

Supporting Information

Arylative Cyclization of 2-Isocyanobiphenyls with Anilines: a One-Pot Synthesis of 6-Arylphenanthridines via Competitive Reaction Pathways

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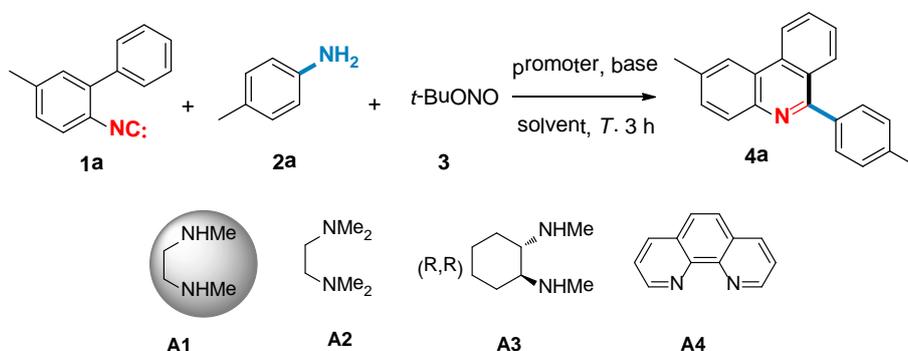
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1. General Information

All reactions involving air sensitive reagents or intermediates were carried out in pre-heated glassware under an argon atmosphere using standard *Schlenk* techniques. All solvents and chemicals were used as received from the suppliers (*Alfa*, *J&K*, *Sigma Aldrich*, *Aladdin*). Reactions were monitored using thin-layer chromatography (TLC) on commercial silica gel plates (GF254). Solvents for flash column chromatography (FC), crystallization and extractions have been distilled once. Visualization of the developed plates was performed under UV light (254 nm). Flash column chromatography was performed on silica gel (200-300 mesh). ^1H and ^{13}C NMR spectra were recorded on a 400 or 500 MHz spectrometer. Chemical shifts (δ) were reported in ppm referenced to an internal tetramethylsilane standard for ^1H NMR. Chemical shifts of ^{13}C NMR are reported relative to CDCl_3 (δ 77.0). The following abbreviations were used to describe peak splitting patterns when appropriate: br s = broad singlet, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet. Coupling constants, J , were reported in Hertz unit (Hz). High resolution mass spectra (HRMS) were obtained on an ESI-LC-MS/MS Spectrometer.

2. Optimization of the Reaction Conditions

Table S1^a



entry	promoter (mol %)	base (equiv)	ration/ 1a:2a:3	solvent [1 mL]	temp (°C)	yield [%] ^b
1	Mn^{2+} (10) ^c	-	1:1.2:1.5	toluene	80	14
2	Mn^{2+} (40) ^c	-	1:1.2:1.5	toluene	80	14
3	$\text{Mn}(\text{acac})_3$ (20)	-	1:1.2:1.5	toluene	80	trace
4	BPO (20)	-	1:1.2:1.5	MeCN	r.t.	trace
5	BPO (20)	-	1:1.2:1.5	MeCN	60	14
6	BPO (10)	-	1:1.2:1.5	MeCN	100	34
7	BPO (10)	-	1:2:2.5	MeCN	100	36
8	BPO (10)	-	1:3:3.5	MeCN	100	41
9	BPO (10)	-	1:1.2:1.5	PhCF_3	100	38

10	BPO (10)	-	1:1.2:1.5	toluene	100	21
11	BPO (10)	-	1:1.2:1.5	1,4-dioxane	100	9
12 ^d	BPO (10)	-	1:1.2:1.5	PhCF ₃	100	28
13 ^e	BPO (10)	-	1:1.2:1.5	PhCF ₃	100	23
14 ^f	BPO (10)	-	1:1.2:1.5	PhCF ₃	100	38
15	BPO (2)	KF (1.1)	1:3:3.5	PhCF ₃	90	65
16	BPO (2)	NaOAc (1.1)	1:3:3.5	PhCF ₃	90	69
17	BPO (2)	<i>t</i> -BuOK (0.2)	1:3:3.5	PhCF ₃	90	65
18	BPO (2)	<i>t</i> -BuOK (1.1)	1:3:3.5	PhCF ₃	90	trace
19	BPO (2)+A1 (20)	K ₂ CO ₃ (1.0)	1:3:3.5	PhCF ₃	70	trace
20	BPO (2)+A1 (20)	NaOAc (1.1)	1:3:3.5	PhCF ₃	70	89
21	BPO (2)+A1 (40)	NaOAc (1.1)	1:3:3.5	PhCF ₃	70	83
22	BPO (2)+A1 (60)	NaOAc (1.1)	1:3:3.5	PhCF ₃	70	71

^a Reaction conditions: All reactions were performed with **1a** (0.2 mmol), **2a** (1.2-3 equiv) and **3** (1.5-3.5 equiv) in 1.0 mL of solvent at indicated temperature, in Ar, for 3 h. ^b Isolated yields of **4a**.

^c Mn²⁺ = Mn(OAc)₂ · 4H₂O. ^d In air. ^e In O₂. ^f In N₂.

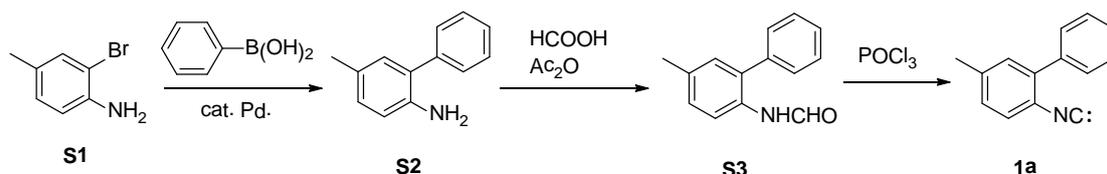
At the outset, we examined the reaction of isocyanide **1a**, *p*-toluidine **2a**, and *t*-BuONO **3** in the presence of Mn(OAc)₂ [10 mol %], it gave phenanthridine **4a** in 14% yield at 80 °C for 3 h (entry 1). However, increasing the manganese salt (40 mol %) did not improve the yield (14%, entry 2). Mn^{III} salt, which is applied in the Chatani's reaction,^{1a} only a trace of the desired product was detected (entry 3). Furthermore, when BPO was used as an additive, higher temperature and addition of *p*-toluidine **2a**, and *t*-BuONO **3** could improve the yields (entries 4-6 and entries 7-8). In addition, it was observed that the reaction was less efficient in other organic solvents (entries 9-11). It was observed that the reaction proceeded more efficiently in inert atmosphere than in air or oxygen (entries 9 and 12-14). Strong base would suppress the reaction (entries 15-18). Conditions involving 20 mol% of DMEDA (**A1**) in combination with NaOAc (1.1 equiv) and BPO (2 mol %) in PhCF₃ at 70 °C for 3 h were identified as the optimal conditions (entries 19-22).

3. Preparation of Starting Materials

a) General Procedure for the Preparation of Biphenyl Isocyanides

All biphenyl isocyanides were prepared according to the reported method.¹ Analytical data of **1a**, **1s**, **1t**, **1u**, **1v**, **1w**, **1x**, **1y**, **1z**, **1ab**, **1ab** are in agreement with those reported in the literature.¹

A typical procedure for the synthesis of **1a** is shown below.

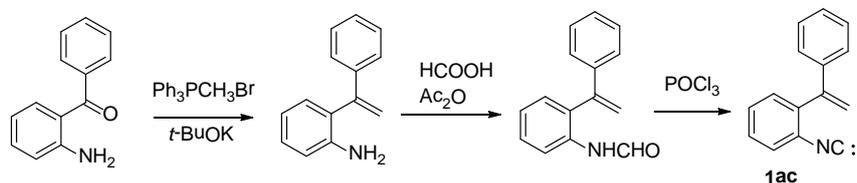


Procedure A: To an oven-dried three necked flask, 2-bromo-4-methylaniline (**S1**, 925 mg, 5 mmol), phenylboronic acid (725 mg, 6 mmol), aqueous solution of K_2CO_3 (2 M, 11 mL) and DME (10 mL) were added under a gentle stream of Ar. The mixture was stirred for 30 min at room temperature under an Ar atmosphere. To the stirred mixture, $PdCl_2(PPh_3)_2$ (70 mg, 0.10 mmol) was added at room temperature, and the mixture was stirred overnight at 80 °C, under Ar. The reaction mixture was then cooled to room temperature and diluted with EtOAc. The organic layer was washed with water and dried over $MgSO_4$. After removing the volatiles in vacuo, the residue was subjected to column chromatography on silica gel (petroleum ether/EtOAc) to afford 4-methyl-2-phenylaniline (**S2**, 788 mg, 86%).

Procedure B: Acetic formic anhydride (0.89 mL) was added dropwise to a stirring solution of **S2** (788 mg, 4.30 mmol) at 0 °C in THF (8 mL). The mixture was stirred for 2 h at room temperature. Then, the mixture was quenched with saturated aqueous solution of $NaHCO_3$ and extracted with EtOAc for three times. The extract was dried over Na_2SO_4 and concentrated under reduced pressure to give formamide **S3** as pale yellow oil (ca. 1.1 g). This material was used for the subsequent dehydration without further purification.²

Procedure C: THF (8 mL), NEt_3 (4.3 mL) were added to the flask containing **S3** obtained above under Ar atmosphere. $POCl_3$ (0.7 mL) in 2 mL of THF was added slowly via syringe for a period of 1 h at 0 °C, and the mixture was stirred for another 2 h at 0 °C. To the reaction mixture was added 15 mL of EtOAc at 0 °C. The mixture was slowly quenched with saturated aqueous solution of $NaHCO_3$ and stirred for 30 min at 0 °C. Then, the mixture was extracted with EtOAc for three times, dried over Na_2SO_4 and evaporated under reduced pressure. The compound was purified by column chromatography (petroleum ether/EtOAc) to give **1a** as a pale yellow solid (811 mg, 84% yield from **S1**).

General Procedure for the Preparation of **1ac**.³

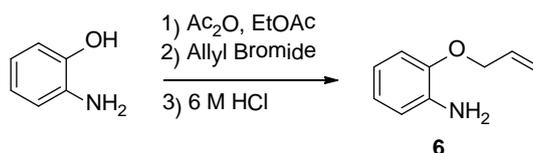


To a solution of Ph_3PMeBr (1.5 equiv) in dry THF (10 mL) was added *t*-BuOK (1.5 equiv) in portions under argon. After the mixture was stirred at room temperature for 0.5 h, a solution of (2-aminophenyl)(phenyl)methanone (1.1 g, 1.0 equiv) in THF (5 mL) was added dropwise. The reaction mixture was then stirred at room temperature under argon overnight. The reaction mixture was quenched with H_2O and extracted twice with EtOAc. The combined organic layers were washed with saturated $NaHCO_3$ and brine, dried over anhydrous sodium sulfate, filtered, and concentrated, and The crude product was purified by column

chromatography (petroleum ether/EtOAc) to give 2-(1-phenylvinyl)aniline (pale yellow solid, 781.2 mg, 72%).

2-(1-phenylvinyl)aniline (3.82 mmol), following the general procedure B and C, 674.3 mg (3.28 mmol, 86%) of **1ac** (orange solid, 674.3 mg, 86%) were isolated. ^1H NMR (400 MHz, CDCl_3) δ 7.44-7.28 (m, 9H), 5.88 (s, 1H), 5.41 (s, 1H); ^{13}C NMR (125 MHz, CDCl_3) δ 166.8, 145.6, 139.4, 139.3, 130.9, 129.2, 128.4, 128.4, 128.1, 127.4, 126.8, 117.6.

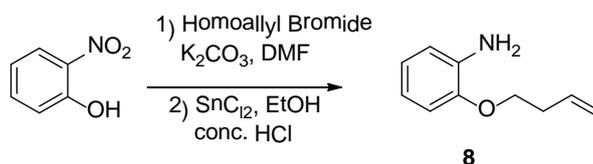
b) Preparation of Anilines **6**⁴ and **8**⁴



To a solution of 2-aminophenol (4.06 g, 37.2 mmol) in EtOAc (40 mL) was added dropwise Ac_2O (8.2 mL, 84 mmol) at 0 °C, and the mixture was stirred at room temperature for 4 h. The mixture was concentrated in vacuo, and the residual solid was recrystallized from MeOH: acetone (1:1) and CH_2Cl_2 at 0 °C. 2-Hydroxyacetanilide (4.73 g, 31.3 mmol, 84%) was isolated as a light yellow powder.

To a solution of 2-hydroxyacetanilide (4.53 g, 30 mmol) and K_2CO_3 (4.20 g, 30 mmol) in anhydrous acetone (11 mL) was added dropwise allyl bromide (2.60 mL, 30 mmol) at 0 °C. The mixture was warmed to reflux and stirred for 20 h. The organic phase was extracted with Et_2O (2×50 mL), washed with water (50 mL), with a solution of NaOH (10%) and dried over anhydrous MgSO_4 . The crude product was purified by flash column chromatography.

A solution of *N*-(2-(allyloxy)phenyl)acetamide (1.91g, 10 mmol) in 6 M HCl (2.4 mL) was refluxed for 4h. The mixture was basified with 4 N sodium hydroxide solution until pH = 14. This basified solution was extracted with EtOAc (2×20 mL) and dried over anhydrous MgSO_4 . The organic solvent was evaporated and the crude product was purified by flash column chromatography to give the desired product **6** as orange oil. ^1H NMR (400 MHz, CDCl_3) δ 6.82-6.80 (m, 2H), 6.75-6.70 (m, 2H), 6.14-6.05 (m, 1H), 5.42 (d, $J = 17.2$ Hz, 1H), 5.29 (d, $J = 10.4$ Hz, 1H), 4.57 (d, $J = 5.2$ Hz, 2H), 3.83 (bs, 2H); ^{13}C NMR (125 MHz, CDCl_3) δ 146.3, 136.6, 133.6, 121.4, 118.4, 117.4, 115.2, 112.1, 69.2; HRMS (ESI): Exact mass calcd for $\text{C}_9\text{H}_{12}\text{NO}$ $[\text{M}+\text{H}]^+$ 150.0913, found 150.0911.

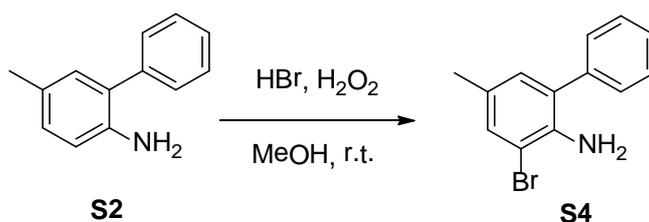


To a solution of 2-nitrophenol (0.7 g, 5 mmol) and K_2CO_3 (1.0 g, 7.5 mmol) in anhydrous DMF (10 mL) was added dropwise homoallyl bromide (0.76 mL, 7.5 mmol) at 0 °C, and the mixture was stirred at 60 °C for 10 h. After completion of the reaction, H_2O (30 mL) was added. The resulting mixture was extracted with EtOAc (2×50 mL), dried over anhydrous Na_2SO_4 , and then concentrated in vacuo. The resulting residue was purified by

flash chromatography to give the desired product as a yellow solid (744 mg, 77% yield).

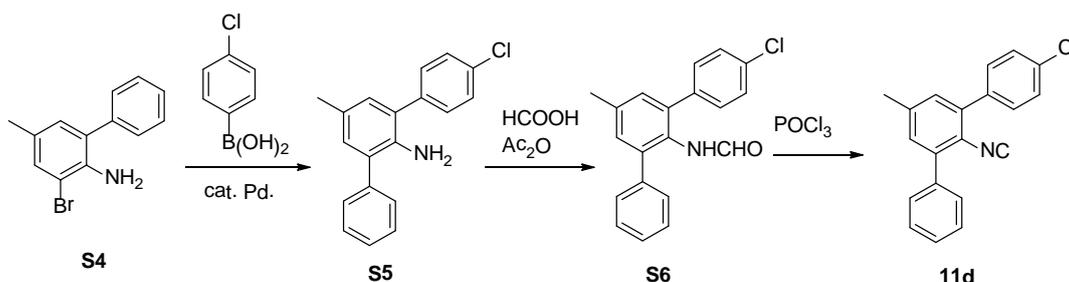
A mixture of $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ (3.6 g) in EtOH (10 mL) and conc. HCl (2.1 mL) was stirred at room temperature until the solution became clear. Then, 1-(but-3-en-1-yloxy)-2-nitrobenzene (734 mg, 3.8 mmol) was added in one portion. The reaction was refluxed for 7 h and cooled to room temperature. The solution was washed with H_2O (15 mL) and then basified with 4N sodium hydroxide solution. The basified solution was extracted with CH_2Cl_2 (2×50 mL) and dried over anhydrous Na_2SO_4 , and then concentrated in vacuo. The resulting residue was purified by flash chromatography to give the desired product **8** as pale yellow oil (440 mg, 71% yield). ^1H NMR (400 MHz, CDCl_3) δ 6.80-6.78 (m, 2H), 6.73-6.69 (m, 2H), 5.97-5.87 (m, 1H), 5.21-5.11 (m, 2H), 4.06 (t, $J = 6.6$ Hz, 2H), 3.79 (bs, 2H), 2.60-2.55 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 146.6, 136.7, 134.6, 121.4, 118.4, 116.9, 115.2, 112.2, 67.7, 33.8; HRMS (ESI): Exact mass calcd for $\text{C}_{10}\text{H}_{14}\text{NO}$ $[\text{M}+\text{H}]^+$ 164.1070, found 164.1068.

c) Preparation of Triaryl Isocyanides



S2 (23.8 mmol) was dissolved in a mixture of 55 mL of methyl alcohol and 4.7 mL of 49% hydro bromic acid (1.2 equiv). After cooling the reaction mixture to room temperature using water bath, hydrogen peroxide (3.0 mL, 1.1 equiv, in 20 mL of methyl alcohol) was added dropwise by dropping funnel. The reaction was left at room temperature (water bath) for 20 h whilst monitoring its progress by TLC. After the completion of bromination, the solvent was removed under reduced pressure and the crude product was taken in ethyl acetate and washed with water, brine and dried over anhydrous Na_2SO_4 . After concentrated under reduced pressure, the residue was separated by column chromatography (petroleum ether/EtOAc) to give the pure product (**S4**, light orange solid, 4.74 g, 18.1 mmol, 76%).⁵ ^1H NMR (400 MHz, CDCl_3) δ 7.47-7.41 (m, 4H), 7.38-36 (m, 1H), 7.26 (s, 1H), 6.88 (s, 1H), 4.04 (br s, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 139.4, 139.0, 132.2, 132.0, 130.2, 128.9, 128.8, 128.3, 127.5, 109.8, 19.9; IR (KBr): 3477, 3385, 3045, 3028, 2924, 1619, 1593, 1473, 1441, 1302, 1234, 1073, 1058, 861, 638, 575 cm^{-1} .

A typical route for the synthesis of **11d** is shown below.

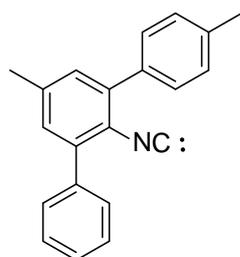


Procedure D: To an oven-dried three-necked flask, 2-bromo-4-methylaniline (**S4**, 2 mmol), 4-chlorophenylboronic acid (1.3 equiv, 2.6 mmol), aqueous solution of K_2CO_3 (2 M, 4.5 mL) and DME (4 mL) were added under a gentle stream of Ar, and the mixture was stirred for 30 min at room temperature under Ar atmosphere. To the stirring mixture, $PdCl_2(PPh_3)_2$ (42 mg, 3 mol%) was added at room temperature, and the mixture was stirred overnight at 80 °C under Ar. The reaction mixture was then cooled to room temperature and diluted with EtOAc. The organic layer was washed with water and dried over $MgSO_4$. After removing the volatiles in vacuo, the residue was subjected to column chromatography on silica gel (petroleum ether/EtOAc) to afford 4-chloro-5'-methyl-[1,1':3,1''-terphenyl]-2'-amine (**S5**, 524 mg, 89%).

Procedure E: Acetic formic anhydride (0.36 mL) was added dropwise to a stirring solution of **S5** (524 mg, 1.78 mmol) at 0 °C in THF (3 mL) and the mixture was stirred for 2 h at room temperature. Then, the mixture was quenched with saturated aqueous solution of $NaHCO_3$ and extracted with EtOAc for three times. The extract was dried over Na_2SO_4 and concentrated under reduced pressure. The compound was purified by column chromatography (petroleum ether/EtOAc) to give formamide **S6** (492 mg, 1.53 mmol).

Procedure F: To the flask containing the whole amount of **S6** obtained above, THF (4 mL), NEt_3 (1.7 mL) were added under Ar atmosphere at 0 °C. $POCl_3$ (0.5 mL) in 1 mL of THF was added slowly via syringe for a period of 1 h, and the mixture was stirred for another 2 h at 0 °C. EtOAc (7 mL) was added, and the mixture was stirred for 10 min at 0 °C. The reaction mixture was slowly quenched with saturated aqueous solution of $NaHCO_3$ and stirred for 30 min at 0 °C. Then, the mixture was extracted with EtOAc for three times, dried over Na_2SO_4 and evaporated under reduced pressure. The compound was purified by column chromatography (petroleum ether/EtOAc) to give **11d** as a white solid (418 mg, 1.38 mmol, 90%).

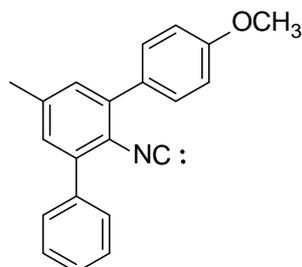
2'-isocyano-4,5'-dimethyl-1,1':3,1''-terphenyl (**11a**)



Following the procedure D, 492.1 mg (90%) of **S5a** (white solid) was isolated. Analytical data of **S5a** is in agreement with that reported in the literature.⁶ Then following the

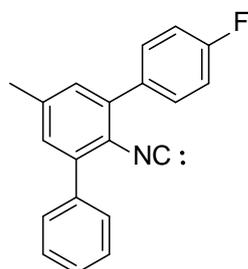
procedures E and F, 382.5 mg (75%) of **11a** (white solid) was isolated. ^1H NMR (400 MHz, CDCl_3) δ 7.54-7.40 (m, 7H), 7.30-26 (m, 2H), 7.19 (m, 2H), 2.44 (s, 3H), 2.42 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 168.4, 139.8, 139.8, 139.3, 138.1, 137.8, 134.8, 130.1, 129.9, 129.2, 129.1, 129.0, 128.4, 128.2, 120.3, 21.3, 21.2.

2'-isocyano-4-methoxy-5'-methyl-1,1':3',1''-terphenyl (**11b**)



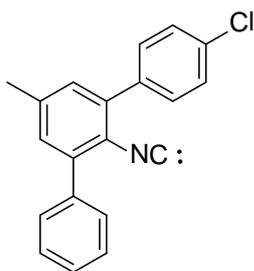
Following the procedure D, 369 mg (64%) of **S5b** (white solid) was isolated. Analytical data of **S5b** is in agreement with that reported in the literature.⁶ Then following the procedures E and F, 304 mg (80%) of **11b** (white solid) was isolated, mp 118 °C. ^1H NMR (400 MHz, CDCl_3) δ 7.54-7.40 (m, 6H), 7.18 (d, $J = 6.0$ Hz, 2H), 7.01 (d, $J = 7.6$ Hz, 2H), 3.87 (s, 3H), 2.43 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.8, 139.9, 139.6, 139.1, 138.0, 130.2, 130.0, 129.7, 129.0, 128.3, 128.1, 114.1, 55.3, 21.1; HRMS (ESI): Exact mass calcd for $\text{C}_{21}\text{H}_{18}\text{NO}$ $[\text{M}+\text{H}]^+$ 300.1383, found 300.1382.

4-fluoro-2'-isocyano-5'-methyl-1,1':3',1''-terphenyl (**11c**)



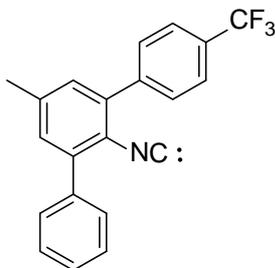
Following the procedure D, 513 mg (92%) of **S5c** (white solid) was isolated. Analytical data of **S5c** is in agreement with that reported in the literature.⁶ Then following the procedures E and F, 383 mg (72%) of **11c** (white solid) was isolated, mp 126 °C. ^1H NMR (400 MHz, CDCl_3) δ 7.54-7.41 (m, 7H), 7.22-7.16 (m, 4H), 2.45 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 169.8, 162.9 (d, $J_{\text{C-F}} = 248$ Hz), 140.0, 139.3, 138.9, 137.7, 133.8, 130.8 (d, $J_{\text{C-F}} = 8.2$ Hz), 130.1 (d, $J_{\text{C-F}} = 26.8$ Hz), 129.0, 128.4, 128.2, 115.4 (d, $J_{\text{C-F}} = 21.7$ Hz), 21.1; HRMS (ESI): Exact mass calcd for $\text{C}_{20}\text{H}_{15}\text{FN}$ $[\text{M}+\text{H}]^+$ 288.1183, found 288.1185.

4-chloro-2'-isocyano-5'-methyl-1,1':3',1''-terphenyl (**11d**)



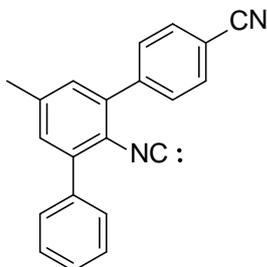
Following the procedure D, 524 mg (89%) of **S5d** (white solid) was isolated. Analytical data of **S5d** is in agreement with that reported in the literature.⁶ Then following the procedures E and F, 418 mg (77%) of **11d** (white solid) was isolated, mp 160 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.53-7.41 (m, 9H), 7.23 (s, 1H), 7.18 (s, 1H), 2.45 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 140.1, 139.4, 138.6, 137.6, 136.2, 134.5, 130.4, 130.3, 129.9, 129.0, 128.7, 128.6, 128.4, 128.3, 21.1; HRMS (ESI): Exact mass calcd for C₂₀H₁₅ClN [M+H]⁺ 304.0888, found 304.0887.

2'-isocyano-5'-methyl-4-(trifluoromethyl)-1,1':3',1''-terphenyl (**11e**)



Following the procedure D, 608 mg (93%) of **S5e** (white solid) was isolated. Analytical data of **S5e** is in agreement with that reported in the literature.⁶ Then following the procedures E and F, 445 mg (71%) of **11e** (white solid) was isolated, mp 159 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.53-7.41 (m, 9H), 7.23 (s, 1H), 7.18 (s, 1H), 2.45 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 141.5, 140.8, 140.5, 139.5, 139.4, 138.9 (q, *J*_{CF3} = 270 Hz), 138.4, 130.9, 130.4, 130.1, 129.8, 129.5, 129.0, 128.6 (q, *J*_{C-F} = 43.1 Hz), 128.5 (q, *J*_{C-F} = 11.0 Hz), 125.4 (q, *J*_{C-F} = 3.9 Hz), 21.1; HRMS (ESI): Exact mass calcd for C₂₁H₁₅F₃N [M+H]⁺ 338.1151, found 338.1353.

2'-isocyano-5'-methyl-[1,1':3',1''-terphenyl]-4-carbonitrile (**11f**)

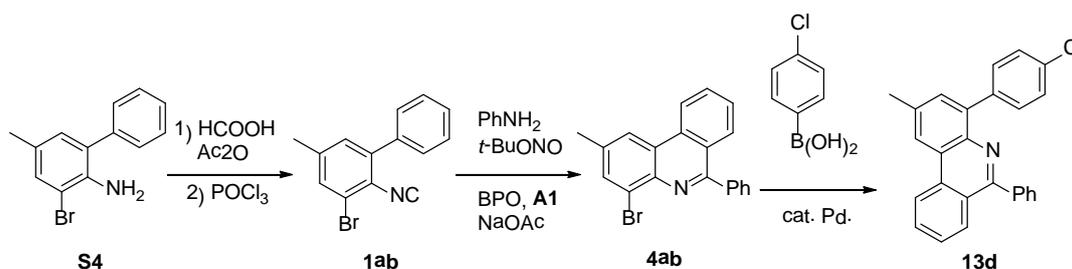


Following the procedure D, 281 mg (49%) of **S5f** (white solid) was isolated. Analytical data of **S5f** is in agreement with that reported in the literature.⁶ Then following the procedures E and F, 216 mg (74%) of **11f** (white solid) was isolated, mp 164 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.78 (d, *J* = 7.6 Hz, 2H), 7.65 (d, *J* = 7.2 Hz, 2H), 7.51-7.43 (m, 5H), 7.28 (s, 1H),

7.18 (s, 1H), 2.47 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.6, 142.4, 140.3, 139.7, 137.9, 137.3, 132.2, 131.2, 129.9, 129.6, 128.9, 128.5, 128.4, 120.5, 118.2, 112.5, 21.1; HRMS (ESI): Exact mass calcd for $\text{C}_{21}\text{H}_{15}\text{N}_2$ $[\text{M}+\text{H}]^+$ 295.1230, found 295.1228.

d) Synthesis of Authentic Samples of 13

A typical route for the synthesis of **13d** is shown below.

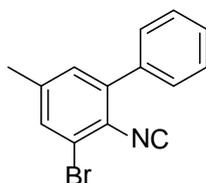


S4 (6 mmol), following the procedures B and C, 1.38 g (85%) of **1ab** (pale yellow solid) was isolated.

1ab (4.7 mmol), following the procedure G, 1.05 g (64%) of **4ab** (orange yellow solid) was isolated.

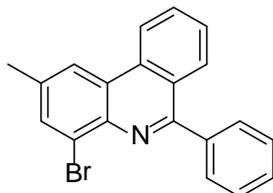
4ab (0.2 mmol), following the procedure D, 73.3 mg (97%) of **13d** (light yellow solid) was isolated.

3-bromo-2-isocyano-5-methyl-1,1'-biphenyl (**1ab**)



1.38 g (85%), white solid, mp 58 °C. ^1H NMR (400 MHz, CDCl_3) δ 7.50-7.45 (m, 6H), 7.16 (s, 1H), 2.40 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 170.3, 140.7, 140.6, 136.9, 132.4, 128.8, 128.6, 128.5, 120.9, 21.1; HRMS (ESI): Exact mass calcd for $\text{C}_{14}\text{H}_{11}\text{BrN}$ $[\text{M}+\text{H}]^+$ 272.0069, found 272.0069.

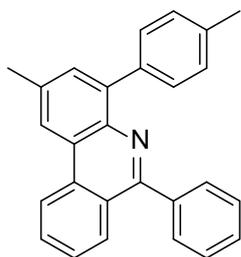
4-bromo-2-methyl-6-phenylphenanthridine (**4ab**)



Following the procedure G, 1.05 g (64%) of **4ab** (orange yellow solid) was isolated, mp 175 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.68 (d, J = 8.0 Hz, 1H), 8.36 (s, 1H), 8.23 (d, J = 8.4 Hz, 1H), 7.93 (s, 1H), 7.88-7.85 (m, 3H), 7.65 (t, J = 7.6 Hz, 1H), 7.58-7.53 (m, 3H), 2.63 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 160.5, 139.5, 139.3, 137.3, 134.1, 133.1, 130.5, 130.4, 128.9, 128.8, 128.3, 127.5, 125.9, 125.1, 124.9, 122.4, 121.3, 21.6; HRMS (ESI): Exact mass

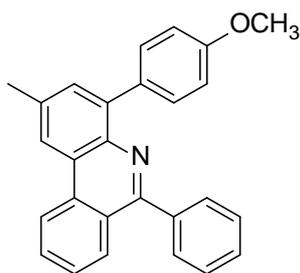
calcd for $C_{20}H_{15}BrN$ $[M+H]^+$ 348.0382, found 348.0385.

2-methyl-6-phenyl-4-(p-tolyl)phenanthridine (**13a**)



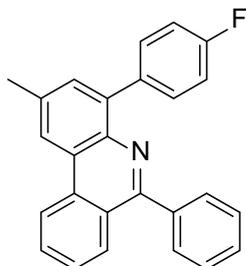
Following the procedure D, 66.1 mg (92%) of **13a** (pale yellow solid) was isolated. mp = 135 °C; 1H NMR (400 MHz, $CDCl_3$) δ 8.74 (d, J = 8.4 Hz, 1H), 8.40 (s, 1H), 8.22 (d, J = 8.0 Hz, 1H), 7.84 (t, J = 7.6 Hz, 1H), 7.78 (d, J = 7.6 Hz, 2H), 7.73 (d, J = 7.6 Hz, 2H), 7.65-7.60 (m, 2H), 7.52-7.43 (m, 3H), 7.28-7.26 (m, 2H), 2.68 (s, 3H), 2.42 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 158.7, 141.0, 140.1, 139.5, 137.0, 136.5, 136.2, 133.6, 131.7, 131.0, 130.4, 130.0, 128.5, 128.4, 128.1, 126.8, 124.7, 123.9, 122.5, 120.8, 22.1, 21.2; HRMS (ESI): Exact mass calcd for $C_{27}H_{22}N$ $[M+H]^+$ 360.1747, found 360.1750.

4-(4-methoxyphenyl)-2-methyl-6-phenylphenanthridine (**13b**)



Following the procedure D, 63.8 mg (85%) of **13b** (pale yellow solid) was isolated. mp = 119 °C; 1H NMR (400 MHz, $CDCl_3$) δ 8.74 (d, J = 8.4 Hz, 1H), 8.39 (s, 1H), 8.23 (d, J = 8.0 Hz, 1H), 7.86-7.79 (m, 5H), 7.64-7.60 (m, 2H), 7.52-7.44 (m, 3H), 7.02 (d, J = 8.0 Hz, 2H), 3.88 (s, 3H), 2.68 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 158.8, 158.6, 140.6, 140.1, 139.5, 136.2, 133.6, 132.4, 132.2, 131.5, 130.3, 130.0, 128.5, 128.4, 128.1, 126.8, 124.6, 124.0, 122.5, 120.6, 113.1, 55.3, 22.1.

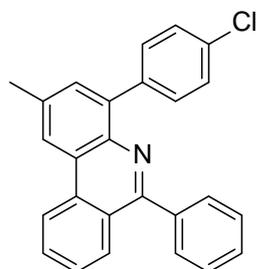
4-(4-fluorophenyl)-2-methyl-6-phenylphenanthridine (**13c**)



Following the procedure D, 66.9 mg (92%) of **13c** (pale yellow solid) was isolated. mp = 155 °C; 1H NMR (400 MHz, $CDCl_3$) δ 8.74 (d, J = 8.0 Hz, 1H), 8.42 (s, 1H), 8.23 (d, J = 8.4 Hz, 1H), 7.85 (t, J = 7.6 Hz, 1H), 7.80-7.76 (m, 4H), 7.65-7.62 (m, 2H), 7.52-7.45 (m, 3H),

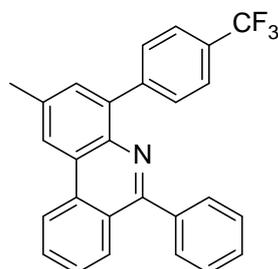
7.15 (t, $J = 8.6$ Hz, 2H), 2.69 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 158.7 (d, $J_{\text{C-F}} = 24.4$ Hz), 140.6, 140.1, 139.5, 136.2, 133.6, 132.4, 132.2, 131.5, 130.3, 130.0, 128.4 (d, $J_{\text{C-F}} = 7.5$ Hz), 128.1, 126.8, 124.6, 123.9, 121.6 (d, $J = 244$ Hz), 113.1, 22.1; HRMS (ESI): Exact mass calcd for $\text{C}_{26}\text{H}_{19}\text{FN}$ $[\text{M}+\text{H}]^+$ 364.1496, found 364.1497.

4-(4-chlorophenyl)-2-methyl-6-phenylphenanthridine (13d)



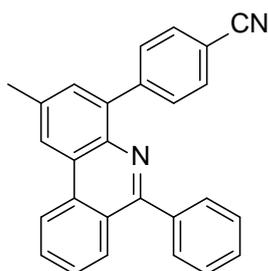
Following the procedure D, 73.3 mg (97%) of **13d** (pale yellow solid) was isolated. ^1H NMR (400 MHz, CDCl_3) δ 8.74 (d, $J = 8.0$ Hz, 1H), 8.43 (s, 1H), 8.23 (d, $J = 8.4$ Hz, 1H), 7.86 (t, $J = 7.6$ Hz, 1H), 7.77-7.75 (m, 4H), 7.65-7.62 (m, 2H), 7.53-7.47 (m, 3H), 7.44-7.41 (m, 2H), 2.69 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 159.0, 140.1, 140.0, 139.5, 138.5, 136.2, 133.6, 133.0, 132.3, 131.4, 130.2, 130.0, 128.5, 128.4, 128.0, 127.6, 126.9, 124.8, 124.0, 122.5, 121.3, 21.9; HRMS (ESI): Exact mass calcd for $\text{C}_{26}\text{H}_{19}\text{ClN}$ $[\text{M}+\text{H}]^+$ 380.1201, found 380.1203.

2-methyl-6-phenyl-4-(4-(trifluoromethyl)phenyl)phenanthridine (13e)



Following the procedure D, 77.2 mg (93%) of **13e** (pale yellow solid) was isolated. mp = 133 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.75 (d, $J = 8.4$ Hz, 1H), 8.47 (s, 1H), 8.23 (d, $J = 8.4$ Hz, 1H), 7.93 (d, $J = 8.0$ Hz, 2H), 7.87 (t, $J = 7.6$ Hz, 1H), 7.76 (d, $J = 7.6$ Hz, 2H), 7.71 (d, $J = 8.0$ Hz, 2H), 7.66-7.63 (m, 2H), 7.53-7.46 (m, 3H), 2.70 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.3, 143.8, 140.0, 139.8, 139.5, 134.9 (q, $J_{\text{CF}_3} = 278$ Hz), 131.6, 131.3, 130.1, 130.0, 129.1 (q, $J_{\text{C-F}} = 33.5$ Hz), 128.5 (q, $J_{\text{C-F}} = 7.7$ Hz), 128.1, 127.0, 125.9, 124.9, 124.3 (q, $J_{\text{C-F}} = 3.9$ Hz), 124.1, 123.2, 122.5, 121.8, 21.8; HRMS (ESI): Exact mass calcd for $\text{C}_{27}\text{H}_{19}\text{F}_3\text{N}$ $[\text{M}+\text{H}]^+$ 414.1464, found 414.1466.

4-(2-methyl-6-phenylphenanthridin-4-yl)benzotrile (13f)



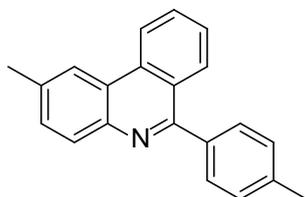
Following the procedure D. 55.6 mg (75%) of **13f** (colorless liquid) was isolated. ^1H NMR (400 MHz, CDCl_3) δ 8.74 (d, $J = 8.4$ Hz, 1H), 8.48 (s, 1H), 7.24 (d, $J = 8.0$ Hz, 1H), 7.92-7.86 (m, 3H), 7.74-7.72 (m, 4H), 7.67-7.62 (m, 2H), 7.52-7.50 (m, 3H), 2.70 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.6, 145.1, 140.0, 139.5, 139.4, 136.4, 133.6, 131.8, 131.5, 131.2, 130.3, 130.1, 129.9, 128.7, 128.2, 127.3, 125.0, 124.2, 122.6, 122.3, 119.2, 110.8, 21.9; HRMS (ESI): Exact mass calcd for $\text{C}_{27}\text{H}_{19}\text{N}_2$ $[\text{M}+\text{H}]^+$ 371.1543, found 371.1545.

4 General Procedure for the Synthesis of 4

Procedure G: A Schlenk-tube containing 2-isocyanobiphenyl **1** (0.2 mmol, 1.0 equiv), aryl amines **2** (0.6 mmol, 3.0 equiv), BPO (2 mol %) and NaOAc (1.1 equiv) was degassed by three evacuation/Ar backfill cycles, then *N,N'*-dimethylethylenediamine (DMEDA, **A1**; 20 mol %) in 0.5 mL of PhCF_3 and *t*-BuONO (3.5 equiv) in 0.5 mL of PhCF_3 were added successively and slowly by syringe. The mixture was stirred at r.t. for 5 minutes, then it was stirred at 70 °C for 3 h. After addition of ethyl acetate (5 mL), the reaction mixture was quenched by 1 N HCl (10 mL). Then, the organic phase was washed with brine and extracted with EtOAc three times, dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The residue was separated by column chromatography (petroleum ether/EtOAc) to give the pure product.

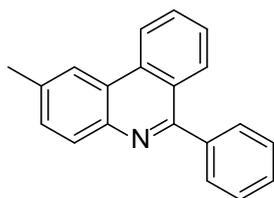
5 Spectral Data of 4

2-methyl-6-(*p*-tolyl) phenanthridine (**4a**)



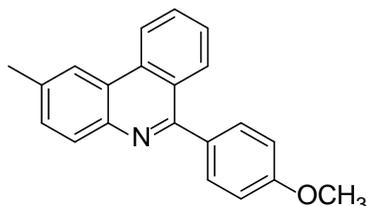
50.4 mg (89%) of **4a** (orange yellow solid) was isolated. mp 120 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.68 (d, $J = 8.0$ Hz, 1H), 8.39 (s, 1H), 8.13 (d, $J = 8.0$ Hz, 2H), 7.83 (t, $J = 7.4$ Hz, 1H), 7.64-7.57 (m, 4H), 7.36 (d, $J = 7.2$ Hz, 2H), 2.65 (s, 3H), 2.48 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 160.3, 142.2, 138.4, 137.0, 136.6, 133.2, 130.5, 130.2, 130.0, 129.7, 129.0, 128.9, 126.8, 125.4, 123.5, 122.1, 121.5, 22.0, 21.4; HRMS (ESI): Exact mass calcd for $\text{C}_{21}\text{H}_{18}\text{N}$ $[\text{M}+\text{H}]^+$ 284.1434, found 284.1437.

2-methyl-6-phenylphenanthridine (**4b**)



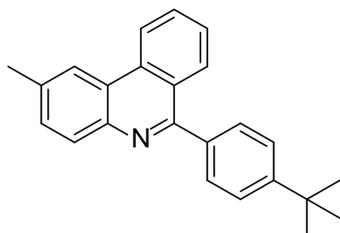
53.3 mg (99%) of **4b** (pale yellow solid) was isolated. mp 77 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.69 (d, *J* = 8.2 Hz, 1H), 8.40 (s, 1H), 8.14 (d, *J* = 8.2 Hz, 1H), 8.09 (d, *J* = 8.4 Hz, 1H), 7.83 (t, *J* = 7.4 Hz, 1H), 7.74-7.73 (d, *J* = 7.2 Hz, 2H), 7.61-7.52 (m, 5H), 2.66 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 160.3, 142.1, 139.9, 136.8, 133.2, 130.5, 130.3, 130.1, 129.7, 128.8, 128.6, 128.4, 126.9, 125.3, 123.6, 122.1, 121.5, 22.0; IR (KBr): 3674, 3649, 3060, 3030, 2920, 2858, 2210, 1612, 1564, 1520, 1493, 1444, 1423, 1362, 1321, 1173, 1151, 1138, 1074, 1041, 1032, 958, 910, 868, 825, 777, 762, 731, 700, 673, 644, 625, 588, 526, 472 cm⁻¹; HRMS (ESI): Exact mass calcd for C₂₀H₁₆N [M+H]⁺ 270.1277, found 270.1279.

6-(4-methoxyphenyl)-2-methylphenanthridine (**4c**)



35.9 mg (60%) of **4c** (white solid) was isolated. mp 131 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.68 (d, *J* = 8.0 Hz, 1H), 8.38 (s, 1H), 8.15-8.11 (m, 2H), 7.83 (t, *J* = 7.6 Hz, 1H), 7.70 (d, *J* = 7.6 Hz, 2H), 7.62-7.56 (m, 2H), 7.08 (d, *J* = 7.6 Hz, 2H), 3.92 (s, 3H), 2.65 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 160.0, 159.9, 142.2, 136.5, 133.2, 132.4, 131.1, 130.5, 130.2, 129.9, 128.8, 126.9, 125.4, 123.4, 122.1, 121.5, 113.8, 55.4, 22.0; IR (KBr): 3903, 3853, 3838, 3820, 3801, 3749, 3735, 3710, 3689, 3674, 3649, 3629, 3566, 1869, 1772, 1734, 1716, 1701, 1684, 1651, 1610, 1558, 1541, 1510, 1493, 1473, 1458, 1419, 1362, 1252, 1174, 1034, 775, 586, 420 cm⁻¹; HRMS (ESI): Exact mass calcd for C₂₁H₁₈NO [M+H]⁺ 300.1383, found 300.1385.

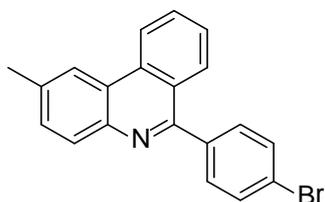
6-(4-*tert*-butylphenyl)-2-methylphenanthridine (**4d**)



55.3 mg (85%) of **4d** (orange liquid) was isolated. mp 114 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.69 (d, *J* = 8.4 Hz, 1H), 8.40 (s, 1H), 8.18-8.12 (m, 2H), 7.84 (t, *J* = 7.6 Hz, 1H), 7.68 (d, *J* = 7.6 Hz, 2H), 7.62-7.56 (m, 4H), 2.65 (s, 3H), 1.41 (s, 9H); ¹³C NMR (125 MHz, CDCl₃) δ 160.3, 151.6, 142.1, 136.6, 133.2, 130.5, 130.2, 130.0, 129.5, 129.0, 126.8, 126.1, 125.3, 123.5, 122.1, 121.5, 34.7, 31.4, 22.0; HRMS (ESI): Exact mass calcd for C₂₄H₂₄N

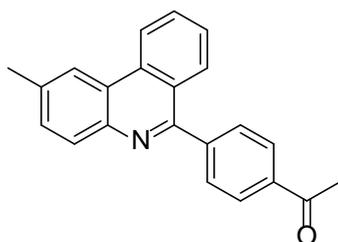
$[M+H]^+$ 326.1903, found 326.1904.

6-(4-bromophenyl)-2-methylphenanthridine (**4e**)



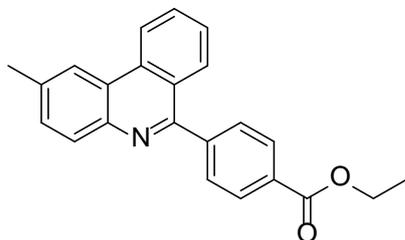
43.2 mg (62%) of **4e** (white solid) was isolated. mp 150 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.70 (d, $J = 8.0$ Hz, 1H), 8.40 (s, 1H), 8.11 (d, $J = 8.4$ Hz, 1H), 8.04 (d, $J = 8.0$ Hz, 1H), 7.85 (t, $J = 7.6$ Hz, 1H), 7.70 (d, $J = 8.0$ Hz, 2H), 7.63-7.58 (m, 4H), 2.66 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.0, 142.0, 138.8, 137.1, 133.2, 131.6, 131.4, 130.7, 130.4, 130.0, 128.3, 127.1, 125.0, 123.6, 123.0, 122.3, 121.6, 22.0; HRMS (ESI): Exact mass calcd for $\text{C}_{20}\text{H}_{15}\text{BrN}$ $[M+H]^+$ 348.0382, found 348.0385.

1-(4-(2-methylphenanthridin-6-yl)phenyl)ethanone (**4f**)



44.8 mg (72%) of **4f** (yellow solid) was isolated. mp 160 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.71 (d, $J = 8.4$ Hz, 1H), 8.42 (s, 1H), 8.16-8.12 (m, 3H), 8.02 (d, $J = 8.4$ Hz, 1H), 7.88-7.84 (m, 3H), 7.63-7.60 (m, 2H), 2.70 (s, 3H), 2.67 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 197.9, 159.0, 144.5, 142.0, 137.3, 137.0, 133.2, 130.7, 130.5, 130.1, 130.1, 128.4, 128.3, 127.1, 124.9, 123.6, 122.3, 121.6, 26.8, 22.0; HRMS (ESI): Exact mass calcd for $\text{C}_{22}\text{H}_{18}\text{NO}$ $[M+H]^+$ 312.1383, found 312.1384.

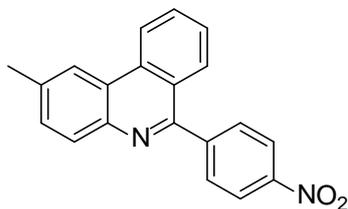
ethyl 4-(2-methylphenanthridin-6-yl)benzoate (**4g**)



41.7 mg (61%) of **4g** (pale yellow solid) was isolated. mp 146 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.70 (d, $J = 8.0$ Hz, 1H), 8.41 (s, 1H), 8.24 (d, $J = 7.6$ Hz, 2H), 8.13 (d, $J = 8.0$ Hz, 1H), 8.01 (d, $J = 8.4$ Hz, 1H), 7.87-7.80 (m, 3H), 7.60 (d, $J = 7.6$ Hz, 2H), 4.45 (q, $J = 6.9$ Hz, 2H), 2.66 (s, 3H), 1.45 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 166.4, 159.2, 144.2, 142.0, 137.2, 133.2, 130.7, 130.5, 130.4, 130.1, 129.8, 129.6, 128.3, 127.1, 125.0, 123.6,

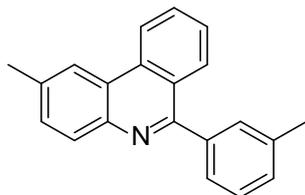
122.3, 121.6, 61.1, 22.0, 14.3; HRMS (ESI): Exact mass calcd for C₂₃H₂₀N₂O₂ [M+H]⁺ 342.1489, found 342.1488.

2-methyl-6-(4-nitrophenyl)phenanthridine (4h)



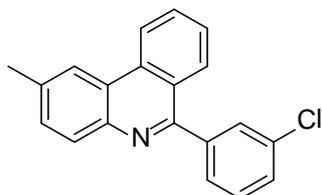
38.4 mg (61%) of **4h** (pale yellow solid) was isolated. mp 185 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.73 (d, *J* = 8.4 Hz, 1H), 8.44-8.42 (m, 3H), 8.12 (d, *J* = 8.8 Hz, 1H), 7.98-7.87 (m, 4H), 7.66-7.62 (m, 2H), 2.68 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 157.7, 148.0, 146.3, 141.9, 137.7, 133.3, 130.9, 130.8, 130.3, 130.1, 127.8, 127.4, 124.6, 123.7, 123.6, 122.5, 121.6, 22.0; HRMS (ESI): Exact mass calcd for C₂₀H₁₅N₂O₂ [M+H]⁺ 315.1128, found 315.1129.

2-methyl-6-(*m*-tolyl)phenanthridine (4i)



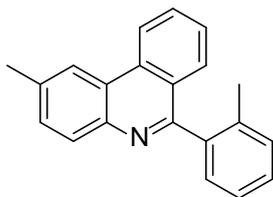
56.1 mg (99%) of **4i** (orange yellow solid) was isolated. ¹H NMR (400 MHz, CDCl₃) δ 8.68 (d, *J* = 8.4 Hz, 1H), 8.40 (s, 1H), 8.15-8.08 (m, 2H), 7.83 (t, *J* = 7.6 Hz, 1H), 7.61-7.55 (m, 3H), 7.50 (d, *J* = 7.6 Hz, 1H), 7.43 (t, *J* = 7.4 Hz, 1H), 7.33 (d, *J* = 7.2 Hz, 1H), 2.66 (s, 3H), 2.47 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 160.5, 142.1, 139.8, 138.1, 136.7, 133.1, 130.5, 130.3, 130.2, 130.0, 129.3, 128.9, 128.1, 126.9, 126.8, 125.4, 123.5, 122.1, 121.5, 22.0, 21.5; HRMS (ESI): Exact mass calcd for C₂₁H₁₈N [M+H]⁺ 284.1434, found 284.1436.

6-(3-chlorophenyl)-2-methylphenanthridine (4j)



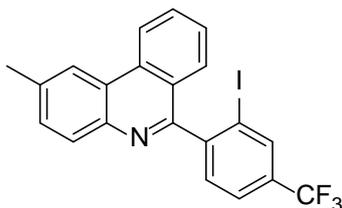
41.3 mg (68%) of **4j** (orange yellow solid) was isolated. mp 117 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.70 (d, *J* = 8.0 Hz, 1H), 8.40 (s, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 8.04 (d, *J* = 8.0 Hz, 1H), 7.86 (t, *J* = 7.4 Hz, 1H), 7.74 (s, 1H), 7.64-7.50 (m, 5H), 2.66 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 158.7, 142.0, 141.6, 137.2, 134.4, 133.2, 130.7, 130.5, 130.1, 129.8, 129.6, 128.7, 128.4, 128.0, 127.1, 125.0, 123.6, 122.3, 121.6, 22.0; HRMS (ESI): Exact mass calcd for C₂₀H₁₅ClN [M+H]⁺ 304.0888, found 304.0888.

2-methyl-6-(*o*-tolyl)phenanthridine (4k)



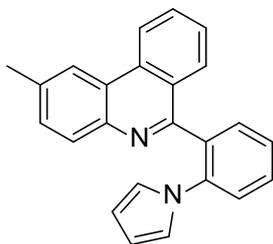
43.1 mg (76%) of **4k** (pale yellow solid) was isolated. ^1H NMR (400 MHz, CDCl_3) δ 8.69 (d, $J = 8.4$ Hz, 1H), 8.42 (s, 1H), 8.14 (d, $J = 8.4$ Hz, 1H), 7.83 (t, $J = 7.6$ Hz, 1H), 7.69 (d, $J = 8.0$ Hz, 1H), 7.60-7.53 (m, 2H), 7.41-7.35 (m, 4H), 2.67 (s, 3H), 2.11 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 160.9, 142.1, 139.3, 136.8, 136.5, 132.7, 130.5, 130.4, 130.3, 130.0, 129.3, 128.6, 128.5, 127.1, 125.9, 125.8, 123.6, 122.1, 121.6, 22.0, 19.8; IR (KBr): 3674, 3649, 3566, 3064, 3020, 2922, 2858, 2208, 1714, 1651, 1612, 1568, 1541, 1520, 1493, 1454, 1360, 1317, 1294, 1153, 1138, 1095, 1039, 960, 908, 868, 825, 764, 731, 679, 625, 586, 550, 521, 488 cm^{-1} ; HRMS (ESI): Exact mass calcd for $\text{C}_{21}\text{H}_{18}\text{N}$ $[\text{M}+\text{H}]^+$ 284.1434, found 284.1436.

6-(2-iodo-4-(trifluoromethyl)phenyl)-2-methylphenanthridine (**4l**)



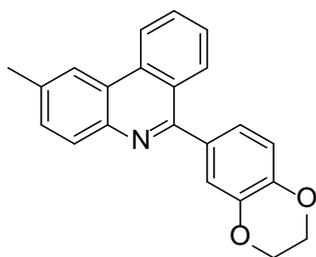
58.4 mg (63%) of **4l** (orange yellow solid) was isolated. mp 107 $^\circ\text{C}$; ^1H NMR (400 MHz, CDCl_3) δ 8.72 (d, $J = 8.4$ Hz, 1H), 8.45 (s, 1H), 8.28 (s, 1H), 8.13 (d, $J = 8.4$ Hz, 1H), 7.88 (t, $J = 7.4$ Hz, 1H), 7.81 (d, $J = 7.6$ Hz, 1H), 7.64-7.59 (m, 4H), 2.68 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 160.5, 148.1, 141.8, 137.7, 136.1 (q, $J_{\text{C-F}} = 4.0$ Hz), 132.0 (q, $J_{\text{C-F}} = 32.7$ Hz), 131.8, 130.8, 130.8, 130.4, 130.1, 129.9, 127.9, 127.4, 125.2 (q, $J_{\text{C-F}} = 3.7$ Hz), 124.5, 122.8 (q, $J_{\text{CF}_3} = 281$ Hz), 122.4, 97.7, 22.0; HRMS (ESI): Exact mass calcd for $\text{C}_{21}\text{H}_{14}\text{F}_3\text{IN}$ $[\text{M}+\text{H}]^+$ 464.0118, found 464.0119.

6-(2-(1H-pyrrol-1-yl)phenyl)-2-methylphenanthridine (**4m**)



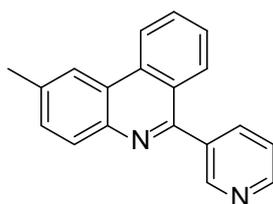
48.2 mg (72%) of **4m** (orange solid) was isolated. mp 133 $^\circ\text{C}$; ^1H NMR (400 MHz, CDCl_3) δ 8.56 (d, $J = 8.0$ Hz, 1H), 8.36 (s, 1H), 8.13 (d, $J = 8.4$ Hz, 1H), 7.73-7.52 (m, 5H), 7.39 (t, $J = 7.2$ Hz, 1H), 6.57 (s, 2H), 5.80 (s, 2H), 2.66 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 158.8, 142.1, 140.0, 137.1, 134.5, 132.2, 131.5, 130.5, 130.4, 130.0, 129.9, 127.3, 127.0, 126.9, 125.3, 125.0, 123.8, 121.9, 121.8, 121.7, 109.2, 22.0; HRMS (ESI): Exact mass calcd for $\text{C}_{24}\text{H}_{19}\text{N}_2$ $[\text{M}+\text{H}]^+$ 335.1543, found 335.1543.

6-(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)-2-methylphenanthridine (**4n**)



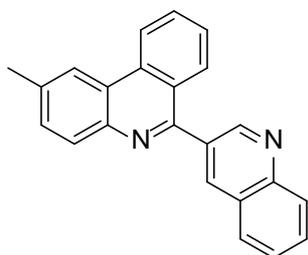
36.0 mg (55%) of **4n** (pale yellow solid) was isolated. mp 110 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.66 (d, *J* = 8.0 Hz, 1H), 8.37 (s, 1H), 8.18 (d, *J* = 8.4 Hz, 1H), 8.11 (d, *J* = 8.4 Hz, 1H), 7.82 (t, *J* = 7.6 Hz, 1H), 7.61-7.55 (m, 2H), 7.29 (s, 1H), 7.26-7.22 (m, 1H), 7.04 (d, *J* = 78.0 Hz, 1H), 4.34 (s, 4H), 2.64 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 159.5, 144.2, 143.4, 142.1, 136.6, 133.3, 133.2, 130.5, 130.2, 130.0, 128.8, 126.9, 125.3, 123.5, 123.2, 122.1, 121.5, 118.9, 117.2, 64.5, 64.4, 22.0; HRMS (ESI): Exact mass calcd for C₂₂H₁₈NO₂ [M+H]⁺ 328.1332, found 328.1337.

2-methyl-6-(pyridin-3-yl)phenanthridine (**4o**)



20.0 mg (37%) of **4o** (pale yellow solid) was isolated. mp 126 °C; ¹H NMR (400 MHz, CDCl₃) δ 9.00 (s, 1H), 8.78 (d, *J* = 4.8 Hz, 1H), 8.72 (d, *J* = 8.0 Hz, 1H), 8.42 (s, 1H), 8.14-8.08 (m, 2H), 8.03 (d, *J* = 8.4 Hz, 1H), 7.88 (t, *J* = 7.6 Hz, 1H), 7.66-7.60 (m, 2H), 7.52 (t, *J* = 6.0 Hz, 1H), 2.67 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 151.3, 142.2, 137.4, 136.9, 132.9, 130.8, 130.6, 130.1, 129.4, 128.3, 128.1, 127.6, 127.4, 127.1, 125.3, 123.7, 122.5, 121.6, 22.0; HRMS (ESI): Exact mass calcd for C₁₉H₁₅N₂ [M+H]⁺ 271.1230, found 271.1230.

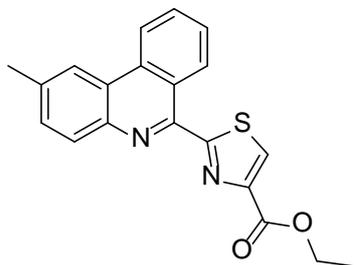
2-methyl-6-(quinolin-3-yl)phenanthridine (**4p**)



24.3 mg (38%) of **4p** (pale yellow solid) was isolated. ¹H NMR (400 MHz, CDCl₃) δ 9.32 (s, 1H), 8.75 (d, *J* = 8.4 Hz, 1H), 8.58 (s, 1H), 8.45 (s, 1H), 8.27-8.23 (m, 1H), 8.16 (d, *J* = 8.4 Hz, 1H), 8.10 (d, *J* = 8.4 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.90 (t, *J* = 7.4 Hz, 1H), 7.82 (t, *J* = 7.6 Hz, 1H), 7.67-7.63 (m, 3H), 2.68 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 157.1, 151.3, 147.9, 142.2, 137.4, 136.9, 133.3, 132.9, 130.8, 130.6, 130.1, 130.0, 129.4, 128.3, 128.1, 127.6, 127.4, 127.1, 125.3, 123.7, 122.5, 121.6, 22.0; HRMS (ESI): Exact mass calcd

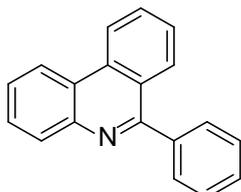
for $C_{23}H_{17}N_2$ $[M+H]^+$ 321.1386, found 321.1389.

ethyl 2-(2-methylphenanthridin-6-yl)thiazole-4-carboxylate (**4q**)



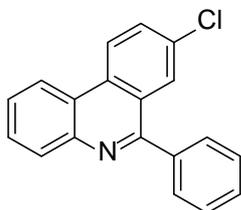
25.8 mg (37%) of **4q** (pale yellow solid) was isolated. 1H NMR (400 MHz, $CDCl_3$) δ 10.0 (d, $J = 8.4$ Hz, 1H), 8.68 (d, $J = 8.4$ Hz, 1H), 8.39 (s, 1H), 8.35 (s, 1H), 8.11 (d, $J = 8.4$ Hz, 1H), 7.92-7.82 (m, 2H), 7.60 (d, $J = 8.8$ Hz, 1H), 4.50 (q, $J = 7.2$ Hz, 2H), 2.66 (s, 3H), 1.48 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.5, 161.6, 148.1, 148.0, 141.4, 138.3, 133.3, 130.8, 130.7, 130.6, 130.3, 130.0, 128.8, 128.3, 127.2, 124.7, 123.5, 121.8, 121.7, 61.4, 22.2, 14.4; HRMS (ESI): Exact mass calcd for $C_{20}H_{17}N_2O_2S$ $[M+H]^+$ 349.1005, found 349.1007.

6-phenylphenanthridine (**4r**)



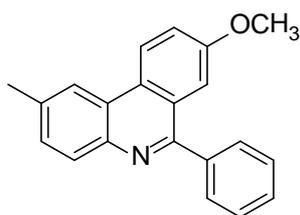
40.9 mg (80%) of **4r** (pale yellow solid) was isolated. mp 70 °C; 1H NMR (400 MHz, $CDCl_3$) δ 8.72 (d, $J = 8.4$ Hz, 1H), 8.63 (d, $J = 8.0$ Hz, 1H), 8.25 (d, $J = 8.0$ Hz, 1H), 8.11 (d, $J = 8.4$ Hz, 1H), 7.87 (t, $J = 7.6$ Hz, 1H), 7.79-7.53 (m, 8H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 156.5, 139.0, 135.0, 128.7, 125.8, 125.6, 124.9, 124.1, 124.0, 123.9, 123.6, 122.3, 122.1, 120.5, 119.0, 117.4, 117.2; HRMS (ESI): Exact mass calcd for $C_{19}H_{14}N$ $[M+H]^+$ 256.1121, found 256.1123.

8-chloro-6-phenylphenanthridine (**4s**)



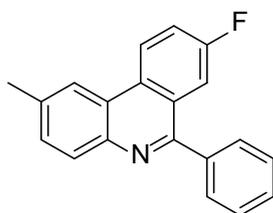
48.7 mg (84%) of **4s** (pale yellow solid) was isolated. 1H NMR (400 MHz, $CDCl_3$) δ 8.67 (d, $J = 8.8$ Hz, 1H), 8.60 (d, $J = 8.4$ Hz, 1H), 8.27 (d, $J = 8.0$ Hz, 1H), 8.10 (s, 1H), 7.85-7.72 (m, 5H), 7.63-7.58 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.1, 143.9, 139.3, 133.2, 132.0, 131.0, 130.6, 129.6, 129.0, 128.8, 128.5, 127.9, 127.2, 126.3, 123.9, 123.2, 121.7; HRMS (ESI): Exact mass calcd for $C_{19}H_{13}ClN$ $[M+H]^+$ 290.0731, found 290.0732.

8-methoxy-2-methyl-6-phenylphenanthridine (4t)



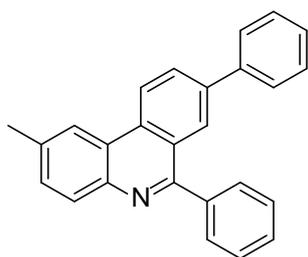
41.9 mg (70%) of **4t** (pale yellow solid) was isolated. ^1H NMR (400 MHz, CDCl_3) δ 8.60 (d, $J = 8.4$ Hz, 1H), 8.31 (s, 1H), 8.10 (d, $J = 8.4$ Hz, 1H), 7.75 (d, $J = 7.6$ Hz, 2H), 7.58-7.48 (m, 5H), 7.46 (s, 1H), 3.83 (s, 3H), 2.64 (s, 3H); ^{13}C NMR (125 MHz, CDCl_3) δ 159.4, 158.3, 141.3, 140.0, 136.9, 130.0, 129.6, 129.5, 128.6, 128.4, 127.6, 126.6, 123.8, 123.7, 121.0, 120.8, 108.9, 55.4, 22.0; HRMS (ESI): Exact mass calcd for $\text{C}_{21}\text{H}_{18}\text{NO}$ $[\text{M}+\text{H}]^+$ 300.1383, found 300.1384.

8-fluoro-2-methyl-6-phenylphenanthridine (4u)



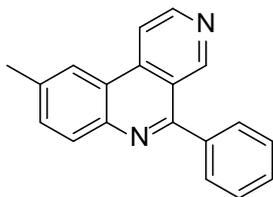
37.4 mg (65%) of **4u** (pale yellow solid) was isolated. mp 128 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.69-8.66 (m, 1H), 8.33 (s, 1H), 8.13 (d, $J = 8.4$ Hz, 1H), 7.73-7.71 (m, 3H), 7.59-7.53 (m, 5H), 2.65 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 161.2 (d, $J_{\text{C-F}} = 246$ Hz), 159.3 (d, $J_{\text{C-F}} = 3.9$ Hz), 142.0, 139.6, 137.2, 130.6, 130.3, 130.0, 129.6, 128.7, 128.4, 126.7 (d, $J_{\text{C-F}} = 7.7$ Hz), 124.7 (d, $J_{\text{C-F}} = 8.3$ Hz), 123.2, 121.2, 119.3 (d, $J_{\text{C-F}} = 24$ Hz), 113.0 (d, $J_{\text{C-F}} = 21.9$ Hz), 22.0; HRMS (ESI): Exact mass calcd for $\text{C}_{20}\text{H}_{15}\text{FN}$ $[\text{M}+\text{H}]^+$ 288.1183, found 288.1186.

8-methoxy-2-methyl-6-phenylphenanthridine (4v)



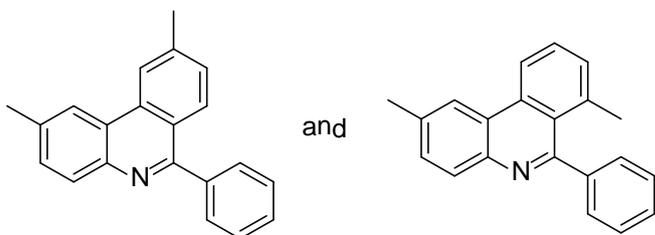
36.5 mg (61%) of **4v** (pale yellow solid) was isolated. mp 146 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.75 (d, $J = 8.8$ Hz, 1H), 8.42 (s, 1H), 8.30 (s, 1H), 8.15 (d, $J = 8.0$ Hz, 1H), 8.09 (d, $J = 8.4$ Hz, 1H), 7.78 (d, $J = 7.2$ Hz, 2H), 7.64-7.51 (m, 6H), 7.48-7.45 (m, 2H), 7.40-7.36 (m, 1H), 2.67 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 160.4, 142.3, 140.5, 140.1, 139.8, 136.8, 132.3, 130.5, 130.2, 129.8, 129.4, 128.9, 128.5, 128.4, 127.6, 127.3, 126.7, 125.7, 123.5, 122.7, 121.5, 21.8; HRMS (ESI): Exact mass calcd for $\text{C}_{26}\text{H}_{20}\text{N}$ $[\text{M}+\text{H}]^+$ 346.1590, found 346.1592.

9-methyl-5-phenylbenzo[*c*][2,7]naphthyridine (**4w**)



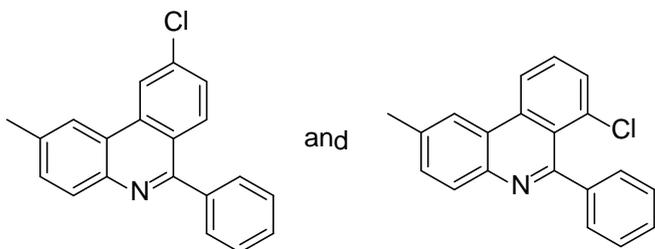
14.1 mg (26%) of **4w** (pale yellow solid) was isolated. mp 103 °C; ¹H NMR (400 MHz, CDCl₃) δ 9.46 (s, 1H), 8.92 (d, *J* = 5.2 Hz, 1H), 8.43 (d, *J* = 5.6 Hz, 1H), 8.38 (s, 1H), 8.18 (d, *J* = 8.4 Hz, 1H), 7.79 (d, *J* = 6.4 Hz, 2H), 7.71 (d, *J* = 8.0 Hz, 1H), 7.59-7.58 (m, 3H), 2.67 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 159.6, 152.4, 148.2, 143.5, 138.3, 138.0, 137.6, 132.8, 130.3, 129.9, 129.2, 128.6, 122.0, 121.4, 120.2, 115.3, 21.9; HRMS (ESI): Exact mass calcd for C₁₉H₁₅N₂ [M+H]⁺ 271.1230, found 271.1230.

2,9-dimethyl-6-phenylphenanthridine (**4x**) and 2,7-dimethyl-6-phenylphenanthridine (**4x'**)



41.9 mg (74%, **4x/4x'** = 2.4:1) of **4x** and **4x'** (pale yellow solid) was isolated. ¹H NMR (400 MHz, CDCl₃) **4x+4x'** δ 8.60 (d, *J* = 8.4 Hz, 0.70H), 8.48 (s, 0.29H), 8.39 (s, 1H), 8.13-8.07 (m, 1H), 7.97 (d, *J* = 8.4 Hz, 0.30H), 7.74-7.71 (m, 1.2H), 7.56-7.41 (m, 4.6H), 7.26-7.21 (m, 1H), 6.93-6.90 (m, 0.7H), 6.81 (d, *J* = 8.0 Hz, 1.26H), 2.66-2.64 (m, 3.9H), 2.08 (s, 2.1H); ¹³C NMR (125 MHz, CDCl₃) **4x+4x'** δ 159.8, 156.0, 144.5, 142.1, 140.9, 140.8, 139.8, 137.6, 136.7, 136.6, 134.4, 133.4, 131.2, 130.5, 130.0, 129.8, 129.7, 129.5, 129.4, 128.8, 128.7, 128.6, 128.3, 128.0, 124.8, 123.7, 123.5, 123.4, 121.8, 121.7, 121.5, 120.3, 120.2, 115.4, 24.9, 22.2, 22.1, 21.9.

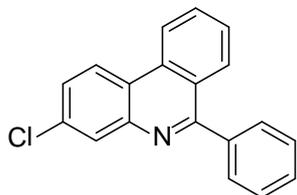
9-chloro-2-methyl-6-phenylphenanthridine (**4y**) and 7-chloro-2-methyl-6-phenylphenanthridine (**4y'**)



37.7 mg (62%, **4y/4y'** = 2.8:1) of **4y** and **4y'** (pale yellow solid) was isolated. ¹H NMR (400 MHz, CDCl₃) **4y+4y'** δ 8.69-8.67 (m, 1H), 8.38 (s, 0.75H), 8.33 (s, 0.27H), 8.33 (s, 0.27H), 8.17-8.12 (m, 1H), 8.05 (d, *J* = 8.8 Hz, 0.21H), 7.77-7.48 (m, 8.15H), 2.68 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) **4y+4y'** δ 159.7, 158.0, 143.2, 142.5, 141.3, 139.5, 137.3, 137.2,

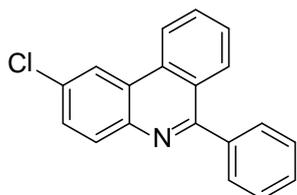
136.8, 136.0, 134.5, 133.5, 131.2, 131.1, 130.4, 130.3, 130.2, 130.1, 129.9, 129.7, 128.8, 128.7, 128.5, 128.0, 127.9, 127.5, 123.5, 122.7, 122.6, 122.5, 121.8, 121.7, 121.5, 121.2, 22.0, 21.9.

3-chloro-6-phenylphenanthridine (**4z**)



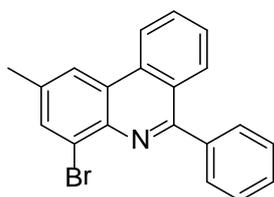
41.7 mg (72%) of **4z** (pale yellow solid) was isolated. mp 124 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.65 (d, *J* = 8.4 Hz, 1H), 8.54 (d, *J* = 8.8 Hz, 1H), 8.24 (s, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 7.88 (t, *J* = 7.8 Hz, 1H), 7.74-7.72 (m, 2H), 7.66-7.62 (m, 2H), 7.57-7.56 (m, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 162.5, 144.9, 139.8, 134.7, 133.4, 130.8, 129.8, 129.1, 128.9, 128.4, 127.5, 127.4, 125.4, 123.3, 122.4, 122.2; HRMS (ESI): Exact mass calcd for C₁₉H₁₃ClN [M+H]⁺ 290.0731, found 290.0734.

2-chloro-6-phenylphenanthridine (**4aa**)

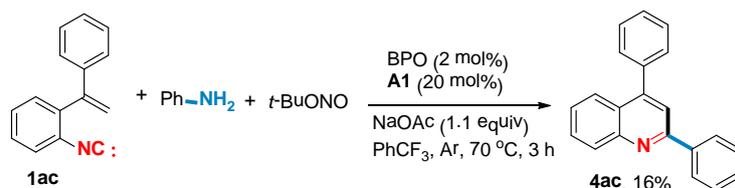


49.3 mg (85%) of **4aa** (pale yellow solid) was isolated. ¹H NMR (400 MHz, CDCl₃) δ 8.65 (d, *J* = 8.4 Hz, 1H), 8.60 (s, 1H), 8.20 (d, *J* = 8.8 Hz, 1H), 8.15 (d, *J* = 8.0 Hz, 1H), 8.91 (t, *J* = 7.8 Hz, 1H), 7.76-7.67 (m, 4H), 7.62-7.56 (m, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 161.5, 142.2, 139.4, 132.8, 132.5, 131.8, 130.8, 129.7, 129.3, 129.0, 128.9, 128.5, 127.8, 125.4, 124.8, 122.2, 121.6; HRMS (ESI): Exact mass calcd for C₁₉H₁₃ClN [M+H]⁺ 290.0731, found 290.0732.

4-bromo-2-methyl-6-phenylphenanthridine (**4ab**)

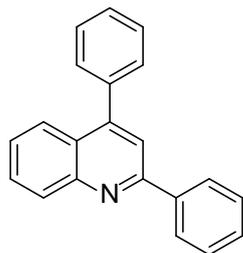


48.7 mg (70%) of **4ab** (orange yellow solid) was isolated. mp 175 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.68 (d, *J* = 8.0 Hz, 1H), 8.36 (s, 1H), 8.23 (d, *J* = 8.4 Hz, 1H), 7.93 (s, 1H), 7.88-7.85 (m, 3H), 7.65 (t, *J* = 7.6 Hz, 1H), 7.58-7.53 (m, 3H), 2.63 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 160.5, 139.5, 139.3, 137.3, 134.1, 133.1, 130.5, 130.4, 128.9, 128.8, 128.3, 127.5, 125.9, 125.1, 124.9, 122.4, 121.3, 21.6; HRMS (ESI): Exact mass calcd for C₂₀H₁₅BrN [M+H]⁺ 348.0382, found 348.0385.



Interestingly, exposure of 1-isocyano-2-(1-phenylvinyl)benzene **1ac**, which instead styryl group of the benzene ring, to the reaction conditions produced 2,4-diphenylquinoline **4ac** in 16% yield.

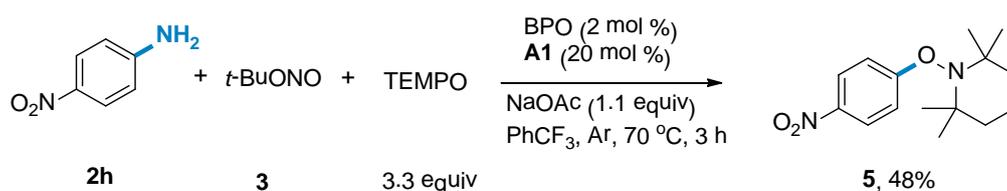
2,4-diphenylquinoline (**4ac**)



9.2 mg (16%) of **4ac** (pale yellow liquid) was isolated. ^1H NMR (500 MHz, CDCl_3) δ 8.25 (d, $J = 8.5$ Hz, 1H), 8.20 (d, $J = 7.5$ Hz, 2H), 7.91 (d, $J = 8.0$ Hz, 1H), 7.83 (s, 1H), 7.74 (t, $J = 7.5$ Hz, 1H), 7.57-7.46 (m, 9H); ^{13}C NMR (125 MHz, CDCl_3) δ 156.9, 149.2, 148.8, 139.7, 138.4, 130.1, 129.5, 129.4, 129.3, 128.8, 128.6, 128.4, 127.6, 126.3, 125.8, 125.6, 119.3.

6 Mechanistic Studies

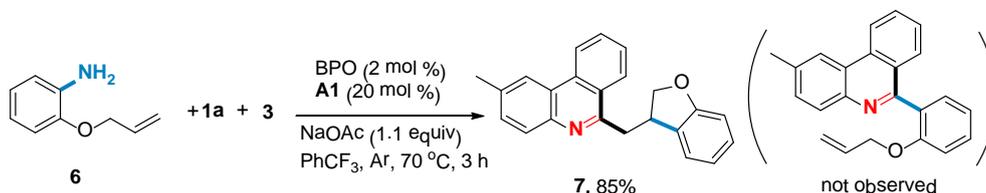
a) Capture of Aryl Radical by TEMPO



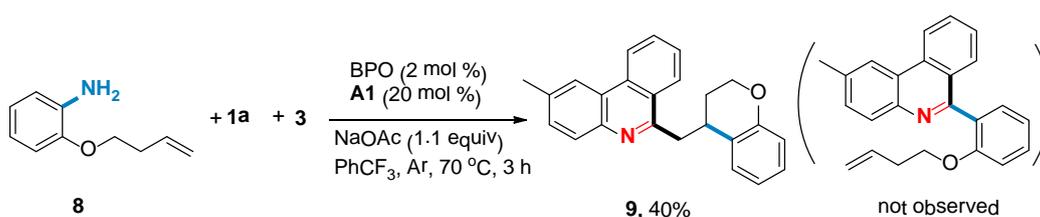
A Schlenk-tube containing *p*-nitroaniline **2h** (0.6 mmol, 3.0 equiv), BPO (2 mol %), NaOAc (1.1 equiv) and TEMPO (3.3 equiv) was degassed by three evacuation/Ar backfill cycles, then *N,N'*-dimethylethylenediamine (DMEDA, **A1**; 20 mol %) in 0.5 mL of PhCF_3 and *t*-BuONO (3.5 equiv) in 0.5 mL of PhCF_3 were added successively and slowly by syringe. The mixture was stirred at rt for 5 minutes, then it was stirred at 70 °C for 3 h. After addition of ethyl acetate (5 mL), the reaction mixture was quenched with HCl (1 N, 10 mL). Then, the organic phase was washed with brine and extracted with EtOAc for three times, dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The residue was separated by column chromatography (petroleum ether/EtOAc) to give the pure product **5** (80.2 mg, 48%, white solid). mp, 81 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.14 (d, $J = 9.6$ Hz, 2H), 7.4-7.2 (m, 2H), 1.66-1.60 (m, 5H), 1.46-1.42 (m, 1H), 1.24 (s, 6H), 0.99 (s, 6H); ^{13}C NMR (125 MHz,

CDCl₃) δ 168.7, 141.2, 125.5, 114.1, 60.9, 39.7, 32.3, 20.5, 16.9; ESI-MS: 279.1 (100, M+1); HRMS (ESI): Exact mass calcd for C₁₅H₂₃N₂O₃ [M+H]⁺ 279.1703, found 279.1686.

b) Radical Clock Probe Experiments



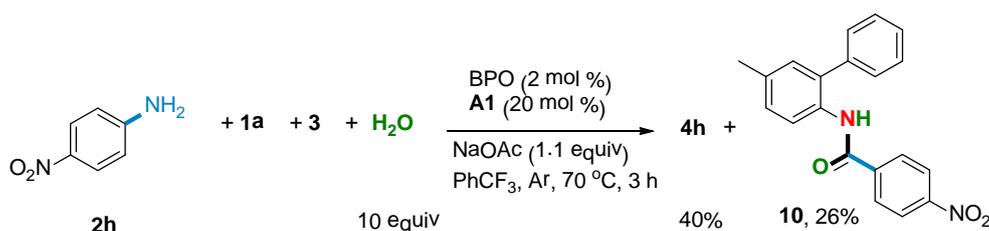
A Schlenk-tube containing 2-isocyanobiphenyl **1a** (0.2 mmol, 1.0 equiv), aryl amines **6** (0.6 mmol, 3.0 equiv), BPO (2 mol %) and NaOAc (1.1 equiv) was degassed by three evacuation/Ar backfill cycles, then *N,N'*-dimethylethylenediamine (DMEDA, **A1**; 20 mol %) in 0.5 mL of PhCF₃ and *t*-BuONO (3.5 equiv) in 0.5 mL of PhCF₃ were added successively and slowly by syringe. The mixture was stirred at r.t. for 5 minutes, then it was stirred at 70 °C for 3 h. After addition of ethyl acetate (5 mL), the reaction mixture was quenched with HCl (1 N, 10 mL). Then, the organic phase was washed with brine and extracted with EtOAc three times, dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The residue was separated by column chromatography (petroleum ether/EtOAc) to give the pure product **7** (55.3 mg, 85%). 6-((2,3-dihydrobenzofuran-3-yl)methyl)-2-methylphenanthridine **7**, pale yellow solid, mp 120 °C. ¹H NMR (400 MHz, CDCl₃) δ 8.28 (d, *J* = 60 Hz, 1H), 8.18 (s, 1H), 8.04 (d, *J* = 8.4 Hz, 1H), 7.85-7.81 (m, 1H), 7.67 (t, *J* = 7.6 Hz, 1H), 7.56 (d, *J* = 8.4 Hz, 1H), 7.23 (d, *J* = 7.6 Hz, 1H), 7.17 (t, *J* = 7.8 Hz, 1H), 6.88-6.85 (m, 2H), 4.96 (t, *J* = 8.4 Hz, 1H), 4.52-4.41 (m, 2H), 3.92-3.87 (m, 1H), 3.61-3.55 (m, 1H), 2.64 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 160.2, 157.5, 141.8, 136.4, 132.5, 130.9, 130.3, 130.2, 129.6, 128.3, 127.2, 125.6, 125.5, 124.5, 123.4, 122.5, 121.6, 120.3, 109.6, 40.6, 40.0, 22.0; HRMS (ESI): Exact mass calcd for C₂₃H₂₀NO [M+H]⁺ 326.1539, found 326.1539.



A Schlenk-tube containing 2-isocyanobiphenyl **1a** (0.2 mmol, 1.0 equiv), aryl amines **8** (0.6 mmol, 3.0 equiv), BPO (2 mol %) and NaOAc (1.1 equiv) was degassed by three evacuation/Ar backfill cycles, then *N,N'*-dimethylethylenediamine (DMEDA, **A1**; 20 mol %) in 0.5 mL of PhCF₃ and *t*-BuONO (3.5 equiv) in 0.5 mL of PhCF₃ were added successively and slowly by syringe. The mixture was stirred for 5 minutes at rt and for 3 h at 70 °C. After addition of ethyl acetate (5 mL), the reaction mixture was quenched with HCl (1 N, 10 mL). Then, the organic phase was washed with brine and extracted with EtOAc three times, dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The residue was separated by column chromatography (petroleum ether/EtOAc) to give the pure product **9** (27.2 mg, 40%). 6-(chroman-4-ylmethyl)-2-methylphenanthridine **9**, orange yellow solid. ¹H NMR (400

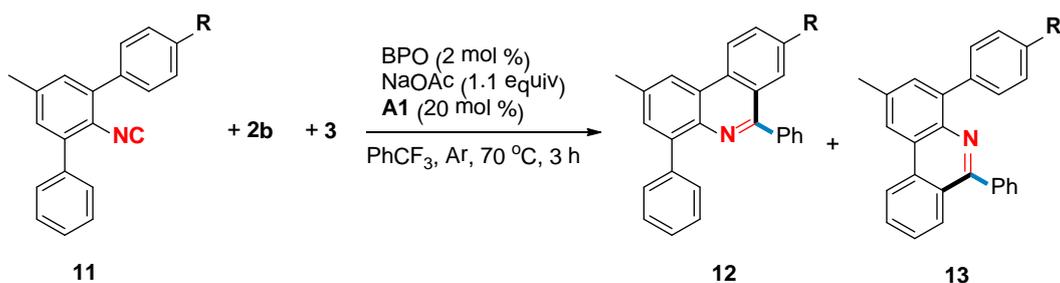
MHz, CDCl₃) δ 8.67 (d, *J* = 8.4 Hz, 1H), 8.36 (s, 1H), 8.28 (d, *J* = 8.0 Hz, 1H), 8.04 (d, *J* = 8.0 Hz, 1H), 7.84 (t, *J* = 7.6 Hz, 1H), 7.69 (t, *J* = 7.4 Hz, 1H), 7.57 (d, *J* = 8.4 Hz, 1H), 7.29 (d, *J* = 8.0 Hz, 1H), 7.14 (t, *J* = 7.8 Hz, 1H), 6.87-6.85 (m, 2H), 4.38-4.34 (m, 1H), 4.22-4.19 (m, 1H), 3.94-3.89 (m, 1H), 3.79-3.75 (m, 1H), 3.53-3.47 (m, 1H), 2.64 (s, 3H), 2.05-1.98 (m, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 158.4, 154.7, 141.9, 136.4, 132.7, 130.3, 130.2, 129.5, 129.1, 127.5, 127.2, 126.2, 125.8, 125.7, 123.4, 122.5, 121.6, 120.2, 117.0, 63.5, 41.8, 33.0, 26.8, 21.9; HRMS (ESI): Exact mass calcd for C₂₄H₂₂NO [M+H]⁺ 340.1696, found 340.1694.

c) Quenching the Nitrilium Intermediate with Water



A Schlenk-tube containing 2-isocyanobiphenyl **1a** (0.2 mmol, 1.0 equiv), *p*-nitroaniline **2h** (0.6 mmol, 3.0 equiv), BPO (2 mol %) and NaOAc (1.1 equiv) was degassed by three evacuation/Ar backfill cycles, then H₂O (10 equiv) and *N,N'*-dimethylethylenediamine (DMEDA, **A1**; 20 mol %) in 0.5 mL of PhCF₃, *t*-BuONO (3.5 equiv) in 0.5 mL of PhCF₃ were added successively and slowly by syringe. The mixture was stirred for 5 minutes at rt and for 3 h 70 °C. Ethyl acetate (5 mL) was added to the reaction mixture, followed by quenching with HCl (1 N, 10 mL). The organic phase was washed with brine and extracted with EtOAc for three times. The combined extract was dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The residue was separated by column chromatography (petroleum ether/EtOAc) to give the cyclization product **4h** (25.1 mg, 40%) and amide **10** (17.3 mg, 26%). *N*-(5-methyl-[1,1'-biphenyl]-2-yl)-4-nitrobenzamide **10**, pale yellow solid, mp 155 °C. ¹H NMR (400 MHz, CDCl₃) δ 8.31 (d, *J* = 8.4 Hz, 1H), 8.23 (d, *J* = 8.0 Hz, 2H), 7.92-7.90 (m, 1H), 7.75-7.73 (d, *J* = 8.0 Hz, 2H), 7.53-7.41 (m, 5H), 7.26-7.25 (m, 2H), 7.15 (s, 1H), 2.40 (s, 3H); ¹³C NMR (125 MHz, CDCl₃) δ 162.8, 149.6, 140.4, 137.9, 134.9, 132.8, 131.7, 131.6, 130.9, 130.6, 129.2, 129.2, 129.1, 128.3, 127.9, 123.9, 123.5, 122.8, 121.4, 20.9; HRMS (ESI): Exact mass calcd for C₂₀H₁₇N₂O₃ [M+H]⁺ 333.1234, found 333.1233.

d) Intramolecular Competition Reactions



A Schlenk-tube containing triaryl isocyanide **11** (0.2 mmol, 1.0 equiv), aniline **2b** (0.6 mmol, 3.0 equiv), BPO (2 mol %) and NaOAc (1.1 equiv) was degassed by three

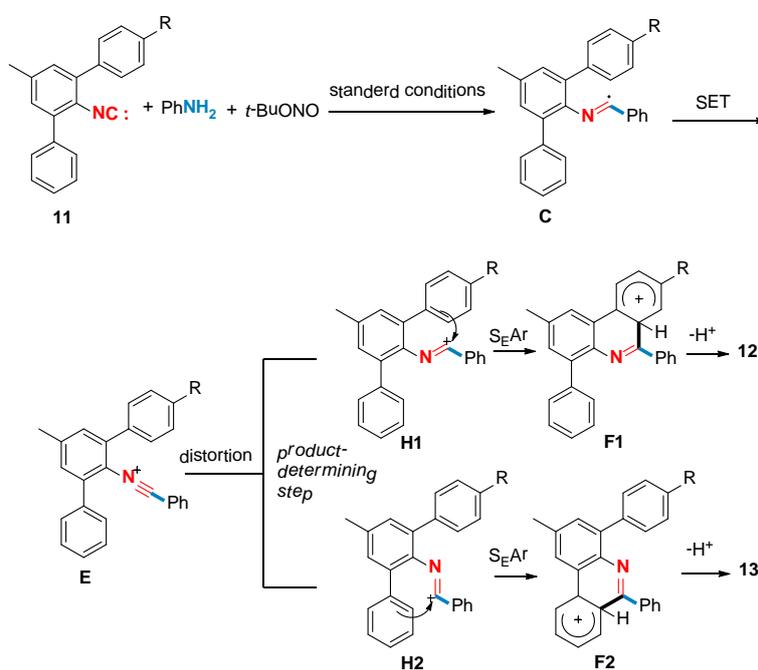
evacuation/Ar backfill cycles, then *N,N'*-dimethylethylenediamine (DMEDA, **A1**; 20 mol %) in 0.5 mL of PhCF₃ and *t*-BuONO (3.5 equiv) in 0.5 mL of PhCF₃ were added successively and slowly by syringe. The mixture was stirred for 5 minutes at rt and for 3 h at 70 °C. The reaction mixture was diluted with ethyl acetate (5 mL), quenched with HCl (1 N, 10 mL). Then, the organic phase was washed with brine and extracted with EtOAc for three times. The combined extract was dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The ¹H NMR of the crude product was taken. The ratio of **12**/**13** was determined by analysing the ¹H NMR and that of the authentic sample of **13**. The total yield of **12** and **13** was not collected. The ratios were listed in Table S2.

Table S2^a

Entry	11	12 : 13 ^b	σ_{meta} ⁷
1	R = CH ₃ , 11a	1.50:1	-0.07
2	R = OCH ₃ , 11b	1.50:1	0.115
3	R = F, 11c	1.44:1	0.337
4	R = Cl, 11d	1.44:1	0.373
5	R = CF ₃ , 11e	1.08:1	0.43
6	R = CN, 11f	1:1.17	0.56

^a Reaction conditions: All reactions were performed with **11** (0.2 mmol), **2b** (3 equiv) and **3** (3.5 equiv) in 1.0 mL of PhF₃ at 70 °C, in Ar, for 3 h. ^b As determined by ¹H NMR spectroscopy. ^c Hammett substituent constants, σ_{meta} , based on the ionization of benzoic acids.⁷

Scheme S1. If an electrophilic aromatic substitution (S_EAr) produced the C-C bond



Triaryl isocyanides **11** were chosen to study the transition-metal-free mediated heterocycle formation. The aryl substituents R could affect the annulation step by controlling the amount of electron density in the reactive intermediate. These substrates allowed the investigation of an intramolecular competition reaction between the reactive intermediate and the C-H bond on either the phenyl or aryl substituent. This was necessary because the rate-determining step

of the mechanism was unknown, and the intramolecular reaction would allow the ratio of phenanthridine products obtained from **11** to offer insight into the mechanism of the C-C bond-forming event even if it occurred after the turnover-limiting step.

A series of triaryl isocyanides with electron-donating or electron-withdrawing aryl substituents were screened as substrates to determine the electronic dependence of the C-H bond functionalization (Table S2). 4-Substituted aryl groups were chosen to simplify product analysis by providing only one regioisomer. Ruling out possible ratio errors of experiments and ^1H NMR, the ration value of **12:13** has a declining trend as the higher σ_{meta} of R substituents.

The product ratios from the reaction of **11** were analyzed using the Hammett equation to determine if an electrophilic aromatic substitution ($\text{S}_{\text{E}}\text{Ar}$) produced the C-C bond. In this mechanism, nucleophilic attack of the pendant aryl or phenyl group onto the electrophilic nitrilium ion **H** would form corresponding arenium ion **F**. If only this mechanism occurs, a linear correlation of the product ratios **12:13** from triaryl isocyanides **11** with Hammett σ_{meta} values should be observed because the C-C bond is forming *meta* to the R group. Figure S1 shows that the relationship between σ_{meta} values and the product ratios from **11** is a curve with negative ρ value rather than a straight line.

Such Hammett curve suggests: a) a positive transition-state intermediate is involved in the annulation step, and it is consistent with the formation of nitrilium ion **E** rather than just only imidoyl radical **C** in the annulation step, since imidoyl radical **C** is rather electron rich, whereas nitrilium ion **E** is the opposite; and b) a change in mechanism (or rate-determining step) happened in these reactions and it will depend on the nature of the substituent. And curve Hammett plots have been interpreted as evidence for dual reaction mechanisms. According to the previous reports and our other mechanism studies, both HAS and $\text{S}_{\text{E}}\text{Ar}$ are highly likely involved in the annulation step.

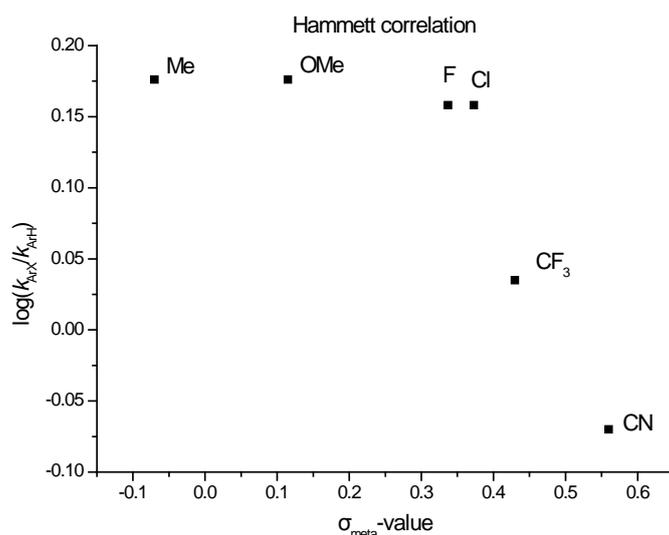
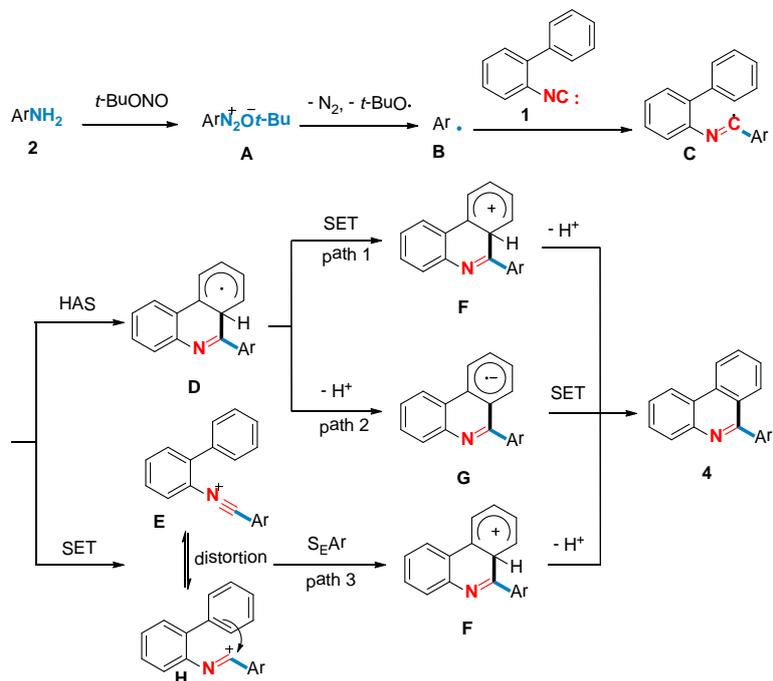


Figure S1. Hammett correlation of $\log(k_{\text{rel}})$ with σ_{meta} value for the transition-metal-free promoted annulation of triaryl isocyanides.

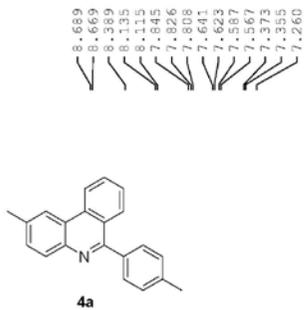
e) Proposed Reaction Mechanism



7 References

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- (7) a) L. P. Hammett, *J. Am. Chem. Soc.* **1937**, *59*, 96; b) C. Hansch, A. Leo, R. W. Taft, *Chem. Rev.* **1991**, *97*, 165.

8 ^1H and ^{13}C NMR Spectra



— 2.650
— 2.478

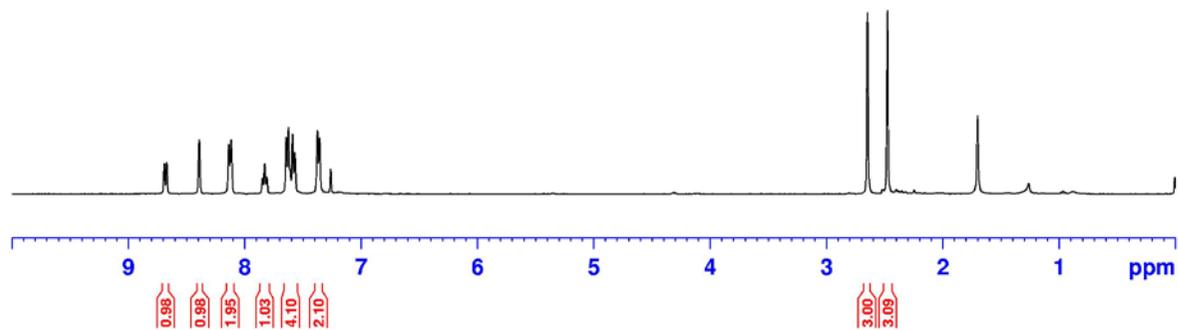


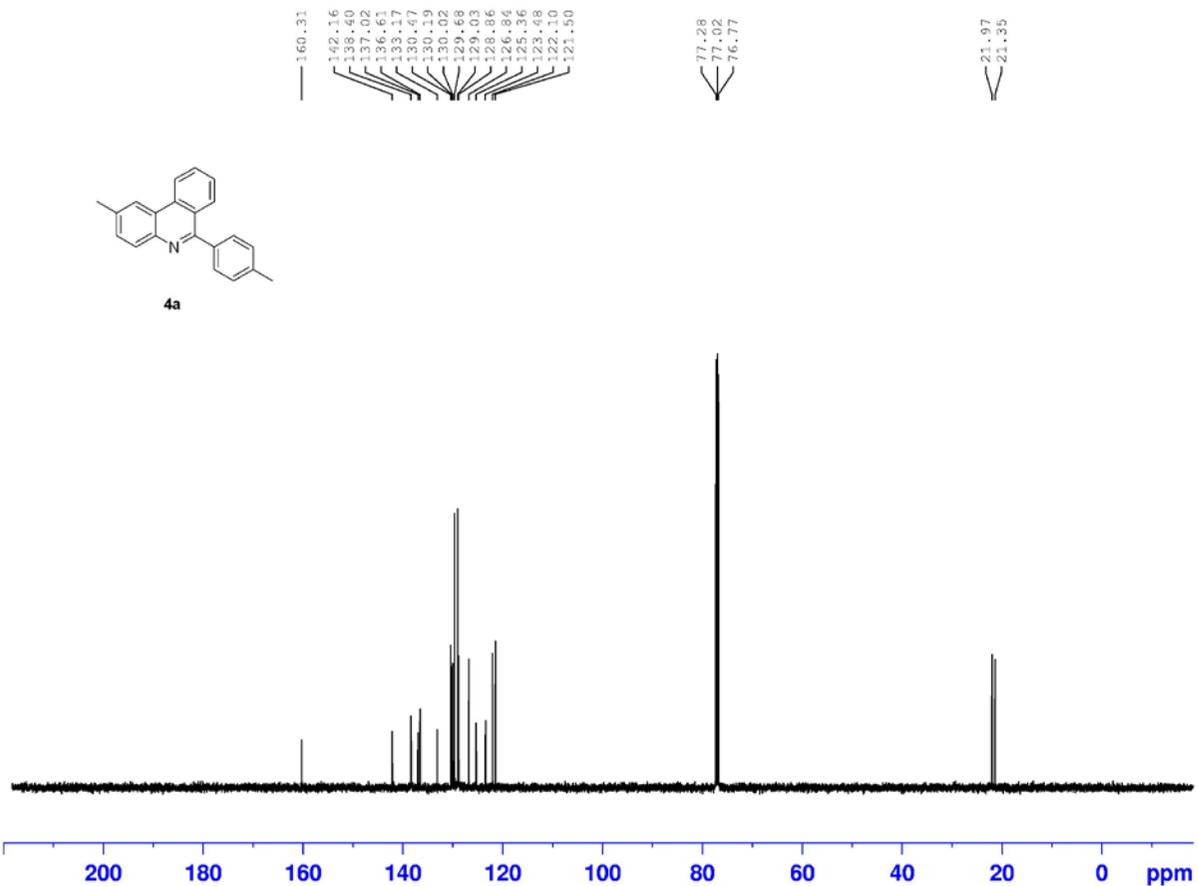
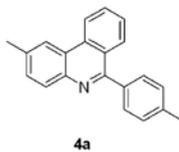
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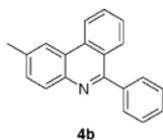
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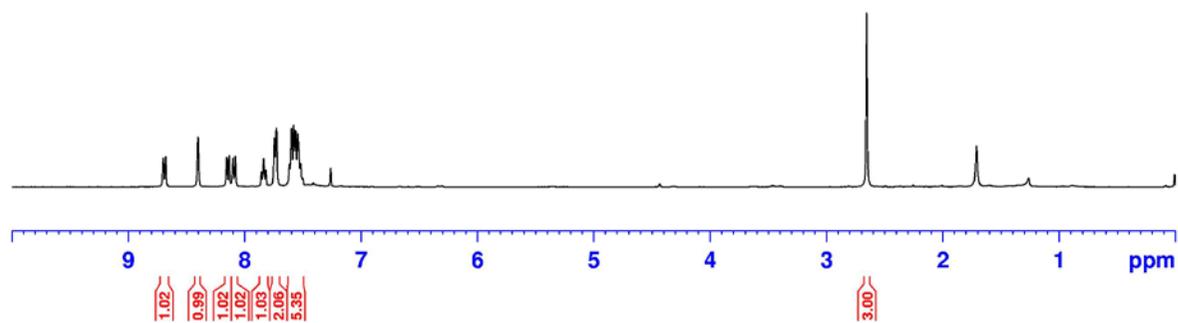
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— 2.656

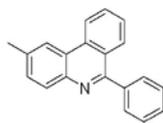


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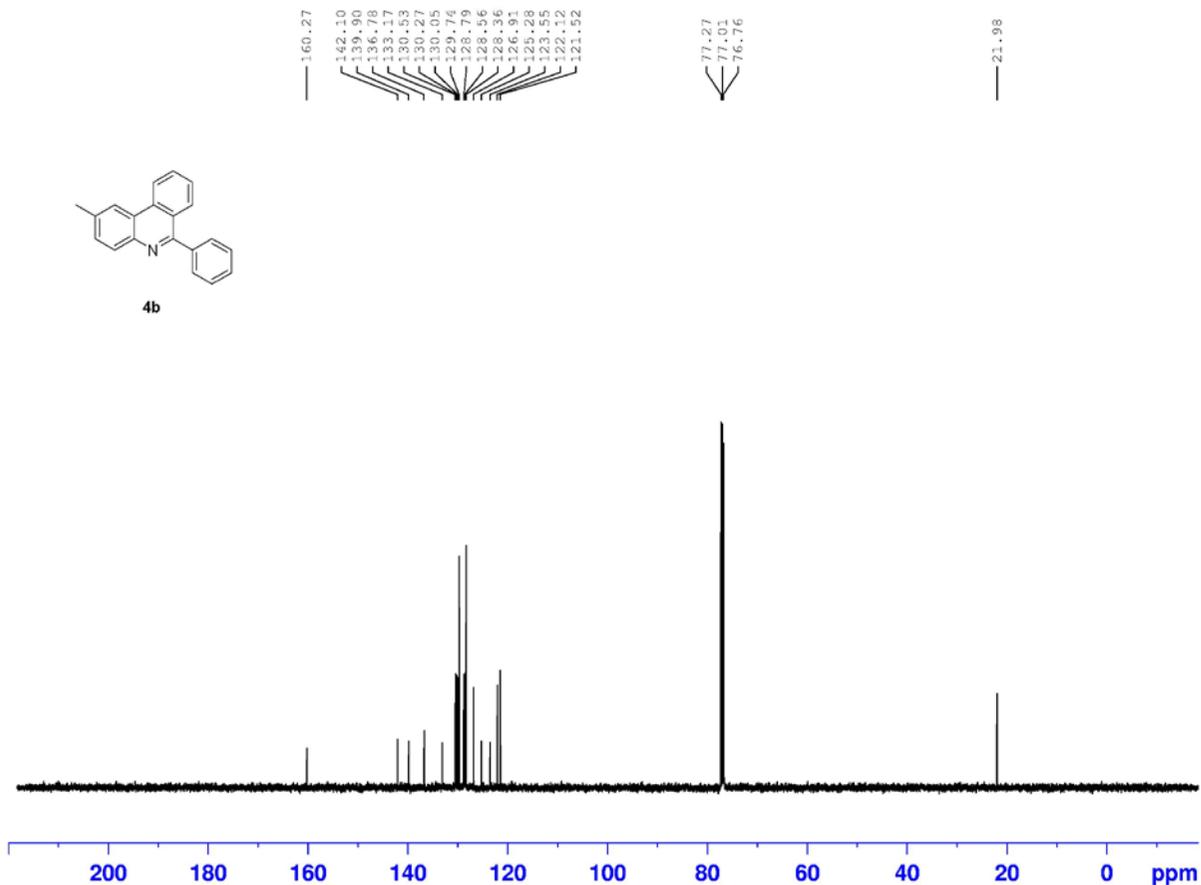
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4b



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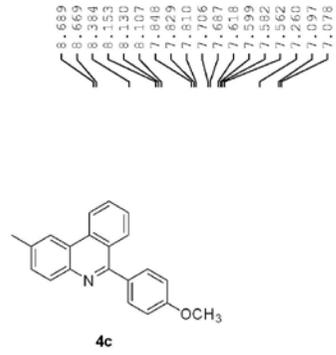
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```

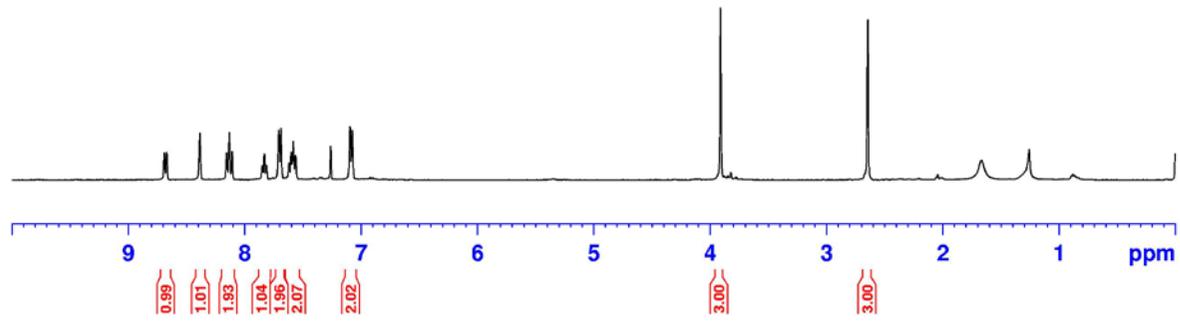
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL2W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



8.689
8.669
8.394
8.153
8.130
8.107
7.848
7.829
7.810
7.796
7.687
7.618
7.599
7.582
7.562
7.260
7.097
7.078

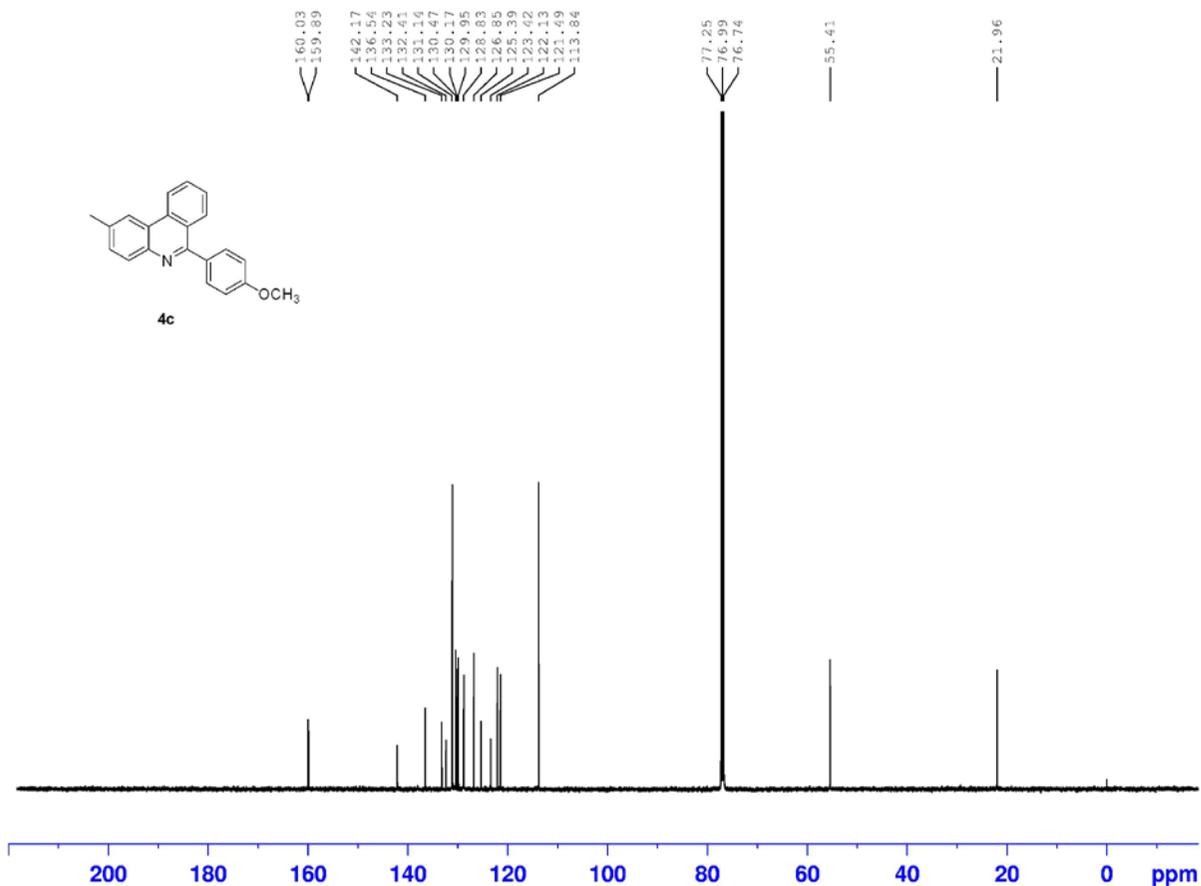
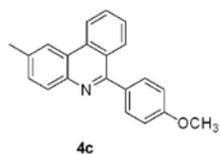
3.912

2.647



```
NAME          pnmr
EXPNO         2821
PROCNO        1
Date_         20130903
Time          18.23
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            322.5
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDD           1
```

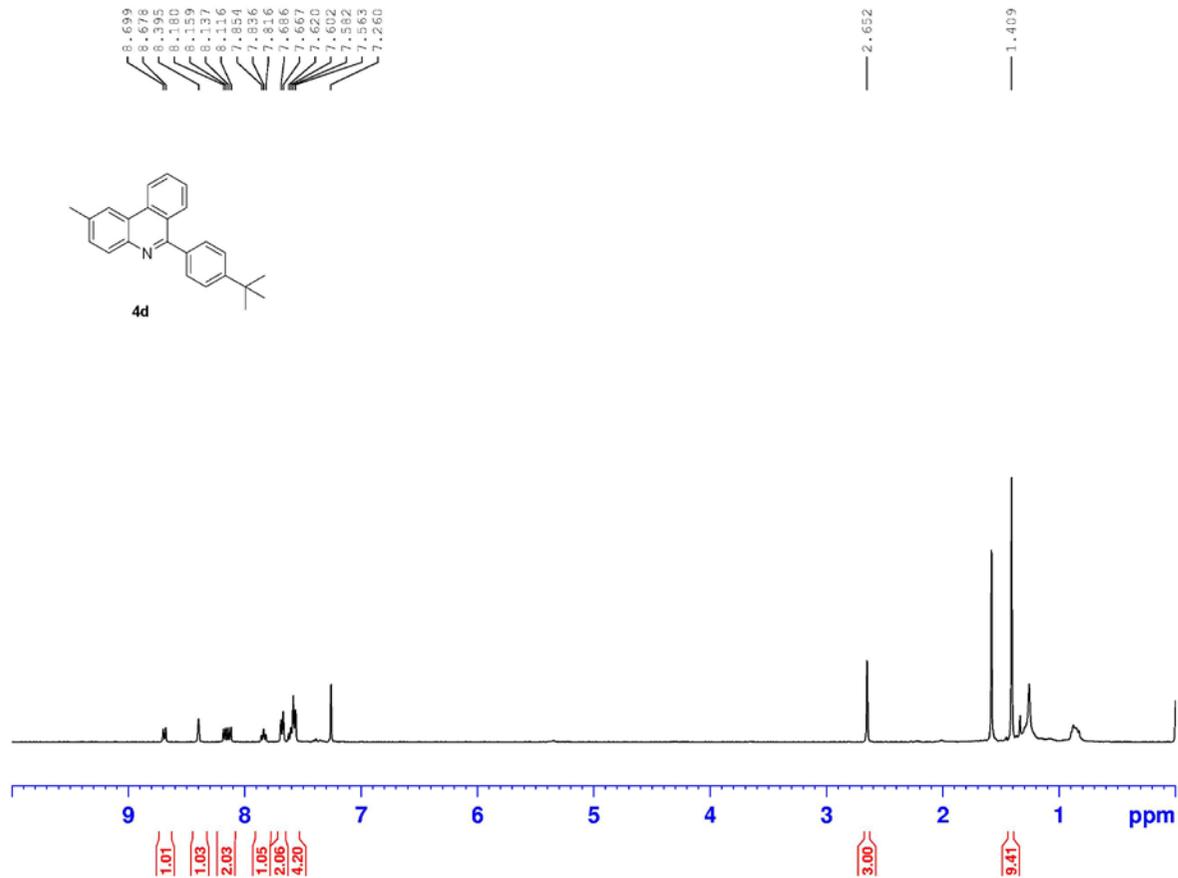
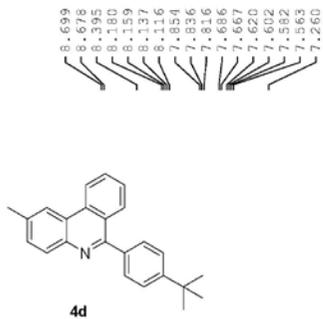
```
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300100 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```
NAME          cmr
EXPNO         28212
PROCNO        1
Date_         20131213
Time         20.25
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            2048
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```

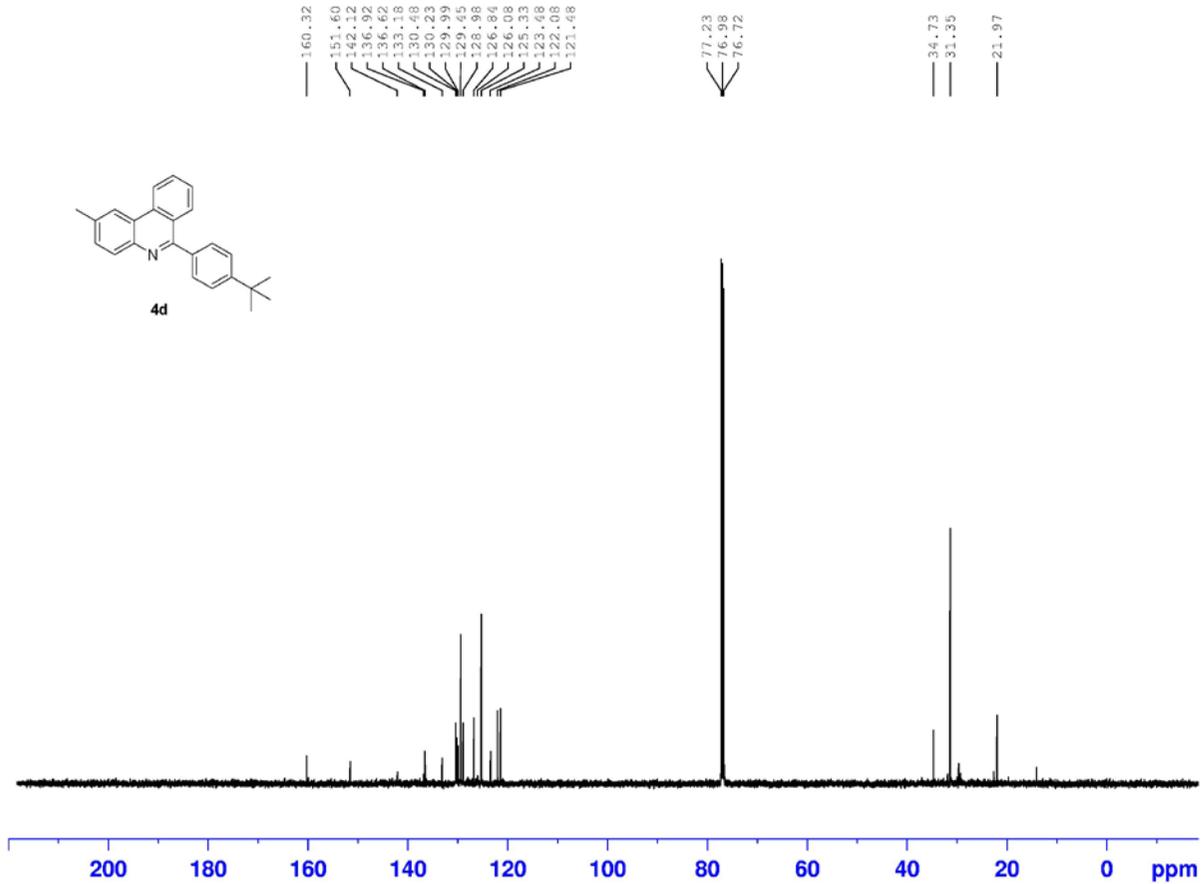
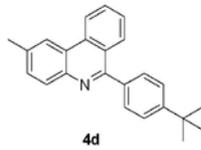


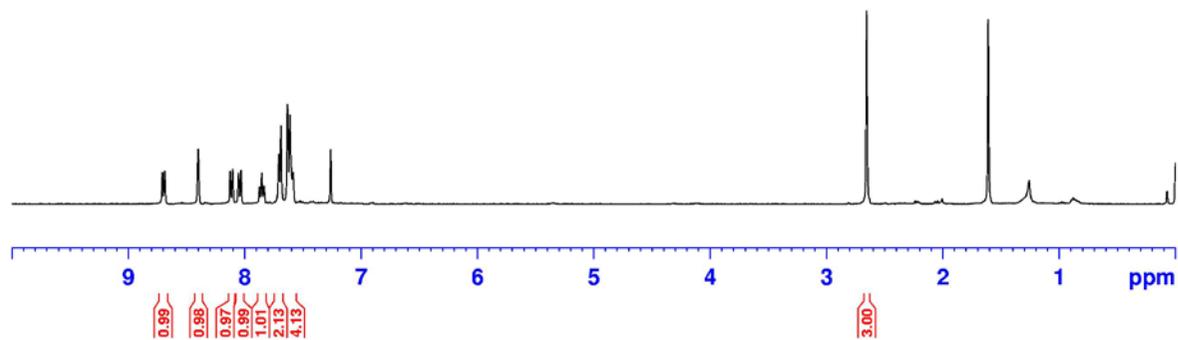
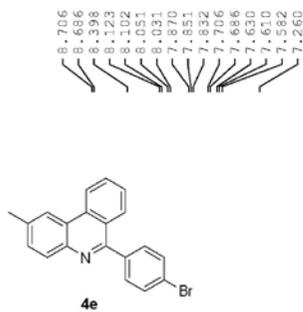
```

NAME          pnmr
EXPNO         30433
PROCNO        1
Date_         20130913
Time          17.35
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.3 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300095 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```





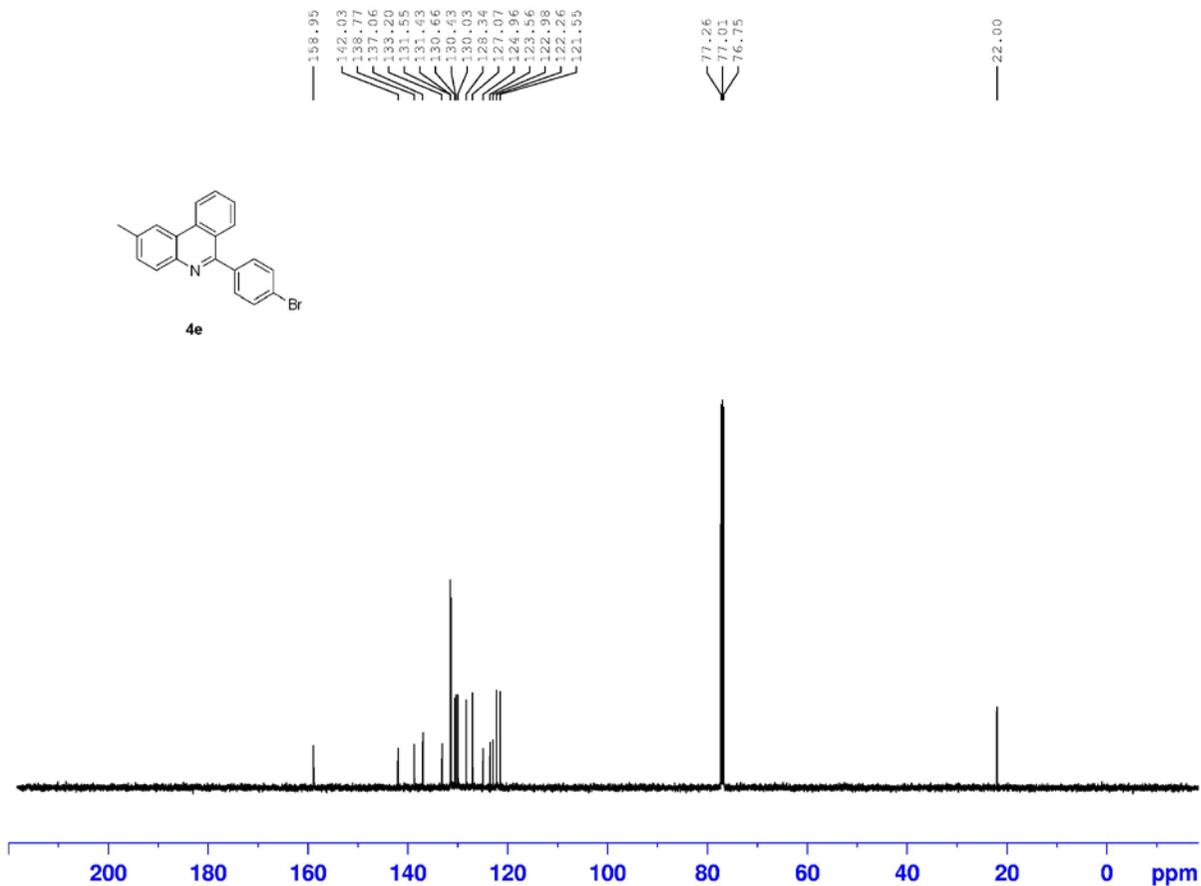
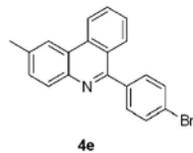
— 2.656



```

NAME                pnmr
EXPNO                3051
PROCNO               1
Date_                20130912
Time                 13.45
INSTRUM              spect
PROBHD               5 mm PABBO BB-
PULPROG              zg30
TD                   65536
SOLVENT              CDCl3
NS                    8
DS                    2
SWH                  8278.146 Hz
FIDRES               0.124314 Hz
AQ                   3.9584243 sec
RG                    362
DW                   60.400 usec
DE                    6.50 usec
TE                   298.3 K
D1                   1.00000000 sec
TDD                   1

===== CHANNEL f1 =====
NUC1                  1H
P1                    12.58 usec
PL1                   0.00 dB
PL1W                  10.87646866 W
SFO1                  400.1324710 MHz
SI                    32768
SF                    400.1300097 MHz
WDW                   EM
SSB                    0
LB                    0.30 Hz
GB                    0
PC                    1.00
  
```



```

NAME          cmr
EXPNO         3051
PROCNO        1
Date_         20130913
Time          14.57
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            32768
SOLVENT       CDCl3
NS            216
DS            4
SWH           29761.904 Hz
FIDRES        0.908261 Hz
AQ            0.5505524 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

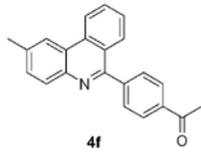
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL2W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

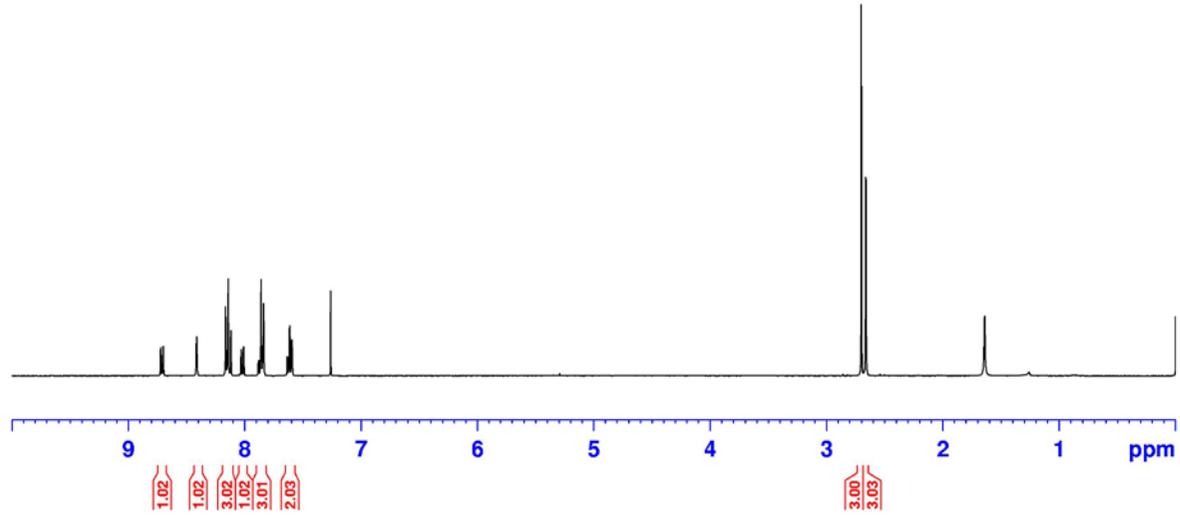
```



6.719
8.698
8.411
8.162
8.157
8.146
8.141
8.118
8.028
8.008
8.007
7.880
7.877
7.857
7.853
7.841
7.836
7.632
7.630
7.615
7.612
7.594
7.591
7.260

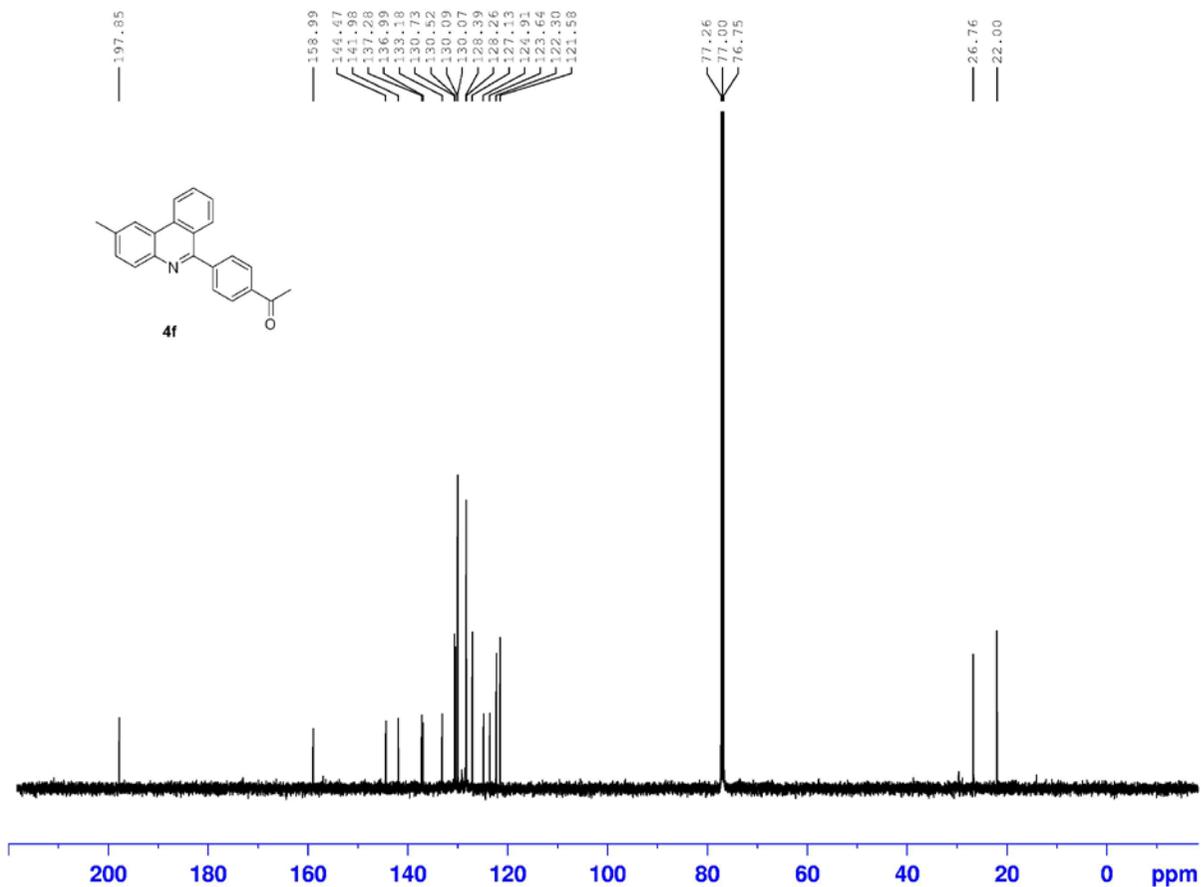


2.702
2.663



```
NAME          pnmr
EXPNO         9
PROCNO        1
Date_         20140417
Time          10.08
INSTRUM       spect
PROBHD        5 mm DUL 13C-1
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.7 K
D1            1.00000000 sec
TDO           1

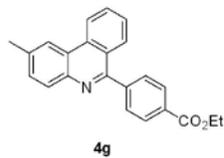
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300095 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```
NAME          cnmr
EXPNO         3044
PROCNO        1
Date_         20130912
Time          15.12
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            252
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



8.712
8.682
8.497
8.232
8.232
8.230
8.120
8.1021
8.000
7.872
7.853
7.824
7.804
7.607
7.588
7.260

4.475
4.458
4.440
4.423

— 2.661

1.468
1.450
1.433

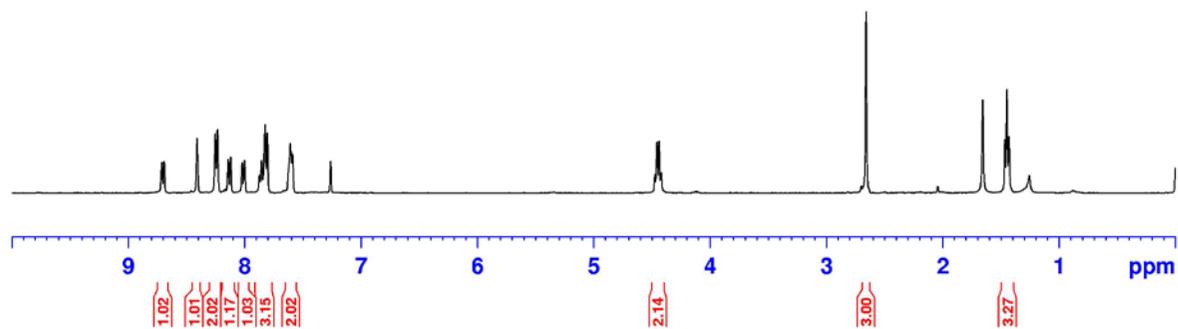


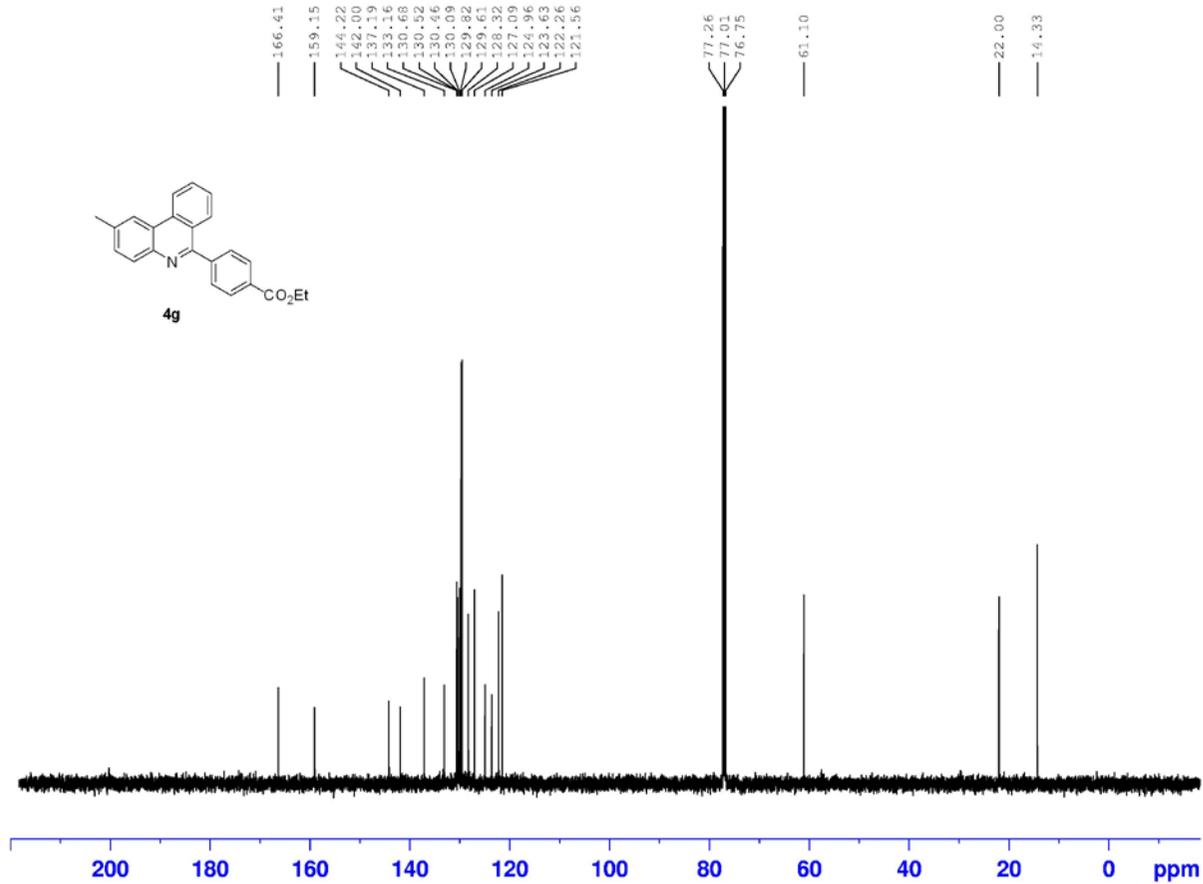
```

NAME          pnmr
EXPNO         2822
PROCNO        1
Date_         20130903
Time          18.31
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            256
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDD           1
  
```

```

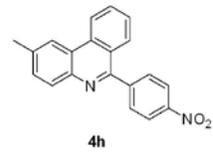
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300097 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



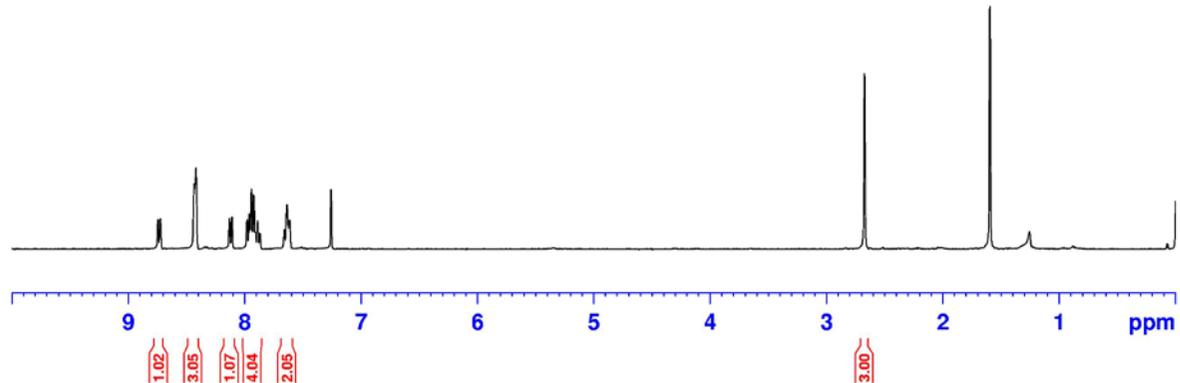




8.744
8.723
8.436
8.421
8.133
8.111
7.983
7.962
7.944
7.925
7.910
7.891
7.871
7.662
7.639
7.615
7.260



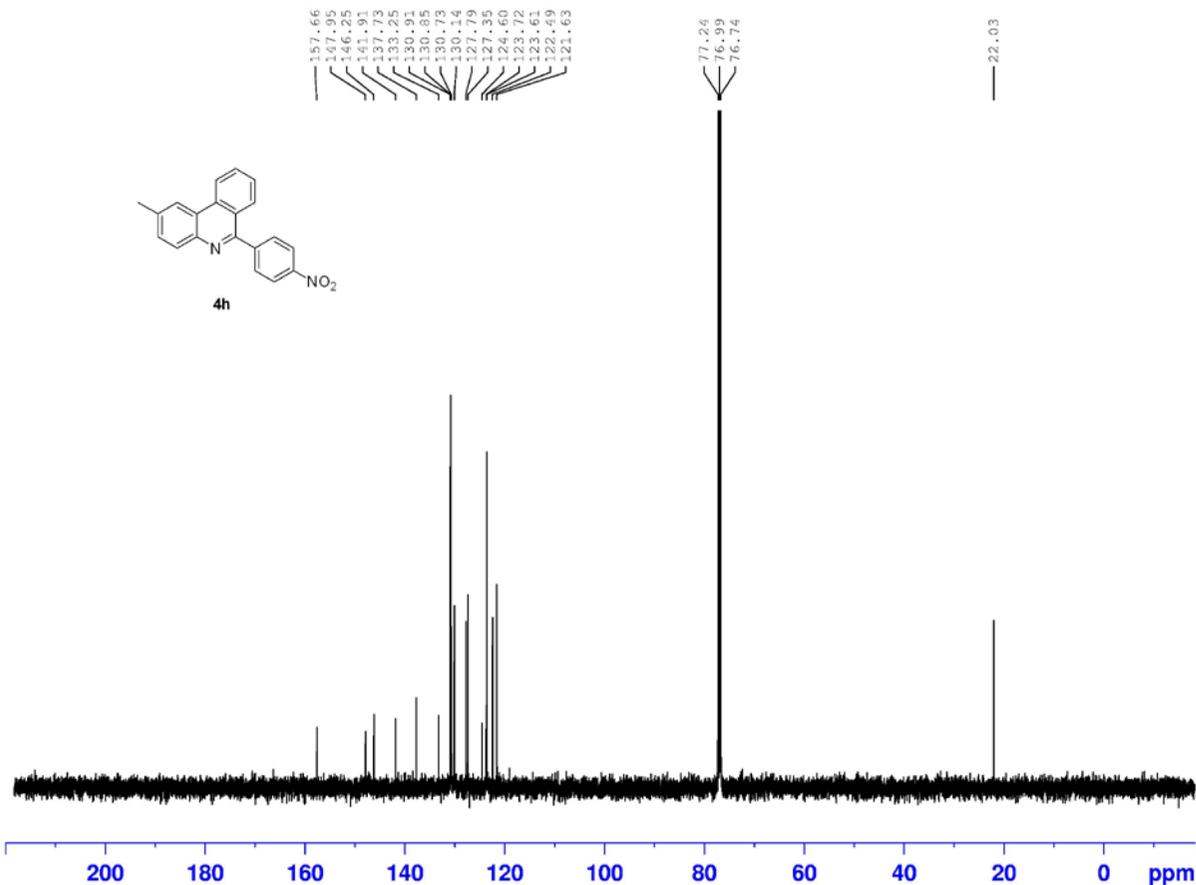
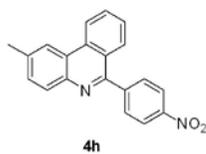
— 2.675



```
NAME          pnmr
EXPNO         293
PROCNO        1
Date_         20130903
Time          18.38
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300098 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```

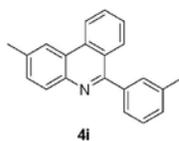
xzh293



```
NAME          cmr
EXPNO         293
PROCNO        1
Date_         20130906
Time          15.29
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            32768
SOLVENT       CDCl3
NS            188
DS            4
SWH           29761.904 Hz
FIDRES        0.908261 Hz
AQ            0.5505524 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL12W         13.02339381 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



8.694
8.673
8.397
8.119
8.129
8.102
8.081
7.851
7.833
7.813
7.611
7.593
7.573
7.551
7.509
7.490
7.451
7.433
7.414
7.336
7.318
7.260

2.654
2.474

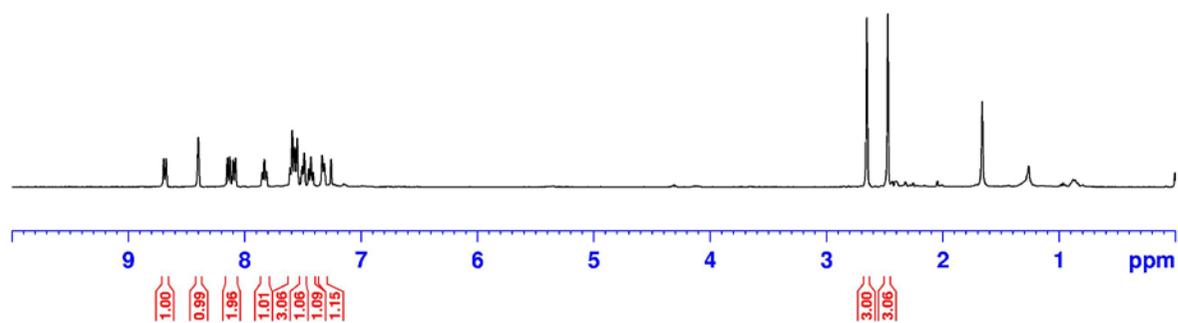


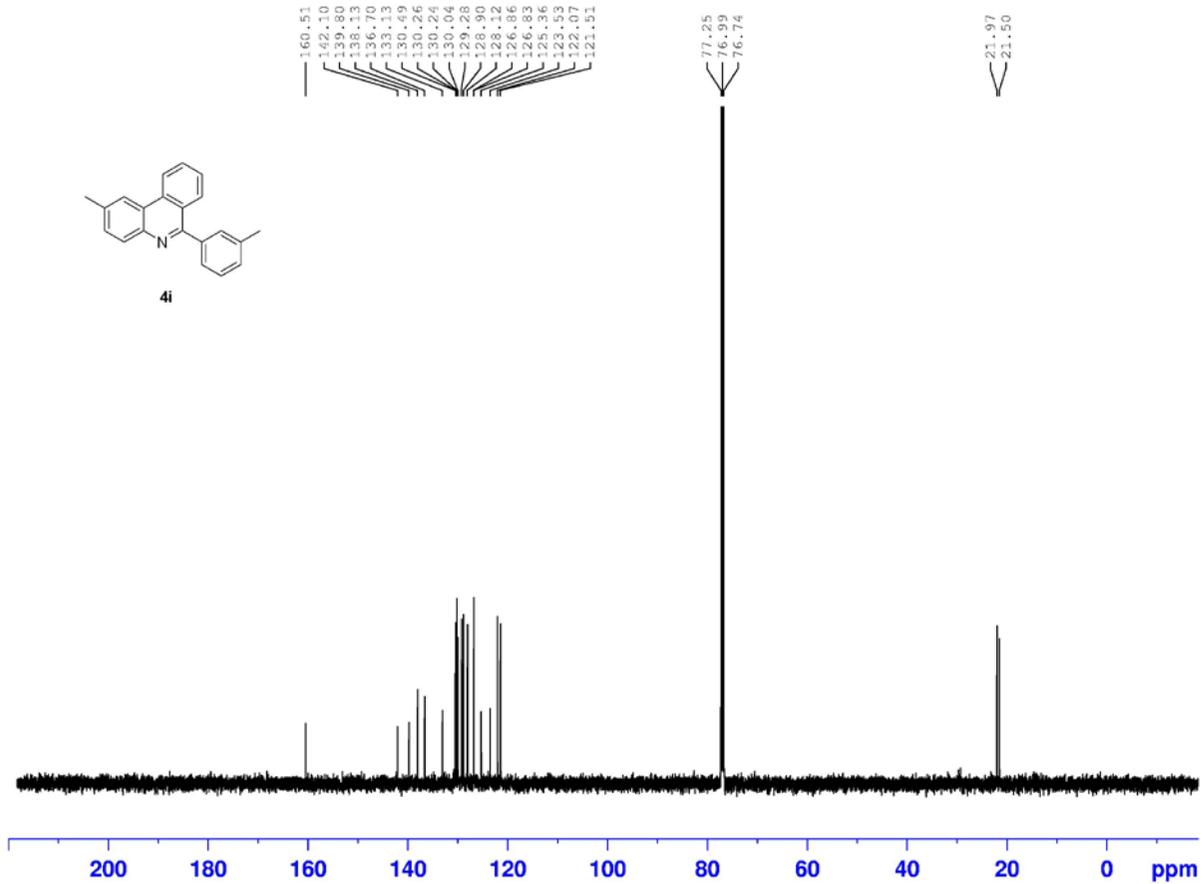
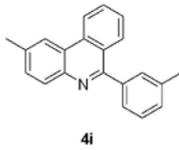
```

NAME                pnmr
EXPNO                29712
PROCNO               1
Date_                20130904
Time                 9.51
INSTRUM              spect
PROBHD               5 mm PABBO BB-
PULPROG              zg30
TD                   65536
SOLVENT              CDCl3
NS                   8
DS                   2
SWH                  8278.146 Hz
FIDRES              0.124314 Hz
AQ                   3.9584243 sec
RG                   256
DW                   60.400 usec
DE                   6.50 usec
TE                   298.0 K
D1                   1.0000000 sec
TD0                  1
  
```

```

===== CHANNEL f1 =====
NUC1                 1H
P1                   12.58 usec
PL1                  0.00 dB
PL1W                 10.87646866 W
SFO1                 400.1324710 MHz
SI                   32768
SF                   400.1300098 MHz
WDW                  EM
SSB                  0
LB                   0.30 Hz
GB                   0
PC                   1.00
  
```





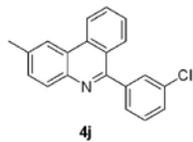
```

NAME          cnmr
EXPNO         29712
PROCNO        1
Date_         20130906
Time         15.13
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            32768
SOLVENT       CDCl3
NS            311
DS            4
SWH           29761.904 Hz
FIDRES        0.908261 Hz
AQ            0.5505524 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            297.2 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

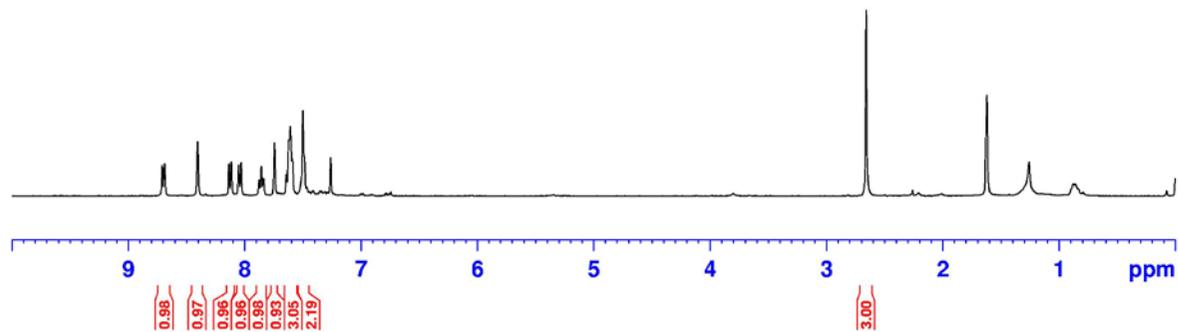
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



8.707
8.687
8.403
8.194
8.113
8.050
8.030
7.874
7.856
7.837
7.742
7.640
7.619
7.567
7.529
7.260

2.660

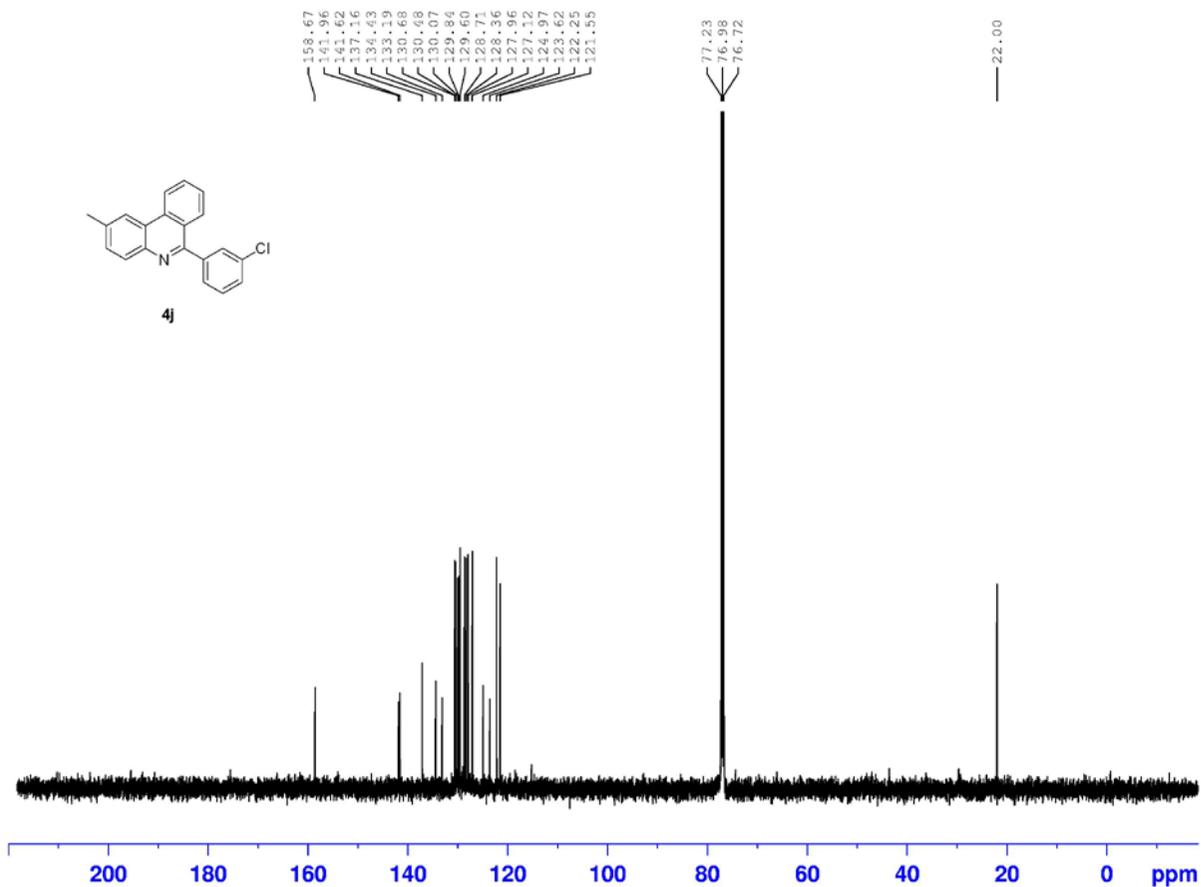
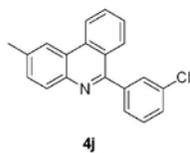


```

NAME          pnmr
EXPNO         30012
PROCNO        1
Date_         20130905
Time          16.27
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            322.5
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300097 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



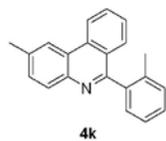
```

NAME          cnmr
EXPNO         30012
PROCNO        1
Date_         20130908
Time         16.00
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            32768
SOLVENT       CDCl3
NS            924
DS            4
SWH           29761.904 Hz
FIDRES       0.908261 Hz
AQ           0.5505524 sec
RG            203
DW           16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

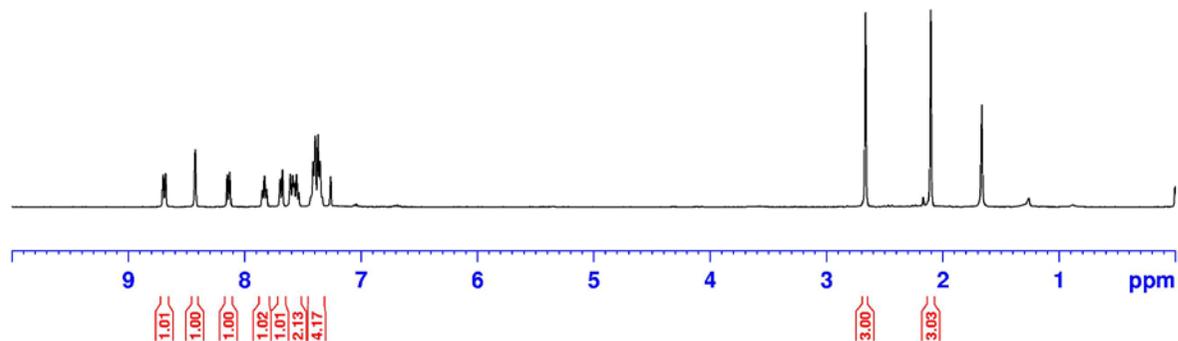
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W         46.89624786 W
SFO1         125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2        80.00 usec
PL2           2.50 dB
PL12         17.40 dB
PL13         17.40 dB
PL1W         13.02339381 W
PL12W        0.42143556 W
PL13W        0.42143556 W
SFO2         500.1320005 MHz
SI            32768
SF           125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



8.700
8.679
8.424
8.414
8.117
8.126
7.827
7.828
7.809
7.695
7.675
7.606
7.586
7.571
7.552
7.533
7.410
7.393
7.369
7.351
7.260



2.666

2.105

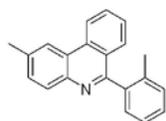


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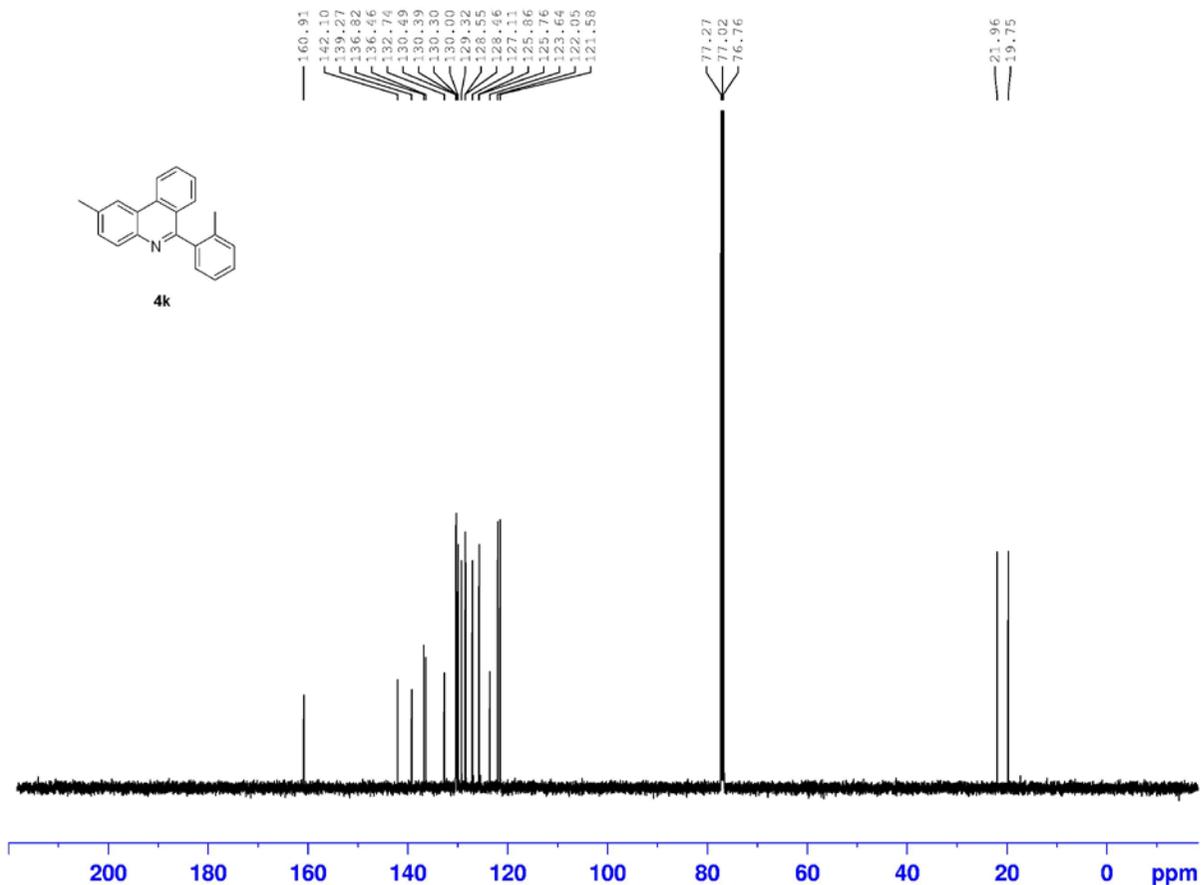
NAME          pnmr
EXPNO         29722
PROCNO        1
Date_         20130904
Time          9.58
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            256
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300097 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



4k



```

NAME          cmr
EXPNO         29722
PROCNO        1
Date_         20130905
Time         15.11
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            32768
SOLVENT       CDCl3
NS            315
DS            4
SWH           29761.904 Hz
FIDRES        0.908261 Hz
AQ            0.5505524 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1
  
```

```

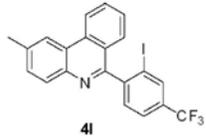
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz
  
```

```

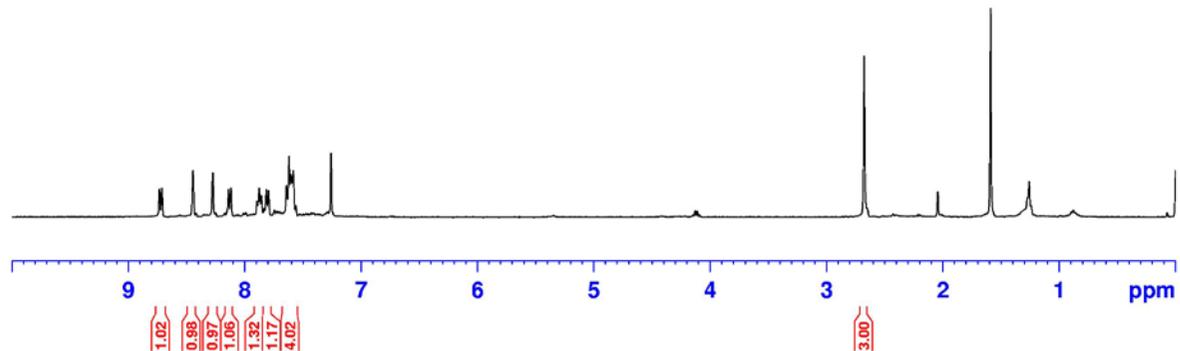
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



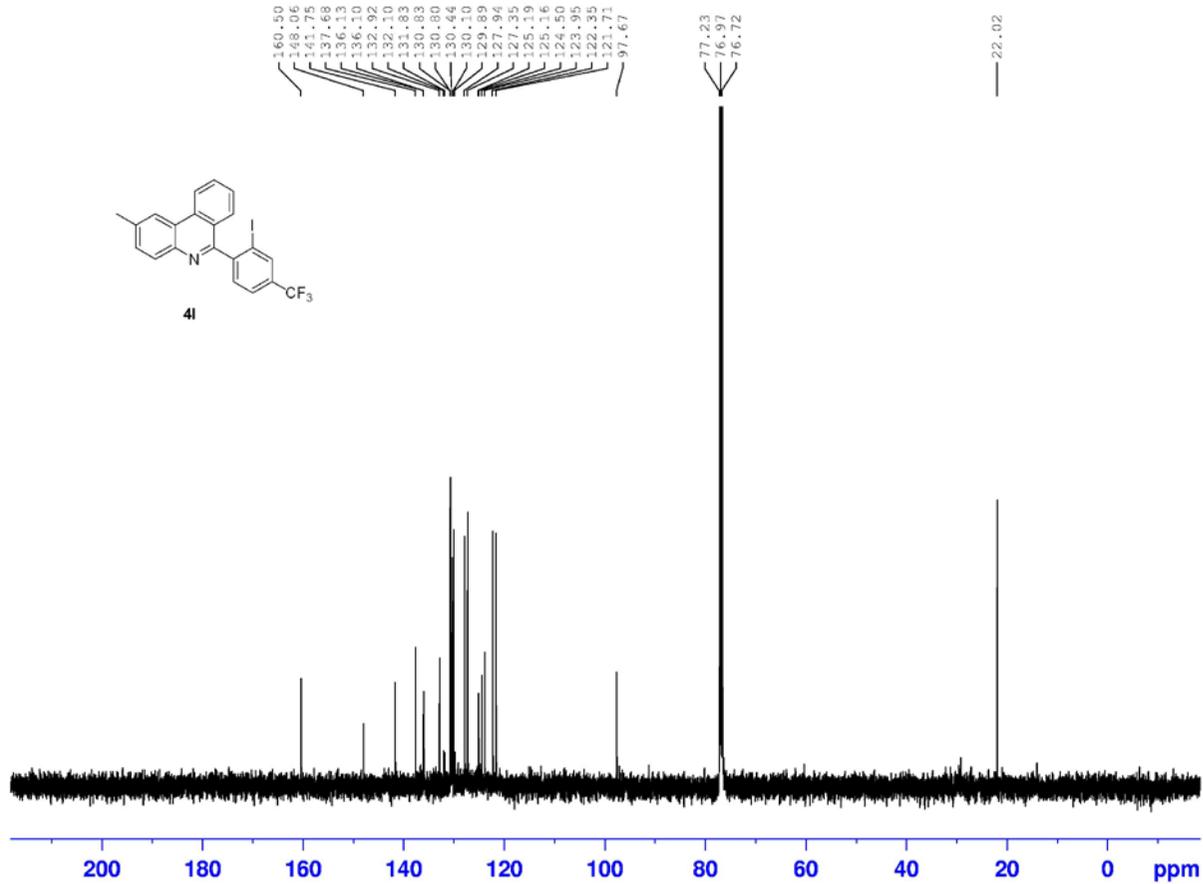
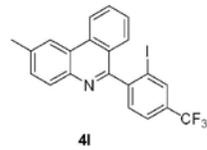
8.734
8.713
8.447
8.276
8.141
8.120
7.896
7.877
7.859
7.816
7.797
7.642
7.621
7.604
7.585
7.260



— 2.678



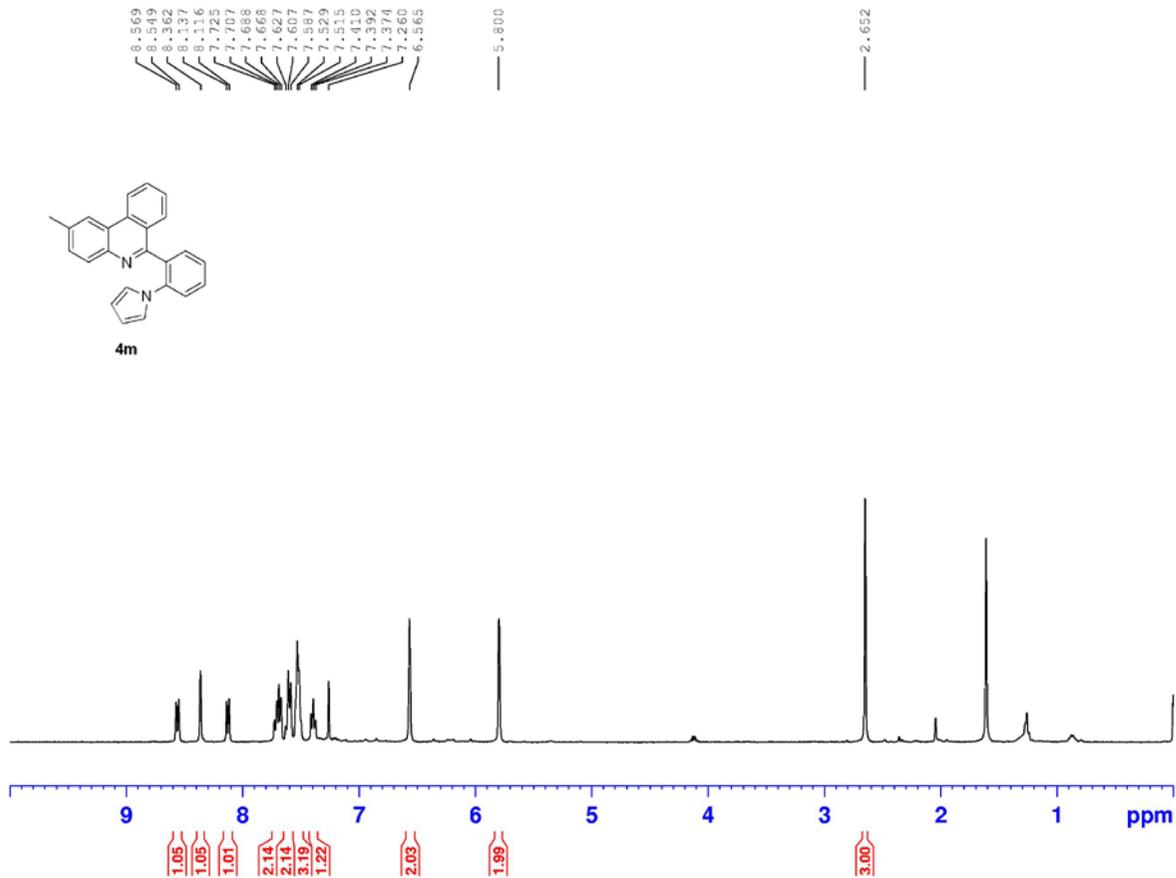
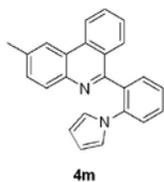
```
NAME          pnmr
EXPNO         3052
PROCNO        1
Date_         20130912
Time          13.52
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.3 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300099 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```
NAME          cmmr
EXPNO         3052
PROCNO        1
Date_         20130913
Time         15.11
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            965
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



```

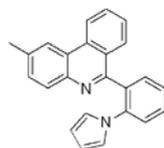
NAME          pnmr
EXPNO         3042
PROCNO        1
Date_         20130911
Time          10.34
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.3 K
D1            1.00000000 sec
TDO           1

```

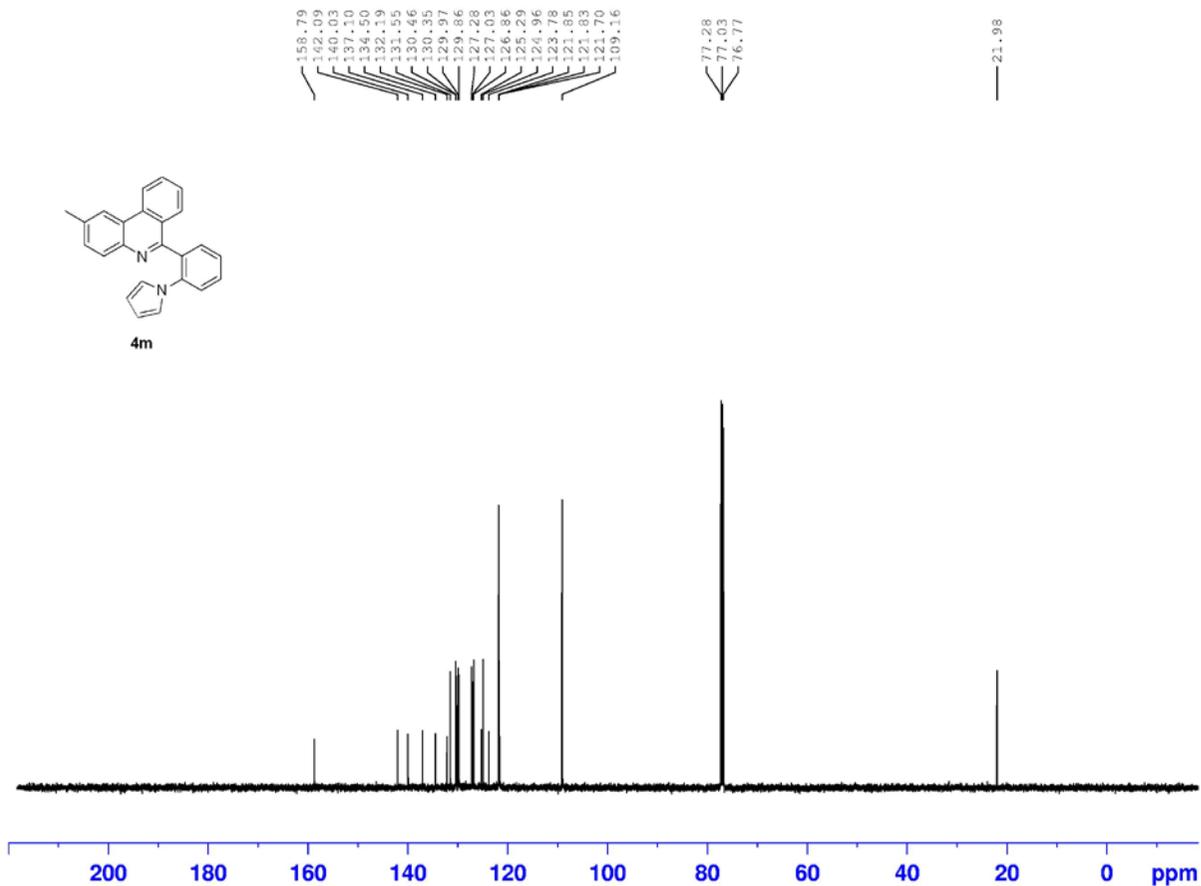
```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300100 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



4m



```

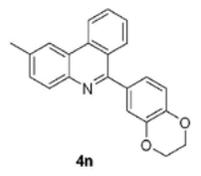
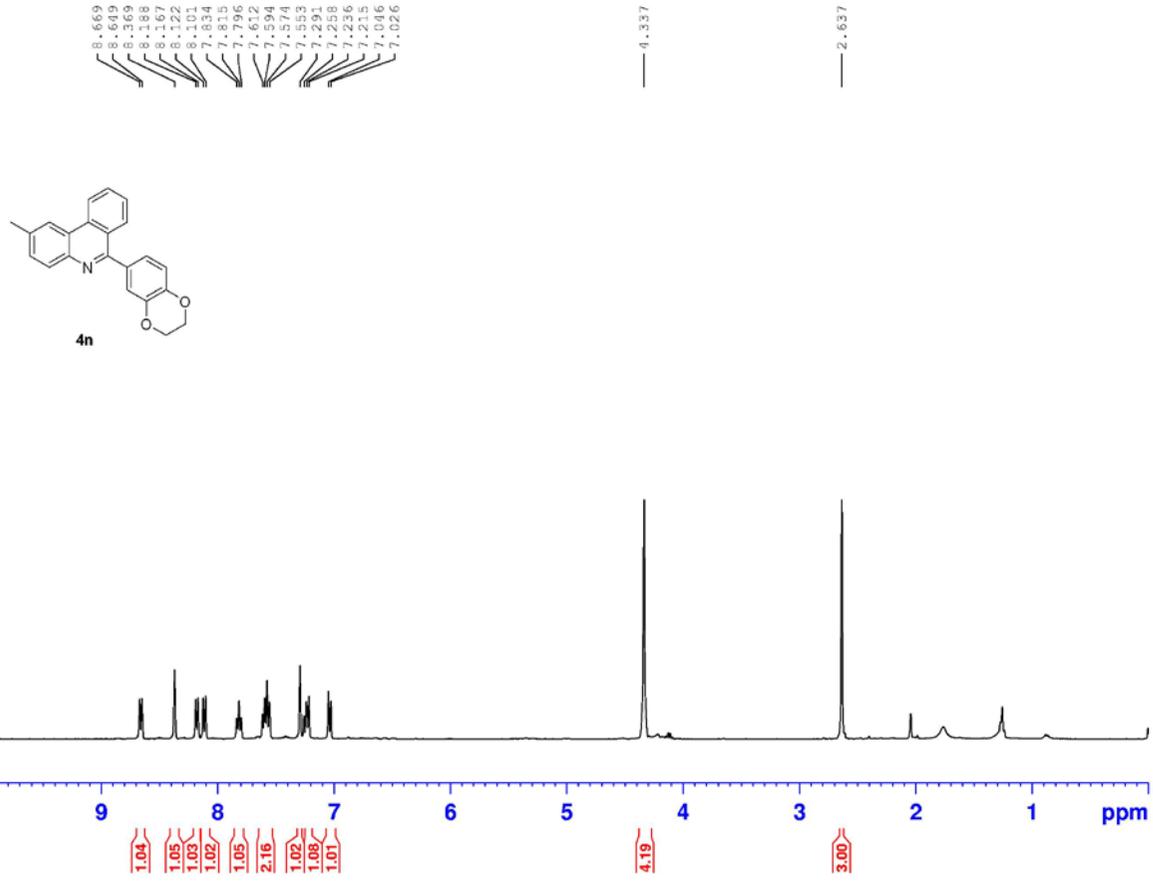
NAME          cmr
EXPNO         3042
PROCNO        1
Date_         20130912
Time         14.57
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            227
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1
  
```

```

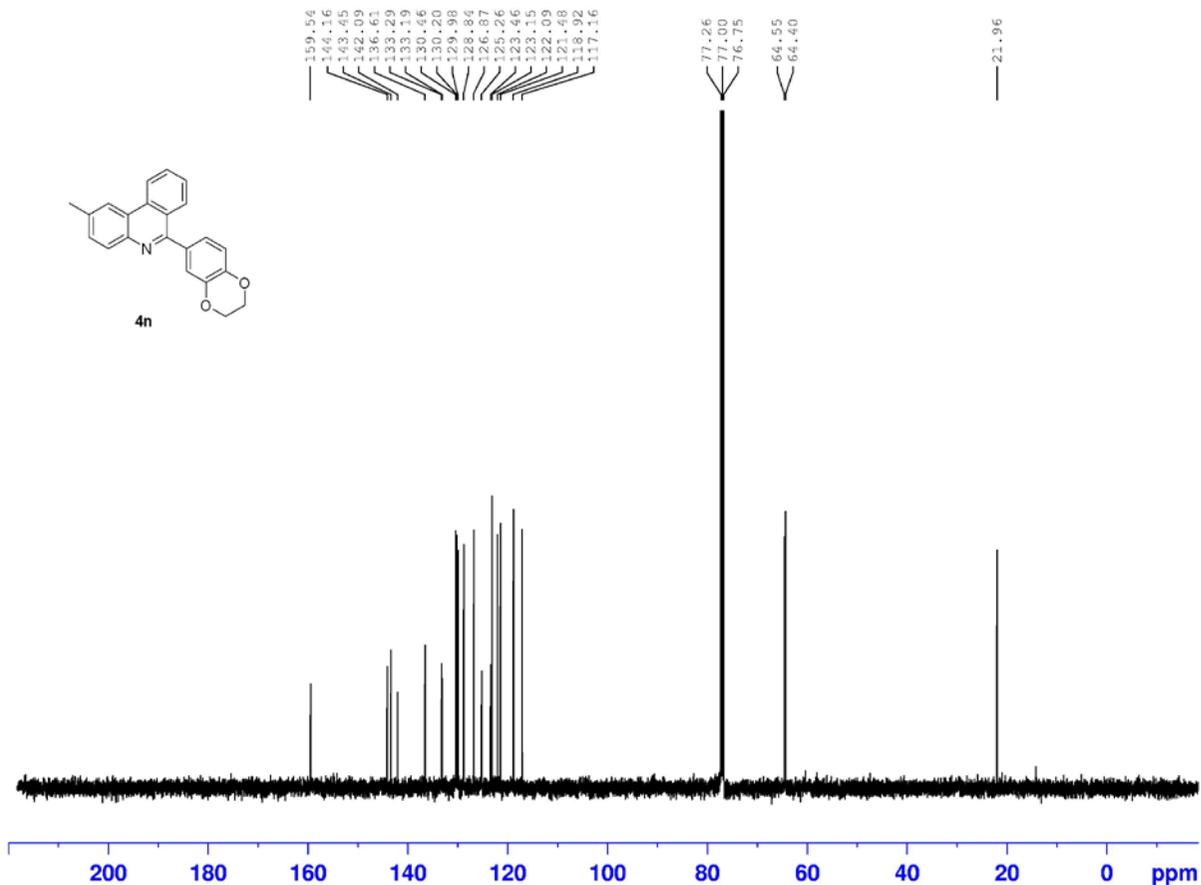
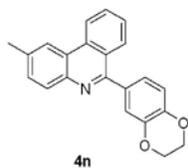
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz
  
```

```

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL12W         13.02339381 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



```
NAME          pnmr
EXPNO         30812
PROCNO        1
Date_         20130924
Time          20.16
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            181
DW            60.400 usec
DE            6.50 usec
TE            298.4 K
D1            1.00000000 sec
TDD           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300105 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



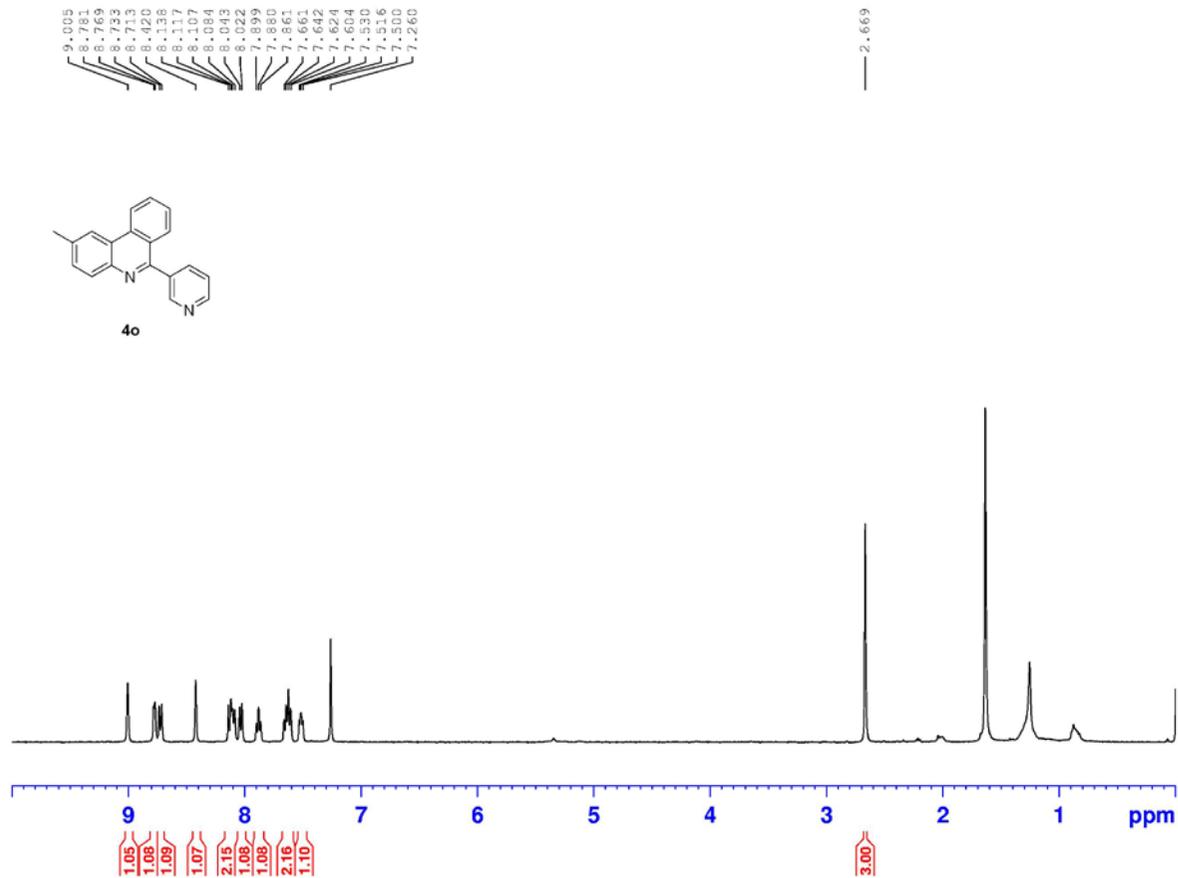
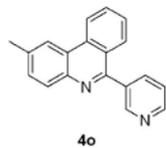
```

NAME          cmr
EXPNO         30812
PROCNO        1
Date_         20130927
Time         15.10
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            32768
SOLVENT       CDCl3
NS            339
DS            4
SWH           29761.904 Hz
FIDRES        0.908261 Hz
AQ            0.5505524 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL2W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



```

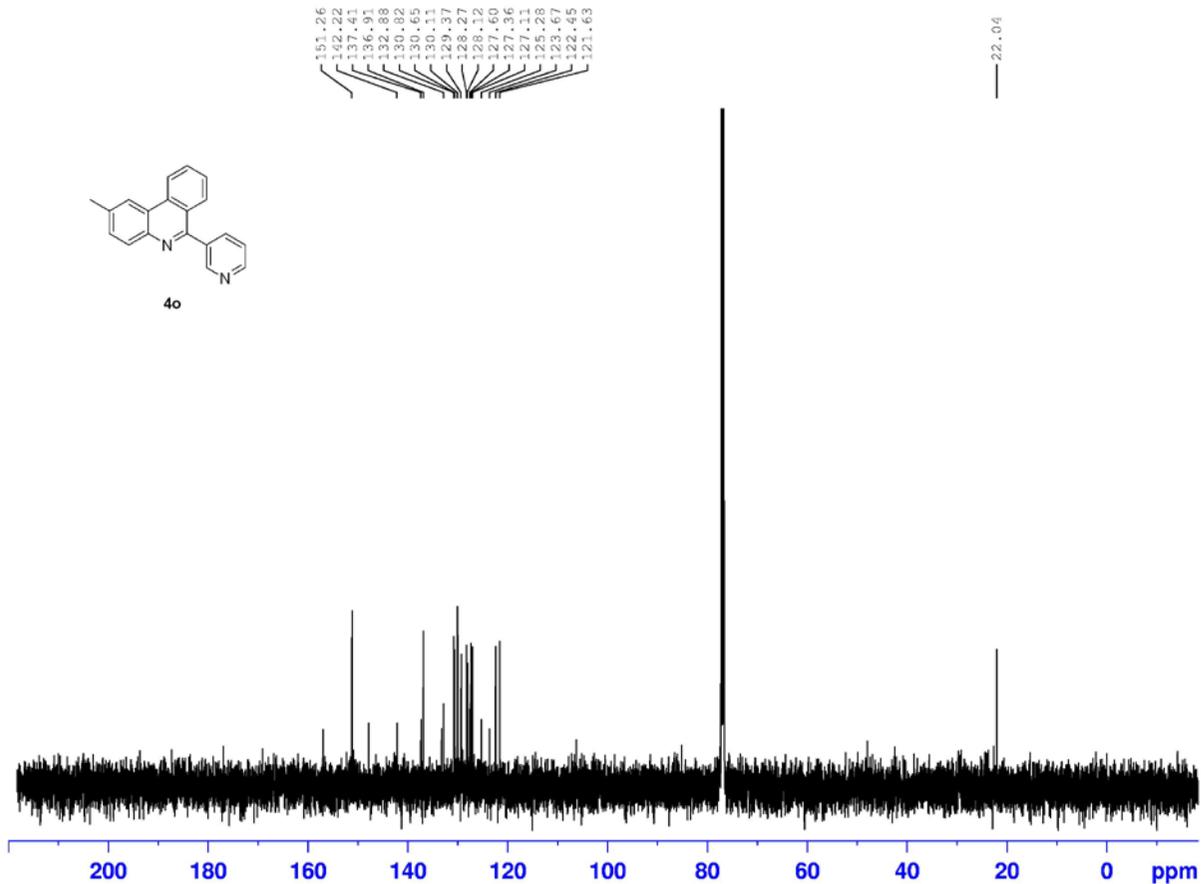
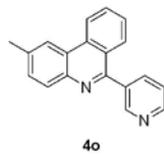
NAME          pnmr
EXPNO         31112
PROCNO        1
Date_         20130927
Time          20.39
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            322.5
DW            60.400 usec
DE            6.50 usec
TE            298.1 K
D1            1.00000000 sec
TDO           1

```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1295916 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



```

NAME          cnmr
EXPNO         31112
PROCNO        1
Date_         20130930
Time         15.45
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            32768
SOLVENT       CDCl3
NS            903
DS            4
SWH           29761.904 Hz
FIDRES        0.908261 Hz
AQ            0.5505524 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

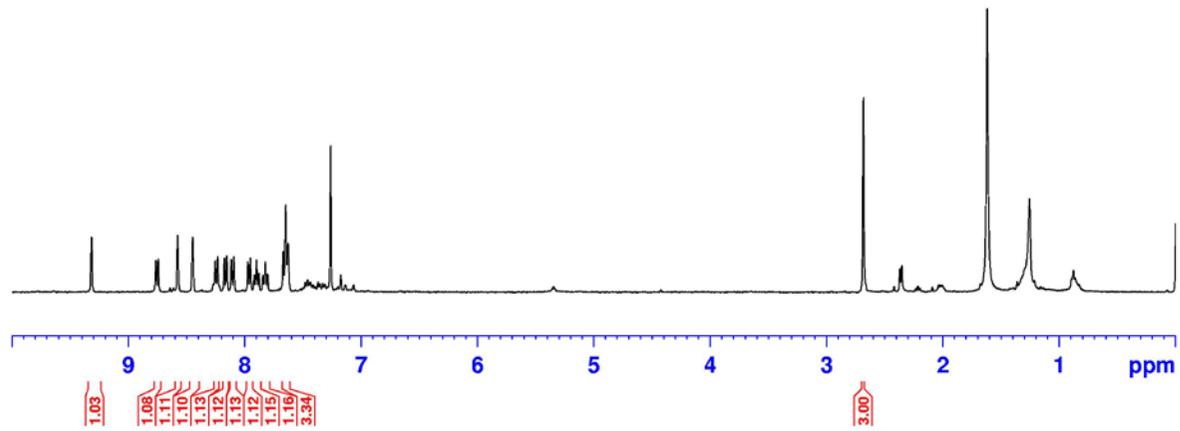
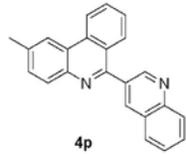
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL12W         13.02339381 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

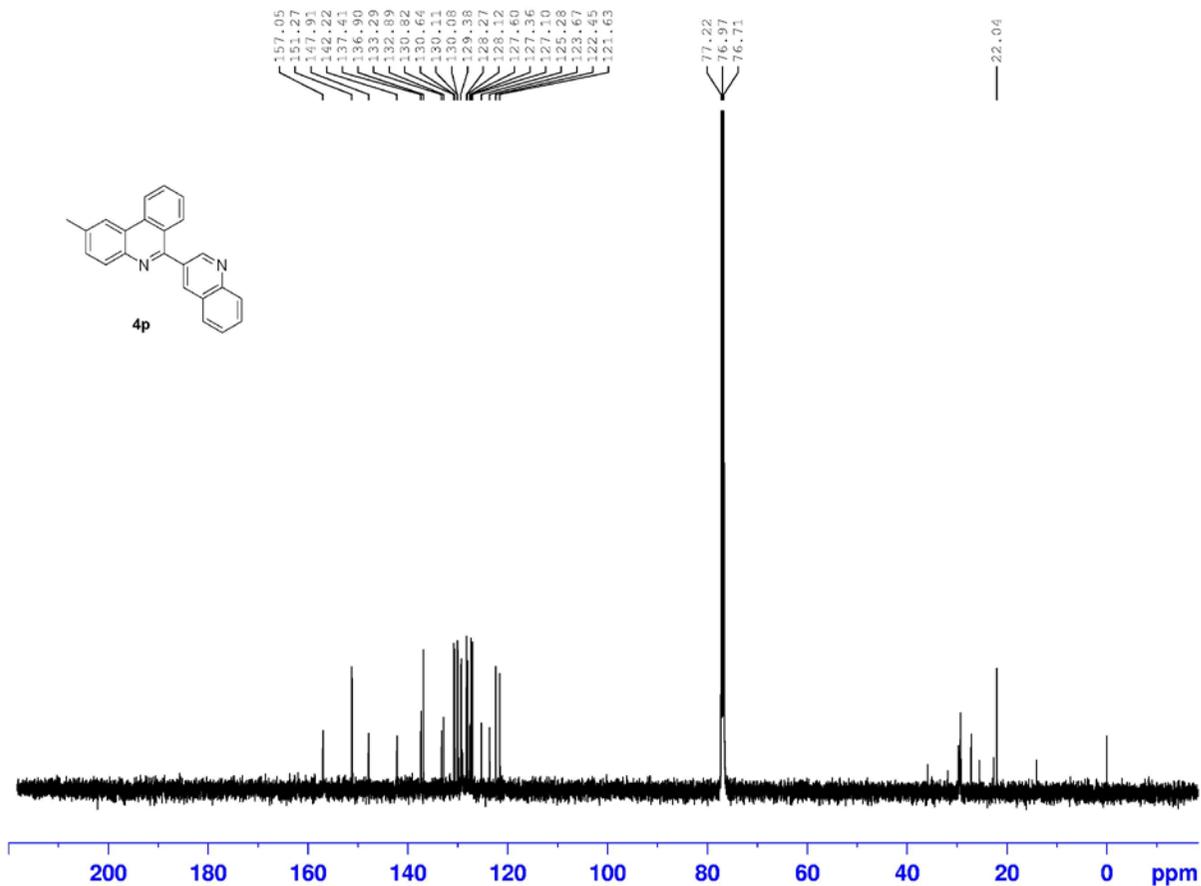
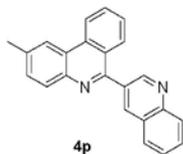


9.315
8.762
8.741
8.575
8.446
8.268
8.252
8.232
8.173
8.152
8.112
8.091
7.971
7.951
7.915
7.897
7.878
7.840
7.822
7.802
7.666
7.646
7.627
7.260



```
NAME          pnmr
EXPNO         31122
PROCNO        1
Date_         20130927
Time          20.45
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            322.5
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300095 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



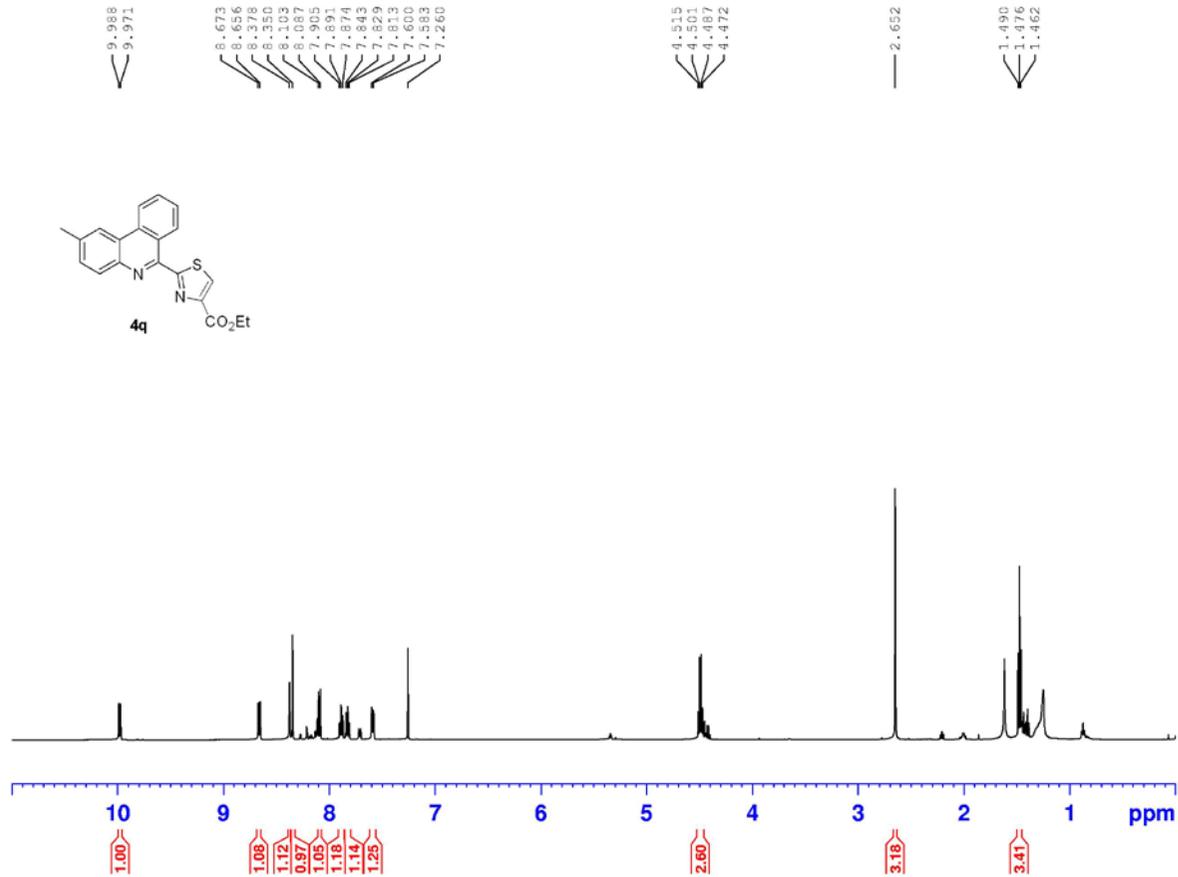
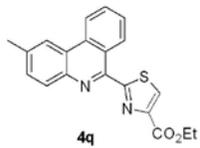
```

NAME          cnmr
EXPNO         31122
PROCNO        1
Date_         20131029
Time          3.54
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPRG        zgpg30
ID            65536
SOLVENT       CDCl3
NS            5120
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            297.2 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1Z          13.02339381 W
PL1ZW         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

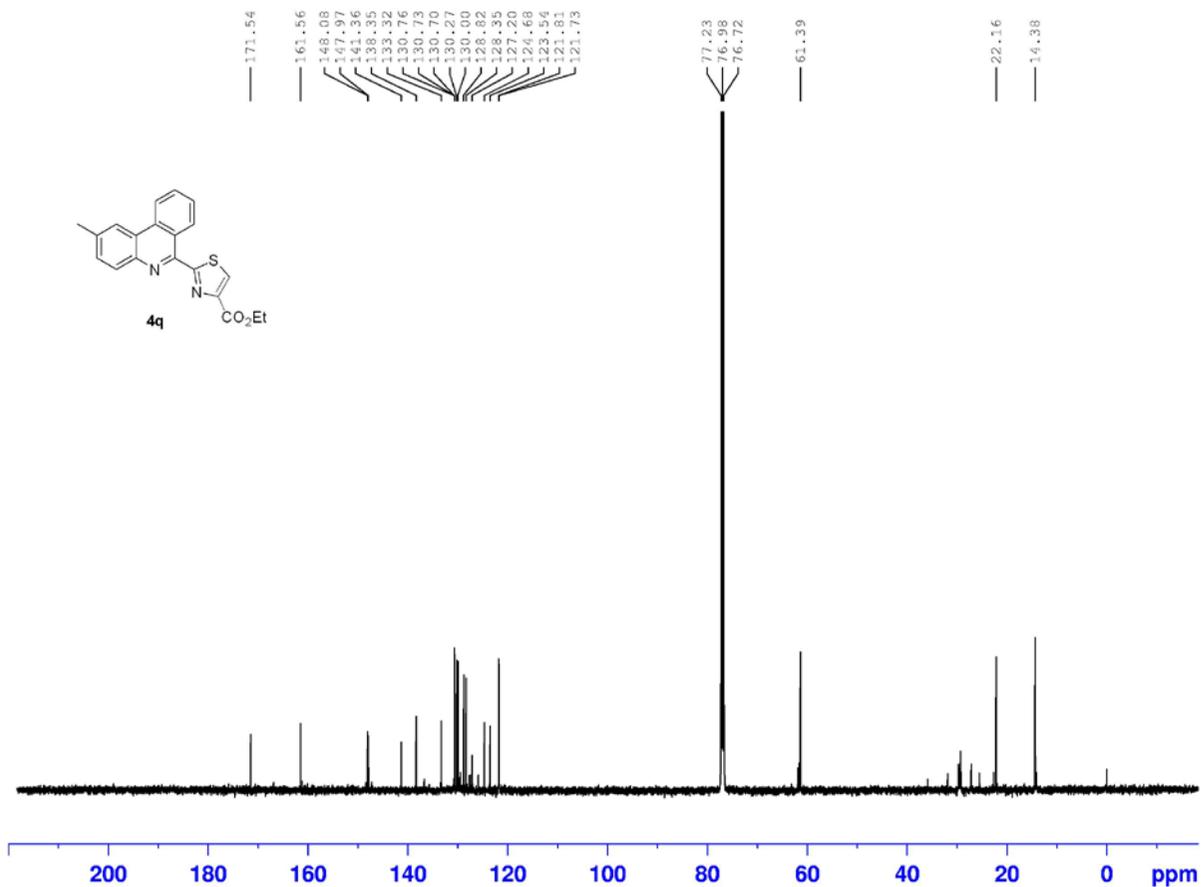
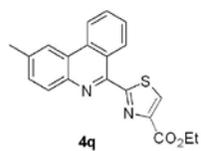


```

NAME          pnmr
EXPNO         31022
PROCNO        1
Date_         20131215
Time          23.36
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            1024
DS            2
SWH           10330.578 Hz
FIDRES        0.157632 Hz
AQ            3.171923 sec
RG            203
DW            48.400 usec
DE            6.50 usec
TE            293.4 K
D1            1.00000000 sec
TDO           1
  
```

```

===== CHANNEL f1 =====
NUC1          1H
P1            14.00 usec
PL1           2.50 dB
PL1W          13.02359581 W
SFO1          500.1330885 MHz
SI            32768
SF            500.1300223 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



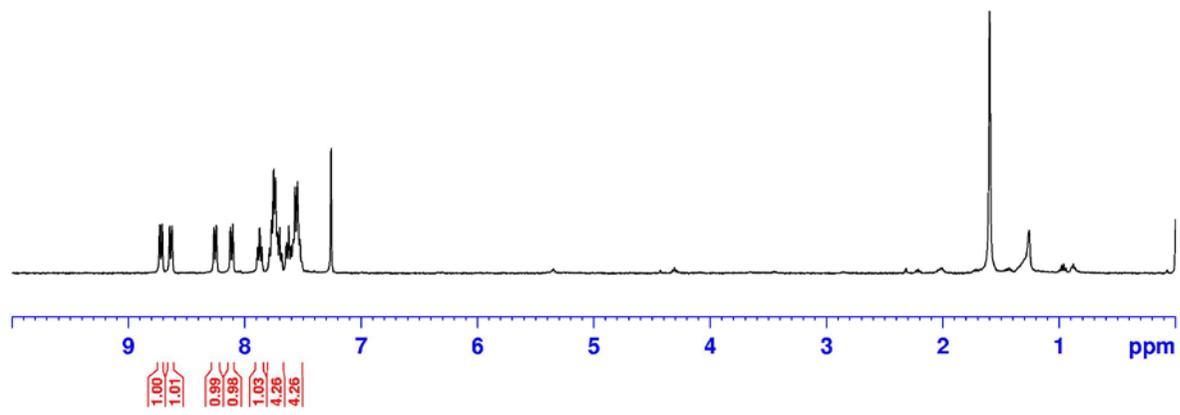
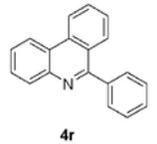
```
NAME          cmr
EXPNO         31022
PROCNO        1
Date_         20131215
Time          12.53
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            7168
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            295.3 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```

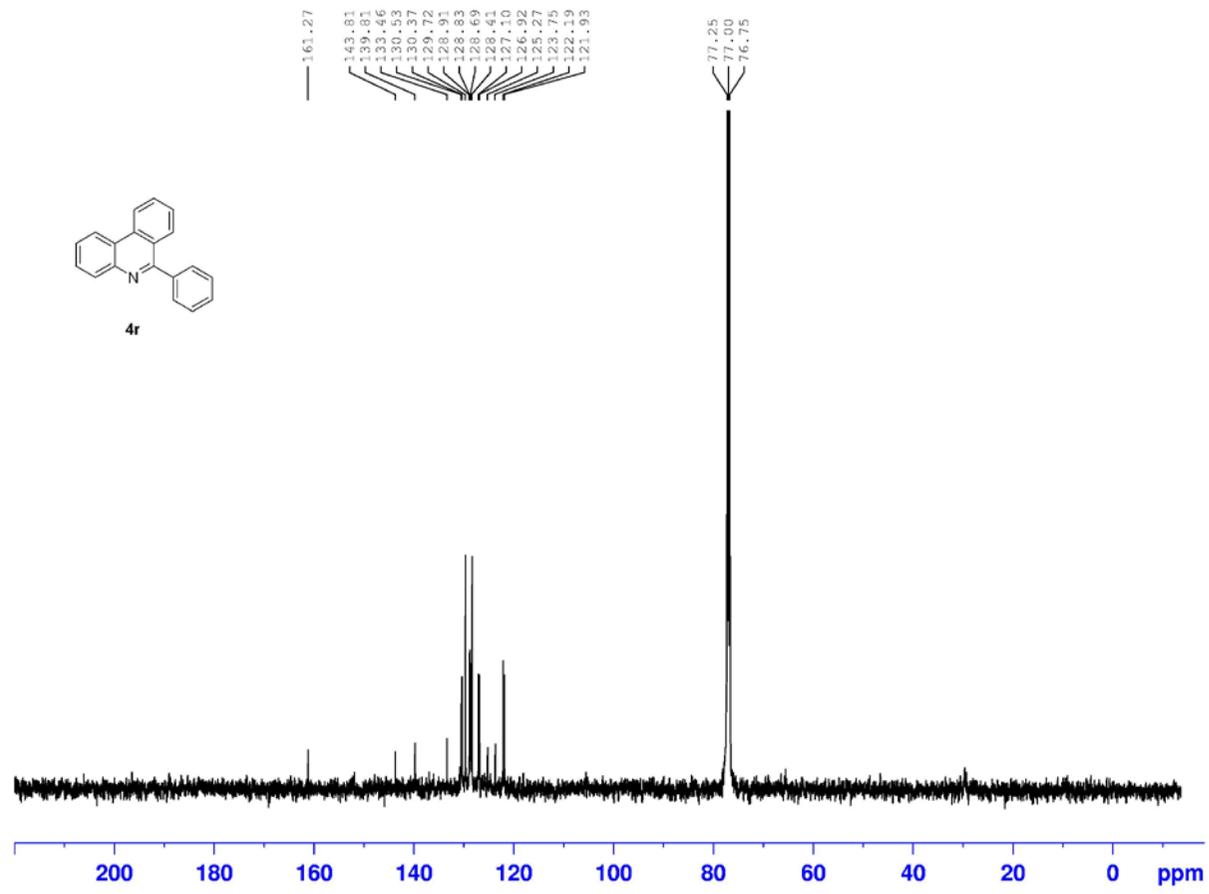
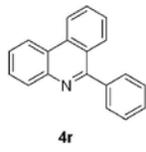


8.729
8.708
8.693
8.682
8.292
8.271
8.171
8.100
7.888
7.869
7.850
7.785
7.767
7.750
7.733
7.718
7.698
7.680
7.642
7.623
7.604
7.585
7.569
7.550
7.527
7.260



```
NAME          pnmr
EXPNO         3272
PROCNO        1
Date_         20131030
Time          21.44
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            297.7 K
D1            1.0000000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300095 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



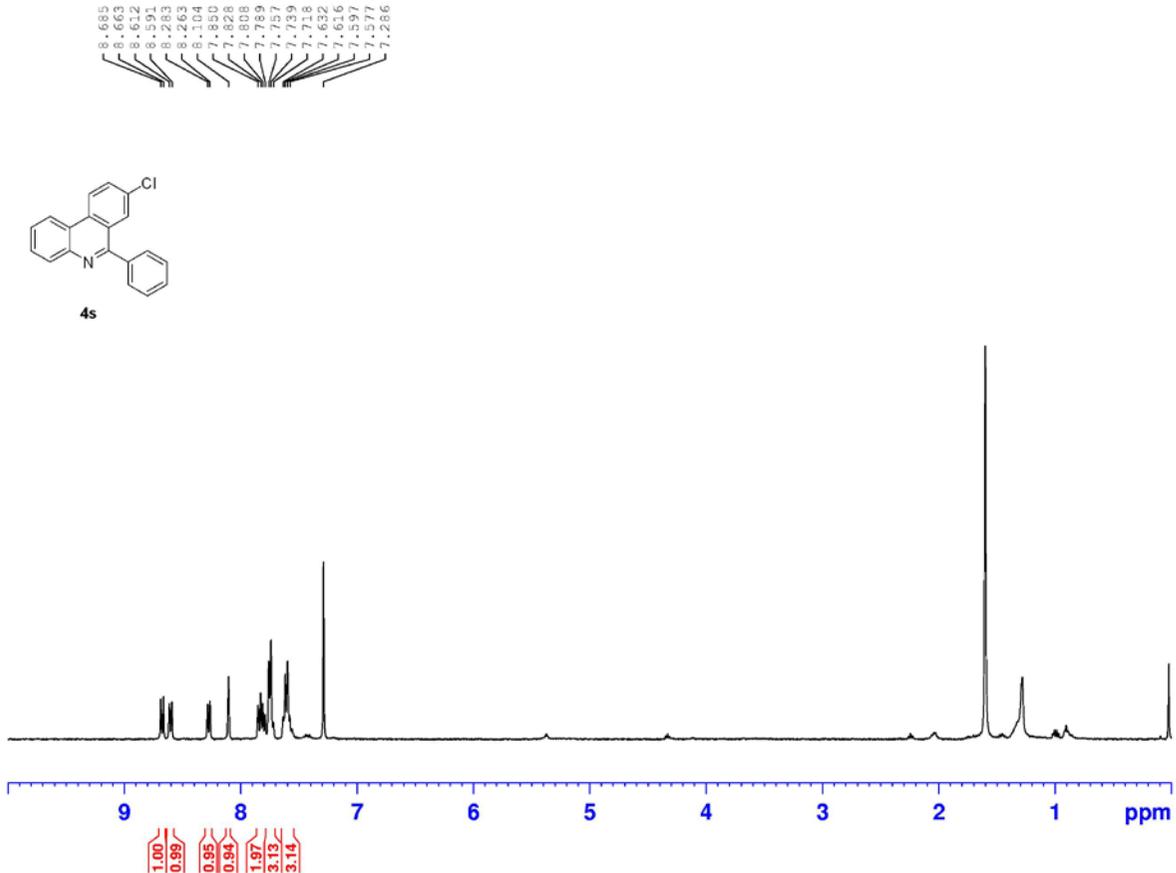
```

NAME          cmr
EXPNO         3272
PROCNO        1
Date_         20131107
Time          21:55
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       DMSO
NS            1024
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

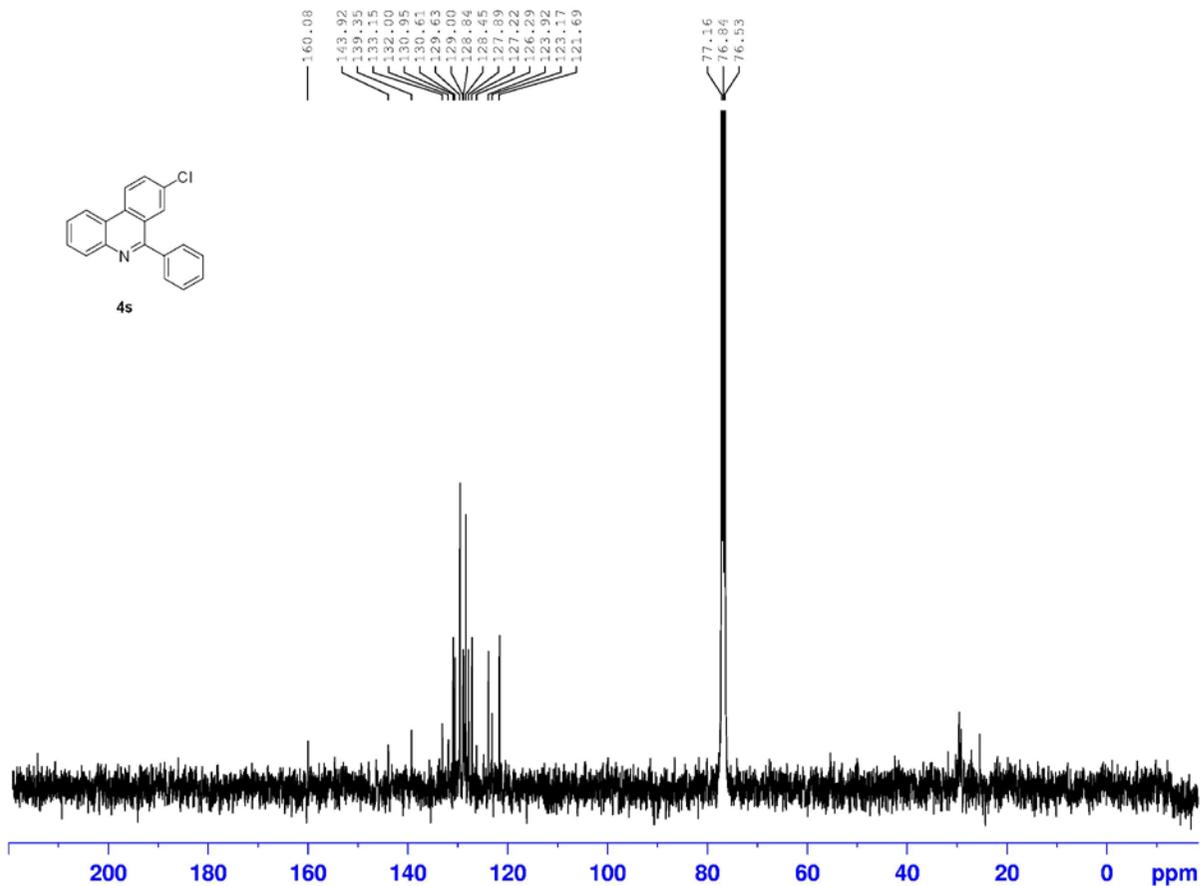
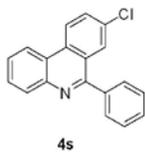
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1Z          13.02339381 W
PL1ZW         0.42143556 W
PL1ZW         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7571946 MHz
WDW           EM
SSB           0
LB            3.00 Hz
GB            0
PC            1.40

```



```
NAME          pnmr
EXPNO         3271
PROCNO        1
Date_         20131030
Time          15.17
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            456.1
DW            60.400 usec
DE            6.50 usec
TE            297.6 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1299991 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```

NAME          cmr
EXPNO         3271
PROCNO        1
Date_         20131112
Time          3.19
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            2048
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1149.4
DW            20.850 usec
DE            6.50 usec
TE            314.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

```

```

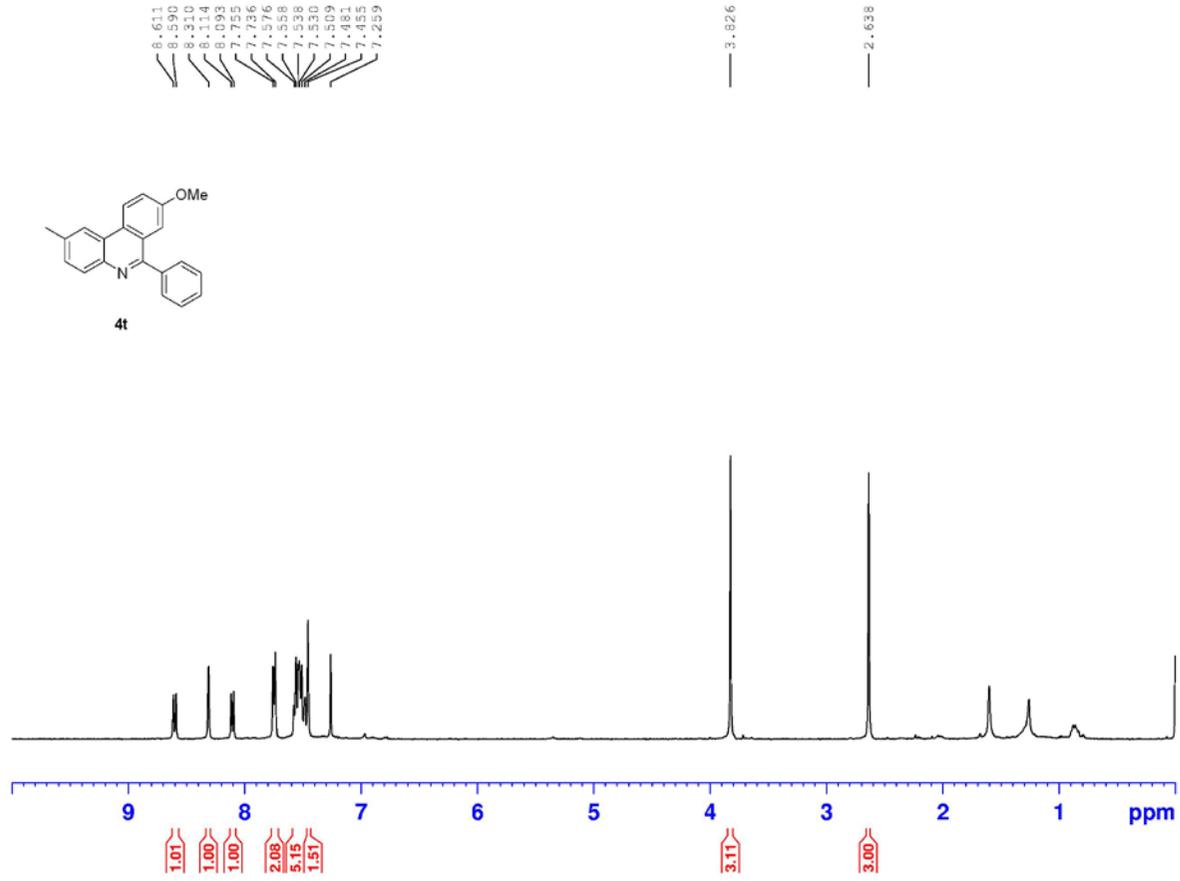
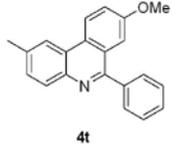
===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

```

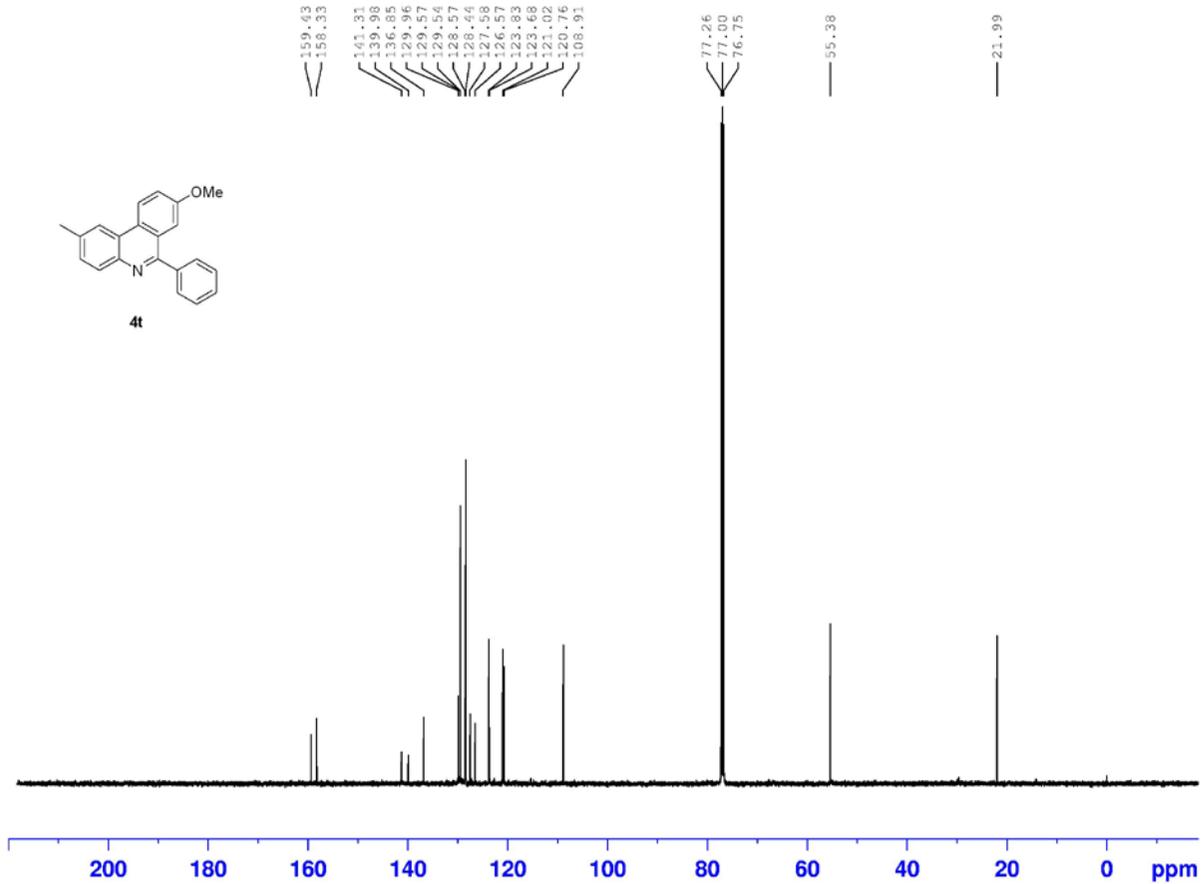
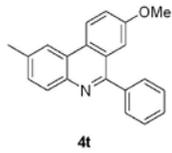
```

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13           0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            3.00 Hz
GB            0
PC            1.40

```



```
NAME          pnmr
EXPNO         3422
PROCNO        1
Date_         20131210
Time          14.45
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            322.5
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300097 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



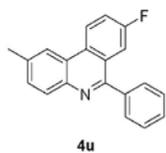
```

NAME          cmr
EXPNO         3422
PROCNO        1
Date_         20131213
Time         22.13
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1212
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320000 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



8.693
8.660
8.671
8.657
8.534
8.173
7.726
7.769
7.597
7.571
7.553
7.529
7.260

— 2.649

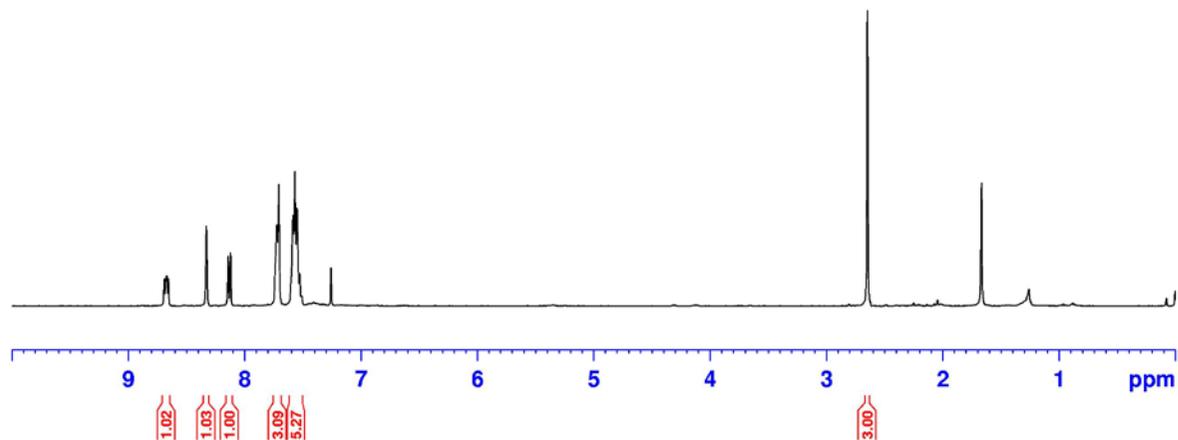


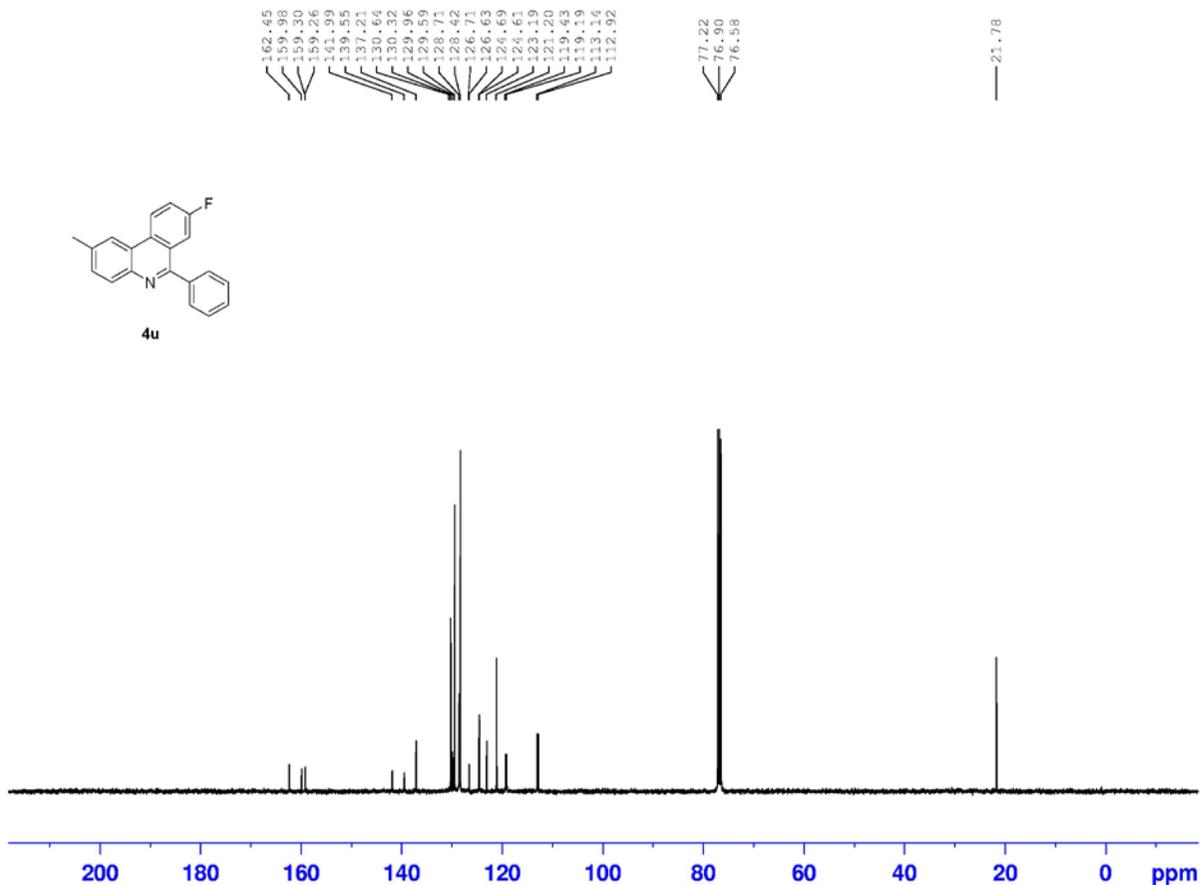
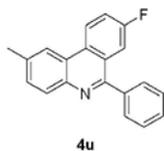
```

NAME          pnmr
EXPNO         3243
PROCNO        1
Date_         20131111
Time          12.27
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES       0.124314 Hz
AQ           3.9584243 sec
RG           256
DW           60.400 usec
DE           6.50 usec
TE           297.7 K
D1           1.00000000 sec
TDO          1
  
```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W         10.87646866 W
SFO1         400.1324710 MHz
SI           32768
SF           400.1300097 MHz
WDW           EM
SSB           0
LB           0.30 Hz
GB           0
PC           1.00
  
```





```

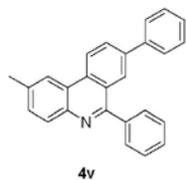
NAME          cmr
EXPNO         3243
PROCNO        1
Date_         20131112
Time         7.30
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPRG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            2048
DS            4
SWH           23900.814 Hz
FIDRES       0.365918 Hz
AQ            1.3664756 sec
RG            1149.4
DW            20.850 usec
DE            6.50 usec
TE            313.8 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1
  
```

```

===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz
  
```

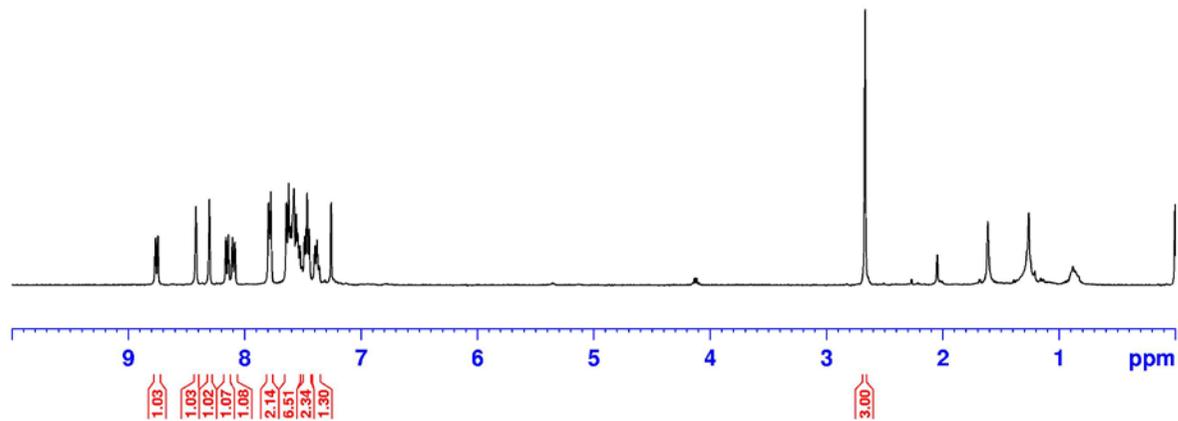
```

===== CHANNEL f2 =====
CPDPRG2      waltz16
NUC2          1H
PCPD2        80.00 usec
PL2           0.00 dB
PL12         16.07 dB
PL13           0.00 dB
PL2W         10.87646866 W
PL12W        0.26883632 W
PL13W        10.87646866 W
SFO2         400.1316005 MHz
SI            32768
SF           100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



8.765
8.743
8.418
8.302
8.139
8.139
8.104
8.083
7.792
7.774
7.639
7.621
7.605
7.574
7.556
7.536
7.524
7.506
7.484
7.469
7.399
7.330
7.322
7.280

— 2.670

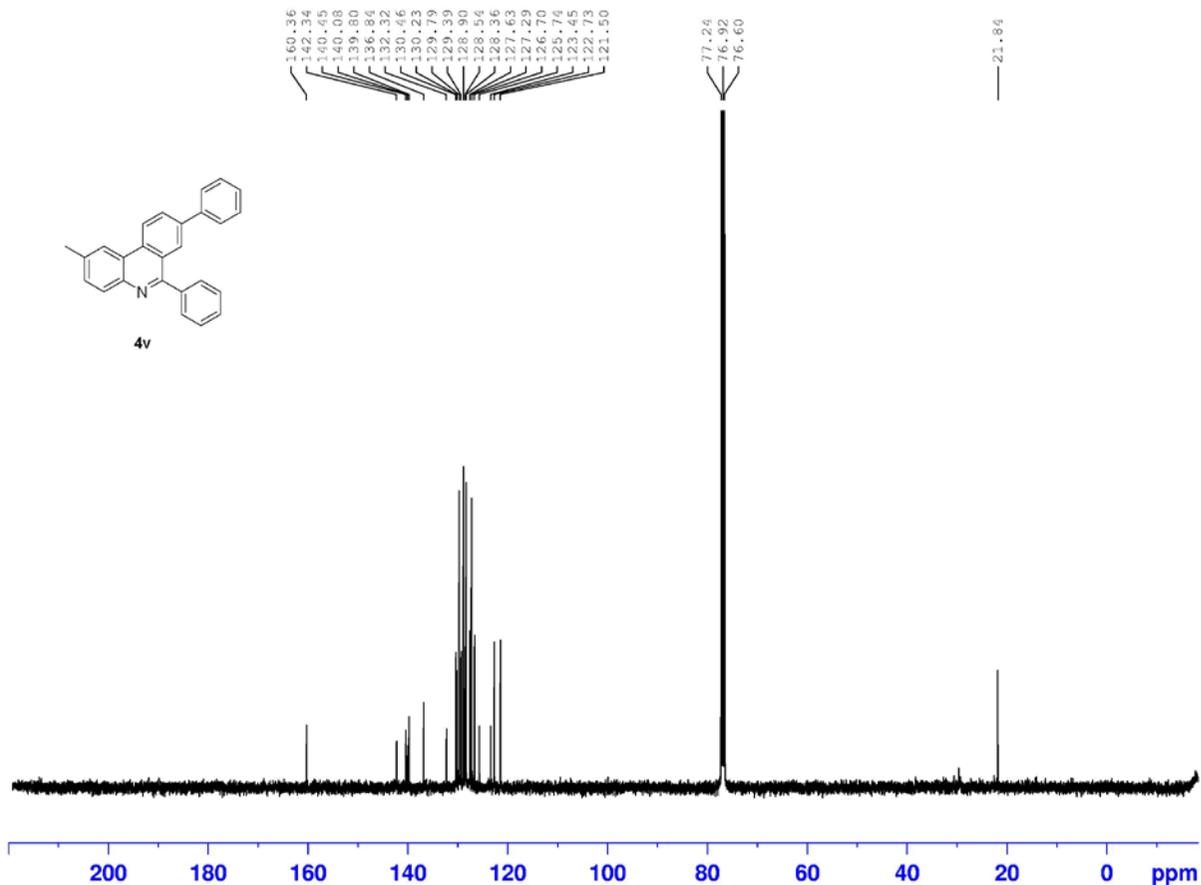
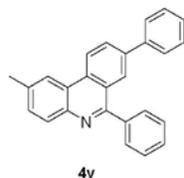


```

NAME          pnmr
EXPNO         334
PROCNO        1
Date_         20131119
Time          9.42
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            322.5
DW            60.400 usec
DE            6.50 usec
TE            296.8 K
D1            1.0000000 sec
TDO           1
  
```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300098 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



```

NAME          cnmr
EXPNO         334
PROCNO        1
Date_         20131119
Time          21.52
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1149.4
DW            20.850 usec
DE            6.50 usec
TE            312.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TDO           1

```

```

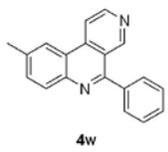
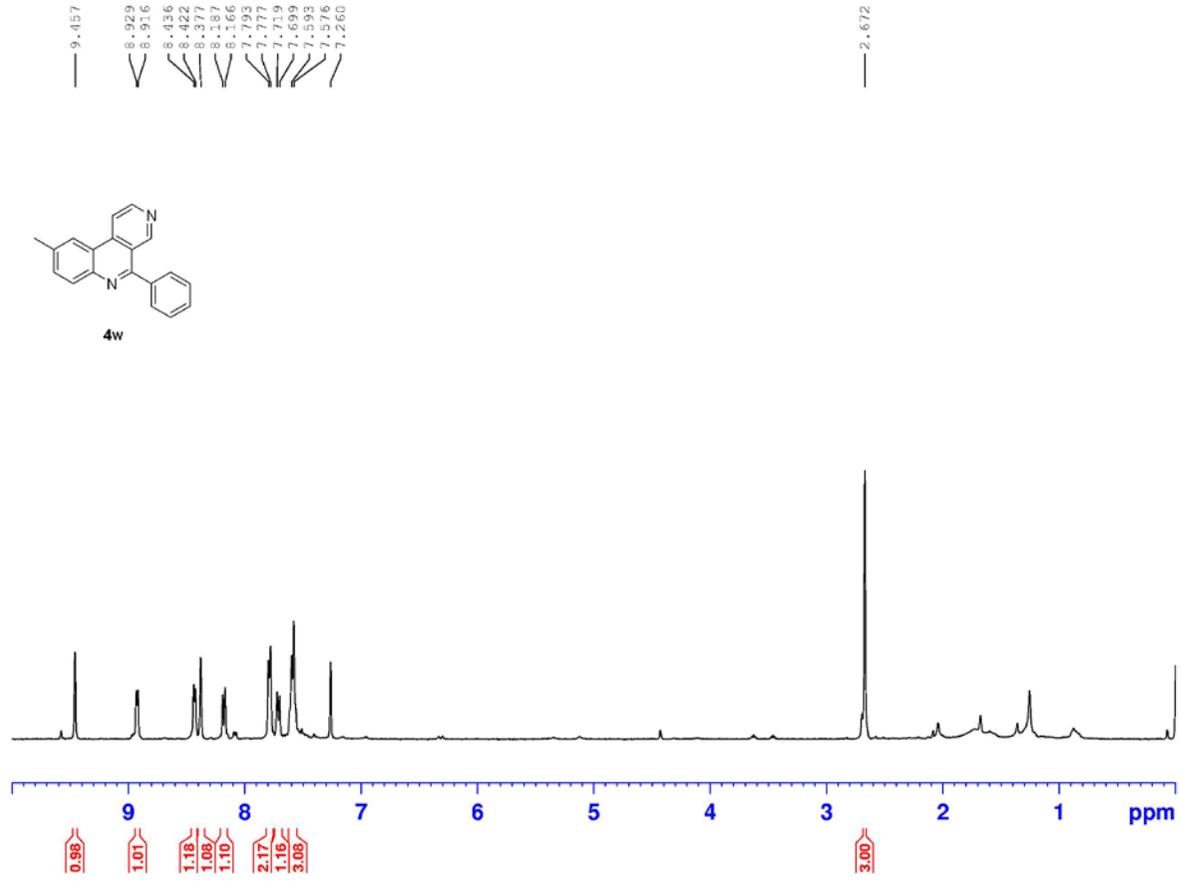
===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

```

```

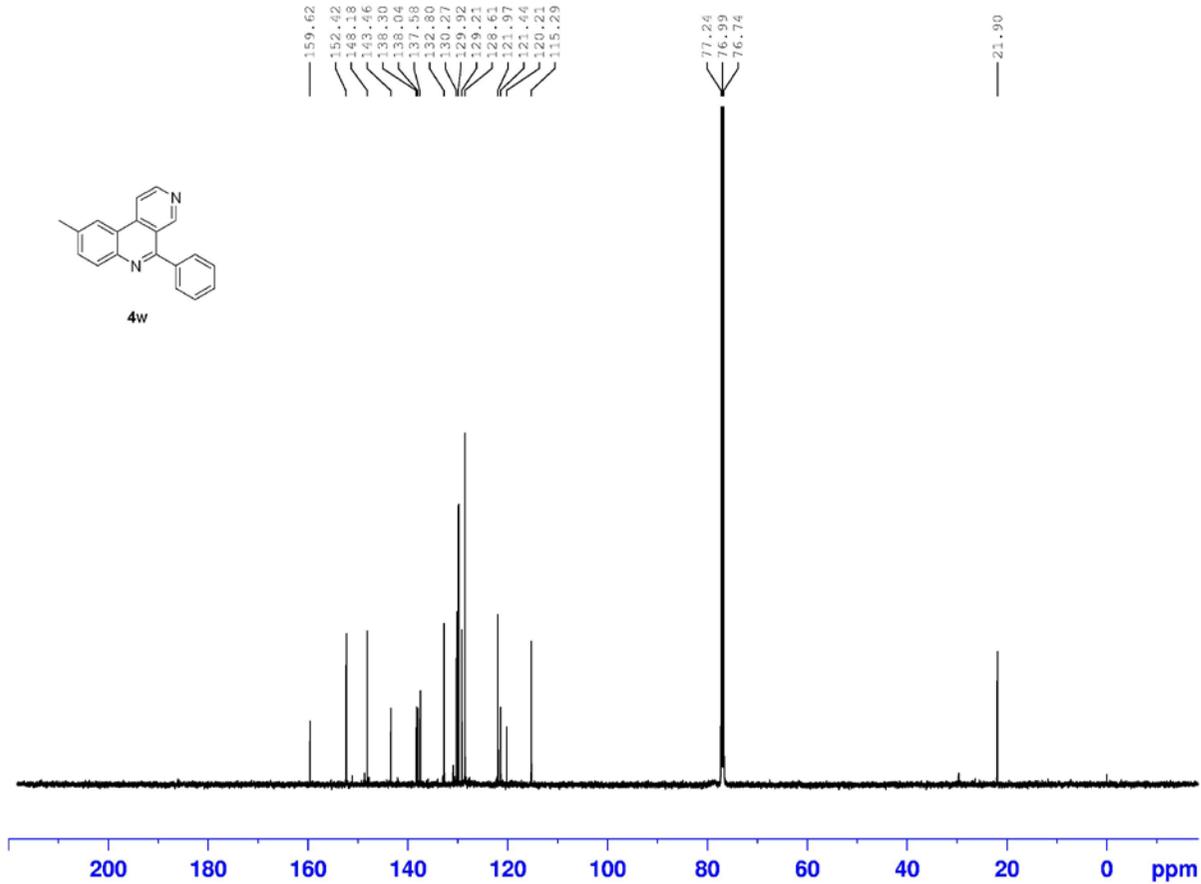
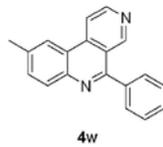
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13          0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



```
NAME          pnmr
EXPNO         3352
PROCNO        1
Date_         20131115
Time          20.00
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            297.1 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300097 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```

NAME          cmr
EXPNO         3352
PROCNO        1
Date_         20131118
Time         3.07
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            3600
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            296.3 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

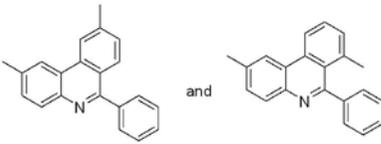
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

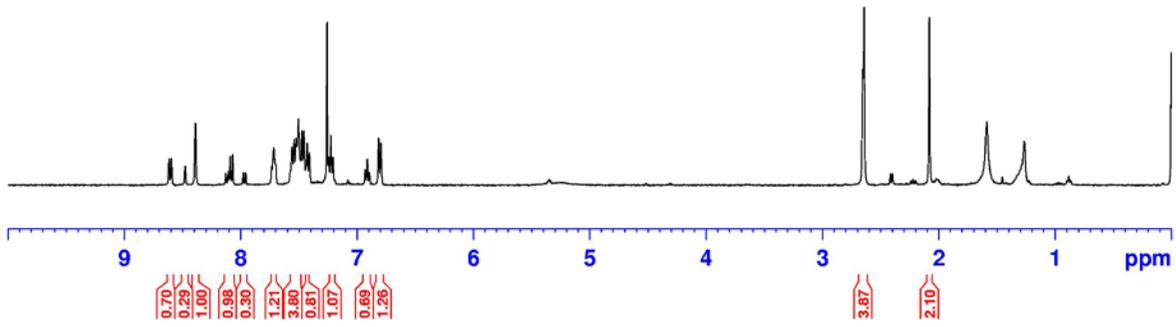


8.615
8.594
8.476
8.387
8.129
8.109
8.092
8.071
7.981
7.960
7.736
7.718
7.709
7.561
7.542
7.524
7.506
7.476
7.459
7.441
7.430
7.412
7.260
7.245
7.227
7.208
6.982
6.964
6.946
6.737



4x / 4x' = 2.4:1

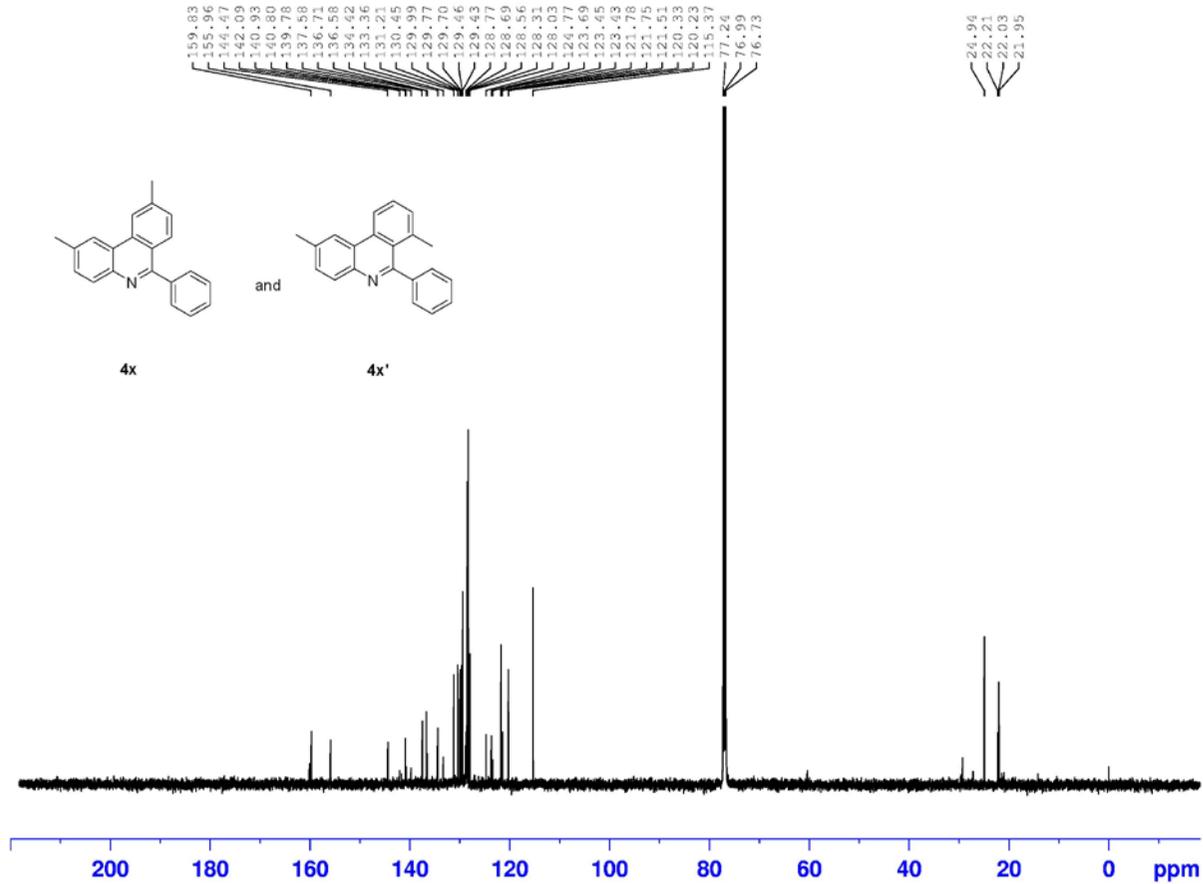
2.65
2.64
2.083

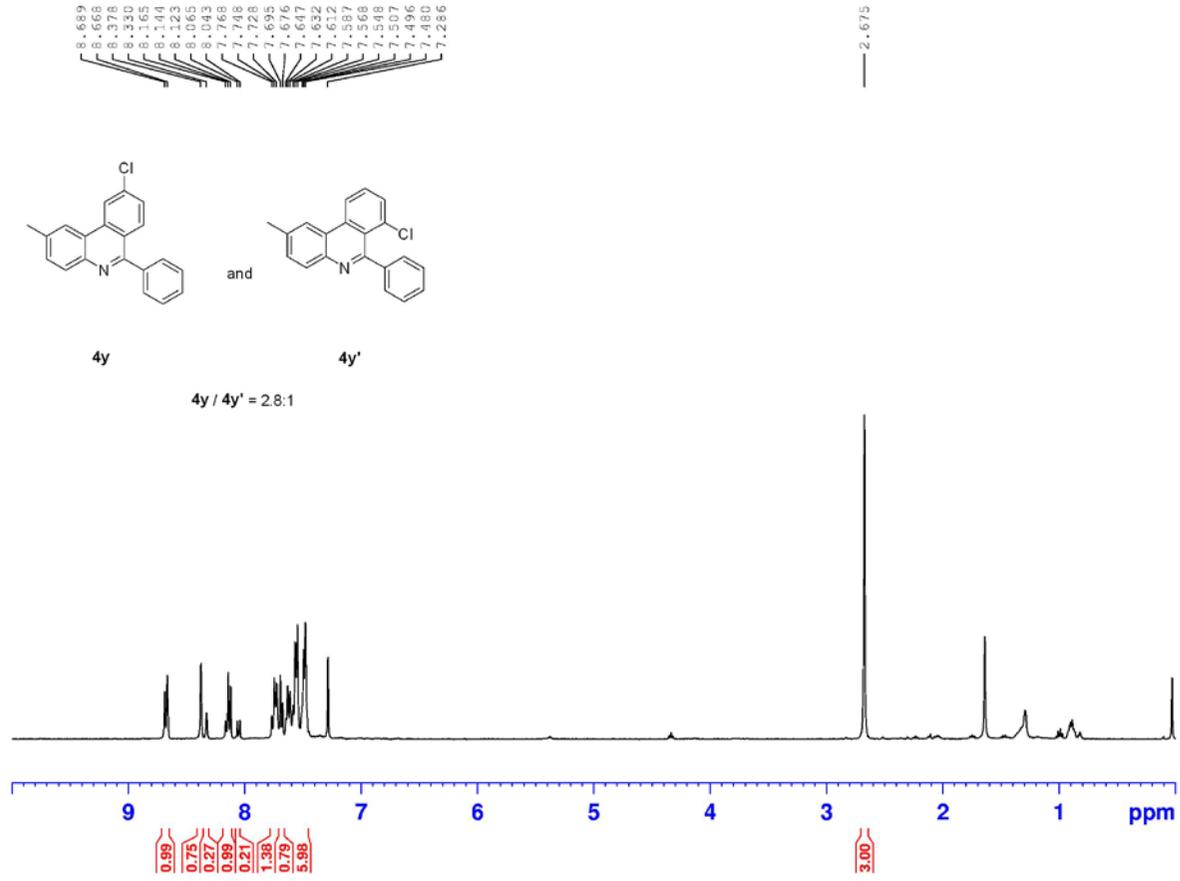


```

NAME          pnmr
EXPNO         37011
PROCNO        1
Date_         20140120
Time          19.31
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            299.7 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300093 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



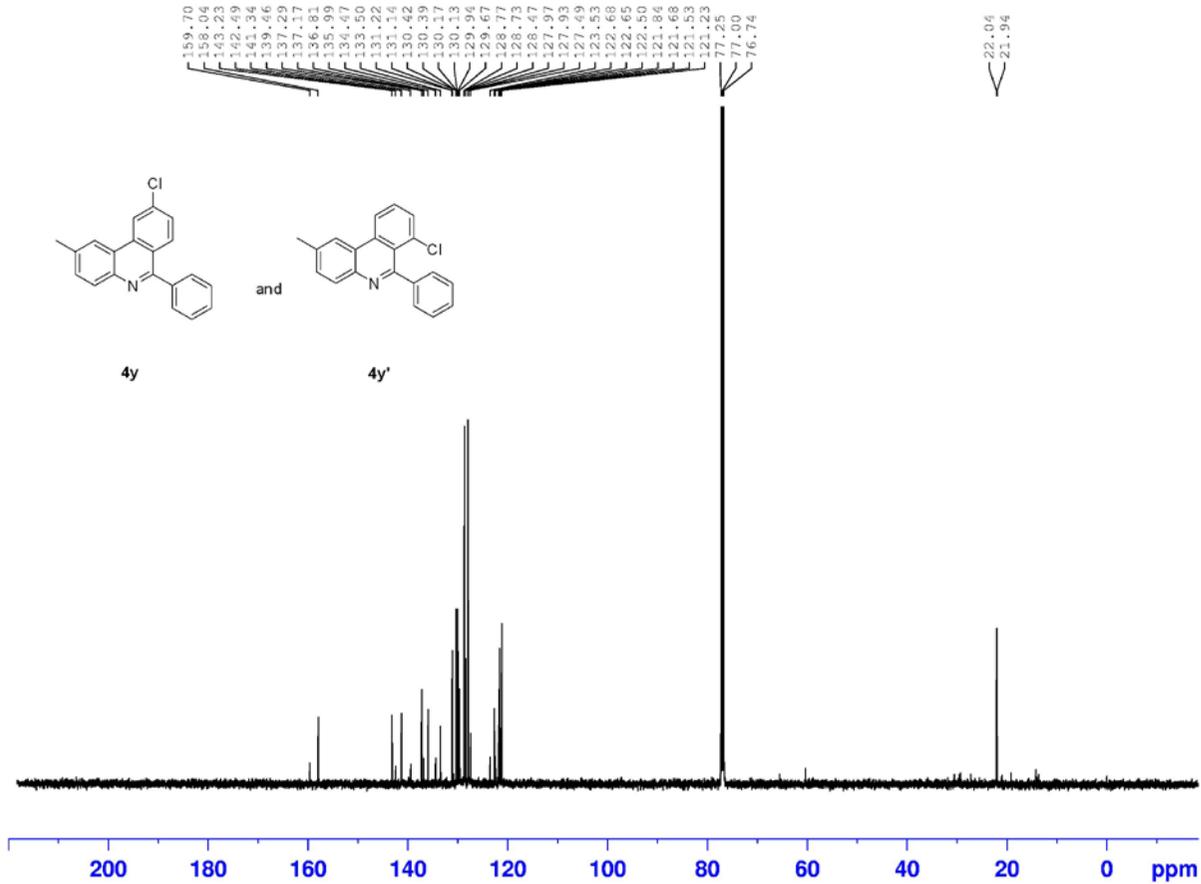


```

NAME          pnmr
EXPNO         37021
PROCNO        1
Date_         20140120
Time          19.38
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            299.0 K
D1            1.00000000 sec
TDO           1
  
```

```

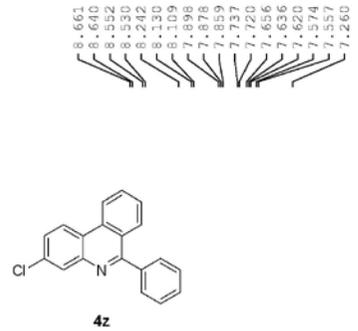
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W         10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1299991 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



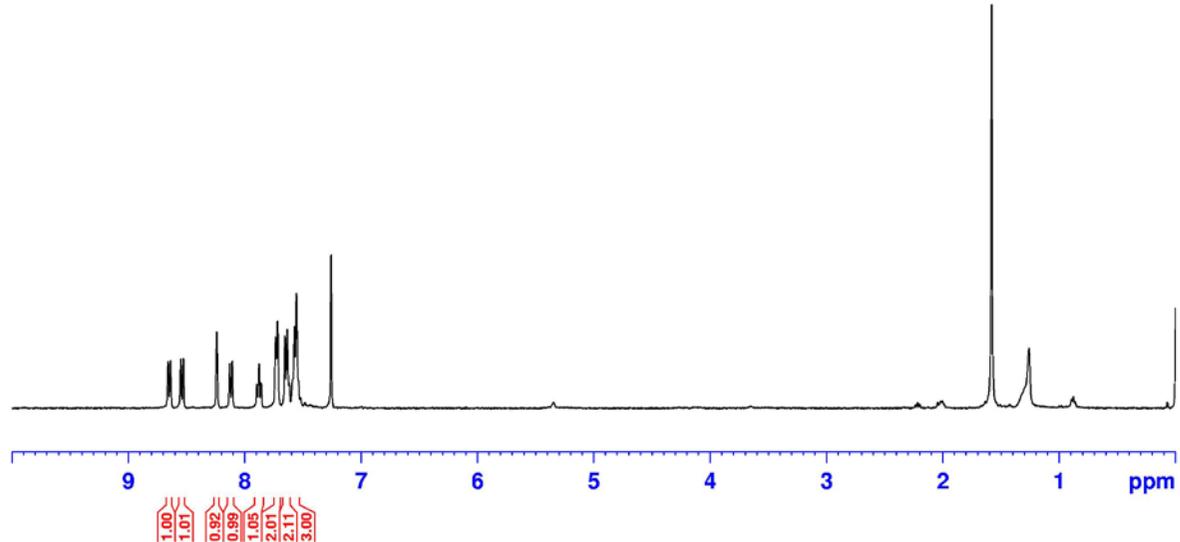
```
NAME          cmmr
EXPNO         37021
PROCNO        1
Date_         20140123
Time         20.30
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

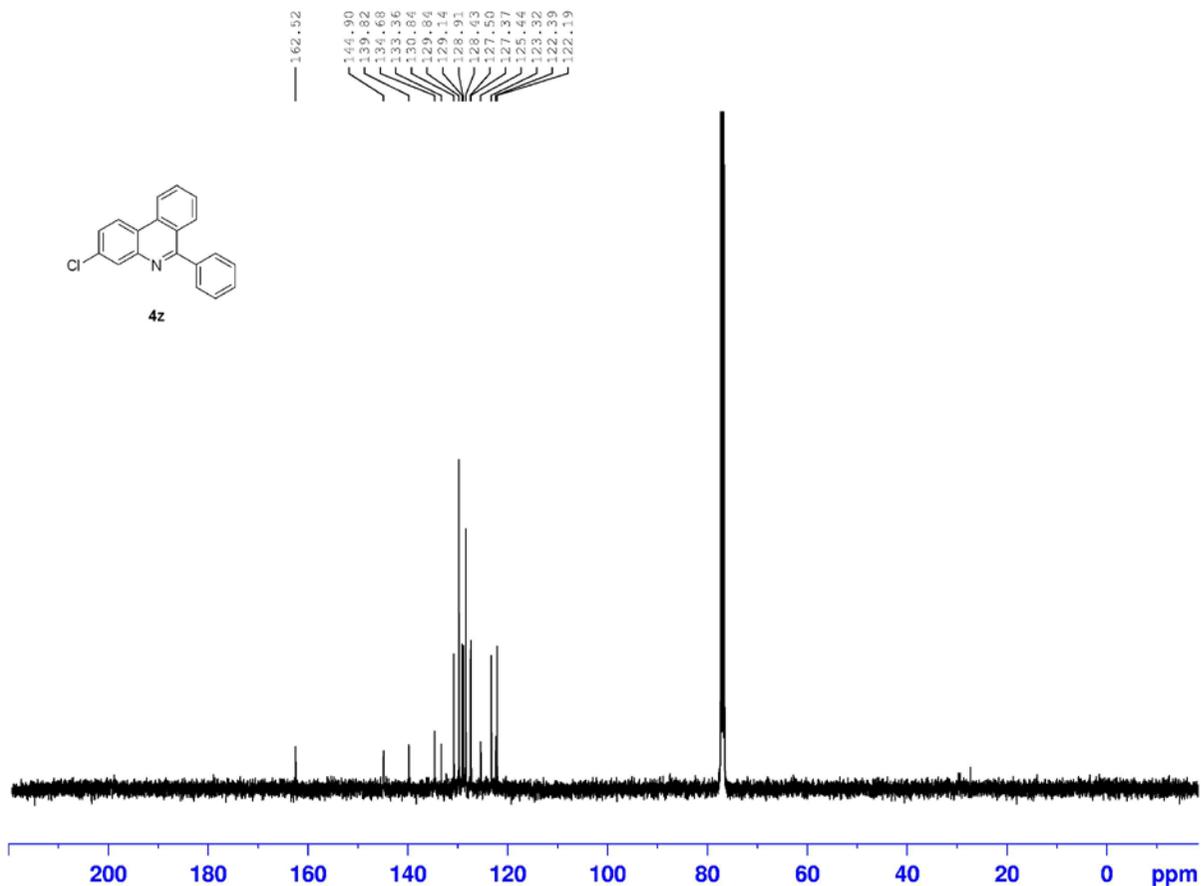
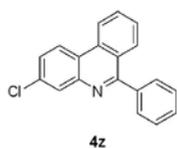
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL12W         13.02339381 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



8.661
8.640
8.552
8.530
8.242
8.130
8.109
7.898
7.878
7.859
7.737
7.720
7.656
7.636
7.620
7.574
7.557
7.260



```
NAME          pnmr
EXPNO         3274
PROCNO        1
Date_         20131031
Time          18.35
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            456.1
DW            60.400 usec
DE            6.50 usec
TE            297.6 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300099 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



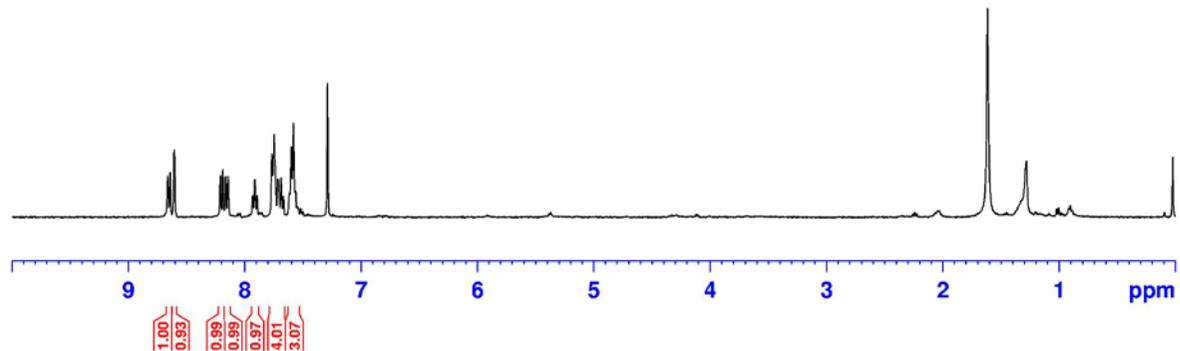
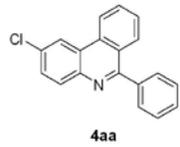
```
NAME          cmr
EXPNO         3274
PROCNO        1
Date_         20131112
Time          5.25
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            2048
DS            4
SWH           23900.814 Hz
FIDRES       0.365918 Hz
AQ           1.3664756 sec
RG            1625.0
DW           20.850 usec
DE            6.50 usec
TE            314.7 K
D1           2.0000000 sec
D11          0.0300000 sec
TDD           1
```

```
===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W         38.68305206 W
SFO1         100.6228298 MHz
```

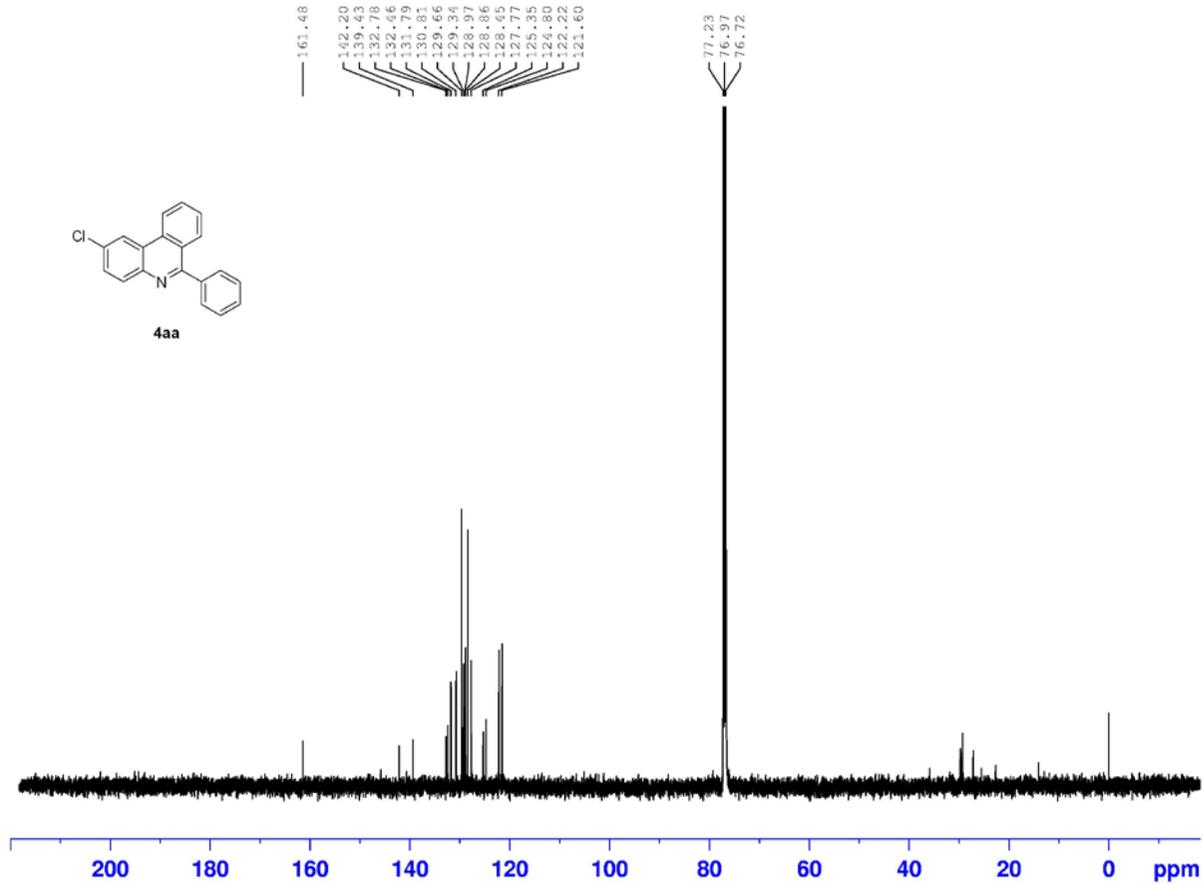
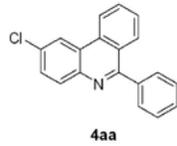
```
===== CHANNEL f2 =====
CPDPRG2      waltz16
NUC2          1H
PCPD2        80.00 usec
PL2           0.00 dB
PL12         16.07 dB
PL13           0.00 dB
PL2W         10.87646866 W
PL12W        0.26883632 W
PL13W        10.87646866 W
SFO2         400.1316005 MHz
SI            32768
SF           100.6127535 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



8.661
8.640
8.604
8.208
8.186
8.160
8.140
7.930
7.911
7.891
7.764
7.746
7.713
7.684
7.666
7.612
7.597
7.579
7.561
7.286



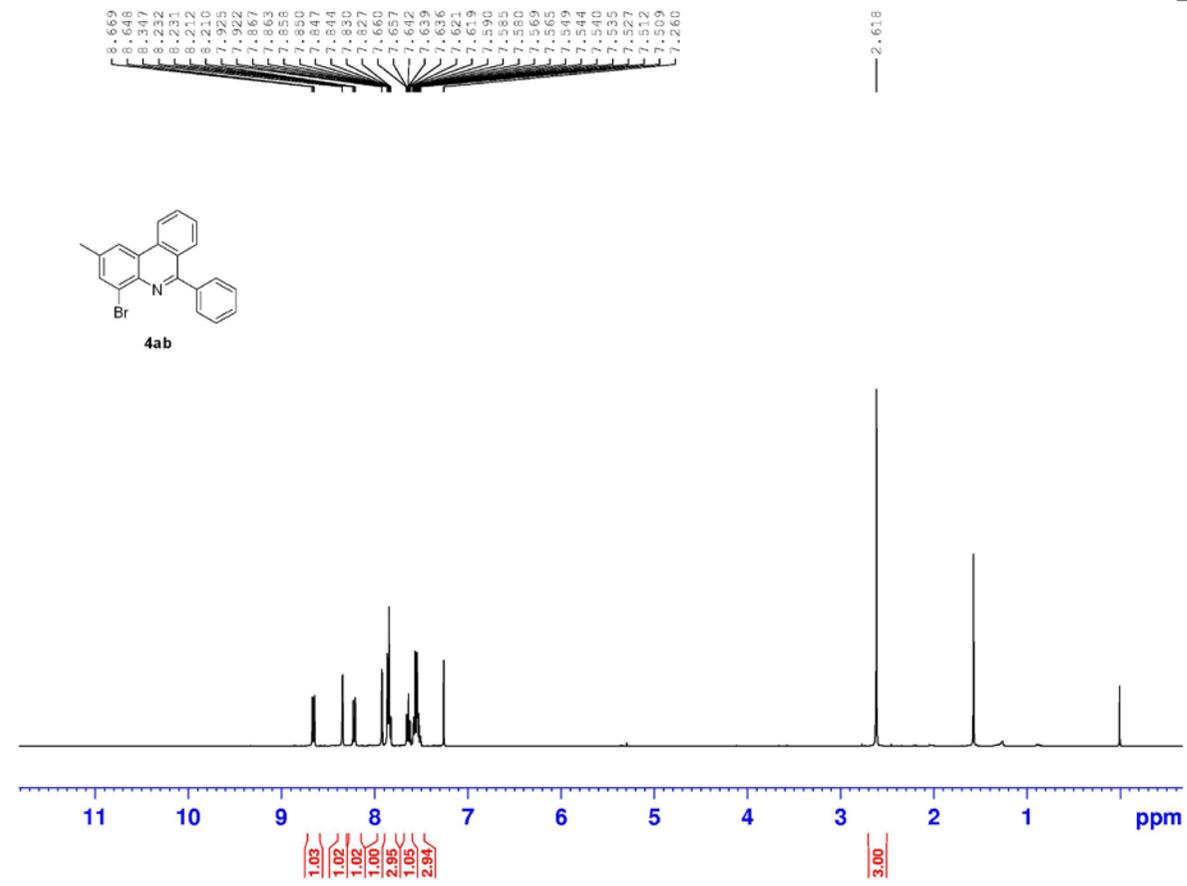
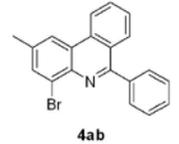
```
NAME          pnmr
EXPNO         3273
PROCNO        1
Date_         20131031
Time          10.21
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            297.5 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1299991 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



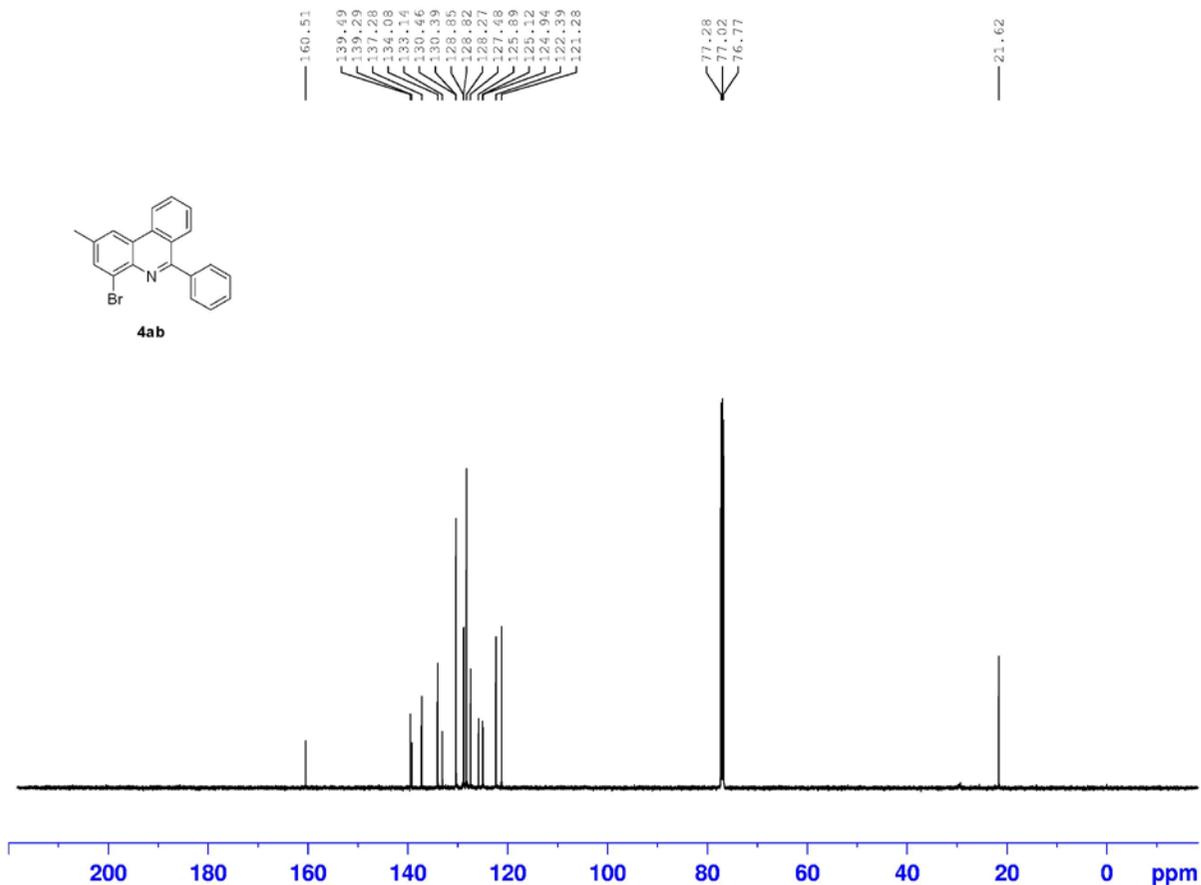
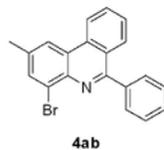
```
NAME          cmr
EXPNO         3273
PROCNO        1
Date_         20131215
Time          19.51
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            3072
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            295.7 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1Z          13.02339381 W
PL1ZW         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



```
NAME                pnmr
EXPNO                10
PROCNO               1
Date_                20140417
Time                10.13
INSTRUM              spect
PROBHD               5 mm DUL 13C-1
PULPROG              zg30
TD                   65536
SOLVENT              CDCl3
NS                   8
DS                   2
SWH                  8278.146 Hz
FIDRES              0.124314 Hz
AQ                   3.9584243 sec
RG                   256
DW                   60.400 usec
DE                   6.50 usec
TE                   298.7 K
D1                   1.00000000 sec
TD0                  1
***** CHANNEL f1 *****
NUC1                 1H
P1                   12.58 usec
PL1                  0.00 dB
PL1W                 10.87646866 W
SFO1                 400.1324710 MHz
SI                   32768
SF                   400.1300093 MHz
WDW                  EM
SSB                  0
LB                   0.30 Hz
GB                   0
PC                   1.00
```



```

NAME          cnmr
EXPNO         36132
PROCNO        1
Date_         20140123
Time         19.27
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPRG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

```

```

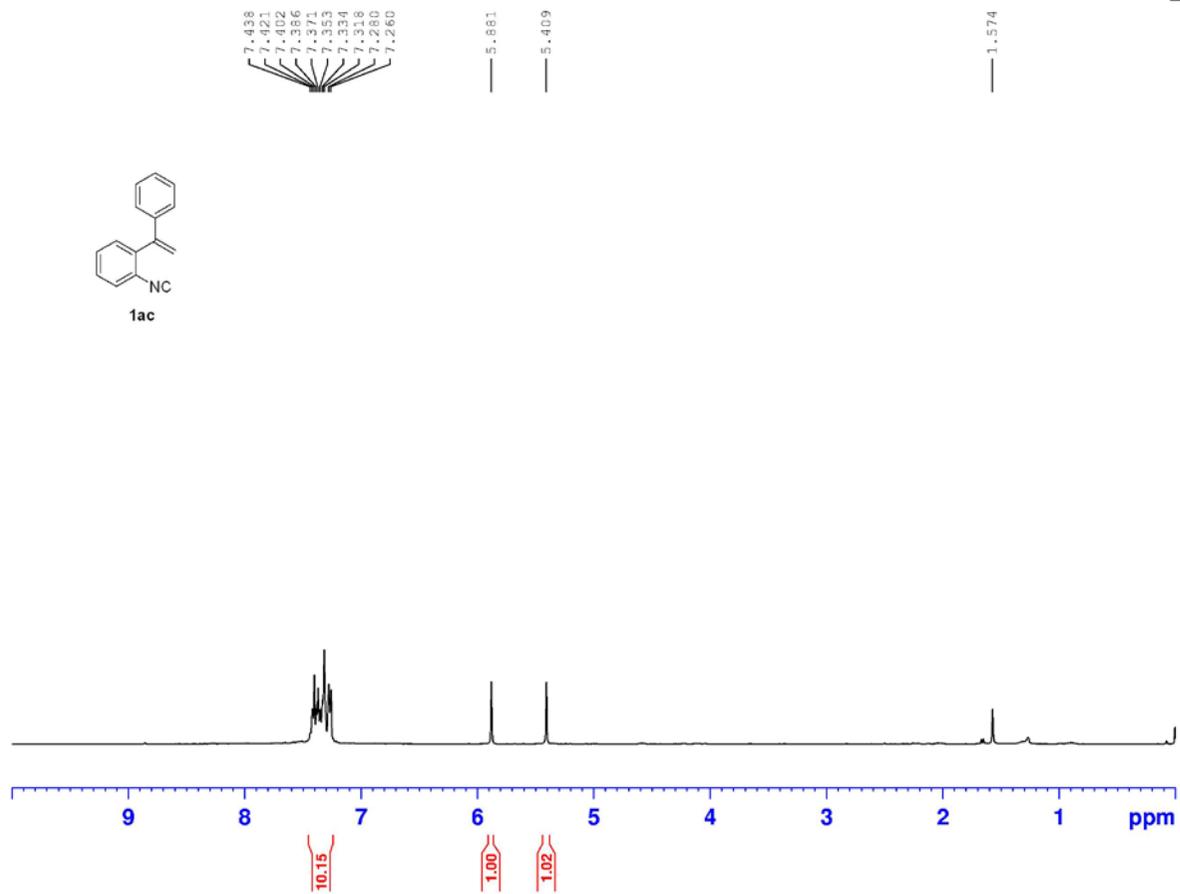
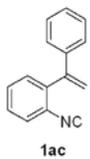
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

```

```

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320000 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

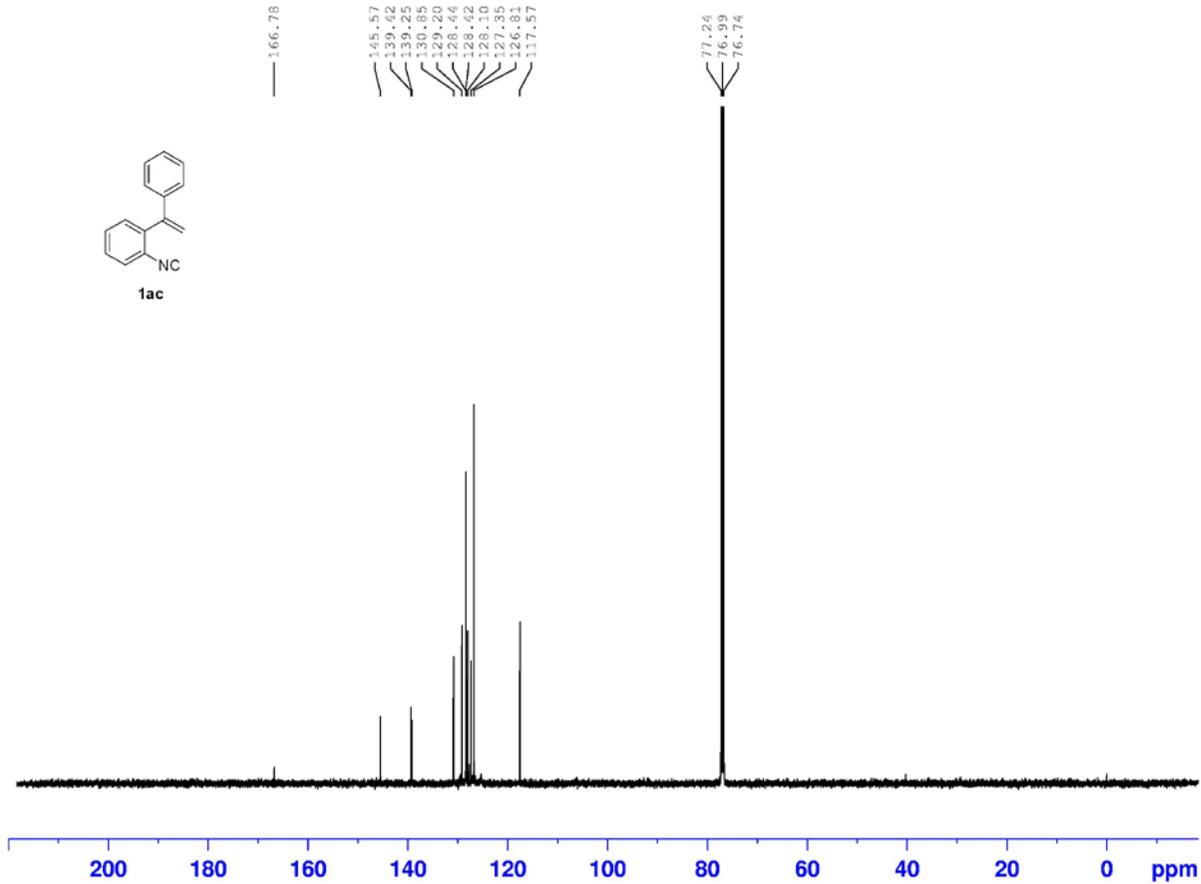
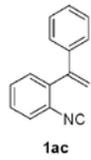


```

NAME          pnmr
EXPNO         3502
PROCNO        1
Date_         20140110
Time          22.47
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            256
DW            60.400 usec
DE            6.50 usec
TE            297.0 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300104 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

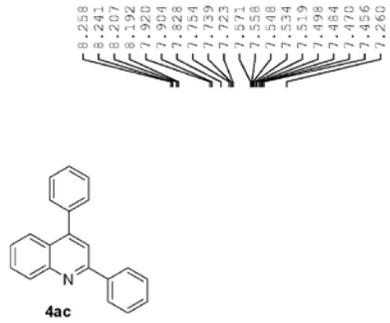
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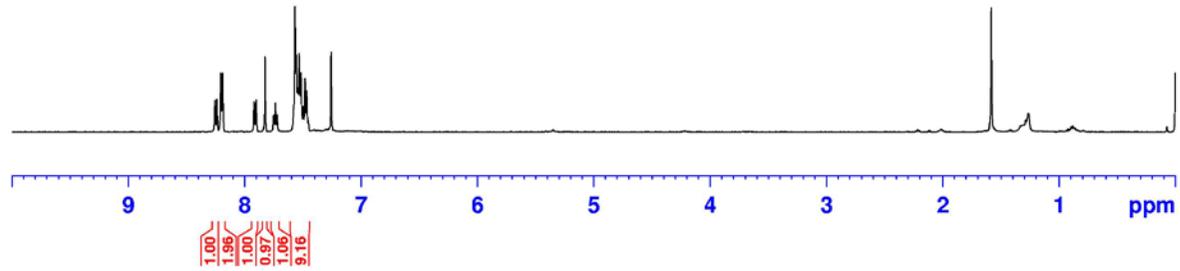
```
NAME          cmr
EXPNO         3502
PROCNO        1
Date_         20140114
Time          17.47
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```

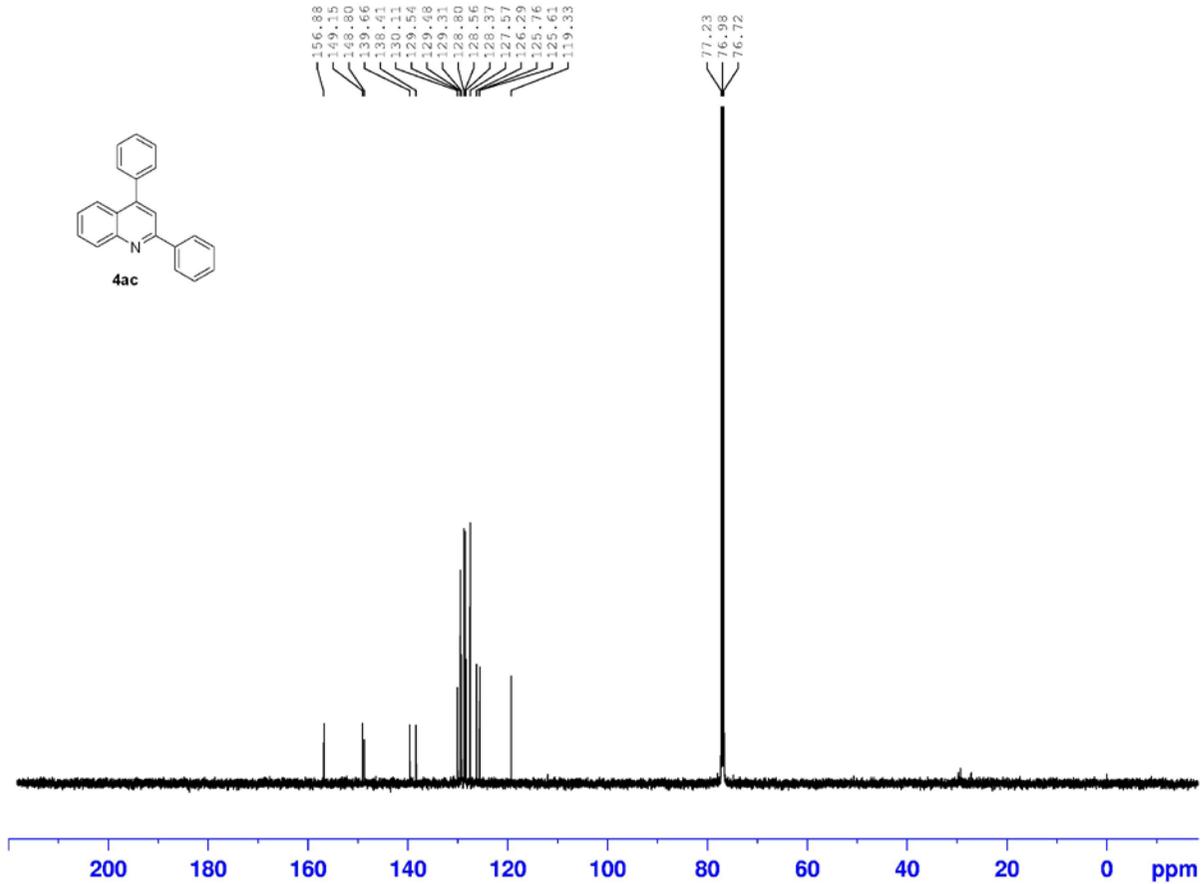
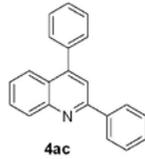


8.288
8.281
8.207
8.192
7.920
7.904
7.868
7.754
7.739
7.722
7.546
7.538
7.524
7.519
7.498
7.484
7.470
7.456
7.280



```
NAME          pnmr
EXPNO         36112
PROCNO        1
Date_         20140111
Time          18.24
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           10330.578 Hz
FIDRES        0.157632 Hz
AQ            3.171923 sec
RG            203
DW            48.400 usec
DE            6.50 usec
TE            298.1 K
D1            1.00000000 sec
TDO           1

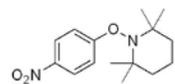
===== CHANNEL f1 =====
NUC1          1H
P1            14.00 usec
PL1           2.50 dB
PL1W          13.02359581 W
SFO1          500.1330885 MHz
SI            32768
SF            500.1300218 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```
NAME          cmr
EXPNO         36112
PROCNO        1
Date_         20140114
Time          3.47
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

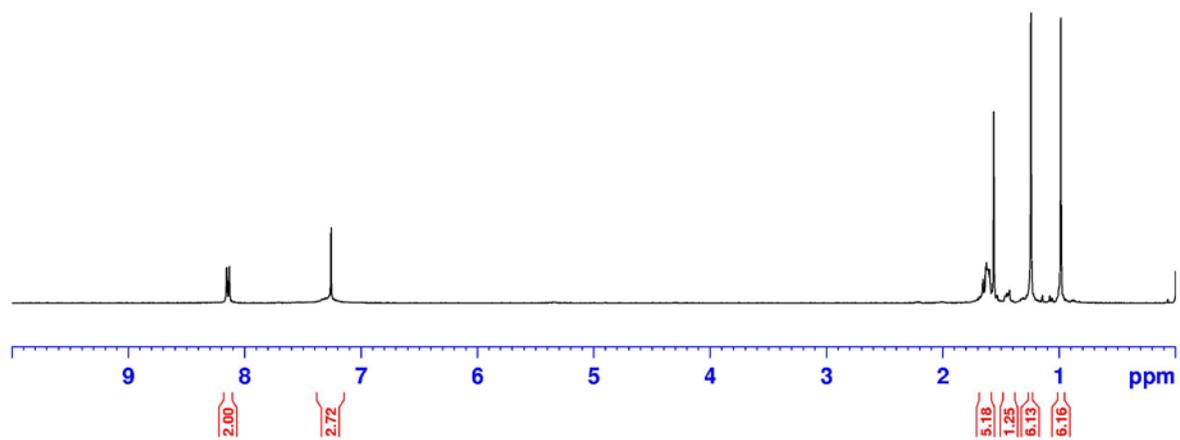
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL2W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320000 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```

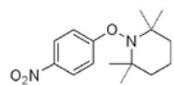


5

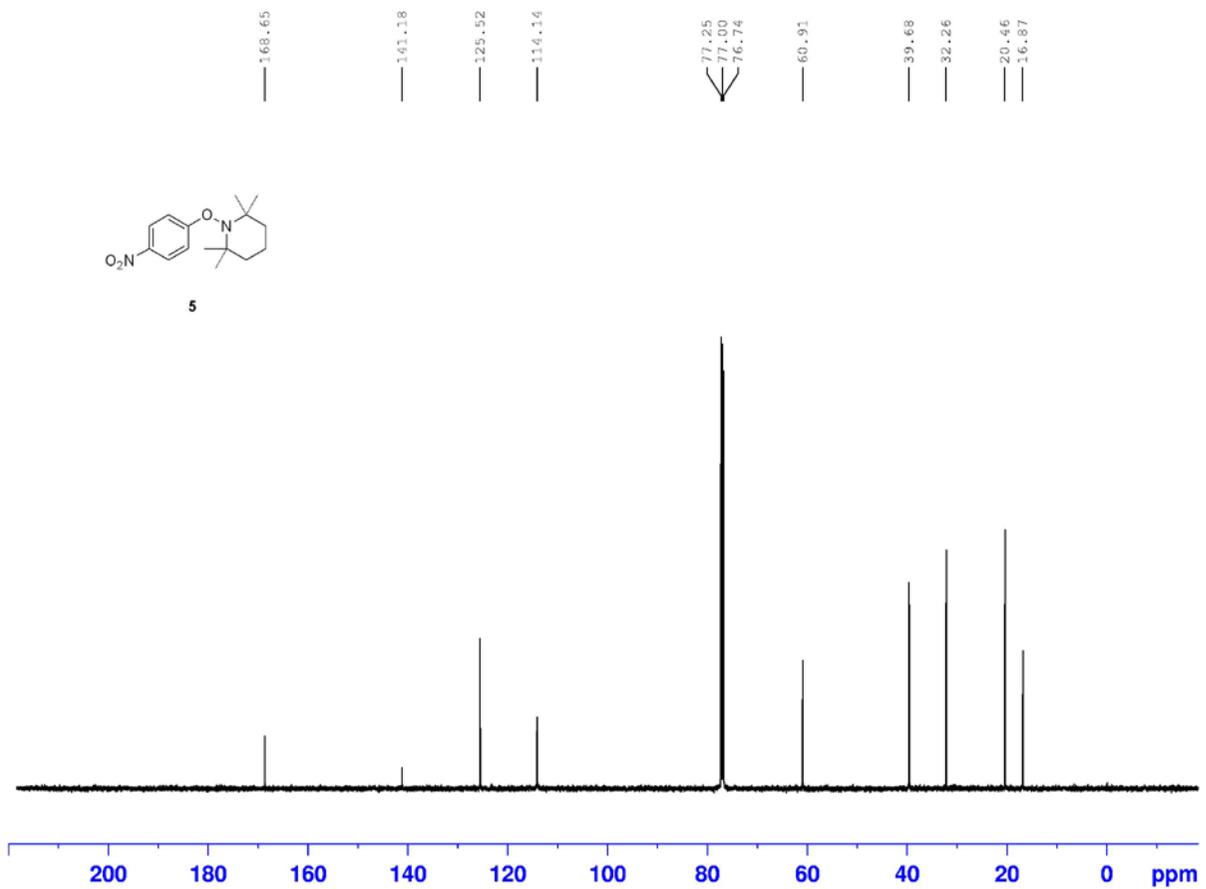
8.153
8.129
7.335
7.312
7.295
7.260
7.240

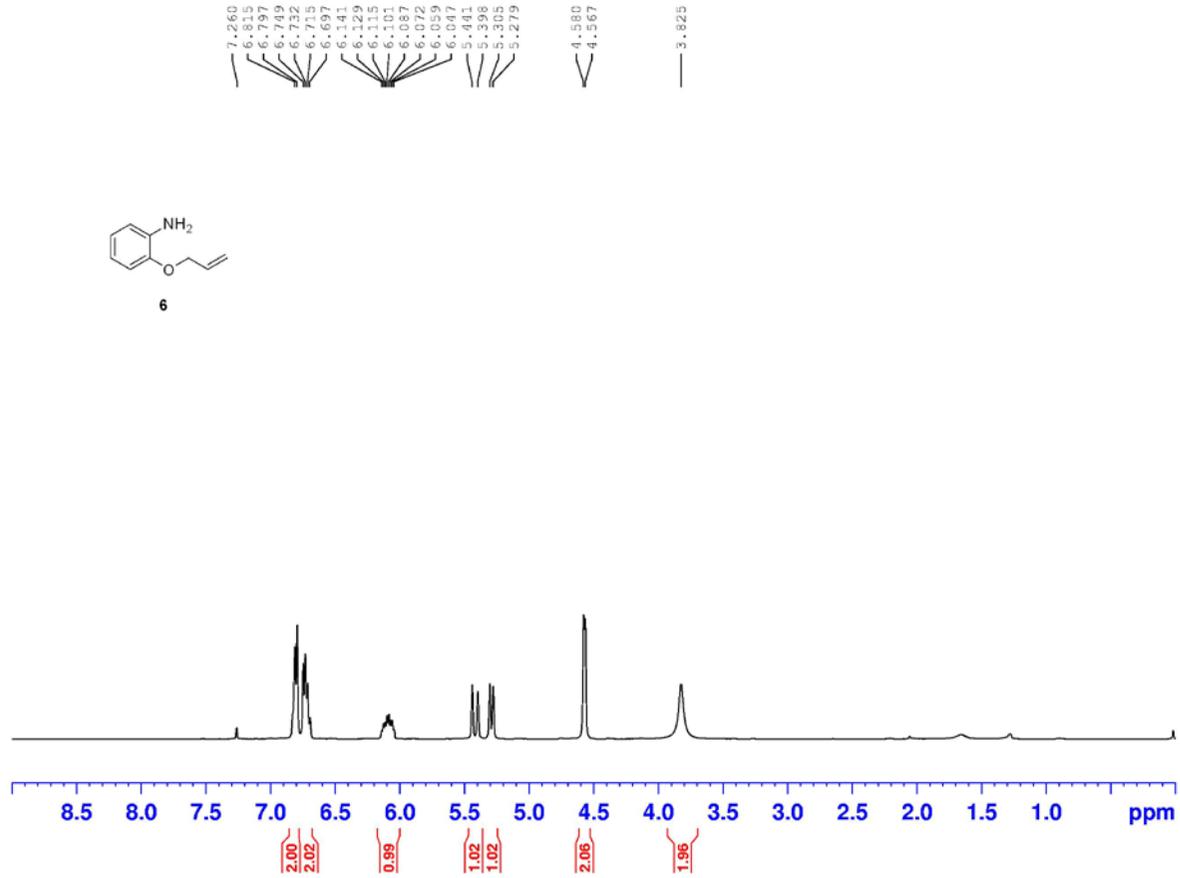
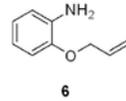
1.656
1.626
1.618
1.612
1.602
1.581
1.481
1.439
1.244
0.988





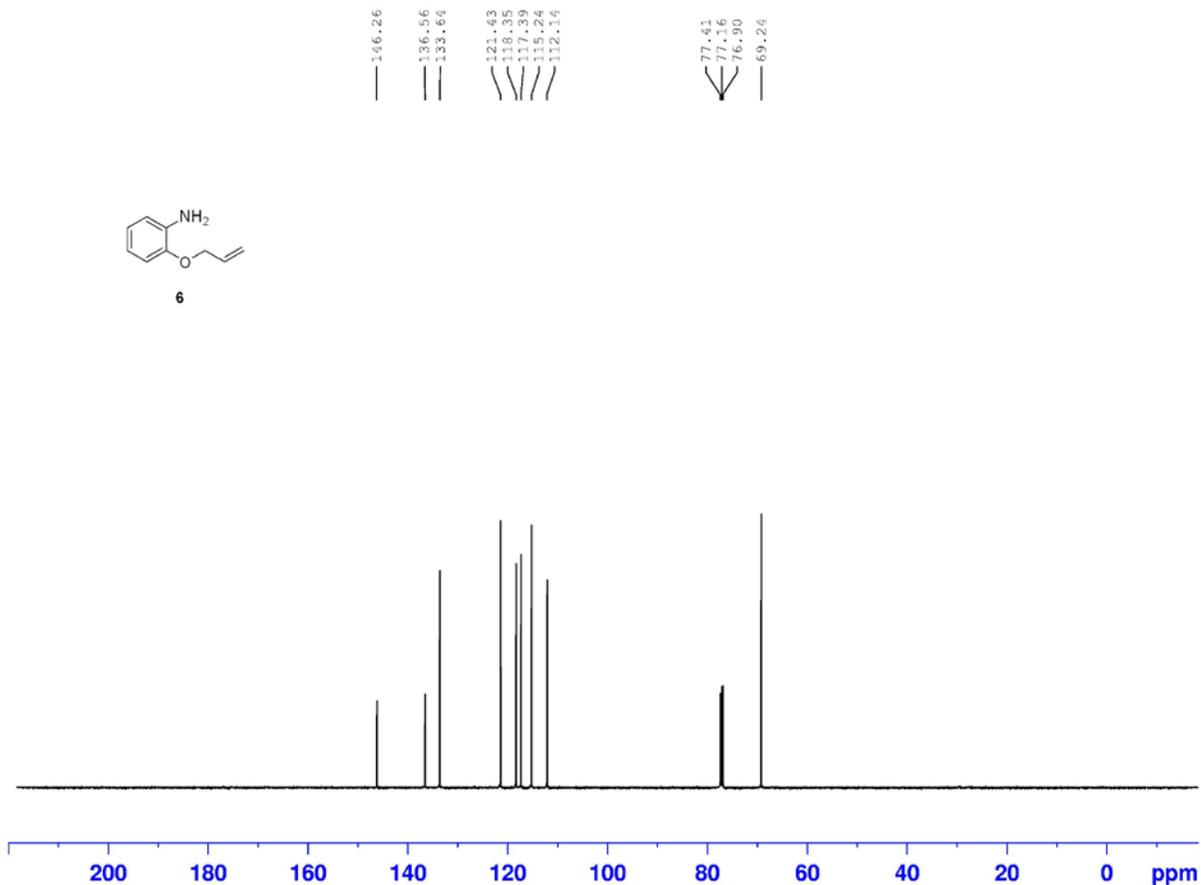
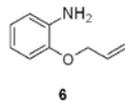
5





```
NAME                pnmr
EXPNO                318
PROCNO               1
Date_                20131021
Time                 14.40
INSTRUM              spect
PROBHD               5 mm PABBO BB-
PULPROG              zg30
TD                   65536
SOLVENT              CDCl3
NS                    8
DS                    2
SWH                  8278.146 Hz
FIDRES               0.124314 Hz
AQ                   3.9584243 sec
RG                    30.5
DW                   60.400 usec
DE                    6.50 usec
TE                   297.6 K
D1                   1.00000000 sec
TDD                  1

===== CHANNEL f1 =====
NUC1                 1H
P1                   12.58 usec
PL1                  0.00 dB
PL1W                 10.87646866 W
SFO1                 400.1324710 MHz
SI                   32768
SF                   400.1300098 MHz
WDW                  EM
SSB                   0
LB                   0.30 Hz
GB                    0
PC                    1.00
```



```

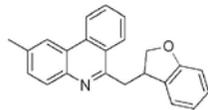
NAME          cnmr
EXPNO         318
PROCNO        1
Date_         20131203
Time          21.01
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            801
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TDO           1
  
```

```

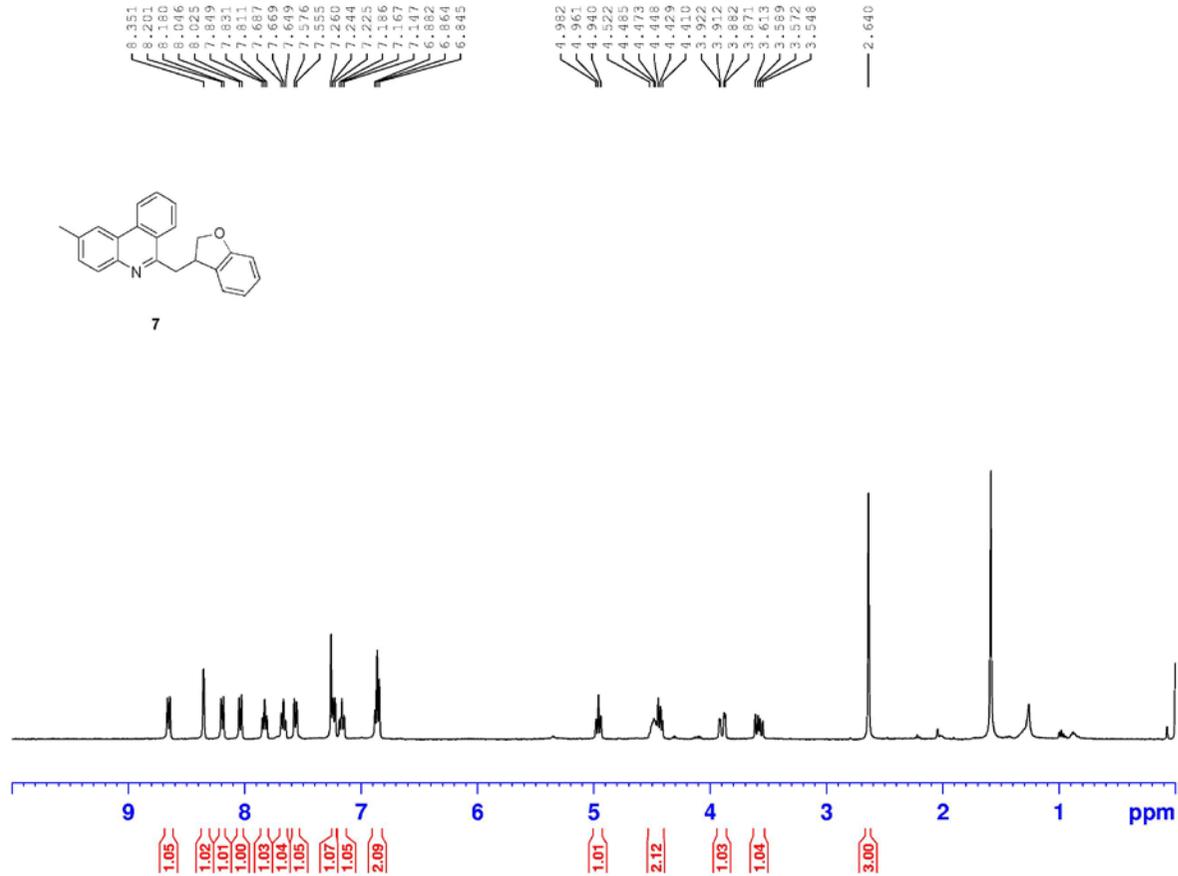
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz
  
```

```

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2           1H
PCPD2         80.00 usec
PL2            2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



7

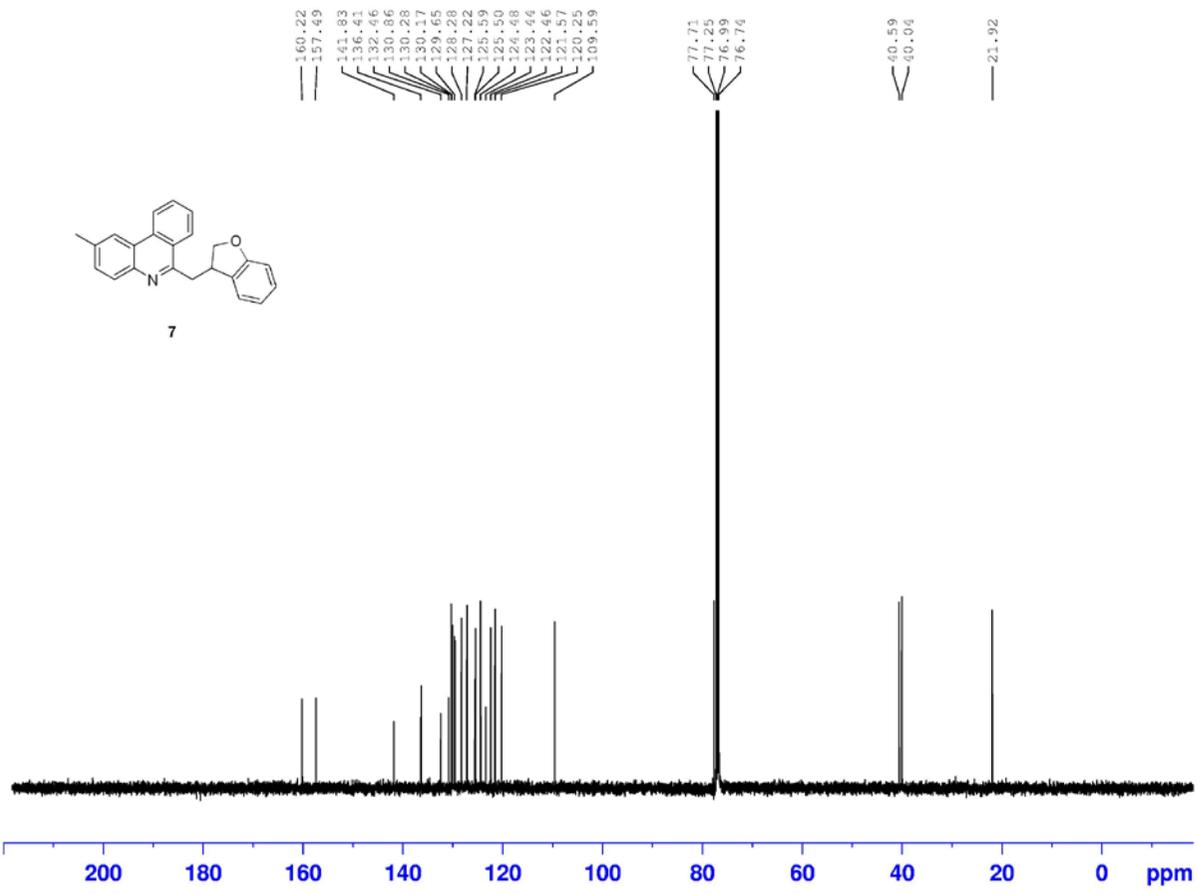
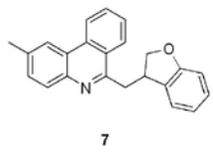


```

NAME                pnmr
EXPNO                320
PROCNO               1
Date_                20131021
Time                 22.21
INSTRUM              spect
PROBHD               5 mm PABBO BB-
PULPROG              zg30
TD                   65536
SOLVENT              CDCl3
NS                   16
DS                   2
SWH                  8278.146 Hz
FIDRES               0.124314 Hz
AQ                   3.9584243 sec
RG                   322.5
DW                   60.400 usec
DE                   6.50 usec
TE                   297.6 K
D1                   1.00000000 sec
TDD                  1

===== CHANNEL f1 =====
NUC1                 1H
P1                   12.58 usec
PL1                  0.00 dB
PL1W                 10.87646866 W
SFO1                 400.1324710 MHz
SI                   32768
SF                   400.1300095 MHz
WDW                  EM
SSB                  0
LB                   0.30 Hz
GB                   0
PC                   1.00

```



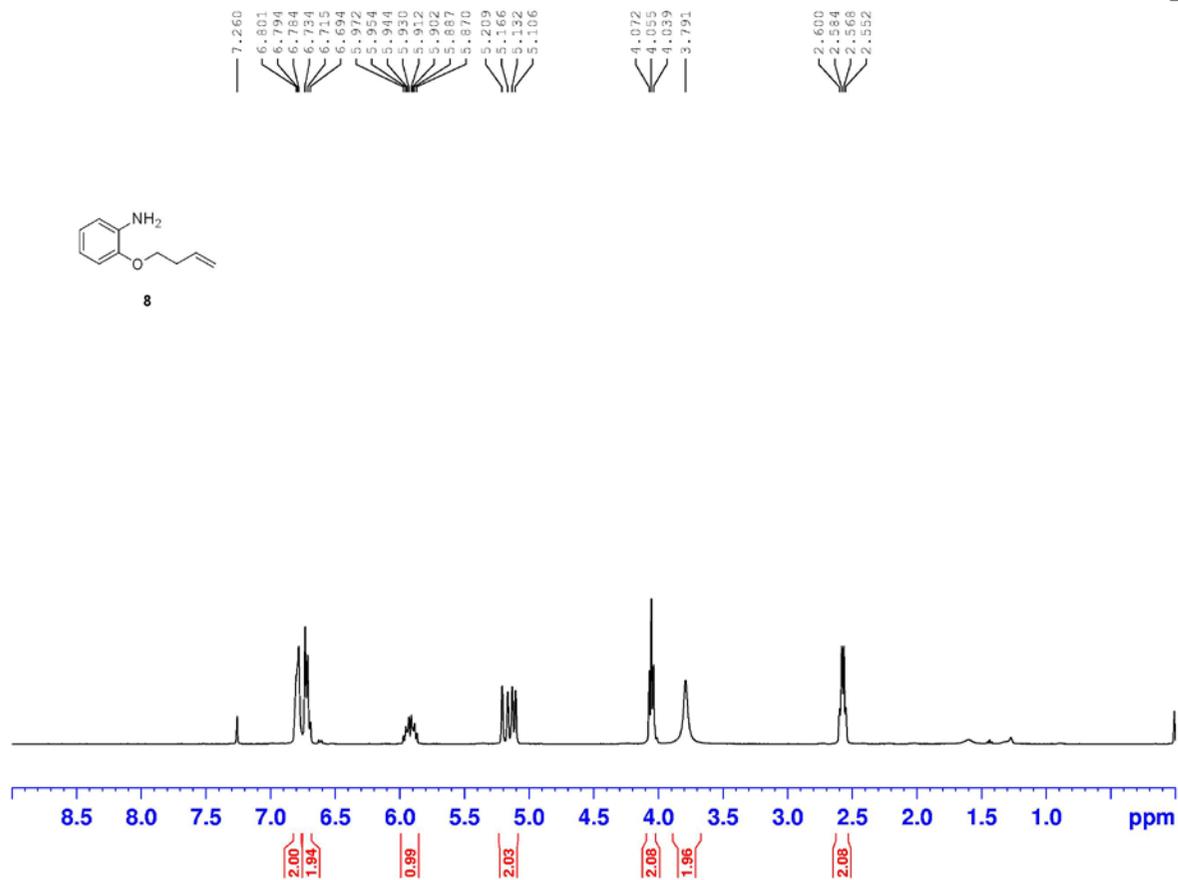
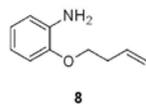
```

NAME          cmmr
EXPNO         320
PROCNO        1
Date_         20131024
Time         20.54
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            561
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.8300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1326005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

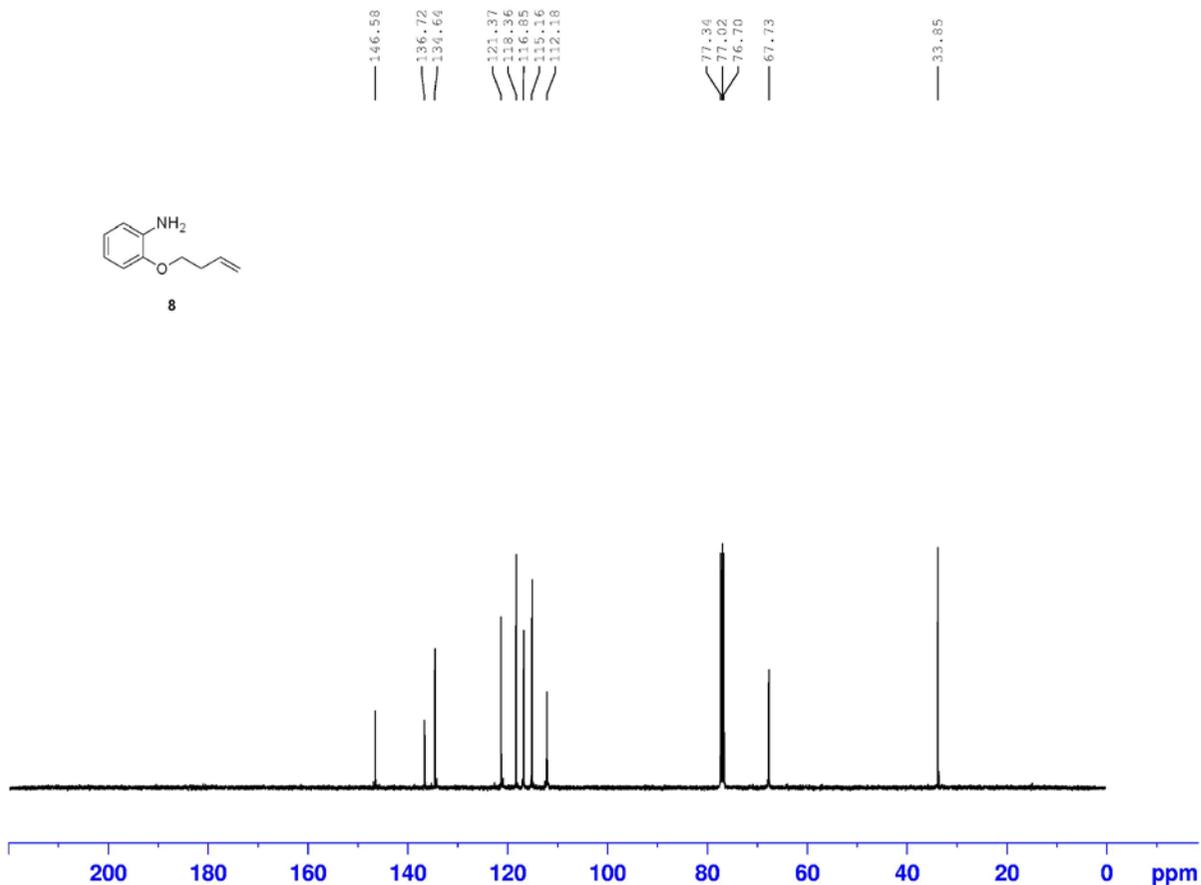
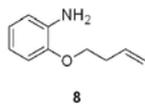


```

NAME                pnmr
EXPNO                3321
PROCNO               1
Date_                20131113
Time                15.41
INSTRUM              spect
PROBHD               5 mm PABBO BB-
PULPROG              zg30
TD                   65536
SOLVENT              CDCl3
NS                   8
DS                   2
SWH                  8278.146 Hz
FIDRES               0.124314 Hz
AQ                   3.9584243 sec
RG                   181
DW                   60.400 usec
DE                   6.50 usec
TE                   297.0 K
D1                   1.00000000 sec
TDD                  1

===== CHANNEL f1 =====
NUC1                 1H
P1                   12.58 usec
PL1                  0.00 dB
PL1W                 10.87646866 W
SFO1                 400.1324710 MHz
SI                   32768
SF                   400.1300096 MHz
WDW                  EM
SSB                   0
LB                   0.30 Hz
GB                   0
PC                   1.00

```



```

NAME          cmr
EXPNO         3221
PROCNO        1
Date_         20131113
Time         17.56
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            512
DS            4
SWH           22075.955 Hz
FIDRES        0.336839 Hz
AQ            1.4844404 sec
RG            1230.2
DW            22.650 usec
DE            6.50 usec
TE            309.2 K
D1            2.0000000 sec
D11           0.0300000 sec
TDO           1

```

```

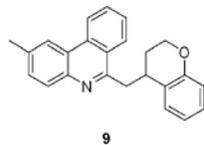
===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.69305206 W
SFO1          100.6238364 MHz

```

```

===== CHANNEL f2 =====
CPDPRG2      waltz16
NUC2          1H
PCPD2        80.00 usec
PL2           0.00 dB
PL12         16.07 dB
PL13          0.00 dB
PL2W         10.87646866 W
PL12W        0.26883632 W
PL13W        10.87646866 W
SFO2         400.1316005 MHz
SI            32768
SF           100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



8.681
8.597
8.586
8.293
8.273
8.019
8.029
7.857
7.838
7.819
7.766
7.687
7.669
7.577
7.556
7.297
7.277
7.260
7.156
7.136
7.117
6.872
6.854

4.380
4.358
4.336
4.219
4.206
4.192
3.936
3.926
3.899
3.890
3.787
3.775
3.764
3.751
3.534
3.508
3.500
3.473
2.640
2.046
2.004
1.979

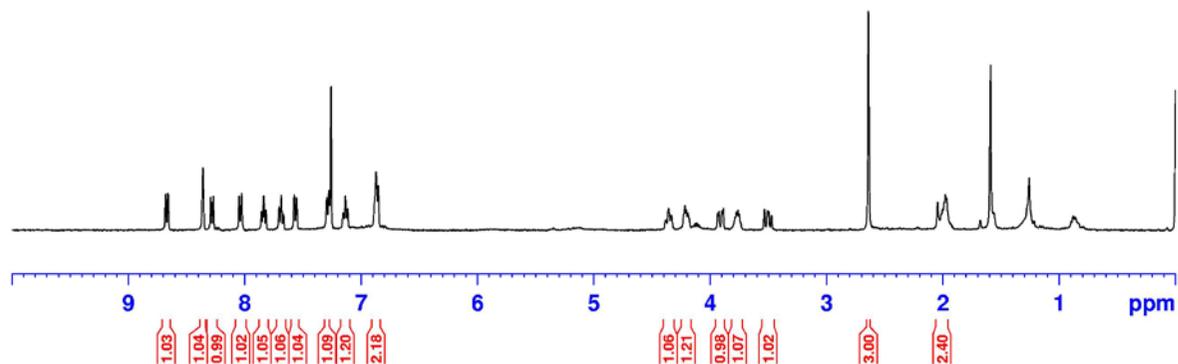


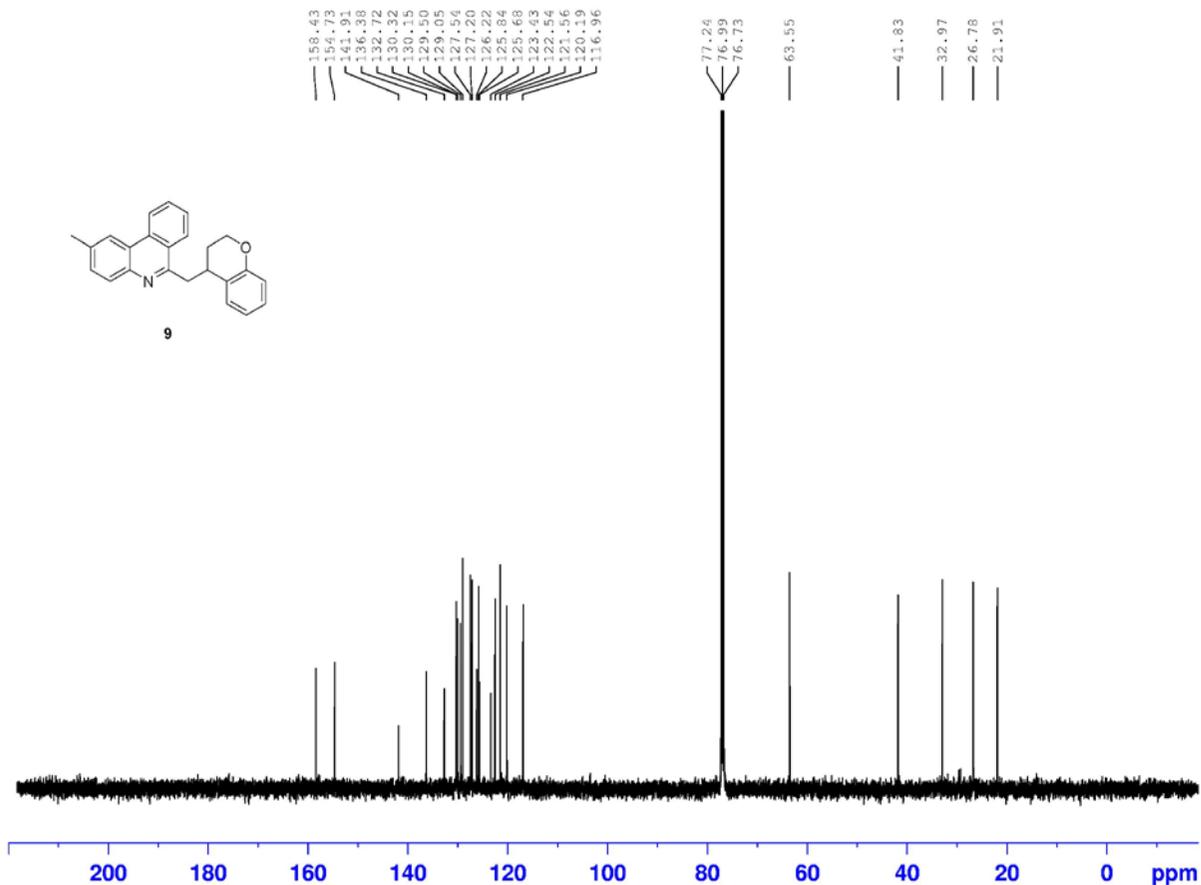
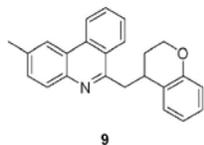
```

NAME                pnmr
EXPNO                3322
PROCNO               1
Date_                20131114
Time                 15.58
INSTRUM              spect
PROBHD               5 mm PABBO BB-
PULPROG              zg30
TD                   65536
SOLVENT              CDCl3
NS                   8
DS                   2
SWH                  8278.146 Hz
FIDRES               0.124314 Hz
AQ                   3.9584243 sec
RG                   362
DW                   60.400 usec
DE                   6.50 usec
TE                   297.0 K
D1                   1.00000000 sec
TDD                  1
  
```

```

***** CHANNEL f1 *****
NUC1                 1H
P1                   12.58 usec
PL1                  0.00 dB
PL1W                 10.87646866 W
SFO1                 400.1324710 MHz
SI                   32768
SF                   400.1300097 MHz
WDW                  EM
SSB                  0
LB                   0.30 Hz
GB                   0
PC                   1.00
  
```





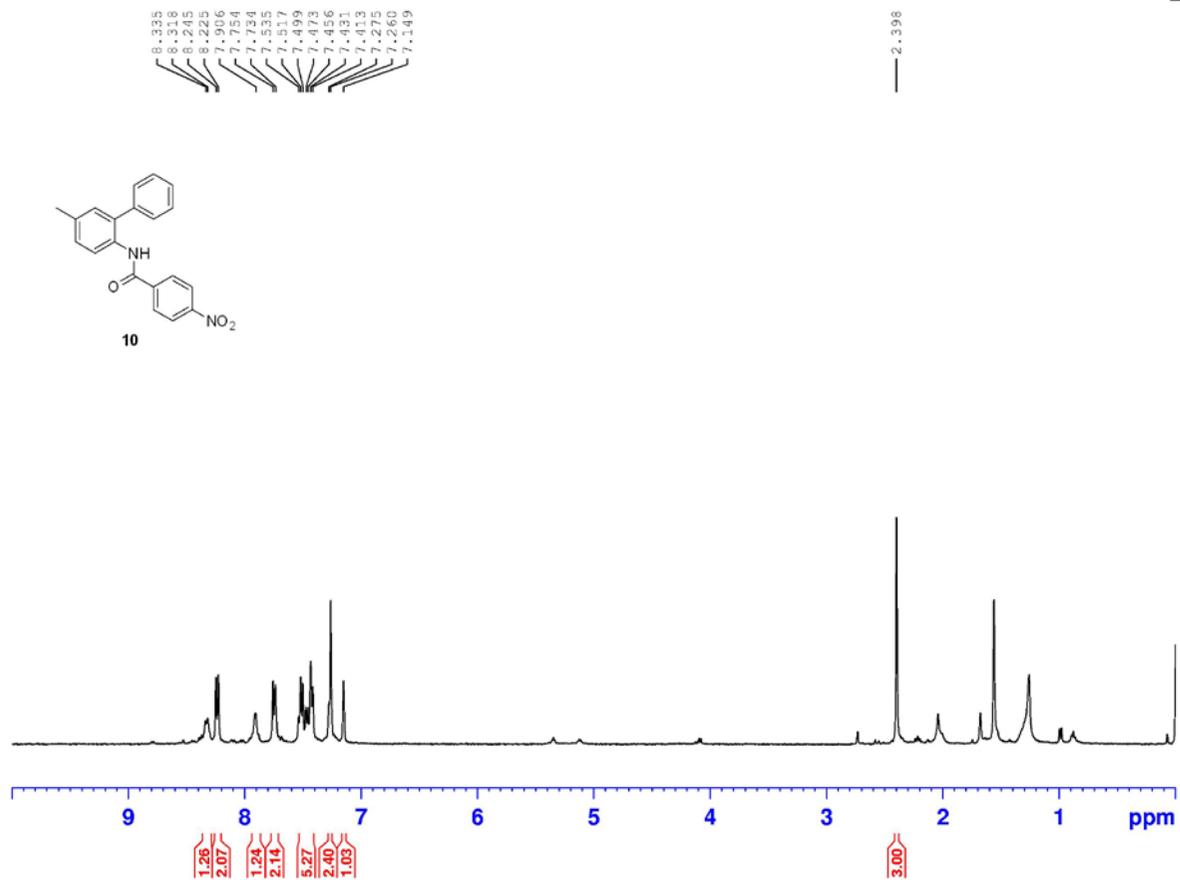
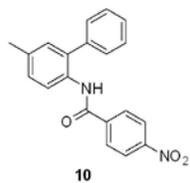
```

NAME          cmmr
EXPNO         3222
PROCNO        1
Date_         20131122
Time         16.49
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            660
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            297.2 K
D1            2.0000000 sec
D11           0.8300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL12W         13.02339381 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

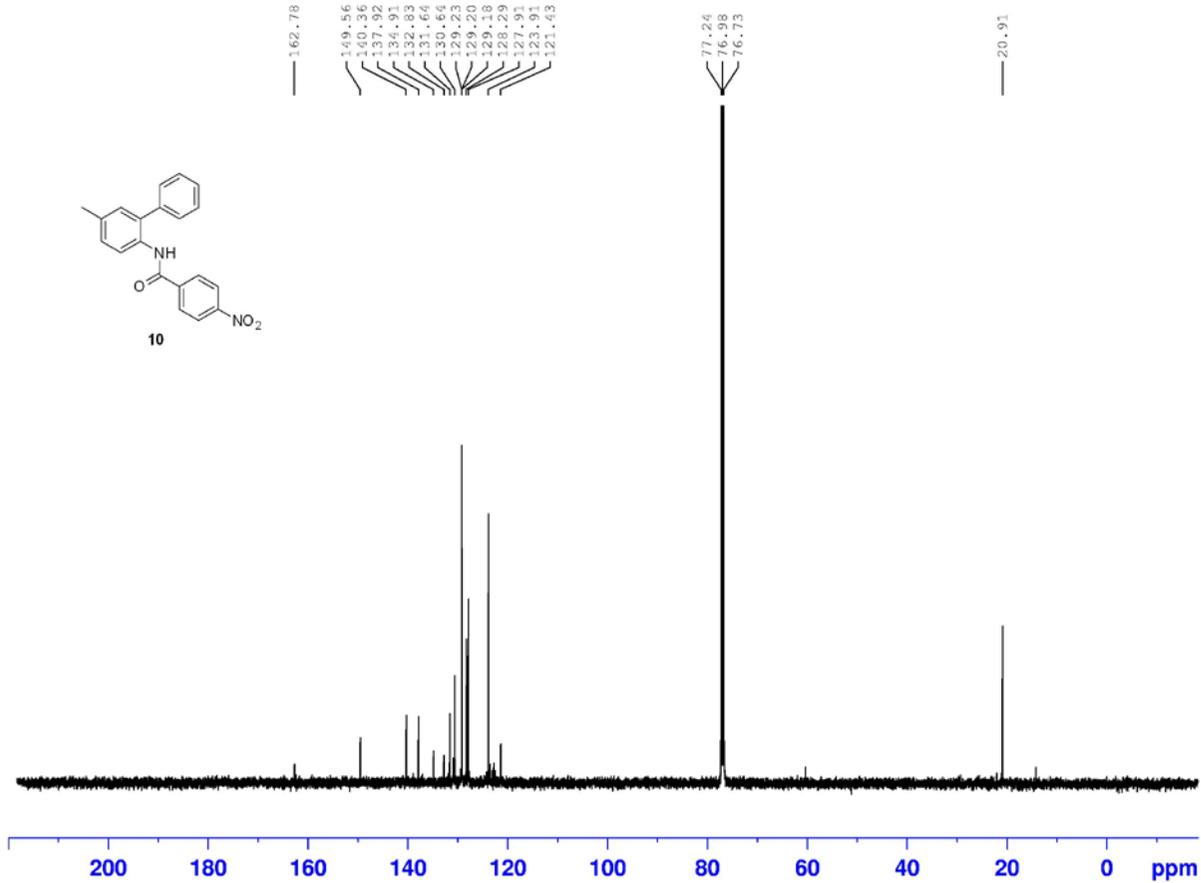
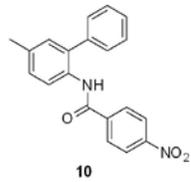


```

NAME          pnmr
EXPNO         3414
PROCNO        1
Date_         20131207
Time          15.47
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1
  
```

```

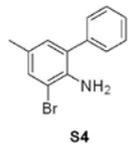
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300094 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



```
NAME          cmr
EXPNO         3414
PROCNO        1
Date_         20131212
Time          17.59
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1Z          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



7.465
 7.437
 7.437
 7.466
 7.399
 7.362
 7.280
 6.880

4.042

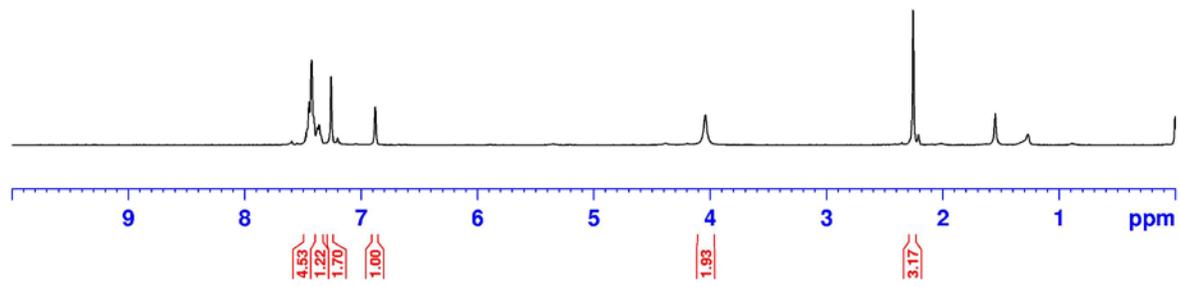
2.257

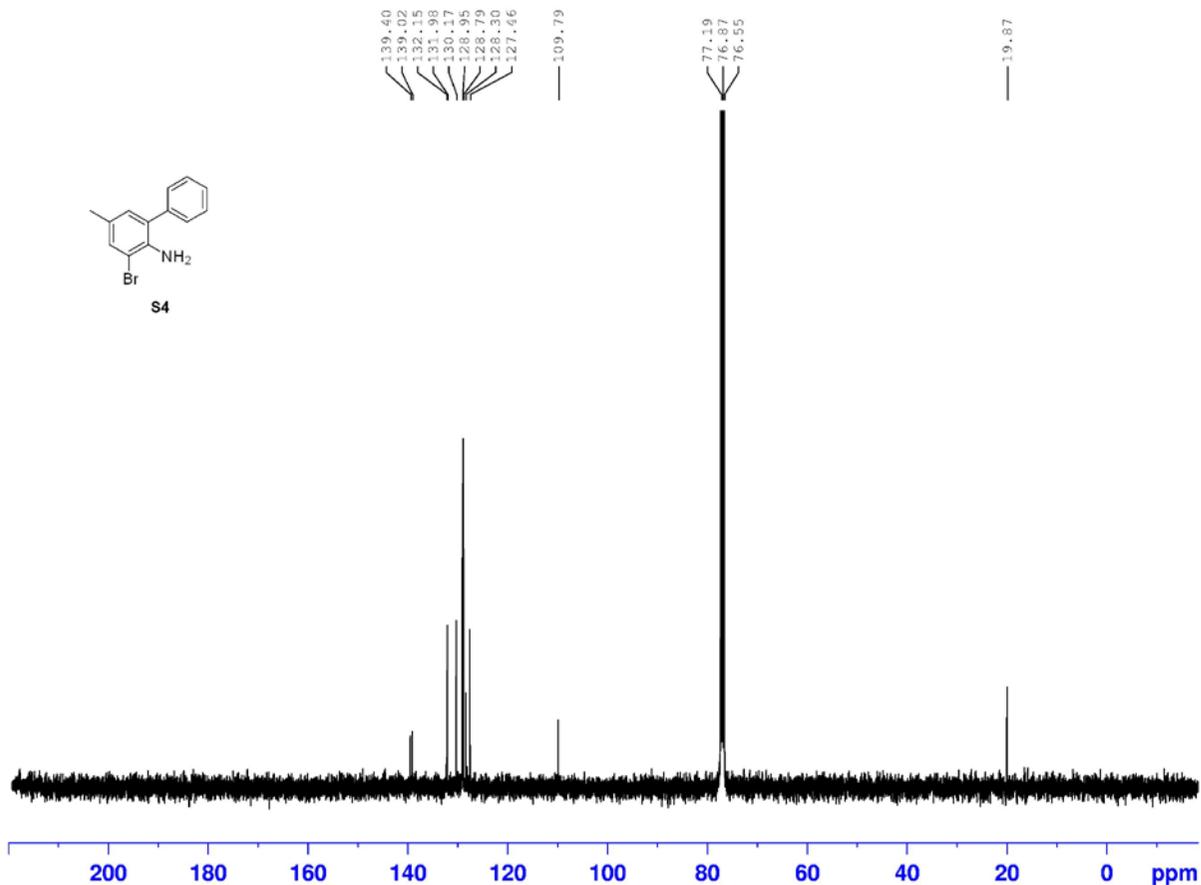
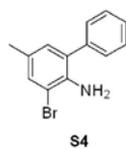


```

NAME                pnmr
EXPNO                3512
PROCNO              1
Date_               20131230
Time                9.29
INSTRUM             spect
PROBHD              5 mm PABBO BB-
PULPROG             zg30
TD                  65536
SOLVENT             CDCl3
NS                   8
DS                   2
SWH                 8278.146 Hz
FIDRES              0.124314 Hz
AQ                  3.9584243 sec
RG                   362
DW                   60.400 usec
DE                   6.50 usec
TE                  298.0 K
D1                   1.00000000 sec
TDD                  1

===== CHANNEL f1 =====
NUC1                 1H
P1                   12.58 usec
PL1                   0.00 dB
PL1W                 10.87646866 W
SFO1                 400.1324710 MHz
SI                    32768
SF                   400.1300095 MHz
WDW                   EM
SSB                    0
LB                    0.30 Hz
GB                    0
PC                    1.00
  
```



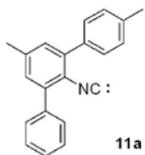


```

NAME          cmr
EXPNO         3512
PROCNO        1
Date_         20140103
Time         4.15
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1024
DW            20.850 usec
DE            6.50 usec
TE            313.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

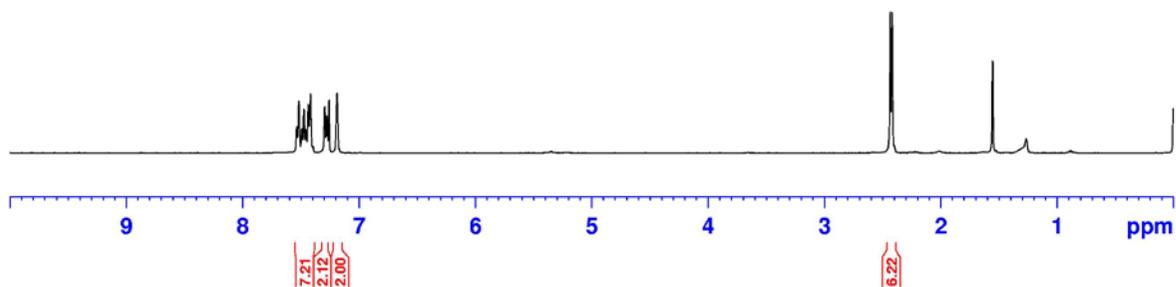
===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13           0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127566 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



7.538
7.519
7.494
7.476
7.457
7.438
7.418
7.398
7.298
7.278
7.260
7.191

2.436
2.419

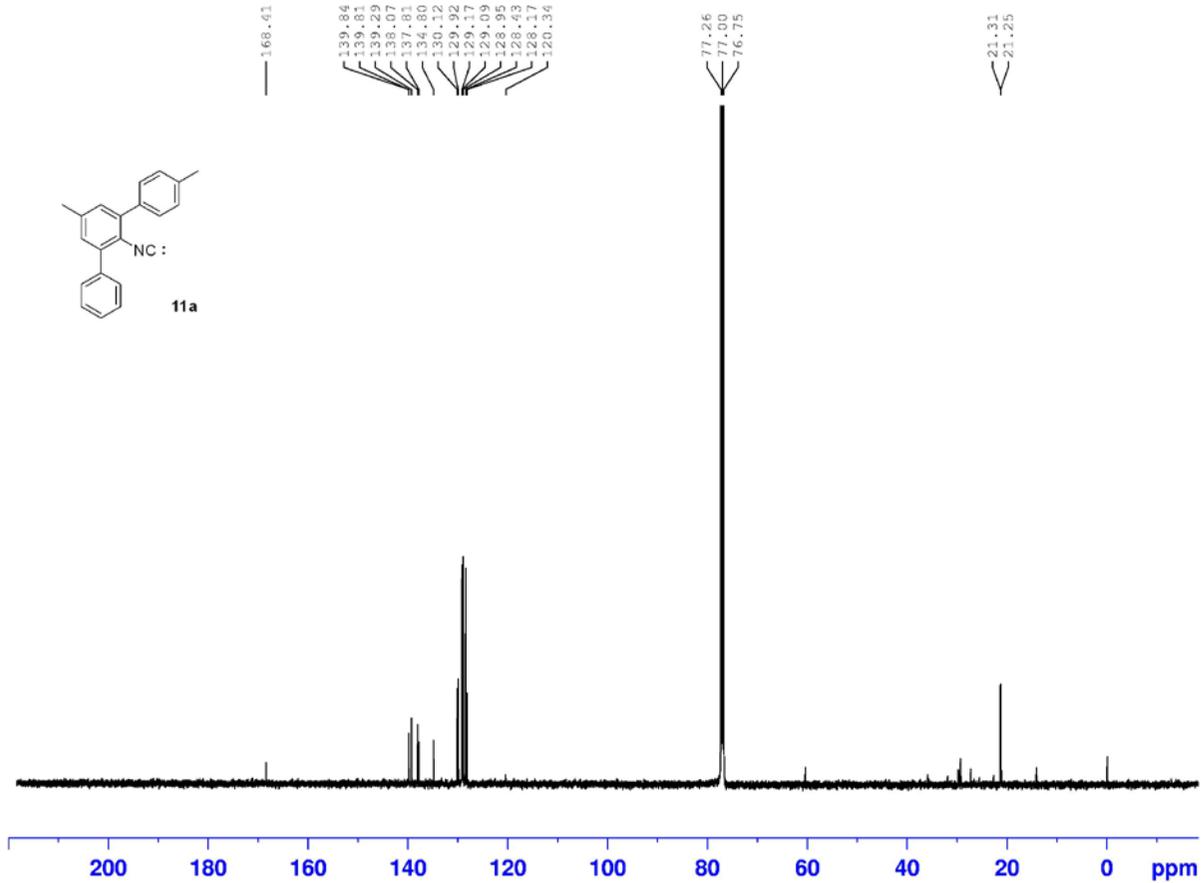
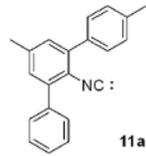


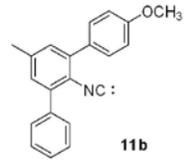
```

NAME                pnmr
EXPNO                36622
PROCNO               1
Date_                20140117
Time                 22.44
INSTRUM              spect
PROBHD                5 mm PABBO BB-
PULPROG               zg30
TD                   65536
SOLVENT               CDCl3
NS                    16
DS                     2
SWH                   8278.146 Hz
FIDRES                0.124314 Hz
AQ                    3.9584243 sec
RG                     322.5
DW                     60.400 usec
DE                      6.50 usec
TE                    297.2 K
D1                    1.00000000 sec
TDO                   1

===== CHANNEL f1 =====
NUC1                  1H
P1                     12.58 usec
PL1                     0.00 dB
PL1W                   10.87646866 W
SFO1                   400.1324710 MHz
SI                      32768
SF                     400.1300097 MHz
WDW                     EM
SSB                      0
LB                      0.30 Hz
GB                      0
PC                      1.00

```

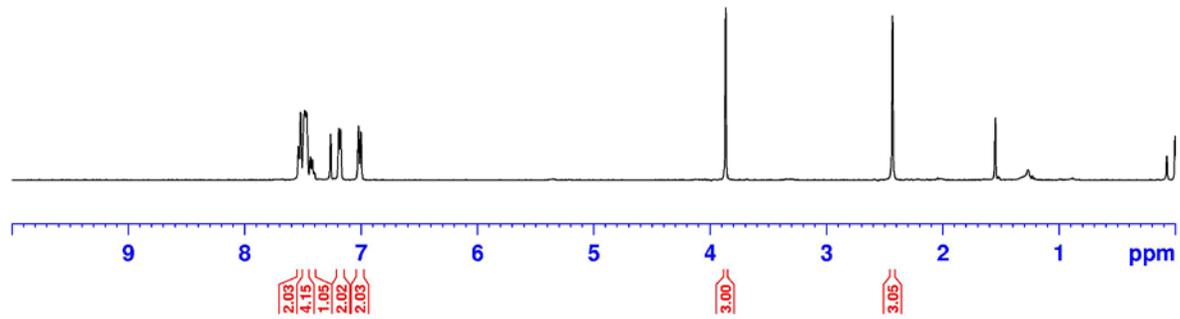




7.537
7.528
7.485
7.477
7.468
7.464
7.434
7.416
7.399
7.260
7.189
7.174
7.020
7.001

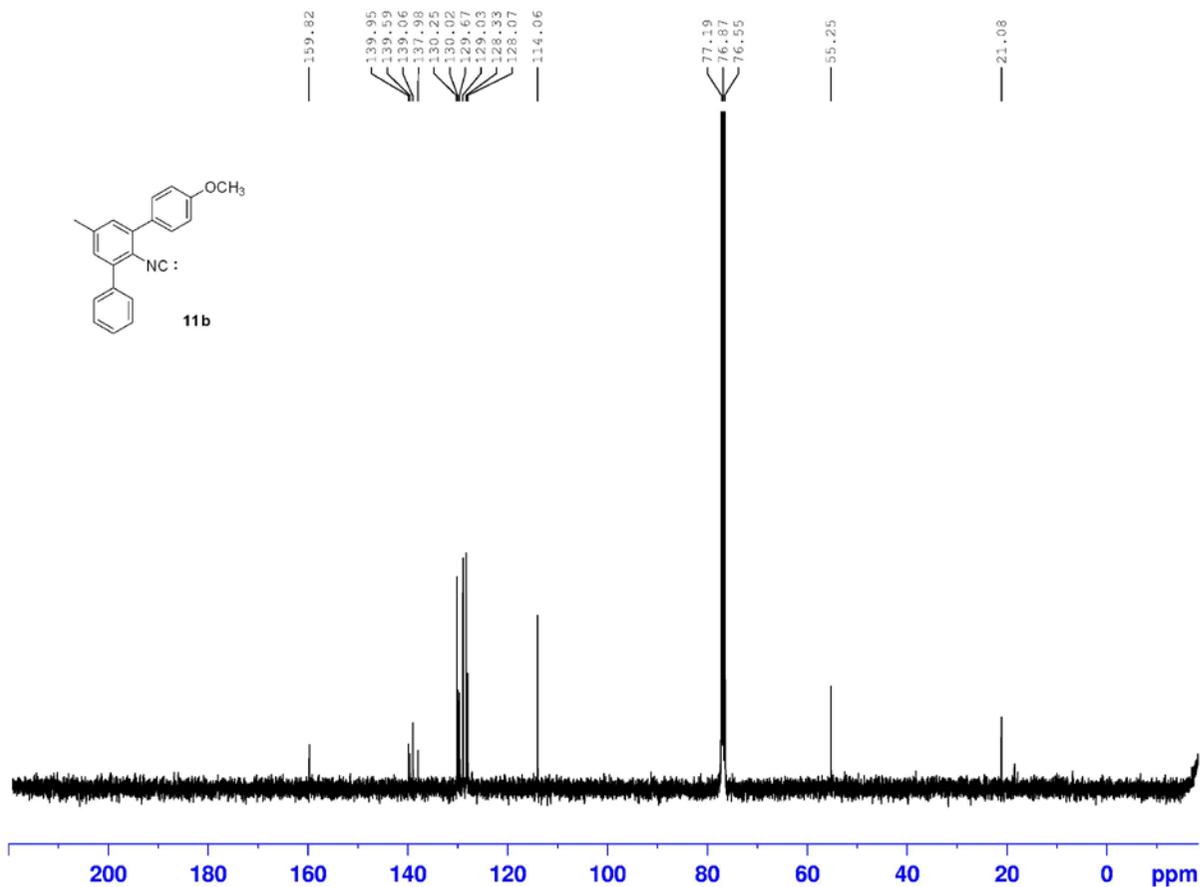
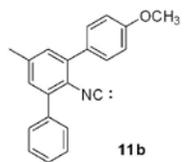
3.868

2.434



```
NAME          pnmr
EXPNO         3541
PROCNO        1
Date_         20131230
Time          11.44
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1

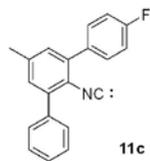
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300094 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```
NAME          cmr
EXPNO         3541
PROCNO        1
Date_         20140103
Time         5.22
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1149.4
DW            20.850 usec
DE            6.50 usec
TE            313.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13           0.00 dB
PL12W         10.87646866 W
PL13W         0.26883632 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



7.539
 7.520
 7.509
 7.489
 7.470
 7.447
 7.429
 7.413
 7.260
 7.221
 7.186
 7.160
 7.136

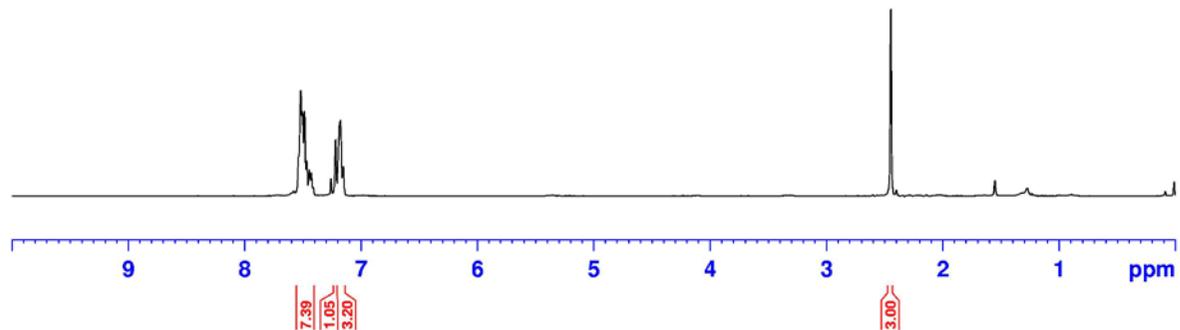
— 2.418

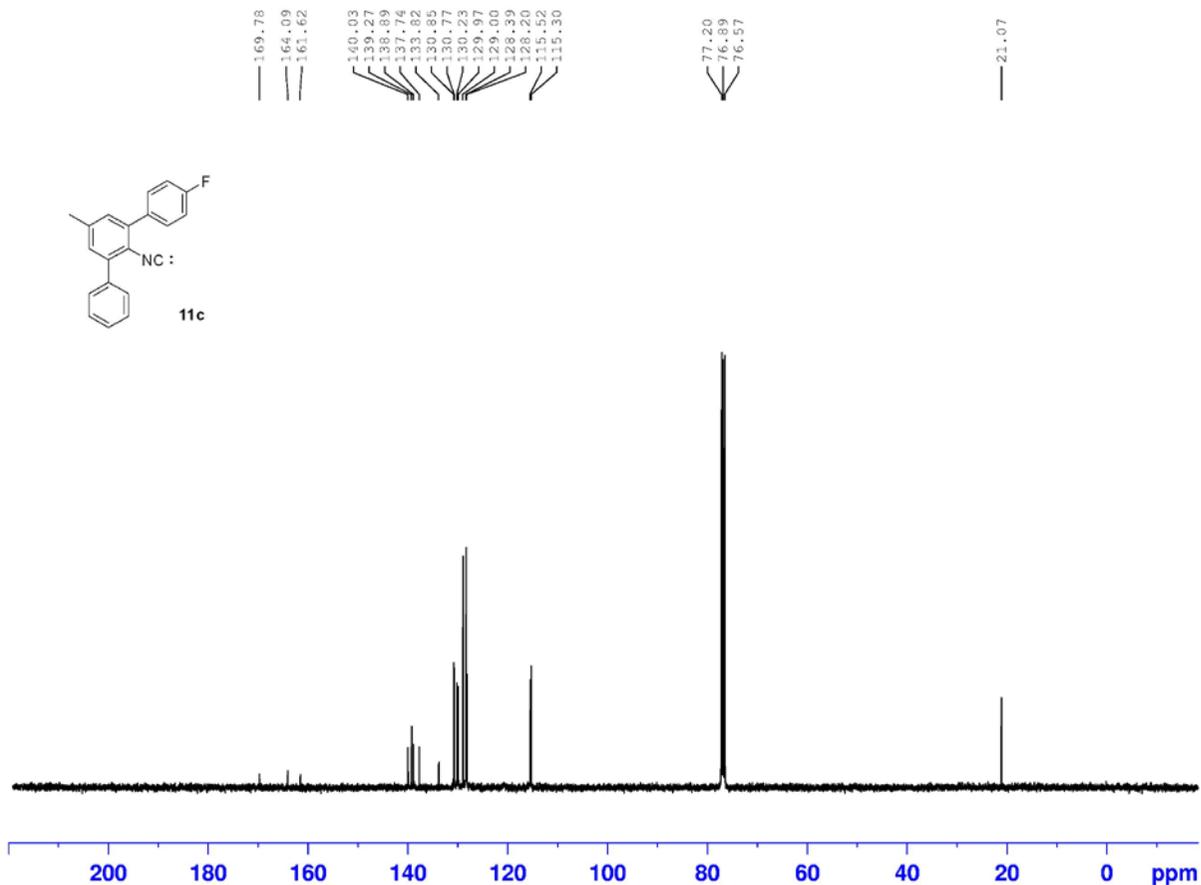
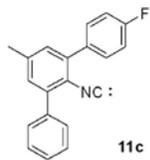


```

NAME          pnmr
EXPNO         3543
PROCNO        1
Date_         20131230
Time          9.51
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            181
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300094 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```





```

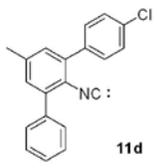
NAME          cmr
EXPNO         3543
PROCNO        1
Date_         20140103
Time         6.29
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1149.4
DW            20.850 usec
DE            6.50 usec
TE            313.2 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1
  
```

```

===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz
  
```

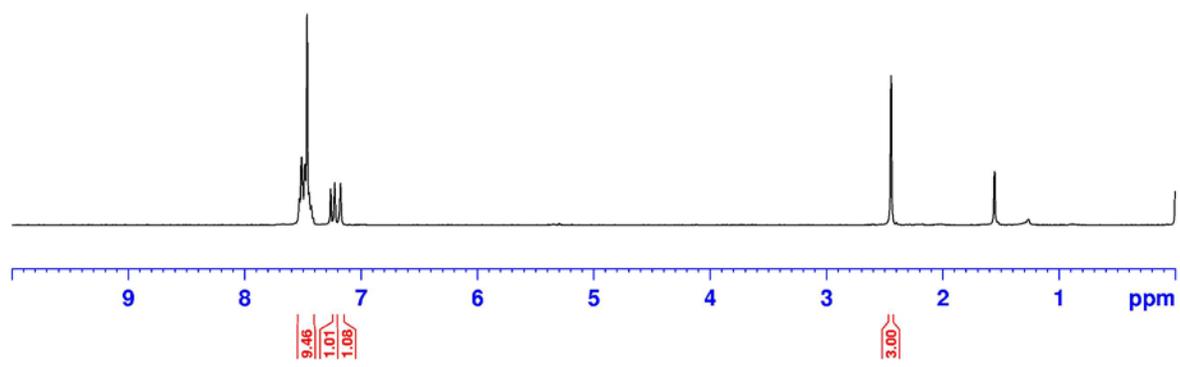
```

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13          0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



7.529
7.510
7.481
7.462
7.445
7.427
7.409
7.260
7.225
7.175

2.416

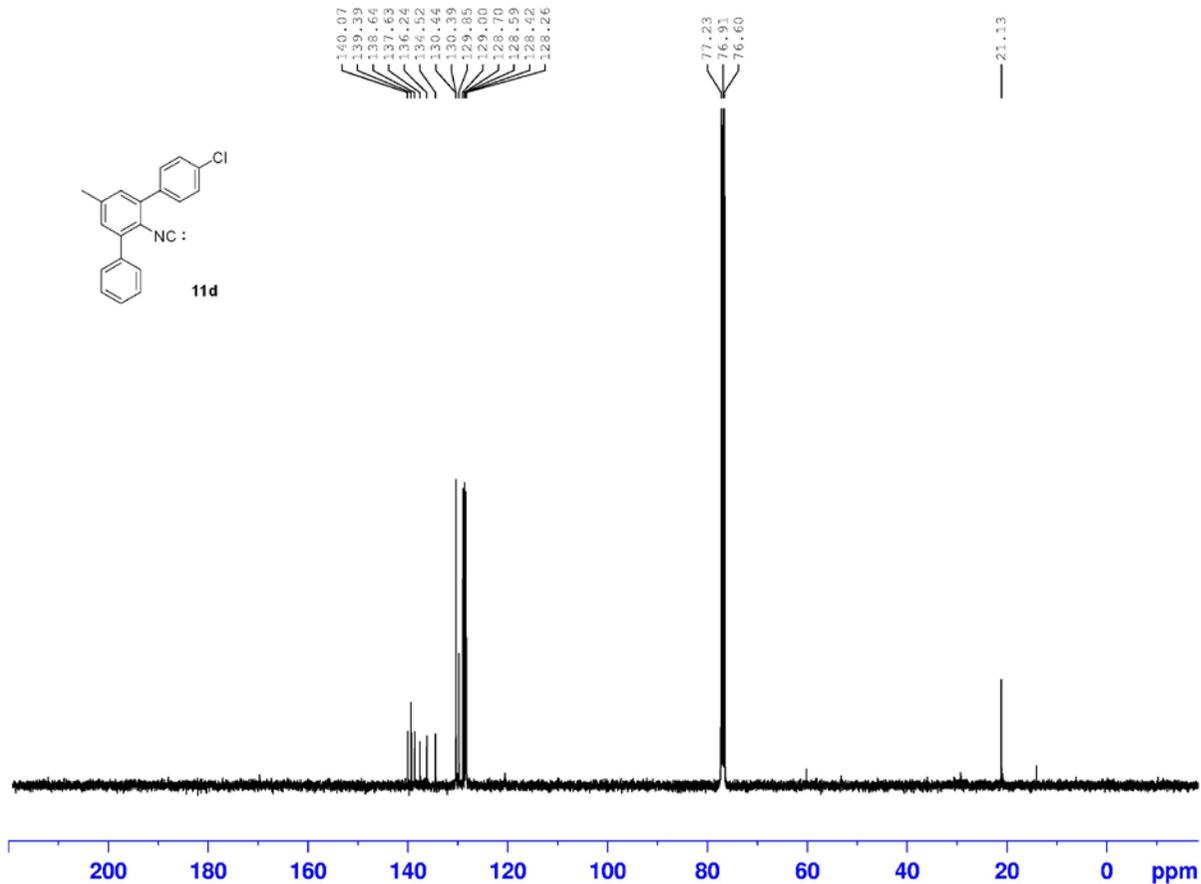
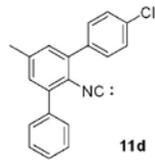


```

NAME          pnmr
EXPNO         35423
PROCNO        1
Date_         20140102
Time          22.22
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            297.0 K
D1            1.00000000 sec
TDO           1
  
```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300097 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```

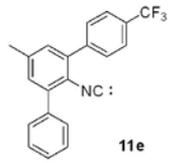


```

NAME          cmr
EXPNO         35423
PROCNO        1
Date_         20140103
Time_         8.41
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1230.2
DW            20.850 usec
DE            6.50 usec
TE            313.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

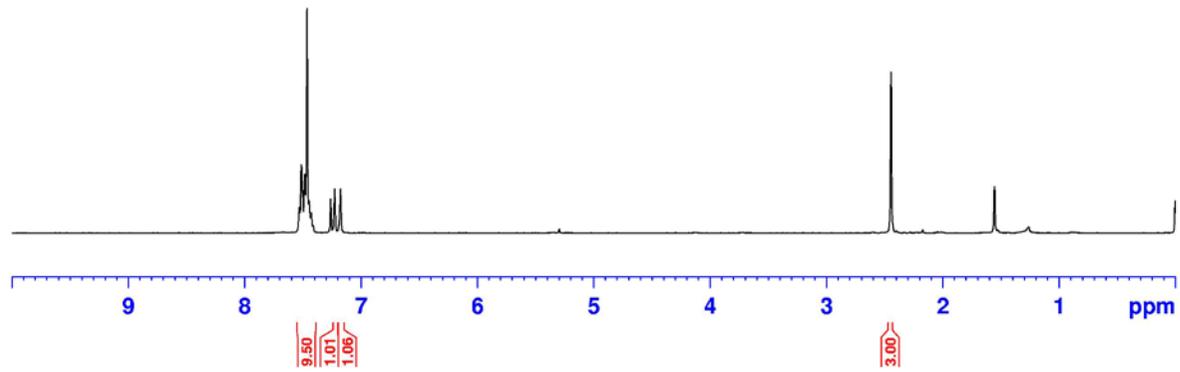
===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13           0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



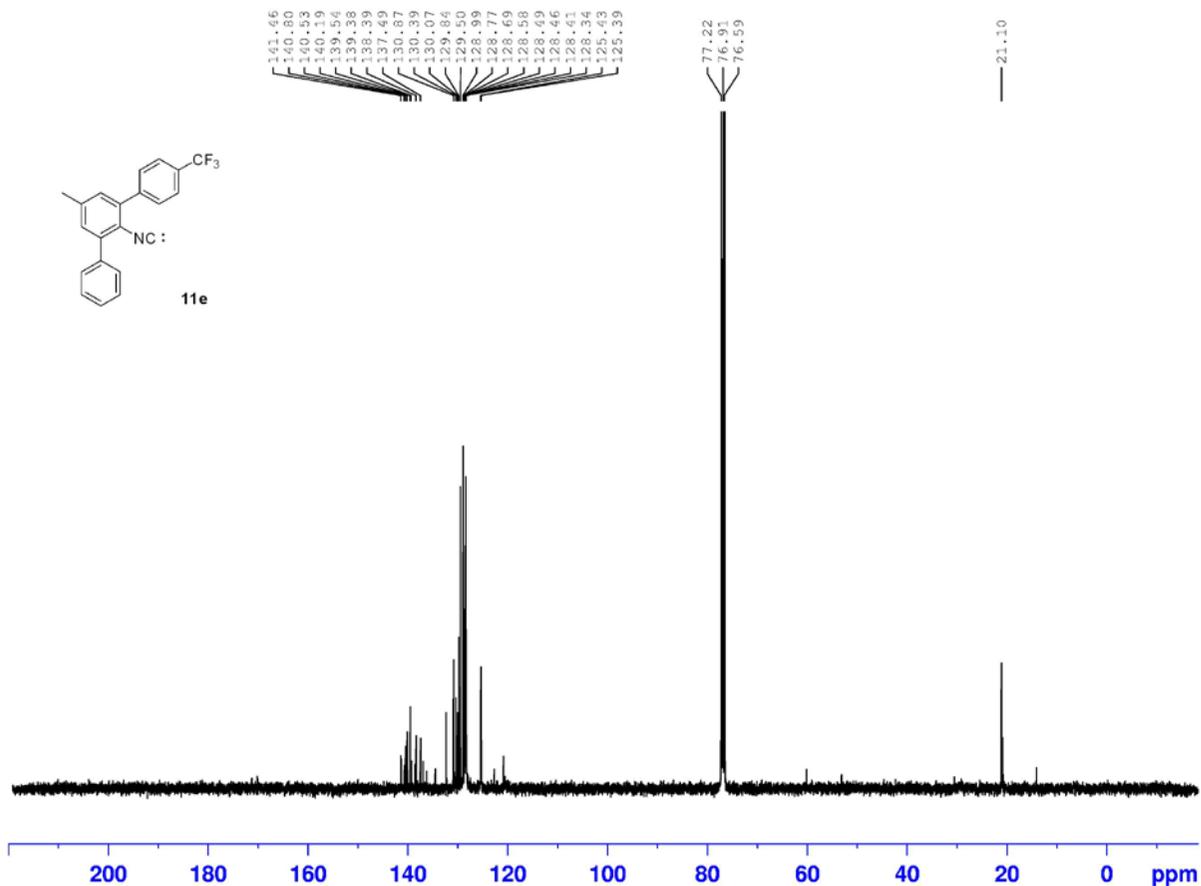
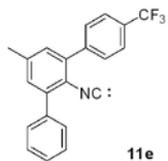
7.529
7.511
7.482
7.463
7.445
7.427
7.410
7.260
7.226
7.175

2.416



```
NAME          pnmr
EXPNO         35722
PROCNO        1
Date_         20140102
Time          22.29
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            296.9 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300097 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



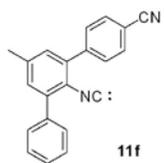
```

NAME          cmr
EXPNO         35722
PROCNO        1
Date_         20140103
Time          9.18
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            786
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1149.4
DW            20.850 usec
DE            6.50 usec
TE            313.2 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

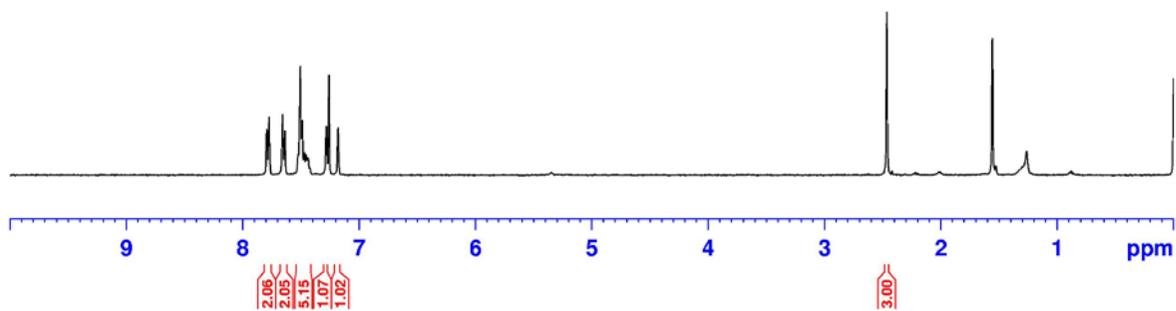
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13           0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



7.794
 7.775
 7.775
 7.659
 7.641
 7.508
 7.491
 7.473
 7.458
 7.439
 7.427
 7.284
 7.260
 7.162

2.465

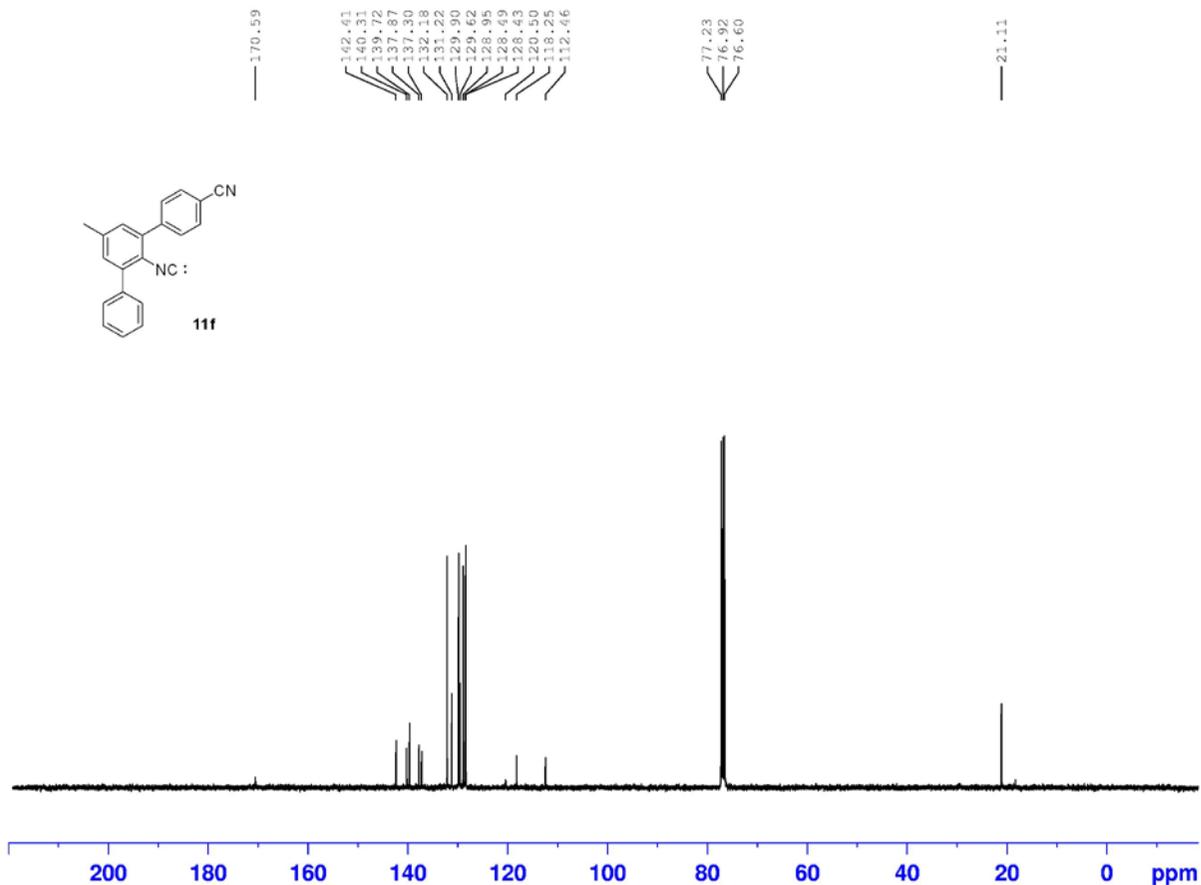
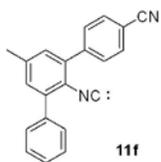


```

NAME          pnmr
EXPNO         3573
PROCNO        1
Date_         20140102
Time          10.16
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            512
DW            60.400 usec
DE            6.50 usec
TE            296.7 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300093 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```

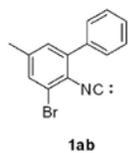
XZH357C



```
NAME          cmr
EXPNO         3573
PROCNO        1
Date_         20140103
Time         7.35
INSTRUM      spect
PROBHD       5 mm PABBO BB-
PULPRG       zgpg30
ID           65536
SOLVENT      CDCl3
NS           1024
DS           4
SWH          23900.814 Hz
FIDRES       0.365918 Hz
AQ           1.3664756 sec
RG           1625.0
DW           20.850 usec
DE           6.50 usec
TE           313.2 K
D1           2.0000000 sec
D11          0.0300000 sec
TDD          1

===== CHANNEL f1 =====
NUC1          13C
P1           10.25 usec
PL1           0.00 dB
PL1W         38.68305206 W
SFO1         100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2      waltz16
NUC2          1H
PCPD2        80.00 usec
PL2           0.00 dB
PL12         16.07 dB
PL13           0.00 dB
PL2W         10.87646866 W
PL12W        0.26883632 W
PL13W        10.87646866 W
SFO2         400.1316005 MHz
SI           32768
SF           100.6127690 MHz
WDW          EM
SSB           0
LB           1.00 Hz
GB           0
PC           1.40
```



7.469
7.260
7.158

2.397

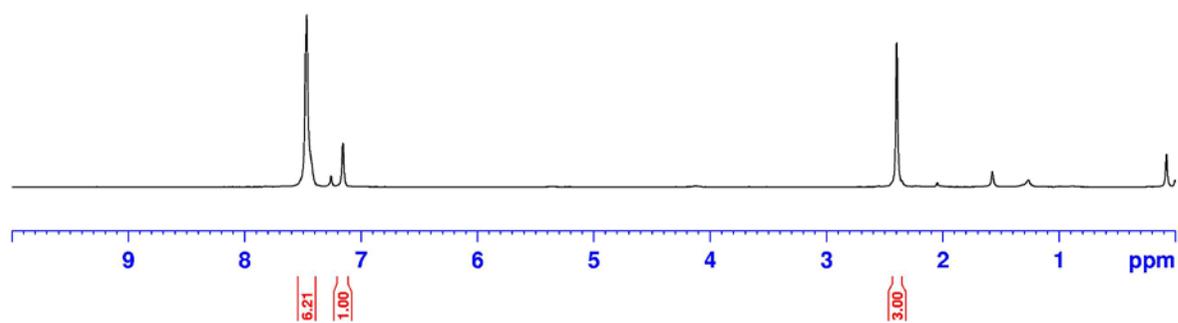


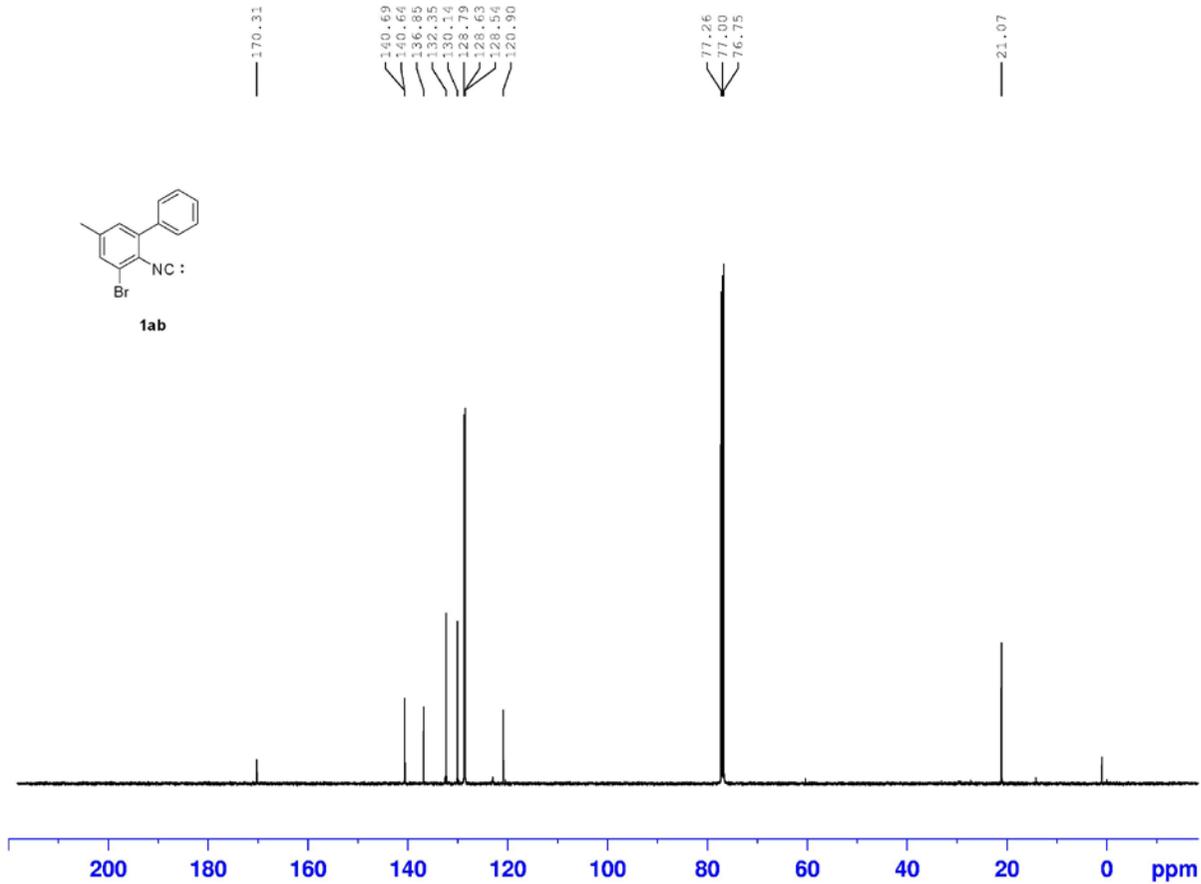
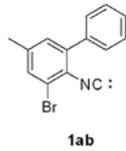
```

NAME          pnmr
EXPNO         3602
PROCNO        1
Date_         20140106
Time          19.53
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            228.1
DW            60.400 usec
DE            6.50 usec
TE            296.6 K
D1            1.00000000 sec
TDO           1
  
```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300101 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```

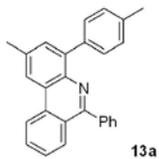




```
NAME          cmr
EXPNO         3602
PROCNO        1
Date_         20140114
Time         19.42
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPRG        zgpg30
ID            65536
SOLVENT       CDCl3
NS            2048
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```



8.746
8.725
8.402
8.229
8.209
7.886
7.888
7.818
7.792
7.773
7.738
7.719
7.698
7.666
7.577
7.552
7.496
7.469
7.468
7.431
7.282
7.280

— 2.681
— 2.420

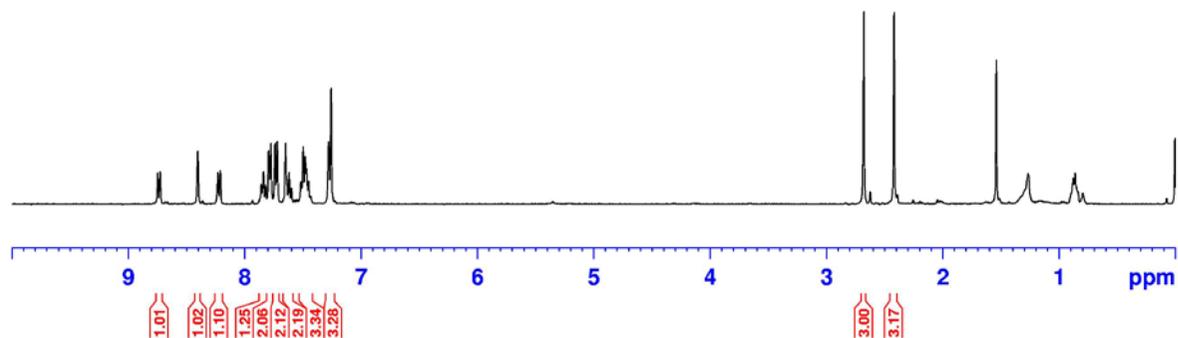


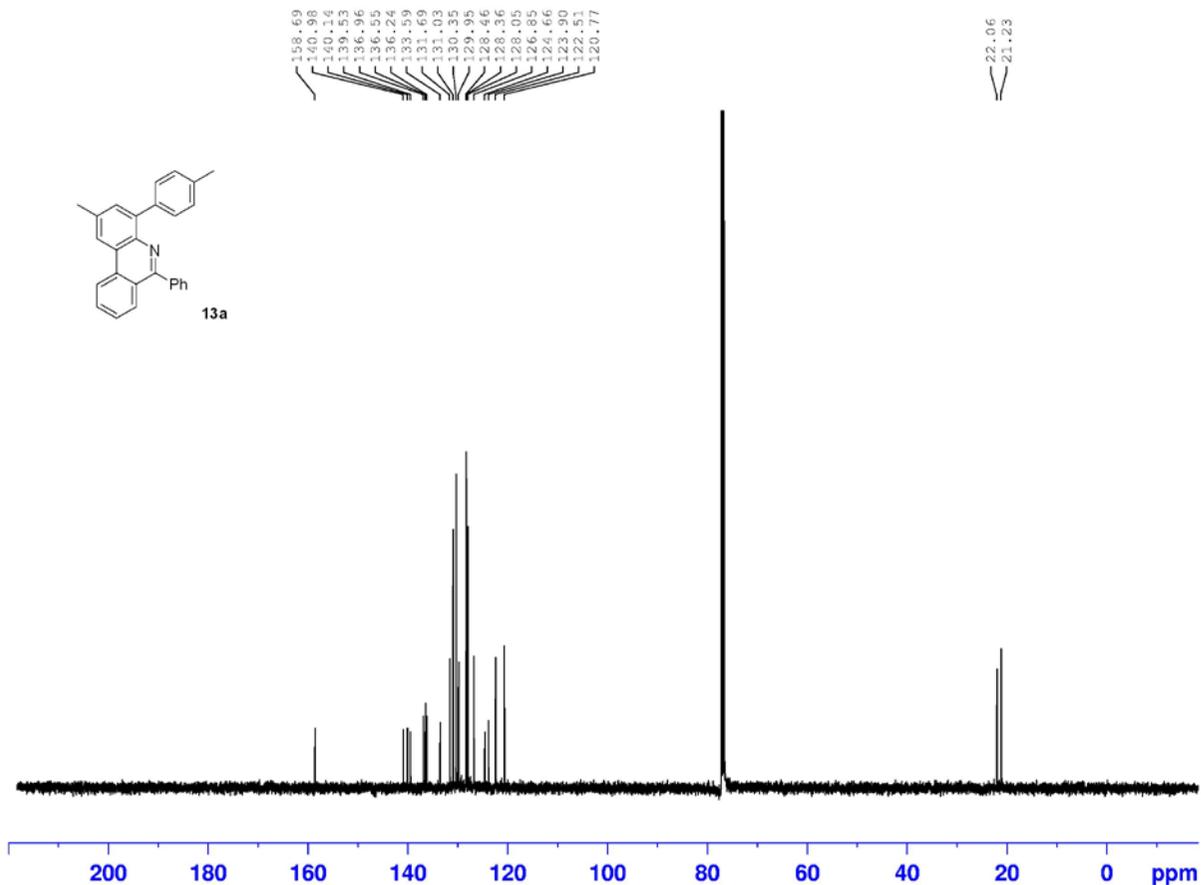
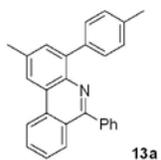
```

NAME          pnmr
EXPNO         3652
PROCNO        1
Date_         20140114
Time         20.56
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1
  
```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300105 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```





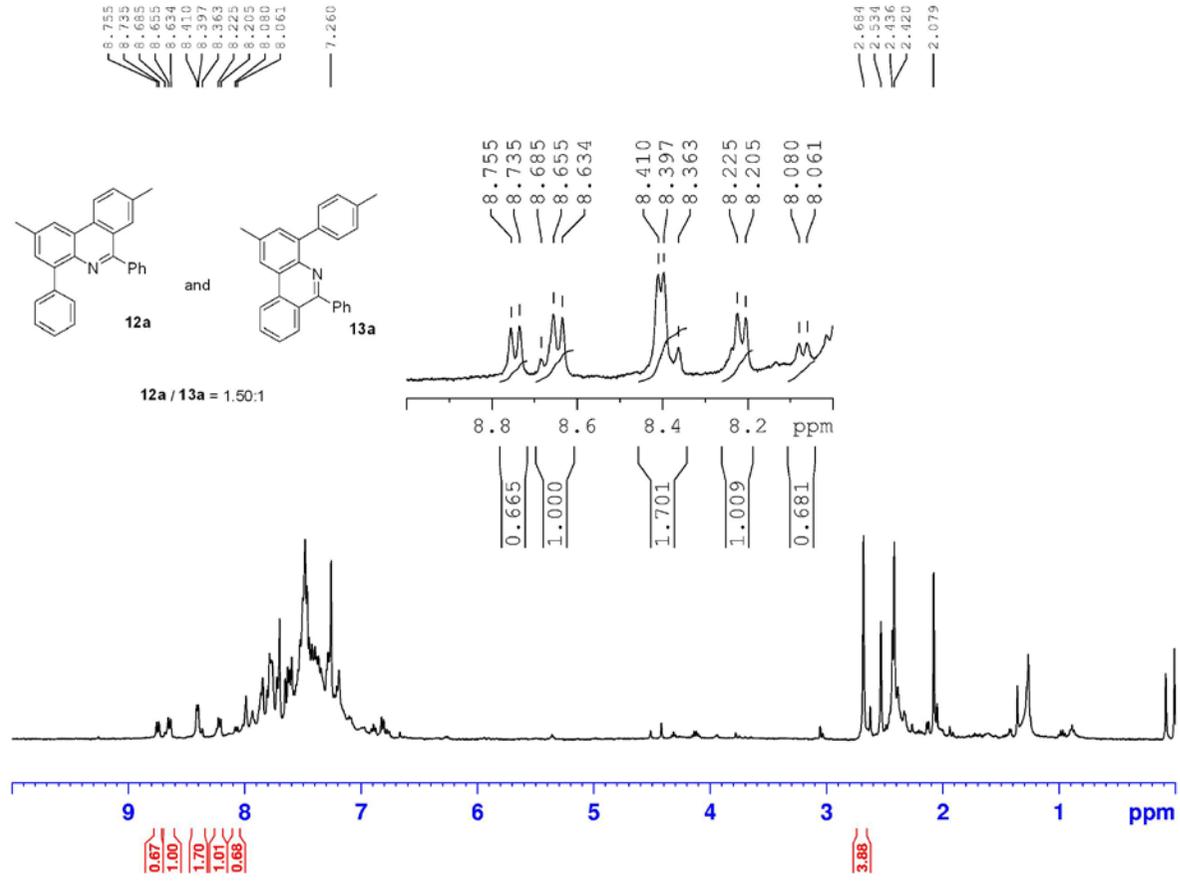
```

NAME          cmr
EXPNO         3652
PROCNO        1
Date_         20140123
Time         21.22
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            899
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

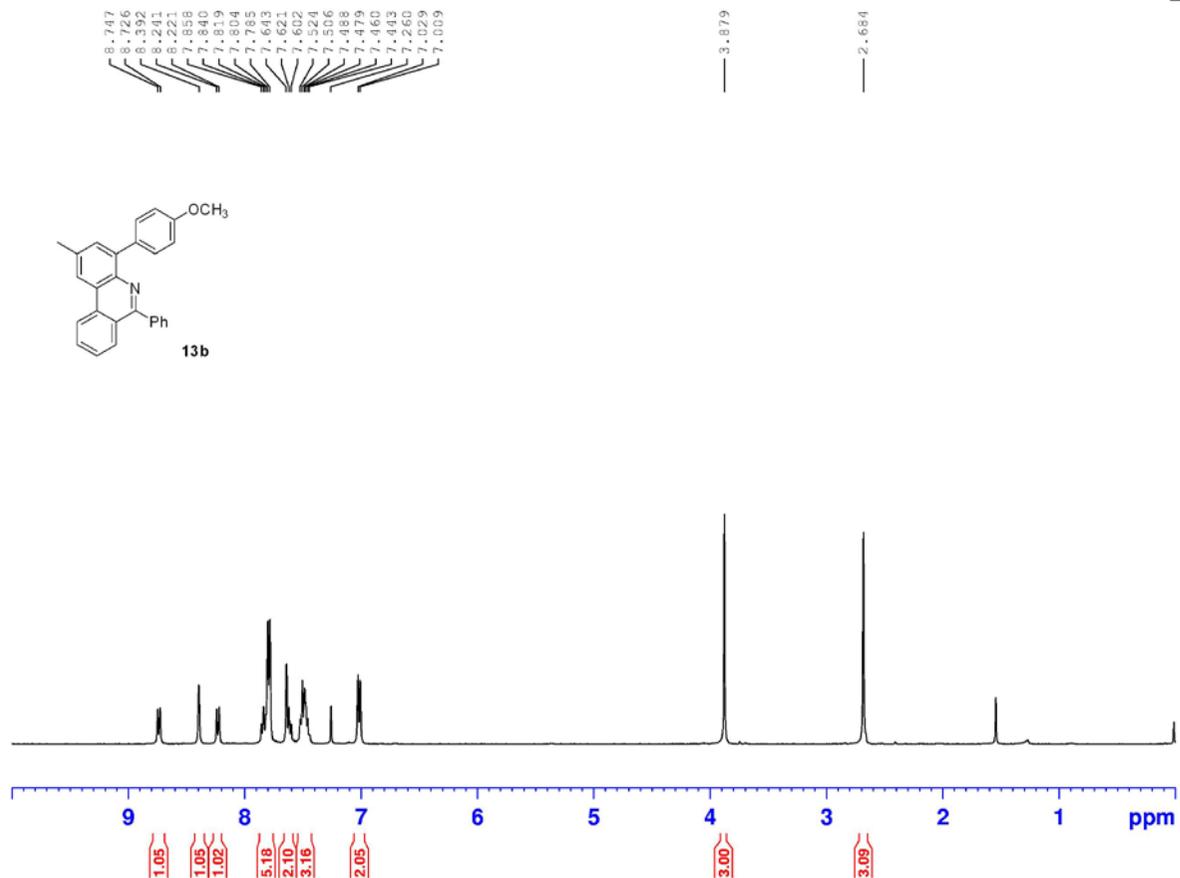
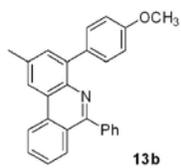
===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1W          13.02339381 W
PL12W         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577950 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



```
NAME          pnmr
EXPNO         3663
PROCNO        1
Date_         20140119
Time          14.36
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            181
DW            60.400 usec
DE            6.50 usec
TE            299.5 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W         10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300098 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```

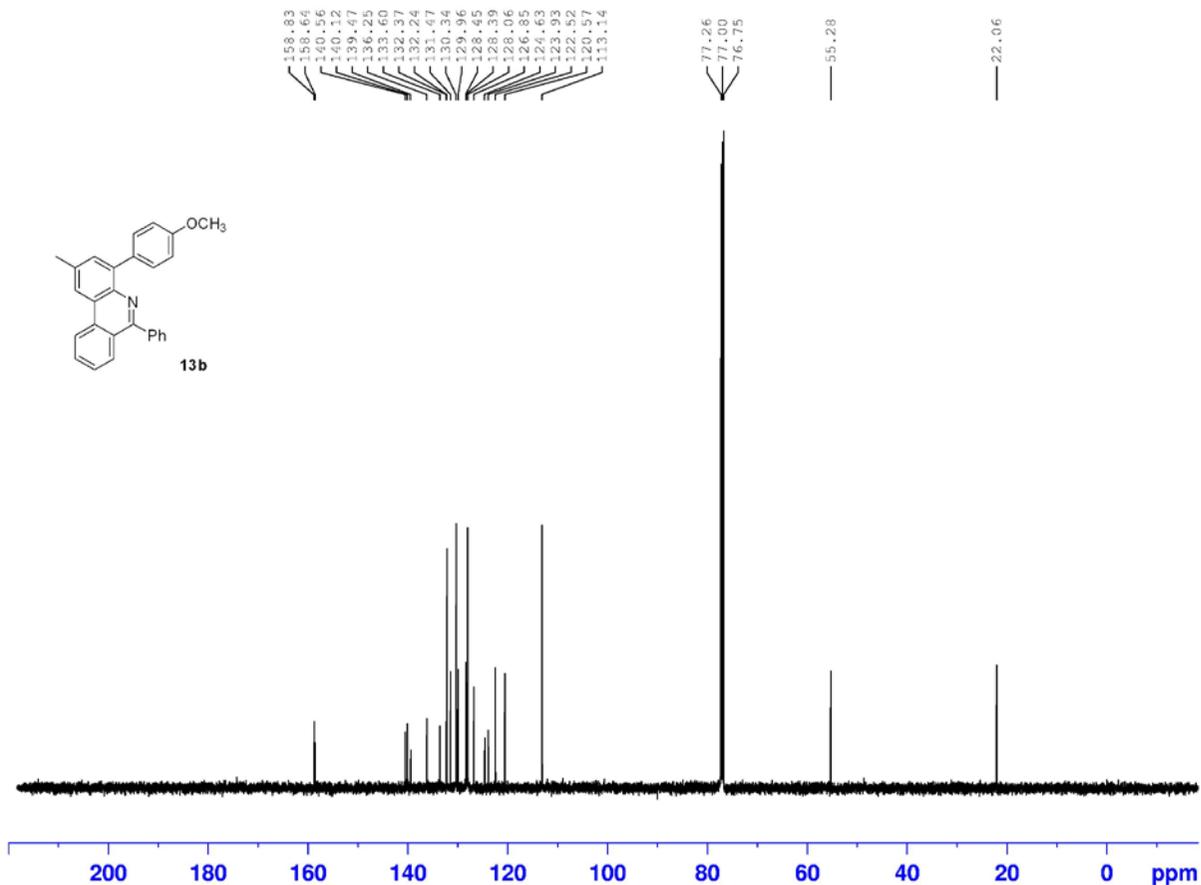
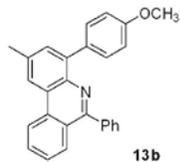


```

NAME          pnmr
EXPNO         36210
PROCNO        1
Date_         20140109
Time          16.39
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            256
DW            60.400 usec
DE            6.50 usec
TE            296.7 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300096 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



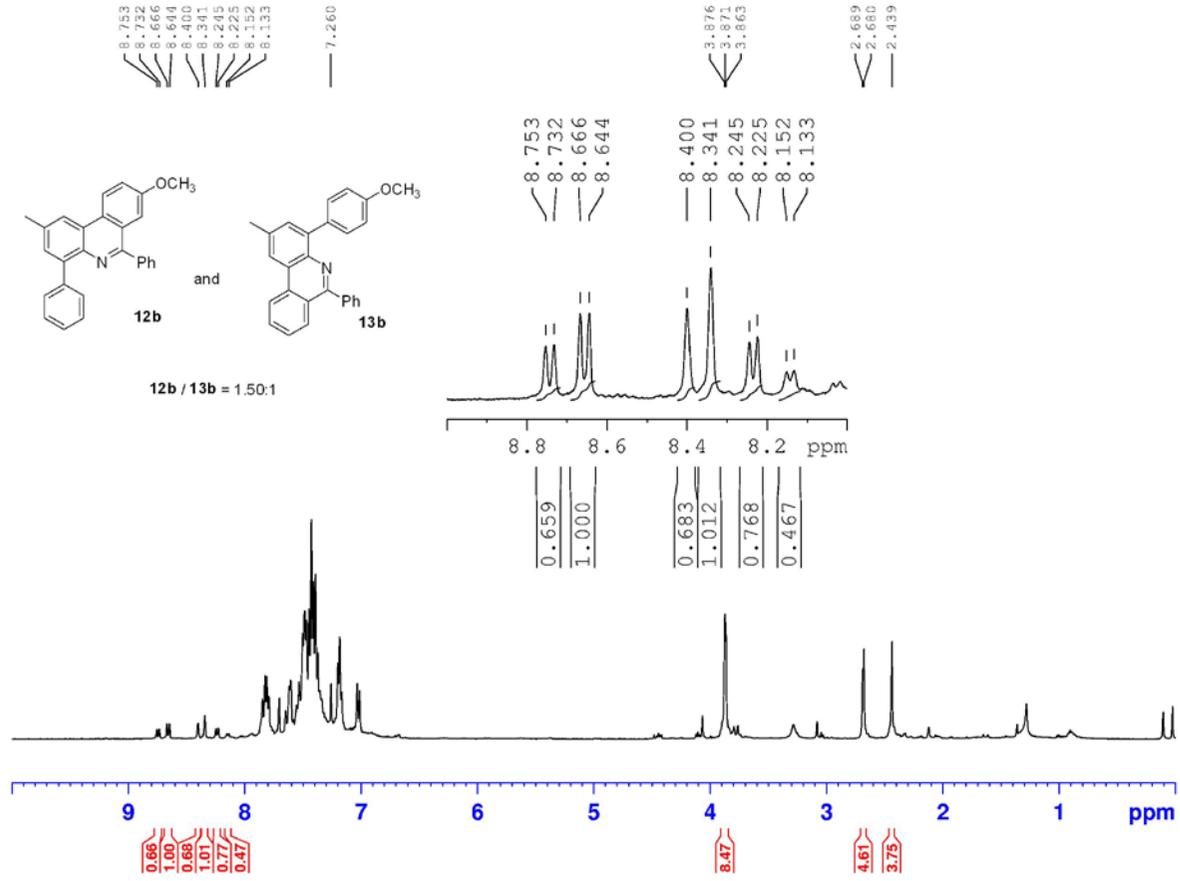
```

NAME          cmr
EXPNO         36210
PROCNO        1
Date_         20140210
Time         16.51
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            304
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TDD           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

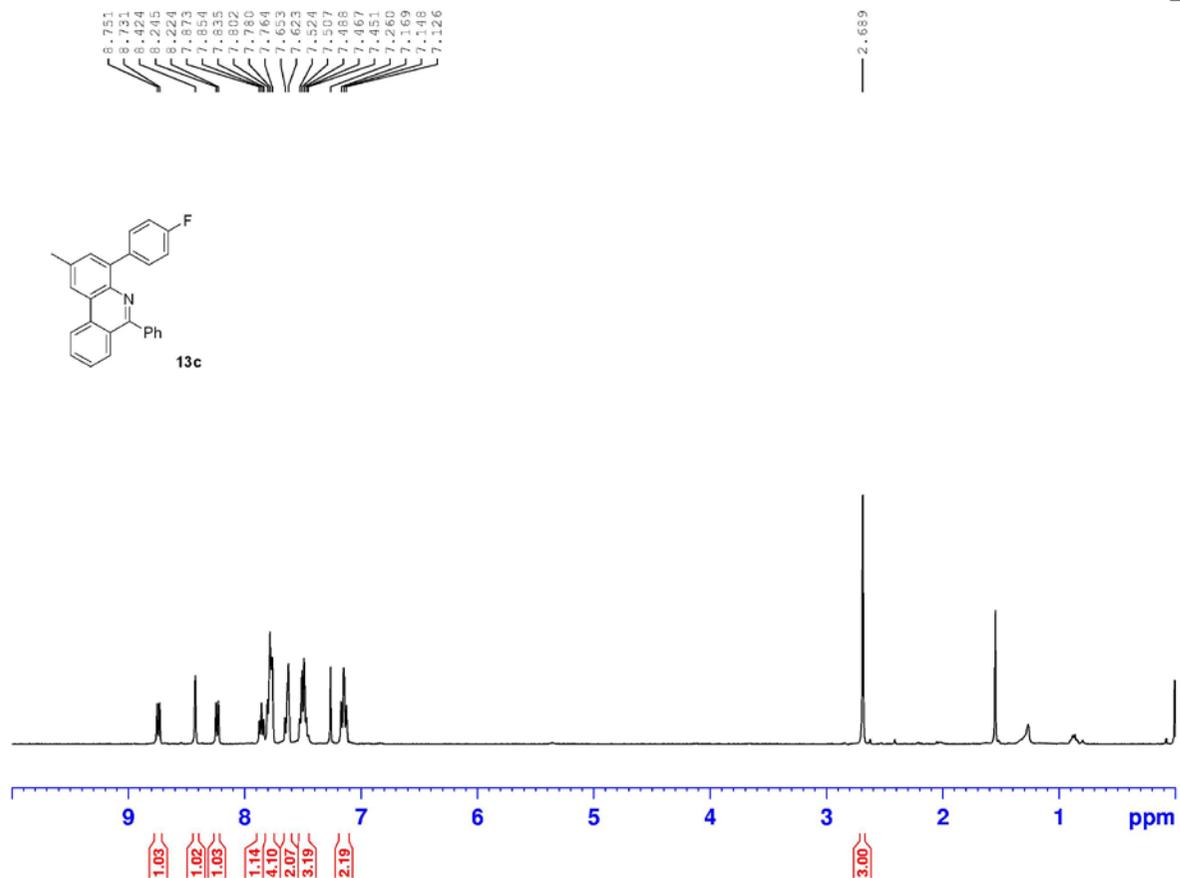
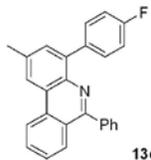
===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1ZM         13.02339381 W
PL1ZW         0.42143556 W
PL13W         0.42143556 W
SFO2          500.1320005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



```

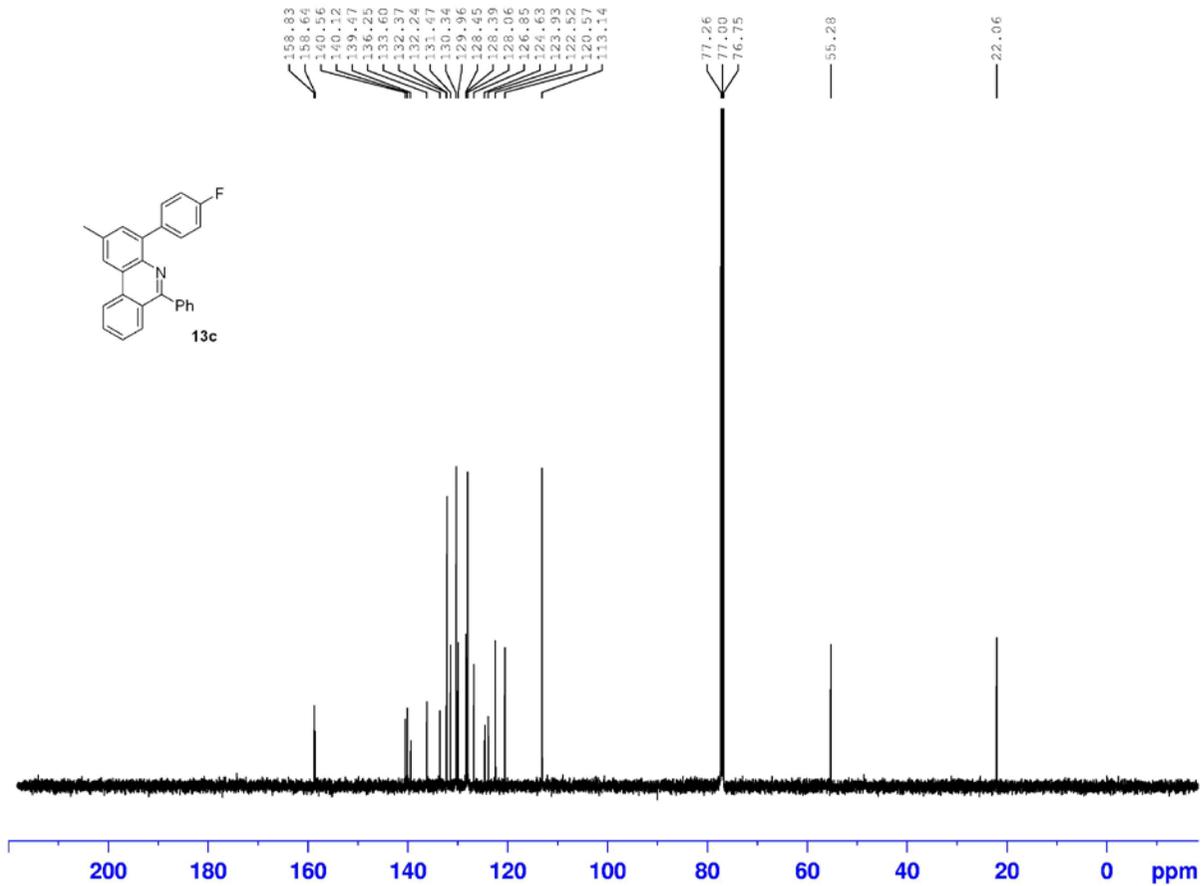
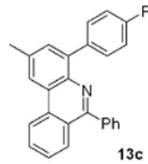
NAME          pnmr
EXPNO         3581
PROCNO        1
Date_         20140110
Time          13.10
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            30.5
DW            60.400 usec
DE            6.50 usec
TE            296.9 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300093 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



```

NAME          pnmr
EXPNO         3622
PROCNO        1
Date_         20140109
Time          19.30
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            296.7 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300092 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



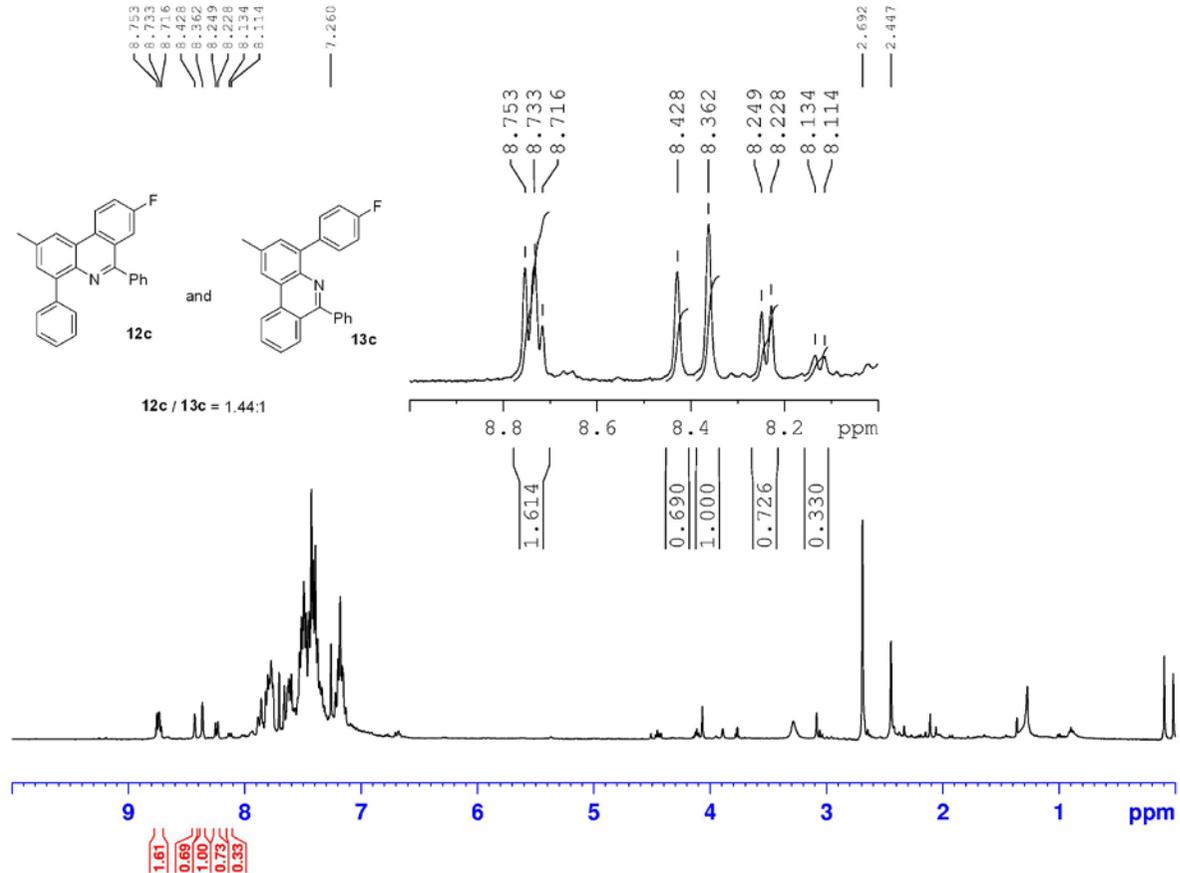
```

NAME          cmmr
EXPNO         36210
PROCNO        1
Date_         20140210
Time         16.51
INSTRUM       Spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            304
DS            4
SWH           29761.904 Hz
FIDRES        0.484131 Hz
AQ            1.1010548 sec
RG            203
DW            16.800 usec
DE            6.50 usec
TE            298.1 K
D1            2.0000000 sec
D11           0.0300000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          13C
P1            13.84 usec
PL1           2.50 dB
PL1W          46.89624786 W
SFO1          125.7703643 MHz

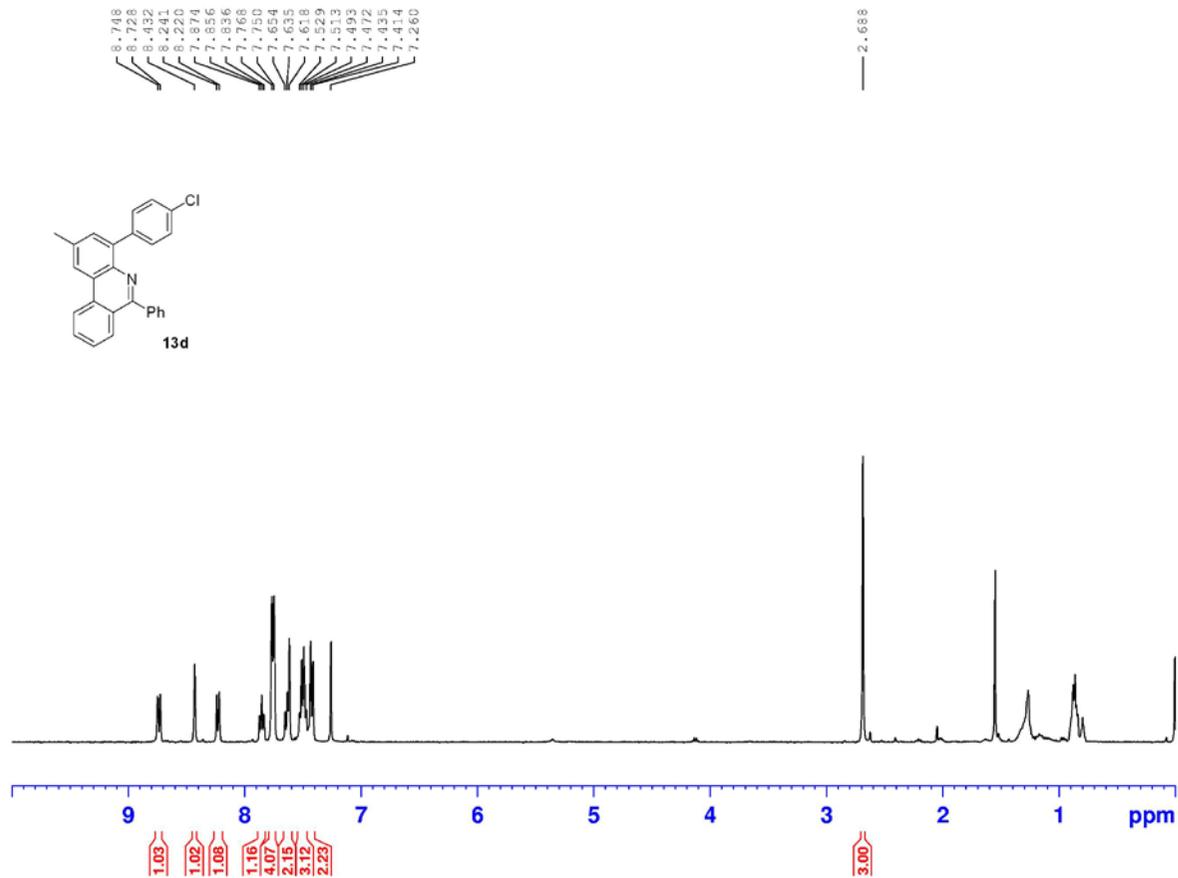
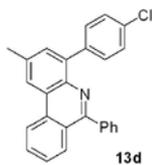
===== CHANNEL f2 =====
CPDPRG2      waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           2.50 dB
PL12          17.40 dB
PL13          17.40 dB
PL1Z          13.02339381 W
PL1ZW         0.42143556 W
PL1ZW         0.42143556 W
SFO2          500.1326005 MHz
SI            32768
SF            125.7577966 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```



```

NAME          pnmr
EXPNO         3582
PROCNO        1
Date_         20140110
Time          13.17
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            114
DW            60.400 usec
DE            6.50 usec
TE            296.9 K
D1            1.00000000 sec
TDO           1
===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300092 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



```

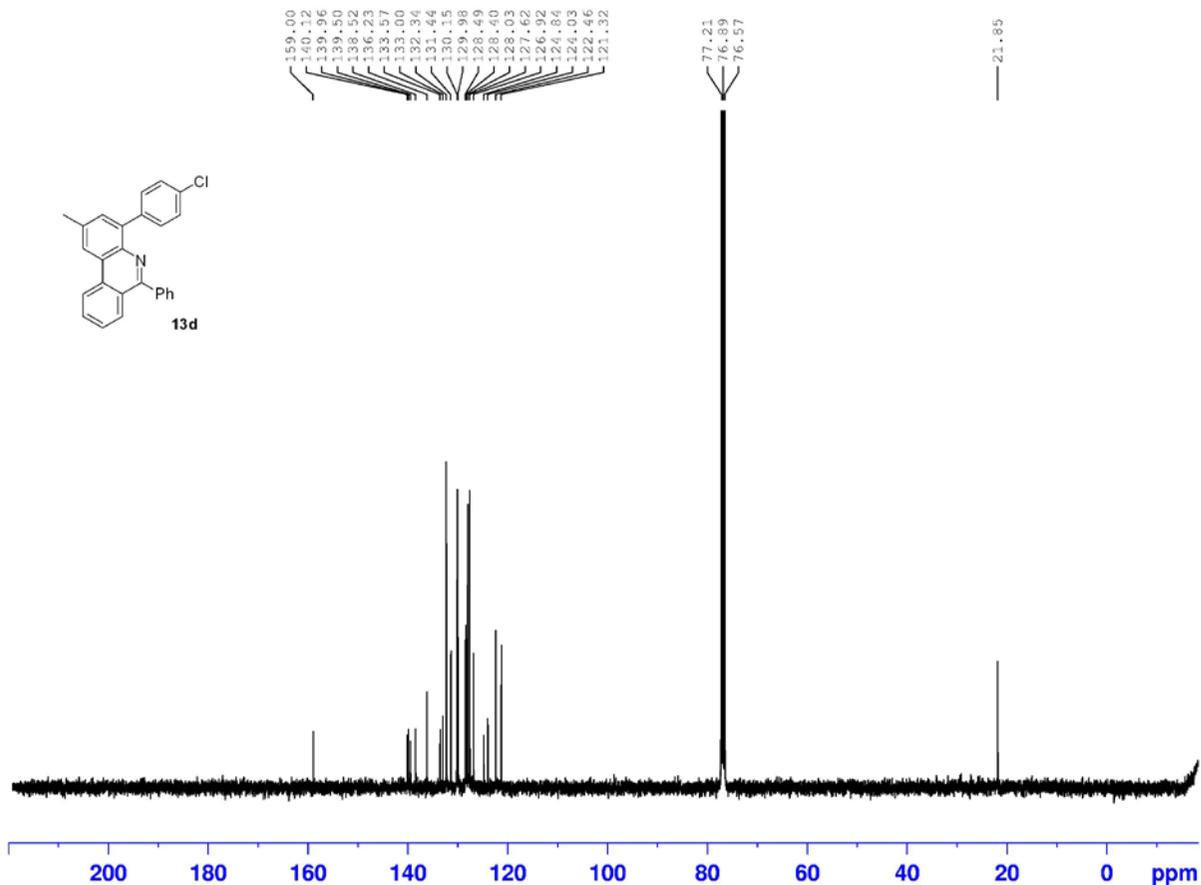
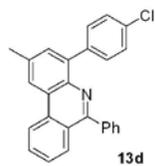
NAME          pnmr
EXPNO         3623
PROCNO        1
Date_         20140109
Time          19.38
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            296.7 K
D1            1.00000000 sec
TDO           1

```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W         10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300091 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



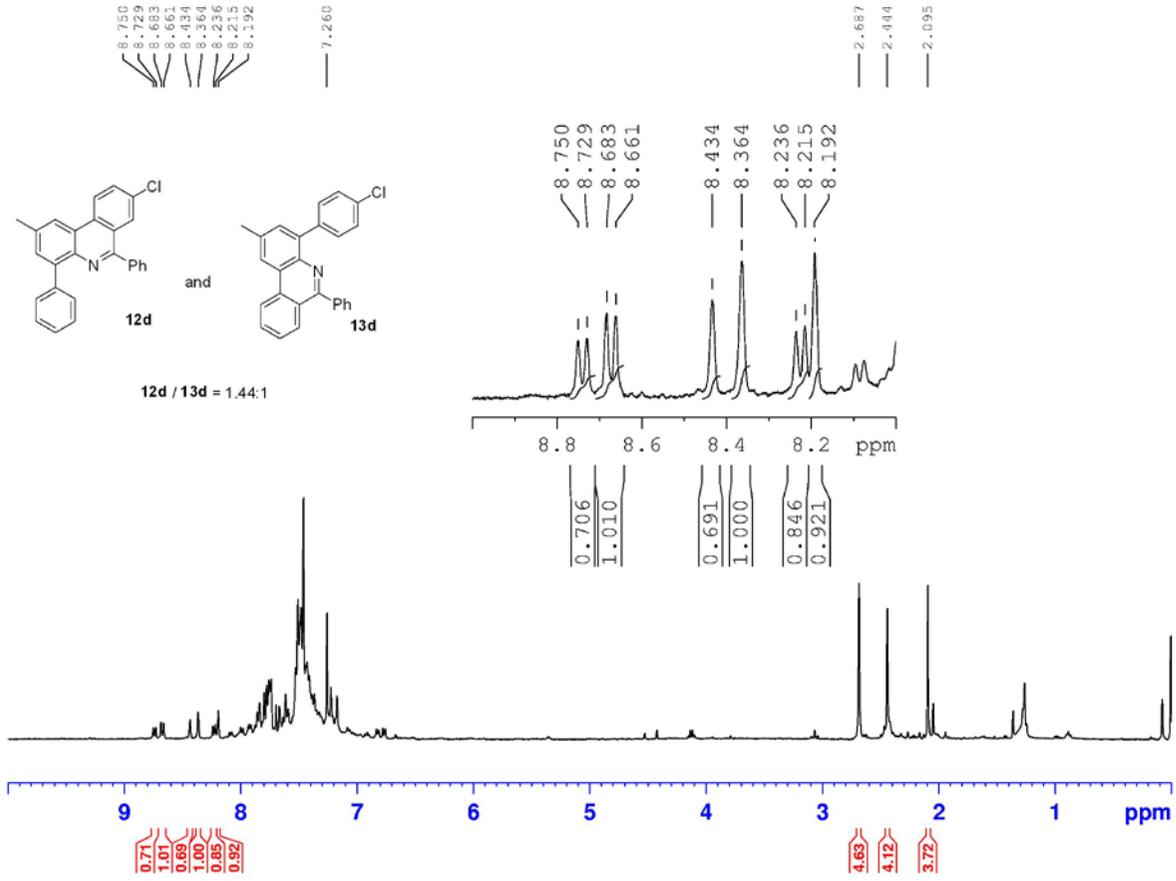
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NAME          cmr
EXPNO         3223
PROCNO        1
Date_         20140210
Time         12.13
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1149.4
DW            20.850 usec
DE            6.50 usec
TE            311.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13          0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

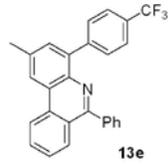
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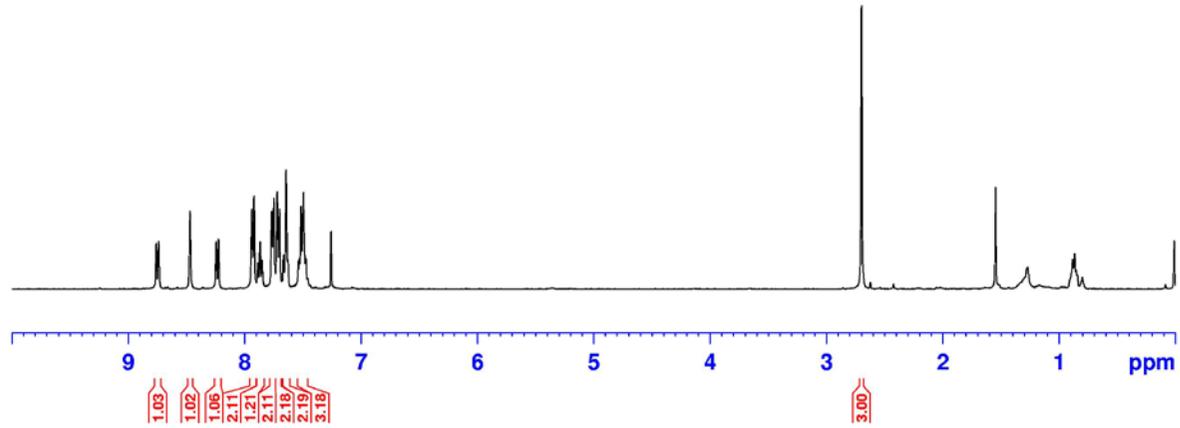
NAME          pnmr
EXPNO         3591
PROCNO        1
Date_         20140103
Time          23.10
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            256
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W         10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300093 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



8.758
8.737
8.717
8.469
8.284
8.223
7.938
7.918
7.885
7.867
7.847
7.767
7.748
7.719
7.699
7.664
7.643
7.627
7.533
7.517
7.498
7.477
7.461
7.260

2.700

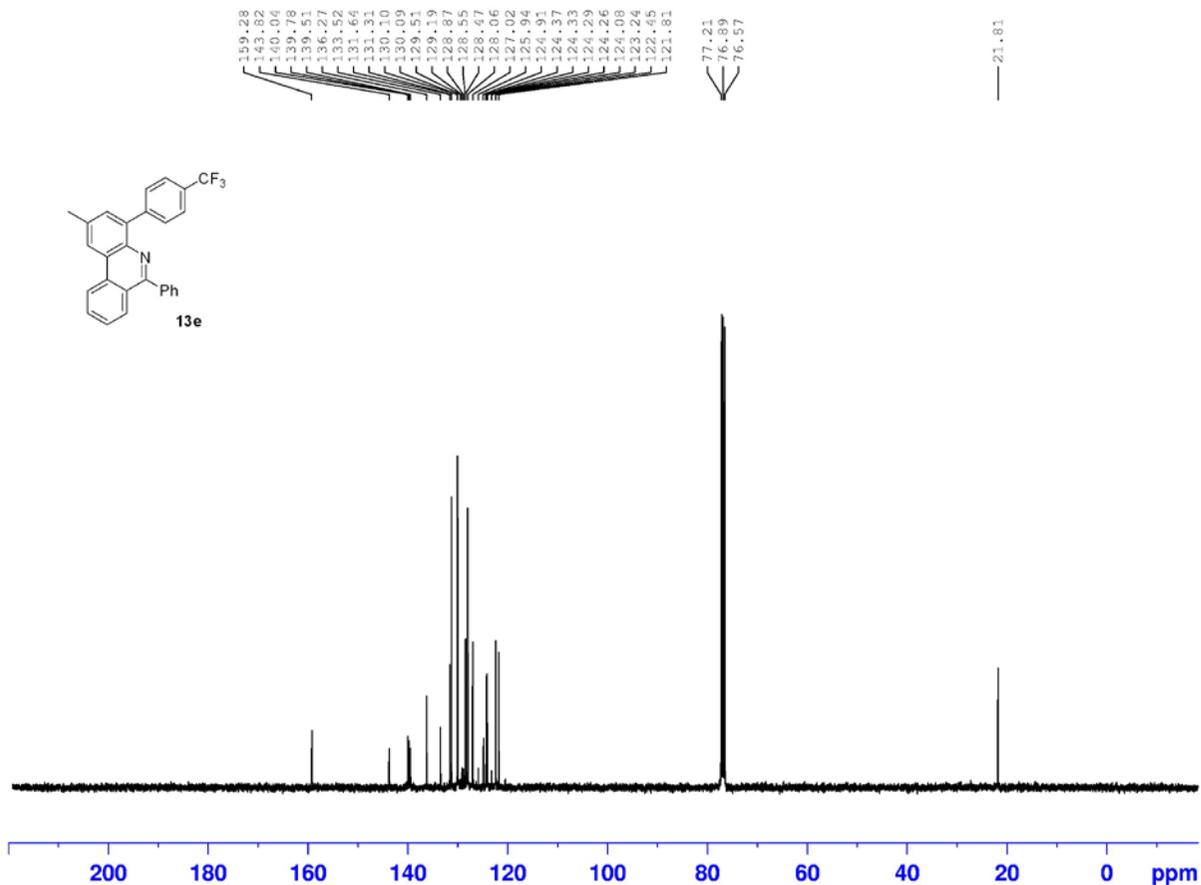
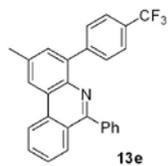


```

NAME          pnmr
EXPNO         3624
PROCNO        1
Date_         20140109
Time          19.45
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            256
DW            60.400 usec
DE            6.50 usec
TE            296.3 K
D1            1.0000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300095 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



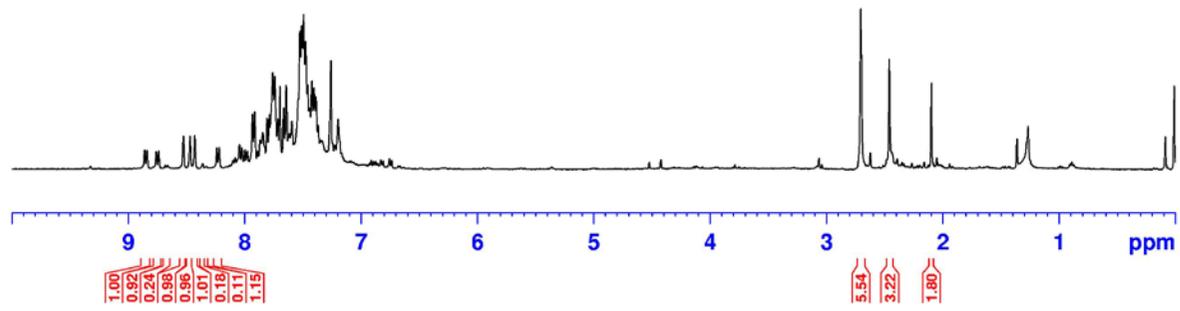
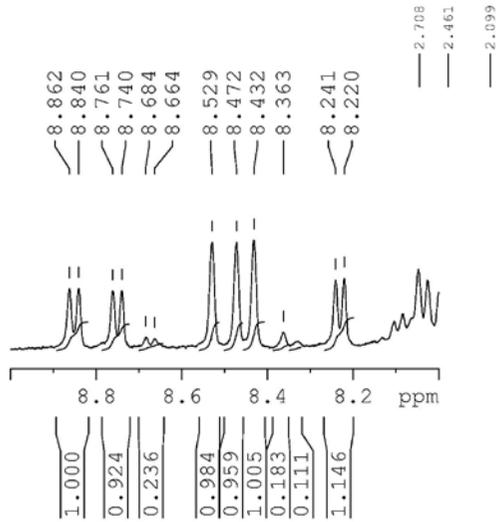
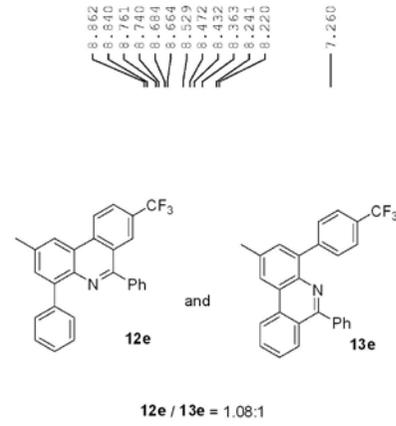
```

NAME          cmr
EXPNO         3624
PROCNO        1
Date_         20140210
Time         13.24
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1625.0
DW            20.850 usec
DE            6.50 usec
TE            312.2 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13          0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

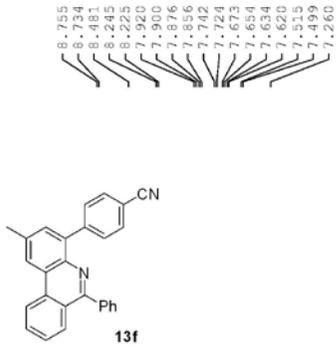
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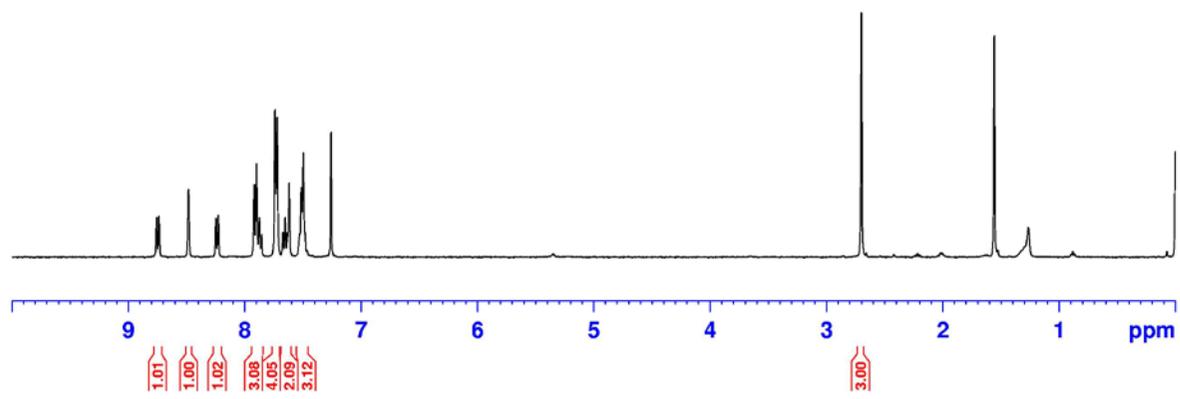
NAME          pnmr
EXPNO         3592
PROCNO        1
Date_         20140103
Time          23.17
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            228.1
DW            60.400 usec
DE            6.50 usec
TE            298.0 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300094 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```



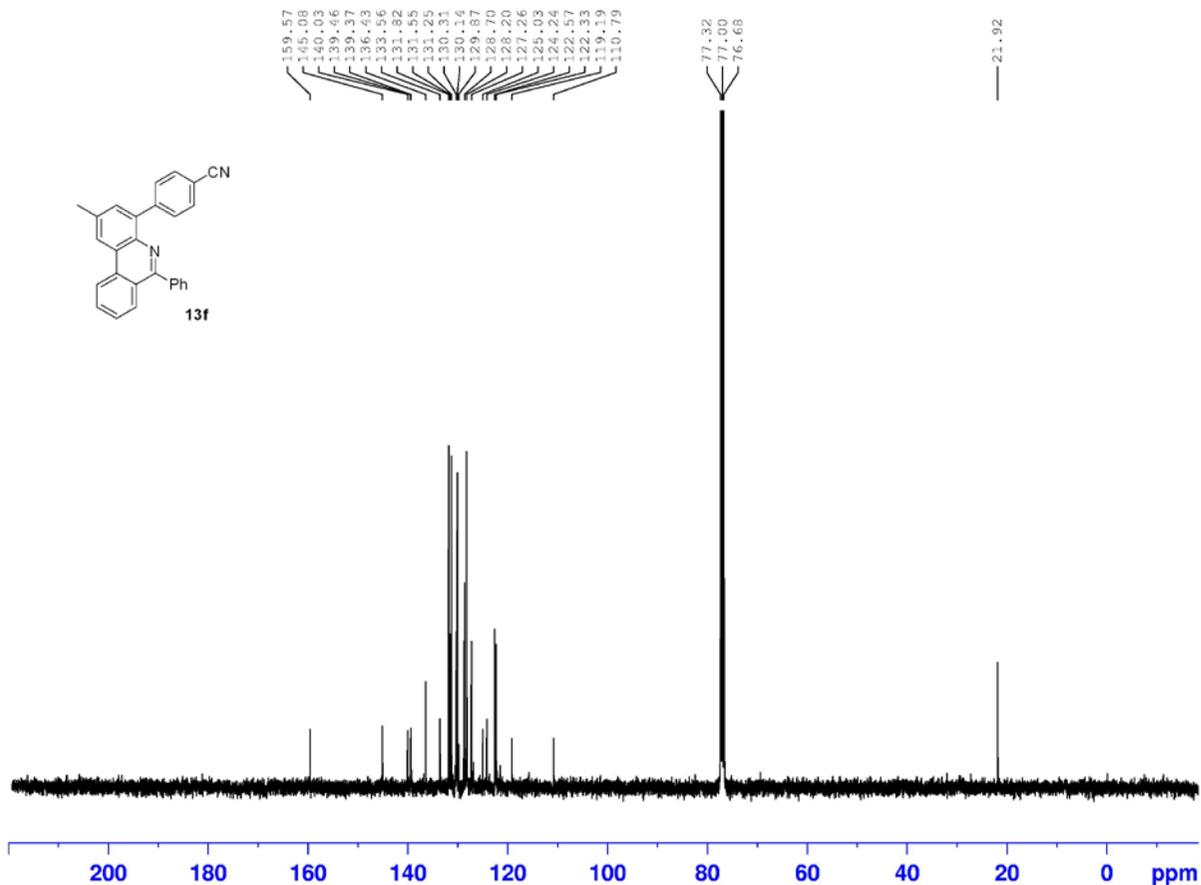
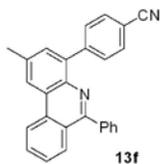
8.755
8.734
8.481
8.245
8.225
7.920
7.900
7.876
7.856
7.742
7.724
7.673
7.654
7.620
7.515
7.499
7.260

— 2.701



```
NAME          pnmr
EXPNO         3625
PROCNO        1
Date_         20140109
Time          15.11
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.124314 Hz
AQ            3.9584243 sec
RG            362
DW            60.400 usec
DE            6.50 usec
TE            296.8 K
D1            1.00000000 sec
TDO           1

===== CHANNEL f1 =====
NUC1          1H
P1            12.58 usec
PL1           0.00 dB
PL1W          10.87646866 W
SFO1          400.1324710 MHz
SI            32768
SF            400.1300096 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```



```

NAME          cmr
EXPNO         3625
PROCNO        1
Date_         20140210
Time          14.08
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
ID            65536
SOLVENT       CDCl3
NS            1024
DS            4
SWH           23900.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            1625.0
DW            20.850 usec
DE            6.50 usec
TE            312.7 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1          13C
P1            10.25 usec
PL1           0.00 dB
PL1W          38.68305206 W
SFO1          100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           0.00 dB
PL12          16.07 dB
PL13          0.00 dB
PL2W          10.87646866 W
PL12W         0.26883632 W
PL13W         10.87646866 W
SFO2          400.1316005 MHz
SI            32768
SF            100.6127575 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

