Substitution Controlled Functionalization of *ortho*-Bromobenzylic Alcohols via Palladium Catalysis: Synthesis of Chromenes and Indenols

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Supporting Information

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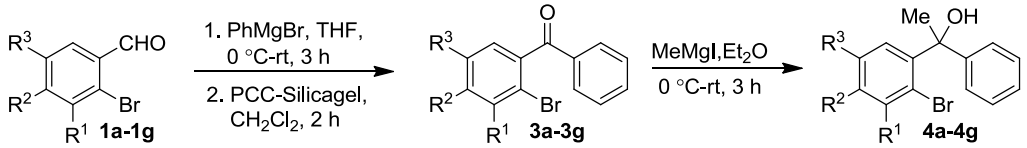
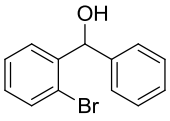
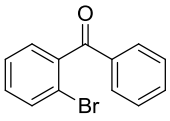
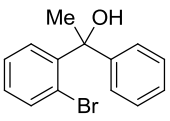
The requisite precursors have been achieved as described below (Tables):

Table: 1

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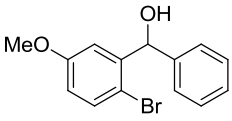	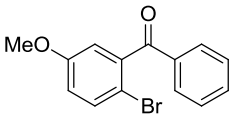	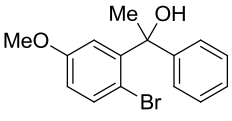
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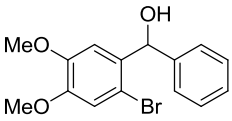	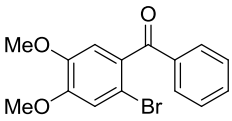	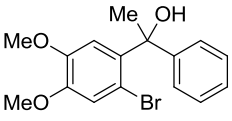
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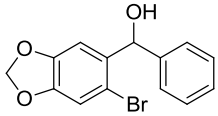	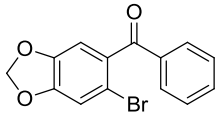	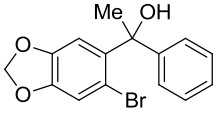
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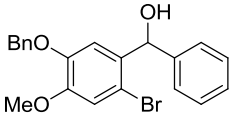	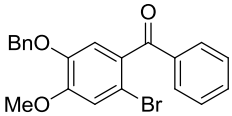	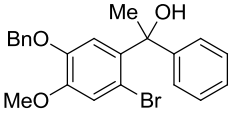
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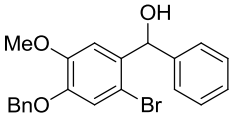	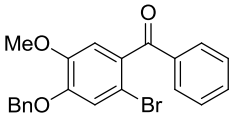	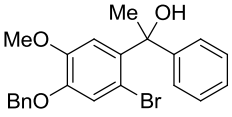
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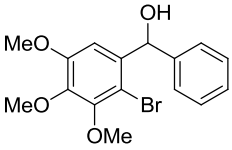
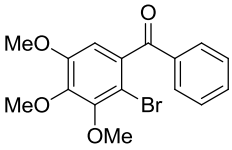
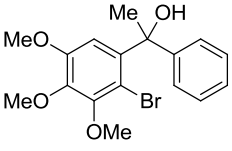
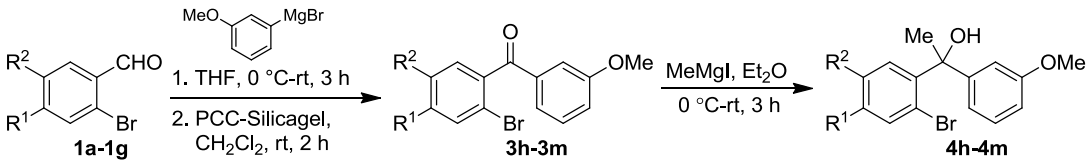
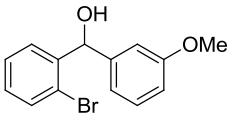
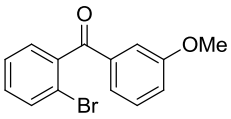
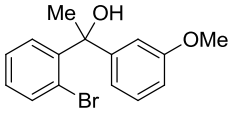
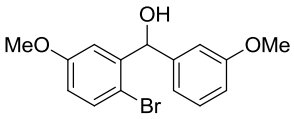
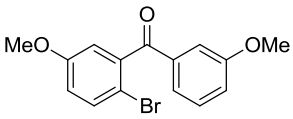
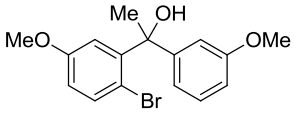
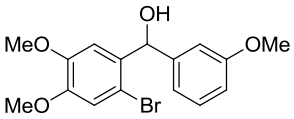
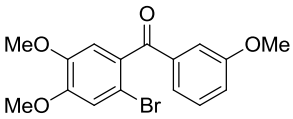
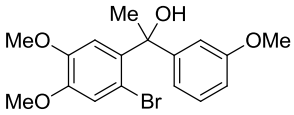
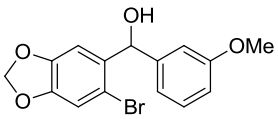
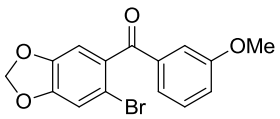
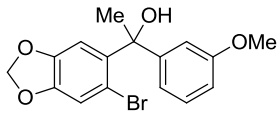
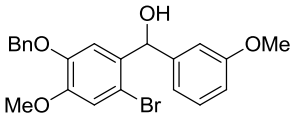
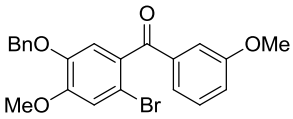
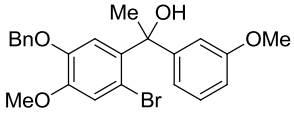
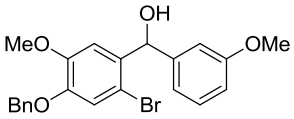
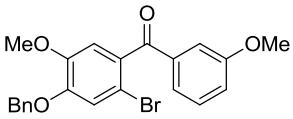
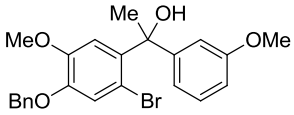
		
2g (98%)	**3g** (94%)	**4g** (92%)

Table: 2



 **2h** (84%)	 **3h** (89%)	 **4h** (91%)
 **2i** (86%)	 **3i** (92%)	 **4i** (90%)
 **2j** (81%)	 **3j** (97%)	 **4j** (98%)
 **2k** (85%)	 **3k** (93%)	 **4k** (97%)
 **2l** (96%)	 **3l** (96%)	 **4l** (97%)
 **2m** (97%)	 **3m** (94%)	 **4m** (98%)

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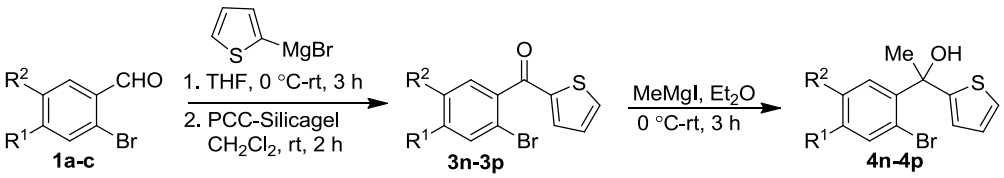
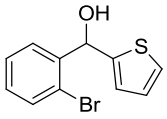
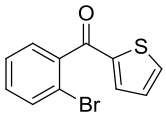
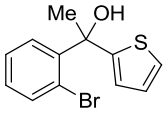
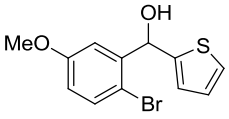
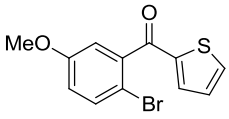
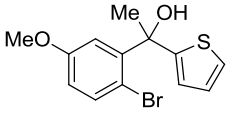
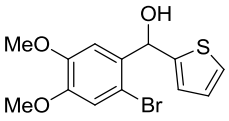
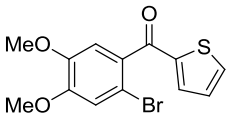
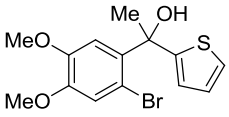


 **2n** (82%)	 **3n** (98%)	 **4n** (97%)
 **2o** (93%)	 **3o** (97%)	 **4o** (93%)
 **2p** (90%)	 **3p** (95%)	 **4p** (95%)

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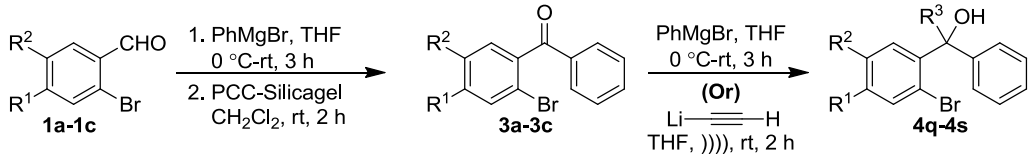


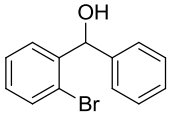
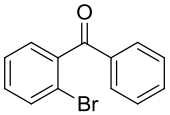
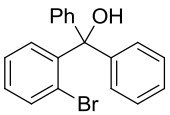
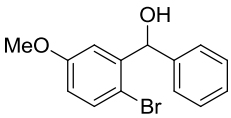
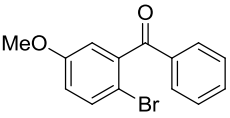
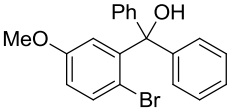
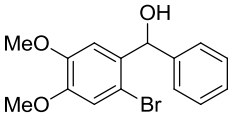
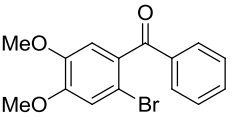
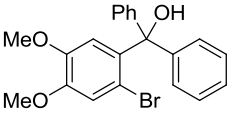
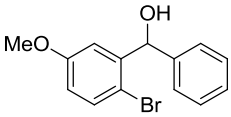
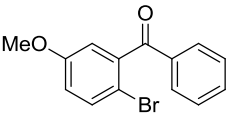
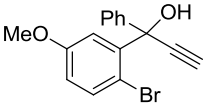
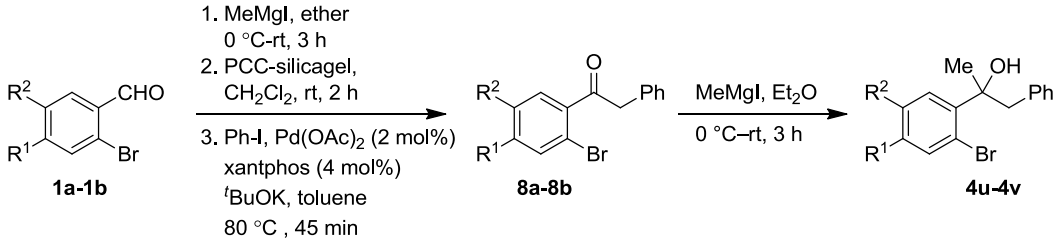
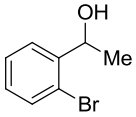
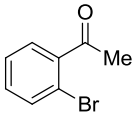
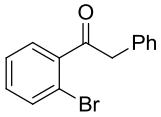
 **2a** (84%)	 **3a** (89%)	 **4q** (91%)
 **2b (**86%)	 **3b** (92%)	 **4r** (90%)
 **2c (**81%)	 **3c** (97%)	 **4s** (98%)
 **2b** (95%)	 **3b** (96%)	 **4t** (63%)

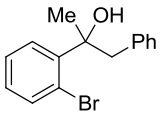
Table: 5

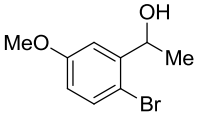


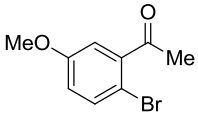

2q (91%)

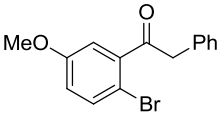

3q (97%)


8a (91%)


4u (91%)


2r (92%)


3r (92%)


8b (90%)

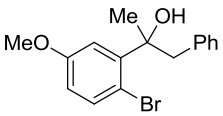
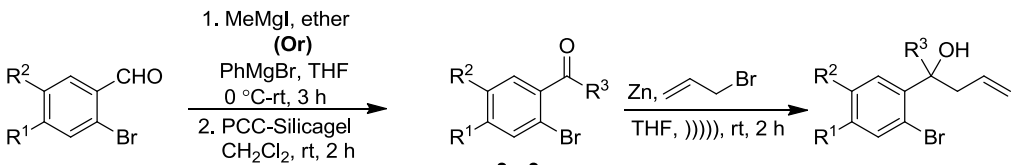

4v (90%)

Table: 6



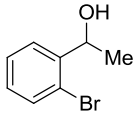
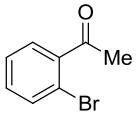
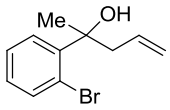
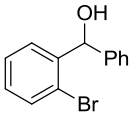
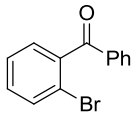
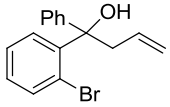
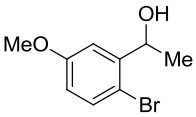
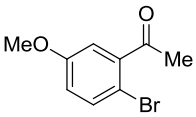
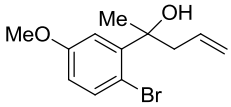
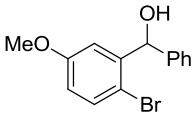
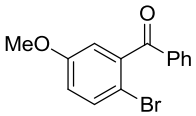
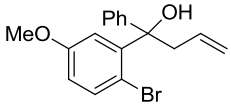
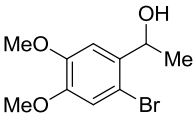
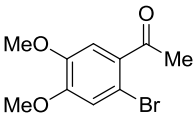
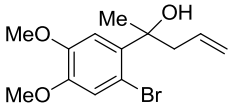
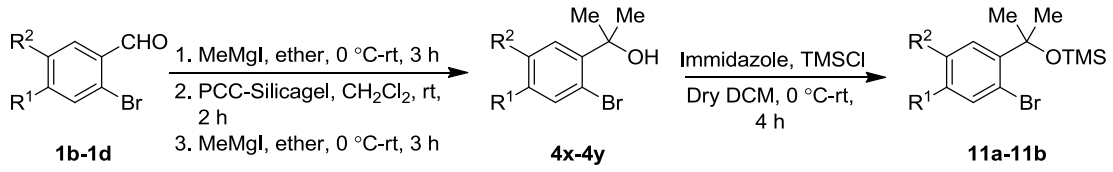
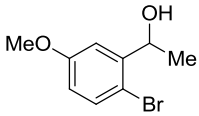
1a-1b	3q-3s 3a-3b	4aa-4ae
 **2q** (91%)	 **3q** (97%)	 **4aa** (95%)
 **2a** (90%)	 **3a** (94%)	 **4ab** (93%)
 **2r** (92%)	 **3r** (92%)	 **4ac** (94%)
 **2b** (95%)	 **3b** (96%)	 **4ad** (91%)
 **2s** (90%)	 **3s** (96%)	 **4ae** (93%)

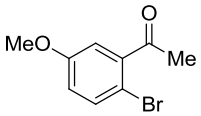
Table: 7



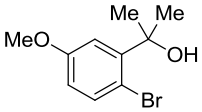
1b-1d **4x-4y** **11a-11b**



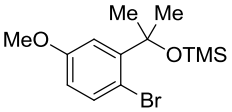
2r (92%)



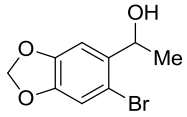
3r (92%)



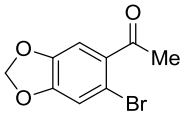
4x (91%)



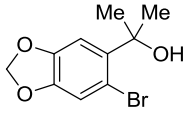
11a (74%)



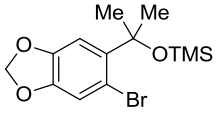
2t (93%)



3t (96%)

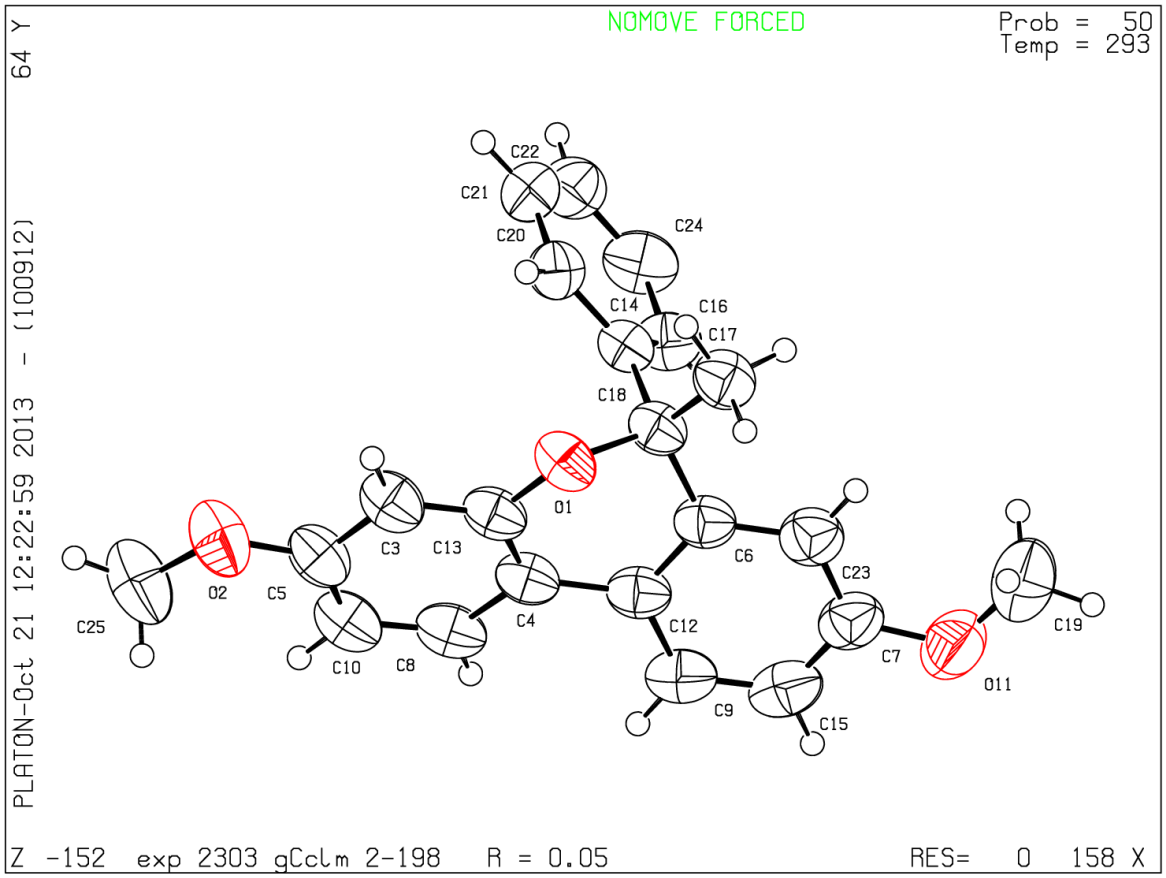


4y (90%)



11b (76%)

X-ray crystal structure data for the cyclic biaryl ether (5b): CCDC 965704



Operator	K. Ravikumar
Diffractometer	Oxford Super Nova
CCDC	965704
Empirical formula	$C_{22}H_{20}O_3$
Formula weight	332.38
Temperature/K	293
Crystal system	monoclinic
Space group	*Cc*
a/Å	17.4301(8)
b/Å	16.1897(6)
c/Å	6.7149(3)
α/°	90.00
β/°	112.144(5)
γ/°	90.00
Volume/Å^3	1755.10(12)

Z	4
ρ_{calc}mg/mm^3	1.212
m/mm^{-1}	0.641
F(000)	680.0
Crystal size/mm^3	0.19 × 0.17 × 0.14
2Θ range for data collection	7.74 to 142.28°
Index ranges	$-19 \le h \le 20$, $-17 \le k \le 15$, $-7 \le l \le 8$
Reflections collected	4142
Independent reflections	2352[R(int) = 0.0195]
Data/restraints/parameters	2352/2/229
Goodness-of-fit on F^2	0.953
Final R indexes [I>=2σ (I)]	R_1 = 0.0470, wR_2 = 0.1194
Final R indexes [all data]	R_1 = 0.0521, wR_2 = 0.1347
Largest diff. peak/hole / e Å^{-3}	0.11/-0.19

1. Check CIF/ Platon report (full structure check) for 5b:

```
Bond precision:        C-C = 0.0045A         Wavelength=1.54184

Cell:           a=17.4301(8)    b=16.1897(6)    c=6.7149(3)
                alpha=90        beta=112.144(5)  gamma=90
Temperature: 293 K

                        Calculated            Reported
Volume                  1755.10(14)           1755.10(12)
Space group             C c                   Cc
Hall group              C-2                   yc ?
Moiety formula          C22 H20 O3            C22 H20 O3
Sum formula             C22 H20 O3            C22 H20 O3
Mr                      332.38                332.38
Dx,g cm-3               1.258                 1.212
Z                       4                     4
Mu (mm-1)               0.662                 0.641
F000                    704.0                 680.0
F000'                   706.10
h,k,lmax                21,19,8               20,17,8
Nref                    3413[1711]            2352
Tmin,Tmax
Tmin'

Correction method= Not given

Data completeness= 1.37/0.69          Theta(max)= 71.140

R(reflections)= 0.0470( 2080)         wR2(reflections)= 0.1347( 2352)
```

S = 0.953 Npar= 229

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

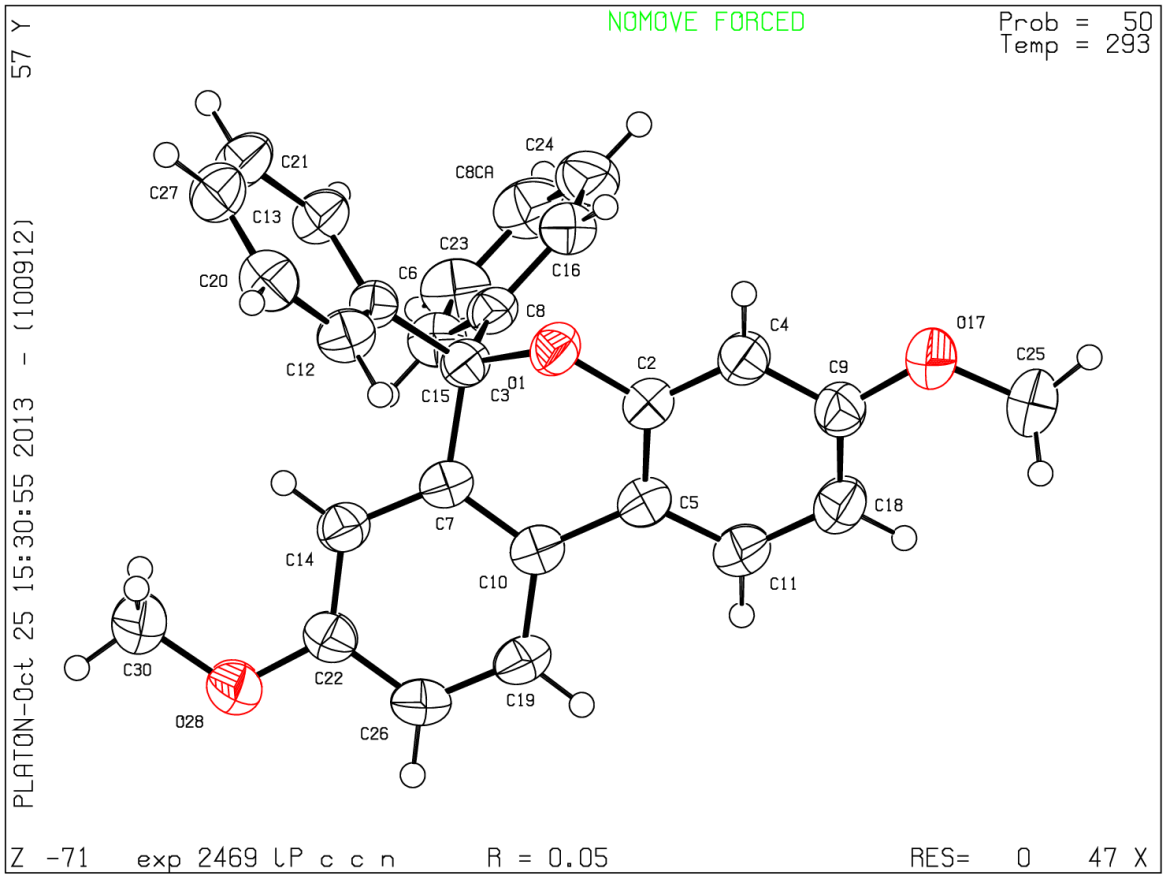
Alert level C

ABSMU01_ALERT_1_C The ratio of given/expected absorption coefficient lies outside the range 0.99 <> 1.01
Calculated value of mu = 0.662
Value of mu given = 0.641
DENSD01_ALERT_1_C The ratio of the submitted crystal density and that calculated from the formula is outside the range 0.99 <> 1.01
Crystal density given = 1.212
Calculated crystal density = 1.258
SHFSU01_ALERT_2_C The absolute value of parameter shift to su ratio > 0.05
Absolute value of the parameter shift to su ratio given 0.100
Additional refinement cycles may be required.
STRVA01_ALERT_4_C Flack test results are ambiguous.
From the CIF: _refine_ls_abs_structure_Flack 0.600
From the CIF: _refine_ls_abs_structure_Flack_su 0.300
PLAT046_ALERT_1_C Reported Z, MW and D(calc) are Inconsistent 1.258
PLAT052_ALERT_1_C Info on Absorption Correction Method Not Given . Please Do !
PLAT053_ALERT_1_C Minimum Crystal Dimension Missing (or Error) ... Please Check
PLAT054_ALERT_1_C Medium Crystal Dimension Missing (or Error) ... Please Check
PLAT055_ALERT_1_C Maximum Crystal Dimension Missing (or Error) ... Please Check
PLAT068_ALERT_1_C Reported F000 Differs from Calcd (or Missing)... Please Check
PLAT340_ALERT_3_C Low Bond Precision on C-C Bonds ..... 0.0045 Ang.

Alert level G

PLAT032_ALERT_4_G Std. Uncertainty on Flack Parameter Value High . 0.300
PLAT128_ALERT_4_G Alternate Setting for Input Space-Group Cc Ia Note
PLAT152_ALERT_1_G The Supplied and Calc. Volume s.u. Differ by ... 2 Units
PLAT199_ALERT_1_G Reported _cell_measurement_temperature ..... (K) 293 Check
PLAT200_ALERT_1_G Reported _diffrn_ambient_temperature ..... (K) 293 Check
PLAT792_ALERT_1_G The Model has Chirality at C18 (Verify) R
PLAT951_ALERT_5_G Reported and Calculated Kmax Values Differ by .. 2
0 **ALERT level A** = Most likely a serious problem - resolve or explain
0 **ALERT level B** = A potentially serious problem, consider carefully
11 **ALERT level C** = Check. Ensure it is not caused by an omission or oversight
7 **ALERT level G** = General information/check it is not something unexpected
12 ALERT type 1 CIF construction/syntax error, inconsistent or missing data
1 ALERT type 2 Indicator that the structure model may be wrong or deficient
1 ALERT type 3 Indicator that the structure quality may be low
3 ALERT type 4 Improvement, methodology, query or suggestion
1 ALERT type 5 Informative message, check

X-ray crystal structure data for the cyclic biaryl ether (5r): CCDC 968817



Operator	K. Ravikumar
Instrument	Oxford Super Nova
CCDC	968817
Empirical formula	$C_{27}H_{22}O_3$
Formula weight	394.45
Crystal system	orthorhombic
Space group	*Pccn*
a/Å	29.0006(11)
b/Å	17.3475(10)
c/Å	7.9792(4)
α/°	90.00
β/°	90.00
γ/°	90.00
Volume/Å^3	4014.2(3)
Z	8

ρ_{calc}mg/mm^3	1.305
m/mm^{-1}	0.668
F(000)	1664.0
Crystal size/mm^3	0.18 × 0.16 × 0.13
2Θ range for data collection	5.94 to 141.4°
Index ranges	$-35 \le h \le 31$, $-20 \le k \le 13$, $-6 \le l \le 9$
Reflections collected	10097
Independent reflections	3799[R(int) = 0.0306]
Data/restraints/parameters	37990/0/273
Goodness-of-fit on F^2	0.974
Final R indexes [I>=2σ (I)]	R_1 = 0.0457, wR_2 = 0.1356
Final R indexes [all data]	R_1 = 0.0644, wR_2 = 0.1574
Largest diff. peak/hole / e Å^{-3}	0.12/-0.17

1. Check CIF/ Platon report (full structure check) for 5r:

```
Bond precision:      C-C = 0.0026 A       Wavelength=1.54180

Cell:       a=29.0006(11)     b=17.3475(10)      c=7.9792(4)
            alpha=90          beta=90            gamma=90
Temperature: 293 K

                         Calculated              Reported
Volume                   4014.2(3)               4014.2(3)
Space group              P c c n                 P c c n
Hall group               -P 2ab 2ac              -P 2ab 2ac
Moiety formula           C27 H22 O3              C27 H22 O3
Sum formula              C27 H22 O3              C27 H22 O3
Mr                       394.45                  394.45
Dx,g cm-3                1.305                   1.305
Z                        8                       8
Mu (mm-1)                0.668                   0.668
F000                     1664.0                  1664.0
F000'                    1668.90
h,k,lmax                 35,21,9                 35,20,9
Nref                     3861                    3799
Tmin,Tmax                0.887,0.917             0.584,1.000
Tmin'                    0.887

Correction method= MULTI-SCAN

Data completeness= 0.984            Theta(max)= 70.700

R(reflections)= 0.0457( 2790)       wR2(reflections)= 0.1574( 3799)

S = 0.974                      Npar= 273
```

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

Alert level G

PLAT005_ALERT_5_G No _iucr_refine_instructions_details in the CIF Please Do !
PLAT093_ALERT_1_G No su's on H-positions, refinement reported as . mixed
PLAT199_ALERT_1_G Reported _cell_measurement_temperature ..... (K) 293 Check
PLAT200_ALERT_1_G Reported _diffrn_ambient_temperature ..... (K) 293 Check
PLAT720_ALERT_4_G Number of Unusual/Non-Standard Labels 2

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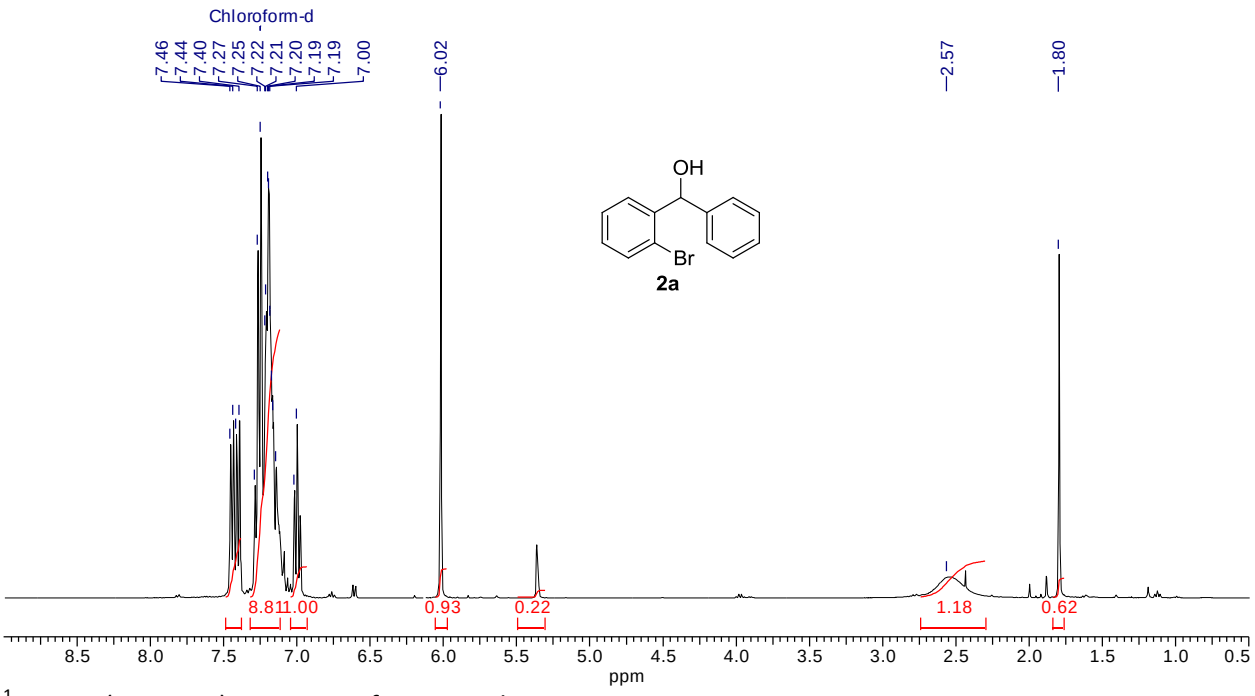
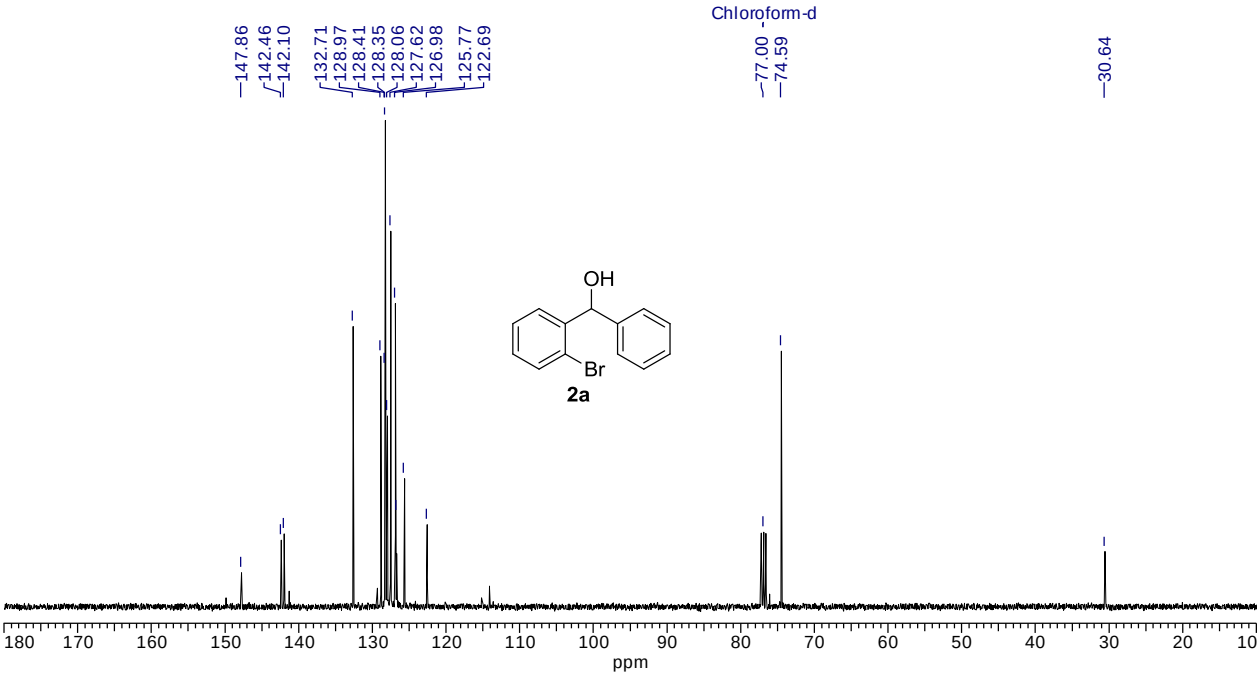
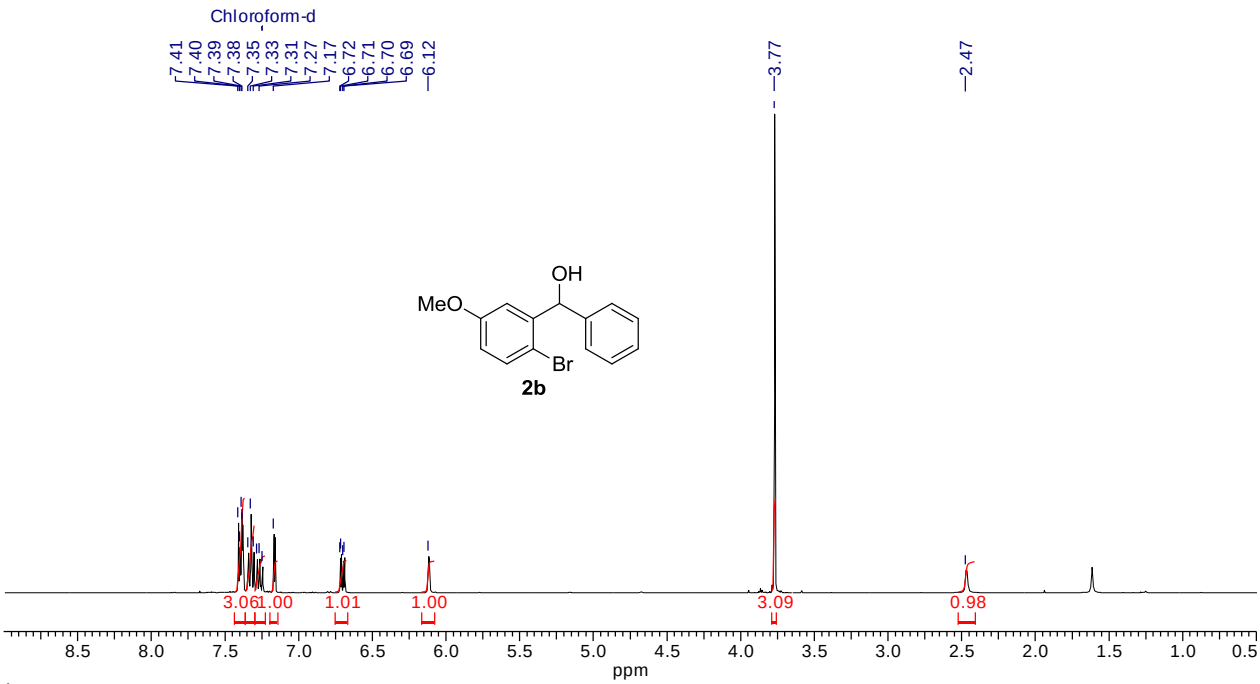
1 ALERT type 5 Informative message, check



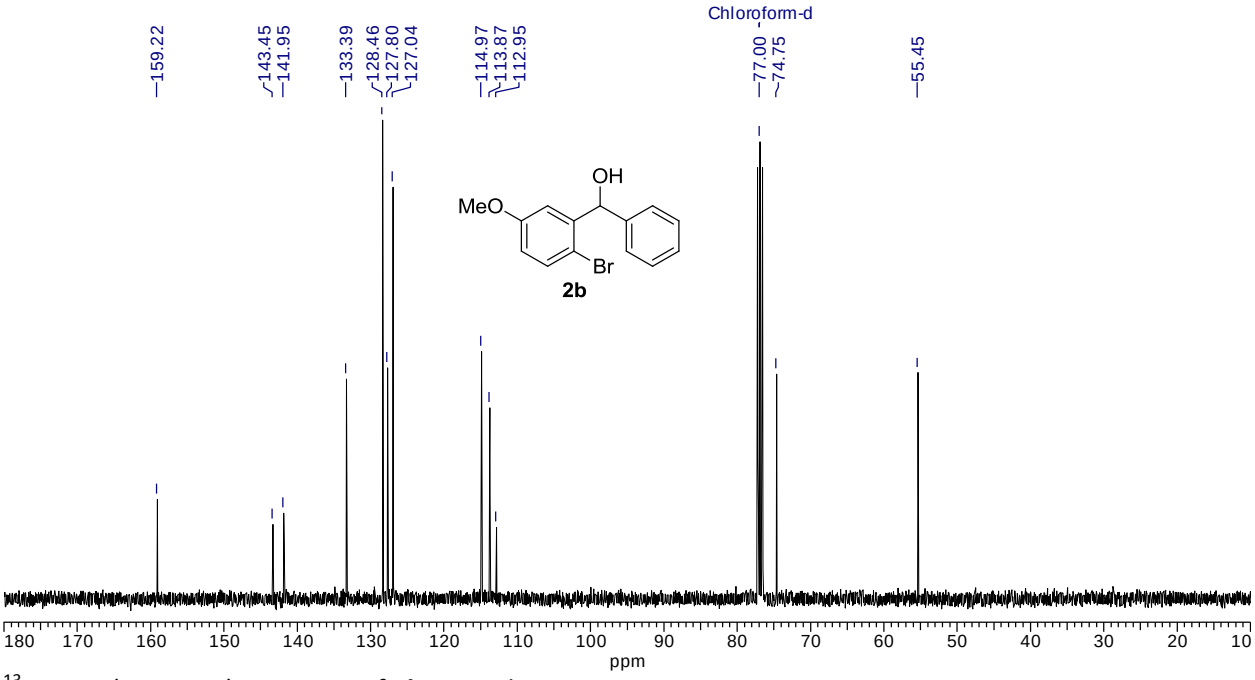
^{1}H NMR (400 MHz) spectrum of **2a** in $CDCl_3$



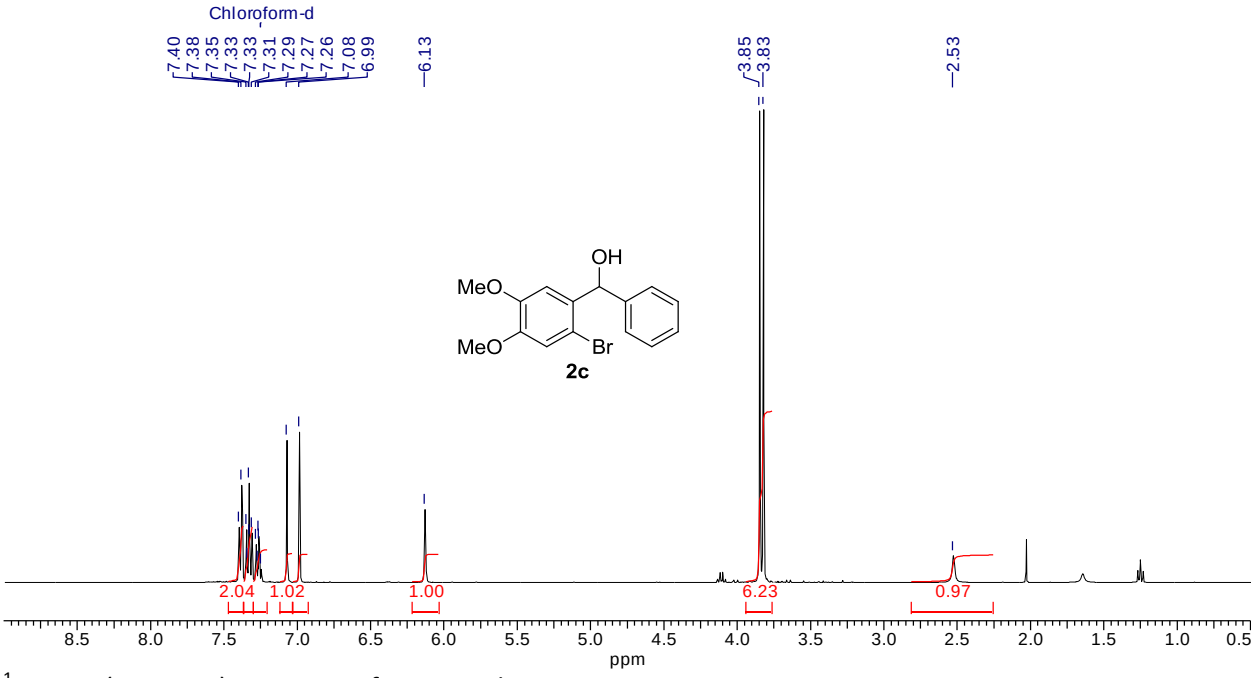
^{13}C NMR (100 MHz) spectrum of **2a** in $CDCl_3$



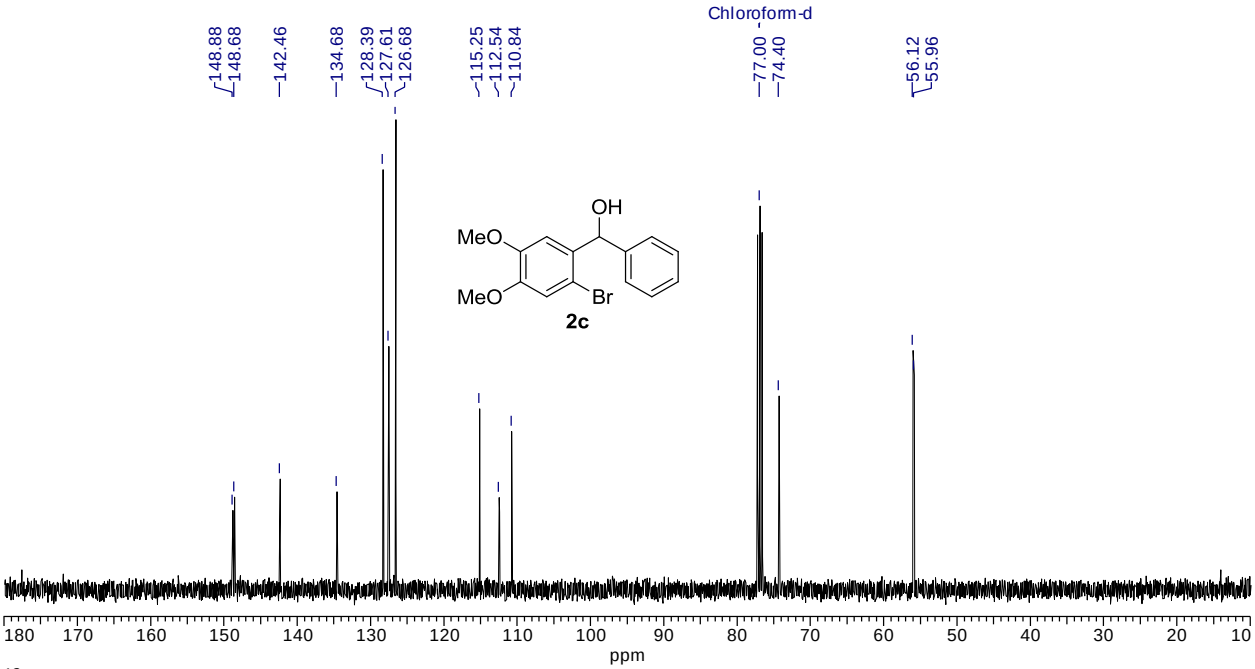
^{1}H NMR (400 MHz) spectrum of **2b** in $CDCl_3$



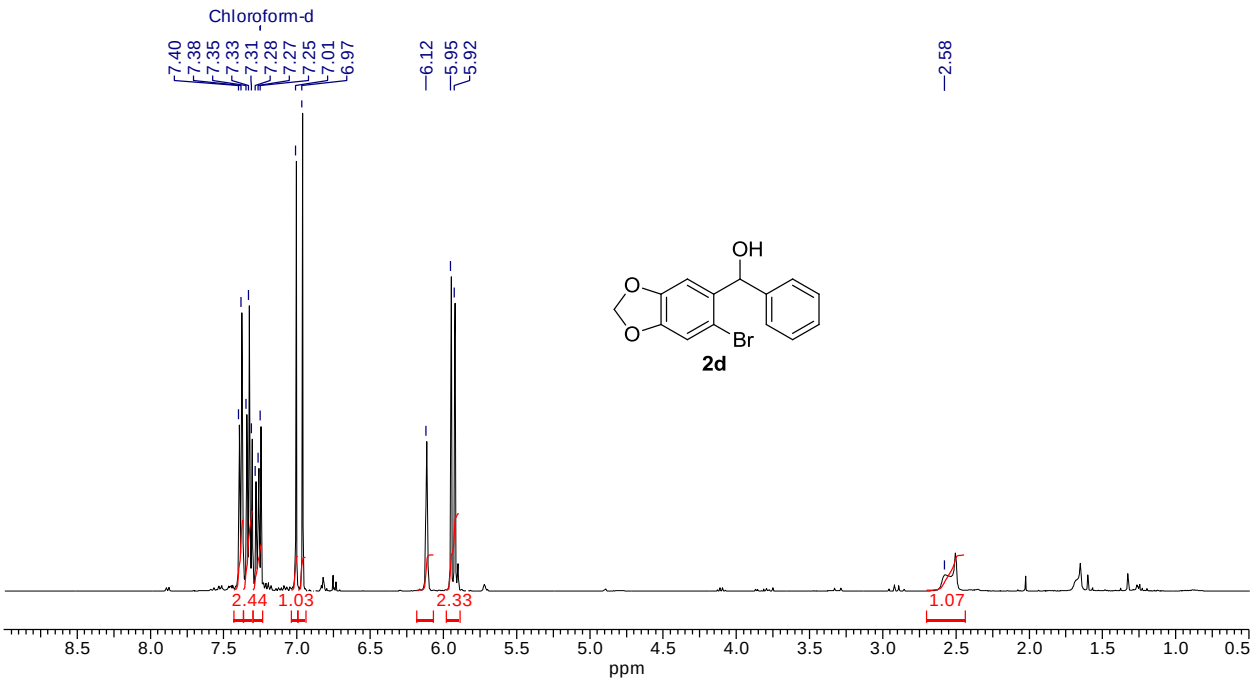
^{13}C NMR (100 MHz) spectrum of **2b** in $CDCl_3$



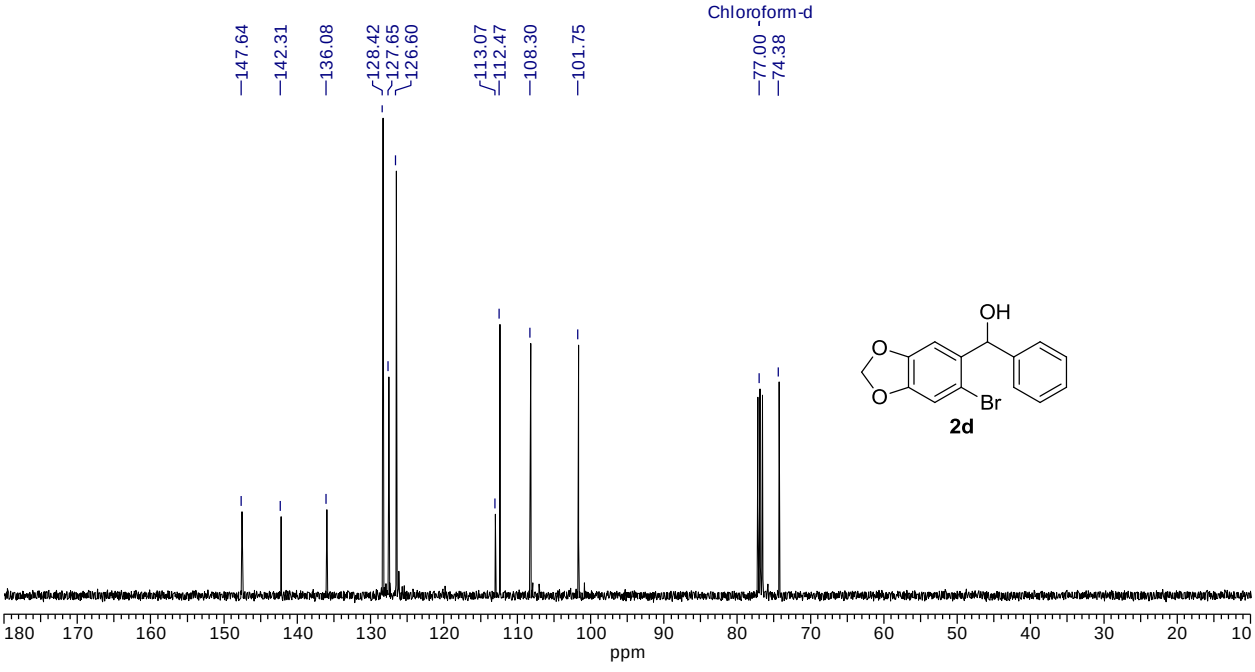
^{1}H NMR (400 MHz) spectrum of **2c** in $CDCl_3$



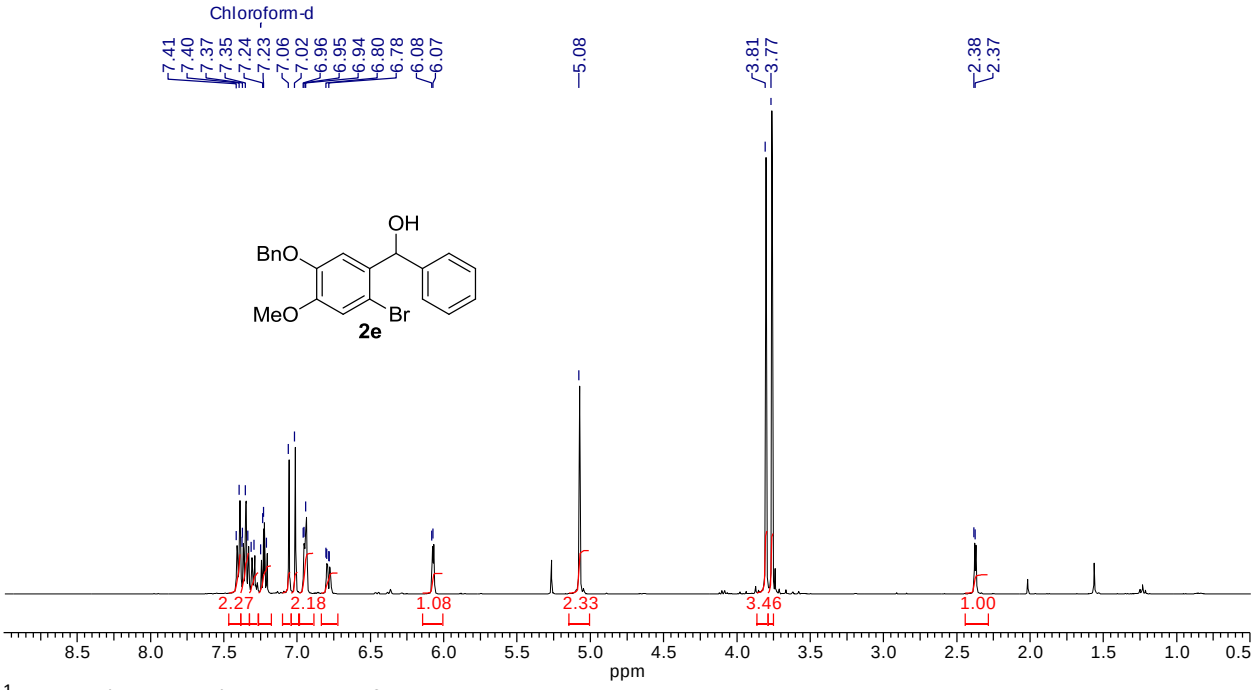
^{13}C NMR (100 MHz) spectrum of **2c** in $CDCl_3$



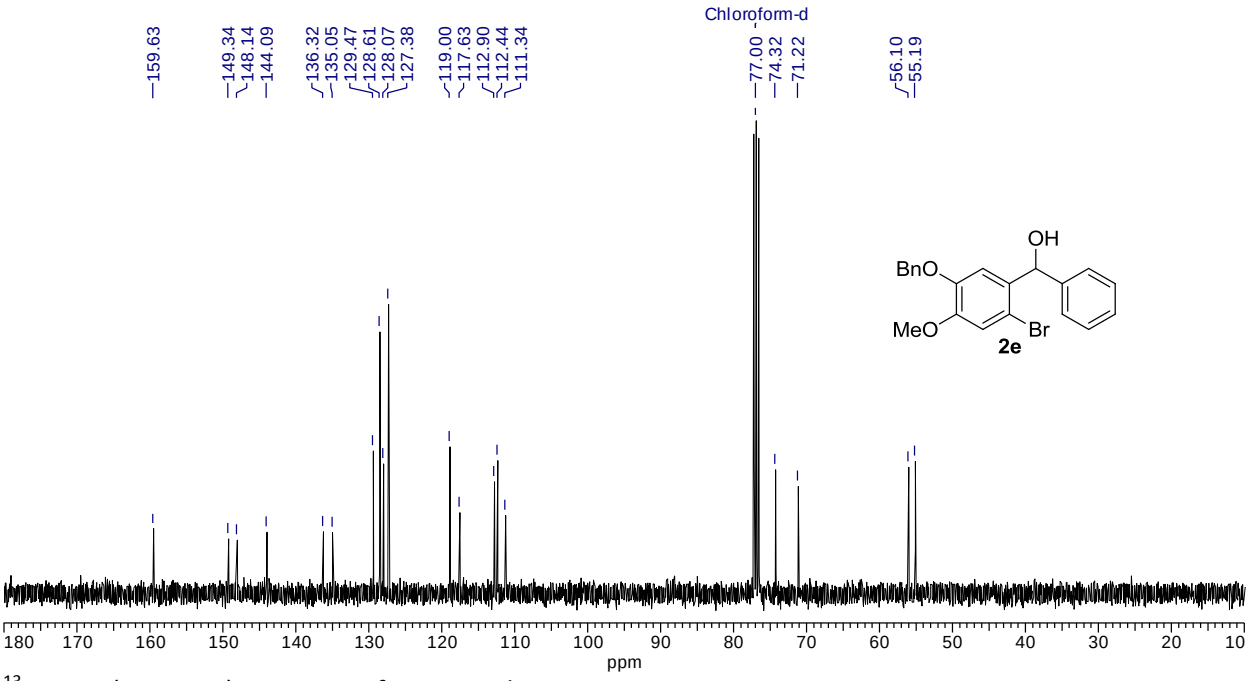
^{1}H NMR (400 MHz) spectrum of **2d** in $CDCl_3$



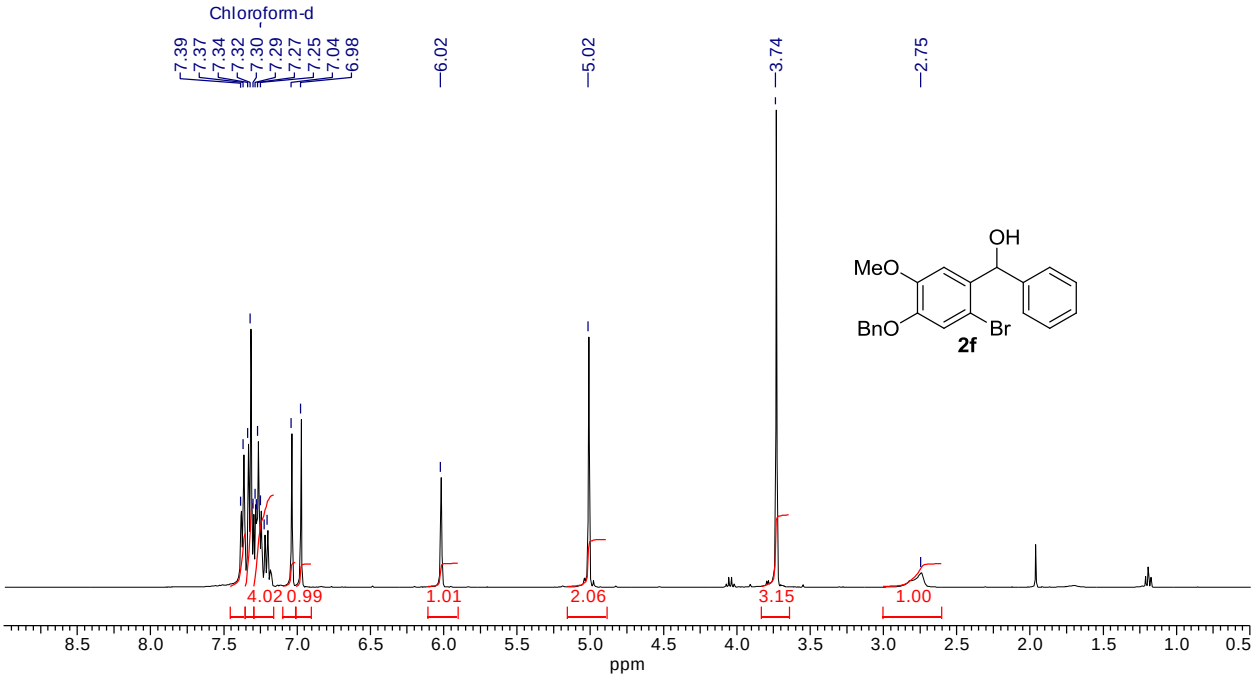
^{13}C NMR (100 MHz) spectrum of **2d** in $CDCl_3$



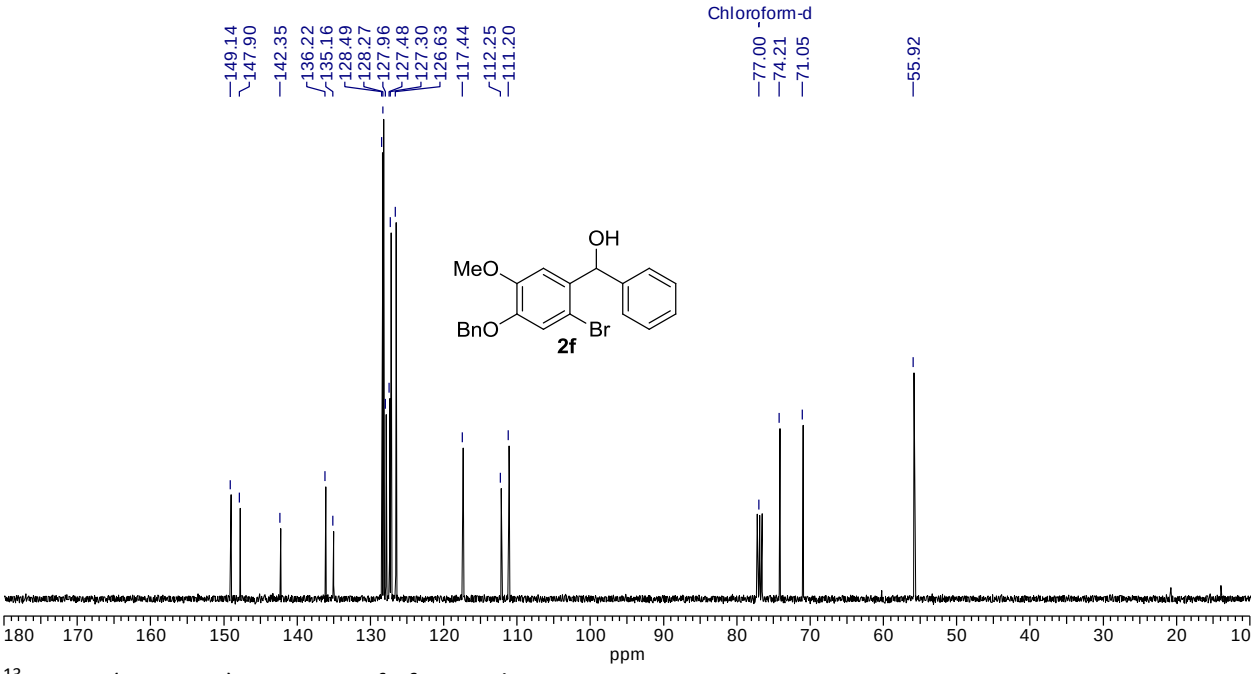
^{1}H NMR (400 MHz) spectrum of **2e** in $CDCl_3$



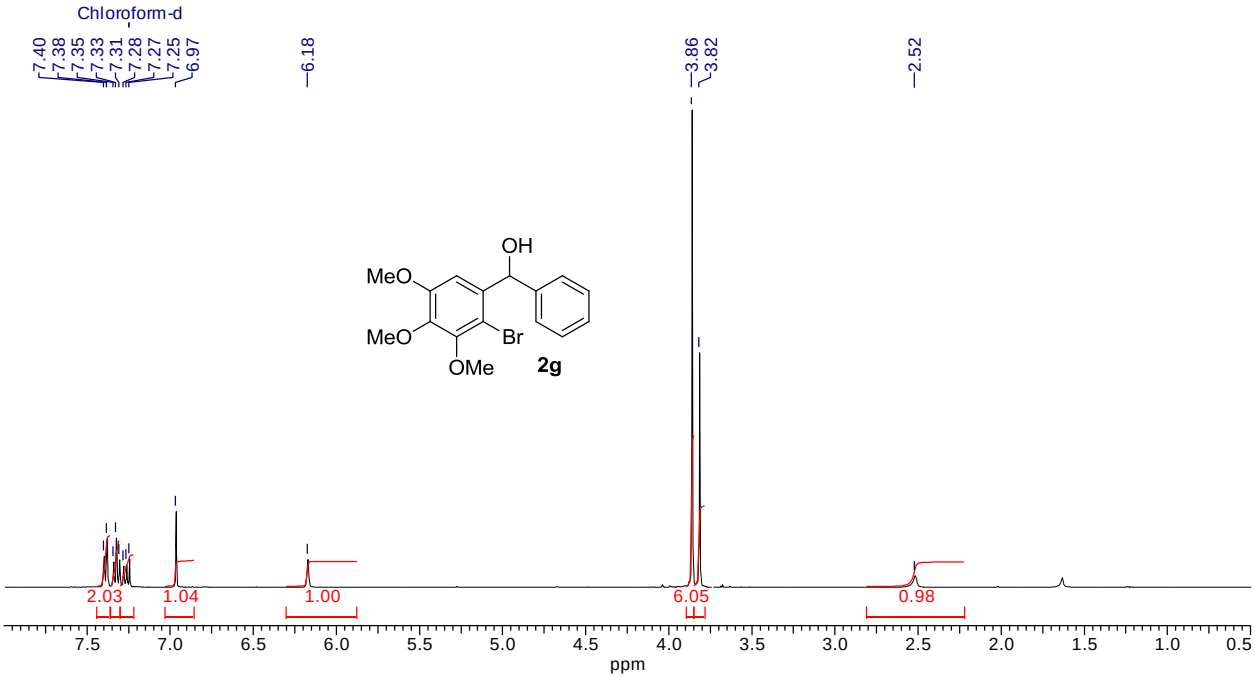
^{13}C NMR (100 MHz) spectrum of **2e** in $CDCl_3$



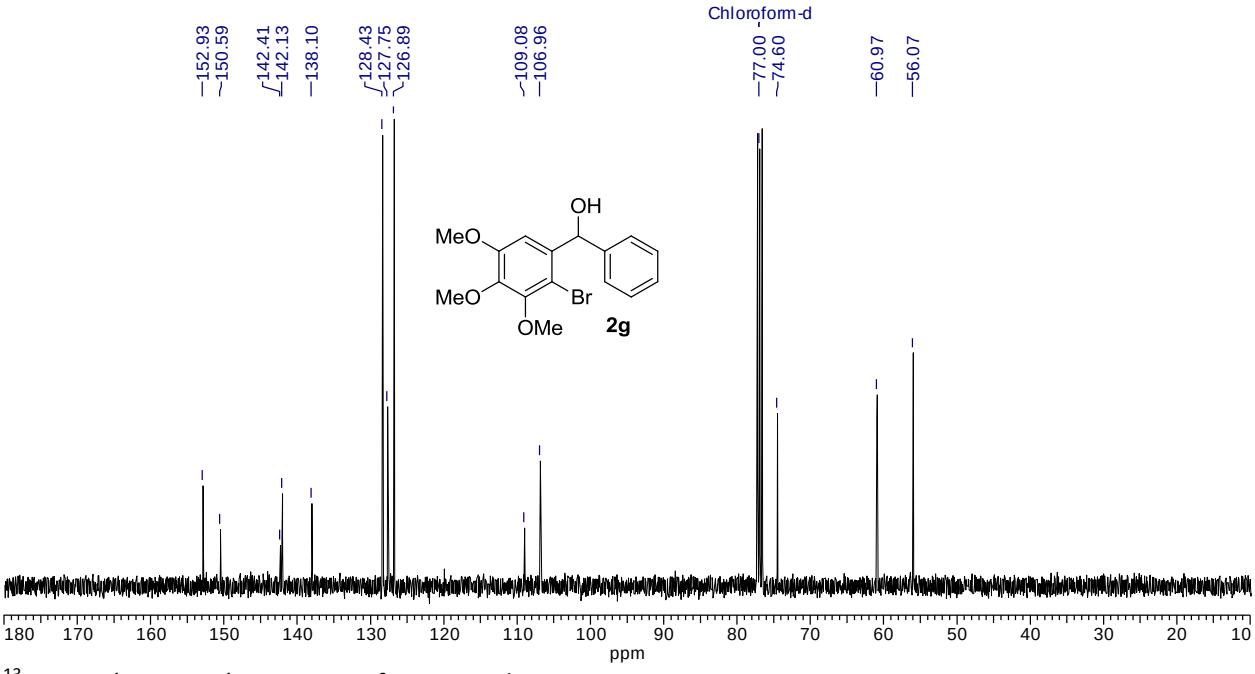
^{1}H NMR (400 MHz) spectrum of **2f** in $CDCl_3$



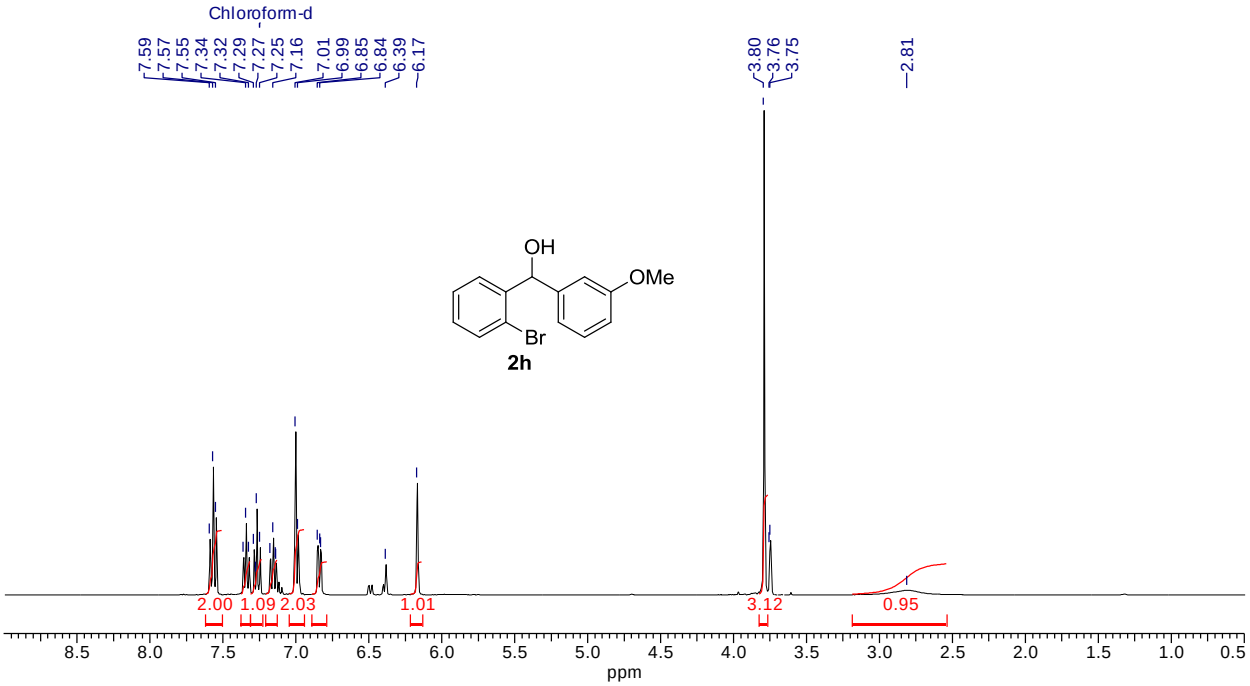
^{13}C NMR (100 MHz) spectrum of **2f** in $CDCl_3$



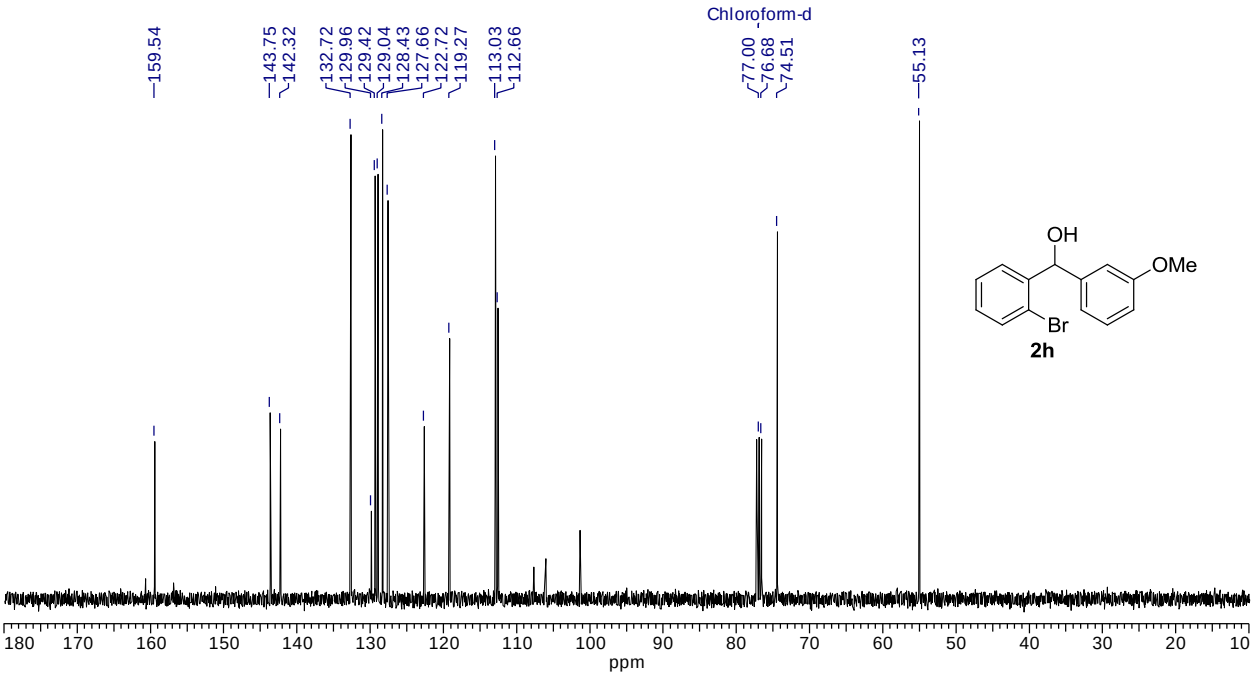
^{1}H NMR (400 MHz) spectrum of **2g** in $CDCl_3$



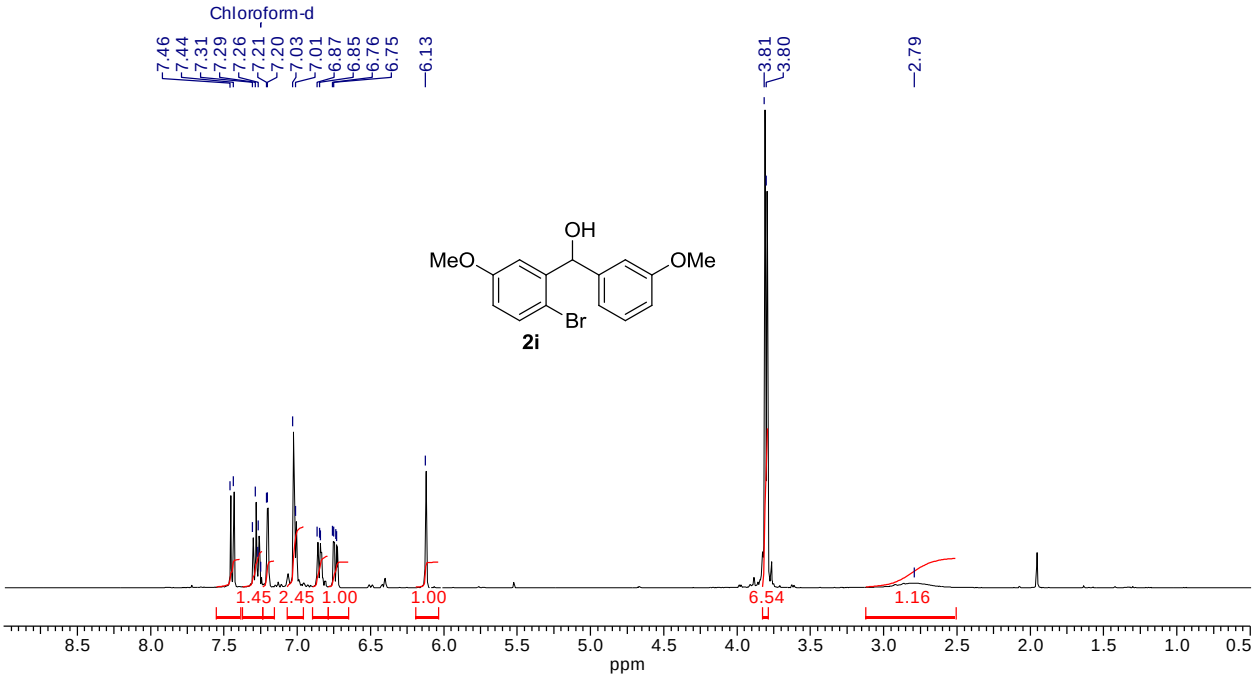
^{13}C NMR (100 MHz) spectrum of **2g** in $CDCl_3$



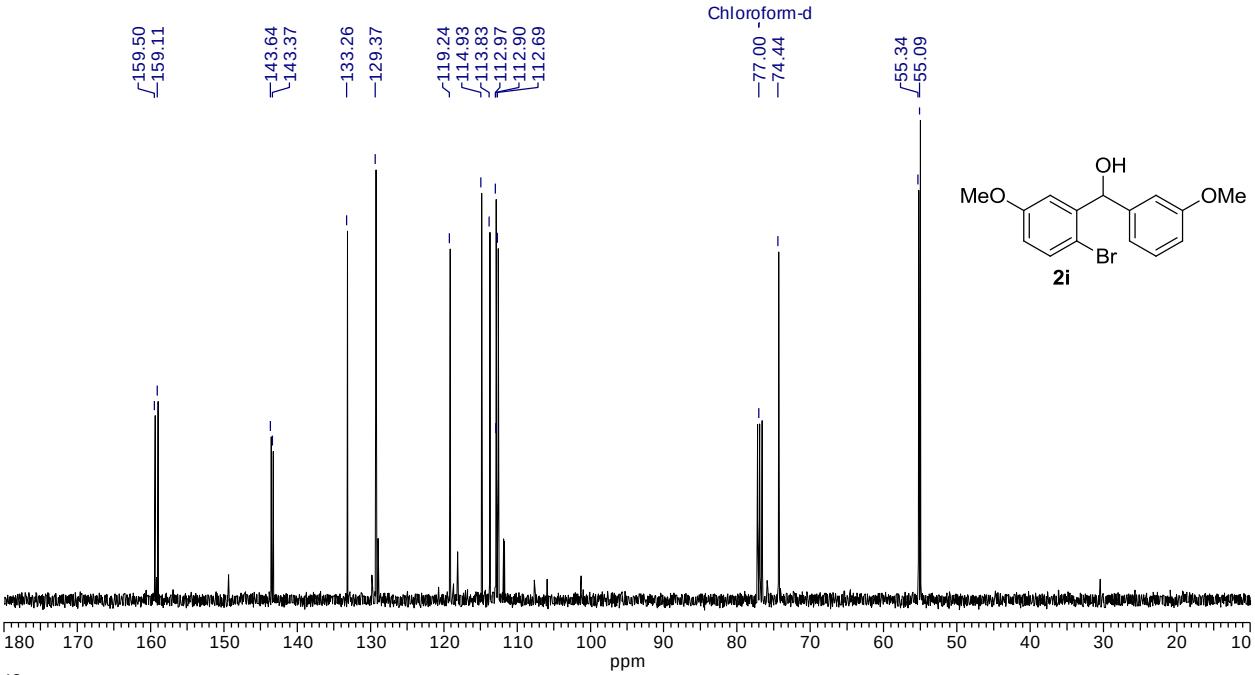
^{1}H NMR (400 MHz) spectrum of **2h** in $CDCl_3$



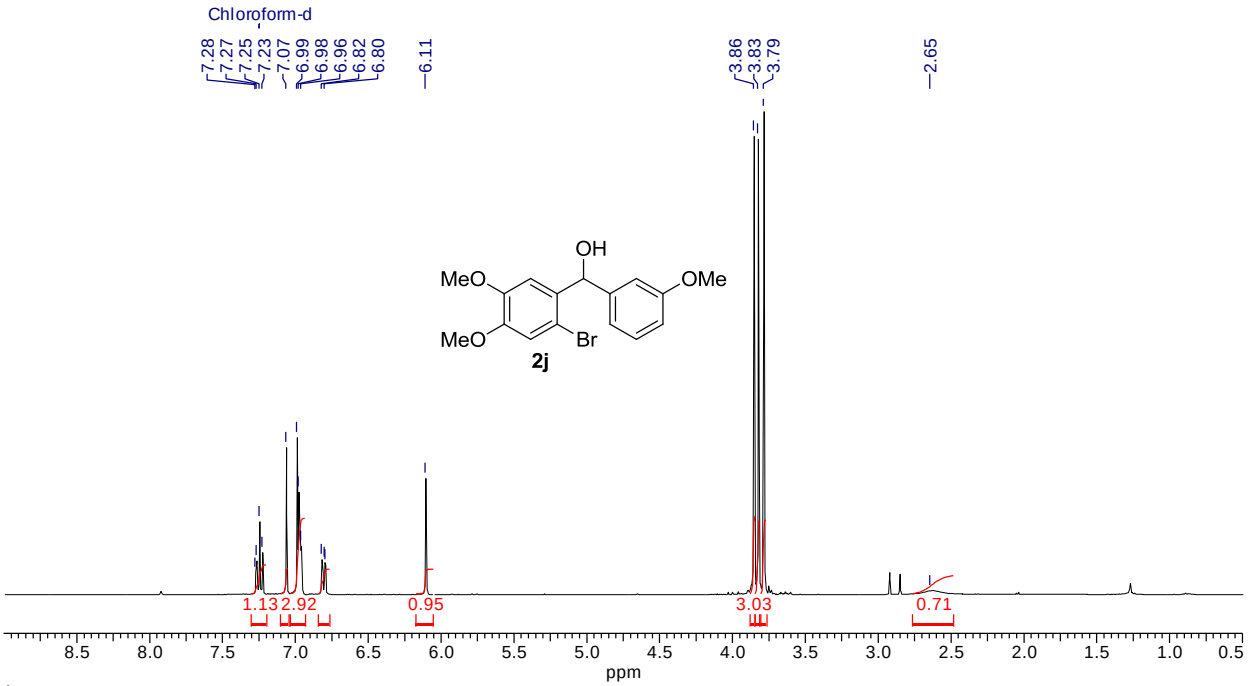
^{13}C NMR (100 MHz) spectrum of **2h** in $CDCl_3$



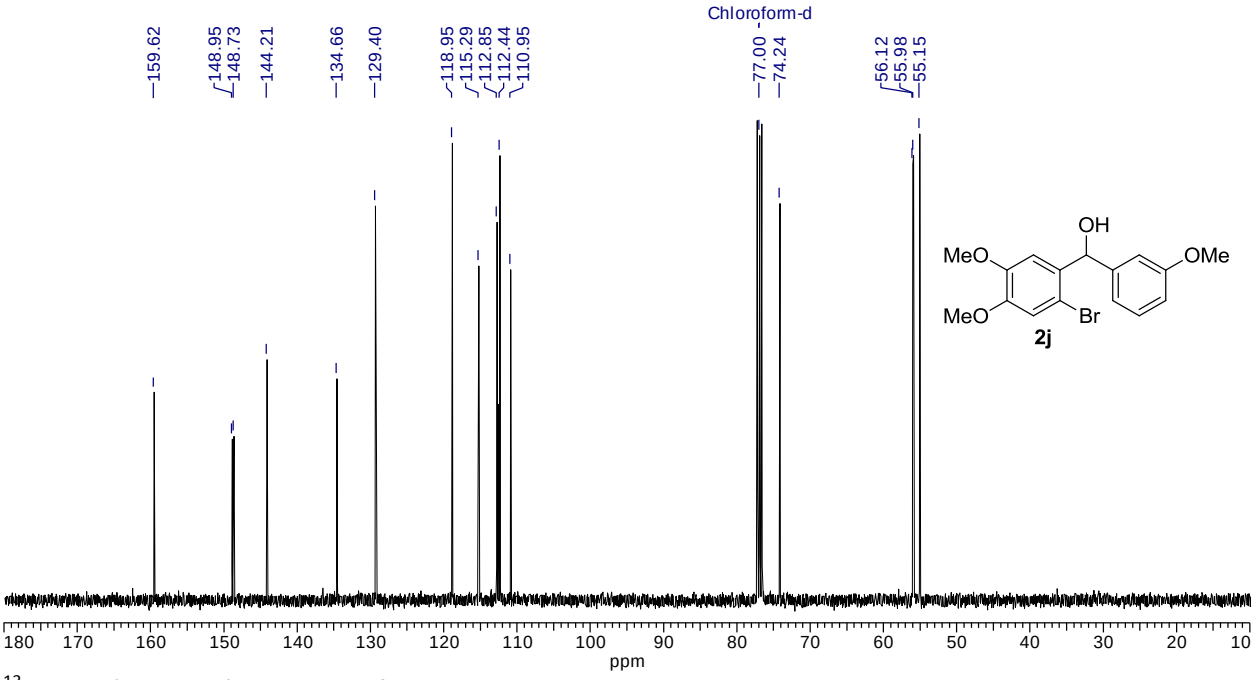
^{1}H NMR (400 MHz) spectrum of **2i** in $CDCl_3$



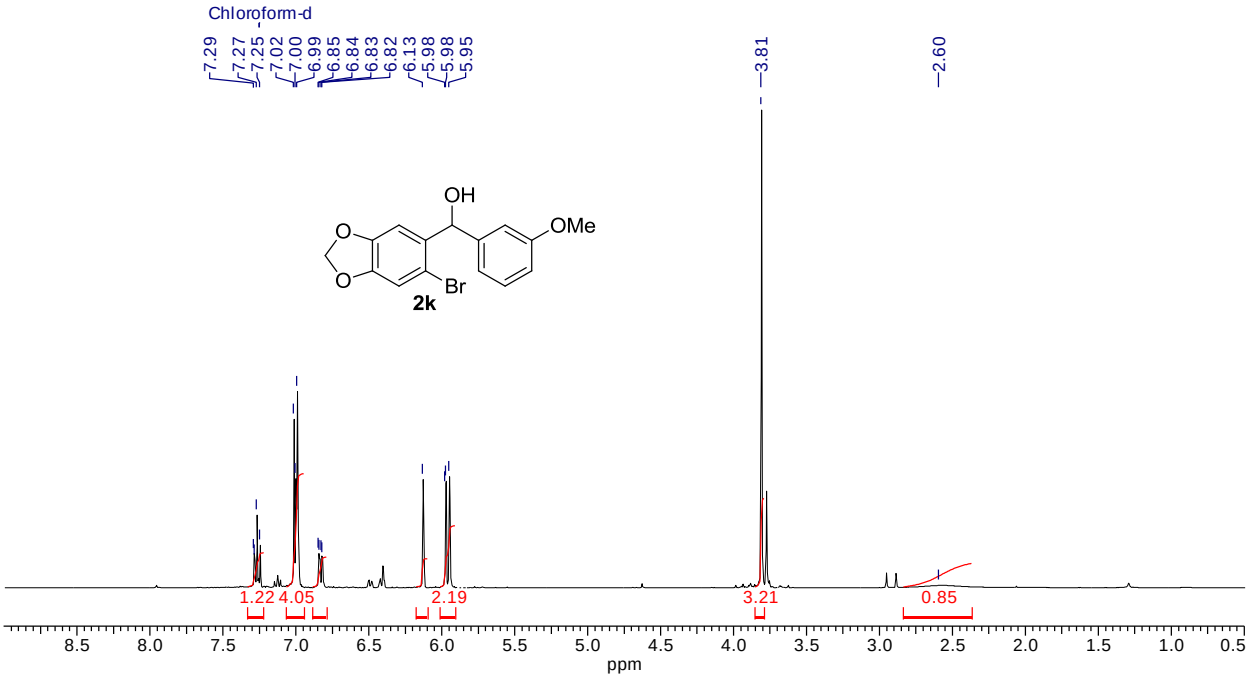
^{13}C NMR (100 MHz) spectrum of **2i** in $CDCl_3$



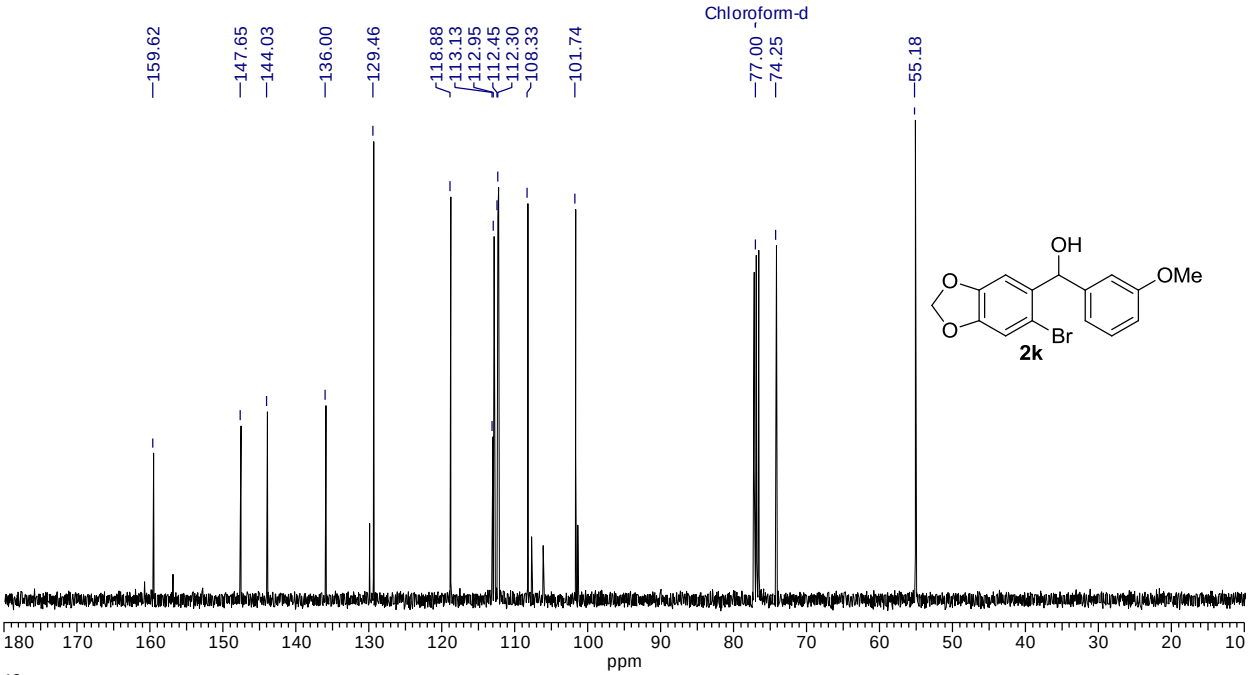
^{1}H NMR (400 MHz) spectrum of **2j** in $CDCl_3$



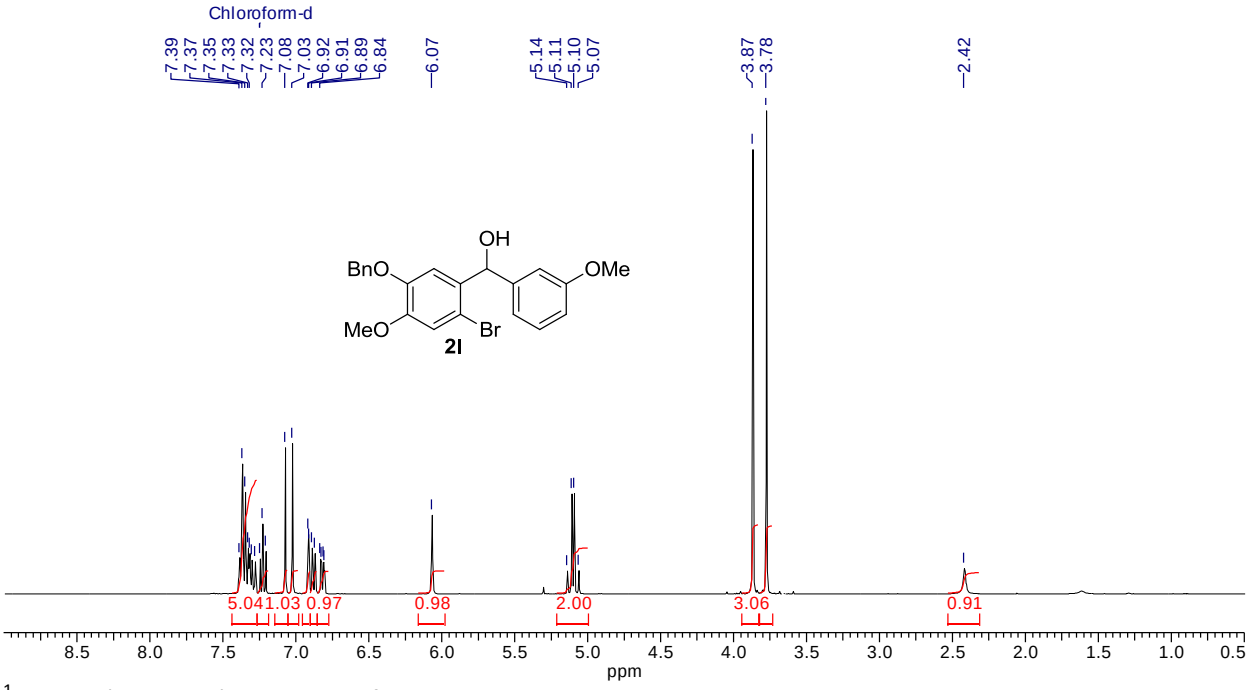
^{13}C NMR (100 MHz) spectrum of **2j** in $CDCl_3$



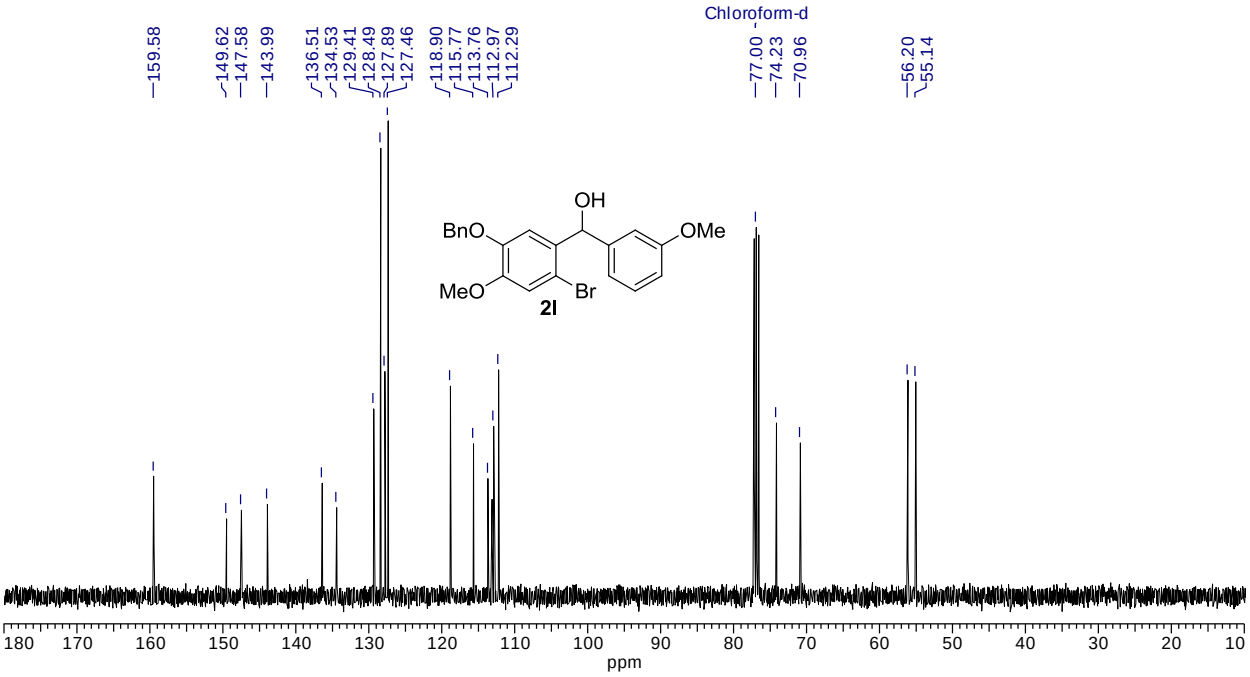
^{1}H NMR (400 MHz) spectrum of **2k** in $CDCl_3$



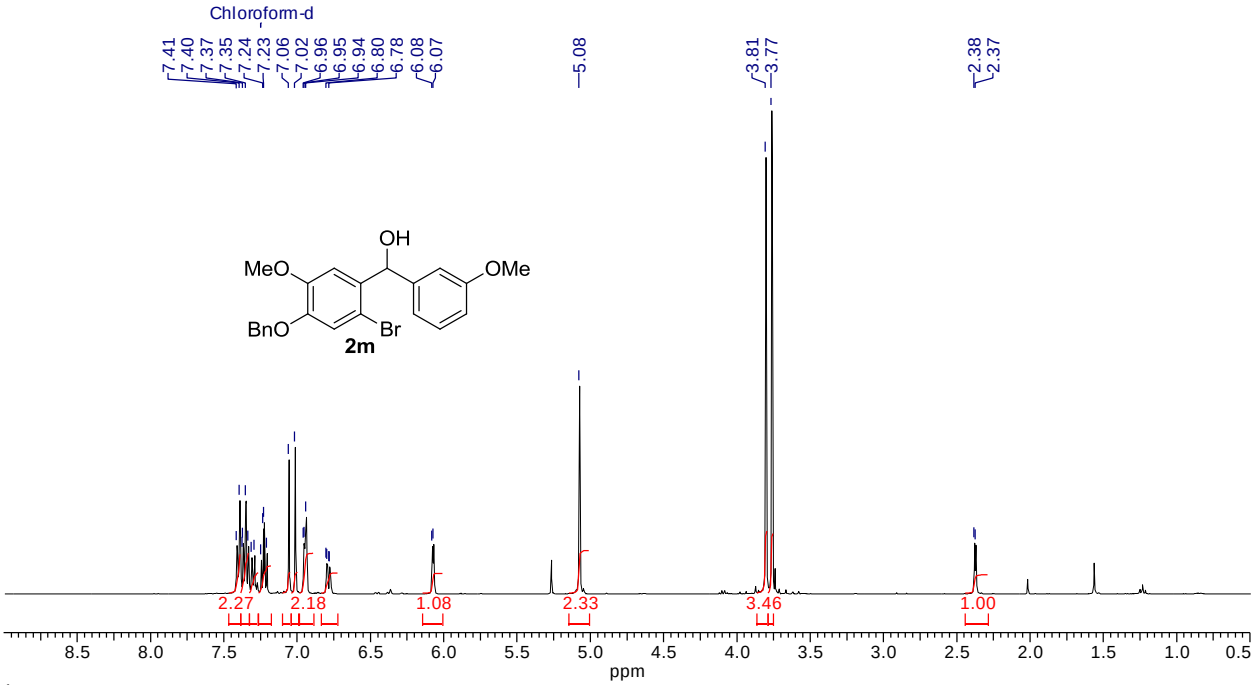
^{13}C NMR (100 MHz) spectrum of **2j** in $CDCl_3$



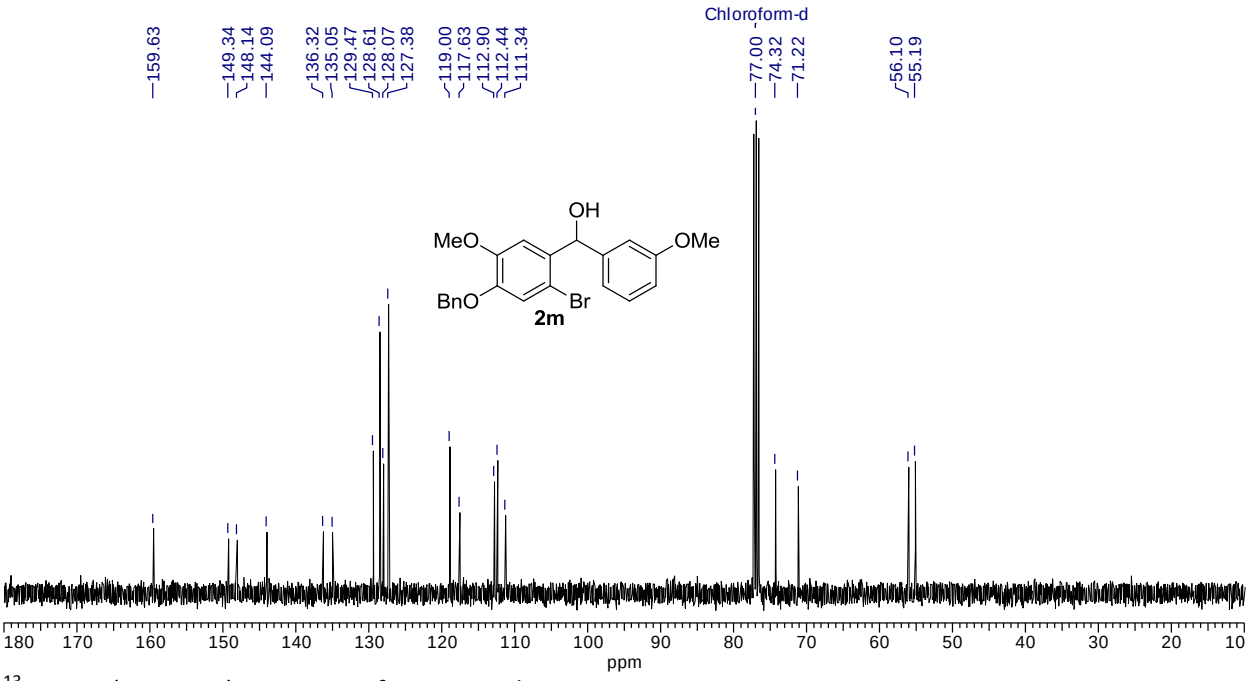
^{1}H NMR (400 MHz) spectrum of **2l** in $CDCl_3$



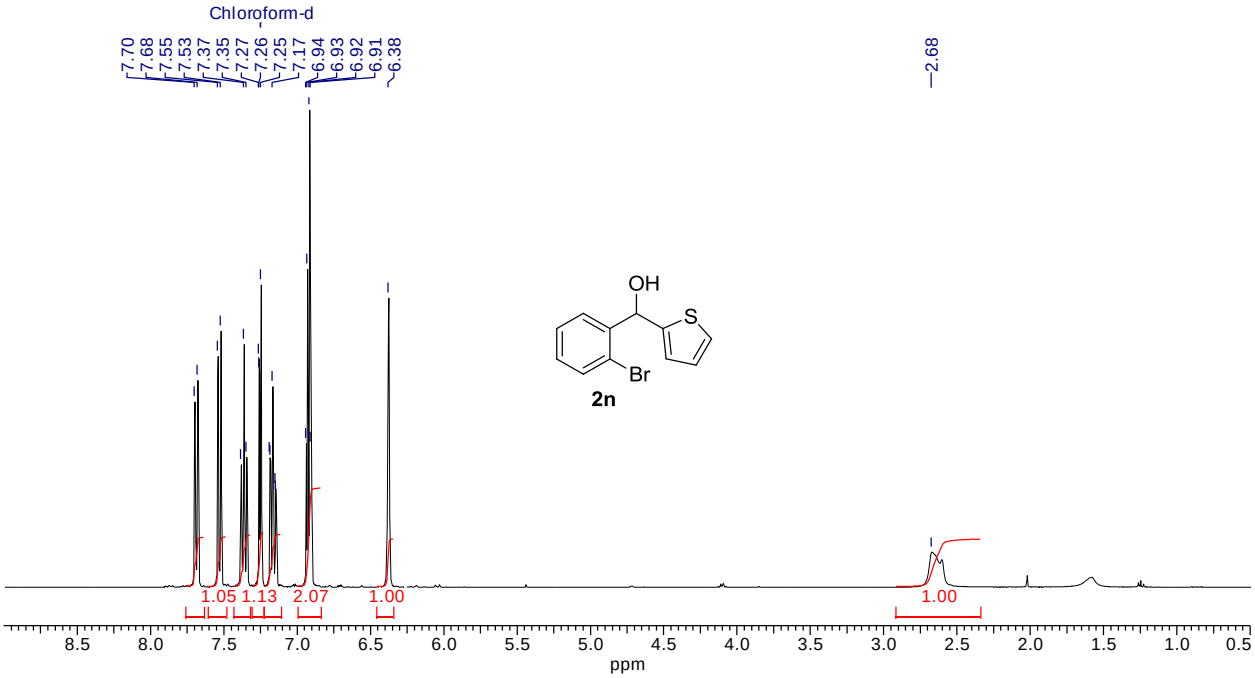
^{13}C NMR (100 MHz) spectrum of **2l** in $CDCl_3$



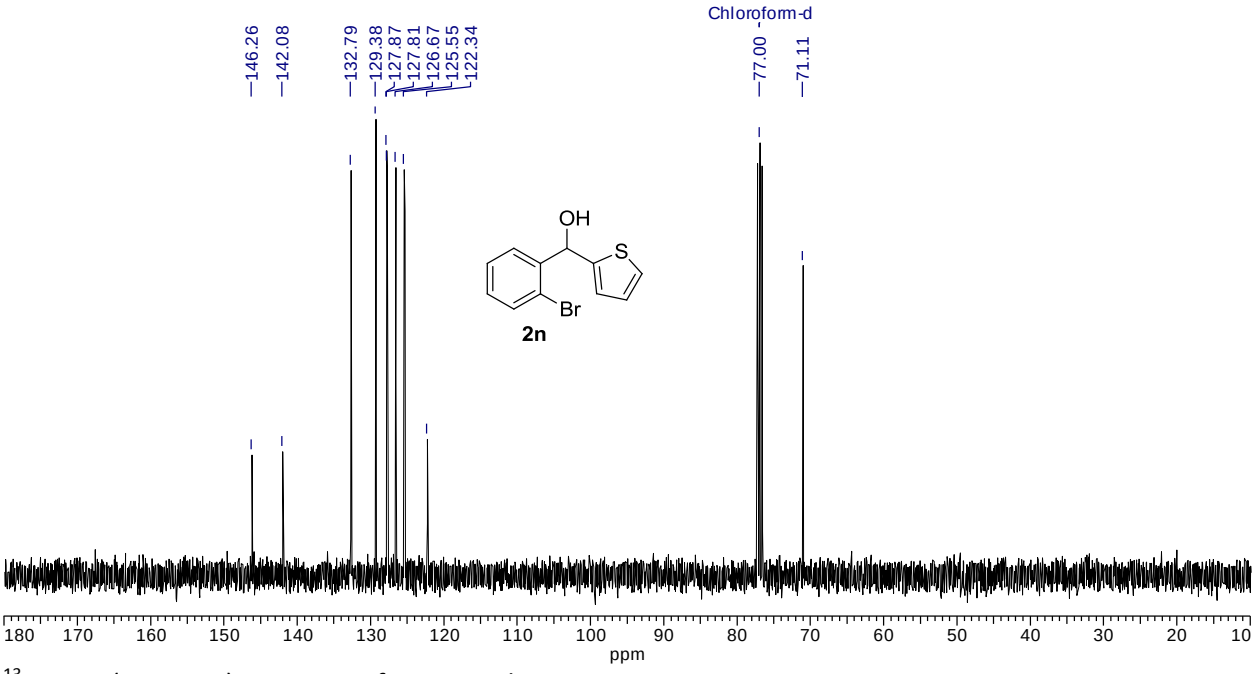
^{1}H NMR (400 MHz) spectrum of **2m** in $CDCl_3$



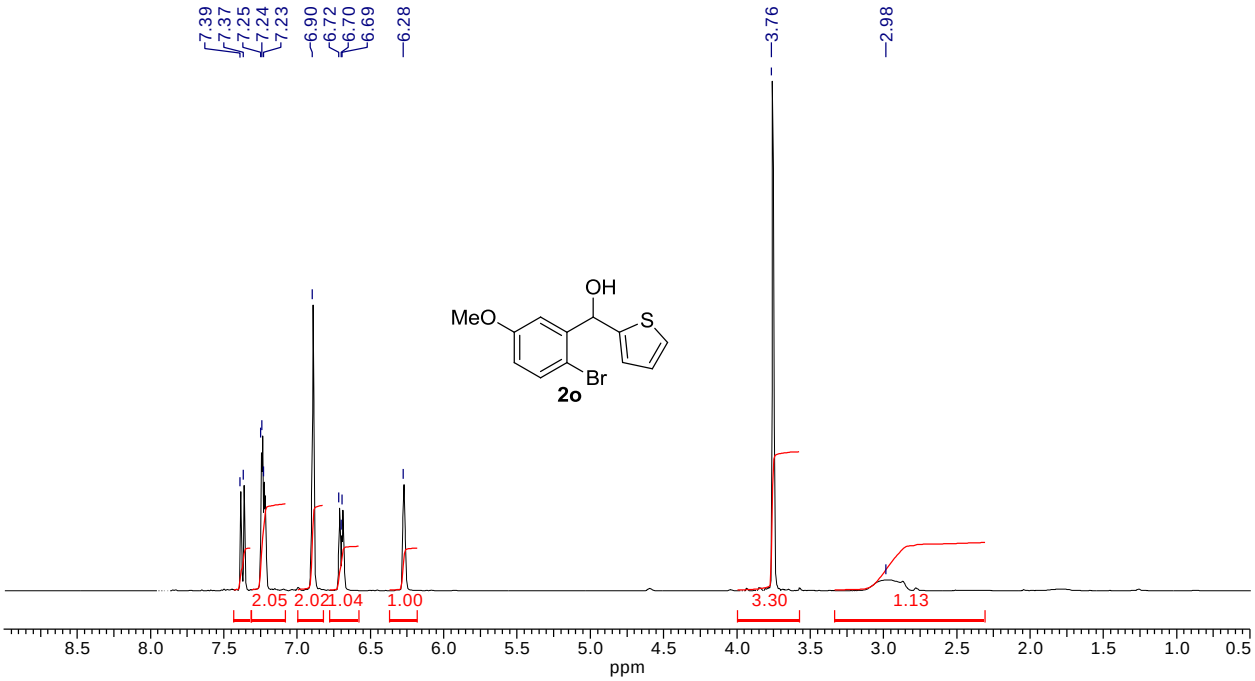
^{13}C NMR (100 MHz) spectrum of **2m** in $CDCl_3$



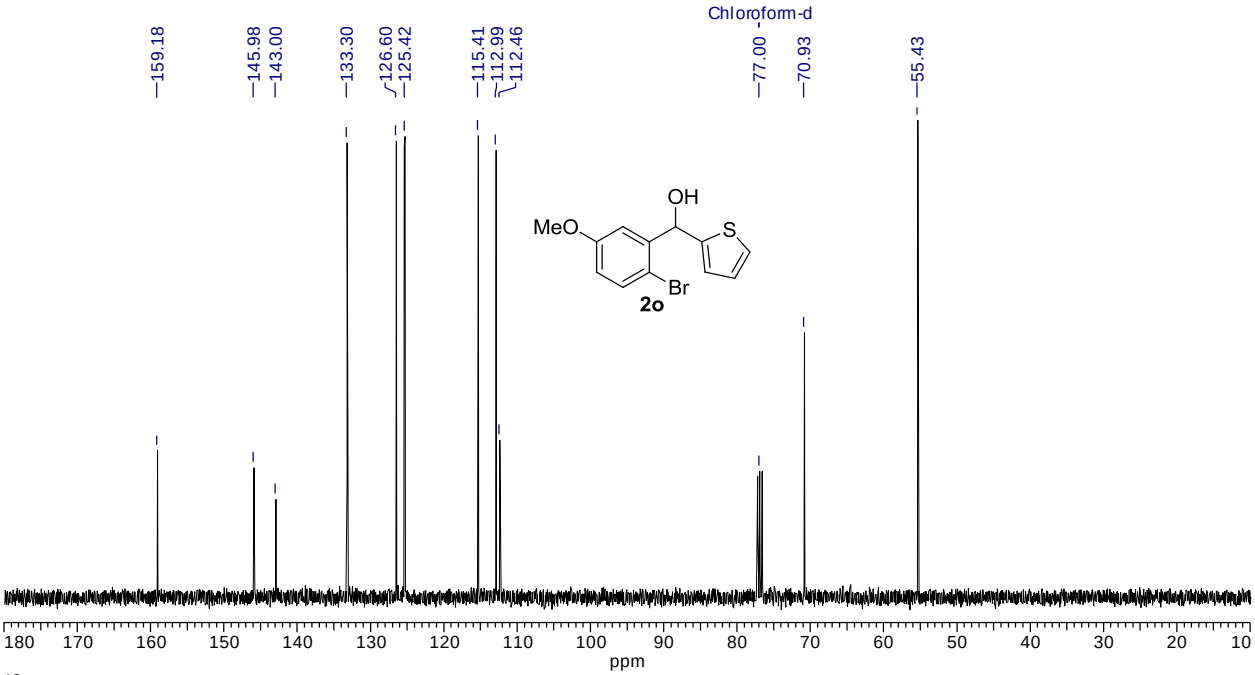
^{1}H NMR (400 MHz) spectrum of **2n** in $CDCl_3$



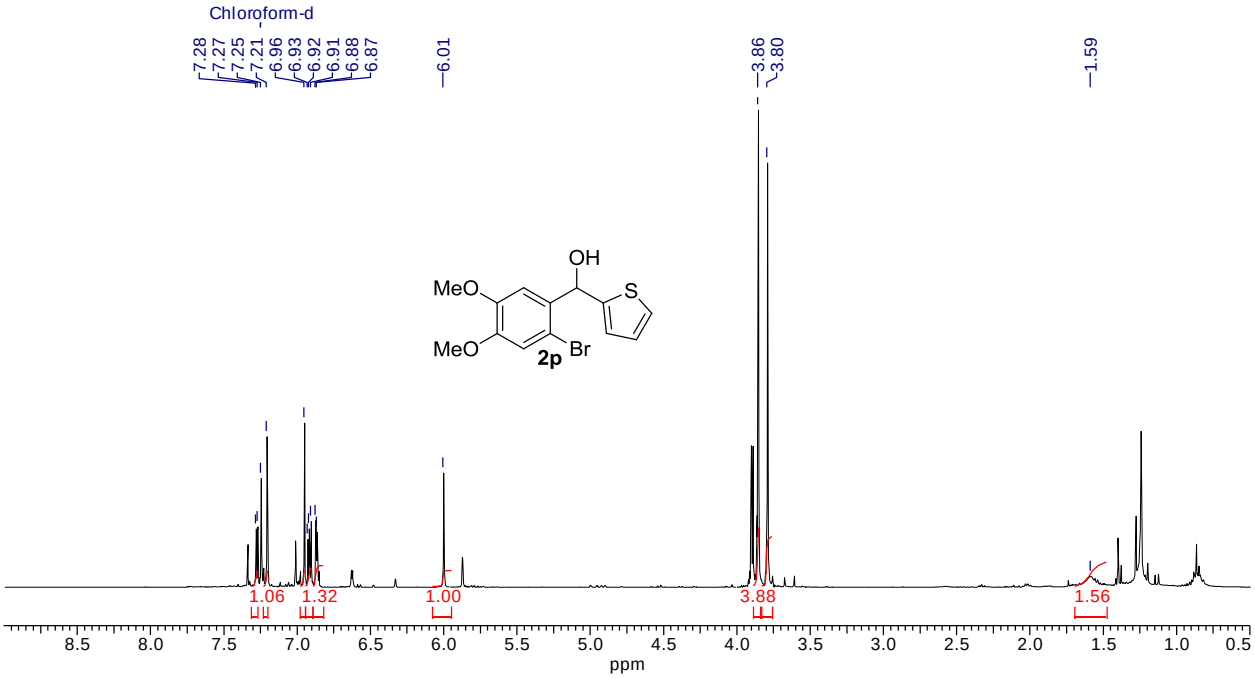
^{13}C NMR (100 MHz) spectrum of **2n** in $CDCl_3$



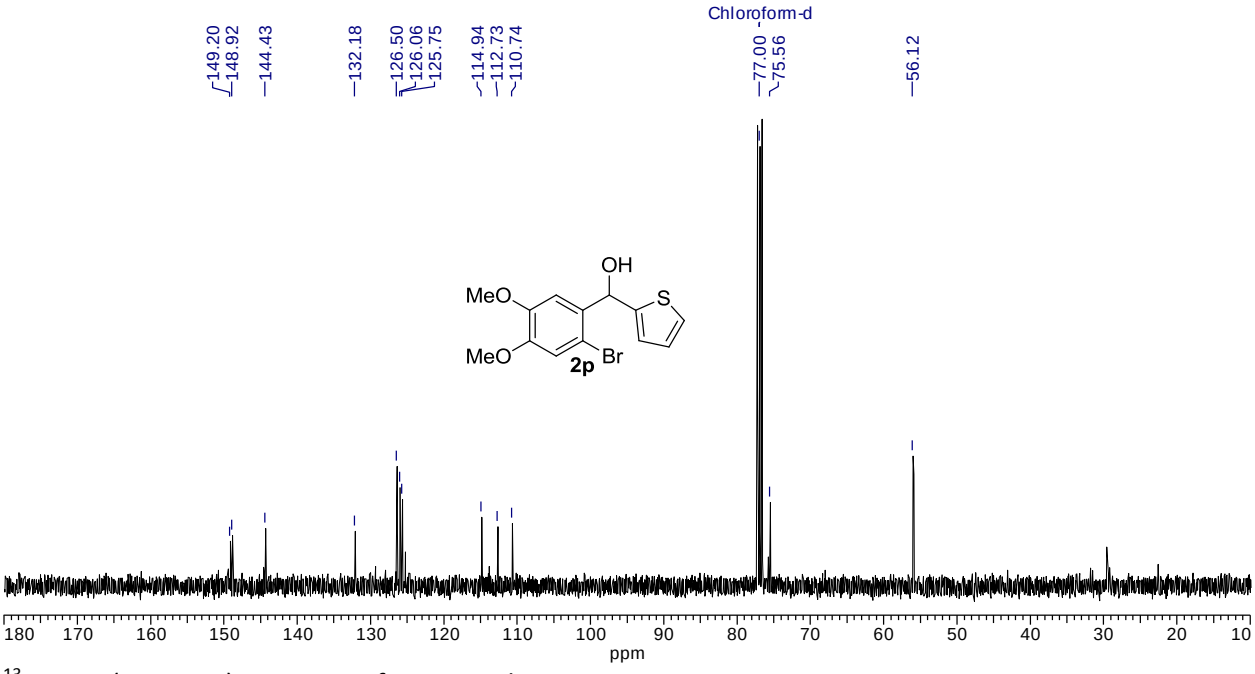
^{1}H NMR (400 MHz) spectrum of **2o** in $CDCl_3$



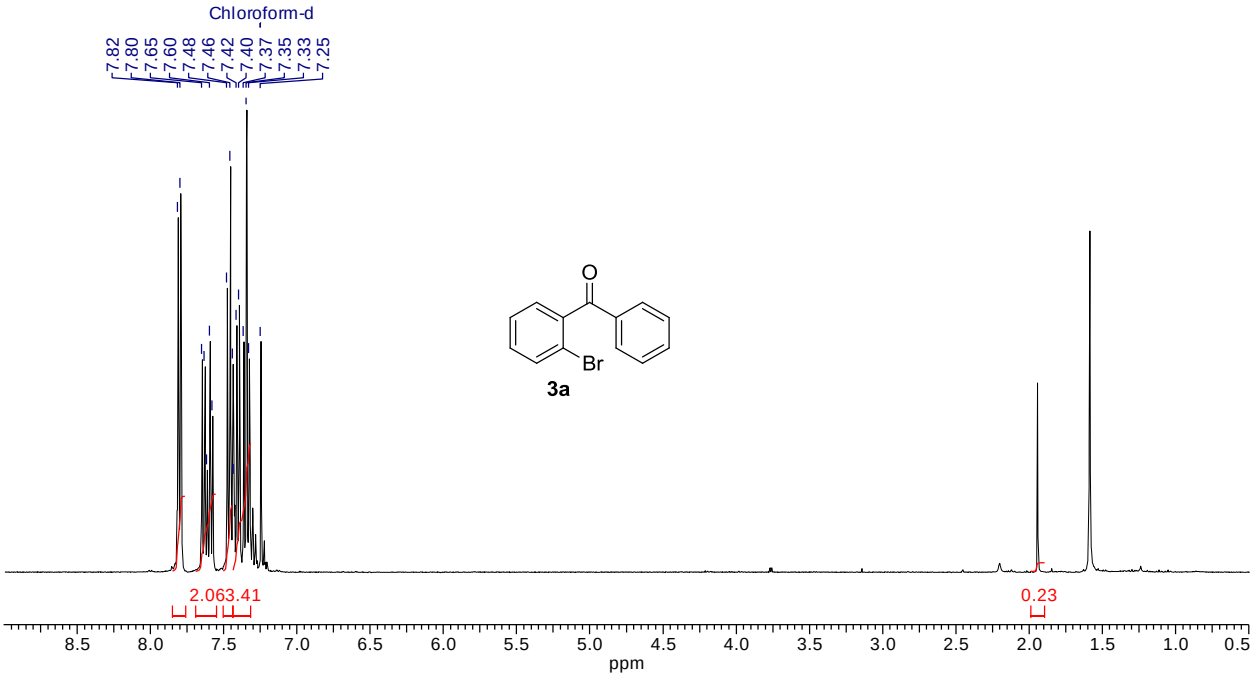
^{13}C NMR (100 MHz) spectrum of **2o** in $CDCl_3$



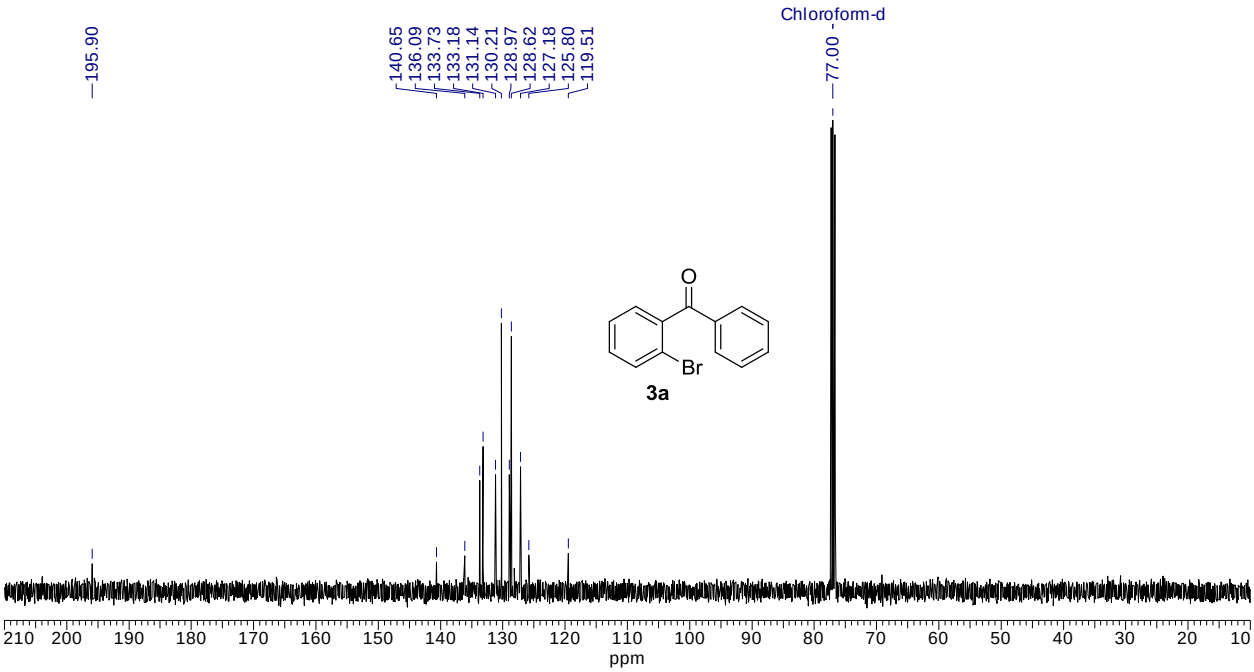
^{1}H NMR (400 MHz) spectrum of **2p** in $CDCl_3$



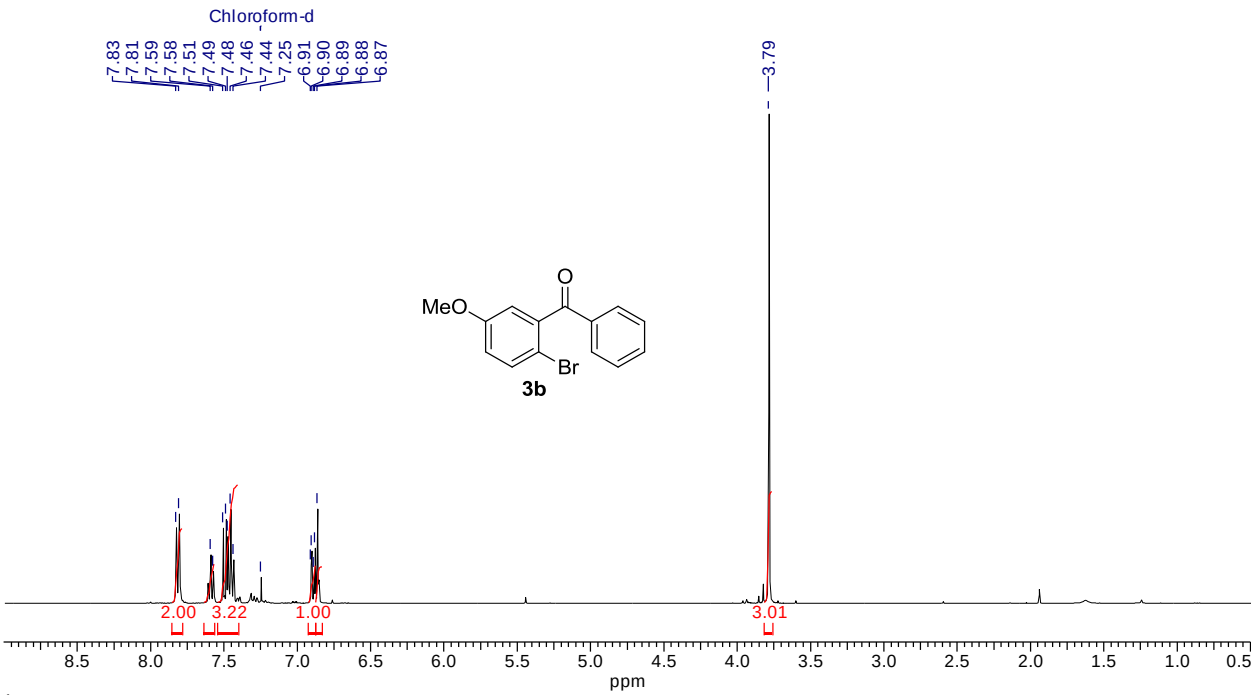
^{13}C NMR (100 MHz) spectrum of **2p** in $CDCl_3$



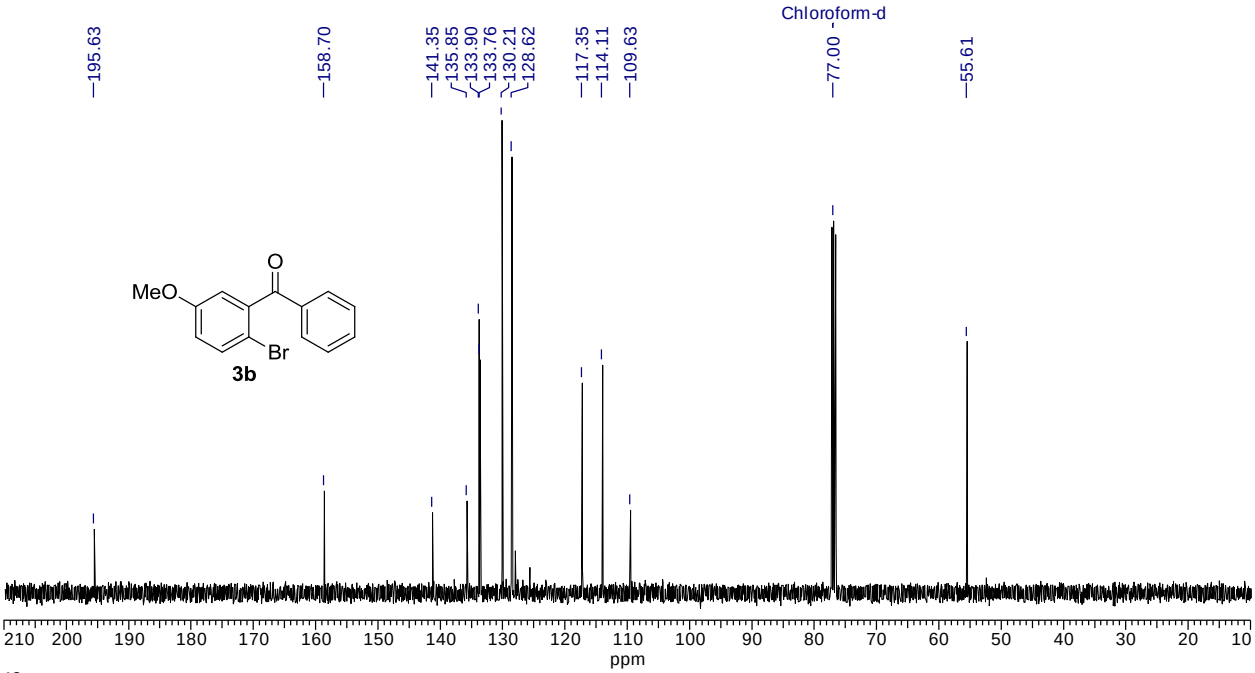
^{1}H NMR (400 MHz) spectrum of **3a** in $CDCl_3$



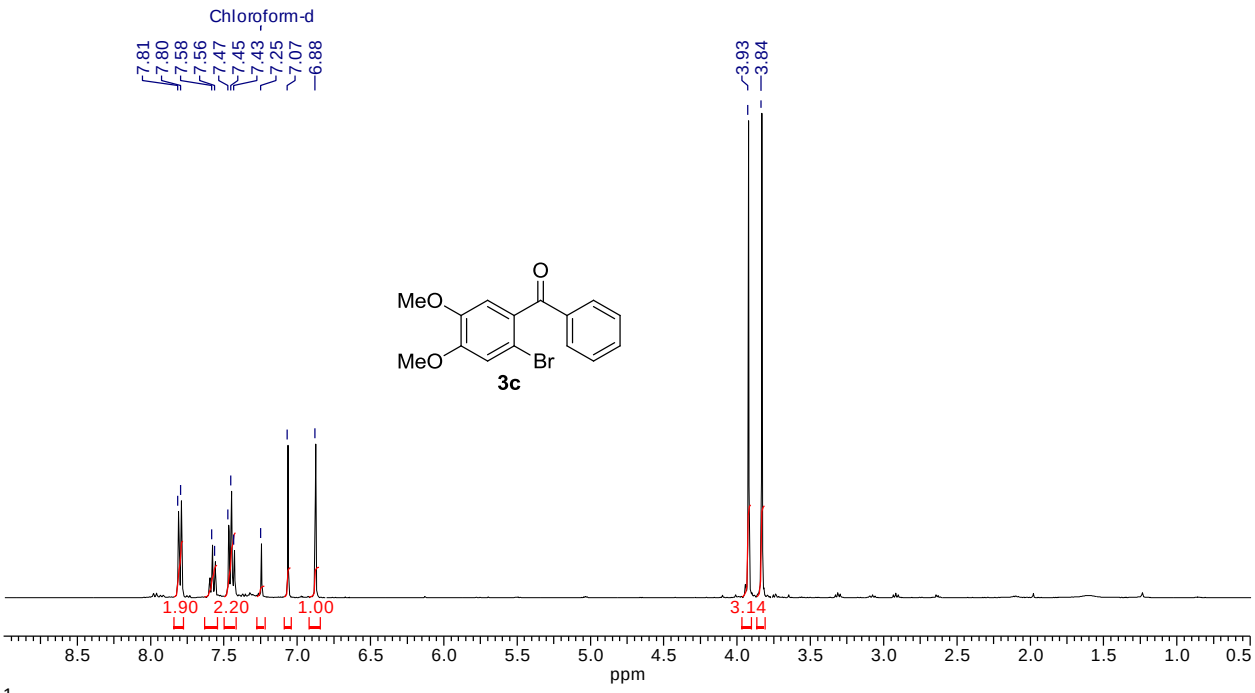
^{13}C NMR (100 MHz) spectrum of **3a** in $CDCl_3$



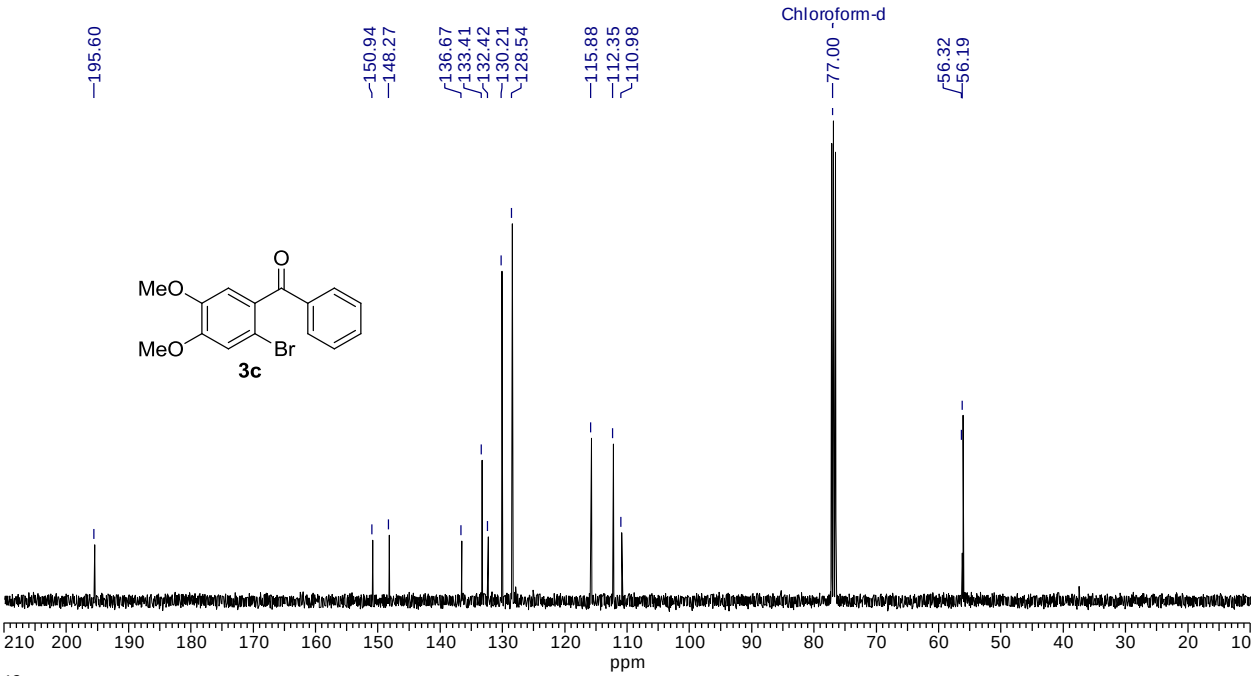
^{1}H NMR (400 MHz) spectrum of **3b** in $CDCl_3$



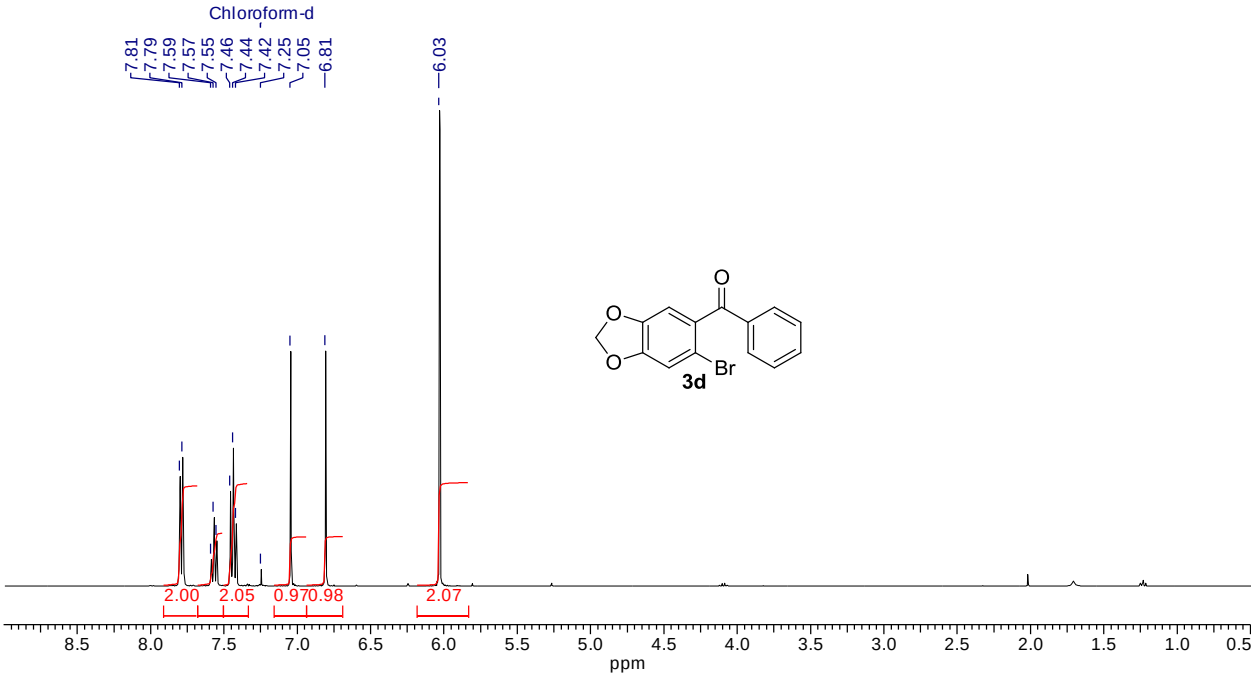
^{13}C NMR (100 MHz) spectrum of **3b** in $CDCl_3$



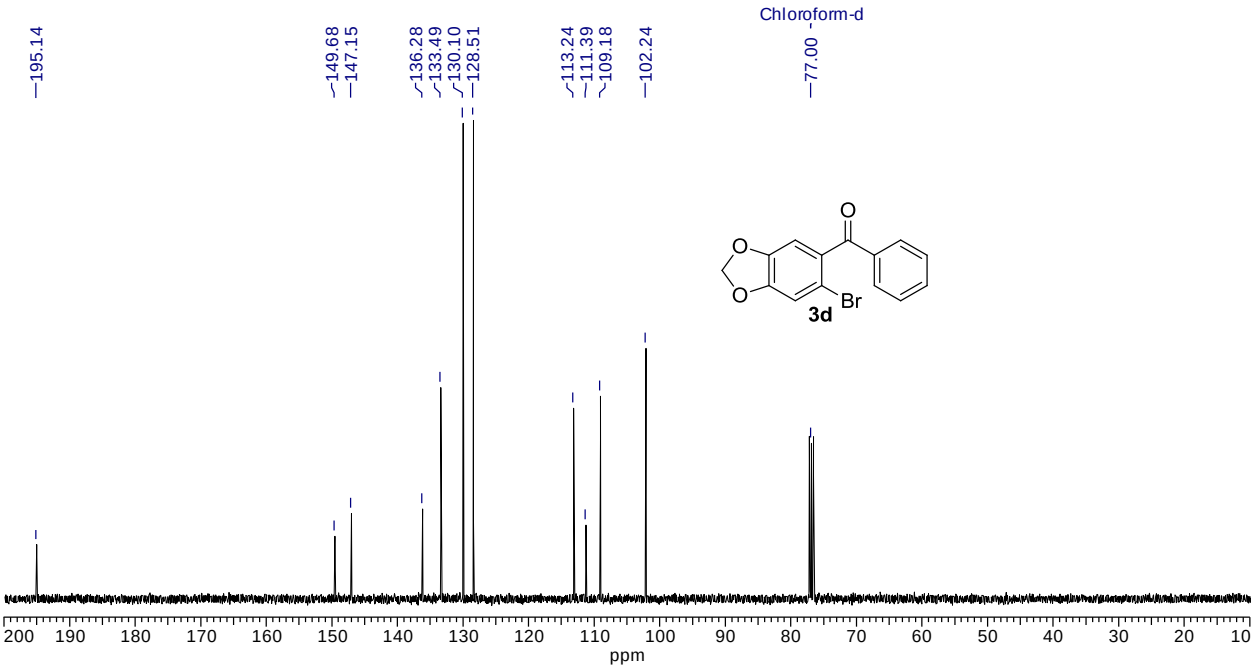
^{1}H NMR (400 MHz) spectrum of **3c** in $CDCl_3$



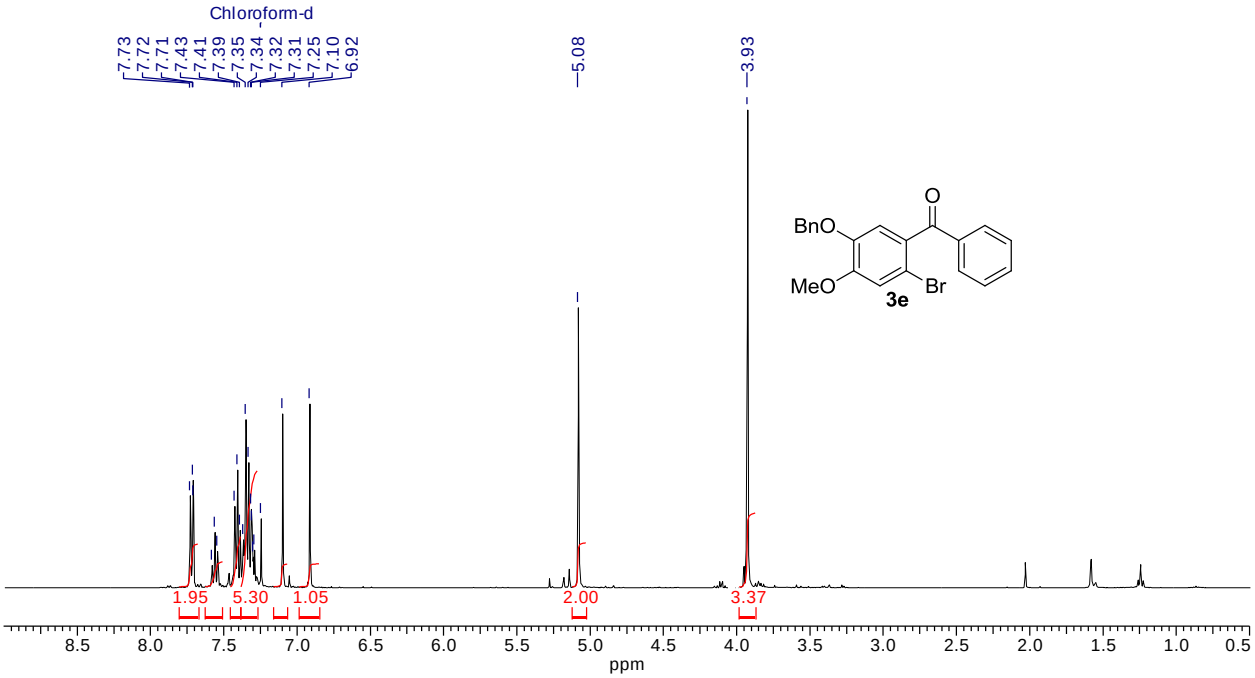
^{13}C NMR (100 MHz) spectrum of **3c** in $CDCl_3$



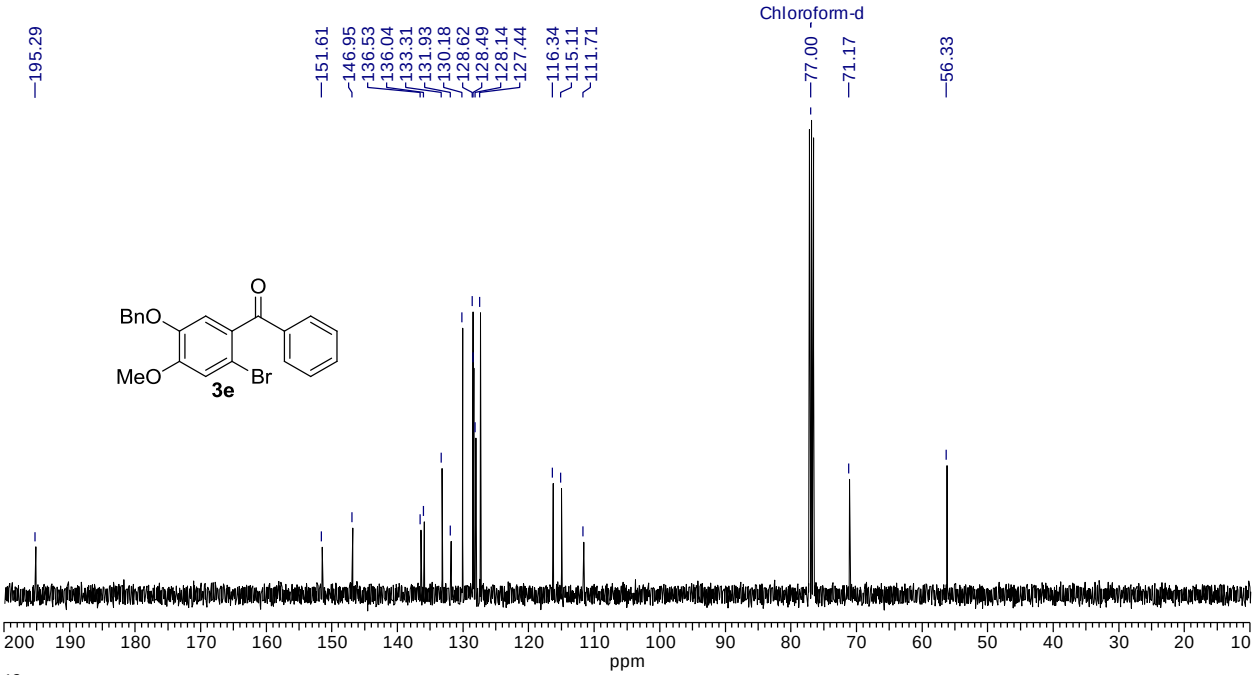
^{1}H NMR (400 MHz) spectrum of **3d** in $CDCl_3$



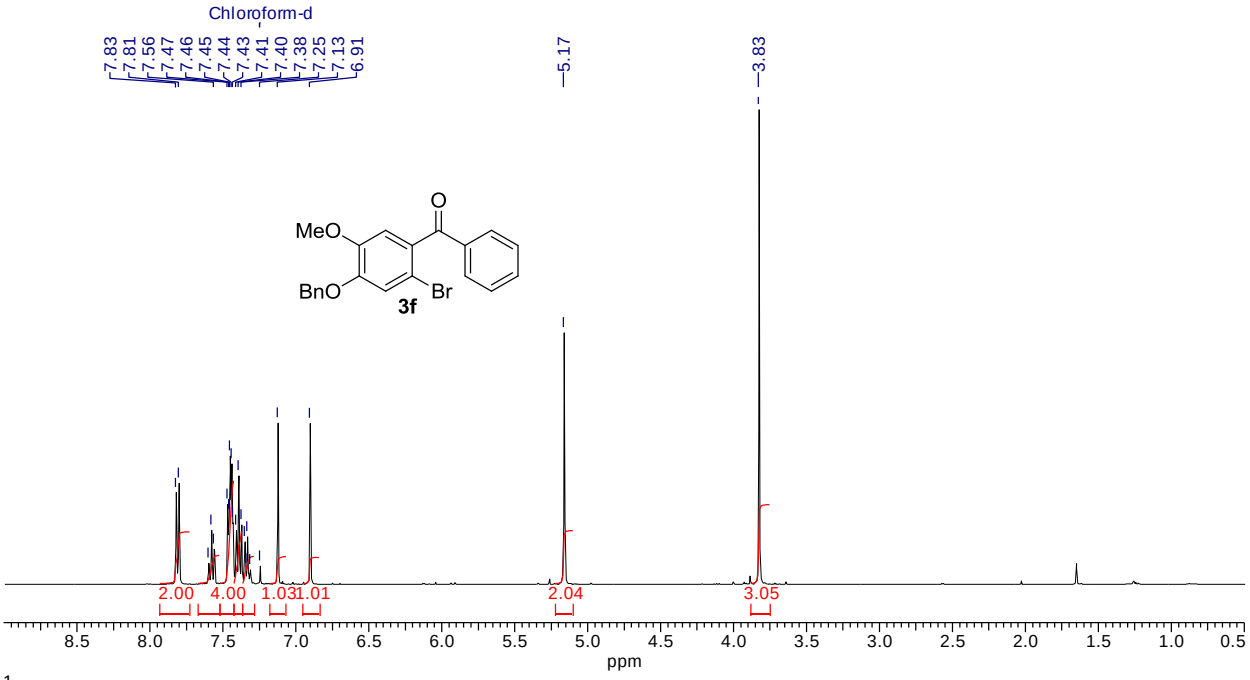
^{13}C NMR (100 MHz) spectrum of **3d** in $CDCl_3$



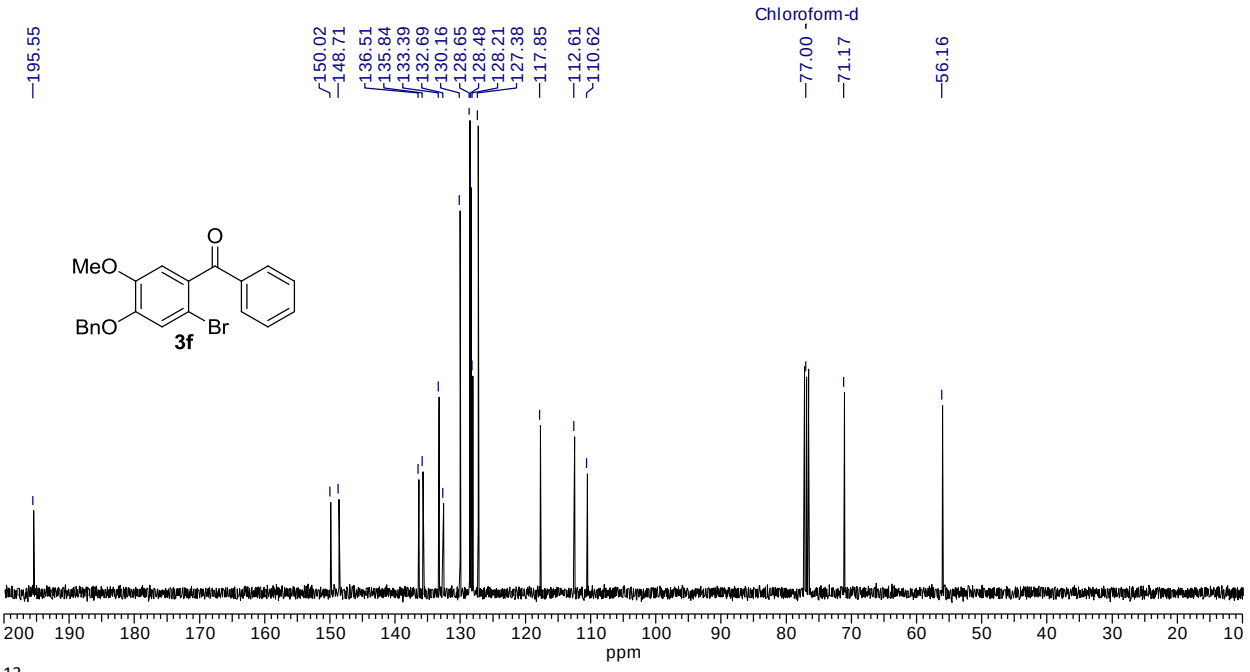
^{1}H NMR (400 MHz) spectrum of **3e** in $CDCl_3$



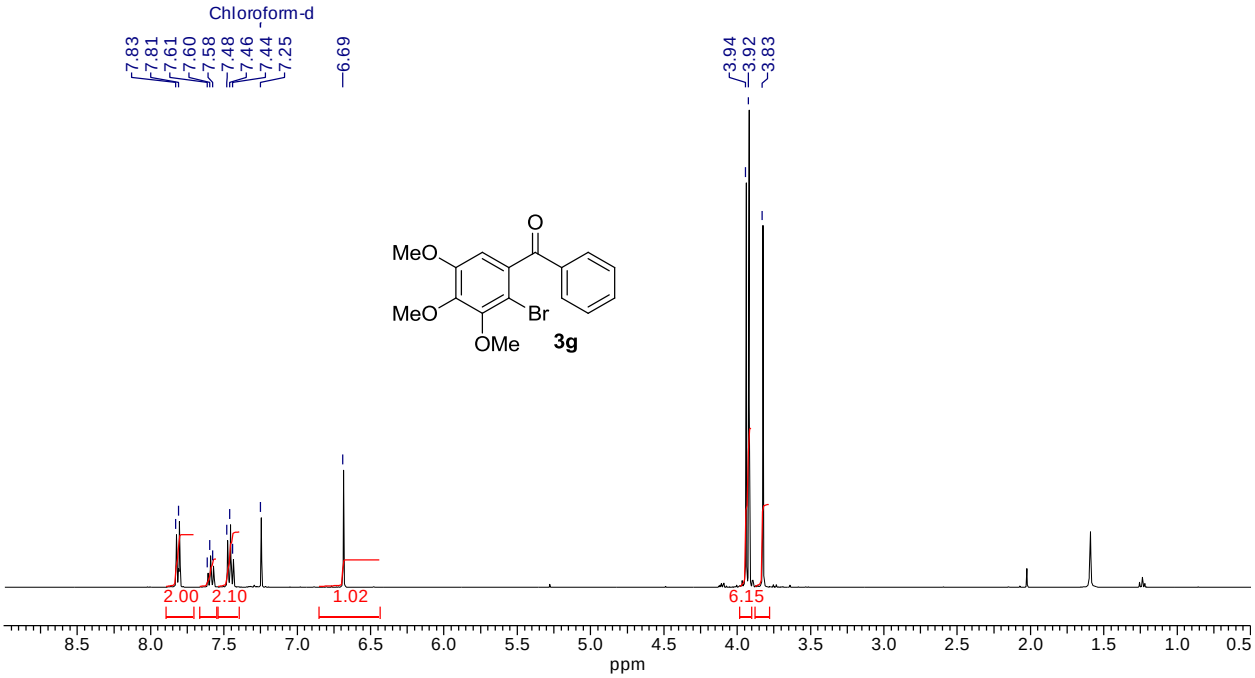
^{13}C NMR (100 MHz) spectrum of **3e** in $CDCl_3$



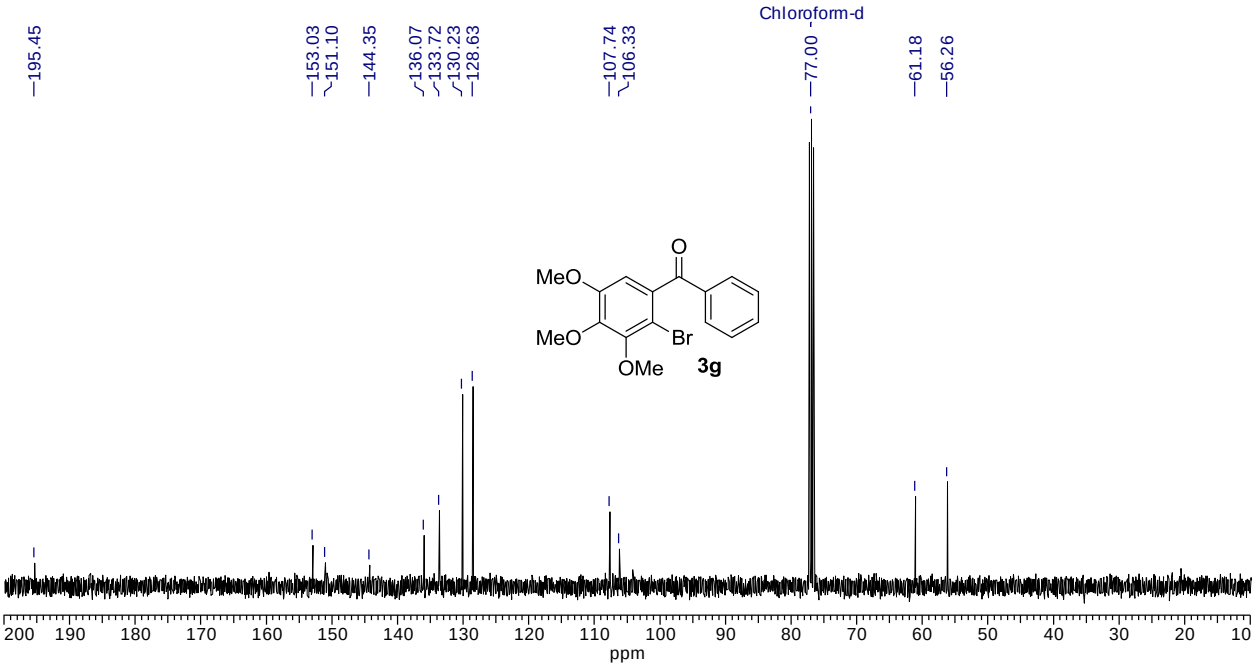
^{1}H NMR (400 MHz) spectrum of **3f** in $CDCl_3$



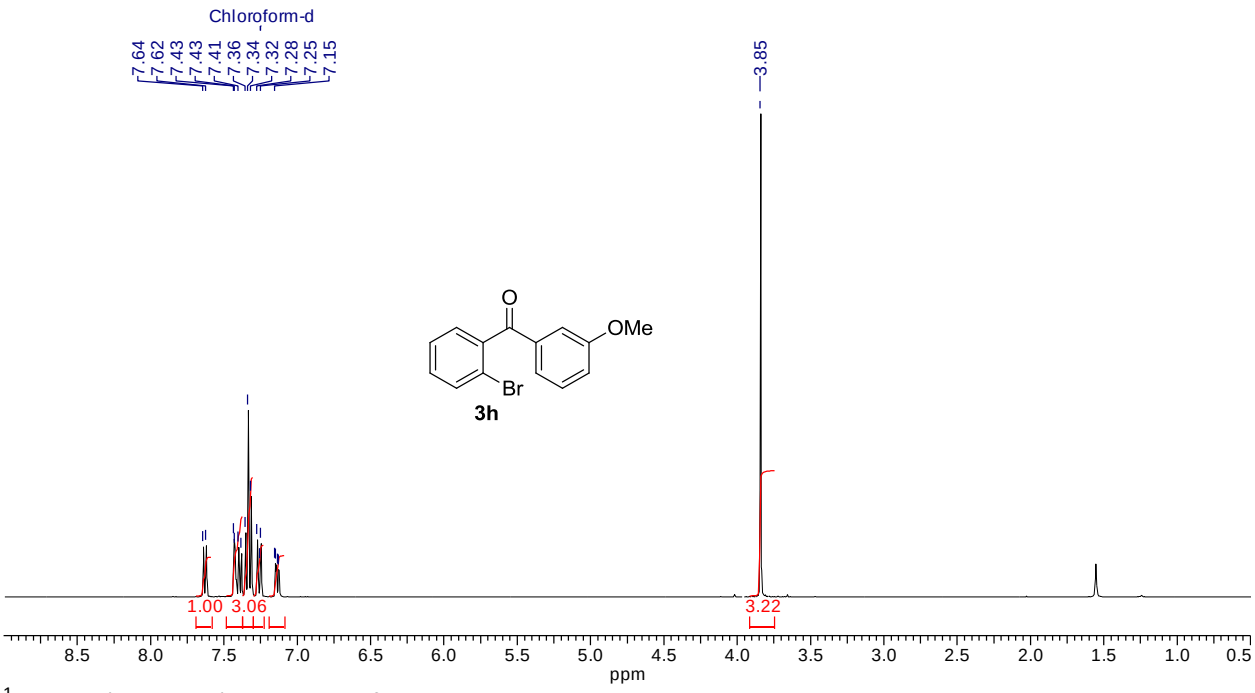
^{13}C NMR (100 MHz) spectrum of **3f** in $CDCl_3$



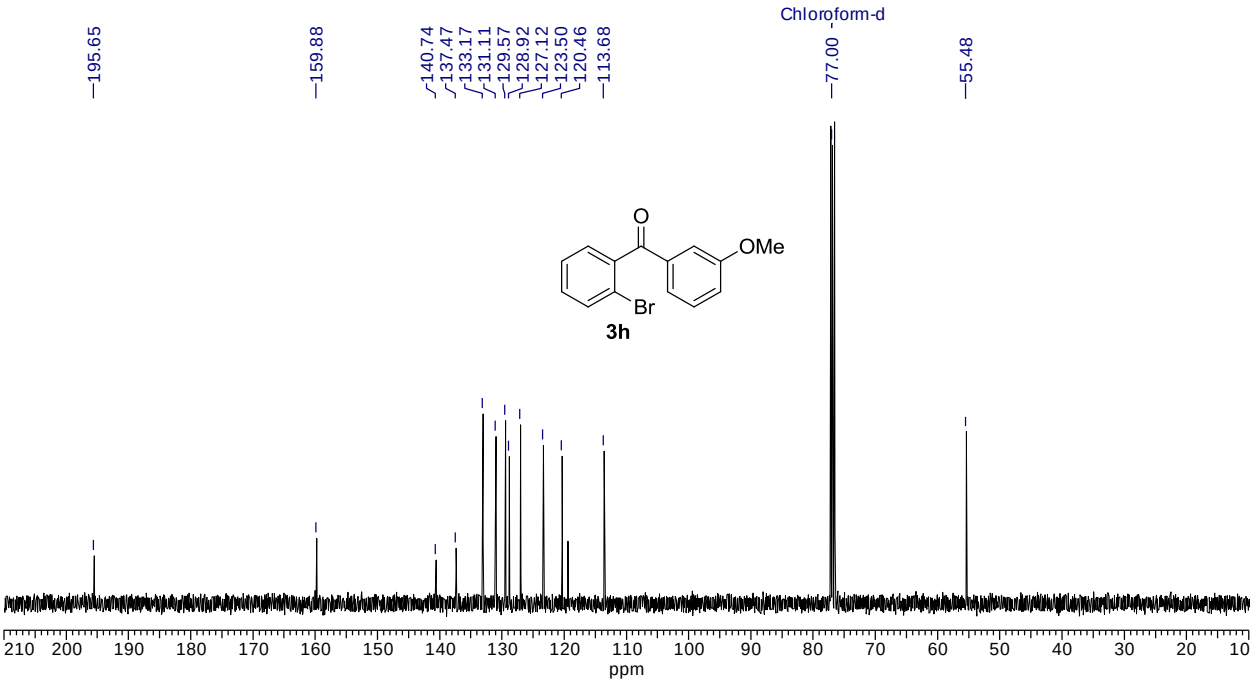
^{1}H NMR (400 MHz) spectrum of **2g** in $CDCl_3$



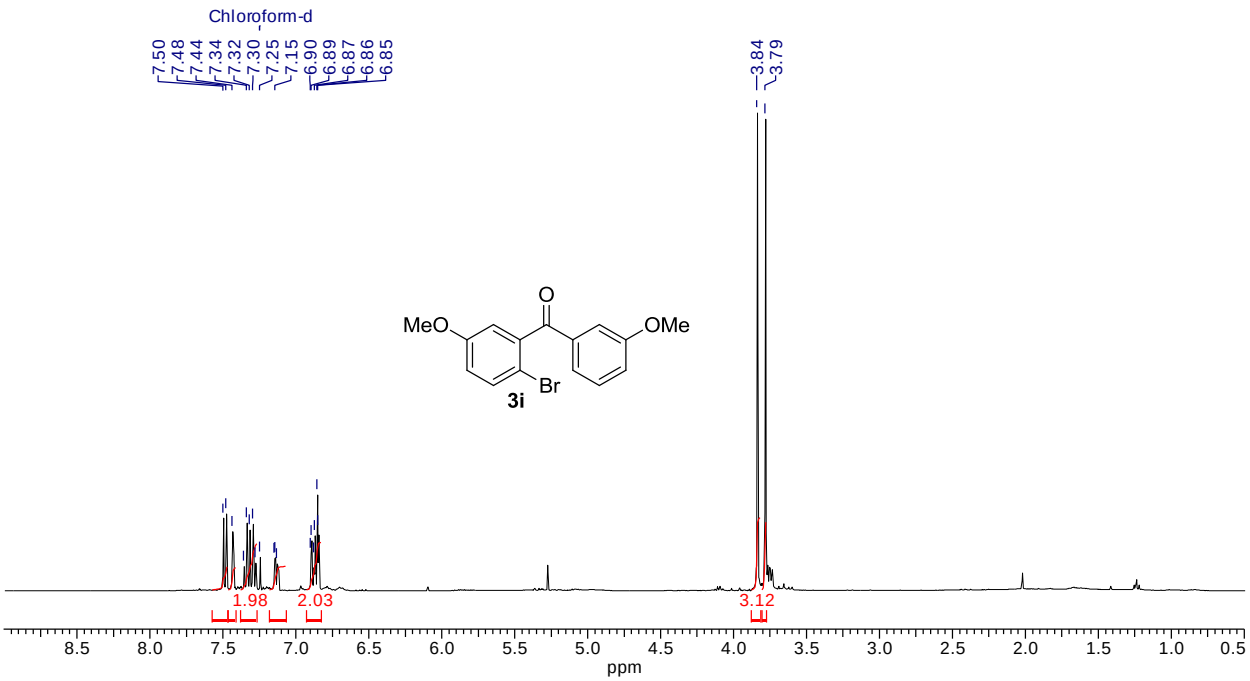
^{13}C NMR (100 MHz) spectrum of **2g** in $CDCl_3$



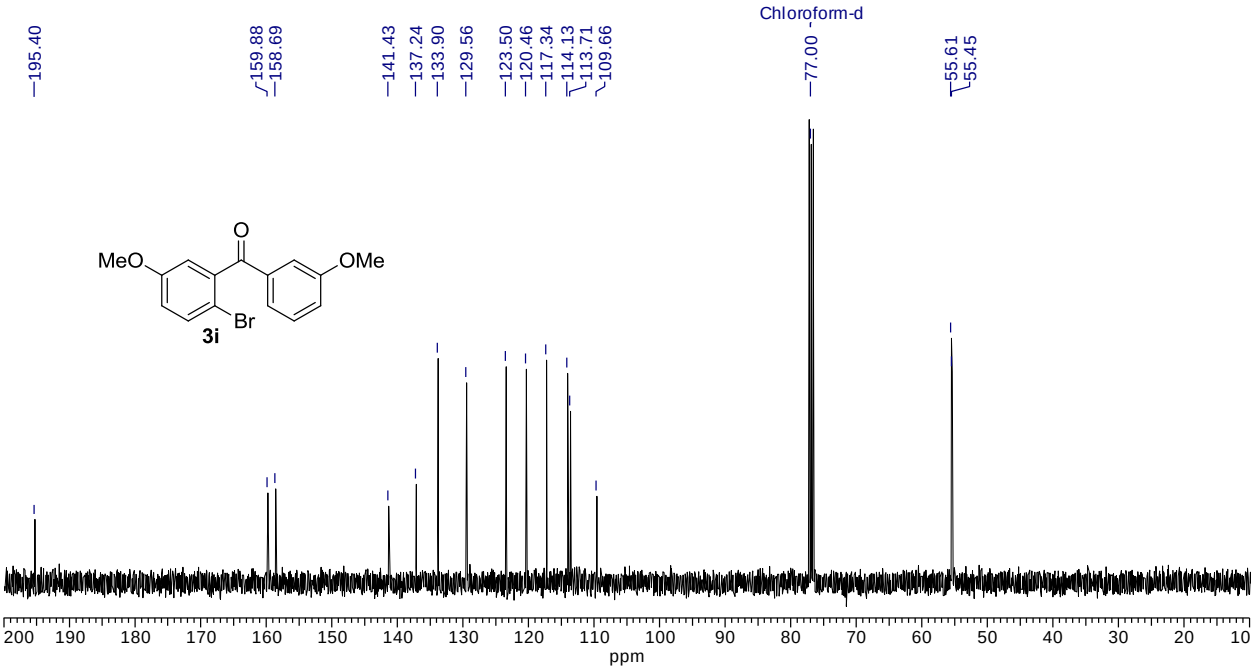
^{1}H NMR (400 MHz) spectrum of **3h** in $CDCl_3$



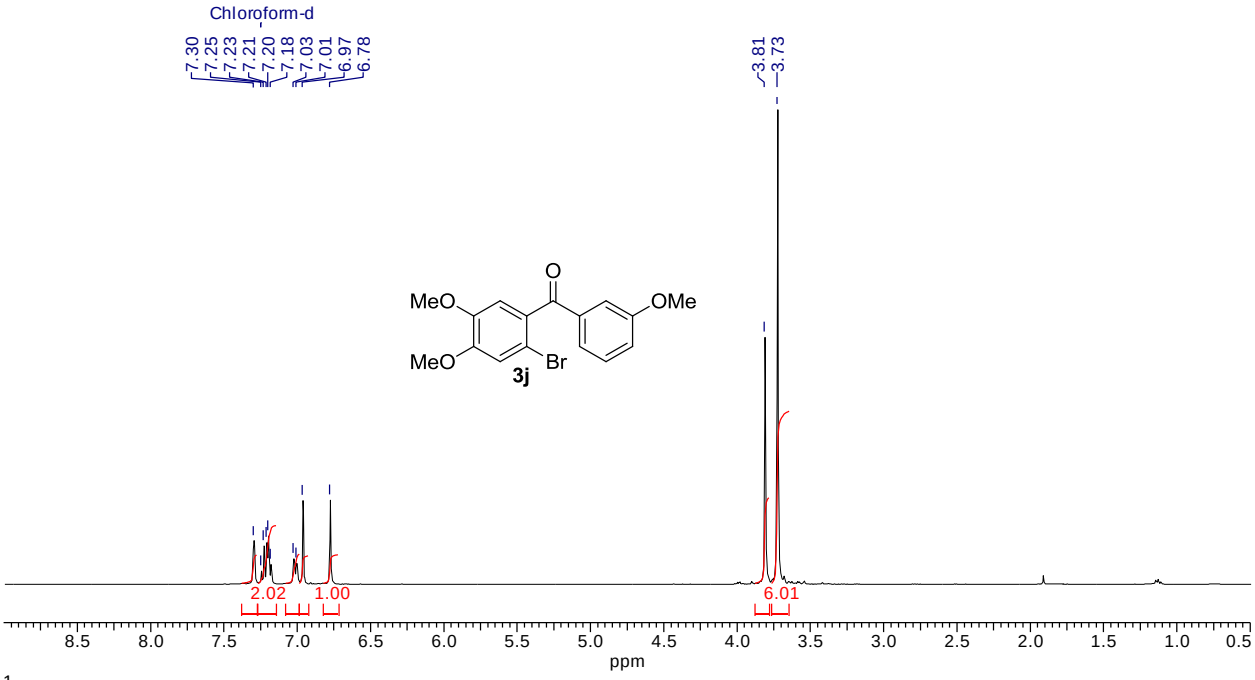
^{13}C NMR (100 MHz) spectrum of **3h** in $CDCl_3$



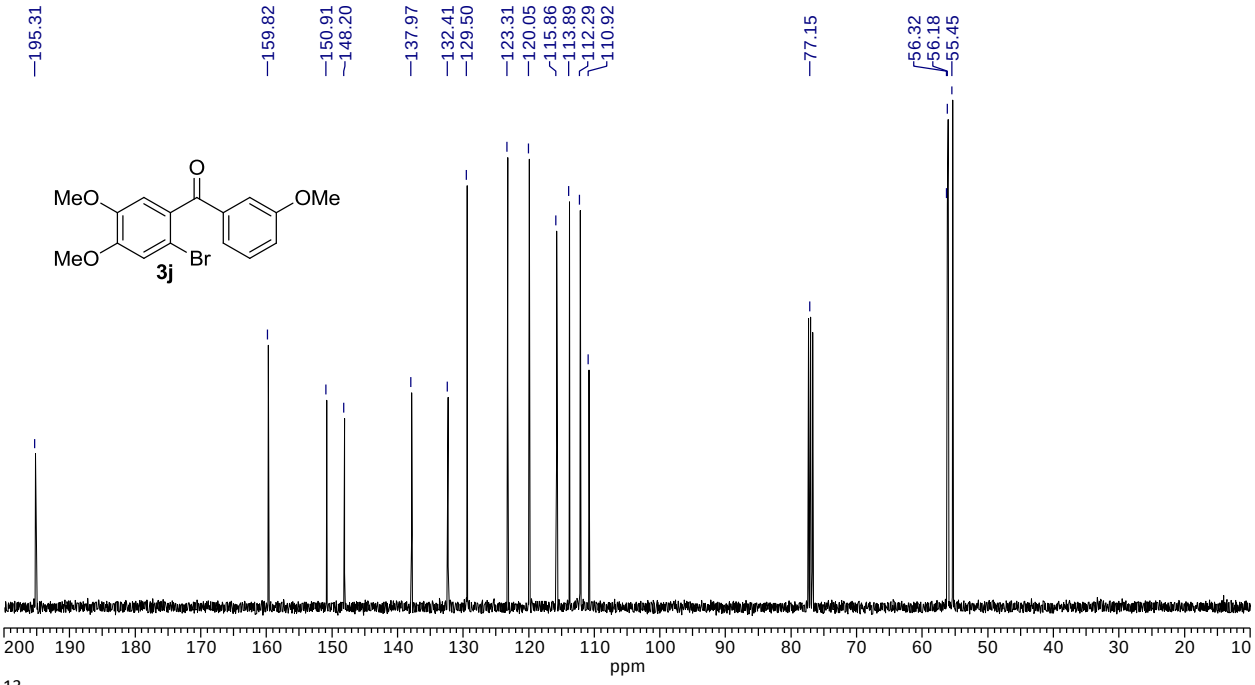
^{1}H NMR (400 MHz) spectrum of **3i** in $CDCl_3$



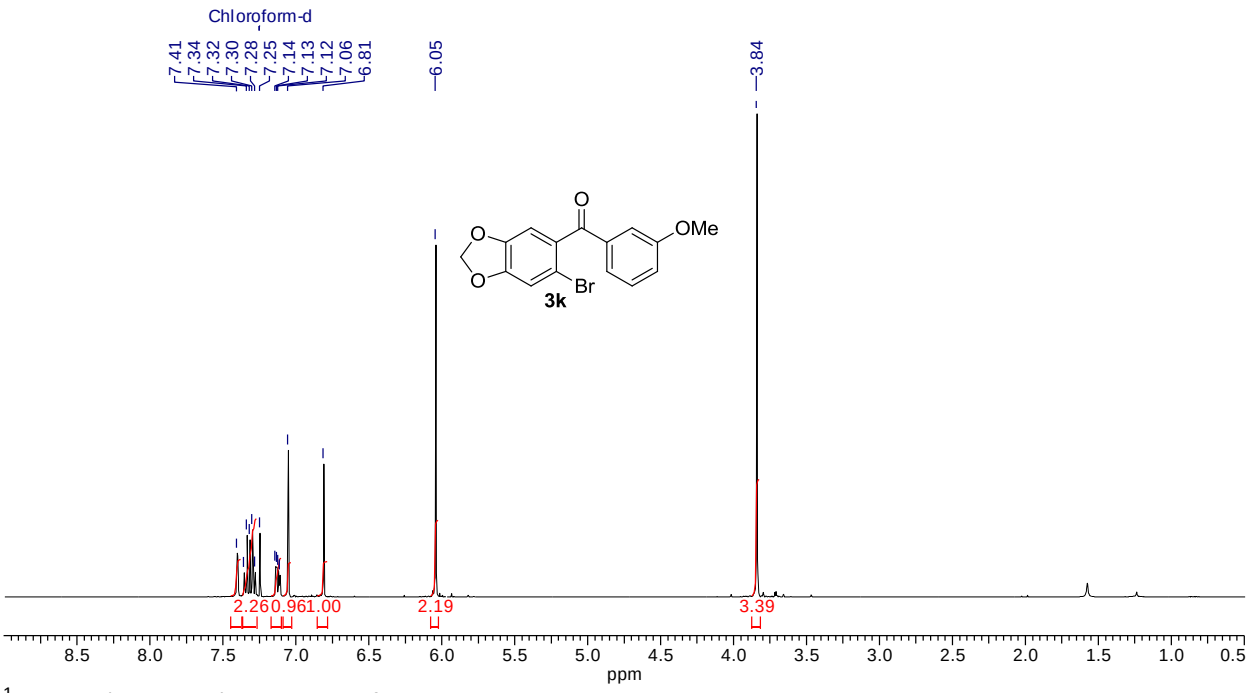
^{13}C NMR (100 MHz) spectrum of **3i** in $CDCl_3$



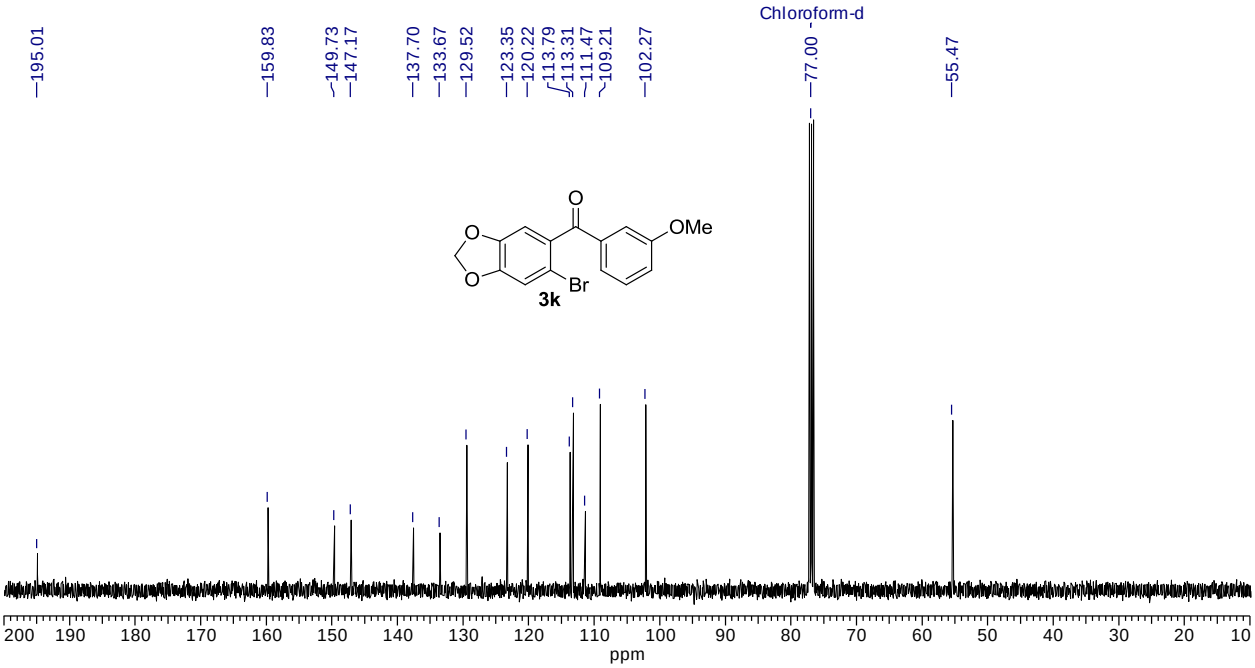
^{1}H NMR (400 MHz) spectrum of **3j** in $CDCl_3$



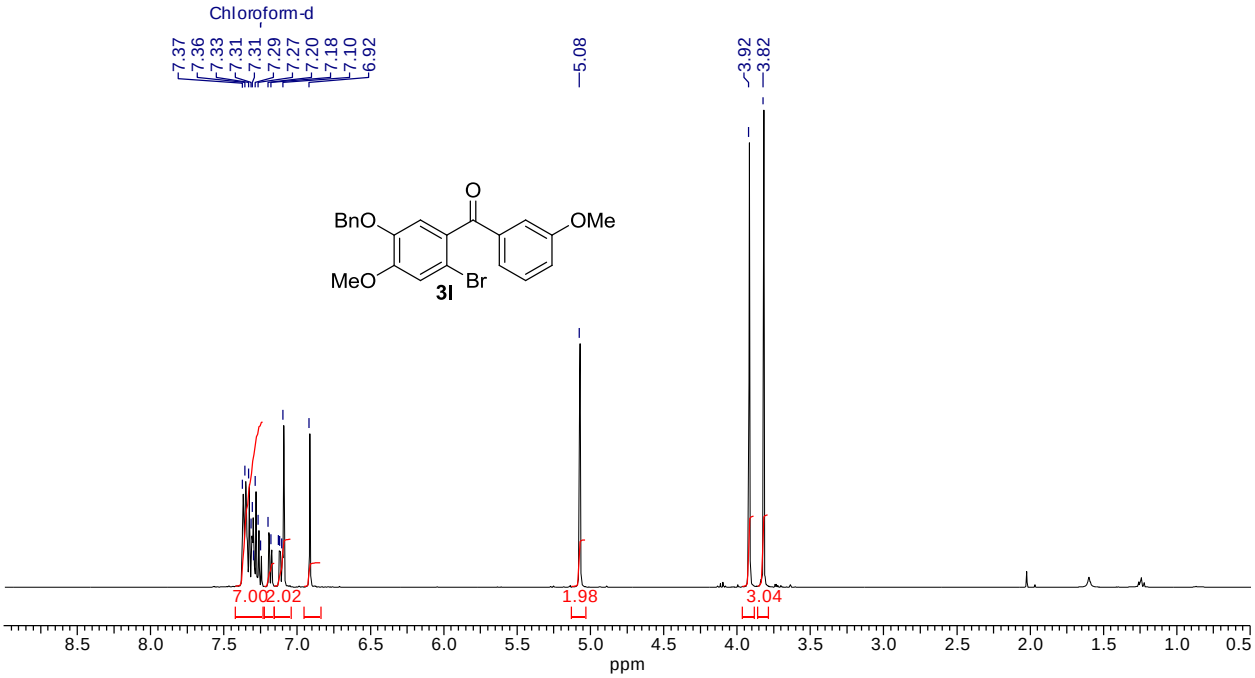
^{13}C NMR (100 MHz) spectrum of **3j** in $CDCl_3$



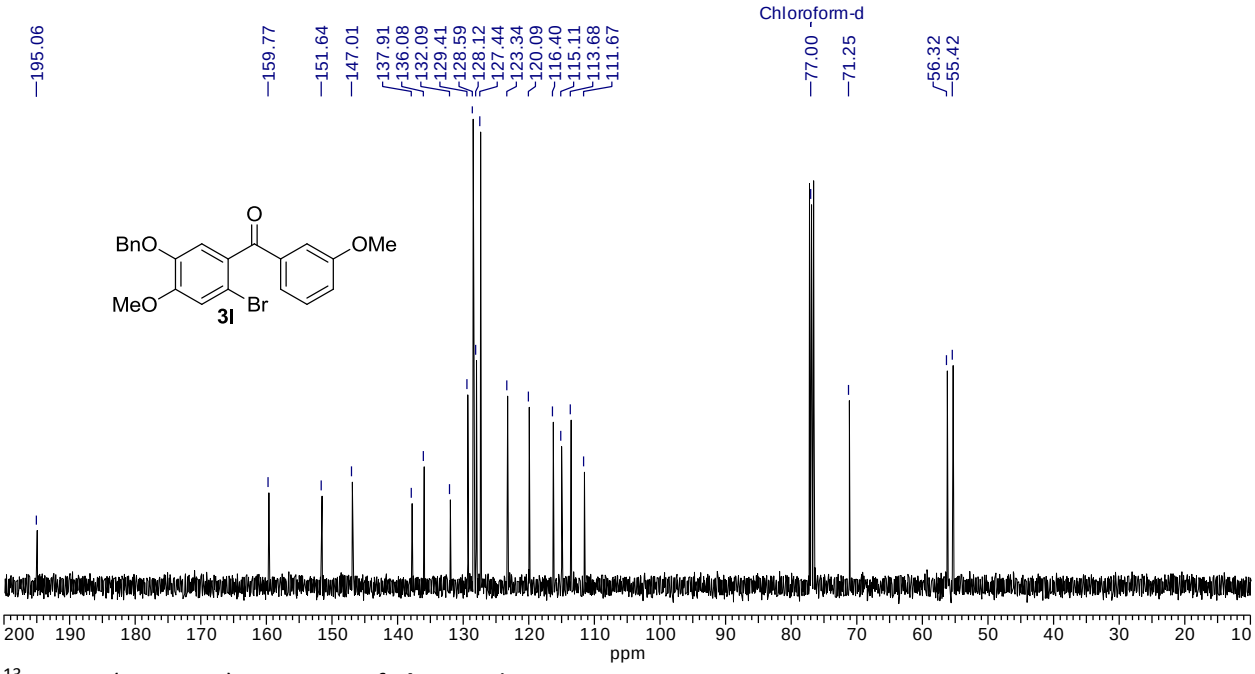
^{1}H NMR (400 MHz) spectrum of **3k** in $CDCl_3$



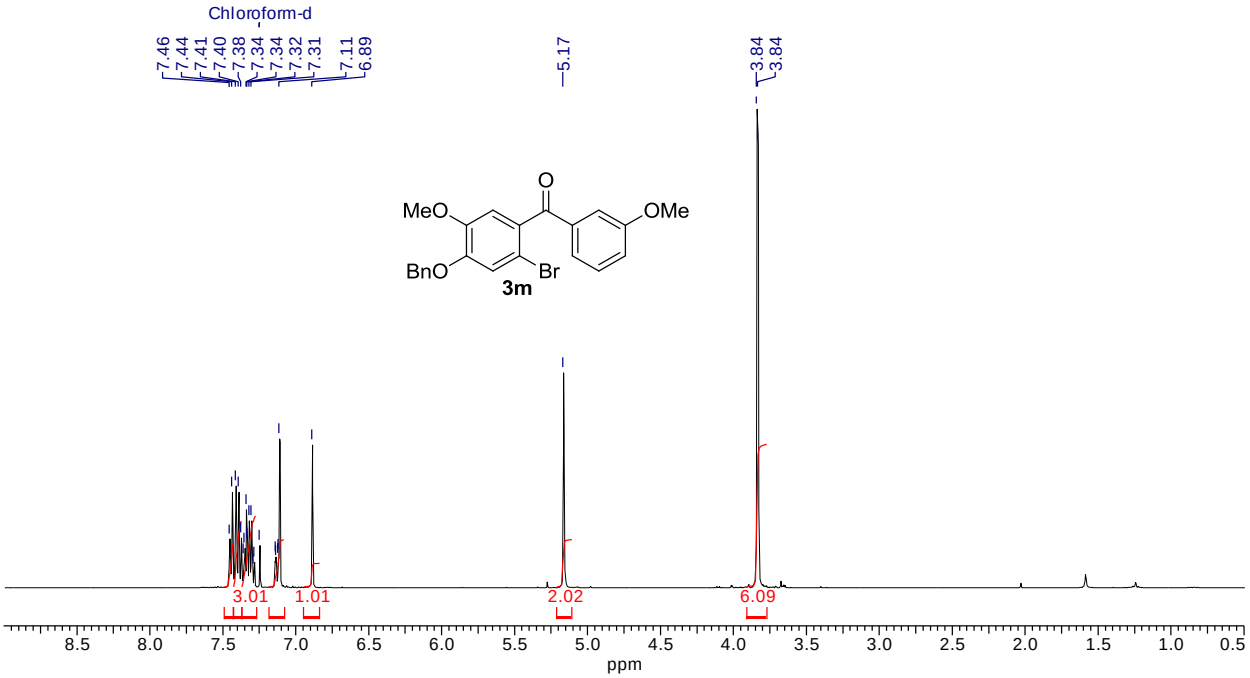
^{13}C NMR (100 MHz) spectrum of **3k** in $CDCl_3$



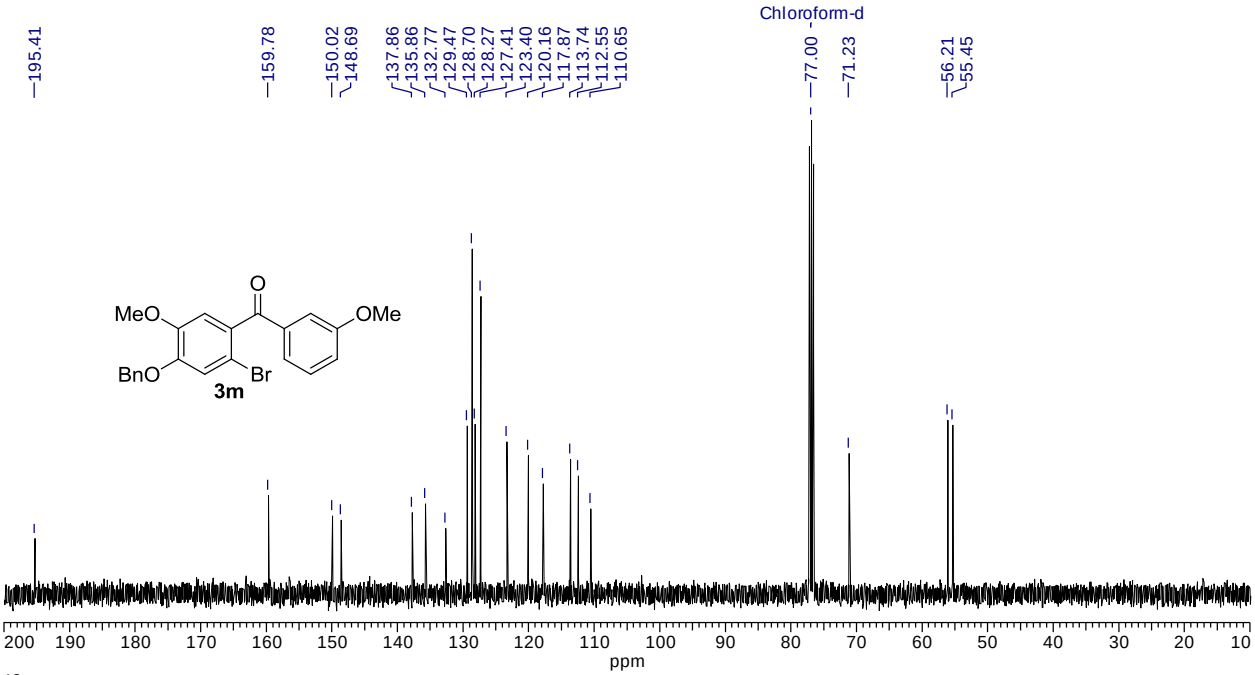
^{1}H NMR (400 MHz) spectrum of **3l** in $CDCl_3$



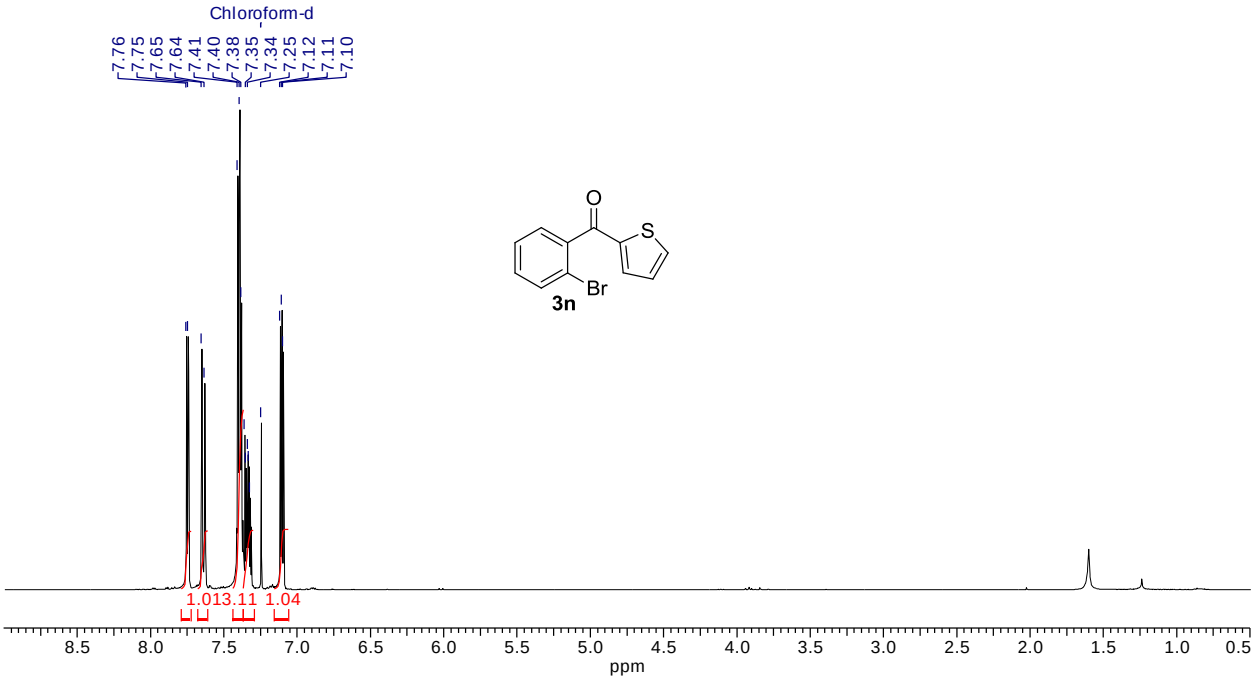
^{13}C NMR (100 MHz) spectrum of **3l** in $CDCl_3$



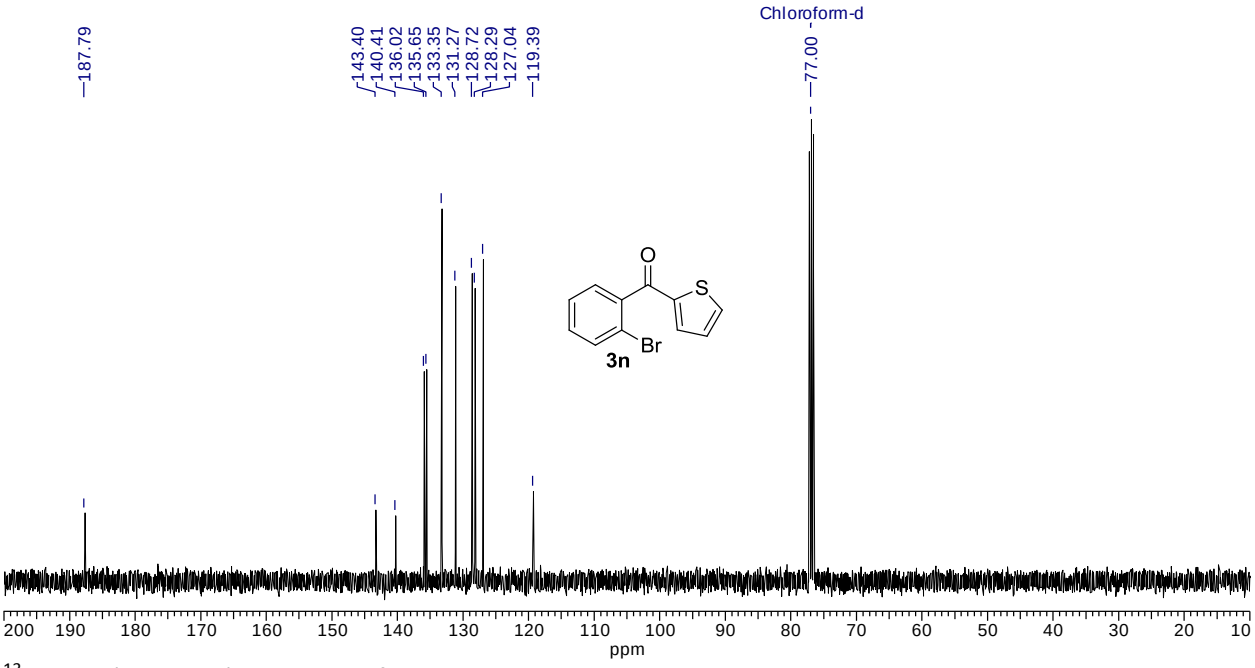
^{1}H NMR (400 MHz) spectrum of **3m** in $CDCl_3$



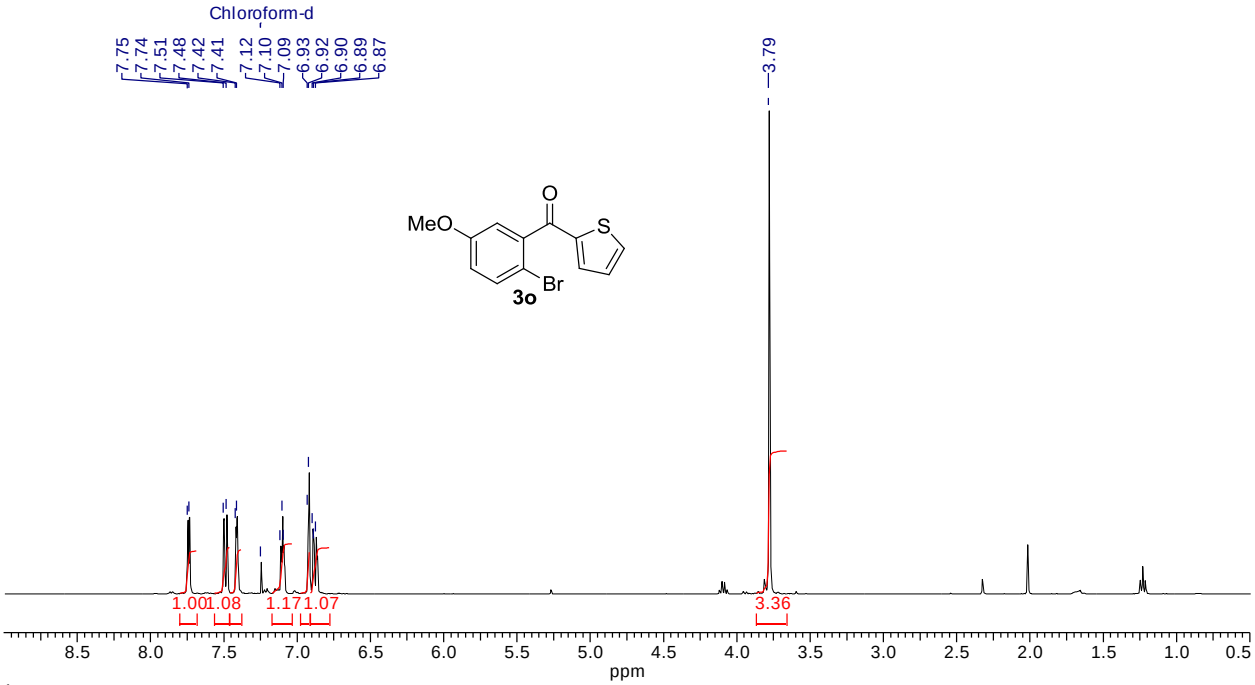
^{13}C NMR (100 MHz) spectrum of **3m** in $CDCl_3$



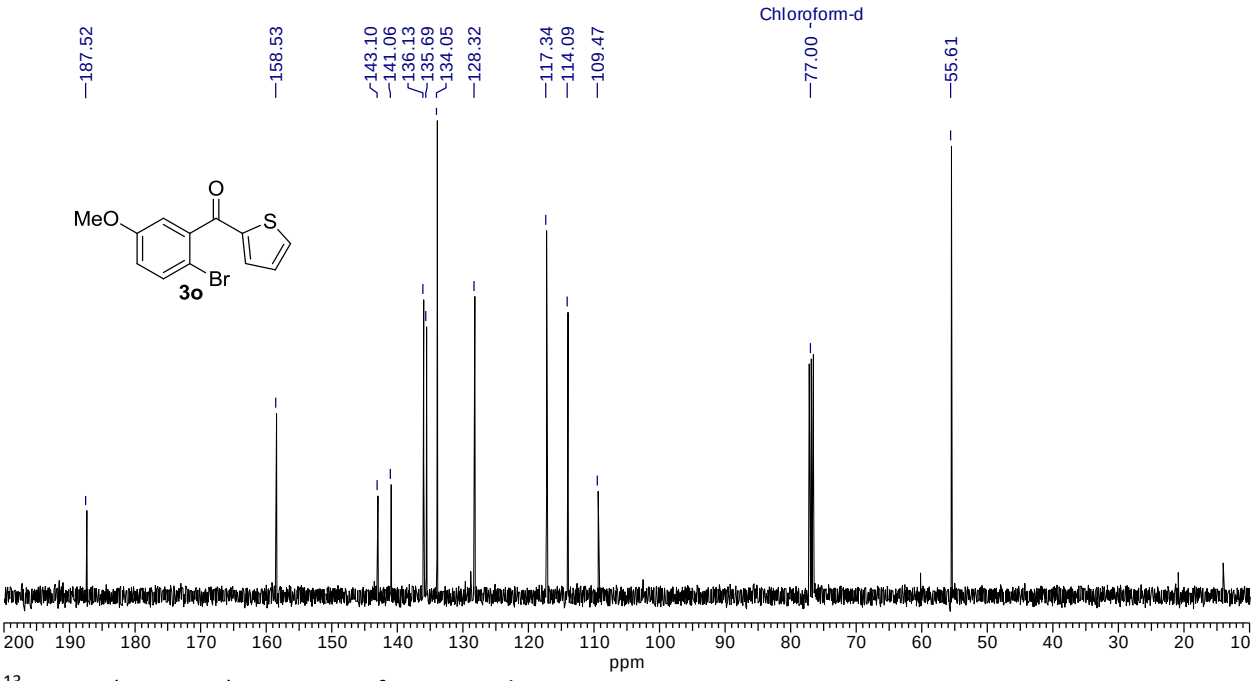
^{1}H NMR (400 MHz) spectrum of **3n** in $CDCl_3$



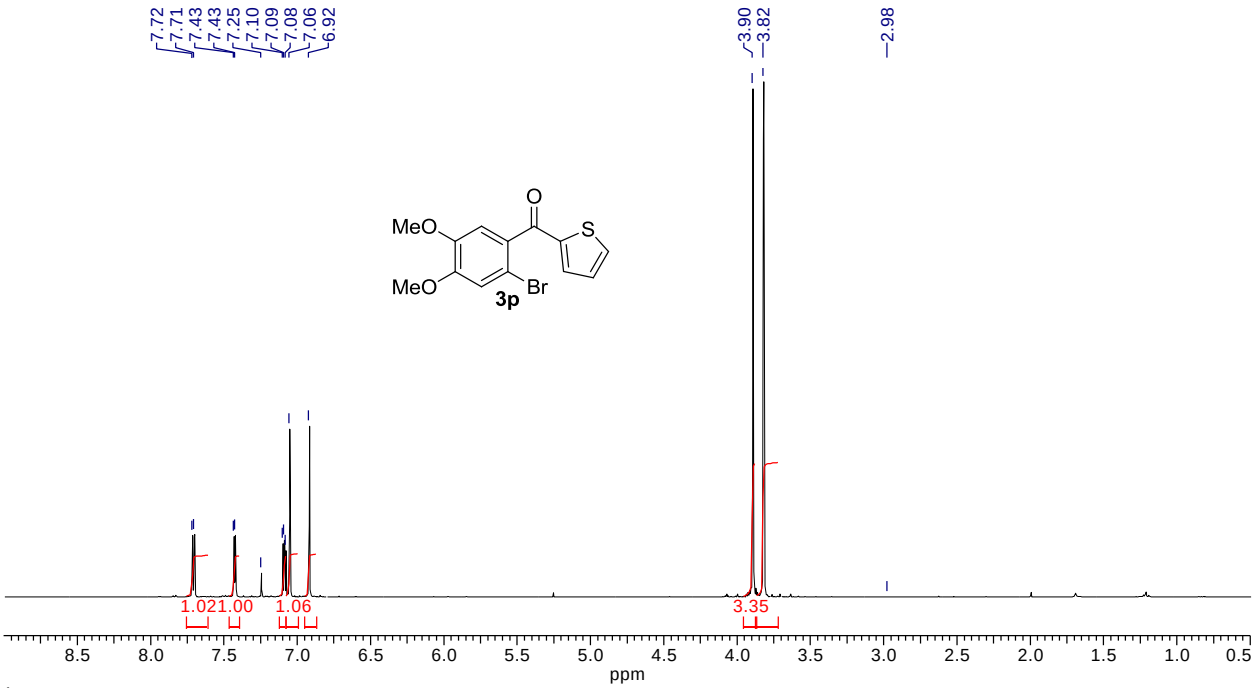
^{13}C NMR (100 MHz) spectrum of **3n** in $CDCl_3$



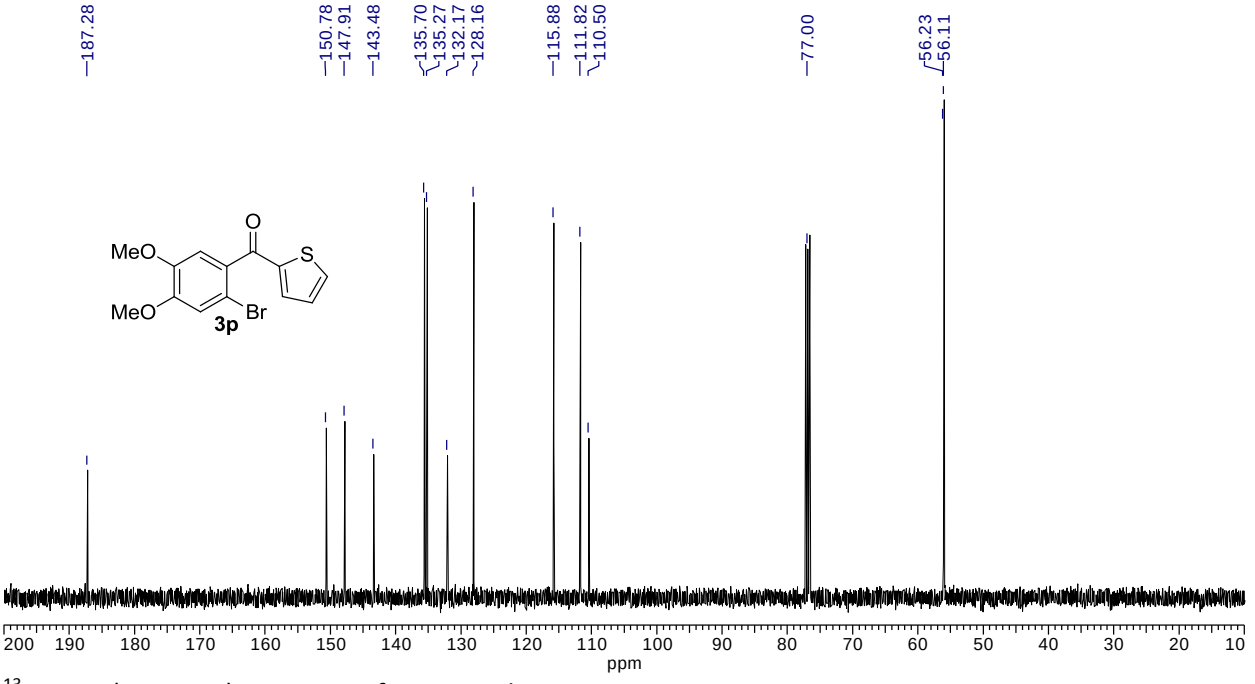
^{1}H NMR (400 MHz) spectrum of **3o** in $CDCl_3$



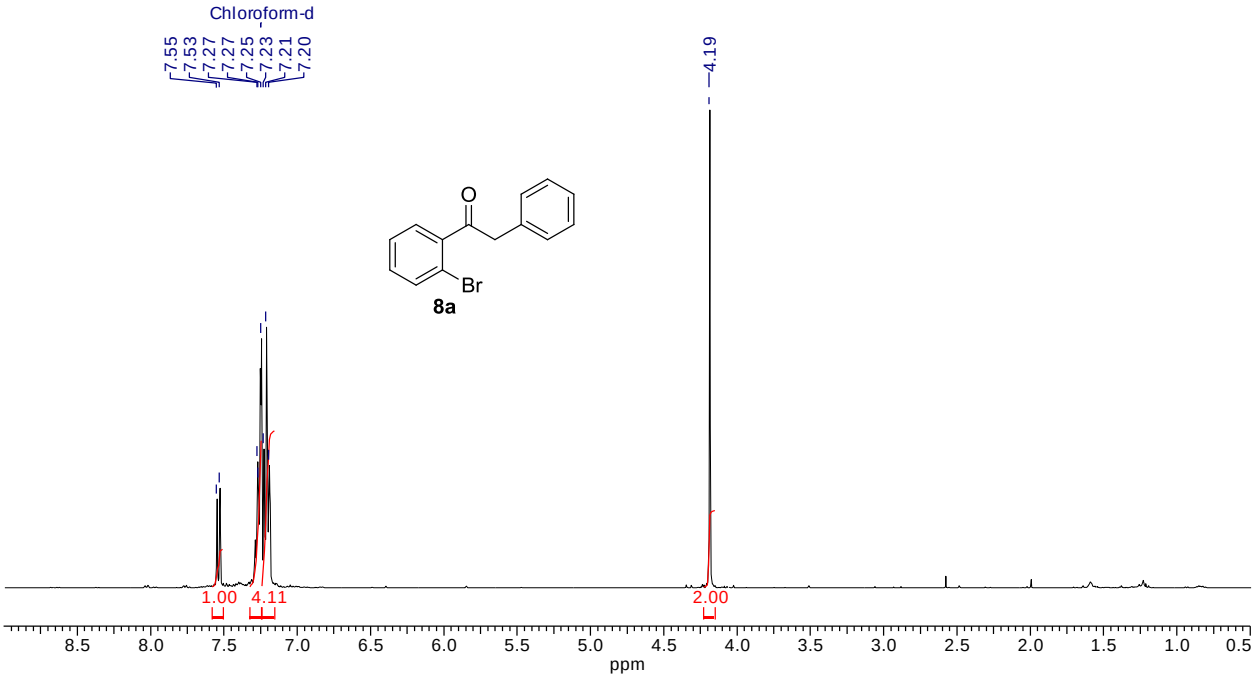
^{13}C NMR (100 MHz) spectrum of **3o** in $CDCl_3$



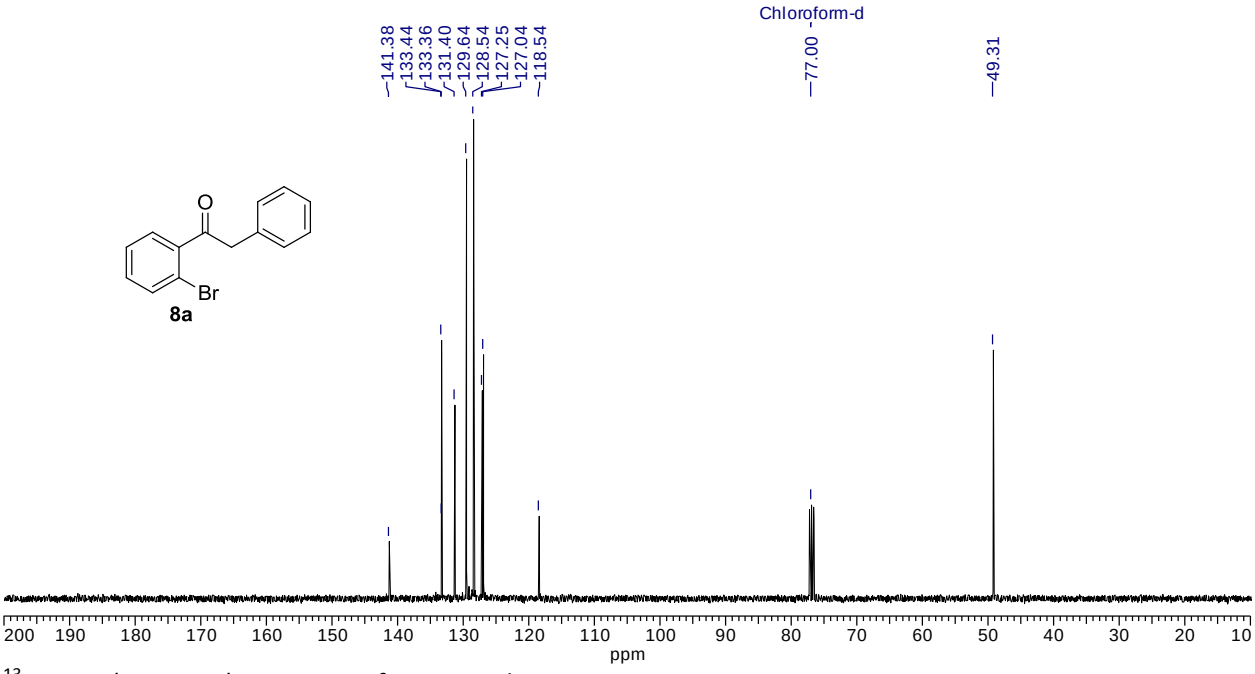
^{1}H NMR (400 MHz) spectrum of **3p** in $CDCl_3$



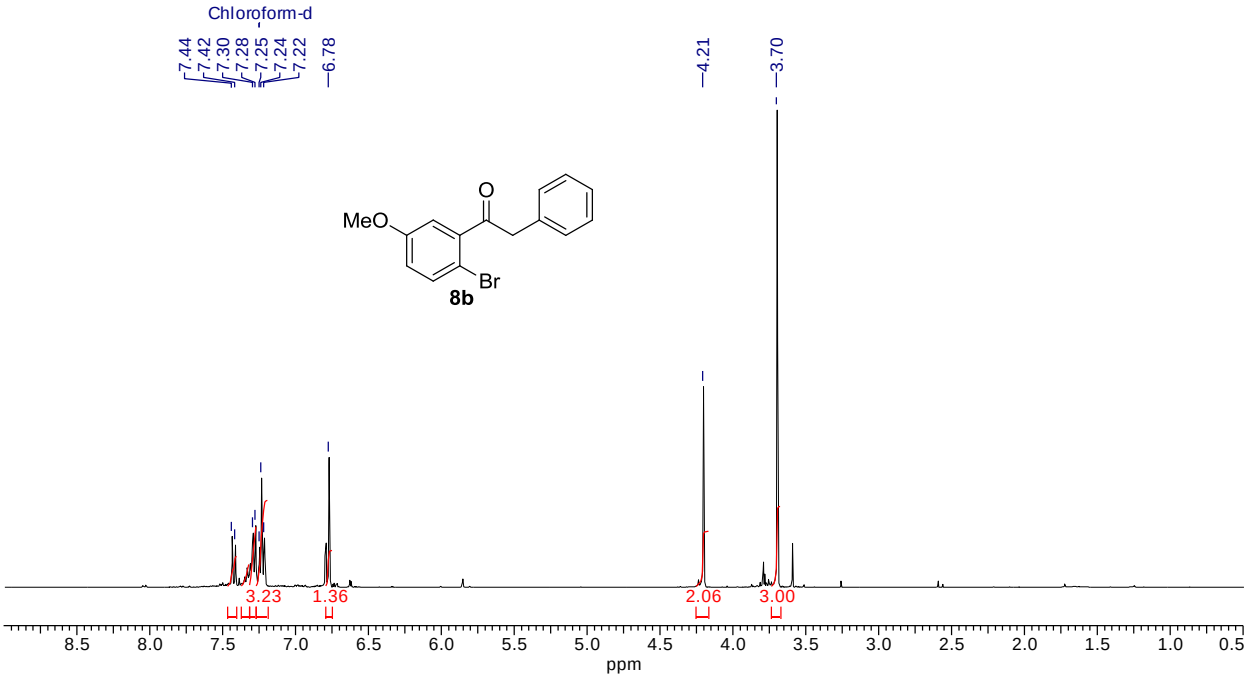
^{13}C NMR (100 MHz) spectrum of **3p** in $CDCl_3$



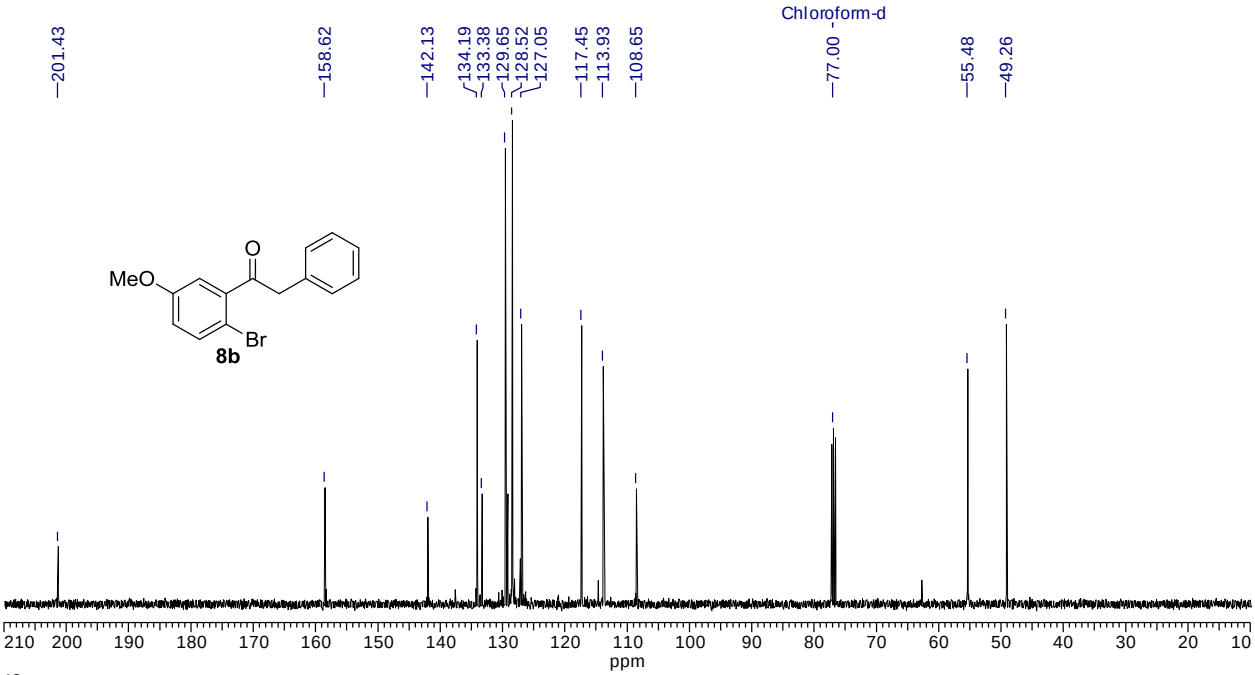
^{1}H NMR (400 MHz) spectrum of **8a** in $CDCl_3$



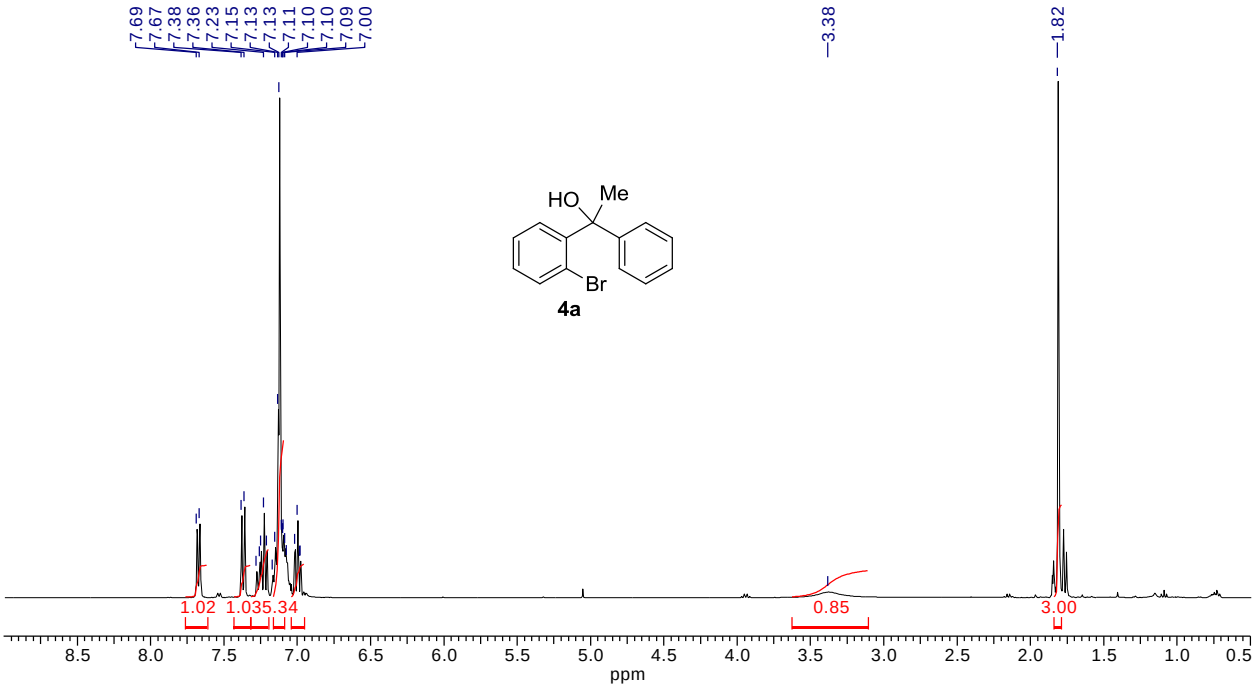
^{13}C NMR (100 MHz) spectrum of **8a** in $CDCl_3$



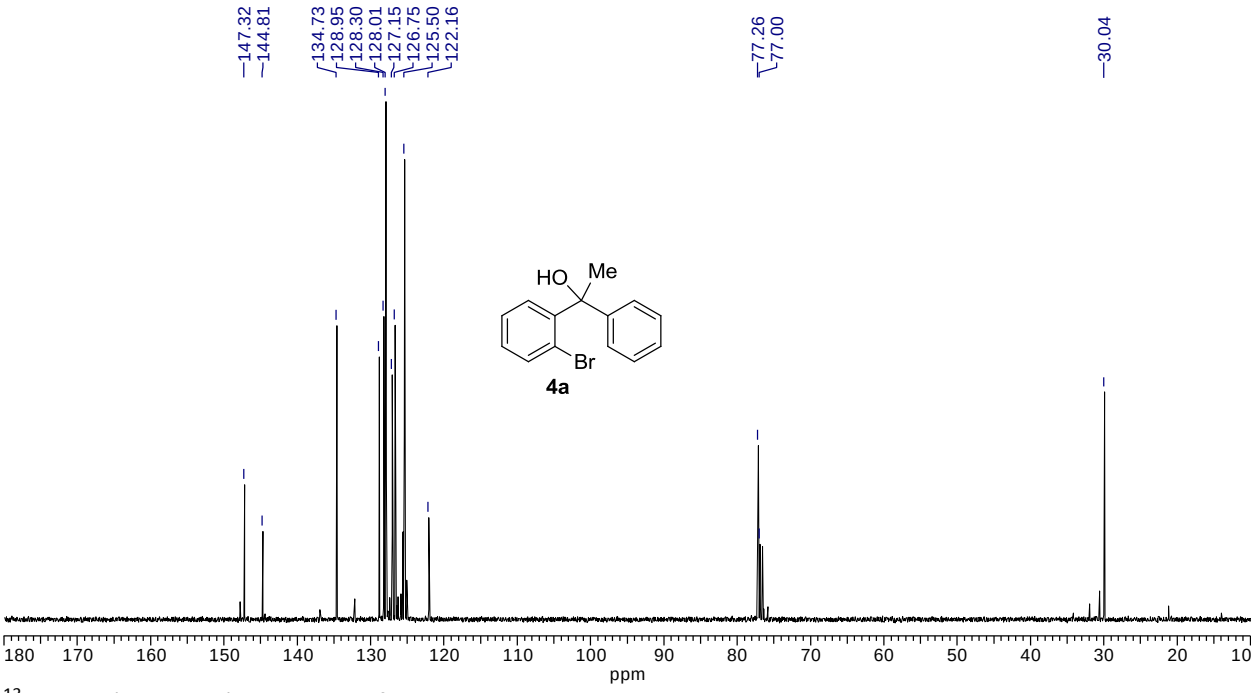
^{1}H NMR (400 MHz) spectrum of **8b** in $CDCl_3$



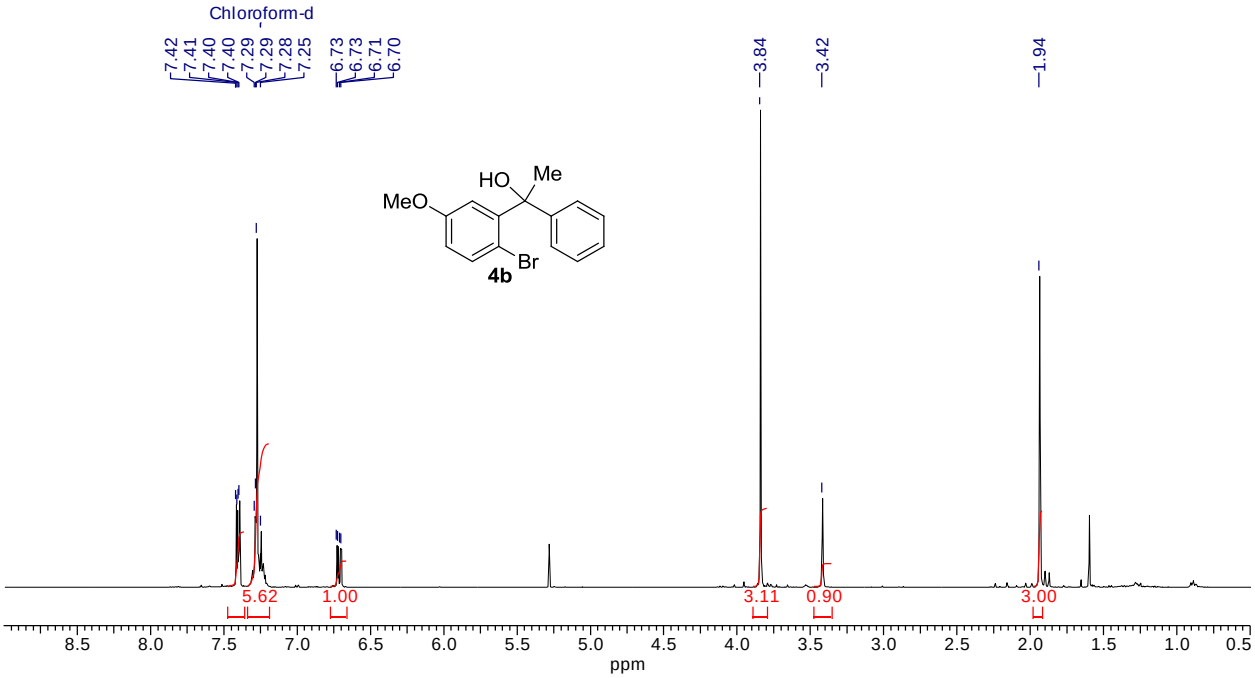
^{13}C NMR (100 MHz) spectrum of **8b** in $CDCl_3$



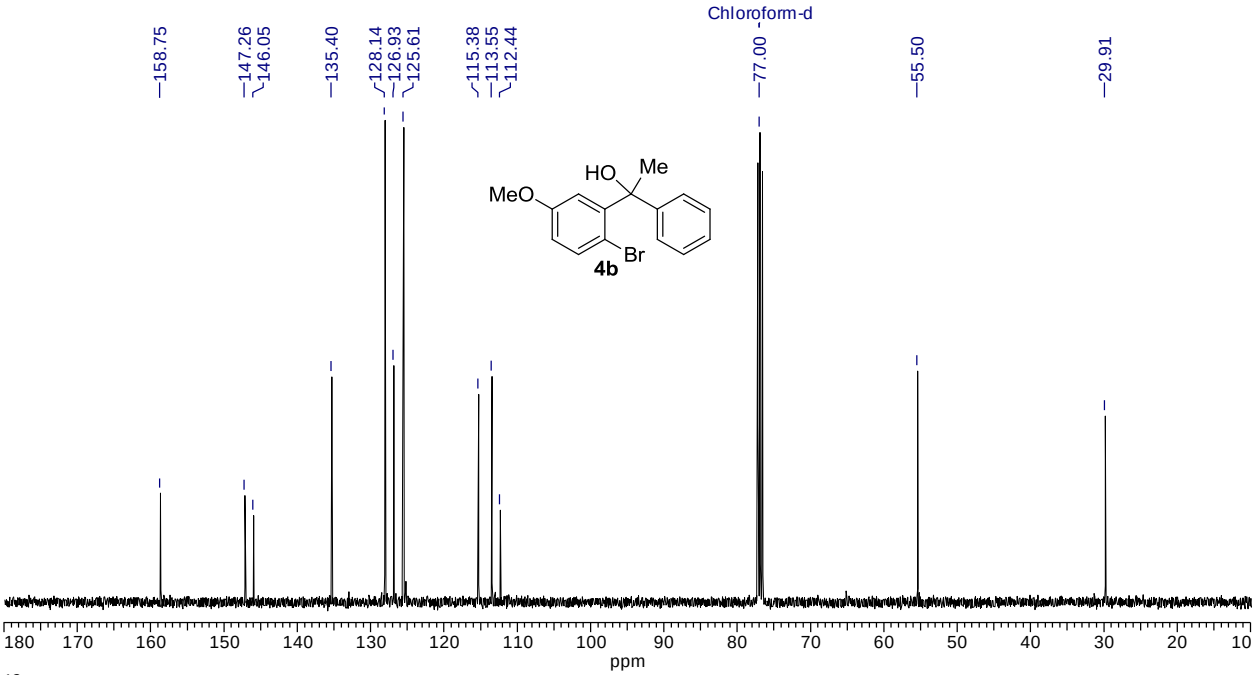
^{1}H NMR (400 MHz) spectrum of **4a** in $CDCl_3$



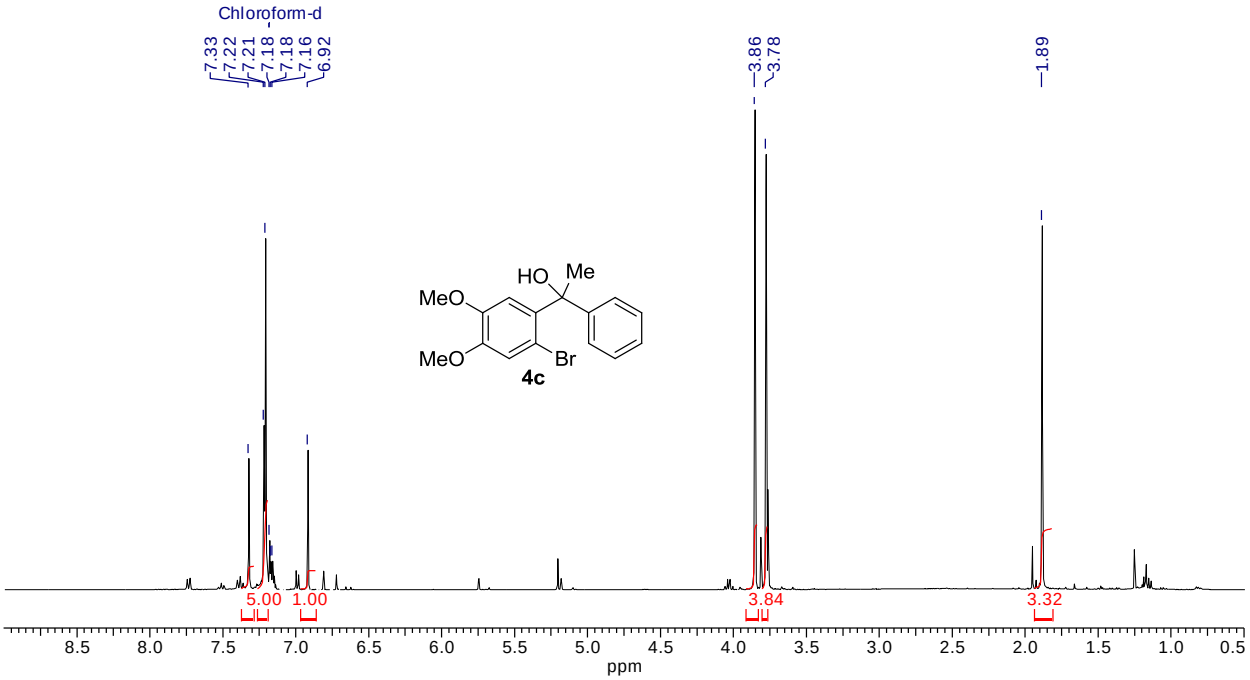
^{13}C NMR (100 MHz) spectrum of **4a** in $CDCl_3$



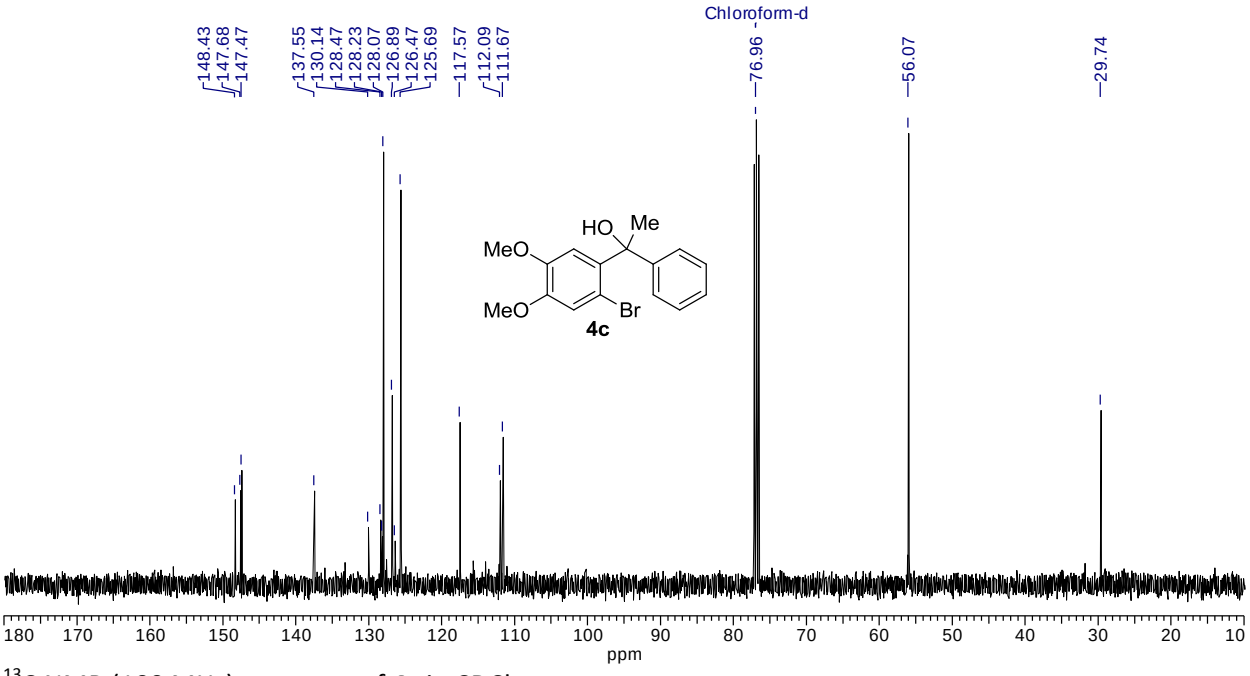
^{1}H NMR (400 MHz) spectrum of **4b** in $CDCl_3$



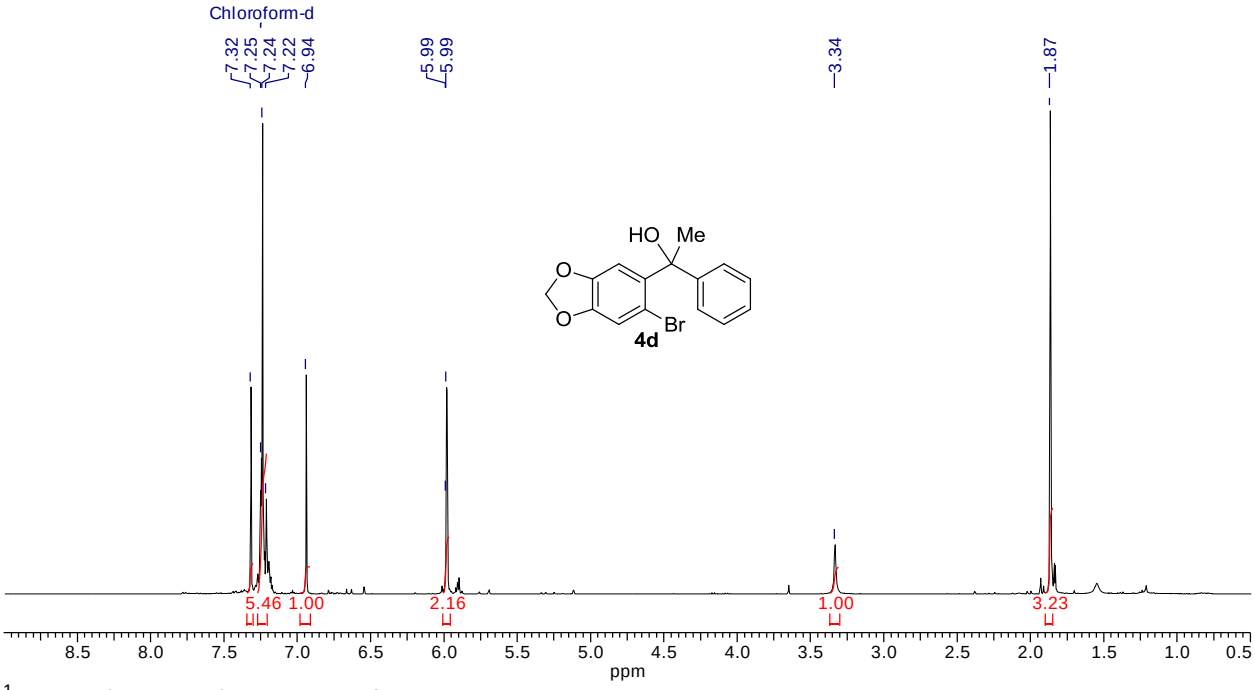
^{13}C NMR (100 MHz) spectrum of **4b** in $CDCl_3$



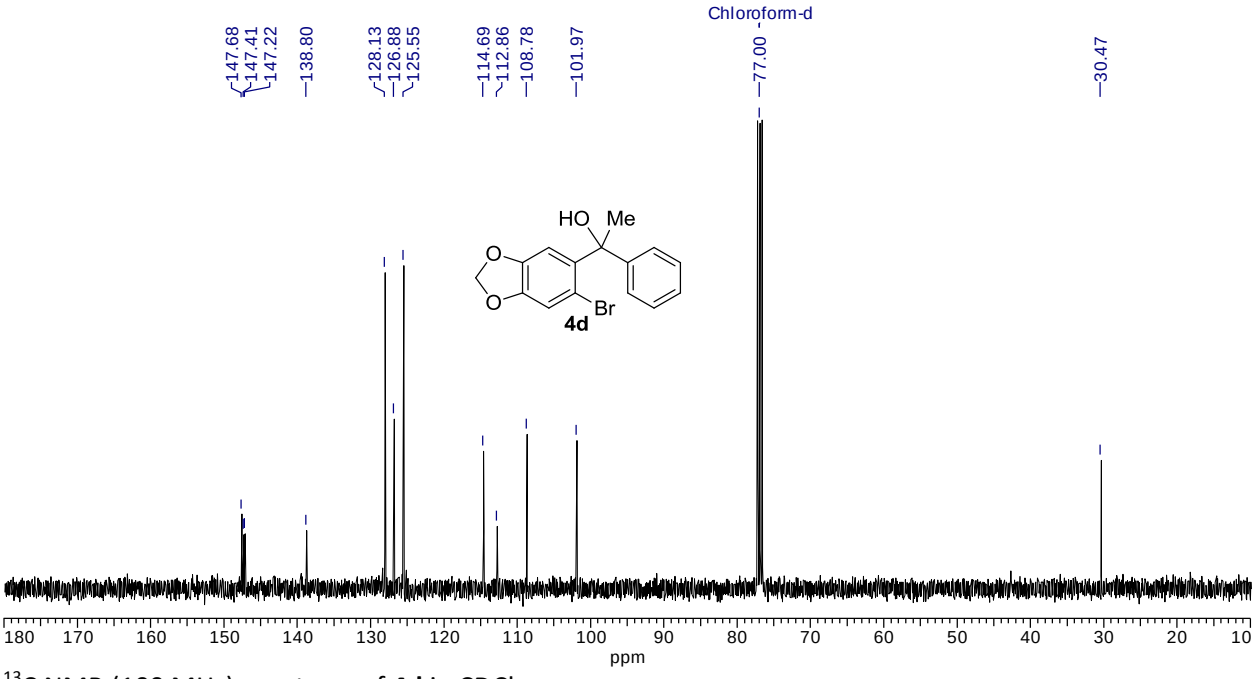
^{1}H NMR (400 MHz) spectrum of **4c** in $CDCl_3$



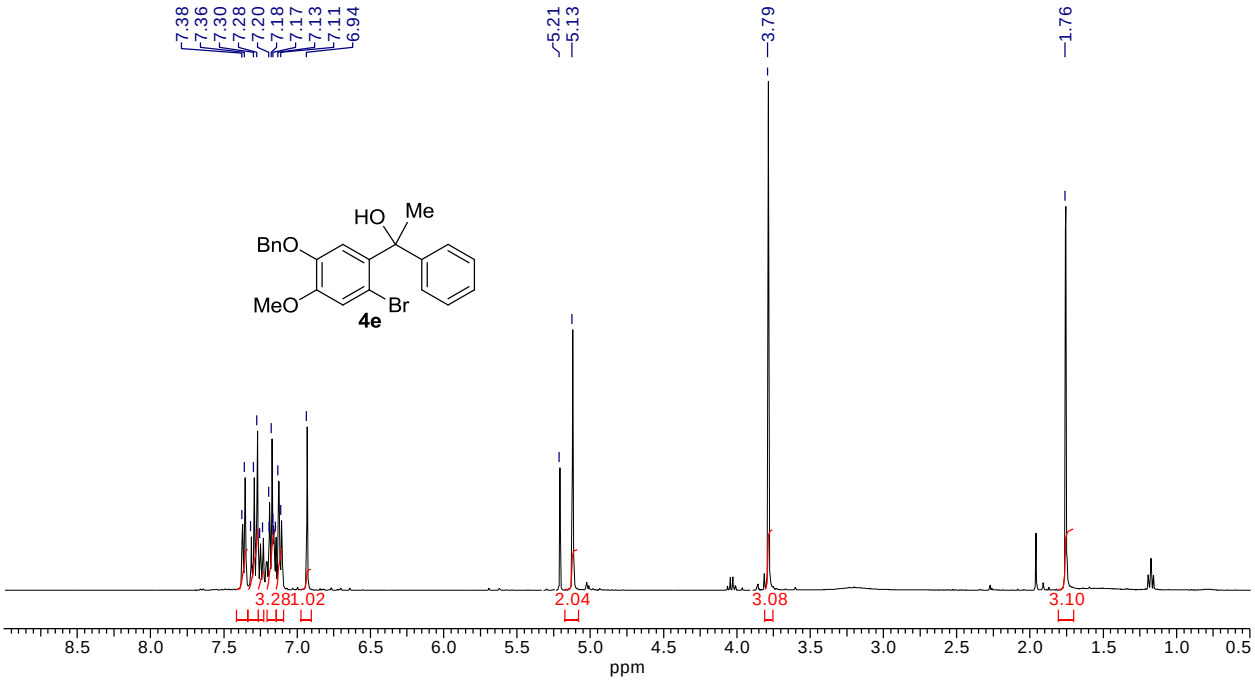
^{13}C NMR (100 MHz) spectrum of **4c** in $CDCl_3$



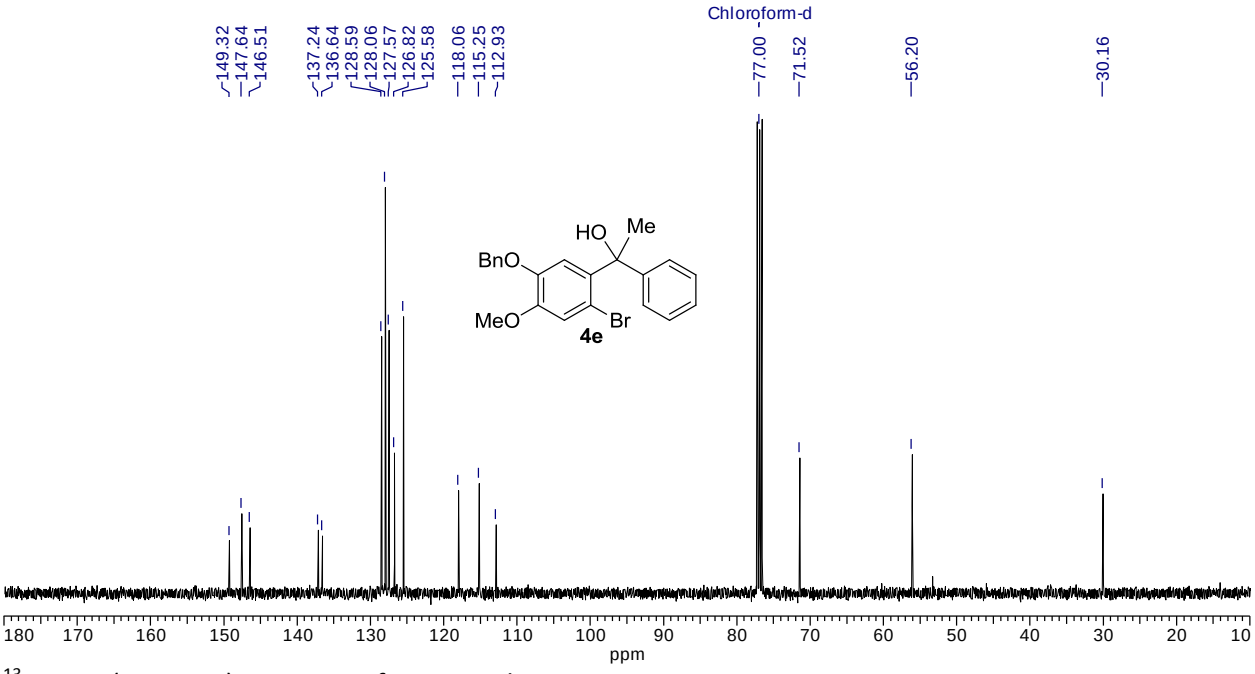
^{1}H NMR (400 MHz) spectrum of **4d** in $CDCl_3$



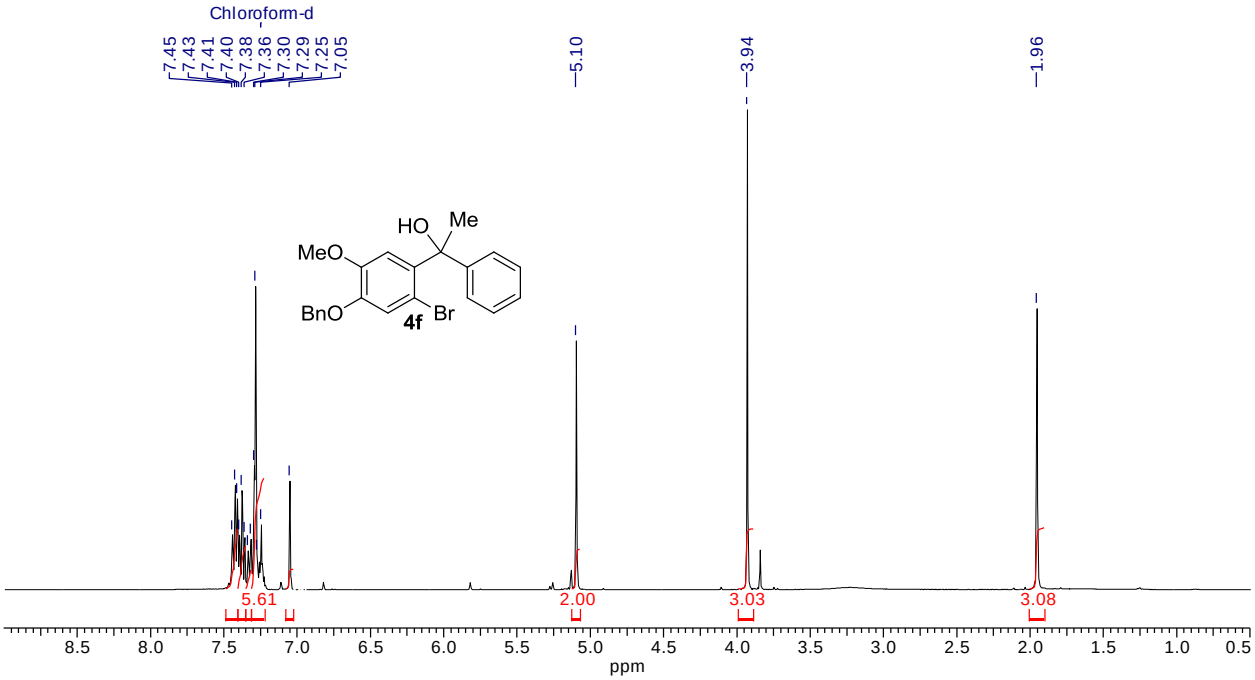
^{13}C NMR (100 MHz) spectrum of **4d** in $CDCl_3$



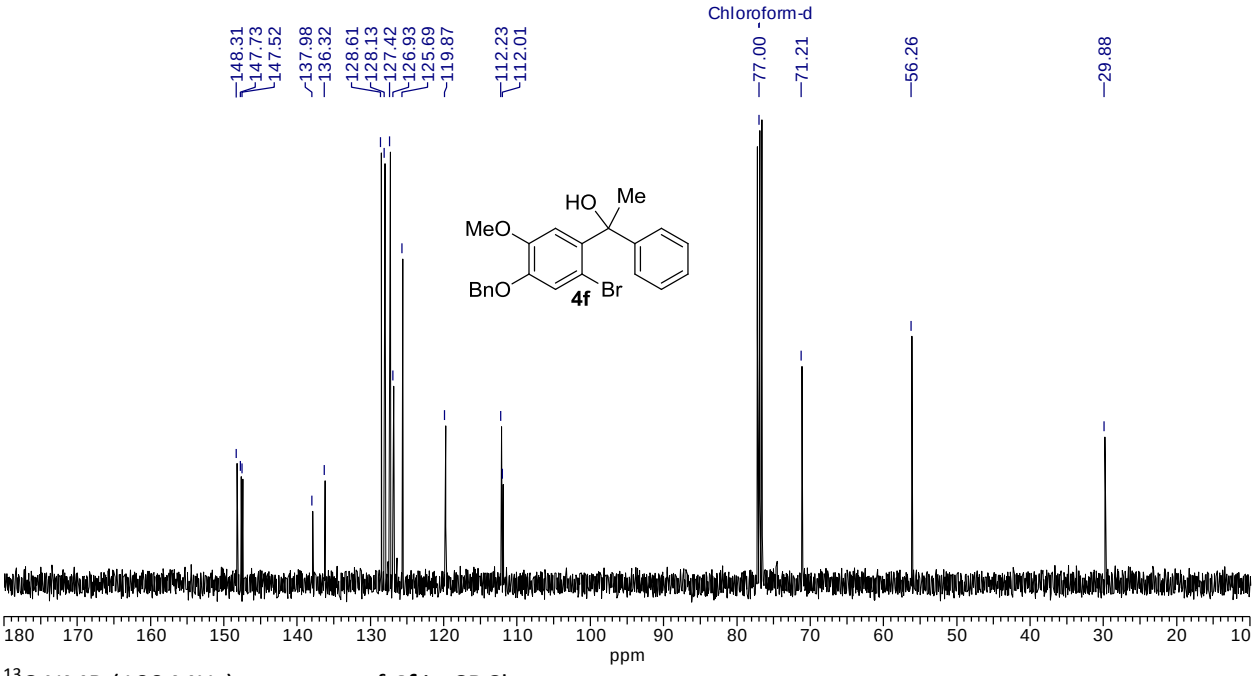
^{1}H NMR (400 MHz) spectrum of **4e** in $CDCl_3$



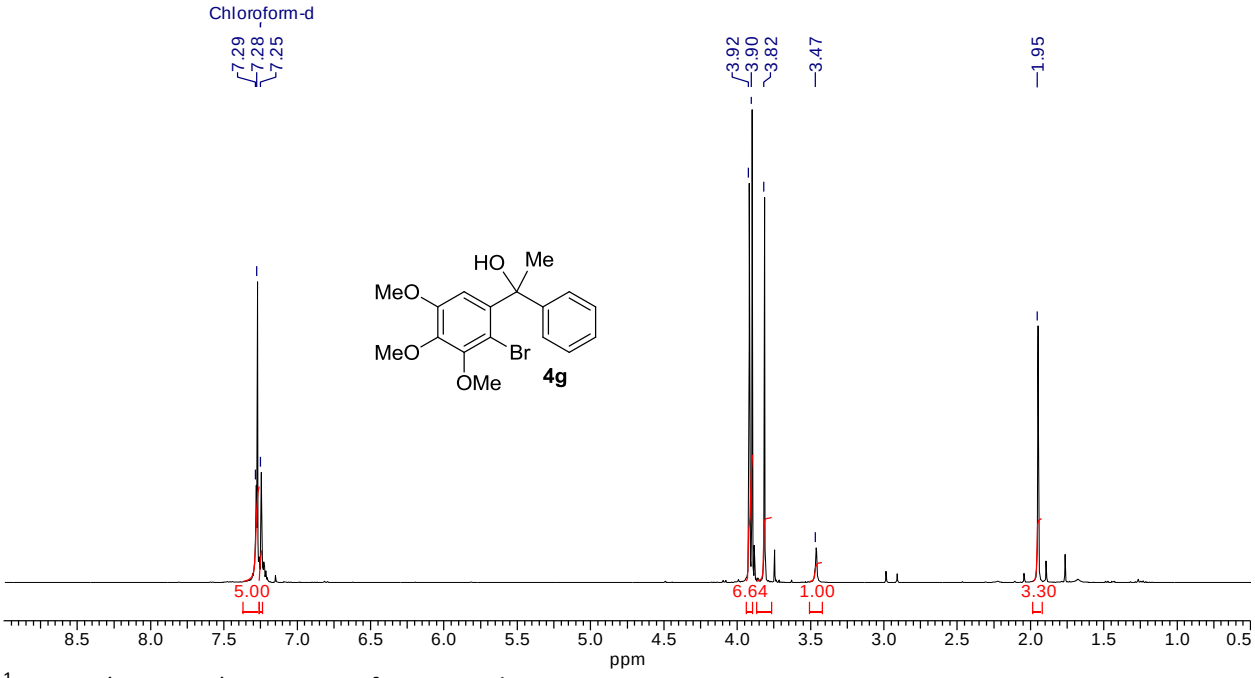
^{13}C NMR (100 MHz) spectrum of **4e** in $CDCl_3$



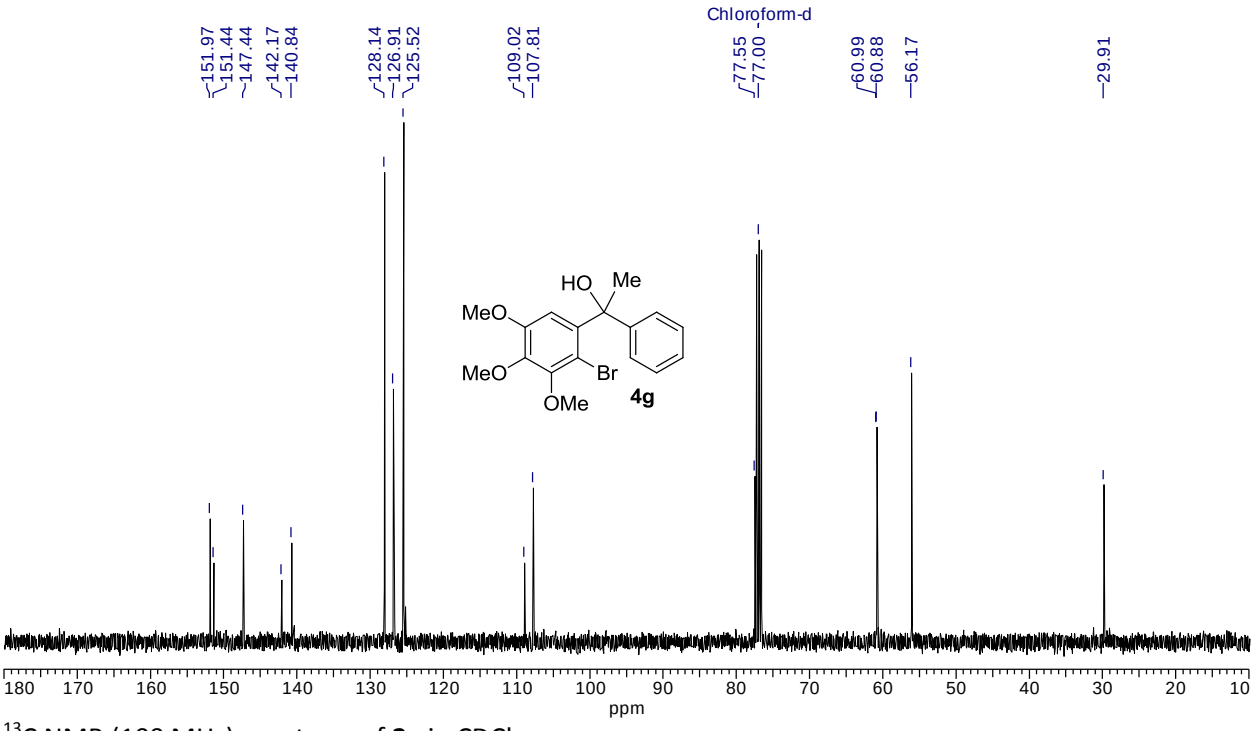
^{1}H NMR (400 MHz) spectrum of **4f** in $CDCl_3$



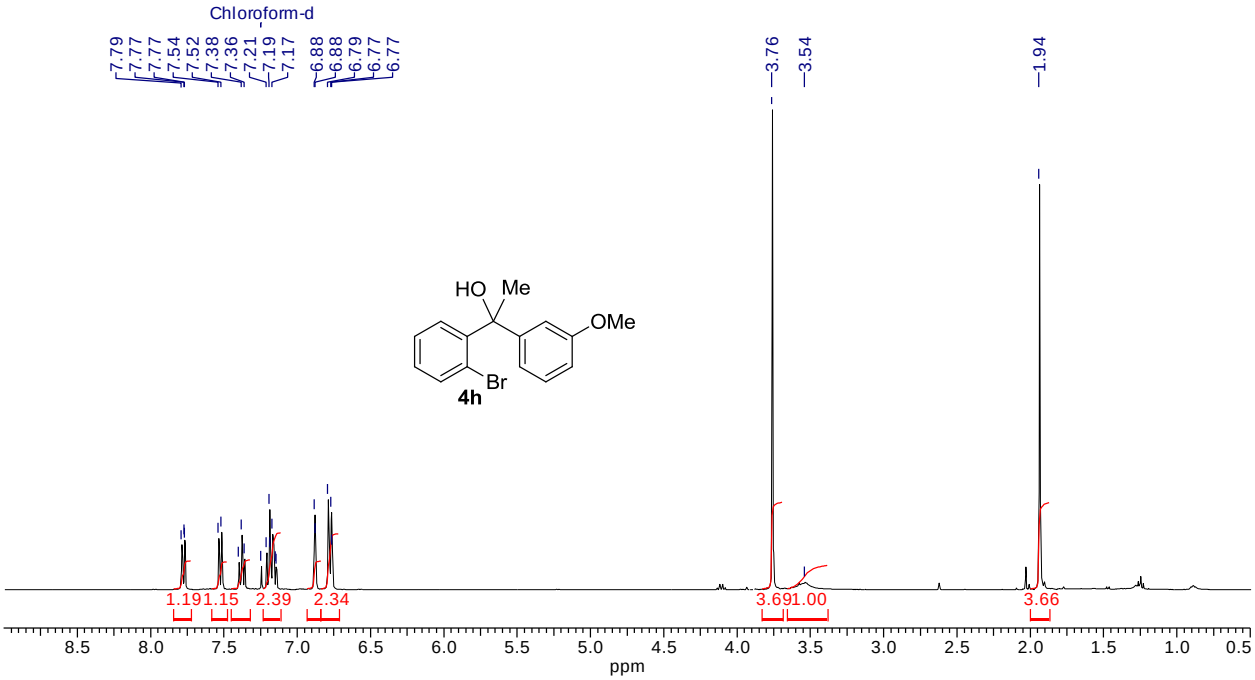
^{13}C NMR (100 MHz) spectrum of **4f** in $CDCl_3$



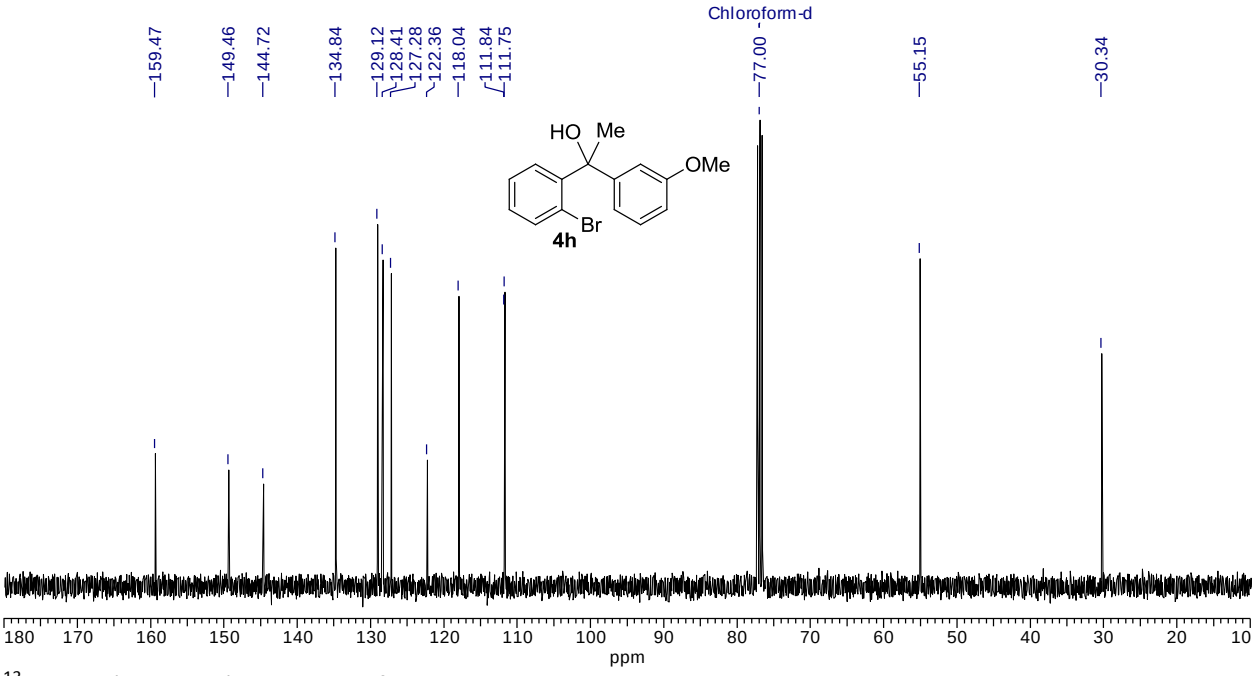
^{1}H NMR (400 MHz) spectrum of **4g** in $CDCl_3$



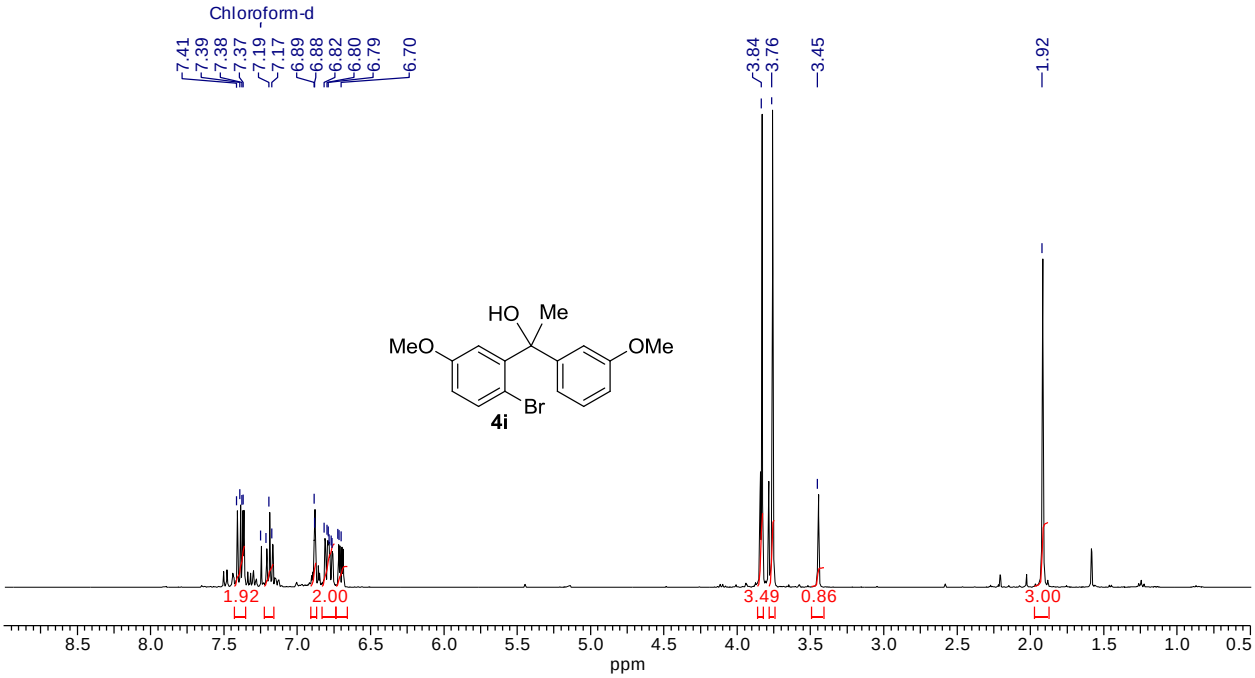
^{13}C NMR (100 MHz) spectrum of **2g** in $CDCl_3$



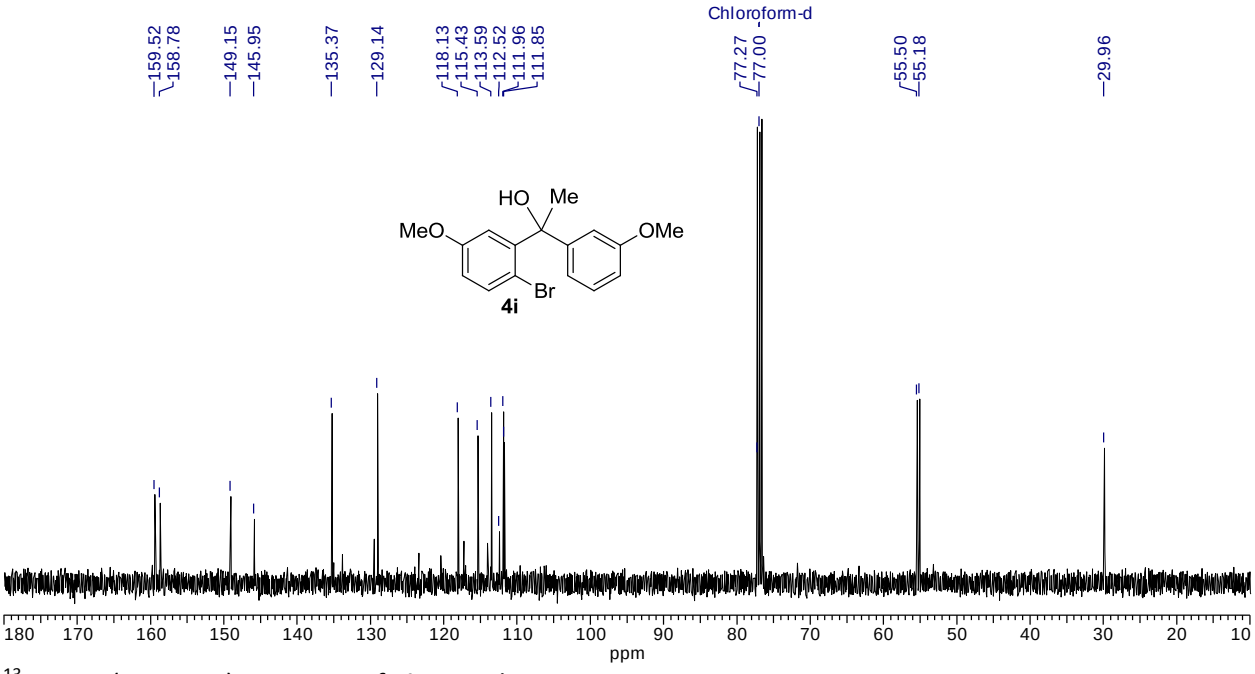
^{1}H NMR (400 MHz) spectrum of **4h** in $CDCl_3$



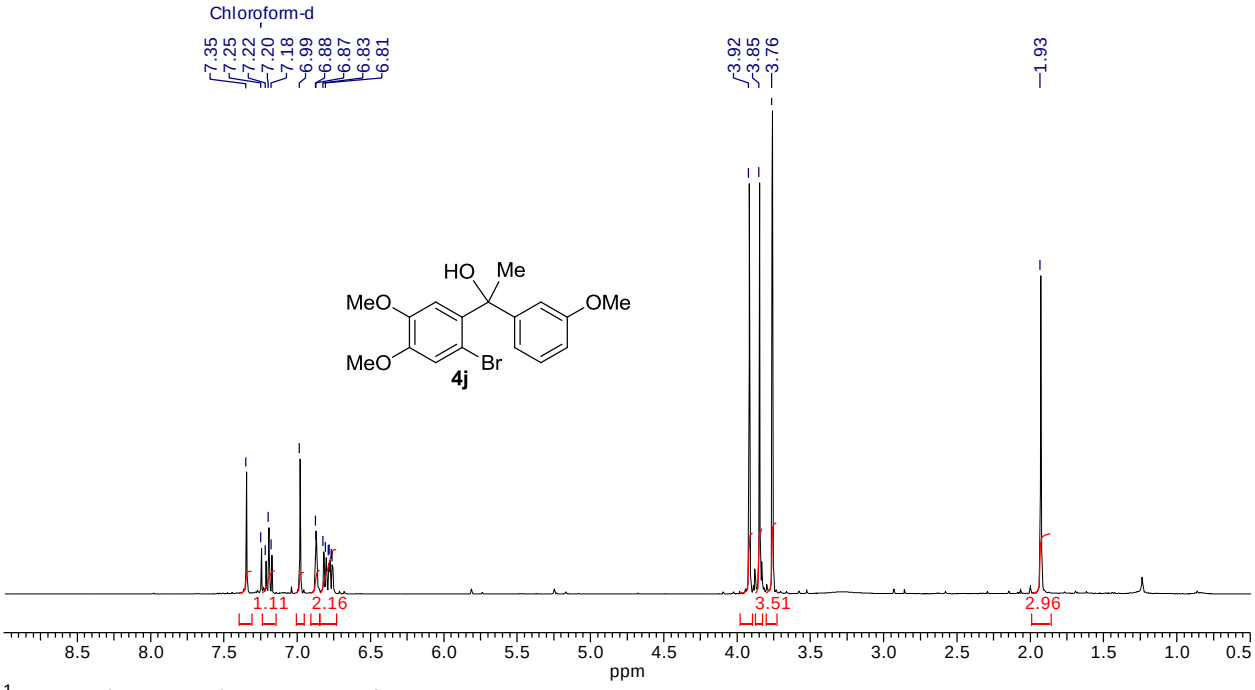
^{13}C NMR (100 MHz) spectrum of **4h** in $CDCl_3$



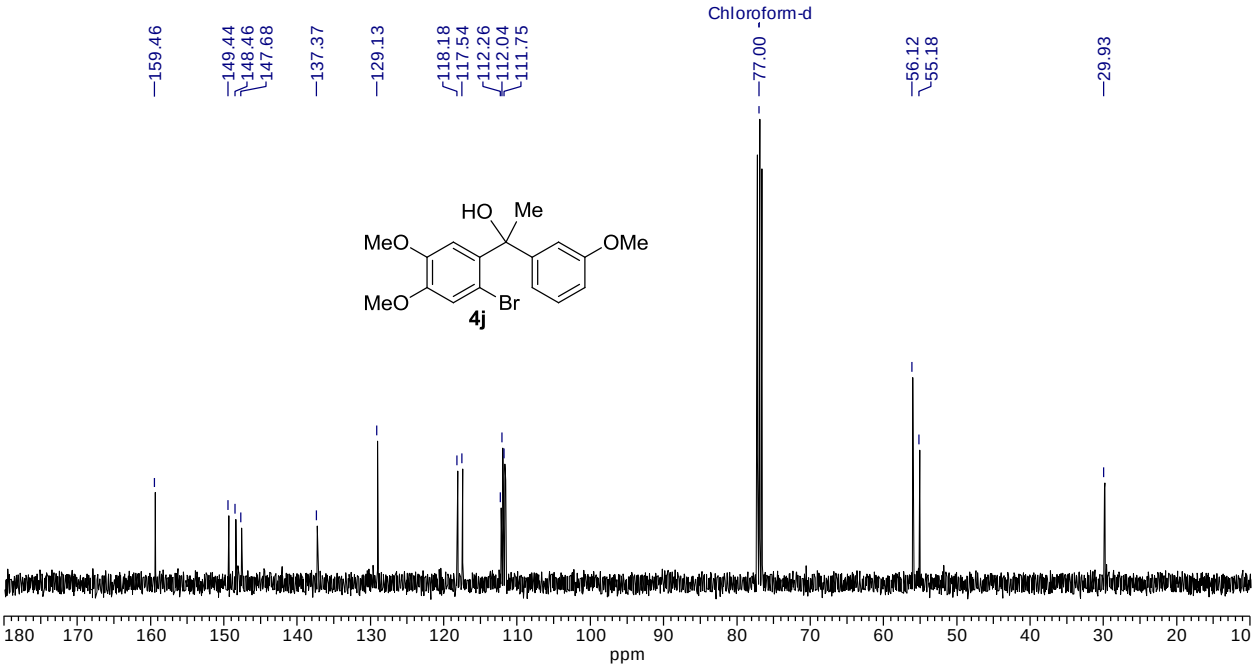
^{1}H NMR (400 MHz) spectrum of **4i** in $CDCl_3$



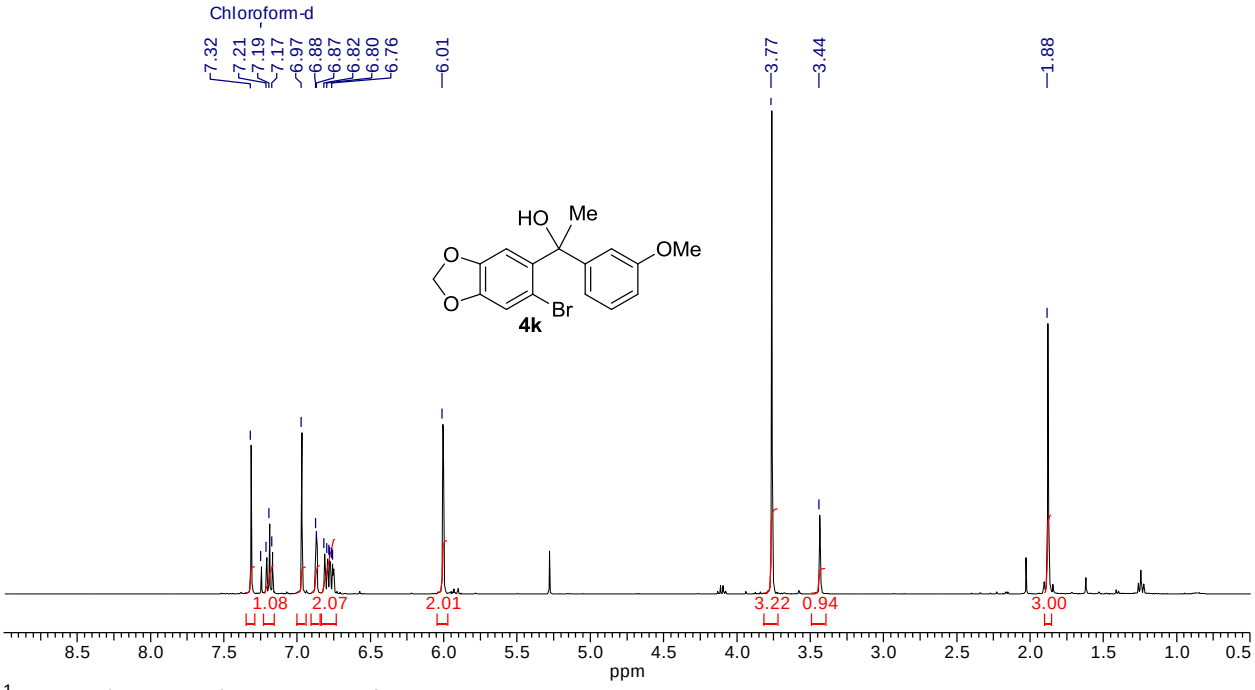
^{13}C NMR (100 MHz) spectrum of **4i** in $CDCl_3$



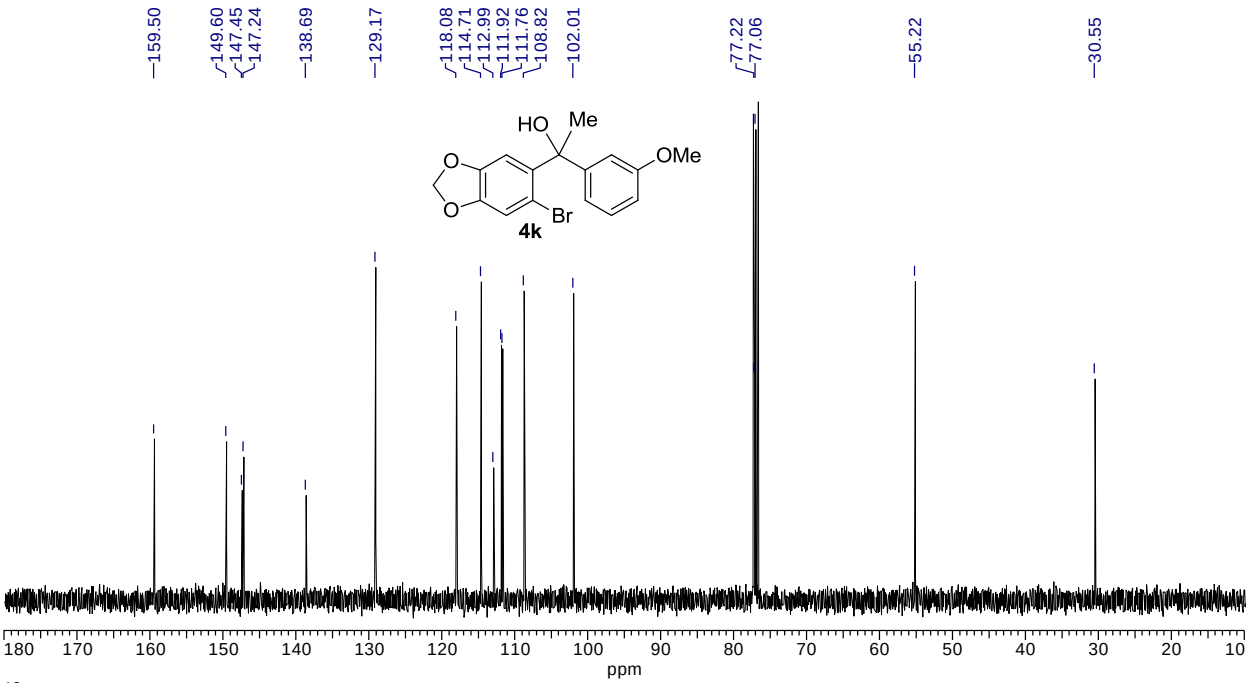
^{1}H NMR (400 MHz) spectrum of **4j** in $CDCl_3$



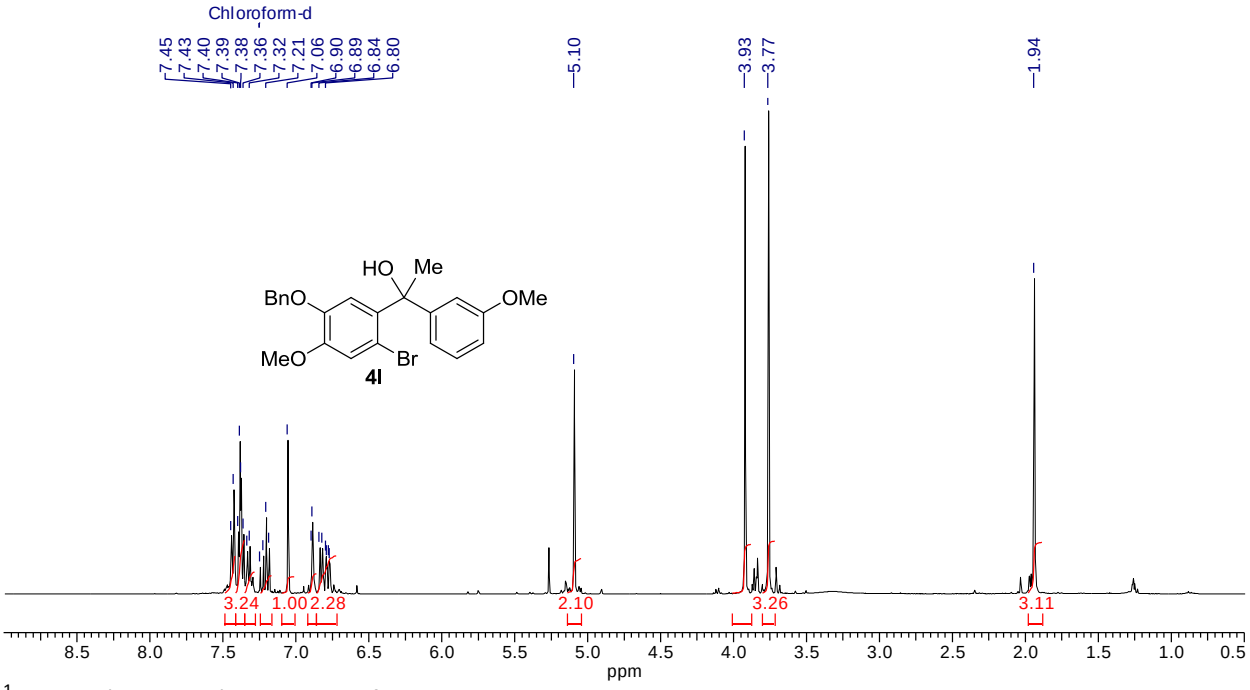
^{13}C NMR (100 MHz) spectrum of **4j** in $CDCl_3$



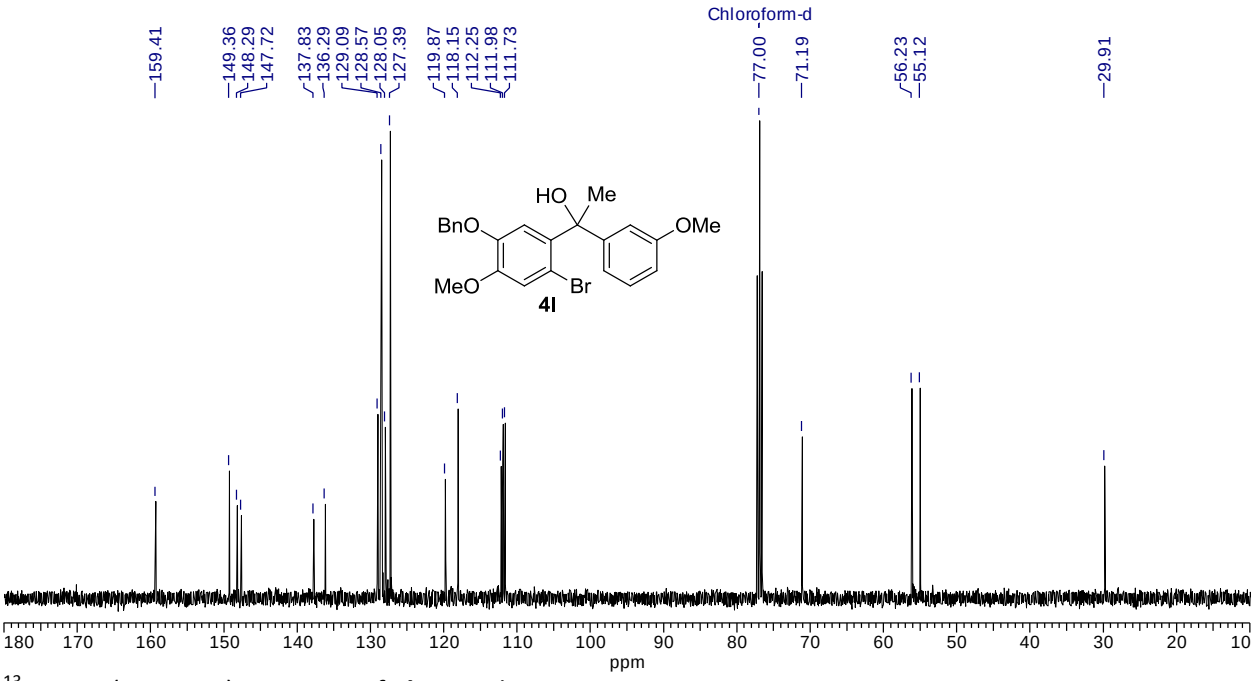
^{1}H NMR (400 MHz) spectrum of **4k** in $CDCl_3$



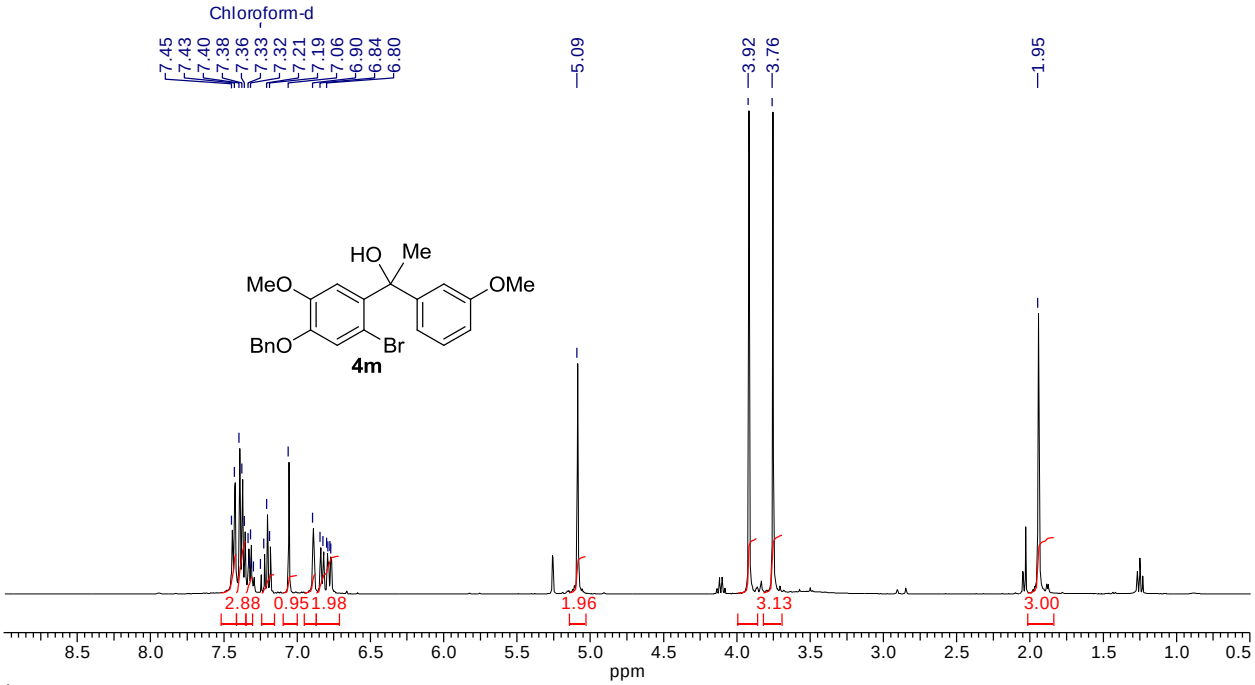
^{13}C NMR (100 MHz) spectrum of **4k** in $CDCl_3$



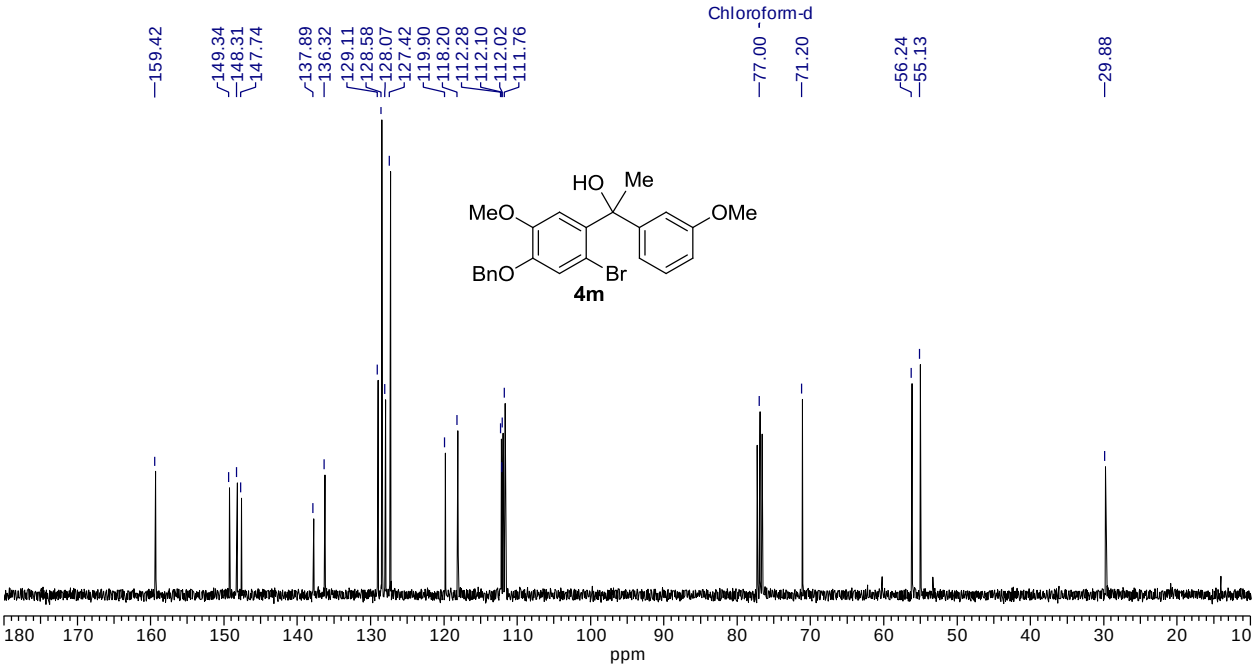
^{1}H NMR (400 MHz) spectrum of **4l** in $CDCl_3$



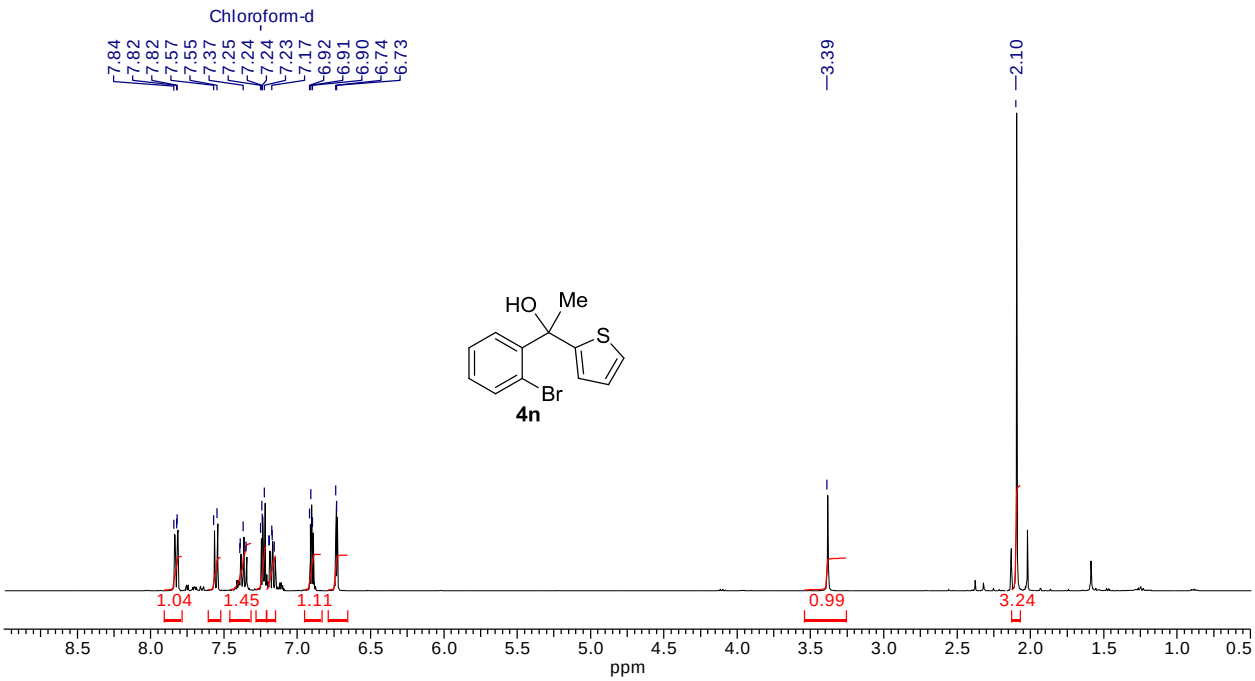
^{13}C NMR (100 MHz) spectrum of **4l** in $CDCl_3$



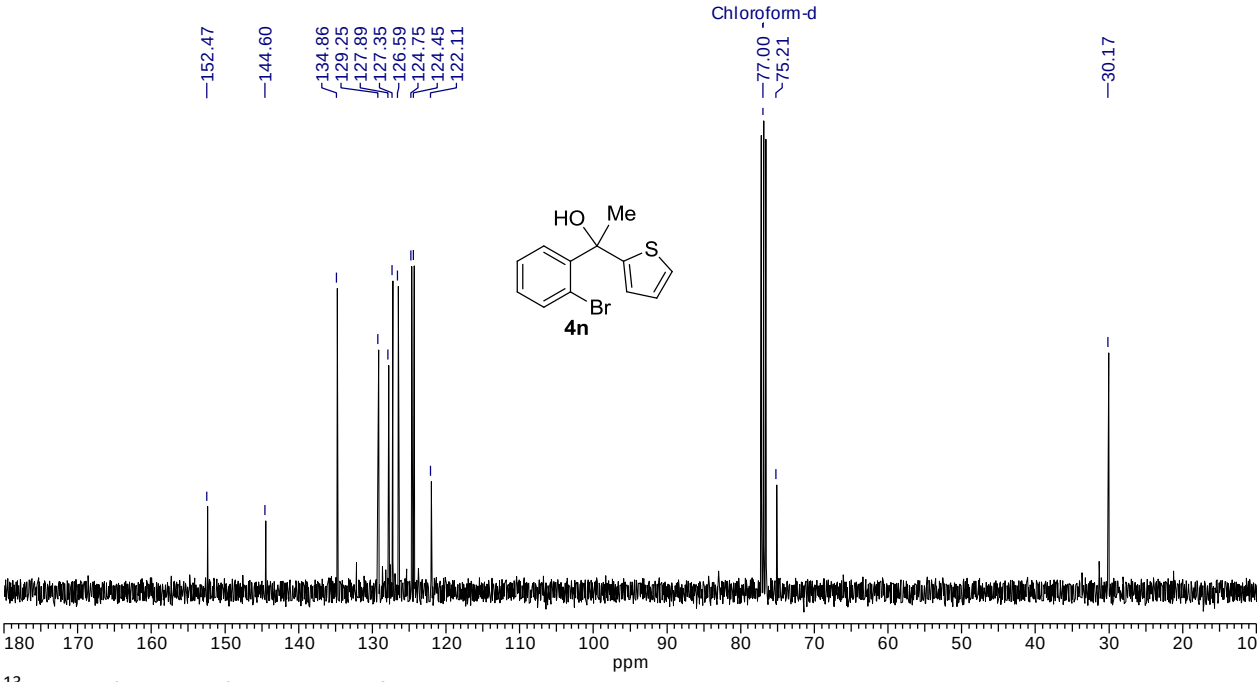
^{1}H NMR (400 MHz) spectrum of **4m** in $CDCl_3$



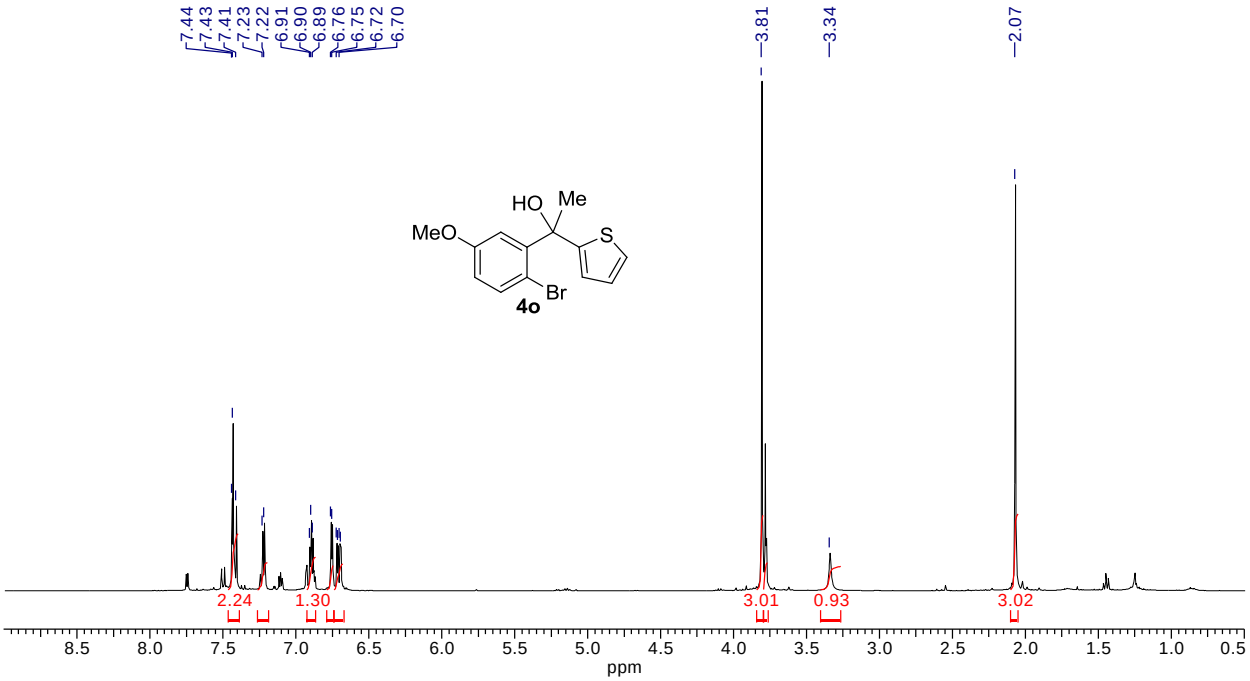
^{13}C NMR (100 MHz) spectrum of **4m** in $CDCl_3$



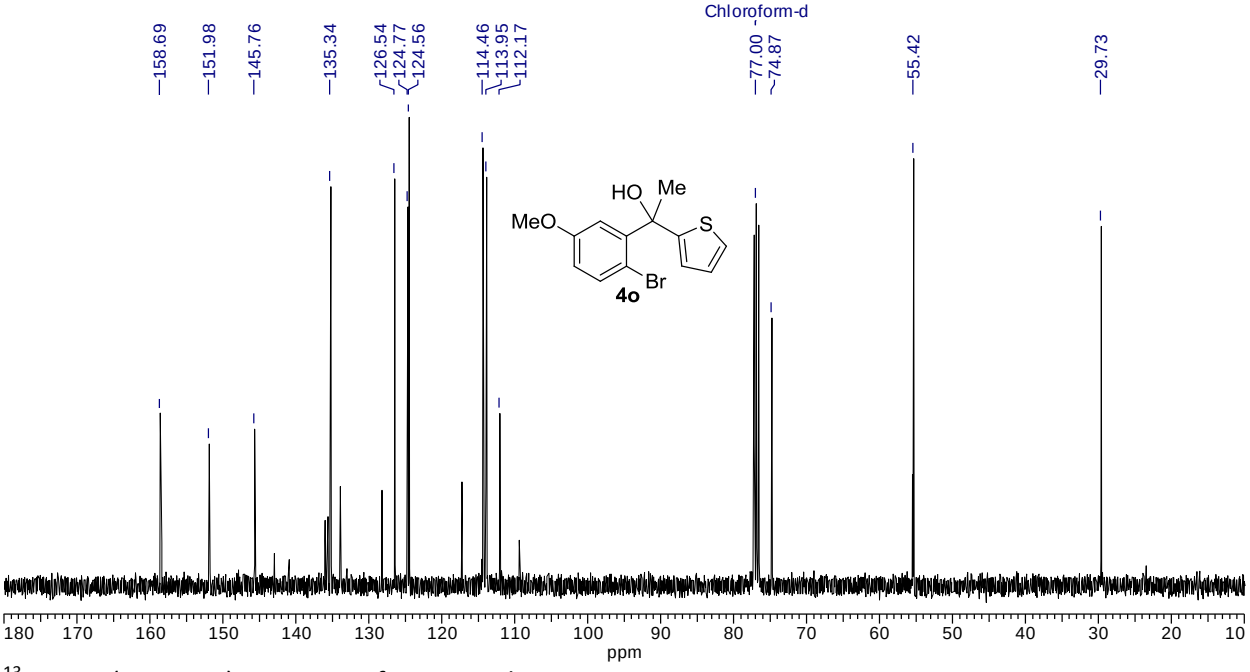
^{1}H NMR (400 MHz) spectrum of **4n** in $CDCl_3$



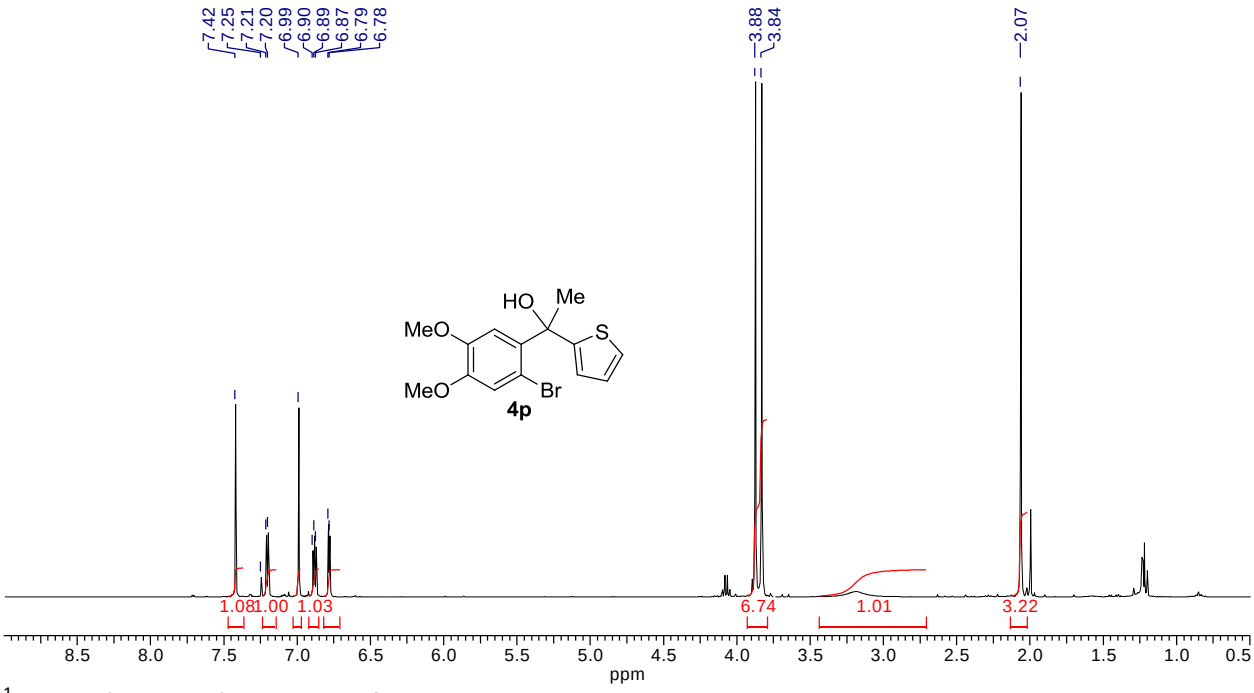
^{13}C NMR (100 MHz) spectrum of **4n** in $CDCl_3$



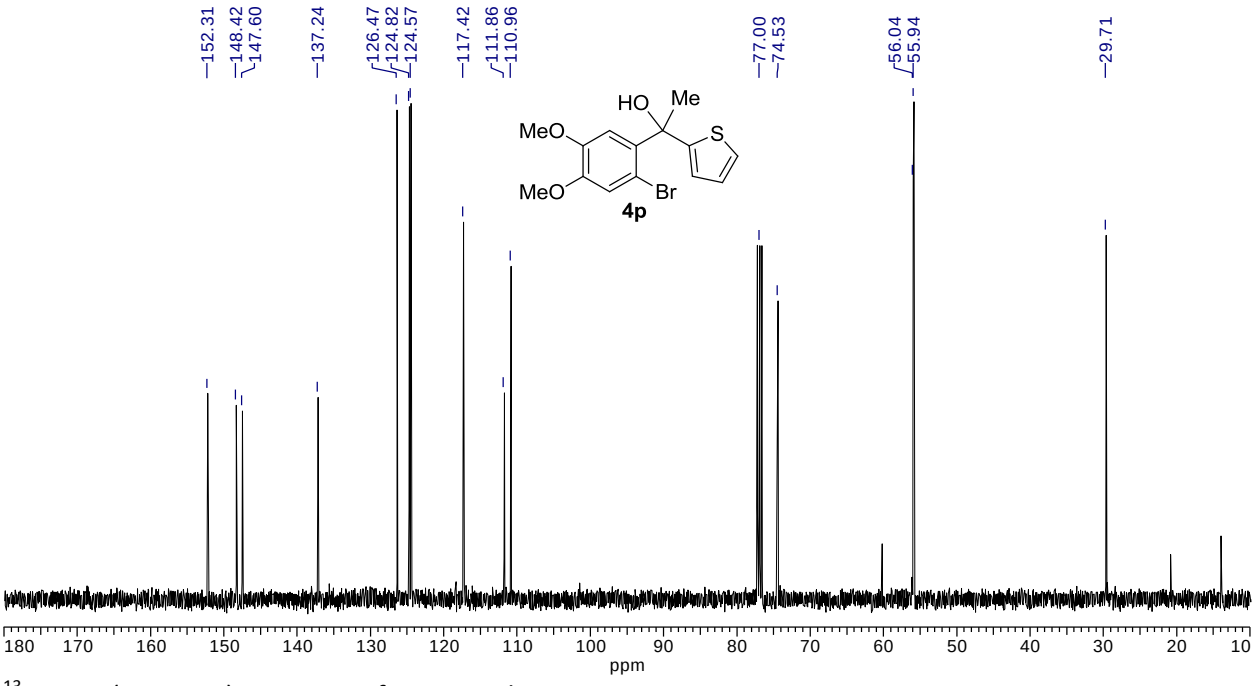
^{1}H NMR (400 MHz) spectrum of **4o** in $CDCl_3$



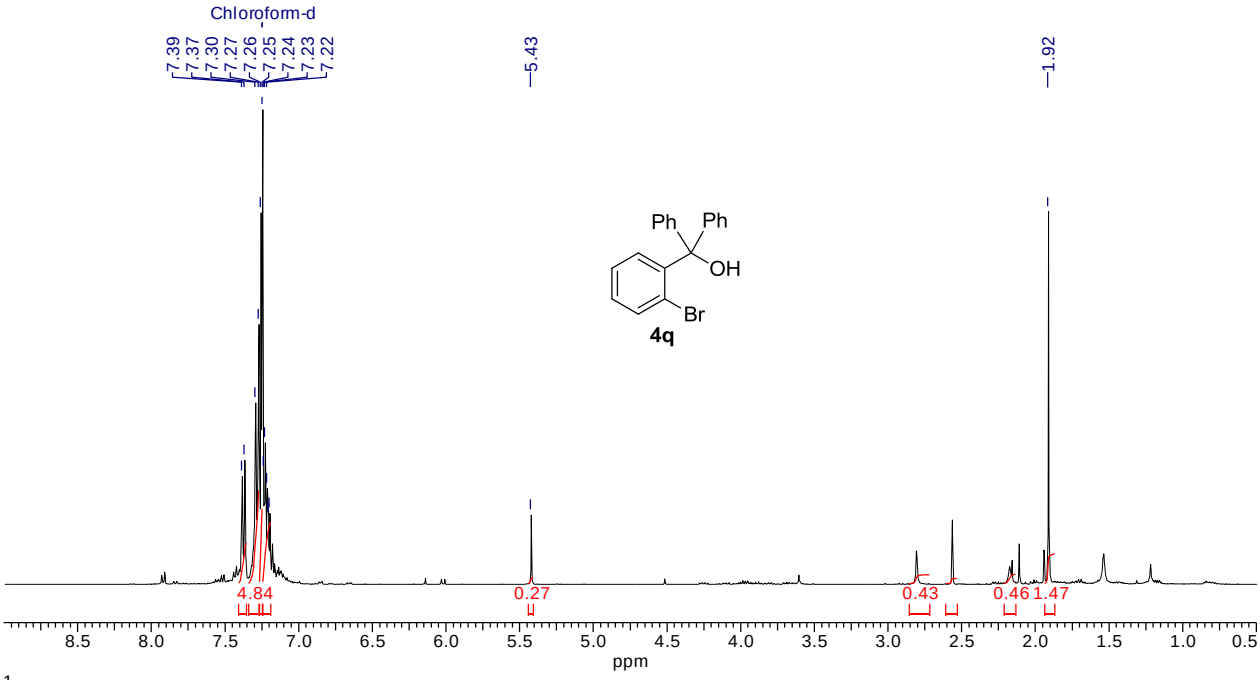
^{13}C NMR (100 MHz) spectrum of **4o** in $CDCl_3$



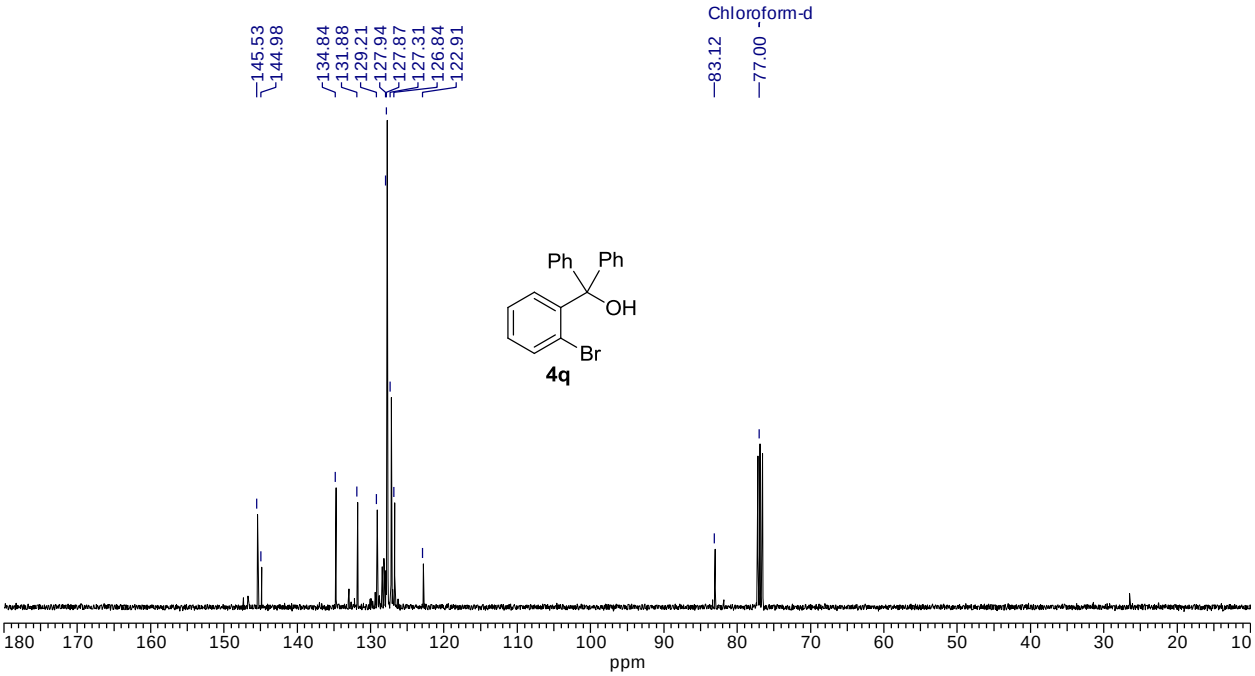
^{1}H NMR (400 MHz) spectrum of **4p** in $CDCl_3$



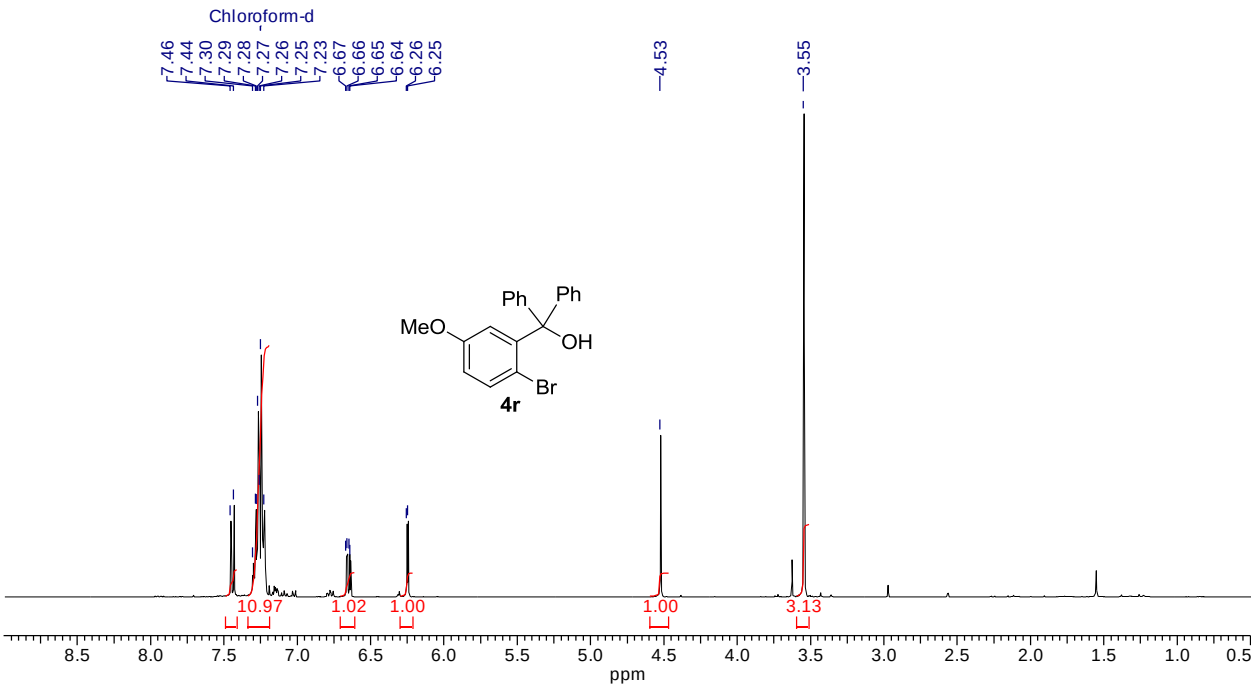
^{13}C NMR (100 MHz) spectrum of **4p** in $CDCl_3$



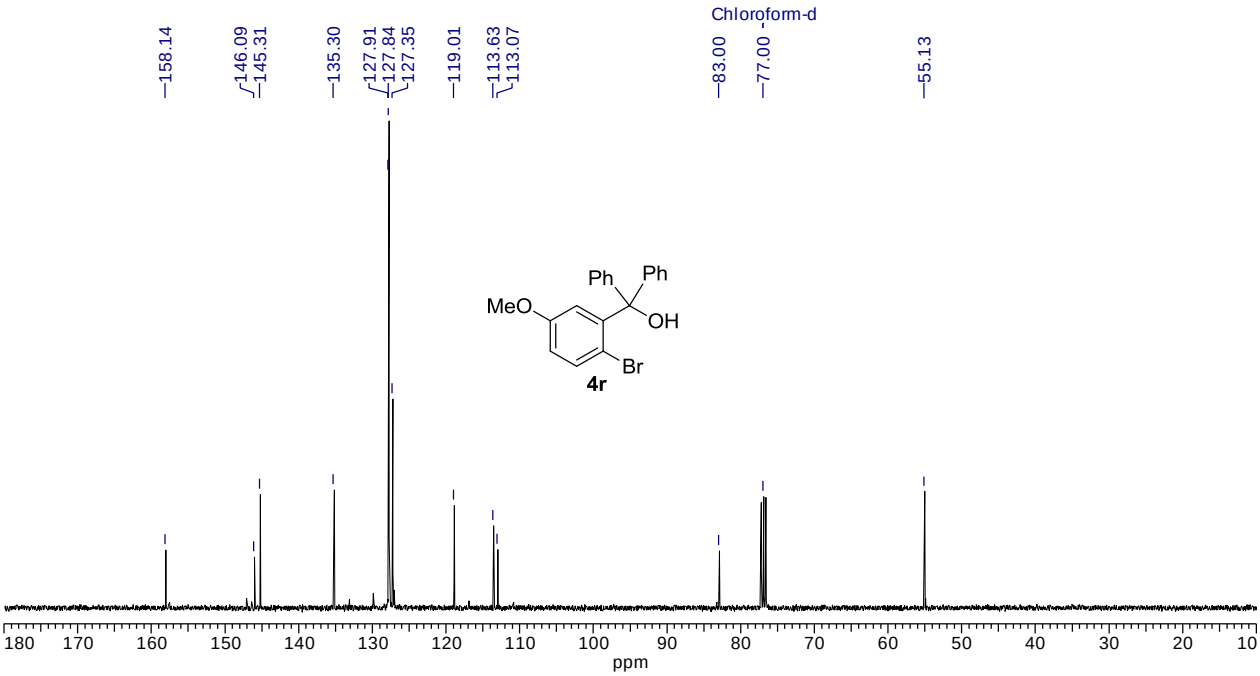
^{1}H NMR (400 MHz) spectrum of **4q** in $CDCl_3$



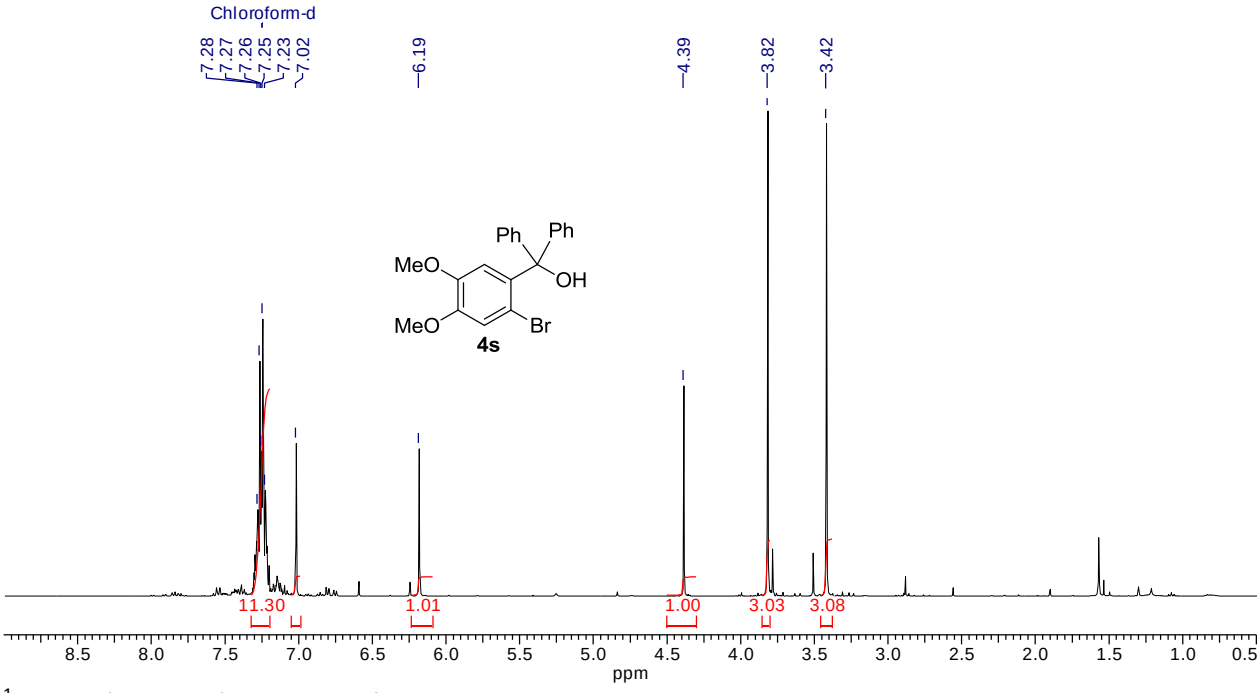
^{13}C NMR (100 MHz) spectrum of **4q** in $CDCl_3$



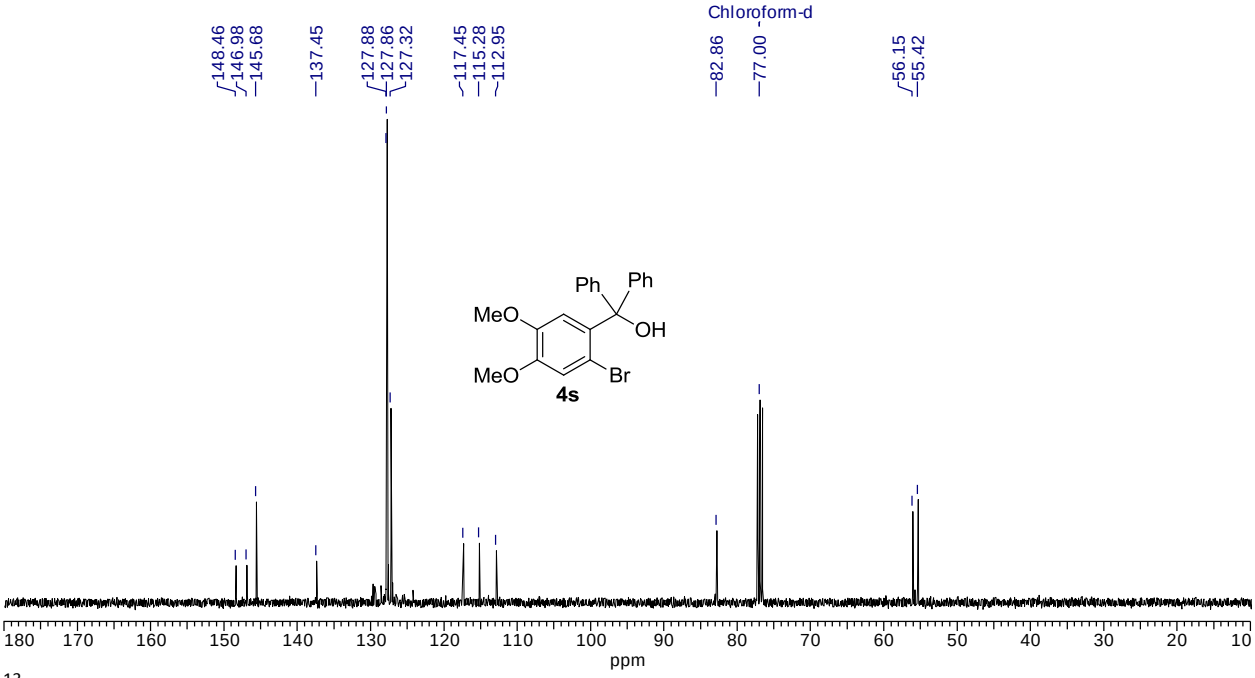
^{1}H NMR (400 MHz) spectrum of **4r** in $CDCl_3$



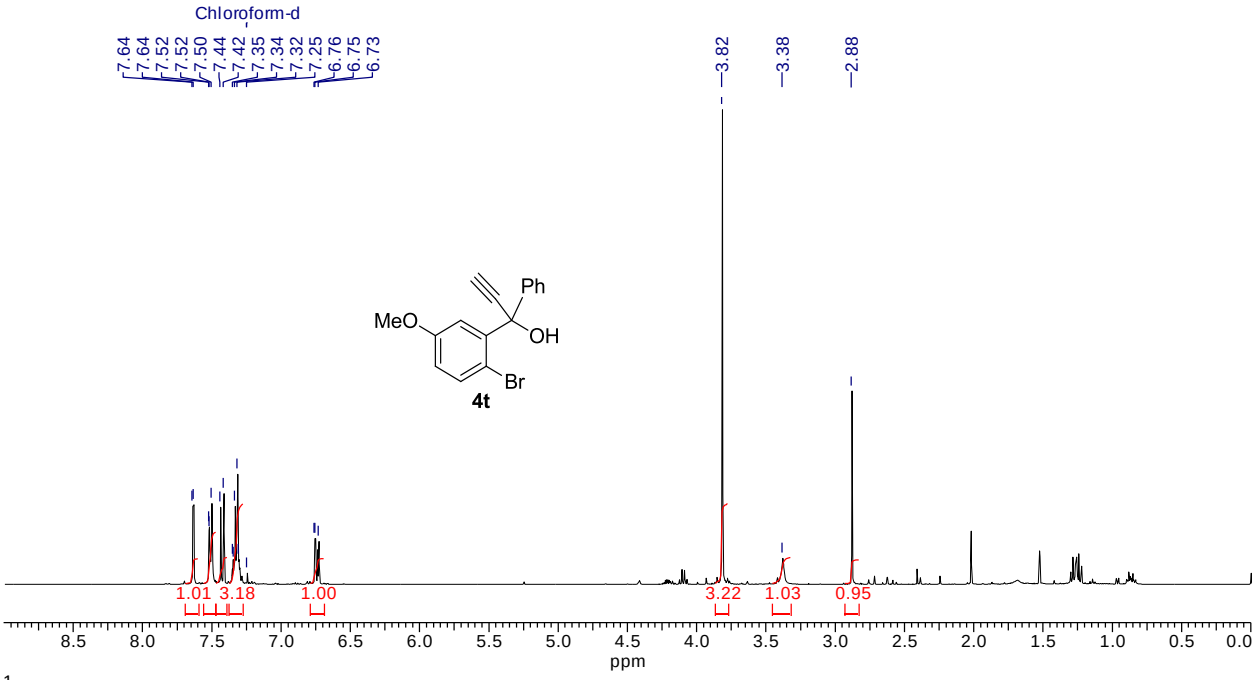
^{13}C NMR (100 MHz) spectrum of **4r** in $CDCl_3$



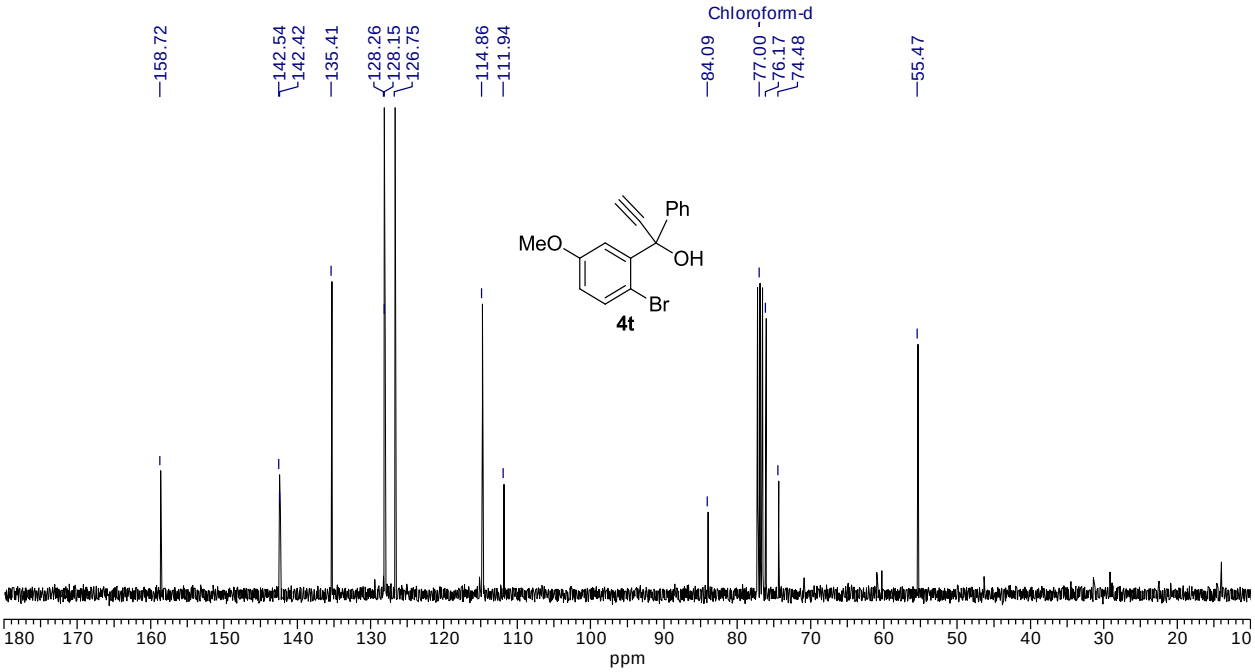
^{1}H NMR (400 MHz) spectrum of **4s** in $CDCl_3$



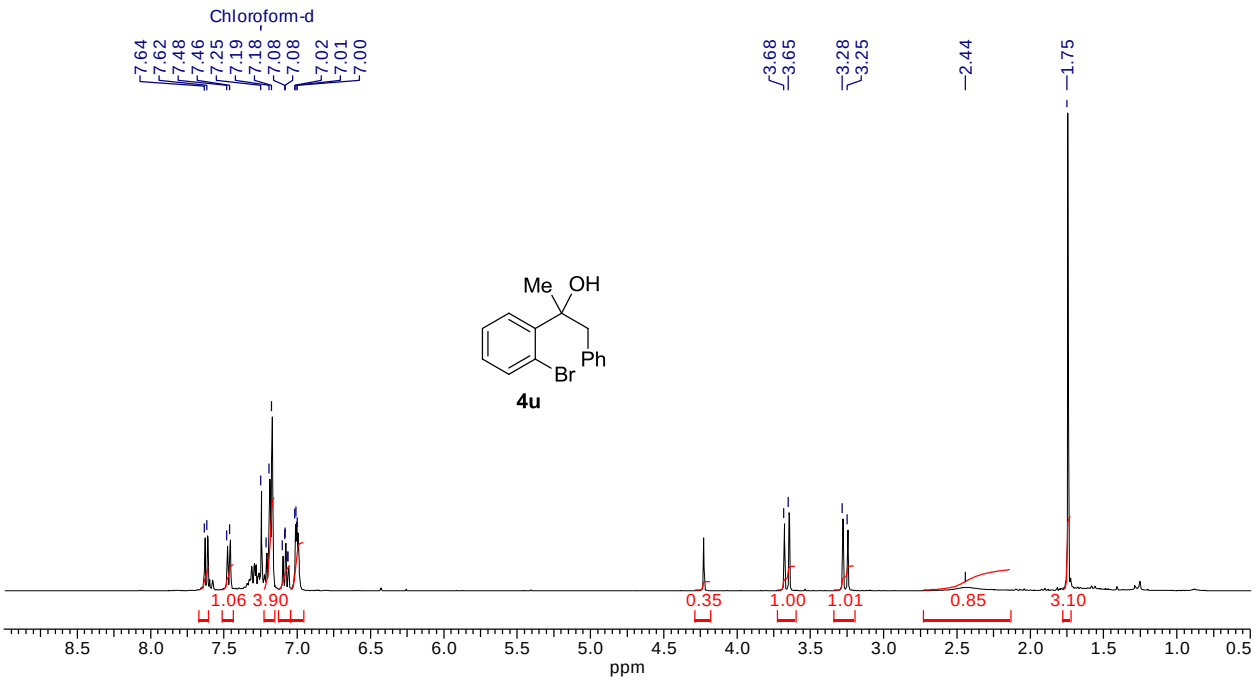
^{13}C NMR (400 MHz) spectrum of **4s** in $CDCl_3$



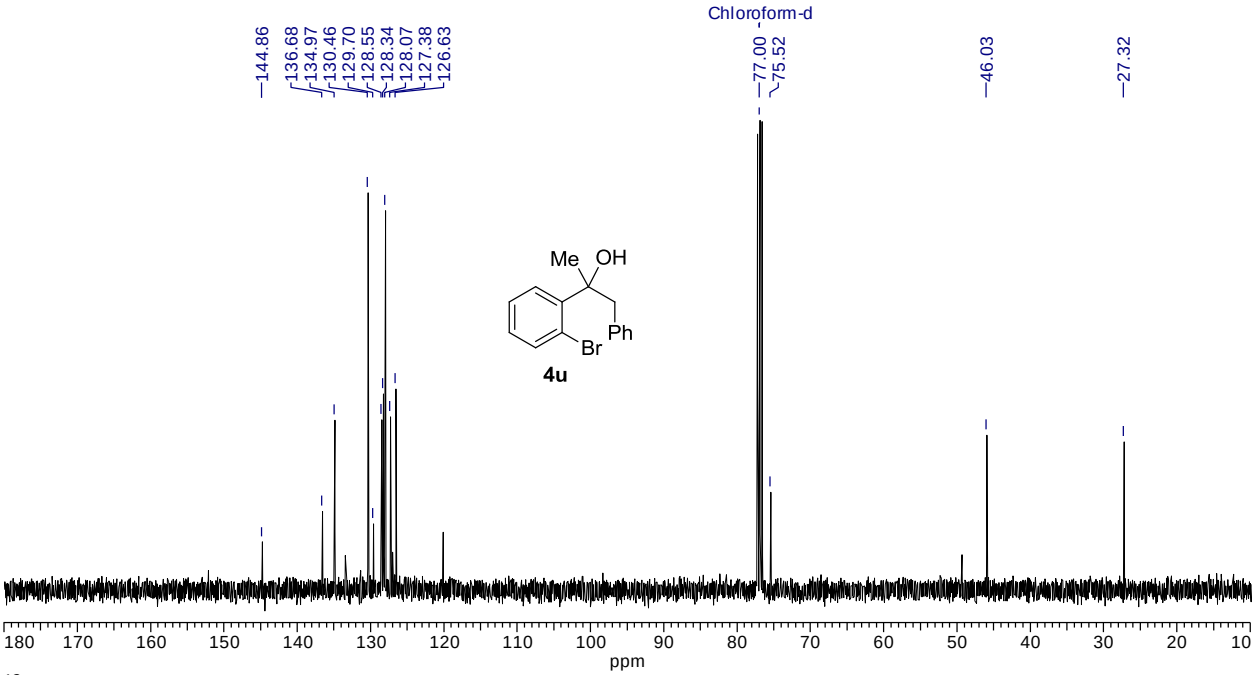
^{1}H NMR (400 MHz) spectrum of **4t** in $CDCl_3$



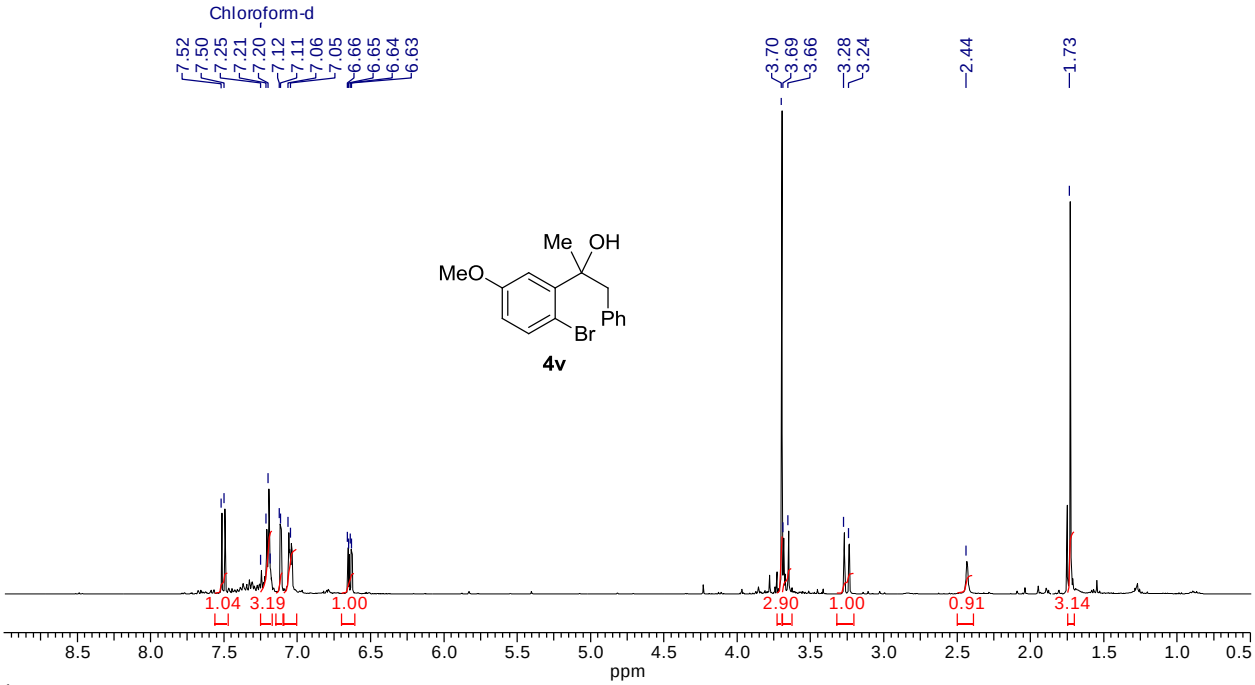
^{13}C NMR (100 MHz) spectrum of **4t** in $CDCl_3$



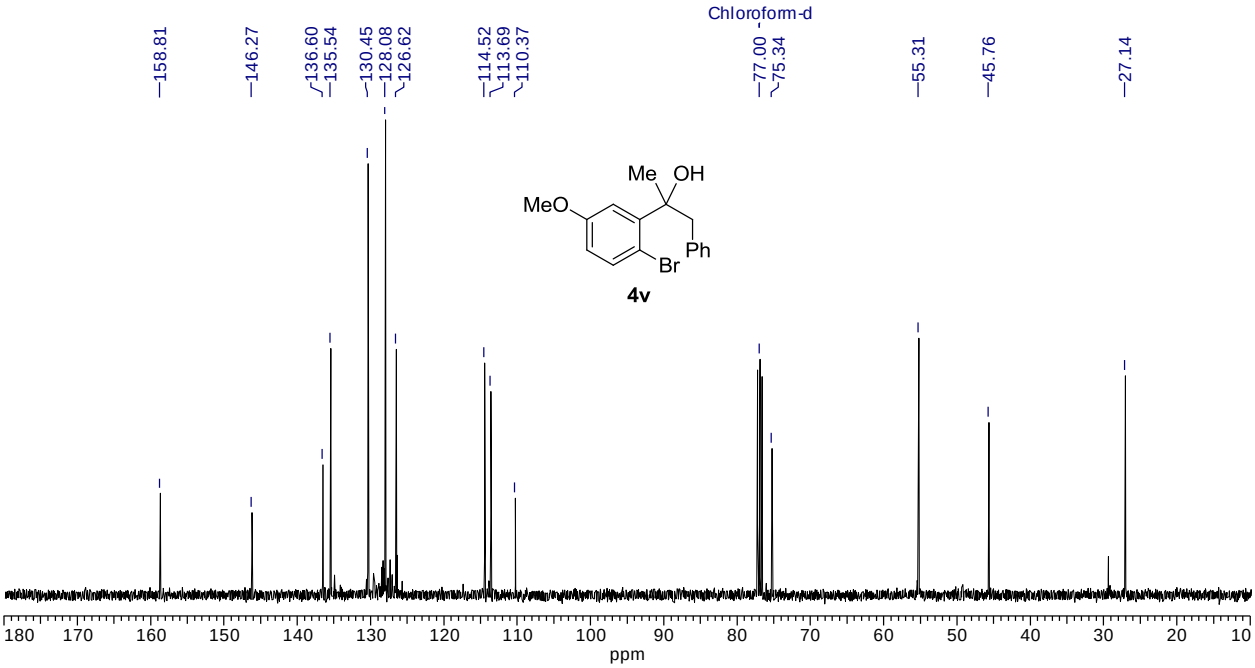
^{1}H NMR (400 MHz) spectrum of **4u** in $CDCl_3$



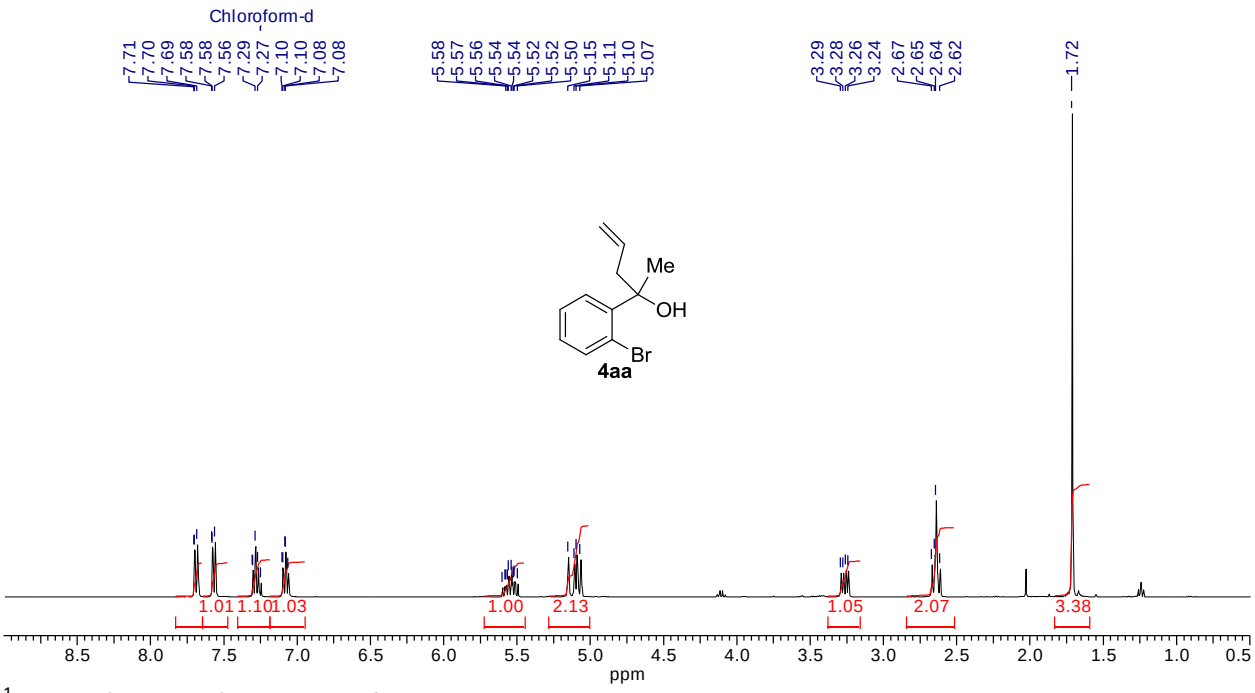
^{13}C NMR (100 MHz) spectrum of **4u** in $CDCl_3$



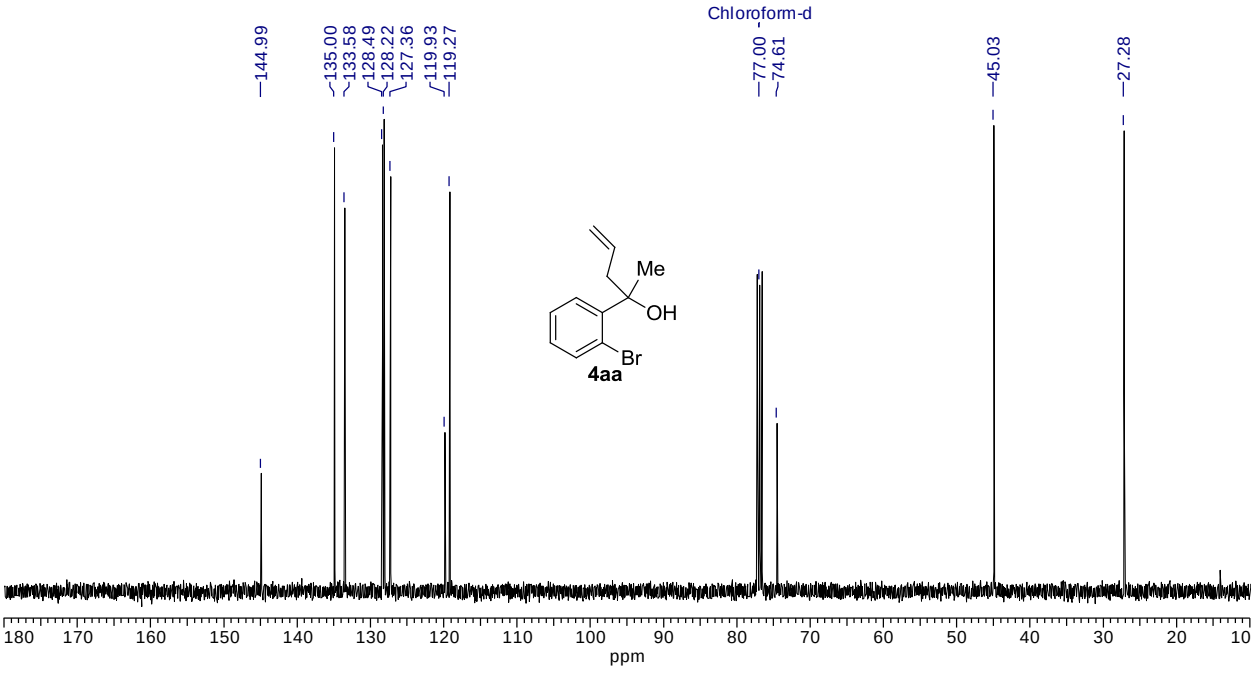
^{1}H NMR (400 MHz) spectrum of **4v** in $CDCl_3$



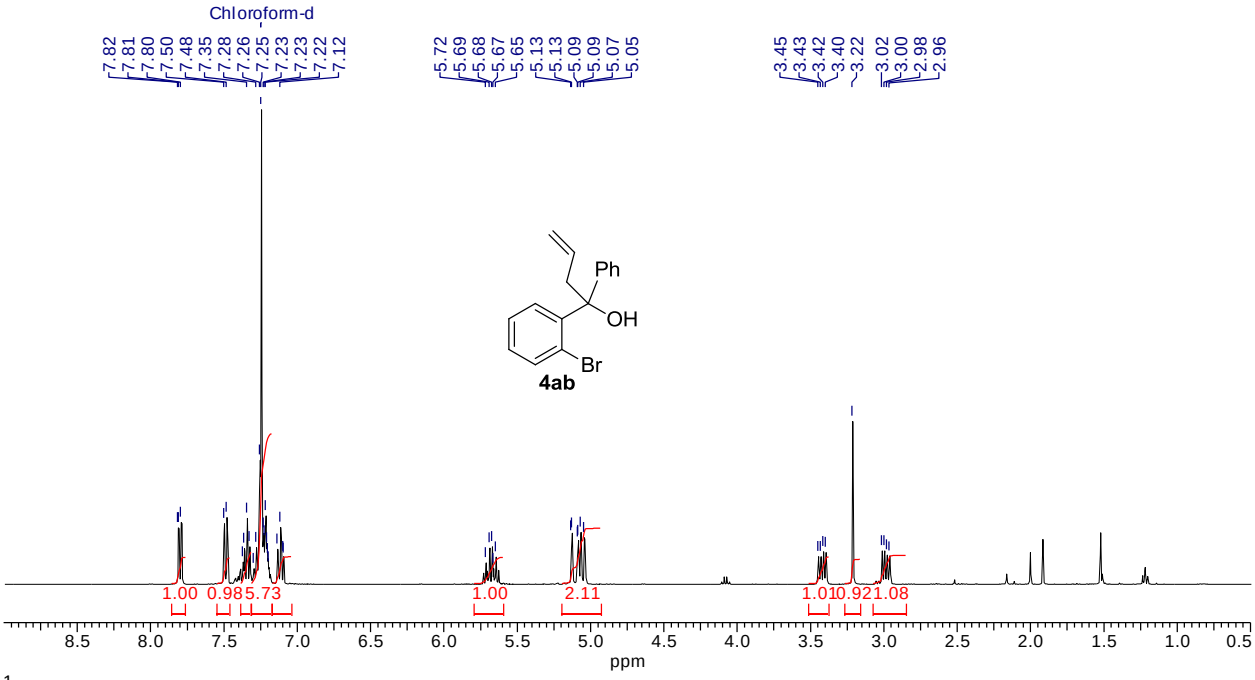
^{13}C NMR (100 MHz) spectrum of **4v** in $CDCl_3$



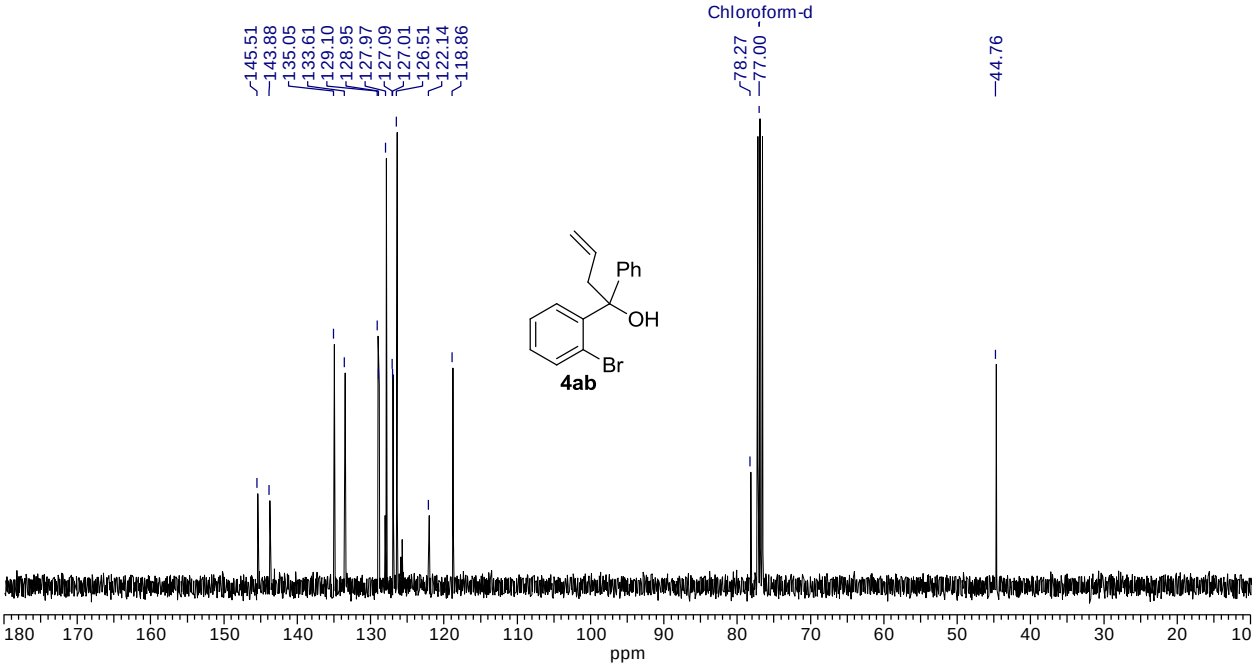
^{1}H NMR (400 MHz) spectrum of **4aa** in $CDCl_3$



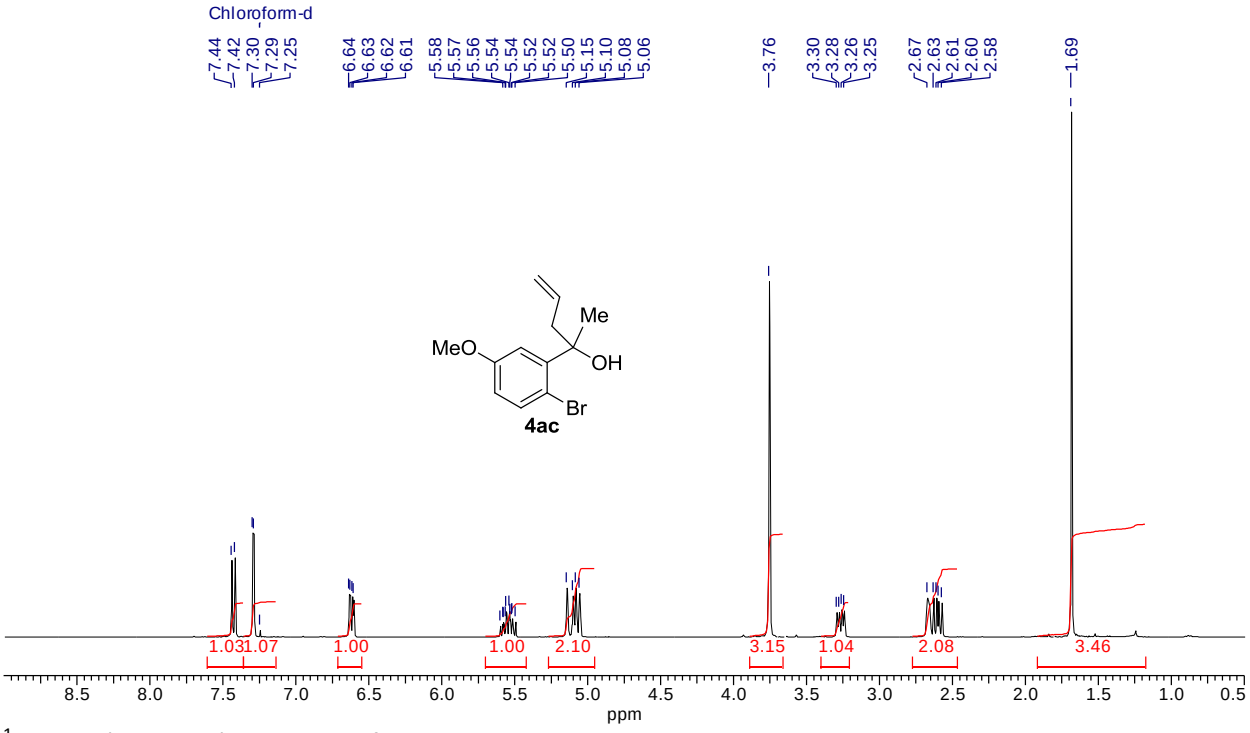
^{13}C NMR (100 MHz) spectrum of **4aa** in $CDCl_3$



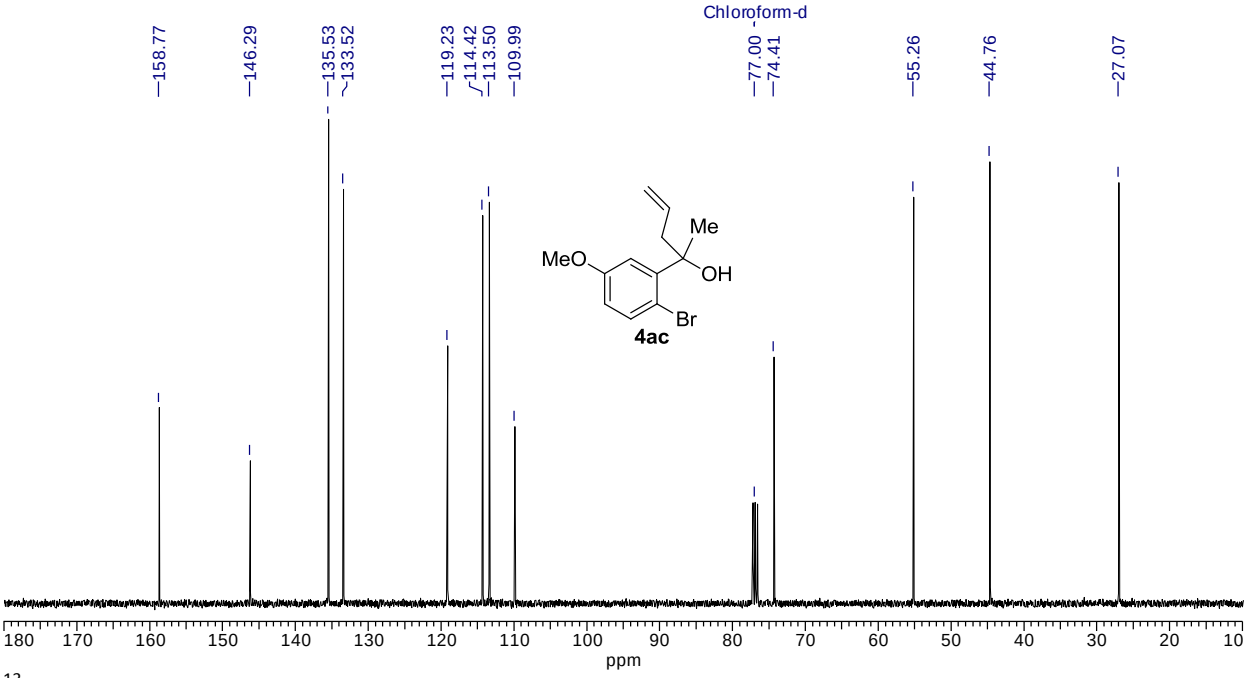
^{1}H NMR (400 MHz) spectrum of **4ab** in $CDCl_3$



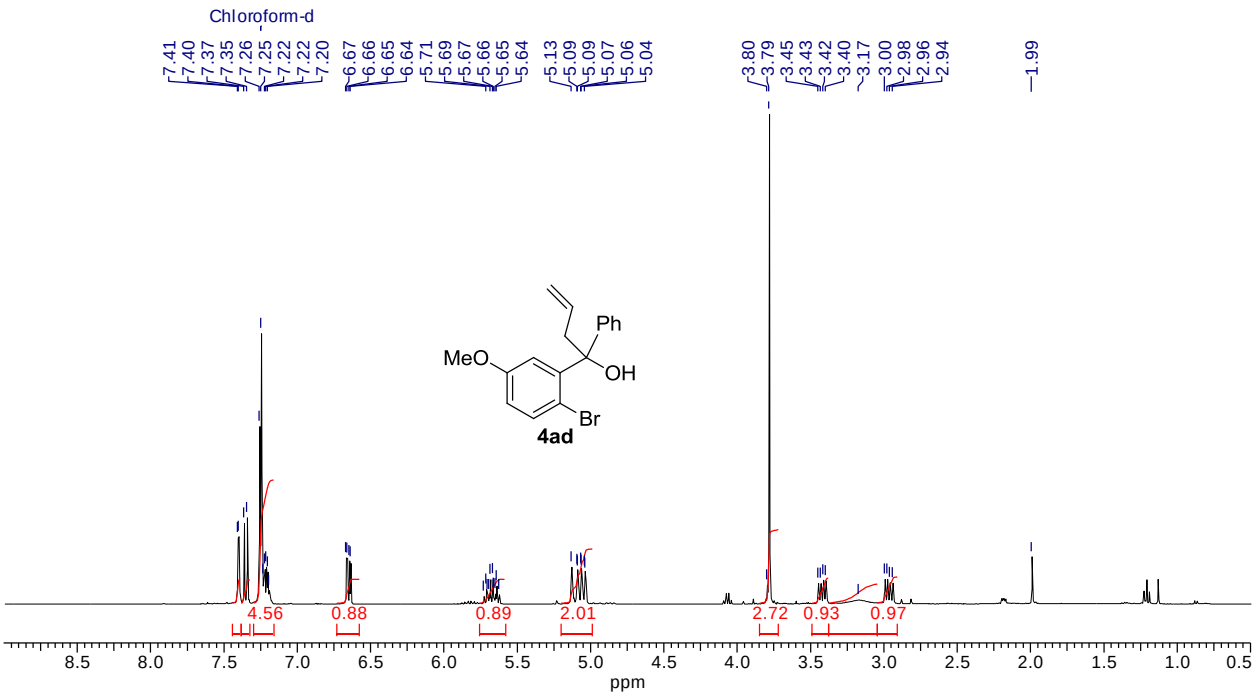
^{13}C NMR (100 MHz) spectrum of **4ab** in $CDCl_3$



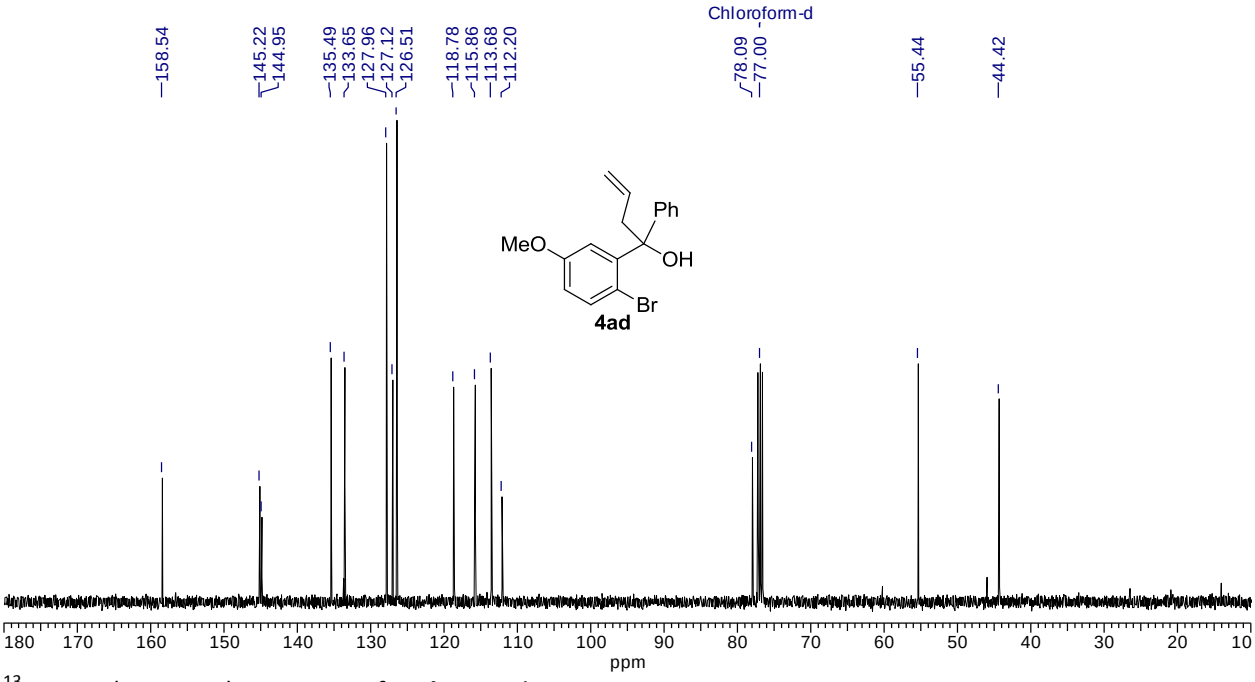
^{1}H NMR (400 MHz) spectrum of **4ac** in $CDCl_3$



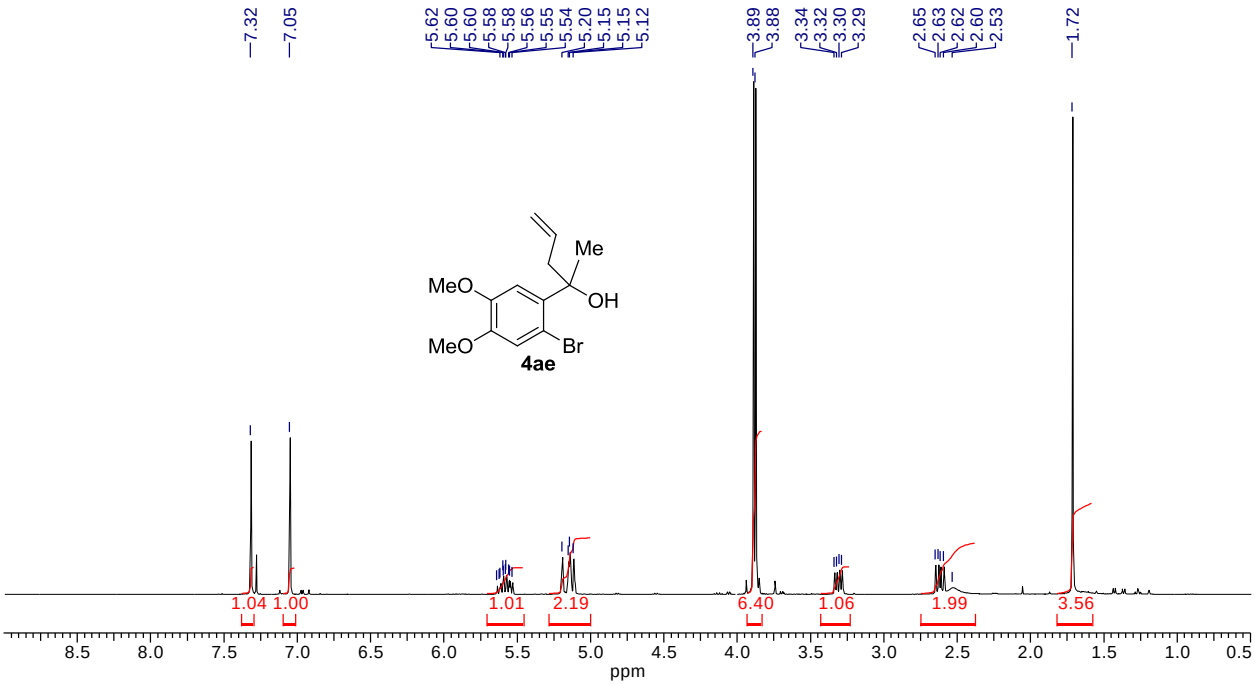
^{13}C NMR (100 MHz) spectrum of **4ac** in $CDCl_3$



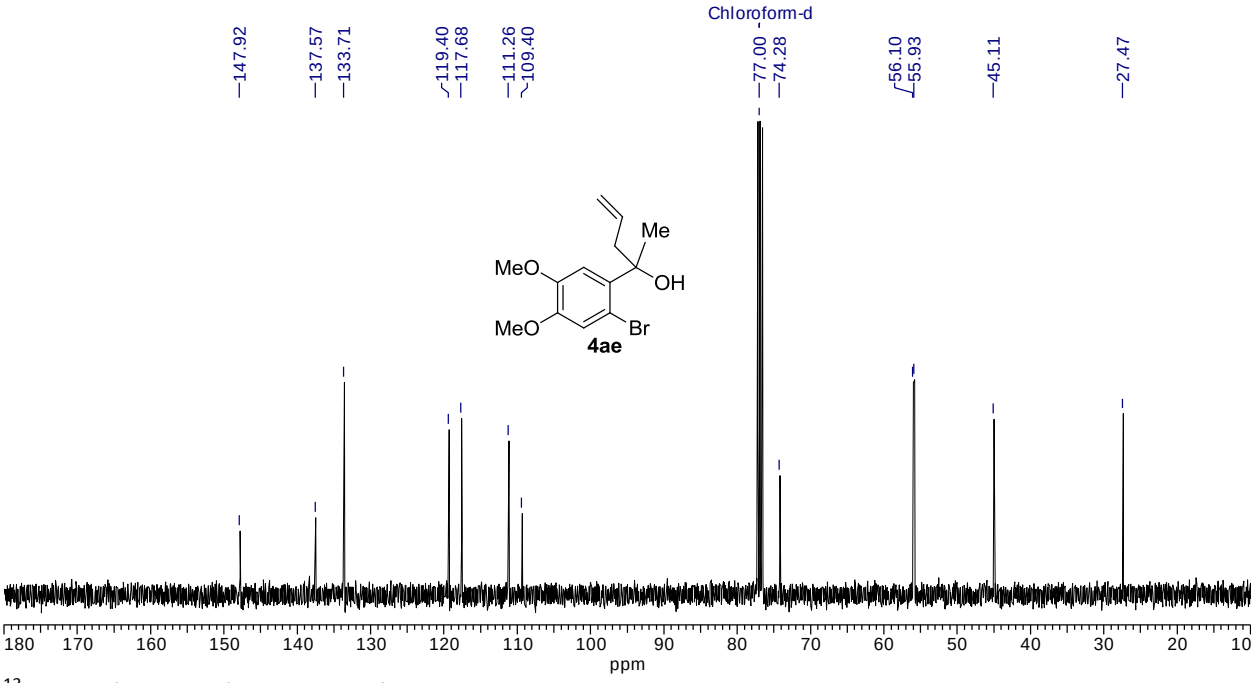
^{1}H NMR (400 MHz) spectrum of **4ad** in $CDCl_3$



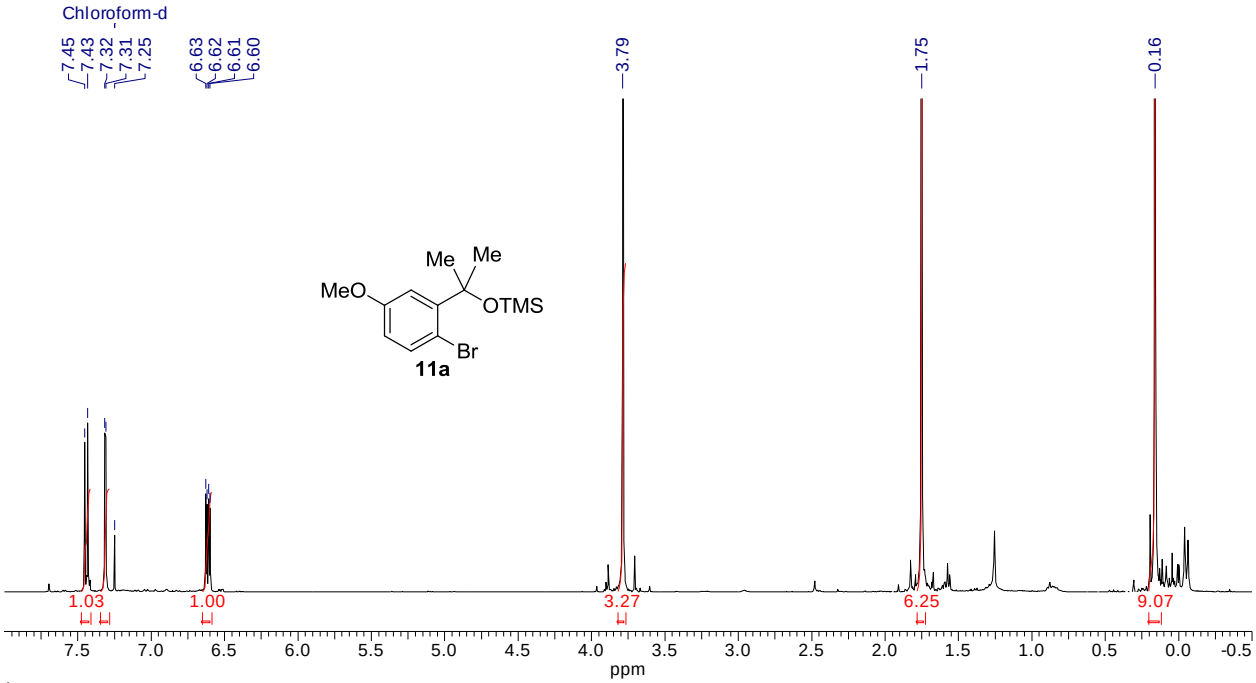
^{13}C NMR (100 MHz) spectrum of **4ad** in $CDCl_3$



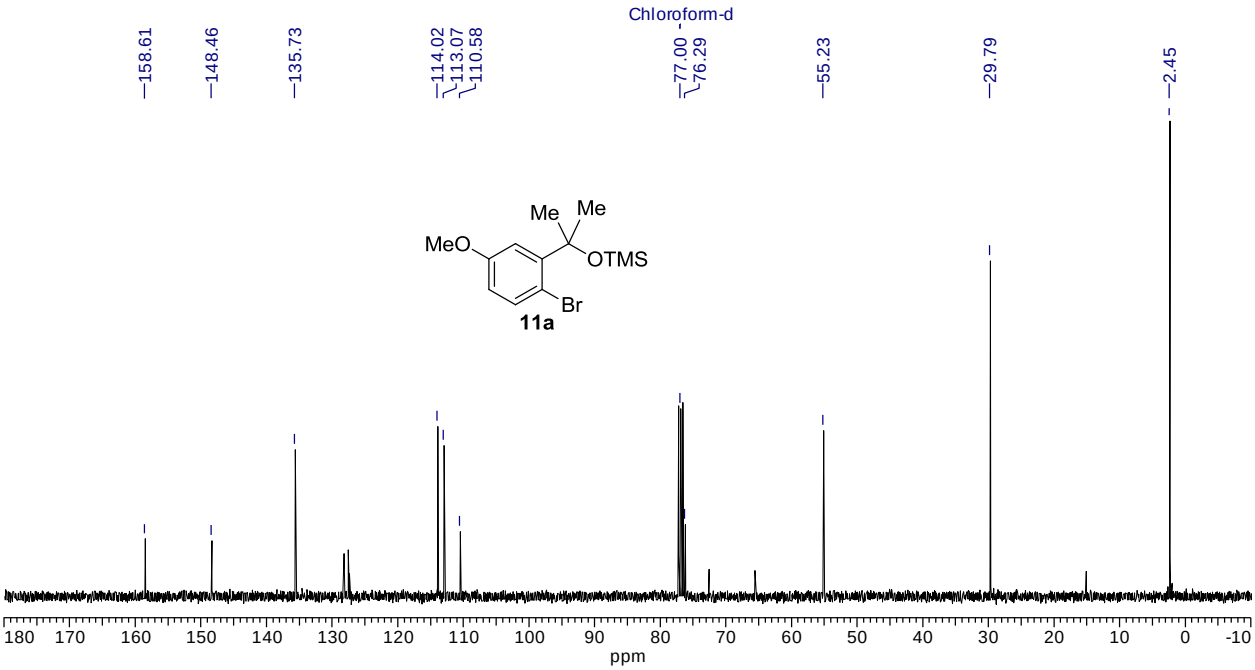
^{1}H NMR (400 MHz) spectrum of **4ae** in $CDCl_3$



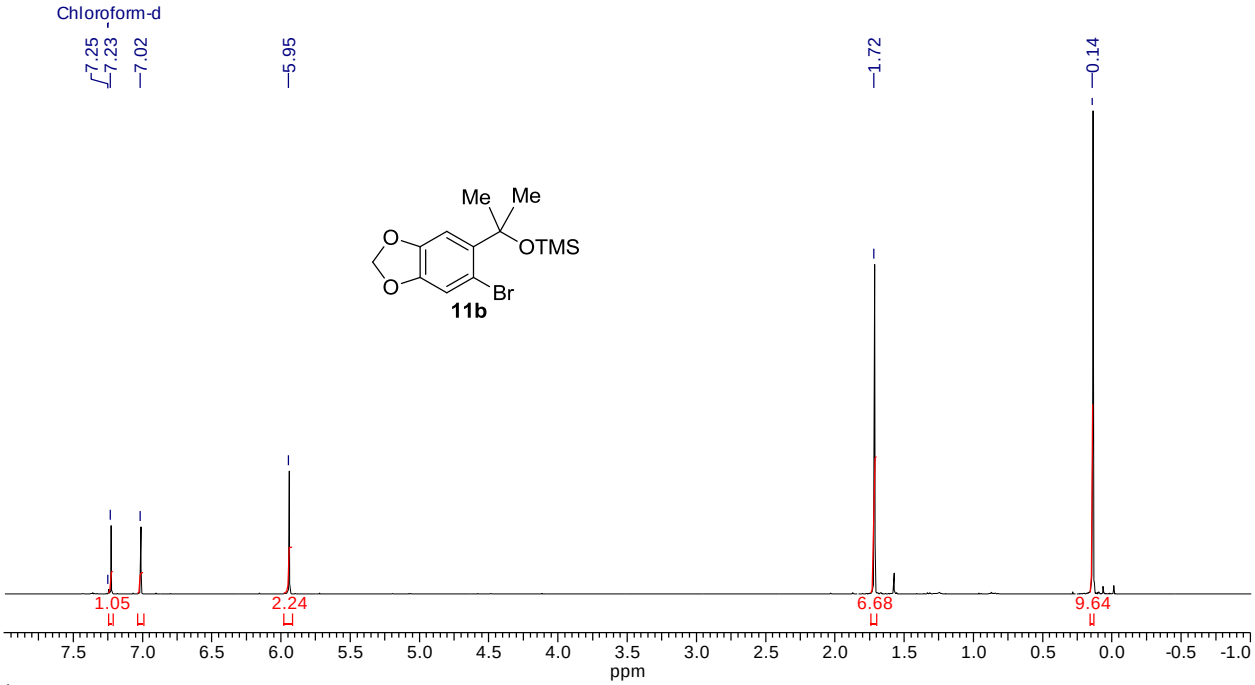
^{13}C NMR (100 MHz) spectrum of **4ae** in $CDCl_3$



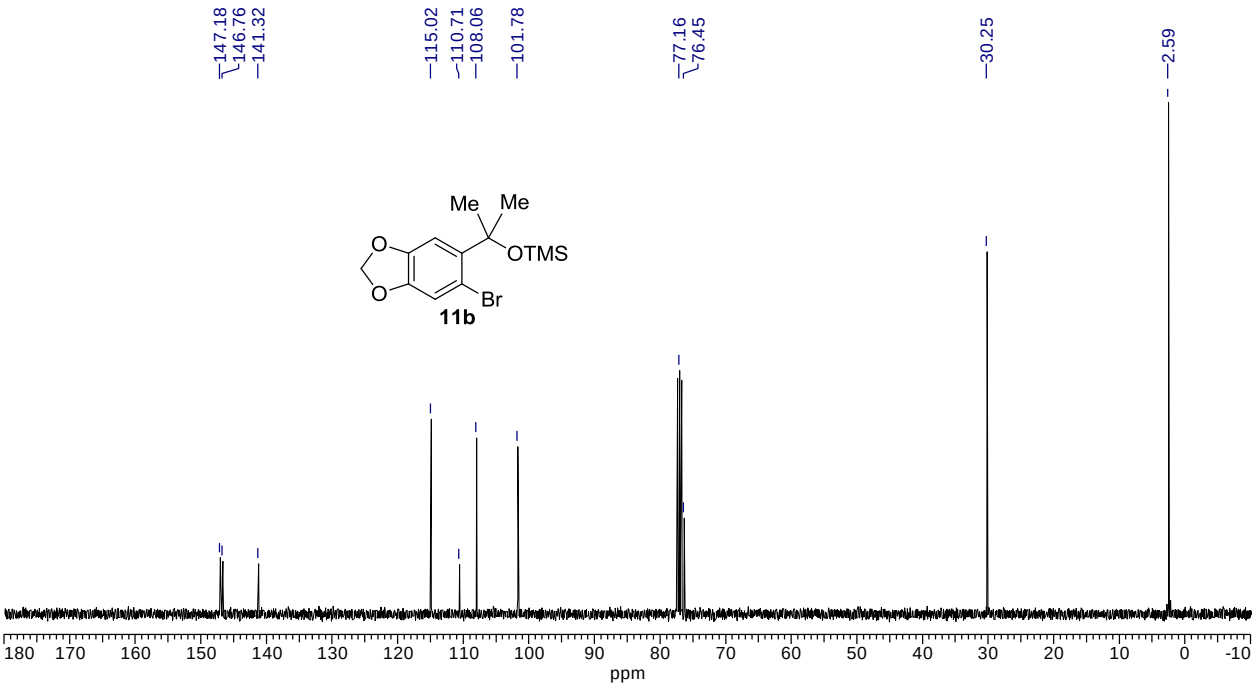
^{1}H NMR (400 MHz) spectrum of **11a** in $CDCl_3$



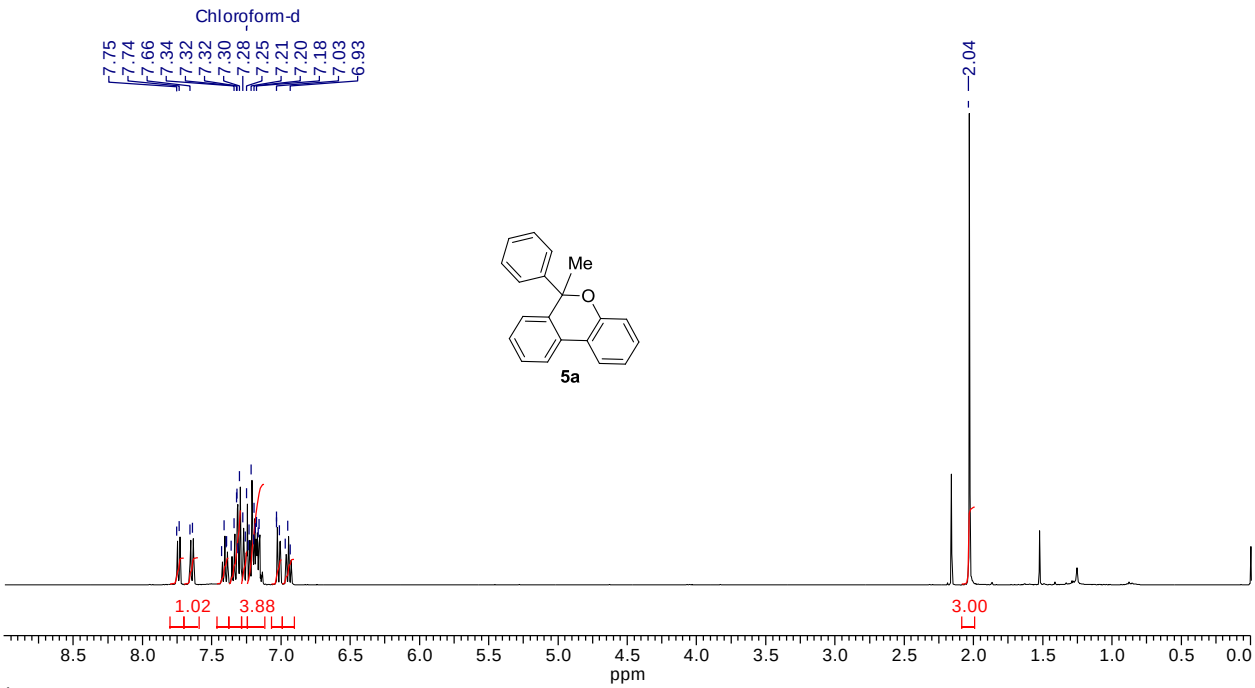
^{13}C NMR (100 MHz) spectrum of **11a** in $CDCl_3$



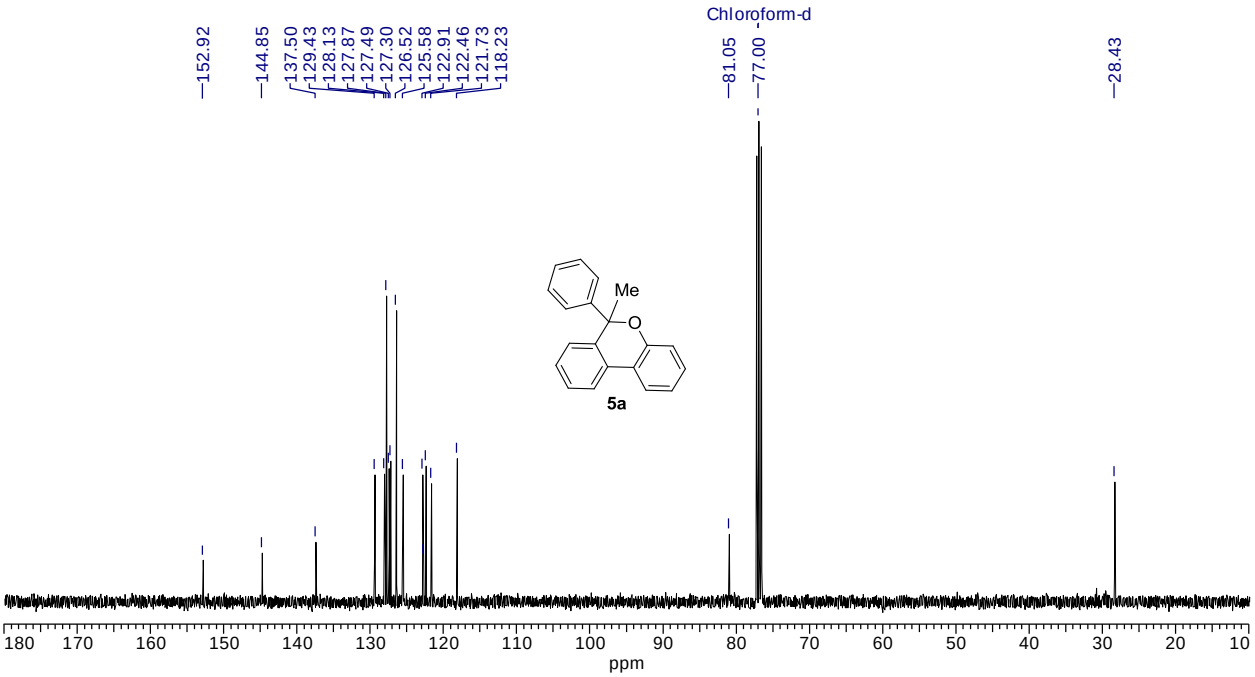
^{1}H NMR (400 MHz) spectrum of **11b** in $CDCl_3$



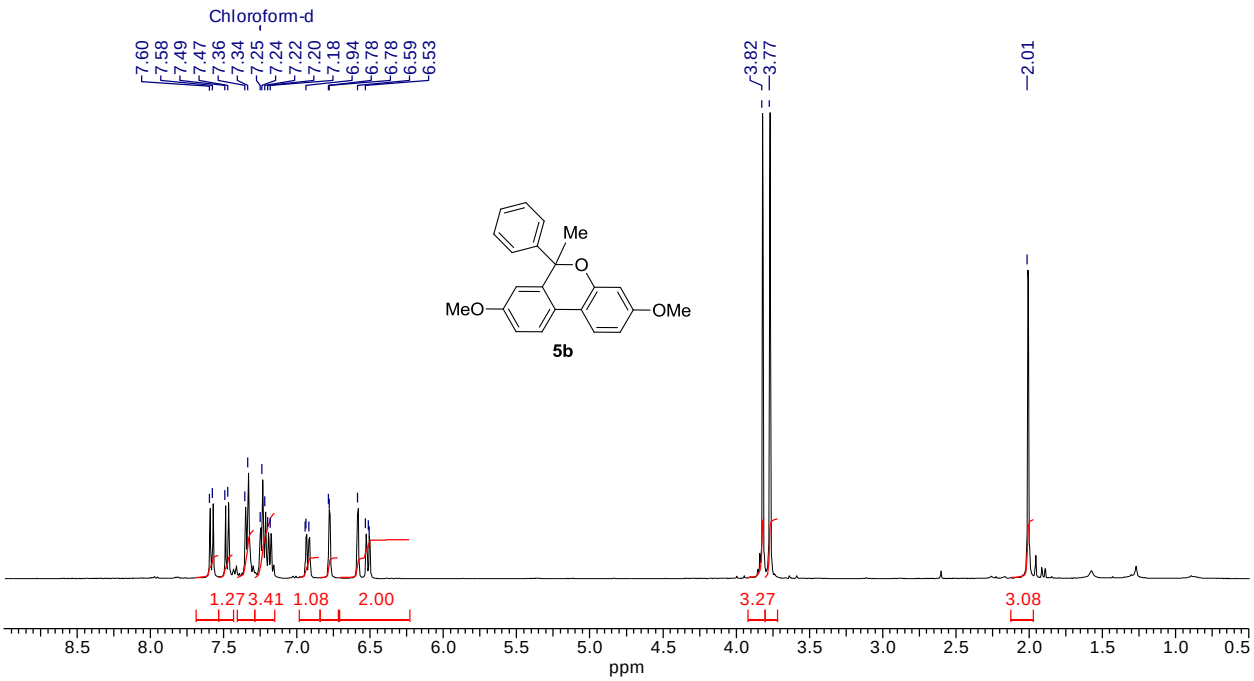
^{13}C NMR (100 MHz) spectrum of **11b** in $CDCl_3$



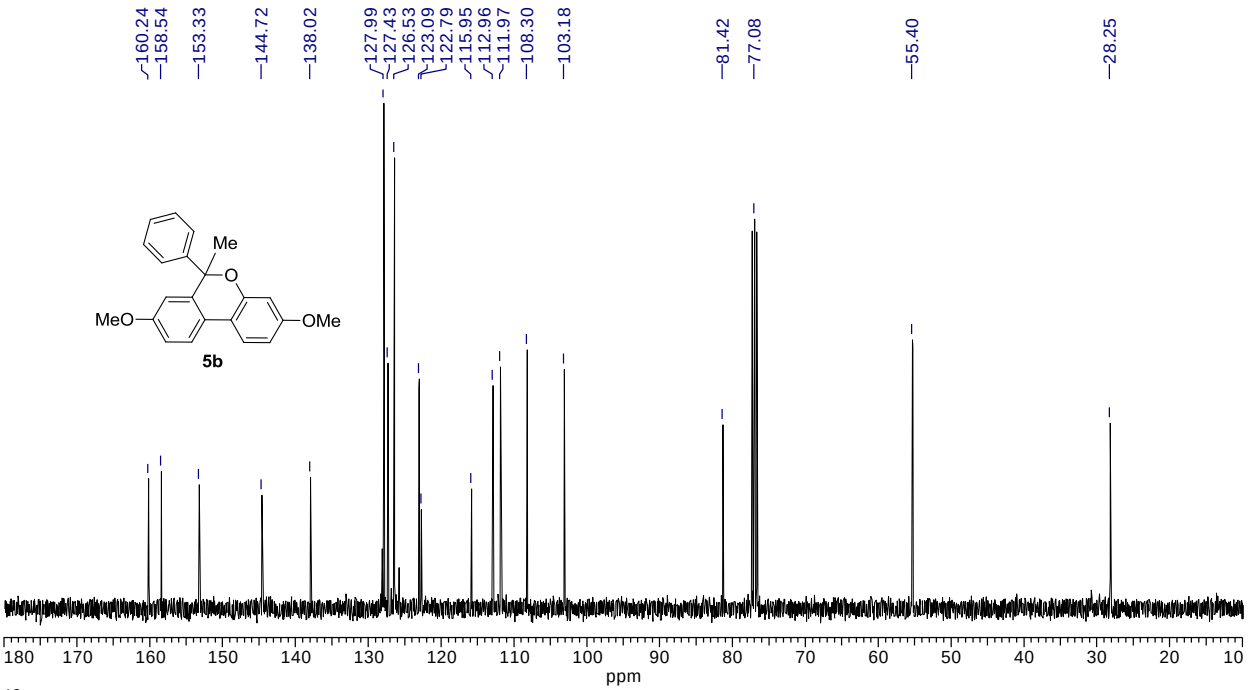
^{1}H NMR (400 MHz) spectrum of **5a** in $CDCl_3$



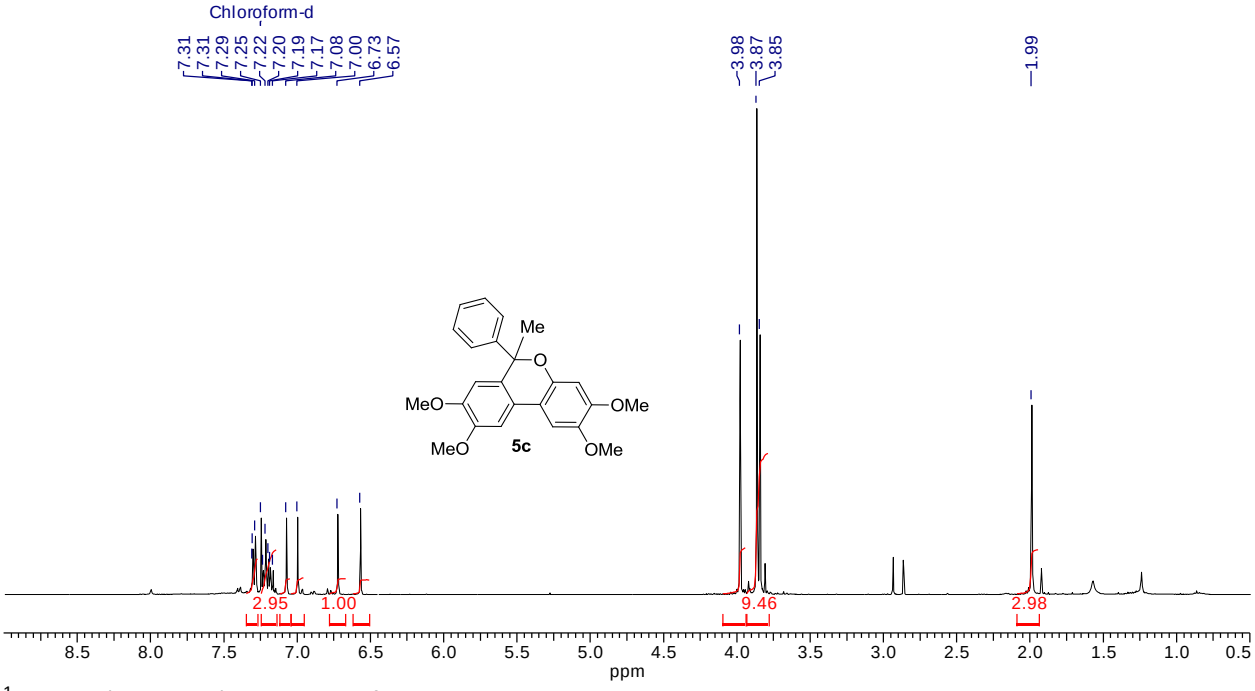
^{13}C NMR (100 MHz) spectrum of **5a** in $CDCl_3$



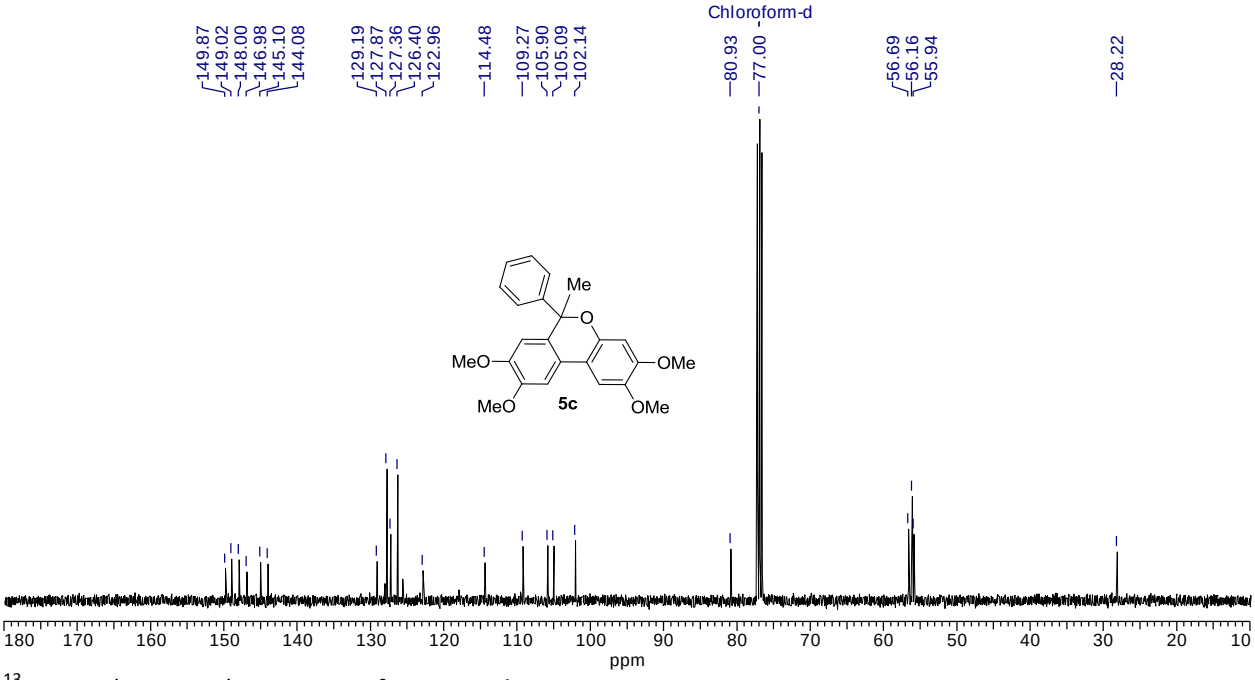
^{1}H NMR (400 MHz) spectrum of **5b** in $CDCl_3$



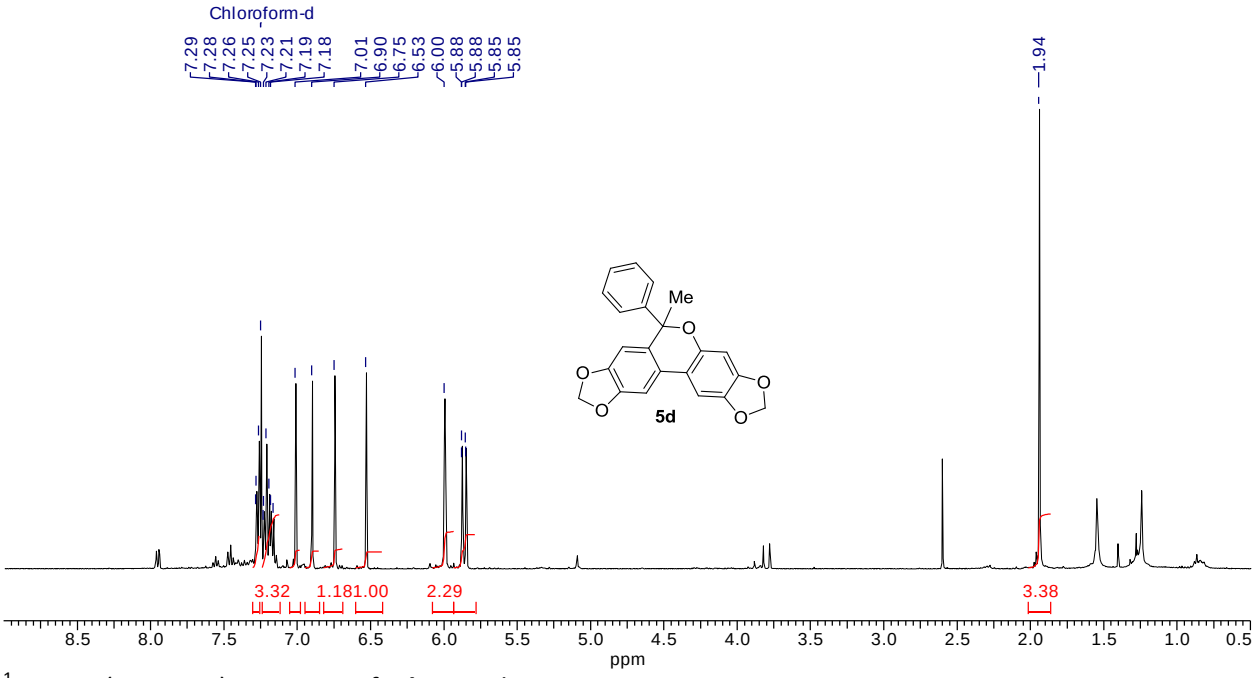
^{13}C NMR (100 MHz) spectrum of **5b** in $CDCl_3$



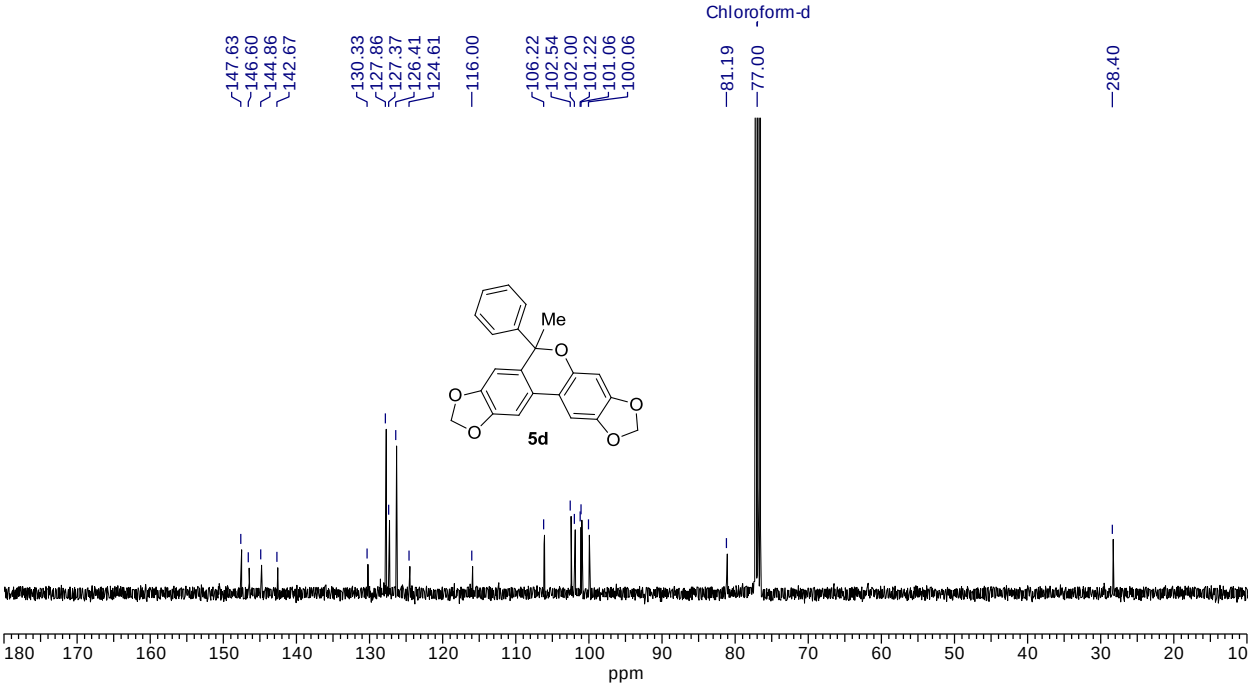
^{1}H NMR (400 MHz) spectrum of **5c** in $CDCl_3$



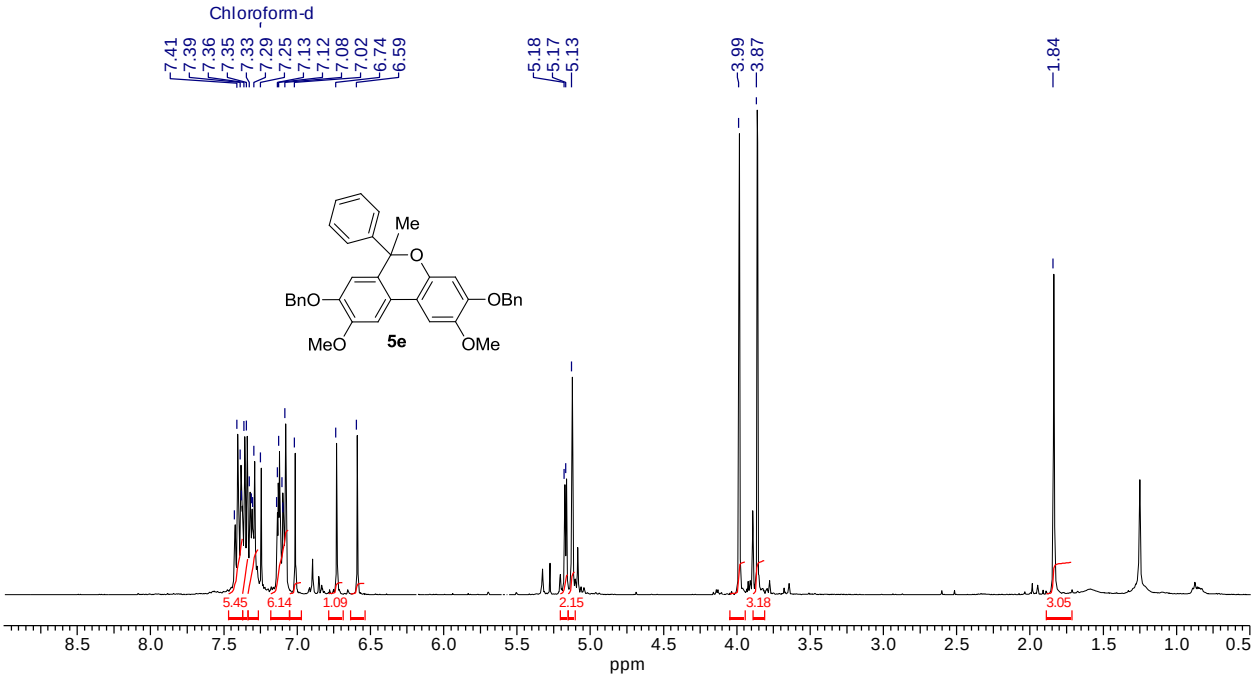
^{13}C NMR (100 MHz) spectrum of **5c** in $CDCl_3$



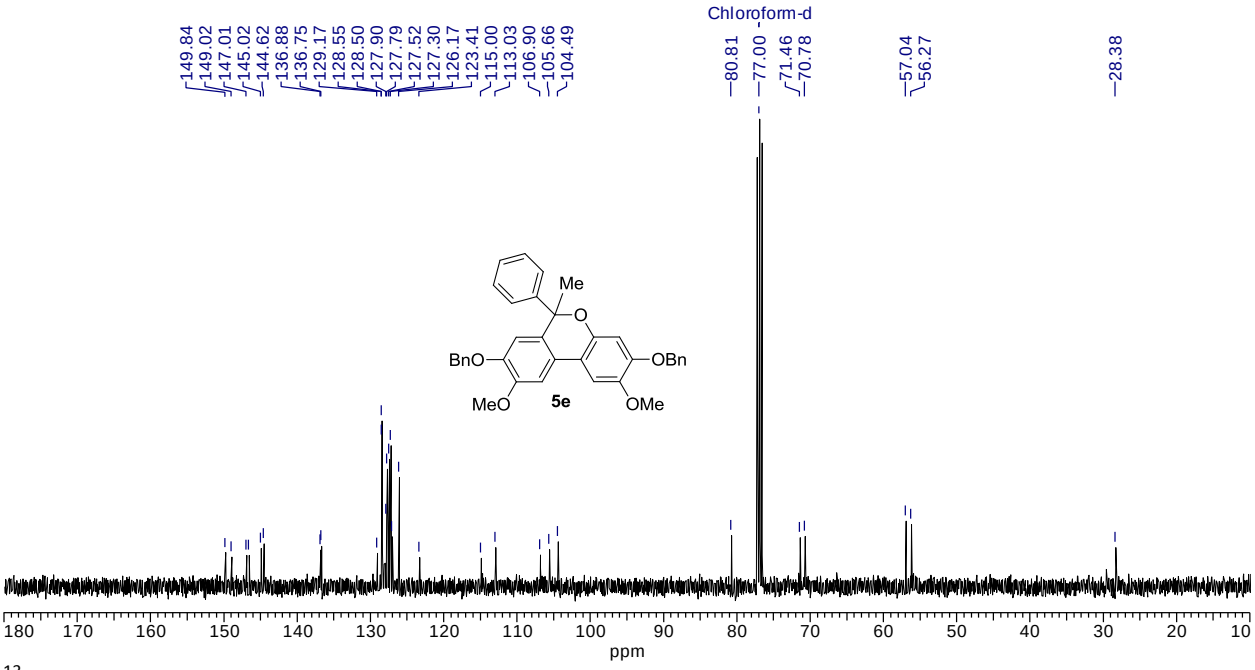
^{1}H NMR (400 MHz) spectrum of **5d** in $CDCl_3$



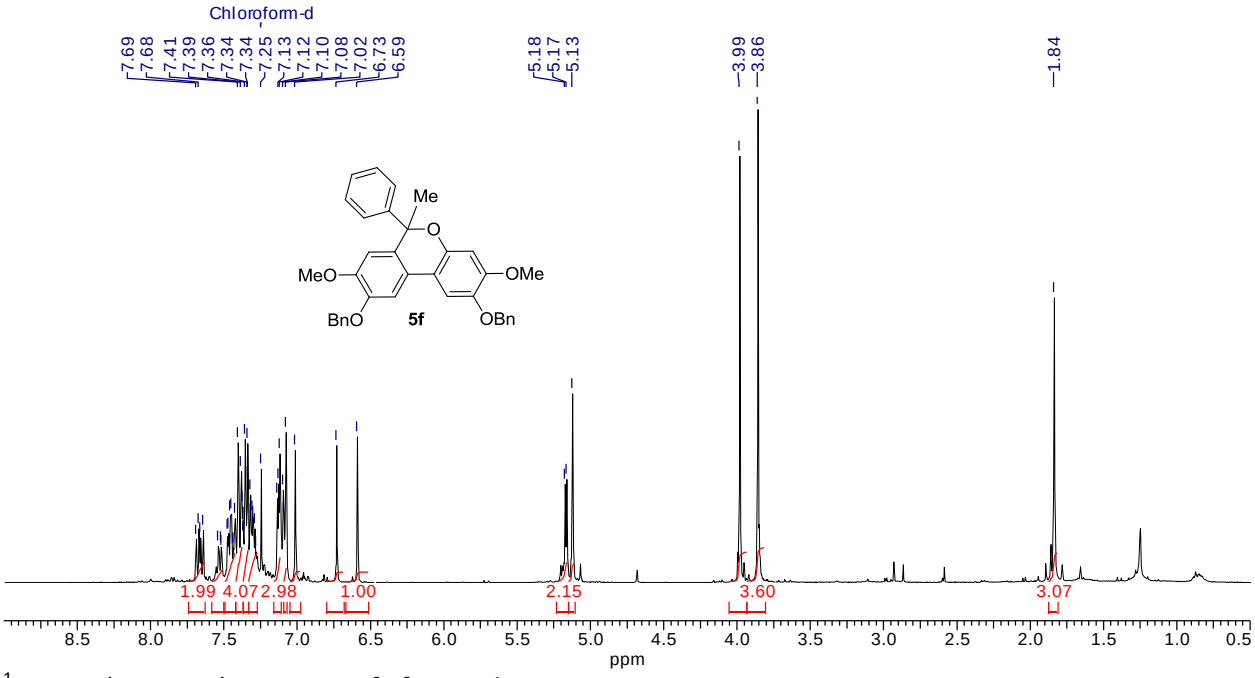
^{13}C NMR (100 MHz) spectrum of **5d** in $CDCl_3$



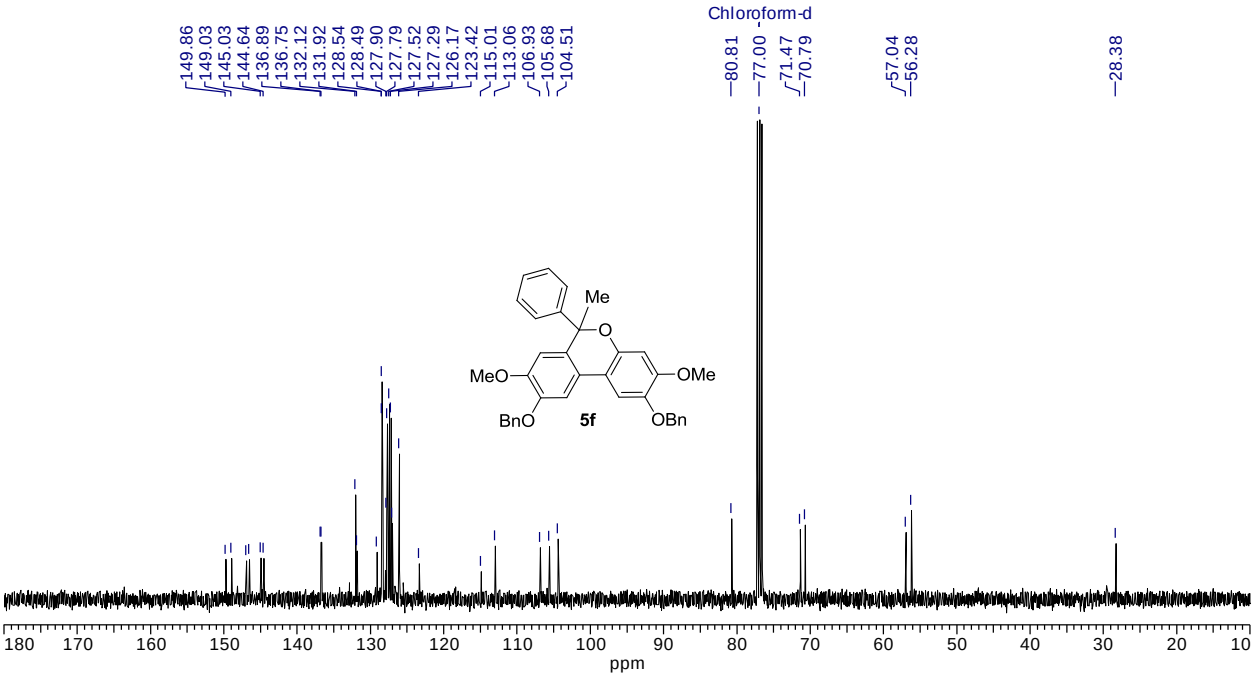
^{1}H NMR (400 MHz) spectrum of **5e** in $CDCl_3$



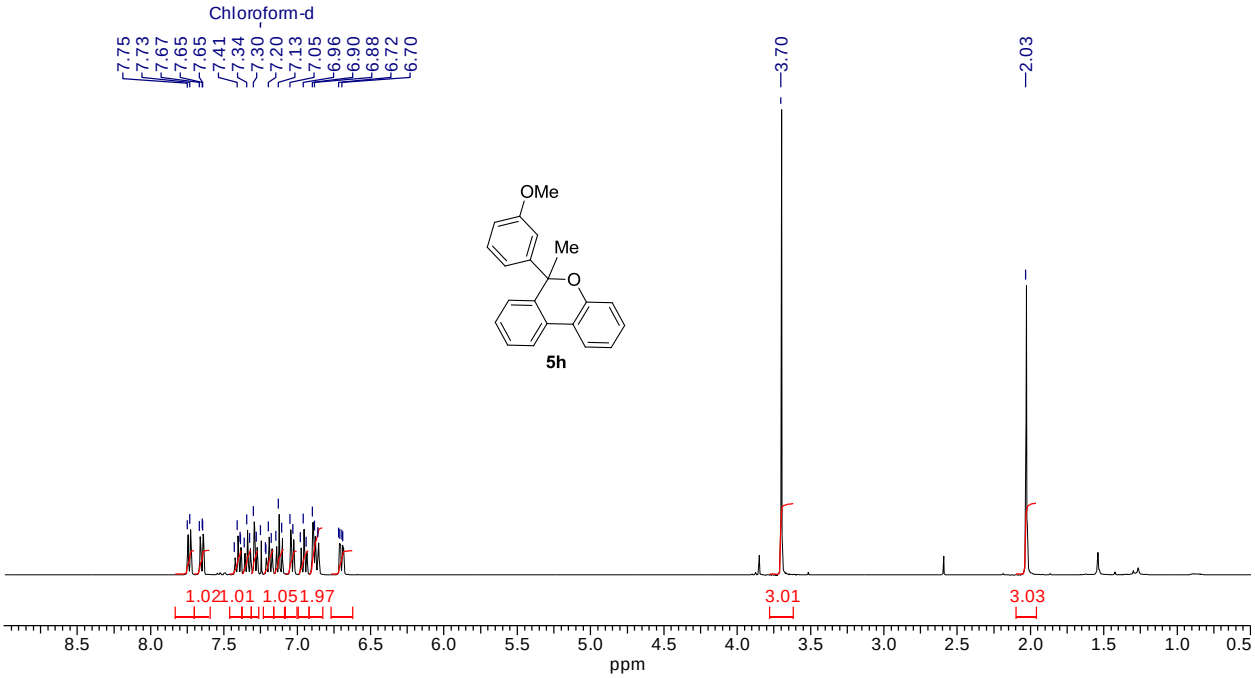
^{13}C NMR (100 MHz) spectrum of **5e** in $CDCl_3$



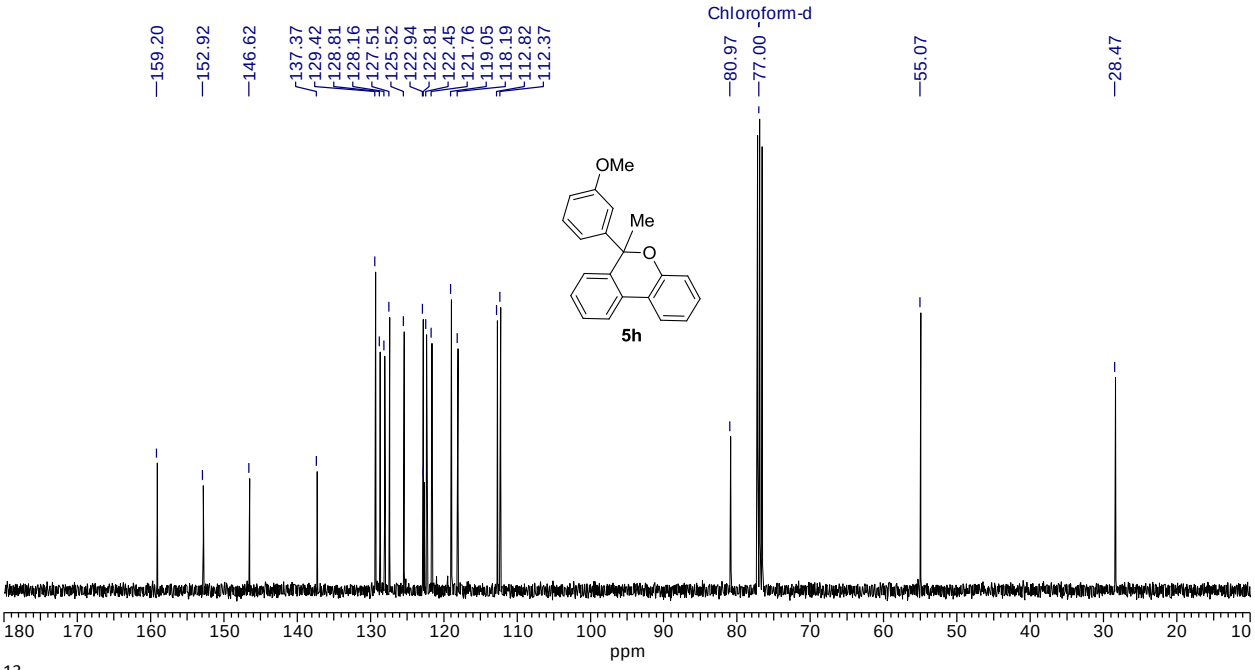
^{1}H NMR (400 MHz) spectrum of **5f** in $CDCl_3$



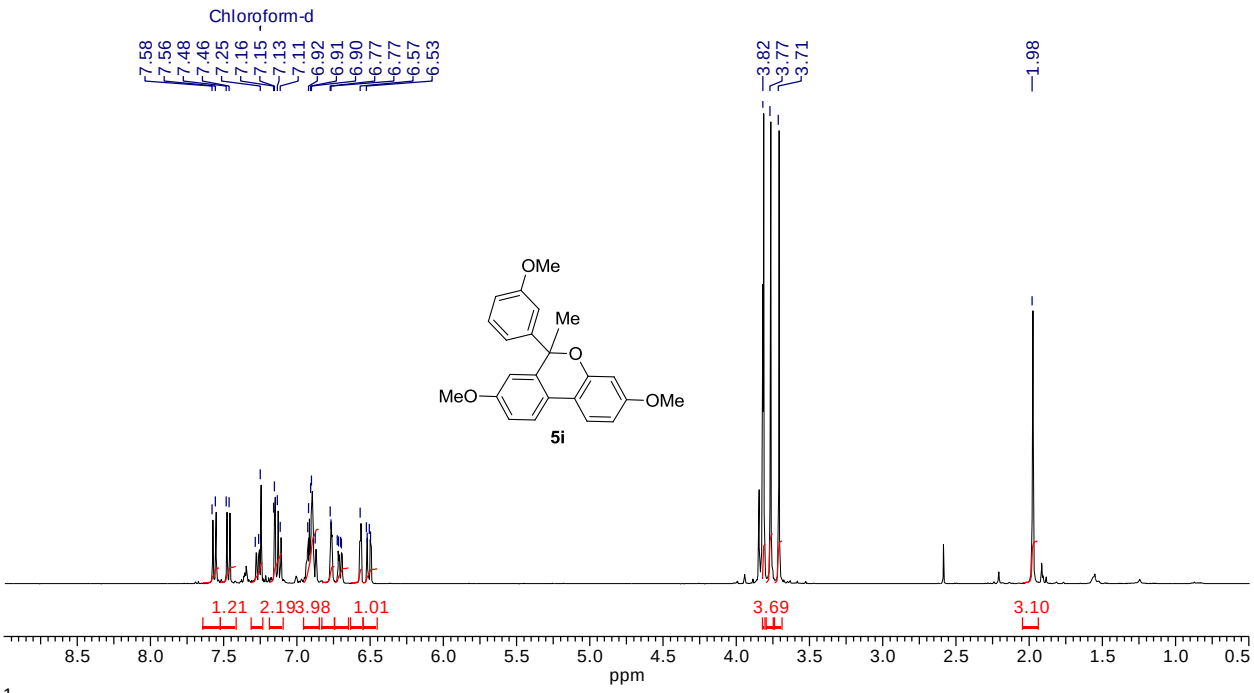
^{13}C NMR (100 MHz) spectrum of **5f** in $CDCl_3$



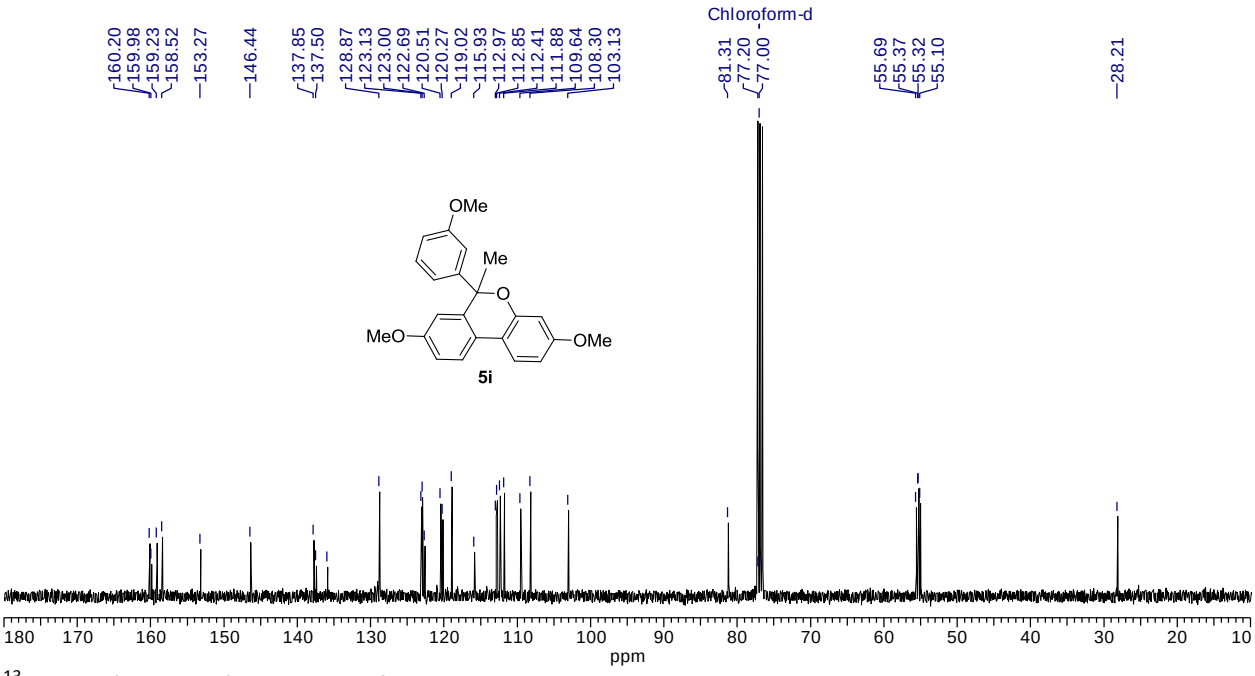
^{1}H NMR (400 MHz) spectrum of **5h** in $CDCl_3$



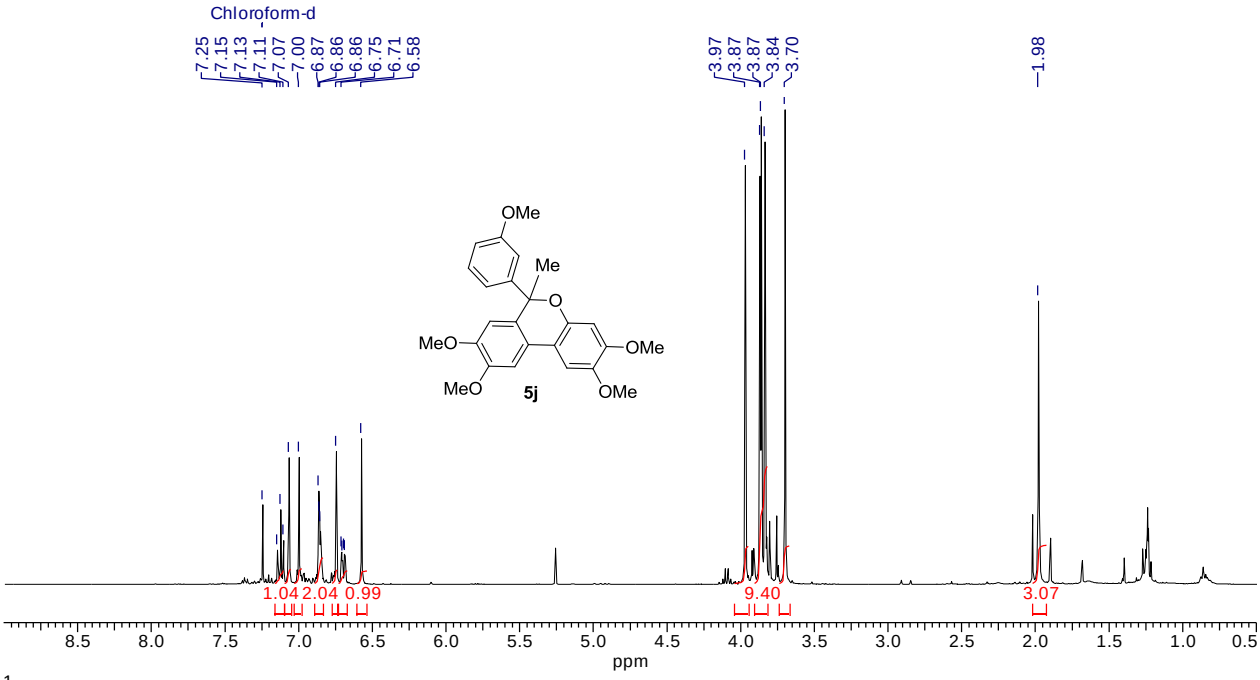
^{13}C NMR (100 MHz) spectrum of **5h** in $CDCl_3$



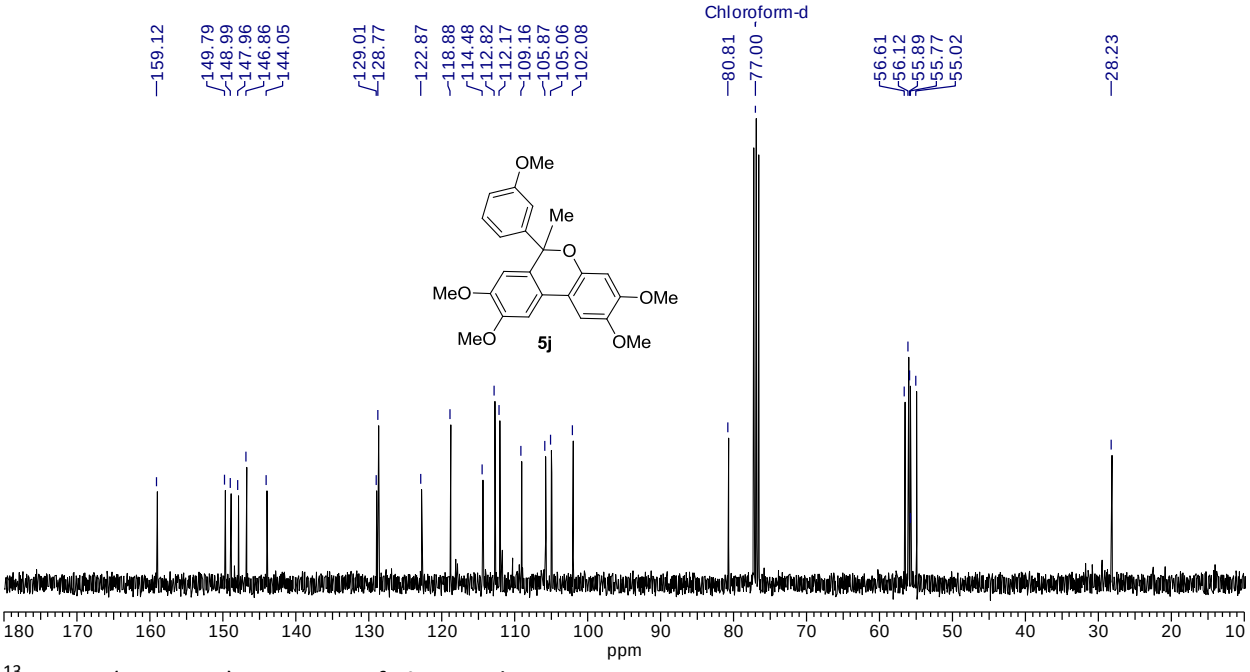
^{1}H NMR (400 MHz) spectrum of **5i** in $CDCl_3$



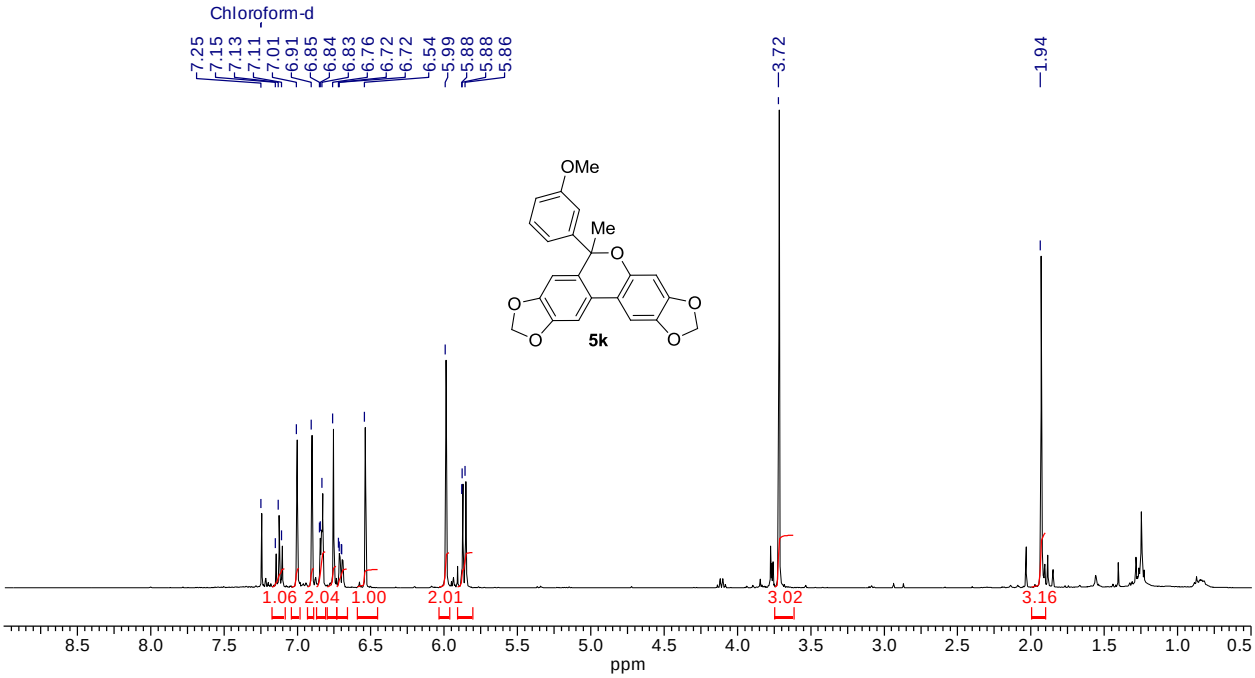
^{13}C NMR (100 MHz) spectrum of **5i** in $CDCl_3$



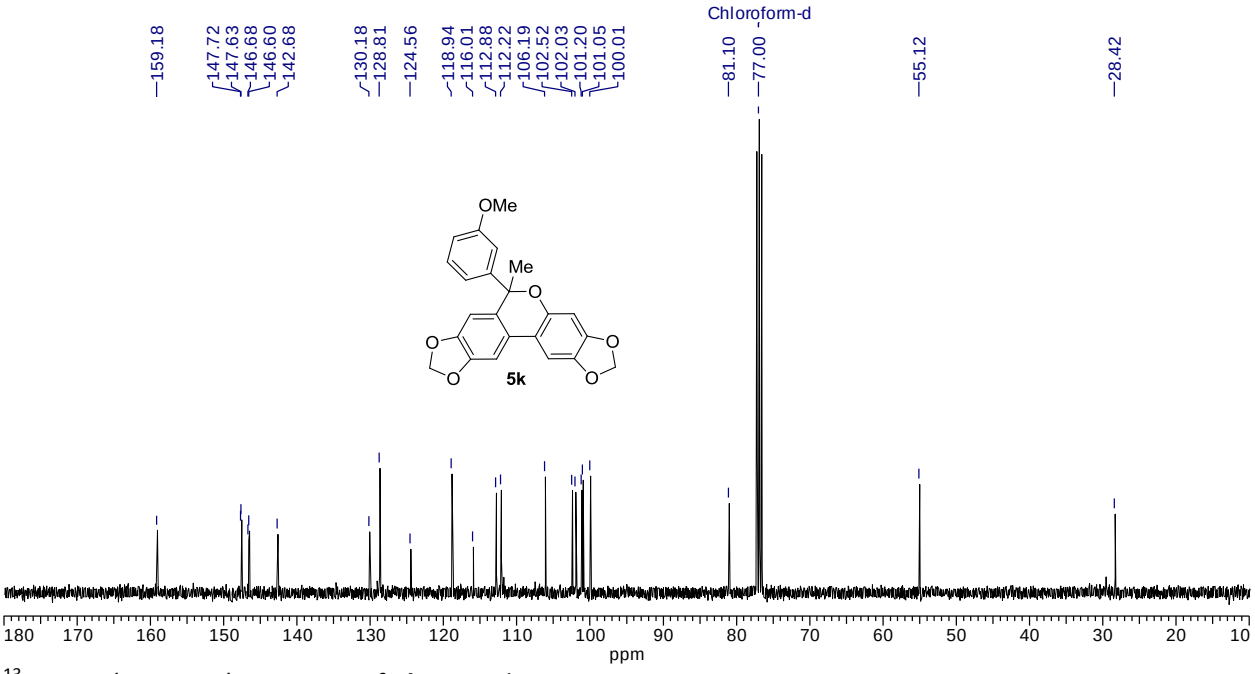
^{1}H NMR (400 MHz) spectrum of **5j** in $CDCl_3$



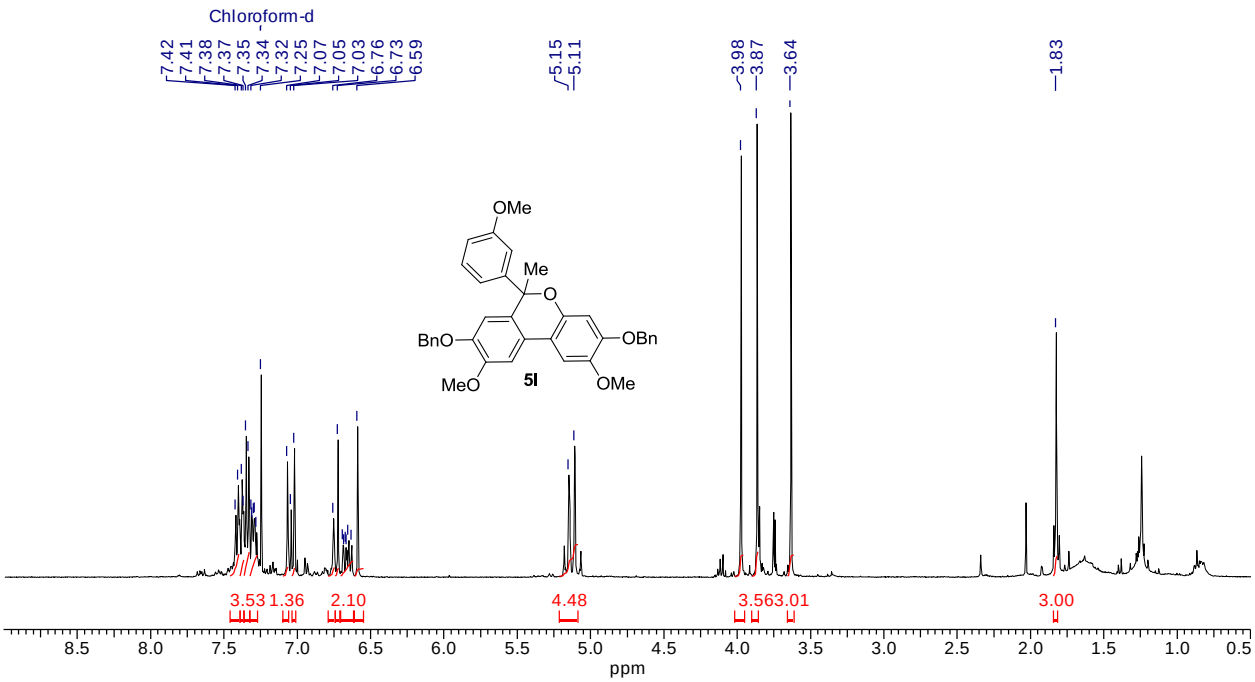
^{13}C NMR (100 MHz) spectrum of **5j** in $CDCl_3$



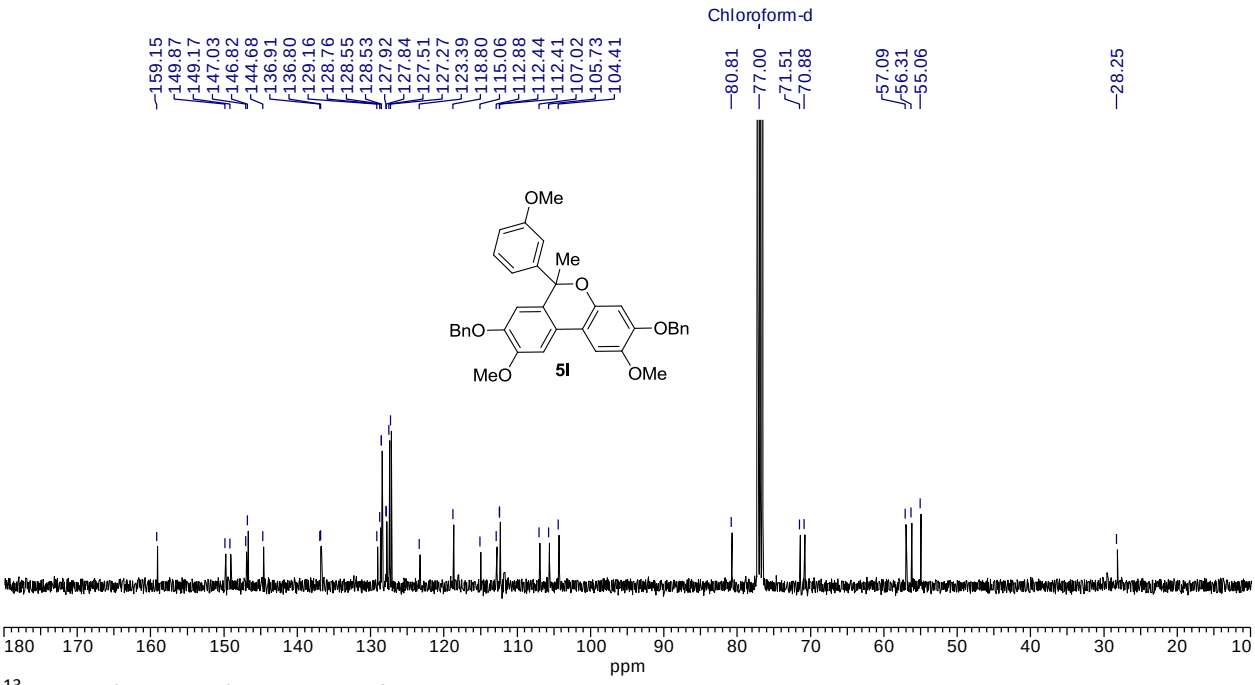
^{1}H NMR (400 MHz) spectrum of **5k** in $CDCl_3$



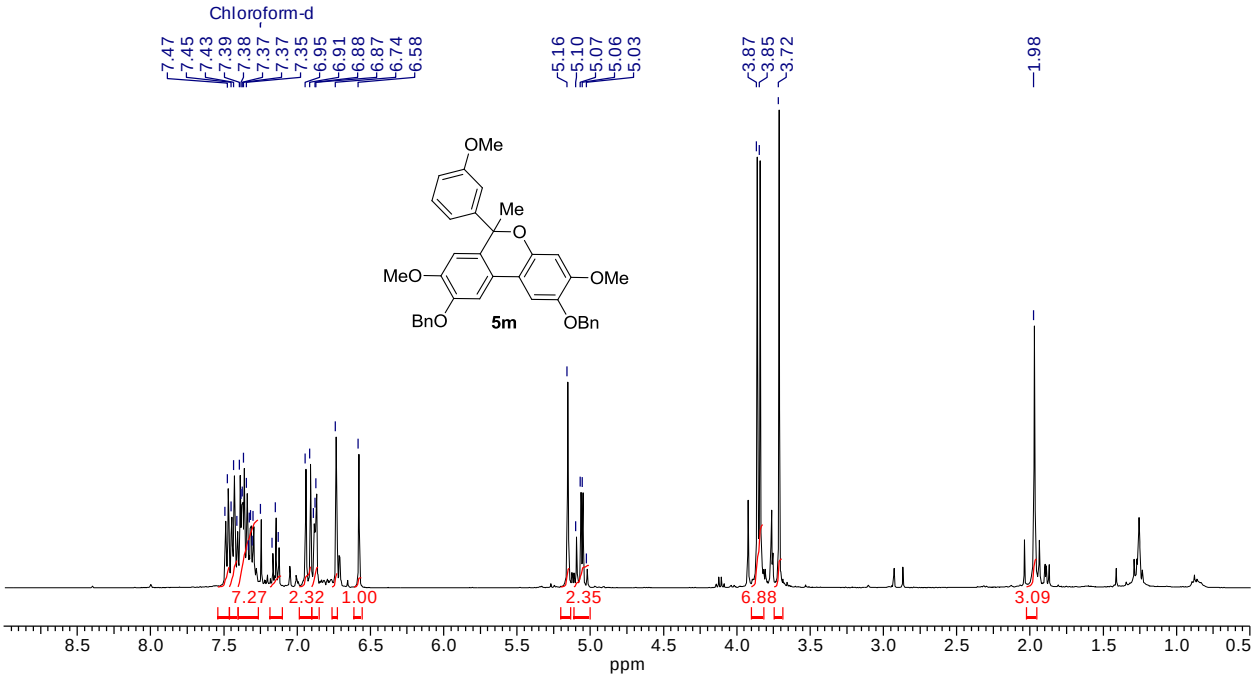
^{13}C NMR (100 MHz) spectrum of **5k** in $CDCl_3$



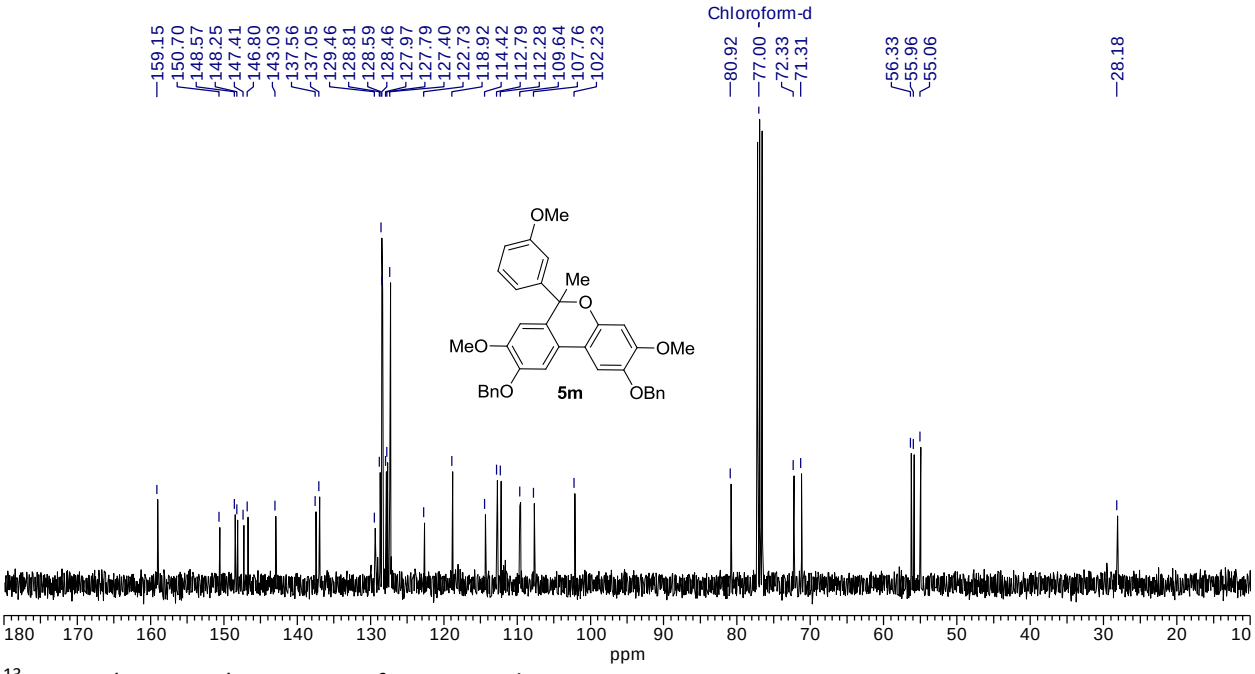
^{1}H NMR (400 MHz) spectrum of **5l** in $CDCl_3$



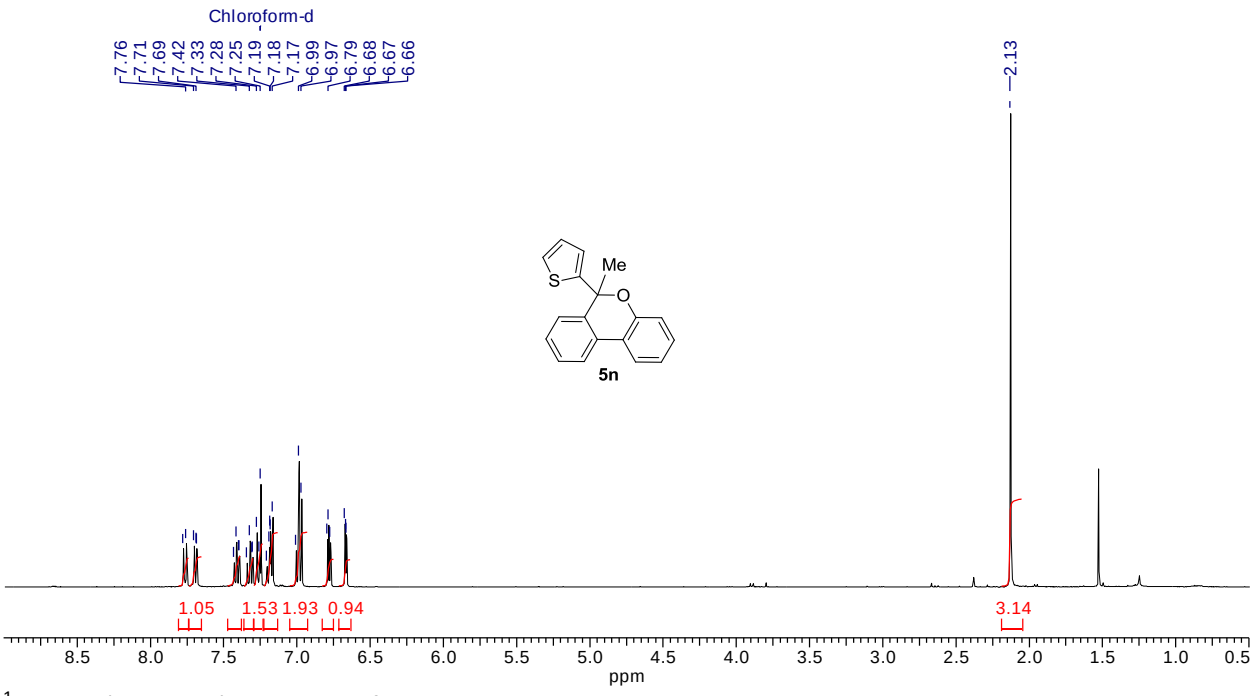
^{13}C NMR (100 MHz) spectrum of **5l** in $CDCl_3$



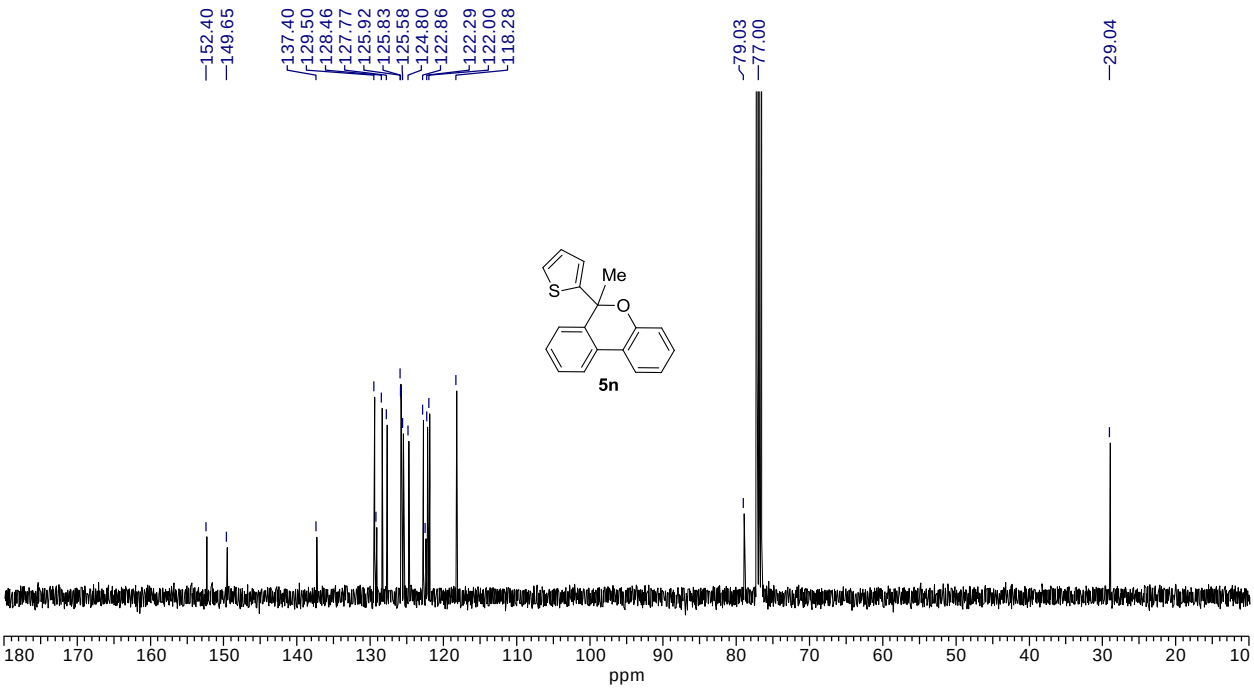
^{1}H NMR (400 MHz) spectrum of **5m** in $CDCl_3$



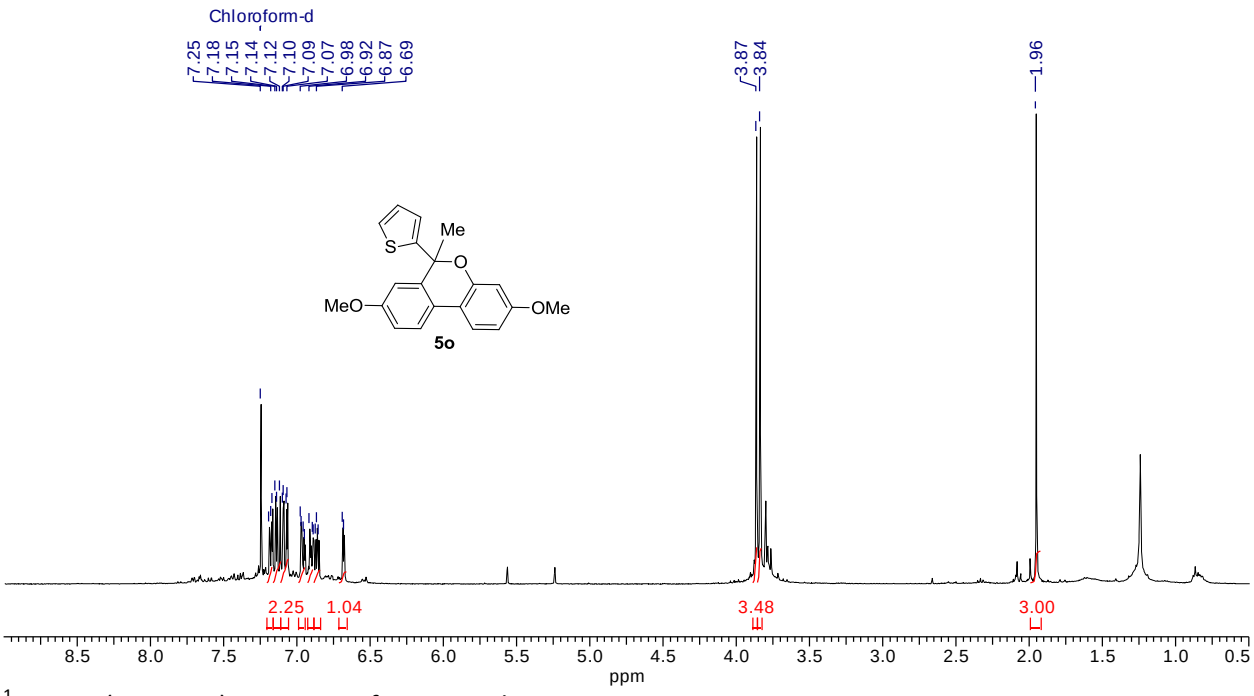
^{13}C NMR (100 MHz) spectrum of **5m** in $CDCl_3$



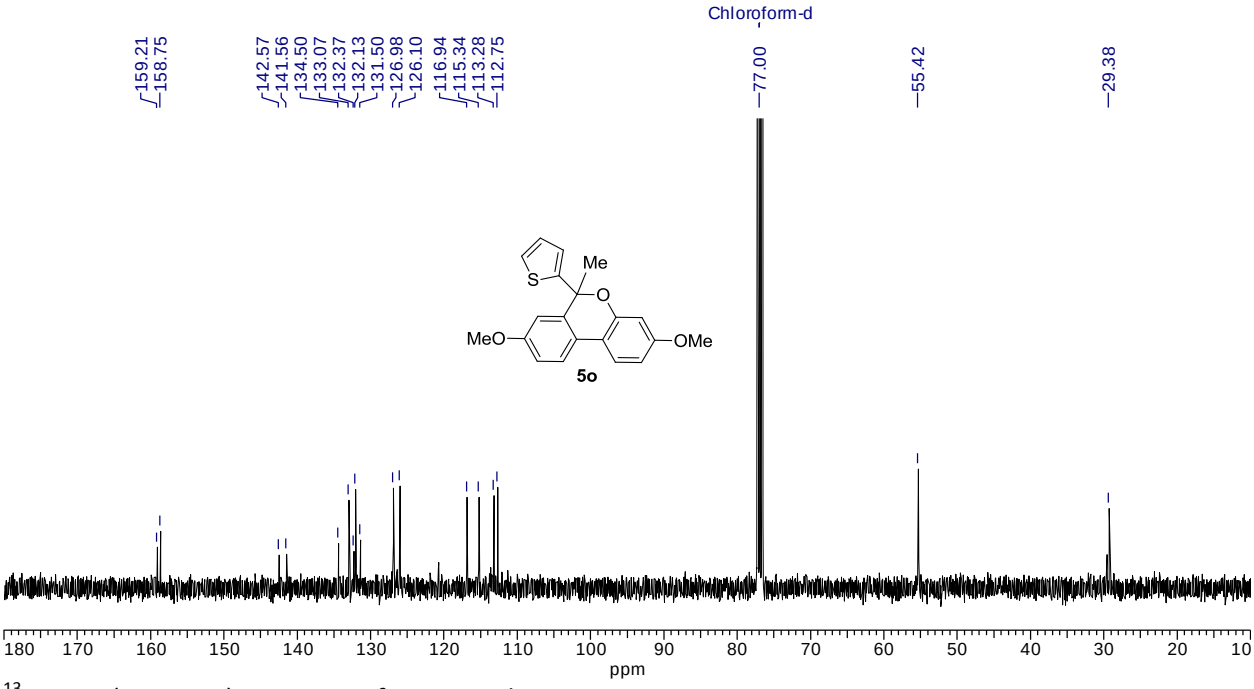
^{1}H NMR (400 MHz) spectrum of **5n** in $CDCl_3$



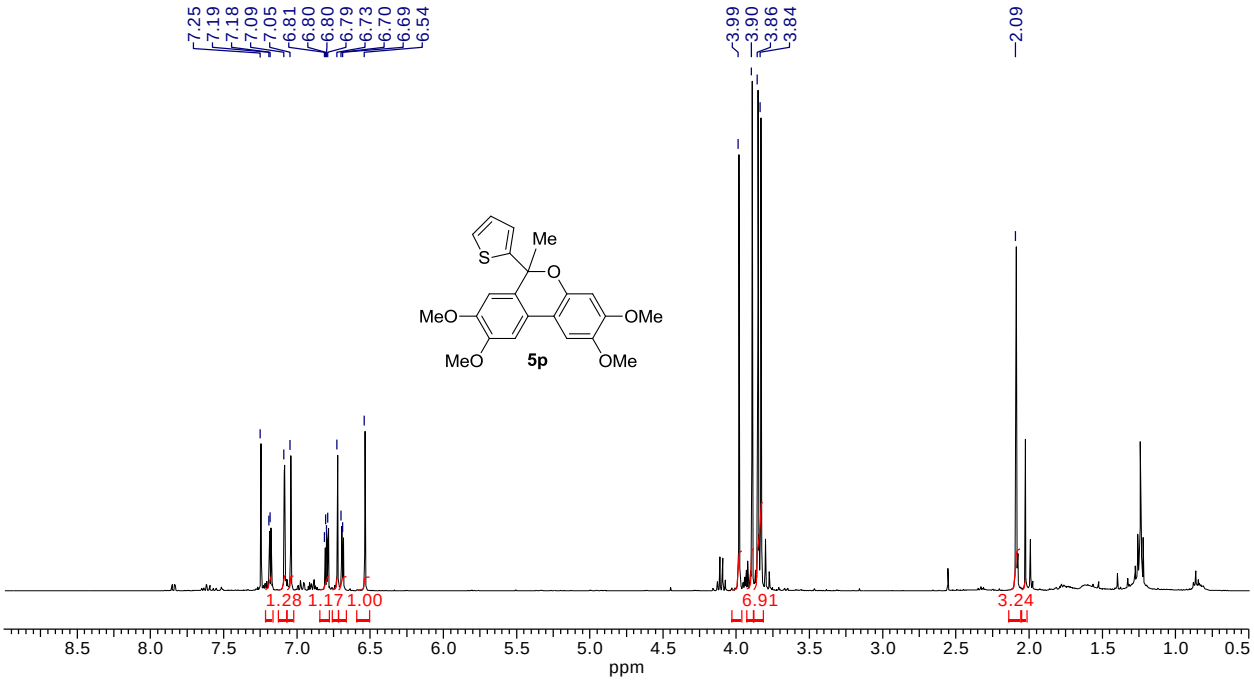
^{13}C NMR (100 MHz) spectrum of **5n** in $CDCl_3$



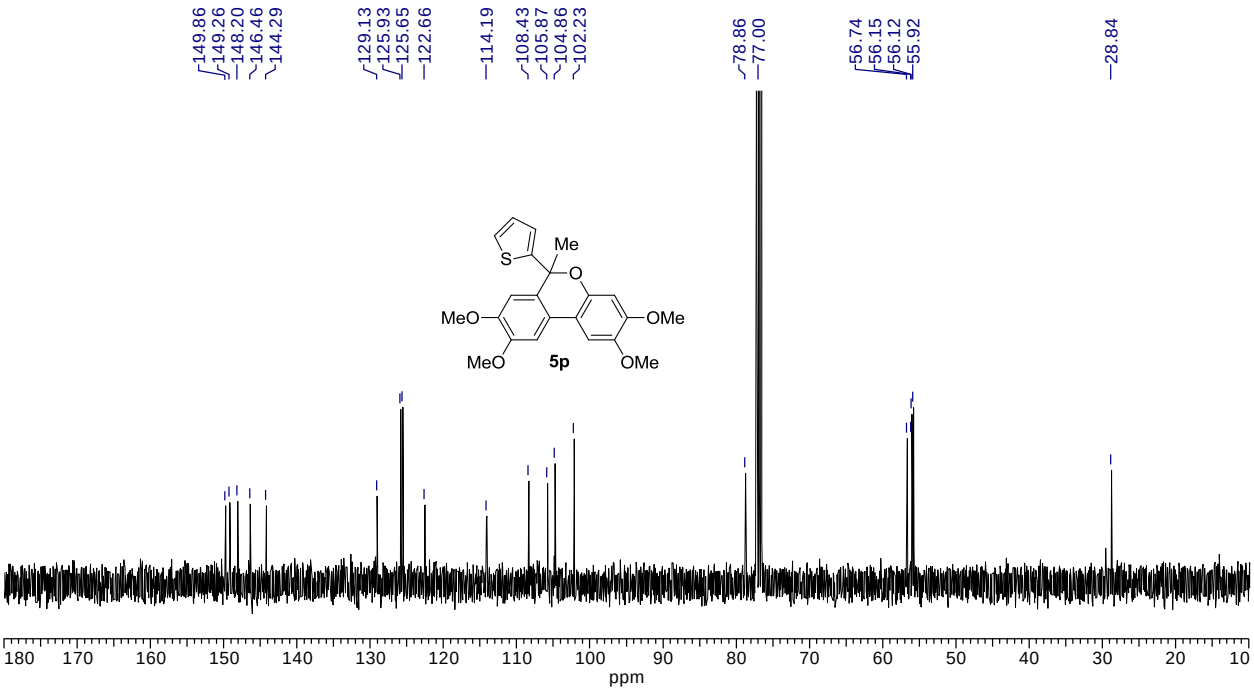
^{1}H NMR (400 MHz) spectrum of **5o** in $CDCl_3$



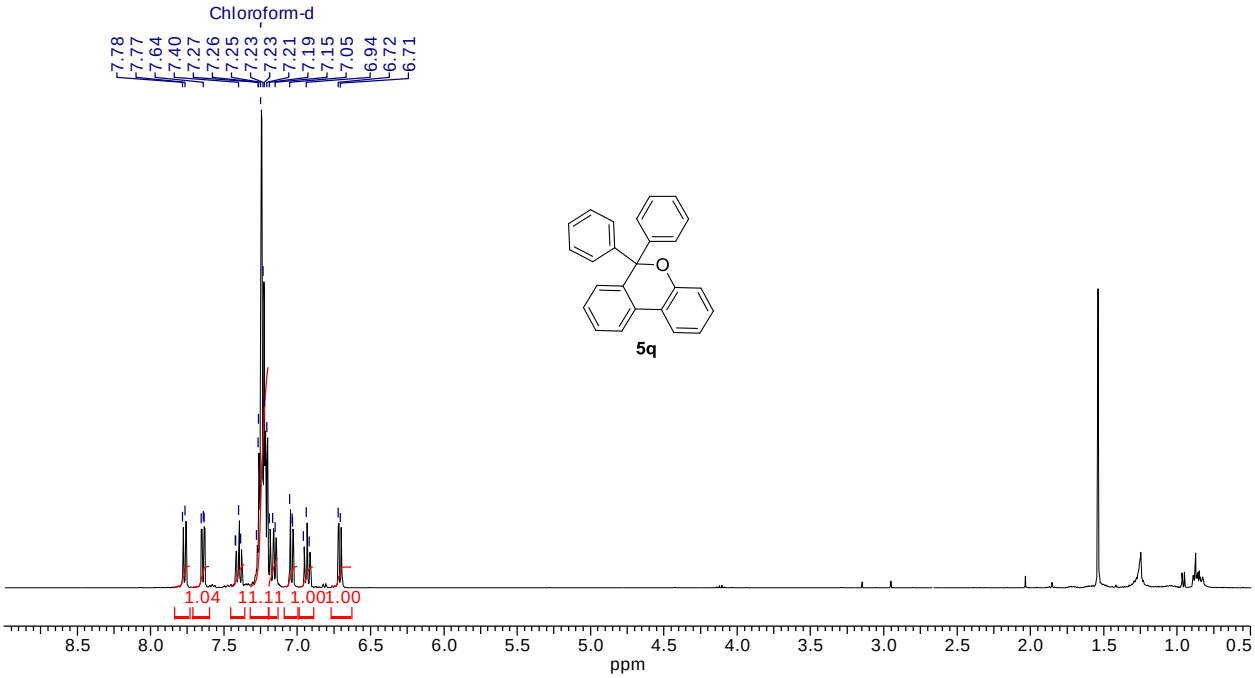
^{13}C NMR (100 MHz) spectrum of **5o** in $CDCl_3$



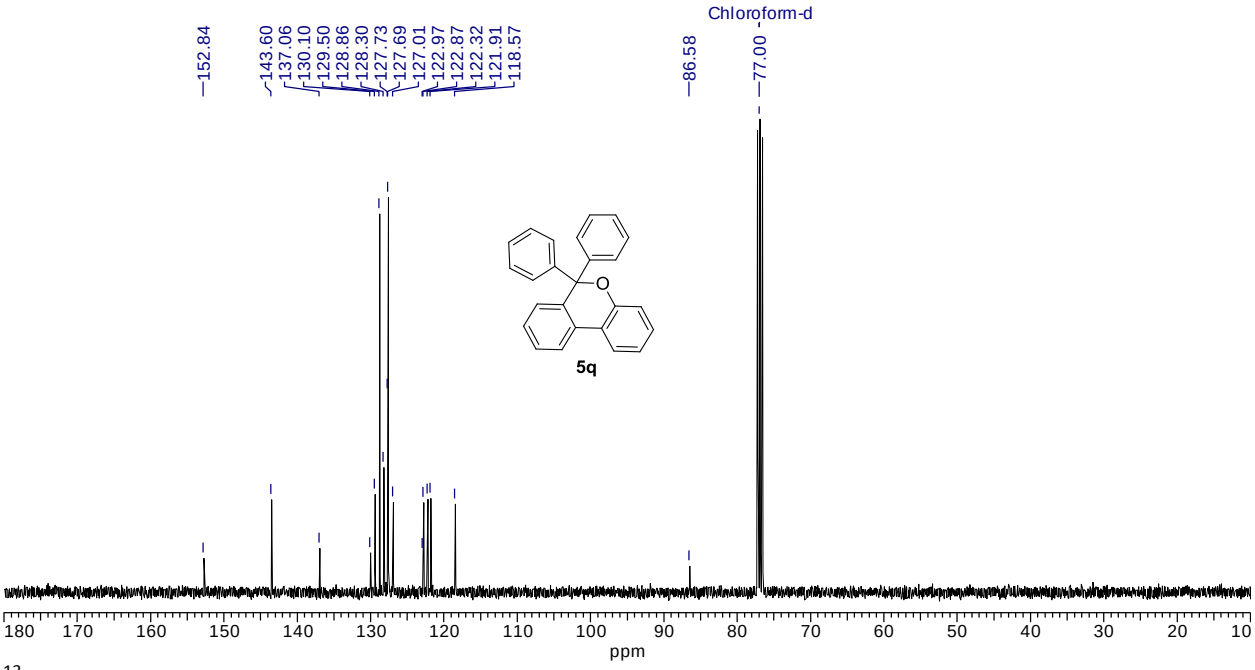
^{1}H NMR (400 MHz) spectrum of **5p** in $CDCl_3$



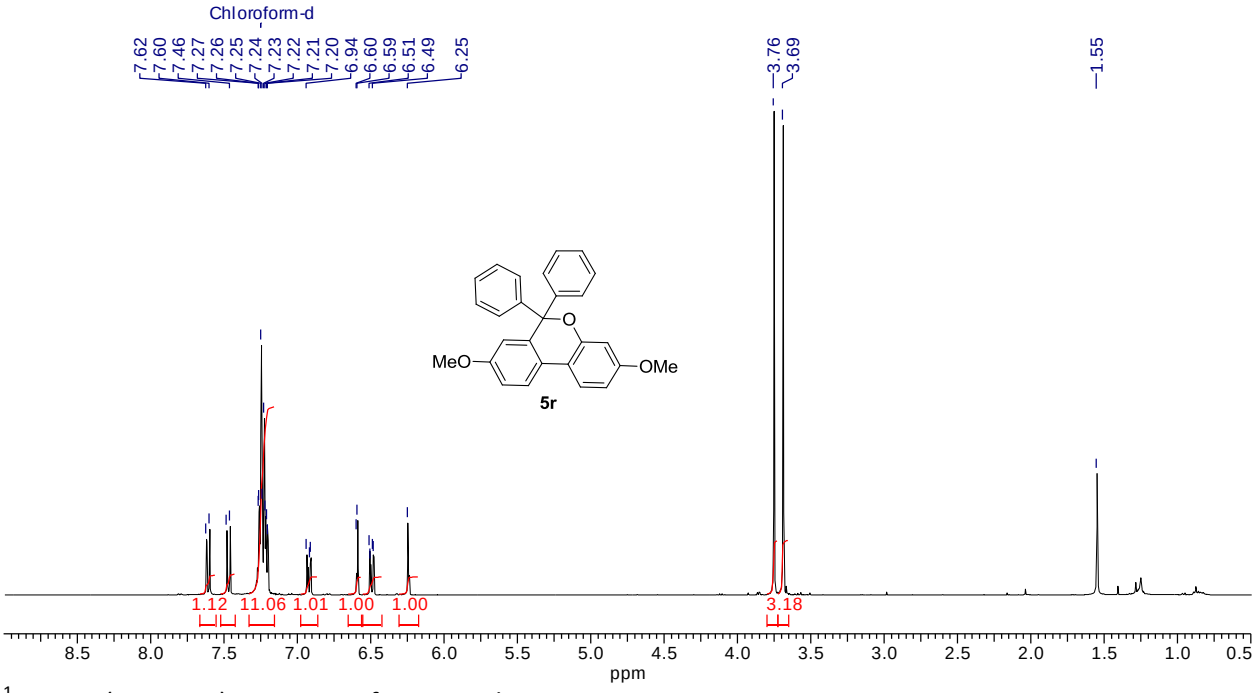
^{13}C NMR (100 MHz) spectrum of **5p** in $CDCl_3$



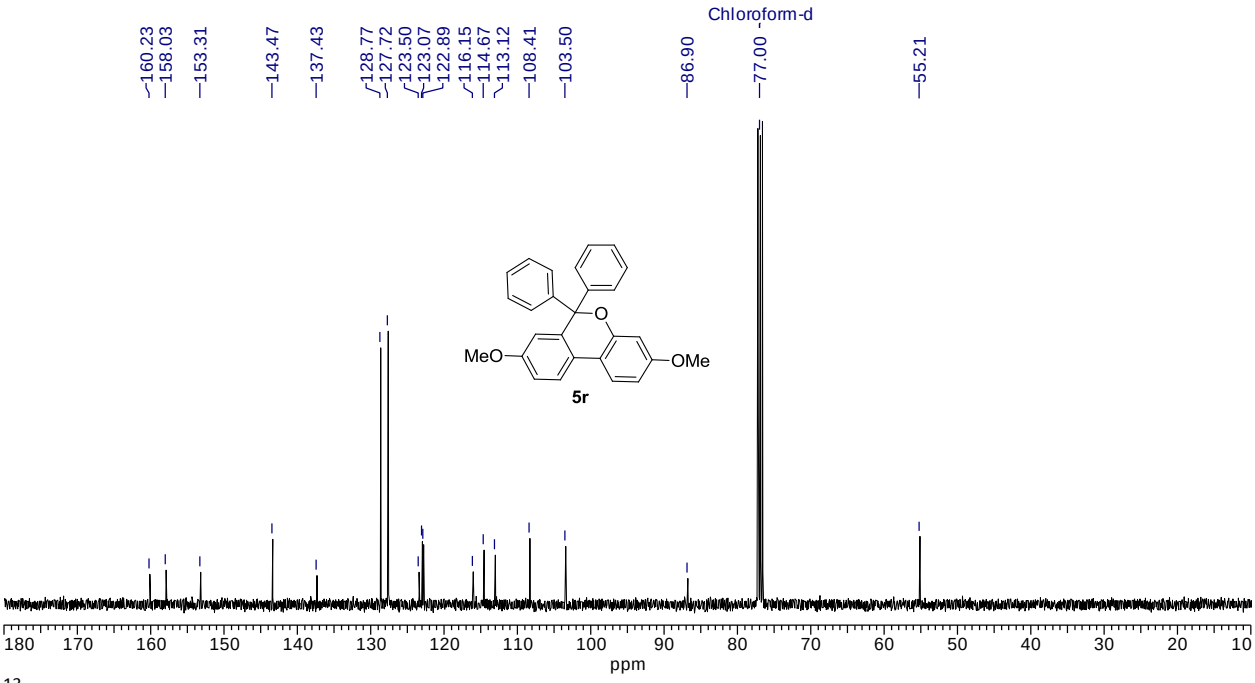
^{1}H NMR (400 MHz) spectrum of **5q** in $CDCl_3$



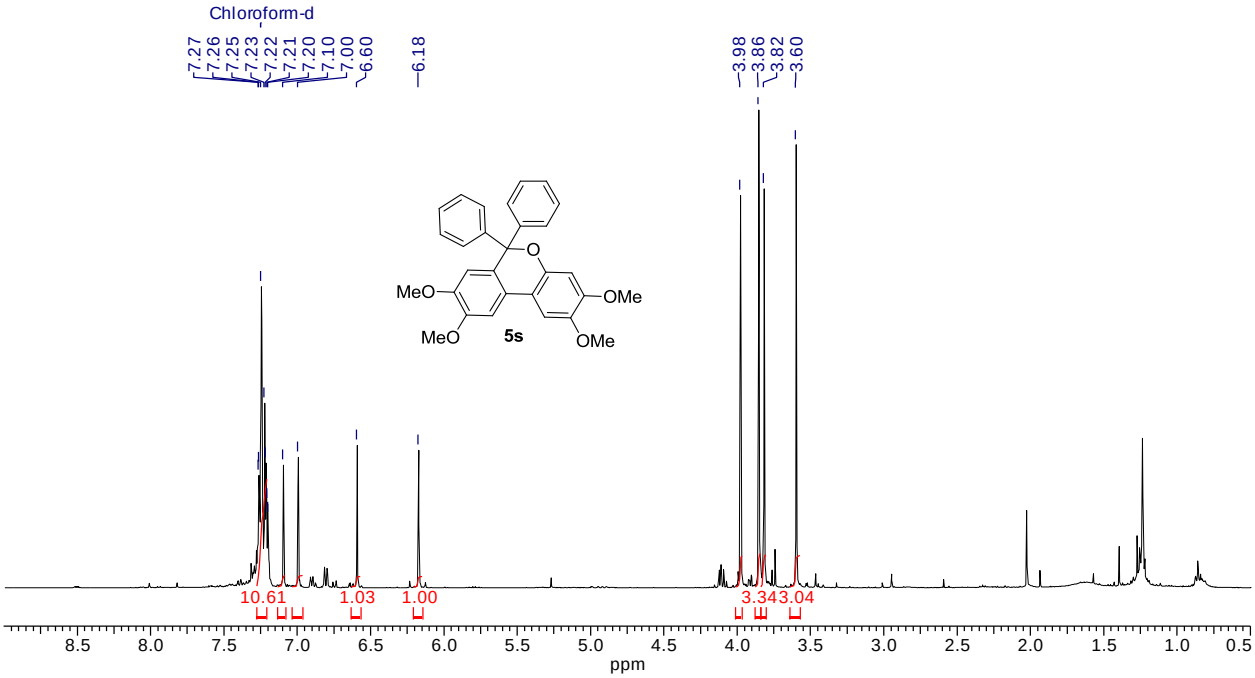
^{13}C NMR (100 MHz) spectrum of **5q** in $CDCl_3$



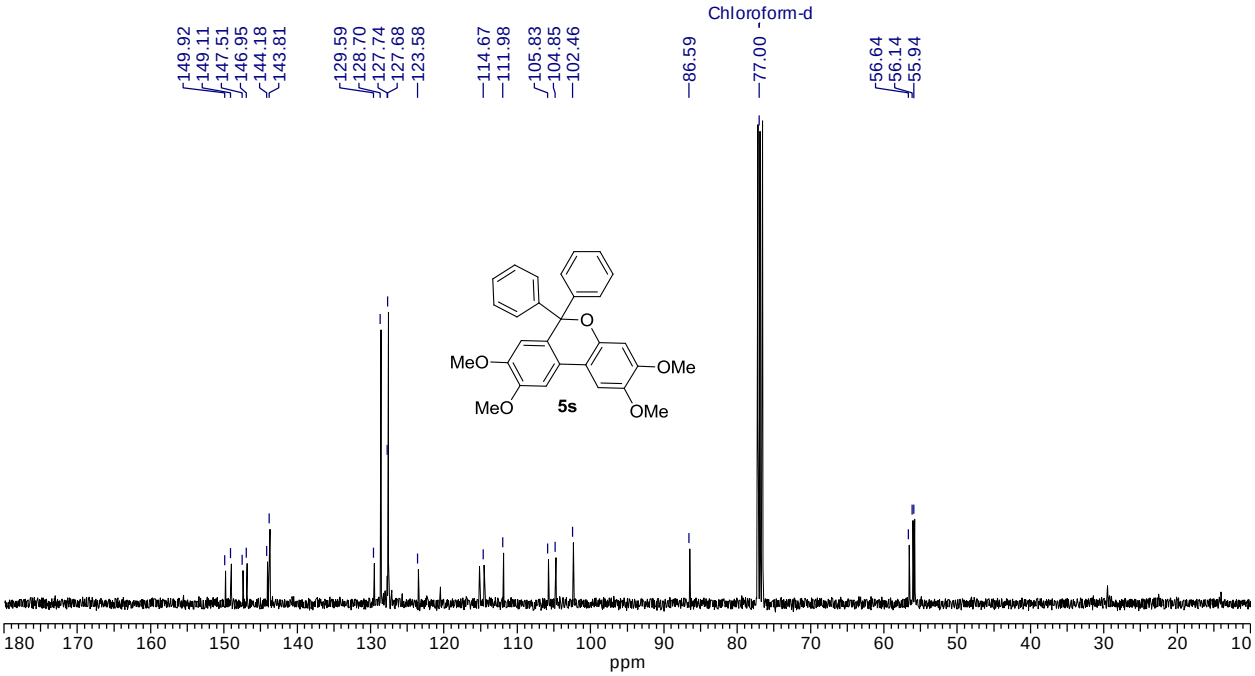
^{1}H NMR (400 MHz) spectrum of **5r** in $CDCl_3$



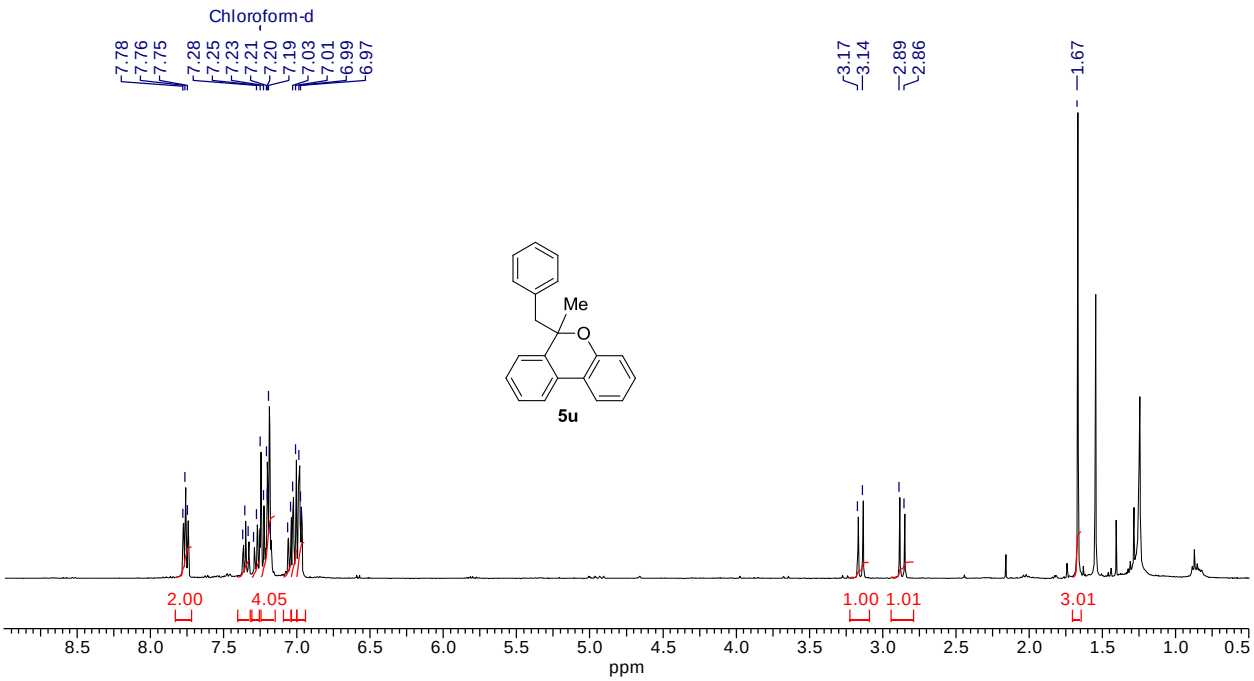
^{13}C NMR (100 MHz) spectrum of **5r** in $CDCl_3$



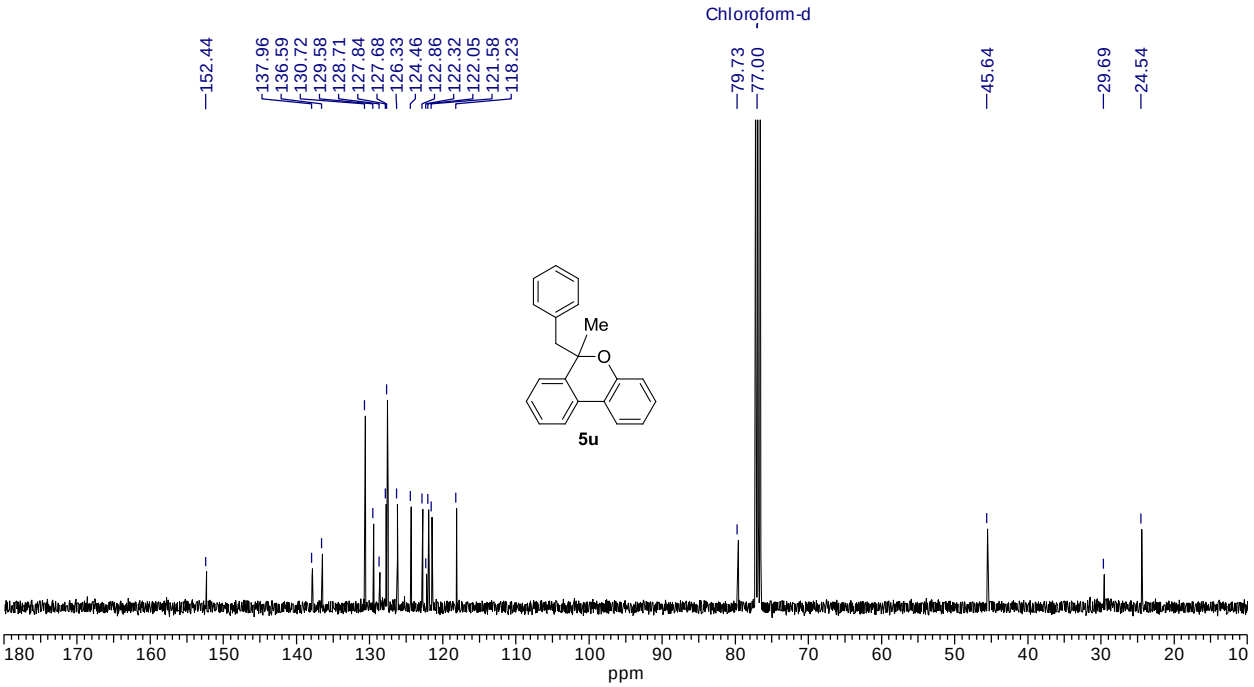
^{1}H NMR (400 MHz) spectrum of **5s** in $CDCl_3$



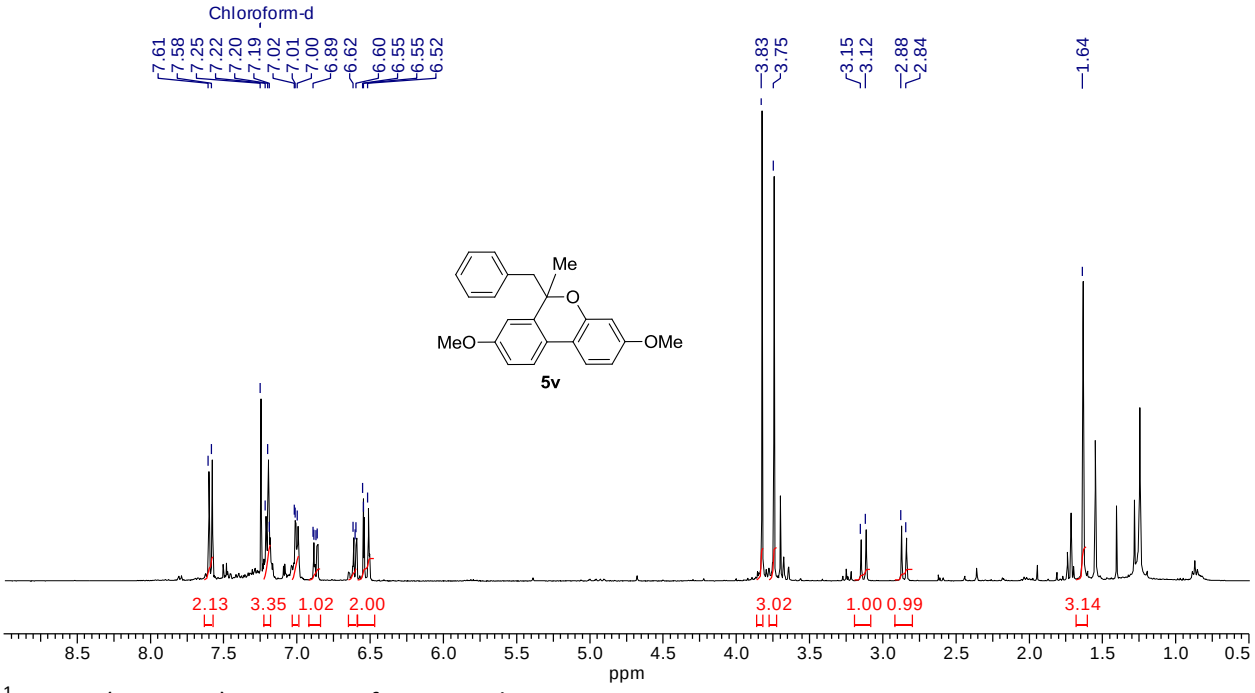
^{13}C NMR (100 MHz) spectrum of **5s** in $CDCl_3$



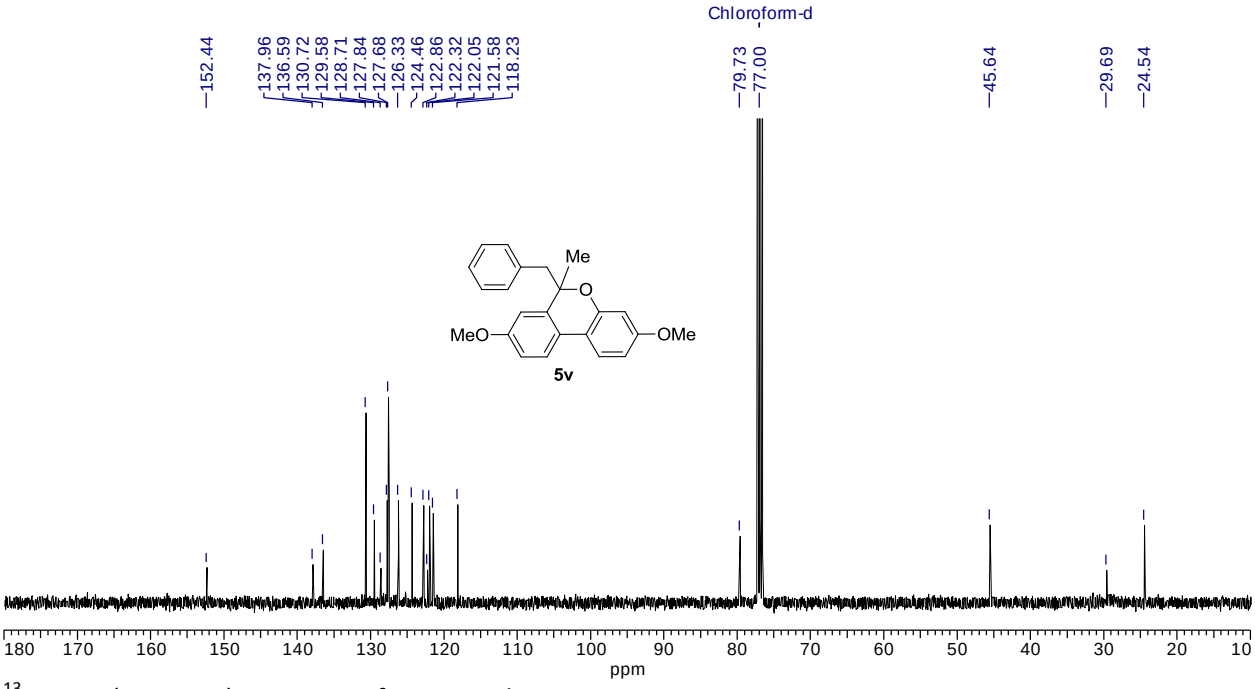
^{1}H NMR (400 MHz) spectrum of **5u** in $CDCl_3$



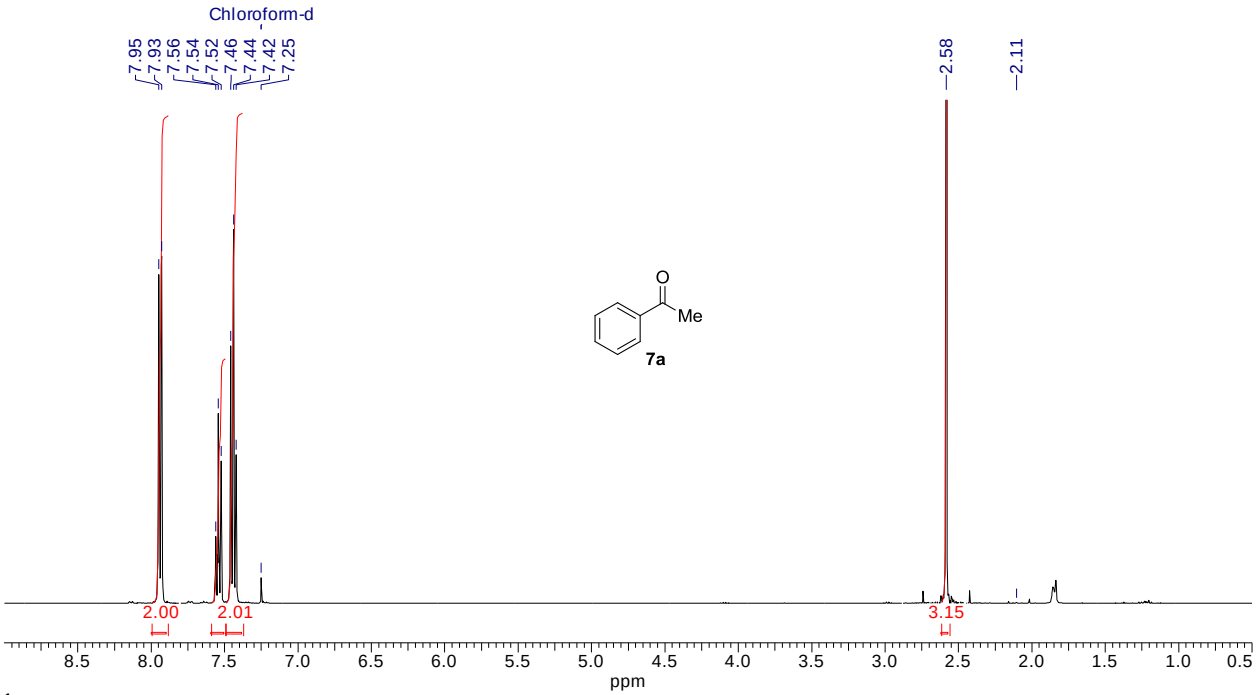
^{13}C NMR (100 MHz) spectrum of **5u** in $CDCl_3$



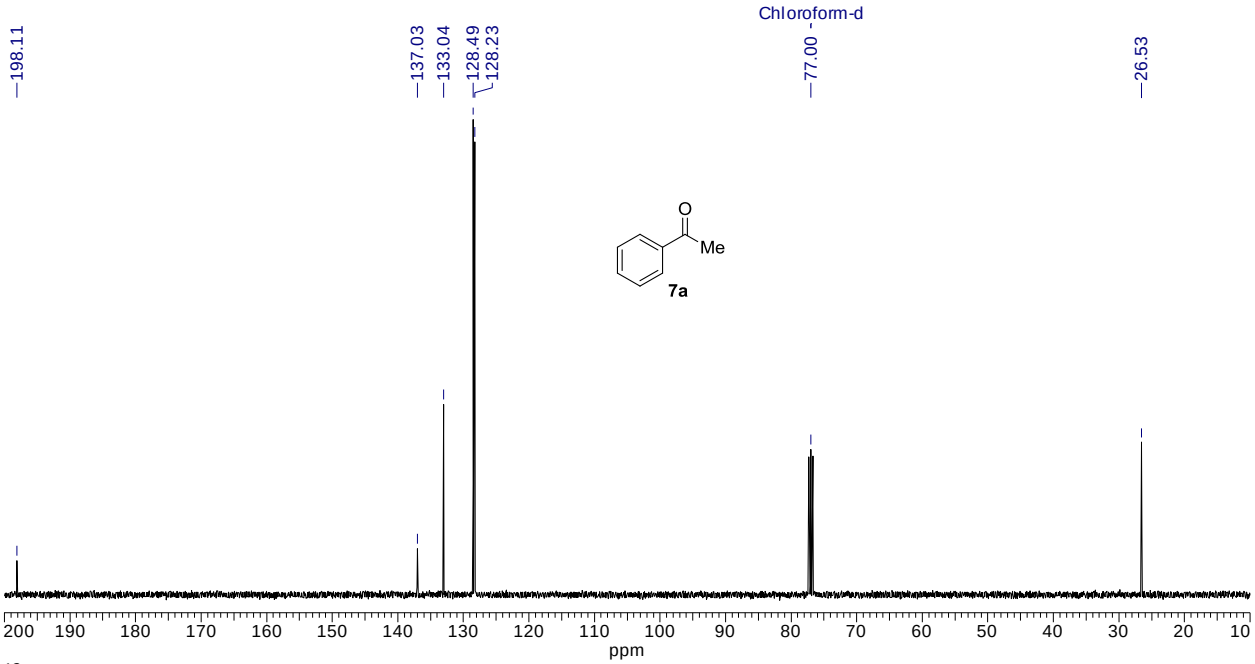
^{1}H NMR (400 MHz) spectrum of **5v** in $CDCl_3$



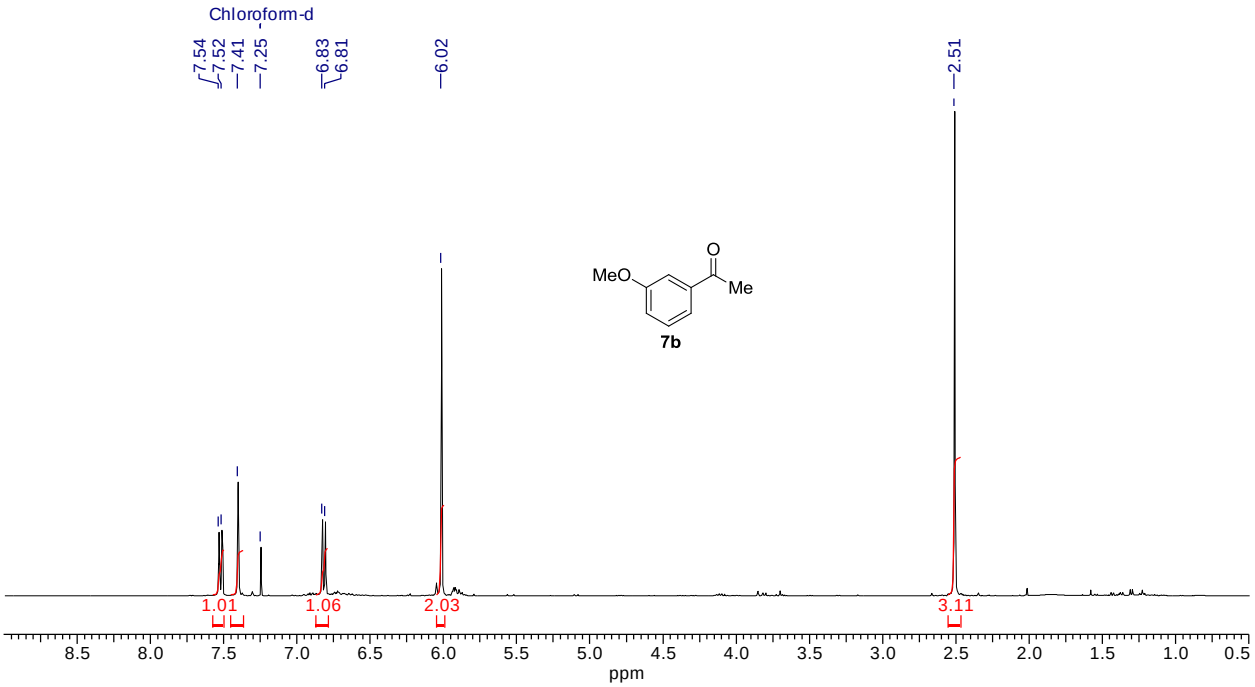
^{13}C NMR (100 MHz) spectrum of **5v** in $CDCl_3$



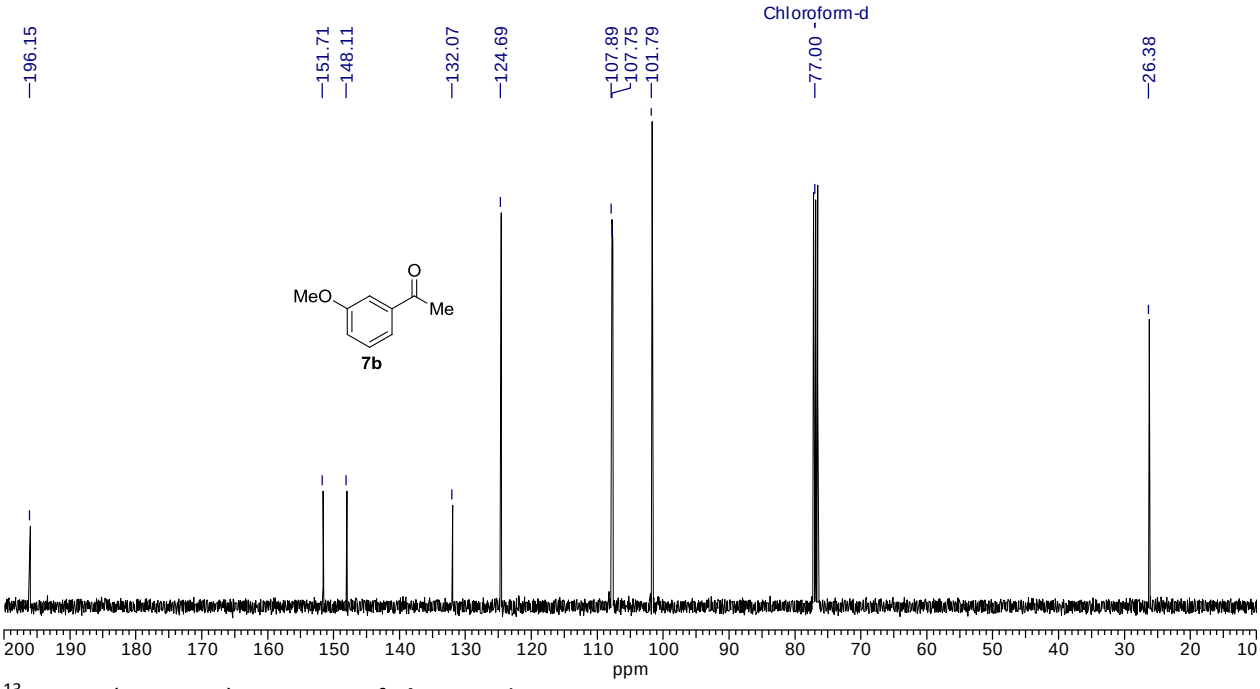
^{1}H NMR (400 MHz) spectrum of **7a** in $CDCl_3$



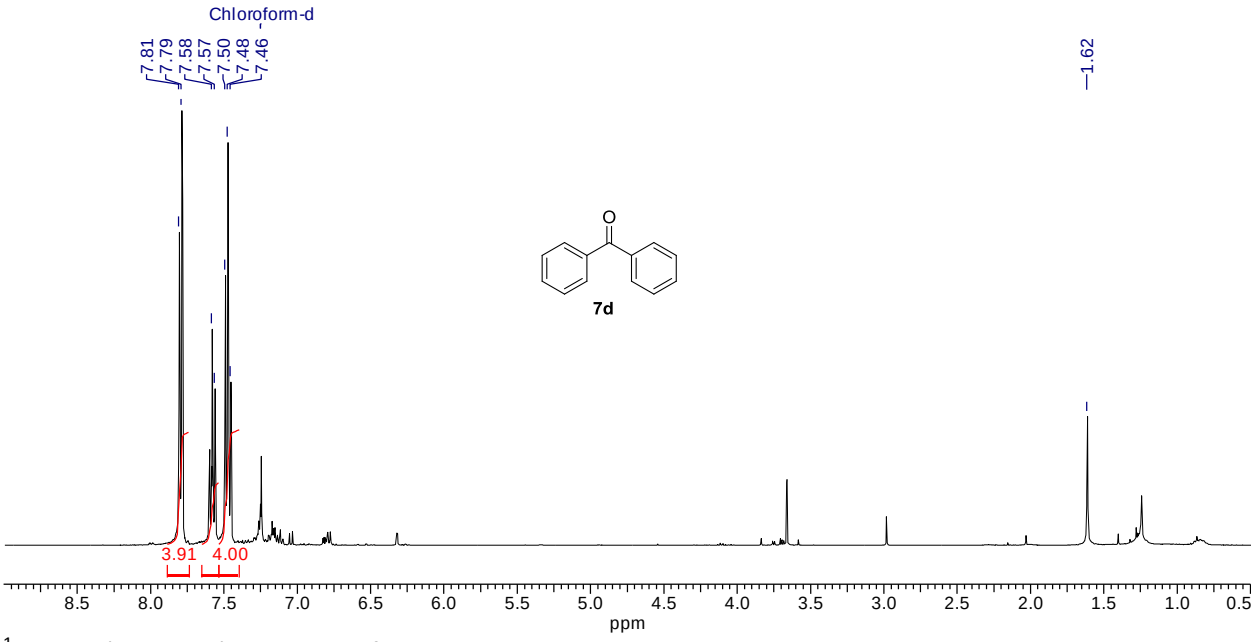
^{13}C NMR (100 MHz) spectrum of **7a** in $CDCl_3$



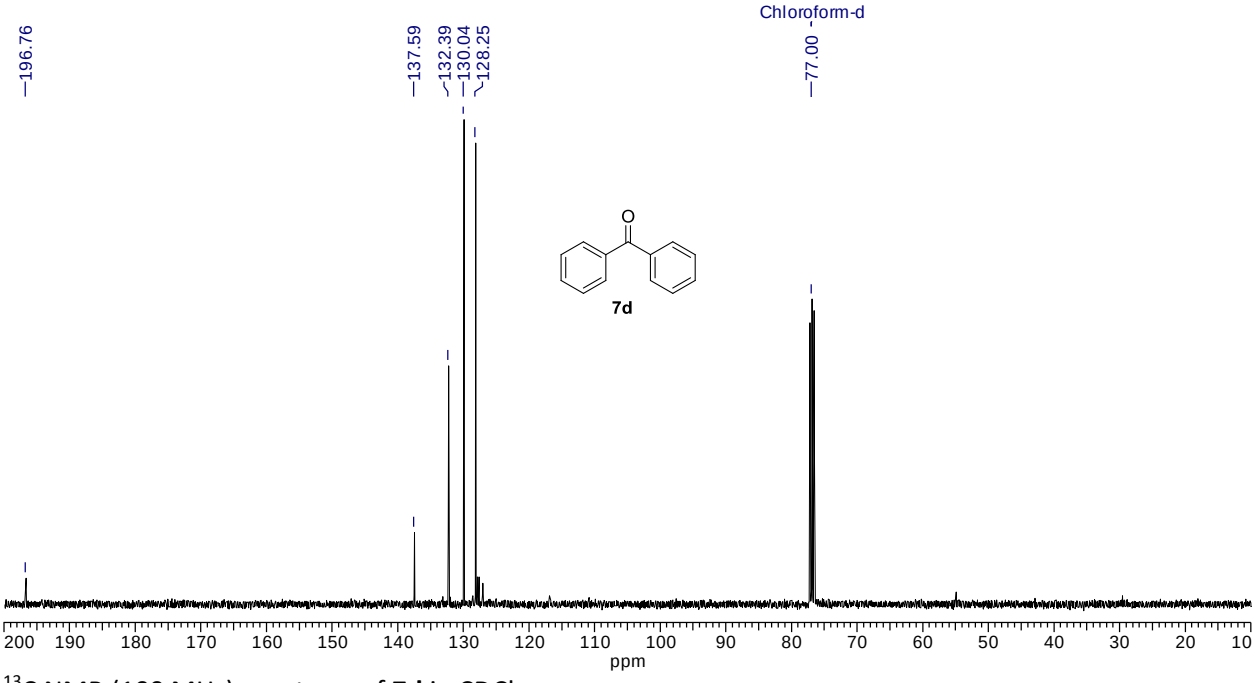
^{1}H NMR (400 MHz) spectrum of **7b** in $CDCl_3$



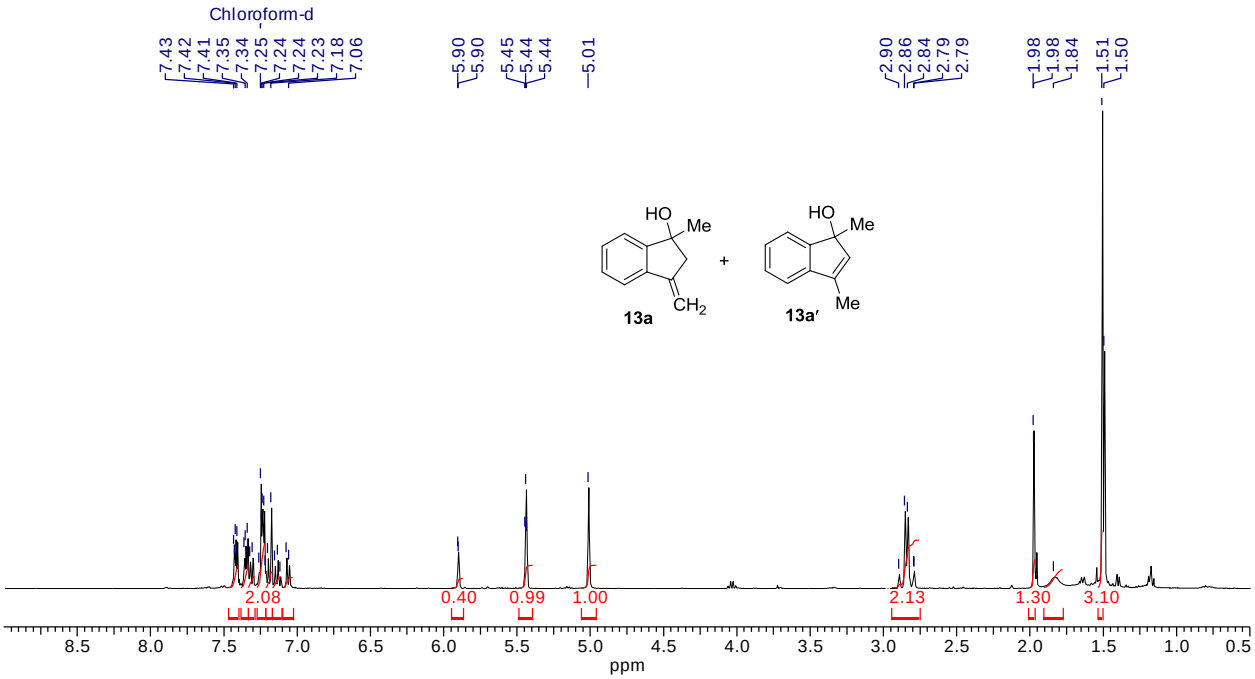
^{13}C NMR (100 MHz) spectrum of **7b** in $CDCl_3$



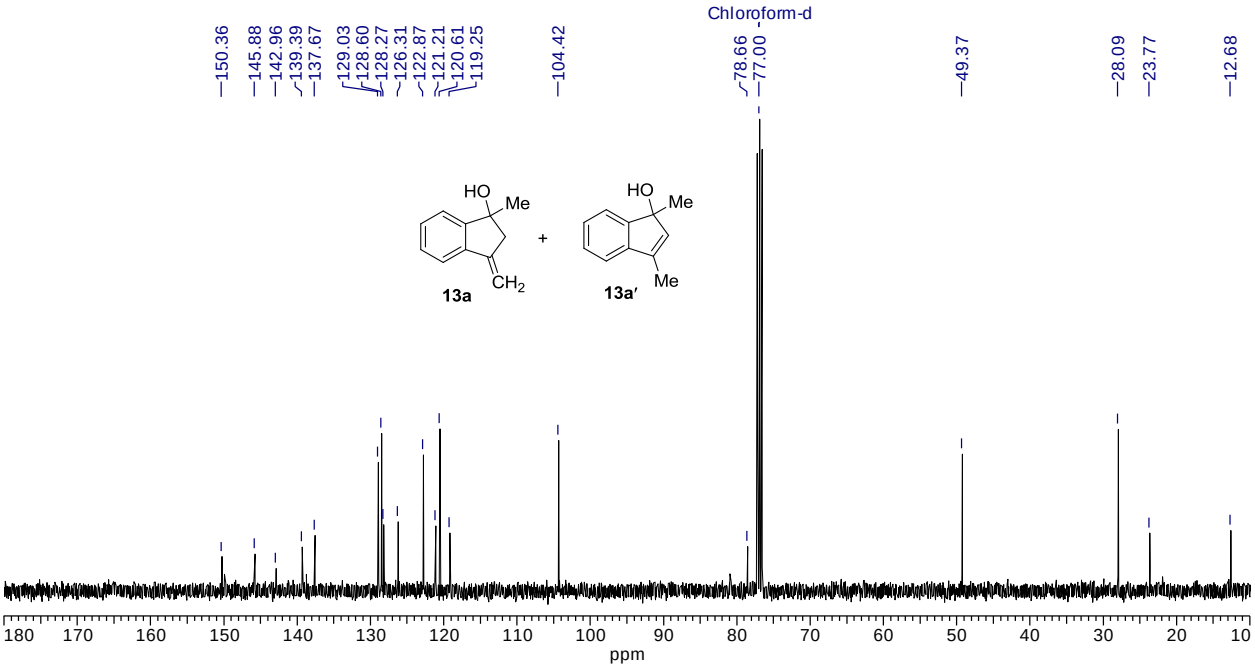
^{1}H NMR (400 MHz) spectrum of **7d** in $CDCl_3$



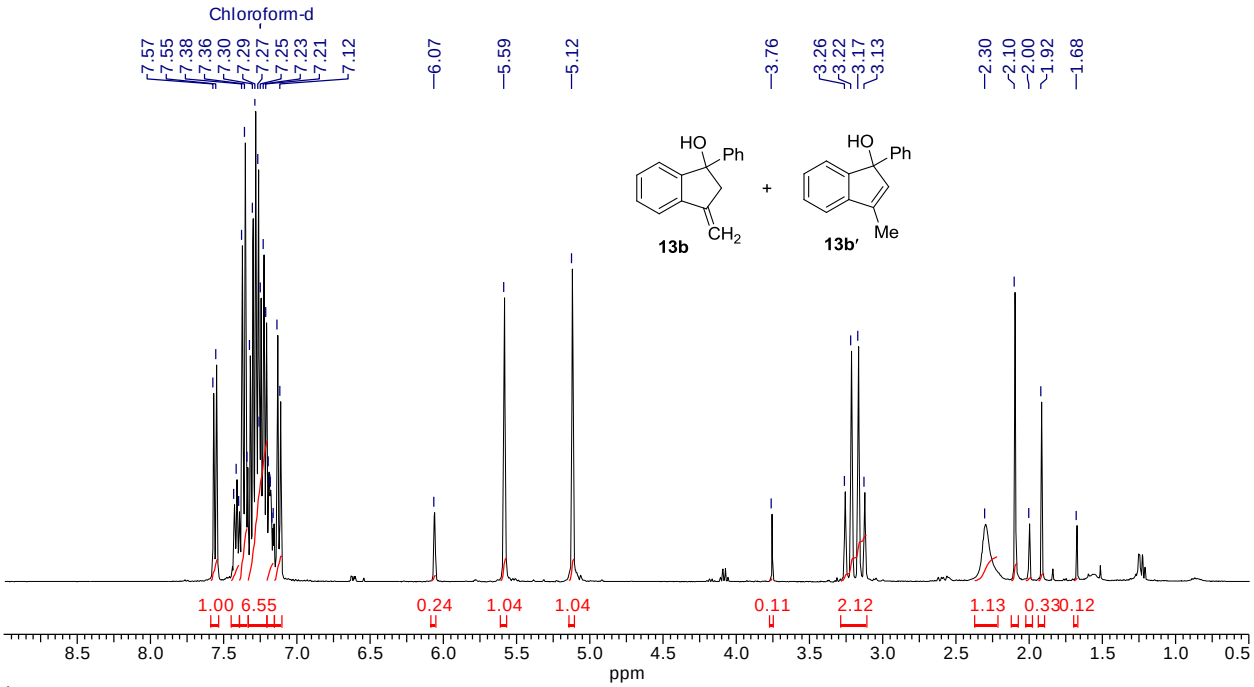
^{13}C NMR (100 MHz) spectrum of **7d** in $CDCl_3$



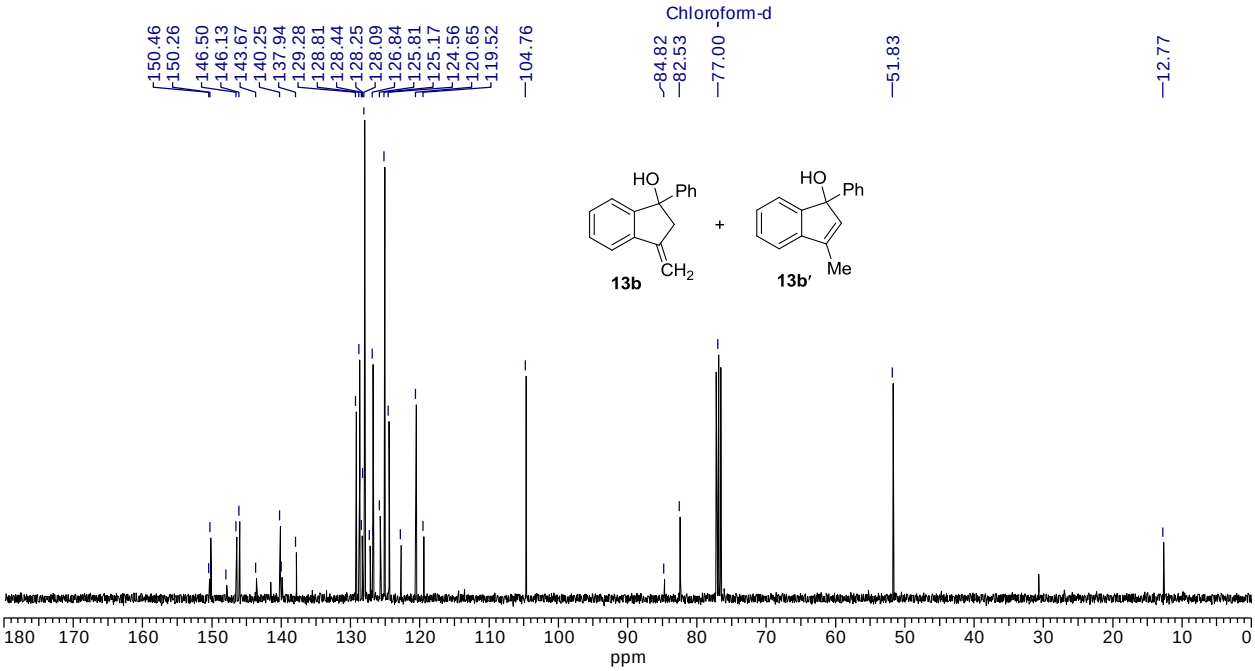
^{1}H NMR (400 MHz) spectrum of **13aa′** in $CDCl_3$



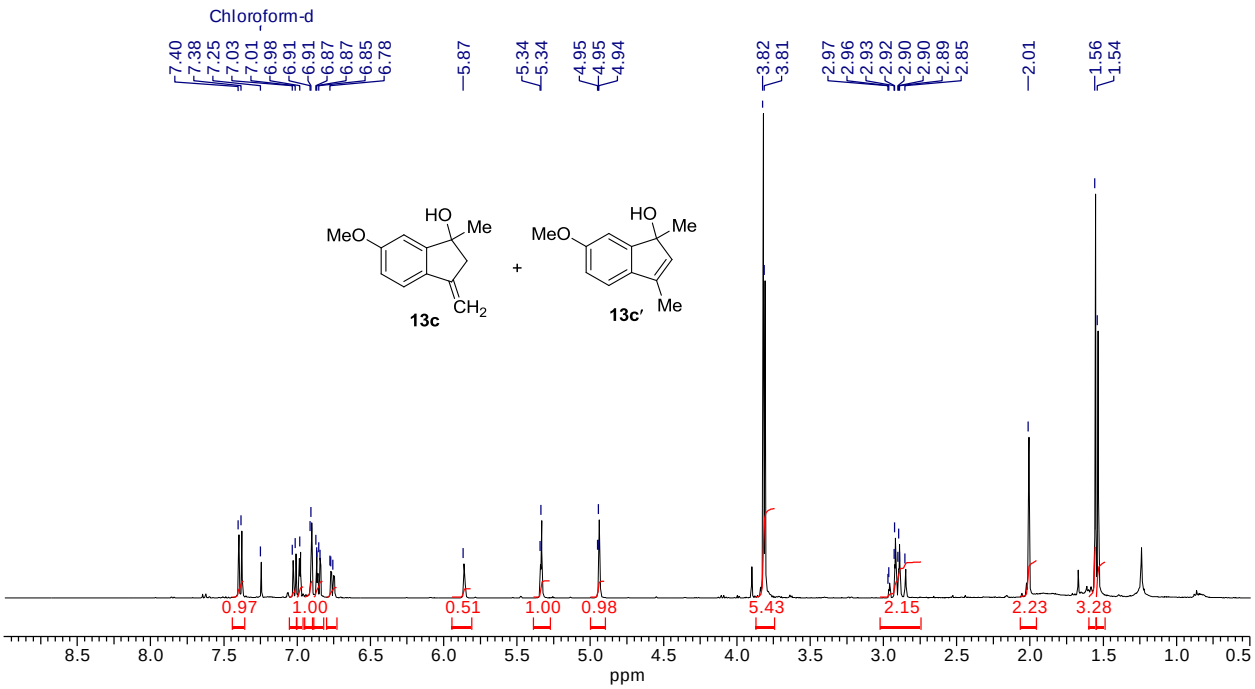
^{13}C NMR (100 MHz) spectrum of **13aa′** in $CDCl_3$



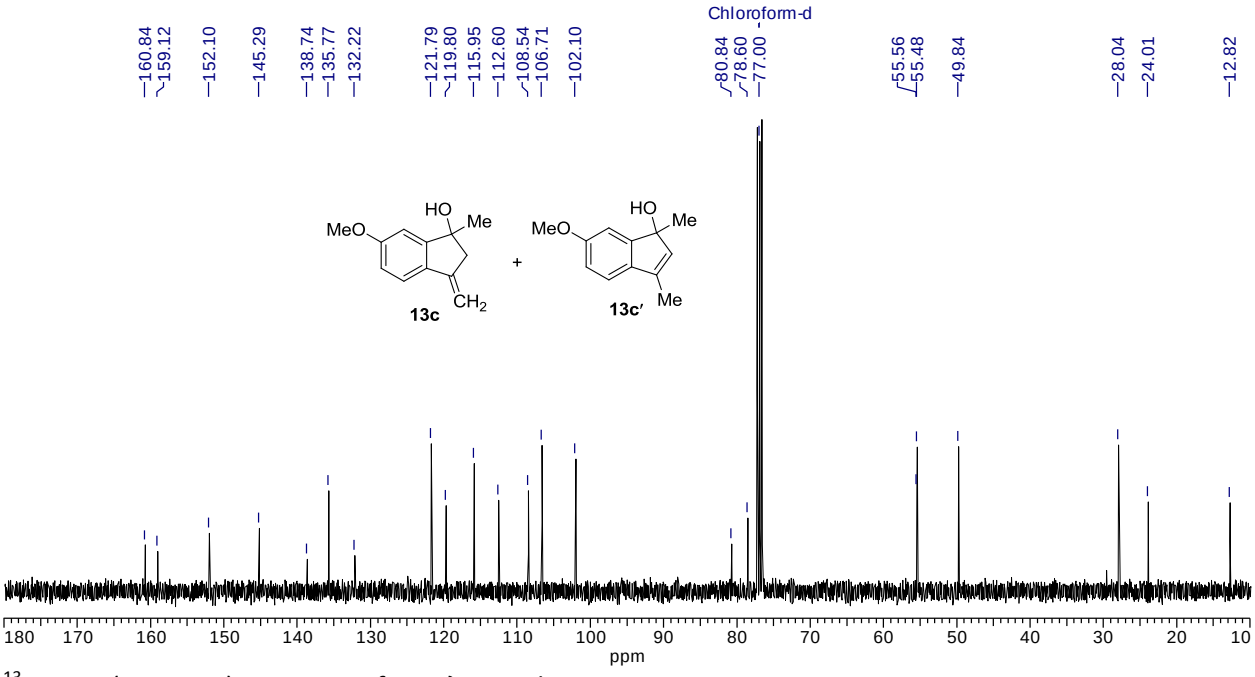
^{1}H NMR (400 MHz) spectrum of **13bb'** in $CDCl_3$



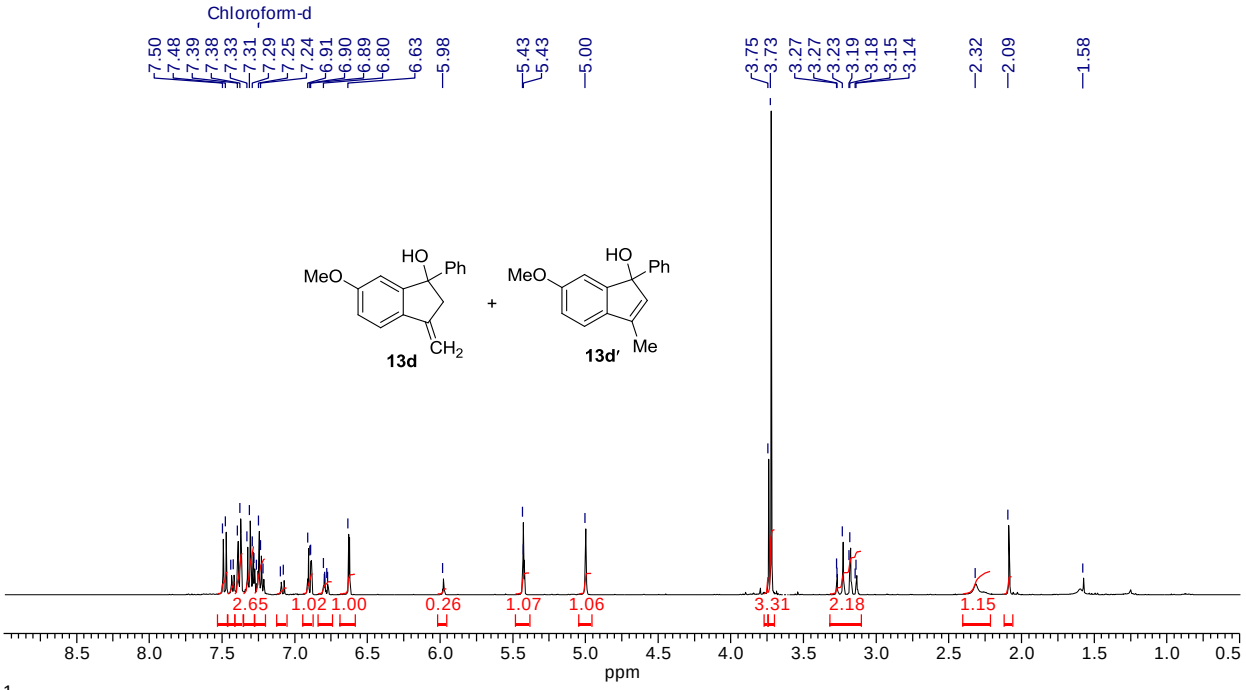
^{13}C NMR (100 MHz) spectrum of **13bb'** in $CDCl_3$



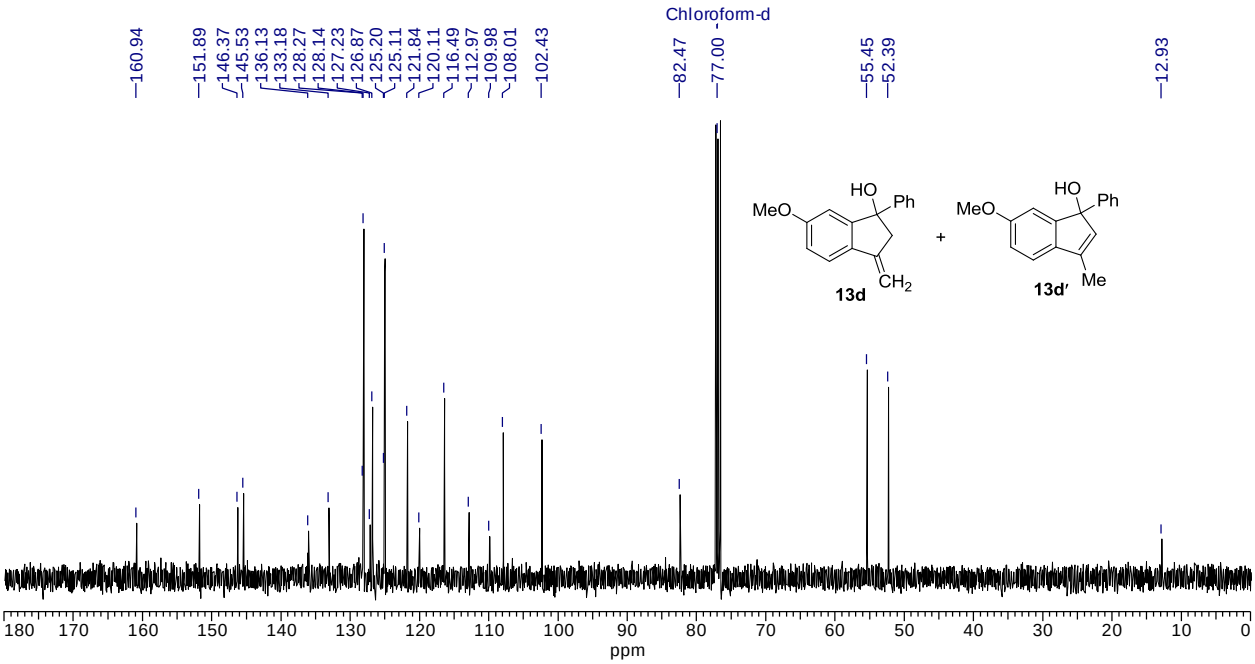
^{1}H NMR (400 MHz) spectrum of **13cc′** in $CDCl_3$



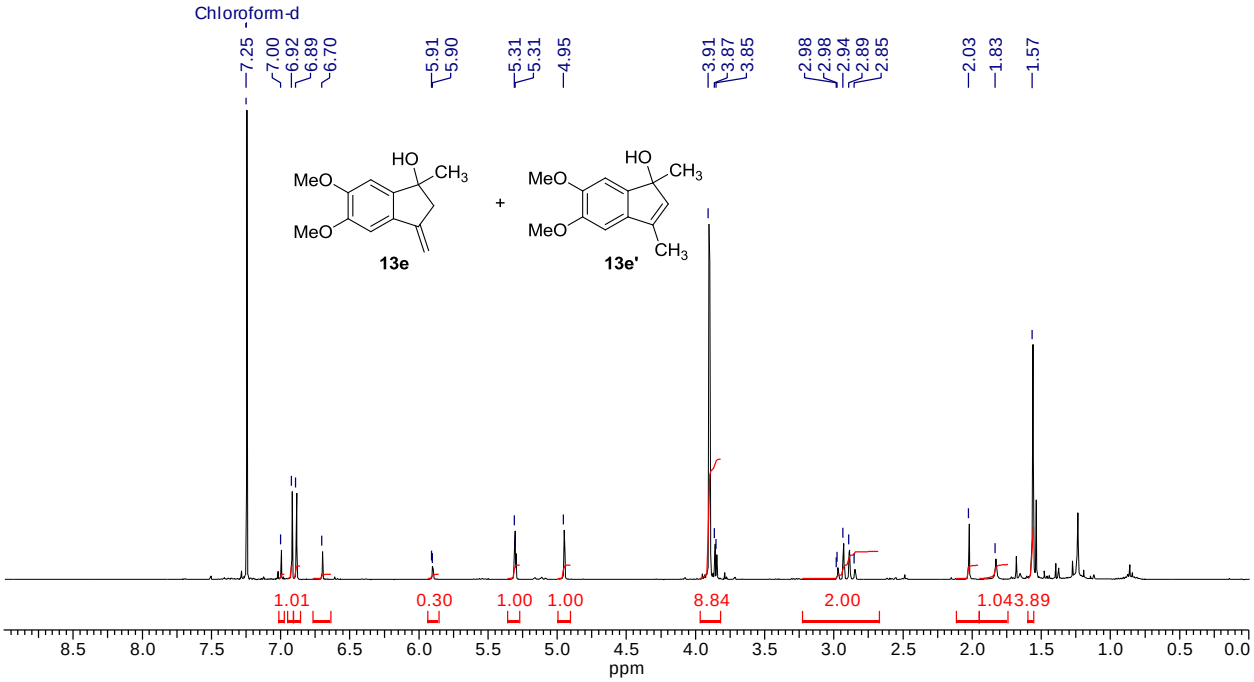
^{13}C NMR (100 MHz) spectrum of **13cc′** in $CDCl_3$



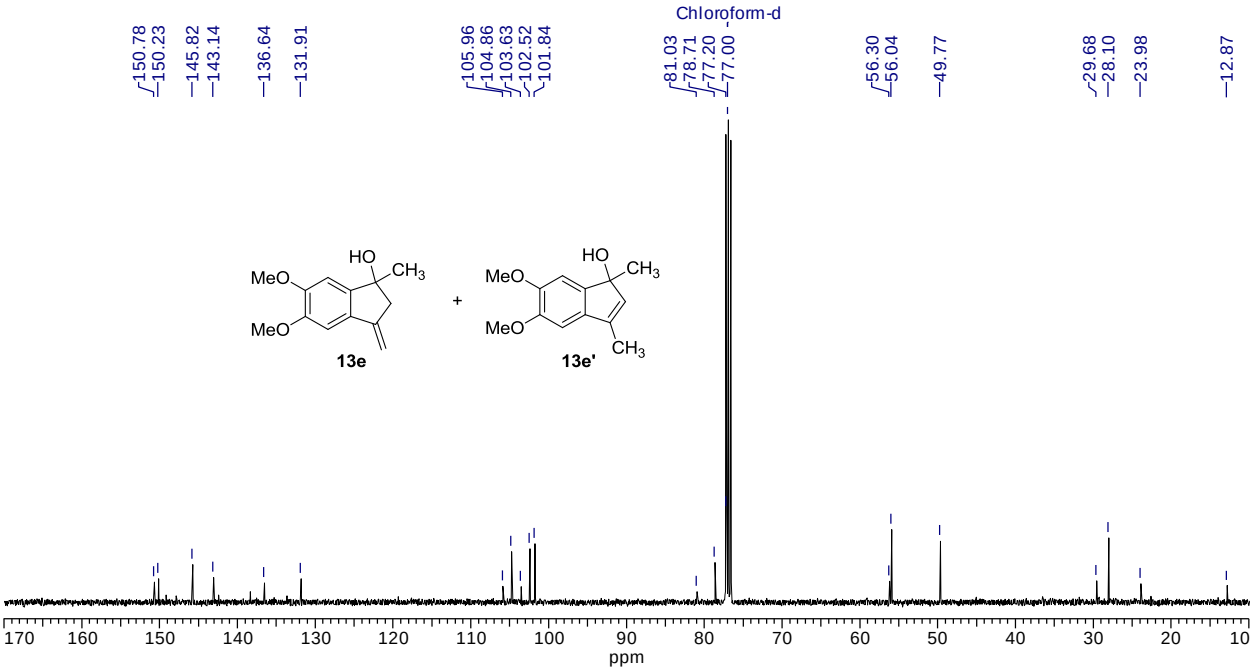
^{1}H NMR (400 MHz) spectrum of **13dd′** in $CDCl_3$



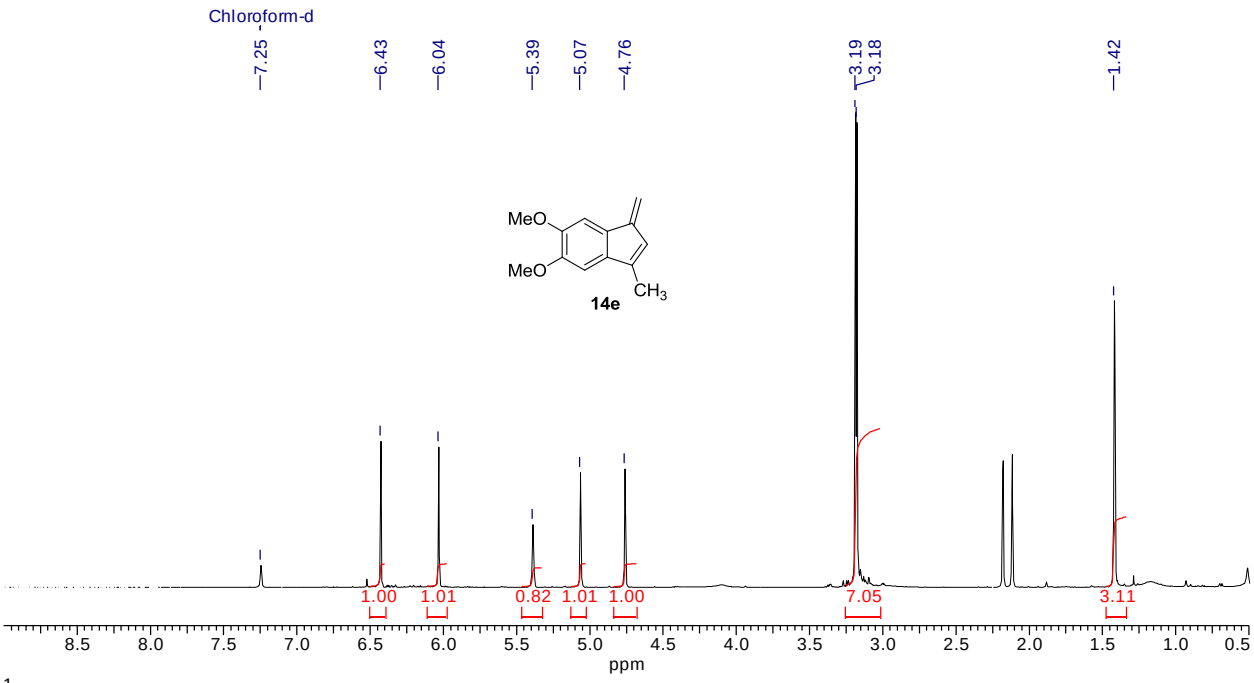
^{13}C NMR (100 MHz) spectrum of **13dd′** in $CDCl_3$



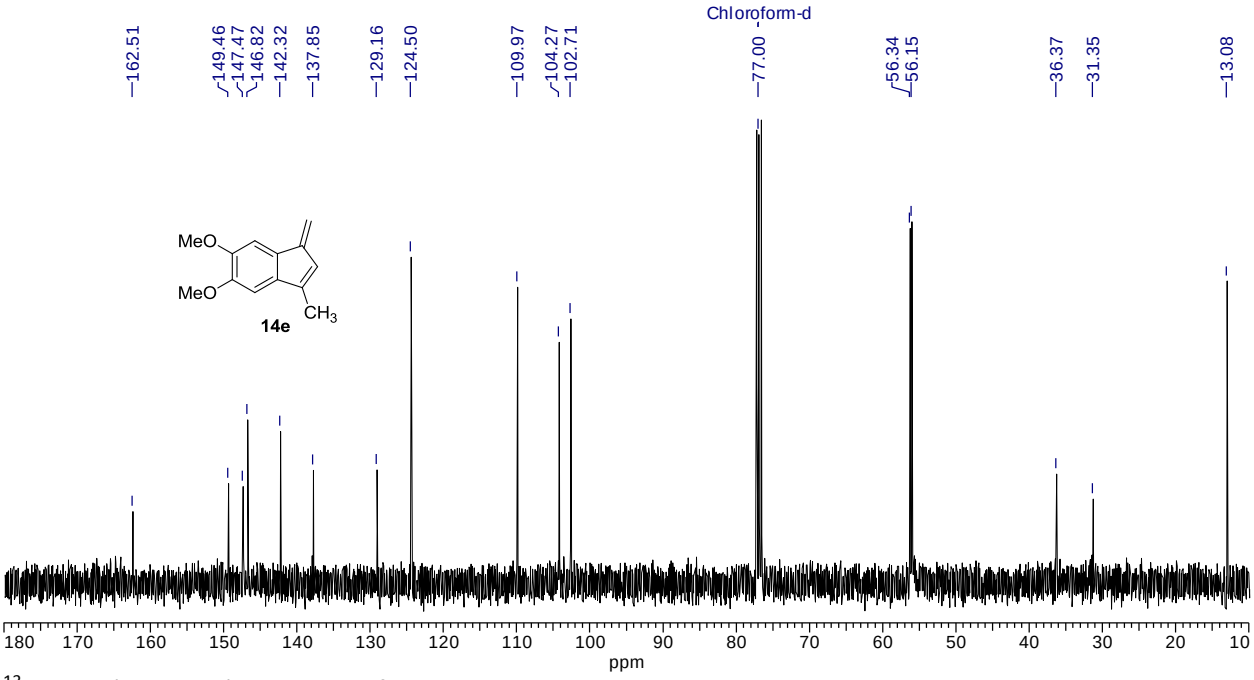
^{1}H NMR (400 MHz) spectrum of **13ee'** in $CDCl_3$



^{13}C NMR (100 MHz) spectrum of **13ee'** in $CDCl_3$



^{1}H NMR (400 MHz) spectrum of**14e** in $CDCl_3$



^{13}C NMR (100 MHz) spectrum of **14e** in $CDCl_3$