Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Copper-catalyzed cyclization reaction: synthesis of trifluoromethylated indolinyl ketones

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1. General Information

All air- and moisture-sensitive manipulations were carried out with standard Schlenk techniques under nitrogen or in a glove box under nitrogen. ^{1}H NMR, ^{13}C NMR, ^{19}F NMR spectra were measured at 300 MHz, 400 MHz (or 500 MHz) and 100 MHz (or 125 MHz) in $CDCl_3$ using TMS signal (δ 0.00 ppm) and the residual signals from $CHCl_3$ (δ 77.0 ppm) as internal references for ^{1}H and ^{13}C NMR respectively. Data for ^{1}H NMR spectra are reported as follows: chemical shift (δ, ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, m = multiplet), coupling constant (Hz), and integration. Reactions were monitored by thin layer chromatography (TLC) using silica gel plates. Flash column chromatography was performed over silica gel (300-400 mesh). Aniline were commercially available. According to the literatures [1], the starting material β-CF_3-enones were prepared.

2. Figure S1. The X-ray crystallographic data of 3a

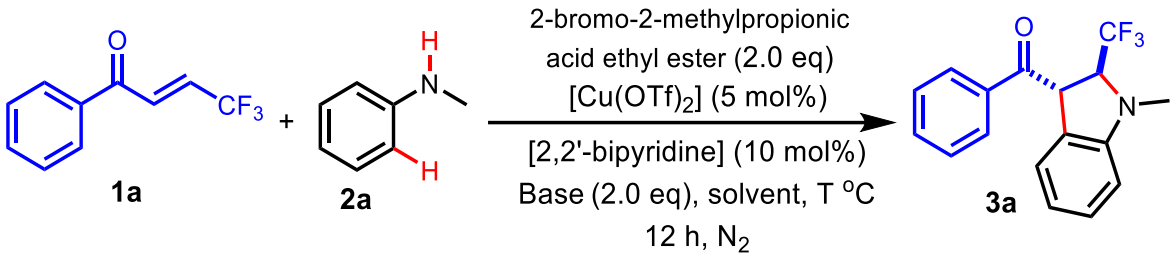
Recrystallization in hexane and dichloromethane afforded single crystals suitable for X-ray analysis. The **3a** was dissolved in DCM and hexane was added slowly and there is an upper layer formed. The small bottle was covered by a parafilm on the top with few small holes and the solvents was slowly evaporated until the crystal was formed.

3a

CCDC: 2063261

3. Optimization of Reaction Conditions[a]

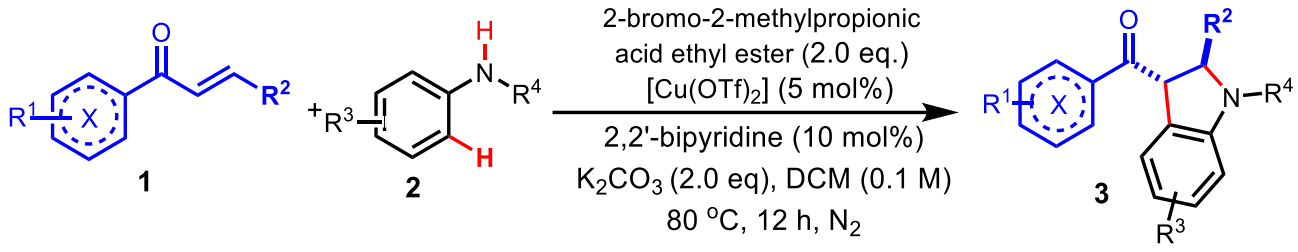
Table S1.



Entry	[Base]	[T]/ ℃	Solvent	Yield [%] [b,c]
1	K_3PO_4	80	DCM	69
2	Na_2CO_3	80	DCM	40
3	$NaHCO_3$	80	DCM	Trace
4	$KHCO_3$	80	DCM	70
5	KOH	80	DCM	ND
6	NaOH	80	DCM	Trace
7	Cs_2CO_3	80	DCM	ND
8	K_2CO_3	80	DCM	78
9	K_2CO_3	100	DCM	76
10	K_2CO_3	60	DCM	68
11	K_2CO_3	40	DCM	30
12	K_2CO_3	25	DCM	Trace
15	K_2CO_3	80	Acetone	ND
16	K_2CO_3	80	dioxane	ND

[a]Unless otherwise noted, all reactions were carried out with 0.2 mmol of **1a**, 0.2 mmol of **2a**, 2.0 equiv of base, 2.0 equiv of 2-bromo-2-methylpropionic acid ethyl ester, 5 mol% of catalyst ([Cu] to L = 1:2) in 2.0 mL solvent for 12 h. [b]Isolated yield. [c] Unless otherwise noted, the dr > 20:1, the diastereomeric ratio was determined by ^{1}H NMR analysis of the crude products. ND = no detected.

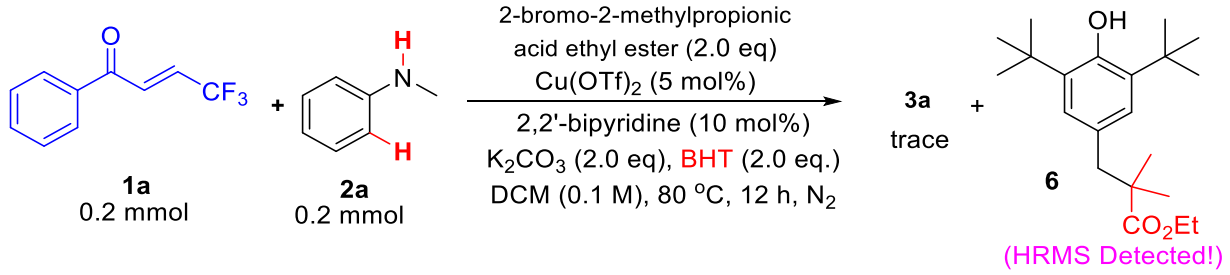
4. General procedure for tandem annulation Reaction



A mixture of $Cu(OTf)_2$ (3.6 mg, 5 mol%), 2,2'-bipyridine (3.1 mg, 10 mol%), K_2CO_3 (0.4 mmol) in DCM (2.0 mL) under nitrogen atmosphere, then **1** (0.2 mmol), **2** (0.2 mmol), 2-bromo-2-methylpropionic acid ethyl ester (0.4 mmol) were added to this mixture. The resulting mixture was then stirred at 80 °C for about 12 h. After cooling to room temperature, the solution was removed by reducing pressure distillation to yield a residue, which was purified by chromatography on a short silica gel column (hexane/EtOAc = 100/1) to afford the desired product **3**.

5. Preliminary mechanistic study

5.1 Free radical-trapping with BHT



A mixture of $Cu(OTf)_2$ (3.6 mg, 5 mol%), 2,2'-bipyridine (3.1 mg, 10 mol%), K_2CO_3 (0.4 mmol) in DCM (2.0 mL) under nitrogen atmosphere, then **1a** (0.2 mmol), **2a** (0.2 mmol), 2-bromo-2-methylpropionic acid ethyl ester (0.4 mmol) and BHT (88.1 mg, 0.40 mmol) were added to this mixture. The resulting mixture was then stirred at 80 °C for about 12 h. The reaction was completely inhibited, along with the formation of its adduct **6** with BHT. The following figure is the HRMS analysis of reaction mixture (Figure S2).

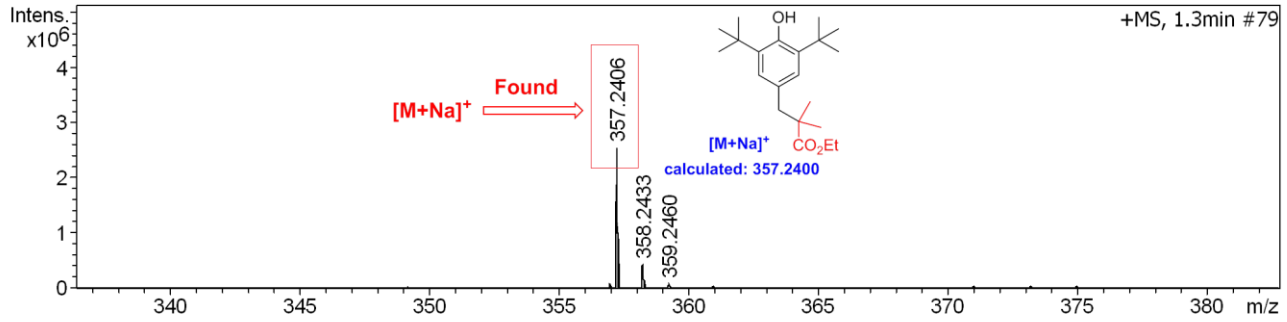
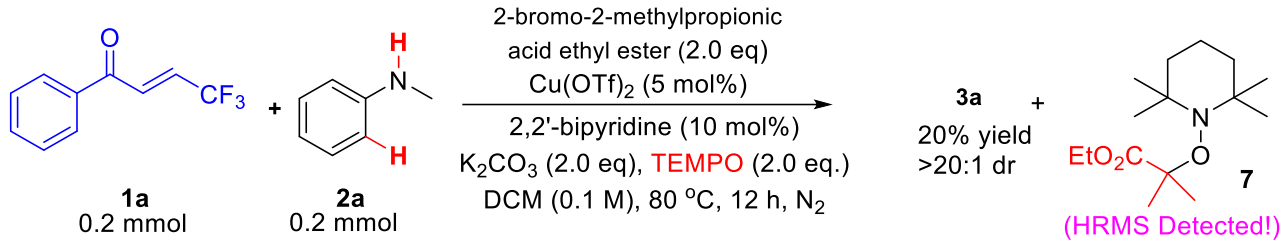


Figure S2. Analysis of reaction mixture by HRMS

5.2 Free radical-trapping with TEMPO



A mixture of $Cu(OTf)_2$ (3.6 mg, 5 mol%), 2,2'-bipyridine (3.1 mg, 10 mol%), K_2CO_3 (0.4 mmol) in DCM (2.0 mL) under nitrogen atmosphere, then **1a** (0.2 mmol), **2a** (0.2 mmol), 2-bromo-2-methylpropionic acid ethyl ester (0.4 mmol) and TEMPO (62.5 mg, 0.40 mmol) were added to this mixture. The resulting mixture was then stirred at 80 °C for about 12 h. The compound **7** via an addition of 2-methylpropionic acid ethyl ester and TEMPO was detected. The following figure is the HRMS analysis of reaction mixture (Figure S3).

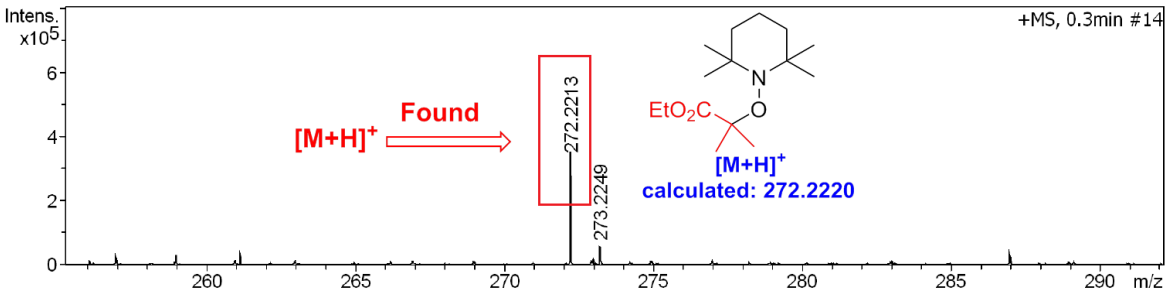
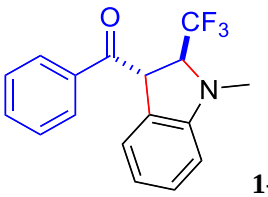


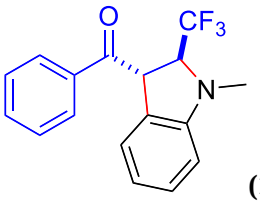
Figure S3. Analysis of reaction mixture by HRMS

6. Characterization data for the products



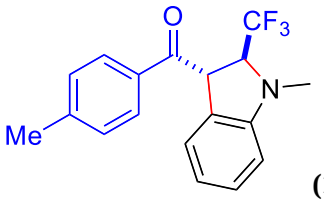
1-methyl-2-(trifluoromethyl)indolin-3-yl)(phenyl)methanone: **3a**

White solid. 48.0 mg, 78% yield. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.10 – 8.07 (m, 2H), 7.70 – 7.65 (m, 1H), 7.59 – 7.54 (m, 2H), 7.14 (t, *J* = 7.8 Hz, 1H), 6.74 (d, *J* = 7.6 Hz, 1H), 6.61 – 6.55 (m, 2H), 5.19 (d, *J* = 6.6 Hz, 1H), 4.77 – 4.69 (m, 1H), 3.04 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 194.61, 152.02, 136.06, 134.04, 129.45, 129.36, 129.08, 126.02 (q, *J* = 278.6 Hz), 124.73, 124.25, 118.88, 109.03, 67.62 (q, *J* = 29.9 Hz), 49.99, 36.89; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.03; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{14}F_3NNaO$: 328.0920, Found: 328.0911.



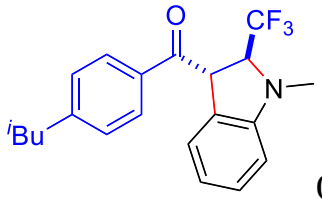
(1-methyl-2-(trifluoromethyl)indolin-3-yl)(phenyl)methanone: from Z-enone, **3a**

White solid. 41.5 mg, 68% yield: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.09 (t, *J* = 7.4 Hz, 2H), 7.69 (t, *J* = 7.0 Hz, 1H), 7.58 (t, *J* = 8.0 Hz, 2H), 7.14 (t, *J* = 7.5 Hz, 1H), 6.74 (d, *J* = 7.5 Hz, 1H), 6.61 – 6.57 (m, 2H), 5.19 (d, *J* = 6.5 Hz, 1H), 4.76 – 4.70 (m, 1H), 3.04 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 194.62, 152.03, 136.04, 134.09, 129.49, 129.38, 129.11, 126.01 (q, *J* = 278.5 Hz), 124.72, 124.27, 118.90, 109.06, 67.59 (q, *J* = 29.8 Hz), 49.98, 36.95; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.05; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{14}F_3NNaO$: 328.0920, Found: 328.0912.



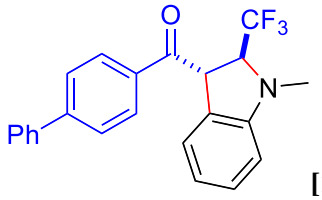
(1-methyl-2-(trifluoromethyl)indolin-3-yl)(p-tolyl)methanone: 3b

White solid. 49.2 mg, 77% yield.: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.99 (d, *J* = 8.0 Hz, 2H), 7.36 (d, *J* = 8.0 Hz, 2H), 7.13 (t, *J* = 7.5 Hz, 1H), 6.76 (d, *J* = 7.5 Hz, 1H), 6.60 – 6.56 (m, 2H), 5.16 (d, *J* = 7.0 Hz, 1H), 4.75 – 4.70 (m, 1H), 3.03 (s, 3H), 2.46 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 194.18, 152.05, 145.17, 133.49, 129.81, 129.63, 129.30, 126.06 (q, *J* = 278.5 Hz), 124.98, 124.27, 118.88, 109.04, 67.64 (q, *J* = 29.8 Hz), 49.87, 36.97, 21.76; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.98; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{16}F_3NNaO$: 342.1076, Found: 342.1082.



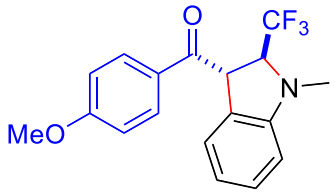
(4-isobutylphenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3c

White solid. 47.0 mg, 65% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 8.4 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.14 (t, *J* = 7.6 Hz, 1H), 6.77 (d, *J* = 7.6 Hz, 1H), 6.61 – 6.57 (m, 2H), 5.17 (d, *J* = 6.4 Hz, 1H), 4.75 – 4.69 (m, 1H), 3.04 (s, 3H), 2.59 (d, *J* = 7.2 Hz, 2H), 2.02 – 1.90 (m, 1H), 0.95 (d, *J* = 6.4 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 194.27, 152.06, 148.83, 133.74, 129.80, 129.47, 129.27, 126.04 (q, *J* = 278.6 Hz), 125.04, 124.24, 118.86, 109.00, 67.71 (q, *J* = 29.8 Hz), 49.87, 45.47, 36.95, 30.12, 22.38; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.96; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{21}H_{22}F_3NNaO$: 384.1546, Found: 384.1539.



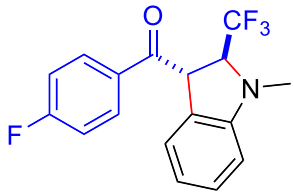
[1,1'-biphenyl]-4-yl(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3d

White solid. 61.0 mg, 80% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.17 (d, *J* = 8.4 Hz, 2H), 7.80 (d, *J* = 8.4 Hz, 2H), 7.69 – 7.67 (m, 2H), 7.50 (t, *J* = 7.2 Hz, 2H), 7.45 – 7.41 (m, 1H), 7.15 (t, *J* = 7.6 Hz, 1H), 6.82 (d, *J* = 7.6 Hz, 1H), 6.62 – 6.59 (m, 2H), 5.22 (d, *J* = 6.4 Hz, 1H), 4.78 – 4.72 (m, 1H), 3.05 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 194.17, 152.08, 146.82, 139.56, 134.65, 130.12, 129.41, 129.11, 128.60, 127.71, 127.39, 126.05 (q, *J* = 278.3 Hz), 124.86, 124.31, 118.95, 109.10, 67.67 (q, *J* = 29.8 Hz), 50.01, 36.99; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.96; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{23}H_{18}F_3NNaO$: 404.1233, Found: 404.1233.



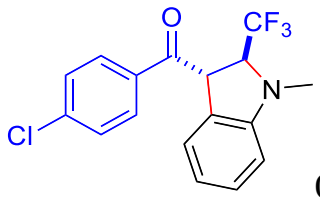
(4-methoxyphenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3e

White solid. 55.7 mg, 83% yield: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.08 (d, *J* = 9.2 Hz, 2H), 7.14 (t, *J* = 7.6 Hz, 1H), 7.05 (d, *J* = 8.8 Hz, 2H), 6.78 (d, *J* = 7.6 Hz, 1H), 6.61 – 6.58 (m, 2H), 5.13 (d, *J* = 6.8 Hz, 1H), 4.75 – 4.68 (m, 1H), 3.92 (s, 3H), 3.03 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.08, 164.36, 152.10, 131.86, 129.29, 128.87, 126.08 (q, *J* = 278.1 Hz), 125.24, 124.19, 118.89, 114.32, 109.05, 67.76 (q, *J* = 29.8 Hz), 55.65, 49.66, 37.04; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.95; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{16}F_3NNaO_2$: 358.1025, Found: 358.1029.



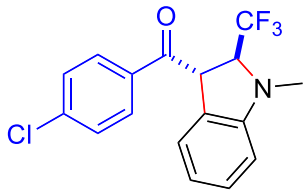
(4-fluorophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3f

White solid. 45.3 mg, 70% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.14 – 8.09 (m, 2H), 7.27 – 7.22 (m, 2H), 7.15 (t, *J* = 7.6 Hz, 1H), 6.73 (d, *J* = 7.6 Hz, 1H), 6.61 – 6.58 (m, 2H), 5.13 (d, *J* = 6.8 Hz, 1H), 4.74 – 4.67 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.10, 166.37 (d, *J* = 255.2 Hz), 152.03, 132.45 (d, *J* = 2.9 Hz), 132.13 (d, *J* = 37.6 Hz), 129.48, 127.34 (q, *J* = 278.7 Hz), 124.54, 124.09, 118.91, 116.32 (q, *J* = 21.8 Hz), 109.11, 67.67 (q, *J* = 29.9 Hz), 49.93, 36.84; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.01, -103.23; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}F_4NNaO$: 346.0825, Found: 346.0826.



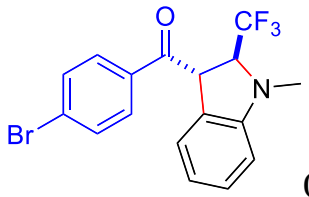
(4-chlorophenyl)(-1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3g

White solid. 49.6 mg, 73% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.02 (d, *J* = 8.8 Hz, 2H), 7.55 (d, *J* = 8.8 Hz, 2H), 7.15 (t, *J* = 7.6 Hz, 1H), 6.71 (d, *J* = 7.6 Hz, 1H), 6.61 – 6.58 (m, 2H), 5.11 (d, *J* = 6.4 Hz, 1H), 4.72 – 4.68 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.46, 151.99, 140.74, 134.38, 130.78, 129.51, 129.45, 125.91 (q, *J* = 278.8 Hz), 124.36, 124.11, 118.92, 109.09, 67.58 (q, *J* = 29.9 Hz), 49.98, 36.81; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.02; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}ClF_3NNaO$: 362.0530, Found: 362.0527.



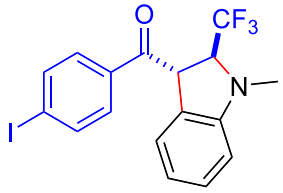
(4-chlorophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: from Z-enone, **3g**

White solid. 39.4 mg, 58% yield: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.02 (d, *J* = 8.5 Hz, 2H), 7.55 (d, *J* = 8.5 Hz, 2H), 7.15 (t, *J* = 7.5 Hz, 1H), 6.72 (d, *J* = 8.0 Hz, 1H), 6.61 – 6.58 (m, 2H), 5.12 (d, *J* = 6.5 Hz, 1H), 4.73 – 4.68 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.46, 152.01, 140.78, 134.36, 130.83, 129.55, 129.49, 125.93 (q, *J* = 278.3 Hz), 124.35, 124.15, 118.95, 109.15, 67.56 (q, *J* = 29.9 Hz), 49.99, 36.87; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.06; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}ClF_3NNaO$: 362.0530, Found: 362.0525.



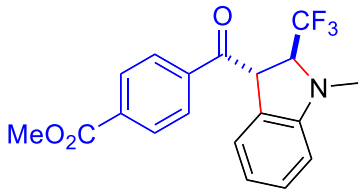
(4-bromophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3h

White solid. 57.6 mg, 75% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.94 (d, *J* = 8.4 Hz, 2H), 7.72 (d, *J* = 8.8 Hz, 2H), 7.15 (t, *J* = 7.6 Hz, 1H), 6.72 (d, *J* = 8.0 Hz, 1H), 6.61 – 6.58 (m, 2H), 5.11 (d, *J* = 6.4 Hz, 1H), 4.73 – 4.66 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.66, 151.98, 134.79, 132.45, 130.85, 129.52, 129.50, 125.91 (q, *J* = 278.6 Hz), 124.32, 124.12, 118.93, 109.10, 67.56 (q, *J* = 29.9 Hz), 49.98, 36.81; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.01; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}BrF_3NNaO$: 406.0025, Found: 406.0028.



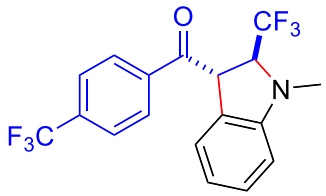
(4-iodophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3i

White solid. 65.5 mg, 76% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.94 (d, *J* = 8.8 Hz, 2H), 7.78 (d, *J* = 8.4 Hz, 2H), 7.15 (t, *J* = 7.6 Hz, 1H), 6.72 (d, *J* = 7.6 Hz, 1H), 6.61 – 6.58 (m, 2H), 5.10 (d, *J* = 6.4 Hz, 1H), 4.73 – 4.66 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.97, 151.97, 138.45, 135.32, 130.68, 129.51, 125.90 (q, *J* = 278.7 Hz), 124.31, 124.14, 118.93, 109.09, 102.37, 67.54 (q, *J* = 29.9 Hz), 49.91, 36.81; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.01; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}F_3INNaO$: 453.9886, Found: 453.9884.



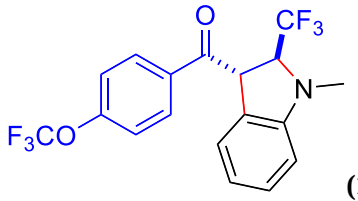
Methyl-4-(1-methyl-2-(trifluoromethyl)indoline-3-carbonyl)benzoate: 3j

White solid. 50.1 mg, 69% yield.: ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.26 (d, *J* = 8.1 Hz, 2H), 8.16 (d, *J* = 8.4 Hz, 2H), 7.18 (t, *J* = 7.5 Hz, 1H), 6.71 (d, *J* = 7.5 Hz, 1H), 6.65 – 6.57 (m, 2H), 5.21 (d, *J* = 6.3 Hz, 1H), 4.80 – 4.71 (m, 1H), 4.01 (s, 3H), 3.07 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 194.15, 166.01, 151.92, 139.30, 134.76, 130.21, 129.55, 129.34, 125.89 (q, *J* = 278.9 Hz), 124.19, 124.05, 118.90, 109.10, 67.35 (q, *J* = 30.0 Hz), 52.63, 50.34, 36.78; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.08; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{19}H_{16}F_3NNaO_3$: 386.0974, Found: 386.0966.



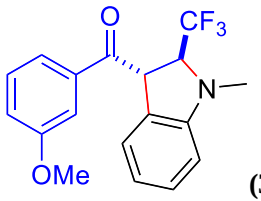
(1-methyl-2-(trifluoromethyl)indolin-3-yl)(4-(trifluoromethyl)phenyl)metha none: 3k

White solid. 49.3 mg, 66% yield: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.18 (d, *J* = 8.0 Hz, 2H), 7.84 (d, *J* = 8.0 Hz, 2H), 7.16 (t, *J* = 8.0 Hz, 1H), 6.68 (d, *J* = 7.6 Hz, 1H), 6.62 – 6.58 (m, 2H), 5.17 (d, *J* = 6.4 Hz, 1H), 4.75 – 4.68 (m, 1H), 3.04 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.78, 151.97, 138.81, 135.33 (q, *J* = 32.5 Hz), 129.77, 129.68, 126.18 (q, *J* = 3.6 Hz), 125.87 (q, *J* = 278.6 Hz), 124.13, 123.95, 123.49 (q, *J* = 271.1 Hz), 119.00, 109.20, 67.48 (q, *J* = 30.0 Hz), 50.28, 36.77; ^{19}F NMR (376 MHz, $CDCl_3$): δ -63.21, -75.10; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{13}F_6NNaO$: 396.0794, Found: 396.0793.



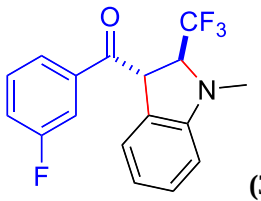
(1-methyl-2-(trifluoromethyl)indolin-3-yl)(4-(trifluoromethoxy)phenyl)methanone: 3l

White solid. 56.8 mg, 73% yield.: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.15 (d, *J* = 9.0 Hz, 2H), 7.40 (d, *J* = 8.0 Hz, 2H), 7.16 (t, *J* = 7.5 Hz, 1H), 6.73 (d, *J* = 8.0 Hz, 1H), 6.63 – 6.60 (m, 2H), 5.13 (d, *J* = 6.5 Hz, 1H), 4.73 – 4.67 (m, 1H), 3.04 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.16, 153.38, 152.00, 134.10, 131.50, 129.56, 125.88 (q, *J* = 278.8 Hz), 124.29, 124.07, 120.68, 120.30 (q, *J* = 258.0 Hz), 118.96, 109.16, 67.63 (q, *J* = 29.9 Hz), 49.98, 36.84; ^{19}F NMR (376 MHz, $CDCl_3$): δ -57.51, -75.03; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{13}F_6NNaO_2$: 412.0743, Found: 412.0733.



(3-methoxyphenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3m

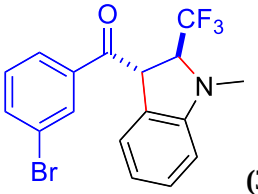
White solid. 46.9 mg, 70% yield: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 7.68 (d, *J* = 7.5 Hz, 1H), 7.58 (s, 1H), 7.49 (t, *J* = 8.0 Hz, 1H), 7.24 – 7.21 (m, 1H), 7.14 (t, *J* = 7.5 Hz, 1H), 6.78 (d, *J* = 7.5 Hz, 1H), 6.60 – 6.58 (m, 2H), 5.15 (d, *J* = 6.5 Hz, 1H), 4.75 – 4.69 (m, 1H), 3.86 (s, 3H), 3.03 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 194.46, 160.23, 152.02, 137.43, 130.07, 129.41, 126.03 (q, *J* = 278.4 Hz), 124.74, 124.36, 122.06, 120.66, 118.95, 113.60, 109.07, 67.65 (q, *J* = 29.9 Hz), 55.54, 50.16, 36.95; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.99; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{16}F_3NNaO_2$: 358.1025, Found: 358.1029.



(3-fluorophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3n

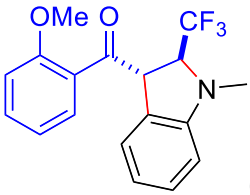
White solid. 47.8 mg, 74% yield.: ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.89 (d, *J* = 7.8 Hz, 1H), 7.77 (dt, *J* = 9.0, 2.7 Hz, 1H), 7.62 – 7.55 (m, 1H), 7.43 – 7.36 (m, 1H), 7.17 (t, *J* = 7.5 Hz, 1H), 6.74 (d, *J* = 7.8 Hz, 1H), 6.63 – 6.59 (m, 2H), 5.13 (d, *J* = 6.6 Hz, 1H), 4.76 – 4.67 (m, 1H), 3.05 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.48 (d, *J* = 1.8 Hz), 164.09, 162.11,

151.97, 138.16 (d, *J* = 6.1 Hz), 130.79 (d, *J* = 7.8 Hz), 129.55, 125.89 (q, *J* = 278.8 Hz), 125.17 (d, *J* = 2.9 Hz), 124.20 (d, *J* = 6.8 Hz), 121.18 (d, *J* = 21.5 Hz), 118.94, 116.14 (d, *J* = 22.5 Hz), 109.13, 67.55 (q, *J* = 29.9 Hz), 50.15, 36.83; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.05, -110.73; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}F_4NNaO$: 346.0825, Found: 346.0816.



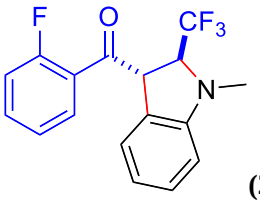
(3-bromophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3o

White solid. 60.7 mg, 79% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.22 (s, 1H), 8.02 (d, *J* = 7.6 Hz, 1H), 7.82 (d, *J* = 8.0 Hz, 1H), 7.47 (t, *J* = 8.0 Hz, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 6.74 (d, *J* = 7.6 Hz, 1H), 6.64 – 6.61 (m, 2H), 5.12 (d, *J* = 6.4 Hz, 1H), 4.75 – 4.68 (m, 1H), 3.05 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.34, 151.97, 137.81, 136.92, 132.37, 130.61, 129.58, 127.92, 125.89 (q, *J* = 278.9 Hz), 124.18, 124.14, 123.56, 118.96, 109.13, 67.50 (q, *J* = 29.9 Hz), 50.12, 36.81; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.01; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}BrF_3NNaO$: 406.0025, Found: 406.0010.



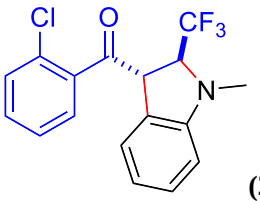
(2-methoxyphenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3p

White solid. 45.6 mg, 68% yield: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.59 – 7.52 (m, 2H), 7.10 (t, *J* = 7.6 Hz, 1H), 7.06 – 7.02 (m, 2H), 6.62 – 6.53 (m, 3H), 5.48 (d, *J* = 6.0 Hz, 1H), 4.74 – 4.67 (m, 1H), 3.93 (s, 3H), 3.02 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 197.61, 158.38, 151.76, 134.32, 131.45, 128.96, 126.96, 126.15 (q, *J* = 278.6 Hz), 125.42, 124.20, 121.13, 118.69, 111.75, 108.73, 67.00 (q, *J* = 29.8 Hz), 55.74, 54.26, 36.83; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.44; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{16}F_3NNaO_2$: 358.1025, Found: 358.1030.



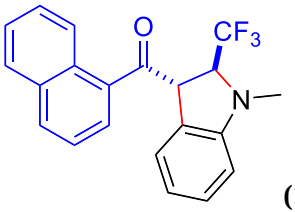
(2-fluorophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3q

White solid. 45.9 mg, 71% yield: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.80 (td, *J* = 7.6, 1.6 Hz, 1H), 7.64 – 7.58 (m, 1H), 7.30 – 7.22 (m, 2H), 7.13 (t, *J* = 8.0 Hz, 1H), 6.72 (d, *J* = 7.6 Hz, 1H), 6.59 – 6.55 (m, 2H), 5.19 (d, *J* = 5.6 Hz, 1H), 4.78 – 4.71 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.48 (d, *J* = 3.8 Hz), 162.53, 160.51, 151.75, 135.50 (d, *J* = 9.1 Hz), 131.71 (d, *J* = 1.8 Hz), 129.41, 125.97 (q, *J* = 278.9 Hz), 125.02 (d, *J* = 3.4 Hz), 124.76 (d, *J* = 11.6 Hz), 124.15 (d, *J* = 1.6 Hz), 118.84, 117.02 (d, *J* = 23.4 Hz), 108.90, 66.75 (q, *J* = 30.0 Hz), 54.29 (d, *J* = 9.0 Hz), 36.61; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.48, -110.80; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}F_4NNaO$: 346.0825, Found: 346.0828.



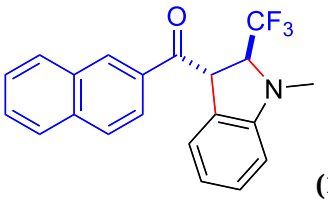
(2-chlorophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3r

White solid. 47.6 mg, 70% yield: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.52 – 7.46 (m, 2H), 7.40 – 7.37 (m, 2H), 7.13 (t, *J* = 7.6 Hz, 1H), 6.57 – 6.53 (m, 2H), 6.47 – 6.45 (m, 1H), 5.18 (d, *J* = 5.6 Hz, 1H), 4.74 – 4.68 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 197.29, 151.51, 137.66, 132.46, 131.51, 130.82, 130.14, 129.49, 127.07, 125.89 (q, *J* = 279.5 Hz), 124.40, 123.44, 118.64, 108.77, 66.18 (q, *J* = 30.1 Hz), 54.11, 36.46; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.54; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{13}ClF_3NNaO$: 362.0530, Found: 362.0523.



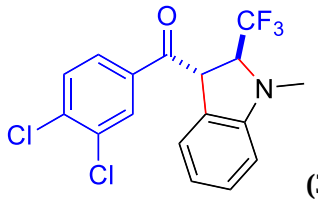
(1-methyl-2-(trifluoromethyl)indolin-3-yl)(naphthalen-1-yl)methanone: 3s

White solid. 56.9 mg, 80% yield.: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.28 (d, *J* = 7.5 Hz, 1H), 8.08 (d, *J* = 8.5 Hz, 1H), 7.97 (d, *J* = 7.0 Hz, 1H), 7.92 – 7.90 (m, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 7.56 – 7.51 (m, 2H), 7.11 (t, *J* = 7.5 Hz, 1H), 6.60 (d, *J* = 8.0 Hz, 1H), 6.46 – 6.42 (m, 2H), 5.27 (d, *J* = 6.0 Hz, 1H), 4.84 – 4.79 (m, 1H), 3.07 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 197.47, 151.87, 135.24, 134.02, 133.54, 130.83, 129.51, 129.36, 128.50, 128.36, 126.96, 126.16 (q, *J* = 278.5 Hz), 125.67, 124.50, 124.29, 124.13, 118.87, 109.01, 67.10 (q, *J* = 29.9 Hz), 53.43, 36.90; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.92; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{21}H_{16}F_3NNaO$: 378.1076, Found: 378.1074.



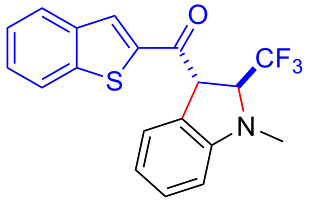
(1-methyl-2-(trifluoromethyl)indolin-3-yl)(naphthalen-2-yl)methanone: 3t

White solid. 59.0 mg, 83% yield.: ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.63 (s, 1H), 8.12 (dd, *J* = 8.7, 1.8 Hz, 1H), 8.04 (d, *J* = 8.1 Hz, 1H), 7.99 – 7.96 (m, 1H), 7.94 – 7.91 (m, 1H), 7.69 – 7.58 (m, 2H), 7.14 (t, *J* = 7.8 Hz, 1H), 6.78 (d, *J* = 7.5 Hz, 1H), 6.61 (d, *J* = 7.8 Hz, 1H), 6.54 (t, *J* = 7.5 Hz, 1H), 5.36 (d, *J* = 6.6 Hz, 1H), 4.85 – 4.76 (m, 1H), 3.06 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 194.46, 152.09, 136.04, 133.43, 132.61, 131.53, 129.84, 129.41, 129.19, 129.08, 127.93, 127.24, 125.72 (q, *J* = 353.6 Hz), 124.87, 124.70, 124.35, 118.93, 109.10, 67.71 (q, *J* = 29.8 Hz), 50.08, 36.98; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.86; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{21}H_{16}F_3NNaO$: 378.1076, Found: 378.1071.



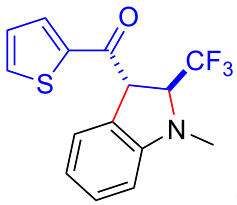
(3,4-dichlorophenyl)(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3u

White solid. 47.1 mg, 63% yield: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.15 (d, *J* = 2.0 Hz, 1H), 7.91 (dd, *J* = 8.5, 2.0 Hz, 1H), 7.68 (d, *J* = 8.5 Hz, 1H), 7.17 (t, *J* = 7.5 Hz, 1H), 6.72 (d, *J* = 7.5 Hz, 1H), 6.62 (t, *J* = 7.5 Hz, 2H), 5.06 (d, *J* = 6.5 Hz, 1H), 4.71 – 4.66 (m, 1H), 3.04 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 192.55, 151.97, 138.94, 135.59, 134.07, 131.30, 131.22, 129.71, 128.31, 125.83 (q, *J* = 278.5 Hz), 124.10, 123.90, 119.01, 109.21, 67.50 (q, *J* = 30.0 Hz), 50.07, 36.80; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.03; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{12}Cl_2F_3NNaO$: 396.0140, Found: 396.0135.



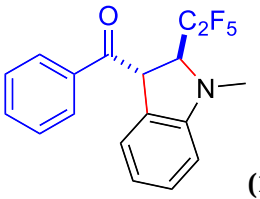
benzo[b]thiophen-2-yl(1-methyl-2-(trifluoromethyl)indolin-3-yl)methanone: 3v

White solid. 57.1 mg, 79% yield: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.19 (s, 1H), 7.99 (d, *J* = 8.0 Hz, 1H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.54 – 7.44 (m, 2H), 7.17 (t, *J* = 7.6 Hz, 1H), 6.97 (d, *J* = 7.6 Hz, 1H), 6.66 – 6.62 (m, 2H), 5.11 (d, *J* = 6.4 Hz, 1H), 4.70 – 4.63 (m, 1H), 3.04 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 189.12, 152.16, 143.39, 142.87, 139.09, 131.15, 129.67, 128.17, 126.44, 125.89 (q, *J* = 278.4 Hz), 125.43, 124.71, 124.29, 123.14, 119.15, 109.29, 67.78 (q, *J* = 30.0 Hz), 51.29, 37.03; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.02; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{19}H_{14}F_3NNaOS$: 384.0640, Found: 384.0638.



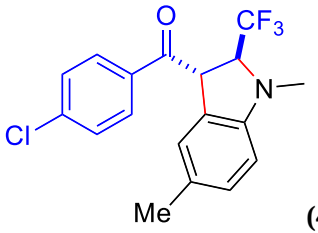
(1-methyl-2-(trifluoromethyl)indolin-3-yl)(thiophen-2-yl)methanone: 3w

White solid. 49.8 mg, 80% yield: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.92 (dd, *J* = 4.0, 1.2 Hz, 1H), 7.80 (dd, *J* = 5.2, 1.2 Hz, 1H), 7.28 – 7.25 (m, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 6.91 (d, *J* = 7.6 Hz, 1H), 6.67 – 6.60 (m, 2H), 4.96 (d, *J* = 6.4 Hz, 1H), 4.66 – 4.59 (m, 1H), 3.03 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 187.63, 152.16, 143.38, 135.87, 133.80, 129.55, 128.68, 125.87 (q, *J* = 278.4 Hz), 124.93, 124.18, 119.08, 109.20, 67.77 (q, *J* = 30.0 Hz), 51.46, 37.02; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.06; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{15}H_{12}F_3NNaOS$: 334.0484, Found: 334.0477.



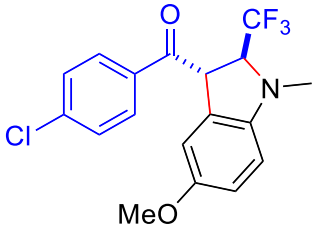
(1-methyl-2-(perfluoroethyl)indolin-3-yl)(phenyl)methanone: 3x

White solid. 42.6 mg, 60% yield.: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.08 (d, *J* = 7.5 Hz, 2H), 7.69 (t, *J* = 7.5 Hz, 1H), 7.58 (t, *J* = 8.0 Hz, 2H), 7.14 (t, *J* = 7.5 Hz, 1H), 6.72 (d, *J* = 7.5 Hz, 1H), 6.63 (d, *J* = 8.0 Hz, 1H), 6.59 (t, *J* = 7.5 Hz, 1H), 5.30 (d, *J* = 6.0 Hz, 1H), 4.88 – 4.82 (m, 1H), 3.05 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 194.63, 152.27, 135.87, 134.09, 129.45, 129.37, 129.14, 125.15, 124.16, 119.17, 119.14 (qt, *J* = 285.0, 35.9 Hz), 114.76 (tq, *J* = 254.2, 35.1 Hz), 109.92, 66.93 (t, *J* = 21.4 Hz), 49.88, 38.58; ^{19}F NMR (376 MHz, $CDCl_3$): δ -81.49 (s, 3F), -121.79 – -123.39 (m, 2F); HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{14}F_5NO$: 378.0888, Found: 378.0886.



(4-chlorophenyl)(1,5-dimethyl-2-(trifluoromethyl)indolin-3-yl)methanone: 4a

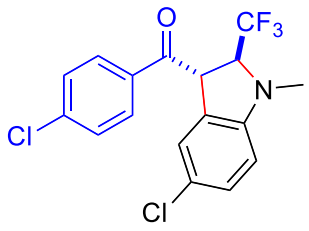
White solid. 53.1 mg, 75% yield.: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.03 (d, *J* = 8.5 Hz, 2H), 7.56 (d, *J* = 8.0 Hz, 2H), 6.96 (d, *J* = 8.0 Hz, 1H), 6.53 (s, 2H), 5.10 (d, *J* = 6.0 Hz, 1H), 4.64 – 4.61 (m, 1H), 3.00 (s, 3H), 2.11 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.80, 150.06, 140.78, 134.42, 130.82, 129.96, 129.50, 128.65, 125.99 (q, *J* = 278.1 Hz), 124.85, 124.66, 109.39, 68.20 (q, *J* = 29.8 Hz), 49.91, 37.62, 20.69; ^{19}F NMR (376 MHz, $CDCl_3$): δ -74.98; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{15}ClF_3NNaO$: 376.0686, Found: 376.0687.



(4-chlorophenyl)(5-methoxy-1-methyl-2-(trifluoromethyl)indolin-3-yl)metha

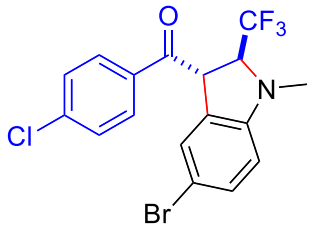
none: 4b

White solid. 51.8 mg, 70% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.04 – 8.00 (m, 2H), 7.57 – 7.54 (m, 2H), 6.73 (dd, *J* = 8.0, 2.4 Hz, 1H), 6.56 (d, *J* = 8.8 Hz, 1H), 6.34 – 6.33 (m, 1H), 5.09 (d, *J* = 6.8 Hz, 1H), 4.65 – 4.58 (m, 1H), 3.60 (s, 3H), 2.98 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 193.51, 153.55, 146.45, 140.88, 134.34, 130.75, 129.55, 125.98 (q, *J* = 277.8 Hz), 125.96, 113.74, 111.75, 110.10, 68.37 (q, *J* = 29.8 Hz), 55.93, 50.03, 38.41; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.08; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{15}ClF_3NNaO_2$: 392.0636, Found: 392.0631.



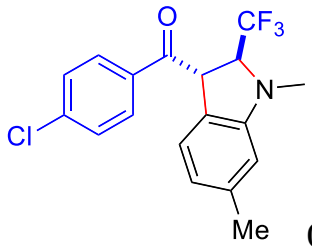
(5-chloro-1-methyl-2-(trifluoromethyl)indolin-3-yl)(4-chlorophenyl)methanone: 4c

White solid. 50.9 mg, 68% yield.: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.03 – 8.01 (m, 2H), 7.60 – 7.57 (m, 2H), 7.11 (dd, *J* = 8.5, 1.5 Hz, 1H), 6.67 (s, 1H), 6.50 (d, *J* = 8.5 Hz, 1H), 5.08 (d, *J* = 6.5 Hz, 1H), 4.72 – 4.67 (m, 1H), 3.02 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 192.95, 150.65, 141.20, 133.86, 130.75, 129.70, 129.44, 126.01, 125.67 (q, *J* = 278.6 Hz), 124.27, 123.57, 109.71, 67.87 (q, *J* = 30.3 Hz), 49.45, 36.75; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.21; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{12}Cl_2F_3NO$: 373.0248, Found: 373.0245.



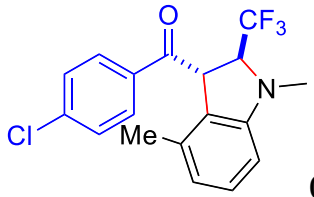
(5-bromo-1-methyl-2-(trifluoromethyl)indolin-3-yl)(4-chlorophenyl)methanone: 4d

White solid. 60.3 mg, 72% yield: ^{1}H NMR (500 MHz, $CDCl_3$) δ: 8.02 (d, *J* = 8.5 Hz, 2H), 7.58 (d, *J* = 8.0 Hz, 2H), 7.26 – 7.24 (m, 1H), 6.80 (s, 1H), 6.46 (d, *J* = 8.5 Hz, 1H), 5.09 (d, *J* = 6.0 Hz, 1H), 4.71 – 4.66 (m, 1H), 3.02 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 192.97, 151.06, 141.21, 133.83, 132.33, 130.75, 129.71, 127.01, 126.50, 125.62 (q, *J* = 278.6 Hz), 110.39, 110.23, 67.82 (q, *J* = 30.0 Hz), 49.38, 36.58; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.21; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{17}H_{12}BrClF_3NO$: 416.9743, Found: 416.9740.



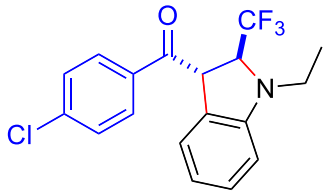
(4-chlorophenyl)(1,6-dimethyl-2-(trifluoromethyl)indolin-3-yl)methanone: 4e

White solid. 32.5 mg, 46% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.03 – 8.00 (m, 2H), 7.56 – 7.53 (m, 2H), 6.59 (d, *J* = 7.6 Hz, 1H), 6.42 – 6.40 (m, 2H), 6.06 (d, *J* = 6.4 Hz, 1H), 4.72 – 4.65 (m, 1H), 3.02 (s, 3H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.51, 152.12, 140.64, 139.74, 134.37, 130.77, 129.41, 125.95 (q, *J* = 278.9 Hz), 123.82, 121.57, 119.66, 109.97, 67.72 (q, *J* = 29.8 Hz), 49.75, 36.79, 21.61; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.16; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{15}ClF_3NNaO$: 376.0686, Found: 376.0677.



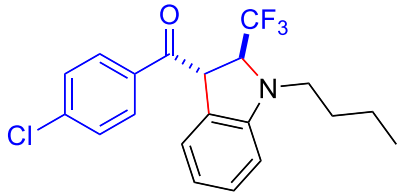
(4-chlorophenyl)(1,4-dimethyl-2-(trifluoromethyl)indolin-3-yl)methanone 4e'

White solid. 21.2 mg, 30% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.97 – 7.94 (m, 2H), 7.50 – 7.46 (m, 2H), 7.11 (t, *J* = 8.0 Hz, 1H), 6.51 (dd, *J* = 13.6, 7.6 Hz, 2H), 5.09 (d, *J* = 6.0 Hz, 1H), 4.09 – 4.03 (m, 1H), 3.00 (s, 3H), 1.90 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.40, 152.54, 140.56, 134.60, 134.06, 130.11, 129.58, 129.38, 125.63 (q, *J* = 279.8 Hz), 125.29, 121.24, 106.62, 70.55 (q, *J* = 29.9 Hz), 49.44, 36.95, 19.50; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.02; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{15}ClF_3NNaO$: 376.0686, Found: 376.0686.



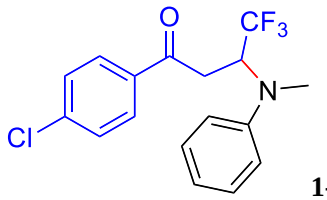
(4-chlorophenyl)(1-ethyl-2-(trifluoromethyl)indolin-3-yl)methanone: 4f

White solid. 46.7 mg, 66% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.03 – 8.00 (m, 2H), 7.56 – 7.53 (m, 2H), 7.13 (t, *J* = 8.0 Hz, 1H), 6.72 (d, *J* = 7.1 Hz, 1H), 6.61 – 6.55 (m, 2H), 5.08 (d, *J* = 5.6 Hz, 1H), 4.91 – 4.84 (m, 1H), 3.59 – 3.50 (m, 1H), 3.44 – 3.35 (m, 1H), 1.21 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.58, 150.68, 140.68, 134.30, 130.79, 129.46, 129.42, 125.95 (q, *J* = 278.5 Hz), 124.64, 124.32, 118.52, 109.21, 64.45 (q, *J* = 30.0 Hz), 49.94, 43.55, 11.09; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.80; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{18}H_{15}ClF_3NNaO$: 376.0686, Found: 376.0684.



(1-butyl-2-(trifluoromethyl)indolin-3-yl)(4-chlorophenyl)methanone: 4g

White solid. 49.6 mg, 65% yield.: ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.03 – 8.00 (m, 2H), 7.56 – 7.53 (m, 2H), 7.12 (t, *J* = 7.6 Hz, 1H), 6.71 (d, *J* = 7.6 Hz, 1H), 6.58 – 6.53 (m, 2H), 5.08 (d, *J* = 6.0 Hz, 1H), 4.91 – 4.84 (m, 1H), 3.48 – 3.40 (m, 1H), 3.34 – 3.26 (m, 1H), 1.78 – 1.67 (m, 1H), 1.63 – 1.54 (m, 1H), 1.43 – 1.34 (m, 2H), 0.97 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 193.55, 151.15, 140.66, 134.30, 130.79, 129.43, 129.41, 129.06, 125.93 (q, *J* = 279.0 Hz), 124.29, 118.29, 108.94, 65.02 (q, *J* = 30.0 Hz), 49.98, 49.14, 28.46, 20.23, 13.90; ^{19}F NMR (376 MHz, $CDCl_3$): δ -75.64; HRMS (ESI) [(M+Na^+)] Calcd. For $C_{20}H_{19}ClF_3NNaO$: 404.0999, Found: 404.0989.



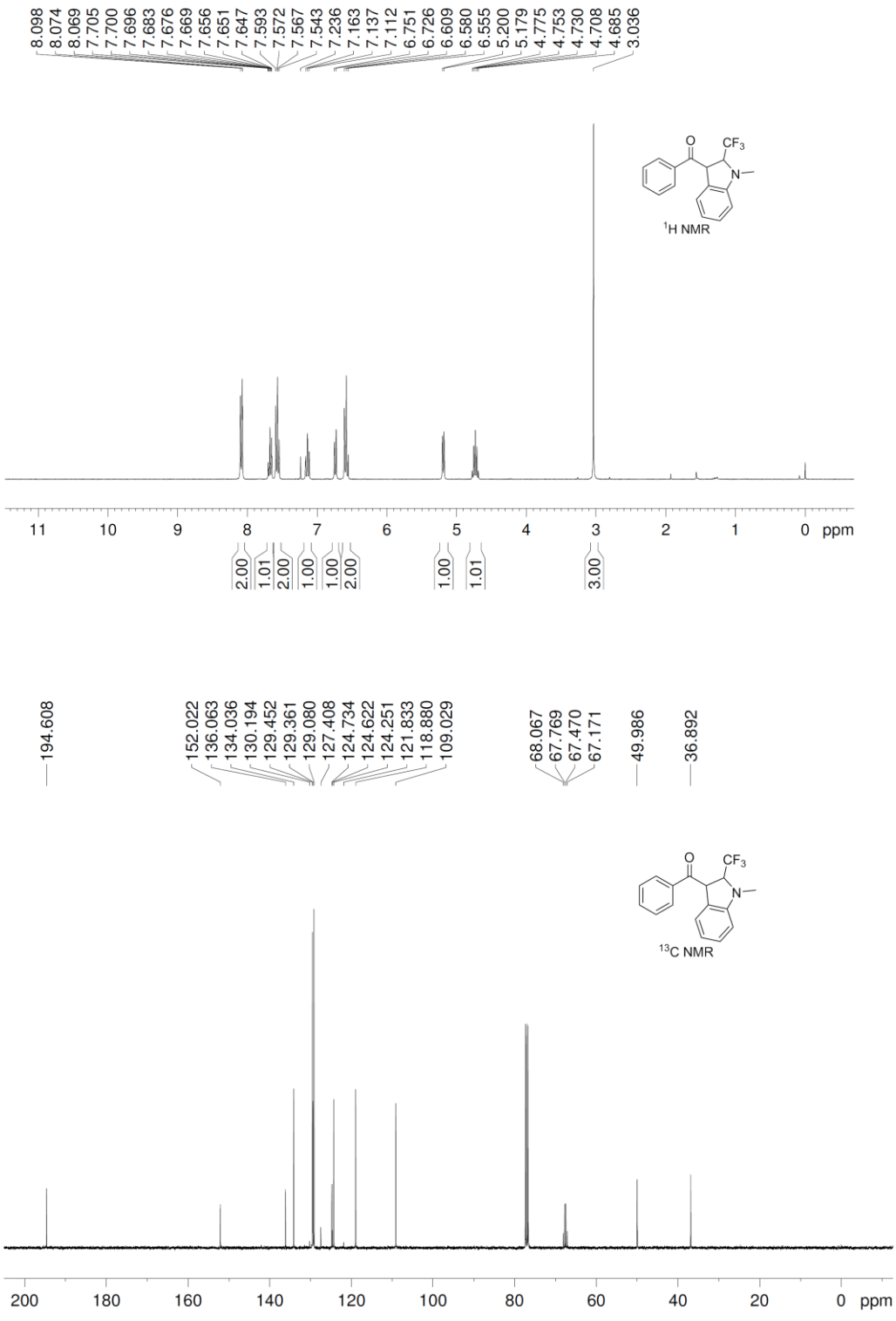
1-(4-chlorophenyl)-4,4,4-trifluoro-3-(methyl(phenyl)amino)butan-1-one: 5

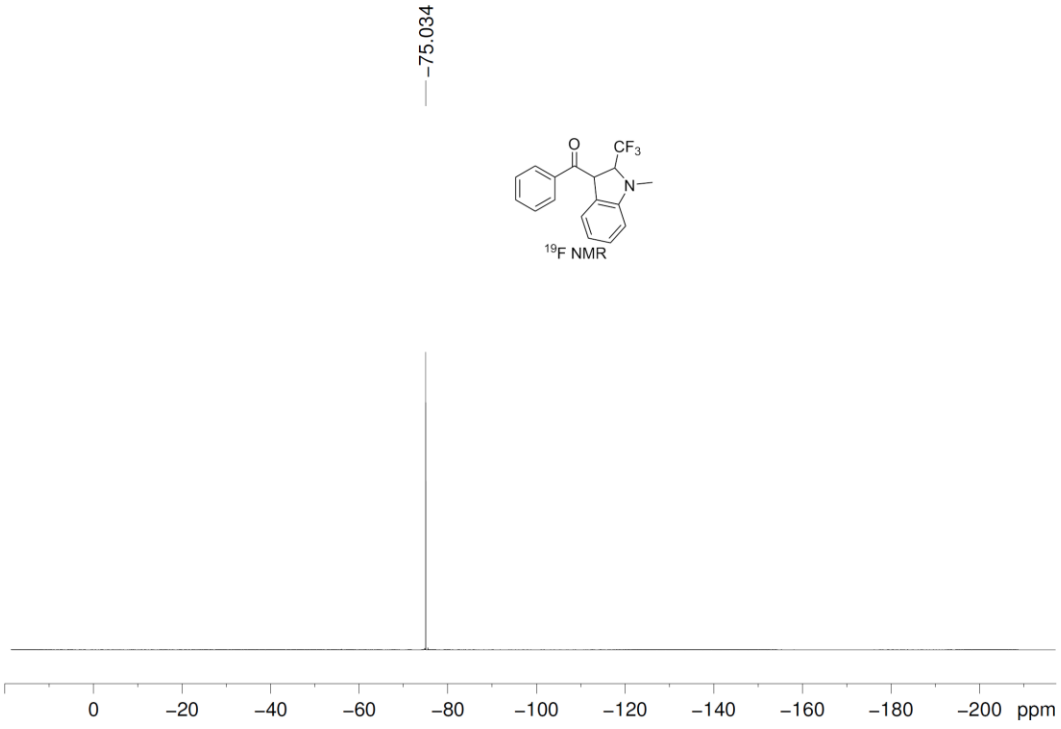
White solid. 52.0 mg, 76% yield.: ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.89 – 7.84 (m, 2H), 7.46 – 7.41 (m, 2H), 7.28 – 7.23 (m, 2H), 6.97 (d, *J* = 8.1 Hz, 2H), 6.84 (t, *J* = 7.2 Hz, 1H), 5.21 – 5.08 (m, 1H), 3.61 (dd, *J* = 17.4, 9.0 Hz, 1H), 3.24 (dd, *J* = 17.4, 3.9 Hz, 1H), 2.87 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 194.01, 149.93, 140.34, 134.66, 129.63, 129.26, 129.25, 126.45 (q, *J* = 285.4 Hz), 119.53, 115.11, 57.55 (q, *J* = 28.8 Hz), 35.43, 32.84; ^{19}F NMR (376 MHz, $CDCl_3$): δ -71.64; HRMS (ESI) [$(M+Na^+)$] Calcd. For $C_{17}H_{15}ClF_3NNaO$: 364.0686, Found: 364.0689.

7. References:

[1] (a) H. Wang, W. Lu and J. Zhang, *Chem. Eur. J.*, 2017, **23**, 13587–13590. (b) P. Kwiatkowski, A. Cholewiak and A. Kasztelan, *Org. Lett.*, 2014, **16**, 5930–5933.

8. ^{1}H, ^{19}F NMR and ^{13}C NMR spectra of the products

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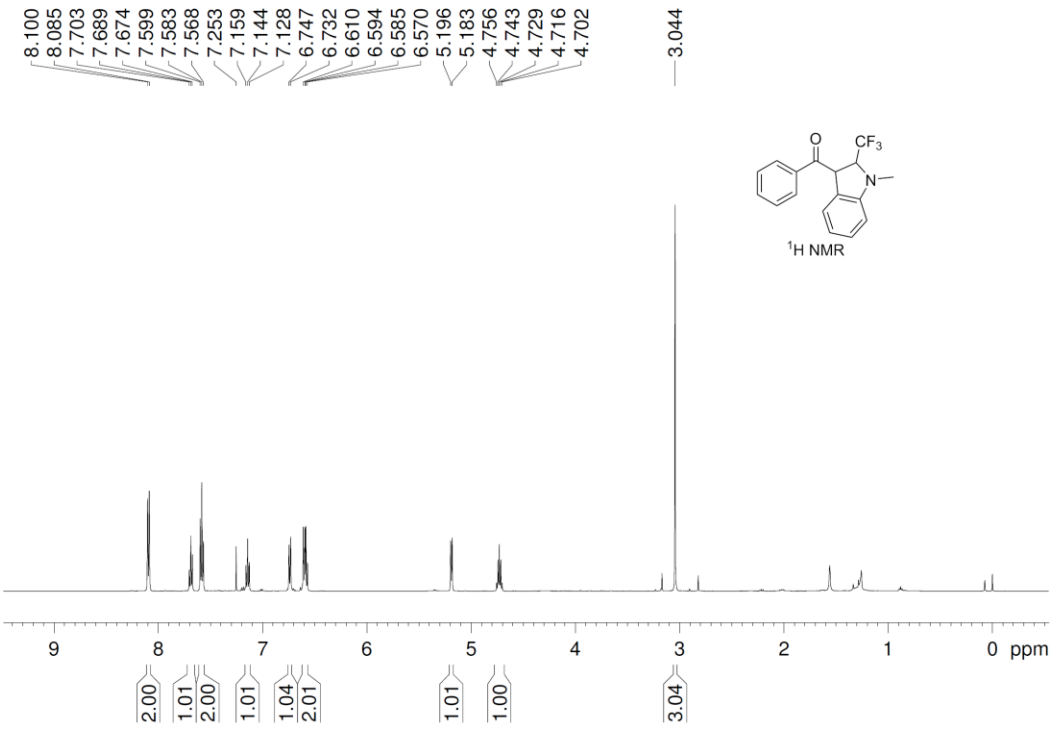
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6.732
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6.570
5.196
5.183
4.756
4.743
4.729
4.716
4.702
3.044
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CF3
N
1H NMR
9
8
7
6
5
4
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1.01
1.04
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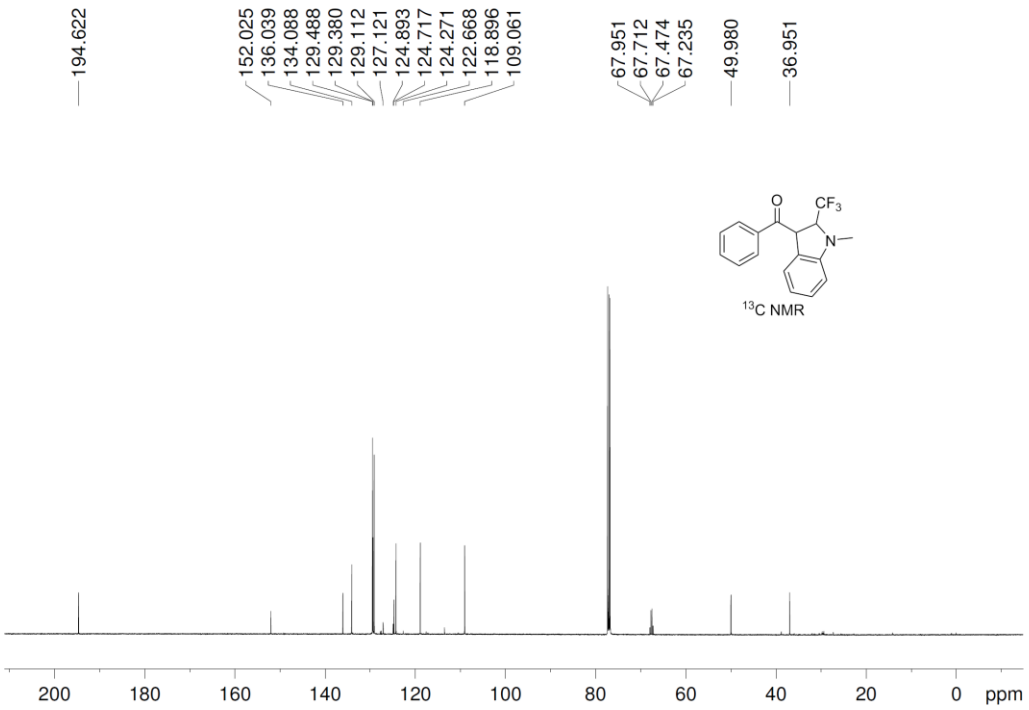
3.04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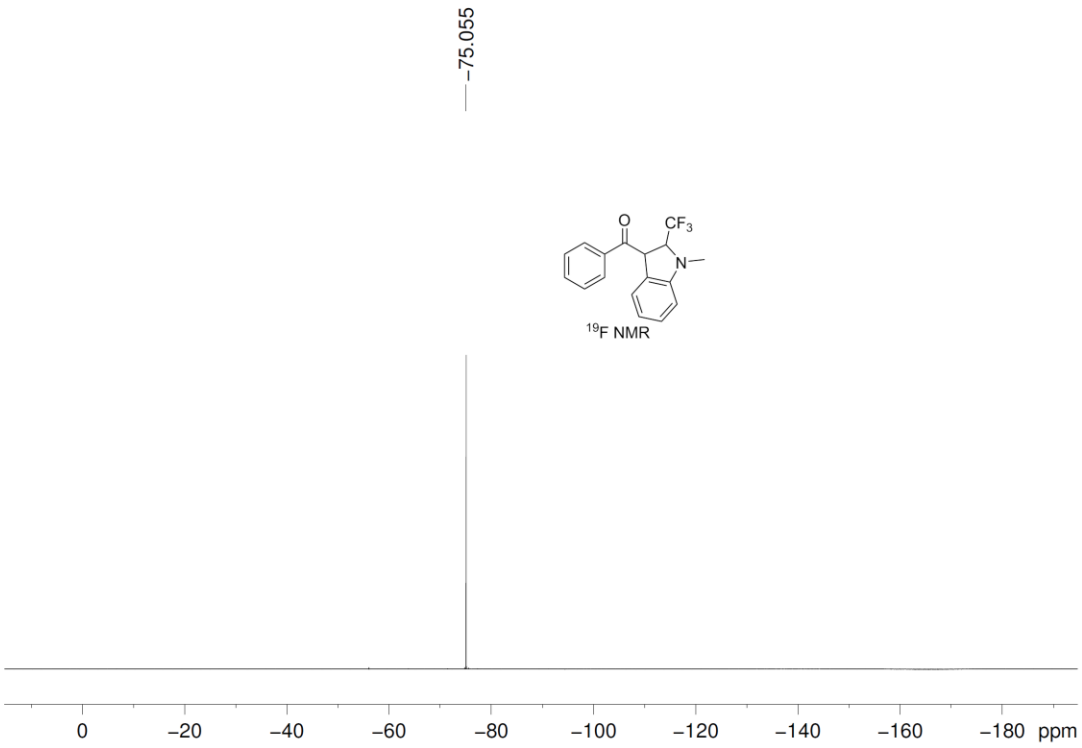
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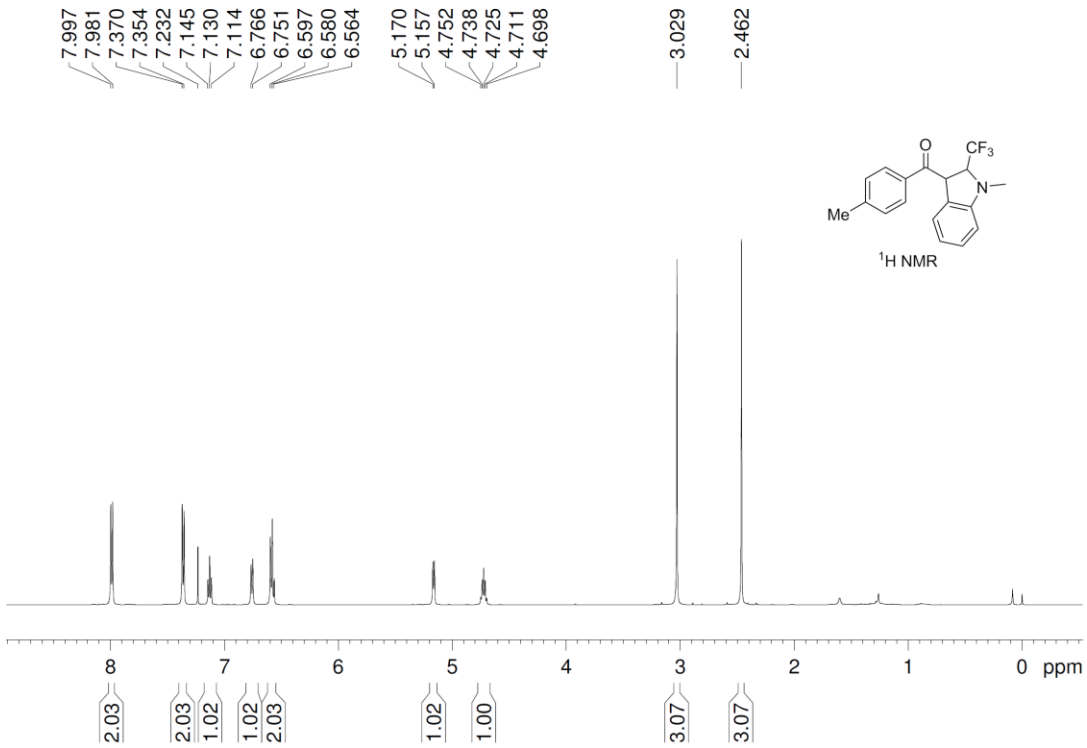
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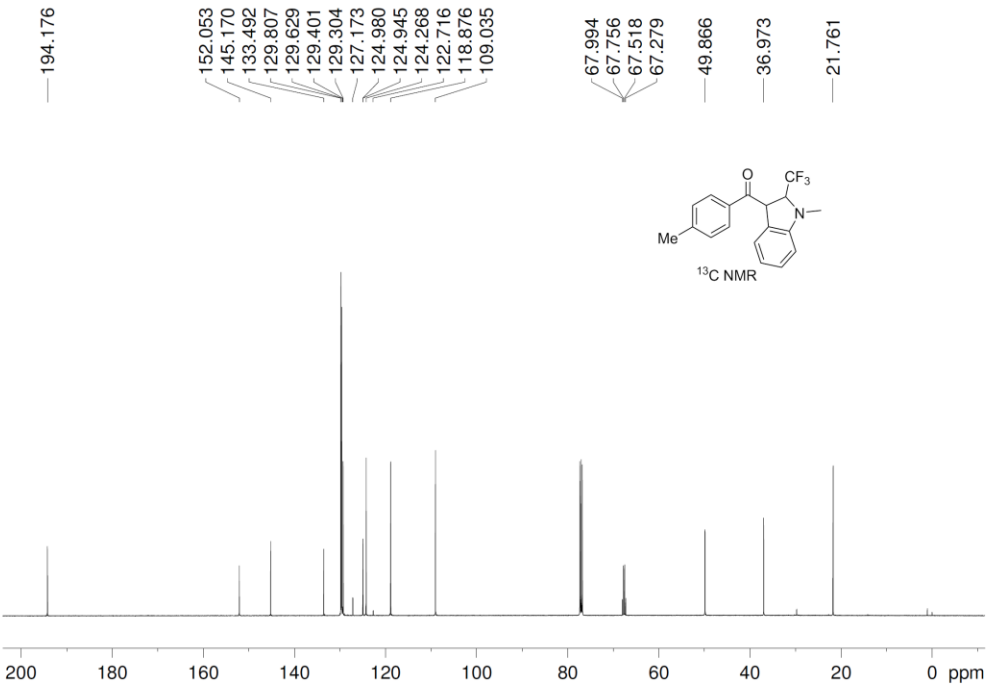
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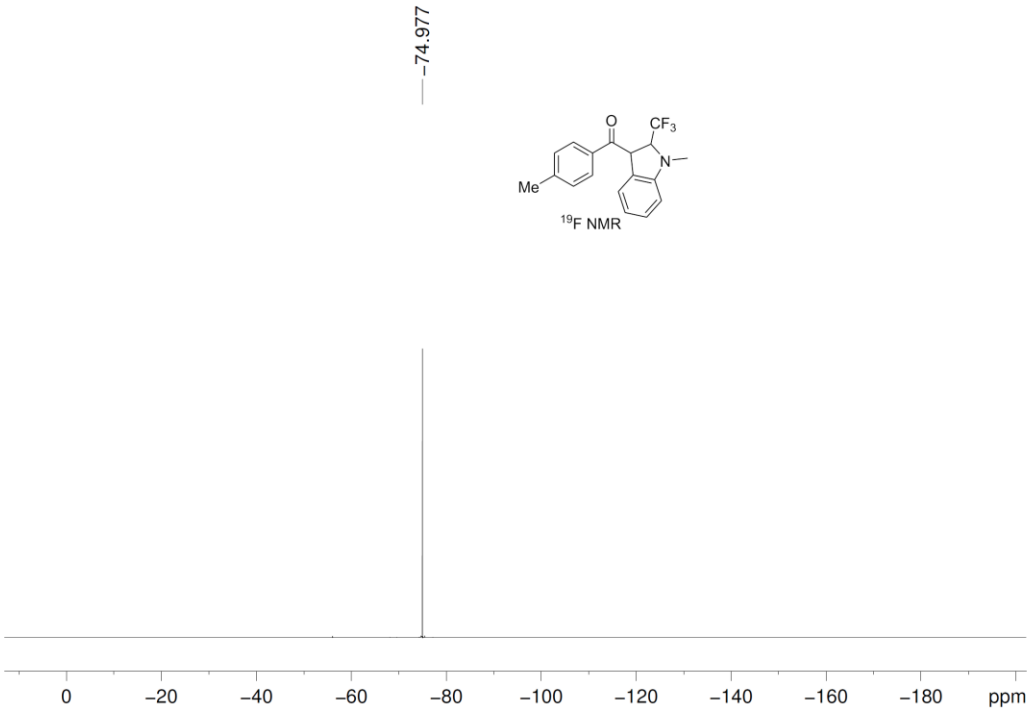
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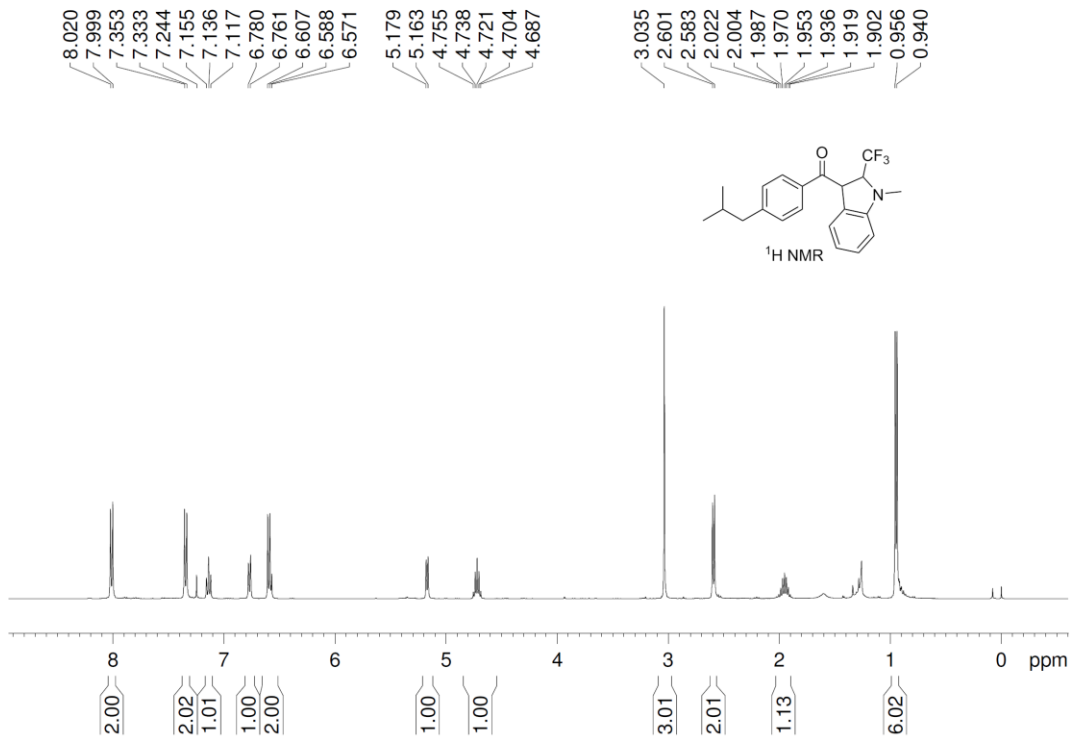
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CF3
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1H NMR
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6
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4
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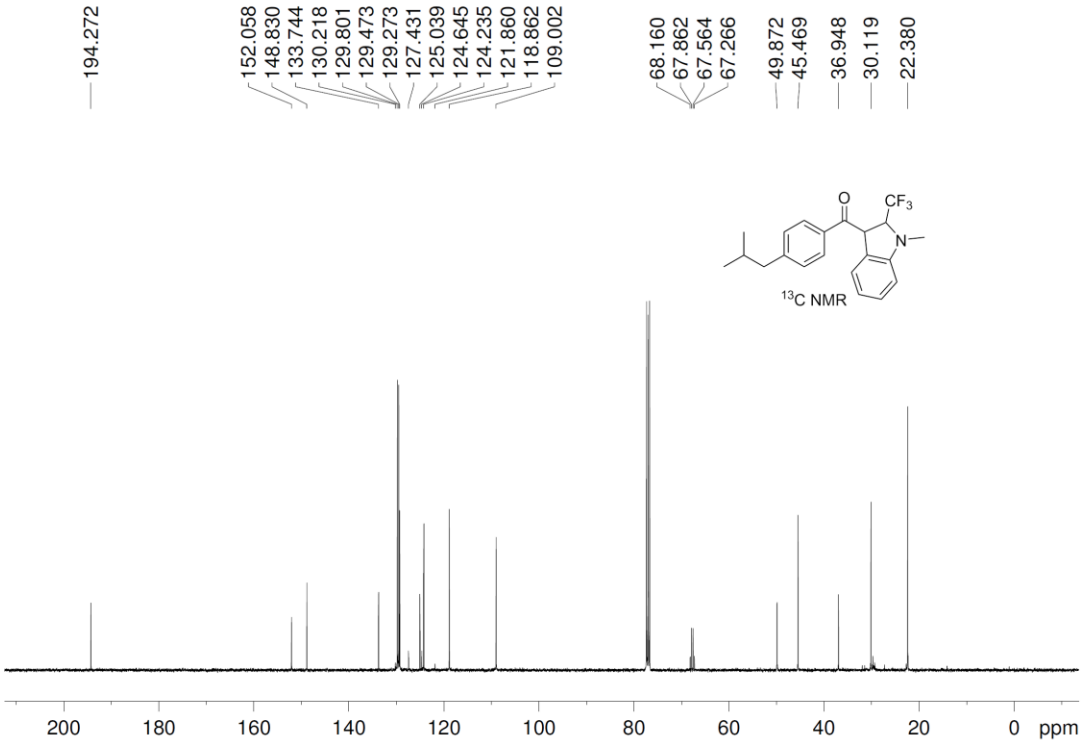
6.02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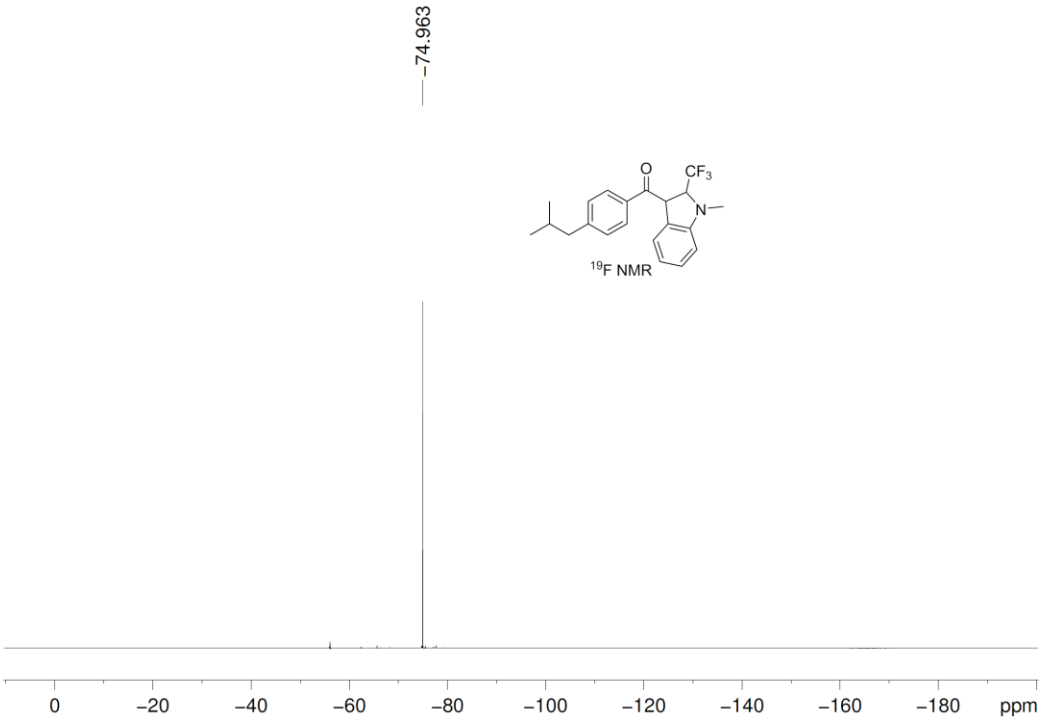
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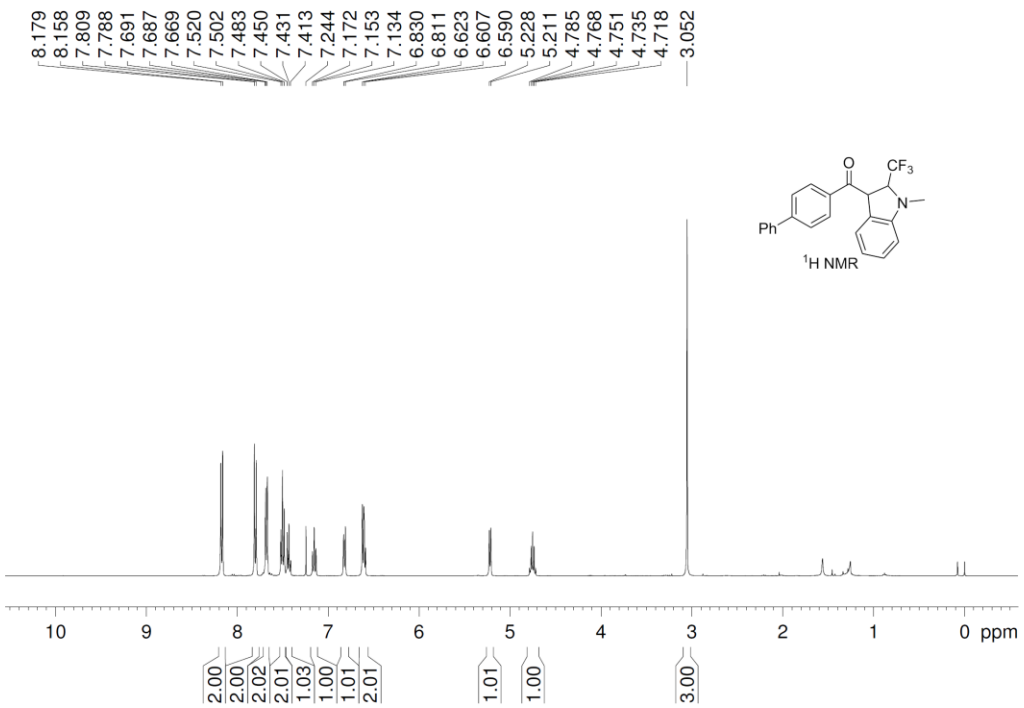
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CF3
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Ph
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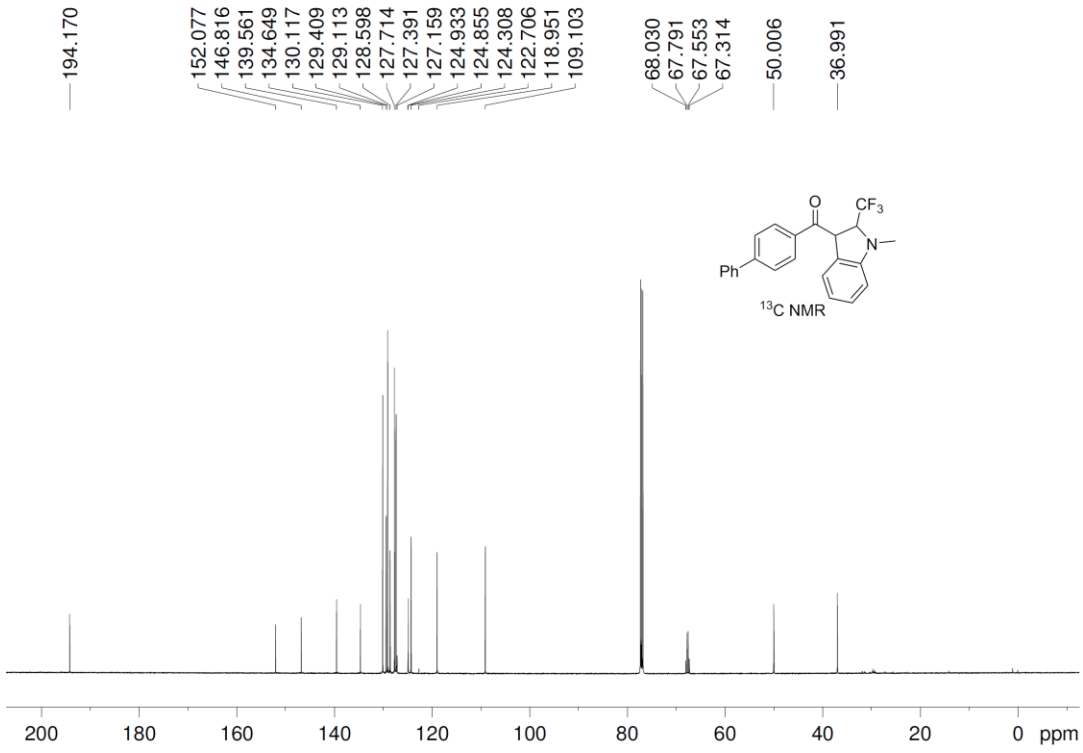
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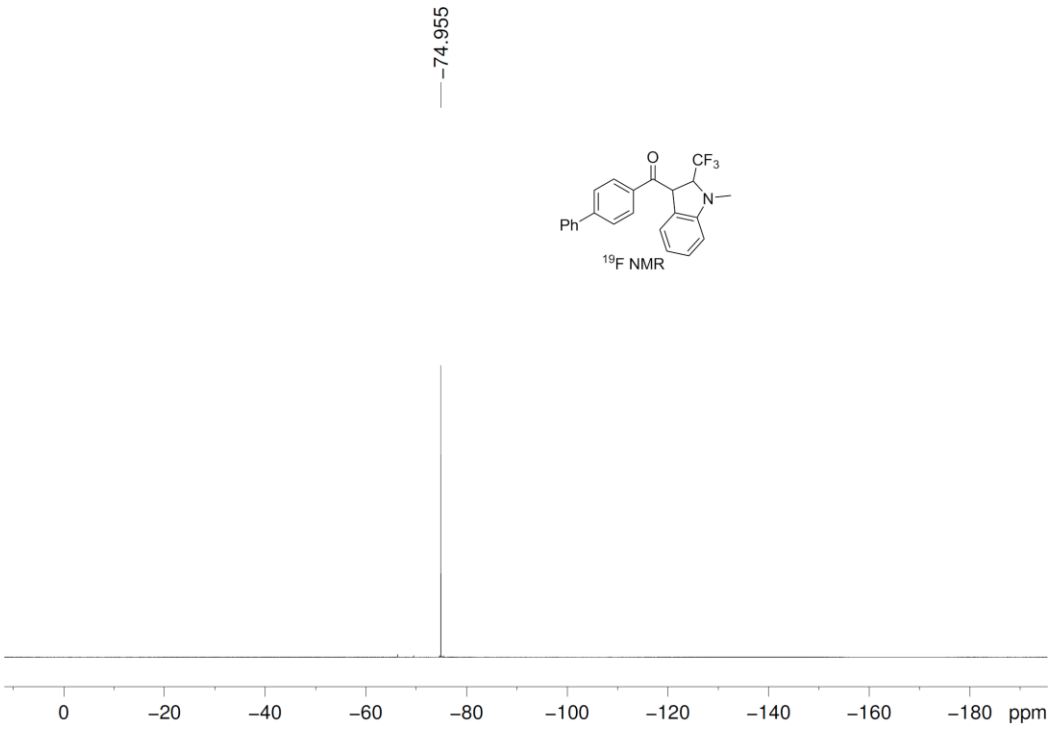
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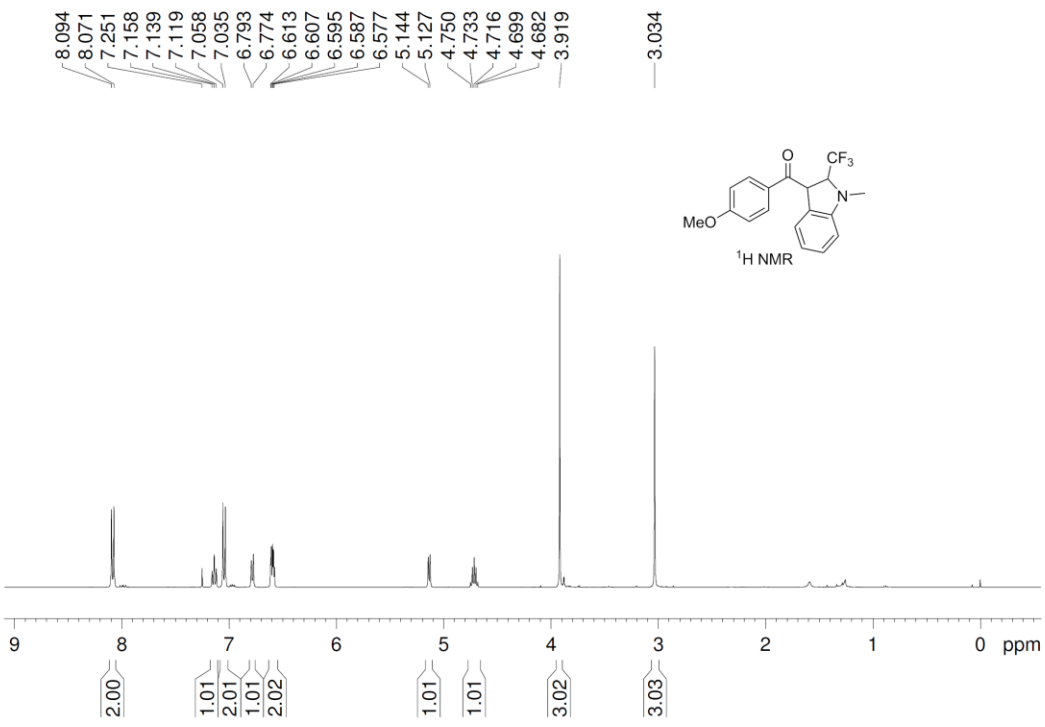
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7.035
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6.774
6.613
6.607
6.595
6.587
6.577
5.144
5.127
4.750
4.733
4.716
4.699
4.682
3.919
3.034
O
CF3
N
MeO
1H NMR
9
8
7
6
5
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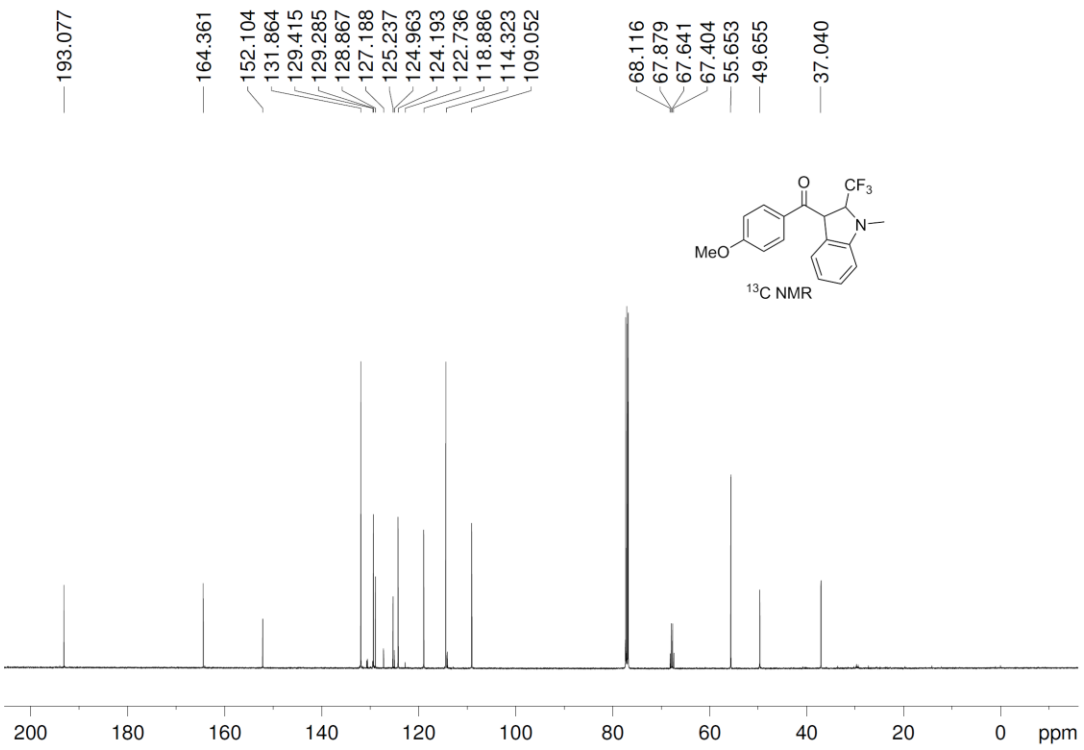
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49.655
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N
MeO
13C NMR
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0
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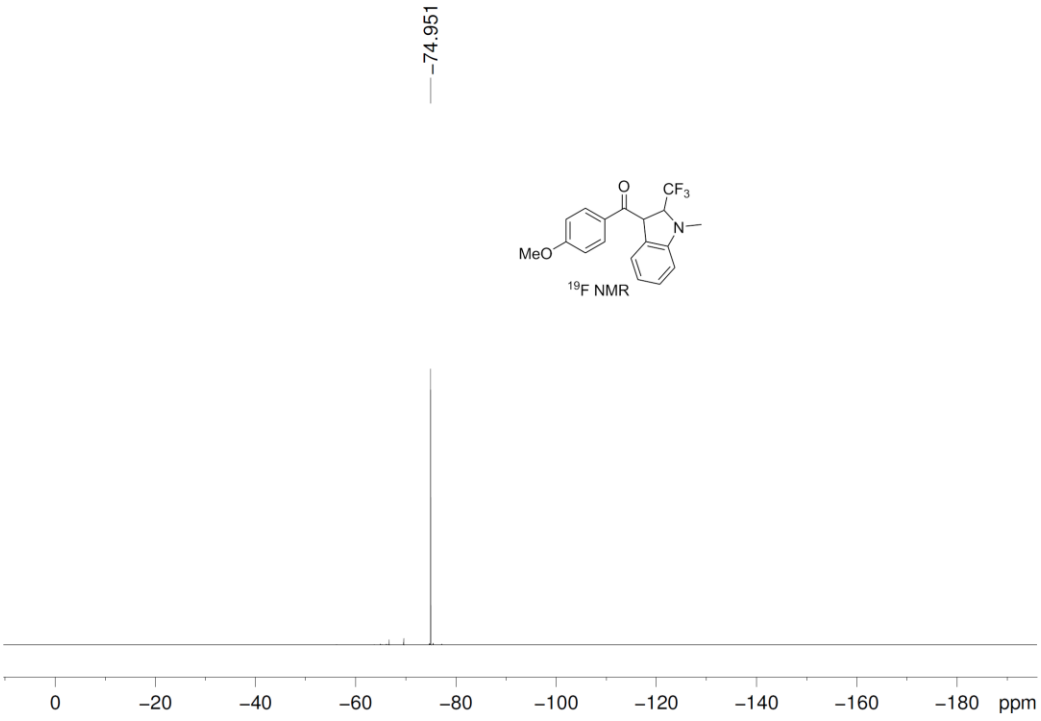
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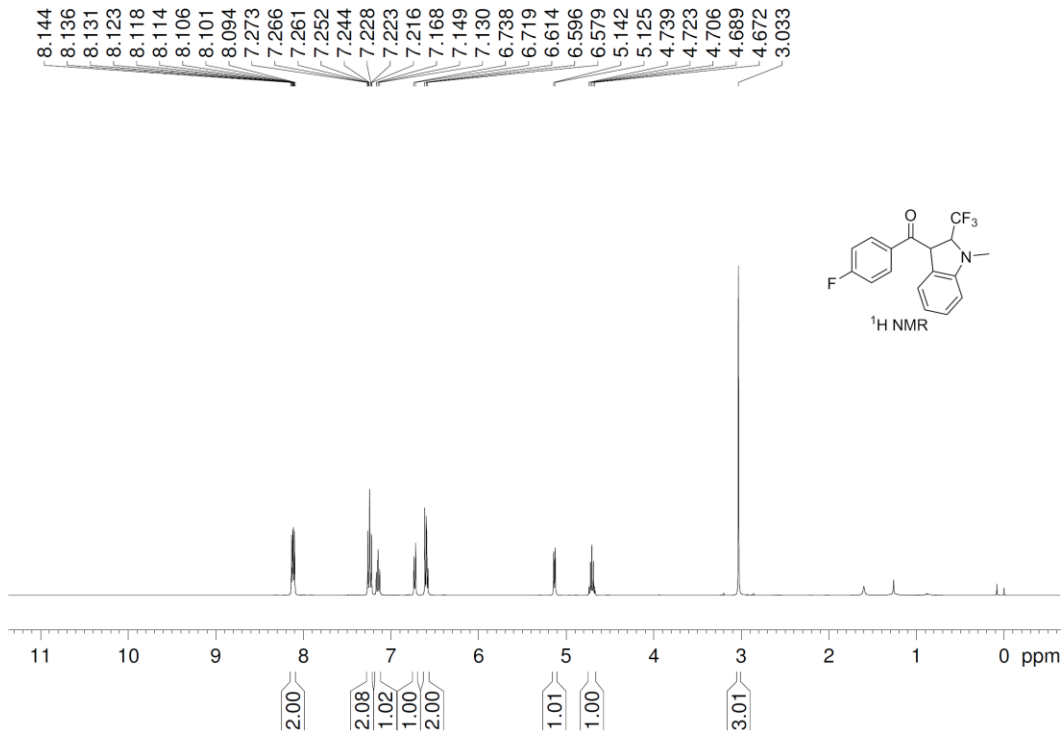
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7.228
7.223
7.216
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7.149
7.130
6.738
6.719
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6.596
6.579
5.142
5.125
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4.723
4.706
4.689
4.672
3.033
O
CF3
N
F
1H NMR
11
10
9
8
7
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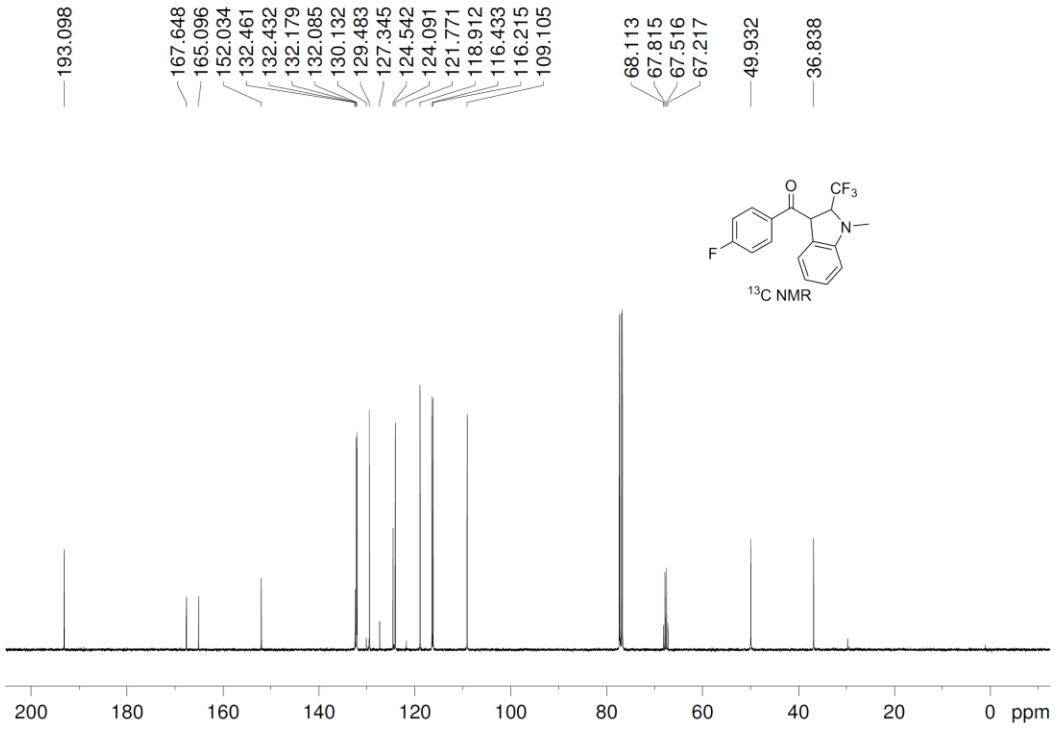
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118.912
116.433
116.215
109.105
68.113
67.815
67.516
67.217
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CF3
N
F
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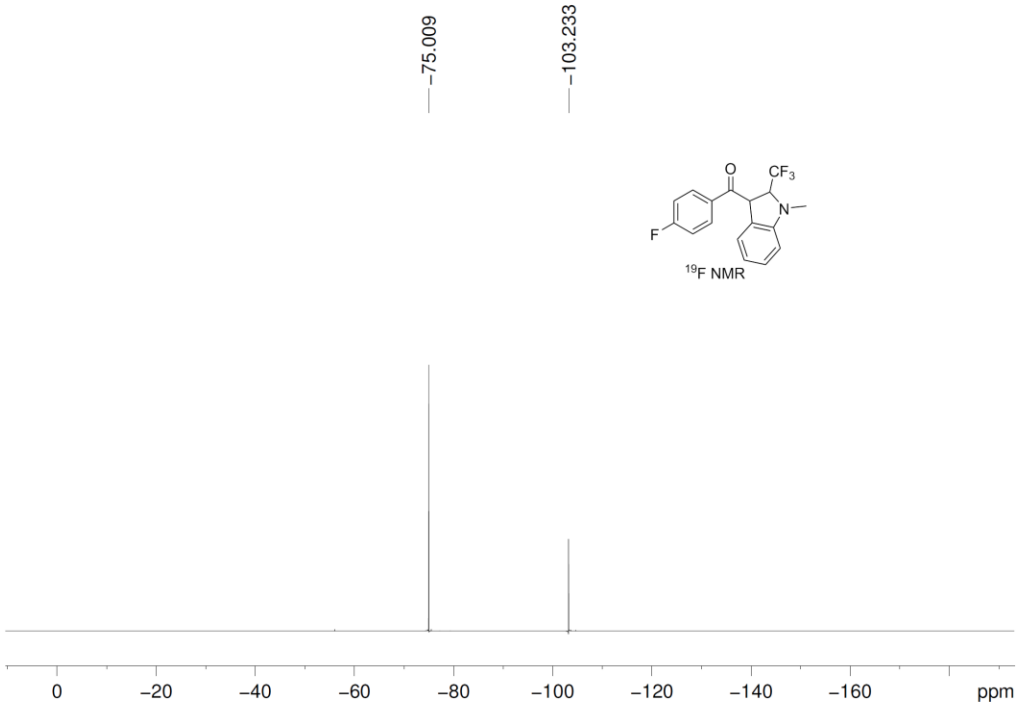
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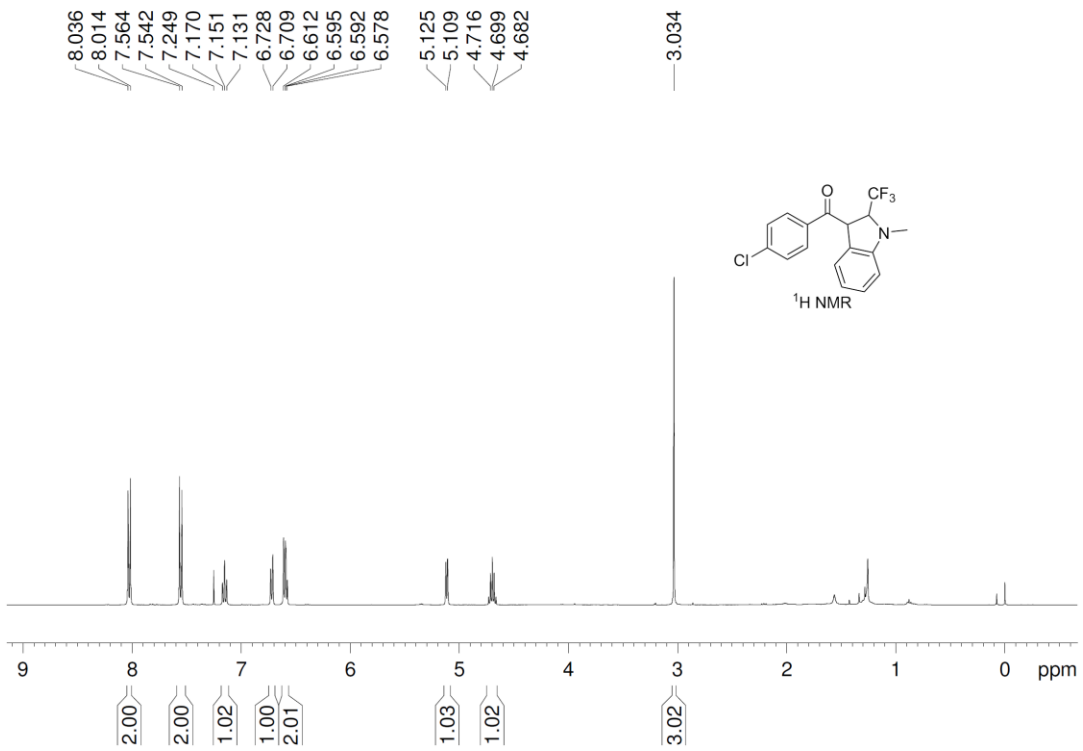
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7.131
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6.709
6.612
6.595
6.592
6.578
5.125
5.109
4.716
4.699
4.682
3.034
O
CF3
N
Cl
1H NMR
9
8
7
6
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4
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ppm
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1.00
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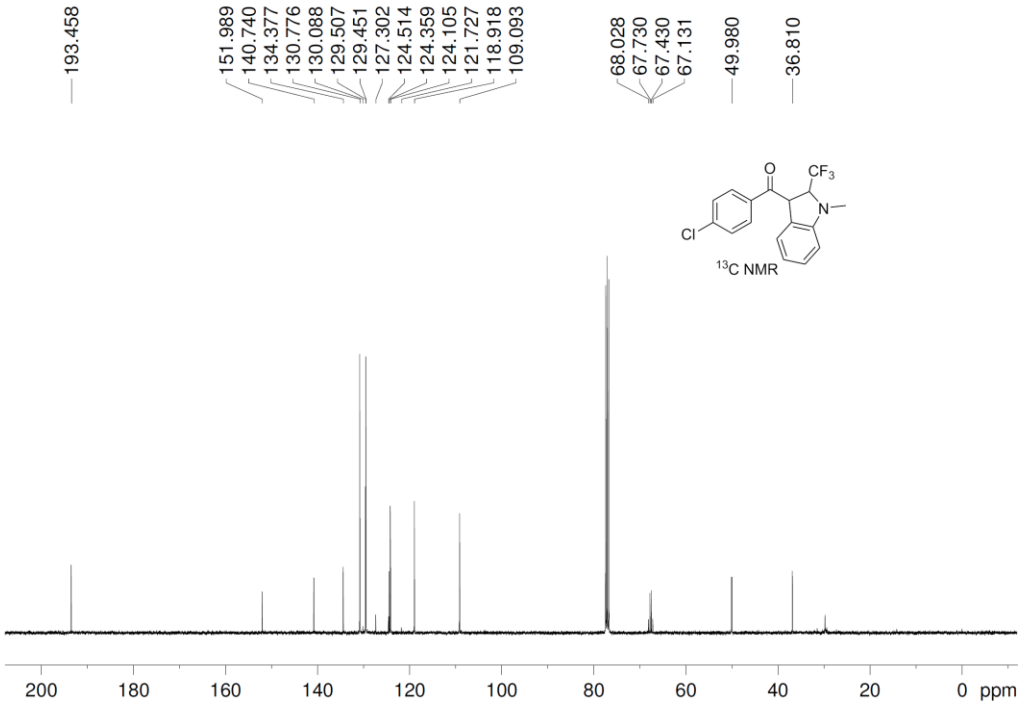
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49.980
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N
Cl
13C NMR
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120
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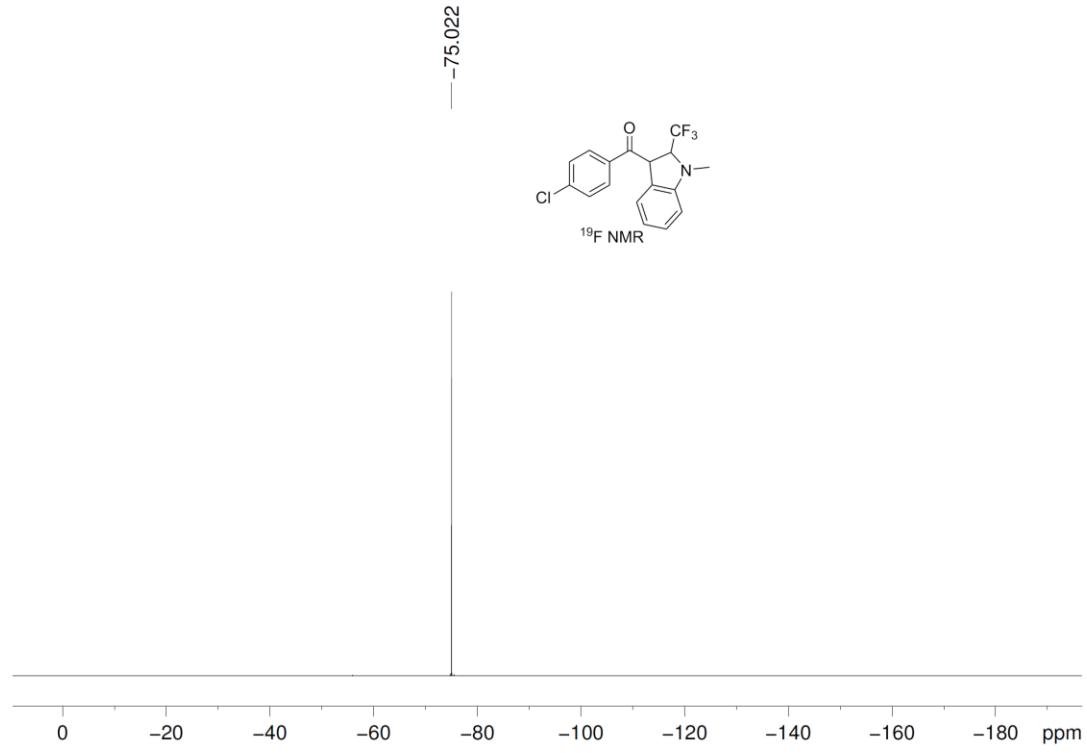
ppm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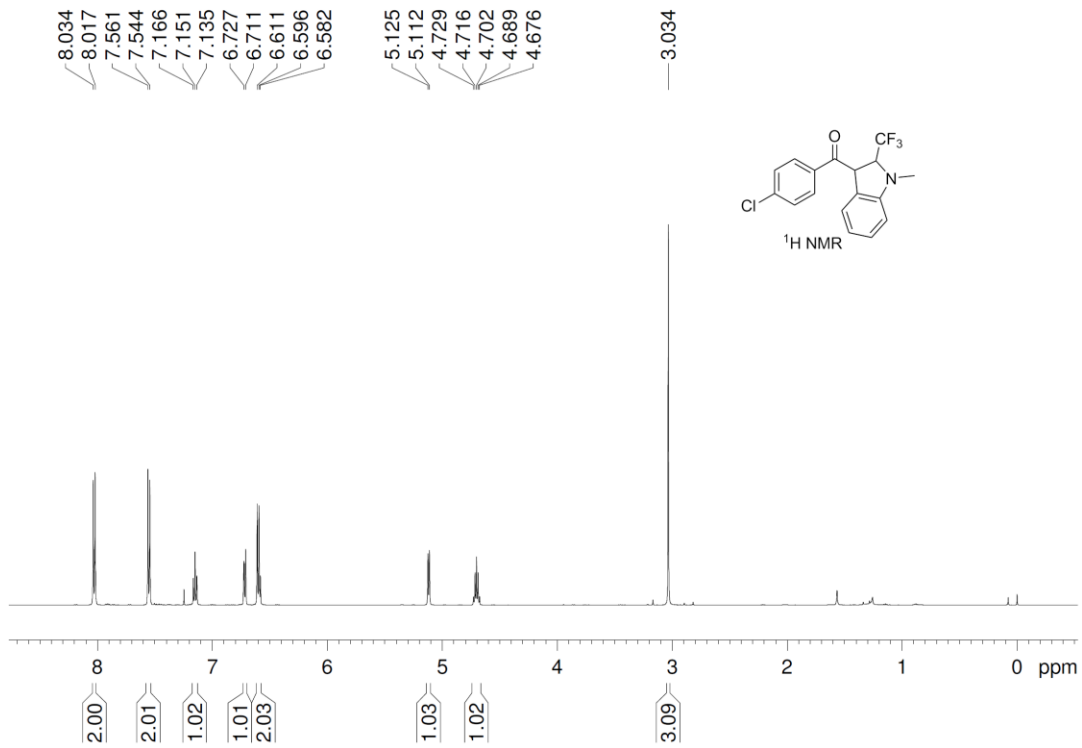
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5.112
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4.716
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O
CF3
N
Cl
1H NMR
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7
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1.01
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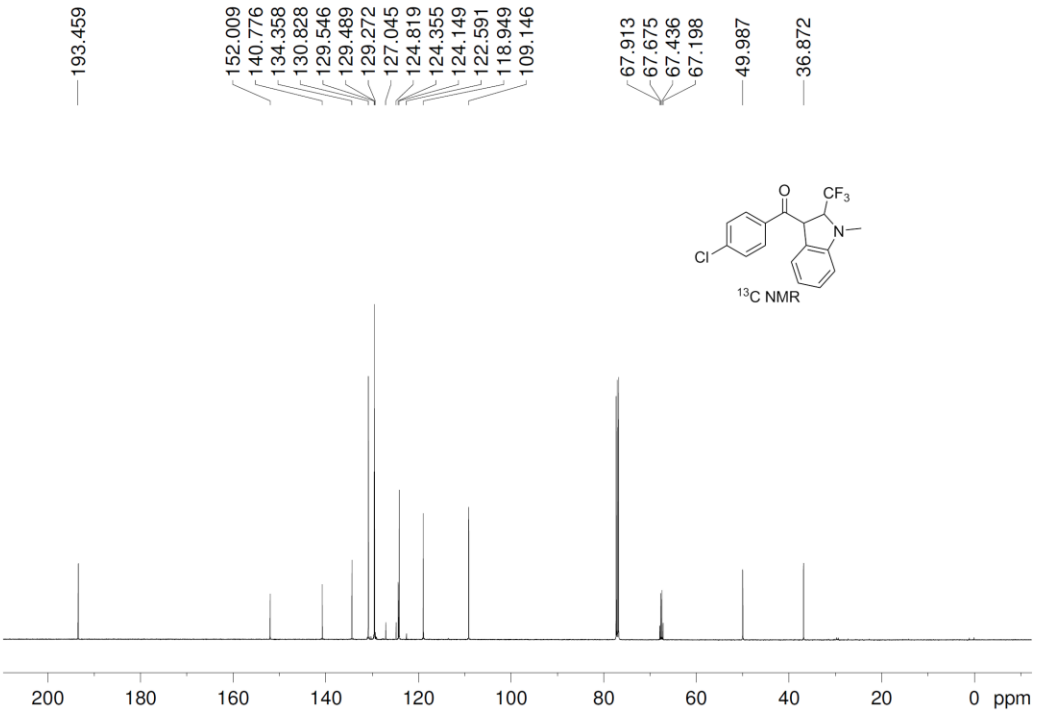
1.03
1.02
3.09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67.198
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N
Cl
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20
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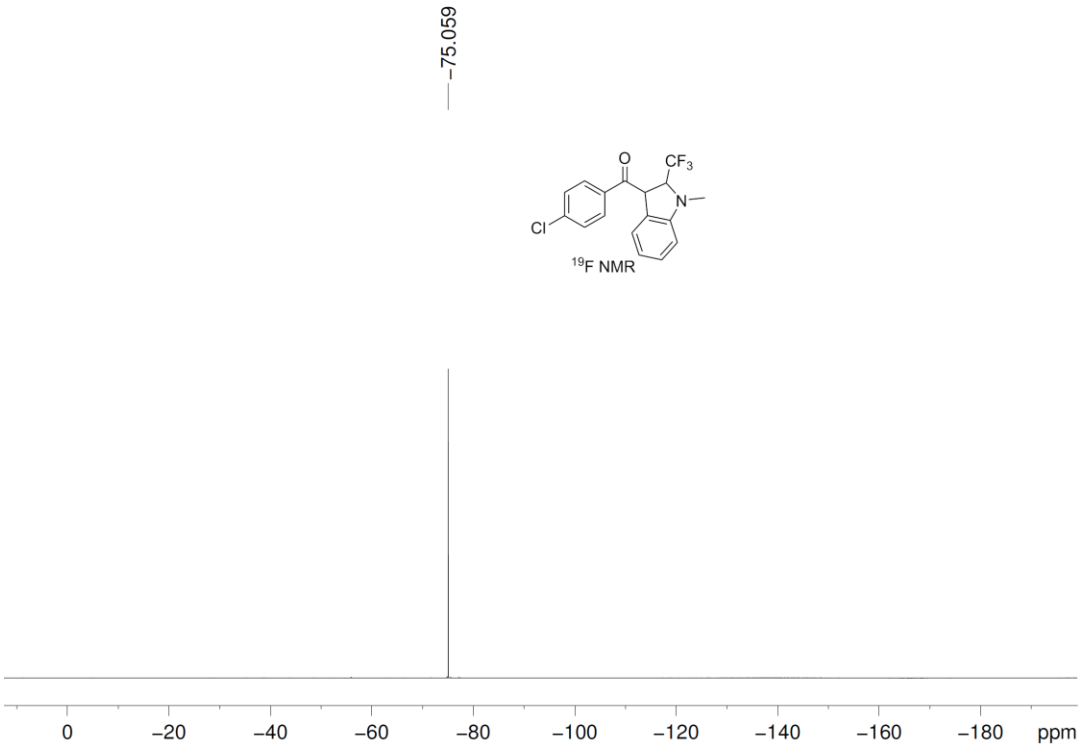
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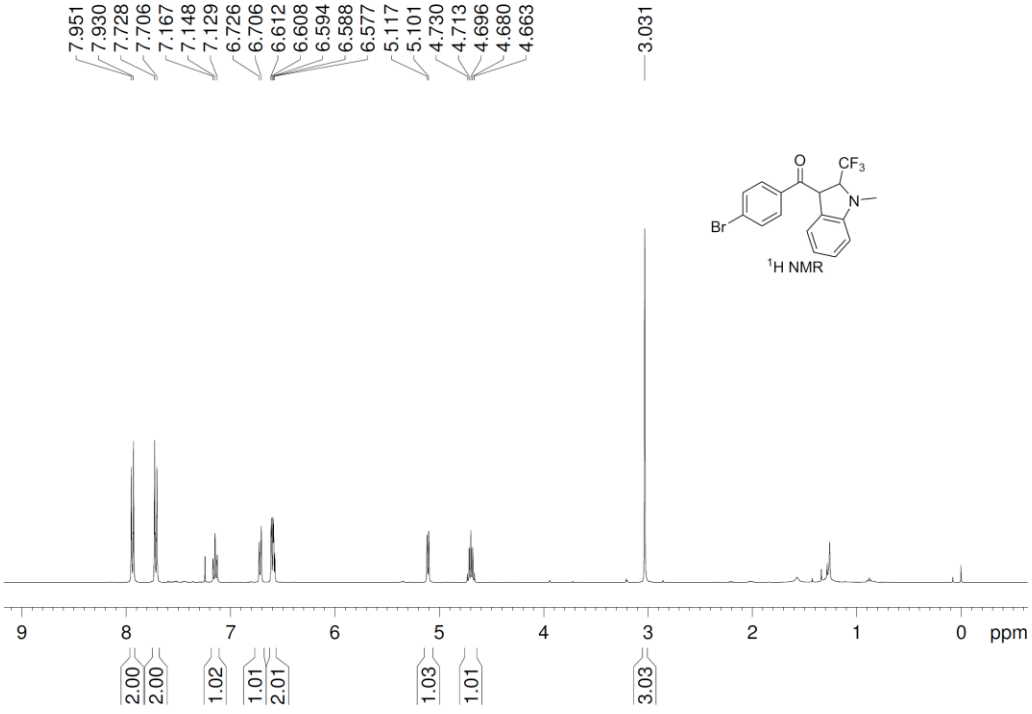
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6.608
6.594
6.588
6.577
5.117
5.101
4.730
4.713
4.696
4.680
4.663
3.031
O
CF3
N
Br
1H NMR
9
8
7
6
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ppm
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2.00
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1.01
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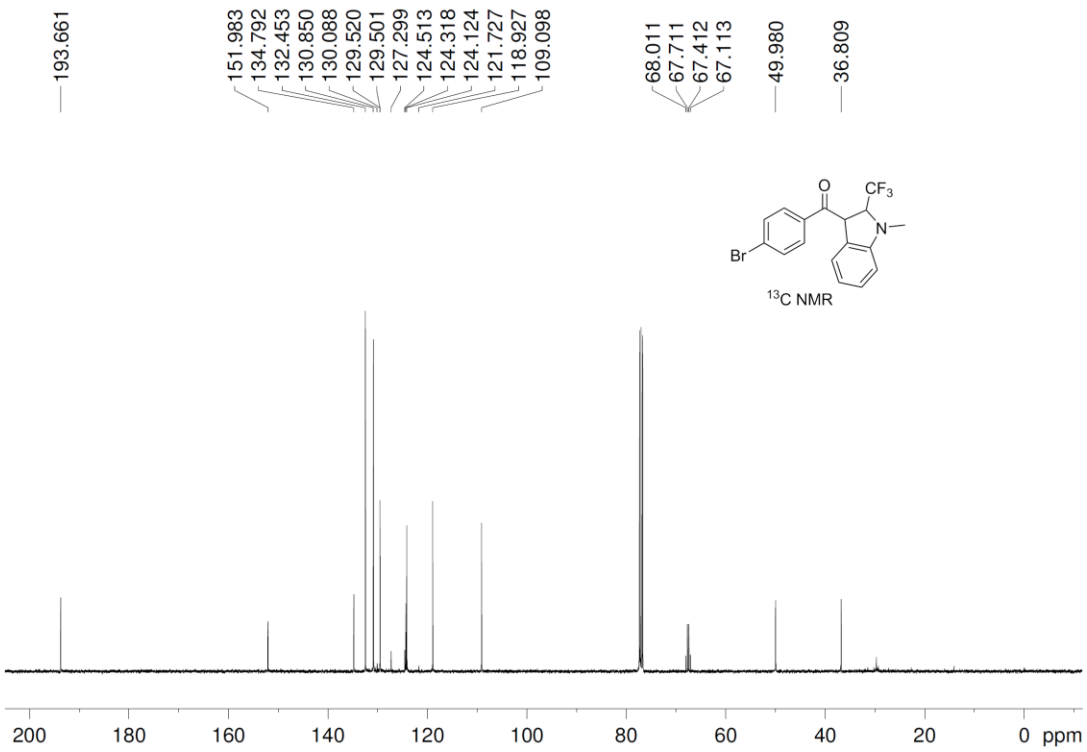
1.03
1.01
3.03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67.412
67.113
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N
Br
13C NMR
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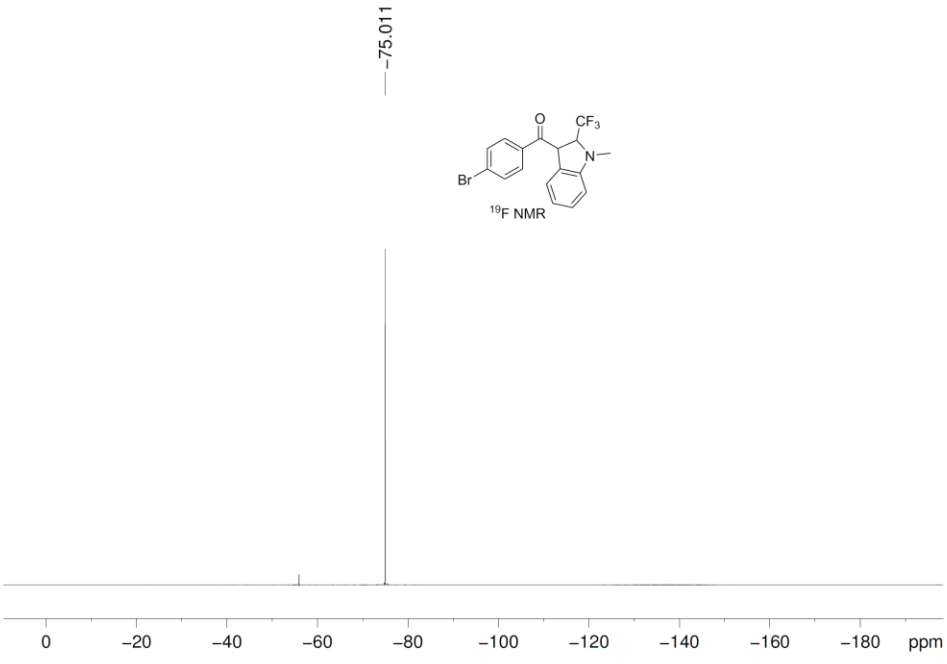
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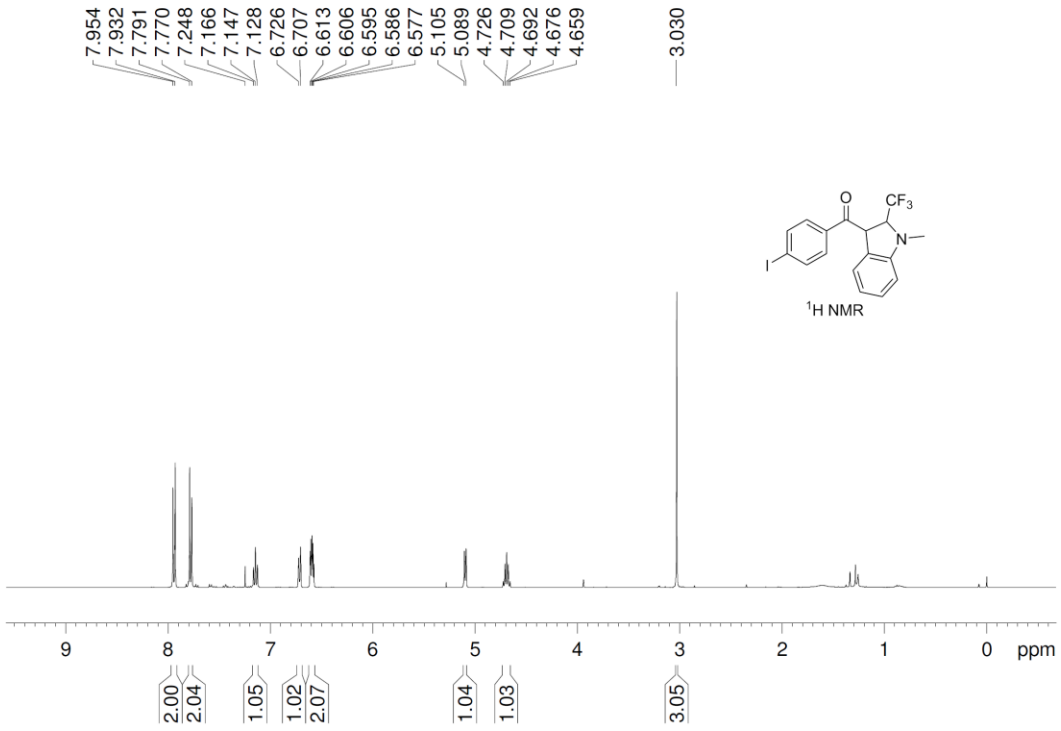
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6.707
6.613
6.606
6.595
6.586
6.577
5.105
5.089
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4.709
4.692
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4.659
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CF3
N
I
1H NMR
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8
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6
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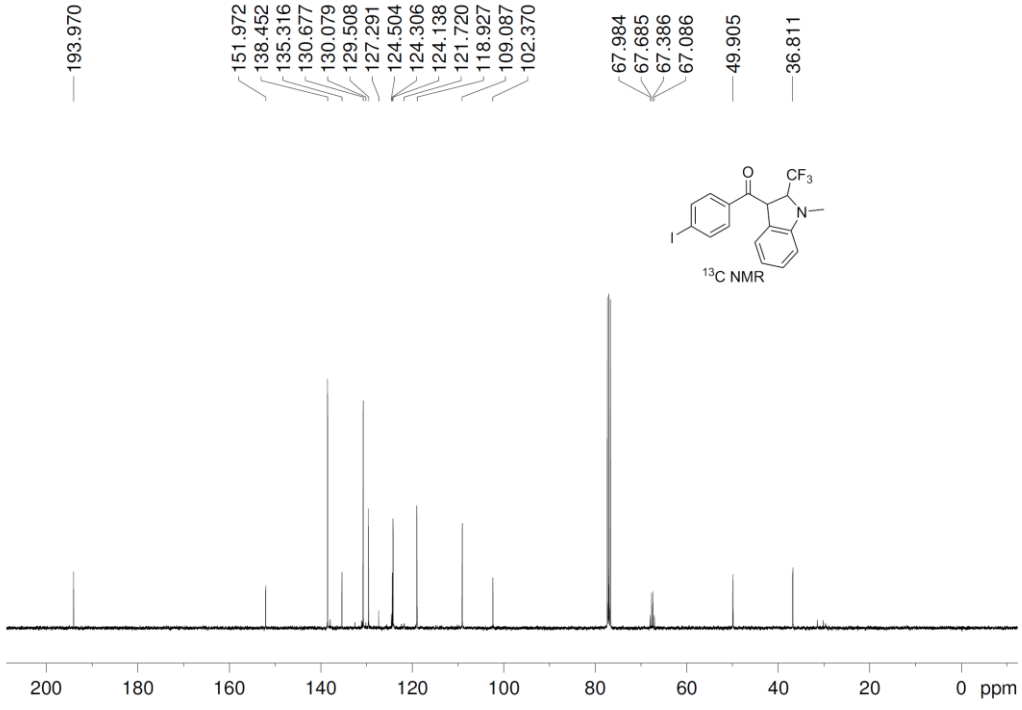
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I
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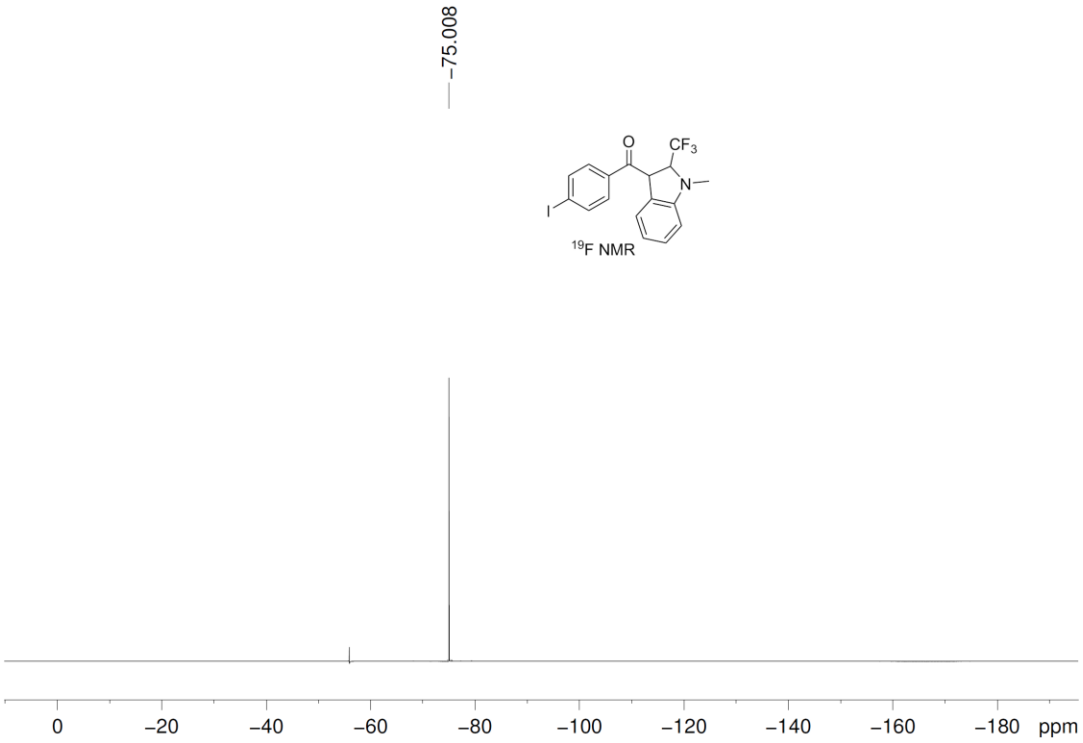
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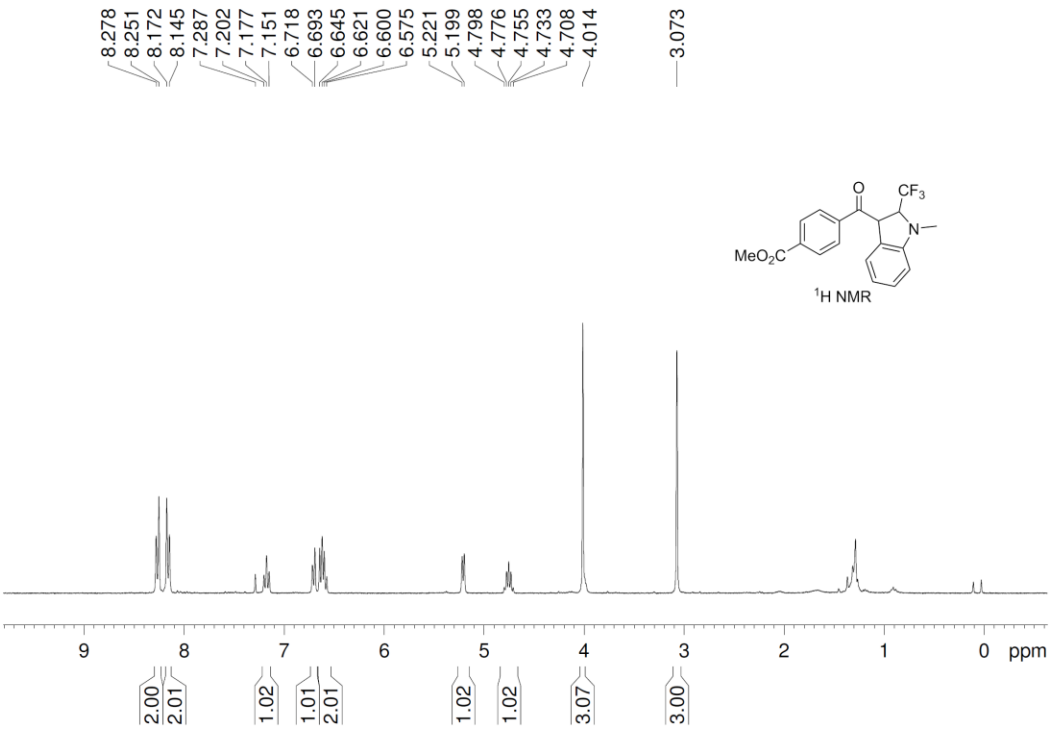
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4.755
4.733
4.708
4.014
3.073
O
CF3
N
MeO2C
1H NMR
9
8
7
6
5
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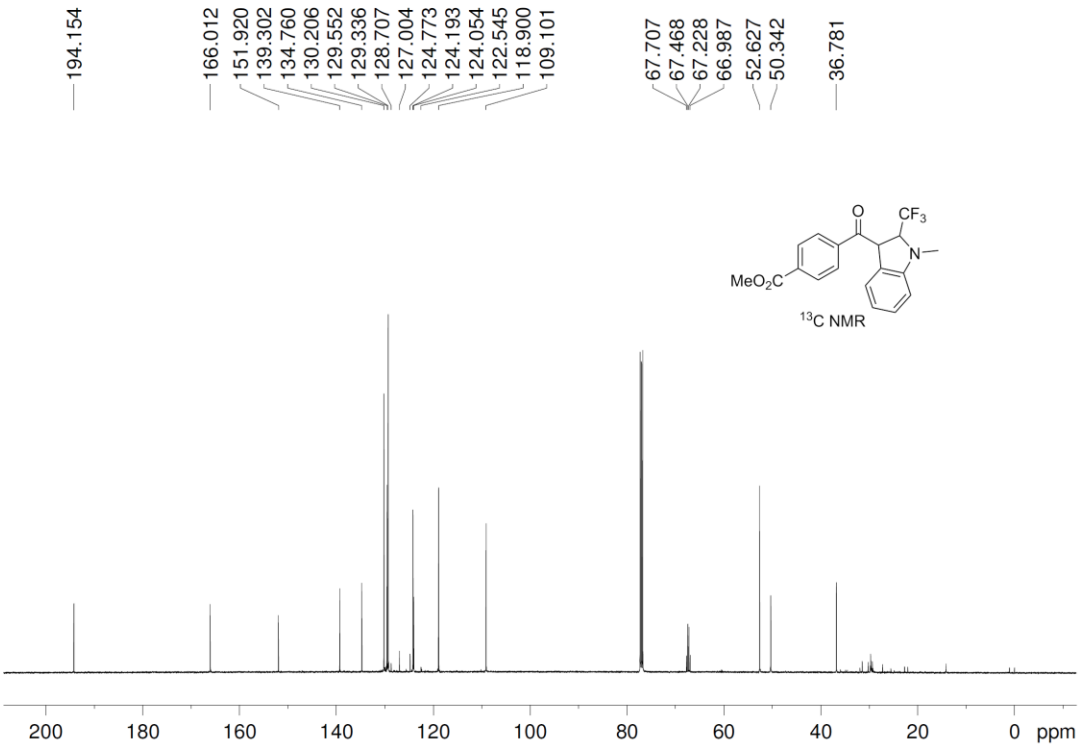
3.00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67.468
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50.342
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MeO2C
13C NMR
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120
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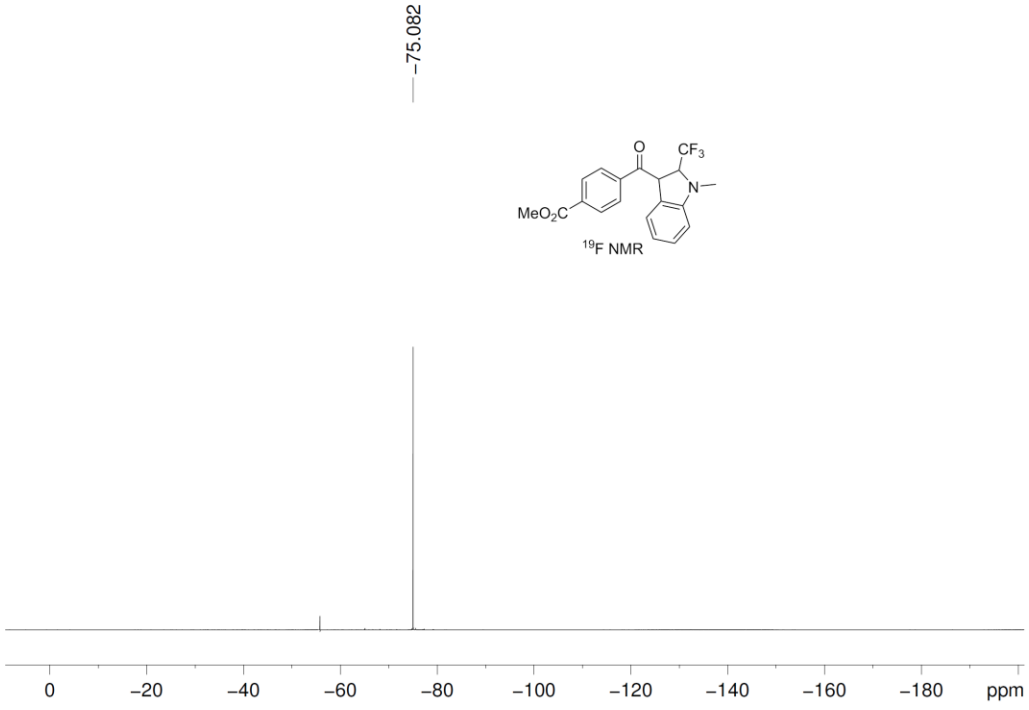
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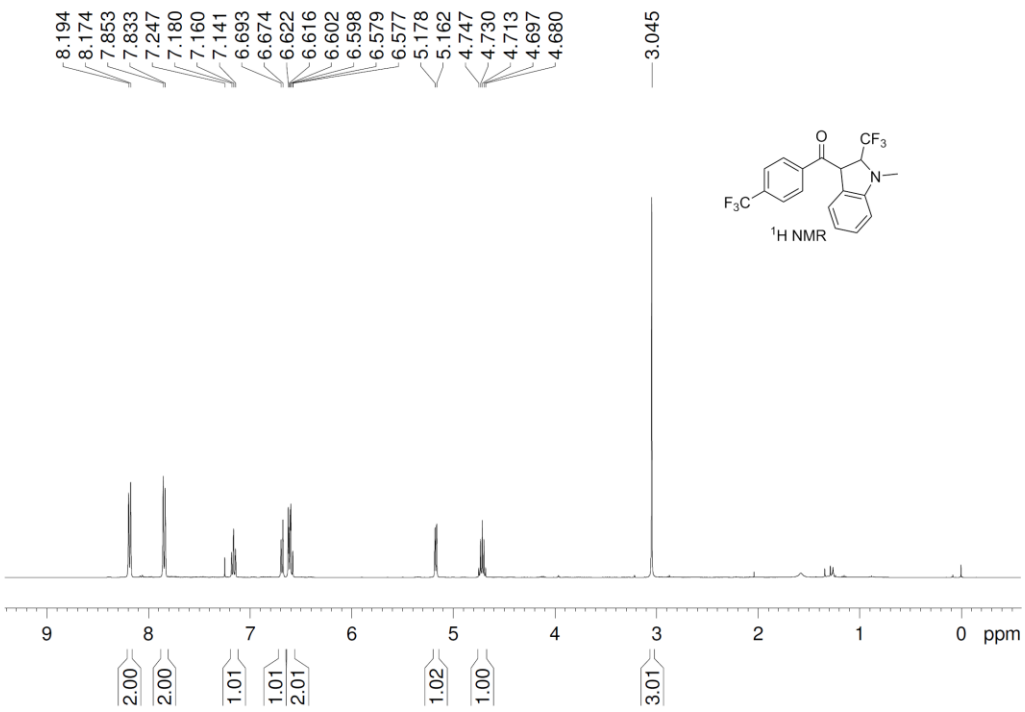
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6.577
5.178
5.162
4.747
4.730
4.713
4.697
4.680
3.045
O
CF3
N
F3C
1H NMR
9
8
7
6
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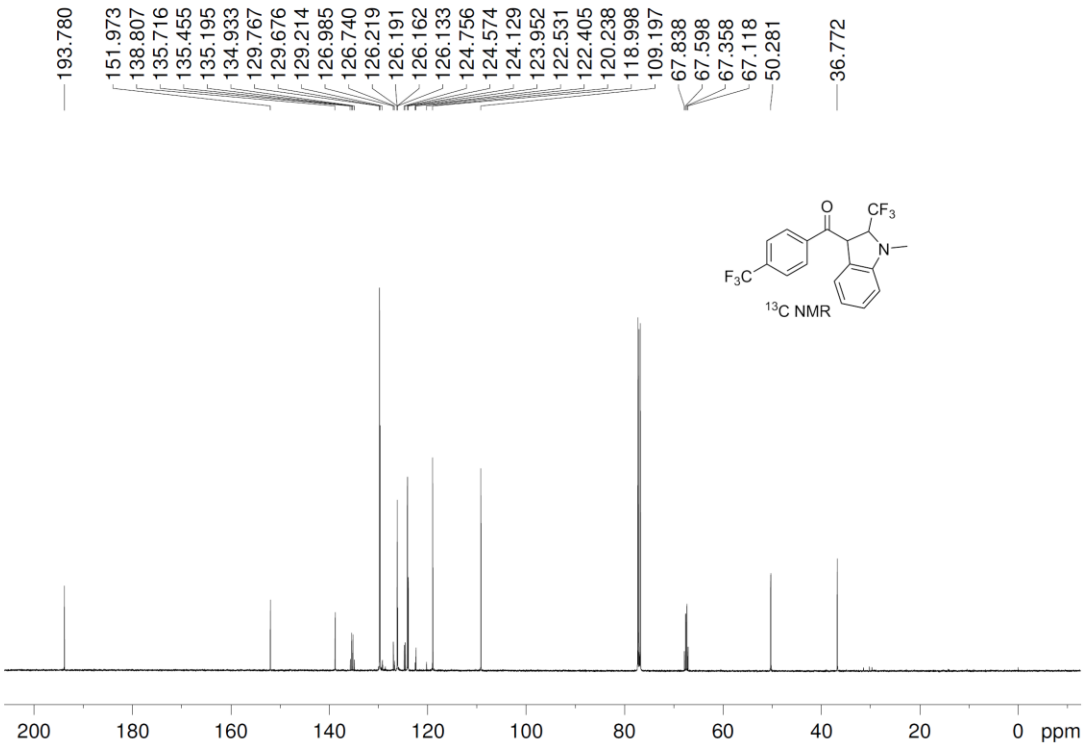
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118.998
109.197
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67.598
67.358
67.118
50.281
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N
F3C
13C NMR
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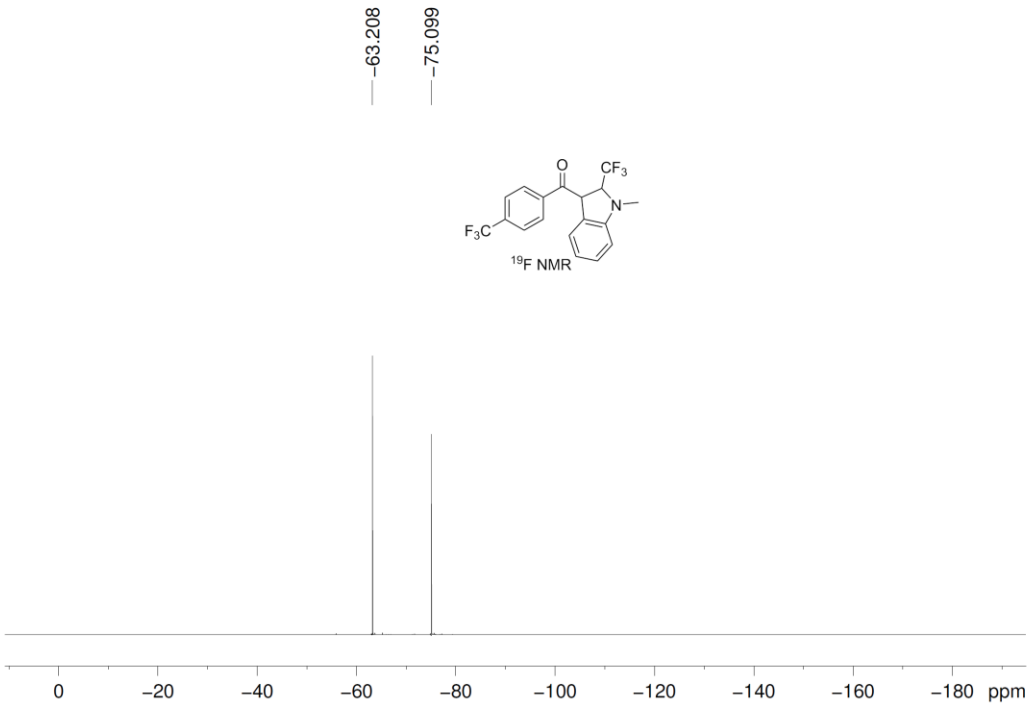
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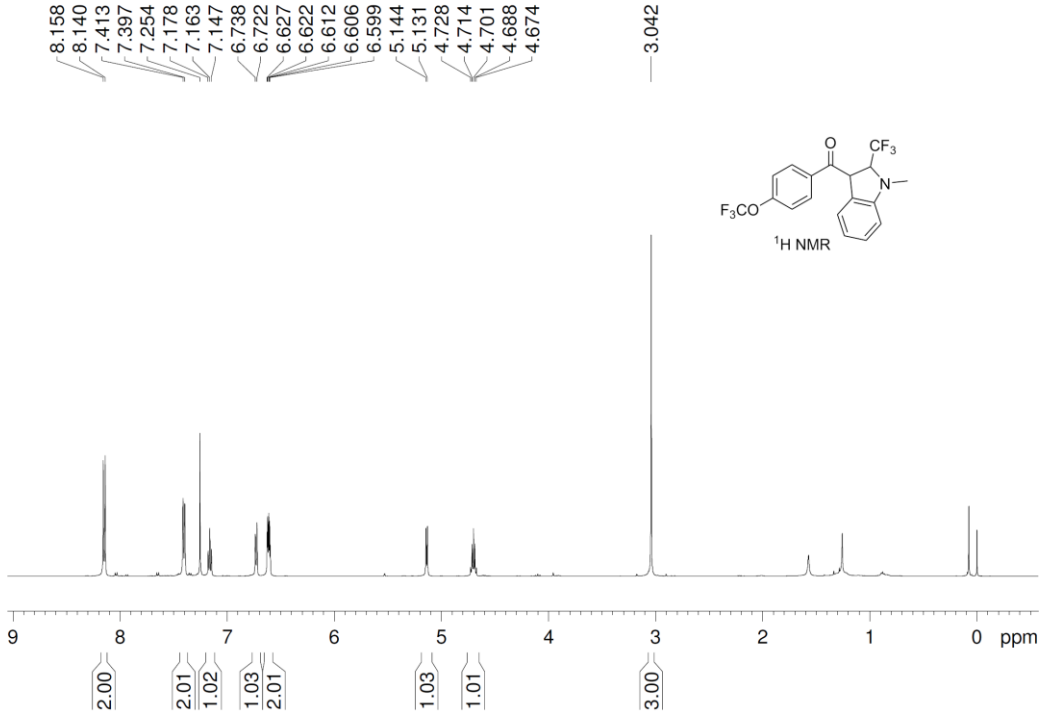
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7.397
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5.144
5.131
4.728
4.714
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4.688
4.674
3.042
O
CF3
F3CO
N
1H NMR
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8
7
6
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1.03
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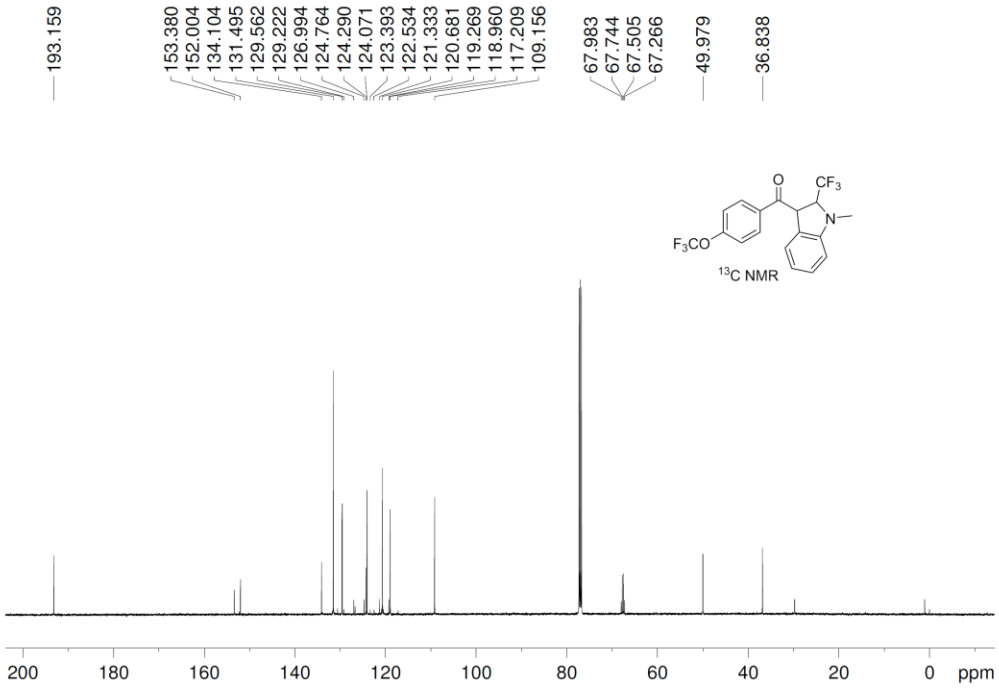
3.00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67.505
67.266
49.979
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F3CO
13C NMR
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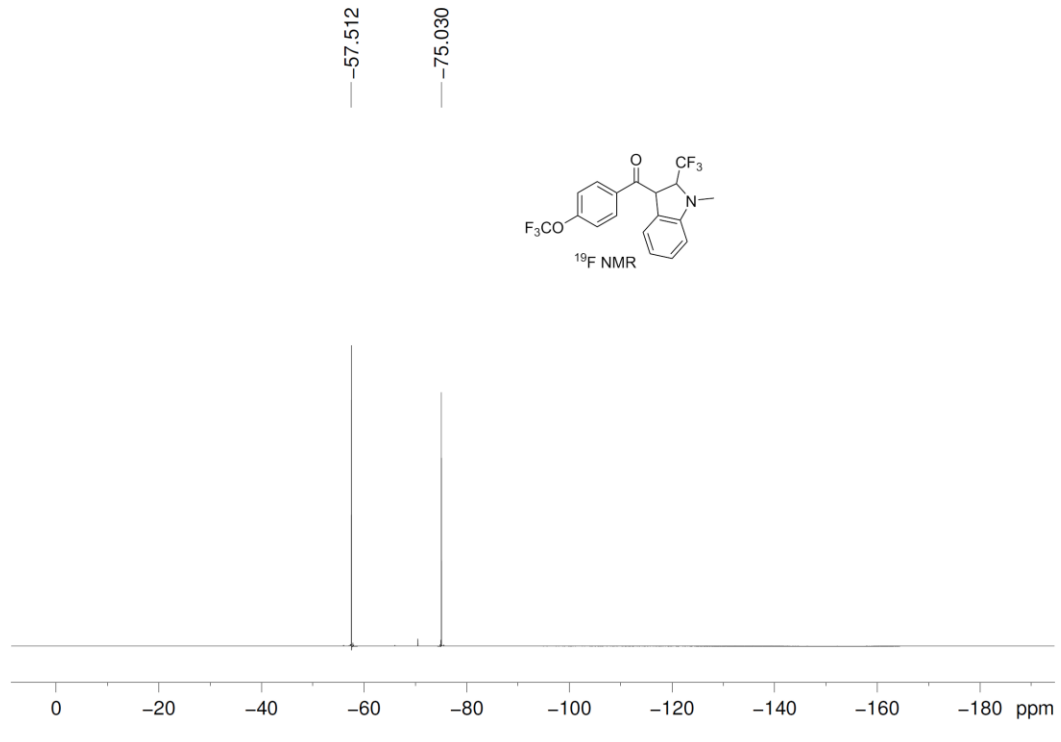
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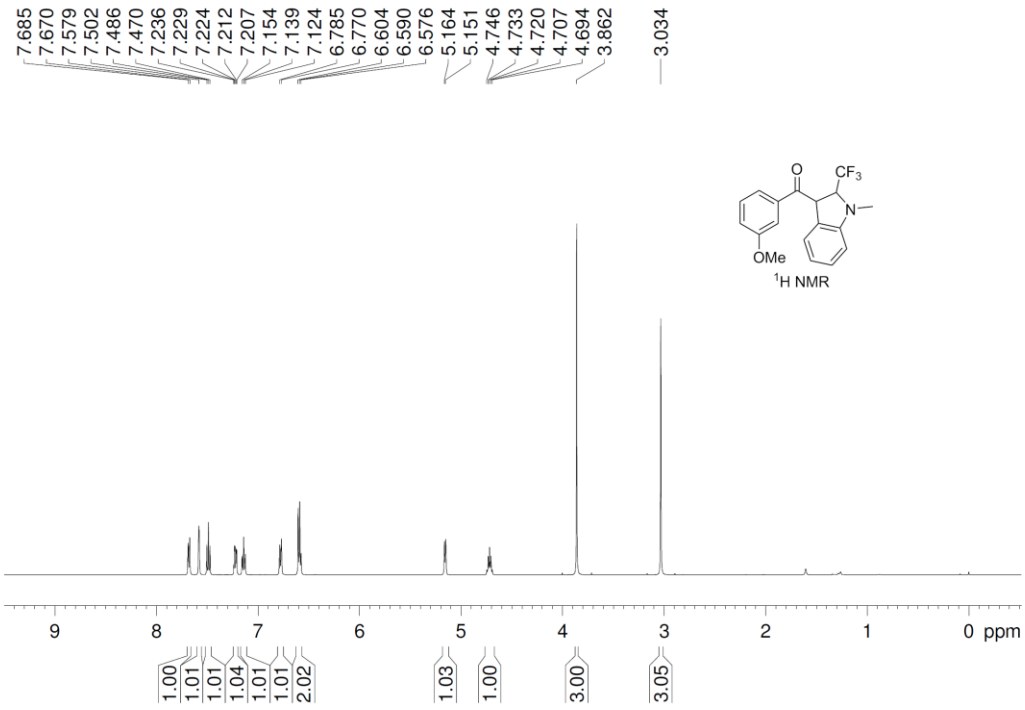
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5.151
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4.733
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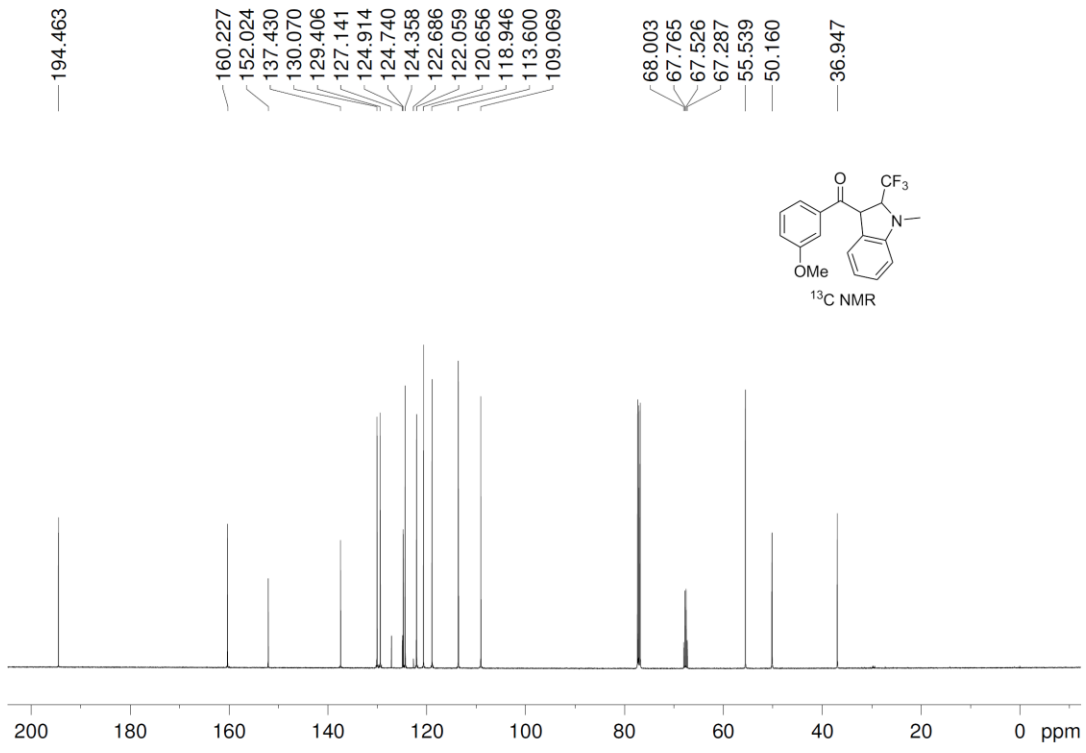
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122.059
120.656
118.946
113.600
109.069
68.003
67.765
67.526
67.287
55.539
50.160
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CF3
N
OMe
13C NMR
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120
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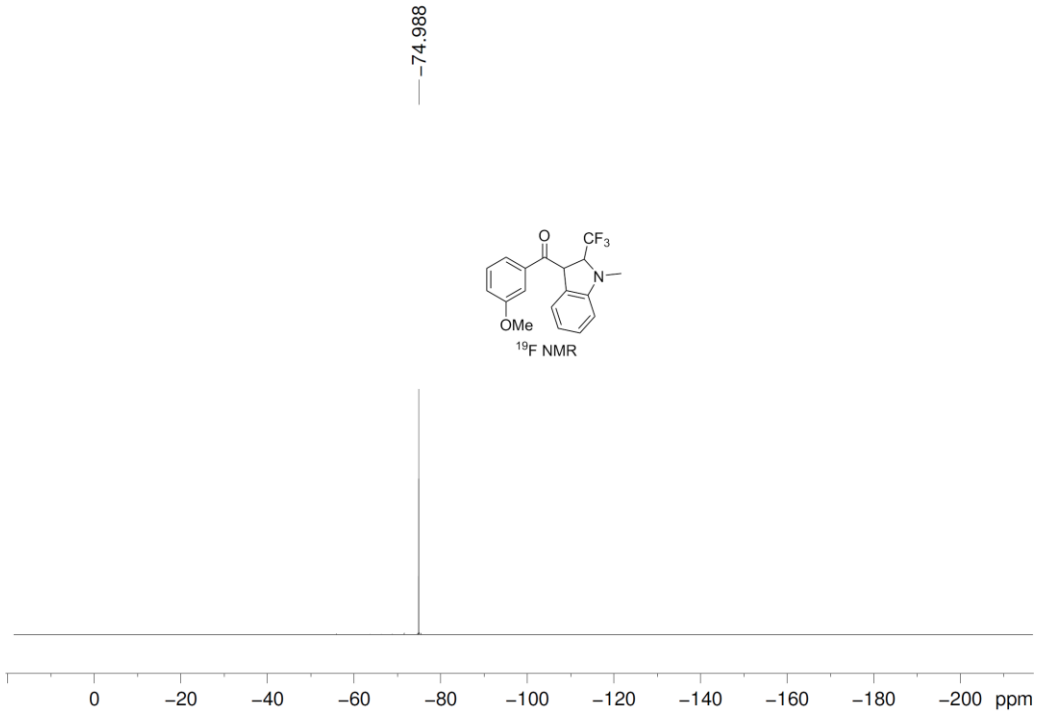
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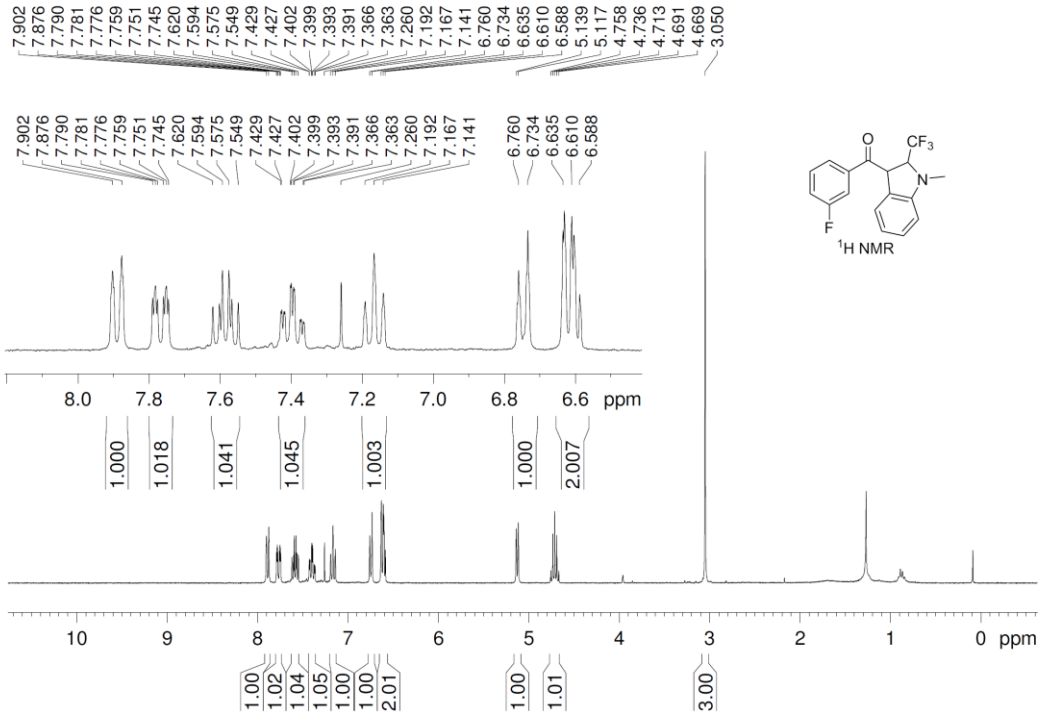
−180
−200
ppm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7.427
7.402
7.399
7.393
7.391
7.366
7.363
7.260
7.192
7.167
7.141
6.760
6.734
6.635
6.610
6.588
5.139
5.117
4.758
4.736
4.713
4.691
4.669
3.050
O
CF3
N
F
1H NMR
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
ppm
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1.018
1.041
1.045
1.003
1.000
2.007
10
9
8
7
6
5
4
3
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1.04
1.05
1.00
1.00
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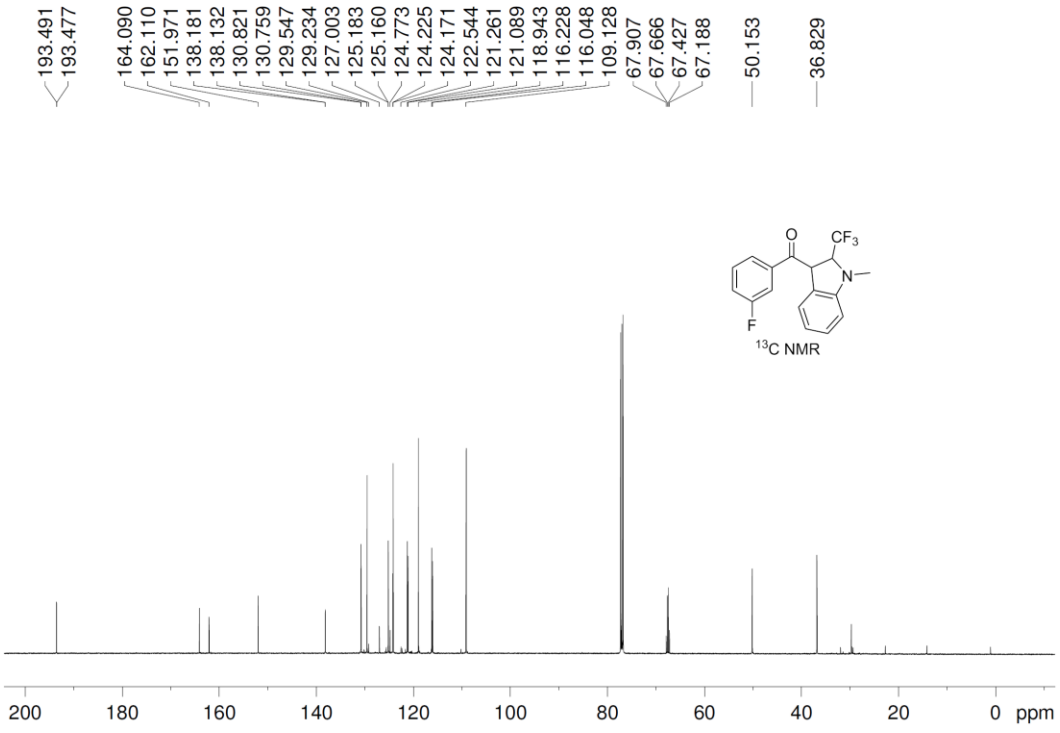
1.00
1.01
3.00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125.160
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124.225
124.171
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121.261
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67.666
67.427
67.188
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N
F
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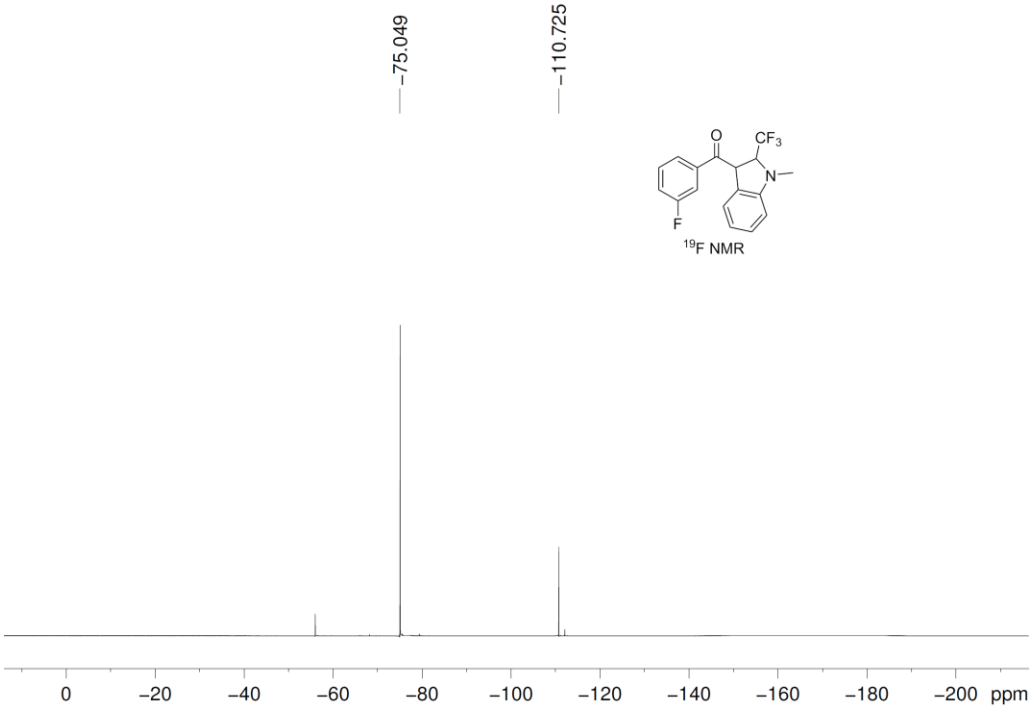
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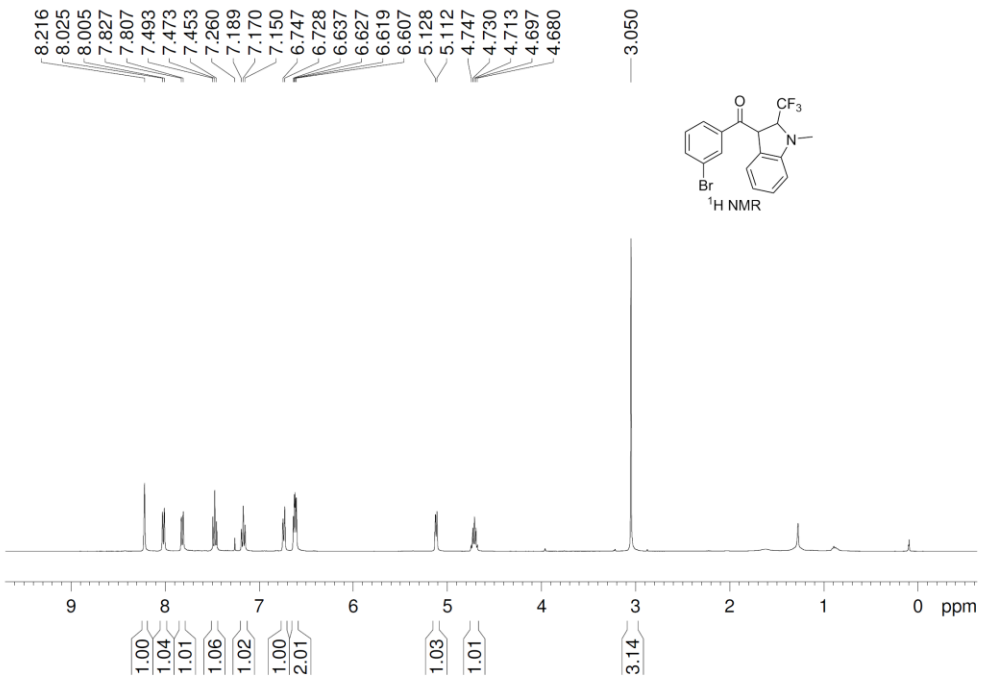
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7.150
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6.728
6.637
6.627
6.619
6.607
5.128
5.112
4.747
4.730
4.713
4.697
4.680
3.050
O
CF3
N
Br
1H NMR
9
8
7
6
5
4
3
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1.00
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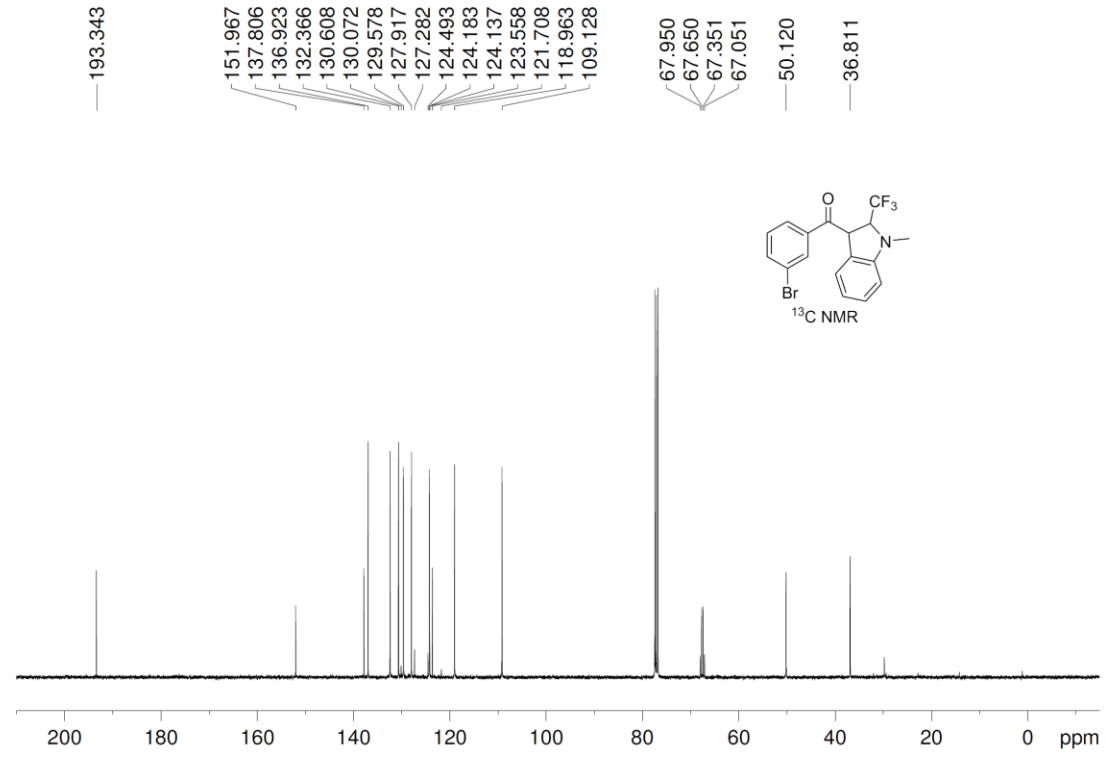
3.14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123.558
121.708
118.963
109.128
67.950
67.650
67.351
67.051
50.120
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N
Br
13C NMR
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120
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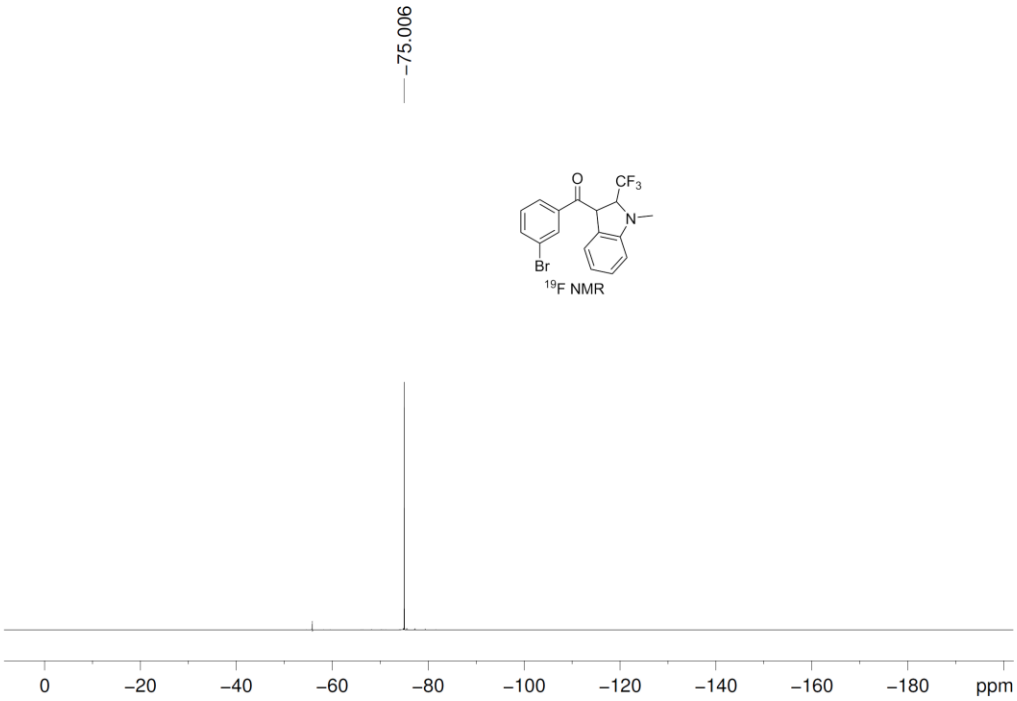
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−180
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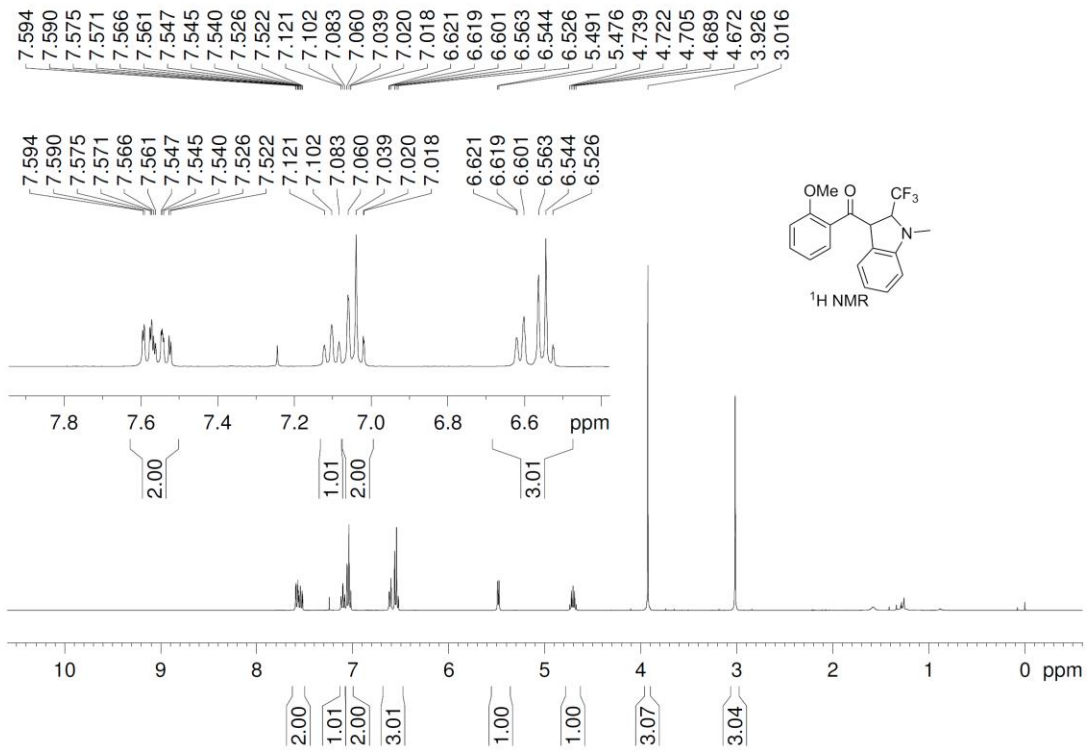
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7.545
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7.522
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7.102
7.083
7.060
7.039
7.020
7.018
6.621
6.619
6.601
6.563
6.544
6.526
5.491
5.476
4.739
4.722
4.705
4.689
4.672
3.926
3.016
OMe O
CF3
N
1H NMR
7.8
7.6
7.4
7.2
7.0
6.8
6.6
ppm
2.00
1.01
2.00
3.01
10
9
8
7
6
5
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2
1
0 ppm
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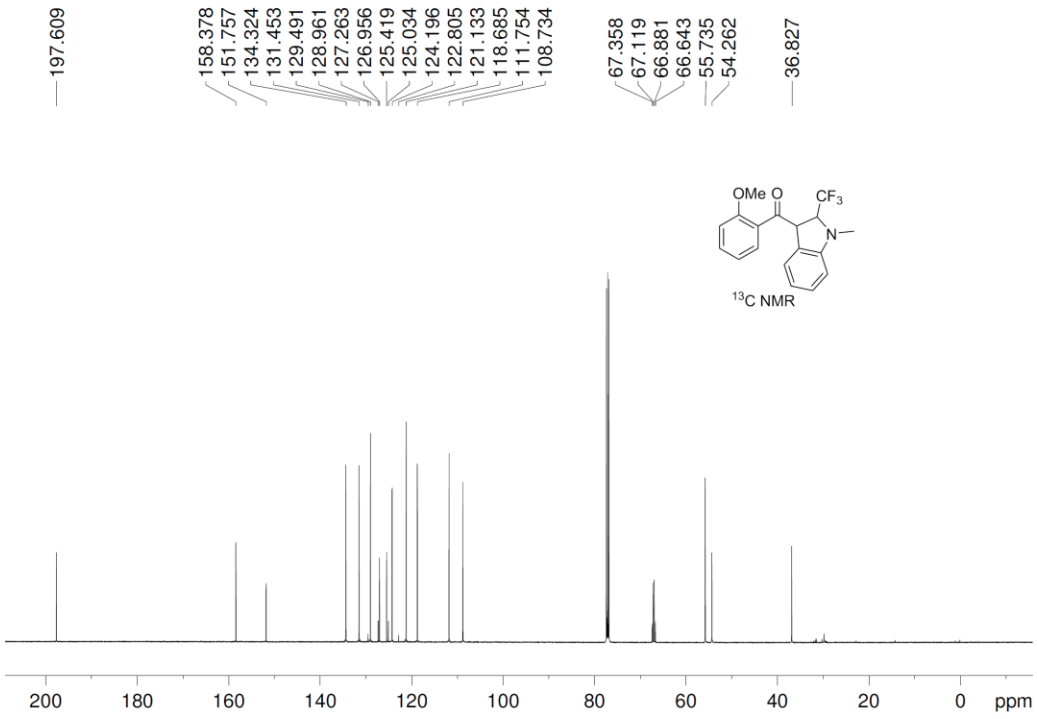
2.00
3.01
1.00
1.00
3.07
3.04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122.805
121.133
118.685
111.754
108.734
67.358
67.119
66.881
66.643
55.735
54.262
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CF3
N
13C NMR
200
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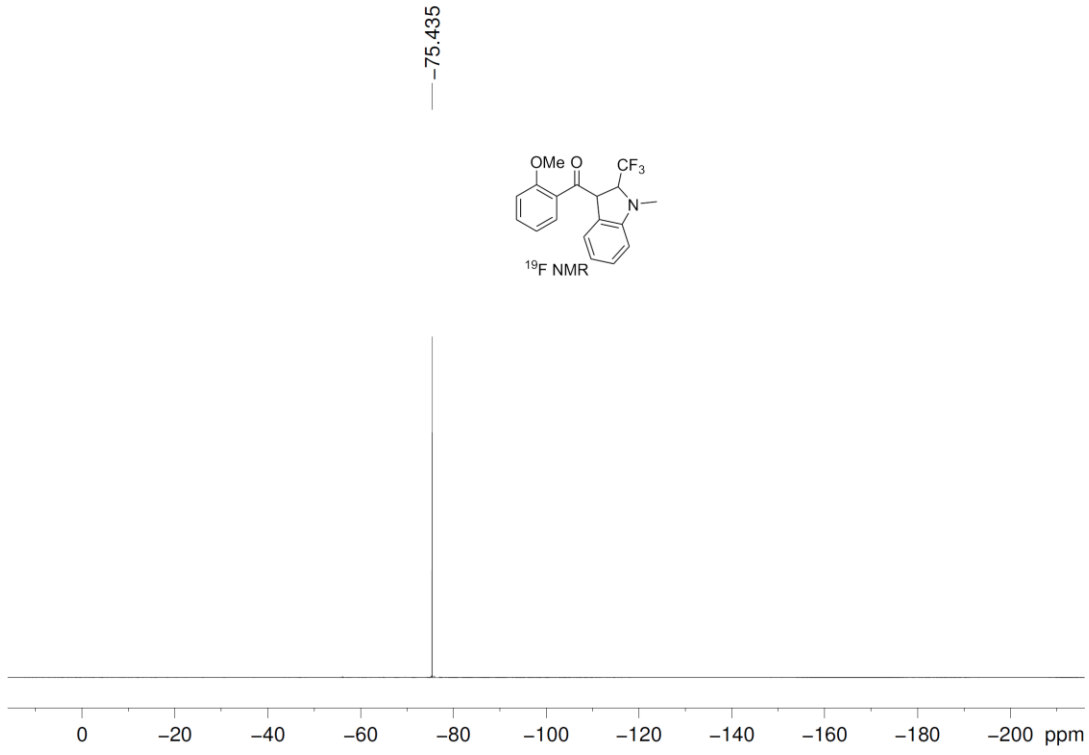
120
100
80
60
40
20
0
ppm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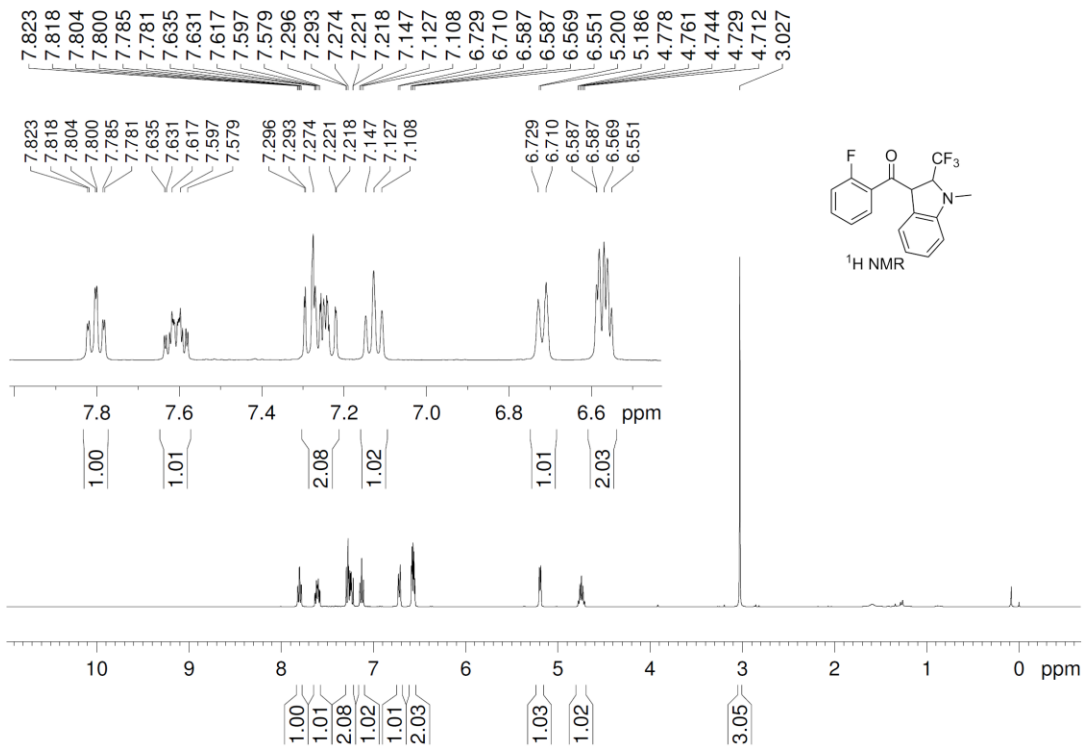
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7.631
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7.597
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7.296
7.293
7.274
7.221
7.218
7.147
7.127
7.108
6.729
6.710
6.587
6.569
6.551
5.200
5.186
4.778
4.761
4.744
4.729
4.712
3.027
F
O
CF3
N
1H NMR
7.8
7.6
7.4
7.2
7.0
6.8
6.6
ppm
1.00
1.01
2.08
1.02
1.01
2.03
10
9
8
7
6
5
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ppm
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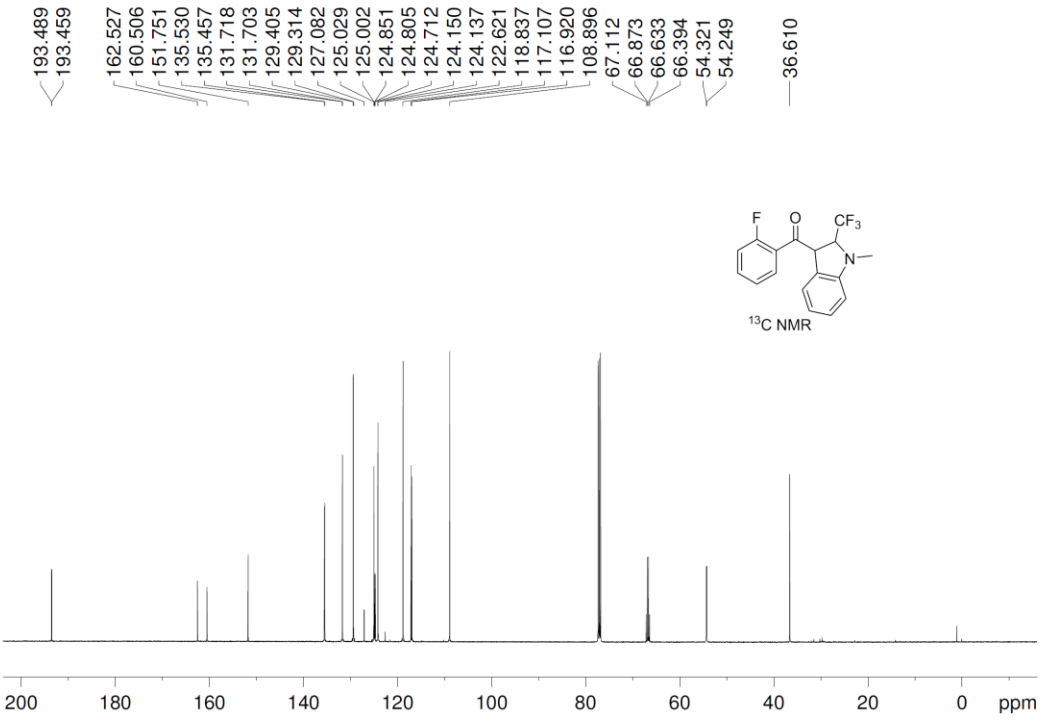
1.01
2.08
1.02
1.01
2.03
1.03
1.02
3.05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125.002
124.851
124.805
124.712
124.150
124.137
122.621
118.837
117.107
116.920
108.896
67.112
66.873
66.633
66.394
54.321
54.249
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CF3
N
13C NMR
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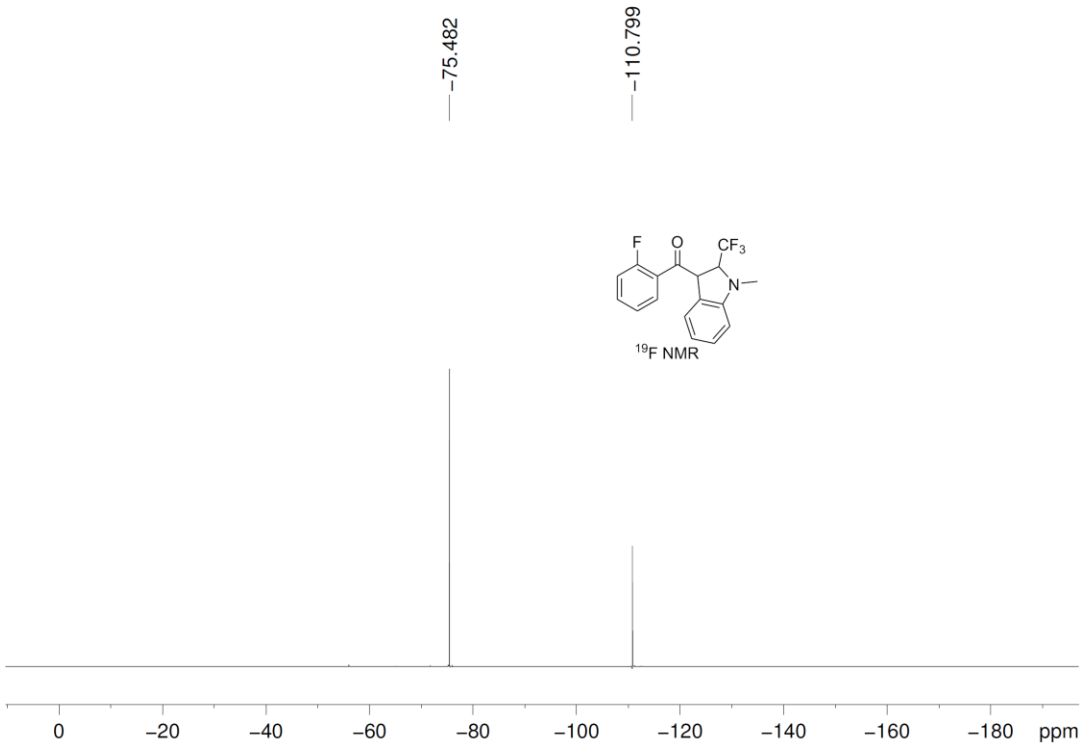
120
100
80
60
40
20
0
ppm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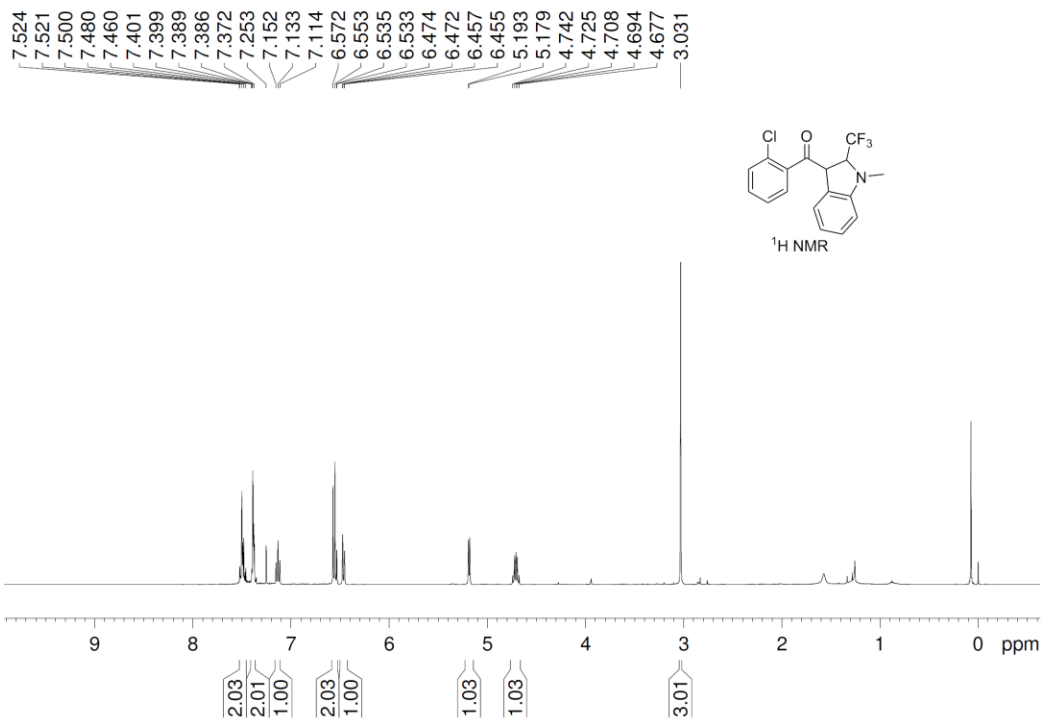
−180
ppm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7.372
7.253
7.152
7.133
7.114
6.572
6.553
6.535
6.533
6.474
6.472
6.457
6.455
5.193
5.179
4.742
4.725
4.708
4.694
4.677
3.031
Cl
O
CF3
N
1H NMR
9
8
7
6
5
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2.03
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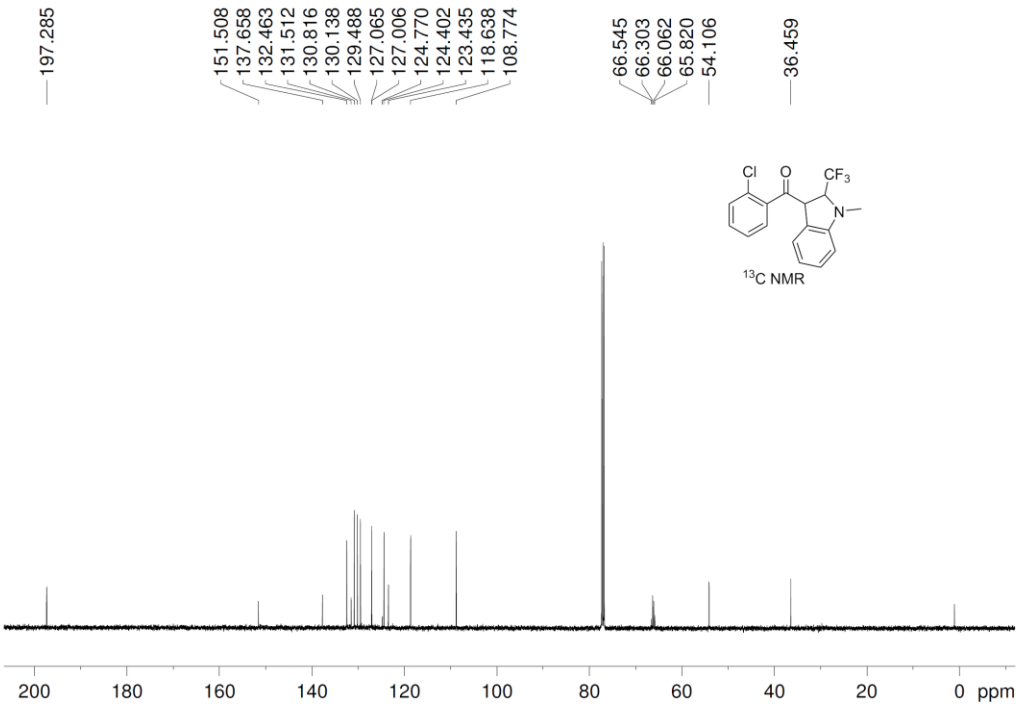
1.03
1.03
3.01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123.435
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66.062
65.820
54.106
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CF3
N
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120
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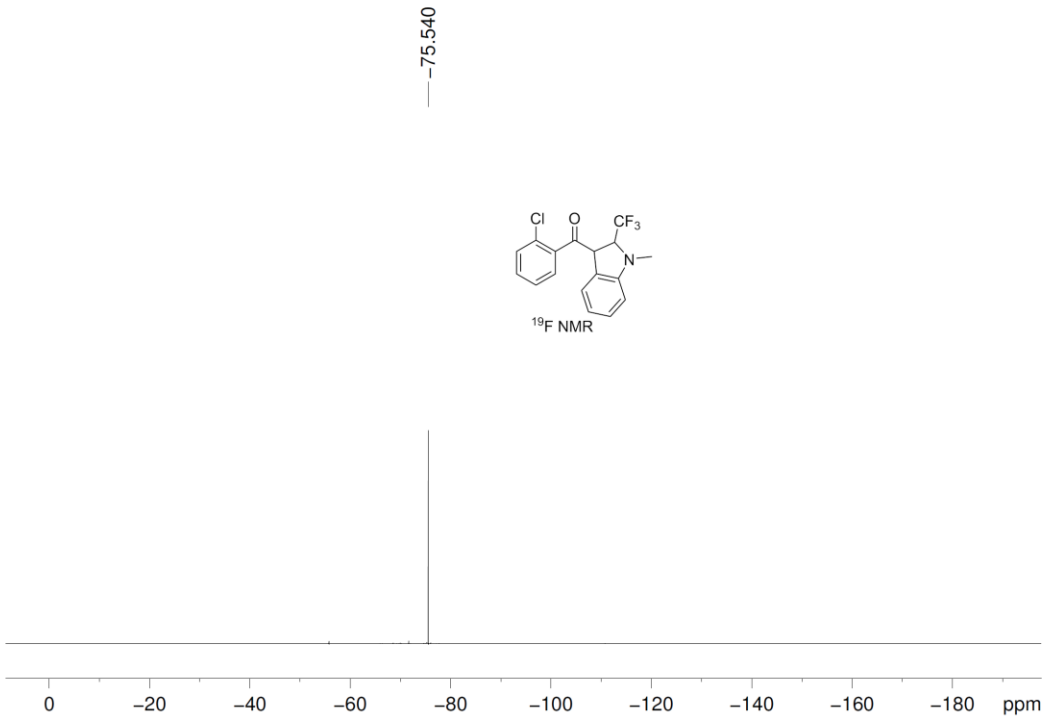
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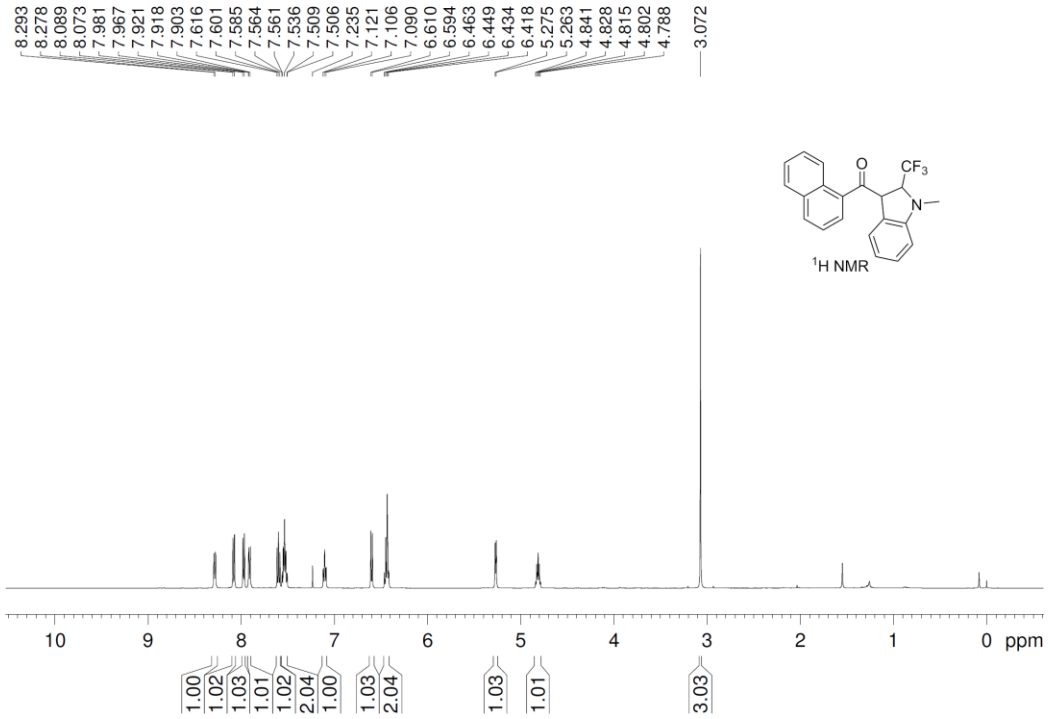
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7.585
7.564
7.561
7.536
7.509
7.506
7.235
7.121
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6.594
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6.434
6.418
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5.263
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4.828
4.815
4.802
4.788
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O
CF3
N
1H NMR
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9
8
7
6
5
4
3
2
1
0 ppm
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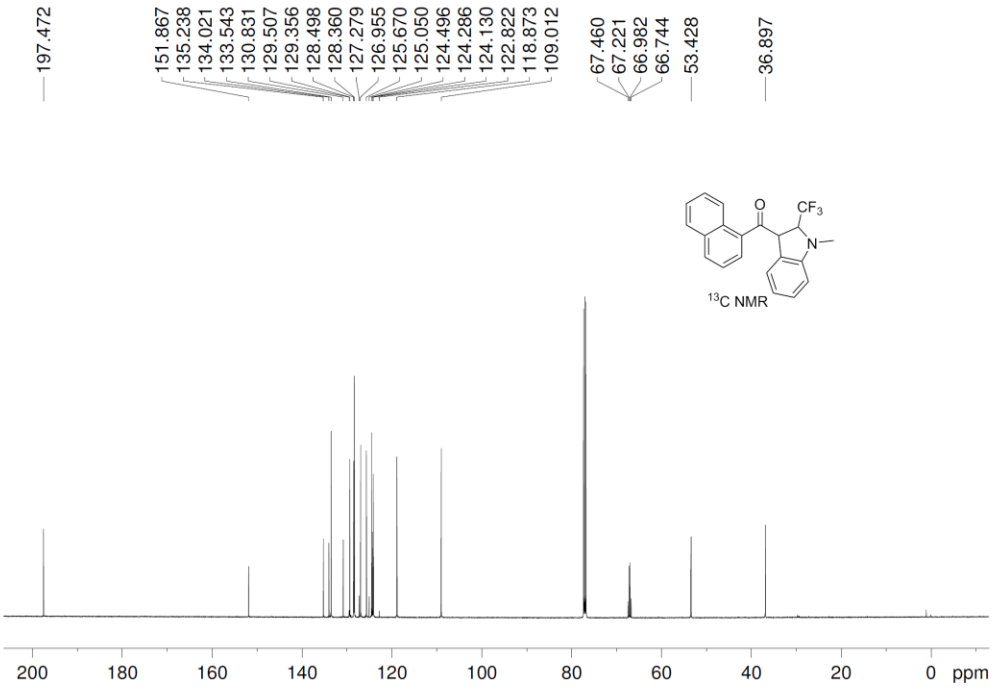
1.01
3.03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118.873
109.012
67.460
67.221
66.982
66.744
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CF3
N
13C NMR
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120
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20
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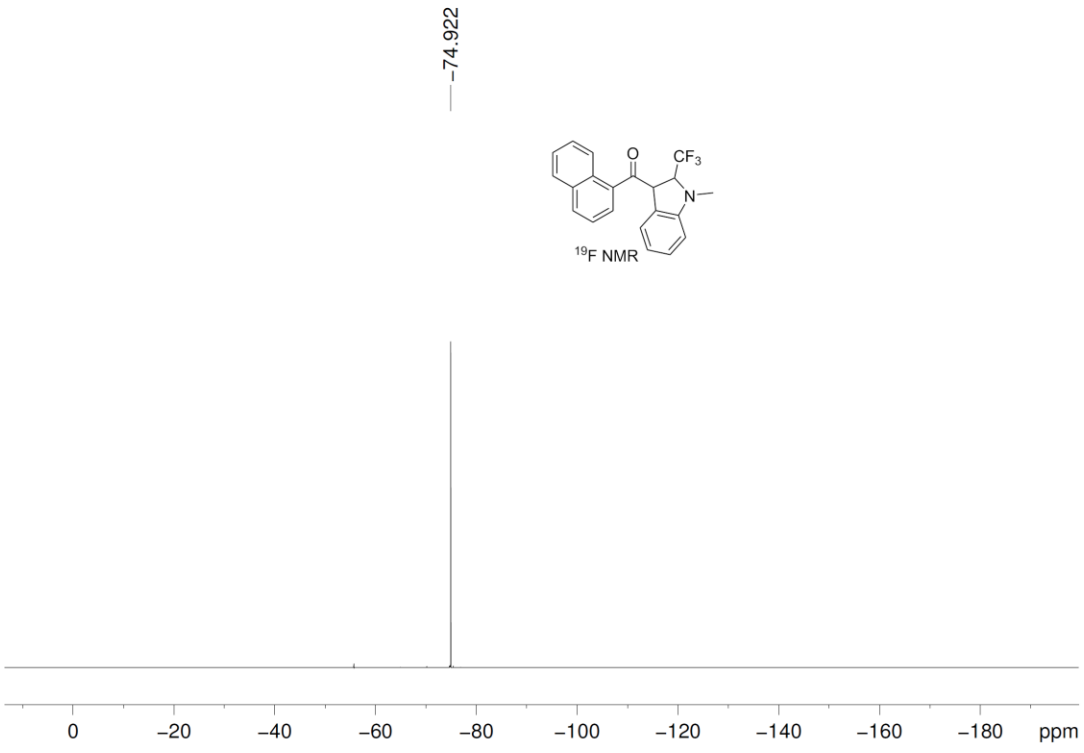
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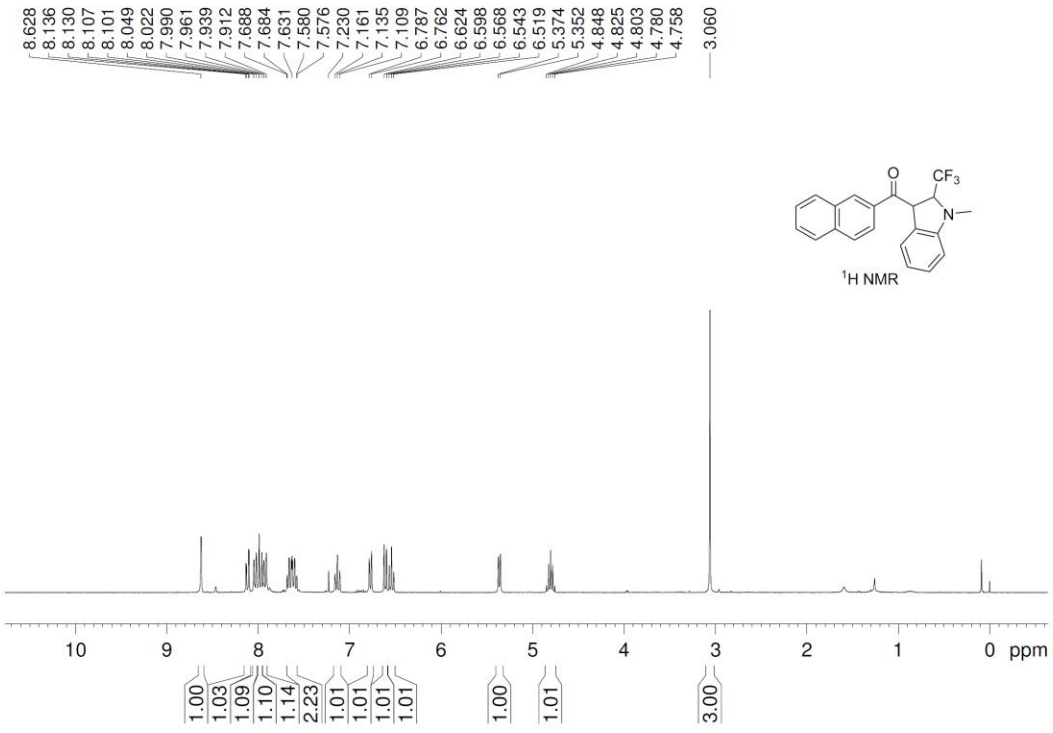
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6.598
6.568
6.543
6.519
5.374
5.352
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4.825
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4.780
4.758
3.060
O
CF3
N
1H NMR
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6
5
4
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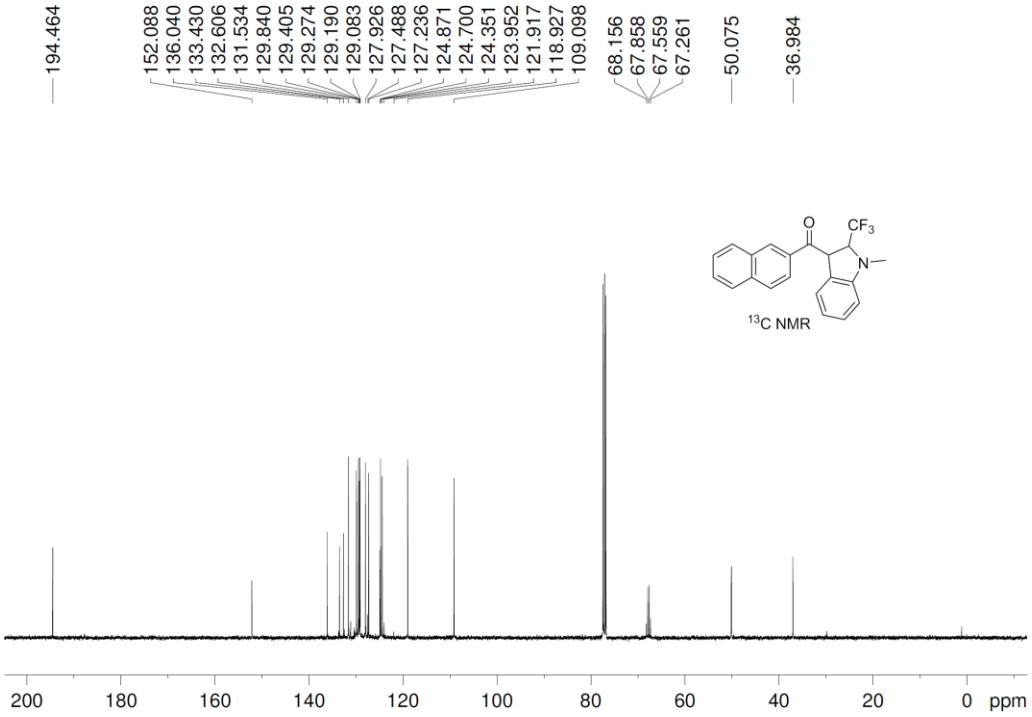
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129.083
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127.488
127.236
124.871
124.700
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121.917
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109.098
68.156
67.858
67.559
67.261
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CF3
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13C NMR
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120
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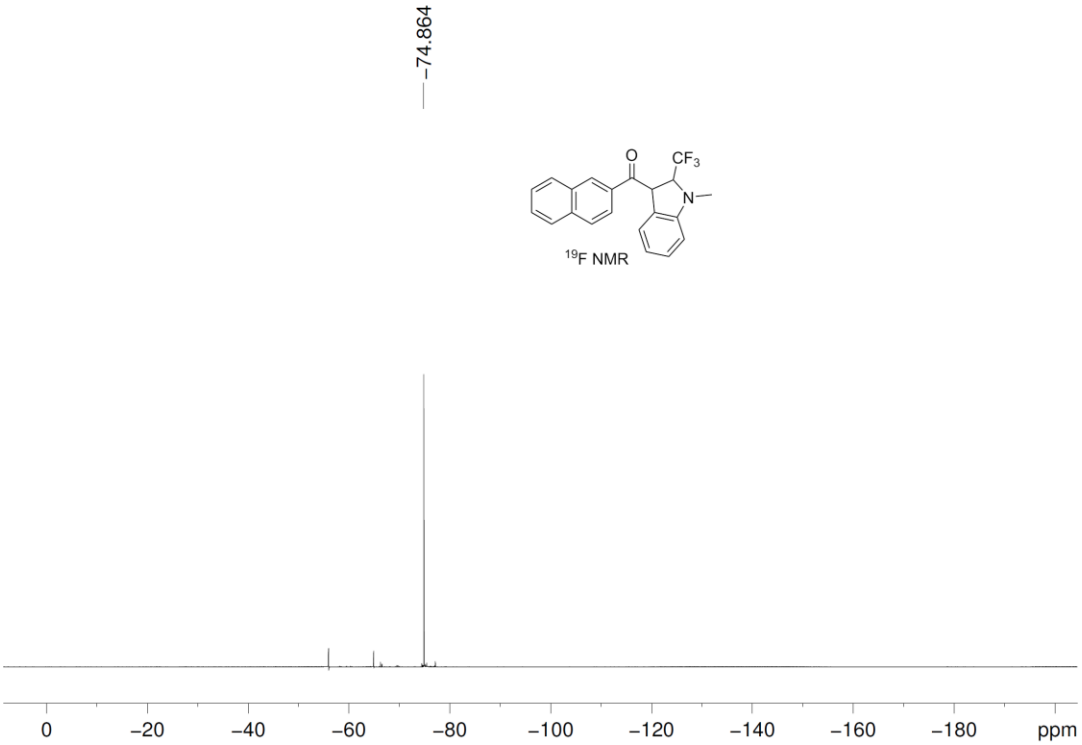
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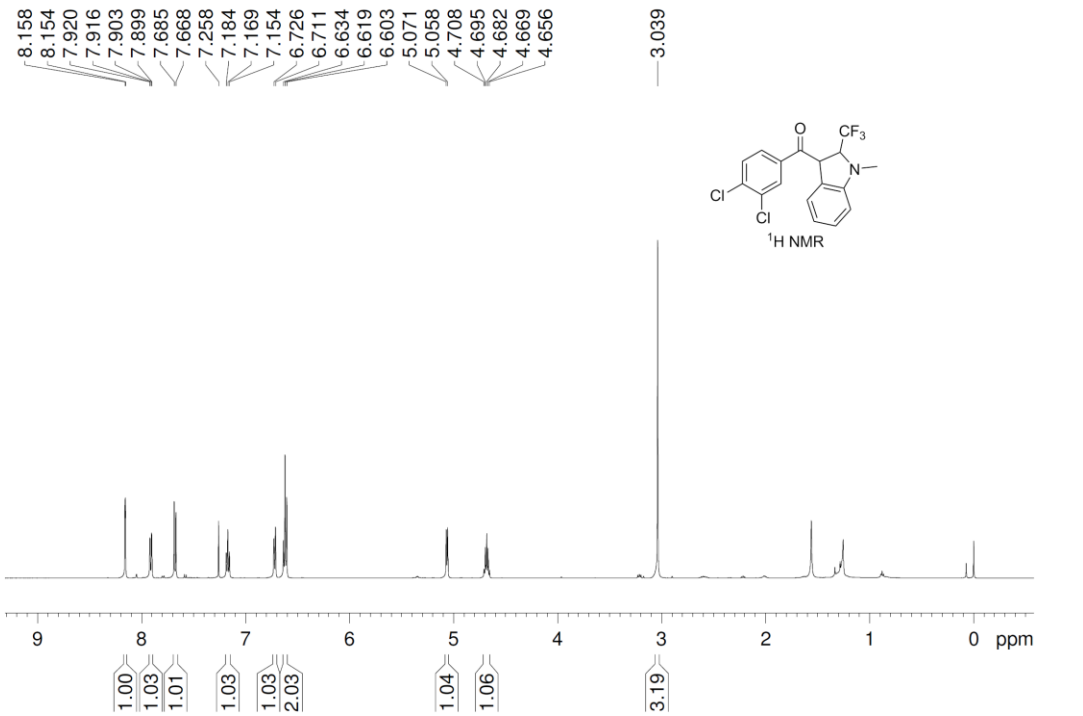
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7.668
7.258
7.184
7.169
7.154
6.726
6.711
6.634
6.619
6.603
5.071
5.058
4.708
4.695
4.682
4.669
4.656
3.039
O
CF3
N
Cl
Cl
1H NMR
9
8
7
6
5
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1.03
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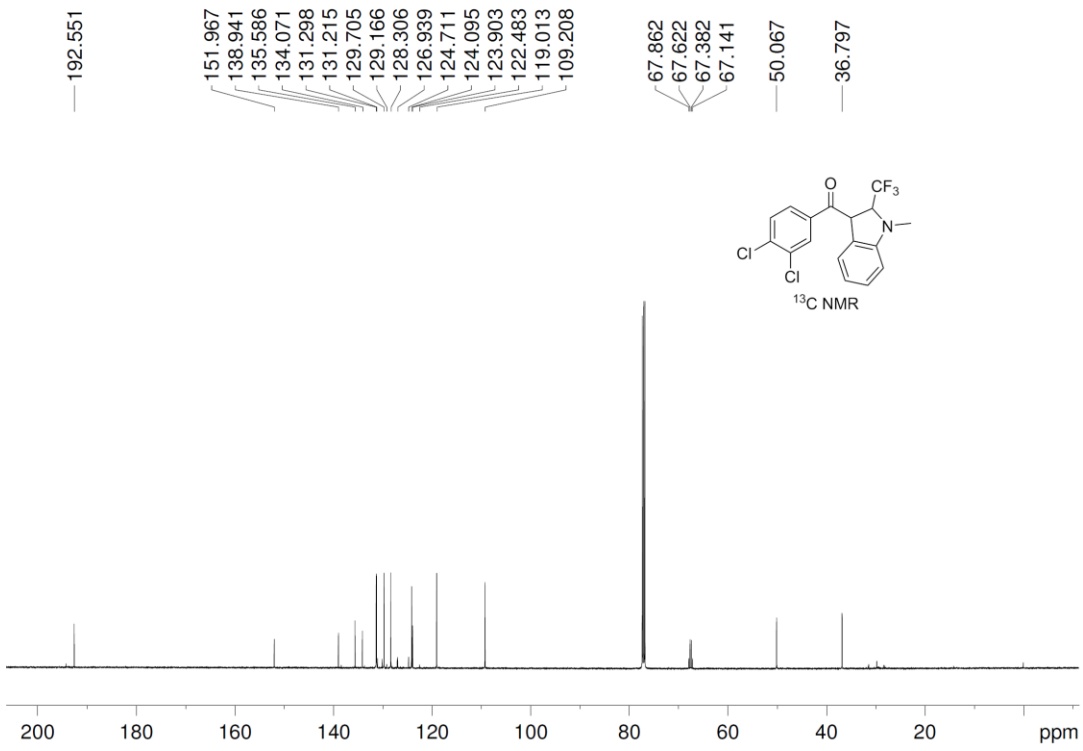
1.06
3.19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67.622
67.382
67.141
50.067
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Cl
Cl
13C NMR
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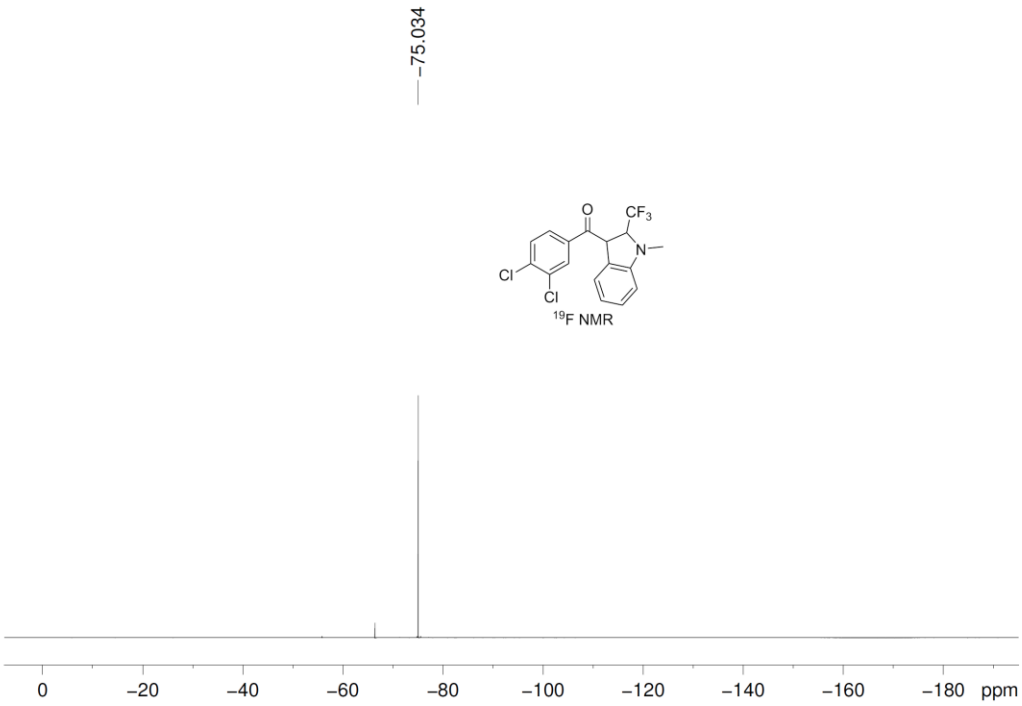
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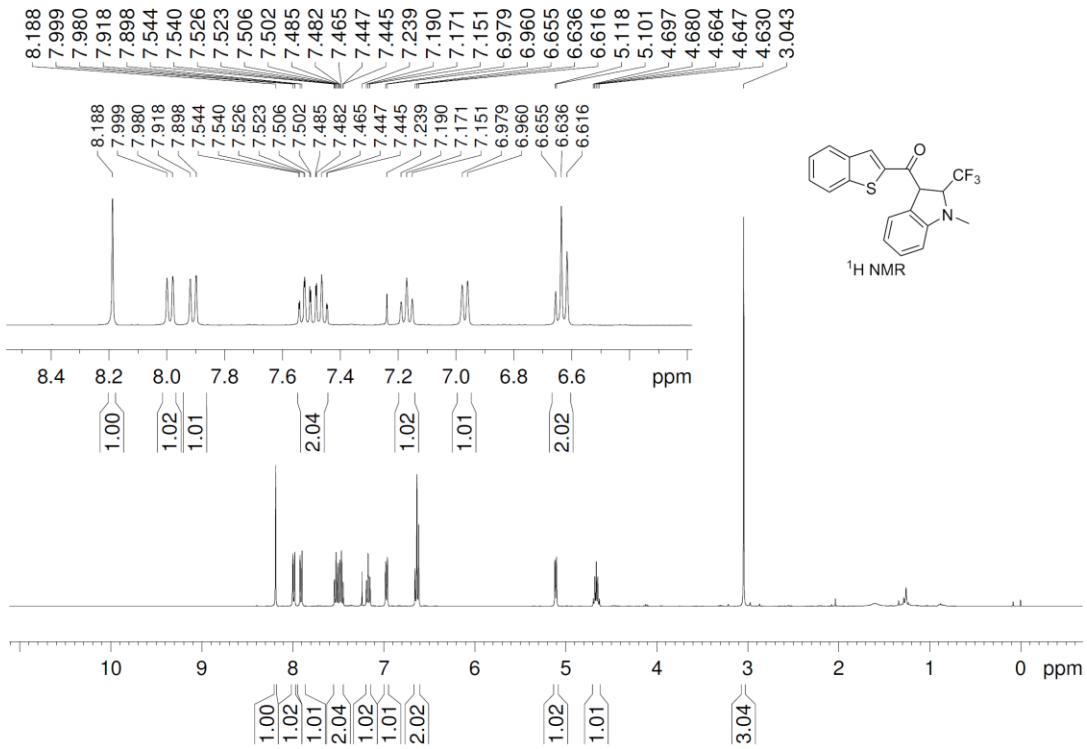
ppm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7.239
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6.636
6.616
5.118
5.101
4.697
4.680
4.664
4.647
4.630
3.043
O
S
CF3
N
1H NMR
8.4
8.2
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
ppm
1.00
1.02
1.01
2.04
1.02
1.01
2.02
10
9
8
7
6
5
4
3
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0
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1.02
1.01
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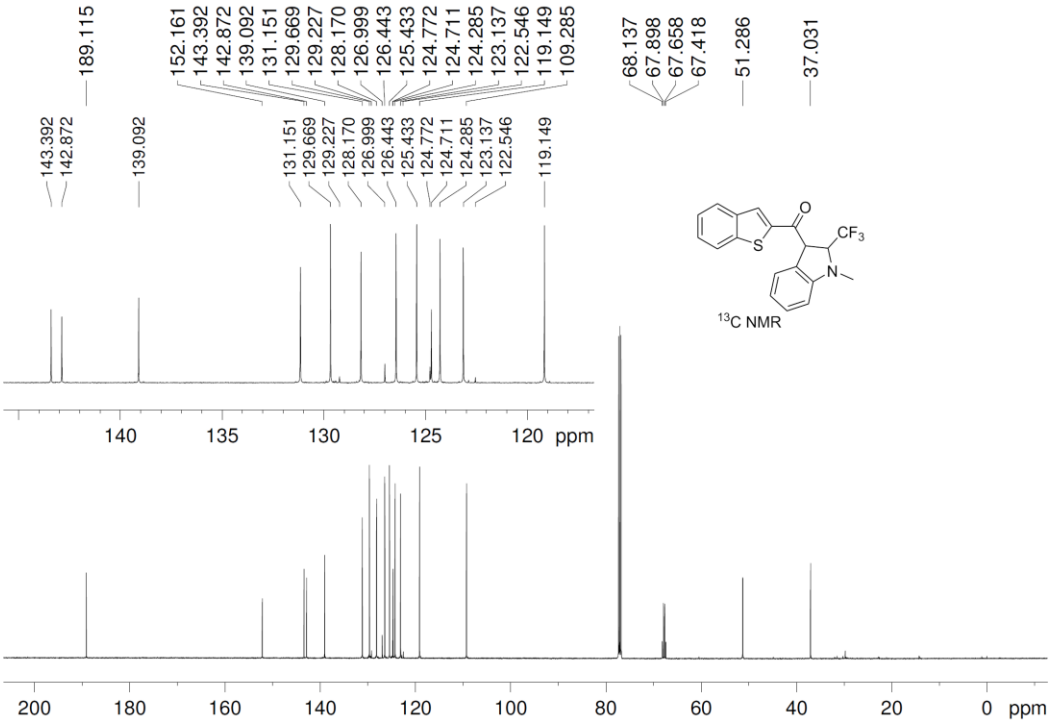
1.02
1.01
2.02
1.02
1.01
3.04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139.092
131.151
129.669
129.227
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126.443
125.433
124.772
124.711
124.285
123.137
122.546
119.149
109.285
68.137
67.898
67.658
67.418
51.286
37.031
O
S
CF3
N
13C NMR
140
135
130
125
120 ppm
200
180
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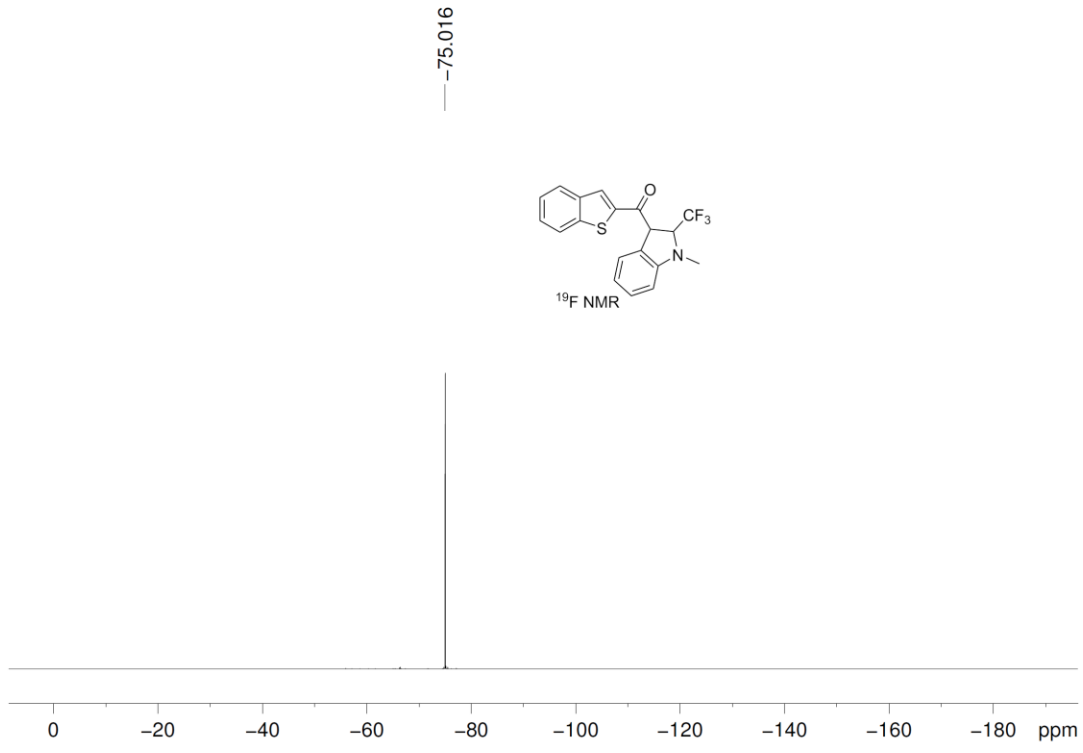
140
120
100
80
60
40
20
0 ppm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S
CF3
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19F NMR
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−20
−40
−60
−80
−100
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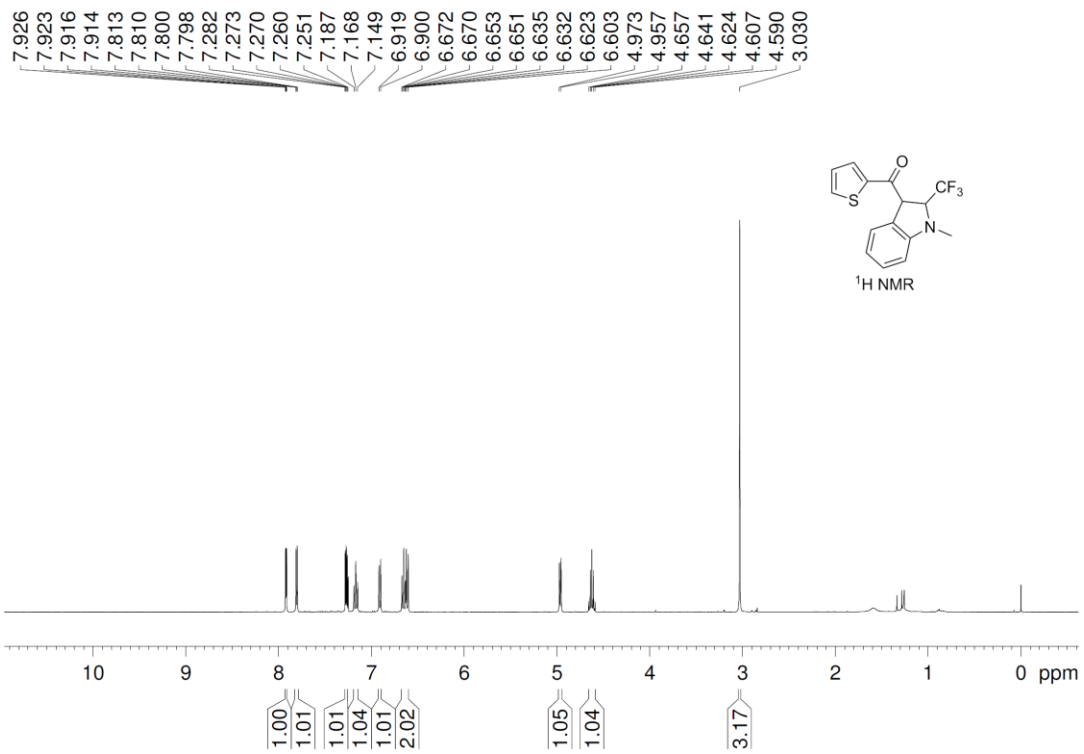
−160
−180 ppm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7.813
7.810
7.800
7.798
7.282
7.273
7.270
7.260
7.251
7.187
7.168
7.149
6.919
6.900
6.672
6.670
6.653
6.651
6.635
6.632
6.623
6.603
4.973
4.957
4.657
4.641
4.624
4.607
4.590
3.030
O
S
CF3
N
1H NMR
10
9
8
7
6
5
4
3
2
1
0 ppm
1.00
1.01
1.01
1.04
1.01
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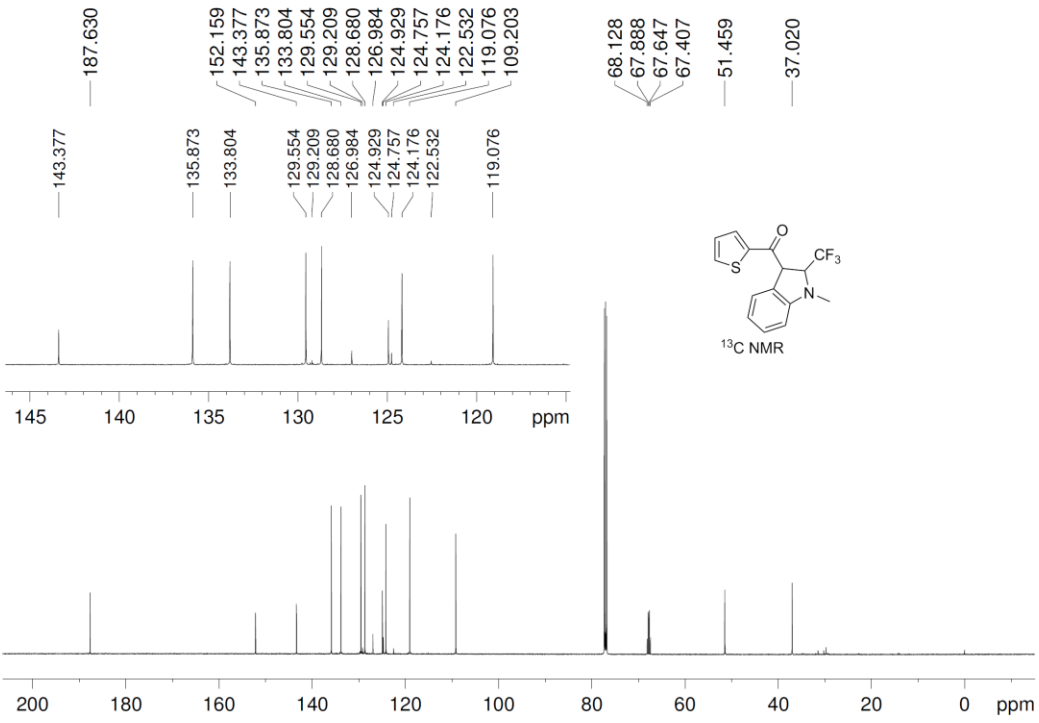
1.05
1.04
3.17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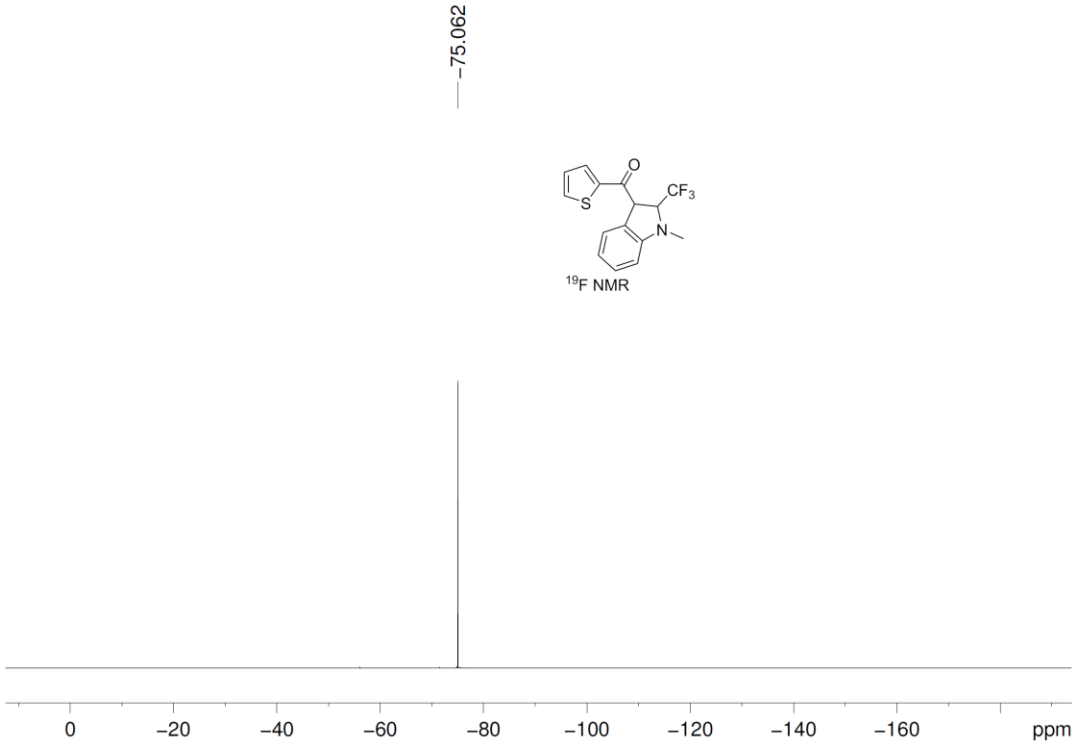
152.159
143.377
135.873
133.804
129.554
129.209
128.680
126.984
124.929
124.757
124.176
122.532
119.076
109.203
68.128
67.888
67.647
67.407
51.459
37.020
143.377
135.873
133.804
129.554
129.209
128.680
126.984
124.929
124.757
124.176
122.532
119.076
O
S
CF3
N
13C NMR
145
140
135
130
125
120
ppm
200
180
160
140
120
100
80
60
40
20
0
ppm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S
CF3
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−40
−60
−80
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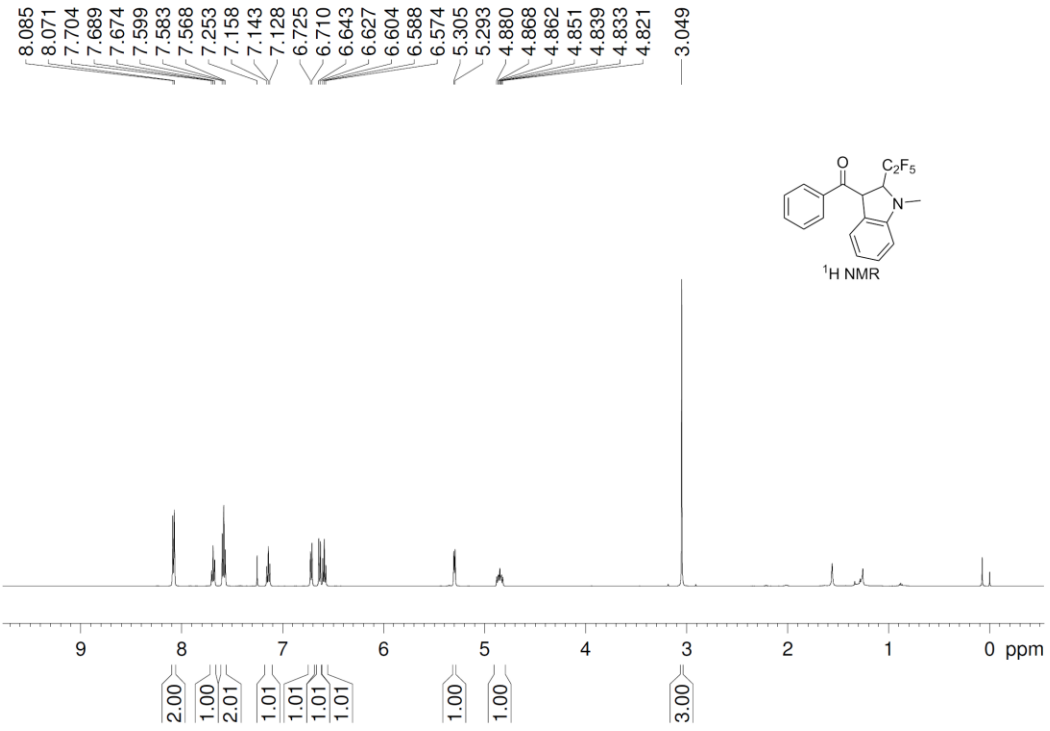
−140
−160
ppm


8.085
8.071
7.704
7.689
7.674
7.599
7.583
7.568
7.253
7.158
7.143
7.128
6.725
6.710
6.643
6.627
6.604
6.588
6.574
5.305
5.293
4.880
4.868
4.862
4.851
4.839
4.833
4.821
3.049
O
C2F5
N
1H NMR
9
8
7
6
5
4
3
2
1
0 ppm
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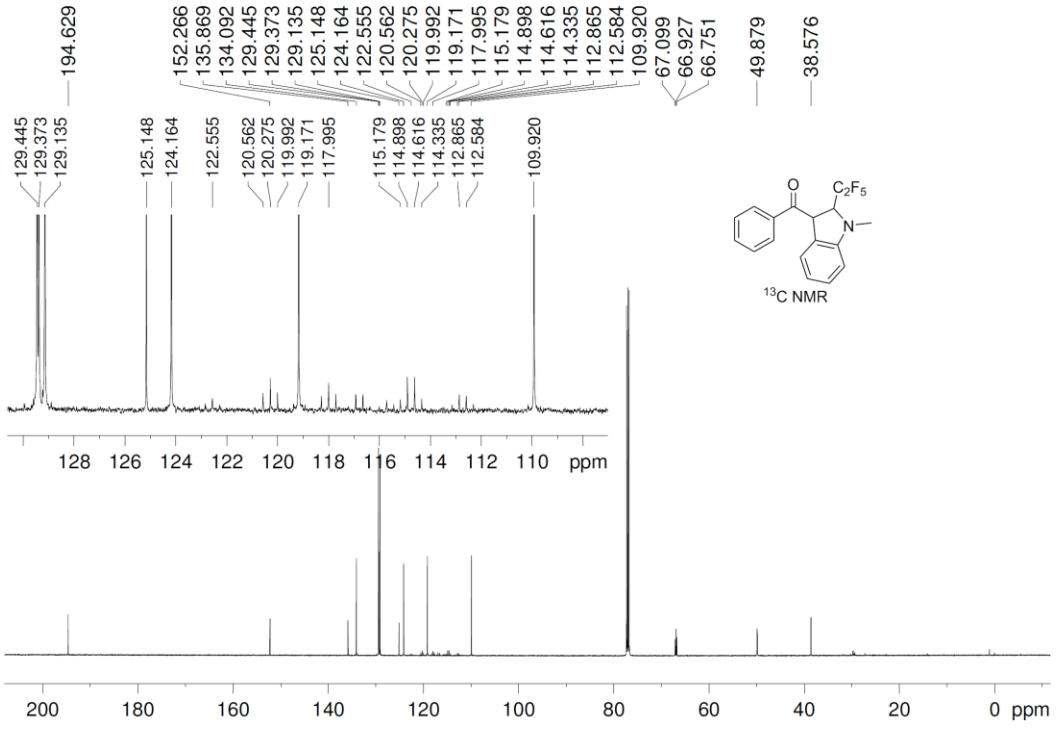
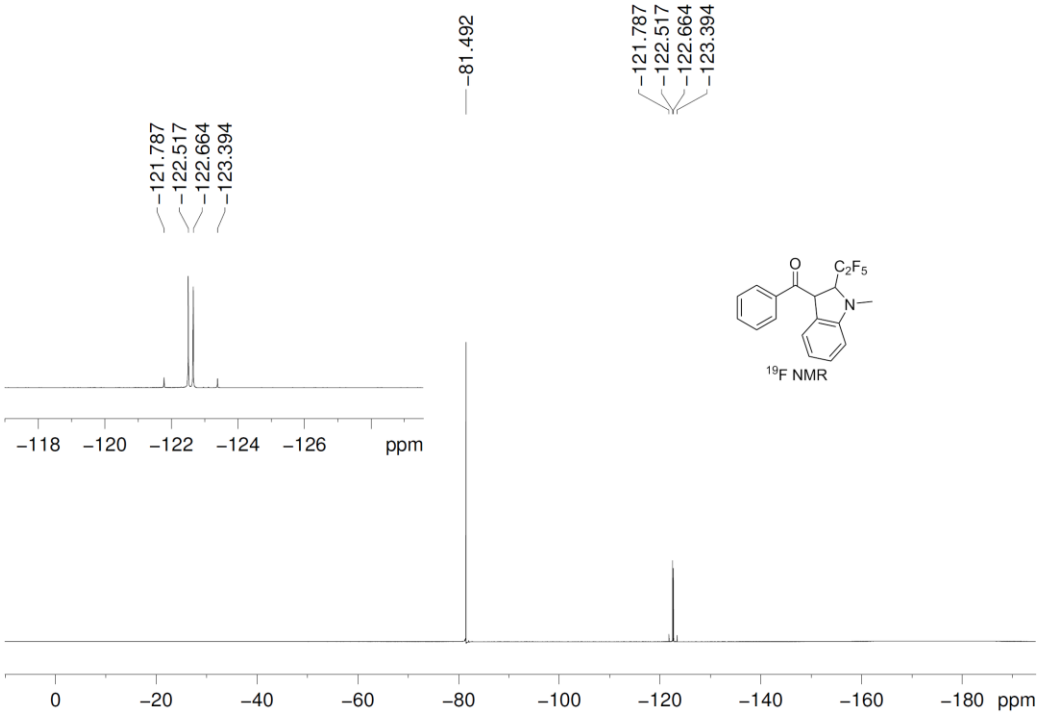
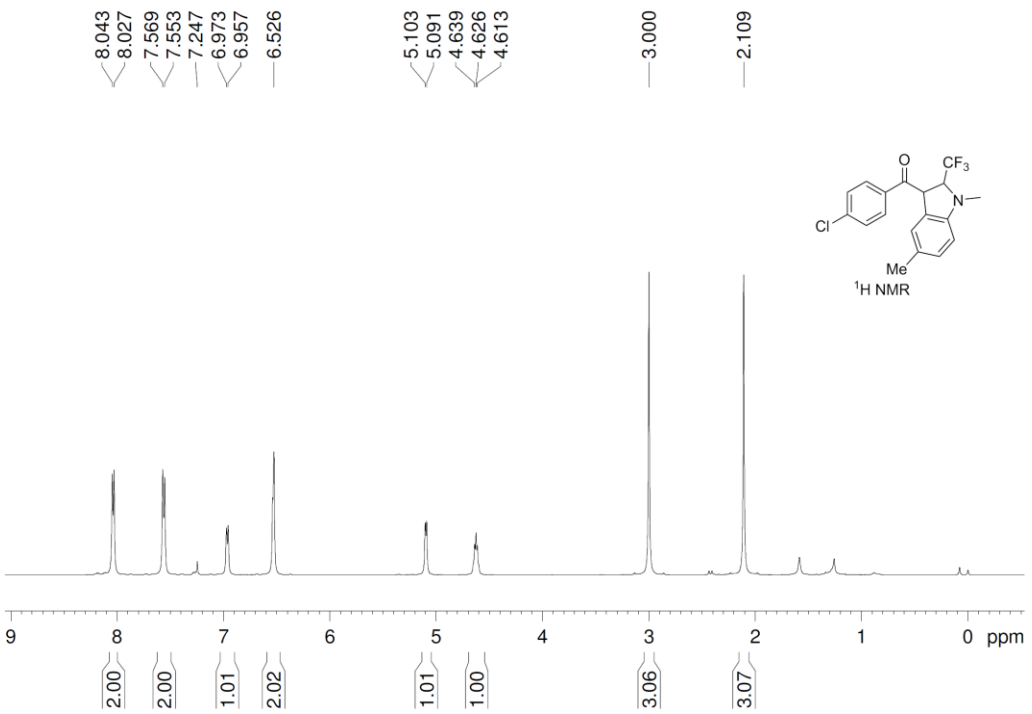
1.00
2.01
1.01
1.01
1.01
1.01
1.00
1.00
3.00


194.629
152.266
135.869
134.092
129.445
129.373
129.135
125.148
124.164
122.555
120.562
120.275
119.992
119.171
117.995
115.179
114.898
114.616
114.335
112.865
112.584
109.920
67.099
66.927
66.751
49.879
38.576
O
C2F5
N
13C NMR
128 126 124 122 120 118 116 114 112 110 ppm
200 180 160 140 120 100 80 60 40 20 0 ppm


−81.492
−121.787
−122.517
−122.664
−123.394
O
C2F5
N
19F NMR
−118 −120 −122 −124 −126 ppm
0 −20 −40 −60 −80 −100 −120 −140 −160 −180 ppm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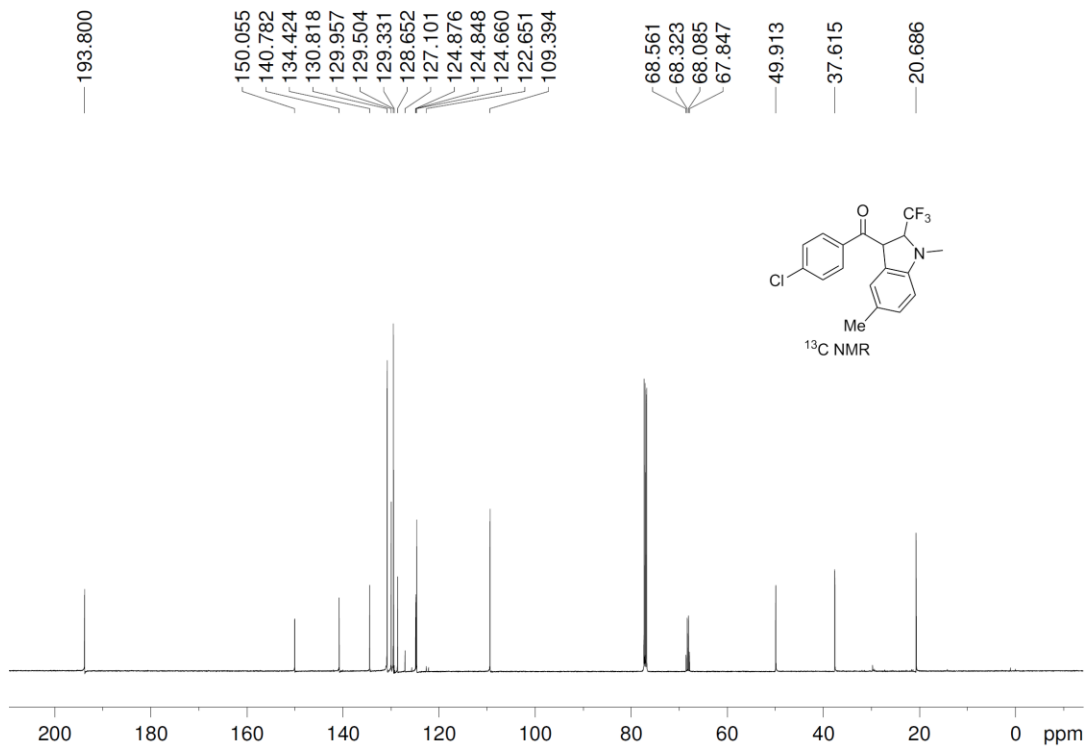
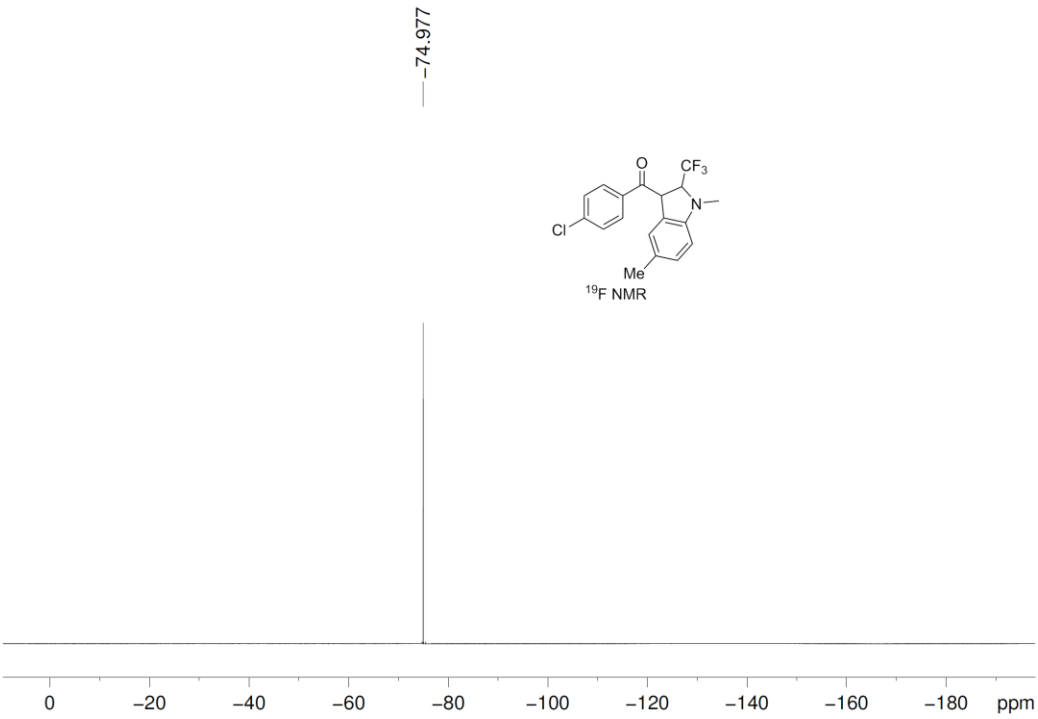
8.027
7.569
7.553
7.247
6.973
6.957
6.526
5.103
5.091
4.639
4.626
4.613
3.000
2.109
O
CF3
N
Cl
Me
1H NMR
9
8
7
6
5
4
3
2
1
0 ppm
2.00
2.00
1.01
2.02
1.01
1.00
3.06
3.07


193.800
150.055
140.782
134.424
130.818
129.957
129.504
129.331
128.652
127.101
124.876
124.848
124.660
122.651
109.394
68.561
68.323
68.085
67.847
49.913
37.615
20.686
O
CF3
N
Cl
Me
13C NMR
200
180
160
140
120
100
80
60
40
20
0 ppm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N
Cl
Me
19F NMR
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−20
−40
−60
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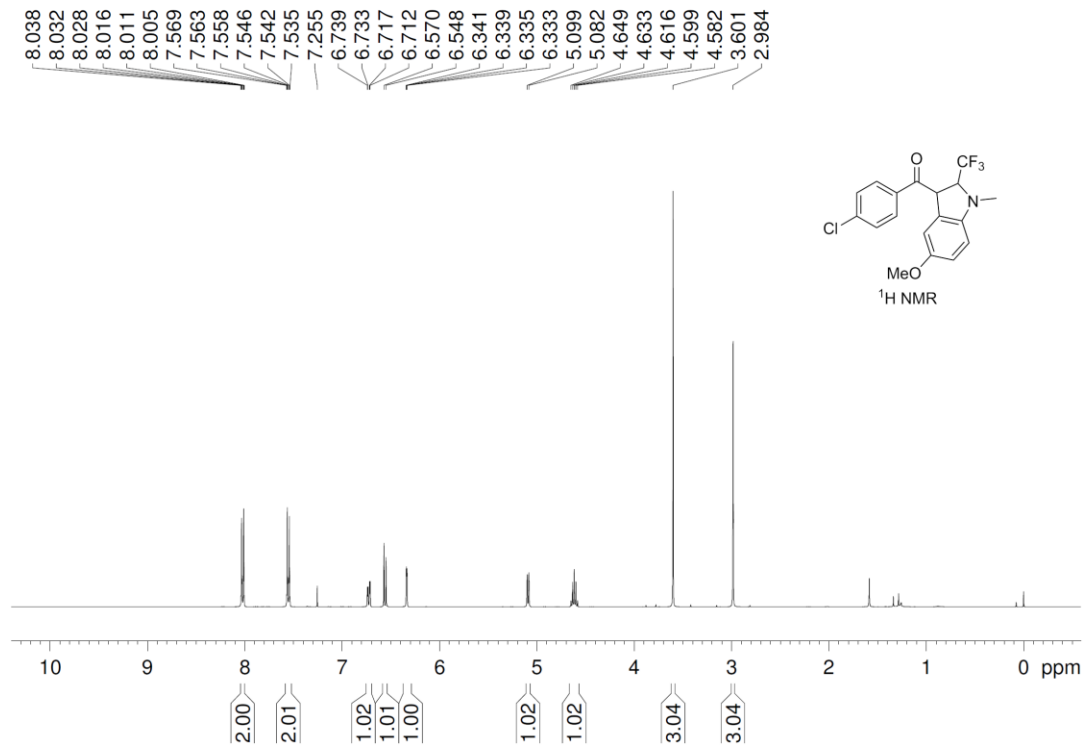
−100
−120
−140
−160
−180
ppm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8.028
8.016
8.011
8.005
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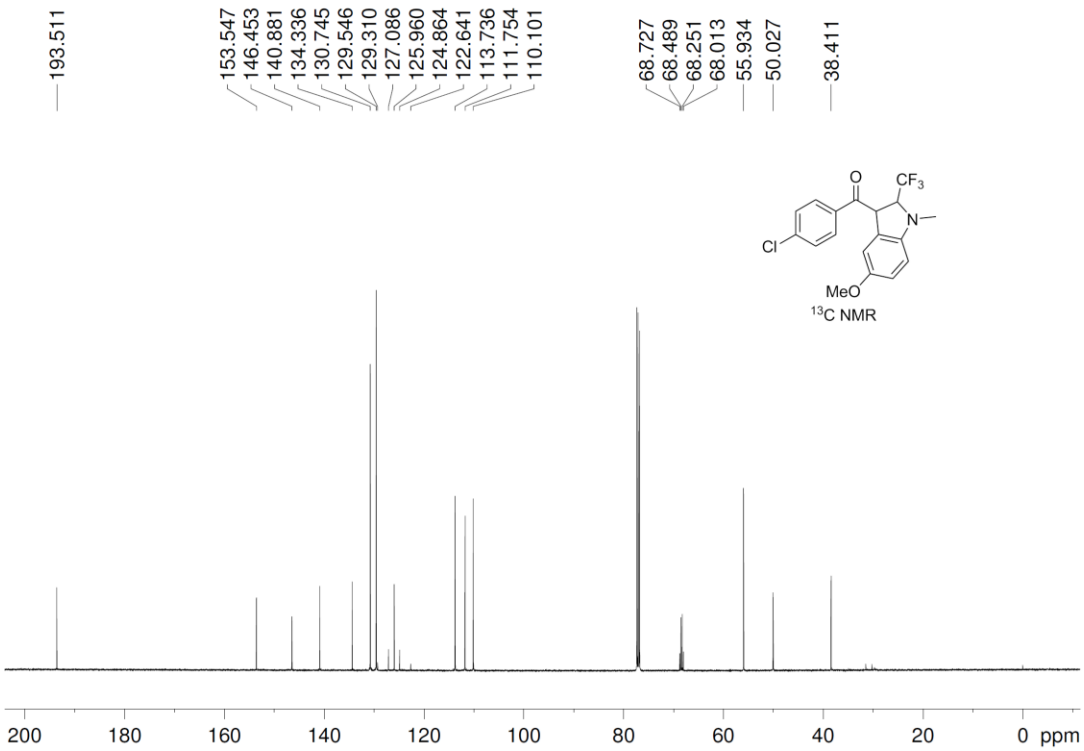
7.563
7.558
7.546
7.542
7.535
7.255
6.739
6.733
6.717
6.712
6.570
6.548
6.341
6.339
6.335
6.333
5.099
5.082
4.649
4.633
4.616
4.599
4.582
3.601
2.984
O
CF3
N
Cl
MeO
1H NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.01
1.02
1.01
1.00
1.02
1.02
3.04
3.04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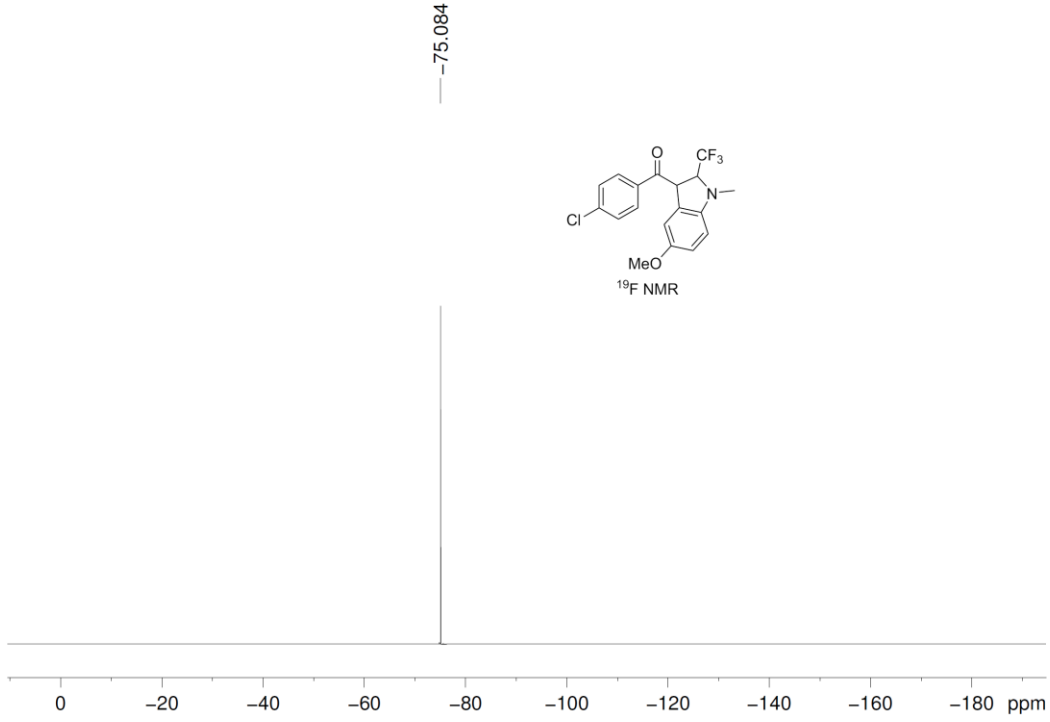
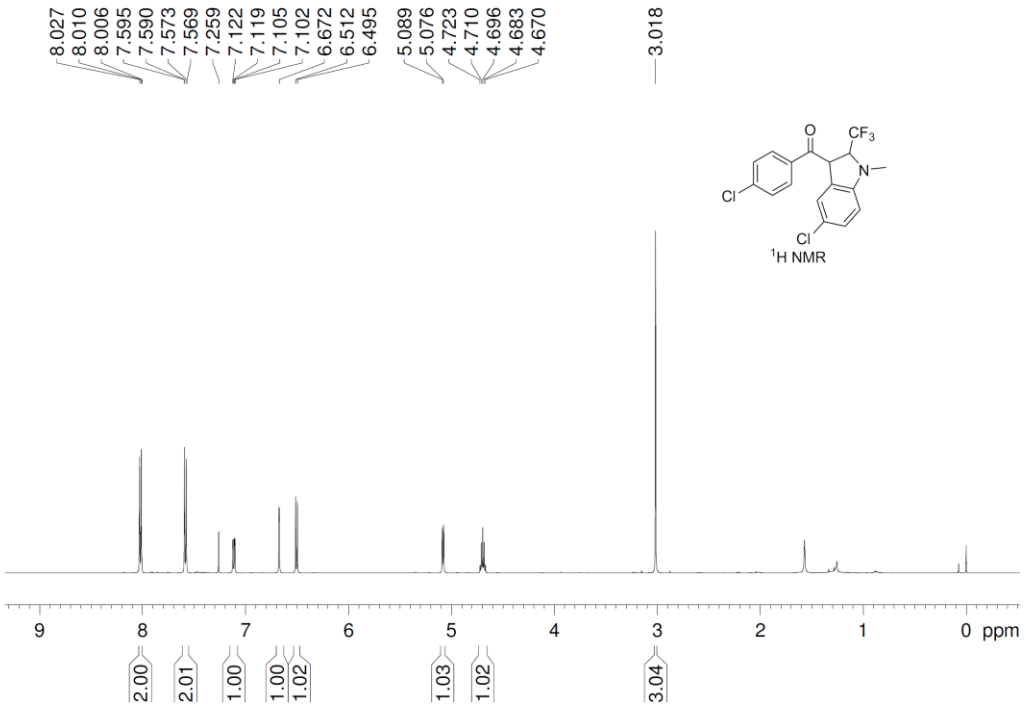
153.547
146.453
140.881
134.336
130.745
129.546
129.310
127.086
125.960
124.864
122.641
113.736
111.754
110.101
68.727
68.489
68.251
68.013
55.934
50.027
38.411
O
CF3
N
Cl
MeO
13C NMR
200
180
160
140
120
100
80
60
40
20
0 ppm


−75.084
O
CF3
N
Cl
MeO
19F NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180 ppm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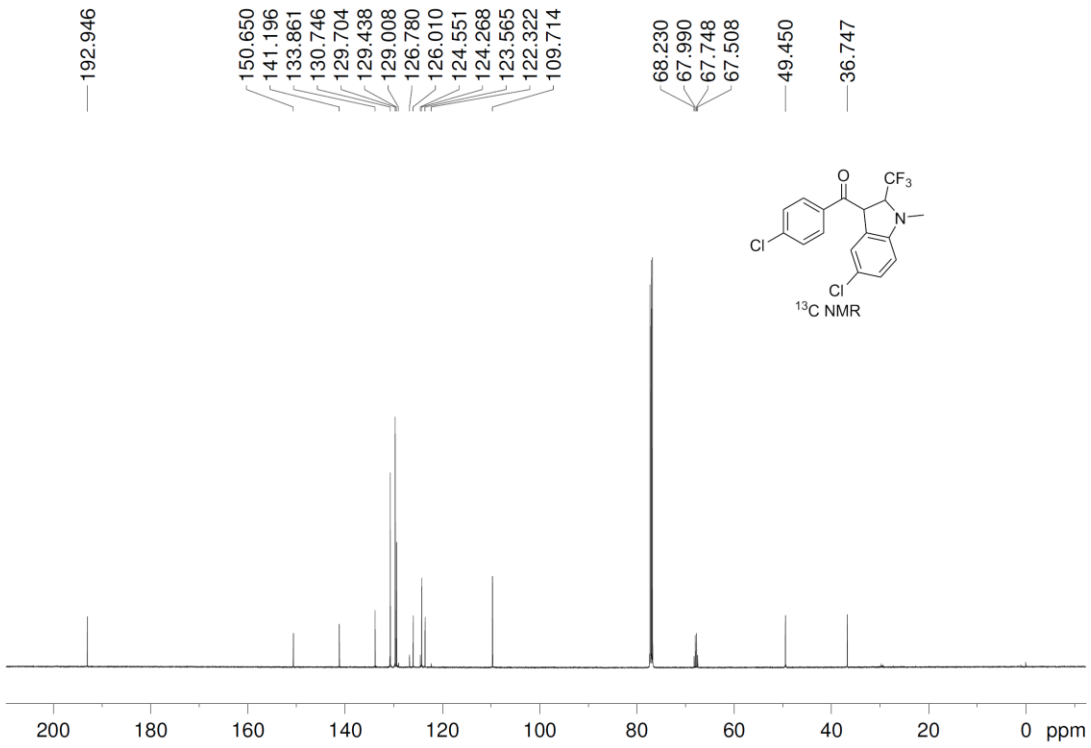
8.010
8.006
7.595
7.590
7.573
7.569
7.259
7.122
7.119
7.105
7.102
6.672
6.512
6.495
5.089
5.076
4.723
4.710
4.696
4.683
4.670
3.018
O
CF3
N
Cl
Cl
1H NMR
9
8
7
6
5
4
3
2
1
0 ppm
2.00
2.01
1.00
1.00
1.02
1.03
1.02
3.04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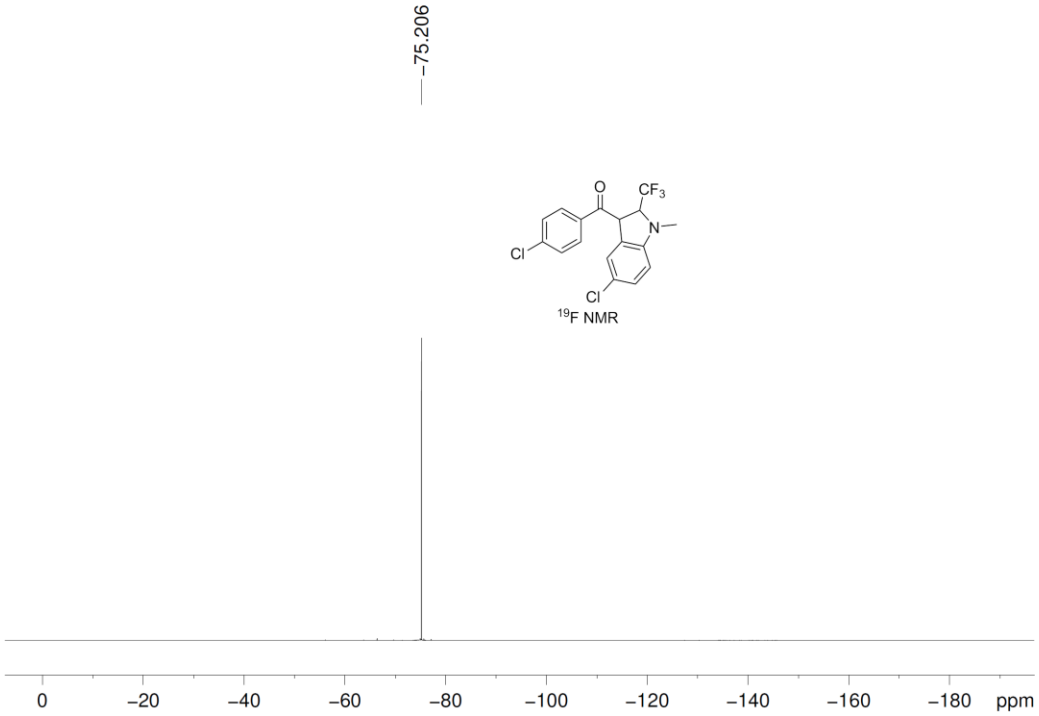
150.650
141.196
133.861
130.746
129.704
129.438
129.008
126.780
126.010
124.551
124.268
123.565
122.322
109.714
68.230
67.990
67.748
67.508
49.450
36.747
O
CF3
N
Cl
Cl
13C NMR
200
180
160
140
120
100
80
60
40
20
0 ppm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Cl
Cl
19F NMR
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−20
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−60
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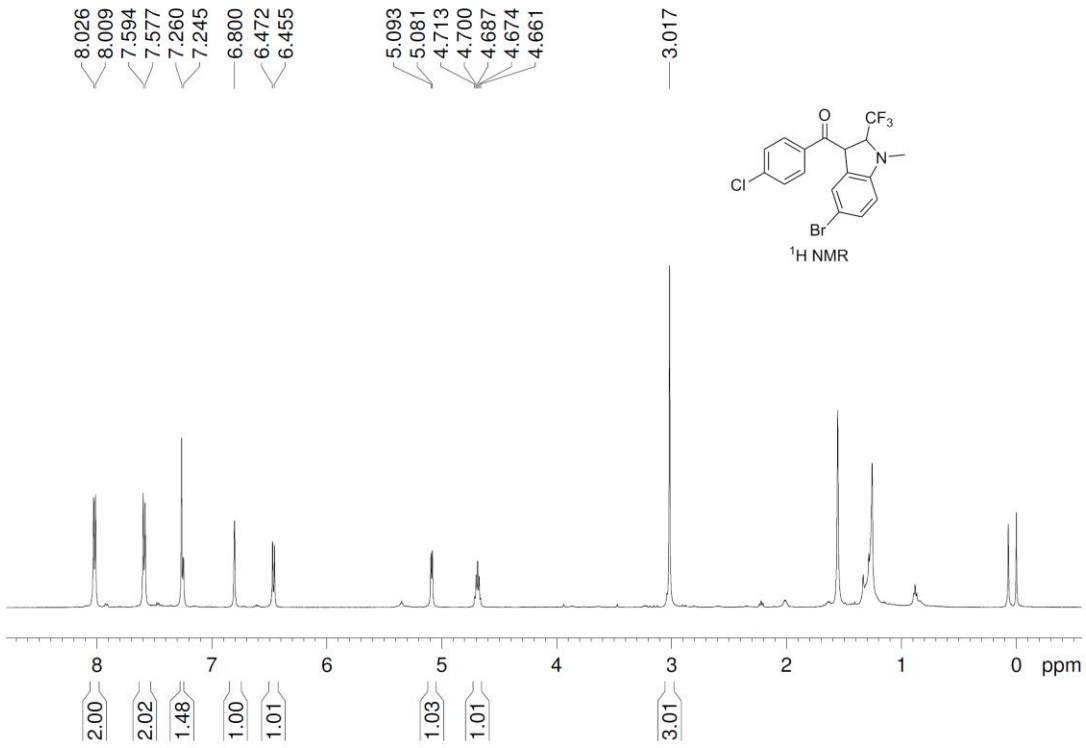
−180
ppm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7.577
7.260
7.245
6.800
6.472
6.455
5.093
5.081
4.713
4.700
4.687
4.674
4.661
3.017
O
CF3
N
Cl
Br
1H NMR
8
7
6
5
4
3
2
1
0
ppm
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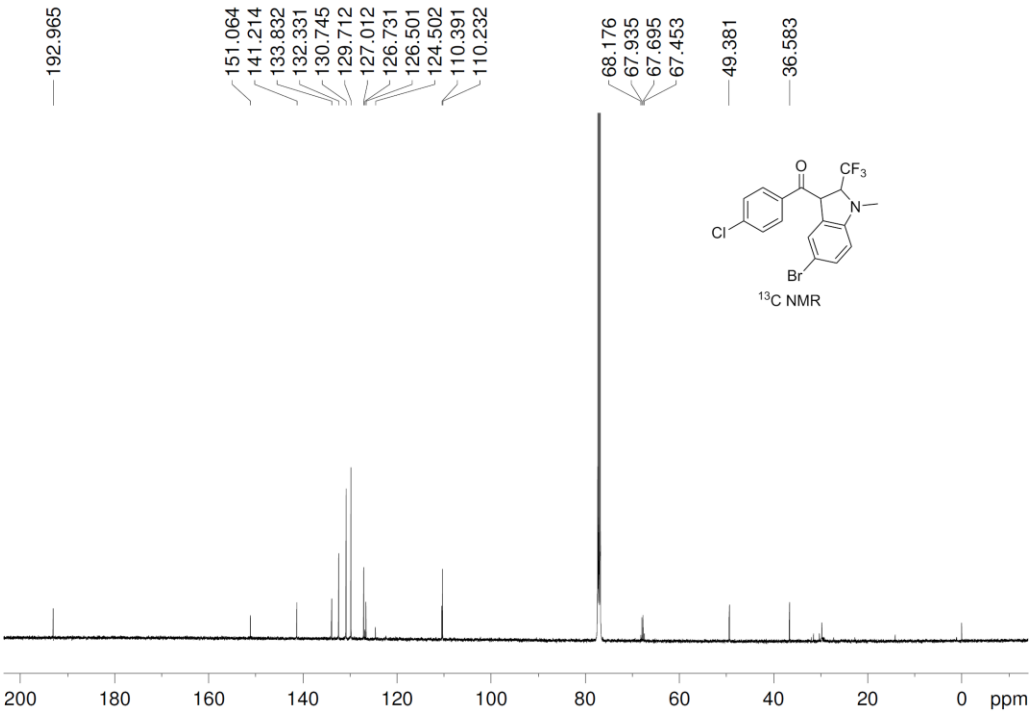
2.02
1.48
1.00
1.01
1.03
1.01
3.01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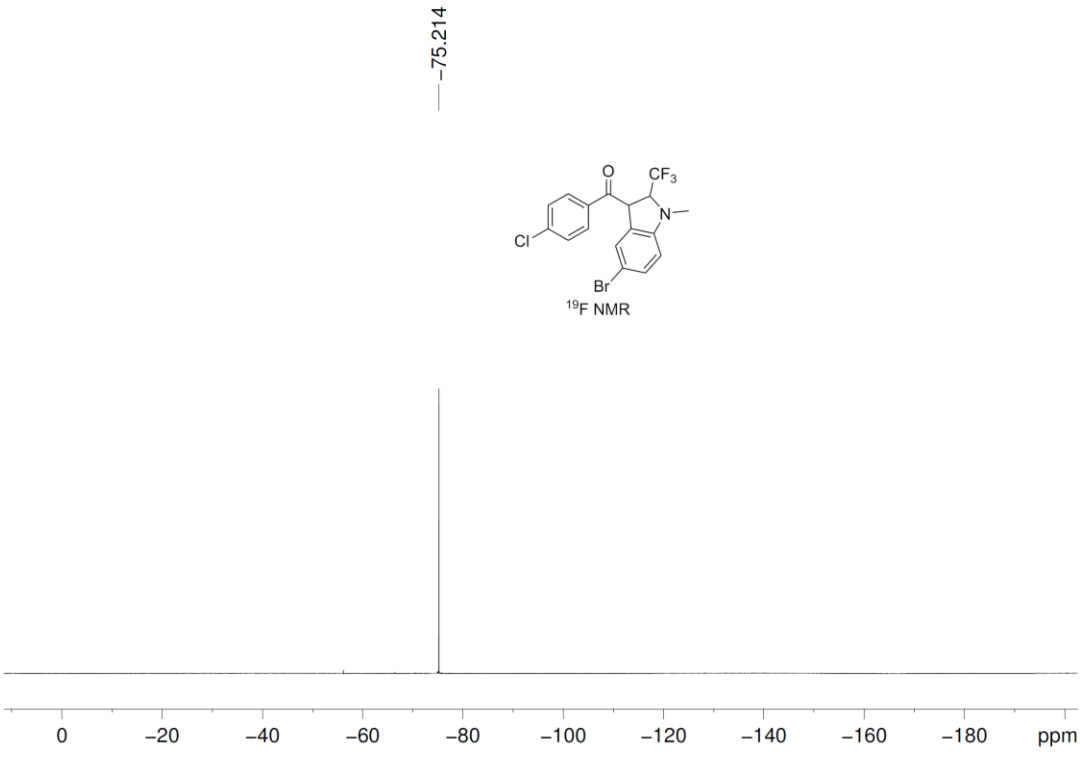
141.214
133.832
132.331
130.745
129.712
127.012
126.731
126.501
124.502
110.391
110.232
68.176
67.935
67.695
67.453
49.381
36.583
O
CF3
N
Cl
Br
13C NMR
200
180
160
140
120
100
80
60
40
20
0
ppm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Cl
Br
19F NMR
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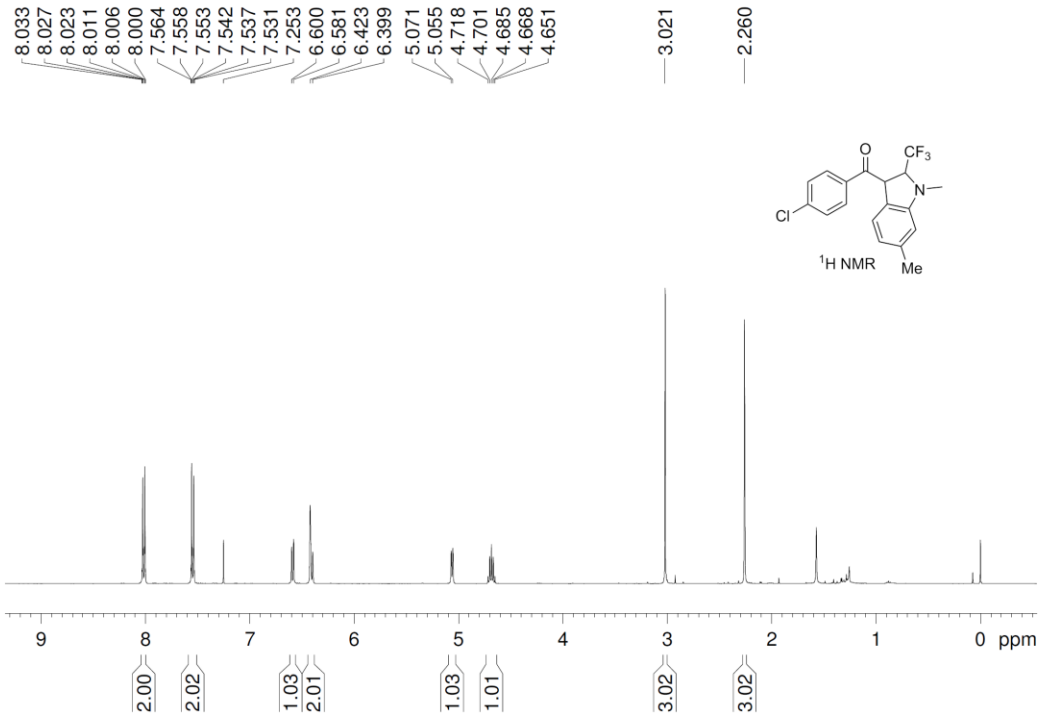
−180
ppm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8.023
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8.000
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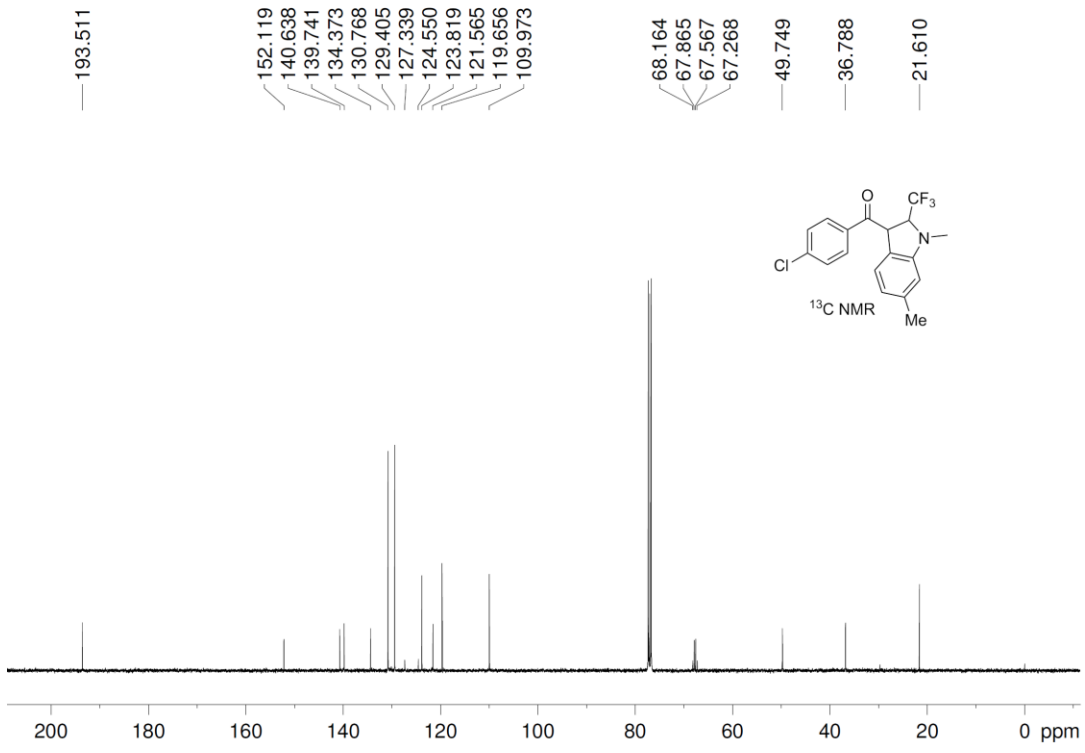
7.558
7.553
7.542
7.537
7.531
7.253
6.600
6.581
6.423
6.399
5.071
5.055
4.718
4.701
4.685
4.668
4.651
3.021
2.260
O
CF3
N
Cl
1H NMR
Me
9
8
7
6
5
4
3
2
1
0 ppm
2.00
2.02
1.03
2.01
1.03
1.01
3.02
3.02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152.119
140.638
139.741
134.373
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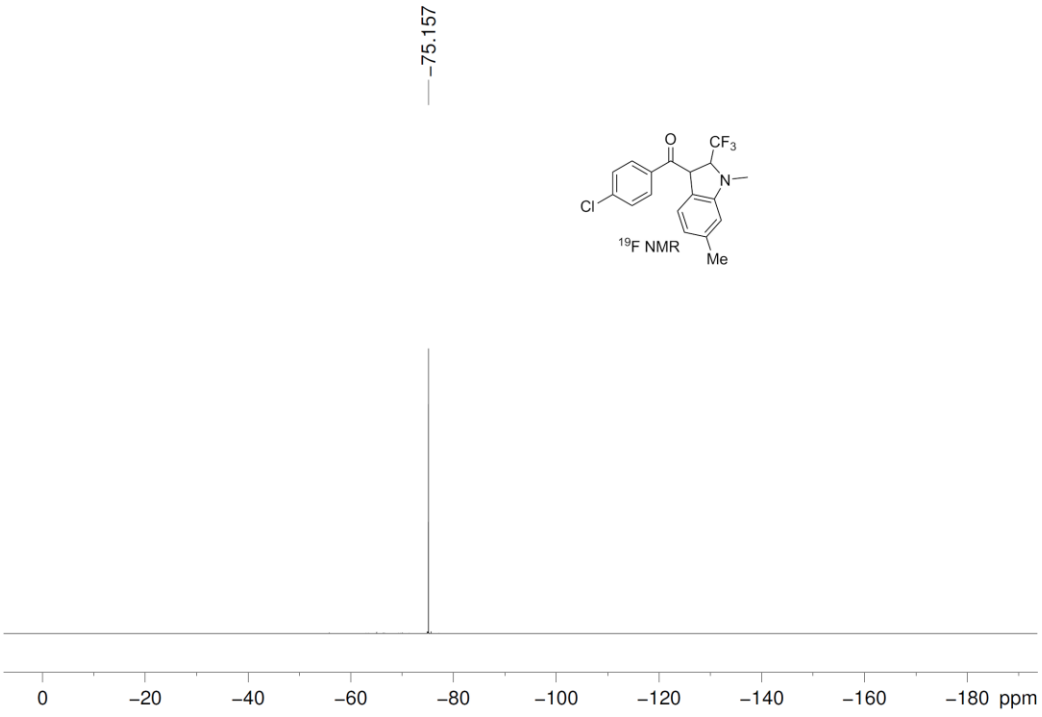
129.405
127.339
124.550
123.819
121.565
119.656
109.973
68.164
67.865
67.567
67.268
49.749
36.788
21.610
O
CF3
N
Cl
13C NMR
Me
200
180
160
140
120
100
80
60
40
20
0 ppm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Cl
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Me
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−20
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−60
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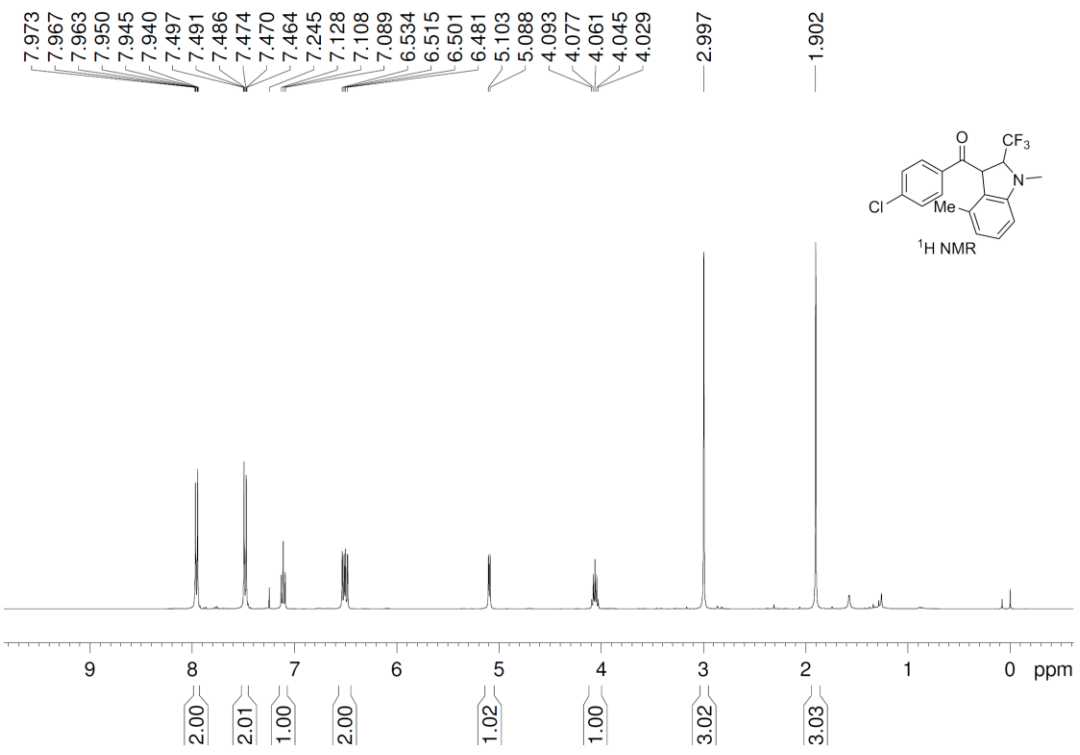
−180 ppm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7.963
7.950
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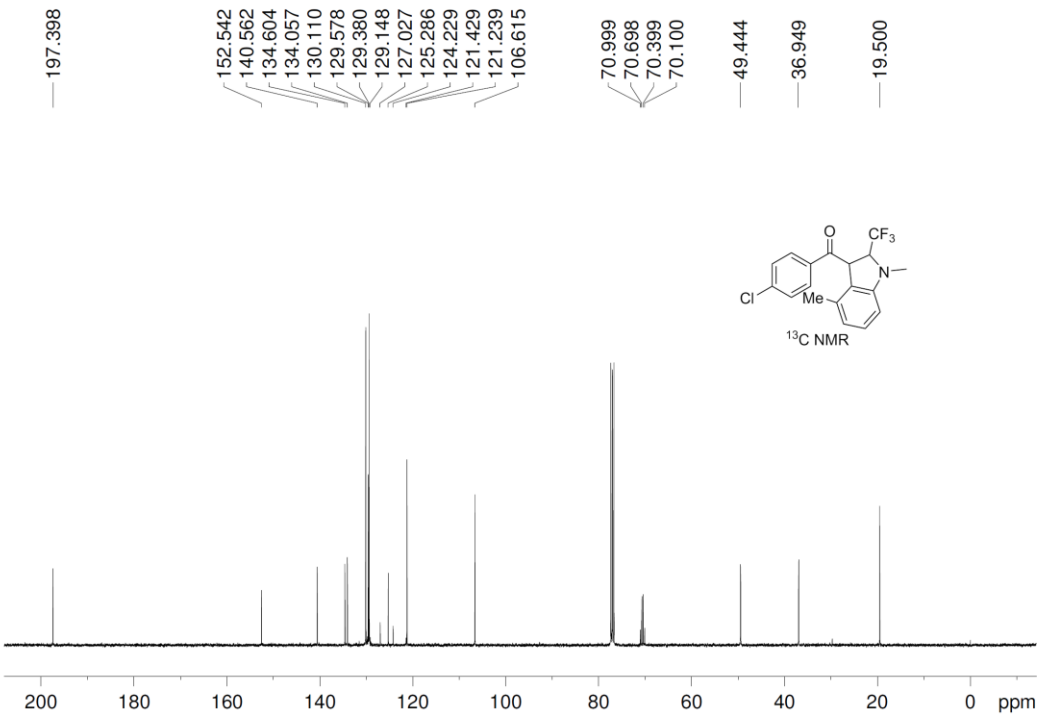
7.940
7.497
7.491
7.486
7.474
7.470
7.464
7.245
7.128
7.108
7.089
6.534
6.515
6.501
6.481
5.103
5.088
4.093
4.077
4.061
4.045
4.029
2.997
1.902
O
CF3
N
Cl
Me
1H NMR
9
8
7
6
5
4
3
2
1
0 ppm
2.00
2.01
1.00
2.00
1.02
1.00
3.02
3.03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134.604
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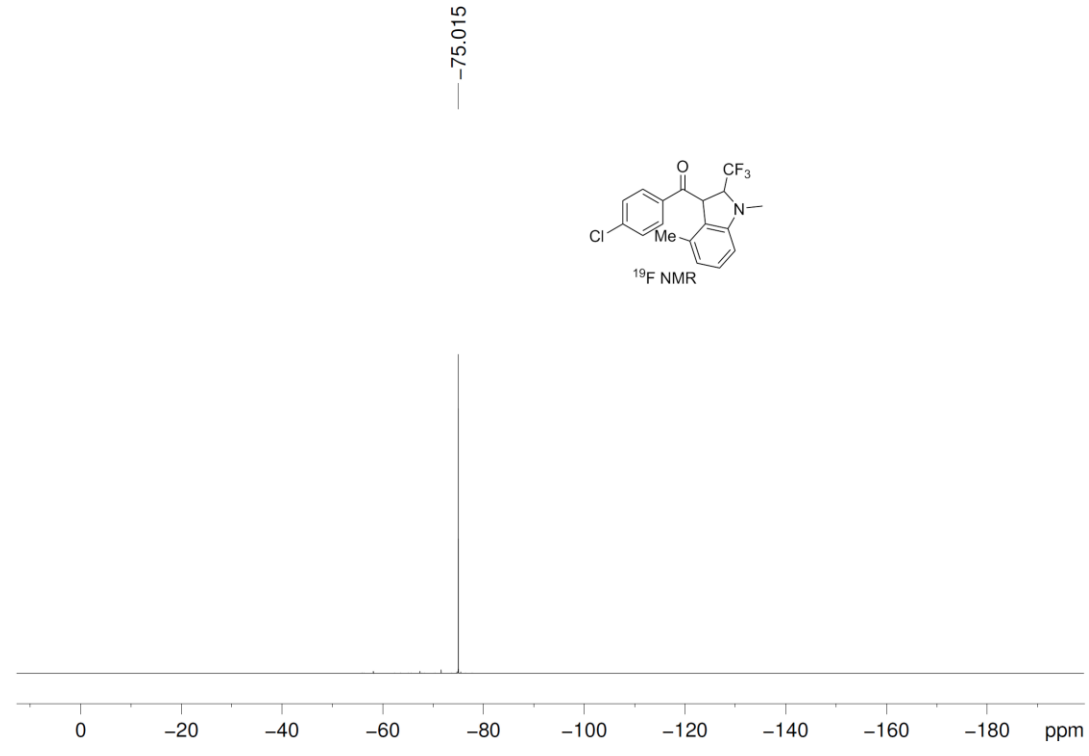
130.110
129.578
129.380
129.148
127.027
125.286
124.229
121.429
121.239
106.615
70.999
70.698
70.399
70.100
49.444
36.949
19.500
O
CF3
N
Cl
Me
13C NMR
200
180
160
140
120
100
80
60
40
20
0
ppm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O
CF3
N
Cl
Me
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−20
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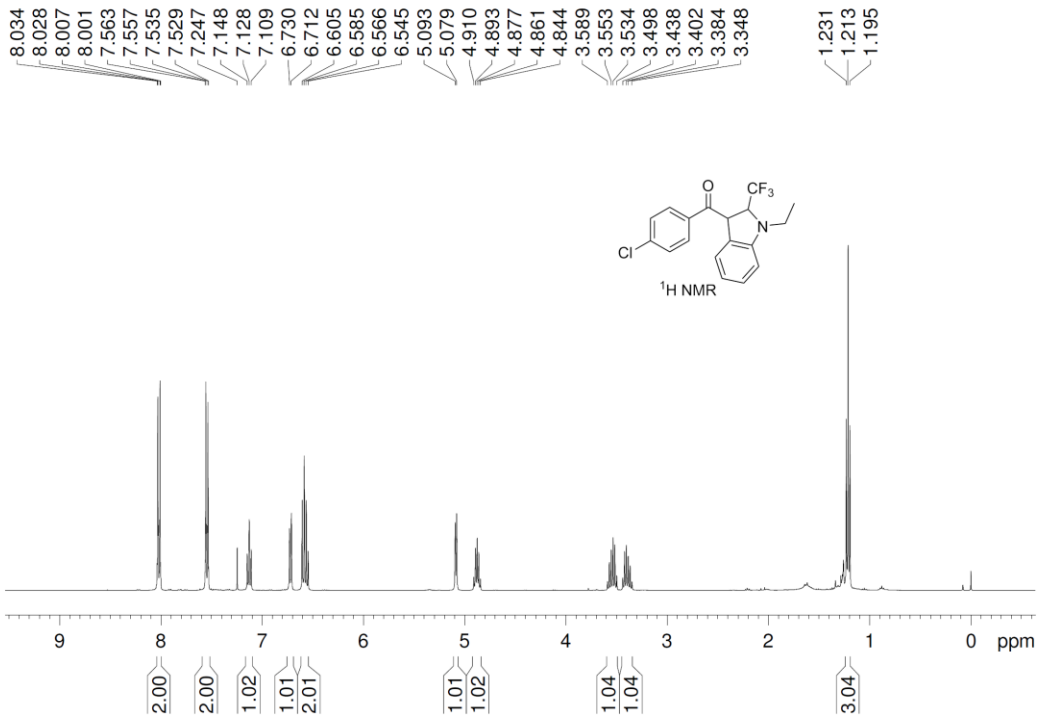
ppm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7.557
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7.148
7.128
7.109
6.730
6.712
6.605
6.585
6.566
6.545
5.093
5.079
4.910
4.893
4.877
4.861
4.844
3.589
3.553
3.534
3.498
3.438
3.402
3.384
3.348
1.231
1.213
1.195
O
CF3
N
Cl
1H NMR
9
8
7
6
5
4
3
2
1
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ppm
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2.00
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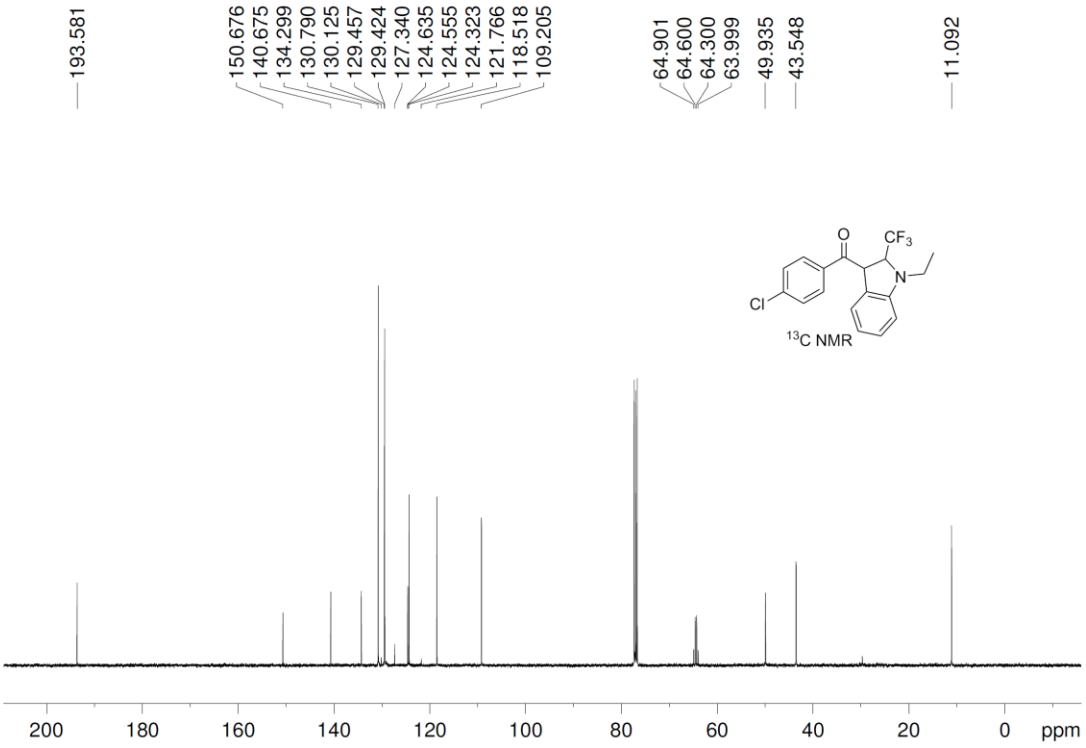
1.01
2.01
1.01
1.02
1.04
1.04
3.04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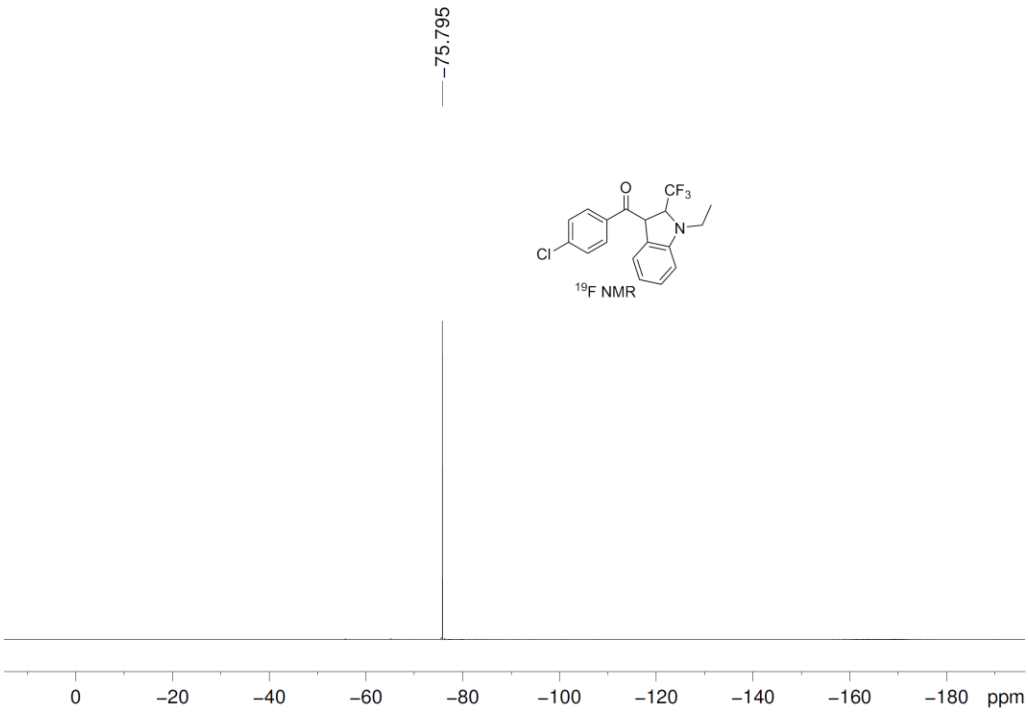
140.675
134.299
130.790
130.125
129.457
129.424
127.340
124.635
124.555
124.323
121.766
118.518
109.205
64.901
64.600
64.300
63.999
49.935
43.548
11.092
O
CF3
N
Cl
13C NMR
200
180
160
140
120
100
80
60
40
20
0
ppm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CF3
N
Cl
19F NMR
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−40
−60
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−160
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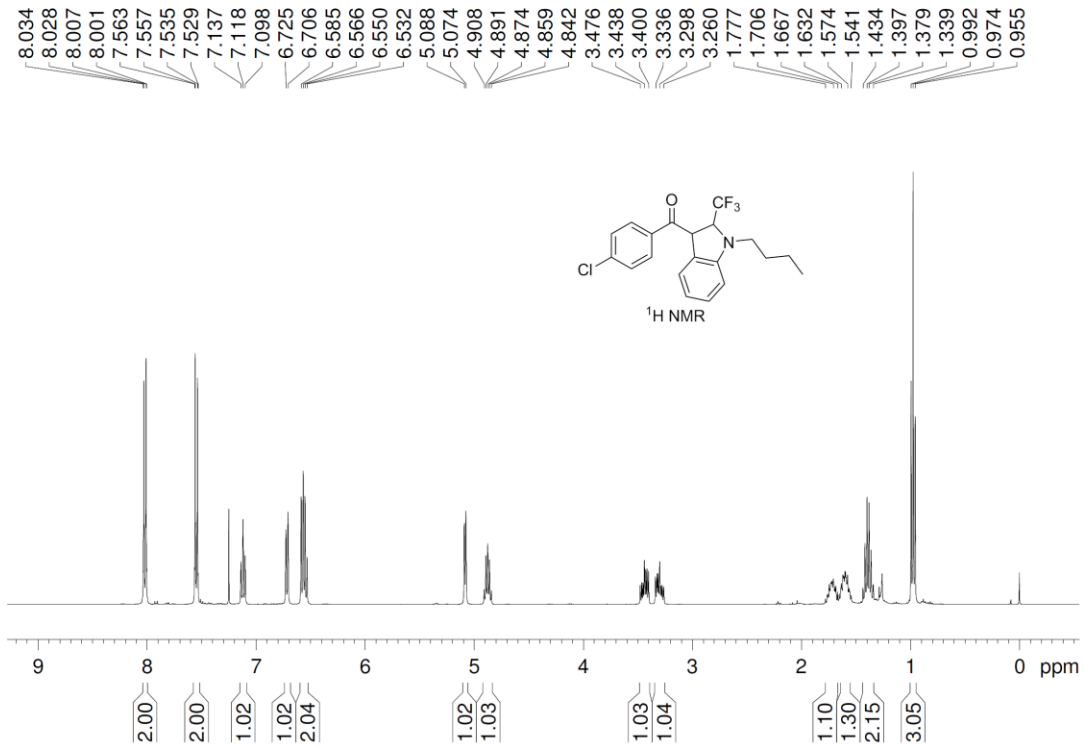
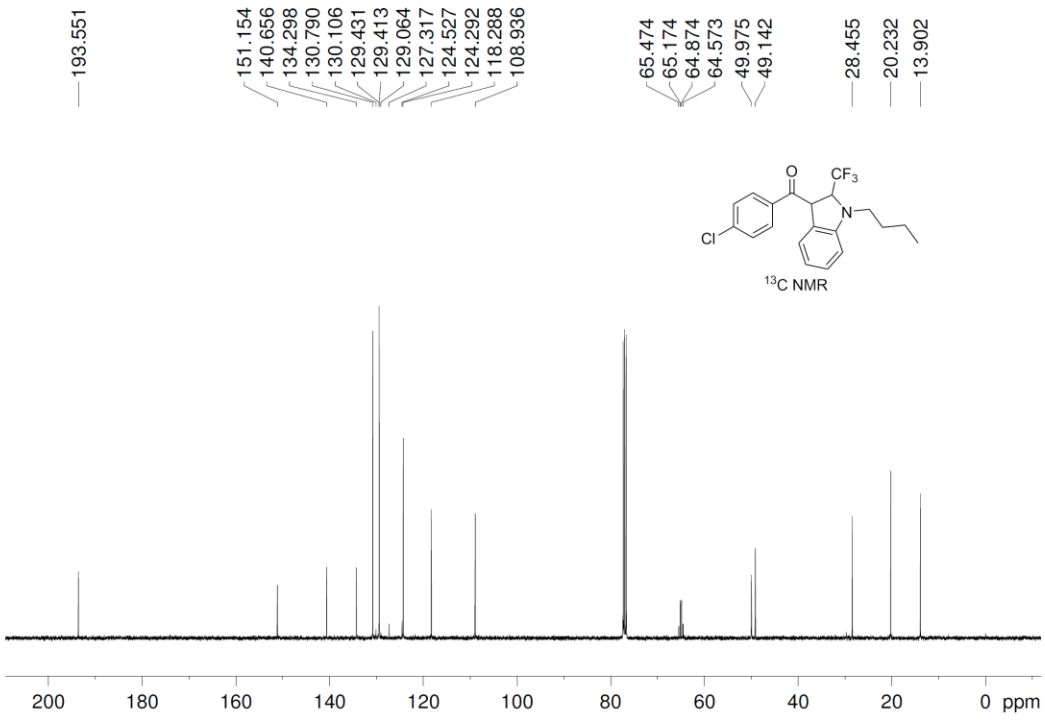
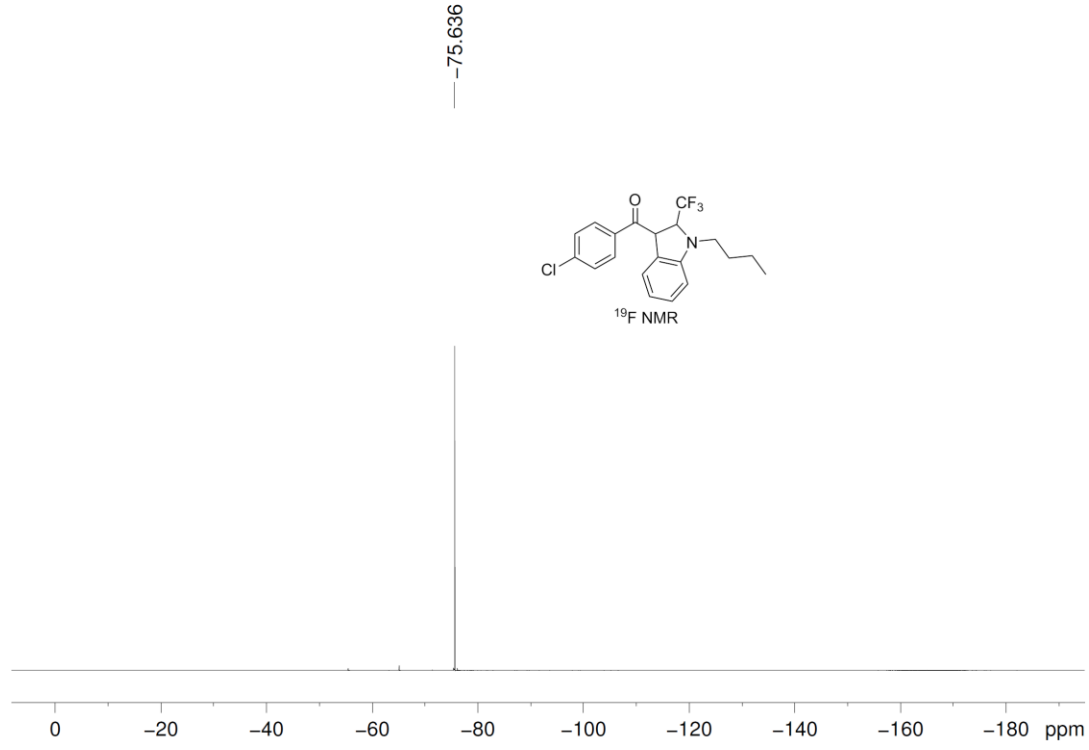
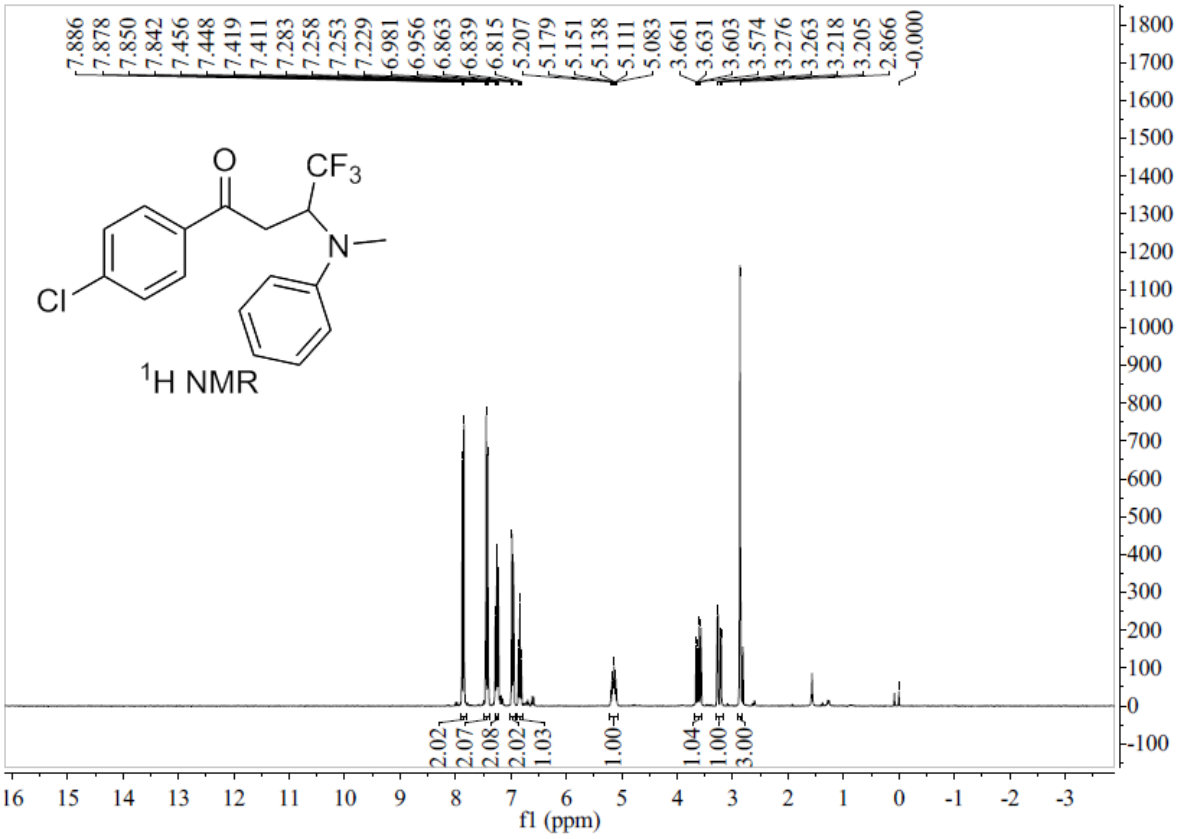
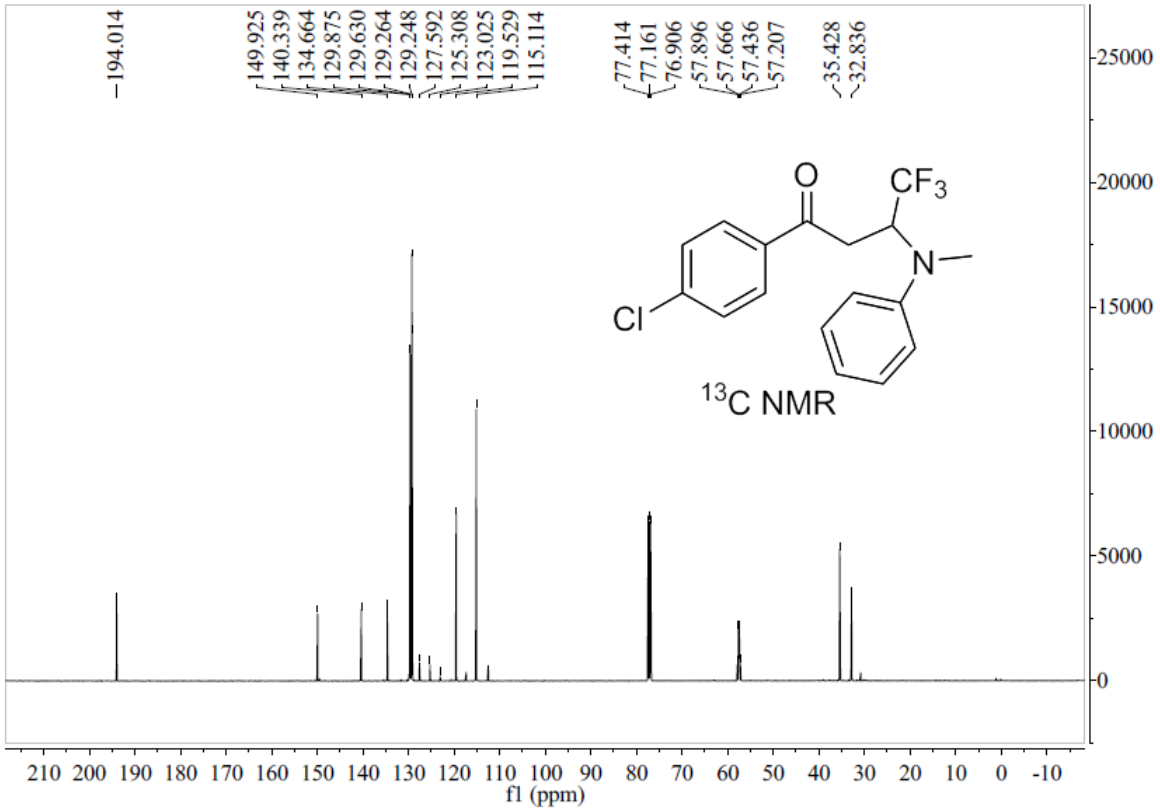
ppm

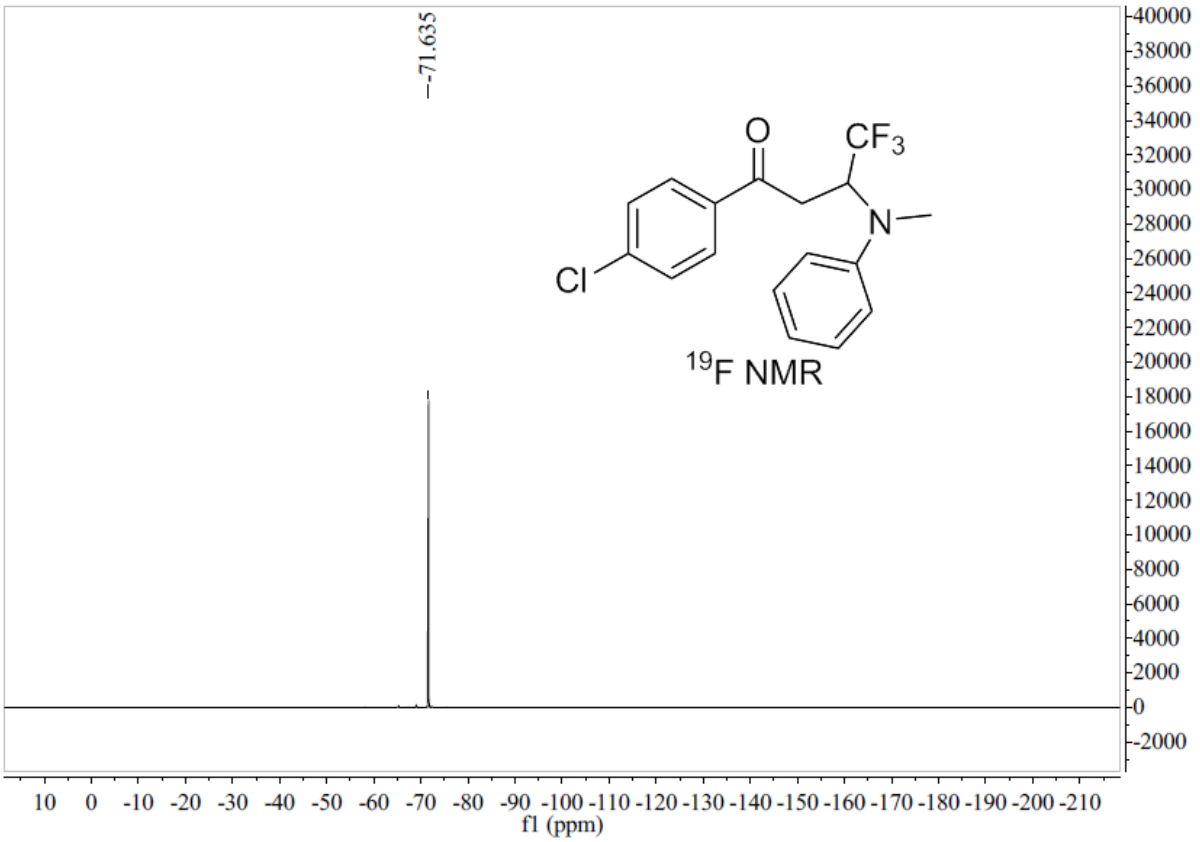

8.034
8.028
8.007
8.001
7.563
7.557
7.535
7.529
7.137
7.118
7.098
6.725
6.706
6.585
6.566
6.550
6.532
5.088
5.074
4.908
4.891
4.874
4.859
4.842
3.476
3.438
3.400
3.336
3.298
3.260
1.777
1.706
1.667
1.632
1.574
1.541
1.434
1.397
1.379
1.339
0.992
0.974
0.955
O
CF3
N
Cl
1H NMR
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.00
1.02
1.02
2.04
1.02
1.03
1.03
1.04
1.10
1.30
2.15
3.05


193.551
151.154
140.656
134.298
130.790
130.106
129.431
129.413
129.064
127.317
124.527
124.292
118.288
108.936
65.474
65.174
64.874
64.573
49.975
49.142
28.455
20.232
13.902
O
CF3
N
Cl
13C NMR
200
180
160
140
120
100
80
60
40
20
0 ppm


−75.636
O
CF3
N
Cl
19F NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180 ppm


7.886
7.878
7.850
7.842
7.456
7.448
7.419
7.411
7.283
7.258
7.253
7.229
6.981
6.956
6.863
6.839
6.815
5.207
5.179
5.151
5.138
5.111
5.083
3.661
3.631
3.603
3.574
3.276
3.263
3.218
3.205
2.866
0.000
O
CF3
N
Cl
1H NMR
2.02
2.07
2.08
2.02
1.03
1.00
1.04
1.00
3.00
f1 (ppm)


194.014
149.925
140.339
134.664
129.875
129.630
129.264
129.248
127.592
125.308
123.025
119.529
115.114
77.414
77.161
76.906
57.896
57.666
57.436
57.207
35.428
32.836
O
CF3
N
Cl
13C NMR
f1 (ppm)


-71.635
O
CF3
N
Cl
19F NMR
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)