Ligand-Enabled Meta-Selective C–H Arylation of Nosyl Protected Phenethylamines, Benzylamines and 2-Aryl Anilines

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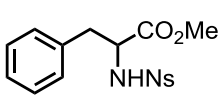
1. General Information

Amines, aryl halides and pyridine ligands were obtained from the commercial sources or synthesized following literature procedures. $Pd(OAc)_2$ was obtained from Strem. AgOAc was purchased from Sigma-Aldrich. Solvents were obtained from Sigma-Aldrich, Alfa-Aesar and Acros and used directly without further purification. Analytical thin layer chromatography was performed on 0.25 mm silica gel 60-F254. Visualization was carried out with UV light and Vogel's permanganate. ^{1}H NMR was recorded on Varian (400 MHz) or Bruker DRX-500 instrument (500 MHz). Chemical shifts were quoted in parts per million (ppm) referenced to 0.0 ppm of tetramethylsilane or 2.05 ppm of acetone-*d*. The following abbreviations (or combinations thereof) were used to explain multiplicities: s = singlet, d = doublet, t = triplet, q =quartet, m = multiplet, br = broad. Coupling constants, *J*, were reported in Hertz unit (Hz). ^{13}C NMR spectra were recorded on Varian (100 MHz), Bruker DRX-500 instrument (125 MHz), and were fully decoupled by broad band proton decoupling. Chemical shifts were reported in ppm referenced to either the center line of a triplet at 77.00 ppm of chloroform-*d* or 206.26 ppm singlet of acetone-*d*. High-resolution mass spectra (HRMS) were recorded on an Agilent Mass spectrometer using ESI-TOF (electrospray ionization-time of flight).

2. Structures of Substrates



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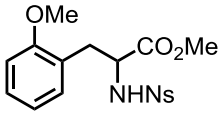

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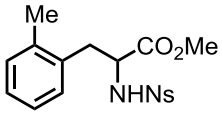

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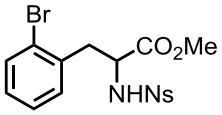

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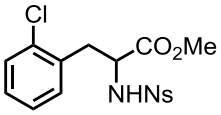

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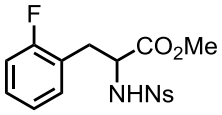

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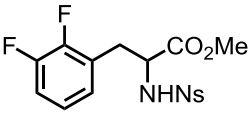

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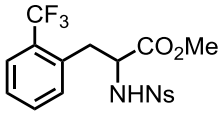

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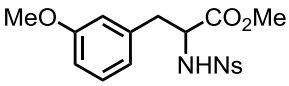

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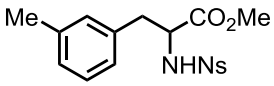

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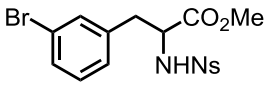

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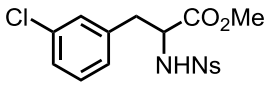

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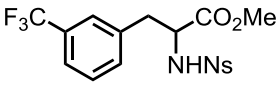

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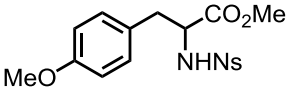

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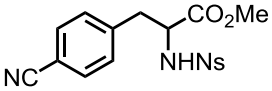

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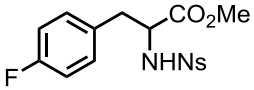

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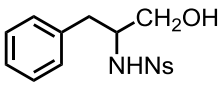

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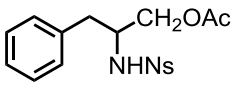

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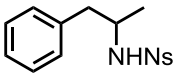

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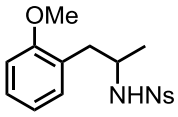

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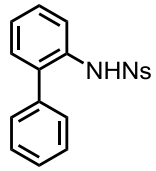

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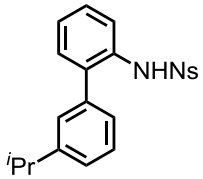

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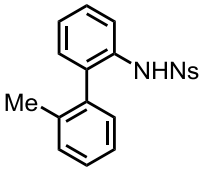

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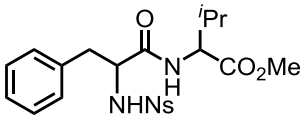

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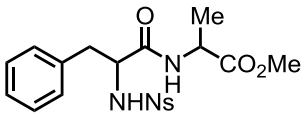

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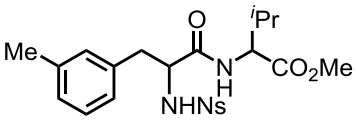

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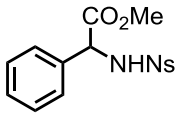

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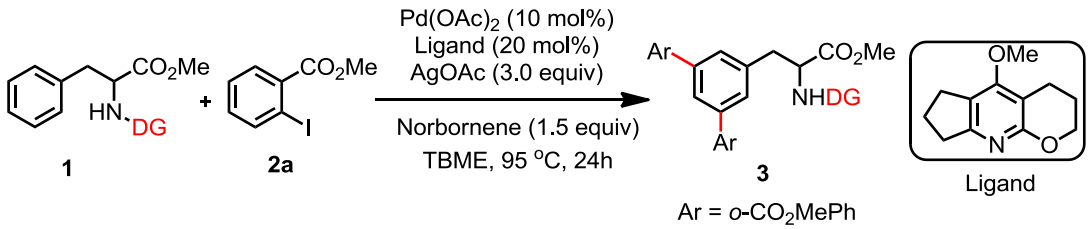
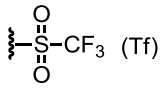
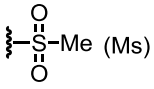
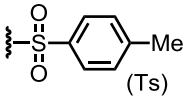
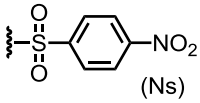
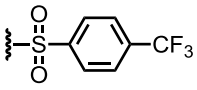
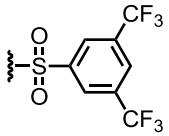
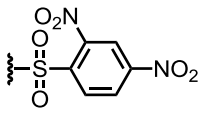
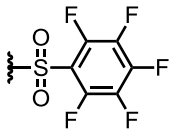
3. Experimental Section

3.1 Optimization of Reaction Conditions

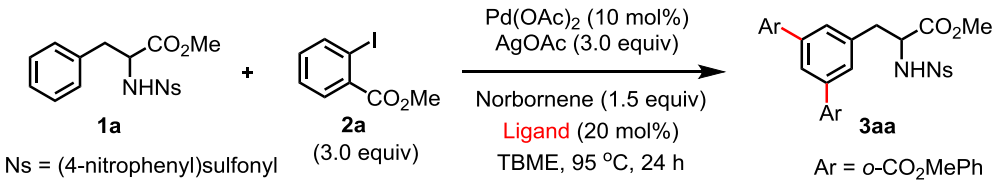
Table 1. Investigation of Directing Groups to Direct *meta*-C-H Arylation[a,b]

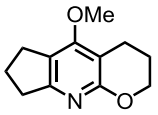
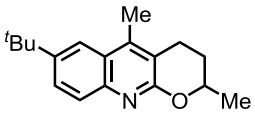
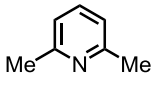
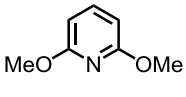
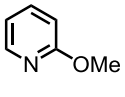
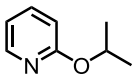
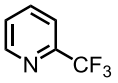
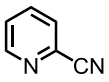
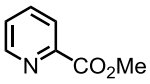
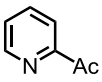
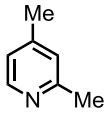
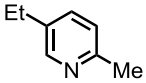
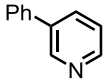
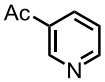
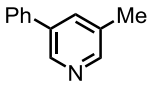
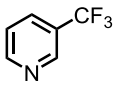
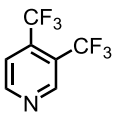
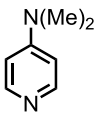
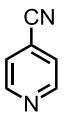
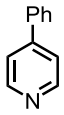
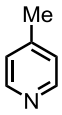
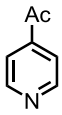


DG =	 (Tf)	 (Ms)	 (Ts)	 (Ns)
	di 28%; mono <5%	di 13%; mono 22%	di 9%; mono 29%	**di 35%; mono 30%**
DG =				
	di 32%; mono 30%	di 30%; mono 20%	di 32%; mono 15%	di 32%; mono 18%
DG =	Acetyl (Ac)	Trifluoroacetyl (Tfa)	*tert*-Butyloxycarbonyl (*t*-Boc)	Carbobenzoxy (Cbz)
	di 0%; mono 0%	di 0%; mono 0%	di 0%; mono 0%	di 0%; mono 0%

[a]Reaction conditions: 0.1 mmol of phenethylamine **1**, 3.0 equiv of methyl 2-iodobenzoate **2a**, 10 mol% of $Pd(OAc)_2$, 20 mol% of ligand, 1.5 equiv of 2-norbornene, 3.0 equiv of AgOAc, 1.0 mL of TBME, 95 °C, under air, 24 h. [b]Yields of the mono- and di-products were determined by ^1H NMR using dibromomethane as an internal standard.

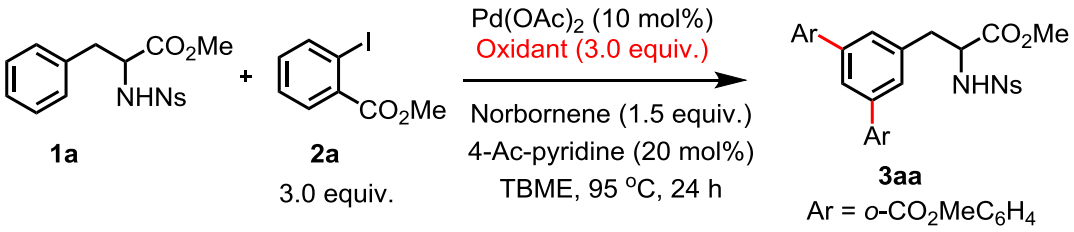
Table 2. Screening of Ligands for *meta*-C-H Arylation of Phenethylamine-Derived Sulfamide 1a[a,b]

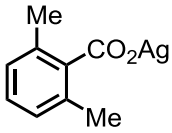


 **L1** di 35%; mono 30%	 **L2** di 30%; mono 18%	 **L3** di 29%; mono 16%	 **L4** NR	 **L5** di 11%; mono 12%
 **L6** di 11%; mono 12%	 **L7** NR	 **L8** NR	 **L9** NR	 **L10** di 0%; mono 5%
 **L11** di 77%; mono 15%	 **L12** di 93%; mono 7%	 **L13** di 95%; mono 5%	 **L14** di 98%	 **L15** di 98%
 **L16** di 96%	 **L17** di 95%	 **L18** di 45%; mono 28%	 **L19** di 62%; mono 30%	 **L20** di 95%
 **L21** di 95%	 **L22** di 98%	 **L23** **di 99%**	 **L24** di 98%	 **L25** di 98%	No ligand No reaction

[a]Reaction conditions: 0.1 mmol of phenethylamine **1a**, 3.0 equiv of methyl 2-iodobenzoate **2a**, 10 mol% of $Pd(OAc)_2$, 20 mol% of ligand, 1.5 equiv of norbornene, 3.0 equiv of AgOAc, 1.0 mL of TBME, 95 °C, under air, 24 h. [b]Yields of the mono- and di-products were determined by 1H NMR using dibromomethane as an internal standard.

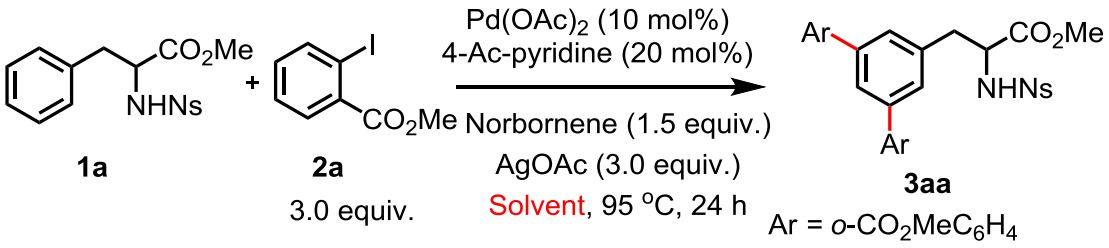
Table 3. Screening of oxidant



entry	oxidant	yield (%) of di-	yield (%) of mono-
1	AgOAc	**99**	1
2	$AdCO_2Ag$	97	3
3	$PhCO_2Ag$	89	11
4	Ag_2CO_3	74	16
5	Ag_2O	6	16
6	AgOTs	0	0
7		74	20

[a] Yields of products were based on phenylalanine **1a** and determined by ^1H NMR using dibromomethane as internal standard.

Table 4. Screening of solvent

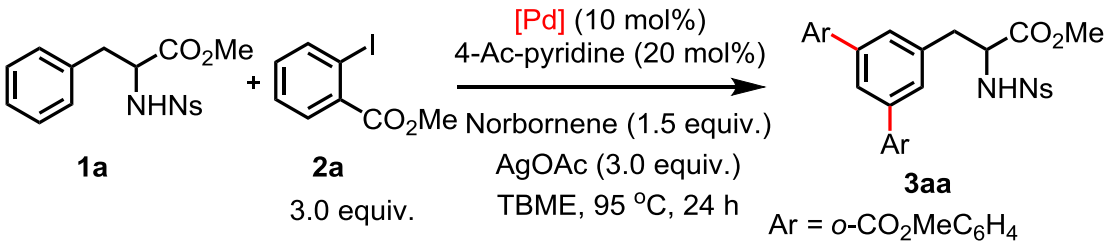


1a **2a** 3.0 equiv. **3aa** Ar = *o*-$CO_2MeC_6H_4$

Entry	Solvent	Yield (%)[a] of di-/mono-/SM
1	**TBME**	**99/1/0**
2	$^{i}Pr_2O$	88/12/0
3	DCE	84/10/6
4	THF	80/20/0
5	Toluene	98/0/0
6	$PhCF_3$	98/2/0
7	EtOAc	90/10/0
8	MeCN	44/38/20
9	1,4-Dioxane	78/13/9
10	^{t}BuOH	42/40/18

[a] Yields of products were based on phenylalanine **1a** and determined by ^{1}H NMR using dibromomethane as internal standard.

Table 5. Screening of [Pd] catalyst

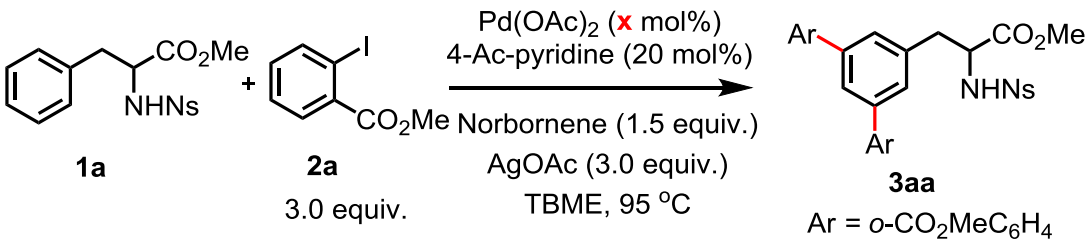


1a **2a** 3.0 equiv. **3aa** Ar = *o*-$CO_2MeC_6H_4$

Entry	[Pd]	Yield (%)[a] of di-/mono-/SM
1	$Pd(OAc)_2$	**99/1/0**
2	$Pd(O_2CEt)_2$	98/2/0
3	PdI_2	98/2/0
4	$Pd(TFA)_2$	80/12/8
5	$PdCl_2(CH_3CN)_2$	90/10/0
6	$PdCl_2(allyl)_2$	64/32/4
7	$Pd(PPh_3)_2Cl_2$	90/10/0
8	$Pd(acac)_2$	60/30/10
9	$Pd(OPiv)_2$	0/4/96
10	---	0/0/100

[a] Yields of products were based on phenylalanine **1a** and determined by ^1H NMR using dibromomethane as internal standard.

Table 6. Screening the loading of $Pd(OAc)_2$

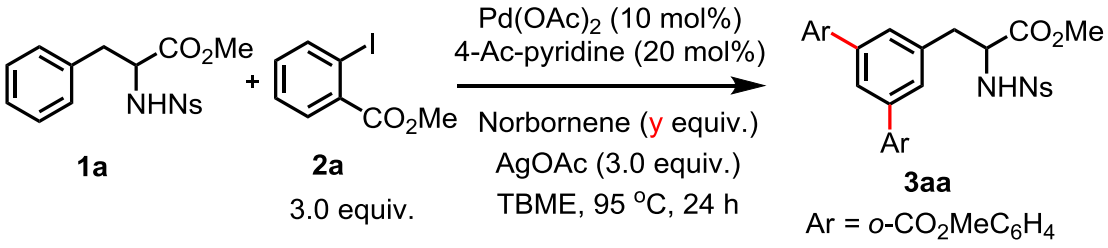


1a **2a** 3.0 equiv. **3aa** Ar = *o*-$CO_2MeC_6H_4$

Entry	x	Time (h)	Yield (%)[a] of di-/mono-/SM
1	0	48	0/0/100
2	2.5	48	48/42/10
3	5	24	85/15/0
4	**10**	**12**	**99/1/0**

[a] Yields of products were based on phenylalanine **1a** and determined by ^1H NMR using dibromomethane as internal standard.

Table 7. Screening the loading of 2-Norbornene.

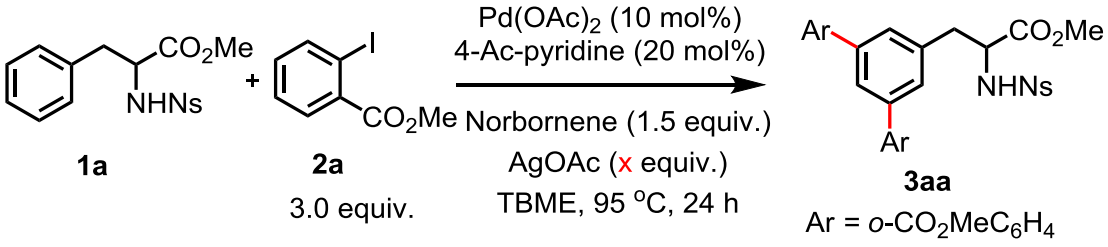


1a **2a** 3.0 equiv. **3aa** Ar = *o*-$CO_2MeC_6H_4$

Entry	y	Yield (%)[a] of di-/mono-/SM
1	1.5	99/1/0
2	1.0	99/1/0
3	0.5	99/1/0
4	0.4	99/1/0
5	0.3	99/1/0
6	**0.2**	**99/1/0**
7	0.1	69/24/7
8	0	0/0/0

[a] Yields of products were based on phenylalanine **1a** and determined by ^{1}H NMR using dibromomethane as internal standard.

Table 8. Screening the equivalents of AgOAc

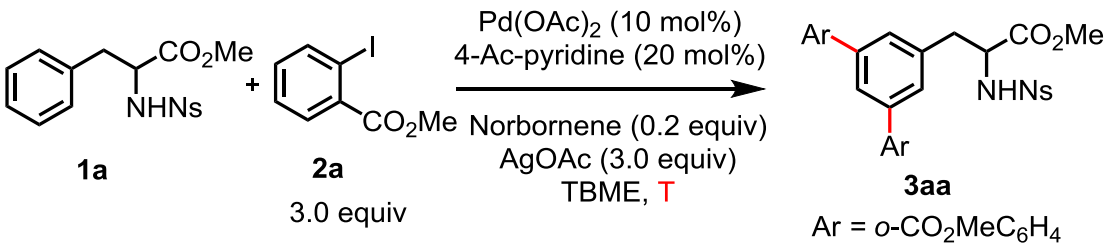


1a **2a** 3.0 equiv. **3aa** Ar = *o*-$CO_2MeC_6H_4$

Entry	x	Yield (%)[a] of di-/mono-/SM
1	0	0/0/100
2	2.0	55/33/12
3	2.5	88/12/0
4	**3.0**	**99/1/0**

[a] Yields of products were based on phenylalanine **1a** and determined by ^{1}H NMR using dibromomethane as internal standard.

Table 9. Screening the reaction temperature

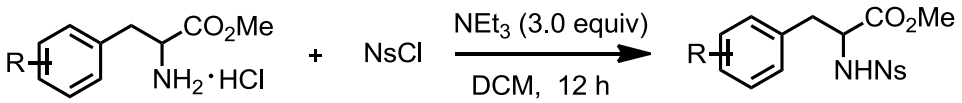


Entry	T (°C)	Time (h)	Yield (%)[a] of di-/mono-/SM
1	25	72	10/20/70
2	60	48	95/3/2
3	**80**	**12**	**99/1/0**
4	95	12	99/1/0
5	110	12	99/0/0

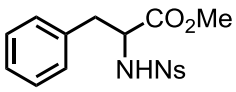
[a] Yields of products were based on phenylalanine **1a** and determined by ^{1}H NMR using dibromomethane as internal standard.

3.2 Substrates Preparation

Synthesis of *N*-Nosyl amino acid methyl esters 1a-p according to the reported procedures.[1]



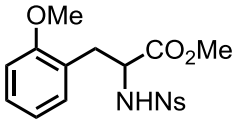
4-Nitrobenzenesulfonyl chloride (NsCl, 1.0 mmol, 1.0 equiv) was added to a cooled (0 °C) solution of amino acid methyl ester hydrochloride (1.0 mmol, 1.0 equiv) and triethylamine (TEA, 3.0 mmol, 3.0 equiv) in DCM (5 mL). After being stirred at room temperature for 12 h, the reaction mixture was poured into H_2O. The organic layer was separated, dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum. The residue was subjected to column chromatography (EtOAc/hexanes = 1:2) to give **1a-p**.



methyl 2-(4-nitrophenylsulfonamido)-3-phenylpropanoate 1a[1]

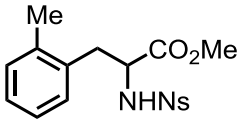
^{1}H NMR (500 MHz, acetone-d_6) δ 8.26 (d, J = 9.0 Hz, 2H), 7.88 (d, J = 9.0 Hz, 2H), 7.43 (d, J = 9.5

Hz, 1H, N-H), 7.18-7.14 (m, 5H), 4.26 (dt, *J* = 5.5, 9.5 Hz, 1H), 3.53 (s, 3H), 3.10 (dd, *J* = 5.5, 13.5 Hz, 1H), 2.91 (dd, *J* = 9.5, 13.5 Hz, 1H); ^{13}C NMR (125 MHz, acetone-d_6) 171.89, 150.67, 147.55, 137.08, 130.17, 129.19, 128.88, 127.61, 124.94, 58.67, 52.50, 39.16.



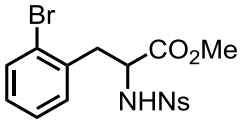
methyl 3-(2-methoxyphenyl)-2-(4-nitrophenylsulfonamido)propanoate 1b

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.12 (d, *J* = 9.0 Hz, 2H), 7.73 (d, *J* = 9.0 Hz, 2H), 7.16 (dt, *J* = 1.5, 8.0 Hz, 1H), 6.98 (dd, *J* = 1.5, 7.5 Hz, 1H), 6.78 (dt, *J* = 1.0, 8.0 Hz, 1H), 6.69 (dd, *J* = 1.0, 8.0 Hz, 1H), 5.77 (d, *J* = 8.5 Hz, 1H, N-H), 4.30-4.25 (m, 1H), 3.75 (s, 3H), 3.65 (s, 3H), 3.05 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.94 (dd, *J* = 9.5, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) 171.71, 157.19, 149.62, 145.63, 131.25, 128.79, 127.90, 123.85, 123.49, 120.76, 110.36, 56.11, 55.31, 52.52, 33.70. HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{17}N_2O_7S$ $[M-H]^-$: 393.0762. found: 393.0760.



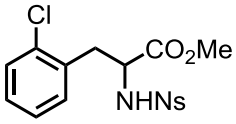
methyl 2-(4-nitrophenylsulfonamido)-3-(o-tolyl)propanoate 1c

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.8 Hz, 2H), 7.74 (d, *J* = 8.8 Hz, 2H), 7.09 (t, *J* =7.6 Hz, 1H), 7.03-6.98 (m, 2H), 6.95 (d, *J* =7.2 Hz, 1H), 5.56 (d, *J* = 9.6 Hz, 1H, N-H), 4.24-4.18 (m, 1H), 3.64 (s, 3H), 3.13 (dd, *J* = 5.6, 14.0 Hz, 1H), 2.89 (dd, *J* = 9.2, 14.0 Hz, 1H), 2.24 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) 171.68, 149.77, 145.42, 136.38, 133.38, 130.64, 130.16, 128.00, 127.48, 126.13, 124.01, 56.37, 52.77, 36.57, 19.22. HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{17}N_2O_6S$ $[M-H]^-$: 377.0813. found: 377.0812.



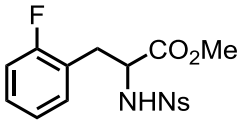
methyl 3-(2-bromophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1d

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.8 Hz, 2H), 7.78 (d, *J* = 8.8 Hz, 2H), 7.35 (d, *J* =8.0 Hz, 1H), 7.14-7.13 (m, 2H), 7.05-7.00 (m, 1H), 5.92 (d, *J* = 9.6 Hz, 1H, N-H), 4.42-4.36 (m, 1H), 3.69 (s, 3H), 3.25 (dd, *J* = 4.8, 13.6Hz, 1H), 2.98 (dd, *J* = 10.0, 14.0 Hz, 1H); ^{13}C NMR (100 MHz,$CDCl_3$) 171.60, 149.71, 145.30, 134.77, 132.89, 131.92, 128.95, 127.99, 127.55, 124.46, 123.98, 55.58, 52.92, 39.00. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{14}BrN_2O_6S$ $[M-H]^-$: 440.9761. found: 440.9764.



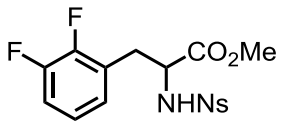
methyl 3-(2-chlorophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1e

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, *J* = 9.2 Hz, 2H), 7.79 (d, *J* = 8.8 Hz, 2H), 7.19-7.09 (m, 4H), 5.65 (br, 1H, N-H), 4.38-4.34 (m, 1H), 3.68 (s, 3H), 3.24 (dd, *J* = 5.2, 13.6 Hz, 1H), 2.99 (dd, *J* = 9.6, 14.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) 171.52, 149.77, 145.37, 134.09, 133.06, 131.85, 129.59, 128.81, 128.01, 126.95, 124.01, 55.58, 52.90, 36.75. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{14}ClN_2O_6S$ $[M-H]^-$: 397.0267. found: 397.0267.



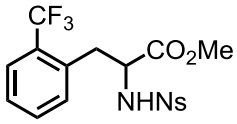
methyl 3-(2-fluorophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1f

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.4 Hz, 2H), 7.85 (d, *J* = 8.8 Hz, 2H), 7.22-7.17 (m, 1H), 7.11 (t, *J* = 7.6 Hz, 1H), 7.01 (t, *J* = 7.6 Hz, 1H), 6.91 (t, *J* = 9.2 Hz, 1H), 5.48 (br, 1H, N-H), 4.27 (t, *J* = 6.8 Hz, 1H), 3.64 (s, 3H), 3.11 (dd, *J* = 5.6, 14.0 Hz, 1H), 3.02 (dd, *J* = 8.0, 14.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) 171.09, 161.09 (d, *J* = 244.3 Hz), 149.90, 145.52, 131.76 (d, *J* = 4.0 Hz), 129.38 (d, *J* = 8.1 Hz), 128.13, 124.30 (d, *J* = 3.6 Hz), 124.11, 122.02 (d, *J* = 15.4 Hz), 115.39 (d, *J* = 21.8 Hz), 55.98, 52.87, 32.86. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{14}FN_2O_6S$ $[M-H]^-$: 381.0562. found: 381.0564.



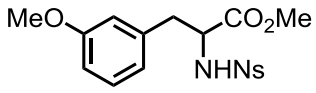
methyl 3-(2,3-difluorophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1g

^{1}H NMR (500 MHz, acetone-d_6) δ 8.32 (d, J = 8.5 Hz, 2H), 7.94 (d, J = 9.0 Hz, 2H), 7.57 (d, J = 10.0 Hz, 1H, N-H), 7.15-7.02 (m, 3H), 4.33 (dt, J = 5.5, 9.5 Hz, 1H), 3.56 (s,3H), 3.23 (dd, J = 5.0, 14.0 Hz, 1H), 3.00 (dd, J = 9.5, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, acetone-d_6) 171.47, 151.39 (dd, J = 12.8, 244.3 Hz), 151.26, 150.34 (dd, J = 13.0, 244.5 Hz), 148.02, 129.37, 128.35 (t, J = 3.2 Hz), 127.31 (d, J = 11.6 Hz), 125.78 (dd, J = 4.7, 6.7 Hz), 125.47, 117.39 (d, J = 17.1 Hz), 57.54, 53.20, 33.09. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{13}F_2N_2O_6S$ [M-H]$^-$: 399.0468. found: 399.0468.



methyl 2-(4-nitrophenylsulfonamido)-3-(2-(trifluoromethyl)phenyl)propanoate 1h

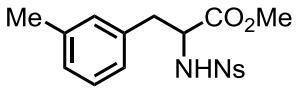
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.24 (d, J = 8.5 Hz, 2H), 7.87 (d, J = 9.0 Hz, 2H), 7.48 (d, J = 8.0 Hz, 1H),7.37 (t, J = 8.0 Hz, 1H), 7.31 (d, J = 8.0 Hz, 1H), 7.27 (d, J = 10.0 Hz, 1H), 5.49 (d, J = 9.0 Hz, 1H, N-H), 4.29-4.25 (m, 1H), 3.64 (s, 3H), 3.19 (dd, J = 5.5, 14.0 Hz, 1H), 3.05 (dd, J = 7.0, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) 170.75, 150.03, 145.32, 135.93, 132.85, 130.98 (q, J = 32.2 Hz), 129.18, 128.16, 126.02 (q, J = 4.0 Hz), 124.26 (q, J = 4.0 Hz), 124.21, 123.76 (q, J = 270.7 Hz), 56.87, 52.91, 39.00. HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{14}F_3N_2O_6S$ [M-H]$^-$: 431.0530 found: 431.0530.



methyl 3-(3-methoxyphenyl)-2-(4-nitrophenylsulfonamido)propanoate 1i

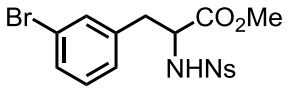
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (d, J = 9.0 Hz, 2H), 7.80 (d, J = 9.0 Hz, 2H), 7.11 (t, J = 8.0 Hz, 1H), 6.71 (dd, J = 2.0, 8.0 Hz, 1H), 6.63 (d, J = 7.5 Hz, 1H), 6.51 (s, 1H), 5.62 (d, J = 9.0 Hz, 1H, N-H), 4.25-4.23 (m, 1H), 3.70 (s, 3H), 3.66 (s, 3H), 3.08 (dd, J = 5.0, 14.0Hz, 1H), 2.88 (dd, J = 8.5, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) 171.24, 159.60, 149.75, 145.46, 136.41, 129.67, 128.04, 123.99, 121.51, 115.04, 112.35, 57.11, 55.01, 52.75, 38.96. HRMS (ESI-TOF) *m/z* Calcd

for $C_{17}H_{17}N_2O_7S$ [M-H]$^-$: 393.0762. found: 393.0761.



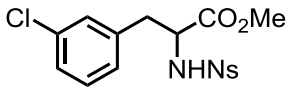
methyl 2-(4-nitrophenylsulfonamido)-3-(m-tolyl)propanoate 1j

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.8 Hz, 2H), 7.80 (d, *J* = 8.8 Hz, 2H), 7.08 (t, *J* = 7.6 Hz, 1H), 7.00 (d, *J* =7.6 Hz, 1H), 6.84 (d, *J* =8.0 Hz, 1H), 6.82 (s, 1H), 5.55 (d, *J* = 9.6 Hz, 1H, N-H), 4.26-4.21 (m, 1H), 3.64 (s, 3H), 3.07 (dd, *J* = 5.2, 14.0 Hz, 1H), 2.90 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.23 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) 171.26, 149.77, 145.51, 138.30, 134.77, 129.94, 128.57, 128.09, 128.03, 126.24, 123.98, 57.19, 52.67, 38.95, 21.19. HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{17}N_2O_6S$ [M-H]$^-$: 377.0813. found: 377.0815.



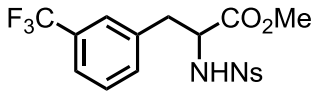
methyl 3-(3-bromophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1k

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.5 Hz, 2H), 7.84 (d, *J* = 8.5 Hz, 2H), 7.32 (dd, *J* = 2.0, 8.0 Hz, 1H), 7.13 (s, 1H), 7.09 (t, *J* =8.0 Hz, 1H), 7.02 (d, *J* =7.5 Hz, 1H),5 .46 (d, *J* = 9.0 Hz, 1H, N-H), 4.26-4.21 (m, 1H), 3.67 (s, 3H), 3.09 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.90 (dd, *J* = 8.0, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) 170.88, 149.99, 145.34, 137.24, 132.27, 130.50, 130.22, 128.09, 127.99, 124.20, 122.68, 56.98, 52.94, 38.75. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{14}BrN_2O_6S$ [M-H]$^-$: 440.9761. found: 440.9758.



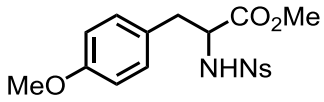
methyl 3-(3-chlorophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1l

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.8 Hz, 2H), 7.83 (d, *J* = 8.8 Hz, 2H), 7.14-7.13 (m, 2H), 6.99-6.97 (m, 2H), 5.85 (br, 1H, N-H), 4.24 (br, 1H), 3.67 (s, 3H), 3.10 (dd, *J* = 4.8, 14.0 Hz, 1H), 2.89 (dd, *J* = 8.0, 14.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) 171.05, 149.83, 145.31, 137.09, 134.27, 129.87, 129.22, 127.97, 127.52, 127.39, 124.09, 57.01, 52.85, 38.51. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{14}ClN_2O_6S$ [M-H]$^-$: 397.0267. found: 397.0269.



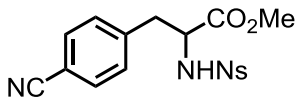
methyl 2-((4-nitrophenyl)sulfonamido)-3-(3-(trifluoromethyl)phenyl)propanoate 1m

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.5 Hz, 2H), 7.87 (d, *J* = 8.5 Hz, 2H), 7.49 (d, *J* = 8.0 Hz, 1H), 7.37 (t, *J* = 8.0 Hz, 1H), 7.32 (d, *J* = 8.0 Hz, 1H), 7.28 (s, 1H), 5.50 (d, *J* = 9.0 Hz, 1H, N-H), 4.29-4.25 (m, 1H), 3.64 (s, 3H), 3.19 (dd, *J* = 5.2, 14.0 Hz, 1H), 3.06 (dd, *J* = 7.5, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.69, 150.03, 145.27, 135.85, 132.87, 130.99 (q, *J* = 32.1 Hz), 129.19, 128.18, 126.03 (q, *J* = 3.6 Hz), 124.31 (q, *J* = 3.6 Hz), 124.24, 123.76 (q, *J* = 270.7 Hz), 55.81, 52.94, 39.04. . HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{14}F_3N_2O_6S$ [M-H]$^-$: 431.0530 found: 431.0530.



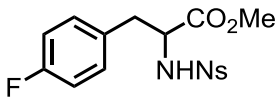
methyl 3-(4-methoxyphenyl)-2-(4-nitrophenylsulfonamido)propanoate 1n[2]

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.5 Hz, 2H), 7.84 (d, *J* = 8.5 Hz, 2H), 6.95 (d, *J* = 9.0 Hz, 2H), 6.71 (d, *J* = 8.5 Hz, 2H), 5.42 (d, *J* = 9.5 Hz, 1H, N-H), 4.24-4.19 (m, 1H), 3.75 (s, 3H), 3.63 (s, 3H), 3.06 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.90 (dd, *J* = 7.5, 14.0 Hz, 1H);^{13}C NMR (125 MHz, $CDCl_3$) δ 171.19, 158.92, 149.83, 145.63, 130.31, 128.20, 126.60, 124.05, 114.03, 57.27, 55.13, 52.70, 38.34.



methyl 3-(4-cyanophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1o

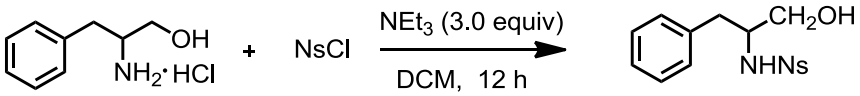
^{1}H NMR (400 MHz, acetone-d_6) δ 8.32 (d, *J* = 9.2 Hz, 2H), 7.93 (d, *J* = 8.8 Hz, 2H), 7.60 (d, *J* = 8.0 Hz, 2H), 7.52 (d, *J* = 9.2 Hz, 1H, N-H), 7.42 (d, *J* = 8.4 Hz, 2H), 4.39-4.33 (m, 1H), 3.54 (s, 3H), 3.23 (dd, *J* = 5.2, 13.6 Hz, 1H), 3.03 (dd, *J* = 9.2, 13.6 Hz, 1H); ^{13}C NMR (100 MHz, acetone-d_6) δ 171.57, 151.85, 147.60, 143.03, 132.97, 131.47, 129.09, 125.07, 119.16, 111.64, 58.15, 53.76, 39.10. HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{14}N_3O_6S$ [M-H]$^-$: 388.0609. found: 388.0610.



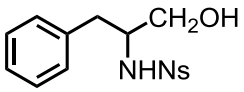
methyl 3-(4-fluorophenyl)-2-(4-nitrophenylsulfonamido)propanoate 1p

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.24 (d, *J* = 9.0 Hz, 2H), 7.88 (d, *J* = 8.5 Hz, 2H), 7.06-7.03 (m, 2H), 6.88 (t, *J* = 7.5 Hz, 2H), 5.84 (d, *J* = 9.0 Hz, 1H,N-H), 4.26-4.22 (m, 1H), 3.61 (s, 3H), 3.10 (dd, *J* = 5.5, 14.0 Hz, 1H), 2.96 (dd, *J* = 7.5, 14.0 Hz, 1H);^{13}C NMR (125 MHz, $CDCl_3$) 171.01, 161.93 (d, *J* = 244.5 Hz), 149.82, 145.44, 130.81 (d, *J* = 8.1 Hz), 130.62 (d, *J* = 3.5 Hz), 128.10, 124.05, 115.36 (d, *J* = 21.0 Hz), 57.07, 52.65, 38.11. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{14}FN_2O_6S$ $[M-H]^-$: 381.0562. found: 381.0560.

Synthesis of *N*-Nosyl 2-amino-3-phenylpropan-1-ol 1q.



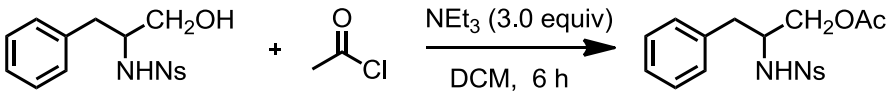
4-Nitrobenzenesulfonyl chloride (NsCl, 1.0 mmol, 1.0 equiv) was added to a cooled (0^{o}C) solution of 2-amino-3-phenylpropan-1-ol hydrochloride (1.0 mmol, 1.0 equiv) and triethylamine (TEA, 3.0 mmol, 3.0 equiv) in DCM (5 mL). After being stirred at room temperature for 12 h, the reaction mixture was poured into H_2O. The organic layer was separated, dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum. The residue was subjected to column chromatography (EtOAc/hexanes = 1:1) to give **1q**.



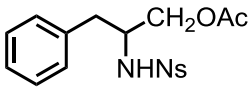
N-(1-hydroxy-3-phenylpropan-2-yl)-4-nitrobenzenesulfonamide 1q[3]

^{1}H NMR (400 MHz, Acetone-d_6) δ 8.19 (d, *J* = 8.8 Hz, 2H),7.84 (d, *J* = 8.8 Hz, 2H), 7.09-7.08 (m, 5H), 6.85 (d, *J* = 7.6 Hz, 1H, N-H), 4.03 (t, *J* = 5.2 Hz, 1H), 3.63-3.51 (m, 3H), 2.97 (dd, *J* = 5.2, 14.0 Hz, 1H), 2.66 (dd, *J* = 8.0, 14.0 Hz, 1H); ^{13}C NMR (100 MHz, Acetone-d_6) δ 150.40, 148.20, 139.12, 130.146, 129.00, 128.691, 126.88, 124.87, 65.08, 58.93, 38.38.

Synthesis of N-Nosyl 2-amino-3-phenylpropyl acetate 1r.



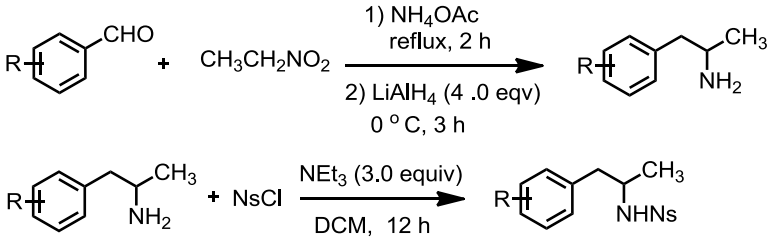
Acetyl chloride (AcCl, 0.5mmol, 1.0 equiv) was added to a cooled (0^o C) solution of **1q** (0.5 mmol, 1.0 equiv) and triethylamine (TEA, 3.0 mmol, 3.0 equiv) in DCM (2.5 mL). After being stirred at room temperature for 6 h, the reaction mixture was poured into H_2O. The organic layer was separated, dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum. The residue was subjected to column chromatography (EtOAc/hexanes = 1:2) to give **1r**.



2-(4-nitrophenylsulfonamido)-3-phenylpropyl acetate 1r

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.5 Hz, 2H), 7.75 (d, *J* = 8.5 Hz, 2H), 7.30-7.11 (m, 3H), 6.98 (d, *J* = 6.0 Hz, 2H), 5.38 (d, *J* = 8.5 Hz, 1H, N-H), 4.15-4.08 (m, 2H), 3.78-3.76 (m, 1H), 2.85 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.67 (dd, *J* = 8.5, 14.0 Hz, 1H), 2.05 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) 171.85, 149.63, 145.99, 136.06, 129.07, 128.64, 127.80, 126.92, 124.09, 65.67, 54.84, 38.29, 22.72. HRMS (ESI-TOF) *m/z* Calcd for $C_{17}H_{17}N_2O_6S$ [M-H]$^-$: 377.0813. found: 377.0811.

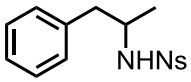
Synthesis of N-Nosyl 1-phenylpropan-2-amine 1s and N-Nosyl 1-(2-methoxyphenyl)propan-2-amine 1t.[4]



A solution of the corresponding arylaldehyde (~0.2 M) in nitroethane and ammonium acetate (0.85 equiv) was refluxed for 2 h, then concentrated under vacuum. The crude oil was diluted with THF and slowly added to an ice-cold solution of $LiAlH_4$ (4 equiv, ~0.5 M) in THF. After the addition, the solution was refluxed for 3 h and allowed to cool to room temperature. H_2O (1.3 g/g $LiAlH_4$) was slowly added under vigorous stirring, followed by 15% aqueous NaOH (1.3 g/g $LiAlH_4$), followed again by H_2O (3.25 g/g $LiAlH_4$). After stirring vigorously for 10 minutes the white precipitate was collected on a filter. The white solid was washed with diethyl ether and the combined filtrates dried and concentrated to yield the 1-(aryl)propan-2-amine. The amines were immediately used in the following step.

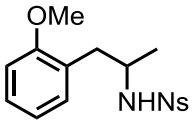
4-Nitrobenzenesulfonyl chloride (NsCl, 1.0 mmol, 1.0 equiv) was added to a cooled (0^oC) solution of 1-(aryl)propan-2-amine (1.0 mmol, 1.0 equiv) and triethylamine (TEA, 3.0 mmol, 3.0 equiv) in DCM (5 mL). After being stirred at room temperature for 12 h, the reaction mixture was poured

into H_2O. The organic layer was separated, dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum. The residue was subjected to column chromatography (EtOAc/hexanes =1:2) to give **1s** and **1t**.



4-nitro-N-(1-phenylpropan-2-yl)benzenesulfonamide 1s [4]

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (d, *J* = 9.0 Hz, 2H), 7.76 (d, *J* = 9.0 Hz, 2H), 7.16-7.14 (m, 3H), 6.97 (dd, *J* = 2.0, 7.5 Hz, 2H), 4.79 (d, *J* = 8.0 Hz, 1H, N-H), 3.59-3.54 (m, 1H), 2.75 (dd, *J* = 5.5, 14.0 Hz, 1H), 2.60 (dd, *J* = 8.0, 14.0 Hz, 1H), 1.24 (d, *J* = 5.5 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ149.63, 146.23, 130.90, 129.12, 128.57, 127.88, 126.80, 124.09, 51.99, 43.36, 22.37.

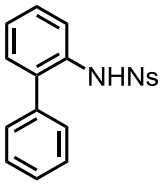


N-(1-(2-methoxyphenyl)propan-2-yl)-4-nitrobenzenesulfonamide 1t

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.5 Hz, 2H), 7.60 (d, *J* = 9.0 Hz, 2H), 7.11 (t, *J* = 8.0 Hz, 1H), 6.82 (d, *J* = 7.5 Hz, 1H), 6.70 (t, *J* = 7.5 Hz, 1H), 6.67 (d, *J* = 8.5 Hz, 1H), 5.22 (br, 1H, N-H), 3.76 (s, 3H), 3.48-3.43 (m, 1H), 2.71 (dd, *J* = 10.0, 14.0 Hz, 1H), 2.57 (dd, *J* = 4.0, 14.0 Hz, 1H), 1.35 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 156.82, 149.40, 145.78, 130.97, 128.31, 127.64, 125.86, 123.80, 121.09, 110.59, 55.49, 52.19, 37.30, 23.59. HRMS (ESI-TOF) *m/z* Calcd for $C_{16}H_{17}N_2O_5S$ $[M-H]^-$: 349.0864. found: 349.0868.

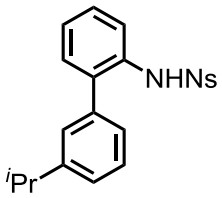
Synthesis of substrate 2-aryl N-nosylaniline 4a-c[5-6]

4-Nitrobenzenesulfonyl chloride (NsCl, 1.0 mmol, 1.0 equiv) was added to a solution of 2-aryl aniline (1.0 mmol, 1.0 equiv) in pyridine (5 mL). After being stirred at 140 ^{o}C for 0.5 h, the reaction mixture was cooled to room temperature and poured into H_2O. The organic layer was separated, dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum. The residue was purified using ethyl acetate/hexanes (1:2) as the eluent to give the substrates **4a-c**.[5-6]



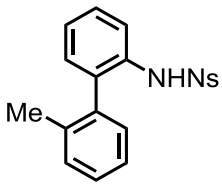
N-([1,1'-biphenyl]-2-yl)-4-nitrobenzenesulfonamide 4a[5]

This compound was prepared according to the procedure in reference 5.



N-(3'-isopropyl-[1,1'-biphenyl]-2-yl)-4-nitrobenzenesulfonamide 4b

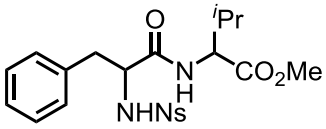
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.8 Hz, 2H), 7.69 (d, *J* = 9.2 Hz, 2H), 7.36 (t, *J* = 8.4 Hz, 1H), 7.25-7.19 (m, 3H), 7.14 (d, *J* = 7.2 Hz, 1H), 6.89 (s, 1H), 6.78 (s, 1H), 6.64-6.62 (m, 1H), 2.87-2.80 (m, 1H), 1.24 (d, *J* = 6.8 Hz, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 150.08, 150.03, 144.63, 136.78, 134.88, 132.40, 130.52, 129.16, 128.70, 128.26, 126.72, 126.28, 125.96, 125.93, 124.01, 122.13, 33.99, 23.86. HRMS (ESI-TOF) *m/z* Calcd for $C_{21}H_{19}N_2O_4S$ $[M-H]^-$: 395.1071. found: 395.1069.



N-(3'-methyl-[1,1'-biphenyl]-2-yl)-4-nitrobenzenesulfonamide 4c

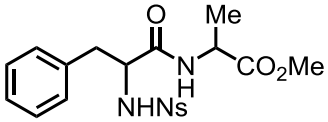
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.23 (d, *J* = 8.5 Hz, 2H), 7.75 (d, *J* = 8.5 Hz, 2H), 7.73 (d, *J* = 8.5 Hz, 1H), 7.36 (dt, *J* = 1.5, 8.0 Hz, 1H), 7.30 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.25 (d, *J* = 8.5 Hz, 1H), 7.18 (dt, *J* = 1.0, 7.5 Hz, 1H), 7.11 (dt, *J* = 1.0, 7.5 Hz, 1H), 7.04 (dd, *J* = 1.5, 8.0 Hz, 1H), 6.51 (dd, *J* = 1.0, 7.5 Hz, 1H), 6.40 (s, 1H), 1.84 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 150.20, 144.79, 136.36, 135.67, 133.07, 132.89, 130.85, 130.34, 129.18, 128.89, 128.79, 128.44, 126.41, 125.48, 124.13, 120.77, 19.46. HRMS (ESI-TOF) *m/z* Calcd for $C_{19}H_{15}N_2O_4S$ $[M-H]^-$: 367.0758. found: 367.0759.

Synthesis *N*-nosyl-dipeptides according to the reported procedures.[4]



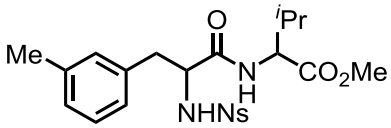
methyl 3-methyl-2-(2-(4-nitrophenylsulfonamido)-3-phenylpropanamido)butanoate 6a

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.15 (d, *J* = 9.0 Hz, 2H), 7.75 (d, *J* = 9.0 Hz, 2H), 7.19-7.14 (m, 3H), 7.01 (d, *J* = 7.5 Hz, 2H), 6.53 (d, *J* = 8.5 Hz, 1H, N-H), 5.63 (d, *J* = 7.5 Hz, 1H, N-H), 4.38 (q, *J* = 4.5 Hz, 1H), 4.01-3.97 (m, 1H), 3.73 (s, 3H), 3.12 (dd, *J* = 5.5, 14.0 Hz, 1H), 2.89 (dd, *J* = 8.5, 14.0 Hz, 1H), 2.10-2.04 (m, 1H), 0.81 (q, *J* = 7.0 Hz, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.89, 169.55, 149.93, 144.59, 135.33, 129.03, 128.97, 128.23, 127.42, 124.20, 58.65, 57.28, 39.23, 31.17, 18.73, 17.45. HRMS (ESI-TOF) *m/z* Calcd for $C_{21}H_{24}N_3O_7S$ $[M-H]^-$: 462.1340. found: 462.1341.



methyl 2-(2-(4-nitrophenylsulfonamido)-3-phenylpropanamido)propanoate 6b[4]

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.14 (d, *J* = 9.0 Hz, 2H), 7.77 (d, *J* = 8.5 Hz, 2H), 7.18-7.11 (m, 3H), 7.02 (d, *J* = 7.5 Hz, 2H), 6.74 (br, 1H, N-H), 6.05 (br, 1H, N-H), 4.48-4.43 (m, 1H), 4.05-4.03 (m, 1H), 3.73 (s, 3H), 3.08 (dd, *J* = 5.5, 14.5 Hz, 1H), 2.94-2.89 (m, 1H), 1.32 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$)δ 172.65, 169.67, 149.85, 145.12, 135.34, 129.19, 128.75, 128.11, 127.26, 124.15, 58.41, 52.62, 48.38, 38.88, 18.10.

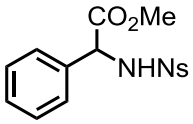


methyl 3-methyl-2-(2-(4-nitrophenylsulfonamido)-3-(m-tolyl)propanamido)butanoate 6c

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.11 (d, *J* = 9.6 Hz, 2H), 7.76 (d, *J* = 9.6 Hz, 2H), 7.02 (t, *J* = 7.5 Hz, 1H), 6.94 (d, *J* = 7.5 Hz, 1H), 6.85 (d, *J* = 7.5 Hz, 1H), 6.82 (s, 1H), 6.81 (d, *J* = 7.5 Hz, 1H, N-H), 6.25 (br, 1H, N-H), 4.42 (dd, *J* = 5.0, 9.0 Hz, 1H), 4.07 (dd, *J* = 6.0, 9.0 Hz, 1H), 3.72 (s, 3H), 3.10 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.85 (dd, *J* = 9.0, 14.0 Hz, 1H), 2.16 (s, 3H), 2.11-2.08 (m, 1H), 0.82 (q, *J* = 7.0Hz, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.94, 170.05, 149.69, 144.80, 138.41, 135.43, 129.76, 128.68, 128.07, 127.87, 126.08, 123.95, 58.80, 57.23, 52.22, 38.91, 31.16, 21.04, 18.64, 17.42. HRMS (ESI-TOF) *m/z* Calcd for $C_{22}H_{26}N_3O_7S$ $[M-H]^-$: 476.1497. found: 476.1500.

Synthesis of methyl 2-(4-nitrophenylsulfonamido)-2-phenylacetate according to the reported procedure.[5]

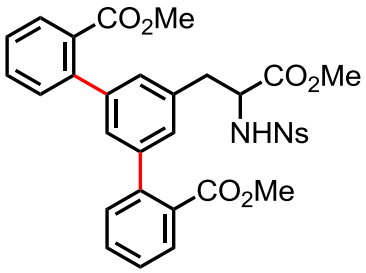
Under anitrogen atmosphere, a round-bottom flask was charged with phenylglycine methyl ester hydrochloric acid salt (0.01 mol), pyridine (1.0 ml) and DCM (20 ml). The mixture was stirred and cooled to 0 ºC.Then *p*-nitrobenzenesulfonyl chloride (0.011 mol) in DCM (20 ml) was added into the mixture slowly. The mixture was warmed to room temperature and further stirred for 30 min. The reaction mixture was diluted with DCM and washed with hydrochloric acid (1 M) and water. The organic layer was dried over anhydrous Na_2SO_4, filtered and concentrated in vacuo. The product was recrystallized from ethyl acetate/hexanes to give white crystals, which was dried under high vacuum.



methyl 2-(4-nitrophenylsulfonamido)-2-phenylacetate 8

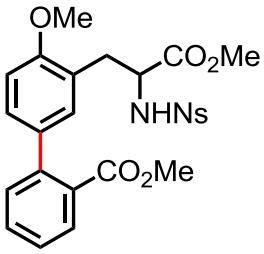
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.8 Hz, 2H), 7.80 (d, *J* = 8.8 Hz, 2H), 7.27-7.14 (m, 5H), 6.10 (br, 1H, N-H), 5.19 (d, *J* = 6.8 Hz, 1H), 3.65 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.09, 149.72, 146.03, 134.46, 128.95, 128.89, 128.19, 127.34, 123.86, 59.52, 53.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{15}H_{13}N_2O_6S$ $[M-H]^-$: 349.0500. found: 349.0504.

3.3 General Procedure for *meta*-C(sp^2)–H Arylation of Substituted Phenethylamines (Tables 3 and 4). Substrate **1** (0.10 mmol), $Pd(OAc)_2$ (0.01 mmol, 2.2 mg), and AgOAc (0.30 mmol, 50.0 mg) were weighed in airand placed in a sealed tube (10 mL) with a magnetic stir bar. To the reaction mixture, 4-acetylpyridine (0.02 mmol, 2.2 μL), norbornene (0.02 mmol, 1.9 mg), aryl halide **2** (0.3 mmol), and TBME (1.0 mL) were added. The reaction mixture was heated to 80 °C for 12 to 24 hours under vigorous stirring. Upon completion, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, and filtered through a pad of celite. The filtrate was concentrated *in vacuo*, and the resulting residue purified by preparative TLC using an eluent of hexanes/ethyl acetate(2/1 to 4/1) to give the desired products **3**.



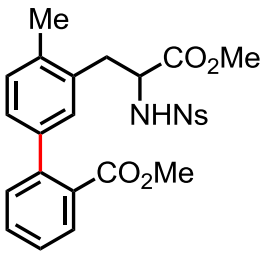
dimethyl 5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 3aa

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.22 (d, *J* = 9.0 Hz, 2H), 7.98 (d, *J* = 9.0 Hz, 2H), 7.88 (d, *J* = 8.0 Hz, 2H), 7.51 (t, *J* = 7.5 Hz, 2H), 7.42 (t, *J* = 8.0 Hz, 2H), 7.28 (d, *J* = 8.0 Hz, 2H), 7.12 (s, 1H), 6.98 (s, 2H), 5.80 (d, *J* = 9.0 Hz, 1H, N-H), 4.42-4.38 (m, 1H), 3.73 (s, 6H), 3.55 (s, 3H), 3.19 (dd, *J* = 6.0, 14.0 Hz, 1H), 3.12 (dd, *J* = 5.5, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.67, 168.45, 149.86, 146.08, 142.02, 141.59, 133.57, 131.49, 130.71, 130.20, 130.16, 128.41, 128.29, 127.66, 127.51, 124.07, 56.89, 52.55, 52.16, 38.90. HRMS (ESI-TOF) *m/z* Calcd for $C_{32}H_{27}N_2O_{10}S$ $[M-H]^-$: 631.1392. found: 631.1389.



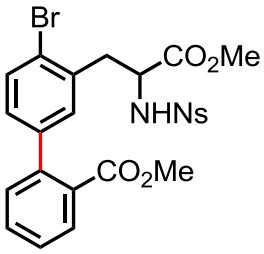
methyl 4'-methoxy-3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3ba

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.5 Hz, 2H), 7.85-7.83 (m, 3H), 7.51 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.39 (t, *J* = 7.5 Hz, 1H), 7.25 (d, *J* = 7.5 Hz, 1H), 7.15 (dd, *J* = 2.5, 8.5, 1H), 6.99 (d, *J* = 2.5, 1H), 6.72 (d, *J* = 8.5,1H), 5.72 (d, *J* = 8.0, 1H, N-H), 4.33-4.29 (m, 1H), 3.76 (s, 3H), 3.73 (s, 3H), 3.63 (s, 3H), 3.07 (dd, *J* = 5.0, 13.5 Hz, 1H), 3.00 (dd, *J* = 8.5, 13.5 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.56, 168.62, 156.64, 149.70, 145.79, 141.75, 133.68, 131.77, 131.46, 130.70, 130.06, 128.73, 128.22, 127.06, 123.89, 122.76, 109.99, 55.75, 55.37, 52.49, 52.19, 33.81. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_9S$ $[M-H]^-$: 527.1130. found: 527.1133.



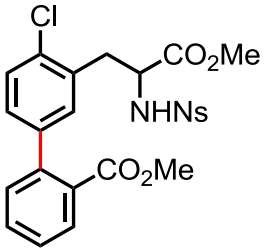
methyl 3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-4'-methyl-[1,1'-biphenyl]-2-carboxylate 3ca

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.8 Hz, 2H), 7.87-7.83 (m, 3H), 7.52 (t, *J* = 7.2 Hz, 1H), 7.40 (t, *J* = 7.2 Hz, 1H), 7.25 (d, *J* = 8.0 Hz, 1H), 7.10-7.04 (m, 2H), 6.99 (s, 1H), 5.60 (br, 1H, N-H), 4.23 (t, *J* = 6.0 Hz, 1H), 3.75 (s, 3H), 3.62 (s, 3H), 3.17 (dd, *J* = 5.6, 14.0 Hz, 1H), 2.97 (dd, *J* = 8.8, 14.0 Hz, 1H), 2.20 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.52, 168.59, 149.80, 145.51, 142.07, 139.11, 135.39, 132.66, 131.50, 130.72, 130.50, 130.48, 130.07, 130.05, 128.25, 127.56, 127.27, 124.03, 55.97, 52.72, 52.23, 36.42, 18.90. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_8S$ $[M-H]^-$: 511.1181. found: 511.1178.



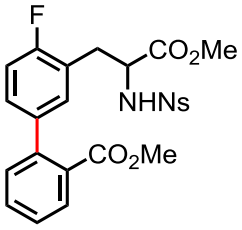
methyl4'-bromo-3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3da

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.8 Hz, 2H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.87 (d, *J* = 8.8 Hz, 2H), 7.55 (t, *J* = 7.6 Hz, 1H), 7.44 (t, *J* = 7.6 Hz, 1H), 7.38 (d, *J* = 8.0 Hz, 1H), 7.25 (d, *J* = 8.8 Hz, 1H), 7.13 (d, *J* = 2.0 Hz, 1H), 7.02 (dd, *J* = 2.0, 8.0 Hz, 1H), 5.70 (d, *J* = 9.2 Hz, 1H, N-H), 4.43-4.36 (m, 1H), 3.77 (s, 3H), 3.66 (s, 3H), 3.26 (dd, *J* = 5.2, 14.0 Hz, 1H), 3.04 (dd, *J* = 9.6, 14.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.34, 168.08, 149.83, 145.40, 141.08, 140.95, 133.99, 132.56, 132.13, 131.78, 130.66, 130.38, 129.72, 129.11, 128.35, 127.83, 124.05, 123.36, 55.30, 52.88, 52.30, 38.91. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{20}BrN_2O_8S$ $[M-H]^-$: 575.0129. found: 575.0131.



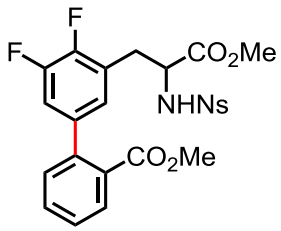
methyl 4'-chloro-3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3ea

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.8 Hz, 2H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.8 Hz, 2H), 7.55 (t, *J* = 6.8 Hz, 1H), 7.44 (t, *J* = 7.4 Hz, 1H), 7.25 (d, *J* = 8.0 Hz, 1H), 7.21 (d, *J* = 8.0 Hz, 1H), 7.13 (s, 1H), 7.10 (dd, *J* = 2.0, 8.4 Hz, 1H), 5.72 (br, 1H, N-H), 4.40-4.37 (m, 1H), 3.76 (s, 3H), 3.64 (s, 3H), 3.25 (dd, *J* = 5.6, 14.0 Hz, 1H), 3.07 (dd, *J* = 8.8, 14.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.29, 168.10, 149.84, 145.46, 141.12, 140.29, 133.10, 132.22, 132.12, 131.75, 130.71, 130.36, 129.77, 129.21, 128.89, 128.30, 127.79, 124.04, 55.27, 52.84, 52.28, 36.64. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{20}ClN_2O_8S$ $[M-H]^-$: 531.0634. found: 531.0630.



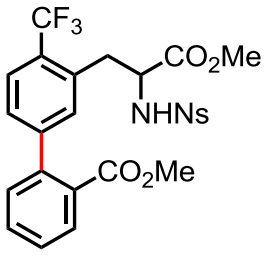
methyl 4'-fluoro-3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3fa

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.8 Hz, 2H), 7.94-7.90 (m, 3H), 7.54 (t, *J* = 7.2 Hz, 1H), 7.43 (t, *J* = 7.6 Hz, 1H), 7.26 (d, *J* = 7.6 Hz, 1H), 7.16-7.12 (m, 1H), 7.09 (d, *J* = 7.2 Hz, 1H), 6.93 (t, *J* = 8.8 Hz, 1H), 5.63 (d, *J* = 9.6 Hz, 1H, N-H), 4.37-4.32 (m, 1H), 3.76 (s, 3H), 3.61 (s, 3H), 3.16-3.06 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.88, 168.15, 160.46 (d, $^{1}J_{CF}$ = 245.0 Hz), 149.90, 145.71, 141.42, 137.49 (d, $^{3}J_{CF}$ = 4.6 Hz), 132.17 (d, $^{4}J_{CF}$ = 4.3 Hz), 131.66, 130.81, 130.32, 129.87, 129.32 (d, $^{3}J_{CF}$ = 8.3 Hz), 128.27, 127.59, 124.11, 121.16 (d, $^{2}J_{CF}$ = 16.1 Hz), 114.99 (d, $^{2}J_{CF}$ = 22.3 Hz), 55.73, 52.80, 52.21, 32.82. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{20}FN_2O_8S$ $[M-H]^-$: 515.0930. found: 515.0934.



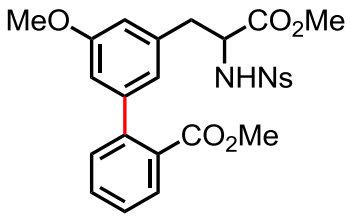
methyl 3',4'-difluoro-5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3ga

^{1}H NMR (500 MHz, acetone-D_6) δ 8.33 (d, *J* = 9.0 Hz, 2H), 7.99 (d, *J* = 9.0 Hz, 2H), 7.85 (dd, *J* = 1.0, 8.0 Hz, 1H), 7.64 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.56 (br, 1H, N-H), 7.53 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.41 (dd, *J* = 1.5, 8.0 Hz, 1H), 7.12-7.08 (m, 1H), 7.03 (d, *J* = 6.0 Hz, 1H), 4.40-4.36 (m, 1H), 3.71 (s, 3H), 3.58 (s, 3H), 3.28 (dd, *J* = 5.5, 14.0 Hz, 1H), 3.04 (dd, *J* = 9.5, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, acetone-D_6) δ 171.59, 168.80, 150.92, 150.49 (dd, *J* = 12.5, 244 Hz), 149.23 (dd, *J* = 12.5, 244 Hz), 147.61, 141.00, 138.92, 132.51, 131.78, 131.74, 130.82, 129.14, 128.92, 128.05, 126.40 (d, *J* = 12.5 Hz), 125.13, 117.16 (d, *J* = 18.7 Hz), 56.97, 52.87, 52.53, 32.90. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{19}F_2N_2O_8S$ $[M-H]^-$: 533.0836. found: 533.0839.



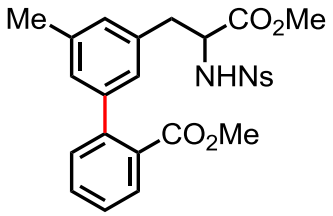
methyl 3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-4'-(trifluoromethyl)-[1,1'-biphenyl]-2-carboxylate 3ha

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.5 Hz, 2H), 7.96 (d, *J* = 7.5 Hz, 1H), 7.87 (d, *J* = 8.5 Hz, 2H), 7.60-7.57 (m, 2H), 7.49 (t, *J* = 8.0 Hz, 1H), 7.30-7.26 (m, 3H), 5.56 (d, *J* = 9.5 Hz, 1H, N-H), 4.33-4.28 (m, 1H), 3.75 (s, 3H), 3.60 (s, 3H), 3.34 (dd, *J* = 5.5, 14.5 Hz, 1H), 3.07 (dd, *J* = 9.5, 15.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.22, 167.92, 149.92, 145.53, 145.28, 140.99, 133.21, 132.44, 131.90, 130.78, 130.49, 129.76, 128.32, 128.21, 127.76, 127.69, 126.46 (q, *J* = 270 Hz), 126.15 (q, *J* = 7.2 Hz), 124.08, 56.62, 52.86, 52.30, 35.84. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{20}F_3N_2O_8S$ $[M-H]^-$: 565.0898. found: 565.0900.



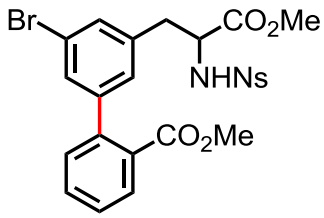
methyl 3'-methoxy-5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3ia

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.21 (d, *J* = 9.0 Hz, 2H), 7.90 (d, *J* = 8.0 Hz, 2H), 7.87 (dd, *J* = 1.5, 8.0 Hz, 1H), 7.53 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.42 (dt, *J* = 1.5, 7.6 Hz, 1H), 7.28 (dd, *J* = 1.5, 7.5 Hz, 1H), 6.70 (s, 1H), 6.61 (s, 1H), 6.43 (s, 1H), 5.66 (d, *J* = 8.5 Hz, 1H, N-H), 4.29-4.25 (m, 1H), 3.76 (s, 3H), 3.69 (s, 3H), 3.63 (s, 3H), 3.08 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.97 (dd, *J* = 7.5, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.02, 168.42, 159.47, 149.80, 145.60, 142.95, 142.06, 135.61, 131.49, 130.55, 130.13, 130.03, 128.27, 127.51, 124.00, 122.31, 113.46, 112.75, 56.95, 55.10, 52.69, 52.24, 38.83. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_9S$ $[M-H]^-$: 527.1130. found: 527.1131.



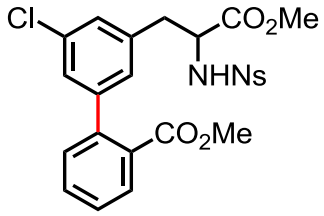
methyl 3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-5'-methyl-[1,1'-biphenyl]-2-carboxylate 3ja

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.8 Hz, 2H), 7.91 (d, *J* = 8.0 Hz, 2H), 7.88 (d, *J* = 8.8 Hz, 1H), 7.52 (dt, *J* = 1.2, 7.2 Hz, 1H), 7.41 (t, *J* = 7.6 Hz, 1H), 7.27 (d, *J* = 7.6 Hz, 1H), 6.99 (s, 1H), 6.83 (s, 1H), 6.76 (s, 1H), 5.63 (d, *J* = 8.8 Hz, 1H, N-H), 4.32-4.26 (m, 1H), 3.75 (s, 3H), 3.60 (s, 3H), 3.08 (dd, *J* = 5.2, 14.0 Hz, 1H), 3.00 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.25 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.98, 168.48, 149.80, 145.74, 142.34, 141.58, 138.17, 134.06, 131.48, 130.67, 130.08, 130.00, 128.55, 128.28, 128.19, 127.33, 126.96, 123.99, 57.01, 52.57, 52.17, 38.80, 21.21. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_8S$ $[M-H]^-$: 511.1181. found: 511.1182.



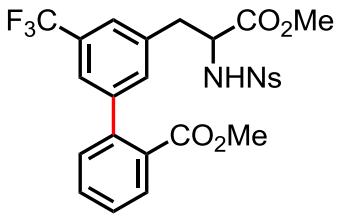
methyl 3'-bromo-5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3ka

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (d, *J* = 9.0 Hz, 2H), 7.95-7.92 (m, 3H), 7.55 (dt, *J* = 1.5, 8.0 Hz, 1H), 7.46 (dt, *J* = 1.0, 8.0 Hz, 1H), 7.31 (s, 1H), 7.25 (d, *J* = 8.0 Hz, 1H), 7.05 (s, 1H), 7.00 (s, 1H), 5.65 (br, 1H, N-H), 4.30 (br, 1H), 3.79 (s, 3H), 3.63 (s, 3H), 3.09 (dd, *J* = 5.0, 14.0 Hz, 1H), 3.00 (dd, *J* = 7.0, 14.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.68, 167.87, 150.00, 145.57, 143.57, 140.98, 136.22, 131.83, 130.71, 130.57, 130.49, 130.35, 129.62, 128.85, 128.23, 128.01, 124.19, 122.19, 56.87, 52.82, 52.32, 38.58. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{20}BrN_2O_8S$ $[M-H]^-$: 575.0129. found: 575.0130.



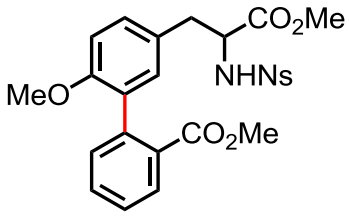
methyl 3'-chloro-5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3la

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.4 Hz, 2H), 7.94 (d, *J* = 7.6 Hz, 1H), 7.92 (d, *J* = 8.8 Hz, 2H), 7.55 (t, *J* = 7.6 Hz, 1H), 7.45 (t, *J* = 7.8 Hz, 1H), 7.25 (d, *J* = 7.6 Hz, 1H), 7.15 (s, 1H), 6.95 (s, 1H), 6.90 (s, 1H), 5.74 (d, *J* = 7.6 Hz, 1H, N-H), 4.30-4.27 (m, 1H), 3.78 (s, 3H), 3.63 (s, 3H), 3.10 (dd, *J* = 4.8, 14.0 Hz, 1H), 3.00 (dd, *J* = 7.2, 14.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.73, 167.90, 149.94, 145.54, 143.32, 141.02, 136.06, 134.01, 131.79, 130.65, 130.43, 129.66, 128.32, 128.20, 127.96, 127.64, 127.45, 124.14, 56.84, 52.79, 52.28, 38.55. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{20}ClN_2O_8S$ $[M-H]^-$: 531.0634. found: 531.0624.



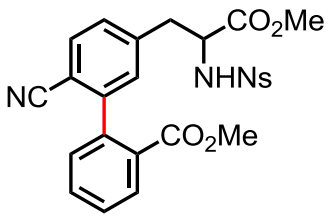
methyl 3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-5'-(trifluoromethyl)-[1,1'-biphenyl]-2-carboxylate 3ma

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.25 (d, *J* = 9.0 Hz, 2H), 7.99 (d, *J* = 7.5 Hz, 1H), 7.94 (d, *J* = 8.8 Hz, 2H), 7.58 (t, *J* = 8.0 Hz, 1H), 7.48 (t, *J* = 8.0 Hz, 1H), 7.42 (s, 1H), 7.31 (s, 1H), 7.29 (d, *J* = 7.5 Hz, 1H), 7.22 (s, 1H), 5.76 (d, *J* = 9.5 Hz, 1H, N-H), 4.39-4.35 (m, 1H), 3.77 (s, 3H), 3.59 (s, 3H), 3.21-3.14 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$)δ 170.48, 167.77, 149.98, 145.66, 145.66, 142.53, 141.13, 135.12, 133.51, 131.99, 130.84, 130.78 (q, *J* = 31.9 Hz), 130.69, 129.54, 128.23, 128.18, 124.50 (q, *J* = 3.8 Hz), 124.36 (q, *J* = 3.8 Hz), 123.74 (q, *J* = 270 Hz), 56.78, 52.74, 52.28, 38.90. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{20}F_3N_2O_8S$ [M-H]$^-$: 565.0898. found: 565.0902.



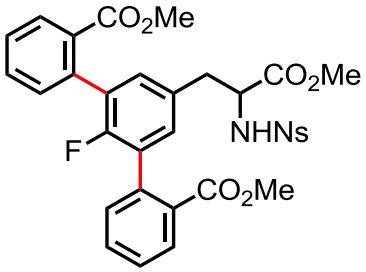
methyl 2'-methoxy-5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3na

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.8 Hz, 2H), 7.92 (d, *J* = 8.0 Hz, 2H), 7.88 (d, *J* = 8.0 Hz, 1H), 7.53 (dt, *J* = 1.2, 7.0 Hz, 1H), 7.40 (dt, *J* = 1.2, 7.4 Hz, 1H), 7.21 (d, *J* = 7.6 Hz, 1H), 6.96 (d, *J* = 8.4 Hz, 1H), 6.92 (s, 1H), 6.71 (d, *J* = 8.4 Hz, 1H), 5.46 (br, 1H, N-H), 4.28 (m, 1H), 3.71 (s, 3H), 3.67 (s, 3H), 3.60 (s, 3H), 3.11-2.98 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.10, 168.22, 155.45, 149.87, 145.73, 138.30, 131.62, 131.24, 131.14, 130.67, 129.44, 129.31, 128.33, 127.37, 126.45, 124.15, 110.35, 57.09, 55.25, 52.65, 51.82, 38.37. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_9S$ [M-H]$^-$: 527.1130. found: 527.1130.



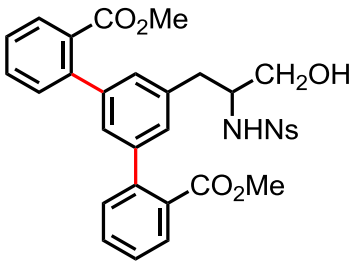
methyl 2'-cyano-5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 3oa

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, *J* = 9.2 Hz, 2H), 8.14-8.12 (m, 1H), 7.97 (d, *J* = 8.8 Hz, 2H), 7.65-7.59 (m, 2H), 7.54 (dt, *J* = 1.2, 7.6 Hz, 1H), 7.28 (dd, *J* = 1.2, 7.6 Hz, 1H), 7.17-7.14 (m, 2H), 5.71 (br, 1H, N-H), 4.38 (br, 1H), 3.78 (s, 3H), 3.55 (s, 3H), 3.19 (br, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.20, 166.77, 150.07, 145.69, 139.27, 132.56, 132.35, 130.98, 129.00, 128.44, 128.30, 124.25, 117.58, 111.43, 56.34, 52.83, 52.33, 39.24. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{20}N_3O_8S$ $[M-H]^-$: 522.0977. found: 522.0980.



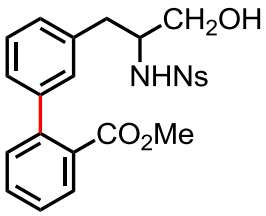
dimethyl 2'-fluoro-5'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 3pa

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (d, *J* = 8.8 Hz, 2H), 8.01-7.96 (m, 4H), 7.55 (dt, *J* = 1.2, 7.6 Hz, 2H), 7.45 (dt, *J* = 1.2, 7.6 Hz, 2H), 7.27 (dd, *J* = 1.6, 8.8 Hz, 2H), 6.97 (d, *J* = 6.4 Hz, 2H), 5.88 (br, 1H, N-H), 4.39 (br, 1H), 3.74 (s, 6H), 3.54 (s, 3H), 3.19-3.08 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.66, 167.56, 155.31 (d, $^{1}J_{CF}$ = 244.6 Hz), 149.92, 146.02, 136.13, 131.78, 131.35, 130.87, 130.45, 130.28, 129.42 (d, $^{3}J_{CF}$ = 3.9 Hz), 129.07 (d, $^{2}J_{CF}$ = 17.4 Hz), 128.31, 128.09, 124.16, 56.85, 52.58, 52.15, 38.44. HRMS (ESI-TOF) *m/z* Calcd for $C_{32}H_{26}FN_2O_{10}S$ $[M-H]^-$: 649.1298. found: 649.1293.



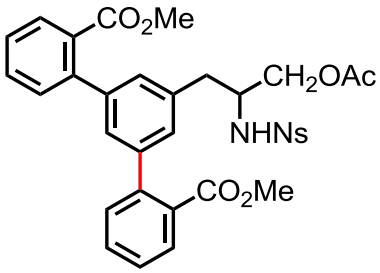
dimethyl 5'-(3-hydroxy-2-(4-nitrophenylsulfonamido)propyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 3qa(di)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.19 (d, *J* = 9.0 Hz, 2H), 7.97 (d, *J* = 8.5 Hz, 2H), 7.85 (d, *J* = 8.0 Hz, 2H), 7.51 (t, *J* = 7.5 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.27 (t, *J* = 8.0 Hz, 2H), 7.12 (s, 1H), 6.97 (s, 2H), 5.62 (d, *J* = 7.5 Hz, 1H, N-H), 3.71 (s, 6H), 3.63-3.59 (m, 3H), 2.89-2.87 (m, 2H), 2.43 (br, 1H, OH); ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.71, 149.79, 146.49, 141.91, 141.45, 135.48, 131.55, 130.69, 130.22, 130.09, 128.55, 128.26, 127.53, 127.11, 124.21, 63.50, 56.50, 52.20, 37.86. HRMS (ESI-TOF) *m/z* Calcd for $C_{31}H_{27}N_2O_9S$ $[M-H]^-$: 603.1443. found: 603.1445.



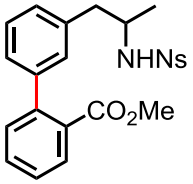
methyl 3'-(3-hydroxy-2-(4-nitrophenylsulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate 3qa(mono)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (d, *J* = 9.0 Hz, 2H), 7.88 (d, *J* = 8.5 Hz, 2H), 7.54 (t, *J* = 7.5 Hz, 1H), 7.43 (t, *J* = 7.5 Hz, 2H), 7.27 (d, *J* = 7.5 Hz, 1H), 7.16-7.12 (m, 2H), 7.00 (s, 1H), 6.91 (d, *J* = 6.5 Hz, 1H), 5.25 (d, *J* = 7.5 Hz, 1H, N-H), 3.75 (s, 3H), 3.70-3.54 (m, 3H), 2.89 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.76 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.19 (br, 1H, OH); ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.59, 149.78, 145.94, 142.23, 141.59, 135.91, 131.64, 130.73, 130.15, 129.99, 129.88, 128.53, 128.26, 127.65, 127.50, 126.95, 124.19, 64.25, 56.88, 52.24, 37.87. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{21}N_2O_7S$ $[M-H]^-$: 469.1075. found: 469.1075.



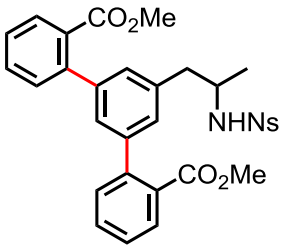
dimethyl 5'-(3-acetoxy-2-(4-nitrophenylsulfonamido)propyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 3ra

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.5 Hz, 2H), 7.96 (d, *J* = 8.0 Hz, 2H), 7.87 (d, *J* = 8.0 Hz, 2H), 7.52 (t, *J* = 7.5 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.27 (d, *J* = 7.5 Hz, 2H), 7.13 (s, 1H), 6.98 (s, 2H), 5.51 (d, *J* = 8.0,1H, N-H), 4.10-4.03 (m, 2H), 3.91-3.87 (m, 1H), 3.71 (s, 6H), 2.93-2.83 (m, 2H), 1.97 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.59, 168.50, 149.77, 146.65, 141.89, 141.56, 134.56, 131.51, 130.67, 130.21, 130.12, 128.54, 128.16, 127.53, 127.33, 124.18, 64.86, 53.85, 52.13, 38.10, 20.65. HRMS (ESI-TOF) *m/z* Calcd for $C_{33}H_{29}N_2O_{10}S$ $[M-H]^-$: 645. found ESI-MS: 645.



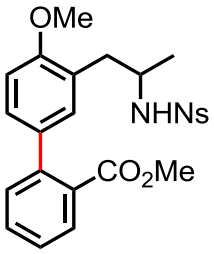
methyl 3'-(2-(4-nitrophenylsulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate3sa(mono) 3sa (mono)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (d, *J* = 9.0 Hz, 2H), 7.89-7.86 (m, 3H), 7.53 (dt, *J* = 1.5, 8.0 Hz, 1H), 7.43 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.27 (dd, *J* = 1.5, 7.5 Hz, 1H), 7.17-7.15 (m, 2H), 6.99 (s, 1H), 6.93-6.91 (m,1H), 4.91 (d, *J* = 7.5 Hz, 1H, N-H), 3.73 (s, 3H), 3.61-3.53 (m, 1H) 2.81 (dd, *J* = 5.5, 14.0 Hz, 1H), 2.65 (dd, *J* = 7.5, 14.0 Hz, 1H), 1.22 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.50, 149.68, 146.46, 142.30, 141.53, 136.09, 131.55, 130.69, 130.13, 130.08, 129.82, 128.35, 128.14, 127.91, 127.43, 126.87, 124.14, 52.18, 51.48, 43.08, 21.94. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{21}N_2O_6S$ $[M-H]^-$: 453.1126. found: 453.1129.



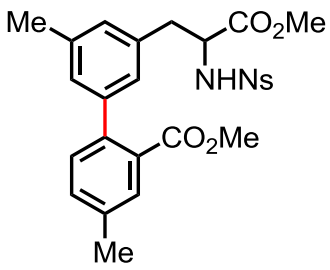
dimethyl 5'-(2-(4-nitrophenylsulfonamido)propyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 3sa(di)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.19 (d, *J* = 9.0 Hz, 2H), 7.97 (d, *J* = 9.0 Hz, 2H), 7.87 (d, *J* = 8.0 Hz, 2H), 7.52 (t, *J* = 7.5 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.29 (d, *J* = 7.5 Hz, 2H), 7.14 (s, 1H), 6.95 (s, 2H), 5.17 (d, *J* = 7.5, 1H, N-H), 3.72-3.67 (m, 7H), 2.86 (dd, *J* = 5.5, 13.5 Hz, 1H), 2.71 (dd, *J* = 6.5, 14.0 Hz, 1H), 1.18 (d, *J* = 6.5 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.56, 149.71, 146.91, 142.05, 141.39, 135.30, 131.51, 130.70, 130.25, 130.13, 128.72, 128.20, 127.51, 127.06, 124.17, 52.17, 50.99, 42.83, 21.38. HRMS (ESI-TOF) *m/z* Calcd for $C_{31}H_{27}N_2O_8S$ $[M-H]^-$: 587.1494. found: 587.1500.



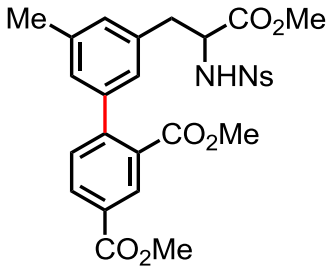
methyl 4'-methoxy-3'-(2-(4-nitrophenylsulfonamido)propyl)-[1,1'-biphenyl]-2-carboxylate 3ta

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.10 (d, *J* = 8.5 Hz, 2H), 7.83 (d, *J* = 7.5 Hz, 1H), 7.76 (d, *J* = 8.5 Hz, 2H), 7.51 (t, *J* = 7.5 Hz, 1H), 7.38 (t, *J* = 7.5 Hz, 1H), 7.19 (d, *J* = 7.5 Hz, 1H), 7.12 (d, *J* = 7.5, 1H), 6.91 (s, 1H), 6.66 (d, *J* = 8.5, 1H), 5.26 (d, *J* = 6.0 Hz, 1H, N-H), 3.75 (s, 3H), 3.70 (s, 3H), 3.56-3.52 (m, 1H), 2.72-2.62 (m, 2H), 1.32 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.66, 156.38, 149.46, 146.13, 141.64, 133.75, 131.61, 131.47, 130.58, 130.10, 130.06, 128.15, 128.08, 127.06, 125.05, 123.81, 110.10, 55.35, 52.17, 51.18, 37.83, 23.20. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{23}N_2O_7S$ $[M-H]^-$: 483.1231. found: 483.1235.



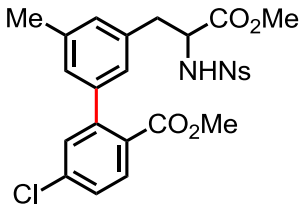
methyl 3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-4,5'-dimethyl-[1,1'-biphenyl]-2-carboxylate 3jb

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.20 (d, *J* = 9.0 Hz, 2H), 7.90 (d, *J* = 8.5 Hz, 2H), 7.69 (d, *J* = 2.0 Hz, 1H), 7.33 (dd, *J* = 2.0, 8.0 Hz, 1H), 7.15 (d, *J* = 7.5 Hz, 1H), 6.97 (s, 1H), 6.79 (s, 1H), 6.73 (s, 1H), 5.55 (d, *J* = 5.0 Hz, 1H, N-H), 4.30-4.28 (m, 1H), 3.74 (s, 3H), 3.60 (s, 3H), 3.06 (dd, *J* = 5.0, 14.0 Hz, 1H), 3.00 (dd, *J* = 7.0, 13.5 Hz, 1H), 2.42 (s, 3H), 2.24 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.97, 168.67, 149.83, 145.78, 141.59, 139.52, 138.15, 137.29, 133.96, 132.23, 130.60, 129.79, 128.38, 128.30, 128.27, 127.04, 124.01, 57.00, 52.58, 52.14, 38.83, 21.24, 20.93. HRMS (ESI-TOF) *m/z* Calcd for $C_{26}H_{25}N_2O_8S$ $[M-H]^-$: 525.1337. found: 525.1338.



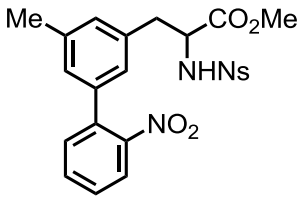
dimethyl3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-5'-methyl-[1,1'-biphenyl]-2,4-dicarboxylate 3jc

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.5 Hz, 2H), 8.05 (d, *J* = 8.0 Hz, 1H), 7.93-7.89 (m, 4H), 7.00 (s, 1H), 6.84 (s, 1H), 6.82 (s, 1H), 5.63 (d, *J* = 8.5 Hz, 1H, N-H), 4.31-4.29 (m, 1H), 3.96 (s, 3H), 3.77 (s, 3H), 3.61 (s, 3H), 3.09 (dd, *J* = 5.0, 14.0 Hz, 1H), 3.01 (dd, *J* = 7.0, 13.5 Hz, 1H), 2.27 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.93, 167.98, 166.01, 149.84, 145.72, 142.24, 140.53, 138.39, 134.49, 134.12, 132.51, 131.62, 130.00, 129.09, 128.26, 128.21, 128.15, 126.77, 124.03, 57.02, 52.60, 52.47, 52.44, 38.86, 21.21. HRMS (ESI-TOF) *m/z* Calcd for $C_{27}H_{25}N_2O_{10}S$ $[M-H]^-$: 569.1235. found: 569.1236.



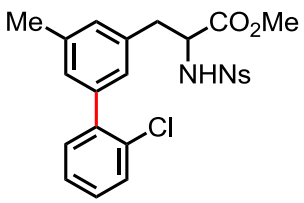
methyl 5-chloro-3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-5'-methyl-[1,1'-biphenyl]-2-carboxylate 3jd

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.23 (d, *J* = 8.5 Hz, 2H), 7.92 (d, *J* = 9.0 Hz, 2H), 7.85 (d, *J* = 8.5 Hz, 1H), 7.38 (dd, *J* = 2.5,8.5 Hz, 1H), 7.26 (s, 1H), 6.97 (s, 1H), 6.83 (s, 1H), 6.79 (s, 1H), 5.64 (d, *J* = 8.5 Hz, 1H, N-H), 4.32-4.28 (m, 1H), 3.75 (s, 3H), 3.59 (s, 3H), 3.08 (dd, *J* = 5.0, 14.0 Hz, 1H), 3.02 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.26 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.87, 167.43, 149.85, 145.76, 144.33, 140.30, 138.34, 137.60, 134.23, 131.67, 130.80, 129.06, 128.28, 128.20, 128.04, 127.44, 126.87, 124.02, 56.97, 52.56, 52.29, 38.83, 21.20. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{22}ClN_2O_8S$ $[M-H]^-$: 545.0791. found ESI-MS: 545.



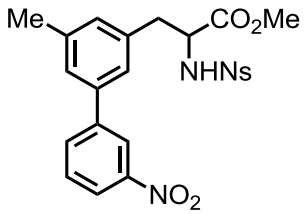
methyl 3-(5-methyl-2'-nitro-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3je

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (dd, *J* = 2.0, 8.8 Hz, 2H), 7.92 (dd, *J* = 2.0, 8.8 Hz, 2H), 7.84 (dd, *J* = 1.2, 8.0 Hz, 1H), 7.60 (t, *J* = 7.4 Hz, 1H), 7.48 (t, *J* = 7.8 Hz, 1H), 7.35 (d, *J* = 8.0 Hz, 1H), 7.00 (s, 1H), 6.88 (s, 1H), 6.81 (s, 1H), 5.58 (d, *J* = 8.8 Hz, 1H, N-H), 4.31-4.26 (m, 1H), 3.60 (s, 3H), 3.08 (dd, *J* = 5.2, 14.0 Hz, 1H), 3.00 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.27 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.94, 149.90, 149.06, 138.88, 137.82, 135.78, 135.19, 132.35, 131.72, 129.80, 128.31, 128.27, 127.66, 125.95, 124.07, 56.89, 52.73, 38.90, 21.20. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{20}N_3O_8S$ $[M-H]^-$: 498.0977. found: 498.0977.



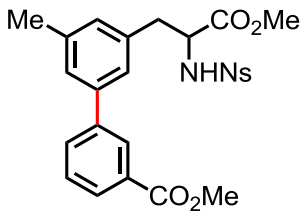
methyl 3-(2'-chloro-5-methyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jf

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (d, *J* = 9.0 Hz, 2H), 7.81 (d, *J* = 8.5 Hz, 1H), 7.44 (d, *J* = 1.5 Hz, 1H), 7.35-7.31 (m, 3H), 7.20 (s, 1H), 7.00 (s, 1H), 6.85 (s, 1H), 5.40 (d, *J* = 9.5 Hz, 1H, N-H), 4.32-4.28 (m, 1H), 3.66 (s, 3H), 3.14 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.95 (dd, *J* = 8.0, 13.5 Hz, 1H), 2.31 (s, 3H);^{13}C NMR (125 MHz, $CDCl_3$) δ 171.16, 149.83, 145.53, 142.20, 140.12, 139.05, 135.55, 134.73, 130.07, 129.54, 128.08, 127.53, 127.01, 126.86, 125.04, 125.00, 123.98, 57.17, 52.82, 39.13, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{20}ClN_2O_6S$ $[M-H]^-$: 487.0736. found: 487.0736.



methyl 3-(5-methyl-3'-nitro-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jg

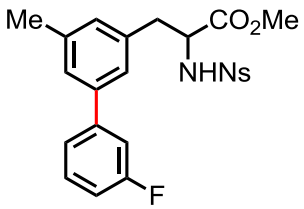
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.32 (s, 1H), 8.21-8.17 (m, 3H), 7.86 (d, *J* = 8.5 Hz, 2H), 7.83 (d, *J* = 7.5 Hz, 1H), 7.60 (t, *J* = 8.0 Hz, 1H), 7.29 (s, 1H), 7.10 (s, 1H), 6.94 (s, 1H), 5.41 (br, 1H, N-H), 4.32 (br, 1H), 3.66 (s, 3H), 3.18 (dd, *J* = 5.0, 14.0 Hz, 1H), 3.01 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.36 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.03, 149.90, 148.71, 145.54, 142.12, 139.41, 139.00, 135.89, 132.77, 130.29, 129.84, 128.15, 126.94, 125.17, 124.04, 122.25, 121.73, 57.05, 52.87, 39.14, 21.36. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{20}N_3O_8S$ $[M-H]^-$: 498.0977. found: 498.0976.



methyl 3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-5'-methyl-[1,1'-biphenyl]-3-carboxylate 3jh

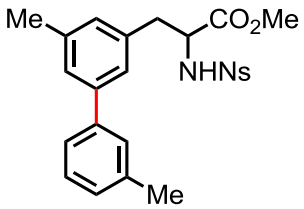
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.5 Hz, 2H), 8.12 (s, 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 7.80

(d, *J* = 7.5 Hz, 2H), 7.67 (d, *J* = 8.0 Hz, 1H), 7.49 (t, *J* = 8.0 Hz, 1H), 7.26 (s, 1H), 7.06 (s, 1H), 6.87 (s, 1H), 5.53 (d, *J* = 9.0 Hz, 1H, N-H), 4.33-4.28 (m, 1H), 3.96 (s, 3H), 3.67 (s, 3H), 3.15 (dd, *J* = 5.0, 13.5 Hz, 1H), 2.95 (dd, *J* = 7.5, 14.0 Hz, 1H), 2.32 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.22, 166.95, 149.77, 145.56, 140.57, 140.37, 139.02, 135.64, 131.19, 130.72, 129.44, 128.96, 128.56, 128.04, 127.96, 126.83, 125.05, 123.95, 57.24, 52.81, 52.25, 39.06, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_8S$ $[M-H]^-$: 511.1181. found: 511.1181.



methyl 3-(3'-fluoro-5-methyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3ji

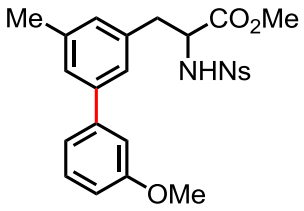
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.5 Hz, 2H), 7.81 (d, *J* = 8.5 Hz, 2H), 7.40-7.35 (m, 1H), 7.25 (d, *J* = 8.5 Hz, 1H), 7.21 (s, 1H), 7.17 (m, 1H), 7.05-7.01 (m, 2H), 6.85 (s, 1H), 5.45 (d, *J* = 9.0 Hz, 1H, N-H), 4.32-4.28 (m, 1H), 3.66 (s, 3H), 3.14 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.95 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.31 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.20, 163.14 (d, $^1J_{CF}$ = 244.7 Hz), 149.82, 145.53, 142.62 (d, $^3J_{CF}$ = 7.5 Hz), 140.23, 139.01, 135.53, 130.32 (d, $^3J_{CF}$ = 7.5 Hz), 129.51, 128.07, 126.83, 125.03, 123.97, 122.46, 114.33 (d, $^2J_{CF}$ = 21.2 Hz), 113.74 (d, $^2J_{CF}$ = 22.8 Hz), 57.18, 52.81, 39.10, 21.31. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{20}FN_2O_6S$ $[M-H]^-$: 471.1032. found: 471.1031.



methyl 3-(3',5-dimethyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jj

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.12 (d, *J* = 9.0 Hz, 2H), 7.77 (d, *J* = 9.0 Hz, 2H), 7.32-7.25 (m, 3H), 7.22 (s, 1H), 7.16 (d, *J* = 7.5 Hz, 1H), 7.01 (s, 1H), 6.79 (s, 1H), 5.32 (d, *J* = 9.0 Hz, 1H, N-H), 4.31-4.26 (m, 1H), 3.67 (s, 3H), 3.13 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.92 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.41 (s, 3H), 2.30 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.26, 149.78, 145.51, 141.70, 140.26, 138.77, 138.47, 135.28, 128.81, 128.75, 128.32, 128.05, 127.61, 126.91, 125.04, 123.94, 57.29, 52.80, 39.18, 21.50, 21.34. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{23}N_2O_6S$ $[M-H]^-$: 467.1282.

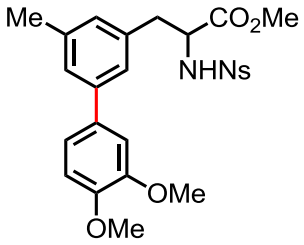
found: 467.1285.



methyl

3-(3'-methoxy-5-methyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jk

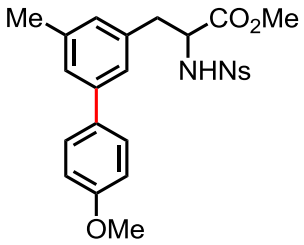
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.13 (d, *J* = 9.0 Hz, 2H), 7.78 (d, *J* = 9.0 Hz, 2H), 7.33 (t, *J* = 8.0 Hz, 1H), 7.22 (s, 1H), 7.05 (d, *J* = 7.5 Hz, 1H), 7.02 (s, 1H), 6.99 (s, 1H), 6.89 (dd, *J* = 2.5, 8.5 Hz, 1H), 6.81 (s, 1H), 5.42 (d, *J* = 8.5 Hz, 1H, N-H), 4.31-4.27 (m, 1H), 3.87 (s, 3H), 3.67 (s, 3H), 3.13 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.93 (dd, *J* = 8.0, 13.5 Hz, 1H), 2.29 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.27, 159.97, 149.77, 145.52, 141.79, 141.36, 138.80, 135.34, 129.84, 129.05, 128.03, 126.88, 125.07, 123.96, 119.29, 112.77, 57.23, 55.31, 52.79, 39.09, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{23}N_2O_7S$ $[M-H]^-$: 483.1231. found: 483.1234



methyl

3-(3',4'-dimethoxy-5-methyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jl

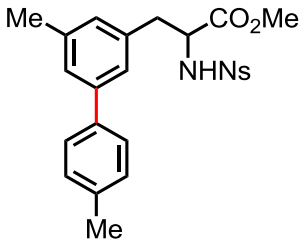
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.13 (d, *J* = 9.0 Hz, 2H), 7.78 (d, *J* = 9.0 Hz, 2H), 7.17 (s, 1H), 7.03-7.02 (m, 3H), 6.92 (d, *J* = 9.0 Hz, 1H), 6.76 (s, 1H), 5.47 (d, *J* = 9.0 Hz, 1H, N-H), 4.32-4.28 (m, 1H), 3.96 (s, 3H), 3.92 (s, 3H), 3.67 (s, 3H), 3.14 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.93 (dd, *J* = 8.5, 14.0 Hz, 1H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.29, 149.74, 149.24, 148.84, 145.53, 141.30, 138.75, 135.33, 133.25, 128.40, 127.99, 126.45, 124.73, 123.91, 119.13, 111.51, 110.15, 57.24, 56.00, 55.97, 52.77, 39.05, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{25}N_2O_8S$ $[M-H]^-$: 513.1337. found: 513.1335.



methyl

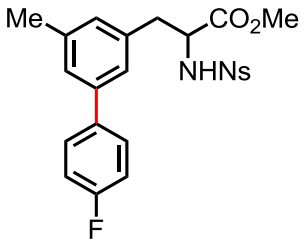
3-(4'-methoxy-5-methyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jm

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.11 (d, *J* = 9.0 Hz, 2H), 7.77 (d, *J* = 9.0 Hz, 2H), 7.40 (d, *J* = 8.5 Hz, 2H), 7.17 (s, 1H), 6.97 (s, 1H), 6.95 (d, *J* = 8.5 Hz, 2H), 6.75 (s, 1H), 5.40 (d, *J* = 8.5 Hz, 1H, N-H), 4.30-4.26 (m, 1H), 3.85 (s, 3H), 3.67 (s, 3H), 3.12 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.91 (dd, *J* = 8.0, 13.5 Hz, 1H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.30, 159.34, 149.75, 145.52, 141.10, 138.76, 135.30, 132.73, 128.26, 128.01, 127.83, 126.38, 124.55, 123.92, 114.28, 57.28, 55.35, 52.79, 39.11, 21.34. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{23}N_2O_7S$ $[M-H]^-$: 483.1231. found: 483.1234.



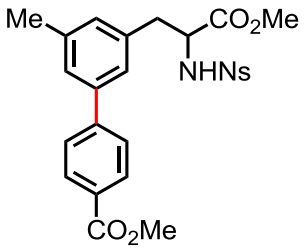
methyl 3-(4',5-dimethyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jn

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, *J* = 8.8 Hz, 2H), 7.76 (d, *J* = 8.8 Hz, 2H), 7.36 (d, *J* = 8.0 Hz, 2H), 7.22 (d, *J* = 8.8 Hz, 2H), 7.20 (s, 1H), 7.00 (s, 1H), 6.77 (s, 1H), 5.45 (d, *J* = 9.2 Hz, 1H, N-H), 4.31-4.25 (m, 1H), 3.67 (s, 3H), 3.12 (dd, *J* = 4.8, 14.0 Hz, 1H), 2.91 (dd, *J* = 8.4, 14.0 Hz, 1H), 2.39 (s, 3H), 2.28 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.34, 149.72, 145.48, 141.41, 138.75, 137.41, 137.31, 135.31, 129.54, 128.58, 127.99, 126.61, 124.77, 123.91, 57.29, 52.79, 39.05, 21.32, 21.06. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{23}N_2O_6S$ $[M-H]^-$: 467.1282. found: 467.1280.



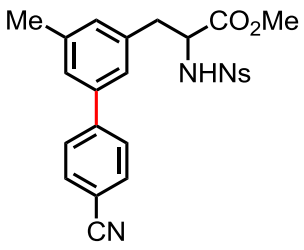
methyl 3-(4'-fluoro-5-methyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jo

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.5 Hz, 2H), 7.80 (d, *J* = 8.5 Hz, 2H), 7.45-7.42 (m, 2H), 7.17 (s, 1H), 7.10 (t, *J* = 8.5 Hz, 2H), 7.00 (s, 1H), 6.81 (s, 1H), 5.43 (d, *J* = 9.0 Hz, 1H, N-H), 4.31-4.27 (m, 1H), 3.66 (s, 3H), 3.13 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.94 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.30 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.21, 162.55 (d, *J* = 245.2 Hz), 149.81, 145.54, 140.56, 138.92, 136.46 (d, *J* = 3.0 Hz), 135.44, 128.90, 128. 43 (d, *J* = 7.8 Hz), 128.07, 126.75, 124.96, 123.95, 115.72 (d, *J* = 21.1 Hz), 57.20, 52.79, 39.12, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{20}FN_2O_6S$ $[M-H]^-$: 471.1032. found: 471.1032.



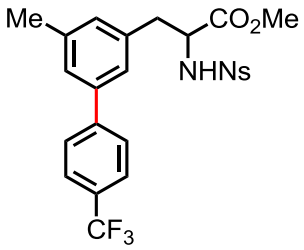
methyl 3'-(3-methoxy-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-5'-methyl-[1,1'-biphenyl]-4-carboxylate 3jp

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.14 (d, *J* = 9.0 Hz, 2H), 8.08 (d, *J* = 8.5 Hz, 2H), 7.81 (d, *J* = 8.5 Hz, 2H), 7.55 (d, *J* = 8.0 Hz, 2H), 7.26 (s, 1H), 7.09 (s, 1H), 6.87 (s, 1H), 5.49 (d, *J* = 9.0 Hz, 1H, N-H), 4.33-4.28 (m, 1H), 3.94 (s, 3H), 3.65 (s, 3H), 3.15 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.97 (dd, *J* = 8.0, 13.5 Hz, 1H), 2.32 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.15, 166.87, 149.82, 145.55, 144.76, 140.31, 139.05, 135.61, 130.14, 129.79, 129.15, 128.06, 127.00, 126.78, 125.26, 123.96, 57.18, 52.79, 52.16, 39.11, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_8S$ $[M-H]^-$: 511.1181. found: 511.1185.



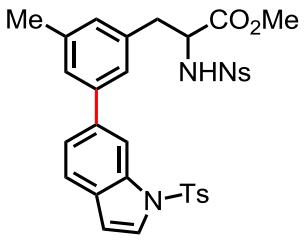
methyl 3-(4'-cyano-5-methyl-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jq

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.5 Hz, 2H), 7.84 (d, *J* = 9.0 Hz, 2H), 7.71 (d, *J* = 8.0 Hz, 2H), 7.60 (d, *J* = 8.0 Hz, 2H), 7.23 (s, 1H), 7.09 (s, 1H), 6.91 (s, 1H), 5.53 (d, *J* = 9.0 Hz, 1H, N-H), 4.33-4.28 (m, 1H), 3.64 (s, 3H), 3.17 (dd, *J* = 5.0, 13.5 Hz, 1H), 2.99 (dd, *J* = 7.5, 14.0 Hz, 1H), 2.33 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.07, 149.87, 145.52, 144.89, 139.49, 139.28, 135.84, 132.64, 130.31, 128.10, 127.52, 126.97, 125.30, 124.00, 118.77, 111.15, 57.07, 52.82, 39.08, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{20}N_3O_6S$ [M-H]$^-$: 478.1078. found: 478.1074.



methyl 3-(5-methyl-4'-(trifluoromethyl)-[1,1'-biphenyl]-3-yl)-2-(4-nitrophenylsulfonamido)propanoate 3jr

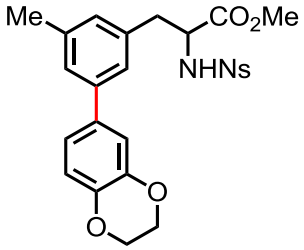
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.8 Hz, 2H), 7.82 (d, *J* = 8.8 Hz, 2H), 7.67 (d, *J* = 8.4 Hz, 2H), 7.59 (d, *J* = 8.4 Hz, 2H), 7.23 (s, 1H), 7.09 (s, 1H), 6.88 (s, 1H), 5.60 (m, *J* = 9.0 Hz, 1H, N-H), 4.32-4.28 (m, 1H), 3.65 (s, 3H), 3.16 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.95 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.31 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 171.25, 149.78, 145.46, 143.84, 140.00, 139.12, 135.69, 129.81, 129.54 (q, *J* = 32.5 Hz), 128.04, 127.15, 126.94, 125.75 (q, *J* = 3.7 Hz), 125.28, 124.17 (q, *J* = 270.6 Hz), 123.97, 57.16, 52.83, 38.98, 21.29.



methyl 3-(3-methyl-5-(1-tosyl-1H-indol-6-yl)phenyl)-2-(4-nitrophenylsulfonamido)propanoate 3js

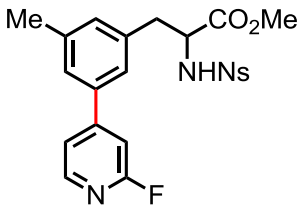
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.10 (d, *J* = 9.0 Hz, 2H), 8.02 (d, *J* = 8.5 Hz, 1H), 7.79 (d, *J* = 8.0 Hz, 2H), 7.77 (d, *J* = 8.5 Hz, 2H), 7.61 (d, *J* = 1.5 Hz, 1H), 7.59 (d, *J* = 3.5 Hz, 1H), 7.42 (dd, *J* = 1.5, 8.5 Hz, 1H), 7.26-7.21 (m, 3H), 7.04 (s, 1H), 6.78 (s, 1H), 6.69 (d, *J* = 1.5 Hz, 1H), 5.39 (d, *J* = 9.0 Hz, 1H, N-H), 4.31-4.26 (m, 1H), 3.65 (s, 3H), 3.13 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.93 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.34 (s, 3H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.22, 149.78, 145.53,

145.02, 141.61, 138.83, 135.89, 135.38, 135.28, 134.32, 131.32, 129.93, 128.65, 128.04, 127.07, 126.82, 125.31, 123.92, 123.80, 119.58, 113.81, 109.18, 57.27, 52.79, 39.18, 21.33. HRMS (ESI-TOF) *m/z* Calcd for $C_{32}H_{28}N_3O_8S_2$ $[M-H]^-$: 646.1323. found: 646.1323.



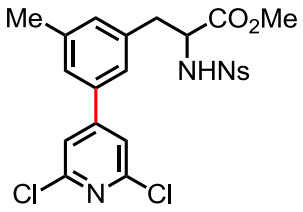
methyl 3-(3-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-5-methylphenyl)-2-(4-nitrophenylsulfonamido)propanoate 3jt

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.13 (dd, *J* = 2.0, 9.0 Hz, 2H), 7.77 (dd, *J* = 2.0, 9.0 Hz, 2H), 7.16 (s, 1H), 6.96-6.89 (m, 4H), 6.76 (s, 1H), 5.30 (d, *J* = 9.0 Hz, 1H, N-H), 4.30-4.26 (m, 5H), 3.68 (s, 3H), 3.11 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.90 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.28 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.27, 149.79, 145.50, 143.73, 143.38, 140.88, 138.79, 135.26, 133.74, 128.49, 128.05, 126.46, 124.52, 123.97, 119.78, 117.63, 115.53, 64.46, 64.42, 57.23, 52.82, 39.13, 21.35. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{23}N_2O_8S$ $[M-H]^-$: 511.1181. found: 511.1179.



methyl 3-(3-(2-fluoropyridin-4-yl)-5-methylphenyl)-2-(4-nitrophenylsulfonamido)propanoate 3ju

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (d, *J* = 5.5 Hz, 1H), 8.21 (d, *J* = 8.5 Hz, 2H), 7.87 (d, *J* = 8.5 Hz, 2H), 7.32 (d, *J* = 8.5 Hz, 1H), 7.28 (s, 1H), 7.14 (s, 1H), 7.05 (s, 1H), 6.98 (s, 1H), 5.55 (d, *J* = 9.0 Hz, 1H, N-H), 4.34-4.30 (m, 1H), 3.63 (s, 3H), 3.18 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.97 (dd, *J* = 7.5, 14.0 Hz, 1H), 2.35 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.94, 164.47 (d, *J* = 236.7 Hz), 153.46 (d, *J* = 7.8 Hz), 149.93, 148.10 (d, *J* = 15.2 Hz), 145.53, 139.49, 137.40, 136.02, 131.39, 128.14, 126.80, 125.16, 124.05, 119.33, 106.95 (d, *J* = 31.2 Hz), 56.99, 52.84, 39.10, 21.32. HRMS (ESI-TOF) *m/z* Calcd for $C_{22}H_{19}FN_3O_6S$ $[M-H]^-$: 472.0984. found: 472.0980.

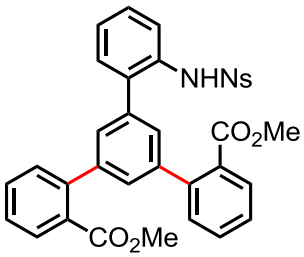


methyl 3-(3-(2,6-dichloropyridin-4-yl)-5-methylphenyl)-2-(4-nitrophenylsulfonamido)propanoate 3jv

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.5 Hz, 2H), 7.89 (d, *J* = 9.0 Hz, 2H), 7.39 (s, 2H), 7.26 (s, 1H), 7.11 (s, 1H), 7.01 (s, 1H), 5.42 (br, 1H, N-H), 4.32-4.30 (m, 1H), 3.62 (s, 3H), 3.18 (dd, *J* = 5.0, 14.0 Hz, 1H), 3.02 (dd, *J* = 7.5, 14.0 Hz, 1H), 2.36 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.84, 153.34, 151.10, 149.99, 145.45, 139.73, 136.19, 136.14, 131.93, 128.18, 126.86, 125.21, 124.11, 120.63, 56.88, 52.87, 39.10, 21.31. HRMS (ESI-TOF) *m/z* Calcd for $C_{22}H_{18}Cl_2N_3O_6S$ $[M-H]^-$: 522.0299. found: 522.0305.

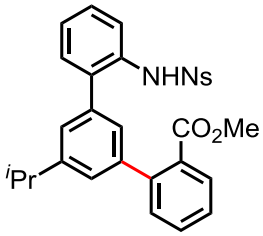
3.4 General Procedure for *meta*-C(sp^2)–HArylationof 2-Aryl Anilines (Tables 5).

The starting material **4** (0.10mmol), $Pd(OAc)_2$ (0.01mmol, 2.2 mg), and AgOAc (0.30mmol, 50.0 mg) were weighed in air and placed in a sealed tube (10 mL) with a magnetic stir bar. To the reaction mixture, 4-acetylpyridine (0.02 mmol, 2.2 μL), norbornene (0.15 mmol, 14.0 mg), aryl iodide **2** (0.3mmol), and TBME (1.0 mL) were added. The reaction mixture was heated to 80 °C for 24 hours under vigorous stirring.Upon completion, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, and filtered through a pad of celite. The filtrate was concentrated *in vacuo*, and the resulting residue purified by preparative TLC using an eluent of hexanes/ethyl acetate (2/1 to 4/1) to give the desired products **5**.



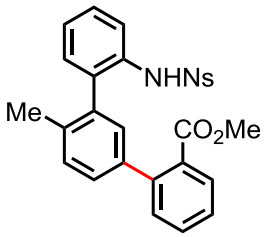
dimethyl5'-(2-(4-nitrophenylsulfonamido)phenyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 5a

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.0 Hz, 2H), 7.85 (d, *J* = 8.0 Hz, 2H), 7.81 (d, *J* = 9.0 Hz, 2H), 7.59 (d, *J* = 8.5 Hz, 2H), 7.55 (t, *J* = 7.5 Hz, 1H), 7.48-7.45 (m, 3H), 7.41 (t, *J* = 8.0 Hz, 1H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.25-7.23 (m, 2H), 7.19 (d, *J* = 8.0 Hz, 1H), 6.60 (s, 2H), 3.82 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.48, 149.62, 144.64, 141.51, 141.44, 135.89, 135.36, 133.31, 131.83, 130.42, 130.39, 129.95, 129.92, 128.91, 128.33, 128.07, 127.88, 127.83, 126.11, 124.53, 123.71, 52.44. HRMS (ESI-TOF) *m/z* Calcd for $C_{34}H_{25}N_2O_8S$ $[M-H]^-$: 621.1337. found: 621.1340.



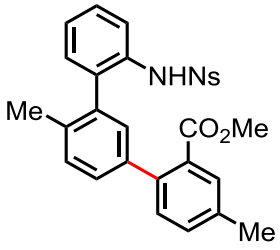
methyl 5'-isopropyl-2''-(4-nitrophenylsulfonamido)-[1,1':3',1''-terphenyl]-2-carboxylate5b

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95-7.92 (m, 3H), 7.82 (d, *J* = 8.0 Hz, 1H), 7.65 (d, *J* = 8.5 Hz, 2H), 7.56 (t, *J* = 7.5 Hz, 1H), 7.48 (t, *J* = 7.5 Hz, 1H), 7.40 (t, *J* = 8.0 Hz, 1H), 7.28-7.15 (m, 5H), 6.66 (s, 1H), 6.41 (s, 1H), 3.83 (s, 3H), 2.83-2.80 (m, 1H), 1.23 (d, *J* = 6.0 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.43, 149.94, 149.81, 144.78, 142.30, 141.36, 136.17, 135.27, 133.00, 131.76, 130.58, 130.28, 130.19, 129.82, 128.74, 128.29, 127.71, 126.73, 126.08, 125.96, 125.78, 123.79, 123.56, 52.50, 33.90, 23.85. HRMS (ESI-TOF) *m/z* Calcd for $C_{29}H_{25}N_2O_6S$ $[M-H]^-$: 529.1439. found: 529.1441.



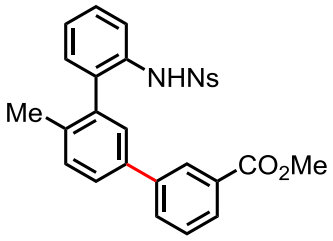
methyl 4'-methyl-2''-(4-nitrophenylsulfonamido)-[1,1':3',1''-terphenyl]-2-carboxylate 5c

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.0 Hz, 1H), 7.87-7.84 (m, 3H), 7.66 (d, *J* = 8.5 Hz, 2H), 7.54 (t, *J* = 7.5 Hz, 1H), 7.47 (t, *J* = 7.5 Hz, 1H), 7.40 (t, *J* = 8.0 Hz, 1H), 7.26-7.20 (m, 4H), 7.09 (d, *J* = 7.5 Hz, 1H), 6.92 (s, 1H), 6.31 (s, 1H), 3.83 (s, 3H), 1.75 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.61, 149.85, 144.98, 141.78, 138.83, 135.48, 135.21, 133.73, 133.18, 131.79, 130.59, 130.44, 130.28, 130.12, 129.86, 129.76, 128.79, 128.42, 128.32, 127.68, 125.70, 123.81, 123.40, 103.42, 52.49, 19.31. HRMS (ESI-TOF) *m/z* Calcd for $C_{27}H_{21}N_2O_6S$ [M-H]$^-$: 501.1126. found: 501.1126.



methyl 4,4'-dimethyl-2''-(4-nitrophenylsulfonamido)-[1,1':3',1''-terphenyl]-2-carboxylate 5d

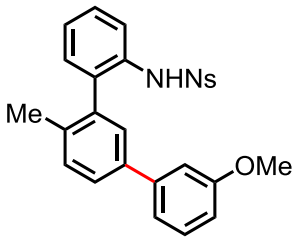
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.0 Hz, 1H), 7.81 (d, *J* = 9.0 Hz, 2H), 7.70 (s, 1H), 7.64 (d, *J* = 9.0 Hz, 2H), 7.40 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.33 (d, *J* = 7.5 Hz, 1H), 7.22 (t, *J* = 7.5 Hz, 1H), 7.21 (s, 2H), 7.12-7.08 (m, 2H), 6.82 (br, 1H), 6.18 (s, 1H), 3.80 (s, 3H), 2.48 (s, 3H), 1.77 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.87, 149.86, 144.88, 138.78, 137.81, 135.26, 135.21, 133.82, 133.21, 132.47, 130.69, 130.54, 130.27, 130.09, 129.82, 129.69, 128.79, 128.47, 128.30, 125.72, 123.81, 123.33, 52.40, 20.94, 19.30. HRMS (ESI-TOF) *m/z* Calcd for $C_{28}H_{23}N_2O_6S$ [M-H]$^-$: 515.1282. found: 515.1279.



methyl 4'-methyl-2''-(4-nitrophenylsulfonamido)-[1,1':3',1''-terphenyl]-3-carboxylate 5e

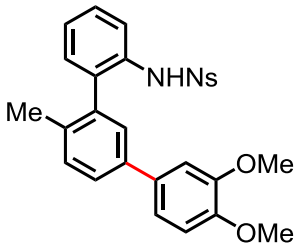
^{1}H NMR (500 MHz, $CDCl_3$) δ 8.07-8.05 (m, 2H), 7.92 (d, *J* = 8.5 Hz, 2H), 7.82 (d, *J* = 8.0 Hz, 1H), 7.65 (d, *J* = 9.0 Hz, 2H), 7.60 (d, *J* = 7.5 Hz, 1H), 7.56 (dd, *J* = 2.0, 8.0 Hz, 1H), 7.51 (t, *J* = 7.5 Hz, 1H), 7.43 (dt, *J* = 2.0, 7.5 Hz, 1H), 7.36 (d, *J* = 8.0 Hz, 1H),7.26 (t, *J* = 7.5 Hz, 1H), 7.13 (dd, *J* = 1.0, 7.5 Hz, 1H), 6.51 (d, *J* = 2.0 Hz, 1H), 6.30 (s, 1H), 3.97 (s, 3H), 1.96 (s, 3H); ^{13}C NMR (125

MHz, $CDCl_3$) 13C NMR (126 MHz, DMSO) δ 166.76, 149.95, 144.47, 140.03, 138.22, 136.37, 135.99, 133.09, 133.02, 131.48, 130.97, 130.90, 130.25, 129.13, 129.08, 128.81, 128.22, 127.81, 127.67, 127.47, 125.80, 124.02, 121.30, 52.32, 19.21. HRMS (ESI-TOF) *m/z* Calcd for $C_{27}H_{21}N_2O_6S$ $[M-H]^-$: 501.1126. found: 501.1128.



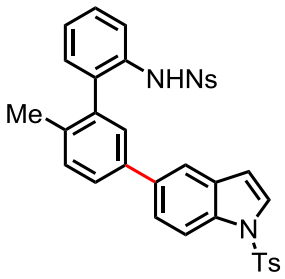
N-(3''-methoxy-6'-methyl-[1,1':3',1''-terphenyl]-2-yl)-4-nitrobenzenesulfonamide 5f

^1H NMR (500 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.5 Hz, 2H),7.83 (d, *J* = 8.5 Hz, 1H), 7.61 (d, *J* = 8.5 Hz, 2H), 7.50 (dd, *J*= 1.5, 8.0 Hz, 1H), 7.42 (t, *J* = 7.5 Hz, 1H), 7.34-7.31 (m, 2H),7.24 (t, *J* = 7.5 Hz, 1H), 7.12 (d, *J* = 6.5 Hz, 1H), 6.95-6.91 (m, 2H), 6.88 (s, 1H), 6.38 (s, 1H), 3.87 (s, 3H), 1.96 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 160.11, 150.01, 144.39, 141.23, 139.15, 136.07, 135.46, 133.38, 133.05, 131.28, 130.15, 130.04, 128.98, 128.15, 127.88, 127.43, 125.79, 124.03, 121.45, 118.99, 113.05, 112.37, 55.29, 19.17. HRMS (ESI-TOF) *m/z* Calcd for $C_{26}H_{21}N_2O_5S$ $[M-H]^-$: 473.1177. found: 473.1189.



N-(3'',4''-dimethoxy-6'-methyl-[1,1':3',1''-terphenyl]-2-yl)-4-nitrobenzenesulfonamide 5g

^1H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.8 Hz, 2H), 7.81 (d, *J* = 8.4 Hz, 1H), 7.63 (d, *J* = 8.8 Hz, 2H), 7.48 (dd, *J*= 1.6, 8.0 Hz, 1H), 7.42 (t, *J* = 7.2 Hz, 1H), 7.31 (d, *J* = 8.0 Hz, 1H), 7.25 (t, *J* = 7.6 Hz, 1H), 7.13 (d, *J* = 7.6 Hz, 1H), 6.97 (s, 1H), 6.90 (d, *J* = 8.4 Hz, 1H), 6.84 (dd, *J* = 1.6, 8.0 Hz, 1H), 6.39 (s, 1H), 6.30 (s, 1H), 3.97 (s, 3H), 3.95 (s, 3H), 1.92 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.99, 149.37, 149.01, 144.42, 139.20, 136.02, 134.75, 133.40, 133.06, 132.64, 131.25, 130.18, 128.94, 128.18, 127.49, 127.13, 125.73, 124.02, 121.34, 118.95, 111.56, 109.96, 56.04, 56.00, 19.12. HRMS (ESI-TOF) *m/z* Calcd for $C_{27}H_{23}N_2O_6S$ $[M-H]^-$: 503.1282. found: 503.1285.

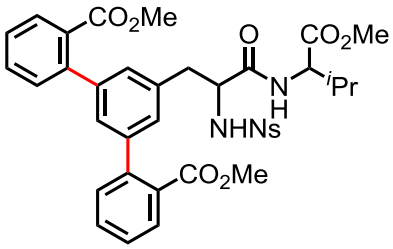


N-(2'-methyl-5'-(1-tosyl-1H-indol-6-yl)-[1,1'-biphenyl]-2-yl)-4-nitrobenzenesulfonamide 5h

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.5 Hz, 1H), 7.86-7.83 (m, 4H), 7.78 (d, *J* = 8.5 Hz, 1H), 7.63-7.61 (m, 3H), 7.52-7.50 (m, 2H), 7.40-7.35 (m, 2H), 7.32 (d, *J* = 8.0 Hz, 1H), 7.26-7.23 (m, 4H), 7.11 (dd, *J* = 1.5, 7.5 Hz, 1H), 6.67 (d, *J* = 3.5 Hz, 1H), 6.54 (s, 1H), 6.35 (s, 1H), 2.32 (s, 3H), 1.92 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 149.95, 145.00, 144.42, 139.43, 136.13, 135.27, 135.22, 135.02, 134.38, 133.27, 133.01, 131.40, 131.35, 130.26, 129.90, 128.94, 128.22, 127.88, 127.66, 127.29, 126.92, 125.71, 123.91, 123.50, 121.14, 119.26, 113.93, 108.94, 21.53, 19.11. HRMS (ESI-TOF) *m/z* Calcd for $C_{34}H_{26}N_3O_6S_2$ $[M-H]^-$: 636.1269. found: 636.1279.

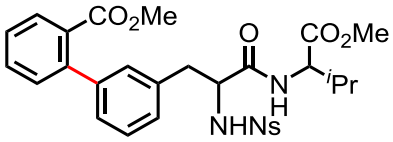
3.5 General Procedure for *meta*-C(sp^2)–H Arylation of *β*-Aryl Dipeptides 6 (Tables 5).

The starting material **6** (0.10 mmol), $Pd(OAc)_2$ (0.01 mmol, 2.2 mg), and AgOAc (0.30 mmol, 50.0 mg) were weighed in air and placed in a sealed tube (10 mL) with a magnetic stir bar. To the reaction mixture, 4-acetylpyridine (0.02 mmol, 2.2 μL), norbornene (0.02 mmol, 1.9 mg), aryl iodide **2** (0.3mmol), and TBME (1.0 mL) were added. The reaction mixture was heated to 80 °C for 24 hours under vigorous stirring. Upon completion, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, and filtered through a pad of celite. The filtrate was concentrated *in vacuo*, and the resulting residue purified by preparative TLC using an eluent of hexanes/ethyl acetate (2/1 to 4/1) to give the desired products **7**.



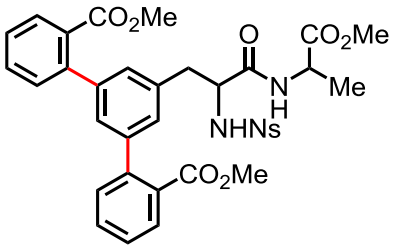
dimethyl 5'-(3-((1-methoxy-3-methyl-1-oxobutan-2-yl)amino)-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 7a(di)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (d, *J* = 9.0 Hz, 2H), 7.94 (d, *J* = 9.0 Hz, 2H), 7.90 (d, *J* = 7.0 Hz, 2H), 7.52 (t, *J* = 7.5 Hz, 2H), 7.42 (t, *J* = 7.0 Hz, 2H), 7.25 (d, *J* = 7.5 Hz, 2H), 7.18 (s, 1H), 6.99 (d, *J* = 1.0 Hz, 2H), 6.82 (d, *J* = 8.5 Hz, 1H), 5.91 (d, *J* = 6.0 Hz, 1H, N-H), 4.34-4.32 (m, 1H), 4.06-4.02 (m, 1H), 3.79 (s, 6H), 3.64 (s, 3H), 3.13-3.04 (m, 2H), 2.04-2.00 (m, 1H), 0.79 (d, *J* = 6.5 Hz, 3H), 0.77 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.78, 169.69, 168.53, 149.94, 145.00, 141.84, 141.43, 133.97, 131.66, 130.65, 130.35, 129.96, 128.63, 128.57, 127.62, 124.19, 58.75, 57.41, 52.31, 52.03, 39.24, 31.05, 18.71, 17.74. HRMS (ESI-TOF) *m/z* Calcd for $C_{37}H_{36}N_3O_{11}S$ $[M-H]^-$: 730.2076. found: 730.2075.



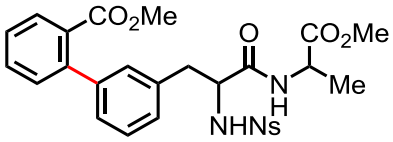
methyl 3'-(3-((1-methoxy-3-methyl-1-oxobutan-2-yl)amino)-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 7a(mono)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.17 (d, *J* = 9.0 Hz, 2H), 7.96 (d, *J* = 7.5 Hz, 1H), 8.87 (d, *J* = 8.5 Hz, 2H),7.56 (t, *J* = 7.5 Hz, 1H), 7.45 (t, *J* = 7.5 Hz, 1H), 7.30 (d, *J* = 7.5 Hz, 1H),7.18 (d, *J* = 7.5 Hz, 1H), 7.13-7.09 (m, 2H), 6.87 (d, *J* = 7.5 Hz, 1H), 6.76 (d, *J* = 8.5 Hz, 1H), 5.68 (d, *J* = 6.5 Hz, N-H), 4.37-4.35 (m, 1H), 3.99-3.94 (m, 1H), 3.85 (s, 3H), 3.70 (s, 3H), 3.12 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.95 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.08-2.02 (m, 1H), 0.83 (d, *J* = 7.0 Hz, 3H), 0.79 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.83, 169.64, 168.31, 149.96, 144.63, 142.45, 141.51, 134.36, 131.92, 130.85, 130.56, 130.36, 129.45, 128.82, 128.57, 127.60, 127.50, 127.33, 124.20, 58.86, 57.37, 52.41, 52.13, 39.24, 31.14, 18.77, 17.61. HRMS (ESI-TOF) *m/z* Calcd for $C_{29}H_{30}N_3O_9S$ $[M-H]^-$: 596.1708. found: 596.1710.



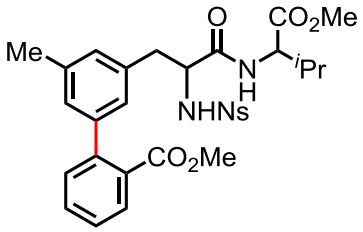
dimethyl 5'-(3-((1-methoxy-1-oxopropan-2-yl)amino)-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 7b(di)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.20 (d, *J* = 9.0 Hz, 2H), 7.99 (d, *J* = 8.5 Hz, 2H), 7.89 (dd, *J* = 1.5, 8.0 Hz, 2H), 7.52 (dt, *J* = 1.5, 7.5 Hz, 2H), 7.42 (dt, *J* = 1.5, 7.5 Hz, 2H), 7.28 (dd, *J* = 1.5, 7.5 Hz, 2H), 7.11 (s, 1H), 7.00 (d, *J* = 1.5 Hz, 2H), 6.75 (d, *J* = 7.5 Hz, 1H, N-H), 6.10 (d, *J* = 7.5 Hz, 1H, N-H), 4.35-4.32 (m, 1H), 4.17-4.14 (m, 1H), 3.75 (s, 6H), 3.60 (s, 3H), 3.25 (dd, *J* = 5.0, 14.0 Hz, 1H), 2.98 (dd, *J* = 7.0, 14.0 Hz, 1H), 1.15 (d, *J* = 7.5 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.40, 169.17, 168.50, 149.98, 145.68, 142.05, 141.44, 133.97, 131.65, 130.75, 130.24, 129.91, 128.72, 128.46, 127.57, 124.24, 58.04, 52.37, 52.25, 48.33, 38.88, 17.81. HRMS (ESI-TOF) *m/z* Calcd for $C_{35}H_{32}N_3O_{11}S$ $[M-H]^-$: 702.1763. found: 702.1769.



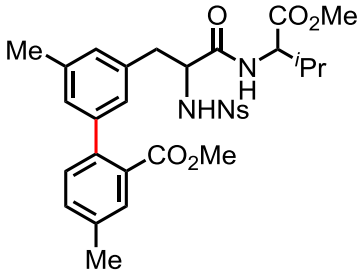
methyl 3'-(3-((1-methoxy-1-oxopropan-2-yl)amino)-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-[1,1'-biphenyl]-2-carboxylate 7b(mono)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.5 Hz, 2H), 7.93-7.90 (m, 3H), 7.55 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.44 (dt, *J* = 1.5, 8.0 Hz, 1H), 7.29 (d, *J* = 7.5 Hz, 1H), 7.15 (d, *J* = 5.0 Hz, 2H), 7.06 (s, 1H), 6.95-6.93 (m, 1H), 6.72 (d, *J* = 7.0 Hz, 1H, N-H), 5.91 (d, *J* = 7.5 Hz, 1H, N-H), 4.41-4.38 (m, 1H), 4.08-4.03 (m, 1H), 3.78 (s, 3H), 3.68 (s, 3H), 3.05 (d, *J* = 6.5 Hz, 2H), 1.24 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.45, 169.29, 168.39, 149.96, 145.27, 141.51, 134.41, 131.79, 130.79, 130.35, 130.05, 129.59, 128.60, 128.44, 127.93, 127.54, 127.31, 124.22, 58.24, 52.47, 52.30, 48.32, 38.94, 17.97. HRMS (ESI-TOF) *m/z* Calcd for $C_{27}H_{26}N_3O_9S$ $[M-H]^-$: 568.1395. found: 568.1395.



methyl 3'-(3-((1-methoxy-3-methyl-1-oxobutan-2-yl)amino)-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-5'-methyl-[1,1'-biphenyl]-2-carboxylate 7c

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (d, *J* = 9.0 Hz, 2H), 7.93 (d, *J* = 7.5 Hz, 1H), 7.87 (d, *J* = 9.0 Hz, 2H), 7.55 (t, *J* = 8.0 Hz, 1H), 7.43 (t, *J* = 7.5 Hz, 1H), 7.31 (d, *J* = 8.0 Hz, 1H), 7.00 (s, 1H), 6.90 (s, 1H), 6.81 (d, *J* = 8.5 Hz, 1H), 6.69 (s, 1H), 5.79 (d, *J* = 6.5 Hz, N-H), 4.39-4.36 (m, 1H), 3.95-3.91 (m, 1H), 3.85 (s, 3H), 3.70 (s, 3H), 3.07 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.89 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.16 (s, 3H), 2.08-2.04 (m, 1H), 0.84 (d, *J* = 7.0 Hz, 3H), 0.78 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.80, 169.74, 168.38, 149.87, 144.61, 141.43, 138.61, 134.36, 131.80, 130.75, 130.43, 129.54, 128.59, 128.29, 128.10, 127.45, 127.44, 124.02, 59.01, 57.33, 52.37, 52.09, 39.16, 31.13, 21.06, 18.66, 17.49. HRMS (ESI-TOF) *m/z* Calcd for $C_{30}H_{32}N_3O_9S$ $[M-H]^-$: 610.1865. found: 610.1863.



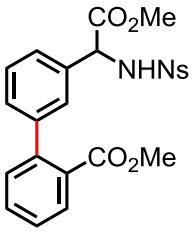
methyl 3'-(3-((1-methoxy-3-methyl-1-oxobutan-2-yl)amino)-2-(4-nitrophenylsulfonamido)-3-oxopropyl)-4,5'-dimethyl-[1,1'-biphenyl]-2-carboxylate 7d

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.5 Hz, 2H), 7.86 (d, *J* = 8.5 Hz, 2H), 7.73 (s, 1H), 7.35 (d, *J* = 7.5 Hz, 1H), 7.19 (d, *J* = 7.5 Hz, 1H), 6.97 (s, 1H), 6.86 (s, 1H), 6.82 (d, *J* = 9.0Hz, 1H), 6.66 (s, 1H), 5.78 (d, *J* = 6.0 Hz, N-H), 4.39-4.37 (m, 1H), 3.94-3.90 (m, 1H), 3.85 (s, 3H), 3.70 (s, 3H), 3.07 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.88 (dd, *J* = 8.0, 14.0 Hz, 1H), 2.44 (s 3H), 2.15 (s, 3H), 2.09-2.03 (m, 1H), 0.85 (d, *J* = 7.0 Hz, 3H), 0.79 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.84, 169.78, 168.57, 149.86, 144.56, 141.39, 139.58, 138.55, 137.41, 134.32, 132.52, 130.90, 130.63, 129.36, 128.59, 128.14, 128.10, 127.42, 124.03, 58.99, 57.32, 52.31, 52.09, 39.11, 31.13, 21.05, 20.92, 18.67, 17.49. HRMS (ESI-TOF) *m/z* Calcd for $C_{31}H_{34}N_3O_9S$ $[M-H]^-$: 624.2021.

found: 624.2022.

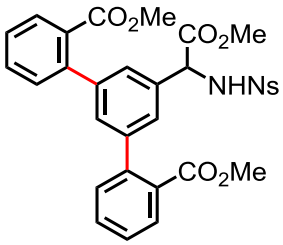
3.6 General Procedure for *meta*-C(sp^2)–H Arylation of Benzylamine 8 (Scheme 2).

Benylamine **8** (0.10 mmol), $Pd(OAc)_2$ (0.01 mmol, 2.2 mg), and AgOAc (0.30 mmol, 50.0 mg) were weighed in air and placed in a sealed tube (10 mL) with a magnetic stir bar. To the reaction mixture, pyridine (0.02 mmol, 1.6 μL), norbornene (0.15 mmol, 14.0 mg), aryl iodide **2** (0.3 mmol), and TBME (1.0 mL) were added. The reaction mixture was heated to 80 °C for 24 hours under vigorous stirring. Upon completion, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, and filtered through a pad of celite. The filtrate was concentrated *in vacuo*, and the resulting residue purified by preparative TLC using an eluent of hexanes/ethyl acetate(2/1 to 4/1) to give the desired products **9**.



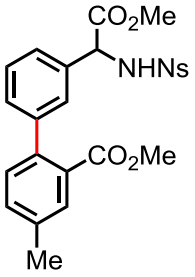
methyl 3'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-[1,1'-biphenyl]-2-carboxylate 9a(mono)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.8 Hz, 2H), 7.82 (d, *J* = 8.0 Hz, 3H), 7.51 (t, *J* = 7.6 Hz, 1H), 7.41 (t, *J* = 7.6 Hz, 1H), 7.21-7.16 (m, 3H), 7.13-7.09 (m, 2H), 6.24 (d, *J* = 6.8 Hz, 1H, N-H), 5.24 (d, *J* = 6.8 Hz, 1H), 3.68 (s, 3H), 3.66 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.02, 168.40, 149.72, 146.00, 141.97, 141.21, 134.29, 131.38, 130.47, 129.92, 128.84, 128.59, 128.25, 127.60, 125.93, 123.94, 59.46, 53.29, 52.02. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{19}N_2O_8S$ $[M-H]^-$: 483.0868. found: 483.0867.



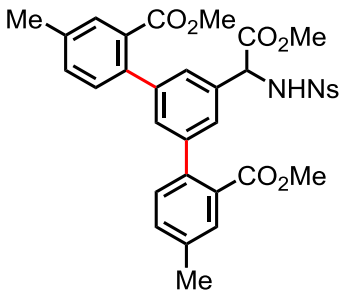
dimethyl 5'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 9a(di)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.8 Hz, 2H), 7.82-7.79 (m, 4H), 7.49 (t, *J* = 7.6 Hz, 2H), 7.41 (t, *J* = 7.6 Hz, 2H), 7.21 (s, 1H), 7.19 (d, *J* = 8.0 Hz, 2H), 7.04 (s, 2H), 6.27 (d, *J* = 6.8 Hz, 1H, N-H), 5.27 (d, *J* = 6.4 Hz, 1H), 3.69 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.94, 168.45, 149.73, 145.98, 141.78, 140.96, 133.99, 131.35, 130.56, 130.46, 129.92, 128.86, 128.34, 127.67, 126.34, 123.98, 59.41, 53.31, 52.02. HRMS (ESI-TOF) *m/z* Calcd for $C_{31}H_{25}N_2O_{10}S$ $[M-H]^-$: 617.1235. found: 617.1236.



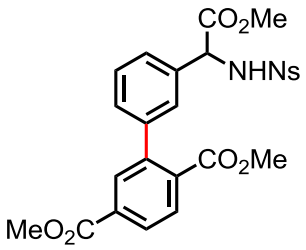
methyl 3'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-4-methyl-[1,1'-biphenyl]-2-carboxylate 9b(mono)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.8 Hz, 2H), 7.80 (d, *J* = 8.0 Hz, 2H), 7.63 (s, 1H), 7.31 (d, *J* = 8.0 Hz, 1H), 7.19 (d, *J* = 5.0 Hz, 2H), 7.08-7.05 (m, 3H), 6.03 (d, *J* = 7.0 Hz, 1H, N-H), 5.22 (d, *J* = 7.0 Hz, 1H), 3.67 (s, 6H), 2.42 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.05, 168.60, 149.77, 146.06, 142.01, 138.38, 137.69, 134.20, 132.12, 130.47, 130.41, 130.29, 128.93, 128.59, 128.26, 127.67, 125.78, 123.97, 59.48, 53.35, 52.00, 20.92. HRMS (ESI-TOF) *m/z* Calcd for $C_{24}H_{21}N_2O_8S$ $[M-H]^-$: 497.1024. found: 497.1030.



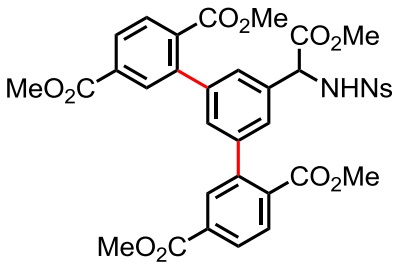
dimethyl 5'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-4,4''-dimethyl-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 9b(di)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.11 (d, *J* = 8.5 Hz, 2H), 7.80 (d, *J* = 9.0 Hz, 2H), 7.60 (s, 2H), 7.29 (d, *J* = 9.0 Hz, 1H), 7.16 (s, 1H), 7.07 (d, *J* = 7.5 Hz, 2H), 6.98 (s, 2H), 6.23 (d, *J* = 5.0 Hz, 1H, N-H), 5.26 (s, 1H), 3.69 (s, 3H), 3.68 (s, 6H), 2.41 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.99, 168.70, 149.71, 146.03, 141.69, 138.13, 137.65, 133.83, 132.04, 130.39, 130.35, 128.89, 128.32, 126.18, 123.97, 59.45, 53.27, 51.96, 20.88. HRMS (ESI-TOF) *m/z* Calcd for $C_{33}H_{29}N_2O_{10}S$ $[M-H]^-$: 645.1548. found: 645.1554.



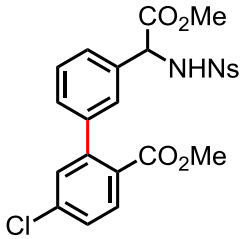
dimethyl 3'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-[1,1'-biphenyl]-2,5-dicarboxylate 9c(mono)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.17 (d, *J* = 9.0 Hz, 2H), 8.06 (dd, *J* = 1.8, 8.5 Hz, 1H), 7.87 -7.81 (m, 4H), 7.25-7.23 (m, 2H), 7.14-7.13 (m, 2H), 6.05 (br, 1H, N-H), 5.24 (s, 1H), 3.97 (s, 3H), 3.72 (s, 3H), 3.68 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.96, 167.82, 165.91, 149.79, 145.99, 141.27, 140.98, 134.65, 134.50, 132.58, 131.39, 129.94, 128.90, 128.79, 128.55, 128.26, 128.23, 127.53, 126.41, 124.00, 59.41, 53.39, 52.56, 52.35. HRMS (ESI-TOF) *m/z* Calcd for $C_{25}H_{21}N_2O_{10}S$ $[M-H]^-$: 541.0922 found: 541.0935.



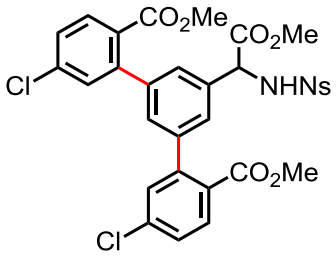
tetramethyl 5'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-[1,1':3',1''-terphenyl]-2,2'',5,5''-tetracarboxylate 9c(di)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.18 (d, *J* = 9.0 Hz, 2H), 8.07 (dd, *J* = 1.8, 8.5 Hz, 2H), 7.87 -7.83 (m, 6H), 7.23 (s, 1H), 7.11 (s, 2H), 6.05 (br, 1H, N-H), 5.28 (s, 1H), 3.97 (s, 6H), 3.76 (s, 6H), 3.72 (s, 3H), 2.63 (s, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.85, 167.81, 165.83, 149.86, 145.92, 141.01, 140.85, 134.70, 134.59, 132.65, 131.33, 130.02, 128.97, 128.74, 128.33, 126.71, 124.11, 59.31, 53.49, 52.57, 52.42. HRMS (ESI-TOF) *m/z* Calcd for $C_{35}H_{29}N_2O_{14}S$ $[M-H]^-$: 733.1345. found: 733.1344.



methyl 5-chloro-3'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-[1,1'-biphenyl]-2-carboxylate 9d (mono)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.19 (d, *J* = 9.0 Hz, 2H), 7.84 (d, *J* = 9.0 Hz, 2H), 7.81 (d, *J* = 8.0 Hz, 1H),7.40 (dd, *J* = 2.0, 8.5 Hz, 1H), 7.24-7.17 (m, 3H), 7.13-7.11 (m, 2H), 6.02 (d, *J* = 6.5 Hz, 1H, N-H), 5.23 (d, *J* = 6.5 Hz, 1H), 3.70 (s, 3H), 3.68 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.98, 167.30, 149.87, 145.99, 143.29, 140.87, 137.61, 134.61, 131.55, 130.67, 128.90, 128.70, 128.31, 127.79, 127.52, 126.35, 124.08, 59.38, 53.42, 52.19. HRMS (ESI-TOF) *m/z* Calcd for $C_{23}H_{18}ClN_2O_8S$ $[M-H]^-$: 517.0478. found: 517.0480.

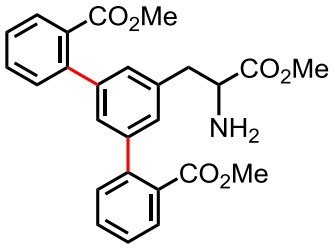


dimethyl 5,5''-dichloro-5'-(2-methoxy-1-(4-nitrophenylsulfonamido)-2-oxoethyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 9d(di)

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.22 (d, *J* = 9.0 Hz, 2H), 7.87 (d, *J* = 8.5 Hz, 2H), 7.81 (d, *J* = 8.5 Hz, 2H), 7.40 (dd, *J* = 2.0, 8.5 Hz, 2H), 7.16-7.10 (m, 3H), 7.09 (d, *J* = 1.2, 2H), 6.08 (d, *J* = 6.5 Hz, 1H, N-H), 5.27 (d, *J* = 6.5 Hz, 1H), 3.71 (s, 6H), 3.70 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.88, 167.27, 149.92, 145.94, 142.85, 140.74, 137.68, 134.58, 131.62, 130.65, 128.93, 128.71, 128.40, 127.95, 126.62, 124.19, 59.25, 53.48, 52.23. HRMS (ESI-TOF) *m/z* Calcd for $C_{31}H_{23}Cl_2N_2O_{10}S$ $[M-H]^-$: 685.0456. found: 685.685.0452.

3.7 Procedure for deprotection (Scheme 4).

4-Methoxybenzenethiol (PMP-SH, 4.0 mmol, 4.0 equiv) and potassium carbonate (4.0 mmol, 4.0 equiv) were added to a solution of diarylation product **3aa** (1.0mmol, 1.0 equiv) in MeCN (8.0 mL) and DMSO (0.3 mL). After being stirred at room temperature for 12 h the reaction mixture was diluted with EtOAc, washed with H_2O and brine, dried over anhydrous Na_2SO_4, filtered, and concentrated under vacuum. The residue was purified by column chromatography on silica gel (eluent: EtOAc/hexanes = 1: 1) to give **10** in 94% yield.



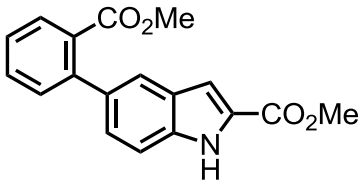
dimethyl 5'-(2-amino-3-methoxy-3-oxopropyl)-[1,1':3',1''-terphenyl]-2,2''-dicarboxylate 10

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 7.6 Hz, 2H), 7.51 (t, *J* = 7.6 Hz, 2H), 7.39 (t, *J* = 7.6 Hz, 4H), 7.16 (s, 1H), 7.13 (s, 2H), 3.79-3.76 (m, 1H), 3.71 (s, 3H), 3.68 (s, 6H), 3.17 (dd, *J* = 5.2, 13.6 Hz, 1H), 2.92 (dd, *J* = 8.0, 13.6 Hz, 1H), 1.64 (br, 2H, NH_2); ^{13}C NMR (100 MHz, $CDCl_3$)δ

175.04, 168.75, 141.88, 141.33, 136.54, 131.10, 130.75, 130.55, 129.68, 128.17, 127.15, 126.75, 55.73, 51.85, 51.84, 40.95. HRMS (ESI-TOF) *m/z* Calcd for $C_{26}H_{26}NO_6$ $[M+H]^+$: 448.1755. found: 448.1758.

3.8 Procedure for Application (Scheme 5).

The starting material **3da** (1.0 mmol, 57.6 mg), CuI (0.01 mmol, 1.9 mg), CsOAc (2.0 mmol, 38.4 mg), and DMSO (2 mL) were added in a sealed tube (10 mL) under N_2 with a magnetic stir bar. The reaction mixture was heated to 90 ℃ for 36 hours with vigorous stirring. Upon completion, the reaction mixture was cooled to room temperature, diluted with ethyl acetate and saturated NH_4Cl, the organic layer was washed with brine, dried over Na_2SO_4 and concentrated *in vacuo*. The residue was purified by column chromatography on silica gel using an eluent of hexanes/ethyl acetate (8/1) to give the desired product **11**.



methyl 5-(2-(methoxycarbonyl)phenyl)-1H-indole-2-carboxylate 11

^{1}H NMR (500 MHz, $CDCl_3$) δ 9.02 (br, 1H, NH), 7.82 (dd, *J* = 1.0, 9.0 Hz, 1H), 7.64 (s, 1H), 7.53 (dt, *J* = 1.5, 7.5 Hz, 1H), 7.44-7.38 (m, 3H), 7.28 (dd, *J* = 1.5, 8.5 Hz, 1H), 7.24 (d, *J* = 1.0 Hz, 1H), 3.95 (s, 3H), 3.61 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.40, 162.33, 142.83, 136.14, 134.24, 131.17, 131.09, 129.71, 127.63, 127.47, 126.83, 126.66, 121.87, 111.38, 109.06, 52.03, 51.95. HRMS (ESI-TOF) *m/z* Calcd for $C_{18}H_{16}NO_4$ $[M+H]^+$: 310.1074. found: 310.1070.

4. References:

(1) Di Gioia, M. L.; Leggio, A.; Le Pera, A.; Liguori, A.; Napoli, A.; Siciliano, C.; Sindona,

G. *J. Org. Chem.* **2003**, *68*, 7416.

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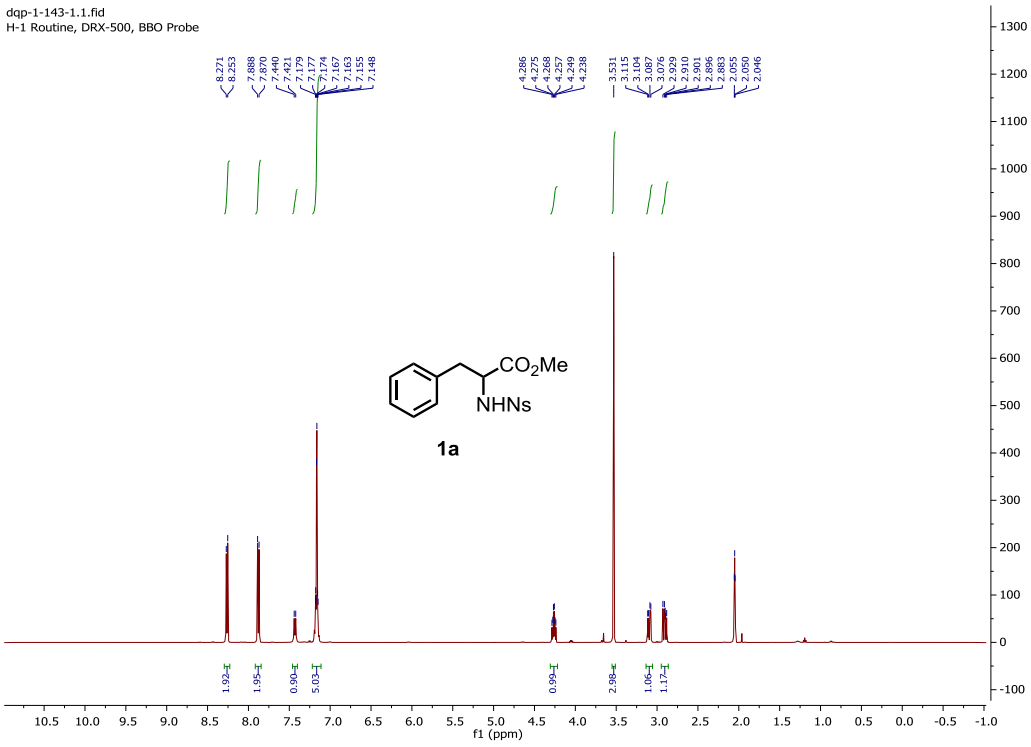
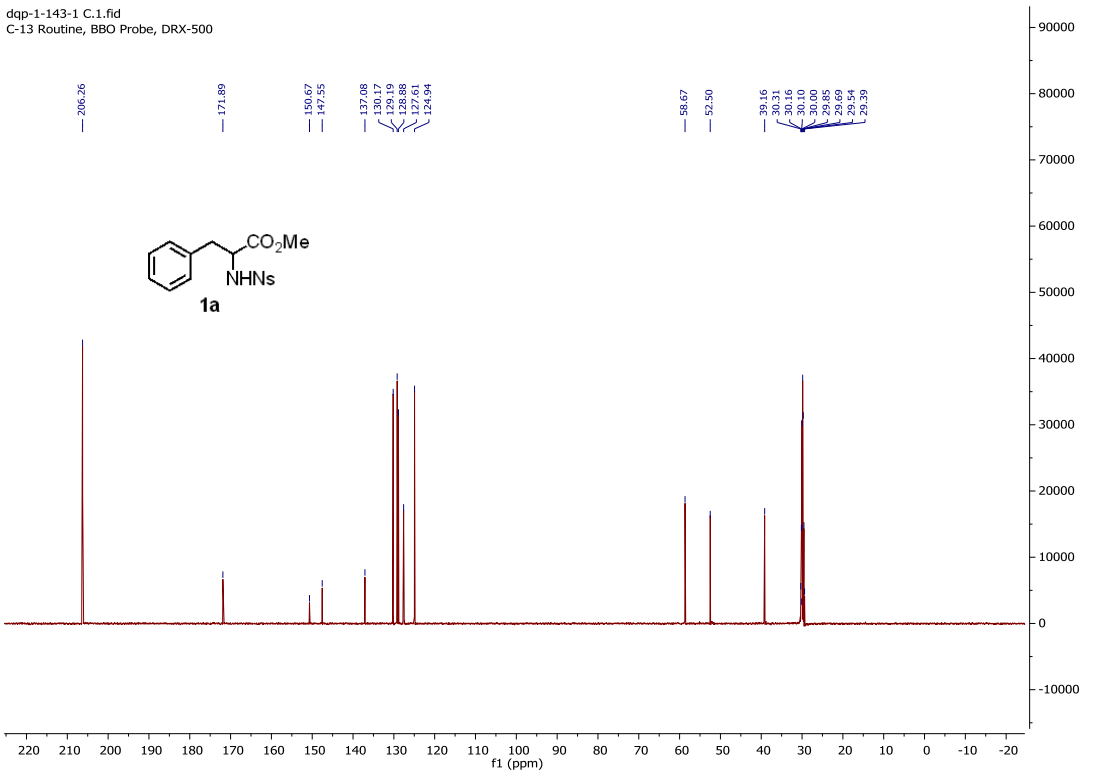
(6) Pegoraro, S.; Lang, M.; Dreker, T.; Kraus, J.; Hamm, S.; Meere, C.; Feurle, J.; Tasler, S.; Prütting, S.; Kuras, Z.; Visan, V.; Grissmer, S. *Bioorg. Med. Chem. Lett.* **2009**, *19*, 2299.

5. ^{1}H and ^{13}C NMR Spectra

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150.67
147.55
137.08
130.17
129.19
128.88
127.61
124.94
58.67
52.50
39.16
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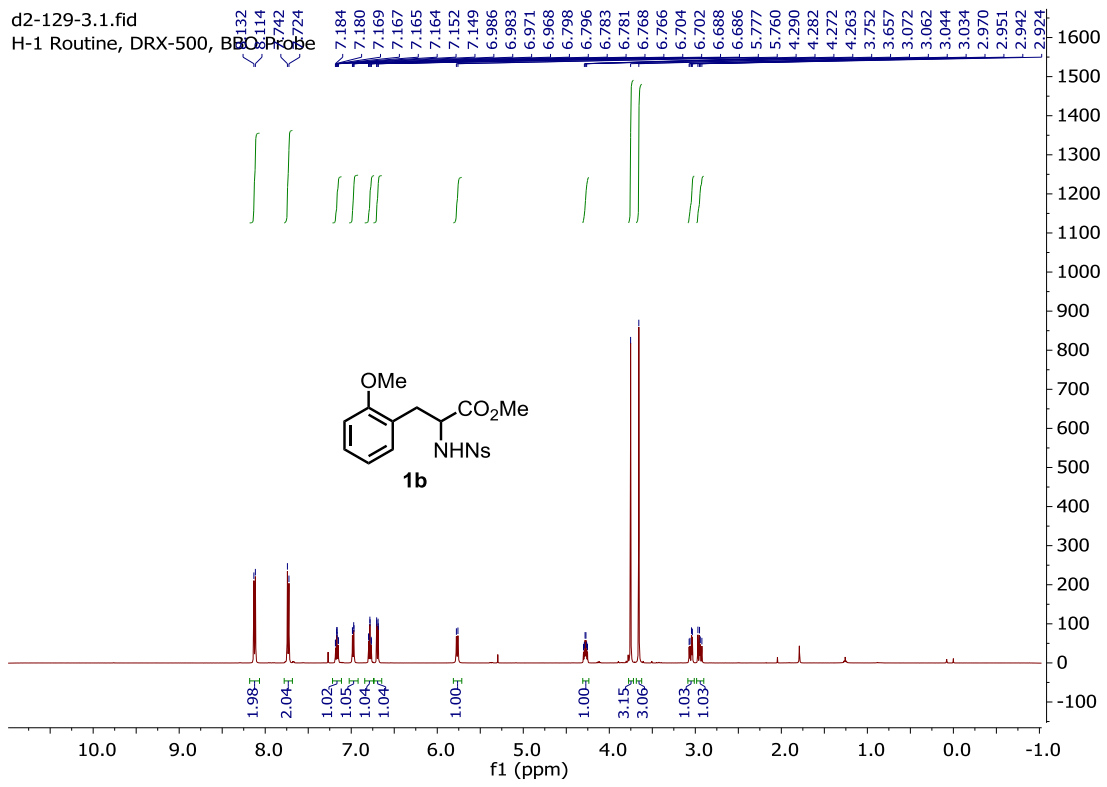
29.54
29.39
CO2Me
NHNs
1a
f1 (ppm)


d2-129-3.1.fid
H-1 Routine, DRX-500, BBO Probe
OMe
CO2Me
NHNs
1b
1.98
2.04
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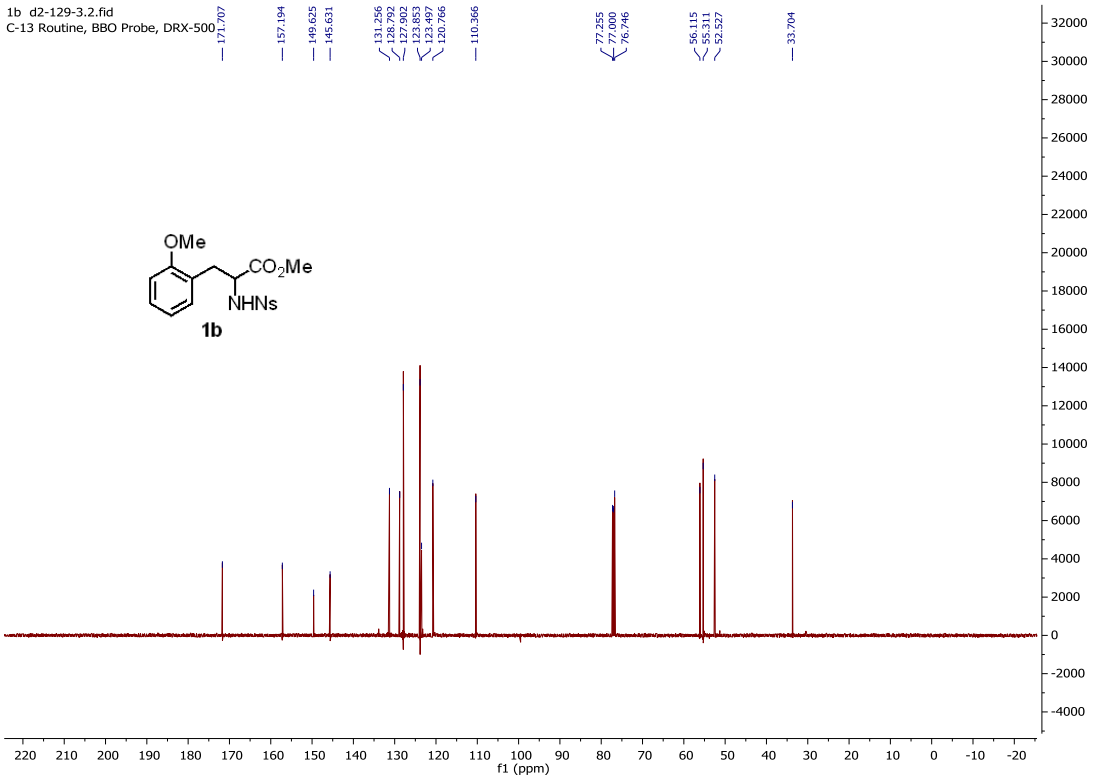
1.00
3.15
3.06
1.03
1.03
f1 (ppm)


1b d2-129-3.2.fid
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145.631
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127.902
123.853
123.497
120.766
110.366
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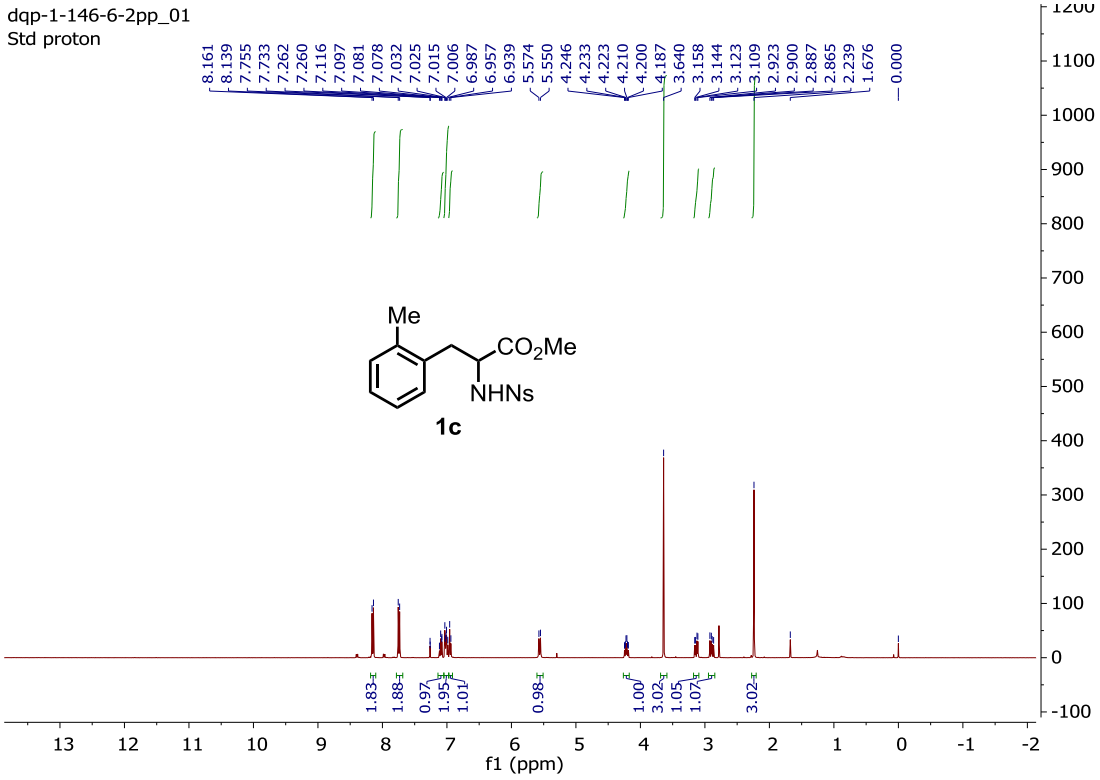
33.704
OMe
CO2Me
NHNs
1b
f1 (ppm)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7.260
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7.081
7.078
7.032
7.025
7.015
7.006
6.987
6.957
6.939
5.574
5.550
4.246
4.233
4.223
4.210
4.200
4.187
3.640
3.158
3.144
3.123
3.109
2.923
2.900
2.887
2.865
2.239
1.676
0.000
Me
CO2Me
NHNs
1c
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1.95
1.01
0.98
1.00
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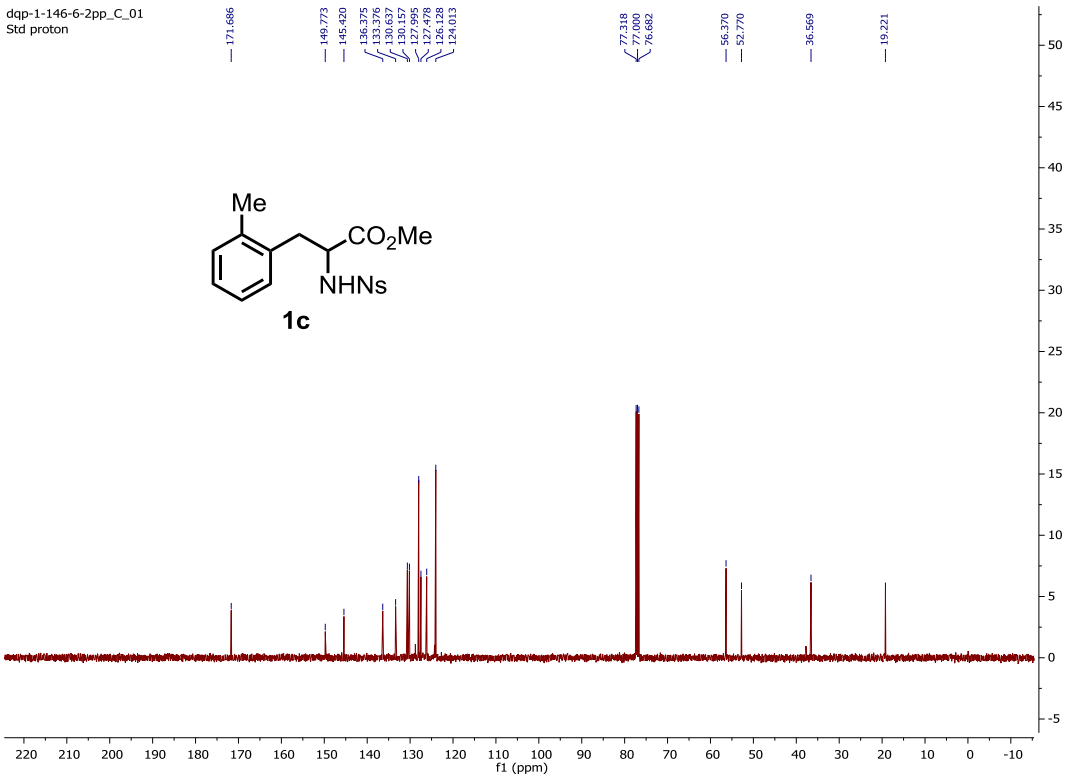
1.05
1.07
3.02
f1 (ppm)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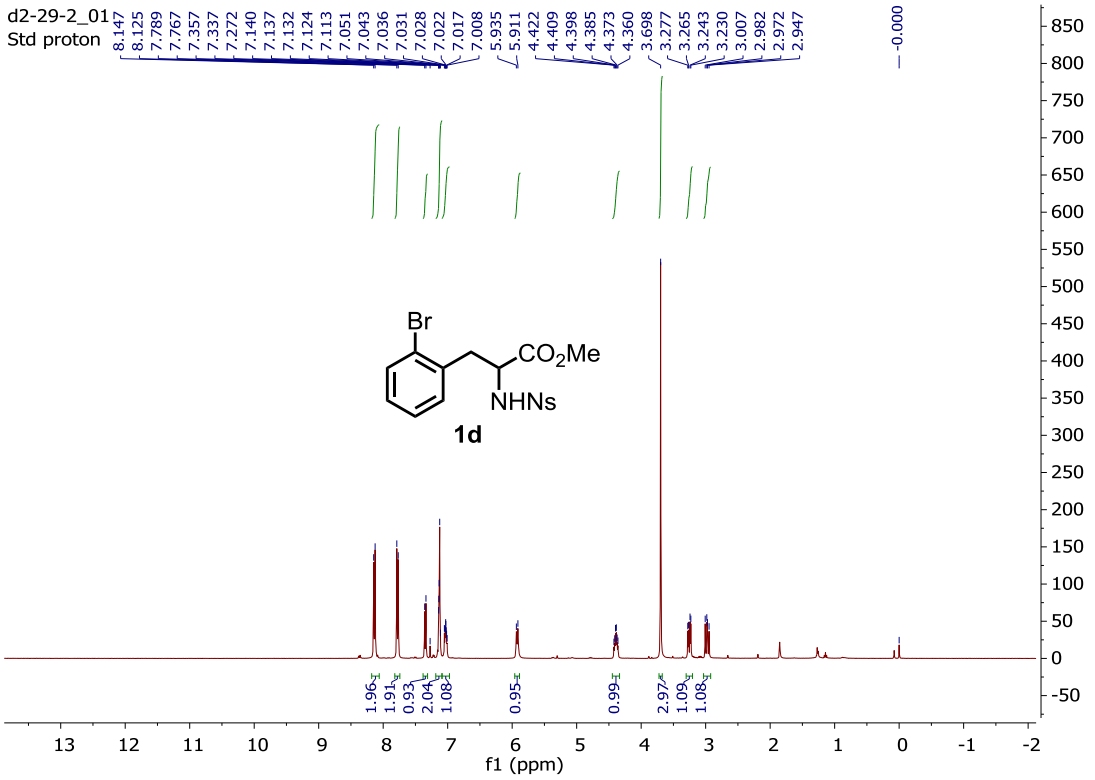
Me
CO2Me
NHNs
1c
f1 (ppm)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Std proton
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7.357
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7.132
7.124
7.113
7.051
7.043
7.036
7.031
7.028
7.022
7.017
7.008
5.935
5.911
4.422
4.409
4.398
4.385
4.373
4.360
3.698
3.277
3.265
3.243
3.230
3.007
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2.972
2.947
-0.000
Br
CO2Me
NHNs
1d
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0.93
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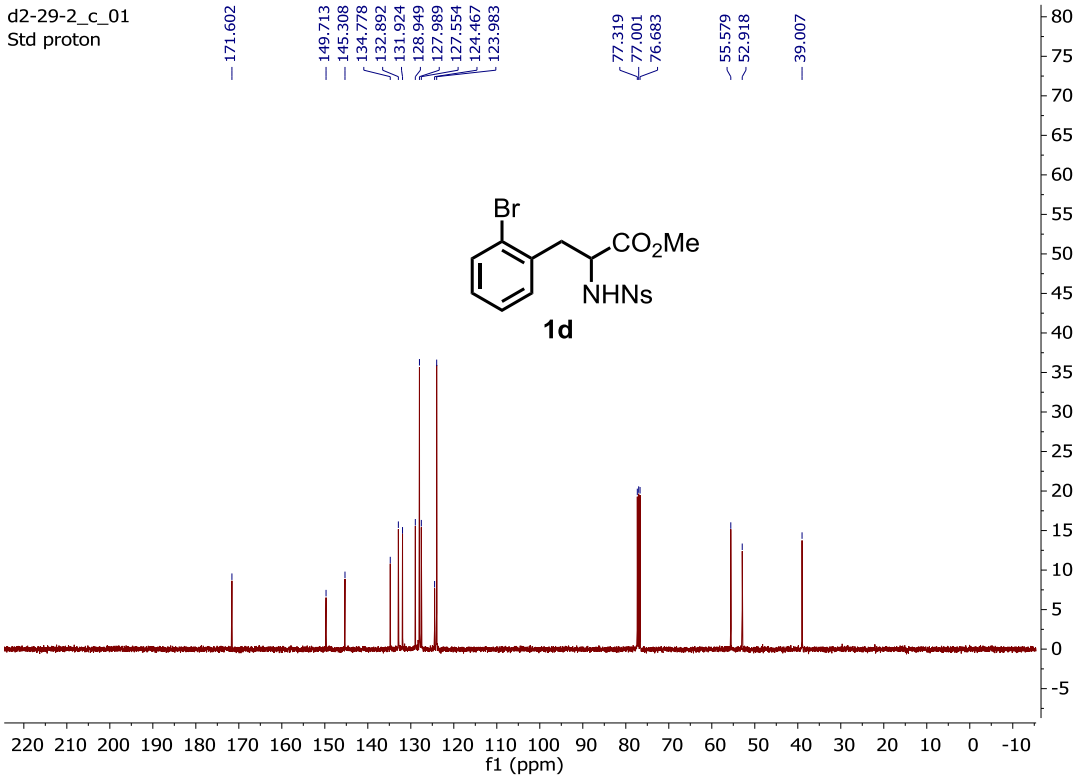
1.08
0.95
0.99
2.97
1.09
1.08
f1 (ppm)


d2-29-2_c_01
Std proton
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128.949
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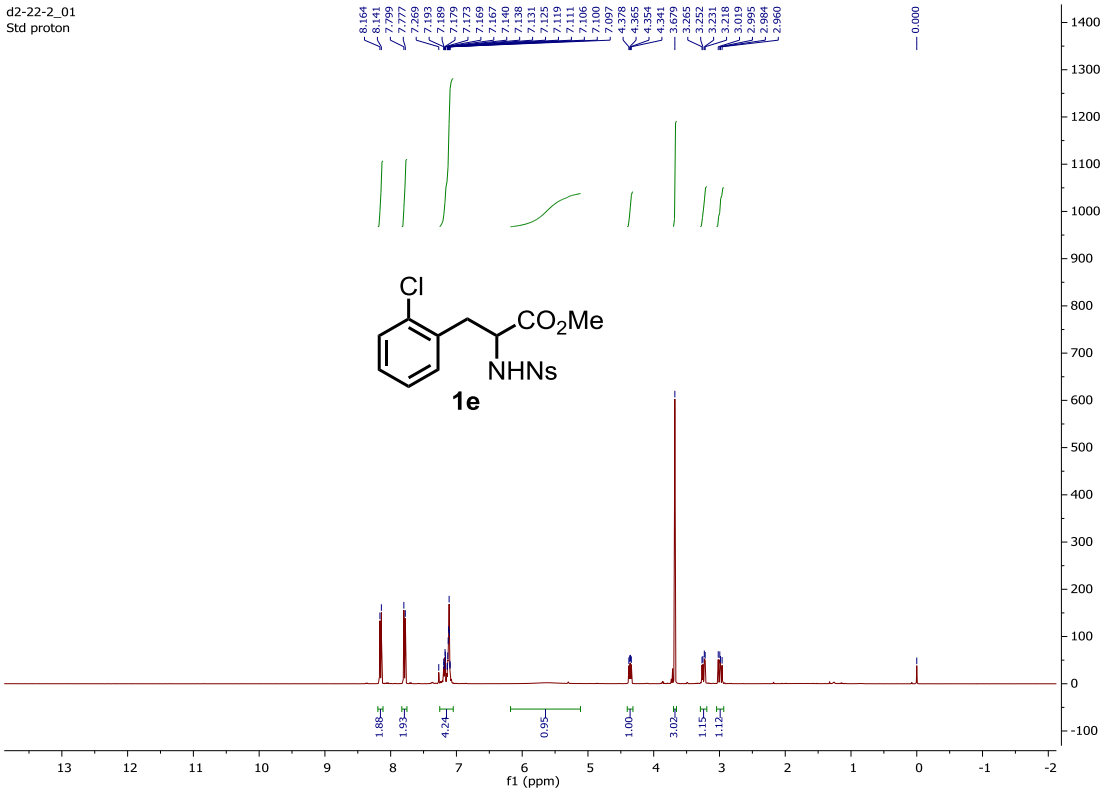
39.007
Br
CO2Me
NHNs
1d
f1 (ppm)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7.799
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7.269
7.193
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7.173
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7.167
7.140
7.138
7.131
7.125
7.119
7.111
7.106
7.100
7.097
4.378
4.365
4.354
4.341
3.265
3.252
3.231
3.218
3.019
2.995
2.984
2.960
0.000
Cl
CO2Me
NHNs
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4.24
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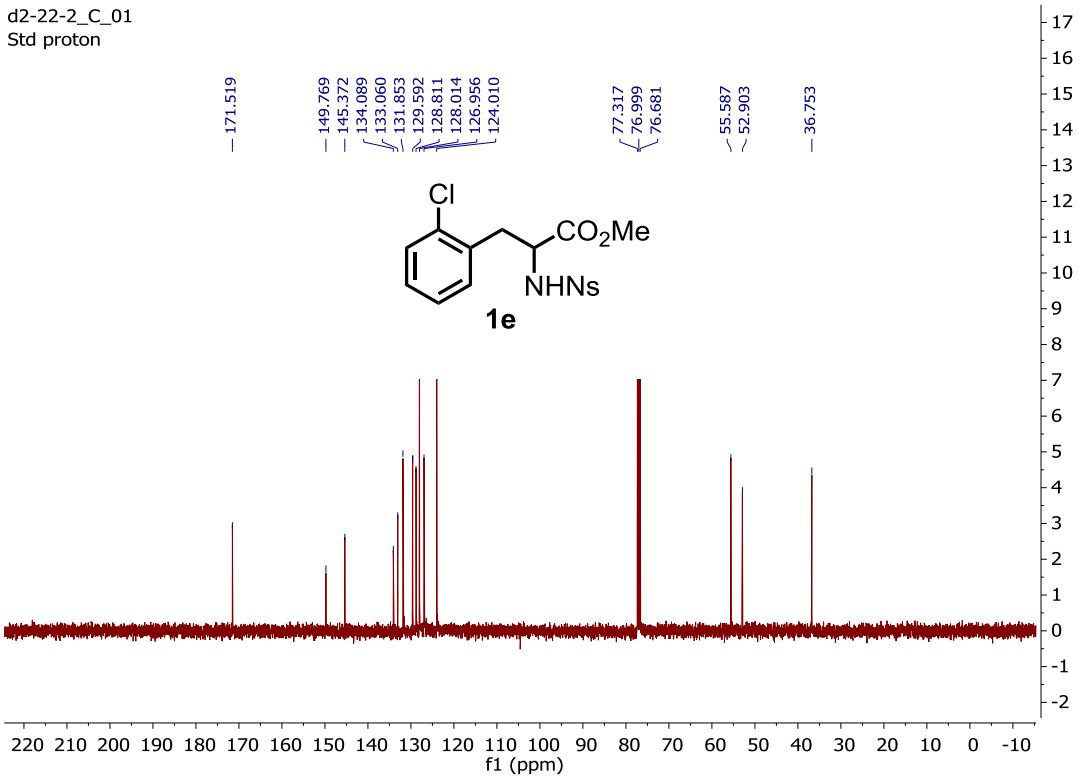
1.00
3.02
1.15
1.12
f1 (ppm)


d2-22-2_C_01
Std proton
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133.060
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129.592
128.811
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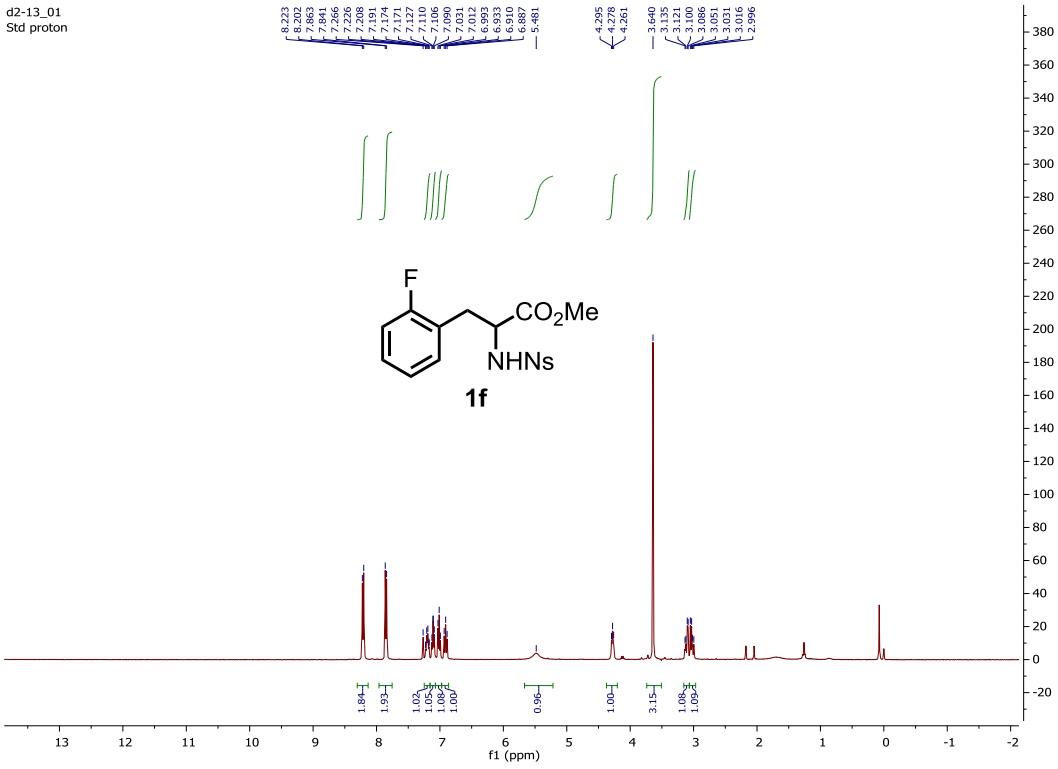
36.753
Cl
CO2Me
NHNs
1e
f1 (ppm)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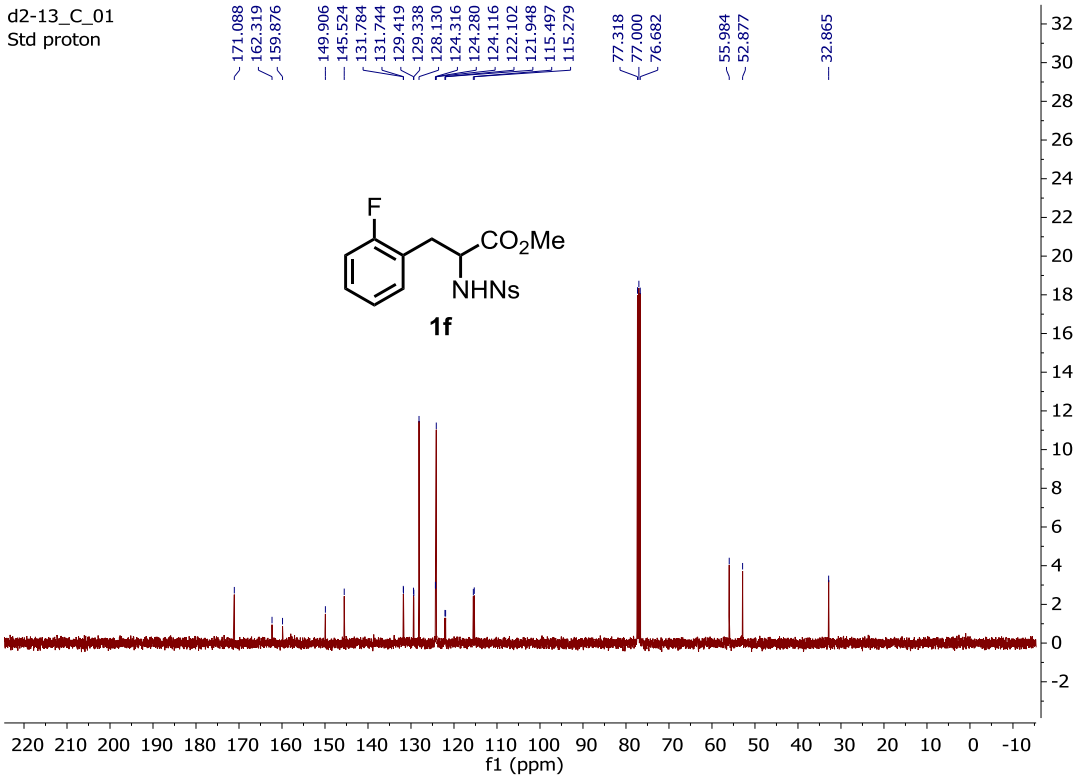
Std proton
F
CO2Me
NHNs
1f
f1 (ppm)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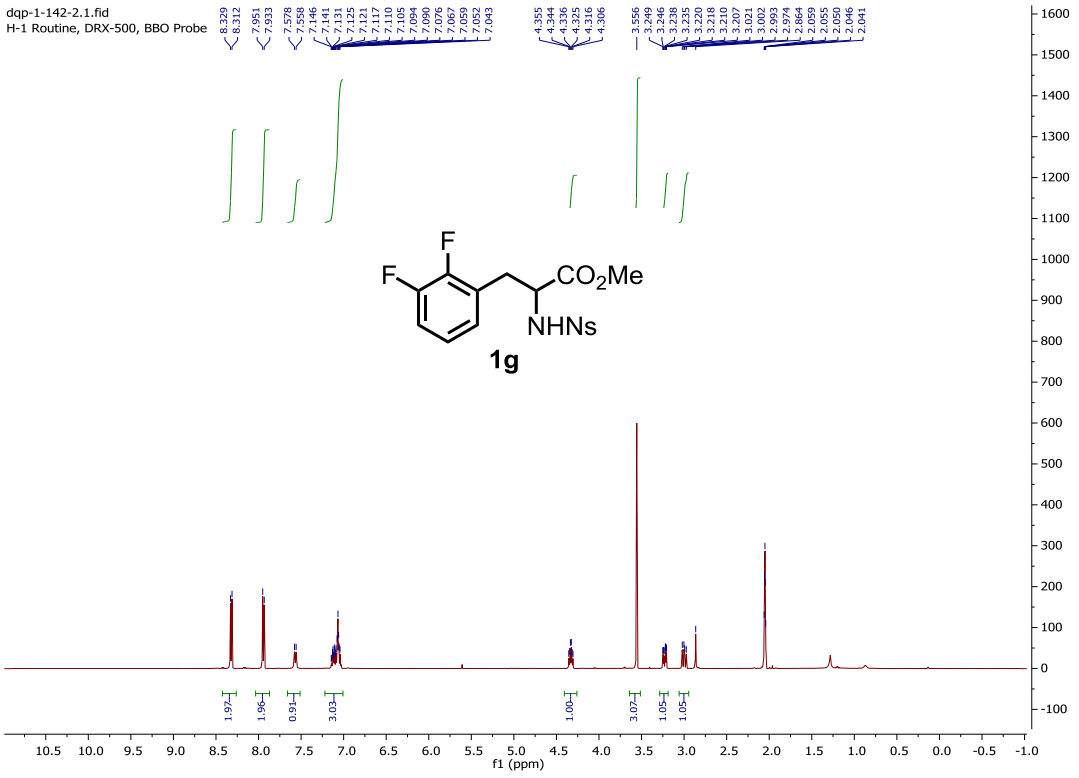
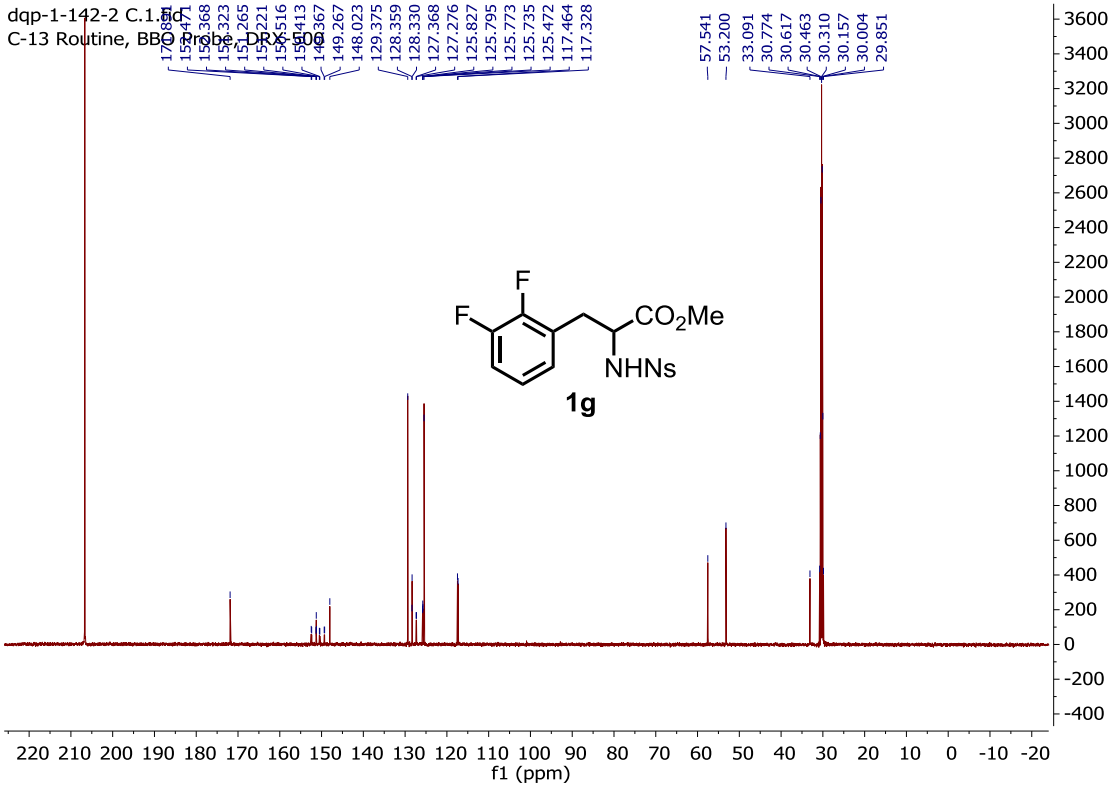
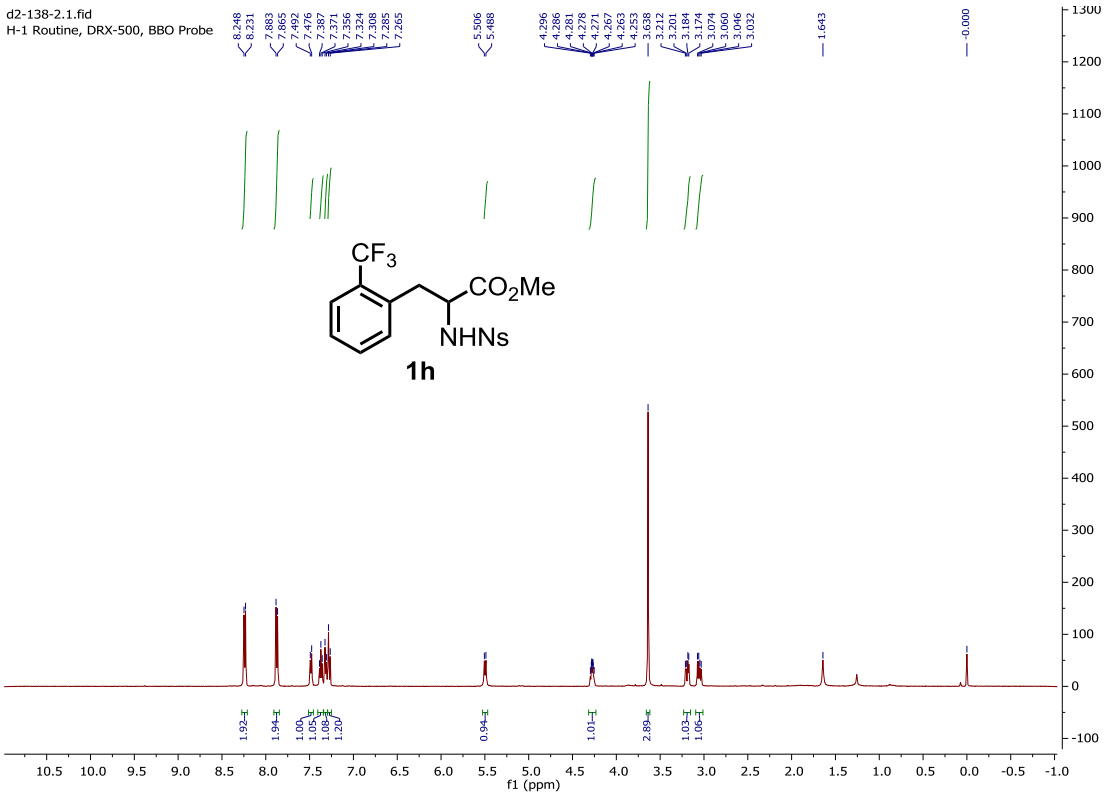
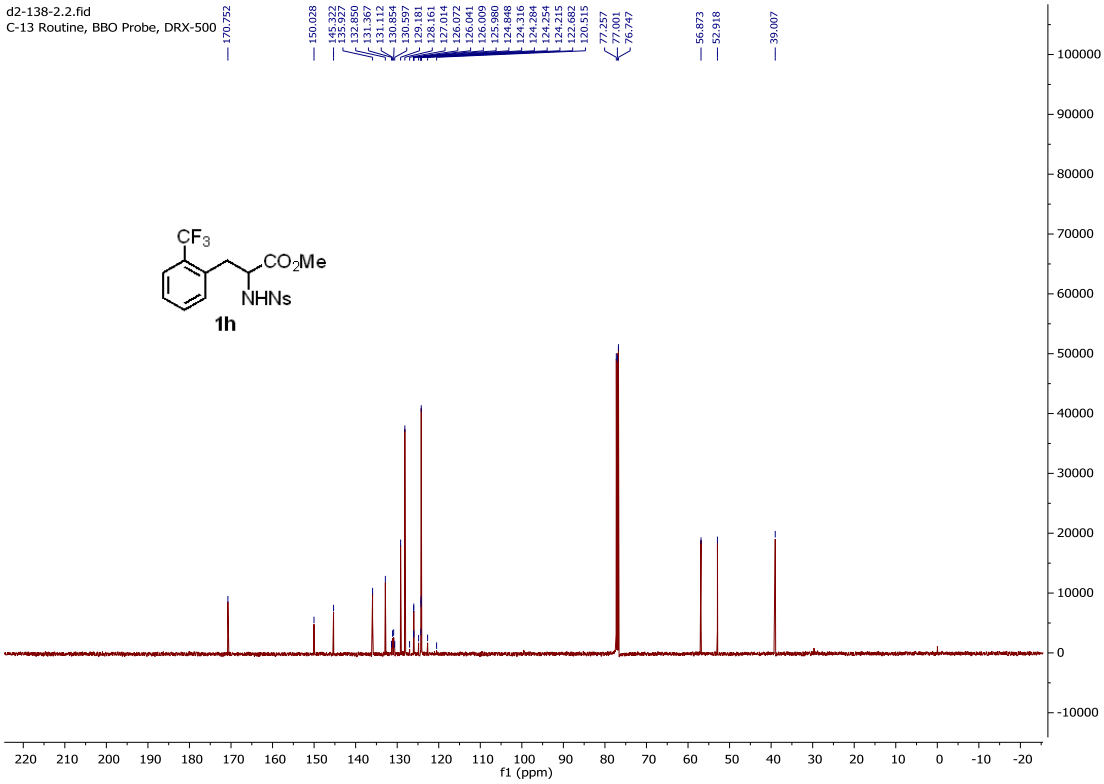
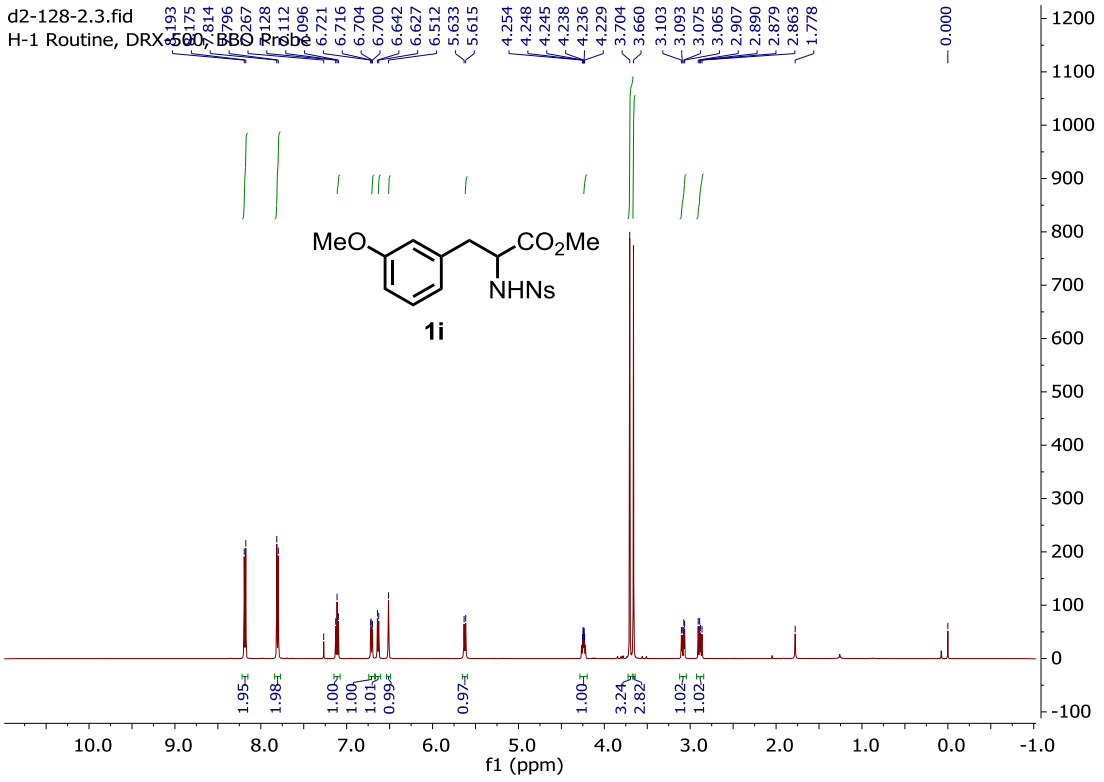
124.116
122.102
121.948
115.497
115.279
77.318
77.000
76.682
55.984
52.877
32.865
F
CO2Me
NHNs
1f
f1 (ppm)

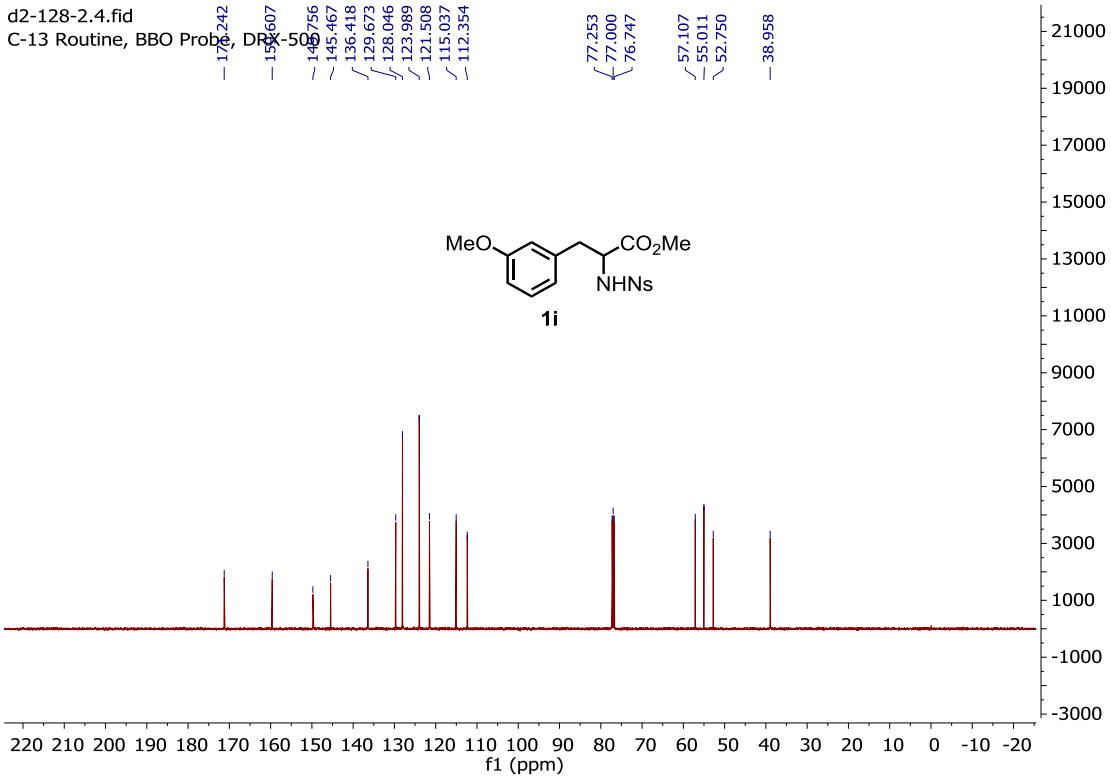

dqp-1-142-2.1.fid
H-1 Routine, DRX-500, BBO Probe
F
F
CO2Me
NHNs
1g
1.97
1.96
0.91
3.03
1.00
3.07
1.05
1.05
f1 (ppm)

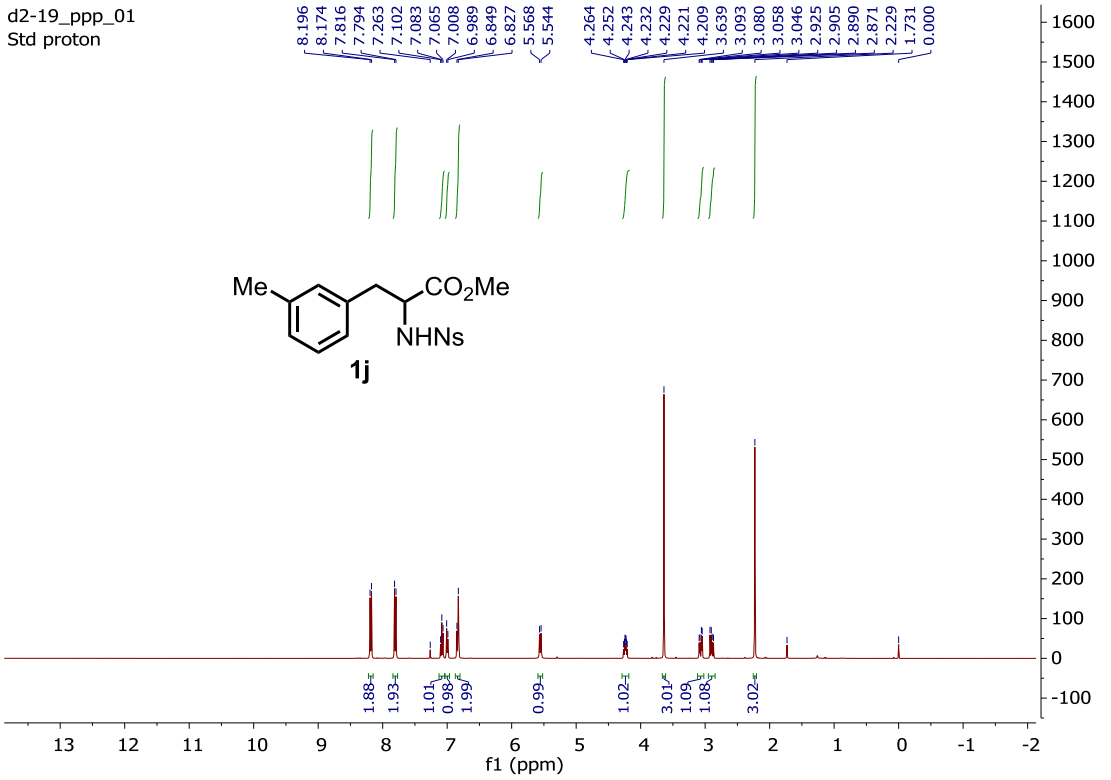

dqp-1-142-2 C.1.fid
C-13 Routine, BBO Probe, DRX-500
170.889
152.471
150.368
150.323
150.265
150.221
150.516
150.413
149.367
149.267
148.023
129.375
128.359
128.330
127.368
127.276
125.827
125.795
125.773
125.735
125.472
117.464
117.328
57.541
53.200
33.091
30.774
30.617
30.463
30.310
30.157
30.004
29.851
F
F
CO2Me
NHNs
1g
f1 (ppm)

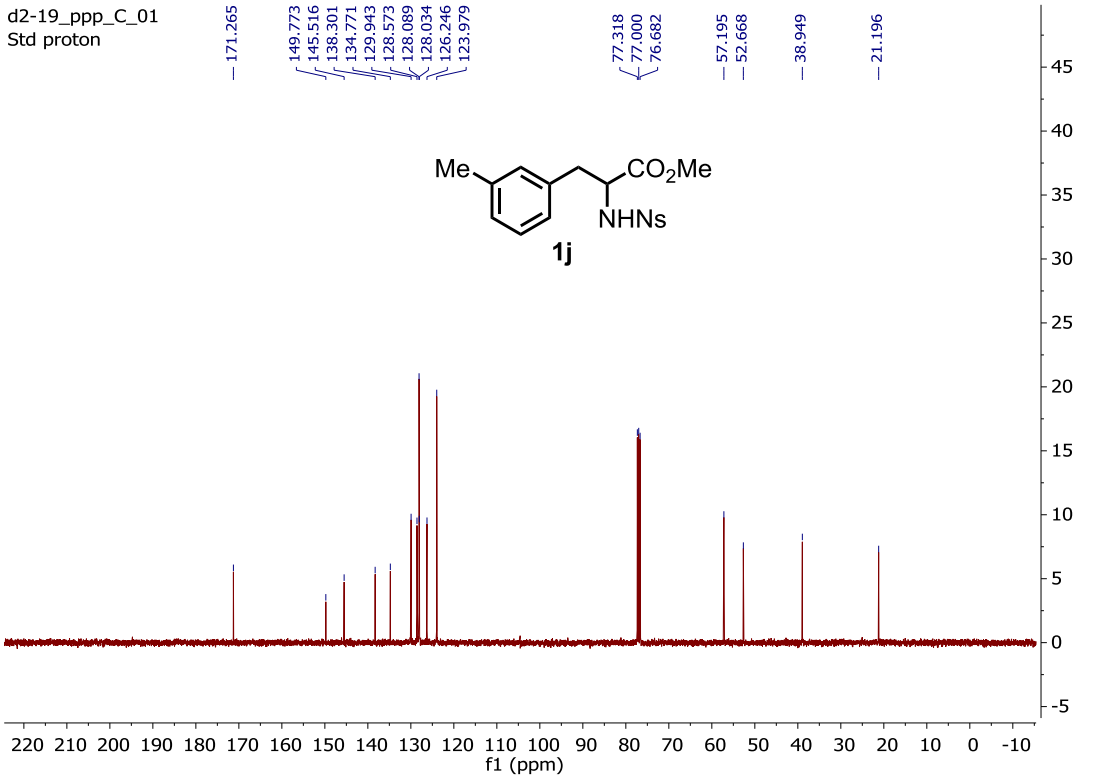

d2-138-2.1.fid
H-1 Routine, DRX-500, BBO Probe
8.248
8.231
7.883
7.865
7.492
7.476
7.387
7.371
7.356
7.324
7.308
7.285
7.265
5.506
5.488
4.296
4.286
4.281
4.278
4.271
4.267
4.263
4.253
3.638
3.212
3.201
3.184
3.174
3.074
3.060
3.046
3.032
1.643
-0.000
CF3
CO2Me
NHNs
1h
1.92
1.94
1.00
1.05
1.08
1.20
0.94
1.01
2.89
1.03
1.06
f1 (ppm)

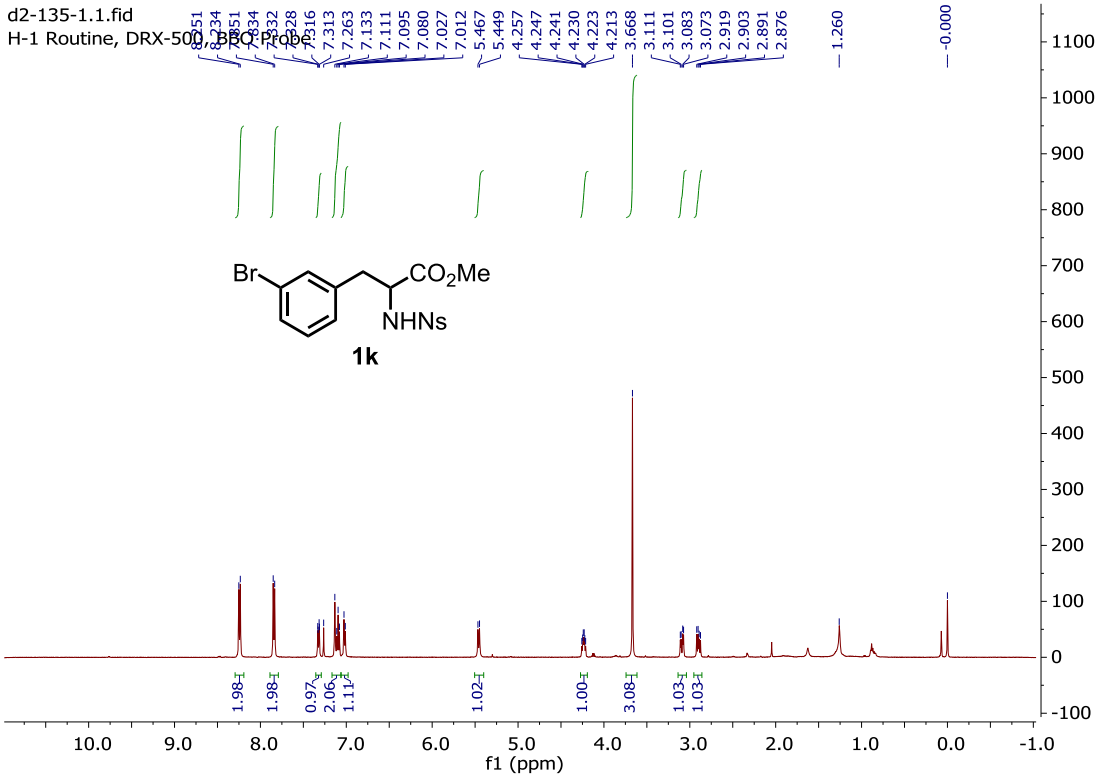

d2-138-2.2.fid
C-13 Routine, BBO Probe, DRX-500
170.752
150.028
145.322
135.927
132.850
131.367
131.112
130.854
130.597
129.181
128.161
127.014
126.072
126.041
126.009
125.980
124.848
124.316
124.284
124.254
124.215
123.682
120.515
77.257
77.001
76.747
56.873
52.918
39.007
CF3
CO2Me
NHNs
1h
f1 (ppm)

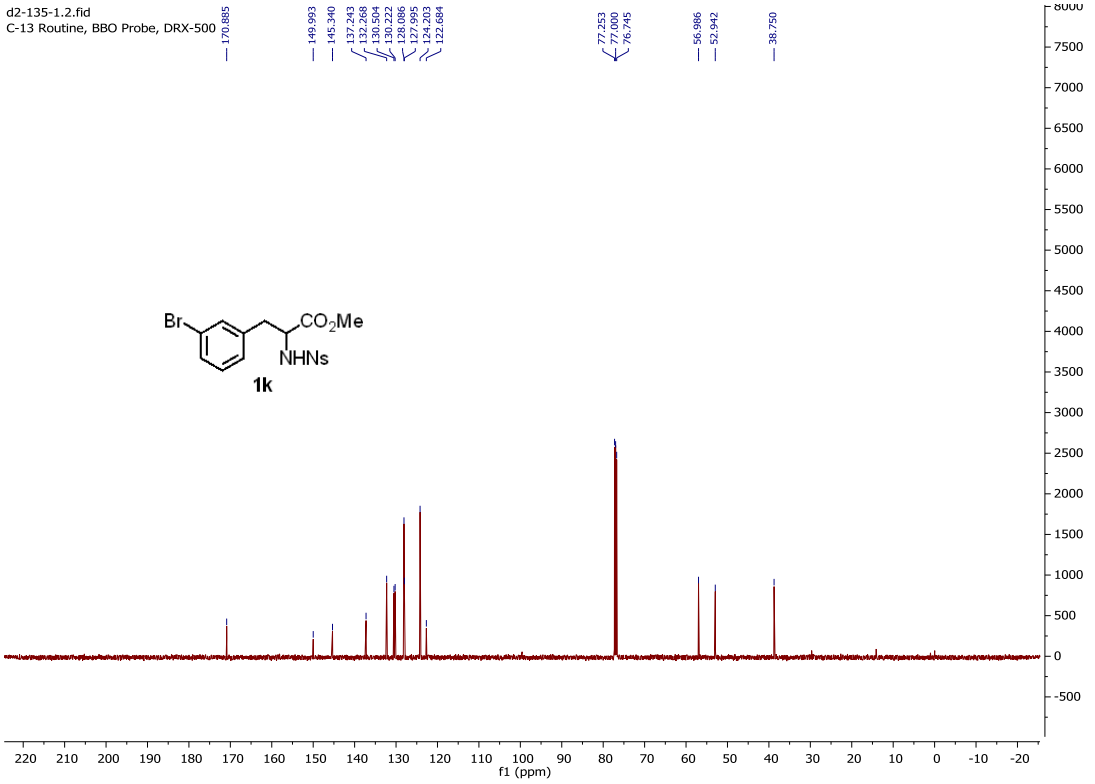

d2-128-2.3.fid
H-1 Routine, DRX-500, BBO Probe
8.193
8.175
7.814
7.796
7.267
7.128
7.112
7.096
6.721
6.716
6.704
6.700
6.642
6.627
6.512
5.633
5.615
4.254
4.248
4.245
4.238
4.236
4.229
3.704
3.660
3.103
3.093
3.075
3.065
2.907
2.890
2.879
2.863
1.778
0.000
MeO
CO2Me
NHNs
1i
1.95
1.98
1.00
1.00
1.01
0.99
0.97
1.00
3.24
2.82
1.02
1.02
f1 (ppm)

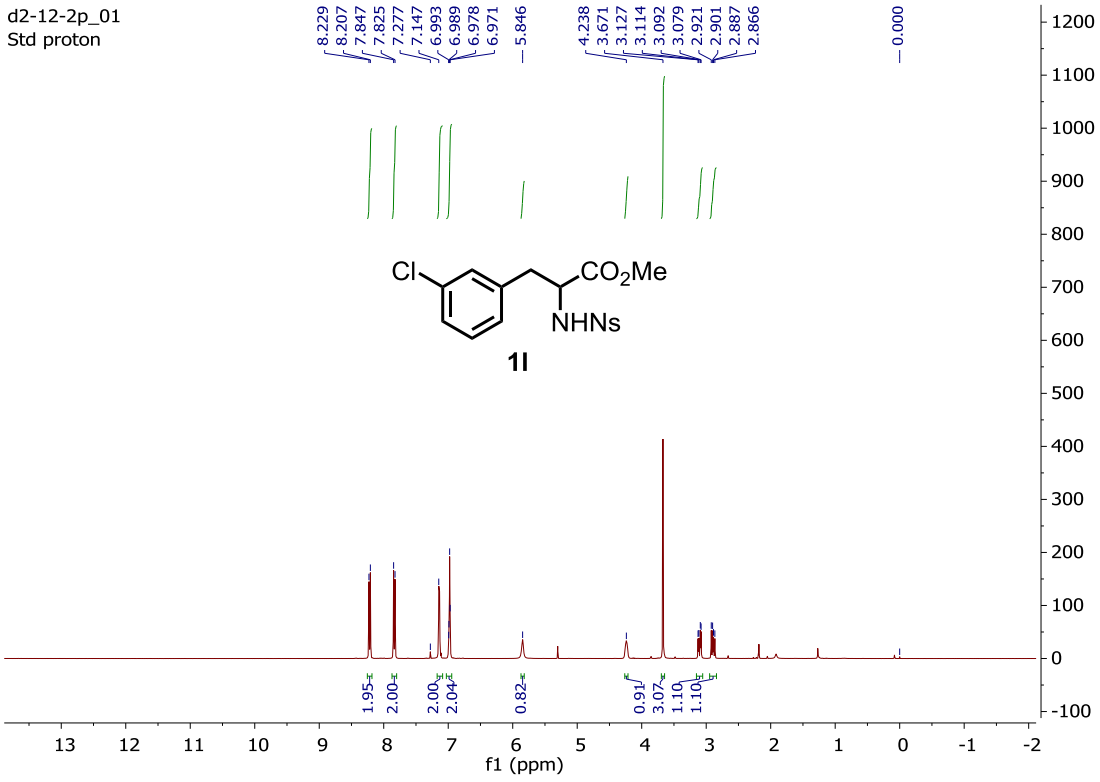

d2-128-2.4.fid
C-13 Routine, BBO Probe, DRX-500
171.242
159.607
147.756
145.467
136.418
129.673
128.046
123.989
121.508
115.037
112.354
77.253
77.000
76.747
57.107
55.011
52.750
38.958
MeO
CO2Me
NHNs
1i
f1 (ppm)

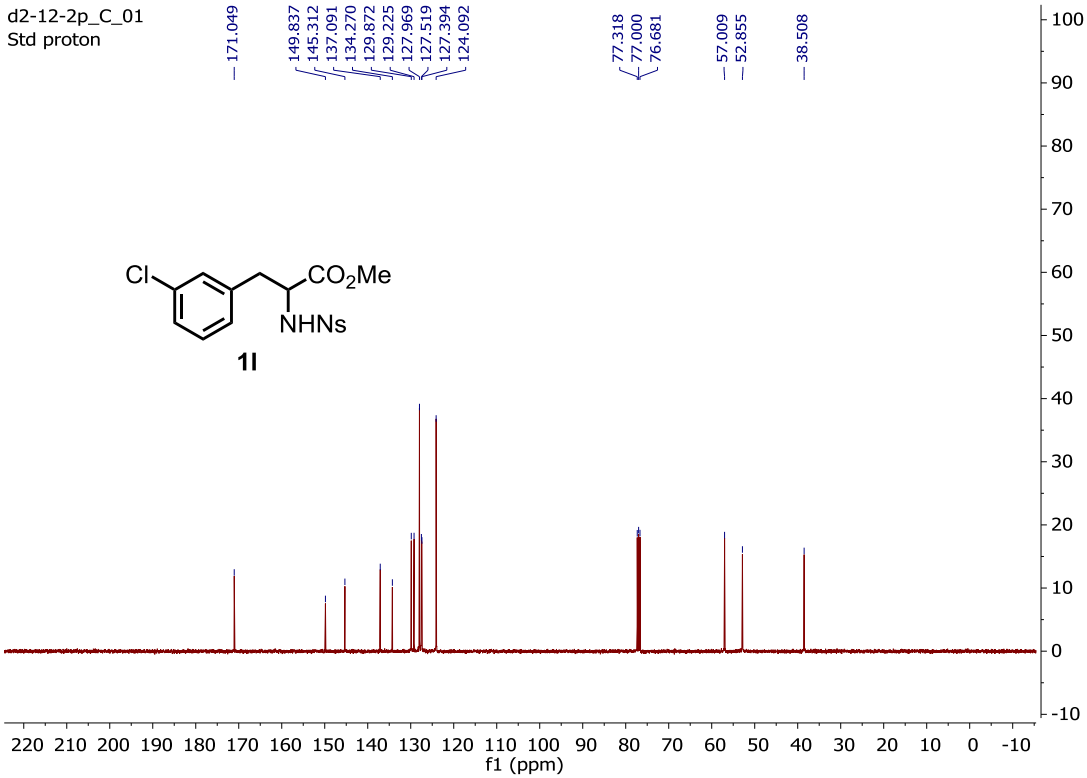

d2-19_ppp_01
Std proton
8.196
8.174
7.816
7.794
7.263
7.102
7.083
7.065
7.008
6.989
6.849
6.827
5.568
5.544
4.264
4.252
4.243
4.232
4.229
4.221
4.209
3.639
3.093
3.080
3.058
3.046
2.925
2.905
2.890
2.871
2.229
1.731
0.000
Me
CO2Me
NHNs
1j
1.88
1.93
1.01
0.98
1.99
0.99
1.02
3.01
1.09
1.08
3.02
f1 (ppm)

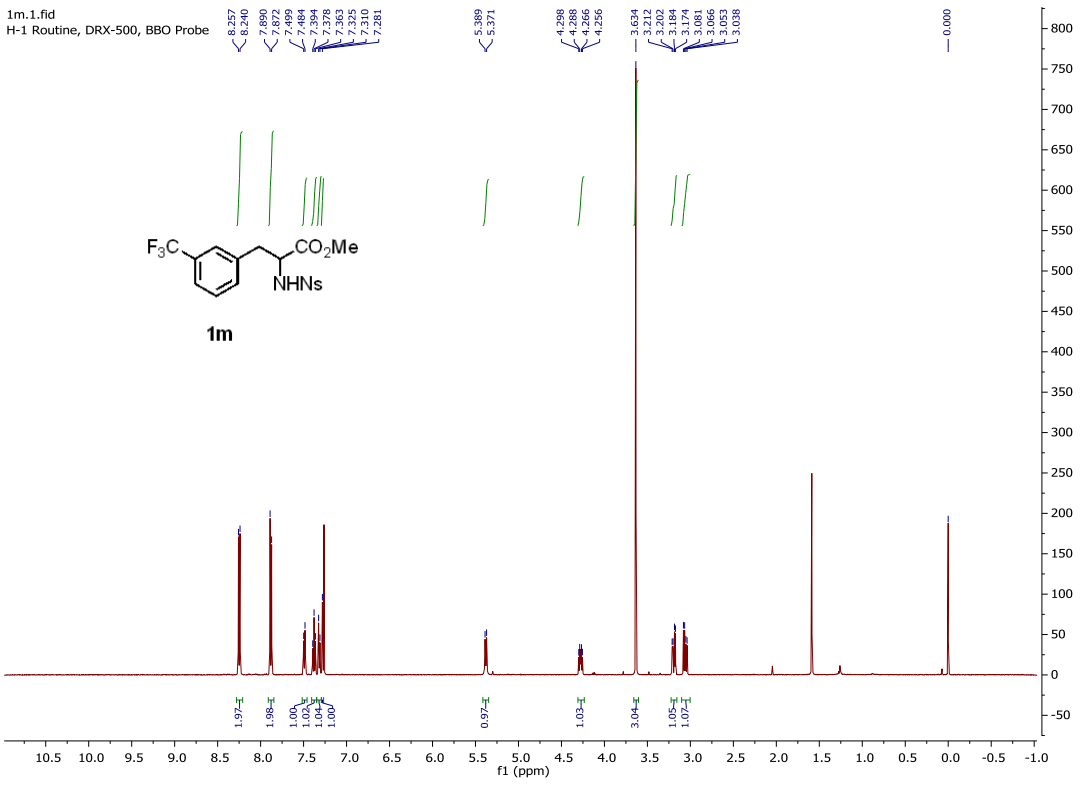

d2-19_ppp_C_01
Std proton
171.265
149.773
145.516
138.301
134.771
129.943
128.573
128.089
128.034
126.246
123.979
77.318
77.000
76.682
57.195
52.668
38.949
21.196
Me
CO2Me
NHNs
1j
f1 (ppm)

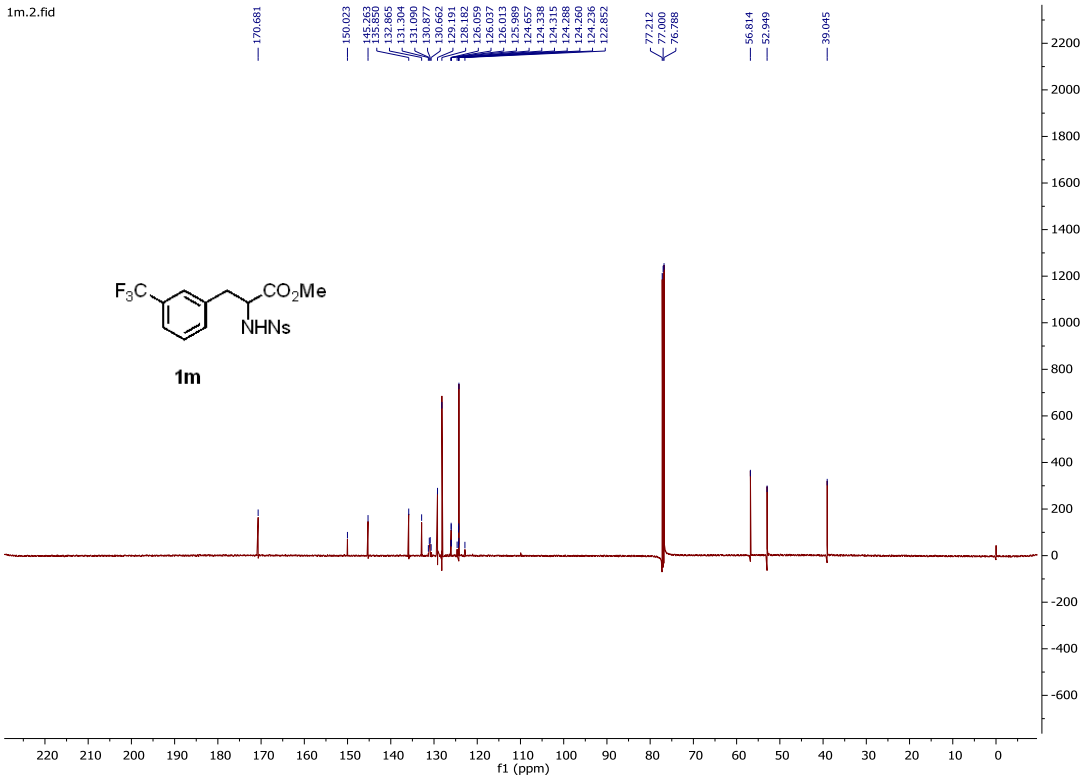

d2-135-1.1.fid
H-1 Routine, DRX-500, BBO Probe
7.851
7.834
7.832
7.828
7.316
7.313
7.263
7.133
7.111
7.095
7.080
7.027
7.012
5.467
5.449
4.257
4.247
4.241
4.230
4.223
4.213
3.668
3.111
3.101
3.083
3.073
2.919
2.903
2.891
2.876
1.260
-0.000
Br
CO2Me
NHNs
1k
1.98
1.98
0.97
2.06
1.11
1.02
1.00
3.08
1.03
1.03
f1 (ppm)


d2-135-1.2.fid
C-13 Routine, BBO Probe, DRX-500
170.885
149.993
145.340
137.243
132.268
130.504
130.222
128.086
127.995
124.203
122.684
77.253
77.000
76.745
56.986
52.942
38.750
Br
CO2Me
NHNs
1k
f1 (ppm)

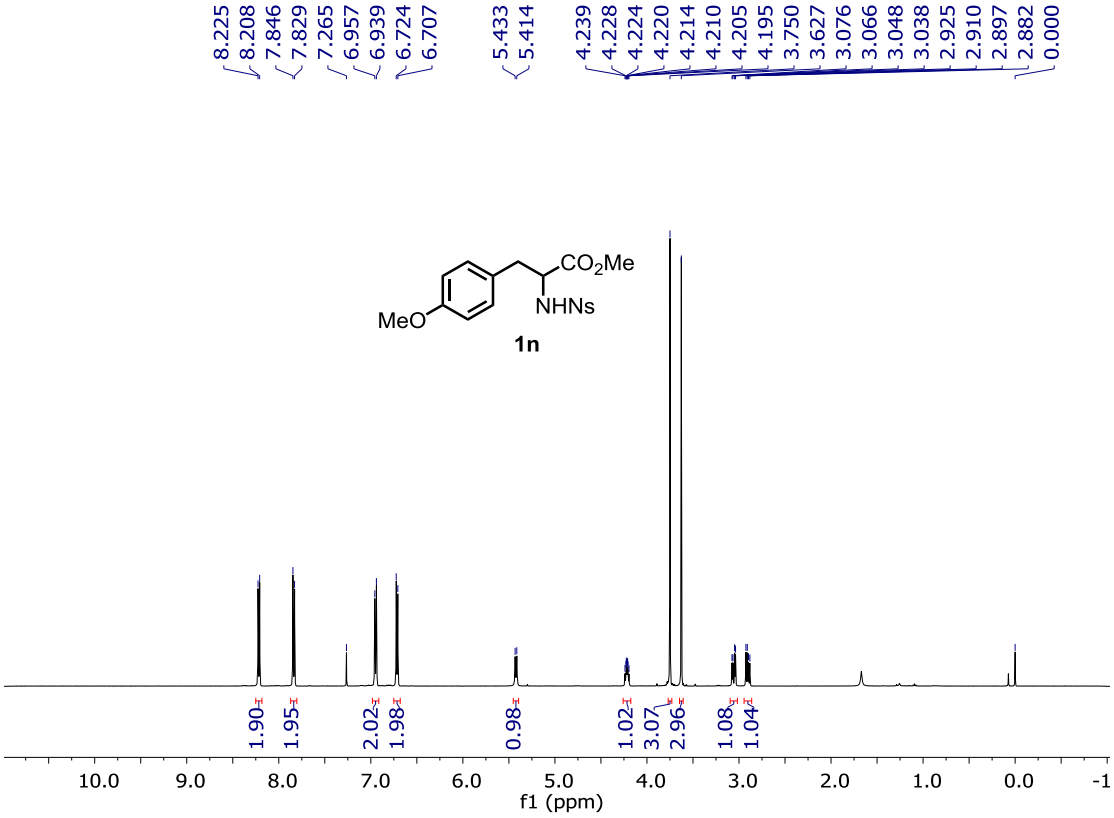

d2-12-2p_01
Std proton
8.229
8.207
7.847
7.825
7.277
7.147
6.993
6.989
6.978
6.971
5.846
4.238
3.671
3.127
3.114
3.092
3.079
2.921
2.901
2.887
2.866
0.000
Cl
CO2Me
NHNs
1l
1.95
2.00
2.00
2.04
0.82
0.91
3.07
1.10
1.10
f1 (ppm)


d2-12-2p_C_01
Std proton
171.049
149.837
145.312
137.091
134.270
129.872
129.225
127.969
127.519
127.394
124.092
77.318
77.000
76.681
57.009
52.855
38.508
Cl
CO2Me
NHNs
1l
f1 (ppm)


1m.1.fid
H-1 Routine, DRX-500, BBO Probe
F3C
CO2Me
NHNs
1m
f1 (ppm)

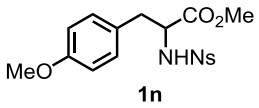


C:/Users/nmruser/Desktop/d2-14-2/1/fid

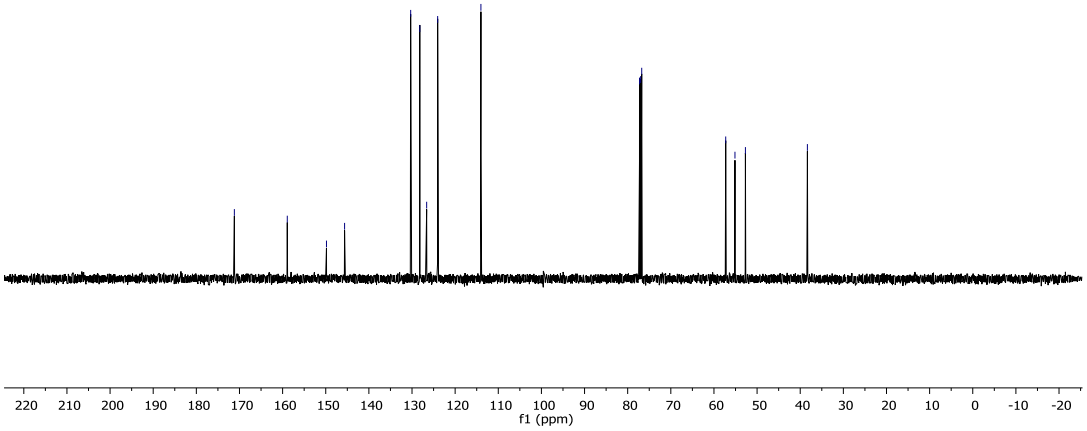


C:/Users/nmruser/Desktop/d2-14-2/2/fid

171.19
158.92
149.83
145.63
130.31
128.20
126.60
124.05
114.03
77.26
77.00
76.75
57.27
55.13
52.70
38.34



1n

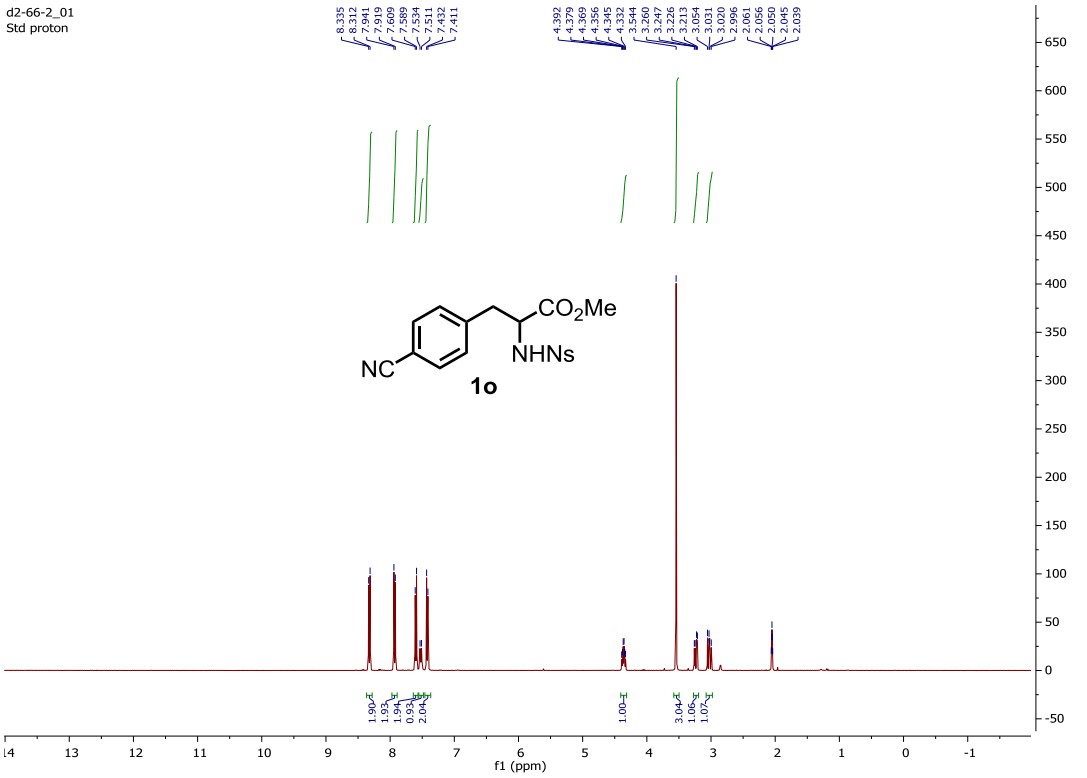


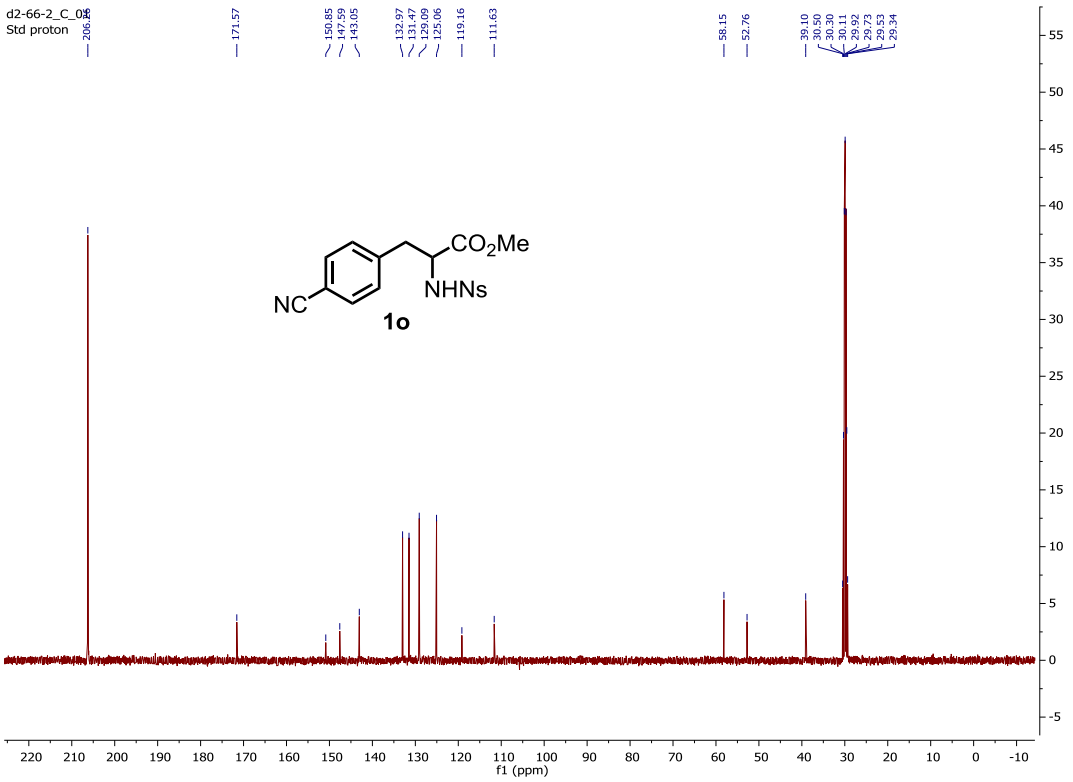
d2-66-2_01
Std proton

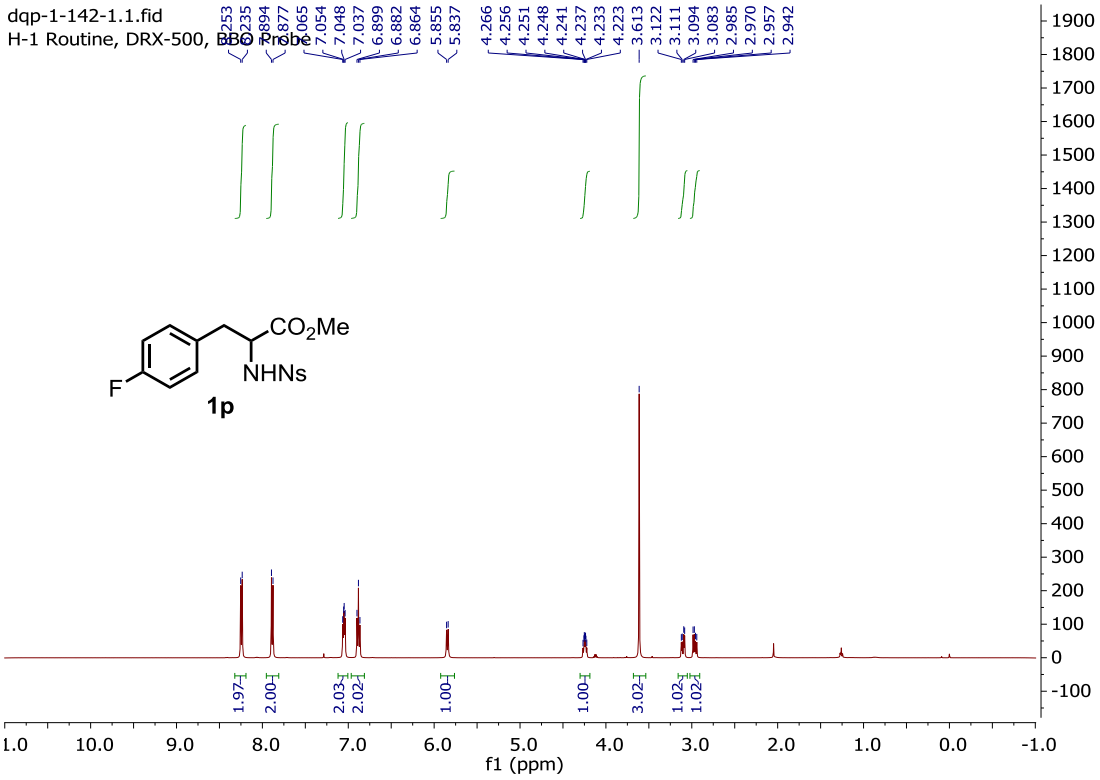
8.335
8.312
7.944
7.919
7.609
7.589
7.534
7.511
7.432
7.411
4.392
4.379
4.369
4.356
4.345
4.332
3.264
3.260
3.247
3.226
3.213
3.054
3.031
3.020
2.996
2.061
2.056
2.050
2.045
2.039

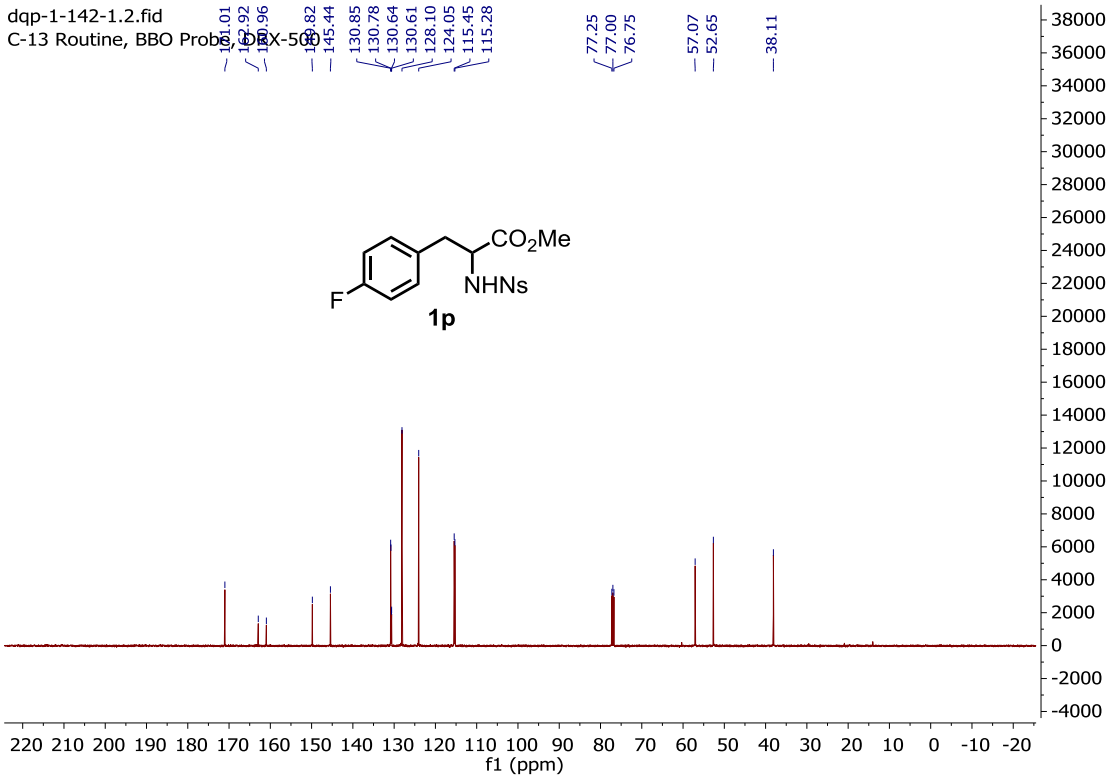
1o

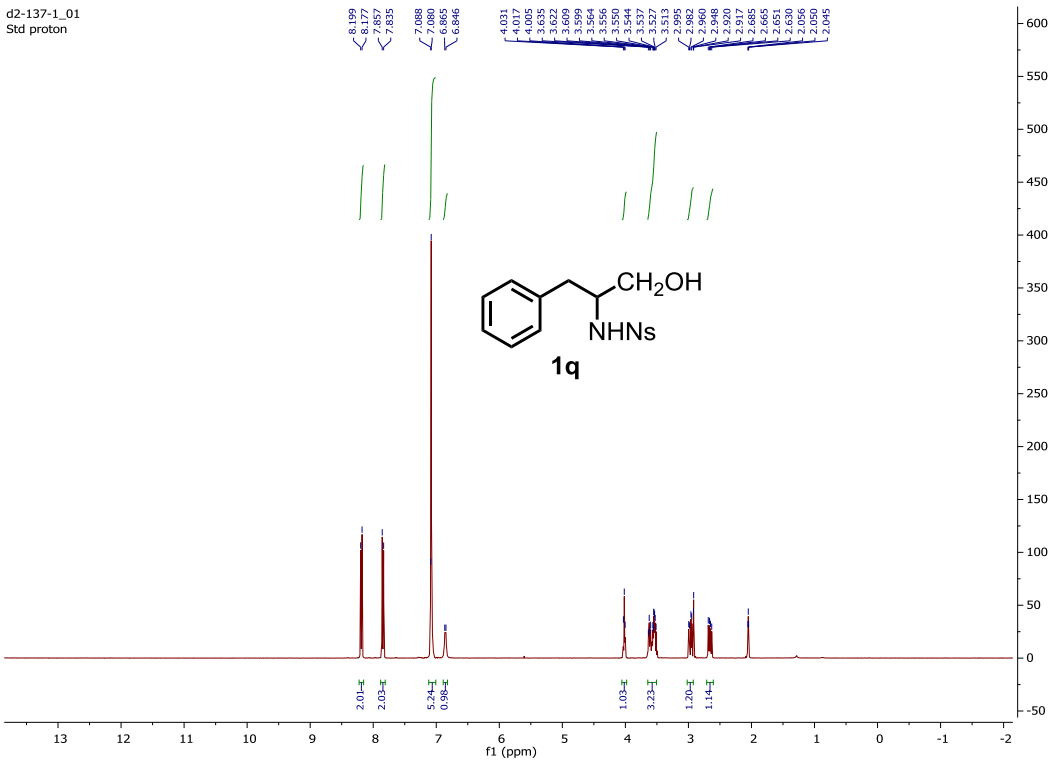
1.90
1.93
1.94
0.93
2.04
1.00
3.04
1.06
1.07

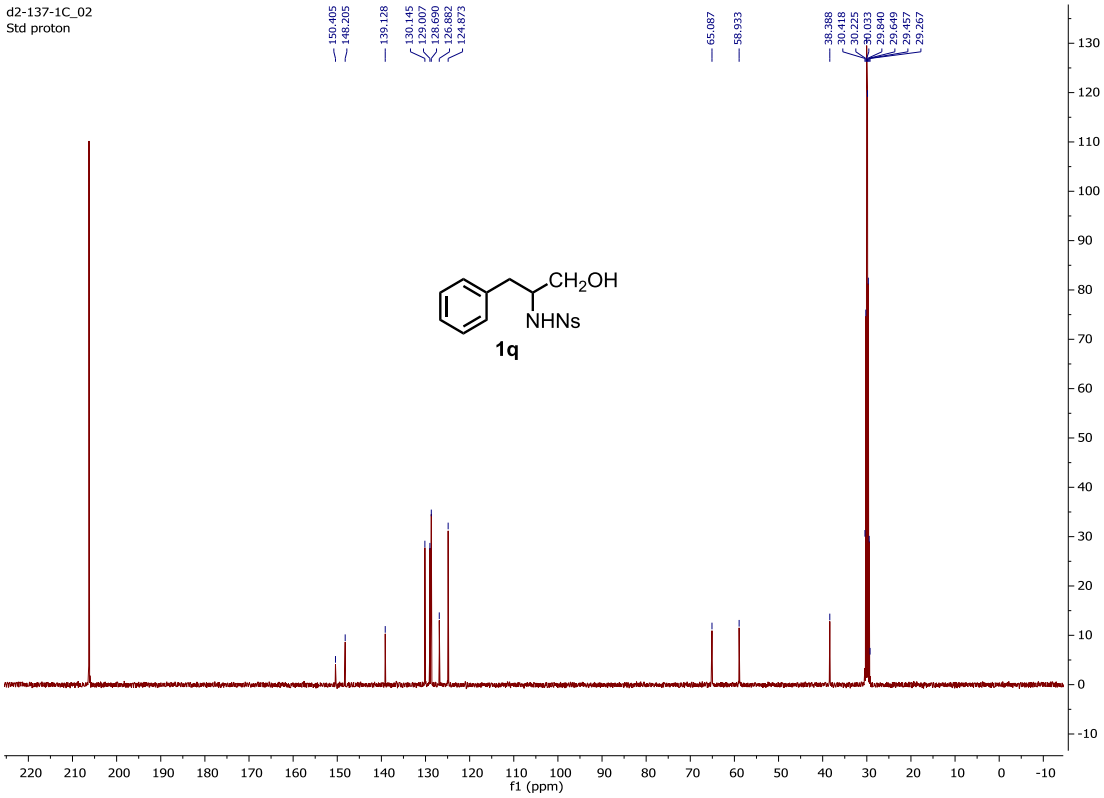


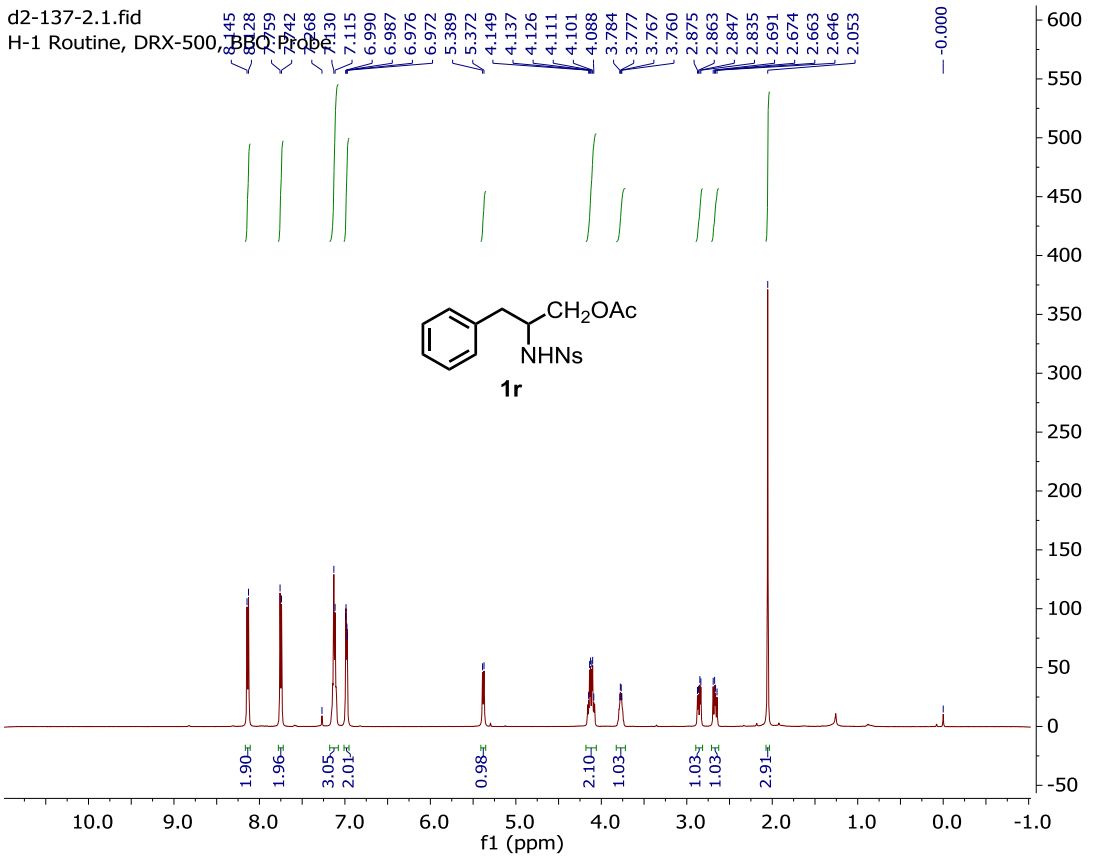

d2-66-2_C_01
Std proton
206.88
171.57
150.85
147.59
143.05
132.97
131.47
129.09
125.06
119.16
111.63
58.15
52.76
39.10
30.50
30.30
30.11
29.92
29.73
29.53
29.34
CO2Me
NHNs
NC
1o
f1 (ppm)

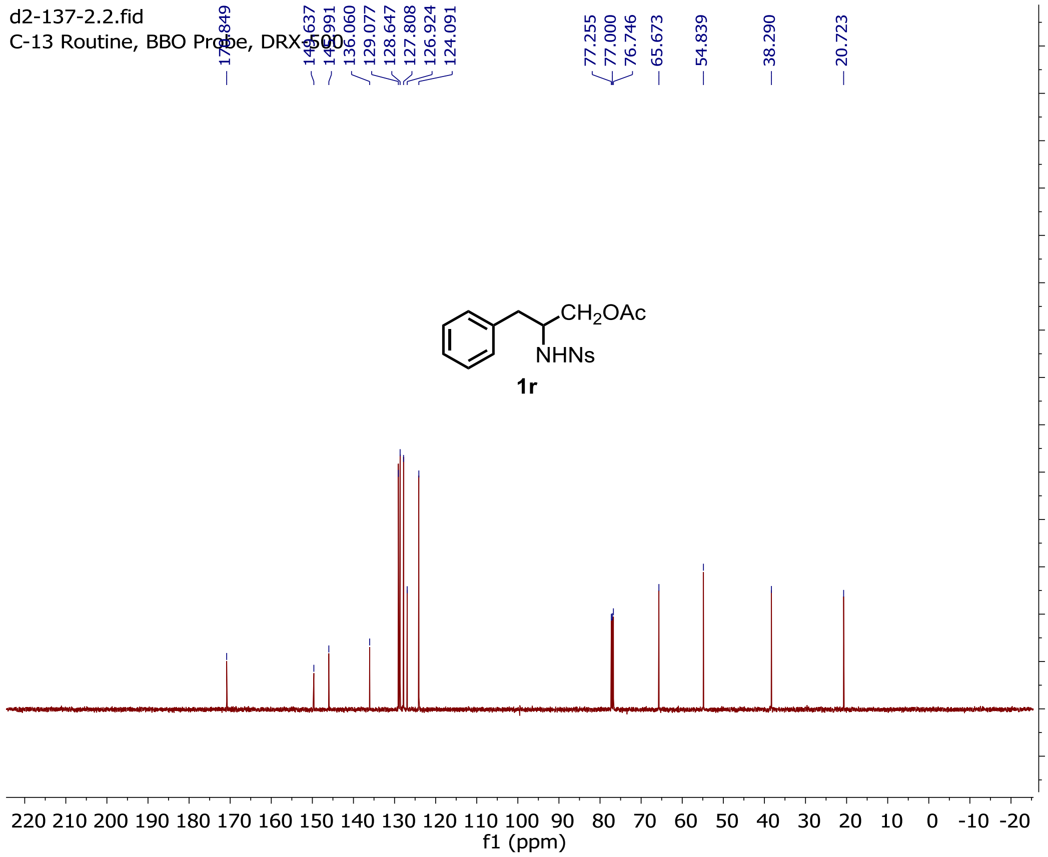

dqp-1-142-1.1.fid
H-1 Routine, DRX-500, BBO Probe
8.253
8.235
7.894
7.877
7.065
7.054
7.048
7.037
6.899
6.882
6.864
5.855
5.837
4.266
4.256
4.251
4.248
4.241
4.237
4.233
4.223
3.613
3.122
3.111
3.094
3.083
2.985
2.970
2.957
2.942
CO2Me
NHNs
F
1p
1.97
2.00
2.03
2.02
1.00
1.00
3.02
1.02
1.02
f1 (ppm)

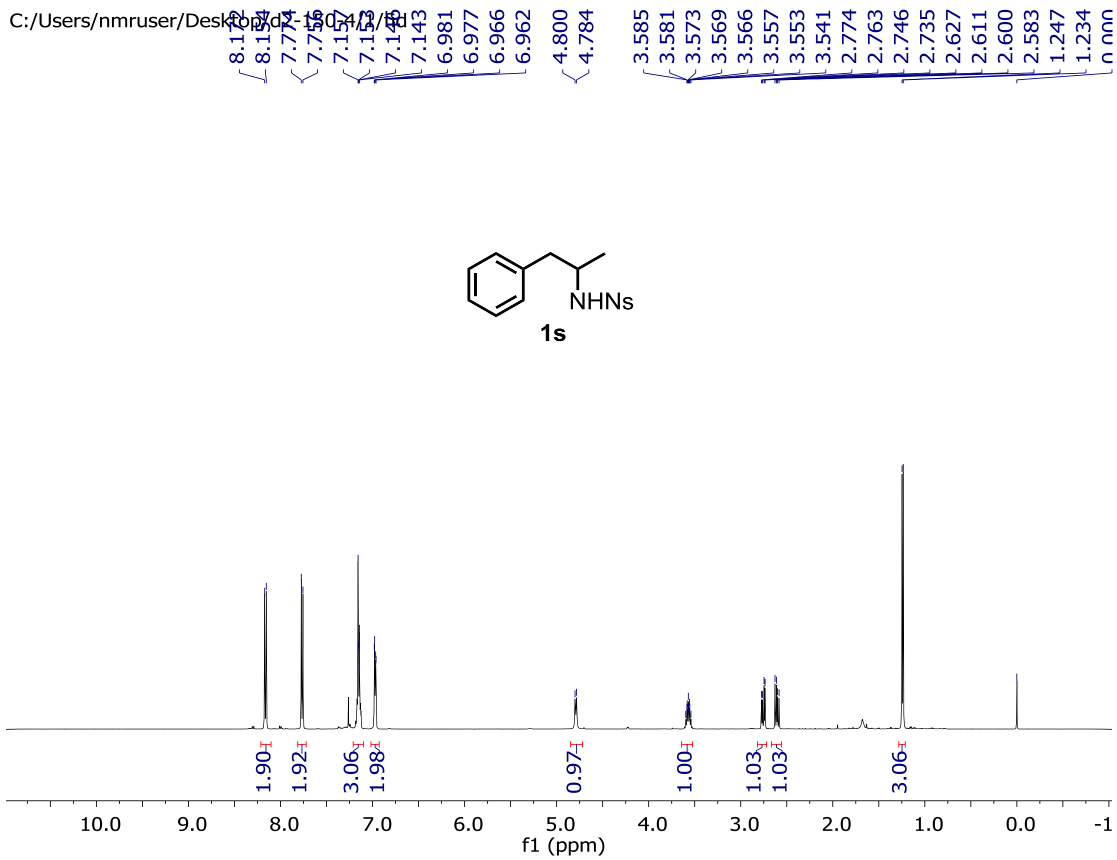

dqp-1-142-1.2.fid
C-13 Routine, BBO Prob
CO2Me
NHNs
F
1p
f1 (ppm)

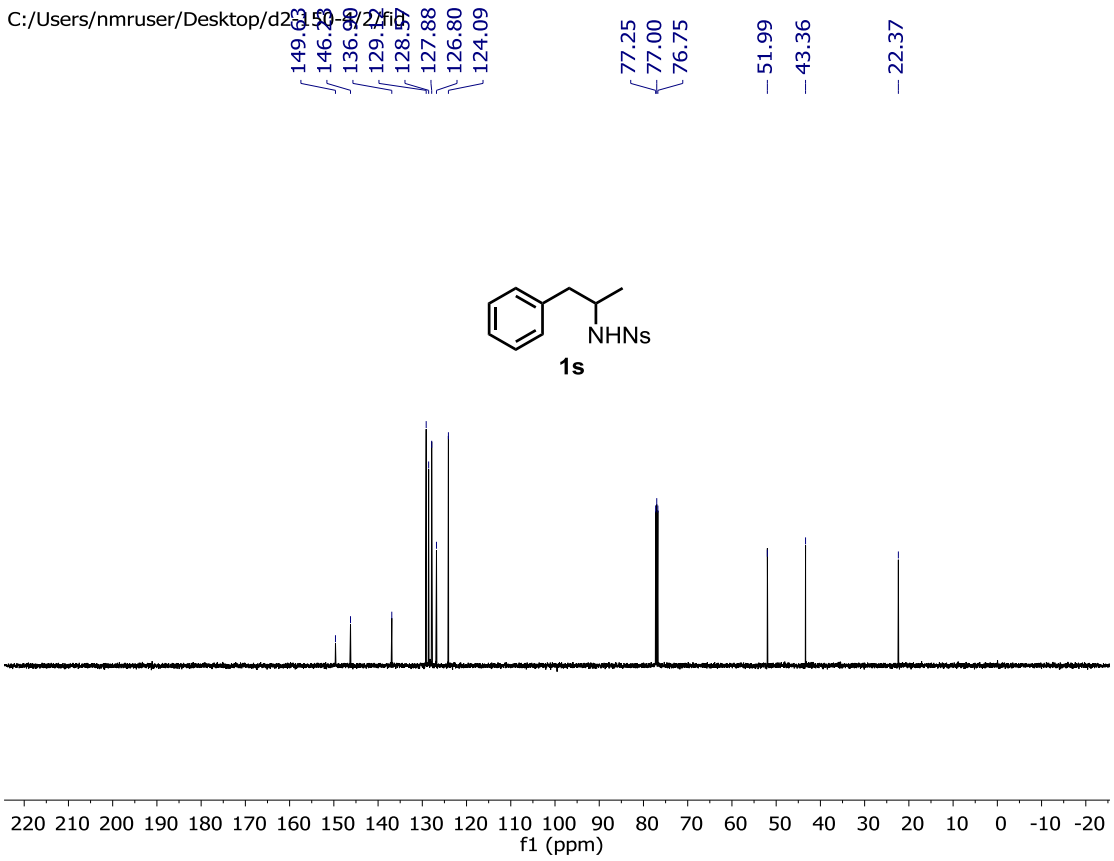

d2-137-1_01
Std proton
CH2OH
NHNs
1q
f1 (ppm)

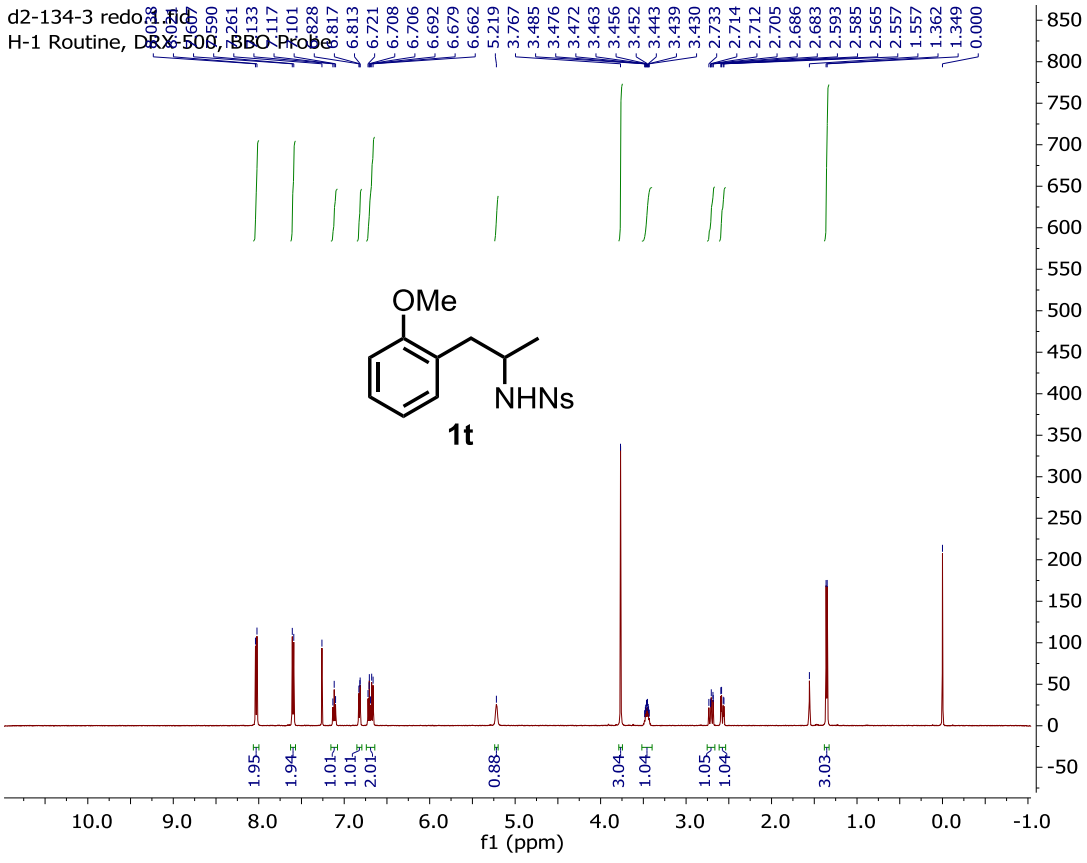

d2-137-1C_02
Std proton
150.405
148.205
139.128
130.145
129.007
128.690
126.882
124.873
65.087
58.933
38.388
30.448
30.225
30.033
29.840
29.649
29.457
29.267
CH2OH
NHNs
1q
f1 (ppm)

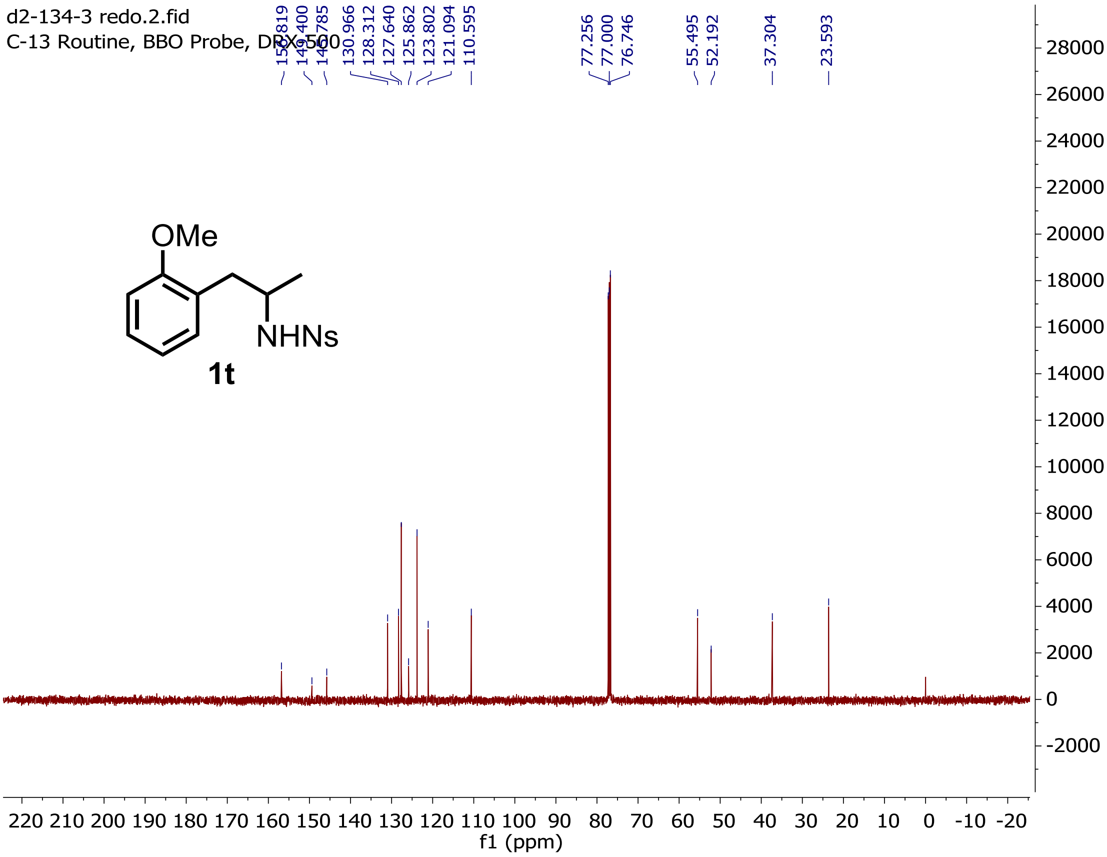

d2-137-2.1.fid
H-1 Routine, DRX-500, BBO Probe
8.45
8.28
7.59
7.42
7.68
7.30
7.115
6.990
6.987
6.976
6.972
5.389
5.372
4.149
4.137
4.126
4.111
4.101
4.088
3.784
3.777
3.767
3.760
2.875
2.863
2.847
2.835
2.691
2.674
2.663
2.646
2.053
-0.000
CH2OAc
NHNs
1r
1.90
1.96
3.05
2.01
0.98
2.10
1.03
1.03
1.03
2.91
f1 (ppm)

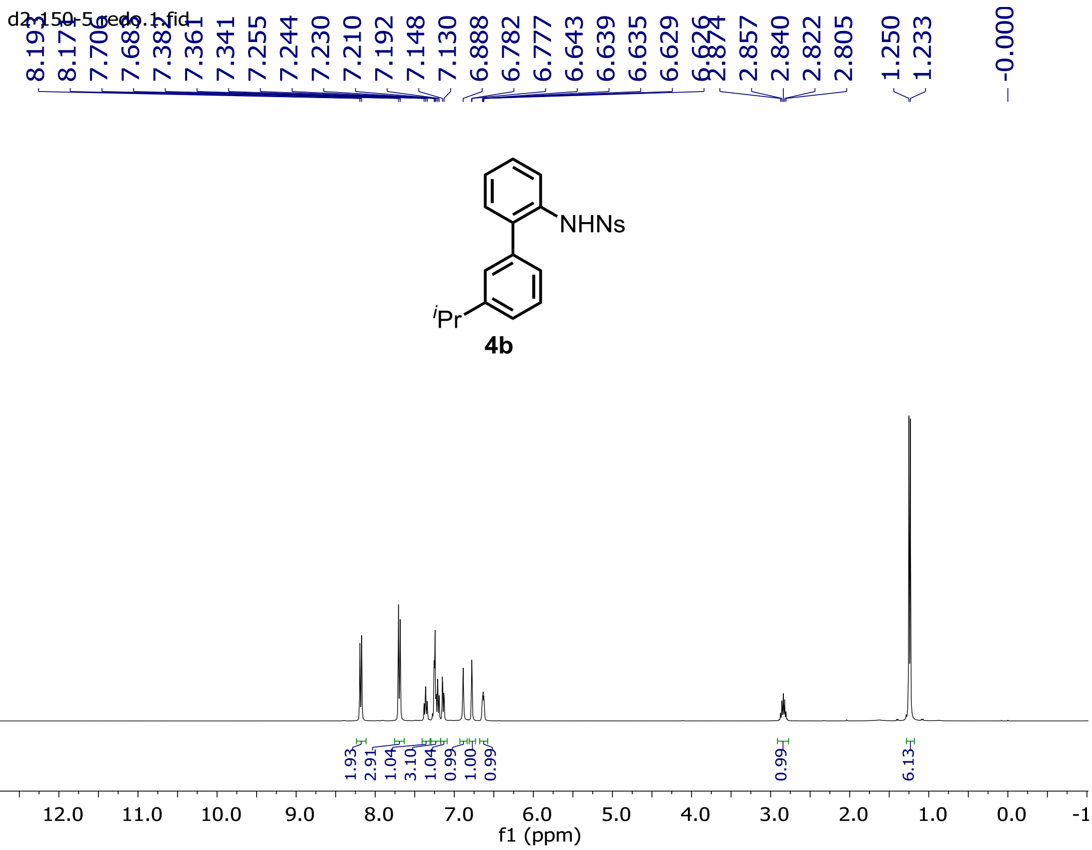

d2-137-2.2.fid
C-13 Routine, BBO Probe, DRX-500
149.637
136.060
129.077
128.647
127.808
126.924
124.091
77.255
77.000
76.746
65.673
54.839
38.290
20.723
CH2OAc
NHNs
1r
f1 (ppm)

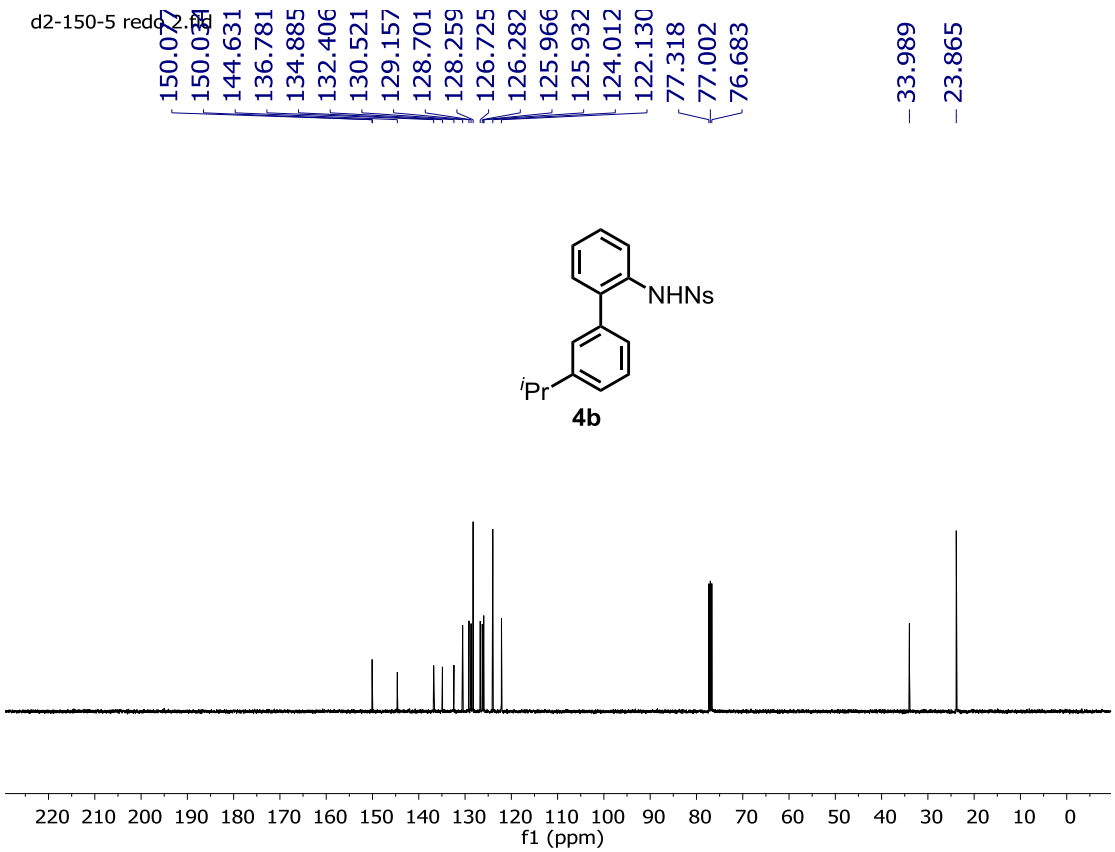

7.143
6.981
6.977
6.966
6.962
4.800
4.784
3.585
3.581
3.573
3.569
3.566
3.557
3.553
3.541
2.774
2.763
2.746
2.735
2.627
2.611
2.600
2.583
1.247
1.234
NHNs
1s
1.90
1.92
3.06
1.98
0.97
1.00
1.03
1.03
3.06
f1 (ppm)

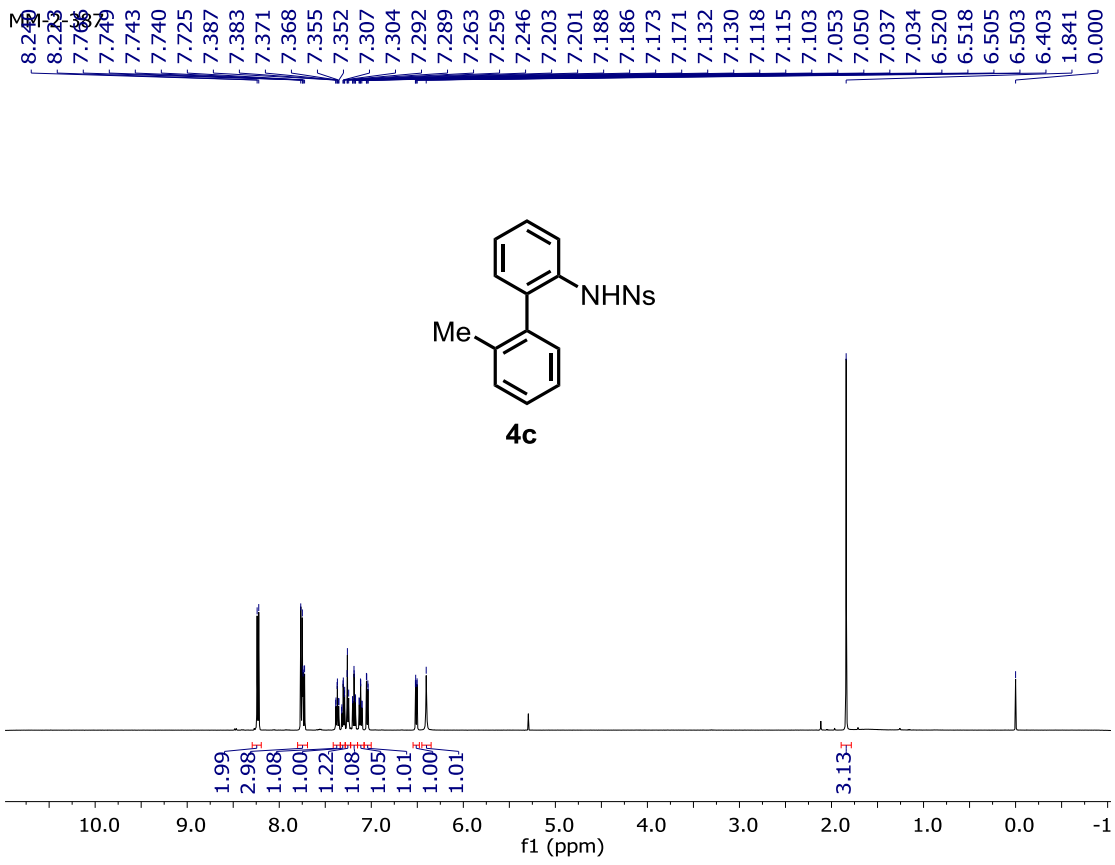

C:/Users/nmruser/Desktop/d2-150-4/2/fid
149.63
146.40
136.94
129.44
128.57
127.88
126.80
124.09
77.25
77.00
76.75
51.99
43.36
22.37
NHNs
1s
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)


d2-134-3 redo 1 1r
H-1 Routine, DRX-500, BBO Probe
OMe
NHNs
1t
1.95
1.94
1.01
1.01
2.01
0.88
3.04
1.04
1.05
1.04
3.03
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
f1 (ppm)

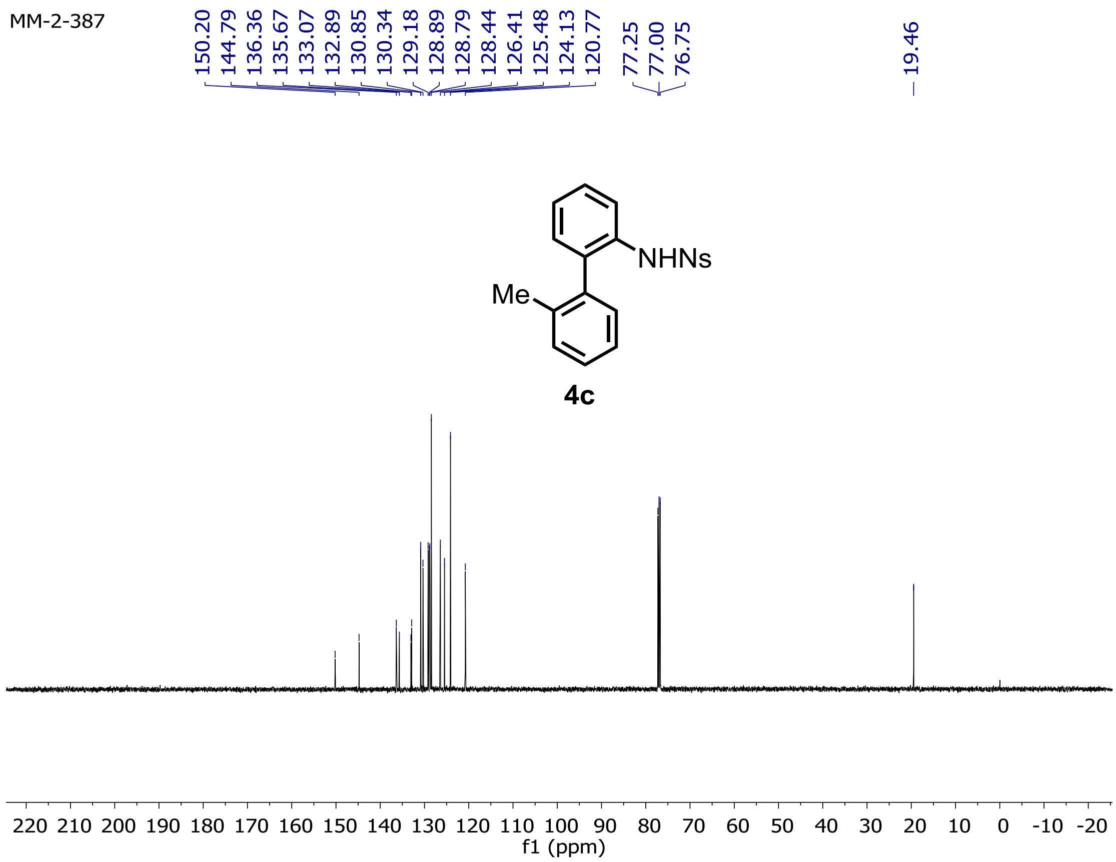

d2-134-3 redo.2.fid
C-13 Routine, BBO Probe, DRX-500
130.966
128.312
127.640
125.862
123.802
121.094
110.595
77.256
77.000
76.746
55.495
52.192
37.304
23.593
OMe
NHNs
1t
f1 (ppm)


d2-150-5 redo.1.fid
7.361
7.341
7.255
7.244
7.230
7.210
7.192
7.148
7.130
6.888
6.782
6.777
6.643
6.639
6.635
6.629
2.857
2.840
2.822
2.805
1.250
1.233
-0.000
NHNs
iPr
4b
f1 (ppm)


d2-150-5 redo 2.fid
150.077
150.031
144.631
136.781
134.885
132.406
130.521
129.157
128.701
128.259
126.725
126.282
125.966
125.932
124.012
122.130
77.318
77.002
76.683
33.989
23.865
NHNs
iPr
4b
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

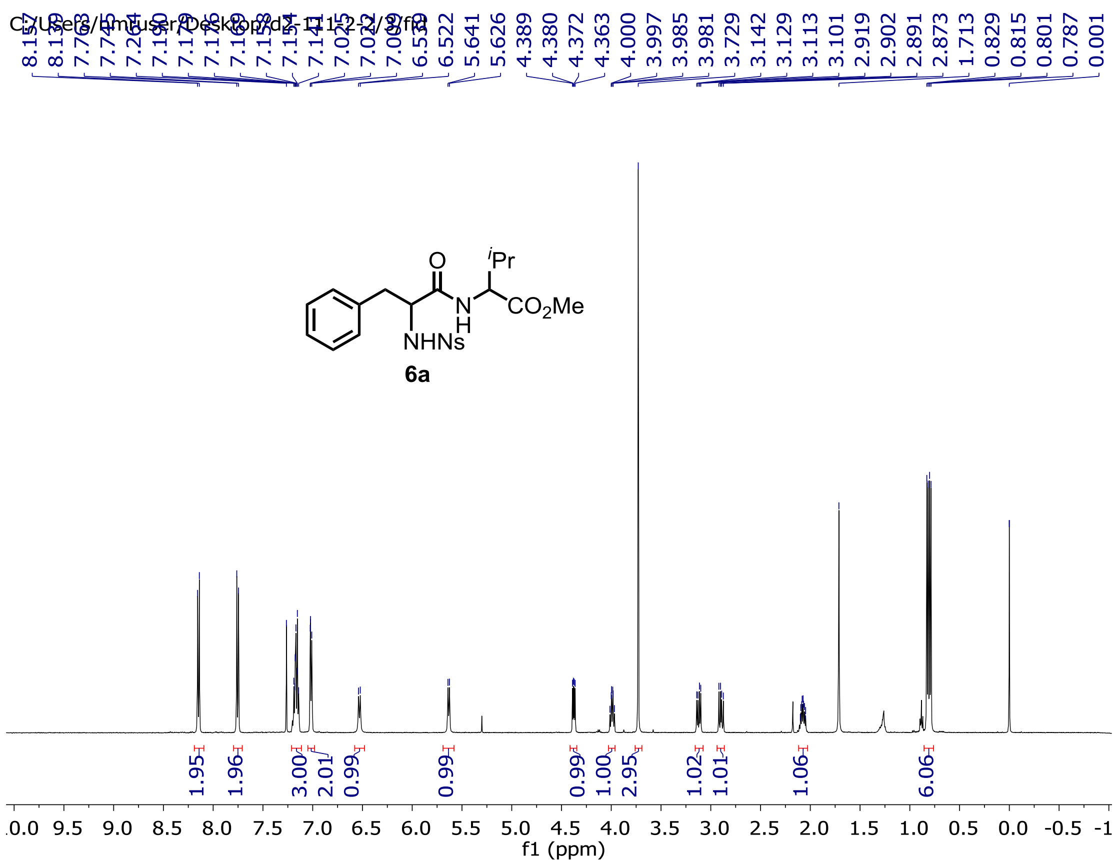

MM-2-187
8.247
8.223
7.766
7.749
7.743
7.740
7.725
7.387
7.383
7.371
7.368
7.355
7.352
7.307
7.304
7.292
7.289
7.263
7.259
7.246
7.203
7.201
7.188
7.186
7.173
7.171
7.132
7.130
7.118
7.115
7.103
7.053
7.050
7.037
7.034
6.520
6.518
6.505
6.503
6.403
1.841
0.000
NHNs
Me
4c
1.99
2.98
1.08
1.00
1.22
1.08
1.05
1.01
1.00
1.01
3.13
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1
f1 (ppm)

MM-2-387



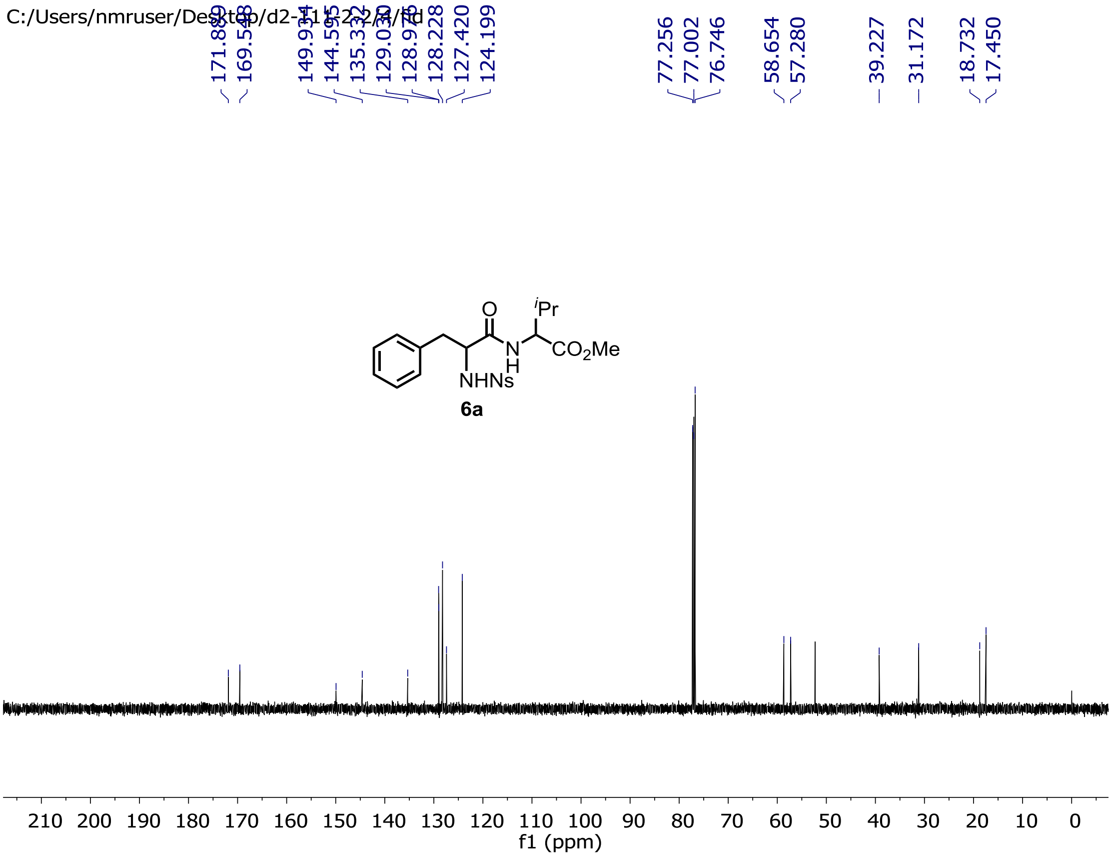
150.20
144.79
136.36
135.67
133.07
132.89
130.85
130.34
129.18
128.89
128.79
128.44
126.41
125.48
124.13
120.77
77.25
77.00
76.75
19.46
NHNs
Me
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

4c

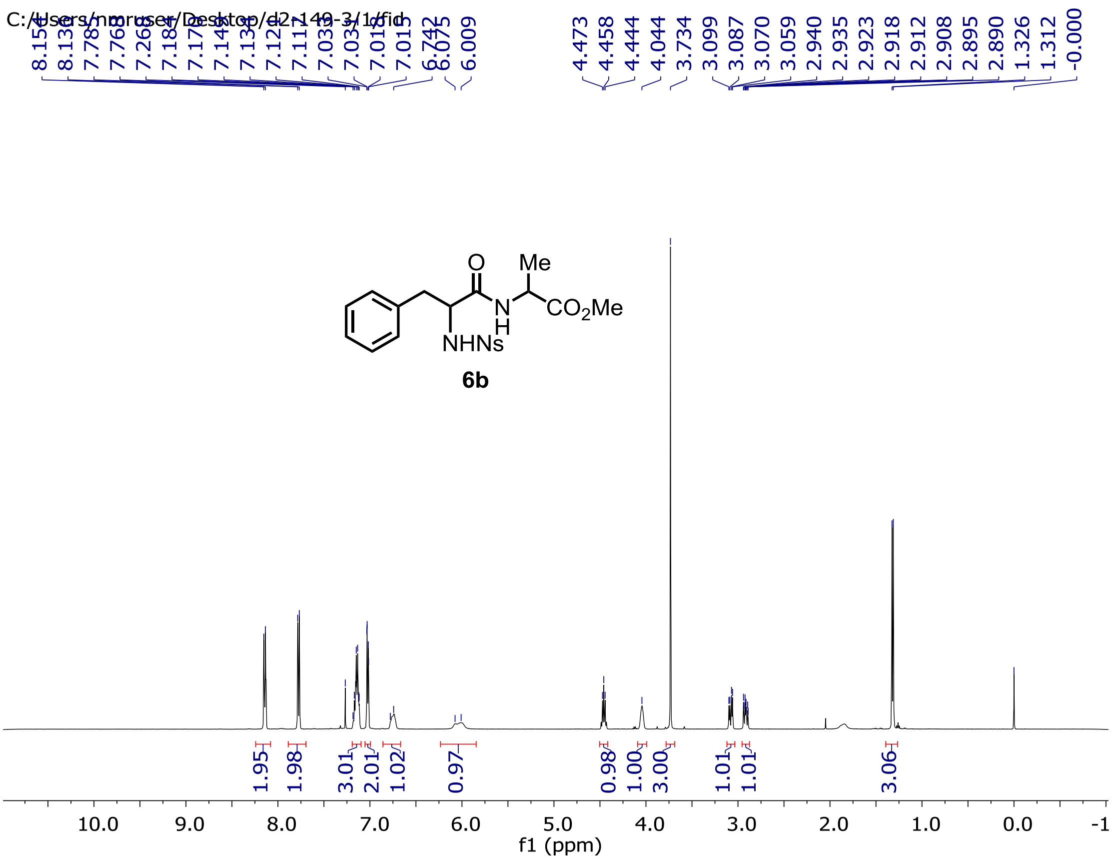


6.522
5.641
5.626
4.389
4.380
4.372
4.363
4.000
3.997
3.985
3.981
3.729
3.142
3.129
3.113
3.101
2.919
2.902
2.891
2.873
1.713
0.829
0.815
0.801
0.787
0.001
O
iPr
N
H
CO2Me
NHNs
1.95
1.96
3.00
2.01
0.99
0.99
0.99
1.00
2.95
1.02
1.01
1.06
6.06
f1 (ppm)

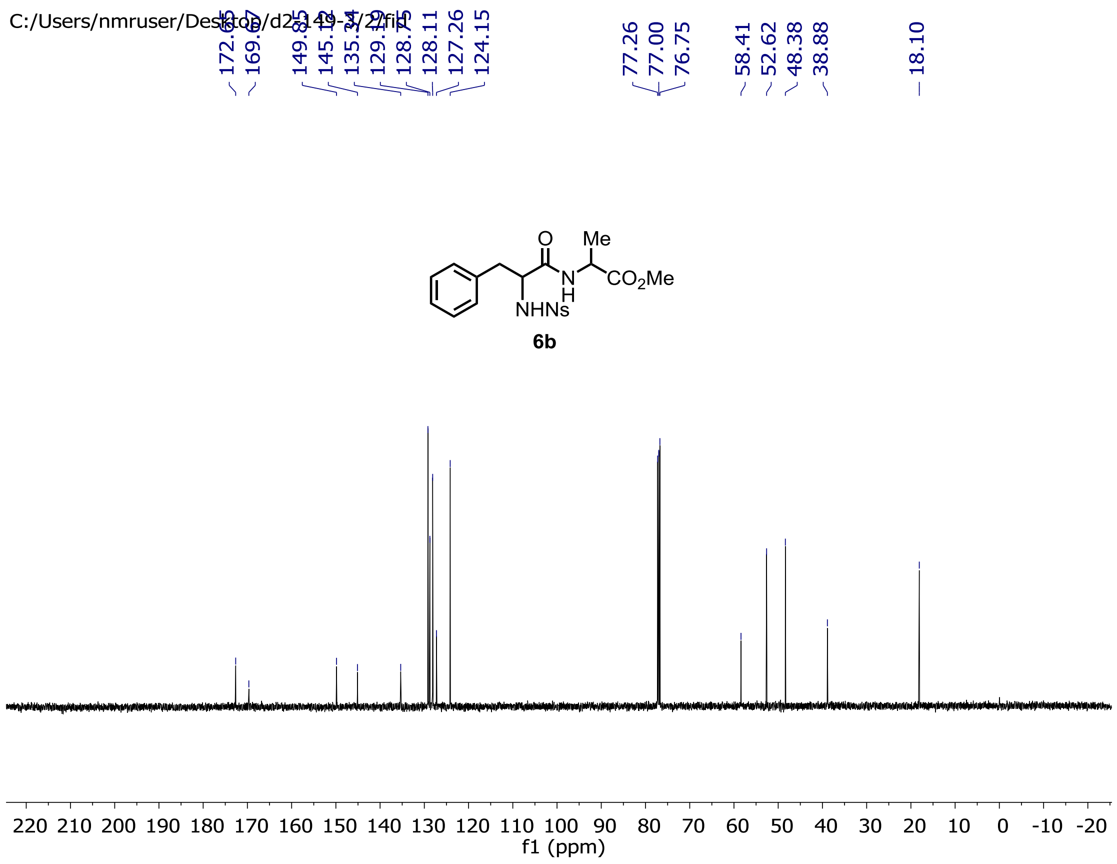
6a

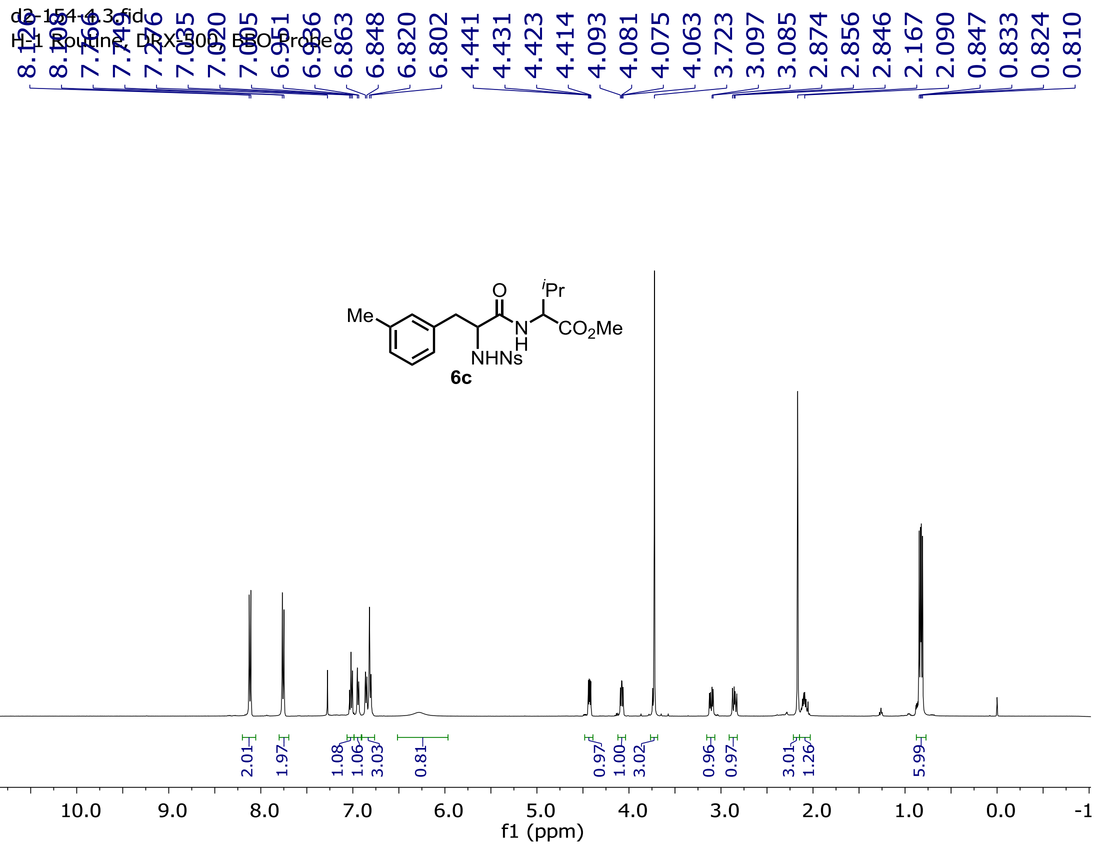


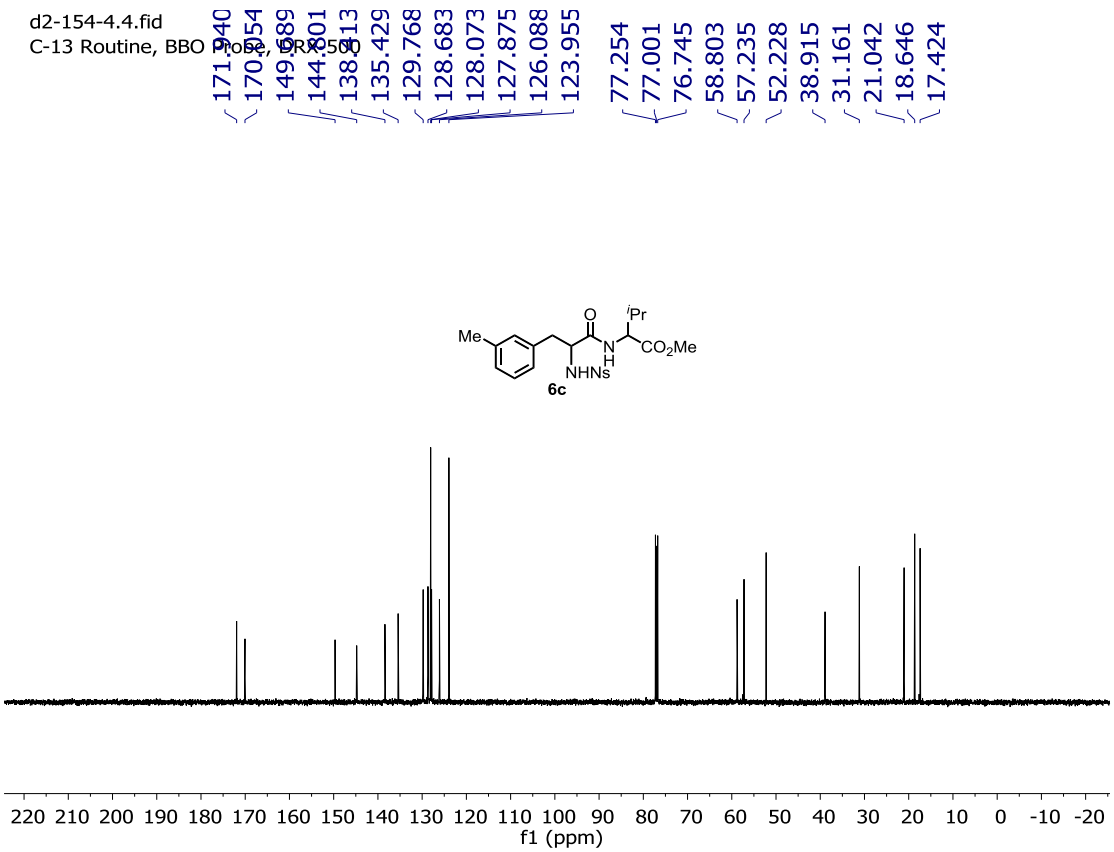
77.256
77.002
76.746
58.654
57.280
39.227
31.172
18.732
17.450
128.228
127.420
124.199
144.595
135.332
169.548
O
^{i}Pr
N
H
CO_2Me
NHNs
6a
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

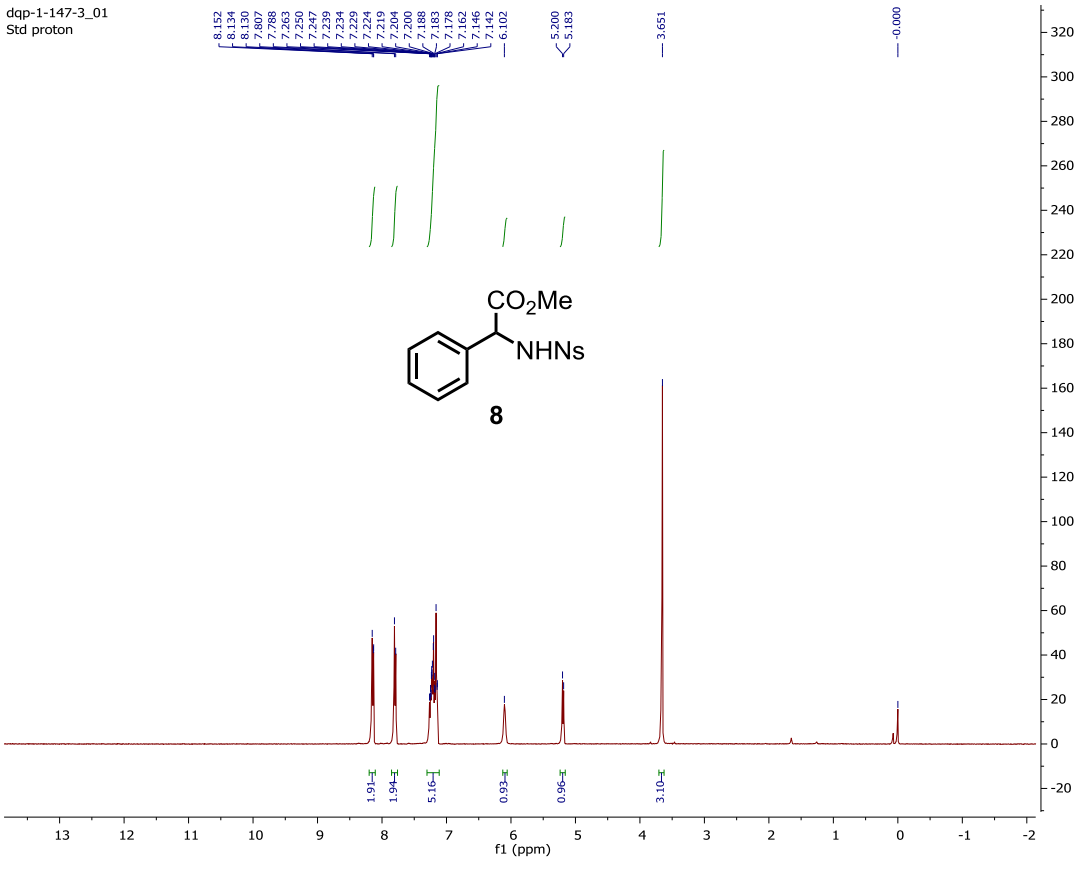


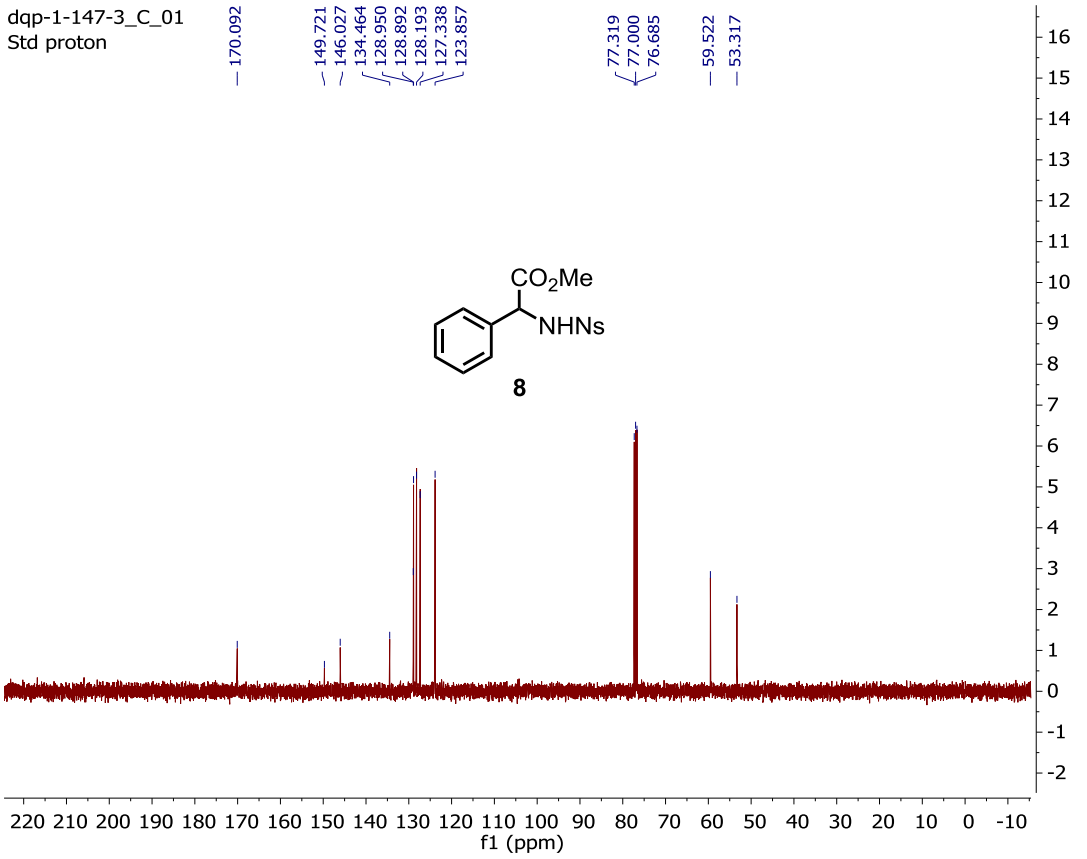
6.075
6.009
4.473
4.458
4.444
4.044
3.734
3.099
3.087
3.070
3.059
2.940
2.935
2.923
2.918
2.912
2.908
2.895
2.890
1.326
1.312
-0.000
O
Me
N
H
CO_2Me
NHNs
6b
1.95
1.98
3.01
2.01
1.02
0.97
0.98
1.00
3.00
1.01
1.01
3.06
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1
f1 (ppm)

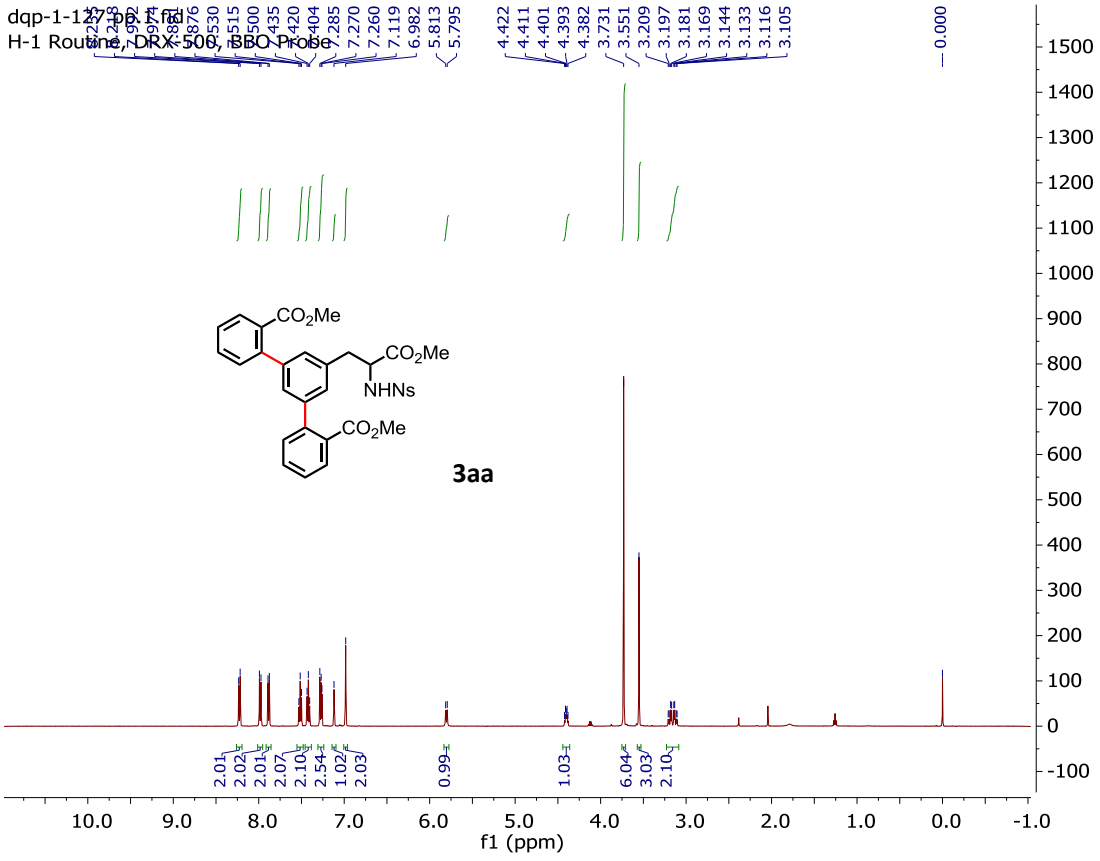

128.11
127.26
124.15
77.26
77.00
76.75
58.41
52.62
48.38
38.88
18.10
NHNs
CO2Me
Me
6b
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

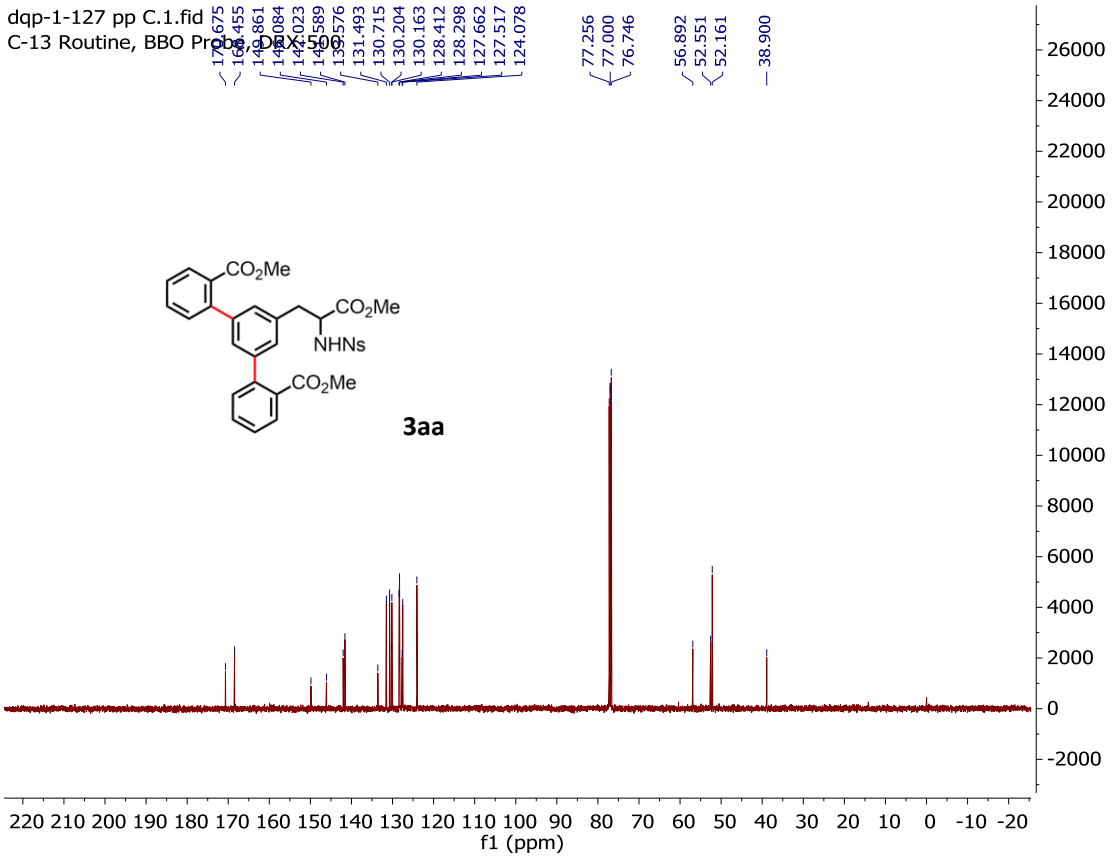

7.035
7.020
7.005
6.951
6.936
6.863
6.848
6.820
6.802
4.441
4.431
4.423
4.414
4.093
4.081
4.075
4.063
3.723
3.097
3.085
2.874
2.856
2.846
2.167
2.090
0.847
0.833
0.824
0.810
Me
iPr
NHNs
CO2Me
6c
2.01
1.97
1.08
1.06
3.03
0.81
0.97
1.00
3.02
0.96
0.97
3.01
1.26
5.99
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1
f1 (ppm)


d2-154-4.4.fid
C-13 Routine, BBO Prose, DRX500
171.940
170.054
149.689
144.001
138.413
135.429
129.768
128.683
128.073
127.875
126.088
123.955
77.254
77.001
76.745
58.803
57.235
52.228
38.915
31.161
21.042
18.646
17.424
Me
O
iPr
N
H
CO2Me
NHNs
6c
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)


dqp-1-147-3_01
Std proton
8.152
8.134
8.130
7.807
7.788
7.263
7.250
7.247
7.239
7.234
7.229
7.224
7.219
7.204
7.200
7.188
7.183
7.178
7.162
7.146
7.142
6.102
5.200
5.183
3.651
-0.000
CO2Me
NHNs
8
1.91
1.94
5.16
0.93
0.96
3.10
13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2
f1 (ppm)


dqp-1-147-3_C_01
Std proton
170.092
149.721
146.027
134.464
128.950
128.892
128.193
127.338
123.857
77.319
77.000
76.685
59.522
53.317
CO2Me
NHNs
8
f1 (ppm)


dqp-1-127-pp-1.fid
H-1 Routine, DRX-500, BBO Probe
4.422
4.411
4.401
4.393
4.382
3.731
3.551
3.209
3.197
3.181
3.169
3.144
3.133
3.116
3.105
0.000
CO2Me
CO2Me
NHNs
CO2Me
3aa
2.01
2.02
2.01
2.07
2.10
2.54
1.02
2.03
0.99
1.03
6.04
3.03
2.10
f1 (ppm)



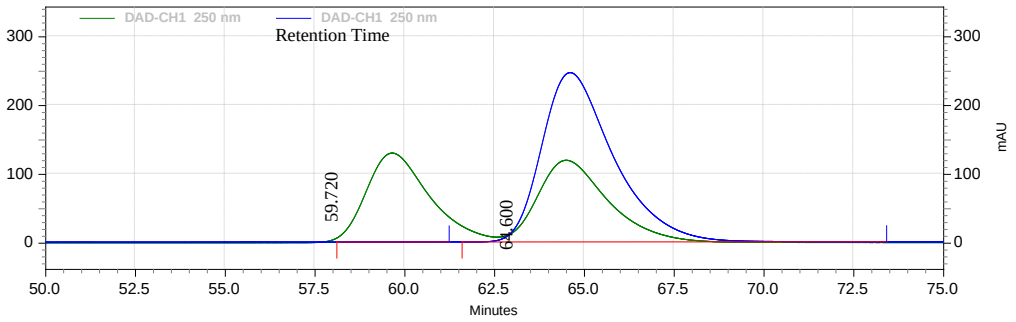
Area % Report

Data File: C:\EZChrom Elite\Enterprise\Projects\Default\Data\DQP\114-2-D-p-20%-0.5mL-ADH

Method: C:\EZChrom Elite\Enterprise\Projects\Default\Method\A 75 min without fc 0.5 ml per min.met

Acquired: 6/4/2015 6:08:22 PM

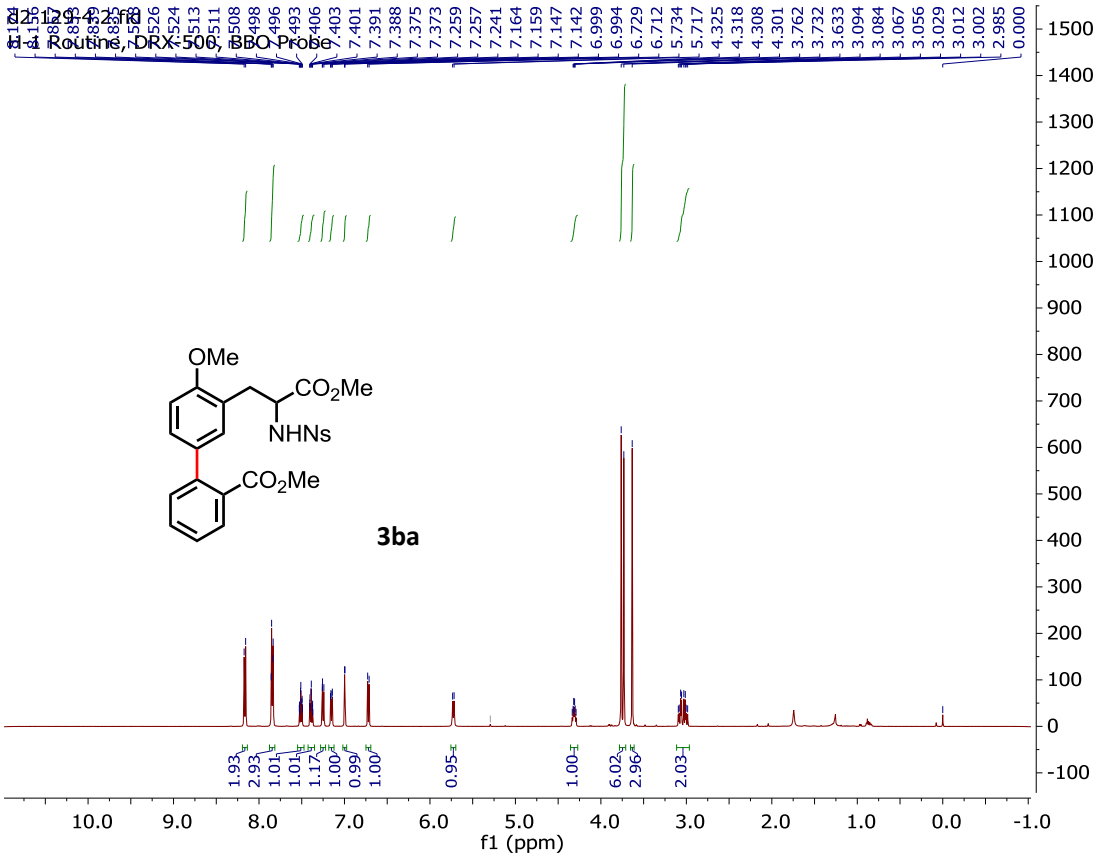
Printed: 8/27/2015 10:23:44 PM

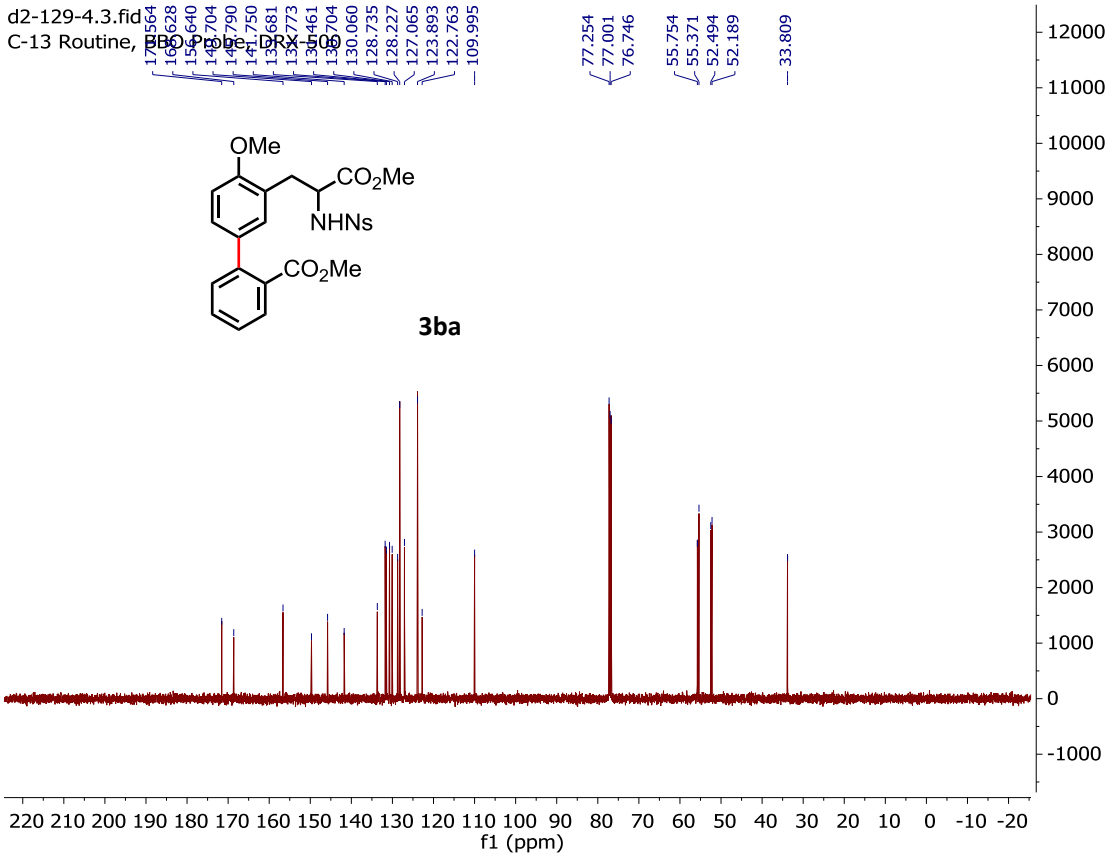


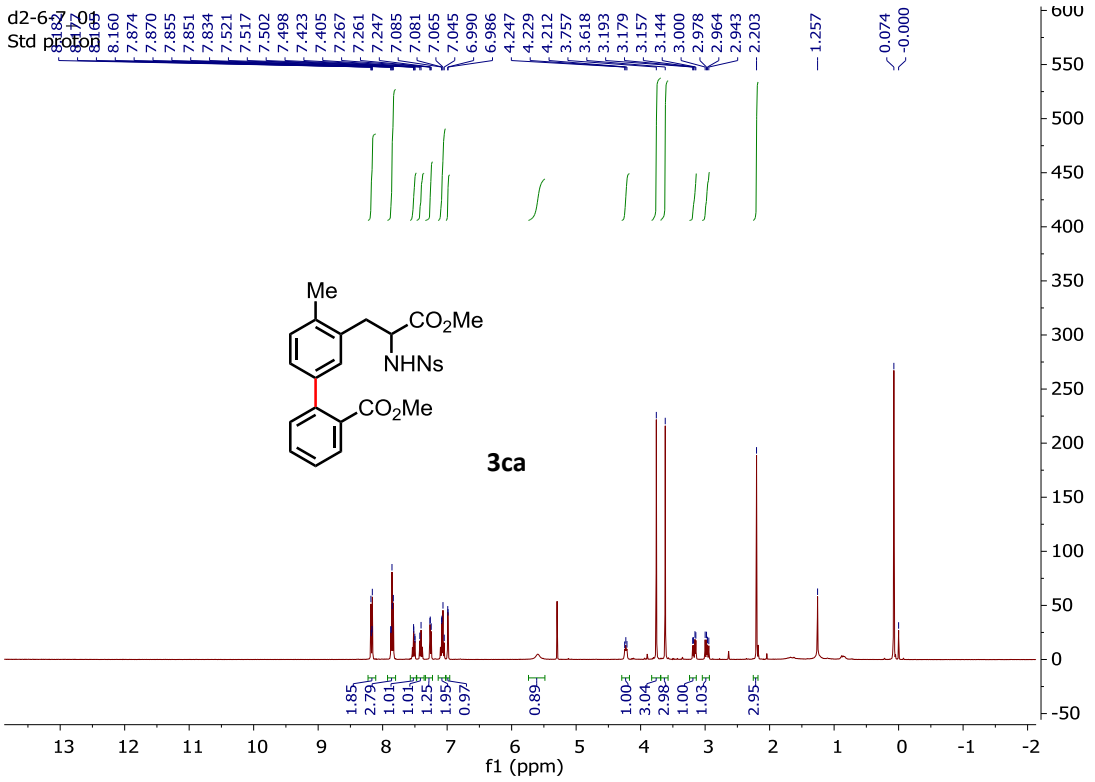
DAD-CH1 250 nm Results

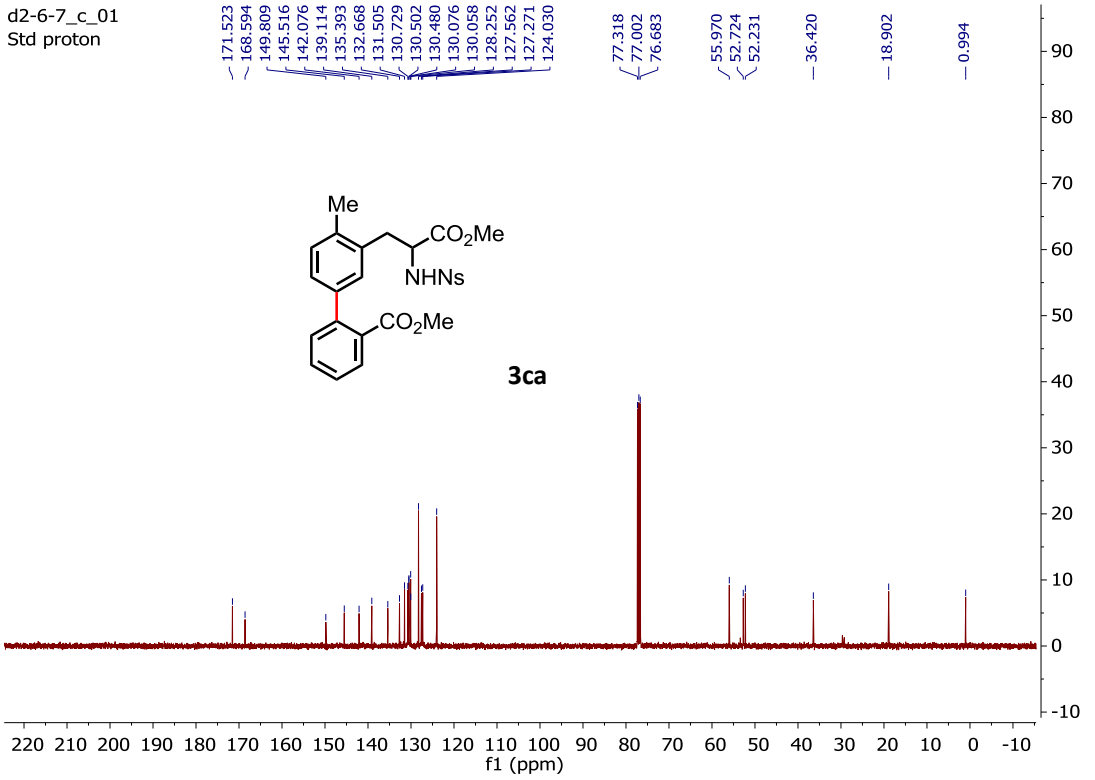
Retention Time	Area	Area %	Height	Height %
59.720	32597	0.02	376	0.04
64.600	137108036	99.98	984748	99.96

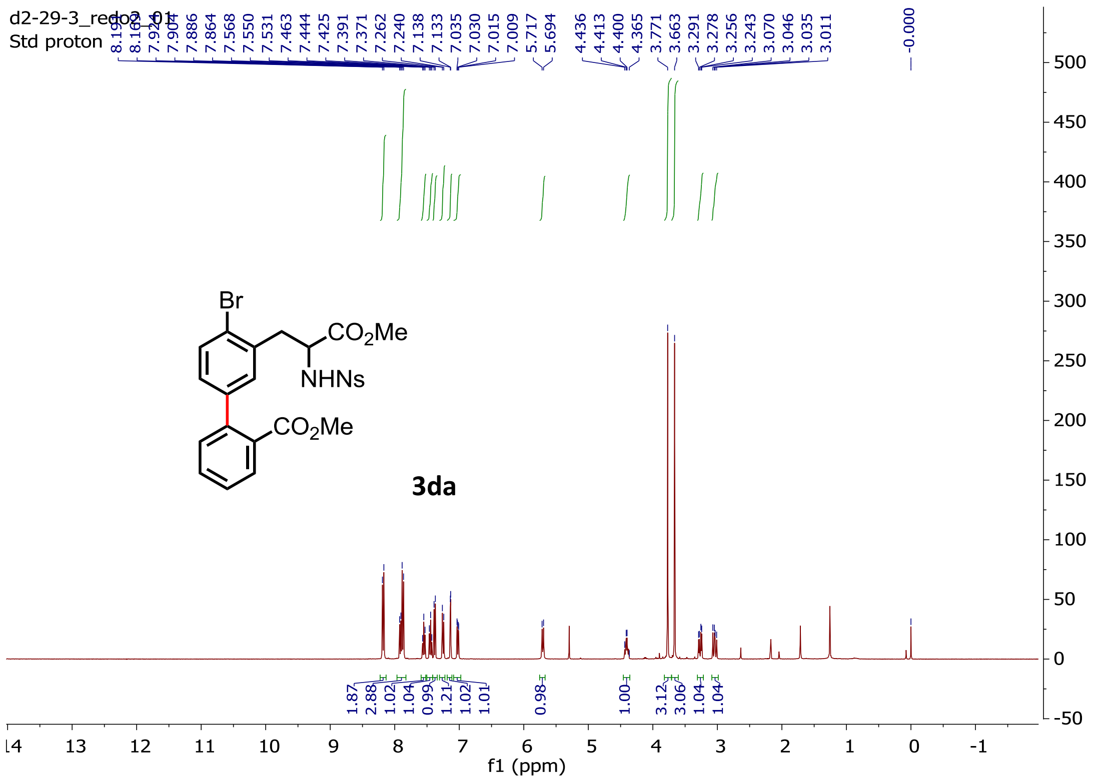
Totals	137140633	100.00	985124	100.00

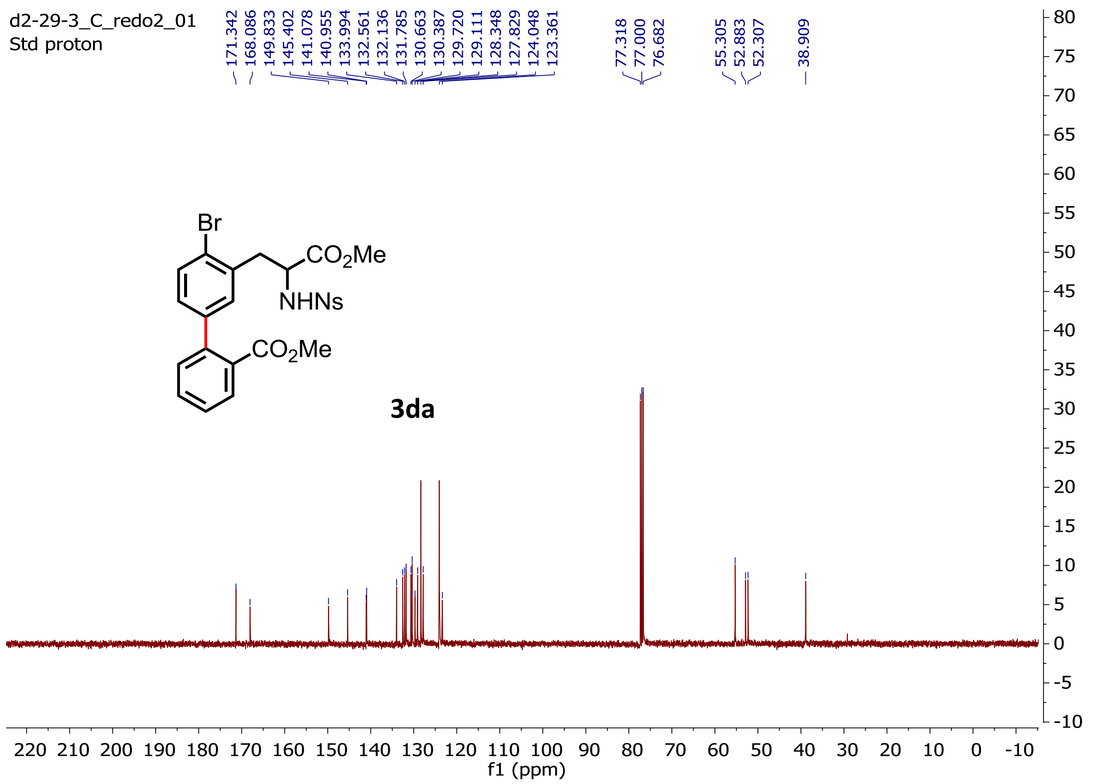

d2-129-4.2.fid
d-1 Routine, DRX-500, BBO Probe
OMe
CO2Me
NHNs
CO2Me
3ba
f1 (ppm)

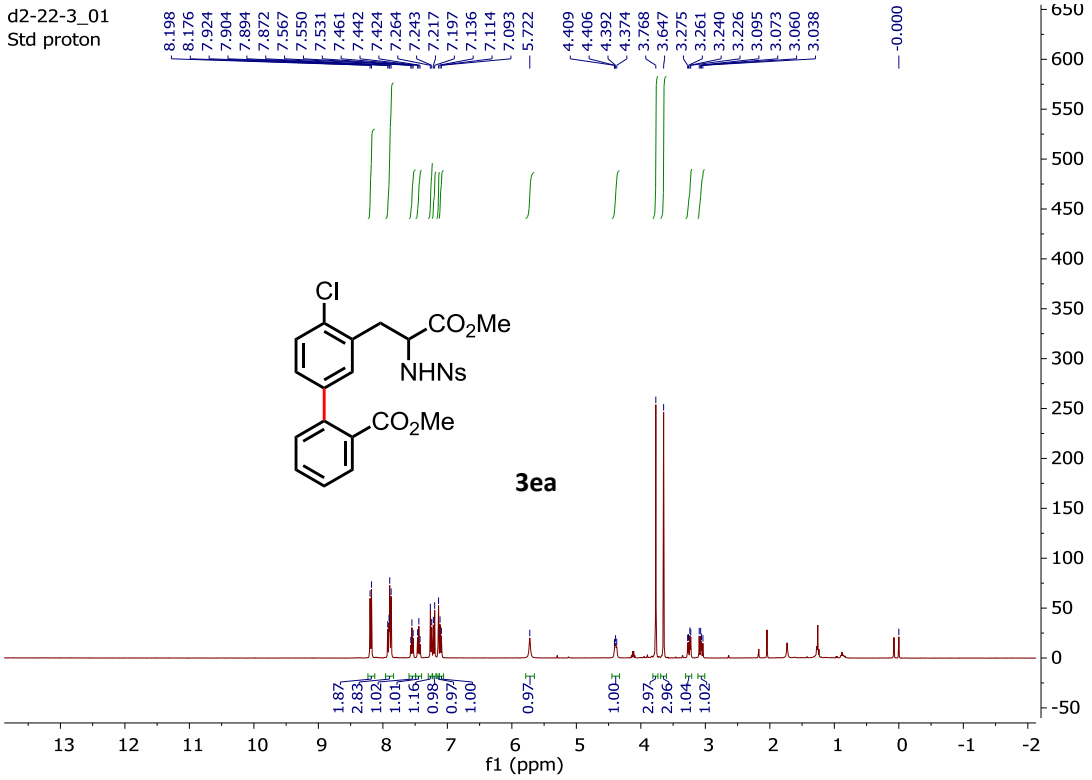

d2-129-4.3.fid
C-13 Routine, BBO Probe, DRX-500
OMe
CO2Me
NHNs
CO2Me
3ba
f1 (ppm)

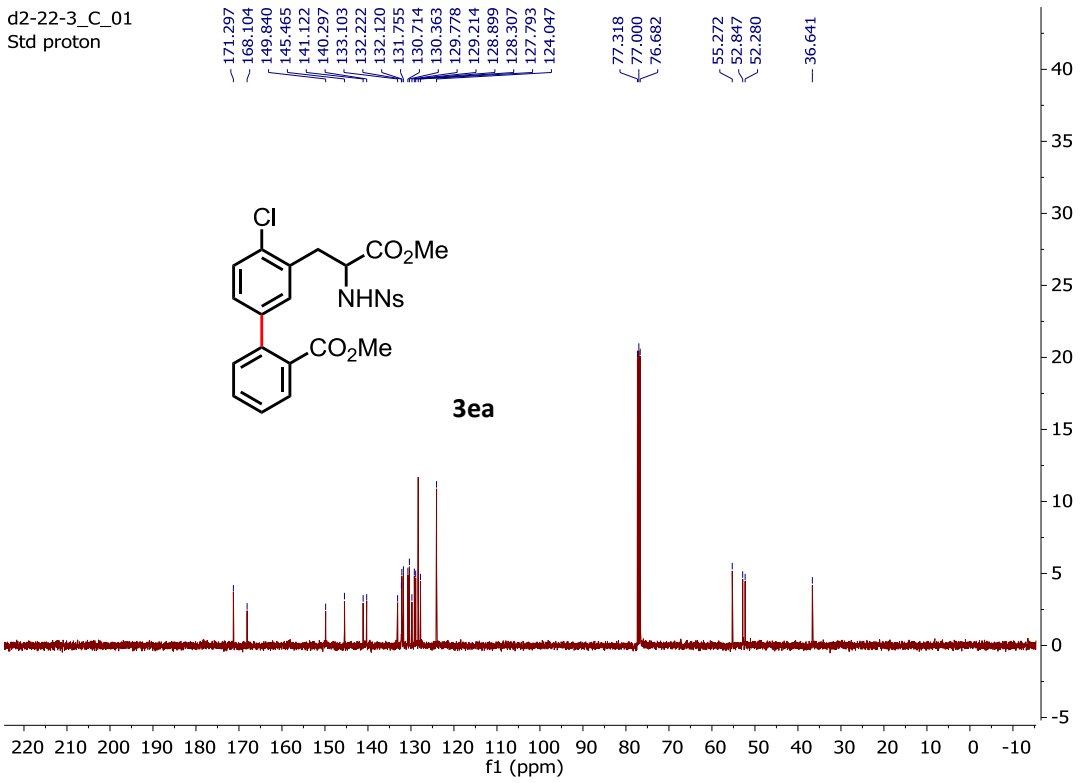

d2-6-7_c_01
Std proton
Me
CO2Me
NHNs
CO2Me
3ca
f1 (ppm)

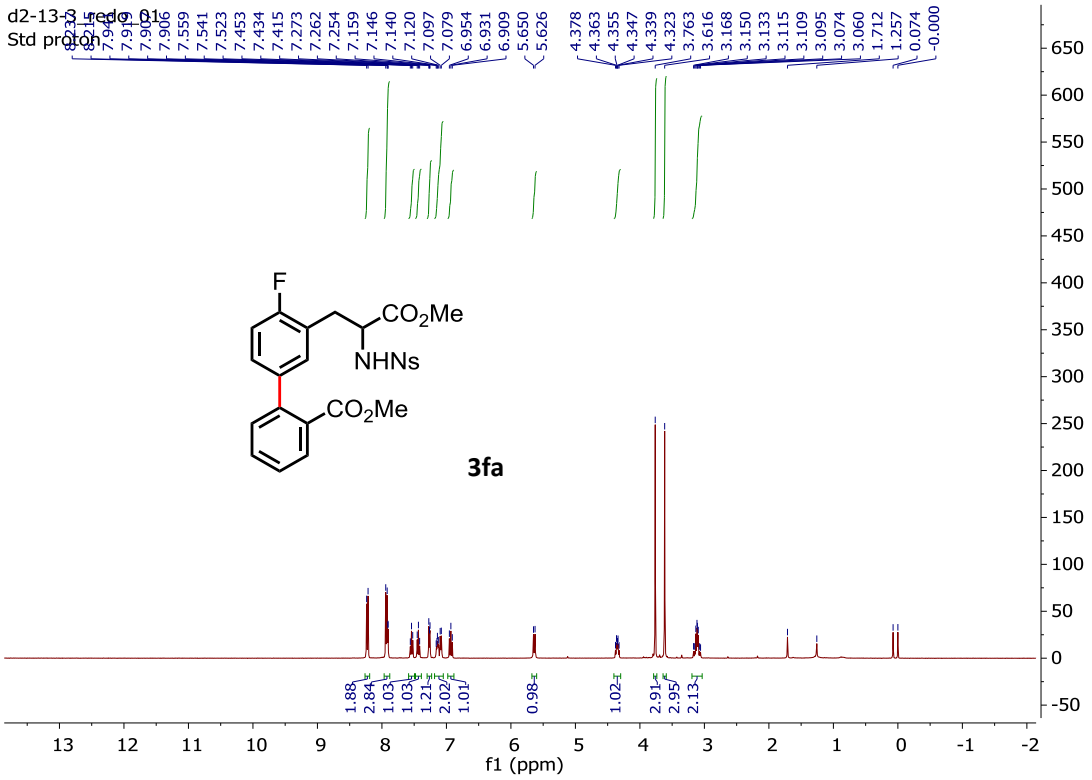

d2-6-7_c_01
Std proton
Me
CO2Me
NHNs
CO2Me
3ca
f1 (ppm)

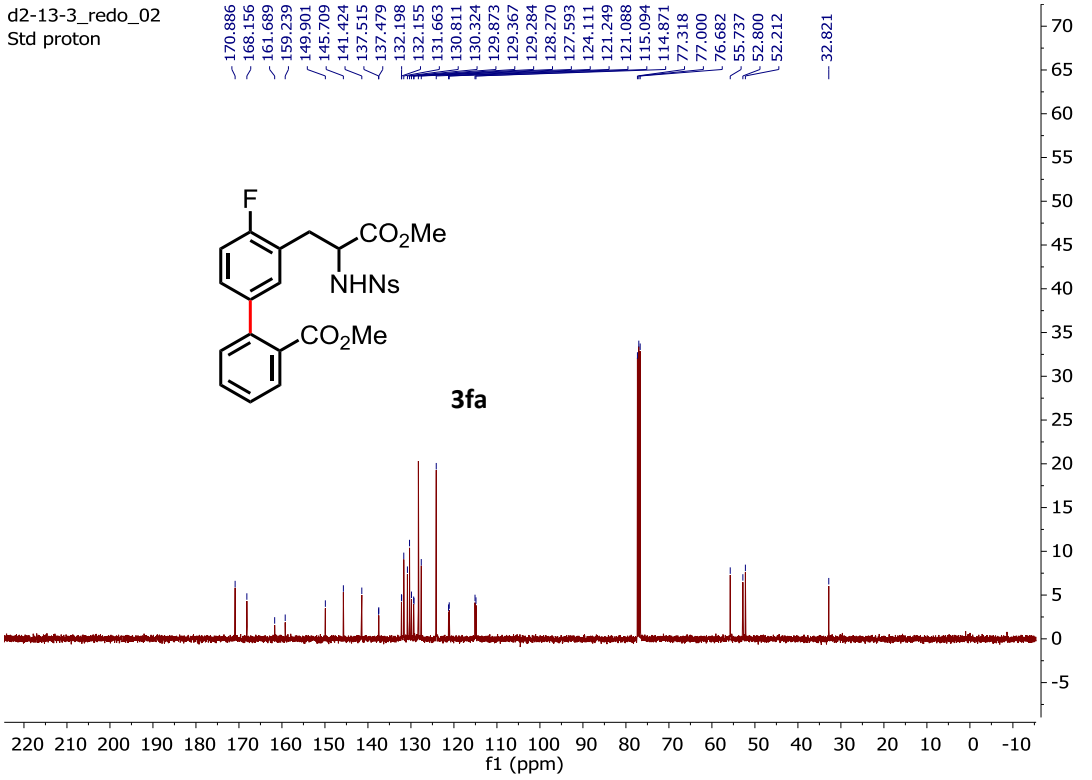

d2-29-3_redo2_01
Std proton
8.190 8.169 7.924 7.904 7.886 7.864 7.568 7.550 7.531 7.463 7.444 7.425 7.391 7.371 7.262 7.240 7.138 7.133 7.035 7.030 7.015 7.009 5.717 5.694 4.436 4.413 4.400 4.365 3.771 3.663 3.291 3.278 3.256 3.243 3.070 3.046 3.035 3.011
-0.000
Br
CO2Me
NHNs
CO2Me
3da
1.87 2.88 1.02 1.04 0.99 1.21 1.02 1.01 0.98 1.00 3.12 3.06 1.04 1.04
f1 (ppm)

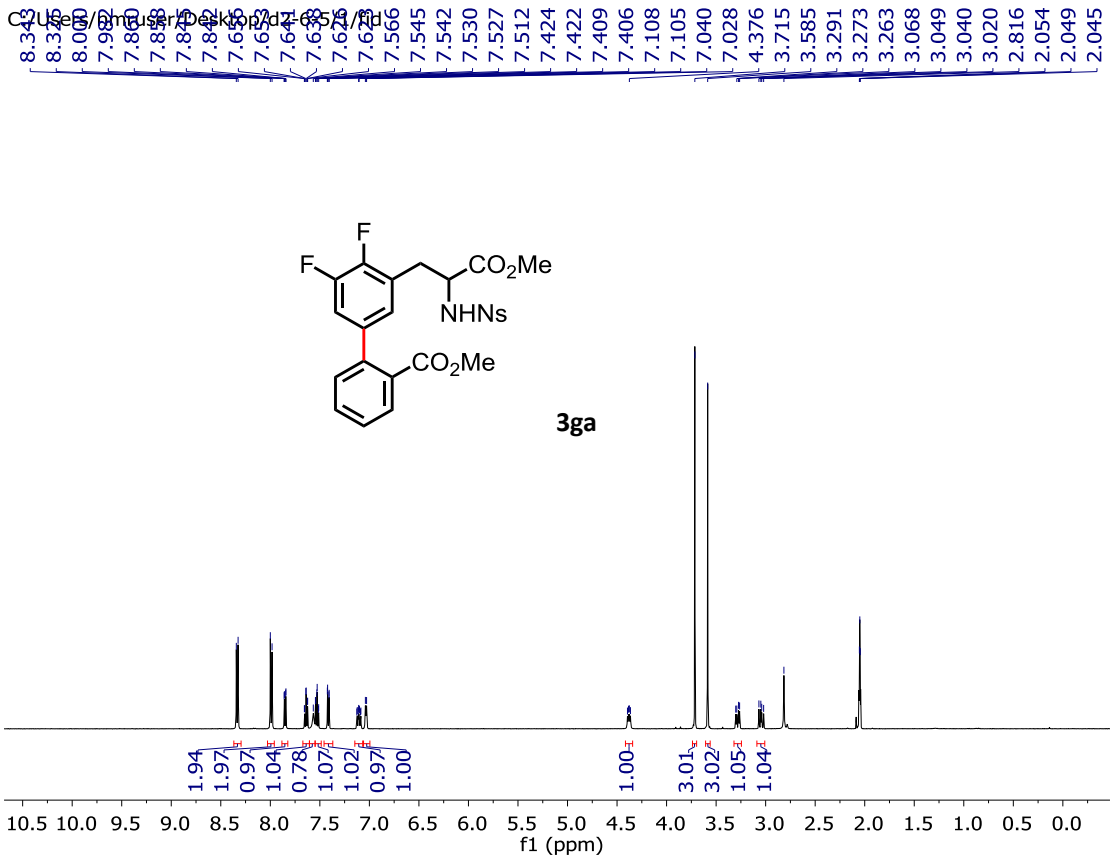

d2-29-3_C_redo2_01
Std proton
171.342 168.086 149.833 145.402 141.078 140.955 133.994 132.561 132.136 131.785 130.663 130.387 129.720 129.111 128.348 127.829 124.048 123.361
77.318 77.000 76.682
55.305 52.883 52.307
38.909
Br
CO2Me
NHNs
CO2Me
3da
f1 (ppm)

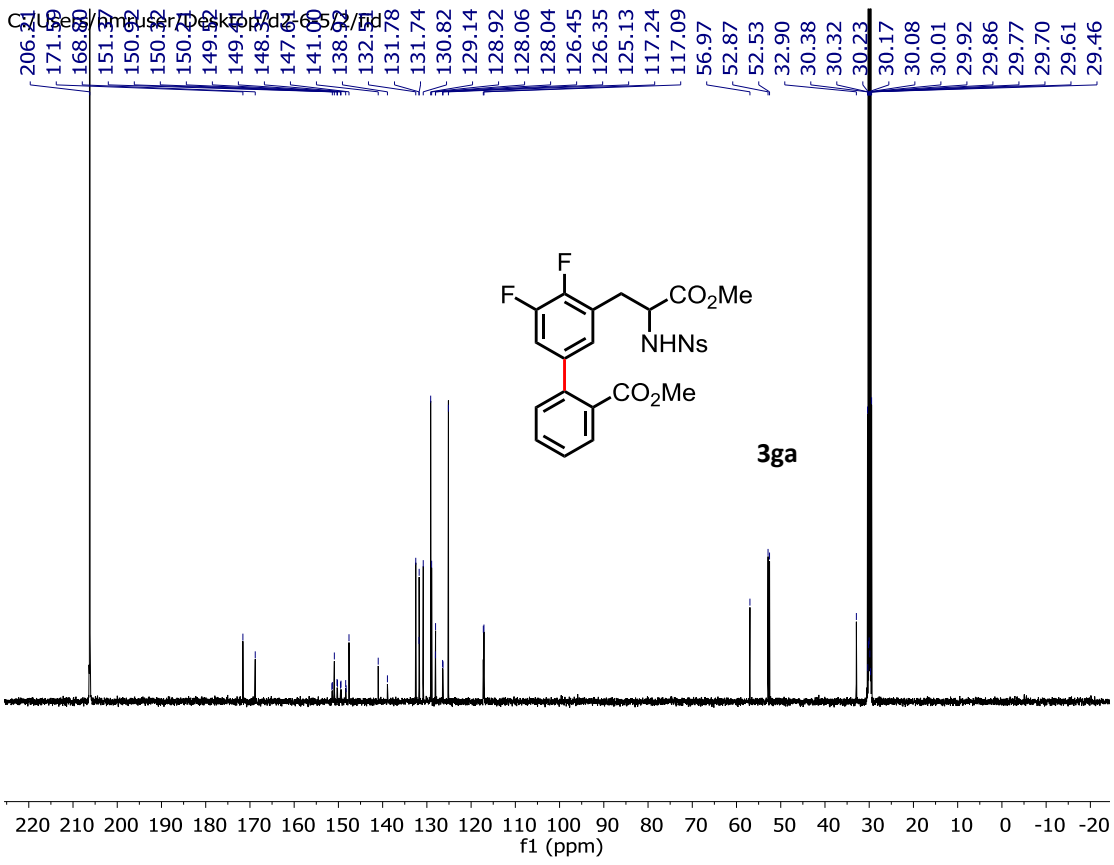

d2-22-3_01
Std proton
8.198
8.176
7.924
7.904
7.894
7.872
7.567
7.550
7.531
7.461
7.442
7.424
7.264
7.243
7.217
7.197
7.136
7.114
7.093
5.722
4.409
4.406
4.392
4.374
3.768
3.647
3.275
3.261
3.240
3.226
3.095
3.073
3.060
3.038
-0.000
Cl
CO2Me
NHNs
CO2Me
3ea
1.87
2.83
1.02
1.01
1.16
0.98
0.97
1.00
0.97
1.00
2.97
2.96
1.04
1.02
f1 (ppm)

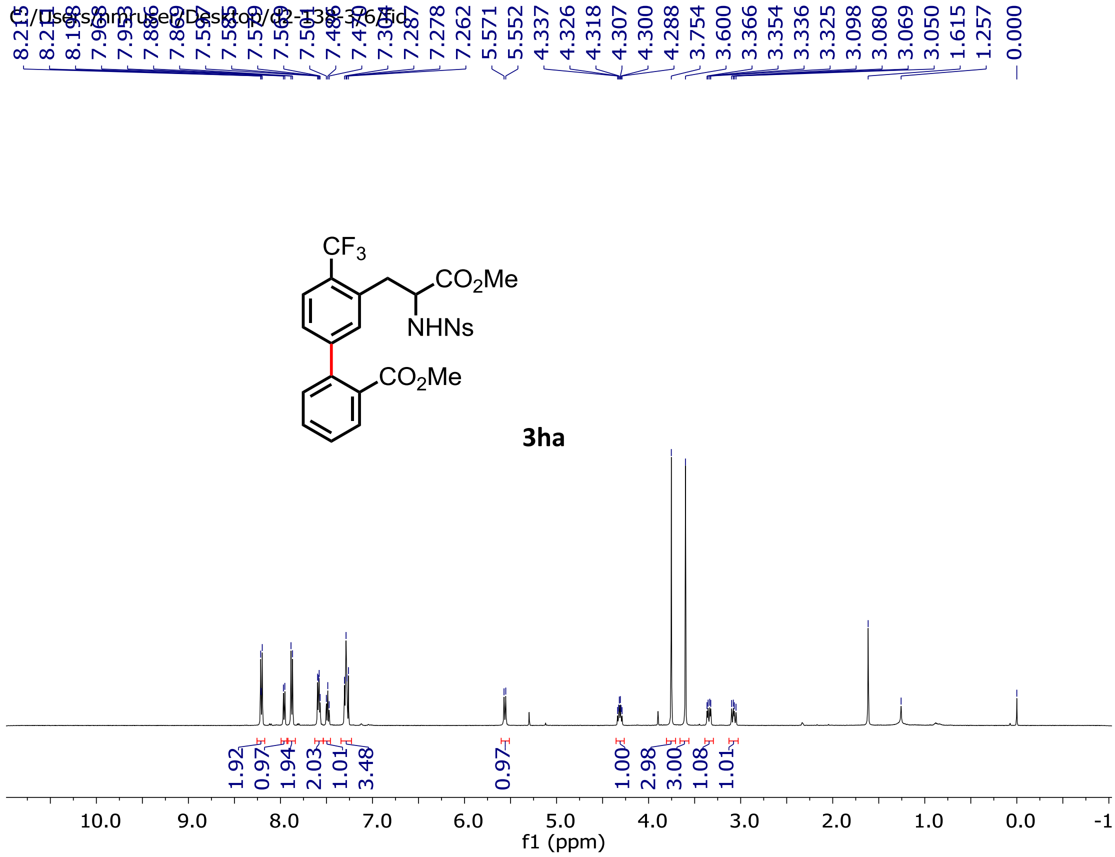

d2-22-3_C_01
Std proton
171.297
168.104
149.840
145.465
141.122
140.297
133.103
132.222
132.120
131.755
130.714
130.363
129.778
129.214
128.899
128.307
127.793
124.047
77.318
77.000
76.682
55.272
52.847
52.280
36.641
Cl
CO2Me
NHNs
CO2Me
3ea
f1 (ppm)


d2-13-3_redo_01
Std proton
F
CO2Me
NHNs
CO2Me
3fa
f1 (ppm)

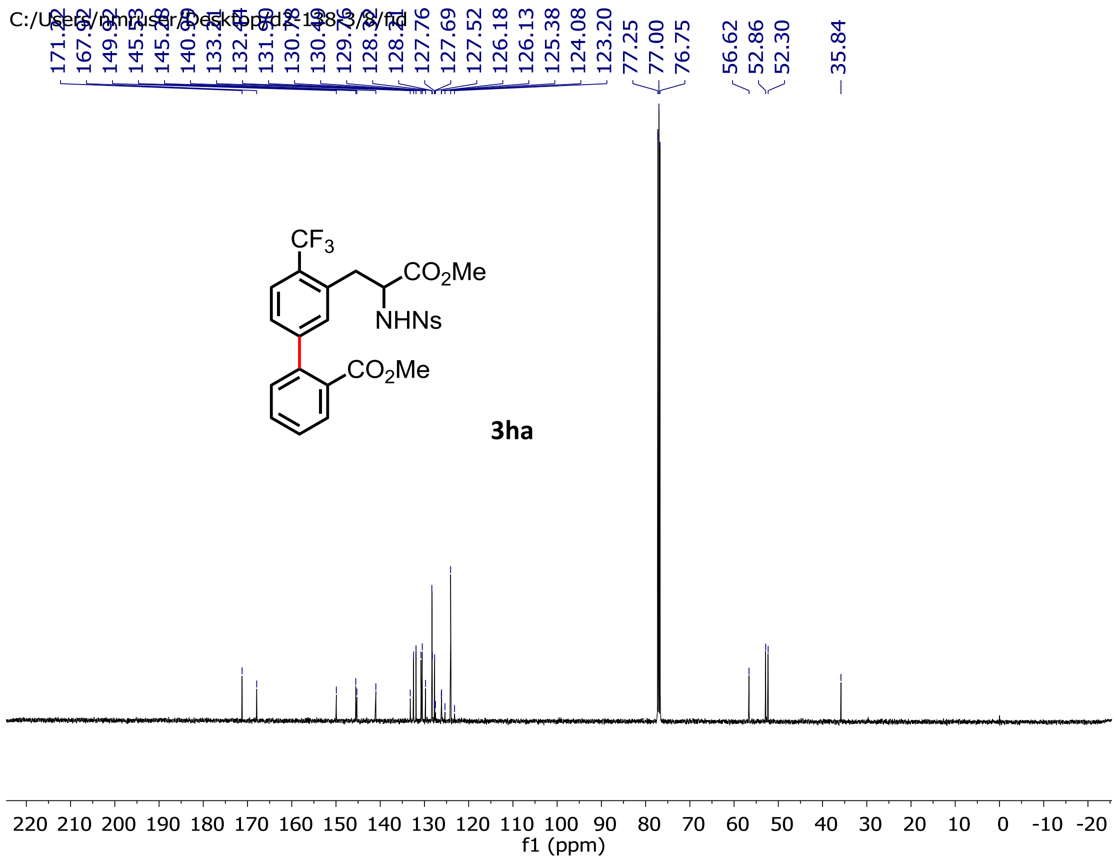

d2-13-3_redo_02
Std proton
F
CO2Me
NHNs
CO2Me
3fa
f1 (ppm)


C:\Users\bmtuser\Desktop\dz-6-5A\1\fid
F
F
CO2Me
NHNs
CO2Me
3ga
1.94
1.97
0.97
1.04
0.78
1.07
1.02
0.97
1.00
1.00
3.01
3.02
1.05
1.04
f1 (ppm)

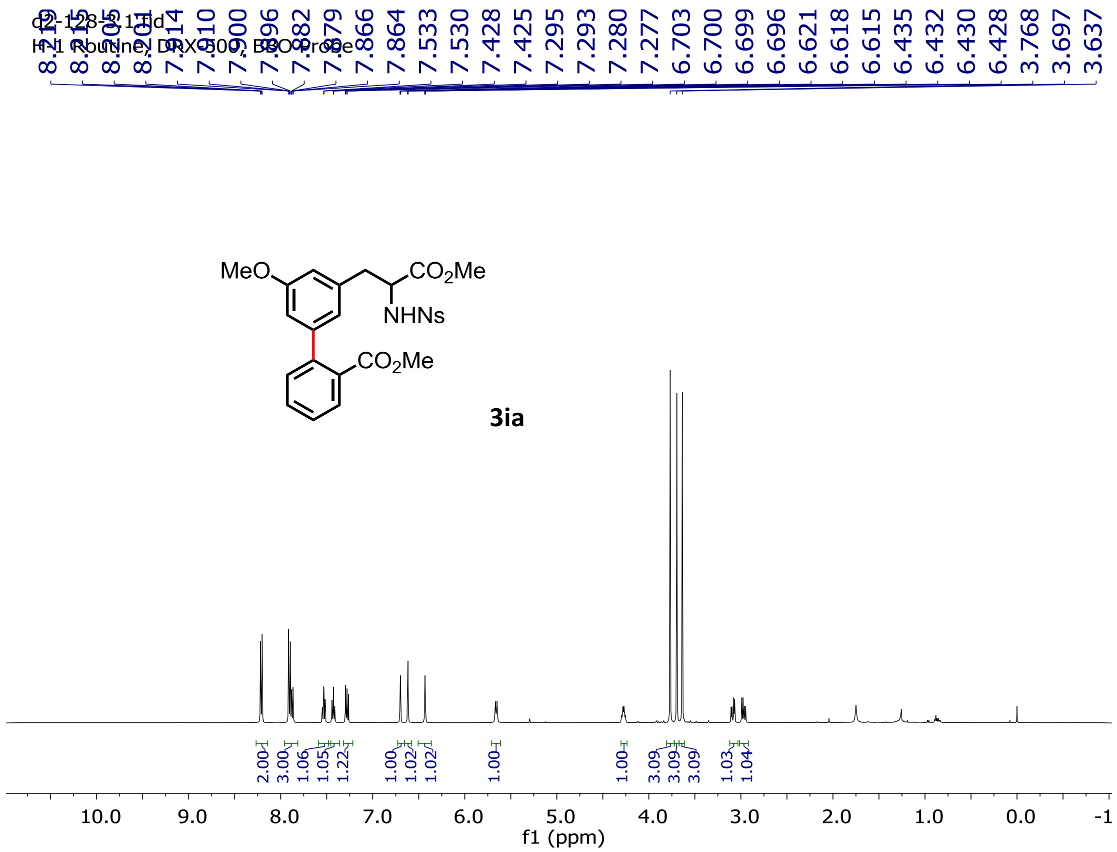

C:\Users\bmtuser\Desktop\dz-6-5A\2\fid
F
F
CO2Me
NHNs
CO2Me
3ga
f1 (ppm)

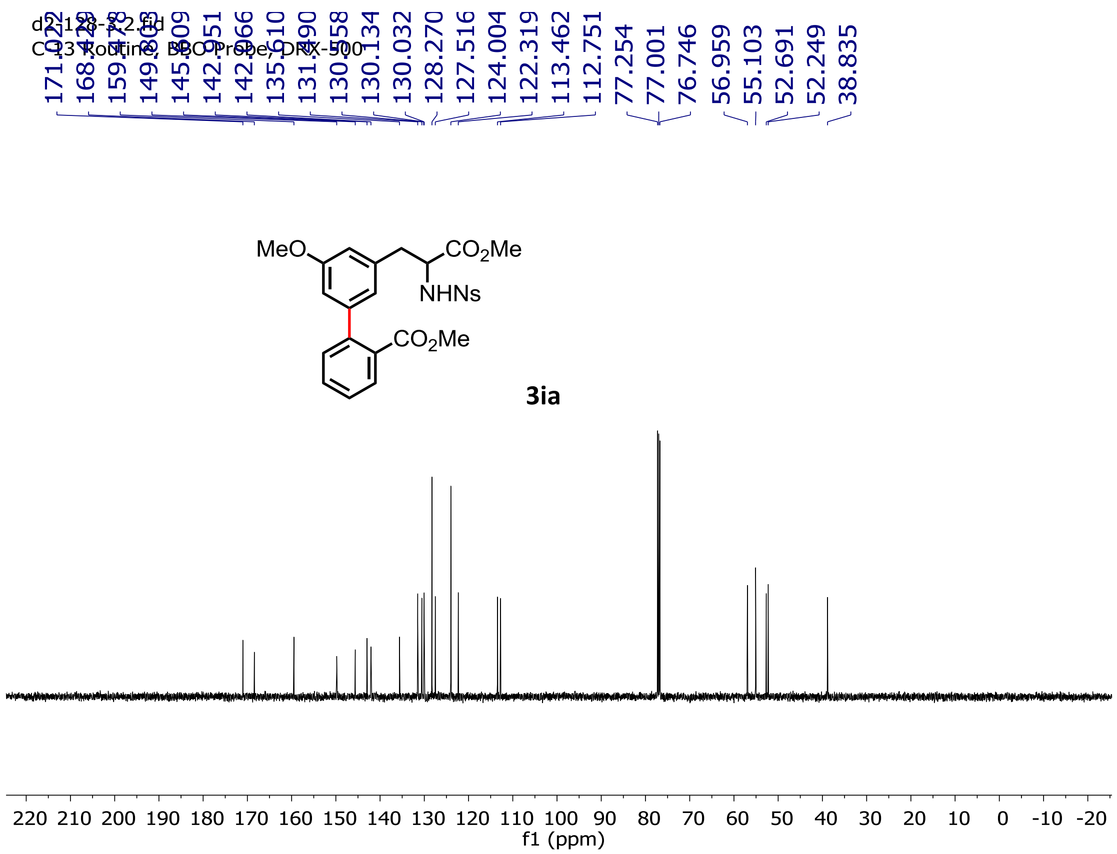


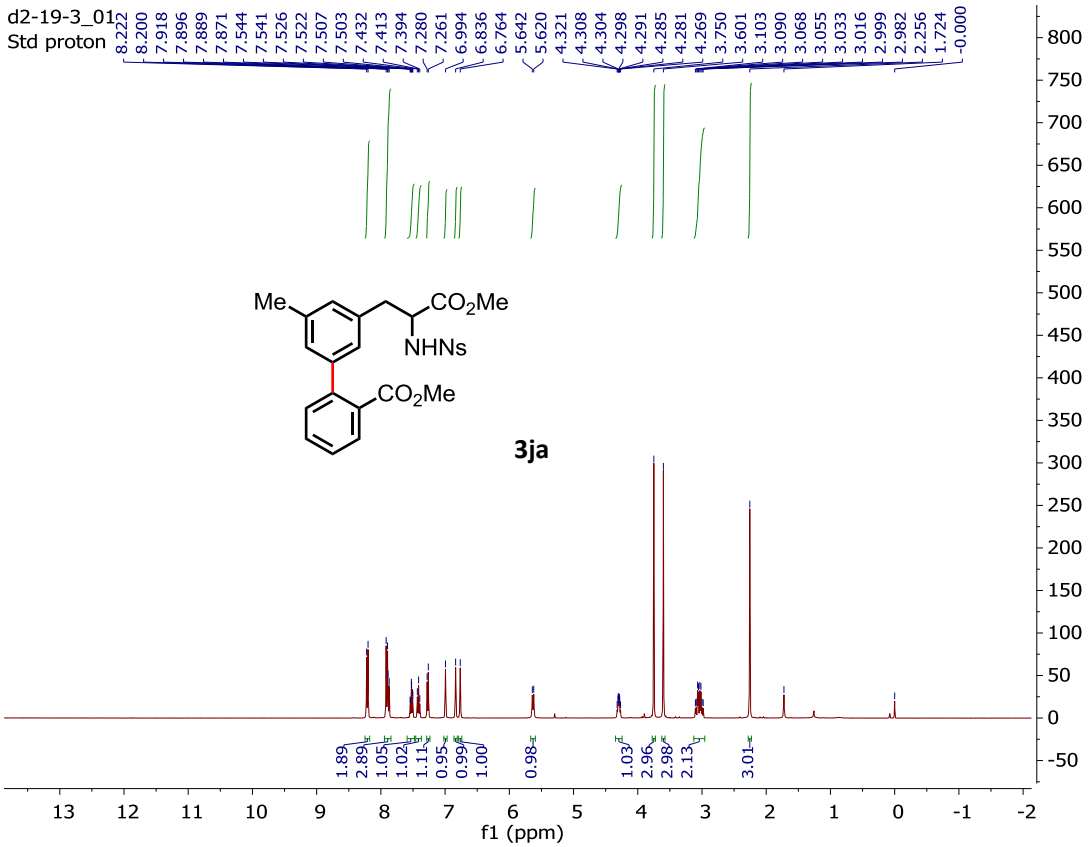
7.287
7.278
7.262
5.571
5.552
4.337
4.326
4.318
4.307
4.300
4.288
3.754
3.600
3.366
3.354
3.336
3.325
3.098
3.080
3.069
3.050
1.615
1.257
0.000
CF3
CO2Me
NHNs
CO2Me
3ha
1.92
0.97
1.94
2.03
1.01
3.48
0.97
1.00
2.98
3.00
1.08
1.01
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1
f1 (ppm)

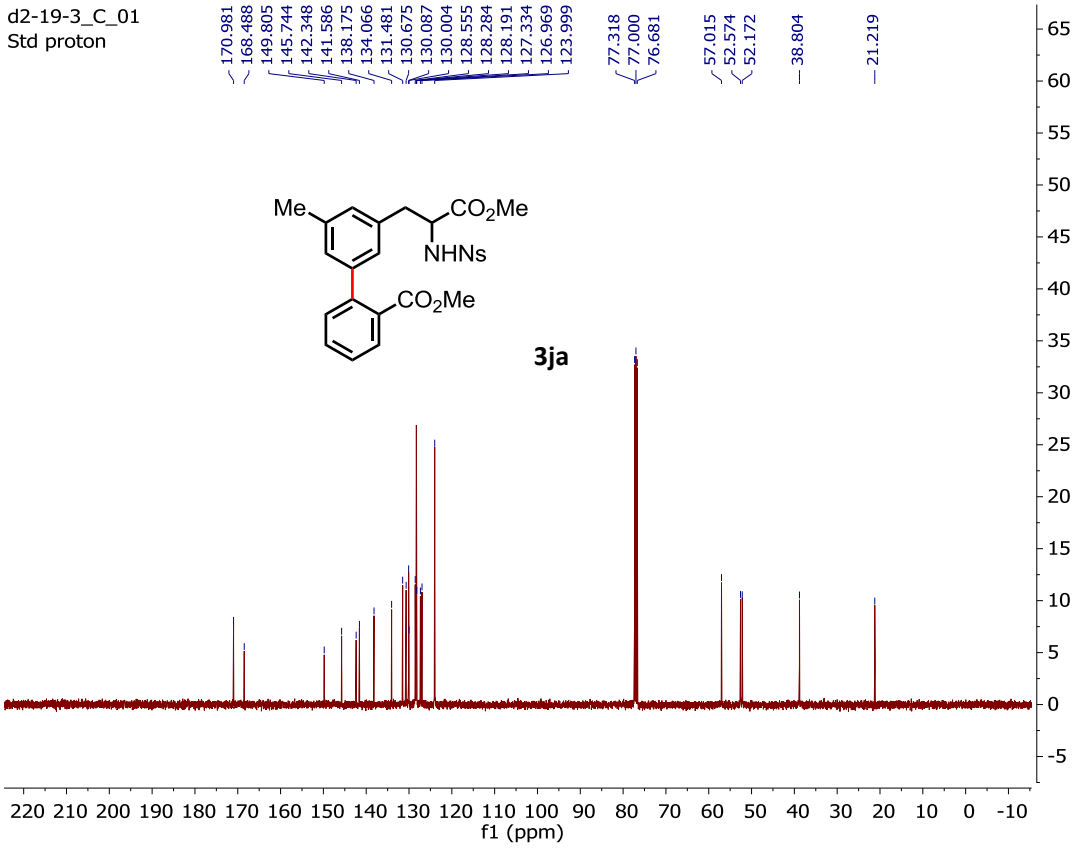


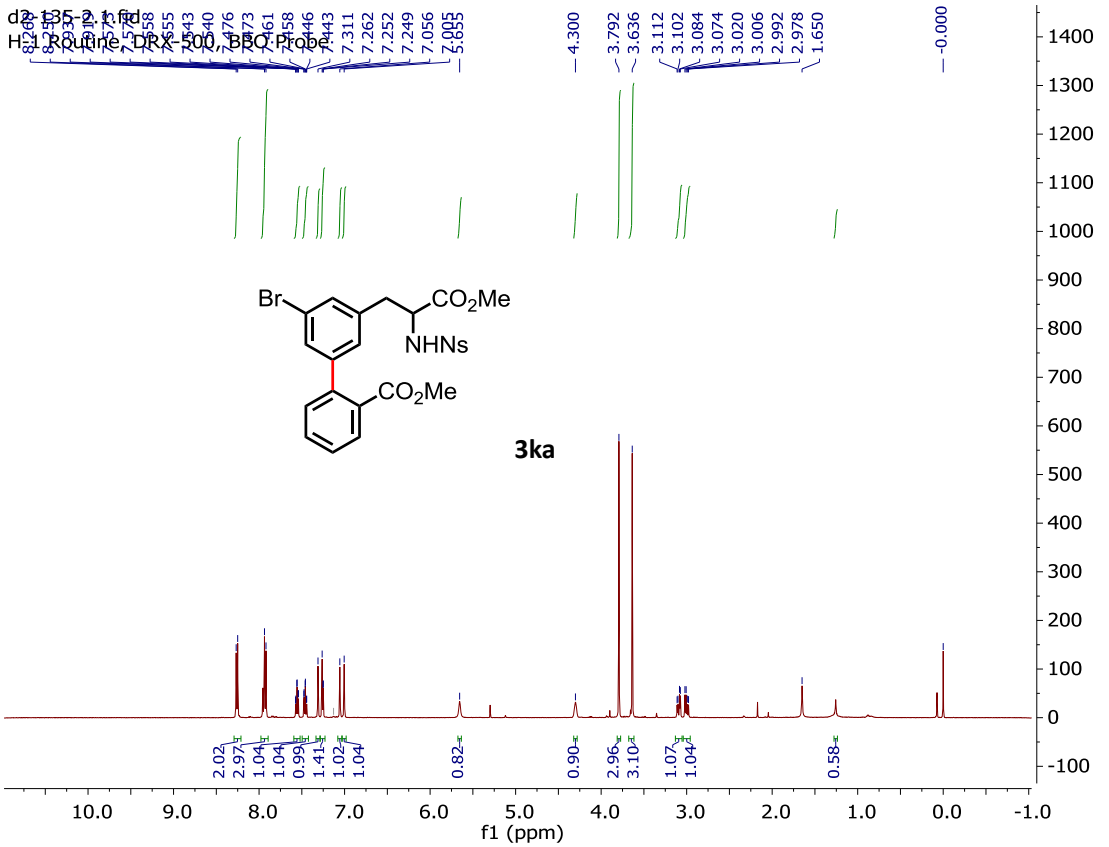
127.76
127.69
127.52
126.18
126.13
125.38
124.08
123.20
77.25
77.00
76.75
56.62
52.86
52.30
35.84
CF3
CO2Me
NHNs
CO2Me
3ha
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

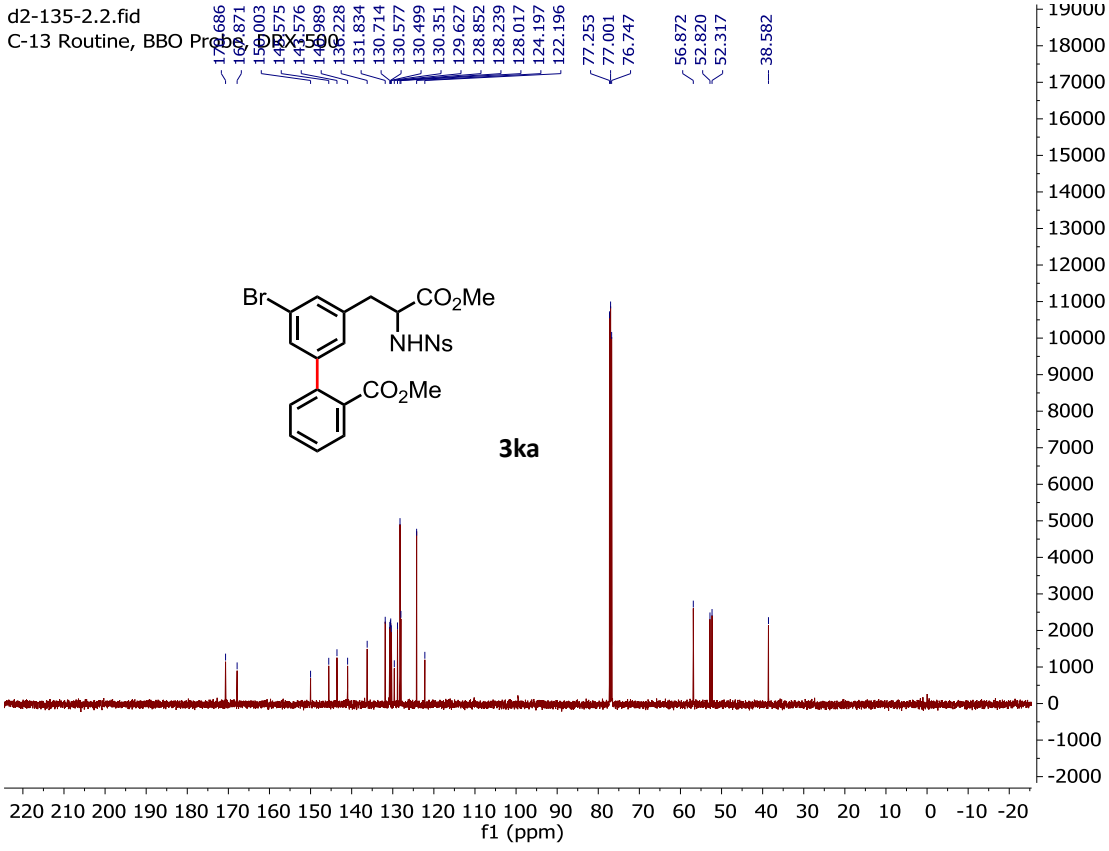

d2-128-3.1.fid
H-1 Routine, DRX-500, BBO Probe
7.914
7.910
7.900
7.896
7.882
7.879
7.866
7.864
7.533
7.530
7.428
7.425
7.295
7.293
7.280
7.277
6.703
6.700
6.699
6.696
6.621
6.618
6.615
6.435
6.432
6.430
6.428
3.768
3.697
3.637
MeO
CO2Me
NHNs
CO2Me
3ia
2.00
3.00
1.06
1.05
1.22
1.00
1.02
1.02
1.00
1.00
3.09
3.09
3.09
1.03
1.04
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1
f1 (ppm)

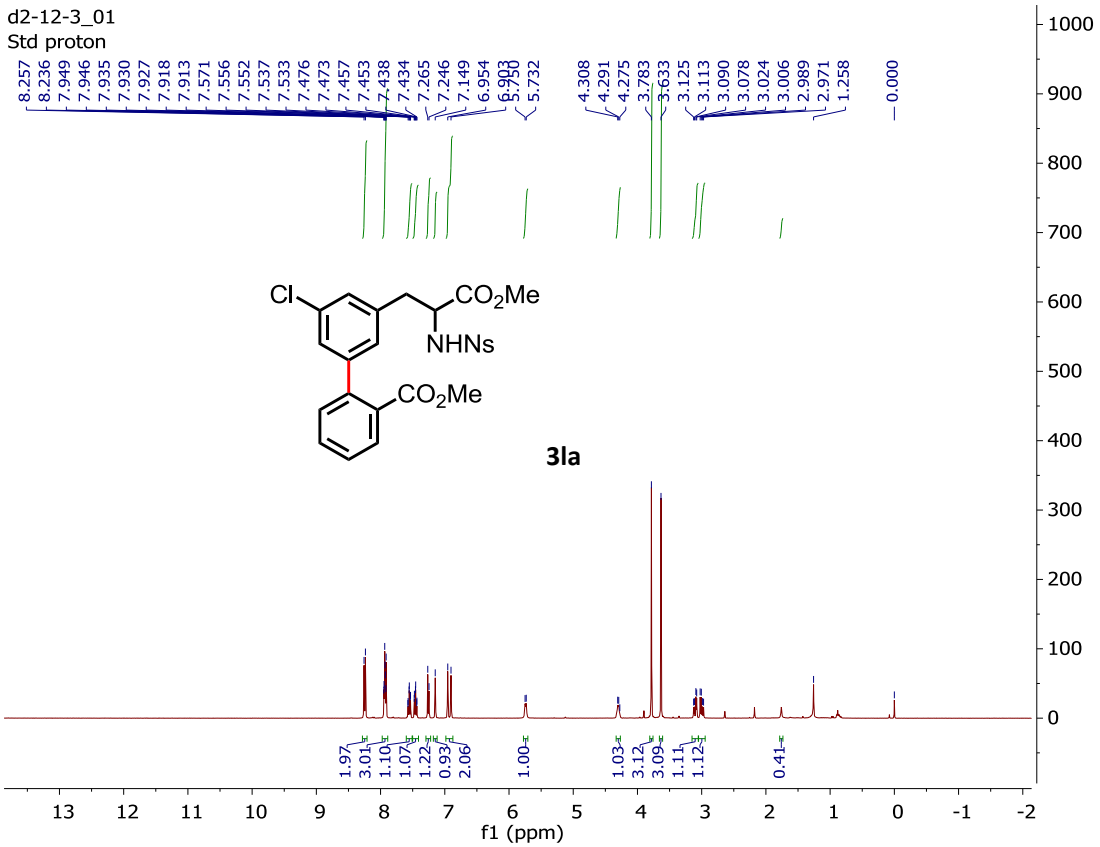

d2-128-3.2.fid
C-13 Routine, BBO Probe, DRX-500
145.009
142.951
142.066
135.910
131.990
130.558
130.134
130.032
128.270
127.516
124.004
122.319
113.462
112.751
77.254
77.001
76.746
56.959
55.103
52.691
52.249
38.835
MeO
CO2Me
NHNs
CO2Me
3ia
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

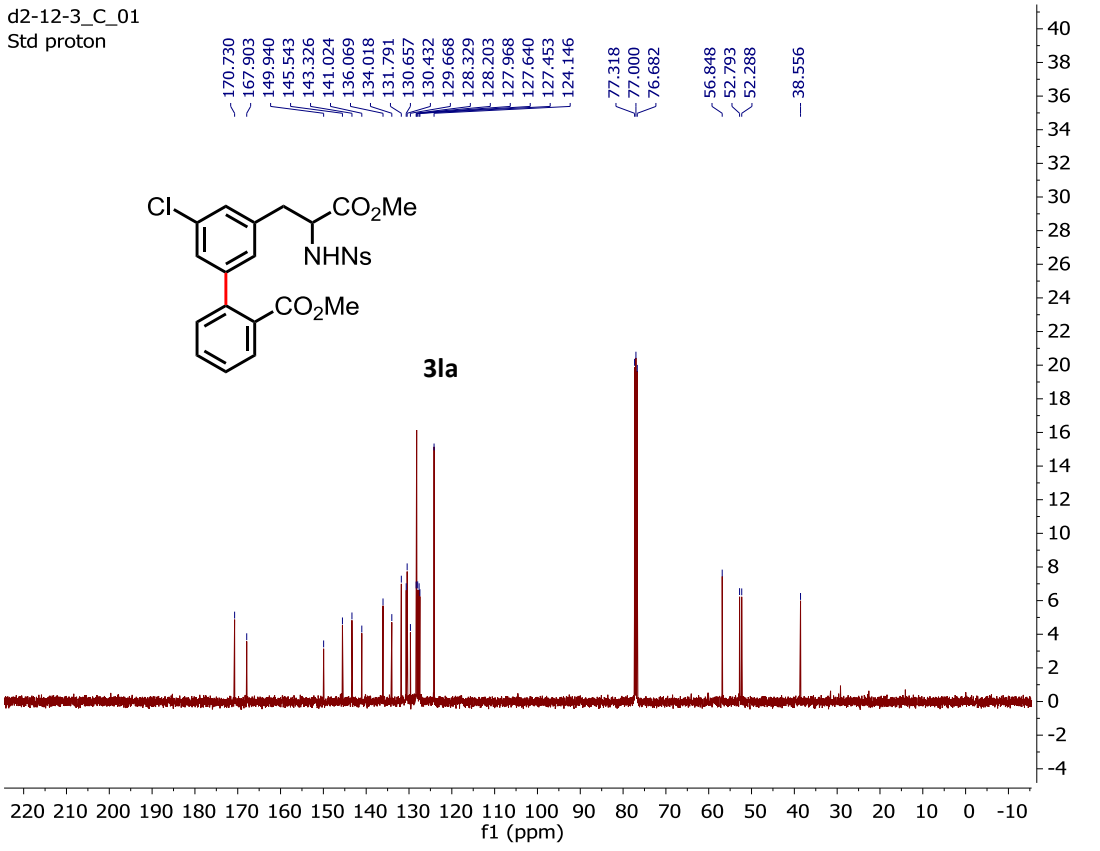

d2-19-3_01
Std proton
8.222
8.200
7.918
7.896
7.889
7.871
7.544
7.541
7.526
7.522
7.507
7.503
7.432
7.413
7.394
7.280
7.261
6.994
6.836
6.764
5.642
5.620
4.321
4.308
4.304
4.298
4.291
4.285
4.281
4.269
3.750
3.601
3.103
3.090
3.068
3.055
3.033
3.016
2.999
2.982
2.256
1.724
-0.000
Me
CO2Me
NHNs
CO2Me
3ja
1.89
2.89
1.05
1.02
1.11
0.95
0.99
1.00
0.98
1.03
2.96
2.98
2.13
3.01
f1 (ppm)

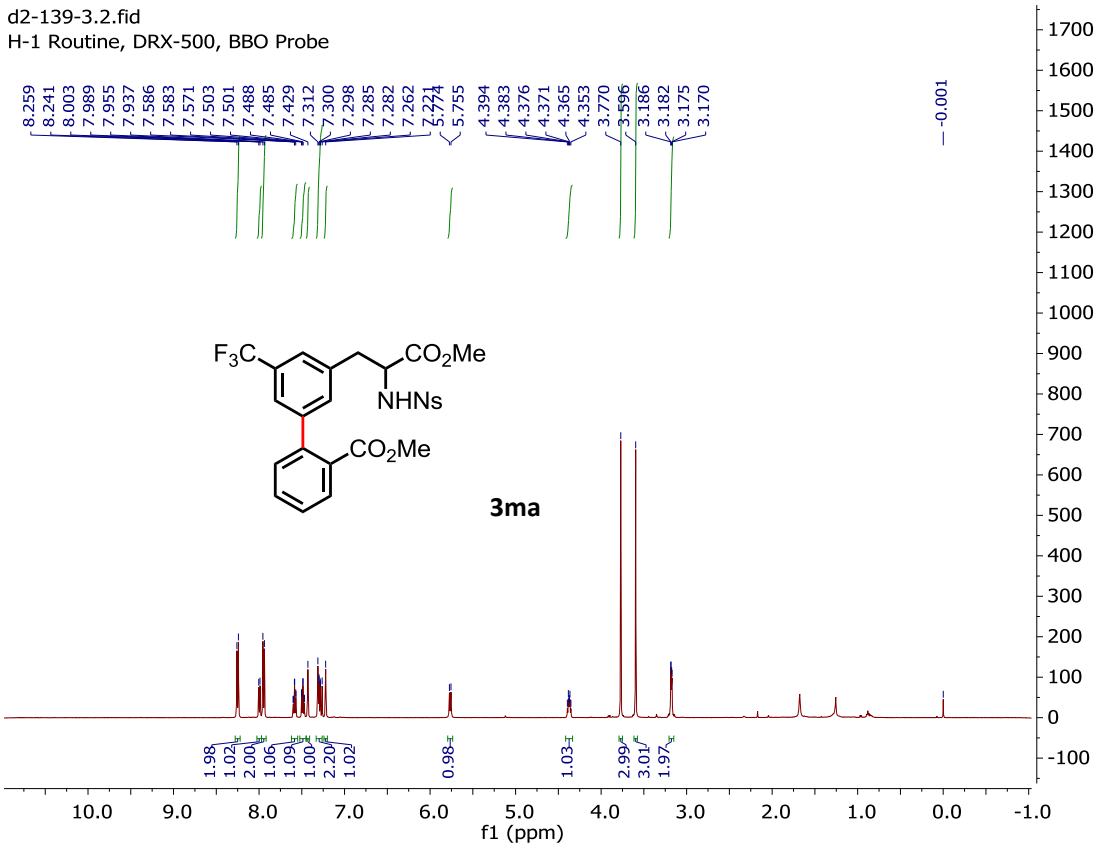

d2-19-3_C_01
Std proton
170.981
168.488
149.805
145.744
142.348
141.586
138.175
134.066
131.481
130.675
130.087
130.004
128.555
128.284
128.191
127.334
126.969
123.999
77.318
77.000
76.681
57.015
52.574
52.172
38.804
21.219
Me
CO2Me
NHNs
CO2Me
3ja
f1 (ppm)

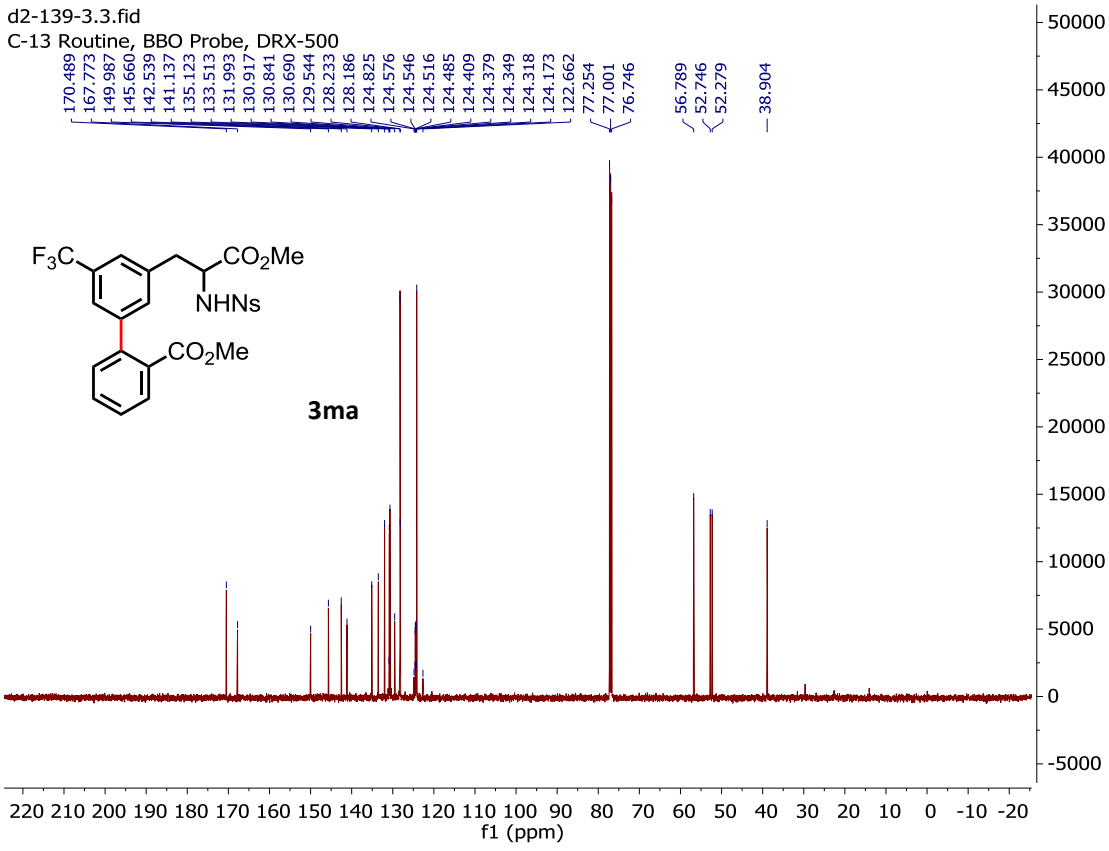

d2-135-2.1.fid
H-1 Routine, DRX-500, BBO Probe
Br
CO2Me
NHNs
CO2Me
3ka
f1 (ppm)

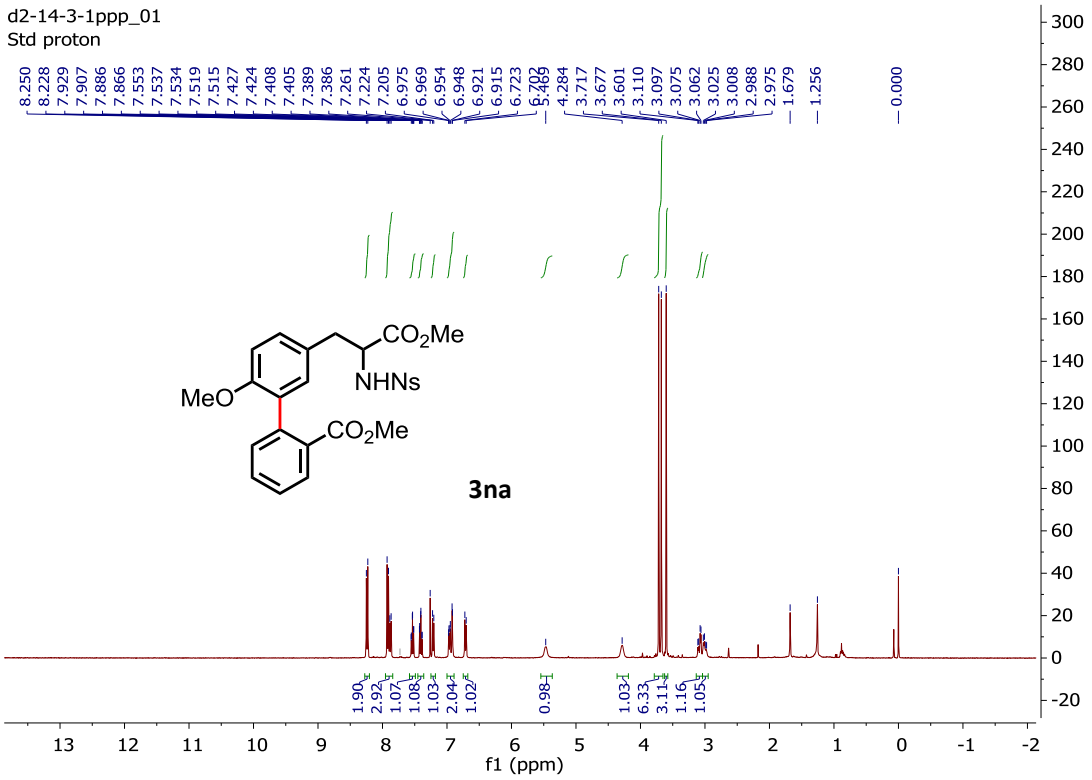

d2-135-2.2.fid
C-13 Routine, BBO Probe, DRX-500
Br
CO2Me
NHNs
CO2Me
3ka
f1 (ppm)

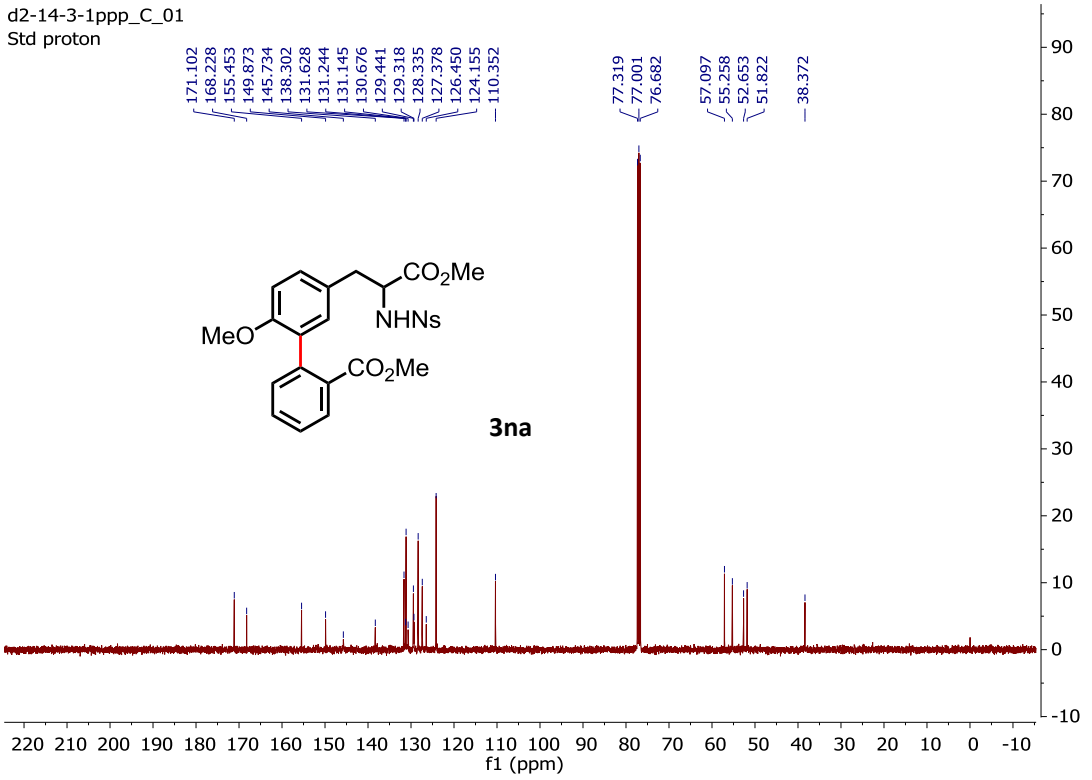

d2-12-3_01
Std proton
8.257
8.236
7.949
7.946
7.935
7.930
7.927
7.918
7.913
7.571
7.556
7.552
7.537
7.533
7.476
7.473
7.457
7.453
7.438
7.434
7.265
7.246
7.149
6.954
6.903
6.750
5.732
4.308
4.291
4.275
3.783
3.633
3.125
3.113
3.090
3.078
3.024
3.006
2.989
2.971
1.258
0.000
Cl
CO2Me
NHNs
CO2Me
3la
1.97
3.01
1.10
1.07
1.22
0.93
2.06
1.00
1.03
3.12
3.09
1.11
1.12
0.41
f1 (ppm)

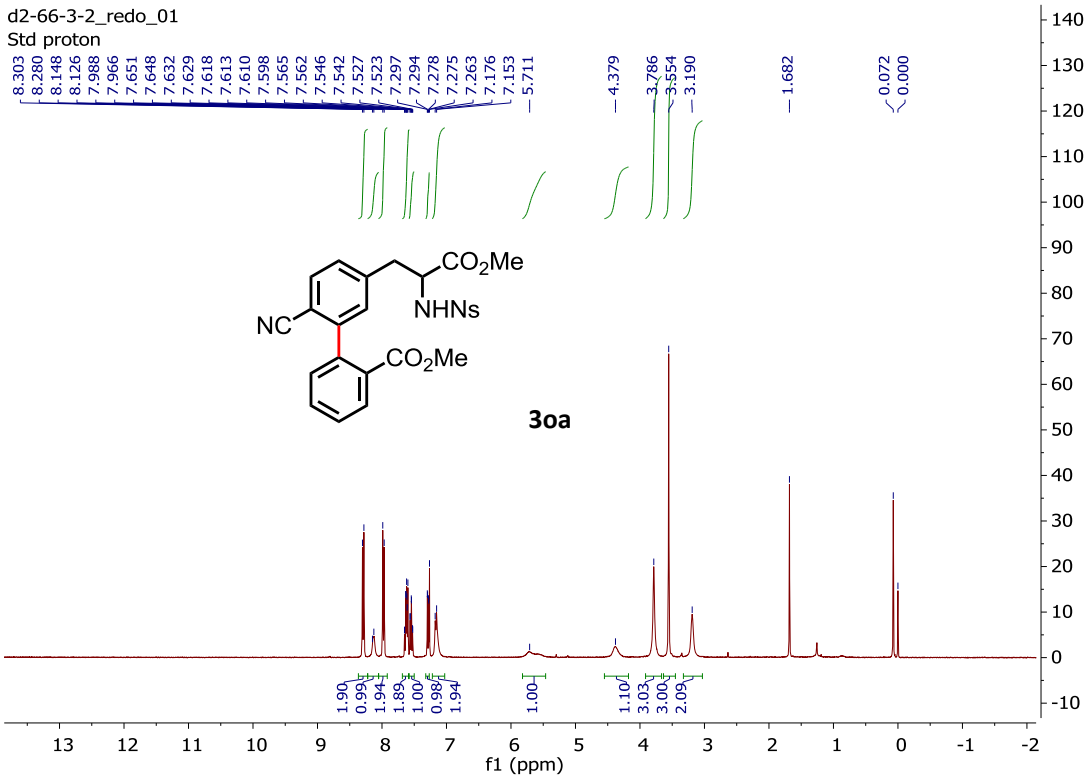

d2-12-3_C_01
Std proton
170.730
167.903
149.940
145.543
143.326
141.024
136.069
134.018
131.791
130.657
130.432
129.668
128.329
128.203
127.968
127.640
127.453
124.146
77.318
77.000
76.682
56.848
52.793
52.288
38.556
Cl
CO2Me
NHNs
CO2Me
3la
f1 (ppm)

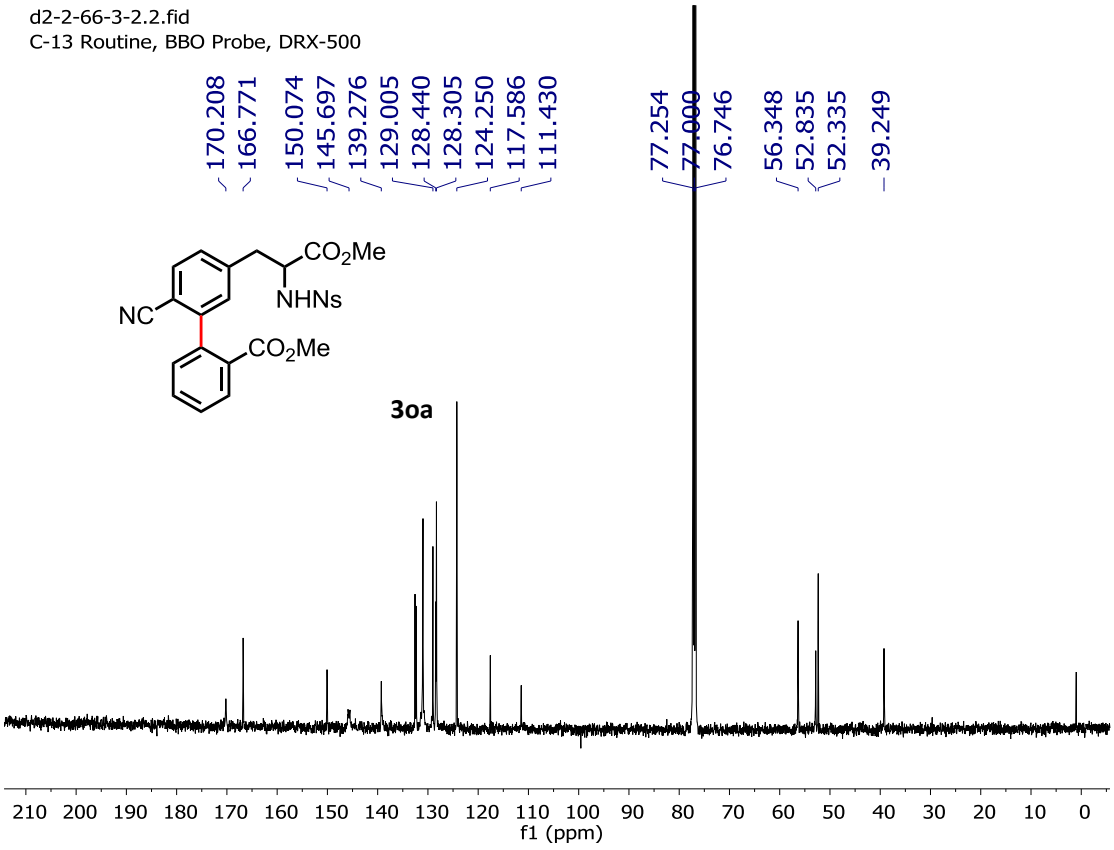

d2-139-3.2.fid
H-1 Routine, DRX-500, BBO Probe
8.259
8.241
8.003
7.989
7.955
7.937
7.586
7.583
7.571
7.503
7.501
7.488
7.485
7.429
7.312
7.300
7.298
7.285
7.282
7.262
7.221
5.774
5.755
4.394
4.383
4.376
4.371
4.365
4.353
3.770
3.596
3.186
3.182
3.175
3.170
-0.001
F3C
CO2Me
NHNs
CO2Me
3ma
1.98
1.02
2.00
1.06
1.09
1.00
2.20
1.02
0.98
1.03
2.99
3.01
1.97
f1 (ppm)

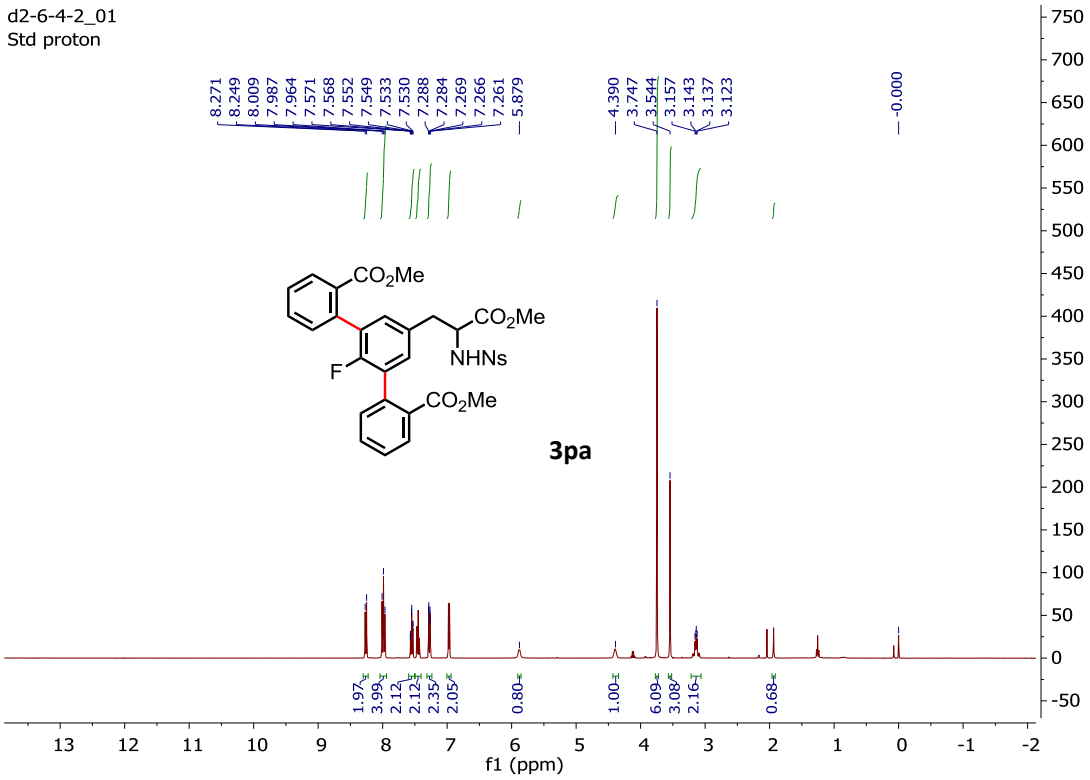

d2-139-3.3.fid
C-13 Routine, BBO Probe, DRX-500
170.489
167.773
149.987
145.660
142.539
141.137
135.123
133.513
131.993
130.917
130.841
130.690
129.544
128.233
128.186
124.825
124.576
124.546
124.516
124.485
124.409
124.379
124.349
124.318
124.173
122.662
77.254
77.001
76.746
56.789
52.746
52.279
38.904
F3C
CO2Me
NHNs
CO2Me
3ma
f1 (ppm)

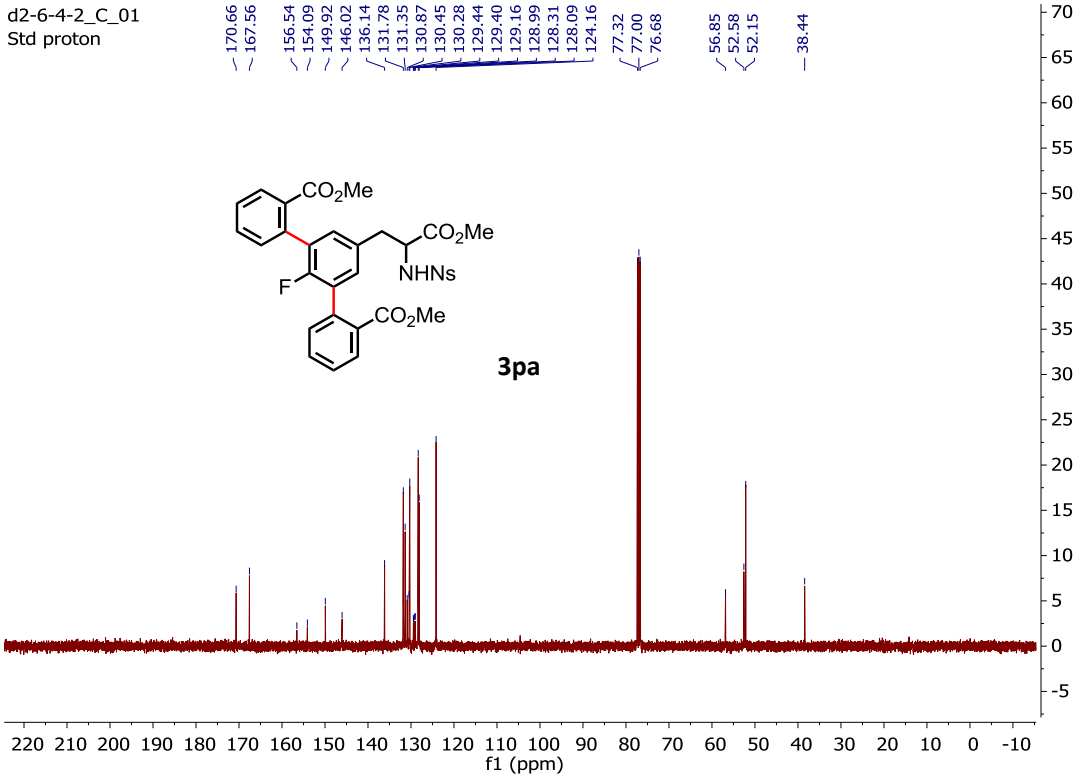

d2-14-3-1ppp_01
Std proton
8.250
8.228
7.929
7.907
7.886
7.866
7.553
7.537
7.534
7.519
7.515
7.427
7.424
7.408
7.405
7.389
7.386
7.261
7.224
7.205
6.975
6.969
6.954
6.948
6.921
6.915
6.723
6.702
4.284
3.717
3.677
3.601
3.110
3.097
3.075
3.062
3.025
3.008
2.988
2.975
1.679
1.256
0.000
CO2Me
NHNs
MeO
CO2Me
3na
1.90
2.92
1.07
1.08
1.03
2.04
1.02
0.98
1.03
6.33
3.11
1.16
1.05
f1 (ppm)


d2-14-3-1ppp_C_01
Std proton
171.102
168.228
155.453
149.873
145.734
138.302
131.628
131.244
131.145
130.676
129.441
129.318
128.335
127.378
126.450
124.155
110.352
77.319
77.001
76.682
57.097
55.258
52.653
51.822
38.372
CO2Me
NHNs
MeO
CO2Me
3na
f1 (ppm)

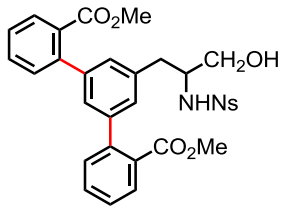

d2-66-3-2_redo_01
Std proton
8.303
8.280
8.148
8.126
7.988
7.966
7.651
7.648
7.632
7.629
7.618
7.613
7.610
7.598
7.565
7.562
7.546
7.542
7.527
7.523
7.297
7.294
7.278
7.275
7.263
7.176
7.153
5.711
4.379
3.786
3.554
3.190
1.682
0.072
0.000
CO2Me
NHNs
NC
CO2Me
3oa
1.90
0.99
1.94
1.89
1.00
0.98
1.94
1.00
1.10
3.03
3.00
2.09
f1 (ppm)


d2-2-66-3-2.2.fid
C-13 Routine, BBO Probe, DRX-500
170.208
166.771
150.074
145.697
139.276
129.005
128.440
128.305
124.250
117.586
111.430
77.254
77.000
76.746
56.348
52.835
52.335
39.249
CO2Me
NHNs
NC
CO2Me
3oa
f1 (ppm)

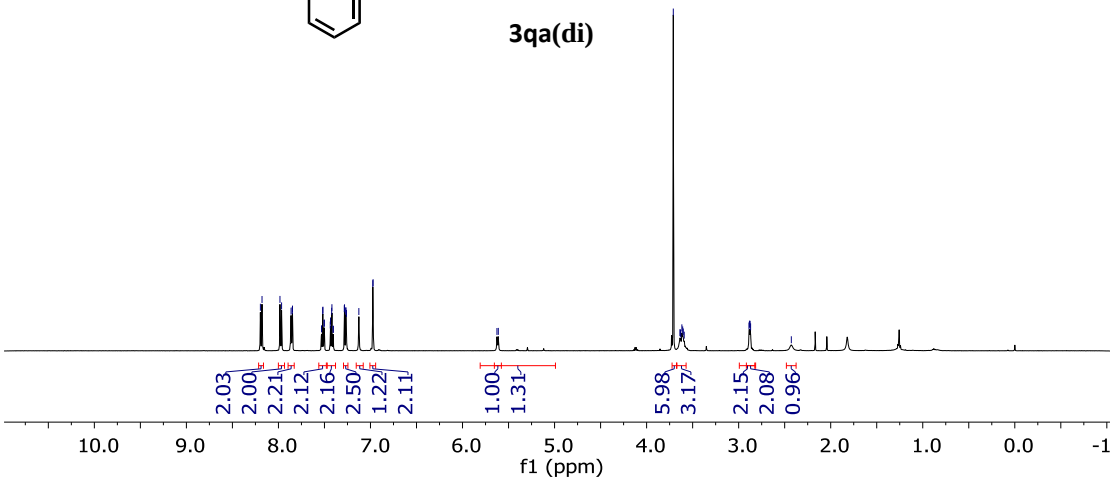

d2-6-4-2_01
Std proton
8.271
8.249
8.009
7.987
7.964
7.571
7.568
7.552
7.549
7.533
7.530
7.288
7.284
7.269
7.266
7.261
5.879
4.390
3.747
3.544
3.157
3.143
3.137
3.123
-0.000
CO2Me
CO2Me
NHNs
F
CO2Me
3pa
1.97
3.99
2.12
2.12
2.35
2.05
0.80
1.00
6.09
3.08
2.16
0.68
f1 (ppm)


d2-6-4-2_C_01
Std proton
170.66
167.56
156.54
154.09
149.92
146.02
136.14
131.78
131.35
130.87
130.45
130.28
129.44
129.40
129.16
128.99
128.31
128.09
124.16
77.32
77.00
76.68
56.85
52.58
52.15
38.44
CO2Me
CO2Me
NHNs
F
CO2Me
3pa
f1 (ppm)

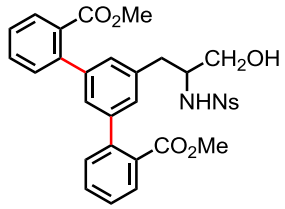
C:/Users/nmruser/Desktop/d2-142-1-1/1/fid



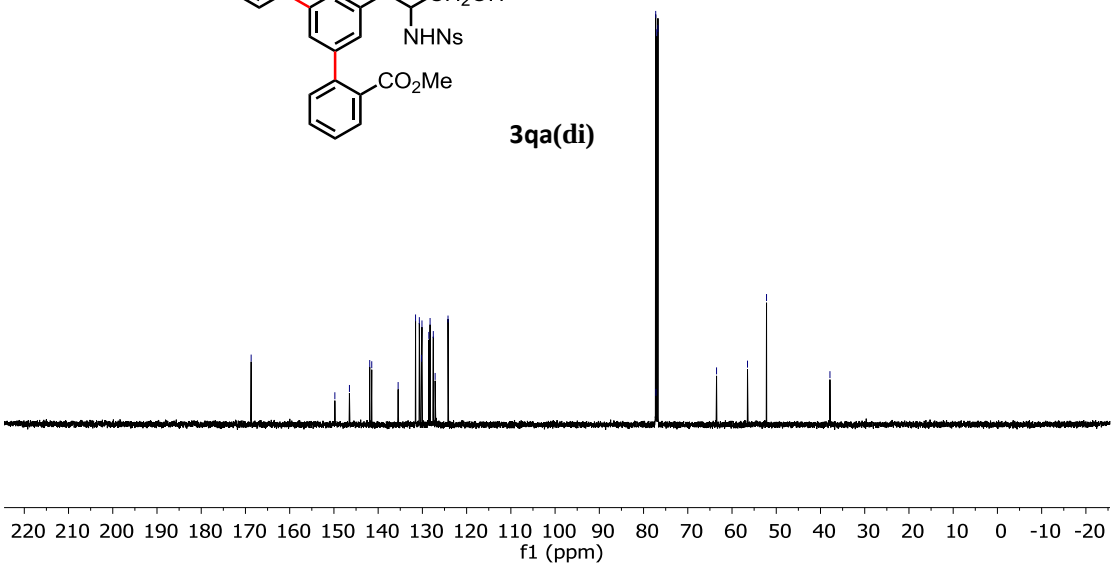
3qa(di)



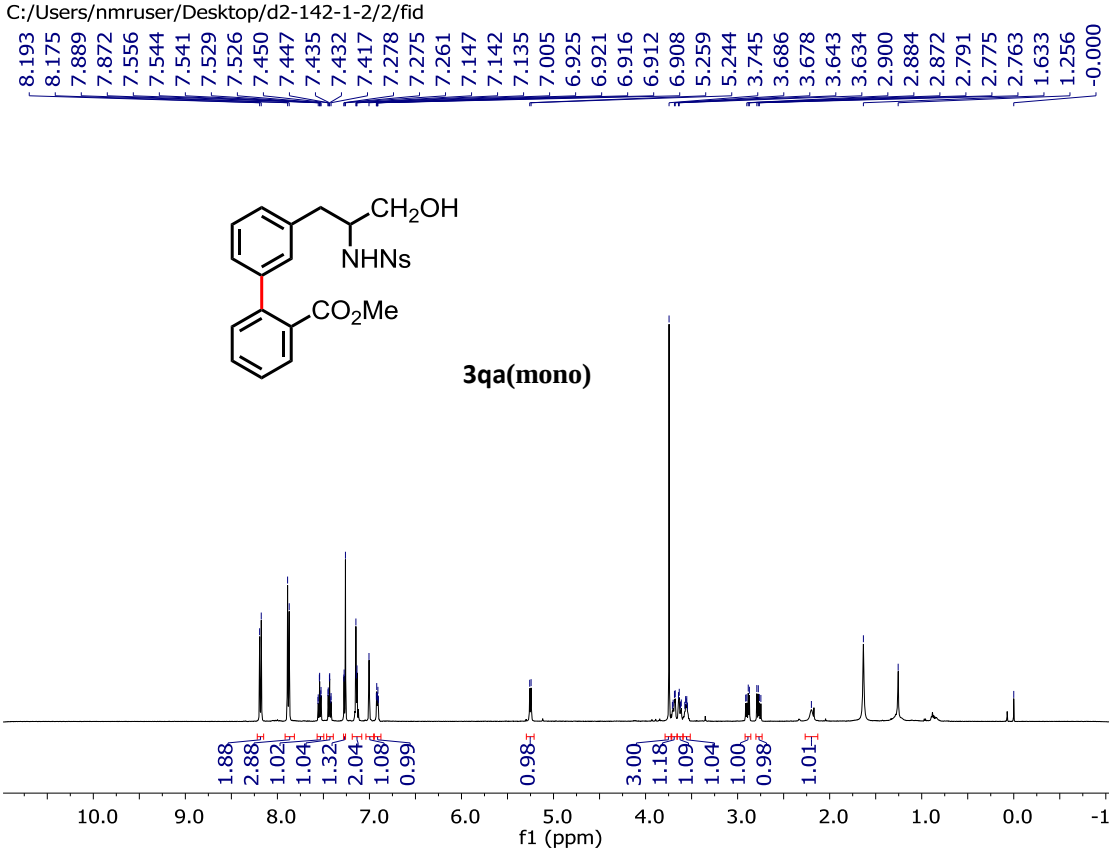
C:/Users/nmruser/Desktop/d2-142-1-1/2/fid



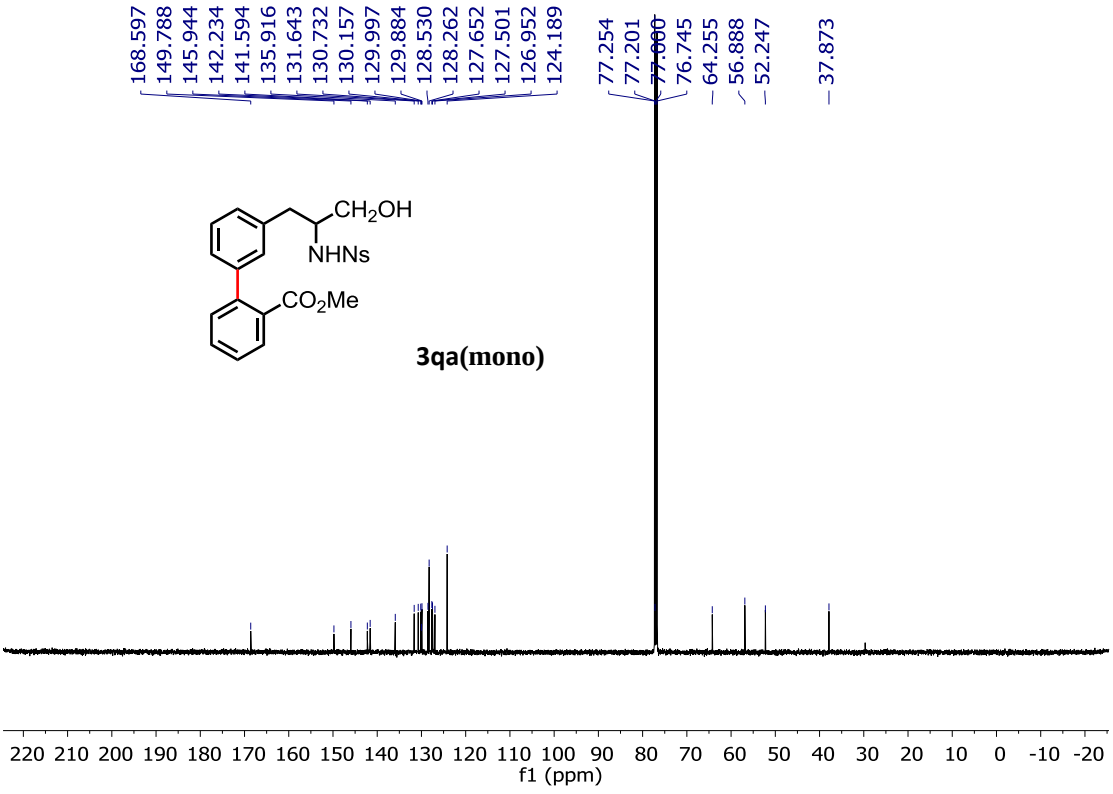
3qa(di)

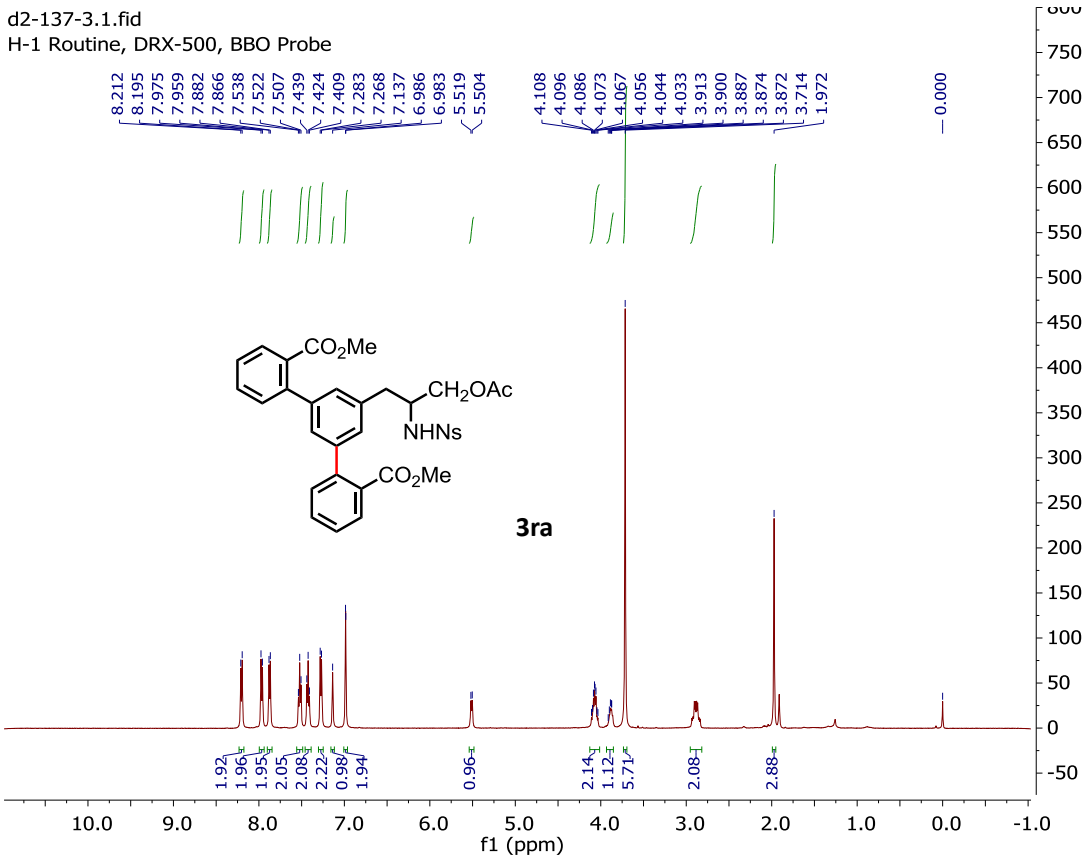


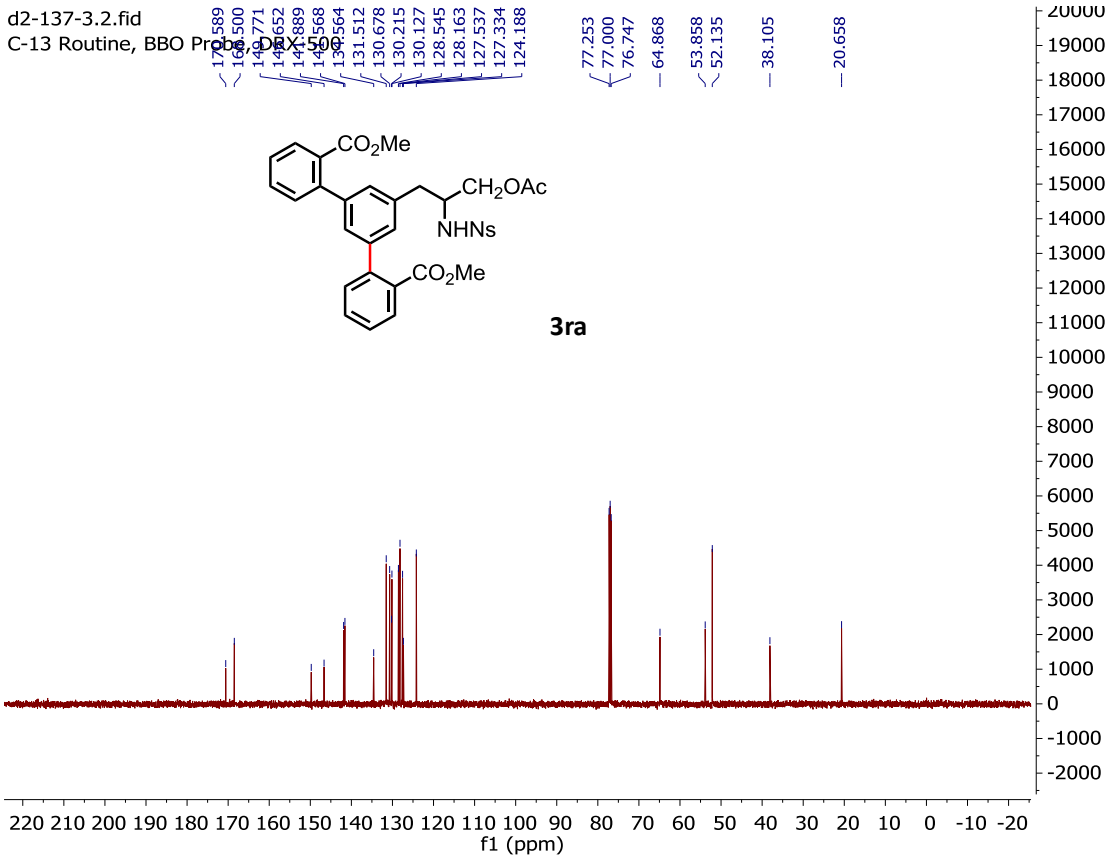
C:/Users/nmruser/Desktop/d2-142-1-2/2/fid



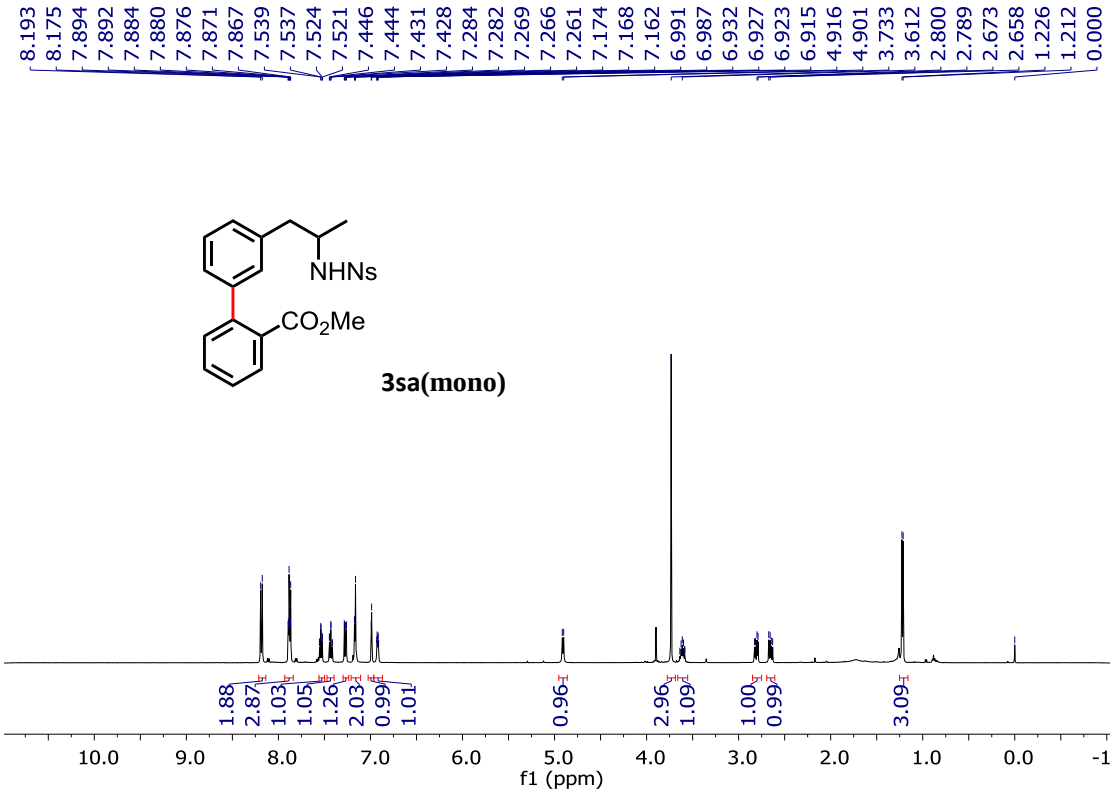
C:/Users/nmruser/Desktop/d2-142-1-2/3/fid



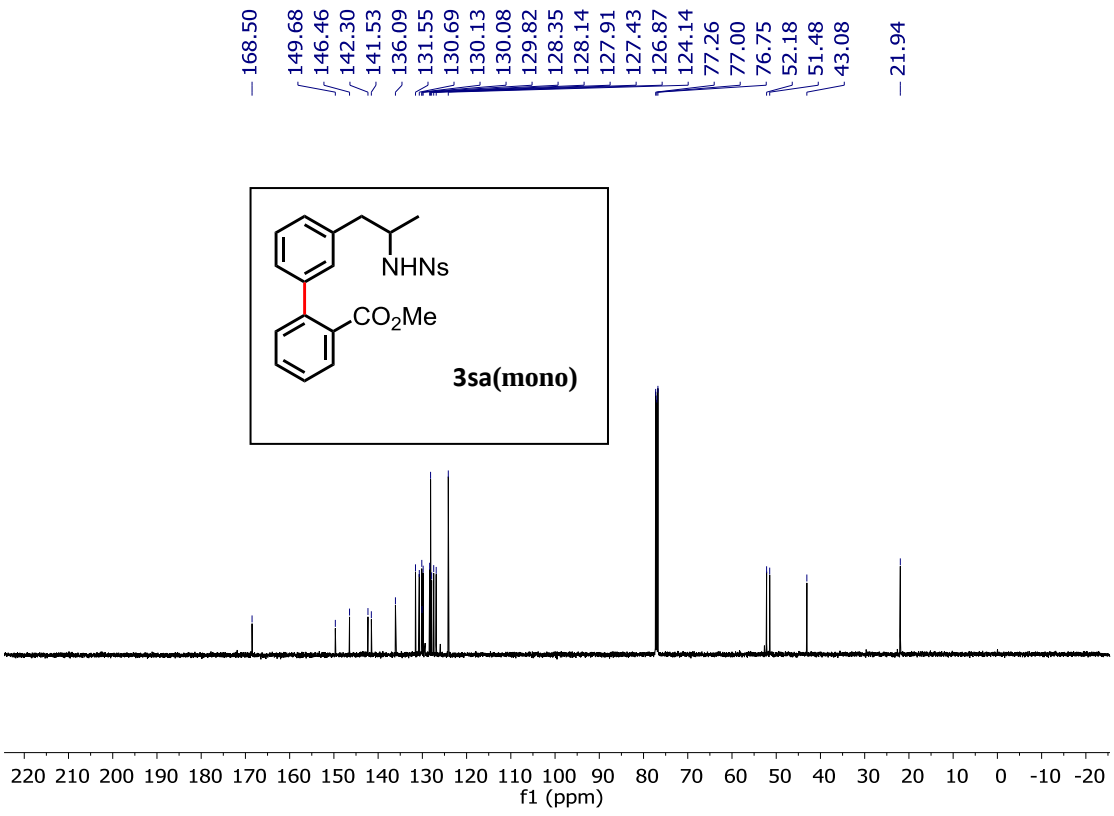

d2-137-3.1.fid
H-1 Routine, DRX-500, BBO Probe
8.212
8.195
7.975
7.959
7.882
7.866
7.538
7.522
7.507
7.439
7.424
7.409
7.283
7.268
7.137
6.986
6.983
5.519
5.504
4.108
4.096
4.086
4.073
4.067
4.056
4.044
4.033
3.913
3.900
3.887
3.874
3.872
3.714
1.972
0.000
CO2Me
CH2OAc
NHNs
CO2Me
3ra
1.92
1.96
1.95
2.05
2.08
2.22
0.98
1.94
0.96
2.14
1.12
5.71
2.08
2.88
f1 (ppm)


d2-137-3.2.fid
C-13 Routine, BBO Probe, DRX-500
170.589
166.500
146.771
146.652
141.889
141.568
135.564
131.512
130.678
130.215
130.127
128.545
128.163
127.537
127.334
124.188
77.253
77.000
76.747
64.868
53.858
52.135
38.105
20.658
CO2Me
CH2OAc
NHNs
CO2Me
3ra
f1 (ppm)

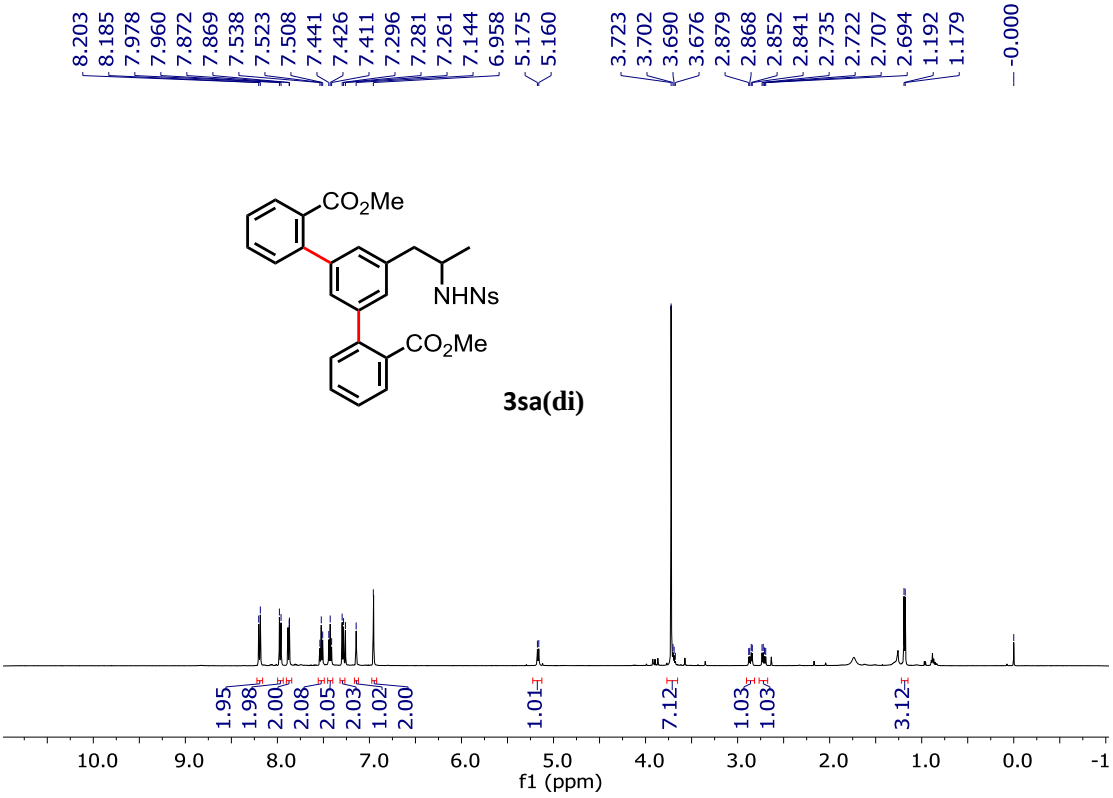
C:/Users/nmruser/Desktop/d2-151-3-2/1/fid



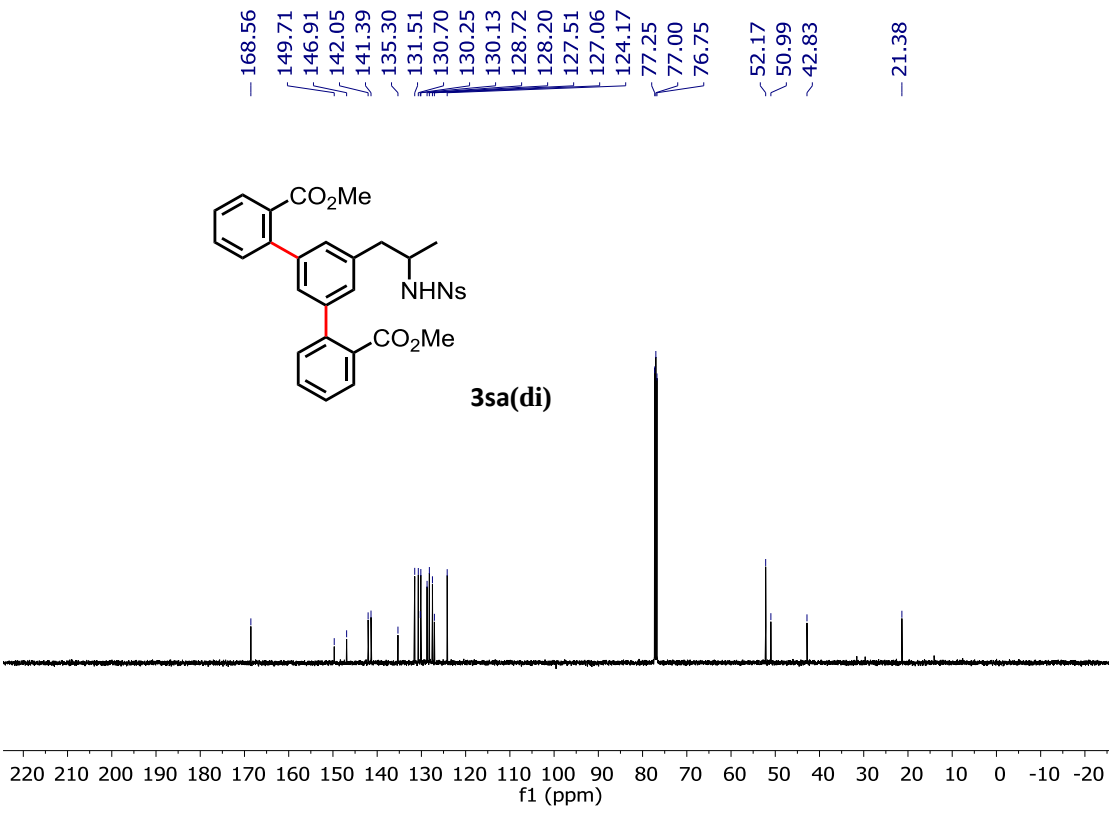
C:/Users/nmruser/Desktop/d2-151-3-2/2/fid



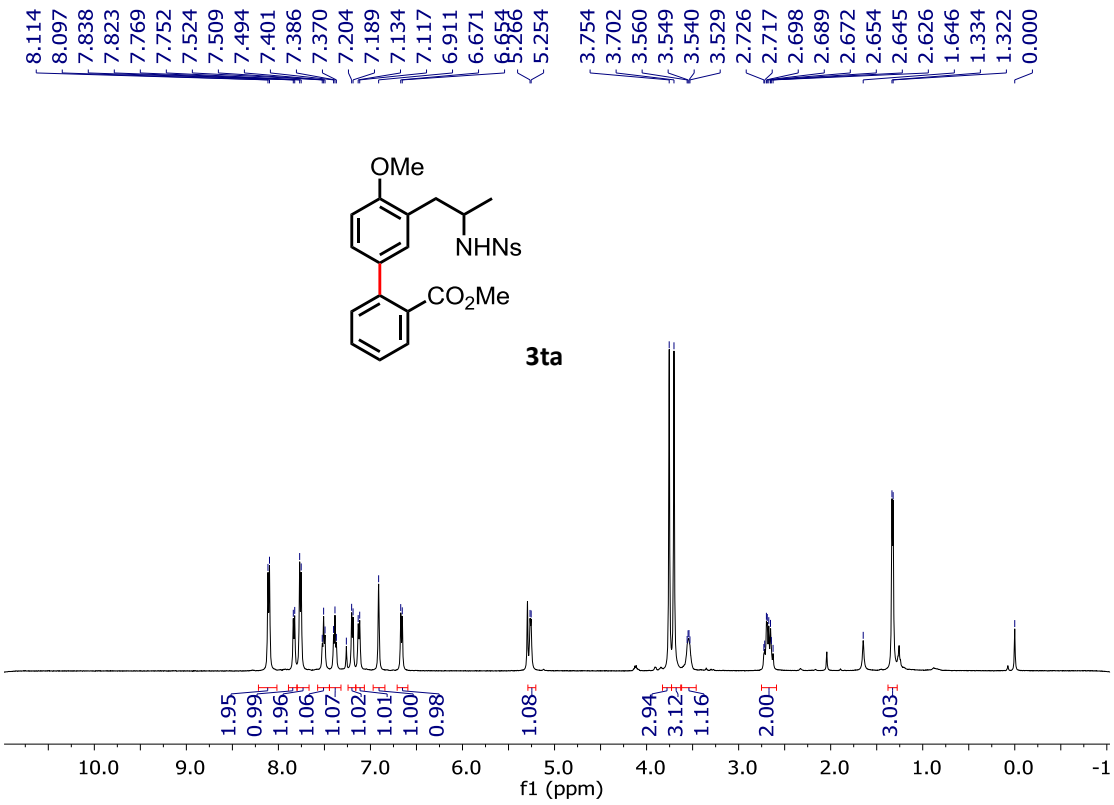
C:/Users/nmruser/Desktop/d2-151-3-1/1/fid



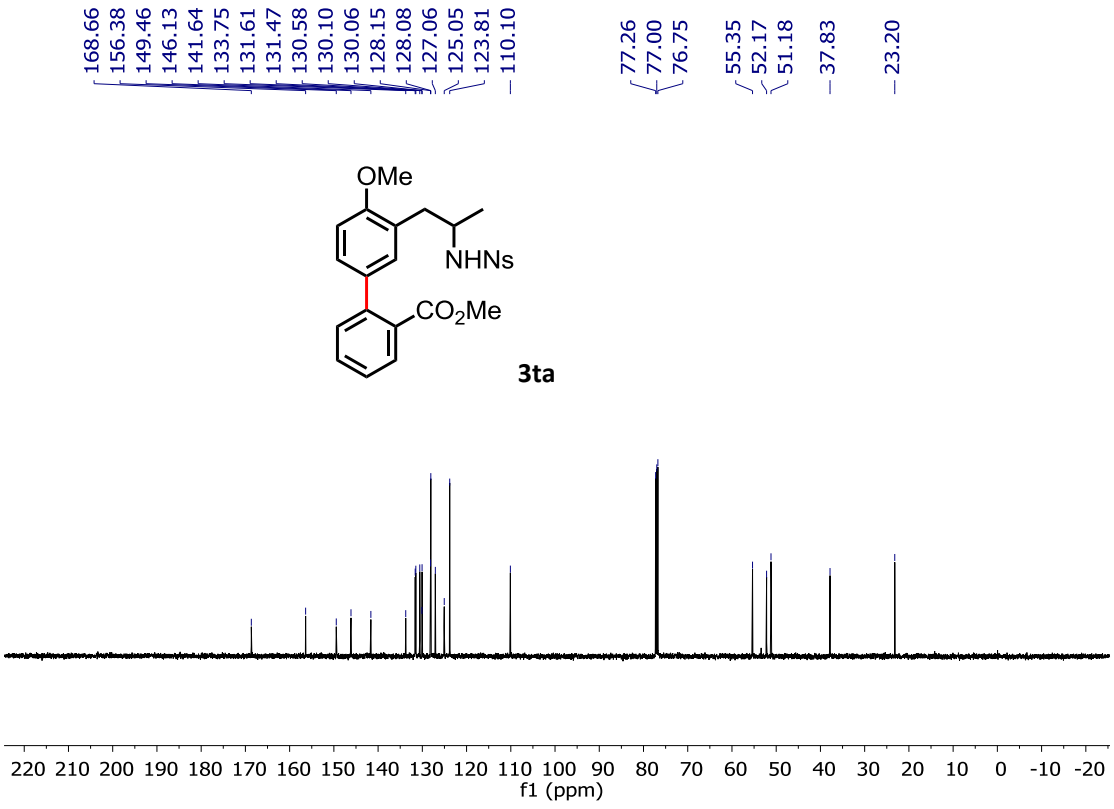
C:/Users/nmruser/Desktop/d2-151-3-1/2/fid

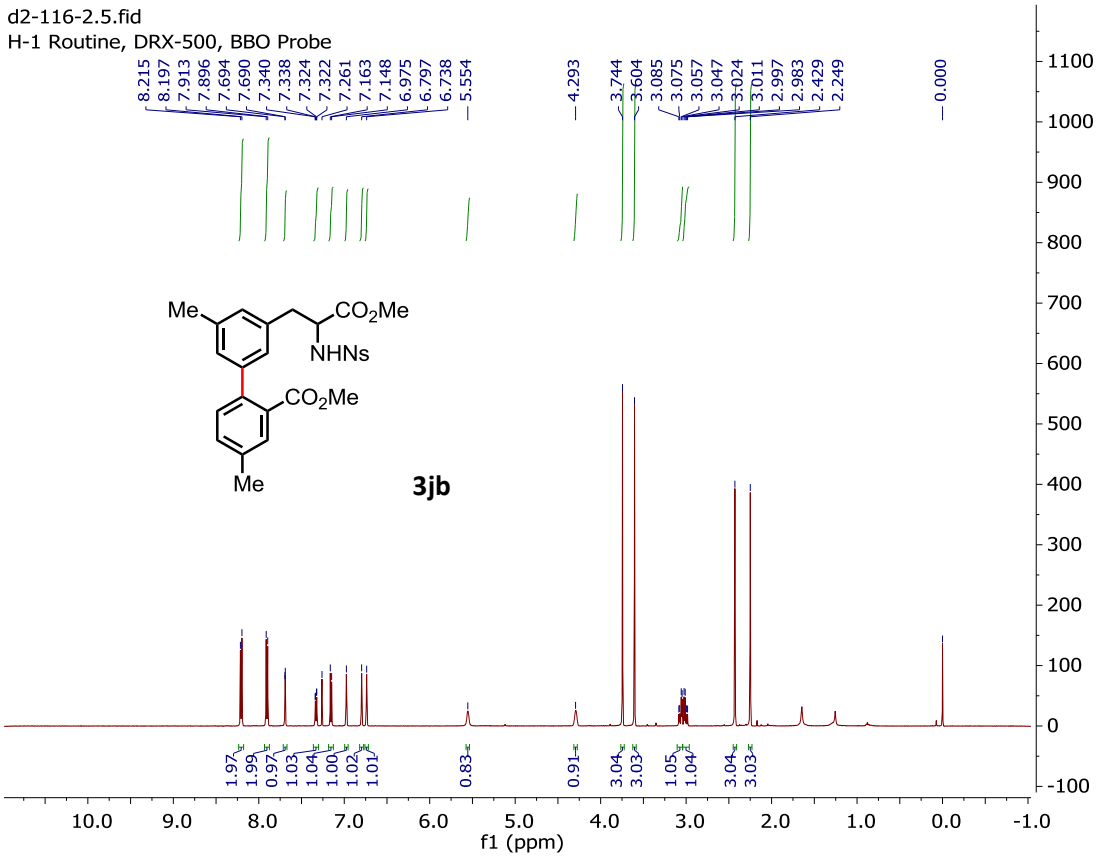


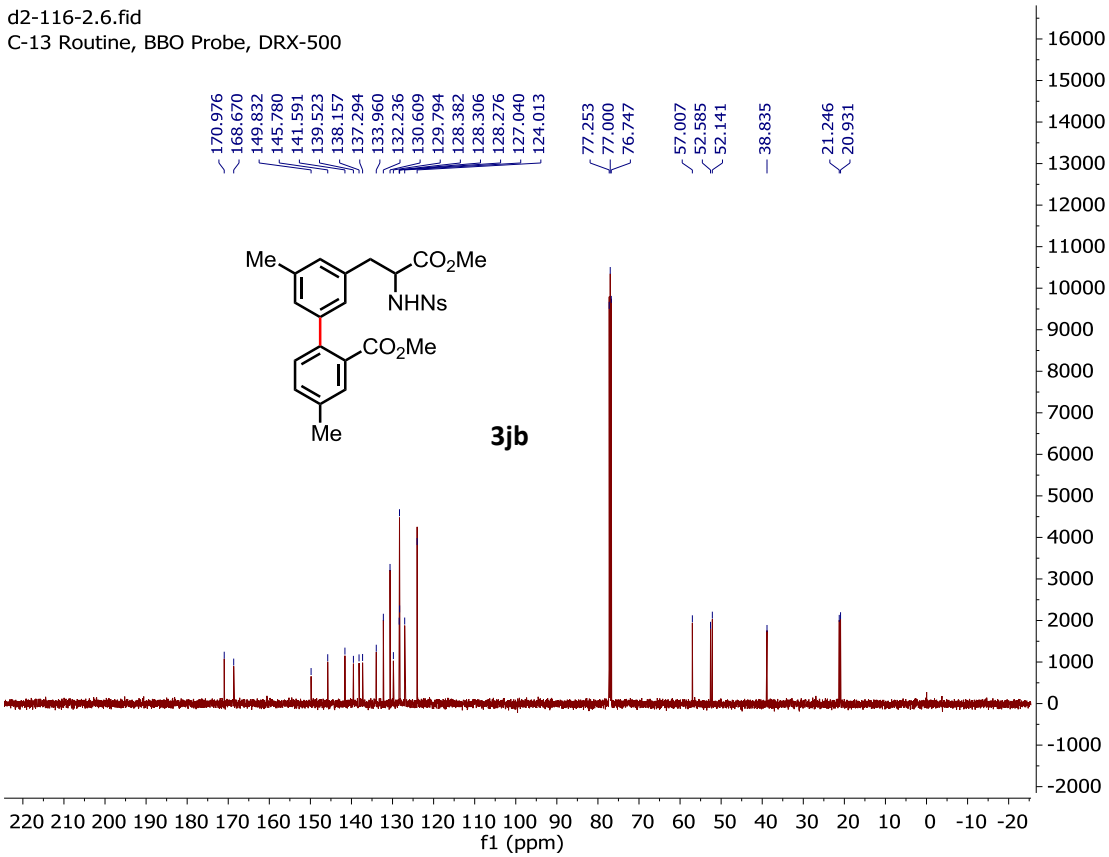
C:/Users/nmruser/Desktop/d2-134-4/1/fid



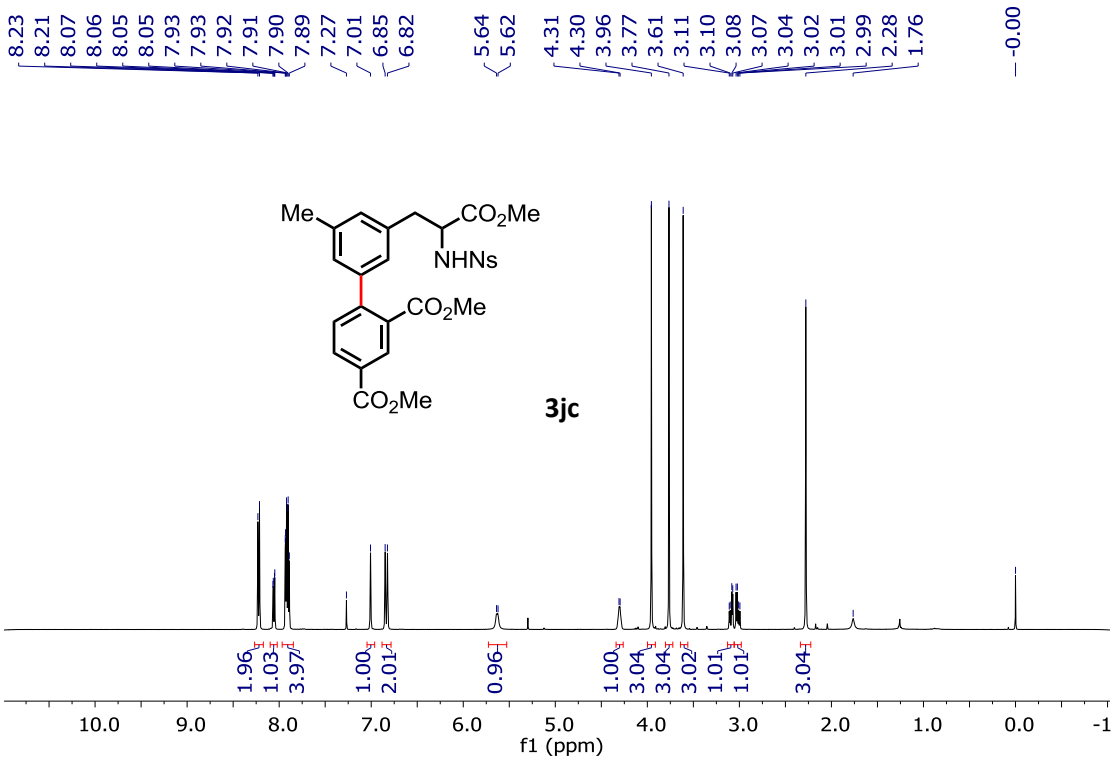
C:/Users/nmruser/Desktop/d2-134-4/2/fid




d2-116-2.5.fid
H-1 Routine, DRX-500, BBO Probe
8.215
8.197
7.913
7.896
7.694
7.690
7.340
7.338
7.324
7.322
7.261
7.163
7.148
6.975
6.797
6.738
5.554
4.293
3.744
3.604
3.085
3.075
3.057
3.047
3.024
3.011
2.997
2.983
2.429
2.249
0.000
Me
CO2Me
NHNs
CO2Me
Me
3jb
1.97
1.99
0.97
1.03
1.04
1.00
1.02
1.01
0.83
0.91
3.04
3.03
1.05
1.04
3.04
3.03
f1 (ppm)


d2-116-2.6.fid
C-13 Routine, BBO Probe, DRX-500
170.976
168.670
149.832
145.780
141.591
139.523
138.157
137.294
133.960
132.236
130.609
129.794
128.382
128.306
128.276
127.040
124.013
77.253
77.000
76.747
57.007
52.585
52.141
38.835
21.246
20.931
Me
CO2Me
NHNs
CO2Me
Me
3jb
f1 (ppm)

C:/Users/nmruser/Desktop/d2-116-4/1/fid



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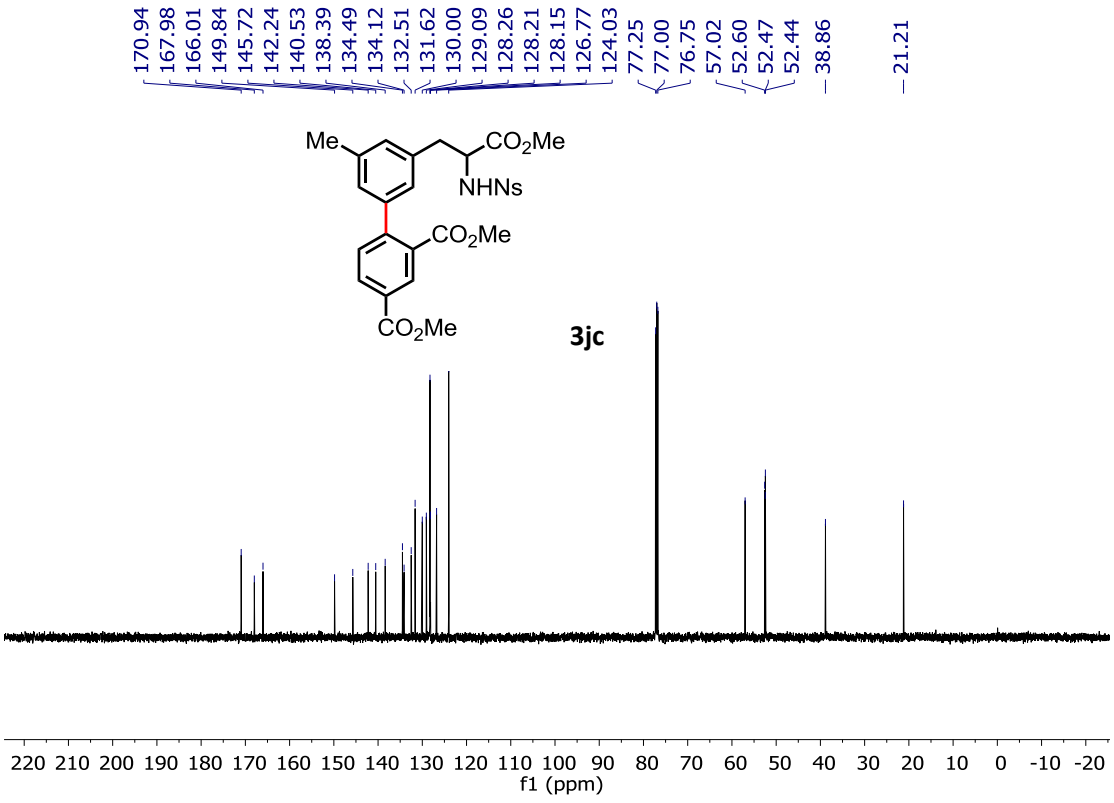

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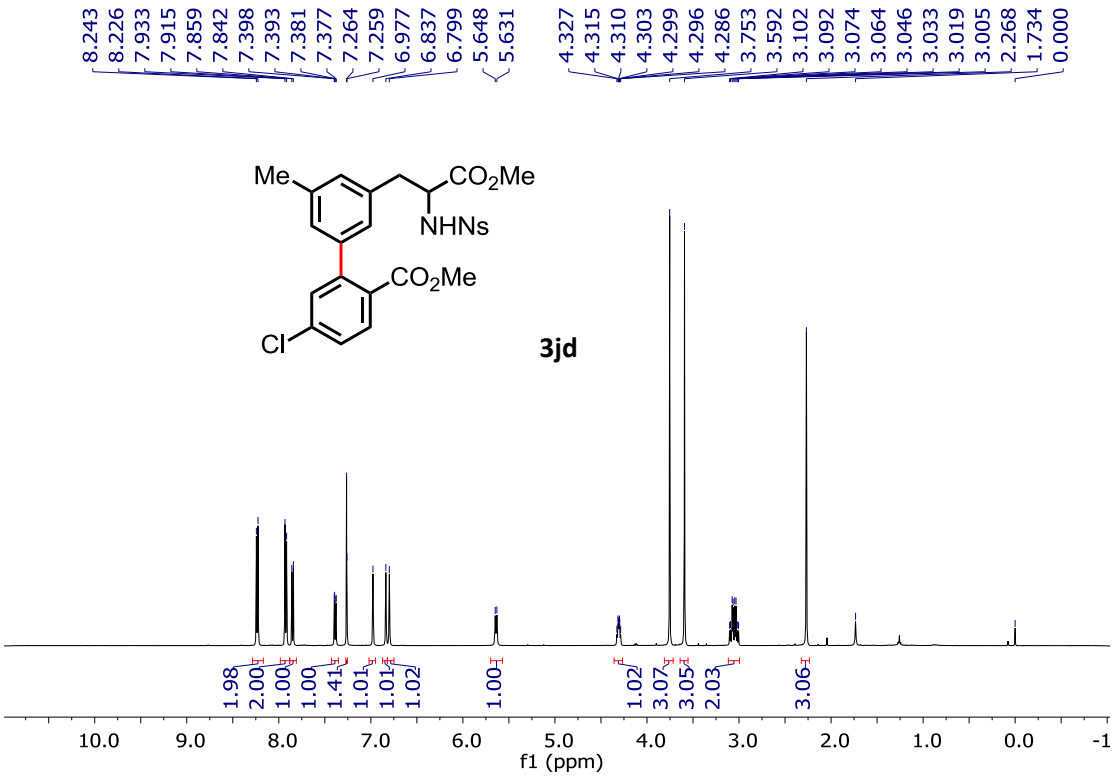

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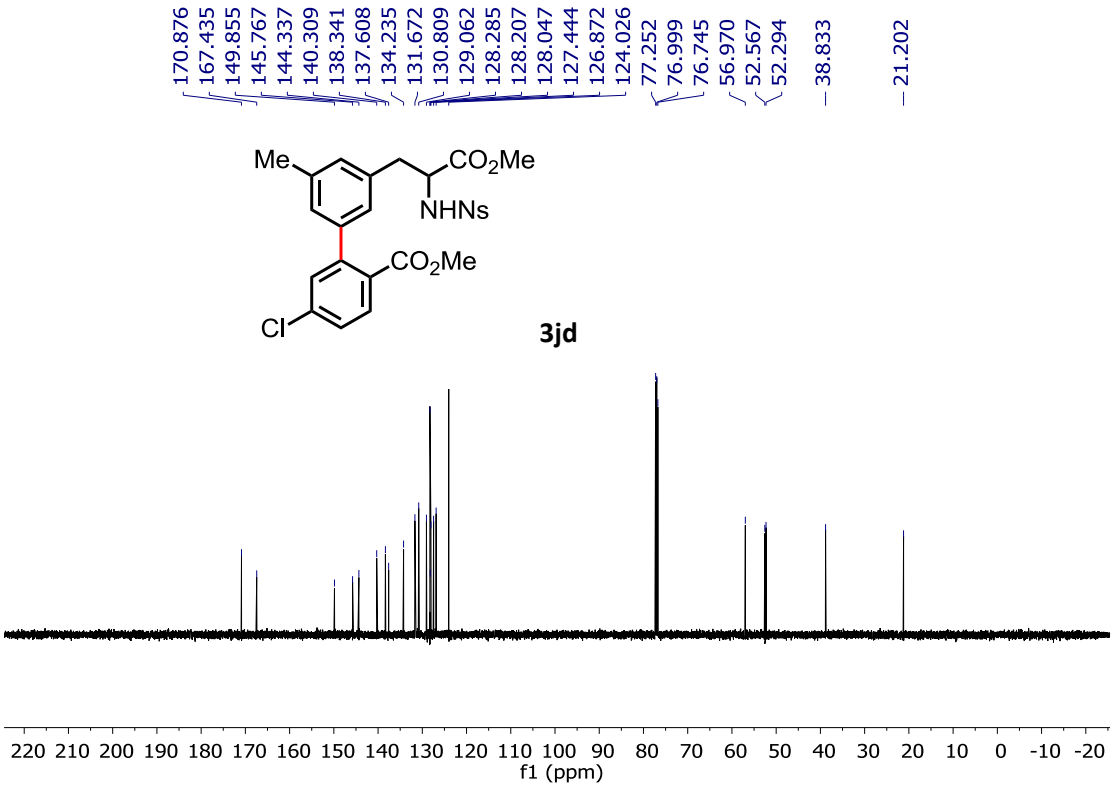
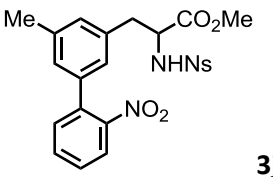
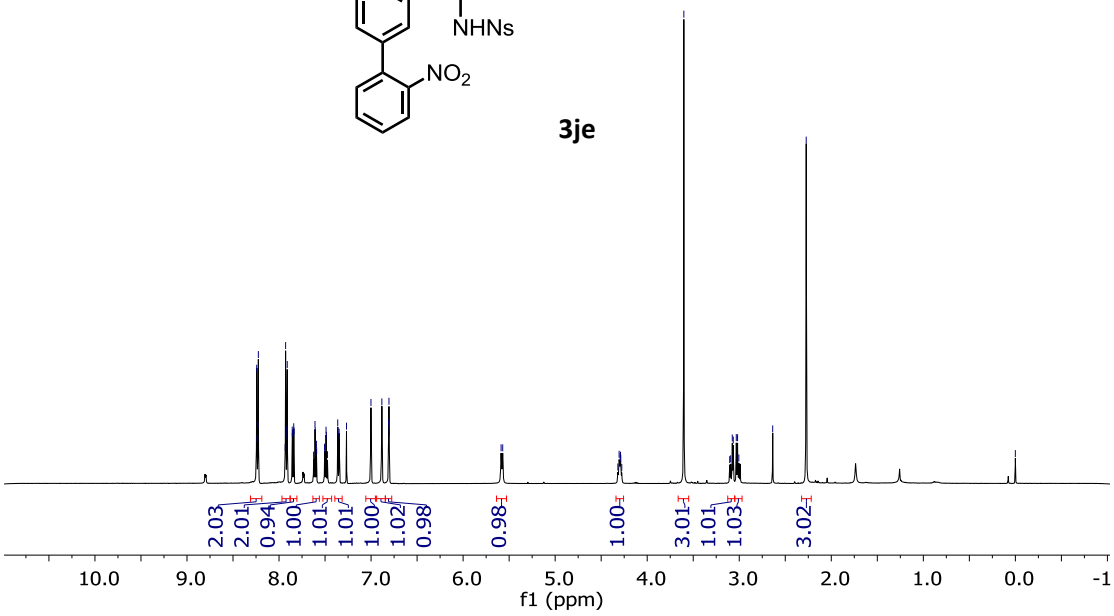


C:/Users/nmruser/Desktop/d2-105-7/1/fid

8.243 8.238 8.229 8.225 7.933 7.928 7.924 7.915 7.911 7.857 7.854 7.840 7.838 7.609 7.607 7.594 7.591 7.505 7.502 7.489 7.486 7.362 7.359 7.347 7.344 7.267 7.001 6.883 6.809 6.806 6.802 5.587 5.570 4.305 3.602 3.076 3.065 3.032 3.018 2.637 2.272 0.000

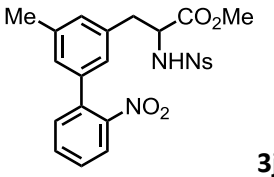


3je

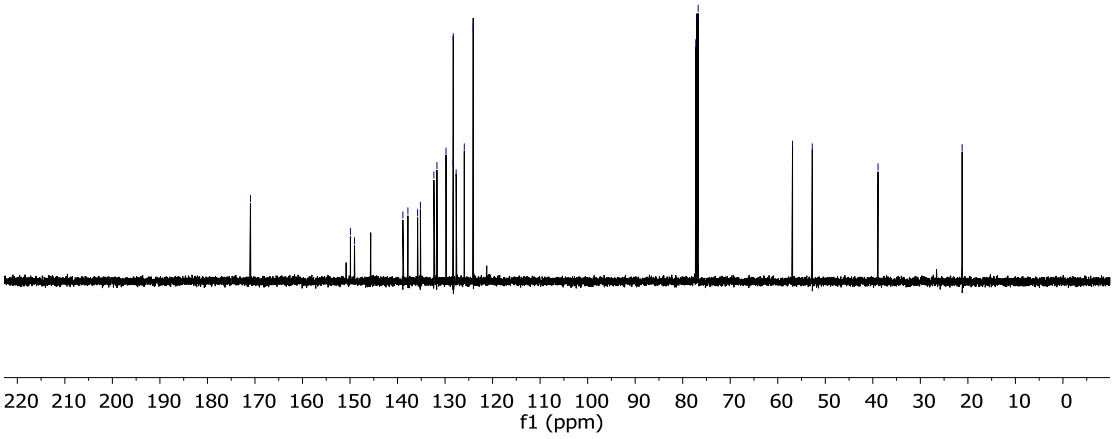


C:/Users/nmruser/Desktop/d2-105-7/2/fid

170.944 149.907 149.060 138.881 137.820 135.783 135.188 132.350 131.717 129.801 128.313 128.274 127.666 125.955 124.077 77.257 77.000 76.747 56.893 52.734 38.901 21.206



3je



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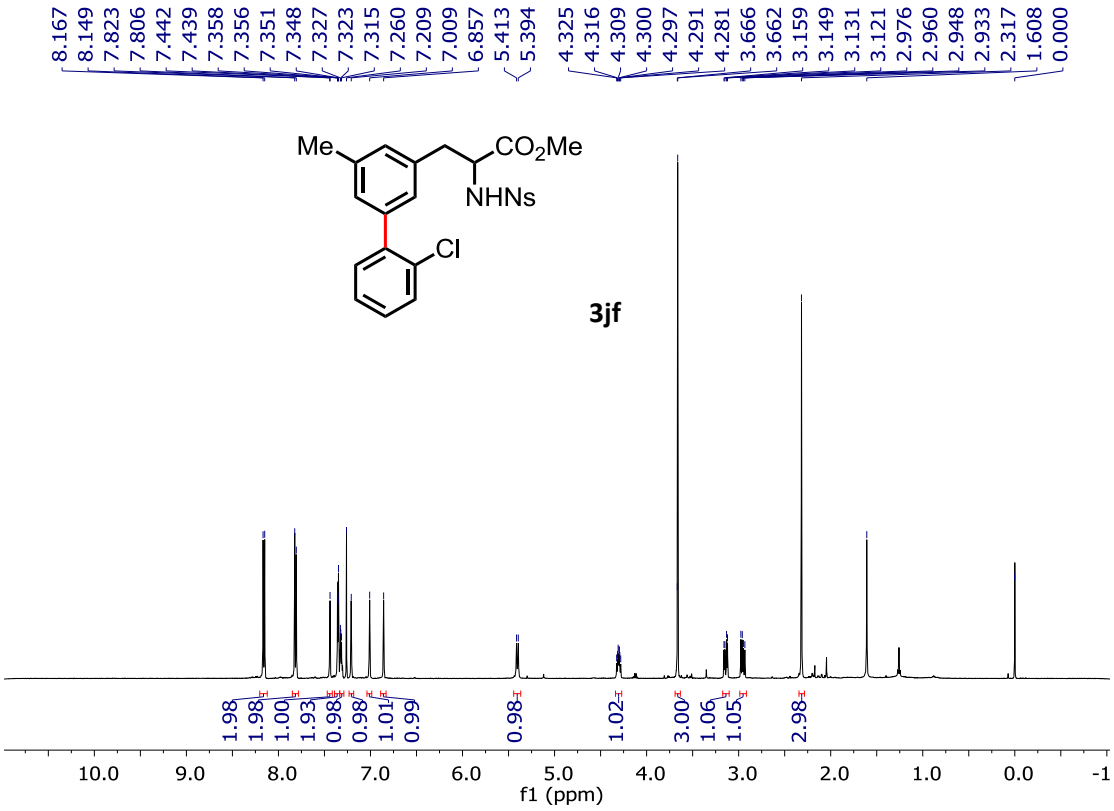

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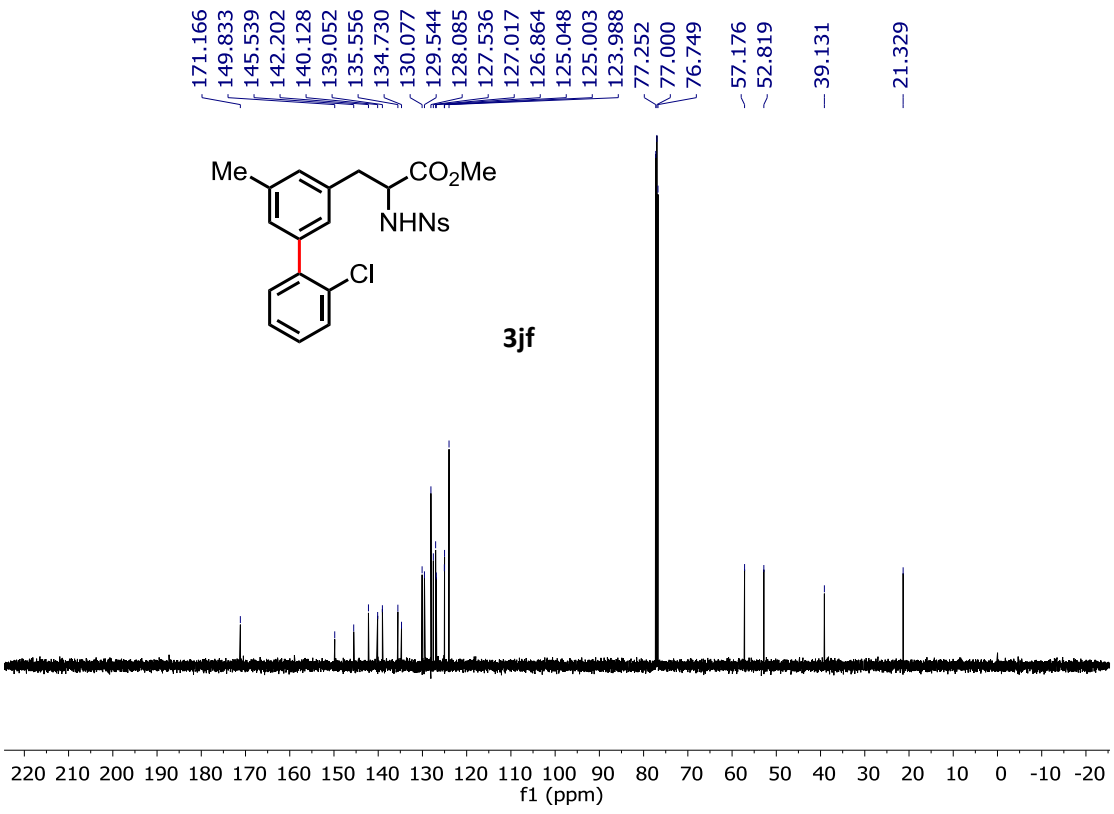
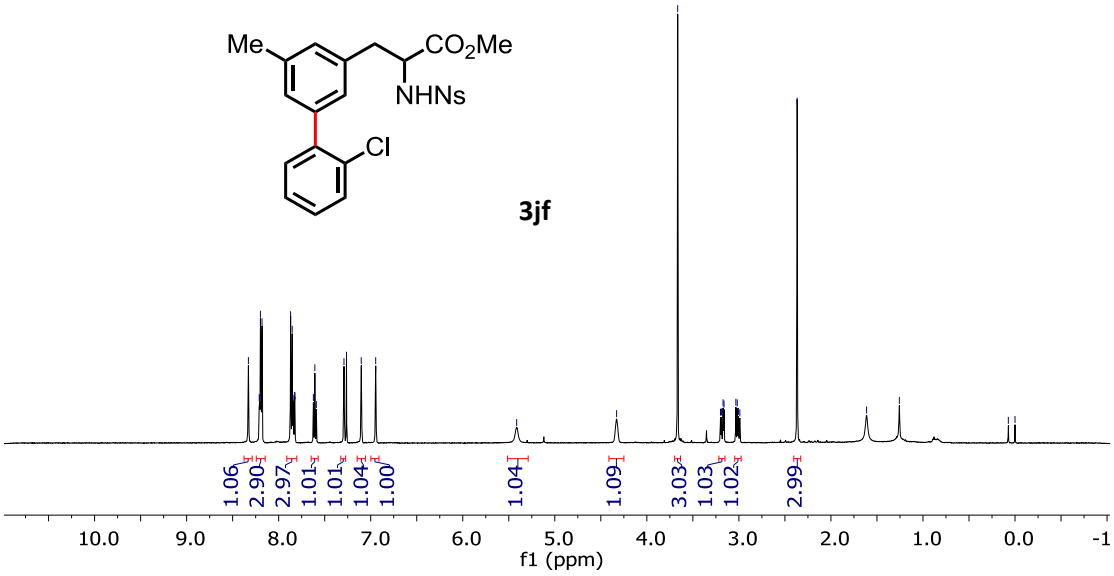


C:/Users/nmruser/Desktop/d2-105-6/7/fid

8.329 8.211 8.206 8.198 8.181 7.871 7.853 7.842 7.827 7.824 7.623 7.607 7.591 7.290 7.263 7.103 6.946 5.414 4.328 3.665 3.200 3.190 3.172 3.162 3.033 3.018 3.005 2.990 2.367 1.613 1.257 0.073 0.000



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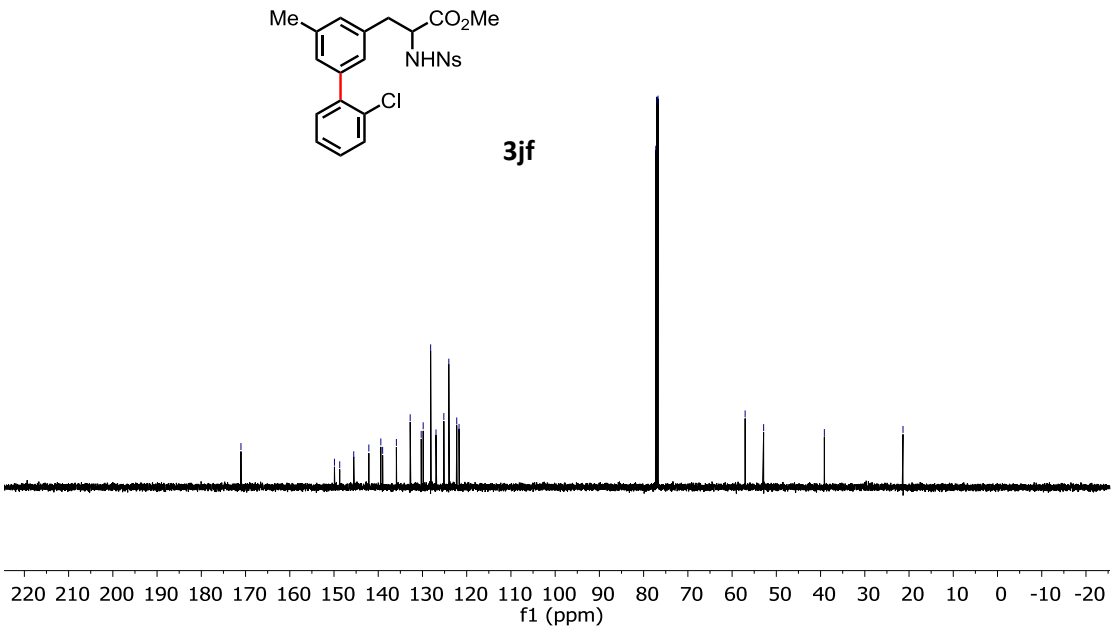
171.035 149.899 148.710 145.541 142.124 139.415 139.003 135.898 132.777 130.288 129.839 128.153 126.944 125.169 124.047 122.254 121.733 77.254 76.999 76.747 57.053 52.871 39.145 21.366



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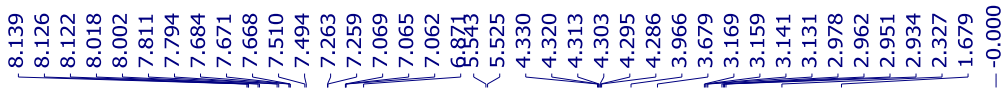
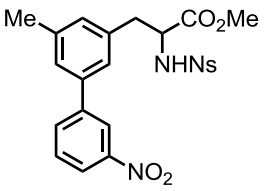
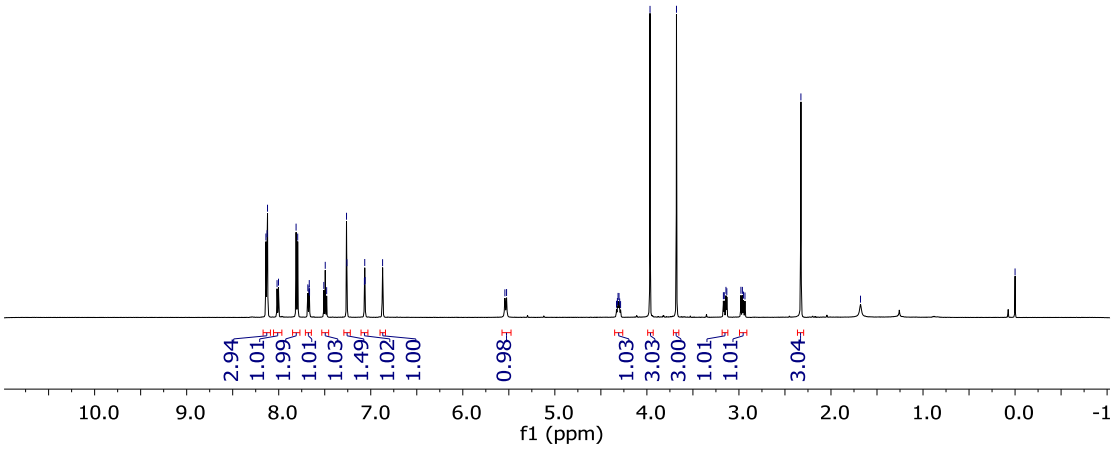




3jg



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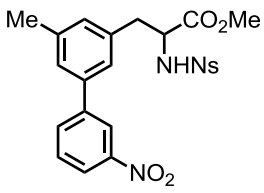
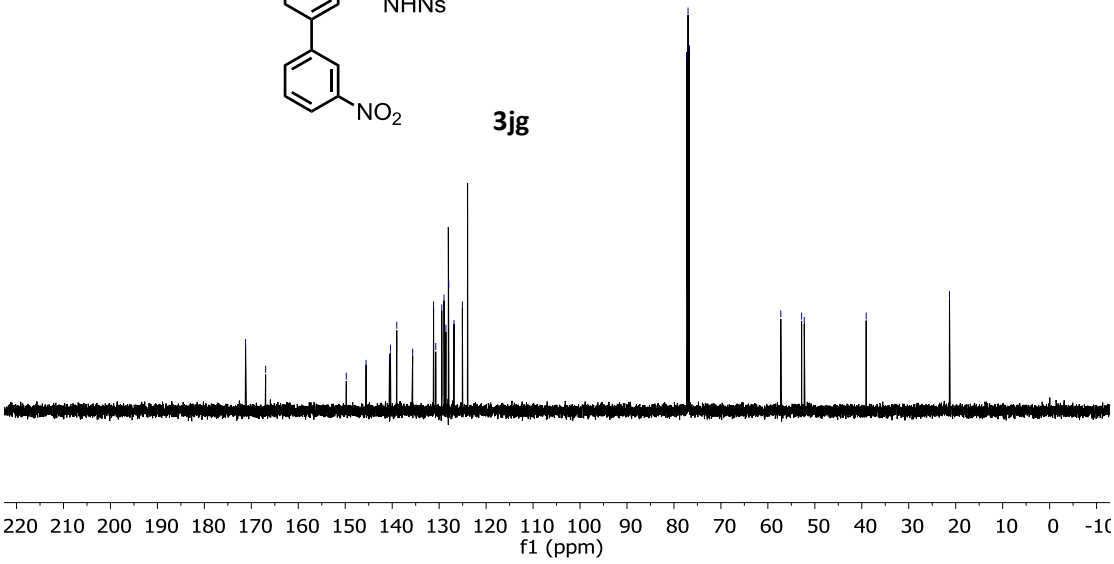
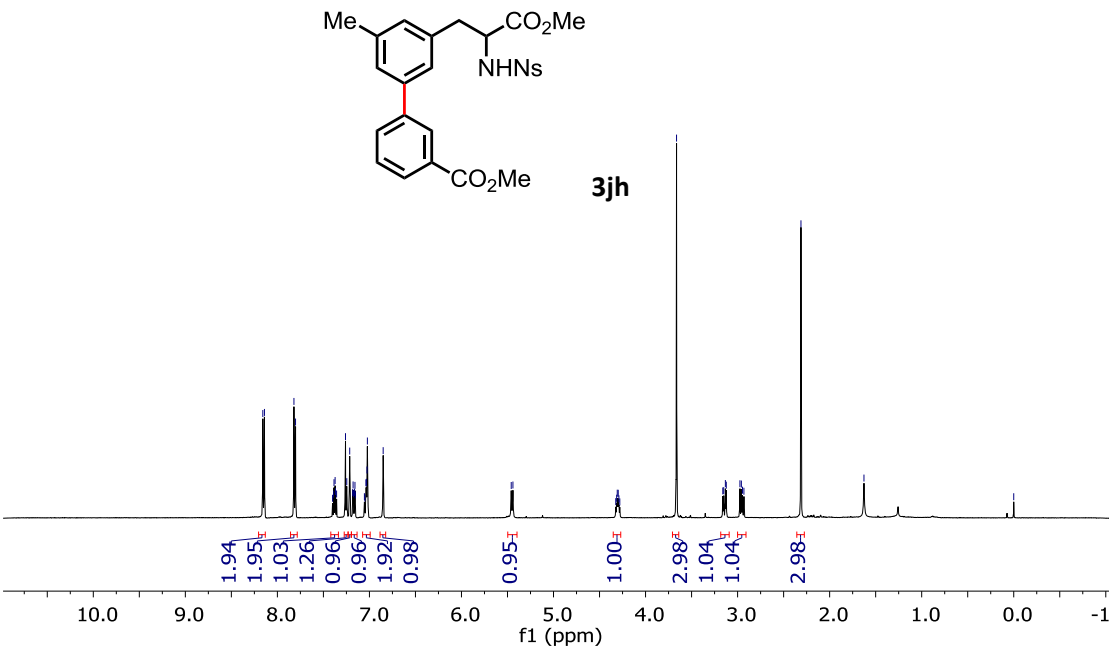


3jg



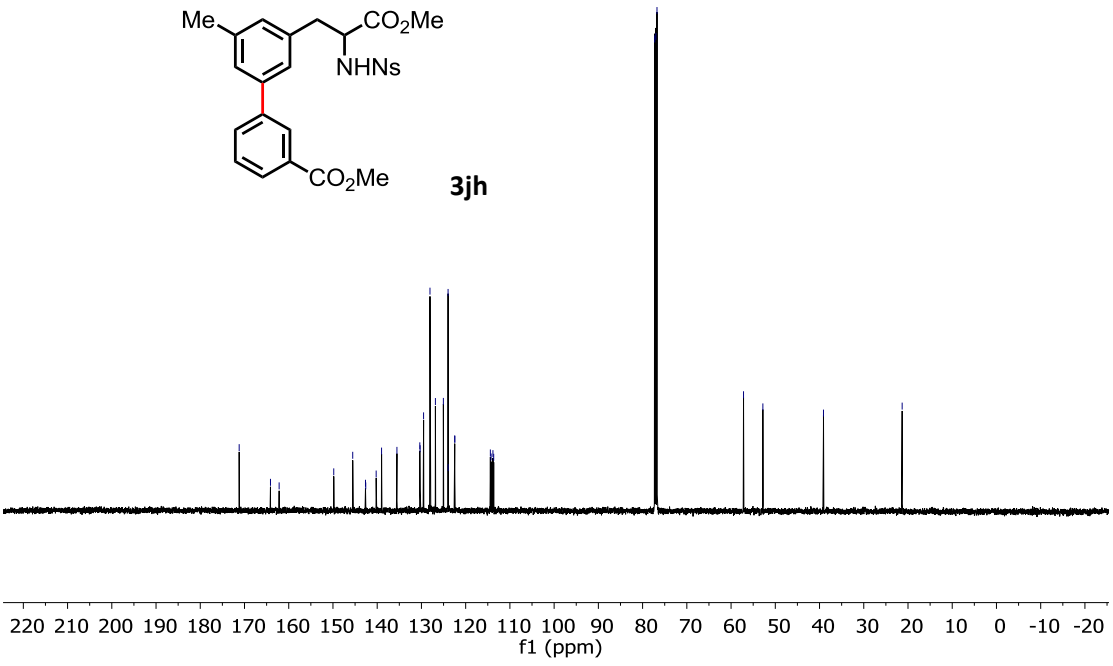
C:/Users/nmruser/Desktop/d2-105-2/3/fid

8.158 8.141 7.820 7.803 7.389 7.385 7.373 7.369 7.357 7.260 7.246 7.214 7.182 7.177 7.173 7.161 7.157 7.153 7.055 7.050 7.038 7.033 7.026 7.022 6.851 5.459 5.441 4.314 4.308 4.297 3.663 3.161 3.151 3.133 3.123 2.975 2.959 2.947 2.931 2.312 1.627 -0.000



C:/Users/nmruser/Desktop/d2-105-2/6/fid

171.202 164.128 162.170 149.821 145.533 142.649 142.590 140.231 139.012 135.539 130.364 130.296 129.516 128.067 126.839 125.038 123.977 123.959 122.474 122.452 114.416 114.247 113.836 113.660 77.255 77.000 76.746 57.182 52.810 39.107 21.319



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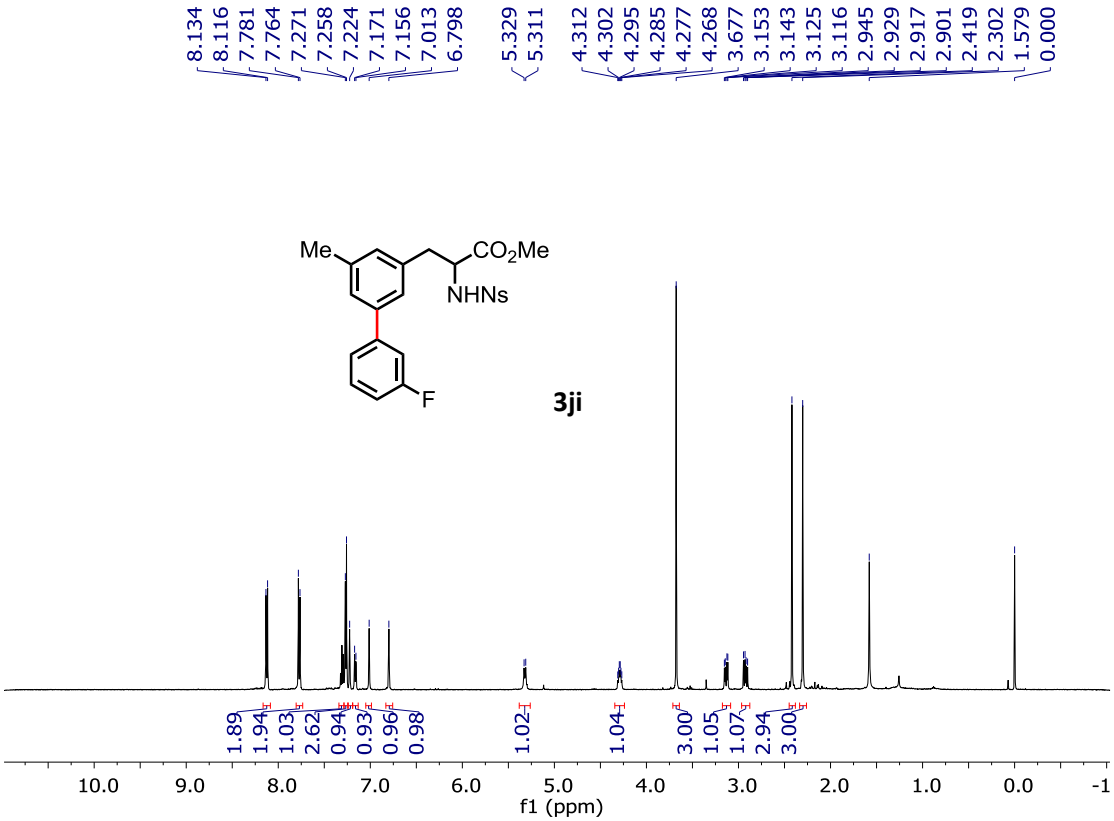
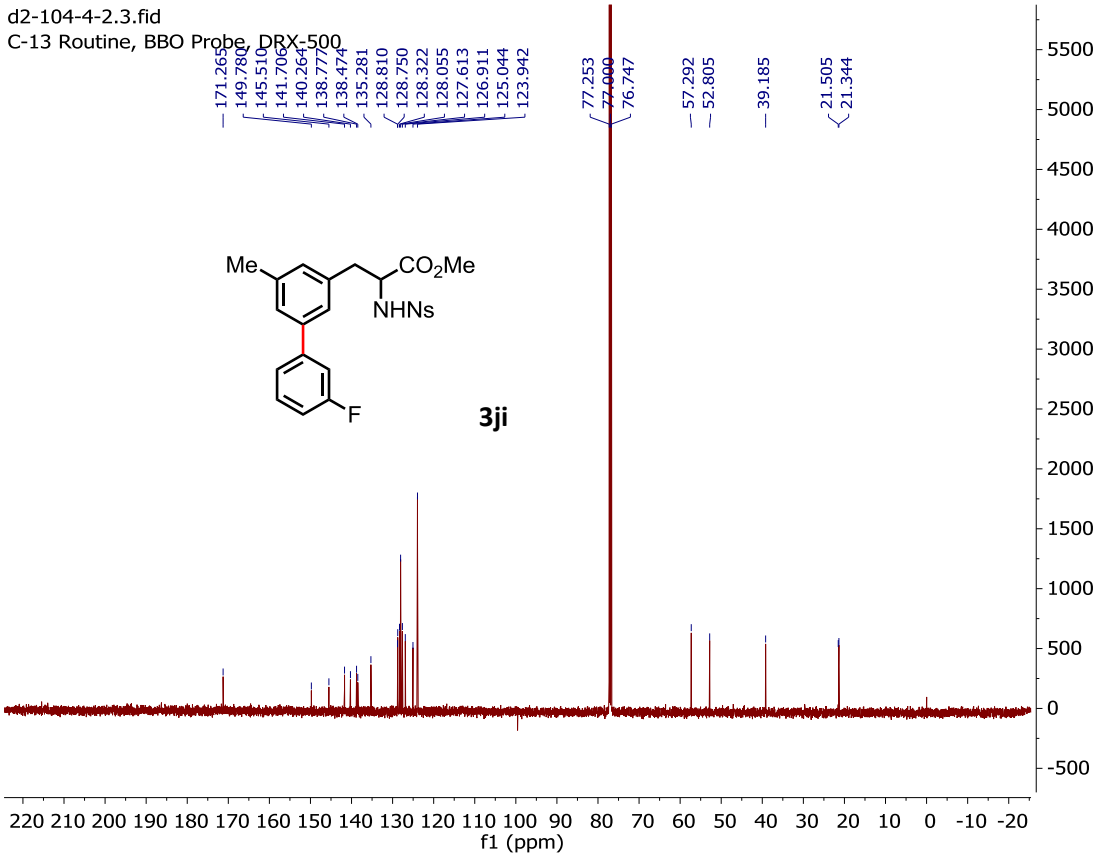


d2-104-4-2.3.fid
C-13 Routine, BBO Probe, DRX-500



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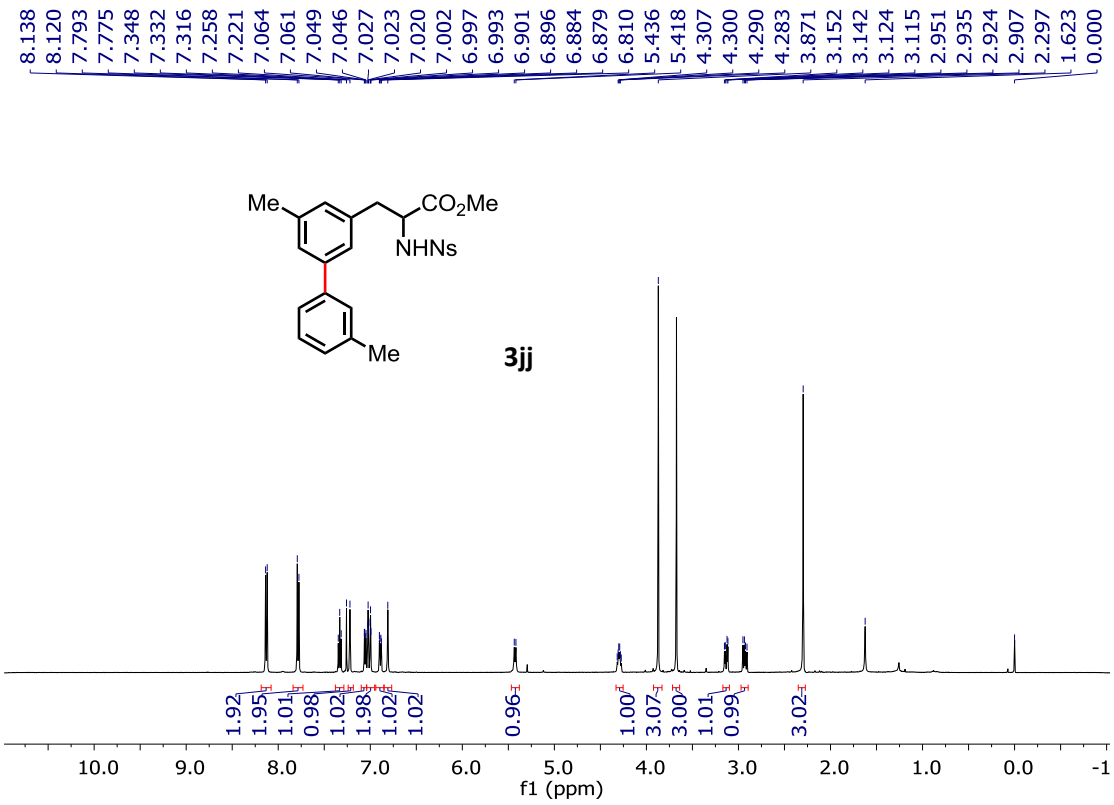

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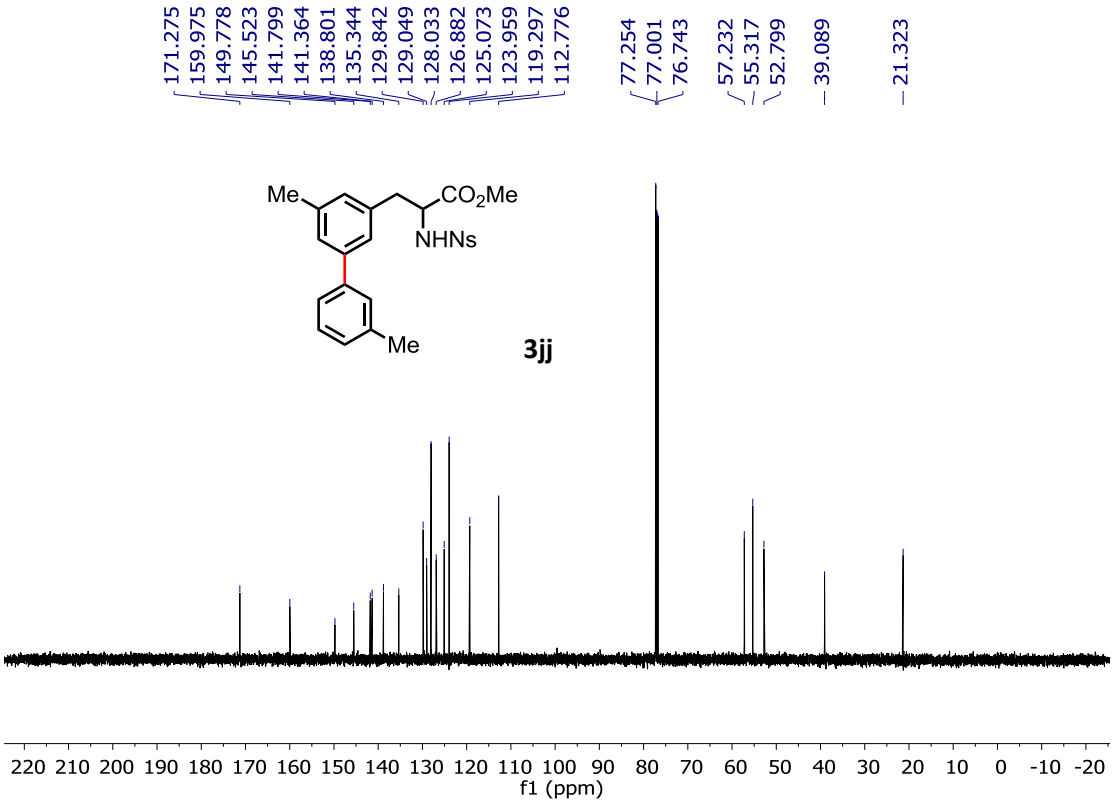
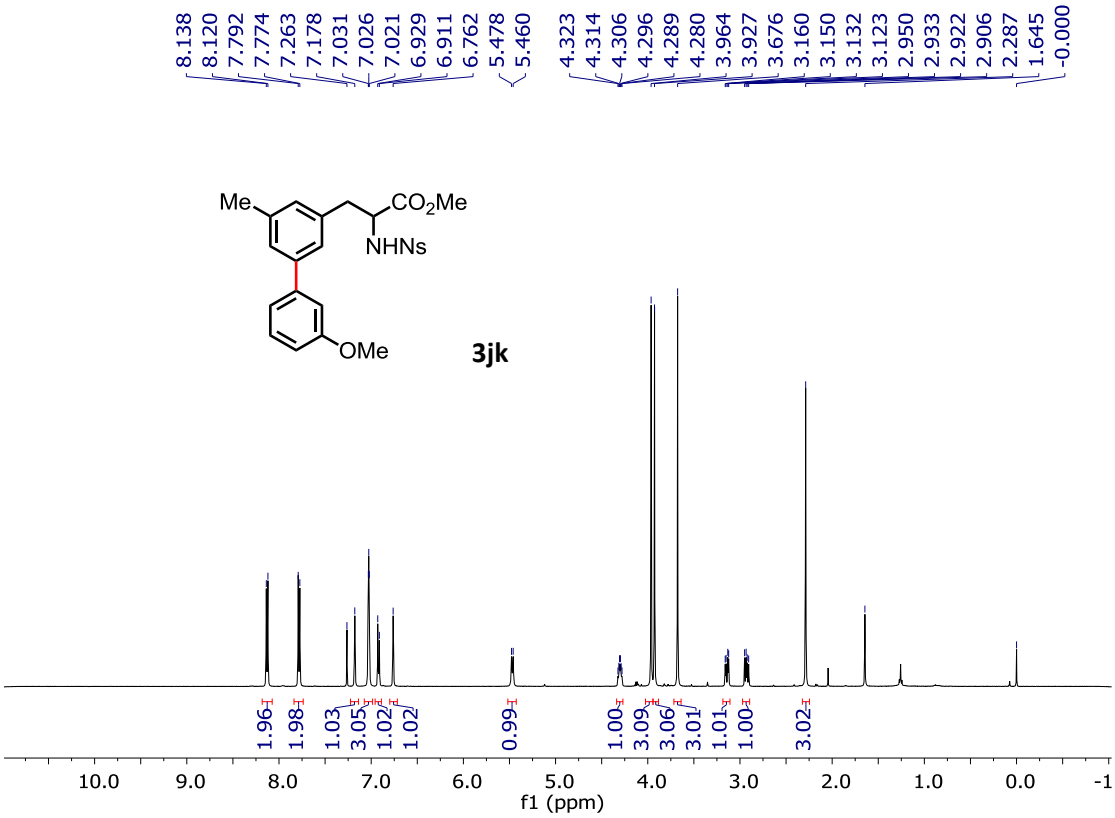
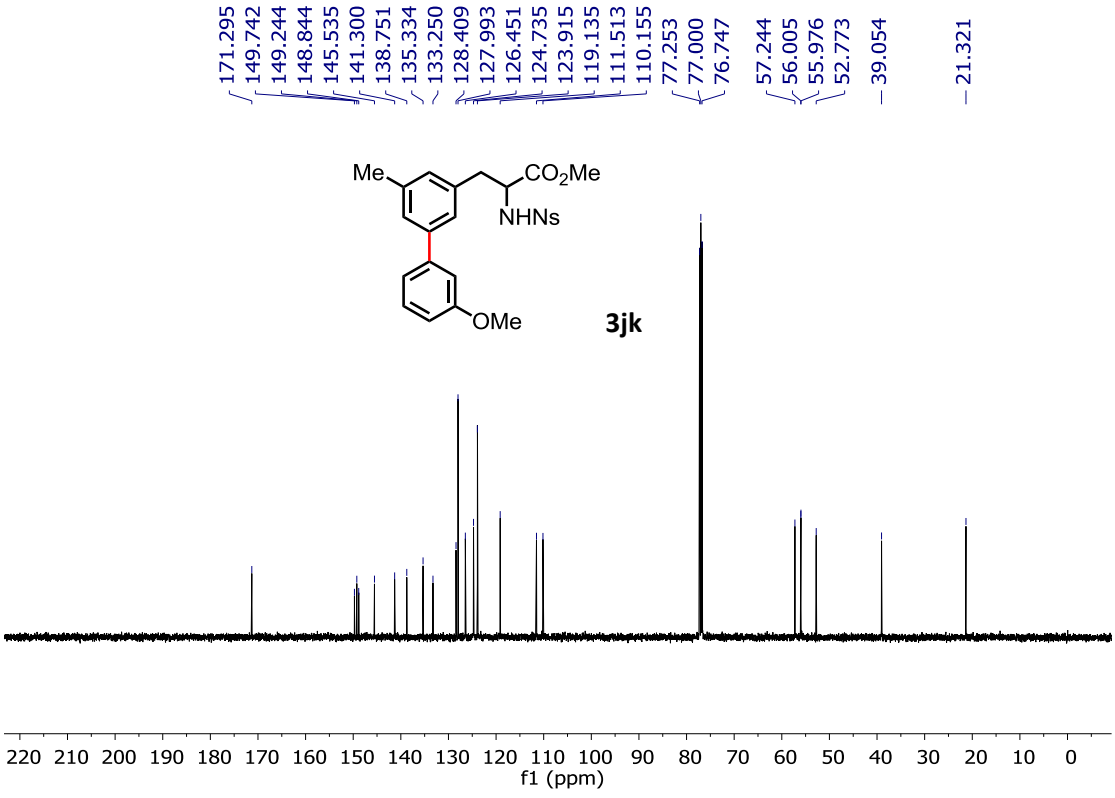


C:/Users/nmruser/Desktop/d2-104-5 redo/1/fid



C:/Users/nmruser/Desktop/d2-104-5 redo/2/fid



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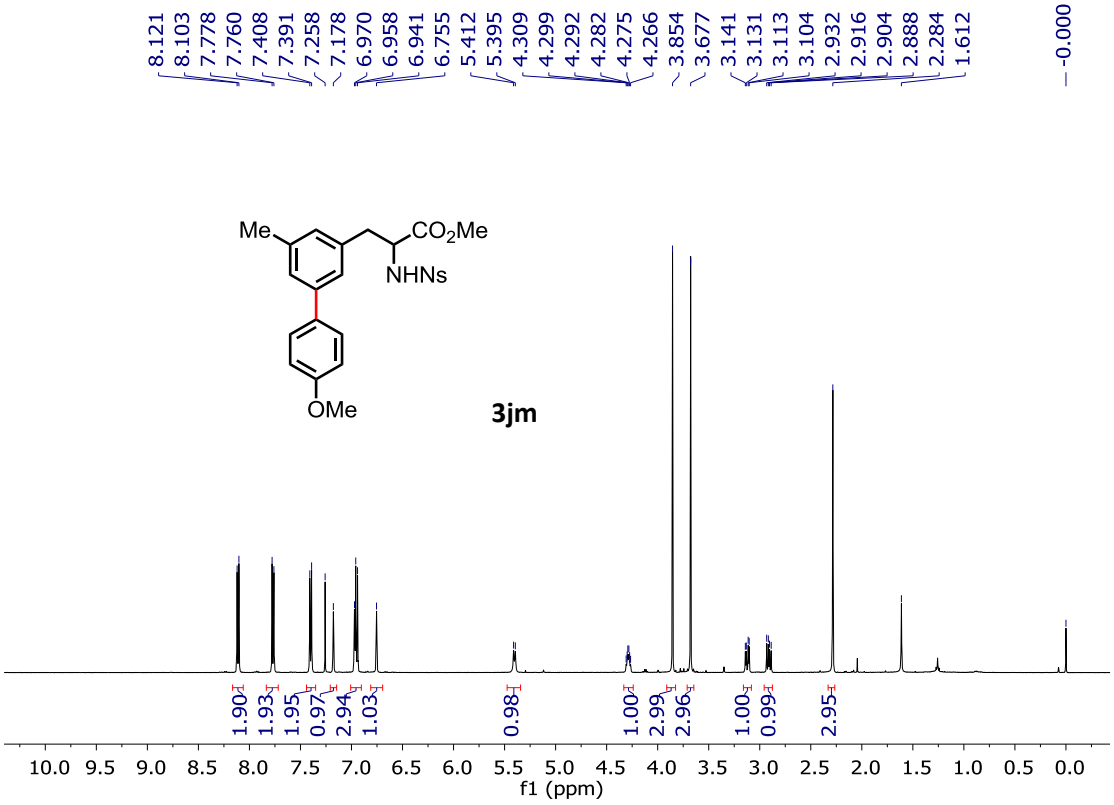

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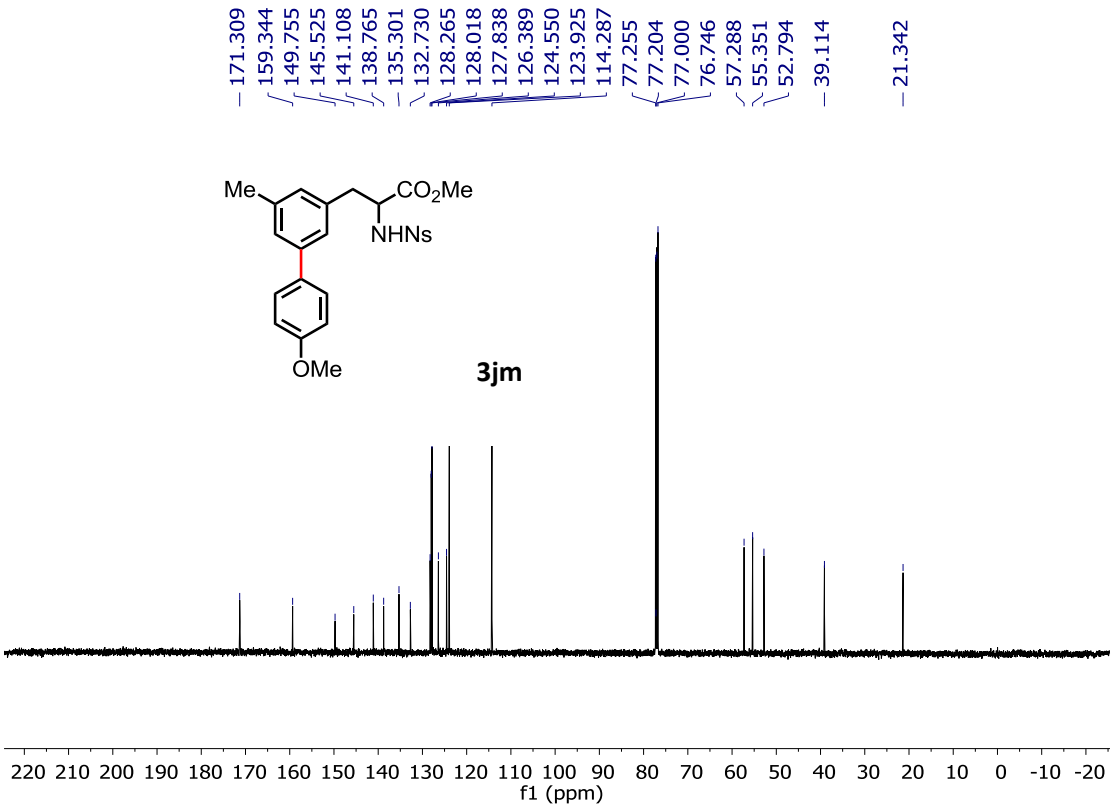
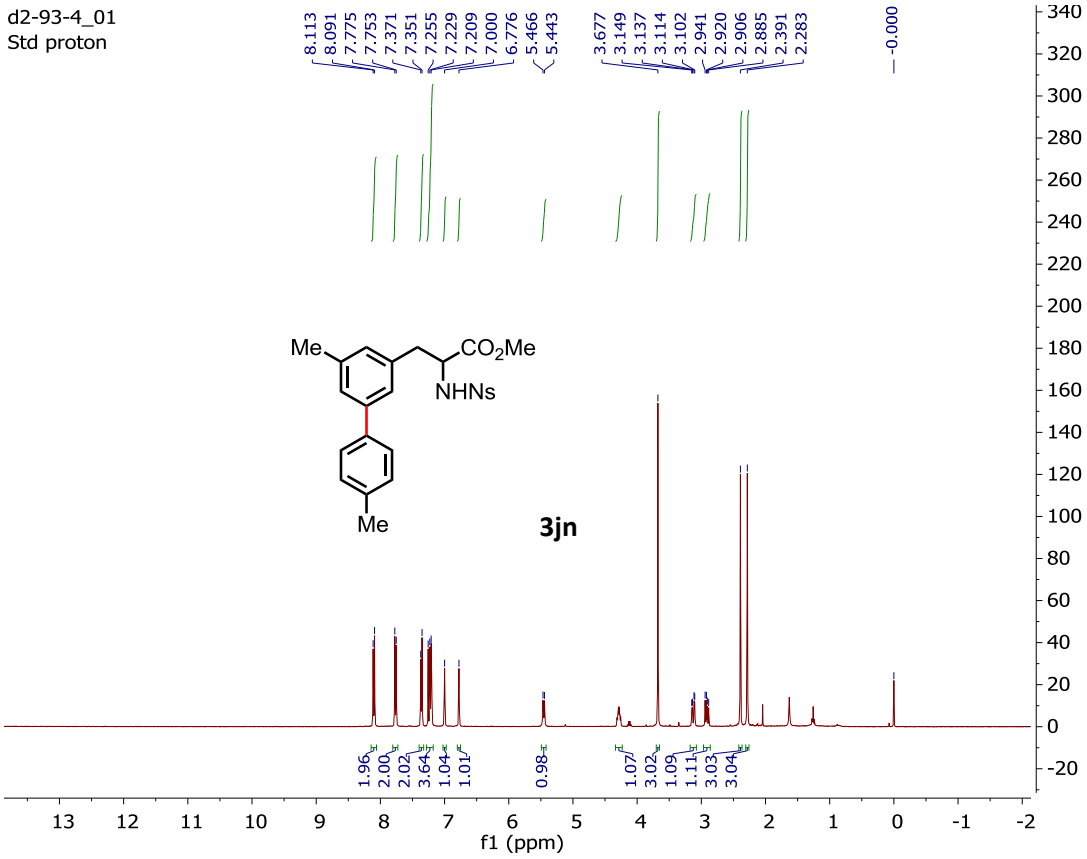
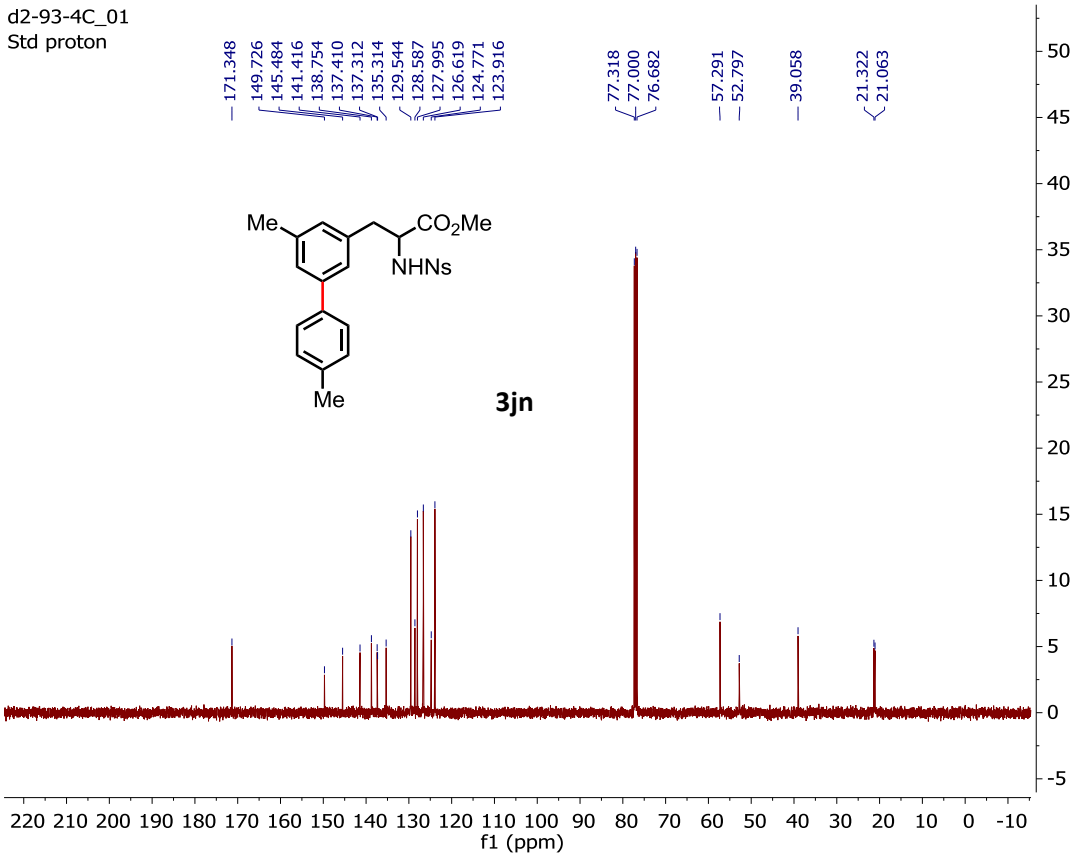
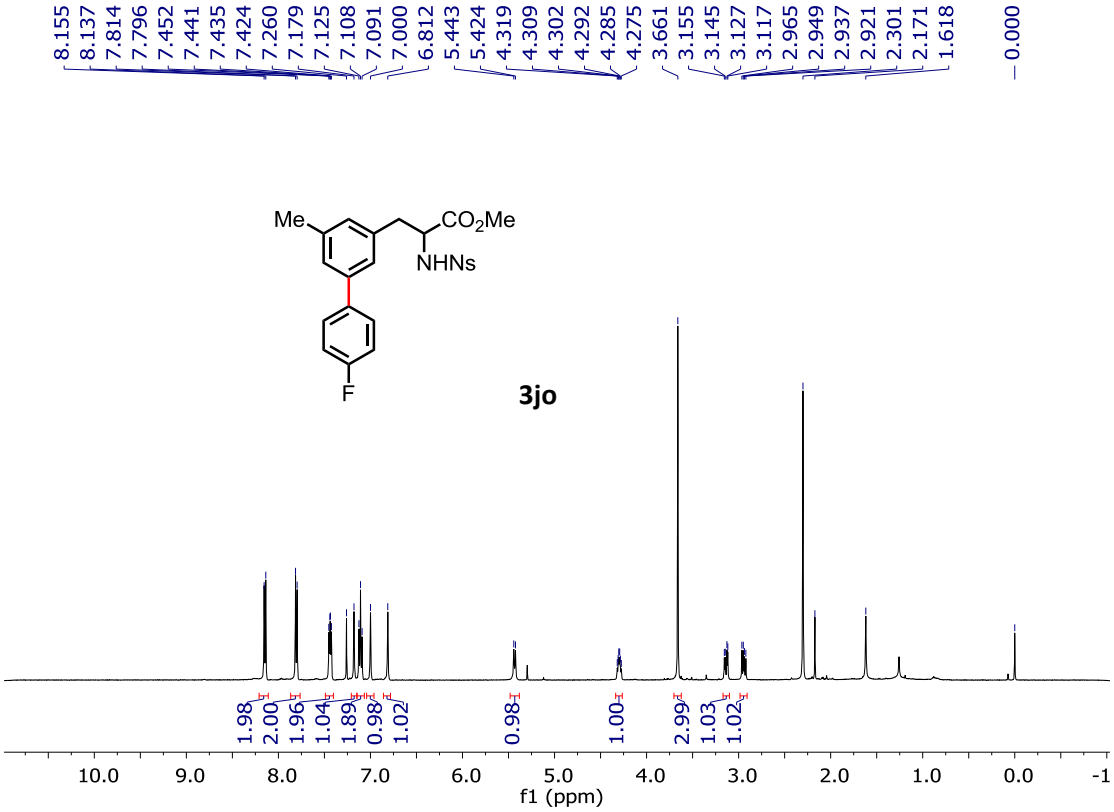



d2-93-4_01
Std proton
8.113
8.091
7.775
7.753
7.371
7.351
7.255
7.229
7.209
7.000
6.776
5.466
5.443
3.677
3.149
3.137
3.114
3.102
2.941
2.920
2.906
2.885
2.391
2.283
-0.000
Me
CO2Me
NHNs
Me
3jn
1.96
2.00
2.02
3.64
1.04
1.01
0.98
1.07
3.02
1.09
1.11
3.03
3.04
f1 (ppm)


d2-93-4C_01
Std proton
171.348
149.726
145.484
141.416
138.754
137.410
137.312
135.314
129.544
128.587
127.995
126.619
124.771
123.916
77.318
77.000
76.682
57.291
52.797
39.058
21.322
21.063
Me
CO2Me
NHNs
Me
3jn
f1 (ppm)

C:/Users/nmruser/Desktop/d2-105-1/1/fid



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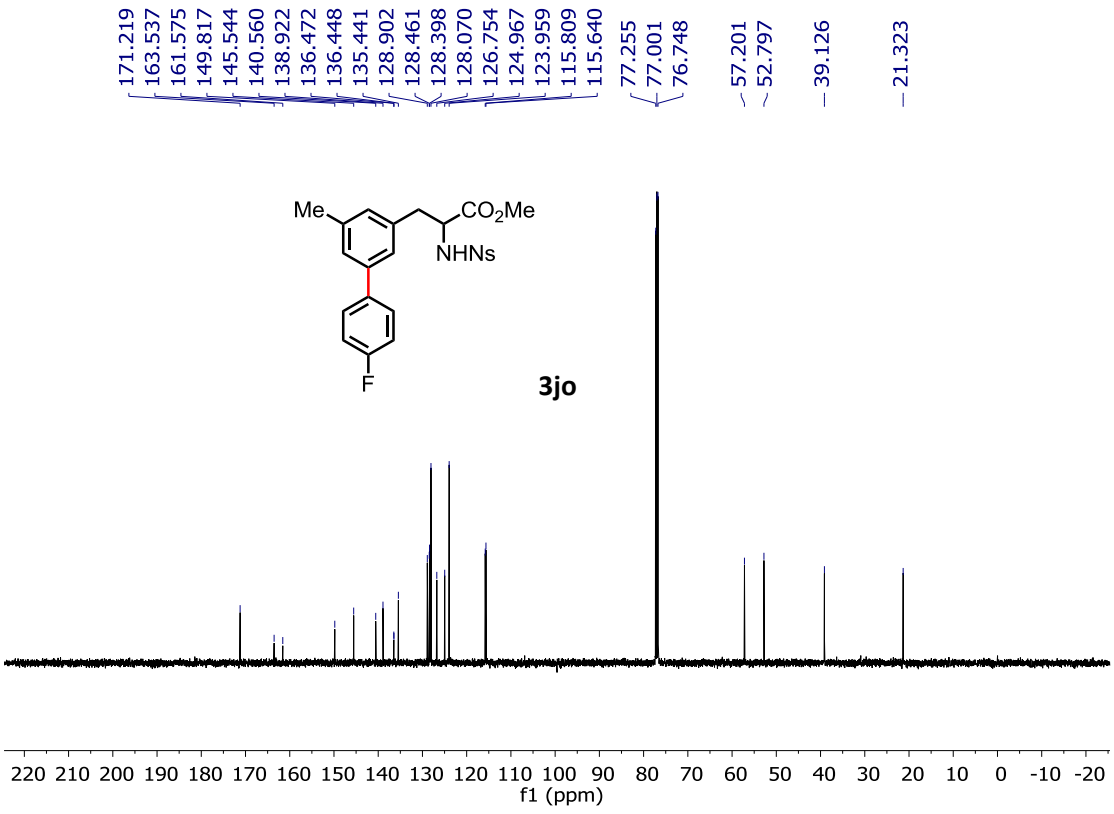

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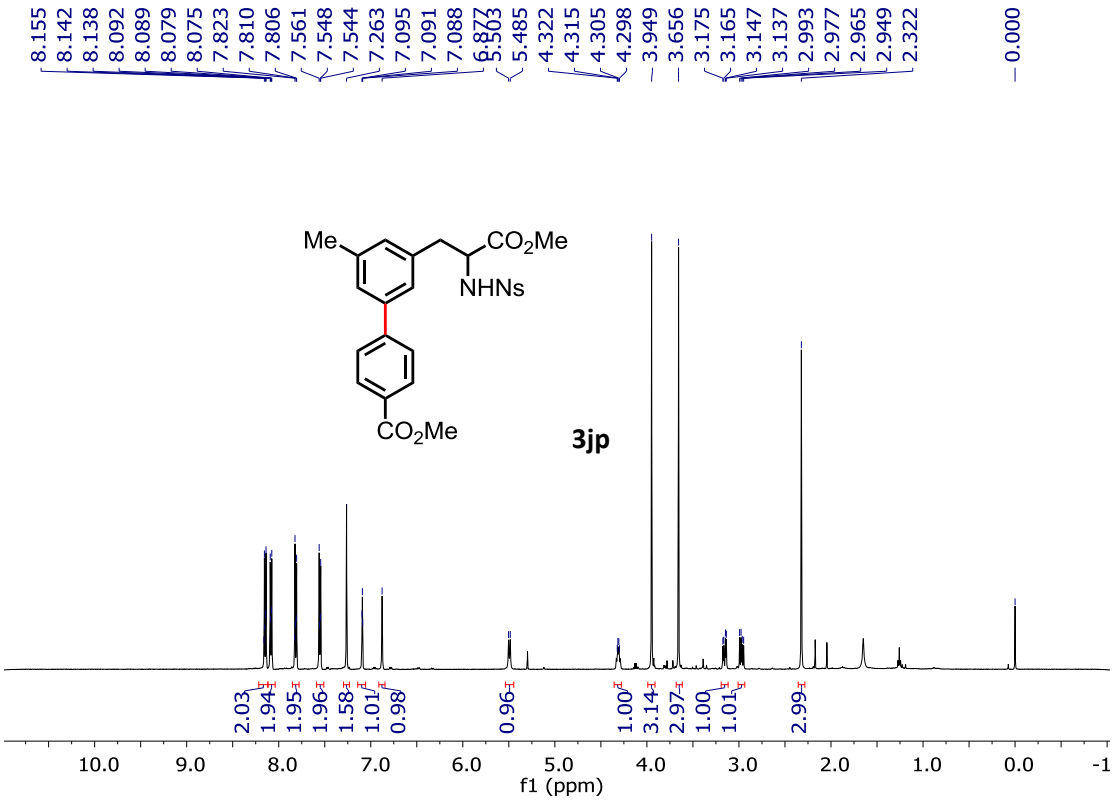

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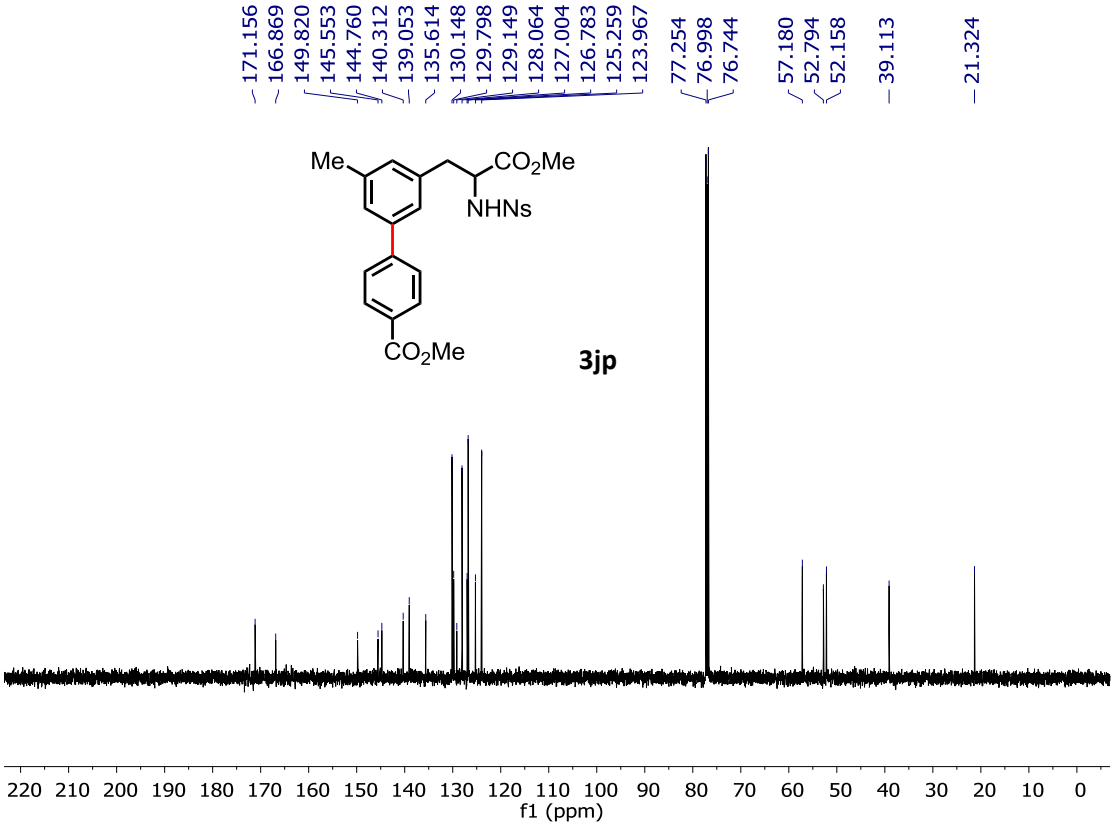

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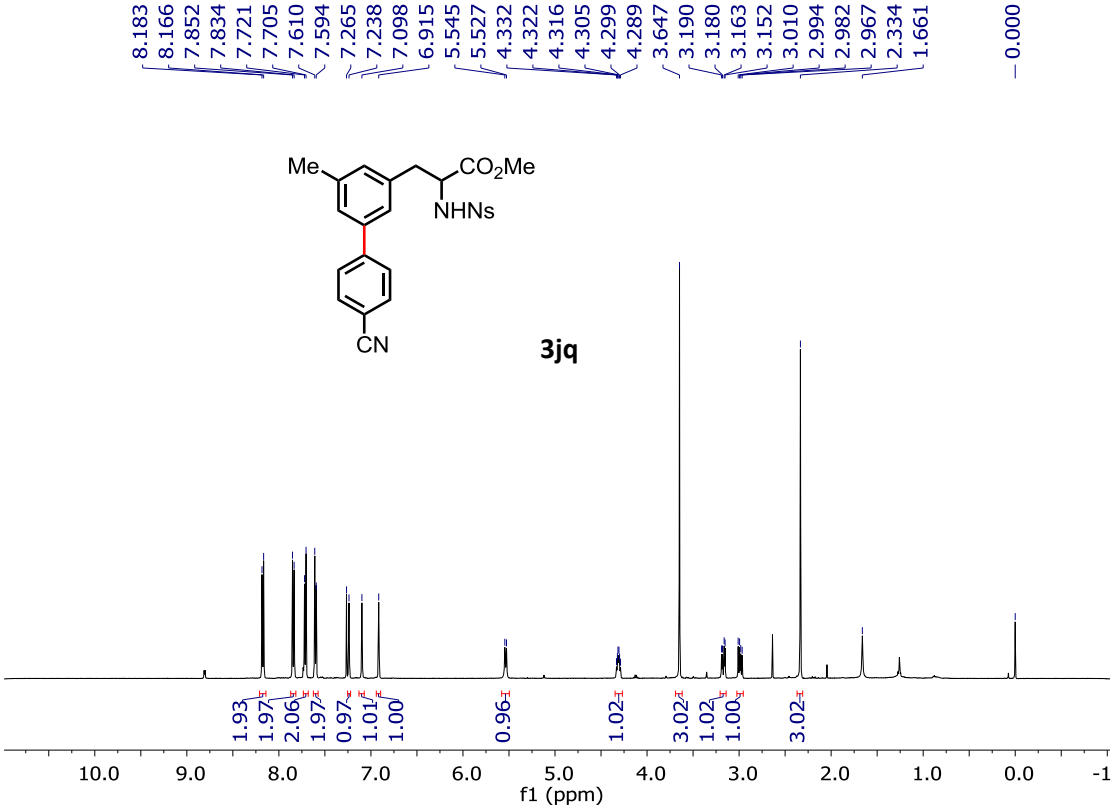
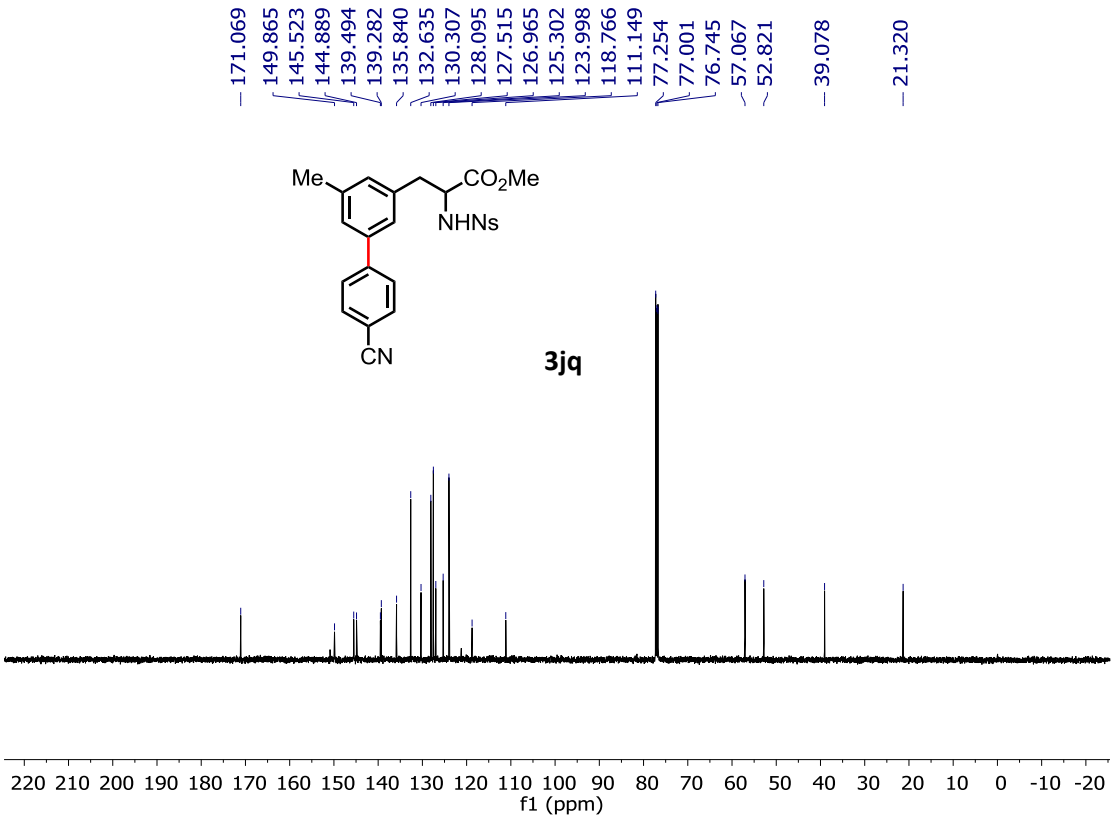
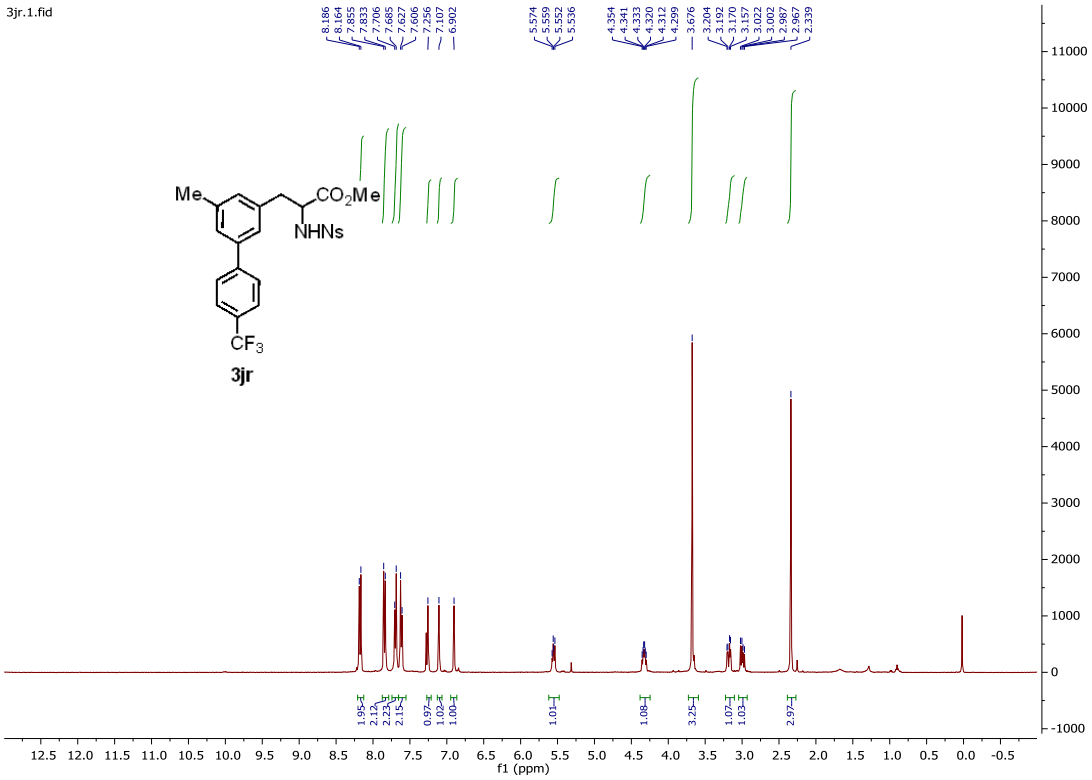
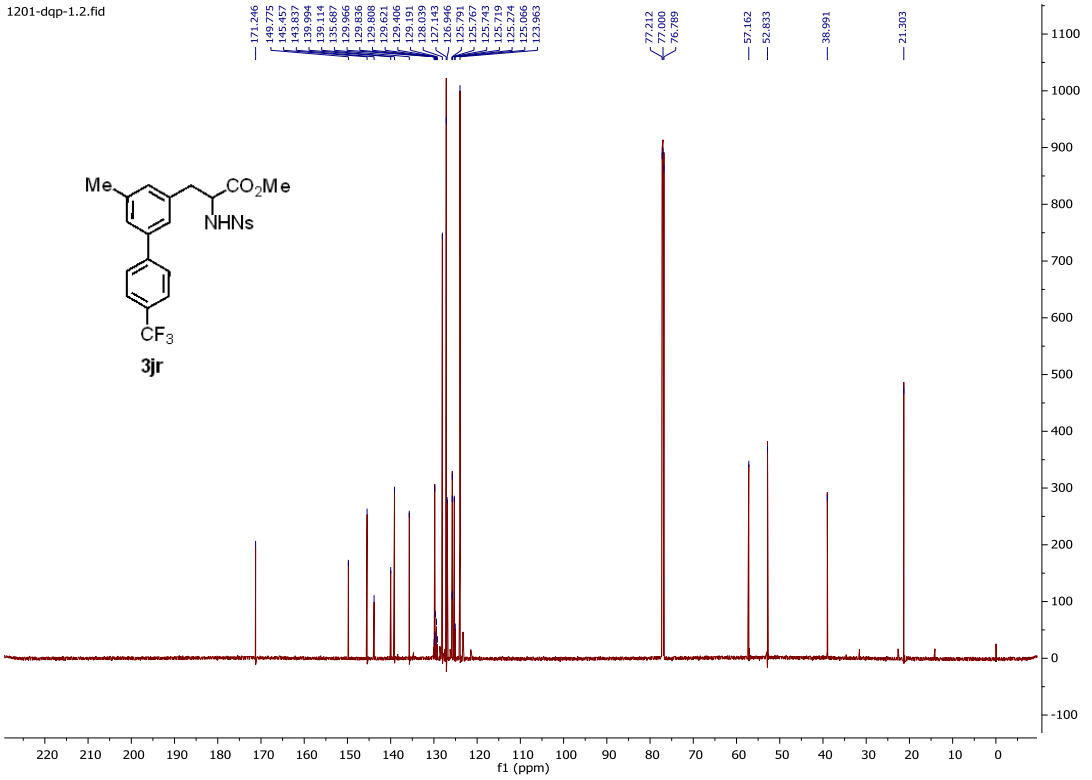
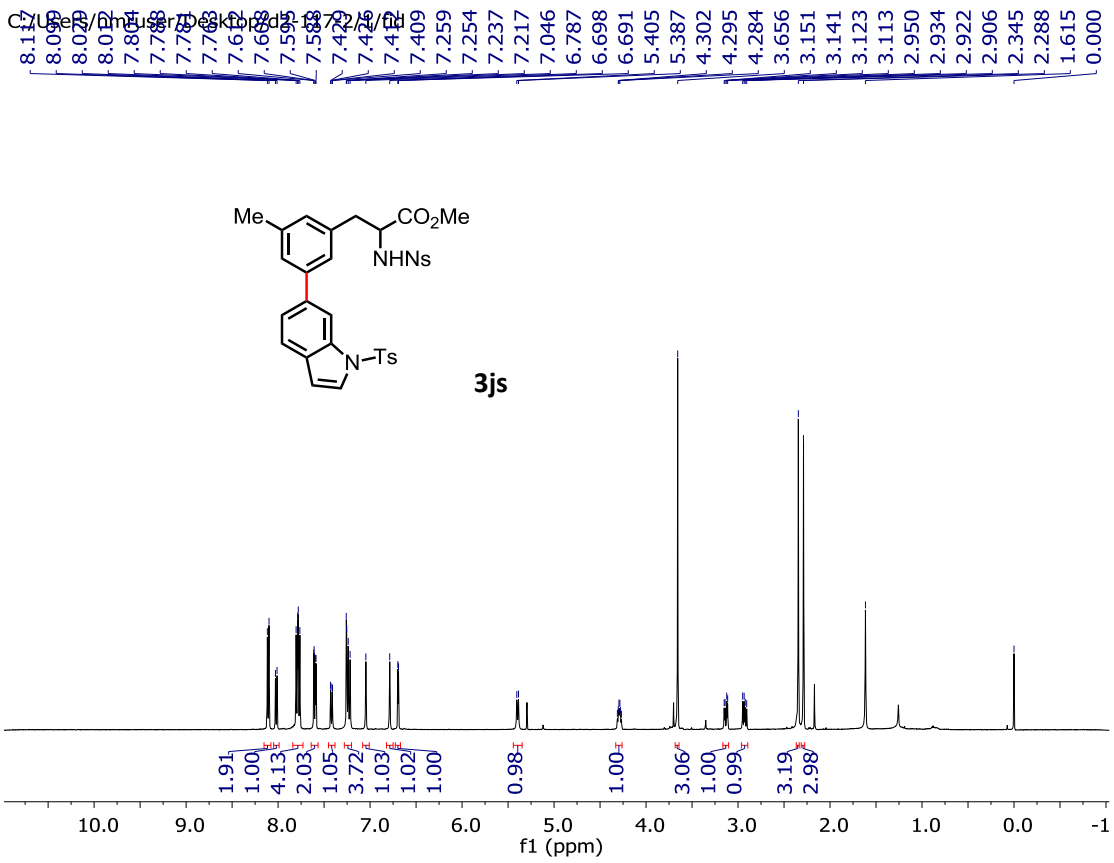


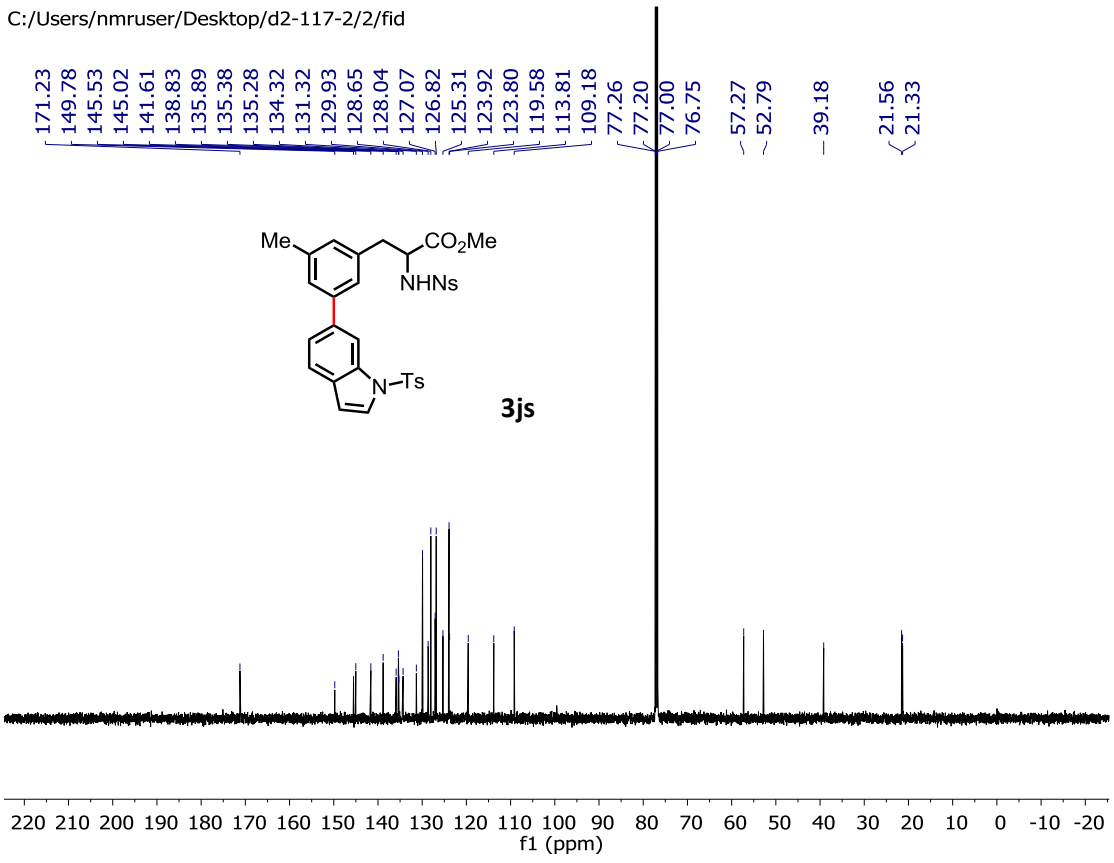
C:/Users/nmruser/Desktop/d2-104-6/2/fid



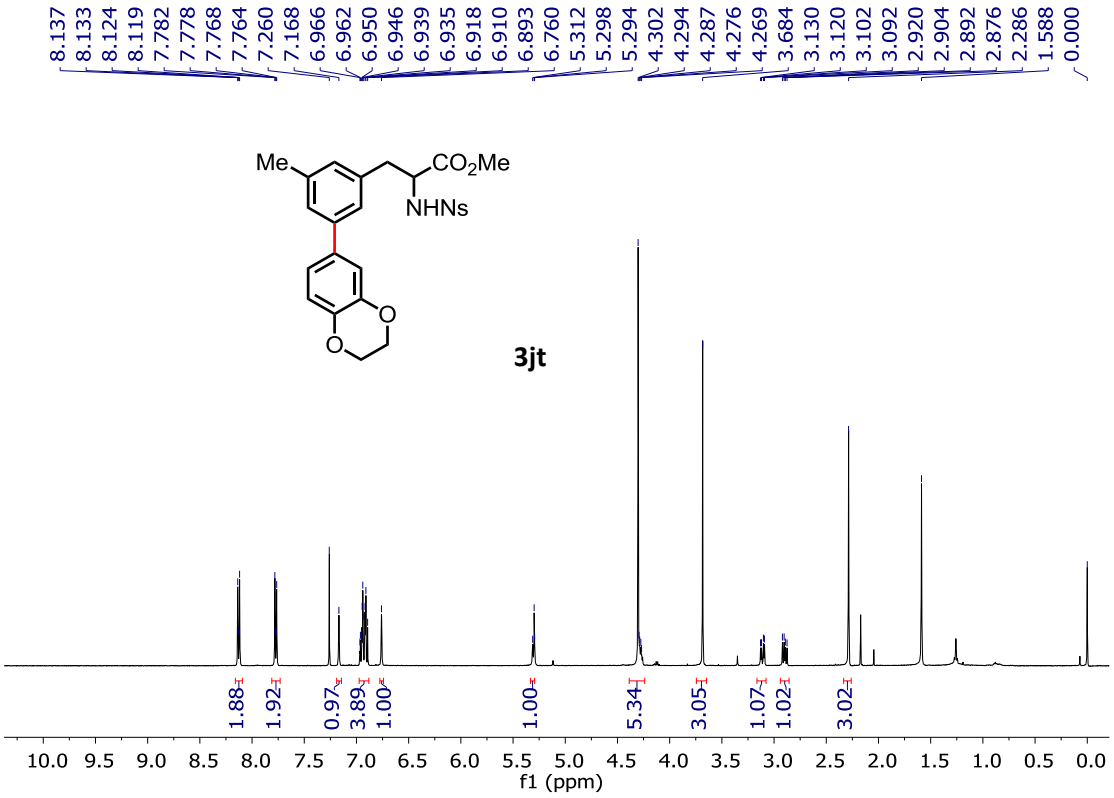

3jr.1.fid
Me
CO2Me
NHNs
CF3
3jr
f1 (ppm)


1201-dqp-1.2.fid
Me
CO2Me
NHNs
CF3
3jr
f1 (ppm)

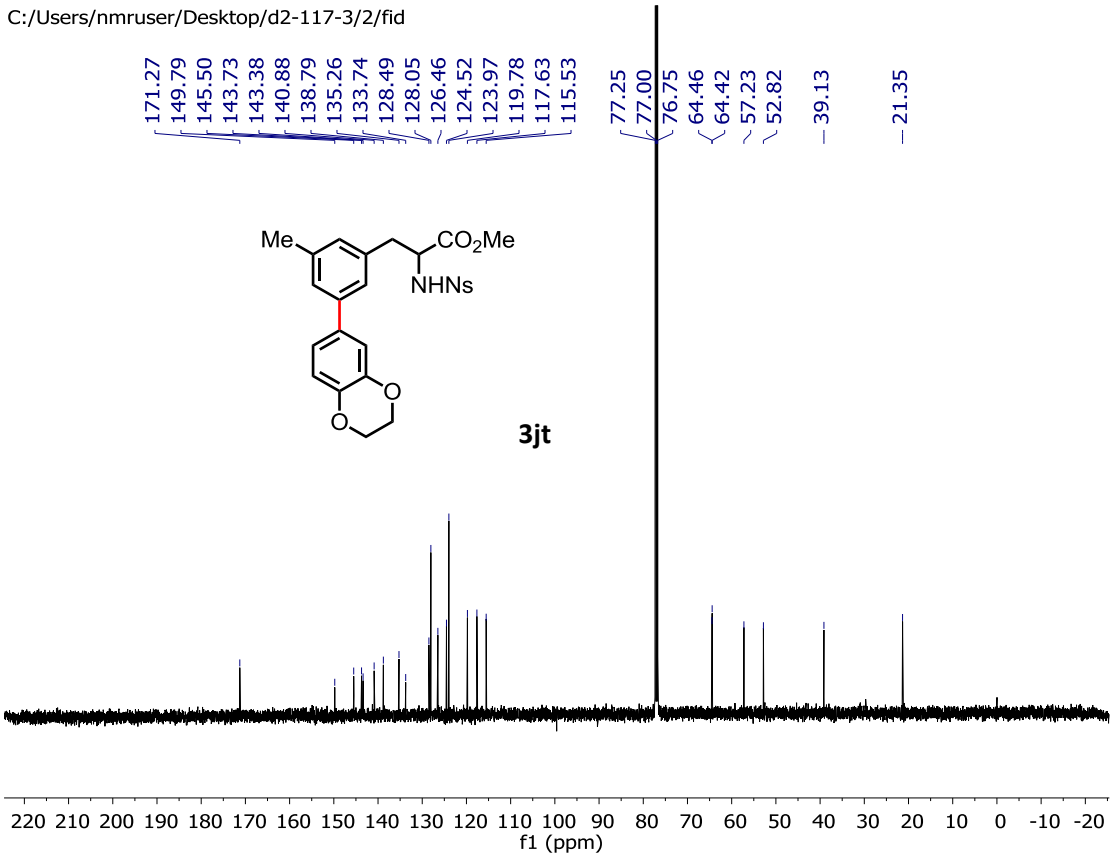

C:/Users/nmruser/Desktop/d2-117-2/2/fid
Me
CO2Me
NHNs
N
Ts
3js
f1 (ppm)


C:/Users/nmruser/Desktop/d2-117-2/2/fid
Me
CO2Me
NHNs
N
Ts
3js
f1 (ppm)

C:/Users/nmruser/Desktop/d2-117-3/1/fid



C:/Users/nmruser/Desktop/d2-117-3/2/fid



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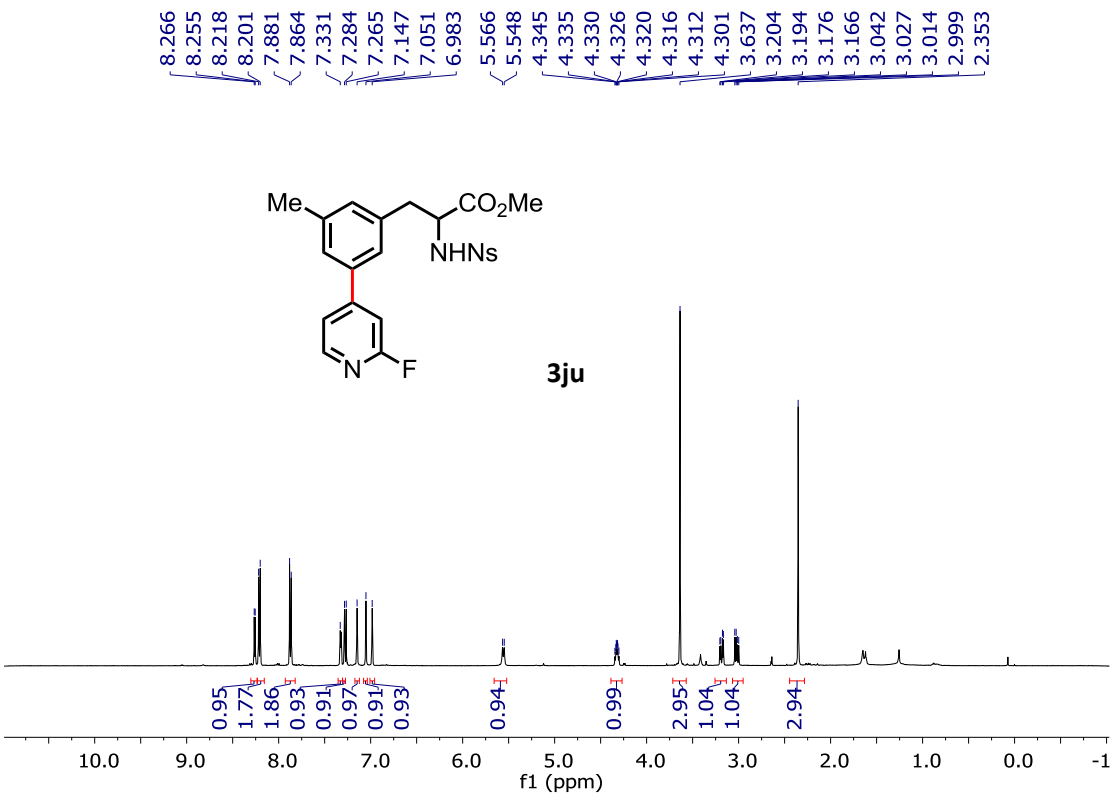

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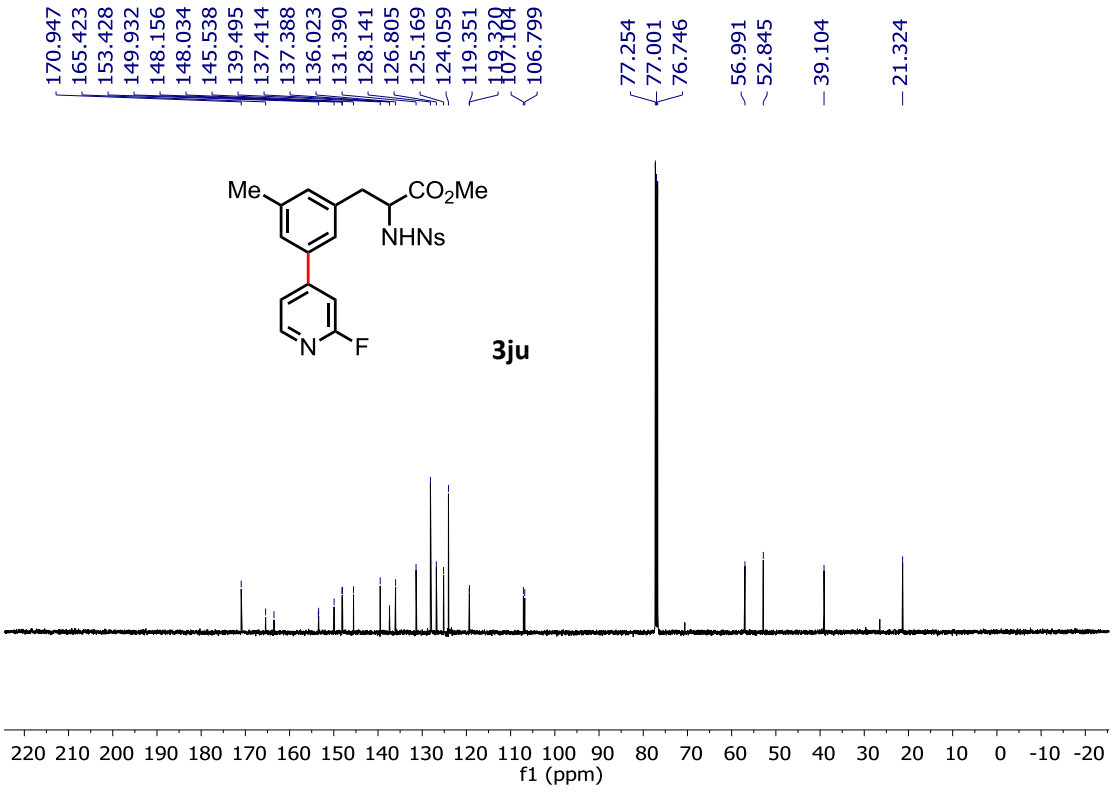
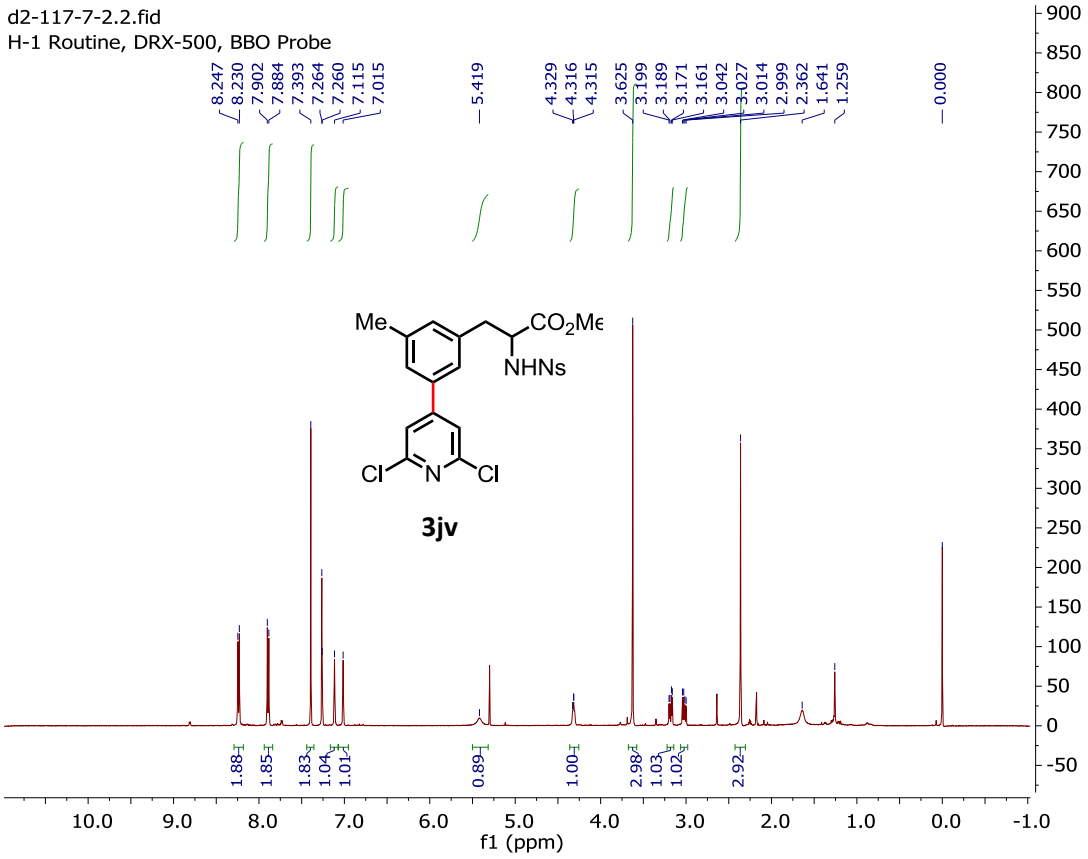
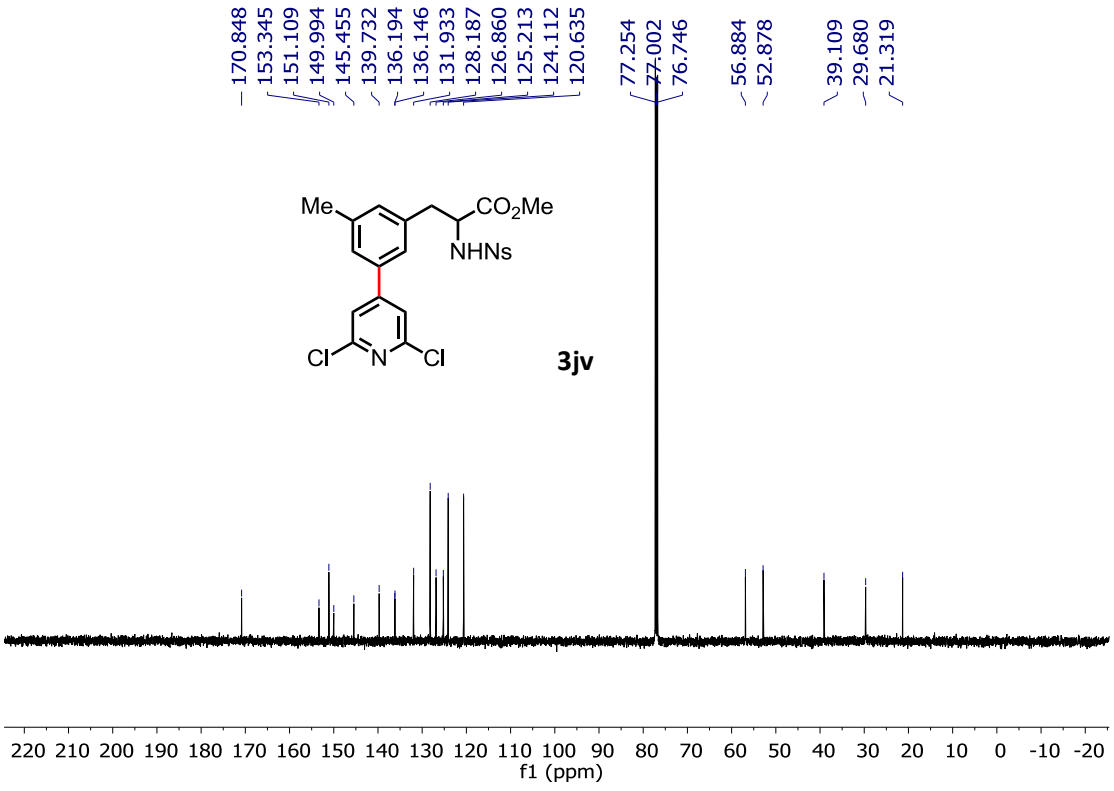




C:/Users/nmruser/Desktop/d2-117-9/4/fid



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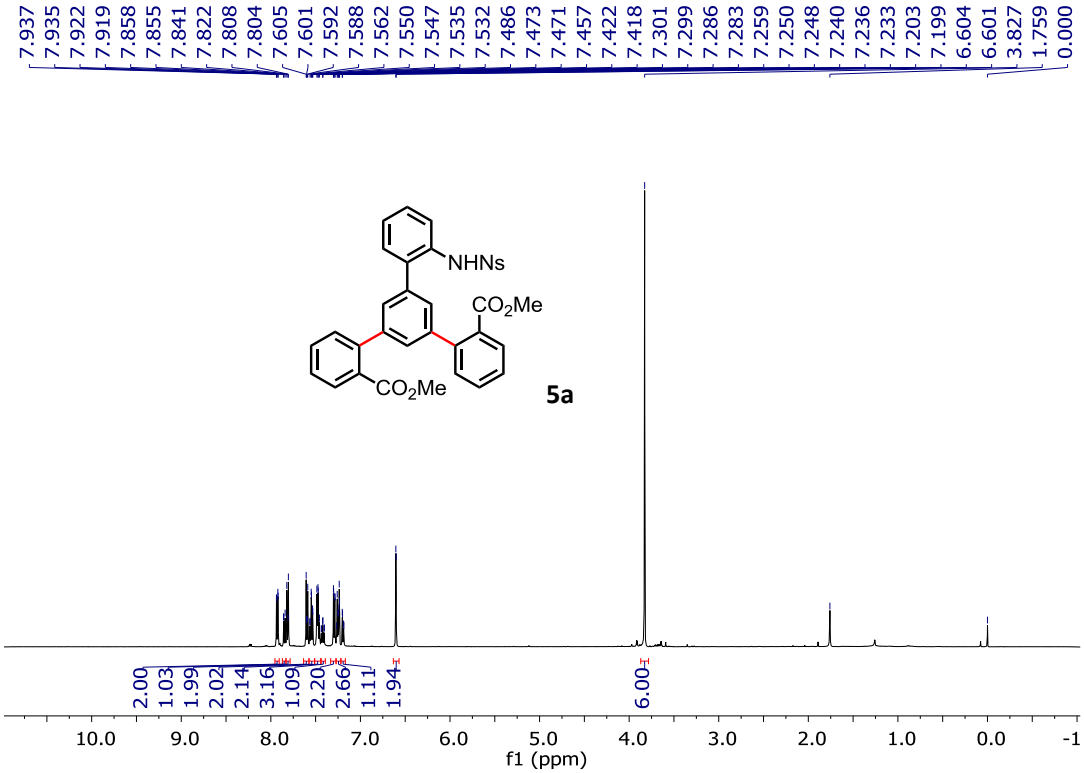

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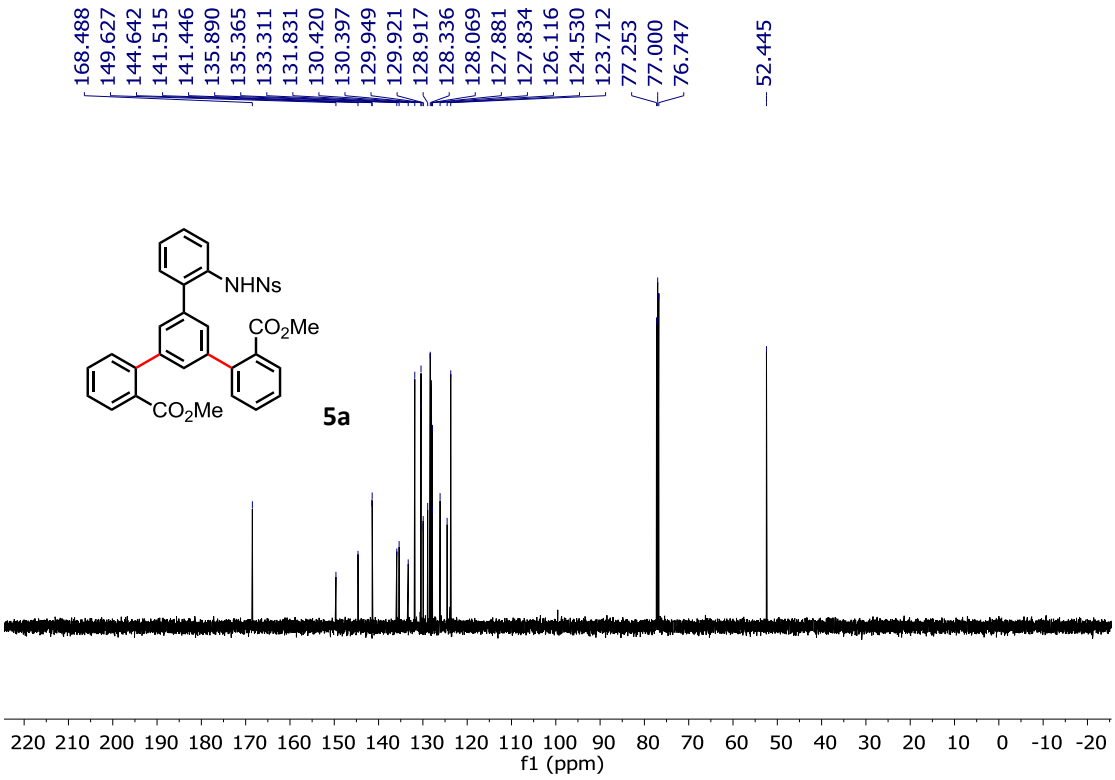
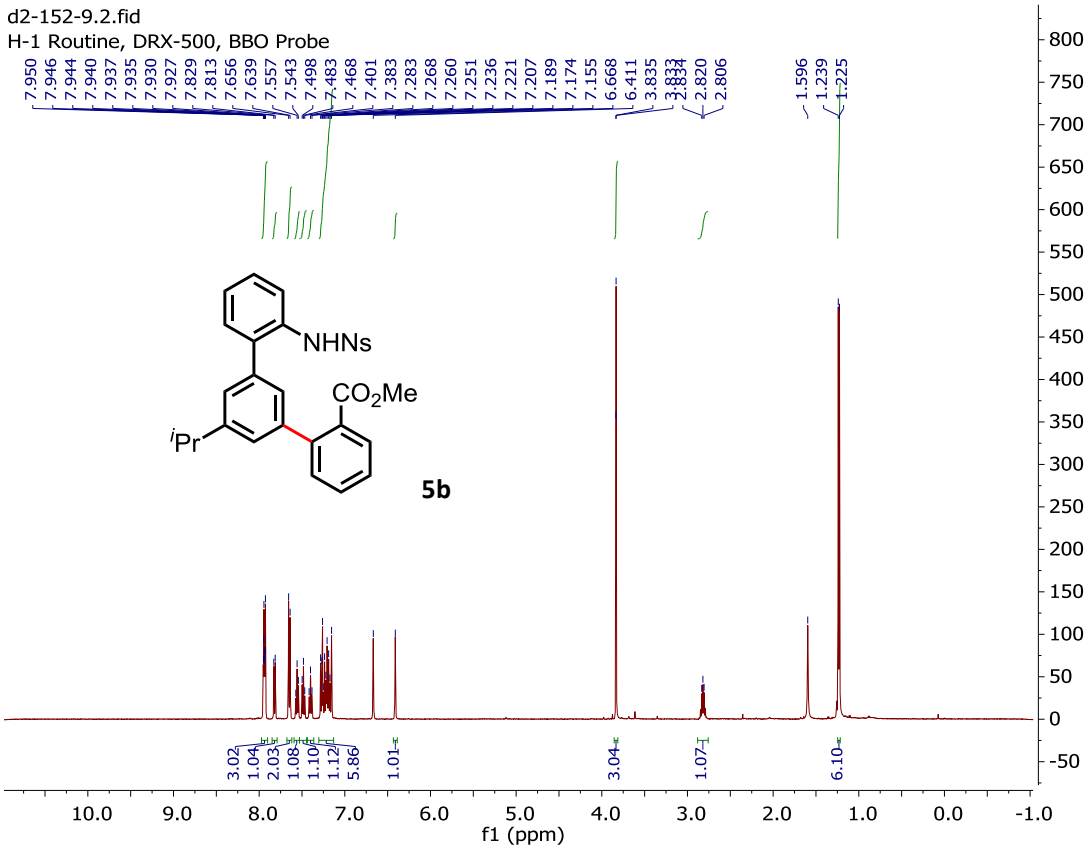
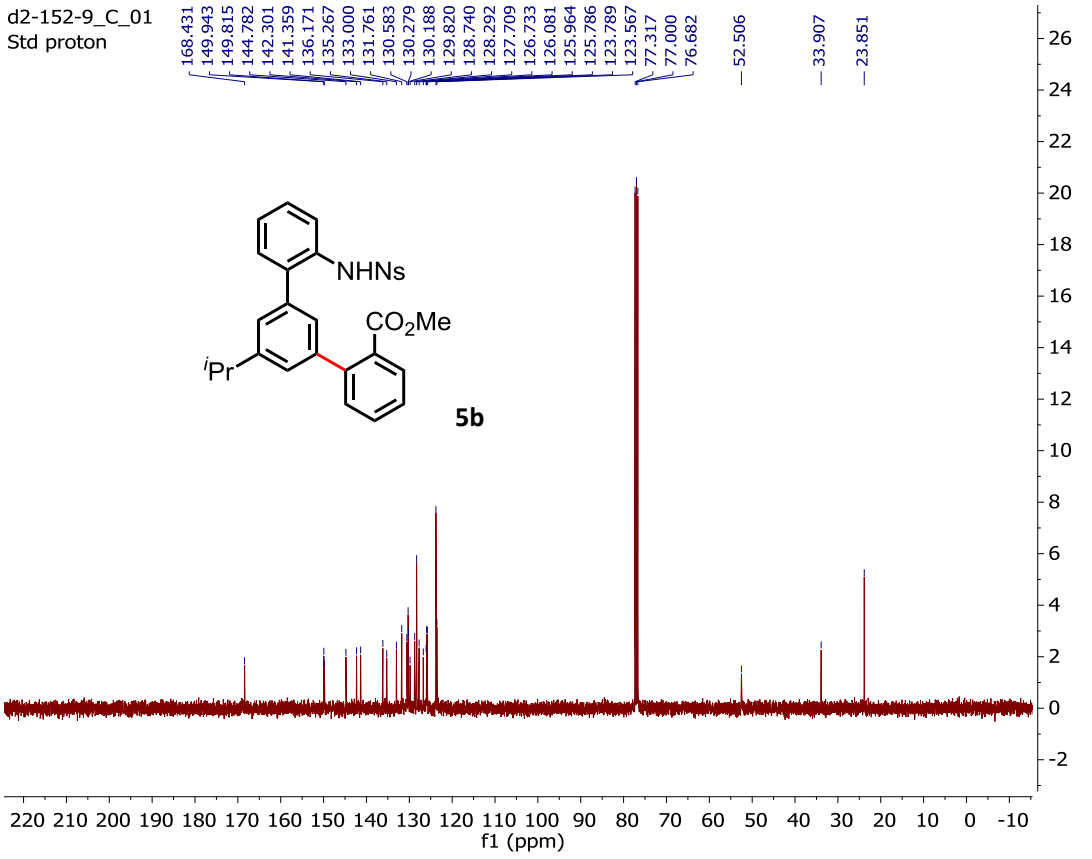
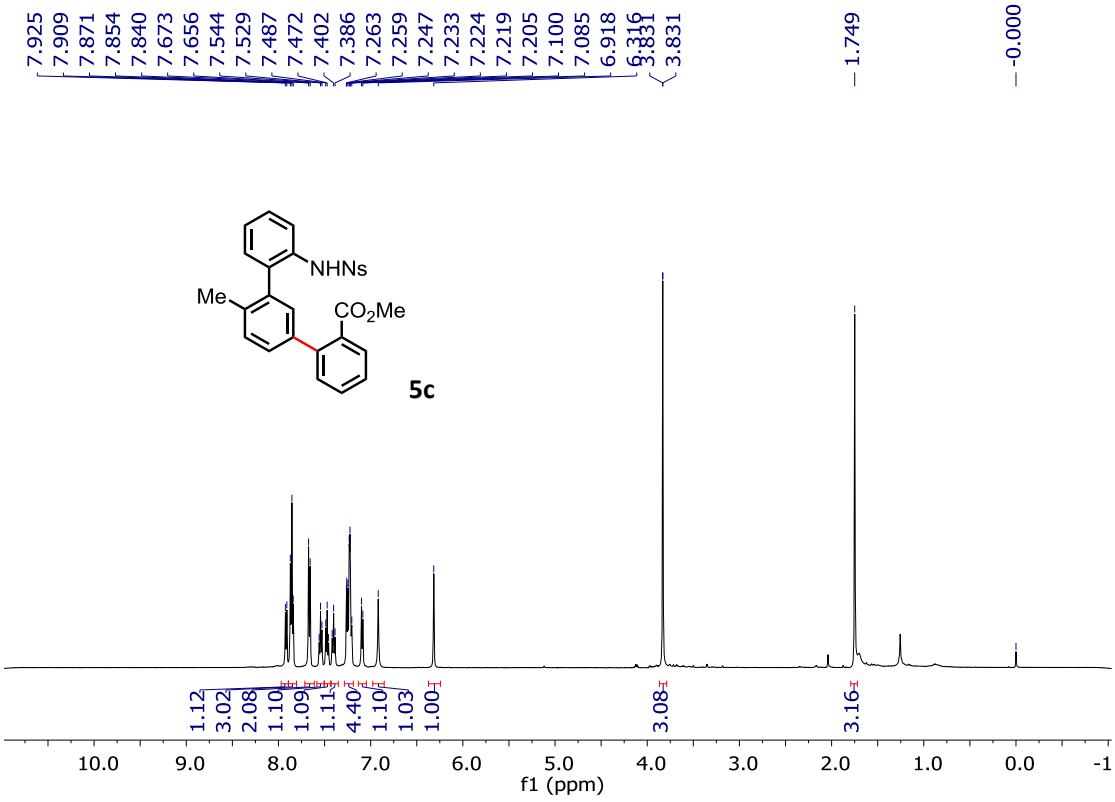


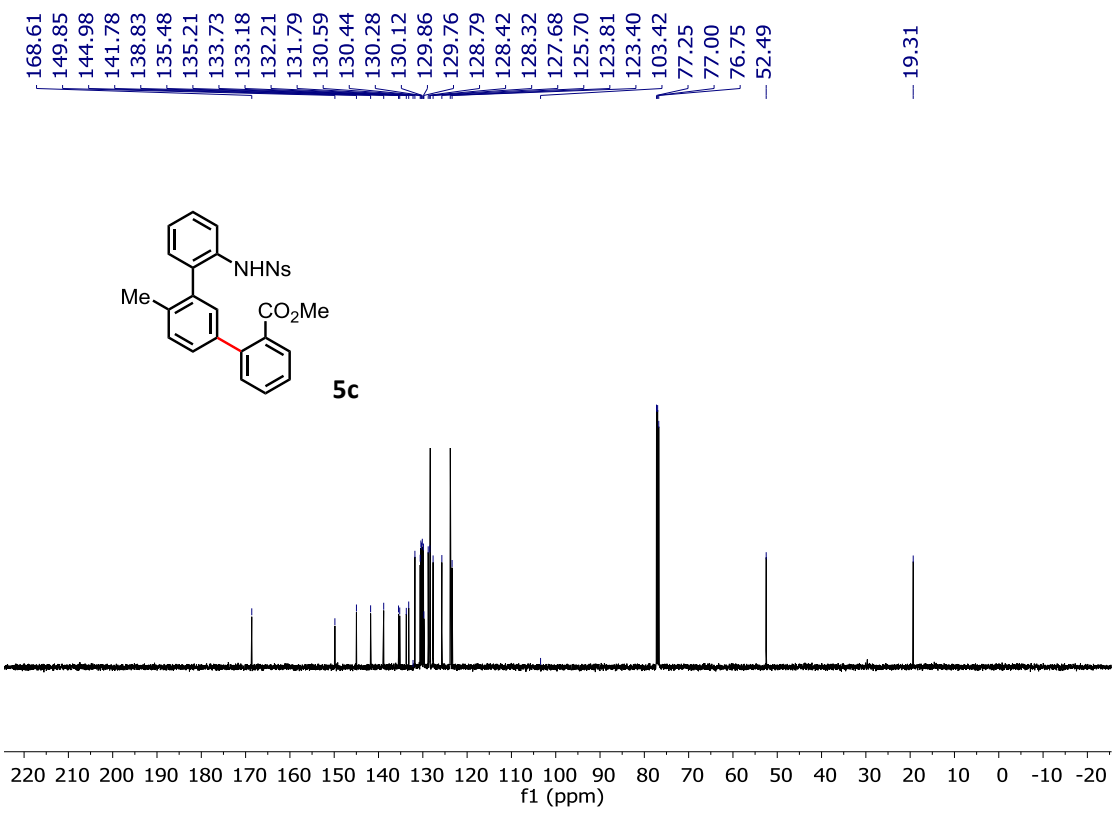

d2-152-9.2.fid
H-1 Routine, DRX-500, BBO Probe
NHNs
CO2Me
iPr
5b
f1 (ppm)

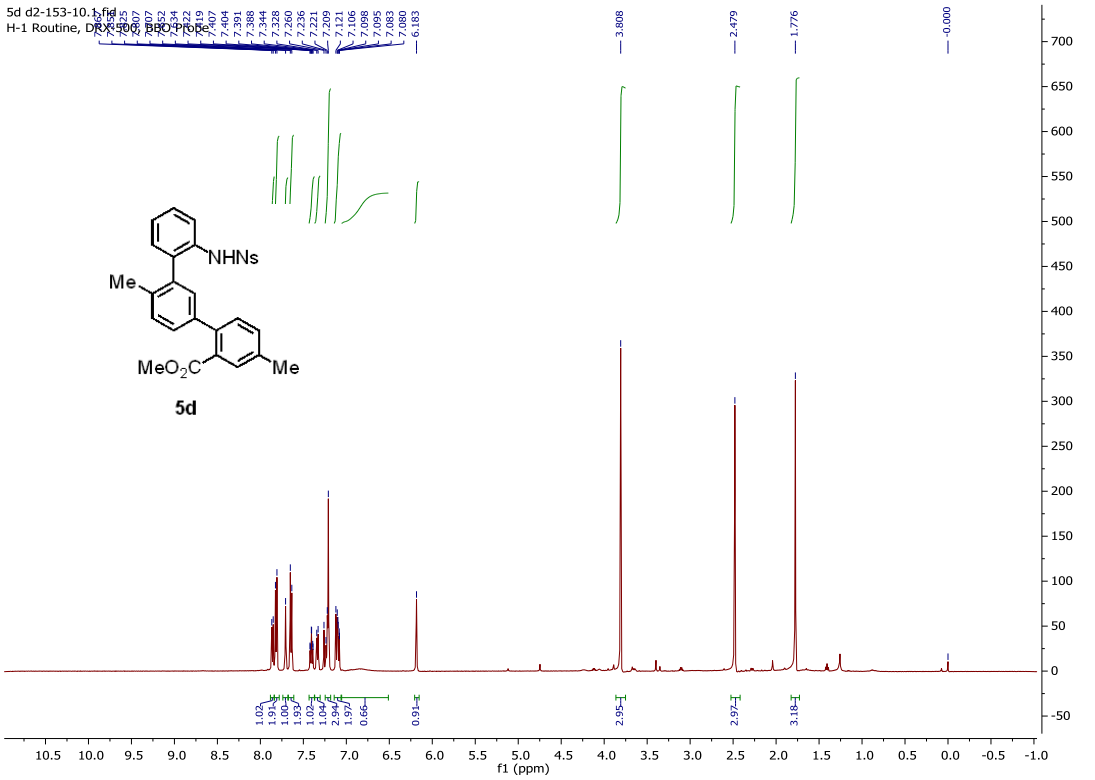

d2-152-9_C_01
Std proton
NHNs
CO2Me
iPr
5b
f1 (ppm)

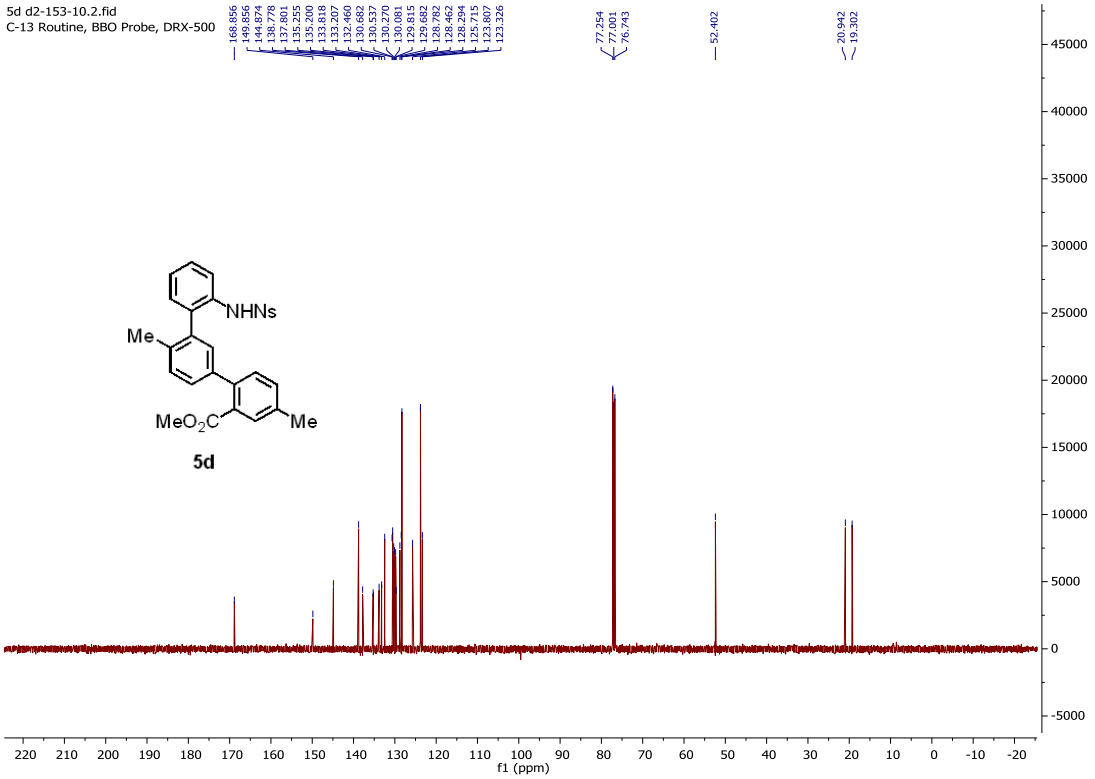
C:/Users/nmruser/Desktop/d2-152-1/1/fid

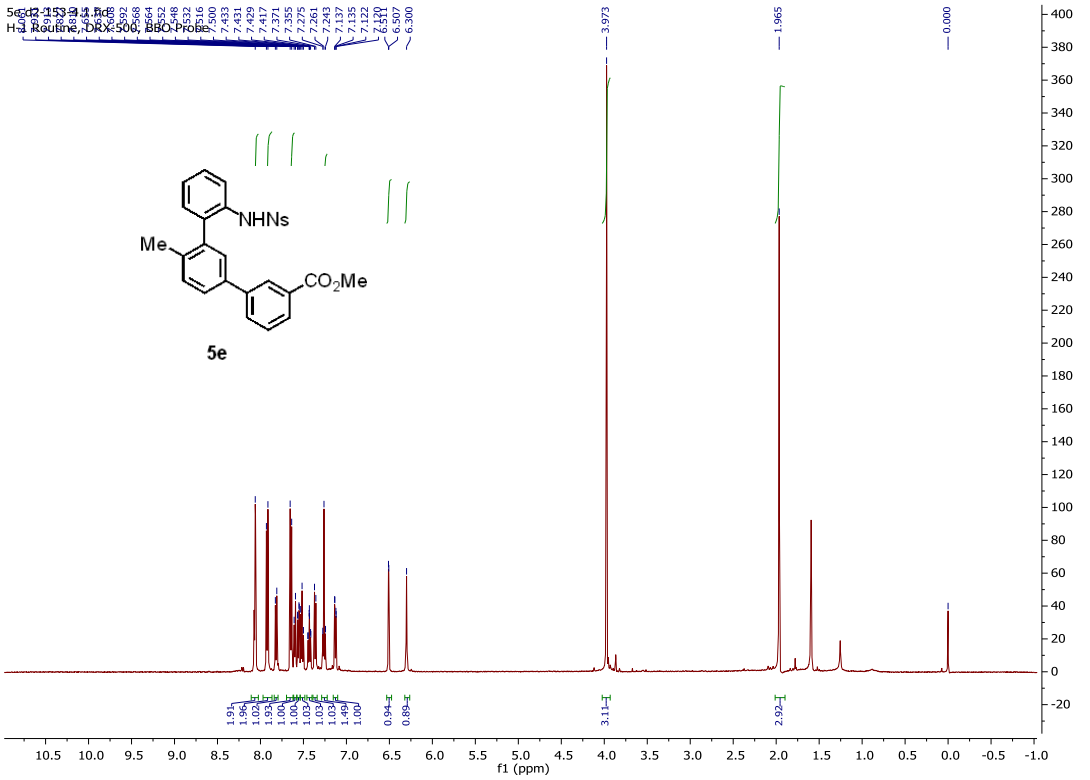


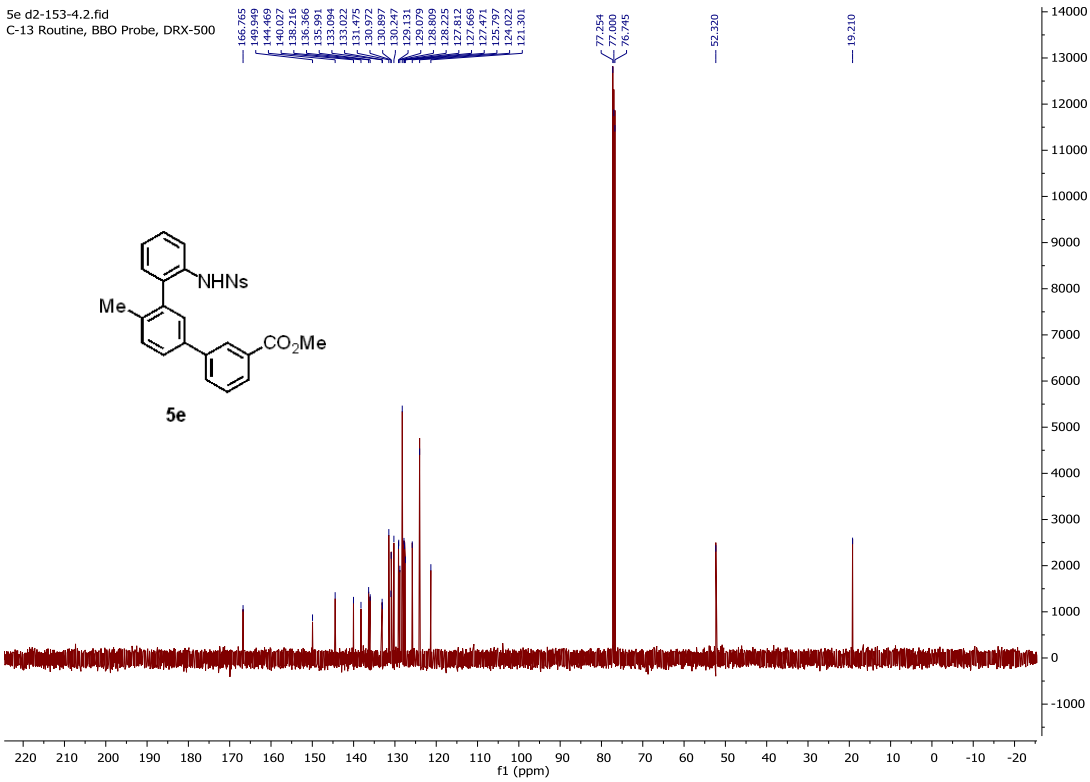
C:/Users/nmruser/Desktop/d2-152-1/2/fid

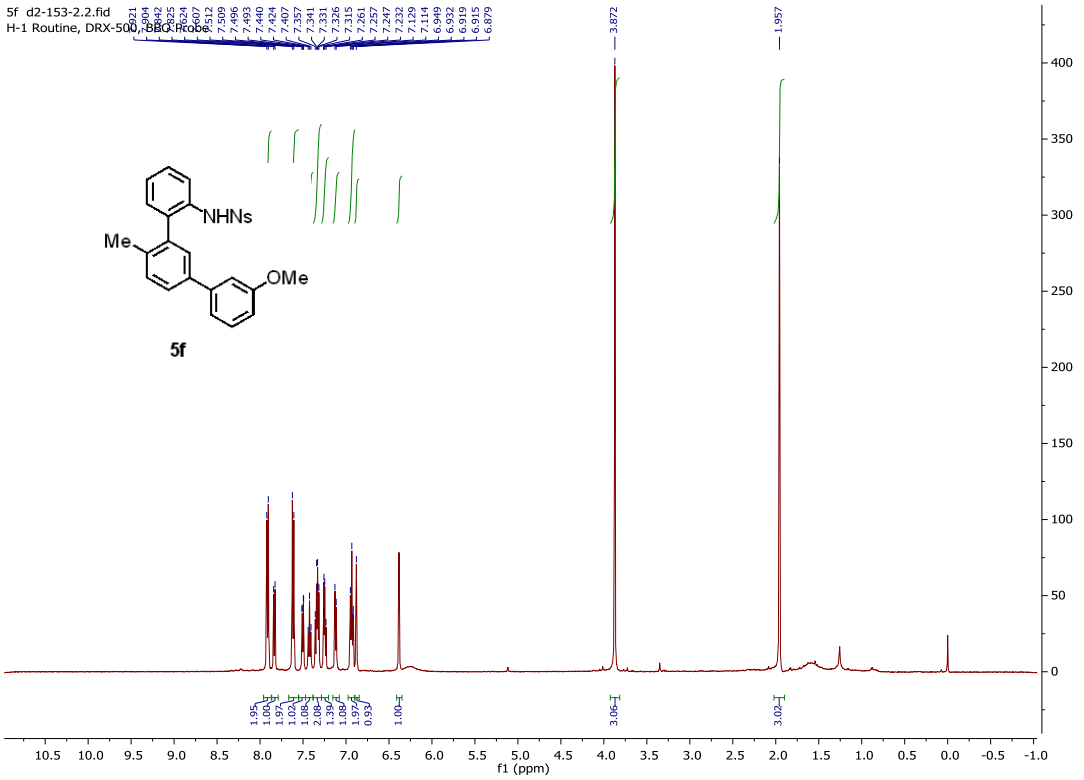


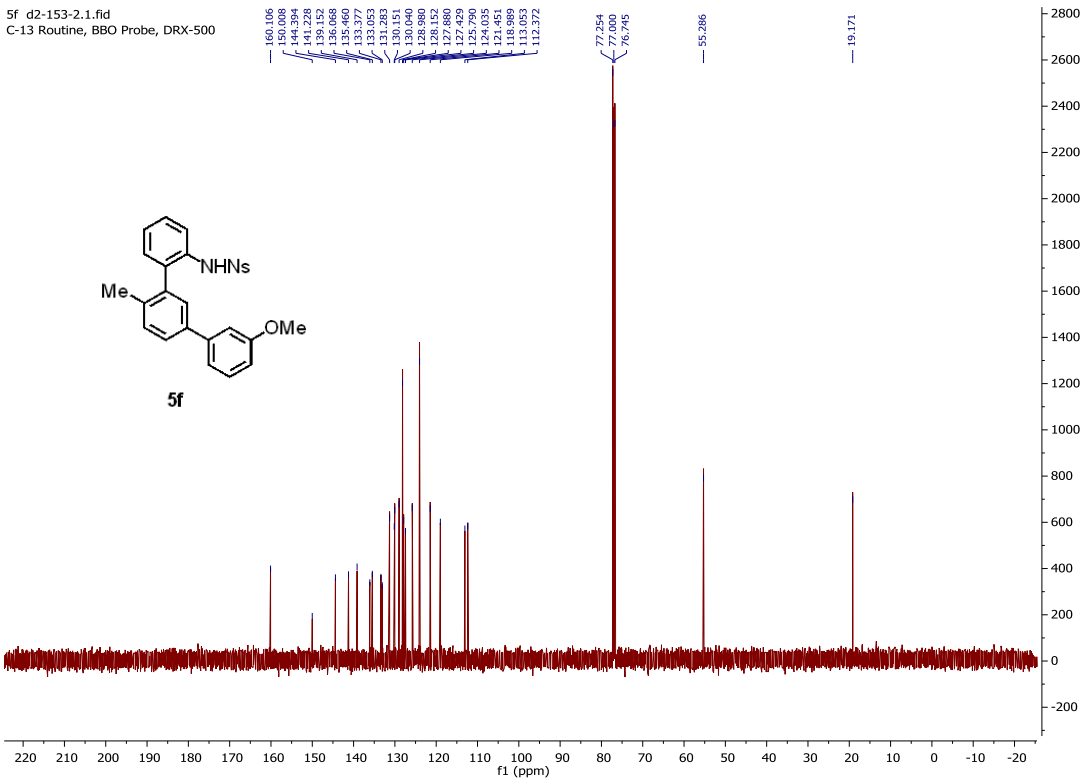

5d d2-153-10.1.fid
H-1 Routine, DRX-500, BBO Probe
NHNs
Me
MeO2C
Me
5d
f1 (ppm)

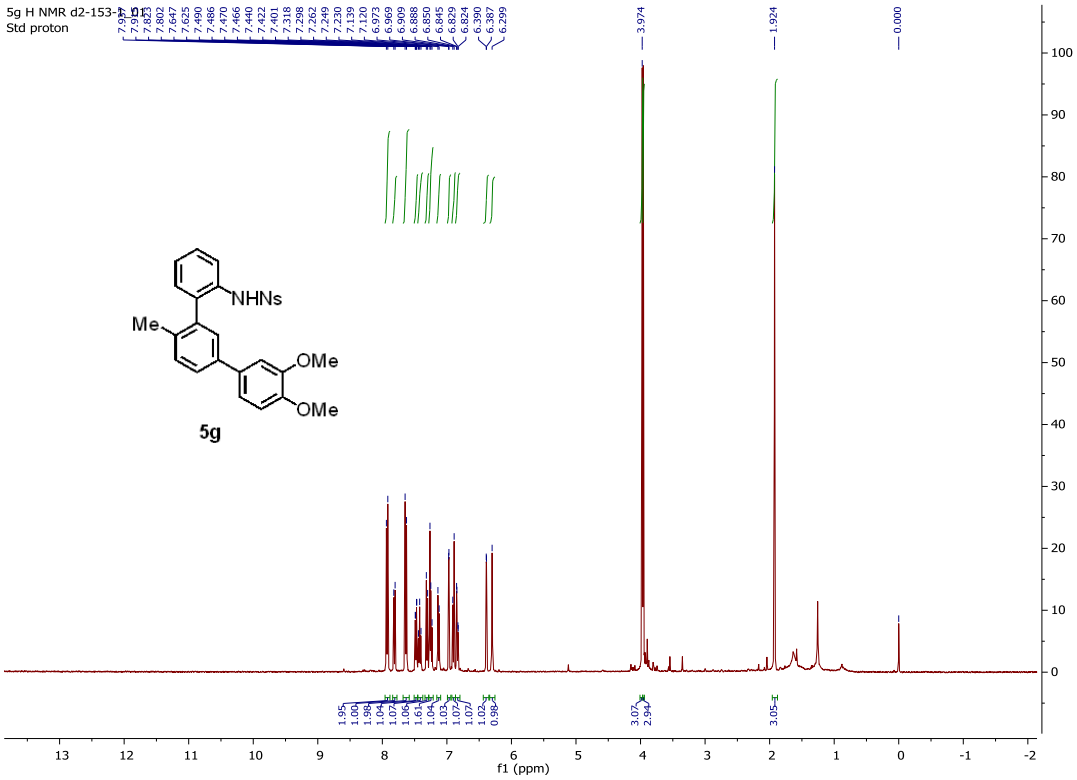

5d d2-153-10.2.fid
C-13 Routine, BBO Probe, DRX-500
NHNs
Me
MeO2C
Me
5d
f1 (ppm)

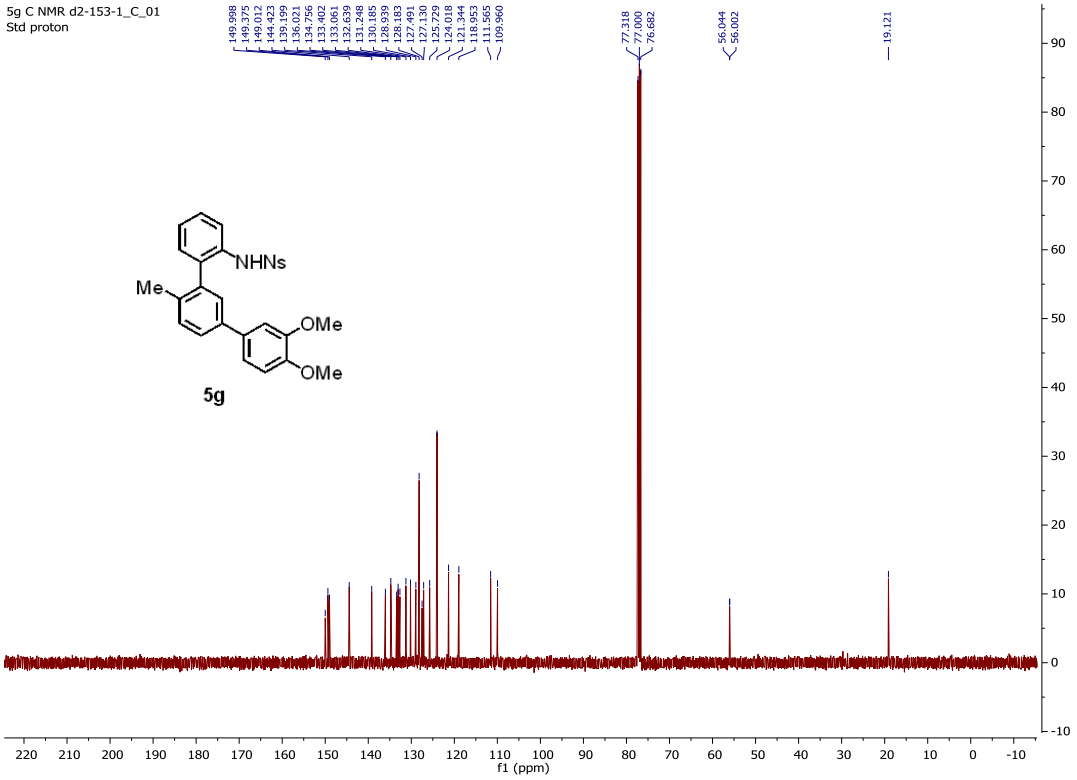

5e d2-153-4.1.fid
H-1 Routine, DRX-500, BBO Probe
NHNs
Me
CO2Me
5e
f1 (ppm)

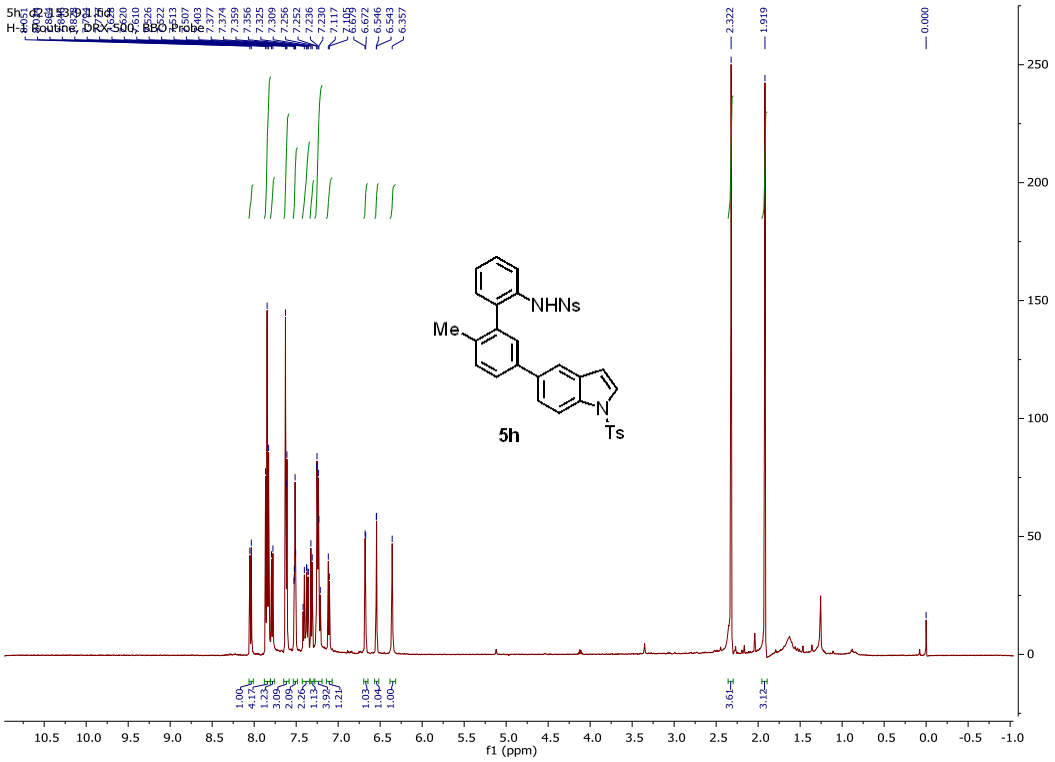

5e d2-153-4.2.fid
C-13 Routine, BBO Probe, DRX-500
NHNs
Me
CO2Me
5e
f1 (ppm)

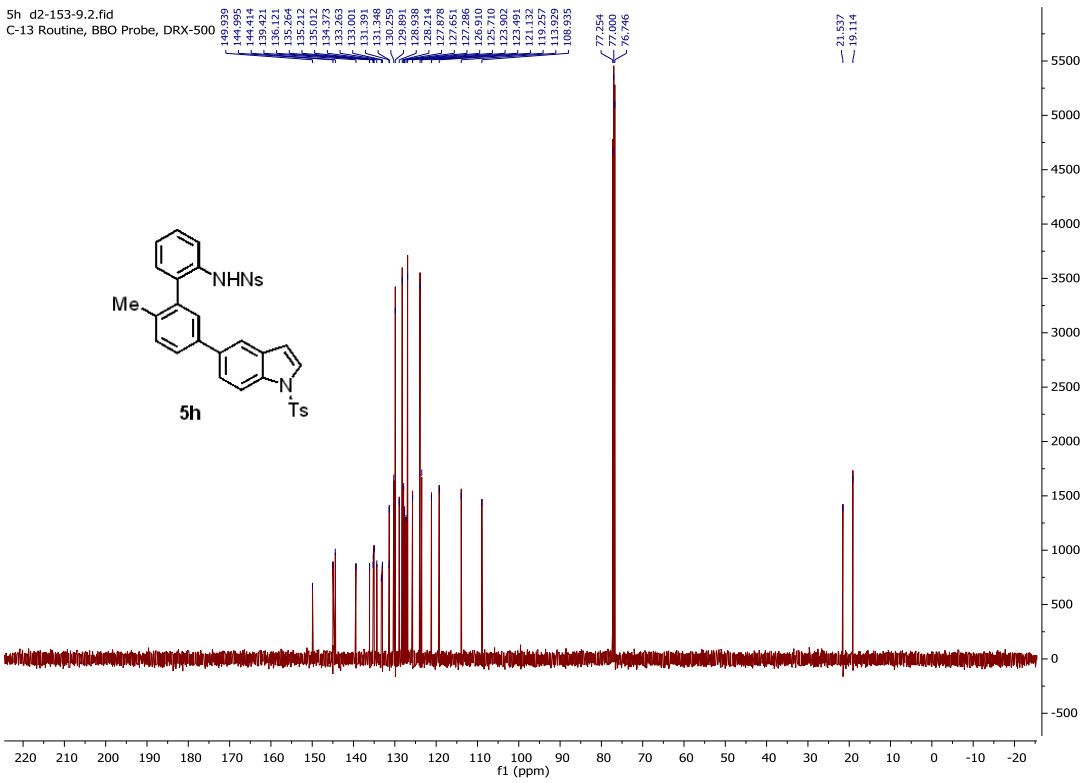

5f d2-153-2.2.fid
H-1 Routine, DRX-500, BBO Probe
NHNs
Me
OMe
5f
f1 (ppm)

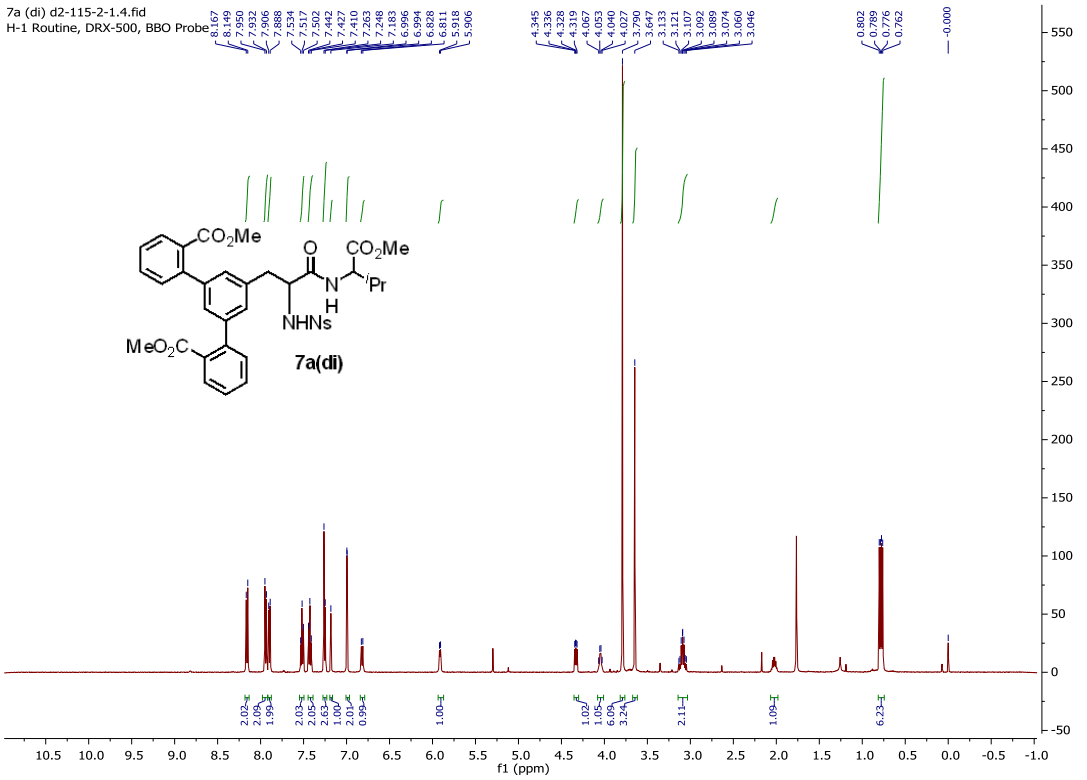

5f d2-153-2.1.fid
C-13 Routine, BBO Probe, DRX-500
NHNs
Me
OMe
5f
f1 (ppm)

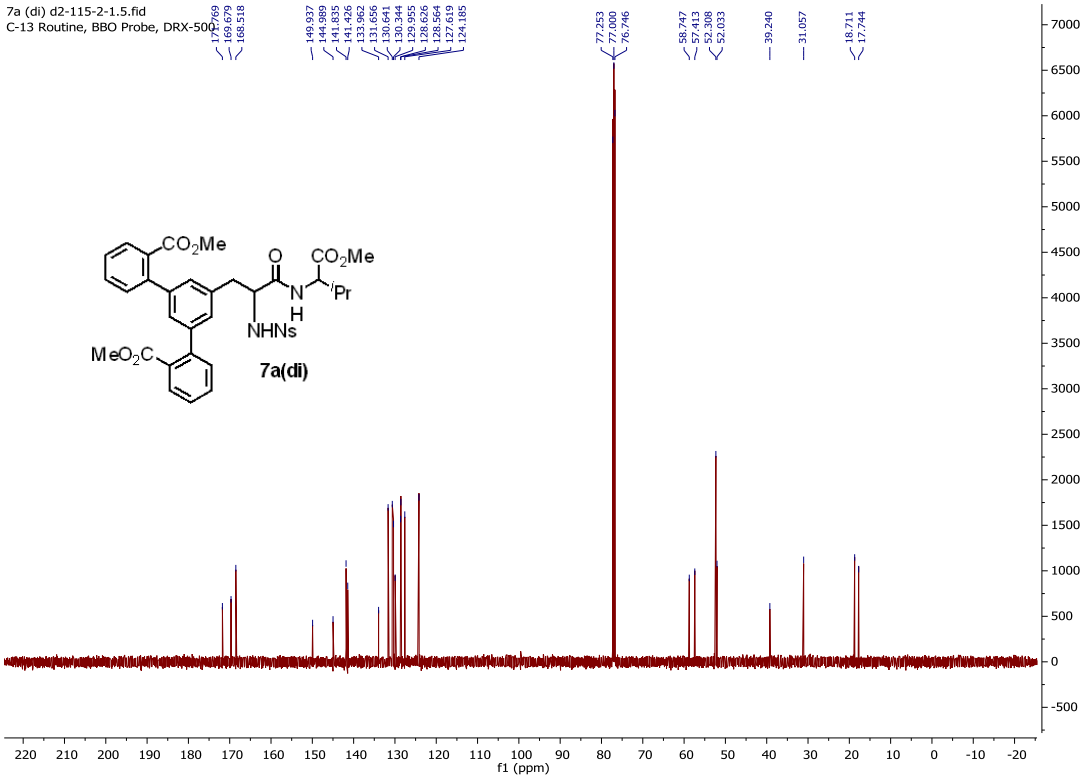

5g H NMR d2-153-1_01
Std proton
NHNs
Me
OMe
OMe
5g
f1 (ppm)

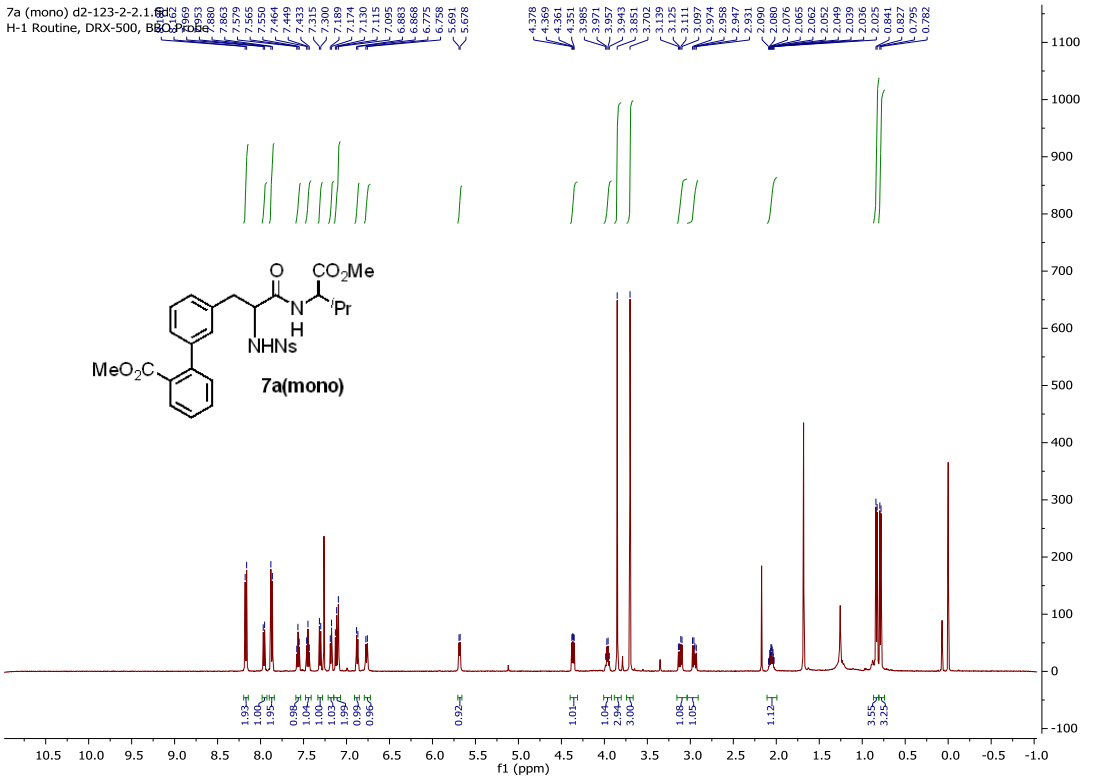

5g C NMR d2-153-1_C_01
Std proton
NHNs
Me
OMe
OMe
5g
f1 (ppm)

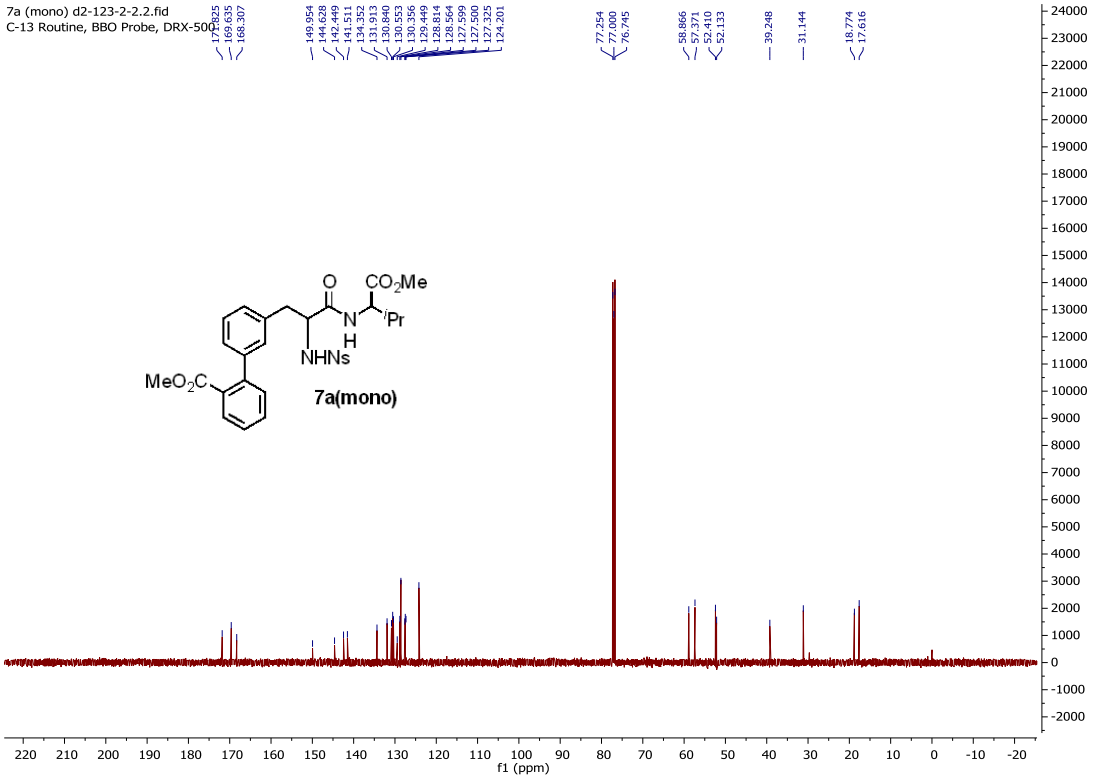

5h d2-153-9.2.fid
H-1 routine, DRX-500, BBO Probe
NHNs
Me
N
Ts
5h
f1 (ppm)

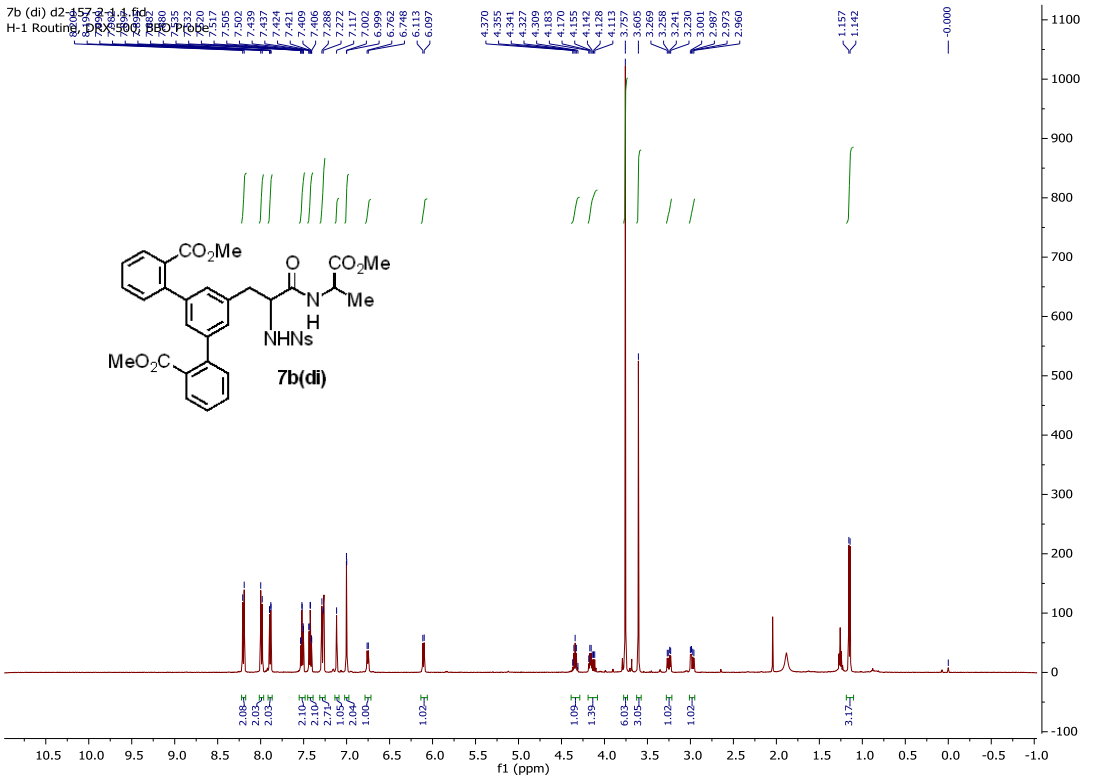

5h d2-153-9.2.fid
C-13 Routine, BBO Probe, DRX-500
NHNs
Me
N
Ts
5h
f1 (ppm)

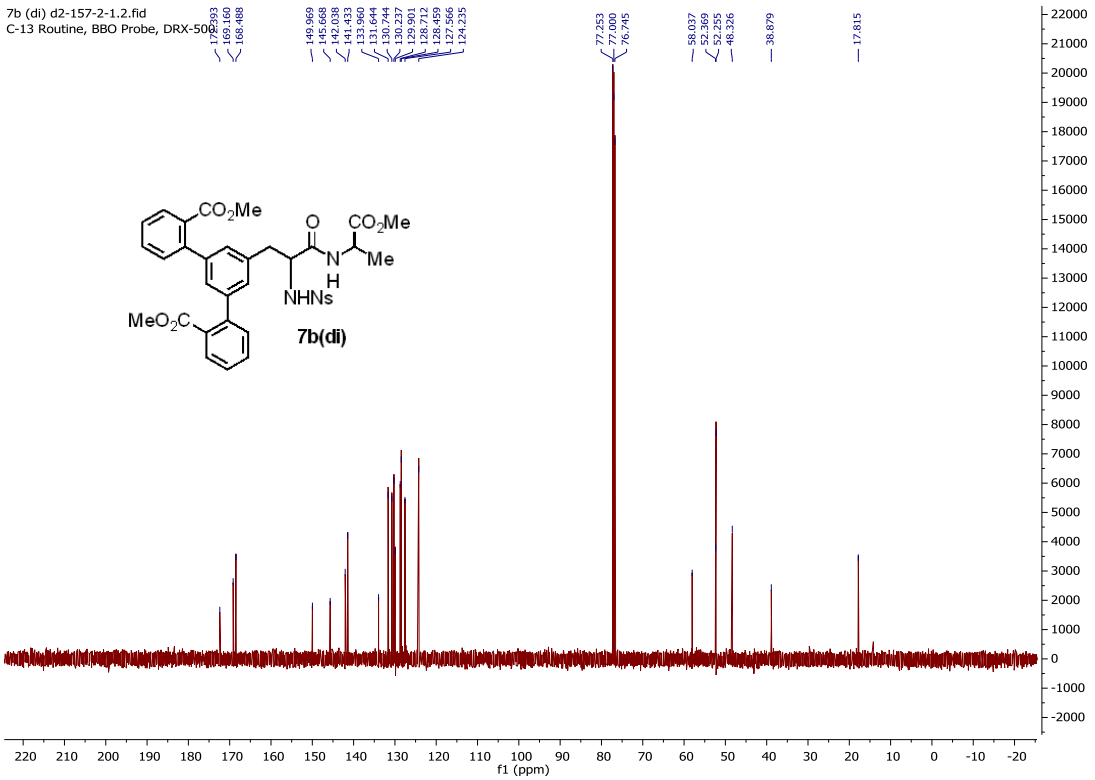

7a (di) d2-115-2-1.4.fid
H-1 Routine, DRX-500, BBO Probe
7a(di)
f1 (ppm)

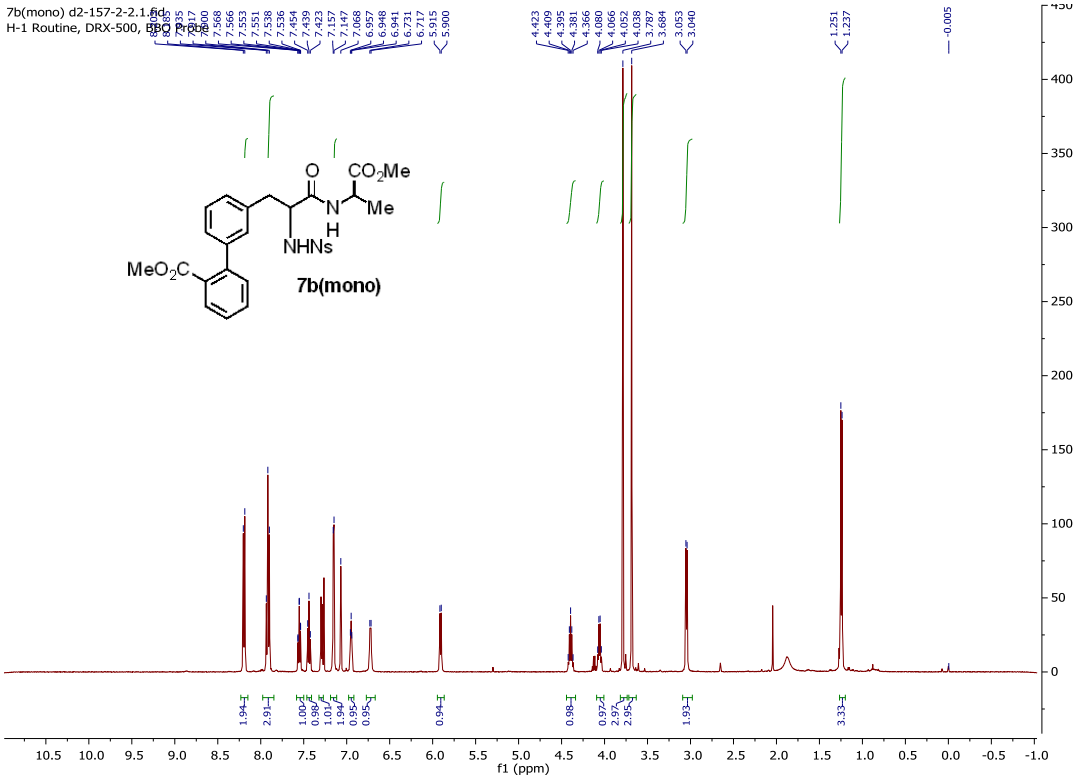

7a (di) d2-115-2-1.5.fid
C-13 Routine, BBO Probe, DRX-500
7a(di)
f1 (ppm)

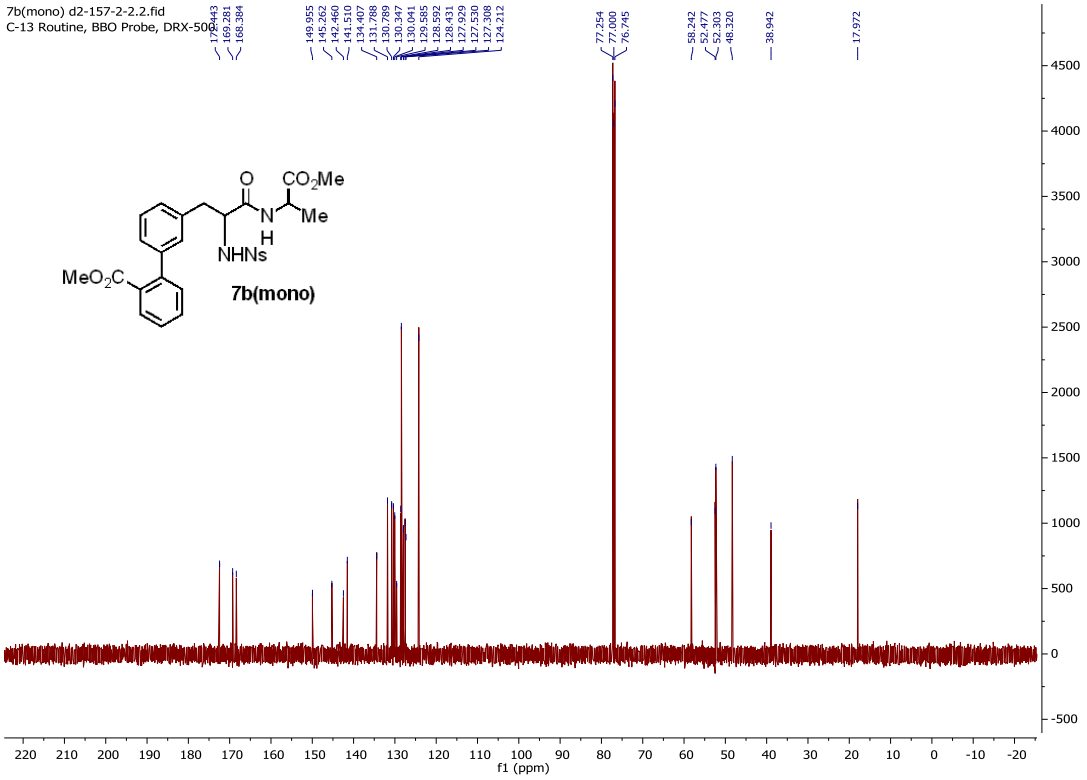

7a (mono) d2-123-2-2-1.fid
H-1 Routine, DRX-500, BBO Probe
7a(mono)
f1 (ppm)

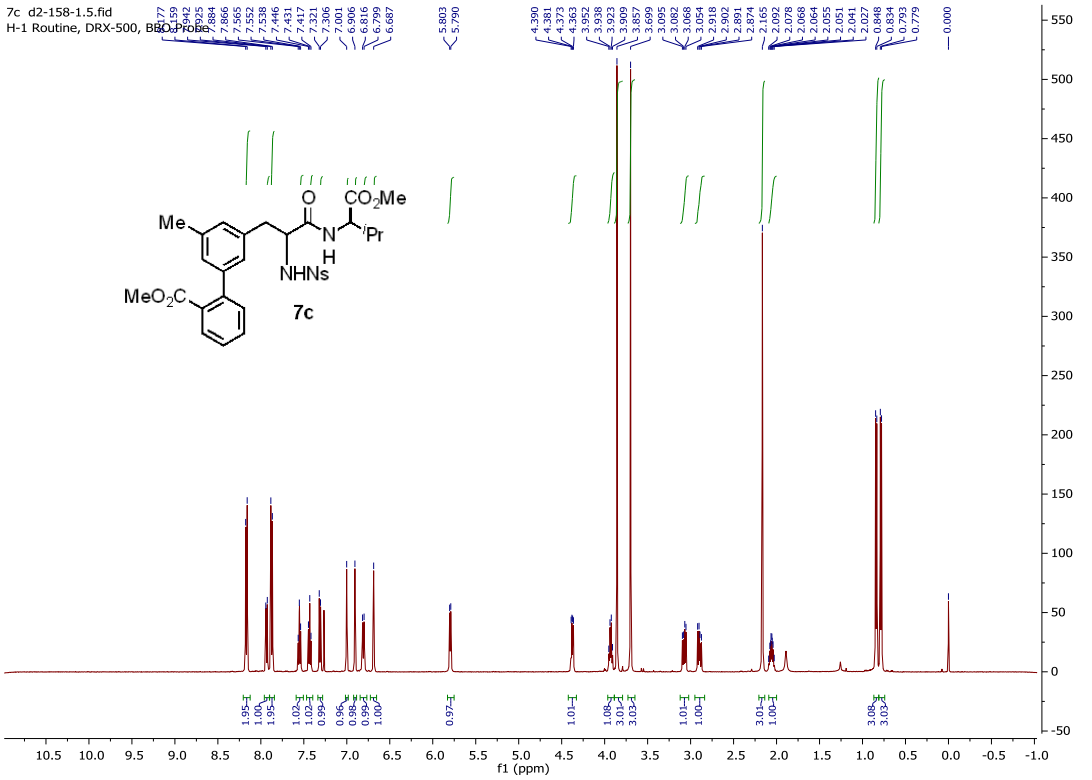

7a (mono) d2-123-2-2-2.fid
C-13 Routine, BBO Probe, DRX-500
7a(mono)
f1 (ppm)

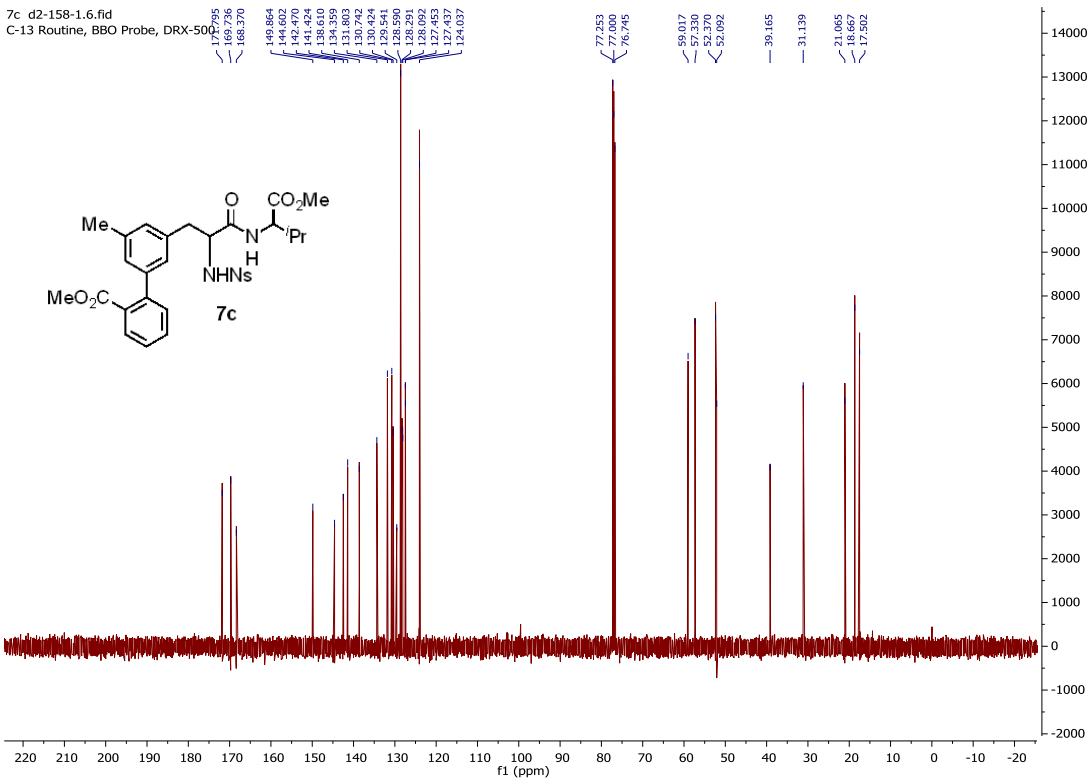

7b (di) d2-157-2-1.1.fid
H-1 Routine, DRX-500, BBO Probe
7b(di)
f1 (ppm)

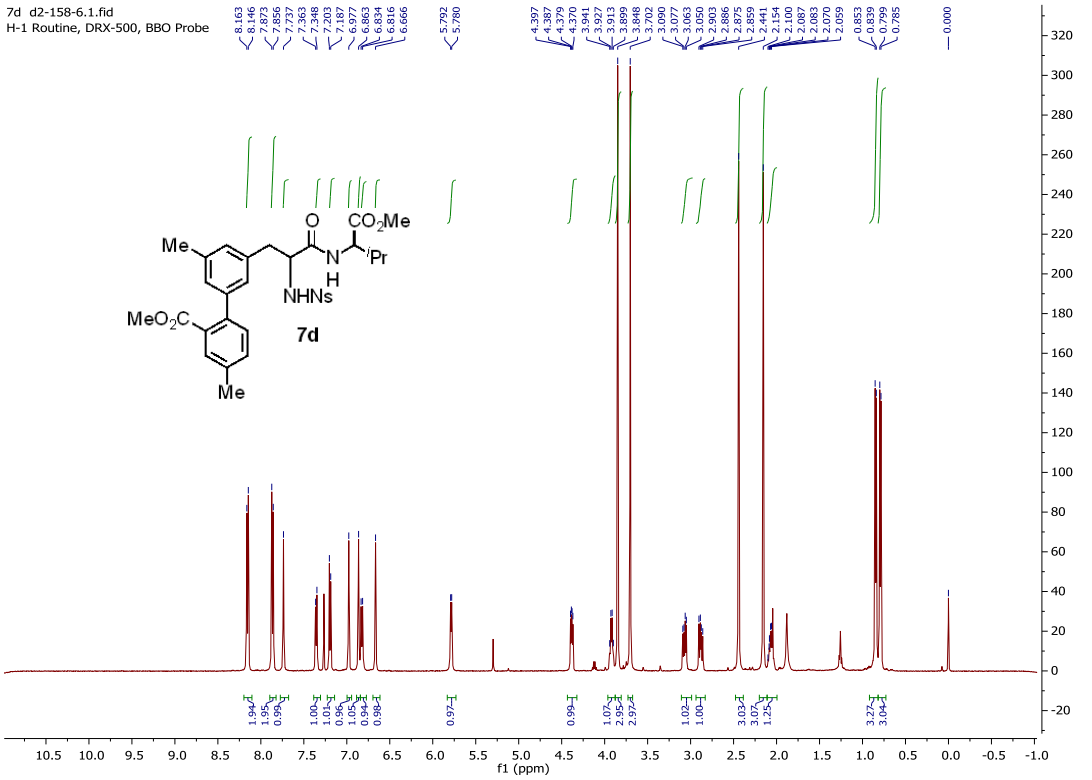

7b (di) d2-157-2-1.2.fid
C-13 Routine, BBO Probe, DRX-500
7b(di)
f1 (ppm)

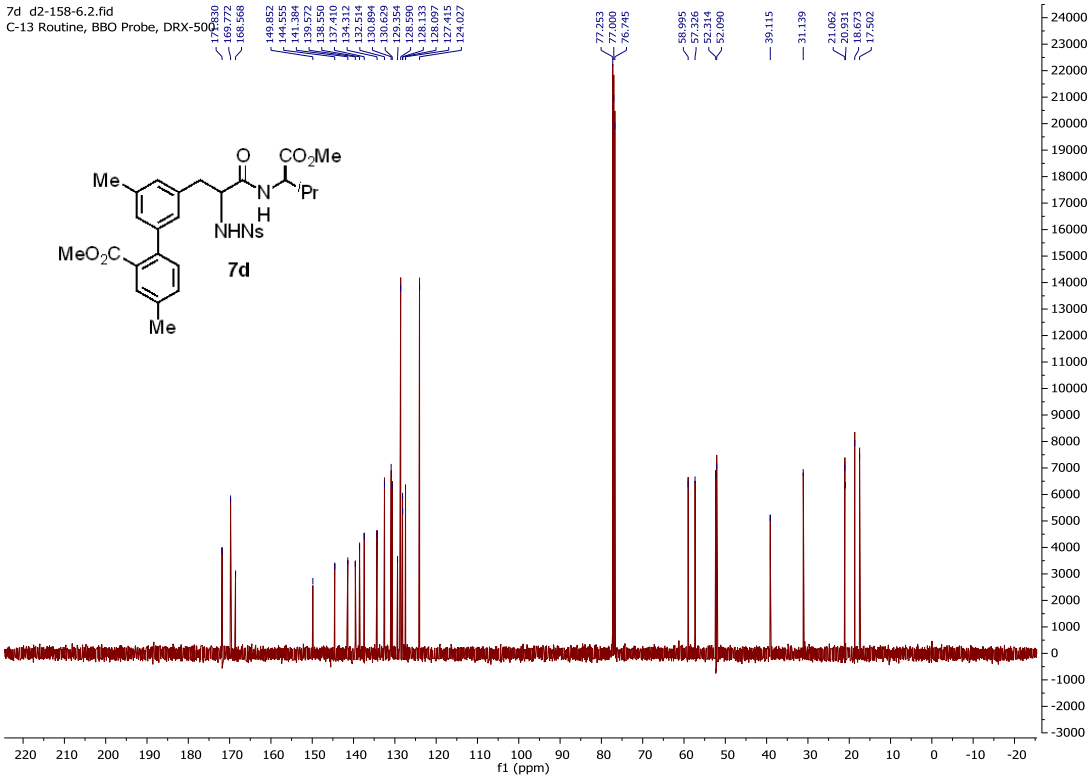

7b(mono) d2-157-2-2.1.fid
H-1 Routine, DRX-500, BBO Probe
7b(mono)
f1 (ppm)

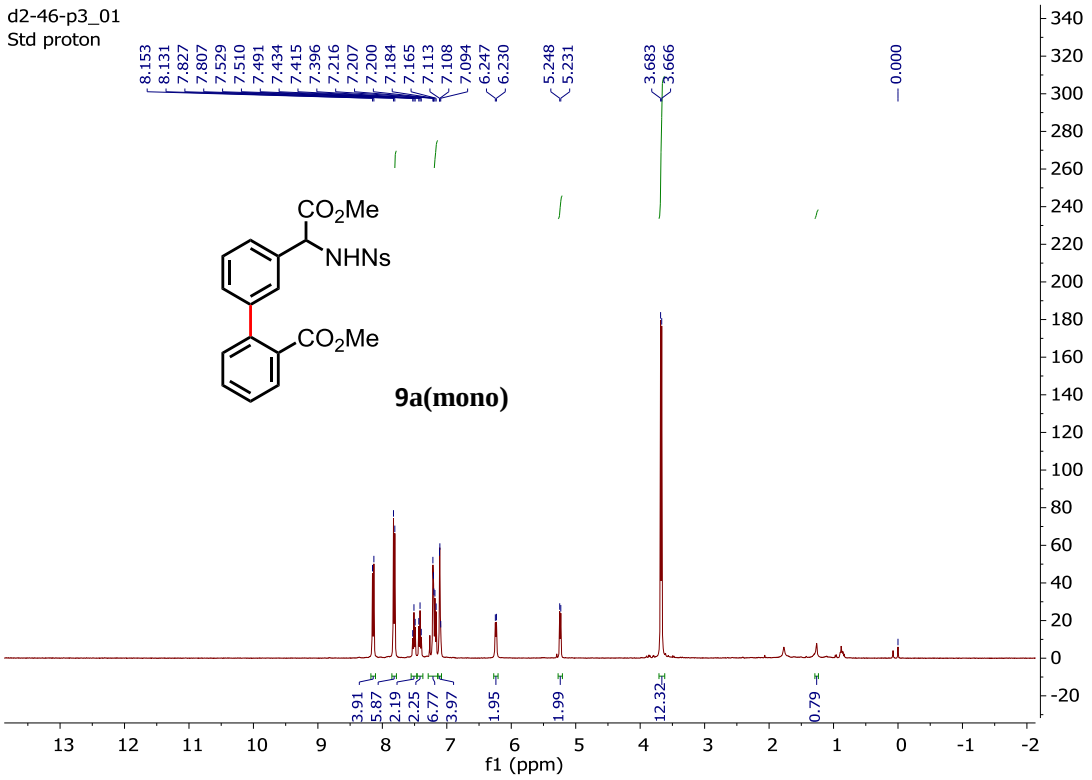

7b(mono) d2-157-2-2.2.fid
C-13 Routine, BBO Probe, DRX-500
7b(mono)
f1 (ppm)

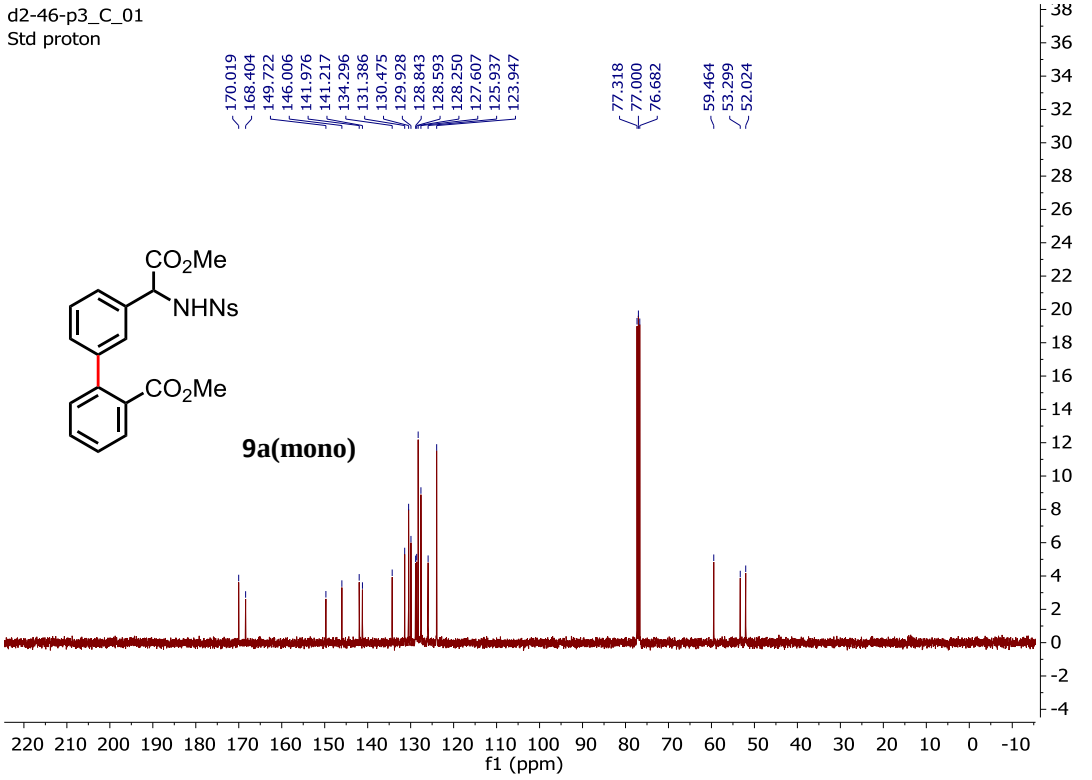

7c d2-158-1.5.fid
H-1 Routine, DRX-500, BBO Probe
Me
MeO2C
O
CO2Me
N
H
iPr
NHNs
7c
f1 (ppm)

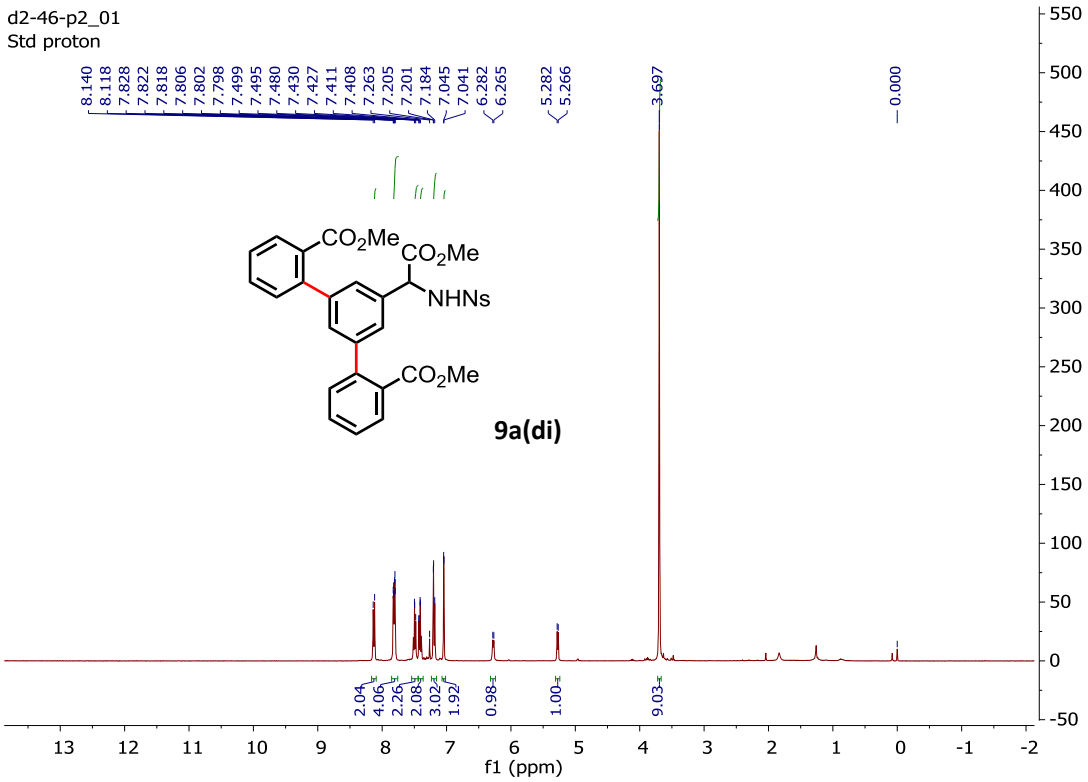

7c d2-158-1.6.fid
C-13 Routine, BBO Probe, DRX-500
Me
MeO2C
O
CO2Me
N
H
iPr
NHNs
7c
f1 (ppm)

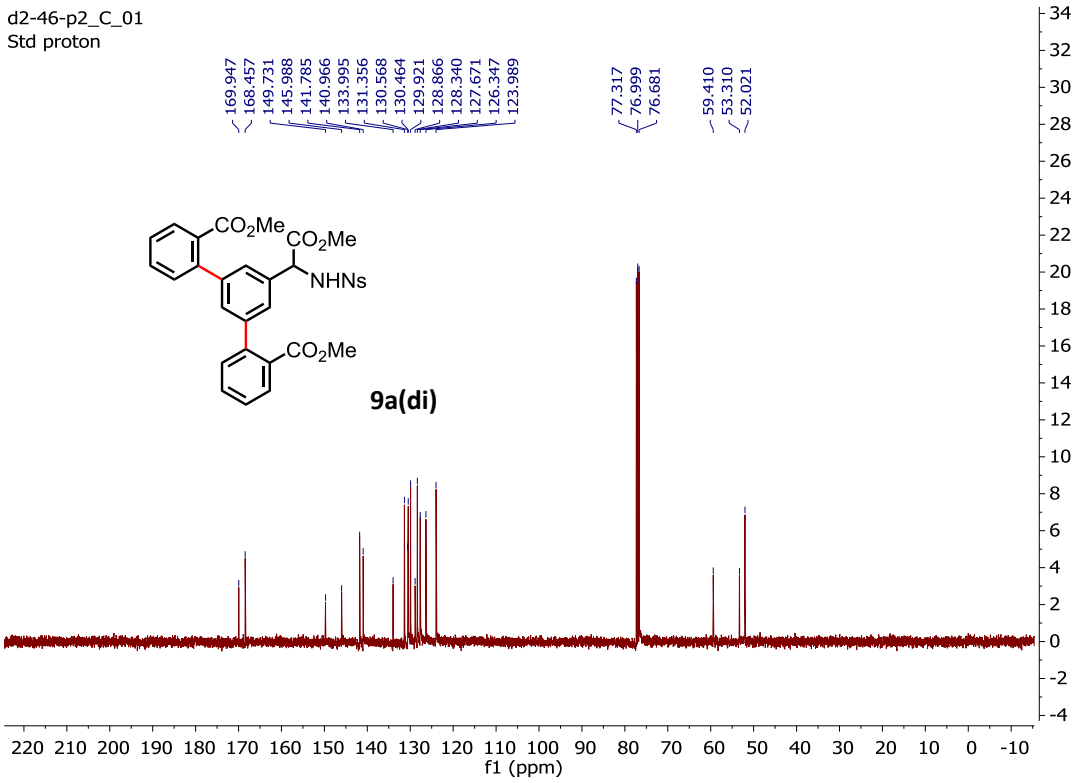

7d d2-158-6.1.fid
H-1 Routine, DRX-500, BBO Probe
f1 (ppm)
7d


7d d2-158-6.2.fid
C-13 Routine, BBO Probe, DRX-500
f1 (ppm)
7d

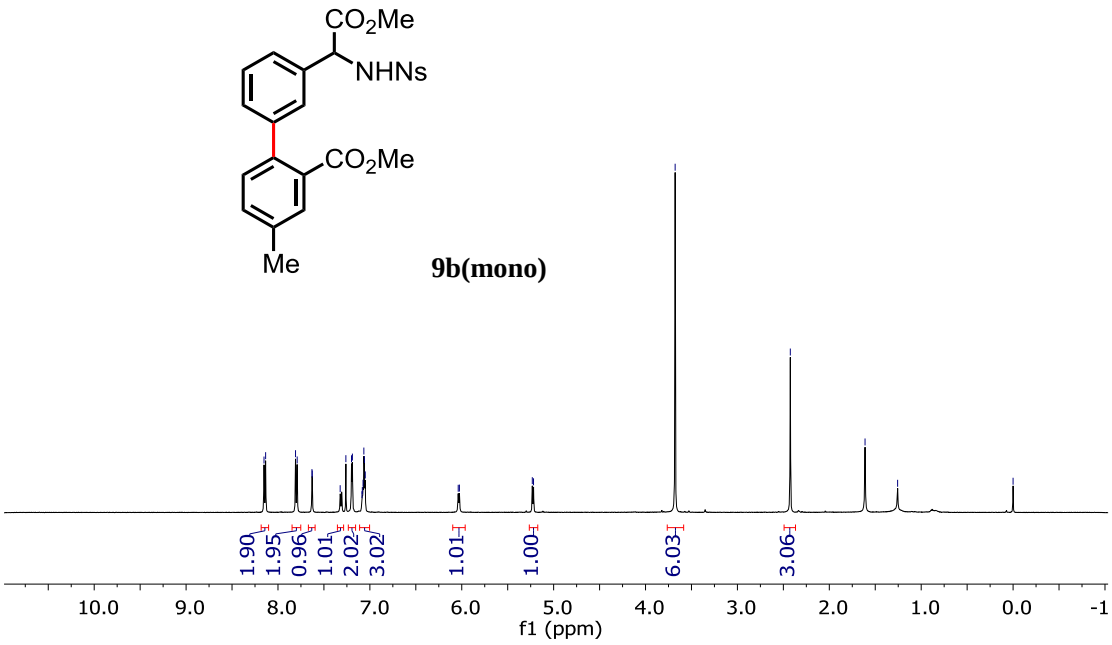

d2-46-p3_01
Std proton
8.153
8.131
7.827
7.807
7.529
7.510
7.491
7.434
7.415
7.396
7.216
7.207
7.200
7.184
7.165
7.113
7.108
7.094
6.247
6.230
5.248
5.231
3.683
3.666
0.000
CO2Me
NHNs
CO2Me
9a(mono)
3.91
5.87
2.19
2.25
6.77
3.97
1.95
1.99
12.32
0.79
f1 (ppm)


d2-46-p3_C_01
Std proton
170.019
168.404
149.722
146.006
141.976
141.217
134.296
131.386
130.475
129.928
128.843
128.593
128.250
127.607
125.937
123.947
77.318
77.000
76.682
59.464
53.299
52.024
CO2Me
NHNs
CO2Me
9a(mono)
f1 (ppm)

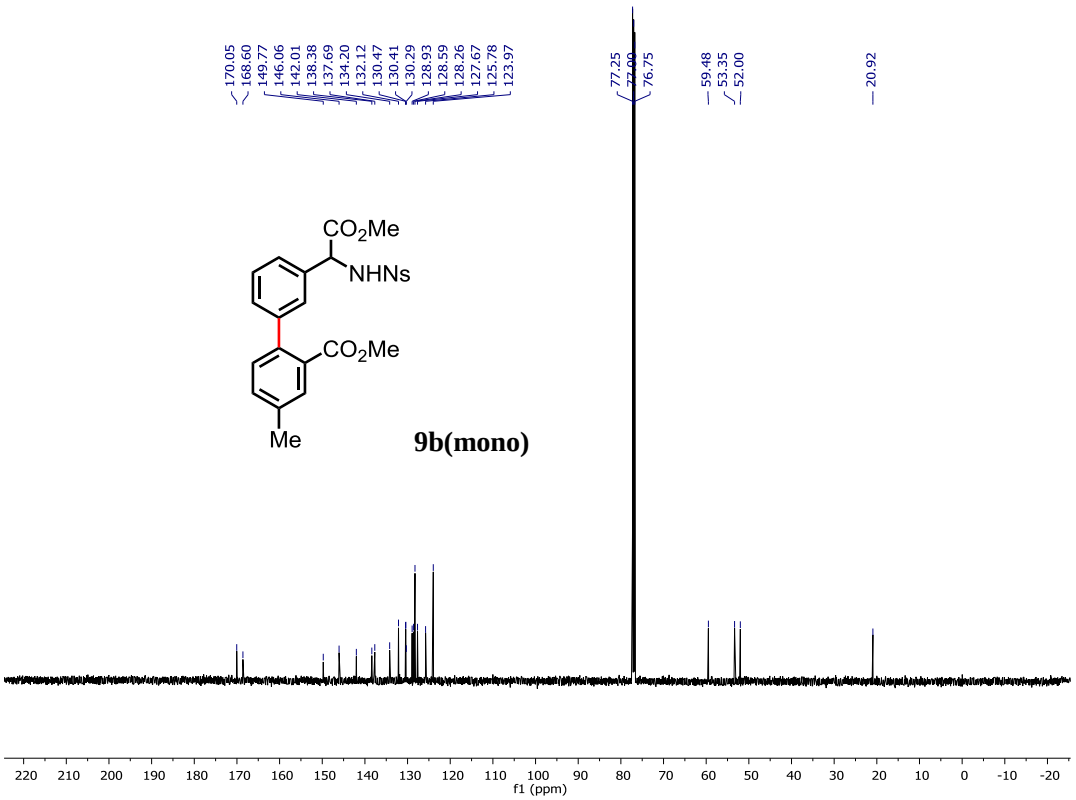

d2-46-p2_01
Std proton
8.140
8.118
7.828
7.822
7.818
7.806
7.802
7.798
7.499
7.495
7.480
7.430
7.427
7.411
7.408
7.263
7.205
7.201
7.184
7.045
7.041
6.282
6.265
5.282
5.266
3.697
0.000
CO2Me
CO2Me
NHNs
CO2Me
9a(di)
2.04
4.06
2.26
2.08
3.02
1.92
0.98
1.00
9.03
f1 (ppm)


d2-46-p2_C_01
Std proton
169.947
168.457
149.731
145.988
141.785
140.966
133.995
131.356
130.568
130.464
129.921
128.866
128.340
127.671
126.347
123.989
77.317
76.999
76.681
59.410
53.310
52.021
CO2Me
CO2Me
NHNs
CO2Me
9a(di)
f1 (ppm)

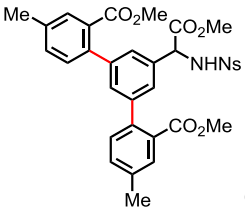
C:/Users/nmruser/Desktop/d2-97-10-2/4/fid



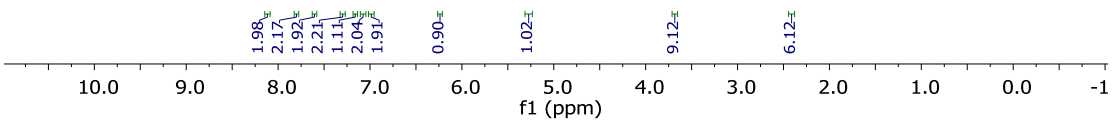
C:/Users/nmruser/Desktop/d2-97-10-2/5/fid



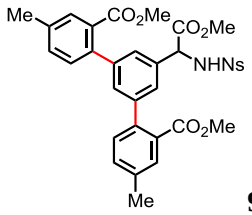
d2-97-11-1.1.fid
H-1 Routine, DRX-500, BBO Probe



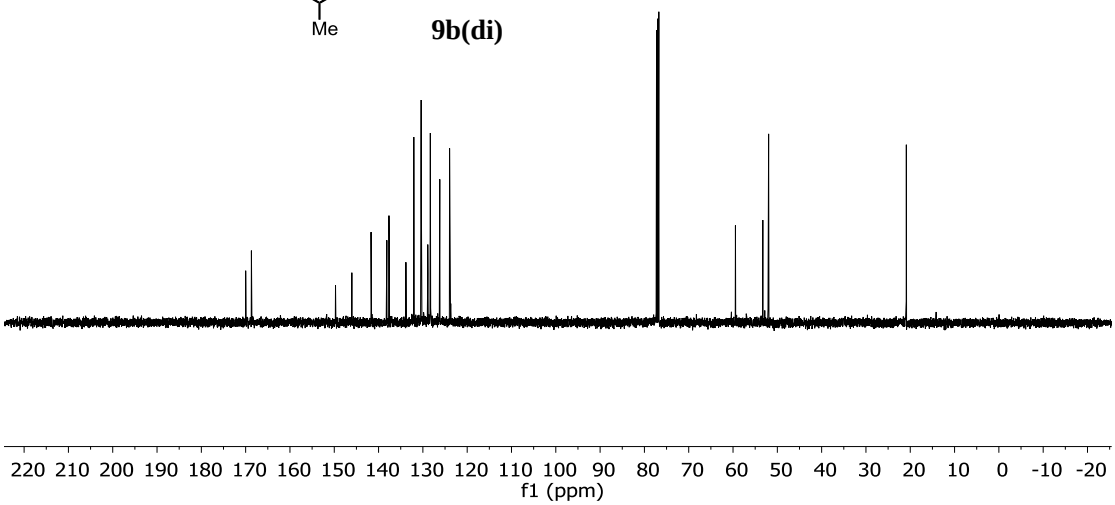
9b(di)

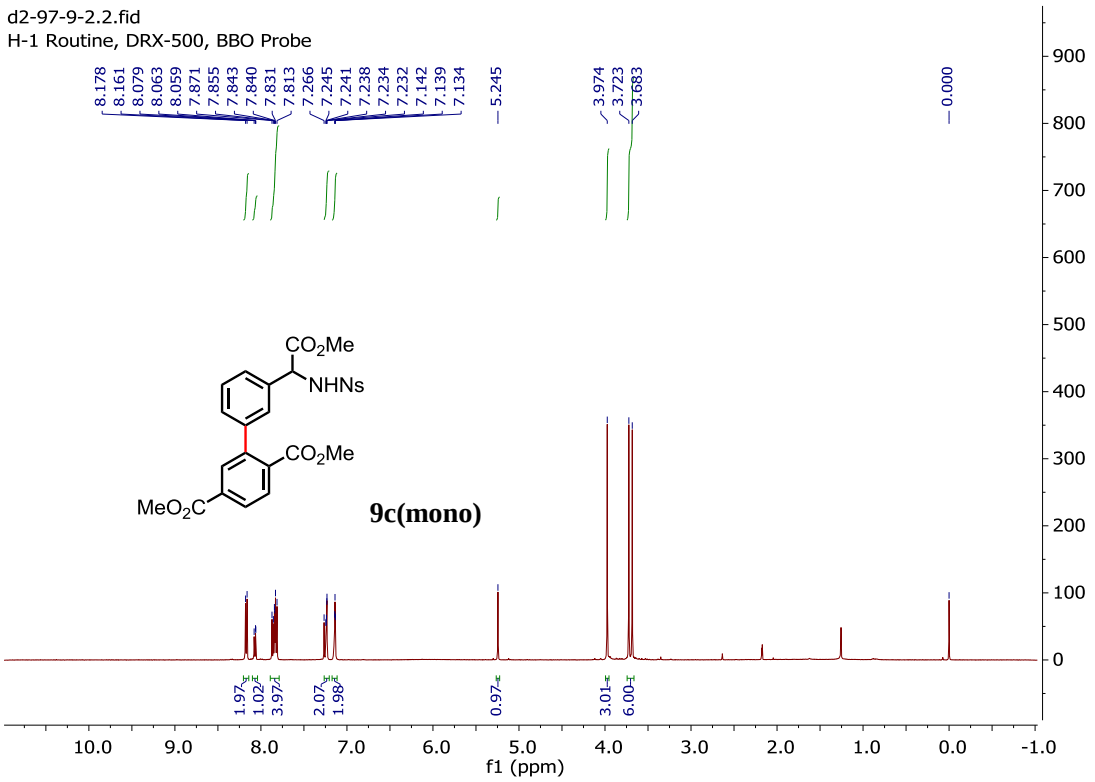


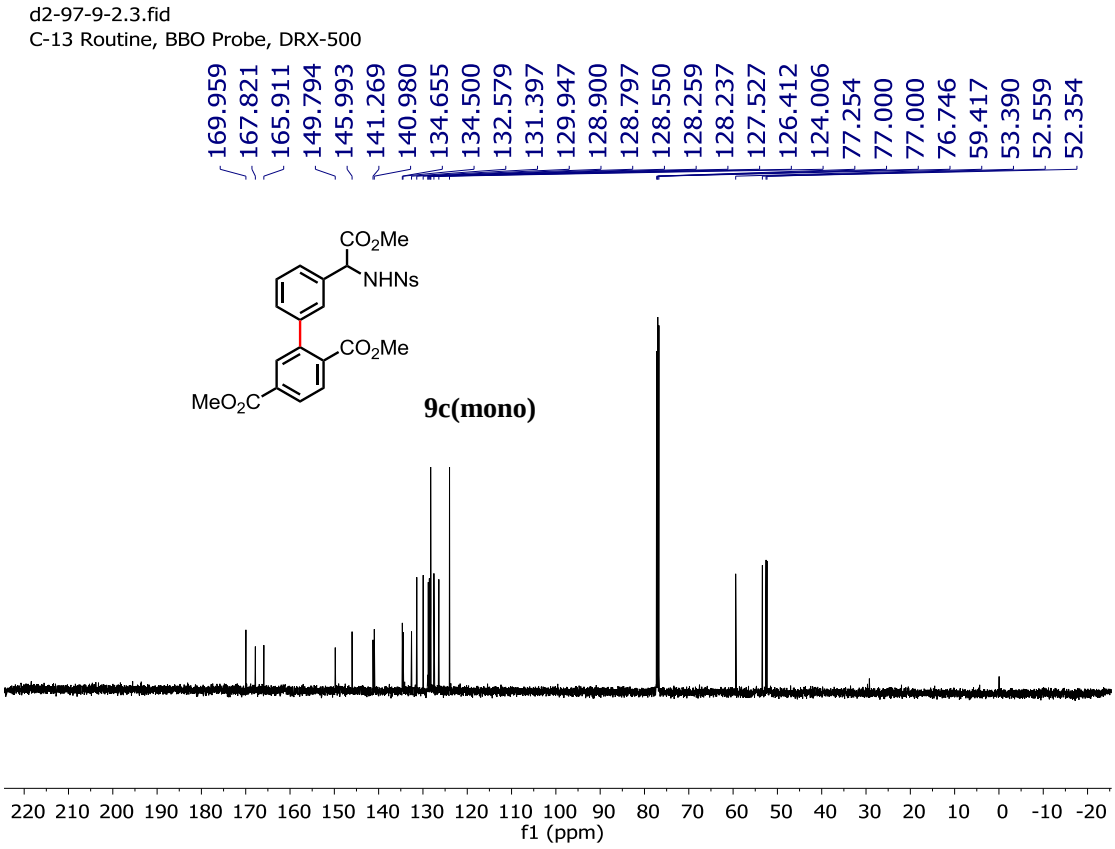
d2-97-11-1.1.fid
C-13 Routine, BBO Probe, DRX-500

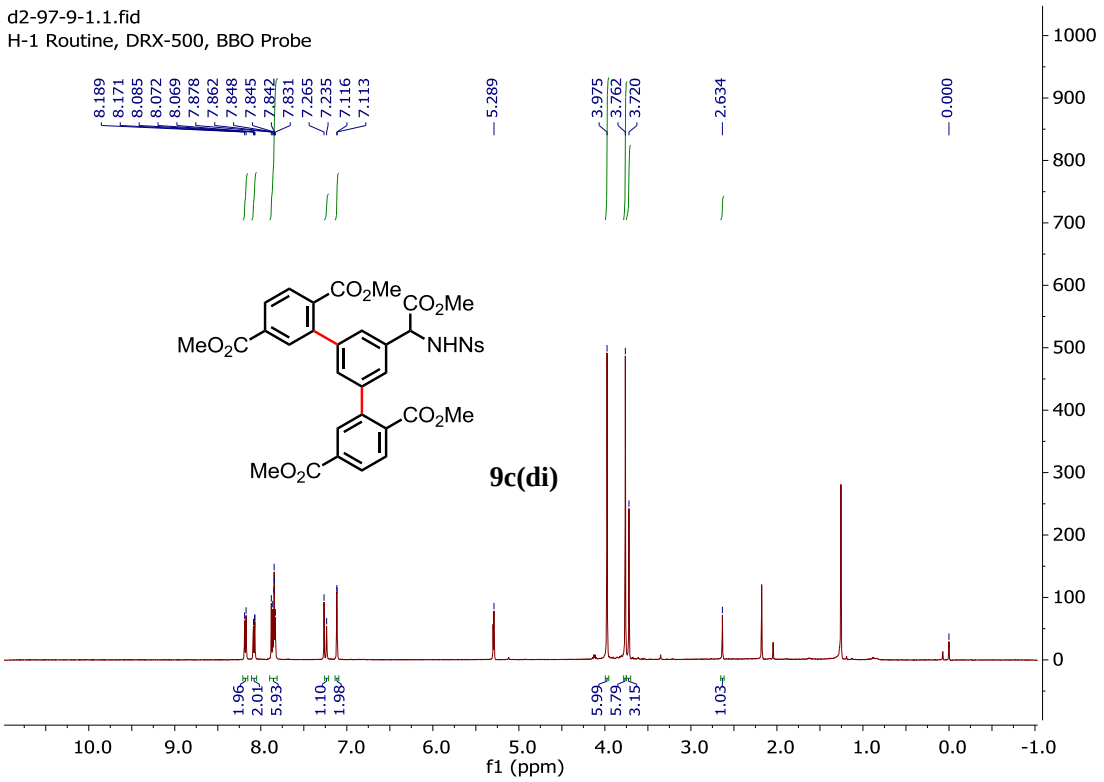


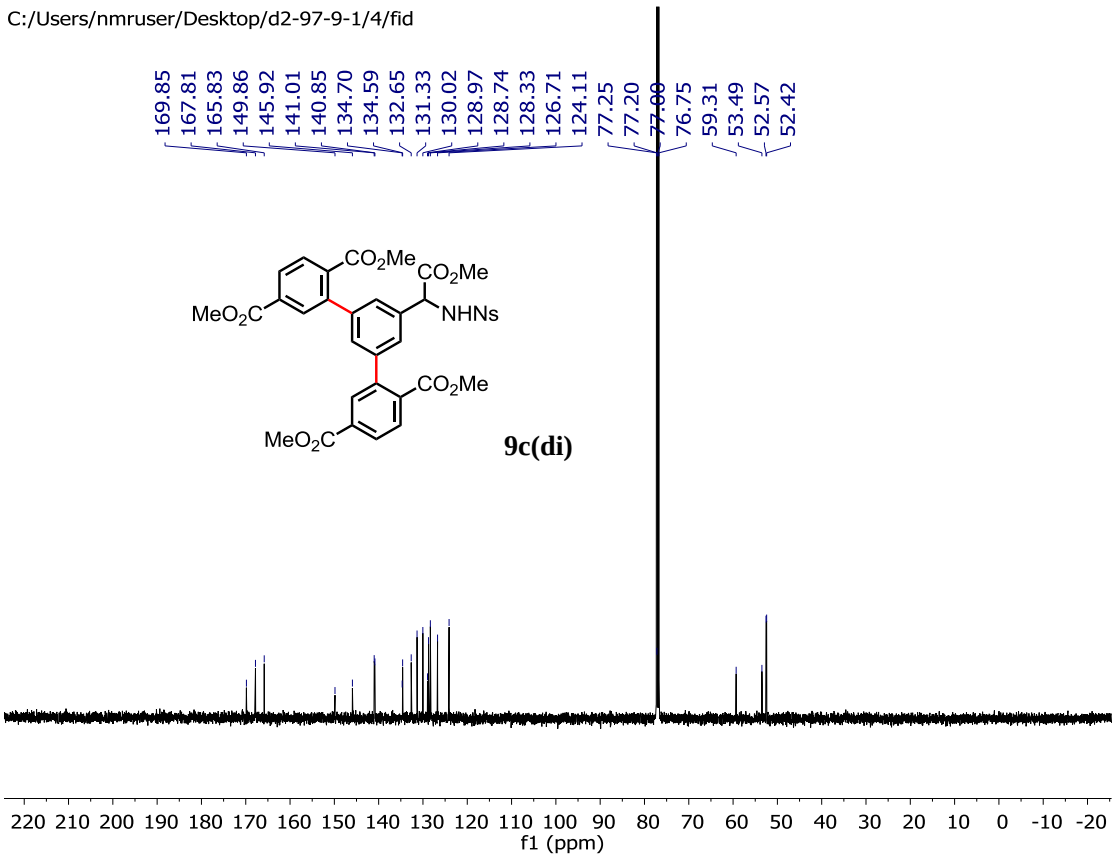
9b(di)

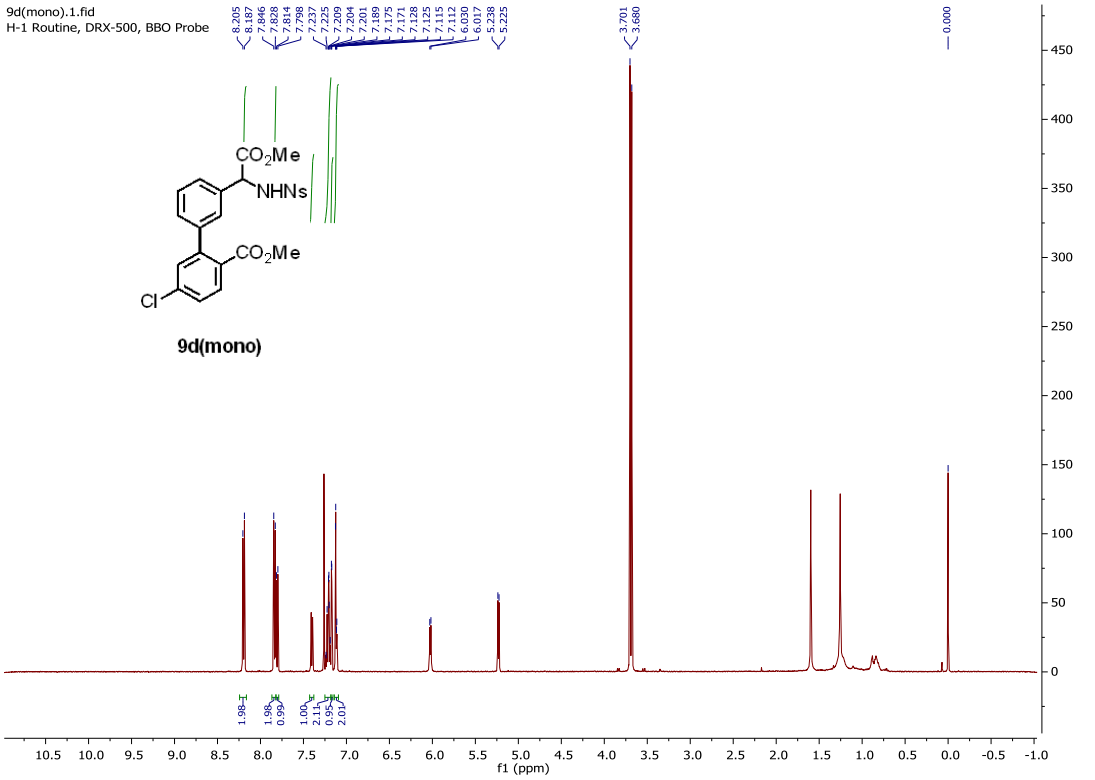


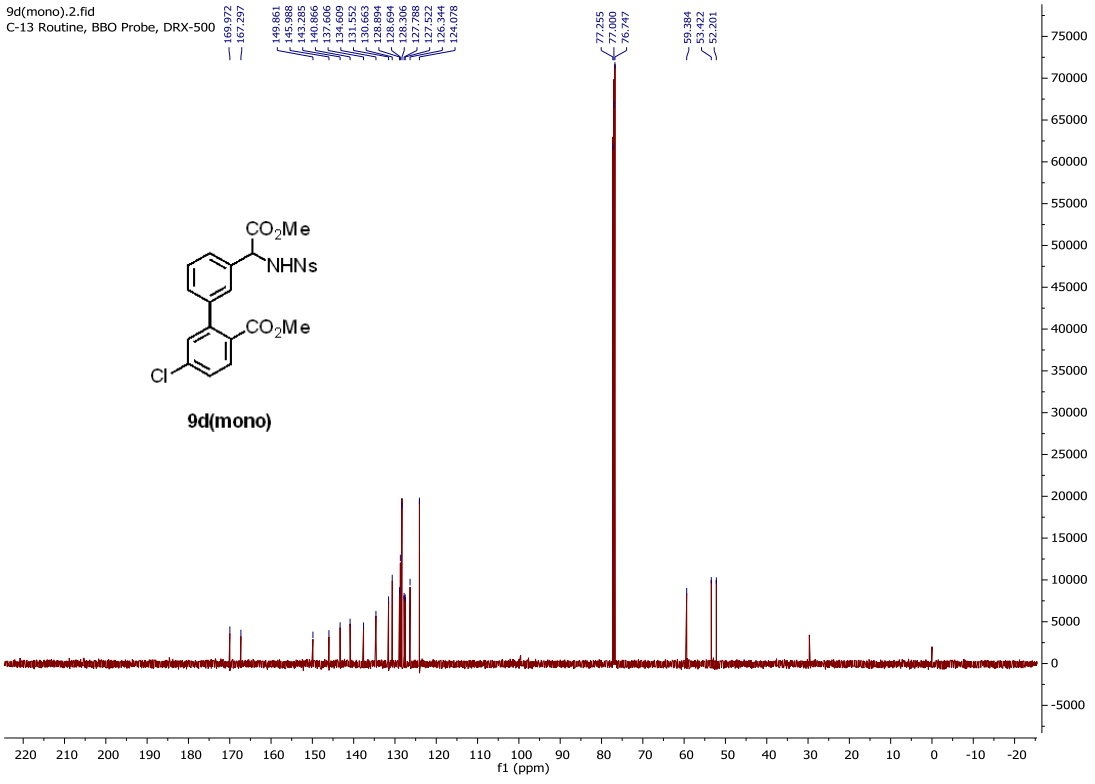

d2-97-9-2.2.fid
H-1 Routine, DRX-500, BBO Probe
8.178
8.161
8.079
8.063
8.059
7.871
7.855
7.843
7.840
7.831
7.813
7.266
7.245
7.241
7.238
7.234
7.232
7.142
7.139
7.134
5.245
3.974
3.723
3.683
0.000
CO2Me
NHNs
CO2Me
MeO2C
9c(mono)
1.97
1.02
3.97
2.07
1.98
0.97
3.01
6.00
f1 (ppm)

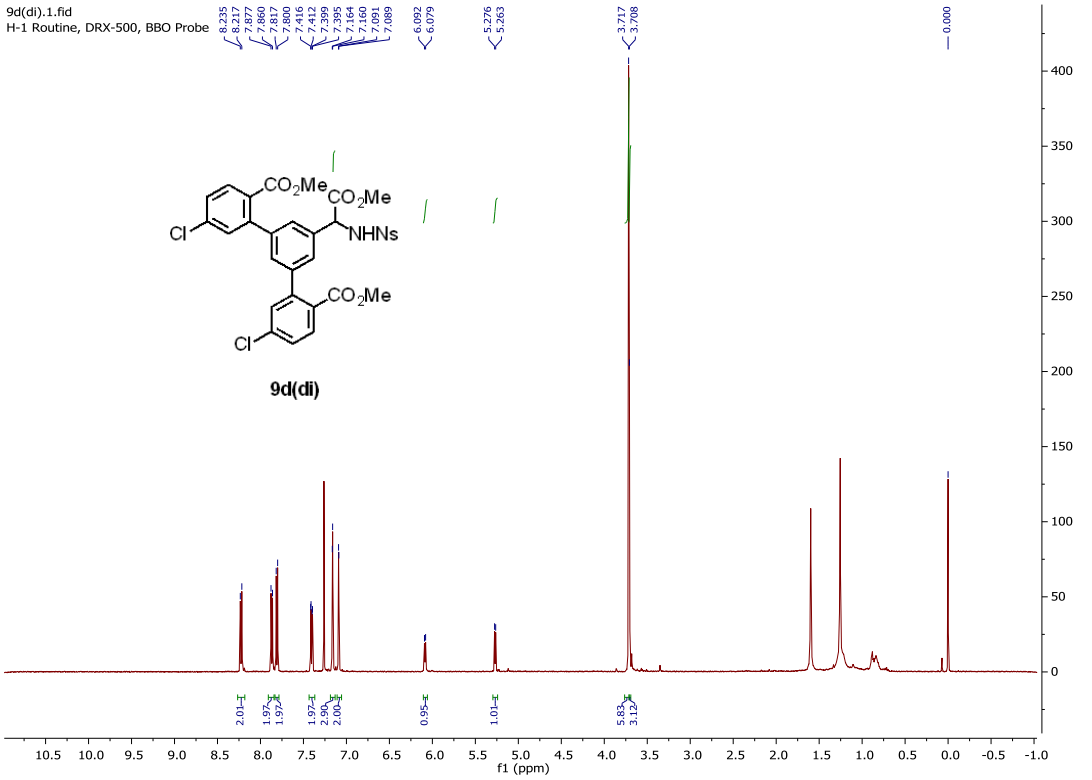

d2-97-9-2.3.fid
C-13 Routine, BBO Probe, DRX-500
169.959
167.821
165.911
149.794
145.993
141.269
140.980
134.655
134.500
132.579
131.397
129.947
128.900
128.797
128.550
128.259
128.237
127.527
126.412
124.006
77.254
77.000
77.000
76.746
59.417
53.390
52.559
52.354
CO2Me
NHNs
CO2Me
MeO2C
9c(mono)
f1 (ppm)

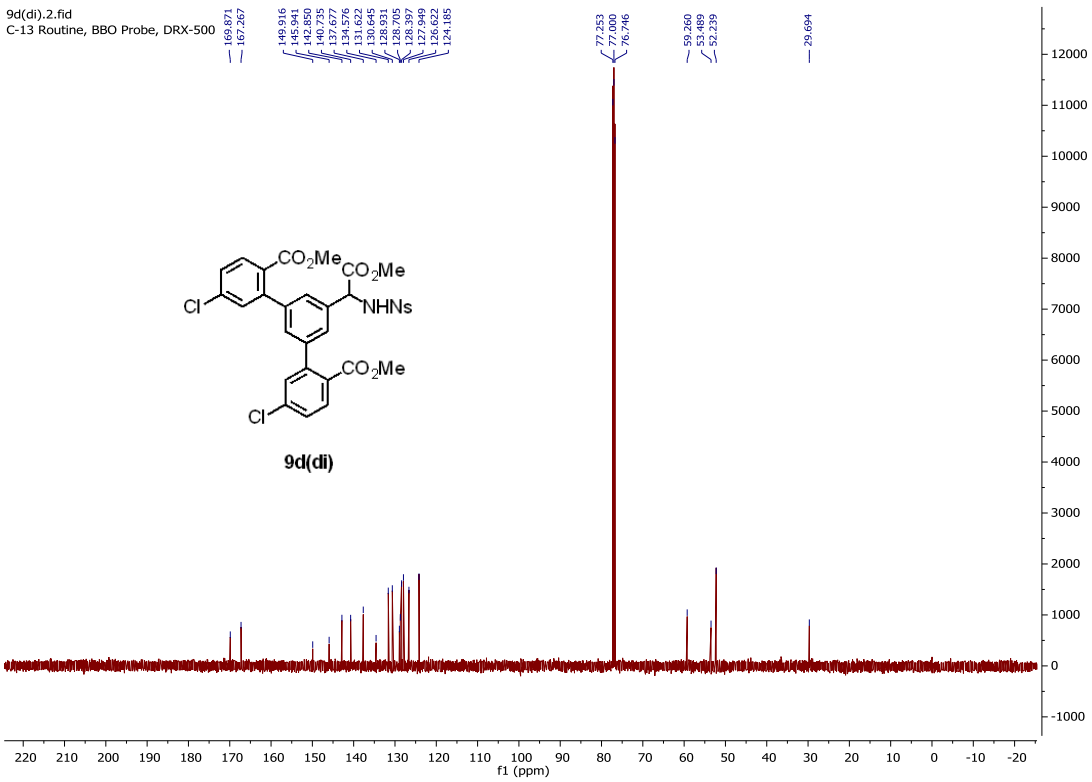

d2-97-9-1.1.fid
H-1 Routine, DRX-500, BBO Probe
8.189
8.171
8.085
8.072
8.069
7.878
7.862
7.848
7.845
7.842
7.831
7.265
7.235
7.116
7.113
5.289
3.975
3.762
3.720
2.634
0.000
CO2Me
CO2Me
MeO2C
NHNs
CO2Me
MeO2C
9c(di)
1.96
2.01
5.93
1.10
1.98
5.99
5.79
3.15
1.03
f1 (ppm)

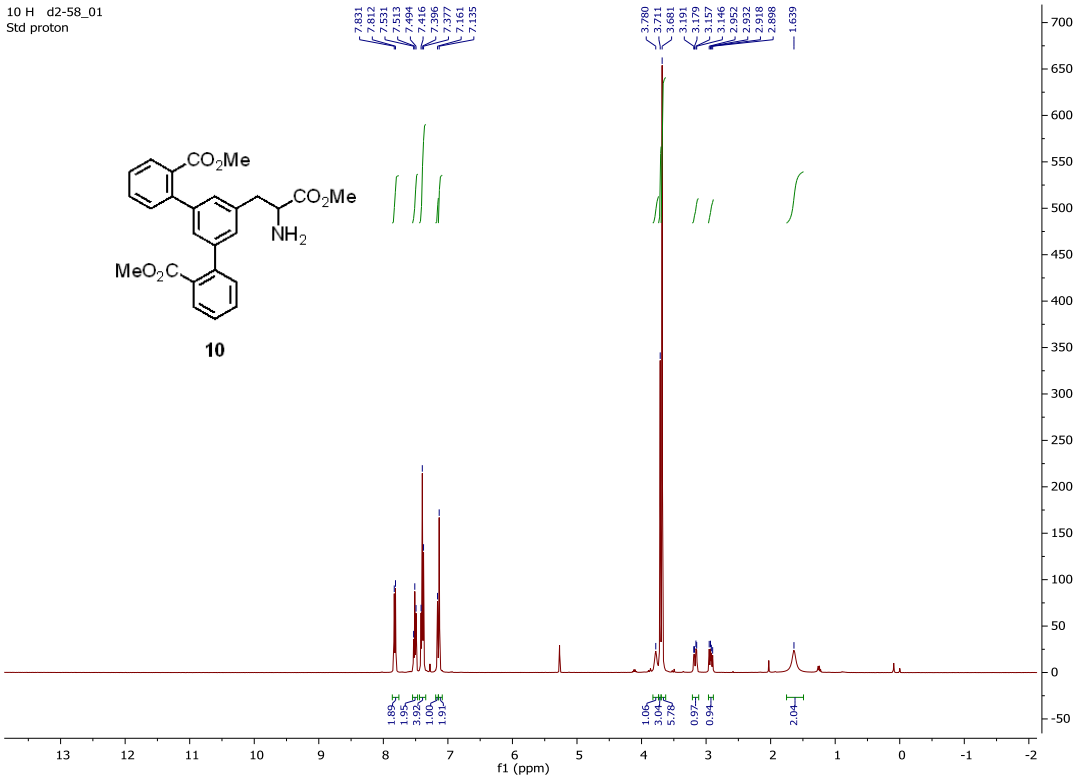

C:/Users/nmruser/Desktop/d2-97-9-1/4/fid
169.85
167.81
165.83
149.86
145.92
141.01
140.85
134.70
134.59
132.65
131.33
130.02
128.97
128.74
128.33
126.71
124.11
77.25
77.20
77.00
76.75
59.31
53.49
52.57
52.42
CO2Me
CO2Me
MeO2C
NHNs
CO2Me
MeO2C
9c(di)
f1 (ppm)

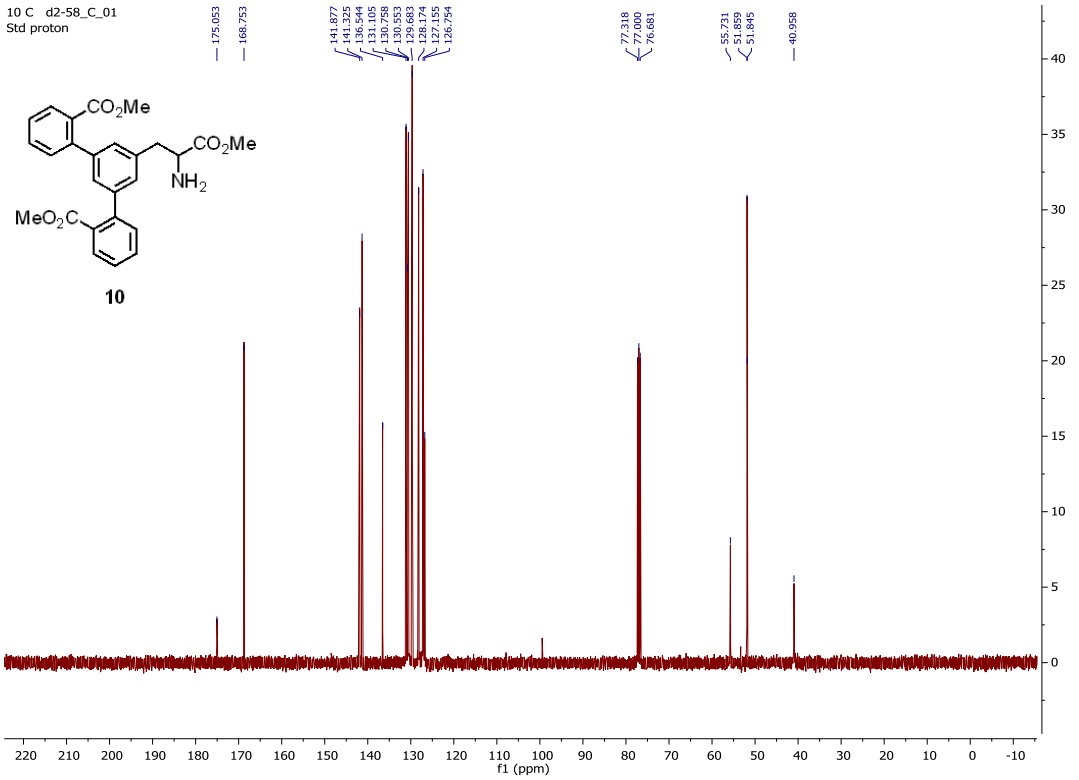

9d(mono).1.fid
H-1 Routine, DRX-500, BBO Probe
8.205
8.187
7.846
7.828
7.814
7.798
7.237
7.225
7.208
7.204
7.201
7.189
7.175
7.171
7.128
7.125
7.115
7.112
6.030
6.017
5.238
5.225
3.701
3.680
0.000
CO2Me
NHNs
CO2Me
Cl
9d(mono)
1.98
1.98
0.99
1.00
2.11
0.95
2.01
f1 (ppm)

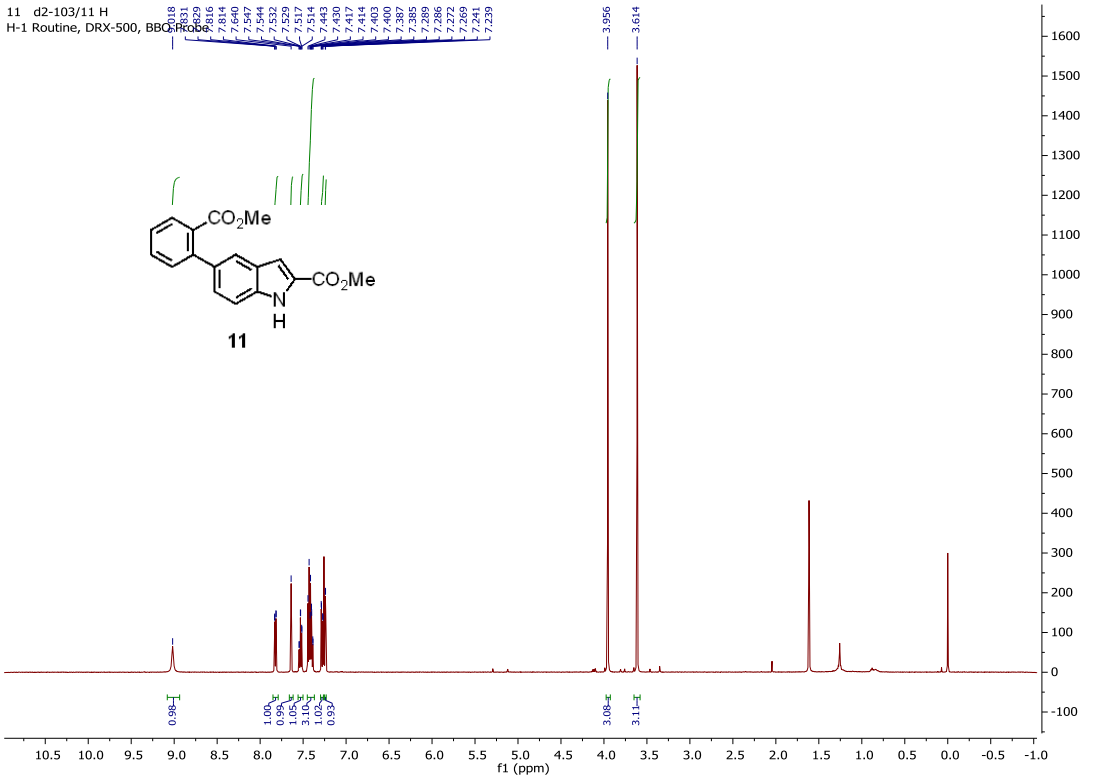

9d(mono).2.fid
C-13 Routine, BBO Probe, DRX-500
169.972
167.297
149.861
145.988
143.285
140.866
137.606
134.699
131.552
130.663
128.894
128.694
128.306
127.788
127.522
126.344
124.078
77.255
77.000
76.747
59.384
53.422
52.201
CO2Me
NHNs
CO2Me
Cl
9d(mono)
f1 (ppm)

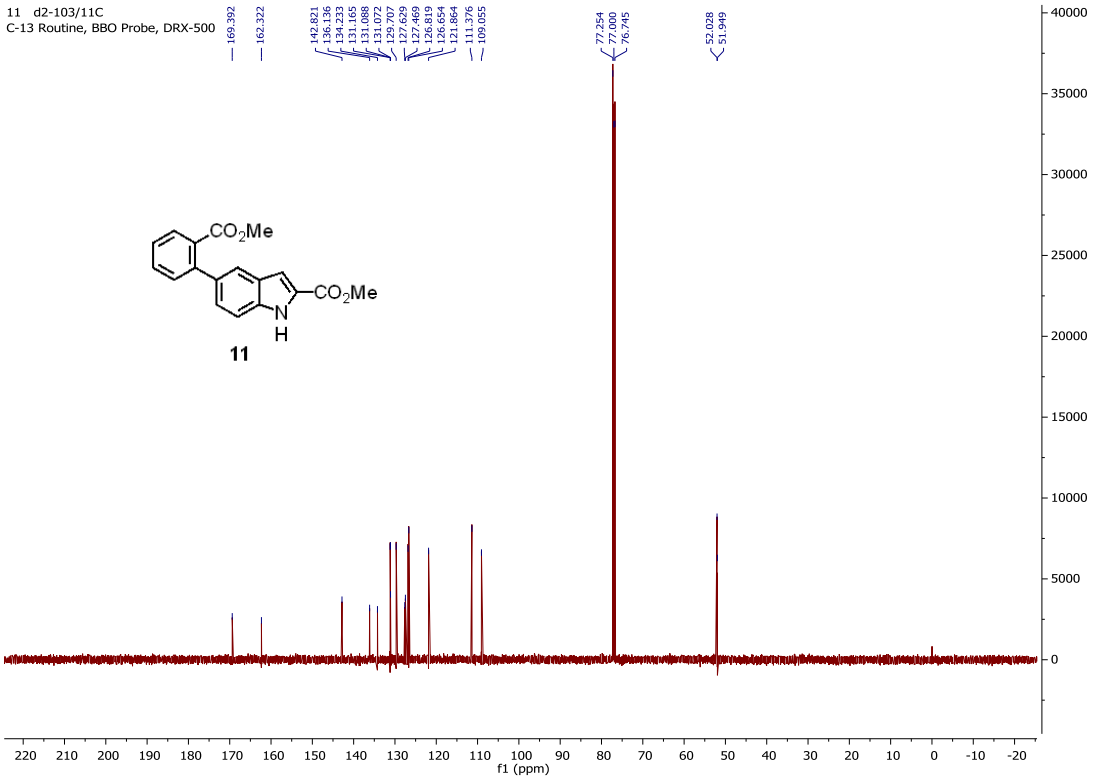

9d(di).1.fid
H-1 Routine, DRX-500, BBO Probe
8.235
8.217
7.877
7.860
7.817
7.800
7.416
7.412
7.399
7.395
7.164
7.160
7.091
7.089
6.092
6.079
5.276
5.263
3.717
3.708
0.000
CO2Me
CO2Me
NHNs
CO2Me
Cl
Cl
9d(di)
2.01
1.97
1.97
1.97
2.00
2.00
0.95
1.01
5.83
3.12
f1 (ppm)


9d(di).2.fid
C-13 Routine, BBO Probe, DRX-500
169.871
167.267
149.916
145.941
142.850
140.735
137.677
134.576
131.622
130.645
128.931
128.705
128.397
127.949
126.622
124.185
77.253
77.000
76.746
59.260
53.489
52.239
29.694
CO2Me
CO2Me
NHNs
CO2Me
Cl
Cl
9d(di)
f1 (ppm)


10 H d2-58_01
Std proton
7.831
7.812
7.531
7.513
7.494
7.466
7.396
7.377
7.161
7.135
3.780
3.711
3.681
3.191
3.179
3.157
3.146
2.952
2.932
2.918
2.898
1.639
CO2Me
CO2Me
NH2
MeO2C
10
1.89
1.95
3.92
1.00
1.91
1.06
3.04
5.78
0.97
0.94
2.04
f1 (ppm)


10 C d2-58_C_01
Std proton
175.053
168.753
141.877
141.325
136.544
131.105
130.758
130.553
129.683
128.174
127.155
126.754
77.318
77.000
76.681
55.731
51.859
51.845
40.958
CO2Me
CO2Me
NH2
MeO2C
10
f1 (ppm)


11 d2-103/11 H
H-1 Routine, DRX-500, BBO Probe
8.038
7.831
7.829
7.816
7.814
7.640
7.547
7.544
7.532
7.529
7.517
7.514
7.446
7.430
7.417
7.414
7.403
7.400
7.387
7.385
7.289
7.286
7.272
7.269
7.241
7.239
3.956
3.614
CO2Me
CO2Me
N
H
11
0.98
1.00
0.99
1.05
3.10
1.02
0.93
3.08
3.11
f1 (ppm)


11 d2-103/11C
C-13 Routine, BBO Probe, DRX-500
169.392
162.322
142.821
136.136
134.233
131.165
131.088
131.072
129.707
127.629
127.469
126.819
126.654
121.864
111.376
109.055
77.254
77.000
76.745
52.028
51.949
CO2Me
CO2Me
N
H
11
f1 (ppm)