Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Tunable Pd/C-catalyzed Oxidative Alkoxycarbonylation /Aminocarbonylation of Aryl hydrazines with Alcohols / Inert Tertiary amines through C-N Bond Activation

Yuvraj A. Kolekar and Bhalchandra M. Bhanage*

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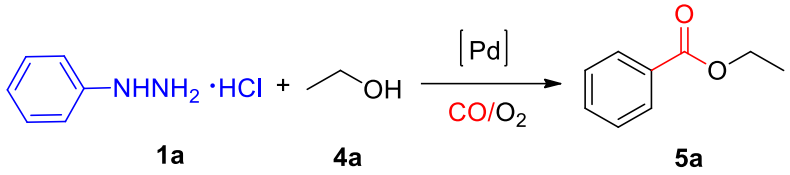
1. Table S-1 Optimization of Reaction Conditions of Oxidative Alkoxycarbonylation[a]



1a 4a 5a

Entry	Catalyst	Solvent	Base	Yield %[b]
1	Pd/C	Propylene Carbonate	--	ND
2	Pd/C	Propylene Carbonate	Et_3N	80
3	$PdCl_2$	Propylene Carbonate	Et_3N	72
4	Pd $(OAc)_2$	Propylene Carbonate	Et_3N	68
5	$PdCl_2(PPh_3)_2$	Propylene Carbonate	Et_3N	73
6	Pd/C	Toluene	Et_3N	65
7	Pd/C	Anisole	Et_3N	62
8	Pd/C	Acetonitrile	Et_3N	52
9	Pd/C	DMF	Et_3N	25
10[c]	Pd/C	Ethanol	Et_3N	91
11[c]	Pd/C	Ethanol	Na_2CO_3	79
12[c, d]	Pd/C	Ethanol	Et_3N	32
13[c, e]	Pd/C	Ethanol	Et_3N	20

[a]**Reaction conditions**: Phenyl hydrazine hydrochloride (1 mmol), Ethanol (1 mL), Solvent (9 mL), Pd catalyst (3 mol%), KI (0.3 mol%), Base (3.0 mmol), 3 atm of CO/O_2 (3:1), 100 °C, 12 h. [b]Yields were detected by GC and GC−MS. [c]Ethanol (10 mL), [d]In absence of KI, [e]In absence of oxidant O_2. ND – not detected.

2. **Table S-2. Effect of catalyst loading for Aminocarbonylation:**

Entry	Catalyst	Catalyst loading [mole%]	Yield [%] [b]
1	5% Pd/C	8	67
2	10% Pd/C	6	60
3	10% Pd/C	8	85
4	10% Pd/C	10	86

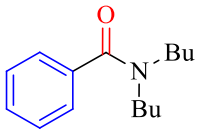
[a]Reaction conditions: $ArNHNH_2$.HCl (1.0 mmol), Bu_3N (1.2 mmol), Pd/C (mol%), propylene carbonate (10 mL) under 7 atm CO/O_2 with ratio (6:1) at 100 °C for 12h. [b]GC-MS Yield

Table S-3. Effect of catalyst loading for Alkoxycarbonylation:

Entry	Catalyst	Catalyst loading [mole%]	Yield [%] [b]
1	5% Pd/C	3	77
2	10% Pd/C	1	68
3	10% Pd/C	3	91
4	10% Pd/C	5	93

[a]Reaction conditions: $ArNHNH_2$.HCl (1.0 mmol), Ethanol (10 mL), Pd/C (mol%), KI (0.3 mmol), Et_3N (3.0 mmol) under 3 atm CO/O_2 with ratio (3:1) at 100 °C for 12h. [b]GC-MS Yield

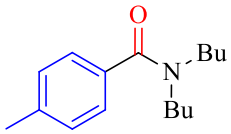
3. ^{1}H and ^{13}C NMR spectra of products:



3a

***N, N*-dibutyl benzamide (3a)**

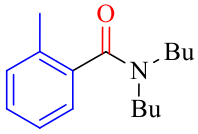
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.24 (s, 5H), 3.38 (s, 2H), 3.08 (s, 2H), 1.54 (s, 2H), 1.33 (d, 4H), 1.02 (s, 2H), 0.86 (s, 3H), 0.66 (s, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 166.80 (s), 132.47, 124.91, 124.12, 123.42, 123.18, 121.57, 72.81, 72.49, 72.17, 43.91, 39.65, 25.37, 15.11, 8.72



3b

***N, N*-dibutyl-4-methylbenzamide (3b)**

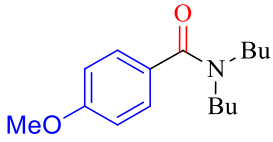
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.04 (d, 2H), 6.95 (d, 2H), 3.27 (s, 2H), 3.01 (s, 2H), 2.12 (s, 3H), 1.51 – 1.06 (m, 6H), 1.01 – 0.40 (m, 8H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.54, 138.65, 134.26, 128.64, 126.32, 77.76, 77.44, 77.12, 48.60, 44.32, 30.04, 21.02, 19.78, 13.56



3c

***N, N*-dibutyl-2-methylbenzamide (3c)**

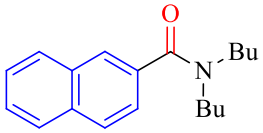
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.23 – 7.07 (m, 4H), 3.61 (s, 1H), 3.31 (s, 1H), 3.08 – 2.95 (m, 2H), 2.24 (s, 3H), 1.37 (dd, 4H), 1.05 (dd, 2H), 0.94 (t, 3H), 0.70 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.13, 137.11, 133.75, 130.14, 128.38, 125.62, 77.40, 77.08, 76.76, 47.96, 43.97, 30.52, 29.52, 20.31, 19.68, 18.82, 13.83, 13.46



3d

***N, N*-dibutyl-4-methoxybenzamide (3d)**

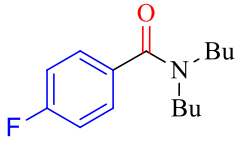
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.01 (s, 2H), 6.57 (d, *J* 2H), 3.45 (d, 3H), 3.05 (d, *J* 4H), 1.25 (s, 4H), 1.11 – 0.78 (m, 4H), 0.57 (s, 6H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.20, 159.97, 129.20, 128.03, 113.25, 77.84, 77.52, 77.19, 54.83, 48.57, 44.46, 29.70, 29.28 – 28.55, 19.71, 13.44



3e

***N, N*-dibutyl-2-naphthamide (3e)**

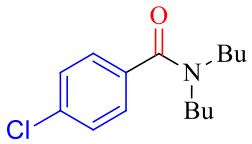
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.83 (d, 4H), 7.56 – 7.40 (m, 3H), 3.52 (s, 2H), 3.23 (s, 2H), 1.67 (s, 2H), 1.46 (d, 4H), 1.09 (s, 2H), 0.98 (s, 3H), 0.73 (s, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.60, 134.67, 133.33, 132.74, 128.18, 127.74, 126.59, 125.91, 124.10 (s), 77.42 (s), 77.11 (s), 76.79 (s), 48.86 (s), 44.53 (s), 32.03 – 31.20 (m), 30.25, 20.29, 19.73, 13.89



3f

***N, N*-dibutyl-4-fluorobenzamide (3f)**

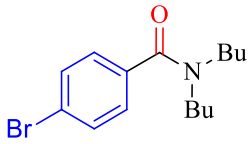
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.29 – 7.15 (m, 2H), 6.94 (t, 2H), 3.35 (s, 2H), 3.07 (s, 2H), 1.50 (s, 2H), 1.31 (d, 4H), 1.02 (s, 2H), 0.83 (s, 3H), 0.67 (s, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 170.58, 164.05, 161.58, 133.27, 128.53, 115.30, 115.08, 77.50, 77.18, 76.86, 48.75, 44.52, 31.18, 30.08, 19.83, 13.55



3g

***N, N*-dibutyl-4-chlorobenzamide (3g)**

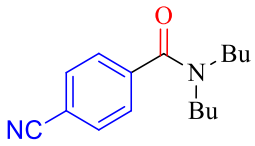
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.32 (d, 1H), 7.25 (d, 1H), 3.43 (s, 1H), 3.13 (s, 1H), 1.59 (s, 1H), 1.39 (d, 2H), 1.10 (s, 1H), 0.93 (s, 1H), 0.80 (d 2H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 170.48, 135.68, 134.97, 128.54, 127.95, 77.34, 77.02, 76.70, 48.79, 44.57, 30.73, 20.20, 19.70, 13.81



3h

***N, N*-dibutyl-4-bromobenzamide (3h)**

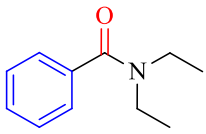
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.48 (d, 2H), 7.19 (d 2H), 3.42 (s, 2H), 3.12 (s, 2H), 1.58 (s, 2H), 1.38 (d, 4H), 1.10 (s, 2H), 0.92 (s, 3H), 0.76 (s, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 170.49, 136.14, 131.50, 128.17, 123.16, 77.36, 77.04, 76.72, 48.78, 44.56, 30.78, 29.62, 20.26, 19.96, 13.70



3i

***N, N*-dibutyl-4-cyanobenzamide (3i)**

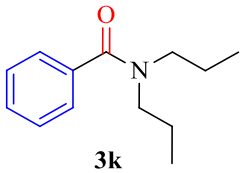
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.67 (d, 4H), 7.42 (d, 4H), 3.53 – 3.39 (m, 5H), 3.12 (dd, 10H), 1.60 (d, 5H), 1.46 (dd, *J* 7H), 1.24 (d, 9H), 0.91 (ddd, 13H), 0.77 (d, 7H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 169.50, 141.65, 132.27, 127.17, 118.13, 112.90, 77.31, 76.99, 76.67, 48.69, 47.05, 44.60, 40.53, 30.72, 29.63, 20.12, 19.67, 14.15 – 14.07, 13.67



3j

***N, N*-diethylbenzamide(3j)**

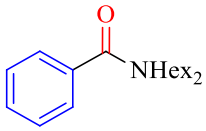
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.29 (s, 5H), 3.47 (s, 2H), 3.17 (s, 2H), 1.16 (s, 3H), 1.02 (s, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.20, 137.21, 128.99, 128.28, 126.17, 77.47, 77.15, 76.83, 43.21, 39.19, 13.47, 12.73 – 11.75



3k

***N, N*-dipropylbenzamide(3k)**

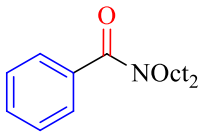
^{1}H NMR (400 MHz, cdcl$_3$) δ 6.97 (s, 5H), 3.09 (s, 2H), 2.78 (s, 2H), 1.32 (s, 2H), 1.13 (s, 2H), 0.59 (s, 3H), 0.33 (s, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.23, 137.12, 128.61, 127.93, 126.09, 77.99, 77.66, 77.34, 50.31, 45.96, 20.98, 20.07 – 19.03, 10.81



3l

***N, N*-dihexylbenzamide(3l)**

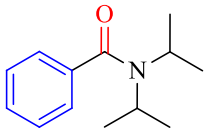
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.33 (m, 5H), 3.45 (s, 2H), 3.19 – 3.11 (m, 2H), 1.61 (s, 2H), 1.47 (s, 2H), 1.27 (t, 10H), 1.08 (s, 2H), 0.89 – 0.79 (m, 6H) 13C {1H} NMR (101 MHz, cdcl$_3$) δ 171.60, 162.68, 137.33, 128.93, 128.26, 126.38, 77.30, 76.98, 76.66, 48.97, 47.45, 44.73, 42.13, 32.67 – 31.23, 28.60, 26.61, 26.10, 22.50, 13.94



3m

***N, N*-dioctylbenzamide(3m)**

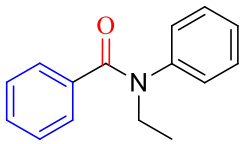
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.40 – 7.21 (m, 5H), 3.44 (s, 2H), 3.13 (s, 2H), 1.61 (s, 2H), 1.44 (s, 2H), 1.38 – 0.94 (m, 20H), 0.84 (s, 6H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.56, 137.35, 128.90, 128.23, 126.38, 77.36, 77.04, 76.72, 31.71, 29.02, 28.52 – 27.84, 27.55, 27.54 – 25.97, 22.55, 14.00



3n

***N, N*-diisopropylbenzamide (3n)**

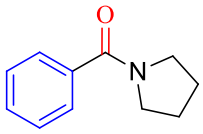
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.46 – 7.28 (m, 5H), 3.73 (s, 2H), 1.37 (d, *J* = 32.7 Hz, 12H). ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 171.11, 138.92, 129.93, 128.55, 125.60, 77.71, 77.08, 76.44, 50.75, 46.24, 20.73



3o

***N*-ethyl-*N*-phenylbenzamide(3o)**

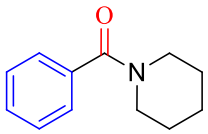
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.25 (dd, 2H), 7.23 – 7.15 (m, 3H), 7.12 (t, 3H), 7.00 (d, 2H), 3.96 (q, 2H), 1.20 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 170.18, 129.40, 129.04, 128.59, 127.88, 127.63, 126.59, 77.34, 77.02, 76.70, 45.34, 12.90



3p

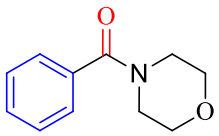
Phenyl (pyrrolidin-1-yl) methanone (3p)

^{1}H NMR (400 MHz, cdcl$_3$) δ 7.53 – 7.43 (m, 2H), 7.35 (dd, 3H), 3.61 (t, 2H), 3.38 (t, 2H), 1.91 (dd, 2H), 1.86 (s, 2H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 169.73, 137.14, 129.71, 128.18, 127.00, 77.33, 77.01, 76.70, 49.55, 46.12, 26.32, 24.39



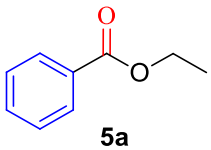
3q

Phenyl (piperidin-1-yl) methanone (3q)
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.33 (s, 5H), 3.66 (s, 2H), 3.29 (s, 2H), 1.62 (s, 4H), 1.46 (s, 2H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 170.26, 136.45, 129.28, 128.32, 126.71, 48.69, 43.09, 26.47, 25.60, 24.53



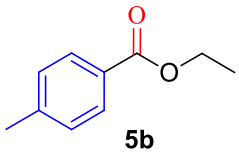
3r

Morpholino (phenyl) methanone (3r)
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.36 (s, 5H), 3.79 – 3.33 (m, 8H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 170.43, 135.21, 129.84, 128.50, 127.01, 77.39, 77.07, 76.75, 66.81, 48.17, 42.77



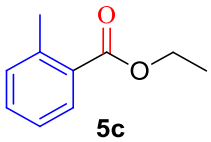
5a

Ethyl benzoate (5a)
1H NMR (400 MHz, cdcl$_3$) δ 8.06 – 7.99 (m, 2H), 7.54 – 7.47 (m, 1H), 7.39 (dd, 2H), 4.35 (q, 2H), 1.36 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 166.54, 132.72, 130.48, 129.46, 128.23, 60.86, 14.25



5b

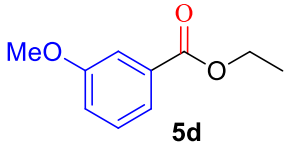
Ethyl-4-Methyl benzoate (5b)
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.90 (d, 2H), 7.18 (d, 2H), 4.32 (q, 2H), 2.36 (s, 3H), 1.35 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 166.61, 143.32, 129.48, 128.94, 127.75, 60.65, 21.51, 14.27



5c

Ethyl-2-Methyl benzoate (5c)

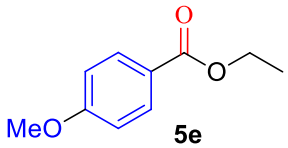
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.92 – 7.87 (m, 1H), 7.39 – 7.33 (m, 1H), 7.24 – 7.19 (m, 2H), 4.38 – 4.30 (m, 2H), 2.58 (s, 3H), 1.40 – 1.34 (m, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 167.65, 139.90, 131.64, 130.41, 129.95, 125.60, 77.34, 77.02, 76.71, 60.61, 21.61, 14.28



5d

Ethyl-3-methoxyl benzoate (5d)

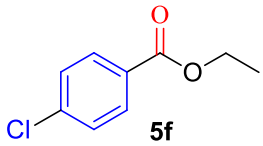
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.63 – 7.59 (m, 1H), 7.53 (dd, 1H), 7.30 (t, 1H), 7.05 (ddd, 1H), 4.34 (q, 2H), 3.81 (s, 3H), 1.36 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 166.41, 159.49, 131.78, 129.25, 121.86, 119.20, 114.00, 77.35, 77.03, 76.71, 60.96, 55.34, 14.25



5e

Ethyl-4-methoxyl benzoate (5e)

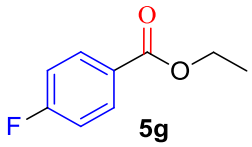
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.98 – 7.91 (m, 2H), 6.84 (d, 2H), 4.28 (q, 2H), 3.77 (s, 3H), 1.31 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 166.24, 163.20, 131.42, 122.88, 113.46, 77.41, 77.09, 76.77, 60.49, 55.24, 14.27



5f

Ethyl-4-chloro benzoate (5f)

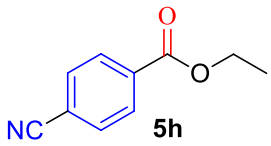
^{1}H NMR (400 MHz, cdcl$_3$) δ 7.99 – 7.90 (m, 2H), 7.41 – 7.32 (m, 2H), 4.34 (q, 2H), 1.35 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 165.65, 139.16, 130.87, 128.91, 128.57, 77.33, 77.01, 76.69, 61.13, 14.22



5g

Ethyl-4-fluoro benzoate (5g)

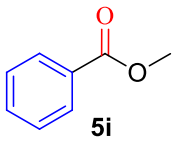
^{1}H NMR (400 MHz, cdcl$_3$) δ 8.04 (ddd, *J* = 6.8, 5.5, 2.1 Hz, 3H), 7.14 – 7.03 (m, 3H), 4.35 (q, 3H), 1.37 (t, 5H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 166.91, 165.61, 164.39, 132.00, 126.70, 115.48, 115.26, 77.28, 76.96, 76.64, 61.03, 14.26



5h

Ethyl-4-cyano benzoate (5h)

^{1}H NMR (400 MHz, cdcl$_3$) δ 8.13 – 8.05 (m, 2H), 7.73 – 7.66 (m, 2H), 4.37 (q, 2H), 1.36 (t, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 164.85, 134.24, 132.10, 129.98, 117.92, 116.20, 77.37, 77.06, 76.74, 61.73, 14.16

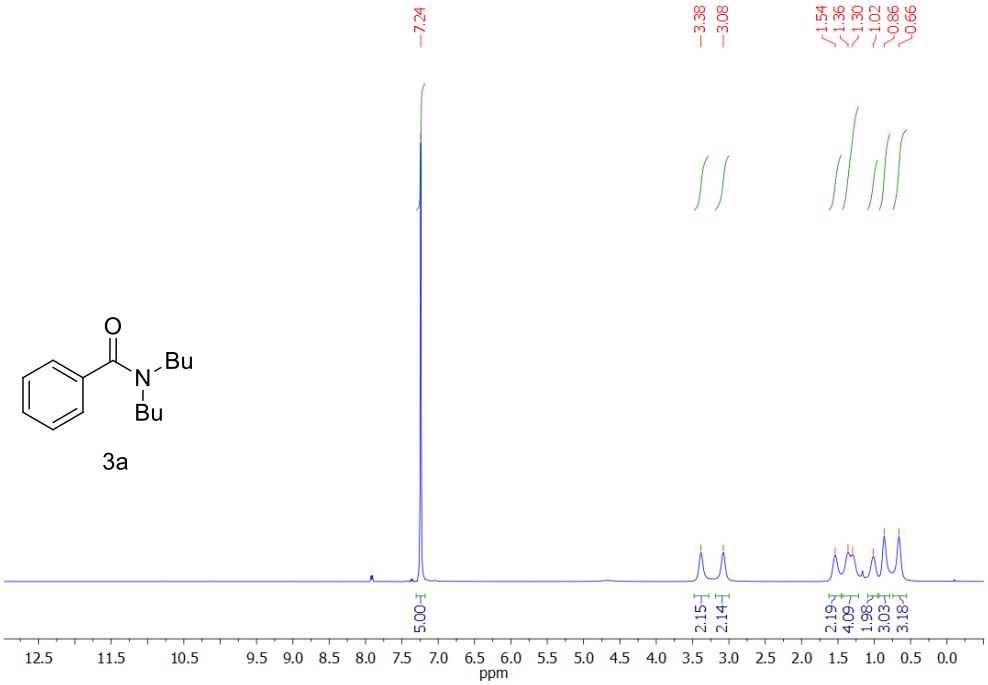


5i

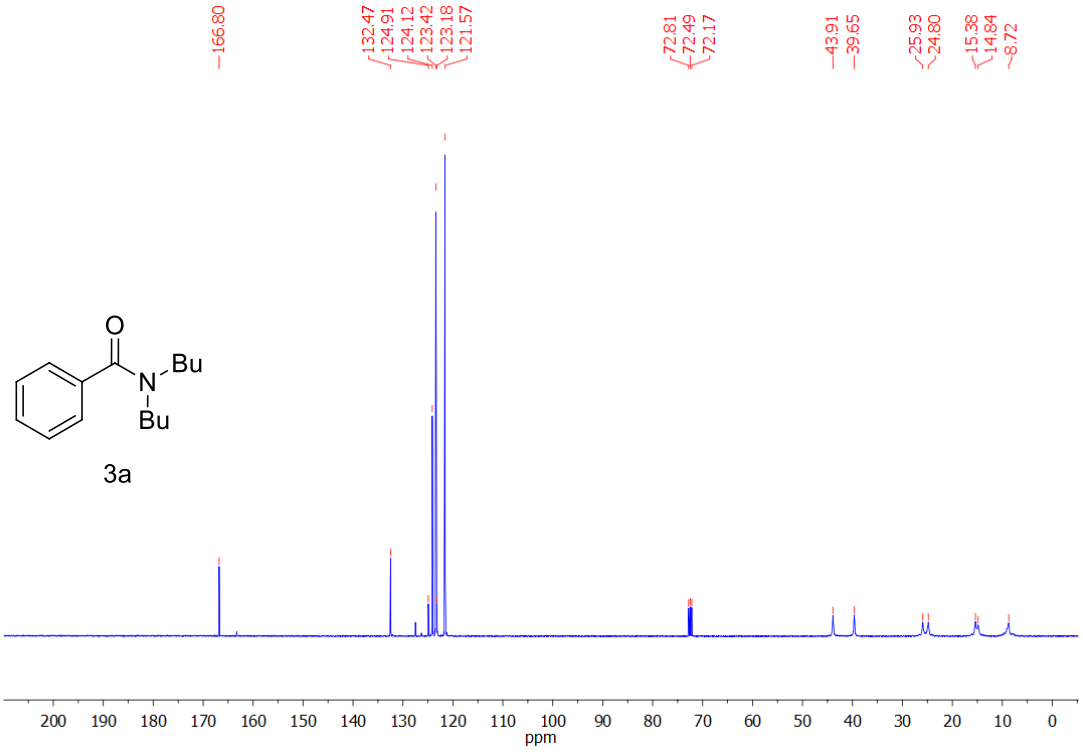
Methyl benzoate (5i)

^{1}H NMR (400 MHz, cdcl$_3$) δ 8.04 – 7.96 (m, 2H), 7.53 – 7.45 (m, 1H), 7.37 (dd, 2H), 3.86 (s, 3H) ^{13}C {1H} NMR (101 MHz, cdcl$_3$) δ 166.96, 132.79, 130.13, 129.48, 128.26, 77.41, 77.09, 76.77, 51.92

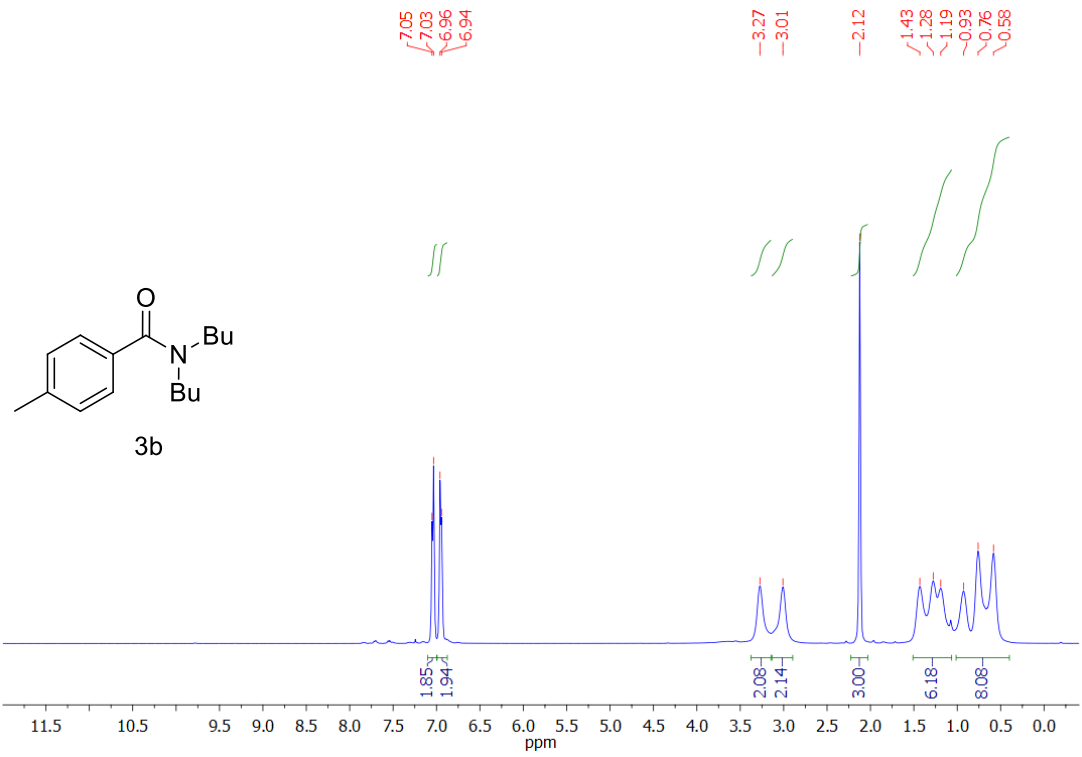
^{1}H NMR (400 MHz, $CDCl_3$) of *N, N*-dibutyl benzamide (3a)



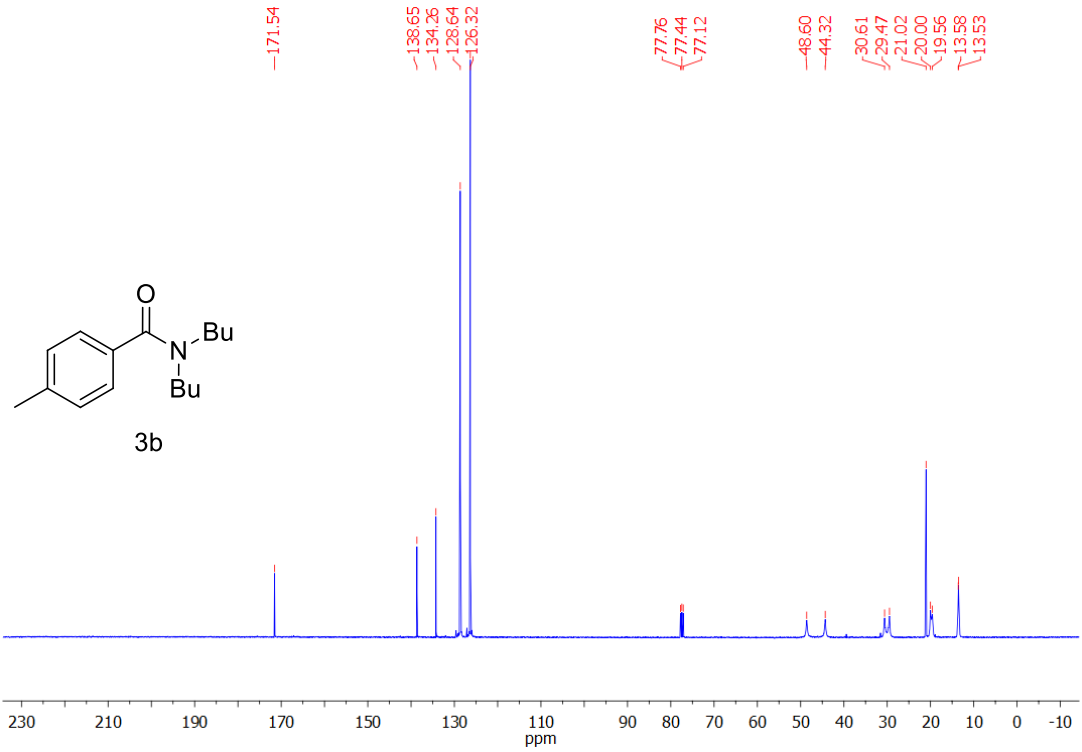
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dibutylbenzamide (3a)



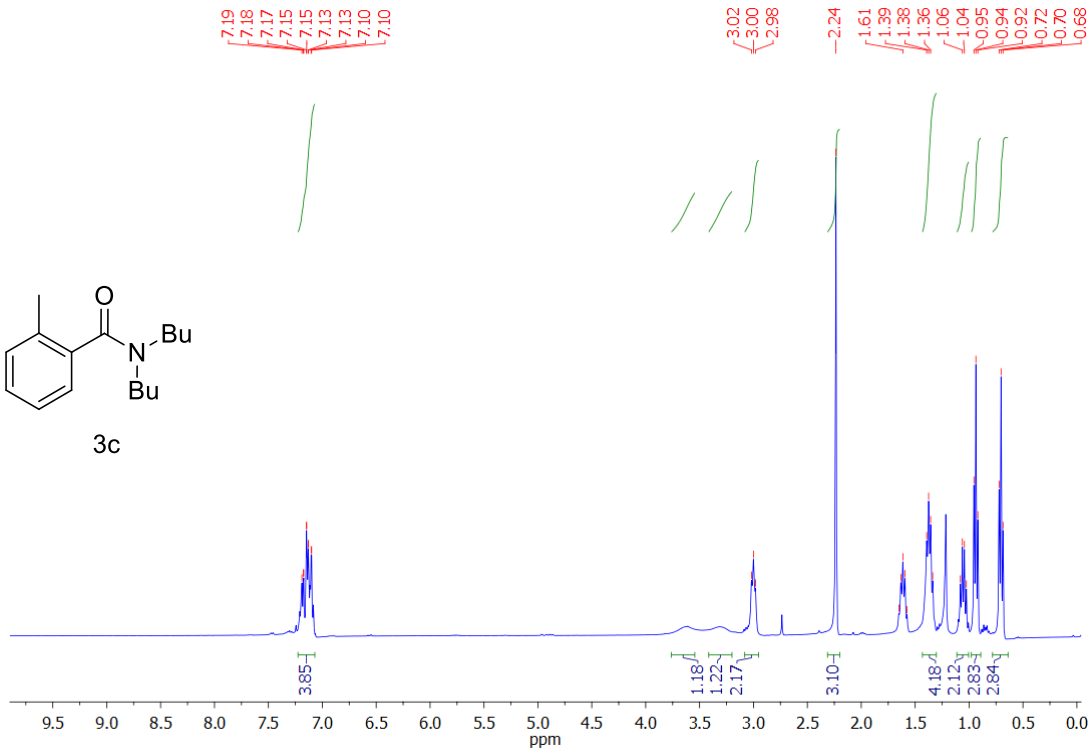
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dibutyl-4-methylbenzamide (3b)



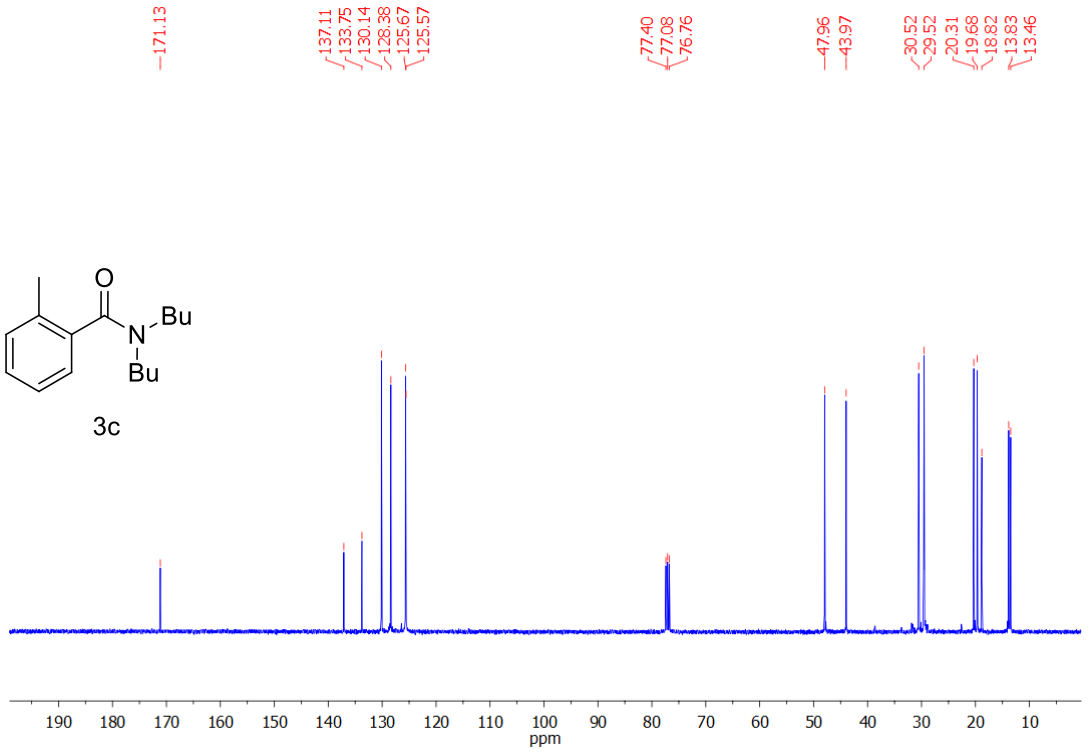
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N, N*-dibutyl-4-methylbenzamide (3b)



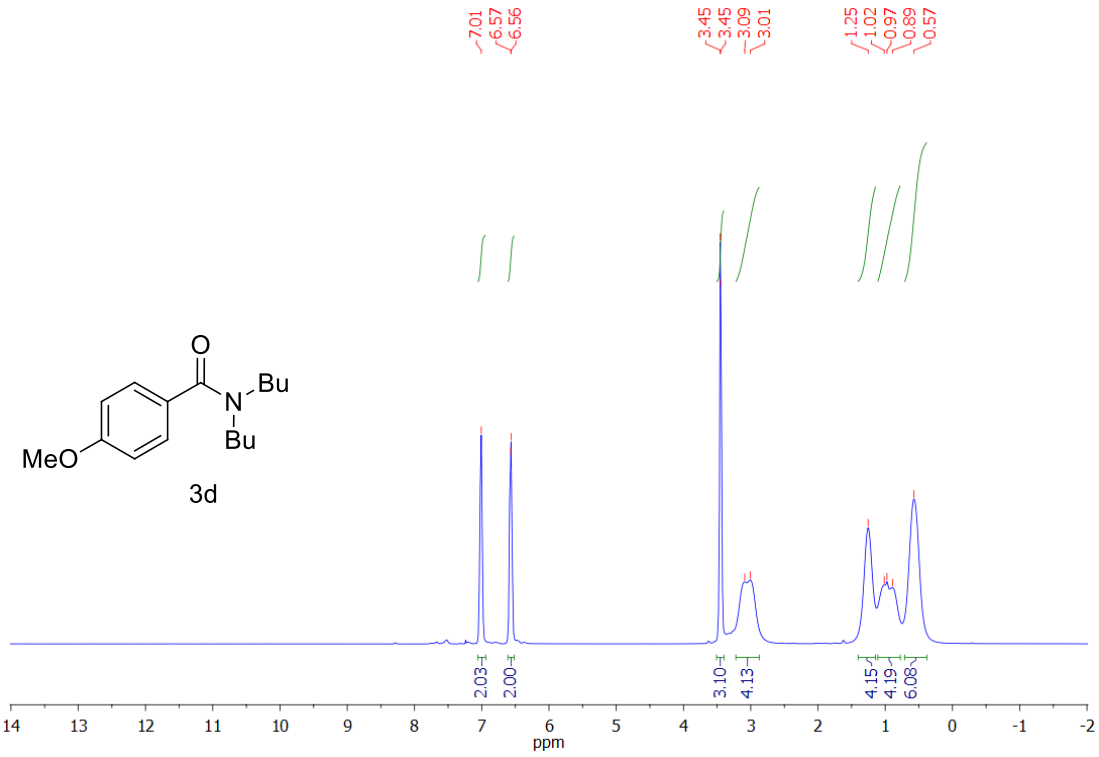
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dibutyl-2-methylbenzamide (3c)



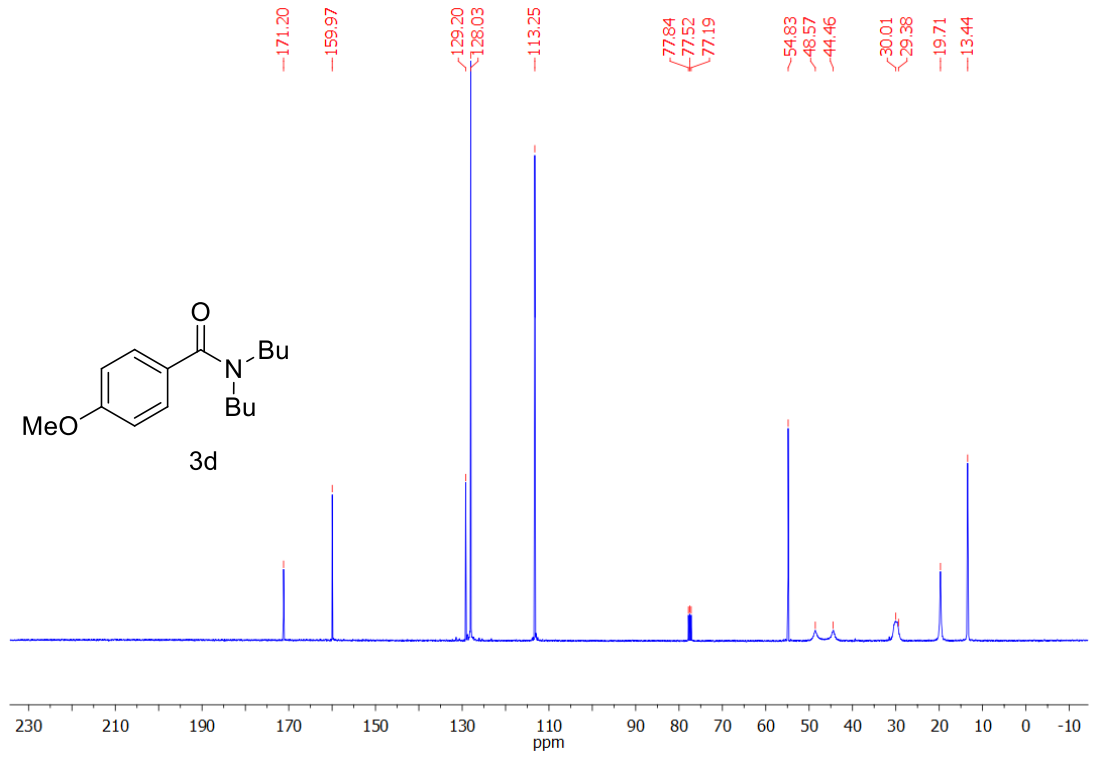
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dibutyl-2-methylbenzamide (3c)



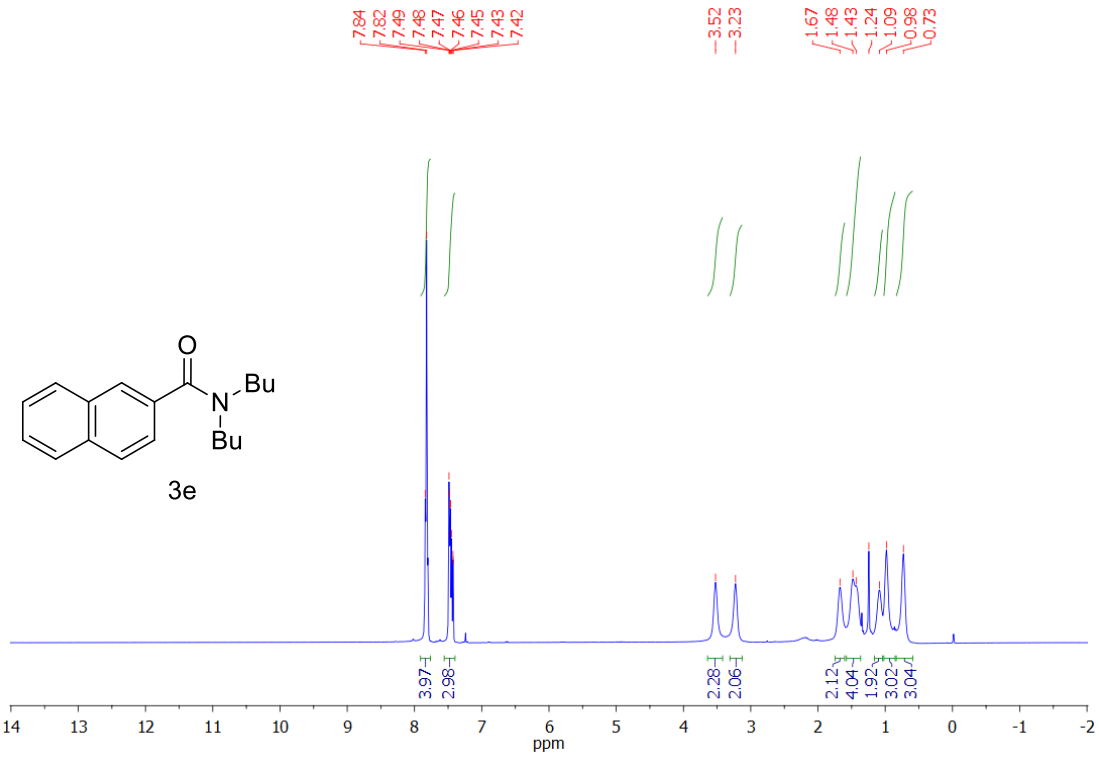
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dibutyl-4-methoxybenzamide (3d)



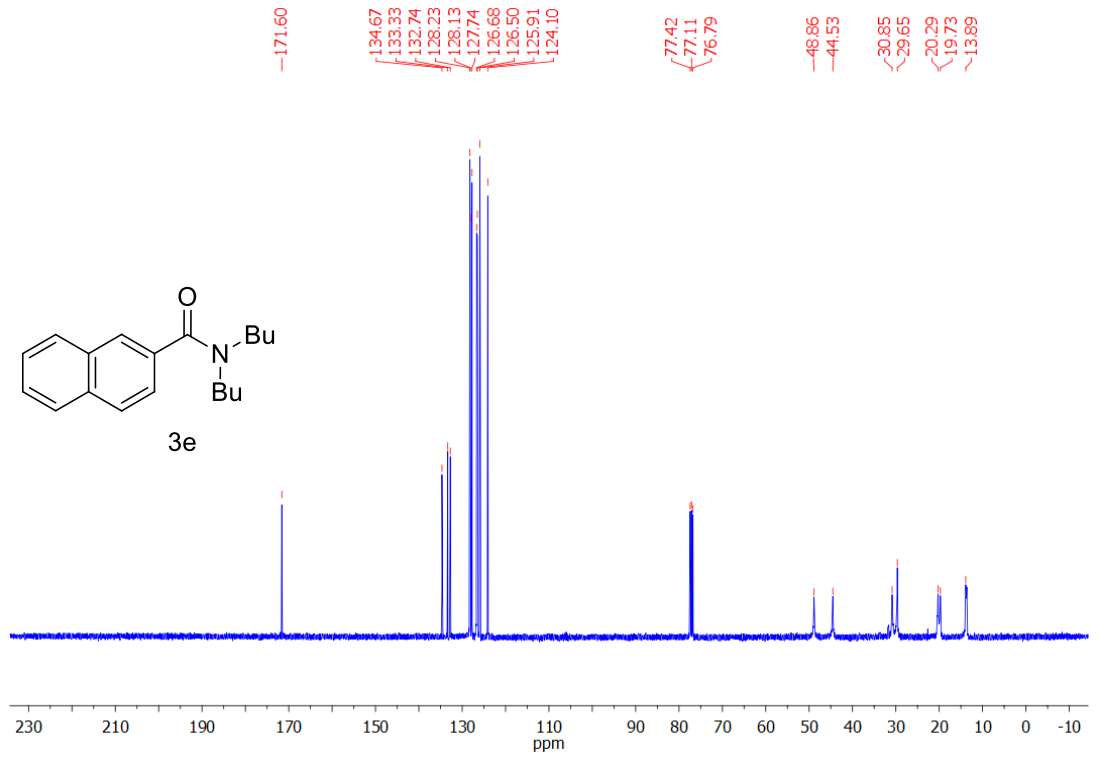
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dibutyl-4-methoxybenzamide (3d)



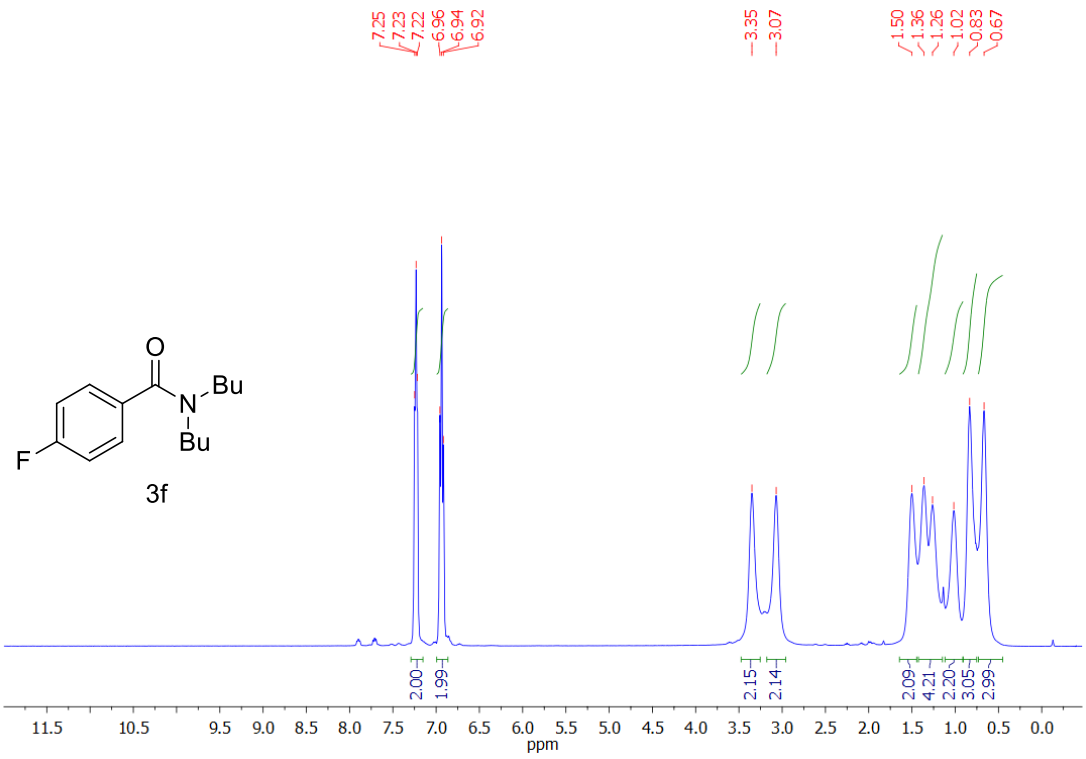
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dibutyl-2-naphthamide (3e)



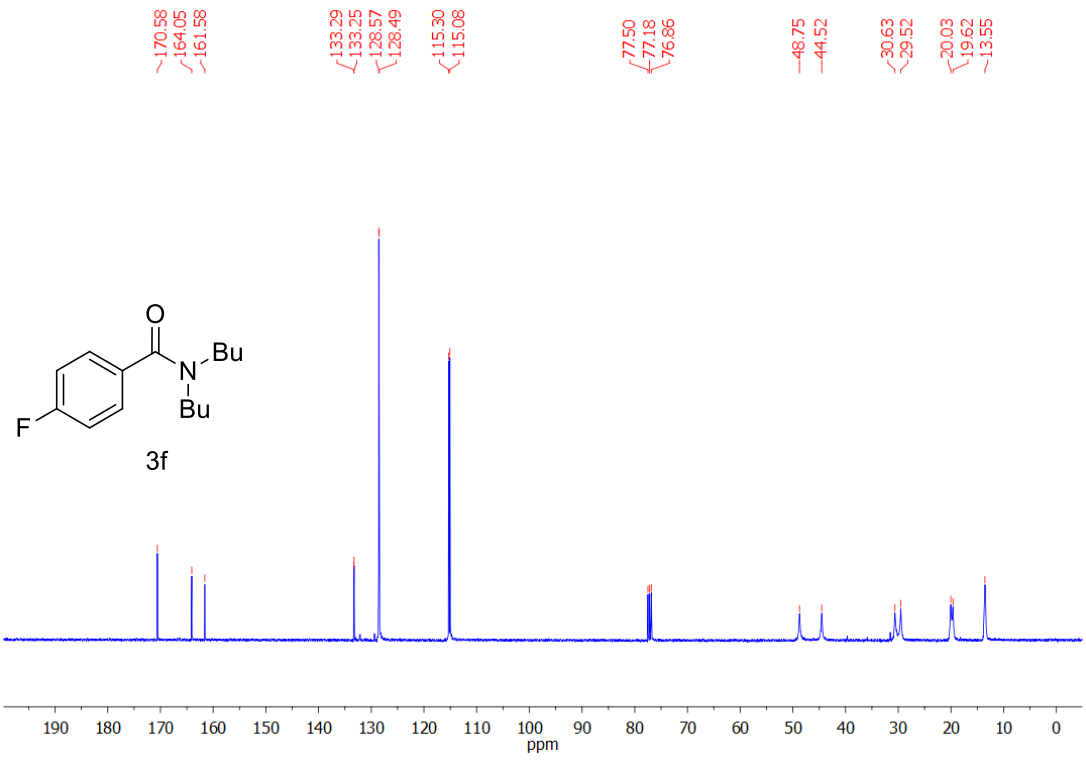
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dibutyl-2-naphthamide (3e)



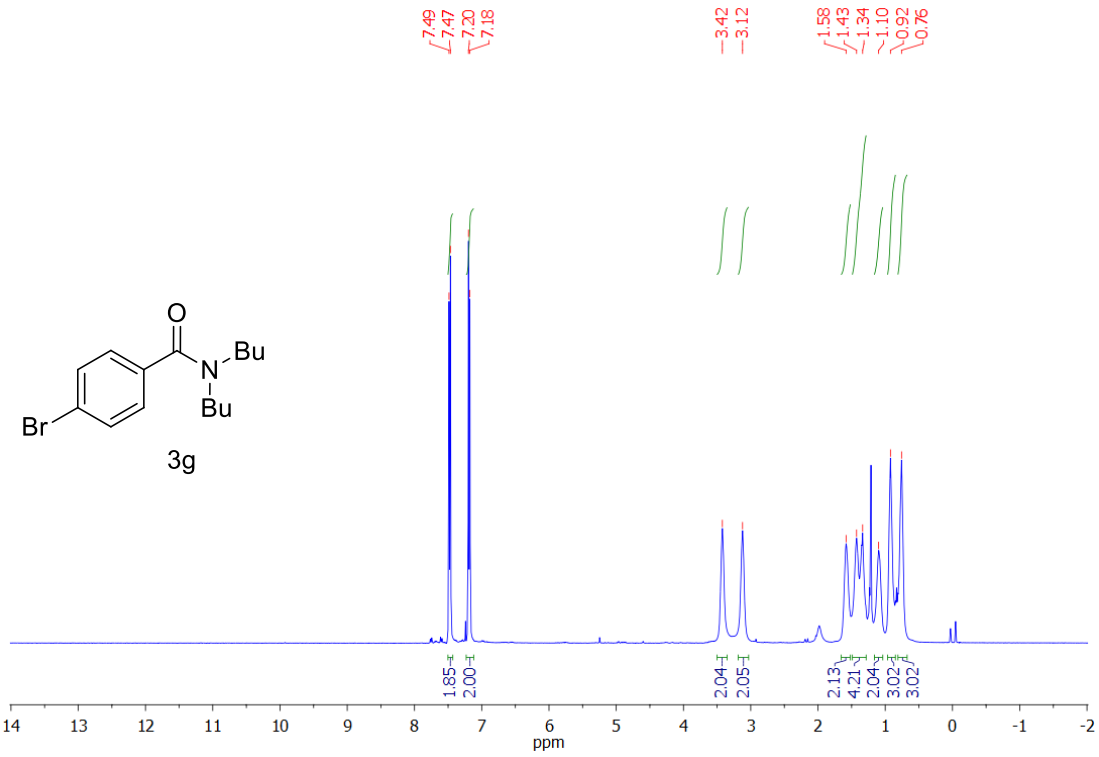
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dibutyl-4-fluorobenzamide (3f)



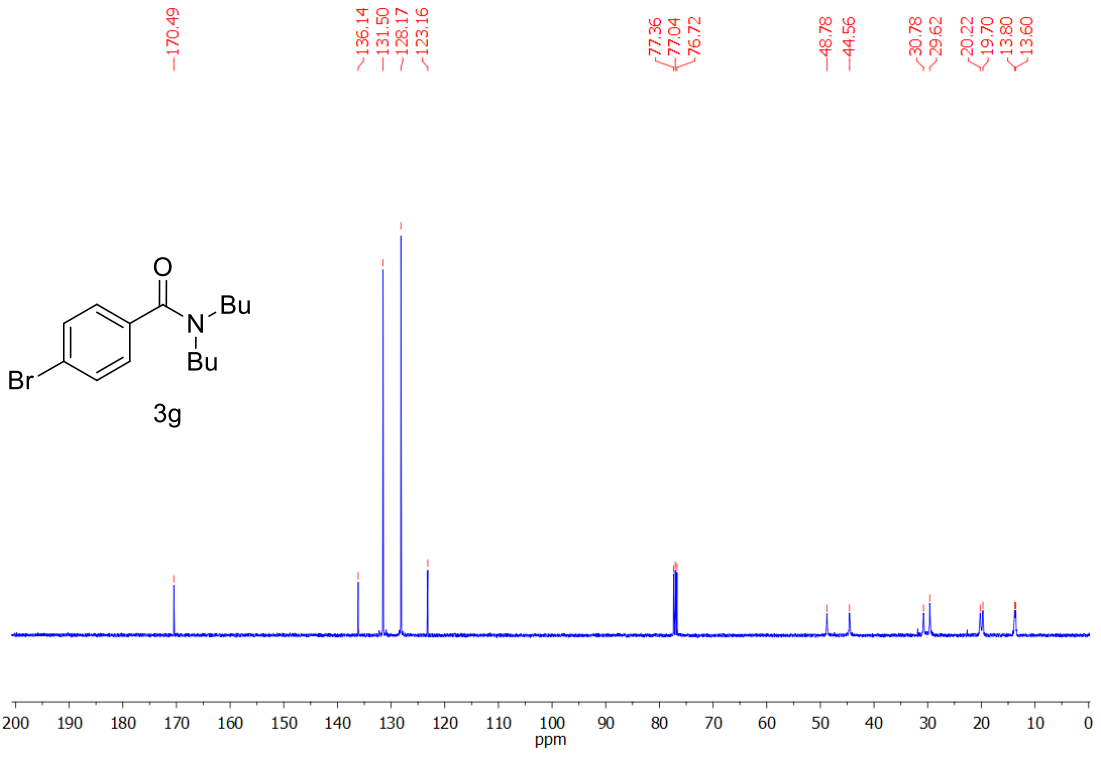
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N*,*N*-dibutyl-4-fluorobenzamide (3f)



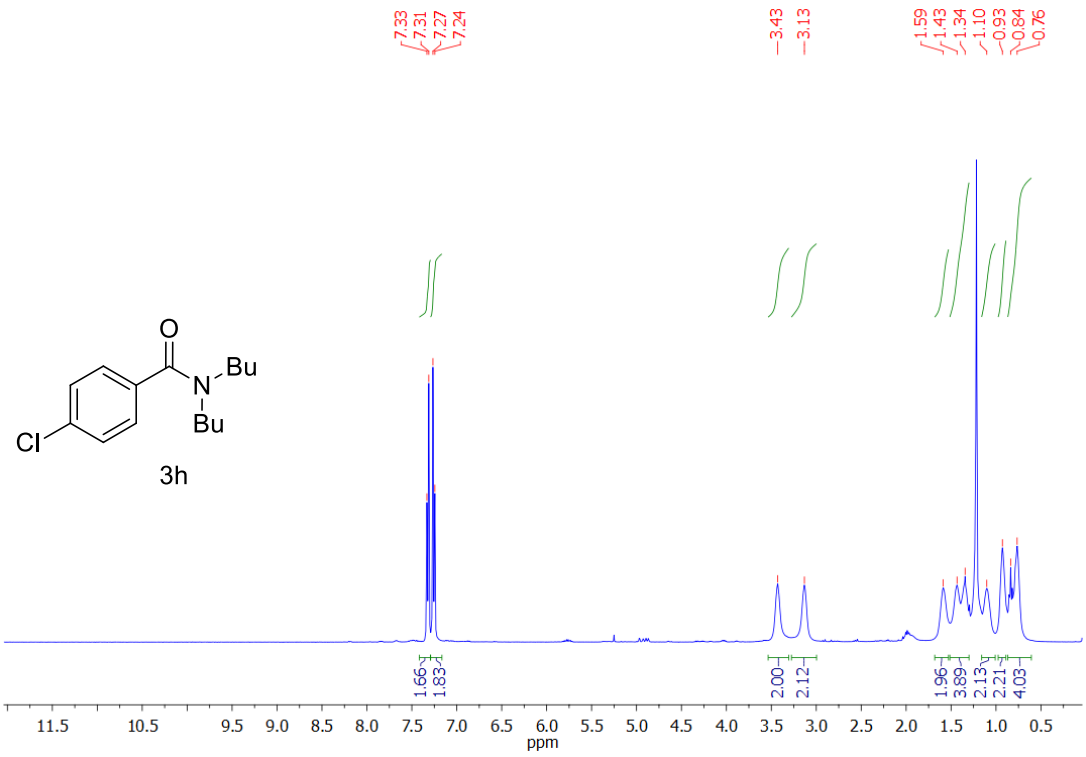
^{1}H NMR (400 MHz, $CDCl_3$) of *N*,*N*-dibutyl-4-bromobenzamide (3g)



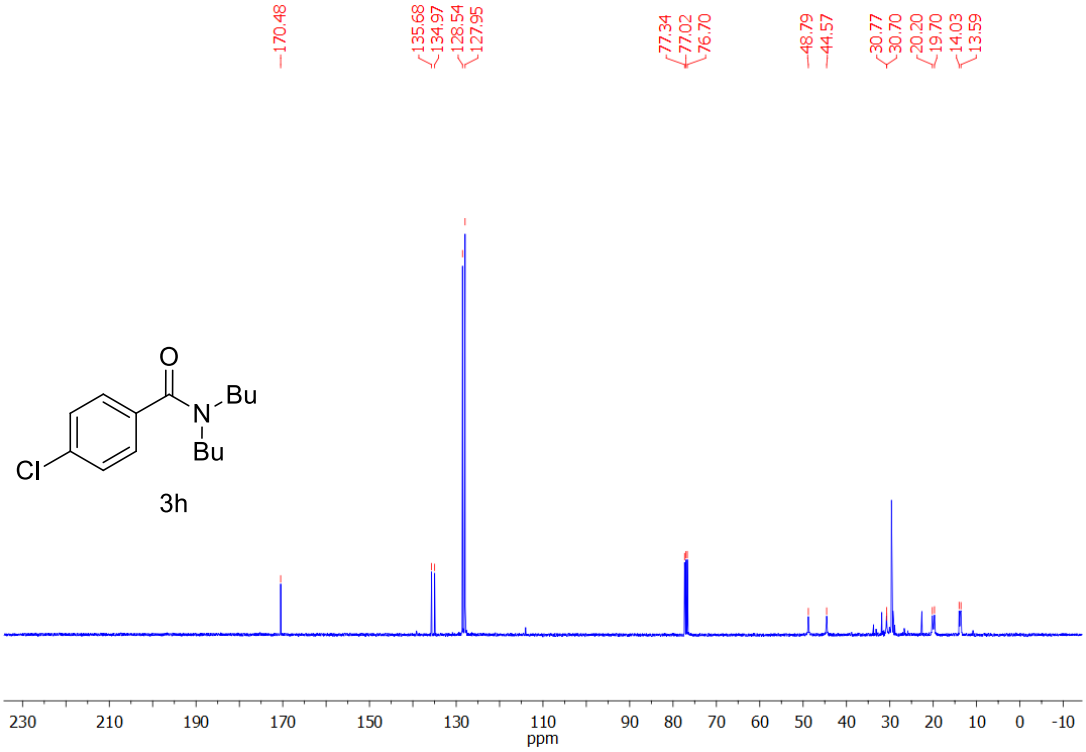
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dibutyl-4-bromobenzamide (3g)



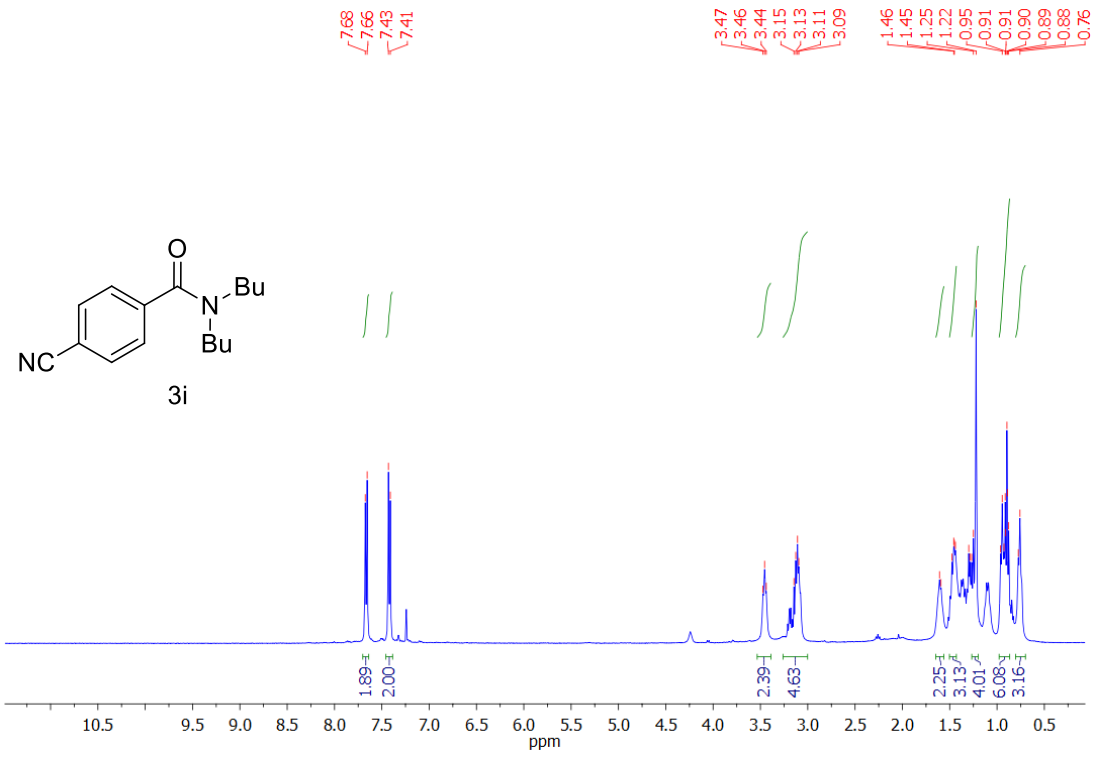
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dibutyl-4-chlorobenzamide (3h)



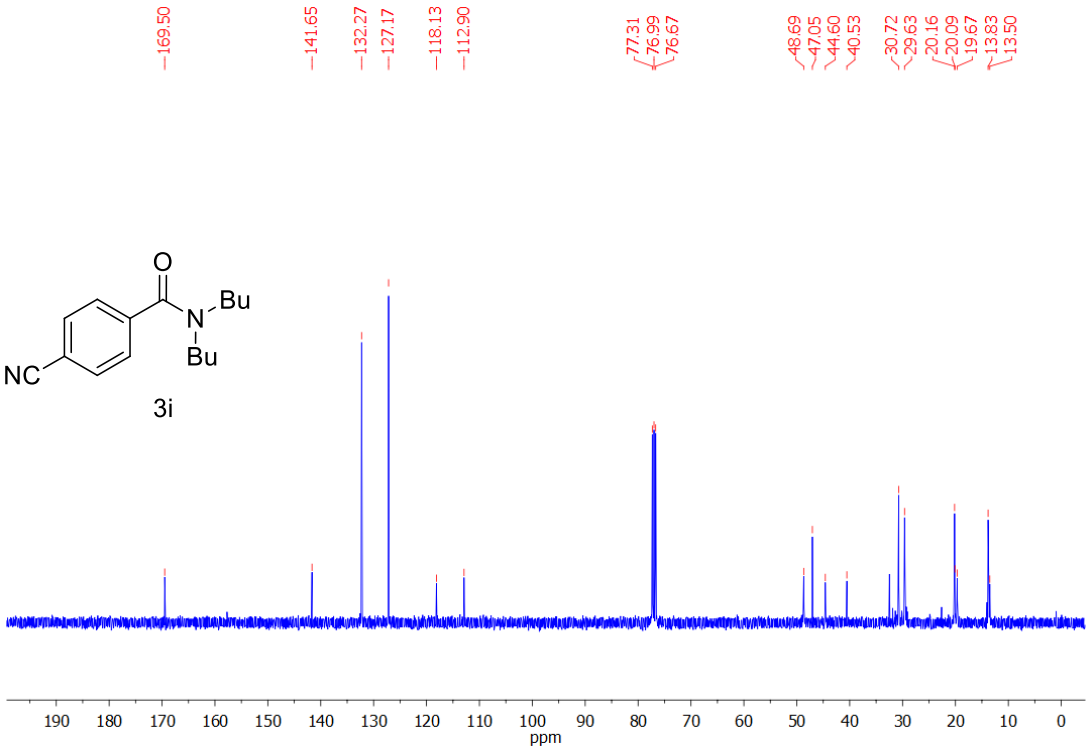
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dibutyl-4-chlorobenzamide (3h)



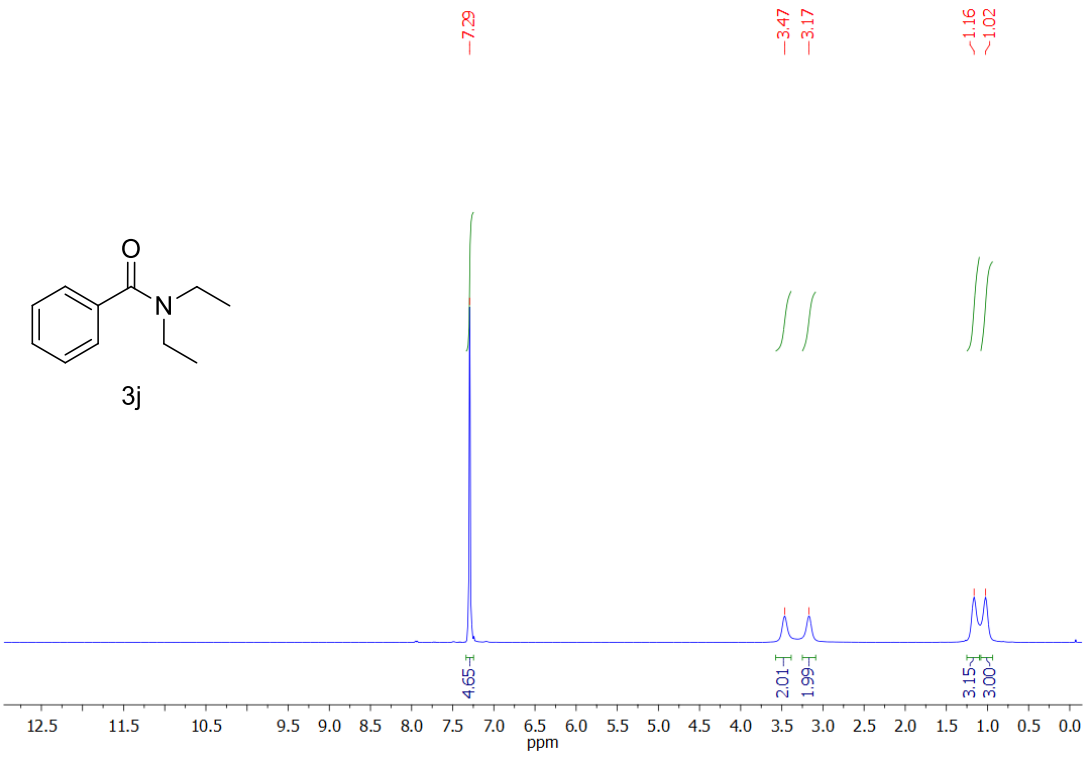
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dibutyl-4-chlorobenzamide (3i)



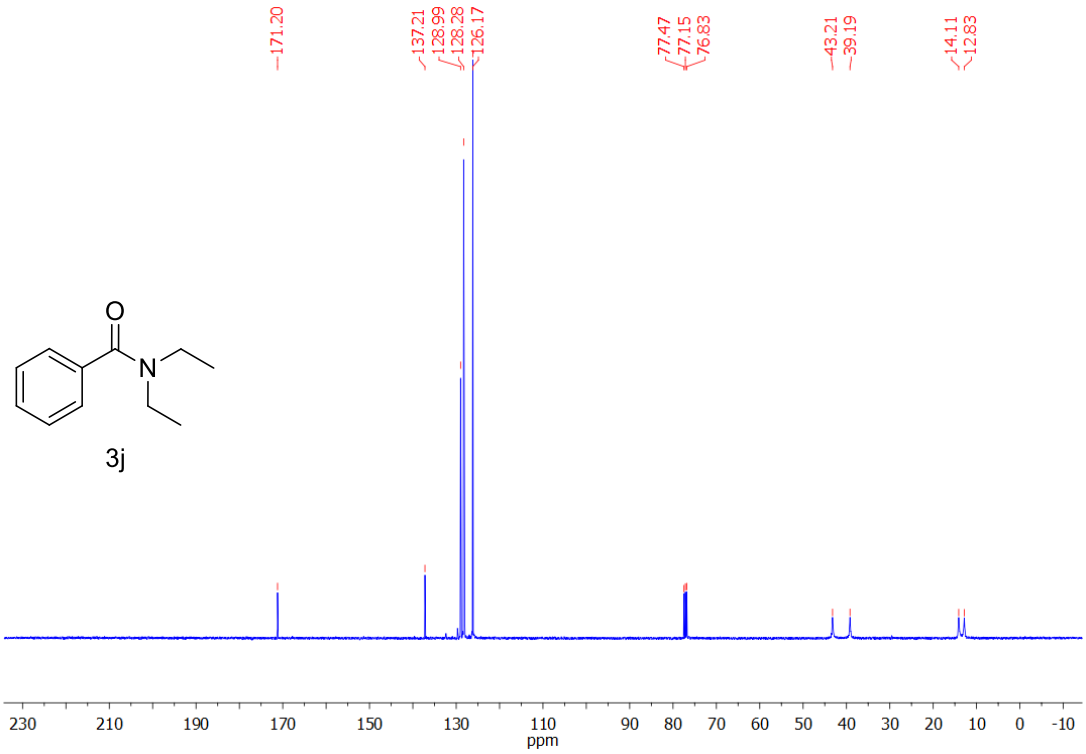
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dibutyl-4-chlorobenzamide (3i)



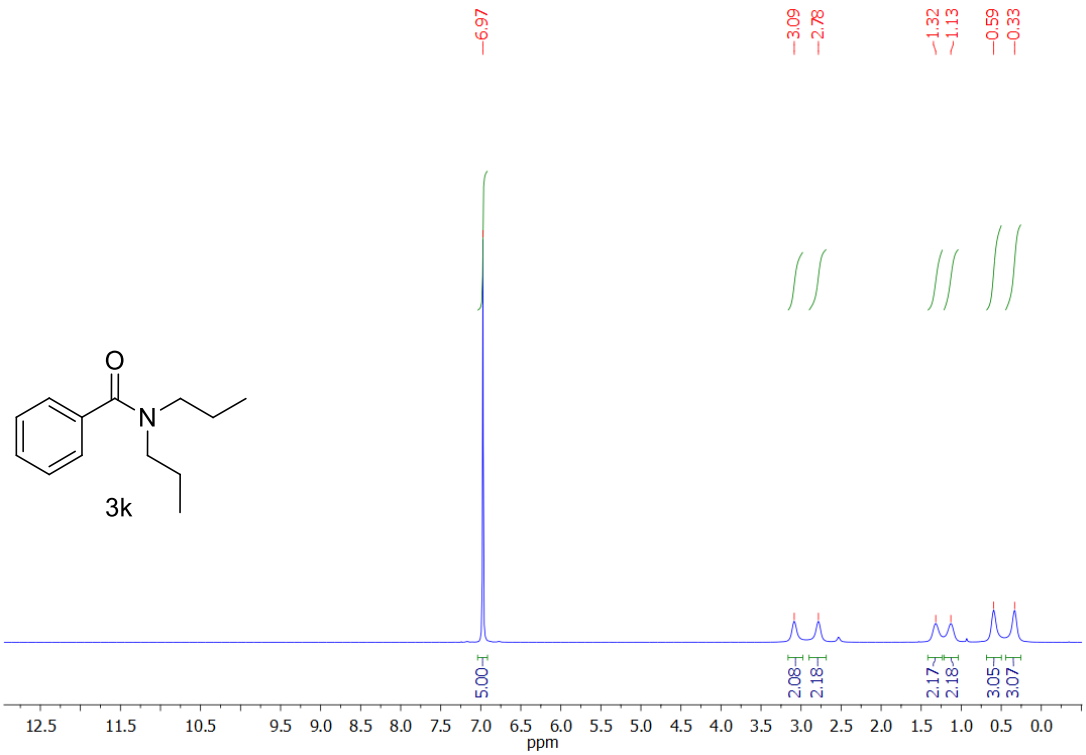
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-diethylbenzamide (3j)



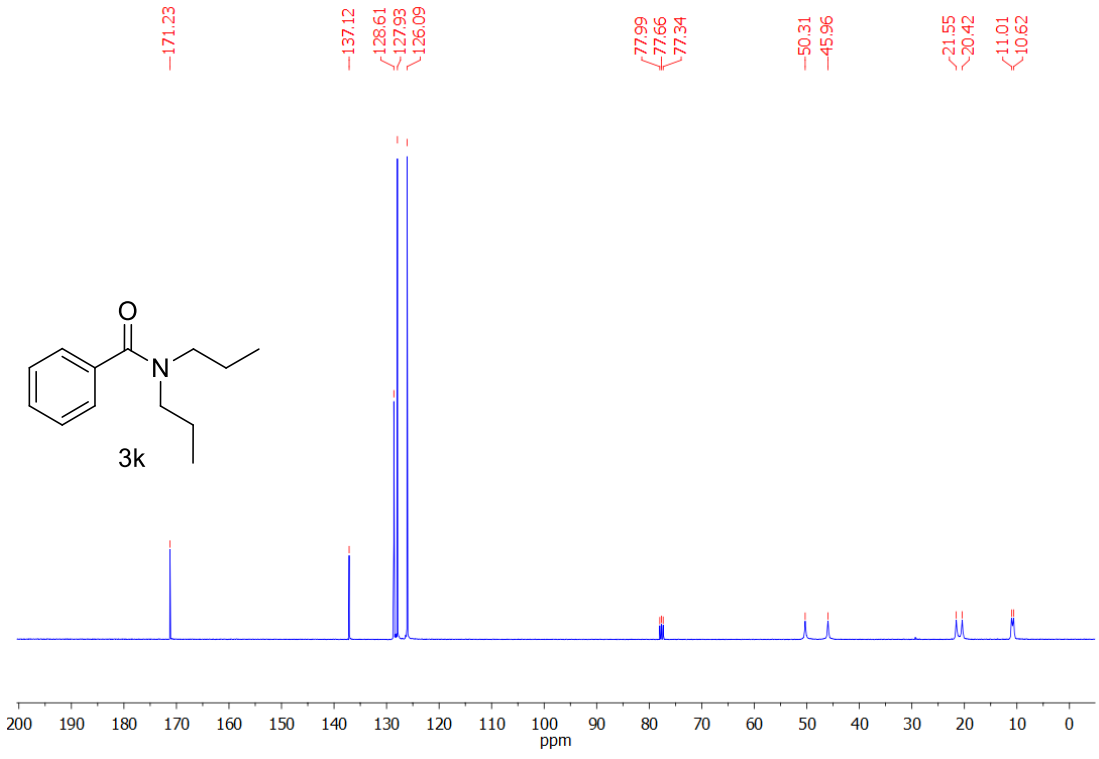
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-diethylbenzamide (3j)



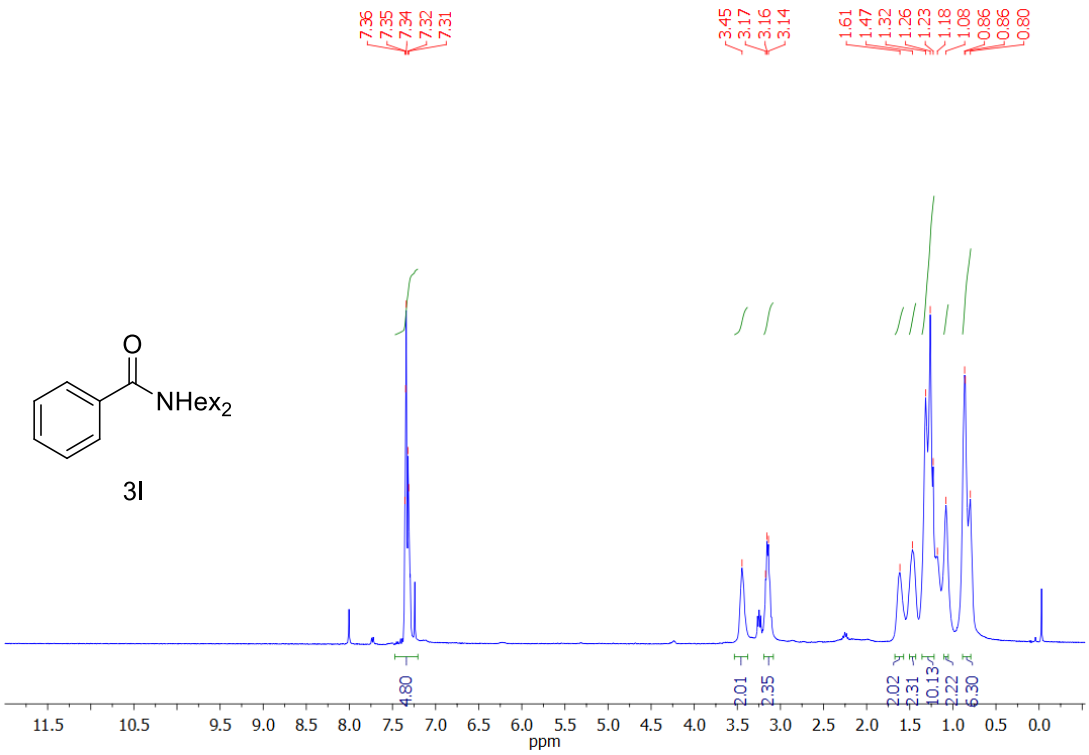
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dipropylbenzamide (3k)



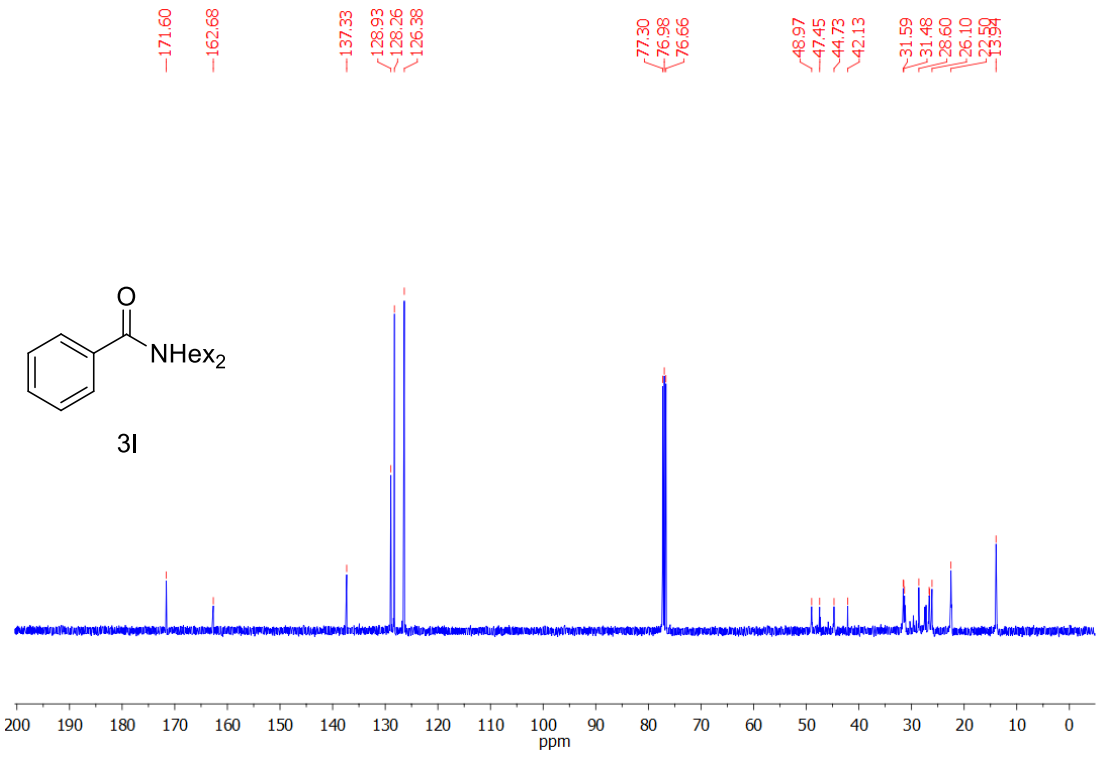
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dipropylbenzamide (3k)



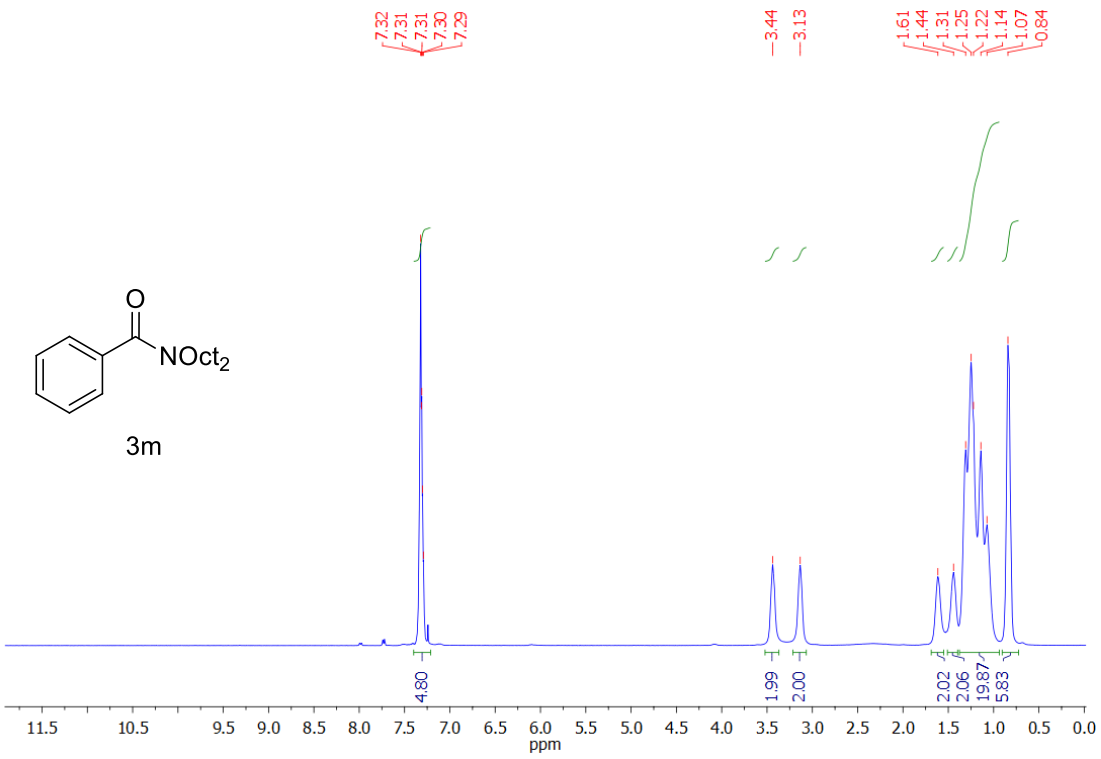
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dihexylbenzamide (3l)



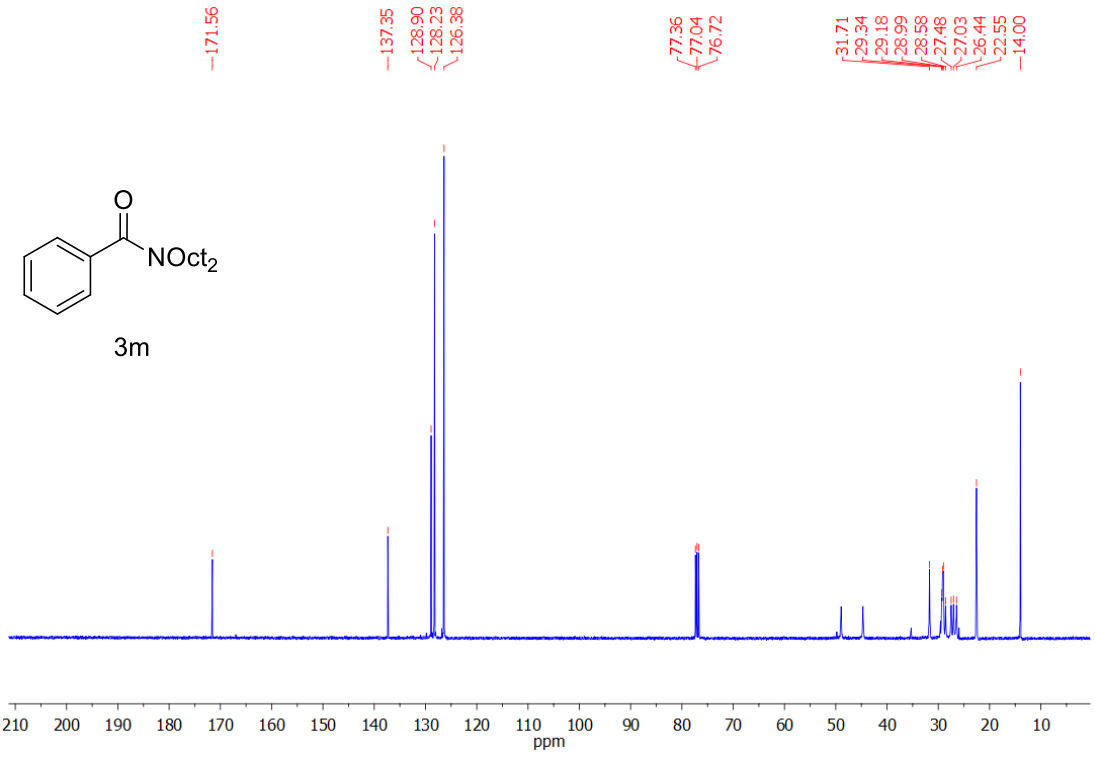
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dihexylbenzamide (3l)



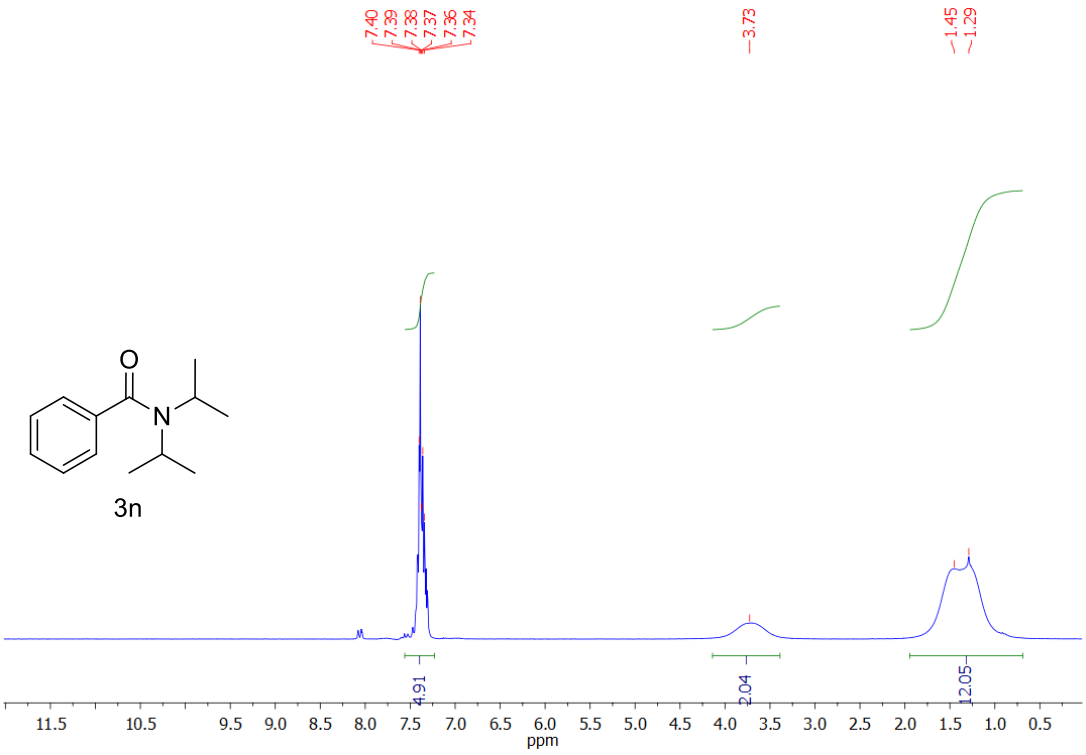
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-dioctylbenzamide (3m)



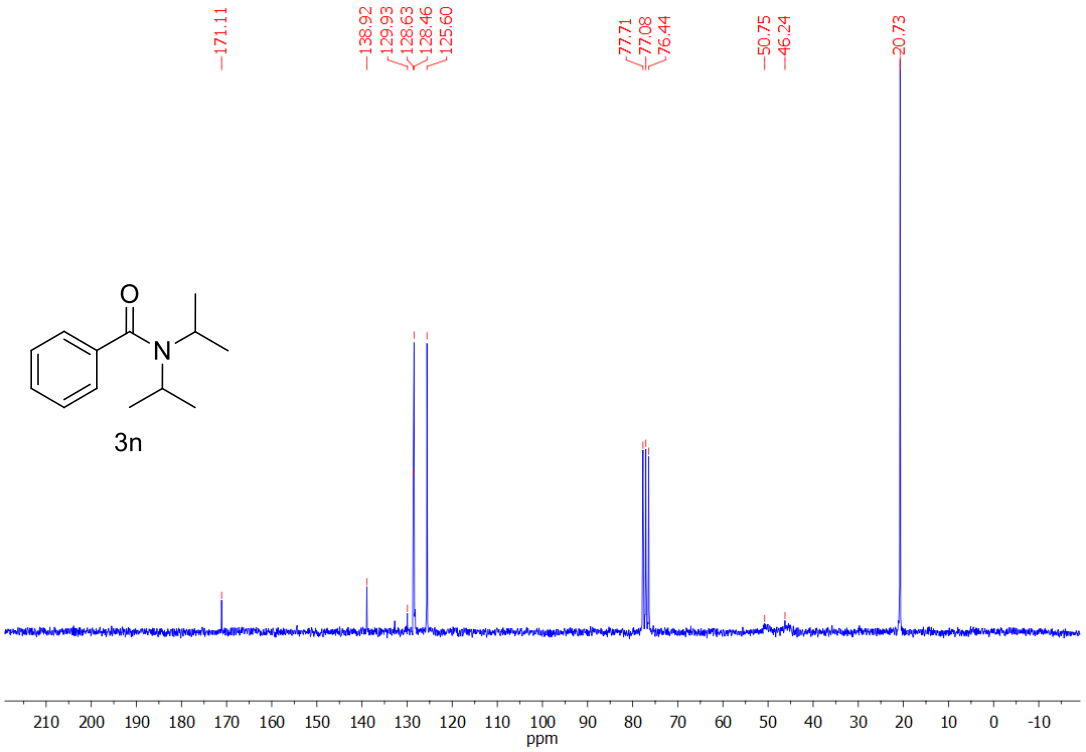
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-dioctylbenzamide (3m)



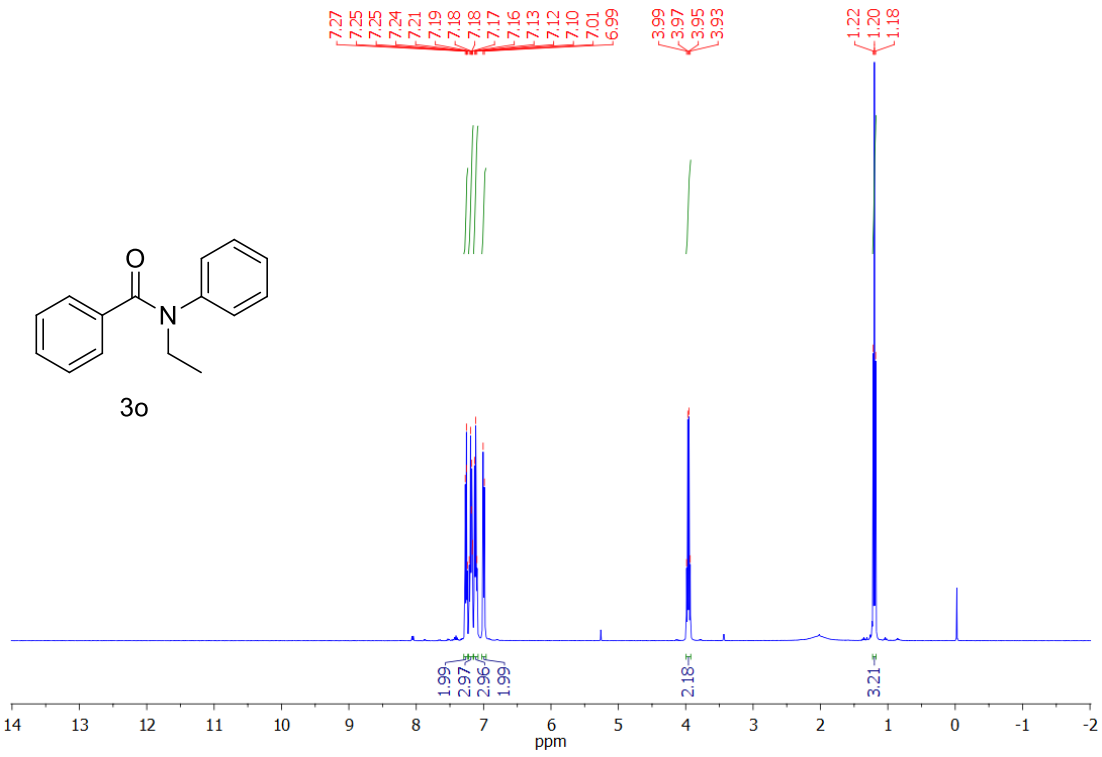
^{1}H NMR (400 MHz, $CDCl_3$) of *N,N*-diisopropylbenzamide (3n)



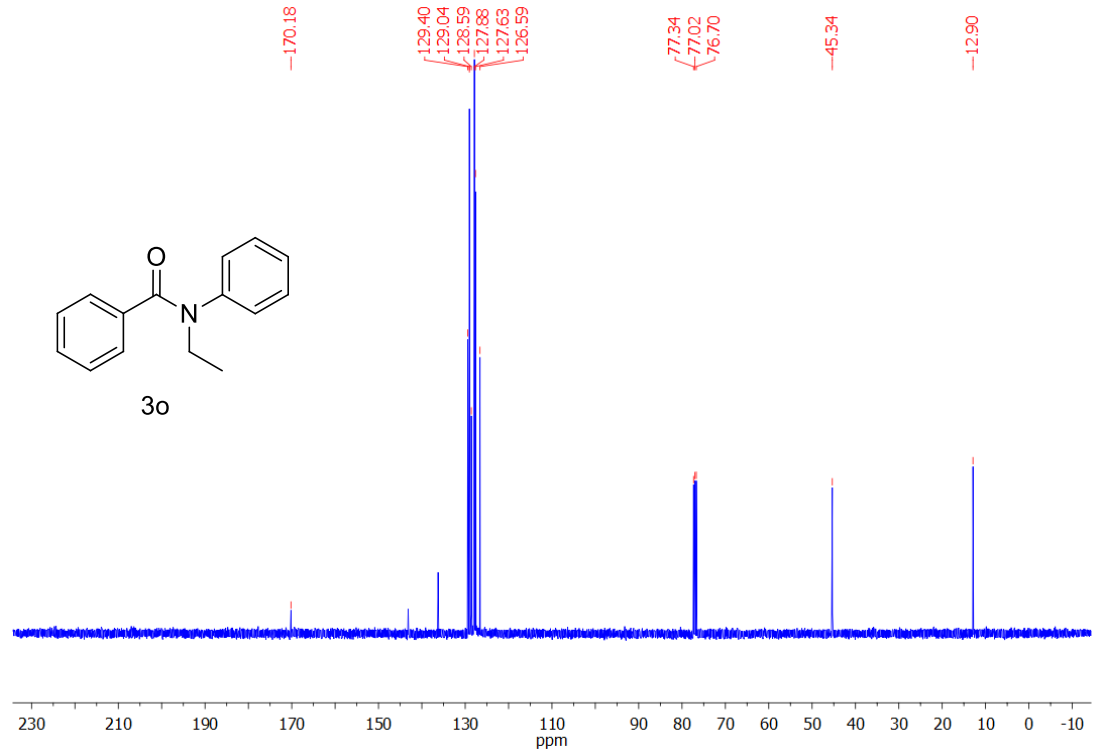
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of *N,N*-diisopropylbenzamide (3n)



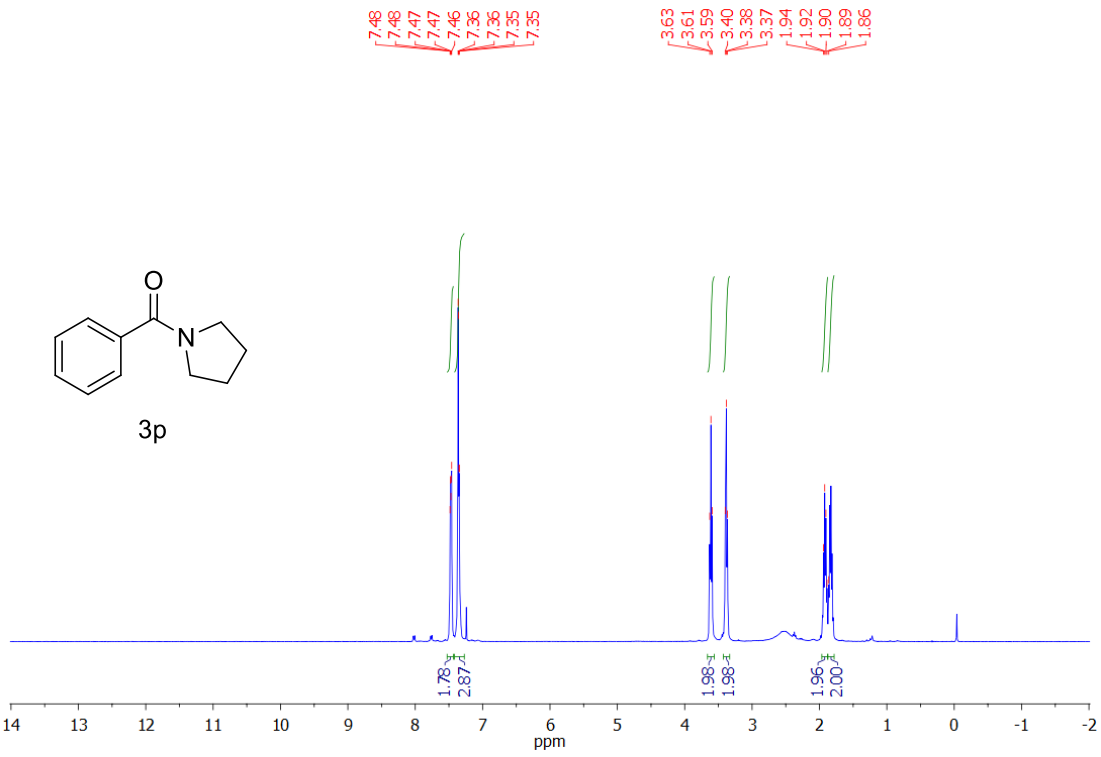
^{1}H NMR (400 MHz, $CDCl_3$) of N-ethyl-N-phenylbenzamide (3o)



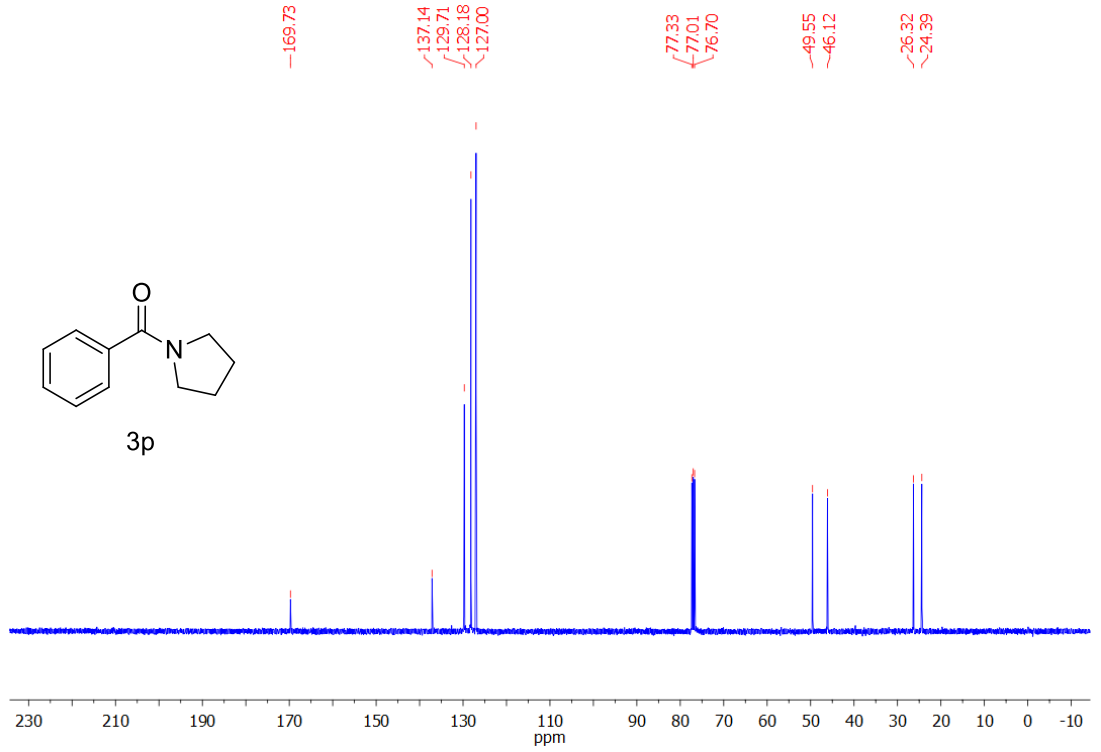
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of N-ethyl-N-phenylbenzamide (3o)



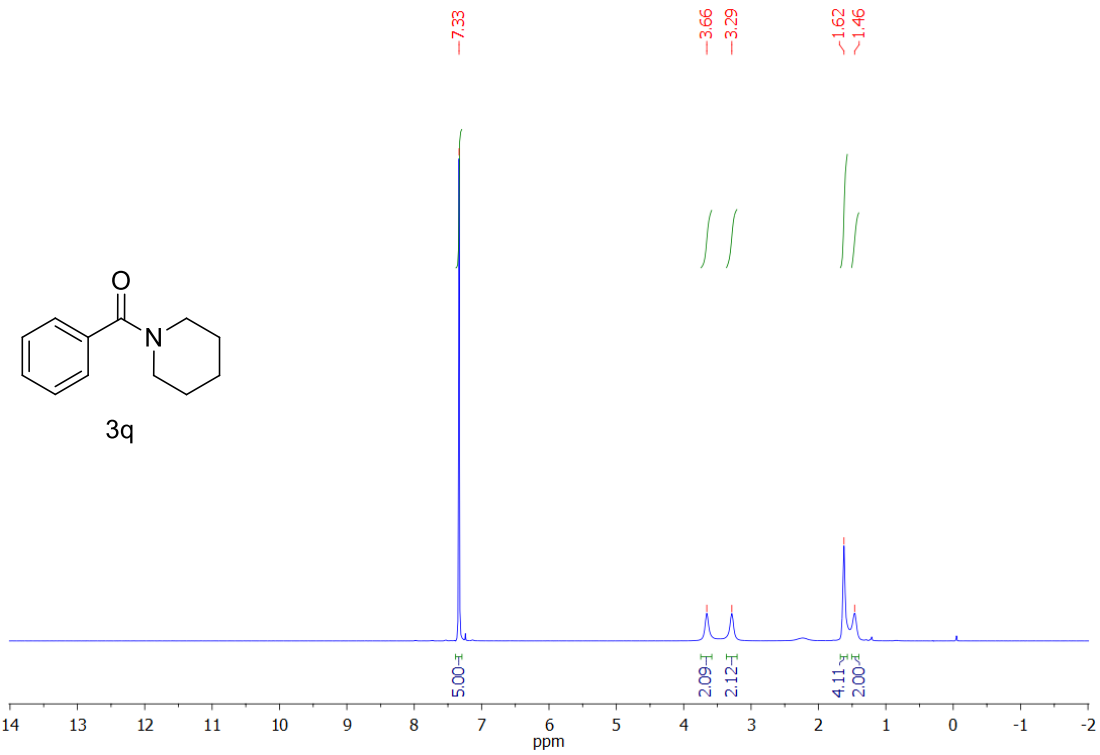
^{1}H NMR (400 MHz, $CDCl_3$) of Phenyl (pyrrolidin-1-yl) methanone (3p)



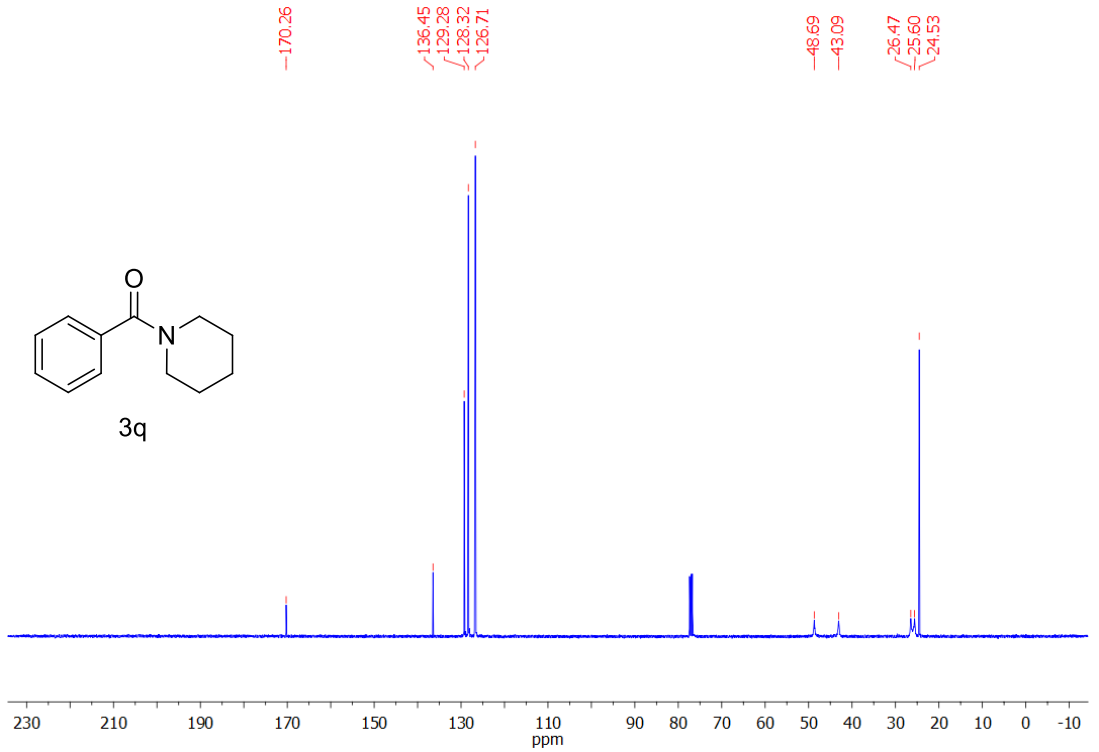
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Phenyl (pyrrolidin-1-yl) methanone (3p)



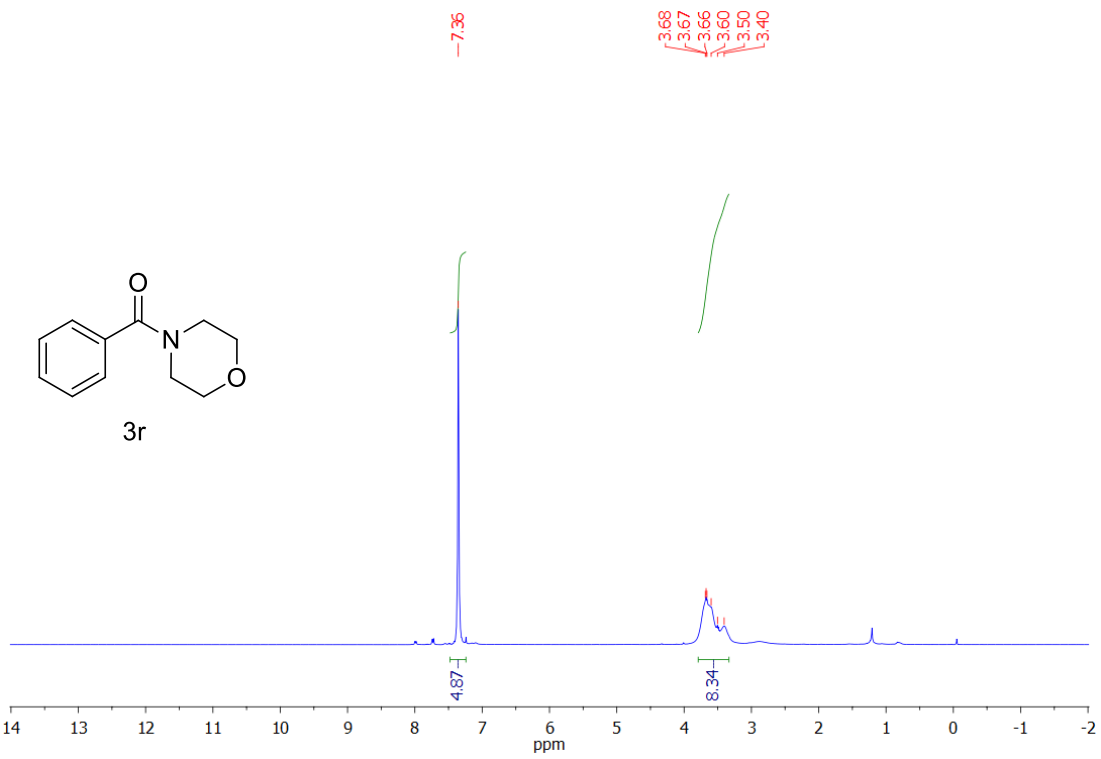
^{1}H NMR (400 MHz, $CDCl_3$) of Phenyl (piperidin-1-yl) methanone (3q)



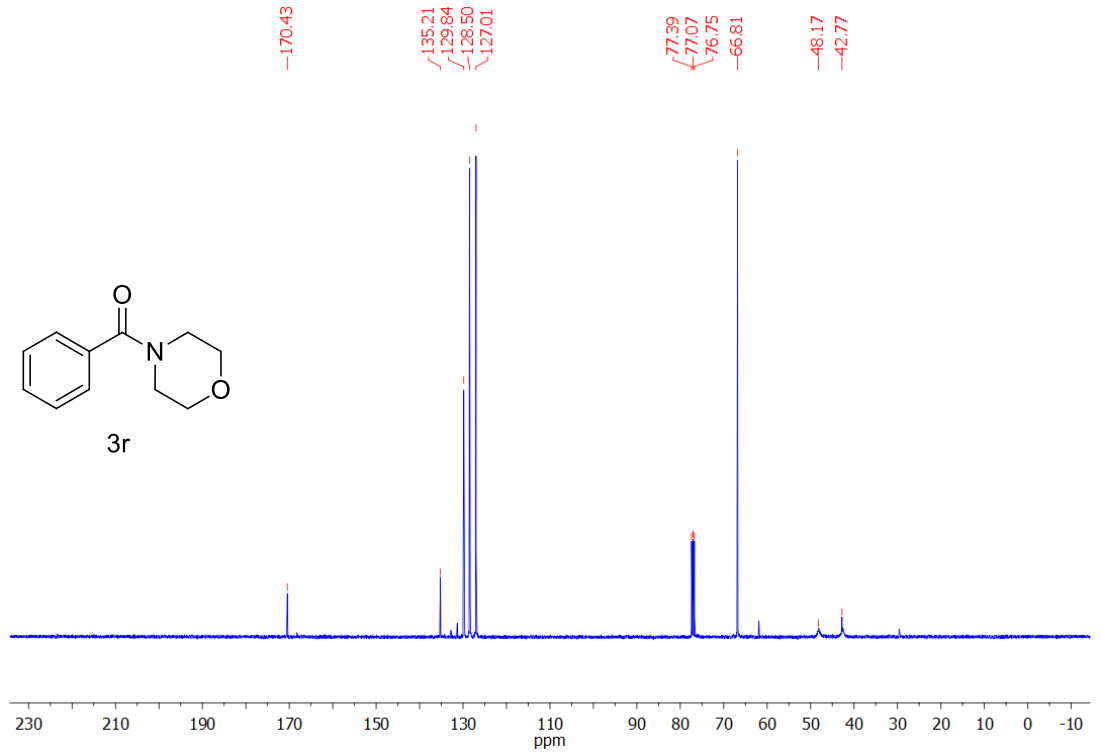
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Phenyl (piperidin-1-yl) methanone (3q)



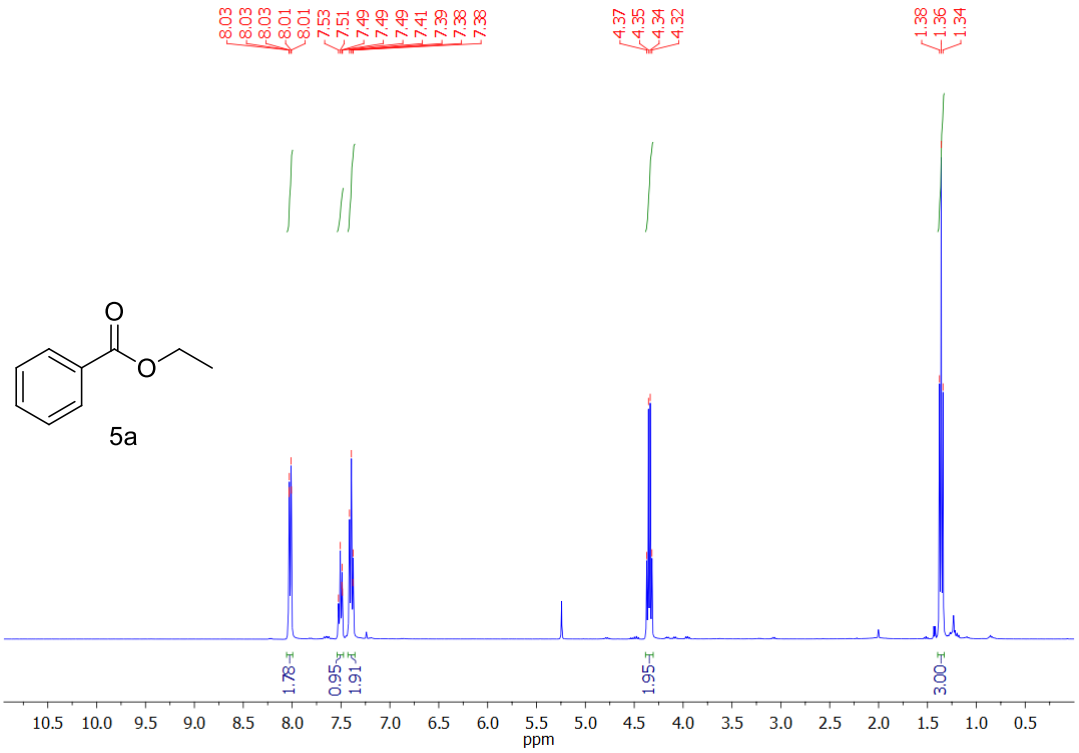
^{1}H NMR (400 MHz, $CDCl_3$) of Morpholino(phenyl)methanone (3r)



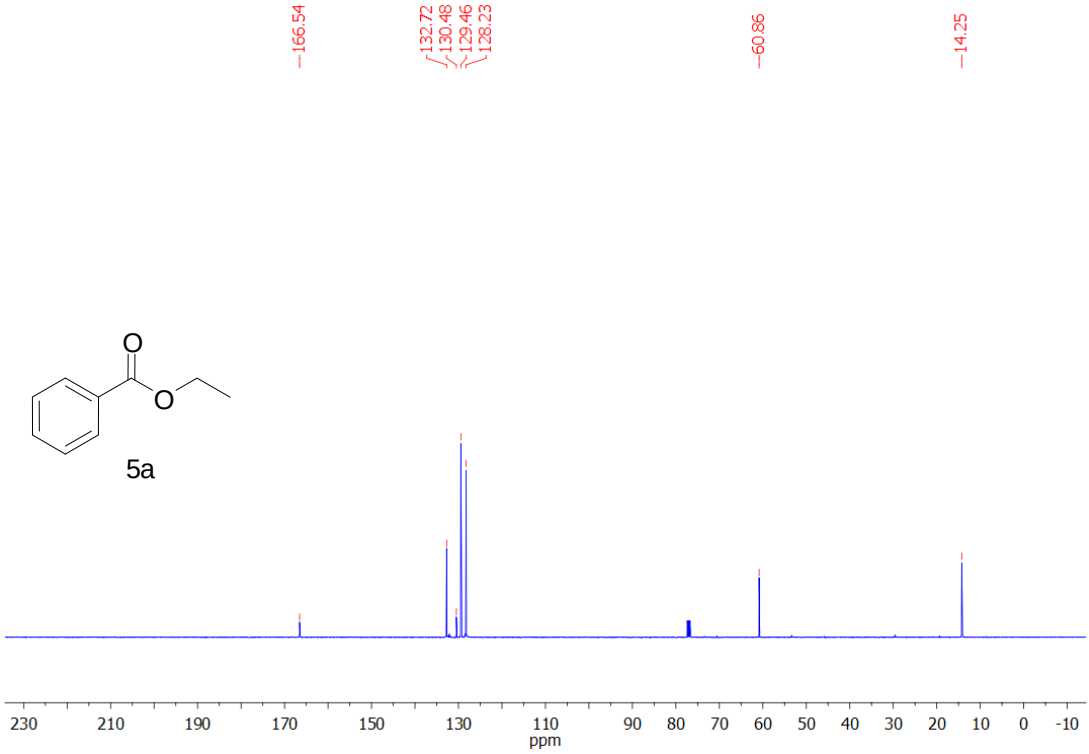
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Morpholino(phenyl)methanone (3r)



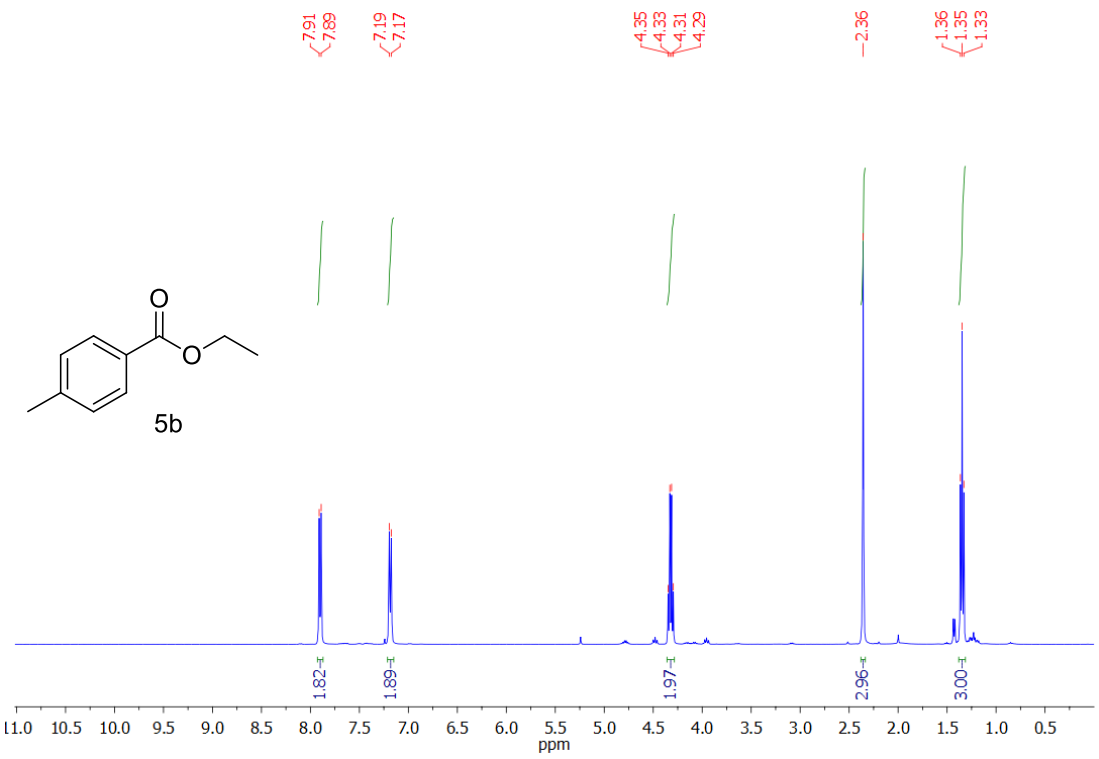
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl benzoate (5a)



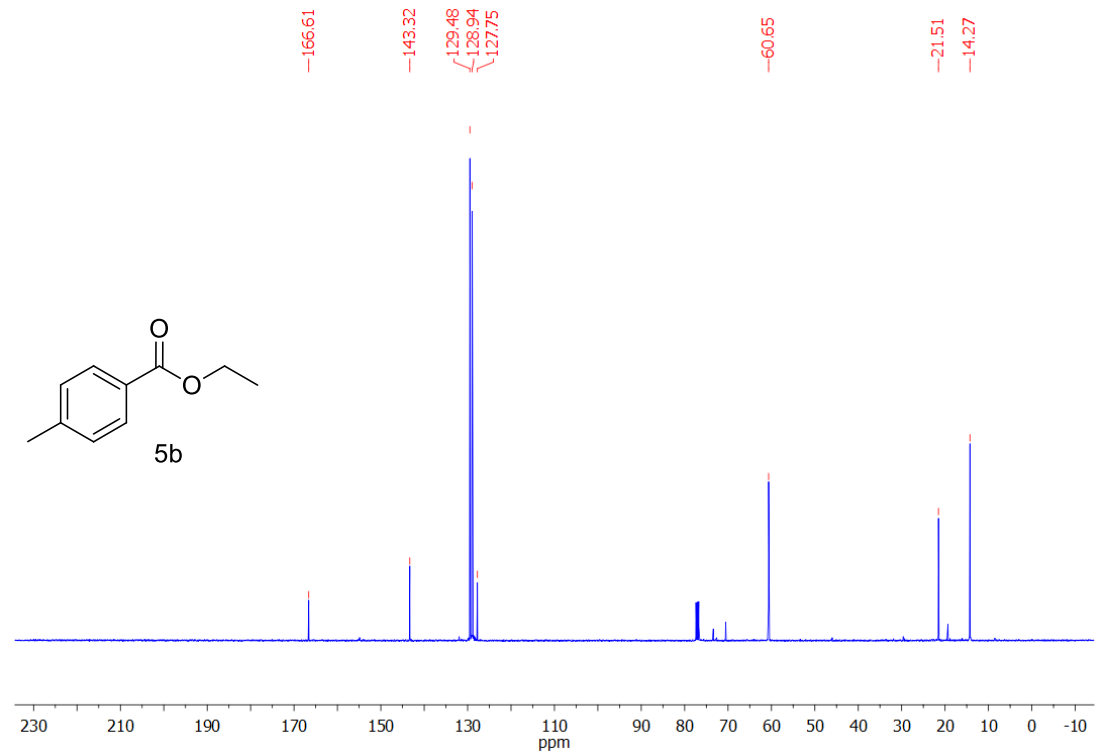
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl benzoate (5a)



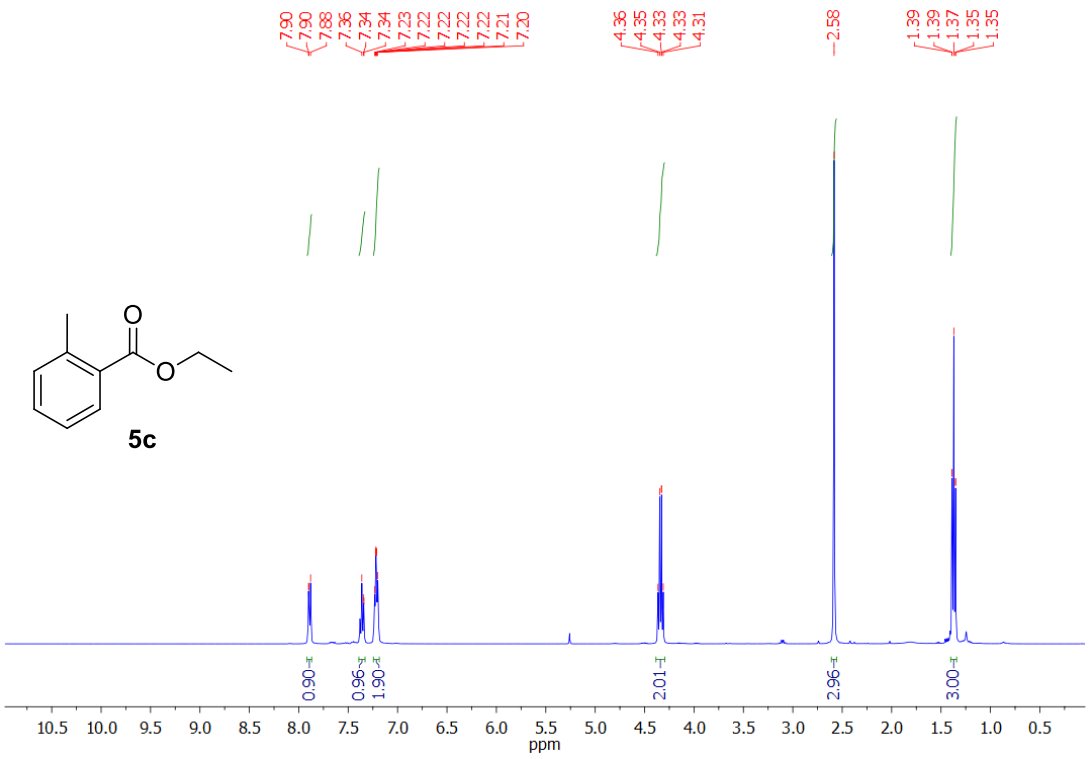
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl-4-Methyl benzoate (5b)



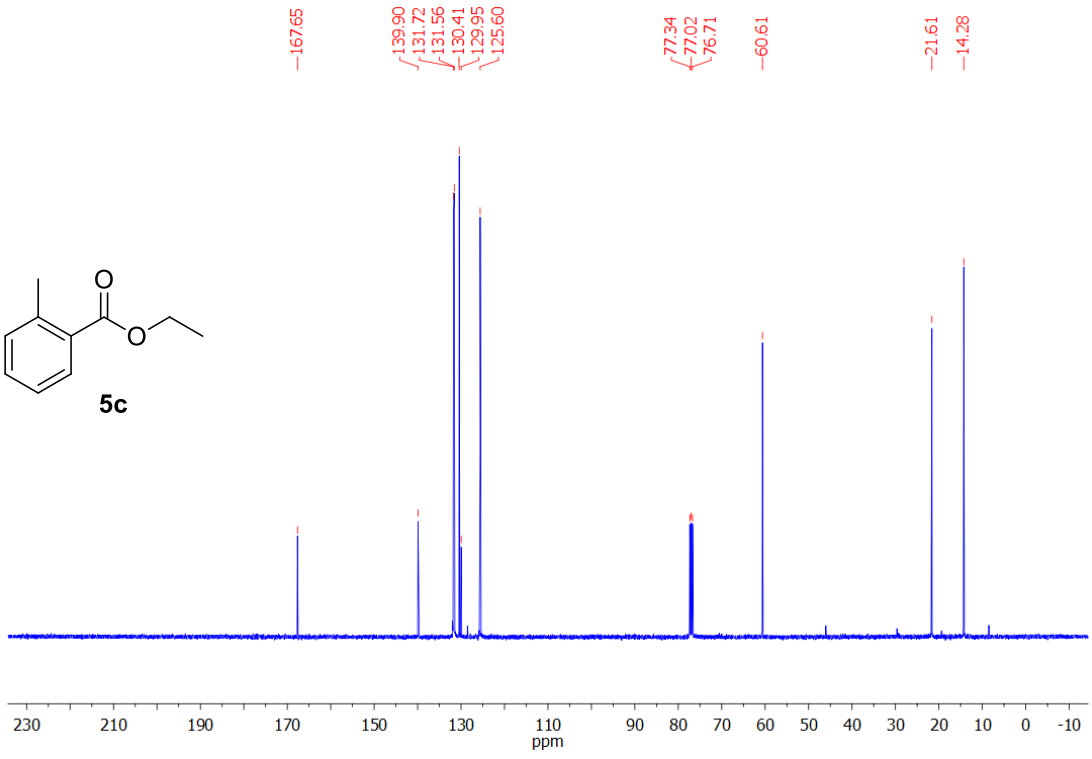
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl-4-Methyl benzoate (5b)



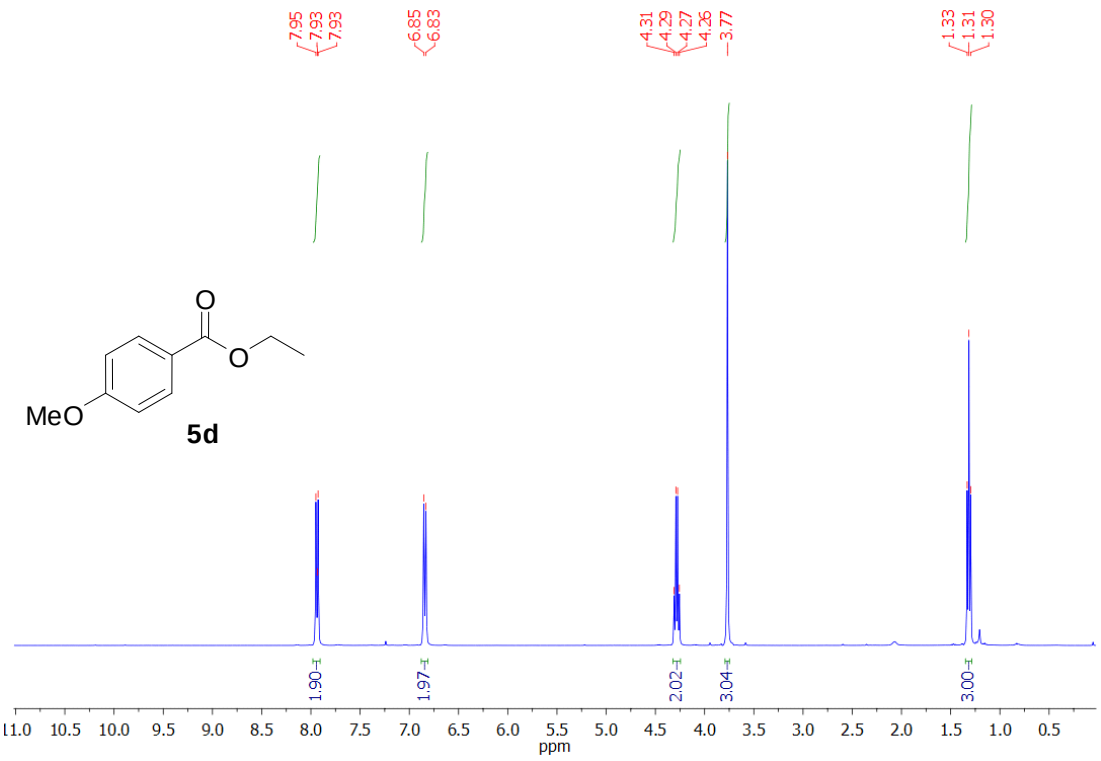
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl-2-Methyl benzoate (5c)



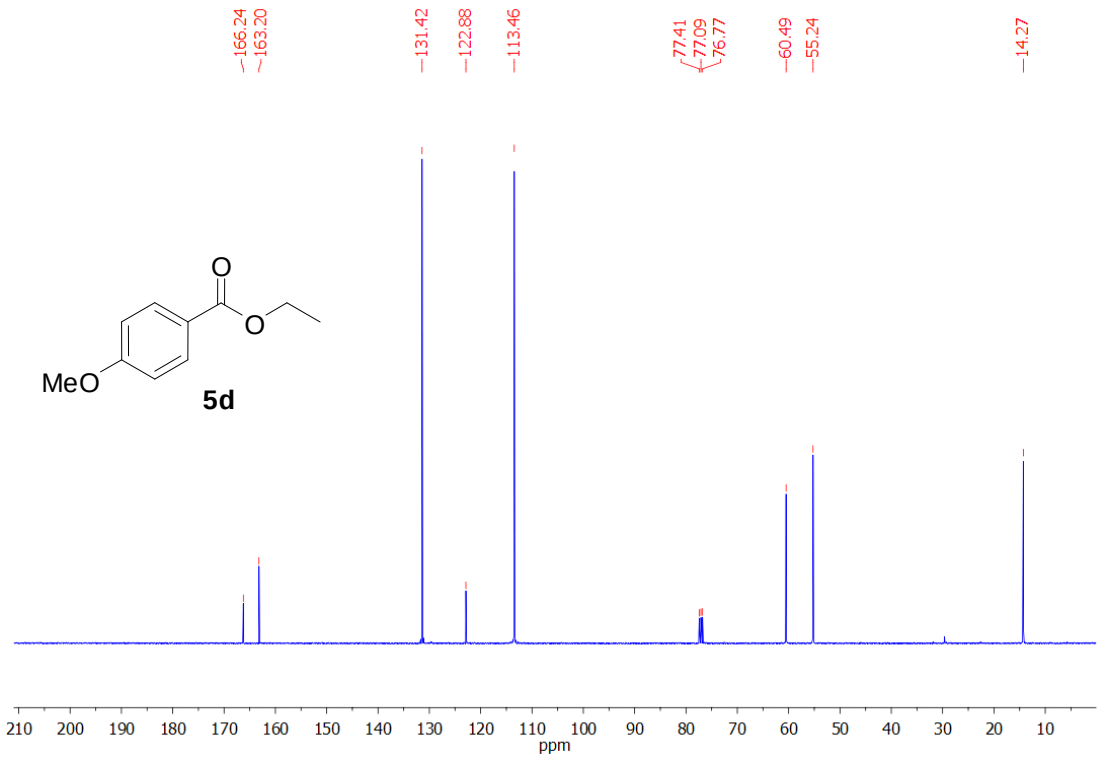
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl-2-Methyl benzoate (5c)



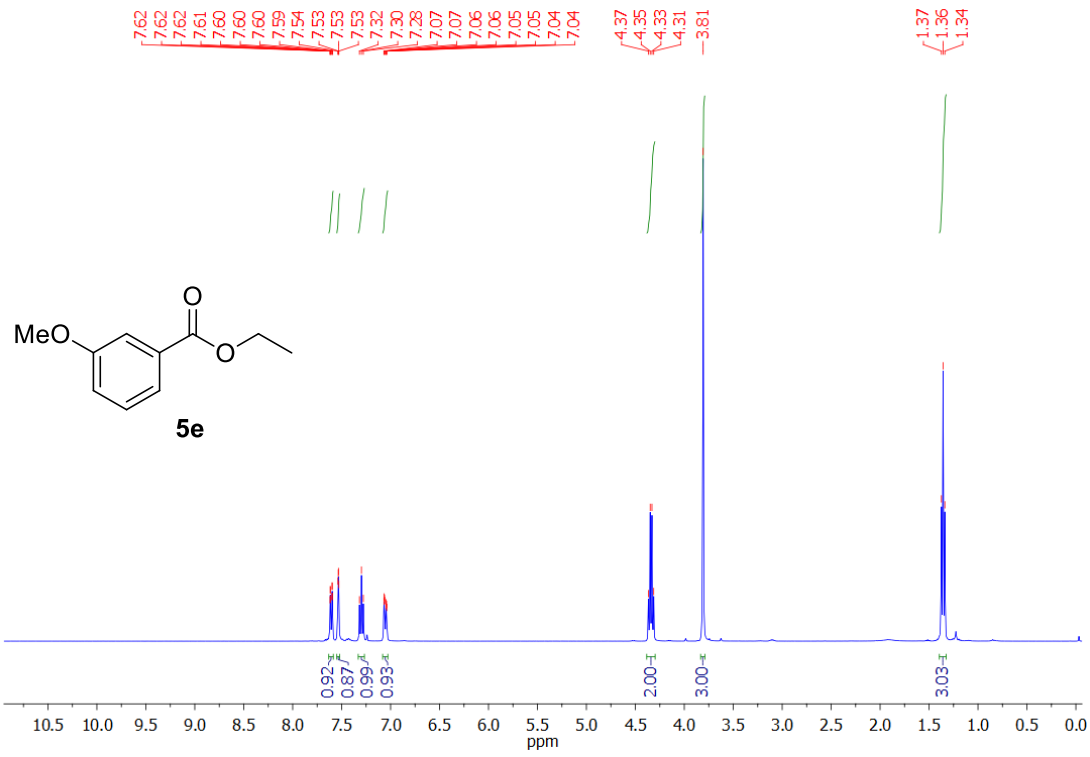
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl-4-Methoxy benzoate (5d)



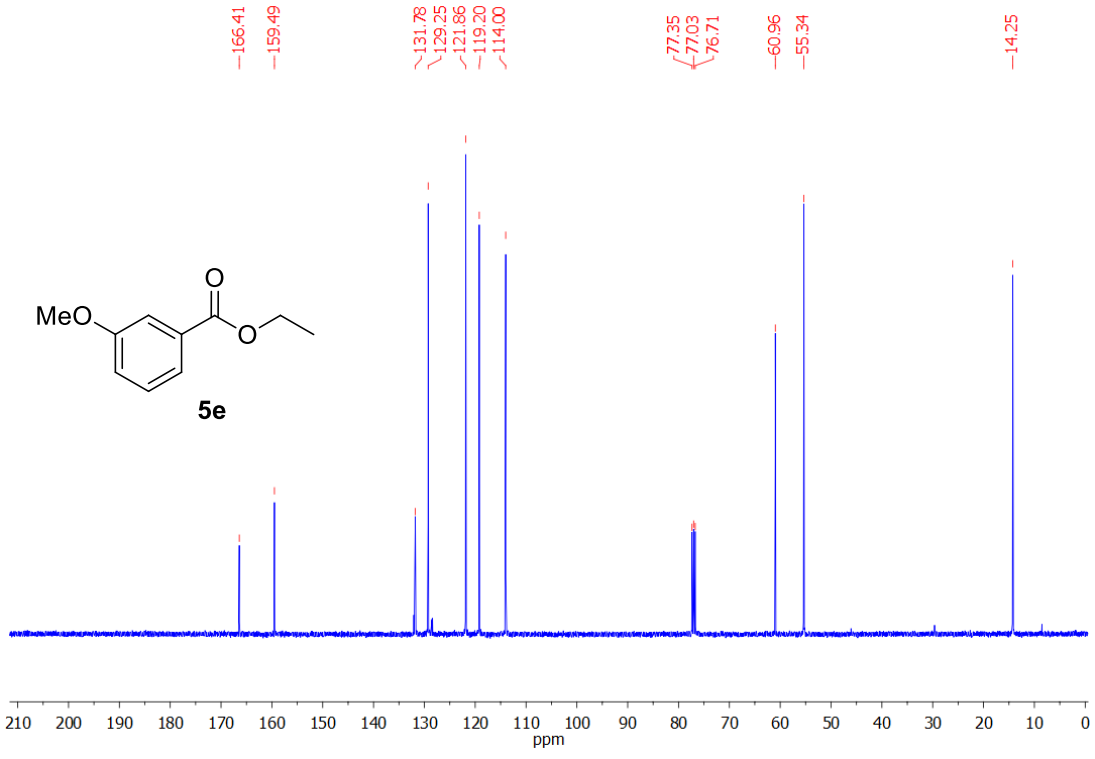
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl-4-Methoxy benzoate (5d)



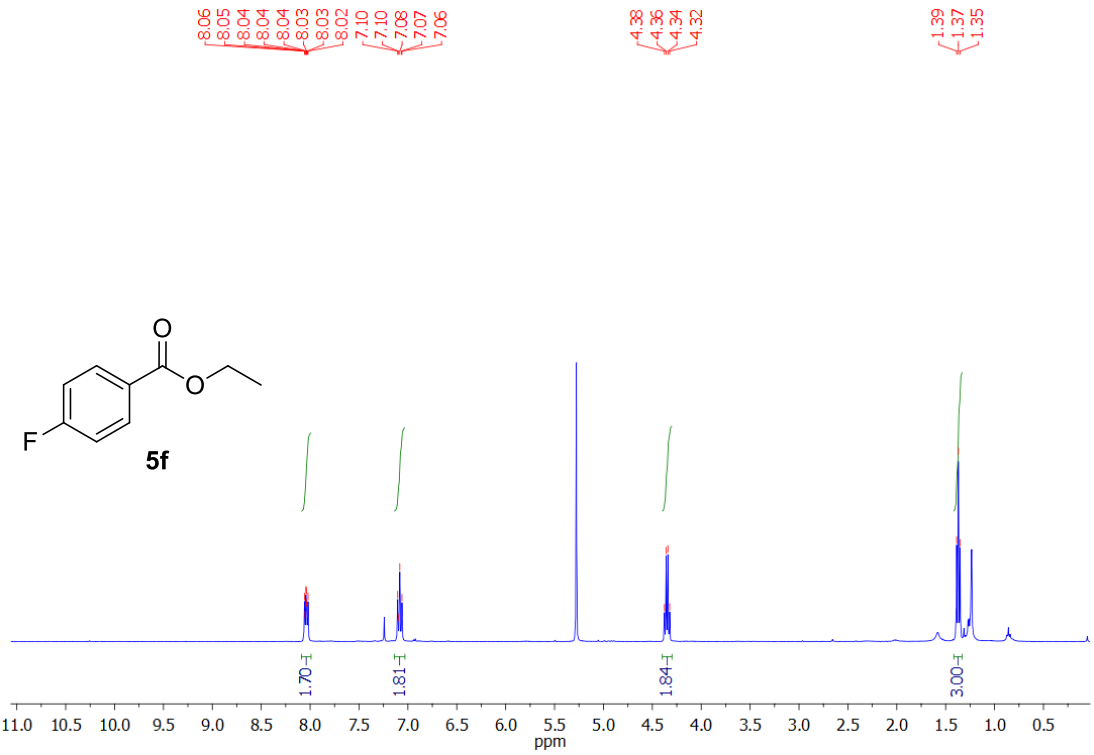
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl-3-Methoxy benzoate (5e)



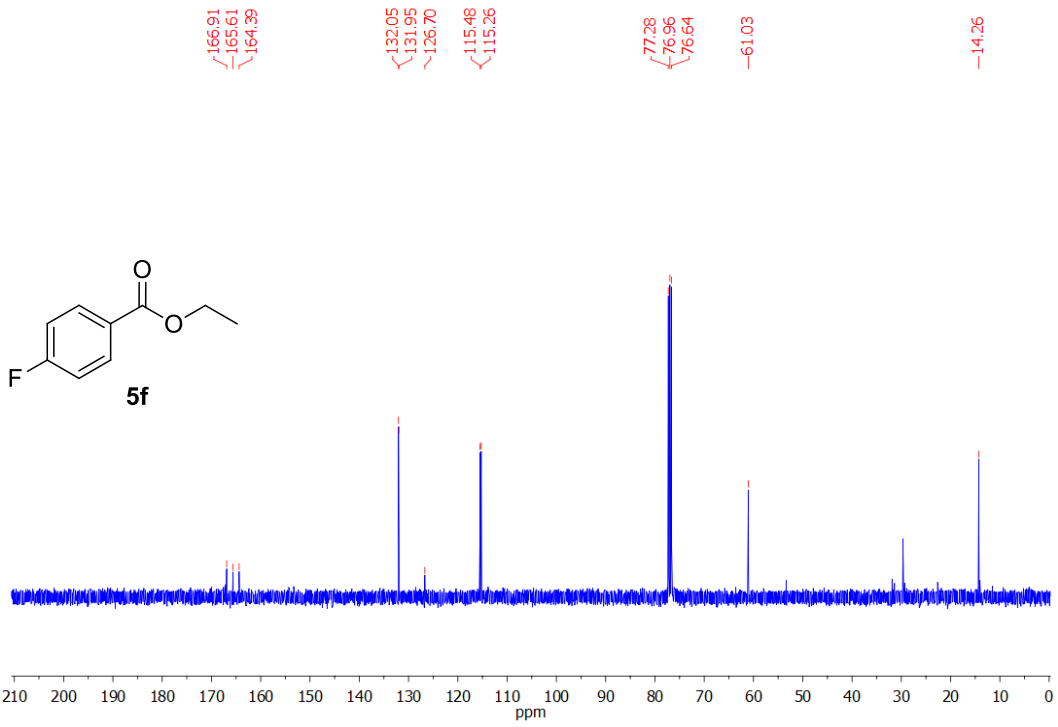
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl-3-Methoxy benzoate (5e)



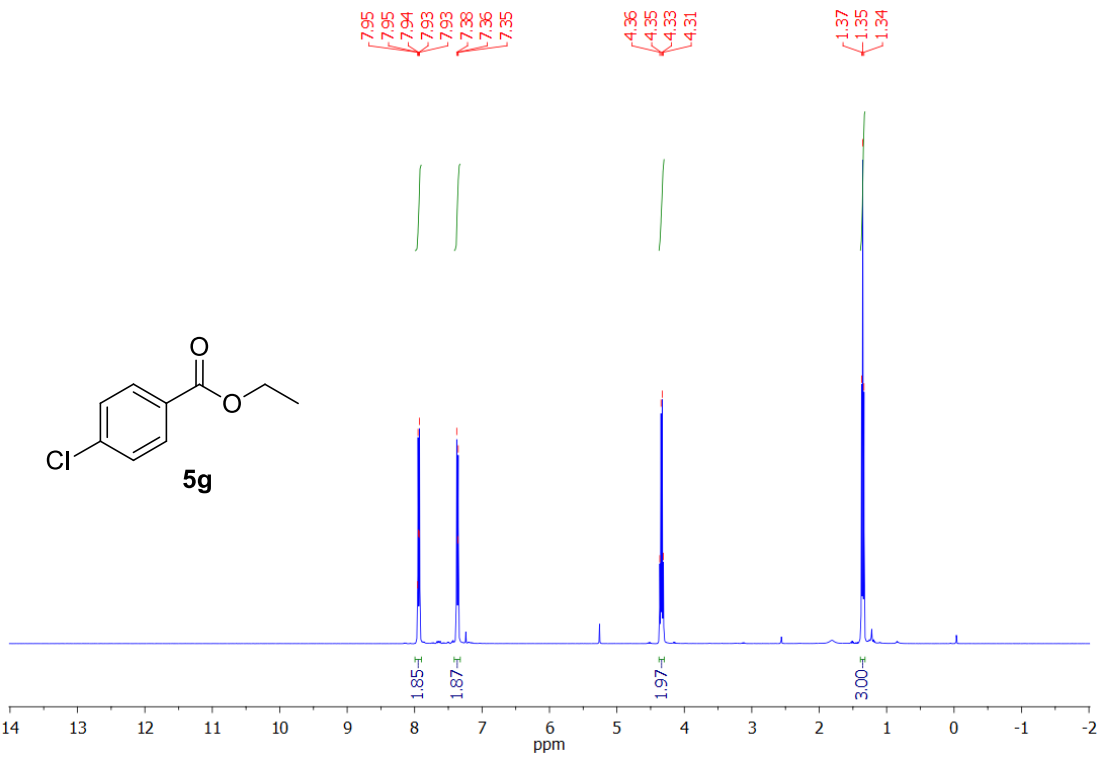
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl-4-Fluoro benzoate (5f)



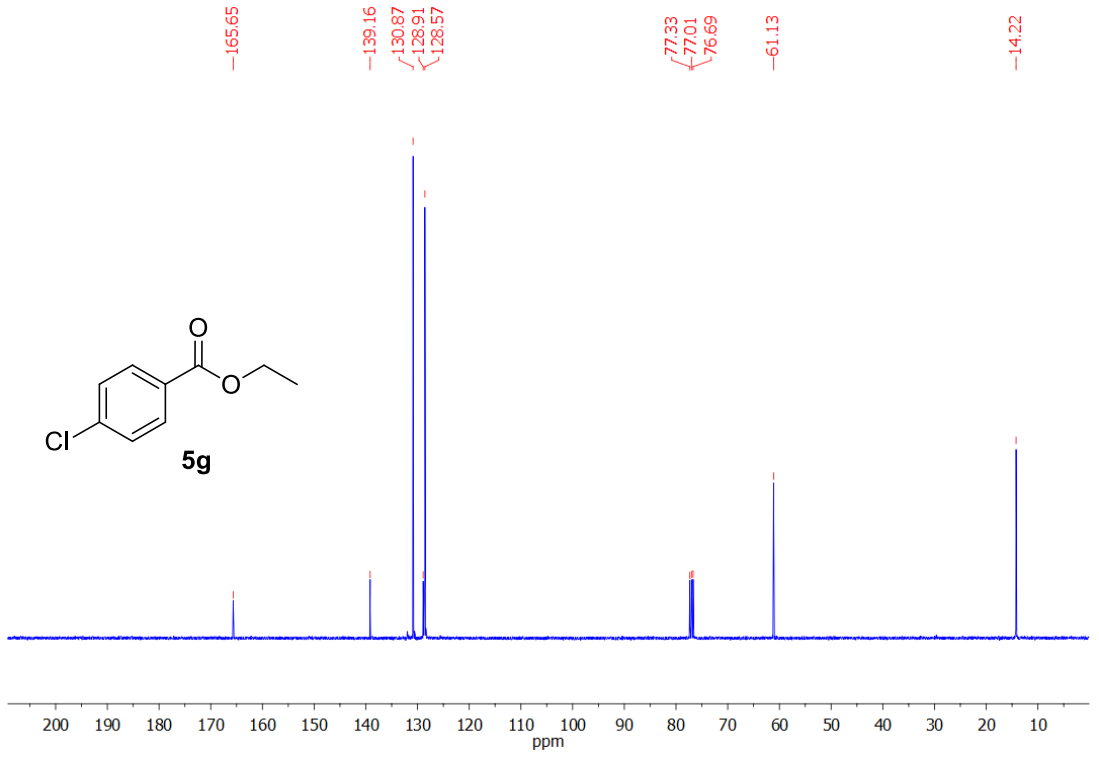
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl-4-Fluoro benzoate (5f)



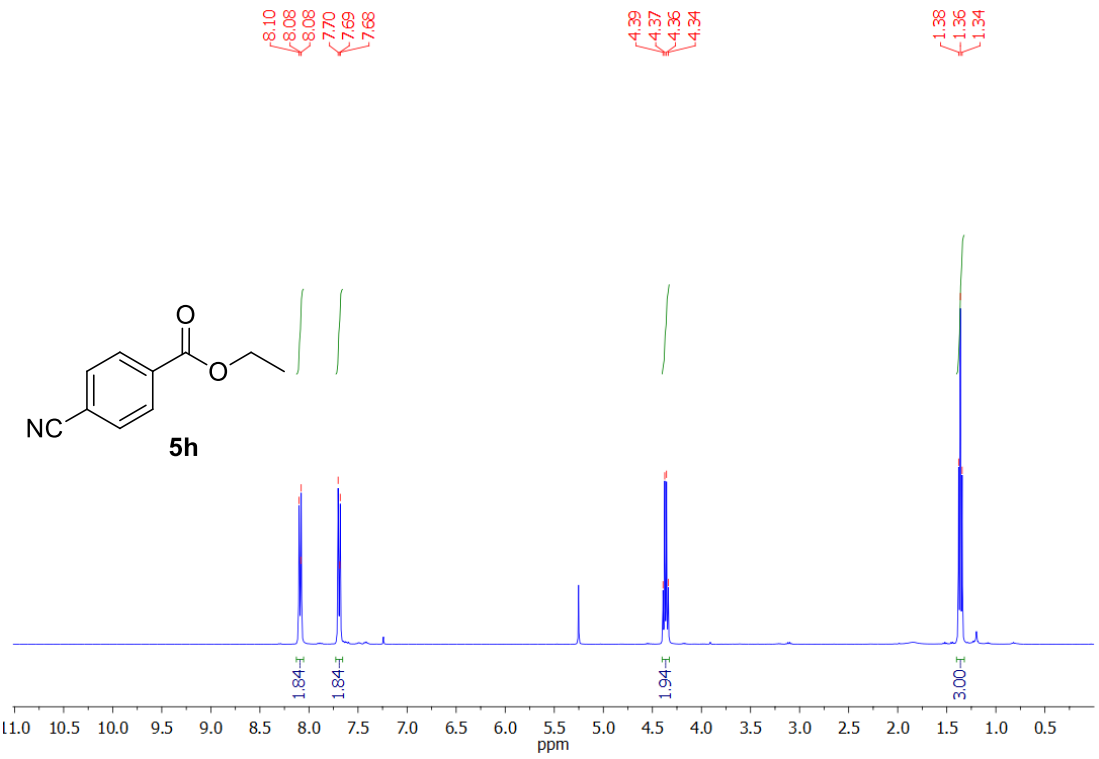
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl-4-Chloro benzoate (5g)



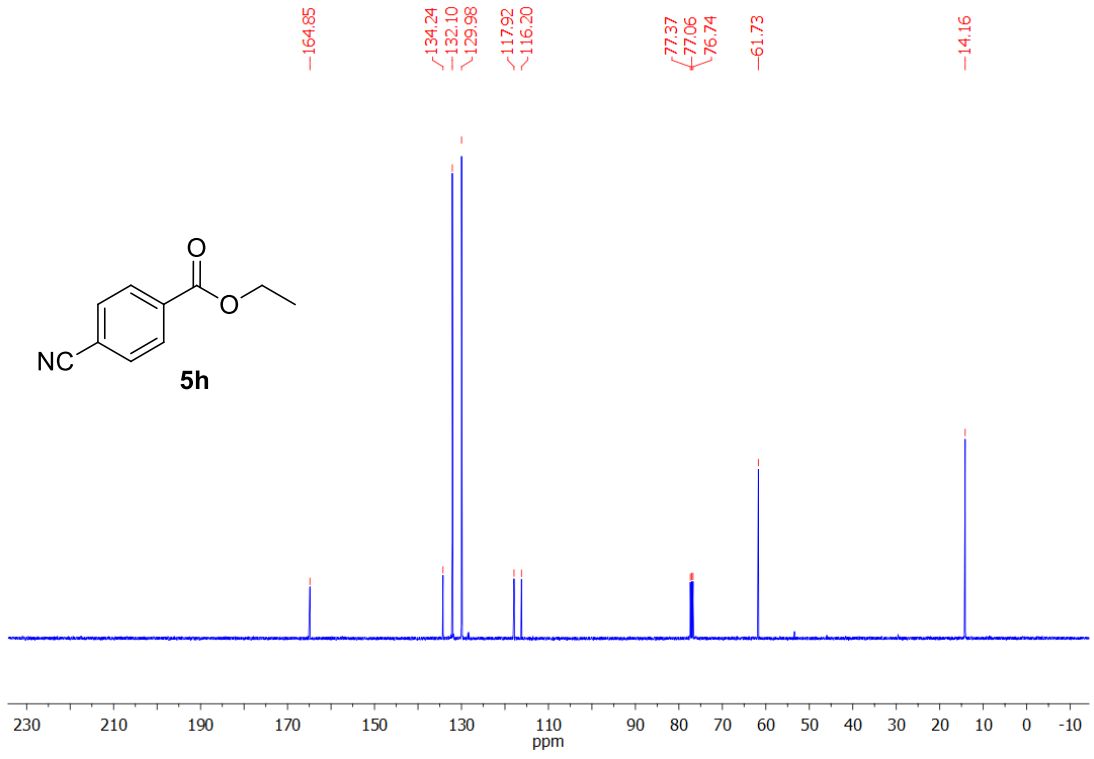
^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl-4-Chloro benzoate (5g)



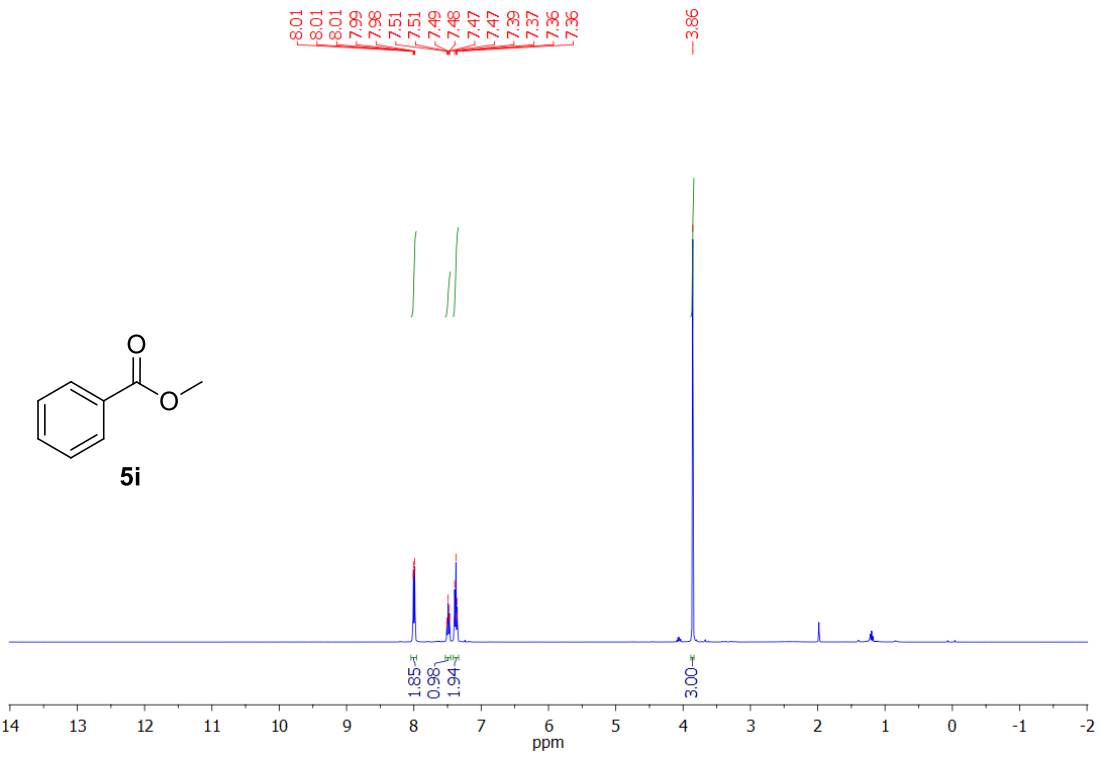
^{1}H NMR (400 MHz, $CDCl_3$) of Ethyl-4-Cyano benzoate (5h)



^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Ethyl-4-Cyano benzoate (5h)

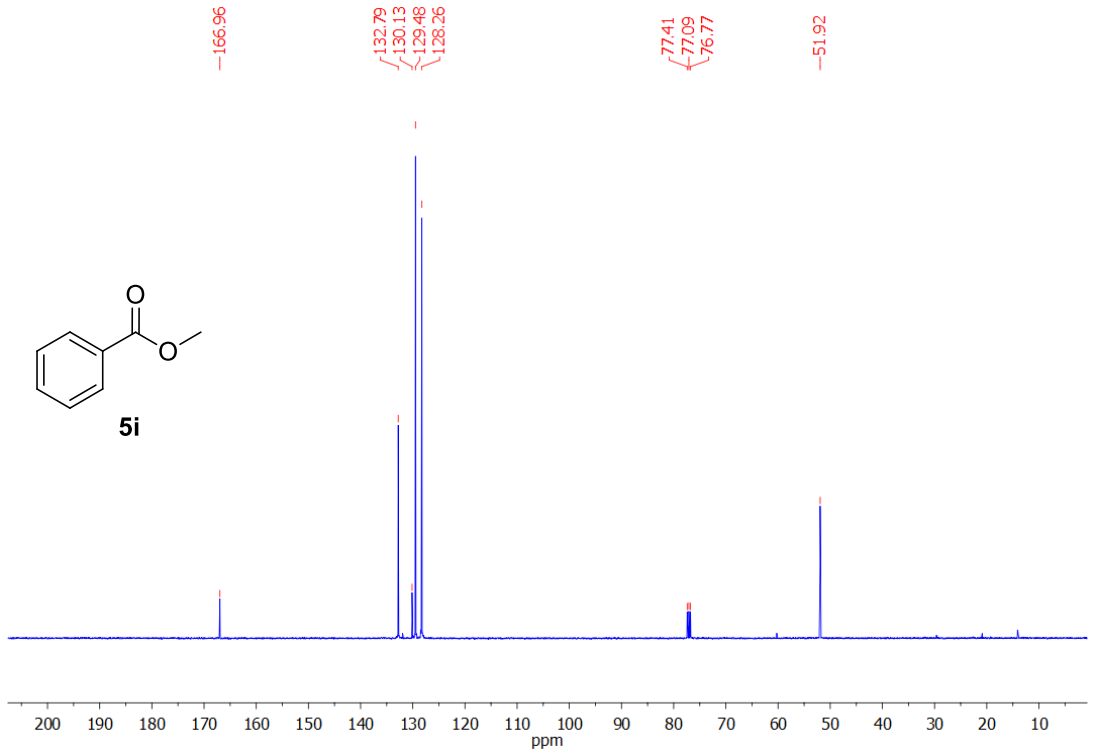


^{1}H NMR (400 MHz, $CDCl_3$) Methyl benzoate (5i)



5i

^{13}C {1H} NMR (101 MHz, $CDCl_3$) of Methyl benzoate (5i)



5i

4. Reference:

i) a) S. M. Islam, K. Ghosh, A. S. Roy and R. A. Molla, *RSC Adv.*, 2014, **4**, 38986–38999. b) P. Baburajan, R. Senthilkumaran and K. P. Elango, *New J. Chem.*, 2013, **37**, 3050.

ii) U. Pathak, S. Bhattacharyya, L. kumar Pandey, S. Mathur and R. Jain, *RSC Adv.*, 2014, **4**, 3900–3903.