

Supporting Information

Copper-Catalyzed Trifluoromethylation of *N*-Aryl Acrylamides On Water at Room Temperature

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General Information

Commercially available reagents and solvents were used without further purification. Column chromatography was carried out using EMD silica gel 60 (0.040-0.063 mm). Thin-Layer-Chromatography analysis was conducted using commercially available EMD TLC Silica gel 60 F254 glass plates. ^1H , ^{13}C and ^{19}F NMR spectra were recorded on a Varian 400 MHz, 500 MHz or 600 MHz spectrometer in CDCl_3 . High resolution mass spectral (HRMS) data were acquired on either a VF Autospec or an analytical VG-70-250 HF spectrometer. 1,3,5-Trifluorobenzene was used as an ^{19}F NMR internal standard. ^1H and ^{19}F multiplicities are reported as follows: singlet (s), doublet (d), triplet (t), quartet (q), doublet of doublets (dd), doublet of triplets (dt) doublet of quartets (dq) and multiplet (m). Room temperature is 24 °C.

Table S1: Optimization of reaction conditions^a

Entry	Catalyst	Additive	Solvent	Time (h) /Temp (°C)	Yield (%) ^b
1	CuCl (1 equiv)	-	DCM/H ₂ O = 2.5:1 (0.2 mL)	20 / 50	trace
2	CuI (1 equiv)	-	DCM/H ₂ O = 2.5:1 (0.2 mL)	20 / 50	trace
3	CuCl ₂ (1 equiv)	-	DCM/H ₂ O = 2.5:1 (0.2 mL)	20 / 50	29
4	CuSO ₄ •5H ₂ O (1 equiv)	-	DCM/H ₂ O = 2.5:1 (0.2 mL)	20 / 50	31
5	Cu(OAc) ₂ •H ₂ O (1 equiv)	-	DCM/H ₂ O = 2.5:1 (0.2 mL)	20 / 50	49
6	Cu(NO ₃) ₂ •2.5H ₂ O (1 equiv)	-	DCM/H ₂ O = 2.5:1 (0.2 mL)	20 / 50	50
4	Cu(NO ₃) ₂ •2.5H ₂ O (1 equiv)	phen (1 equiv)	2 wt% TPGS-750-M (0.2 mL)	24 / RT	30
5	Cu(NO ₃) ₂ •2.5H ₂ O (1 equiv)	DBU (1 equiv)	2 wt% TPGS-750-M (0.2 mL)	24 / RT	42
6	Cu(NO ₃) ₂ •2.5H ₂ O (1 equiv)	TMEDA (1 equiv)	2 wt% TPGS-750-M (0.2 mL)	48 / RT	trace
7	Cu(NO ₃) ₂ •2.5H ₂ O (20%)	TMEDA (20%)	2 wt% TPGS-750-M (0.2 mL)	24 / RT	64
8	Cu(NO ₃) ₂ •2.5H ₂ O (10%)	TMEDA (20%)	2 wt% TPGS-750-M (0.2 mL)	24 / RT	61
9	Cu(NO₃)₂•2.5H₂O	TMEDA	2 wt% TPGS-750-M	24 / RT	87

	(10%)	(10%)	(0.2 mL)		
10	Cu(NO ₃) ₂ •2.5H ₂ O	TMEDA	2 wt% TPGS-750-M	24 / RT	84
	(10%)	(5%)	(0.2 mL)		
11	Cu(NO ₃) ₂ •2.5H ₂ O	TMEDA	2 wt% TPGS-750-M	24 / RT	65
	(5%)	(10%)	(0.2 mL)		

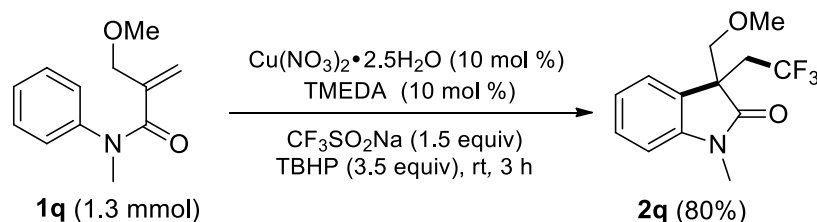
^a These reactions were carried out by using **1a** (0.1 mmol) with CF₃SO₂Na (1.5 equiv) and TBHP (3.5 equiv). ^b Determined by ¹⁹F NMR analysis using 1,3,5-trifluorobenzene as an internal standard.

Table S2. NaSO₂CF₃/TBHP ratio screen for Cu-catalyzed trifluoromethylation of **1a**^a

Entry	CF ₃ SO ₂ Na (x equiv)	TBHP (y equiv)	Time	Yield (%) ^b
1	1.3	3.0	6 h	trace ^c
2	1.3	3.5	3 h	75 ^c
3	1.3	4.0	3 h	73 ^c
4	1.5	3.0	6 h	15 ^c
5	1.5	3.5	1 h	87
6	1.5	4.0	1 h	81
7	2	3.5	1 h	80
8	2	4.0	1 h	77
9	3	5.5	1 h	58
10	3	7.0	1 h	52

^a Reaction conditions: **1a** (0.1 mmol), Cu(NO₃)₂•2.5H₂O (10 mol %), TMEDA (10 mol %), CF₃SO₂Na (x equiv) and TBHP (y equiv) in H₂O (0.5 M). ^b Determined by ¹⁹F NMR analysis using 1,3,5-trifluorobenzene as an internal standard. ^c Incomplete reaction.

Studies on E Factors:



All aqueous media excluded as waste
Solvents used: 1mL EtOAc (0.898g)
Product: 0.284 g
Yield: 80%

$$\text{E-Factors} = \frac{0.898 \text{ g waste}}{0.284 \text{ g product}} = 3.2$$

All aqueous media included as waste

Solvents used: 2 mL H₂O (2 g)

1 mL EtOAc (0.898 g)

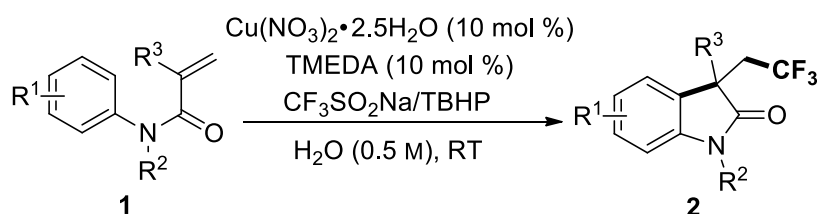
Product: 0.284 g

Yield: 80%

$$\text{E-Factors} = \frac{(0.898 + 2) \text{ g waste}}{0.284 \text{ g product}} = 10.2$$

Based on	E-Factors
Total organic solvent	3.2
Aqueous media included	10.2

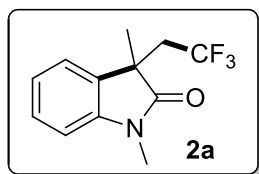
General Procedures for Cu-Catalyzed Aryltrifluoromethylation



For substrates **1a**, **1c–f**, **1k**, **1l** and **1o–q**: In a 10 mL microwave reaction tube, substrates **1** (0.3 mmol), CF₃SO₂Na (1.5 equiv), Cu(NO₃)₂·2.5H₂O (10 mol %), TMEDA (10 mol %) and water (0.6 mL) were added. Then TBHP (3.5 equiv., 70% aqueous) was added dropwise to the mixture. The mixture was stirred at room temperature for the indicated time until complete consumption of starting material as monitored by TLC. Upon completion, the mixture was extracted with EtOAc and concentrated *in vacuo* affording the crude product, which was purified by chromatography on silica gel (eluent: hexanes/ethyl acetate) to give the corresponding products **2** (**2a**, **2c–f**, **2k**, **2l** and **2o–q**).

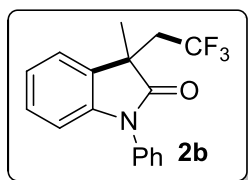
For substrates **1b**, **1g–j**, **1m**, **1n** and **1r**: In a 10 mL microwave reaction tube, substrates **1** (0.3 mmol), CF₃SO₂Na (3.0 equiv), Cu(NO₃)₂·2.5H₂O (10 mol %), TMEDA (10 mol %) and water (0.6 mL) were added. Then TBHP (7.0 equiv., 70% aqueous) was added dropwise to the mixture. The mixture was stirred at room temperature until complete consumption of starting material as monitored by TLC. Upon completion, the mixture was extracted with EtOAc and concentrated *in vacuo* affording the crude product, which was purified by chromatography on silica gel (eluent: hexanes/ethyl acetate) to give the desired products **2** (**2b**, **2g–j**, **2m**, **2n** and **2r**).

Characterization Data



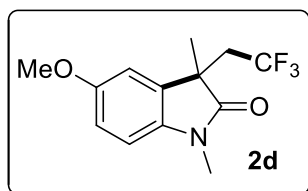
1,3-Dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2a)^{1,2,3}

Yield 75%; white solid; ¹H NMR (500 MHz, CDCl₃) δ 7.34 – 7.29 (m, 1H), 7.26 (d, *J* = 4.0 Hz, 1H), 7.09 (dt, *J* = 7.6, 0.8 Hz, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 3.24 (s, 1H), 2.82 (dq, *J* = 15.2, 10.7 Hz, 1H), 2.65 (dq, *J* = 15.2, 10.5 Hz, 1H), 1.41 (s, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 178.4, 142.8, 131.0, 128.5, 125.2 (q, *J* = 278.1 Hz), 123.5, 122.6, 108.4, 44.4, 40.6 (q, *J* = 28.3 Hz), 26.4, 25.0. ¹⁹F NMR (376 MHz, CDCl₃) δ -62.0 (t, *J* = 10.6 Hz).



3-Methyl-1-phenyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2b)^{1,2,3}

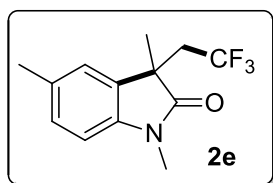
Yield 62%; white solid; ¹H NMR (500 MHz, CDCl₃) δ 7.53 (dt, *J* = 10.0, 1.9 Hz, 1H), 7.45 – 7.38 (m, 3H), 7.33 (d, *J* = 7.4 Hz, 1H), 7.24 (dt, *J* = 7.8, 1.3 Hz, 1H), 7.13 (dt, *J* = 7.5, 1.0 Hz, 1H), 6.84 (d, *J* = 7.9 Hz, 1H), 2.97 (dq, *J* = 15.1, 10.7 Hz, 1H), 2.73 (dq, *J* = 15.2, 10.4 Hz, 1H), 1.54 (s, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 177.9, 142.9, 134.3, 130.7, 129.6, 128.4, 128.2, 126.6, 123.7 (d, *J* = 1.2 Hz), 123.0, 109.7, 44.5 (d, *J* = 2.1 Hz), 41.1 (q, *J* = 28.2 Hz), 25.4. ¹⁹F NMR (376 MHz, CDCl₃) δ -61.9 (t, *J* = 10.6 Hz).



5-Methoxy-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2d)^{1,2,3}

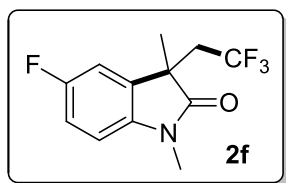
Yield 75%; white solid; ¹H NMR (500 MHz, CDCl₃) δ 6.87 (d, *J* = 2.5 Hz, 1H), 6.82 (dd, *J* = 8.5, 2.5 Hz, 1H), 6.77 (d, *J* = 8.4 Hz, 1H), 3.79 (s, 3H), 3.20 (s, 3H), 2.80 (dq, *J* = 15.2, 10.5

Hz, 1H), 2.61 (dq, $J = 15.2, 10.5$ Hz, 1H), 1.38 (s, 3H). ^{13}C NMR (126 MHz, CDCl_3) δ 178.0, 156.0, 136.3, 132.3, 128.2, 126.3, 124.1, 112.5, 111.2, 108.7, 55.8, 44.7 (d, $J = 2.2$ Hz), 40.52 (q, $J = 28.9$ Hz), 26.4, 25.0. ^{19}F NMR (376 MHz, CDCl_3) δ -61.9 (t, $J = 10.6$ Hz).



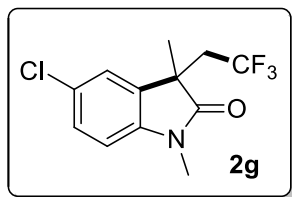
1,3,5-Trimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2e)^{1,2,3}

Yield 73%; white solid; ^1H NMR (500 MHz, CDCl_3) δ 7.10 (d, $J = 7.9$ Hz, 1H), 7.07 (s, 1H), 6.77 (d, $J = 7.9$ Hz, 1H), 3.21 (s, 3H), 2.80 (dq, $J = 15.1, 10.7$ Hz, 1H), 2.62 (dq, $J = 15.1, 10.5$ Hz, 1H), 2.35 (s, 3H), 1.39 (s, 3H). ^{13}C NMR (126 MHz, CDCl_3) δ 178.4, 140.5, 132.2, 131.1, 128.7, 126.4, 124.3 (d, $J = 1.4$ Hz), 108.1, 44.4 (d, $J = 2.1$ Hz), 40.61 (q, $J = 28.2$ Hz), 26.4, 25.0, 21.1. ^{19}F NMR (376 MHz, CDCl_3) δ -61.9 (t, $J = 10.6$ Hz).



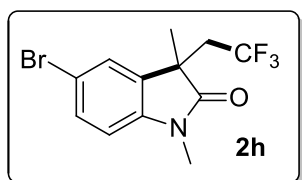
5-Fluoro-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2f)^{1,3}

Yield 72%; colorless oil; ^1H NMR (500 MHz, CDCl_3) δ 7.04 – 6.98 (m, 2H), 6.80 (dd, $J = 9.2, 4.2$ Hz, 1H), 3.22 (s, 1H), 2.82 (dq, $J = 15.2, 10.4$ Hz, 1H), 2.62 (dq, $J = 15.2, 10.4$ Hz, 1H), 1.40 (s, 3H). ^{13}C NMR (126 MHz, CDCl_3) δ 178.1, 159.3 (d, $J = 241.0$ Hz), 138.8 (d, $J = 1.7$ Hz), 132.6 (d, $J = 8.3$ Hz), 125.1 (q, $J = 278.2$ Hz), 114.8 (d, $J = 23.5$ Hz), 111.8 (dd, $J = 25.0, 1.6$ Hz), 108.9 (d, $J = 8.2$ Hz), 44.8 (d, $J = 2.0$ Hz), 40.5 (q, $J = 28.4$ Hz), 26.6, 24.9. ^{19}F NMR (376 MHz, CDCl_3) δ -62.0 (t, $J = 10.5$ Hz), -120.4 (td, $J = 8.3, 4.0$ Hz).



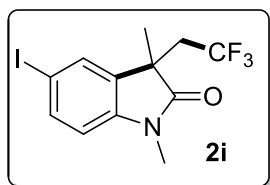
5-Chloro-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2g)^{1,2,3}

Yield 72%; white solid; ¹H NMR (500 MHz, CDCl₃) δ 7.29 (dd, *J* = 2.0, 0.9 Hz, 1H), 7.28 (dd, *J* = 2.0, 0.9 Hz, 1H), 7.24 (d, *J* = 1.8 Hz, 1H), 6.80 (d, *J* = 8.3 Hz, 1H), 3.22 (s, 3H), 2.83 (dq, *J* = 15.2, 10.6 Hz, 1H), 2.62 (dq, *J* = 15.2, 10.4 Hz, 1H), 1.40 (s, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 177.9, 141.4, 132.7, 128.5, 128.1, 126.1, 124.1, 123.9, 109.4, 44.6, 40.55 (q, *J* = 28.4 Hz), 26.5, 24.9. ¹⁹F NMR (376 MHz, CDCl₃) δ -62.0 (t, *J* = 10.5 Hz).



5-Bromo-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2h)^{1,2,3}

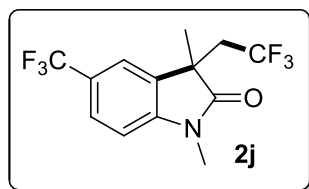
Yield 82%; white solid; ¹H NMR (500 MHz, CDCl₃) δ 7.43 (dd, *J* = 8.3, 1.9 Hz, 1H), 7.37 (d, *J* = 1.8 Hz, 1H), 6.75 (d, *J* = 8.3 Hz, 1H), 3.21 (s, 3H), 2.81 (dq, *J* = 15.2, 10.6 Hz, 1H), 2.62 (dq, *J* = 15.2, 10.4 Hz, 1H), 1.39 (s, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 177.8, 141.9, 133.0, 131.4, 126.8 (d, *J* = 1.5 Hz), 126.1, 123.9, 115.3, 109.9, 44.5, 40.5 (q, *J* = 28.4 Hz), 26.5, 24.9. ¹⁹F NMR (376 MHz, CDCl₃) δ -62.0 (t, *J* = 10.5 Hz).



5-Iodo-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2i)^{1,2,3}

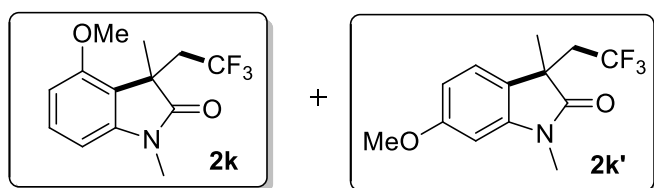
Yield 75%; white solid; ¹H NMR (600 MHz, CDCl₃) δ 7.62 (dd, *J* = 8.2, 1.6 Hz, 1H), 7.54 (d, *J* = 1.2 Hz, 1H), 6.66 (d, *J* = 8.2 Hz, 1H), 3.20 (s, 3H), 2.81 (dq, *J* = 15.2, 10.6 Hz, 1H), 2.61 (dq, *J* = 15.2, 10.4 Hz, 1H), 1.39 (s, 3H). ¹³C NMR (151 MHz, CDCl₃) δ 177.6, 142.6, 137.4,

133.4, 132.3, 110.5, 85.0, 44.3, 40.56 (q, $J = 28.3$ Hz), 26.5, 24.9. ^{19}F NMR (376 MHz, CDCl_3) δ -62.0 (t, $J = 10.5$ Hz).



1,3-Dimethyl-3-(2,2,2-trifluoroethyl)-5-(trifluoromethyl)indolin-2-one (2j)

Yield 63%; white solid, mp 86-88 °C; ^1H NMR (500 MHz, CDCl_3) δ 7.60 (dd, $J = 8.2, 0.8$ Hz, 1H), 7.49 (s, 1H), 6.96 (d, $J = 8.2$ Hz, 1H), 3.27 (s, 3H), 2.86 (dq, $J = 15.2, 10.6$ Hz, 1H), 2.69 (dq, $J = 15.1, 10.3$ Hz, 1H), 1.44 (s, 3H). ^{13}C NMR (126 MHz, CDCl_3) δ 178.3, 145.8, 131.5, 126.4 (q, $J = 4.0$ Hz), 126.1, 125.2, 124.9, 123.9, 123.2, 120.6, 108.3, 44.3 (d, $J = 2.1$ Hz), 40.6 (q, $J = 28.5$ Hz), 26.6, 24.9. ^{19}F NMR (376 MHz, CDCl_3) δ -61.6, -62.1 (t, $J = 10.5$ Hz). HRMS (EI) calcd. for $\text{C}_{13}\text{H}_{11}\text{F}_6\text{NO}$, 311.0745; found: 311.0742.



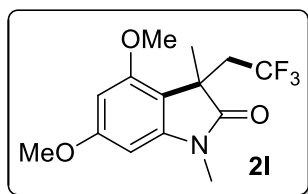
4-Methoxy-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2k)

Total yield 74%; colorless oil; ^1H NMR (500 MHz, CDCl_3) δ 7.26 (t, $J = 9.2$ Hz, 1H), 6.63 (d, $J = 8.5$ Hz, 1H), 6.53 (d, $J = 7.8$ Hz, 1H), 3.86 (s, 3H), 3.20 (s, 3H), 2.98 (dq, $J = 14.8, 10.5$ Hz, 1H), 2.80 (dq, $J = 14.8, 10.7$ Hz, 1H), 1.43 (s, 3H). ^{13}C NMR (126 MHz, CDCl_3) δ 178.9, 156.3, 144.0, 129.7, 126.4, 124.2, 116.6, 105.8, 101.7, 55.4, 44.2, 39.0 (q, $J = 27.9$ Hz), 26.6, 22.9. ^{19}F NMR (376 MHz, CDCl_3) δ -64.1 (t, $J = 10.7$ Hz). HRMS (EI) calcd. For $\text{C}_{13}\text{H}_{14}\text{F}_3\text{NO}_2$, 273.0977; found: 273.0974.

6-Methoxy-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one 2k'

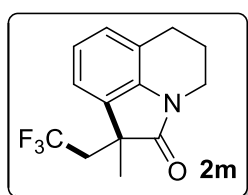
^1H NMR (500 MHz, CDCl_3) δ 7.15 (d, $J = 8.2$ Hz, 1H), 6.58 (dd, $J = 8.2, 2.3$ Hz, 1H), 6.46 (d, $J = 2.3$ Hz, 1H), 3.83 (s, 3H), 3.21 (s, 3H), 2.77 (dq, $J = 15.2, 10.8$ Hz, 1H), 2.61 (dq, $J = 15.2, 10.5$ Hz, 1H), 1.37 (s, 3H). ^{13}C NMR (126 MHz, CDCl_3) δ 179.1, 160.4, 144.1, 130.1, 124.2, 122.9, 113.2, 106.5, 96.4, 55.5, 43.9, δ 40.7 (d, $J = 22.6$ Hz), 26.4, 25.1. ^{19}F NMR

(376 MHz, CDCl₃) δ -62.0 (t, J = 10.6 Hz). HRMS (EI) calcd. for C₁₃H₁₄F₃NO₂, 273.0977; found: 273.0978.



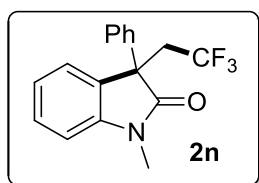
4,6-Dimethoxy-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2l)

Yield 50%; white solid, mp 85-87 °C; ¹H NMR (500 MHz, CDCl₃) δ 6.17 (d, J = 2.0 Hz, 1H), 6.11 (d, J = 2.0 Hz, 1H), 3.83 (s, 3H), 3.83 (s, 3H), 3.19 (s, 3H), 2.92 (dq, J = 14.8, 10.6 Hz, 1H), 2.76 (dq, J = 14.8, 10.7 Hz, 1H), 1.40 (s, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 179.5, 161.8, 157.0, 144.6, 126.4, 124.2, 108.7, 92.4, 88.4, 55.5 (d, J = 20.6 Hz), 43.9, 39.2 (q, J = 27.6 Hz), 26.6, 23.2. ¹⁹F NMR (376 MHz, CDCl₃) δ -64.1 (t, J = 10.5 Hz). HRMS (EI) calcd. for C₁₄H₁₆F₃NO₃, 303.1082; found: 303.1074.



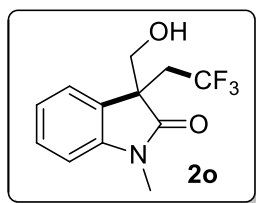
1-Methyl-1-(2,2,2-trifluoroethyl)-5,6-dihydro-1H-pyrrolo[3,2,1-ij]quinolin-2(4H)-one (2m)^{1,3}

Yield 58%; colorless oil; ¹H NMR (500 MHz, CDCl₃) δ 7.10 (d, J = 7.4 Hz, 1H), 7.05 (dd, J = 7.7, 0.8 Hz, 1H), 6.97 (t, J = 7.6 Hz, 1H), 3.74 – 3.71 (m, 2H), 2.86 – 2.72 (m, 3H), 2.70 – 2.58 (m, 1H), 2.07 – 1.95 (m, 2H), 1.41 (s, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 177.3, 138.6, 129.7, 127.3, 126.5, 124.3, 122.0, 121.4 (d, J = 1.6 Hz), 120.5, 45.6, 40.4 (q, J = 28.3 Hz), 39.0, 24.5 (d, J = 8.3 Hz), 21.1. ¹⁹F NMR (376 MHz, CDCl₃) δ -61.9 (t, J = 10.7 Hz).



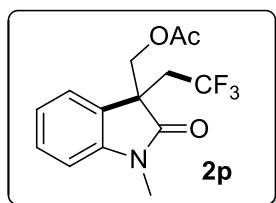
1-Methyl-3-phenyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2n)^{1,2,3}

Yield 50%; colorless oil; ¹H NMR (500 MHz, CDCl₃) δ 7.40 (dt, *J* = 7.7, 0.9 Hz, 1H), 7.35 – 7.27 (m, 6H), 7.17 (t, *J* = 7.4 Hz, 1H), 6.94 (d, *J* = 7.8 Hz, 1H), 3.43 (dq, *J* = 15.2, 10.8 Hz, 1H), 3.23 (s, 3H), 3.05 (dq, *J* = 15.2, 10.4 Hz, 1H). ¹³C NMR (126 MHz, CDCl₃) δ 176.7, 143.8, 138.6, 129.1, 128.8, 127.9, 126.4, 126.0, 124.0, 122.6, 108.7, 105.0, 40.9 (q, *J* = 28.1 Hz), 26.7. ¹⁹F NMR (376 MHz, CDCl₃) δ -61.20 (t, *J* = 10.3 Hz).



3-(Hydroxymethyl)-1-methyl-3-(2,2,2-trifluoroethyl)indolin-2-one (2o)^{1,2}

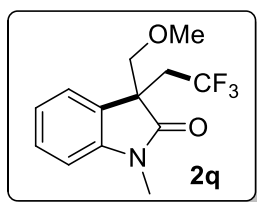
Yield 71%; yellow oil; ¹H NMR (500 MHz, CDCl₃) δ 7.36 (t, *J* = 7.7 Hz, 1H), 7.28 (d, *J* = 7.4 Hz, 1H), 7.11 (t, *J* = 7.6 Hz, 1H), 6.91 (d, *J* = 7.8 Hz, 1H), 3.74 (d, *J* = 11.0 Hz, 1H), 3.67 (d, *J* = 11.1 Hz, 1H), 3.24 (s, 3H), 3.10 – 3.00 (m, 1H), 2.86 – 2.75 (m, 1H), 2.71 (d, *J* = 10.2 Hz, 1H). ¹³C NMR (126 MHz, CDCl₃) δ 177.1, 143.6, 129.1, 127.0, 126.7, 124.5, 124.0, 122.9, 108.7, 67.4, 49.8, 36.4 (q, *J* = 28.7 Hz), 26.4. ¹⁹F NMR (376 MHz, CDCl₃) δ -61.5 (t, *J* = 10.6 Hz).



1-Methyl-2-oxo-3-(2,2,2-trifluoroethyl)indolin-3-yl)methyl acetate (2p)^{1,2}

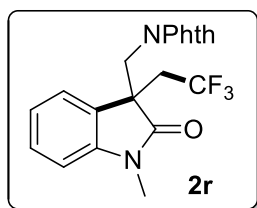
Yield 77%; light yellow oil; ¹H NMR (500 MHz, CDCl₃) δ 7.35 (dt, *J* = 7.8, 1.1 Hz, 1H), 7.29 (d, *J* = 7.4 Hz, 1H), 7.09 (dt, *J* = 7.6, 0.8 Hz, 1H), 6.89 (d, *J* = 7.8 Hz, 1H), 4.39 (d, *J* = 10.9 Hz, 1H), 4.07 (d, *J* = 10.9 Hz, 1H), 3.24 (s, 3H), 2.93 – 2.86 (m, 1H), 2.86 – 2.78 (m, 1H), 1.96 (s, 3H). ¹³C NMR (126 MHz, CDCl₃) δ 175.1, 170.0, 143.6, 129.3, 126.5, 126.3, 124.6 (d, *J* = 1.3 Hz), 124.0, 122.7, 108.5, 97.3, 67.0, 48.2, 36.7 (q, *J* = 29.1 Hz), 26.5, 20.5.

^{19}F NMR (376 MHz, CDCl_3) δ -61.4 (t, J = 10.4 Hz).



3-(Methoxymethyl)-1-methyl-3-(2,2,2-trifluoroethyl)indolin-2-one **2q**^{1,3}

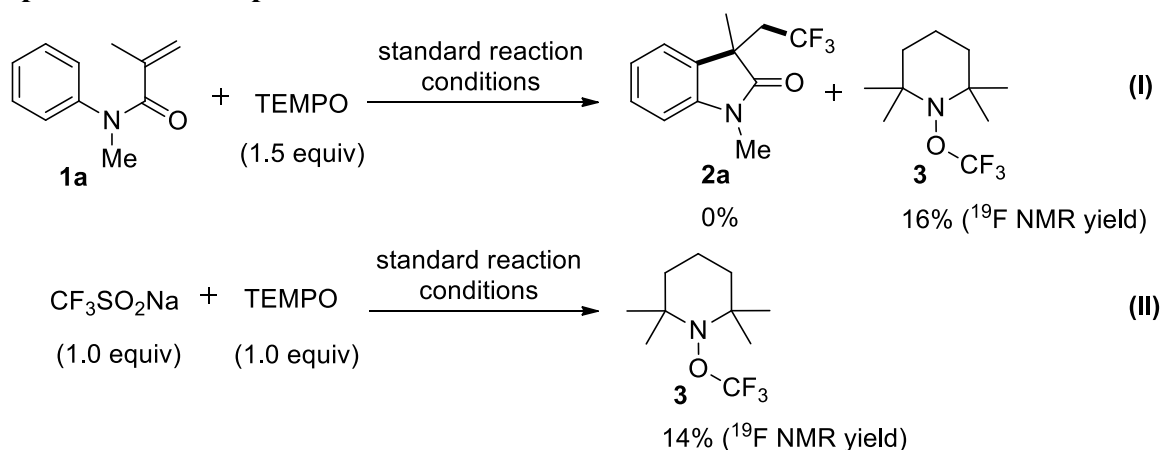
Yield 80%; white solid; ^1H NMR (500 MHz, CDCl_3) δ 7.37 (d, J = 7.4 Hz, 1H), 7.33 (dt, J = 7.8, 1.2 Hz, 1H), 7.08 (dt, J = 7.6, 0.9 Hz, 1H), 6.87 (d, J = 7.8 Hz, 1H), 3.60 (d, J = 8.8 Hz, 1H), 3.37 (d, J = 9.0 Hz, 1H), 3.27 (s, 3H), 3.23 (s, 3H), 2.94 (dq, J = 15.2, 10.6 Hz, 1H), 2.80 (dq, J = 15.2, 10.8 Hz, 1H). ^{13}C NMR (126 MHz, CDCl_3) δ 175.8, 143.5, 129.4, 128.7, 128.2, 126.6, 124.9 (d, J = 1.2 Hz), 124.4, 122.5, 108.3, 76.4, 59.6, 49.5, 36.7 (q, J = 28.7 Hz), 26.4. ^{19}F NMR (376 MHz, CDCl_3) δ -61.5 (t, J = 10.6 Hz).



2-((1-Methyl-2-oxo-3-(2,2,2-trifluoroethyl)indolin-3-yl)methyl)isoindoline-1,3-dione (**2r**)^{1,2,3}

Yield 90%; white solid; ^1H NMR (500 MHz, CDCl_3) δ 7.85 – 7.82 (m, 1H), 7.72 (dd, J = 5.5, 3.0 Hz, 1H), 7.31 (td, J = 7.8, 1.1 Hz, 1H), 7.23 (d, J = 7.4 Hz, 1H), 7.03 (dd, J = 11.2, 3.9 Hz, 1H), 6.88 (d, J = 7.8 Hz, 1H), 3.99 (d, J = 14.2 Hz, 1H), 3.88 (d, J = 14.2 Hz, 1H), 3.24 (s, 2H), 3.08 (dq, J = 15.6, 10.4 Hz, 1H), 2.98 (dq, J = 15.6, 10.4 Hz, 1H). ^{13}C NMR (126 MHz, CDCl_3) δ 175.5, 168.0, 143.4, 134.2, 131.6, 129.3, 126.6, 126.1, 124.4, 123.9, 123.6, 122.5, 108.7, 48.4, 44.0, 38.07 (q, J = 28.2 Hz), 26.6. ^{19}F NMR (376 MHz, CDCl_3) δ -61.5 (t, J = 10.3 Hz).

Experiments in the presence of TEMPO.



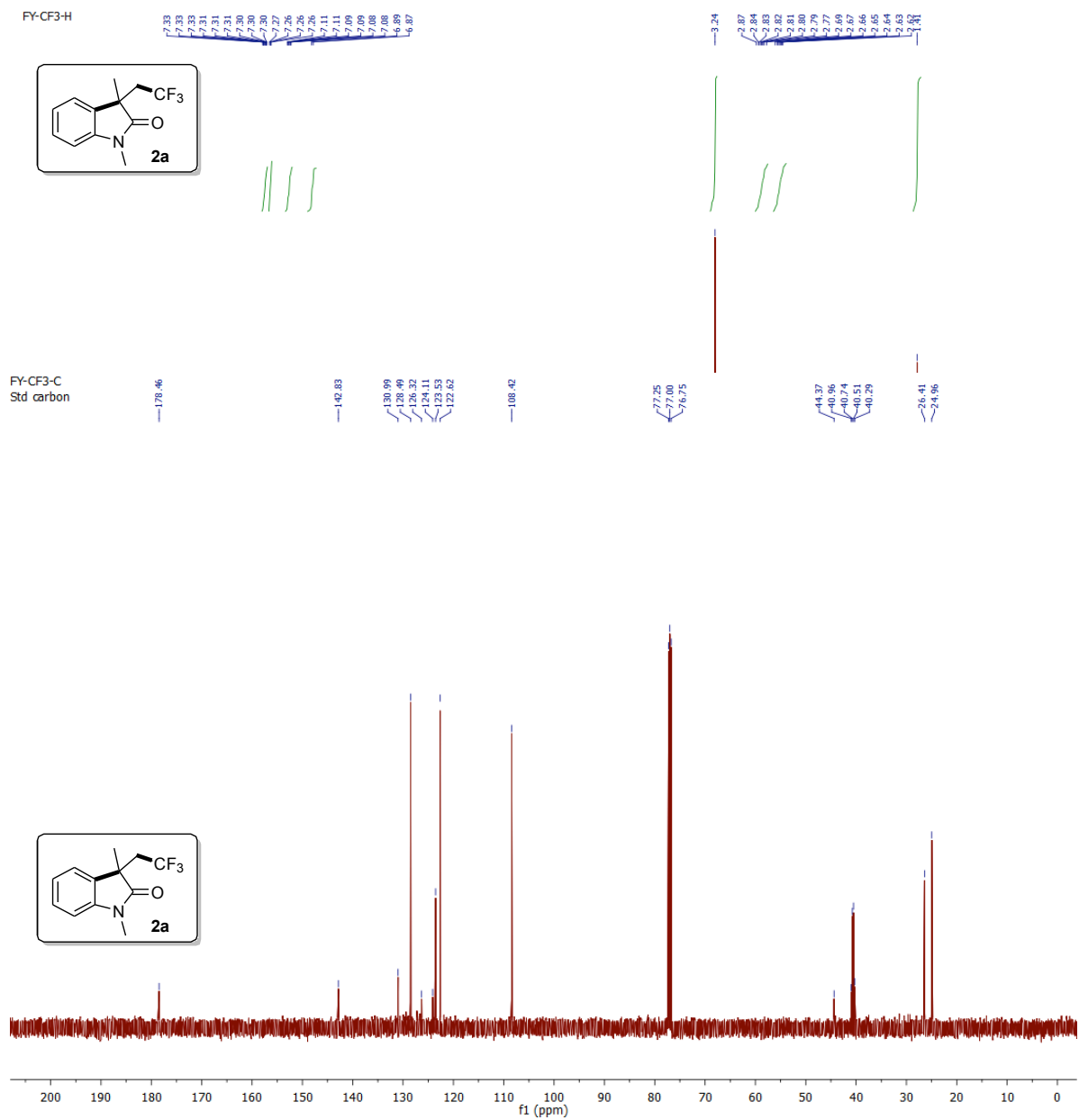
(I) In a 10 mL microwave reaction tube, substrates **1a** (0.3 mmol), $\text{CF}_3\text{SO}_2\text{Na}$ (1.5 equiv), 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO, 1.5 equiv), $\text{Cu}(\text{NO}_3)_2 \cdot 2.5\text{H}_2\text{O}$ (10 mol %), TMEDA (10 mol %) and water (0.6 mL) were added. TBHP (3.5 equiv., 70% aqueous) was then added dropwise to the mixture which was stirred at RT for 2 h. ^{19}F NMR analysis (using 1,3,5-trifluorobenzene as an ^{19}F NMR internal standard) of this reaction mixture showed that TEMPO- CF_3 was formed in 16% yield; formation of **2a** was totally suppressed by TEMPO, suggestive that this transformation may involve the CF_3 radical.

(II) In a 10 mL microwave reaction tube, $\text{CF}_3\text{SO}_2\text{Na}$ (1.0 equiv., 0.3 mmol), TEMPO (1.0 equiv., 0.3 mmol), $\text{Cu}(\text{NO}_3)_2 \cdot 2.5\text{H}_2\text{O}$ (10 mol %), TMEDA (10 mol %) and water (0.6 mL) were added. TBHP (2.5 equiv., 70% aqueous) was then added dropwise to the mixture. The mixture was stirred at RT for 2 h. ^{19}F NMR analysis of this reaction mixture showed that TEMPO- CF_3 was formed in 14% yield. ^{19}F NMR (376 MHz, CDCl_3) δ -55.66 (s, 3F).

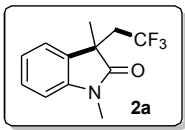
References:

- (1) X. Mu, T. Wu, H. Wang, Y. Guo, G. Liu, *J. Am. Chem. Soc.* 2012, **134**, 878
- (2) P. Xu, J. Xie, Q.-C. Xue, C.-D. Pan, Y.-X. Cheng, C.-J. Zhu, *Chem. Eur. J.* 2013, **19**, 14039
- (3) H. Egami, R. Shimizu, M. Sodeoka, *J. Fluorine Chem.*, 2013, **152**, 51.
- (4) X. Wang, Y. Ye, S. Zhang, J. Feng, Y. Xu, Y. Zhang, J. Wang, *J. Am. Chem. Soc.* 2011, **133**, 16410.

Spectral data

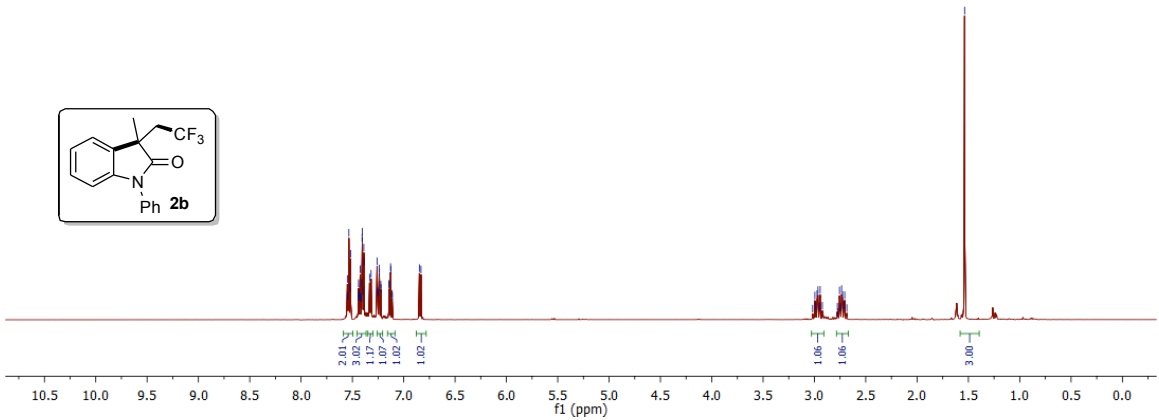
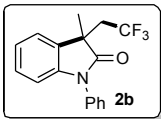
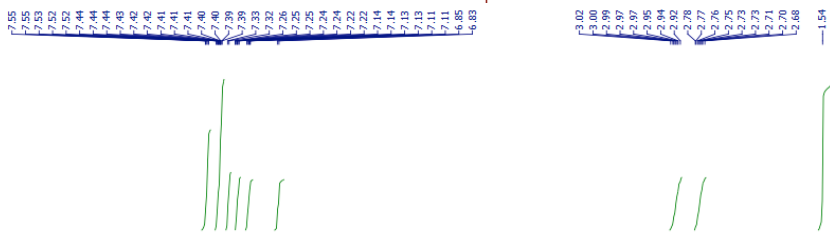


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-62.00
-62.03

FY-233-3-H



FY-233-3-C
Std carbon

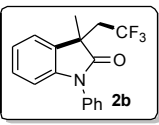
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129.64
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123.73
123.03
109.74

77.25
77.00
76.75

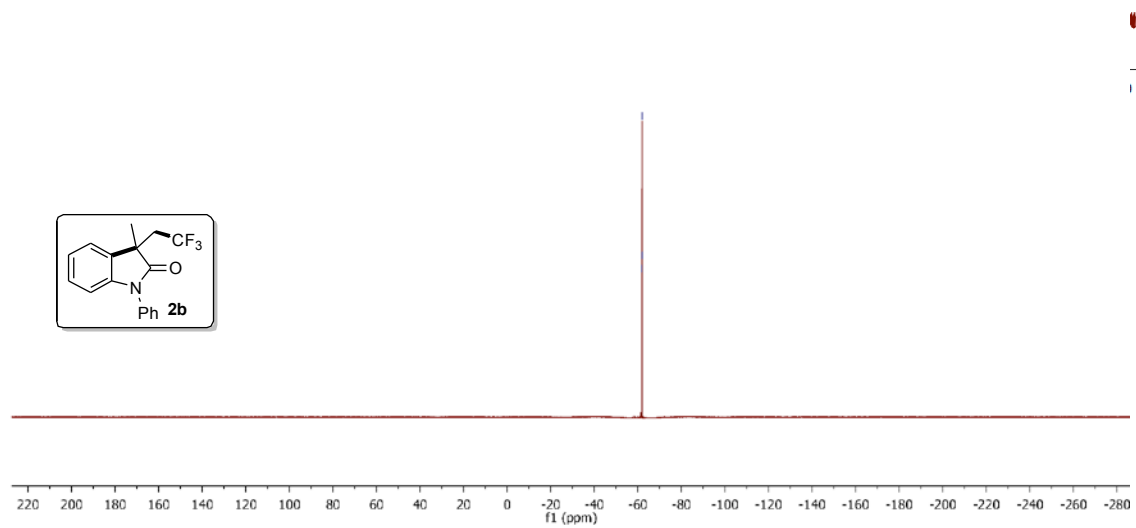
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41.17
40.95
40.72

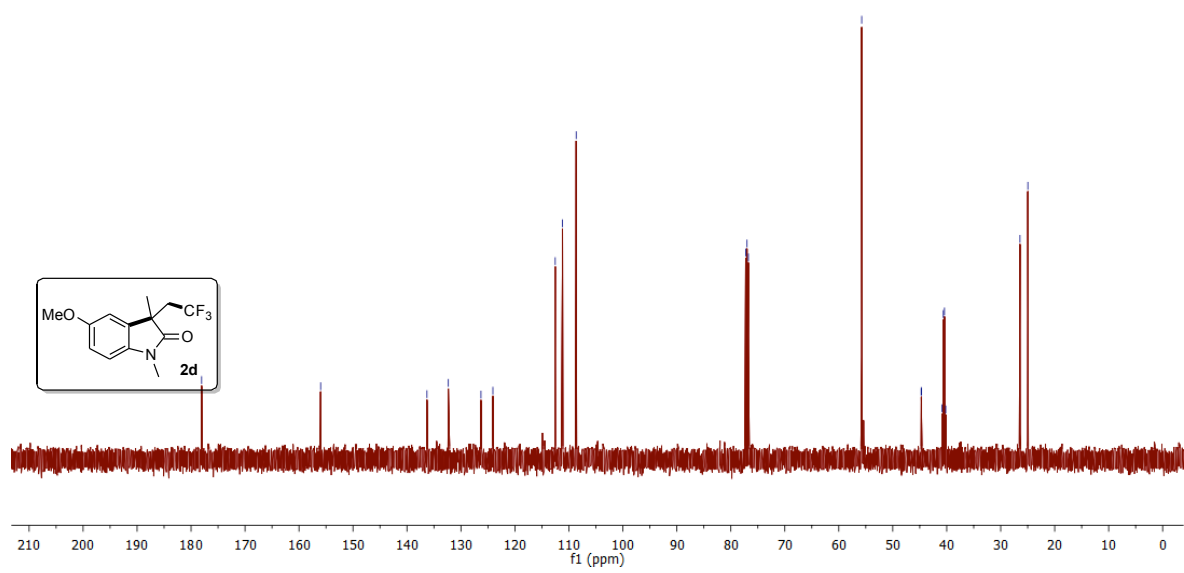
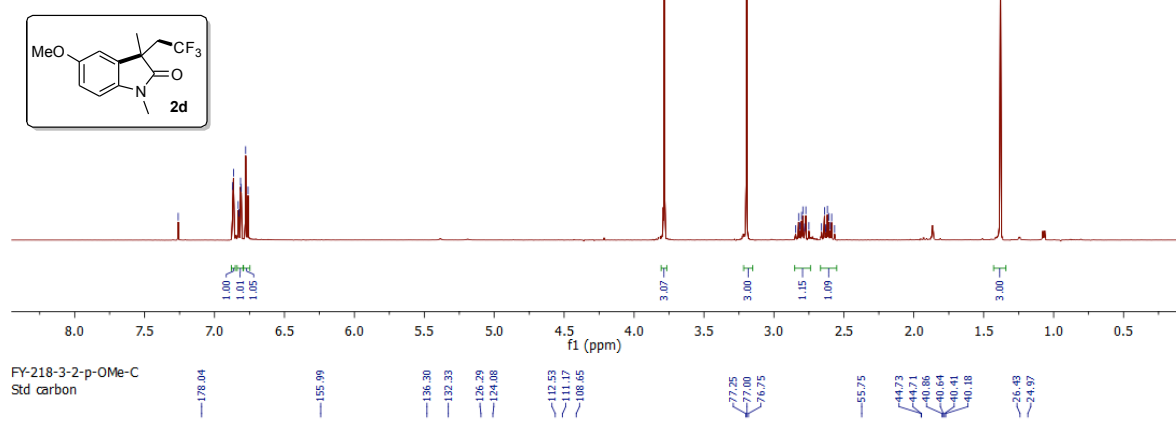
25.48



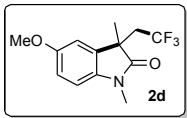
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61.83
61.86
61.89

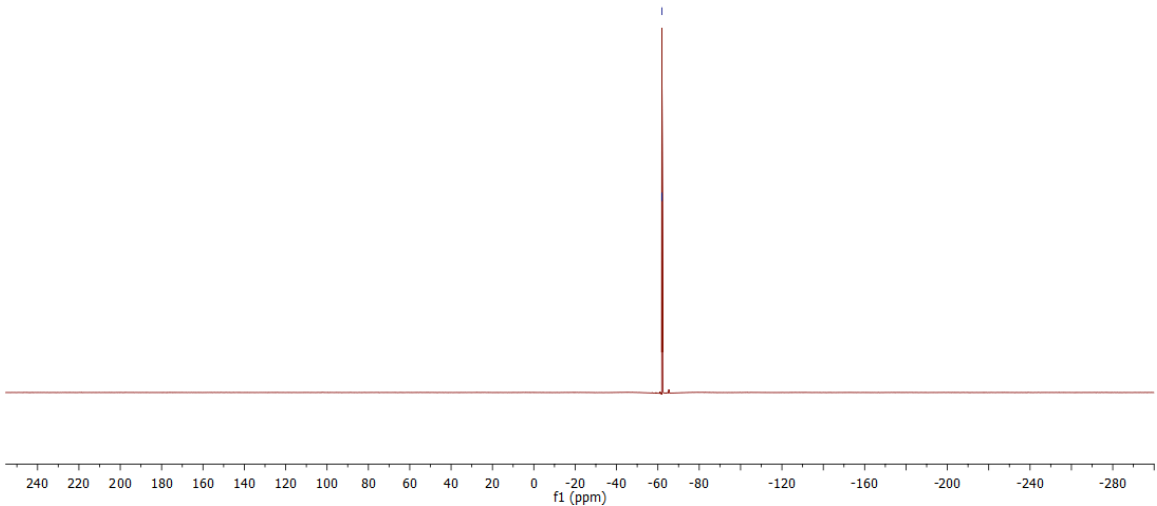




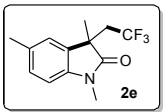
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61.90
61.92
61.95



FY-218-2-p-Me-H



7.26

7.11

7.03

7.00

6.77

6.76

3.21

2.82

2.79

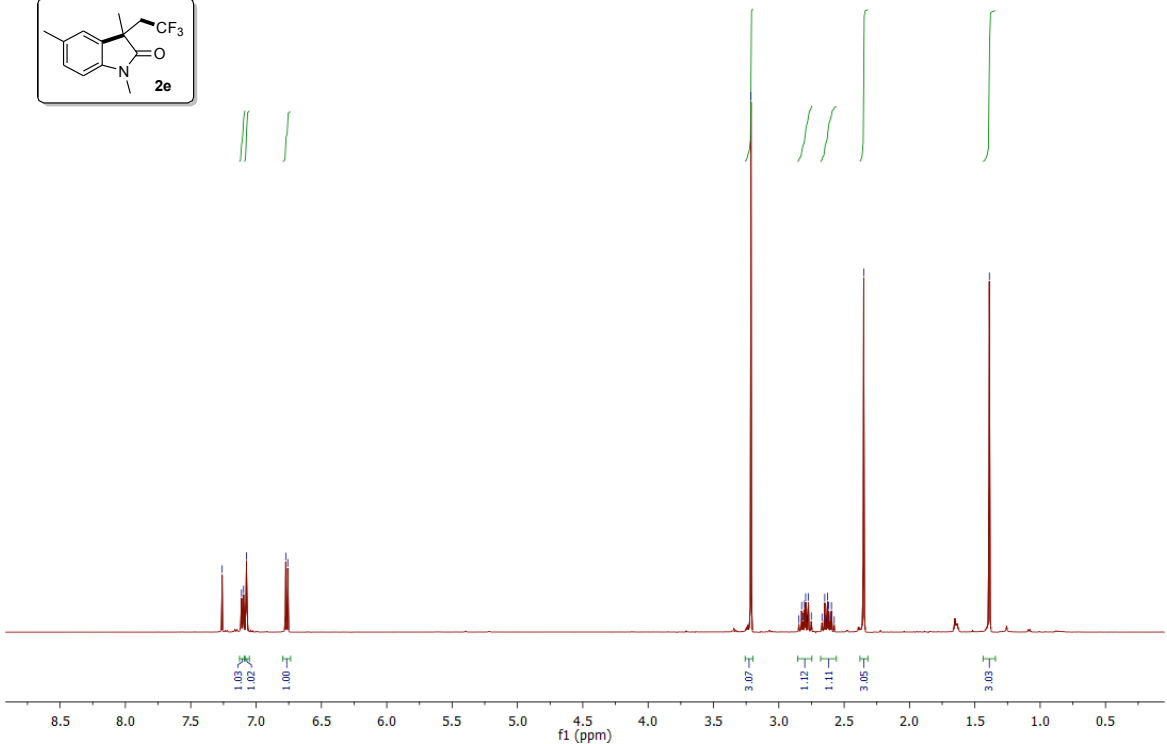
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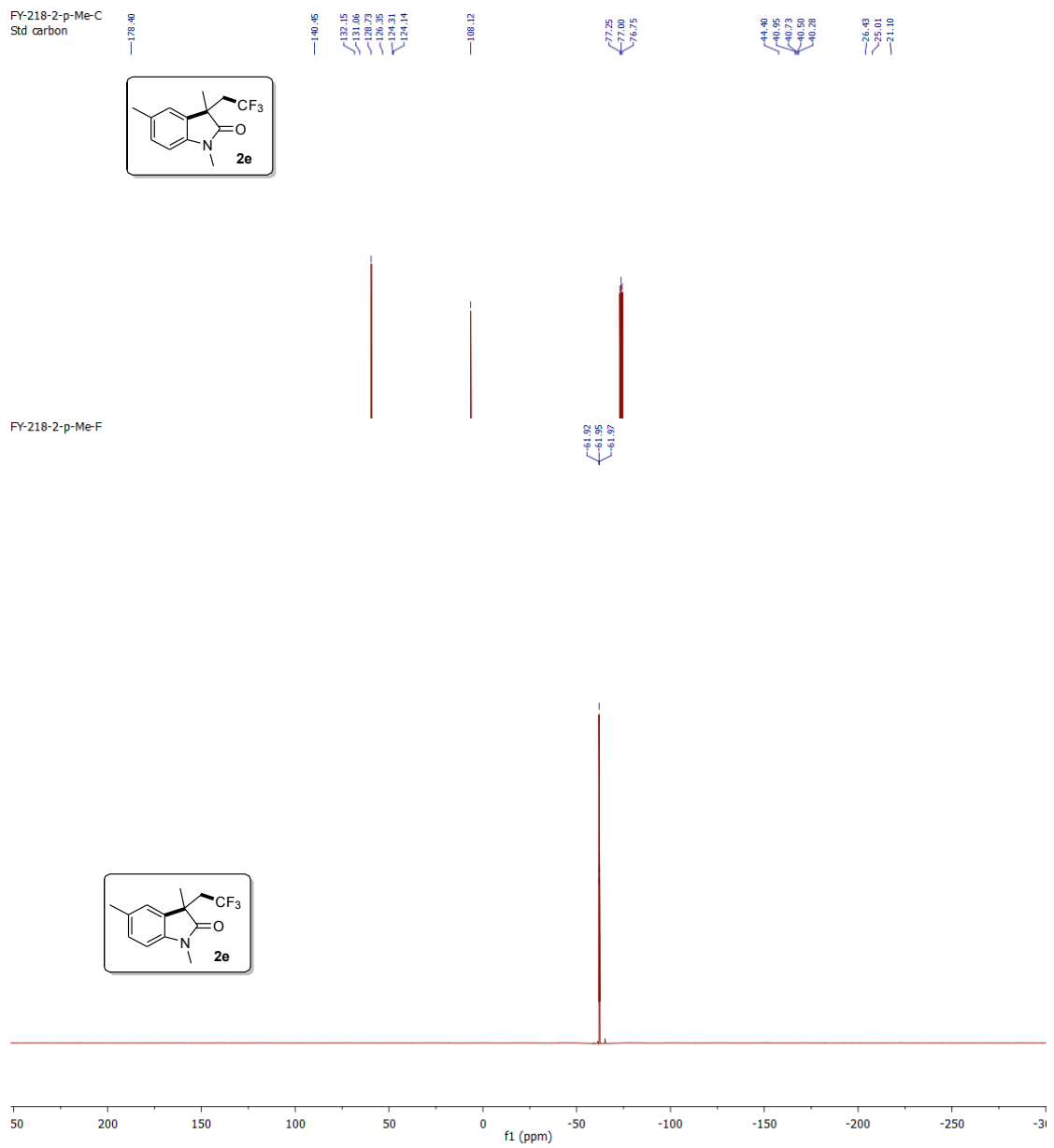
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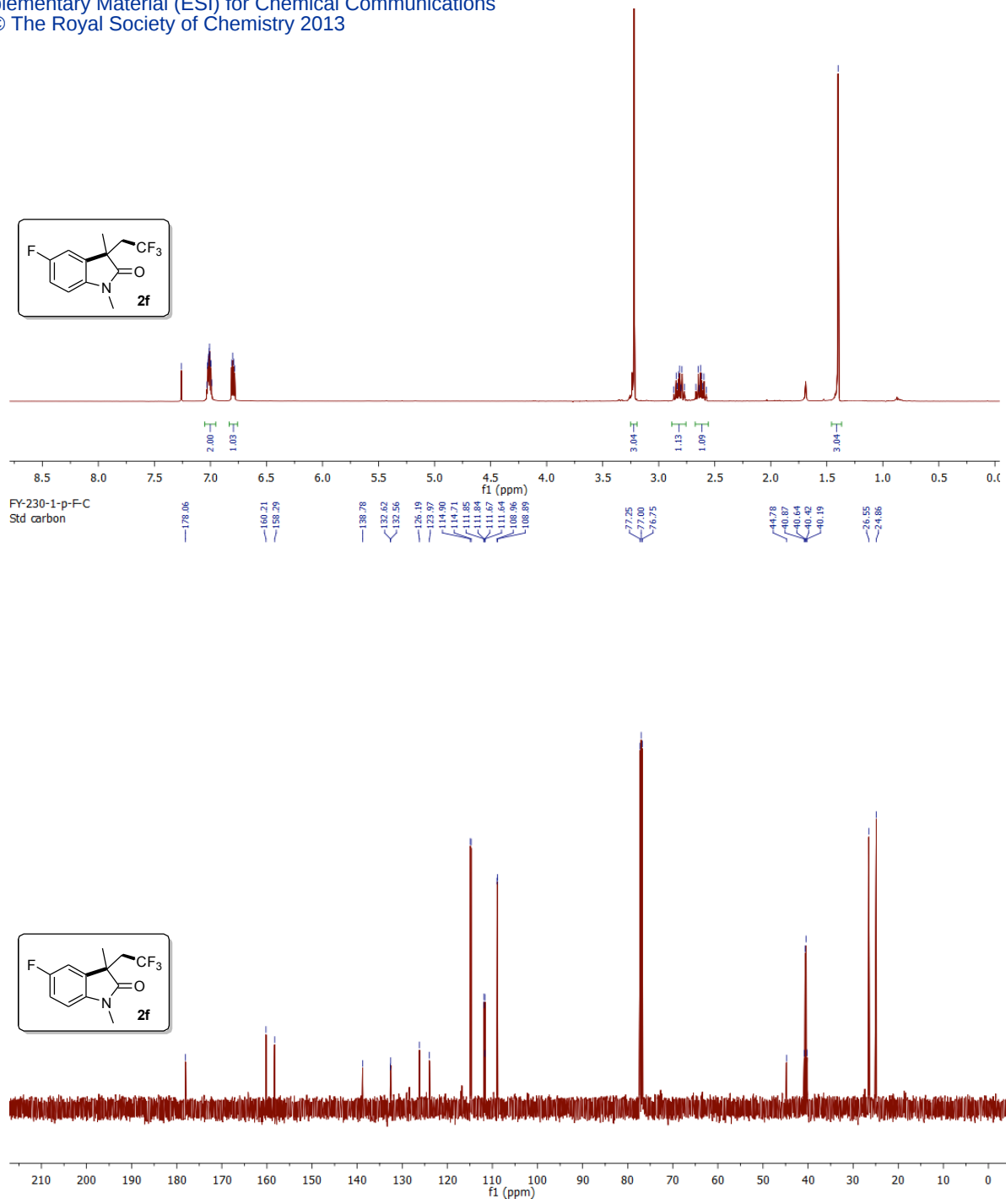
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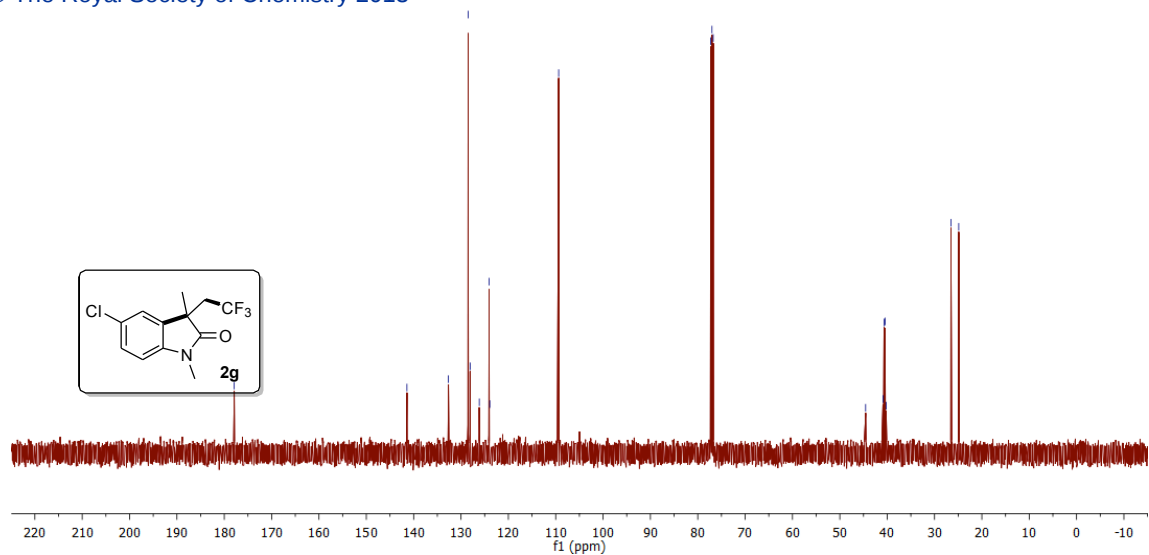
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1.39

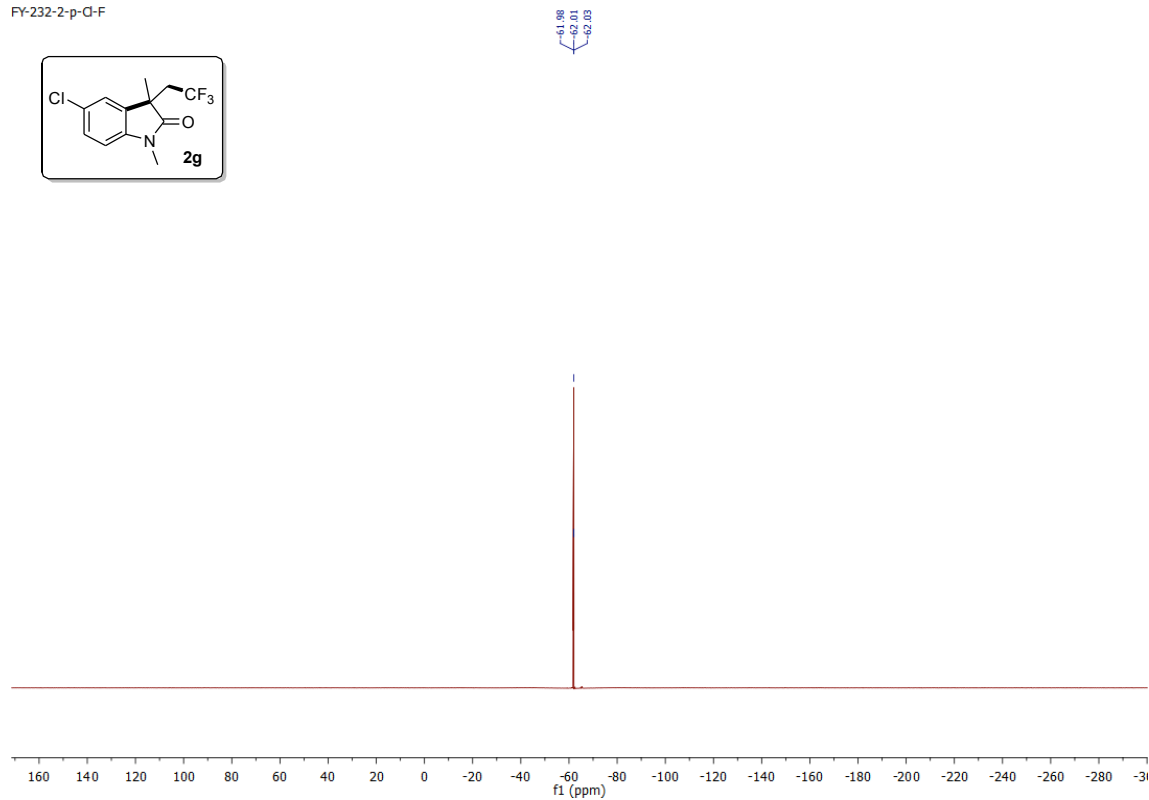


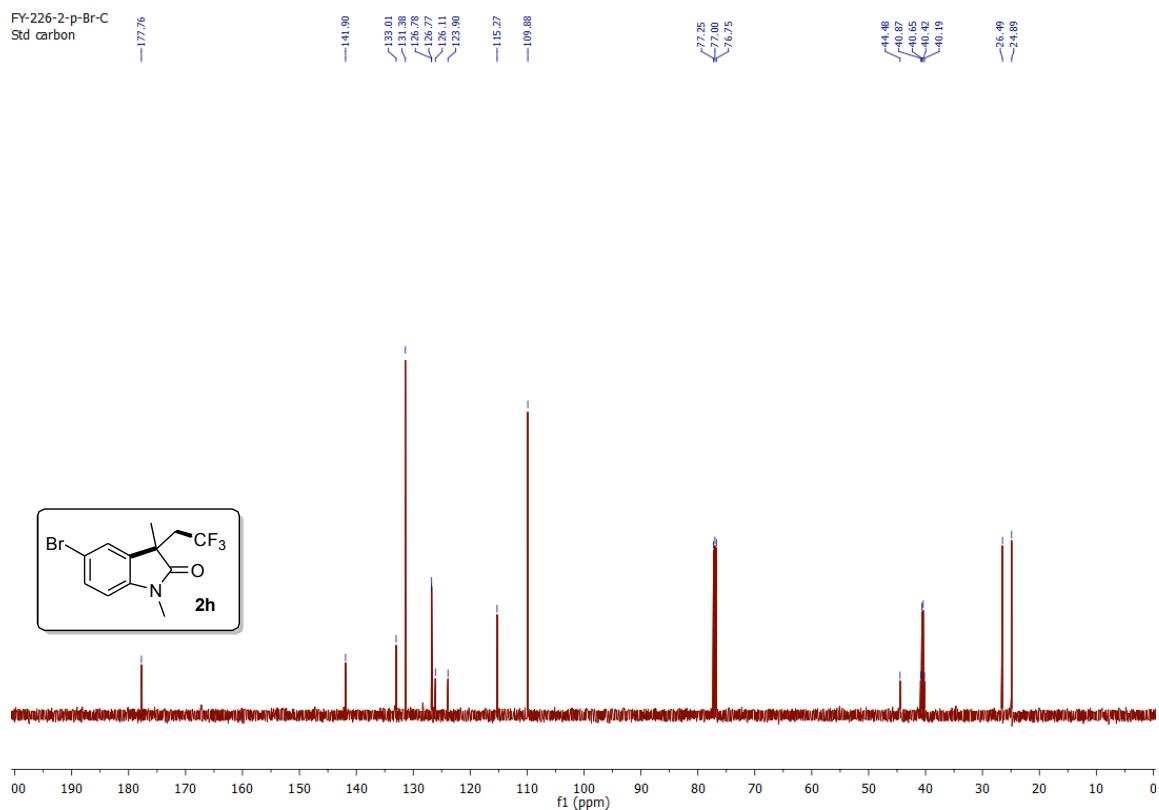
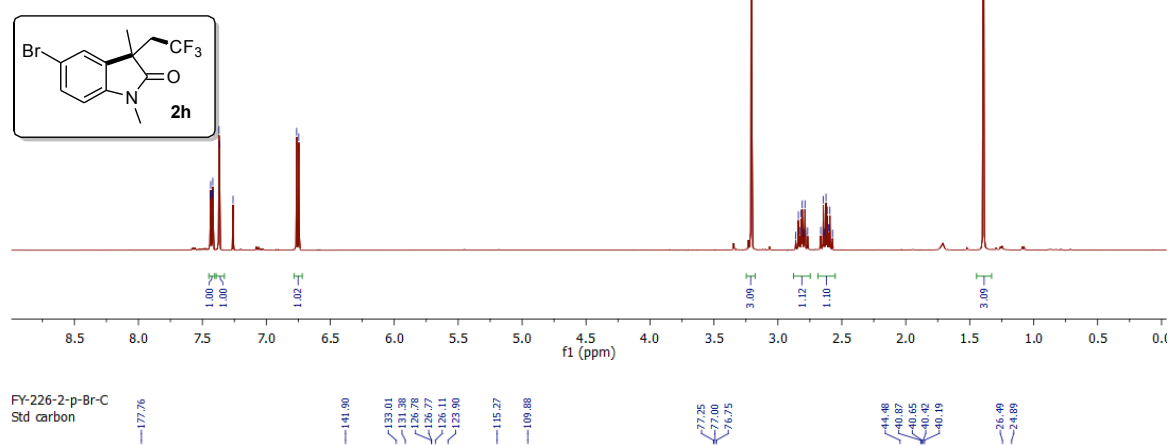


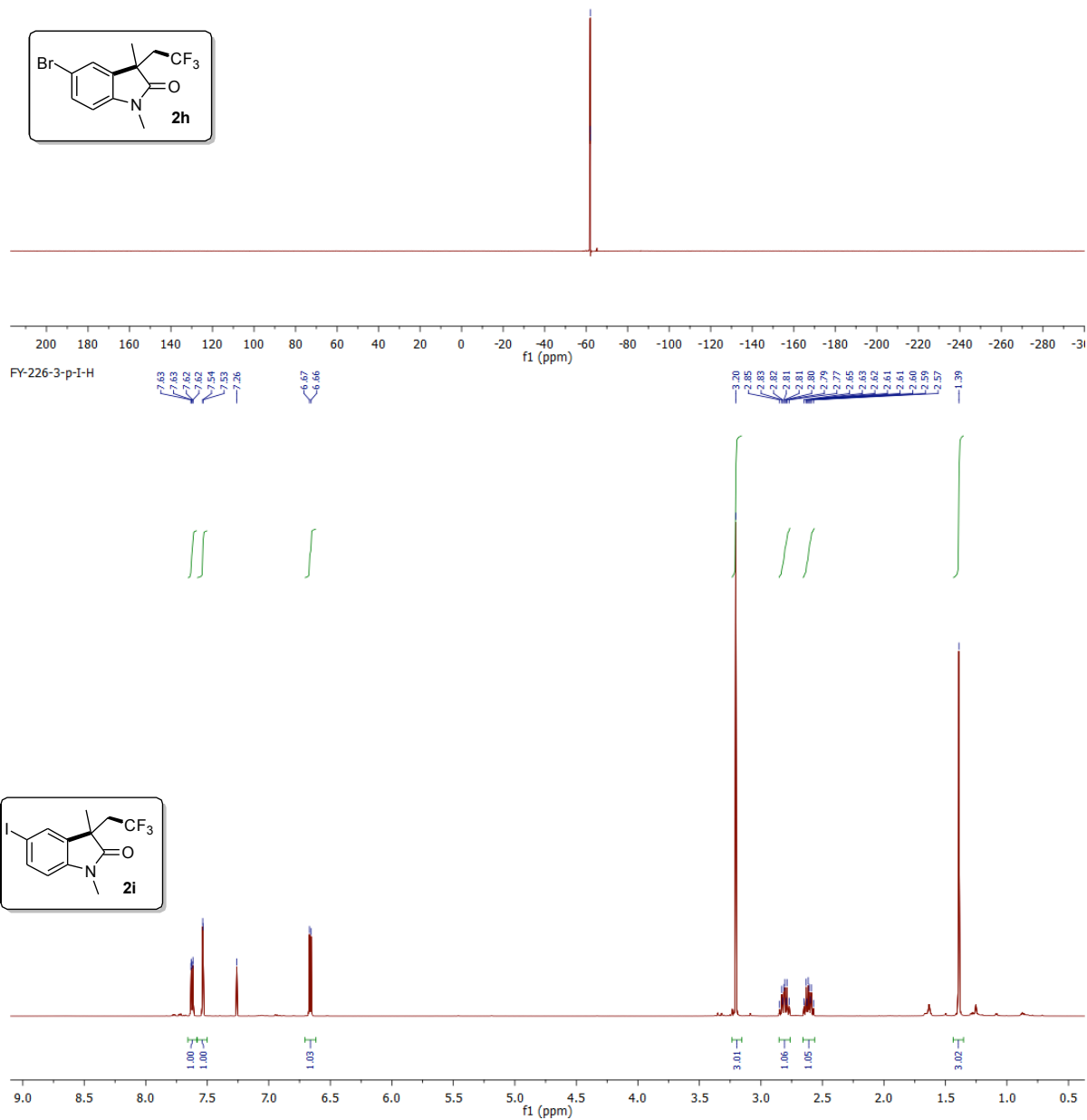


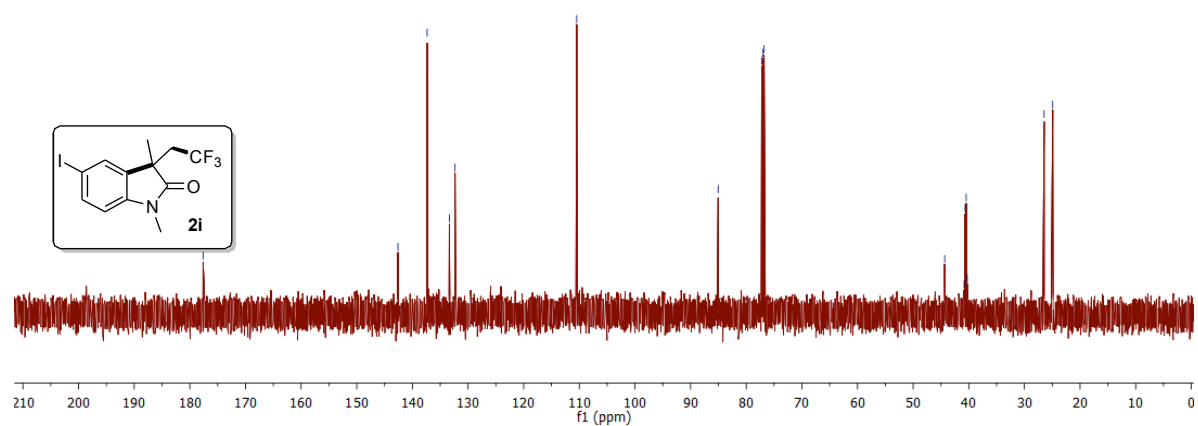


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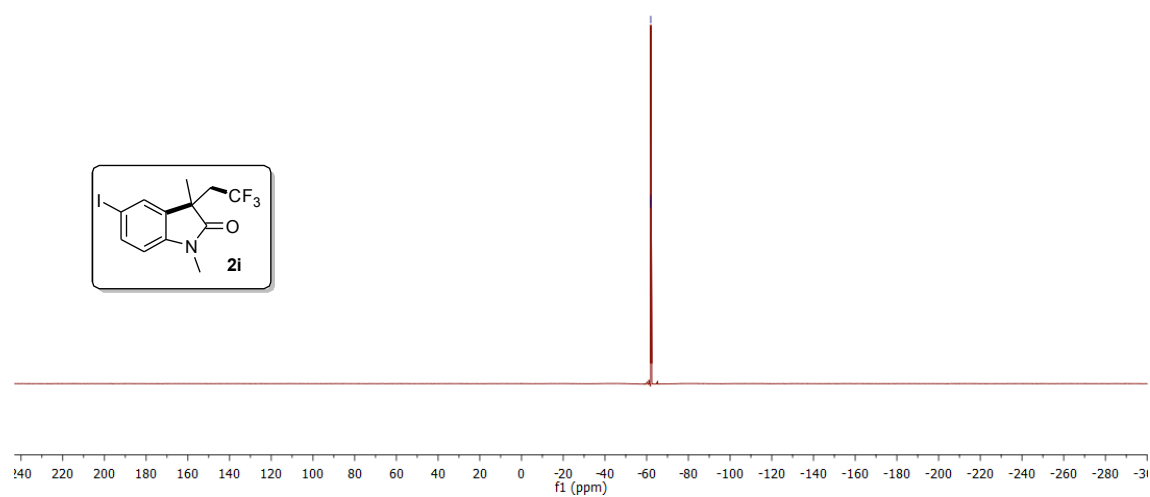


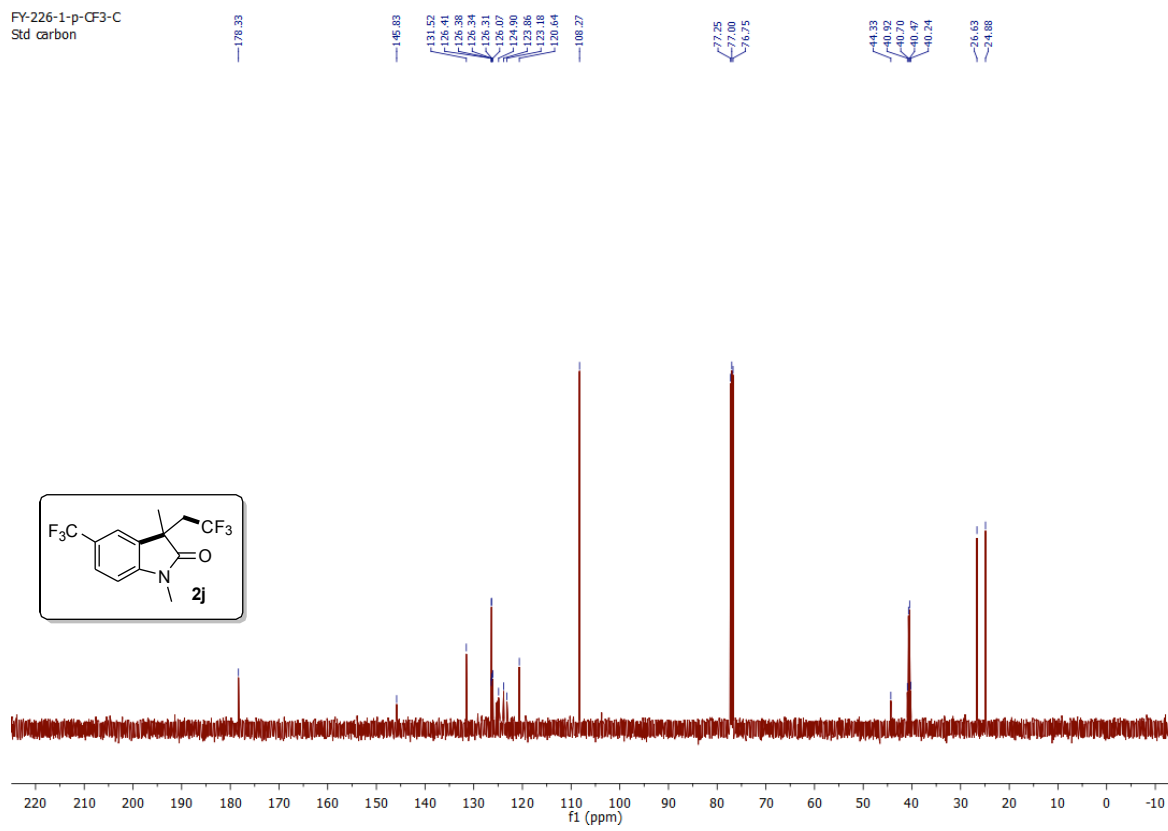
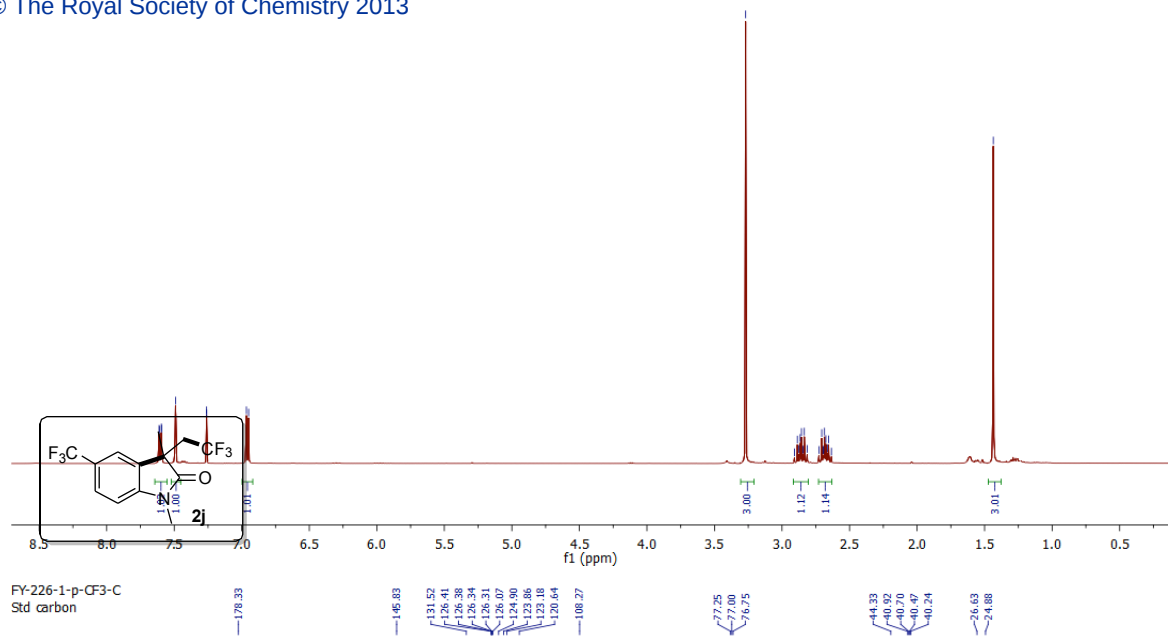


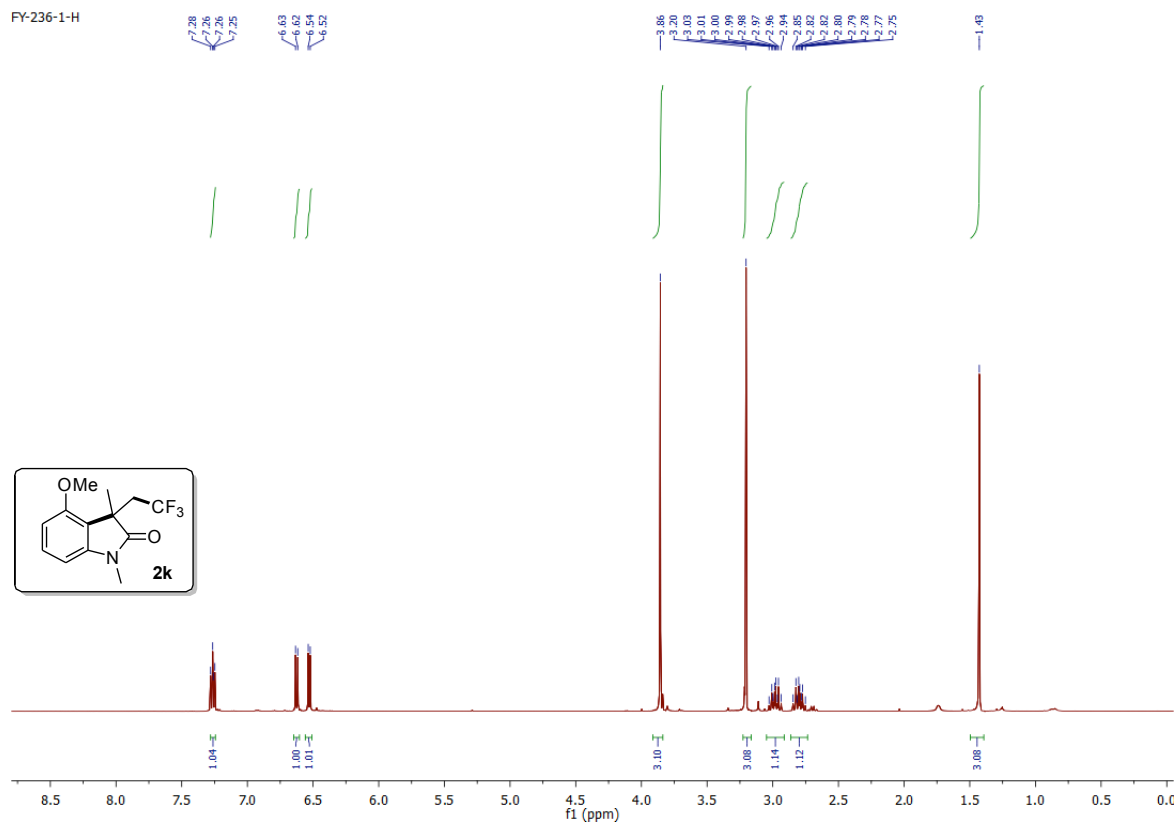
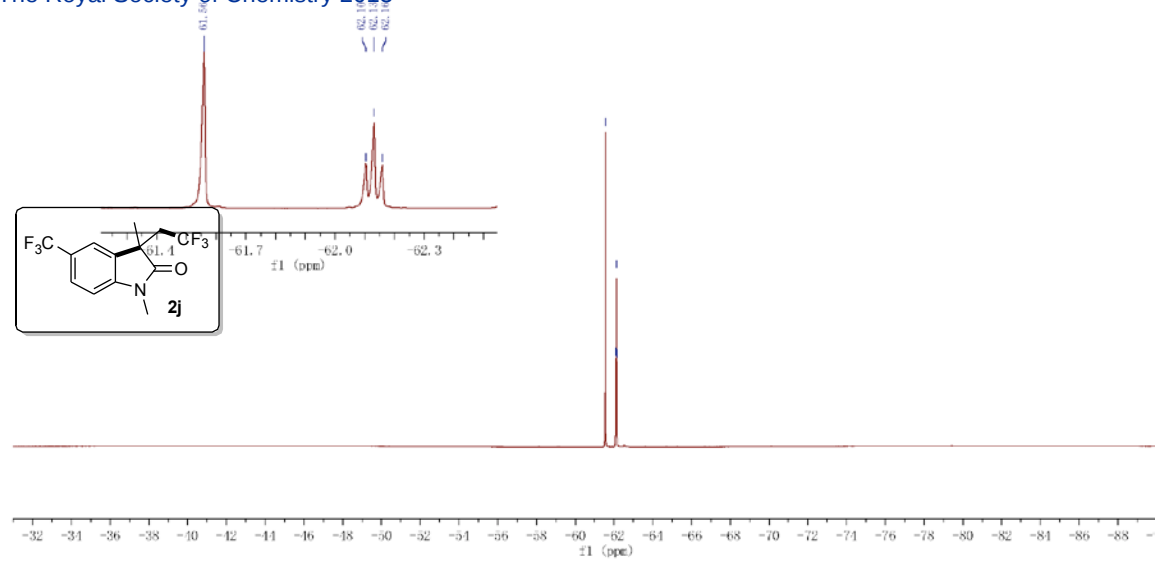


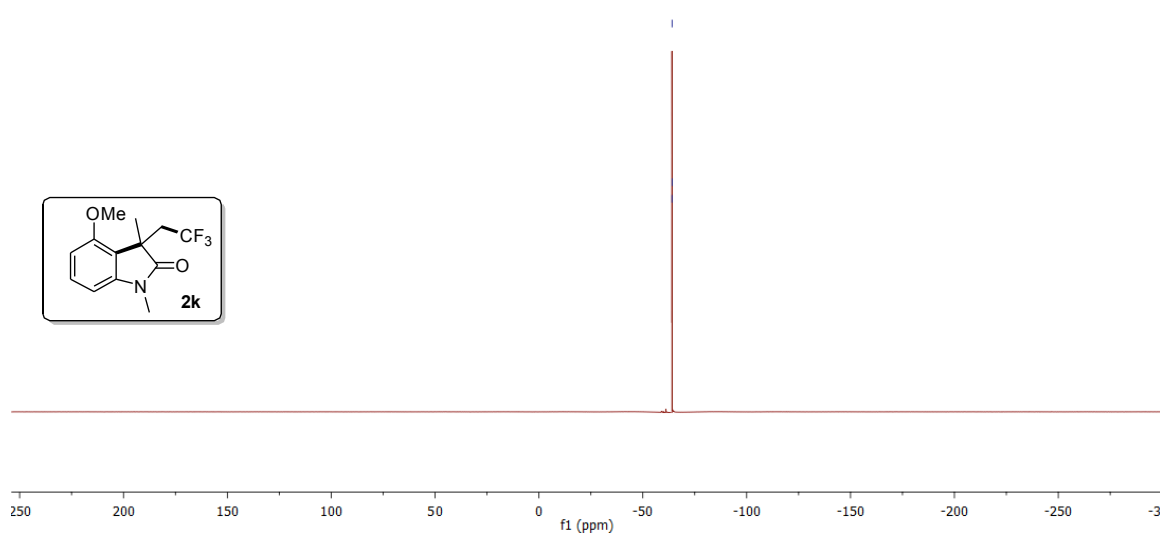
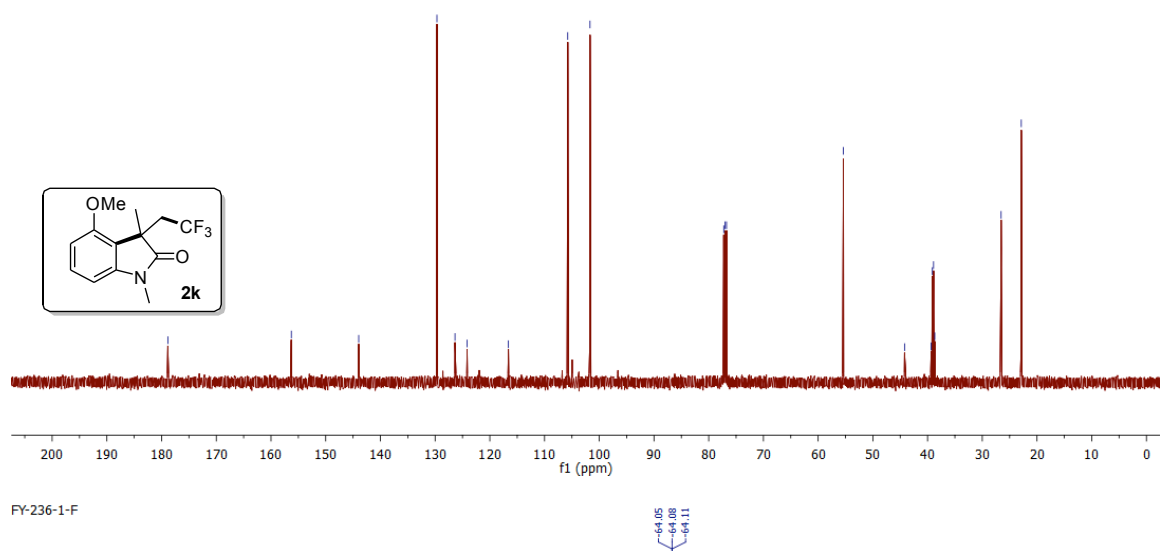
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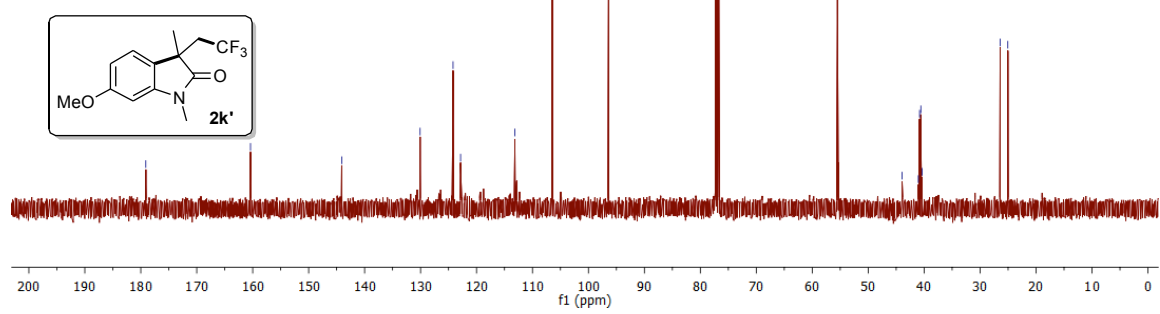
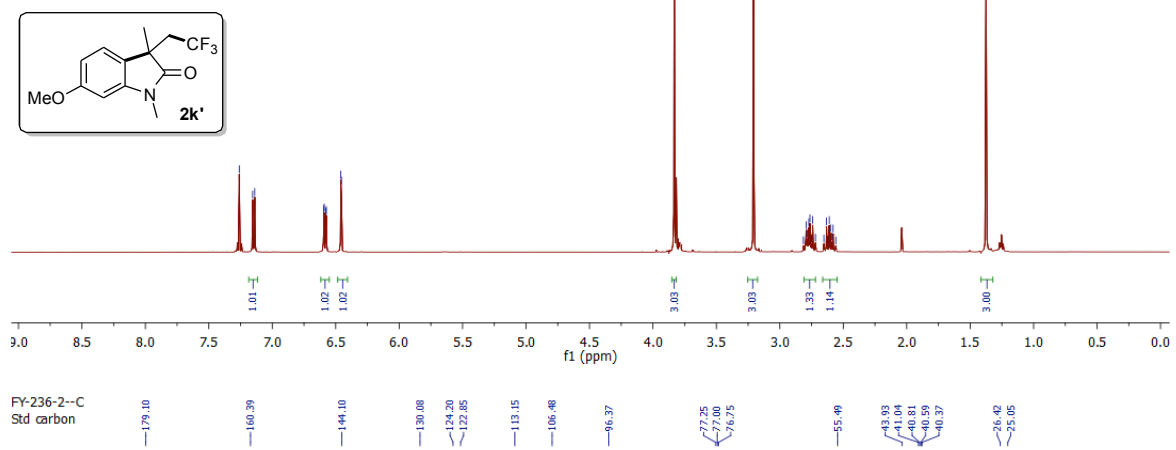
-61.96
-61.99
-62.02

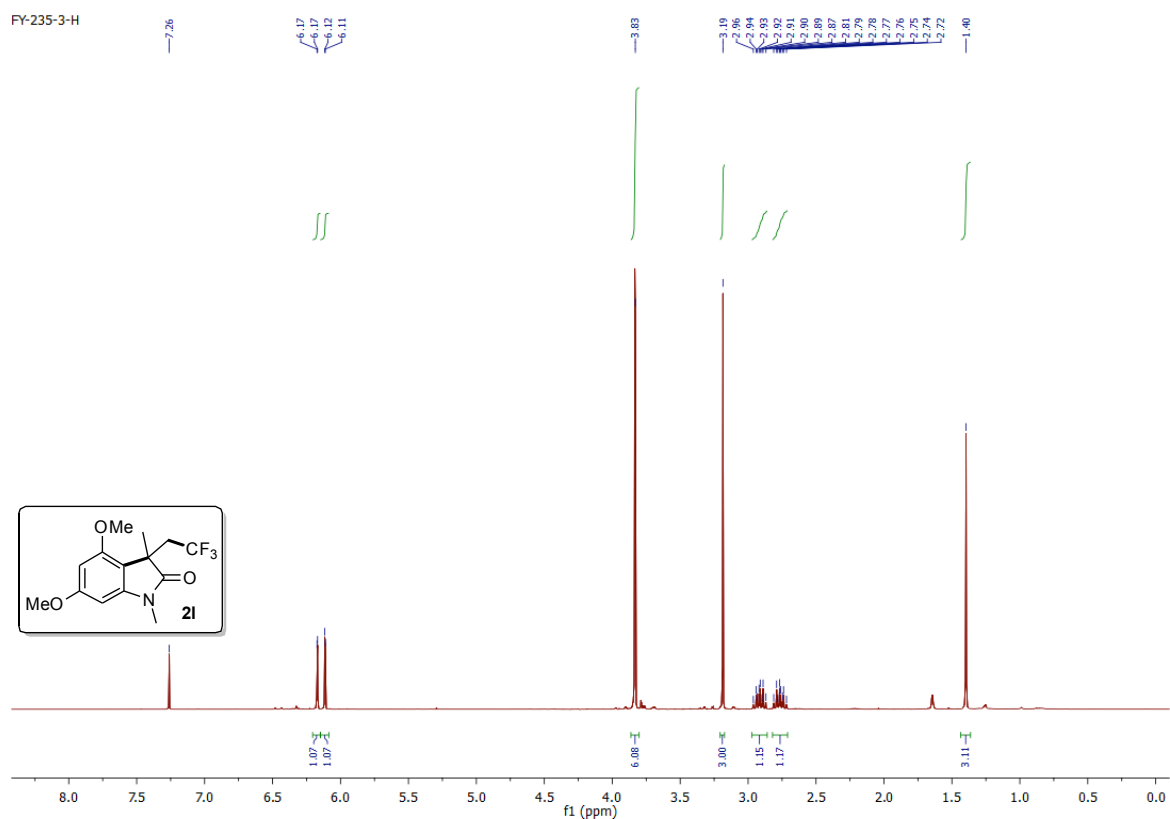
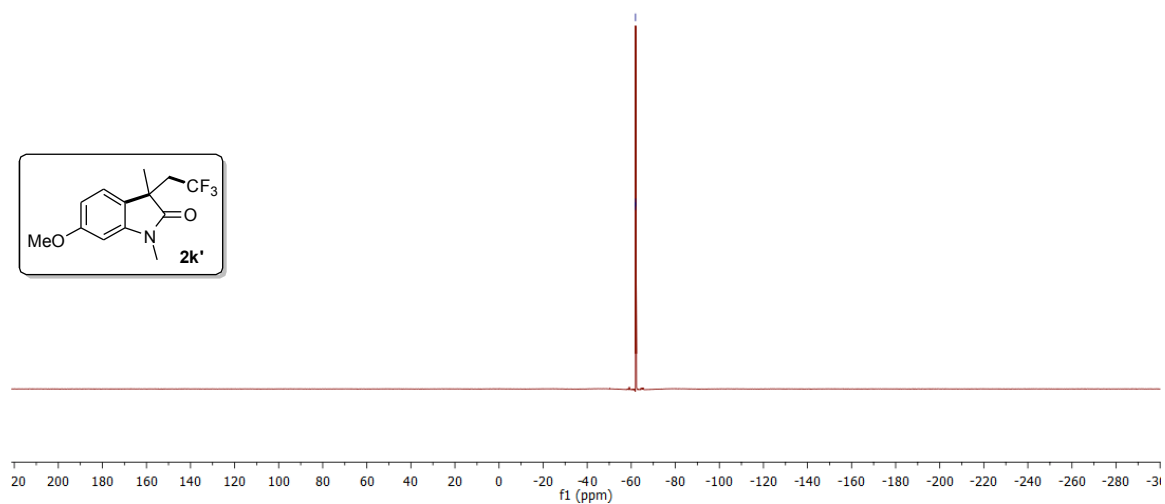


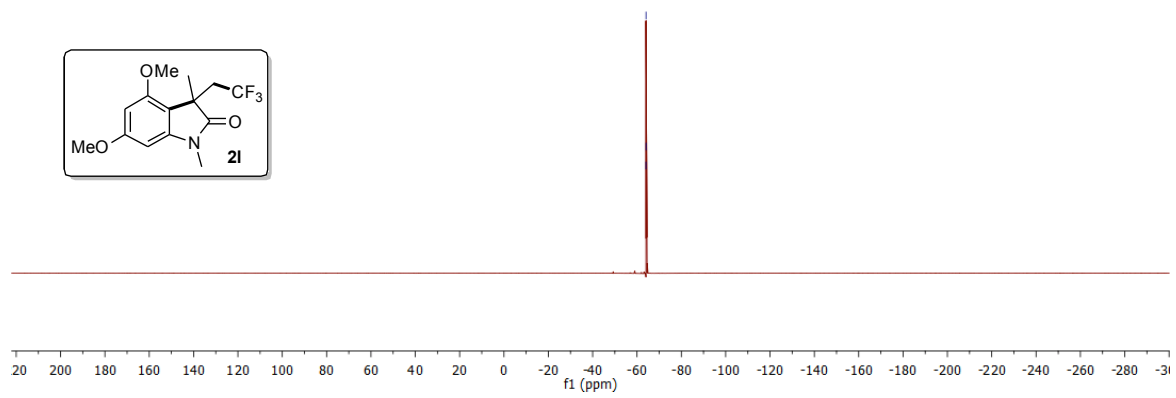
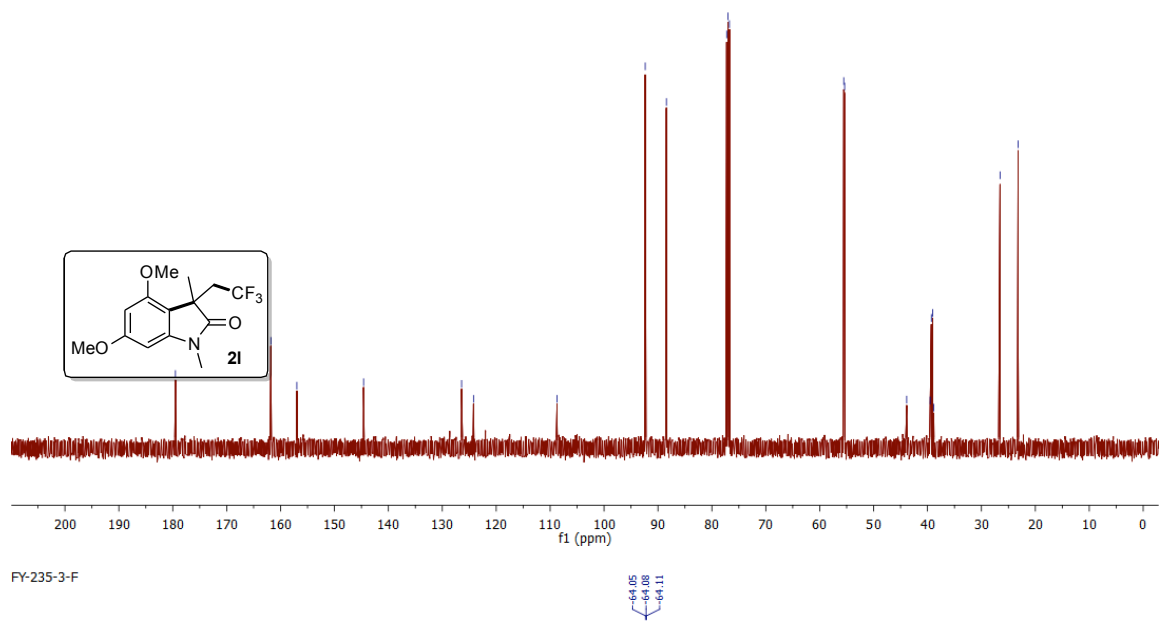


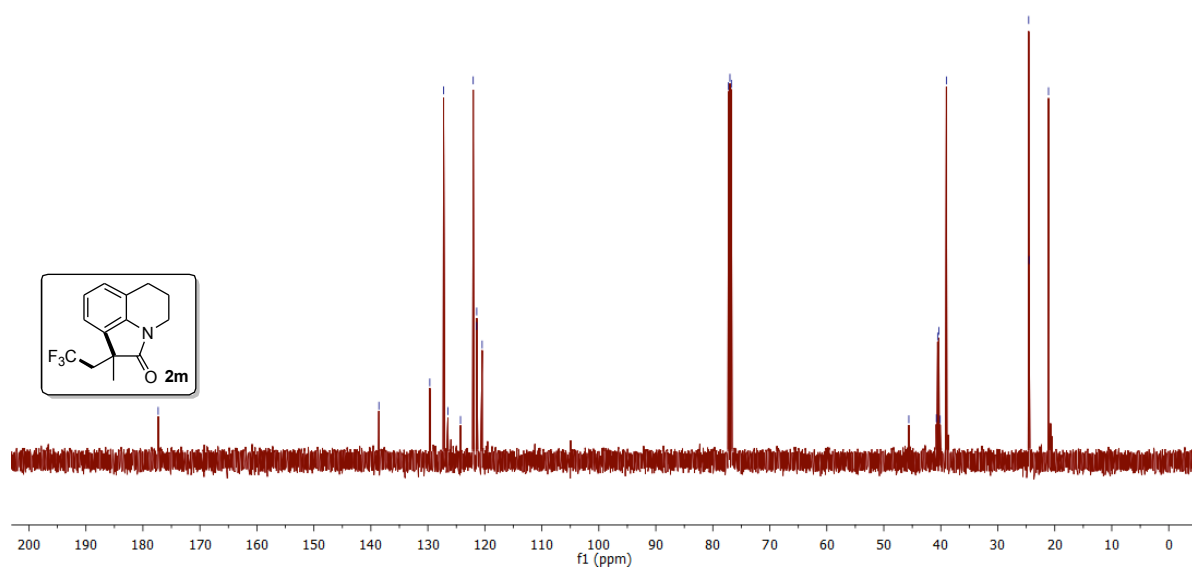
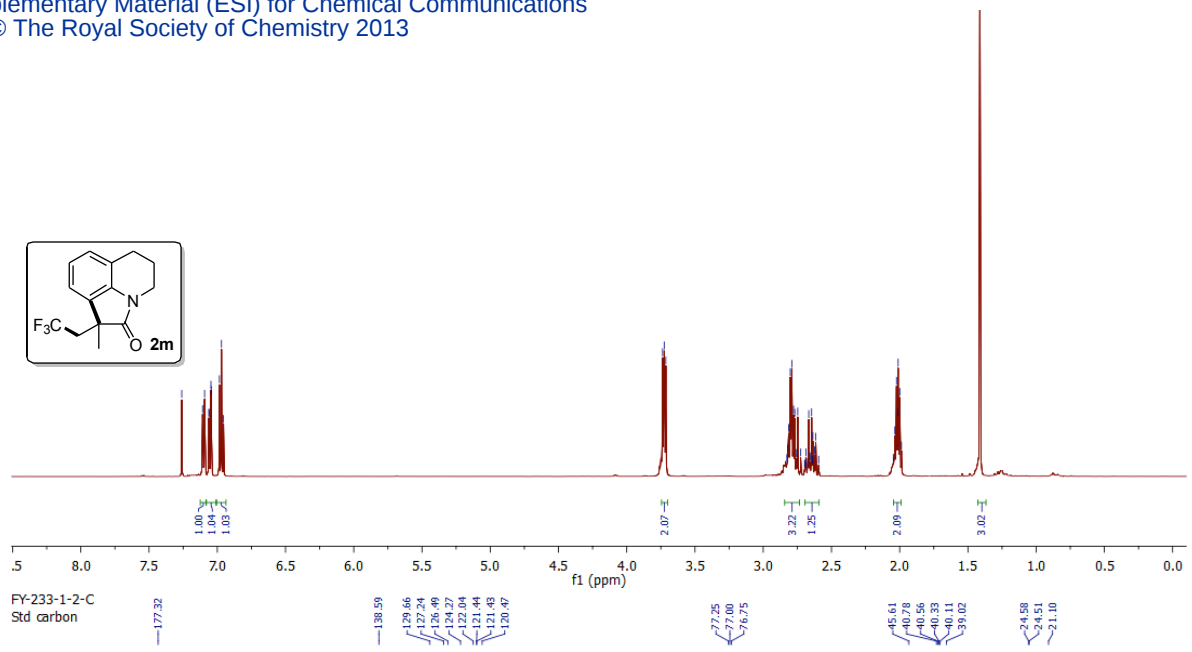


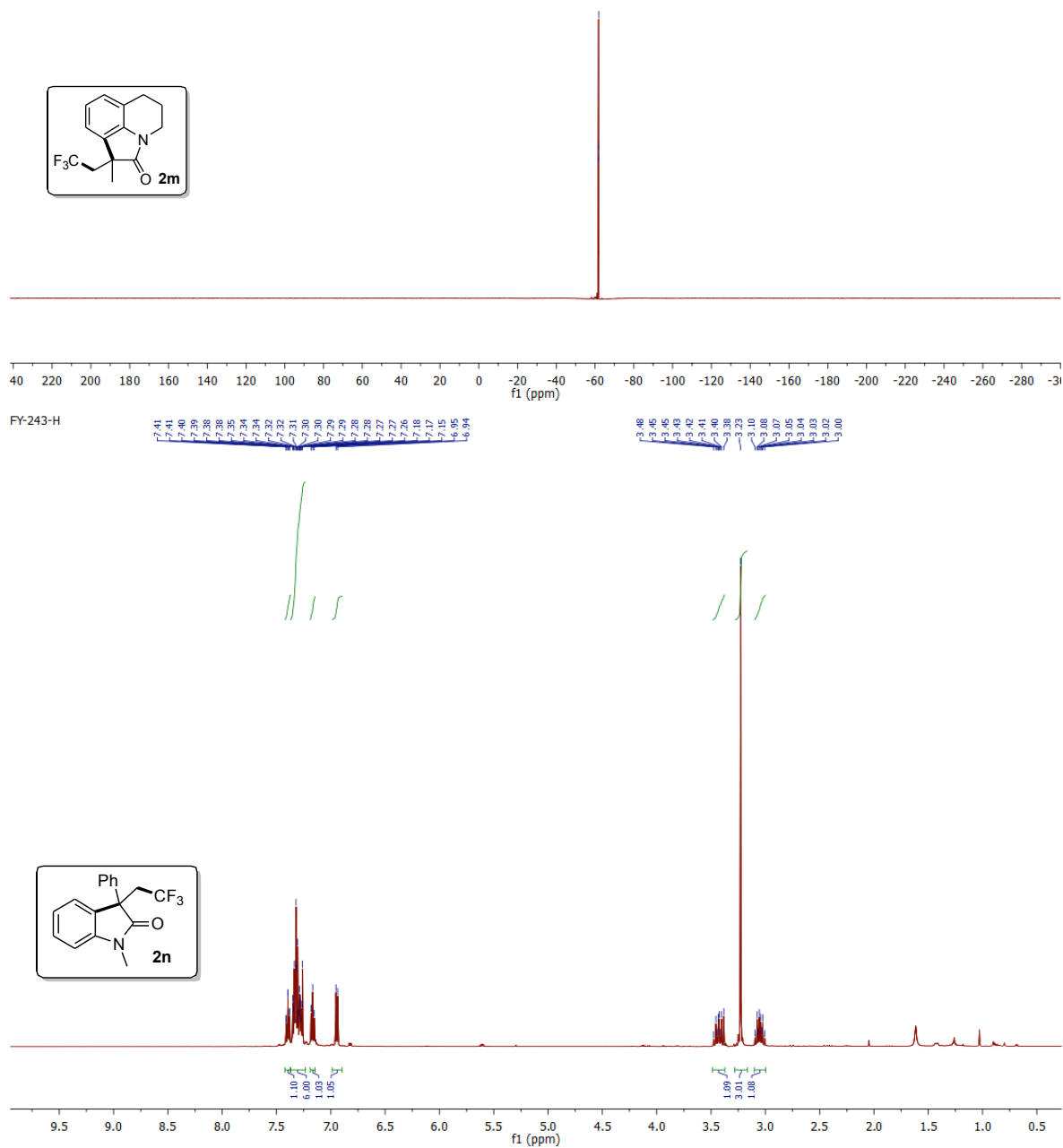


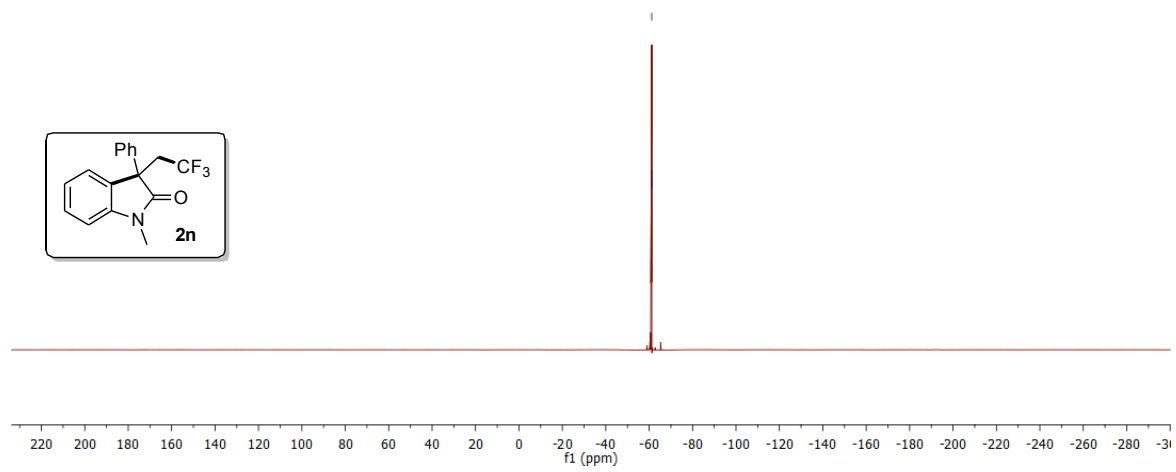
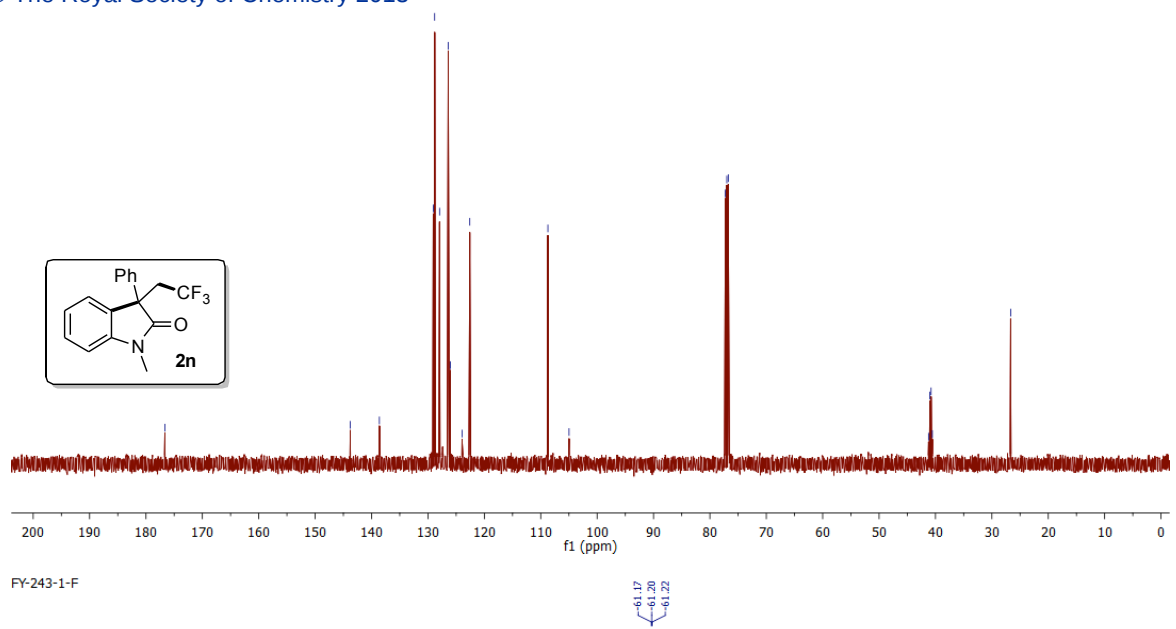


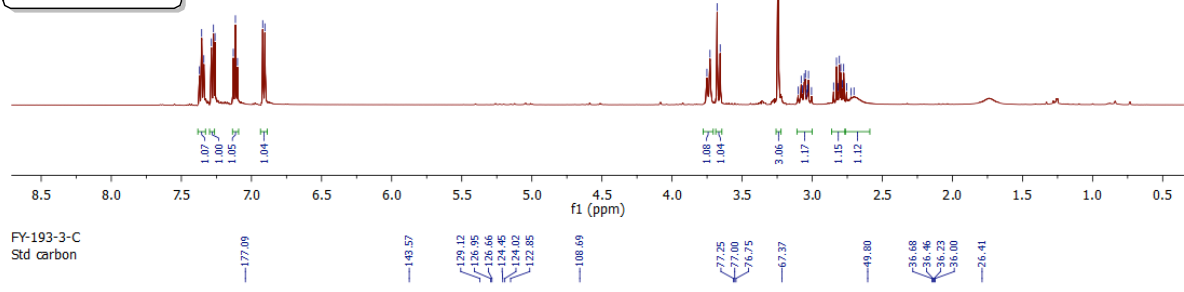
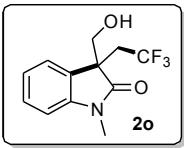












FY-193-3-C
Std carbon

