

## Supporting information

### Direct synthesis of aryl-annulated [c]carbazoles by gold(I)-catalysed cascade reaction of azide-diyne and arenes

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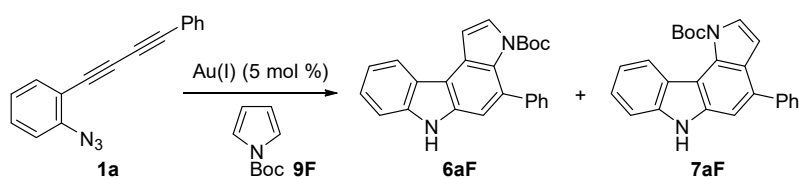
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**Table S1.** Reaction Optimisation Using *N*-Boc-pyrrole <sup>a</sup>

Entry	Catalyst	Solvent	Temperature (°C)	Condition	Time (h)	Yield <sup>b</sup> (%)	Ratio <sup>c</sup> (6:7)
1	Ph <sub>3</sub> PAuCl/AgNTf <sub>2</sub>	TCE	110		24	<5 <sup>d</sup>	87 : 13
2	IPrAuCl/AgNTf <sub>2</sub>	TCE	110		1	60	91 : 9
3	JohnPhosAuCl/AgNTf <sub>2</sub>	TCE	110		1	56	92 : 8
4	XPhosAuCl/AgNTf <sub>2</sub>	TCE	110		1	62	93 : 7
5	BrettPhosAuCl/AgNTf <sub>2</sub>	TCE	110		1	55	94 : 6
6	BrettPhosAuCl/AgSbF <sub>6</sub>	TCE	110		3	51	89 : 11
7	BrettPhosAuCl/AgOTf	TCE	110		20	<12 <sup>d</sup>	75 : 25
8	<b>BrettPhosAu(MeCN)SbF<sub>6</sub></b>	<b>TCE</b>	<b>110</b>	<b>C</b>	<b>0.5</b>	<b>58</b>	<b>95 : 5</b>
9	BrettPhosAuNTf <sub>2</sub>	TCE	110		0.5	58	95 : 5
10	<b>BrettPhosAu(MeCN)SbF<sub>6</sub></b>	<b>DCE</b>	<b>80</b>	<b>D</b>	<b>1.5</b>	<b>60</b>	<b>92 : 8</b>
11	BrettPhosAu(MeCN)SbF <sub>6</sub>	toluene	80		24	37	88 : 12
12	BrettPhosAu(MeCN)SbF <sub>6</sub>	MeCN	80		30	<48 <sup>d</sup>	87 : 13
13	BrettPhosAu(MeCN)SbF <sub>6</sub>	EtOH	reflux		24	<36 <sup>d</sup>	52 : 48
14	BrettPhosAu(MeCN)SbF <sub>6</sub>	AcOH	80		2	<49 <sup>d</sup>	53 : 47
15	BrettPhosAu(MeCN)SbF <sub>6</sub>	DCE	RT		72	59	72 : 28
16	BrettPhosAu(MeCN)SbF <sub>6</sub>	DCE	50		10	62	90 : 10
17	BrettPhosAu(MeCN)SbF <sub>6</sub>	TCE	140		0.25	51	91 : 9

<sup>a</sup> Reaction conditions: **9F** (5 equiv.), gold catalyst (5 mol %). <sup>b</sup> Combined isolated yields. <sup>c</sup> Determined by <sup>1</sup>H NMR spectroscopy. <sup>d</sup> Contained small amounts of impurities.

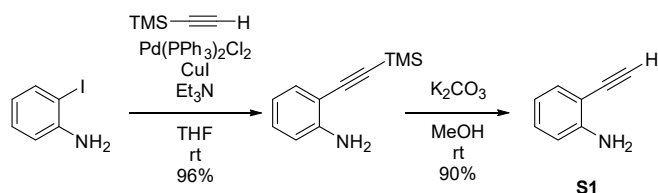
## Experimental Section

### 1. General Methods

IR spectra were determined on a JASCO FT/IR-4100 spectrometer. Exact mass (HRMS) spectra were recorded on JMS-HX/HX 110A mass spectrometer or Shimadzu LC-ESI-IT-TOF-MS equipment.  $^1\text{H}$  NMR spectra were recorded using a JEOL AL-400 or JEOL AL-500 spectrometer at 500 MHz frequency. Chemical shifts are reported in  $\delta$  (ppm) relative to  $\text{Me}_4\text{Si}$  (in  $\text{CDCl}_3$ ) as internal standard.  $^{13}\text{C}$  NMR spectra were recorded using a JEOL AL-500 and referenced to the residual solvent signal. Melting points were measured by a hot stage melting points apparatus (uncorrected). For column chromatography, silica gel (Wakogel C-200: Wako Pure Chemical Industries, Ltd), and amine silica gel (CHROMATOREX NH-DM1020: Fuji Silysia Chemical Ltd) were employed.

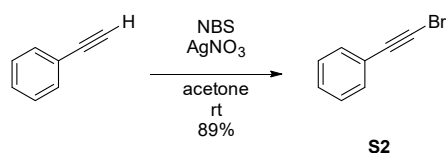
### 2. Preparation of the Cyclisation Precursors

#### 2-Ethynylaniline (**S1**)<sup>1,2</sup>



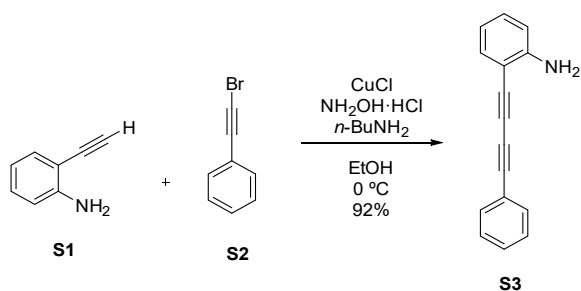
A mixture of 2-iodoaniline (4.38 g, 20.0 mmol), TMS acetylene (3.39 mL, 24.0 mmol),  $\text{PdCl}_2(\text{PPh}_3)_2$  (337 mg, 0.48 mmol),  $\text{CuI}$  (91.4 mg, 0.48 mmol), and  $\text{Et}_3\text{N}$  (13.9 mL, 100 mmol) in THF (20 mL) was stirred at room temperature under Ar for 3 h. The mixture was filtered through a pad of Celite and concentrated in vacuo. The residue was purified by column chromatography on silica gel (hexane/EtOAc = 20/1) to give 2-[(trimethylsilyl)ethynyl]aniline<sup>2</sup> (3.65 g, 96%) as an orange oil. To a solution of this oil (1.70 g, 9.00 mmol) in MeOH (30 mL) was added  $\text{K}_2\text{CO}_3$  (410 mg, 2.97 mmol). The reaction mixture was stirred at room temperature for 2 h and concentrated in vacuo. The residue was diluted with  $\text{H}_2\text{O}$ . The organic layer was washed with  $\text{H}_2\text{O}$  and brine, dried over  $\text{MgSO}_4$ , filtered, and concentrated in vacuo to give **S1** (951 mg, 90%) as a brown oil. The spectral data were in good agreement with those previously reported.<sup>2</sup>

#### (Bromoethynyl)benzene (**S2**)<sup>1,3</sup>



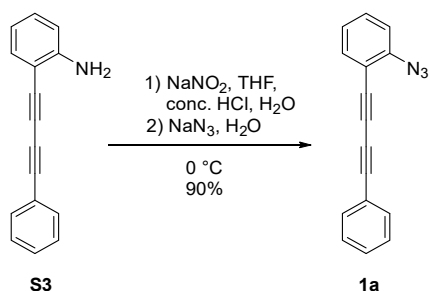
To a solution of ethynylbenzene (1.27 mL, 10.0 mmol) in acetone (50 mL) were added NBS (1.96 g, 11.0 mmol) and  $\text{AgNO}_3$  (170 mg, 1.00 mmol). The mixture was stirred at room temperature for 7 h. The mixture was diluted with *n*-hexane and filtered through a pad of silica gel. The filtrate was concentrated in vacuo to give **S2** (1.74 g, 89%) as a brown oil. The spectral data were in good agreement with those previously reported.<sup>3</sup>

## 2-(Phenylbuta-1,3-diyn-1-yl)aniline (**S3**)<sup>1,4a</sup>



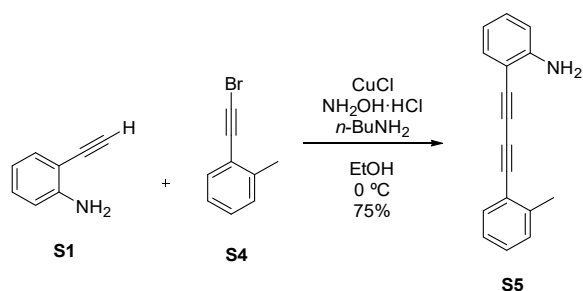
To a mixture of **S1** (1.06 g, 9.09 mmol), CuCl (45.0 mg, 0.455 mmol), NH<sub>2</sub>OH·HCl (253 mg, 3.64 mmol), and *n*-BuNH<sub>2</sub> (2.26 mL, 22.8 mmol) in dry EtOH (22.8 mL) was added a solution of **S2** (2.14 g, 11.8 mmol) in dry EtOH (4.55 mL) via dropping funnel at 0 °C under Ar.<sup>4b</sup> The mixture was stirred at room temperature for 1.5 h and concentrated in vacuo. The residue was diluted with Et<sub>2</sub>O. The organic layer was washed with saturated aqueous NH<sub>4</sub>Cl, H<sub>2</sub>O, and brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated in vacuo. The filtrate was purified by column chromatography on silica gel (hexane/EtOAc = 10/1) to give **S3** (1.80 g, 92%) as a light yellow powder. The spectral data were in good agreement with those previously reported<sup>4a</sup>: <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 4.32 (s, 2H), 6.69–6.70 (m, 2H), 7.16 (dd, *J* = 7.5, 1.5 Hz, 1H), 7.32–7.39 (m, 4H), 7.52–7.54 (m, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 73.9, 78.7, 78.9, 82.6, 105.7, 114.2, 117.7, 121.5, 128.3 (2C), 129.0, 130.5, 132.2 (2C), 132.8, 149.5.

## 1-Azido-2-(phenylbuta-1,3-diyn-1-yl)benzene (**1a**)<sup>1,5</sup>



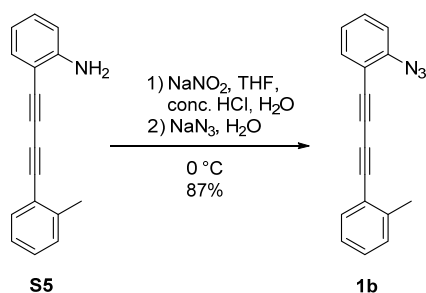
A solution of **S3** (1.09 g, 5.00 mmol) in THF/H<sub>2</sub>O/conc. HCl (1/1/1, 10.0 mL) was cooled to 0 °C. To the solution was added NaNO<sub>2</sub> (690 mg, 10.0 mmol) in H<sub>2</sub>O (10.0 mL) via dropping funnel at 0 °C. After the mixture was stirred at 0 °C for 15 min, NaN<sub>3</sub> (650 mg, 10.0 mmol) in H<sub>2</sub>O (10.0 mL) was slowly added to the mixture at 0 °C,<sup>6</sup> and the mixture was stirred for 3 h. The reaction mixture was quenched with H<sub>2</sub>O. The resulting mixture was extracted with EtOAc twice. The combined organic layer was washed with brine, dried over MgSO<sub>4</sub>, filtered, and concentrated in vacuo. The residue was purified by column chromatography on silica gel (hexane/EtOAc = 20/1) to give **1a** (1.09 g, 90%) as a light yellow powder: mp 93–96 °C; IR (neat) 2130, 2100; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 7.11 (t, *J* = 7.0 Hz, 1H), 7.15 (d, *J* = 8.5 Hz, 1H), 7.33–7.41 (m, 4H), 7.50–7.54 (m, 3H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 73.6, 77.0, 79.3, 83.3, 113.8, 118.5, 121.6, 124.6, 128.4 (2C), 129.3, 130.4, 132.5 (2C), 134.4, 142.6; HRMS (ESI) calcd for C<sub>16</sub>H<sub>10</sub>N<sub>3</sub> [M+H]<sup>+</sup>: 244.0869, found 244.0867.

### 2-(*o*-Tolylbuta-1,3-diyn-1-yl)aniline (S5)



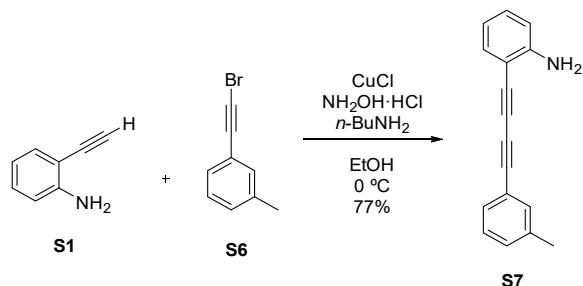
By a procedure identical with that described for the preparation of **S3**, **S1** (451 mg, 3.85 mmol) was converted to **S5** (671 mg, 75%) by the reaction with **S4** (983 mg, 5.04 mmol): yellow powder; mp 100–101.5 °C; IR (neat) 3479, 3392, 2211, 2137; <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ: 2.49 (s, 3H), 4.32 (s, 2H), 6.67–6.71 (m, 2H), 7.14–7.18 (m, 2H), 7.21–7.28 (m, 2H) 7.35 (d, *J* = 8.0 Hz, 1H), 7.49 (d, *J* = 7.6 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 20.7, 77.4, 79.1 (2C), 81.7, 106.2, 114.4, 117.9, 121.6, 125.7, 129.1, 129.6, 130.6, 132.8, 133.1, 141.6, 149.5; HRMS (ESI) calcd for C<sub>17</sub>H<sub>14</sub>N [M+H]<sup>+</sup>: 232.1126, found 232.1114

### 1-Azido-2-(*o*-tolylbuta-1,3-diyn-1-yl)benzene (1b)



By a procedure identical with that described for the preparation of **1a**, **S5** (550 mg, 2.38 mmol) was converted to **1b** (530 mg, 87%): light yellow powder: mp 61–63 °C; IR (neat) 2127, 2094; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.49 (s, 3H), 7.09–7.17 (m, 3H), 7.20–7.28 (m, 2H), 7.38 (ddd, *J* = 7.9, 7.9, 1.5 Hz, 1H), 7.49–7.52 (m, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 20.7, 77.1, 77.5, 79.4, 82.4, 113.9, 118.5, 121.4, 124.6, 125.6, 129.3, 129.6 (2C), 130.3, 134.4, 141.8, 142.5; HRMS (FAB) calcd for C<sub>17</sub>H<sub>12</sub>N<sub>3</sub> [M+H]<sup>+</sup>: 258.1031, found 258.1026.

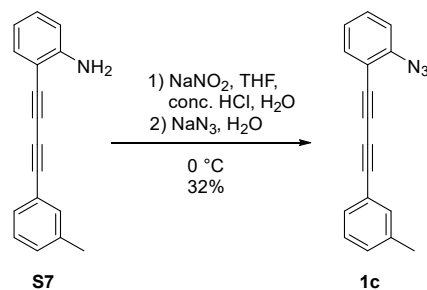
### 2-(*m*-Tolylbuta-1,3-diyn-1-yl)aniline (S7)



By a procedure identical with that described for the preparation of **S3**, **S1** (421 mg, 3.59 mmol) was converted to **S7** (637 mg, 77%) by the reaction with **S6** (912 mg, 4.67 mmol): yellow powder; mp 67–69 °C; IR (neat) 3476, 3378, 2207, 2136; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.34 (s, 3H), 4.32 (s, 2H), 6.66–6.70 (m, 2H), 7.13–7.26 (m, 3H),

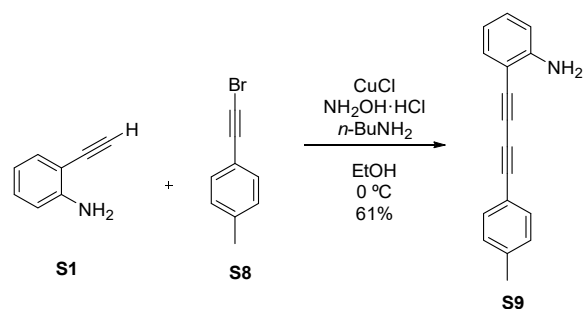
7.32-7.35 (m, 3H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 21.2, 73.5, 78.4, 79.1, 82.9, 106.2, 114.4, 117.9, 121.6, 128.3, 129.5, 130.1, 130.6, 133.0, 133.1, 138.2, 149.5; HRMS (ESI) calcd for  $\text{C}_{17}\text{H}_{14}\text{N}$   $[\text{M}+\text{H}]^+$ : 232.1126, found 232.1127

### 1-Azido-2-(*m*-tolylbuta-1,3-diyn-1-yl)benzene (**1c**)



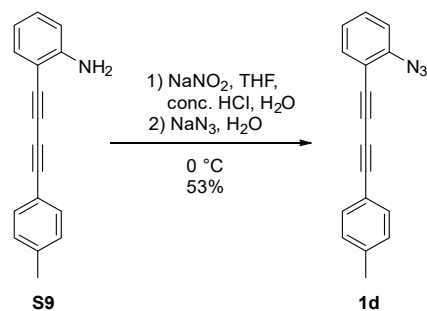
By a procedure identical with that described for the preparation of **1a**, **S7** (500 mg, 2.16 mmol) was converted to **1c** (180 mg, 32%): beige powder; mp  $70\text{--}71\text{ }^\circ\text{C}$ ; IR (neat) 2126, 2094;  $^1\text{H}$ -NMR ( $\text{CDCl}_3$ )  $\delta$ : 2.34 (s, 3H), 7.09-7.12 (m, 1H), 7.15 (d,  $J = 7.5$  Hz, 1H), 7.19 (d,  $J = 8.0$  Hz, 1H), 7.21 (dd,  $J = 8.0, 8.0$  Hz, 1H), 7.33-7.35 (m, 2H), 7.38 (ddd,  $J = 8.0, 8.0, 1.5$  Hz, 1H), 7.50 (dd,  $J = 8.0, 1.5$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 21.7, 73.0, 76.6, 79.5, 83.6, 114.0, 118.5 (2C), 124.7, 129.2 (2C), 130.3, 132.4 (2C), 134.4, 139.8, 142.5; HRMS (FAB) calcd for  $\text{C}_{17}\text{H}_{12}\text{N}_3$   $[\text{M}+\text{H}]^+$ : 258.1031, found 258.1037.

### 2-(*p*-Tolylbuta-1,3-diyn-1-yl)aniline (**S9**)<sup>4a</sup>



By a procedure identical with that described for the preparation of **S3**, **S1** (805 mg, 6.87 mmol) was converted to **S9** (966 mg, 61%) by the reaction with **S8** (2.14 g, 11.8 mmol): yellow powder. The spectral data were in good agreement with those previously reported.<sup>4a</sup>

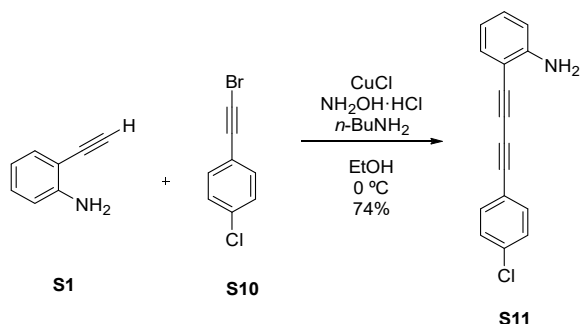
### 1-Azido-2-(*p*-tolylbuta-1,3-diyn-1-yl)benzene (**1d**)



By a procedure identical with that described for the preparation of **1a**, **S9** (966 mg, 4.18 mmol) was converted to **1d** (570 mg, 53%): yellow powder; mp  $100\text{--}102\text{ }^\circ\text{C}$ ; IR (neat) 2116, 2092;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 2.37 (s,

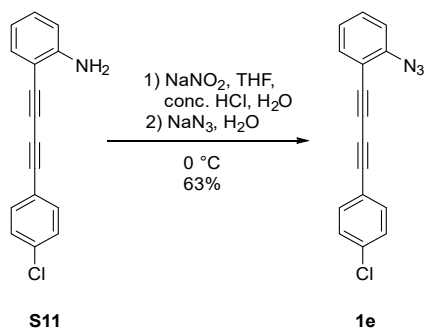
3H), 7.08-7.15 (m, 1H), 7.13-7.15 (m, 3H), 7.36-7.39 (m, 1H), 7.42-7.44 (m, 2H), 7.50 (dd,  $J = 7.7, 1.4$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 21.6, 73.0, 76.6, 79.5, 83.6, 114.0, 118.5 (2C), 124.6, 129.2 (3C), 130.2, 134.4 (2C), 139.8, 142.5; HRMS (FAB) calcd for  $\text{C}_{17}\text{H}_{12}\text{N}_3$   $[\text{M}+\text{H}]^+$ : 258.1031, found 258.1026.

### 2-[(4-Chlorophenyl)buta-1,3-diyne-1-yl]aniline (S11)



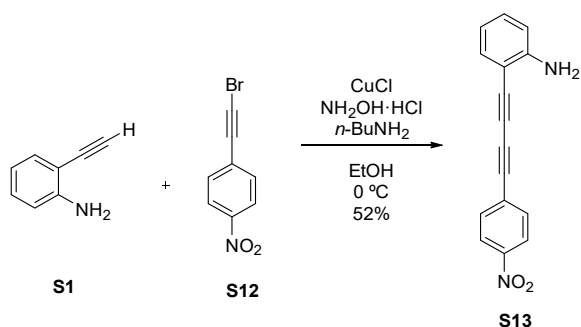
By a procedure identical with that described for the preparation of **S3**, **S1** (389 mg, 3.32 mmol) was converted to **S11** (617 mg, 74%) by the reaction with **S10** (932 mg, 4.32 mmol): yellow powder; mp 134-136 °C; IR (neat) 3477, 3378, 2206, 2139;  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$ : 4.31 (s, 2H), 6.67-6.71 (m, 2H), 7.17 (dd,  $J = 8.8, 8.0$  Hz, 1H), 7.31-7.35 (m, 3H), 7.45 (dd,  $J = 6.7, 2.0$  Hz, 2H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 74.9, 78.8, 79.2, 81.4, 105.9, 114.4, 118.0, 120.4, 128.9 (2C), 130.8, 133.1 (2C), 133.5, 135.3, 149.6; HRMS (ESI) calcd for  $\text{C}_{16}\text{H}_{11}\text{ClN}$   $[\text{M}+\text{H}]^+$ : 252.0580, found 252.0575.

### 1-Azido-2-[(4-chlorophenyl)buta-1,3-diyne-1-yl]benzene (1e)



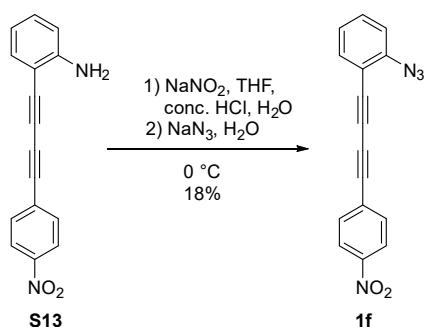
By a procedure identical with that described for the preparation of **1a**, **S11** (500 mg, 1.99 mmol) was converted to **1e** (351 mg, 63%): white powder; mp 144-145 °C; IR (neat) 2129, 2097;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.09-7.16 (m, 2H), 7.31 (d,  $J = 8.6$  Hz, 2H), 7.37-7.41 (m, 1H), 7.45 (d,  $J = 8.6$  Hz, 2H), 7.50 (dd,  $J = 8.0, 1.1$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 74.6, 77.5, 79.0, 82.0, 113.6, 118.5, 120.1, 124.7, 128.8 (2C), 130.5, 133.7 (2C), 134.4, 135.5, 142.7; HRMS (FAB) calcd for  $\text{C}_{16}\text{H}_9\text{ClN}_3$   $\text{MH}^+$ : 278.0485, found 278.0481.

### 2-[(4-Nitrophenyl)buta-1,3-diyn-1-yl]aniline (S13)



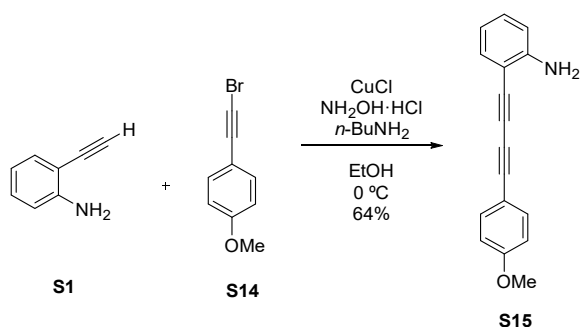
By a procedure identical with that described for the preparation of **S3**, **S1** (562 mg, 4.80 mmol) was converted to **S13** (653 mg, 52%) by the reaction with **S12** (1.42 g, 6.24 mmol): orange powder; mp 215–217 °C; IR (neat) 3499, 3397, 2127, 2097, 1591; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 4.34 (s, 2H), 6.69–6.72 (m, 2H), 7.21 (ddd, *J* = 7.8, 7.8, 1.0 Hz, 1H), 7.36 (d, *J* = 6.9 Hz, 1H), 7.66 (d, *J* = 8.5 Hz, 2H), 8.23 (d, *J* = 8.5 Hz, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 78.4, 79.0, 80.4, 91.2, 105.3, 114.5 (2C), 118.1, 123.7, 128.9, 131.3, 133.0 (2C), 133.2, 133.4, 149.9; HRMS (FAB<sup>+</sup>) calcd for C<sub>16</sub>H<sub>11</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 263.0821, found 263.0825.

### 1-Azido-2-[(4-nitrophenyl)buta-1,3-diyn-1-yl]benzene (1f)



By a procedure identical with that described for the preparation of **1a**, **S13** (550 mg, 2.10 mmol) was converted to **1f** (108 mg, 18%): yellow powder; mp 168–171 °C; IR (neat) 2131, 2100, 1518; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 7.14 (dd, *J* = 7.6, 7.6 Hz, 1H), 7.18 (d, *J* = 7.6 Hz, 1H), 7.41–7.45 (m, 1H), 7.53 (dd, *J* = 7.6, 1.2 Hz, 1H), 7.66–7.71 (m, 2H), 8.20–8.25 (m, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 78.4, 78.6, 79.9, 80.7, 113.1, 118.6, 123.7 (2C), 124.7, 128.6, 131.0, 133.2, 134.5 (2C), 143.0, 147.5; HRMS (FAB) calcd for C<sub>16</sub>H<sub>9</sub>N<sub>4</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 289.0726, found 289.0722.

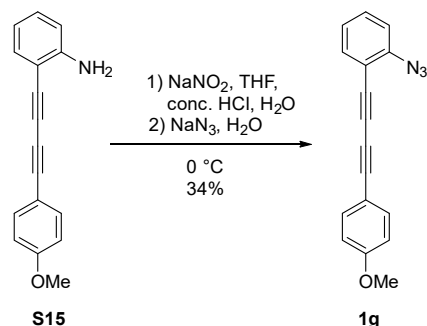
### 2-[(4-Methoxyphenyl)buta-1,3-diyn-1-yl]aniline (S15)<sup>4a</sup>





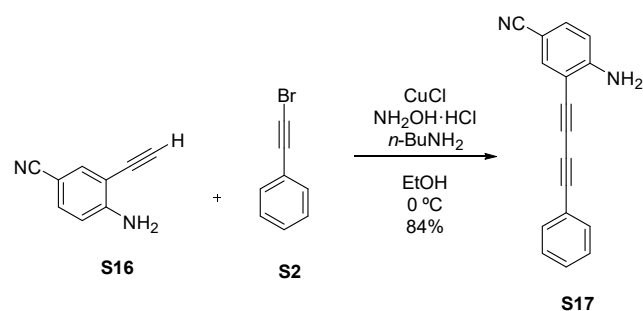
By a procedure identical with that described for the preparation of **S3**, **S1** (972 mg, 8.30 mmol) was converted to **S15** (1.31 g, 64%) by the reaction with **S14** (2.61 g, 12.4 mmol). The spectral data were in good agreement with those previously reported.<sup>4a</sup>

#### 1-Azido-2-[(4-methoxyphenyl)buta-1,3-diyne-1-yl]benzene (**1g**)



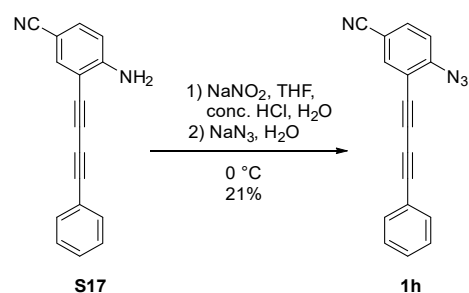
By a procedure identical with that described for the preparation of **1a**, **S15** (495 mg, 2.00 mmol) was converted to **1g** (188 mg, 34%): orange solid: mp 89–90 °C; IR (neat) 2127, 2096; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 3.83 (s, 3H), 6.86 (d, *J* = 7.6 Hz, 2H), 7.08–7.15 (m, 2H), 7.37 (ddd, *J* = 7.9, 7.9, 1.7 Hz, 1H), 7.46–7.51 (m, 3H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 55.3, 72.5, 76.4, 77.2, 79.6, 83.6, 113.5, 114.1, 118.5 (2C), 124.6, 130.2, 134.2, 134.3 (2C), 142.5, 160.4; HRMS (FAB) calcd for C<sub>17</sub>H<sub>12</sub>N<sub>3</sub>O [M+H]<sup>+</sup>: 274.0980, found 274.0981.

#### 4-Amino-3-(phenylbuta-1,3-diyne-1-yl)benzonitrile (**S17**)



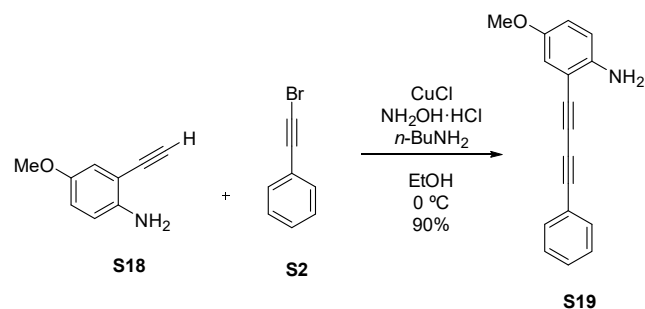
By a procedure identical with that described for the preparation of **S3**, **S16** (325 mg, 2.29 mmol) was converted to **S17** (463 mg, 84%) by the reaction with **S2** (538 mg, 2.97 mmol): white solid: mp 181–182 °C; IR (neat) 3473, 3355, 2216, 2127, 2097; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 4.83 (br s, 2H), 6.70 (d, *J* = 8.6 Hz, 1H), 7.34–7.41 (m, 4H), 7.54 (dd, *J* = 8.6, 1.7 Hz, 2H), 7.62 (d, *J* = 1.7 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 73.2, 75.6, 80.5, 83.8, 100.4, 114.1, 119.0, 121.3, 128.5 (3C), 129.6, 132.5 (2C), 133.9, 137.4, 152.4; HRMS (FAB<sup>+</sup>) calcd for C<sub>17</sub>H<sub>11</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 243.0922, found 243.0919.

#### 4-Azido-3-(phenylbuta-1,3-diyn-1-yl)benzonitrile (**1h**)



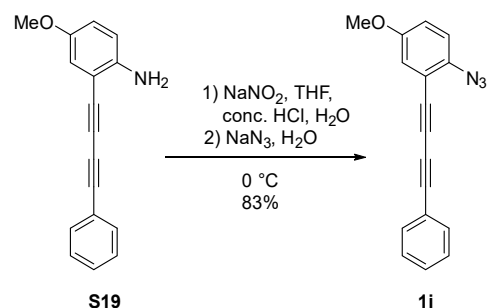
By a procedure identical with that described for the preparation of **1a**, **S17** (242 mg, 1.00 mmol) was converted to **1h** (56.4 mg, 21%): orange powder; mp 138–140 °C; IR (neat) 2226, 2122, 2084;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.23 (d,  $J = 8.6$  Hz, 1H), 7.35–7.43 (m, 3H), 7.54–7.56 (m, 2H), 7.63 (dd,  $J = 8.3, 1.7$  Hz, 1H), 7.77 (d,  $J = 1.7$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 73.0, 74.3, 81.6, 84.7, 108.5, 115.3, 117.4, 119.4, 121.1, 128.5 (2C), 129.8, 132.6 (2C), 133.2, 137.9, 146.9; HRMS (FAB) calcd for  $\text{C}_{17}\text{H}_9\text{N}_4$   $[\text{M}+\text{H}]^+$ : 269.0827, found 269.0826.

#### 4-Methoxy-2-(phenylbuta-1,3-diyn-1-yl)aniline (**S19**)



By a procedure identical with that described for the preparation of **S3**, **S18** (452 mg, 3.07 mmol) was converted to **S19** (680 mg, 90%) by the reaction with **S2** (723 mg, 3.99 mmol): yellow crystals; mp 85–87 °C; IR (neat) 3456, 3367, 2209, 2125;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 3.73 (s, 3H), 4.05 (s, 2H), 6.65 (d,  $J = 8.7$  Hz, 1H), 6.80 (dd,  $J = 8.7, 2.9$  Hz, 1H), 6.87 (d,  $J = 2.9$  Hz, 1H), 7.32–7.39 (m, 3H), 7.52 (dd,  $J = 7.9, 2.4$  Hz, 2H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 55.8, 73.8, 78.6, 79.0, 82.8, 106.6, 116.1, 118.8, 121.8, 128.4 (3C), 129.2, 132.4 (2C), 144.0, 151.7; HRMS (ESI) calcd for  $\text{C}_{17}\text{H}_{14}\text{NO}$   $[\text{M}+\text{H}]^+$ : 248.1075, found 248.1088.

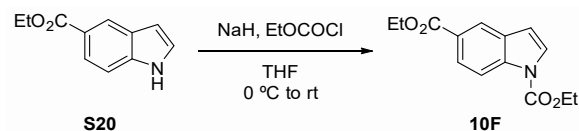
#### 1-Azido-4-methoxy-2-(phenylbuta-1,3-diyn-1-yl)benzene (**1i**)



By a procedure identical with that described for the preparation of **1a**, **S19** (495 mg, 2.00 mmol) was converted to **1i** (454 mg, 83%): pale yellow solid; mp 75–77 °C; IR (neat) 2121, 2088;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 3.79 (s, 3H), 6.95 (dd,  $J = 8.6, 2.9$  Hz, 1H), 7.01 (d,  $J = 2.9$  Hz, 1H), 7.05 (d,  $J = 8.6$  Hz, 1H), 7.32–7.40 (m, 3H), 7.52–7.55

(m, 2H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 55.7, 73.5, 76.9, 79.1, 83.4, 114.4, 117.6, 118.1, 119.7, 121.5, 128.4 (2C), 129.4, 132.5 (2C), 135.3, 156.3; HRMS (FAB) calcd for  $\text{C}_{17}\text{H}_{12}\text{N}_3$   $[\text{M}+\text{H}]^+$ : 274.0980, found 274.0981.

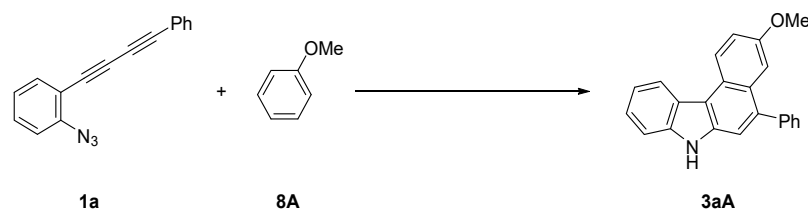
### Diethyl 1*H*-Indole-1,5-dicarboxylate (**10F**)



To a suspension of NaH (60% dispersion in paraffin liquid; 160 mg, 4.00 mmol) in THF (2.0 mL) at 0 °C was added **S20** (378 mg, 2.00 mmol), and the mixture was stirred at 0 °C for 10 min under Ar. To the reaction mixture was added dropwise  $\text{ClCO}_2\text{Et}$  (0.286 mL, 3.00 mmol). After being stirred at room temperature for 2 h, the reaction mixture was diluted with  $\text{H}_2\text{O}$  and extracted with EtOAc. The combined organic layer was dried over  $\text{Na}_2\text{SO}_4$  and filtered and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 30/1) to give **10F** (453 mg, 87%) as a white solid: mp 73–74 °C; IR (neat) 1742, 1710;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 1.42 (t,  $J = 7.2$  Hz, 3H), 1.48 (t,  $J = 7.2$  Hz, 3H), 4.40 (q,  $J = 7.2$  Hz, 2H), 4.51 (q,  $J = 7.2$  Hz, 2H), 6.67 (d,  $J = 3.5$  Hz, 1H), 7.67 (d,  $J = 3.5$  Hz, 1H), 8.04 (dd,  $J = 8.7, 1.7$  Hz, 1H), 8.21 (d,  $J = 9.3$  Hz, 1H), 8.30–8.31 (m, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 14.3 (2C), 60.8, 63.5, 108.3, 114.7, 123.1, 125.2, 125.7, 126.7, 130.2, 137.8, 150.7, 166.9; HRMS (ESI) calcd for  $\text{C}_{14}\text{H}_{16}\text{NO}_4$   $[\text{M}+\text{H}]^+$ : 262.1079, found 262.1066.

## 3. Gold-Catalysed Cascade Cyclisation

### General Procedure for Synthesis of Benzo[*c*]carbazole: Synthesis of 3-Methoxy-5-phenyl-7*H*-benzo[*c*]carbazole (**3aA**)



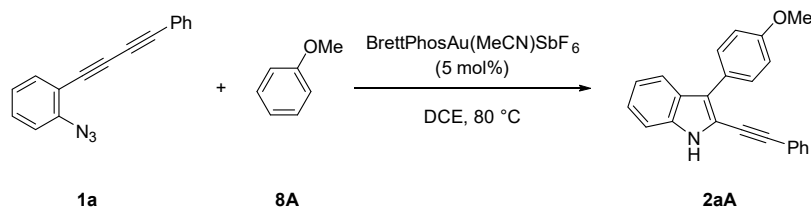
**Condition A (Table 1, Entry 10):** To a solution of **1a** (48.6 mg, 0.200 mmol) and **8A** (216 mg, 2.00 mmol) in DCE (1.00 mL) was added  $[\text{JohnPhosAu}(\text{MeCN})\text{SbF}_6]$  (7.70 mg, 10.0  $\mu\text{mol}$ ) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 1 h. After disappearance of **1a** on TLC, the reaction mixture was allowed to warm to 140 °C and stirred at this temperature for 16 h. The mixture was concentrated in vacuo. The residue was purified by column chromatography on silica gel (hexane/EtOAc = 20/1) to give **3aA** (48.3 mg, 75%).

**Condition B (Table 1, Entry 12):** To a solution of **1a** (48.6 mg, 0.200 mmol) in anisole (**8A**) (1.00 mL) was added  $[\text{BrettPhosAu}(\text{MeCN})\text{SbF}_6]$  (10.1 mg, 10.0  $\mu\text{mol}$ ) at 140 °C. The mixture was stirred at 140 °C in pre-heated bath for 19.5 h and concentrated in vacuo. The residue was purified by column chromatography on silica gel (hexane/EtOAc = 20/1) to give **3aA** (55.6 mg, 86%) as a white solid. Recrystallization from EtOAc–hexane gave pure **3aA**.

Compound **3aA**: colorless crystals; mp 168–172 °C; IR (neat): 3404;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 3.80 (s, 3H), 7.37–7.42 (m, 3H), 7.44–7.47 (m, 2H), 7.51–7.60 (m, 6H), 8.39 (s, 1H), 8.55 (d,  $J = 8.0$  Hz, 1H), 8.78 (d,  $J = 9.7$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 55.3, 107.6, 111.1, 114.0, 115.3, 117.8, 120.1, 121.9, 123.6, 124.3, 124.9,

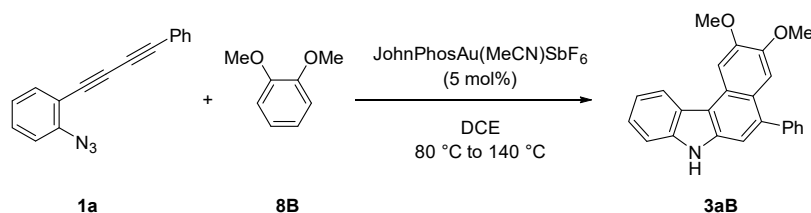
125.3, 127.3, 128.3 (2C), 128.9, 130.1 (2C), 135.5, 138.6, 138.7, 141.4, 155.4; HRMS (ESI) calcd for C<sub>23</sub>H<sub>18</sub>NO [M+H]<sup>+</sup> 324.1383, found 324.1379.

### 3-(4-Methoxyphenyl)-2-(phenylethynyl)-1H-indole (2aA) (Table 1, Entry 4).



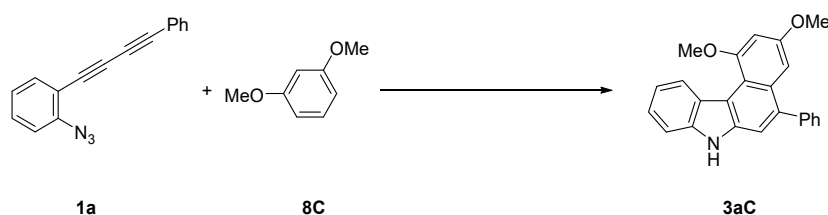
To a solution of **1a** (48.6 mg, 0.200 mmol) and anisole (**8A**) (216 mg, 2.00 mmol) in 1,2-DCE (1.00 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (10.1 mg, 10.0 μmol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 30 h and concentrated in vacuo. The residue was purified by column chromatography on silica gel (hexane/EtOAc = 20/1) to give **2aA** as brown solid (42.1 mg, 65%). Recrystallization from EtOAc–hexane gave pure **2aA**: colorless crystals; mp 97–107 °C; IR (neat): 3409, 2205; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 3.89 (s, 3H), 7.06 (d, *J* = 8.6 Hz, 2H), 7.17 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.28 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.34–7.37 (m, 4H), 7.47–7.49 (m, 2H), 7.80 (d, *J* = 8.6 Hz, 2H), 7.82 (d, *J* = 8.0 Hz, 1H), 8.26 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 55.3, 82.3, 94.3, 110.9, 114.0 (2C), 115.5, 120.1, 120.6, 122.4, 122.7, 123.9, 126.1, 126.7, 128.4 (3C), 130.0 (2C), 131.3 (2C), 136.0, 158.4; HRMS (ESI) calcd for C<sub>23</sub>H<sub>18</sub>NO [M+H]<sup>+</sup> 324.1383, found 324.1378.

### 2,3-Dimethoxy-5-phenyl-7H-benzo[*c*]carbazole (3aB).



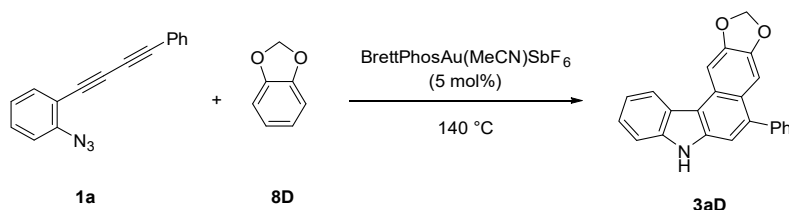
According to the general procedure described for the preparation of **3aA**, **1a** (48.6 mg, 0.200 mmol) was converted into **3aB** (49.9 mg, 70%) (condition A; 80 °C, 2 h then 140 °C, 15 h). The reaction of **1a** (48.6 mg, 0.200 mmol) and **2B** (1.00 mL) under condition B (140 °C, 27 h) gave **3aB** (70 mg, quant) as a white solid. Recrystallization from EtOAc–hexane gave pure **3aB**: colorless crystals; mp 245–257 °C; IR (neat): 3332; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 3.82 (s, 3H), 4.20 (s, 3H), 7.38–7.40 (m 3H), 7.44 (dd, *J* = 7.4 Hz, 2H), 7.50–7.57 (m, 5H), 8.13 (s, 1H), 8.34 (s, 1H), 8.46 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 55.7, 55.9, 103.3, 107.3, 111.1, 111.5, 114.7, 120.0, 121.4, 122.6, 123.6, 124.2, 125.7, 127.2, 128.3 (2C), 130.1 (2C), 136.2, 138.4, 138.8, 141.7, 146.7, 149.9; HRMS (ESI) calcd for C<sub>24</sub>H<sub>20</sub>NO<sub>2</sub> [M+H]<sup>+</sup> 354.1489, found 354.1489.

### 1,3-Dimethoxy-5-phenyl-7H-benzo[*c*]carbazole (3aC).



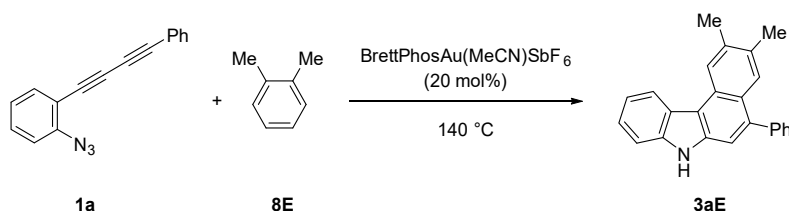
According to the general procedure (condition A; 80 °C, 2 h then 140 °C, 15 h) described for the preparation of **3aA**, **1a** (48.6 mg, 0.200 mmol) was converted into **3aC** (28.3 mg, 40%). The reaction of **1a** (48.6 mg, 0.200 mmol) and **8C** (1.00 mL) under the condition B (140 °C, 26 h) gave **3aC** (67.3 mg, 95%) as a brown solid. Recrystallization from EtOAc–hexane gave pure **3aC**: colorless crystals; mp 205–210 °C; IR (neat): 3396; <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ: 3.73 (s, 3H), 4.14 (s, 3H), 6.77 (d, *J* = 2.3 Hz, 1H), 6.94 (d, *J* = 2.3 Hz, 1H), 7.25–7.29 (dd, 1H), 7.36–7.51 (m, 8H), 8.29 (s, 1H), 8.87 (d, *J* = 8.1 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 55.1, 55.2, 98.4, 99.5, 110.5, 114.4, 114.7, 118.0, 119.3, 124.3, 124.3, 126.7, 127.2, 128.2 (2C), 130.0 (2C), 130.2, 136.0, 138.4, 139.1, 141.9, 155.6, 156.9; HRMS (ESI) calcd for C<sub>24</sub>H<sub>20</sub>NO<sub>2</sub> [M+H]<sup>+</sup> 354.1489, found 354.1490.

### 5-Phenyl-7H-[1,3]dioxolo[4',5':4,5]benzo[1,2-*c*]carbazole (**3aD**).



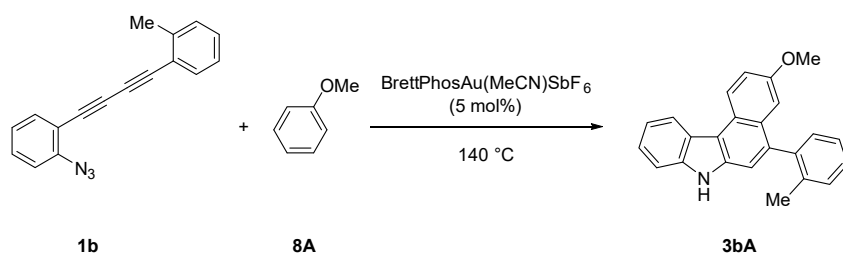
According to the general procedure (condition B; 140 °C, 18 h) described for the preparation of **3aA**, **1a** (48.6 mg, 0.200 mmol) was converted into **3aD** (51.1 mg, 76%) as a white solid. Recrystallization from EtOAc–hexane gave pure **3aD**: colorless crystals; mp 192–198 °C; IR (neat): 3411; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 6.07 (s, 2H), 7.31 (s, 1H), 7.37 (dd, *J* = 7.7, 7.7 Hz, 1H), 7.41 (s, 1H), 7.43–7.46 (m, 2H), 7.48–7.55 (m, 5H), 8.18 (s, 1H), 8.30 (s, 1H), 8.47 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 100.9, 101.1, 104.6, 111.0, 111.5, 115.4, 120.1, 121.6, 123.7, 123.9, 124.3, 126.8, 127.2, 128.3 (2C), 130.1 (2C), 136.2, 138.8, 139.0, 141.6, 145.2, 148.1; HRMS (ESI) calcd for C<sub>23</sub>H<sub>16</sub>NO<sub>2</sub> [M+H]<sup>+</sup> 338.1176, found 338.1173.

### 2,3-Dimethyl-5-phenyl-7H-benzo[*c*]carbazole (**3aE**).



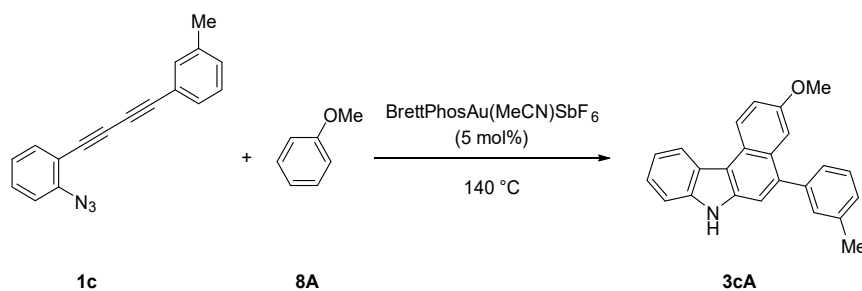
According to the general procedure (condition B; 140 °C, 1 h) described for the preparation of **3aA**, **1a** (48.6 mg, 0.200 mmol) was converted into **3aE** (26.7 mg, 42%) as a white solid. In the case, the reaction was conducted using 20 mol % BrettPhosAu(MeCN)SbF<sub>6</sub> (40.4 mg, 0.04 mmol). Recrystallization from EtOAc–hexane gave pure **3aE**: colorless crystals; mp 232–242 °C; IR (neat): 3422; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.38 (s, 3H), 2.58 (s, 3H), 7.37–7.40 (m, 1H), 7.42–7.47 (m, 3H), 7.50–7.58 (m, 5H), 7.73 (s, 1H), 8.29 (s, 1H), 8.60 (d, *J* = 7.4 Hz, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 20.3, 20.7, 110.0, 112.7, 114.5, 120.0, 122.0, 123.5, 124.0, 124.1, 126.5, 127.1 (2C), 128.2 (2C), 128.9, 130.3 (2C), 132.3, 136.3, 136.4, 138.6, 139.0, 141.6; HRMS (ESI) calcd for C<sub>24</sub>H<sub>20</sub>N [M+H]<sup>+</sup> 322.1590, found 322.1589.

### 3-Methoxy-5-(*o*-tolyl)-7*H*-benzo[*c*]carbazole (3bA)



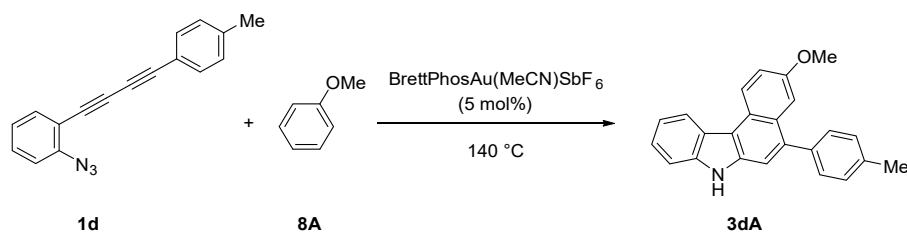
According to the general procedure (condition B; 140 °C, 20 h) described for the preparation of **3aA**, **1d** (51.4 mg, 0.200 mmol) was converted into **3bA** (60.3 mg, 89%) as a colorless oil: IR (neat): 3407; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.05 (s, 3H), 3.73 (s, 3H), 6.93 (d, *J* = 2.9 Hz, 1H), 7.31-7.32 (m, 2H), 7.36-7.39 (m, 4H), 7.41 (s, 1H), 7.42-7.45 (m, 1H), 7.53 (d, *J* = 8.0 Hz, 1H), 8.28 (s, 1H), 8.54 (d, *J* = 7.4 Hz, 1H), 8.76 (d, *J* = 9.2 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 20.1, 55.2, 107.4, 111.1, 113.7, 115.2, 117.7, 120.1, 121.8, 123.7, 124.3, 124.8, 125.0, 125.7, 127.7, 129.2, 129.9, 130.4, 135.5, 137.0, 138.2, 138.6, 140.7, 155.5; HRMS (ESI) calcd for C<sub>24</sub>H<sub>20</sub>NO [M+H]<sup>+</sup> 338.1539, found 338.1538.

### 3-Methoxy-5-(*m*-tolyl)-7*H*-benzo[*c*]carbazole (3cA)



According to the general procedure (condition B; 140 °C, 20 h) described for the preparation of **3aA**, **1c** (51.4 mg, 0.200 mmol) was converted into **3cA** (63.6 mg, 94%) as a colorless oil: IR (neat): 3411; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.46 (s, 3H), 3.80 (s, 3H), 7.27 (d, *J* = 7.4 Hz, 1H), 7.36-7.39 (m, 4H), 7.41-7.42 (m, 2H), 7.44 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.53 (s, 1H), 7.55 (d, *J* = 8.0 Hz, 1H), 8.33 (s, 1H), 8.54 (d, *J* = 7.4 Hz, 1H), 8.77 (d, *J* = 9.2 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 21.5, 55.3, 107.7, 111.1, 113.9, 115.2, 117.8, 120.1, 121.9, 123.7, 124.3, 124.8, 125.3, 127.2, 128.0, 128.2, 128.9, 130.8, 135.5, 138.0, 138.7, 138.8, 141.4, 155.4; HRMS (ESI) calcd for C<sub>24</sub>H<sub>20</sub>NO [M+H]<sup>+</sup> 338.1539, found 338.1538.

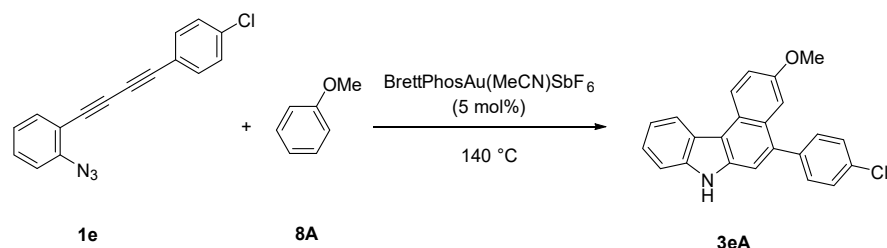
### 3-Methoxy-5-(*p*-tolyl)-7*H*-benzo[*c*]carbazole (3dA)



According to the general procedure (condition B; 140 °C, 20 h) described for the preparation of **3aA**, **1b** (51.4 mg, 0.200 mmol) was converted into **3dA** (47.0 mg, 70%). Recrystallization from EtOAc–hexane gave pure **3dA**: colorless crystals; mp 162–170 °C; IR (neat): 3407; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.47 (s, 3H), 3.79 (s, 3H), 7.30

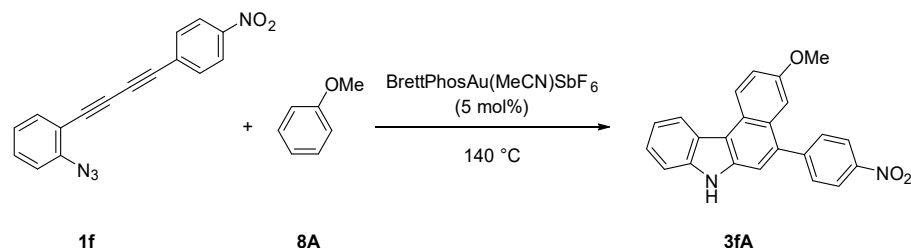
(d,  $J = 8.0$  Hz, 2H), 7.34-7.40 (m, 2H), 7.41-7.46 (m, 5H), 7.48 (d,  $J = 8.0$  Hz, 1H), 8.22 (s, 1H) 8.52 (d,  $J = 8.0$  Hz, 1H), 8.75 (d,  $J = 9.2$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 21.3, 55.3, 107.6, 111.1, 114.0, 117.8, 120.0, 121.9, 123.6, 124.3, 124.8, 125.2, 128.9, 129.0 (2C), 130.0 (2C), 130.1, 135.5, 136.9, 138.4, 138.6, 138.7, 155.4; HRMS (ESI) calcd for  $\text{C}_{24}\text{H}_{20}\text{NO}$   $[\text{M}+\text{H}]^+$  338.1539, found 338.1539.

### 5-(4-chlorophenyl)-3-methoxy-7H-benzo[*c*]carbazole (3eA)



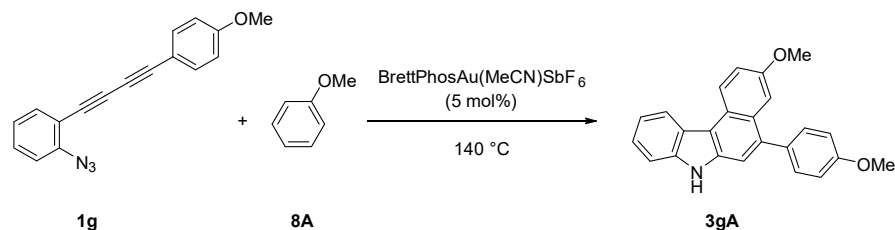
According to the general procedure (condition B; 140 °C, 22.5 h) described for the preparation of **3aA**, **1e** (55.5 mg, 0.200 mmol) was converted into **3eA** (53.5 mg, 74%). Recrystallization from EtOAc–hexane gave pure **3eA**: colorless crystals; mp 170–177 °C; IR (neat): 3406;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 3.11 (s, 3H), 7.30 (d,  $J = 2.9$  Hz, 1H), 7.36-7.40 (m, 3H), 7.43-7.51 (m, 6H), 8.23 (s, 1H), 8.52 (d,  $J = 7.4$  Hz, 1H), 8.76 (d,  $J = 9.2$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 55.3, 107.1, 111.1, 114.0, 115.5, 118.0, 120.2, 121.9, 123.5, 124.5, 124.9, 125.2, 128.5 (2C), 128.6, 131.4 (2C), 133.2, 135.3, 137.1, 138.7, 139.8, 155.5; HRMS (ESI) calcd for  $\text{C}_{23}\text{H}_{17}\text{ClNO}$   $[\text{M}+\text{H}]^+$  358.0993, found 358.0991.

### 3-Methoxy-5-(4-nitrophenyl)-7H-benzo[*c*]carbazole (3fA)



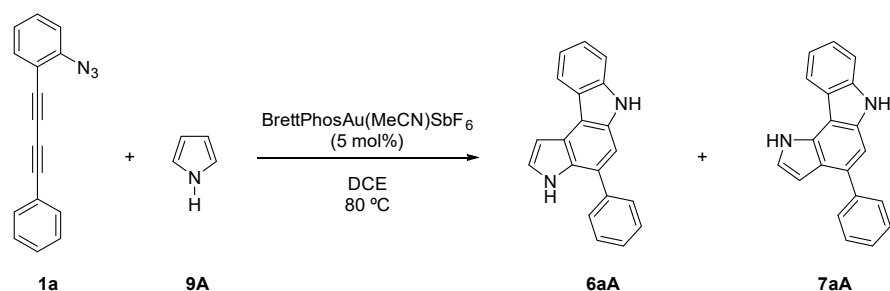
According to the general procedure (condition B; 140 °C, 23 h) described for the preparation of **3aA**, **1f** (57.6 mg, 0.200 mmol) was converted into **3fA** (32.0 mg, 43%). Recrystallization from EtOAc–hexane gave pure **3fA**: colorless crystals; mp 244–248 °C; IR (neat): 3343, 1498, 1344;  $^1\text{H}$  NMR (600 MHz,  $\text{CDCl}_3$ )  $\delta$ : 3.82 (s, 3H), 7.39-7.45 (m, 3H), 7.49 (dd,  $J = 7.4$  Hz, 1H), 7.57 (s, 1H), 7.60 (d,  $J = 7.7$  Hz, 1H), 7.77 (d,  $J = 8.8$  Hz, 2H), 8.40 (d,  $J = 8.8$  Hz, 2H), 8.43 (s, 1H), 8.56 (d,  $J = 7.7$  Hz, 1H), 8.81 (d,  $J = 8.8$  Hz, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 55.4, 106.8, 111.3, 114.3, 116.5, 118.3, 120.4, 122.2, 123.4, 123.7 (2C), 125.0, 125.2, 125.4, 128.1, 131.0 (2C), 135.2, 135.8, 139.0, 147.2, 148.6, 155.9; HRMS (ESI) calcd for  $\text{C}_{23}\text{H}_{17}\text{N}_2\text{O}_3$  ( $[\text{M}-\text{H}]^-$ ) 367.1088, found 367.1088.

### 3-Methoxy-5-(4-methoxyphenyl)-7H-benzo[*c*]carbazole (3gA)



According to the general procedure (condition B; 140 °C, 12 h) described for the preparation of **3aA**, **1g** (54.6 mg, 0.200 mmol) was converted into **3gA** (42.8 mg, 61%) as a brown solid: mp 175–185 °C; IR (neat): 3406; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 3.78 (s, 3H), 3.88 (s, 3H), 7.00 (d, *J* = 8.6 Hz, 2H), 7.33–7.45 (m, 8H), 8.19 (s, 1H), 8.51 (d, *J* = 8.0 Hz, 1H), 8.74 (d, *J* = 8.6 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 55.3, 55.3, 107.5, 111.1, 113.7 (2C), 114.0, 115.0, 117.8, 120.0, 121.8, 123.6, 124.2, 124.8, 125.2, 129.0, 131.1 (2C), 133.7, 135.5, 138.2, 138.7, 155.4, 158.8; HRMS (ESI) calcd for C<sub>24</sub>H<sub>20</sub>NO<sub>2</sub> [M+H]<sup>+</sup> 354.1489, found 354.1489.

#### 4-Phenyl-3,6-dihydropyrrolo[2,3-*c*]carbazole (**6aA**) and Its [3,2-*c*]-Isomer (**7aA**) (Table 3, Entry 1)<sup>1</sup>

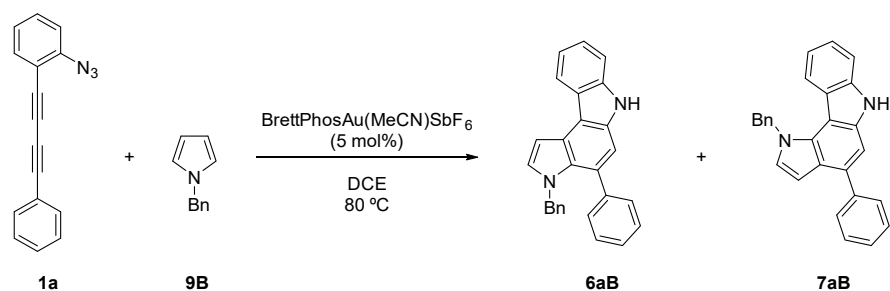


To a solution of **1a** (24.3 mg, 0.100 mmol) and **9A** (0.0347 mL, 0.5 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 8 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give a mixture of **6aA** and **7aA** containing a small amount of impurities (17.6 mg, <62%; **6aA**:**7aA** = 25:75). These isomers were separated by column chromatography on amine silica gel (hexane/CHCl<sub>3</sub> = 2/1) to give, in the order of elution, **6aA** and **7aA**.

Compound **6aA**: brown viscous oil; IR (neat) 3406; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 7.15 (dd, *J* = 2.5, 1.5 Hz, 1H), 7.24 (s, 1H), 7.28–7.32 (m, 1H), 7.35 (dd, *J* = 3.0, 3.0 Hz, 1H), 7.38–7.45 (m, 3H), 7.52 (dd, *J* = 8.0, 8.0 Hz, 2H), 7.66–7.69 (m, 2H), 8.04 (s, 1H), 8.28 (d, *J* = 7.0 Hz, 1H), 8.54 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 101.4, 106.2, 110.5, 113.7, 119.2, 121.1, 121.3, 123.6, 124.18, 124.23, 125.0, 127.4, 128.5 (2C), 128.9, 129.2 (2C), 134.9, 139.1, 139.7; HRMS (ESI) calcd for C<sub>20</sub>H<sub>15</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 283.1230, found 283.1231.

Compound **7aA**: white solid; mp 231–234 °C; IR (neat) 3395; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 6.87 (dd, *J* = 3.5, 2.5 Hz, 1H), 7.31–7.34 (m, 3H), 7.39–7.44 (m, 2H), 7.51–7.54 (m, 3H), 7.78–7.79 (m, 2H), 8.08 (d, *J* = 6.5 Hz, 1H), 8.27 (s, 1H), 8.79 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 103.4, 104.6, 106.8, 110.7, 119.5, 120.2, 120.3, 121.7 (2C), 124.3, 127.0, 128.5 (2C), 129.1 (2C), 130.2, 133.7, 137.1, 138.7, 141.6; HRMS (ESI) calcd for C<sub>20</sub>H<sub>15</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 283.1230, found 283.1231.

#### 3-Benzyl-4-phenyl-3,6-dihydropyrrolo[2,3-*c*]carbazole (**6aB**) and Its [3,2-*c*]-Isomer (**7aB**) (Table 3, Entry 2)<sup>1</sup>



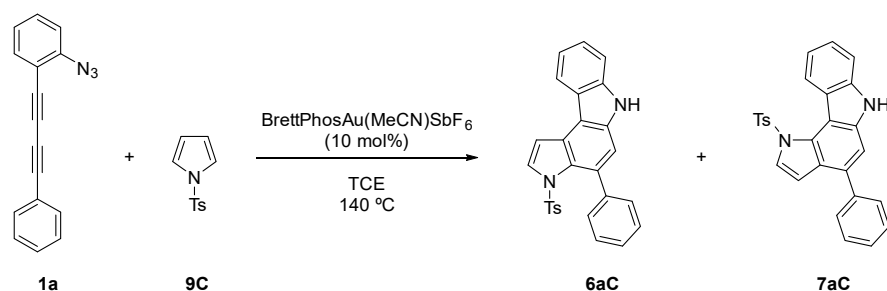


To a solution of **1a** (24.3 mg, 0.100 mmol) and **9B** (78.6 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 10 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 10/1) to give a **6aB** (4.20 mg, 11%) and **7aB** (19.0 mg, 51%) in the order of elution, **6aB** and **7aB**; (**6aB**:**7aB** = 18:82).

Compound **6aB**: yellow solid; mp 163–168 °C; IR (neat) 3728; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 5.00 (s, 2H), 6.47 (m, 2H), 7.05 (s, 1H), 7.06–7.13 (m, 3H), 7.20 (d, *J* = 3.0 Hz, 1H), 7.22–7.28 (m, 5H), 7.30–7.35 (m, 2H), 7.41 (dt, *J* = 8.0, 1.0 Hz, 1H), 7.48 (d, *J* = 8.0 Hz, 1H), 8.06 (s, 1H), 8.30 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 52.2, 100.2, 108.7, 110.5, 113.8, 119.2, 121.2, 123.4, 123.7, 124.2, 125.8 (2C), 126.6, 126.9, 127.1, 127.6 (2C), 128.2 (2C), 128.7, 129.9 (2C), 130.8, 134.0, 138.8, 139.2, 140.6; HRMS (ESI) calcd for C<sub>27</sub>H<sub>21</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 373.1699, found 373.1700.

Compound **7aB**: white solid; mp 173–178 °C; IR (neat) 3728; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 6.02 (s, 2H), 6.84 (d, *J* = 3.0 Hz, 1H), 7.00–7.04 (m, 2H), 7.24–7.33 (m, 7H), 7.39–7.42 (m, 2H), 7.50 (t, *J* = 8.0 Hz, 2H), 7.75 (d, *J* = 7.5 Hz, 2H), 8.01 (d, *J* = 8.5 Hz, 1H), 8.23 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 53.2, 103.6, 104.8, 106.9, 110.6, 119.3, 121.0, 121.7, 122.6, 123.9, 126.5 (2C), 126.6, 127.0, 127.5, 128.4 (2C), 128.9 (2C), 129.2 (2C), 132.6, 134.1, 138.0, 138.7 (2C), 141.3; HRMS (ESI) calcd for C<sub>27</sub>H<sub>21</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 373.1699, found 373.1702.

#### 4-Phenyl-3-tosyl-3,6-dihydropyrrolo[2,3-*c*]carbazole (**6aC**) and Its [3,2-*c*]-Isomer (**7aC**) (Table 3, Entry 3)<sup>1</sup>

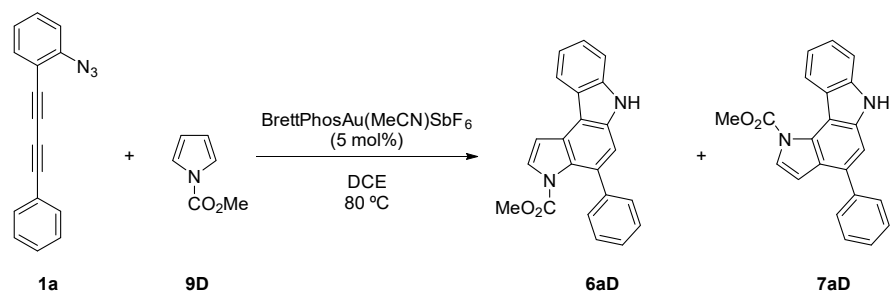


To a solution of **1a** (24.3 mg, 0.100 mmol) and **9c** (111 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (10.1 mg, 10.0 μmol) at 140 °C. The mixture was stirred at 140 °C in pre-heated bath for 30 min and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give a mixture of **6aC** and **7aC** (14.7 mg, 34%; **6aC**:**7aC** = 58:42). These isomers were separated by column chromatography on silica gel (toluene) to give, in the order of elution, **6aC** and **7aC**.

Compound **6aC**: brown viscous oil; IR (neat) 3736; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.24 (s, 3H), 6.98 (d, *J* = 8.5 Hz, 2H), 7.18–7.21 (m, 3H), 7.27–7.31 (m, 2H), 7.37–7.47 (m, 7H), 7.80 (d, *J* = 4.0 Hz, 1H), 8.13–8.14 (m, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 21.5, 110.0, 110.8, 111.6, 114.1, 119.8, 121.1, 122.8, 125.4, 126.5 (2C), 127.0, 127.4, 127.7 (2C), 128.9, 129.1 (2C), 129.3 (2C), 130.2, 132.0, 134.4, 136.6, 139.6, 141.8, 144.0; HRMS (ESI) calcd for C<sub>27</sub>H<sub>21</sub>N<sub>2</sub>O<sub>2</sub>S [M+H]<sup>+</sup>: 437.1318, found 437.1318.

Compound **7aC**: white viscous oil; IR (neat) 3390; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 2.24 (s, 3H), 6.98 (d, *J* = 8.6 Hz, 2H), 7.19 (t, *J* = 7.2 Hz, 3H), 7.29 (dt, *J* = 12.4, 3.3 Hz, 2H), 7.37–7.39 (m, 3H), 7.42 (t, *J* = 7.4 Hz, 1H), 7.45–7.47 (m, 3H), 7.80 (d, *J* = 4.0 Hz, 1H), 8.14 (d, *J* = 7.4 Hz, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 21.5, 109.3, 110.0, 112.6, 114.2, 119.2, 121.7, 125.5, 125.7, 125.9, 126.8 (2C), 127.3, 128.3, 128.6 (2C), 128.9 (2C), 129.0 (2C), 132.4, 133.1, 133.6, 139.6, 139.7, 140.1, 144.3; HRMS (ESI) calcd for C<sub>27</sub>H<sub>21</sub>N<sub>2</sub>O<sub>2</sub>S [M+H]<sup>+</sup>: 437.1318, found 437.1317.

#### Methyl 4-Phenylpyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (**6aD**) and Its [3,2-*c*]-Isomer (**7aD**) (Table 3, Entry 4)

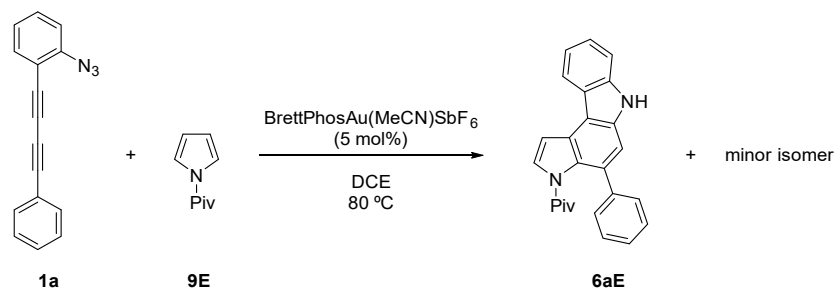


To a solution of **1a** (24.3 mg, 0.100 mmol) and **9D** (62.3 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 1.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give a mixture of **6aD** and **7aD** (21.2 mg, 62%; **6aD**:**7aD** = 81:19). These isomers were separated by column chromatography on amine silica gel (hexane/CHCl<sub>3</sub> = 1/2) to give, in the order of elution, **6aD** and **7aD**.

Compound **6aD**: white powder; mp 173–175 °C; IR (neat) 3380, 1751; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 3.25 (s, 3H), 7.28 (d, *J* = 3.5 Hz, 1H), 7.31–7.37 (m, 3H), 7.42–7.53 (m, 6H), 7.80 (d, *J* = 3.4 Hz, 1H), 8.21 (s, 1H), 8.25 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 53.2, 106.2, 110.2, 110.7, 114.1, 119.6, 121.3, 123.1, 125.1, 125.8, 126.6, 127.2, 127.4, 128.5 (2C), 128.7 (2C), 136.4, 139.6, 139.6, 143.1, 152.0; HRMS (ESI) calcd for C<sub>22</sub>H<sub>17</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 341.1290, found 341.1284.

Compound **7aD**: orange viscous oil; IR (neat) 3398, 1734; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 4.12 (s, 3H), 6.88 (d, *J* = 4.6 Hz, 1H), 7.27–7.30 (m, 1H), 7.41–7.47 (m, 3H), 7.49–7.53 (m, 3H), 7.63 (d, *J* = 3.5 Hz, 1H), 7.66 (d, *J* = 8.0 Hz, 2H), 7.94 (d, *J* = 8.0 Hz, 1H), 8.36 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 54.2, 107.8, 109.0, 110.2, 110.4, 119.2, 122.0, 123.3, 124.9, 125.3, 125.5, 127.2, 128.6 (2C), 129.2 (2C), 129.9, 133.4, 139.3, 139.5, 140.6, 152.2; HRMS (ESI) calcd for C<sub>22</sub>H<sub>17</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 341.1290, found 341.1290

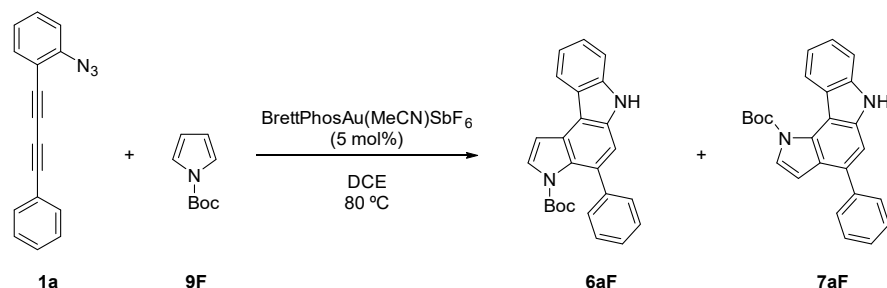
#### 2,2-Dimethyl-1-(4-phenylpyrrolo[2,3-*c*]carbazol-3(6*H*)-yl)propan-1-one (**6aE**) (Table 3, Entry 5)



To a solution of **1a** (24.3 mg, 0.100 mmol) and **9E** (75.6 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 1.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give an inseparable mixture of **6aE** and minor isomer (21.9 mg, 60%; **6aE**: minor isomer = 82:18): orange viscous oil; IR (neat) 3393, 1695; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.37 (s, 9H), 7.23 (d, *J* = 3.4 Hz, 1H), 7.25 (s, 1H), 7.32 (dd, *J* = 7.2, 5.4 Hz, 2H), 7.42–7.49 (m, 6H), 7.74 (d, *J* = 4.0 Hz, 1H), 8.23 (d, *J* = 9.7 Hz, 2H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>; including amide rotamers) δ: 28.8 and 29.3 (totally 3C), 41.6, 105.6, 107.9, 108.3, 109.9, 110.1, 119.1, 122.0, 122.5,

123.5, 124.6, 124.9, 125.7, 126.6, 127.1, 127.4, 128.5 (2C), 129.3 (2C), 131.3, 139.2, 140.8, 177.9; HRMS (ESI) calcd for C<sub>25</sub>H<sub>23</sub>N<sub>2</sub>O [M+H]<sup>+</sup>: 367.1810, found 367.1801.

***tert*-Butyl 4-Phenylpyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (**6aF**) and Its [3,2-*c*]-Isomer (**7aF**) (Table 3, Entry 6)<sup>1</sup>**

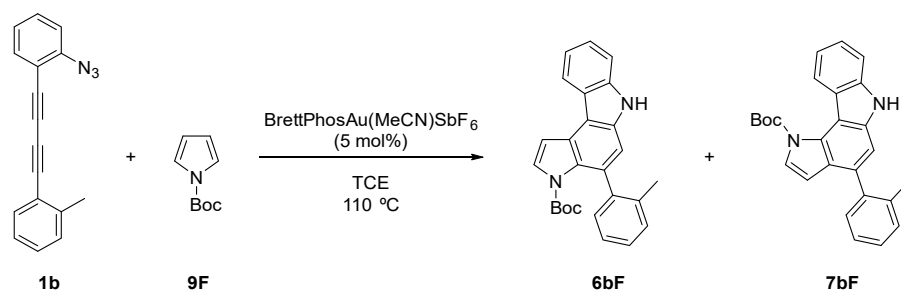


To a solution of **1a** (24.3 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 1.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 10/1) to give a mixture of **6aF** and **7aF** (23.1 mg, 60%; **6aF**:**7aF** = 92:8). These isomers were separated by reverse-column chromatography on silica gel (MeCN/0.1% TFA aq.) to give, in the order of elution, **6aF** and **7aF**.

Compound **6aF**: pale yellow solid; mp 173–178 °C; IR (neat) 3397, 1742; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.30 (s, 9H), 7.21 (d, *J* = 3.5 Hz, 1H), 7.29 (s, 1H), 7.32 (t, *J* = 8.0 Hz, 2H), 7.40-7.46 (m, 4H), 7.57 (d, *J* = 8.0 Hz, 2H), 7.73 (d, *J* = 4.0 Hz, 1H), 8.16 (s, 1H), 8.24 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 27.6 (3C), 83.5, 105.5, 110.1, 110.7, 113.8, 119.5, 121.2, 123.2, 124.9, 125.9, 126.6, 127.4 (2C), 127.5, 128.5 (2C), 128.8, 129.1, 136.4, 139.5, 142.7, 149.6; HRMS (ESI) calcd for C<sub>25</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 383.1754, found 383.1755.

Compound **7aF**: white viscous oil; IR (neat) 3592, 1747; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.72 (s, 9H), 6.84 (d, *J* = 3.5 Hz, 1H), 7.28 (ddd, *J* = 8.0, 6.5, 1.5 Hz, 1H), 7.38-7.44 (m, 4H), 7.50 (t, *J* = 7.0 Hz, 2H), 7.56 (d, *J* = 4.0 Hz, 1H), 7.65 (d, *J* = 7.0 Hz, 2H), 7.98 (d, *J* = 8.5 Hz, 1H), 8.27 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 28.2 (3C), 83.6, 107.6, 108.1, 110.0, 110.4, 119.0, 122.1, 123.2, 124.7, 125.4, 125.9, 127.1, 128.5 (2C), 129.2 (2C), 129.9, 133.3, 139.2, 139.5, 140.8, 150.0; HRMS (ESI) calcd for C<sub>25</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 383.1754, found 383.1754.

***tert*-Butyl 4-(*o*-Tolyl)pyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (**6bF**) and Its [3,2-*c*]-Isomer (**7bF**) (Table 5)**

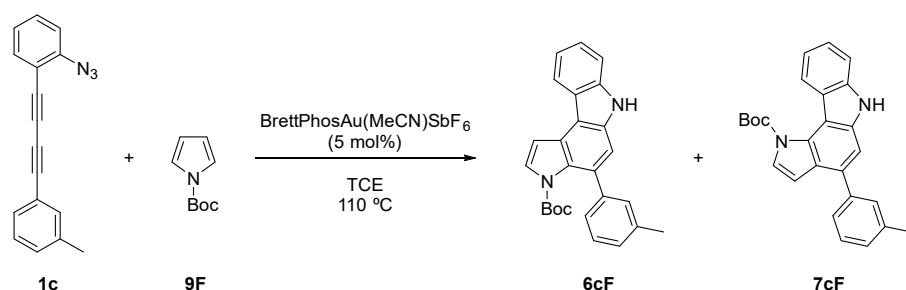


To a solution of **1b** (25.7 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 0.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 10/1) to give a mixture of **6bF** and **7bF** (22.8 mg, 58%; **6bF**:**7bF** = 95:5). These isomers were separated by column chromatography on amine silica gel (toluene) to give, in the order of elution, **6bF** and **7bF**.

Compound **6bF**: pale yellow solid; mp 154–156 °C; IR (neat) 3734, 1730; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.32 (s, 9H), 2.17 (s, 3H), 7.20 (d, *J* = 3.4 Hz, 1H), 7.21 (s, 1H), 7.23-7.26 (m, 3H), 7.30 (dd, *J* = 7.5, 7.5 Hz, 1H), 7.34-7.37 (m, 1H), 7.42 (dd, *J* = 7.5, 7.5 Hz, 1H), 7.47 (d, *J* = 8.0 Hz, 1H), 7.67 (d, *J* = 3.4 Hz, 1H), 8.13 (br s, 1H), 8.25 (d, *J* = 7.4 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 20.2, 27.6 (3C), 83.1, 104.9, 110.5, 110.7, 113.8, 119.5, 121.2, 123.3, 124.9, 125.2, 125.6, 126.7, 128.0, 128.1, 128.4, 129.0, 129.9, 135.5, 135.9, 139.5, 142.1, 149.1; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 397.1911, found 397.1921.

Compound **7bF**: white solid; mp 96–98 °C; IR (neat) 3707, 1732; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.73 (s, 9H), 2.17 (s, 3H), 6.36 (d, *J* = 4.0 Hz, 1H), 7.23 (s, 1H), 7.28 (m, 2H), 7.32-7.34 (m, 3H), 7.40 (ddd, *J* = 7.4, 7.4, 1.1 Hz, 1H), 7.44 (d, *J* = 7.4 Hz, 1H), 7.49 (d, *J* = 4.0 Hz, 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 8.26 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 20.3, 28.2 (3C), 83.5, 108.1, 108.3, 110.0, 110.2, 119.0, 122.1, 124.1, 124.6, 125.1, 125.5, 126.0, 127.5, 129.4, 130.1, 130.3, 133.1, 136.4, 138.9, 139.4, 140.2, 150.1; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 397.1911, found 397.1912.

### *tert*-Butyl 4-(*m*-Tolyl)pyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (**6cF**) and Its [3,2-*c*]-Isomer (**7cF**) (Table 5)

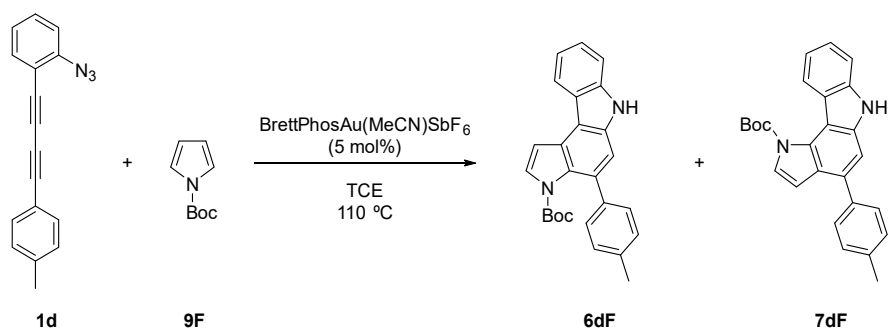


To a solution of **1c** (25.7 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 0.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 10/1) to give a mixture of **6cF** and **7cF** (21.7 mg, 55%; **6cF**:**7cF** = 95:5). These isomers were separated by column chromatography on amine silica gel (hexane/toluene = 1/5) to give, in the order of elution, **6cF** and **7cF**.

Compound **6cF**: pale yellow solid; mp 185–186 °C; IR (neat) 3413, 1732; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.30 (s, 9H), 2.37 (s, 3H), 7.13 (d, *J* = 7.4 Hz, 1H), 7.20 (d, *J* = 3.4 Hz, 1H), 7.26-7.32 (m, 3H), 7.36-7.42 (m, 4H), 7.73 (d, *J* = 3.4 Hz, 1H), 8.13 (br s, 1H), 8.23 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 21.5, 27.5 (3C), 83.5, 105.4, 110.1, 110.7, 113.7, 119.5, 121.2, 123.2, 124.5, 124.9, 125.8, 127.4, 127.5, 128.1, 128.6, 128.9, 129.1, 136.4, 137.9, 139.5, 142.6, 149.7; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 397.1911, found 397.1920.

Compound **7cF**: pale yellow viscous oil; IR (neat) 3394, 1743; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.72 (s, 9H), 2.46 (s, 3H), 6.84 (d, *J* = 4.0 Hz, 1H), 7.23 (d, *J* = 7.4 Hz, 1H), 7.25-7.29 (m, 1H), 7.37 (s, 1H), 7.38-7.47 (m, 5H), 7.55 (d, *J* = 3.4 Hz, 1H), 7.98 (d, *J* = 8.0 Hz, 1H), 8.25 (br s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 21.6, 28.2 (3C), 83.6, 107.5, 108.2, 110.0, 110.3, 119.0, 122.1, 123.2, 124.7, 125.3, 125.9, 126.3, 127.9, 128.4, 129.9, 129.9, 133.4, 138.1, 139.2, 139.5, 140.7, 150.0; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 397.1911, found 397.1909.

***tert*-Butyl 4-(*p*-Tolyl)pyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (6dF) and Its [3,2-*c*]-Isomer (7dF) (Table 5)**

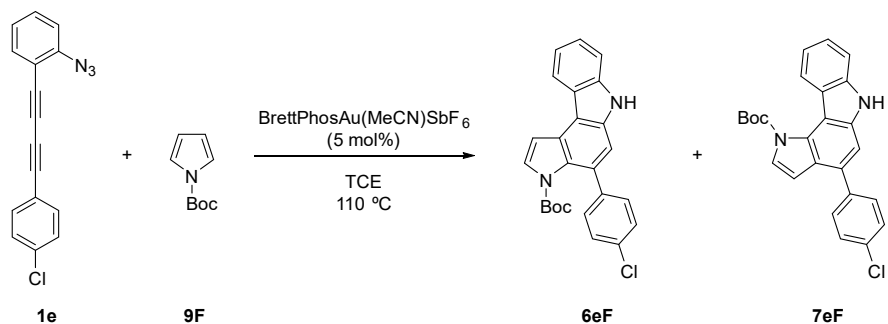


To a solution of **1d** (24.3 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 0.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 10/1) to give a mixture of **6dF** and **7dF** (22.6 mg, 57%; **6dF**:**7dF** = 95:5). These isomers were separated by column chromatography on amine silica gel (toluene) to give, in the order of elution, **6dF** and **7dF**.

Compound **6dF**: pale yellow solid; mp 170–172 °C; IR (neat) 3402, 1736; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.31 (s, 9H), 2.41 (s, 3H), 7.21 (d, *J* = 3.4 Hz, 1H), 7.24 (d, *J* = 8.0 Hz, 2H), 7.29–7.32 (m, 2H), 7.40–7.43 (m, 1H), 7.46–7.49 (m, 3H), 7.72 (d, *J* = 4.0 Hz, 1H), 8.16 (s, 1H), 8.23 (d, *J* = 7.4 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 21.2, 27.6 (3C), 83.4, 105.4, 109.9, 110.6, 113.7, 119.5, 121.2, 123.3, 124.8, 125.8, 127.3 (2C), 127.7, 128.8, 129.1, 129.2 (2C), 136.2, 136.5, 139.5, 139.8, 149.6; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 397.1911, found 397.1912.

Compound **7dF**: white solid; mp 164–166 °C; IR (neat) 3415, 1742; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.72 (s, 9H), 2.45 (s, 3H), 6.84 (d, *J* = 3.4 Hz, 1H), 7.27 (ddd, *J* = 7.4, 7.4, 1.7 Hz, 1H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.36 (s, 1H), 7.38–7.43 (m, 2H), 7.55 (t, *J* = 3.7 Hz, 3H), 7.98 (d, *J* = 8.0 Hz, 1H), 8.25 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 21.2, 28.2 (3C), 83.5, 107.4, 108.2, 110.0, 110.2, 119.0, 122.1, 123.2, 124.6, 125.3, 125.9, 129.1 (2C), 129.3 (2C), 129.9, 133.3, 136.9, 137.9, 139.3, 139.5, 150.0; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 397.1911, found 397.1923.

***tert*-Butyl 4-(4-Chlorophenyl)pyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (6eF) and Its [3,2-*c*]-Isomer (7eF) (Table 5)**

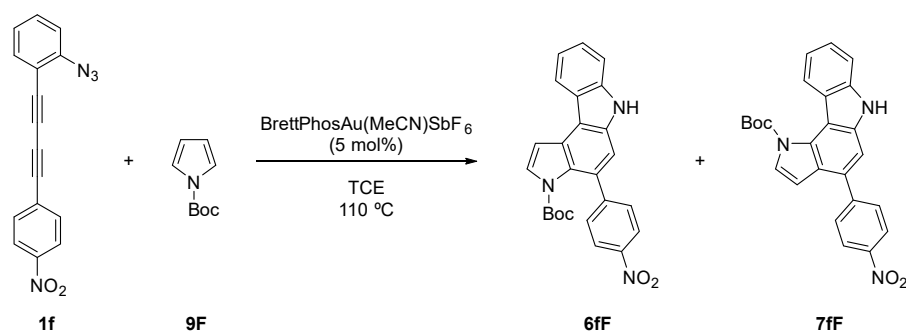


To a solution of **1e** (27.8 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 1.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 10/1) to give a mixture of **6eF** and **7eF** (27.2 mg, 65%; **6eF**:**7eF** = 95:5). These isomers were separated by column chromatography on amine silica gel (toluene) to give, in the order of elution, **6eF** and **7eF**.

Compound **6eF**: pale yellow solid; mp 185–187 °C; IR (neat) 3395, 1740; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.37 (s, 9H), 7.21 (d, *J* = 3.4 Hz, 1H), 7.26 (s, 1H), 7.32 (dd, *J* = 7.3, 7.3, 1.0 Hz, 1H), 7.39 (dd, *J* = 6.3, 1.7 Hz, 2H), 7.43 (ddd, *J* = 6.5, 6.5, 1.0 Hz, 1H), 7.48 (m, 3H), 7.72 (d, *J* = 4.0 Hz, 1H), 8.18 (s, 1H), 8.24 (d, *J* = 7.4 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 27.7 (3C), 83.6, 105.6, 110.0, 110.8, 114.1, 119.6, 121.3, 123.1, 125.1, 125.9, 127.4, 128.5 (2C), 128.7 (2C), 129.1, 132.3, 136.4, 139.6, 141.3, 149.3; HRMS (FAB) calcd for C<sub>25</sub>H<sub>22</sub>ClN<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 417.1364, found 417.1373.

Compound **7eF**: white solid; mp 103–105 °C; IR (neat) 3394, 1747; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.72 (s, 9H), 6.77 (d, *J* = 3.4 Hz, 1H), 7.25–7.31 (m, 1H), 7.31 (s, 1H), 7.41 (d, *J* = 3.4 Hz, 2H), 7.45–7.47 (m, 2H), 7.55–7.57 (m, 3H), 7.98 (d, *J* = 8.0 Hz, 1H), 8.25 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 28.2 (3C), 83.7, 107.4, 107.7, 110.1, 110.6, 119.1, 122.0, 123.0, 124.9, 125.6, 126.0, 128.7 (2C), 123.0, 130.4 (2C), 131.9, 133.1, 139.1, 139.3, 139.5, 150.0; HRMS (FAB) calcd for C<sub>25</sub>H<sub>22</sub>ClN<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 417.1364, found 417.1367.

***tert*-Butyl 4-(4-Nitrophenyl)pyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (**6fF**) and Its [3,2-*c*]-Isomer (**7fF**) (Table 5)**

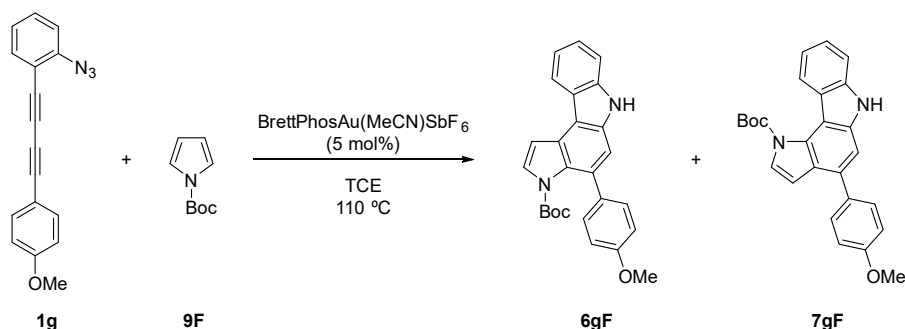


To a solution of **1f** (28.8 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 1.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give a mixture of **6fF** and **7fF** (27.4 mg, 64%; **6fF**:**7fF** = 91:9). These isomers were separated by column chromatography on amine silica gel (hexane/toluene = 1/5) to give, in the order of elution, **6fF** and **7fF**.

Compound **6fF**: yellow solid; mp 186–188 °C; IR (neat) 3396, 1738, 1514; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.40 (s, 9H), 7.24 (d, *J* = 3.4 Hz, 1H), 7.31 (s, 1H), 7.34 (dd, *J* = 7.3, 1.5 Hz, 1H), 7.46–7.51 (m, 2H), 7.66–7.68 (m, 2H), 7.73 (d, *J* = 3.4 Hz, 1H), 8.26–8.29 (m, 4H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 27.8 (3C), 83.8, 105.9, 110.2, 110.9, 115.0, 119.9, 121.5, 122.9, 123.6 (2C), 125.6, 126.1, 126.1, 127.1, 128.1 (2C), 129.0, 136.2, 139.8, 146.2, 149.1, 149.8; HRMS (FAB) calcd for C<sub>25</sub>H<sub>22</sub>N<sub>3</sub>O<sub>4</sub> [M+H]<sup>+</sup>: 428.1605, found 428.1614.

Compound **7fF**: orange solid; mp 189–191 °C; IR (neat) 3415, 1744, 1508; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.74 (s, 9H), 6.77 (d, *J* = 4.0 Hz, 1H), 7.29–7.32 (m, 1H), 7.40 (s, 1H), 7.44–7.46 (m, 2H), 7.61 (d, *J* = 4.0 Hz, 1H), 7.80 (dd, *J* = 6.6, 2.0 Hz, 2H), 7.99 (d, *J* = 8.0 Hz, 1H), 8.35–8.37 (m, 3H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 28.1 (3C), 84.0, 107.2, 107.8, 110.2, 111.4, 119.3, 121.8, 122.8, 123.9 (2C), 125.3, 126.1, 126.2, 129.8 (2C), 130.1, 130.4, 139.0, 139.7, 146.8, 147.6, 149.8; HRMS (FAB) calcd for C<sub>25</sub>H<sub>22</sub>N<sub>3</sub>O<sub>4</sub> [M+H]<sup>+</sup>: 428.1605, found 428.1606.

***tert*-Butyl 4-(4-Methoxyphenyl)pyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (**6gF**) and Its [3,2-*c*]-Isomer (**7gF**) (Table 5)**

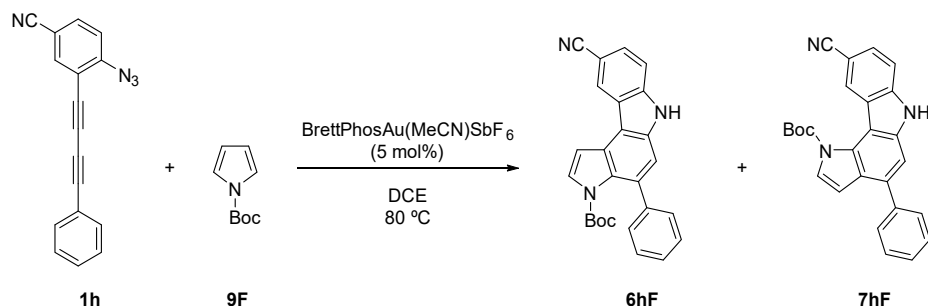


To a solution of **1g** (27.3 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 0.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give a mixture of **6gF** and **7gF** (27.8 mg, 67%; **6gF**:**7gF** = 95:5). These isomers were separated by column chromatography on amine silica gel (toluene) to give, in the order of elution, **6gF** and **7gF**.

Compound **6gF**: white solid; mp 118–120 °C; IR (neat) 3397, 1743; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.34 (s, 9H), 3.82 (s, 3H), 6.93 (dd, *J* = 6.6, 2.0 Hz, 2H), 7.20 (d, *J* = 4.0 Hz, 1H), 7.24 (s, 1H), 7.30 (ddd, *J* = 7.3, 7.3, 1.3 Hz, 1H), 7.39–7.44 (m, 2H), 7.47 (dd, *J* = 6.3, 2.3 Hz, 2H), 7.71 (d, *J* = 3.4 Hz, 1H), 8.17 (s, 1H), 8.23 (d, *J* = 7.4 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 27.7 (3C), 55.4, 83.4, 105.5, 109.8, 110.7, 113.5, 114.0 (2C), 119.4, 121.1, 123.2, 124.8, 125.9, 127.7, 128.4 (2C), 128.5, 129.1, 135.3, 136.6, 139.5, 149.6, 158.5; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>3</sub> [M+H]<sup>+</sup>: 413.1860, found 413.1861.

Compound **7gF**: white solid; mp 102–105 °C; IR (neat) 3398, 1728; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.72 (s, 9H), 3.89 (s, 3H), 6.83 (d, *J* = 3.4 Hz, 1H), 7.04 (dd, *J* = 6.3, 2.3 Hz, 2H), 7.26–7.29 (m, 1H), 7.35 (s, 1H), 7.40 (ddd, *J* = 7.4, 7.4, 1.1 Hz, 1H), 7.44 (d, *J* = 7.4 Hz, 1H), 7.55 (d, *J* = 4.0 Hz, 1H), 7.58 (dd, *J* = 6.6, 2.0 Hz, 2H), 7.97 (d, *J* = 7.4 Hz, 1H), 8.26 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 28.2 (3C), 55.4, 83.6, 107.3, 108.1, 110.0, 110.1, 114.0 (2C), 118.9, 122.1, 123.2, 124.6, 125.2, 125.8, 129.9, 130.2 (2C), 133.0, 133.3, 139.3, 139.5, 150.0, 158.9; HRMS (FAB) calcd for C<sub>26</sub>H<sub>25</sub>N<sub>2</sub>O<sub>3</sub> [M+H]<sup>+</sup>: 413.1860, found 413.1860.

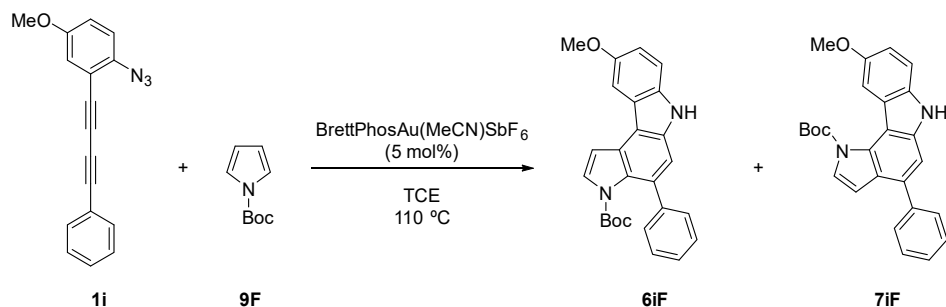
***tert*-Butyl 9-Cyano-4-phenylpyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (**6hF**) and Its [3,2-*c*]-Isomer (**7hF**) (Table 5)**



To a solution of **1h** (26.8 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 1 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 3/1) to give an inseparable mixture of **6hF** and **7hF** (24.9 mg, 61%; **6hF**:**7hF** = 81:19): brown solid; IR (neat) 3332, 2218, 1730;

$^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ ; mixture of isomers)  $\delta$ : 1.33 (s, 9H), 6.84 (d,  $J = 4.0$  Hz, 0.2H), 7.15 (d,  $J = 4.0$  Hz, 0.8H), 7.27 (s, 0.8H), 7.32-7.36 (m, 1.2H), 7.39-7.53 (m, 4.2H), 7.59-7.62 (m, 1H), 7.65 (dd,  $J = 8.6, 1.7$  Hz, 1H), 7.76 (d,  $J = 3.4$  Hz, 0.8H), 8.32 (s, 0.2H), 8.51 (d,  $J = 1.1$  Hz, 0.8H), 8.57 (s, 0.8H), 8.69 (s, 0.2H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ ; mixture of isomers)  $\delta$ : 27.6, 28.4, 84.5, 105.0, 107.7, 108.2, 110.7, 111.3, 120.7, 121.0, 125.8, 126.1, 127.0, 127.4, 127.5, 127.6, 128.7, 129.2, 129.7, 131.5, 135.0, 139.5, 140.2, 141.2, 150.1; HRMS (ESI) calcd for  $\text{C}_{26}\text{H}_{22}\text{N}_3\text{O}_2$   $[\text{M}+\text{H}]^+$ : 408.1712, found 408.1709.

***tert*-Butyl 9-Methoxy-4-phenylpyrrolo[2,3-*c*]carbazole-3(6*H*)-carboxylate (6iF) and Its [3,2-*c*]-Isomer (7iF) (Table 5)**

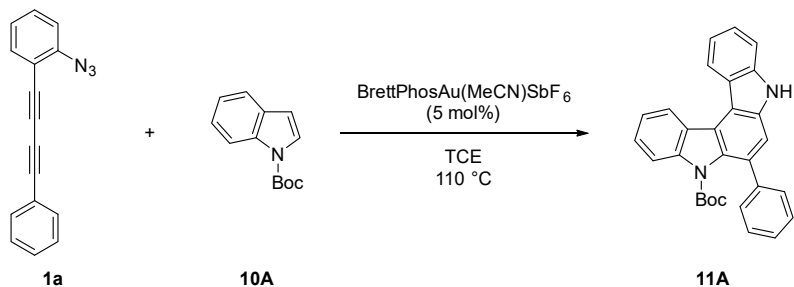


To a solution of **1i** (27.3 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00  $\mu\text{mol}$ ) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 0.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give a mixture of **6iF** and **7iF** (21.5 mg, 52%; **6iF**:**7iF** = 91:9). These isomers were separated by column chromatography on amine silica gel (toluene/Et<sub>2</sub>O = 6/1) to give, in the order of elution, **6iF** and **7iF**.

Compound **6iF**: light brown solid; mp 189–190 °C; IR (neat) 3413, 1747;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 1.30 (s, 9H), 3.98 (s, 3H), 7.07 (dd,  $J = 8.9, 2.6$  Hz, 1H), 7.18 (d,  $J = 4.0$  Hz, 1H), 7.28 (s, 1H), 7.32 (dd,  $J = 7.4, 7.4$  Hz, 1H), 7.36 (d,  $J = 9.2$  Hz, 1H), 7.42 (dd,  $J = 7.7, 7.7$  Hz, 2H), 7.57 (d,  $J = 7.4$  Hz, 2H), 7.70 (d,  $J = 2.3$  Hz, 1H), 7.72 (d,  $J = 4.0$  Hz, 1H), 8.03 (s, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 27.6 (3C), 56.2, 83.5, 104.4, 105.3, 110.3, 111.3, 113.8, 113.9, 123.7, 125.8, 126.6, 127.3, 127.4 (2C), 128.5 (2C), 128.8, 129.0, 134.6, 137.3, 142.7, 149.6, 153.9; HRMS (FAB) calcd for  $\text{C}_{26}\text{H}_{25}\text{N}_2\text{O}_3$   $[\text{M}+\text{H}]^+$ : 413.1860, found 413.1869.

Compound **7iF**: white solid; mp 145–146 °C; IR (neat) 3589, 1734;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ )  $\delta$ : 1.74 (s, 9H), 3.95 (s, 3H), 6.83 (d,  $J = 4.0$  Hz, 1H), 7.08 (dd,  $J = 8.6, 2.9$  Hz, 1H), 7.36 (d,  $J = 8.6$  Hz, 1H), 7.40 (s, 1H), 7.41-7.43 (m, 1H), 7.49-7.52 (m, 2H), 7.55-7.56 (m, 2H), 7.64-7.67 (m, 2H), 8.19 (s, 1H);  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ )  $\delta$ : 28.2 (3C), 55.9, 83.4, 107.8, 108.3, 108.9, 110.5, 110.6, 114.5, 122.6, 123.0, 125.2, 127.1, 128.5 (2C), 129.2 (2C), 129.9, 133.2, 134.6, 140.1, 140.8, 150.1, 153.3; HRMS (FAB) calcd for  $\text{C}_{26}\text{H}_{25}\text{N}_2\text{O}_3$   $[\text{M}+\text{H}]^+$ : 413.1860, found 413.1867.

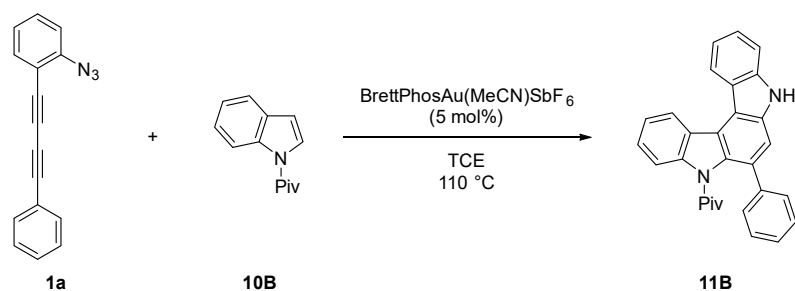
***tert*-Butyl 6-Phenylindolo[2,3-*c*]carbazole-5(8*H*)-carboxylate (11A) (Table 6)**





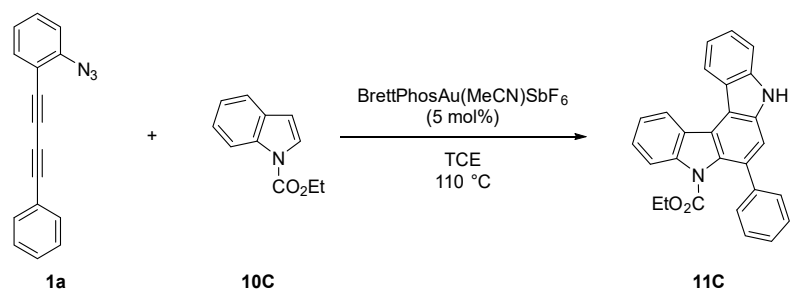
To a solution of **1a** (24.3 mg, 0.100 mmol) and **10A** (109 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 3 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/toluene = 1/1) to give **11A** (15.1 mg, 35%): white powder; mp 194–195 °C; IR (neat) 3412, 1750; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.23 (s, 9H), 7.33 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.36–7.39 (m, 1H), 7.44–7.46 (m, 5H), 7.51–7.57 (m, 2H), 7.67–7.68 (m, 2H), 8.25 (dd, *J* = 7.2, 2.0 Hz, 1H), 8.35 (s, 1H), 8.78 (d, *J* = 8.0 Hz, 1H), 8.82–8.83 (m, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 27.5 (3C), 83.6, 110.9, 112.1, 114.6, 115.6, 119.4, 122.4, 122.6, 122.7, 122.9, 123.4, 125.4, 126.2, 126.5, 126.9, 127.2 (2C), 129.1 (2C), 129.4, 131.6, 137.4, 140.0, 140.5, 142.2, 151.1; HRMS (ESI) calcd for C<sub>29</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 433.1916, found 433.1912.

### 2,2-Dimethyl-1-[6-phenylindolo[2,3-*c*]carbazol-5(8*H*)-yl]propan-1-one (**11B**) (Table 6)



To a solution of **1a** (24.3 mg, 0.100 mmol) and **10B** (101 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 6.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/toluene = 1/1) to give **11B** (4.90 mg, 12%): yellow solid; mp 227–230 °C; IR (neat) 3412, 1692; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 0.63 (s, 9H), 7.40–7.43 (m, 2H), 7.49–7.51 (m, 6H), 7.58 (dd, *J* = 8.0, 8.0 Hz, 2H), 7.74–7.75 (m, 2H), 8.38 (s, 1H), 8.86 (d, *J* = 8.6 Hz, 1H), 8.89–8.90 (m, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 27.7 (3C), 46.4, 110.9, 111.4, 111.6, 116.1, 119.52, 119.55, 121.1, 122.9, 123.1, 123.6 (2C), 125.5, 126.1, 127.4, 128.0, 129.1 (2C), 130.5 (2C), 132.7, 136.4, 138.8, 139.5, 140.0, 186.7; HRMS (ESI) calcd for C<sub>29</sub>H<sub>25</sub>N<sub>2</sub>O [M+H]<sup>+</sup>: 417.1967, found 417.1977

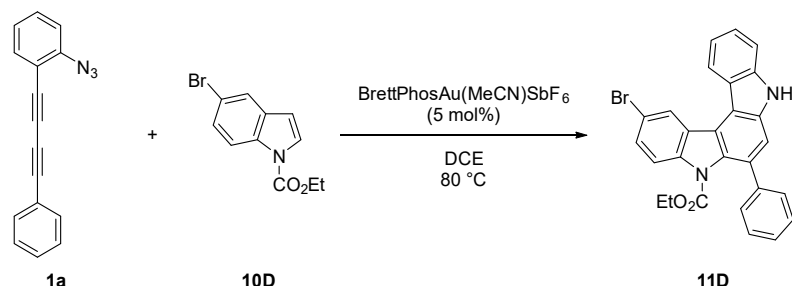
### Ethyl 6-Phenylindolo[2,3-*c*]carbazole-5(8*H*)-carboxylate (**11C**) (Table 6)



To a solution of **1a** (24.3 mg, 0.100 mmol) and **10C** (94.6 mg, 0.500 mmol) in TCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 110 °C. The mixture was stirred at 110 °C in pre-heated bath for 6.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/toluene = 1/2) to give **11C** (17.9 mg, 44%): white powder; mp 226–228 °C; IR (neat) 3410, 1725; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 0.94 (t, *J* = 7.2 Hz, 3H), 3.59 (q, *J* = 7.3 Hz, 2H), 7.32–7.35 (m, 1H), 7.36–7.40 (m, 1H), 7.45–7.47 (m, 5H), 7.52–7.59 (m, 2H), 7.63 (dd, *J* = 8.0, 1.1 Hz, 2H), 8.32–8.34 (m, 2H), 8.78 (d, *J* = 7.4 Hz, 1H), 8.82–8.83 (m, 1H); <sup>13</sup>C NMR (125 MHz,

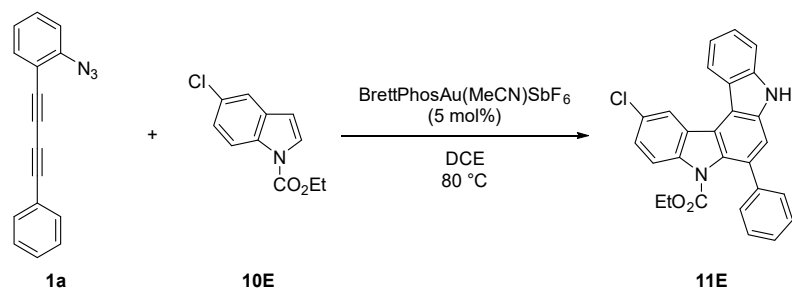
CDCl<sub>3</sub>)  $\delta$ : 13.9, 62.9, 110.9, 112.0, 114.6, 115.7, 119.5, 122.3, 122.6, 122.9 (2C), 123.5, 125.6, 125.9, 126.7, 126.9 (3C), 129.0 (3C), 131.1, 137.4, 140.05, 140.11, 142.3, 152.5; HRMS (ESI) calcd for C<sub>27</sub>H<sub>21</sub>N<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 405.1603, found 405.1594.

#### Ethyl 2-Bromo-6-phenylindolo[2,3-*c*]carbazole-5(8*H*)-carboxylate (**11D**) (Table 6)



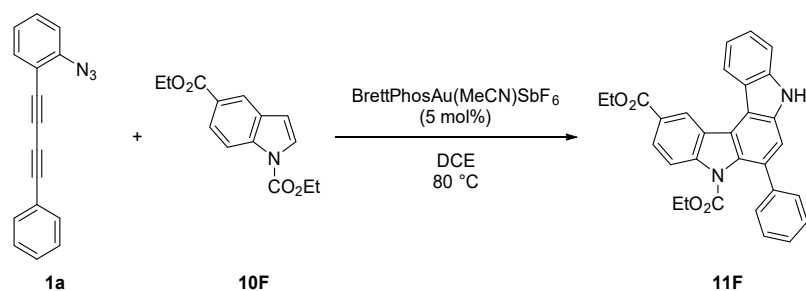
To a solution of **1a** (24.3 mg, 0.100 mmol) and **10D** (134 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00  $\mu$ mol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 4.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give **11D** (24.0 mg, 50%): white powder; mp 246–248 °C; IR (neat) 3420, 1729; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>)  $\delta$ : 0.95 (t, *J* = 7.2 Hz, 3H), 3.59 (q, *J* = 7.3 Hz, 2H), 7.37 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.42–7.45 (m, 1H), 7.49–7.54 (m, 4H), 7.55 (s, 1H), 7.64–7.66 (m, 3H), 8.19 (d, *J* = 8.6 Hz, 1H), 8.39 (s, 1H), 8.66 (d, *J* = 8.0 Hz, 1H), 8.90 (d, *J* = 1.7 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>)  $\delta$ : 13.9, 63.1, 111.0, 112.8, 115.7, 115.8, 116.0, 119.9, 121.2, 122.4, 123.3, 125.4, 125.9, 126.9 (2C), 127.1, 127.7, 129.0, 129.1 (2C), 129.4, 131.6, 137.3, 138.8, 140.0, 142.0, 152.1; HRMS (ESI) calcd for C<sub>27</sub>H<sub>20</sub>BrN<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 483.0708, found 483.0695.

#### Ethyl 2-Chloro-6-phenylindolo[2,3-*c*]carbazole-5(8*H*)-carboxylate (**11E**) (Table 6)



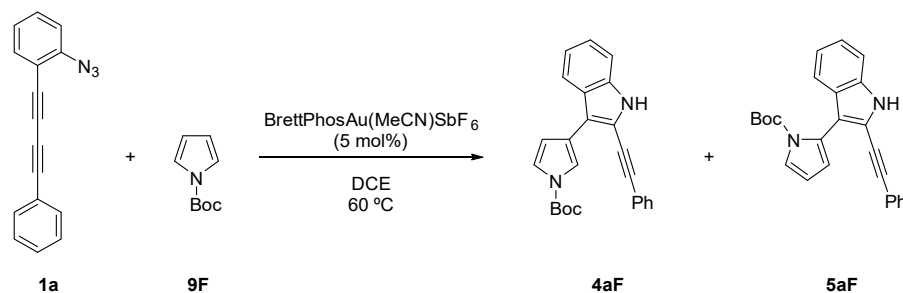
To a solution of **1a** (24.3 mg, 0.100 mmol) and **10E** (112 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00  $\mu$ mol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 4.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give **11E** (23.0 mg, 52%): white powder; mp 241–243 °C; IR (neat) 3420, 1728; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>)  $\delta$ : 0.95 (t, *J* = 7.2 Hz, 3H), 3.59 (q, *J* = 7.1 Hz, 2H), 7.36–7.39 (m, 1H), 7.42–7.45 (m, 1H), 7.51–7.53 (m, 5H), 7.56 (s, 1H), 7.65 (dd, *J* = 6.6, 1.4 Hz, 2H), 8.24 (d, *J* = 9.2 Hz, 1H), 8.40 (s, 1H), 8.69 (d, *J* = 8.0 Hz, 1H), 8.76 (d, *J* = 2.3 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>)  $\delta$ : 13.9, 63.1, 111.0, 112.8, 115.6, 115.7, 119.9, 121.7, 122.4, 122.5, 123.4, 125.9, 126.6, 126.9 (2C), 127.1, 128.3, 129.0, 129.1 (3C), 131.7, 137.3, 138.5, 140.1, 142.1, 152.2; HRMS (ESI) calcd for C<sub>27</sub>H<sub>20</sub>ClN<sub>2</sub>O<sub>2</sub> [M+H]<sup>+</sup>: 439.1213, found 439.1195.

### Diethyl 6-Phenylindolo[2,3-*c*]carbazole-2,5(8*H*)-dicarboxylate (**11F**) (Table 6)



To a solution of **1a** (24.3 mg, 0.100 mmol) and **10F** (131 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 80 °C. The mixture was stirred at 80 °C in pre-heated bath for 7.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give **11F** (31.8 mg, <67%): white powder; mp 292–294 °C; IR (neat) 3342, 1698; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 0.97 (t, *J* = 7.2 Hz, 3H), 1.54 (t, *J* = 7.2 Hz, 3H), 3.60 (q, *J* = 7.3 Hz, 2H), 4.53 (q, *J* = 7.1 Hz, 2H), 7.39 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.46 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.51–7.60 (m, 4H), 7.61 (s, 1H), 7.68 (d, *J* = 7.4 Hz, 2H), 8.27 (dd, *J* = 8.6, 1.1 Hz, 1H), 8.31 (d, *J* = 8.6 Hz, 1H), 8.44 (s, 1H), 8.89 (d, *J* = 8.0 Hz, 1H), 9.61 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 13.9, 14.5, 61.1, 63.3, 111.0, 112.6, 114.0, 115.9, 120.0, 121.9, 122.5, 123.6, 125.0 (2C), 125.7, 126.0, 127.0 (3C), 127.2, 128.0, 128.9, 129.1 (2C), 131.6, 137.5, 140.2, 142.0, 152.1, 167.0; HRMS (ESI) calcd for C<sub>30</sub>H<sub>25</sub>N<sub>2</sub>O<sub>4</sub> [M+H]<sup>+</sup>: 477.1814, found 477.1824

### *tert*-Butyl 3-[2-(Phenylethynyl)-1*H*-indol-3-yl]-1*H*-pyrrole-1-carboxylate (**4aF**) and Its 2-Indolyl Isomer (**5aF**) (Scheme 5)



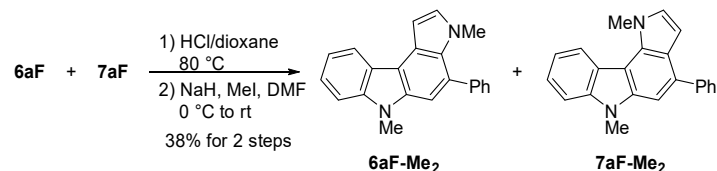
To a solution of **1a** (24.3 mg, 0.100 mmol) and **9F** (83.6 mg, 0.500 mmol) in DCE (0.5 mL) was added [BrettPhosAu(MeCN)SbF<sub>6</sub>] (5.05 mg, 5.00 μmol) at 60 °C. The mixture was stirred at 60 °C in pre-heated bath for 1.5 h and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 10/1) to give a mixture of **4aF** and **5aF** (9.40 mg, 25%; **4aF**:**5aF** = 69:31). These isomers were separated by column chromatography on silica gel (hexane/toluene = 1/2) to give, in the order of elution, **4aF** and **5aF**.

Compound **4aF**: brown viscous oil; IR (neat) 3404, 2978, 1738; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.63 (s, 9H), 6.96 (dd, *J* = 3.2, 1.4 Hz, 1H), 7.20 (ddd, *J* = 4.0, 4.0, 1.5 Hz, 1H), 7.29 (ddd, *J* = 3.5, 3.5, 1.0 Hz, 1H), 7.34–7.40 (m, 5H), 7.55–7.57 (m, 2H), 7.80 (s, 1H), 7.88 (d, *J* = 8.0 Hz, 1H), 8.21 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 28.0 (3C), 82.4, 83.6, 95.7, 110.9, 112.1, 115.4, 116.2, 116.9, 120.2, 120.3, 120.4, 120.6, 122.8, 123.9, 125.9, 128.5, 128.5 (2C), 131.3 (2C), 136.2, 148.9; HRMS (FAB) calcd for C<sub>25</sub>H<sub>22</sub>N<sub>2</sub>O<sub>2</sub> [M<sup>+</sup>]: 382.1681, found 382.1677.

Compound **5aF**: brown viscous oil; IR (neat) 3370, 2979, 1734; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 1.19 (s, 9H), 6.34 (dd, *J* = 3.2, 3.2 Hz, 1H), 6.44 (dd, *J* = 3.4, 1.7 Hz, 1H), 7.13 (dd, *J* = 7.4, 7.4 Hz, 1H), 7.24 (d, *J* = 8.0 Hz, 1H), 7.31–7.34 (m, 4H), 7.44–7.46 (m, 2H), 7.48–7.50 (m, 2H), 8.22 (s, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 27.3 (3C),

81.7, 83.2, 94.8, 110.7, 110.8, 115.5, 116.3, 117.3, 120.4, 120.5, 122.6, 122.6, 123.7, 126.2, 127.8, 128.3 (2C), 128.4, 131.4 (2C), 135.4, 149.5; HRMS (FAB) calcd for C<sub>25</sub>H<sub>22</sub>N<sub>2</sub>O<sub>2</sub> [M<sup>+</sup>]: 382.1681, found 382.1678.

### 3,6-Dimethyl-4-phenyl-3,6-dihydropyrrolo[2,3-c]carbazole (**6aF-Me<sub>2</sub>**) and Its [3,2-c]-Isomer (**7aF-Me<sub>2</sub>**)

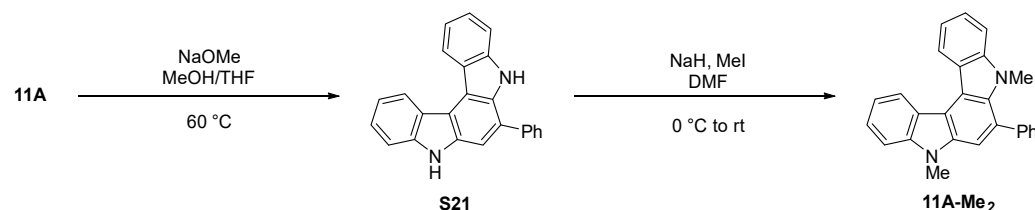


To a solution of **6aF** and **7aF** (50.0 mg, 0.130 mmol; **6aF**:**7aF** = 16:84) in 4 M HCl/dioxane (5.7 mL) was stirred at 80 °C for 16 min. The solvent was removed under vacuum. The crude was then poured into aqueous NaHCO<sub>3</sub>, extracted with EtOAc, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated in vacuo. The residue was purified by amine silica gel (hexane/CHCl<sub>3</sub> = 2/3) to give an isomeric mixture of **6aA** and **7aA** (22.0 mg, 60%). To a solution of this mixture (obtained by repeated reactions; 75.1 mg, 0.266 mmol) in DMF (0.912 mL) was added NaH (60% dispersion in paraffin liquid; 84.8 mg, 2.12 mmol) at 0 °C under Ar. The reaction mixture was stirred at room temperature for 30 min. MeI (0.132 ml, 2.12 mmol) was added to the reaction mixture. After being stirred for 14 h, the mixture was quenched with H<sub>2</sub>O, extracted with CHCl<sub>3</sub>, washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 30/1) to give **6aF-Me<sub>2</sub>** and **7aF-Me<sub>2</sub>** (52.8 mg, 64%; **6aF-Me<sub>2</sub>**: **7aF-Me<sub>2</sub>** = 12:88). These isomers were separated by careful column chromatography on silica gel (hexane/EtOAc = 30/1) to give, in the order of elution, **6aF-Me<sub>2</sub>** and **7aF-Me<sub>2</sub>**.

Compound **6aF-Me<sub>2</sub>**: white powder; mp 140–142 °C; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 3.39 (s, 3H), 3.91 (s, 3H), 7.09–7.15 (m, 3H), 7.26–7.31 (m, 1H), 7.44–7.46 (m, 5H), 7.56 (d, *J* = 6.9 Hz, 2H), 8.30 (d, *J* = 7.4 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 29.4, 37.2, 99.1, 106.3, 112.9, 118.4, 121.2, 122.9, 123.0, 123.9, 126.0, 127.2, 127.3, 127.6 (2C), 129.3, 130.3 (2C), 131.1, 135.5, 140.4, 141.2; HRMS (ESI) calcd for C<sub>22</sub>H<sub>19</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 311.1548, found 311.1556.

Compound **7aF-Me<sub>2</sub>**: white powder; mp 111–113 °C; <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 3.96 (s, 3H), 4.55 (s, 3H), 6.74 (d, *J* = 2.9 Hz, 1H), 7.03 (d, *J* = 3.4 Hz, 1H), 7.23 (ddd, *J* = 7.6, 7.6, 1.3 Hz, 1H), 7.27 (s, 1H), 7.40–7.53 (m, 5H), 7.77–7.78 (m, 2H), 8.56 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 29.5, 39.0, 102.0, 102.7, 106.7, 108.6, 118.6, 120.7, 121.8, 122.3, 123.7, 126.9, 127.0, 127.5, 128.4 (2C), 129.1 (2C), 132.3, 133.8, 139.2, 141.7; HRMS (ESI) calcd for C<sub>22</sub>H<sub>19</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 311.1548, found 311.1545.

### 5,8-Dimethyl-6-phenyl-5,8-dihydroindolo[2,3-c]carbazole (**11A-Me<sub>2</sub>**)

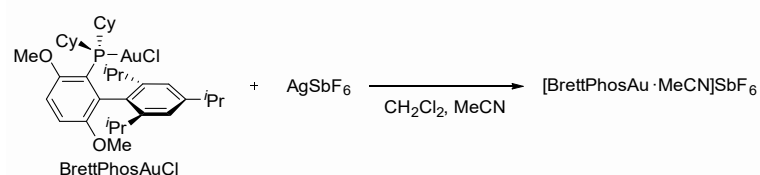


To a solution of **11A** (121 mg, 0.280 mmol) in THF (2.8 mL) was added NaOMe (5 M in MeOH) (1.68 mL, 8.39 mmol) at 60 °C. The mixture was stirred at 60 °C for 60 h. The mixture was quenched with sat. NaHCO<sub>3</sub> and the whole was extracted with Et<sub>2</sub>O, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 5/1) to give **S21** (52.2 mg, 56%) as a solid. To a solution of this solid (52.2 mg, 0.157 mmol) in DMF (0.502 mL) was added NaH (60% dispersion in paraffin liquid; 50.2 mg, 1.26 mmol)

at 0 °C under Ar. After being stirred at room temperature for 10 min, MeI (0.0391 ml, 0.628 mmol) was added to the mixture. After being stirred for 40 h, the mixture was quenched with H<sub>2</sub>O, extracted with CHCl<sub>3</sub>, washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated in vacuo. The residue was purified by column chromatography (hexane/EtOAc = 30/1) to give **11A-Me<sub>2</sub>** (36.1 mg, 64%): yellow viscous oil; <sup>1</sup>H NMR (500 MHz, CD<sub>2</sub>Cl<sub>2</sub>) δ: 3.46 (s, 3H), 3.97 (s, 3H), 7.40-7.44 (m, 3H), 7.47-7.57 (m, 7H), 7.62 (dd, *J* = 8.3, 1.4 Hz, 2H), 8.93 (d, *J* = 8.0 Hz, 1H), 8.96 (d, *J* = 8.0 Hz, 1H); <sup>13</sup>C NMR (125 MHz, CD<sub>2</sub>Cl<sub>2</sub>) δ: 29.4, 33.7, 108.5, 109.0, 110.1, 115.5, 117.9, 118.4, 118.6, 122.3, 122.5, 123.4, 123.5, 124.8, 125.0, 125.1, 127.3, 127.9 (2C), 130.1 (2C), 134.1, 135.9, 141.1, 141.4, 142.3; HRMS (ESI) calcd for C<sub>26</sub>H<sub>21</sub>N<sub>2</sub> [M+H]<sup>+</sup>: 361.1705, found 361.1690.

#### 4. Preparation of the Catalyst

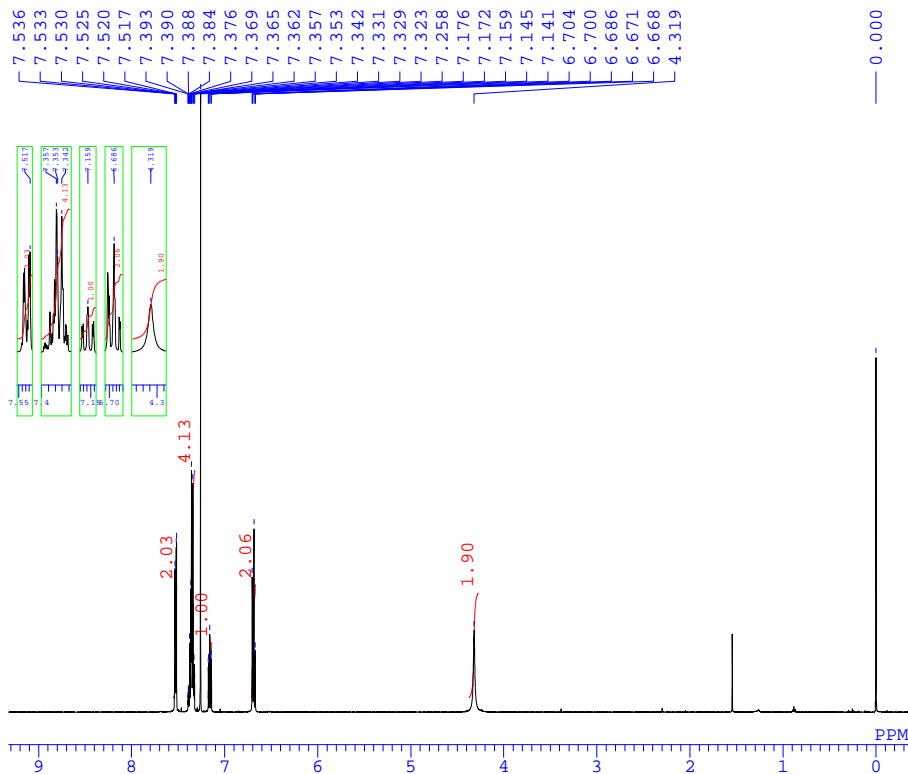
##### [BrettPhosAu·MeCN]SbF<sub>6</sub><sup>6</sup>



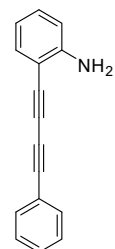
This catalyst was prepared according to the literature procedure for the synthesis of [L Au·MeCN]SbF<sub>6</sub> (L = {2-[2,4,6-(*i*-Pr)<sub>3</sub>C<sub>6</sub>H<sub>2</sub>]C<sub>6</sub>H<sub>4</sub>}P(*t*-Bu)<sub>2</sub>). AgSbF<sub>6</sub> (0.6 M solution in CH<sub>2</sub>Cl<sub>2</sub>; 1.98 mL, 1.19 mmol) was added to a stirred solution of chloro[2-(dicyclohexylphosphino)-3,6-dimethoxy-2',4',6'-triisopropyl-1,1'-biphenyl]gold(I) (BrettPhosAuCl) (897 mg, 1.17 mmol) in MeCN (7.5 mL) and CH<sub>2</sub>Cl<sub>2</sub> (7.5 mL), and the mixture was stirred at room temperature in the dark (using aluminium foil) for 8 h. The mixture was filtered through a pad of Celite and the solvent was removed in vacuo to afford a white powder (1.29 g, quant): <sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>) δ: 0.90 (d, *J* = 6.3 Hz, 6H), 1.07-1.09 (m, 2H), 1.17-1.24 (m, 4H), 1.27 (d, *J* = 6.9 Hz, 6H), 1.33 (d, *J* = 6.9 Hz, 6H), 1.37-1.40 (m, 4H), 1.49-1.50 (m, 2H), 1.67-1.98 (m, 8H), 2.25-2.30 (m, 2H), 2.37 (s, 3H), 2.55-2.59 (m, 2H), 2.92-2.98 (m, 1H), 3.56 (s, 3H), 3.94 (s, 3H), 6.95-7.12 (m, 4H); <sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>) δ: 2.52, 24.1 (d, *J* = 19.2 Hz, 4C), 24.8 (2C), 25.6 (2C), 26.5 (d, *J* = 16.8 Hz, 2C), 27.0 (d, *J* = 13.2 Hz, 2C), 30.0 (2C), 30.6 (2C), 33.7, 34.6, 34.7, 38.1 (d, *J* = 36.0 Hz, 2C), 54.9, 56.0, 110.8 (d, *J* = 7.2 Hz), 114.2, 114.7, 115.1, 118.9, 121.6 (2C), 131.5 (d, *J* = 8.4 Hz), 136.7 (d, *J* = 13.2 Hz), 147.3, 149.2, 153.1 (d, *J* = 10.8 Hz), 154.8; HRMS (FAB) calcd for C<sub>35</sub>H<sub>53</sub>AuO<sub>2</sub>P<sup>+</sup> [M-MeCN-SbF<sub>6</sub>]<sup>+</sup>: 733.3443, found 733.3444.

#### 5. References

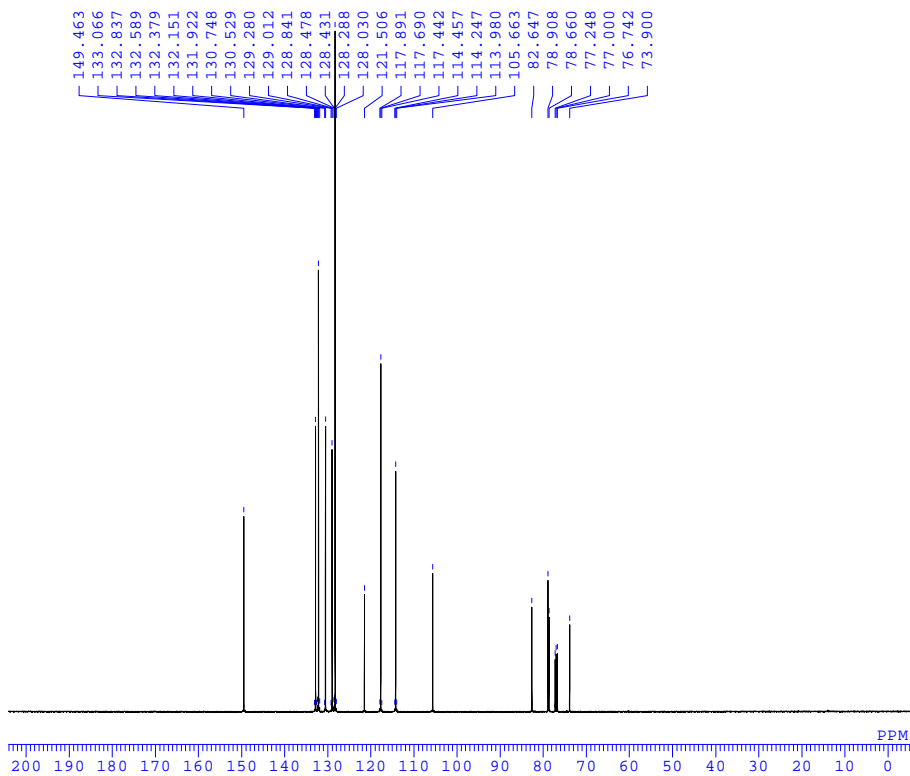
- (1) Matsuoka, J.; Matsuda, Y.; Kawada, Y.; Oishi, S.; Ohno, H. *Angew. Chem. Int. Ed.* **2017**, *56*, 7444–7448.
- (2) Sakai, N.; Annaka, K.; Konakahara, T. *J. Org. Chem.* **2006**, *71*, 3653–3655.
- (3) Nie, X.; Wang, G. *J. Org. Chem.* **2006**, *71*, 4734–4741.
- (4) (a) Fiandanese, V.; Bottalico, D.; Marchese G.; Punzi, A. *Tetrahedron* **2008**, *64*, 7301–7306. (b) Padwa, A.; Austin, D. J.; Gareau, Y.; Kassir, J. M.; Xu, S. L. *J. Am. Chem. Soc.* **1993**, *115*, 2637–2647.
- (5) Kueh, J. T. B.; Choi, K. W.; Brimble, M. A. *Org. Biomol. Chem.* **2012**, *10*, 5993–6002.
- (6) Obradors, C.; Leboeuf, D.; Aydin, J.; Echavarren, A. M. *Org. Lett.* **2013**, *15*, 1576.



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OBFIN 6.01 Hz  
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FREQU 7507.39 Hz  
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PD 5.0000 sec  
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IRNUC 1H  
CTEMP 21.0 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 50



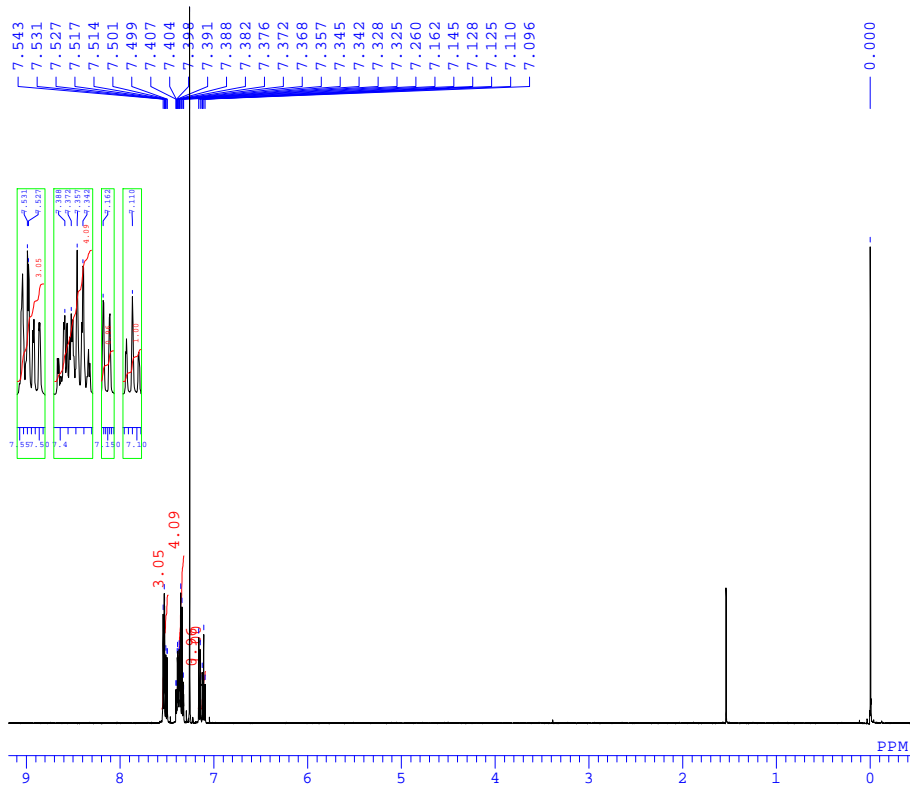
S3



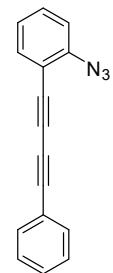
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POINT 26214  
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SCANS 1024  
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PD 2.0000 sec  
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CTEMP 21.1 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 58



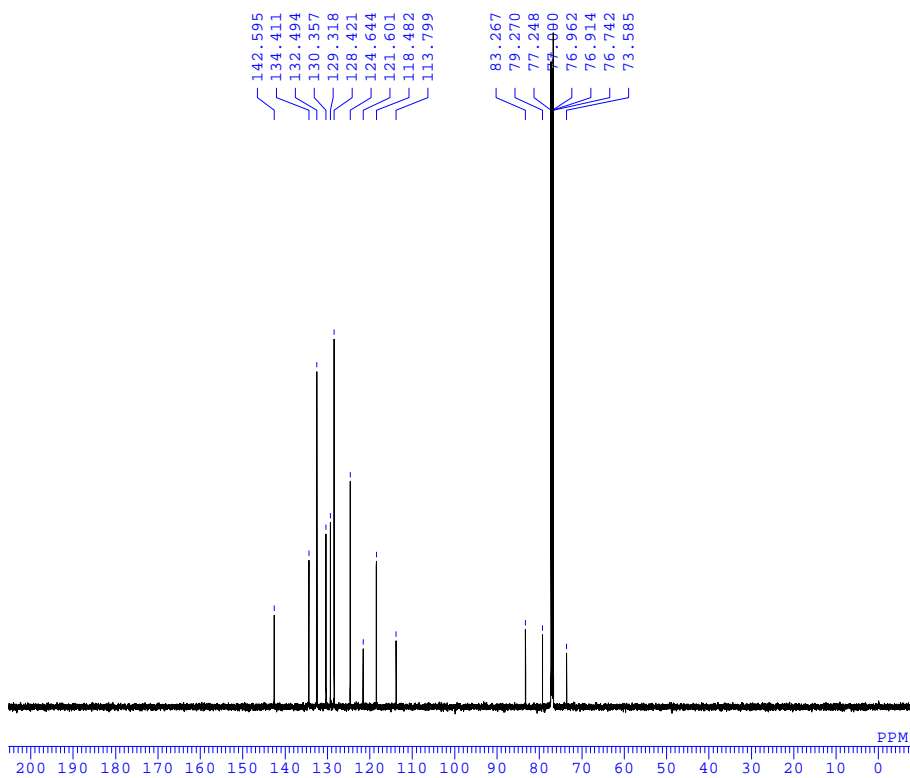
S3



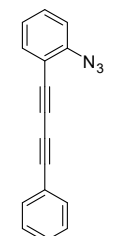
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OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
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PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 21.7 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 54



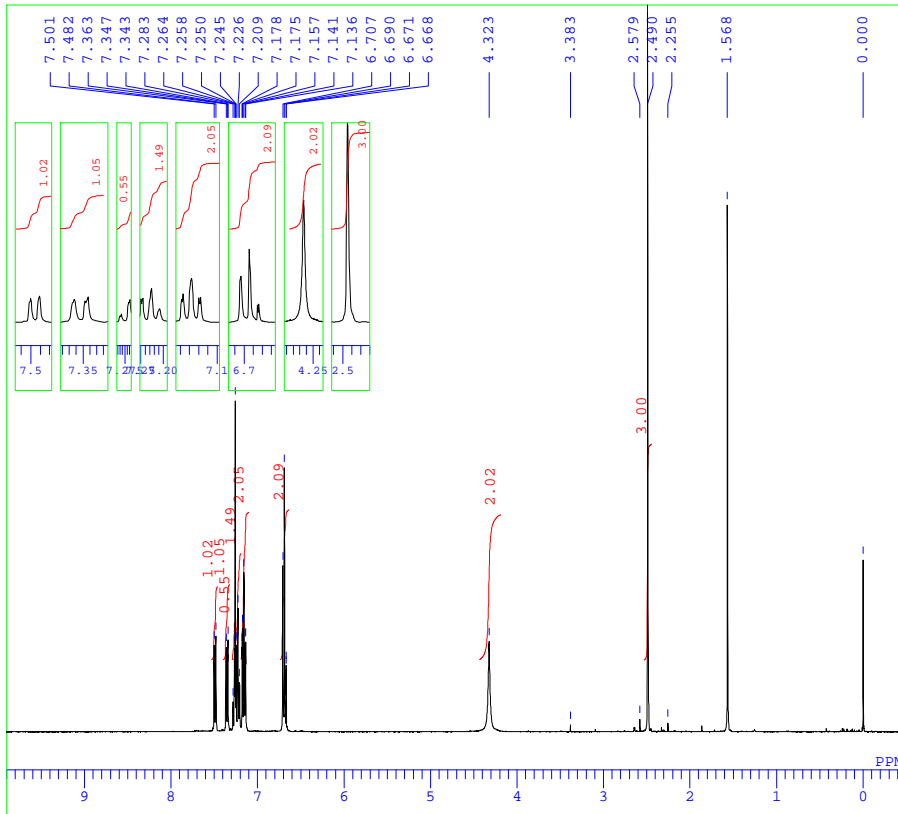
1a



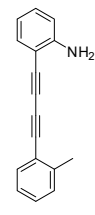
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OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 1058  
ACQTM 0.8336 sec  
PD 2.0000 sec  
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CTEMP 21.2 c  
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BF 1.20 Hz  
RGAIN 58



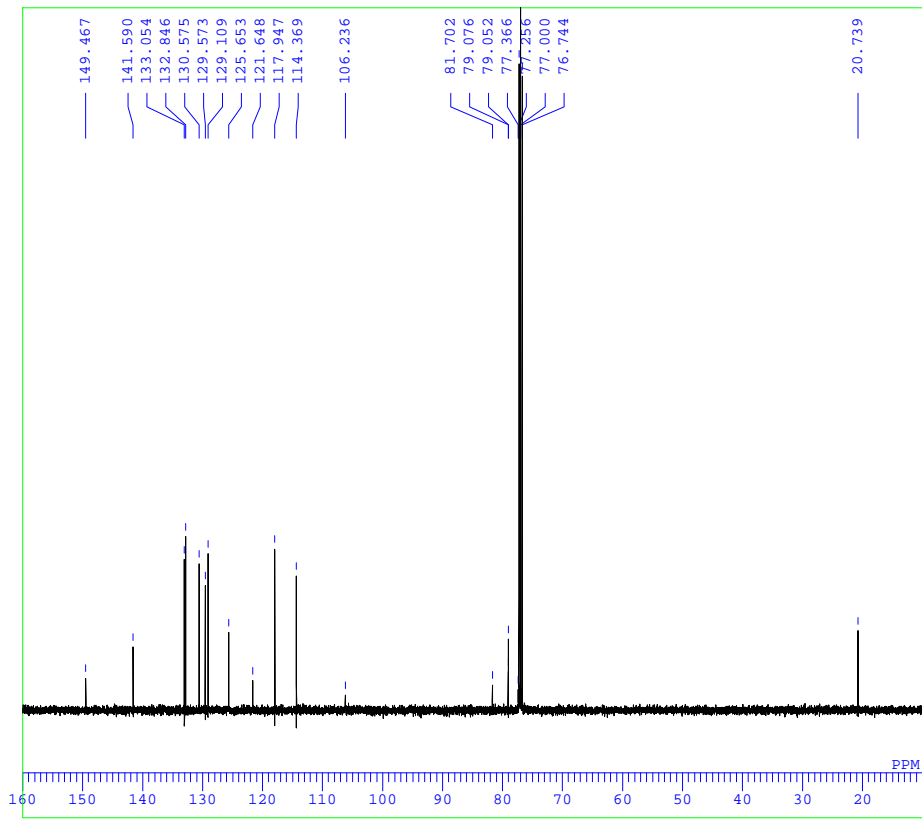
1a



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 PD 5.0000 sec  
 PW1 3.15 usec  
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 CTEMP 20.2 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 40



S5

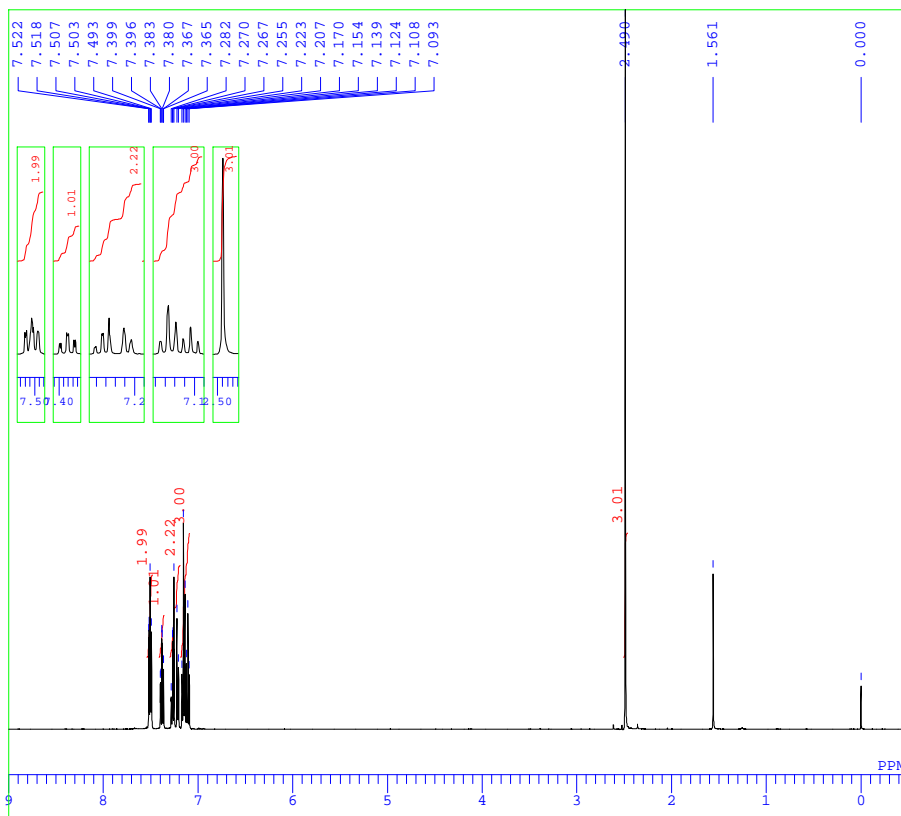


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 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 25163.56 Hz  
 SCANS 2049  
 ACQTM 0.6511 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.7 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 72

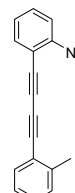


S5

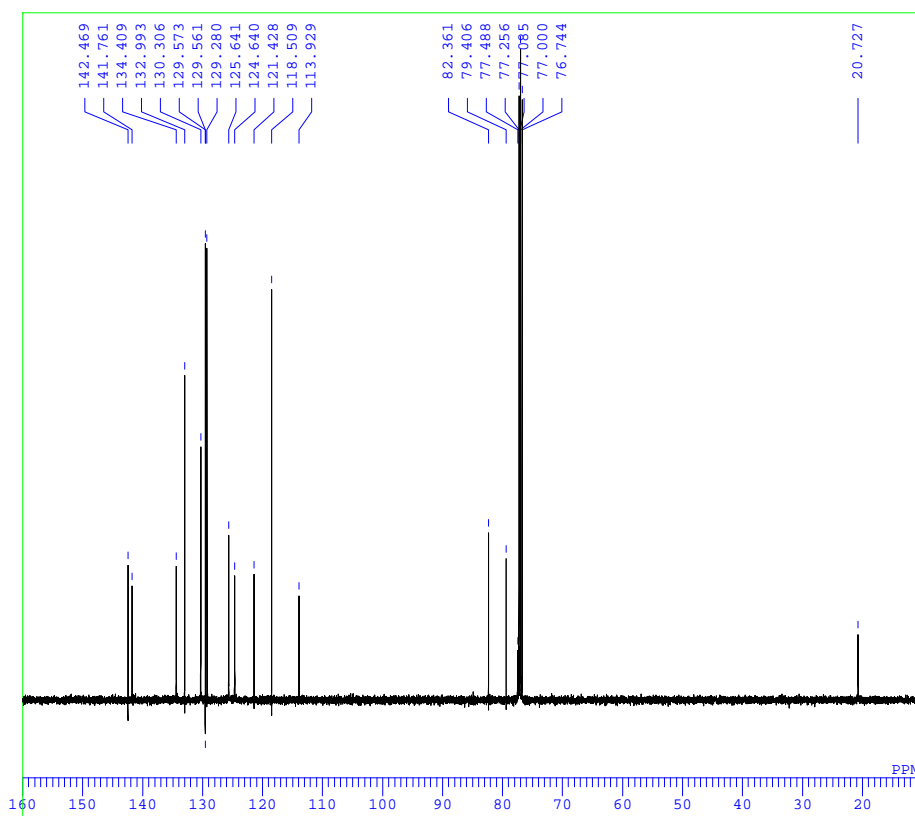




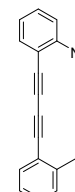
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OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PWL 7.15 usec  
IRNUC 1H  
CTEMP 21.1 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 50



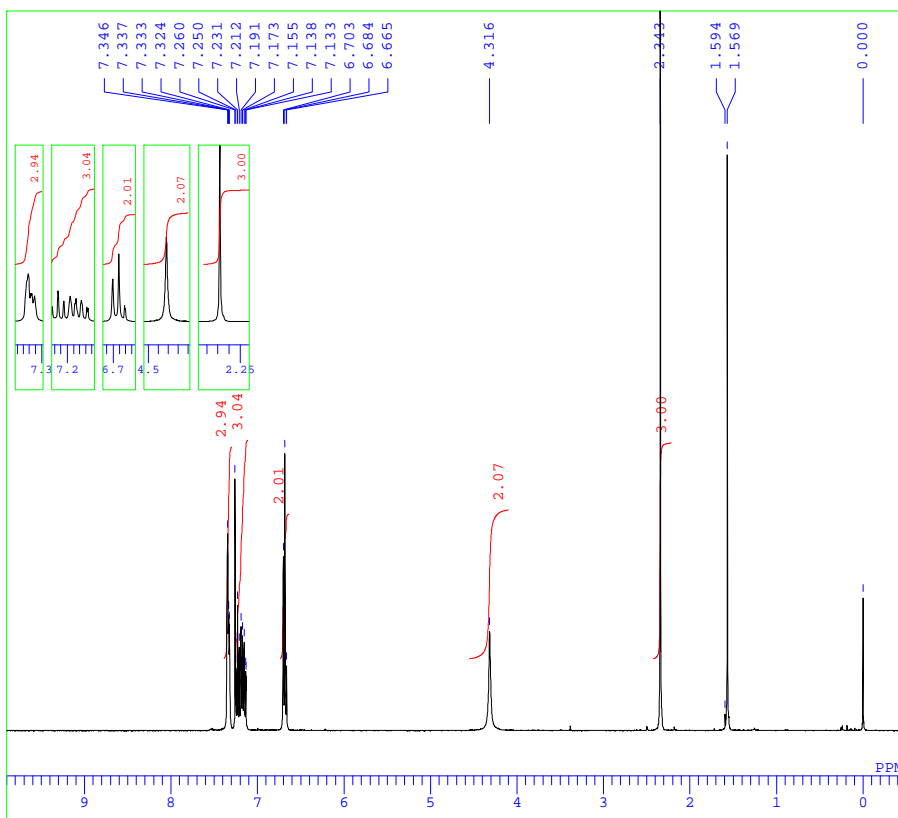
1b



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OBFIN 4.21 Hz  
POINT 16384  
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SCANS 2200  
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PD 1.0000 sec  
PWL 3.67 usec  
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CTEMP 22.2 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 0.12 Hz  
RGAIN 70



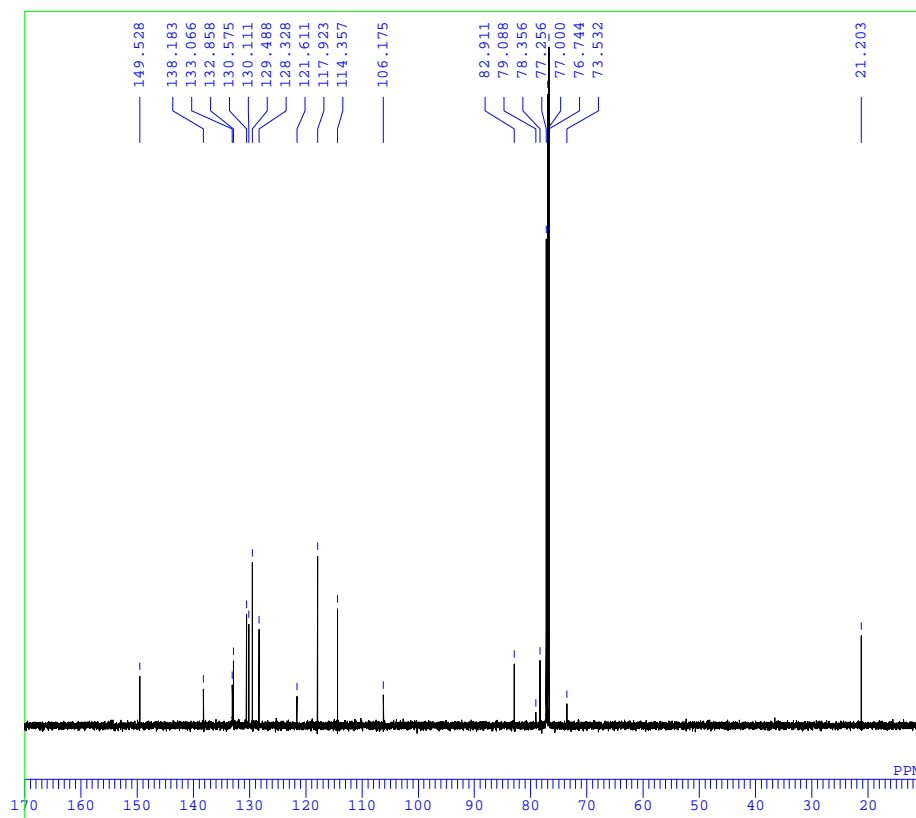
1b



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 OBSET 4.19 KHz  
 OBFIN 7.29 Hz  
 POINT 13107  
 FREQU 7621.95 Hz  
 SCANS 8  
 ACQTM 1.7197 sec  
 PD 5.0000 sec  
 PW1 3.15 usec  
 IRNUC 1H  
 CTEMP 19.8 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 38



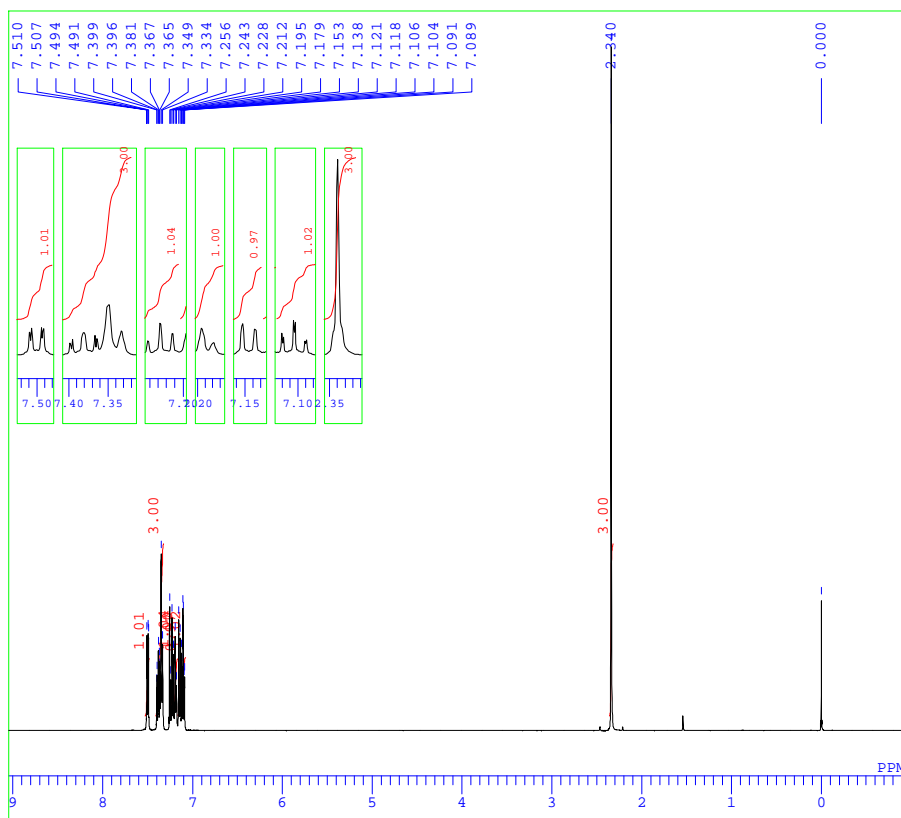
S7



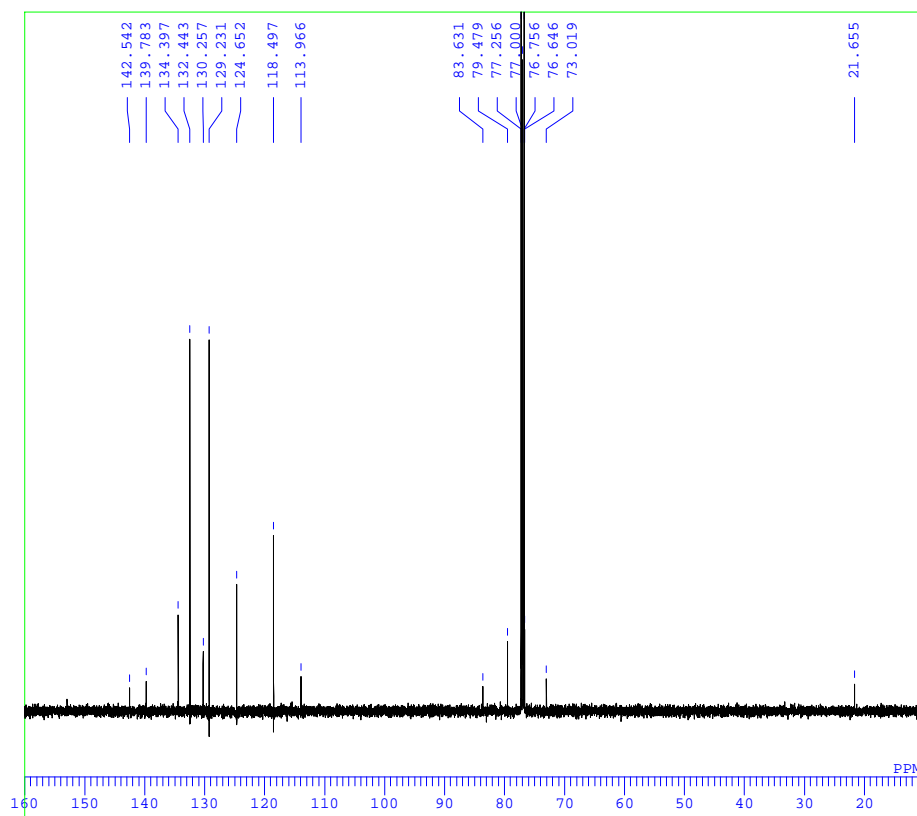
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 PD 1.0000 sec  
 PW1 3.67 usec  
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 EXREF 77.00 ppm  
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 RGAIN 70



S7

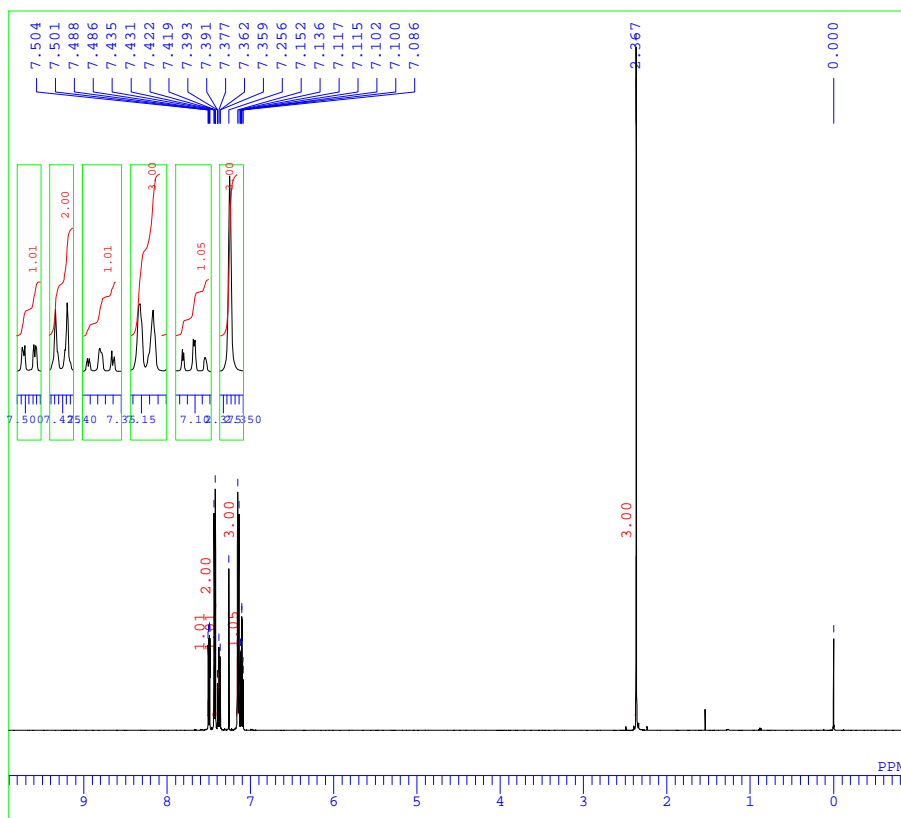


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OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 6.82 usec  
IRNUC 1H  
CTEMP 20.3 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 46

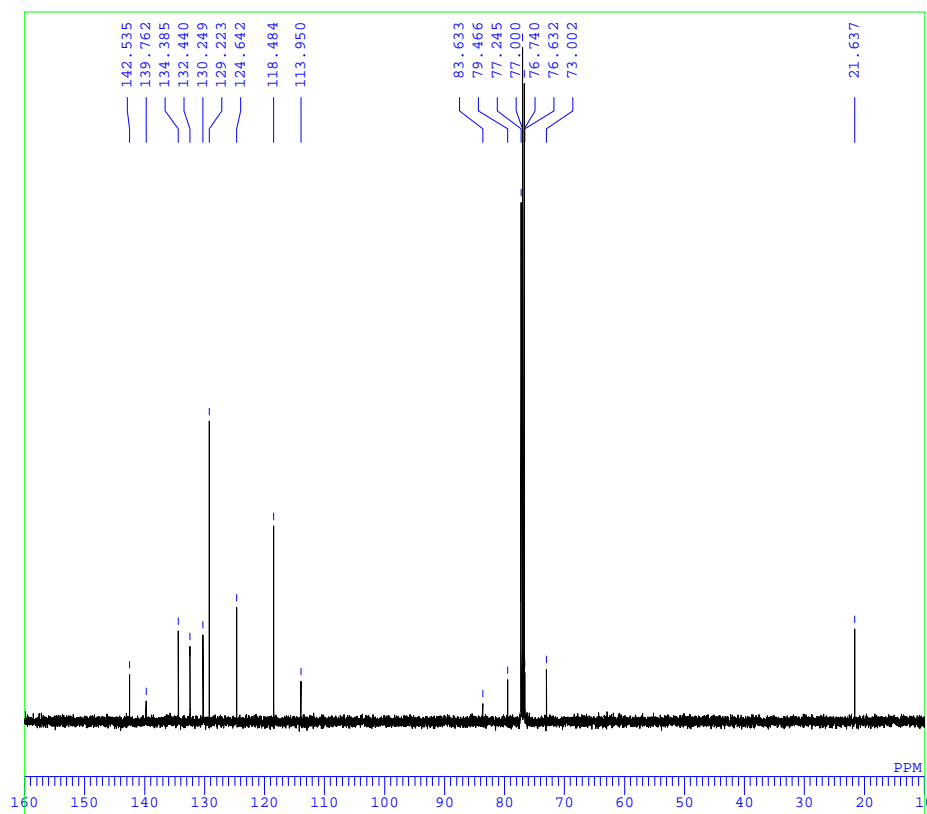
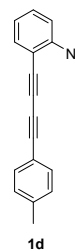


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ACQTM 0.6511 sec  
PD 1.0000 sec  
PW1 3.67 usec  
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CTEMP 22.2 c  
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EXREF 77.00 ppm  
BF 0.12 Hz  
RGAIN 70

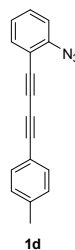


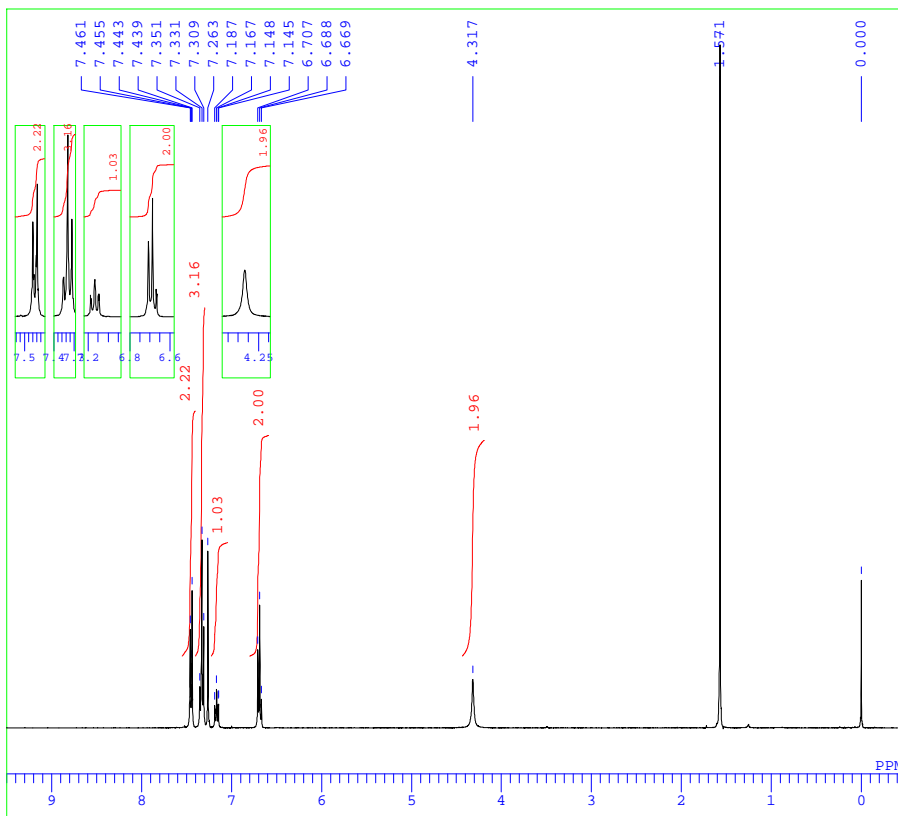


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 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 6.82 usec  
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 CTEMP 20.3 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 46

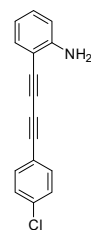


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 OBFIN 4.21 Hz  
 POINT 13107  
 FREQU 25252.14 Hz  
 SCANS 2136  
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 PD 1.0000 sec  
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 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 58

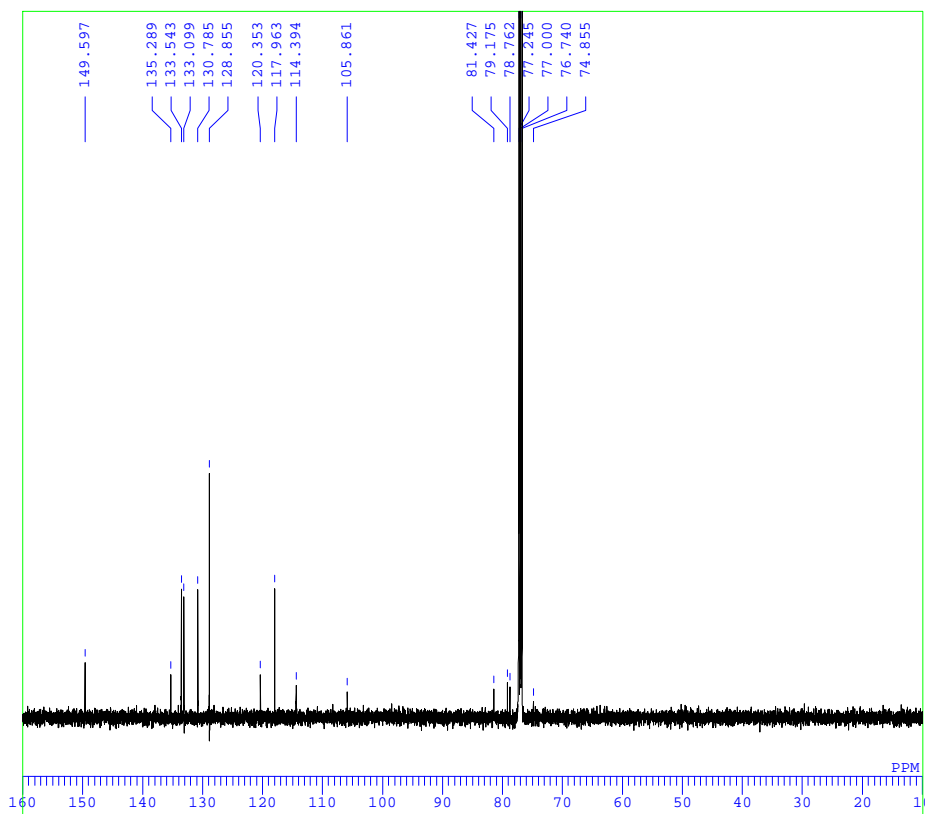




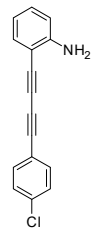
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 OBFIN 7.29 Hz  
 POINT 13107  
 FREQU 7621.95 Hz  
 SCANS 8  
 ACQTM 1.7197 sec  
 PD 5.0000 sec  
 PW1 3.15 usec  
 IRNUC 1H  
 CTEMP 19.8 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



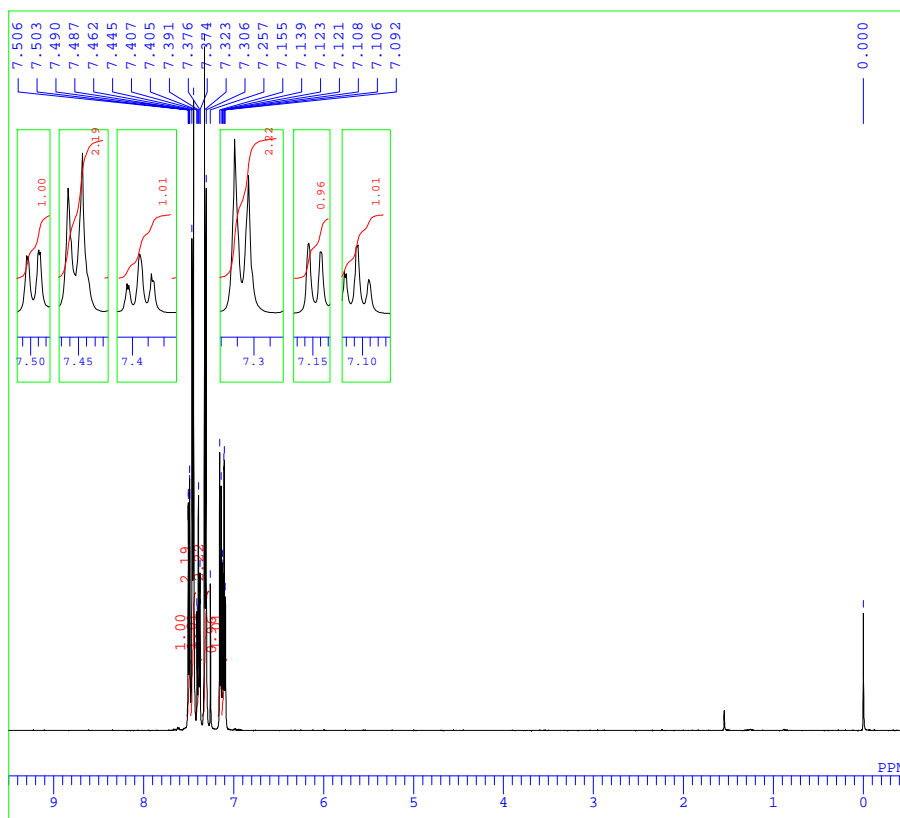
S11



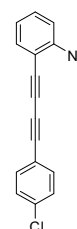
DFILE A123 C.als  
 COMNT  
 DATIM 2018-04-28 19:07:07  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 31565.66 Hz  
 SCANS 3555  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.6 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 58



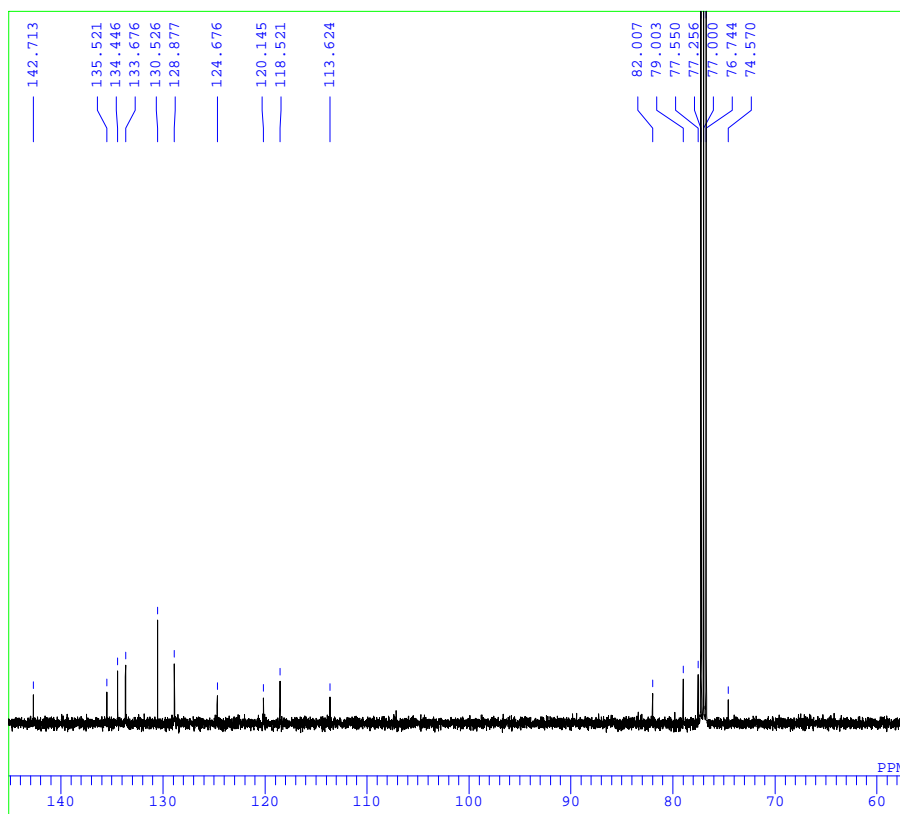
S11



DFILE A-141 H-1.als  
COMNT single\_pulse  
DATIM 2016-02-13 09:33:22  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFREQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 6.82 usec  
IRNUC 1H  
CTEMP 20.0 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 44



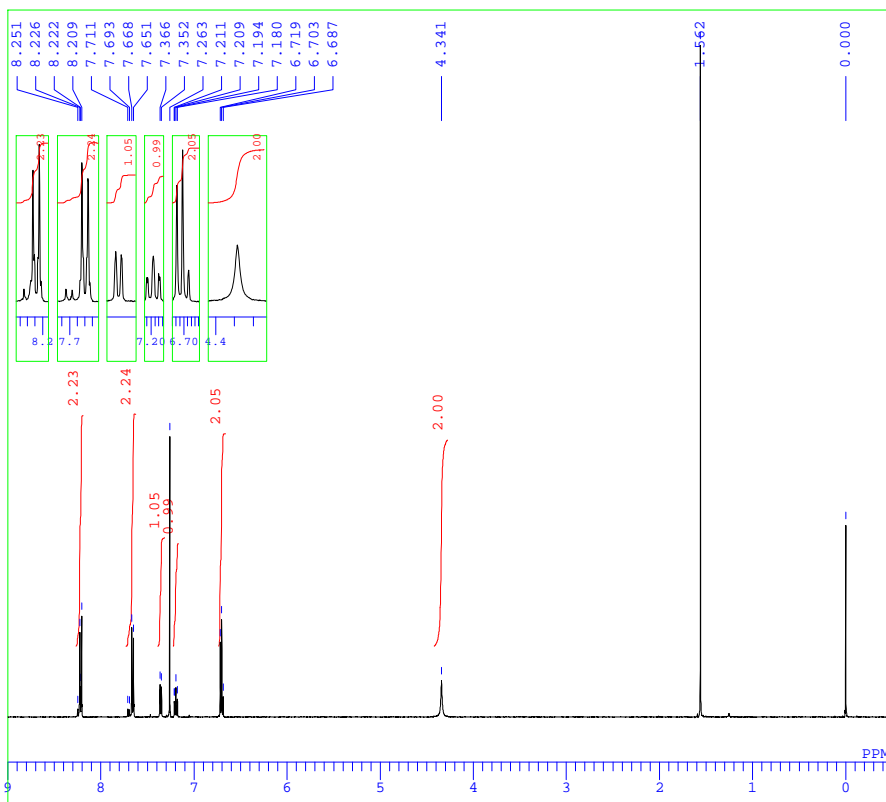
1e



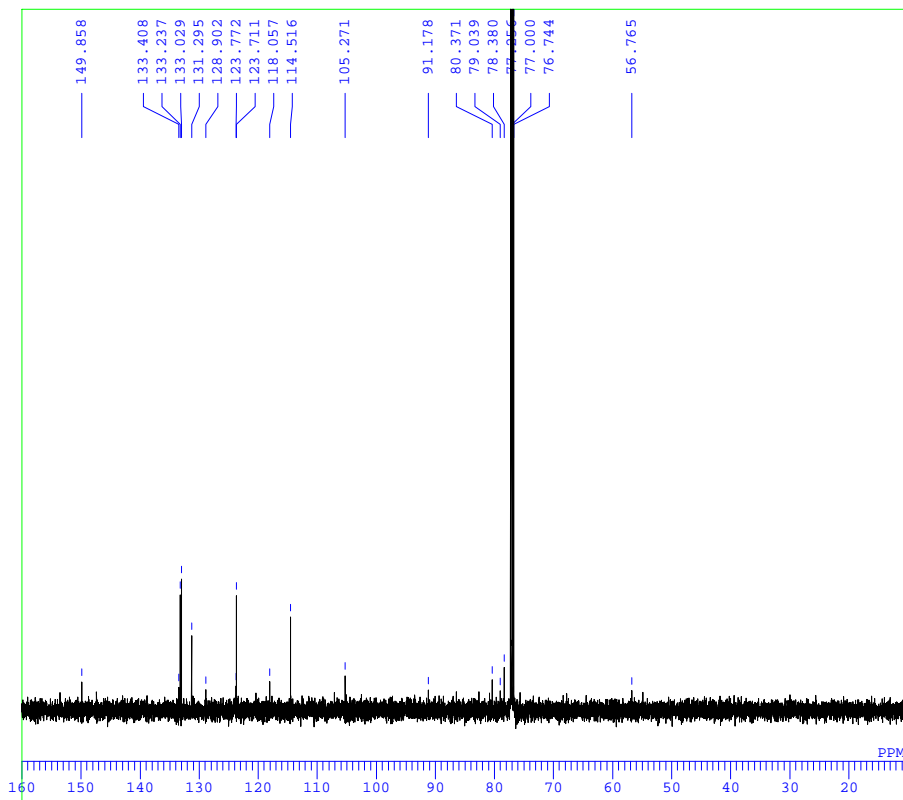
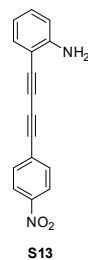
DFILE A141 C.als  
COMNT  
DATIM 2018-04-26 06:50:42  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFREQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 16384  
FREQU 25163.56 Hz  
SCANS 2200  
ACQTM 0.6511 sec  
PD 1.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 22.2 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 0.12 Hz  
RGAIN 70



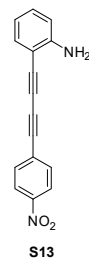
1e

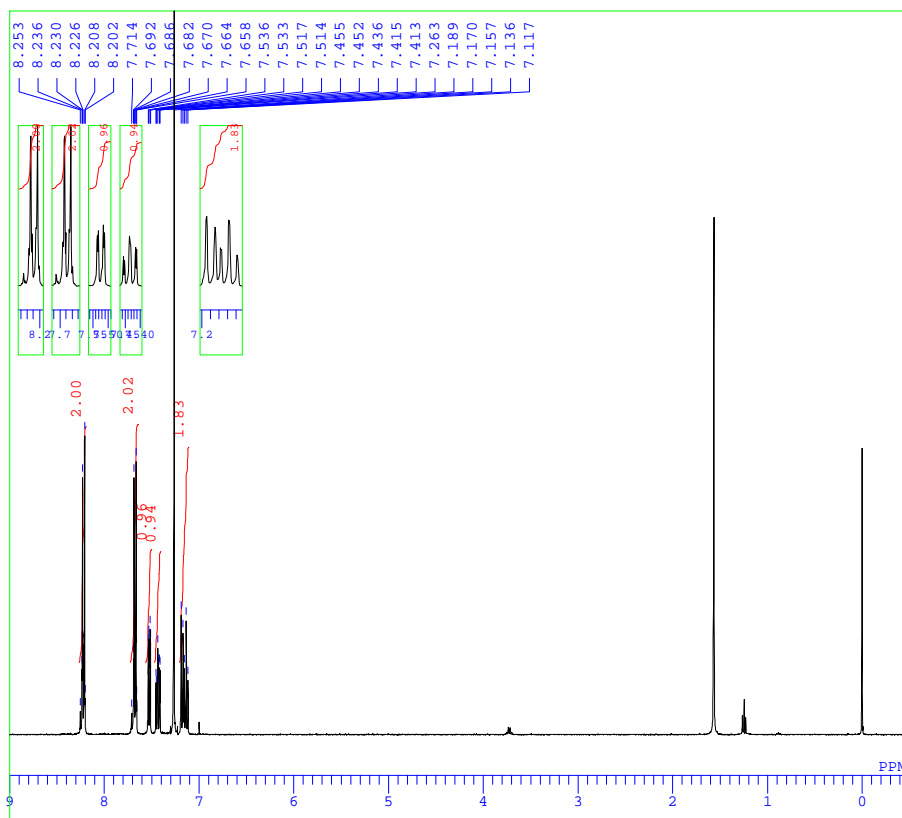


DFILE A137.als  
COMNT single\_pulse  
DATIM 2018-04-25 19:54:36  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 21.2 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 52

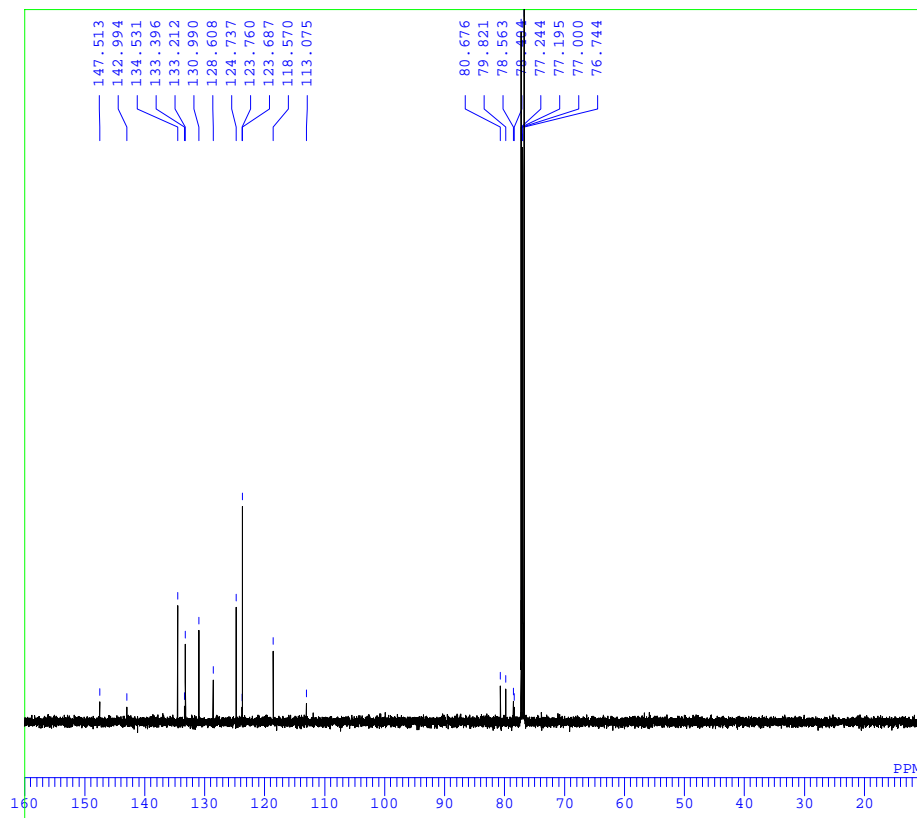
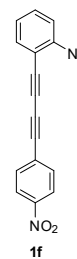


DFILE A137 C.als  
COMNT  
DATIM 2018-04-26 08:01:47  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 16384  
FREQU 25163.56 Hz  
SCANS 2200  
ACQTM 0.6511 sec  
PD 1.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 22.2 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 0.12 Hz  
RGAIN 70

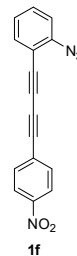




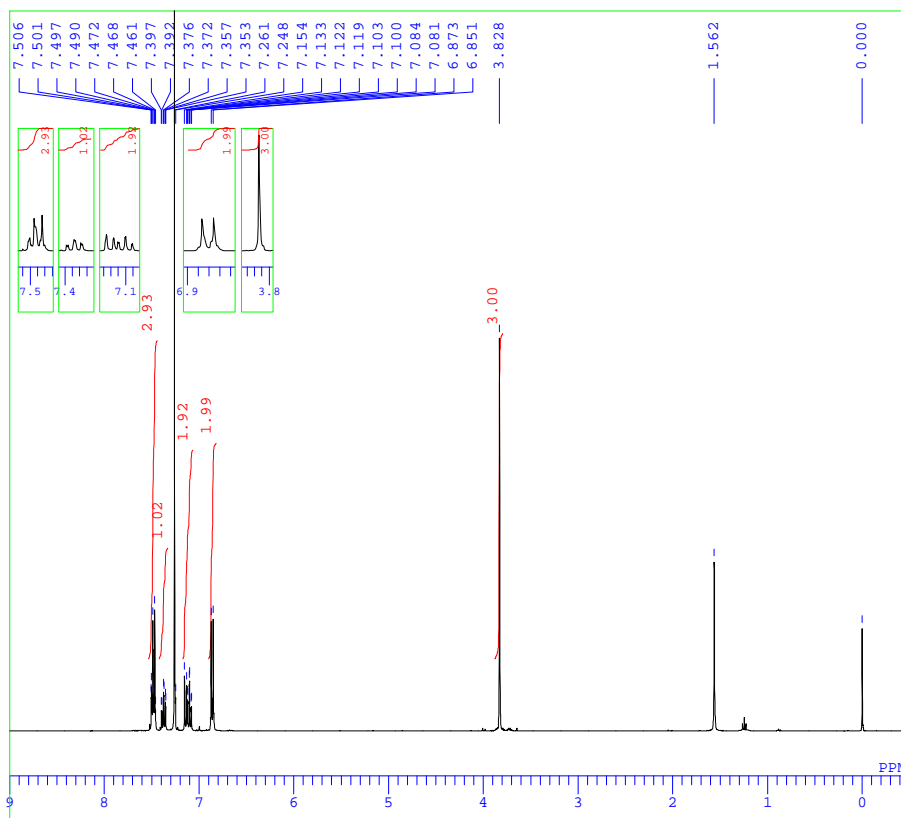
DFILE A143.als  
 COMNT single\_pulse  
 DATIM 2018-04-26 12:15:14  
 OBNUC 1H  
 EXMOD proton.jxp  
 OBFREQ 399.78 MHz  
 OBSET 4.19 KHz  
 OBFIN 7.29 Hz  
 POINT 13107  
 FREQU 7621.95 Hz  
 SCANS 8  
 ACQTM 1.7197 sec  
 PD 5.0000 sec  
 PW1 3.15 usec  
 IRNUC 1H  
 CTEMP 20.1 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



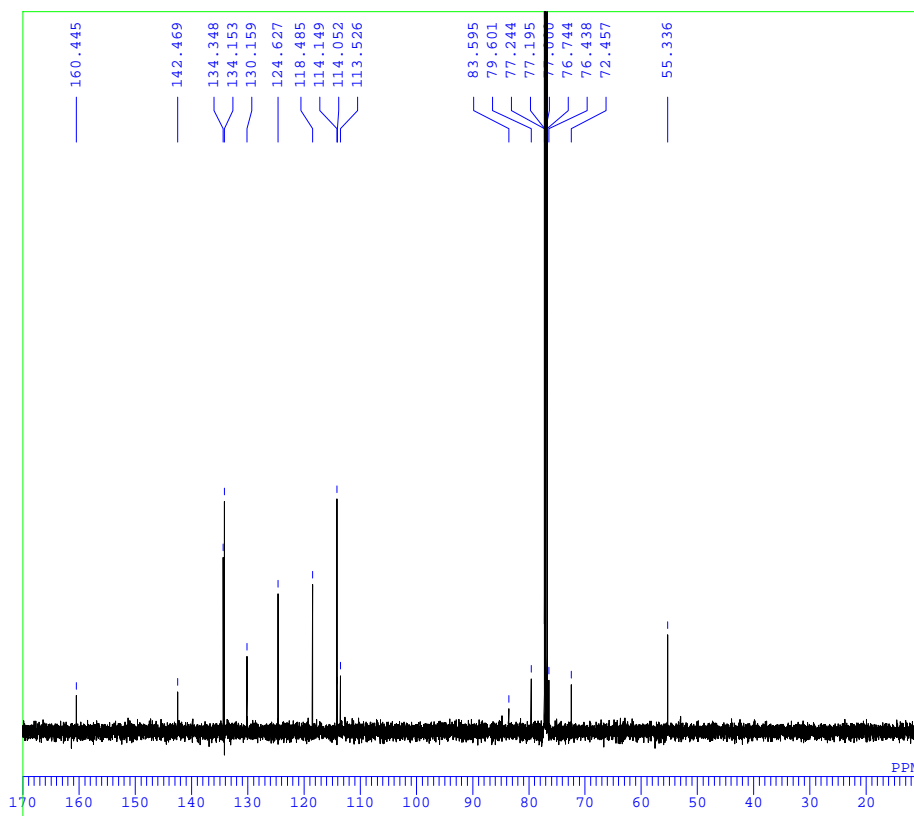
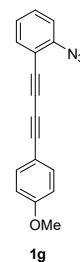
DFILE A143 c.als  
 COMNT  
 DATIM 2018-04-26 16:32:13  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 25163.56 Hz  
 SCANS 2118  
 ACQTM 0.6511 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.7 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 70



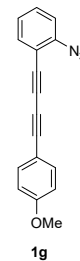


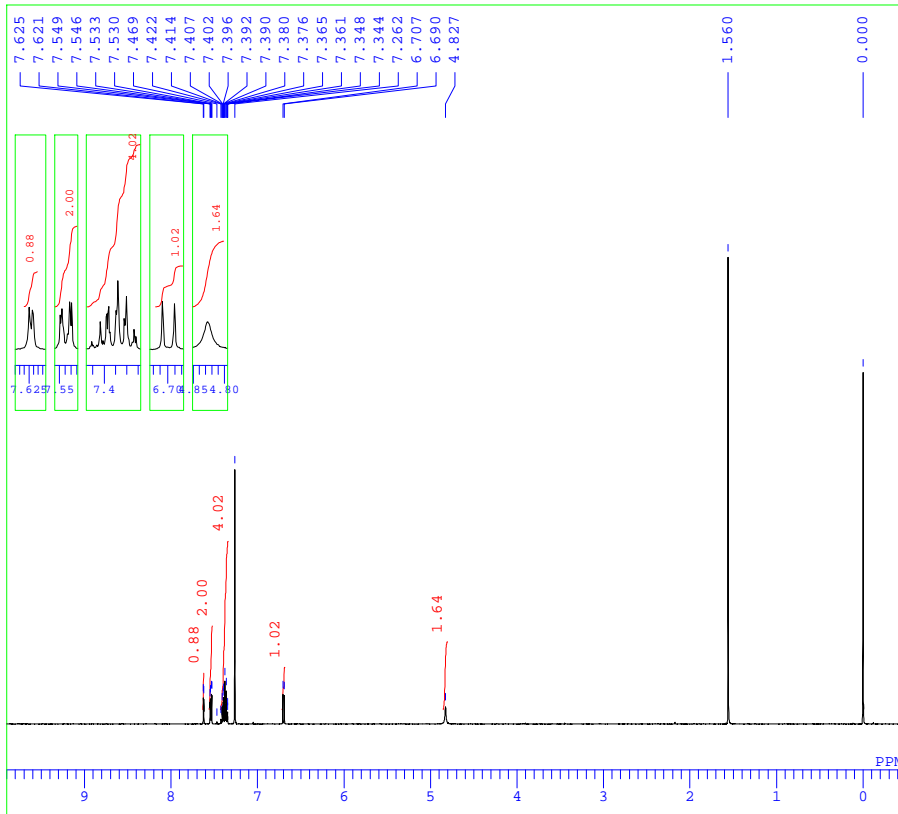


DFILE A72.als  
 COMNT single\_pulse  
 DATIM 2018-04-26 12:19:50  
 OBNUC 1H  
 EXMOD proton.jxp  
 OBFREQ 399.78 MHz  
 OBSET 4.19 KHz  
 OBFIN 7.29 Hz  
 POINT 13107  
 FREQU 7621.95 Hz  
 SCANS 8  
 ACQTM 1.7197 sec  
 PD 5.0000 sec  
 PW1 3.15 usec  
 IRNUC 1H  
 CTEMP 20.4 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 42

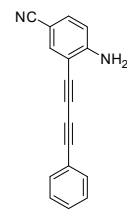


DFILE A72 C.als  
 COMNT 2018-04-26 13:26:10  
 DATIM 2018-04-26 13:26:10  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 25163.56 Hz  
 SCANS 1380  
 ACQTM 0.6511 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.6 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 70

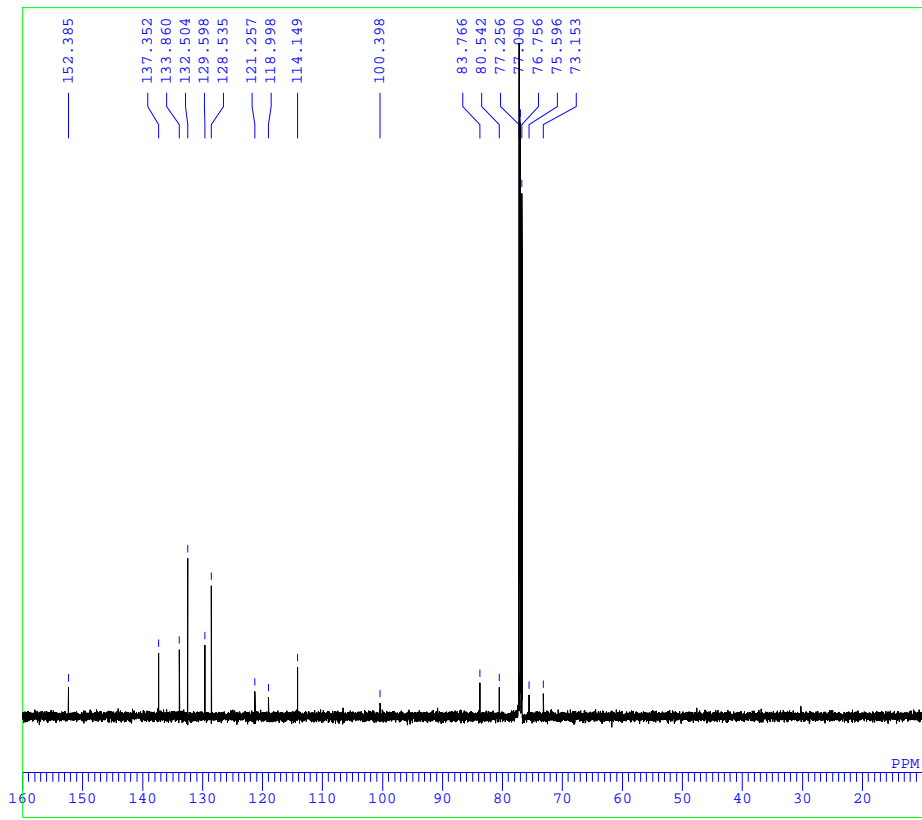




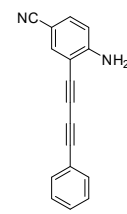
DFILE C-39 H-1.als  
 COMNT single\_pulse  
 DATIM 2017-07-11 11:19:47  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 20.7 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 54



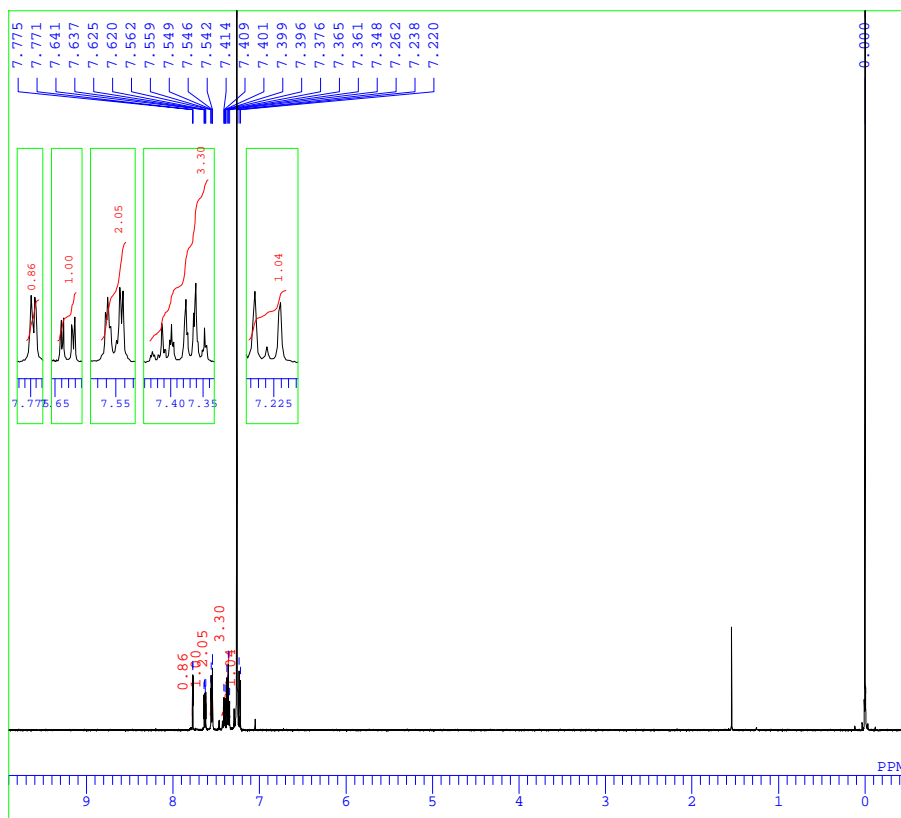
S17



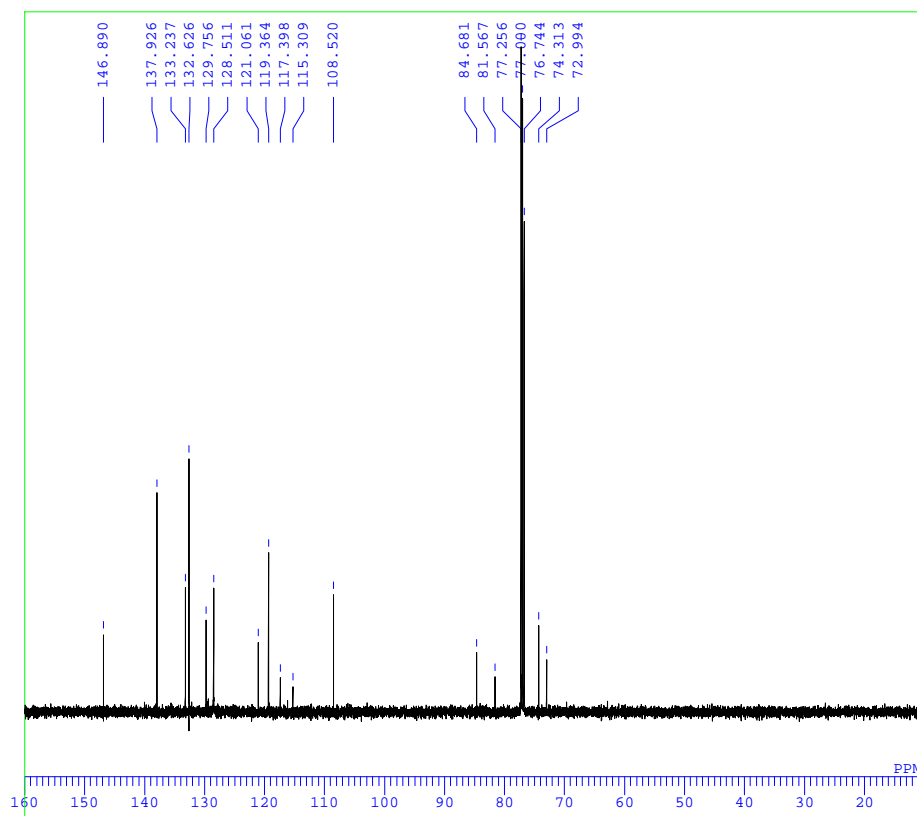
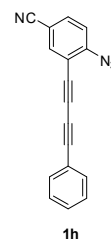
DFILE C39 C.als  
 COMNT  
 DATIM 2018-04-26 09:11:22  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 25163.56 Hz  
 SCANS 2200  
 ACQTM 0.6511 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 22.5 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 70



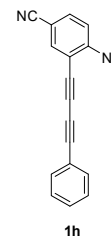
S17

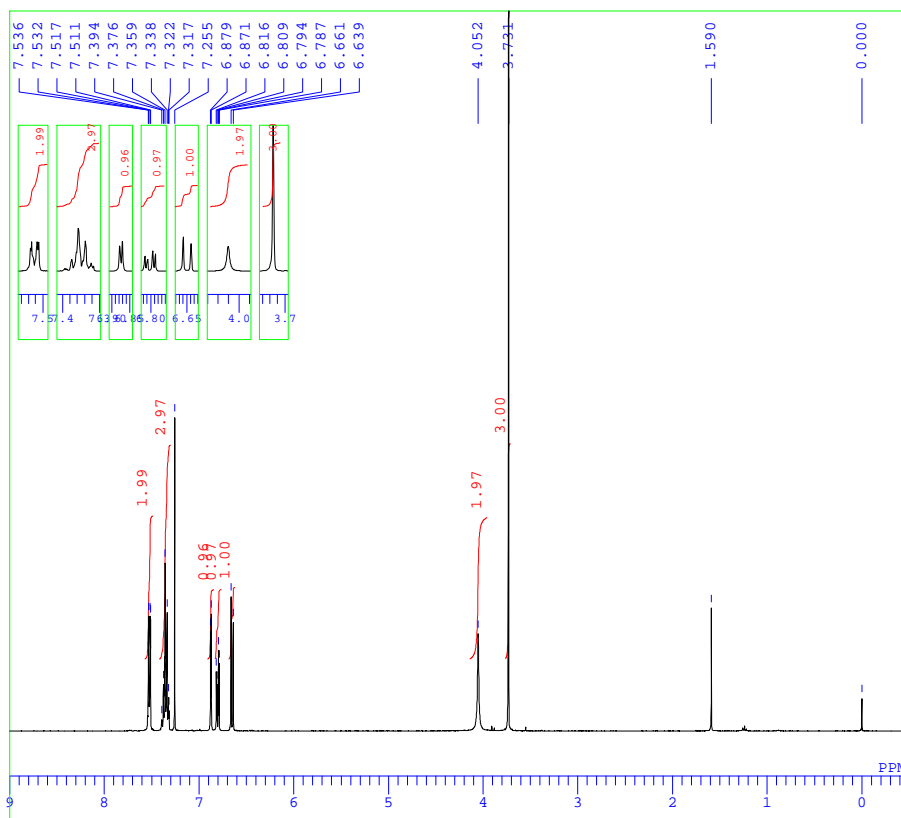


DFILE C-40 H 1 11-1.als  
 COMNT single\_pulse  
 DATIM 2017-01-11 12:50:07  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 20.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 54

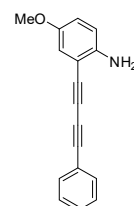


DFILE C40 C.als  
 COMNT  
 DATIM 2018-04-26 09:54:13  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 25163.56 Hz  
 SCANS 1204  
 ACQTM 0.6511 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.6 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 70

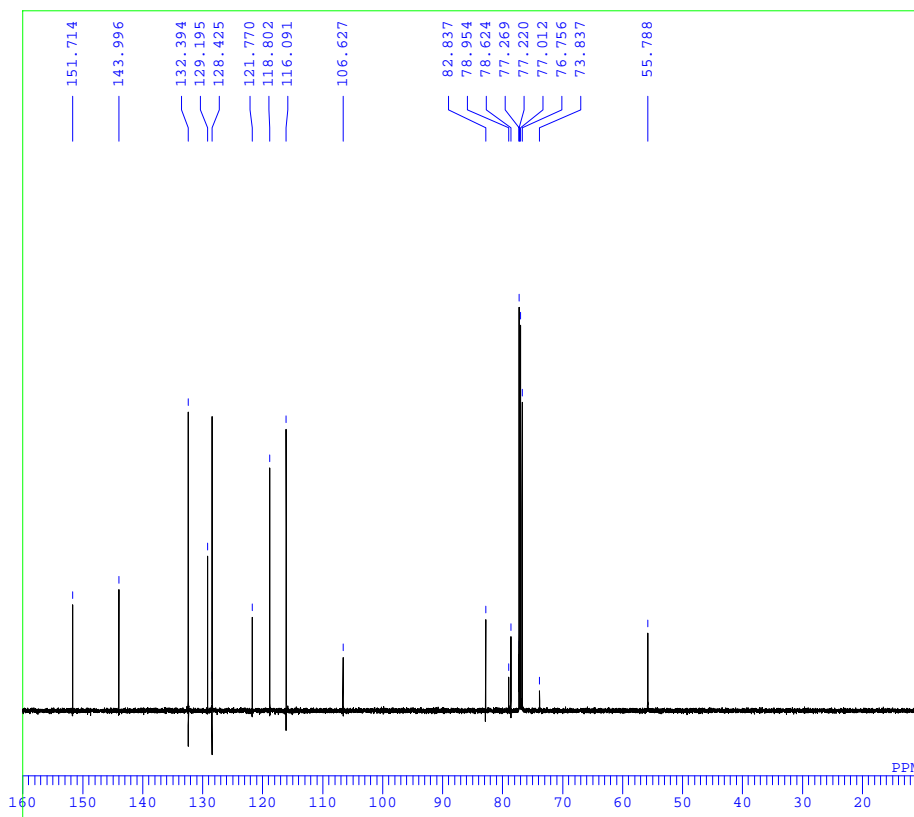




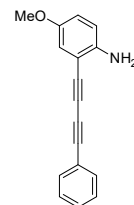
DFILE A191.als  
 COMNT single\_pulse  
 DATIM 2018-04-26 12:23:27  
 OBNUC 1H  
 EXMOD proton.jxp  
 OBFREQ 399.78 MHz  
 OBSSET 4.19 KHz  
 OBFIN 7.29 Hz  
 POINT 13107  
 FREQU 7621.95 Hz  
 SCANS 8  
 ACQTM 1.7197 sec  
 PD 5.0000 sec  
 PW1 3.15 usec  
 IRNUC 1H  
 CTEMP 20.3 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 32



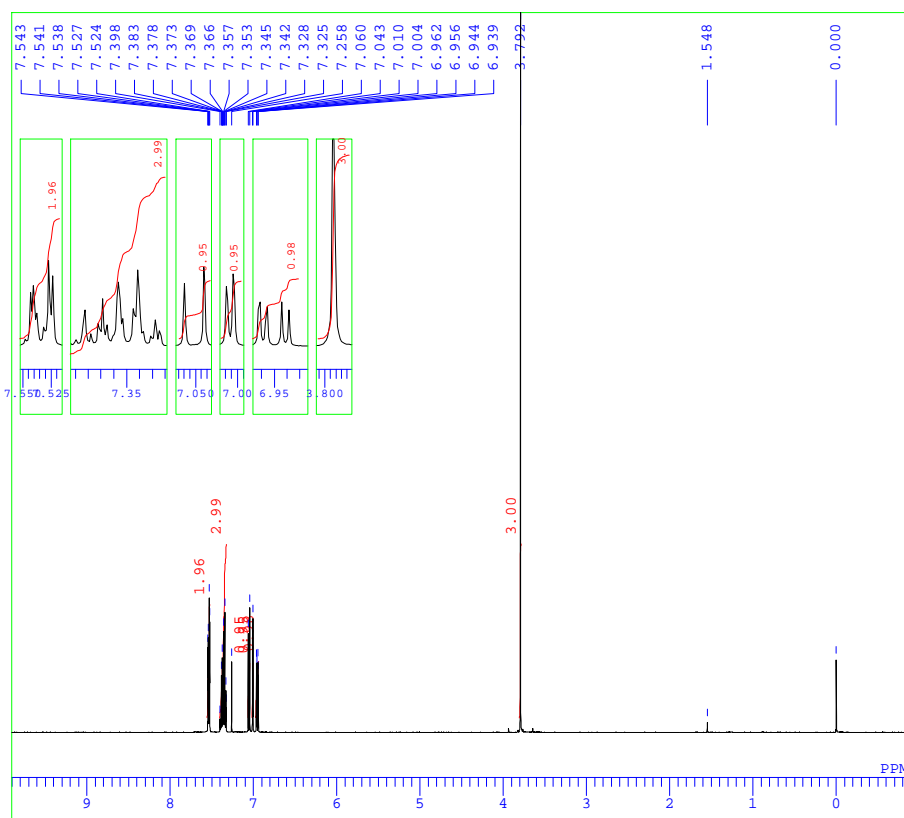
S19



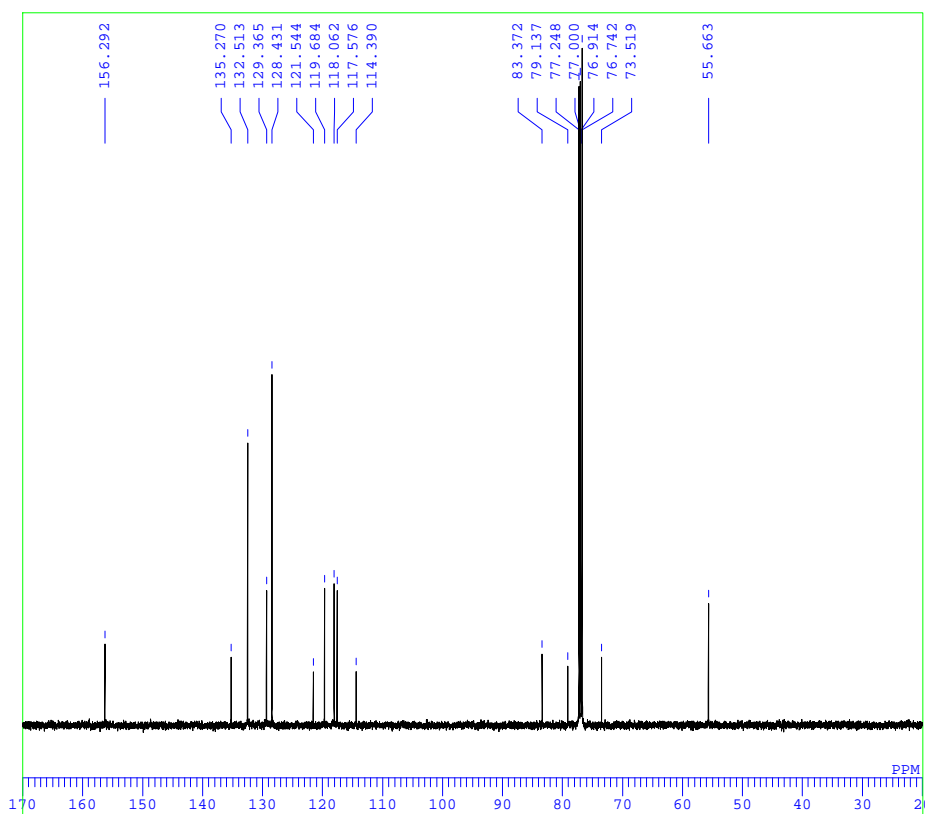
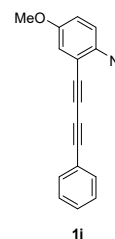
DFILE A191 C.als  
 COMNT  
 DATIM 2018-04-26 18:32:48  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 25163.56 Hz  
 SCANS 2021  
 ACQTM 0.6511 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.3 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 68



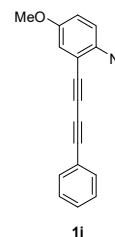
S19

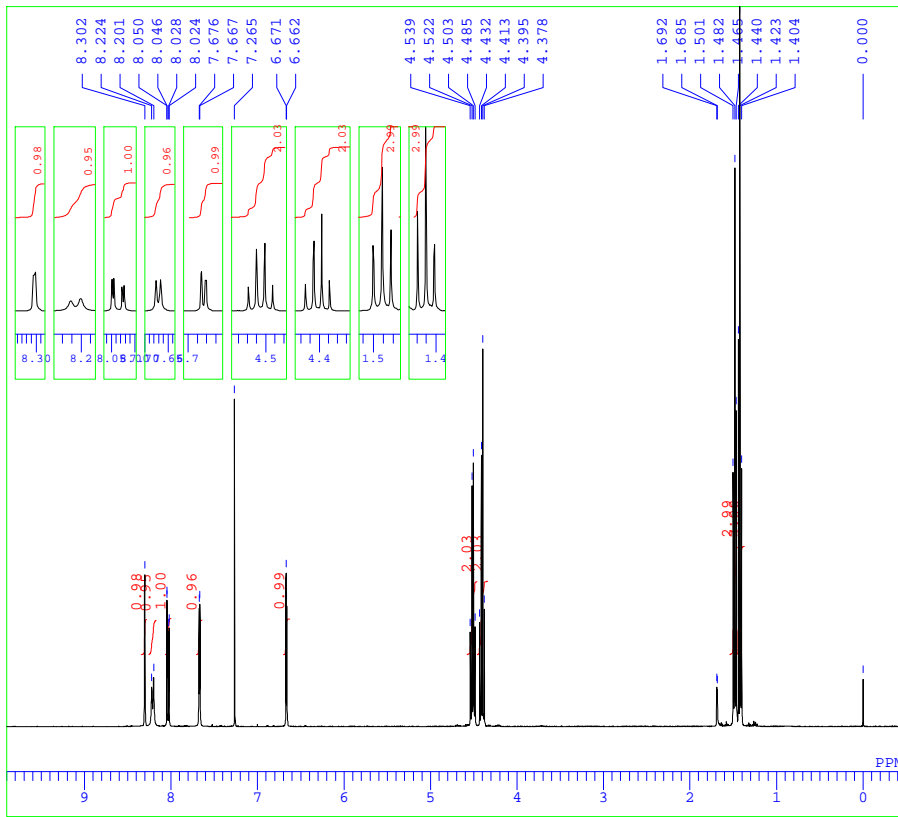


DFILE A-192 H.als  
 COMNT single\_pulse  
 DATIM 2016-02-12 15:55:24  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 6.82 usec  
 IRNUC 1H  
 CTEMP 20.0 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 46

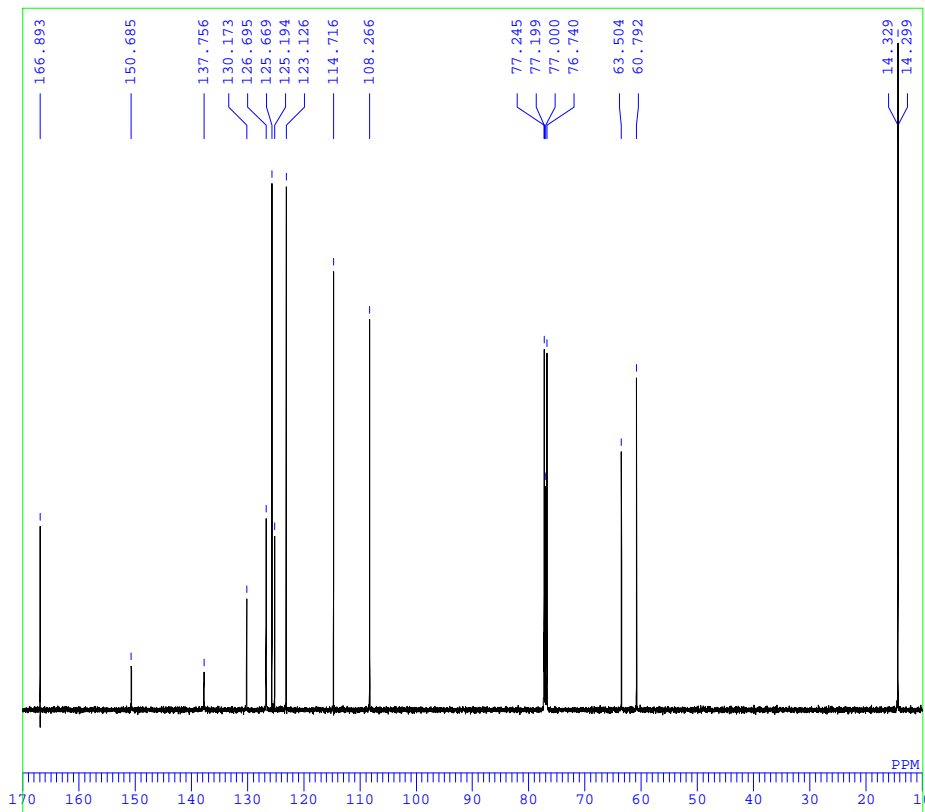
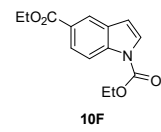


DFILE A-192 C-1.als  
 COMNT single pulse decoupled gat  
 DATIM 2016-02-12 16:25:56  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 632  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.50 usec  
 IRNUC 1H  
 CTEMP 20.6 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 54

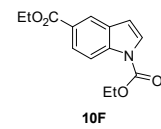


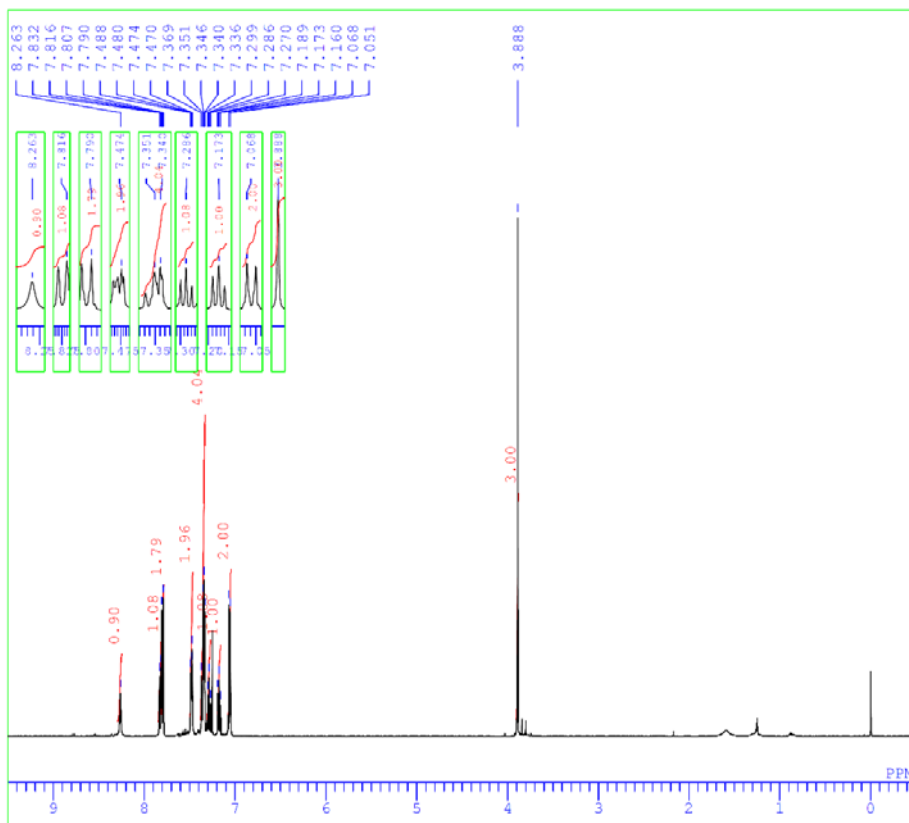


DFILE B176.als  
 COMNT single\_pulse  
 DATIM 2018-04-28 11:36:26  
 OBNUC 1H  
 EXMOD proton.jxp  
 OBFRQ 399.78 MHz  
 OBSET 4.19 KHz  
 OBFIN 7.29 Hz  
 POINT 13107  
 FREQU 7598.78 Hz  
 SCANS 8  
 ACQTM 1.7249 sec  
 PD 5.0000 sec  
 PW1 3.15 usec  
 IRNUC 1H  
 CTEMP 20.3 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 34



DFILE B176 C.als  
 COMNT  
 DATIM 2018-04-28 06:11:27  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 13107  
 FREQU 25252.14 Hz  
 SCANS 2500  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.6 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 60

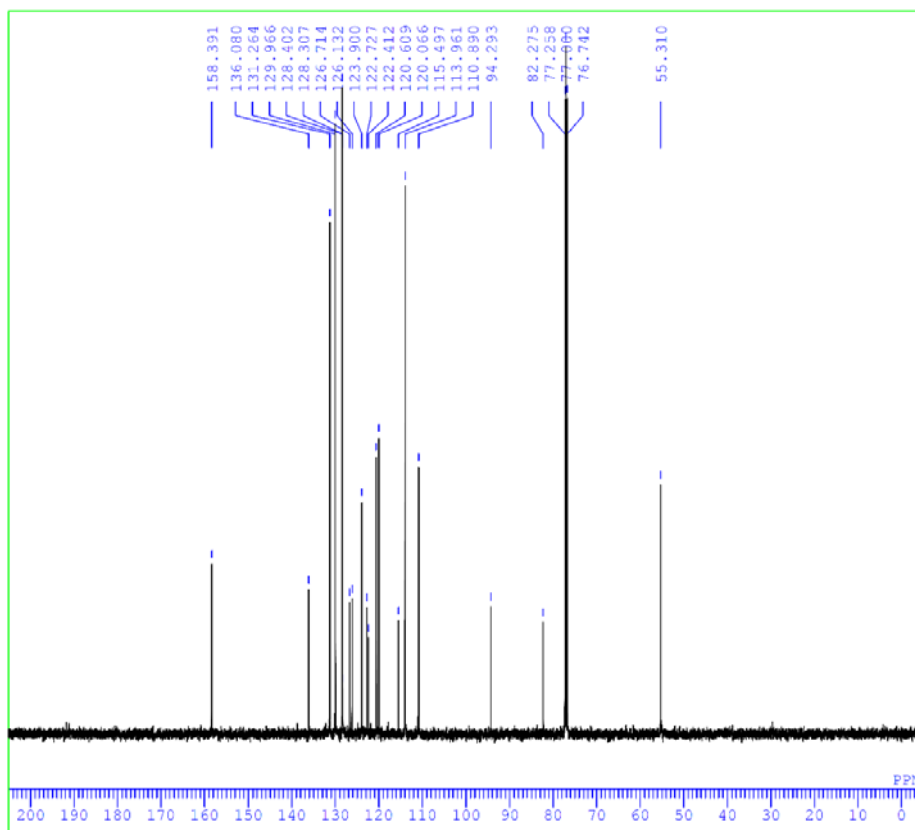
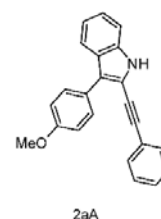




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DFILE anisole intermediate h-1.als
COMNT single_pulse
DATIM 2018-01-22 19:27:10
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
AQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 18.6 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 46

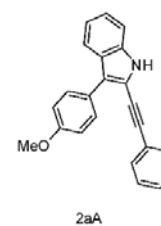
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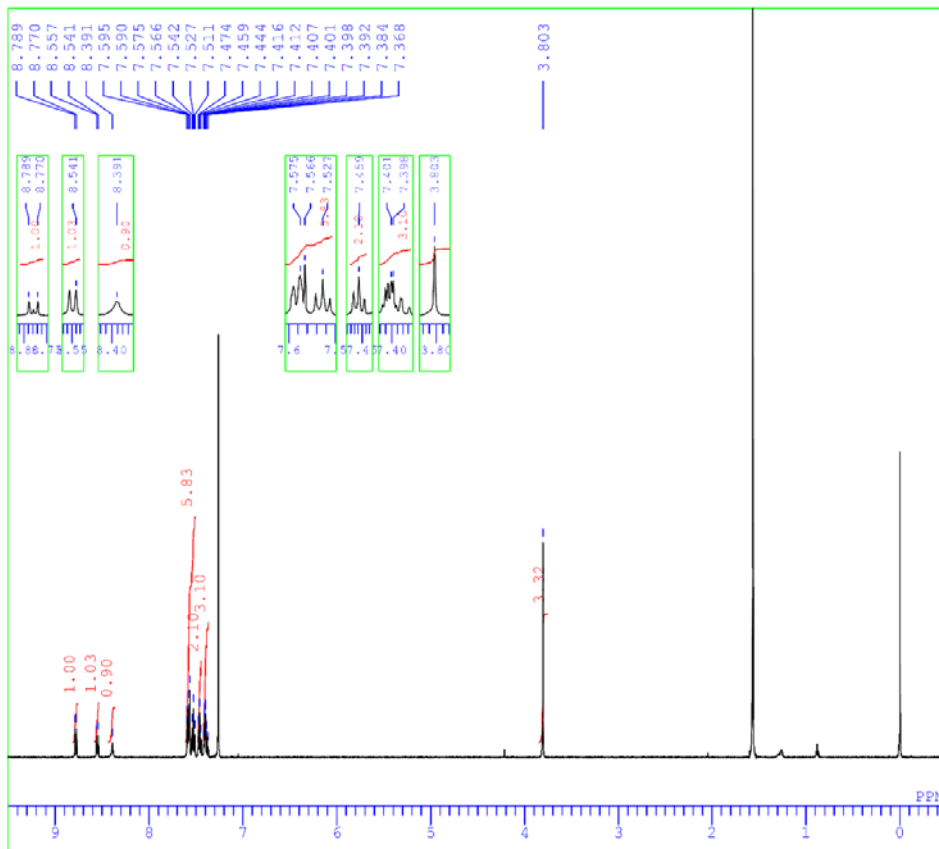


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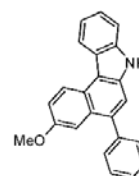
DFILE anisole intermediate c-1.als
COMNT
DATIM 2016-11-04 17:45:14
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 26214
FREQU 31446.06 Hz
SCANS 464
AQTM 0.8336 sec
PD 2.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 22.3 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 60

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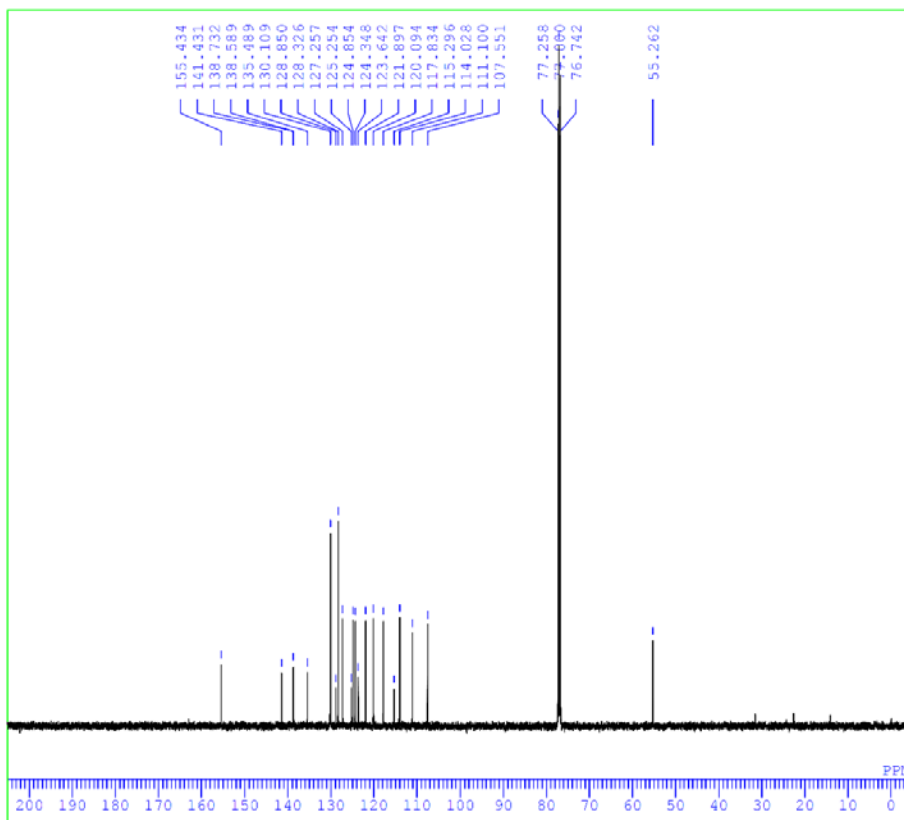




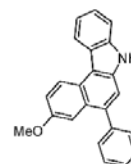
DFILE anisole product h-1.als  
 COMNT single\_pulse  
 DATIM 2016-06-23 15:36:49  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 6.50 usec  
 IRNUC 1H  
 CTEMP 21.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 52



3aA

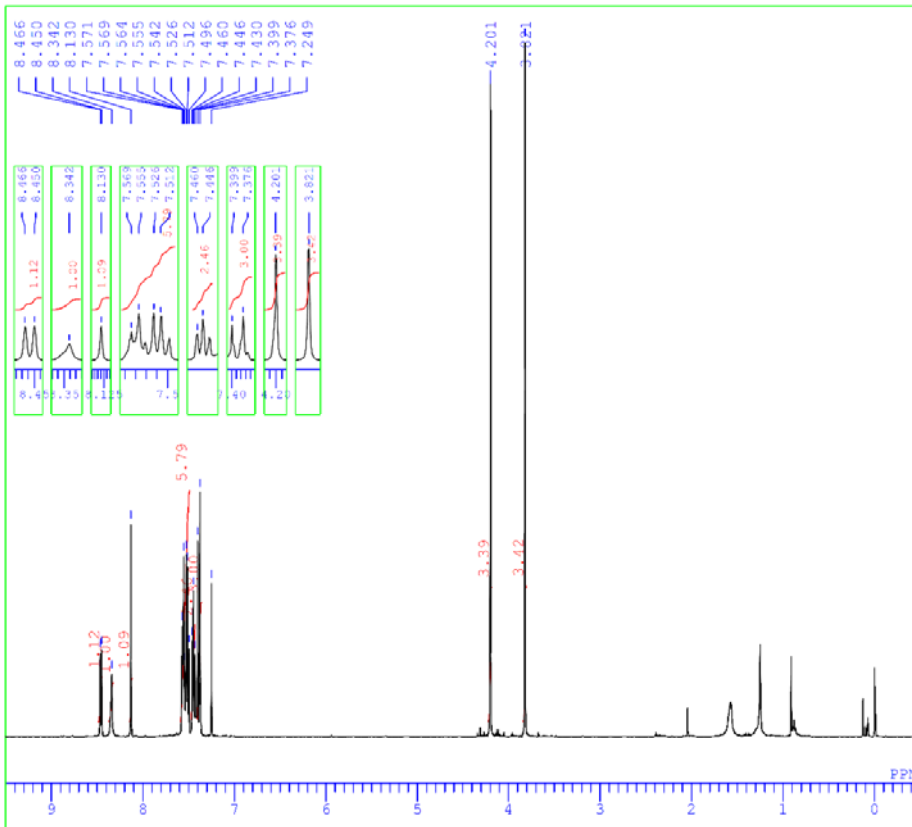


DFILE anisole product c-1.als  
 COMNT single\_pulse\_decoupled\_gated\_1  
 DATIM 2016-06-23 17:40:33  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.73 usec  
 IRNUC 1H  
 CTEMP 21.6 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 54



3aA

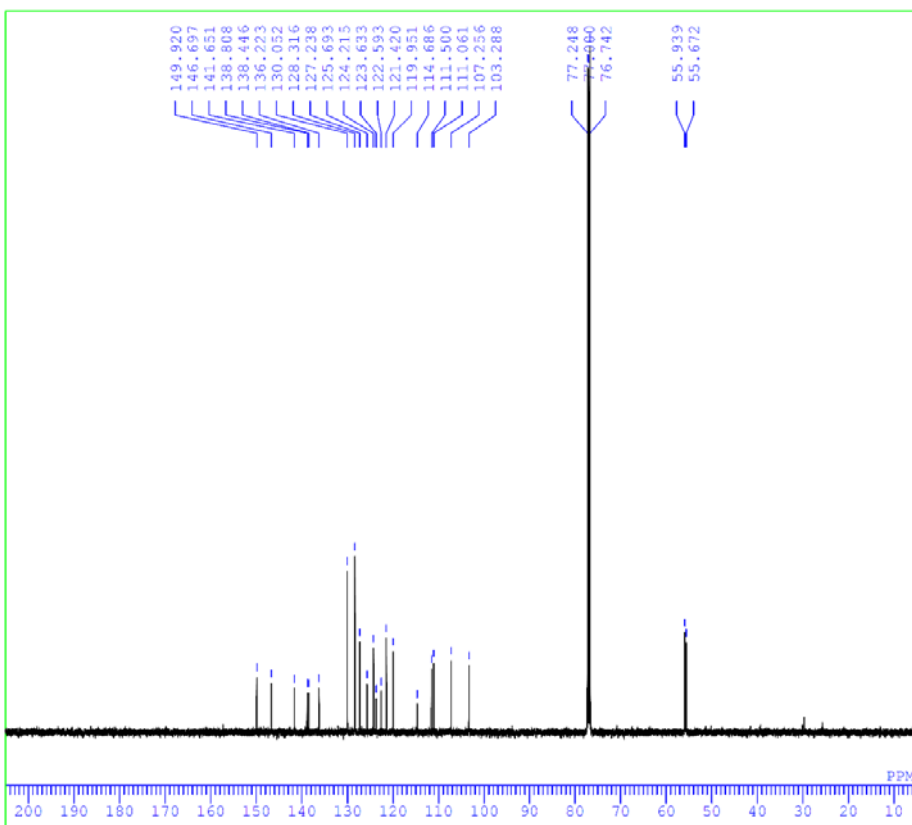
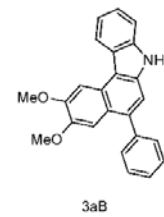




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DFFILE 1,2-dimethoxybenzene h-1.als
COMNT single_pulse
DATIM 2017-09-15 10:52:02
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
ACQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 21.1 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 44

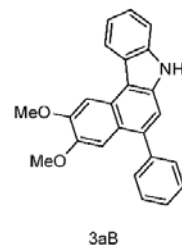
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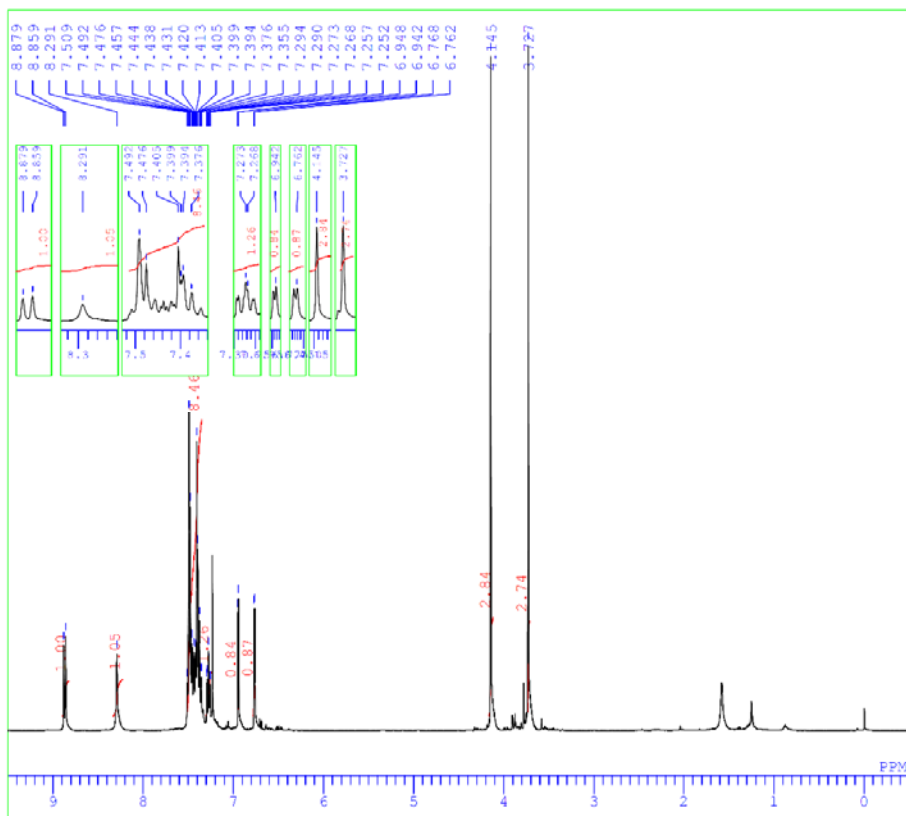


```

DFFILE 1,2-dimethoxybenzene c-1.als
COMNT single_pulse_dec
DATIM 2017-09-15 11:41:46
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 26214
FREQU 31446.06 Hz
SCANS 1024
ACQTM 0.8336 sec
PD 2.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 21.7 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 60

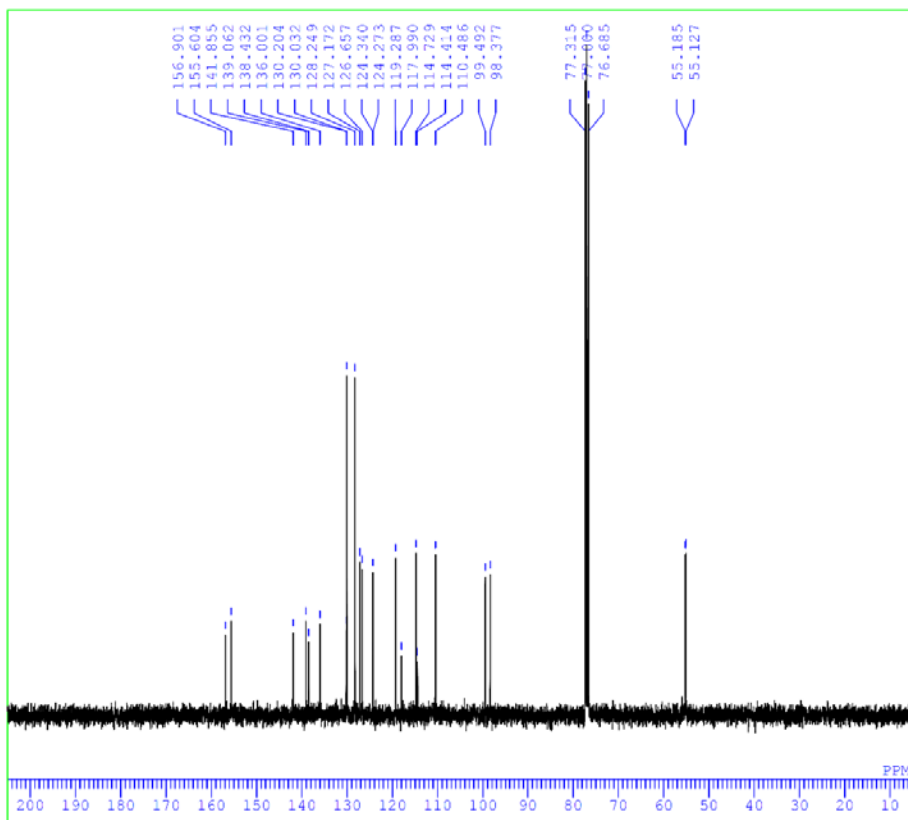
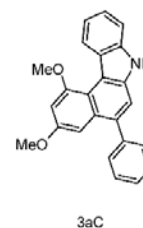
```





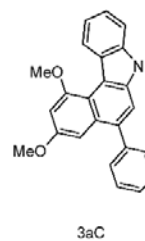
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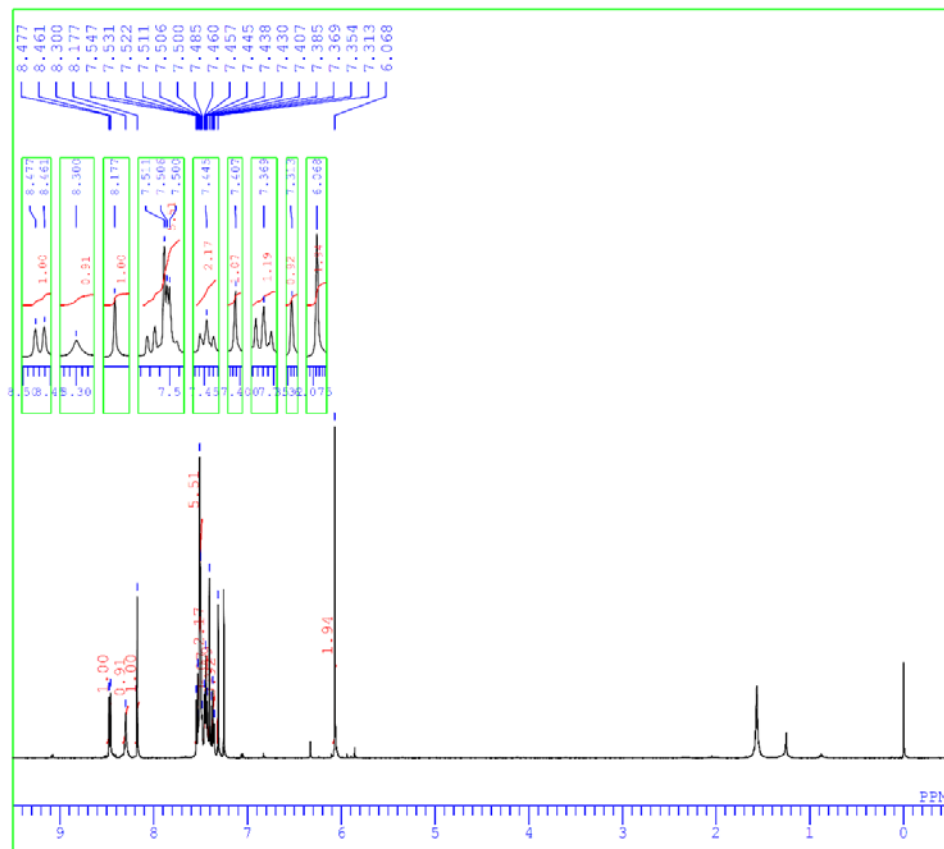
DFILE 1,3-dimethoxybenzene_Proton-1.
COMMT single_pulse
DATIM 2016-07-16 11:23:37
OBNUC 1H
EXMOD proton.jxp
OBFREQ 399.78 MHz
OBSET 4.19 KHz
OBFIN 7.29 Hz
POINT 13107
FREQU 7598.78 Hz
SCANS 8
ACQTM 1.7249 sec
PD 5.0000 sec
PWI 3.06 usec
IRNUC 1H
CTEMP 19.7 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 36
  
```



```

DFILE 1,3-dimethoxybenzene_Carbon-1.
COMMT single_pulse_decoupled_gated_1
DATIM 2016-07-21 15:36:46
OBNUC 13C
EXMOD carbon.jxp
OBFREQ 100.53 MHz
OBSET 5.35 KHz
OBFIN 5.86 Hz
POINT 26214
FREQU 25125.63 Hz
SCANS 128
ACQTM 1.0433 sec
PD 2.0000 sec
PWI 3.77 usec
IRNUC 1H
CTEMP 19.7 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 50
  
```

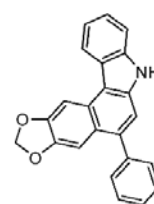




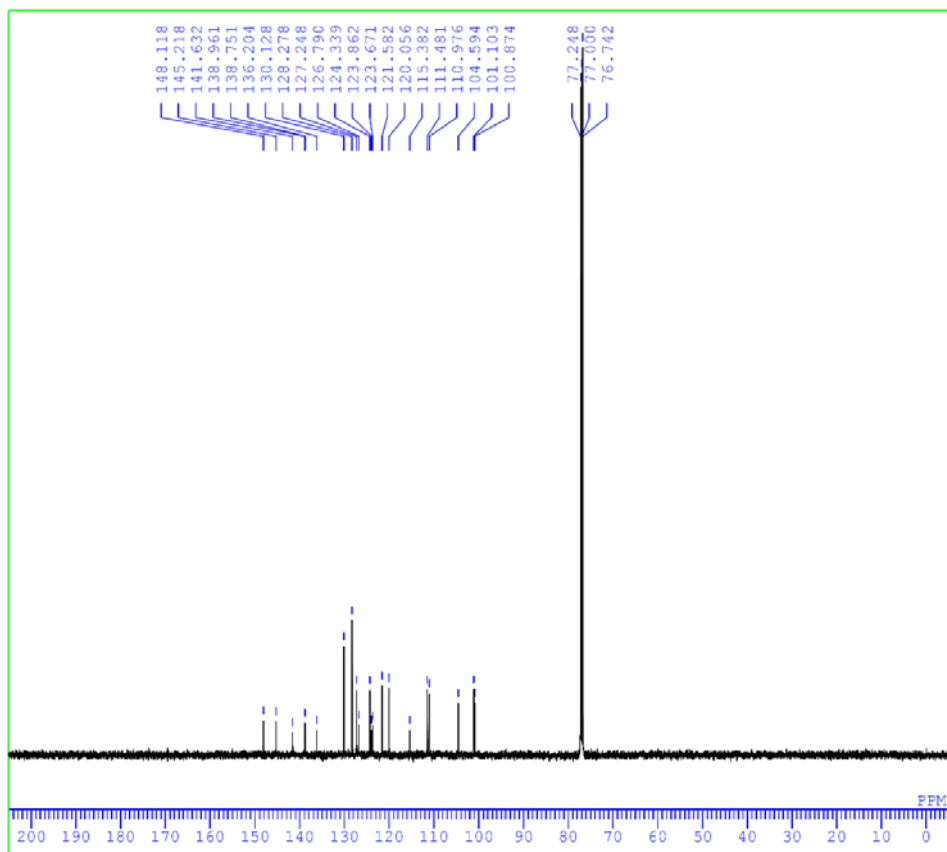
```

DFILE 1,3-benzodioxole h-1.als
COMNT single_pulse
DATIM 2016-11-02 17:10:21
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
AQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 21.7 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 48

```



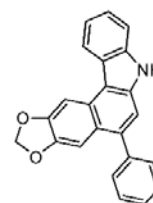
3aD



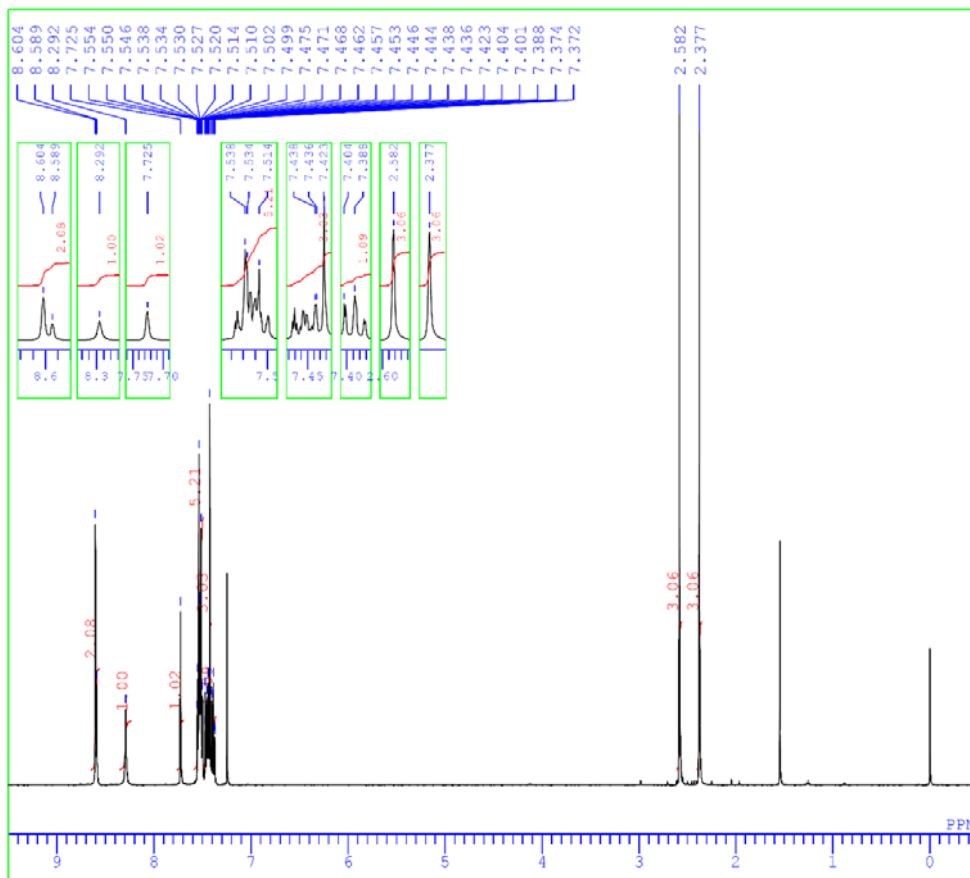
```

DFILE 1,3-benzodioxole c-1.als
COMNT
DATIM 2016-11-02 18:01:44
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 26214
FREQU 31446.06 Hz
SCANS 1024
AQTM 0.8336 sec
PD 2.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 22.2 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 58

```

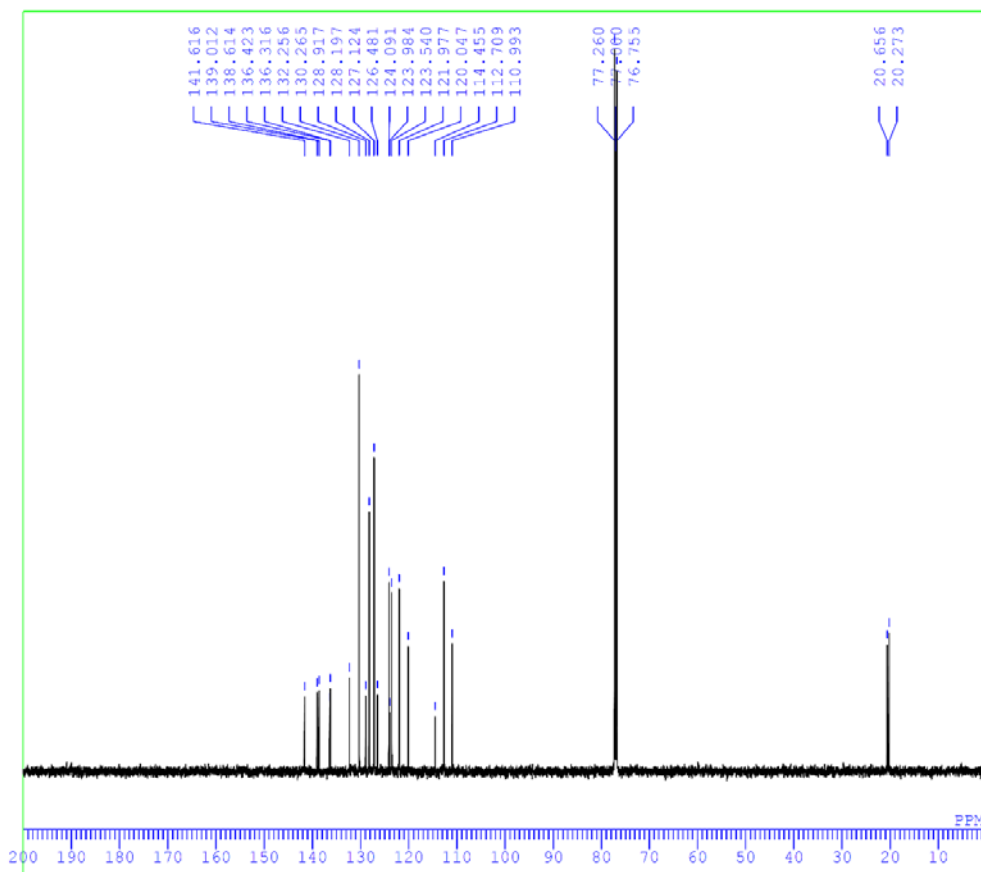
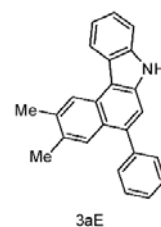


3aD



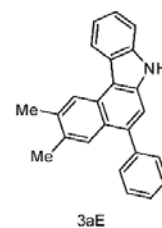
```

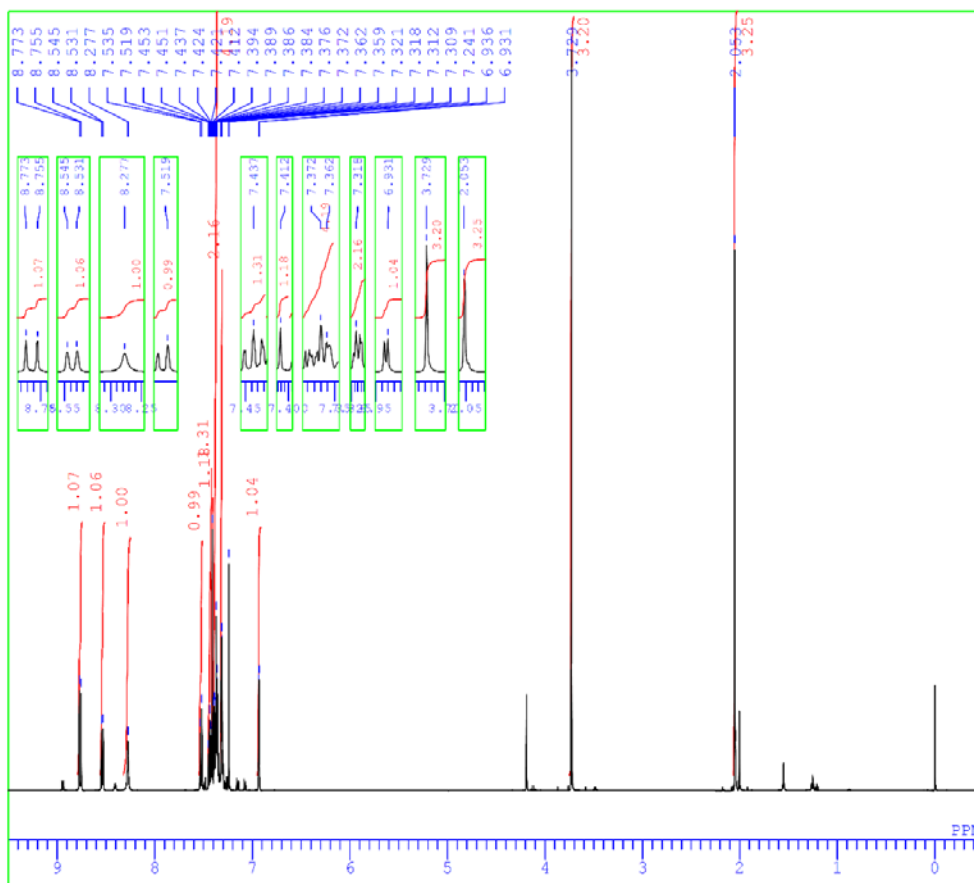
DFILE o-xylene h-1.als
COMNT single_pulse
DATIM 2018-03-08 16:12:04
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
ACQTM 1.7459 sec
PD 5.0000 sec
PW1 7.15 usec
IRNUC 1H
CTEMP 20.2 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 46
  
```



```

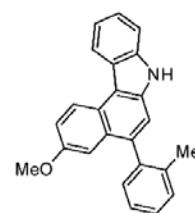
DFILE o-xylene c-1.als
COMNT
DATIM 2018-03-08 17:05:18
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 13107
FREQU 25252.14 Hz
SCANS 2077
ACQTM 0.5190 sec
PD 1.0000 sec
PW1 3.67 usec
IRNUC 1H
CTEMP 20.6 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 54
  
```



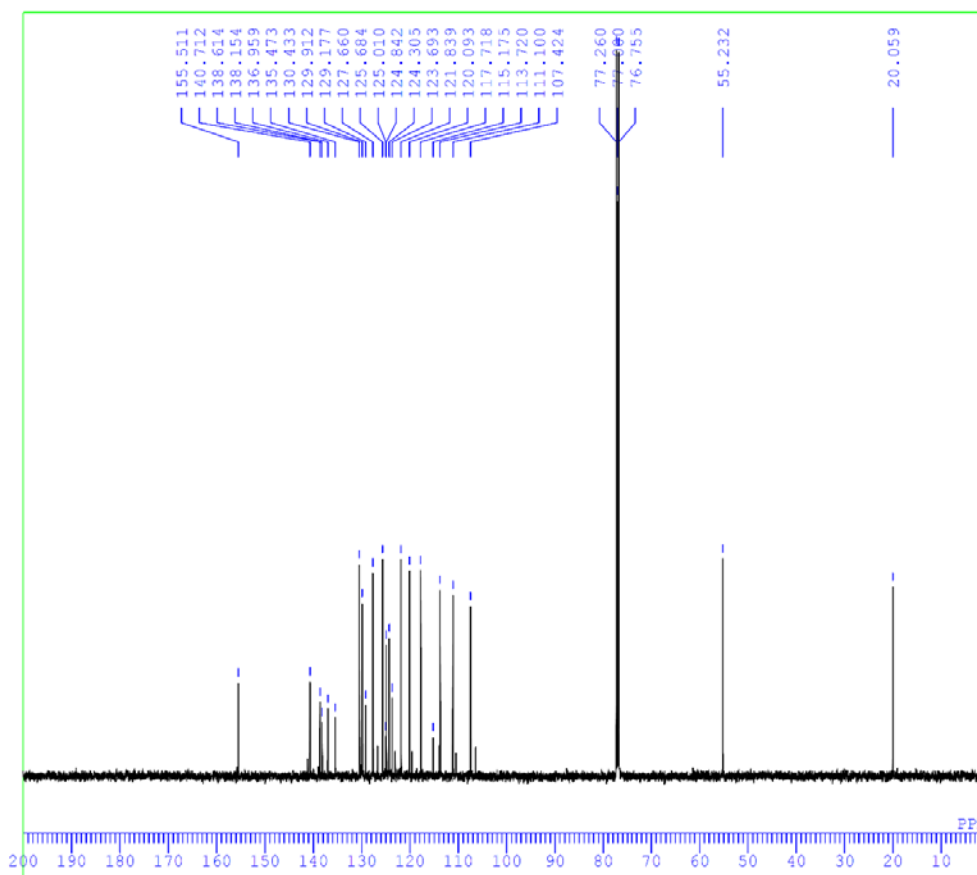


```

DFILE o-methyl h-1.als
COMNT single pulse
DATIM 2018-03-06 14:45:12
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
ACQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 19.6 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 44
  
```

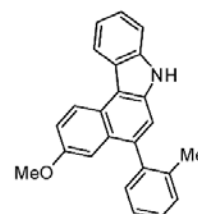


3ba

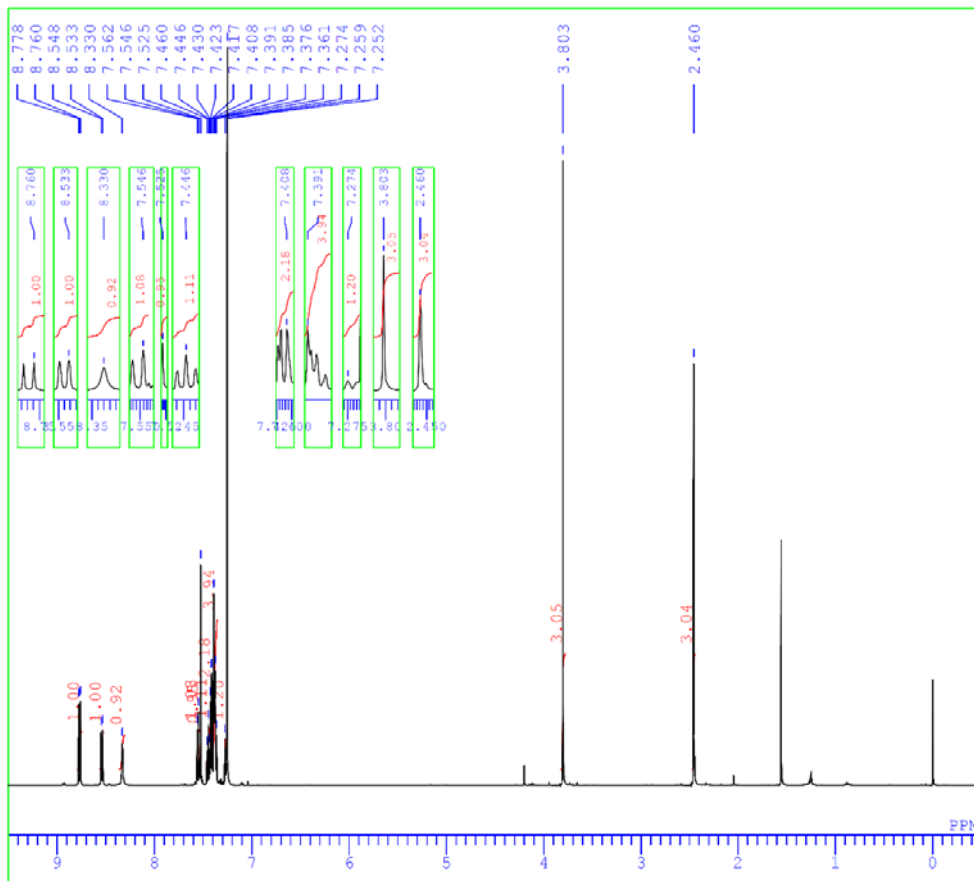


```

DFILE o-methyl c-1.als
COMNT
DATIM 2018-03-06 15:22:28
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 13107
FREQU 25252.14 Hz
SCANS 1425
ACQTM 0.5190 sec
PD 1.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 20.2 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 56
  
```



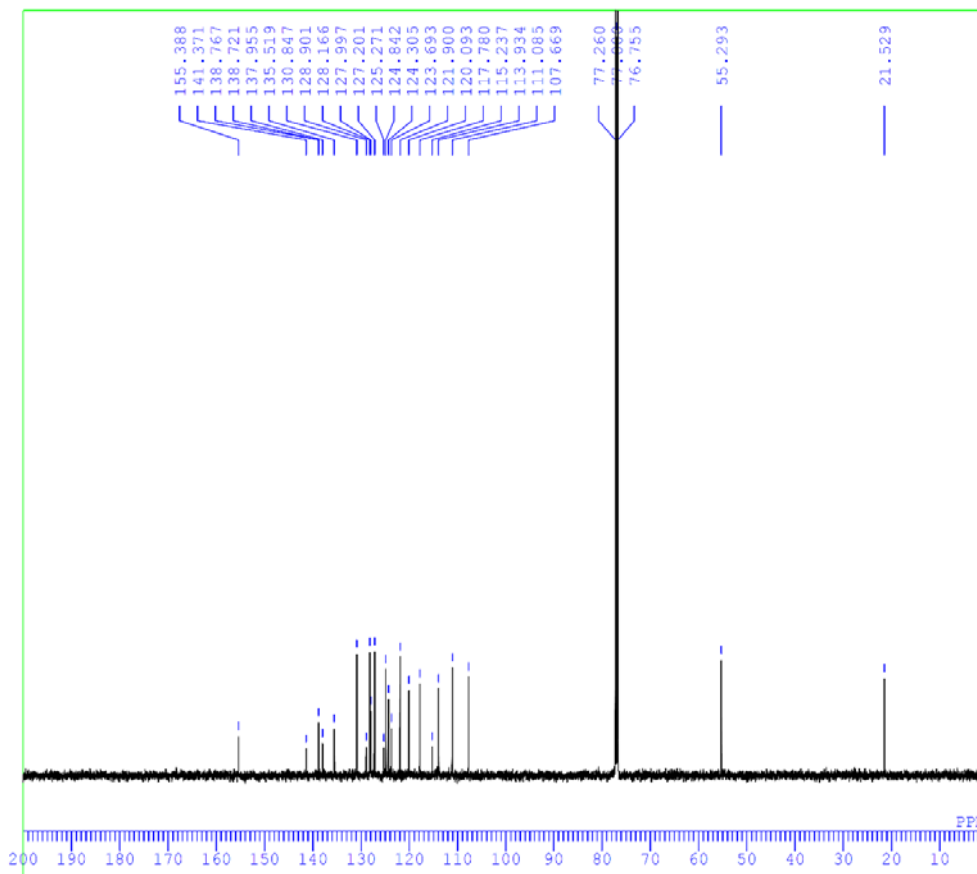
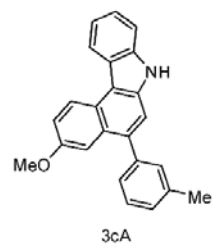
3ba



```

DFILE m-methyl h-1.als
COMNT single_pulse
DATIM 2018-03-05 14:40:30
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
ACQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 19.8 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 48

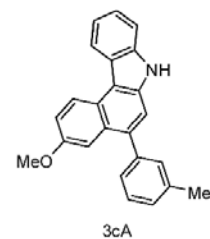
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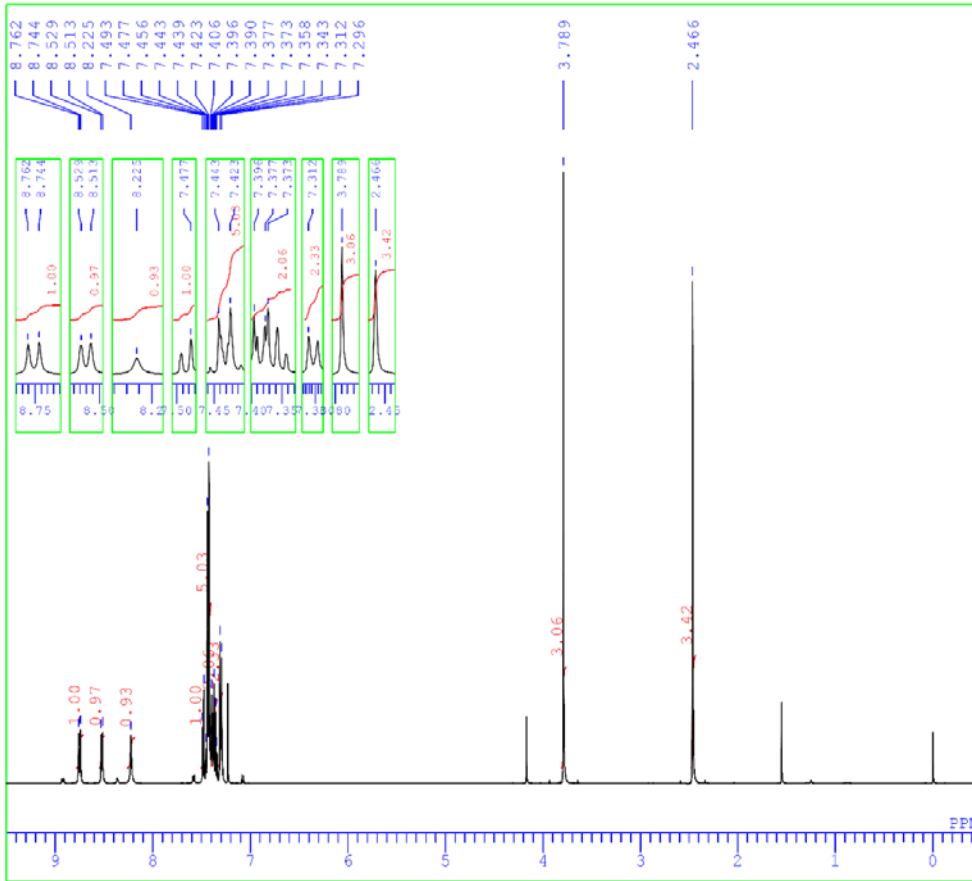


```

DFILE m-methyl c-1.als
COMNT
DATIM 2018-03-05 15:37:39
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 13107
FREQU 25252.14 Hz
SCANS 2216
ACQTM 0.5190 sec
PD 1.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 20.5 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 56

```

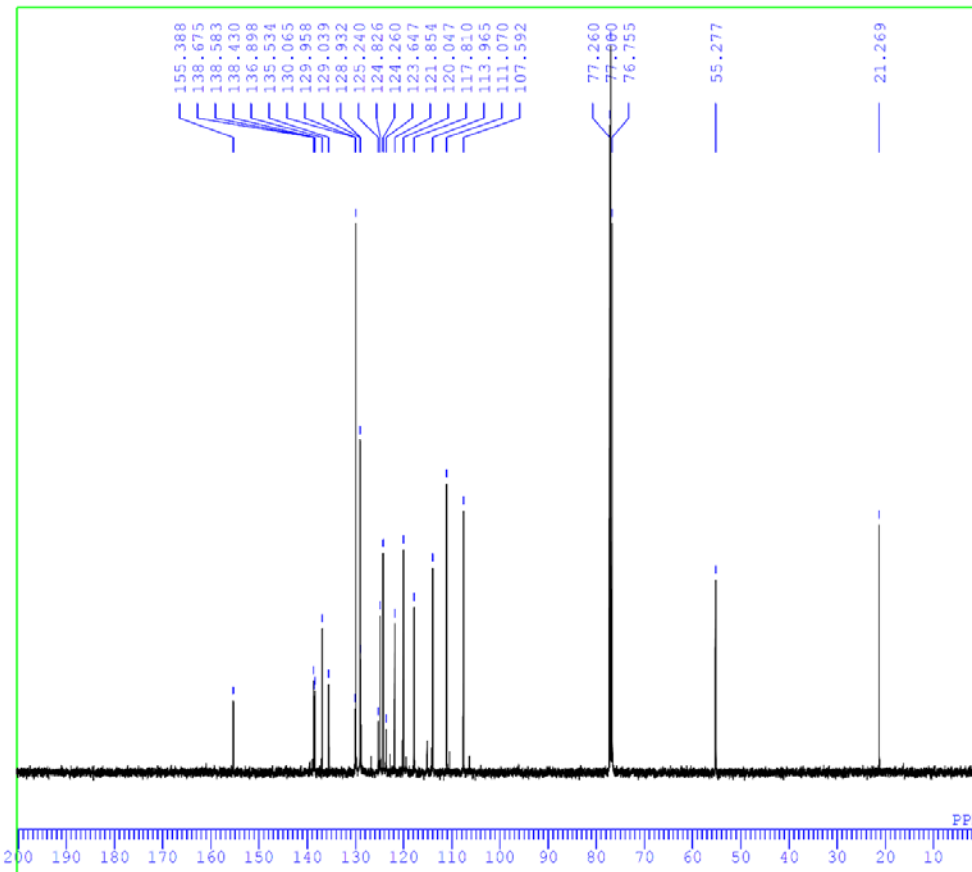
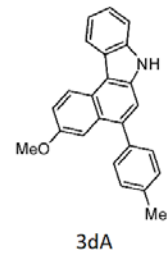




```

DFILE p-methyl h-1.als
COMNT single pulse
DATIM 2018-03-05 16:55:01
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
ACQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 19.8 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 42

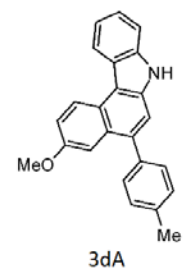
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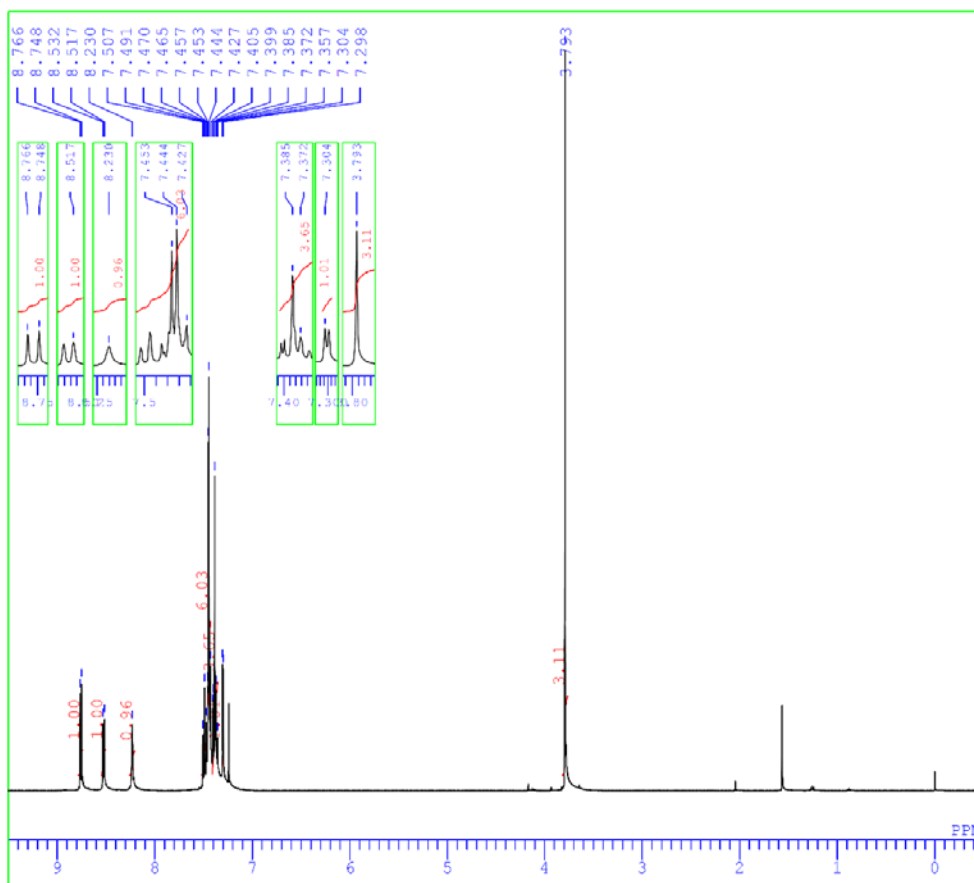


```

DFILE p-methyl c-1.als
COMNT
DATIM 2018-03-05 17:35:48
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 13107
FREQU 25252.14 Hz
SCANS 1567
ACQTM 0.5190 sec
PD 1.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 20.3 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 58

```

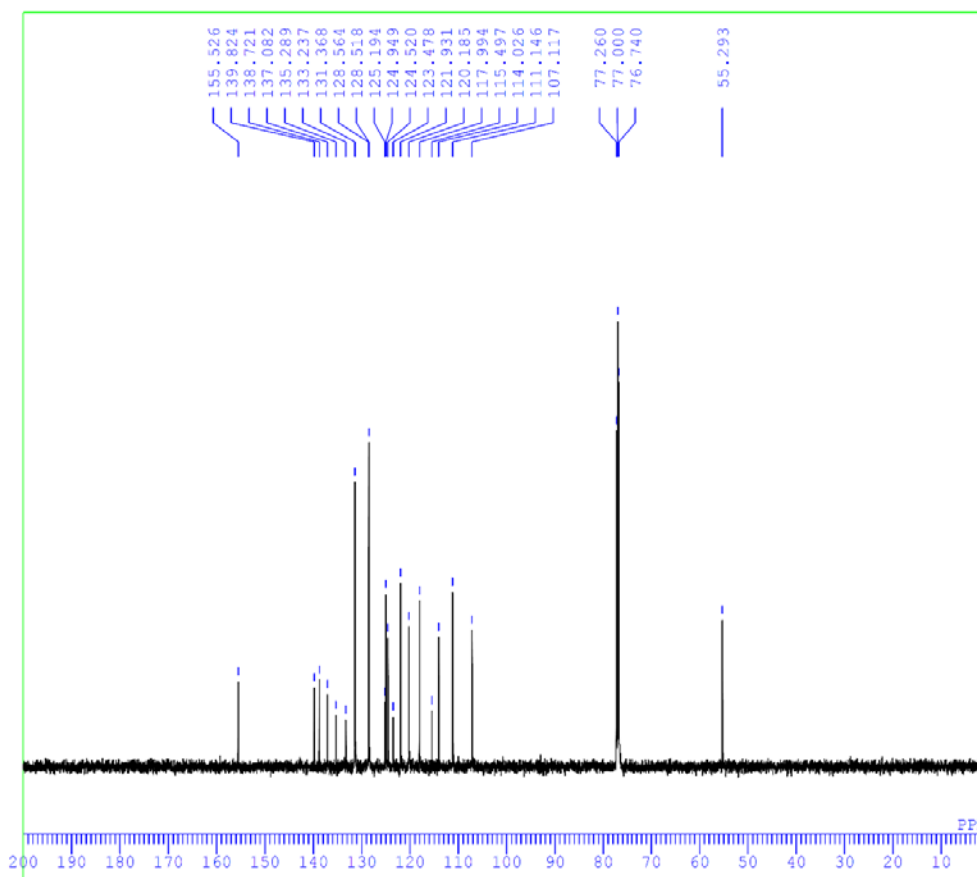
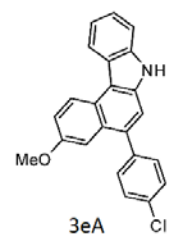




```

DFILE chloro h-1.als
COMNT single pulse
DATIM 2018-02-21 14:53:57
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
ACQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 18.6 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 44

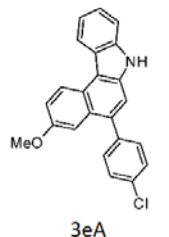
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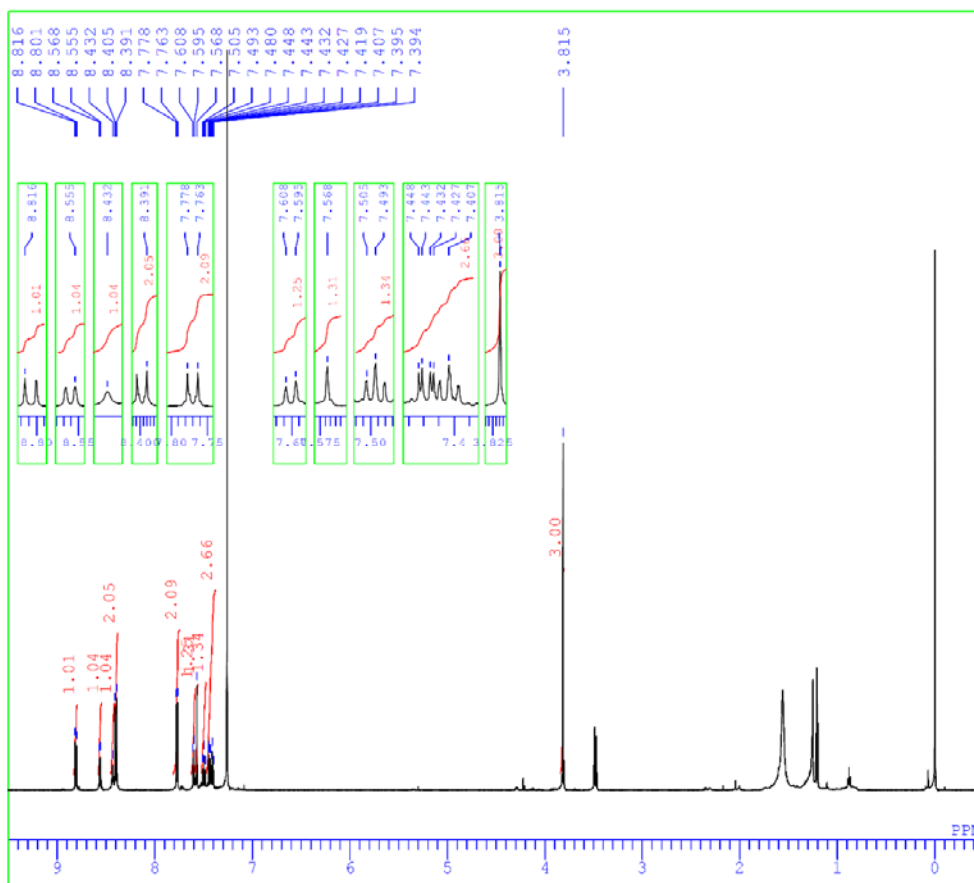
```

DFILE chloro c-1.als
COMNT
DATIM 2018-02-21 15:10:38
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 13107
FREQU 25252.14 Hz
SCANS 616
ACQTM 0.5190 sec
PD 1.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 19.1 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 56

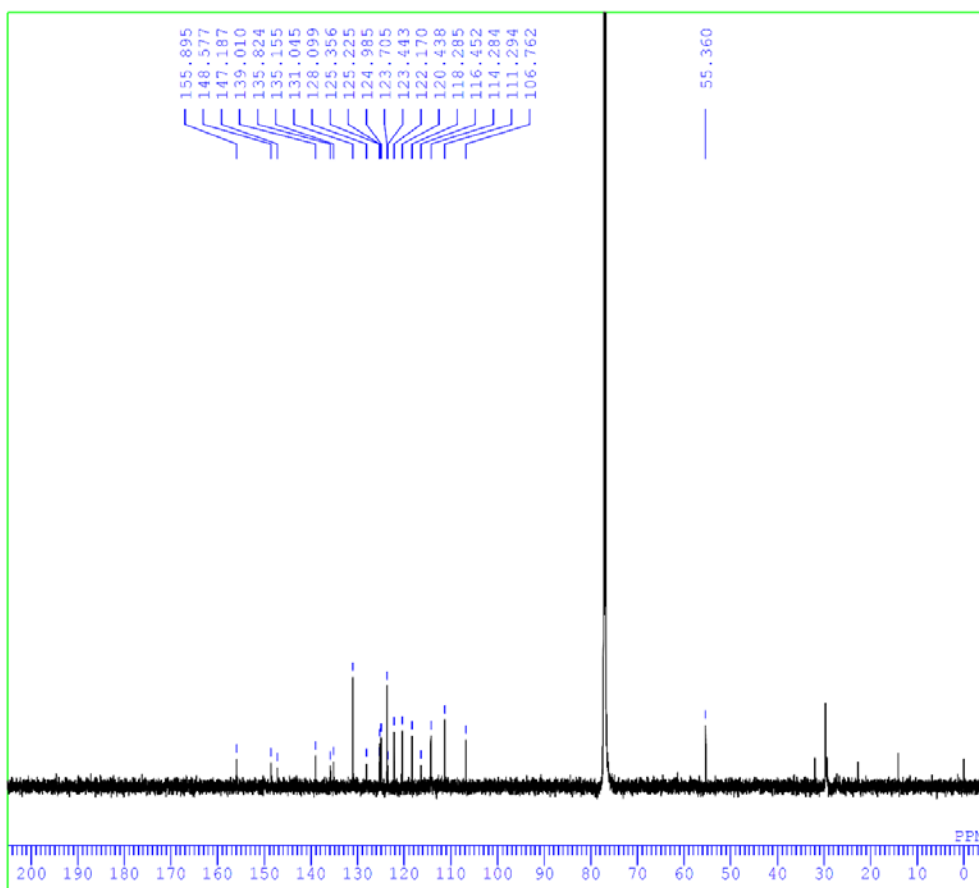
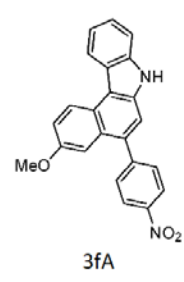
```



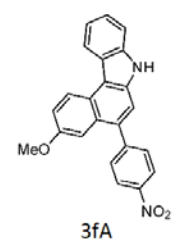


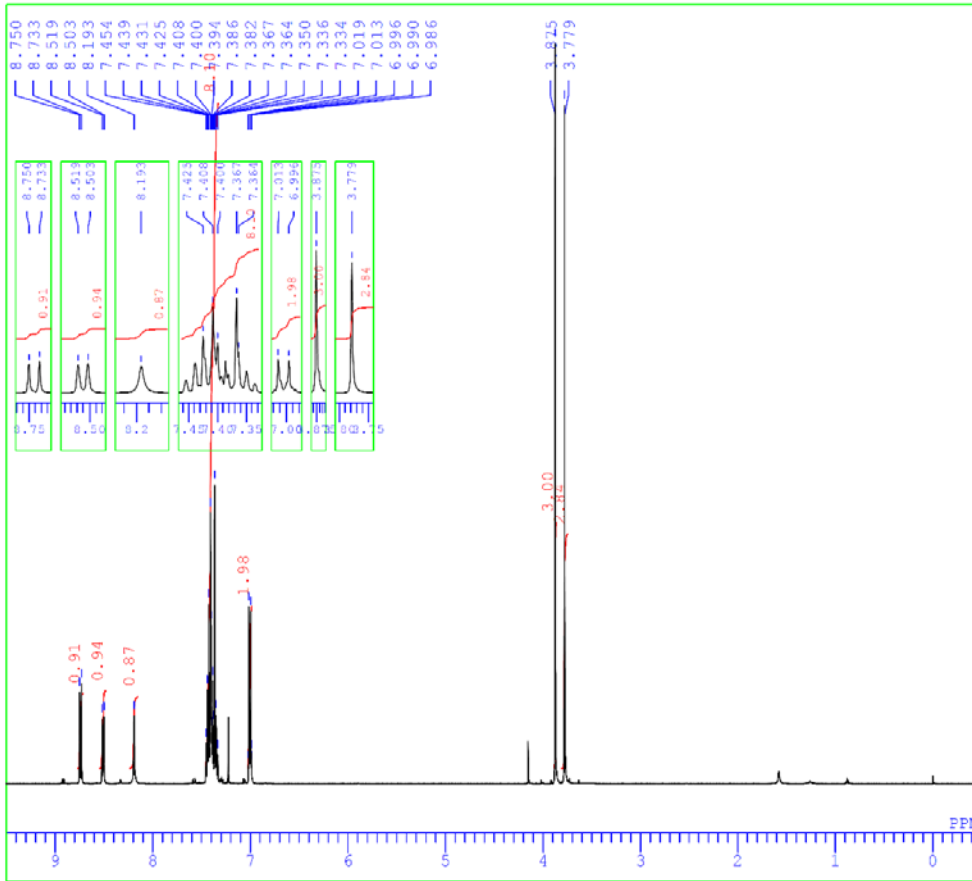


DFILE nitro h-1.als  
 COMNT  
 DATIM 2018-03-08 14:09:33  
 OBNUC 1H  
 EXMOD zg30  
 OBFREQ 600.13 MHz  
 OBSSET 3.00 KHz  
 OBFIN 0.65 Hz  
 POINT 16384  
 FREQU 8992.81 Hz  
 SCANS 128  
 ACQTM 0.0000 sec  
 PD 0.0000 sec  
 PW1 10.00 usec  
 IRNUC  
 CTEMP 24.9 c  
 SLVNT CDCl3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 574



DFILE nitro c-1.als  
 COMNT  
 DATIM 2018-03-23 06:58:45  
 OBNUC 13C  
 EXMOD zgpg30  
 OBFREQ 150.91 MHz  
 OBSSET 7.89 KHz  
 OBFIN 8.81 Hz  
 POINT 32768  
 FREQU 35971.22 Hz  
 SCANS 80000  
 ACQTM 0.0000 sec  
 PD 0.0000 sec  
 PW1 10.00 usec  
 IRNUC  
 CTEMP 24.9 c  
 SLVNT CDCl3  
 EXREF 219.18 ppm  
 BF 1.20 Hz  
 RGAIN 4597

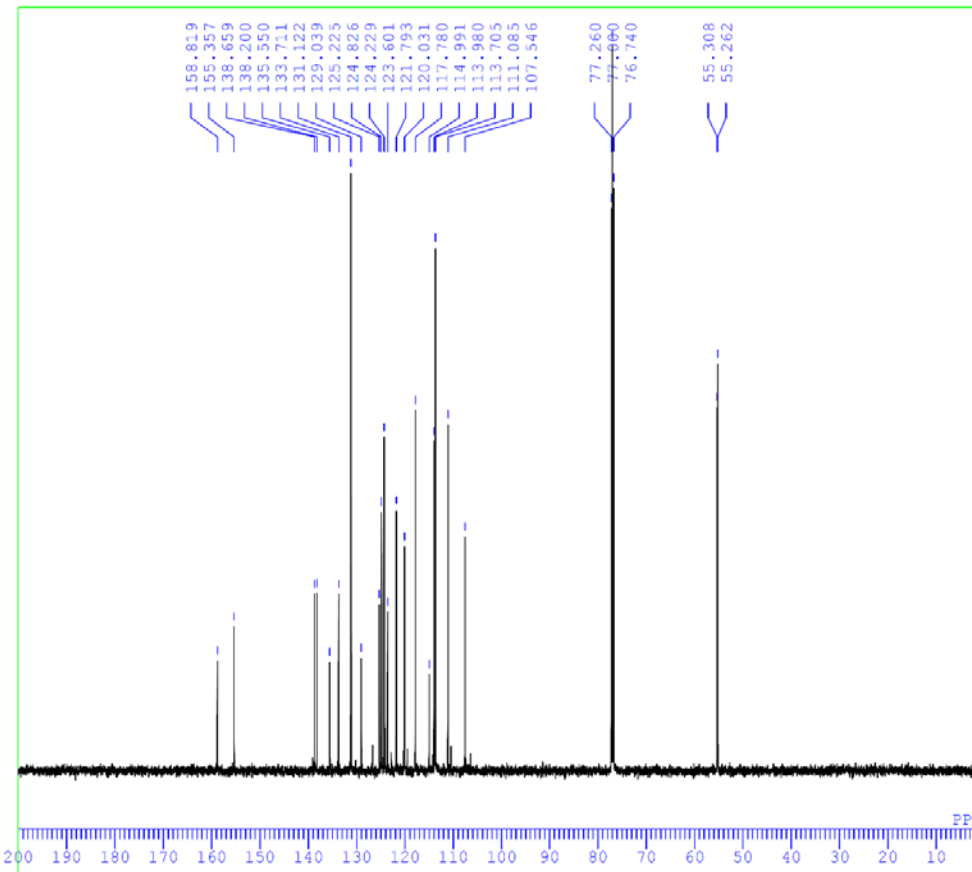
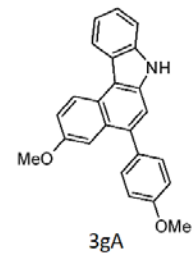




```

DFILE methoxy h-1.als
COMNT single pulse
DATIM 2018-03-01 16:39:44
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
ACQTM 1.7459 sec
PD 5.0000 sec
PWL 7.15 usec
IRNUC 1H
CTEMP 19.6 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 40

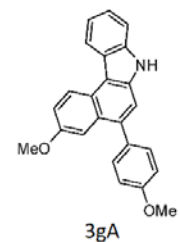
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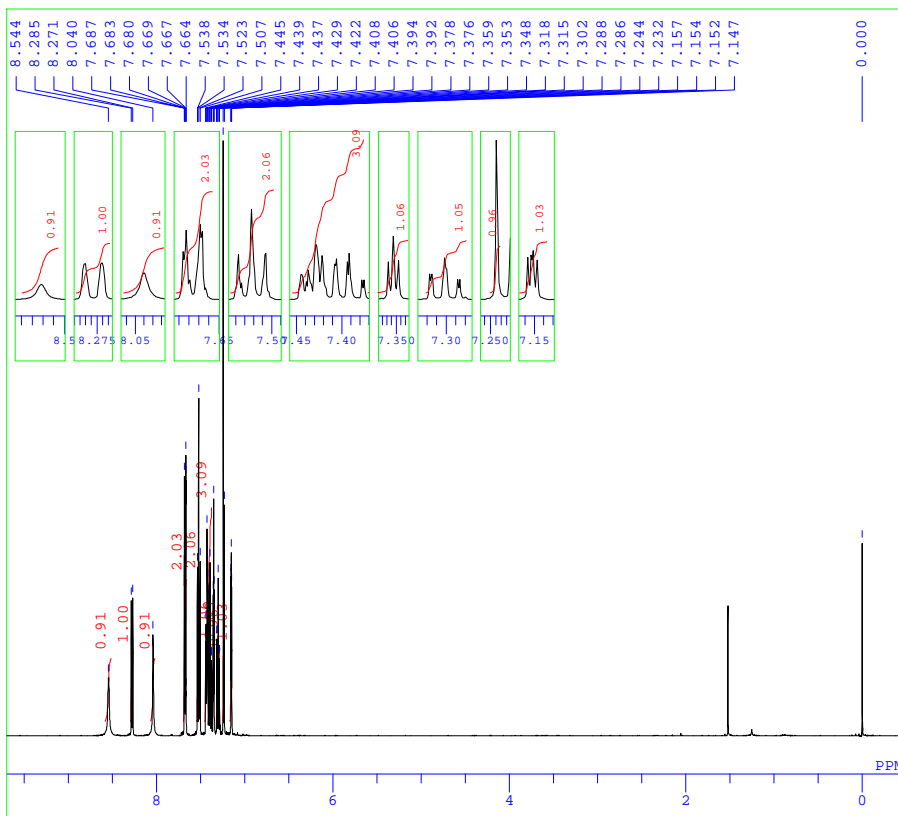


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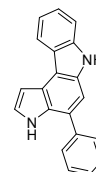
DFILE methoxy c-1.als
COMNT
DATIM 2018-03-01 17:13:56
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 13107
FREQU 25252.14 Hz
SCANS 1332
ACQTM 0.5190 sec
PD 1.0000 sec
PWL 3.67 usec
IRNUC 1H
CTEMP 20.0 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 60

```

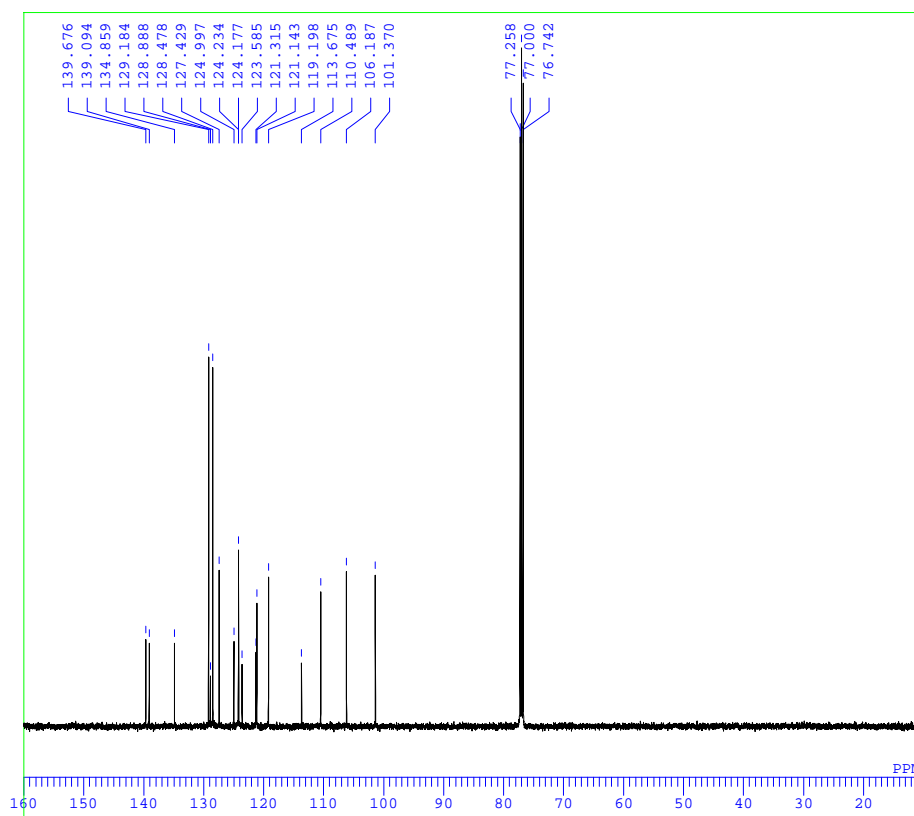




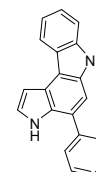
DFILE 6aA H-1.als  
COMNT single\_pulse  
DATIM 2017-02-23 21:40:53  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 19.7 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 44



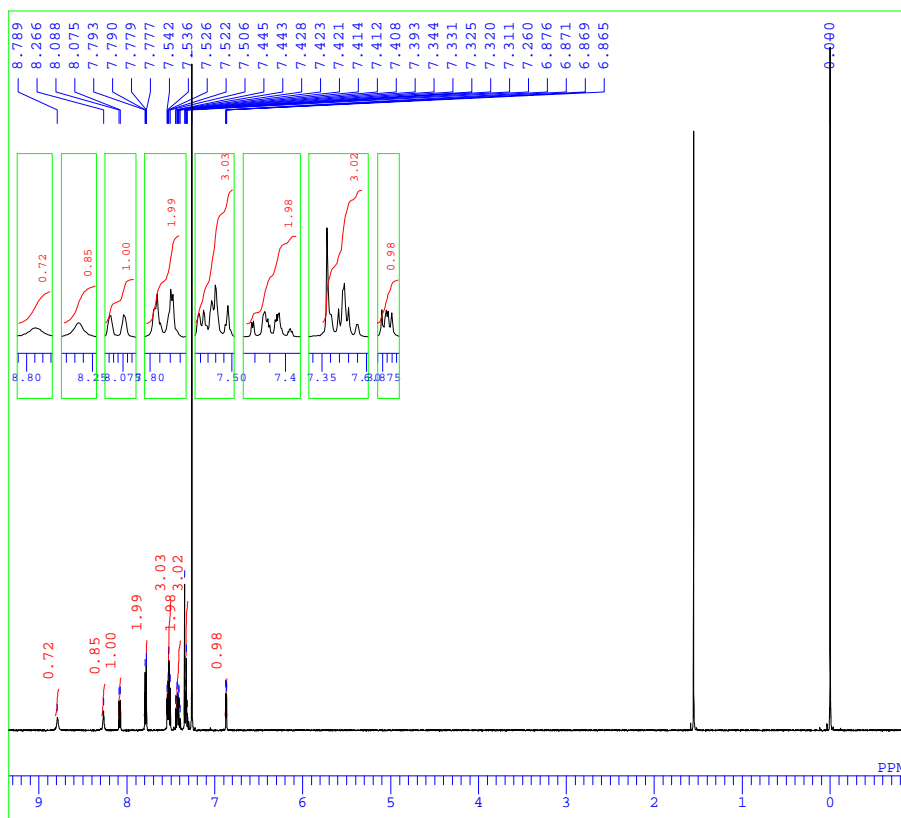
6aA



DFILE 6aA C-1.als  
COMNT  
DATIM 2017-02-24 01:01:33  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 1024  
ACQTM 0.8336 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 20.4 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60



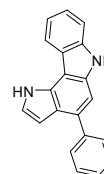
6aA



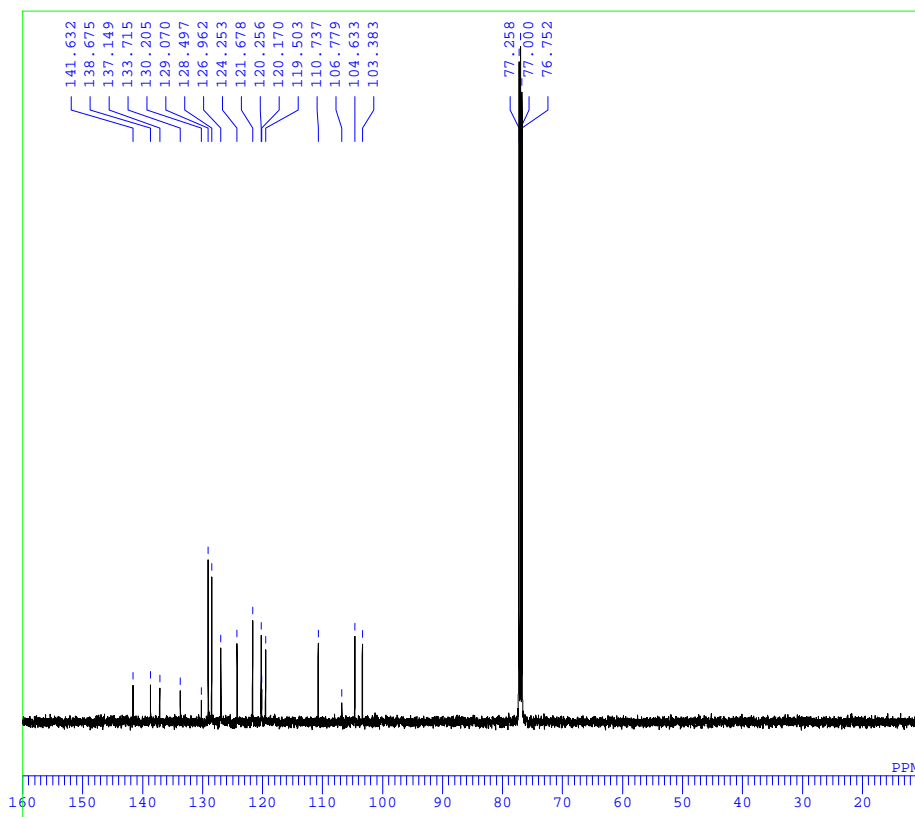
```

DFILE 7aA H-1.als
COMNT single_pulse
DATIM 2017-02-24 16:25:33
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
AQTM 1.7459 sec
PD 5.0000 sec
PW1 7.15 usec
IRNUC 1H
CTEMP 19.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 54

```



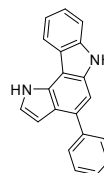
7aA



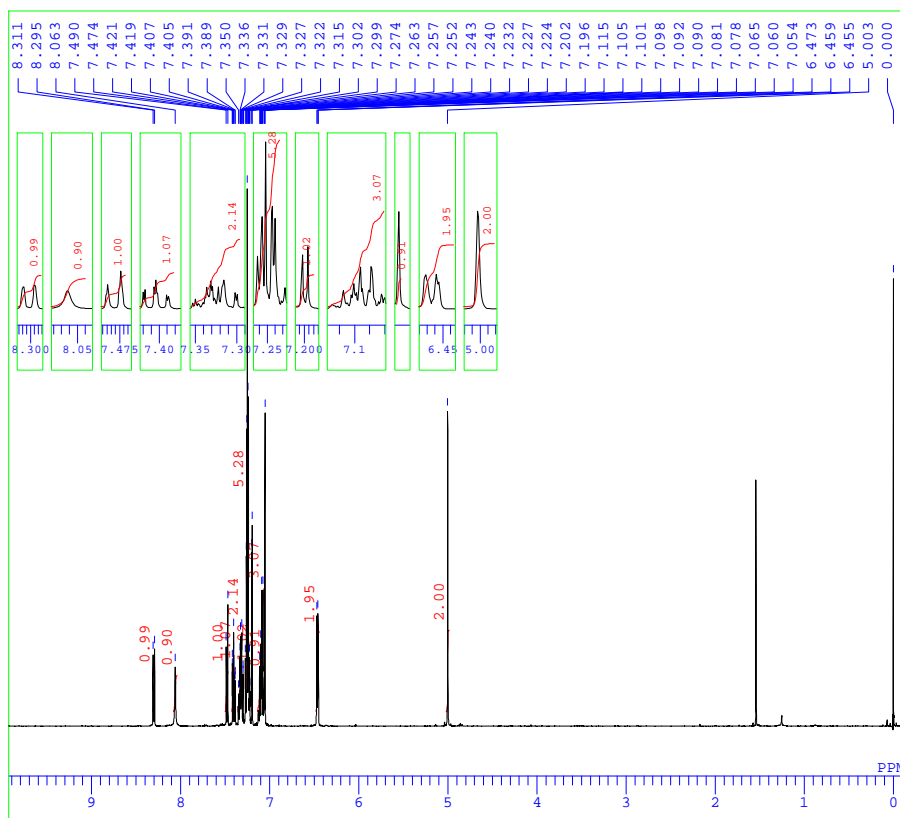
```

DFILE 7aA C-1.als
COMNT
DATIM 2017-02-24 00:05:10
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 26214
FREQU 31446.06 Hz
SCANS 1024
AQTM 0.8336 sec
PD 2.0000 sec
PW1 3.67 usec
IRNUC 1H
CTEMP 20.4 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 54

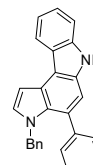
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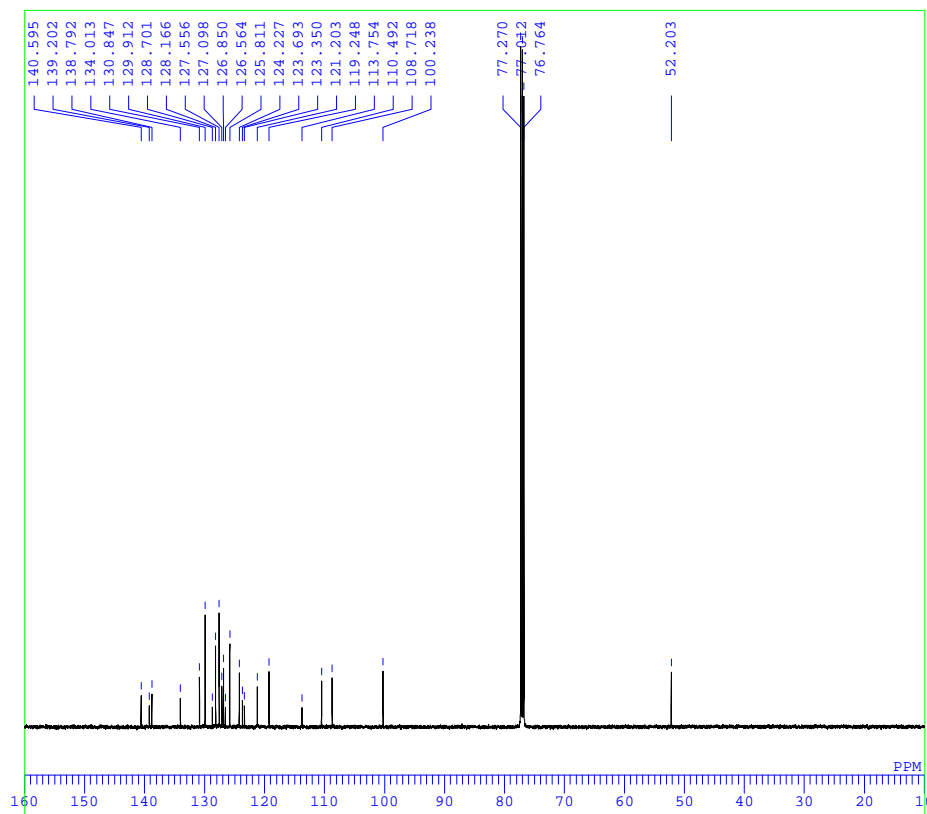
7aA



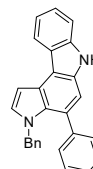
DFILE 6aB H-1.als  
 COMNT single\_pulse  
 DATIM 2017-02-22 17:44:13  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.8 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 48



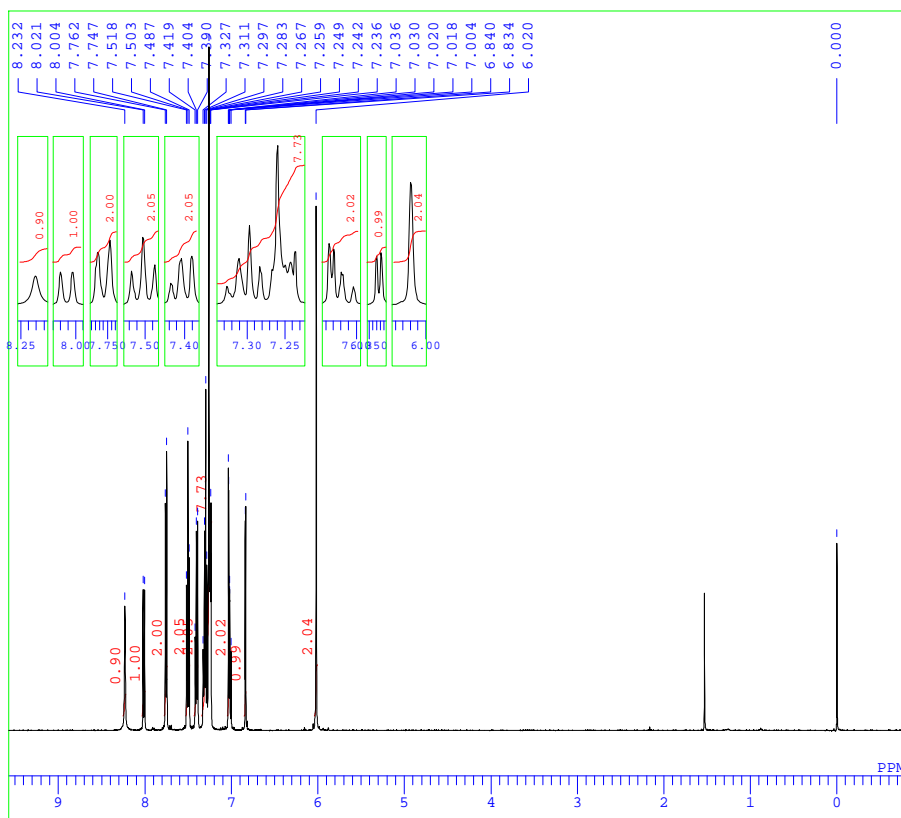
6aB



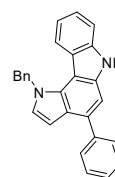
DFILE 6aB C-1.als  
 COMNT  
 DATIM 2017-02-24 04:12:56  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 3900  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.3 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 1.20 Hz  
 RGAIN 60



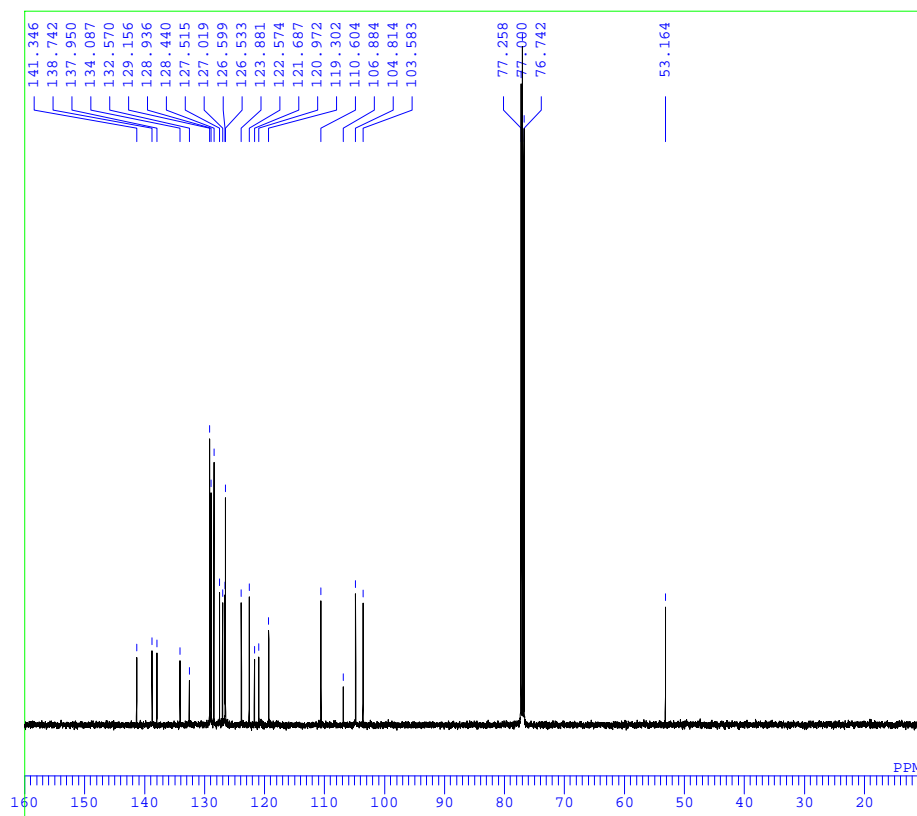
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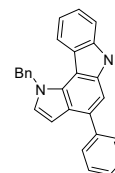
DFILE 7aB H-1.als  
COMNT single\_pulse  
DATIM 2017-02-22 17:49:26  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
AQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 19.8 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 44



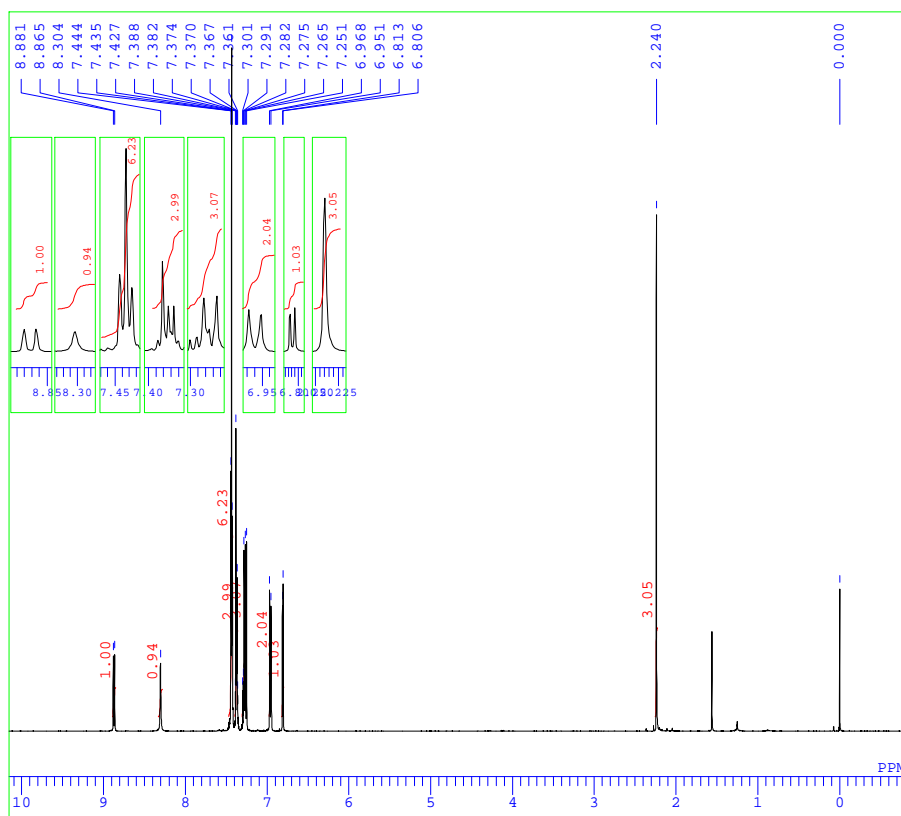
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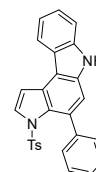
DFILE 7aB C-1.als  
COMNT  
DATIM 2017-02-24 05:06:42  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 1024  
AQTM 0.8336 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 20.2 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60



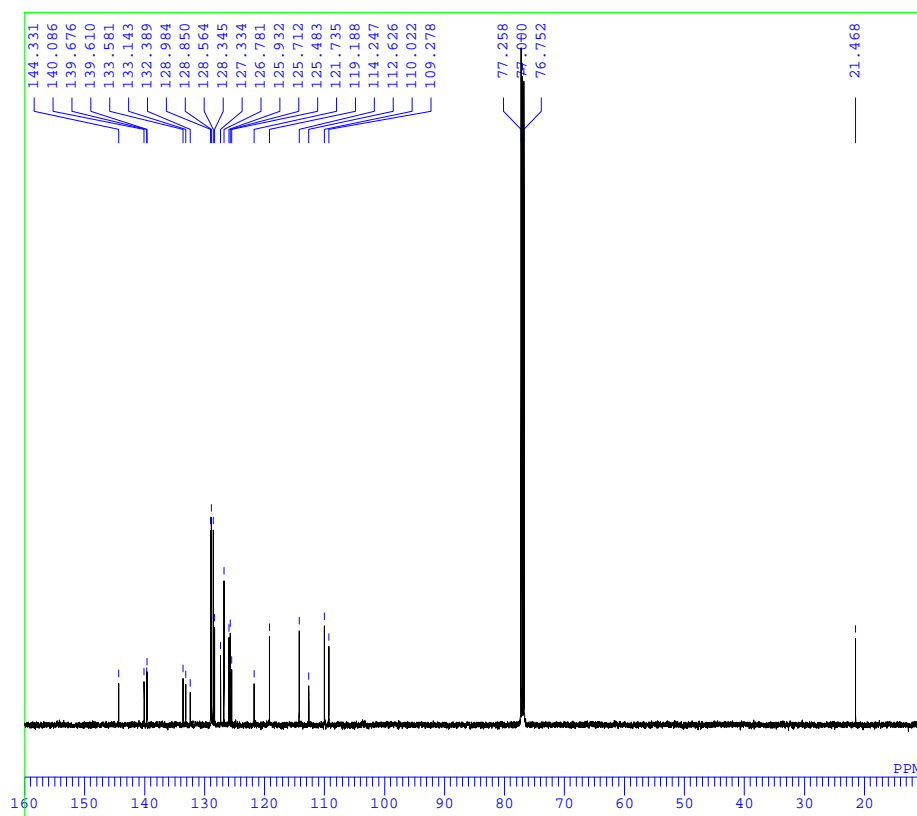
7aB



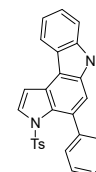
DFILE 6aC H-1.als  
 COMNT single\_pulse  
 DATIM 2017-02-22 17:53:52  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRO 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PWL 7.15 usec  
 IRNUC 1H  
 CTEMP 19.8 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



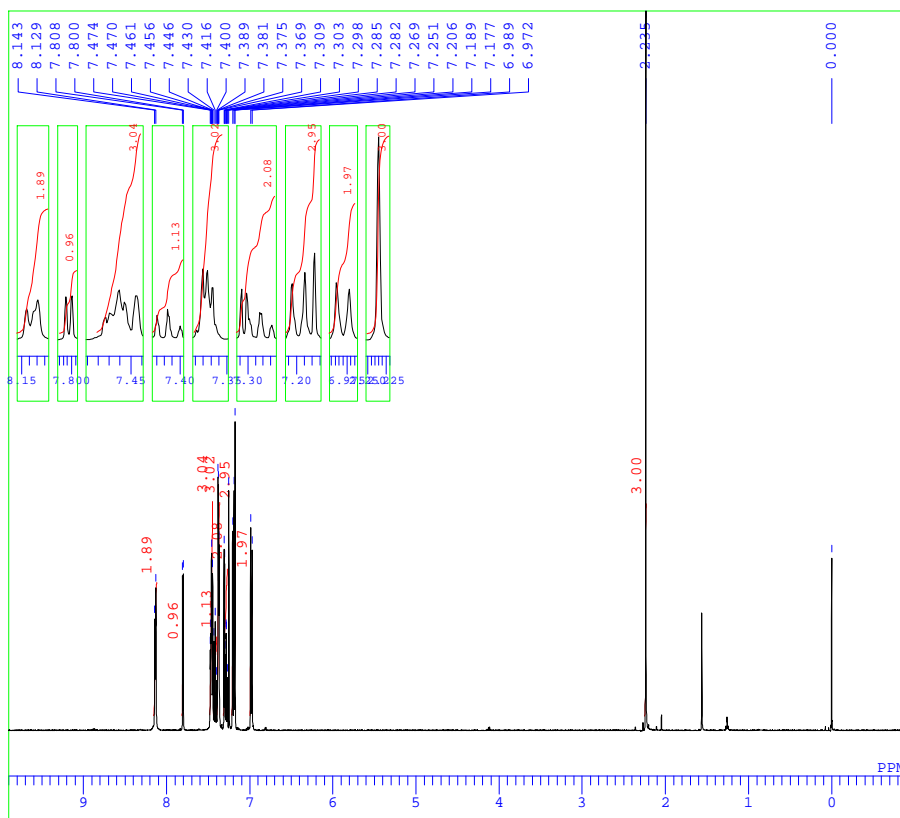
6aC



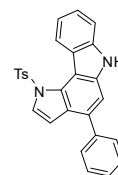
DFILE 6aC C-1.als  
 COMNT  
 DATIM 2017-02-24 07:51:52  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRO 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PWL 3.67 usec  
 IRNUC 1H  
 CTEMP 20.0 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 60



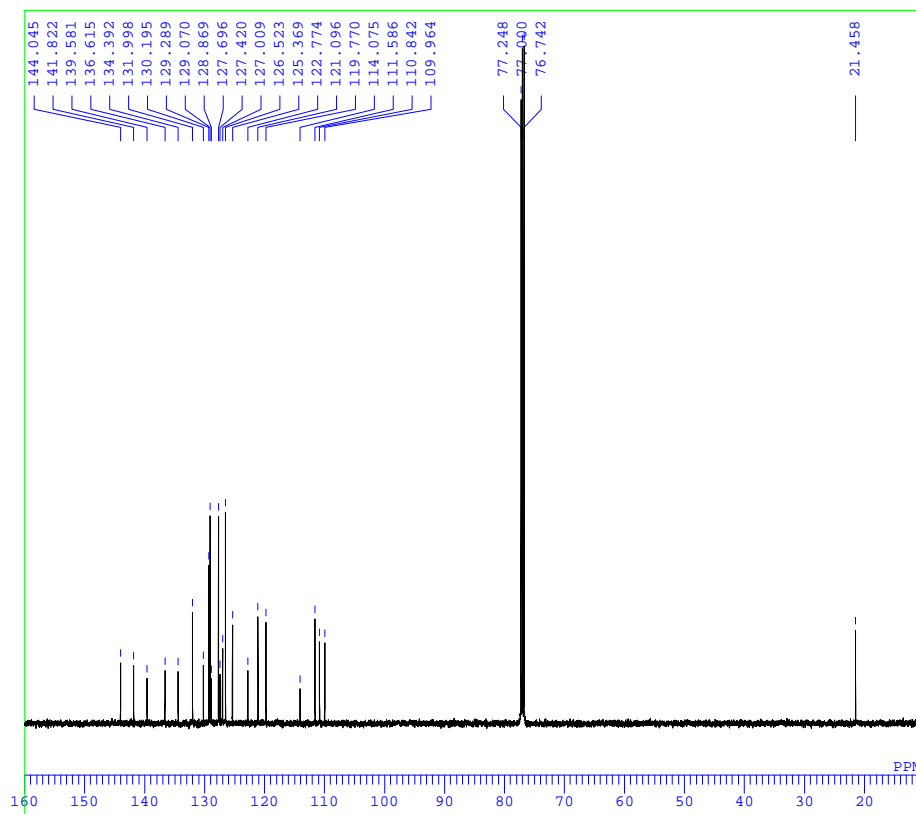
6aC



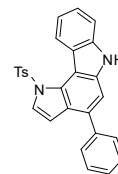
DFILE 7aC H-1.als  
 COMNT single\_pulse  
 DATIM 2017-02-22 17:58:39  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRO 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.8 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



7aC

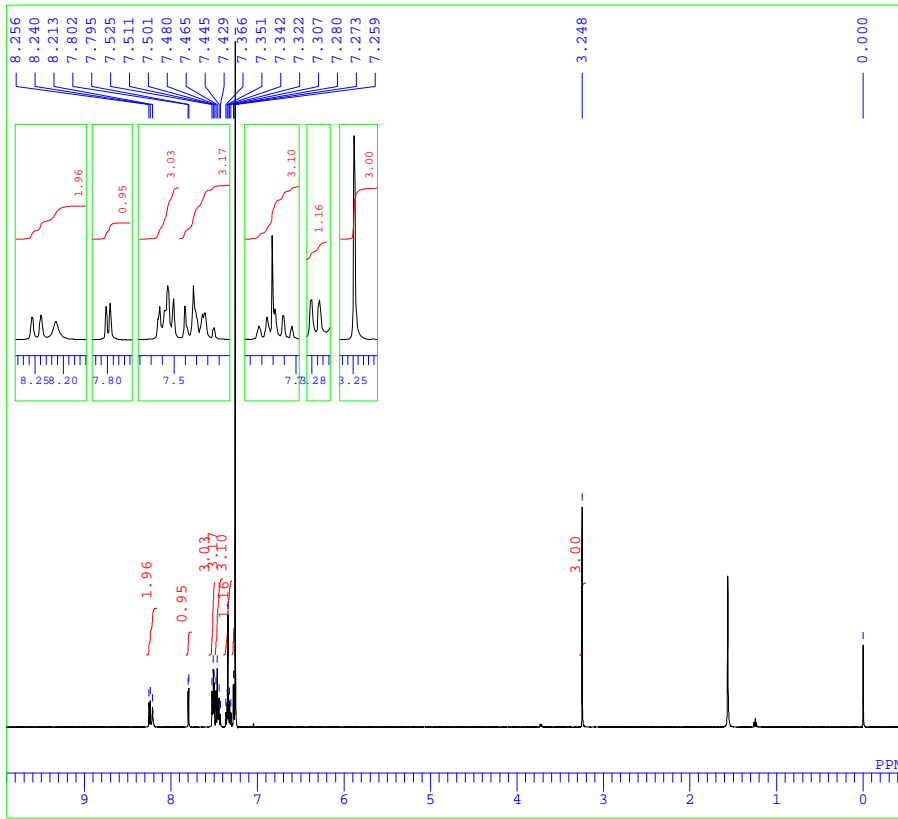


DFILE 7aC C-1.als  
 COMNT  
 DATIM 2017-02-24 08:46:53  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRO 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.0 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 60

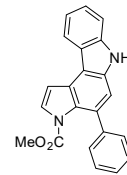


7aC

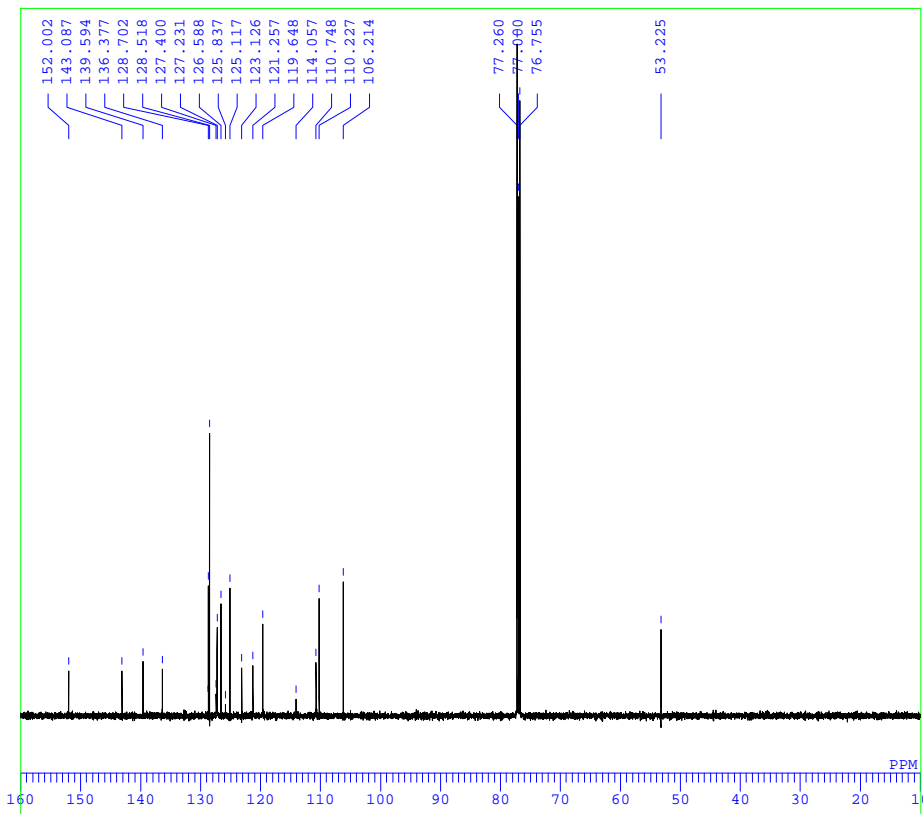




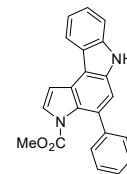
DFILE 6aD.als  
COMNT single\_pulse  
DATIM 2018-04-27 19:42:40  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 21.2 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 50



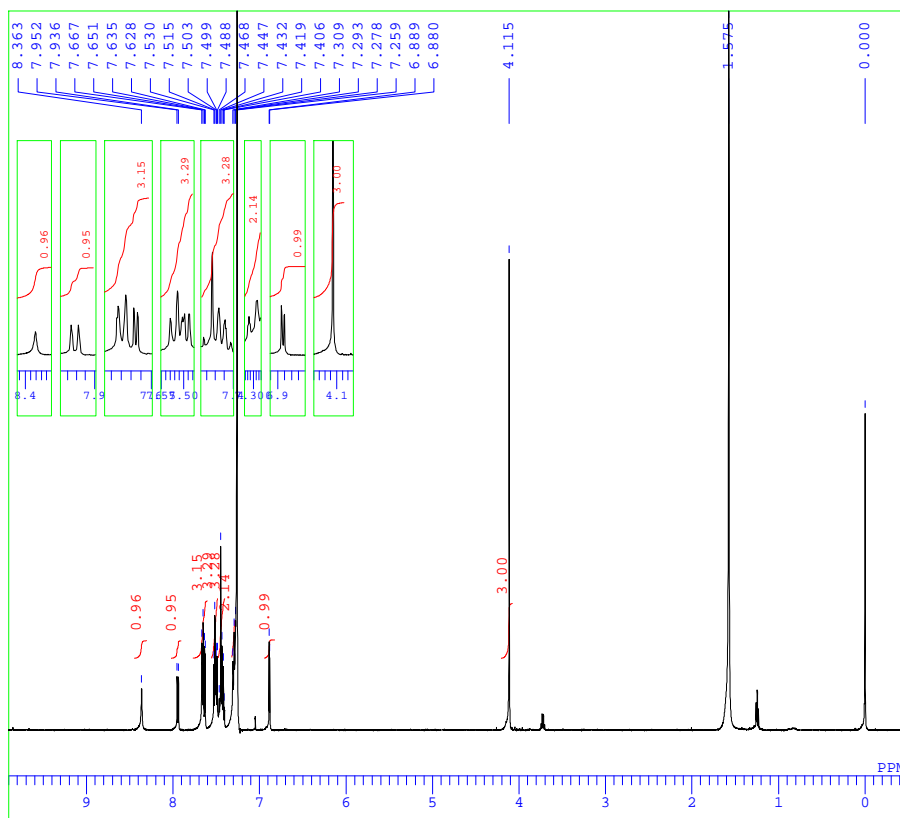
6aD



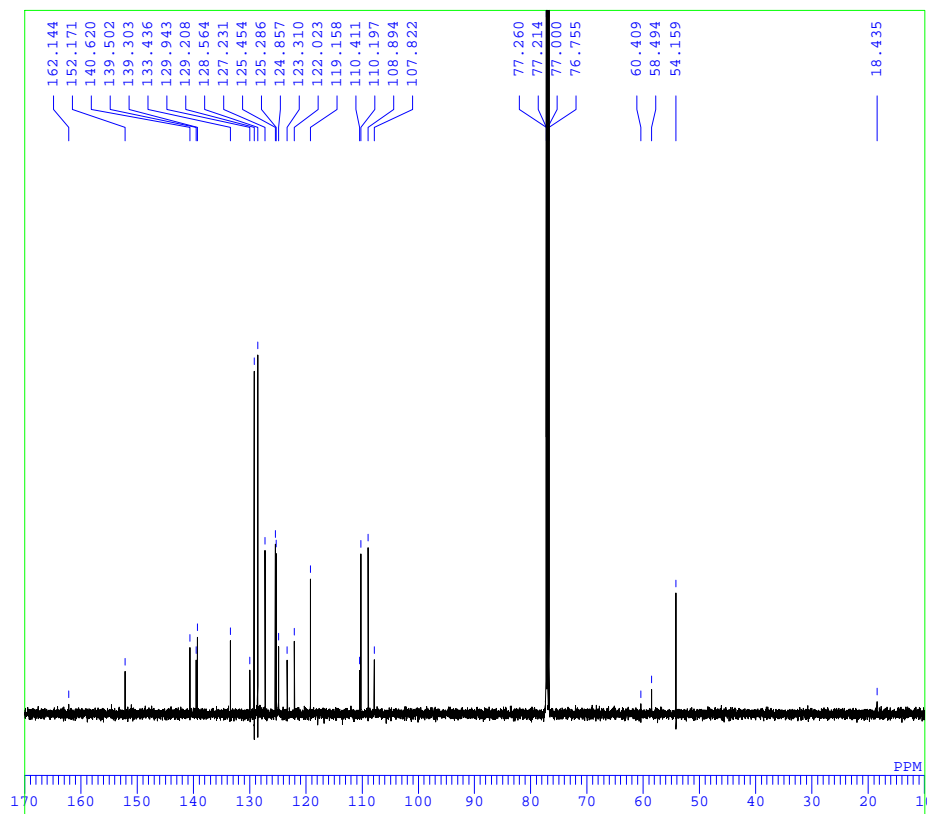
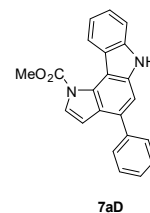
DFILE 6aD Cc-1.als  
COMNT  
DATIM 2018-04-29 18:34:57  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 13107  
FREQU 25252.14 Hz  
SCANS 3507  
ACQTM 0.5190 sec  
PD 1.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 21.4 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 0.12 Hz  
RGAIN 60



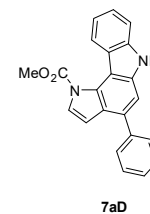
6aD

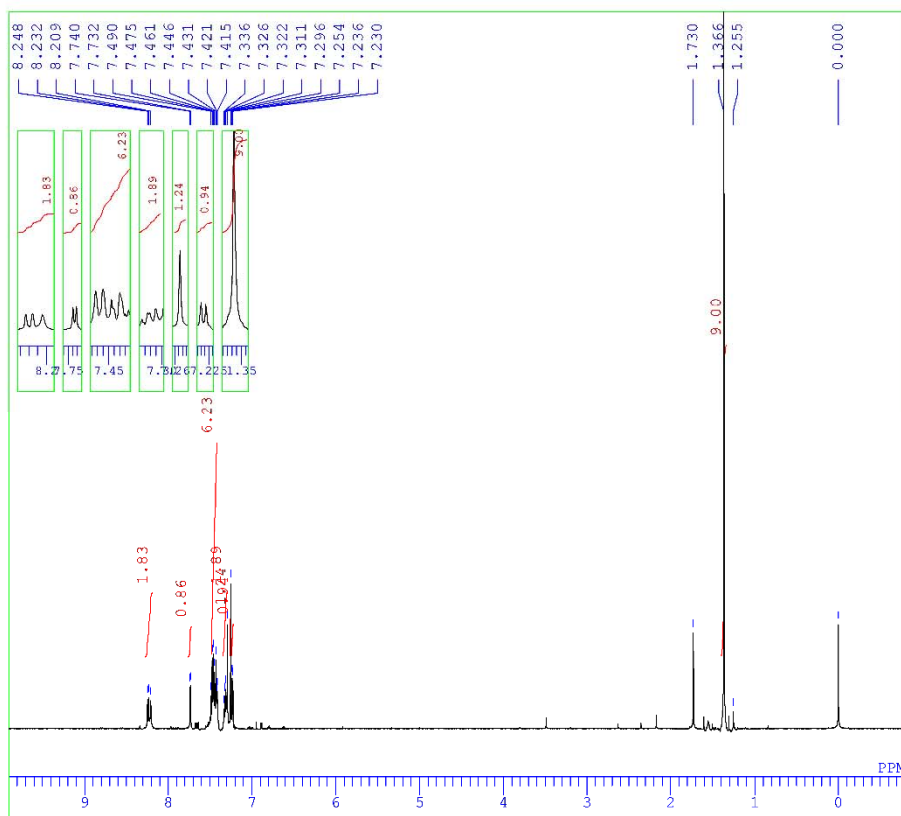


DFILE 7aD.als  
 COMNT single\_pulse  
 DATIM 2018-04-28 15:40:00  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 16  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 21.5 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 50

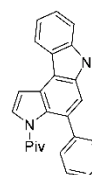


DFILE 7aD C.als  
 COMNT  
 DATIM 2018-04-28 21:43:57  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 31565.66 Hz  
 SCANS 5000  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.5 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 60



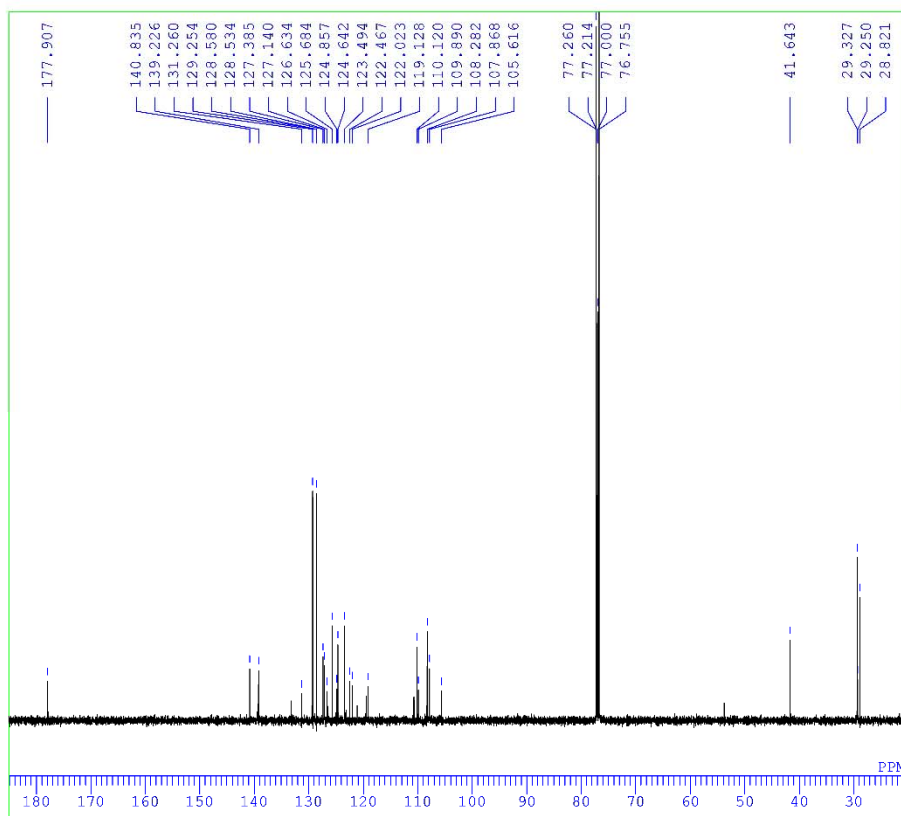


DFILE D-22.als  
 COMNT single\_pulse  
 DATIM 2018-03-02 15:21:53  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTRMP 19.3 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 48

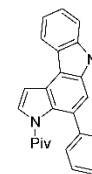


+ minor isomer

6aE

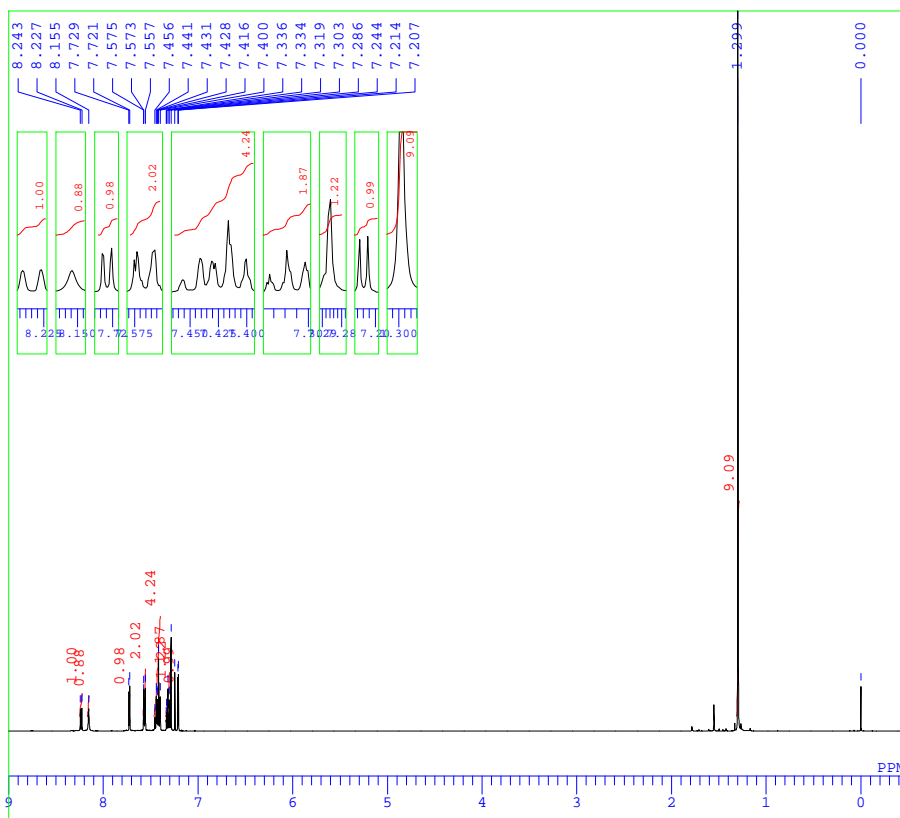


DFILE D22 C.als  
 COMNT  
 DATIM 2018-05-23 17:33:15  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 13107  
 FREQU 25252.14 Hz  
 SCANS 2200  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 uscc  
 IRNUC 1H  
 CTRMP 21.8 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 60

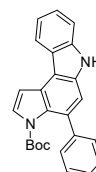


+ minor isomer

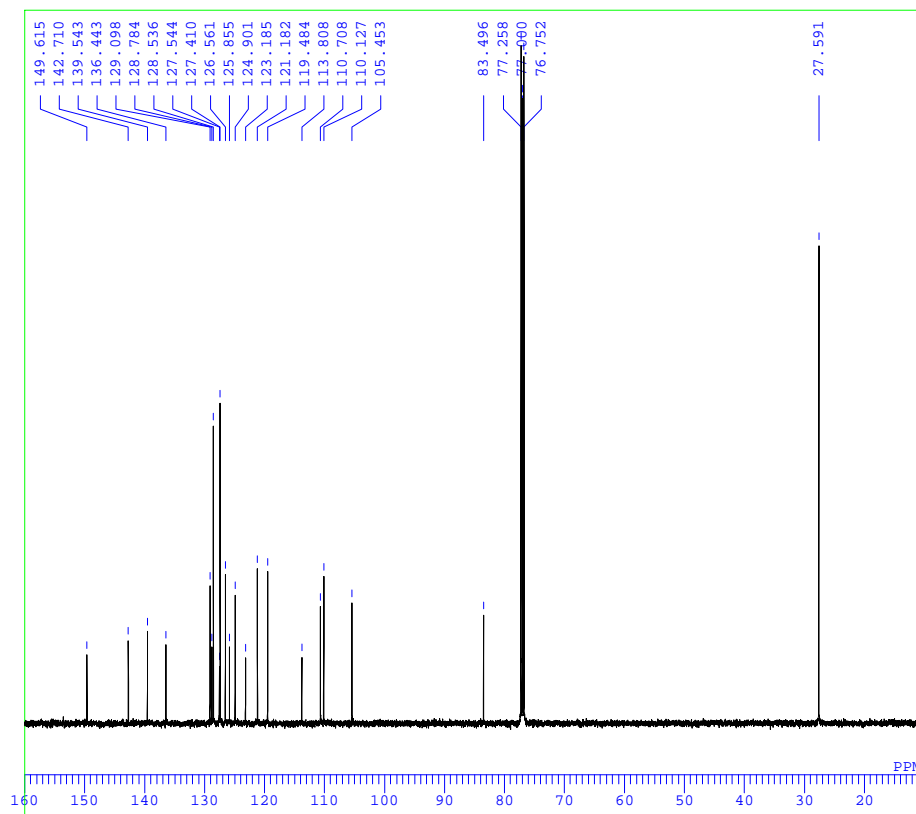
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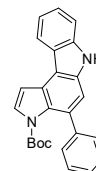
DFILE 6aF H-1.als  
 COMNT single\_pulse  
 DATIM 2017-02-24 16:33:32  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



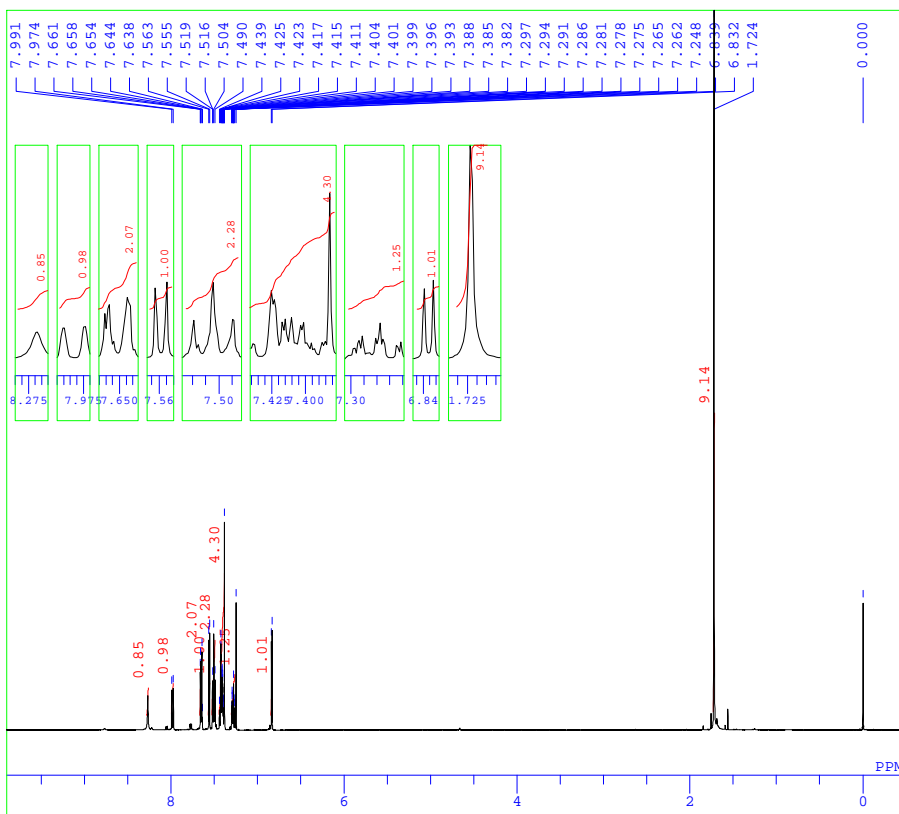
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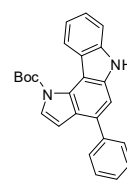
DFILE 6aF C-1.als  
 COMNT  
 DATIM 2017-02-24 06:01:34  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.1 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 60



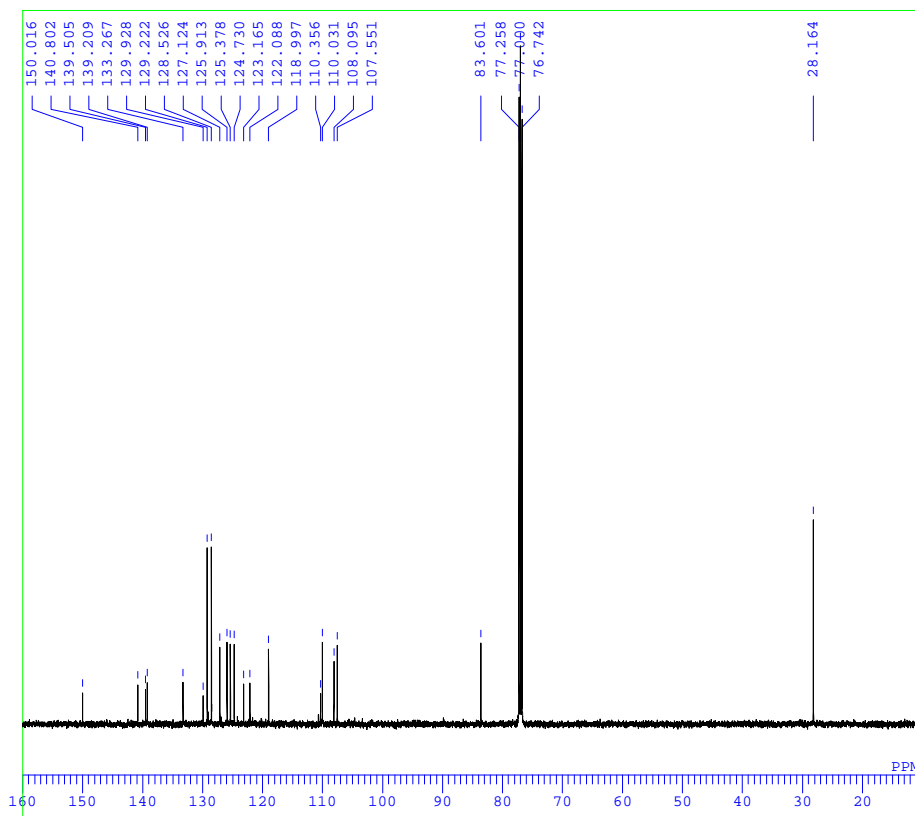
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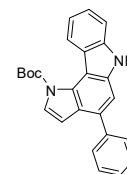
DFILE 7aF H-1.als  
 COMNT single\_pulse  
 DATIM 2017-02-23 21:44:59  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



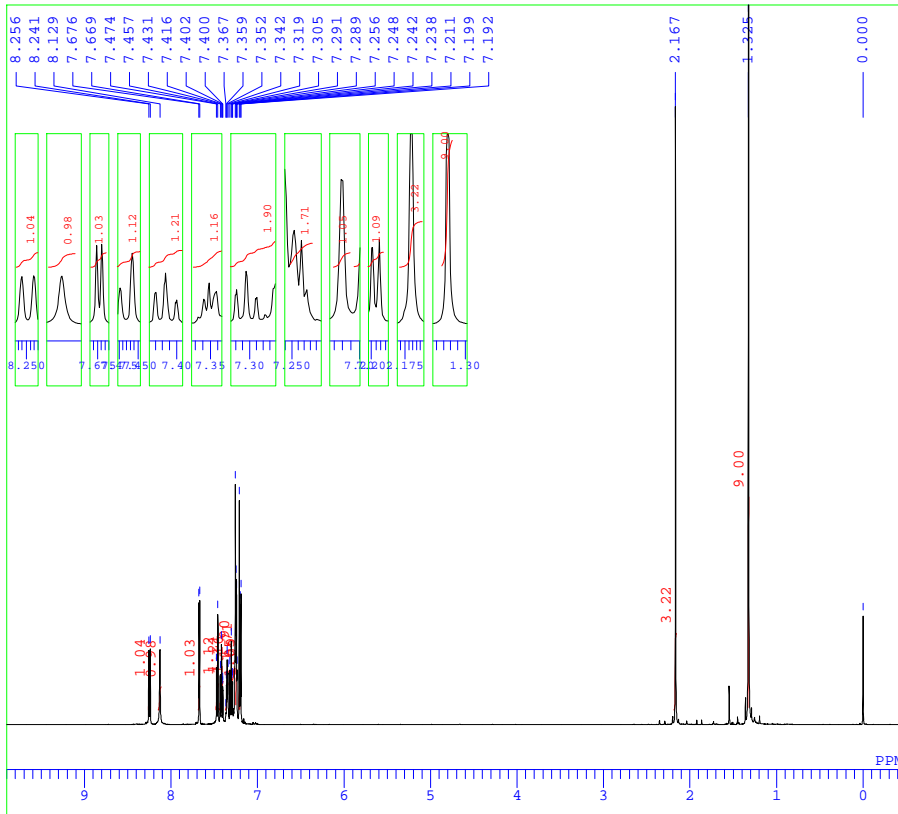
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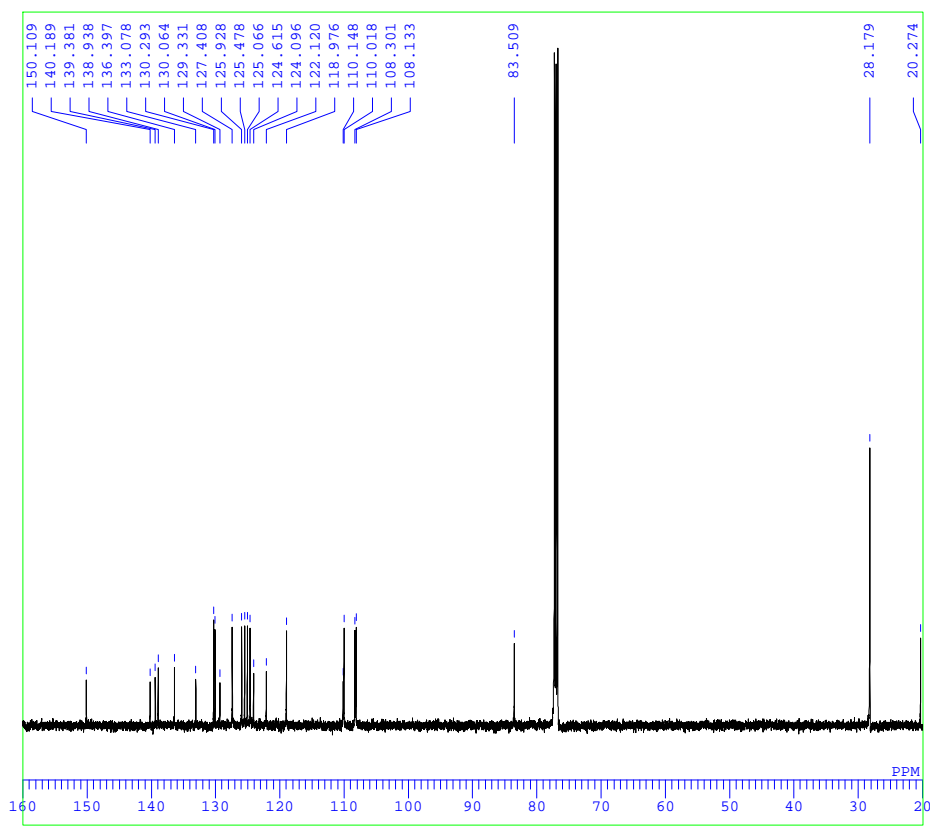
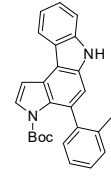
DFILE 7aF C-1.als  
 COMNT  
 DATIM 2017-02-24 06:56:18  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.0 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 60



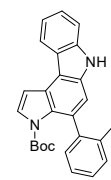
7aF

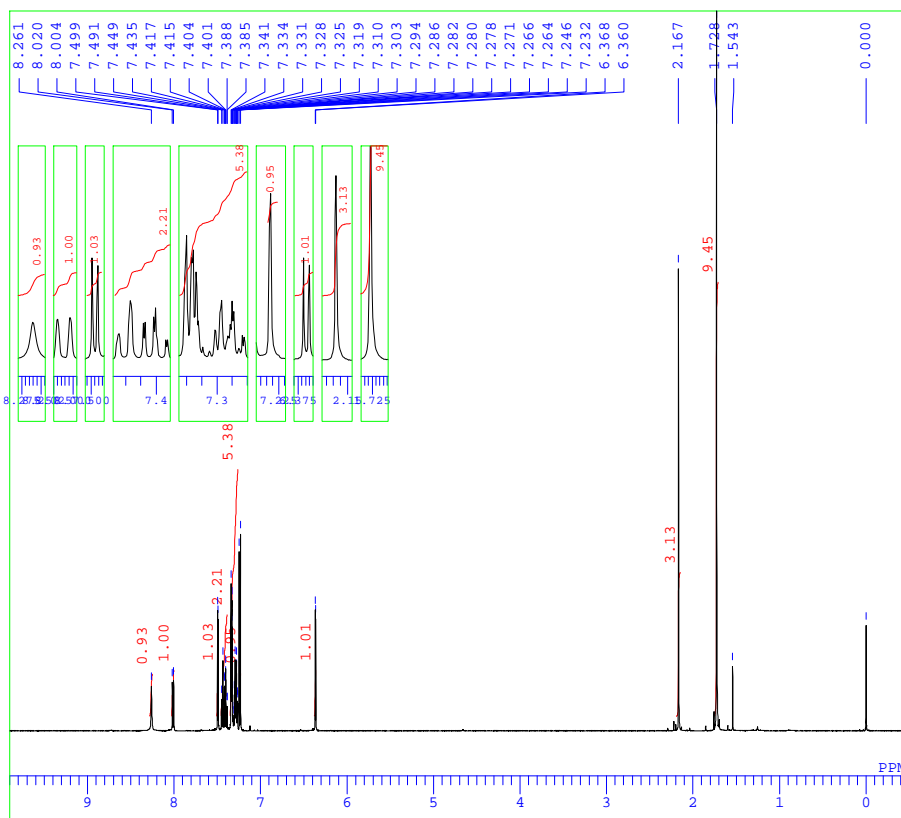


DFILE C-34 ue H 1 26-1.als  
 COMNT single\_pulse  
 DATIM 2017-01-26 21:24:44  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 18.9 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 42

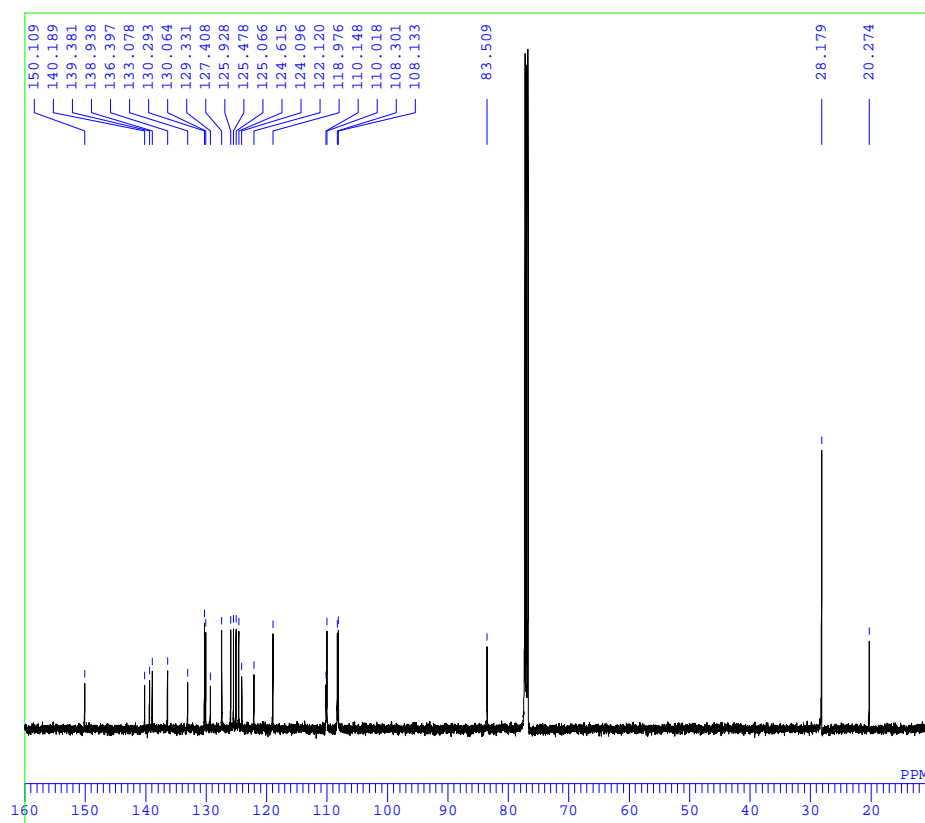
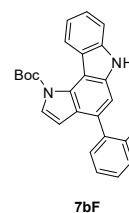


DFILE C-34 sita C 2 3-1.als  
 COMNT  
 DATIM 2017-02-03 14:26:05  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 32768  
 FREQU 31446.54 Hz  
 SCANS 1024  
 ACQTM 1.0420 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.3 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 70

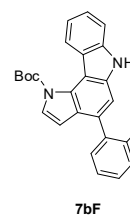


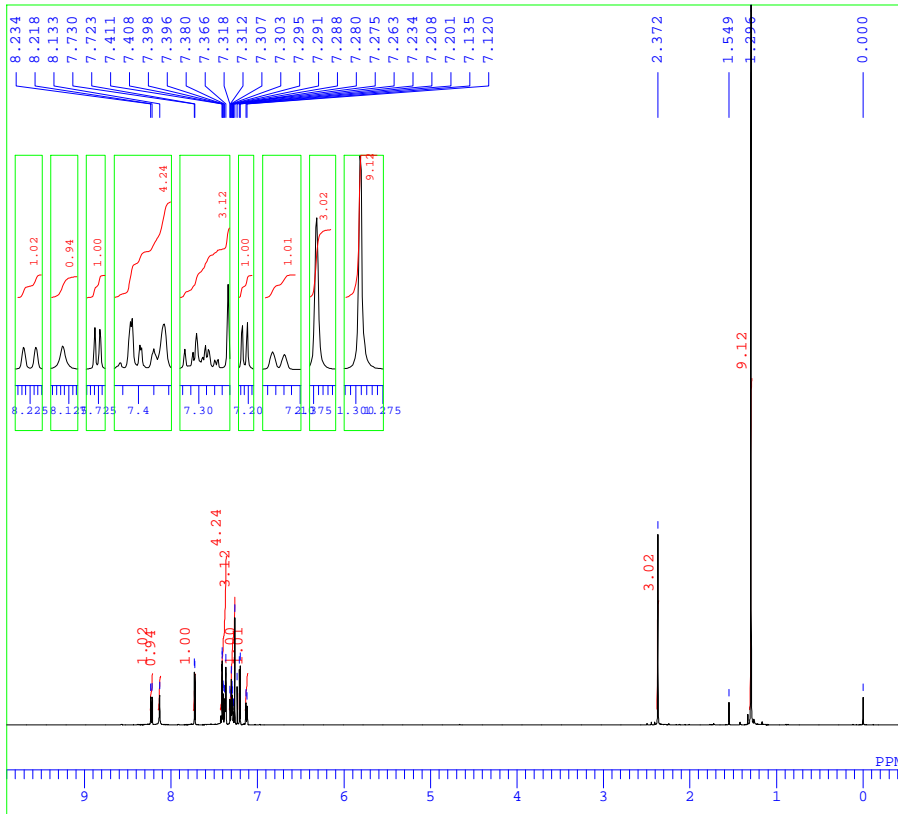


DFILE C-34 d H.als  
COMNT single\_pulse  
DATIM 2017-02-08 13:25:11  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 20.4 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 44

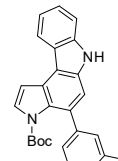


DFILE C-34 d C.als  
COMNT  
DATIM 2017-02-03 14:26:05  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 32768  
FREQU 31446.54 Hz  
SCANS 1024  
ACQTM 1.0420 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 20.3 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 70

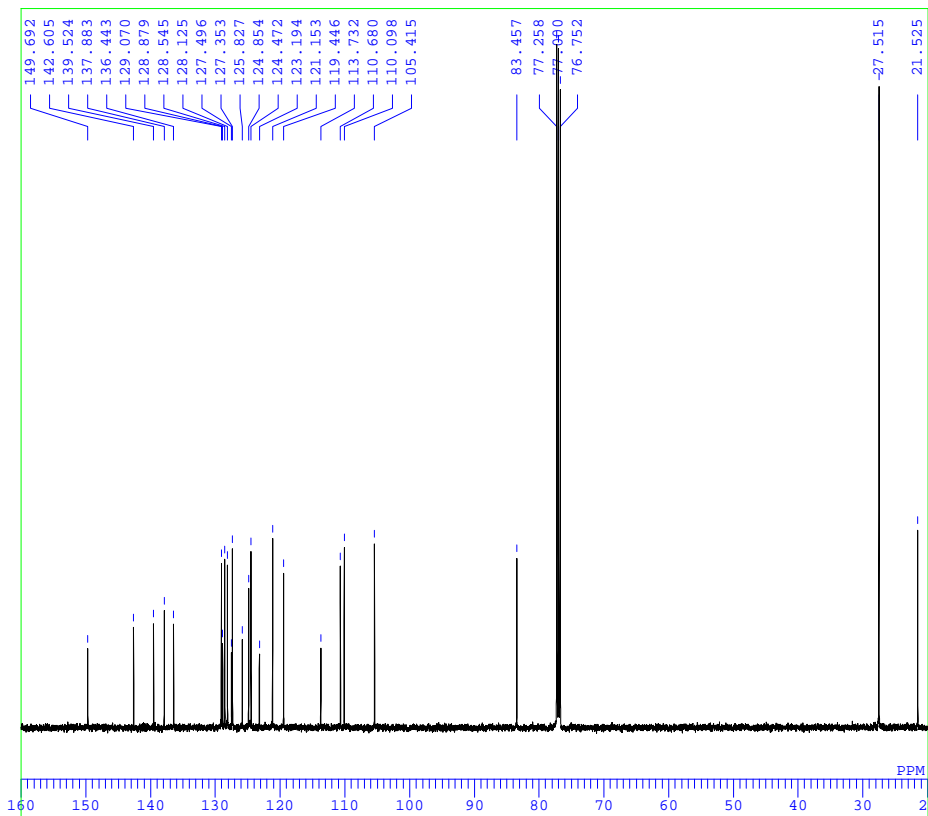




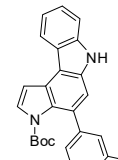
DFILE C-30 u H.als  
COMNT single\_pulse  
DATIM 2017-01-27 20:56:05  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRO 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 19.6 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 40



6cF

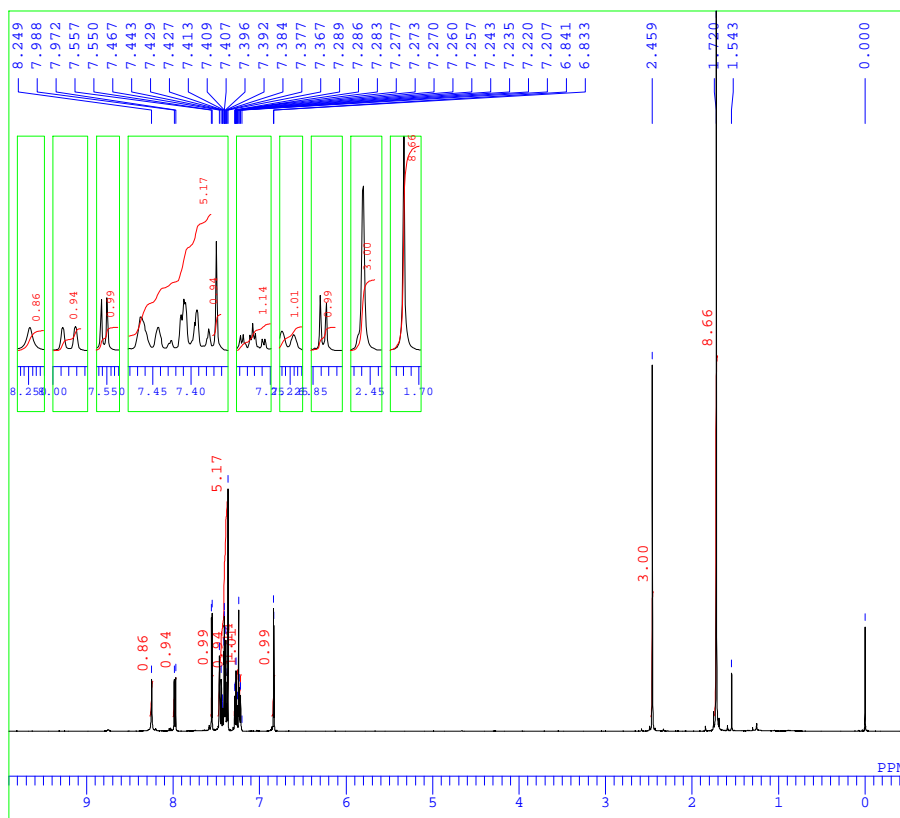


DFILE C-30 u C.als  
COMNT  
DATIM 2017-01-26 23:51:11  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRO 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 1024  
ACQTM 0.8336 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 20.0 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 54

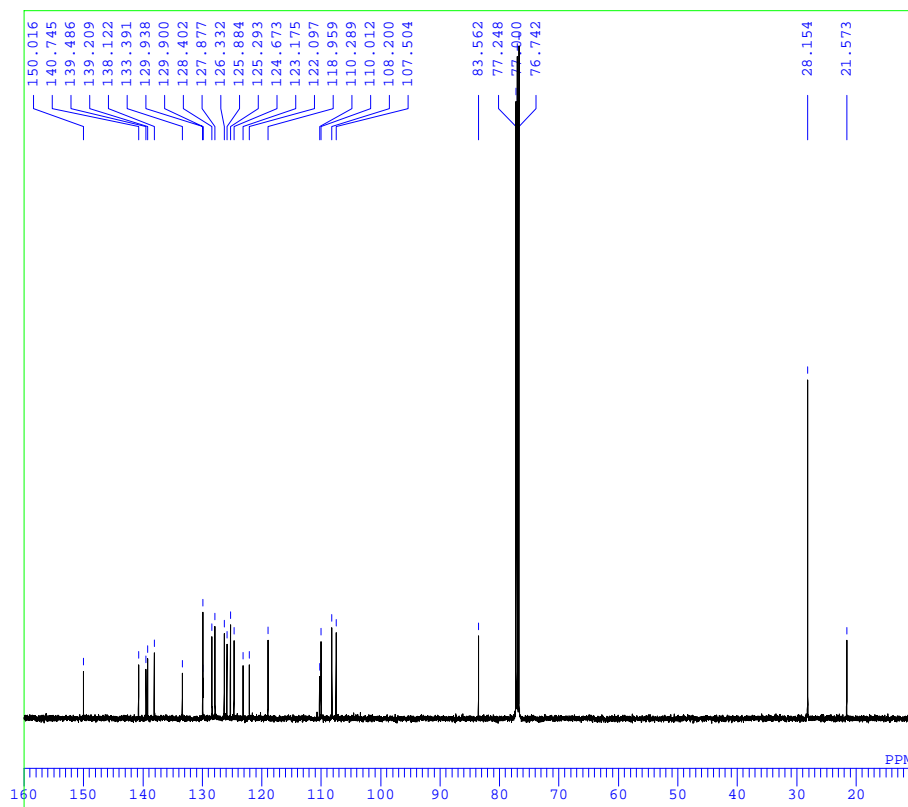
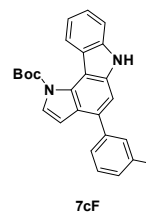


6cF

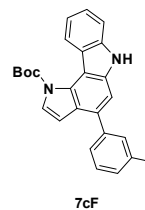


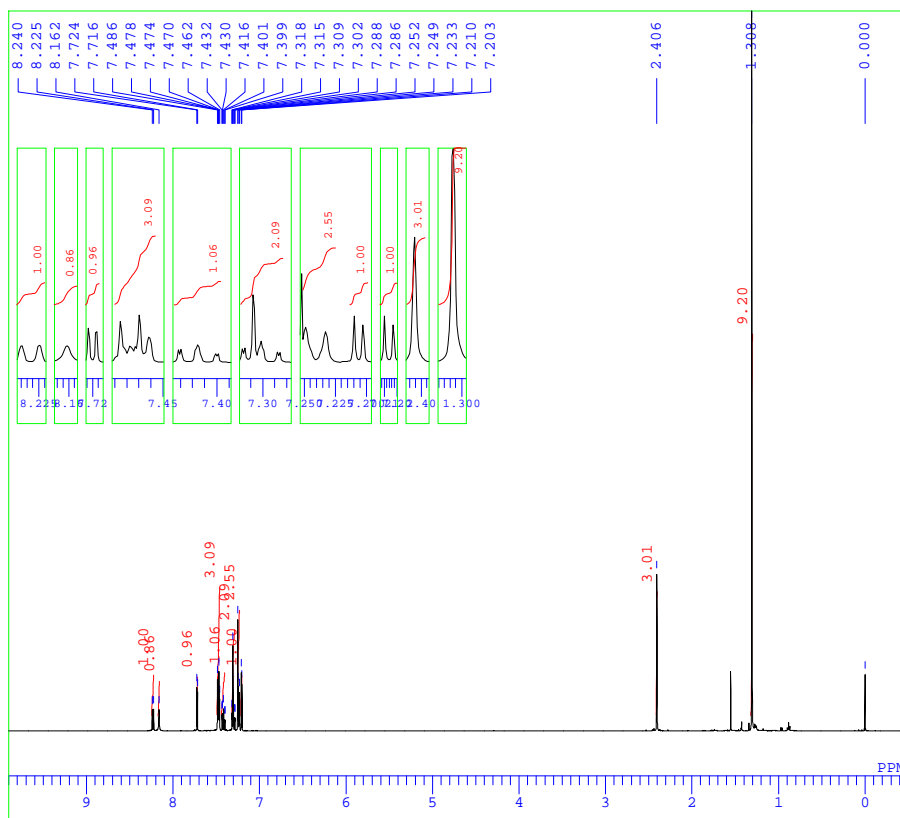


DFILE C-30 d H.als  
 COMNT single\_pulse  
 DATIM 2017-01-27 21:01:29  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.5 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44

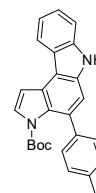


DFILE C-30 d C.als  
 COMNT  
 DATIM 2017-01-27 00:53:29  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 19.8 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 58

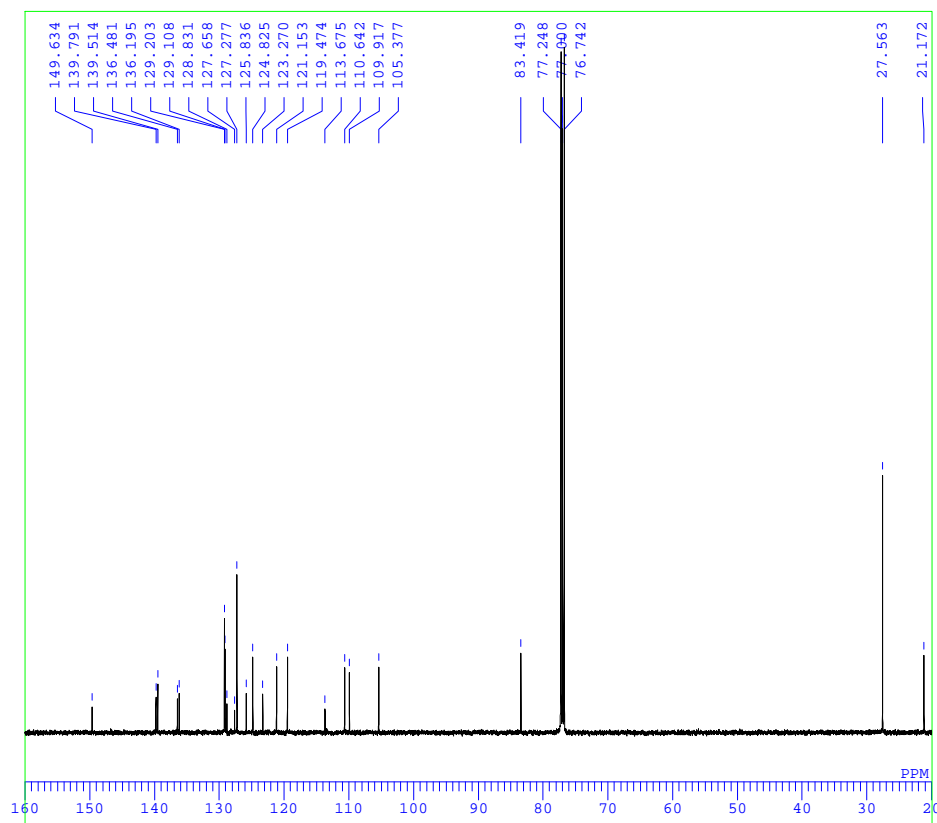




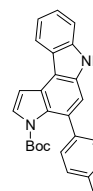
DFILE C-35 u H.als  
COMNT single\_pulse  
DATIM 2017-02-24 16:39:36  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 19.7 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 46



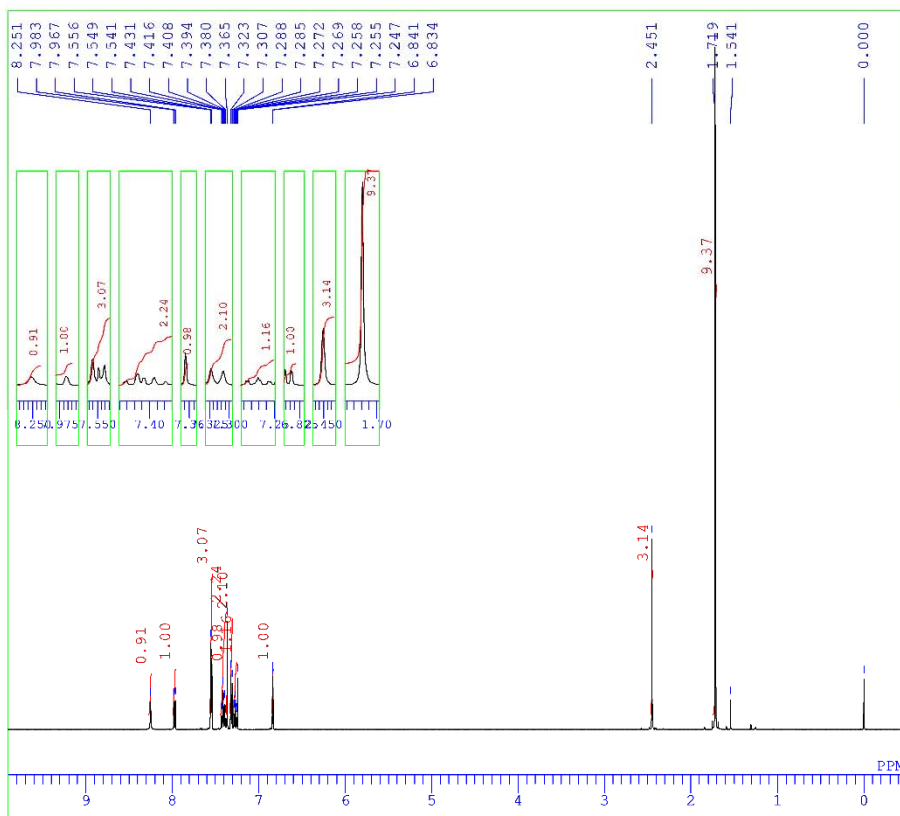
6dF



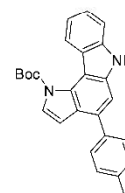
DFILE C-35 u C.als  
COMNT  
DATIM 2017-01-28 06:21:27  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 2048  
ACQTM 0.8336 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 20.8 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60



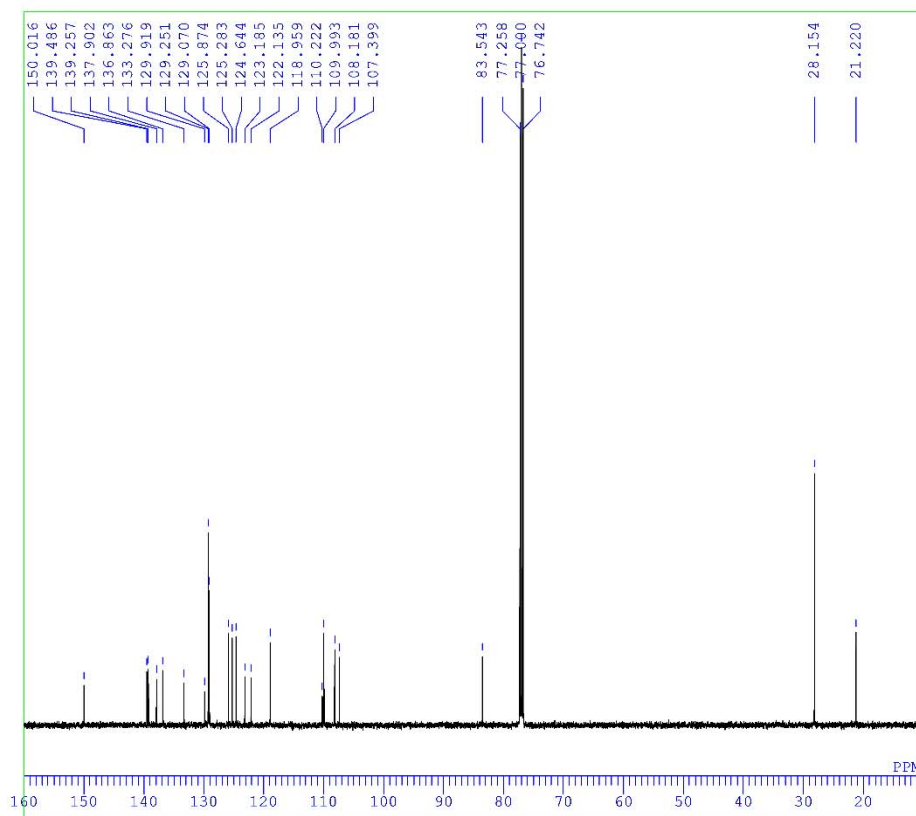
6dF



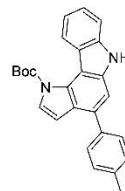
DFILE C-35 d H.als  
 COMNT single\_pulse  
 DATIM 2017-01-27 21:23:20  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBF1RQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBF1IN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTMMP 19.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



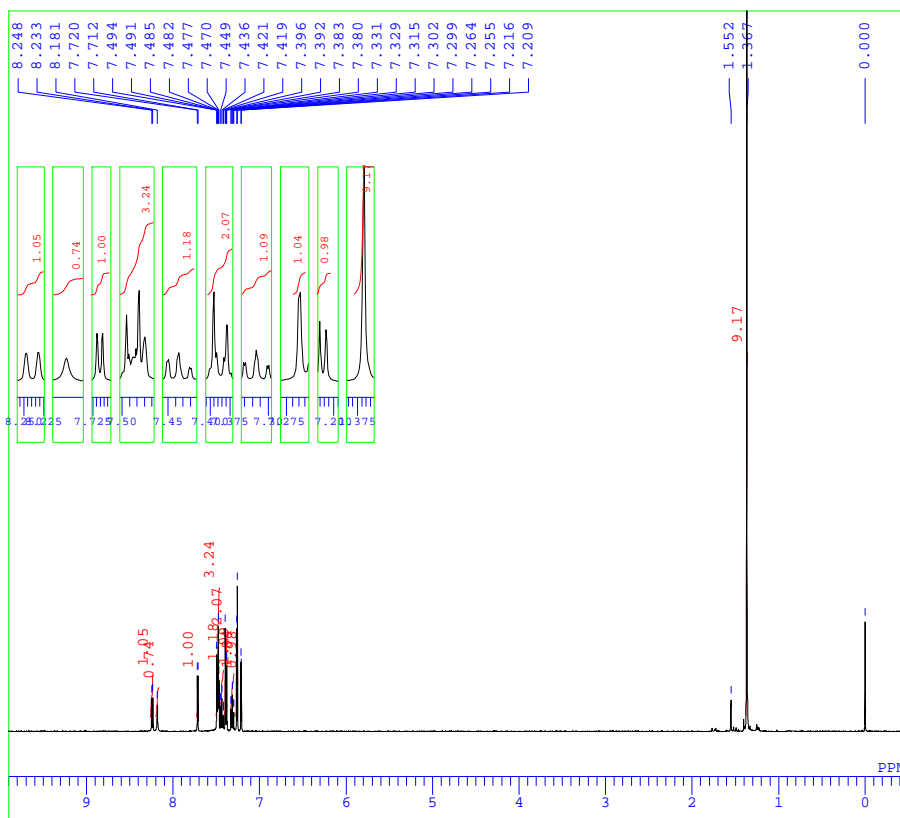
7dF



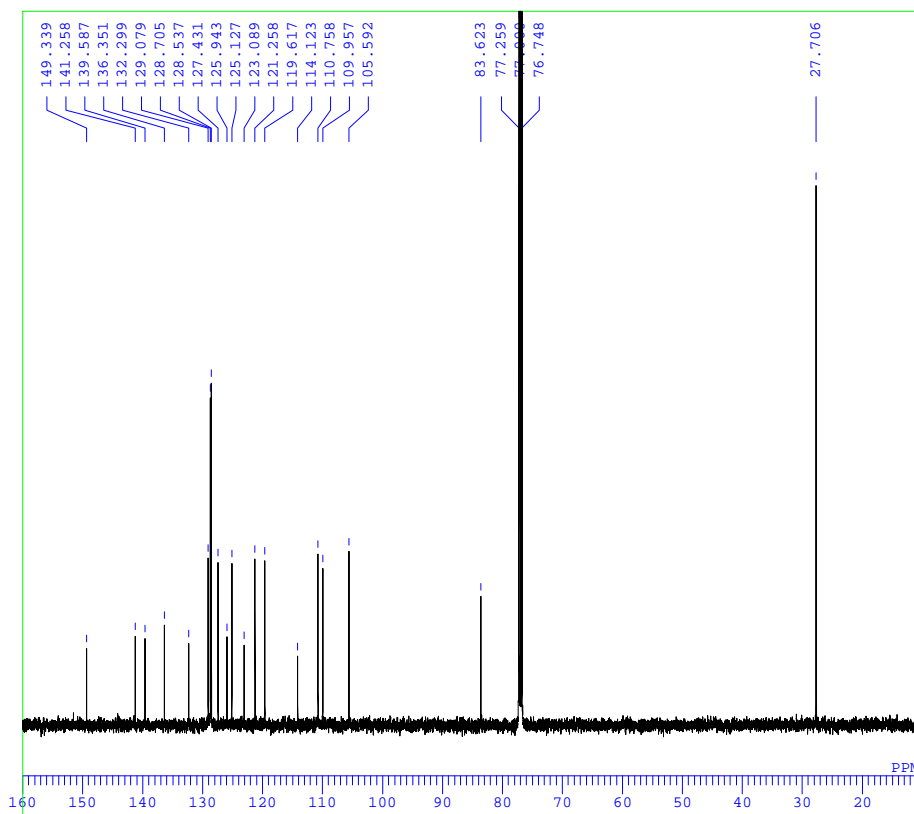
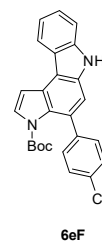
DFILE C-35 d C.als  
 COMNT  
 DATIM 2017-01-28 07:16:31  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBF1RQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBF1IN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTMMP 20.8 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 60



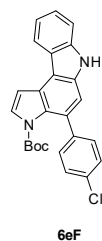
7dF

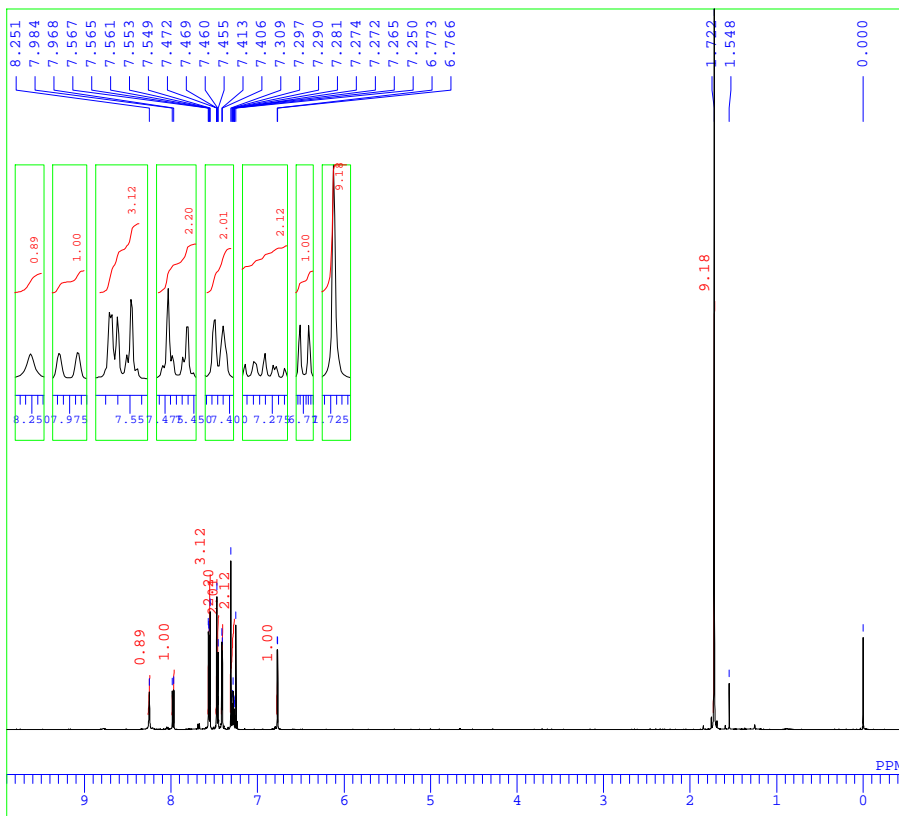


DFILE C-33 u H.als  
 COMNT single\_pulse  
 DATIM 2017-02-09 13:23:17  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 20.1 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 46

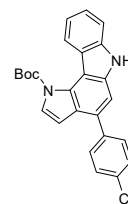


DFILE C33 u C.als  
 COMNT  
 DATIM 2017-02-03 12:29:04  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 32768  
 FREQU 31446.54 Hz  
 SCANS 1024  
 ACQTM 1.0420 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.1 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 70

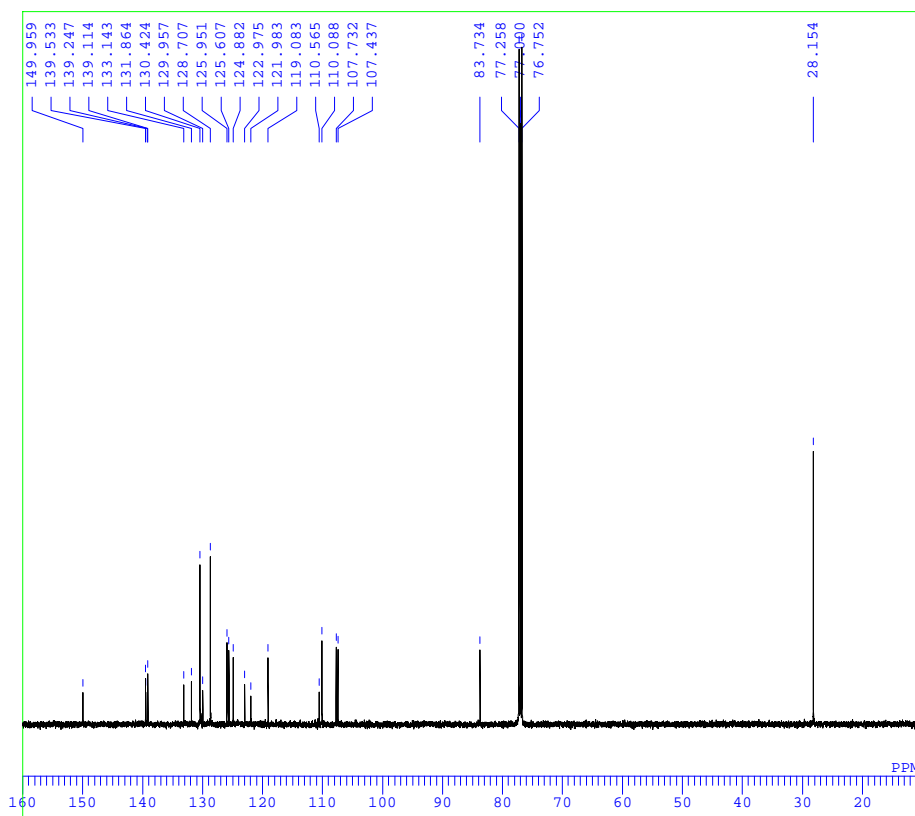




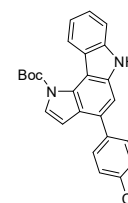
DFILE C-33 d H.als  
 COMNT single\_pulse  
 DATIM 2017-01-27 21:12:06  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.5 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 46



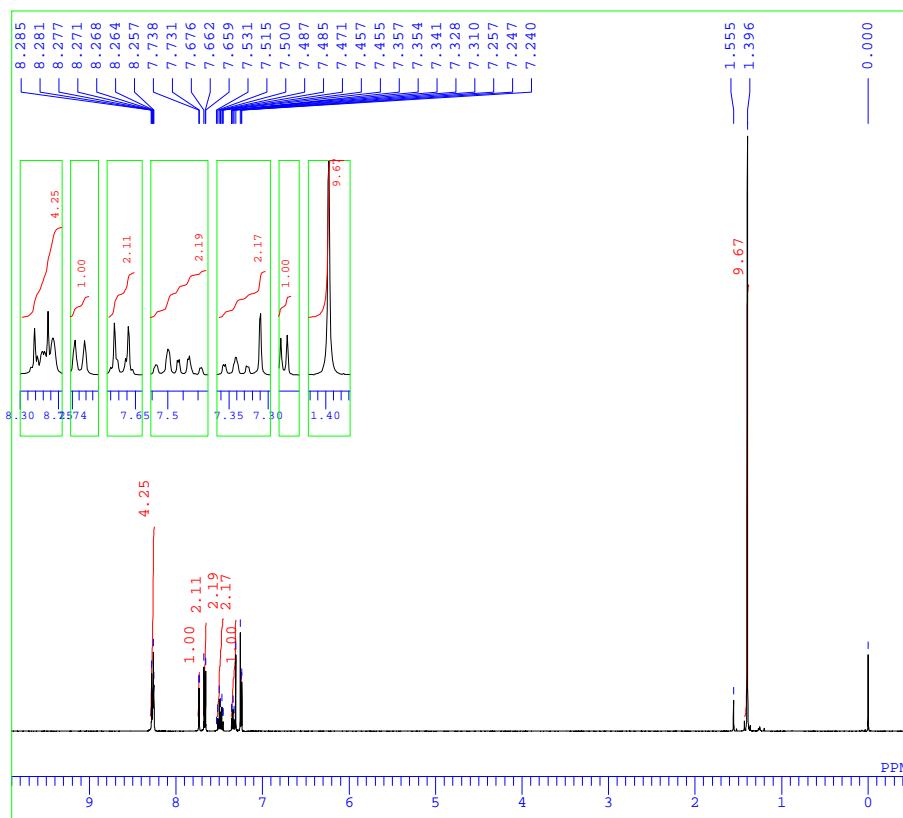
7eF



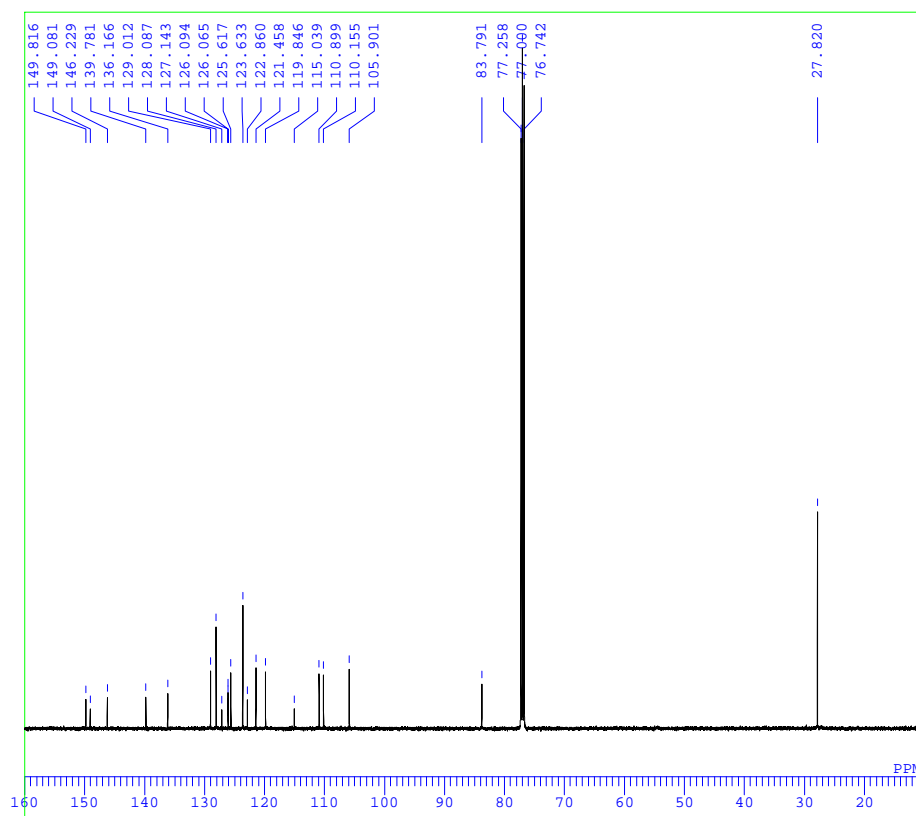
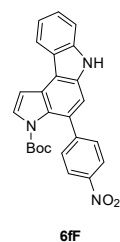
DFILE C-33 d C.als  
 COMNT  
 DATIM 2017-01-28 04:36:45  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.9 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 60



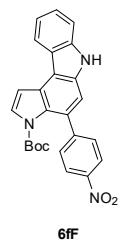
7eF

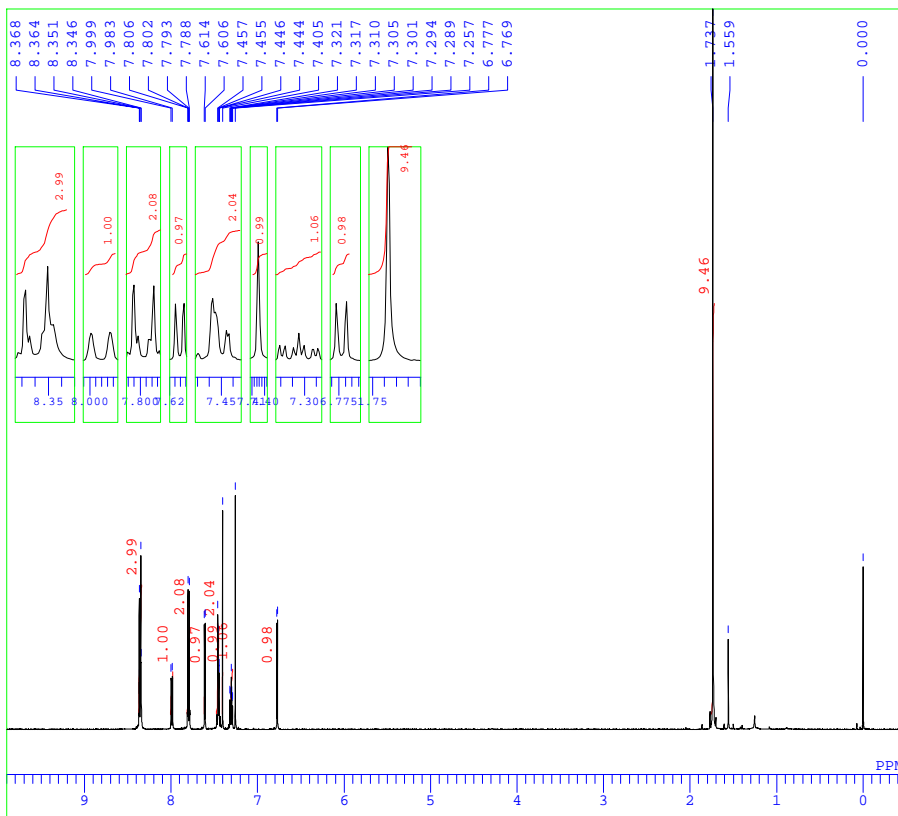


DFILE C-29 u H.als  
COMNT single\_pulse  
DATIM 2017-02-08 13:05:22  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 20.3 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 48

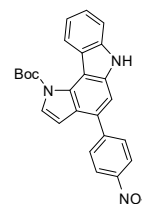


DFILE C-29 u C.als  
COMNT  
DATIM 2017-02-02 05:16:08  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 3800  
ACQTM 0.8336 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 20.2 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60

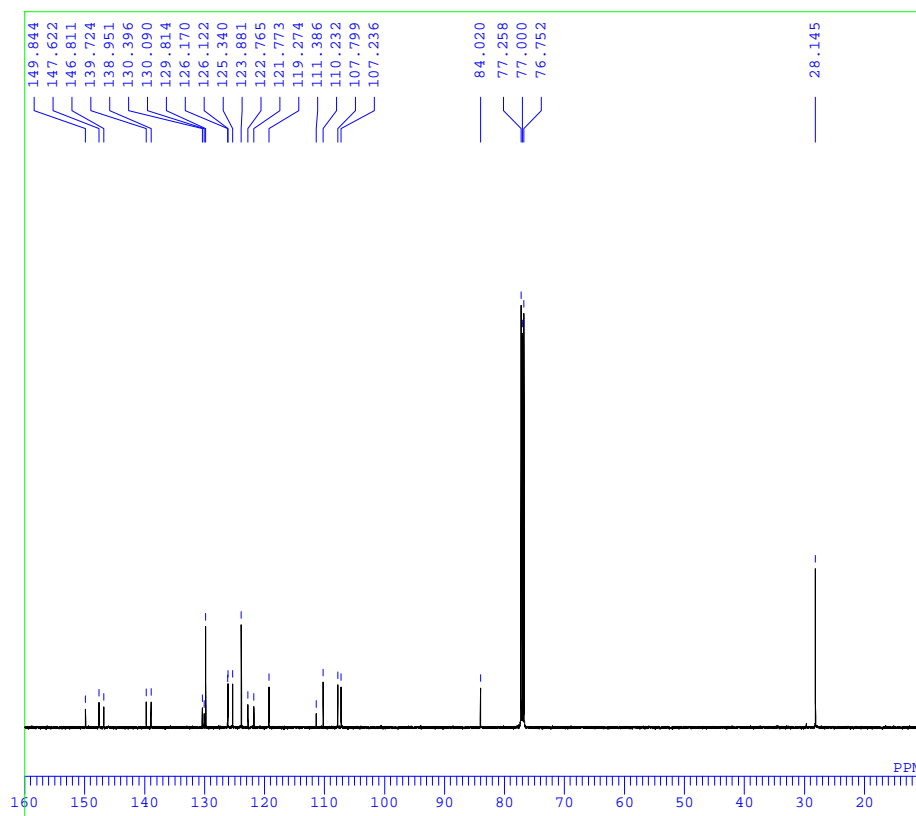




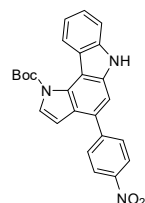
DFILE C-29 d H.als  
COMNT single\_pulse  
DATIM 2017-02-08 13:11:43  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 20.4 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 46



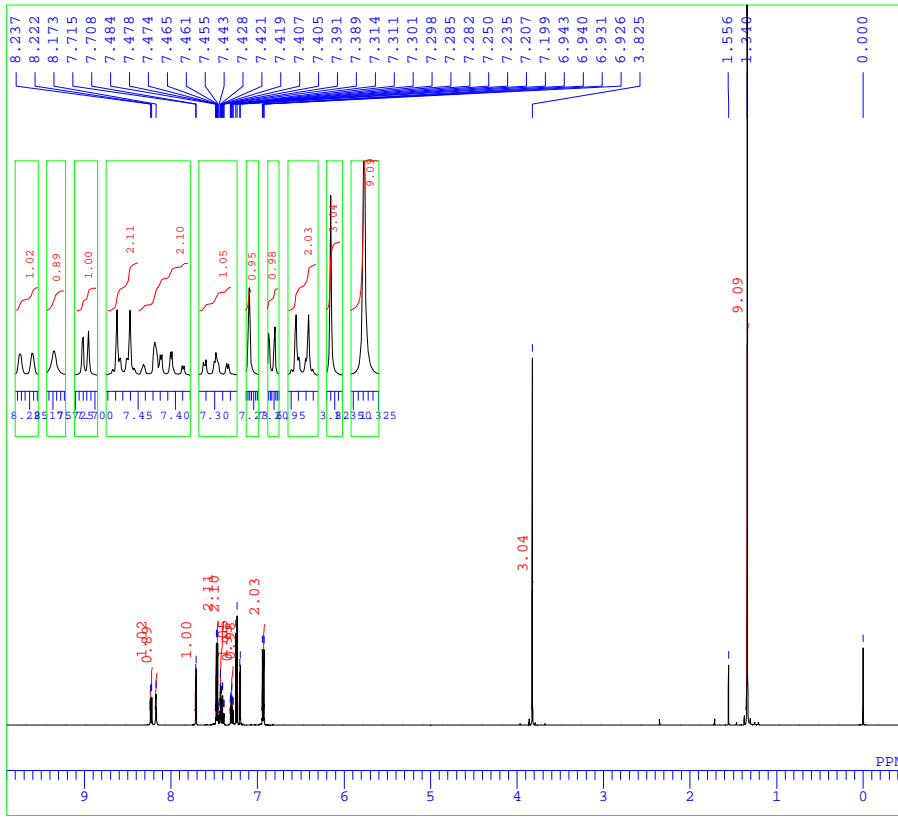
7f



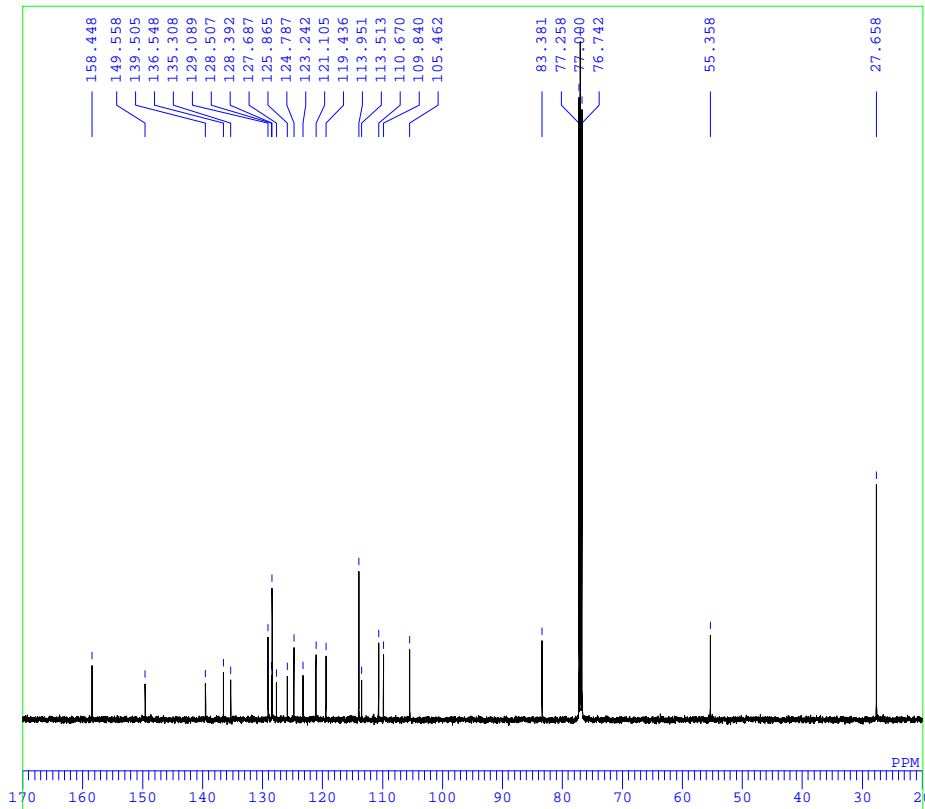
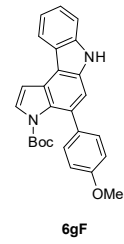
DFILE C-29 d C.als  
COMNT  
DATIM 2017-02-02 08:27:49  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 3800  
ACQTM 0.8336 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 19.9 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60



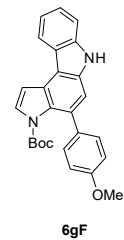
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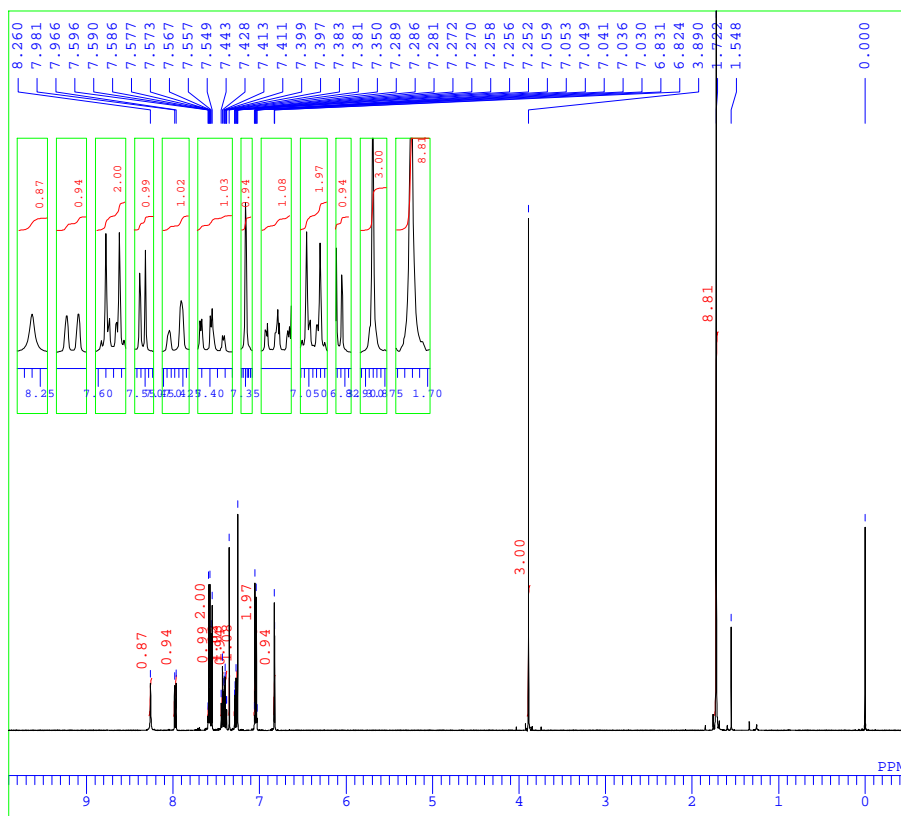
DFILE C-32 u H.als  
 COMNT single\_pulse  
 DATIM 2017-01-27 21:07:15  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



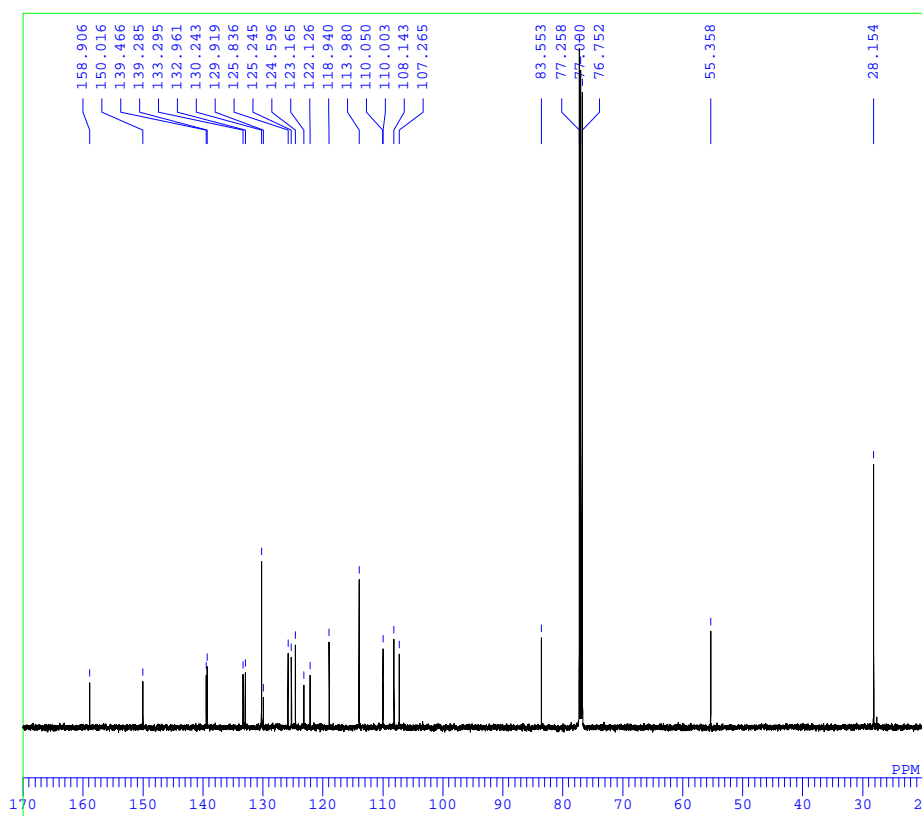
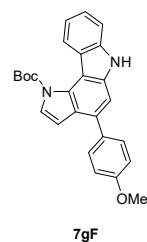
DFILE C-32 u C.als  
 COMNT  
 DATIM 2017-01-27 01:50:51  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 19.6 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 58



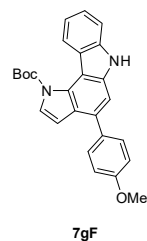


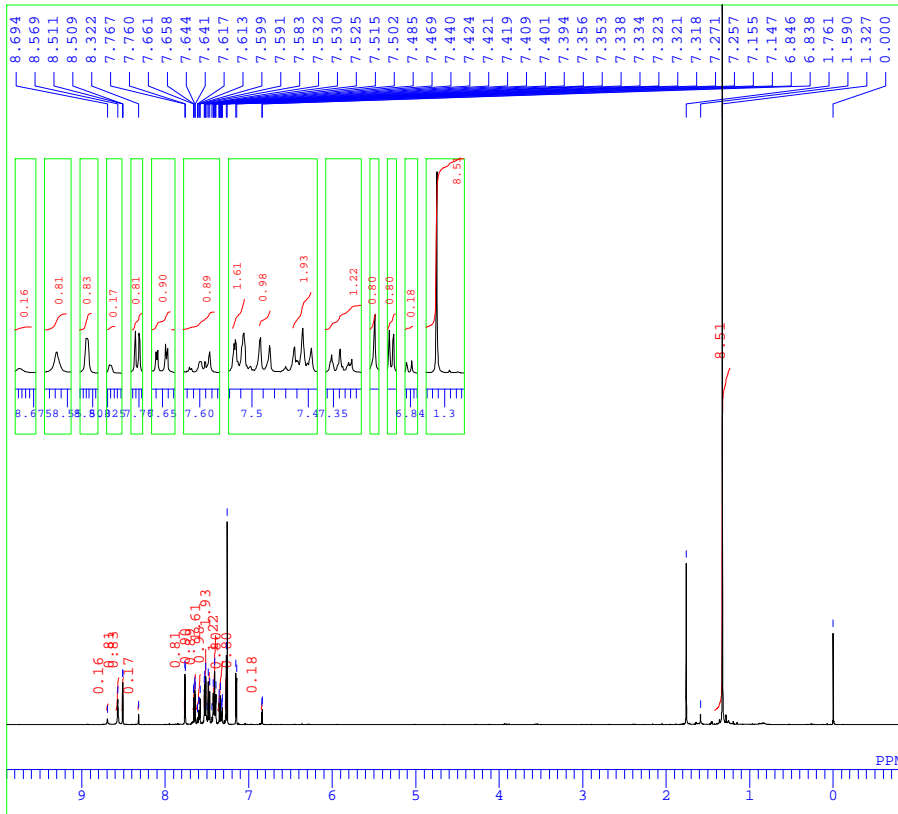


DFILE C-32 d H.als  
 COMNT single\_pulse  
 DATIM 2017-02-08 13:18:54  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 20.4 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 46

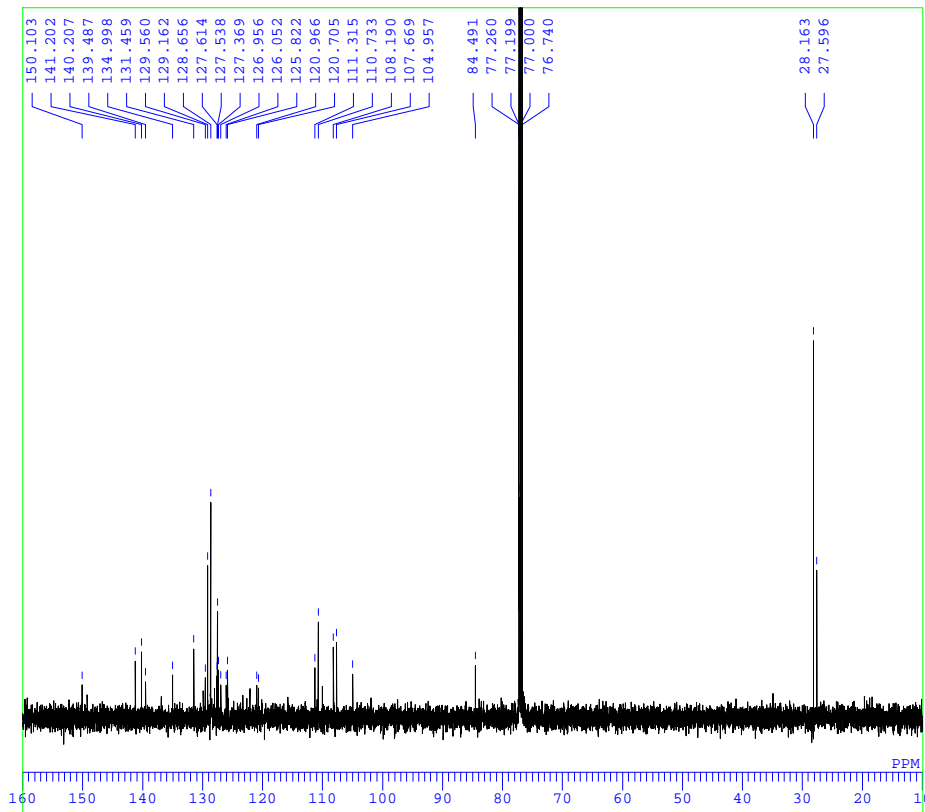
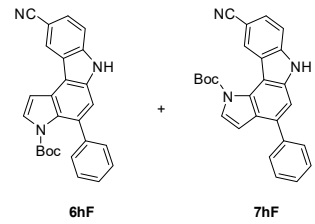


DFILE C-32 d C.als  
 COMNT  
 DATIM 2017-01-28 02:43:08  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.9 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 58

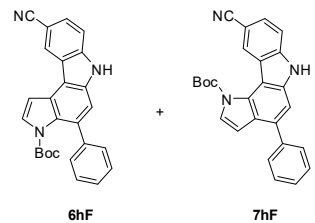


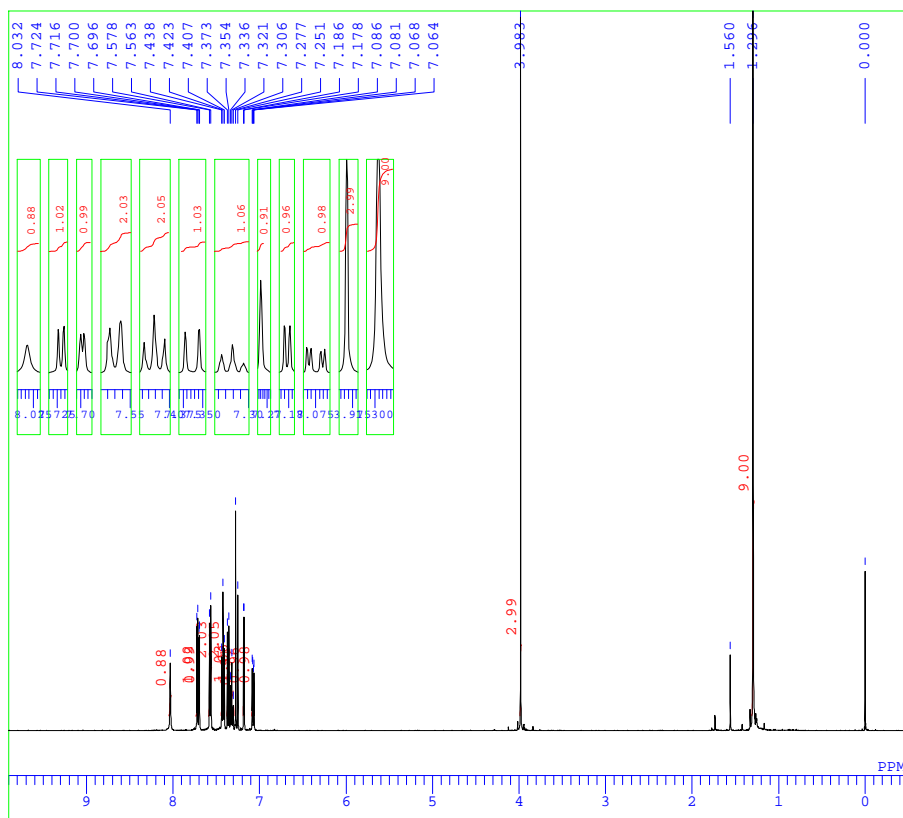


DFILE B-41 H.als  
COMNT single\_pulse  
DATIM 2016-03-11 19:56:47  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 6.82 usec  
IRNUC 1H  
CTEMP 20.2 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 46

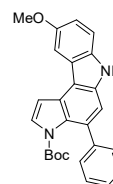


DFILE B41 C.als  
COMNT  
DATIM 2018-05-23 15:23:31  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 16384  
FREQU 31565.66 Hz  
SCANS 1926  
ACQTM 0.5190 sec  
PD 1.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 21.7 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 0.12 Hz  
RGAIN 60

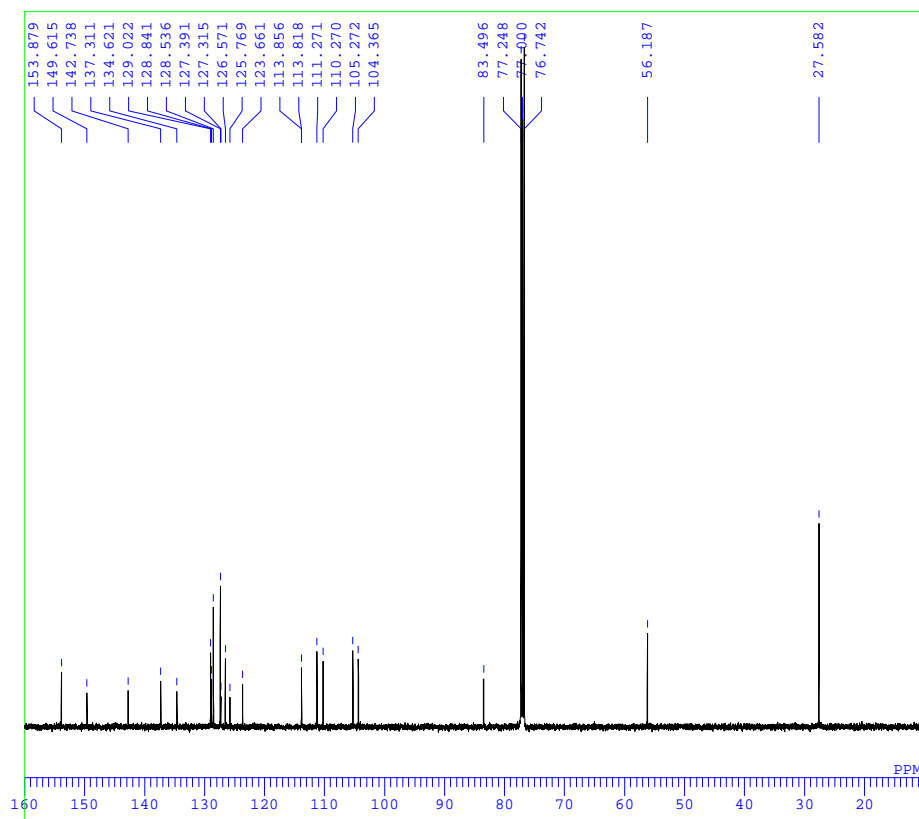




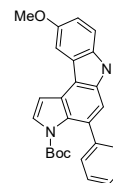
DFILE C-42 u H.als  
 COMNT single\_pulse  
 DATIM 2017-01-27 21:27:46  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 44



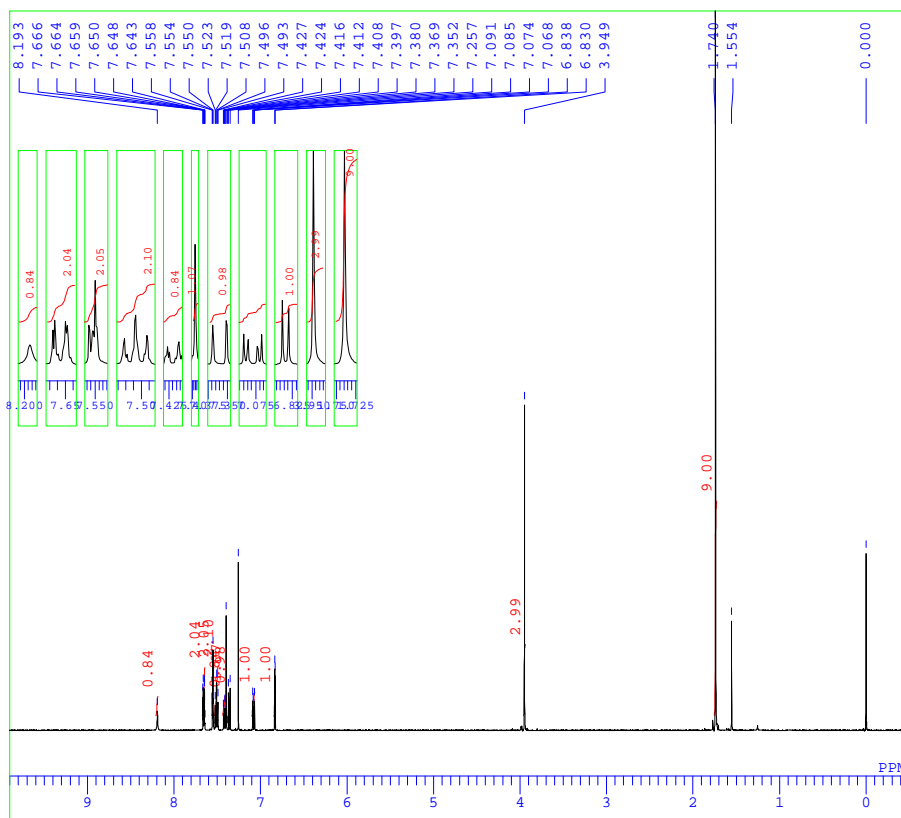
6iF



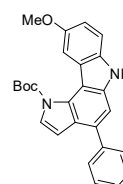
DFILE C-42 u C.als  
 COMNT  
 DATIM 2017-01-28 08:11:48  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 26214  
 FREQU 31446.06 Hz  
 SCANS 1024  
 ACQTM 0.8336 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 20.9 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 60



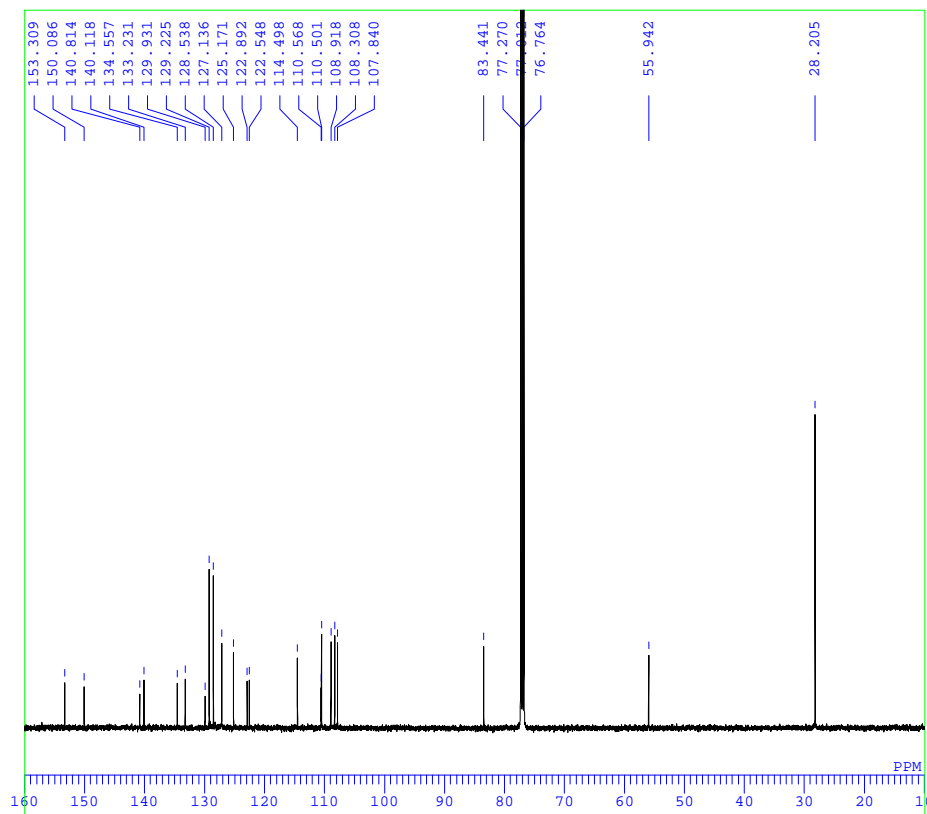
6iF



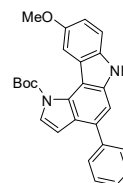
DFILE C-42 d H.als  
COMNT single\_pulse  
DATIM 2017-02-08 13:30:24  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 20.4 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 50



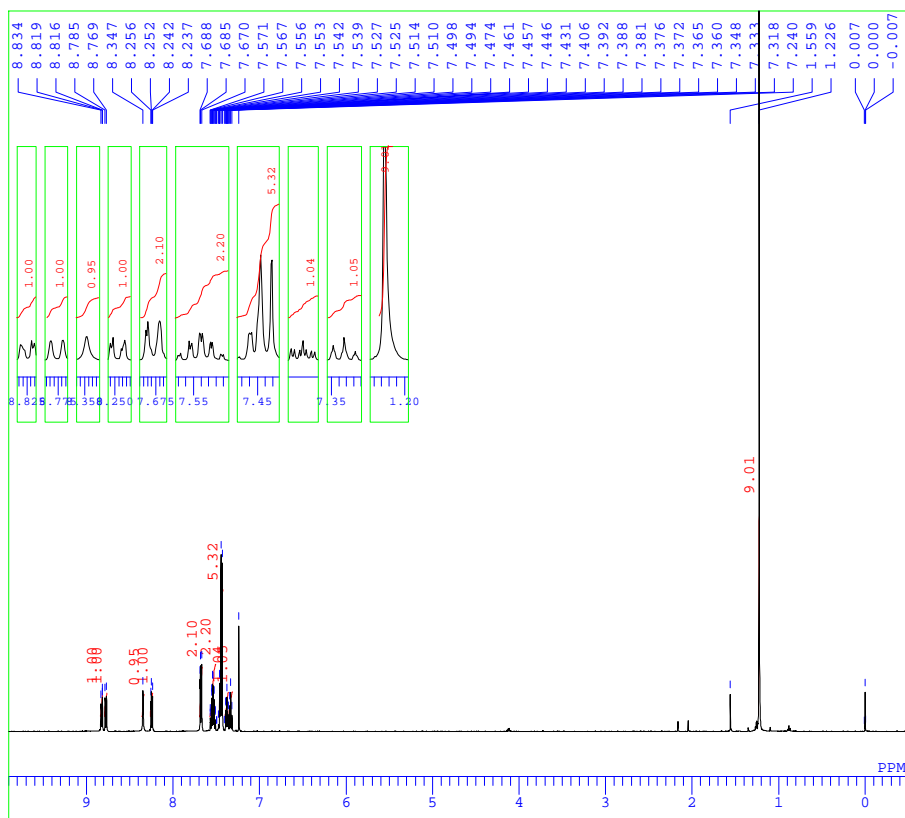
7IF



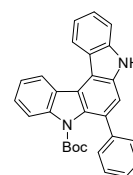
DFILE C-42 d C.als  
COMNT  
DATIM 2017-01-27 07:50:26  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 26214  
FREQU 31446.06 Hz  
SCANS 5120  
ACQTM 0.8336 sec  
PD 2.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 19.6 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 1.20 Hz  
RGAIN 58



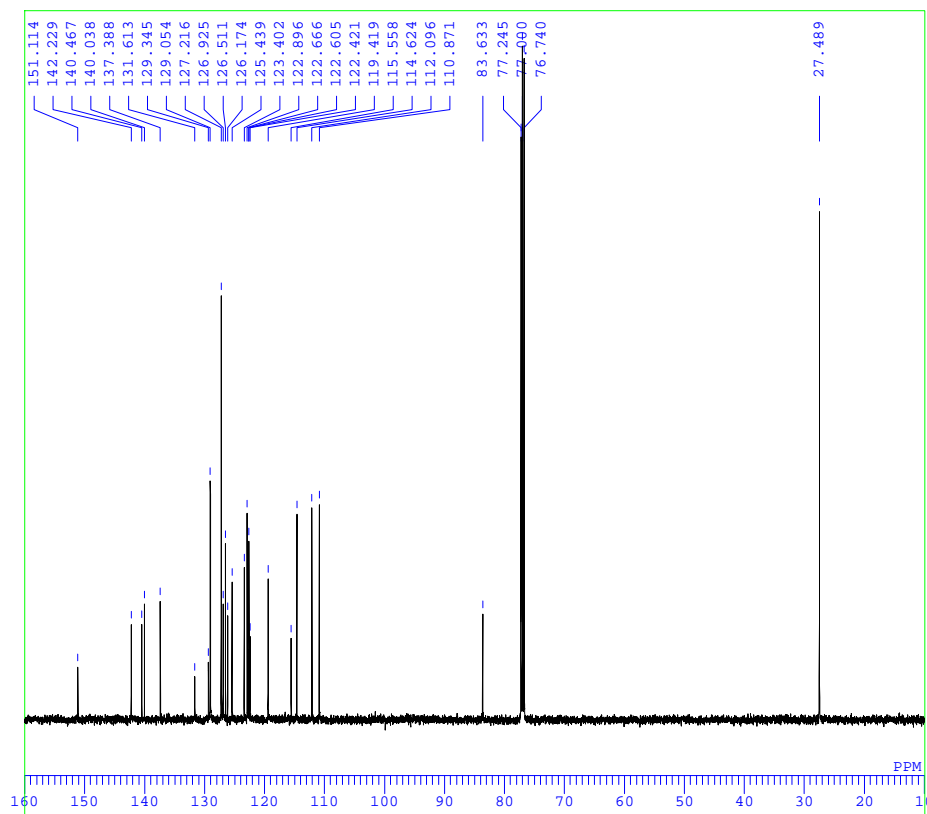
7IF



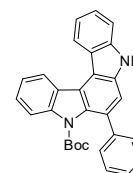
D-17 H.als  
single\_pulse  
2018-03-07 13:02:42  
1H  
single\_pulse.ex2  
500.16 MHz  
2.41 KHz  
6.01 Hz  
13107  
7507.39 Hz  
8  
1.7459 sec  
5.0000 sec  
7.15 usec  
1H  
19.5 c  
CDCL3  
0.00 ppm  
0.12 Hz  
42



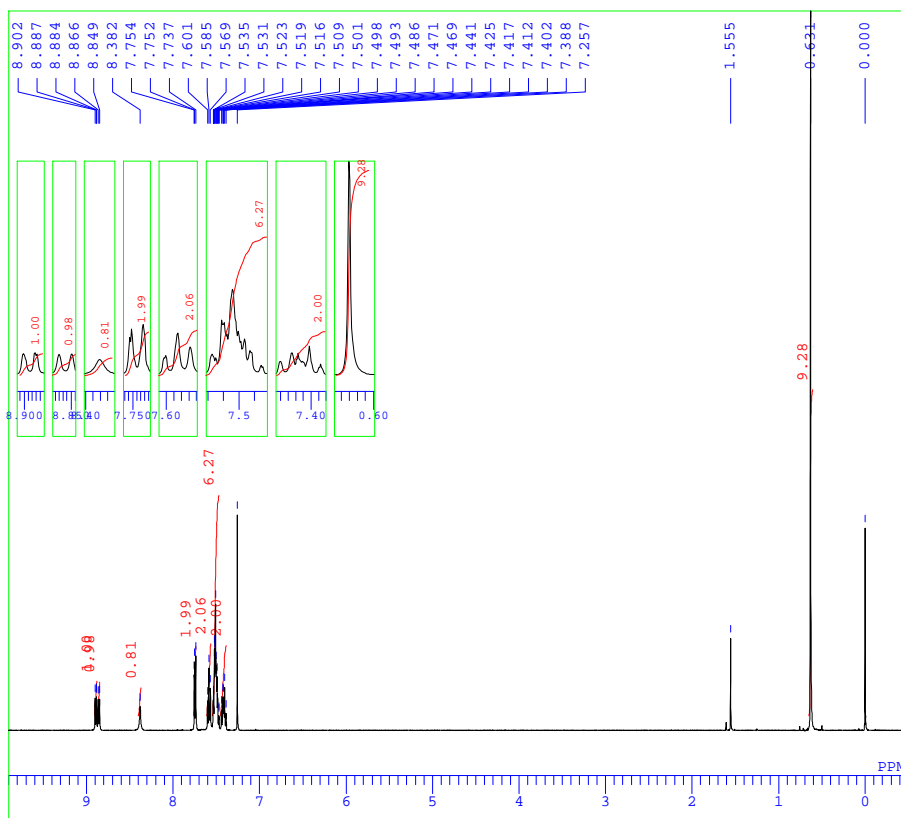
11A



D-17 C-1.als  
single\_pulse\_dec  
2018-03-08 08:59:34  
13C  
125.77 MHz  
7.87 KHz  
4.21 Hz  
13107  
25252.14 Hz  
1413  
0.5190 sec  
1.0000 sec  
3.67 usec  
1H  
19.5 c  
CDCL3  
77.00 ppm  
1.20 Hz  
60



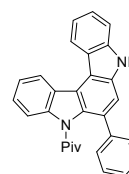
11A



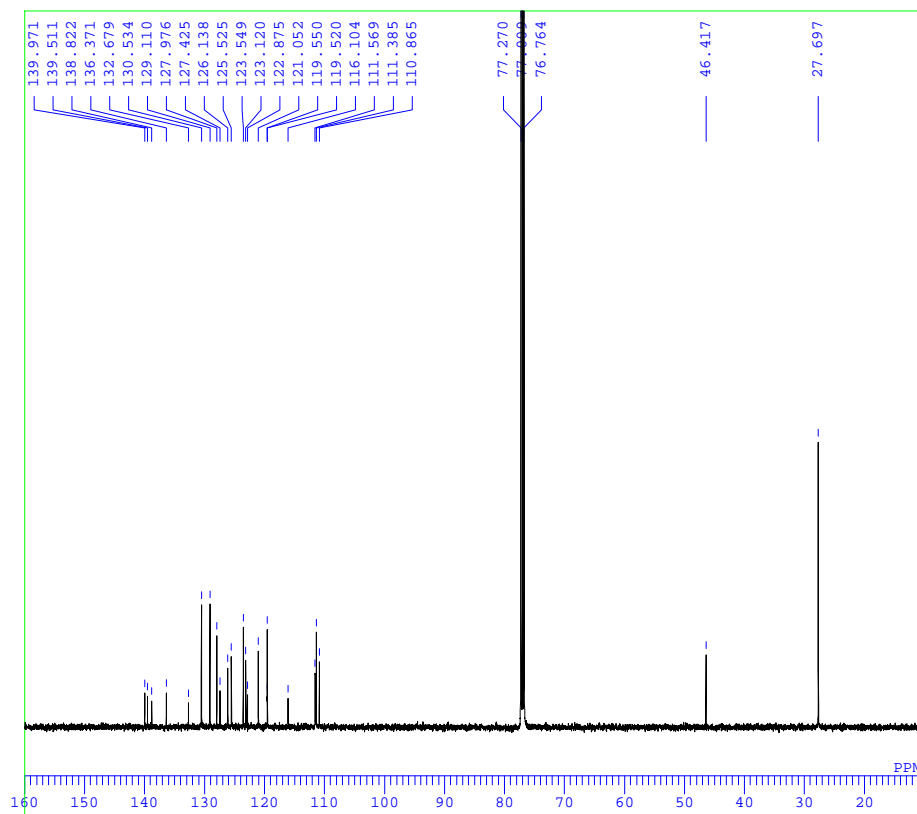
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DFILE C-126 H-1.als
COMNT single_pulse
DATIM 2018-03-07 22:40:02
OBNUC 1H
EXMOD single_pulse.ex2
OBFRQ 500.16 MHz
OBSET 2.41 KHz
OBFIN 6.01 Hz
POINT 13107
FREQU 7507.39 Hz
SCANS 8
AQTM 1.7459 sec
PD 5.0000 sec
PW1 7.15 usec
IRNUC 1H
CTEMP 19.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.12 Hz
RGAIN 50

```



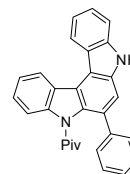
11B



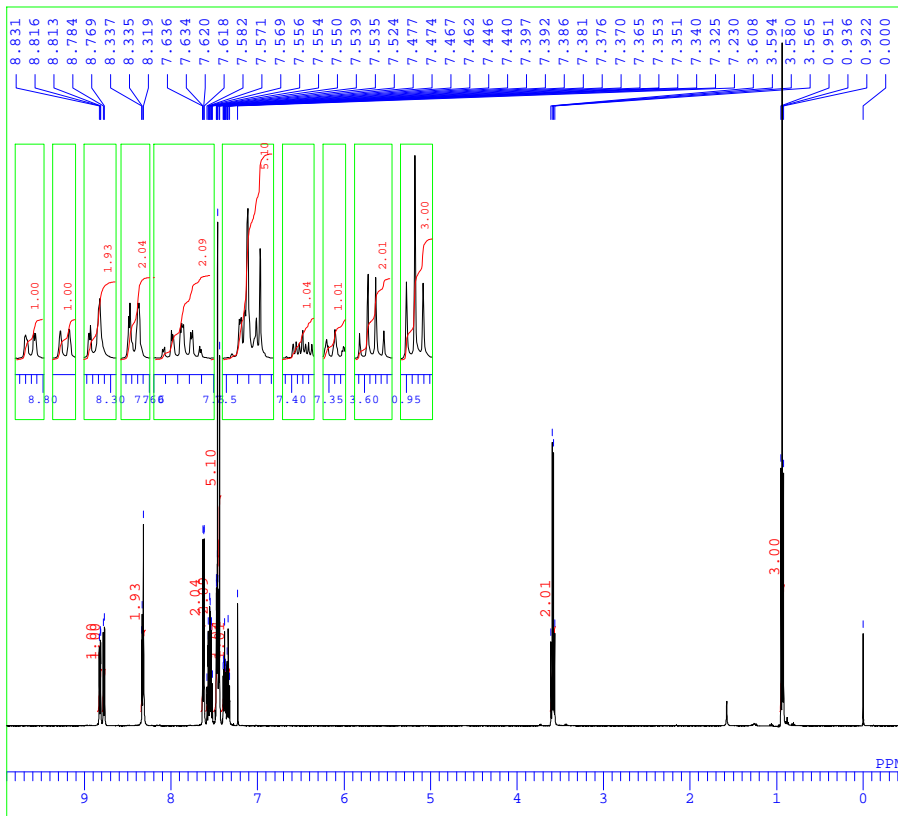
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DFILE C-126 C-1.als
COMNT
DATIM 2018-03-08 07:14:32
OBNUC 13C
EXMOD single_pulse_dec
OBFRQ 125.77 MHz
OBSET 7.87 KHz
OBFIN 4.21 Hz
POINT 13107
FREQU 25252.14 Hz
SCANS 7168
AQTM 0.5190 sec
PD 1.0000 sec
PW1 3.67 usec
IRNUC 1H
CTEMP 19.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 1.20 Hz
RGAIN 60

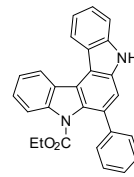
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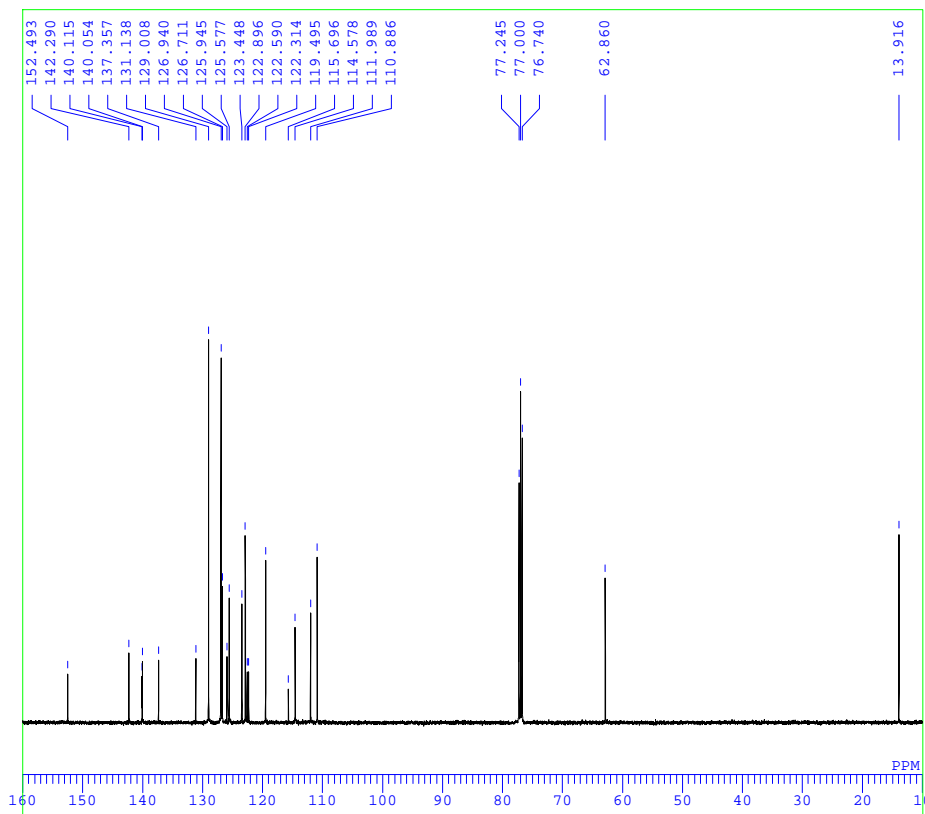
11B



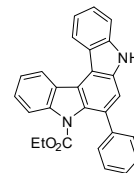
DFILE B-154 H-1.als  
COMNT single\_pulse  
DATIM 2018-03-06 18:20:48  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFREQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
AQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 19.4 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 40



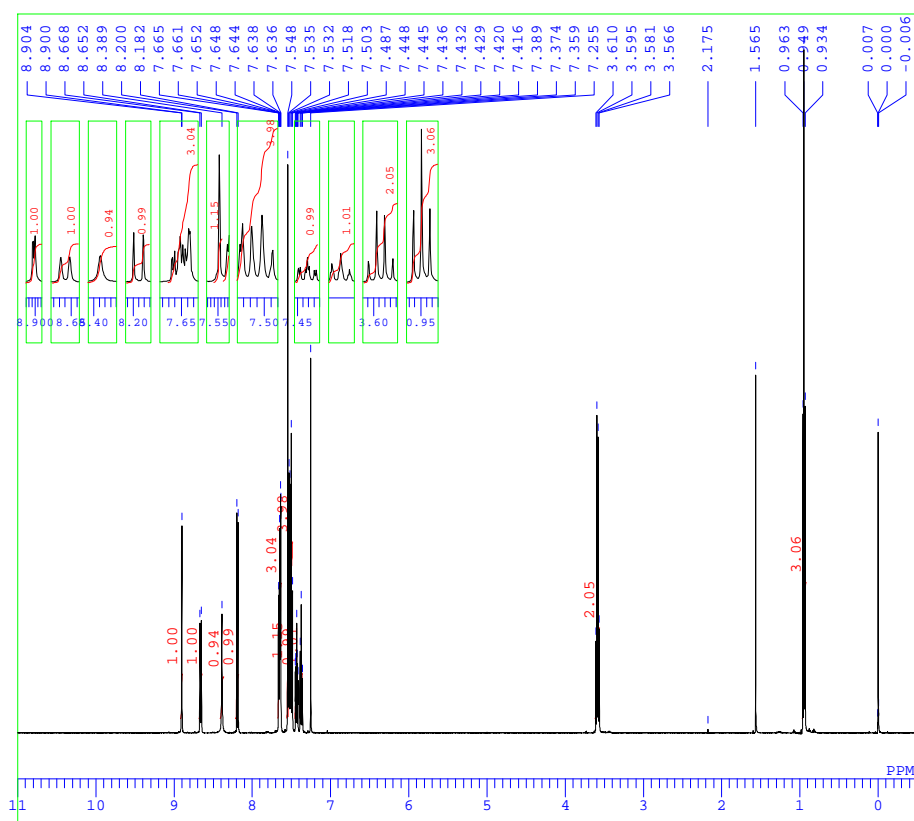
11c



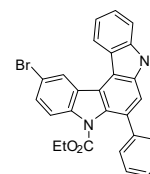
DFILE B-154 C-1.als  
COMNT  
DATIM 2018-03-07 23:55:47  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFREQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 13107  
FREQU 25252.14 Hz  
SCANS 2048  
AQTM 0.5190 sec  
PD 1.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 19.8 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60



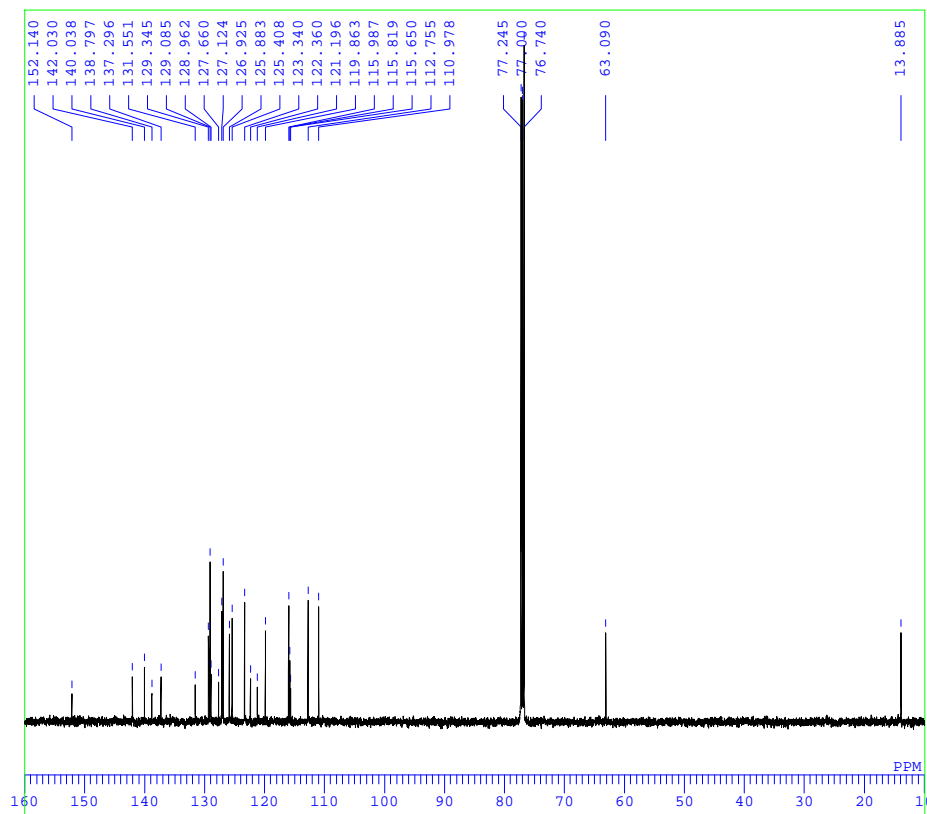
11c



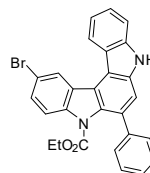
DFILE C-23 H-1.als  
COMNT single\_pulse  
DATIM 2018-03-06 18:28:52  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 19.5 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 48



11D

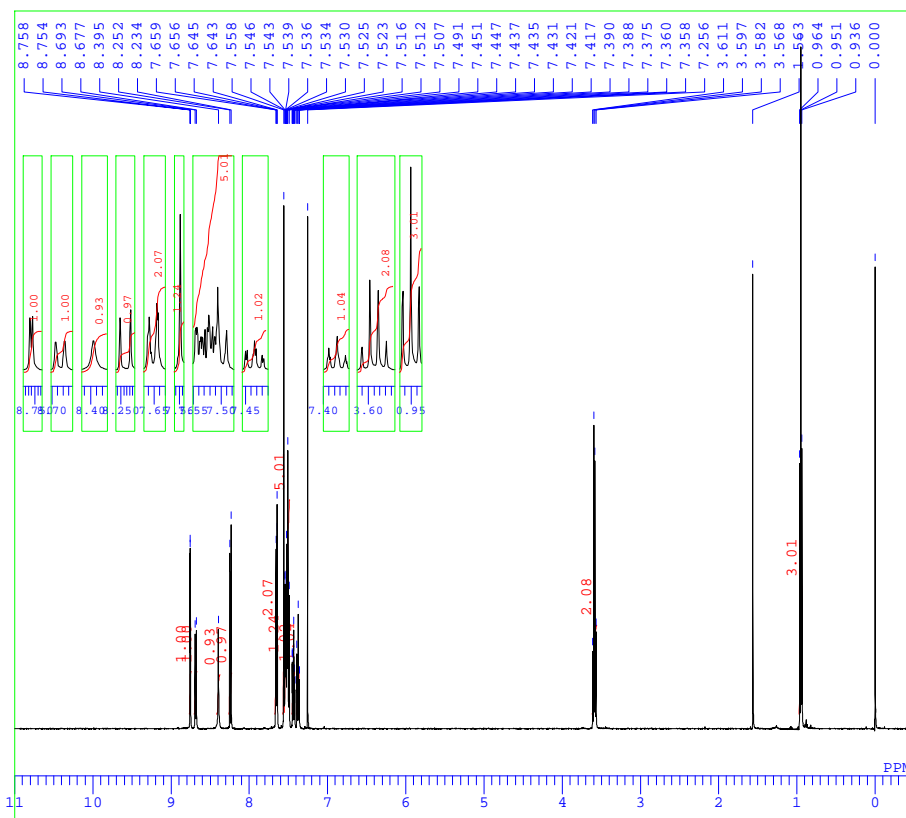


DFILE C-23 C-1.als  
COMNT  
DATIM 2018-03-08 02:57:26  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 13107  
FREQU 25252.14 Hz  
SCANS 2048  
ACQTM 0.5190 sec  
PD 1.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 19.6 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60

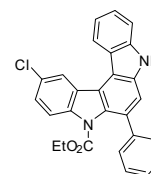


11D

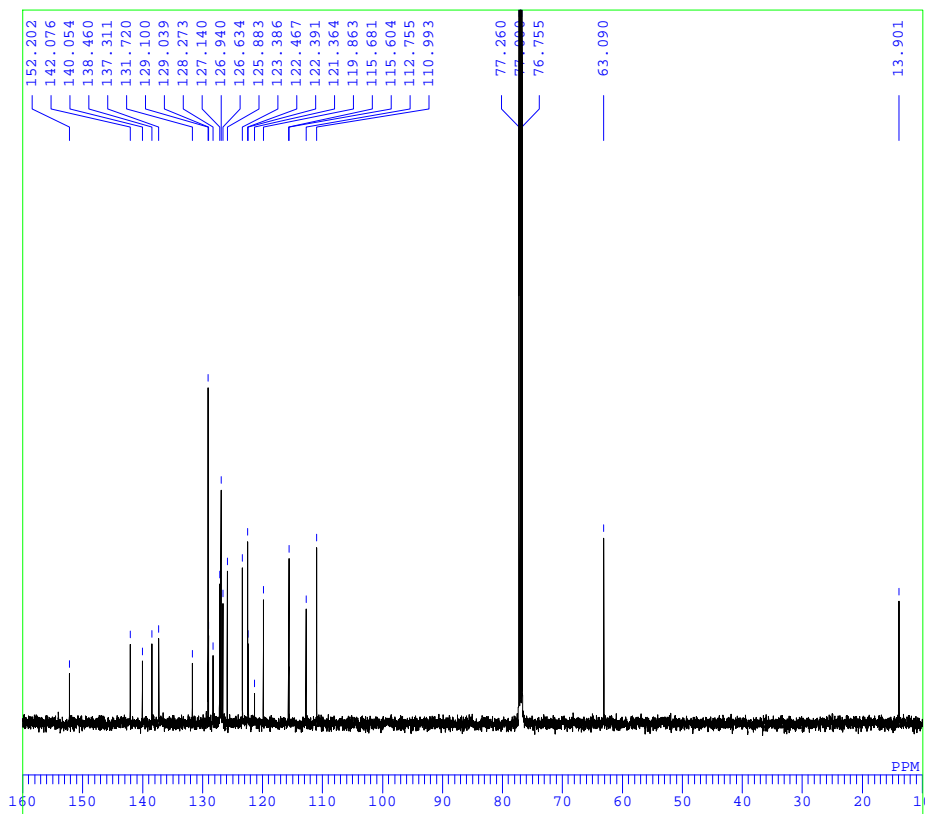




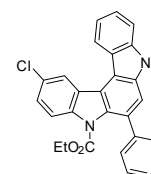
DFILE C-24 H-1.als  
COMNT single\_pulse  
DATIM 2018-03-06 18:32:48  
OBNUC 1H  
EXMOD single\_pulse.ex2  
OBFRQ 500.16 MHz  
OBSET 2.41 KHz  
OBFIN 6.01 Hz  
POINT 13107  
FREQU 7507.39 Hz  
SCANS 8  
ACQTM 1.7459 sec  
PD 5.0000 sec  
PW1 7.15 usec  
IRNUC 1H  
CTEMP 19.6 c  
SLVNT CDCL3  
EXREF 0.00 ppm  
BF 0.12 Hz  
RGAIN 48



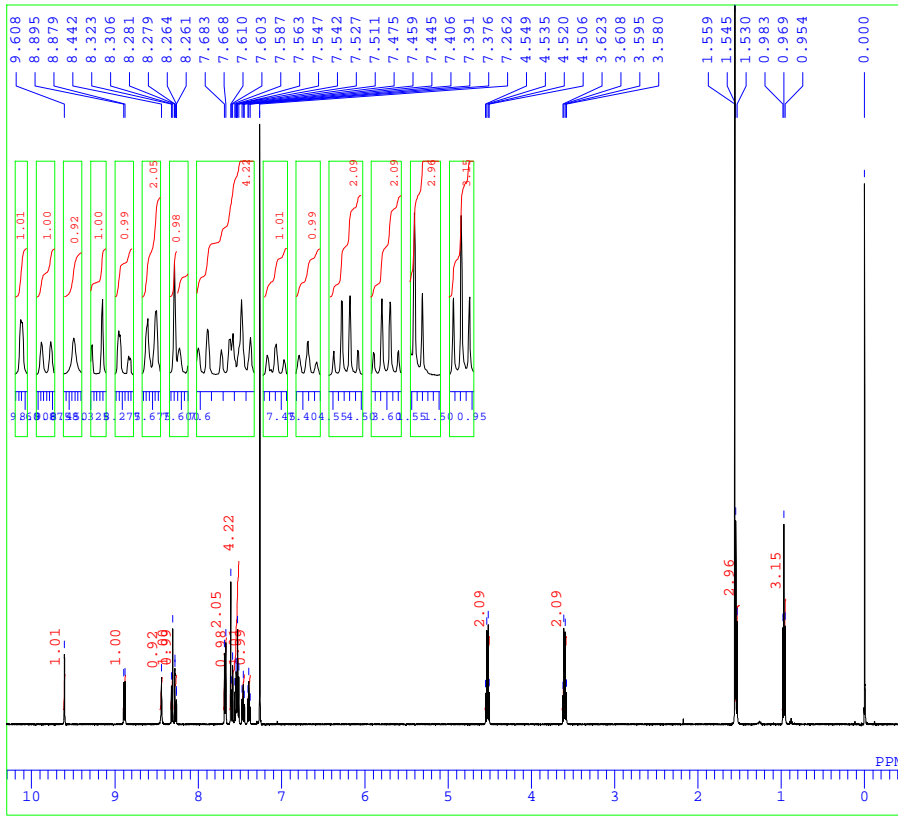
11E



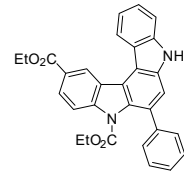
DFILE C-24 C-1.als  
COMNT  
DATIM 2018-03-08 04:06:05  
OBNUC 13C  
EXMOD single\_pulse\_dec  
OBFRQ 125.77 MHz  
OBSET 7.87 KHz  
OBFIN 4.21 Hz  
POINT 13107  
FREQU 25252.14 Hz  
SCANS 2048  
ACQTM 0.5190 sec  
PD 1.0000 sec  
PW1 3.67 usec  
IRNUC 1H  
CTEMP 19.5 c  
SLVNT CDCL3  
EXREF 77.00 ppm  
BF 1.20 Hz  
RGAIN 60



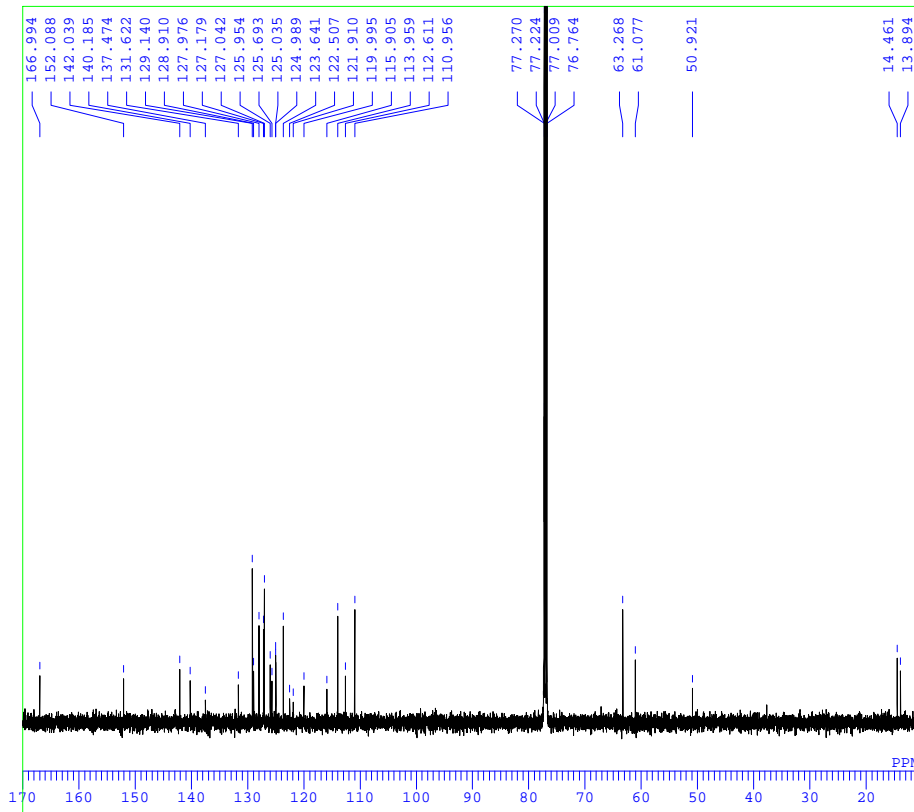
11E



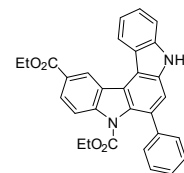
DFILE B-194 H-1.als  
 COMNT single\_pulse  
 DATIM 2018-03-06 18:24:42  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 19.5 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 52



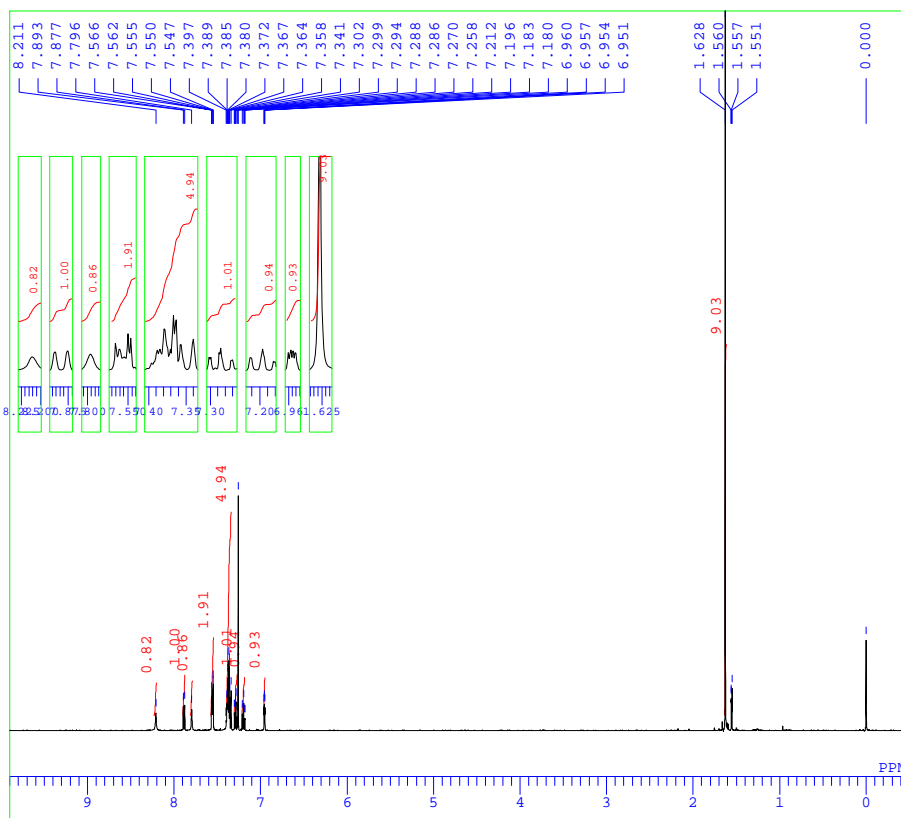
11F



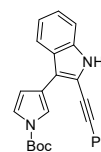
DFILE A194 C.als  
 COMNT  
 DATIM 2018-04-29 13:25:59  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 31565.66 Hz  
 SCANS 18969  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.6 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 60



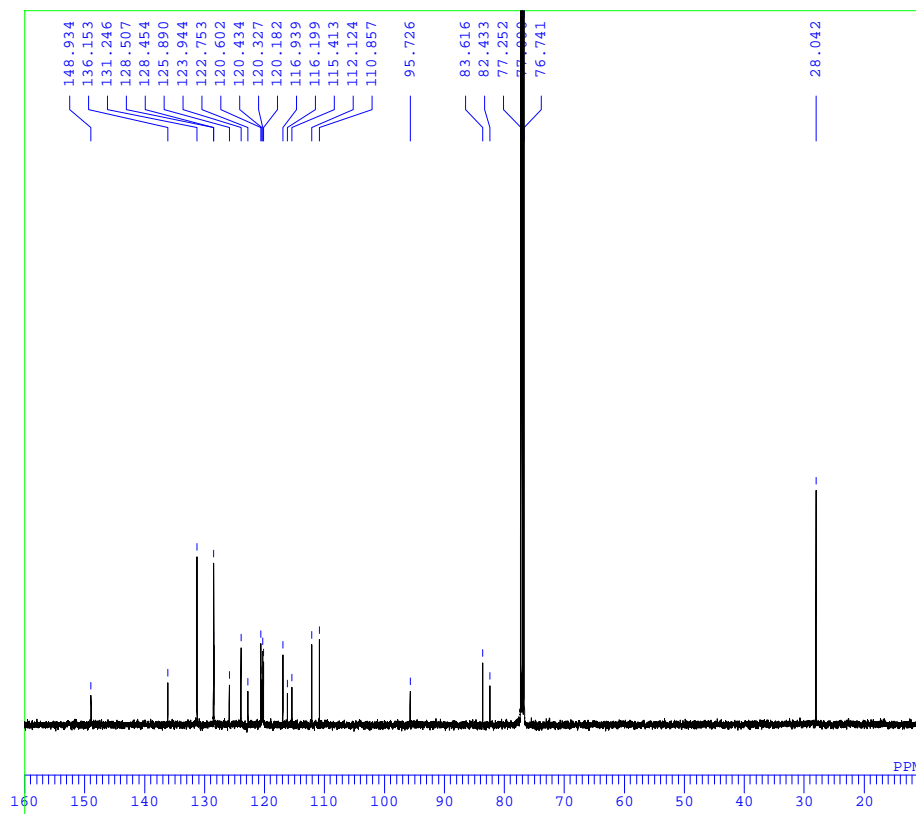
11F



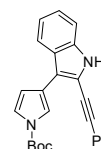
DFILE 4aF H-1.als  
 COMNT single\_pulse  
 DATIM 2017-02-16 15:06:51  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 20.0 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 50



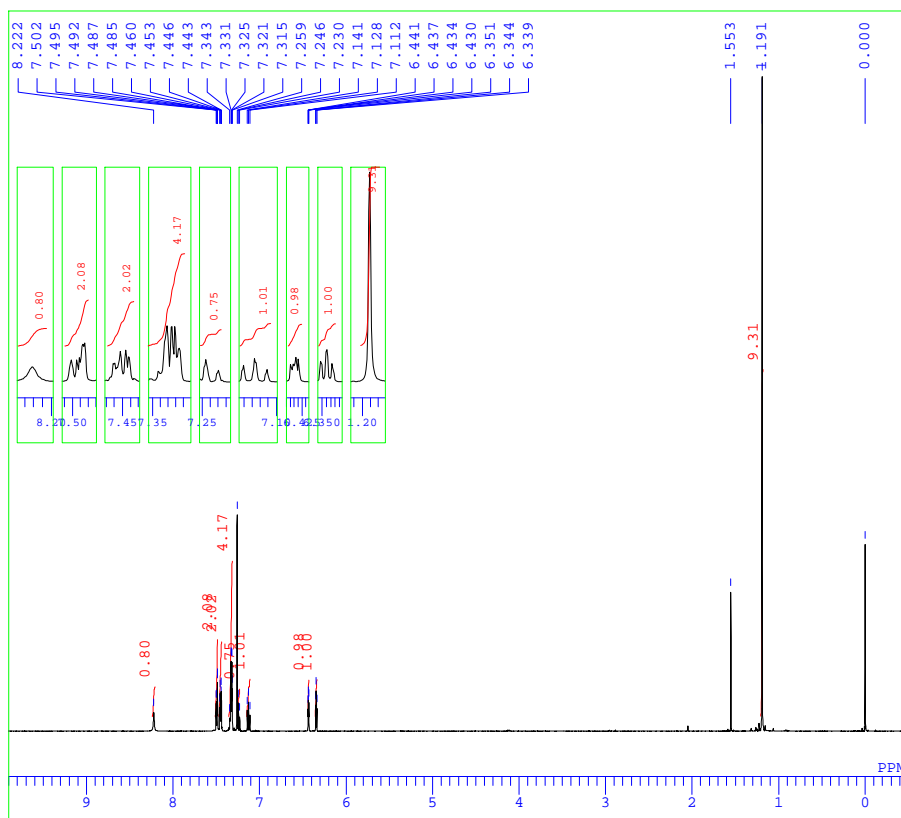
4aF



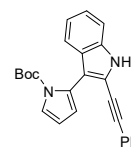
DFILE 4aF C-1.als  
 COMNT  
 DATIM 2016-11-10 15:50:03  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 32768  
 FREQU 31446.54 Hz  
 SCANS 1024  
 ACQTM 1.0420 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 22.2 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 70



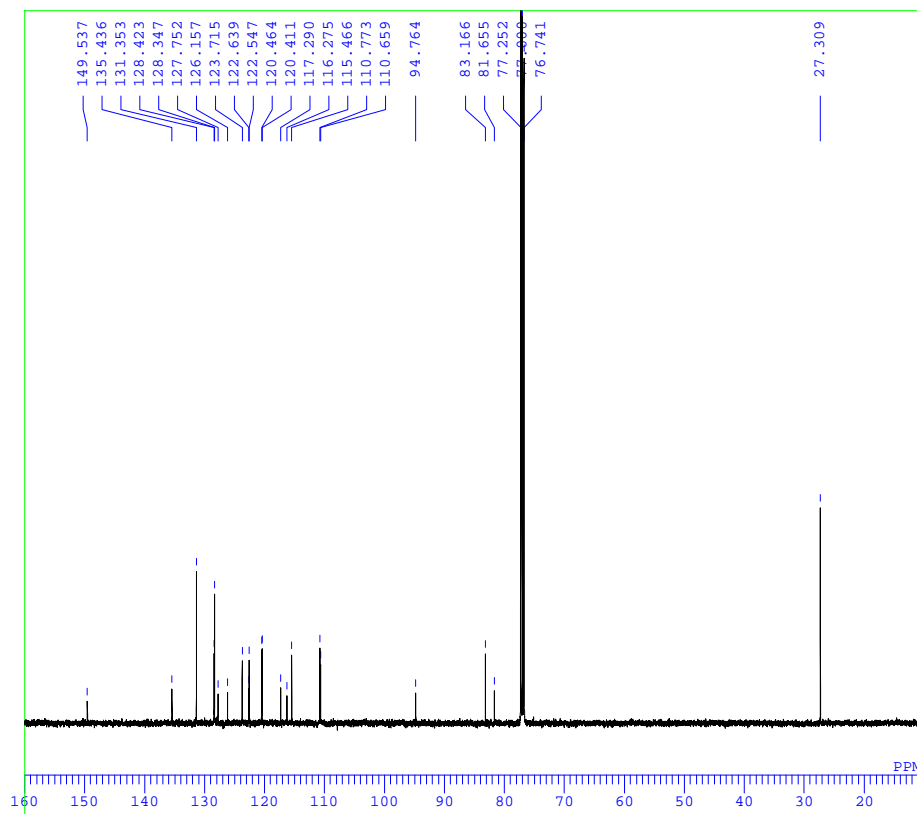
4aF



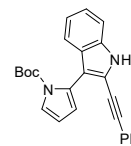
DFILE 5aF H-1.als  
 COMNT single\_pulse  
 DATIM 2017-02-16 15:10:30  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 20.2 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 50



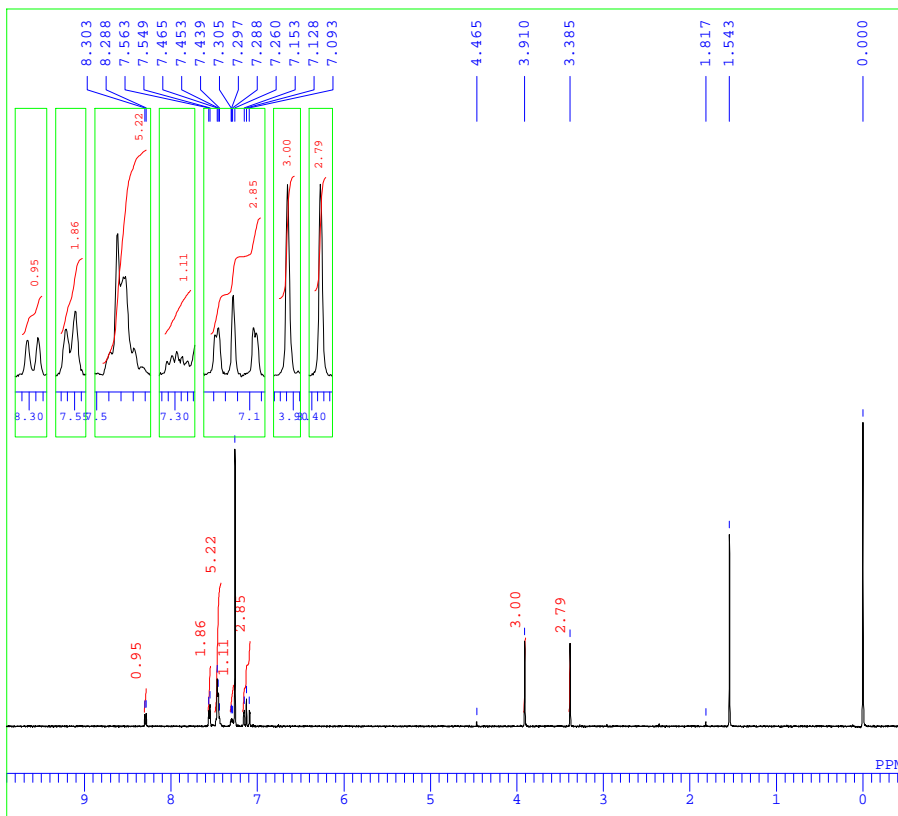
5aF



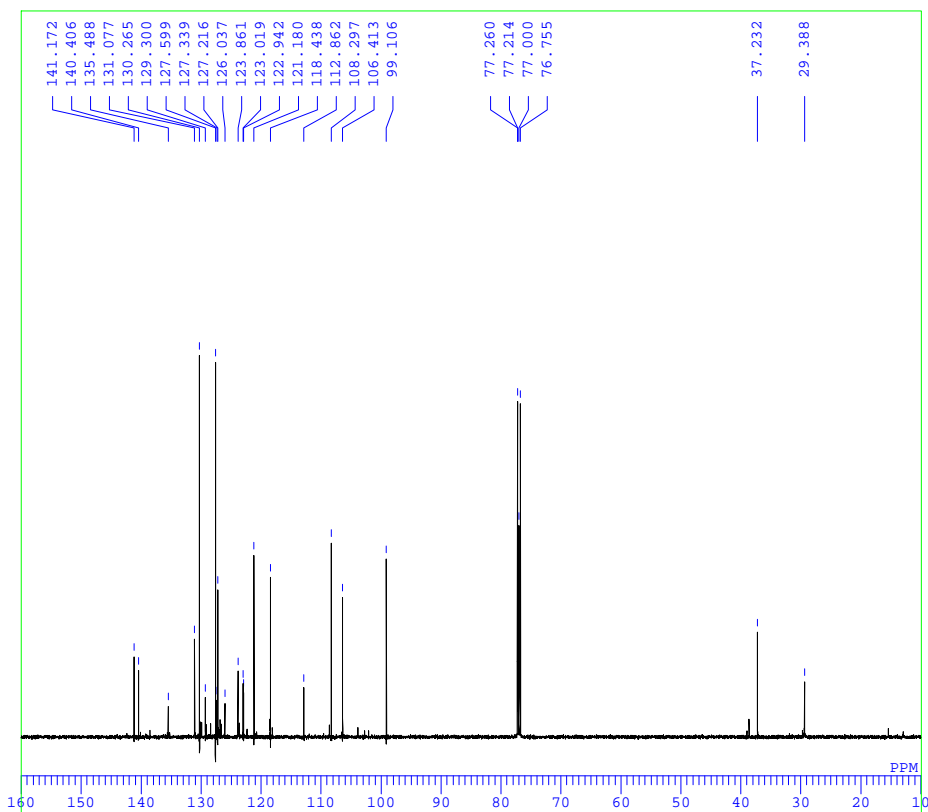
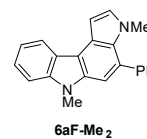
DFILE 5aF C-1.als  
 COMNT  
 DATIM 2016-11-10 19:17:52  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 32768  
 FREQU 31446.54 Hz  
 SCANS 1024  
 ACQTM 1.0420 sec  
 PD 2.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 22.1 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 1.20 Hz  
 RGAIN 70



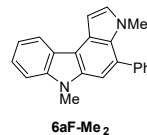
5aF

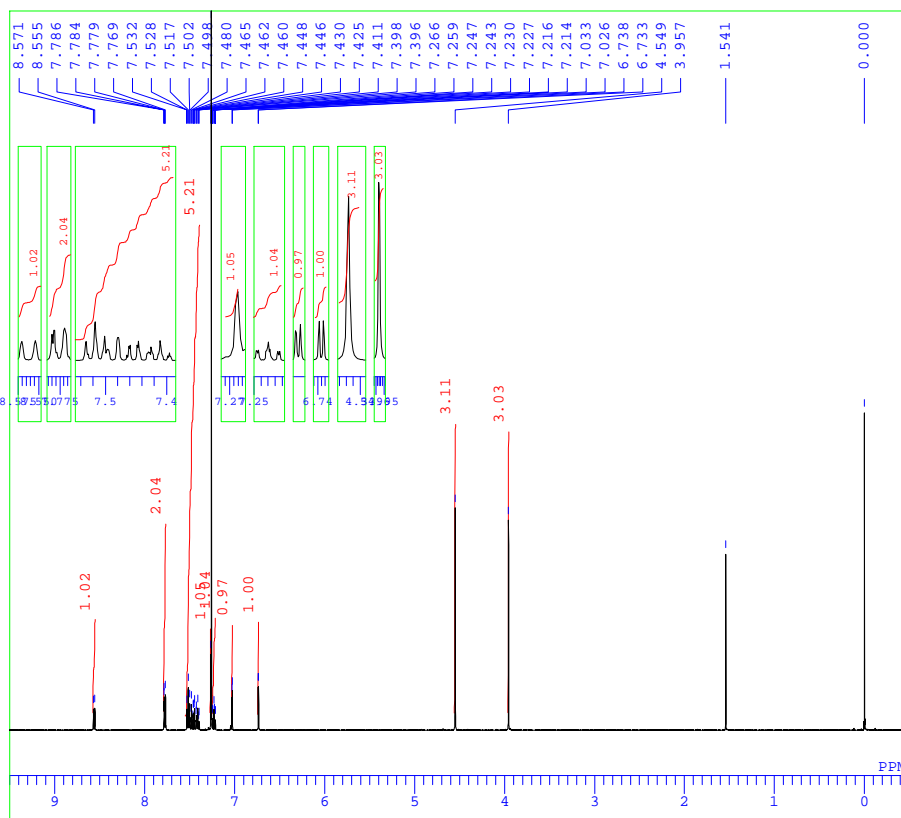


DFILE B-58 u H.als  
 COMNT single\_pulse  
 DATIM 2016-04-27 14:43:56  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 6.82 usec  
 IRNUC 1H  
 CTEMP 21.7 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 56

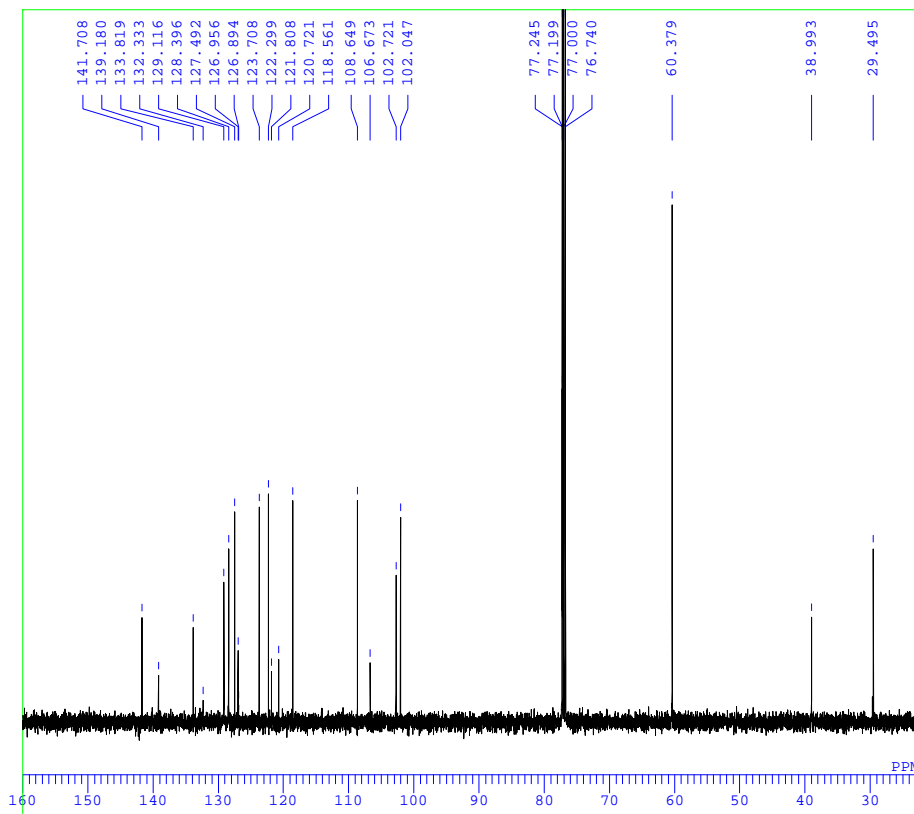
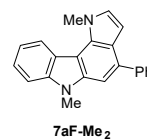


DFILE B58 up C.als  
 COMNT  
 DATIM 2018-04-29 16:54:31  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 13107  
 FREQU 25252.14 Hz  
 SCANS 4218  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.5 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 60

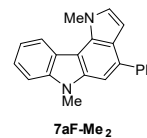


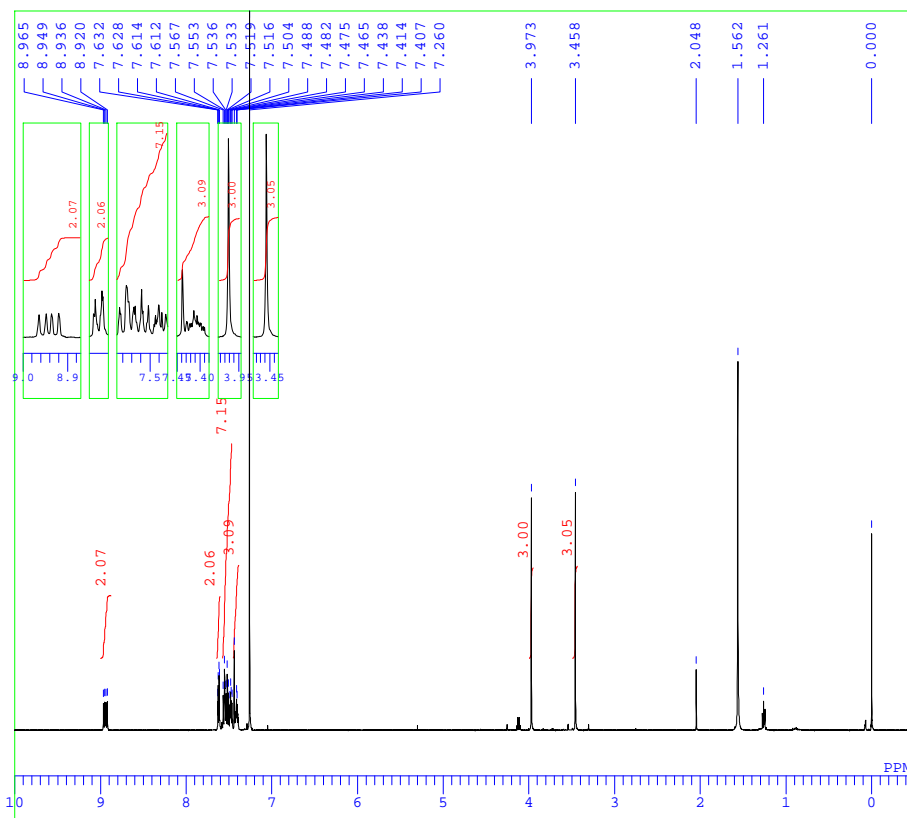


DFILE B-58 d H.als  
 COMNT single\_pulse  
 DATIM 2016-04-25 21:46:32  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFRQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 6.82 usec  
 IRNUC 1H  
 CTEMP 21.2 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 54

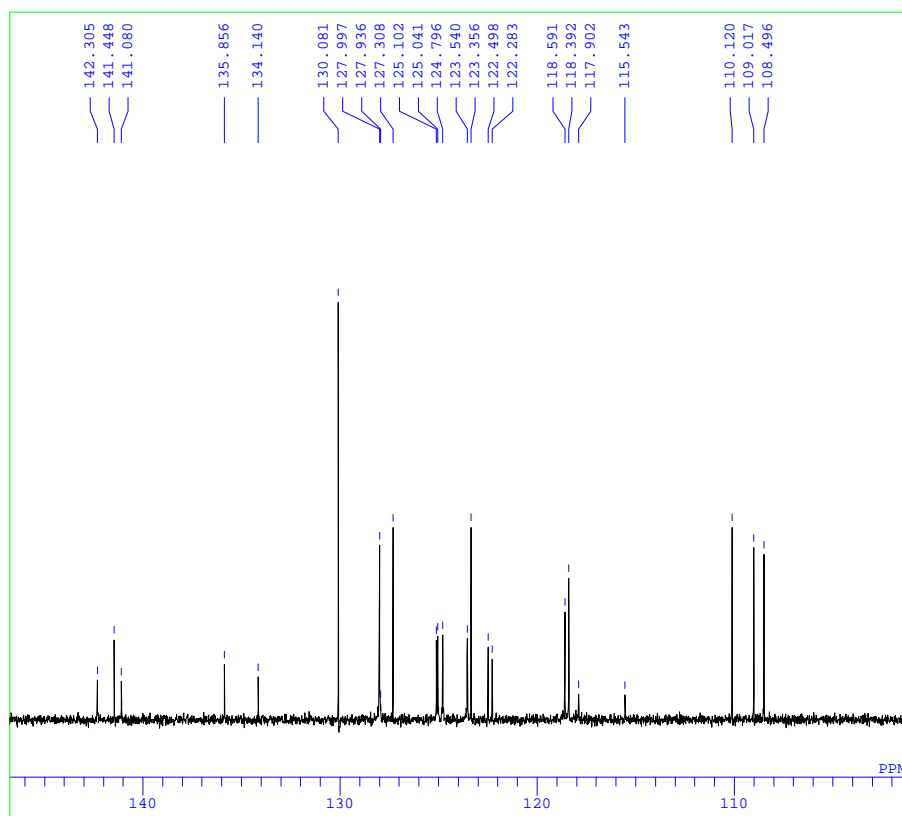
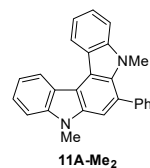


DFILE 7aF-Me2Cc.als  
 COMNT  
 DATIM 2018-06-05 17:29:35  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFRQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 31565.66 Hz  
 SCANS 1849  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.2 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 58





DFILE B190.als  
 COMNT single\_pulse  
 DATIM 2018-05-23 18:36:49  
 OBNUC 1H  
 EXMOD single\_pulse.ex2  
 OBFREQ 500.16 MHz  
 OBSET 2.41 KHz  
 OBFIN 6.01 Hz  
 POINT 13107  
 FREQU 7507.39 Hz  
 SCANS 8  
 ACQTM 1.7459 sec  
 PD 5.0000 sec  
 PW1 7.15 usec  
 IRNUC 1H  
 CTEMP 20.9 c  
 SLVNT CDCL3  
 EXREF 0.00 ppm  
 BF 0.12 Hz  
 RGAIN 50



DFILE B190 C.als  
 COMNT  
 DATIM 2018-05-23 11:22:42  
 OBNUC 13C  
 EXMOD single\_pulse\_dec  
 OBFREQ 125.77 MHz  
 OBSET 7.87 KHz  
 OBFIN 4.21 Hz  
 POINT 16384  
 FREQU 31565.66 Hz  
 SCANS 1747  
 ACQTM 0.5190 sec  
 PD 1.0000 sec  
 PW1 3.67 usec  
 IRNUC 1H  
 CTEMP 21.9 c  
 SLVNT CDCL3  
 EXREF 77.00 ppm  
 BF 0.12 Hz  
 RGAIN 60

