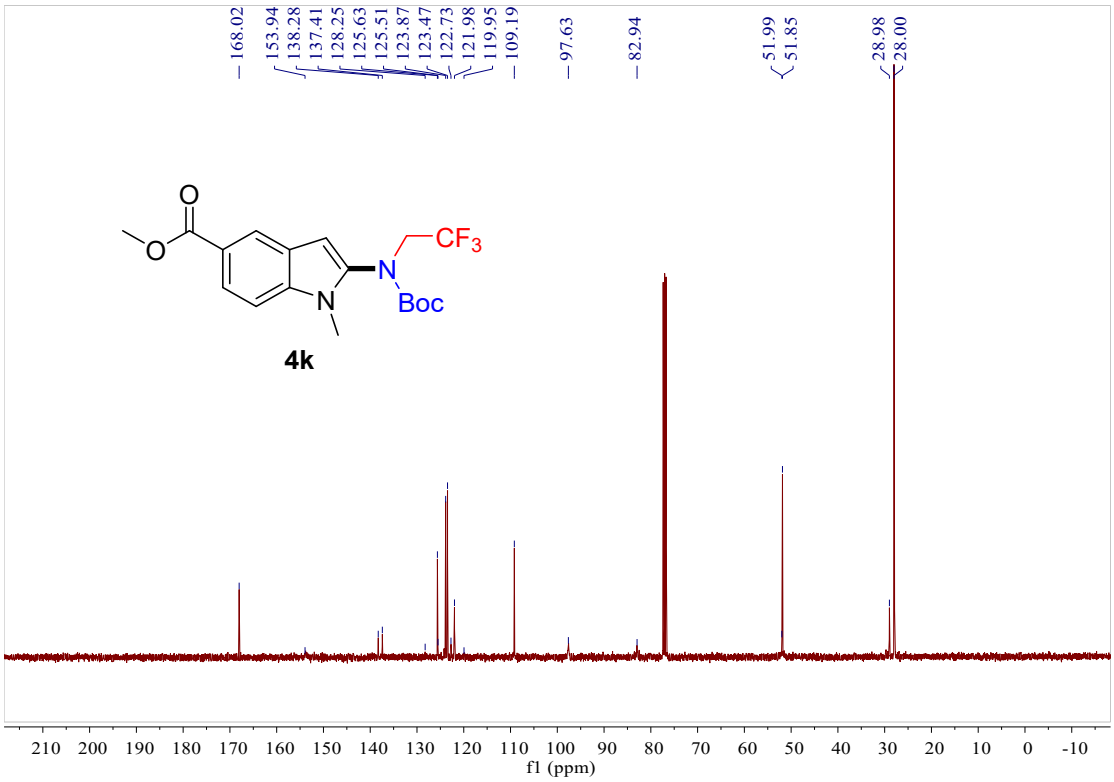


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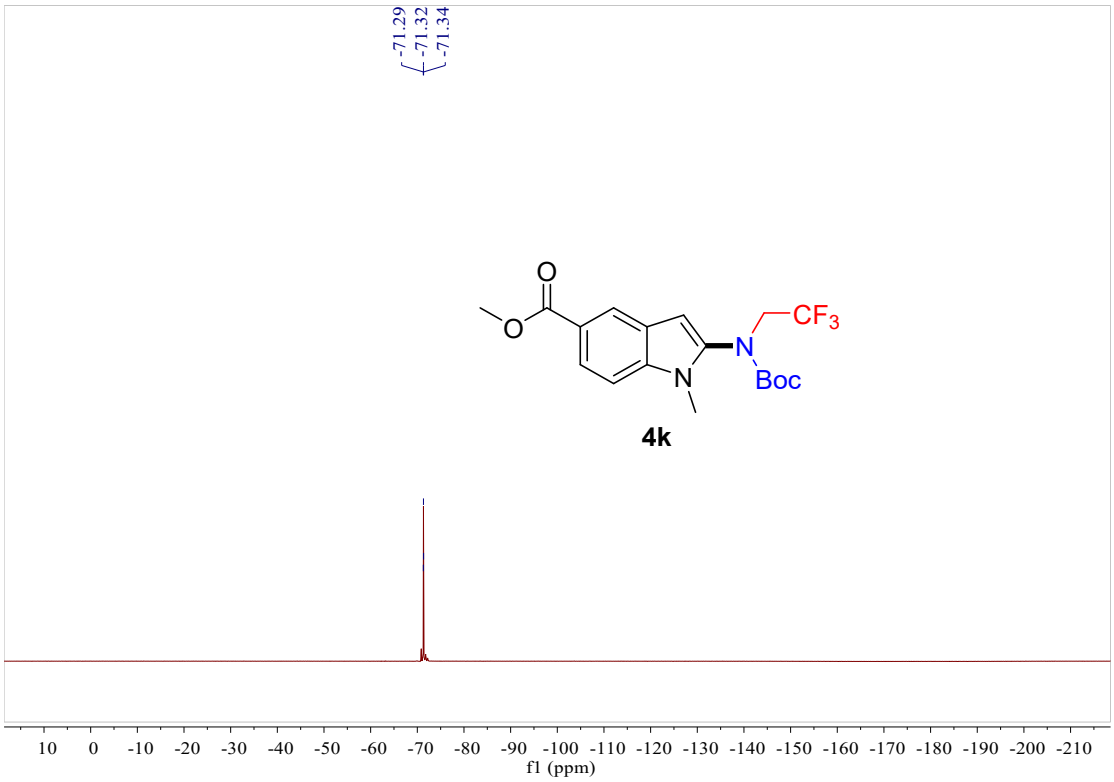


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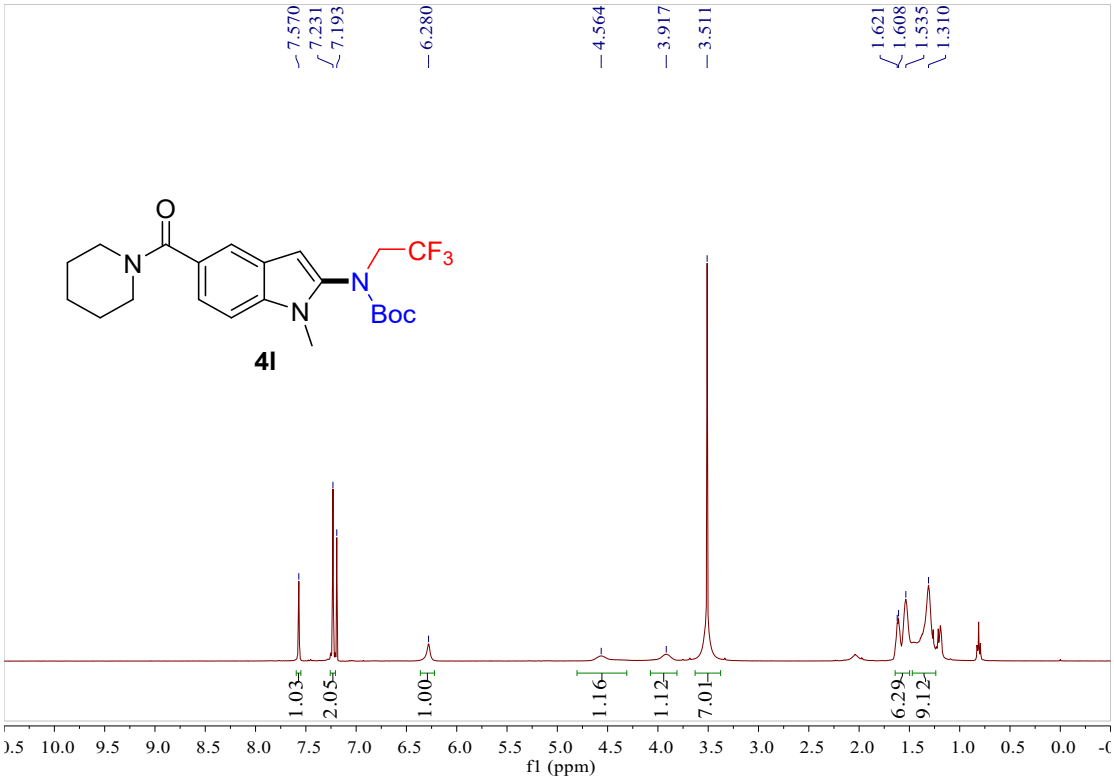


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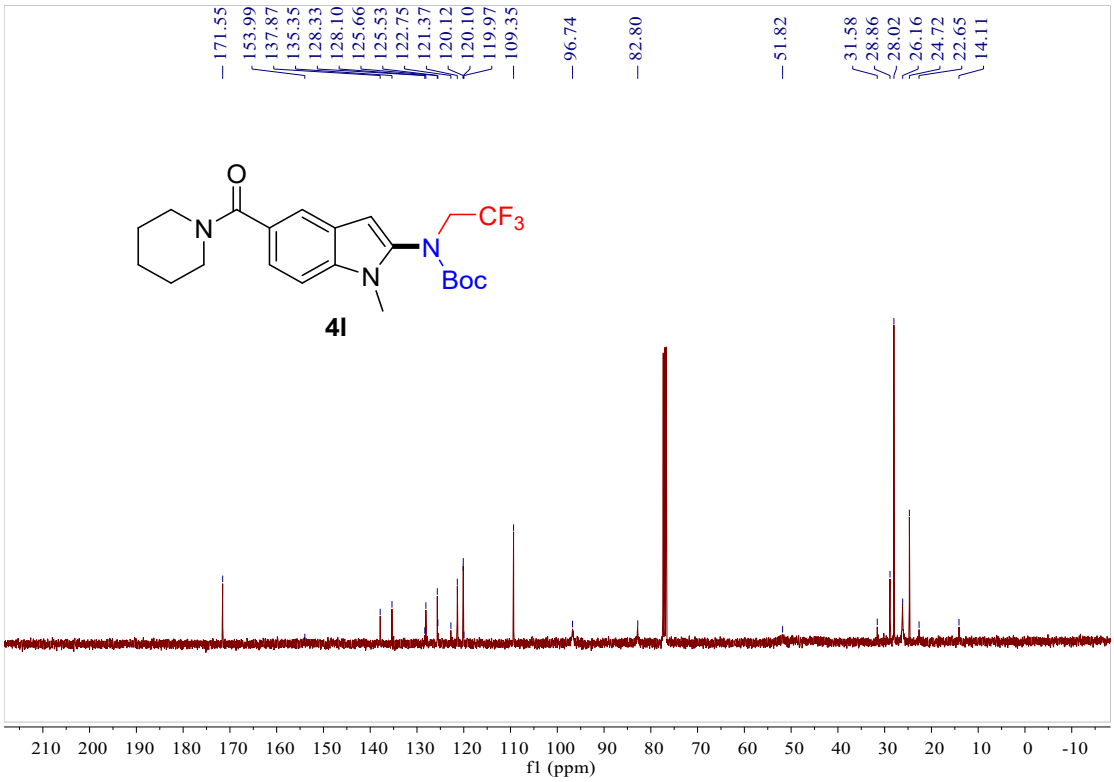


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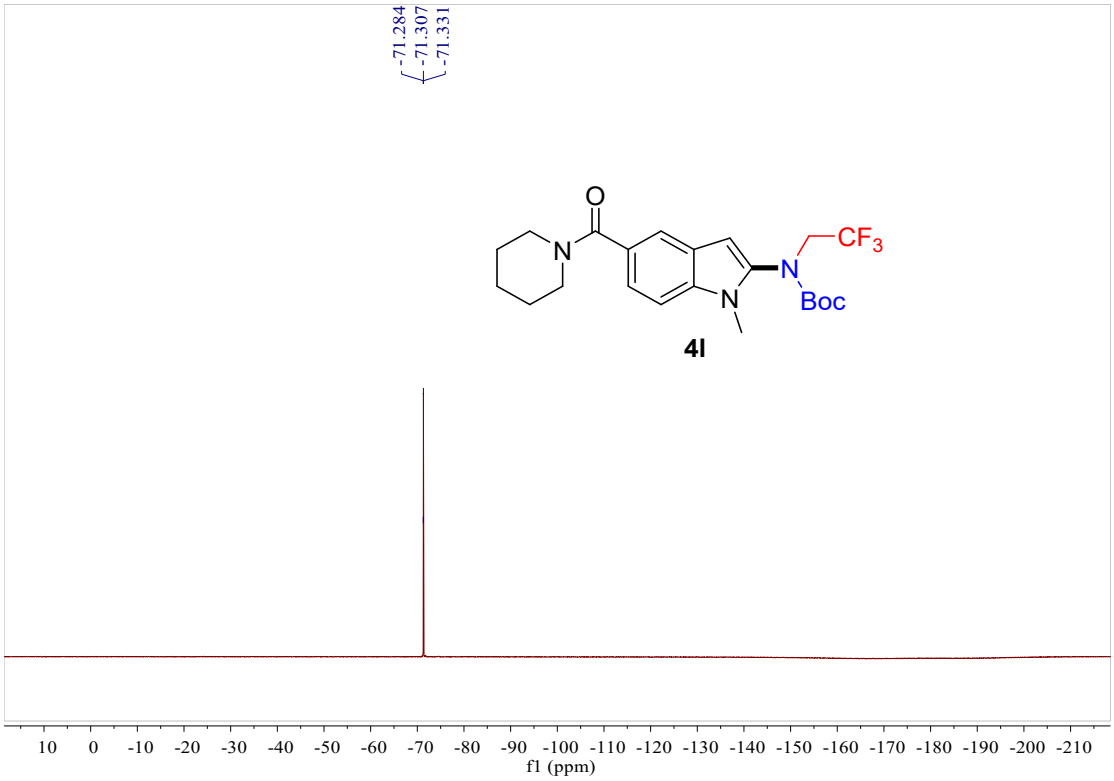


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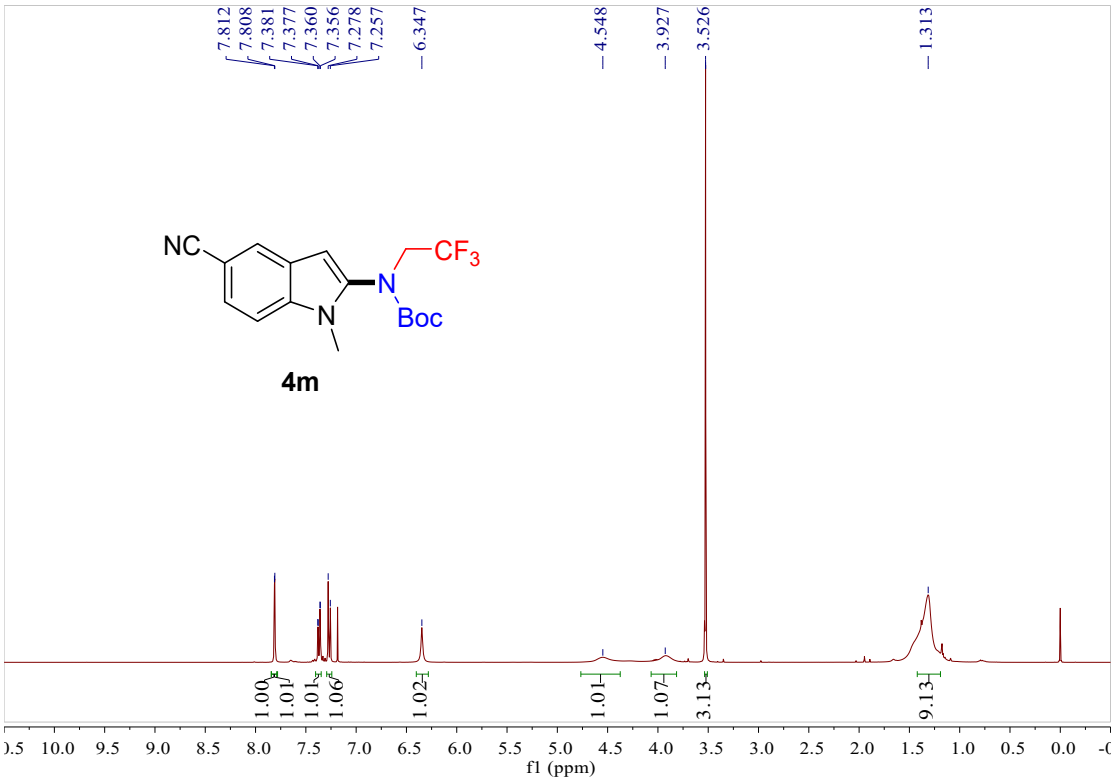


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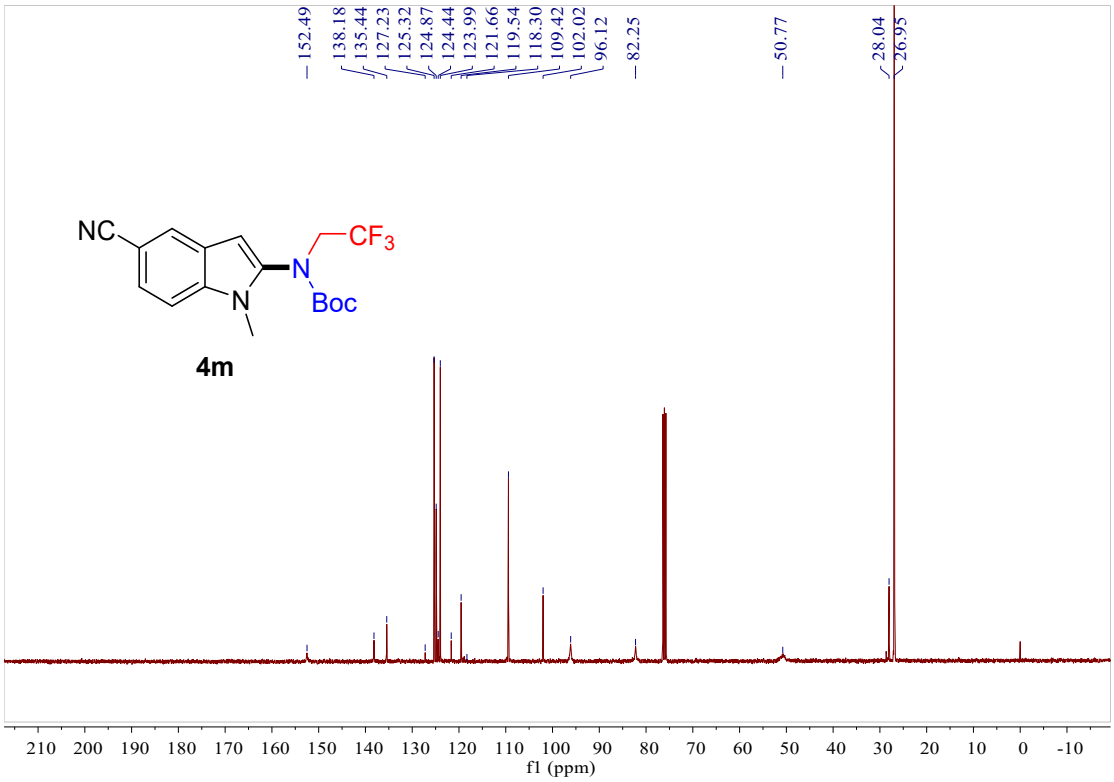
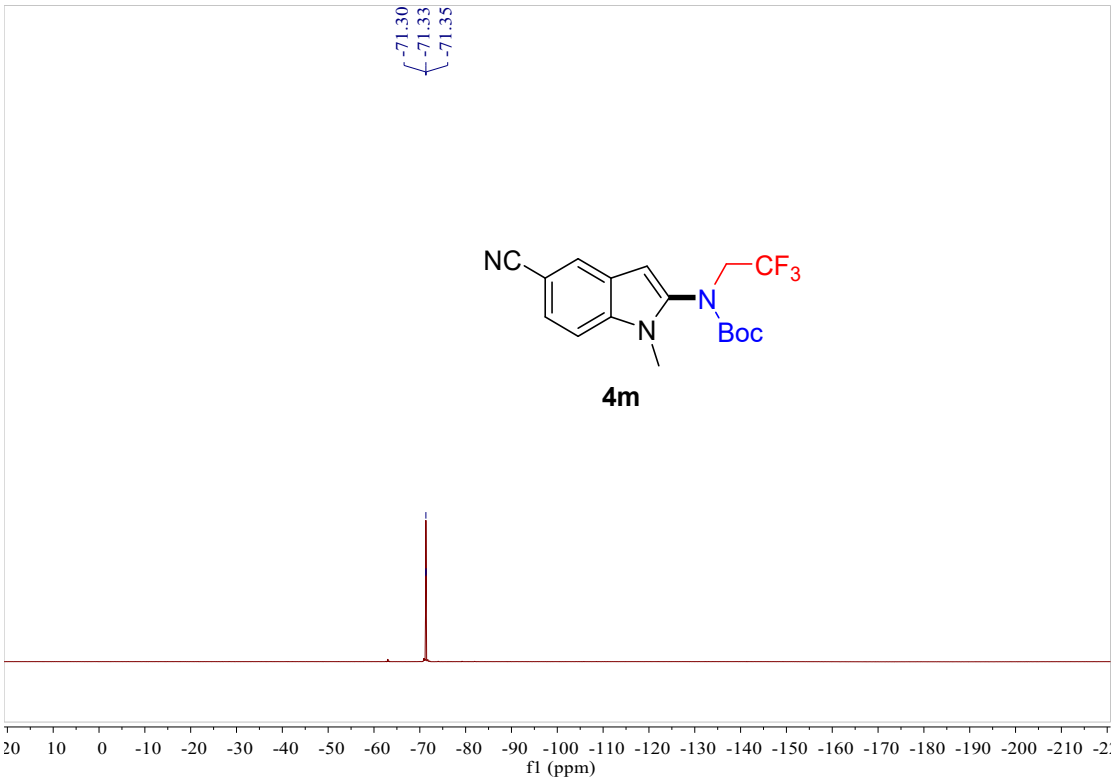



*[19]F NMR (376 MHz, $CDCl_3$)*

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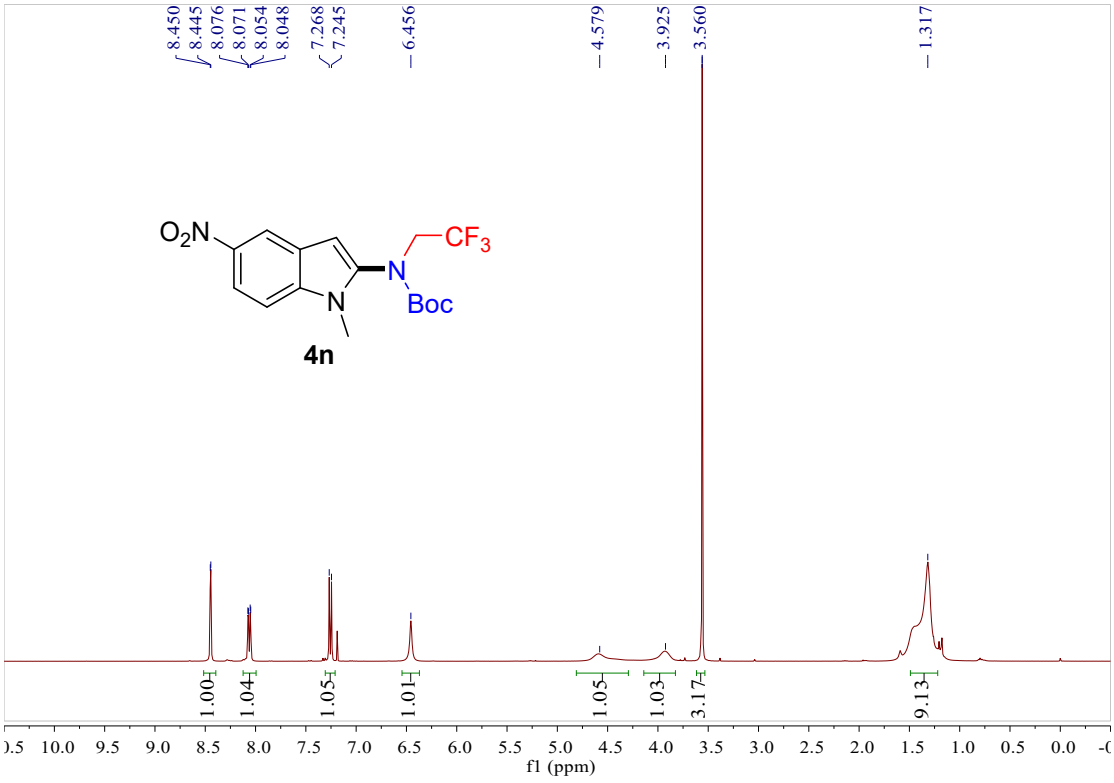


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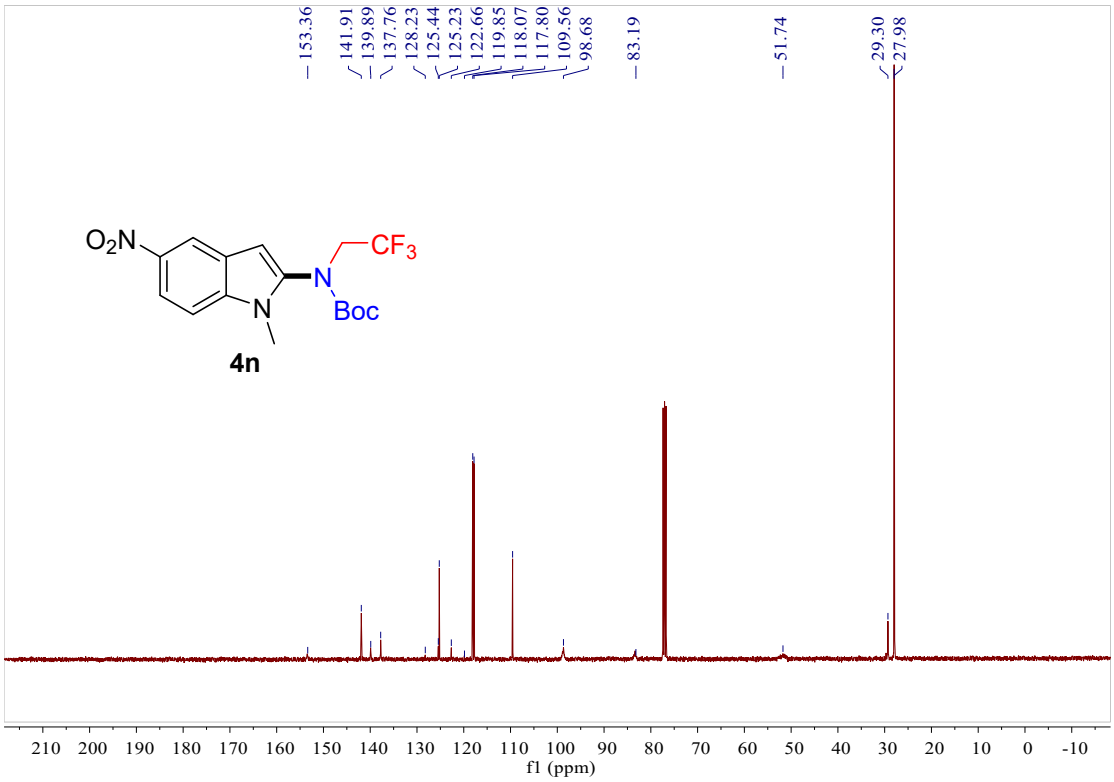


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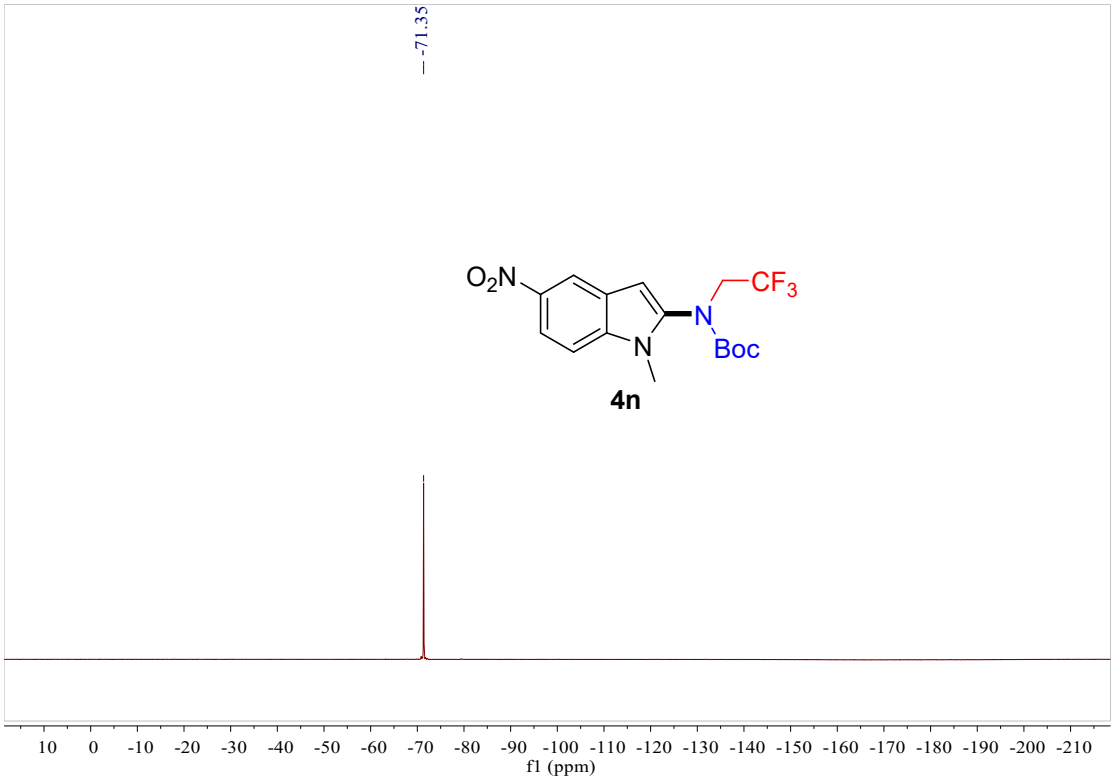


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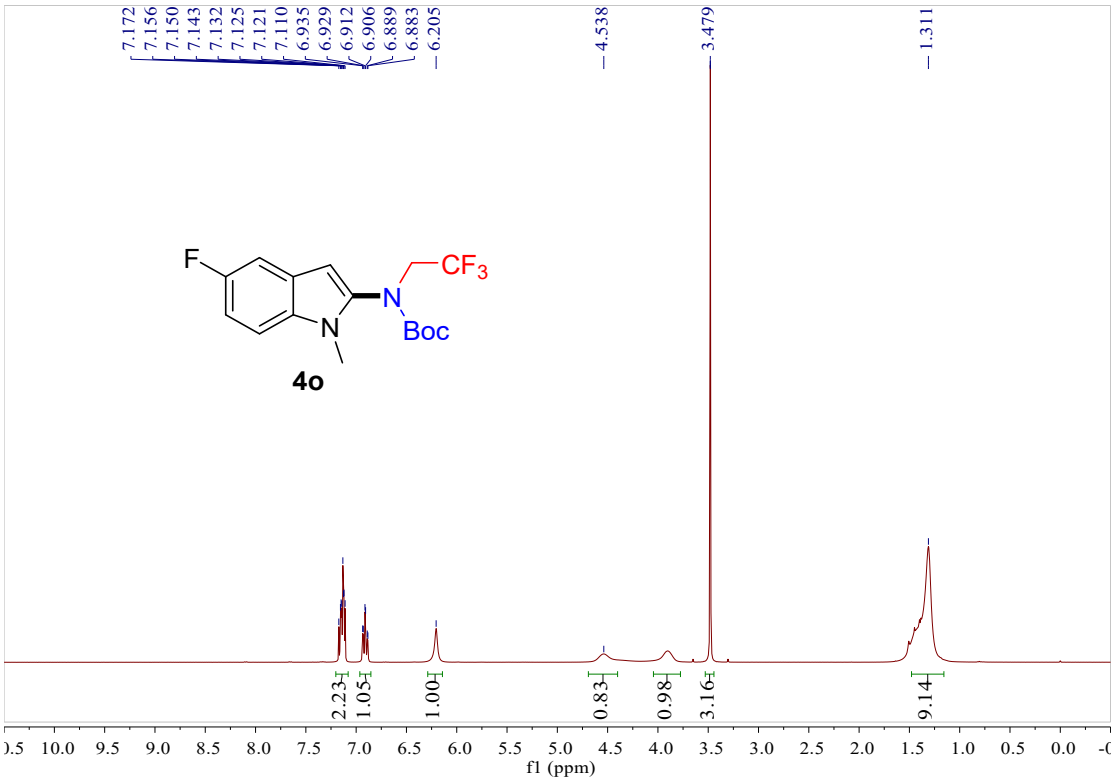


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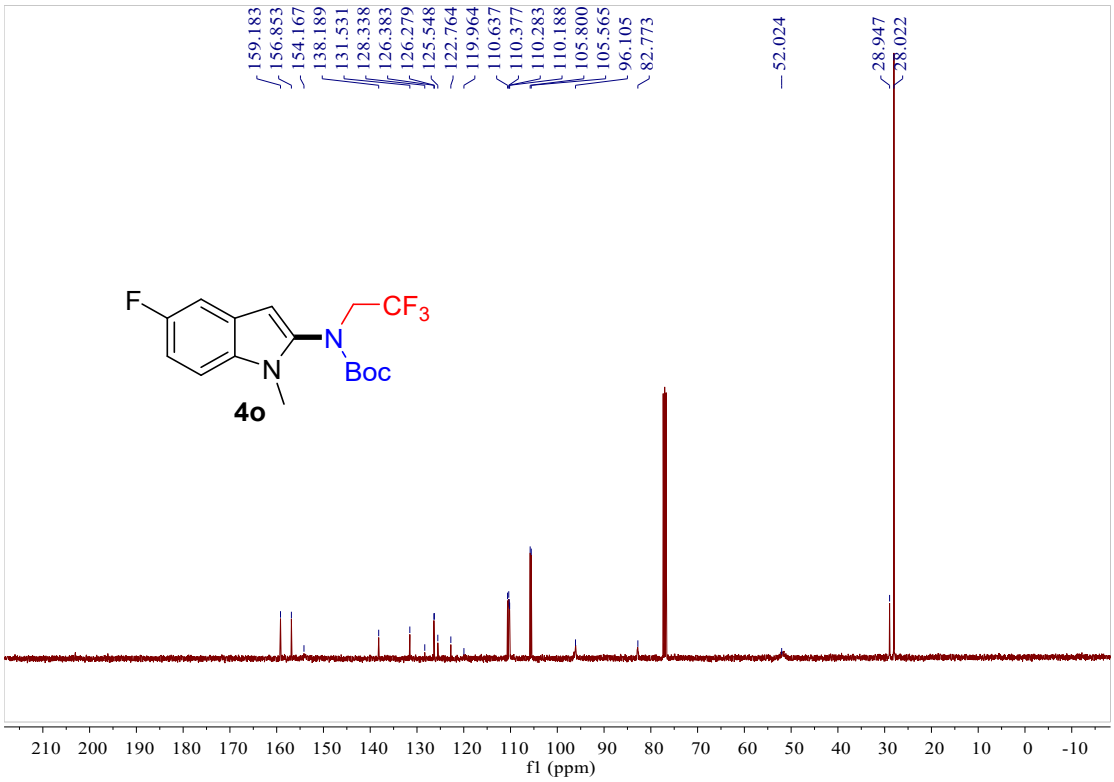


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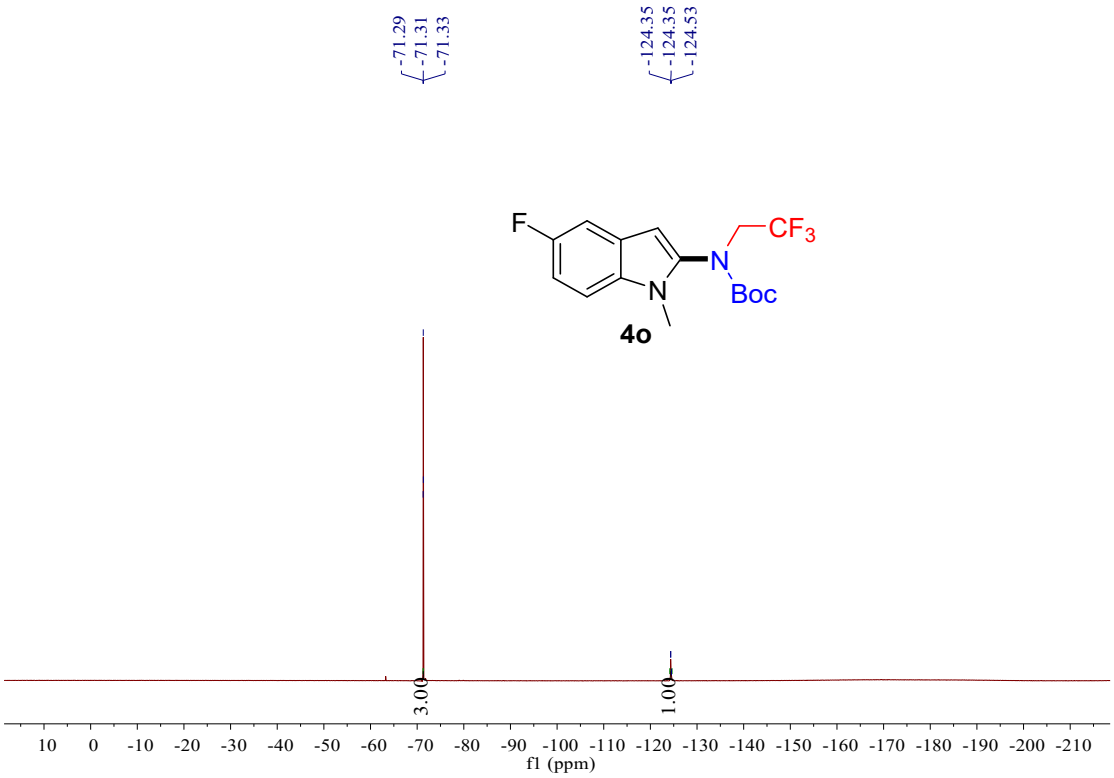


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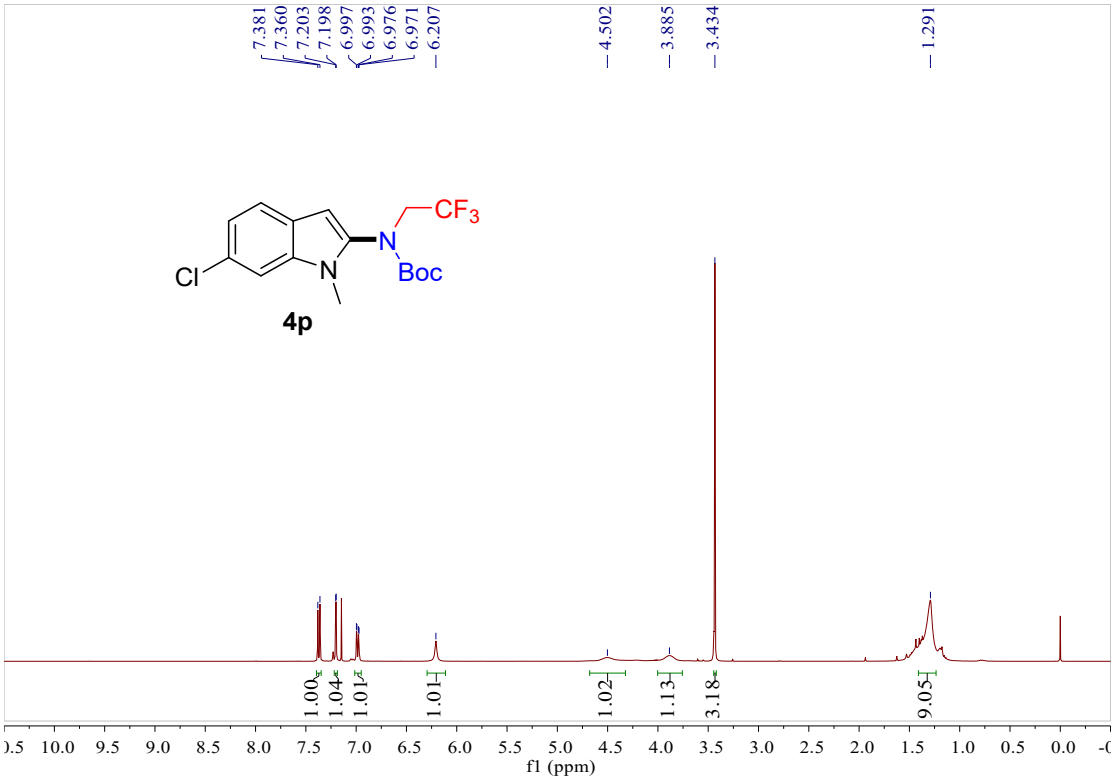


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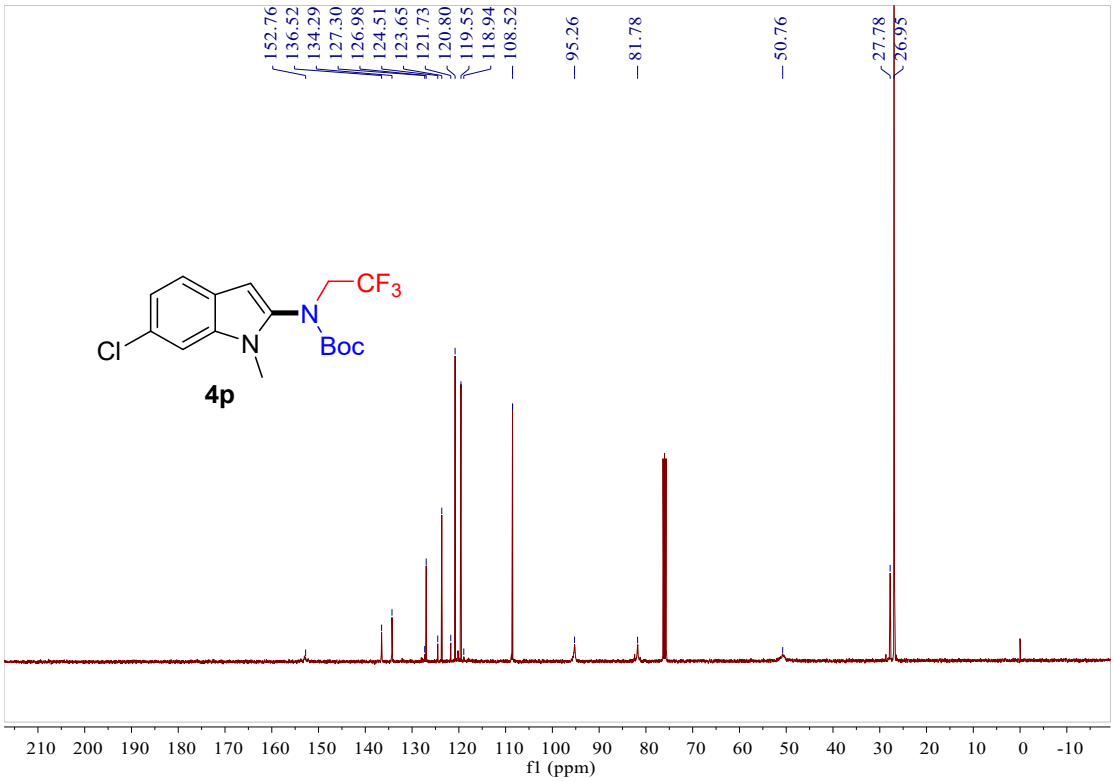
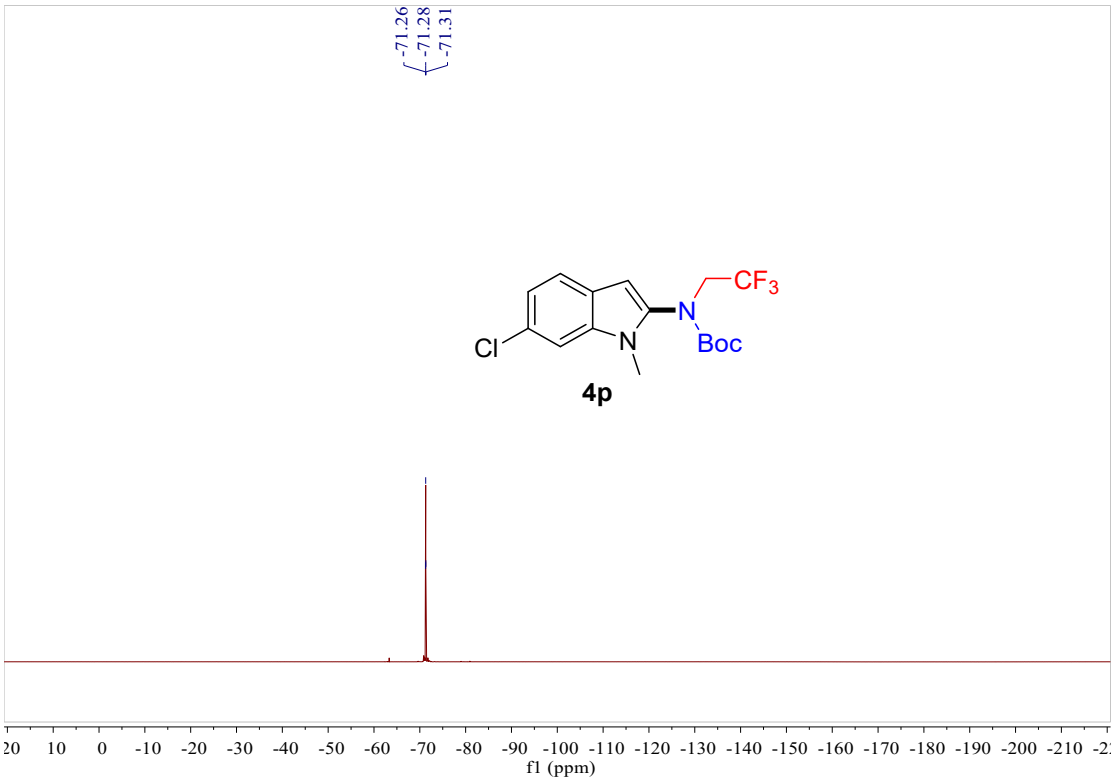



*$^{19}F$ NMR (376 MHz, $CDCl_3$)*

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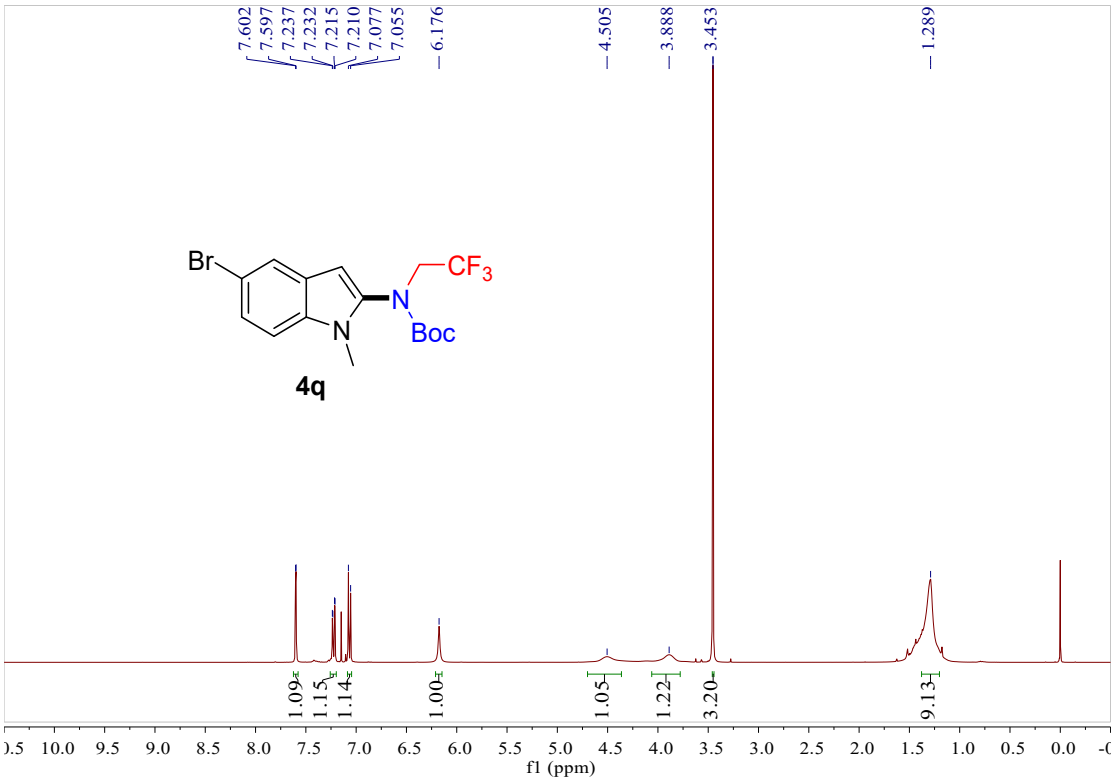


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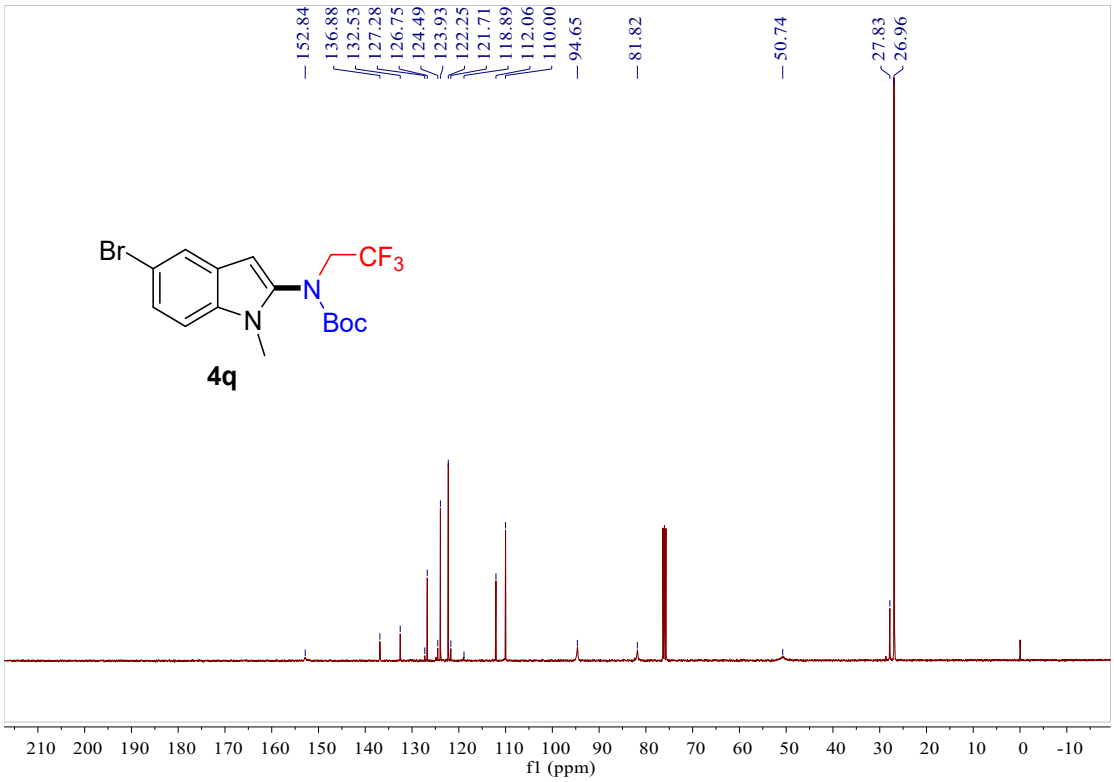


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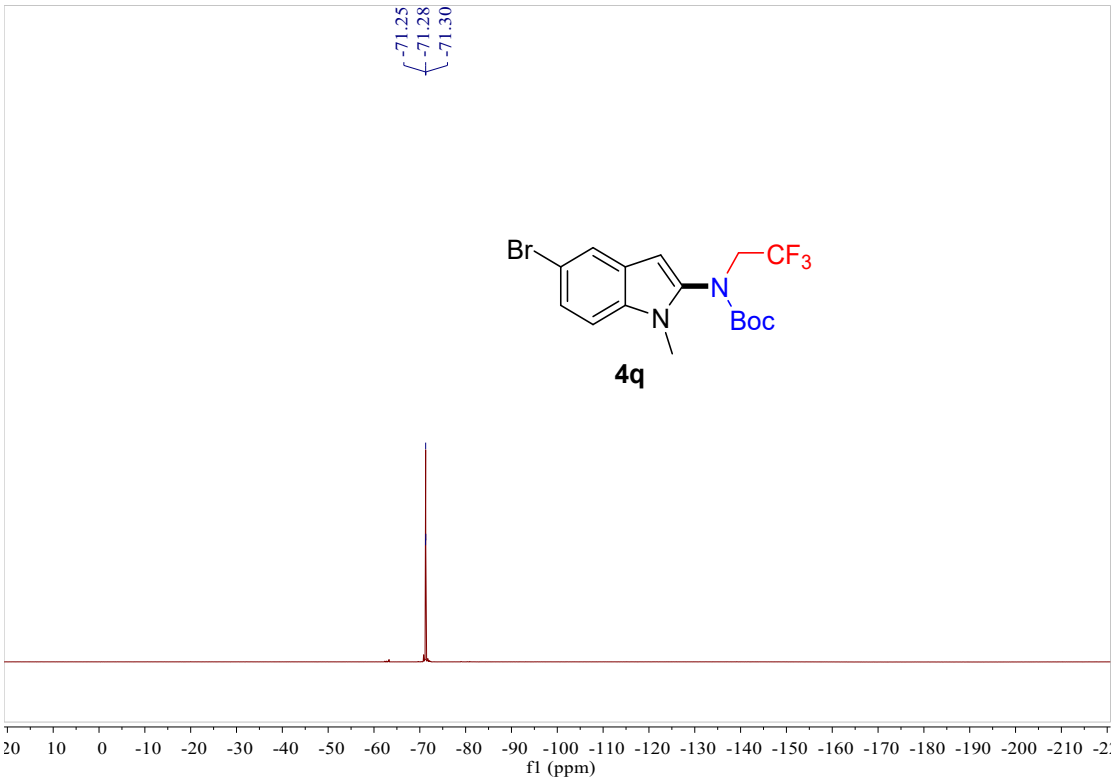


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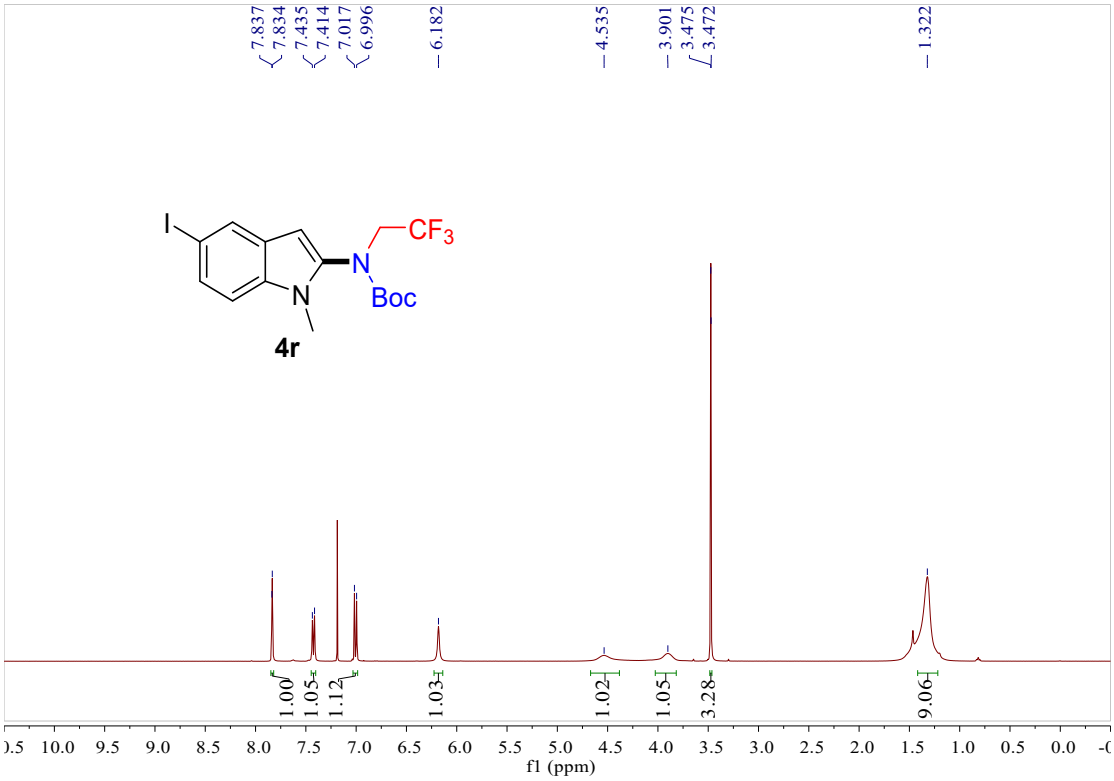


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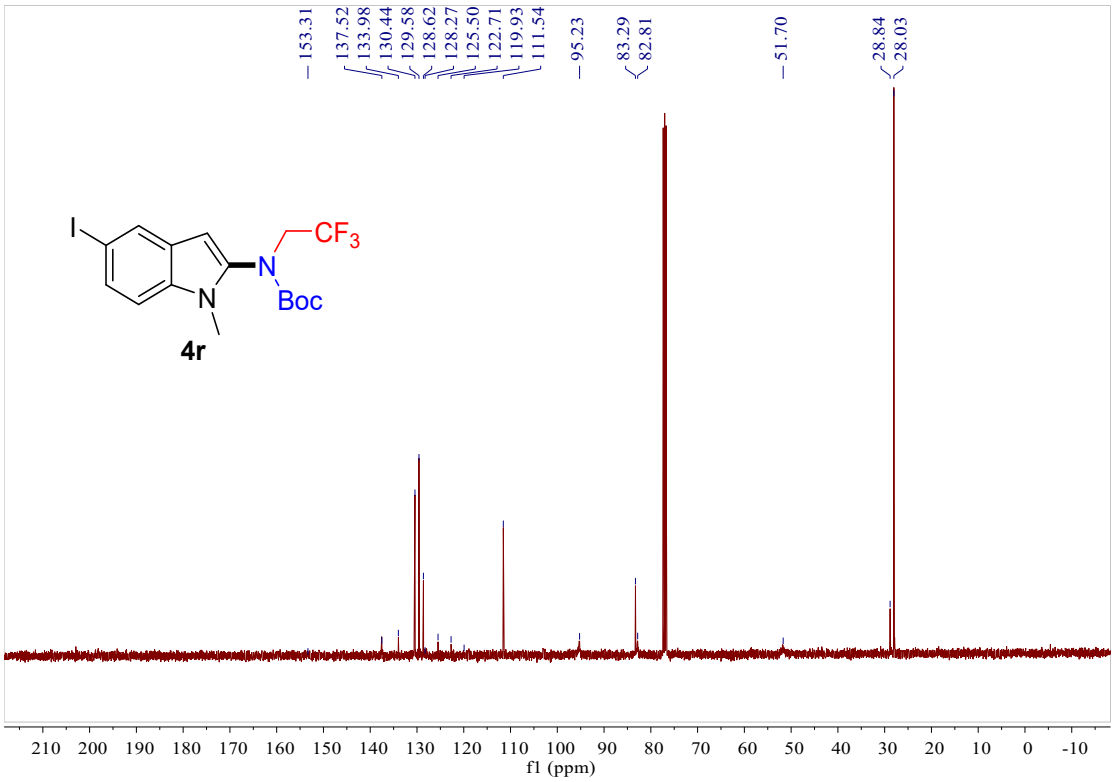
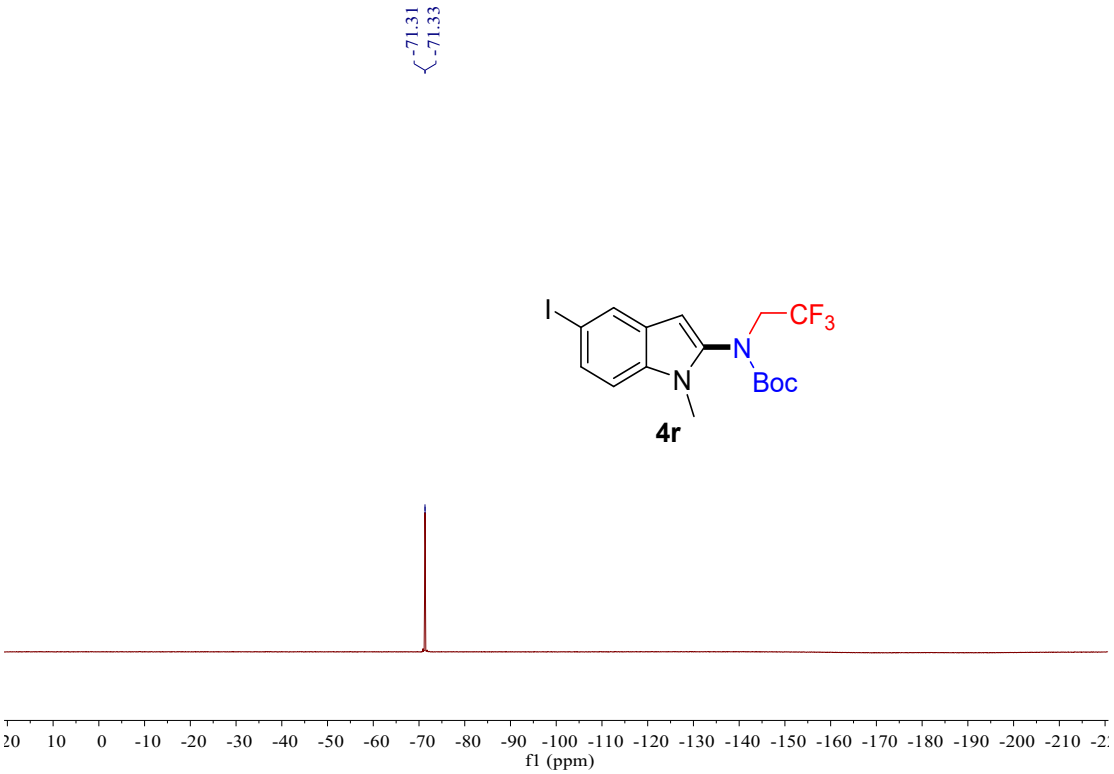
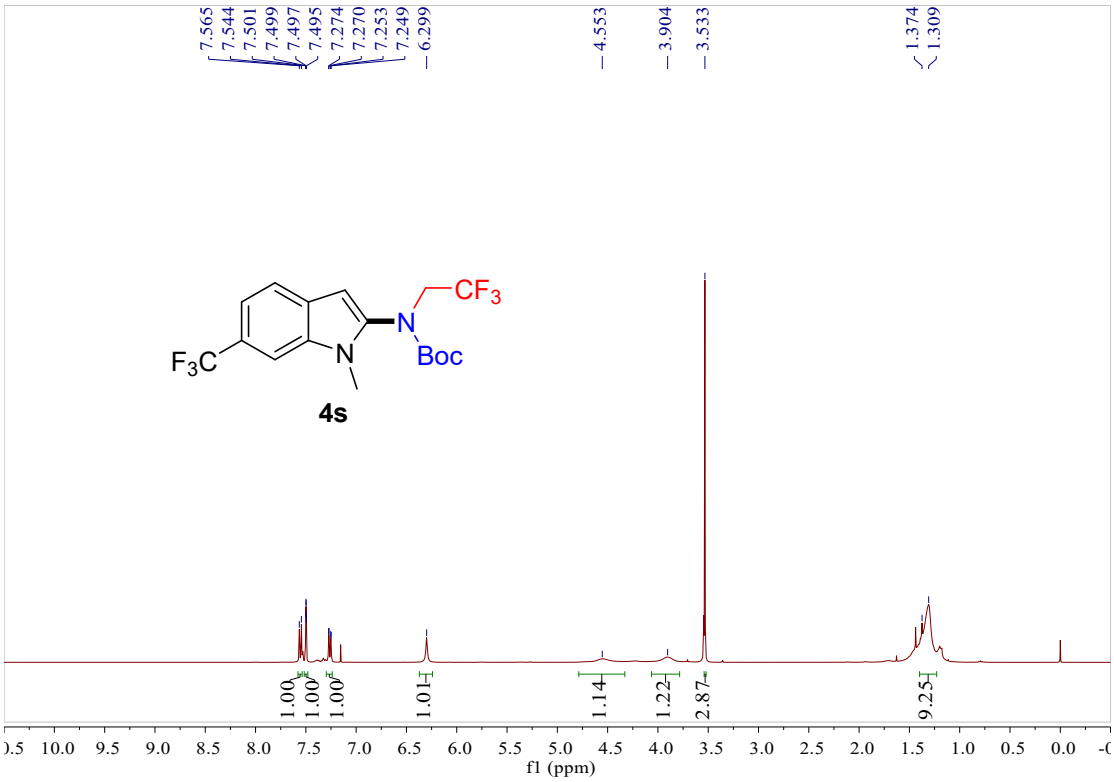


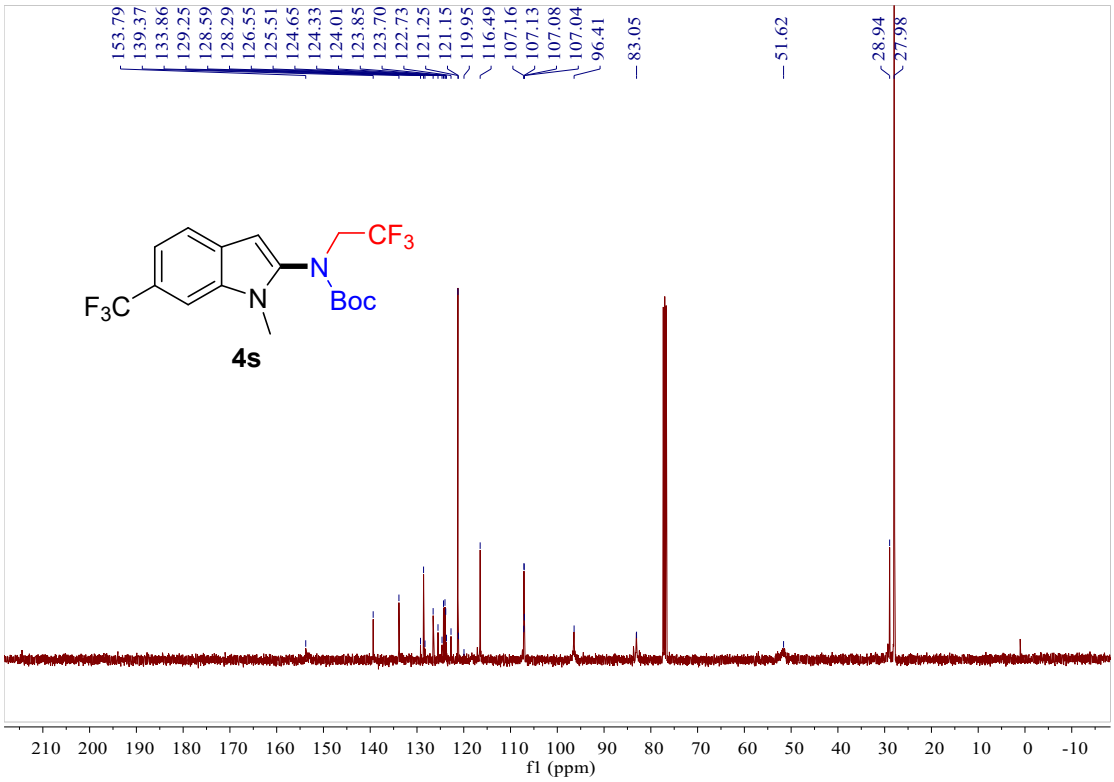

*$^{19}F$ NMR (376 MHz, $CDCl_3$)*



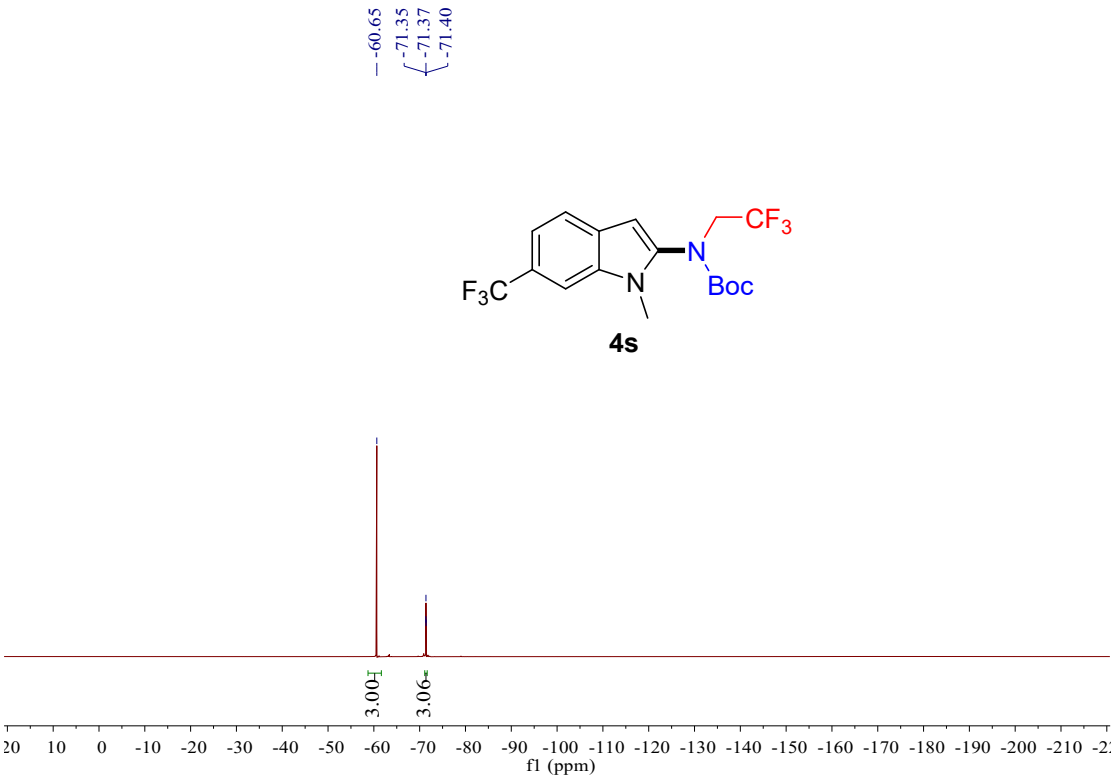

*$^{1}H$ NMR (400 MHz, $CDCl_3$)*




*$^{13}$C NMR (101 MHz, $CDCl_3$)*




*$^{19}$F NMR (376 MHz, $CDCl_3$)*

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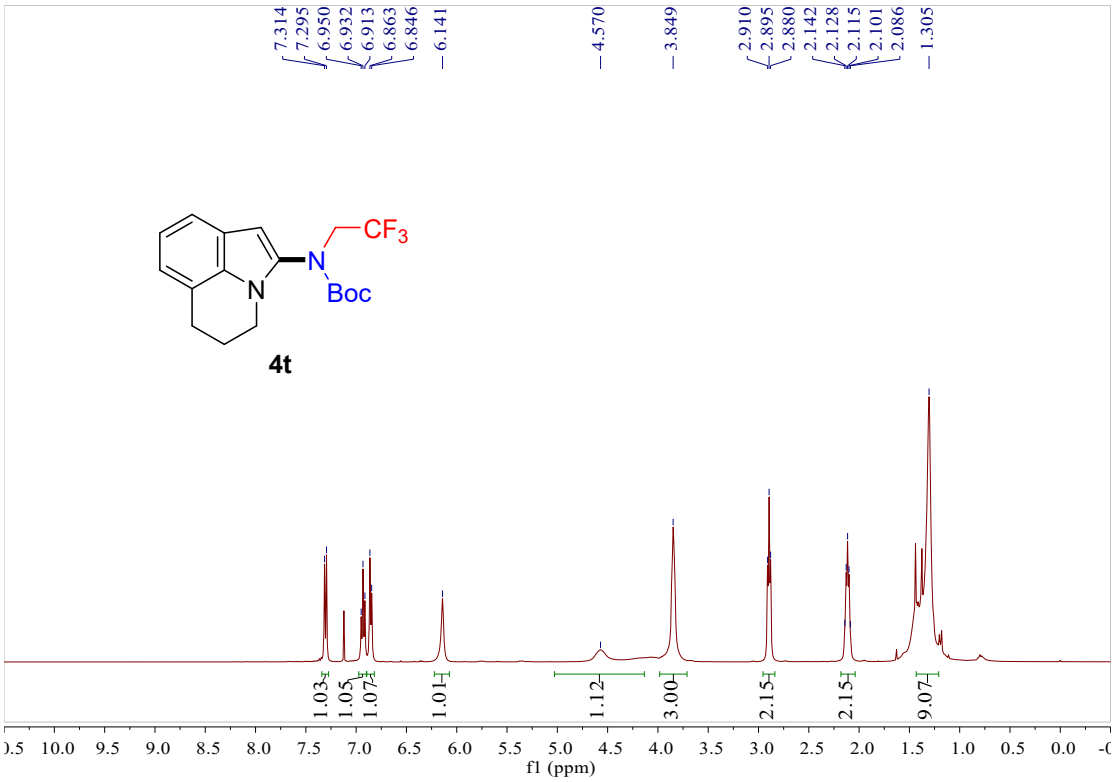


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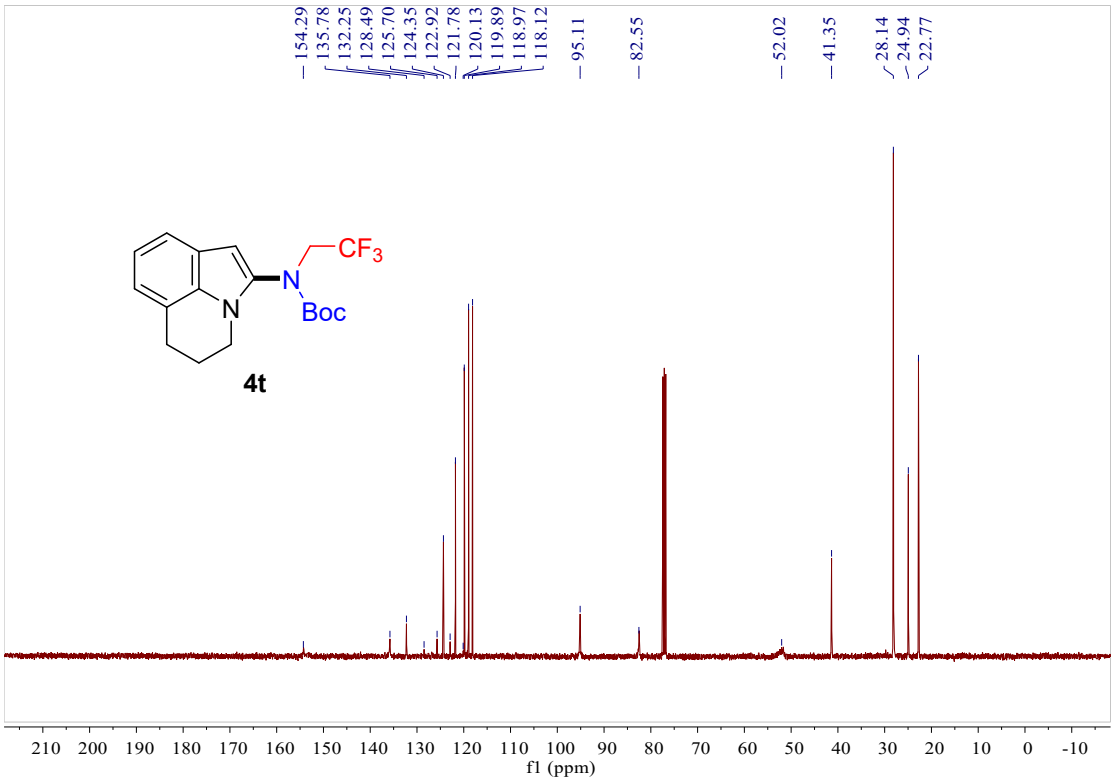
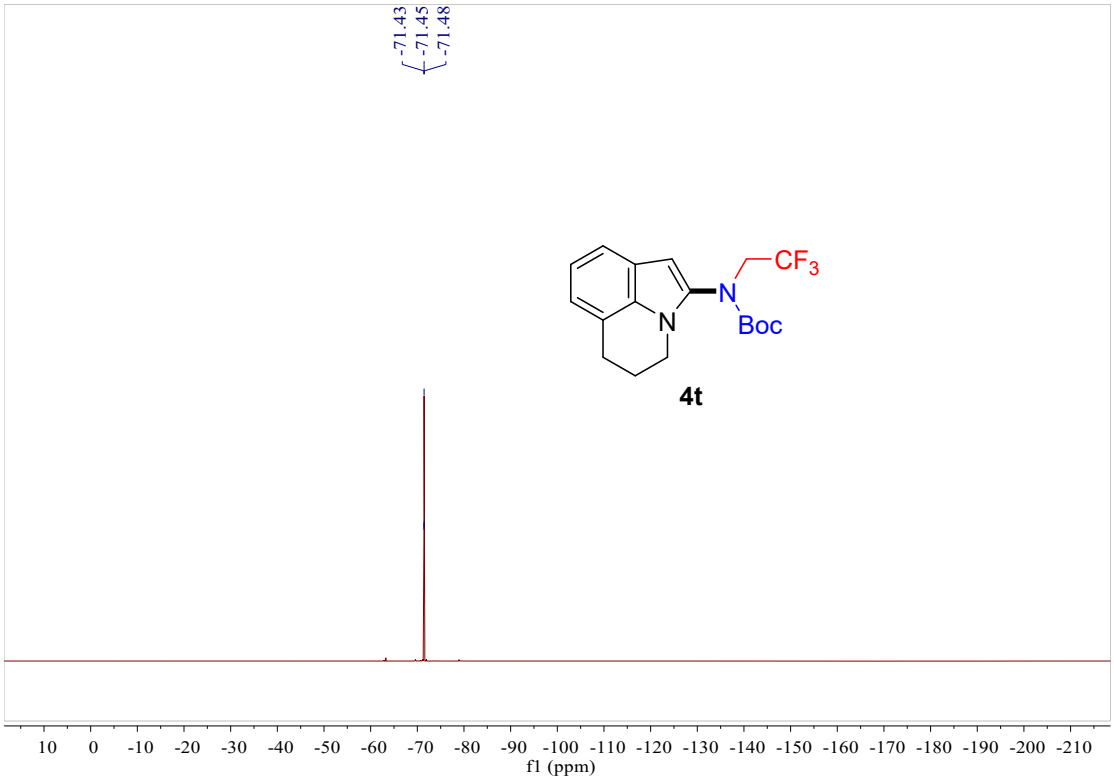



*[19]F NMR (377 MHz, $CDCl_3$)*

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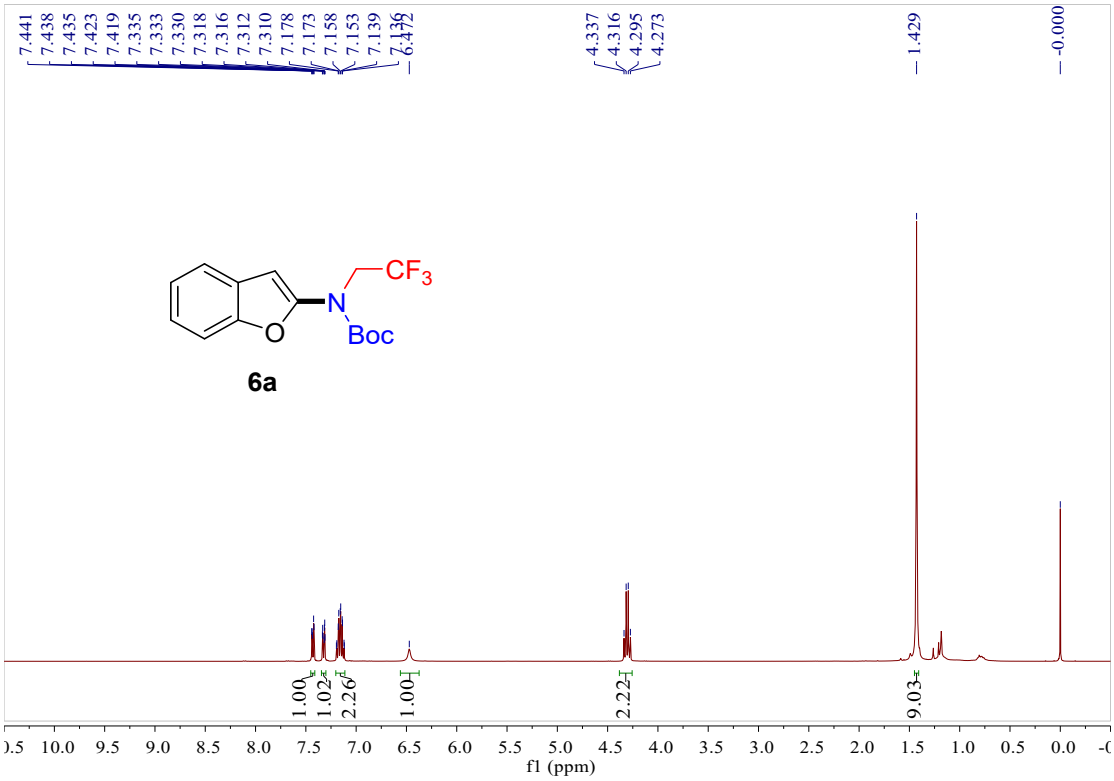
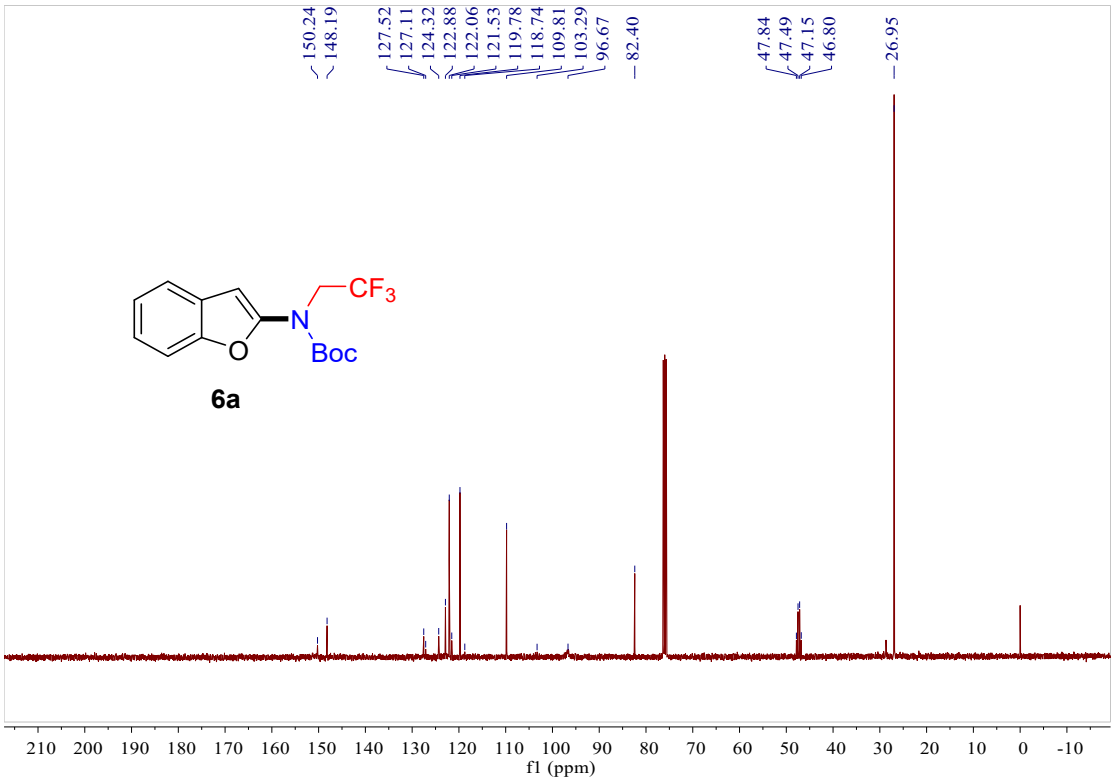
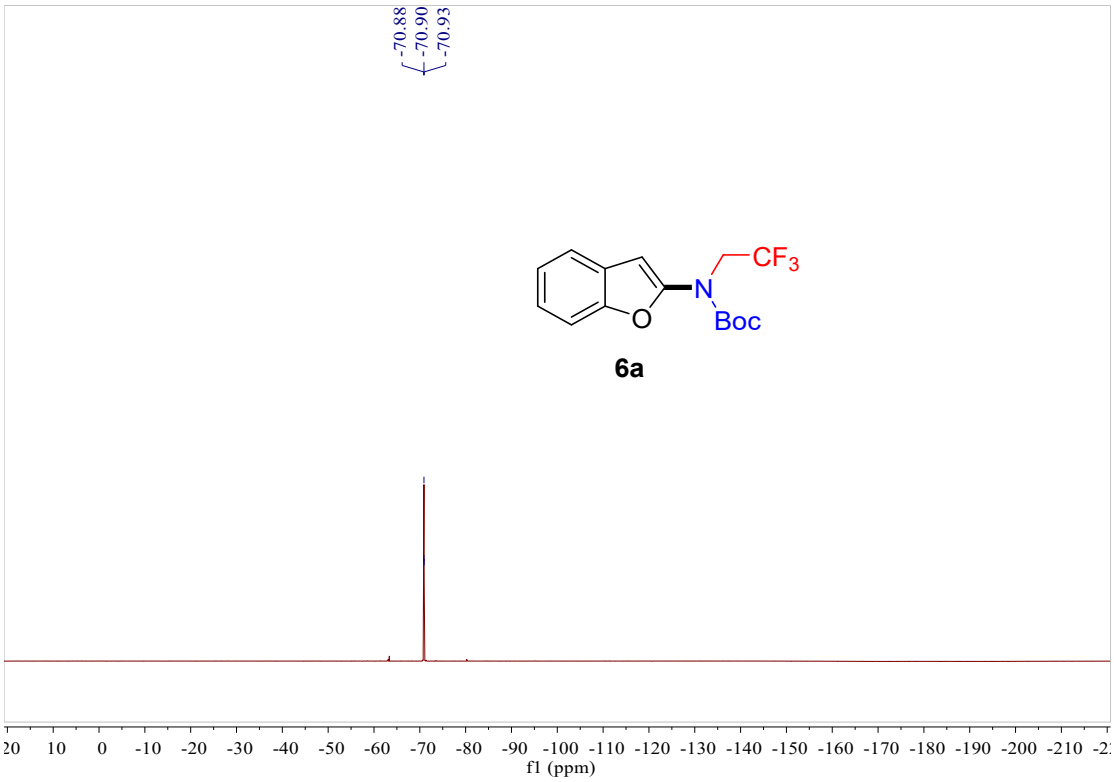


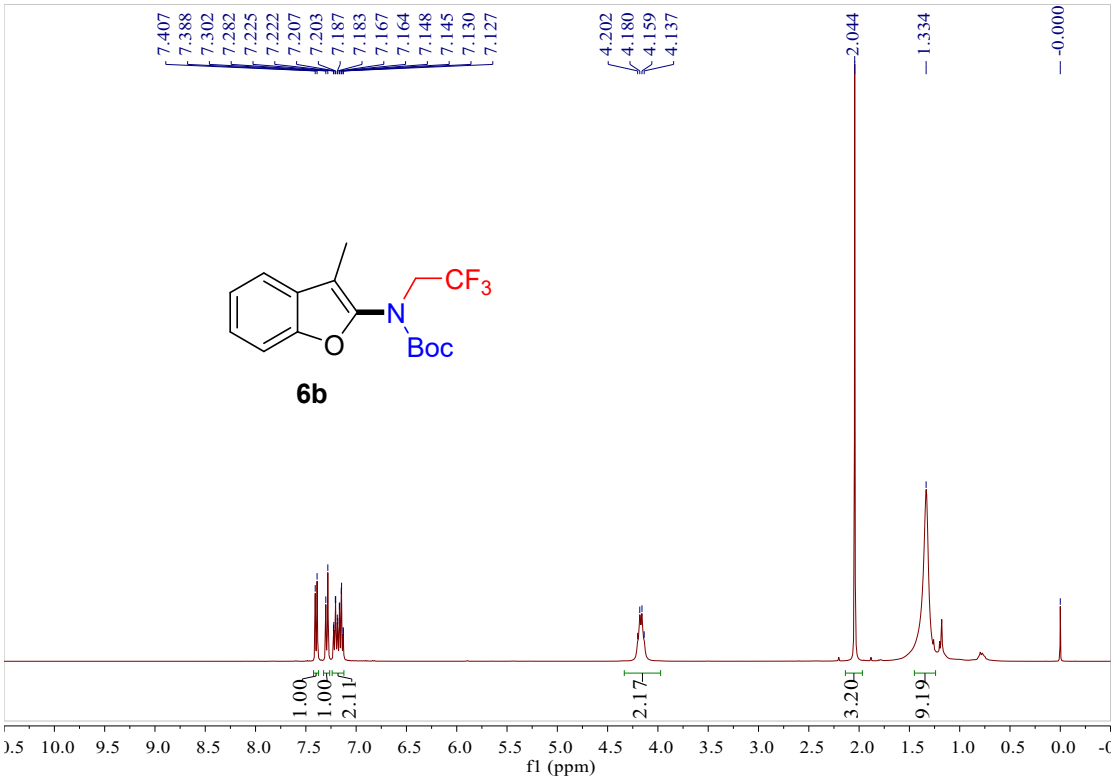

*$^{13}$C NMR (101 MHz, $CDCl_3$)*



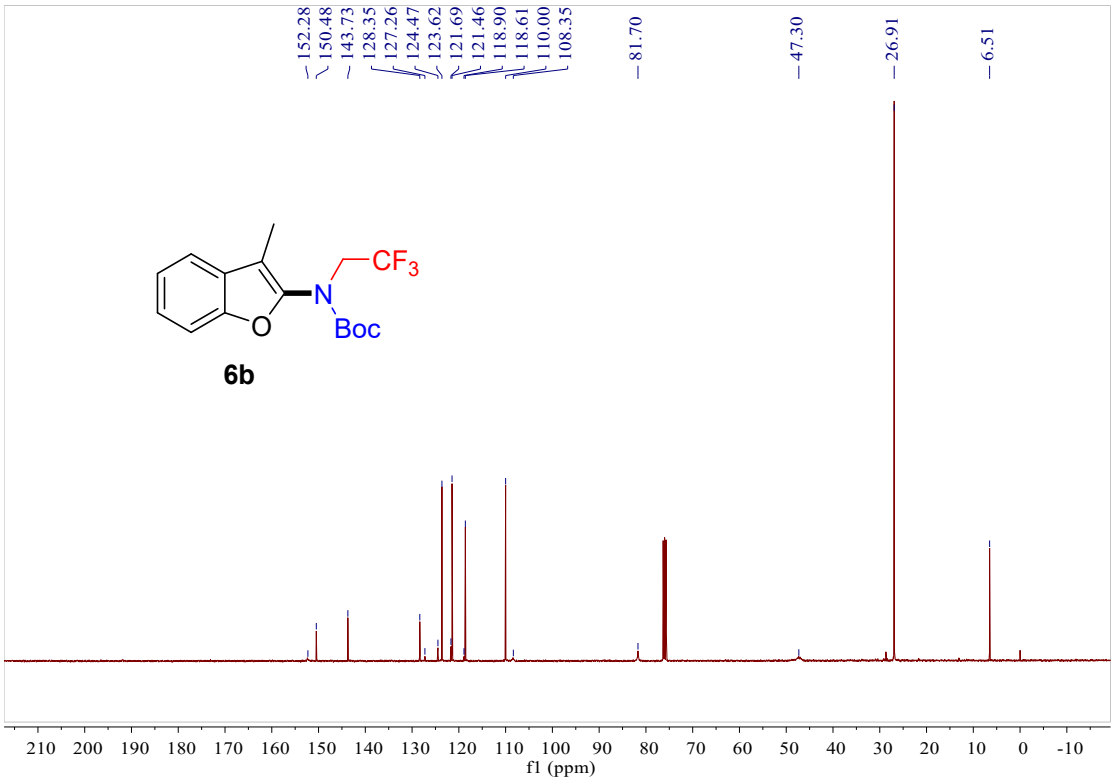

*$^{19}$F NMR (376 MHz, $CDCl_3$)*



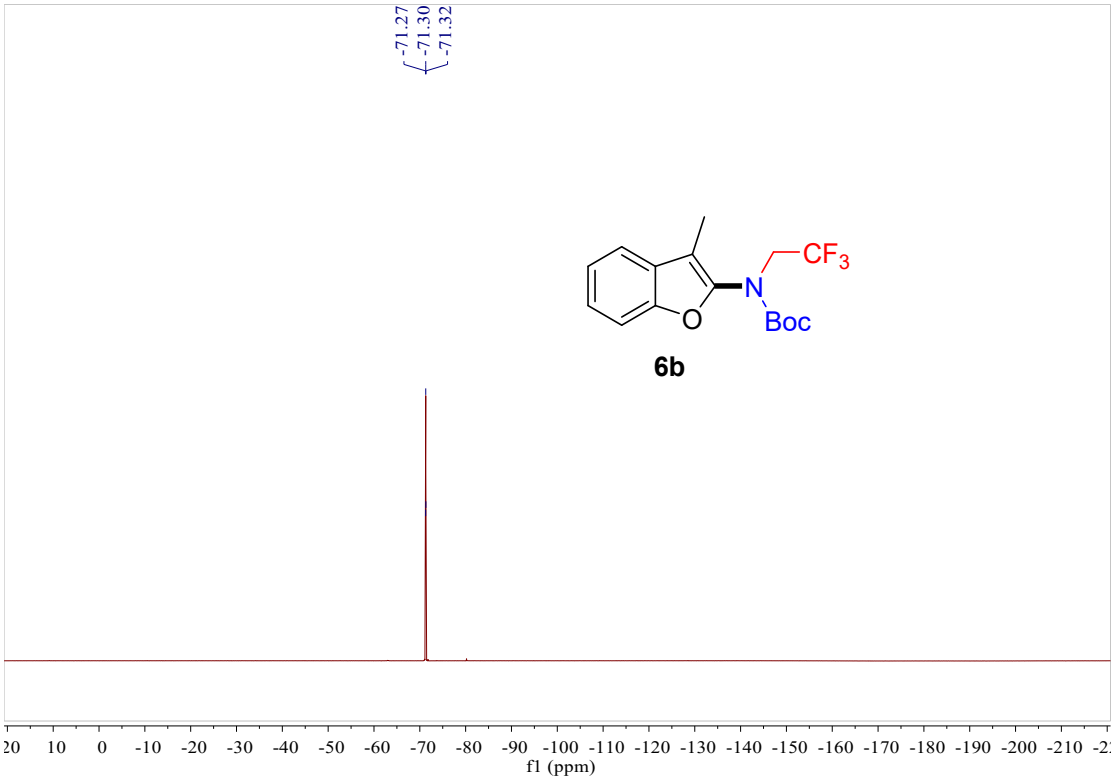

*$^{1}$H NMR (400 MHz, $CDCl_3$)*



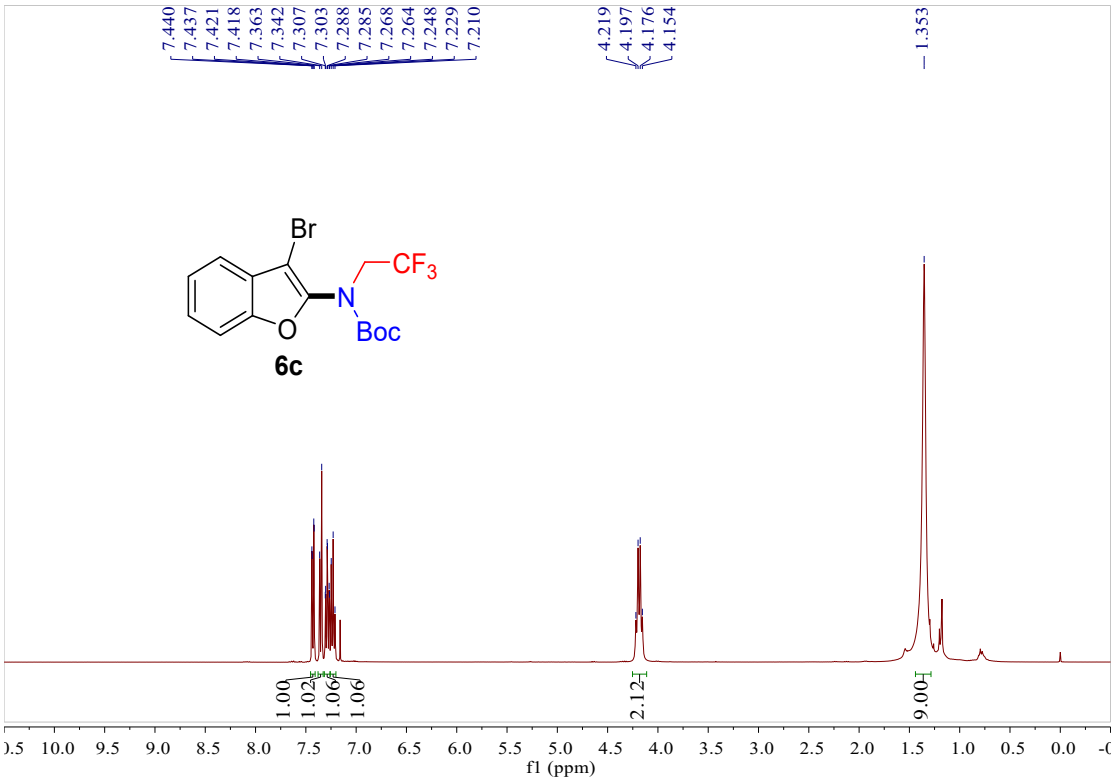

*$^{13}$C NMR (101 MHz, $CDCl_3$)*



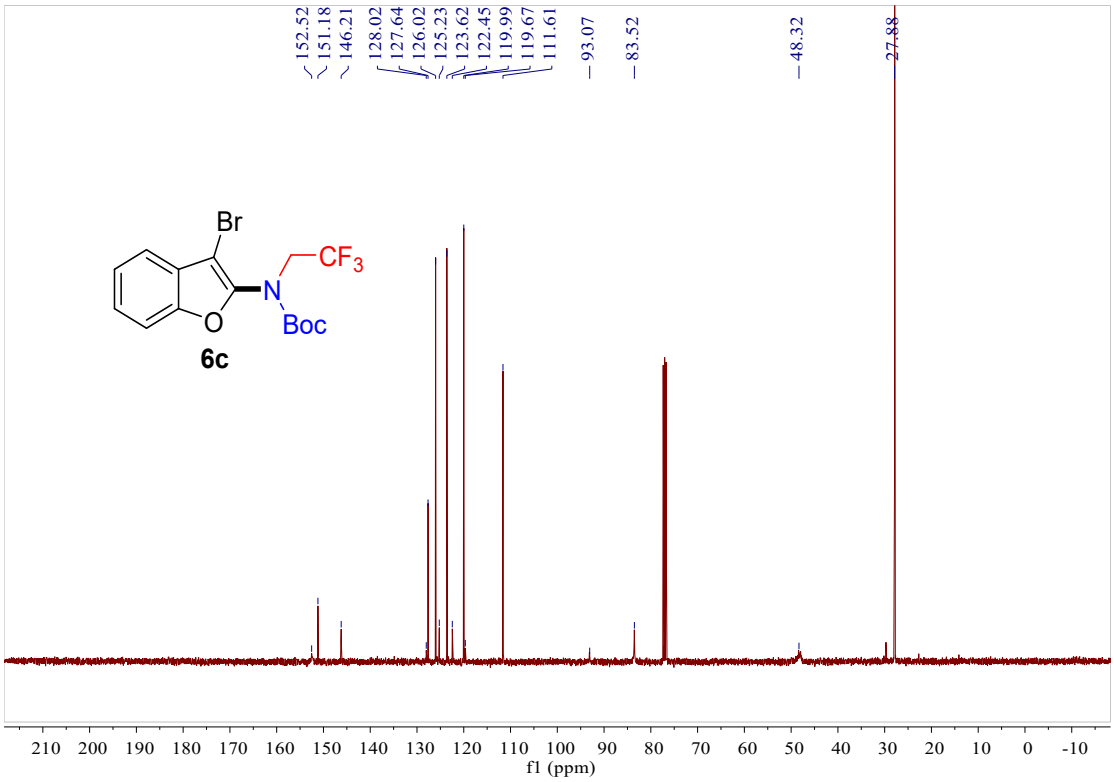

*$^{19}F$ NMR (376 MHz, $CDCl_3$)*



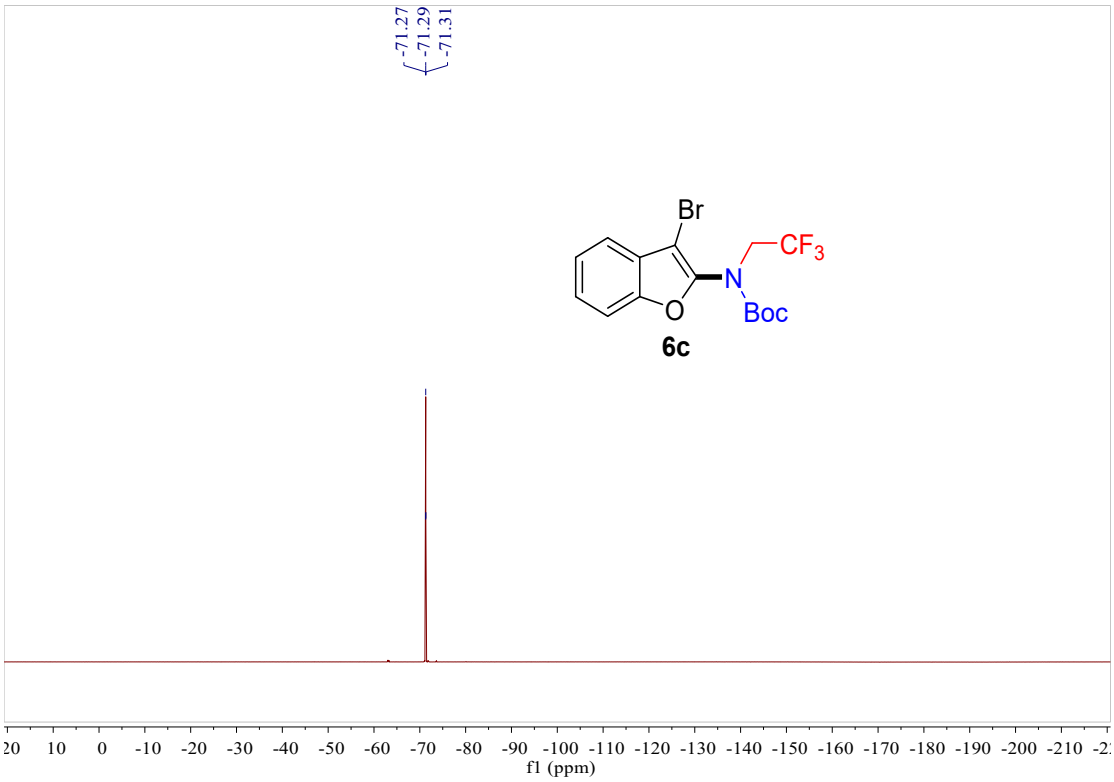

*$^{1}H$ NMR (400 MHz, $CDCl_3$)*




*$^{13}$C NMR (101 MHz, $CDCl_3$)*




*$^{19}$F NMR (376 MHz, $CDCl_3$)*

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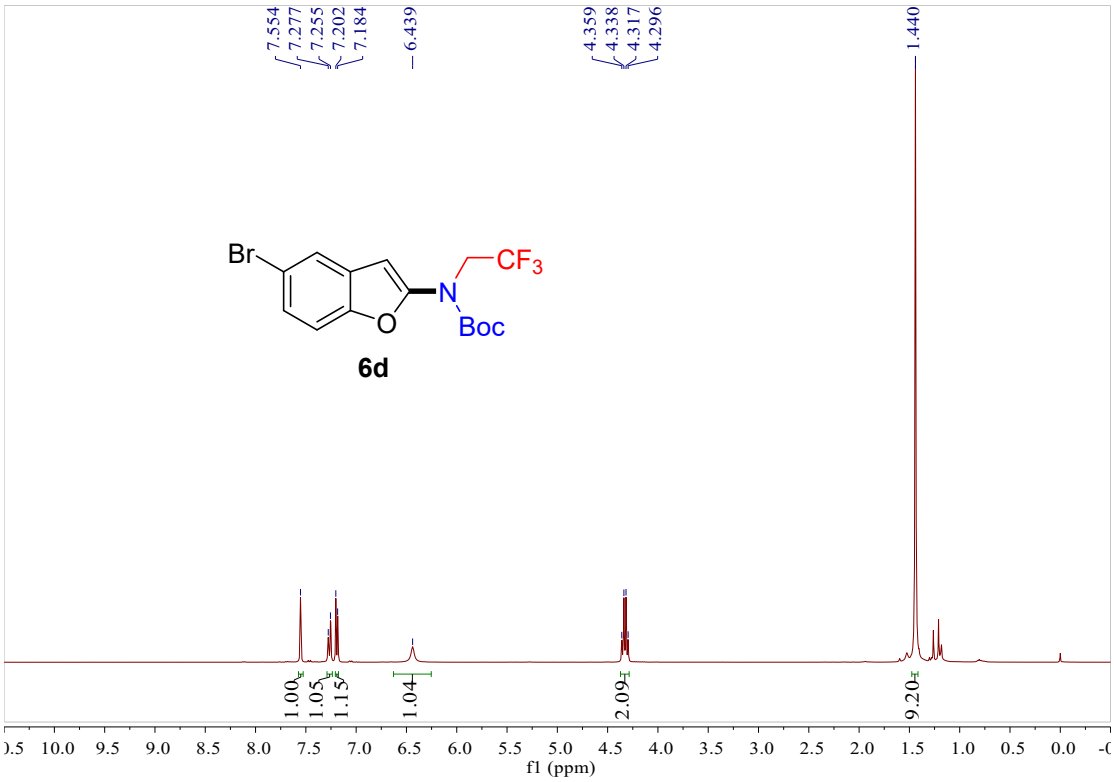


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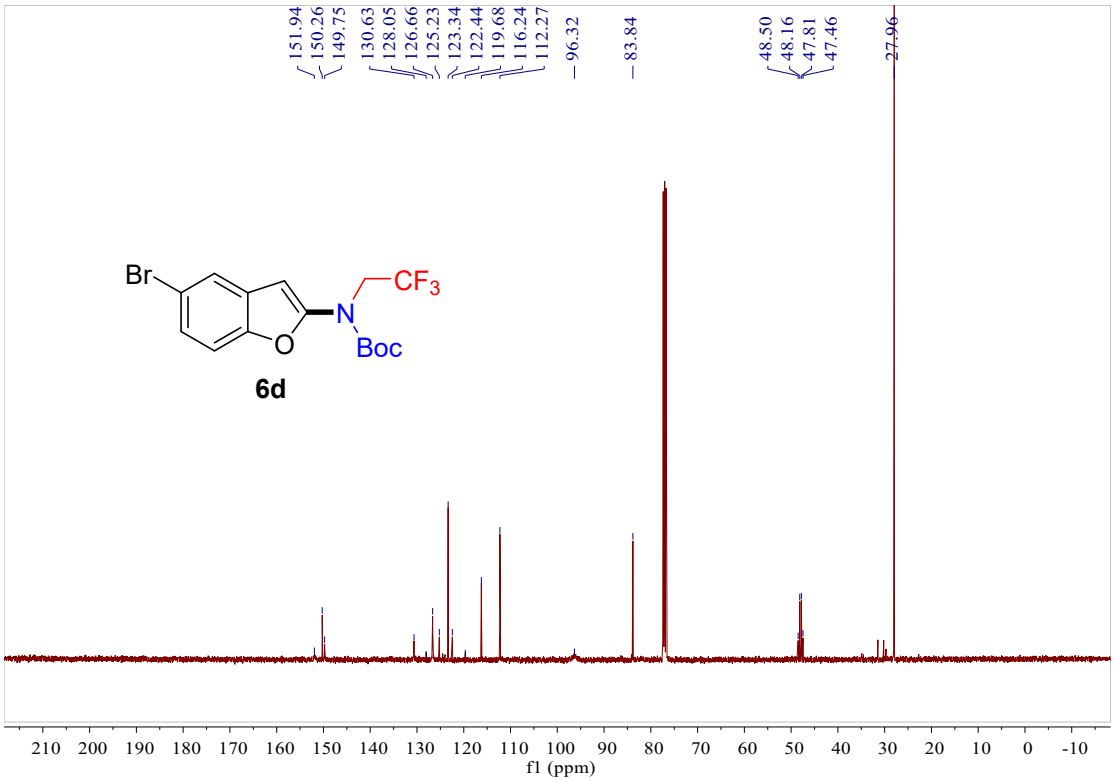
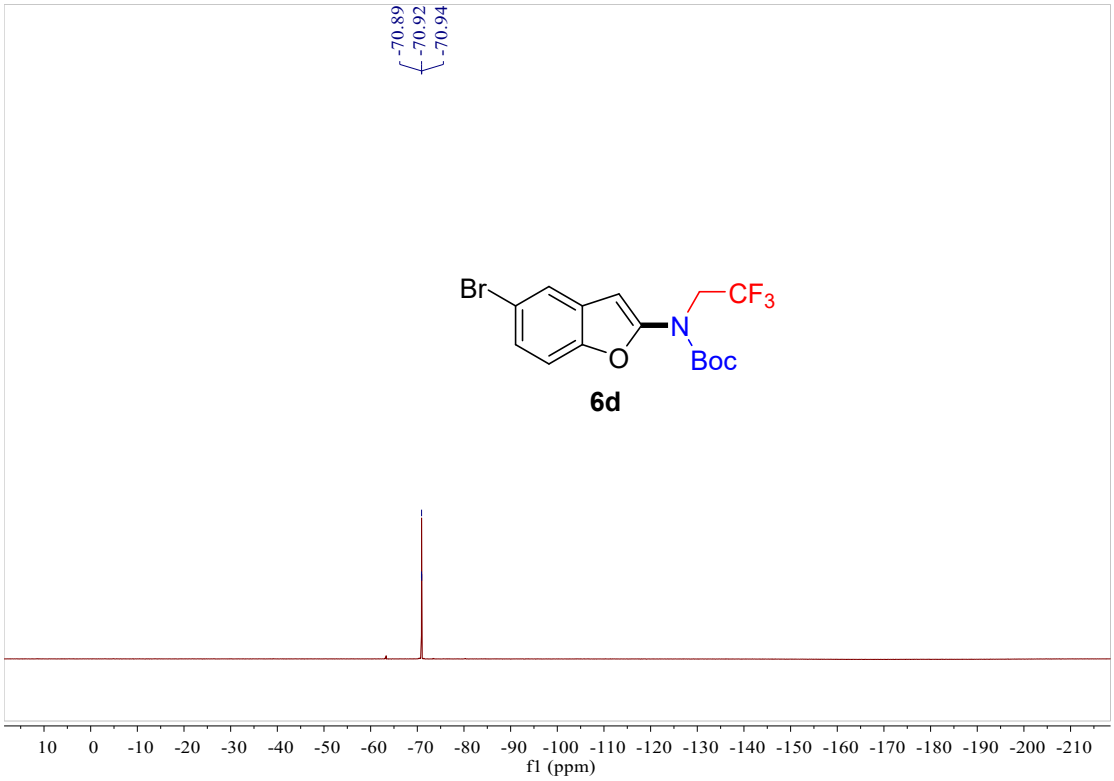



*$^{19}F$ NMR (377 MHz, $CDCl_3$)*

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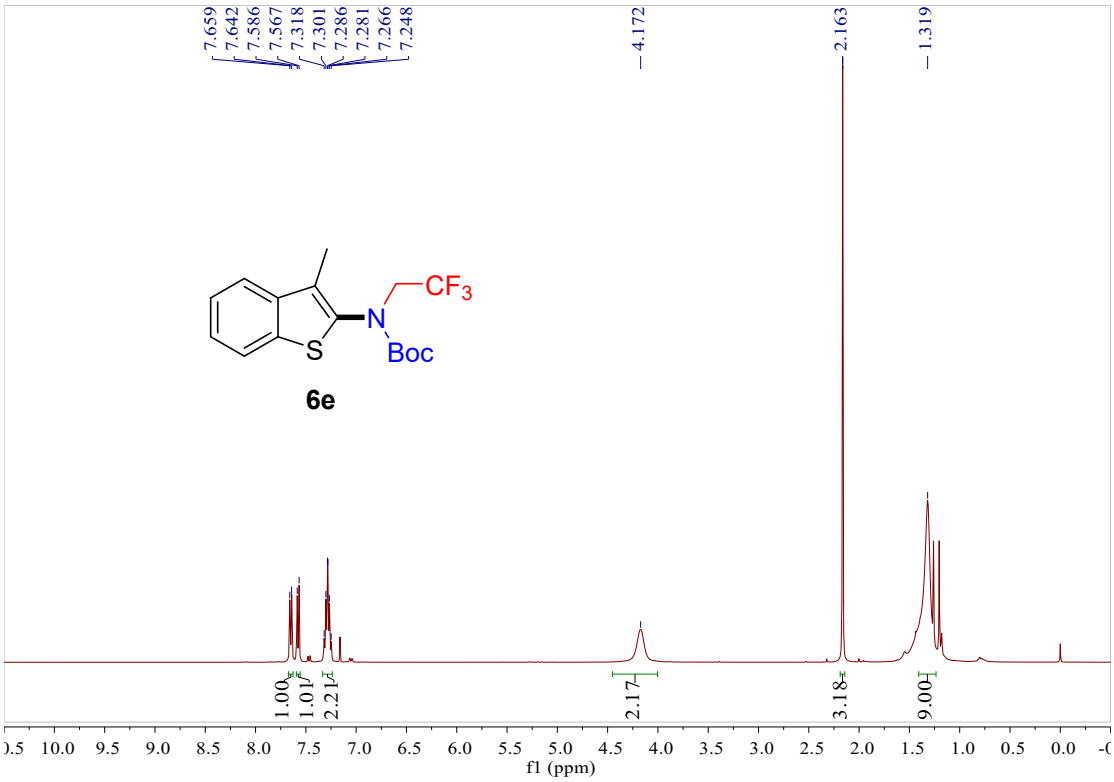
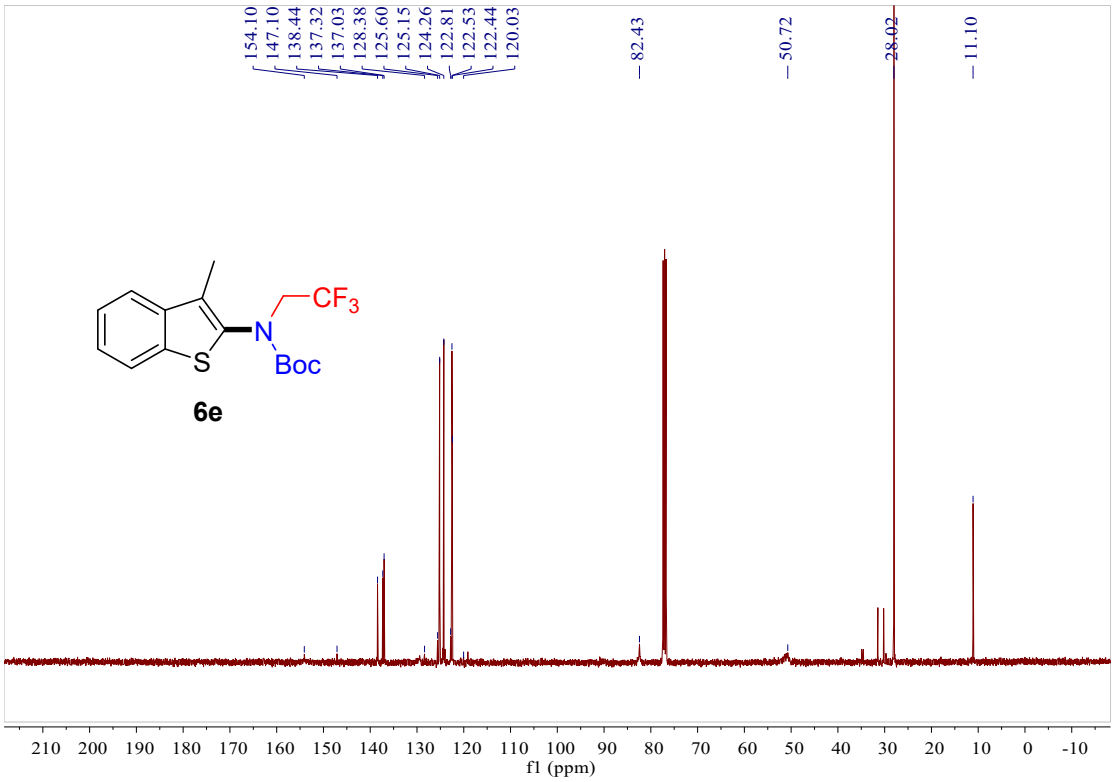
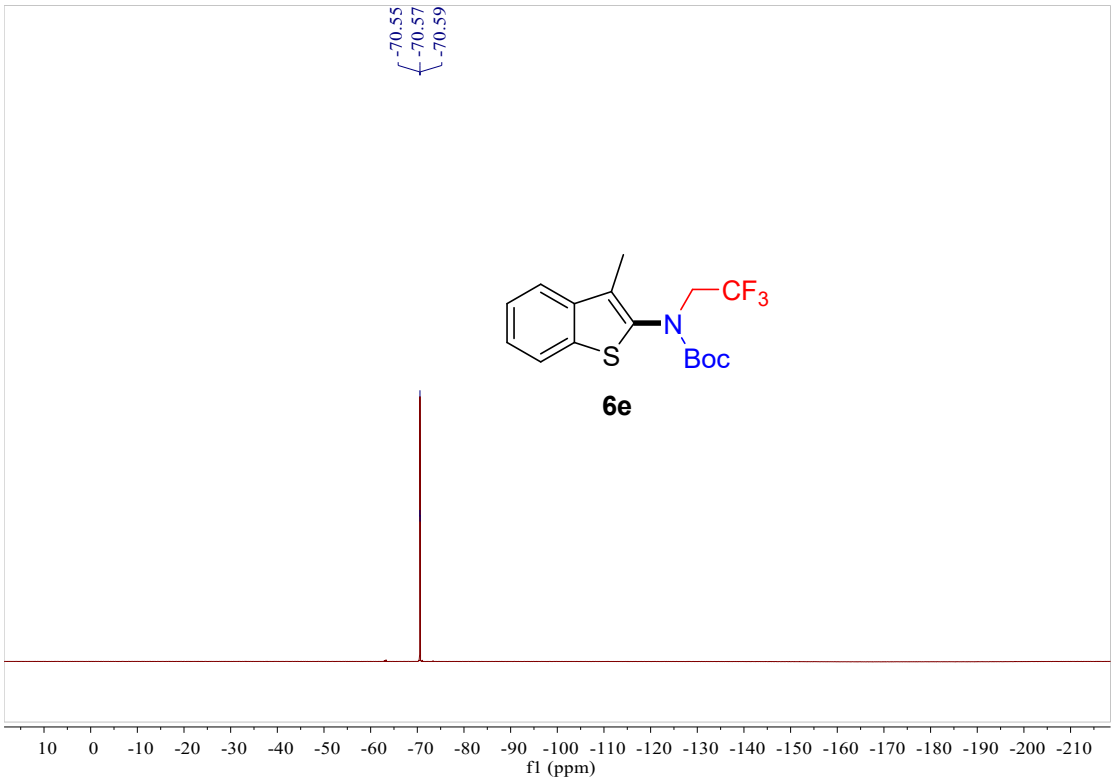


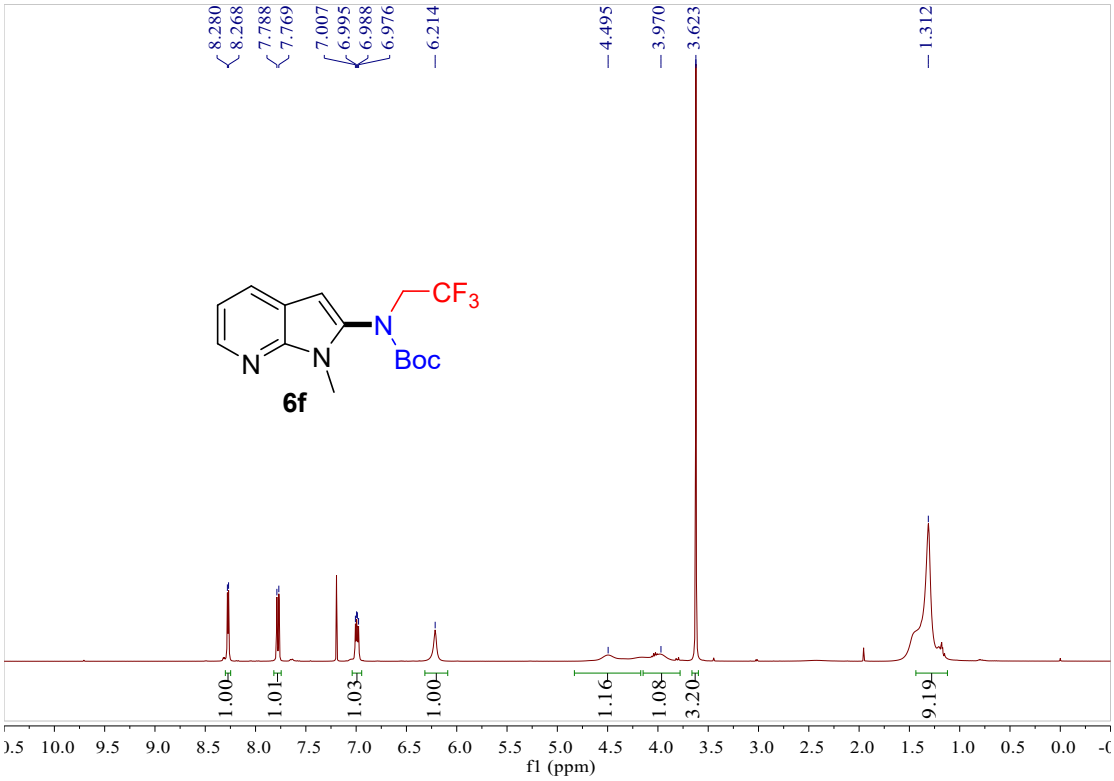

*$^{13}$C NMR (101 MHz, $CDCl_3$)*



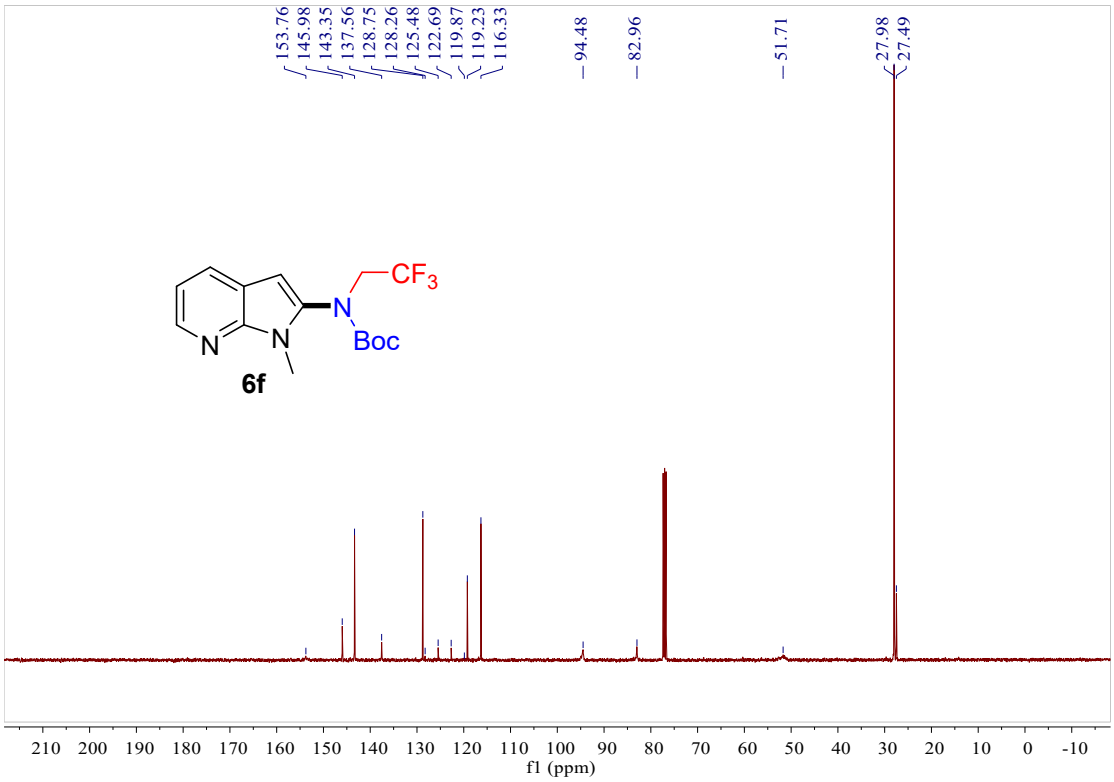

*$^{19}$F NMR (377 MHz, $CDCl_3$)*




*[1]H NMR (400 MHz, CDCl3)*




*[13]C NMR (101 MHz, CDCl3)*

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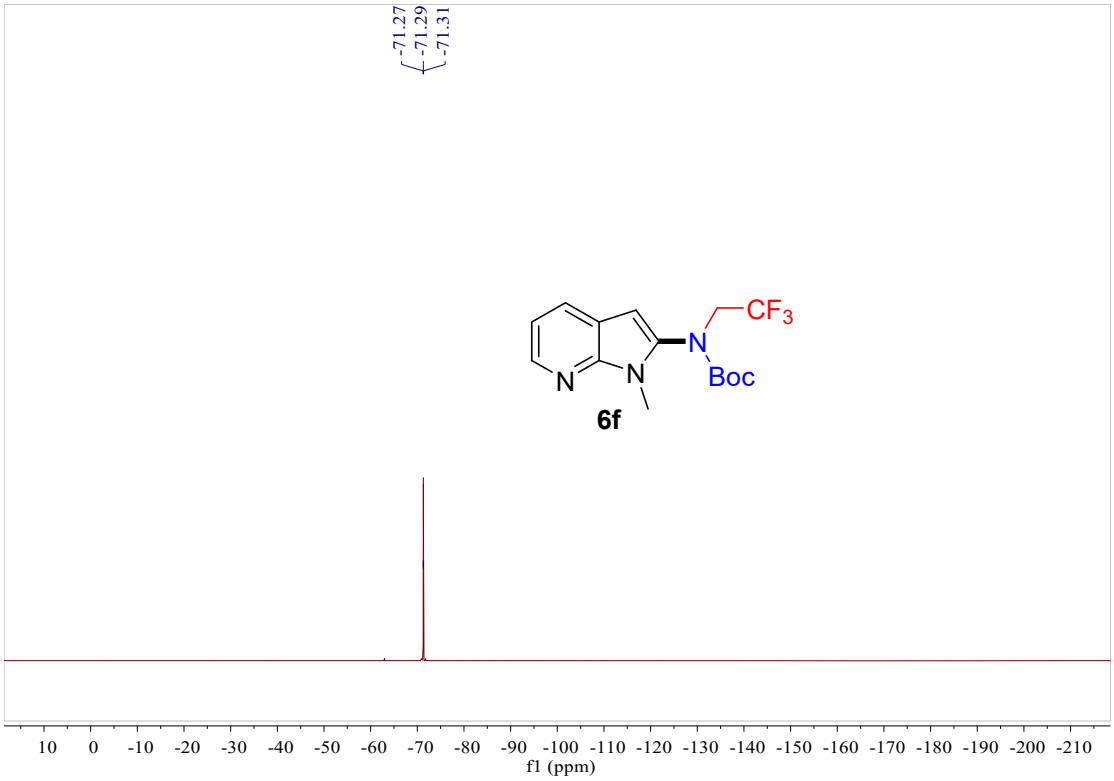


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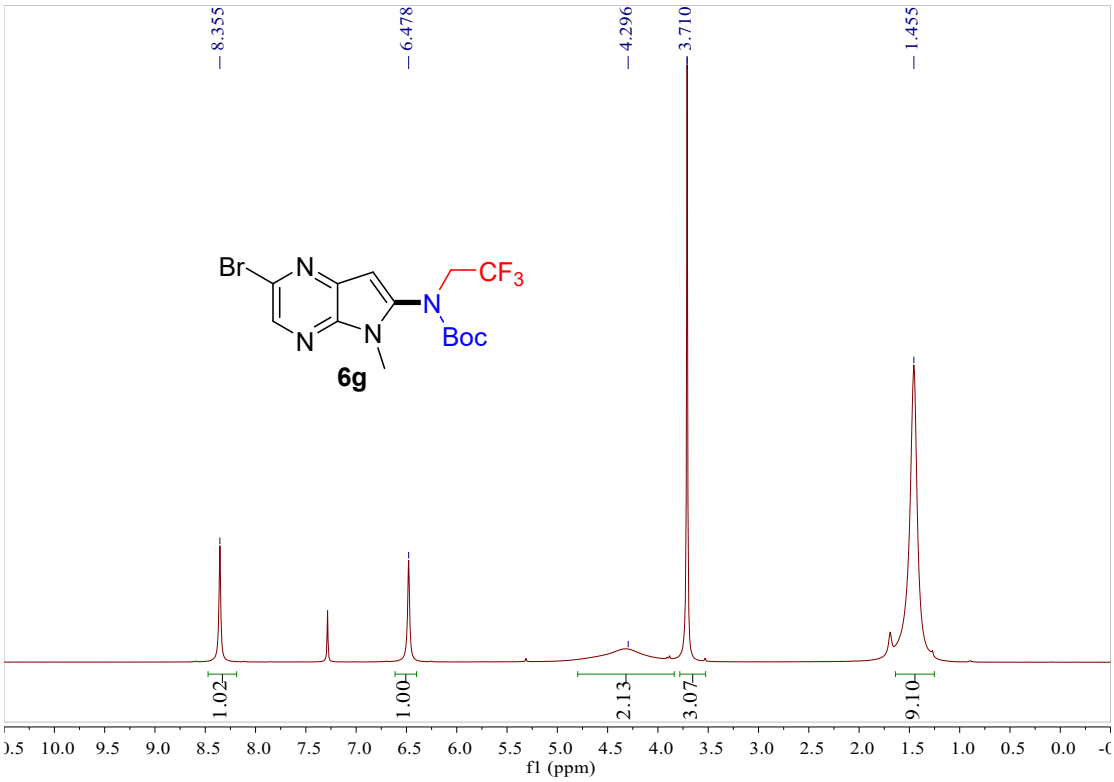
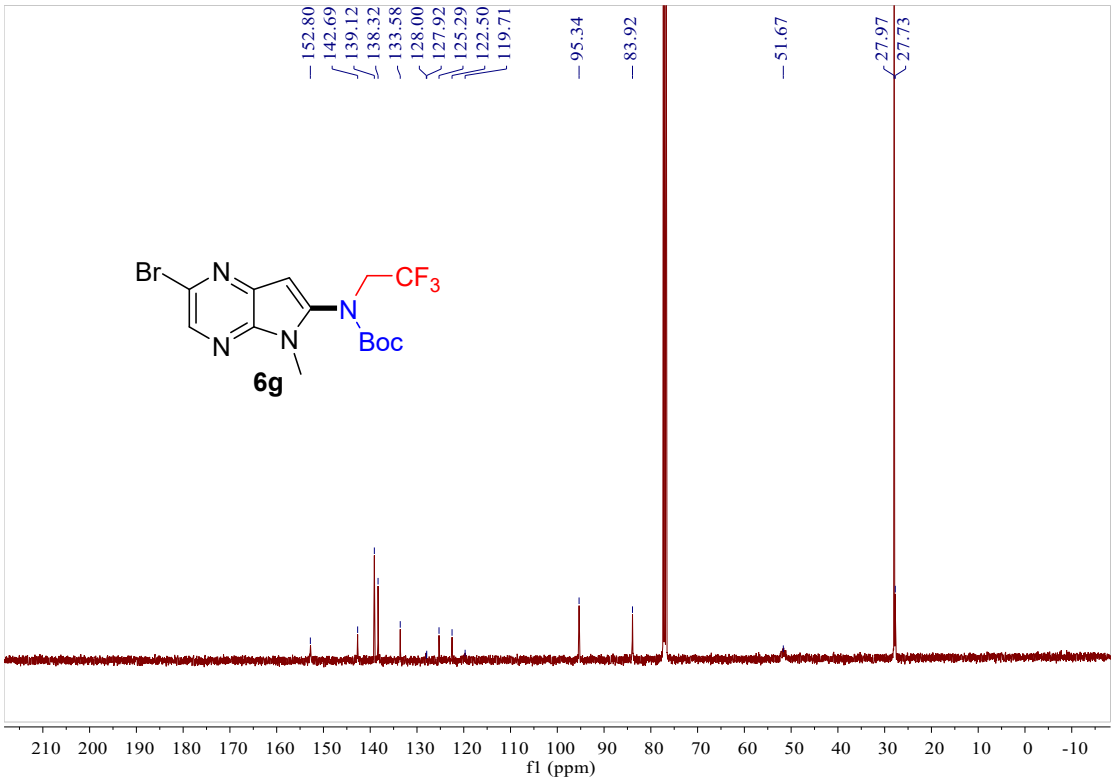
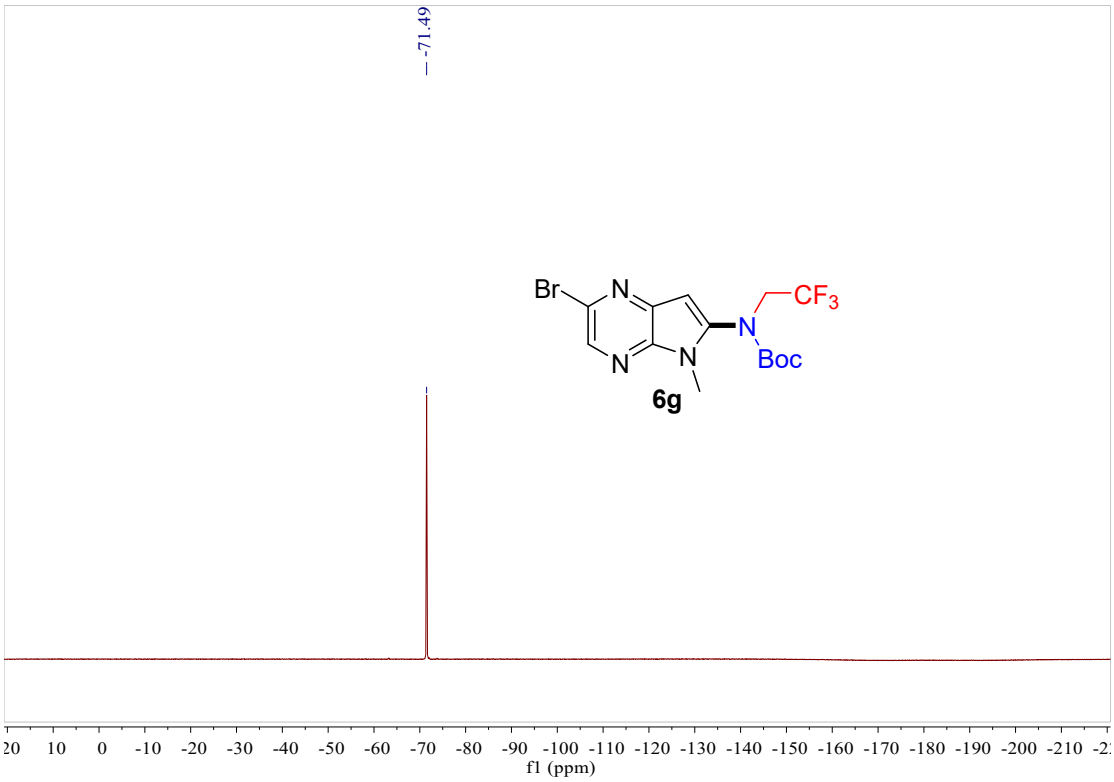


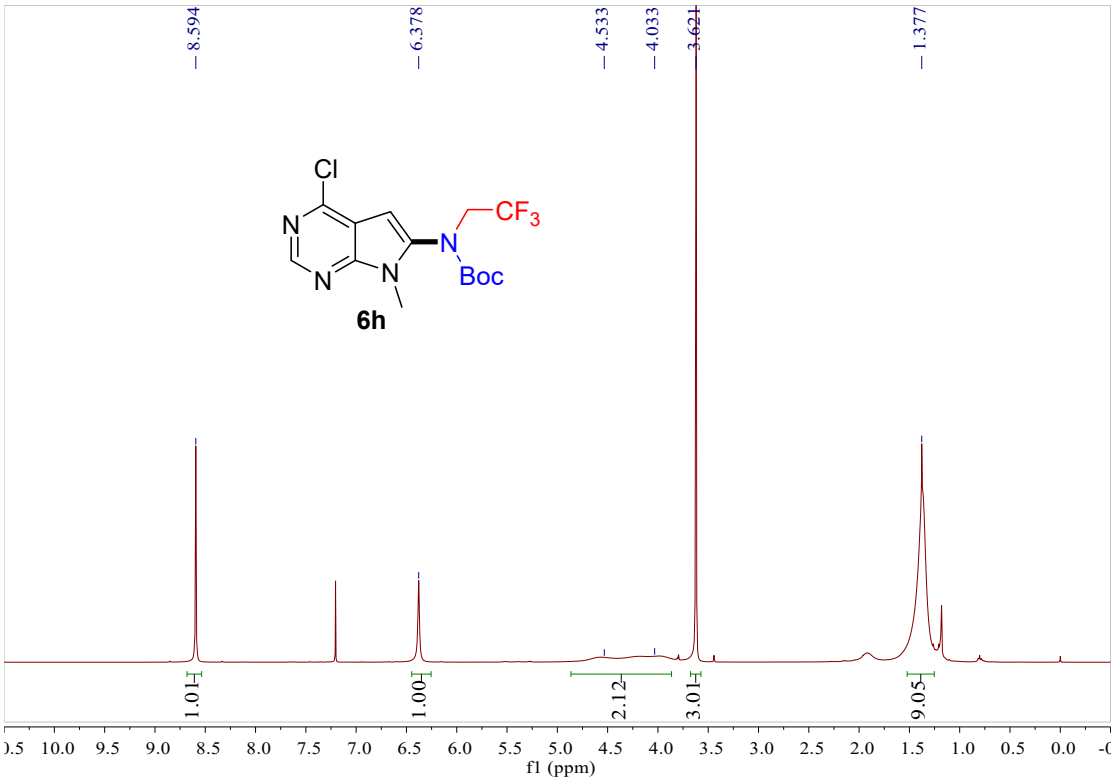

*[13]C NMR (101 MHz, $CDCl_3$)*




*[19]F NMR (376 MHz, $CDCl_3$)*




*[1]H NMR (400 MHz, CDCl3)*

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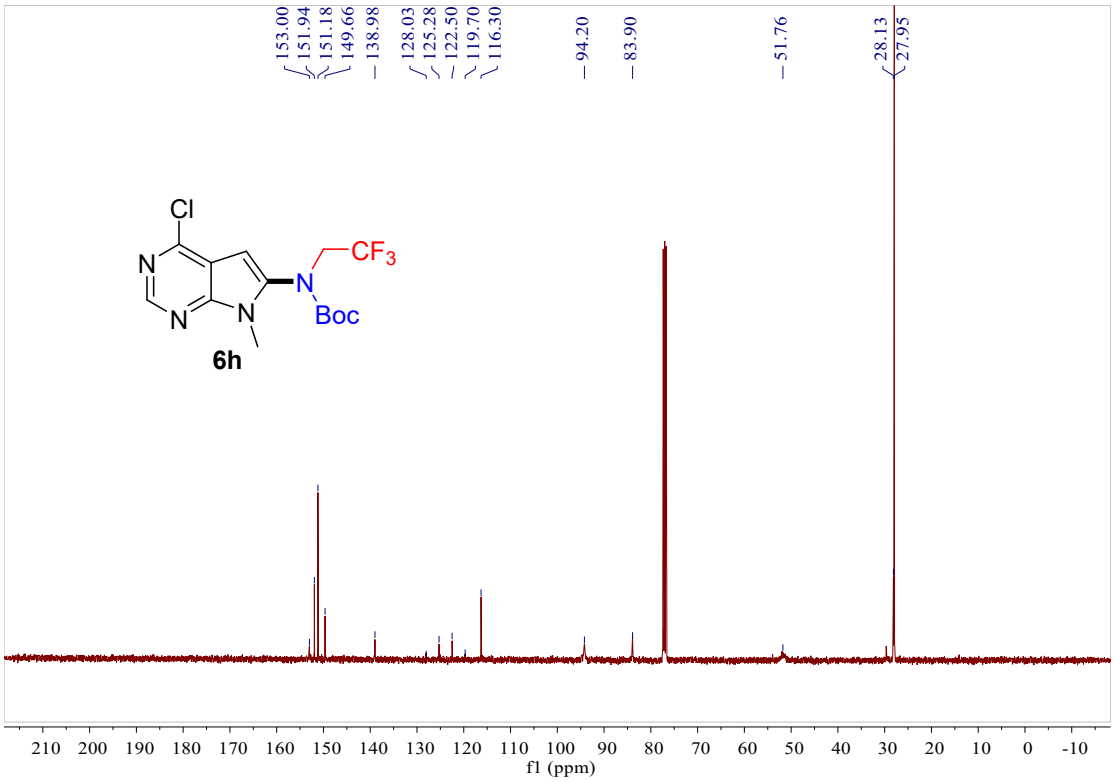
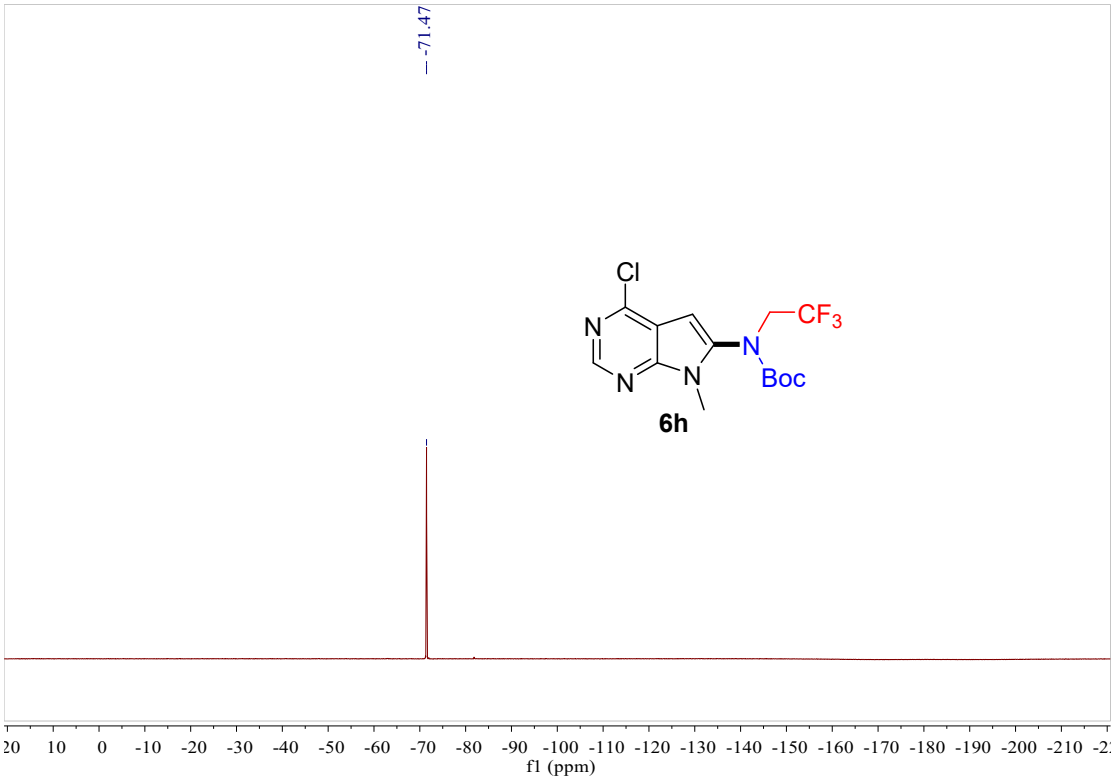



*$^{19}F$ NMR (376 MHz, $CDCl_3$)*

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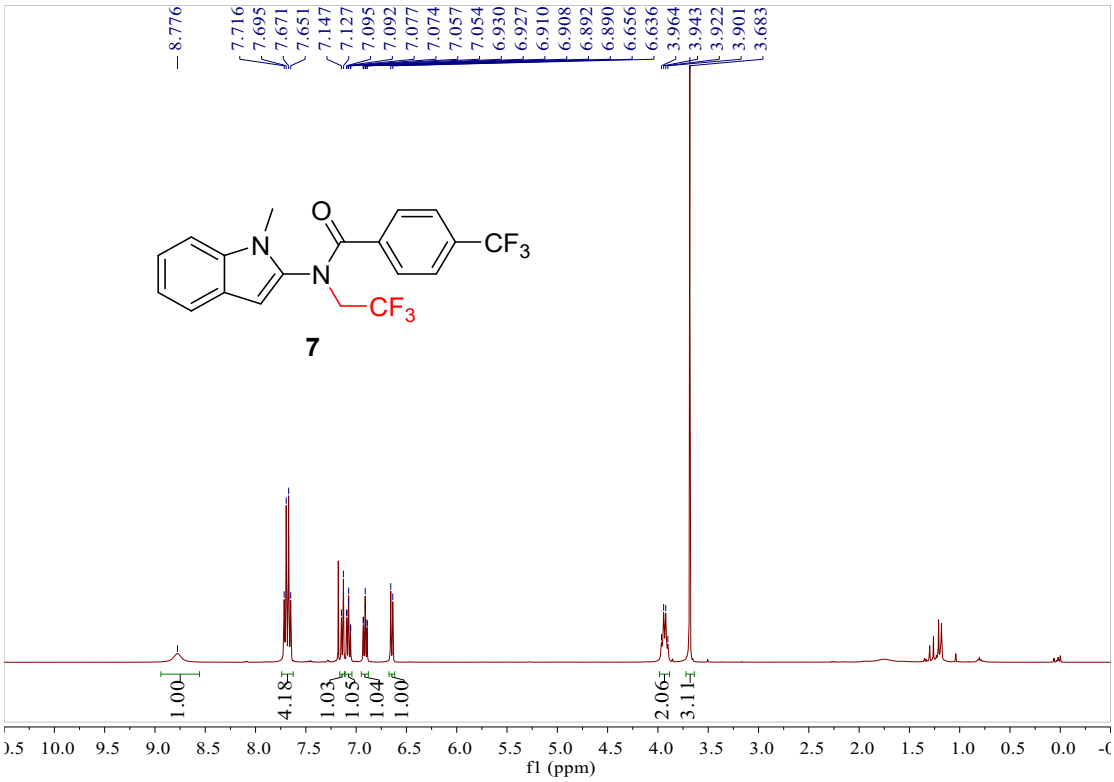


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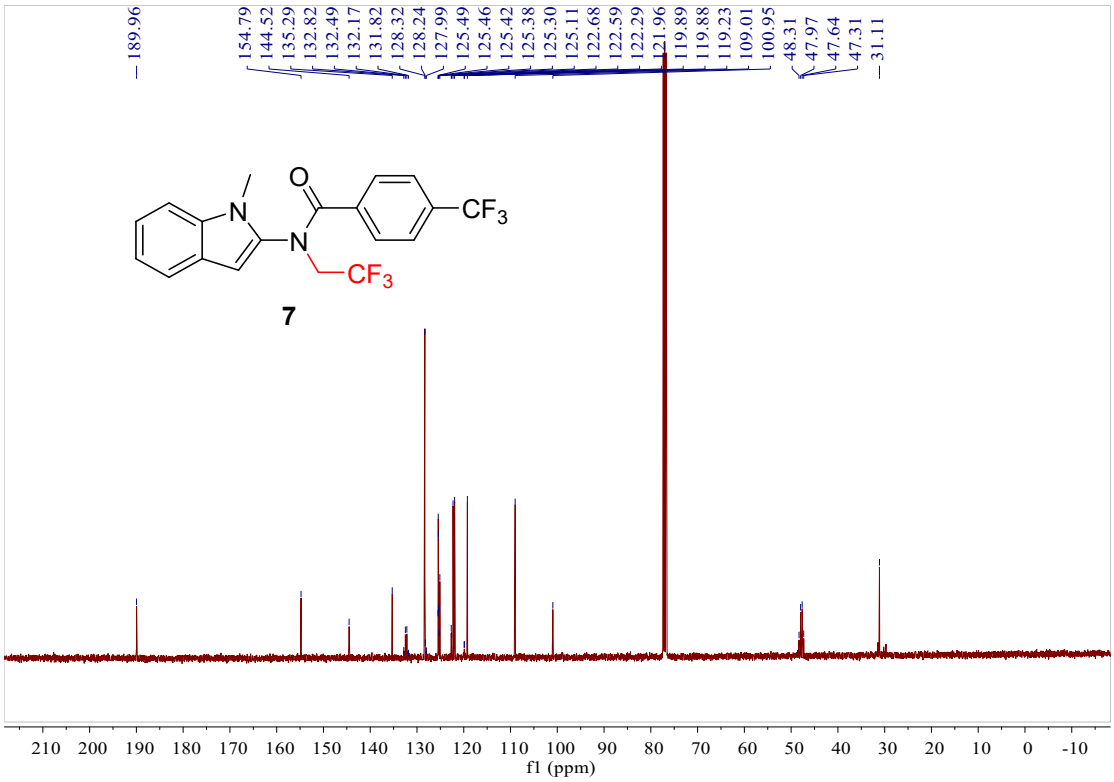


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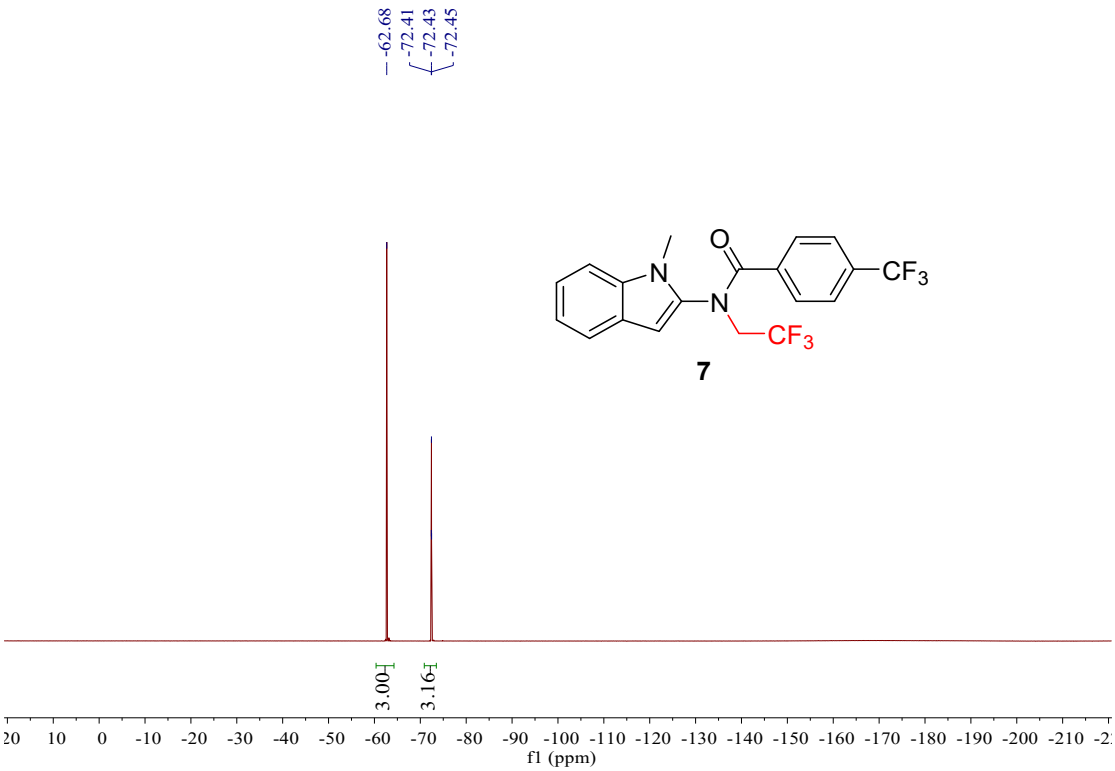


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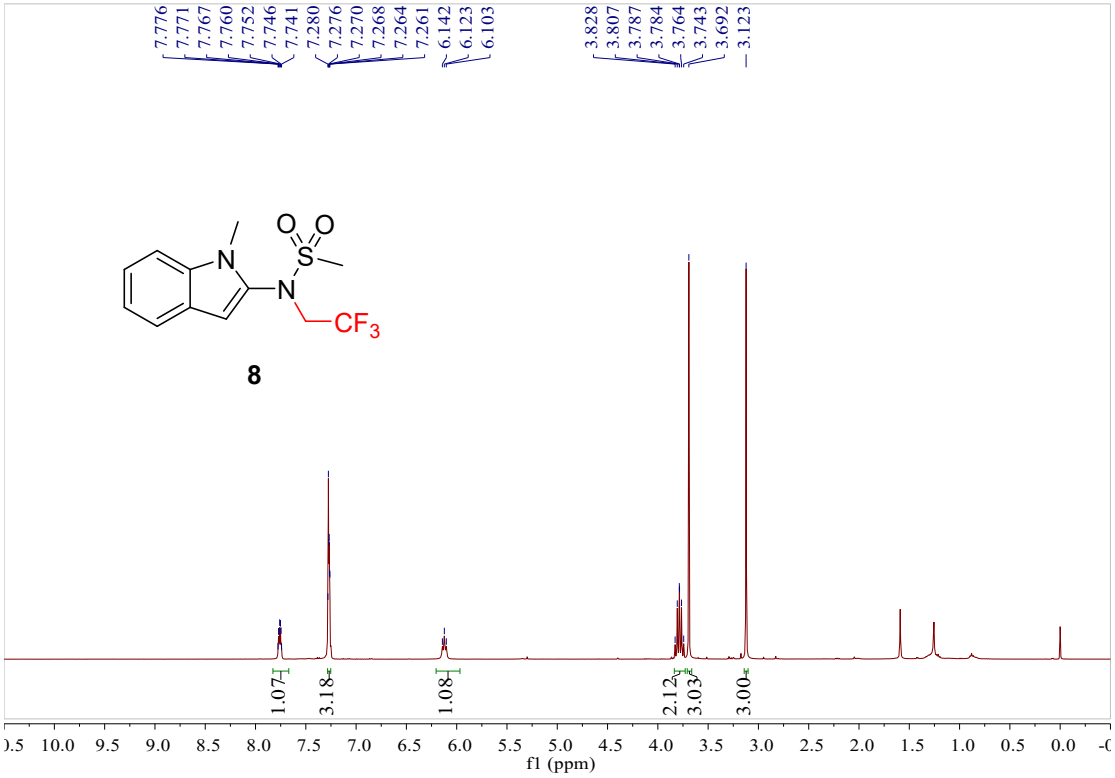


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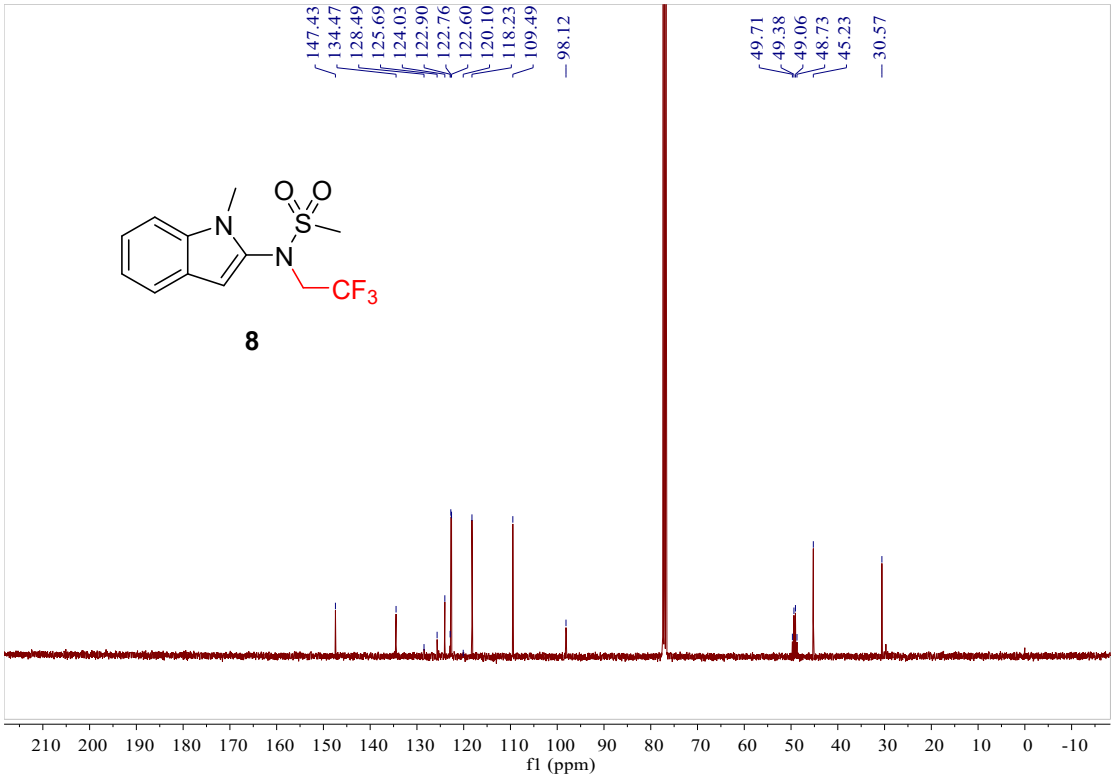


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