Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Supplementary Information

Disilanes as Oxygen Scavengers and Surrogates of Hydrosilanes Suitable for Selective Reduction of Nitroarenes, Phosphine Oxides and other Valuable Substrates

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General considerations

Commercially available starting materials, reagents, catalysts and anhydrous and degassed solvents were used without further purification. Flash column chromatography was performed with Merck silica gel 60 (230-400 mesh). The solvents for column chromatography were distilled before use. Thin layer chromatography was carried out using Merck TLC Silica gel 60 F_{254} and visualized by short-wavelength ultraviolet light or by treatment with potassium permanganate ($KMnO_4$) stain. ^{1}H, ^{13}C and ^{31}P NMR spectra were recorded on a Bruker 250 and 500 MHz at 20ºC. All ^{1}H NMR spectra are reported in parts per million (ppm) downfield of TMS and were measured relative to the signals for $CHCl_3$ (7.26 ppm) and DMSO (2.50 ppm). All ^{13}C NMR spectra were reported in ppm relative to residual $CHCl_3$ (77.00 ppm) or DMSO (39.70 ppm) and were obtained with ^{1}H decoupling. Coupling constants, *J*, are reported in Hertz (Hz). Gas chromatographic analyses was performed on Gas Chromatograph Mass Spectrometer GCMS-QP2010 Ultra instrument.

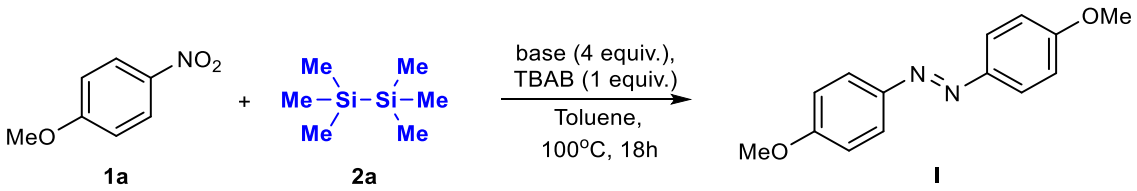
Optimization details

The optimal reaction conditions were identified by Microscale High-Throughput Experimentation Screening. Parallel synthesis was accomplished in an MBraun glovebox operating with a constant Ar-purge (oxygen and water <5 ppm). Screening reactions were carried out in 1 mL V-type pressure vials using suitable heating blocks. Liquid chemicals were dosed using gas tight microsyringes.

General experimental procedure on the instance of base screening

The reactions were set up inside of glovebox under an argon atmosphere. The heating block containing 1 mL V-type pressure vials were loaded with 4-nitroanisole (1 equiv., 0.3 mmol), hexamethyldisilane (4 equiv.), appropriate base (4 equiv.), TBAB (1 equiv.) and toluene (2 mmol). Afterwards, the V-type pressure vials were sealed and stirred outside the glovebox for 18h at 100ºC. Further, the reaction mixtures were cooled to room temperature, opened to air and a solution of biphenyl in DCM was syringed into each vial. Using a gas tight microsyringe, portions of each reaction mixture (10 μL) were transferred into vials prefilled with 600 μL of DCM. The vials were sealed with a stopper and analysed by Gas Chromatograph Mass Spectrometer GCMS-QP2010 Ultra instrument.

Table S1. Screening of bases.[a]

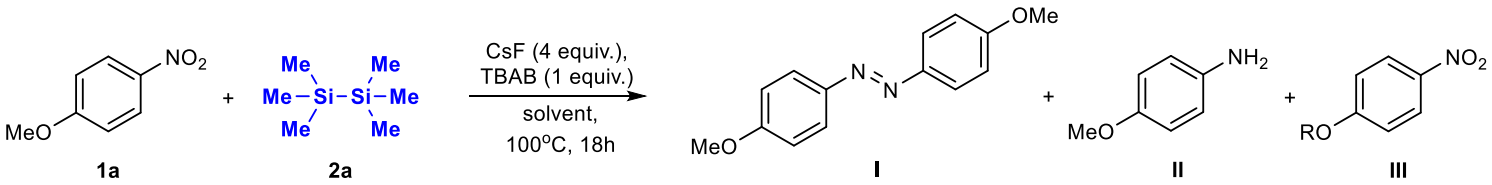


1a **2a** **I**

entry	base	conversion **1a** (%)[b]	yield **I** (%)[b]
1	NaF	13	0
2	LiF	8	0
3	KF	23	18
4	**CsF**	**100**	**88 (79)[c]**
5	AgF	100	62
6	TBAF[d]	100	76
7	TBAF x $3H_2O$[d]	23	0
8	NaOH	86	43
9	KOH	93	56
10	K_2CO_3	6	0
11	Cs_2CO_3	8	0
12	K_3PO_4	5	0
13	KOAc	2	0
14	KO*t*Bu	100	23
15	NaOMe	100	0
16	Pyridine	3	0
17	No base	2	0

[a] Reaction conditions: **1a** (0.3 mmol), **2a** (4 equiv.), base (4 equiv.), TBAB (1 equiv.), Toluene (2 mmol), 100ºC, 18h. [b] Conversion and yield determined by GC using biphenyl as an internal standard. [c] Isolated yield. [d] In this case TBAB was not used.

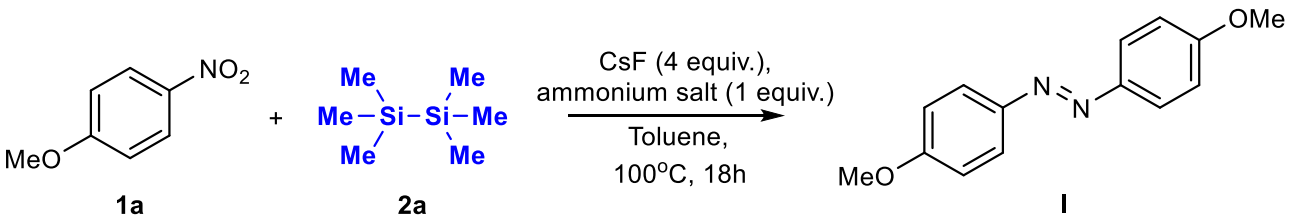
Table S2. Screening of solvents.[a]



entry	solvent	conversion **1a** (%)[b]	yield **I/II/III** (%)[b]
1	THF	6	0/0/0
2	1,4-Dioxane	18	9/0/0
3	DCE	3	0/0/0
4	MeCN	4	0/0/0
5	Benzene	83	64/0/0
6	**Toluene**	**100**	**88 (79)[c]/0/0**
7	1,2-Dichlorobenzene	72	48/0/0
8	Cyclohexane	75	57/0/0
9	DMA	100	39/0/0
10	DMSO	100	33/0/0
11	Pyridine	63	42/0/0
12	TMEDA	15	0/0/0
13	DME	56	35/0/0
14	TBAB	100	83/0/0
15	BMIMCl	100	79/0/0
16	EtOH	100	12/7/74[d]
17	EtOH/Toluene	100	21/4/59[d]

[a] Reaction conditions: **1a** (0.3 mmol), **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.), solvent (2 mmol), 100ºC, 18h. [b] Conversion and yield determined by GC using biphenyl as an internal standard. [c] Isolated yield. [d] OR = OEt, the reaction was performed at 120ºC, within 72h.

Table S3. Screening of ammonium salts.[a]

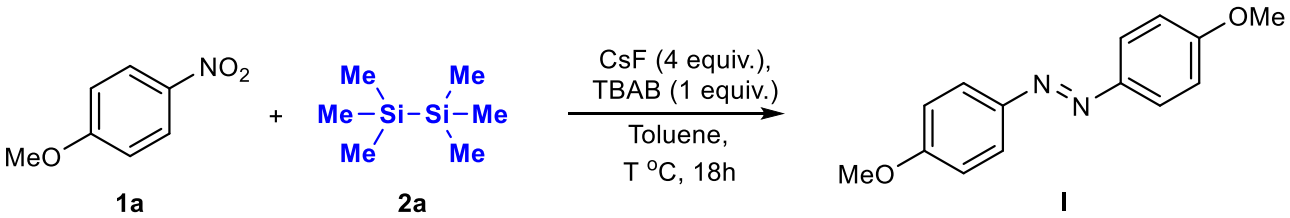


1a **2a** **I**

entry	ammonium salt	conversion **1a** (%)[b]	yield **I** (%)[b]
1	**TBAB**	**100**	**88 (79)**[c]
2	TBAI	100	79
3	Tetrabutylammonium chloride	95	81
4	Tetramethylammonium bromide	100	84
5	BMIMCl	100	86
6	Phenyltrimethylammonium chloride	76	59
7	TBAF[d]	100	76
8	No ammonium salt	7	0

[a] Reaction conditions: **1a** (0.3 mmol), **2a** (4 equiv.), CsF (4 equiv.), ammonium salt (1 equiv.), Toluene (2 mmol), 100ºC, 18h. [b] Conversion and yield determined by GC using biphenyl as an internal standard. [c] Isolated yield. [d] In this case CsF was not used.

Table S4. Screening of the reaction temperature.[a]

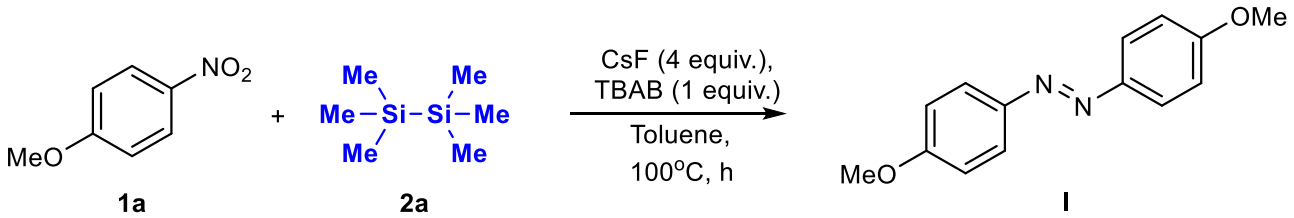


1a **2a** **I**

entry	T °C	conversion **1a** (%)[b]	yield **I** (%)[b]
1	25°C	0	0
2	50°C	3	0
3	75°C	62	44
4	**100°C**	**100**	**88 (79)[c]**
5	120°C	100	72
6	140°C	100	37

[a] Reaction conditions: **1a** (0.3 mmol), **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.), Toluene (2 mmol), T °C, 18h. [b] Conversion and yield determined by GC using biphenyl as an internal standard. [c] Isolated yield.

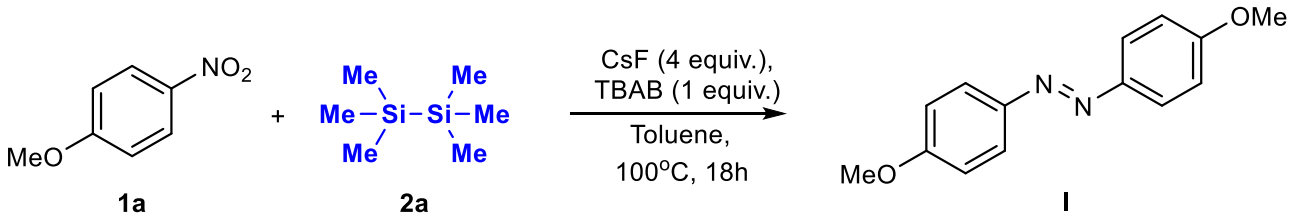
Table S5. Screening of duration of the reaction.[a]



entry	h	conversion **1a** (%)[b]	yield **I** (%)[b]
1	1	36	29
2	3	51	45
3	6	76	69
4	12	93	81
5	**18**	**100**	**88 (79)[c]**
6	24	100	83

[a] Reaction conditions: **1a** (0.3 mmol), **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.), Toluene (2 mmol), 100°C, h. [b] Conversion and yield determined by GC using biphenyl as an internal standard. [c] Isolated yield.

Table S6. Blank experiments, synthesis of azo compounds I.[a]

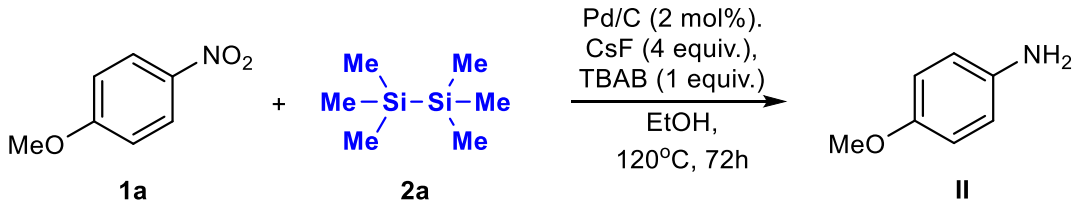


1a **2a** **I**

entry	**2a**	CsF	TBAB	Toluene	conversion **1a** (%)[b]	yield **I** (%)[b]
1	✓	✓	✓	✓	**100**	**88 (79)**[c]
2	✗	✓	✓	✓	3	0
3	✓	✗	✓	✓	2	0
4	✓	✓	✗	✓	2	0
5	✓	✓	✓	✗	100	83

[a] Reaction conditions: **1a** (0.3 mmol), **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.), Toluene (2 mmol), 100°C, 18h. [b] Conversion and yield determined by GC using biphenyl as an internal standard. [c] Isolated yield.

Table S7. Blank experiments, synthesis of anilines II.[a]

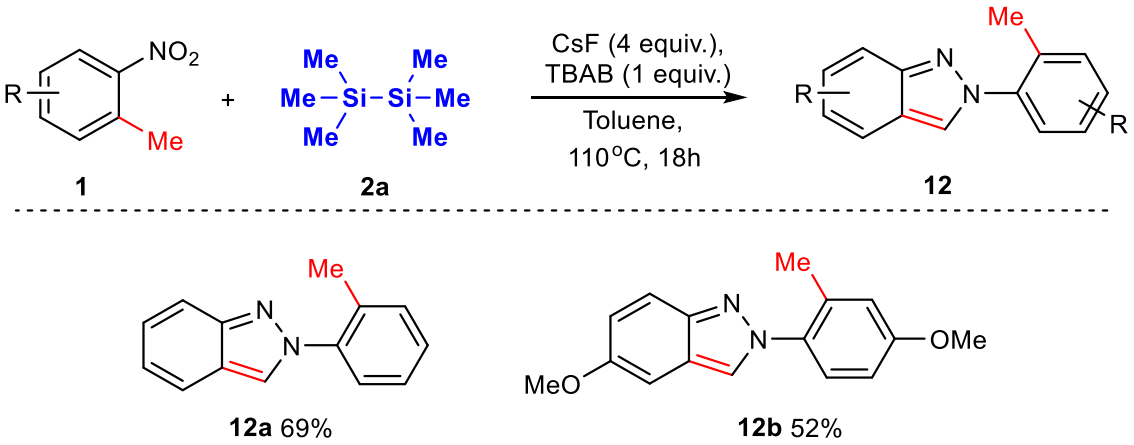


1a **2a** **II**

entry	**2a**	Pd/C	CsF	TBAB	EtOH	conversion **1a** (%)[b]	yield **II** (%)[b]
1	✓	✓	✓	✓	✓	**100**	**98 (86)**[c]
2	✗	✓	✓	✓	✓	8	0
3	✓	✗	✓	✓	✓	100	7
4	✓	✓	✗	✓	✓	16	0
5	✓	✓	✓	✗	✓	12	0
6	✓	✓	✓	✓	✗	100	0

[a] Reaction conditions: **1a** (0.3 mmol), **2a** (6 equiv.), CsF (4 equiv.), TBAB (1 equiv.), Pd/C (2 mol%), EtOH (2 mmol), 120ºC, 72h. [b] Conversion and yield determined by GC using biphenyl as an internal standard. [c] Isolated yield.

Scheme S1. Synthesis of indazoles from 2-nitrotoluene derivatives.



General procedures

Unless otherwise stated, commercial reagents were used without purification. Compounds **3a**,[1] **3b**,[2] **3c**,[3] **3d**,[3] **3e**,[4] **3f**,[5] **3g**,[6] **4e**,[7] **5c**,[8] **6a**,[9] **6b**,[10] **6c**,[11] **6d**,[12] **6e**,[13] **6f**,[10] **6g**,[13] **6h**,[14] **6i**,[10] **6j**,[15] **7a**,[16] **7b**,[10] **7c**,[17] **8a**,[15] **8b**,[18] **8c**,[15] **9a**,[19] **9b**,[19] **9c**,[20] **9d**,[21] **10a**,[22] **10b**,[20] **10c**,[20] **10d**,[23] **11a**,[24] **11b**,[25] **11c**,[26] **11d**,[28] **11e**,[27] **11f**,[28] **11g**,[25] **11h**,[29] are known. Enamine Ltd. Company (Ukraine) kindly provided phosphine oxides.

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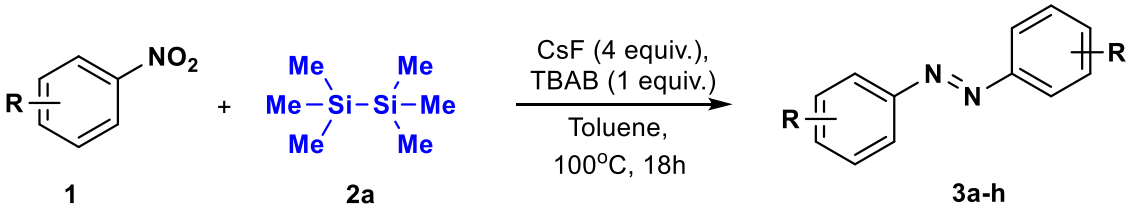
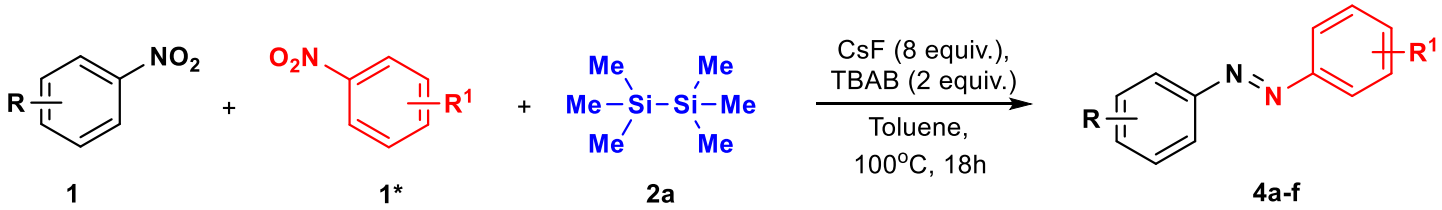


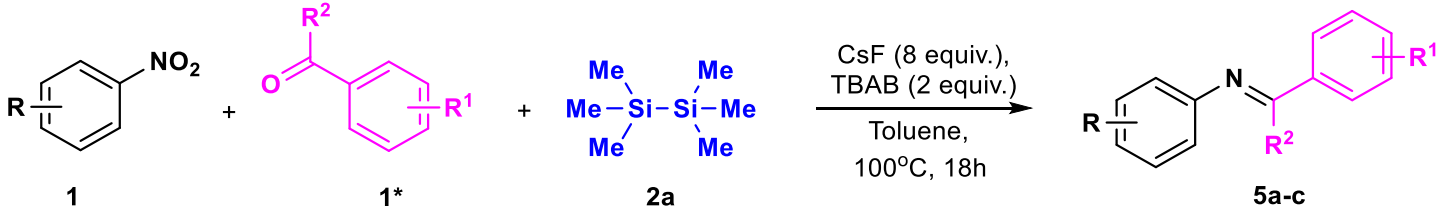
1 2a 3a-h

Method A: synthesis of symmetrical azobenzenes. Preparation of compounds 3a-h. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding nitrobenzene **1** (1 equiv.), hexamethyldisilane **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.) and Toluene (3 mL for 4 mmol of starting nitrobenzene) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired azobenzene.

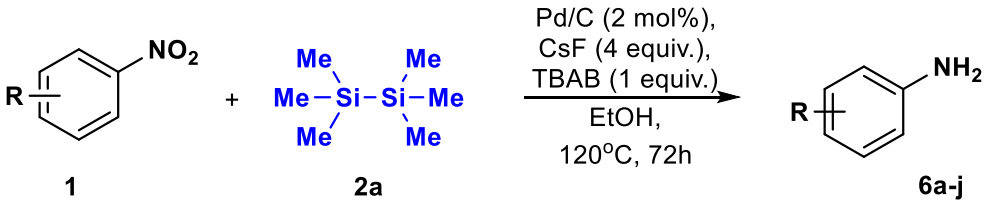


1 1* 2a 4a-f

Method A: synthesis of unsymmetrical azobenzenes. Preparation of compounds 4a-f. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding nitroarene **1** (1 equiv.), nitrobenzene **1*** (3 equiv.), hexamethyldisilane **2a** (8 equiv.), CsF (8 equiv.), TBAB (2 equiv.) and Toluene (3 mL for 2 mmol of starting nitroarene) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired azobenzene.

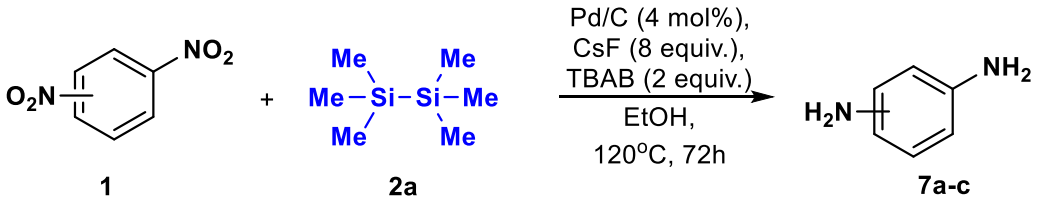


Method A: synthesis of Schiff bases. Preparation of compounds 5a-c. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding nitroarene **1** (1 equiv.), carbonyl compound **1*** (3 equiv.), hexamethyldisilane **2a** (8 equiv.), CsF (8 equiv.), TBAB (2 equiv.) and Toluene (3 mL for 2 mmol of starting nitroarene) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired Schiff base.



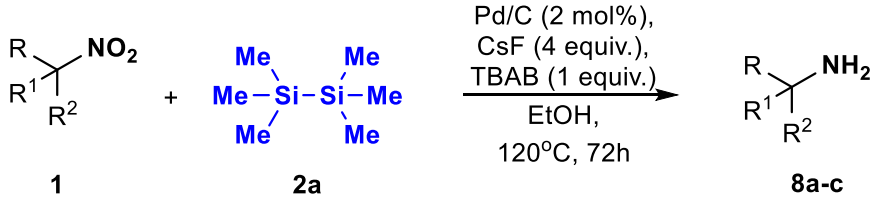
Method B: synthesis of anilines. Preparation of compounds 6a-j. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding nitrobenzene **1** (1 equiv.), hexamethyldisilane **2a** (6 equiv.), Pd/C (2 mol%), CsF (4 equiv.), TBAB (1 equiv.) and ethanol (3 mL for 2 mmol of starting nitrobenzene) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was treated with water. The water phase was extracted by DCM. The

organic layer was dried and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired aniline.



1 2a 7a-c

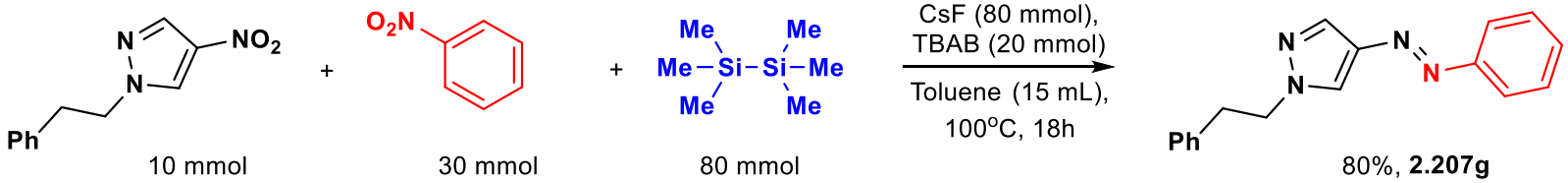
Method B: reduction of dinitro compounds. Preparation of compounds 7a-c. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding nitrobenzene **1** (1 equiv.), hexamethyldisilane **2a** (12 equiv.), Pd/C (4 mol%), CsF (8 equiv.), TBAB (2 equiv.) and ethanol (3 mL for 1 mmol of starting nitrobenzene) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was treated with water. The water phase was extracted by DCM. The organic layer was dried and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired aniline.



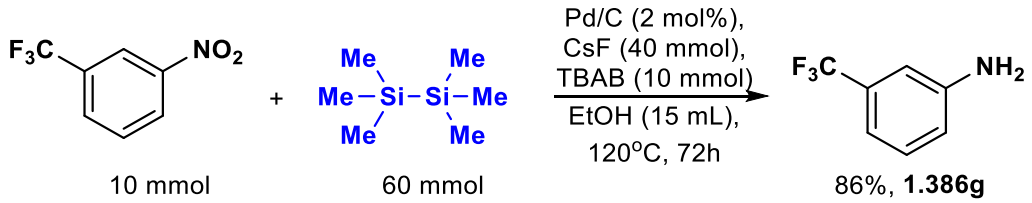
1 2a 8a-c

Method B: reduction of nitroalkanes. Preparation of compounds 8a-c. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding nitroalkane **1** (1 equiv.), hexamethyldisilane **2a** (6 equiv.), Pd/C (2 mol%), CsF (4 equiv.), TBAB (1 equiv.) and ethanol (3 mL for

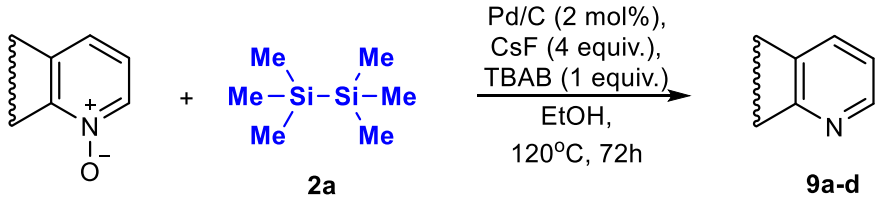
2 mmol of starting nitroalkane) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and treated with a dilute solution of hydrochloric acid. Afterwards, the aqueous layer was separated, washed with DCM, neutralized and then treated with aqueous solution of NaOH. The resulting solution was extracted with DCM; the organic layers were combined and dried. Afterwards, the DCM was removed by distillation under atmospheric pressure that was followed by distillation of aliphatic amine using a dephlegmator.



Method A: multigram synthesis of 4a. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding nitropyrazole (10 mmol), nitrobenzene (30 mmol), hexamethyldisilane (80 mmol), CsF (80 mmol), TBAB (20 mmol) and Toluene (15 mL) were weighed and placed into a round bottom flask (volume 100 mL) equipped with a magnetic stir bar, which then was capped with a rubber septum. Afterwards, the reaction vessel was connected with an argon balloon and heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired azo compound.

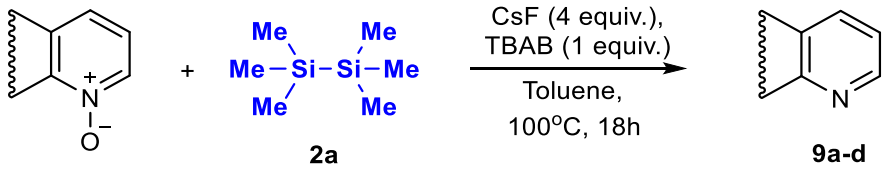


Method B: multigram synthesis of 6f. Under inert atmosphere (glovebox operating with a constant Ar-purge) 3-nitrobenzotrifluoride (10 mmol), hexamethyldisilane (60 mmol), Pd/C (2 mol%), CsF (40 mmol), TBAB (10 mmol) and ethanol (15 mL) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was treated with water. The water phase was extracted by DCM. The organic layer was dried and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired aniline.

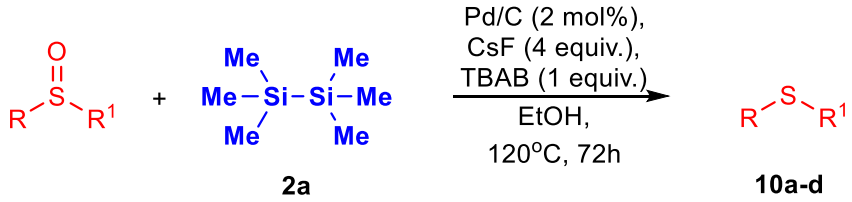


2a **9a-d**

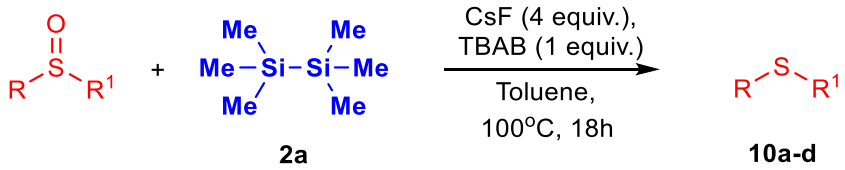
Method B: the Pd-catalysed reduction of *N*-oxides. Preparation of compounds 9a-d. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding *N*-oxide (1 equiv.), hexamethyldisilane **2a** (6 equiv.), Pd/C (2 mol%), CsF (4 equiv.), TBAB (1 equiv.) and ethanol (3 mL for 2 mmol of starting *N*-oxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was treated with water. The water phase was extracted by DCM. The organic layer was dried and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired pyridine derivative.



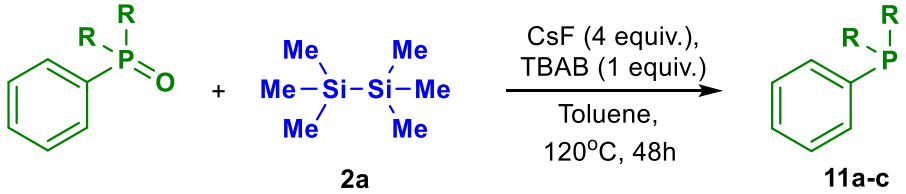
Method A: the metal-free reduction of *N*-oxides. Preparation of compounds 9a-d. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding *N*-oxide (1 equiv.), hexamethyldisilane **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.) and Toluene (3 mL for 4 mmol of starting *N*-oxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired pyridine derivative.



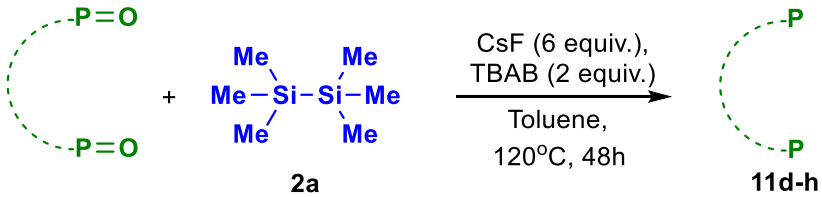
Method B: the Pd-catalysed reduction of sulfoxides. Preparation of compounds 10a-d. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding sulfoxide (1 equiv.), hexamethyldisilane **2a** (6 equiv.), Pd/C (2 mol%), CsF (4 equiv.), TBAB (1 equiv.) and ethanol (3 mL for 2 mmol of starting sulfoxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired sulfide.



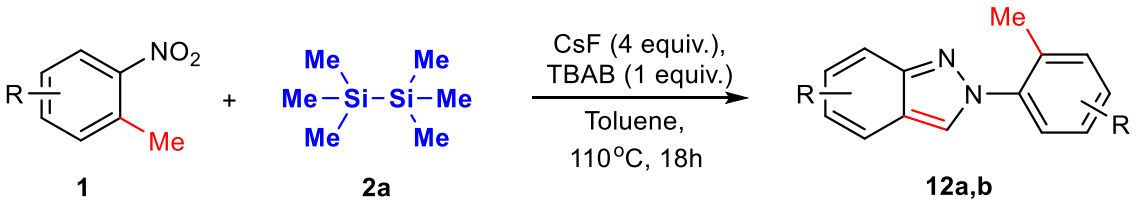
Method A: the metal-free reduction of sulfoxides. Preparation of compounds 10a-d. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding sulfoxide (1 equiv.), hexamethyldisilane **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.) and Toluene (3 mL for 4 mmol of starting sulfoxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired sulfide.



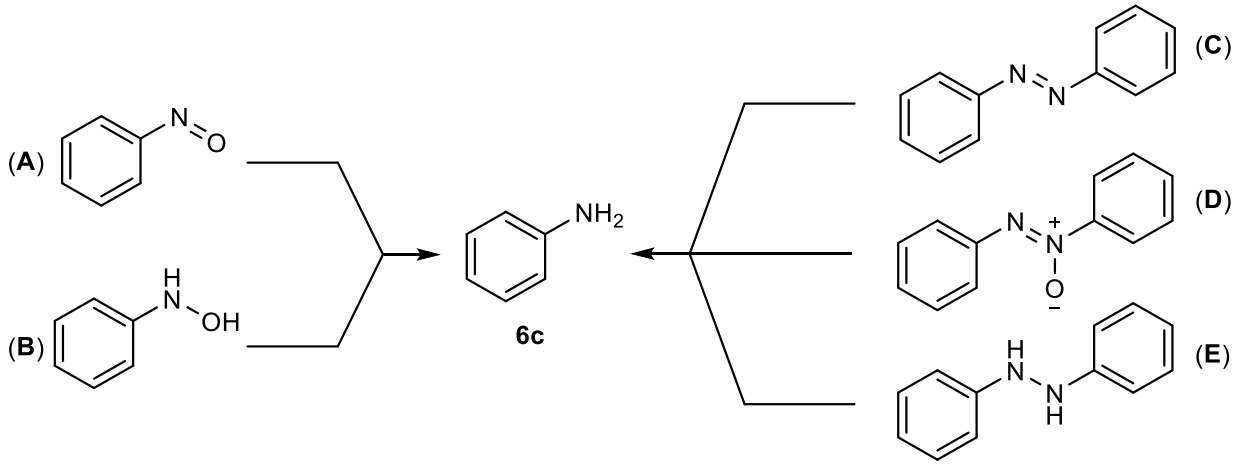
Method A: the metal-free reduction of phosphine oxides. Preparation of compounds 11a-c. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding phosphine oxide (1 equiv.), hexamethyldisilane **2a** (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.) and Toluene (3 mL for 4 mmol of starting phosphine oxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 48 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using degassed hexane/ethyl acetate mixtures to provide the desired phosphine.



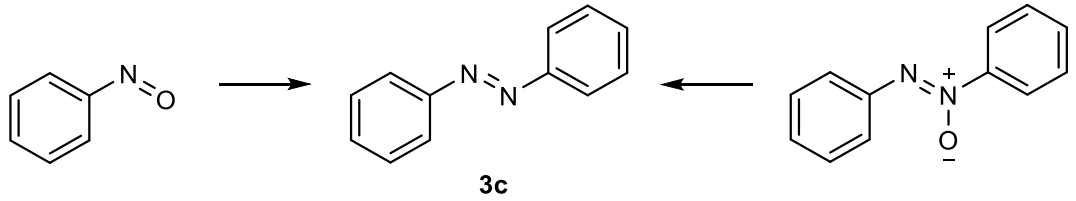
Method A: the metal-free reduction of phosphine oxides. Preparation of compounds 11d-h. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding phosphine oxide (1 equiv.), hexamethyldisilane **2a** (8 equiv.), CsF (6 equiv.), TBAB (2 equiv.) and Toluene (3 mL for 2 mmol of starting phosphine oxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 48 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using degassed hexane/ethyl acetate mixtures to provide the desired phosphine.



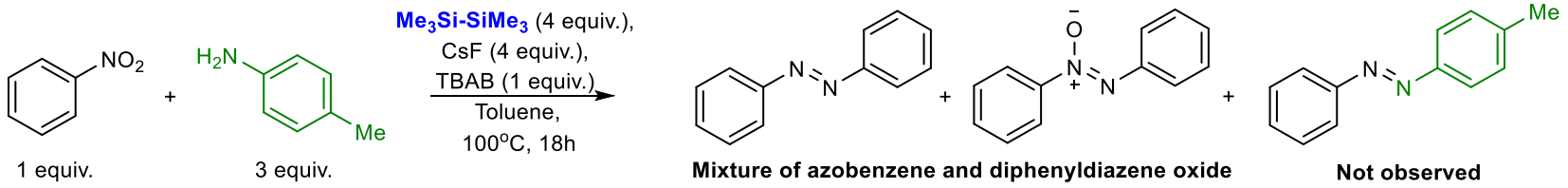
General procedure for the synthesis of indazoles from derivatives of 2-nitrotoluene. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding derivatives of 2-nitrotoluene (1 equiv.), hexamethyldisilane (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.) and Toluene (3 mL for 4 mmol of starting derivatives of 2-nitrotoluene) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 110°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired indazole.



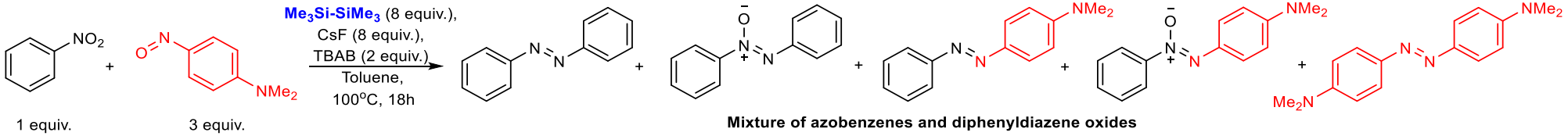
Method B: the reduction of corresponding intermediates to aniline. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding intermediate (1 equiv.), hexamethyldisilane (6 equiv.), Pd/C (2 mol%), CsF (4 equiv.), TBAB (1 equiv.) and ethanol (3 mL for 2 mmol of starting intermediate) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120^{o}C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was treated with water. The water phase was extracted by DCM. The organic layer was dried and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired aniline.



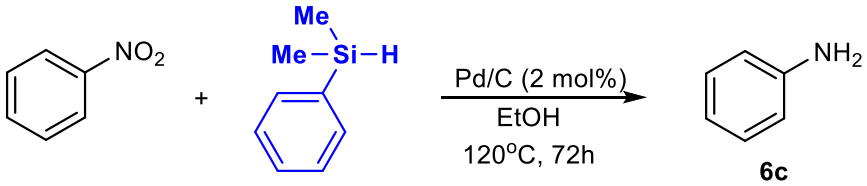
Method A: the synthesis of azobenzene from suitable intermediates. Under inert atmosphere (glovebox operating with a constant Ar-purge) corresponding intermediate (1 equiv.), hexamethyldisilane (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.) and Toluene (3 mL for 4 mmol of starting intermediate) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired azobenzene.



Competitive experiment between nitrobenzene and *p*-toluidine. Under inert atmosphere (glovebox operating with a constant Ar-purge) nitrobenzene (1 equiv., 0.3 mmol), *p*-toluidine (3 equiv.), hexamethyldisilane (4 equiv.), CsF (4 equiv.), TBAB (1 equiv.) and Toluene (2 mmol) were weighed and placed into the V-type pressure vial equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and analysed by GC/MS which indicated that the only product is azobenzene in addition to corresponding diphenyldiazene oxide.

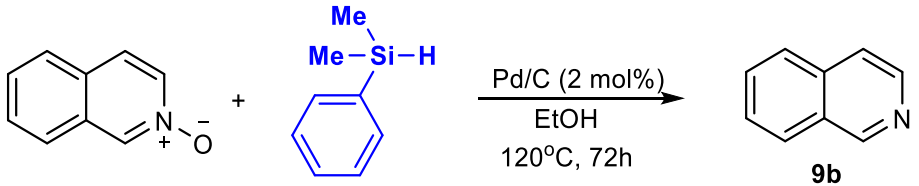


Competitive experiment between nitrobenzene and nitrosobenzene. Under inert atmosphere (glovebox operating with a constant Ar-purge) nitrobenzene (1 equiv., 0.3 mmol), appropriate nitrosobenzene (3 equiv.), hexamethyldisilane (8 equiv.), CsF (8 equiv.), TBAB (2 equiv.) and Toluene (2 mmol) were weighed and placed into the V-type pressure vial equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 100°C for 18 h. Upon completion, the reaction was cooled to room temperature and analysed by GC/MS which showed the formation of a mixture of three different azobenzenes and diphenyldiazene oxide.



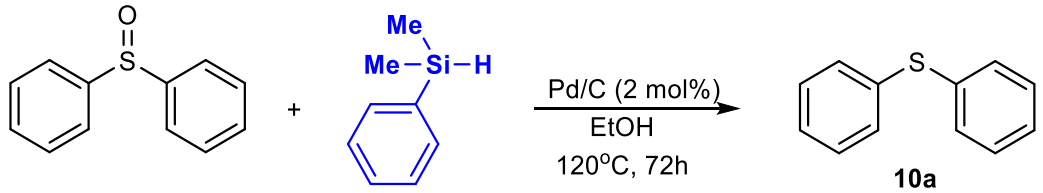
6c

General procedure for the synthesis of aniline from nitrobenzene using dimethyl(phenyl)silane. Under inert atmosphere (glovebox operating with a constant Ar-purge) nitrobenzene (1 equiv.), dimethyl(phenyl)silane (6 equiv.), Pd/C (2 mol%) and ethanol (3 mL for 2 mmol of starting nitrobenzene) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired aniline.



9b

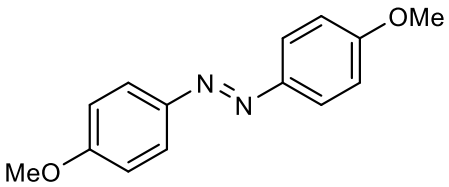
General procedure for the synthesis of isoquinoline from isoquinoline *N*-oxide using dimethyl(phenyl)silane. Under inert atmosphere (glovebox operating with a constant Ar-purge) isoquinoline *N*-oxide (1 equiv.), dimethyl(phenyl)silane (6 equiv.), Pd/C (2 mol%) and ethanol (3 mL for 2 mmol of starting isoquinoline *N*-oxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired isoquinoline.



10a

General procedure for the synthesis of diphenyl sulfide from diphenyl sulfoxide using dimethyl(phenyl)silane. Under inert atmosphere (glovebox operating with a constant Ar-purge) diphenyl sulfoxide (1 equiv.), dimethyl(phenyl)silane (6 equiv.), Pd/C (2 mol%) and ethanol (3 mL for 2 mmol of starting diphenyl sulfoxide) were weighed and placed into an Ace Pressure Tube equipped with a magnetic stir bar, which then was capped with a stopper. Afterwards, the reaction mixture was heated to 120°C for 72 h. Upon completion, the reaction was cooled to room temperature, filtered through a celite pad and concentrated under vacuum. The residue was purified by column chromatography typically using hexane/ethyl acetate mixtures to provide the desired diphenyl sulfide.

Characterization of products

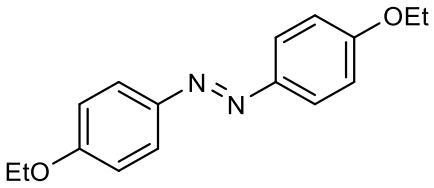


***1,2-Bis(4-methoxyphenyl)diazene* (3a).**

Yield = 79% (0.191g). The product is an intense yellow solid. mp 139-141ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.88 (s, 6H, OMe), 6.99-7.02 (m, 4H, CH_{Ar}), 7.88-7.90 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 55.5, 114.1, 124.3, 147.0, 161.5.

Anal. calcd. for $C_{14}H_{14}N_2O_2$: C, 69.41; H, 5.82; N, 11.56. Found: C, 70.33; H, 5.73; N, 11.62.

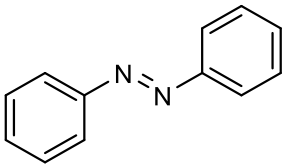


***1,2-Bis(4-ethoxyphenyl)diazene* (3b).**

Yield = 77% (0.208g). The product is a yellow solid. mp 151-152ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 1.46 (t, 6H, ^{3}J = 7.4 Hz, OCH_2CH_3), 4.10 (q, 4H, ^{3}J = 6.9 Hz, OCH_2CH_3), 6.98-7.00 (m, 4H, CH_{Ar}), 7.86-7.87 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 14.8, 63.7, 114.6, 124.3, 146.9, 161.0.

Anal. calcd. for $C_{16}H_{18}N_2O_2$: C, 71.09; H, 6.71; N, 10.36. Found: C, 71.21; H, 6.66; N, 10.42.

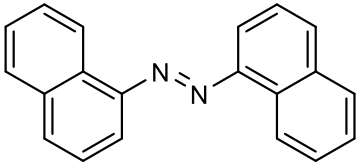


***1,2-Diphenyldiazene* (3c).**

Yield = 86% (0.157g). The product is an orange solid. mp 68-69ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.50-7.53 (m, 2H, CH_{Ar}), 7.55-7.59 (m, 4H, CH_{Ar}), 8.00-8.02 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 122.8, 129.0, 130.9, 152.6.

Anal. calcd. for $C_{12}H_{10}N_2$: C, 79.10; H, 5.53; N, 15.37. Found: C, 79.17; H, 5.61; N, 15.41.

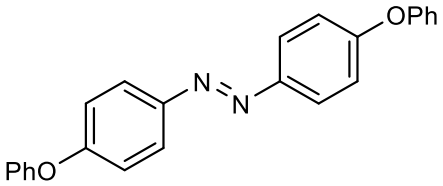


***1,2-Di(naphthalen-1-yl)diazene* (3d).**

Yield = 62% (0.175g). The product is a brown solid. mp more than 200ºC. **^{1}H NMR** (200 MHz, $CDCl_3$): δ 7.74-7.99 (m, 8H, CH_{Ar}), 8.09-8.13 (m, 2H, CH_{Ar}), 8.37-8.42 (m, 2H, CH_{Ar}), 9.80-9.84 (m, 2H, CH_{Ar}).

^{13}C NMR due to bed solubility it was not possible to measure.

Anal. calcd. for $C_{20}H_{14}N_2$: C, 85.08; H, 5.00; N, 9.92. Found: C, 85.22; H, 5.08; N, 9.78.

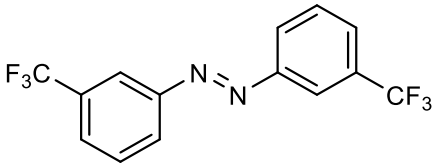


***1,2-Bis(4-phenoxyphenyl)diazene* (3e).**

Yield = 67% (0.245g). The product is a yellow solid. mp 139-141°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.08-7.09 (m, 4H, CH_{Ar}), 7.10-7.11 (m, 4H, CH_{Ar}), 7.18 (tt, 2H, ^{3}J = 7.4 Hz, ^{4}J = 0.9 Hz, CH_{Ar}), 7.38-7.41 (m, 4H, CH_{Ar}), 7.89-7.91 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 118.4, ,119.7, 124.1, 124.5, 130.0, 148.3, 156.3, 159.8.

Anal. calcd. for $C_{24}H_{18}N_2O_2$: C, 78.67; H, 4.95; N, 7.65. Found: C, 78.71; H, 5.03; N, 7.72.

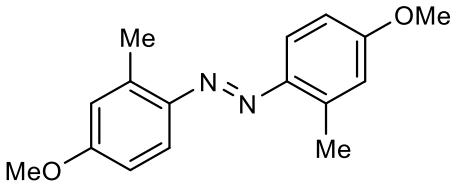


***1,2-Bis(3-(trifluoromethyl)phenyl)diazene* (3f).**

Yield = 88% (0.280g). The product is a yellow solid. mp 82-84°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.68 (t, 2H, ^{3}J = 8.2 Hz, CH_{Ar}), 7.77 (d, 2H, ^{3}J = 7.3 Hz, CH_{Ar}), 8.13 (d, 2H, ^{3}J = 8.2 Hz, CH_{Ar}), 8.22 (s, 2H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 119.7 (q, $^{3}J_{CF}$ = 3.5 Hz), 123.8 (q, $^{1}J_{CF}$ = 272.1 Hz), 126.5, 127.8, 127.9, 129.8, 131.8 (q, $^{2}J_{CF}$ = 33.6 Hz), 152.2.

Anal. calcd. for $C_{14}H_8F_6N_2$: C, 52.84; H, 2.53; N, 8.80. Found: C, 52.72; H, 2.48; N, 8.64.

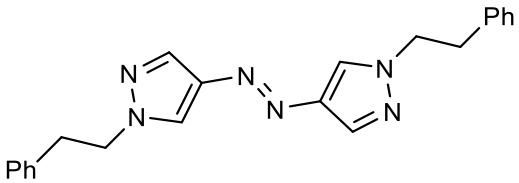


***1,2-Bis(4-methoxy-2-methylphenyl)diazene* (3g).**

Yield = 42% (0.113g). The product is a yellow solid. mp 158-160°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.72 (s, 6H, 2xMe), 3.06 (s, 6H, 2xOMe), 6.77-6.83 (m, 4H, CH_{Ar}), 7.68 (d, 2H, ^{3}J = 8.8 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 17.9, 55.4, 112.3, 115.2, 117.3, 139.9, 145.5, 161.2.

Anal. calcd. for $C_{16}H_{18}N_2O_2$: C, 71.09; H, 6.71; N, 10.36. Found: C, 71.22; H, 6.62; N, 10.42.

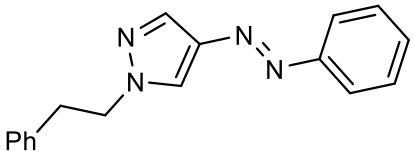


***1,2-Bis(1-phenethyl-1H-pyrazol-4-yl)diazene* (3h).**

Yield = 72% (0.266g). The product is an orange solid. mp 139-141°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.20 (t, 4H, ^{3}J = 7.0 Hz, CH_2), 4.36 (t, 4H, ^{3}J = 7.0 Hz, CH_2), 7.10-7.11 (m, 4H, CH_{Ar}), 7.26-7.29 (m, 6H, CH_{Ar}), 7.65 (s, 2H, Pyrazole), 7.93 (s, 2H, Pyrazole).

^{13}C NMR (126 MHz, $CDCl_3$): δ 36.6, 54.3, 125.8, 126.9, 128.6, 128.69, 128.7, 132.6, 137.6, 141.3.

Anal. calcd. for $C_{22}H_{22}N_6$: C, 71.33; H, 5.99; N, 22.69. Found: C, 71.53; H, 5.78; N, 22.61.

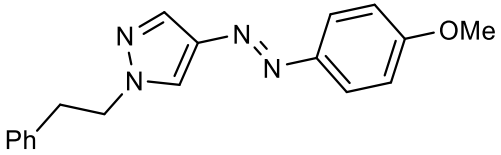


***1-Phenethyl-4-(phenyldiazenyl)-1H-pyrazole* (4a).**

Yield = 78% (0.215g). The product is an orange solid. mp 78-80°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.23 (t, 2H, ^{3}J = 7.5 Hz, CH_2), 4.36 (t, 2H, ^{3}J = 7.5 Hz, CH_2), 7.12-7.14 (m, 2H, CH_{Ar}), 7.23-7.30 (m, 3H, CH_{Ar}), 7.49 (m, 3H, CH_{Ar}), 8.16 (s, 1H, Pyrazole), 8.22-8.25 (m, 2H, CH_{Ar}), 8.54 (s, 1H, Pyrazole).

^{13}C NMR (126 MHz, $CDCl_3$): δ 36.6, 54.2, 121.8, 126.7, 126.8, 131.0, 137.5, 139.3, 146.9.

Anal. calcd. for $C_{17}H_{16}N_4$: C, 73.89; H, 5.84; N, 20.27. Found: C, 73.77; H, 5.78; N, 20.13.

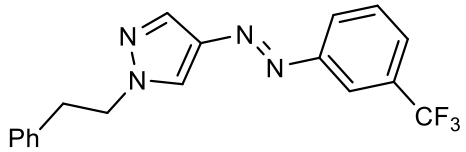


***4-((4-Methoxyphenyl)diazenyl)-1-phenethyl-1H-pyrazole* (4b).**

Yield = 69% (0.211g). The product is an orange solid. mp 93-95°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.22 (t, 2H, ^{3}J = 7.4 Hz, CH_2), 3.87 (s, 3H, OMe), 4.39 (t, 2H, ^{3}J = 7.6 Hz, CH_2), 6.94-6.96 (m, 2H, CH_{Ar}), 7.12-7.14 (m, 2H, CH_{Ar}), 7.22-7.30 (m, 3H, CH_{Ar}), 8.12 (s, 1H, Pyrazole), 8.18-8.20 (m, 2H, CH_{Ar}), 8.50 (s, 1H, Pyrazole).

^{13}C NMR (126 MHz, $CDCl_3$): δ 36.6, 54.2, 55.7, 113.7, 123.4, 126.5, 126.8, 128.6, 128.7, 128.8, 137.6, 139.1, 140.3, 161.7.

Anal. calcd. for $C_{18}H_{18}N_4O$: C, 70.57; H, 5.92; N, 18.29. Found: C, 70.49; H, 5.73; N, 18.36.

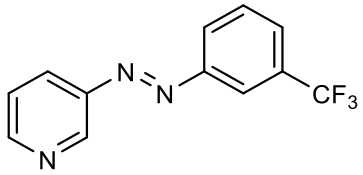


***1-Phenethyl-4-((3-(trifluoromethyl)phenyl)diazenyl)-1H-pyrazole* (4c).**

Yield = 76% (0.261g). The product is an orange solid. mp 77-79°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.24 (t, 2H, ^{3}J = 7.5 Hz, CH_2), 4.10 (t, 2H, ^{3}J = 7.5 Hz, CH_2), 7.11-7.13 (m, 2H, CH_{Ar}), 7.23-7.30 (m, 3H, CH_{Ar}), 7.64 (t, 1H, ^{3}J = 7.9 Hz, CH_{Ar}), 7.77 (d, 1H, ^{3}J = 7.9 Hz, CH_{Ar}), 8.10 (s, 1H, Pyrazole), 8.44 (d, 1H, ^{3}J = 8.3 Hz, CH_{Ar}), 8.52 (s, 1H, Pyrazole), 8.55 (s, 1H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 36.6, 54.3, 119.2 (q, J_{CF} = 3.9 Hz), 123.4 (q, $^{1}J_{CF}$ = 272.1 Hz, CF_3), 125.1, 126.9, 127.0, 127.6 (q, J_{CF} = 3.0 Hz), 128.5, 128.7, 128.8, 129.6, 131.5 (q, $^{2}J_{CF}$ = 34.0 Hz, CCF$_3$), 137.4, 139.,5, 143.1, 147.0.

Anal. calcd. for $C_{18}H_{15}F_3N_4$: C, 62.79; H, 4.39; N, 16.27. Found: C, 62.61; H, 4.47; N, 16.35.

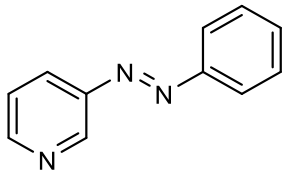


***(E)-3-((3-(Trifluoromethyl)phenyl)diazenyl)pyridine* (4d).**

Yield = 56% (0.141g). The product is an orange oil. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.46-7.49 (m, 1H, CH_{Ar}), 7.68 (t, 1H, ^{3}J = 8.3 Hz, CH_{Ar}), 7.75 (d, 1H, ^{3}J = 7.8 Hz, CH_{Ar}), 8.13 (d, 1H, ^{3}J = 8.3 Hz, CH_{Ar}), 8.17 (dt, 1H, ^{3}J = 8.2 Hz, ^{4}J = 1.8 Hz, CH_{Ar}), 8.21 (br. s, 1H, CH_{Ar}), 8.74 (dd, 1H, ^{3}J = 4.6 Hz, ^{4}J = 1.8 Hz, CH_{Ar}), 9.23 (d, 1H, ^{4}J = 2.0 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 119.8 (q, J_{CF} = 4.0 Hz), 123.9 (q, $^{1}J_{CF}$ = 231.4 Hz, CF_3), 124.1, 126.4, 127.0, 128.0 (q, J_{CF} = 3.1 Hz), 129.8, 131.7 (q, $^{2}J_{CF}$ = 33.3 Hz, CCF$_3$), 147.6, 148.9, 152.4.

Anal. calcd. for $C_{12}H_8N_3F_3$: C, 57.37; H, 3.21; N, 16.73. Found: C, 57.48; H, 3.32; N, 16.58.

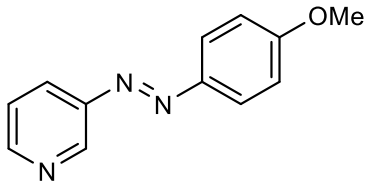


***3-(Phenyldiazenyl)pyridine* (4e).**

Yield = 65% (0.119g). The product is an orange solid. mp 56-59ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.42-7.45 (m, 1H, CH_{Ar}), 7.50-7.55 (m, 3H, CH_{Ar}), 7.93-7.95 (m, 2H, CH_{Ar}), 8.13-8.15 (m, 1H, CH_{Ar}), 8.69-8.70 (m, 1H, CH_{Ar}), 9.19-9.20 (m, 1H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 120.4, 123.0, 123.9, 126.8, 129.2, 131.8, 147.4, 151.7.

Anal. calcd. for $C_{11}H_9N_3$: C, 72.11; H, 4.95; N, 22.94. Found: C, 72.02; H, 5.03; N, 22.84.

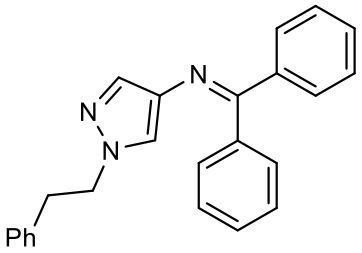


***3-((4-Methoxyphenyl)diazenyl)pyridine* (4f).**

Yield = 81% (0.119g). The product is an orange solid. mp 66-68ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.89 (s, 3H, OMe), 7.01 (dt, 2H, ^{3}J = 9.0 Hz, ^{4}J = 2.1 Hz, CH_{Ar}), 7.40-7.42 (m, 1H, CH_{Ar}), 7.93 (dt, 2H, ^{3}J = 8.9 Hz, ^{4}J = 2.0 Hz, CH_{Ar}), 8.08-8.11 (m, 1H, CH_{Ar}), 8.65 (dd, 1H, ^{3}J = 4.7 Hz, ^{4}J = 1.6 Hz, CH_{Ar}), 9.14 (d, 1H, ^{4}J = 2.0 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 55.6, 114.3, 123.9, 125.1, 126.7, 146.9, 147.1, 147.9, 151.0, 162.6.

Anal. calcd. for $C_{12}H_{11}N_3O$: C, 67.59; H, 5.20; N, 19.71. Found: C, 67.71; H, 5.25; N, 19.71.

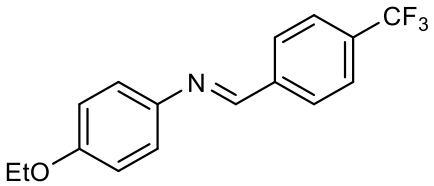


***N-(1-Phenethyl-1H-pyrazol-4-yl)-1,1-diphenylmethanimine* (5a).**

Yield = 68% (0.239g). The product is a green oil. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.05 (t, 2H, ^{3}J = 7.2 Hz, CH_2), 4.17 (t, 2H, ^{3}J = 7.4 Hz, CH_2), 6.57 (s, 1H, Pyrazole), 6.87 (s, 1H, Pyrazole), 7.02-7.04 (m, 2H, CH_{Ar}), 7.17-7.18 (m, 2H, CH_{Ar}), 7.23-7.29 (m, 3H, CH_{Ar}), 7.35-7.40 (m, 3H, CH_{Ar}), 7.44-7.46 (m, 3H, CH_{Ar}), 7.71-7.73 (m, 2H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 36.6, 53.7, 125.0, 126.6, 127.7, 128.1, 128.3, 128.5, 128.6, 128.8, 129.2, 130.0, 132.4, 135.7, 137.9, 138.5, 139.7, 165.1.

Anal. calcd. for $C_{24}H_{21}N_3$: C, 82.02; H, 6.02; N, 11.96. Found: C, 81.89; H, 5.93; N, 12.03.

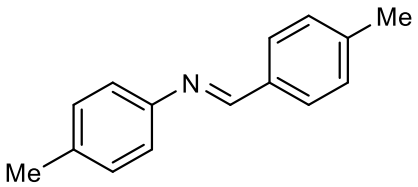


***N-(4-Ethoxyphenyl)-1-(4-(trifluoromethyl)phenyl)methanimine* (5b).**

Yield = 44% (0.219g). The product is a green solid. mp 137-139ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 1.42 (t, 3H, ^{3}J = 6.8 Hz, OCH_2CH_3), 4.05 (q, 2H, ^{3}J = 6.8 Hz, OCH_2CH_3), 6.92 (dt, 2H, ^{3}J = 8.9 Hz, ^{4}J = 2.2 Hz, CH_{Ar}), 7.25 (dt, 2H, ^{3}J = 8.9 Hz, ^{4}J = 2.2 Hz, CH_{Ar}), 7.70 (d, 2H, ^{3}J = 8.2 Hz, CH_{Ar}), 7.98 (d, 2H, ^{3}J = 8.0 Hz, CH_{Ar}), 8.52 (s, 1H, NCH).

^{13}C NMR (126 MHz, $CDCl_3$): δ 14.9, 63.7, 115.0, 122.4, 123.9 (q, $^1J_{CF}$ = 271.7 Hz, CF_3), 125.6 (q, J_{CF} = 3.9 Hz), 128.7, 132.2 (q, $^2J_{CF}$ = 30.2 Hz, CCF_3), 139.6, 143.9, 156.1, 158.2.

Anal. calcd. for $C_{16}H_{14}F_3NO$: C, 65.52; H, 4.81; N, 4.78. Found: C, C, 65.42; H, 4.95; N, 4.69.

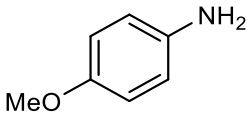


***N,1-Di-p-tolylmethanimine* (5c).**

Yield = 42% (0.089g). The product is a yellow solid. mp 95-97°C. **^{1}H NMR** (500 MHz, $CDCl_3$): 2.38 (s, 3H, Me), 2.42 (s, 3H, Me), 7.13 (d, 2H, ^3J = 8.4 Hz, CH_{Ar}), 7.19 (d, 2H, ^3J = 8.0 Hz, CH_{Ar}), 7.27 (d, 2H, ^3J = 8.0 Hz, CH_{Ar}), 7.79 (d, 2H, ^3J = 8.0 Hz, CH_{Ar}), 8.44 (s, 1H, NCH).

^{13}C NMR (126 MHz, $CDCl_3$): δ 21.0, 21.6, 120.8, 128.7, 129.4, 129.7, 133.7, 135.6, 141.6, 149.6, 159.6.

Anal. calcd. for $C_{15}H_{15}N$: C, 86.08; H, 7.22; N, 6.69. Found: C, 86.22; H, 7.18; N, 6.73.

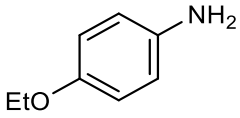


***4-Methoxyaniline* (6a).**

Yield = 86% (0.105g). The product is a yellow solid. mp 56-58°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.40 (br. s, 2H, NH_2), 3.74 (s, 3H, OMe), 6.63 (dt, 2H, ^3J = 8.9 Hz, ^4J = 2.3 Hz, CH_{Ar}), 6.74 (dt, 2H, ^3J = 8.8 Hz, ^4J = 2.2 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 55.6, 114.7, 116.3, 139.9, 152.7.

Anal. calcd. for C_7H_9NO: C, 68.27; H, 7.37; N, 11.37. Found: C, 68.33; H, 7.31; N, 11.30.

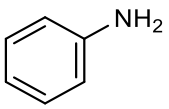


***4-Ethoxyaniline* (6b).**

Yield = 83% (0.114g). The product is a slightly yellow liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 1.37 (t, 3H, ^{3}J = 7.0 Hz, OCH_2CH_3), 3.35 (br. s, 2H, NH_2), 3.95 (q, 2H, ^{3}J = 7.0 Hz, OCH_2CH_3), 6.63-6.65 (m, 2H, CH_{Ar}), 6.73-6.75 (m, 2H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 15.0, 64.0, 115.6, 116.4, 139.8, 152.1.

Anal. calcd. for $C_8H_{11}NO$: C, 70.04; H, 8.08; N, 10.21. Found: C, 70.22; H, 8.21; N, 10.07.

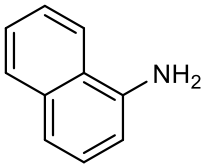


***Aniline* (6c).**

Yield = 91% (0.085g). The product is a colorless liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.60 (br. s, 2H, NH_2), 6.69-6.72 (m, 2H, CH_{Ar}), 6.79 (t, 1H, ^{3}J = 7.4 Hz, CH_{Ar}), 7.16-7.20 (m, 2H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 115.1, 118.5, 129.2, 146.3.

Anal. calcd. for C_6H_7N: C, 77.38; H, 7.58; N, 15.04. Found: C, 77.21; H, 7.62; N, 15.18.



***Naphthalen-1-amine* (6d).**

Yield = 64% (0.092g). The product is a colorless soloid. mp 48-50°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 4.14 (br. s, 2H, NH_2), 6.79 (dd, 1H, ^{3}J = 7.1 Hz, ^{4}J = 1.5 Hz, CH_{Ar}), 7.31-7.37 (m, 2H, CH_{Ar}), 7.46-7.52 (m, 2H, CH_{Ar}),7.83-7.85 (m, 2H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 109.6, 118.9, 120.8, 123.6, 124.8, 125.8, 126.3, 128.5, 134.3, 142.0.

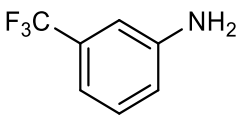
Anal. calcd. for $C_{10}H_9N$: C, 83.88; H, 6.34; N, 9.78. Found: C, 83.92; H, 6.26; N, 9.72.

***N^{1},N^{1}-Dimethylbenzene-1,4-diamine* (6e).**

Yield = 68% (0.092g). The product is a dark red solid. mp 52-53°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.83 (s, 6H, NMe_2), 3.30 (br. s, 2H, NH_2), 6.66 (d, 2H, ^{3}J = 8.6 Hz, CH_{Ar}), 6.70 (d, 2H, ^{3}J = 8.6 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 42.2, 115.6, 116.5, 138.0, 144.6.

Anal. calcd. for $C_8H_{12}N_2$: C, 70.55; H, 8.88; N, 20.57. Found: C, 70.36; H, 8.81; N, 20.67.

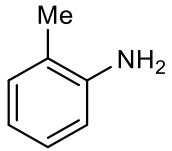


***3-(Trifluoromethyl)aniline* (6f).**

Yield = 87% (0.140g). The product is a yellowish oil. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.82 (br. s, 2H, NH_2), 6.81 (dd, 1H, ^{3}J = 8.0 Hz, ^{4}J = 2.1 Hz, CH_{Ar}), 6.89 (br. s, 1H, CH_{Ar}), 6.99 (d, 1H, ^{3}J = 7.7 Hz, CH_{Ar}), 7.23 (d, 1H, ^{3}J = 7.9 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 111.3 (q, $^3J_{CF}$ = 4.0 Hz), 114.9 (q, $^3J_{CF}$ = 4.0 Hz), 118.0, 124.2 (q, $^1J_{CF}$ = 271 Hz, CF_3), 129.7, 131.6 (q, $^2J_{CF}$ = 32.2 Hz), 146.7.

Anal. calcd. for $C_7H_6F_3N$: C, 52.18; H, 3.75; N, 8.69. Found: C, 52.22; H, 3.69; N, 8.56.

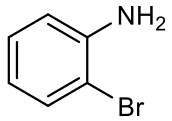


***o-Toluidine* (6g).**

Yield = 75% (0.080g). The product is a light brown liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.19 (s, 3H, Me), 3.59 (br. s, 2H, NH_2), 6.69 (d, 1H, ^3J = 7.4 Hz, CH_{Ar}), 6.73 (t, 1H, ^3J = 7.4 Hz, CH_{Ar}), 7.04-7.08 (m, 2H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 17.3, 114.9, 118.6, 122.3, 126.9, 130.4, 144.5.

Anal. calcd. for C_7H_9N: C, 78.46; H, 8.47; N, 13.07. Found: C, 78.51; H, 8.52; N, 13.00.

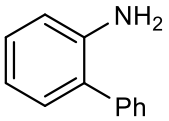


***2-Bromoaniline* (6h).**

Yield = 63% (0.108g). The product is a white solid. mp 25-26°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 4.08 (br. s, 2H, NH_2), 6.61-6.65 (m, 1H, CH_{Ar}), 6.76 (dd, 1H, ^3J = 8.0 Hz, ^4J = 1.5 Hz, CH_{Ar}), 7.10-7.13 (m, 1H, CH_{Ar}), 7.41 (dd, 1H, ^3J = 8.0 Hz, ^4J = 1.3 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 109.3, 115.7, 119.3, 128.3, 132.5, 144.0.

Anal. calcd. for C_6H_6BrN: C, 41.89; H, 3.52; N, 8.14. Found: C, 41.79; H, 3.58; N,8.23.

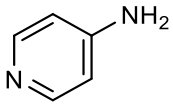


***[1,1'-Biphenyl]-2-amine* (6i).**

Yield = 61% (0.103g). The product is a colorless solid. mp 45-46°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.75 (br. s, 2H, NH_2), 6.78 (dd, 1H, ^{3}J = 7.4 Hz, ^{4}J = 1.1 Hz, CH_{Ar}), 6.84 (dt, 1H, ^{3}J = 8.0 Hz, ^{4}J = 0.8 Hz, CH_{Ar}), 7.13-7.18 (m, 2H, ^{3}J = 11.2 Hz, CH_{Ar}), 7.34-7.37 (m, 1H, CH_{Ar}), 7.44-7.48 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 115.6, 118.7, 127.2, 127.6, 128.5, 128.8, 129.1, 130.4, 139.5, 143.4.

Anal. calcd. for $C_{12}H_{11}N$: C, 85.17; H, 6.55; N, 8.28. Found: C, 85.09; H, 6.78; N, 8.31.

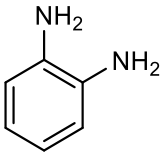


***4-Aminopyridine* (6j).**

Yield = 67% (0.063g). The product is a white solid. mp 155-156°C. **^{1}H NMR** (500 MHz, *DMSO-d_6*): δ 5.98 (br. s, 2H, NH_2), 6.44-6.45 (m, 2H, Pyridine), 7.95-7.97 (m, 2H, Pyridine).

^{13}C NMR (126 MHz, *DMSO-d_6*): δ 108.9, 149.5, 154.2.

Anal. calcd. for $C_5H_6N_2$: C, 63.81; H, 6.43; N, 29.77. Found: C, 63.71; H, 6.48; N, 29.83.

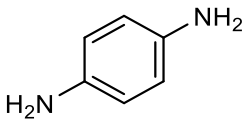


***Benzene-1,2-diamine* (7a).**

Yield = 72% (0.078g). The product is a colorless solid. mp 102-103ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.43 (br. s, 4H, 2xNH_2), 6.71-6.75 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 116.7, 120.2, 134.7.

Anal. calcd. for $C_6H_8N_2$: C, 66.64; H, 7.46; N, 25.90. Found: C, 66.81; H, 7.22; N, 25.83.

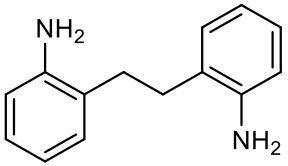


***Benzene-1,4-diamine* (7b).**

Yield = 77% (0.083g). The product is a white solid. mp 145-146ºC. **^{1}H NMR** (500 MHz, *DMSO-d_6*): δ 4.18 (br. s, 4H, 2xNH_2), 6.36 (br. s, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, *DMSO-d_6*): δ 115.4, 139.0.

Anal. calcd. for $C_6H_8N_2$: C, 66.64; H, 7.46; N, 25.90. Found: C, 66.52; H, 7.39; N, 25.99.



***2,2'-(Ethane-1,2-diyl)dianiline* (7c).**

Yield = 69% (0.146g). The product is a white solid. mp 72-74ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.82 (s, 4H, 2xCH_2), 3.59 (br. s, 4H, 2xNH_2), 6.69 (dd, 2H, ^{3}J = 7.8 Hz, ^{4}J = 0.9 Hz, CH_{Ar}), 6.78 (dt, 2H, ^{3}J = 7.4 Hz, ^{4}J = 1.1 Hz, CH_{Ar}), 7.06-7.10 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 30.9, 115.8, 119.0, 126.2, 127.2, 129.4, 144.3.

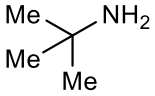
Anal. calcd. for $C_{14}H_{16}N_2$: C, 79.21; H, 7.60; N, 13.20. Found: C, 79.36; H, 7.72; N, 13.28.

***Cyclohexanamine* (8a).**

Yield = 79% (0.078g). The product is a yellowish liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 0.98-1.04 (m, 2H, Cyclohexyl), 1.08-1.13 (m, 1H, Cyclohexyl), 1.19-1.28 (m, 4H, NH_2, Cyclohexyl), 1.55-1.59 (m, 1H, Cyclohexyl), 1.66-1.70 (m, 2H, Cyclohexyl), 1.77-1.80 (m, 2H, Cyclohexyl), 2.56-2.62 (m, 1H, Cyclohexyl).

^{13}C NMR (126 MHz, $CDCl_3$): δ 25.1, 25.7, 36.9, 50.4.

Anal. calcd. for $C_6H_{13}N$: C, 72.66; H, 13.21; N, 14.12. Found: C, 72.72; H, 13.16; N, 14.23.

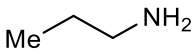


***2-Methylpropan-2-amine* (8b).**

Yield = 67% (0.049g). The product is a colorless liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 1.12 (s, 9H, *t*Bu), 1.18 (br. s, 2H, NH_2).

^{13}C NMR (126 MHz, $CDCl_3$): δ 32.5, 47.3.

Anal. calcd. for $C_4H_{11}N$: C, 65.69; H, 15.16; N, 19.15. Found: C, 65.52; H, 15.26; N, 19.02.

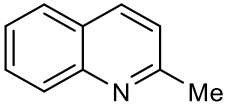


***Propan-1-amine* (8c).**

Yield = 49% (0.026g). The product is a colorless liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 0.89 (t, 3H, ^{3}J = 7.5 Hz, $CH_3CH_2CH_2NH_2$), 1.15 (br. s, 2H, $CH_3CH_2CH_2NH_2$), 1.41-1.45 (m, 2H, $CH_3CH_2CH_2NH_2$), 2.63 (t, 2H, ^{3}J = 7.5 Hz, $CH_3CH_2CH_2NH_2$).

^{13}C NMR (126 MHz, $CDCl_3$): δ 11.3, 26.9, 44.1.

Anal. calcd. for C_3H_9N: C, 60.96; H, 15.35; N, 23.70. Found: C, 60.90; H, 15.38; N, 23.72.

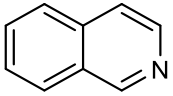


***2-Methylquinoline* (9a).**

Yield = 81% (0.116g), 93% (0.133g). The product is a colorless oil. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.74 (s, 3H, Me), 7.26 (d, 1H, ^{3}J = 8.1 Hz, CH_{Ar}), 7.45-7.48 (m, 1H, CH_{Ar}), 7.65-7.69 (m, 1H, CH_{Ar}), 7.75 (d, 1H, ^{3}J = 8.1 Hz, CH_{Ar}), 8.02 (dd, 2H, ^{3}J = 8.2 Hz, ^{4}J = 3.6 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 25.3, 122.0, 125.6, 126.4, 127.5, 128.6, 129.4, 136.1, 147.8, 158.9.

Anal. calcd. for $C_{10}H_9N$: C, 83.88; H, 6.34; N, 9.78. Found: C, 83.97; H, 6.41; N, 9.69.

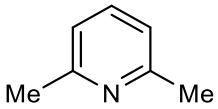


***Isoquinoline* (9b).**

Yield = 76% (0.098g), 89% (0.115g). The product is a yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.59-7.62 (m, 1H, CH_{Ar}), 7.64 (d, 1H, ^{3}J = 5.8 Hz, CH_{Ar}), 7.68-7.71 (m, 1H, CH_{Ar}), 7.81 (d, 1H, ^{3}J = 7.6 Hz, CH_{Ar}), 7.97 (dd, 1H, ^{3}J = 8.1 Hz, ^{4}J = 0.7 Hz, CH_{Ar}), 8.52 (d, 1H, ^{3}J = 5.7 Hz, CH_{Ar}), 9.26 (s, 1H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 120.4, 126.5, 127.2, 127.6, 128.7, 130.3, 135.8, 143.0, 152.5.

Anal. calcd. for C_9H_7N: C, 83.69; H, 5.46; N, 10.84. Found: C, 83.77; H, 5.50; N, 10.76.

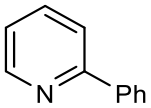


***2,6-Dimethylpyridine* (9c).**

Yield = 71% (0.076g) 84% (0.090g). The product is a yellowish oli. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.49 (s, 6H, 2xMe), 6.91 (d, 2H, ^{3}J = 7.4 Hz, CH_{Ar}), 7.42 (d, 1H, ^{3}J = 7.9 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 24.5, 120.1, 136.4, 157.6.

Anal. calcd. for C_7H_9N: C, 78.46; H, 8.47; N, 13.07. Found: C, 78.61; H, 8.41; N, 13.16.

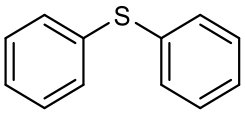


***2-Phenylpyridine* (9d).**

Yield = 77% (0.119g), 91% (0.141g). The product is a colorless oil. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.22-7.25 (m, 1H, CH_{Ar}), 7.40-7.44 (m, 1H, CH_{Ar}), 7.47-7.50 (m, 2H, CH_{Ar}), 7.73-7.78 (m, 2H, CH_{Ar}), 7.98-8.00 (m, 2H, CH_{Ar}), 8.70-8.71 (m, 1H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 120.6, 122.1, 127.0, 128.8, 129.0, 136.8, 139.4, 149.7, 157.5.

Anal. calcd. for $C_{11}H_9N$: C, 85.13; H, 5.85; N, 9.03. Found: C, 85.22; H, 5.81; N, 9.00.

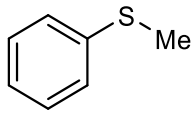


***Diphenylsulfane* (10a).**

Yield = 82% (0.153g), 96% (0.179g). The product is a colorless liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.23-7.27 (m, 2H, CH_{Ar}), 7.30-7.32 (m, 4H, CH_{Ar}), 7.35-7.36 (m, 4H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 127.0, 129.2, 131.0, 135.8.

Anal. calcd. for $C_{12}H_{10}S$: C, 77.38; H, 5.41. Found: C, 77.43; H, 5.61.

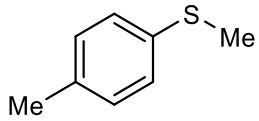


***Methyl(phenyl)sulfane* (10b).**

Yield = 66% (0.082g), 85% (0.105g). The product is a colorless liquid. **^{1}H NMR** (500 MHz, $CDCl_3$): 2.78 (s, 3H, Me), 7.11-7.15 (m, 1H, Ph), 7.25-7.28 (m, 4H, Ph).

^{13}C NMR (126 MHz, $CDCl_3$): δ 15.8, 125.0, 126.6, 128.8, 138.4.

Anal. calcd. for C_7H_8S: C, 67.69; H, 6.49. Found: C, 67.52; H, 6.38.

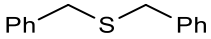


***Methyl(p-tolyl)sulfane* (10c).**

Yield = 70% (0.097g), 87% (0.120g). The product is a colorless liquide. **^{1}H NMR** (500 MHz, $CDCl_3$): 2.32 (s, 3H, Me), 2.47 (s, 3H, SMe), 7.10 (d, 2H, ^{3}J = 7.9 Hz, CH_{Ar}), 7.18 (d, 2H, ^{3}J = 7.9 Hz, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 16.5, 20.9, 127.2, 129.6, 134.7, 135.0.

Anal. calcd. for $C_8H_{10}S$: C, 69.51; H, 7.29. Found: C, 69.57; H, 7.31.

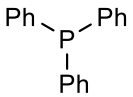


***Dibenzylsulfane* (10d).**

Yield = 67% (0.143g), 78% (0.167g). The product is a white solid. mp 49-50ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 3.94 (br. s, 4H, 2xCH_2), 7.27-7.37 (m, 10H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 35.5, 127.0, 128.4, 129.0, 138.1.

Anal. calcd. for $C_{14}H_{14}S$: C, 78.46; H, 6.58. Found: C, 78.55; H, 6.41.



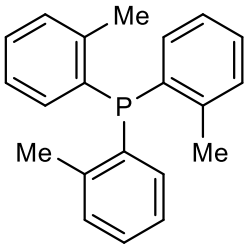
***Triphenylphosphane* (11a).**

Yield = 87% (0.228g). The product is a white solid. mp 80-81ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.33-7.37 (m, 15H, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -5.4.

^{13}C NMR (126 MHz, $CDCl_3$): δ 128.5 (d, J_{CP} = 7 Hz), 128.7, 133.7, 133.8, 137.1 (d, J_{CP} = 10.2 Hz).

Anal. calcd. for $C_{18}H_{15}P$: C, 82.43; H, 5.76. Found: C, 82.49; H, 5.86.



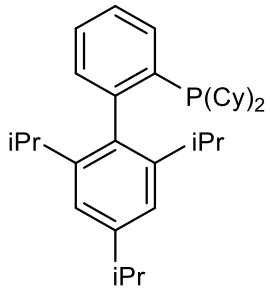
***Tri-o-tolylphosphane* (11b).**

Yield = 85% (0.258g). The product is a white solid. mp 123-124°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.42 (s, 9H, 3xMe), 6.74-6.76 (m, 3H, CH_{Ar}), 7.08-7.11 (m, 3H, CH_{Ar}), 7.24-7.30 (m, 6H, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -29.5.

^{13}C NMR (126 MHz, $CDCl_3$): δ 21.1, 21.3, 126.1, 128.7, 130.0 (d, J_{CP} = 4.7 Hz), 133.0, 134.4 (d, $^{2}J_{CP}$ = 10.5 Hz), 134.5, 142.7 (d, $^{1}J_{CP}$ = 25.1 Hz).

Anal. calcd. for $C_{21}H_{21}P$: C, 82.87; H, 6.95. Found: C, 82.93; H, 7.00.



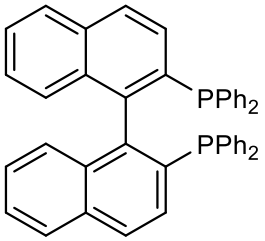
***Dicyclohexyl(2',4',6'-triisopropyl-[1,1'-biphenyl]-2-yl)phosphane* (11c).**

Yield = 79% (0.376g). The product is a white solid. mp 187-189°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 0.96 (s, 3H, Me), 0.97 (s, 3H, Me), 1.15-1.23 (m, 8H, Cy), 1.18 (s, 3H, Me), 1.23 (s, 3H, Me), 1.30 (s, 3H, Me), 1.31 (s, 3H, Me), 1.58-1.86 (m, 14H, Cy), 2.41 (q, 2H, ^{3}J = 6.9 Hz, 2xC*H*Me_2), 2.93 (q, 1H, ^{3}J = 6.9 Hz, C*H*Me_2), 7.00 (s, 2H, CH_{Ar}), 7.14-7.16 (m, 1H, CH_{Ar}), 7.31-7.34 (m, 2H, CH_{Ar}), 7.59-7.60 (m, 1H, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -12.4.

^{13}C NMR (126 MHz, $CDCl_3$): δ 22.9, 24.0, 25.9, 26.5, 27.3 (d, J_{CP} = 8.6 Hz), 27.5 (d, J_{CP} = 11.4 Hz), 29.3 (d, J_{CP} = 12.1 Hz), 30.6, 30.8 (d, J_{CP} = 15.7 Hz), 34.0, 34.5 (d, J_{CP} = 15.0 Hz), 120.3, 126.1, 127.6, 131.5 (d, J_{CP} = 5.7 Hz), 132.3 (d, J_{CP} = 2.3 Hz), 136.4-136.6 (m), 145.9, 147.6, 147.7 (d, J_{CP} = 31.8 Hz).

Anal. calcd. for $C_{33}H_{49}P$: C, 83.14; H, 10.36. Found: C, 83.25; H, 10.28.



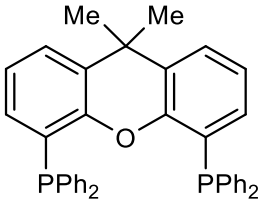
***2,2'-Bis(diphenylphosphanyl)-1,1'-binaphthalene* (11d).**

Yield = 82% (0.510g). The product is a white solid. mp above 200ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 6.83 (d, 2H, ^{3}J = 8.5 Hz, CH_{Ar}), 6.90-6.93 (m, 2H, CH_{Ar}), 7.04-7.19 (m, 20H, CH_{Ar}), 7.33-7.36 (m, 2H, CH_{Ar}), 7.45 (dd, 2H, ^{3}J = 8.4 Hz, ^{4}J = 2.5 Hz, CH_{Ar}), 7.83 (d, 2H, ^{3}J = 8.1 Hz, CH_{Ar}), 7.89 (d, 2H, ^{3}J = 8.6 Hz, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -15.6.

^{13}C NMR (126 MHz, $CDCl_3$): δ 125.8, 126.5, 127.5 (d, J_{CP} = 9.0 Hz), 127.7, 128.0-128.1 (m), 128.4, 130.5, 132.8-133.0 (m), 133.2, 134.1-134.3 (m).

Anal. calcd. for $C_{44}H_{32}P_2$: C, 84.87; H, 5.18. Found: C, 84.96; H, 5.22.



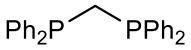
***(9,9-Dimethyl-9H-xanthene-4,5-diyl)bis(diphenylphosphane)* (11e).**

Yield = 78% (0.451g). The product is a white solid. mp above 200ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 1.68 (s, 6H, 2xMe), 6.57-6.59 (m, 2H, CH_{Ar}), 6.98 (t, 2H, ^{3}J = 7.6 Hz, CH_{Ar}), 7.19-7.29 (m, 20, CH_{Ar}), 7.42 (dd, 2H, ^{3}J = 7.8 Hz, ^{4}J = 1.4 Hz, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -18.0.

^{13}C NMR (126 MHz, $CDCl_3$): δ 31.8, 123.3, 125.7-125.9 (m), 126.3, 128.1-128.8 (m), 129.9, 132.1, 133.9 (t, J_{CP} = 10.8 Hz), 137.4 (t, J_{CP} = 5.8 Hz), 152.5 (t, J_{CP} = 8.9 Hz).

Anal. calcd. for $C_{39}H_{32}OP_2$: C, 80.95; H, 5.57. Found: C, 81.00; H, 5.61.



***Bis(diphenylphosphanyl)methane* (11f).**

Yield = 74% (0.284g). The product is a white solid. mp 117-119°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.84 (t, 2H, ^{3}J = 1.4 Hz, CH_2), 7.32 (t, 12H, ^{3}J = 3.4 Hz, CH_{Ar}), 7.44-7.48 (m, 8H, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -22.5.

^{13}C NMR (126 MHz, $CDCl_3$): δ 28.0 (t, $^{1}J_{CP}$ = 22.6 Hz), 128.4 (t, J_{CP} = 3.4 Hz), 128.7, 132.8 (t, $^{2}J_{CP}$ = 10.3 Hz), 138.7.

Anal. calcd. for $C_{25}H_{22}P_2$: C, 78.12; H, 5.77. Found: C, 78.03; H, 5.56.

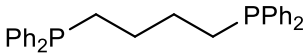
***1,3-Bis(diphenylphosphanyl)propane* (11g).**

Yield = 69% (0.284g). The product is a white solid. mp 62-65°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 1.61-1.67 (m, 2H $CH_2CH_2CH_2$), 2.22 (t, 4H, ^{3}J = 8.0 Hz, $CH_2CH_2CH_2$), 7.31-7.32 (m, 12H, CH_{Ar}), 7.37-7.40 (m, 8H, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -17.5.

^{13}C NMR (126 MHz, $CDCl_3$): δ 22.3 (t, J_{CP} = 15.9 Hz), 29.5 (t, J_{CP} = 11.2 Hz), 128.3 (d, J_{CP} = 6.6 Hz), 128.5, 132.7 (d, J_{CP} = 18.3 Hz), 138.3 (d, J_{CP} = 11.9 Hz).

Anal. calcd. for $C_{27}H_{26}P_2$: C, 78.63; H, 6.35. Found: C, 78.86; H, 6.39.



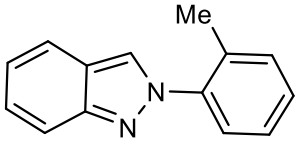
***1,4-Bis(diphenylphosphanyl)butane* (11h).**

Yield = 61% (0.260g). The product is a white solid. mp 132-134°C. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 1.57-1.58 (m, 4H $CH_2CH_2CH_2CH_2$), 2.25 (t, 4H, ^{3}J = 7.2 Hz, $CH_2CH_2CH_2CH_2$), 7.32-7.35 (m, 12H, CH_{Ar}), 7.39-7.42 (m, 8H, CH_{Ar}).

^{31}P NMR (81 MHz, $CDCl_3$): -16.1.

^{13}C NMR (126 MHz, $CDCl_3$): δ 27.4-27.7 (m), 128.4 (d, J_{CP} = 6.7 Hz), 128.6, 132.6 (d, J_{CP} = 18.7 Hz), 138.4 (d, J_{CP} = 11.2 Hz).

Anal. calcd. for $C_{28}H_{28}P_2$: C, 78.96; H, 6.62. Found: C, 78.73; H, 6.58.

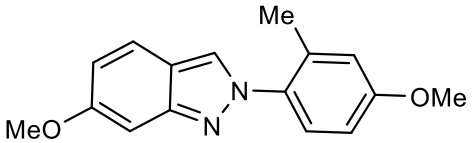


***2-(o-Tolyl)-2H-indazole* (12a).**

Yield = 69% (0.144g). The product is an orange oil. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.26 (s, 3H, Me), 6.82-6.84 (m, 1H, CH_{Ar}), 7.14-7.17 (m, 1H, CH_{Ar}), 7.34-7.45 (m, 4H, CH_{Ar}), 7.75 (d, 1H, ^{3}J = 8.3 Hz, CH_{Ar}), 7.81 (dd, 1H, ^{3}J = 8.0 Hz, ^{4}J = 0.8 Hz,CH_{Ar}), 8.10 (s, 1H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 17.8, 117.8, 120.2, 121.9, 122.1, 124.3, 126.3, 126.5, 126.6, 129.1, 131.2, 133.9, 140.3, 149.2.

Anal. calcd. for $C_{14}H_{12}N_2$: C, 80.74; H, 5.81; N, 13.45. Found: C, 80.81; H, 6.12; N, 13.25.



***6-Methoxy-2-(4-methoxy-2-methylphenyl)-2H-indazole* (12b).**

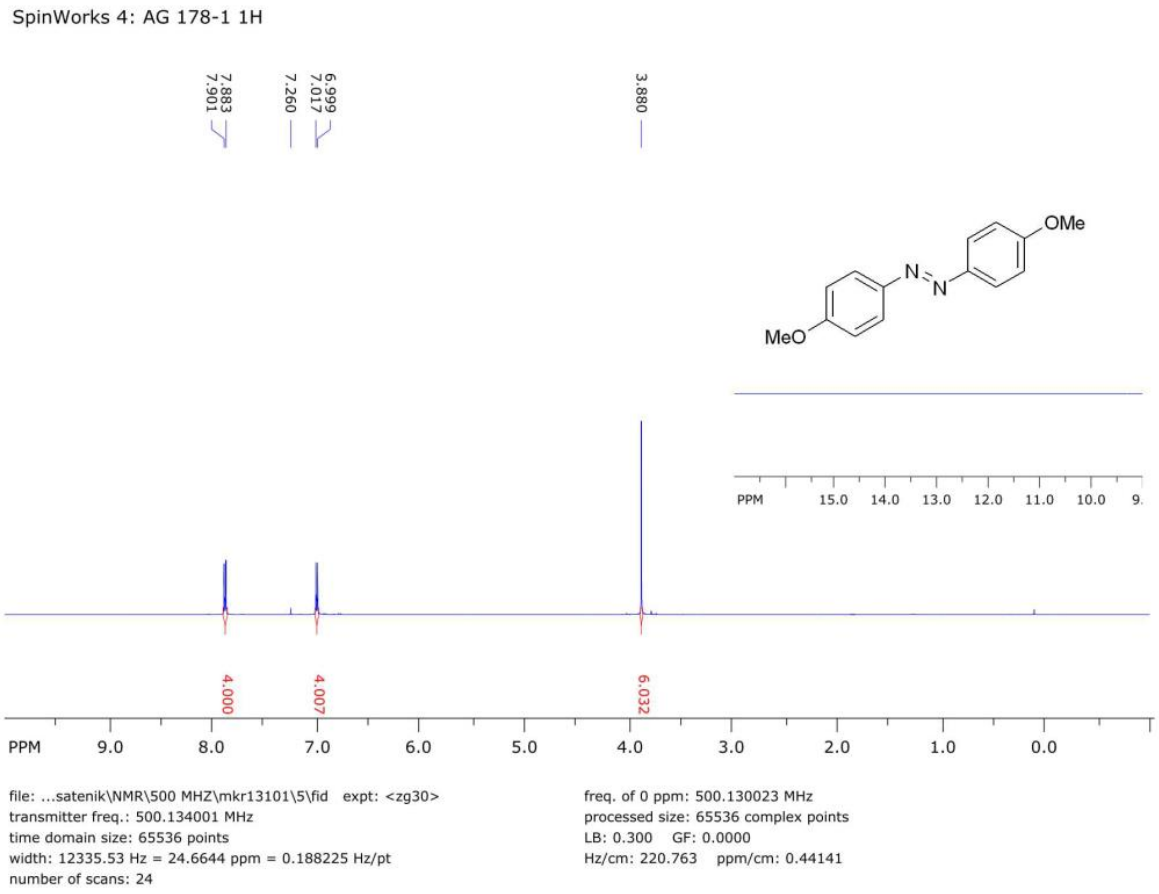
Yield = 52% (0.131g). The product is a yellow solid. mp 108-110ºC. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 2.18 (s, 3H, Me), 3.86 (s, 3H, OMe), 3.86 (s, 3H, OMe), 6.82-6.84 (m, 1H, CH_{Ar}), 6.85-6.86 (m, 1H, CH_{Ar}), 6.93-6.94 (m, 1H, CH_{Ar}), 7.04 (dd, 1H, ^{3}J = 9.3 Hz, ^{4}J = 2.4 Hz, CH_{Ar}), 7.32 (d, 1H, ^{3}J = 7.5 Hz, CH_{Ar}), 7.67 (d, 1H, ^{3}J = 9.0 Hz, CH_{Ar}), 7.90 (s, 1H, CH_{Ar}).

^{13}C NMR (126 MHz, $CDCl_3$): δ 18.0, 55.4, 55.5, 96.3, 111.5, 116.1, 119.2, 121.2, 121.7, 123.6, 127.7, 133.7, 135.5, 146.0, 155.2, 159.7.

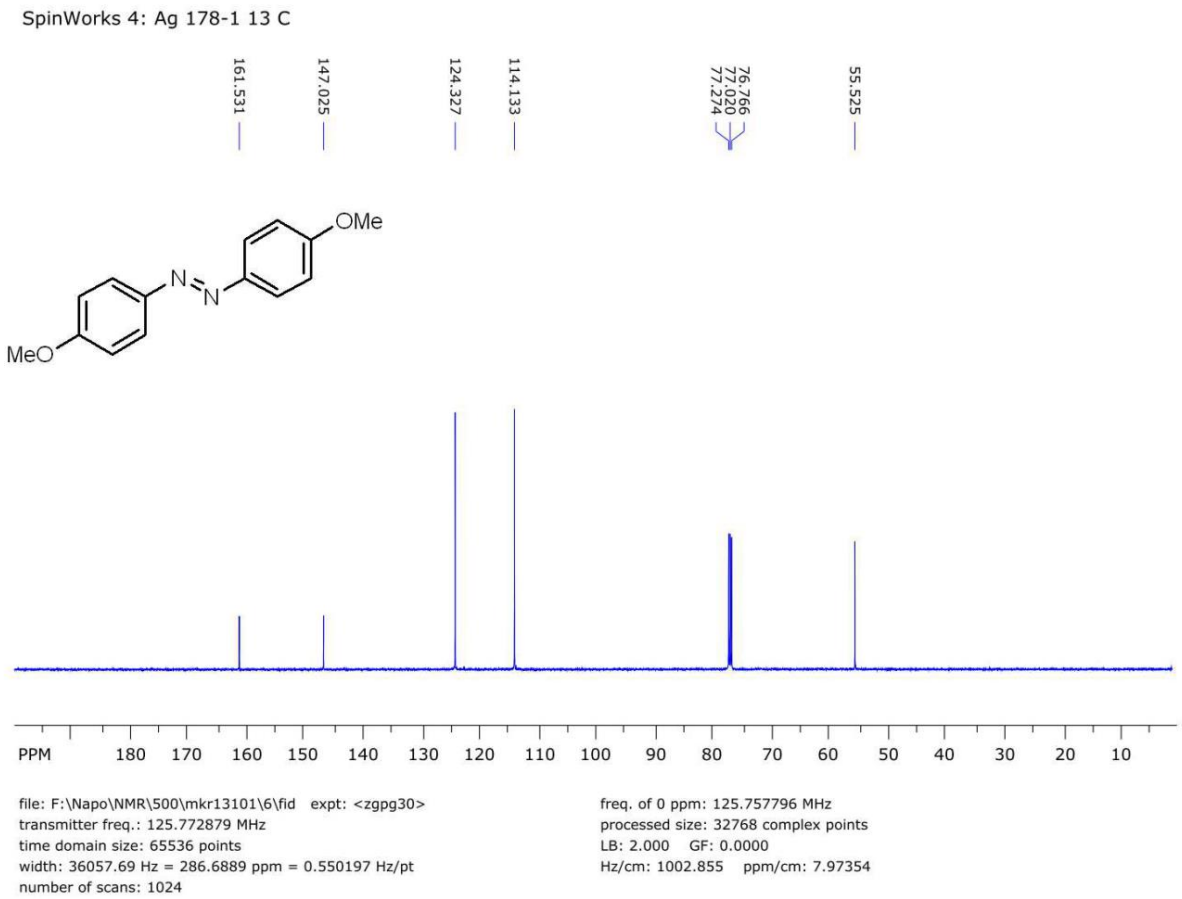
Anal. calcd. for $C_{16}H_{16}N_2O_2$: C, 71.62; H, 6.01; N, 10.44. Found: C, 71.69; H, 6.15; N, 10.30.

Copies of spectra

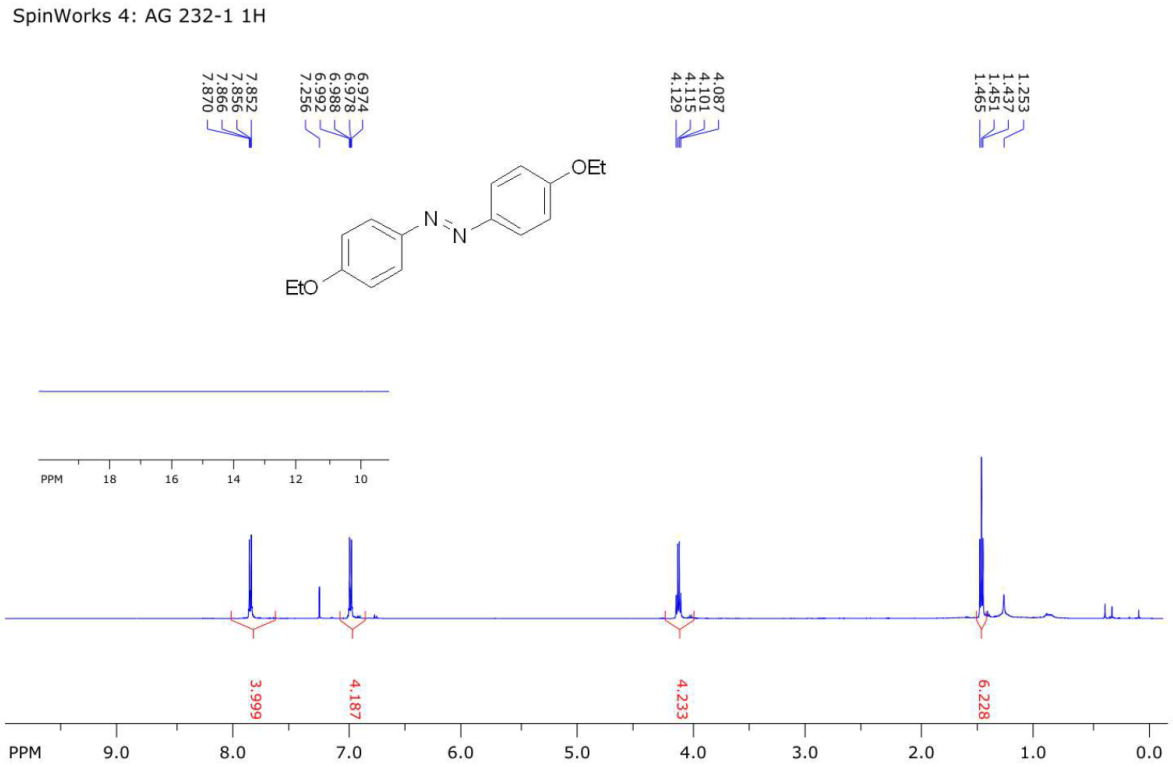
Compound 3a



Compound 3a


SpinWorks 4: Ag 178-1 13 C
161.531
147.025
124.327
114.133
77.274
77.020
76.766
55.525
OMe
N
N
MeO
PPM
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
file: F:\Napo\NMR\500\mkr13101\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757796 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1002.855 ppm/cm: 7.97354

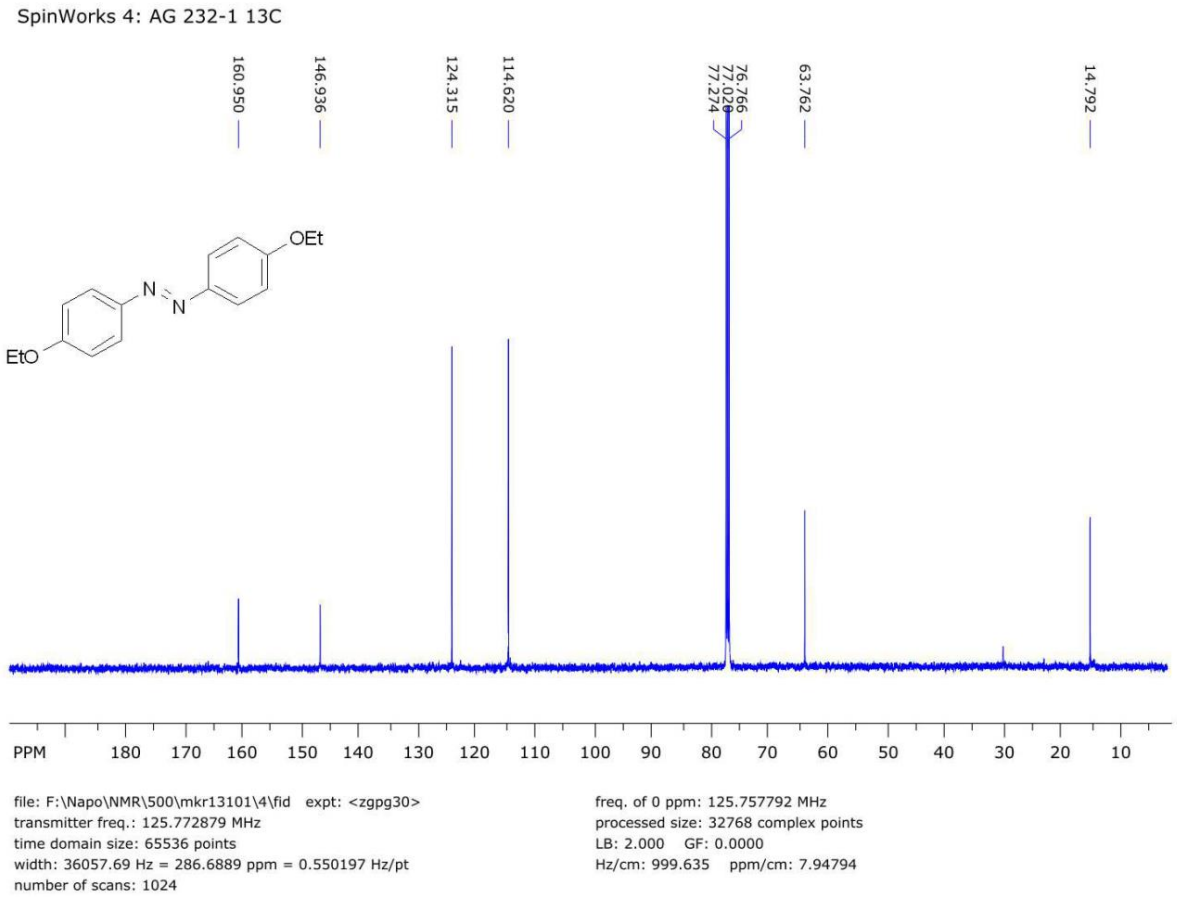
Compound 3b



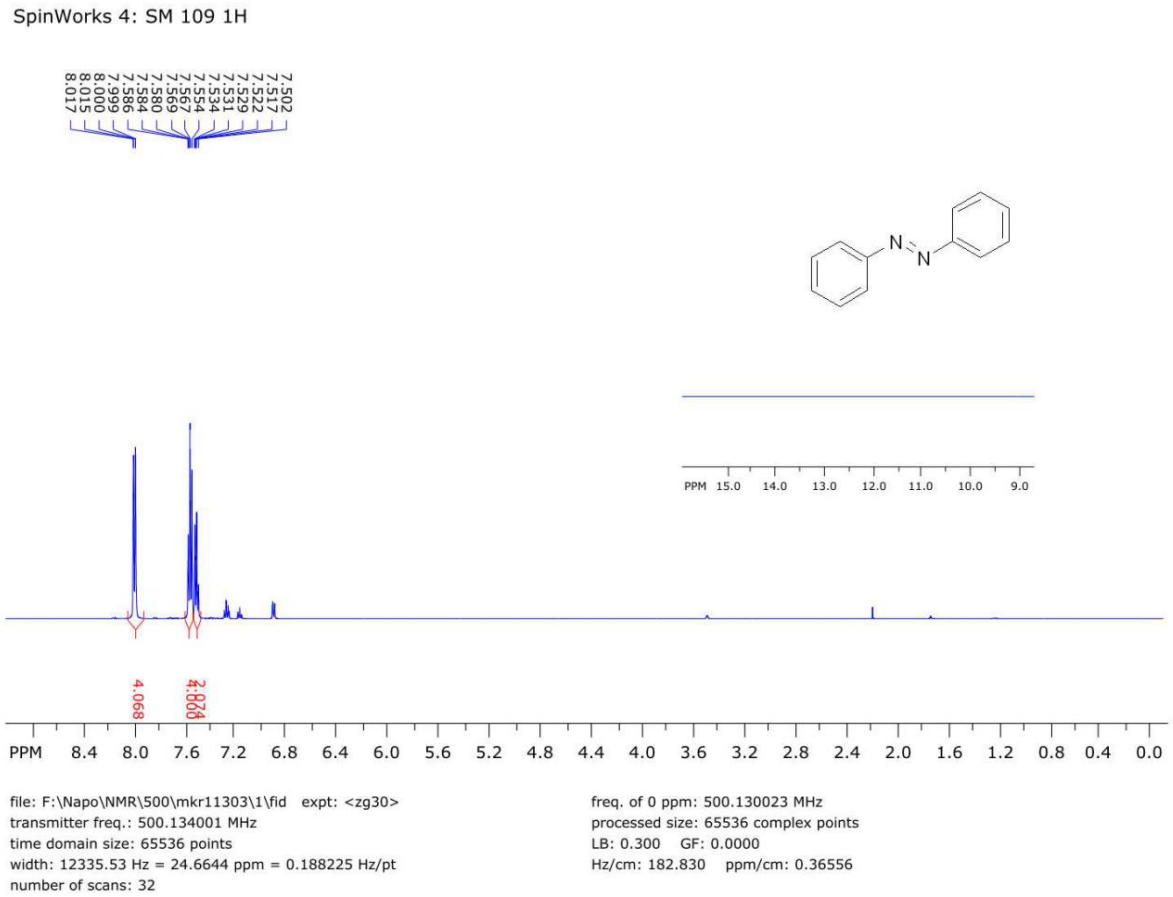
file: F:\Napo\NMR\500\mkr13101\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24

freq. of 0 ppm: 500.130025 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 203.206 ppm/cm: 0.40630

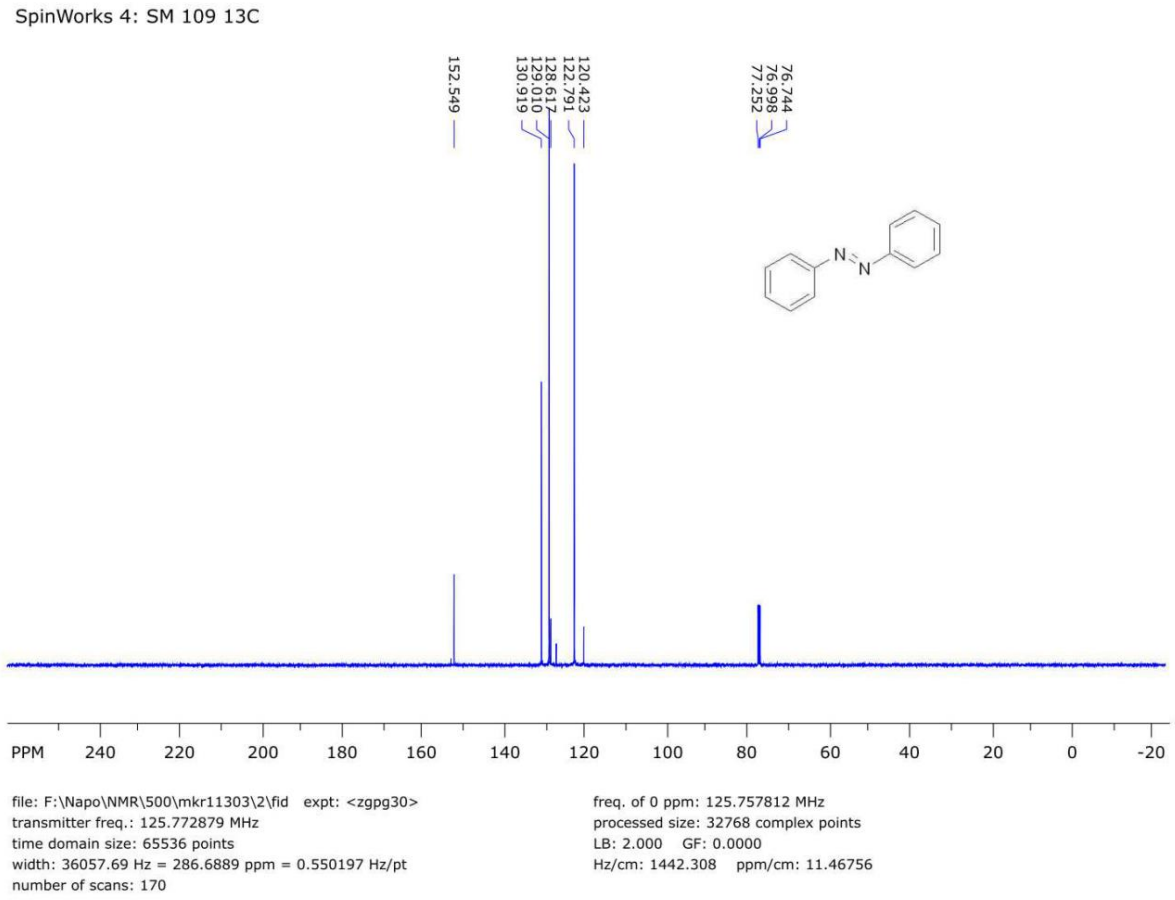
Compound 3b


SpinWorks 4: AG 232-1 13C
160.950
146.936
124.315
114.620
77.274
76.766
77.020
63.762
14.792
OEt
EtO
N
N
PPM
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
file: F:\Napo\NMR\500\mkr13101\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757792 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 999.635 ppm/cm: 7.94794

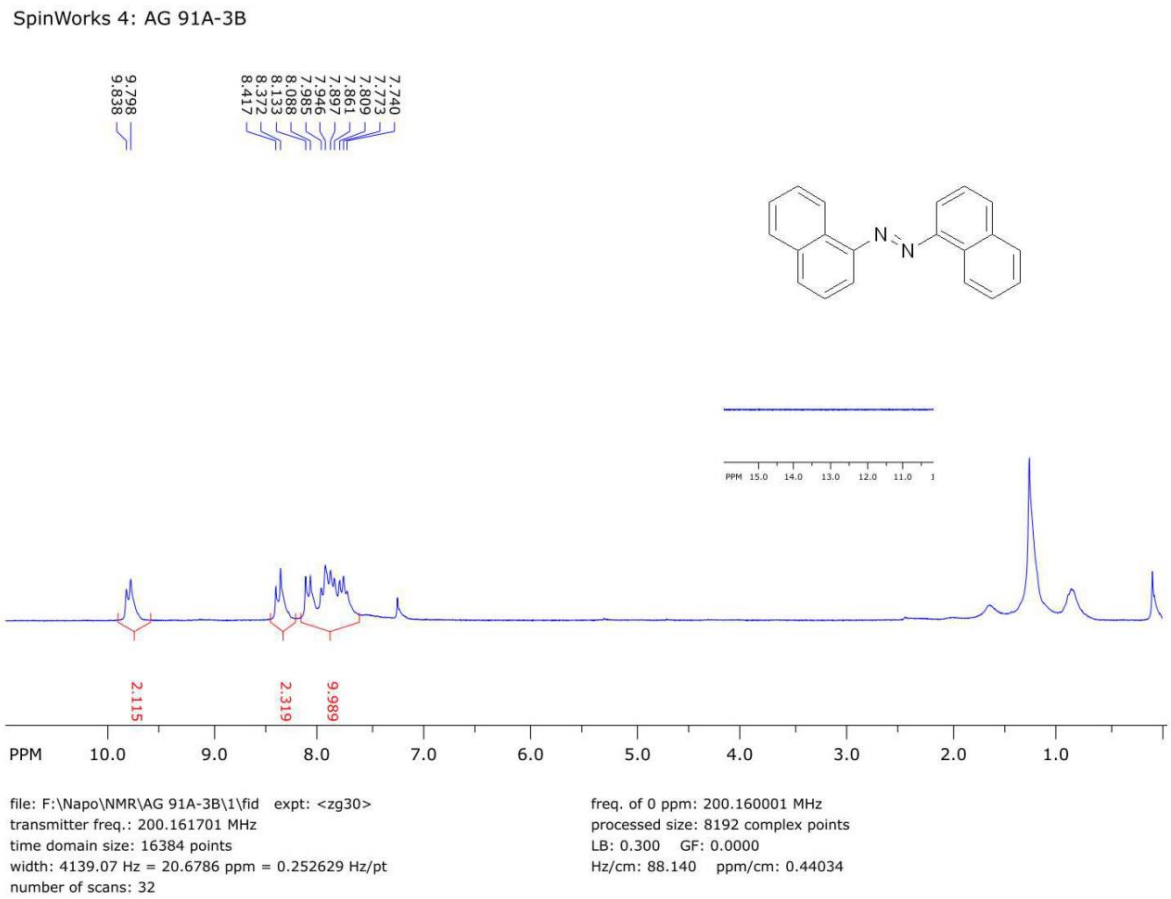
Compound 3c


SpinWorks 4: SM 109 1H
8.017
8.015
8.000
7.999
7.586
7.584
7.580
7.569
7.567
7.554
7.534
7.531
7.529
7.522
7.517
7.502
N
N
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0
4.068
4.000
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4 0.0
file: F:\Napo\NMR\500\mkr11303\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 182.830 ppm/cm: 0.36556

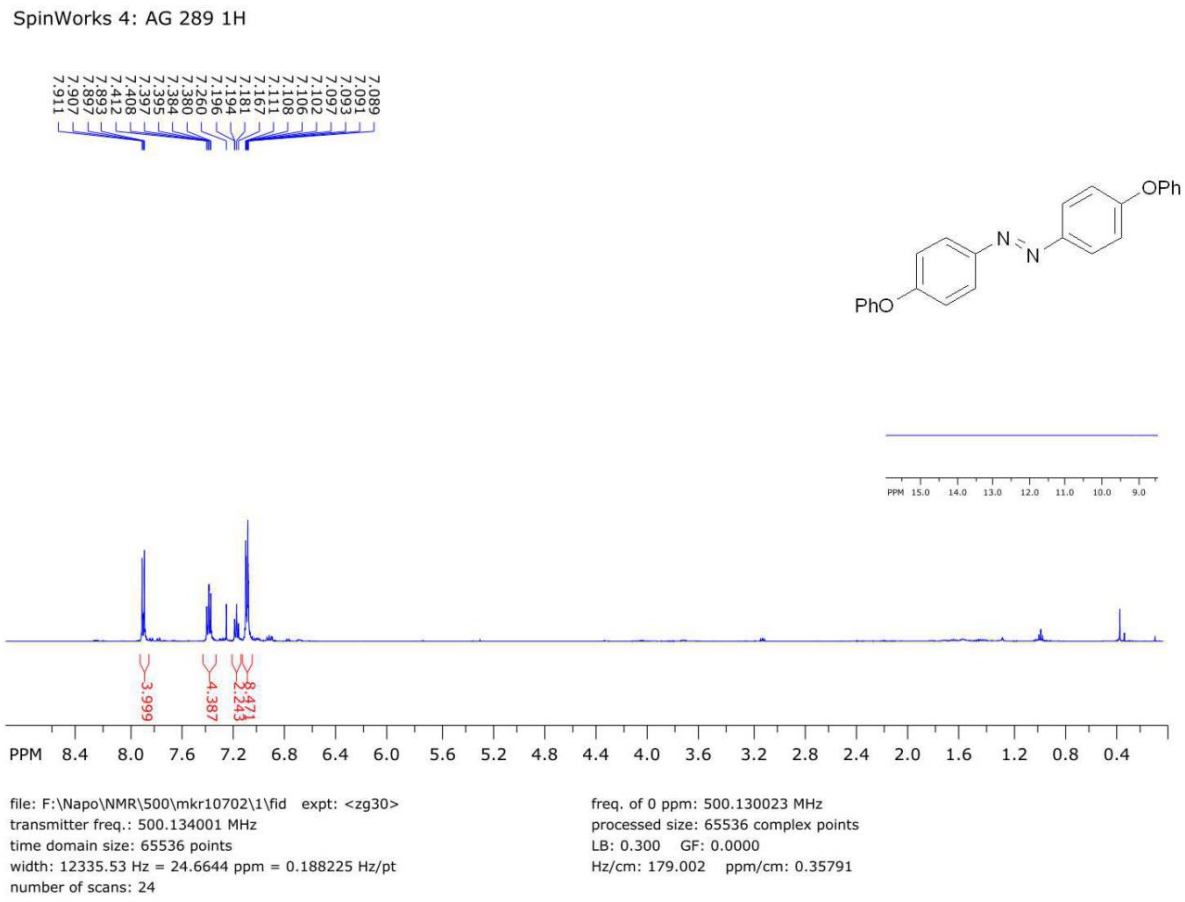
Compound 3c


SpinWorks 4: SM 109 13C
152.549
130.919
129.010
128.617
122.791
120.423
77.252
76.998
76.744
N
N
PPM
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
file: F:\Napo\NMR\500\mkr11303\2\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 170
freq. of 0 ppm: 125.757812 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1442.308 ppm/cm: 11.46756

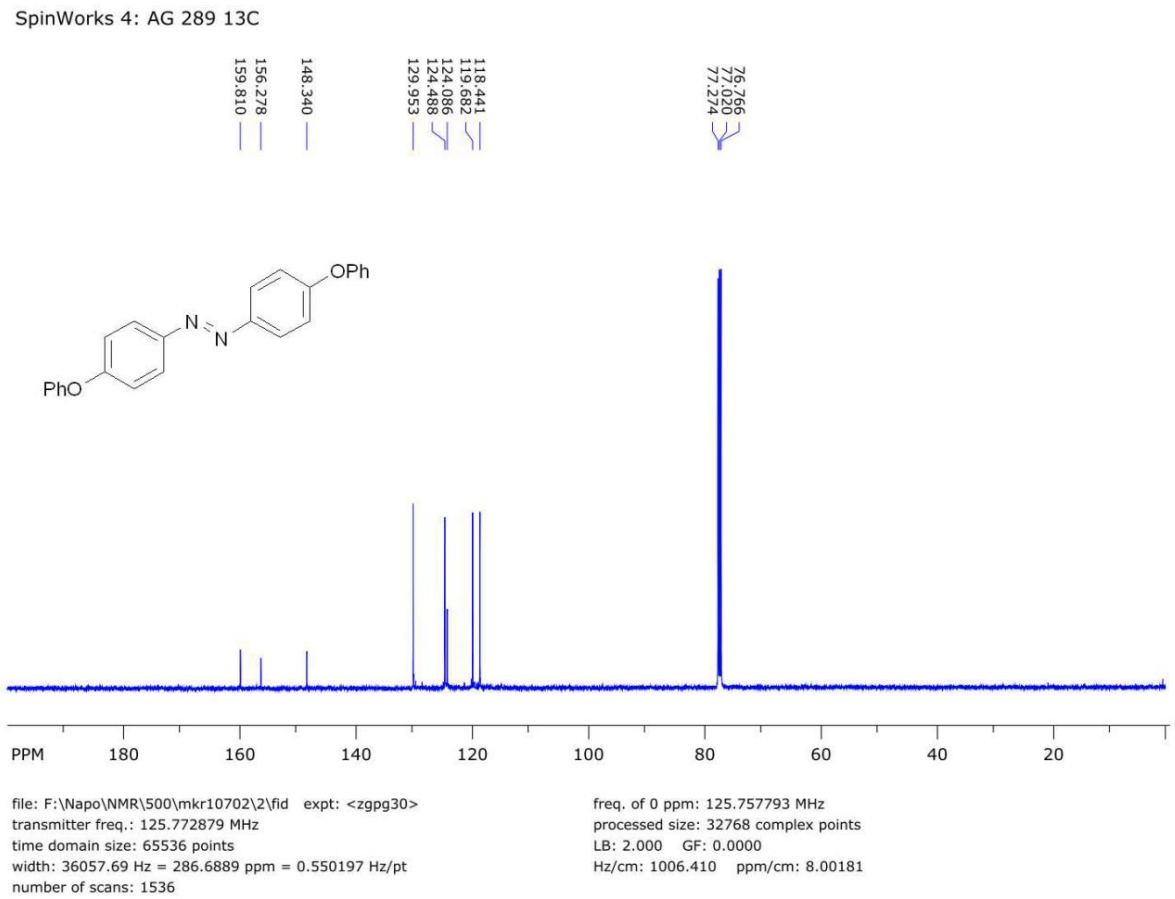
Compound 3d


SpinWorks 4: AG 91A-3B
9.798
9.838
8.417
8.372
8.133
8.088
7.985
7.946
7.897
7.861
7.809
7.773
7.740
N
N
PPM 15.0 14.0 13.0 12.0 11.0
2.115
2.319
9.989
PPM 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0
file: F:\Napo\NMR\AG 91A-3B\1\fid expt: <zg30>
transmitter freq.: 200.161701 MHz
time domain size: 16384 points
width: 4139.07 Hz = 20.6786 ppm = 0.252629 Hz/pt
number of scans: 32
freq. of 0 ppm: 200.160001 MHz
processed size: 8192 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 88.140 ppm/cm: 0.44034

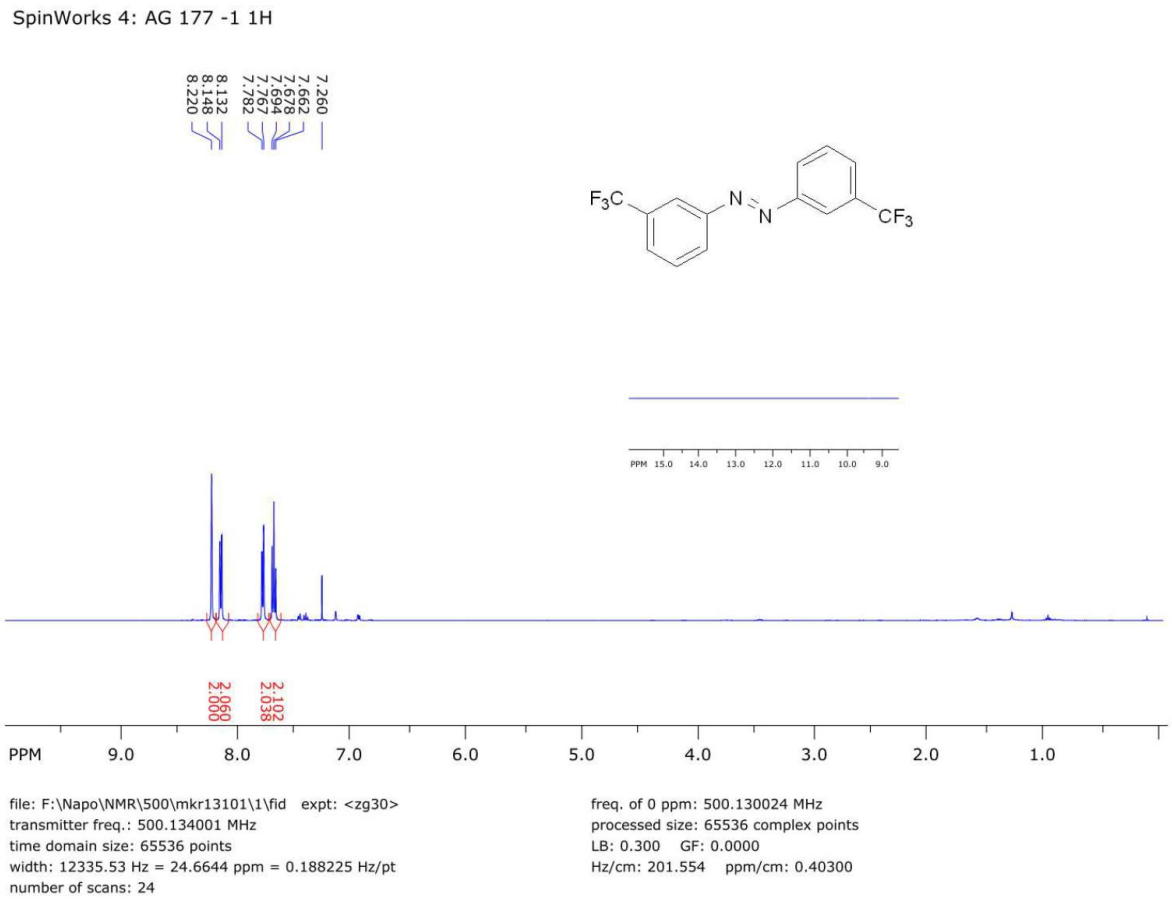
Compound 3e


SpinWorks 4: AG 289 1H
7.911
7.907
7.897
7.893
7.412
7.408
7.397
7.395
7.384
7.380
7.260
7.196
7.194
7.187
7.181
7.167
7.111
7.108
7.106
7.102
7.097
7.093
7.091
7.089
OPh
N
N
PhO
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0
3.999
4.387
8.471
2.243
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10702\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 179.002 ppm/cm: 0.35791

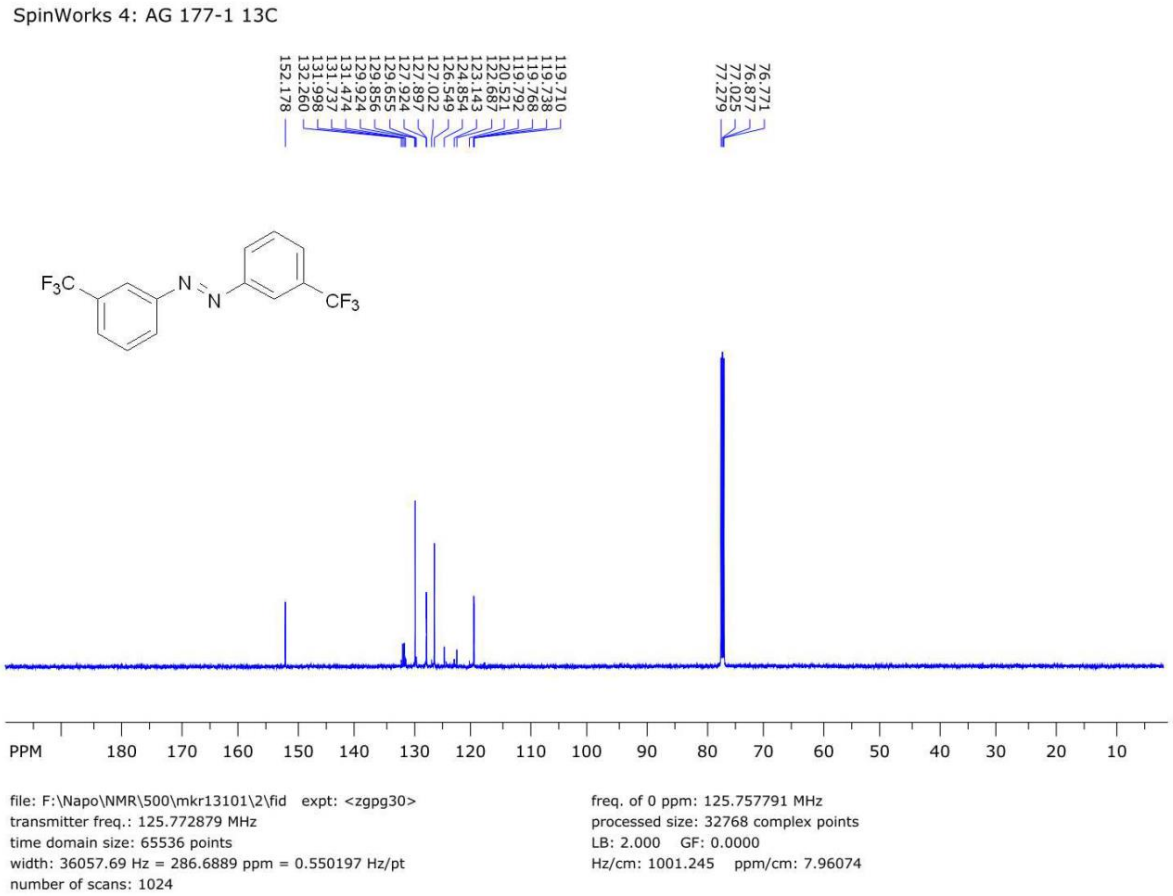
Compound 3e


SpinWorks 4: AG 289 13C
159.810
156.278
148.340
129.953
124.488
124.086
119.682
118.441
77.274
77.020
76.766
OPh
N
N
PhO
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\mkr10702\2\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1536
freq. of 0 ppm: 125.757793 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1006.410 ppm/cm: 8.00181

Compound 3f


SpinWorks 4: AG 177 -1 1H
8.220
8.148
8.132
7.782
7.767
7.694
7.678
7.662
7.260
F3C
N
N
CF3
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0
2.060
2.000
2.102
2.038
PPM 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0
file: F:\Napo\NMR\500\mkr13101\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 201.554 ppm/cm: 0.40300

Compound 3f



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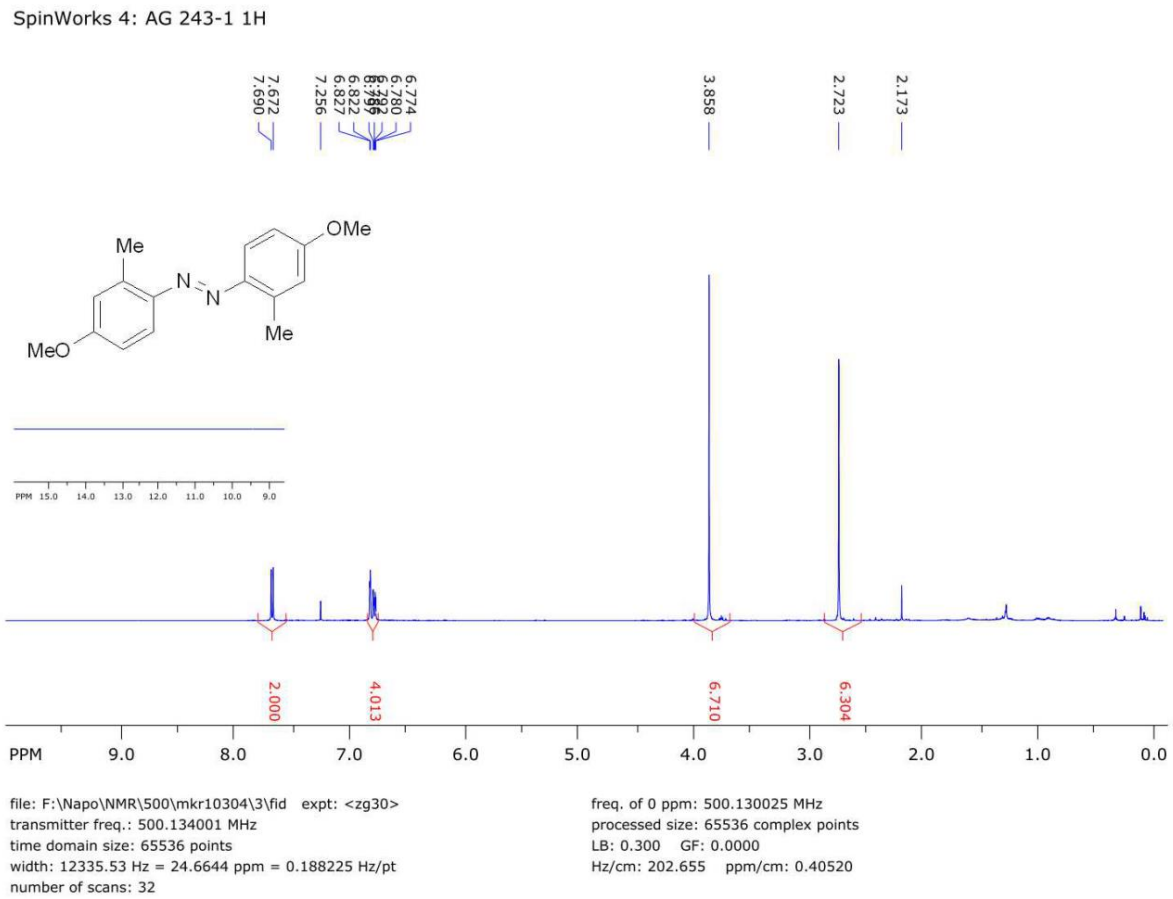
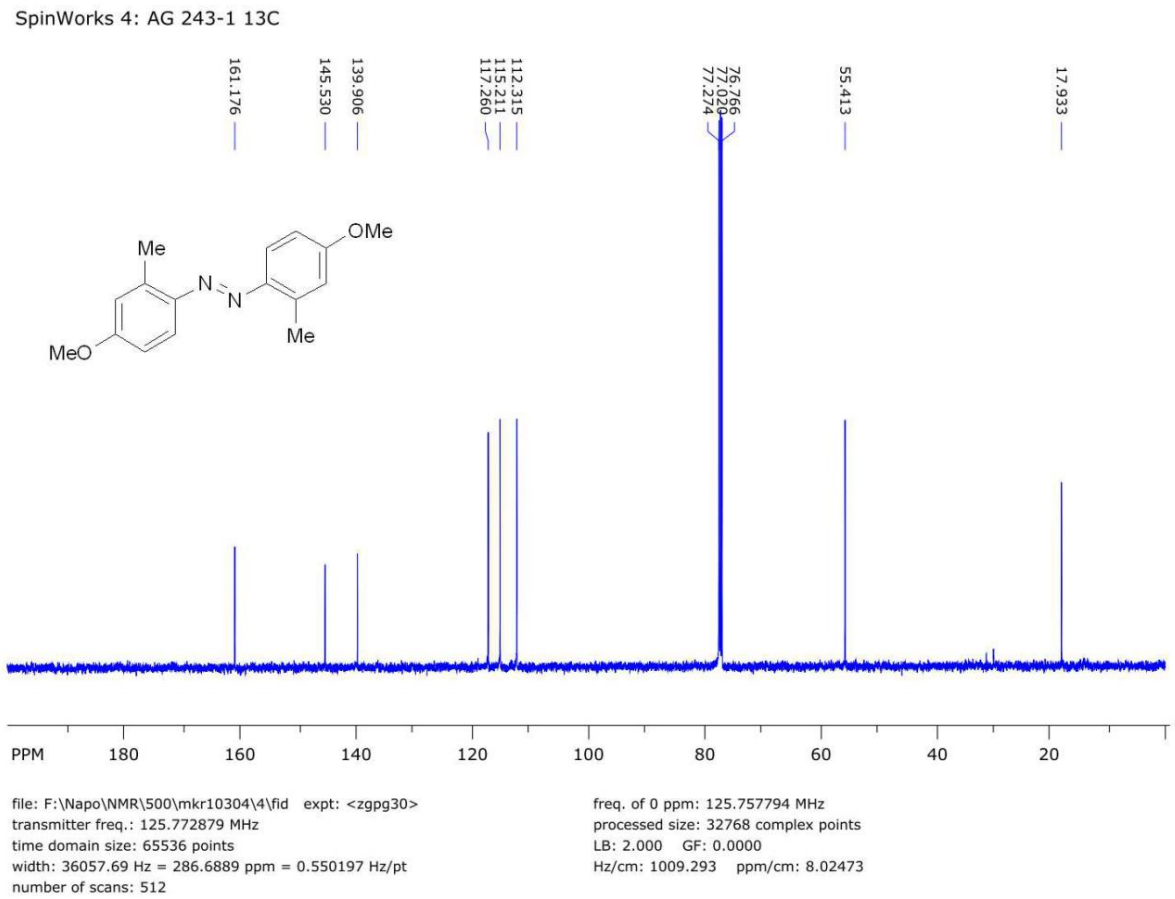
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024

freq. of 0 ppm: 125.757791 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1001.245 ppm/cm: 7.96074

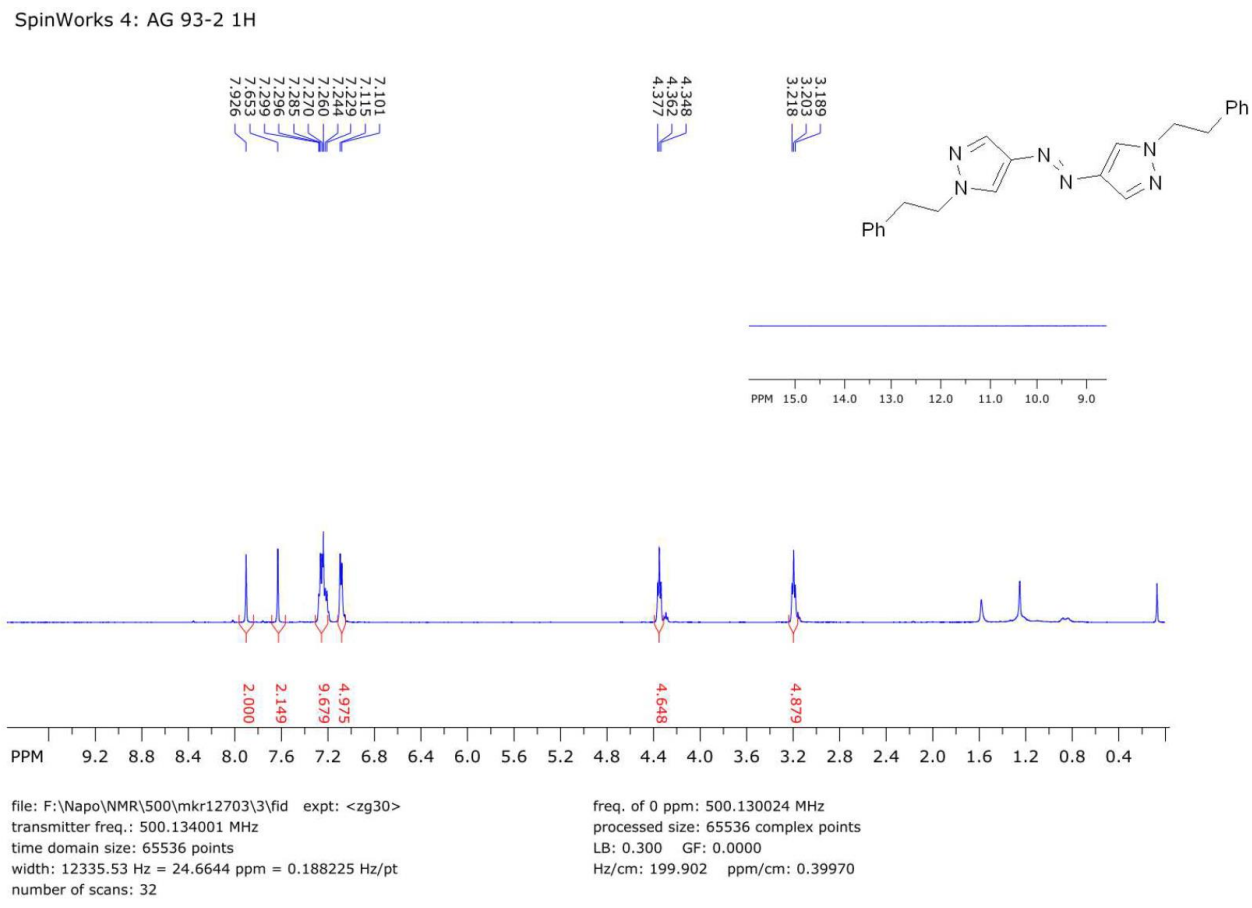
Compound 3g


SpinWorks 4: AG 243-1 1H
7.672
7.690
7.256
6.827
6.822
6.774
6.780
3.858
2.723
2.173
Me
N
N
OMe
Me
MeO
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0
2.000
4.013
6.710
6.304
PPM 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
file: F:\Napo\NMR\500\mkr10304\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130025 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 202.655 ppm/cm: 0.40520

Compound 3g


SpinWorks 4: AG 243-1 13C
161.176
145.530
139.906
117.260
115.211
112.315
77.274
77.029
76.766
55.413
17.933
Me
N
N
OMe
Me
MeO
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\mkr10304\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757794 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1009.293 ppm/cm: 8.02473

Compound 3h



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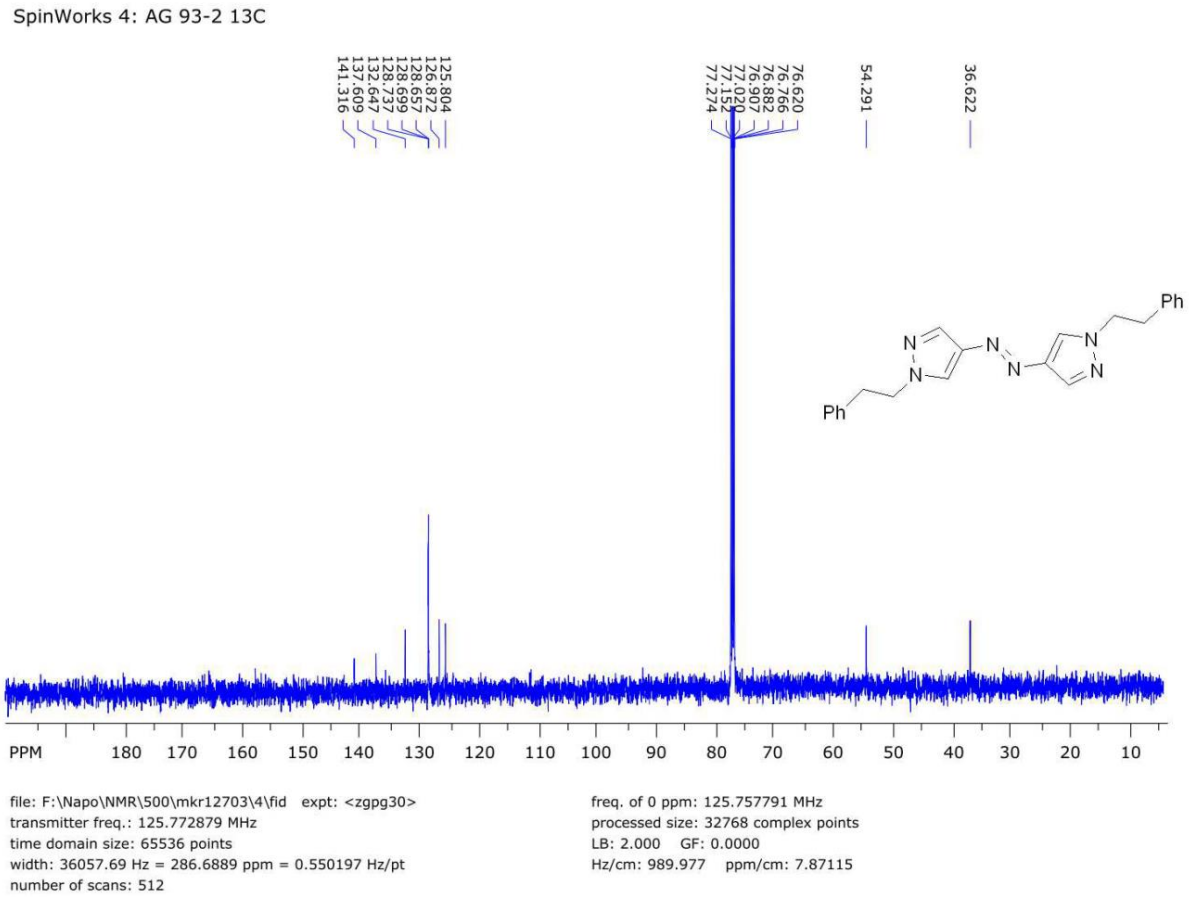
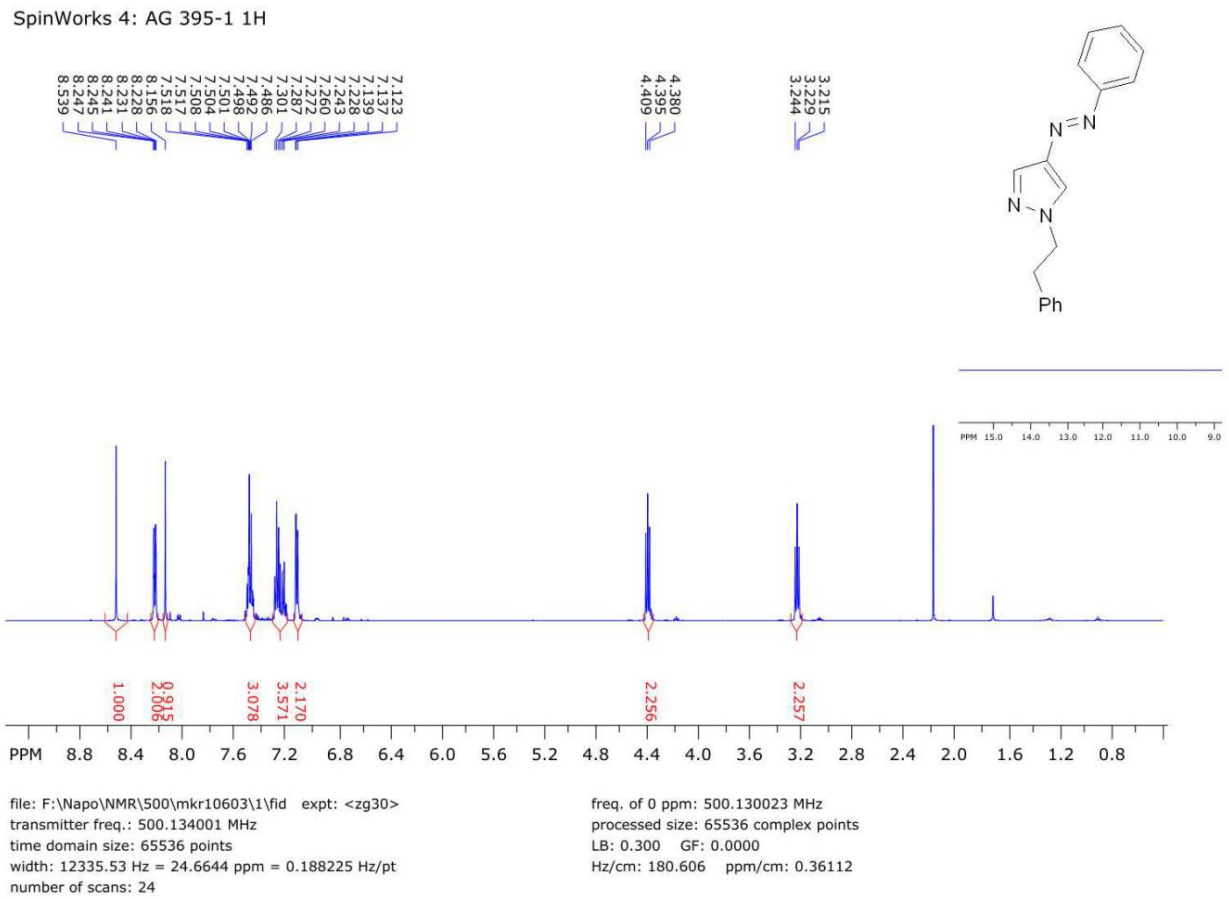
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 199.902 ppm/cm: 0.39970

Compound 3h


SpinWorks 4: AG 93-2 13C
141.316
137.609
132.647
128.737
128.699
128.657
126.872
125.804
77.274
77.152
77.020
76.907
76.882
76.766
76.620
54.291
36.622
Ph
Ph
PPM
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
file: F:\Napo\NMR\500\mkr12703\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757791 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 989.977 ppm/cm: 7.87115

Compound 4a



file: F:\Napo\NMR\500\mkr10603\1\fid expt: <zg30>
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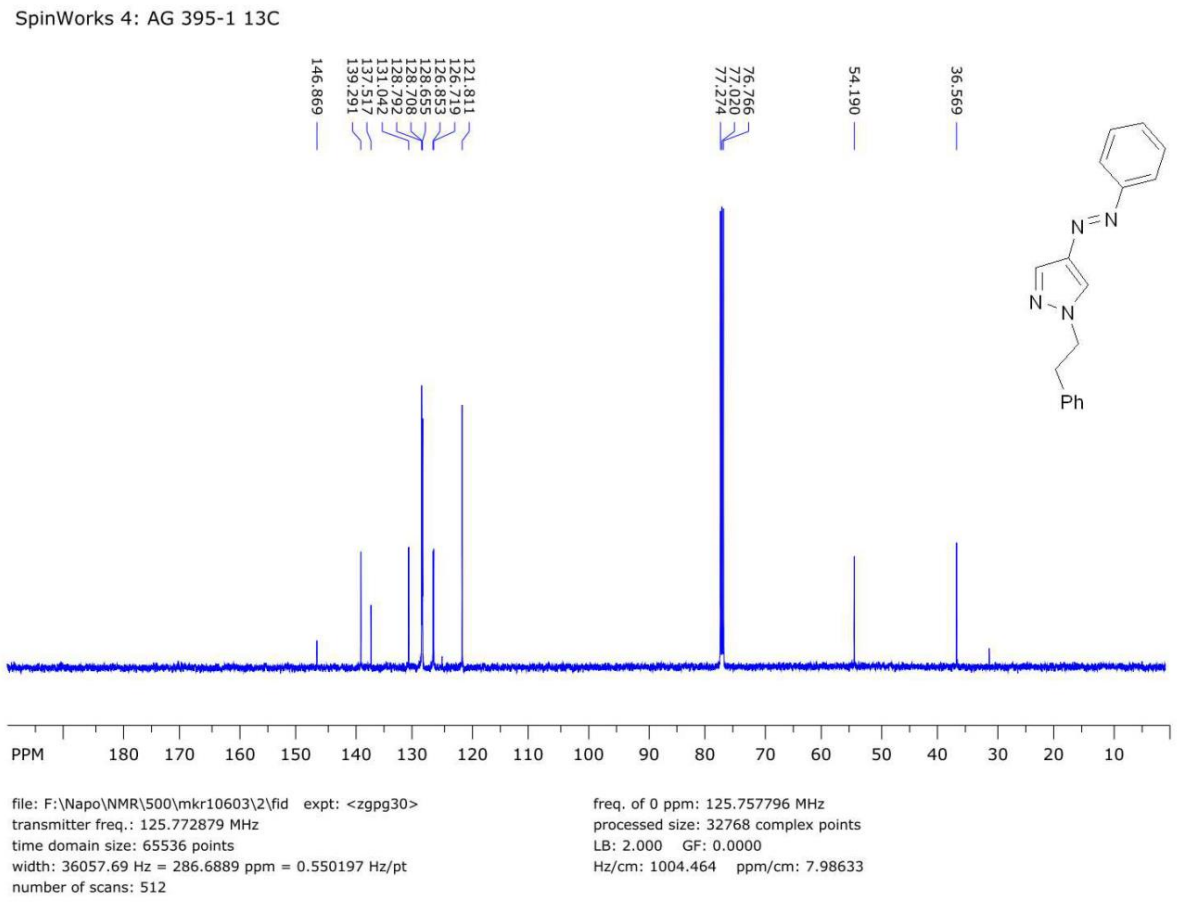
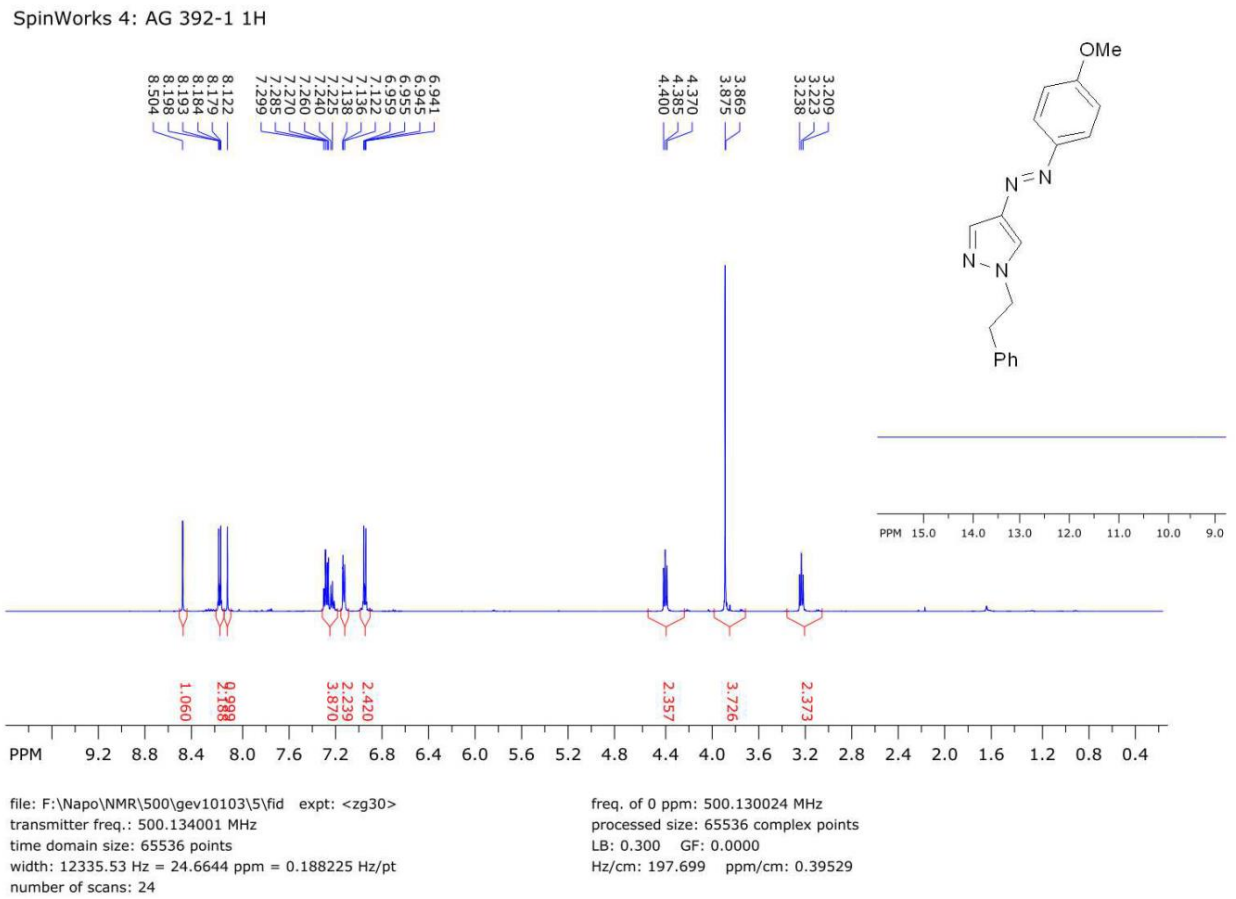
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24

freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 180.606 ppm/cm: 0.36112

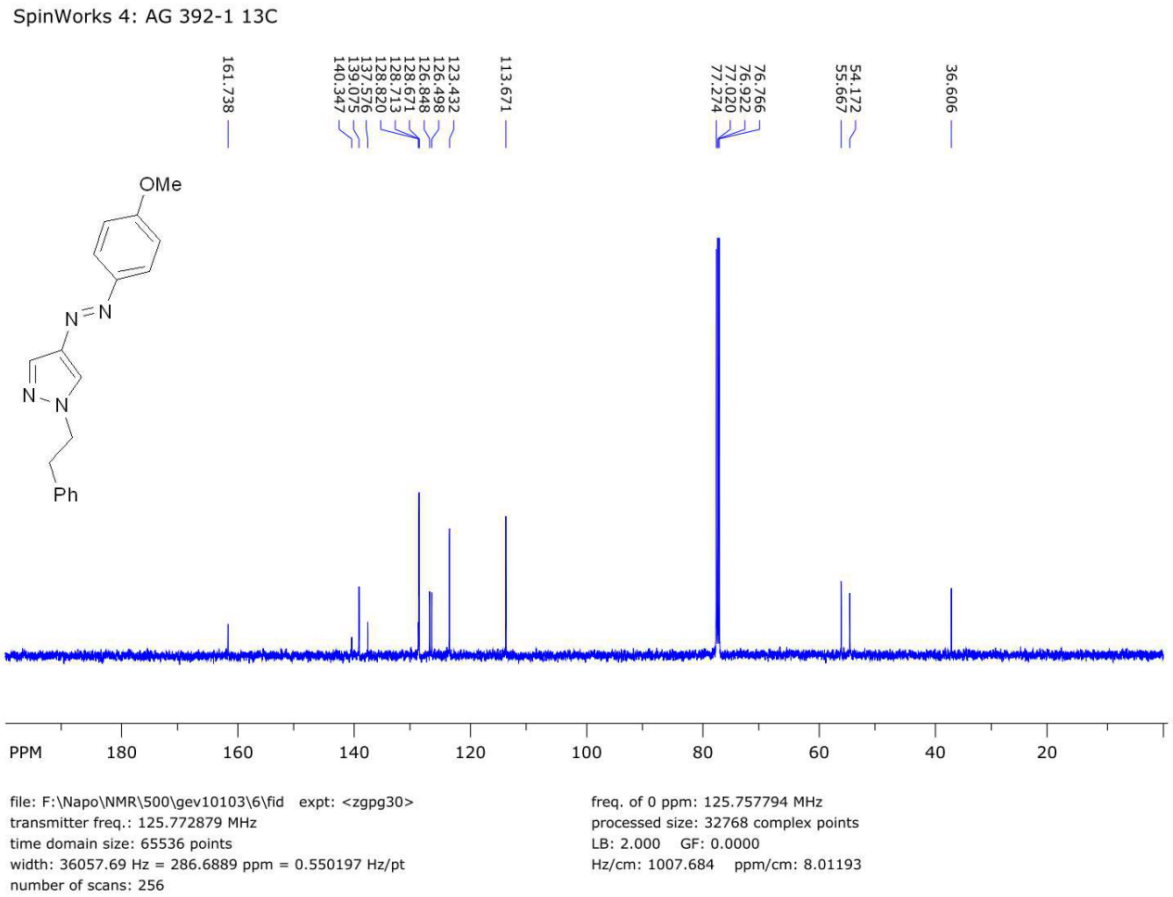
Compound 4a


SpinWorks 4: AG 395-1 13C
146.869
139.291
137.517
131.042
128.792
128.708
128.655
126.853
126.719
121.811
77.274
77.020
76.766
54.190
36.569
N=N
N
N
Ph
PPM
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
file: F:\Napo\NMR\500\mkr10603\2\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757796 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1004.464 ppm/cm: 7.98633

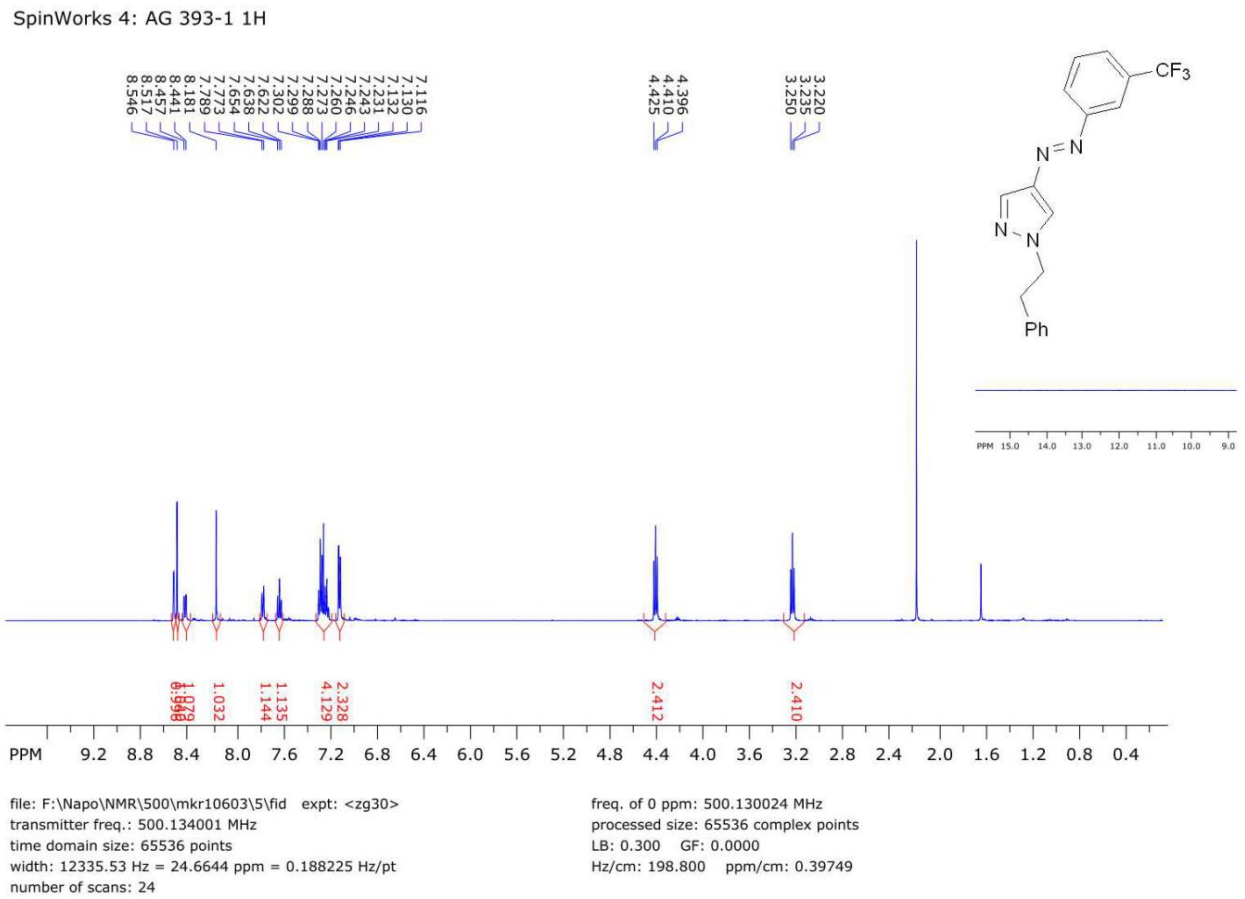
Compound 4b


SpinWorks 4: AG 392-1 1H
8.504
8.198
8.193
8.184
8.179
8.122
7.299
7.285
7.270
7.260
7.240
7.225
7.138
7.136
7.122
6.959
6.955
6.945
6.941
4.400
4.385
4.370
3.875
3.869
3.238
3.223
3.209
OMe
N
N
N
N
Ph
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0
1.060
2.239
3.870
2.420
2.357
3.726
2.373
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\gev10103\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 197.699 ppm/cm: 0.39529

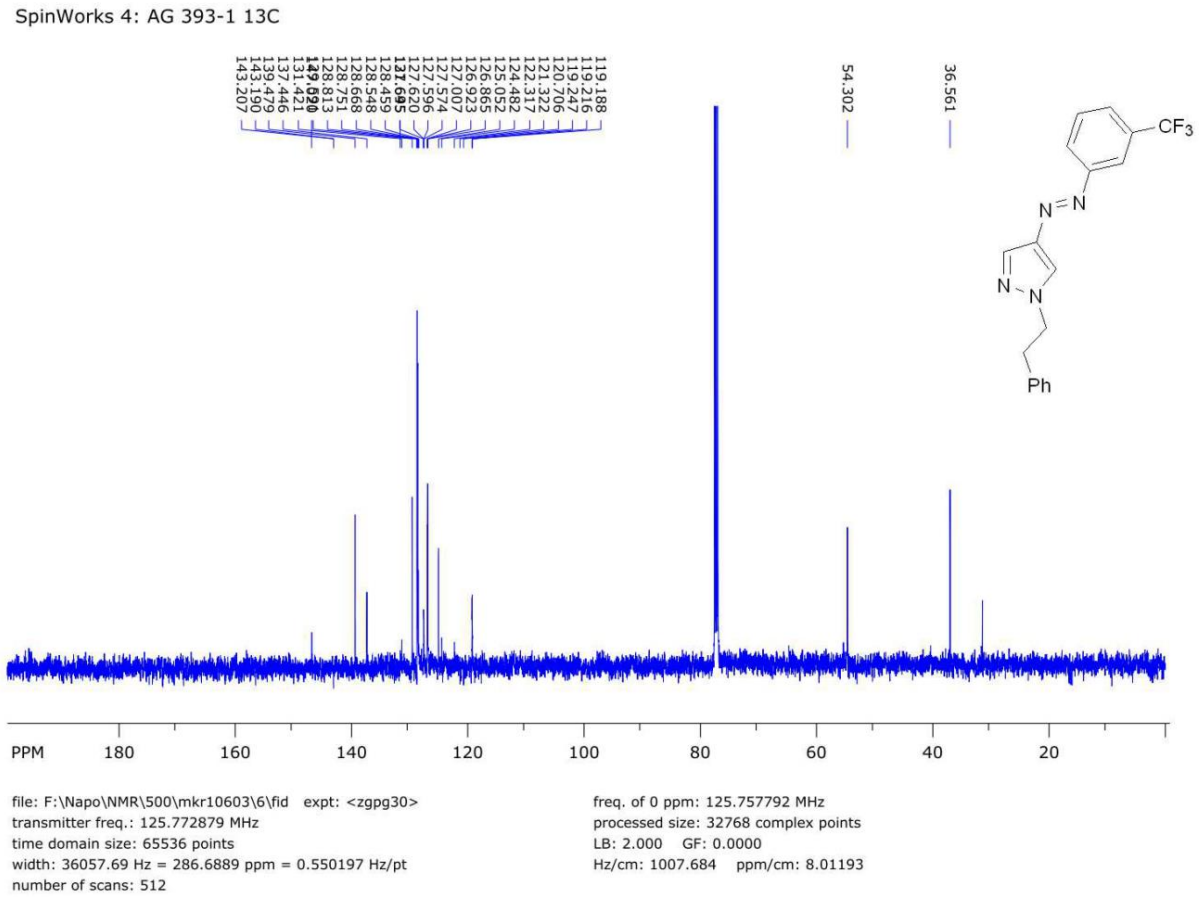
Compound 4b


SpinWorks 4: AG 392-1 13C
161.738
140.347
139.075
137.576
128.820
128.713
128.671
126.848
126.498
123.432
113.671
77.274
77.020
76.922
76.766
55.667
54.172
36.606
OMe
N=N
N
N
Ph
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\gev10103\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 256
freq. of 0 ppm: 125.757794 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1007.684 ppm/cm: 8.01193

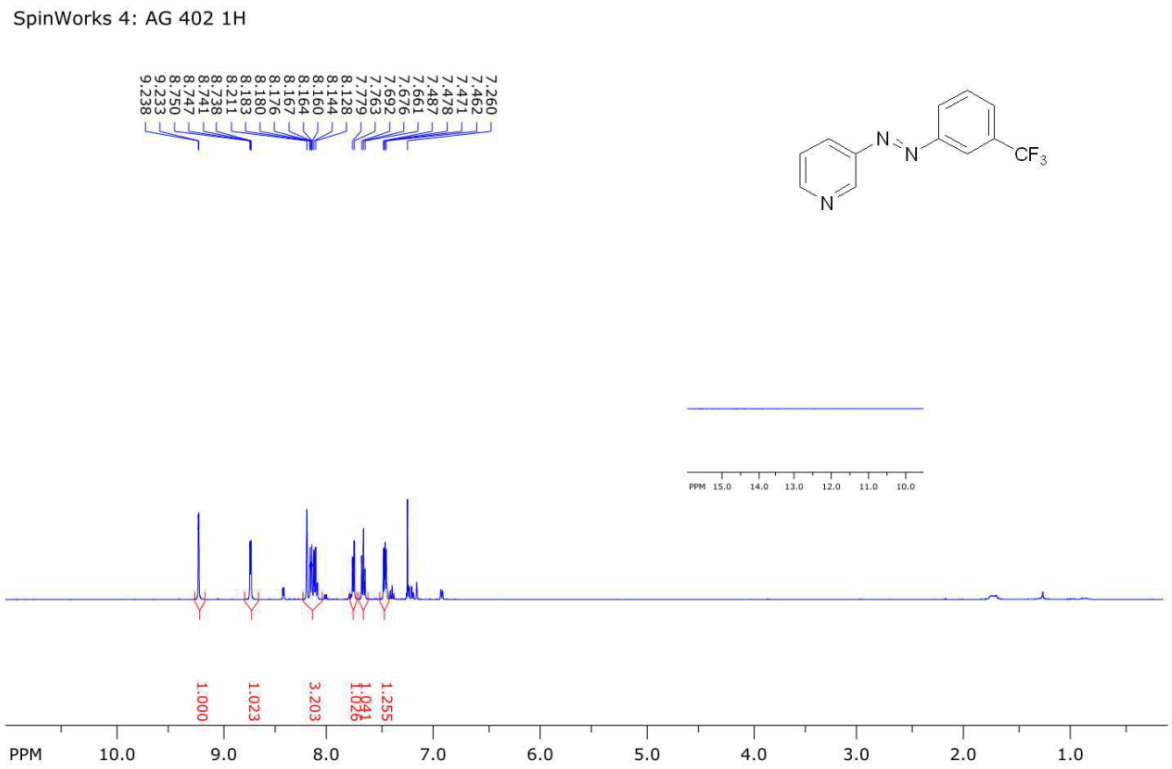
Compound 4c


SpinWorks 4: AG 393-1 1H
8.546
8.517
8.457
8.441
8.181
7.789
7.773
7.654
7.638
7.622
7.302
7.299
7.288
7.273
7.260
7.246
7.243
7.231
7.132
7.130
7.116
4.425
4.410
4.396
3.250
3.235
3.220
CF3
N
N
N
N
Ph
1.032
1.144
1.135
4.129
2.328
2.412
2.410
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10603\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.800 ppm/cm: 0.39749

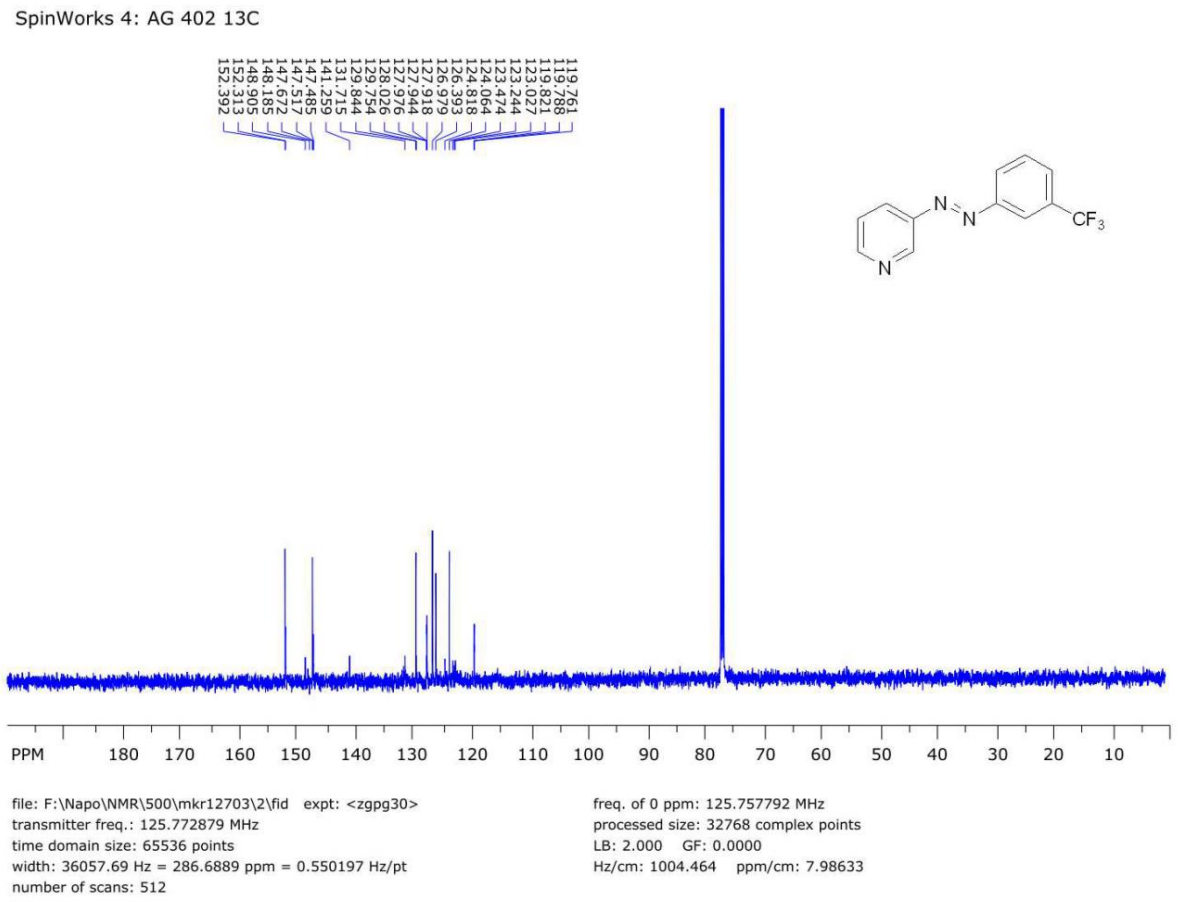
Compound 4c


SpinWorks 4: AG 393-1 13C
143.207
143.190
139.479
137.446
131.421
128.813
128.751
128.668
128.548
128.459
127.620
127.596
127.574
127.007
126.923
126.855
125.052
124.482
122.317
121.322
120.706
119.247
119.216
119.188
54.302
36.561
CF3
N
N
N
N
Ph
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\mkr10603\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757792 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1007.684 ppm/cm: 8.01193

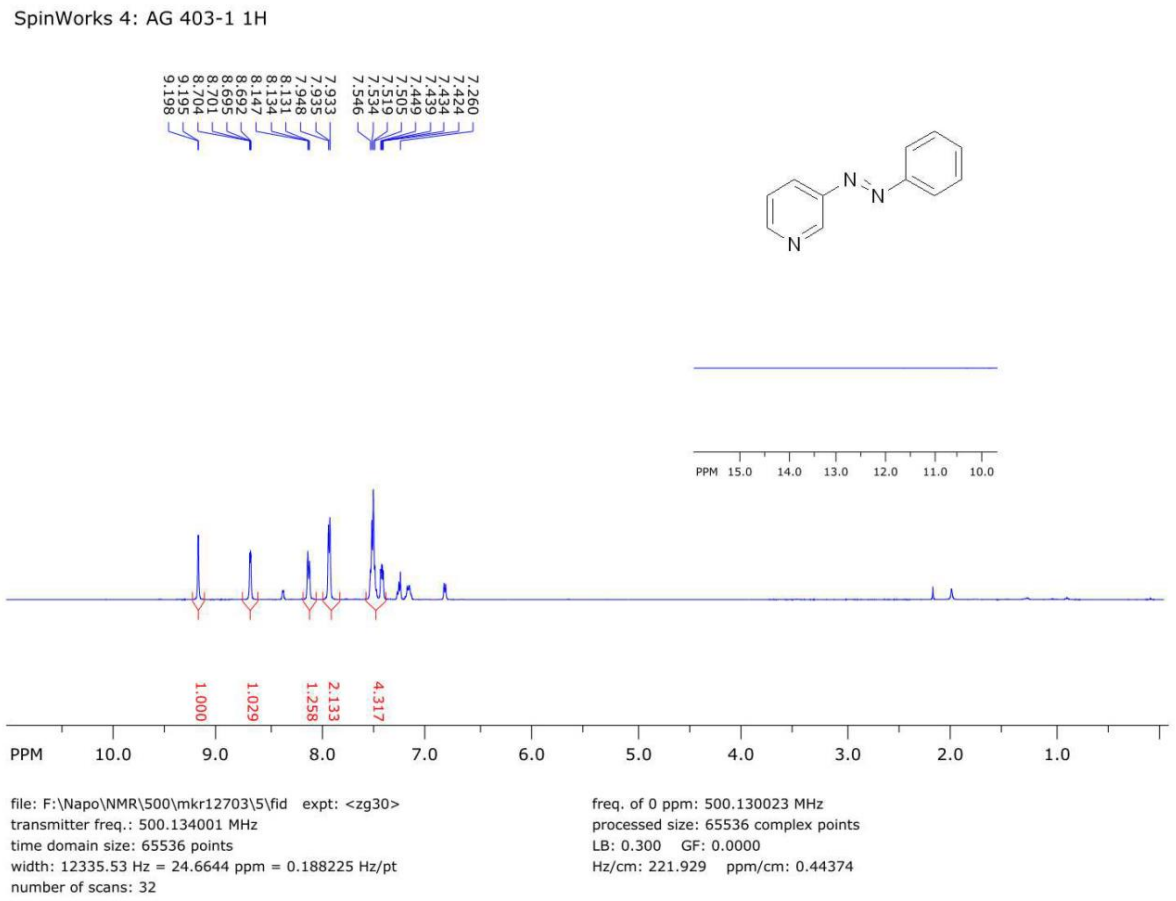
Compound 4d


SpinWorks 4: AG 402 1H
9.238
9.233
8.750
8.747
8.741
8.738
8.731
8.183
8.180
8.176
8.167
8.164
8.160
8.144
8.128
7.779
7.763
7.692
7.676
7.661
7.487
7.478
7.471
7.462
7.260
N
N
N
CF3
PPM 15.0 14.0 13.0 12.0 11.0 10.0
1.000
1.023
3.203
1.041
1.026
1.255
PPM 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0
file: F:\Napo\NMR\500\mkr12703\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 219.176 ppm/cm: 0.43823

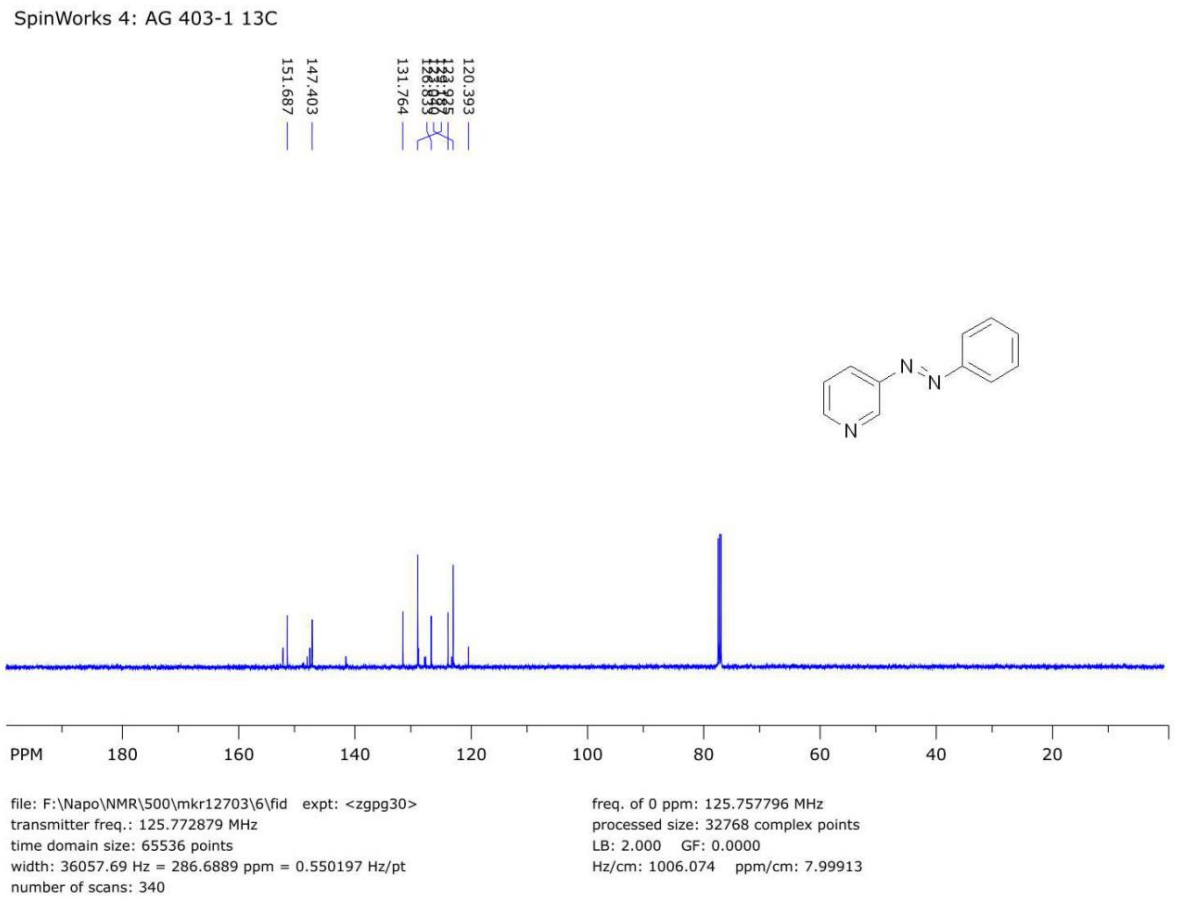
Compound 4d


SpinWorks 4: AG 402 13C
152.392
152.313
148.905
148.185
147.672
147.517
147.485
141.259
131.715
129.844
129.754
128.026
127.976
127.944
127.918
126.979
126.395
124.818
124.064
123.474
123.244
123.027
119.821
119.788
119.761
N
N
N
CF3
PPM
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
file: F:\Napo\NMR\500\mkr12703\2\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757792 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1004.464 ppm/cm: 7.98633

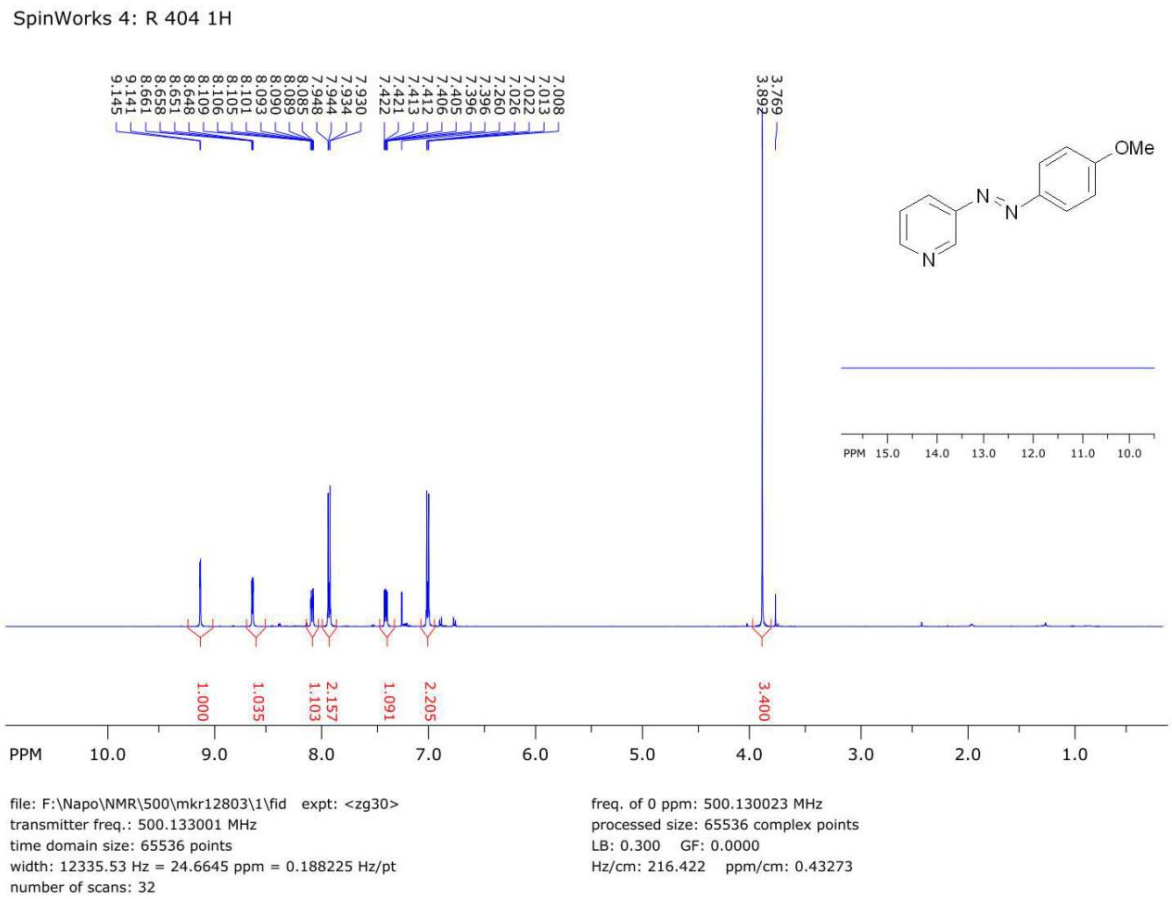
Compound 4e


SpinWorks 4: AG 403-1 1H
9.198
9.195
8.704
8.701
8.695
8.692
8.147
8.134
8.131
7.948
7.935
7.933
7.546
7.534
7.519
7.505
7.449
7.439
7.434
7.424
7.260
N
N
N
PPM 15.0 14.0 13.0 12.0 11.0 10.0
1.000
1.029
1.258
2.133
4.317
PPM 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0
file: F:\Napo\NMR\500\mkr12703\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 221.929 ppm/cm: 0.44374

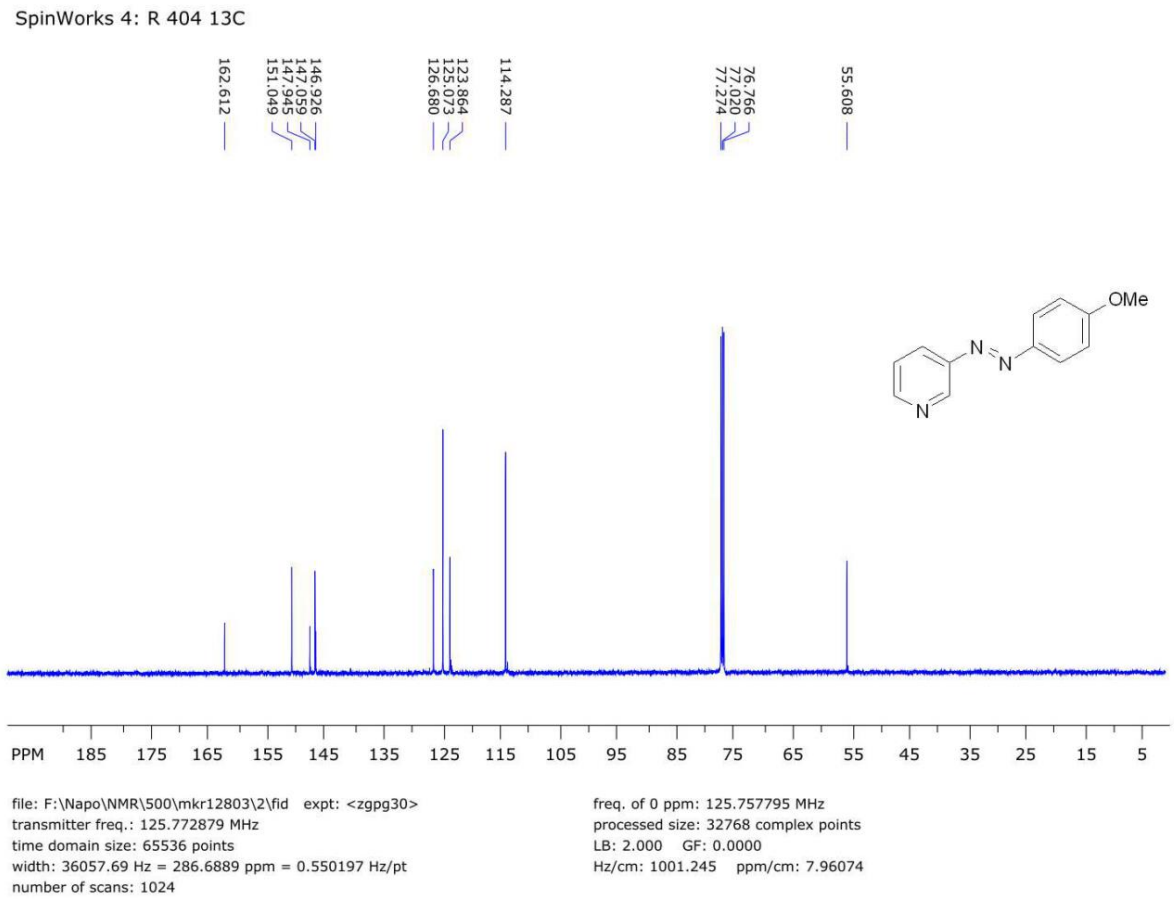
Compound 4e


SpinWorks 4: AG 403-1 13C
151.687
147.403
131.764
120.393
N
N
N
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\mkr12703\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 340
freq. of 0 ppm: 125.757796 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1006.074 ppm/cm: 7.99913

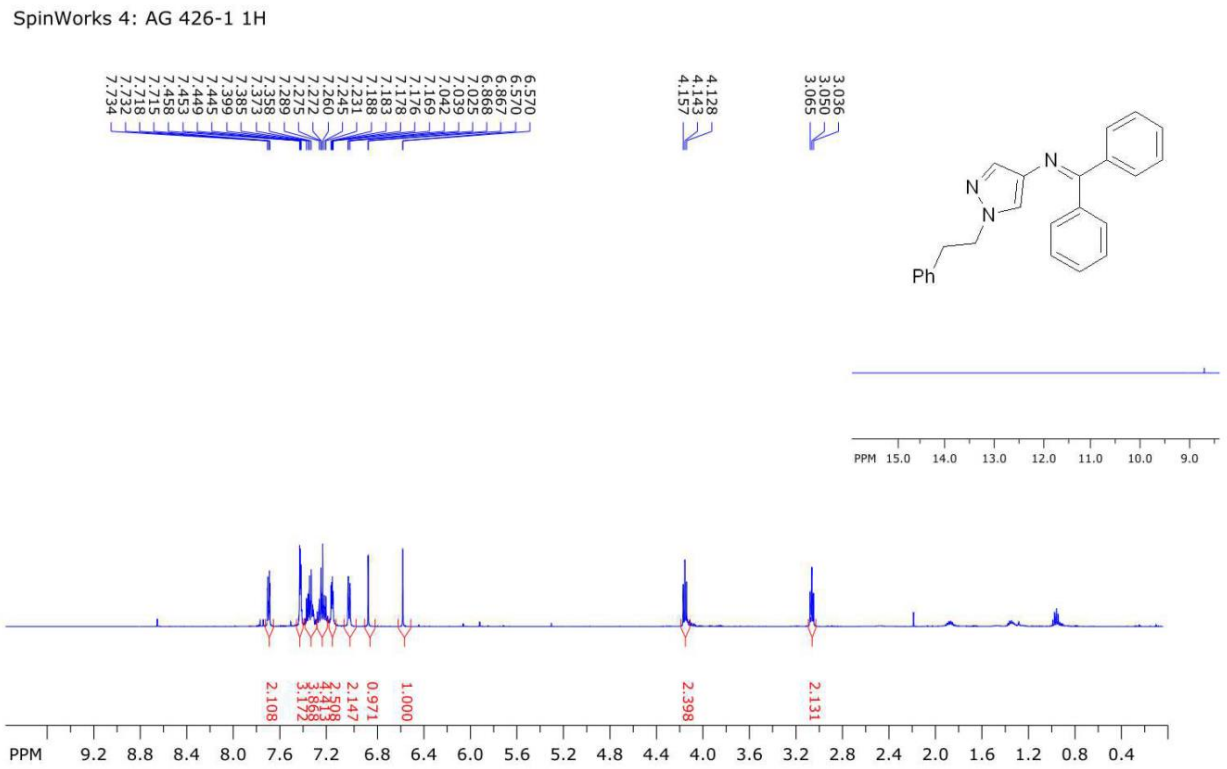
Compound 4f


SpinWorks 4: R 404 1H
9.145
9.141
8.661
8.658
8.651
8.648
8.109
8.106
8.105
8.101
8.093
8.090
8.089
8.085
7.948
7.944
7.934
7.930
7.422
7.421
7.413
7.412
7.406
7.405
7.396
7.396
7.260
7.026
7.022
7.013
7.008
3.892
3.769
OMe
N
N
N
PPM 15.0 14.0 13.0 12.0 11.0 10.0
1.000
1.035
1.103
2.157
1.091
2.205
3.400
PPM 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0
file: F:\Napo\NMR\500\mkr12803\1\fid expt: <zg30>
transmitter freq.: 500.133001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6645 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 216.422 ppm/cm: 0.43273

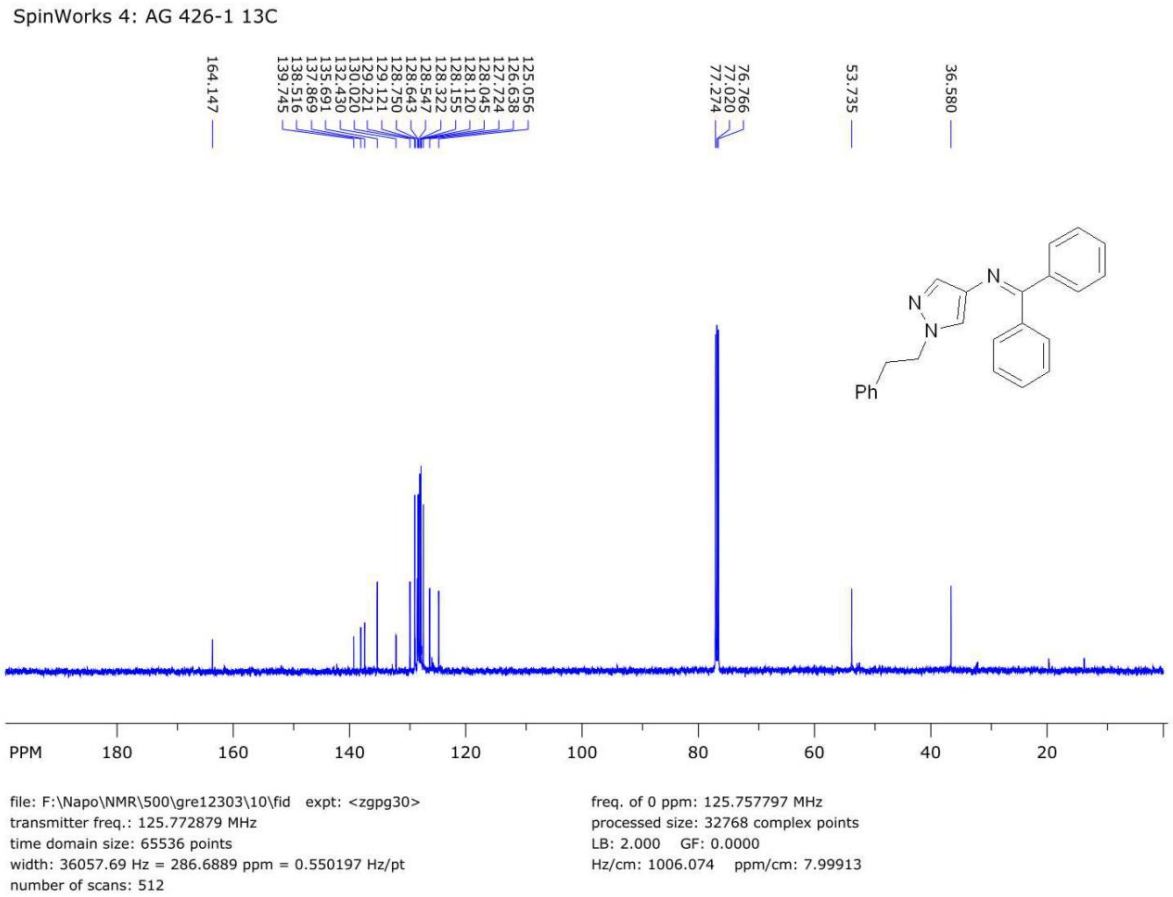
Compound 4f


SpinWorks 4: R 404 13C
162.612
151.049
147.945
147.059
146.926
126.680
125.073
123.864
114.287
77.274
77.020
76.766
55.608
OMe
N
N
N
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr12803\2\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757795 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1001.245 ppm/cm: 7.96074

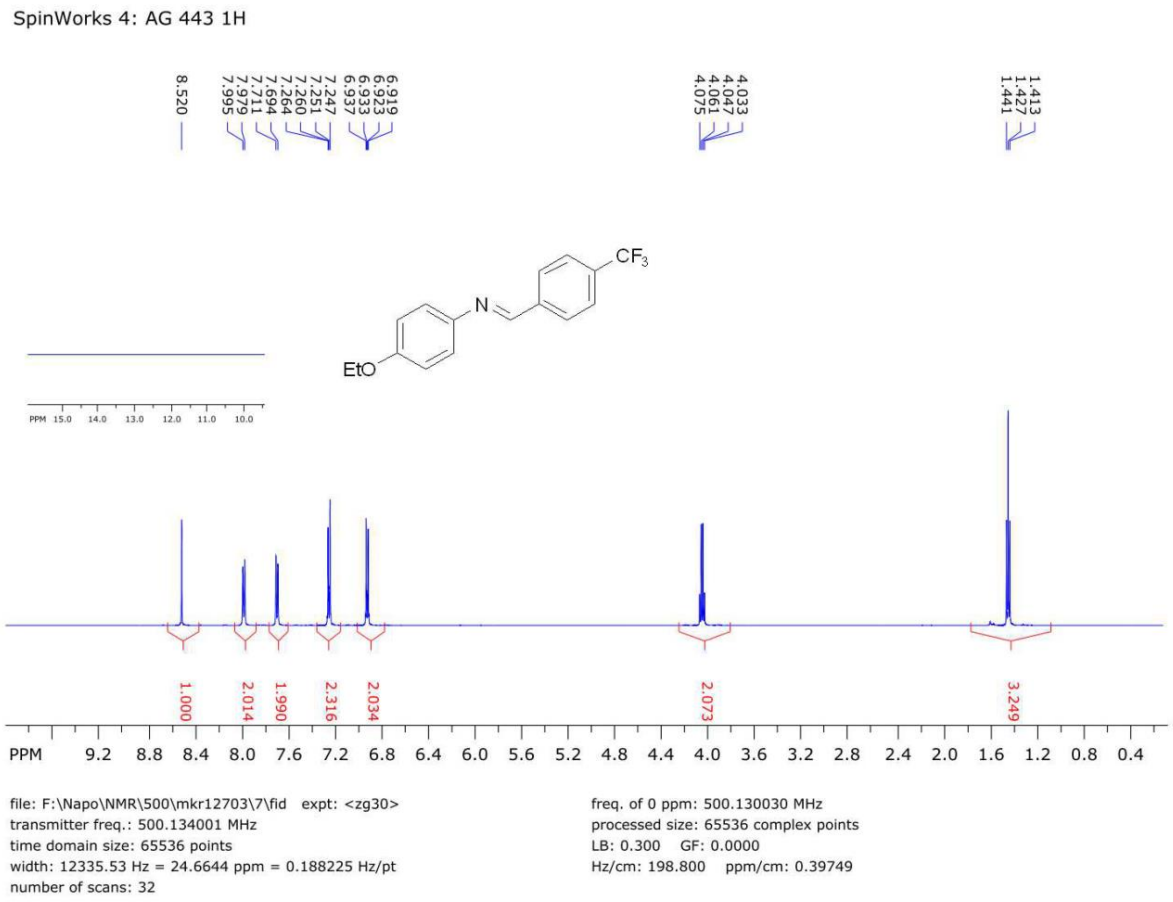
Compound 5a


SpinWorks 4: AG 426-1 1H
7.734 7.732 7.718 7.715 7.458 7.453 7.449 7.445 7.399 7.385 7.373 7.358 7.289 7.275 7.272 7.260 7.245 7.231 7.188 7.183 7.178 7.176 7.169 7.042 7.039 7.025 6.868 6.867 6.570 6.570
4.157 4.143 4.128
3.065 3.050 3.036
N
N
N
Ph
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0
2.108 3.172 2.508 2.147 0.971 1.000 2.398 2.131
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\gre12303\9\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 199.351 ppm/cm: 0.39860

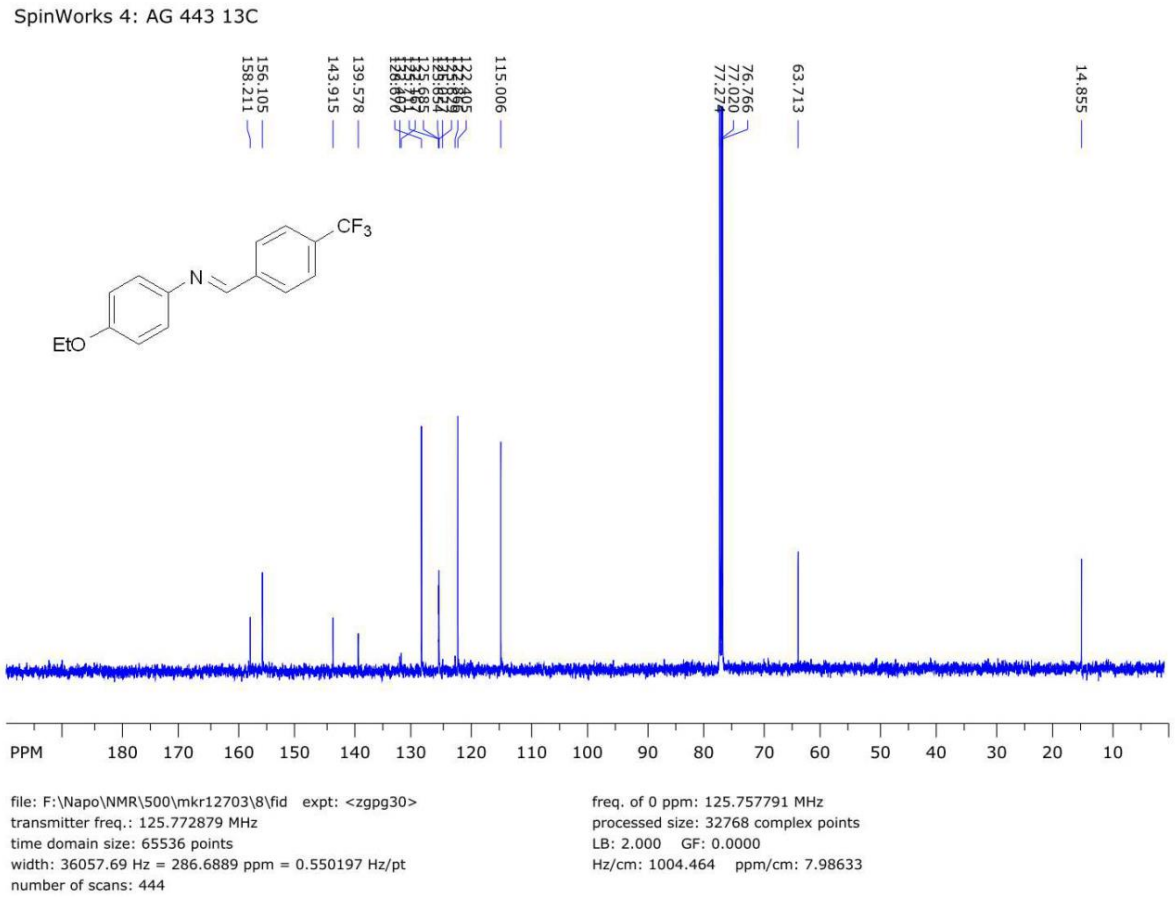
Compound 5a


SpinWorks 4: AG 426-1 13C
164.147
139.745
138.516
137.869
135.691
132.430
130.020
129.221
129.121
128.750
128.643
128.547
128.322
128.155
128.120
128.045
127.724
126.638
125.056
77.274
77.020
76.766
53.735
36.580
N
N
N
Ph
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\gre12303\10\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757797 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1006.074 ppm/cm: 7.99913

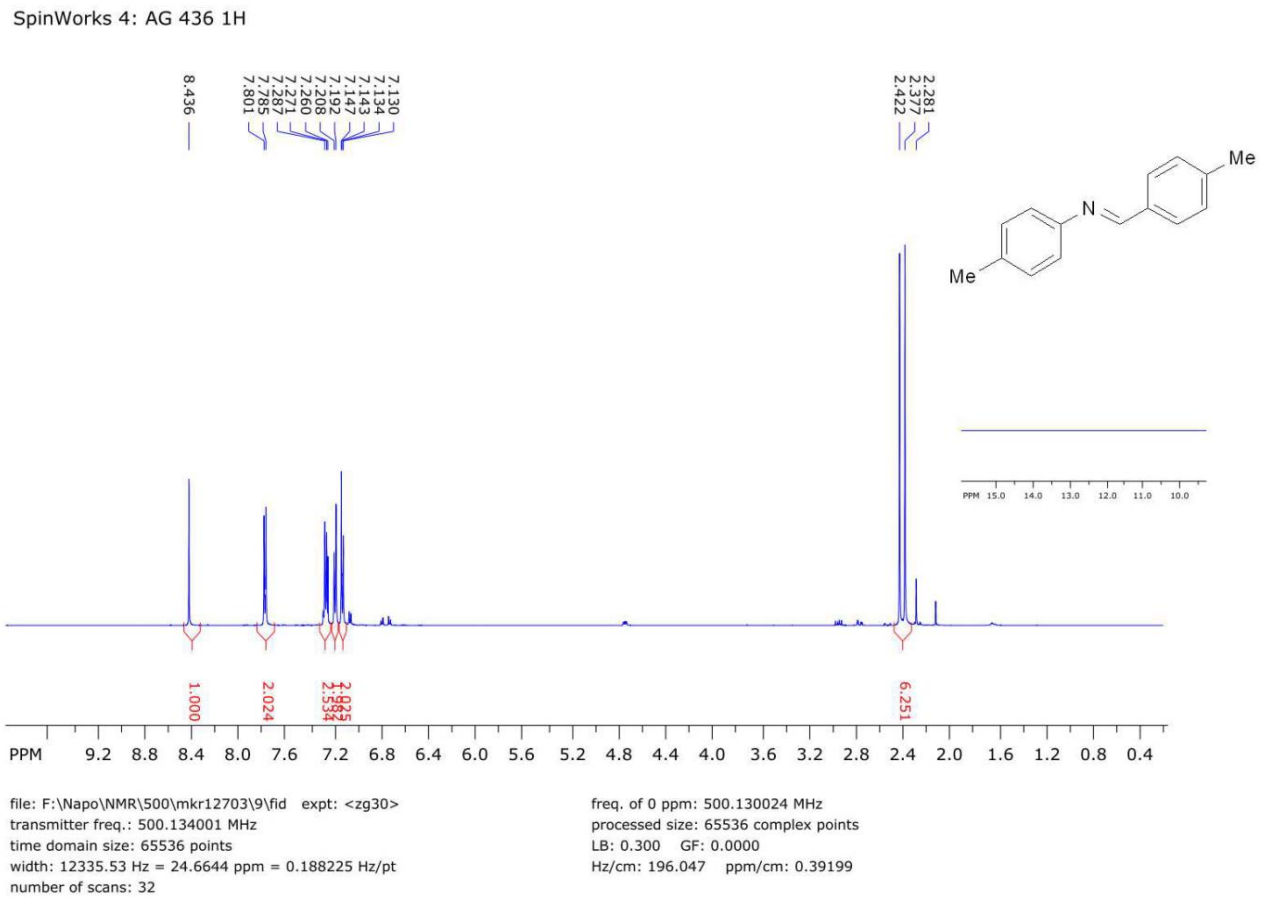
Compound 5b


SpinWorks 4: AG 443 1H
8.520
7.995
7.979
7.711
7.694
7.264
7.260
7.251
7.247
6.937
6.933
6.923
6.919
4.075
4.061
4.047
4.033
1.441
1.427
1.413
CF3
N
EtO
PPM 15.0 14.0 13.0 12.0 11.0 10.0
1.000
2.014
1.990
2.316
2.034
2.073
3.249
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr12703\7\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130030 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.800 ppm/cm: 0.39749

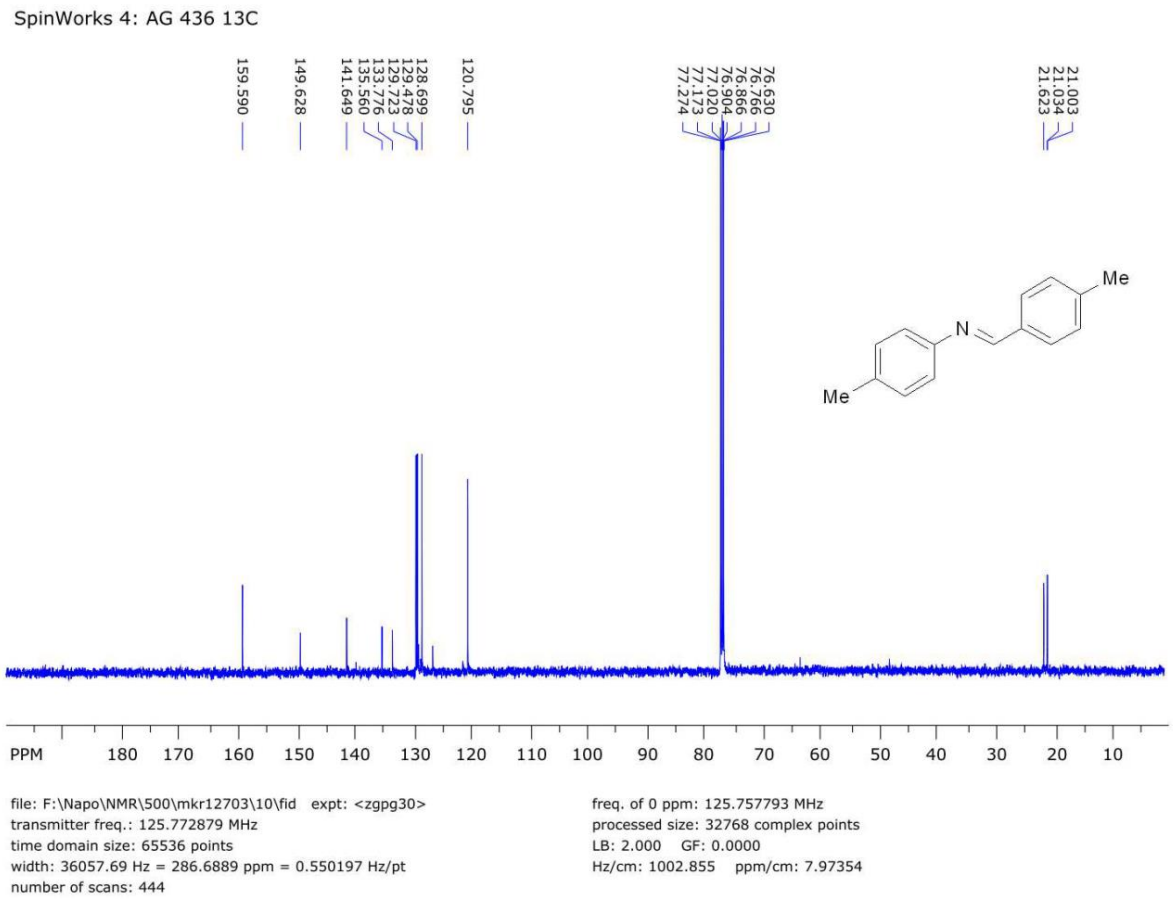
Compound 5b


SpinWorks 4: AG 443 13C
156.105
158.211
143.915
139.578
115.006
77.274
77.020
76.766
63.713
14.855
CF3
N
EtO
PPM
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
file: F:\Napo\NMR\500\mkr12703\8\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 444
freq. of 0 ppm: 125.757791 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1004.464 ppm/cm: 7.98633

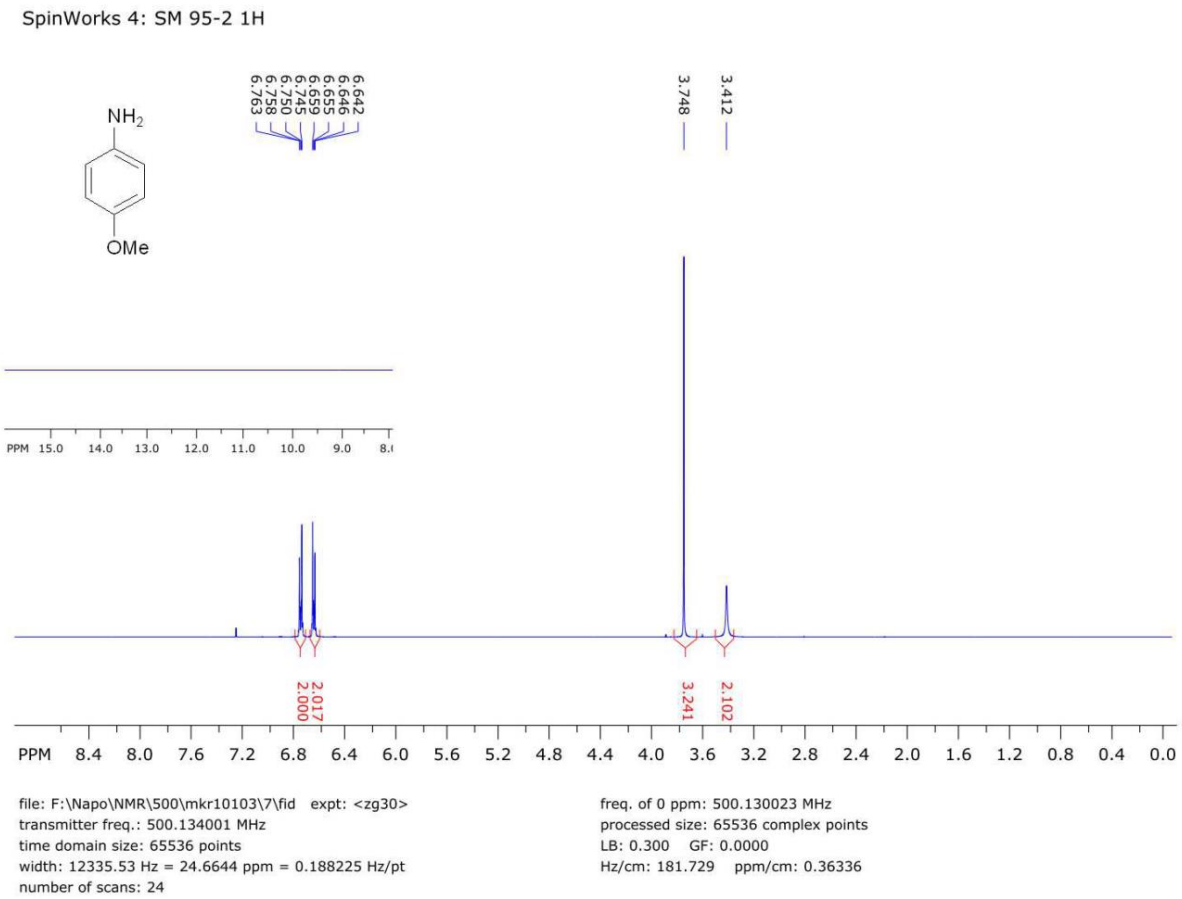
Compound 5c


SpinWorks 4: AG 436 1H
8.436
7.801
7.785
7.287
7.271
7.260
7.208
7.192
7.147
7.143
7.134
7.130
2.422
2.377
2.281
Me
N
Me
1.000
2.024
2.025
1.982
2.534
6.251
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr12703\9\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 196.047 ppm/cm: 0.39199

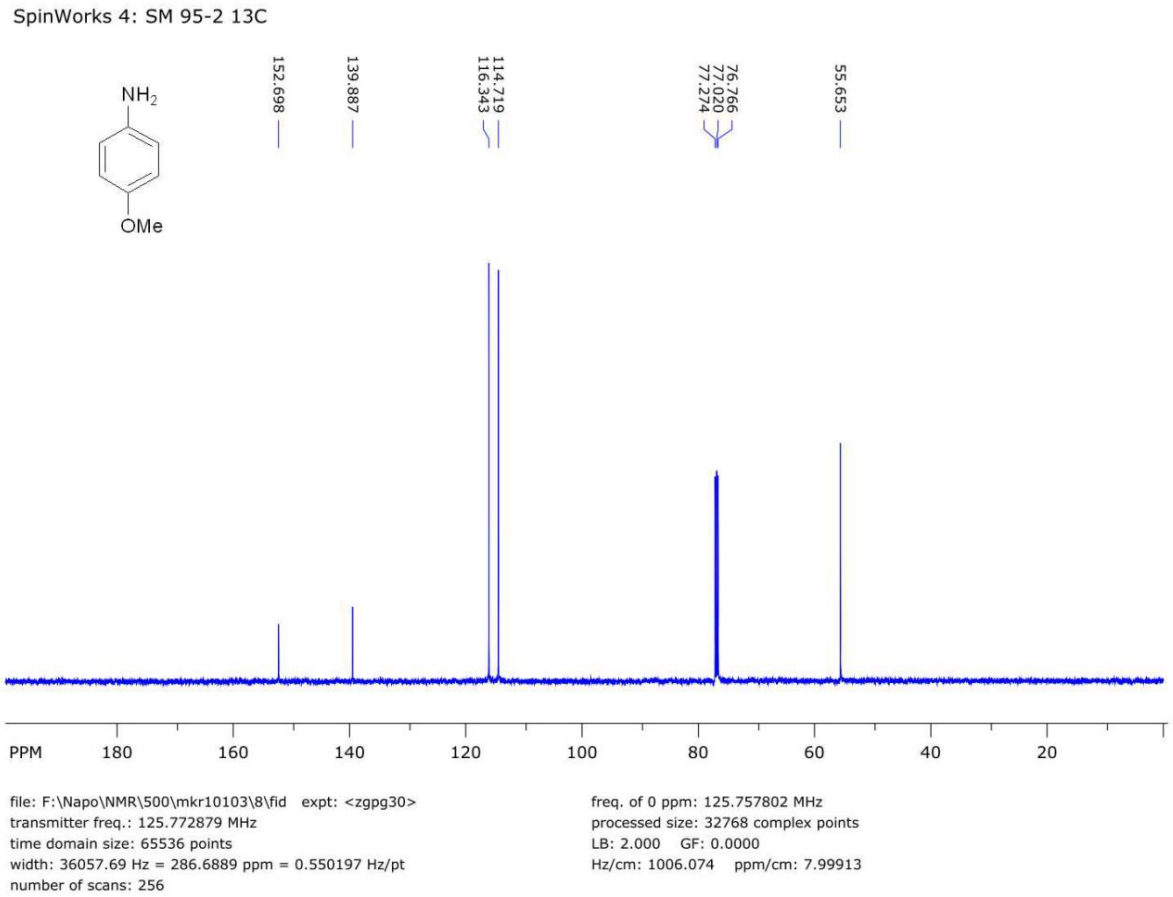
Compound 5c


SpinWorks 4: AG 436 13C
159.590
149.628
141.649
135.560
133.776
129.723
129.478
128.699
120.795
77.274
77.173
77.020
76.904
76.866
76.766
76.630
21.623
21.034
21.003
Me
N
Me
PPM
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
file: F:\Napo\NMR\500\mkr12703\10\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 444
freq. of 0 ppm: 125.757793 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1002.855 ppm/cm: 7.97354

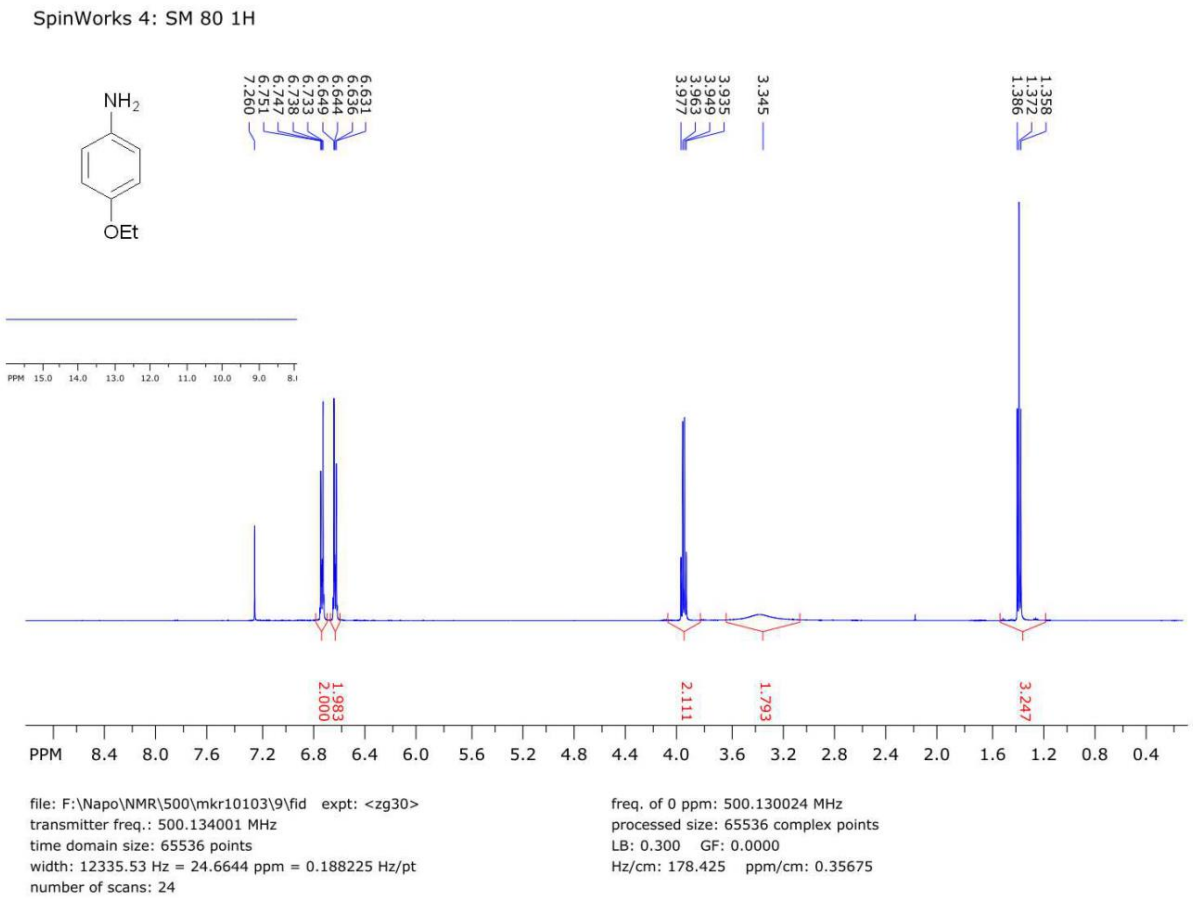
Compound 6a


SpinWorks 4: SM 95-2 1H
NH2
OMe
6.763
6.758
6.750
6.745
6.659
6.655
6.646
6.642
3.748
3.412
2.017
2.000
3.241
2.102
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4 0.0
file: F:\Napo\NMR\500\mkr10103\7\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 181.729 ppm/cm: 0.36336

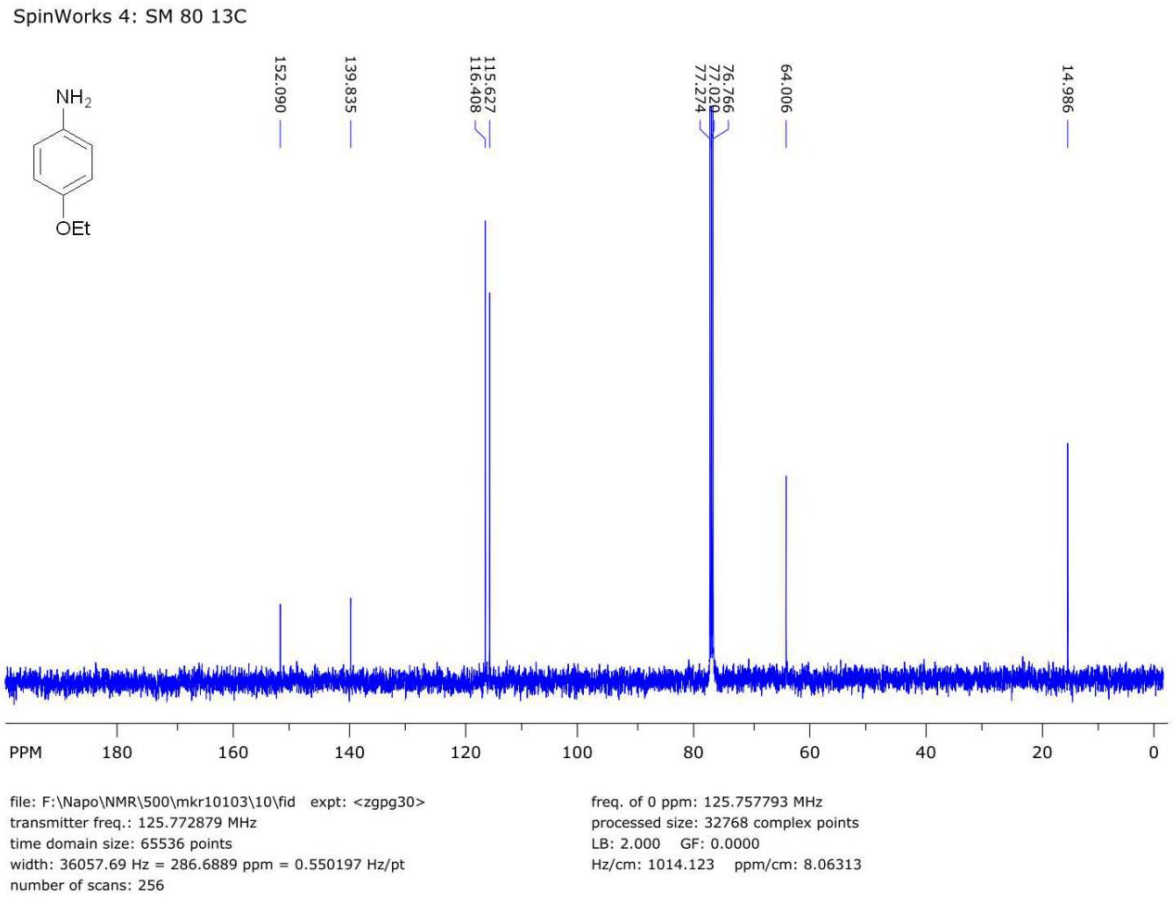
Compound 6a


SpinWorks 4: SM 95-2 13C
NH2
OMe
152.698
139.887
116.343
114.719
77.274
77.020
76.766
55.653
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\mkr10103\8\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 256
freq. of 0 ppm: 125.757802 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1006.074 ppm/cm: 7.99913

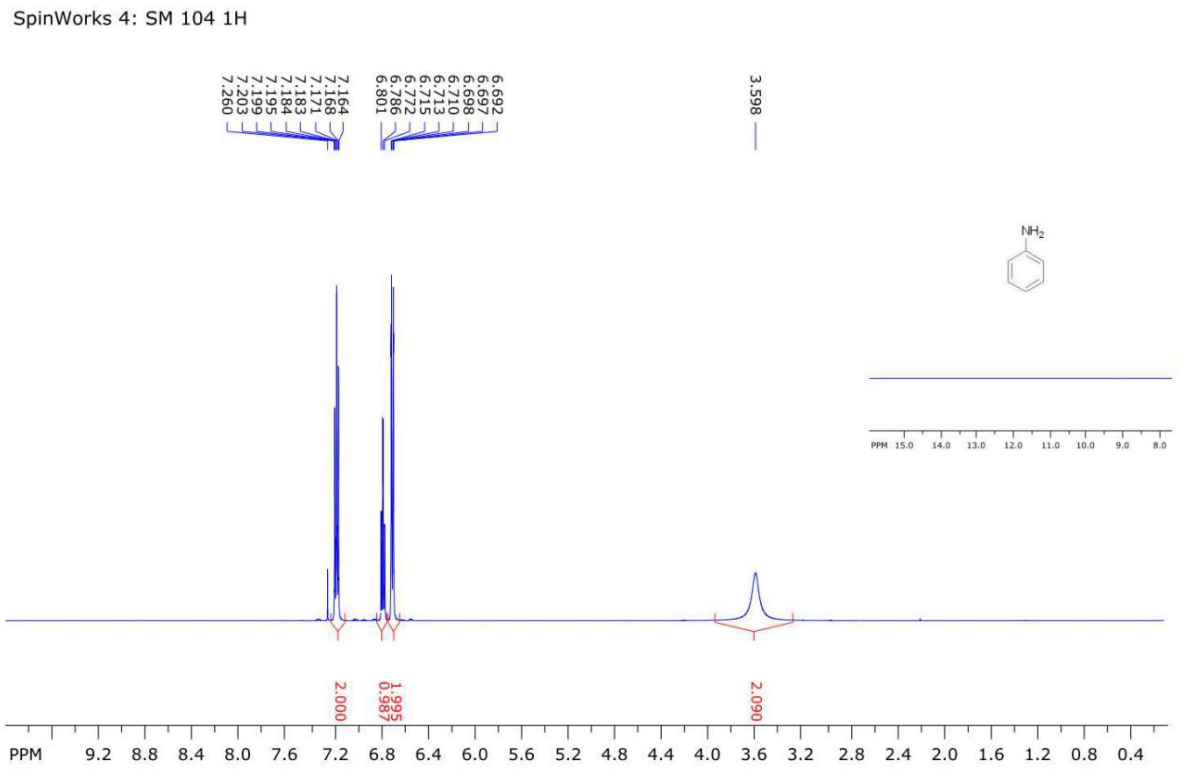
Compound 6b


SpinWorks 4: SM 80 1H
NH2
OEt
7.260
6.751
6.747
6.738
6.733
6.649
6.644
6.636
6.631
3.977
3.963
3.949
3.935
3.345
1.386
1.372
1.358
1.983
2.000
2.111
1.793
3.247
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10103\9\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 178.425 ppm/cm: 0.35675

Compound 6b


SpinWorks 4: SM 80 13C
NH2
OEt
152.090
139.835
115.627
116.408
76.766
77.020
77.274
64.006
14.986
PPM
180
160
140
120
100
80
60
40
20
0
file: F:\Napo\NMR\500\mkr10103\10\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 256
freq. of 0 ppm: 125.757793 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1014.123 ppm/cm: 8.06313

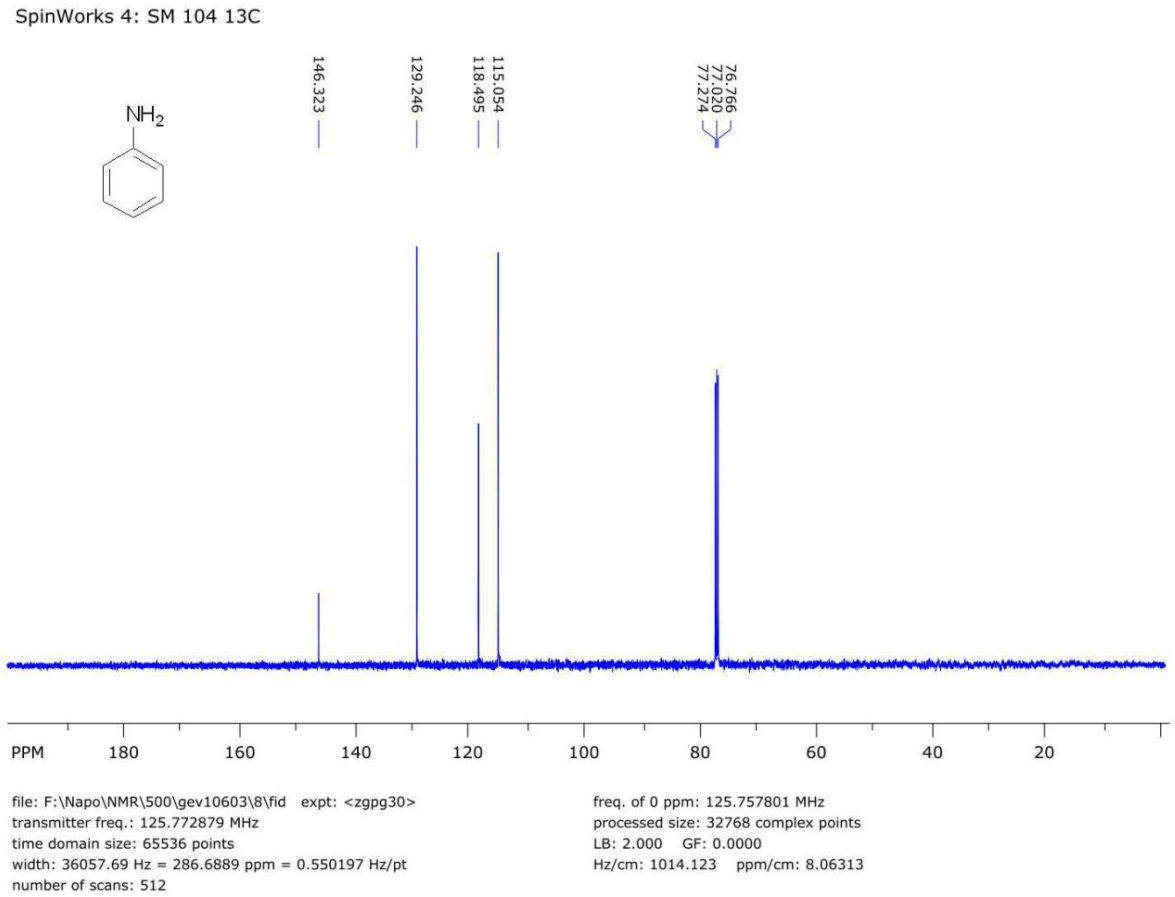
Compound 6c



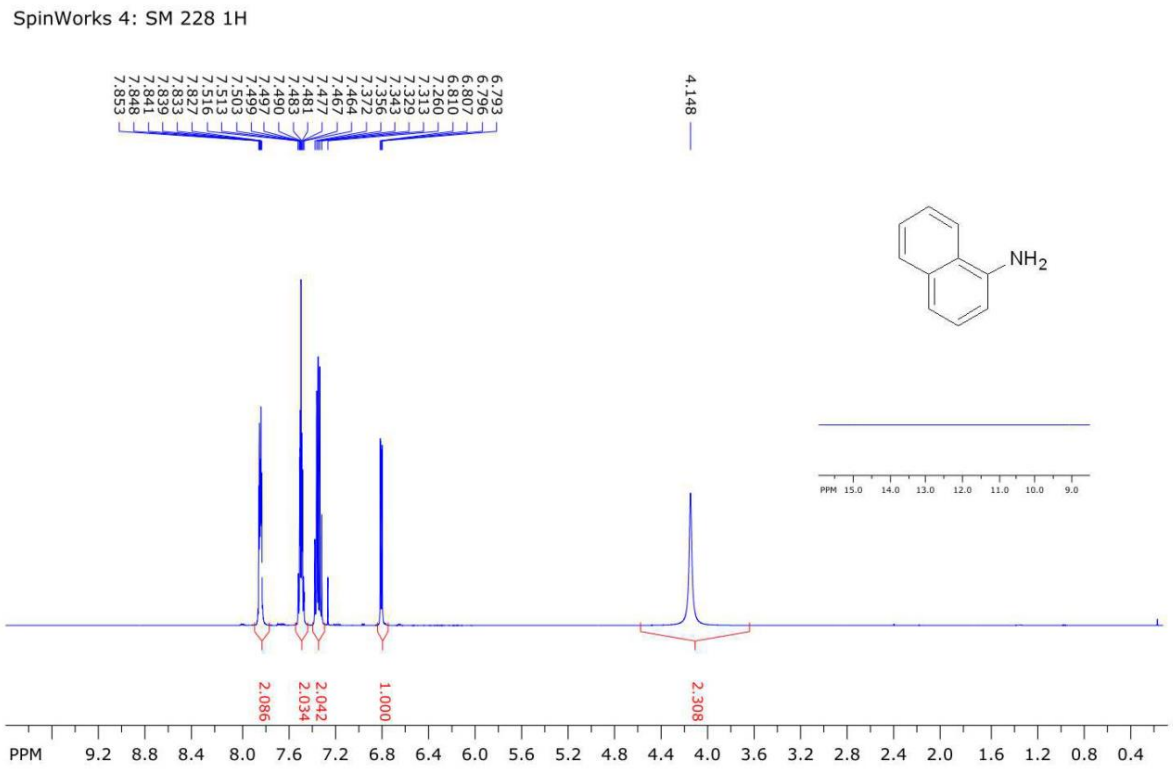
file: F:\Napo\NMR\500\gev10603\7\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.250 ppm/cm: 0.39639

Compound 6c


SpinWorks 4: SM 104 13C
NH2
146.323
129.246
118.495
115.054
77.274
77.020
76.766
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\gev10603\8\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757801 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1014.123 ppm/cm: 8.06313

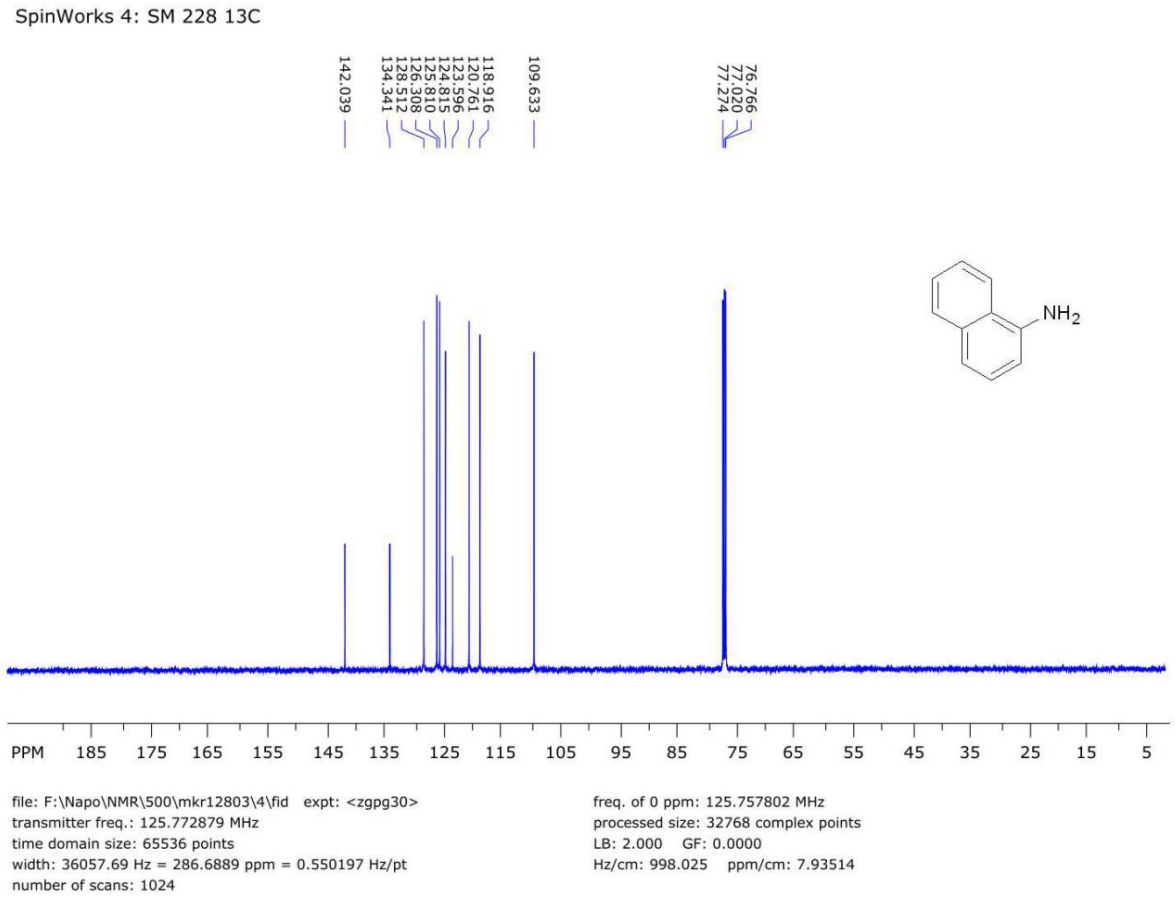
Compound 6d



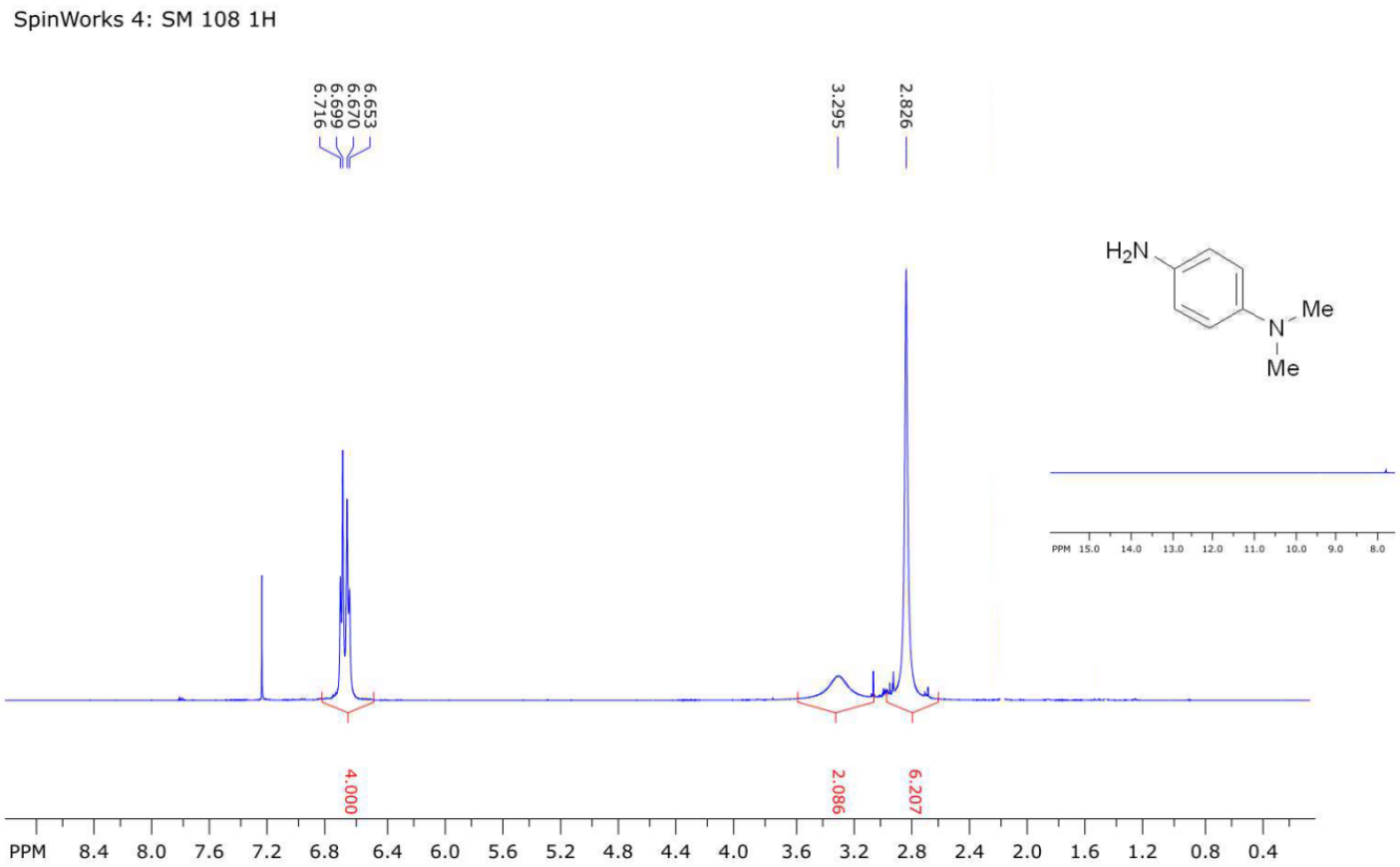
file: F:\Napo\NMR\500\mkr12803\3\fid expt: <zg30>
transmitter freq.: 500.133001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6645 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.800 ppm/cm: 0.39749

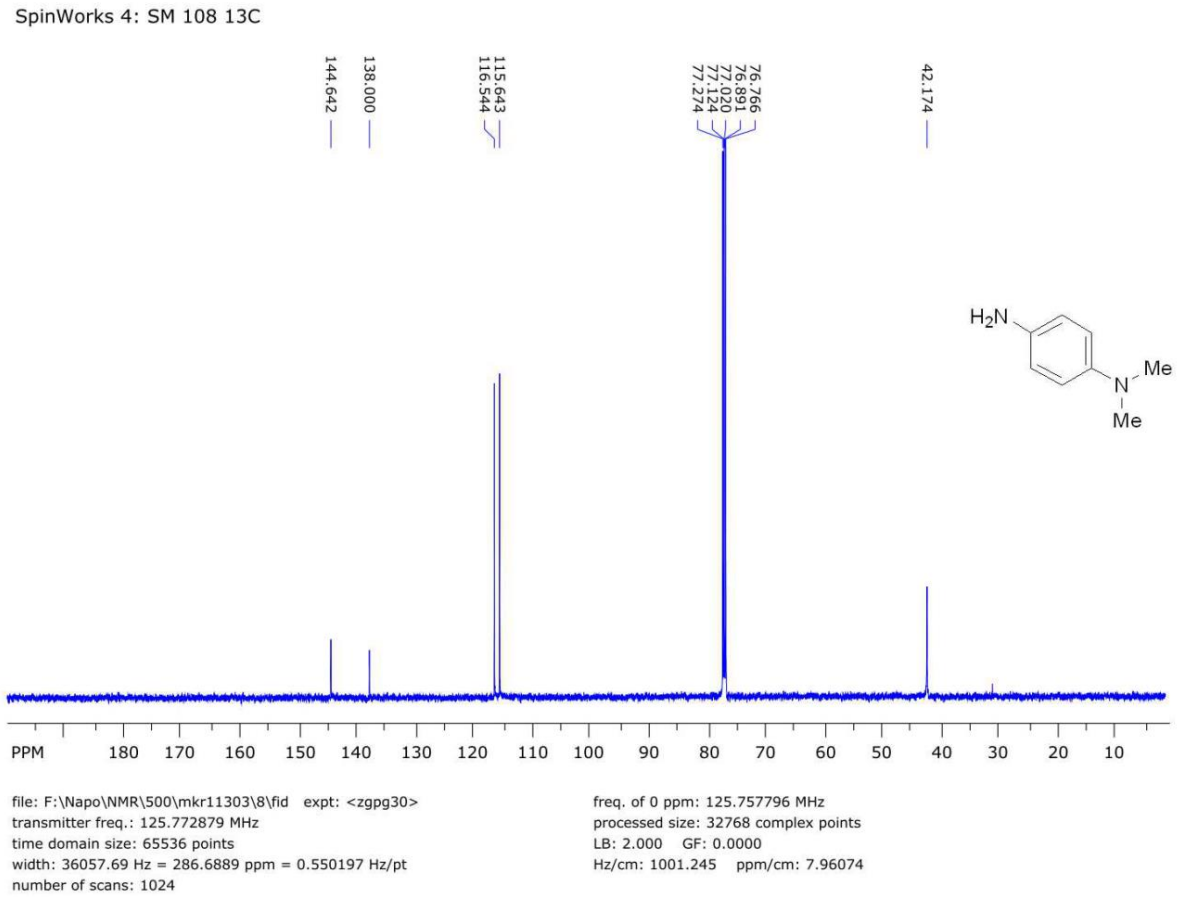
Compound 6d


SpinWorks 4: SM 228 13C
142.039
134.341
128.512
126.308
125.810
124.815
123.596
120.761
118.916
109.633
77.274
77.020
76.766
NH2
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr12803\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757802 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 998.025 ppm/cm: 7.93514

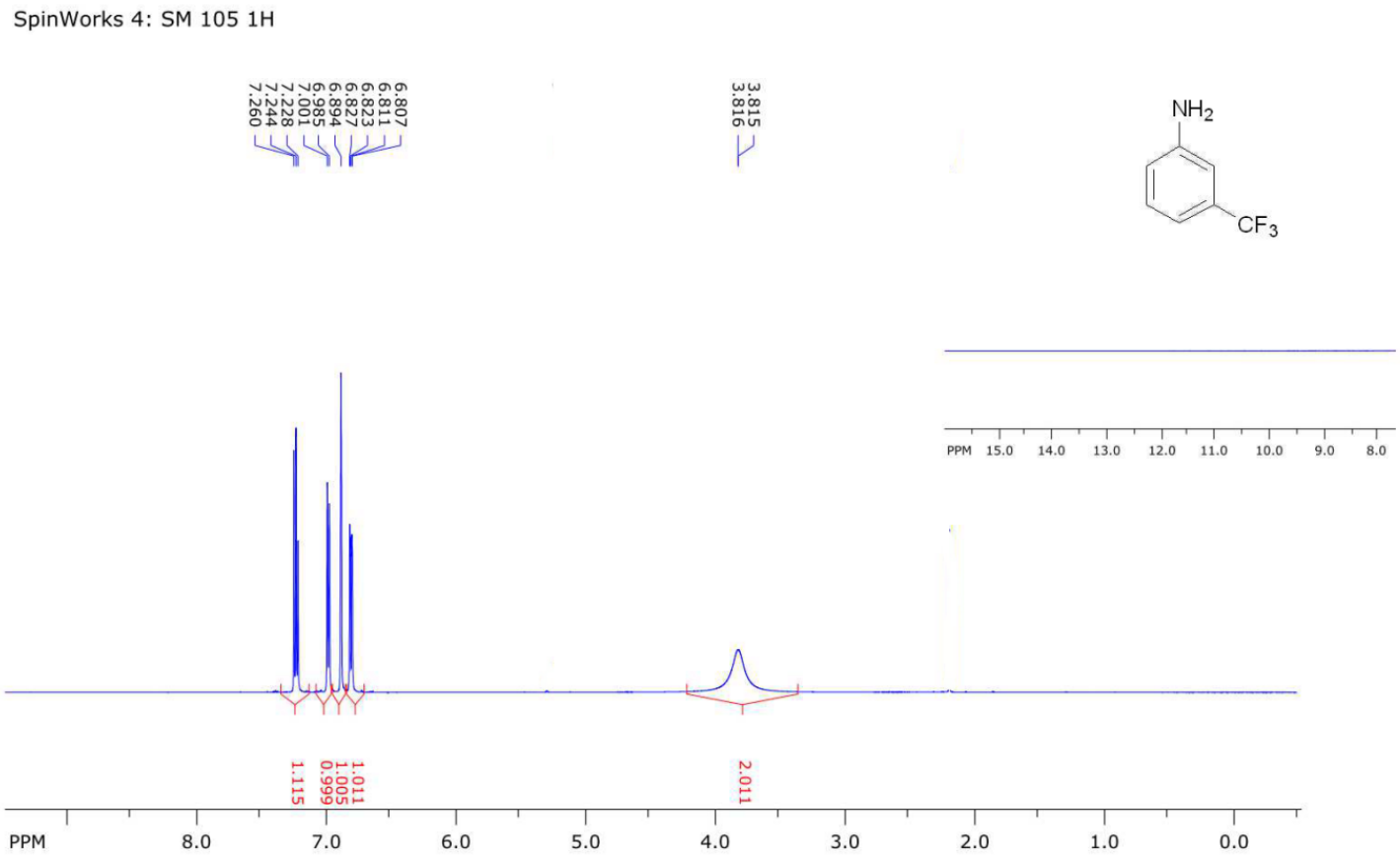
Compound 6e


SpinWorks 4: SM 108 1H
6.716
6.699
6.670
6.653
3.295
2.826
H2N
Me
N
Me
4.000
2.086
6.207
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr11303\7\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130026 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 179.526 ppm/cm: 0.35896

Compound 6e


SpinWorks 4: SM 108 13C
144.642
138.000
115.643
116.544
77.274
77.124
77.020
76.891
76.766
42.174
H2N
N
Me
Me
PPM
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
file: F:\Napo\NMR\500\mkr11303\8\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757796 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1001.245 ppm/cm: 7.96074

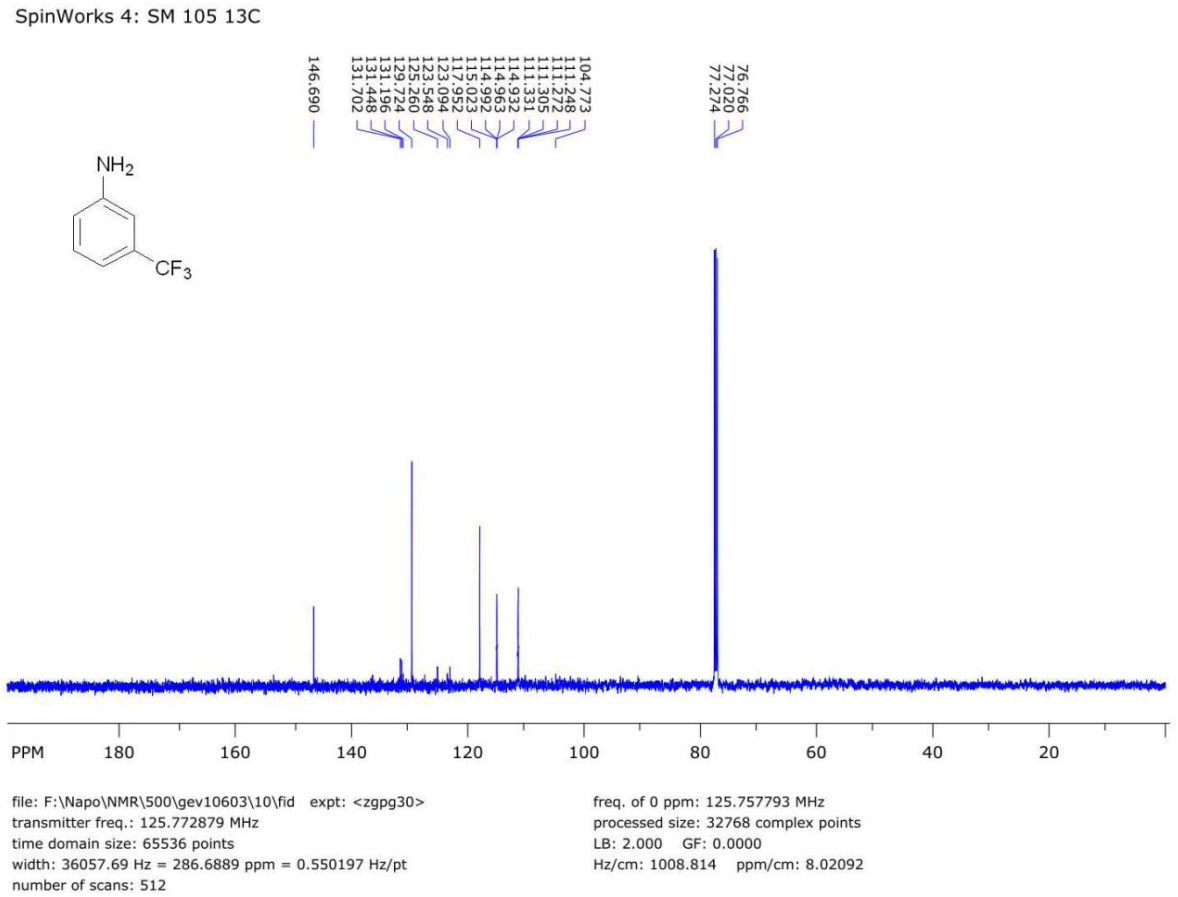
Compound 6f



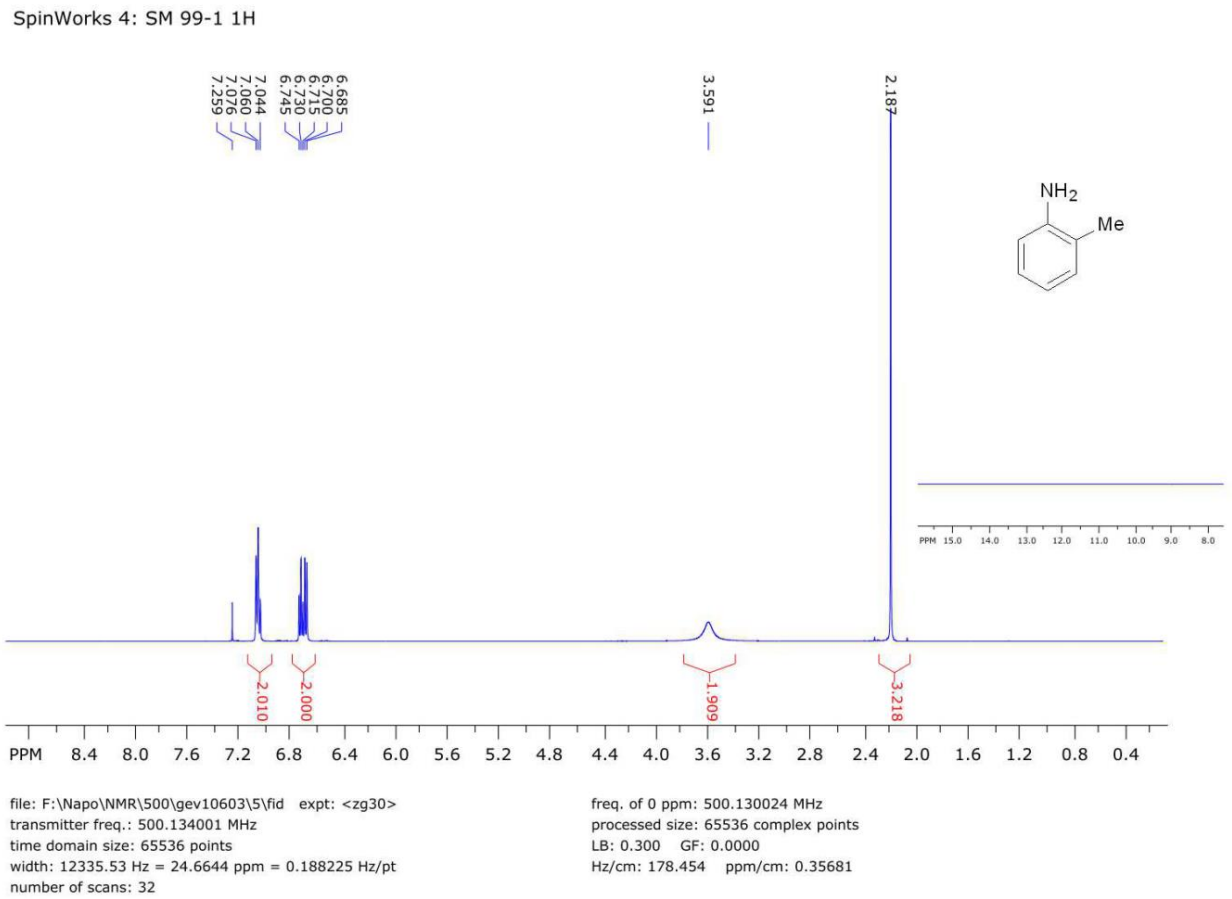
file: F:\Napo\NMR\500\gev10603\9\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 200.359 ppm/cm: 0.40061

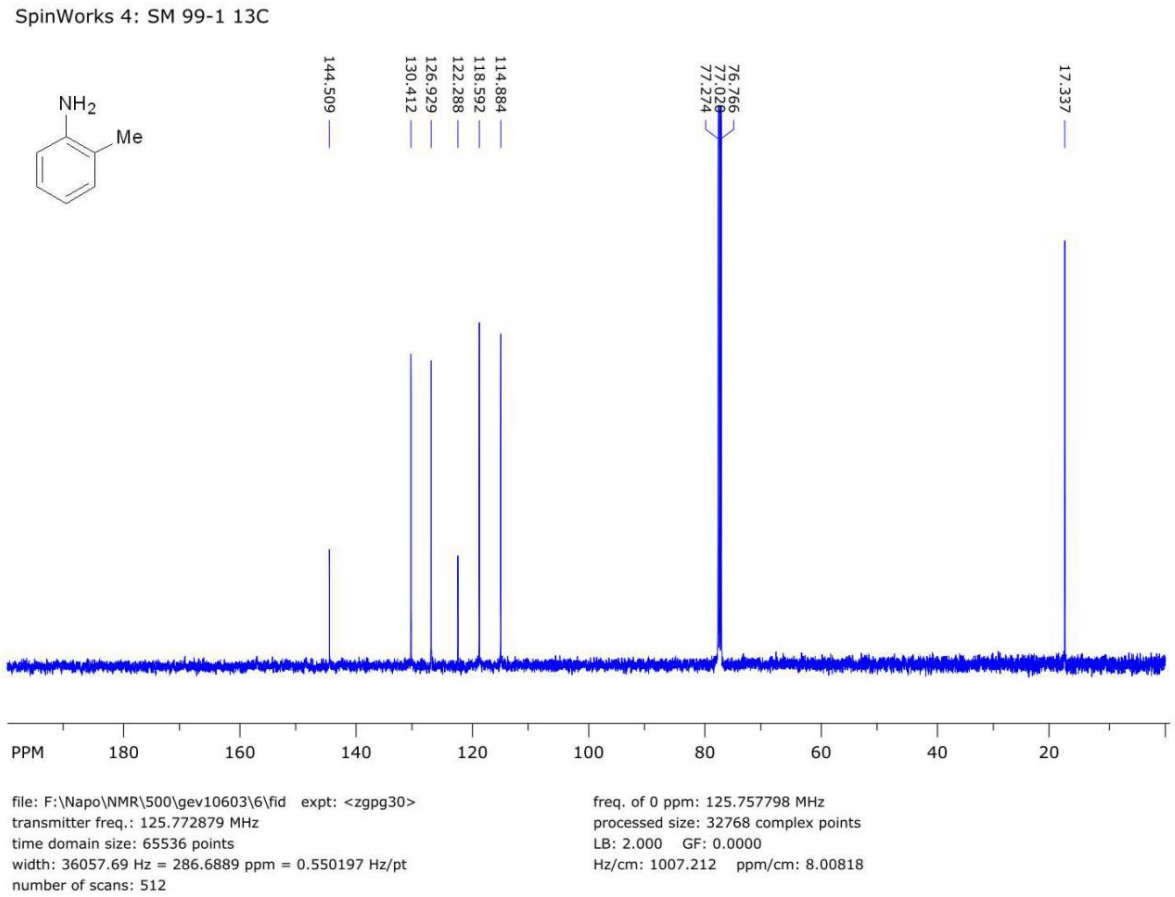
Compound 6f


SpinWorks 4: SM 105 13C
146.690
131.702
131.448
131.196
129.724
125.260
123.548
123.094
117.952
115.032
114.992
114.963
114.932
111.331
111.305
111.248
111.222
104.773
77.274
77.020
76.766
NH2
CF3
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\gev10603\10\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757793 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1008.814 ppm/cm: 8.02092

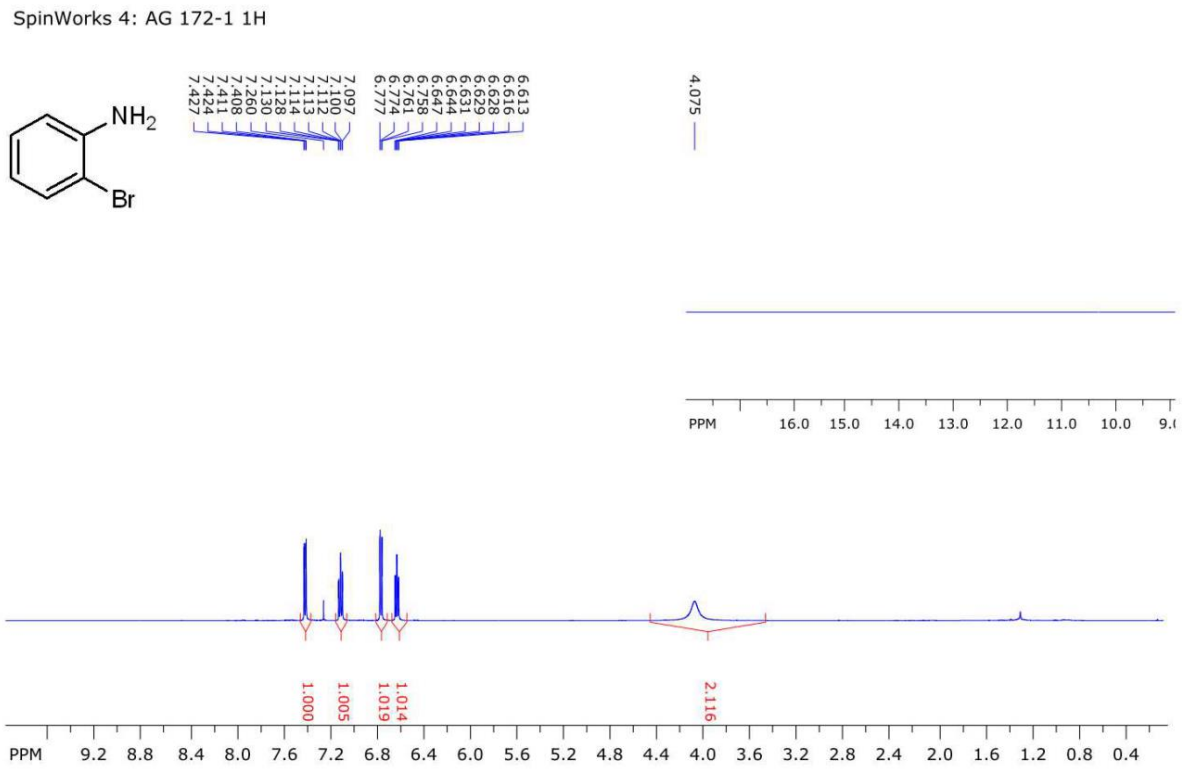
Compound 6g


SpinWorks 4: SM 99-1 1H
7.259
7.076
7.060
7.044
6.745
6.730
6.715
6.700
6.685
3.591
2.187
NH2
Me
2.010
2.000
1.909
3.218
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\gev10603\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 178.454 ppm/cm: 0.35681

Compound 6g


SpinWorks 4: SM 99-1 13C
NH2
Me
144.509
130.412
126.929
122.288
118.592
114.884
77.274
77.026
76.766
17.337
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\gev10603\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757798 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1007.212 ppm/cm: 8.00818

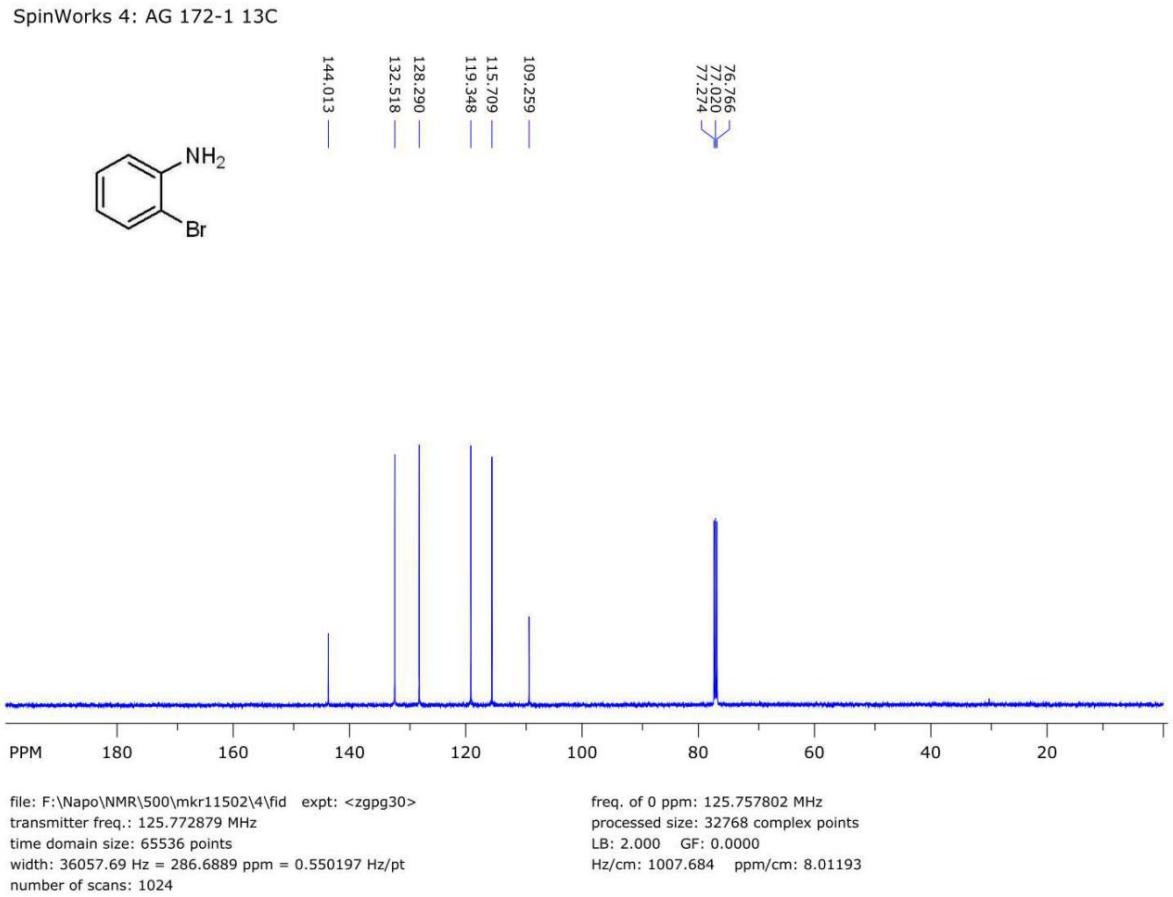
Compound 6h



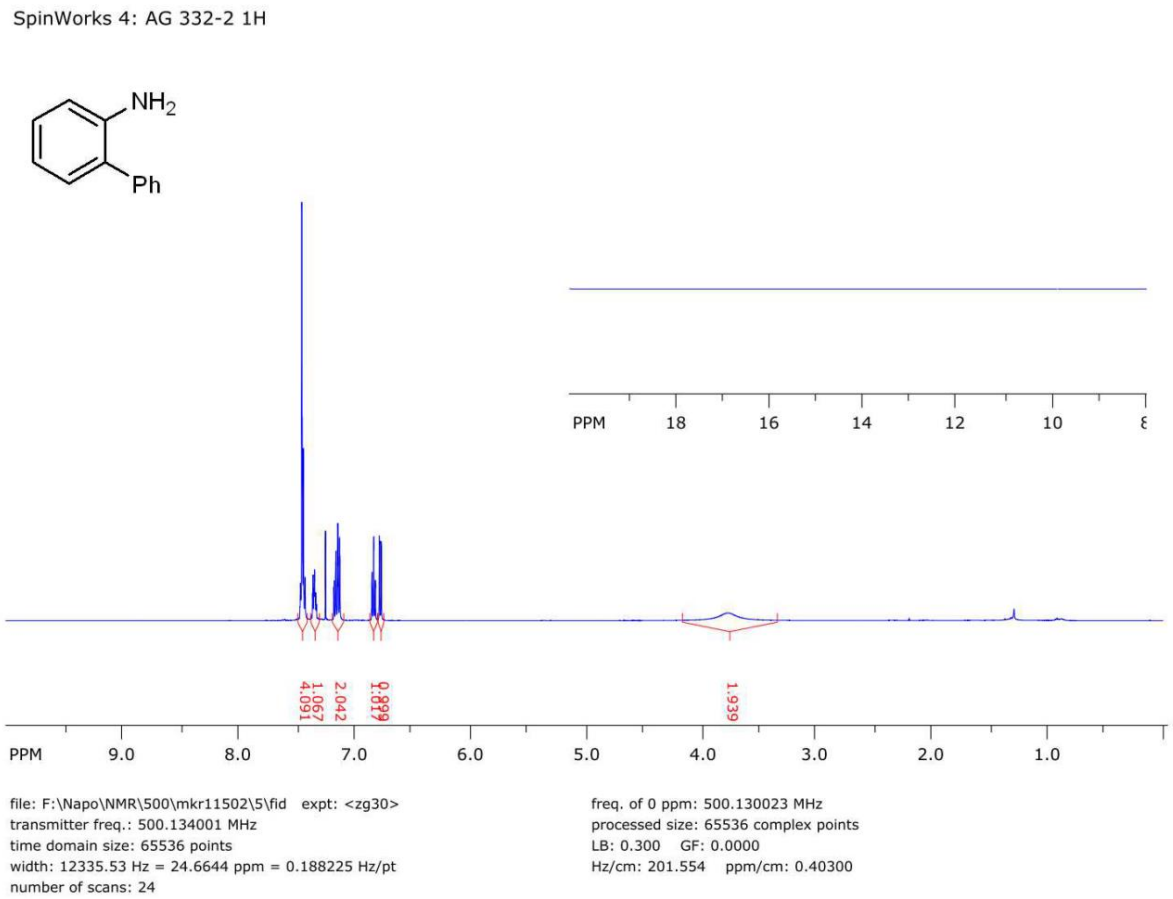
file: F:\Napo\NMR\500\mkr11502\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24

freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.800 ppm/cm: 0.39749

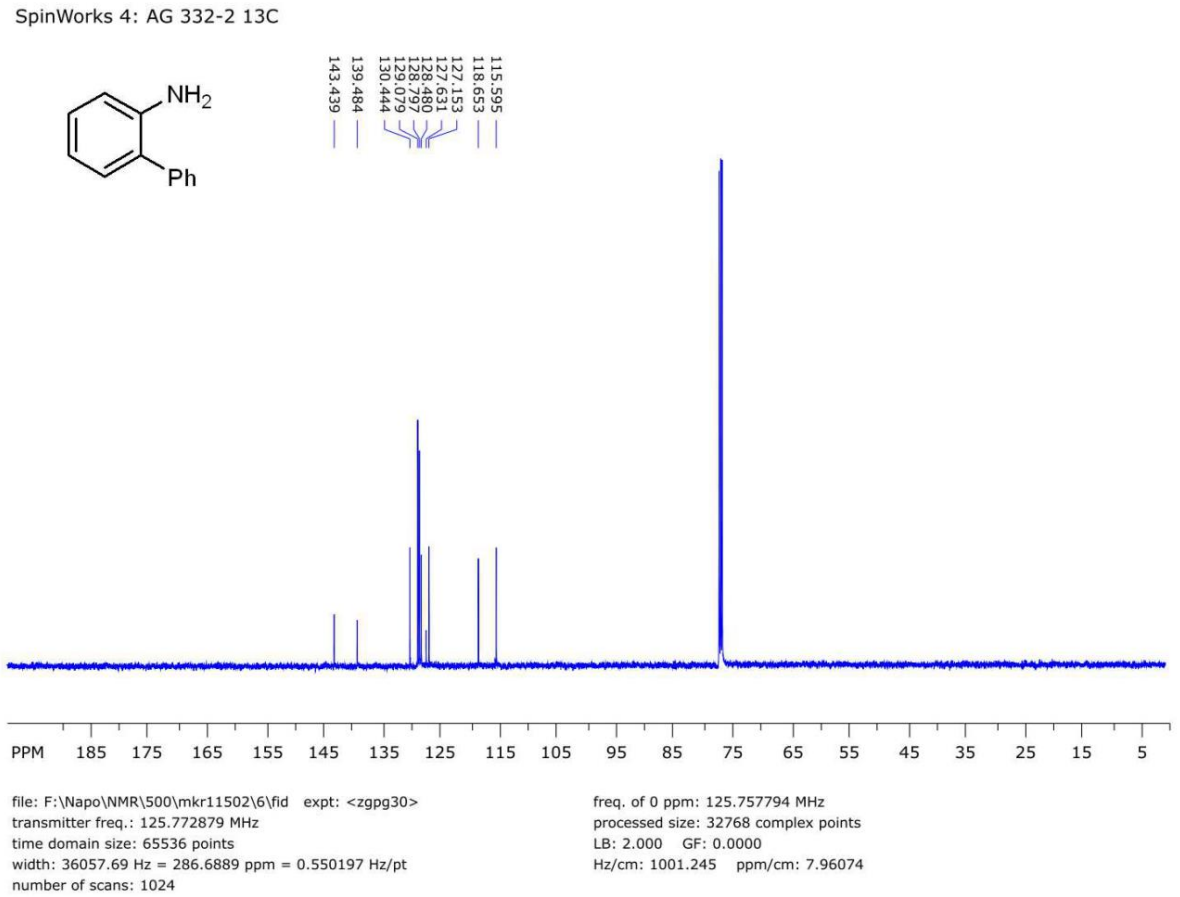
Compound 6h


SpinWorks 4: AG 172-1 13C
144.013
132.518
128.290
119.348
115.709
109.259
77.274
77.020
76.766
NH2
Br
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\mkr11502\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757802 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1007.684 ppm/cm: 8.01193

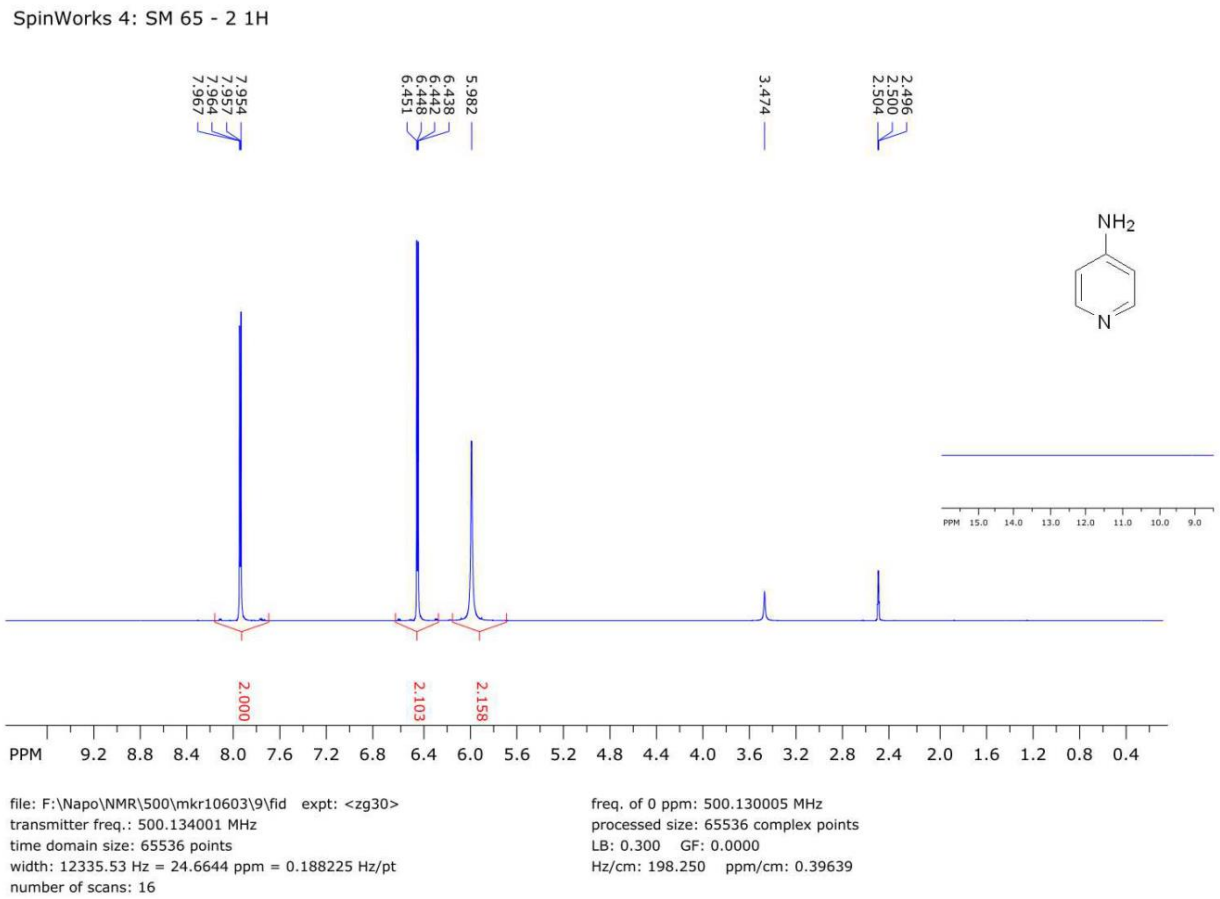
Compound 6i


SpinWorks 4: AG 332-2 1H
NH2
Ph
PPM 18 16 14 12 10
4.091
1.067
2.042
0.899
0.879
1.939
PPM 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0
file: F:\Napo\NMR\500\mkr11502\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 201.554 ppm/cm: 0.40300

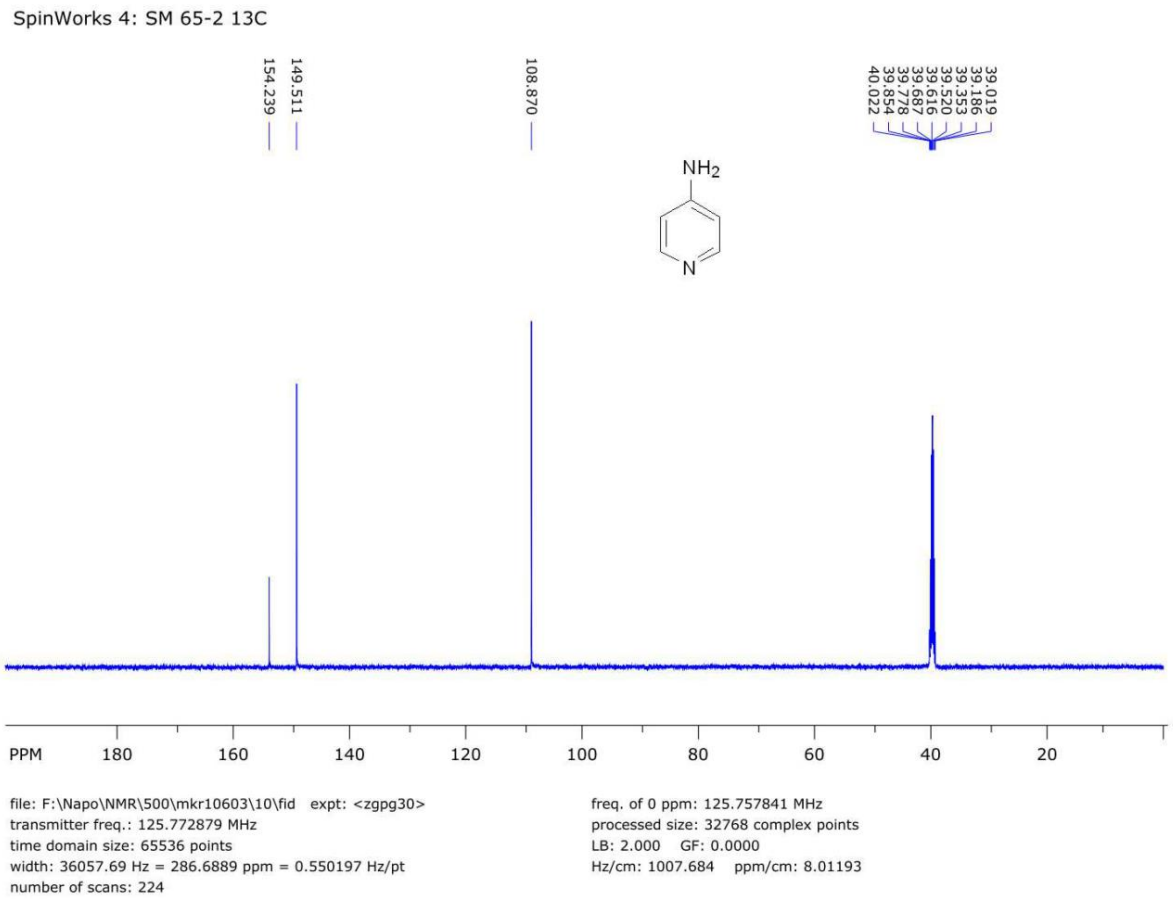
Compound 6i


SpinWorks 4: AG 332-2 13C
NH2
Ph
143.439
139.484
130.444
129.079
128.797
128.480
127.631
127.153
118.653
115.595
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr11502\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757794 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1001.245 ppm/cm: 7.96074

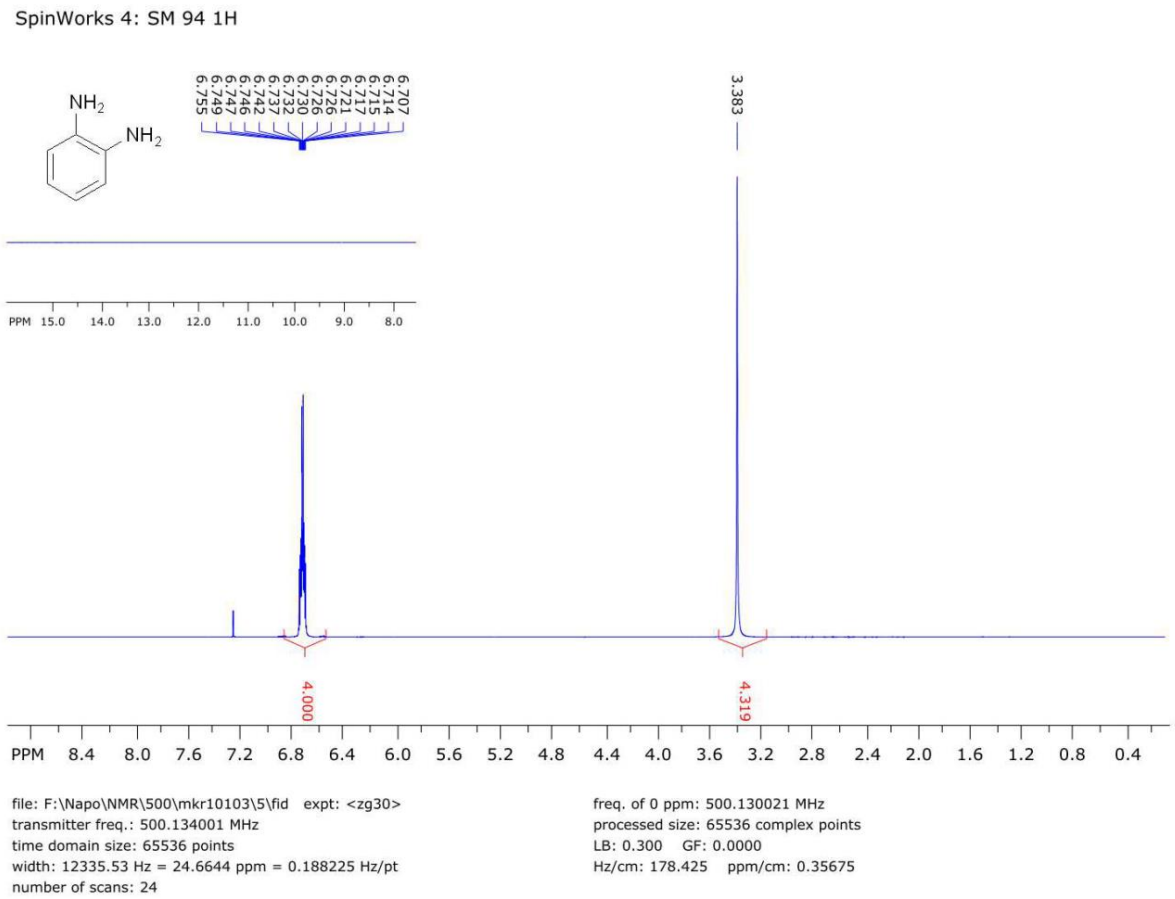
Compound 6j


SpinWorks 4: SM 65 - 2 1H
7.967
7.964
7.957
7.954
6.451
6.448
6.442
6.438
5.982
3.474
2.504
2.500
2.496
NH2
N
2.000
2.103
2.158
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10603\9\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 16
freq. of 0 ppm: 500.130005 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.250 ppm/cm: 0.39639

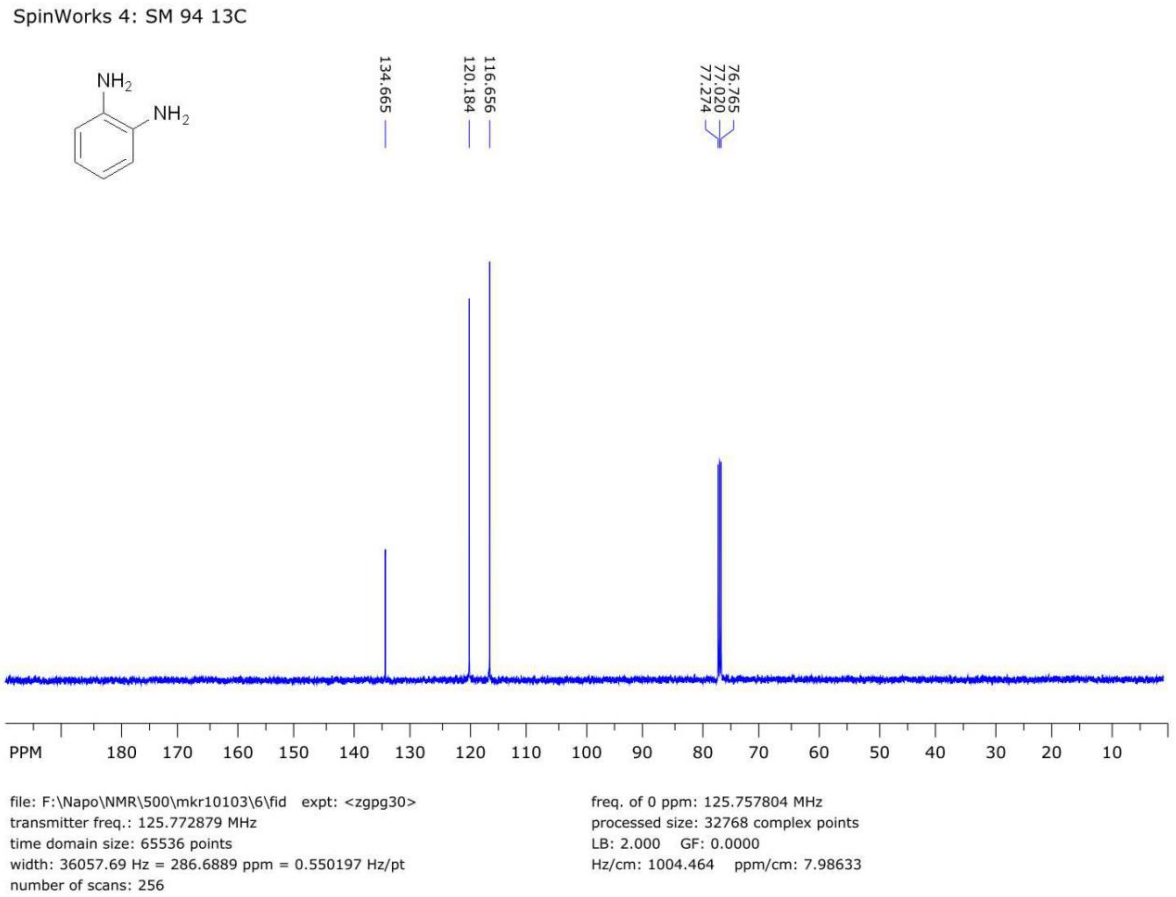
Compound 6j


SpinWorks 4: SM 65-2 13C
154.239
149.511
108.870
40.022
39.854
39.778
39.687
39.616
39.520
39.353
39.186
39.019
NH2
N
PPM
180
160
140
120
100
80
60
40
20
file: F:\Napo\NMR\500\mkr10603\10\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 224
freq. of 0 ppm: 125.757841 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1007.684 ppm/cm: 8.01193

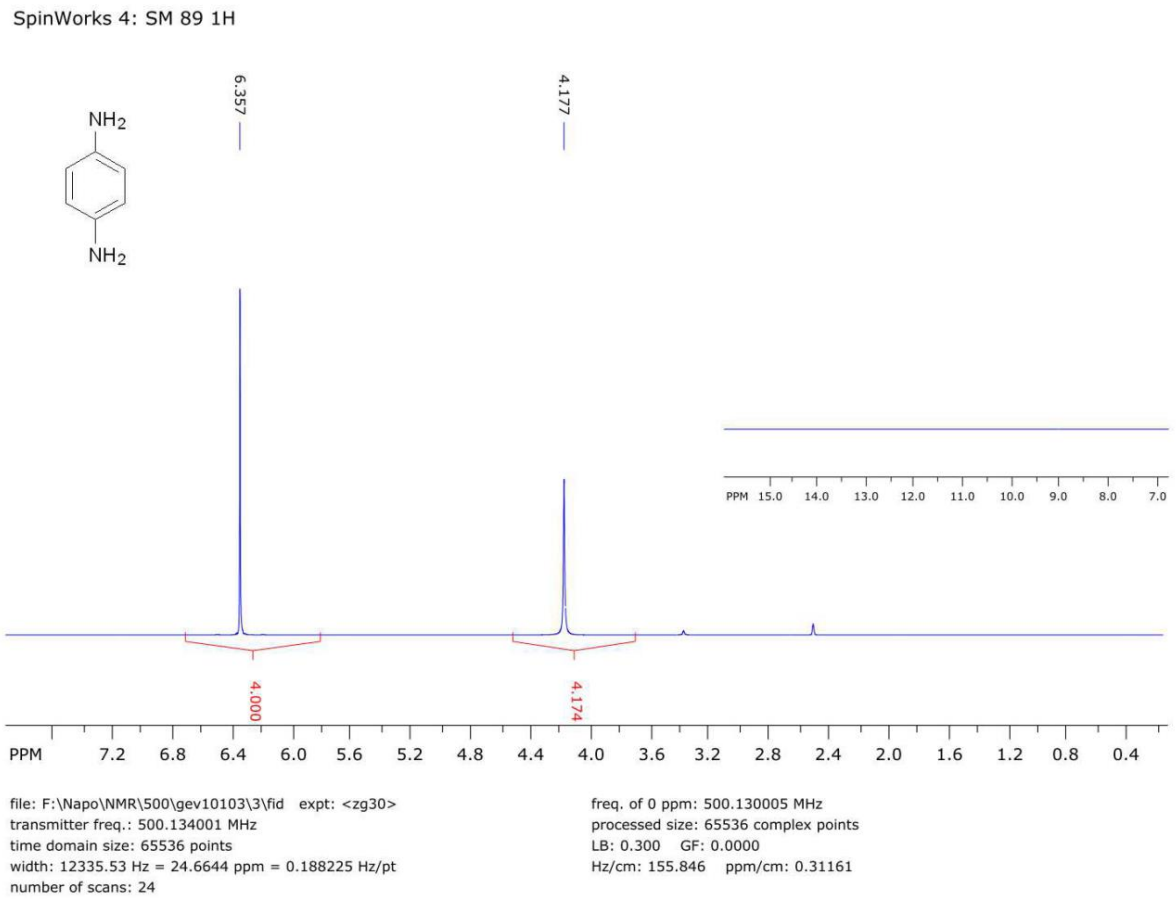
Compound 7a


SpinWorks 4: SM 94 1H
NH2
NH2
6.755
6.749
6.747
6.746
6.742
6.737
6.732
6.730
6.726
6.726
6.721
6.717
6.715
6.714
6.707
3.383
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0 8.0
4.000
4.319
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10103\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130021 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 178.425 ppm/cm: 0.35675

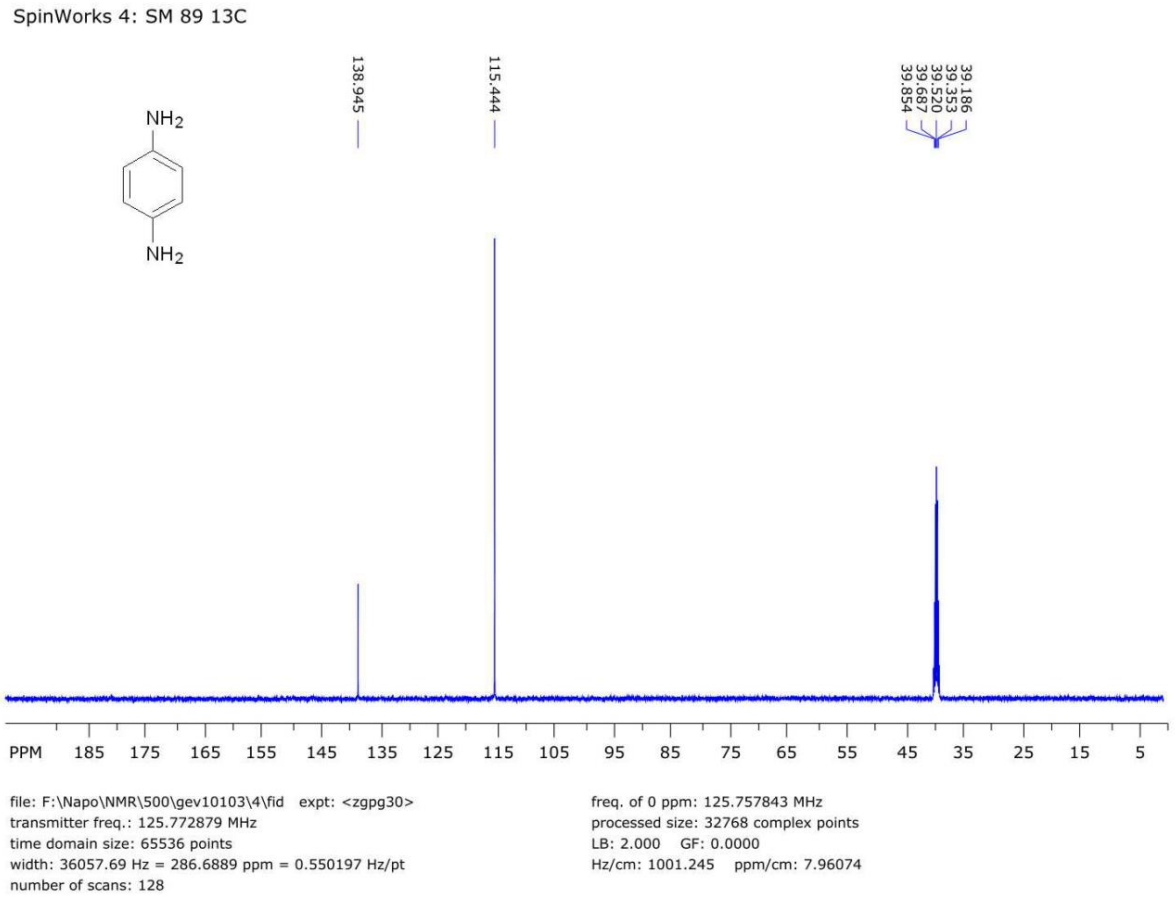
Compound 7a


SpinWorks 4: SM 94 13C
NH2
NH2
134.665
120.184
116.656
77.274
77.020
76.765
PPM
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
file: F:\Napo\NMR\500\mkr10103\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 256
freq. of 0 ppm: 125.757804 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1004.464 ppm/cm: 7.98633

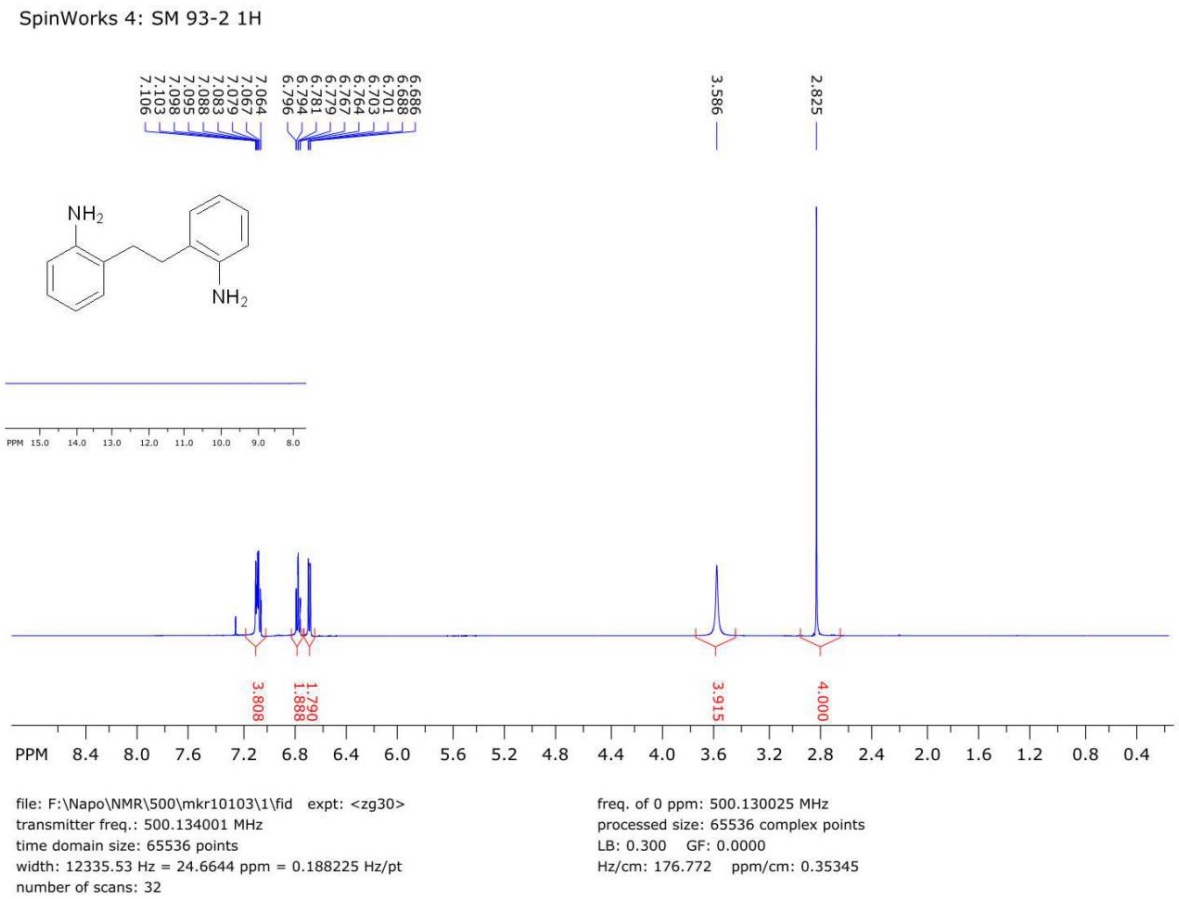
Compound 7b


SpinWorks 4: SM 89 1H
6.357
4.177
NH2
NH2
PPM 15.0 14.0 13.0 12.0 11.0 10.0 9.0 8.0 7.0
4.000
4.174
PPM 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\gev10103\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130005 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 155.846 ppm/cm: 0.31161

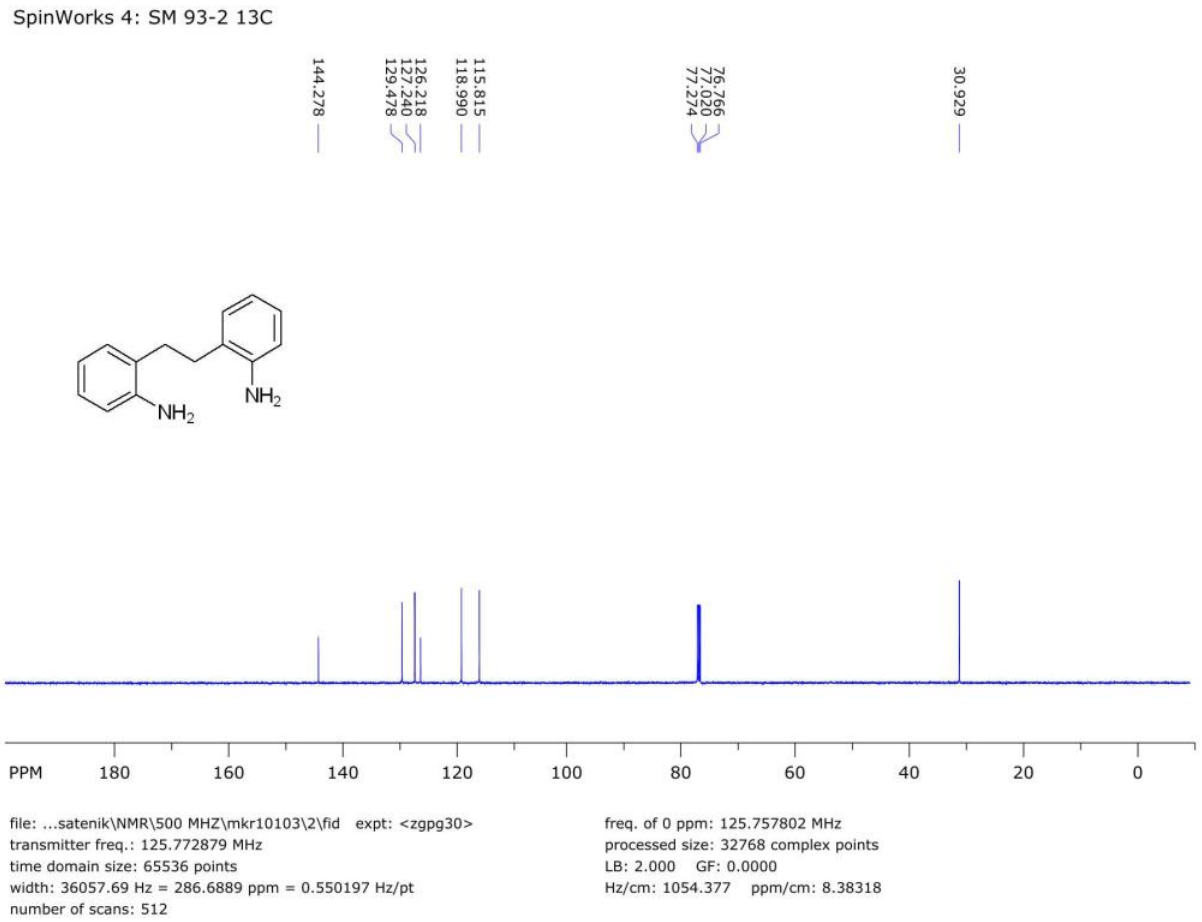
Compound 7b


SpinWorks 4: SM 89 13C
138.945
115.444
39.854
39.687
39.520
39.353
39.186
NH2
NH2
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\gev10103\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 128
freq. of 0 ppm: 125.757843 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1001.245 ppm/cm: 7.96074

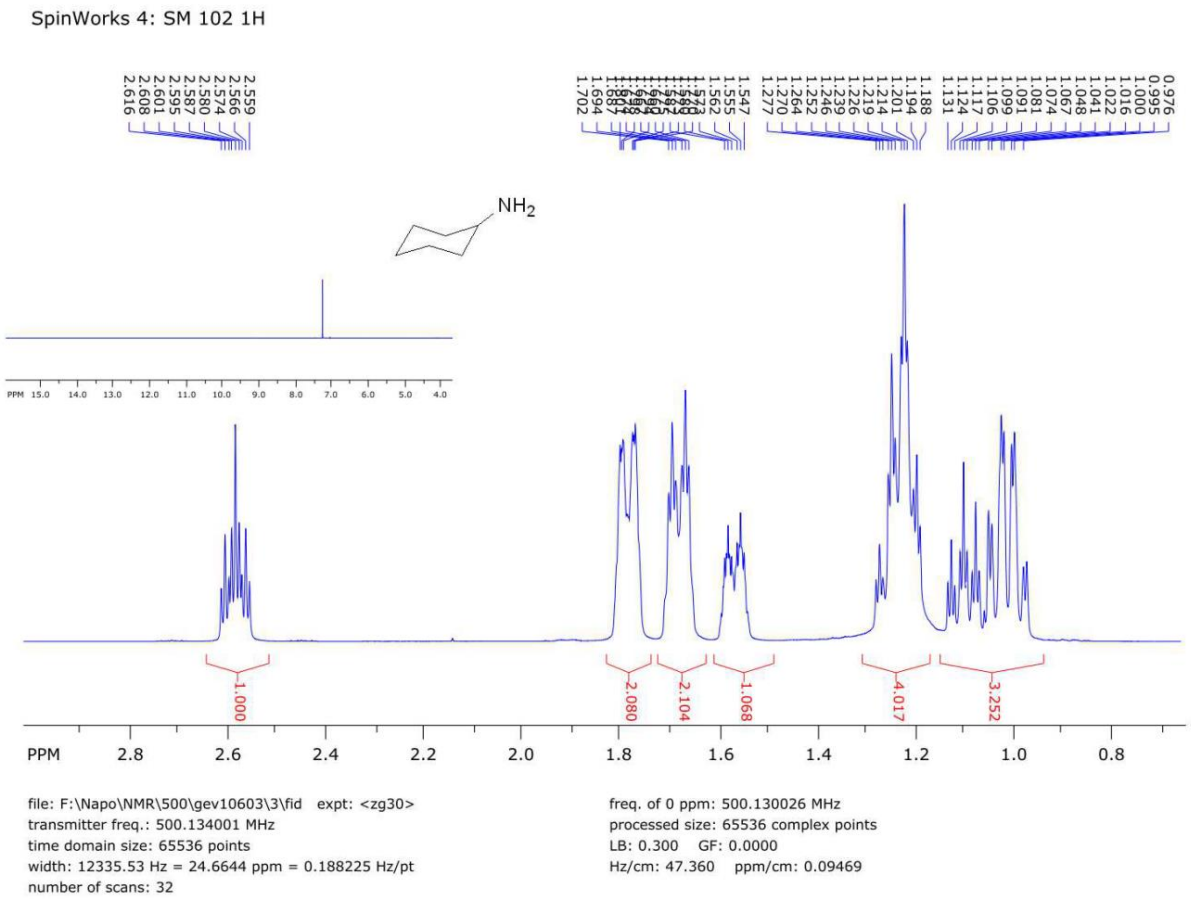
Compound 7c


SpinWorks 4: SM 93-2 1H
7.106
7.103
7.098
7.095
7.088
7.083
7.079
7.067
7.064
6.796
6.794
6.781
6.779
6.767
6.764
6.703
6.701
6.688
6.686
3.586
2.825
NH2
NH2
3.808
1.790
1.888
3.915
4.000
PPM 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10103\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130025 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 176.772 ppm/cm: 0.35345

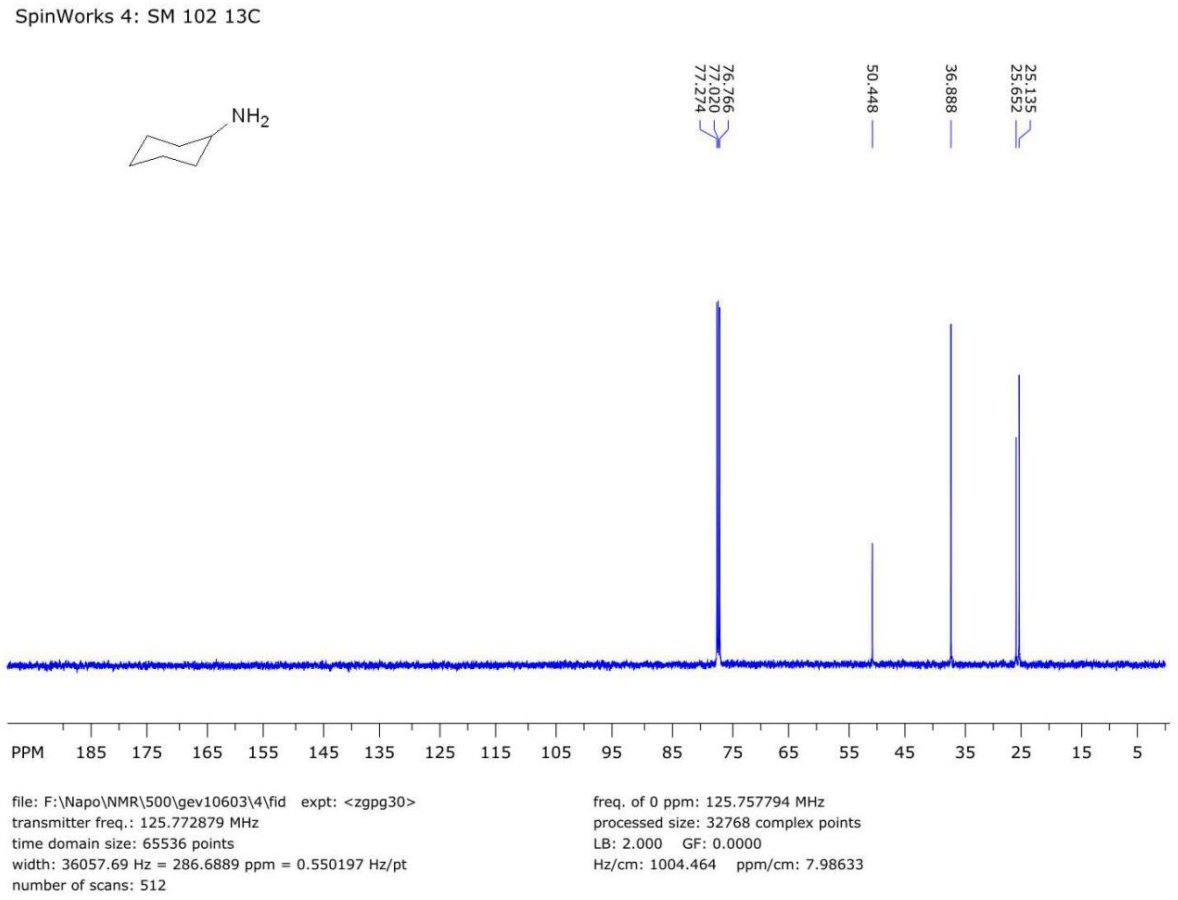
Compound 7c


SpinWorks 4: SM 93-2 13C
144.278
129.478
127.240
126.218
118.990
115.815
77.274
77.020
76.766
30.929
NH2
NH2
PPM
180
160
140
120
100
80
60
40
20
0
file: ...satenik\NMR\500 MHZ\mkr10103\2\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757802 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1054.377 ppm/cm: 8.38318

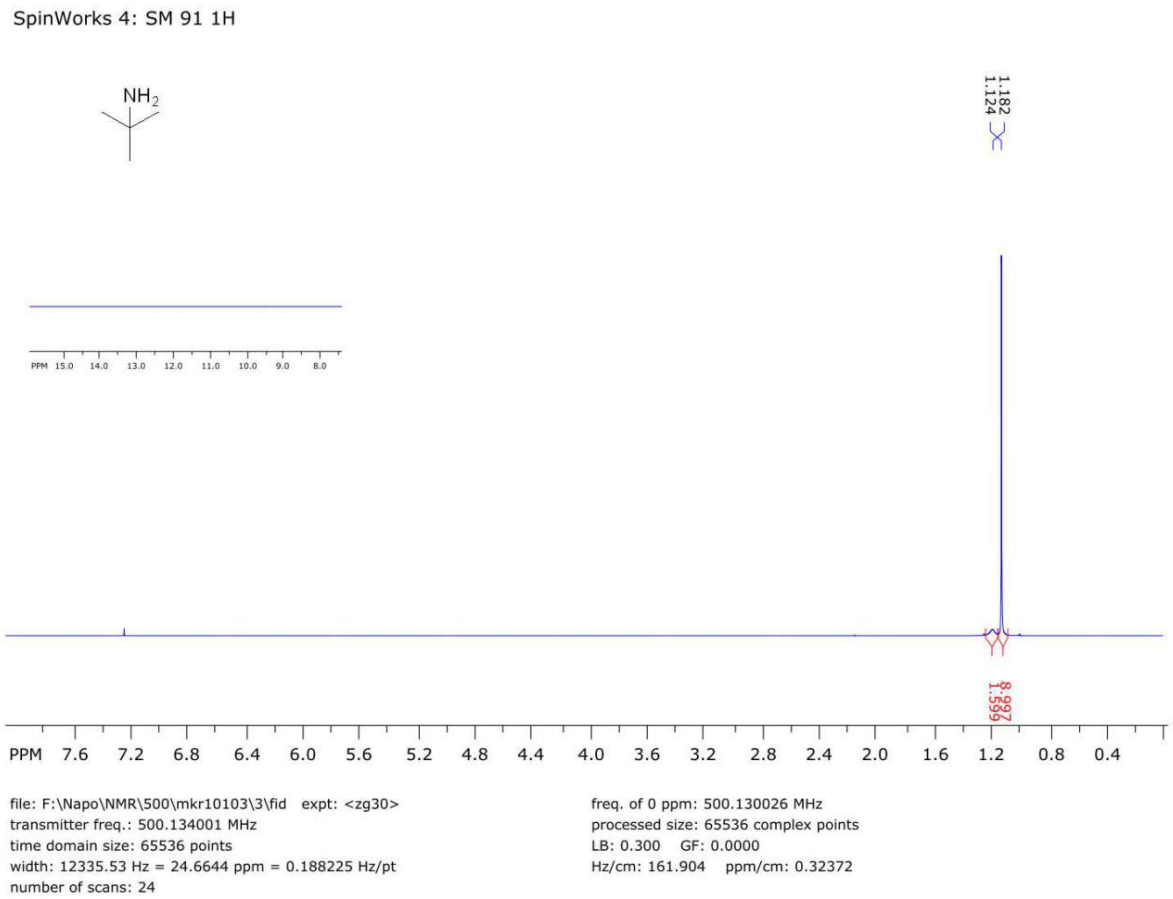
Compound 8a


SpinWorks 4: SM 102 1H
NH2
PPM
1.000
2.080
2.104
1.068
4.017
3.252
file: F:\Napo\NMR\500\gev10603\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130026 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 47.360 ppm/cm: 0.09469

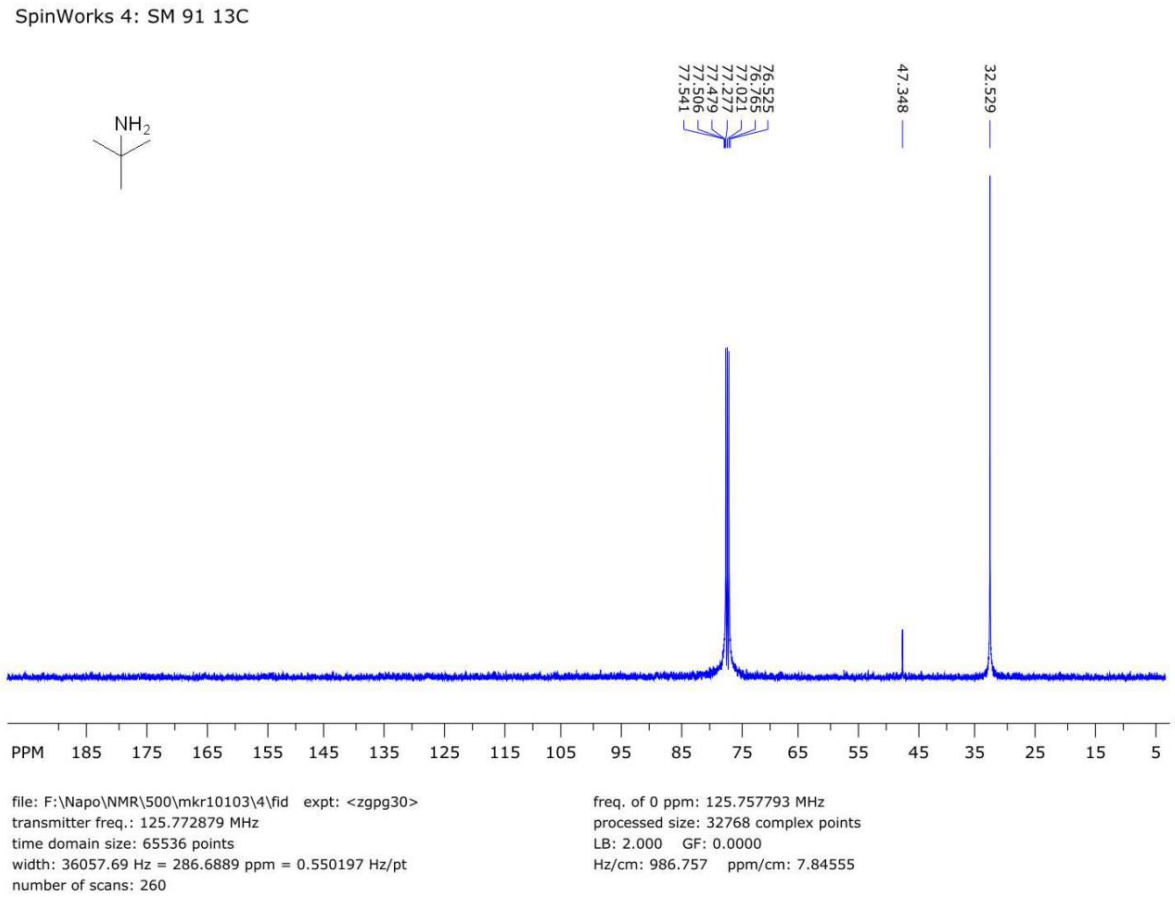
Compound 8a


SpinWorks 4: SM 102 13C
NH2
76.766
77.020
77.274
50.448
36.888
25.135
25.652
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\gev10603\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 512
freq. of 0 ppm: 125.757794 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1004.464 ppm/cm: 7.98633

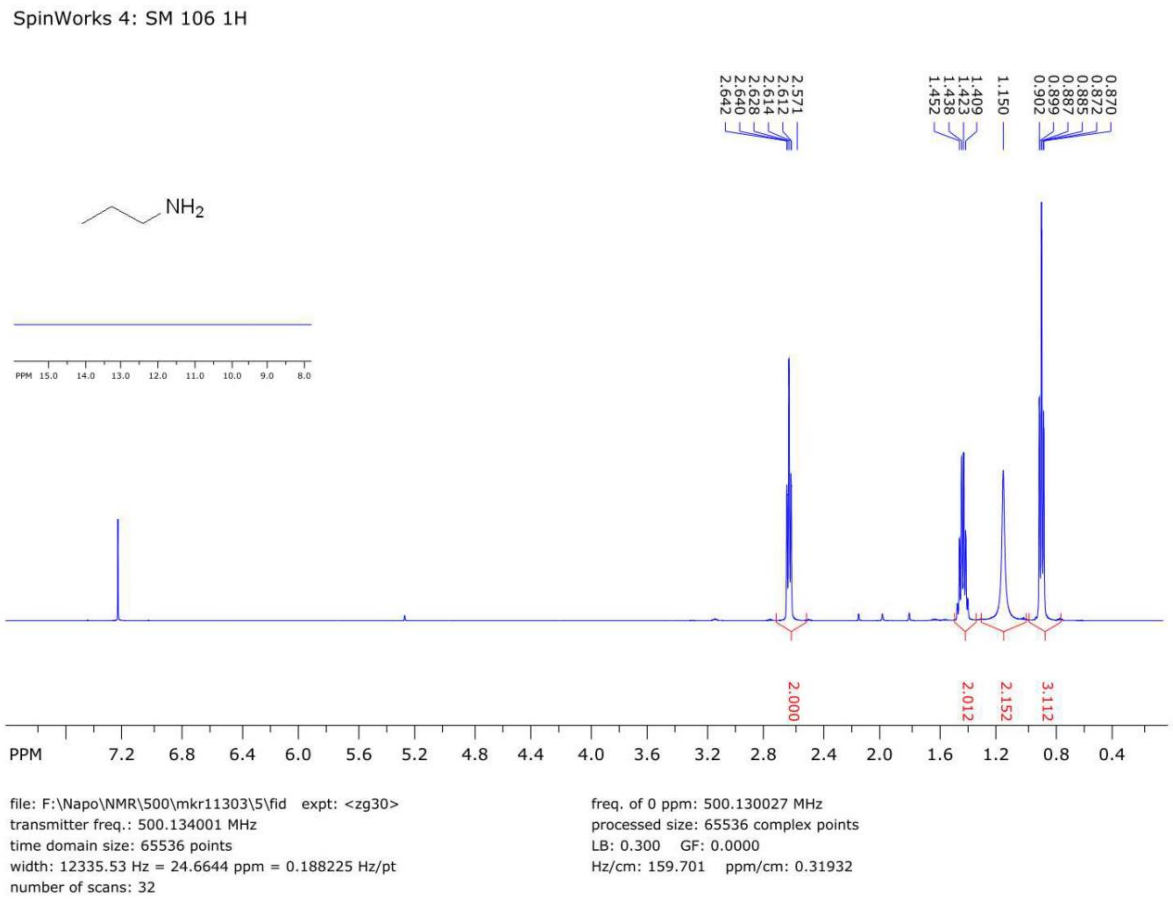
Compound 8b


SpinWorks 4: SM 91 1H
NH2
1.182
1.124
8.997
1.599
PPM 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10103\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130026 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 161.904 ppm/cm: 0.32372

Compound 8b


SpinWorks 4: SM 91 13C
NH2
77.541
77.506
77.479
77.277
77.021
76.765
76.525
47.348
32.529
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr10103\4\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 260
freq. of 0 ppm: 125.757793 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 986.757 ppm/cm: 7.84555

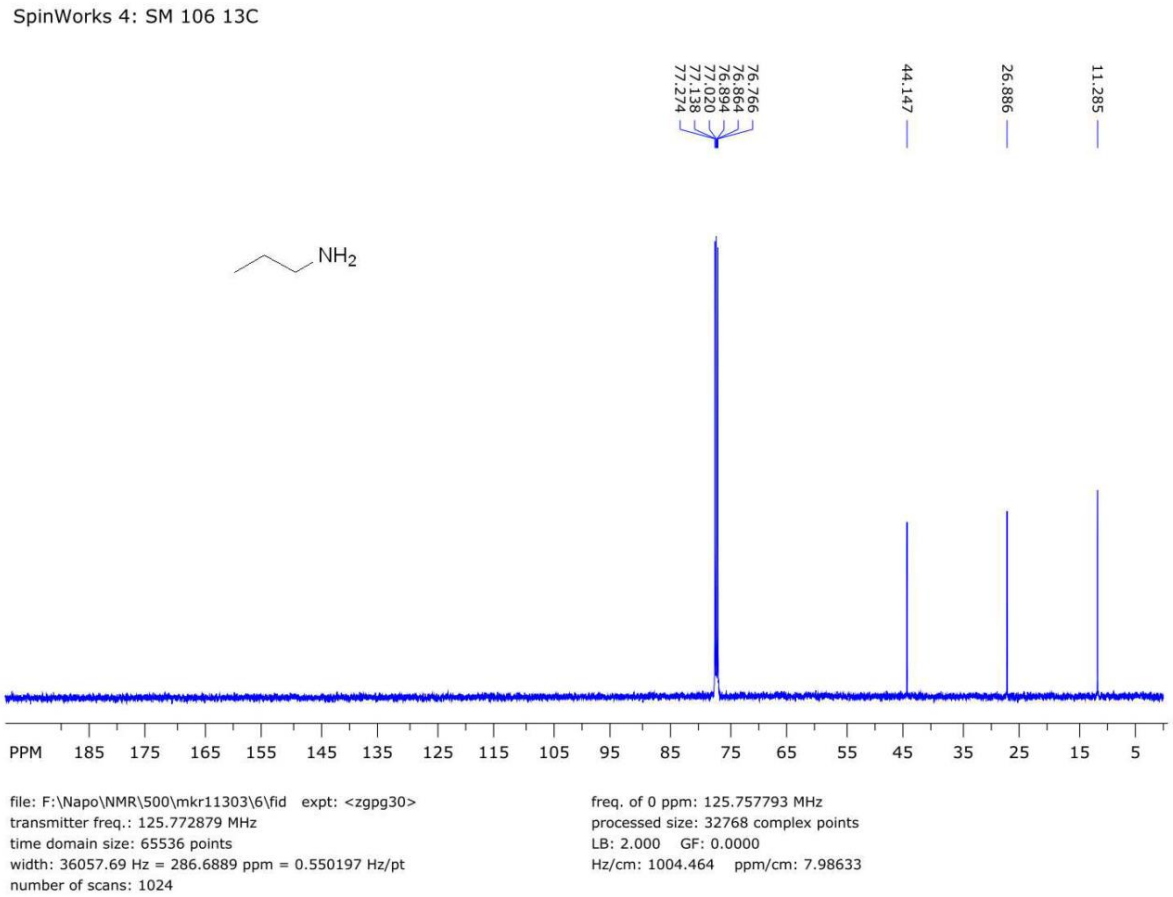
Compound 8c



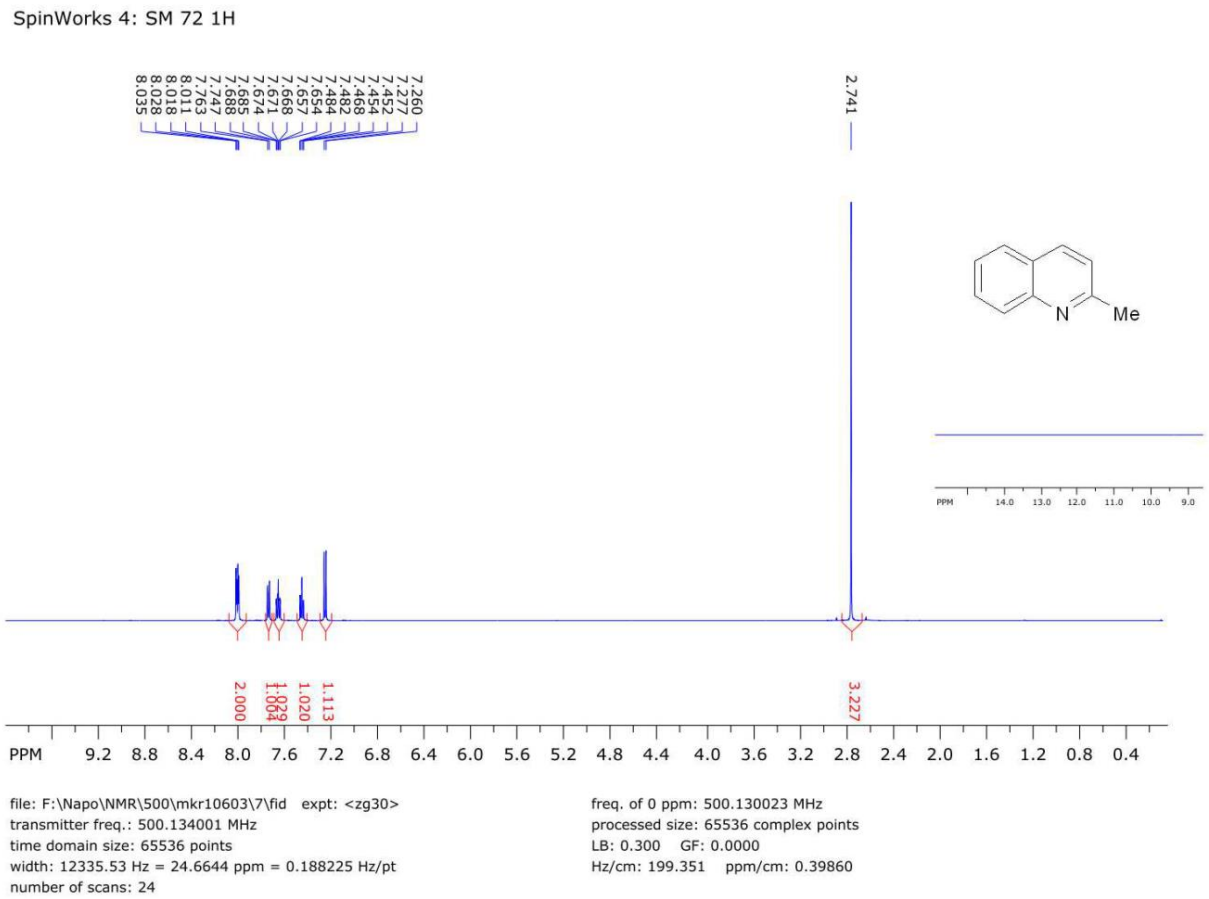
file: F:\Napo\NMR\500\mkr11303\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130027 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 159.701 ppm/cm: 0.31932

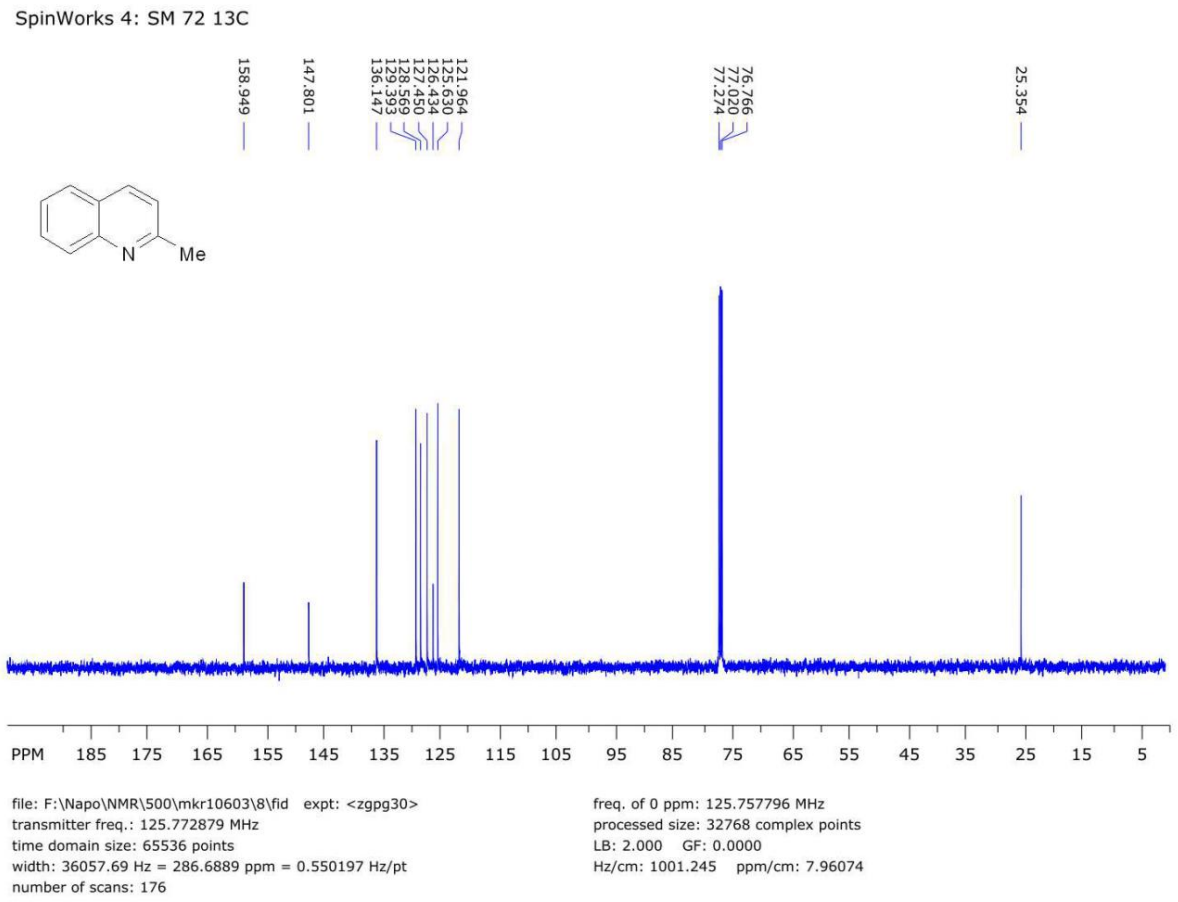
Compound 8c


SpinWorks 4: SM 106 13C
77.274
77.138
77.020
76.894
76.864
76.766
44.147
26.886
11.285
NH2
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr11303\6\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1024
freq. of 0 ppm: 125.757793 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1004.464 ppm/cm: 7.98633

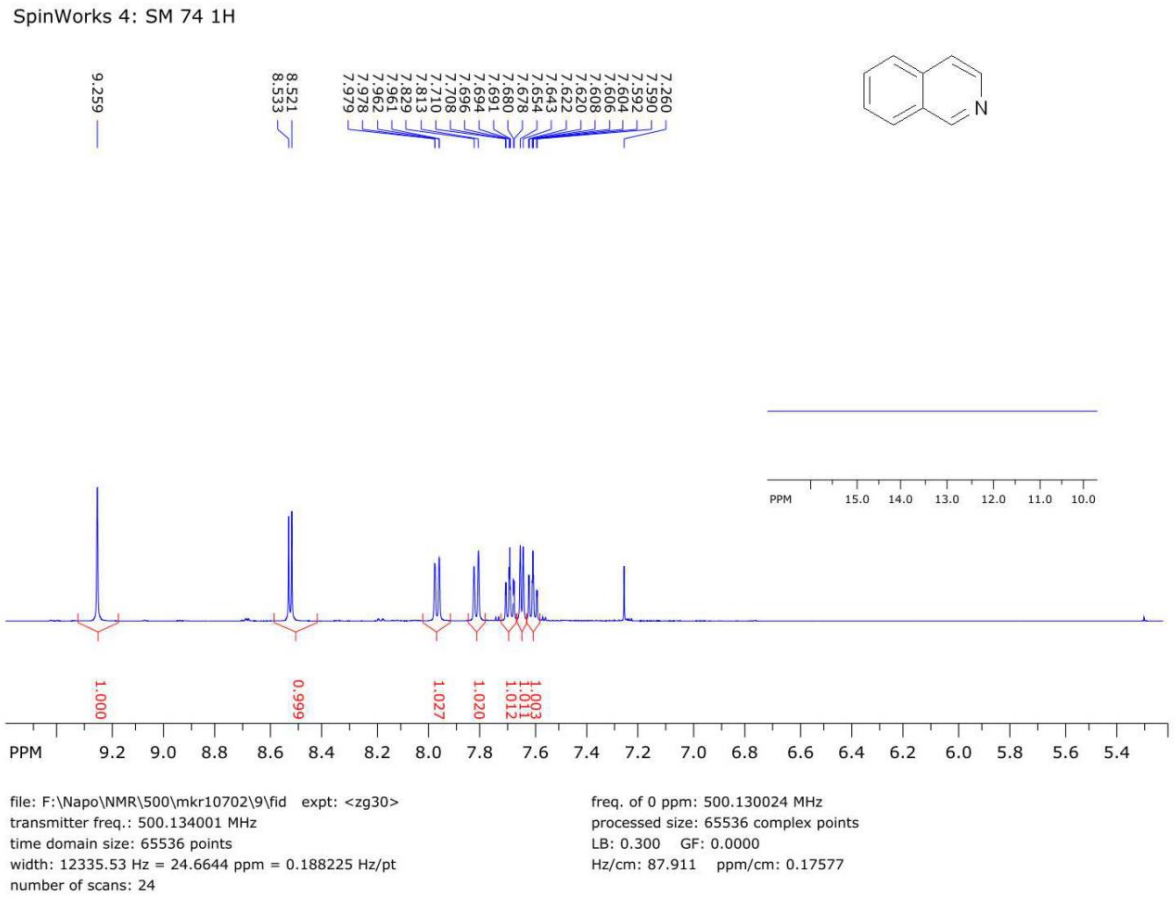
Compound 9a


SpinWorks 4: SM 72 1H
8.035
8.028
8.018
8.011
7.763
7.747
7.688
7.685
7.674
7.671
7.668
7.657
7.654
7.484
7.482
7.468
7.454
7.452
7.277
7.260
2.741
N
Me
PPM 14.0 13.0 12.0 11.0 10.0 9.0
2.000
1.029
1.004
1.020
1.113
3.227
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10603\7\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 199.351 ppm/cm: 0.39860

Compound 9a


SpinWorks 4: SM 72 13C
158.949
147.801
136.147
129.393
128.569
127.450
126.434
125.630
121.964
77.274
77.020
76.766
25.354
N
Me
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr10603\8\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 176
freq. of 0 ppm: 125.757796 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1001.245 ppm/cm: 7.96074

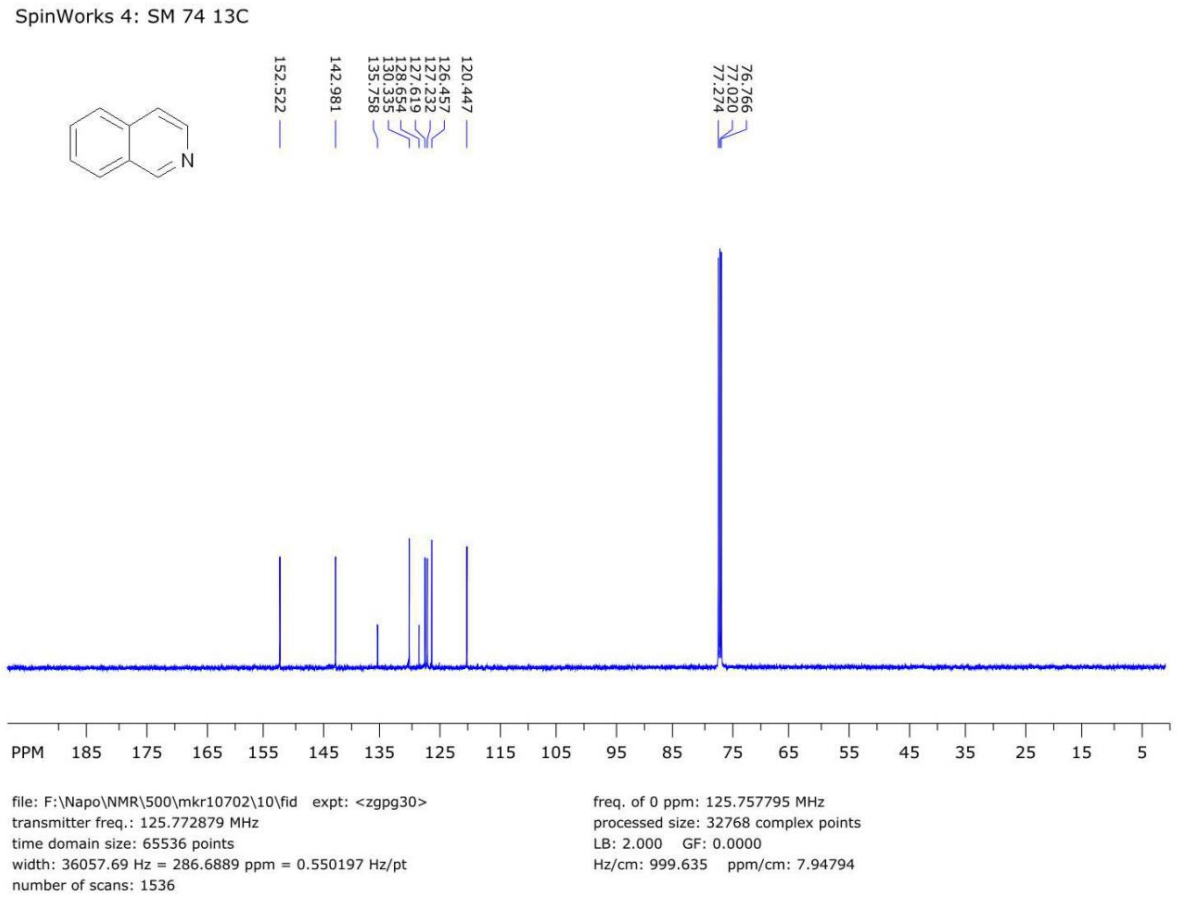
Compound 9b



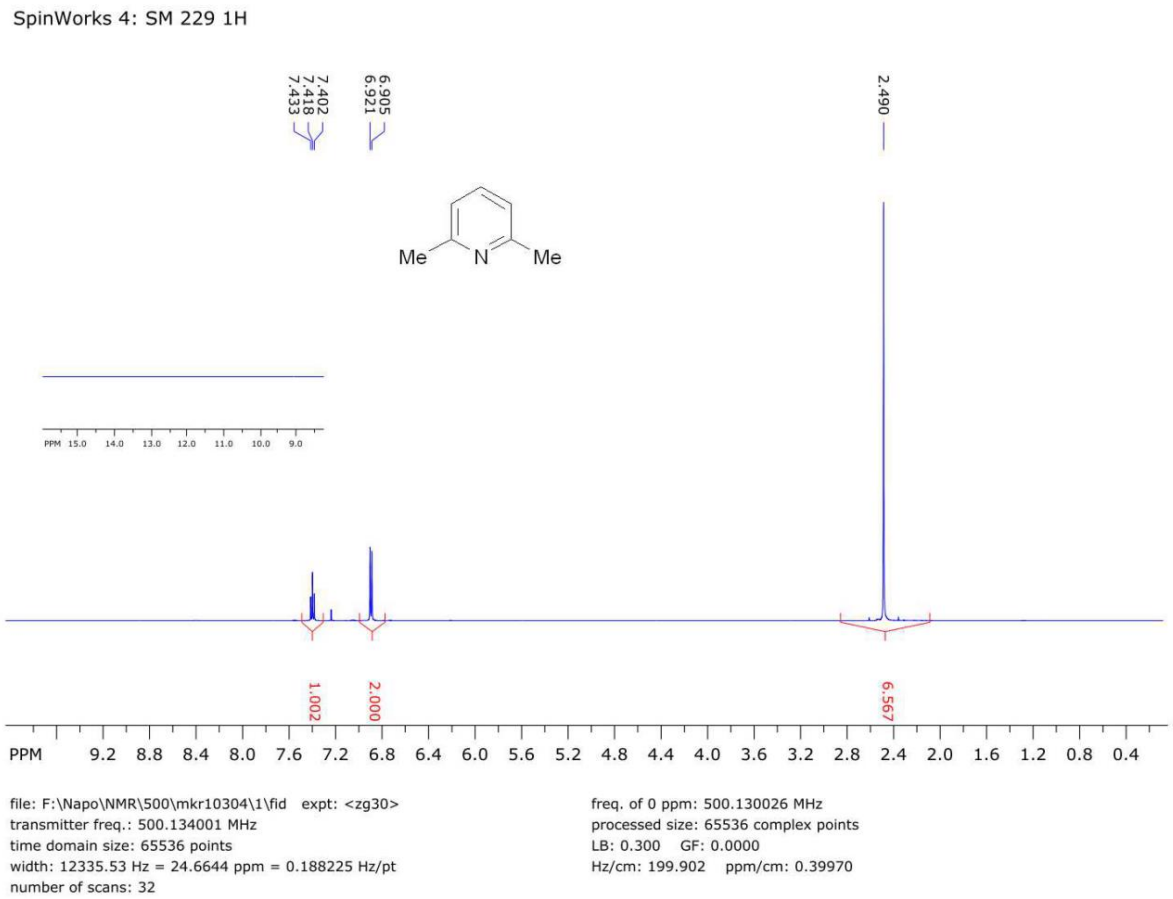
file: F:\Napo\NMR\500\mkr10702\9\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24

freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 87.911 ppm/cm: 0.17577

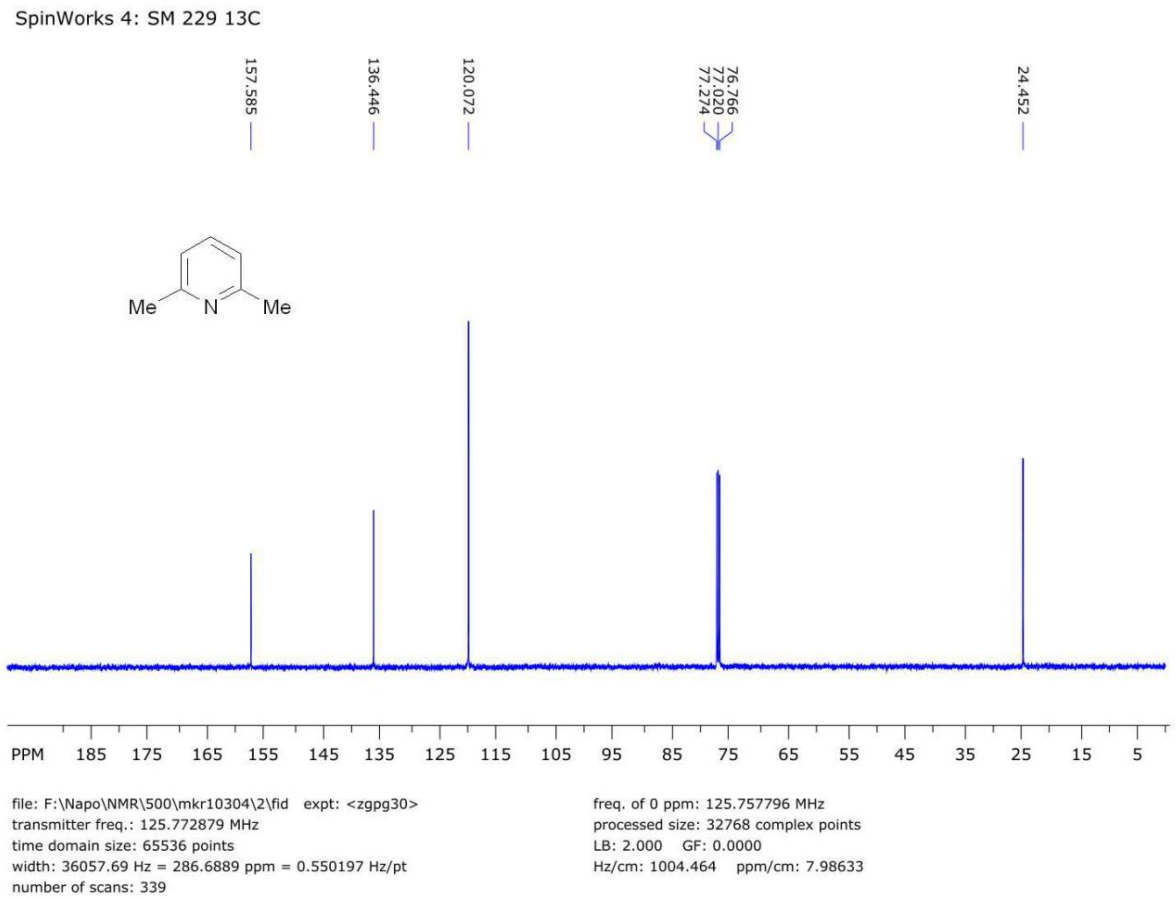
Compound 9b


SpinWorks 4: SM 74 13C
152.522
142.981
135.758
130.335
127.619
127.232
126.457
120.447
77.274
77.020
76.766
N
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr10702\10\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1536
freq. of 0 ppm: 125.757795 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 999.635 ppm/cm: 7.94794

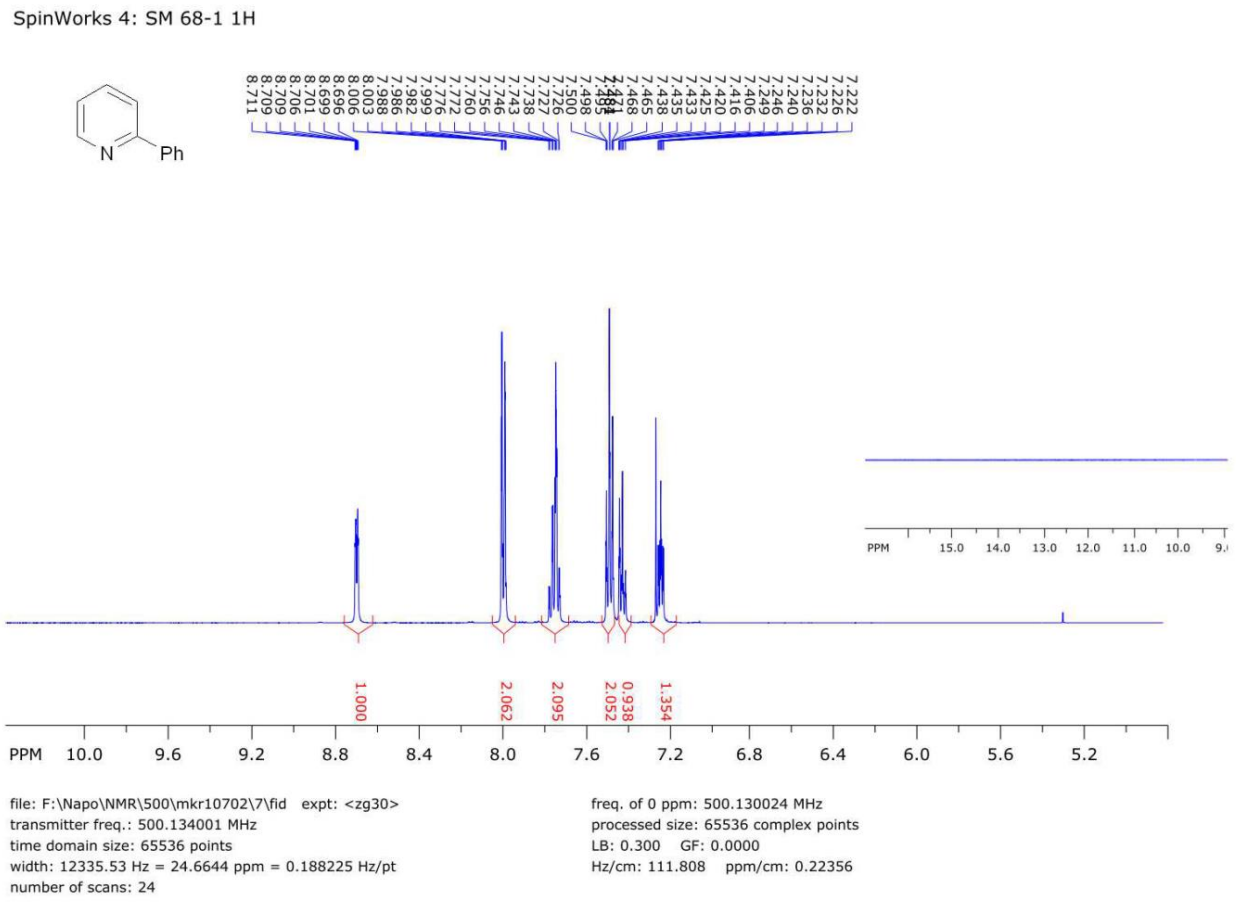
Compound 9c


SpinWorks 4: SM 229 1H
7.433
7.418
7.402
6.921
6.905
2.490
Me
N
Me
1.002
2.000
6.567
PPM 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2 4.8 4.4 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4
file: F:\Napo\NMR\500\mkr10304\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32
freq. of 0 ppm: 500.130026 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 199.902 ppm/cm: 0.39970

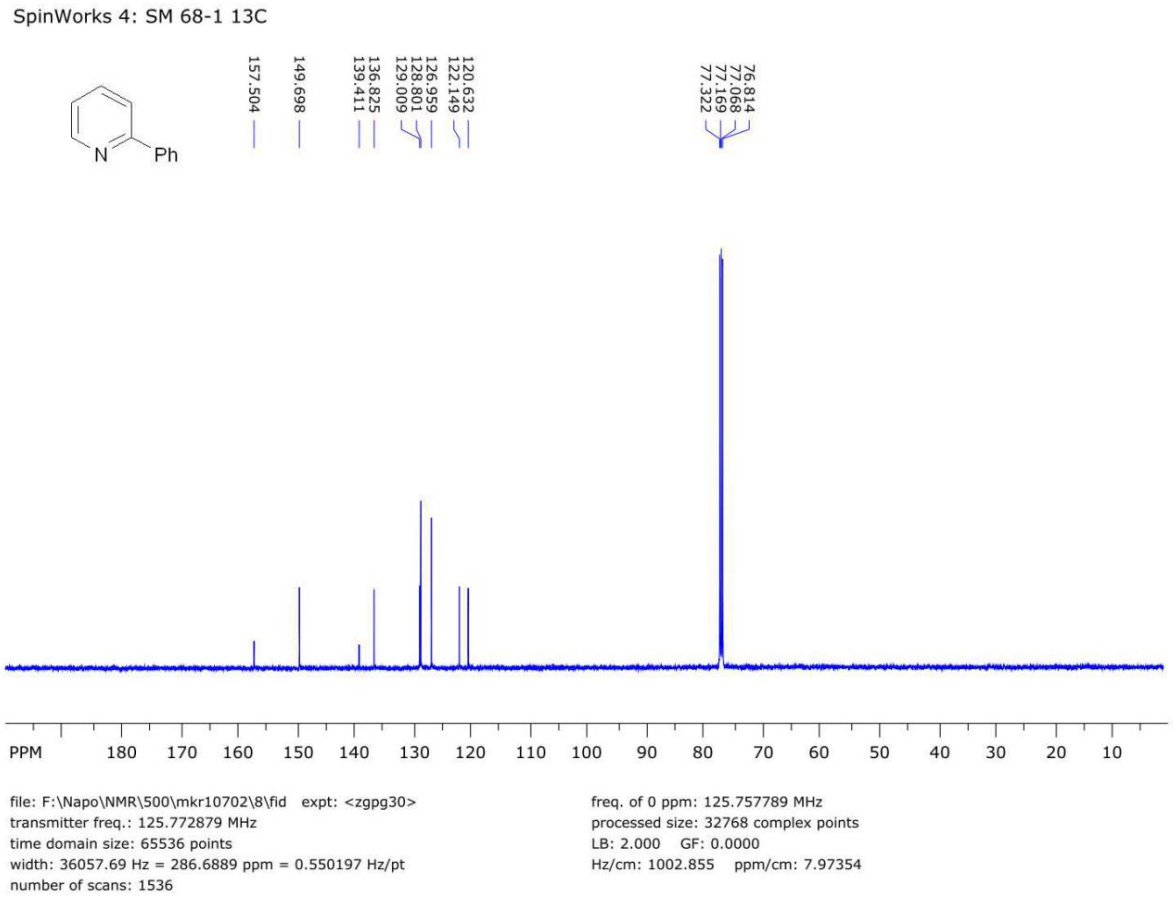
Compound 9c


SpinWorks 4: SM 229 13C
157.585
136.446
120.072
77.274
77.020
76.766
24.452
Me
N
Me
PPM 185 175 165 155 145 135 125 115 105 95 85 75 65 55 45 35 25 15 5
file: F:\Napo\NMR\500\mkr10304\2\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 339
freq. of 0 ppm: 125.757796 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1004.464 ppm/cm: 7.98633

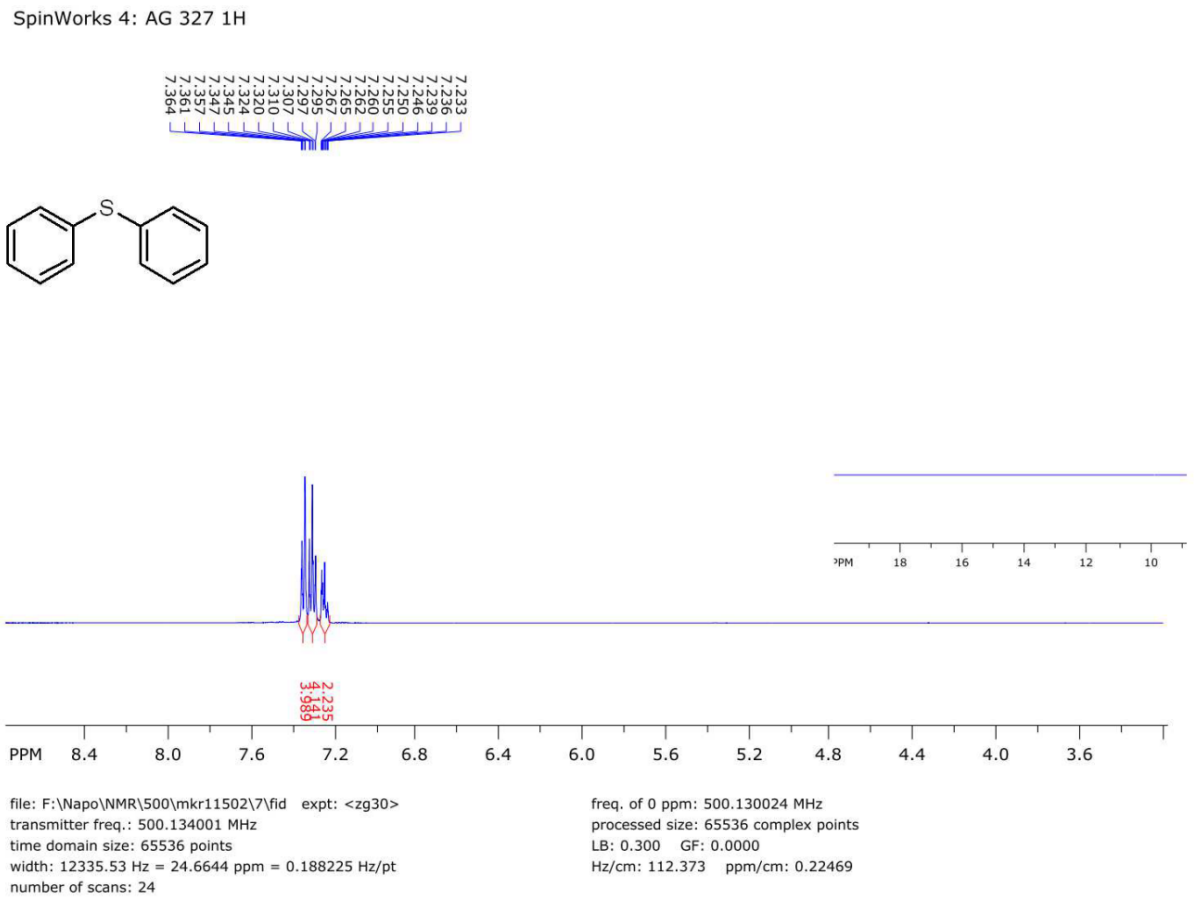
Compound 9d


SpinWorks 4: SM 68-1 1H
N
Ph
8.711 8.709 8.709 8.706 8.701 8.699 8.696 8.006 8.003 7.988 7.986 7.982 7.999 7.776 7.772 7.760 7.756 7.746 7.743 7.738 7.727 7.726 7.500 7.498 7.468 7.465 7.438 7.435 7.433 7.425 7.420 7.416 7.406 7.246 7.240 7.236 7.232 7.226 7.222
1.000 2.062 2.095 0.938 2.052 1.354
PPM 10.0 9.6 9.2 8.8 8.4 8.0 7.6 7.2 6.8 6.4 6.0 5.6 5.2
PPM 15.0 14.0 13.0 12.0 11.0 10.0
file: F:\Napo\NMR\500\mkr10702\7\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24
freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 111.808 ppm/cm: 0.22356

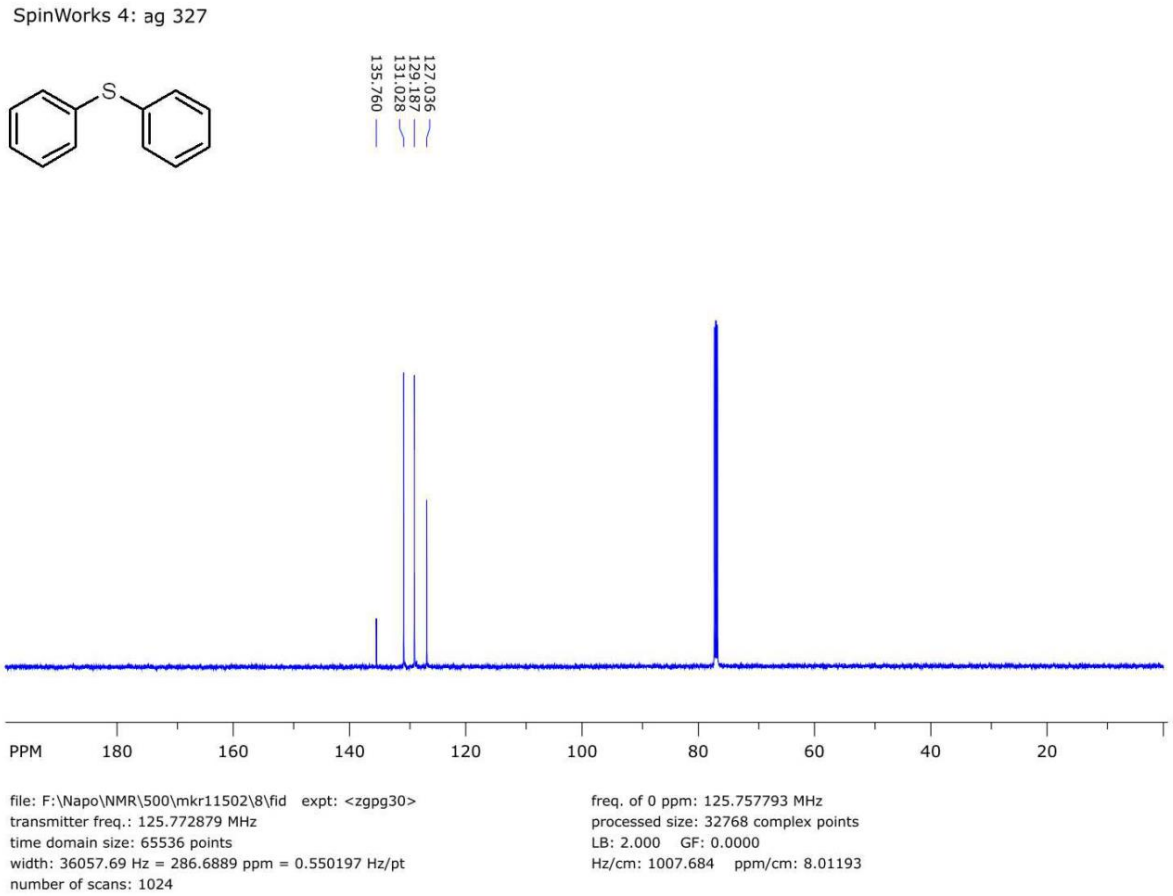
Compound 9d


SpinWorks 4: SM 68-1 13C
157.504
149.698
139.411
136.825
129.009
128.801
126.959
122.149
120.632
77.322
77.169
77.068
76.814
N
Ph
PPM
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
file: F:\Napo\NMR\500\mkr10702\8\fid expt: <zgpg30>
transmitter freq.: 125.772879 MHz
time domain size: 65536 points
width: 36057.69 Hz = 286.6889 ppm = 0.550197 Hz/pt
number of scans: 1536
freq. of 0 ppm: 125.757789 MHz
processed size: 32768 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 1002.855 ppm/cm: 7.97354

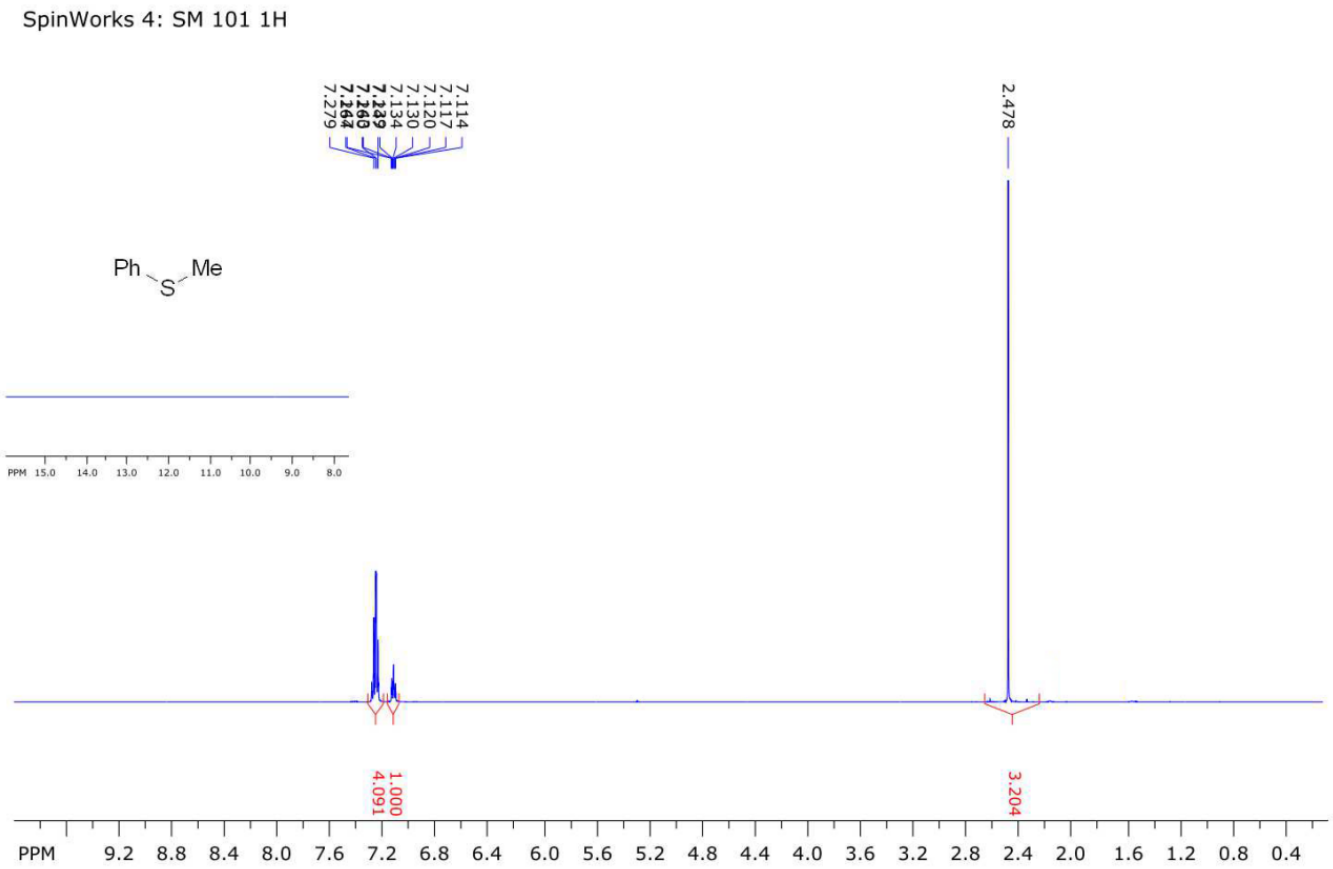
Compound 10a



Compound 10a



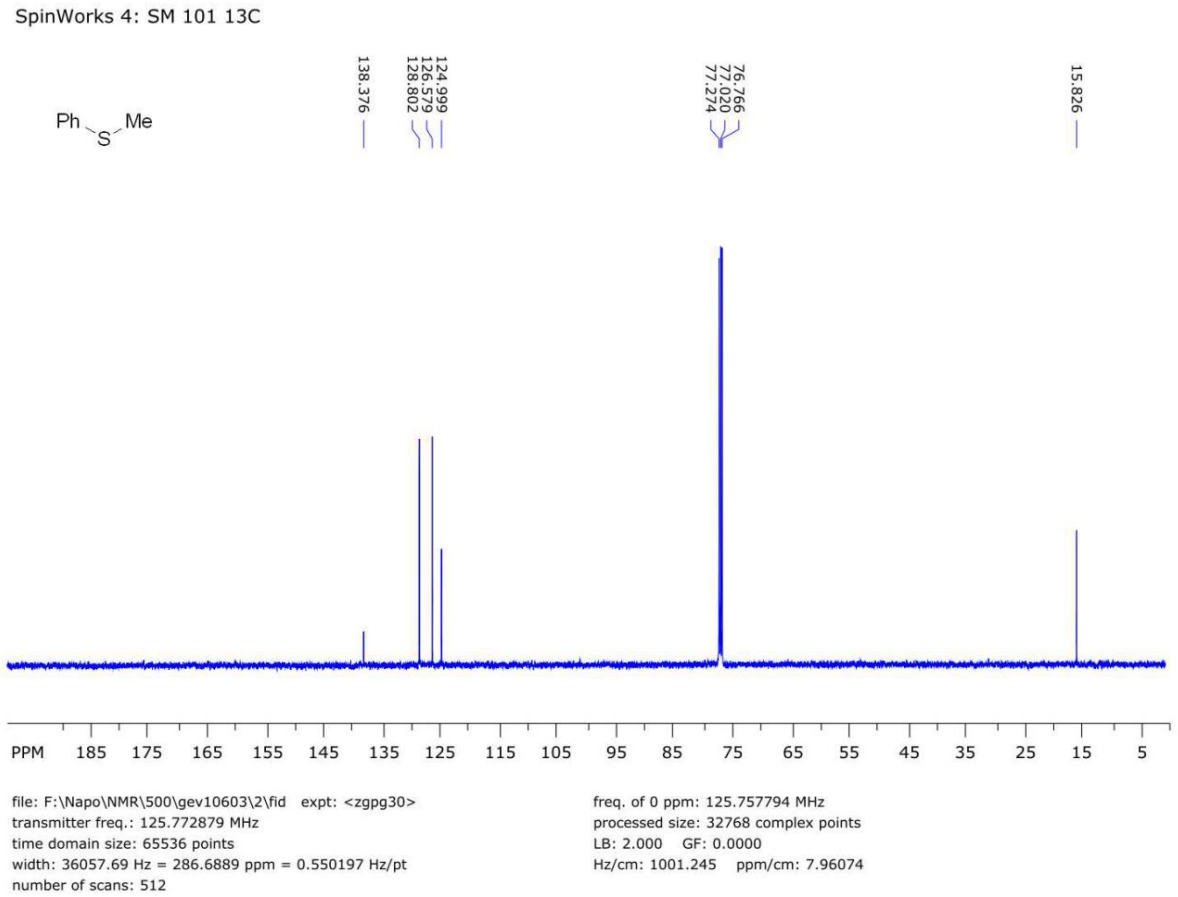
Compound 10b



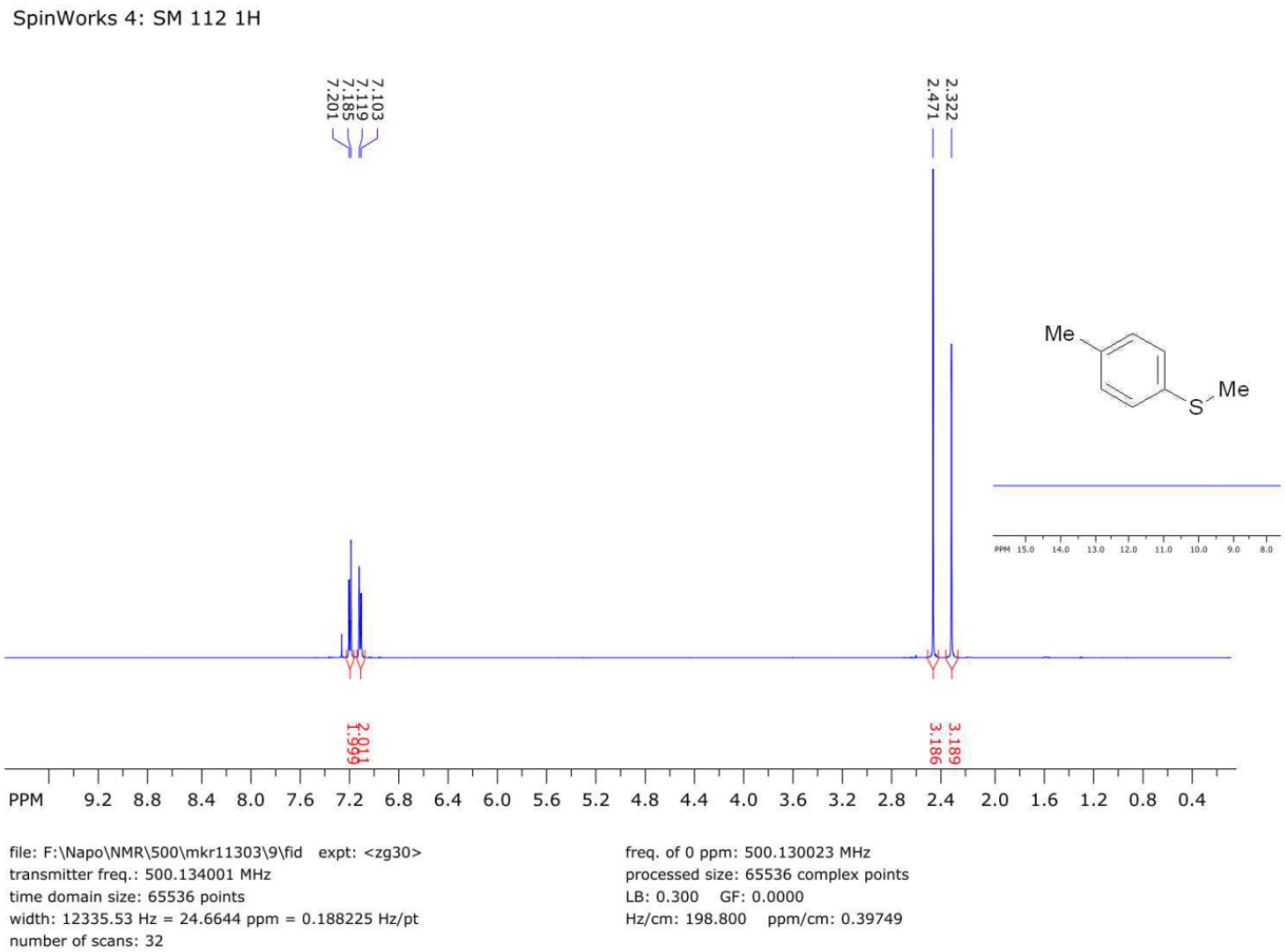
file: F:\Napo\NMR\500\gev10603\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130030 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.250 ppm/cm: 0.39639

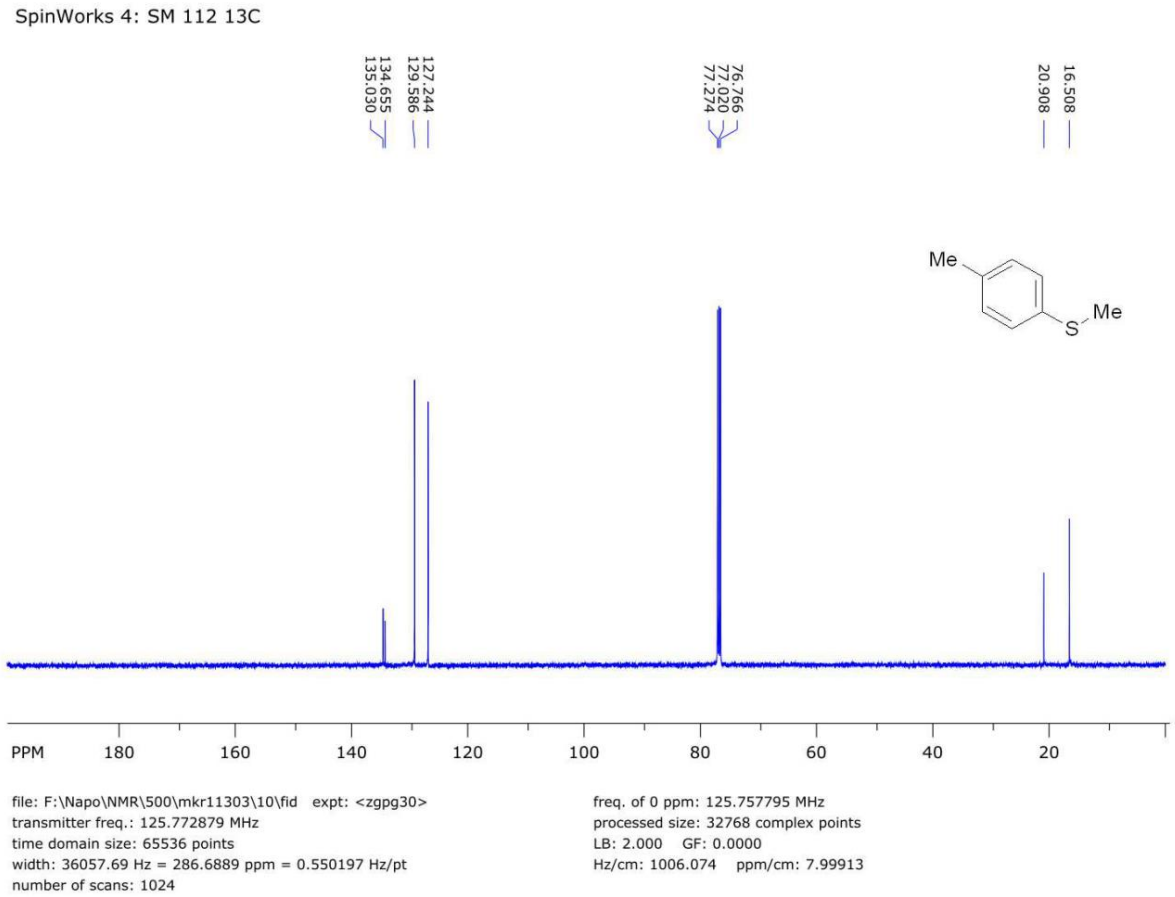
Compound 10b



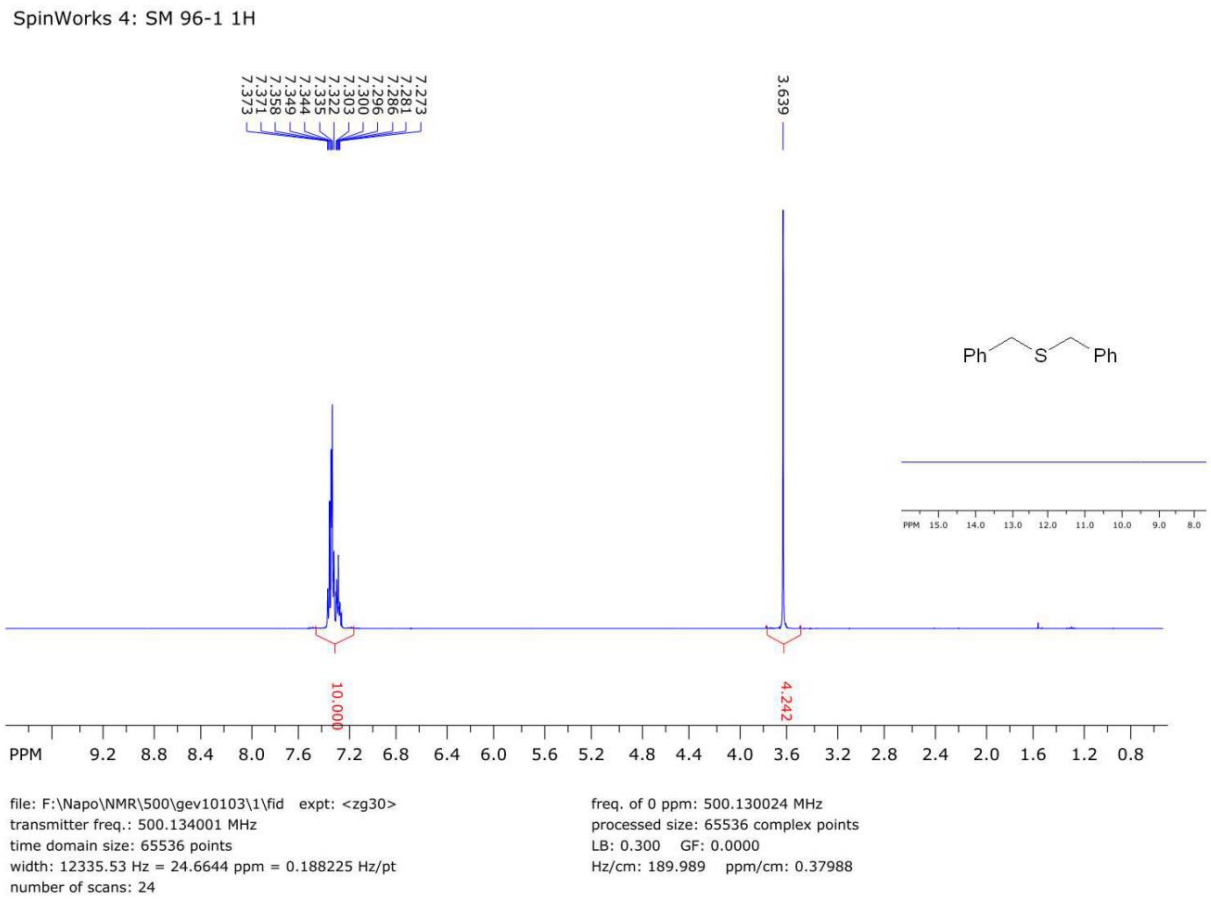
Compound 10c



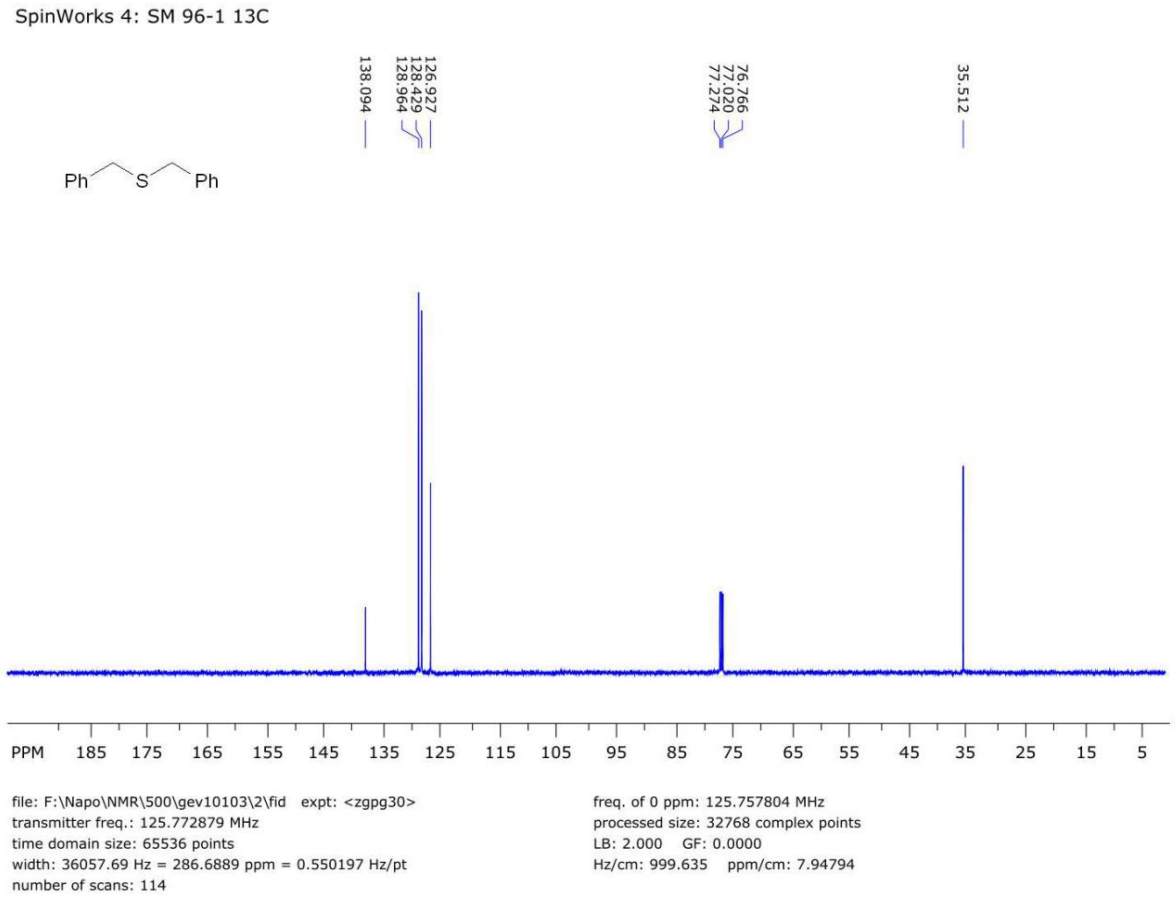
Compound 10c



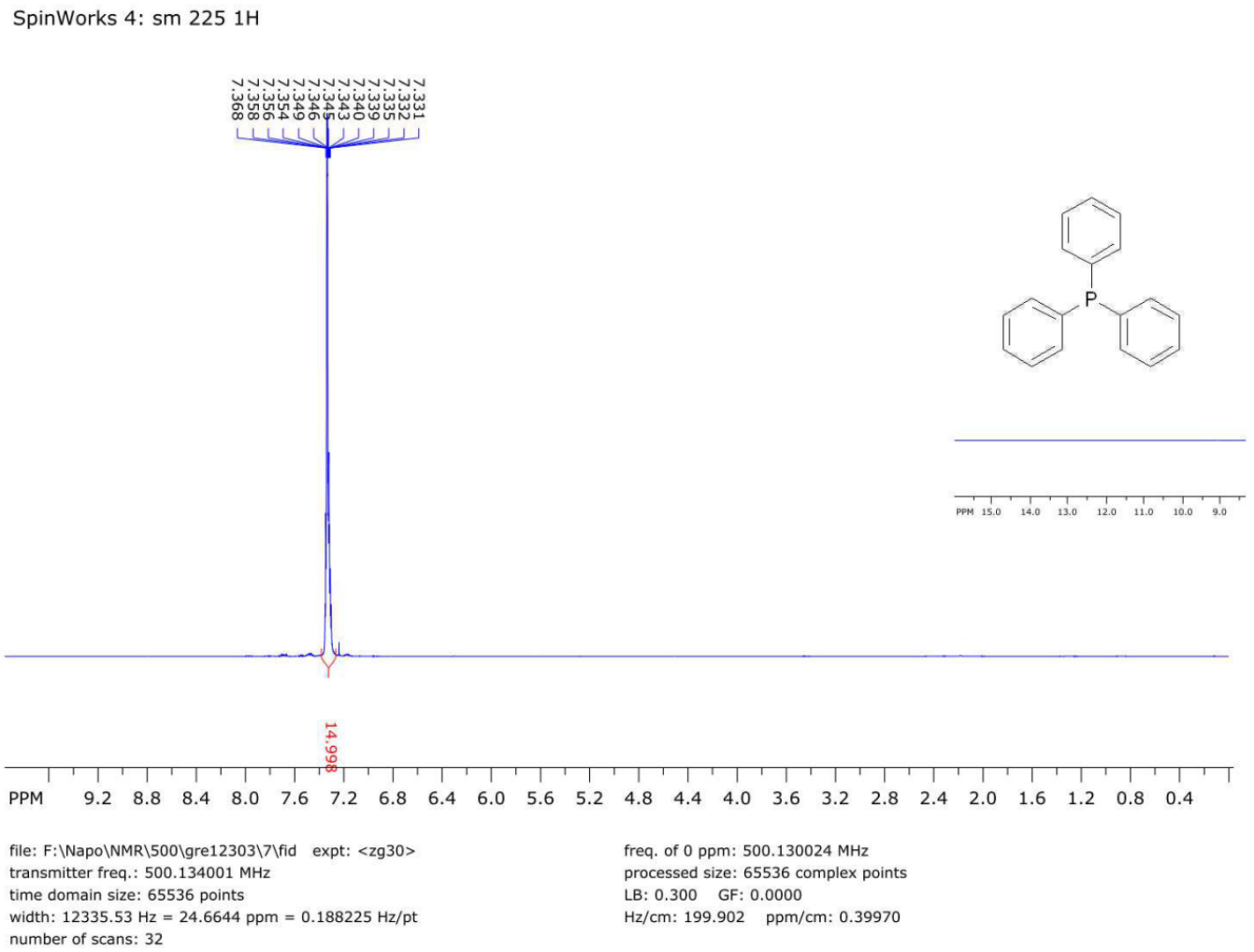
Compound 10d



Compound 10d



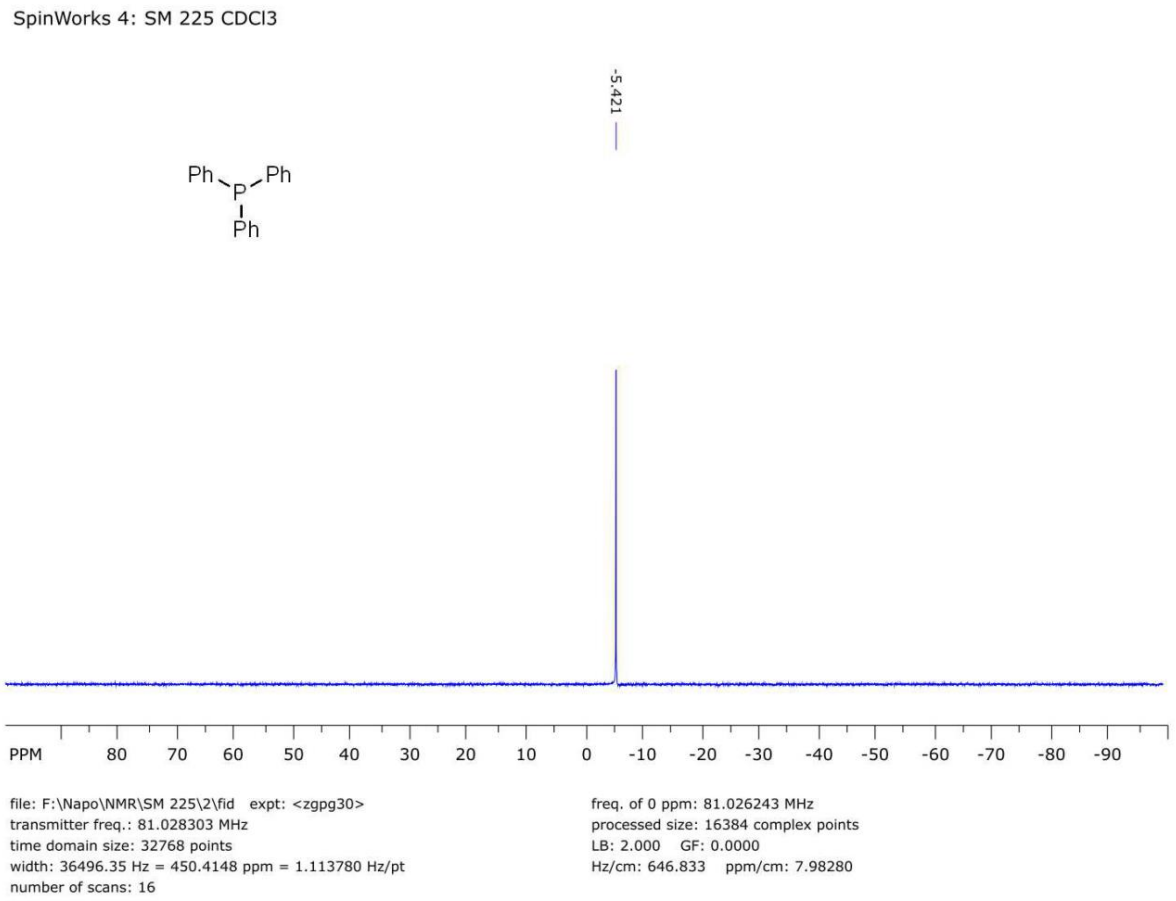
Compound 11a



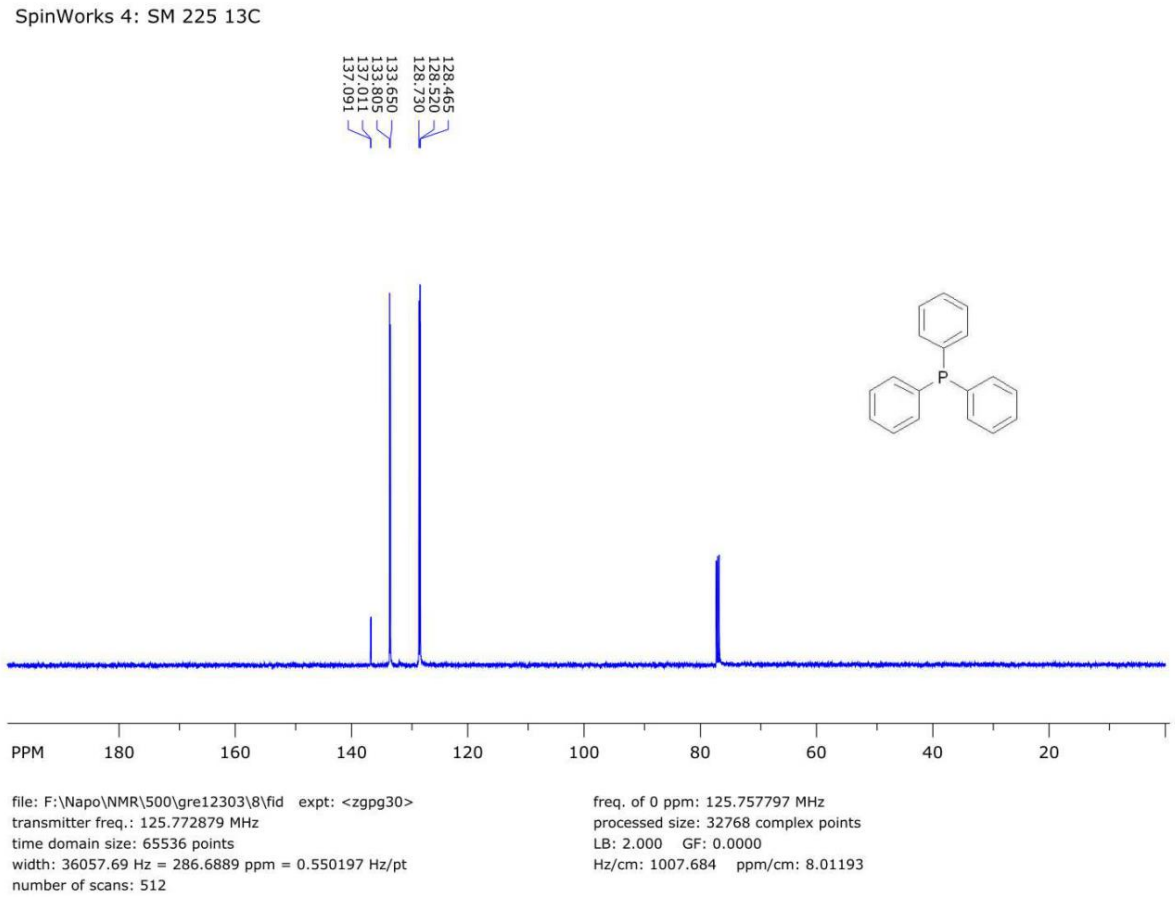
file: F:\Napo\NMR\500\gre12303\7\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 199.902 ppm/cm: 0.39970

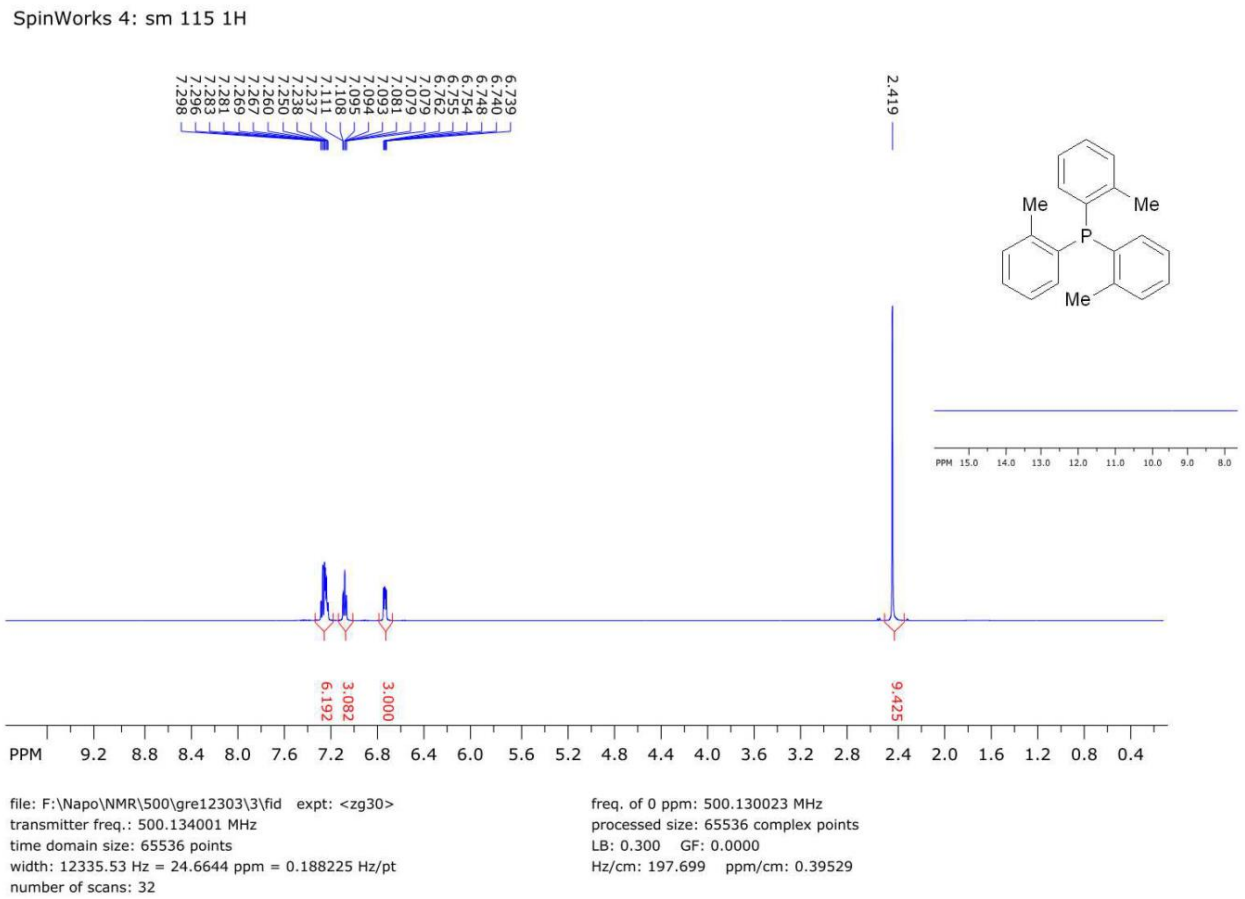
Compound 11a



Compound 11a

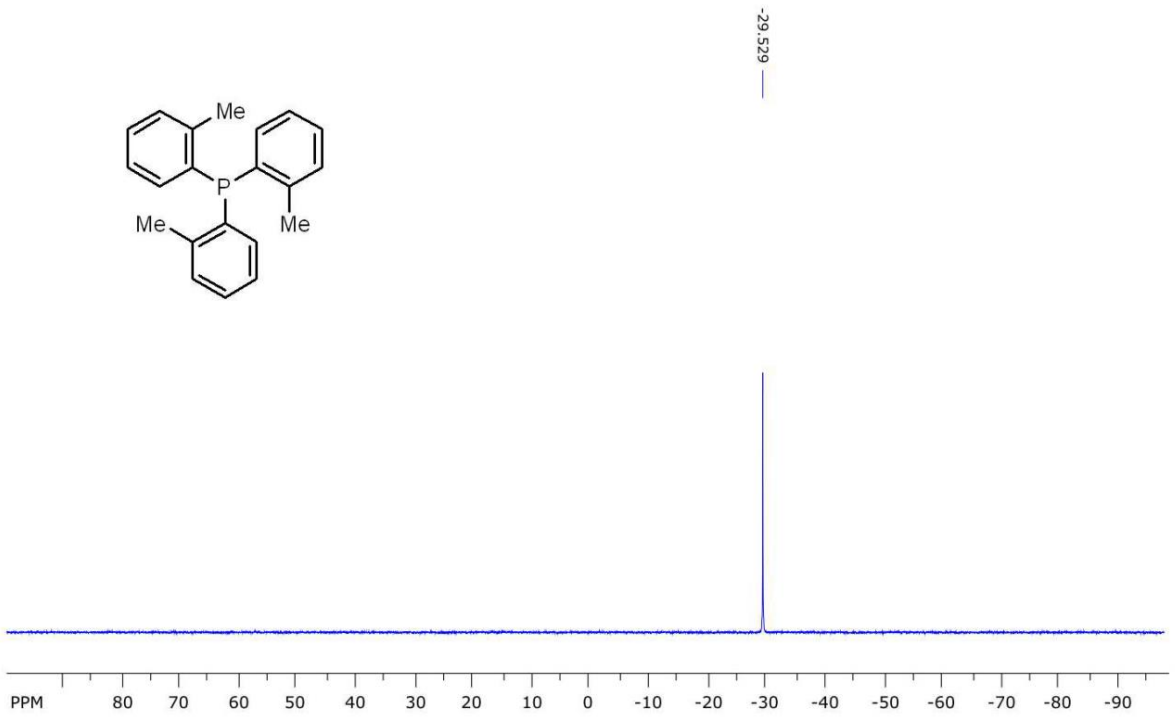


Compound 11b



Compound 11b

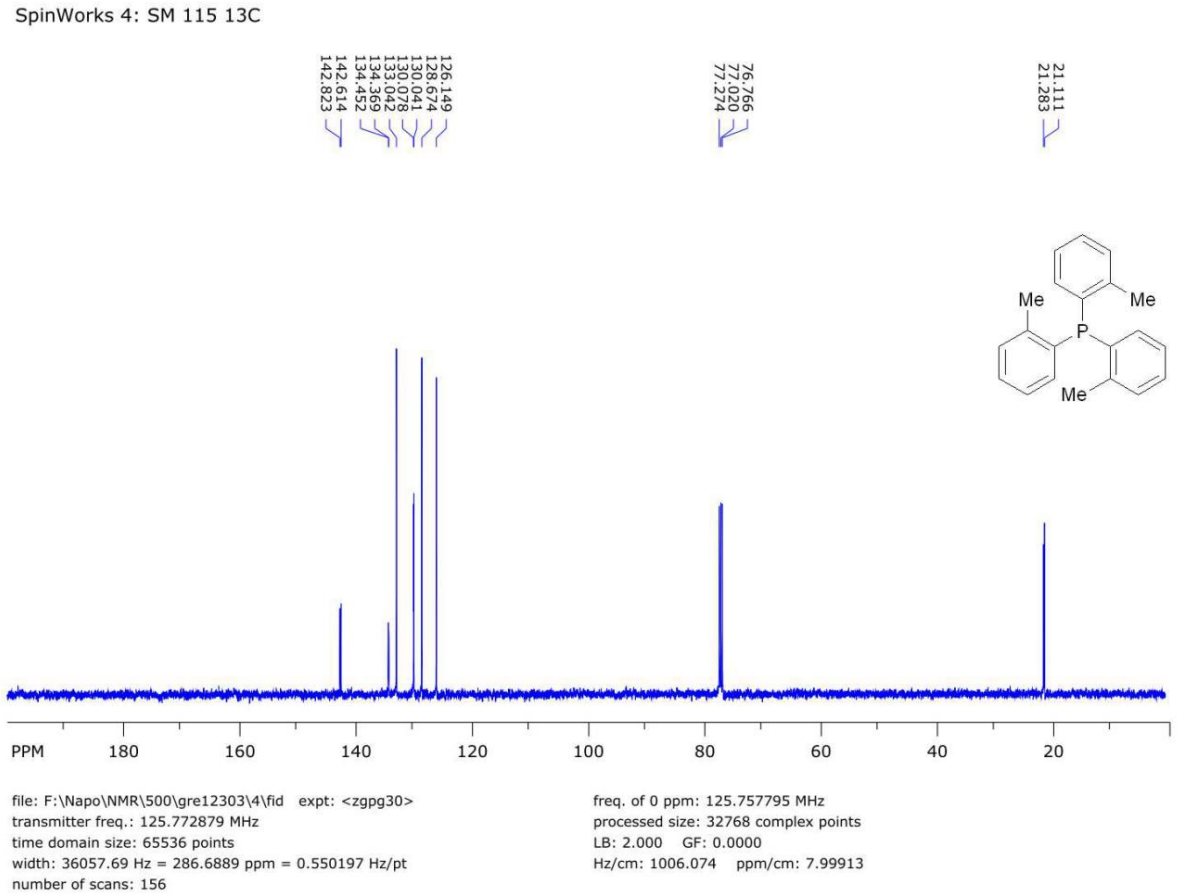
SpinWorks 4: SM 115-1 CDCl3



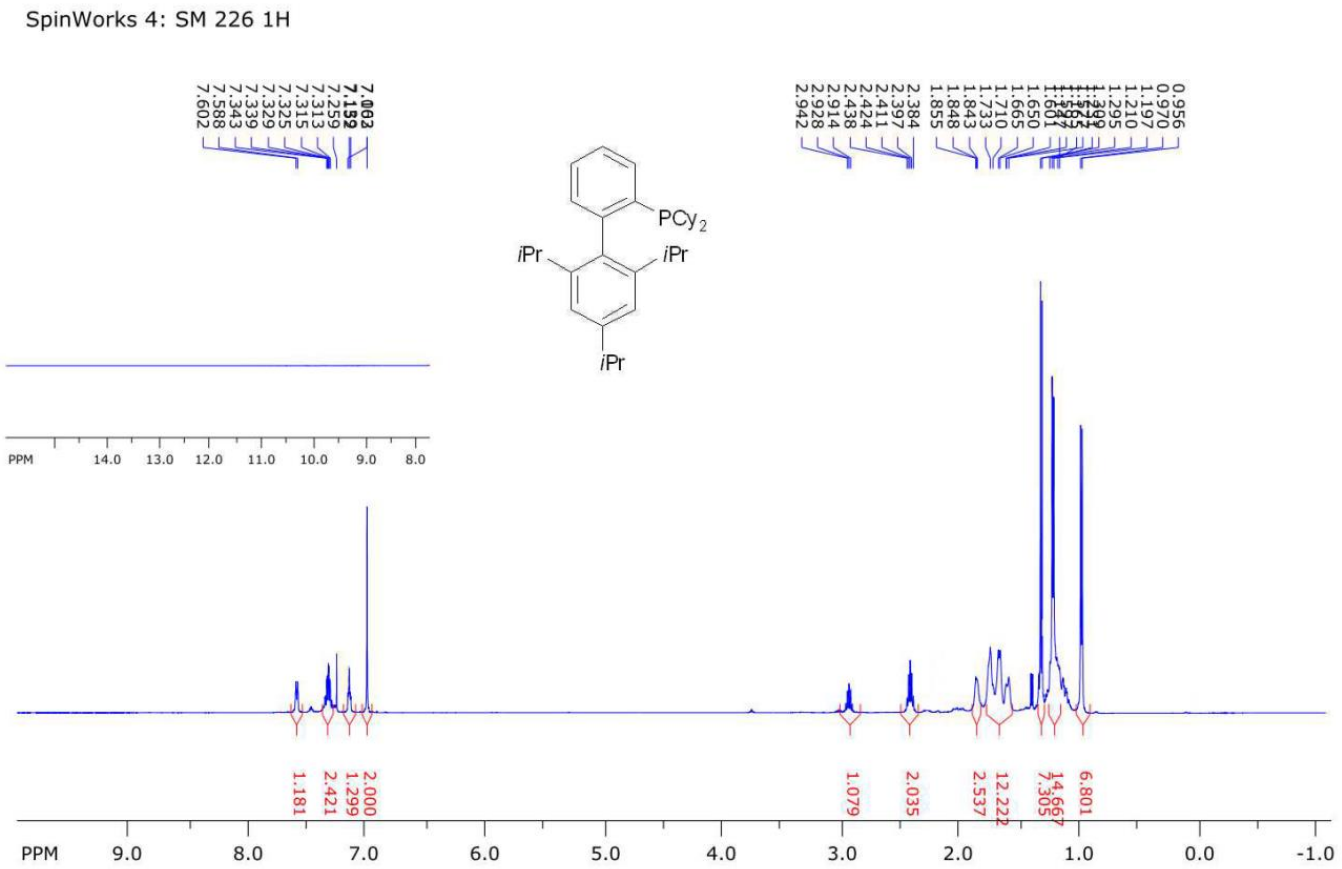
file: F:\Napo\NMR\SM 115-1\2\fid expt: <zgpg30>
transmitter freq.: 81.028303 MHz
time domain size: 32768 points
width: 36496.35 Hz = 450.4148 ppm = 1.113780 Hz/pt
number of scans: 16

freq. of 0 ppm: 81.026243 MHz
processed size: 16384 complex points
LB: 2.000 GF: 0.0000
Hz/cm: 641.945 ppm/cm: 7.92248

Compound 11b



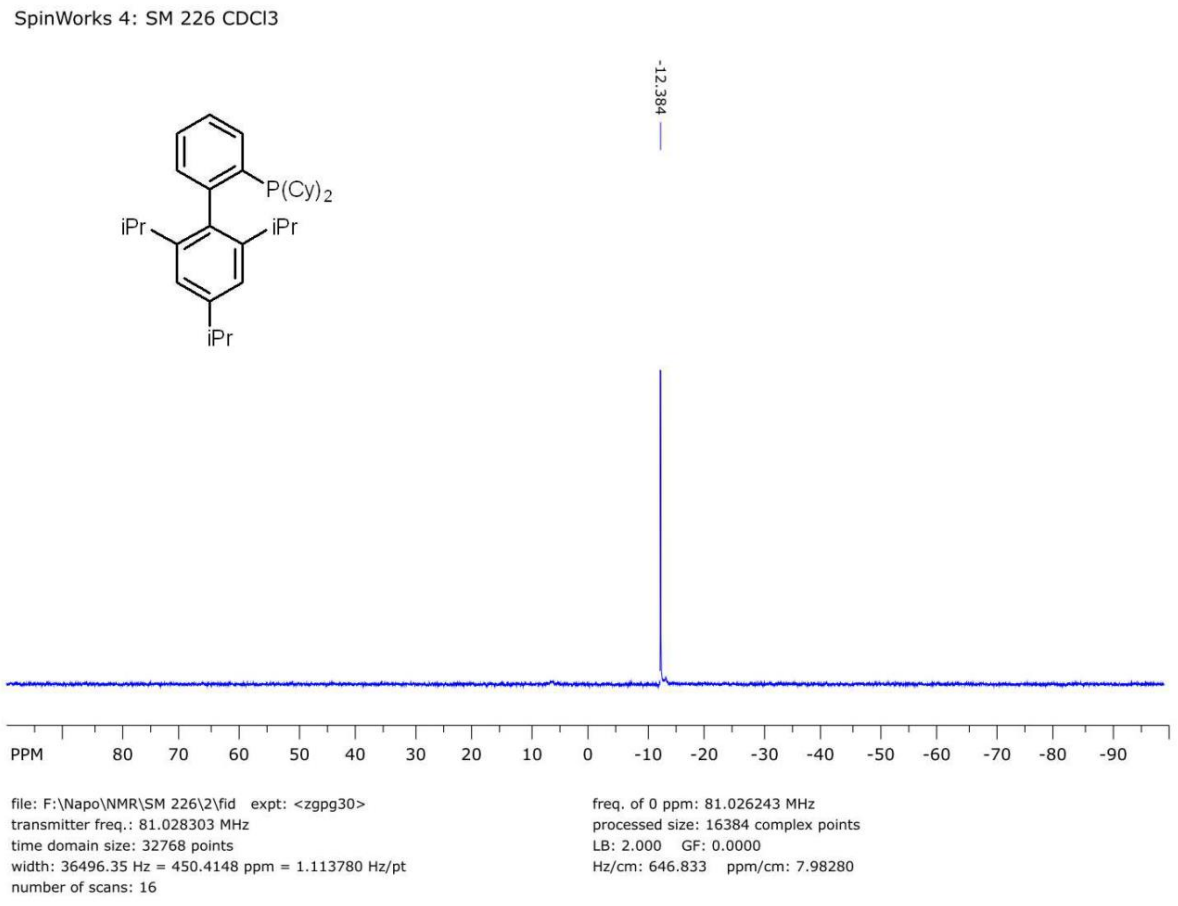
Compound 11c



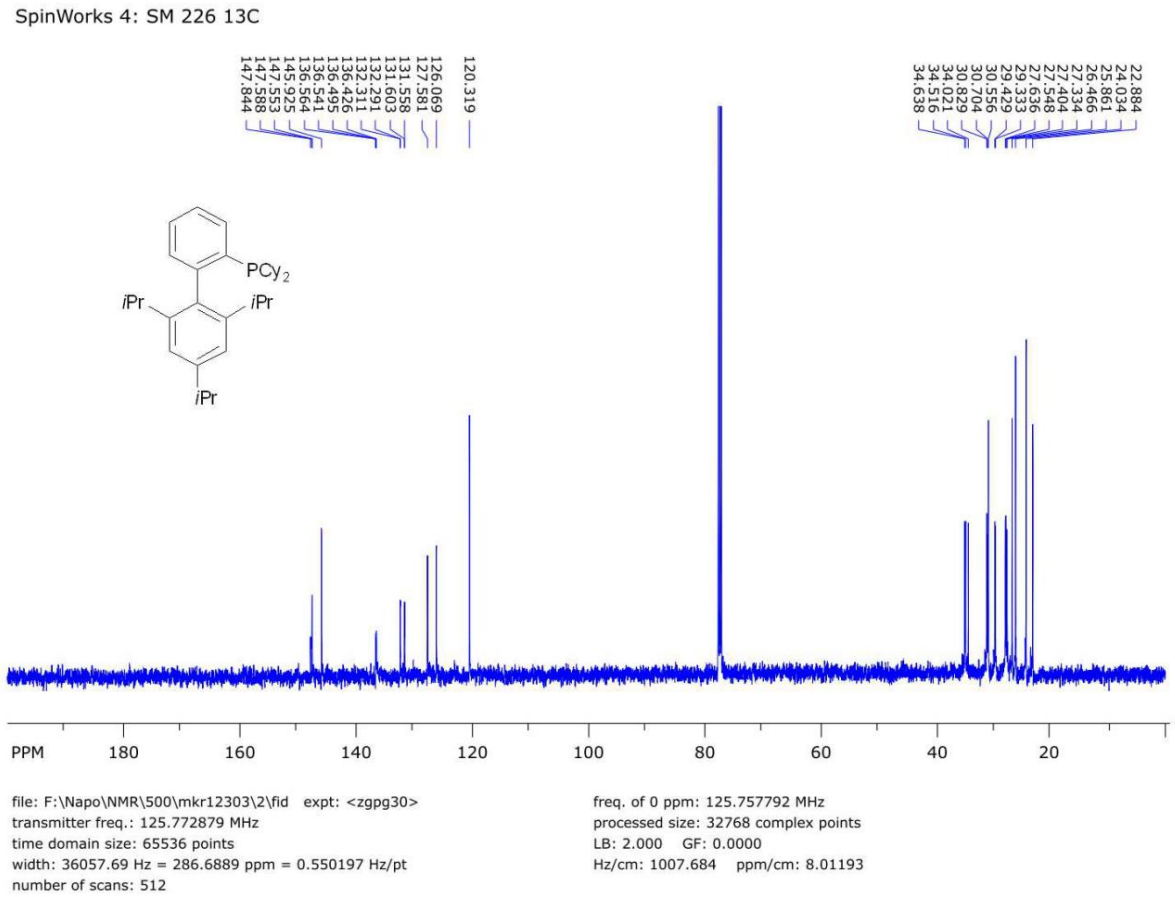
file: F:\Napo\NMR\500\mkr12303\1\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 221.379 ppm/cm: 0.44264

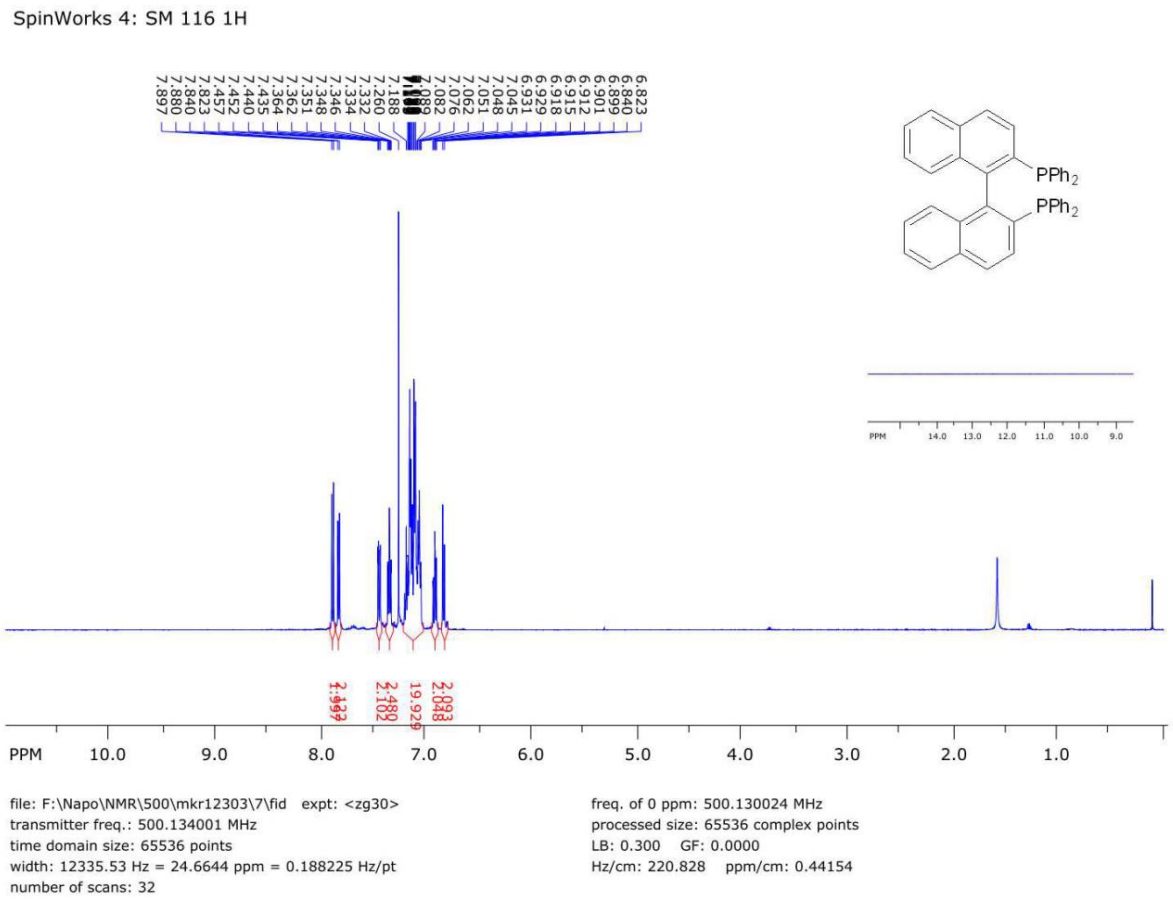
Compound 11c



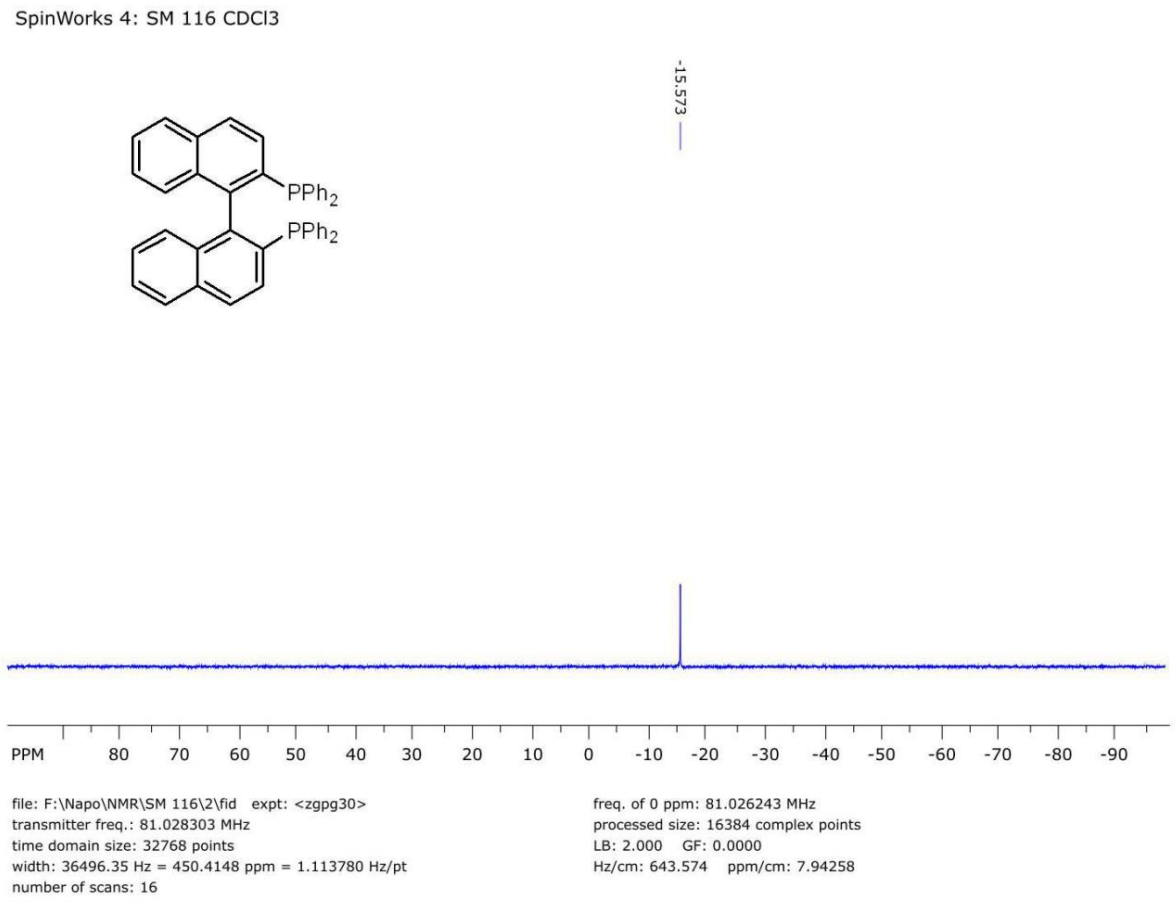
Compound 11c



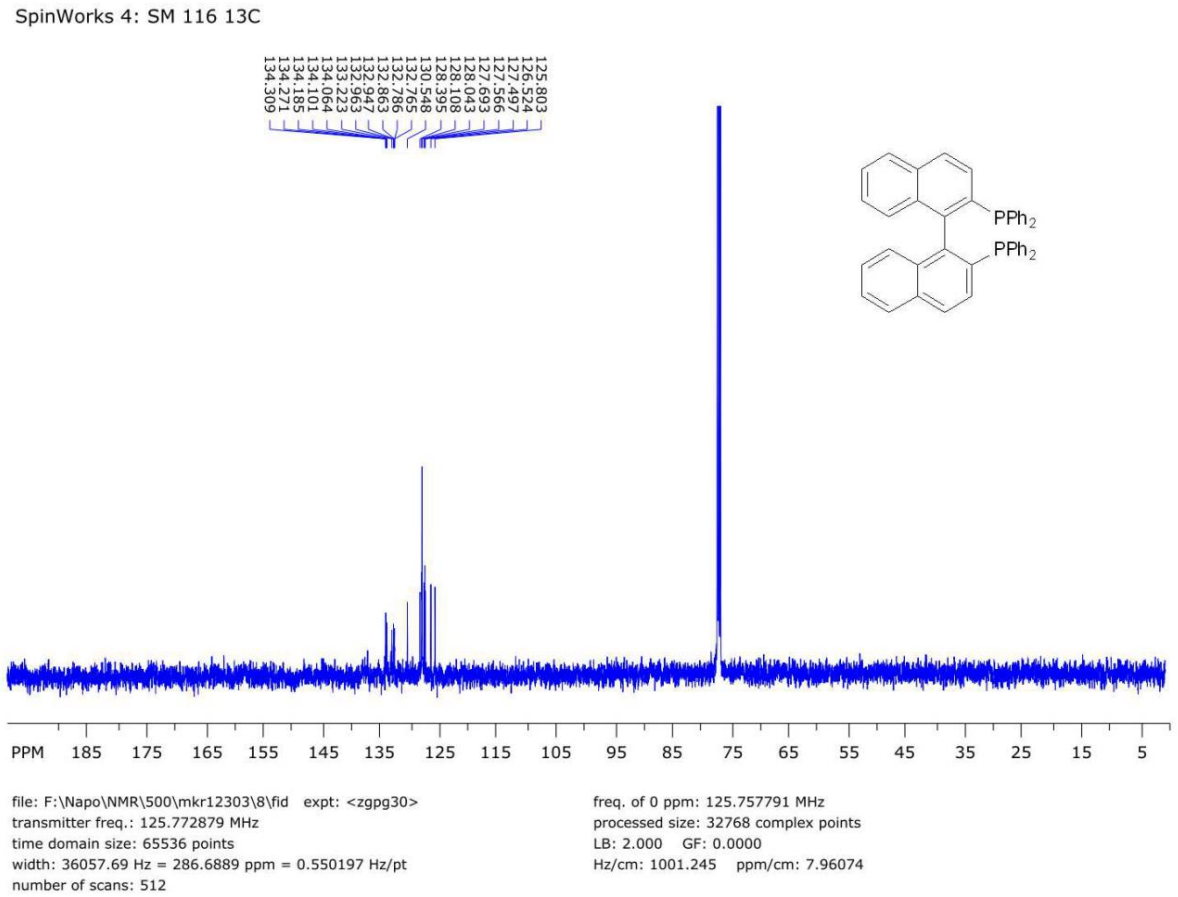
Compound 11d



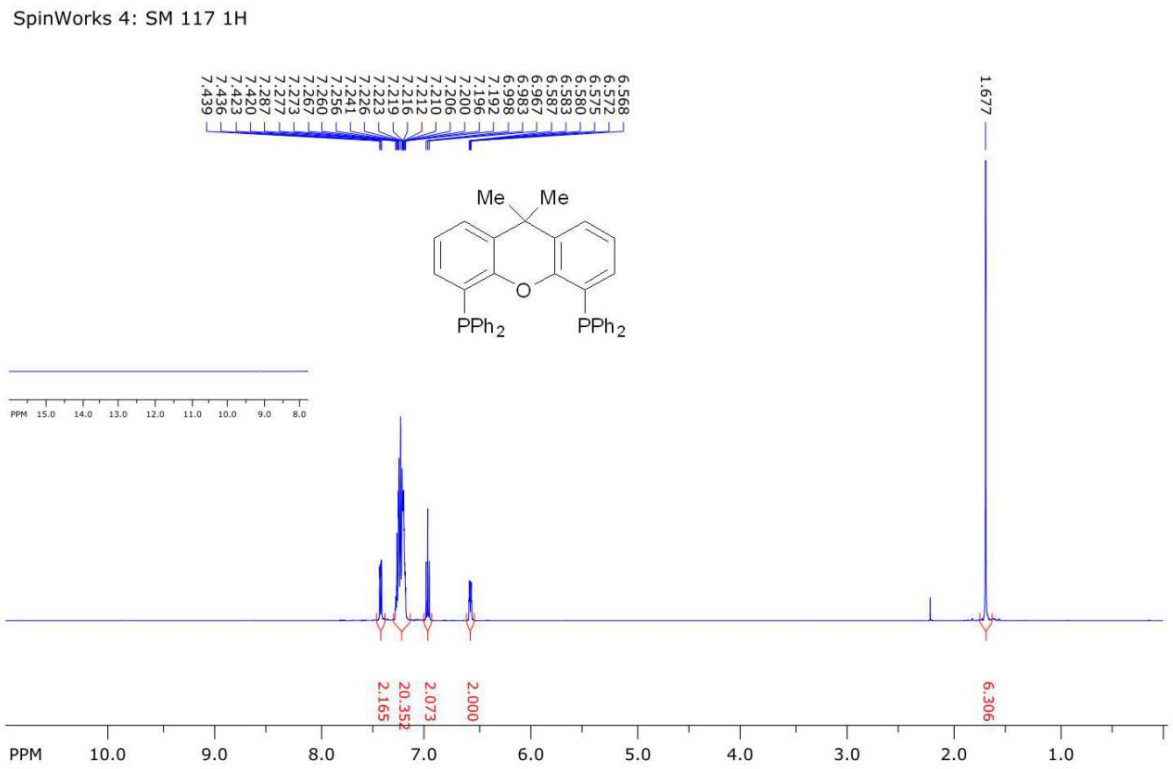
Compound 11d



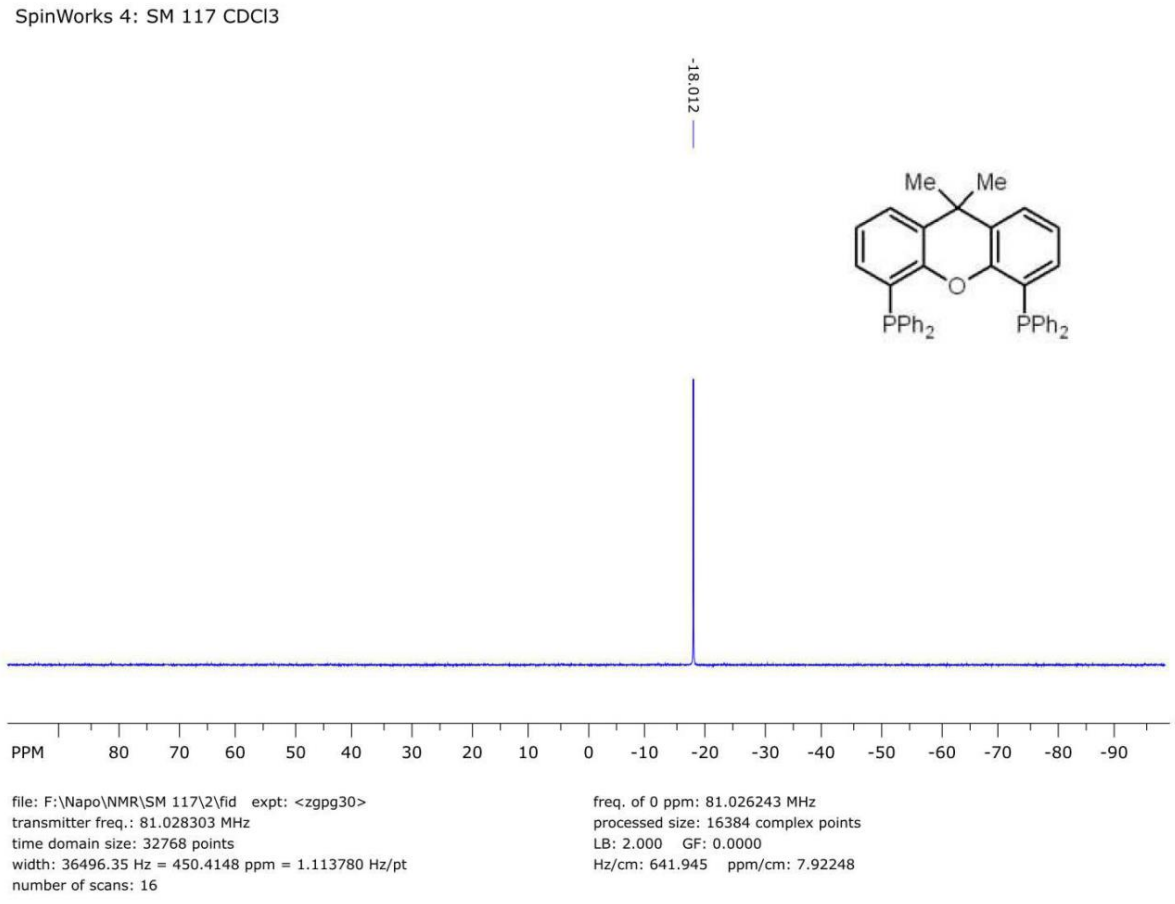
Compound 11d



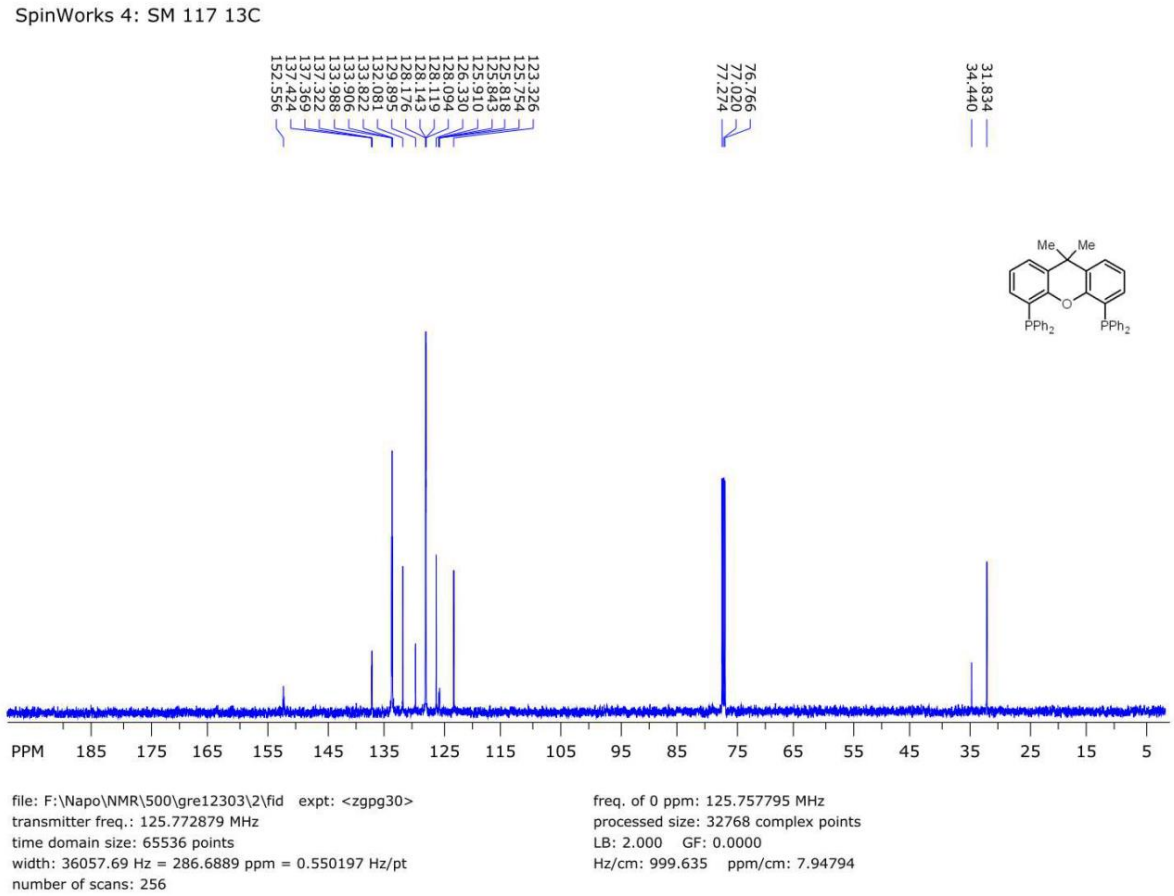
Compound 11e



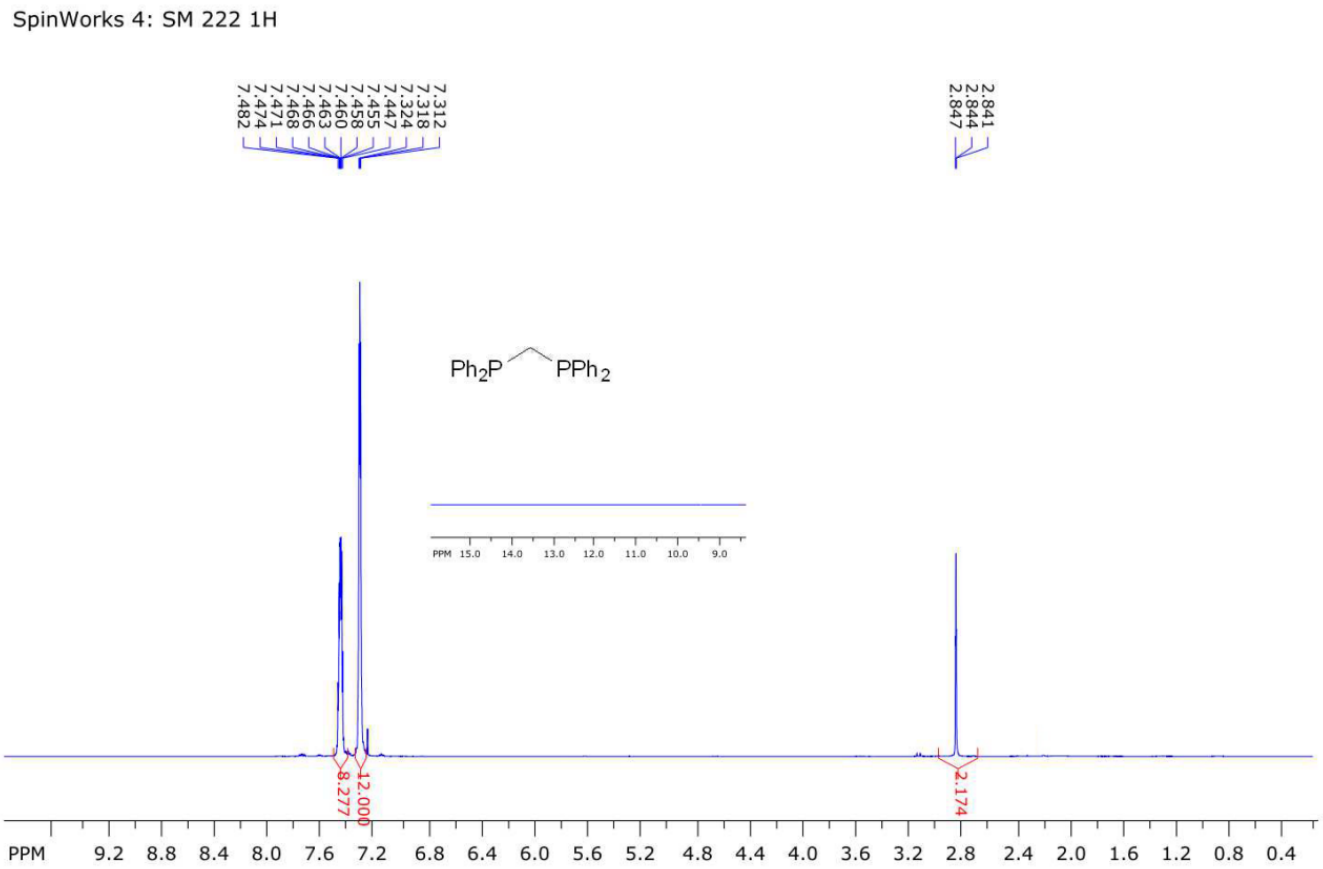
Compound 11e



Compound 11e



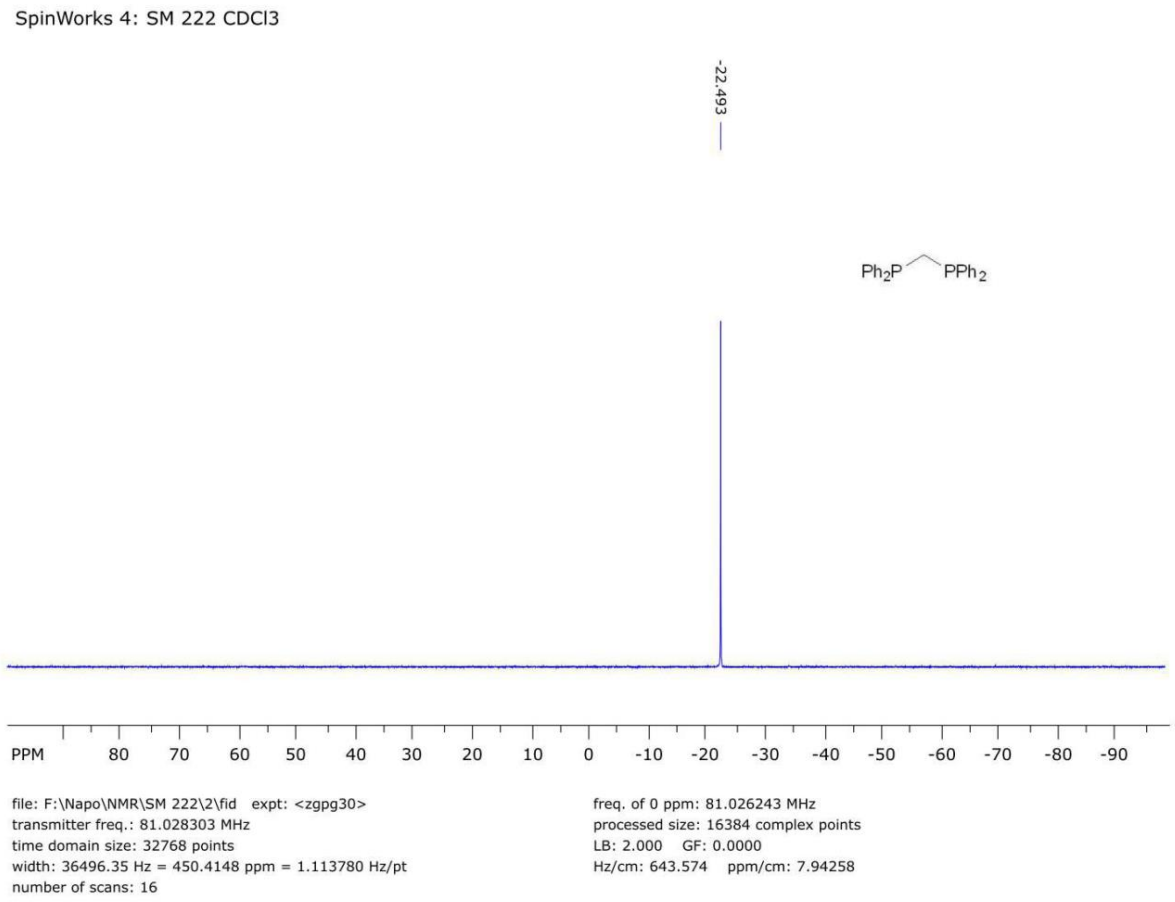
Compound 11f



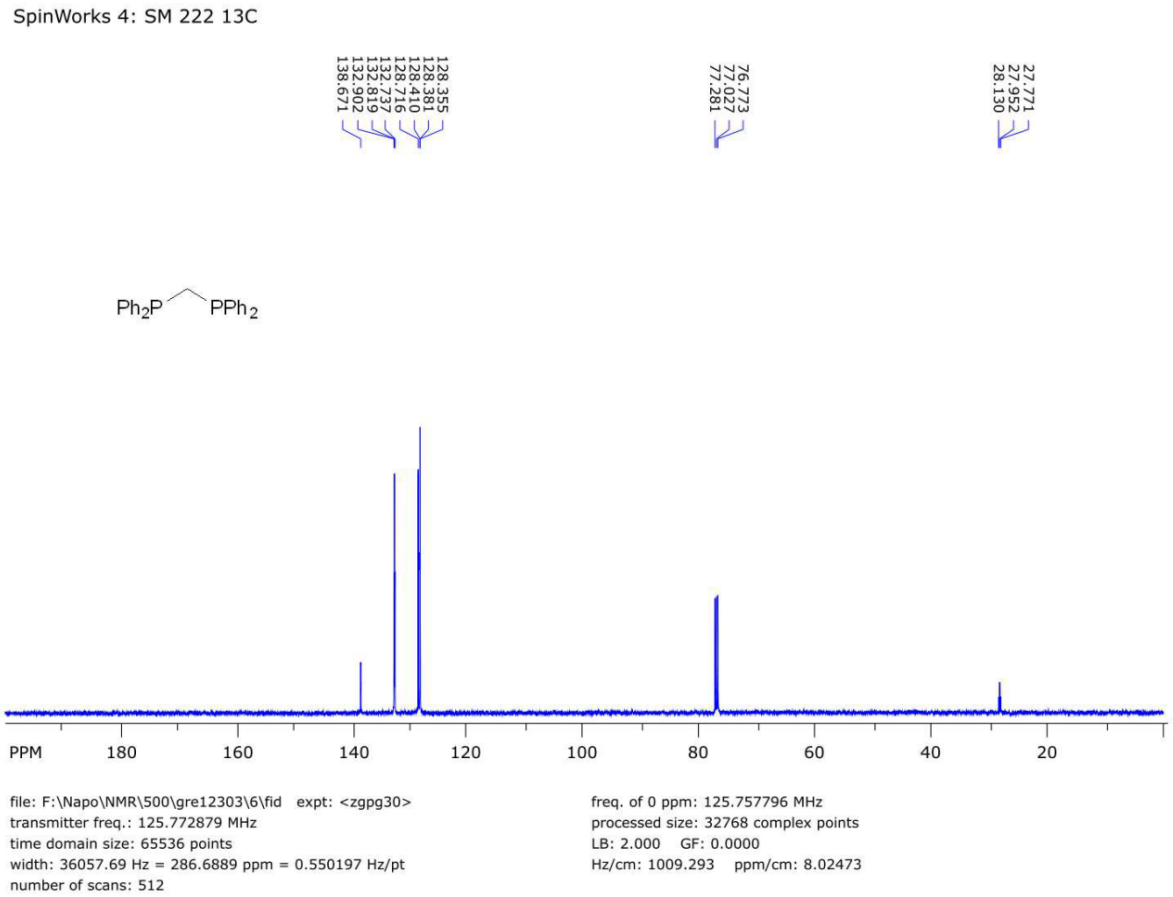
file: F:\Napo\NMR\500\gre12303\5\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130024 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 196.597 ppm/cm: 0.39309

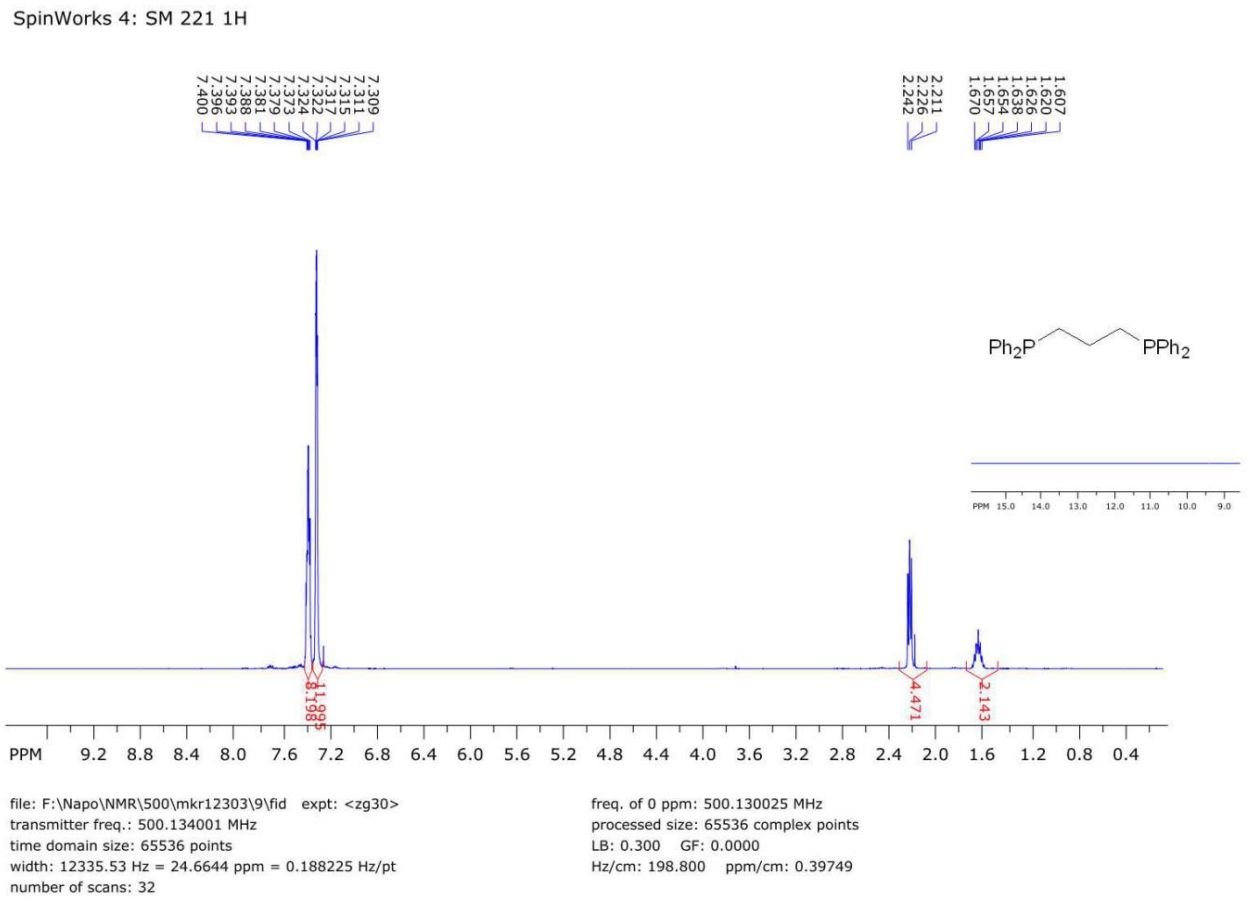
Compound 11f



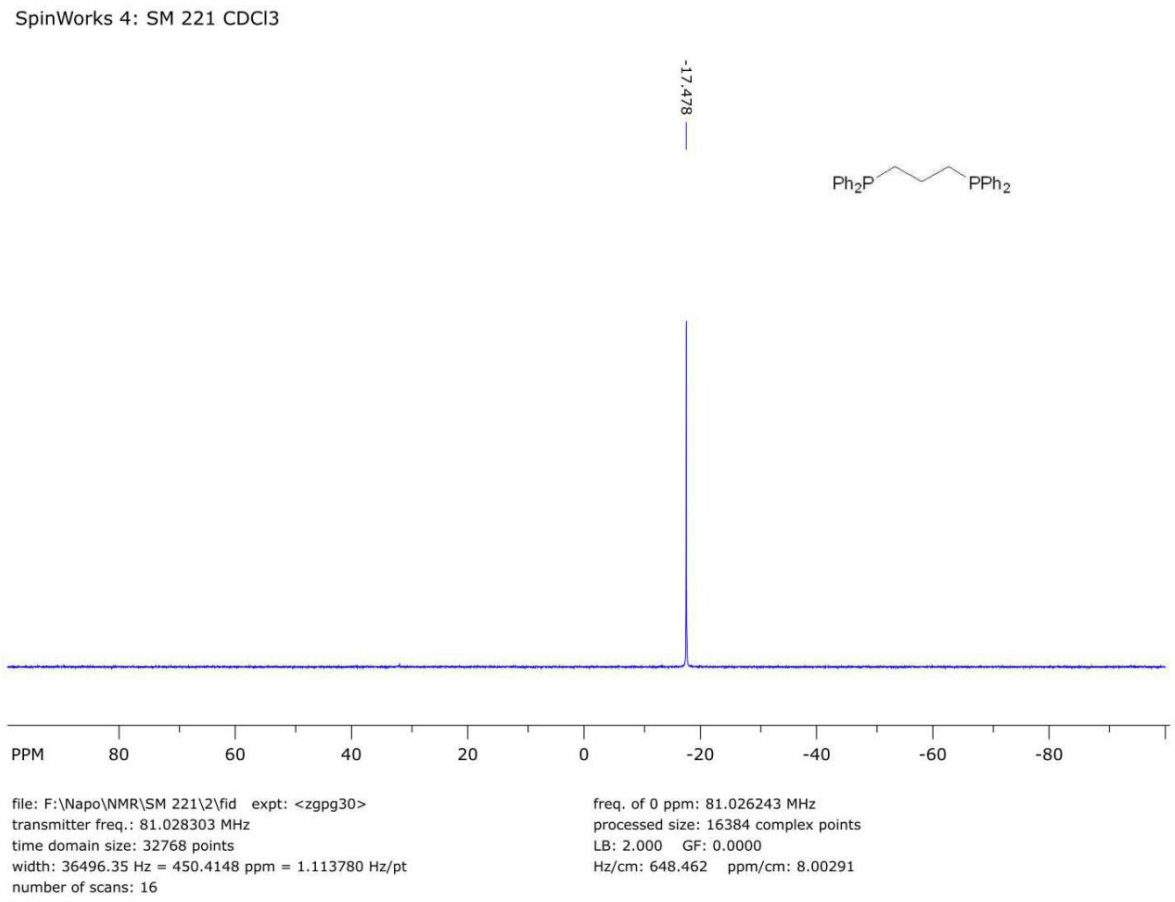
Compound 11f



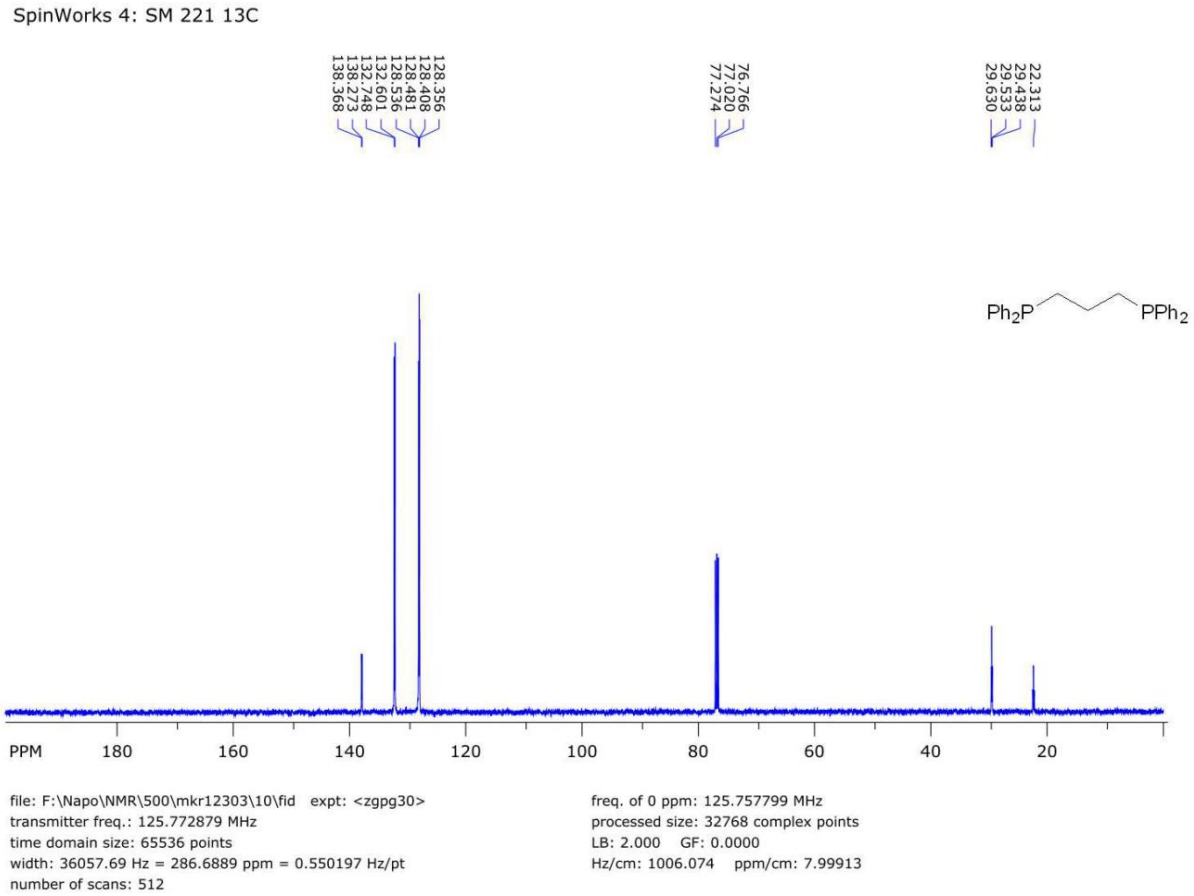
Compound 11g



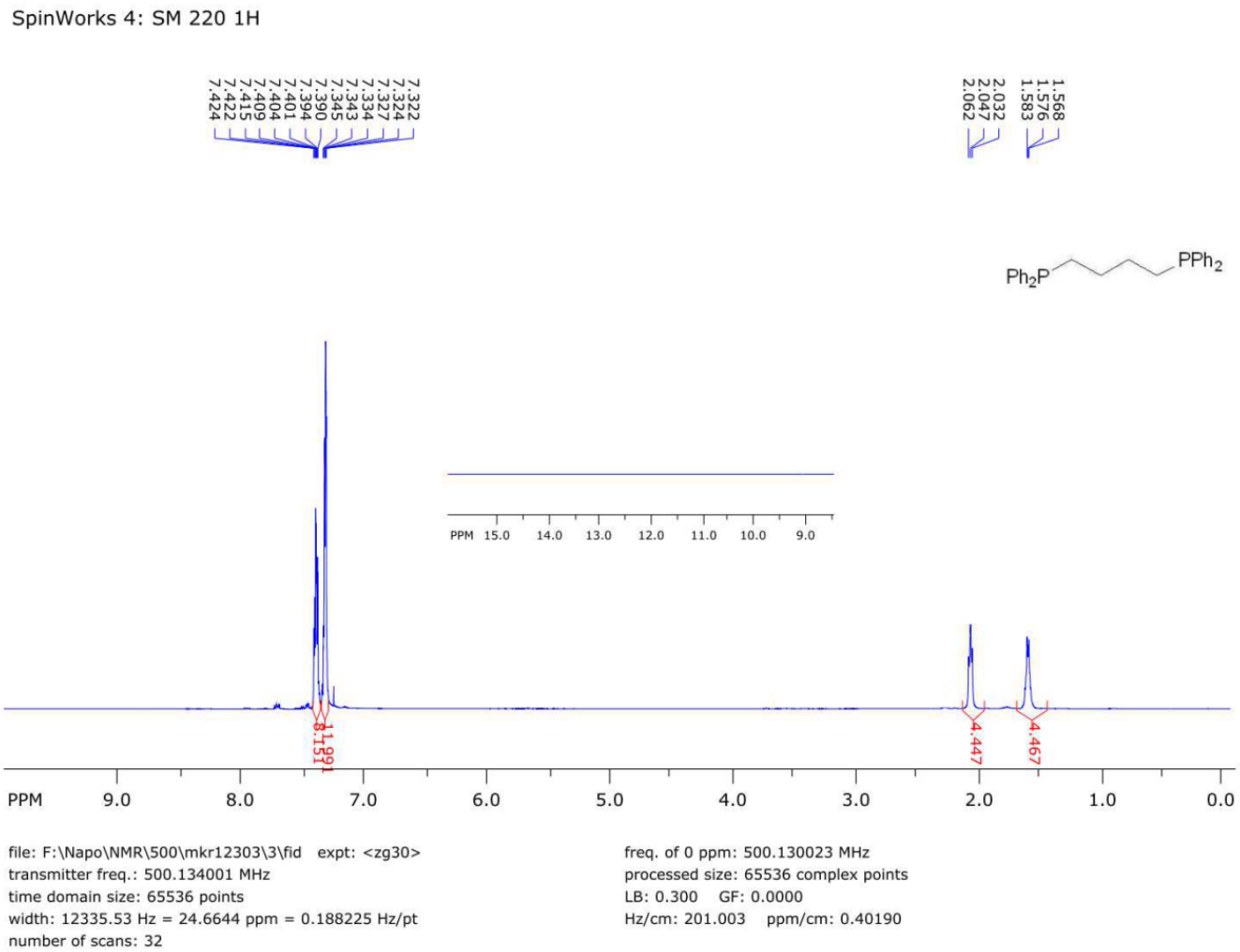
Compound 11g



Compound 11g



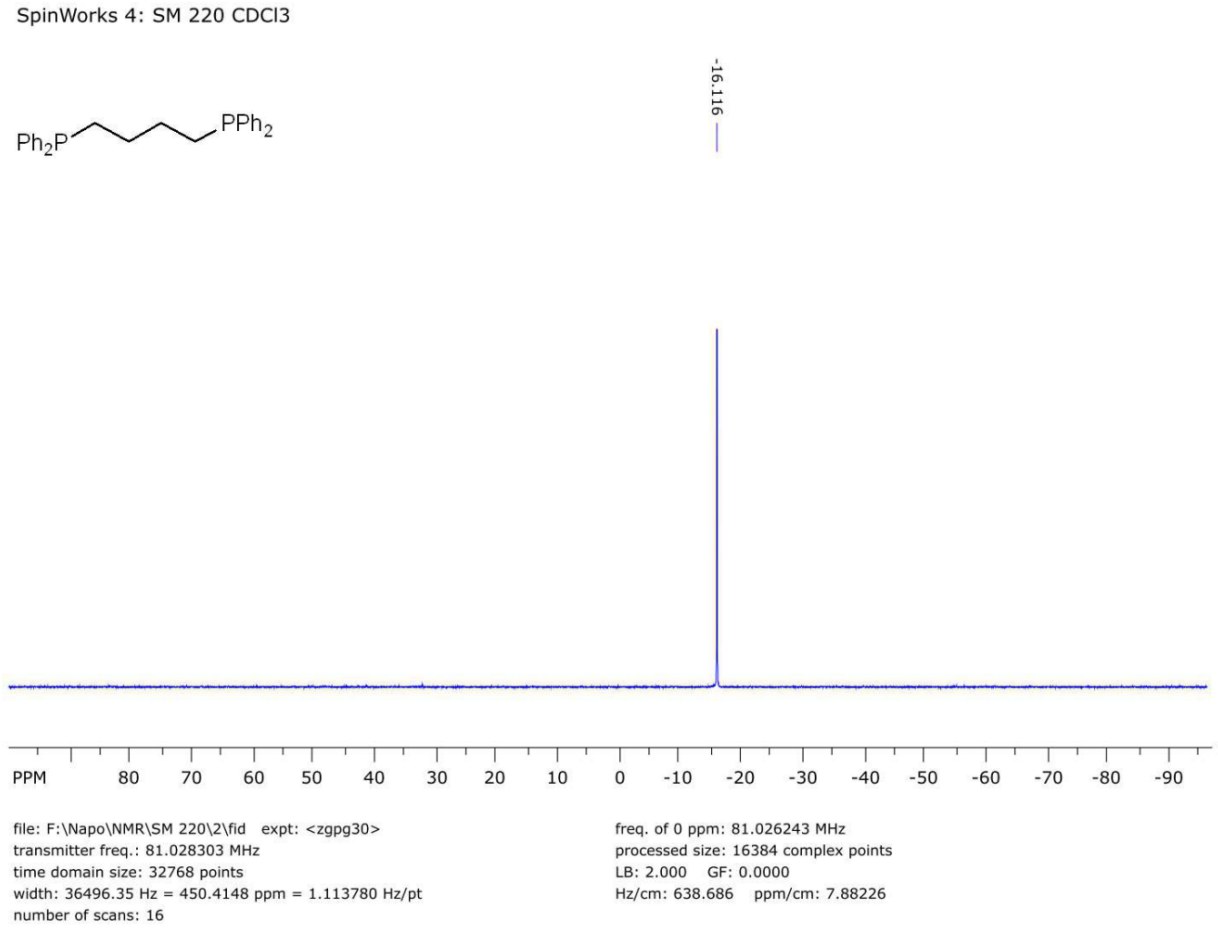
Compound 11h



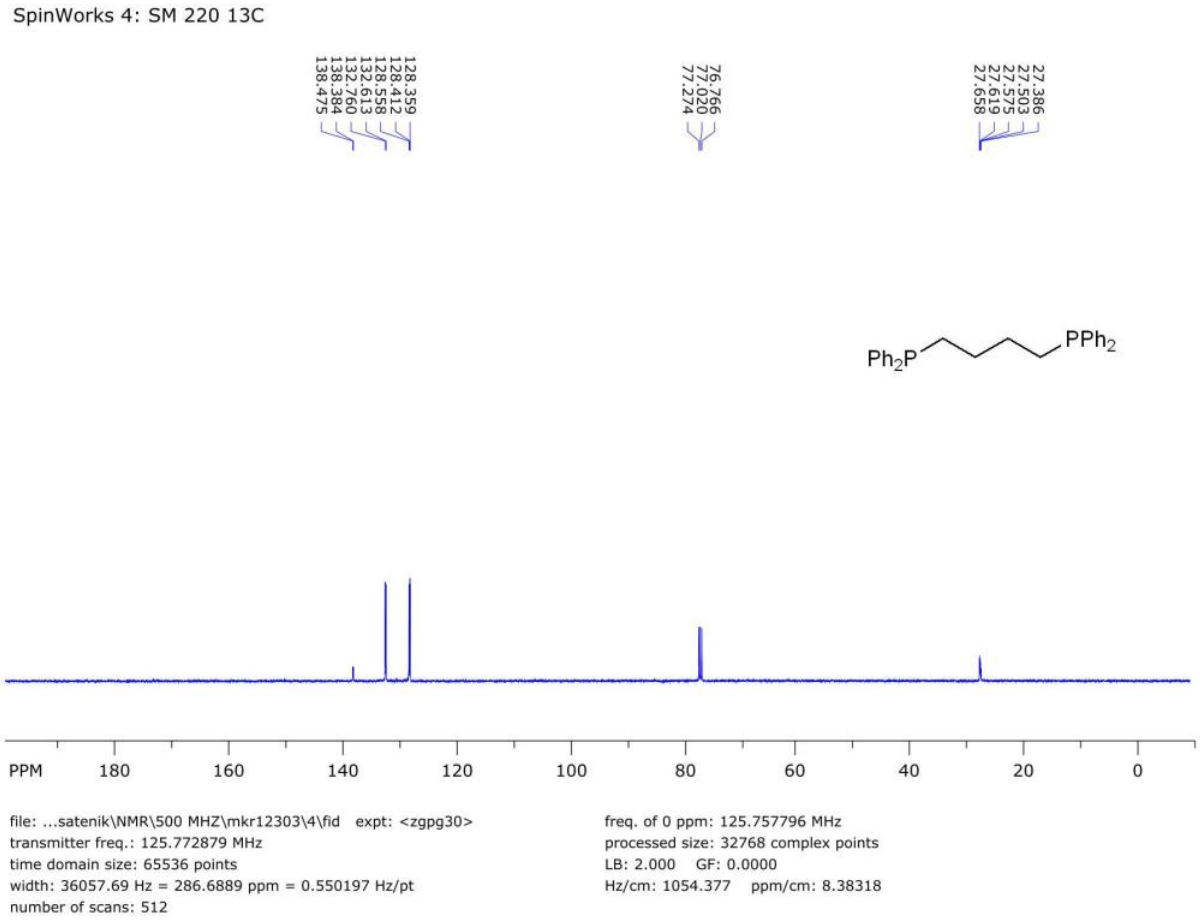
file: F:\Napo\NMR\500\mkr12303\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 32

freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 201.003 ppm/cm: 0.40190

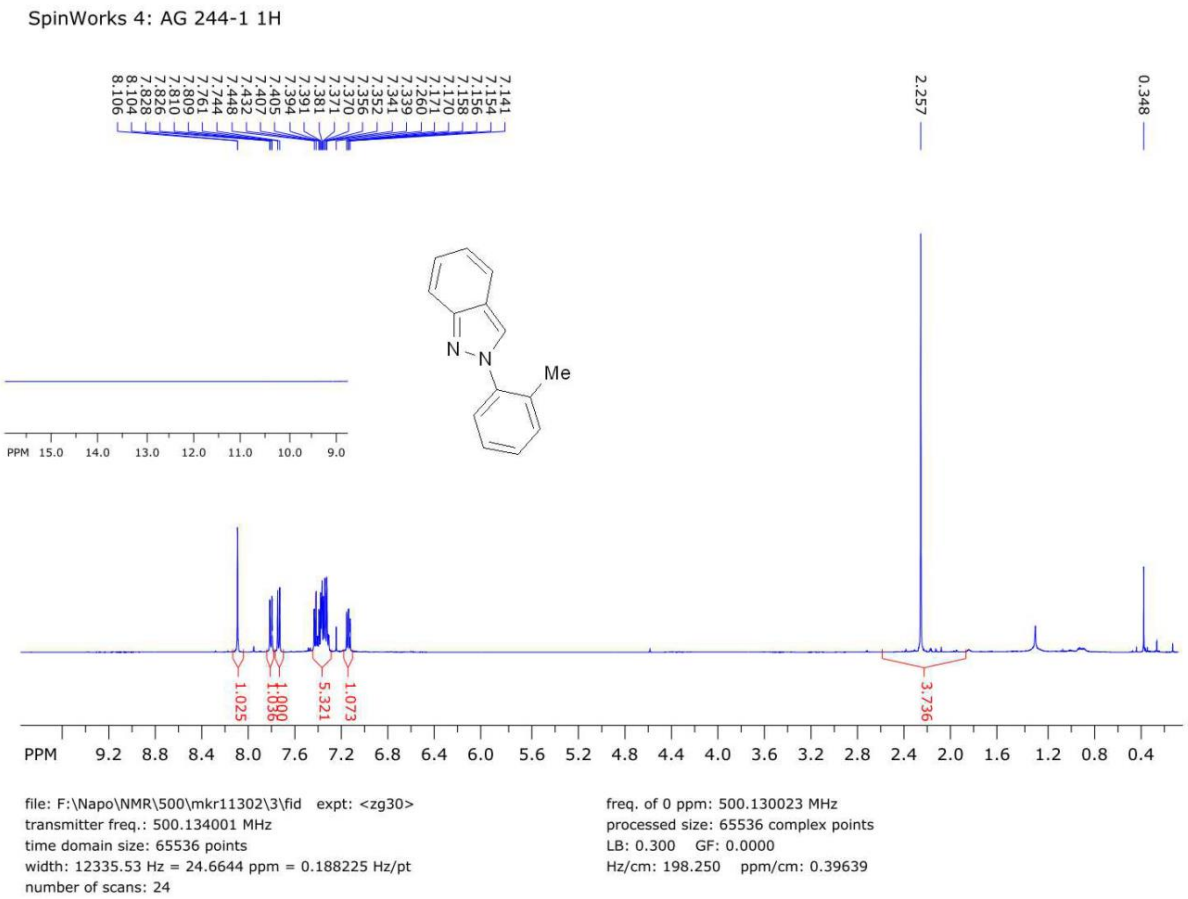
Compound 11h



Compound 11h



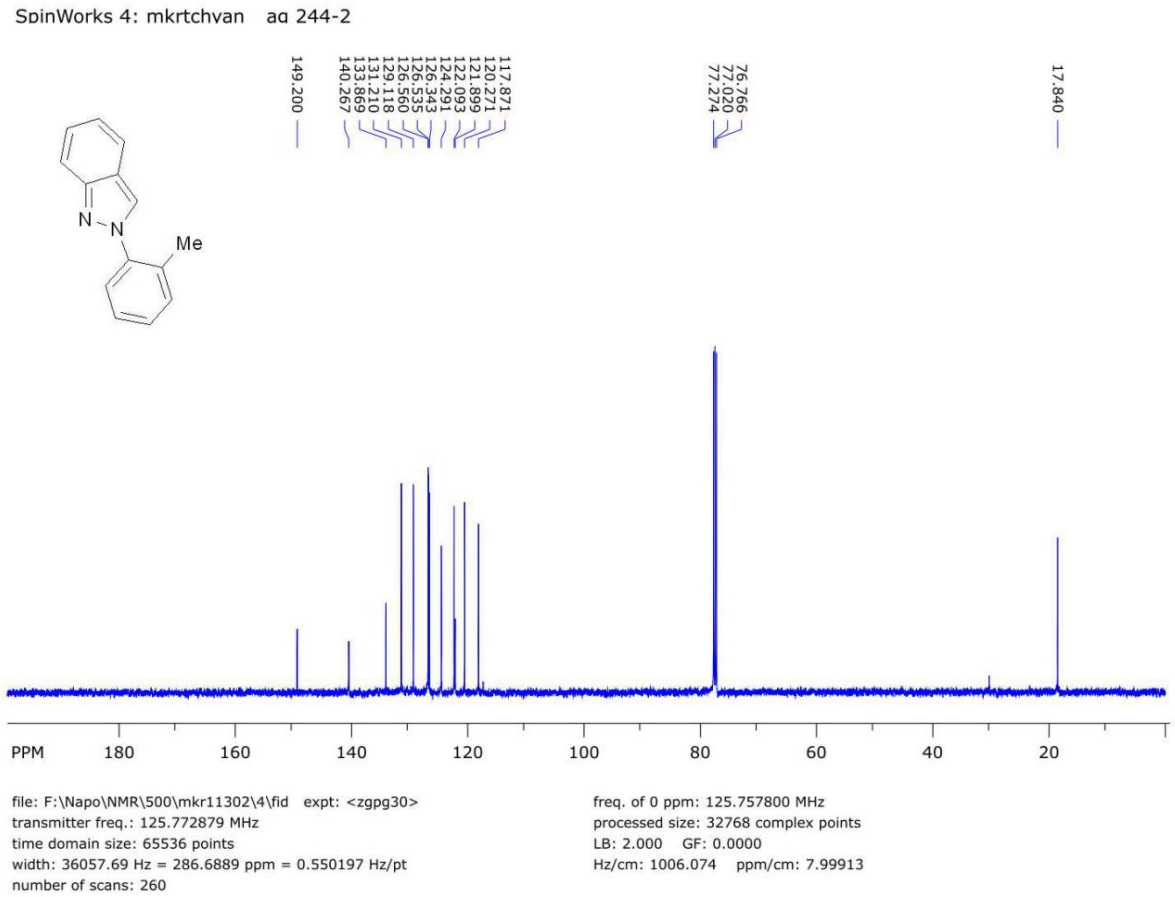
Compound 12a



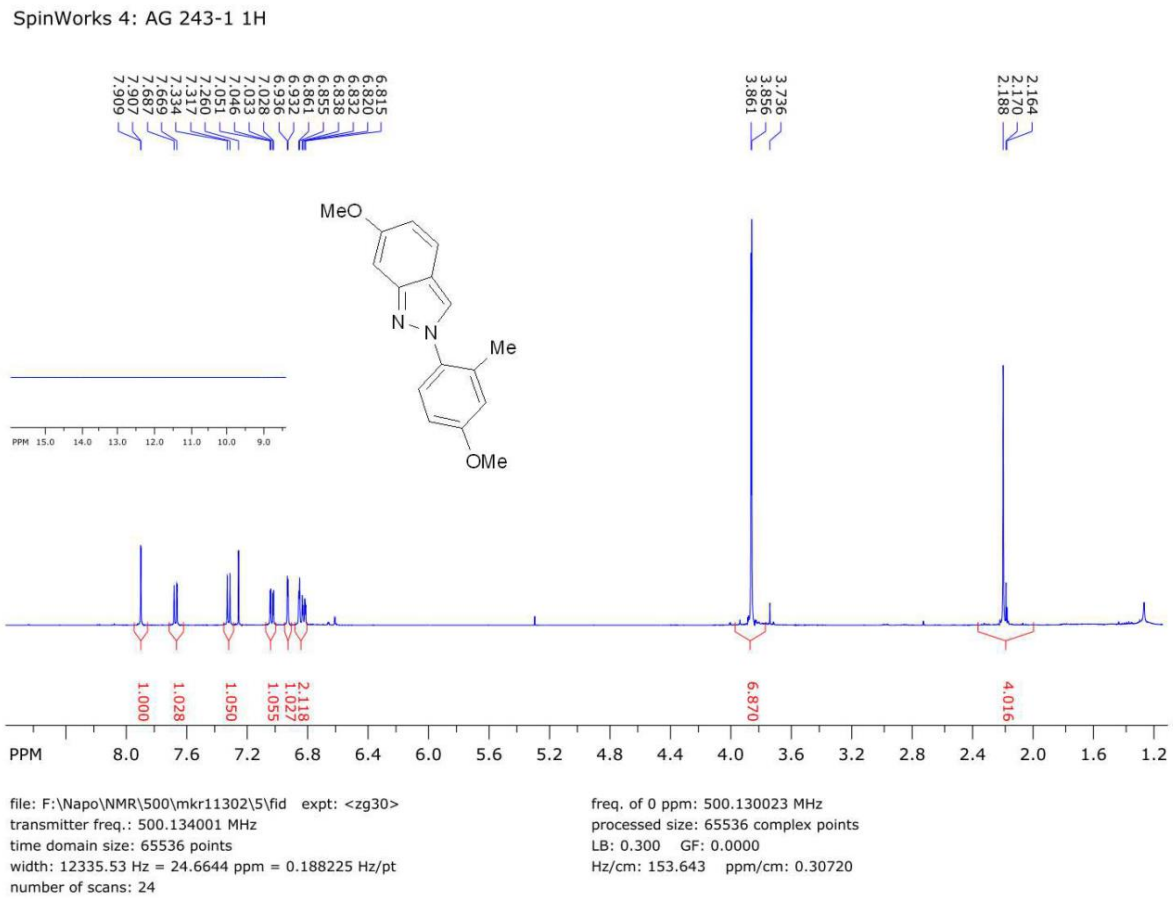
file: F:\Napo\NMR\500\mkr11302\3\fid expt: <zg30>
transmitter freq.: 500.134001 MHz
time domain size: 65536 points
width: 12335.53 Hz = 24.6644 ppm = 0.188225 Hz/pt
number of scans: 24

freq. of 0 ppm: 500.130023 MHz
processed size: 65536 complex points
LB: 0.300 GF: 0.0000
Hz/cm: 198.250 ppm/cm: 0.39639

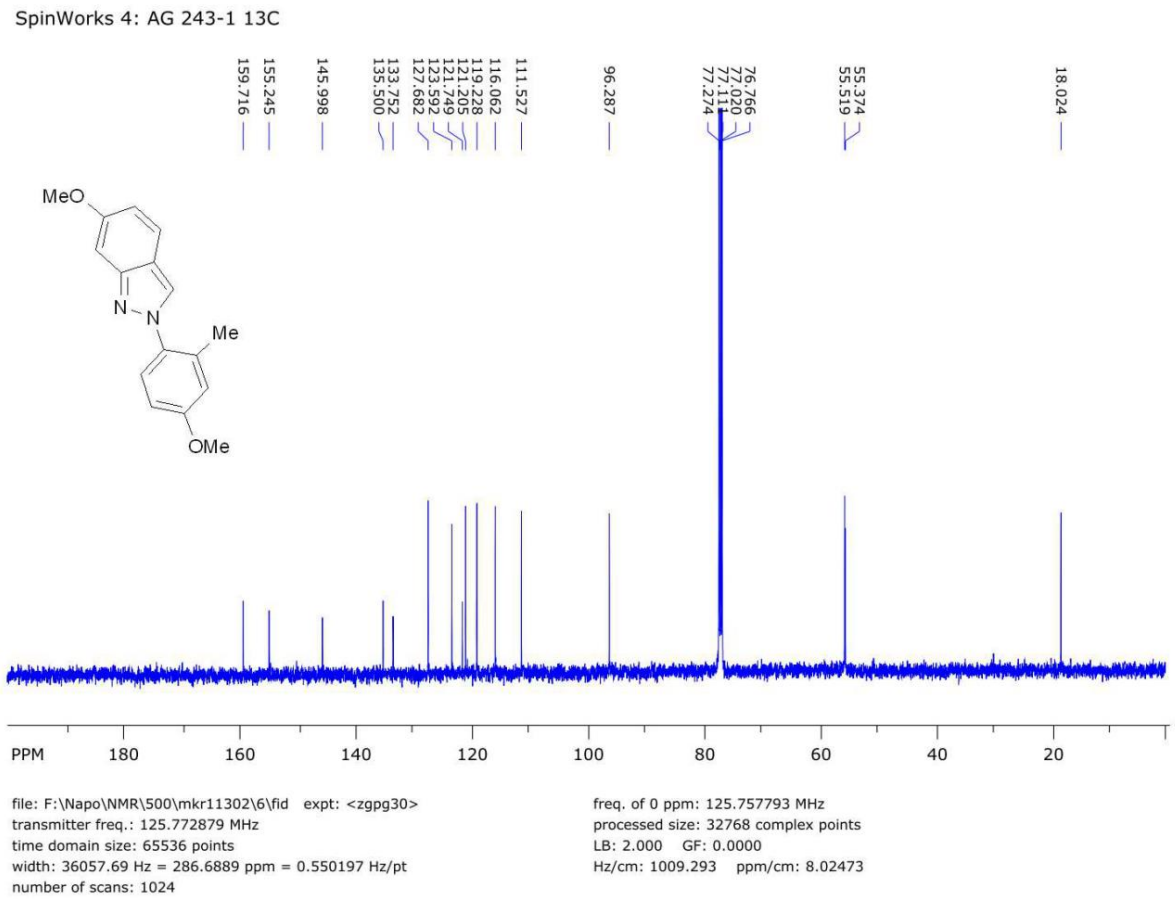
Compound 12a



Compound 12b



Compound 12b



Competitive experiments between nitrobenzene and *p*-toluidine

Sample Information

Sample Name	: AG-459A
Sample ID	: AG-459A
Analyzed	: 3/8/2017 6:45:08 PM
Vial #	: 8
Injection Volume	: 0.40
$EndIf$Data File	: F:\Napo\GC\Satenik's files\2017\02_2017\AG-45
Method File	: C:\GCMSsolution\Data\widma\metody\ewelina 0
Tuning File	: C:\GCMSsolution\System\Tune1\tuning 02.03.2(

Configuration Control

<<Column>>
Name : ZB5MSi
Serial # :
Thickness : 0.25um
Length : 30.0m
Inside Diameter : 0.25mm
Max Usable Temp : 360°C
Installation Date : 2013/11/06
Description :

Method

[Comment]

===== Analytical Line 1 =====

[GC-2010]

Column Oven Temp.	:50.0 °C
Injection Temp.	:250.00 °C
Injection Mode	:Splitless
Sampling Time	:1.00 min
Pressure	:69.4 kPa
Total Flow	:63.0 mL/min
Column Flow	:1.22 mL/min
Linear Velocity	:40.0 cm/sec
Purge Flow	:1.0 mL/min
Split Ratio	:50.0

Oven Temp. Program

Rate	Temperature(°C)	Hold Time(min)
-	50.0	3.00
30.00	150.0	5.00
25.00	250.0	20.00

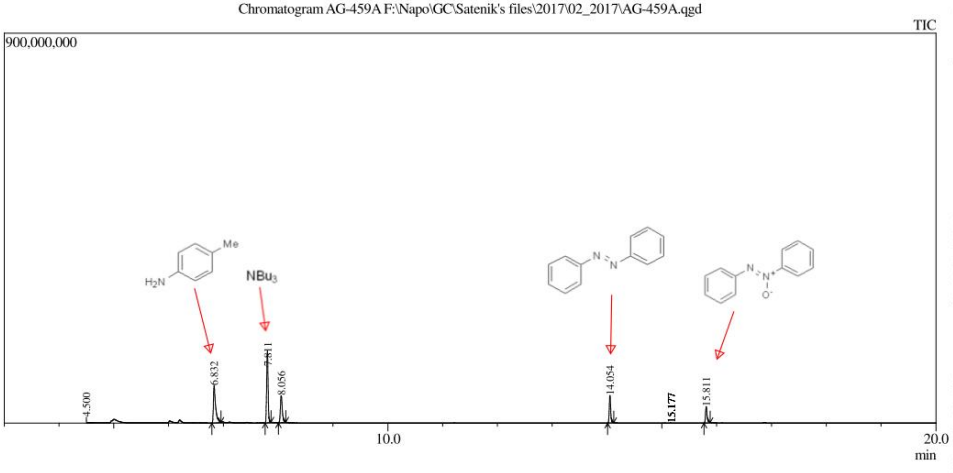
[GCMS-QP2010 Ultra]

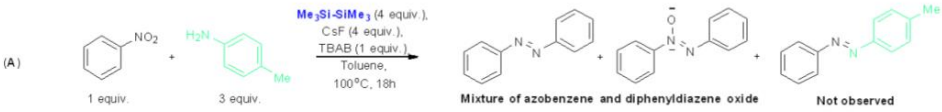
IonSourceTemp	:200.00 °C
Interface Temp.	:200.00 °C
Solvent Cut Time	:4.50 min
Detector Gain Mode	:Relative
Detector Gain	:1.20 kV +0.20 kV
Threshold	:0

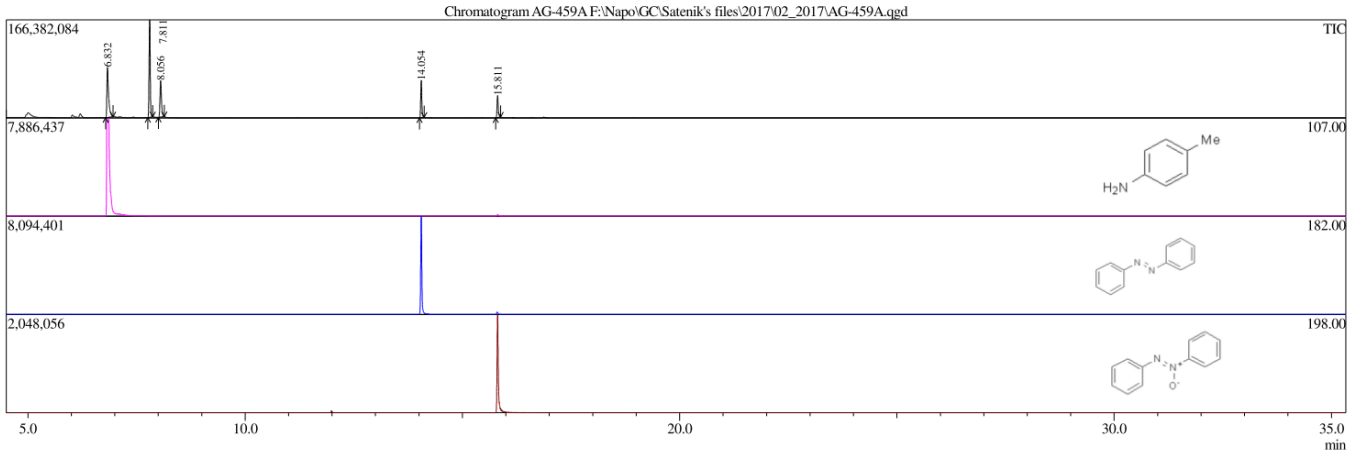
[MS Table]
--Group 1 - Event 1--

Start Time	:4.50min
End Time	:35.33min
ACQ Mode	:Scan
Event Time	:0.10sec
Scan Speed	:20000
Start m/z	:35.00
End m/z	:1000.00

Chromatogram AG-459A F:\Napo\GC\Satenik's files\2017\02_2017\AG-459A.qgd

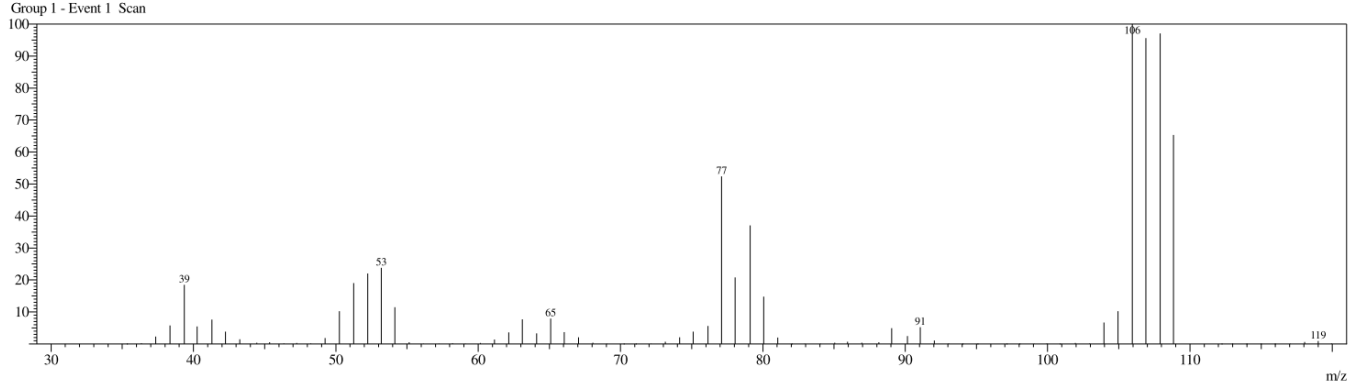






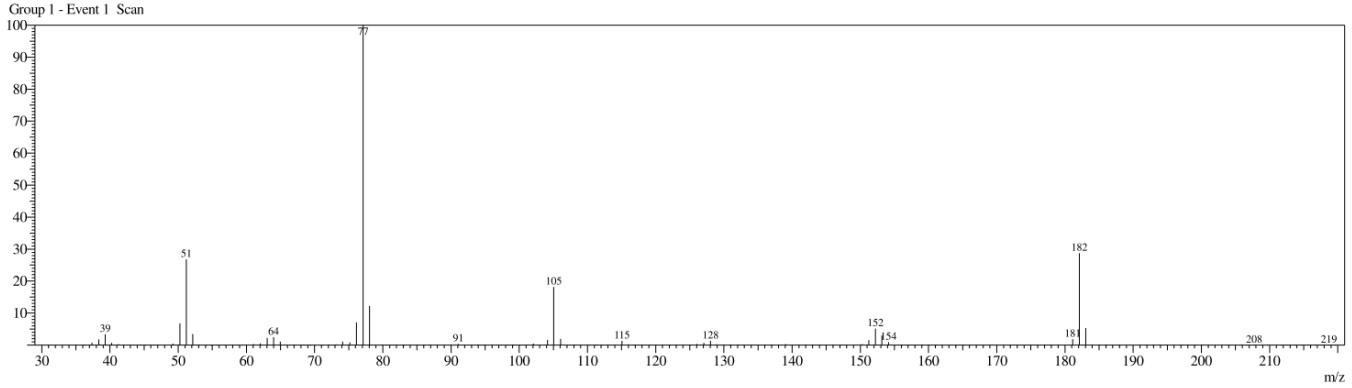
Spectrum

R.Time:6.848(Scan#:1410)
MassPeaks:555
Group 1 - Event 1 Scan



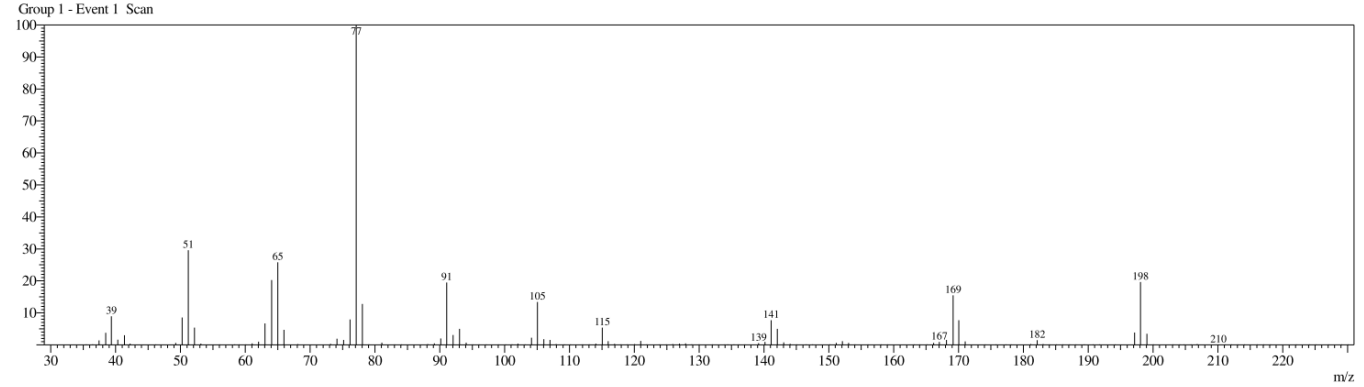
Spectrum

R.Time:14.073(Scan#:5745)
MassPeaks:590
Group 1 - Event 1 Scan



Spectrum

R.Time:15.818(Scan#:6792)
MassPeaks:574
Group 1 - Event 1 Scan



Competitive experiments between nitrobenzene and nitrosobenzene

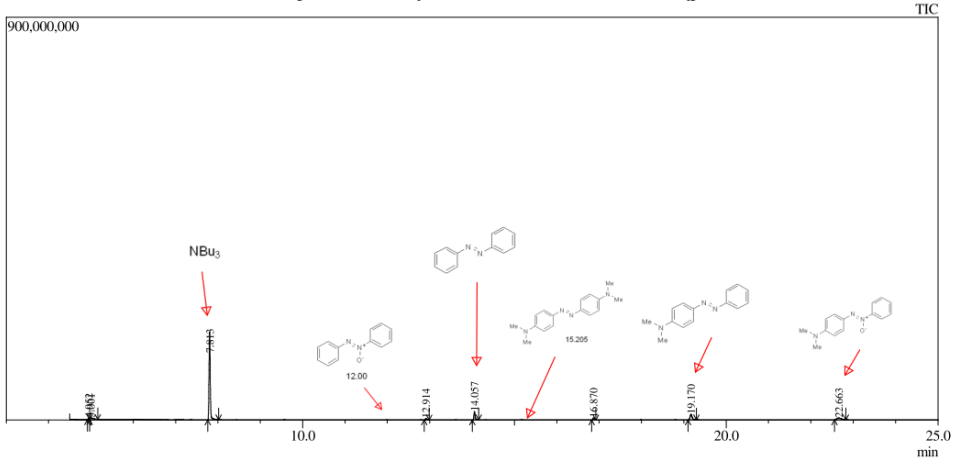
Sample Information

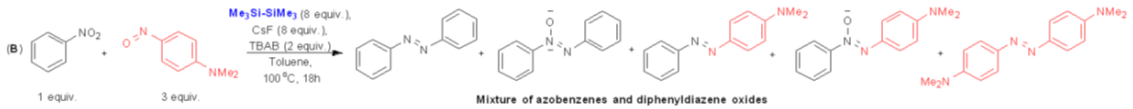
Sample Name	: AG-458A
Sample ID	: AG-458A
Analyzed	: 3/8/2017 6:04:27 PM
Vial #	: 7
Injection Volume	: 0.40
SEndIf\$Data File	: F:\Napo\GC\Satenik's files\2017\02_2017\A
Method File	: C:\GCMSsolution\Data\widma\metody\ewel
Tuning File	: C:\GCMSsolution\System\Tune1\tuning 02.(

Configuration Control

<<Column>>
Name : ZB5MSi
Serial # :
Thickness : 0.25um
Length : 30.0m
Inside Diameter : 0.25mm
Max Usable Temp : 360°C
Installation Date : 2013/11/06
Description :

Chromatogram AG-458A F:\Napo\GC\Satenik's files\2017\02_2017\AG-458A.qgd





Method

[Comment]

===== Analytical Line 1 =====

[GC-2010]

Column Oven Temp.	:50.0 °C
Injection Temp.	:250.00 °C
Injection Mode	:Splitless
Sampling Time	:1.00 min
Pressure	:69.4 kPa
Total Flow	:63.0 mL/min
Column Flow	:1.22 mL/min
Linear Velocity	:40.0 cm/sec
Purge Flow	:1.0 mL/min
Split Ratio	:50.0

Oven Temp. Program

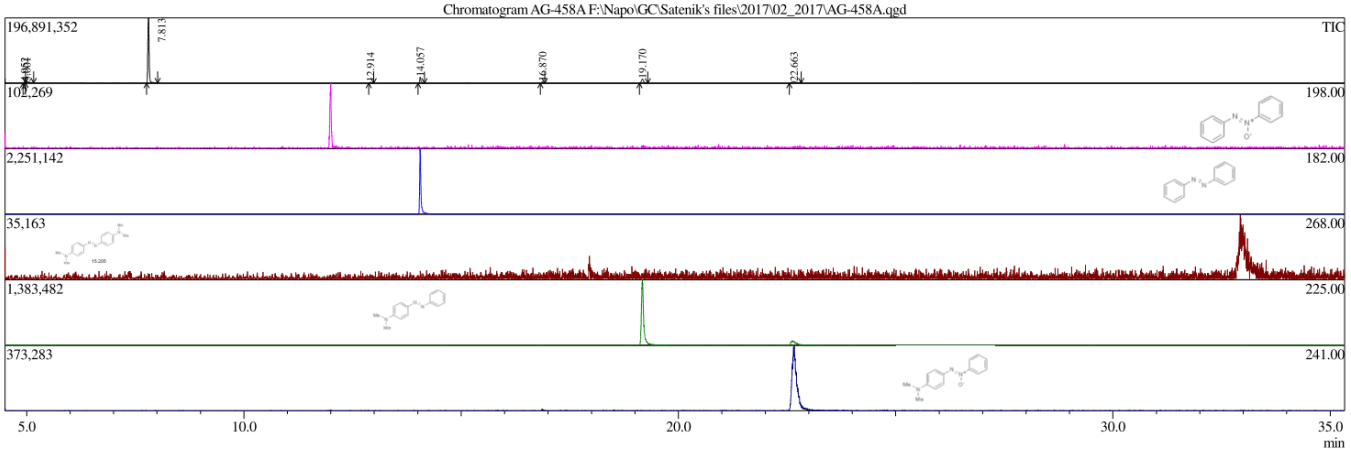
Rate	Temperature(°C)	Hold Time(min)
-	50.0	3.00
30.00	150.0	5.00
25.00	250.0	20.00

[GCMS-QP2010 Ultra]

IonSourceTemp	:200.00 °C
Interface Temp.	:200.00 °C
Solvent Cut Time	:4.50 min
Detector Gain Mode	:Relative
Detector Gain	:1.20 kV +0.20 kV
Threshold	:0

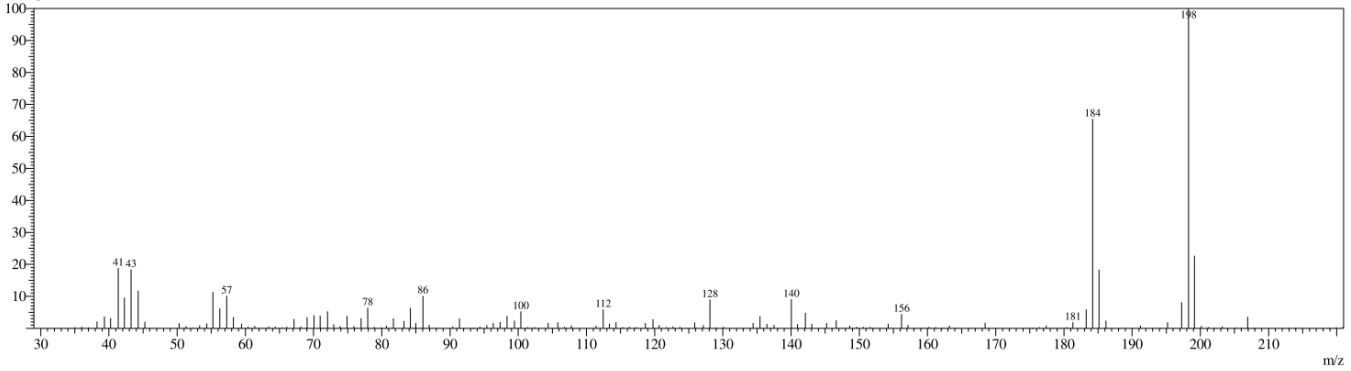
[MS Table]
--Group 1 - Event 1--

Start Time	:4.50min
End Time	:35.33min
ACQ Mode	:Scan
Event Time	:0.10sec
Scan Speed	:20000
Start m/z	:35.00
End m/z	:1000.00



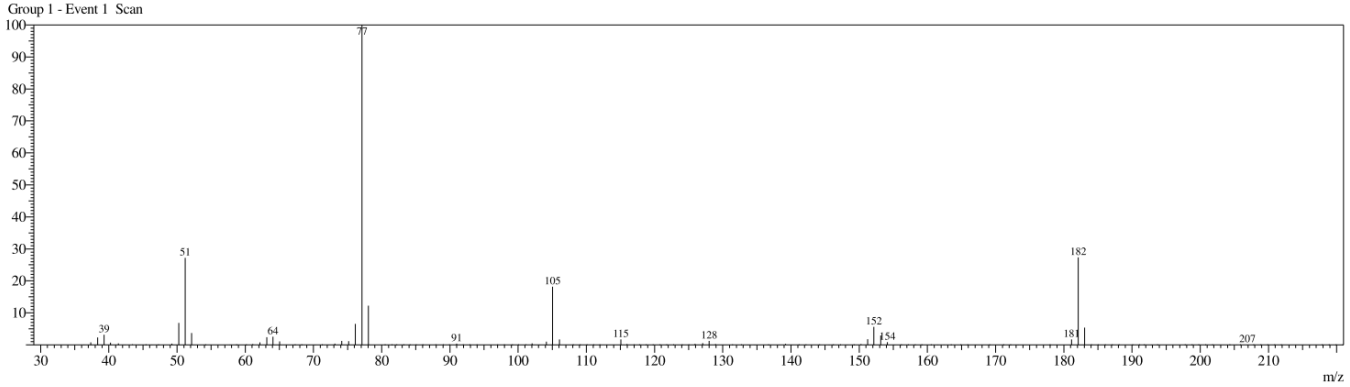
Spectrum

R.Time:12.000(Scan#:4501)
MassPeaks:554
Group 1 - Event 1 Scan



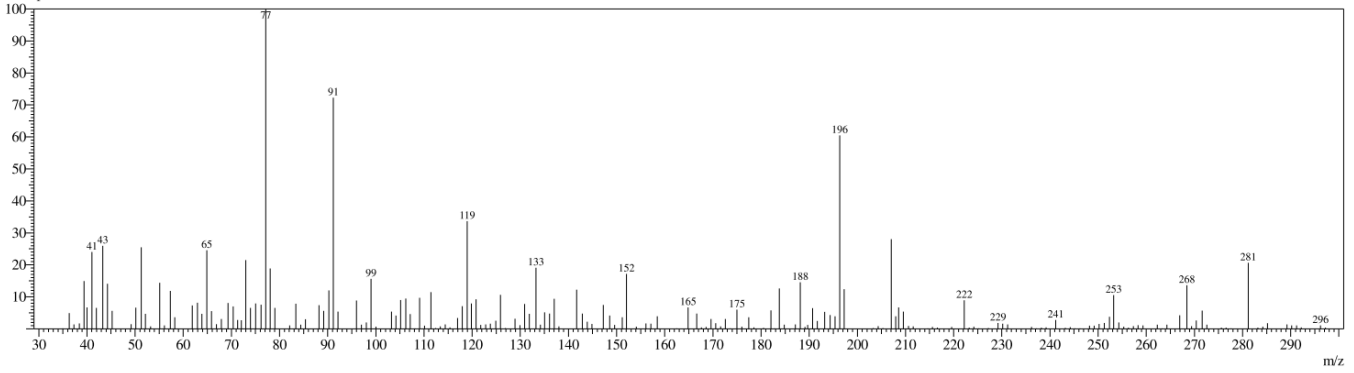
Spectrum

R.Time:14.068(Scan#:5742)
MassPeaks:561
Group 1 - Event 1 Scan



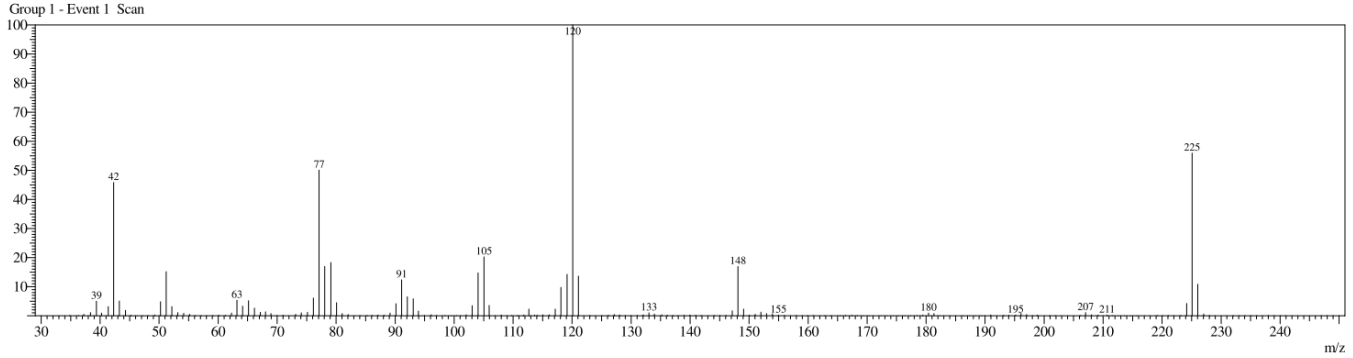
Spectrum

R.Time:15.208(Scan#:6426)
MassPeaks:567
Group 1 - Event 1 Scan



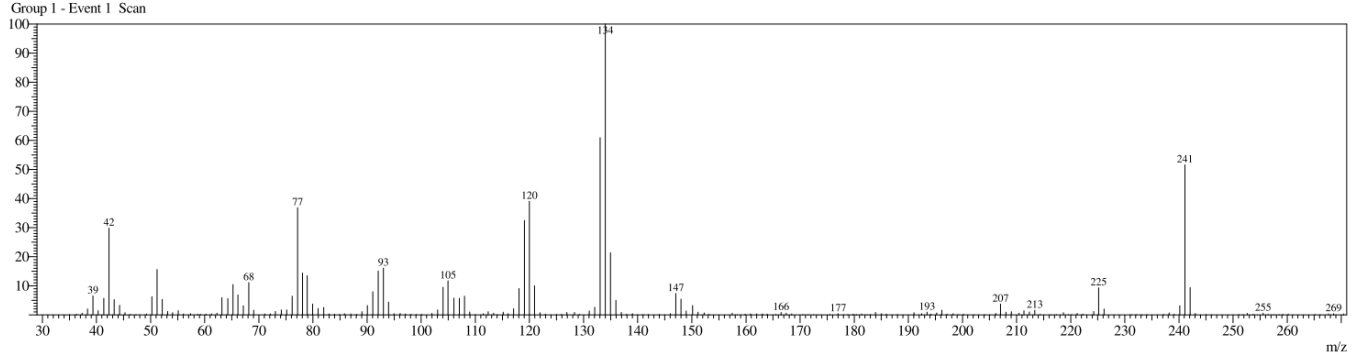
Spectrum

R.Time:19.163(Scan#:8799)
MassPeaks:587
Group 1 - Event 1 Scan



Spectrum

R.Time:22.680(Scan#:10909)
MassPeaks:603
Group 1 - Event 1 Scan



Detection of the analogue of hexamethyldisiloxane

Sample Information

Sample Name	: AG-396A
Sample ID	: AG-396A
Analyzed	: 3/8/2017 8:46:51 PM
Vial #	: 11
Injection Volume	: 0.40
$EndIfSData File	: F:\Napo\GC\AG-396A.qgd
Method File	: C:\GCMSsolution\Data\widma\metody\ewelina 05.04.2016-d³.qgm
Tuning File	: C:\GCMSsolution\System\Tune1\tuning 02.03.2017-EI.qgt

Configuration Control

<<Column>>
Name : ZB5MSi
Serial # :
Thickness : 0.25um
Length : 30.0m
Inside Diameter : 0.25mm
Max Usable Temp : 360°C
Installation Date : 2013/11/06
Description :

Method

[Comment]

===== Analytical Line 1 =====

[GC-2010]

Column Oven Temp.	:50.0 °C
Injection Temp.	:250.00 °C
Injection Mode	:Splitless
Sampling Time	:1.00 min
Pressure	:69.4 kPa
Total Flow	:63.0 mL/min
Column Flow	:1.22 mL/min
Linear Velocity	:40.0 cm/sec
Purge Flow	:1.0 mL/min
Split Ratio	:50.0

Oven Temp. Program

Rate	Temperature(°C)	Hold Time(min)
-	50.0	3.00
30.00	150.0	5.00
25.00	250.0	20.00

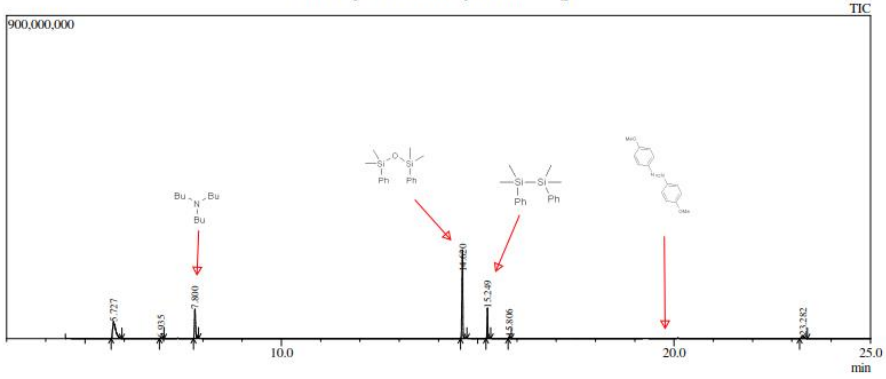
[GCMS-QP2010 Ultra]

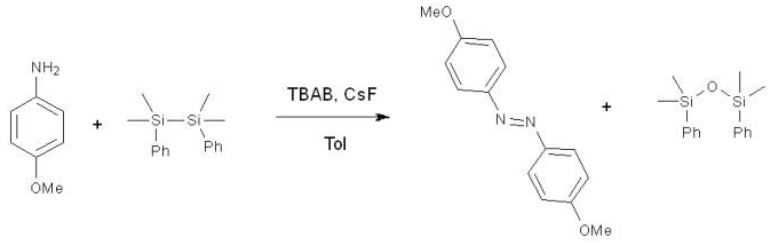
IonSourceTemp	:200.00 °C
Interface Temp.	:200.00 °C
Solvent Cut Time	:4.50 min
Detector Gain Mode	:Relative
Detector Gain	:1.20 kV +0.20 kV
Threshold	:0

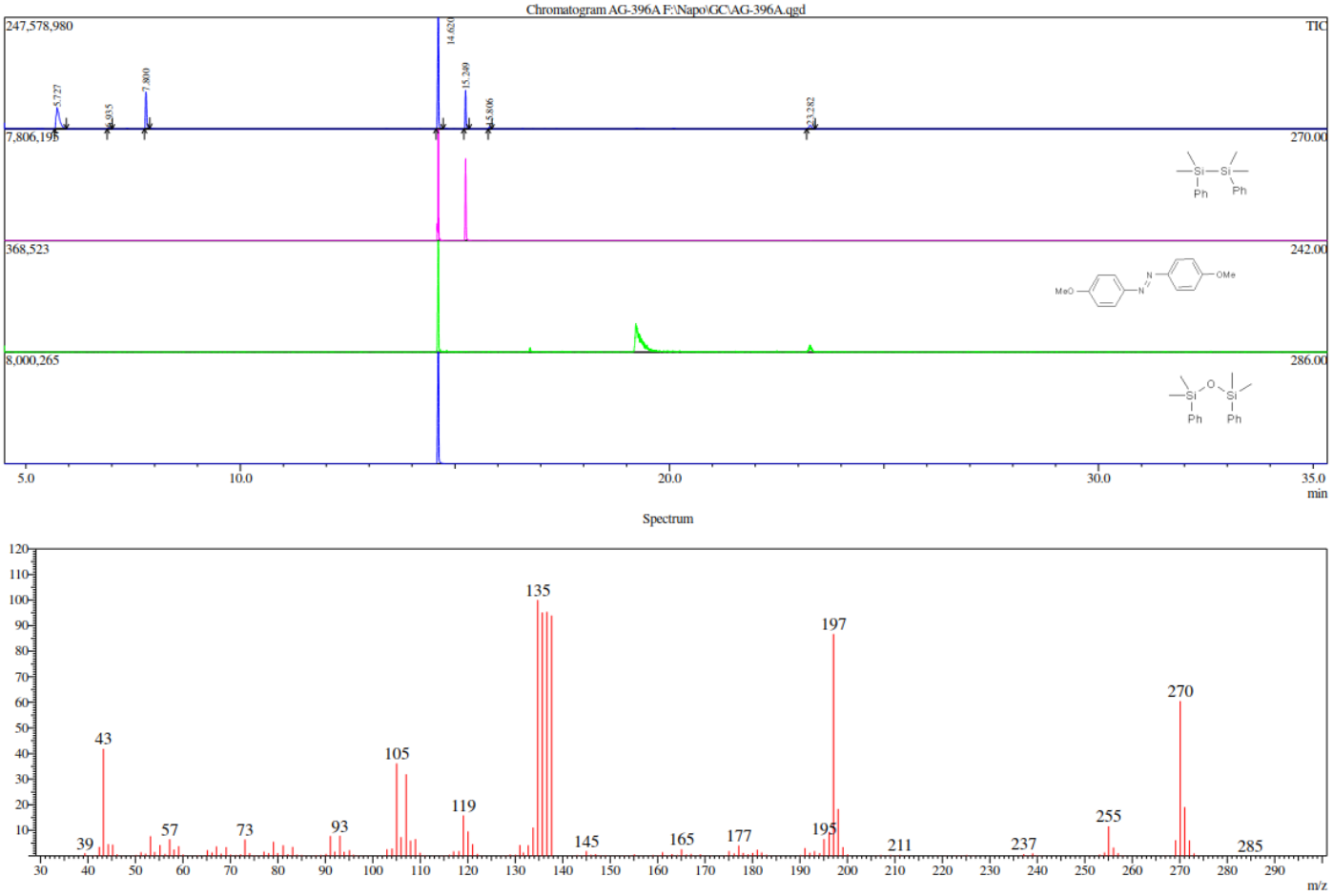
[MS Table]
--Group 1 - Event 1--

Start Time	:4.50min
End Time	:35.33min
ACQ Mode	:Scan
Event Time	:0.10sec
Scan Speed	:20000
Start m/z	:35.00
End m/z	:1000.00

Chromatogram AG-396A F:\Napo\GC\AG-396A.qgd






Chromatogram AG-396A F:\Napo\GC\AG-396A.qgd
247,578,980
TIC
14.620
5.727
7.800
15.249
15.806
23.282
7,806,195
270.00
368,523
242.00
8,000,265
286.00
5.0
10.0
20.0
30.0
35.0
min
Spectrum
120
110
100
90
80
70
60
50
40
30
20
10
135
197
270
43
105
119
39
57
73
93
145
165
177
195
211
237
255
285
30
40
50
60
70
80
90
100
110
120
130
140
150
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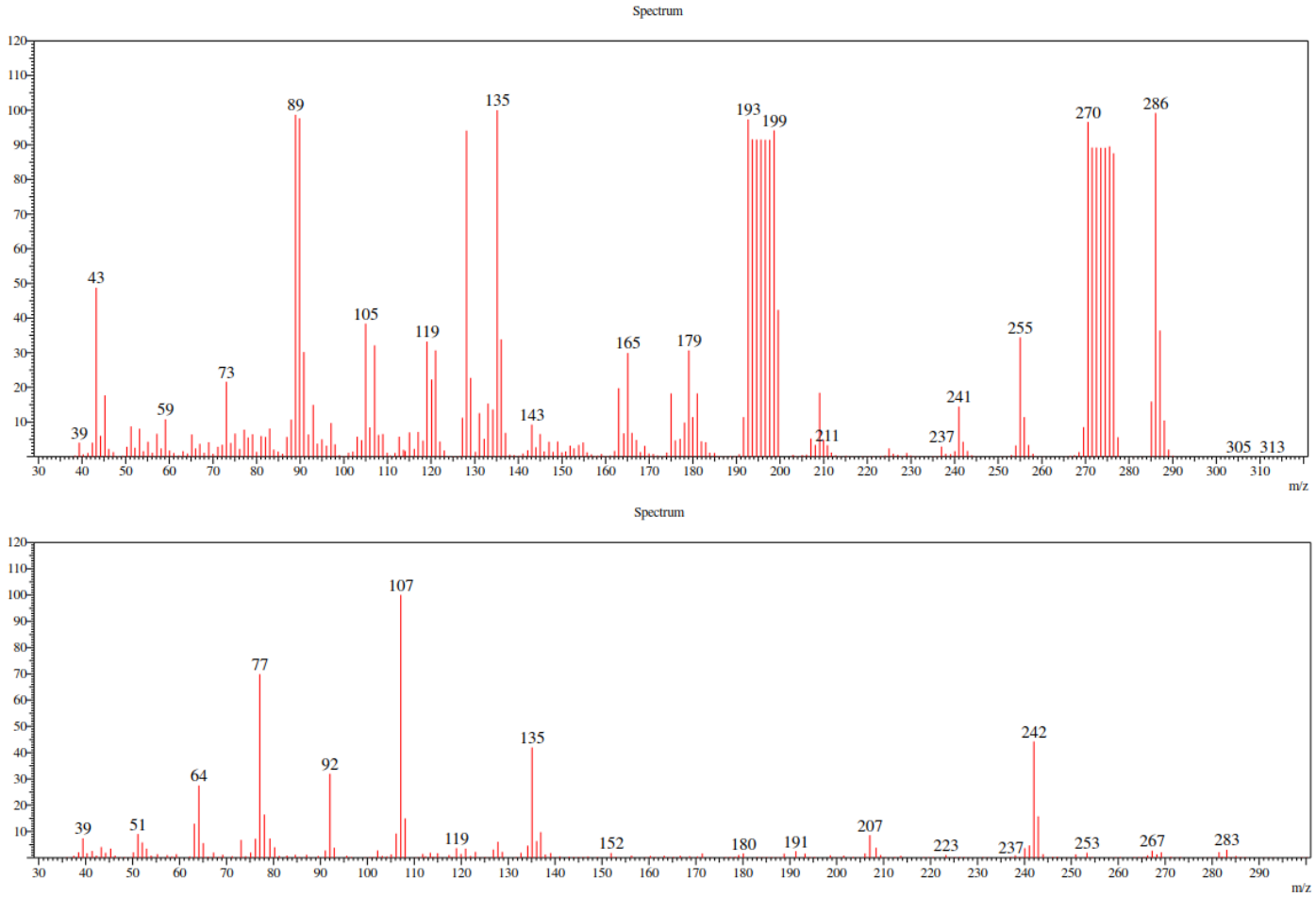
170
180
190
200
210
220
230
240
250
260
270
280
290
m/z


Spectrum
89
135
193
199
270
286
43
105
119
165
179
255
73
241
59
143
211
39
237
305
313
m/z
Spectrum
107
77
135
242
64
92
39
51
119
152
180
191
207
223
237
253
267
283
m/z