Visible-Light-Induced alkyl-arylation of olefins *via* a Halogen-Atom Transfer Process

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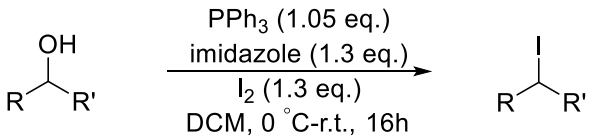
I. General Remarks: Column chromatography was carried out on silica gel. Unless noted ^{1}H NMR spectra were recorded on 400 MHz in $CDCl_3$, ^{13}C NMR spectra were recorded on 101MHz in $CDCl_3$, ^{19}F NMR spectra were recorded on 376 MHz in $CDCl_3$. IR spectra were recorded on an FT-IR spectrometer and only major peaks are reported in cm^{-1}. UV-vis spectra were recorded on a TU-1950 UV spectrometer and are reported in 200-700 nm. The fluorescence emission intensities were recorded on a CARY Eclipse spectrofluorimeter. Melting points were determined on a microscopic apparatus and were uncorrected. All new products were further characterized by HRMS (high resolution mass spectra), high resolution mass spectrometry (HRMS) spectra were obtained on a micrOTOF-Q instrument equipped with an ESI source; copies of their ^{1}H NMR and ^{13}C NMR spectra are provided. All reagents were used as received unless otherwise stated.

Figure S1. Typical experimental setup for photoredox catalytic reactions.

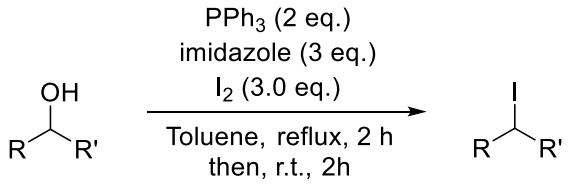
II. Synthesis of Photocatalysts and alkyl iodides.

General Procedure A:



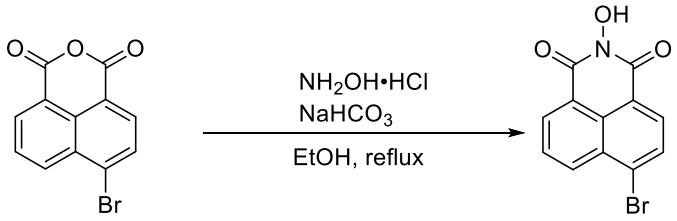
To a solution of alcohol (1 equiv.) in CH_2Cl_2 at r.t. was added PPh_3 (1.05 equiv.) and imidazole (1.3 equiv.). The mixture was cooled down to 0 °C and iodine (1.3 equiv.) was added portion wise (4 to 5 portions). The round bottom flask was wrapped with aluminium foil and the reaction was allowed to warm to r.t. and stirred overnight. The reaction was quenched by addition of H_2O, the aqueous layer was extracted with CH_2Cl_2 (twice) and the combined organic layers were washed with an aqueous solution of sodium thiosulphate, dried over $MgSO_4$, filtered and concentrated under

reduced pressure. Purification by flash chromatography on silica gel (solid deposit) afforded the desired iodide.

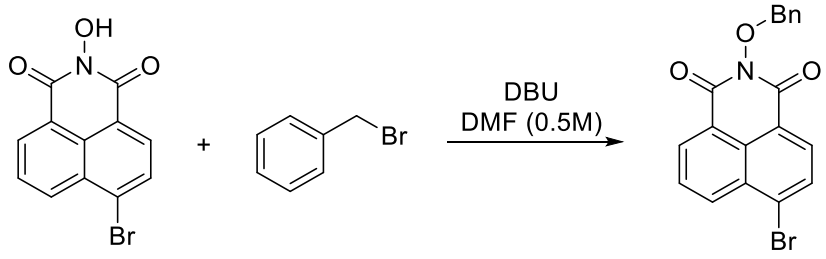


To a solution of alcohol (1 equiv.) in toluene at r.t. was added PPh_3 (2 equiv.), imidazole (3 equiv.) and iodide (3 equiv.). The reaction was refluxed and stirred for 2 h before being cooled down to r.t. and stirred for another 2h. The reaction was quenched by the addition of H_2O, the aqueous layer was extracted with CH_2Cl_2 (twice) and the combined organic layers were washed with an aqueous solution of sodium thiosulphate, dried over $MgSO_4$, filtered and concentrated under reduced pressure. Purification by flash chromatography on silica gel (solid deposit) afforded the desired iodide.

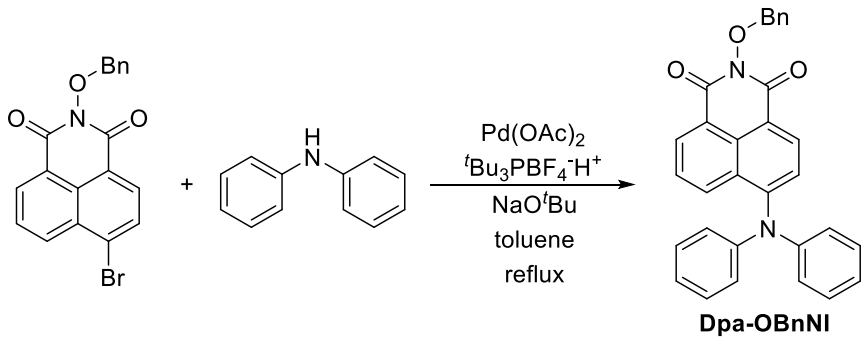
III. Synthesis of Photocatalyst



To a stirred solution of 4-bromo-1,8-naphthalic anhydride (2.77g, 10.0 mmol) in EtOH (30 mL) were added hydroxylamine hydrochloride (1.042g, 15.0 mmol) and $NaHCO_3$ (1.26g, 15.0 mmol). The mixture was refluxed for 6h, and then the solvent was removed under reduced pressure. The resulting yellow residue was triturated with H_2O and 1M HCl, collected by vacuum filtration, washed with H_2O, and dried in vacuo affording *N*-hydroxy-4-bromo-1,8-naphthalimide (2.42g, 83%) as a yellow solid.



To a stirred mixture of *N*-hydroxy-4-bromo-1,8-naphthalimide (1.26 g, 4 mmol) and benzyl bromide (748 mg, 4.4 mmol) in DMF (0.5 M) was added DBU (729 mg, 4.8 mmol) over 1h at ambient temperature. The reaction mixture was poured into HCl (1N) and then the product was extracted with CH_2Cl_2 (three times). The combined organic layer was washed with brine, dried over Na_2SO_4, and concentrated in vacuo. Purification of the crude product by flash column chromatography (silica gel; PE: DCM = 1:1) afforded the *N*-(phenylmethoxy)-4-bromo-1,8-naphthalimide (1.39 g, 91%).



N-(phenylmethoxy)-4-bromo-1,8-naphthalimide (382 mg, 1 mmol), diphenylamine (203 mg, 1.2 mmol), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol), tri-*tert*-butylphosphine tetrafluoroborate (12 mg, 0.04 mmol) and sodium *tert*-butoxide (195 mg, 2 mmol) were mixed in dry toluene (10 mL) under N_2 atmosphere. The final mixture was stirred for 8 h at 120 °C. After cooling, water (20 mL) was added and the mixture was extracted with DCM (20 mL). The organic layer was separated and washed with water and brine solution (3 × 20 mL) separately. The organic layer was dried over anhydrous Na_2SO_4, and the solvent was evaporated under reduced pressure. The crude product was purified by column chromatography (silica gel, PE: DCM=3:1, v/v). Dissolve the above solid in 20 mL solution (PE: DCM=3:1) and recrystallize to afford the target compound Dpa-OBnNI (orange solid, 329 mg, 70%).

The following three catalysts (Figure S2) have been reported by our previous report, the synthetic method and photophysical properties can be referred to the article (*Org. Lett.*, **2022**, *24*, 3797-3801).

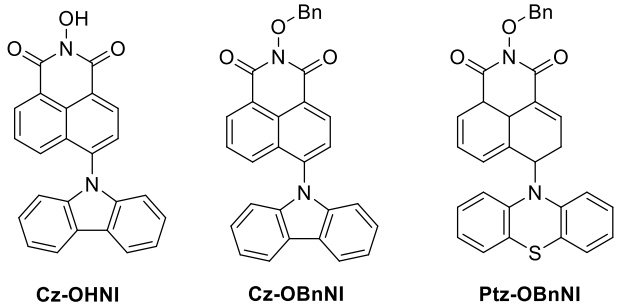
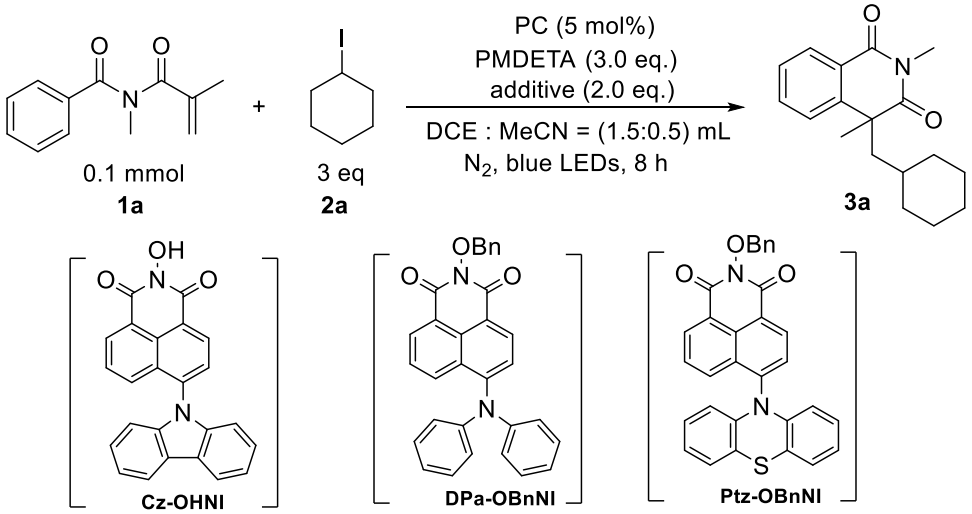


Figure S2. The structures of using photocatalysts.

IV. Optimization conditions for the synthesis of products 3.

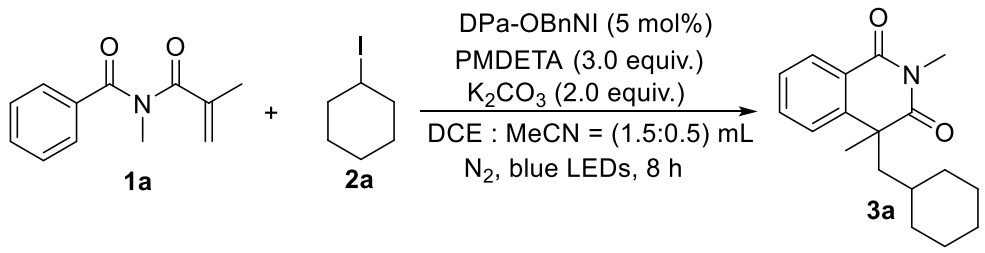
Table S1. Screening of photocatalysts[a]



entry[a]	catalyst (mol%)	reductant (equiv.)	additive (equiv.)	yield (%)[b]
1	Cz-OHNI (5)	PMDETA (3.0)	Na_2CO_3 (2)	16
2	Cz-OHNI (5)	PMDETA (3.0)	K_2CO_3 (2)	25
3	**DPa-OBnNI (5)**	**PMDETA (3.0)**	**K_2CO_3 (2)**	**46**
4	Ptz-OBnNI (5)	PMDETA (3.0)	_	<5
5	DPa-OBnNI (5)	PMDETA (3.0)	_	20
6	DPa-OBnNI (2)	PMDETA (3.0)	K_2CO_3 (2)	35
7[c]	4CzIPN (2)	PMDETA (3.0)	Cs_2CO_3 (2)	18
8[c]	$Ir(ppy)_2(dtbbpy)PF_6$ (2)	PMDETA (3.0)	Cs_2CO_3 (2)	26
9[c]	-	PMDETA (3.0)	Cs_2CO_3 (2)	N.D.

[a]Reaction conditions: **1a** (1.0 equiv., 0.1 mmol), **2a** (3.0 equiv., 0.3 mmol), irradiated by 40W blue LED (450-480 nm) under N_2 atmosphere at 30-32°C for the indicated time. [b]Isolated yields of the **3a.** [c]Using DCE (2 mL) as solvent, Na_2SO_4 (2.0 equiv, 0.2 mmol) was used, irradiated by 30W blue LED (450-480 nm) at 27-28°C. PMDETA was *N*, *N*, *N*, *N*′, *N*′-Pentamethyldiethylenetriamine. 40W blue LED: LINBA, PAR 40 LED spotlight. 30W blue LED: FORWARD LIGHTING AHEAD, PAR 30 LED spotlight.

Table S2. Optimization of light source[a]

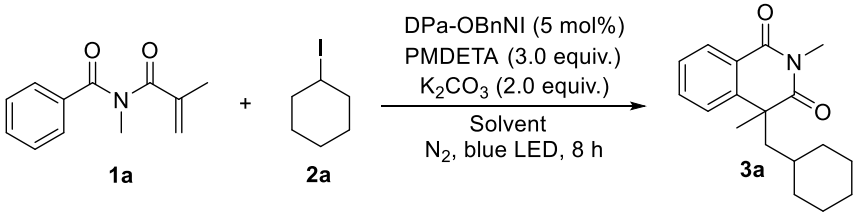


entry[a]	catalyst (mol%)	Light source	additive (equiv.)	yield (%)[b]
1	DPa-OBnNI (5)	40 W blue LED	K_2CO_3 (2)	46
2	**DPa-OBnNI (5)**	**30 W blue LED**	**K_2CO_3 (2)**	**51**
3	DPa-OBnNI (5)	No light	K_2CO_3 (2)	N. D

[a]Reaction conditions: **1a** (1.0 equiv., 0.1 mmol), **2a** (3.0 equiv., 0.3 mmol), irradiated by LED under N_2 atmosphere for the indicated time. [b]Isolated yields of product **3a**. 30W blue LED (450-480 nm) at 27-

28°C. 40W blue LED (450-480 nm) at 30-32°C.

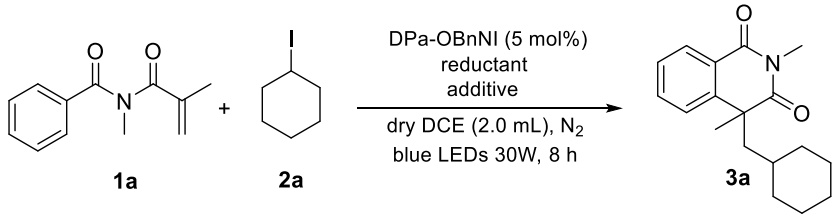
Table S3. Screening of solvents[a]



entry[a]	catalyst (mol%)	solvent (mL)	additive (equiv.)	yield (%)[b]
1	DPa-OBnNI (5)	Acetone (2.0)	K_2CO_3 (2)	39
2	**DPa-OBnNI (5)**	**dry DCE (2.0)**	**K_2CO_3 (2)**	**54**
3	DPa-OBnNI (5)	dry THF (2.0)	K_2CO_3 (2)	43
4	DPa-OBnNI (5)	DCE: MeCN (1.5:0.5)	K_2CO_3 (2)	51
5	DPa-OBnNI (5)	dry MeCN (2.0)	K_2CO_3 (2)	42

[a]Reaction conditions: **1a** (1.0 equiv., 0.1 mmol), **2a** (3.0 equiv., 0.3 mmol), irradiated by 30W blue LED (450-480 nm) under N_2 atmosphere at 27-28°C for the indicated time. [b]Isolated yields of the **3a.**

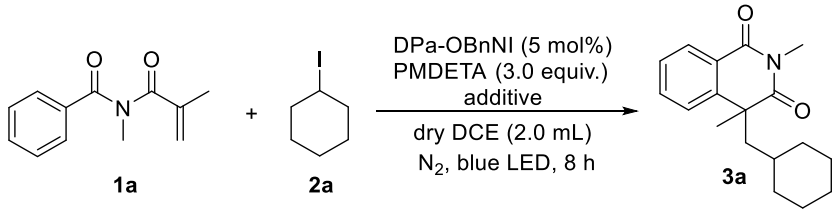
Table S4. Screening of reductant[a]



entry[a]	catalyst (mol%)	reductant (equiv.)	solvent (mL)	additive (equiv.)	yield (%)[b]
1	**DPa-OBnNI (5)**	**PMDETA (3.0)**	**dry DCE (2.0)**	**K_2CO_3 (2)**	**54**
2	DPa-OBnNI (5)	DBU (3.0)	dry DCE (2.0)	K_2CO_3 (2)	N.D.
3[c]	DPa-OBnNI (5)	Et_3N (3.0)	dry DCE (2.0)	Cs_2CO_3 (2)	42

[a]Reaction conditions: **1a** (1.0 equiv., 0.1 mmol), **2a** (3.0 equiv., 0.3 mmol), irradiated by 30W blue LED (450-480 nm) under N_2 atmosphere at 27-28°C for the indicated time. [b]Isolated yields of product **3a.** [c]Na_2SO_4 (2.0 equiv, 0.2 mmol) was used.

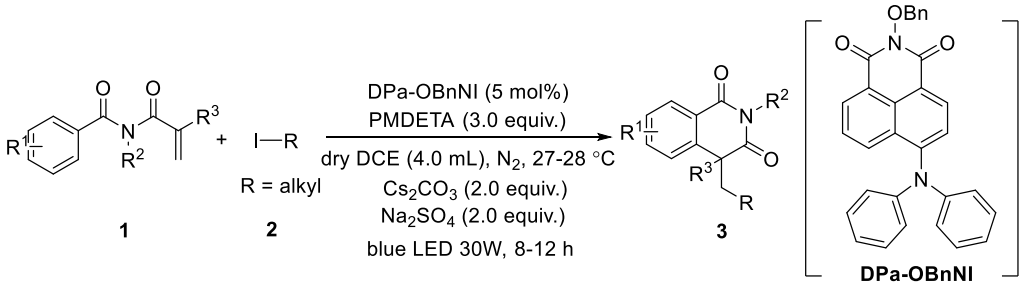
Table S5. Screening of the additive and the amount of base[a]



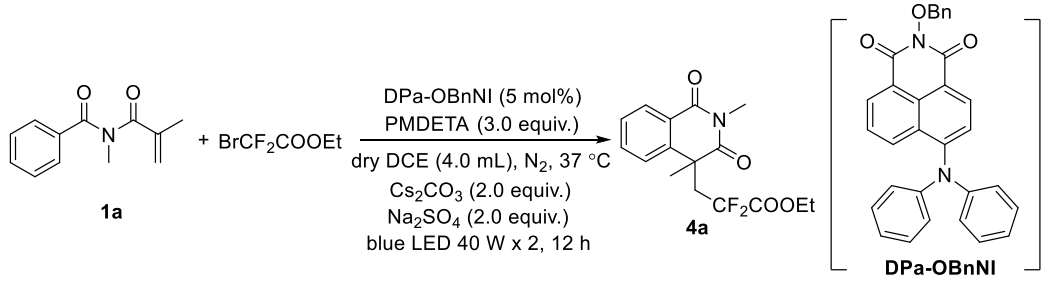
entry[a]	catalyst (mol%)	reductant (equiv.)	solvent (mL)	additive (equiv.)	yield (%)[b]
1	DPa-OBnNI (5)	PMDETA (3.0)	dry DCE (2.0)	K_2CO_3(2.0) +Na_2SO_4 (1.0)	61
2	DPa-OBnNI (5)	PMDETA (3.0)	dry DCE (2.0)	K_2CO_3(2.0) +$MgSO_4$ (1.0)	52
3	DPa-OBnNI (5)	PMDETA (3.0)	dry DCE (2.0)	K_3PO_4 (2.0) +Na_2SO_4 (1.0)	51
4	DPa-OBnNI (5)	PMDETA (3.0)	dry DCE (2.0)	K_2CO_3(2.0) +Na_2SO_4 (2.0)	62
5	**DPa-OBnNI (5)**	**PMDETA (3.0)**	**dry DCE (2.0)**	**Cs_2CO_3(2.0) +Na_2SO_4 (2.0)**	**64**
6	DPa-OBnNI (5)	PMDETA (3.0)	dry DCE (2.0)	K_2HPO_4(2.0) +Na_2SO_4(2.0)	35

[a]Reaction conditions: **1a** (1.0 equiv., 0.1 mmol), **2a** (3.0 equiv., 0.3 mmol), irradiated by 30W blue LED (450-480 nm) under N_2 atmosphere at 27-28°C for the indicated time. [b]Isolated yields of the **3a**.

V. General Procedure for the synthesis of products 3, 4.



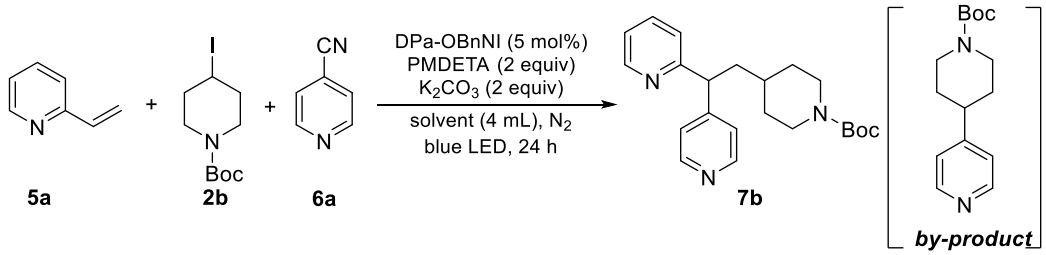
General Procedure: An oven-dried Schlenk tube (10 mL) was equipped with a magnetic stir bar, Cs_2CO_3 (2.0 equiv., 0.4 mmol, 130 mg), Na_2SO_4 (2.0 equiv., 0.4 mmol. 56.8 mg), DPa-OBnNI (5 mol%, 0.01 mmol 4.8 mg). **2** (3.0 equiv., 0.6 mmol). The flask was evacuated and backfilled with N_2 for 3 times. Then *N*-methacryloyl-*N*-methylbenzamide **1** (1.0 equiv., 0.2 mmol), PMDETA (3.0 equiv., 0.6 mmol, 104 mg), dry DCE (4.0 mL) were added with syringe. The reaction mixture was then stirred at 27-28°C under the irradiation of 30W blue LEDs, unless noted. The Schlenk tube was positioned approximately 2 cm away from the blue LEDs lamp. After being stirred at r.t. for the indicated time, 6 mL water was added to quench the reaction, and the resulting mixture was extracted three times with DCM. The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated. Purification of the crude product by flash column chromatography afforded the product.



General Procedure: An oven-dried Schlenk tube (10 mL) was equipped with a magnetic stir bar, Cs_2CO_3 (2.0 equiv., 0.4 mmol, 130 mg), Na_2SO_4 (2.0 equiv., 0.4 mmol. 56.8 mg), DPa-OBnNI (5 mol%, 0.01 mmol 4.8 mg). The flask was evacuated and backfilled with N_2 for 3 times. Then *N*-methacryloyl-*N*-methylbenzamide **1** (1.0 equiv, 0.2 mmol), PMDETA (3.0 equiv., 0.6 mmol, 104 mg), dry DCE (2.0 mL) were added with syringe, $BrCF_2COOEt$ (3 equiv., 0.6 mmol, 121 mg) in DCE (2.0 mL) added with syringe. The reaction mixture was then stirred at room temperature under the irradiation of two 40W blue LED, unless noted. The Schlenk tube was positioned approximately 2 cm away from the blue LEDs lamp. After being stirred at 37°C for the indicated time, 6 mL water was added to quench the reaction, and the resulting mixture was extracted three times with DCM. The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated. Purification of the crude product by flash column chromatography afforded the product.

VI. Optimization conditions for the synthesis of products 7, 8, 9;

Table S6. Screening of the solvents[a].

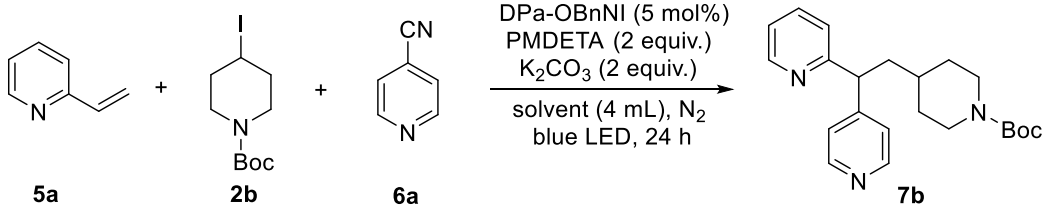


5a 2b 6a 7b

entry[a]	catalyst (mol%)	reductant (equiv.)	solvent (mL)	by-product (%)	yield (%)[b]
1	DPa-OBnNI (5)	PMDETA (2.0)	acetone (4.0)	-	51
2	DPa-OBnNI (5)	PMDETA (2.0)	DMSO (4.0)	-	trace
3	DPa-OBnNI (5)	PMDETA (2.0)	DMF (4.0)	-	trace
4	DPa-OBnNI (5)	PMDETA (2.0)	Toluene (4.0)	-	22
5	DPa-OBnNI (5)	PMDETA (2.0)	DCM (4.0)	-	22
6	**DPa-OBnNI (5)**	**PMDETA (2.0)**	**EA (4.0)**	**-**	**54**
7	DPa-OBnNI (5)	PMDETA (2.0)	THF (4.0)	39	50
8	DPa-OBnNI (5)	PMDETA (2.0)	MeCN (4.0)	46	50
9	DPa-OBnNI (5)	PMDETA (2.0)	Acetone: EA (3:1)	44	48
10	DPa-OBnNI (5)	PMDETA (2.0)	Acetone: EA (2:2)	40	50
11[c, d]	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	8	33
12[c, d]	DPa-OBnNI (5)	PMDETA (2.0)	Acetone (4.0)	11	24

[a]Reaction conditions: **5a** (2.0 equiv., 0.4 mmol), **2b** (2.0 equiv., 0.4 mmol), **6a** (0.2 mmol, 1.0 equiv.), irradiated by two 40W blue LED (450-480 nm) under N_2 atmosphere at 37-40°C for the indicated time. [b]Isolated yields of the **7b**. [c]Using Na_2CO_3 instead of K_2CO_3. [d]Using **5a** (2.0 equiv., 0.4 mmol), **2b** (1.0 equiv., 0.2 mmol), **6a** (1.0 equiv., 0.2 mmol). 40 W blue LED: LINBA, PAR 40 LED spotlight.

Table S7. Screening of the proportion of raw materials[a].

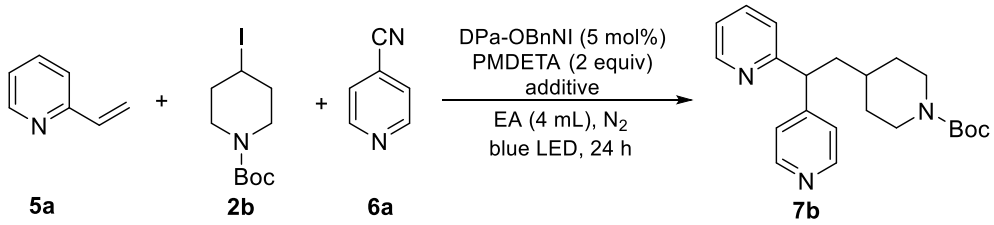


5a 2b 6a 7b

entry[a]	**5a** (equiv.)	**2b** (equiv.)	**6a** (equiv.)	solvent (mL)	yield (%)[b]
1	2.0	2.0	1.0	EtOAc (4)	65
2	1.0	3.0	3.0	EtOAc (4)	40
3	1.0	3.0	3.0	EtOAc (4)	55
4	1.0	2.0	2.0	EtOAc (4)	57
5[c]	**2.0**	**2.0**	**1.0**	EtOAc (4)	**69**
6[c]	2.0	1.0	1.0	EtOAc (4)	33

[a]Reaction conditions: **5a**, **2b**, **6a**, irradiated by two 40W blue LED (450-480 nm) under N_2 atmosphere at 37-40°C for the indicated time. [b]Isolated yields of the **7b**. [c]Using Na_2CO_3 instead of K_2CO_3. 40 W blue LED: LINBA, PAR 40 LED spotlight.

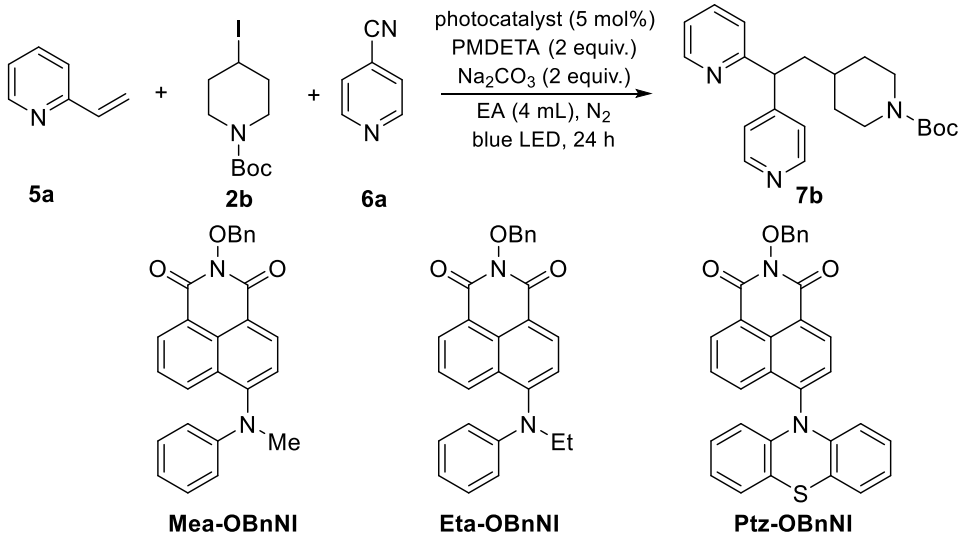
Table S8. Screening of the additives[a]



entry[a]	catalyst (mol%)	reductant (equiv.)	solvent (mL)	additive (equiv.)	yield (%)[b]
1	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	CH_3COOCs (2.0)	27
2	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	Cs_2CO_3 (2.0)	37
3	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	CH_3COONa (2.0)	49
4	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	CH_3COOK (2.0)	49
5	**DPa-OBnNI (5)**	**PMDETA (2.0)**	**EA (4.0)**	**Na_2CO_3** (2.0)	**69**
6	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	K_2CO_3 (2.0)	65
7	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	Na_2HPO_4 (2.0)	59
8	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	NaH_2PO_4 (2.0)	61
9[c]	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	CH_3COOCs (2.0)	57
10[c]	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	K_2CO_3 (2.0)	54
11[c]	DPa-OBnNI (5)	PMDETA (2.0)	EA (4.0)	Na_2CO_3 (2.0)	48

[a]Reaction conditions: **5a** (2.0 equiv., 0.4 mmol), **2b** (2.0 equiv., 0.4 mmol), **6a** (0.2 mmol, 1.0 equiv.), irradiated by two 40W blue LED (450-480 nm) under N_2 atmosphere at 37-40°C for the indicated time. [b]Isolated yields of the **7b**. [c]Using **5a** (2.0 equiv., 0.4 mmol), **2b** (1.0 equiv., 0.2 mmol), **6a** (0.4 mmol, 2.0 equiv.). 40 W blue LED: LINBA, PAR 40 LED spotlight.

Table S9. Screening of the catalysts[a].

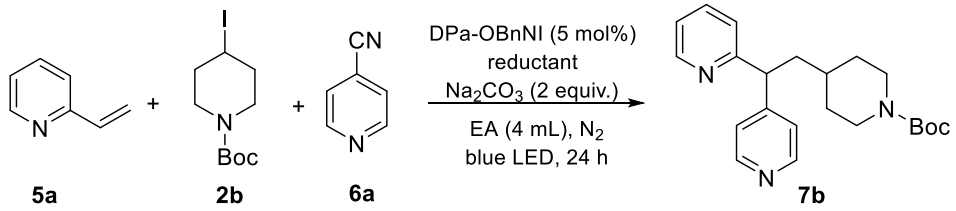


entry[a]	catalyst (mol%)	reductant (equiv.)	solvent (mL)	yield (%)[b]
1	Mea-OBnNI (5)	PMDETA (2.0)	EA (4.0)	54
2	Eta-OBnNI (5)	PMDETA (2.0)	EA (4.0)	46
3	**Dpa-OBnNI (5)**	**PMDETA (2.0)**	**EA (4.0)**	**69**
4	Ptz-OBnNI (5)	PMDETA (2.0)	EA (4.0)	13
5	4CzIPN (5)	PMDETA (2.0)	EA (4.0)	11
6	$Ir(ppy)_2(dtbbpy)PF_6$ (5)	PMDETA (2.0)	EA (4.0)	33
7	-	PMDETA (2.0)	EA (4.0)	N.D.

[a]Reaction conditions: **5a** (2.0 equiv., 0.4 mmol), **2b** (2.0 equiv., 0.4 mmol), **6a** (0.2 mmol, 1.0 equiv.), irradiated by two 40W blue LED (450-480 nm) under N_2 atmosphere at 37-40°C for the indicated time.

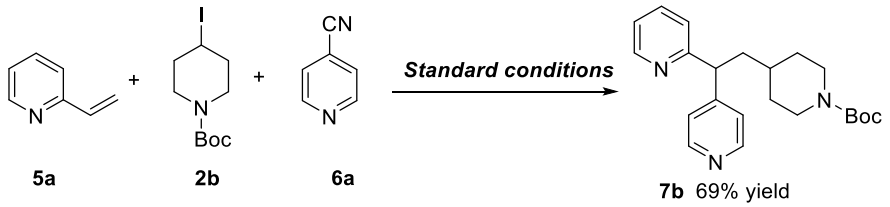
[b]Isolated yields of the **7b**. 40 W blue LED: LINBA, PAR 40 LED spotlight.

Table S10. Screening of reductants.[a]



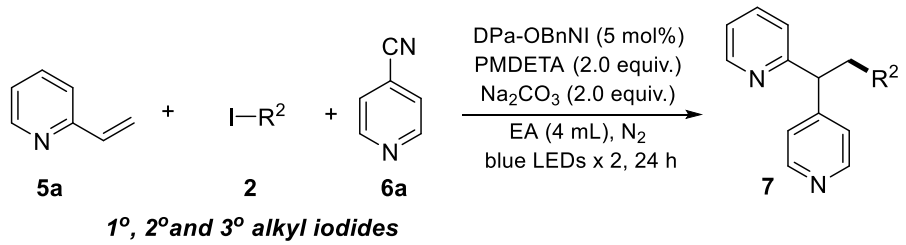
entry[a]	catalyst (mol%)	reductant (equiv.)	solvent (mL)	yield (%)[b]
1	**DPa-OBnNI (5)**	**PMDETA (2.0)**	**EA (4.0)**	**69**
2	DPa-OBnNI (5)	DABCO (2.0)	EA (4.0)	n. d
3	DPa-OBnNI (5)	Et_3N (2.0)	EA (4.0)	n. d
4	DPa-OBnNI (5)	DIPEA (2.0)	EA (4.0)	<5
5	DPa-OBnNI (5)	TEMED (2.0)	EA (4.0)	12

[a]Reaction conditions: **5a** (2.0 equiv., 0.4 mmol), **2b** (2.0 equiv., 0.4 mmol), **6a** (0.2 mmol, 1.0 equiv.), irradiated by two 40W blue LED (450-480 nm) under N_2 atmosphere at 37-40°C for the indicated time.
[b]Isolated yields of the **7b**. 40 W blue LED: LINBA, PAR 40 LED spotlight.



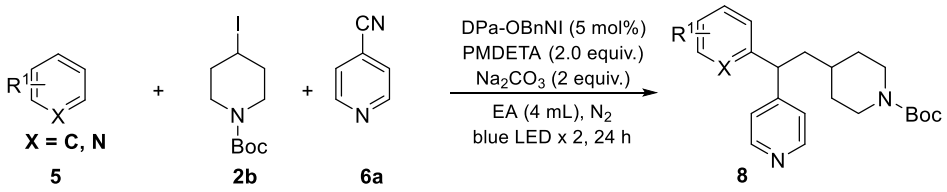
Standard conditions: **5a** (2.0 equiv., 0.4 mmol), **2b** (2.0 equiv., 0.4 mmol), **6a** (0.2 mmol, 1.0 equiv.), DPa-OBnNI (5 mol%, 0.01 mol), PMDETA (2 equiv., 0.4 mmol), Na_2CO_3 (2 equiv., 0.4 mmol), EtOAc (4 mL) irradiated by two 40 W blue LED under N_2 atmosphere for 24 h at 37-40°C.

VII. General Procedure for the synthesis of products 7, 8, 9.

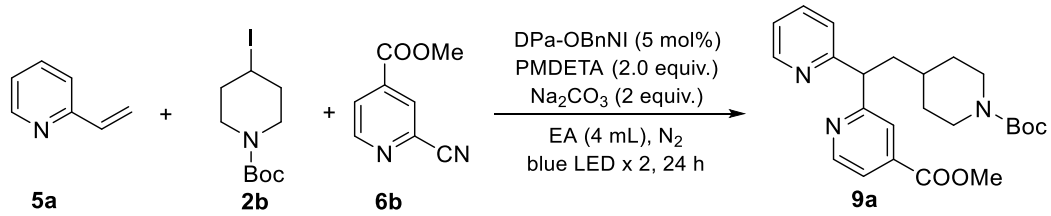


General Procedure: An oven-dried Schlenk tube (10 mL) was equipped with a magnetic stir bar, Na_2CO_3 (2.0 equiv., 0.4 mmol, 42.4 mg), DPa-OBnNI (5 mol%, 0.01 mmol, 4.8mg). **2** (2.0 equiv., 0.4 mmol) (If it is a liquid, add it with a syringe), **6a** (1.0 equiv., 0.2 mmol). The flask was evacuated and backfilled with N_2 for 3 times. Then **5a** (2.0 equiv., 0.4 mmol, 42 mg), PMDETA (2.0 equiv., 0.4 mmol, 70 mg), EA (4.0 mL) was added with syringe. The reaction mixture was then stirred at room temperature under the irradiation of two 40W blue LEDs, unless noted. The Schlenk tube was positioned approximately 2 cm away from the blue LEDs lamp. After being stirred at 37-40°C for the indicated time, 6 mL water was added to quench the reaction, and the resulting mixture was extracted three times with EA. The combined organic

extracts were washed with brine, dried over Na_2SO_4, and concentrated. Purification of the crude product by flash column chromatography afforded the product **7**.



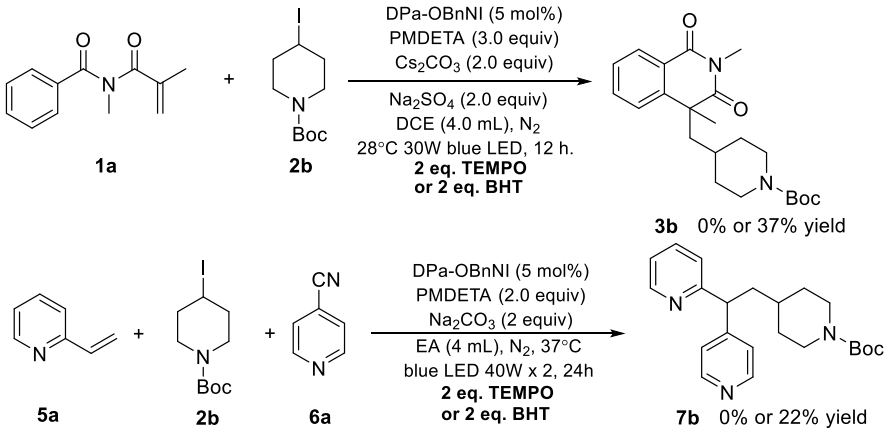
General Procedure: An oven-dried Schlenk tube (10 mL) was equipped with a magnetic stir bar, Na_2CO_3 (2.0 equiv, 0.4 mmol, 42.4 mg), DPa-OBnNI (5 mol%, 0.01 mmol 4.8 mg). **2b** (2.0 equiv, 0.4mmol, 125 mg), **6a** (1.0 equiv, 0.2 mmol). The flask was evacuated and backfilled with N_2 for 3 times. Then **5** (2.0 equiv, 0.4 mmol, 42 mg), PMDETA (2.0 equiv, 0.4 mmol, 70 mg), EA (4.0 mL) was added with syringe. The reaction mixture was then stirred at room temperature under the irradiation of two 40W blue LEDs, unless noted. The Schlenk tube was positioned approximately 2 cm away from the blue LEDs lamp. After being stirred at 37-40°C for the indicated time, 6 mL water was added to quench the reaction, and the resulting mixture was extracted three times with EA. The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated. Purification of the crude product by flash column chromatography afforded the product **8**.



General Procedure: An oven-dried Schlenk tube (10 mL) was equipped with a magnetic stir bar, Na_2CO_3 (2.0 equiv., 0.4 mmol, 42.4 mg), DPa-OBnNI (5 mol%, 0.01 mmol, 4.8 mg). **2b** (2.0 equiv., 0.4mmol), **6b** (1.0 equiv., 0.2 mmol). The flask was evacuated and backfilled with N_2 for 3 times. Then **5a** (2.0 equiv., 0.4 mmol, 42 mg), PMDETA (2.0 equiv., 0.4 mmol, 70 mg), EA (4.0 mL) was added with syringe. The reaction mixture was then stirred at room temperature under the irradiation of two 40W blue LEDs, unless noted. The Schlenk tube was positioned approximately 2 cm away from the blue LEDs lamp. After being stirred at 37-40°C for the indicated time, 6 mL water was added to quench the reaction, and the resulting mixture was extracted three times with EA. The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated. Purification of the crude product by flash column chromatography afforded the product **9a**.

VIII. Mechanism experiment

VIII.I. Radical trapping experiments



An oven-dried Schlenk tube (10 mL) was equipped with a magnetic stir bar, Na_2SO_4 (2.0 equiv., 0.4 mmol, 56.8 mg), Cs_2CO_3 (2.0 equiv., 0.4 mmol, 130 mg), DPa-OBnNI (5 mol%, 0.01 mmol, 4.8 mg). **2b** (2.0 equiv., 0.4mmol, 187 mg.), a radical quencher (TEMPO or BHT, 0.4 mmol, 2 equiv., 63 mg or 88 mg). The flask was evacuated and backfilled with N_2 for 3 times. Then **1a** (0.2 mmol, 40.6 mg), PMDETA (3.0 equiv., 0.6 mmol, 104 mg), DCE (4.0 mL) was added with syringe. The reaction mixture was then stirred at room temperature under the irradiation of 30W blue LEDs, unless noted. The Schlenk tube was positioned approximately 2 cm away from the blue LEDs lamp. After being stirred at r.t. for the indicated time, 6 mL water was added to quench the reaction, and the resulting mixture was extracted three times with EA. The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated. Purification of the crude product by flash column chromatography afforded the product.

The product **3b** was significantly suppressed by radical quenchers (0% yield with TEMPO, 37% yield with BHT), which indicated that a radical process was involved in this transformation.

An oven-dried Schlenk tube (10 mL) was equipped with a magnetic stir bar, Na_2CO_3 (2.0 equiv., 0.4 mmol, 42.4 mg), DPa-OBnNI (5 mol%, 0.01 mmol, 4.8 mg). **2b** (2.0 equiv., 0.4mmol, 187 mg.), **6a** (1.0 equiv, 0.2 mmol), a radical quencher (TEMPO or BHT, 0.4 mmol, 2 equiv., 63 mg or 88 mg). The flask was evacuated and backfilled with N_2 for 3 times. Then **5a** (2.0 equiv., 0.4 mmol, 42 mg), PMDETA (2.0 equiv., 0.4 mmol, 70 mg), EA (4.0 mL) was added with syringe. The reaction mixture was then stirred at room temperature under the irradiation of two 40W blue LEDs, unless noted. The Schlenk tube was positioned approximately 2 cm away from the blue LEDs lamp. After being stirred at r.t. for the indicated time, 6 mL water was added to quench the reaction, and the resulting mixture was extracted three times with EA. The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated. Purification of the crude product by flash column chromatography afforded the product.

The product **7b** was significantly suppressed by radical quenchers (0% yield with TEMPO, 22% yield with BHT), which indicated that a radical process was involved in this transformation.

VIII.II. Stern-Volmer Emission quenching experiments

Emission quenching experiments were recorded using a Cary Eclipse FL0911M001 Fluorescence Spectrometer. DPa-OBnNI solutions were excited at 447 nm and the emission intensity at 641 nm was observed. All experiments were performed under nitrogen atmosphere with a gas-tight quartz cuvette containing 3.0 mL of iridium catalyst solution at room temperature, a 5×10^{-4} M solution of DPa-OBnNI in EtOAc was collected. Then appropriate amount of quencher was added to the measured solution and the emission spectrum of the sample was collected.

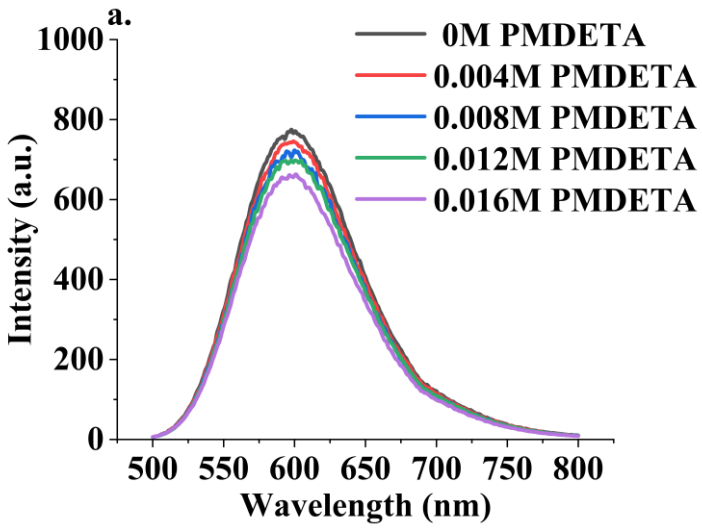


Figure S3. DPa-OBnNI emission quenching experiment by PMDETA.

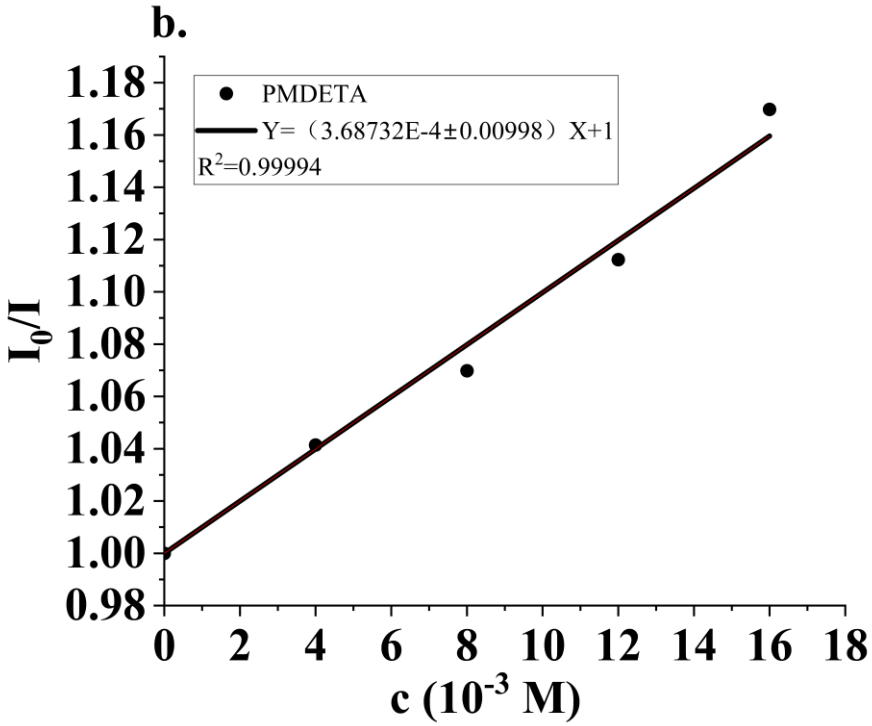


Figure S4. Stern-Volmer plot of DPa-OBnNI with different concentrations of PMDETA

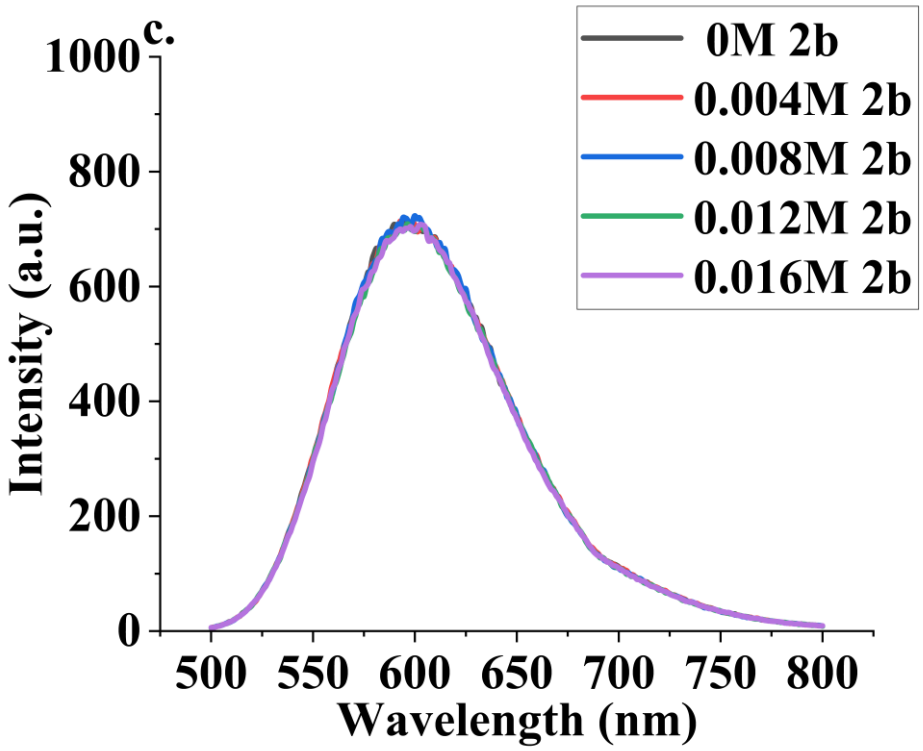


Figure S5. DPa-OBnNI emission quenching experiment by tert-butyl 4-iodopiperidine-1-carboxylate.

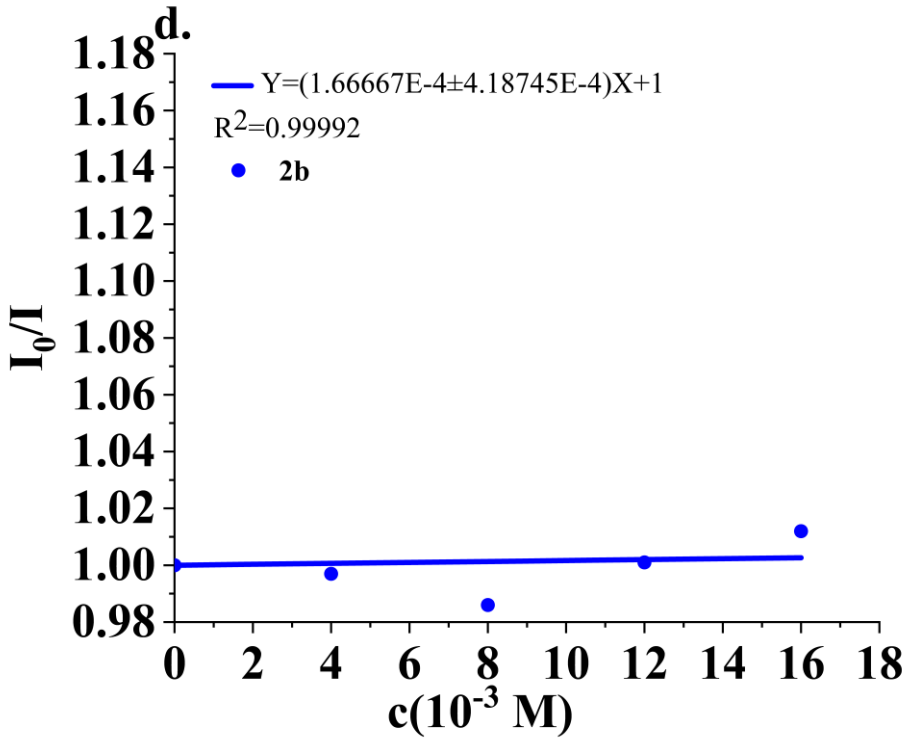


Figure S6. Stern-Volmer plot of DPa-OBnNI with different concentrations of 4-iodopiperidine-1-carboxylate

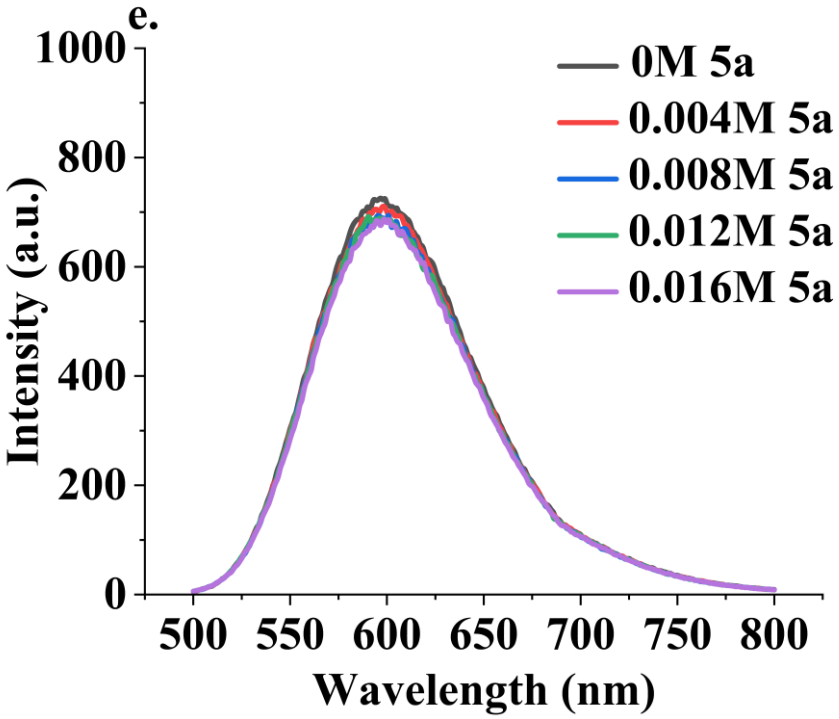


Figure S7. DPa-OBnNI emission quenching experiment by 2-vinylpyridine

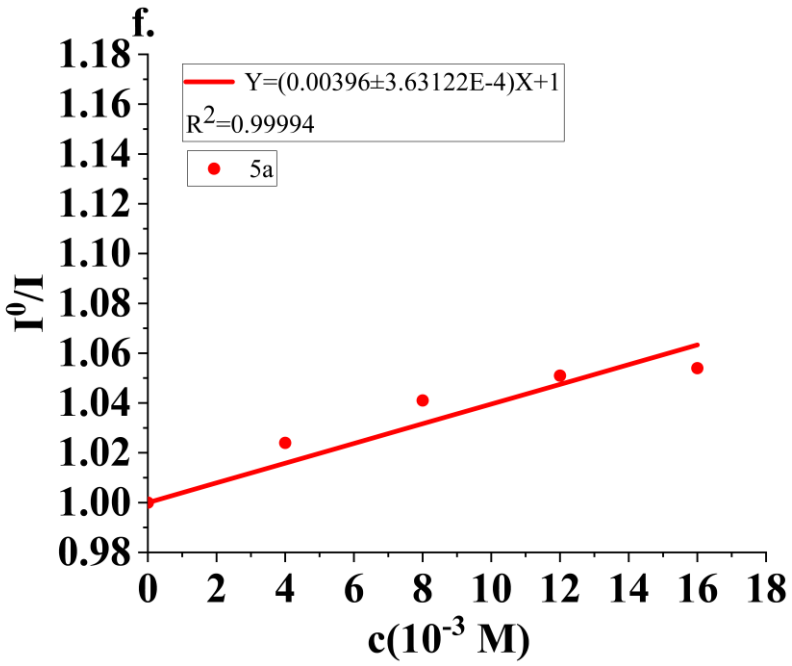


Figure S8. Stern-Volmer plot of DPa-OBnNI with different concentrations of 2-vinylpyridine

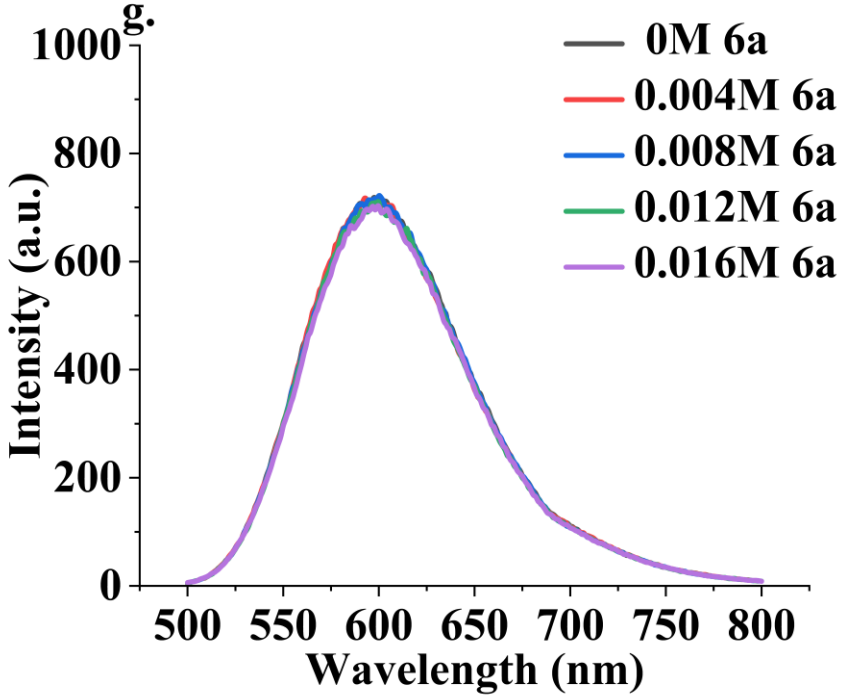


Figure S9. DPa-OBnNI emission quenching experiment by isonicotinonitrile

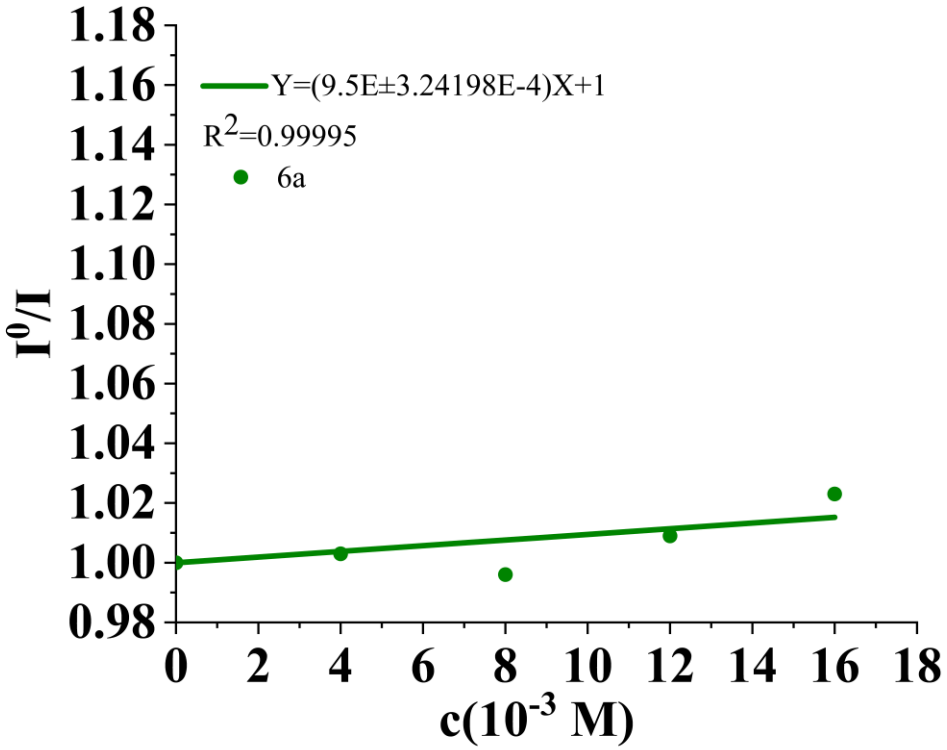


Figure S10. Stern-Volmer plot of DPa-OBnNI with different concentrations of isonicotinonitrile

A plausible reaction mechanism for the radical cyclization was proposed in **Scheme S11**. First, the photocatalyst DPa-OBnNI is excited by visible light to provide the excited-state DPa-OBnNI*

($E_{1/2}$(PC*/PC$^{\bullet-}$) = 1.31 V), which then undergoes a single electron transfer (SET) process with PMDETA ($E_{1/2}^{ox}$ = 0.66 V) to afford the PMDETA$^{\bullet+}$. The cation radical PMDETA$^{\bullet+}$ can form a α-aminoalkyl radical PMDETA$^{\bullet}$ through a deprotonation process, which then goes through a halogen-atom transfer (XAT) process with alkyl iodide **2b** to give alkyl radical **A**. Subsequent facile addition of alkyl radical **A** to acryloylbenzamide substrate **1a** leads to the formation of the radical **B**. Then, intermediate **B** goes through an intramolecular radical cyclization to give **C**, which could be oxidized by imine cation to deliver **D**. Finally, the deprotonation of intermediate **D** afforded the desired cyclization product **3b**.

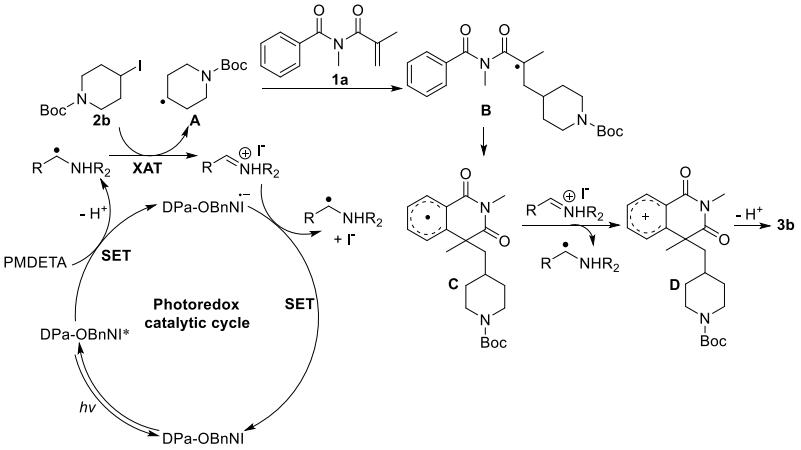
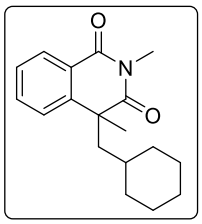


Figure S11. Proposed mechanism for the radical cyclization

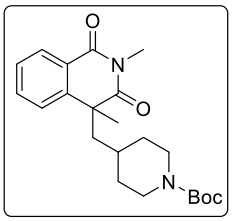
IX. Date of products 3, 4, 7, 8, 9.



3a

4-(cyclohexylmethyl)-2,4-dimethylisoquinoline-1,3(2H,4H)-dione, 64%, colorless oil, 18.3 mg, 27°C, 8 h. CAS:1969275-61-3[1].

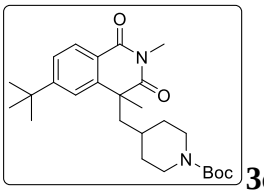
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.18 (d, *J* = 3.9 Hz, 1H), 7.60 – 7.50 (m, 1H), 7.40 – 7.29 (m, 2H), 3.31 (d, *J* = 3.4 Hz, 3H), 2.24 (d, *J* = 7.0 Hz, 1H), 1.81 (dd, *J* = 14.0, 3.8 Hz, 1H), 1.49 (d, *J* = 3.5 Hz, 3H), 1.39 (s, 3H), 1.19 (d, *J* = 7.2 Hz, 2H), 0.89 – 0.66 (m, 6H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.81, 164.46, 143.90, 133.68, 128.81, 127.10, 125.69, 124.54, 49.58, 46.64, 34.82, 34.25, 32.97, 31.56, 27.12, 25.98, 25.95, 25.91.



3b

tert-butyl 4-((2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate, 74%, colorless oil, 57.2 mg, 27°C, 8 h.

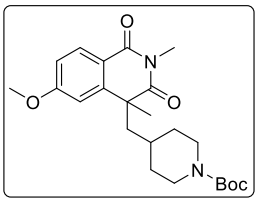
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.20 (d, *J* = 7.8 Hz, 1H), 7.58 (td, *J* = 7.5, 1.3 Hz, 1H), 7.41 – 7.32 (m, 2H), 3.78 (s, 2H), 3.32 (s, 3H), 2.32 (dd, *J* = 14.0, 6.4 Hz, 2H), 1.88 (dd, *J* = 14.0, 4.5 Hz, 1H), 1.51 (s, 3H), 1.33 (m, 10H), 1.19 – 1.14 (m, 1H), 1.00 – 0.80 (m, 4H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.54, 164.27, 154.57, 143.49, 133.92, 129.04, 127.40, 125.61, 124.45, 79.25, 48.34, 46.61, 33.37, 32.89, 32.02, 31.80, 28.37, 27.21. IR (cm^{-1}): 2926, 1690, 1669, 1605, 868, 801, 768, 702. HRMS (ESI) m/z calcd for $C_{22}H_{31}N_2O_4^+$ $(M+H)^+$ 387.2278, found 387.2277.



3c

tert-butyl 4-((6-(*tert*-butyl)-2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 90%, colorless oil, 79.6 mg, 27°C, 10 h.

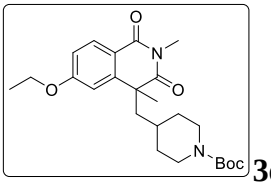
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.3 Hz, 1H), 7.40 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.32 (s, 1H), 3.77 (s, 2H), 3.31 (s, 3H), 2.31 (t, *J* = 7.0 Hz, 3H), 1.87 (dd, *J* = 13.9, 4.1 Hz, 1H), 1.51 (s, 3H), 1.30 (d, *J* = 14.8 Hz, 18H), 1.20 – 1.17 (m, 1H), 0.93 (t, *J* = 12.4 Hz, 3H), 0.82 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.79, 164.21, 157.62, 154.58, 143.05, 128.81, 124.67, 122.31, 121.91, 79.20, 48.47, 46.89, 35.26, 33.41, 32.89, 32.27, 31.57, 31.01, 28.34, 27.07. IR (cm^{-1}): 2963, 2927, 2868, 1694, 1666, 1609, 846, 785, 769, 706. HRMS (ESI) m/z calcd for $C_{26}H_{39}N_2O_4^+$ $(M+H)^+$ 443.2904, found 443.2905.



3d

tert-butyl 4-((6-methoxy-2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 68%, colorless oil, 56.6 mg, 27°C, 10 h.

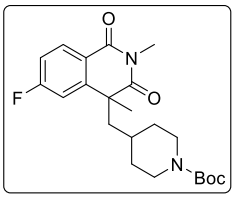
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.22 (d, *J* = 8.8 Hz, 1H), 6.97 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.84 (d, *J* = 2.4 Hz, 1H), 3.91 (s, 3H), 3.87 – 3.80 (m, 1H), 3.37 (s, 3H), 2.47 – 2.34 (m, 3H), 1.90 (dd, *J* = 14.1, 5.0 Hz, 1H), 1.56 (s, 3H), 1.40 (s, 9H), 1.24 (d, *J* = 9.6 Hz, 2H), 1.08 (d, *J* = 12.7 Hz, 3H), 0.97 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.57, 164.05, 163.85, 154.53, 145.73, 131.37, 117.48, 113.06, 110.85, 79.20, 55.52, 48.46, 46.75, 33.32, 32.87, 32.03, 31.87, 28.34, 27.01. IR (cm^{-1}): 2927, 2850, 1690, 1664, 1604, 871, 776, 702. HRMS (ESI) m/z calcd for $C_{23}H_{33}N_2O_5^+$ $(M+H)^+$ 417.2384, found 417.2385.



3e

tert-butyl 4-((6-ethoxy-2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 53%, colorless oil, 45.6 mg, 27°C, 10 h.

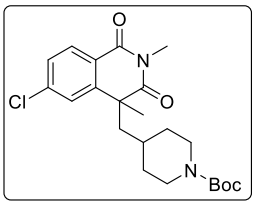
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.13 (d, *J* = 8.8 Hz, 1H), 6.88 (dd, *J* = 8.9, 2.1 Hz, 1H), 6.76 (d, *J* = 2.4 Hz, 1H), 4.10 – 4.02 (m, 2H), 3.79 (s, 2H), 3.29 (s, 3H), 2.30 (dd, *J* = 14.1, 6.8 Hz, 3H), 1.83 (dd, *J* = 14.0, 5.0 Hz, 1H), 1.48 (s, 3H), 1.42 – 1.39 (m, 2H), 1.33 (s, 9H), 1.17 (d, *J* = 12.4 Hz, 2H), 1.01 (d, *J* = 15.6 Hz, 3H), 0.87 (ddd, *J* = 14.7, 8.0, 3.1 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.63, 163.90, 163.49, 154.55, 145.72, 131.34, 117.30, 113.51, 111.26, 79.20, 63.91, 48.46, 46.74, 33.34, 32.87, 32.05, 31.88, 28.36, 27.01, 14.59. IR (cm^{-1}): 2974, 2928, 1691, 1664, 1604, 1582, 871, 776, 702. HRMS (ESI) m/z calcd for $C_{24}H_{35}N_2O_5^+$ $(M+H)^+$ 431.2540, found 431.2540.



3f

tert-butyl 4-((6-fluoro-2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 55%, colorless oil, 44.5 mg, 27ºC, 10 h.

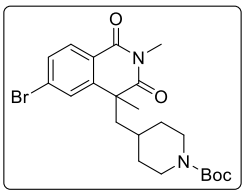
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.23 (dd, *J* = 8.8, 5.9 Hz, 1H), 7.09 (td, *J* = 8.3, 2.4 Hz, 1H), 7.01 (dd, *J* = 9.4, 2.5 Hz, 1H), 3.80 (s, 2H), 3.31 (s, 3H), 2.33 (dd, *J* = 14.5, 5.8 Hz, 3H), 1.81 (dd, *J* = 14.4, 4.3 Hz, 1H), 1.50 (s, 3H), 1.33 (s, 9H), 1.15 (d, *J* = 8.9 Hz, 1H), 0.99 (m, 3H), 0.89 (m, 1H).^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.00, 167.59, 165.05, 163.29, 154.54, 146.67 (d, *J* = 8.57 Hz), 132.20 (d, *J* = 9.75 Hz), 120.94, 115.62 (d, *J* = 21.98 Hz), 112.52 (d, *J* = 22.87 Hz), 79.32, 48.38, 46.84, 33.36, 32.88, 31.95, 31.79, 28.37, 27.23. IR (cm^{-1}): 2926, 2854, 1713, 1691, 1671, 1615, 1593, 871, 837, 778, 699, 653. HRMS (ESI) m/z calcd for $C_{22}H_{30}FN_2O_4^+$ $(M+H)^+$ 405.2184, found 405.2179.



3g

tert-butyl 4-((6-chloro-2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 62%, colorless oil, 52.2 mg, 27ºC, 10 h.

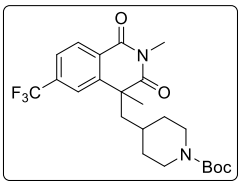
^{1}H NMR **(**400 MHz, Chloroform-*d*) δ 8.21 (d, *J* = 8.4 Hz, 1H), 7.43 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.39 (d, *J* = 2.0 Hz, 1H), 3.87 (s, 2H), 3.38 (s, 3H), 2.47 – 2.36 (m, 3H), 1.90 (dd, *J* = 14.4, 4.4 Hz, 1H), 1.58 (m, 3H), 1.41 (s, 9H), 1.20 (m, 1H), 1.07 (m, 3H), 0.93 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.82, 163.38, 154.52, 145.24, 140.59, 130.68, 128.11, 125.76, 122.96, 79.30, 48.32, 46.67, 33.33, 32.87, 31.94, 31.69, 28.36, 27.27. IR (cm^{-1}): 2926, 2866, 1713, 1691, 1669, 1597, 849, 777, 696. HRMS (ESI) m/z calcd for $C_{22}H_{30}ClN_2O_4^+$ $(M+H)^+$ 421.1889, found 421.1889.



3h

tert-butyl 4-((6-bromo-2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 38%, colorless oil, 35.4 mg, 27°C, 10 h.

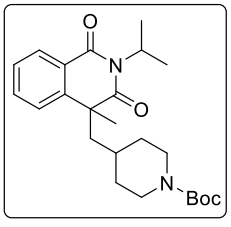
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.95 (d, *J* = 8.3 Hz, 1H), 7.82 – 7.76 (m, 1H), 7.59 (dd, *J* = 8.5, 1.9 Hz, 1H), 3.87 (s, 2H), 3.38 (s, 3H), 2.45 – 2.35 (m, 3H), 1.89 (d, *J* = 14.1 Hz, 1H), 1.57 (d, *J* = 2.9 Hz, 3H), 1.41 (s, 9H), 1.21 (d, *J* = 9.6 Hz, 1H), 1.04 (m, 3H), 0.93 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.69, 163.78, 154.55, 136.91, 134.86, 131.05, 130.70, 130.39, 128.79, 123.93, 79.33, 48.37, 46.65, 46.49, 33.35, 32.89, 32.00, 28.38, 27.30. IR (cm^{-1}): 2955, 2924, 2867, 1690, 1669, 1588, 846, 775, 696. HRMS (ESI) m/z calcd for $C_{22}H_{30}BrN_2O_4^+$ $(M+H)^+$ 465.1383, found 465.1387.



3i

tert-butyl 4-((2,4-dimethyl-1,3-dioxo-6-(trifluoromethyl)-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 59%, colorless oil, 53.6 mg, 27°C, 10 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.41 (d, *J* = 8.2 Hz, 1H), 7.73 – 7.64 (m, 2H), 3.86 (s, 2H), 3.41 (s, 3H), 2.48 – 2.36 (m, 3H), 1.96 (dd, *J* = 14.3, 4.2 Hz, 1H), 1.62 (s, 3H), 1.40 (s, 9H), 1.22 (d, *J* = 10.1 Hz, 1H), 1.03 (d, *J* = 11.3 Hz, 3H), 0.88 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.66, 163.11, 154.55, 144.32, 135.67 (d, *J* = 32.94 Hz), 135.35, 129.98, 127.36, 124.68, 124.24 (q, *J* = 3.71 Hz), 122.76 (q, *J* = 3.87 Hz), 79.37, 48.41, 46.82, 33.40, 32.87, 32.03, 31.56, 28.37, 27.45. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -63.10. IR (cm^{-1}): 2920, 2870, 1712, 1679, 1665, 1500, 859, 787, 766, 704. HRMS (ESI) m/z calcd for $C_{23}H_{30}F_3N_2O_4^+$ $(M+H)^+$ 455.2152, found 455.2153.

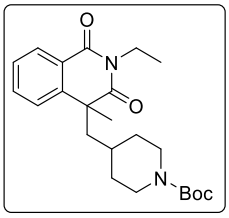


3j

tert-butyl 4-((2-isopropyl-4-methyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 69%, colorless oil, 57.2 mg. 27°C, 8 h.

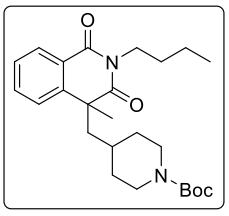
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.24 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.62 (td, *J* = 7.6, 1.5 Hz, 1H), 7.45 – 7.36 (m, 2H), 5.22 (p, *J* = 6.9 Hz, 1H), 3.85 (s, 2H), 2.36 (dd, *J* = 14.1, 6.6 Hz, 2H), 1.91 (dd, *J* = 14.1, 4.8 Hz, 1H), 1.56 (s, 3H), 1.48 (dd, *J* = 7.0, 4.7 Hz, 6H), 1.45 (d, *J* = 3.1 Hz, 1H), 1.40 (s, 9H), 1.26 (m, 1H), 1.05 (tq, *J* = 8.3, 4.2 Hz,

3H), 0.91 (dt, *J* = 16.8, 4.4 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.43, 164.26, 154.60, 143.43, 133.62, 129.03, 127.29, 125.44, 125.11, 79.23, 48.16, 46.77, 45.38, 33.41, 32.85, 32.18, 31.53, 28.36, 19.57, 19.54. IR (cm^{-1}): 2969, 2928, 1694, 1664, 1603, 768, 706. HRMS (ESI) m/z calcd for $C_{24}H_{35}N_2O_4^+$ $(M+H)^+$ 415.2591, found 415.2590.



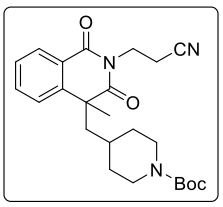
3k

tert-butyl 4-((2-ethyl-4-methyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 76%, colorless oil, 60.9 mg, 27ºC, 10 h.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.66 – 7.61 (m, 1H), 7.47 – 7.39 (m, 2H), 4.08 (q, *J* = 7.0 Hz, 2H), 3.84 (s, 2H), 2.39 (dd, *J* = 13.6, 6.0 Hz, 3H), 1.95 (dd, *J* = 14.1, 4.8 Hz, 1H), 1.57 (s, 3H), 1.40 (s, 9H), 1.26 (m, 1H), 1.22 (t, *J* = 7.0 Hz, 3H), 1.04 (m, 3H), 0.89 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.95, 163.70, 154.55, 143.50, 133.80, 128.99, 127.32, 125.59, 124.59, 79.20, 48.14, 46.45, 35.53, 33.40, 32.83, 32.11, 31.76, 28.34, 12.98. IR (cm^{-1}): 2974, 2931, 2867, 1691, 1666, 1604, 855, 768, 705. HRMS (ESI) m/z calcd for $C_{23}H_{33}N_2O_4^+$ $(M+H)^+$ 401.2435, found 401.2436.



3l

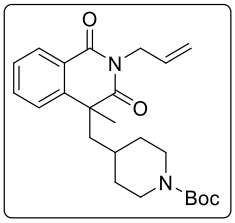
tert-butyl 4-((2-butyl-4-methyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 70%, colorless oil, 60 mg, 27ºC, 10 h.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.19 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.56 (td, *J* = 7.6, 1.5 Hz, 1H), 7.40 – 7.31 (m, 2H), 3.99 – 3.91 (m, 2H), 3.78 (s, 2H), 2.32 (dd, *J* = 14.0, 6.4 Hz, 3H), 1.87 (dd, *J* = 14.1, 5.0 Hz, 1H), 1.53 (t, *J* = 7.6 Hz, 2H), 1.49 (s, 3H), 1.32 (m, 11H), 1.18 (m, 1H), 1.01 – 0.92 (m, 3H), 0.89 (t, *J* = 7.3 Hz, 3H), 0.80 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.14, 163.92, 154.54, 143.52, 133.78, 129.04, 127.32, 125.58, 124.55, 79.20, 48.07, 46.53, 40.25, 33.44, 32.81, 32.17, 31.90, 29.86, 28.34, 20.23, 13.73. IR (cm^{-1}): 2960, 2930, 2869, 1694, 1667, 1605, 856, 769, 705. HRMS (ESI) m/z calcd for $C_{25}H_{37}N_2O_4^+$ $(M+H)^+$ 429.2748, found 429.2748.



3m

tert-butyl 4-((2-(2-cyanoethyl)-4-methyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 62%, colorless oil, 52.8 mg, 27°C, 10 h.

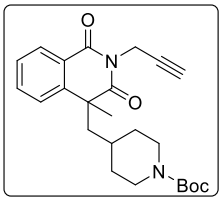
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.27 (d, *J* = 9.4 Hz, 1H), 7.68 (t, *J* = 7.6 Hz, 1H), 7.46 (dd, *J* = 20.5, 7.9 Hz, 2H), 4.41 – 4.29 (m, 2H), 3.85 (s, 2H), 2.79 (td, *J* = 6.8, 4.0 Hz, 2H), 2.41 (dd, *J* = 14.2, 6.5 Hz, 3H), 1.99 (dd, *J* = 14.2, 5.7 Hz, 1H), 1.61 (s, 3H), 1.40 (s, 9H), 1.27 – 1.23 (m, 1H), 1.16 – 1.08 (m, 1H), 1.04 (m, 2H), 0.90 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.18, 163.64, 154.56, 143.47, 134.43, 129.32, 127.62, 125.80, 123.77, 116.99, 79.25, 47.82, 46.92, 35.56, 33.44, 32.79, 32.29, 32.21, 28.35, 16.34. IR (cm^{-1}): 2973, 2927, 2866, 2250, 1714, 1693, 1674, 1605, 856, 768, 736, 705, 678. HRMS (ESI) m/z calcd for $C_{24}H_{32}N_3O_4^+$ $(M+H)^+$ 426.2387, found 426.2387.



3n

tert-butyl 4-((2-allyl-4-methyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 33%, colorless oil, 27.2 mg, 27°C, 10 h.

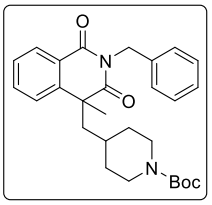
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.27 (d, *J* = 9.4 Hz, 1H), 7.65 (td, *J* = 7.6, 1.5 Hz, 1H), 7.48 – 7.40 (m, 2H), 5.95 – 5.84 (m, 1H), 5.31 – 5.16 (m, 2H), 4.64 (d, *J* = 6.9 Hz, 2H), 3.84 (s, 2H), 2.39 (dd, *J* = 14.1, 6.4 Hz, 3H), 1.95 (dd, *J* = 14.1, 5.1 Hz, 1H), 1.58 (s, 3H), 1.40 (s, 9H), 1.26 (m, 1H), 1.03 (d, *J* = 14.7 Hz, 3H), 0.90 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.86, 163.68, 154.58, 143.60, 133.96, 131.87, 129.15, 127.42, 125.64, 124.46, 118.03, 79.24, 48.20, 46.69, 42.42, 33.40, 32.84, 32.25, 31.84, 28.37. IR (cm^{-1}): 2971, 2927, 2865, 1691, 1670, 1605, 768, 706. HRMS (ESI) m/z calcd for $C_{24}H_{33}N_2O_4^+$ $(M+H)^+$ 413.2435, found 413.2436.



3o

tert-butyl 4-((4-methyl-1,3-dioxo-2-(prop-2-yn-1-yl)-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 45%, colorless oil, 36.9 mg, 27°C, 10 h.

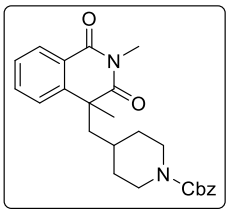
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.22 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.60 (td, *J* = 7.6, 1.5 Hz, 1H), 7.42 – 7.34 (m, 2H), 4.73 (d, *J* = 2.5 Hz, 2H), 3.77 (s, 2H), 2.34 (dd, *J* = 14.1, 6.7 Hz, 3H), 2.09 (t, *J* = 2.4 Hz, 1H), 1.90 (dd, *J* = 14.1, 4.6 Hz, 1H), 1.53 (s, 3H), 1.32 (s, 9H), 1.18 (m, 1H), 1.02 – 0.92 (m, 3H), 0.81 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.32, 163.11, 154.55, 143.49, 134.28, 129.26, 127.52, 125.69, 124.20, 79.21, 78.19, 70.46, 48.68, 46.78, 33.26, 32.84, 32.12, 31.44, 29.49, 28.36. IR (cm^{-1}): 3290, 2977, 2925, 2853, 1715, 1676, 1604, 806, 769, 706, 677. HRMS (ESI) m/z calcd for $C_{24}H_{31}N_2O_4^+$ $(M+H)^+$ 411.2278, found 411.2278.



3p

tert-butyl 4-((2-benzyl-4-methyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 81%, colorless oil, 75 mg, 27°C, 10 h.

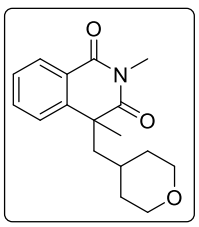
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.21 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.55 (td, *J* = 7.7, 1.5 Hz, 1H), 7.42 – 7.30 (m, 4H), 7.19 (dt, *J* = 13.7, 6.9 Hz, 3H), 5.23 (d, *J* = 13.6 Hz, 1H), 5.05 (d, *J* = 13.6 Hz, 1H), 3.65 (s, 2H), 2.24 (dd, *J* = 14.1, 5.8 Hz, 1H), 2.10 (dt, *J* = 23.6, 11.9 Hz, 2H), 1.82 (dd, *J* = 14.1, 4.4 Hz, 1H), 1.49 (s, 3H), 1.31 (s, 9H), 0.94 – 0.86 (m, 1H), 0.85 – 0.70 (m, 4H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.99, 163.94, 154.43, 143.57, 136.93, 133.96, 129.18, 129.14, 128.29, 127.52, 127.36, 125.57, 124.45, 79.08, 48.68, 46.62, 43.47, 33.14, 32.67, 32.15, 28.33. IR (cm^{-1}): 2971, 2928, 2864, 1690, 1669, 1604, 1585, 867, 768, 707, 676. HRMS (ESI) m/z calcd for $C_{28}H_{35}N_2O_4^+$ $(M+H)^+$ 463.2591, found 463.2591.



3q

benzyl 4-((2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) piperidine-1-carboxylate. 59%, colorless oil, 49.6 mg, 27°C, 10 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.64 (td, *J* = 7.6, 1.5 Hz, 1H), 7.43 (dd, *J* = 18.5, 7.8 Hz, 2H), 7.35 – 7.28 (m, 5H), 5.05 (s, 2H), 3.93 (s, 2H), 3.39 (s, 3H), 2.48 (s, 2H), 2.39 (dd, *J* = 14.2, 6.3 Hz, 1H), 1.95 (dd, *J* = 14.1, 4.4 Hz, 1H), 1.57 (s, 3H), 1.26 (m, 1H), 1.06 (m, 3H), 0.94 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.40, 164.16, 154.94, 143.37, 136.76, 133.87, 128.99, 128.34, 127.81, 127.69, 127.38, 125.54, 124.39, 66.84, 48.18, 46.55, 43.69, 43.66, 33.20, 32.73, 31.91, 31.71, 27.15. IR (cm^{-1}): 2929, 2853, 1699, 1667, 1605, 1586, 767, 701, 679. HRMS (ESI) m/z calcd for $C_{25}H_{29}N_2O_4^+$ $(M+H)^+$ 421.2122, found 421.2119.

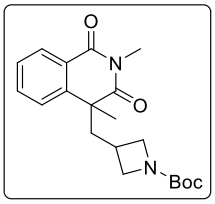


3r

2,4-dimethyl-4-((tetrahydro-2H-pyran-4-yl) methyl) isoquinoline-1,3(2H, 4H)-dione. 64%, colorless oil, 36.8 mg, 27°C, 10 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.27 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.65 (td, *J* = 7.6, 1.5 Hz, 1H), 7.47 – 7.41 (m, 2H), 3.78 – 3.67 (m, 2H), 3.39 (s, 3H), 3.11 – 3.04 (m, 2H), 2.40 (dd, *J* = 14.1, 6.4 Hz, 1H), 1.95 (dd, *J* = 14.1, 4.7 Hz, 1H), 1.59 (s, 3H),

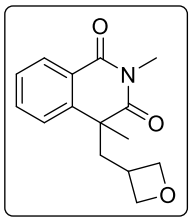
1.26 – 1.18 (m, 2H), 1.17 – 1.09 (m, 2H), 0.98 – 0.93 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.52, 164.26, 143.54, 133.87, 128.98, 127.36, 125.61, 124.43, 67.53, 67.51, 48.91, 46.53, 33.74, 32.94, 32.39, 31.63, 27.17. IR (cm^{-1}): 2957, 2939, 2841, 1709, 1666, 1604, 879, 853, 820, 765, 738, 701, 679, 659. HRMS (ESI) m/z calcd for $C_{17}H_{22}NO_3^+$ $(M+H)^+$ 288.1594, found 288.1595.



3s

tert-butyl 3-((2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl) methyl) azetidine-1-carboxylate. 57%, colorless oil, 40.9 mg, 27ºC, 10 h.

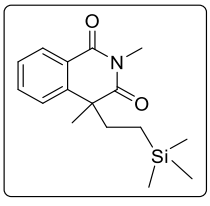
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.25 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.66 (td, *J* = 7.6, 1.5 Hz, 1H), 7.48 – 7.43 (m, 2H), 3.74 (t, *J* = 8.3 Hz, 1H), 3.51 – 3.41 (m, 2H), 3.38 (s, 3H), 3.07 (dd, *J* = 8.7, 5.8 Hz, 1H), 2.55 – 2.48 (m, 1H), 2.18 – 2.09 (m, 2H), 1.68 (s, 3H), 1.36 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.96, 164.02, 155.87, 142.50, 134.05, 128.95, 127.72, 125.44, 124.59, 79.30, 48.25, 46.78, 28.34, 28.25, 27.64, 27.18, 25.83. IR (cm^{-1}): 2973, 2879, 1701, 1669, 1605, 861, 770, 702, 679. HRMS (ESI) m/z calcd for $C_{20}H_{27}N_2O_4^+$ $(M+H)^+$ 359.1965, found 359.1966.



3t

2,4-dimethyl-4-(oxetan-3-ylmethyl) isoquinoline-1,3(2H, 4H)-dione. 63%, colorless oil, 32.7 mg, 27ºC, 10 h.

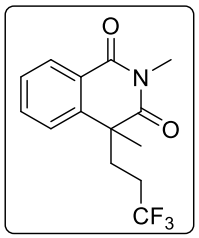
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.24 (d, *J* = 7.8 Hz, 1H), 7.65 (t, *J* = 7.7 Hz, 1H), 7.46 (t, *J* = 7.8 Hz, 2H), 4.51 – 4.46 (m, 1H), 4.28 (d, *J* = 6.6 Hz, 1H), 4.16 (d, *J* = 7.9 Hz, 1H), 3.87 (t, *J* = 6.6 Hz, 1H), 3.37 (s, 3H), 2.69 (d, *J* = 7.4 Hz, 1H), 2.57 (dd, *J* = 13.6, 6.7 Hz, 1H), 2.23 (dd, *J* = 13.6, 7.7 Hz, 1H), 1.68 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.96, 164.03, 142.55, 133.95, 128.96, 127.71, 125.45, 124.56, 76.85, 76.71, 47.63, 46.66, 32.31, 27.49, 27.17. IR (cm^{-1}): 2957, 2868, 1712, 1668, 1605, 857, 772, 701, 679. HRMS (ESI) m/z calcd for $C_{15}H_{18}NO_3^+$ $(M+H)^+$ 260.1281, found 260.1283.



3u

2,4-dimethyl-4-(2-(trimethylsilyl) ethyl) isoquinoline-1,3(2H,4H)-dione. 45%, colorless oil, 26.1 mg, 27ºC, 10 h.

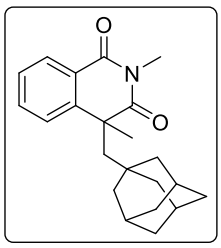
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.37 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.78 – 7.73 (m, 1H), 7.57 – 7.46 (m, 2H), 3.50 (s, 3H), 2.36 (td, *J* = 13.7, 4.4 Hz, 1H), 1.90 (td, *J* = 13.8, 3.5 Hz, 1H), 1.73 (s, 3H), 0.25 – 0.10 (m, 2H), 0.00 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.69, 164.65, 143.70, 133.89, 128.64, 127.14, 125.42, 125.06, 49.48, 38.43, 28.31, 26.99, 11.68, -2.12. IR (cm^{-1}): 2925, 1713, 1671, 1606, 862, 838, 761, 702, 680. HRMS (ESI) m/z calcd for $C_{16}H_{24}NO_2Si^+$ $(M+H)^+$ 290.1571, found 290.1569.



3v

2,4-dimethyl-4-(3,3,3-trifluoropropyl) isoquinoline-1,3(2H,4H)-dione. 30%, colorless oil, 17.1 mg, 32ºC, 20 h.

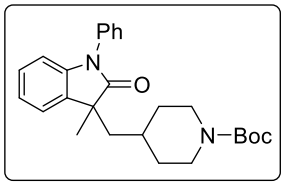
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.28 (d, *J* = 9.4 Hz, 1H), 7.70 (t, *J* = 7.6 Hz, 1H), 7.51 – 7.42 (m, 2H), 3.40 (s, 3H), 2.61 (td, *J* = 13.1, 4.7 Hz, 1H), 2.14 (td, *J* = 13.2, 3.8 Hz, 1H), 1.86 – 1.75 (m, 1H), 1.65 (s, 3H), 1.62 – 1.58 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.52, 163.94, 141.88, 134.52, 129.33, 127.95, 125.04, 124.90, 124.80, 46.71, 33.55 (q, *J* = 2.86 Hz), 31.48, 30.16, 29.87, 27.28. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -66.53. IR (cm^{-1}): 2953, 1715, 1668, 1605, 1467, 849, 768, 701, 678. HRMS (ESI) m/z calcd for $C_{14}H_{15}F_3NO_2^+$ $(M+H)^+$ 286.1049, found 286.1048.



3w

4-(((3r,5r,7r)-adamantan-1-yl) methyl)-2,4-dimethylisoquinoline-1,3(2H,4H)-dione. 23%, colorless oil, 15.5 mg, 28ºC, 20 h.

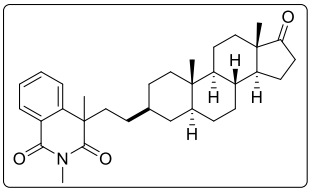
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.19 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.52 (ddd, *J* = 7.9, 7.2, 1.5 Hz, 1H), 7.40 – 7.32 (m, 2H), 3.32 (s, 3H), 2.31 (d, *J* = 14.4 Hz, 1H), 1.85 (d, *J* = 14.4 Hz, 1H), 1.63 (s, 3H), 1.55 (s, 1H), 1.48 (s, 3H), 1.43 (d, *J* = 12.5 Hz, 3H), 1.32 (m, 1H), 1.29 (m, 1H), 1.02 (m, 6H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.73, 164.44, 144.44, 133.19, 128.83, 127.16, 126.68, 124.04, 56.53, 45.18, 43.28, 36.53, 34.05, 33.96, 28.48, 27.18. IR (cm^{-1}): 2901, 2847, 1712, 1669, 1606, 768, 755, 702, 677. HRMS (ESI) m/z calcd for $C_{22}H_{28}NO_2^+$ $(M+H)^+$ 338.2115, found 338.2114.



3x

tert-butyl 4-((3-methyl-2-oxo-1-phenylindolin-3-yl) methyl) piperidine-1-carboxylate. 51%, colorless oil, 42.9 mg, 27ºC, 10 h. CAS: 2855070-45-8[2].

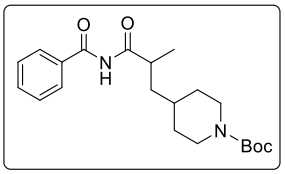
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.53 (t, *J* = 7.8 Hz, 2H), 7.43 – 7.35 (m, 3H), 7.26 – 7.18 (m, 2H), 7.10 (t, *J* = 7.5 Hz, 1H), 6.85 (d, *J* = 8.1 Hz, 1H), 3.89 (s, 2H), 2.48 (q, *J* = 9.5, 7.0 Hz, 2H), 2.08 (dd, *J* = 14.0, 6.6 Hz, 1H), 1.85 (dd, *J* = 14.0, 5.6 Hz, 1H), 1.46 (s, 3H), 1.40 (s, 9H), 1.26 (m, 1H), 1.18 (d, *J* = 14.7 Hz, 2H), 1.10 (dd, *J* = 11.3, 3.7 Hz, 1H), 0.98 (td, *J* = 12.0, 3.9 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 180.04, 154.68, 142.87, 134.59, 133.80, 129.62, 127.95, 127.69, 126.31, 123.01, 122.97, 109.45, 79.17, 47.77, 44.80, 33.35, 33.01, 32.54, 28.39, 26.38. IR (cm^{-1}): 2970, 2924, 2865, 1721, 1691, 1611, 1595, 869, 755, 700, 637.



3y

4-(2-((3R,5S,8R,9S,10S,13S,14S)-10,13-dimethyl-17-oxohexadecahydro-1H-cyclopenta[a]phenanthren-3-yl)ethyl)-2,4-dimethylisoquinoline-1,3(2H,4H)-dione. 25%, colorless oil, 24.5 mg. 28ºC, 12 h.

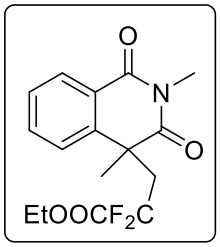
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.25 (d, *J* = 7.9 Hz, 1H), 7.63 (t, *J* = 7.6 Hz, 1H), 7.46 – 7.37 (m, 2H), 3.38 (s, 3H), 2.37 (td, *J* = 18.6, 17.8, 8.2 Hz, 2H), 2.09 – 1.97 (m, 1H), 1.95 – 1.84 (m, 2H), 1.75 – 1.65 (m, 2H), 1.62 (s, 3H), 1.57 (d, *J* = 1.8 Hz, 2H), 1.52 – 1.40 (m, 4H), 1.26 (s, 1H), 1.22 (d, *J* = 9.6 Hz, 1H), 1.18 – 1.12 (m, 2H), 1.12 – 1.05 (m, 2H), 0.97 (d, *J* = 9.6 Hz, 1H), 0.90 – 0.84 (m, 2H), 0.83 (m, 1H), 0.80 (s, 3H), 0.73 (m, 1H), 0.67 (s, 3H), 0.59 – 0.48 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 176.86, 164.47, 143.89, 133.79, 128.85, 127.19, 125.69, 124.53, 54.49, 51.44, 49.85, 49.53, 47.81, 47.74, 46.69, 46.62, 46.24, 46.16, 38.23, 36.67, 35.79, 35.73, 35.71, 35.52, 35.33, 34.97, 30.75, 30.72, 30.19, 29.81, 28.52, 28.37, 27.18, 27.12, 21.69, 20.09, 13.76, 12.10. IR (cm^{-1}): 2922, 2853, 1739, 1712, 1669, 1605, 769, 736, 702, 678. HRMS (ESI) m/z calcd for $C_{31}H_{42}NO_3^+$ $(M+H)^+$ 476.3159, found 476.3159.



3z

tert-butyl 4-(3-benzamido-2-methyl-3-oxopropyl) piperidine-1-carboxylate. 59%, colorless oil, 44.1 mg (0.1 mmol), 27ºC, 10 h.

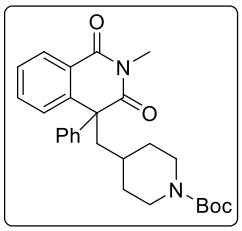
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.72 (s, 1H), 7.87 (d, *J* = 8.7 Hz, 2H), 7.64 – 7.58 (m, 1H), 7.50 (t, *J* = 7.7 Hz, 2H), 4.07 (s, 3H), 3.76 (q, *J* = 7.0 Hz, 1H), 2.66 (s, 3H), 1.84 (s, 2H), 1.67 (d, *J* = 13.5 Hz, 2H), 1.44 (s, 9H), 1.25 (d, *J* = 6.9 Hz, 3H), 1.14 – 1.09 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 204.68, 179.60, 165.24, 154.81, 133.20, 132.91, 128.97, 127.63, 79.2, 39.87, 37.15, 36.33, 33.71, 32.43, 31.86, 28.43, 17.36. IR (cm^{-1}): 3283, 2972, 2927, 2850, 1710, 1692, 1601, 864, 769, 709, 624. HRMS (ESI) m/z calcd for $C_{21}H_{31}N_2O_4^+$ $(M+H)^+$ 375.2278, found 375.2275.



4a

ethyl 3-(2,4-dimethyl-1,3-dioxo-1,2,3,4-tetrahydroisoquinolin-4-yl)-2,2-difluoropropanoate. 56%, yellow oil, 36.7 mg, 37ºC, 12h. CAS:1943678-54-3[3]

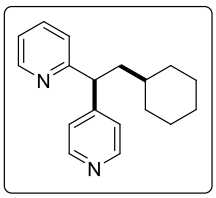
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.28 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.63 (td, *J* = 7.6, 1.5 Hz, 1H), 7.49 – 7.40 (m, 2H), 4.05 – 3.88 (m, 2H), 3.40 (s, 3H), 3.29 (ddd, *J* = 16.7, 15.1, 12.6 Hz, 1H), 2.89 (dt, *J* = 18.4, 14.8 Hz, 1H), 1.66 (s, 3H), 1.20 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 174.86, 163.74, 163.51 (t, *J* = 32.03 Hz), 140.62, 133.39, 127.83, 125.94, 124.51, 116.87 (t, *J* = 251.49 Hz), 62.97, 45.02 (dd, *J* = 23.78, 21.79 Hz), 43.55 (d, *J* = 6.44 Hz), 31.42, 27.27, 13.58. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -99.61, -100.32, -103.86, -104.57. IR (cm^{-1}): 2985, 1764, 1716, 1671, 1468, 1454, 1419, 1365, 1303, 1095, 154, 1016, 766, 702.



4b

tert-butyl 4-((2-methyl-1,3-dioxo-4-phenyl-1,2,3,4-tetrahydroisoquinolin-4-yl)methyl)piperidine-1-carboxylate. 60%, colorless oil, 53.6 mg, 28ºC, 10 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.52 (p, *J* = 4.4 Hz, 1H), 7.39 (d, *J* = 4.4 Hz, 3H), 7.29 – 7.19 (m, 5H), 4.01 (s, 2H), 3.10 (s, 3H), 2.66 – 2.49 (m, 2H), 2.07 (dt, *J* = 14.1, 7.1 Hz, 1H), 1.72 (dt, *J* = 13.9, 7.0 Hz, 1H), 1.64 – 1.55 (m, 2H), 1.44 (s, 9H), 1.31 – 1.24 (m, 1H), 1.05 (dqd, *J* = 24.5, 12.3, 4.3 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 177.39, 174.44, 154.74, 139.27, 135.00, 132.41, 128.71, 128.65, 128.31, 128.09, 127.22, 79.14, 48.30, 40.61, 34.77, 33.46, 32.18, 31.73, 28.38. IR (cm^{-1}): 2974, 2927, 2851, 1694, 1682, 1601, 1582, 1493, 1447, 1423, 1365, 1281, 1242, 1205, 1169, 1127, 1061, 1043, 1025, 1004, 967, 867, 799, 769, 723, 670, 665. HRMS (ESI) m/z calcd for $C_{27}H_{33}N_2O_4^+$ $(M+H)^+$ 449.2345, found 449.2347.

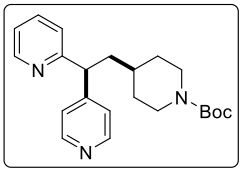


7a

2-(2-cyclohexyl-1-(pyridin-4-yl) ethyl) pyridine. 71%, colorless oil, 37.8 mg, 39ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.45 (dd, *J* = 32.7, 5.0 Hz, 3H), 7.54 – 7.45 (m, 1H), 7.20 (d, *J* = 4.8 Hz, 2H), 7.07 (dd, *J* = 13.7, 6.5 Hz, 2H), 4.11 (t, *J* = 7.9 Hz, 1H), 2.04 (dt, *J* = 14.4, 7.4 Hz, 1H), 1.87 (dt, *J* = 14.0, 7.2 Hz, 1H), 1.67 (d, *J* = 11.7 Hz,

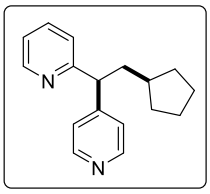
2H), 1.61 – 1.49 (m, 3H), 1.04 (d, *J* = 8.1 Hz, 4H), 0.87 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.38, 152.98, 149.74, 149.52, 136.54, 123.44, 122.65, 121.65, 50.05, 42.21, 35.00, 33.32, 33.19, 26.47, 26.08, 26.06. IR (cm^{-1}): 3020, 2921, 2850, 1594, 1511, 1447, 1411, 811, 582. HRMS (ESI) m/z calcd for $C_{18}H_{23}N_2^+$ $(M+H)^+$ 267.1856, found 267.1857.



7b

tert-butyl 4-(2-(pyridin-2-yl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 69%, colorless oil, 50.7 mg, 37ºC, 24 h.

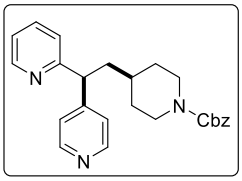
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.57 (d, *J* = 5.8 Hz, 1H), 8.49 (d, *J* = 6.1 Hz, 2H), 7.60 (td, *J* = 7.7, 1.9 Hz, 1H), 7.28 (d, *J* = 6.1 Hz, 2H), 7.17 – 7.12 (m, 2H), 4.17 (t, *J* = 7.9 Hz, 1H), 4.03 (s, 2H), 2.58 (d, *J* = 12.8 Hz, 2H), 2.27 – 2.17 (m, 1H), 2.05 – 1.95 (m, 1H), 1.70 (d, *J* = 13.3 Hz, 2H), 1.44 (s, 9H), 1.27 (d, *J* = 3.2 Hz, 1H), 1.16 (dq, *J* = 11.6, 5.9, 4.9 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.61, 154.63, 152.44, 149.68, 149.43, 136.58, 123.17, 122.63, 121.73, 79.10, 49.69, 41.08, 33.42, 31.91, 28.28. IR (cm^{-1}): 2926, 2853, 1690, 1597, 1588, 1569, 865, 823, 757, 639. HRMS (ESI) m/z calcd for $C_{22}H_{30}N_3O_2^+$ $(M+H)^+$ 368.2333, found 368.2330.



7c

2-(2-cyclopentyl-1-(pyridin-4-yl) ethyl) pyridine. 57%, colorless oil, 28.8 mg, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.57 (d, *J* = 4.8 Hz, 1H), 8.48 (d, *J* = 4.3 Hz, 2H), 7.62 – 7.55 (m, 1H), 7.28 (dd, *J* = 5.7, 1.9 Hz, 2H), 7.19 – 7.08 (m, 2H), 4.08 (t, *J* = 7.8 Hz, 1H), 2.25 (dt, *J* = 13.7, 7.6 Hz, 1H), 2.09 (dt, *J* = 13.8, 7.4 Hz, 1H), 1.72 (d, *J* = 8.0 Hz, 2H), 1.57 (dd, *J* = 15.8, 7.3 Hz, 3H), 1.45 (dt, *J* = 9.8, 4.7 Hz, 2H), 1.21 – 1.08 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.35, 152.91, 149.76, 149.53, 136.53, 123.41, 122.70, 121.67, 52.27, 41.07, 37.79, 32.70, 32.53, 25.08, 25.05. IR (cm^{-1}): 3005, 2947, 2856, 1587, 1569, 1553, 819, 790, 749. HRMS (ESI) m/z calcd for $C_{17}H_{21}N_2^+$ $(M+H)^+$ 253.1699, found 253.1698.

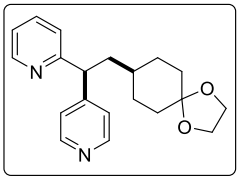


7d

benzyl 4-(2-(pyridin-2-yl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 62%, colorless oil, 49.8 mg, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.57 (s, 3H), 7.59 (s, 1H), 7.33 (d, *J* = 3.6 Hz, 7H), 7.14 (s, 2H), 5.10 (s, 2H), 4.15 (m, 3H), 2.57 (d, *J* = 51.9 Hz, 3H), 1.70 (m, 2H),

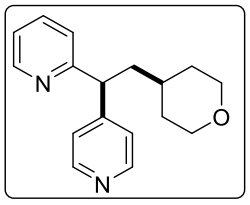
1.27 (m, 4H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.62, 155.08, 152.33, 149.84, 149.52, 136.82, 136.60, 128.33, 127.79, 127.67, 123.16, 122.67, 121.78, 66.82, 49.74, 43.88, 41.06, 33.39. IR (cm^{-1}): 3029, 3006, 2927, 2852, 1698, 1587, 1557, 864, 822, 789, 750, 698, 638. HRMS (ESI) m/z calcd for $C_{25}H_{28}N_3O_2^+$ $(M+H)^+$ 402.2176, found 402.2177.



7e

2-(1-(pyridin-4-yl)-2-(1,4-dioxaspiro [4.5] decan-8-yl) ethyl) pyridine. 51%, colorless oil, 33mg, 40^{o}C, 24 h.

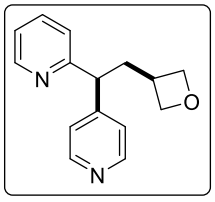
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.60 – 8.45 (m, 3H), 7.59 (td, *J* = 7.7, 1.9 Hz, 1H), 7.28 – 7.24 (m, 2H), 7.18 – 7.10 (m, 2H), 4.14 (t, *J* = 7.9 Hz, 1H), 3.90 (d, *J* = 3.9 Hz, 4H), 2.24 – 2.14 (m, 1H), 1.99 (dt, *J* = 14.0, 7.2 Hz, 1H), 1.79 – 1.65 (m, 4H), 1.44 – 1.29 (m, 4H), 1.15 (ddt, *J* = 10.8, 7.4, 3.6 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.07, 152.78, 149.83, 149.58, 136.61, 123.31, 122.68, 121.75, 108.84, 64.16, 53.37, 50.46, 40.99, 34.25, 33.77, 30.11, 30.06. IR (cm^{-1}): 2926, 1588, 1569, 1553, 819, 790, 749. HRMS (ESI) m/z calcd for $C_{20}H_{25}N_2O_2^+$ $(M+H)^+$ 325.1911, found 325.1909.



7f

2-(1-(pyridin-4-yl)-2-(tetrahydro-2H-pyran-4-yl) ethyl) pyridine. 43%, yellow oil, 23.1 mg, 39^{o}C, 24h.

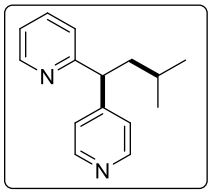
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.54 (dd, *J* = 32.8, 5.0 Hz, 3H), 7.60 (td, *J* = 7.7, 2.1 Hz, 1H), 7.28 (d, *J* = 3.4 Hz, 2H), 7.15 (d, *J* = 6.8 Hz, 2H), 4.17 (t, *J* = 7.9 Hz, 1H), 3.90 (d, *J* = 9.5 Hz, 2H), 3.25 (t, *J* = 10.5 Hz, 2H), 2.13 (ddd, *J* = 82.6, 13.5, 5.9 Hz, 2H), 1.62 (t, *J* = 9.7 Hz, 2H), 1.35 (d, *J* = 14.7 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.79, 152.58, 149.79, 149.57, 136.65, 123.29, 122.70, 121.83, 67.76, 49.58, 41.59, 32.97, 32.53. IR (cm^{-1}): 3005, 2925, 2841, 1597, 1588, 1569, 856, 822, 789, 750, 632. HRMS (ESI) m/z calcd for $C_{17}H_{21}N_2O^+$ $(M+H)^+$ 269.1648, found 269.1647.



7g

2-(2-(oxetan-3-yl)-1-(pyridin-4-yl) ethyl) pyridine. 60%, colorless oil, 28.8 mg, 40^{o}C, 24 h.

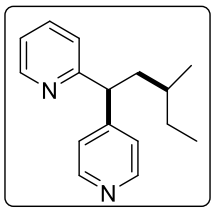
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.58 (d, *J* = 4.8 Hz, 1H), 8.52 – 8.48 (m, 2H), 7.60 (td, *J* = 7.7, 1.9 Hz, 1H), 7.26 – 7.23 (m, 2H), 7.16 (dd, *J* = 7.6, 4.9 Hz, 1H), 7.11 (d, *J* = 7.8 Hz, 1H), 4.62 (ddd, *J* = 17.6, 7.8, 5.9 Hz, 2H), 4.33 (dt, *J* = 20.0, 6.3 Hz, 2H), 3.90 (t, *J* = 7.7 Hz, 1H), 2.98 – 2.88 (m, 1H), 2.67 (dt, *J* = 13.6, 7.9 Hz, 1H), 2.49 – 2.40 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.05, 151.89, 149.94, 149.60, 136.77, 123.16, 122.87, 122.06, 77.18, 77.17, 51.09, 38.45, 33.82. IR (cm^{-1}): 2958, 2925, 2865, 1598, 1588, 1570, 1492, 1470, 1433, 1414, 853, 821, 794, 751, 643. HRMS (ESI) m/z calcd for $C_{15}H_{17}N_2O^+$ $(M+H)^+$ 241.1335, found 241.1334.



7h

2-(3-methyl-1-(pyridin-4-yl) butyl) pyridine. 78%, colorless oil, 35.3 mg, 24 h, 37ºC, d.r =1: 6.

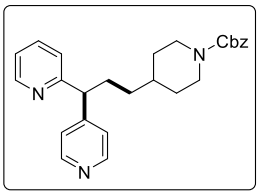
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.59 – 8.47 (m, 3H), 7.59 (td, *J* = 7.7, 1.9 Hz, 1H), 7.30 – 7.27 (m, 2H), 7.19 – 7.10 (m, 2H), 4.14 (t, *J* = 7.9 Hz, 1H), 2.16 – 2.08 (m, 1H), 1.99 – 1.91 (m, 1H), 1.43 – 1.33 (m, 1H), 0.93 (dd, *J* = 6.6, 3.9 Hz, 6H), 0.86 (d, *J* = 6.5 Hz, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 164.97, 162.23, 162.08, 152.80, 149.74, 149.50, 149.33, 149.07, 136.50, 136.11, 136.05, 123.36, 122.65, 121.63, 121.04, 120.78, 53.34, 50.83, 45.38, 45.01, 43.65, 36.31, 35.89, 29.62, 25.56, 23.21, 22.52, 22.44, 22.08. IR (cm^{-1}): 3068, 3006, 2955, 2926, 2867, 1587, 1569, 1493, 1469, 1432, 1413, 1384, 1366, 829, 812, 790, 749, 639. HRMS (ESI) m/z calcd for $C_{15}H_{19}N_2^+$ $(M+H)^+$ 227.1543, found 227.1542.



7i

2-(3-methyl-1-(pyridin-4-yl) pentyl) pyridine. 83%, colorless oil, 39.9 mg, 37ºC, 24 h. d. r =1: 1.

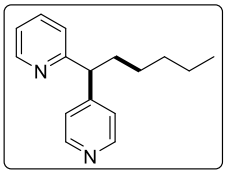
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.61 – 8.44 (m, 3H), 7.62 – 7.51 (m, 1H), 7.30 – 7.24 (m, 2H), 7.19 – 7.09 (m, 2H), 4.15 (t, *J* = 7.2 Hz, 1H), 2.30 (ddd, *J* = 14.0, 9.1, 5.2 Hz, 1H), 2.13 (dtd, *J* = 15.2, 10.4, 9.7, 6.1 Hz, 1H), 1.96 (dt, *J* = 14.0, 7.3 Hz, 1H), 1.79 (dt, *J* = 13.9, 7.1 Hz, 1H), 1.44 – 1.33 (m, 2H), 1.24 – 1.12 (m, 2H), 0.93 – 0.86 (m, 3H), 0.86 – 0.80 (m, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.58, 162.06, 153.21, 152.64, 149.76, 149.72, 149.57, 149.49, 136.54, 136.51, 123.52, 123.32, 122.79, 122.54, 121.67, 121.64, 50.74, 50.60, 41.65, 41.42, 31.86, 31.82, 29.43, 29.38, 18.99, 18.94, 11.01. IR (cm^{-1}): 3006, 2959, 2925, 2872, 1587, 1570, 1493, 1468, 1433, 1414, 1378, 819, 788, 748, 619. HRMS (ESI) m/z calcd for $C_{16}H_{21}N_2^+$ $(M+H)^+$ 241.1699, found 241.1697.



7j

benzyl 4-(3-(pyridin-2-yl)-3-(pyridin-4-yl) propyl) piperidine-1-carboxylate. 28%, colorless oil, 23.3 mg, 37ºC, 24 h.

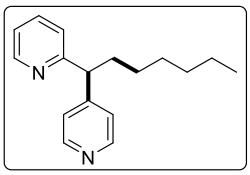
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.44 (dd, *J* = 32.2, 5.2 Hz, 3H), 7.53 – 7.45 (m, 1H), 7.27 – 7.17 (m, 7H), 7.04 (t, *J* = 6.2 Hz, 2H), 5.02 (s, 2H), 4.04 (s, 2H), 3.87 (t, *J* = 7.6 Hz, 1H), 2.62 (q, *J* = 13.2, 11.1 Hz, 3H), 2.24 – 2.12 (m, 1H), 2.09 – 1.93 (m, 1H), 1.56 (d, *J* = 12.4 Hz, 2H), 1.38 – 1.27 (m, 1H), 1.04 – 0.72 (m, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 155.10, 152.49, 149.67, 149.45, 136.83, 136.49, 128.30, 127.74, 127.65, 123.20, 122.67, 121.69, 66.76, 53.16, 44.03, 35.76, 34.38, 31.82, 31.57. IR (cm^{-1}): 3006, 2927, 2852, 1690, 1588, 1569, 1470, 1432, 1363, 751, 698. HRMS (ESI) m/z calcd for $C_{26}H_{30}N_3O_2^+$ $(M+H)^+$ 416.2333, found 416.2335.



7k

2-(1-(pyridin-4-yl) hexyl) pyridine. 54%, colorless oil, 26 mg, 37ºC, 24 h.

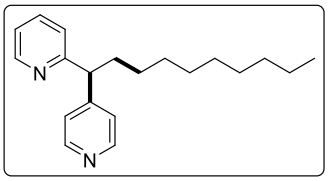
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.54 (d, *J* = 33.2 Hz, 3H), 7.63 – 7.56 (m, 1H), 7.27 (d, *J* = 3.7 Hz, 2H), 7.15 (d, *J* = 7.8 Hz, 2H), 4.00 (t, *J* = 7.8 Hz, 1H), 2.22 (q, *J* = 7.2 Hz, 1H), 2.05 (q, *J* = 7.0, 6.5 Hz, 1H), 1.90 (m, 1H), 1.29 (m, 6H), 0.84 (t, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.28, 152.89, 149.73, 149.54, 136.54, 123.41, 122.69, 121.69, 53.20, 34.54, 31.65, 27.40, 22.42, 13.95. IR (cm^{-1}): 2955, 2926, 2856, 1588, 1569, 1493, 1468, 1433, 1414, 819, 749. HRMS (ESI) m/z calcd for $C_{16}H_{21}N_2^+$ $(M+H)^+$ 241.1699, found 241.1698.



7l

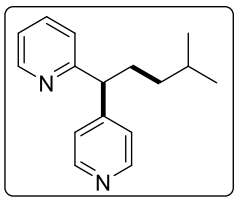
2-(1-(pyridin-4-yl) heptyl) pyridine. 40%, colorless oil, 20.4 mg, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.57 (d, *J* = 5.0 Hz, 1H), 8.49 (d, *J* = 6.1 Hz, 2H), 7.59 (td, *J* = 7.7, 1.9 Hz, 1H), 7.27 (dd, *J* = 4.3, 1.8 Hz, 2H), 7.16 – 7.08 (m, 2H), 4.01 (t, *J* = 7.7 Hz, 1H), 2.28 – 2.17 (m, 1H), 2.10 – 2.00 (m, 1H), 1.33 – 1.21 (m, 8H), 0.85 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.22, 152.97, 149.61, 149.51, 136.52, 123.42, 122.67, 121.67, 53.18, 34.58, 31.58, 29.10, 27.67, 22.51, 13.96. IR (cm^{-1}): 3068, 3006, 2954, 2927, 2855, 1588, 1569, 1493, 1469, 1433, 1414, 811, 786, 749, 724, 639. HRMS (ESI) m/z calcd for $C_{17}H_{23}N_2^+$ $(M+H)^+$ 255.1856, found 255.1855.



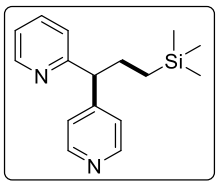
7m

2-(1-(pyridin-4-yl) decyl) pyridine. 31%, colorless oil, 18.4 mg, 37°C, 24 h.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.57 (d, *J* = 3.1 Hz, 1H), 8.49 (d, *J* = 5.2 Hz, 2H), 7.59 (td, *J* = 7.7, 1.9 Hz, 1H), 7.27 (d, *J* = 5.1 Hz, 2H), 7.17 – 7.10 (m, 2H), 4.00 (t, *J* = 7.7 Hz, 1H), 2.22 (dq, *J* = 15.4, 7.7 Hz, 1H), 2.05 (dq, *J* = 13.7, 7.6 Hz, 1H), 1.22 (m, 14H), 0.86 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.23, 153.01, 149.61, 149.53, 136.54, 123.44, 122.68, 121.68, 34.58, 31.82, 29.47, 29.45, 29.39, 29.21, 27.72, 22.61, 14.04. IR (cm^{-1}): 2924, 2853, 1597, 1589, 1570, 1561, 1554, 1493, 1468, 1432, 1413, 749. HRMS (ESI) m/z calcd for $C_{20}H_{29}N_2^+$ $(M+H)^+$ 297.2325, found 297.2325.



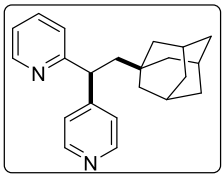
7n

2-(4-methyl-1-(pyridin-4-yl) pentyl) pyridine. 51%, colorless oil, 24.5 mg, 37°C, 24 h.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.58 (d, *J* = 5.7 Hz, 1H), 8.49 (d, *J* = 5.1 Hz, 2H), 7.59 (t, *J* = 7.7 Hz, 1H), 7.27 (d, *J* = 3.4 Hz, 2H), 7.17 – 7.08 (m, 2H), 3.96 (t, *J* = 7.7 Hz, 1H), 2.27 – 2.17 (m, 1H), 2.06 (dq, *J* = 13.8, 7.6 Hz, 1H), 1.56 (dq, *J* = 13.2, 6.6 Hz, 1H), 1.12 (q, *J* = 7.3 Hz, 2H), 0.86 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.27, 152.87, 149.72, 149.54, 136.52, 123.40, 122.64, 121.67, 53.47, 36.94, 32.44, 27.96, 22.47, 22.45. IR (cm^{-1}): 3068, 3006, 2953, 2926, 2868, 1597, 1588, 1569, 1493, 1469, 1433, 1414, 1384, 1366, 818, 749, 639. HRMS (ESI) m/z calcd for $C_{16}H_{21}N_2^+$ $(M+H)^+$ 241.1699, found 241.1698.



7o

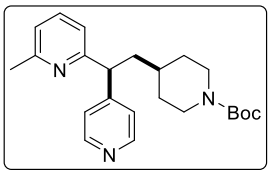
2-(1-(pyridin-4-yl)-3-(trimethylsilyl) propyl) pyridine. 52%, colorless oil, 28.1 mg, 37°C, 24 h.
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.61 (d, *J* = 5.8 Hz, 1H), 8.52 (d, *J* = 6.1 Hz, 2H), 7.62 (td, *J* = 7.7, 1.9 Hz, 1H), 7.30 (dd, *J* = 4.7, 1.6 Hz, 2H), 7.19 – 7.13 (m, 2H), 3.95 (t, *J* = 7.6 Hz, 1H), 2.28 – 2.17 (m, 1H), 2.10 – 2.02 (m, 1H), 0.48 – 0.41 (m, 2H), 0.00 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.20, 152.67, 149.73, 149.59, 136.48, 123.53, 122.77, 121.66, 56.60, 29.23, 15.05, -1.83. IR (cm^{-1}): 3068, 3007, 2952, 2924, 2854, 1597, 1589, 1570, 1469, 1433, 1413, 1248, 857, 837, 748, 702. HRMS (ESI) m/z calcd for $C_{16}H_{23}N_2Si^+$ $(M+H)^+$ 271.1625, found 271.1623.



7p

2-(2-((3r,5r,7r)-adamantan-1-yl)-1-(pyridin-4-yl) ethyl) pyridine. 36%, 22.9 mg, colorless oil, 37ºC, 24 h.

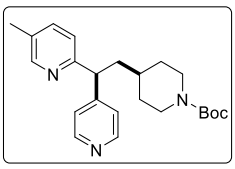
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.49 (dd, *J* = 5.2, 1.9 Hz, 1H), 8.40 – 8.36 (m, 2H), 7.50 (td, *J* = 7.6, 1.9 Hz, 1H), 7.25 – 7.21 (m, 2H), 7.13 (d, *J* = 7.8 Hz, 1H), 7.02 (ddd, *J* = 7.5, 4.8, 1.2 Hz, 1H), 4.16 (dd, *J* = 7.6, 5.4 Hz, 1H), 2.23 (dd, *J* = 14.2, 7.6 Hz, 1H), 1.83 – 1.77 (m, 4H), 1.57 (d, *J* = 14.6 Hz, 3H), 1.48 (d, *J* = 12.4 Hz, 3H), 1.37 (d, *J* = 12.2 Hz, 3H), 1.30 (d, *J* = 12.2 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.30, 154.74, 149.63, 149.39, 136.57, 123.32, 122.78, 121.54, 53.38, 49.08, 48.16, 42.88, 41.64, 36.92, 36.35, 33.43, 29.67, 29.43, 28.62. IR (cm^{-1}): 2902, 2846, 1596, 1587, 1493, 1468, 1450, 1433, 1415, 1362, 811, 749. HRMS (ESI) m/z calcd for $C_{22}H_{27}N_2^+$ $(M+H)^+$ 319.2169, found 319.2170.



8a

tert-butyl 4-(2-(6-methylpyridin-2-yl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 56%, colorless oil, 42.7 mg, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.37 (s, 2H), 7.40 (dt, *J* = 7.7, 3.9 Hz, 1H), 7.22 (d, *J* = 8.5 Hz, 2H), 6.88 (dd, *J* = 11.9, 8.5 Hz, 2H), 4.06 (d, *J* = 8.0 Hz, 1H), 3.96 (s, 2H), 2.45 (d, *J* = 3.4 Hz, 5H), 2.08 (dt, *J* = 14.5, 7.0 Hz, 1H), 1.94 – 1.83 (m, 1H), 1.65 – 1.54 (m, 2H), 1.39 – 1.34 (m, 9H), 1.20 – 1.03 (m, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.08, 158.24, 154.77, 152.82, 149.73, 136.71, 123.40, 121.27, 119.28, 79.18, 49.99, 41.47, 33.64, 32.08, 28.43, 24.61. IR (cm^{-1}): 2975, 2927, 2851, 1690, 1595, 1574, 1557, 1454, 1423, 865, 824, 759, 732, 646. HRMS (ESI) m/z calcd for $C_{23}H_{32}N_3O_2^+$ $(M+H)^+$ 382.2489, found 382.2486.

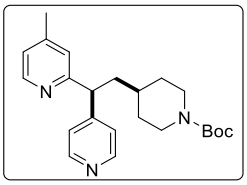


8b

tert-butyl 4-(2-(5-methylpyridin-2-yl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 50%, colorless oil, 38.2 mg, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-d) δ 8.48 (d, *J* = 6.1 Hz, 2H), 8.40 (s, 1H), 7.40 (dd, *J* = 7.9, 2.3 Hz, 1H), 7.25 (d, *J* = 6.2 Hz, 2H), 7.05 (d, *J* = 7.9 Hz, 1H), 4.12 (t, *J* = 7.9 Hz, 1H), 4.03 (s, 2H), 2.56 (t, *J* = 12.4 Hz, 2H), 2.29 (s, 3H), 2.23 – 2.16 (m, 1H), 1.97 (dt, *J* = 13.8, 7.0 Hz, 1H), 1.67 (t, *J* = 14.1 Hz, 2H), 1.44 (s, 9H), 1.28 – 1.21 (m, 1H), 1.13 (qd, *J* = 12.1, 6.1 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 158.78, 154.74, 152.81, 149.95, 149.81, 137.20, 131.21, 123.18, 122.14, 79.19, 49.34, 41.21,

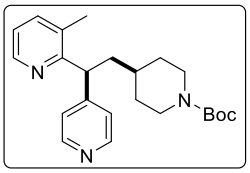
33.53, 32.08, 28.39, 17.97. IR (cm^{-1}): 2974, 2926, 2850, 1690, 1594, 1570, 1482, 1423, 1365, 866, 836, 769, 628. HRMS (ESI) m/z calcd for $C_{23}H_{32}N_3O_2^+$ $(M+H)^+$ 382.2489, found 382.2486.



8c

tert-butyl 4-(2-(4-methylpyridin-2-yl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 56%, colorless oil, 42.7 mg, 37ºC, 24 h.

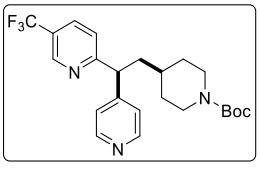
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.49 (d, *J* = 6.1 Hz, 2H), 8.42 (d, *J* = 5.7 Hz, 1H), 7.29 – 7.25 (m, 2H), 6.96 (d, *J* = 3.1 Hz, 2H), 4.11 (t, *J* = 7.9 Hz, 1H), 4.02 (s, 2H), 2.58 (d, *J* = 12.5 Hz, 2H), 2.30 (s, 3H), 2.20 (dt, *J* = 14.4, 7.5 Hz, 1H), 1.98 (dt, *J* = 14.1, 7.2 Hz, 1H), 1.69 (d, *J* = 10.4 Hz, 2H), 1.44 (s, 9H), 1.26 (ddd, *J* = 11.1, 7.0, 3.5 Hz, 1H), 1.14 (tt, *J* = 10.8, 5.9 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.49, 154.71, 152.61, 149.79, 149.21, 147.75, 123.57, 123.22, 122.83, 79.15, 52.99, 49.65, 41.11, 33.48, 32.00, 28.35, 20.93, 8.08. IR (cm^{-1}): 2975, 2926, 2851, 1690, 1595, 1560, 1477, 1420, 1365, 866, 822, 768, 733. HRMS (ESI) m/z calcd for $C_{23}H_{32}N_3O_2^+$ $(M+H)^+$ 382.2489, found 382.2486.



8d

tert-butyl 4-(2-(3-methylpyridin-2-yl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 48%, colorless oil, 36.6 mg, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.51 – 8.44 (m, 3H), 7.40 (d, *J* = 7.0 Hz, 1H), 7.23 (d, *J* = 6.1 Hz, 2H), 7.07 (dd, *J* = 7.6, 4.7 Hz, 1H), 4.29 (t, *J* = 7.6 Hz, 1H), 4.03 (s, 2H), 2.62 – 2.51 (m, 2H), 2.27 (s, 3H), 1.96 (s, 1H), 1.71 (d, *J* = 12.2 Hz, 1H), 1.60 (t, *J* = 6.4 Hz, 1H), 1.44 (s, 9H), 1.33 – 1.07 (m, 4H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 159.16, 154.81, 152.51, 149.77, 146.97, 138.15, 131.33, 123.58, 121.75, 79.23, 45.09, 42.04, 33.62, 28.45, 18.90. IR (cm^{-1}): 2974, 2926, 2849, 1690, 1595, 1584, 1571, 1465, 1448, 1421, 1365, 866, 829, 788, 732. HRMS (ESI) m/z calcd for $C_{23}H_{32}N_3O_2^+$ $(M+H)^+$ 382.2489, found 382.2486.

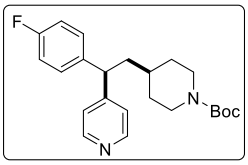


8e

tert-butyl 4-(2-(pyridin-4-yl)-2-(5-(trifluoromethyl) pyridin-2-yl) ethyl) piperidine-1-carboxylate. 43%, colorless oil, 37.4 mg, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.85 (s, 1H), 8.53 (d, *J* = 4.7 Hz, 2H), 7.83 (dd, *J* = 8.2, 2.4 Hz, 1H), 7.30 – 7.24 (m, 3H), 4.23 (t, *J* = 7.8 Hz, 1H), 4.04 (s, 2H), 2.58 (d, *J* = 12.0 Hz, 2H), 2.23 (dt, *J* = 14.3, 7.3 Hz, 1H), 2.03 (dt, *J* = 13.9, 7.0 Hz, 1H),

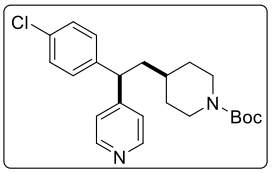
1.67 (d, *J* = 8.1 Hz, 2H), 1.44 (s, 9H), 1.26 – 1.12 (m, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.70, 154.74, 151.44, 150.03, 146.57 (q, *J* = 4.04 Hz), 133.86 (q, *J* = 3.31 Hz), 125.10, 124.77, 123.27, 122.51, 79.32, 49.88, 41.97, 41.18, 33.52, 32.02, 28.40. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.50. IR (cm^{-1}): 2976, 2928, 2852, 1690, 1605, 1595, 1574, 1443, 1366, 1328, 866, 772, 734, 627. HRMS (ESI) m/z calcd for $C_{23}H_{29}F_3N_3O_2^+$ $(M+H)^+$ 436.2206, found 436.2206.



8f

tert-butyl 4-(2-(4-fluorophenyl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 50%, colorless oil, 38.4 mg, 37ºC, 24 h. CAS: 3026256-97-0[4].

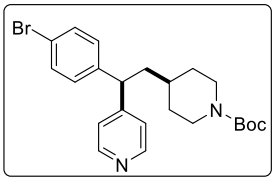
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.50 (d, *J* = 5.8 Hz, 2H), 7.20 – 7.15 (m, 2H), 7.13 (d, *J* = 6.2 Hz, 2H), 6.99 (t, *J* = 8.6 Hz, 2H), 4.02 (t, *J* = 8.0 Hz, 3H), 2.55 (d, *J* = 11.2 Hz, 2H), 1.98 – 1.92 (m, 2H), 1.67 (t, *J* = 14.9 Hz, 2H), 1.44 (s, 9H), 1.31 – 1.22 (m, 1H), 1.21 – 1.09 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.73, 160.28, 154.64, 153.45, 149.87, 138.43 (d, *J* = 3.32 Hz), 129.15 (d, *J* = 7.93 Hz), 122.88, 115.62 (d, *J* = 21.34 Hz), 79.18, 46.49, 41.82, 33.28, 32.12, 31.82, 28.32. ^{19}F NMR (376 MHz, Chloroform-*d*) δ -115.81. IR (cm^{-1}): 2974, 2925, 2852, 1687, 1596, 1508, 1423, 865, 835, 819, 768.



8g

tert-butyl 4-(2-(4-chlorophenyl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 46%, colorless oil, 36.9 mg, 37ºC, 24 h. CAS: 3026256-98-1[4].

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.50 (m, 2H), 7.29 – 7.26 (m, 2H), 7.13 (dd, *J* = 9.4, 7.0 Hz, 4H), 4.11 – 3.96 (m, 3H), 2.56 (t, *J* = 12.6 Hz, 2H), 1.98 – 1.90 (m, 2H), 1.66 (t, *J* = 13.7 Hz, 2H), 1.44 (s, 9H), 1.27 (td, *J* = 10.4, 3.4 Hz, 1H), 1.21–1.08 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 154.75, 153.25, 150.01, 141.30, 132.65, 129.13, 128.96, 123.00, 79.33, 46.75, 41.75, 33.39, 32.25, 31.93, 28.44. IR (cm^{-1}): 2975, 2927, 2851, 1687, 1598, 1560, 1491, 1424, 1365, 865, 831, 768, 732, 645, 623, 592, 553.

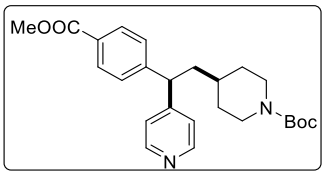


8h

tert-butyl 4-(2-(3-methylpyridin-2-yl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate. 52%, colorless oil, 46.3 mg, 37ºC, 24 h. 3026257-01-9[4].

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.49 (d, *J* = 5.0 Hz, 2H), 7.43 (d, *J* = 6.6 Hz, 2H), 7.10 (dd, *J* = 12.4, 7.2 Hz, 4H), 4.10 – 3.94 (m, 3H), 2.55 (d, *J* = 15.3 Hz, 2H),

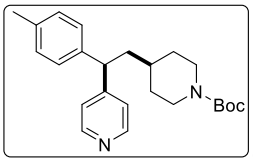
1.94 (t, *J* = 8.6 Hz, 2H), 1.66 (t, *J* = 14.5 Hz, 2H), 1.44 (s, 9H), 1.32 – 1.22 (m, 1H), 1.21 – 1.08 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 154.59, 153.01, 149.83, 141.68, 131.74, 129.37, 122.84, 120.53, 79.17, 46.65, 41.50, 34.06, 33.21, 32.08, 31.75, 28.29. IR (cm^{-1}): 2974, 2927, 2853, 1689, 1597, 1586, 1422, 864, 812, 766, 715.



8i

tert-butyl 4-(2-(4-acetoxyphenyl)-2-(pyridin-4-yl) ethyl) piperidine-1-carboxylate, 38%, yellow oil, 32.3 mg, 37°C, 24 h.

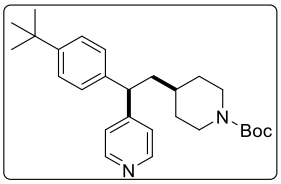
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.51 (d, *J* = 5.0 Hz, 2H), 7.98 (d, *J* = 8.0 Hz, 2H), 7.29 (d, *J* = 8.8 Hz, 2H), 7.14 (d, *J* = 5.6 Hz, 2H), 4.12 – 3.98 (m, 3H), 3.90 (s, 3H), 2.54 (d, *J* = 12.1 Hz, 2H), 1.99 (dd, *J* = 10.9, 7.6 Hz, 2H), 1.67 (t, *J* = 14.8 Hz, 2H), 1.44 (s, 9H), 1.26 (m, 1H), 1.15 (d, *J* = 11.3 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.64, 154.68, 152.76, 150.01, 147.97, 130.07, 128.83, 127.80, 122.98, 79.28, 52.02, 47.34, 41.54, 33.38, 32.16, 31.89, 28.37. IR (cm^{-1}): 2926, 2853, 1723, 1690, 1610, 1595, 1417, 1365, 1280, 1165, 1112, 865, 774, 754, 708. HRMS (ESI) m/z calcd for $C_{25}H_{33}N_2O_4^+$ $(M+H)^+$ 425.2435, found 425.2436.



8j

tert-butyl 4-(2-(pyridin-4-yl)-2-(p-tolyl) ethyl) piperidine-1-carboxylate, 47%, colorless oil, 35.8 mg, 37°C, 24 h. CAS: 3026256-91-4[4].

^{1}H NMR (400 MHz, CDCl3) δ 8.48 (d, *J* = 4.8 Hz, 2H), 7.08-7.14 (m, 6H), 4.02 – 3.96 (m, 3H), 2.53-2.60 (m, 2H), 2.31 (s, 3H), 1.90-1.99 (m, 2H), 1.63-1.71 (m, 2H), 1.44 (s, 9H), 1.26-1.27 (m, 1H), 1.11-1.20 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 154.74, 154.07, 149.83, 139.72, 136.38, 129.42, 127.60, 123.01, 79.22, 46.95, 41.81, 33.35, 32.26, 31.91, 28.40, 20.92. IR (cm^{-1}): 3022, 2974, 2924, 2849, 1691, 1595, 1557, 1512, 1423, 1365, 865, 813, 769, 732.

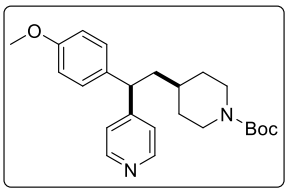


8k

tert-butyl 4-(2-(4-(tert-butyl)phenyl)-2-(pyridin-4-yl)ethyl)piperidine-1-carboxylate, 55%, yellow oil, 46.6 mg, 39°C, 24 h. CAS: 3026256-93-6[4].

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.48 (d, *J* = 5.2 Hz, 2H), 7.34-7.28 (m, 2H), 7.14 (dd, *J* = 10.8, 7.2 Hz, 4H), 3.99 (t, *J* = 8.0 Hz, 3H), 2.59 (d, *J* = 12.6 Hz, 2H), 1.96 (td, *J* = 7.4, 3.1 Hz, 2H), 1.67 (d, *J* = 11.8 Hz, 2H), 1.44 (s, 9H), 1.29 (s, 10H), 1.14 (qd, *J* = 12.1, 3.9 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 154.74, 153.96,

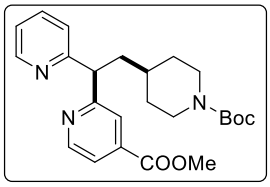
149.79, 149.55, 139.67, 127.25, 125.56, 123.13, 79.21, 46.88, 41.86, 34.32, 33.28, 32.06, 31.26. IR (cm^{-1}): 2958, 2925, 2868, 1693, 1594, 1558, 1513, 1463, 1416, 1377, 1365, 1167, 866, 828, 769.



8l

tert-butyl 4-(2-(4-methoxyphenyl)-2-(pyridin-4-yl)ethyl)piperidine-1-carboxylate, 64%, yellow oil, 51 mg, 39ºC, 24 h. CAS: 3026256-94-7[4].

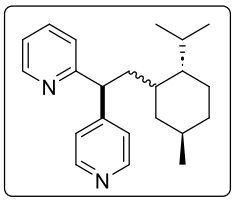
^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.47 (d, *J* = 6.2 Hz, 2H), 7.15-7.09 (m, 4H), 6.88-6.81 (m, 2H), 4.12-3.91 (m, 3H), 3.78 (s, 3H), 2.58 (d, *J* = 12.9 Hz, 2H), 2.02-1.83 (m, 2H), 1.74-1.59 (m, 2H), 1.44 (s, 9H), 1.28 (ddq, *J* = 13.9, 6.5, 3.7 Hz, 1H), 1.21-1.08 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 158.31, 154.72, 154.22, 149.78, 134.72, 128.66, 122.96, 114.08, 79.22, 55.15, 46.45, 41.89, 33.31, 32.22, 31.84, 28.37. IR (cm^{-1}): 2926, 2850, 1689, 1596, 1511, 1465, 1422, 1365, 1247, 1166, 967, 864, 832.



9a

methyl 2-(2-(1-(tert-butoxycarbonyl) piperidin-4-yl)-1-(pyridin-2-yl) ethyl) isonicotinate. 31%, 26.4 mg, colorless oil, 37ºC, 24 h.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.70 (d, *J* = 5.9 Hz, 1H), 8.56 (dd, *J* = 5.8, 1.9 Hz, 1H), 7.90 (s, 1H), 7.66 (dd, *J* = 5.1, 1.5 Hz, 1H), 7.59 (td, *J* = 7.7, 1.9 Hz, 1H), 7.32 (d, *J* = 7.9 Hz, 1H), 7.12 (ddd, *J* = 7.5, 4.9, 1.2 Hz, 1H), 4.50 (t, *J* = 7.9 Hz, 1H), 4.01 (s, 2H), 3.93 (s, 3H), 2.54 (d, *J* = 12.5 Hz, 2H), 2.22 (t, *J* = 6.9 Hz, 2H), 1.72 (s, 1H), 1.43 (s, 9H), 1.27 – 1.10 (m, 4H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 165.72, 163.87, 162.05, 154.82, 150.00, 149.40, 137.88, 136.57, 122.94, 122.20, 121.71, 120.79, 79.17, 52.91, 52.58, 40.97, 33.74, 32.08, 28.42. IR (cm^{-1}): 2974, 2927, 2850, 1733, 1691, 1588, 1561, 1469, 1433, 1365, 865, 762, 686. HRMS (ESI) m/z calcd for $C_{24}H_{32}N_3O_4^+$ $(M+H)^+$ 426.2387, found 426.2388.

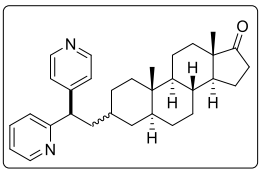


7q

2-(2-((1R,2S,5R)-2-isopropyl-5-methylcyclohexyl)-1-(pyridin-4-yl) ethyl) pyridine, 38%, colorless oil, 24.5 mg, 37ºC, 24 h. d. r.=1: 2.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.62 – 8.43 (m, 3H), 7.59 (dtd, *J* = 16.7, 7.6, 2.0 Hz, 1H), 7.35 – 7.25 (m, 2H), 7.22 – 7.04 (m, 2H), 4.20 (dd, *J* = 11.4, 4.1 Hz, 1H), 2.61 (ddd, *J* = 14.1, 11.4, 2.9 Hz, 1H), 2.17 – 2.06 (m, 1H), 1.93 (ddd, *J* = 18.8, 12.4, 3.8 Hz, 1H), 1.75 – 1.53 (m, 3H), 1.49 – 1.38 (m, 1H), 1.21 – 1.07 (m, 1H), 1.04 –

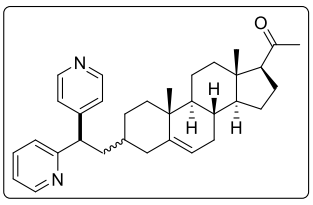
0.92 (m, 1H), 0.91 – 0.77 (m, 9H), 0.66 (dd, *J* = 6.6, 3.8 Hz, 1H), 0.54 (dd, *J* = 6.9, 2.3 Hz, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.08, 161.56, 153.86, 152.20, 149.74, 149.69, 149.62, 149.41, 136.48, 136.39, 136.37, 123.74, 123.33, 123.16, 122.40, 122.38, 121.74, 121.70, 121.61, 121.57, 53.36, 50.97, 50.22, 50.18, 49.86, 48.36, 48.34, 41.37, 41.21, 38.75, 38.16, 38.01, 37.93, 36.48, 36.27, 35.82, 35.76, 35.09, 35.05, 32.47, 32.45, 32.42, 32.28, 30.63, 30.24, 29.64, 28.97, 28.91, 26.34, 26.26, 25.93, 25.81, 24.94, 24.10, 24.05, 22.82, 22.76, 21.59, 21.52, 20.69, 20.55, 15.11, 15.04. IR (cm^{-1}): 3068, 3006, 2952, 2921, 2867, 1587, 1569, 1492, 1469, 1455, 1433, 1414, 1385, 1367, 844, 820, 791, 770, 748. HRMS (ESI) m/z calcd for $C_{22}H_{31}N_2^+$ $(M+H)^+$ 323.2482, found 323.2481.



7r

(3R,5S,8R,9S,10S,13S,14S)-10,13-dimethyl-3-(2-(pyridin-2-yl)-2-(pyridin-4-yl) ethyl) hexadecahydro-17H-cyclopenta[a]phenanthren-17-one, 26%, colorless oil, 23.7 mg, 37ºC, 24 h. d. r.= 1: 1.17.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.59 – 8.45 (m, 3H), 7.59 (tdd, *J* = 7.7, 4.0, 1.8 Hz, 1H), 7.31 – 7.24 (m, 2H), 7.21 – 7.08 (m, 2H), 4.05 (t, *J* = 7.8 Hz, 1H), 3.48 (q, *J* = 7.0 Hz, 1H), 2.47 – 2.29 (m, 2H), 2.20 – 1.99 (m, 3H), 1.95 – 1.86 (m, 1H), 1.81 – 1.72 (m, 2H), 1.68 – 1.40 (m, 7H), 1.30 – 1.09 (m, 9H), 1.02 – 0.92 (m, 1H), 0.84 (s, 3H), 0.77 (d, *J* = 6.5 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.38, 162.11, 153.07, 152.79, 149.72, 149.51, 136.56, 136.53, 123.47, 123.34, 122.85, 122.72, 121.70, 65.78, 54.73, 54.71, 54.63, 53.37, 51.54, 51.46, 51.29, 51.20, 47.77, 40.51, 40.38, 38.26, 36.80, 36.66, 36.57, 36.17, 35.78, 35.02, 33.22, 33.15, 33.04, 32.64, 31.55, 30.85, 30.81, 30.53, 30.35, 28.54, 25.45, 25.04, 21.69, 20.19, 19.99, 15.21, 13.78, 12.19, 11.66. IR (cm^{-1}): 2920, 2854, 1738, 1588, 1569, 1470, 1452, 1433, 1413, 1373, 830, 787, 749, 653. HRMS (ESI) m/z calcd for $C_{31}H_{41}N_2O^+$ $(M+H)^+$ 457.3213, found 457.3213.

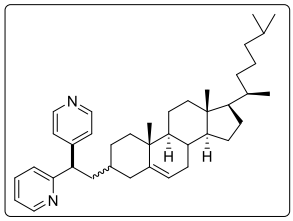


7s

1-((3S,8S,9S,10R,13S,14S,17S)-10,13-dimethyl-3-(2-(pyridin-2-yl)-2-(pyridin-4-yl) ethyl)-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[a] phenanthren-17-yl) ethan-1-one, 25%, colorless oil, 21.4 mg, 37ºC, 24 h. d. r.=1: 1.49.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.59-8.52 (m, 1H), 8.46 (d, *J* = 2.5 Hz, 2H), 7.56 (th, *J* = 7.5, 2.4 Hz, 1H), 7.28-7.21 (m, 2H), 7.18-7.02 (m, 2H), 5.30 (s, 1H), 4.01 (q, *J* = 9.0, 8.2 Hz, 1H), 2.49 (q, *J* = 8.5 Hz, 1H), 2.13 (d, *J* = 14.7 Hz, 2H), 2.11-2.07 (m, 3H), 1.97 (dq, *J* = 22.2, 7.8, 6.9 Hz, 4H), 1.87-1.75 (m, 1H), 1.70-1.52 (m, 6H), 1.49-1.37 (m, 4H), 1.22-1.00 (m, 4H), 0.99-0.87 (m, 4H), 0.60 (d, *J* = 9.9 Hz, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 209.40, 209.38, 162.02, 149.73, 149.67,

149.51, 149.47, 149.02, 140.16, 140.05, 136.51, 136.49, 136.47, 136.09, 123.31, 122.76, 122.73, 122.58, 121.64, 121.12, 119.30, 119.27, 63.63, 63.60, 56.87, 53.33, 50.62, 50.59, 50.14, 50.10, 50.01, 43.88, 41.94, 41.91, 39.49, 39.38, 39.17, 38.78, 37.33, 37.06, 36.75, 36.70, 36.39, 35.67, 35.47, 33.96, 33.93, 31.74, 31.71, 31.68, 31.63, 31.61, 31.55, 31.41, 28.93, 28.77, 26.17, 25.68, 24.37, 22.74, 20.80, 20.67, 19.31, 13.11. IR (cm^{-1}): 2924, 2851, 1702, 1588, 1569, 1492, 1471, 1433, 1414, 1384, 1357, 821, 795, 748, 701, 635. HRMS (ESI) m/z calcd for $C_{33}H_{43}N_2O^+$ $(M+H)^+$ 483.3370, found 483.3369.



7t

2-(2-((3S,9S,10R,13R,14S,17R)-10,13-dimethyl-17-((R)-6-methylheptan-2-yl)-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[a]phenanthren-3-yl)-1-(pyridin-4-yl) ethyl) pyridine, 25%, colorless oil, 27.6 mg, 37ºC, 24 h. d. r=1: 2.17.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.45 (dd, *J* = 35.7, 4.6 Hz, 3H), 7.54 – 7.45 (m, 1H), 7.22 – 7.18 (m, 2H), 7.13 – 6.96 (m, 3H), 5.19 (d, *J* = 21.6 Hz, 1H), 3.97 (q, *J* = 8.2 Hz, 1H), 2.14 – 1.67 (m, 8H), 1.62 – 1.29 (m, 12H), 1.03 (p, *J* = 9.6, 8.8 Hz, 7H), 0.89 (d, *J* = 12.1 Hz, 4H), 0.87 – 0.76 (m, 12H), 0.59 (s, 3H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.19, 153.14, 149.71, 149.63, 149.57, 149.53, 148.98, 140.20, 140.09, 136.55, 136.52, 136.50, 123.43, 123.40, 122.79, 122.76, 121.67, 121.65, 121.50, 121.07, 120.83, 119.66, 119.62, 56.77, 56.16, 56.10, 53.36, 50.69, 50.66, 50.36, 50.31, 50.08, 42.26, 39.78, 39.48, 37.39, 37.33, 37.12, 36.82, 36.78, 36.50, 36.16, 35.77, 35.74, 35.56, 34.01, 33.99, 31.87, 31.85, 31.81, 31.78, 31.65, 31.39, 30.16, 29.65, 28.19, 27.96, 26.25, 25.81, 24.22, 23.83, 23.77, 22.77, 22.51, 20.85, 20.72, 19.36, 18.68, 11.81. IR (cm^{-1}): 2923, 2866, 1588, 1468, 1433, 1414, 1378, 798, 747. HRMS (ESI) m/z calcd for $C_{39}H_{57}N_2^+$ $(M+H)^+$ 553.4516, found 553.4519.

X. References.

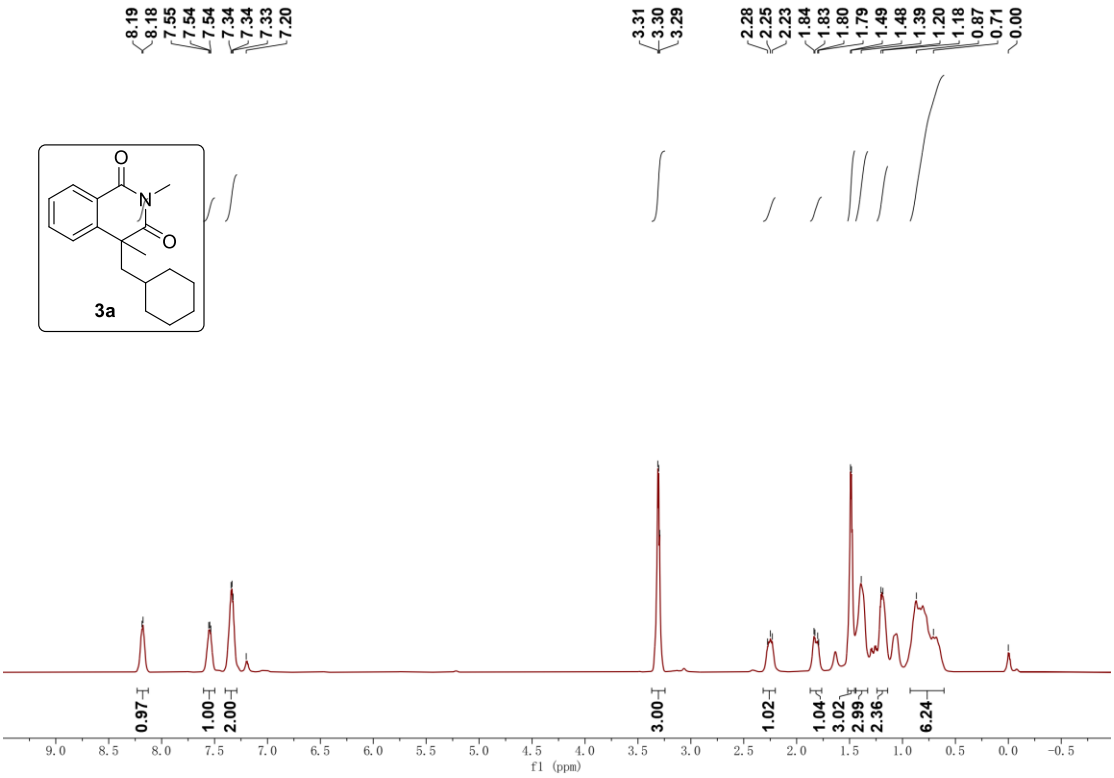
[1] K. Muralirajan, R. Kancherla, A. Gimnkhan and M. Rueping, *Org.Lett.*, **2021**, *23*, 6905-6910.

[2] H. Chen, Z. Sun, H. Yang, F. Mao, X. Yan, X. LI and X. Xu, *Synlett.*, **2023**, *34*, 63 -66.

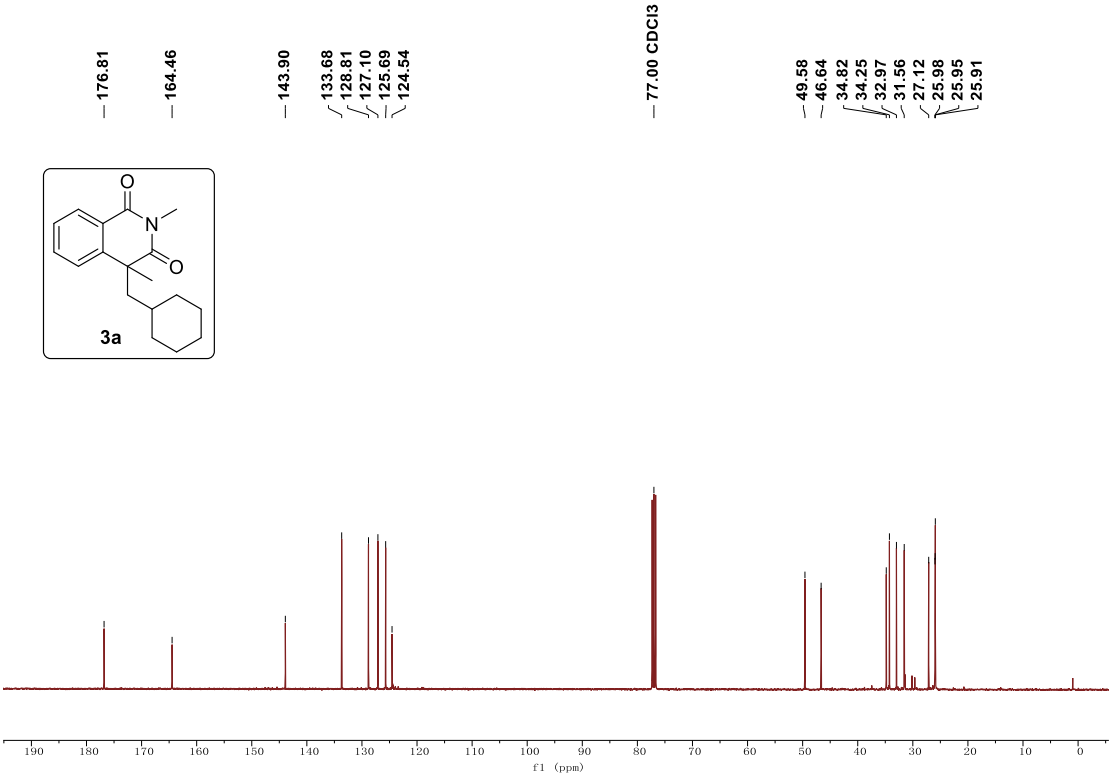
[3] X. -F. Xia, S.-L. Zhu, Y. Li and H. Wang, *RSC Adv.*, **2016**, *6*, 51703-51709.

[4] W. Yu, H. Wang, K. Zhao, W. Li, T. Wang and J. Fu, *J. Org. Chem.*, **2024**, *89*, 17 03-1708.

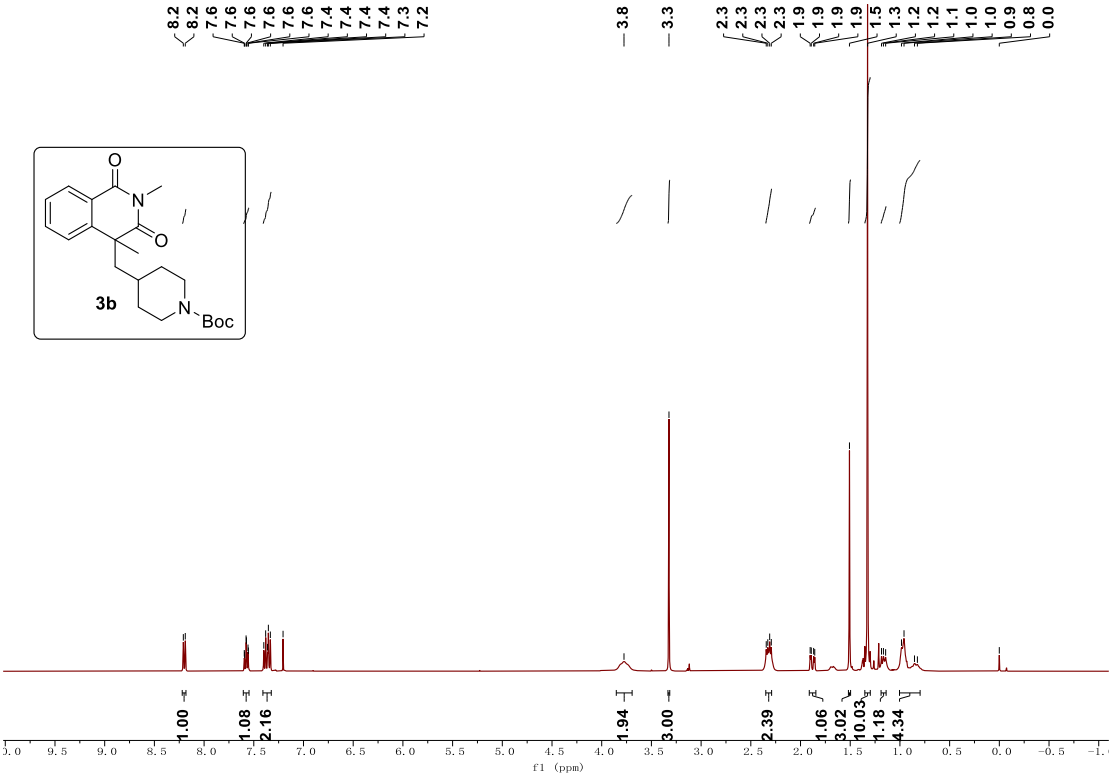
XI. ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra of compounds 3, 4, 7, 8, 9.



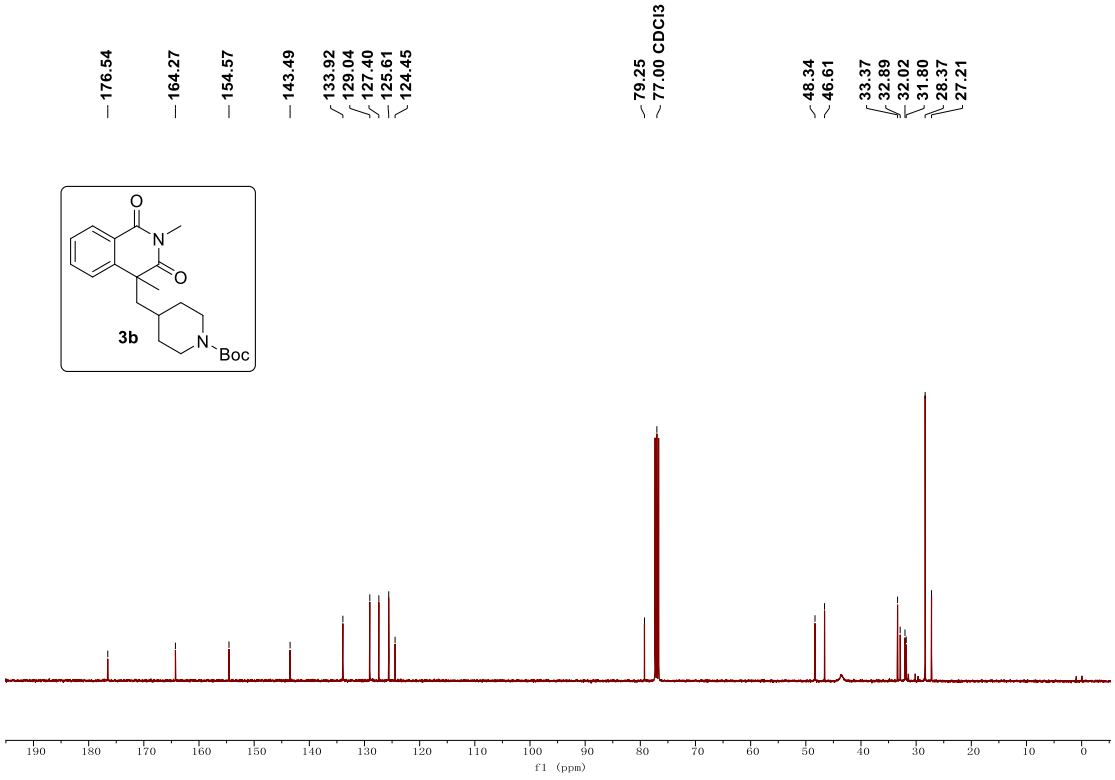
^{1}H NMR Spectra of **3a** ($CDCl_3$, 400 MHz)



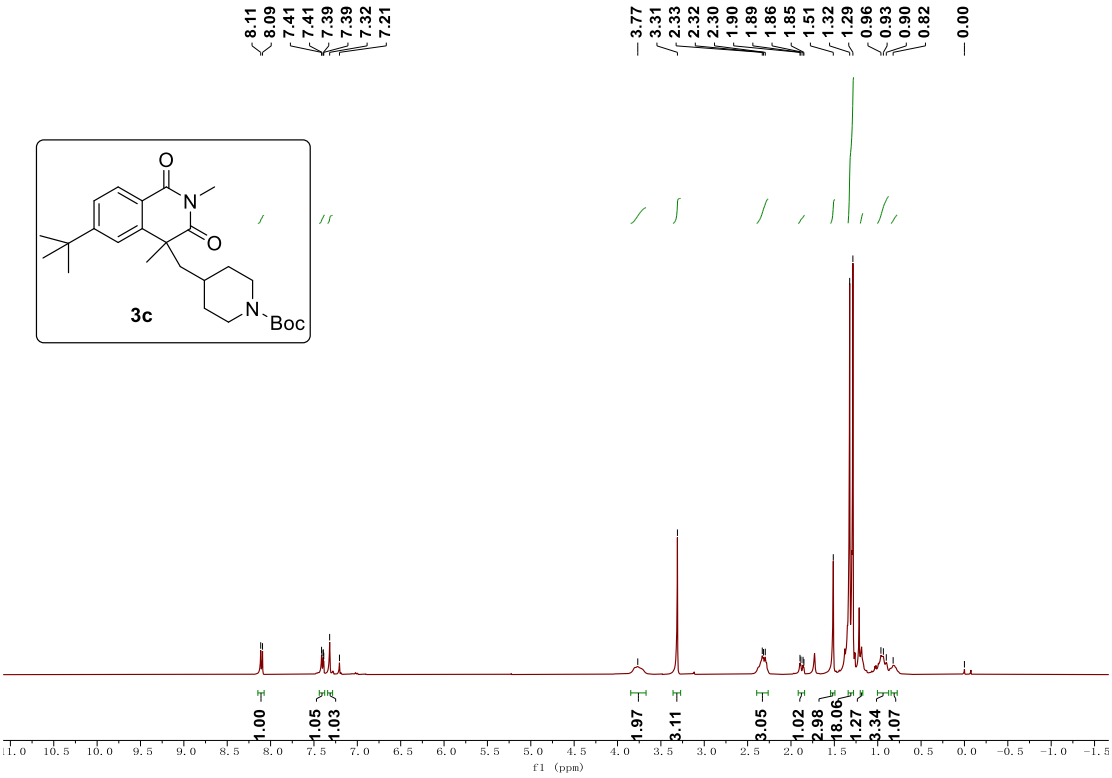
^{13}C NMR Spectra of **3a** ($CDCl_3$, 101 MHz)



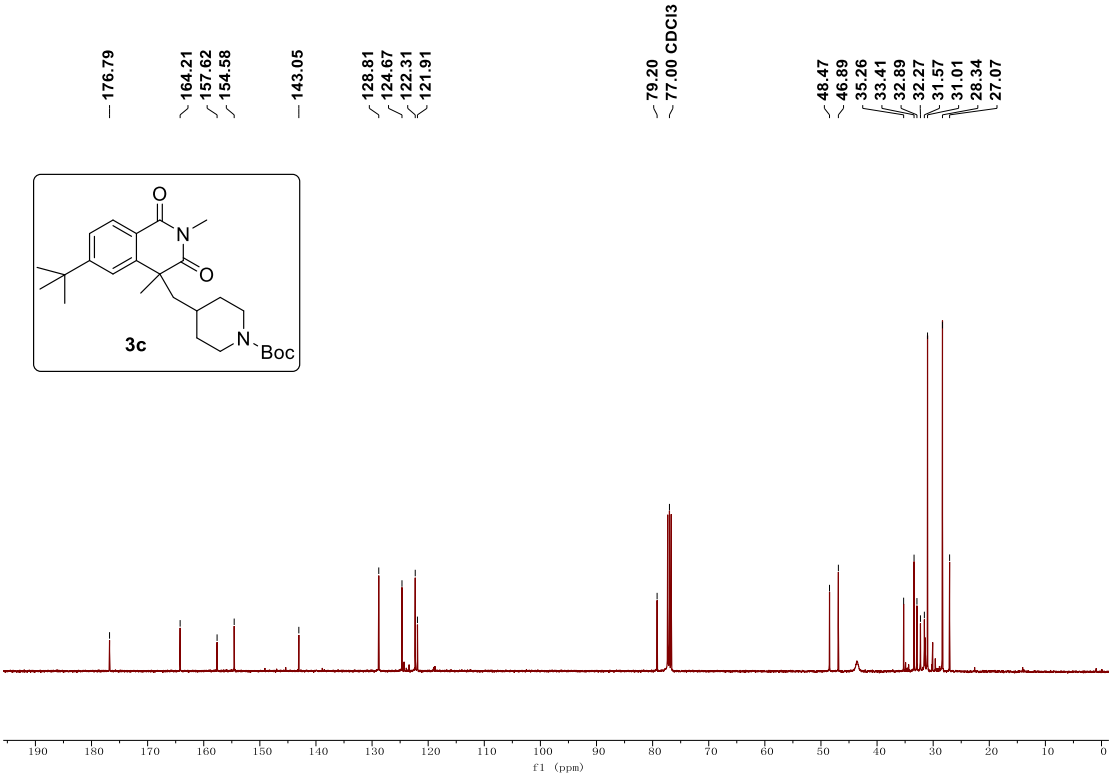
^{1}H NMR Spectra of **3b** ($CDCl_3$, 400 MHz)



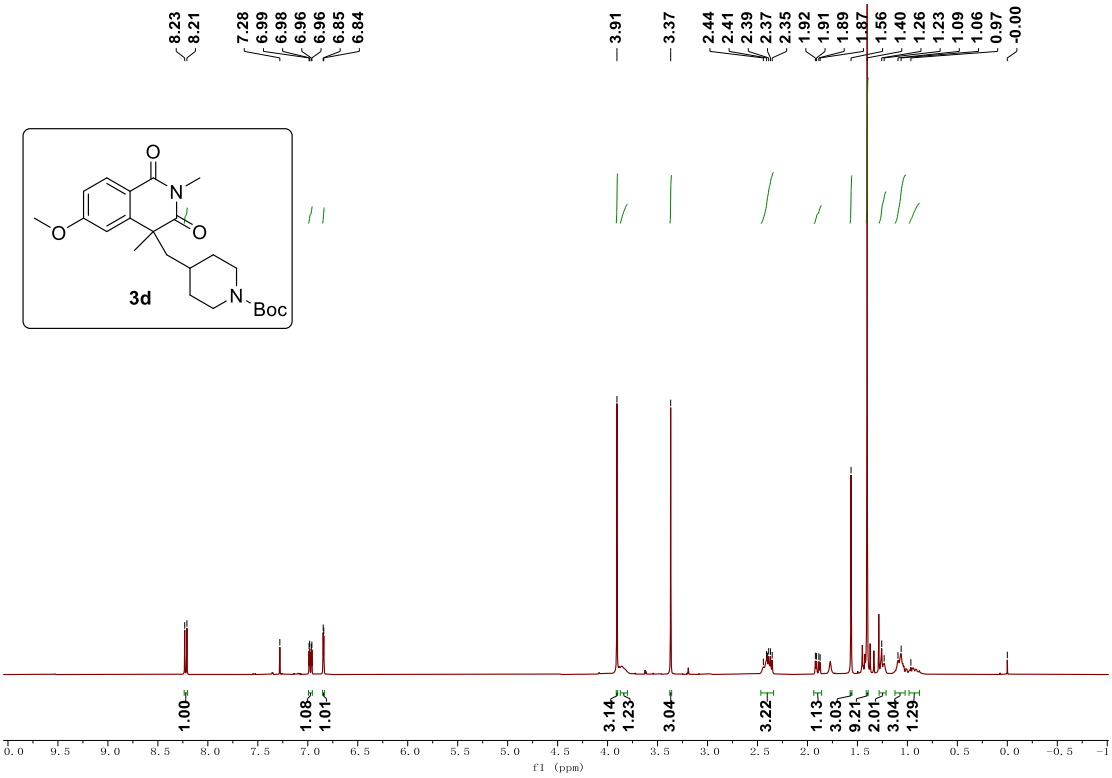
^{13}C NMR Spectra of **3b** ($CDCl_3$, 101 MHz)



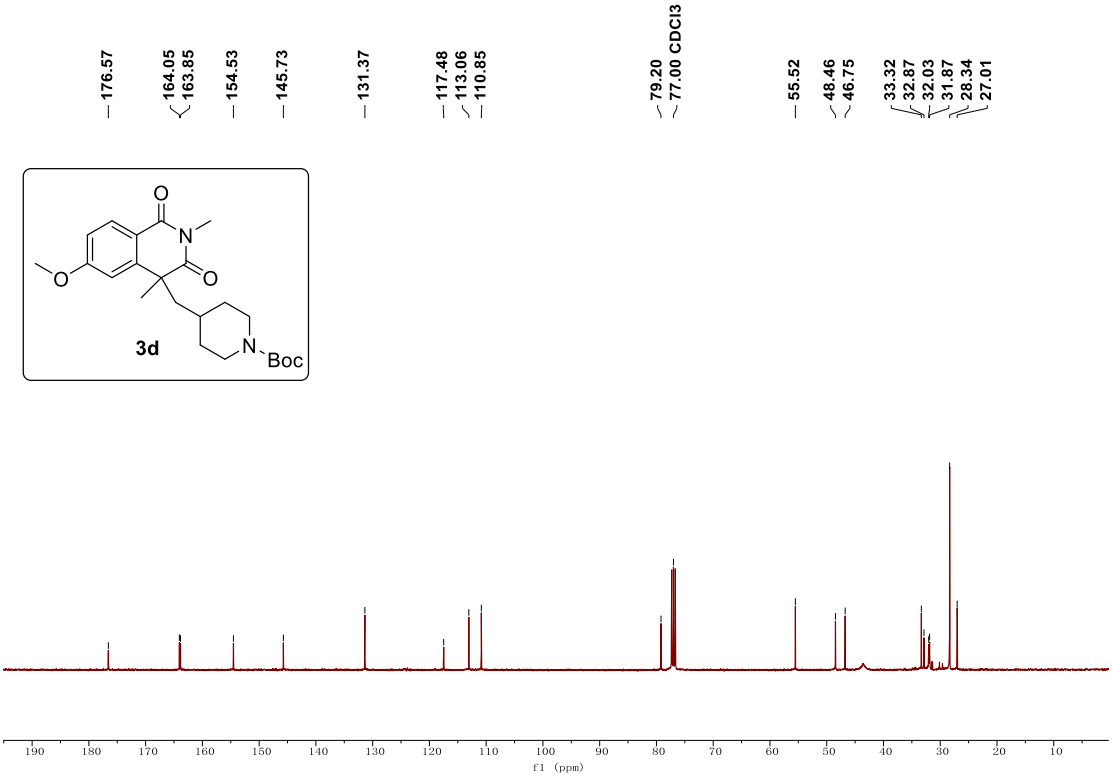
^{1}H NMR Spectra of **3c** ($CDCl_3$, 400 MHz)



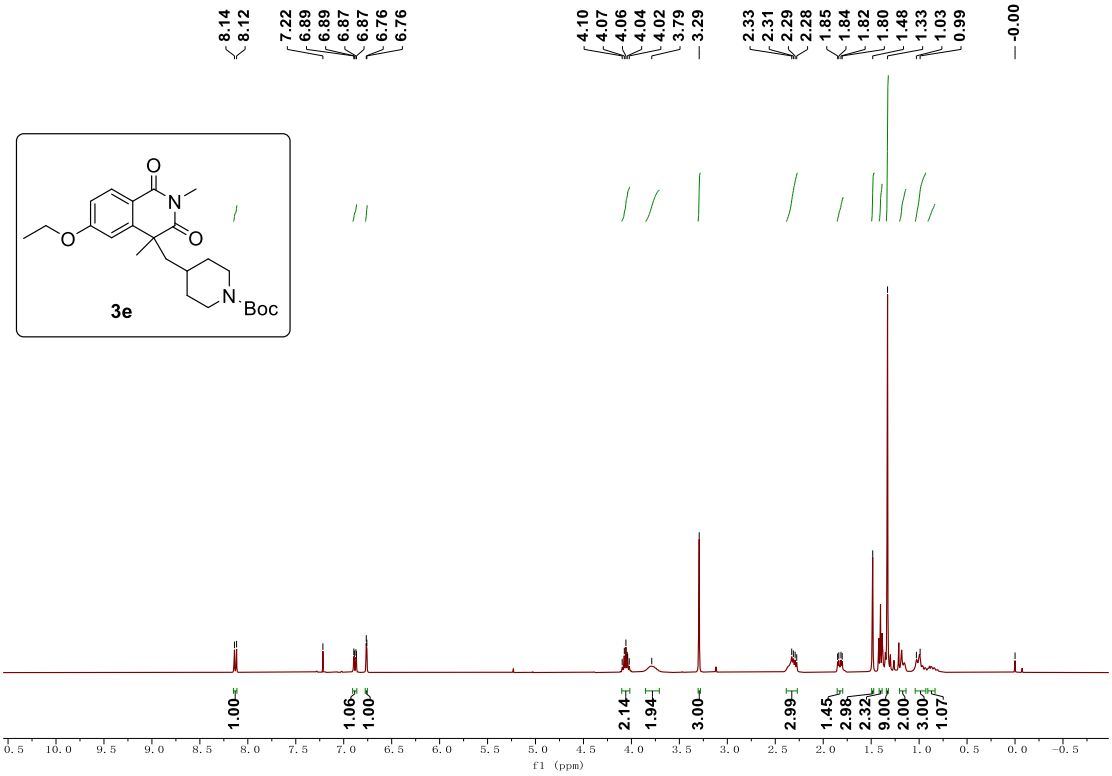
^{13}C NMR Spectra of **3c** ($CDCl_3$, 101 MHz)



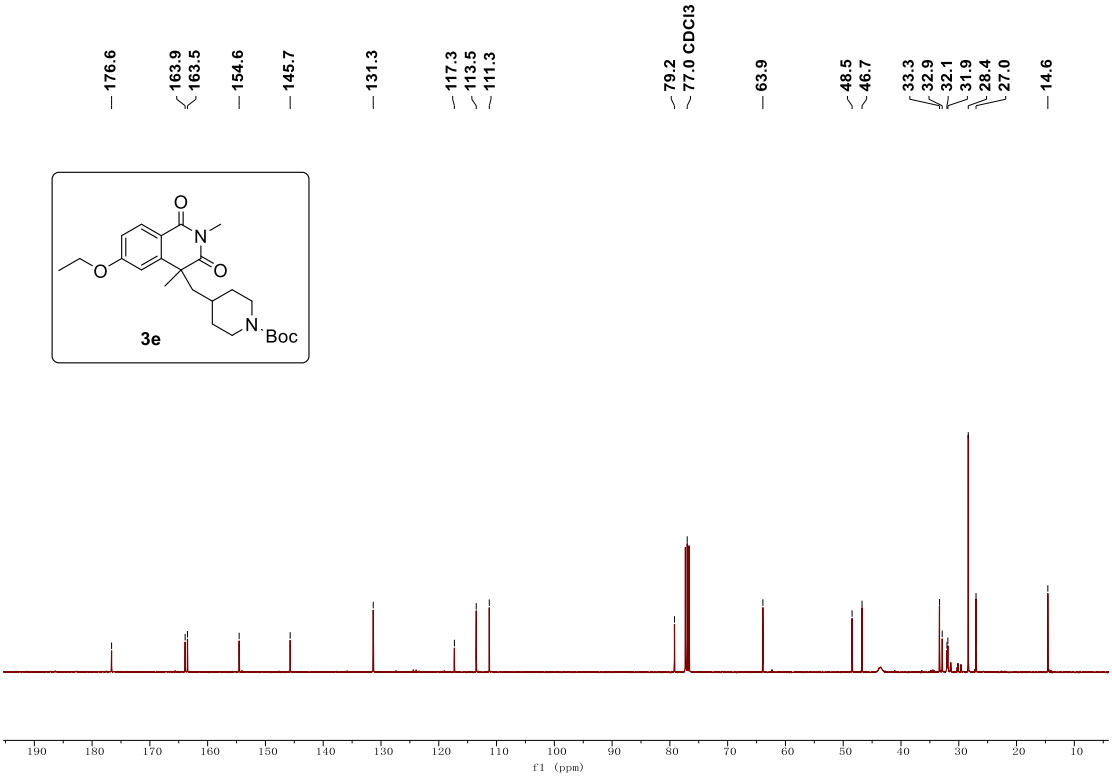
^{1}H NMR Spectra of **3d** ($CDCl_3$, 400 MHz)



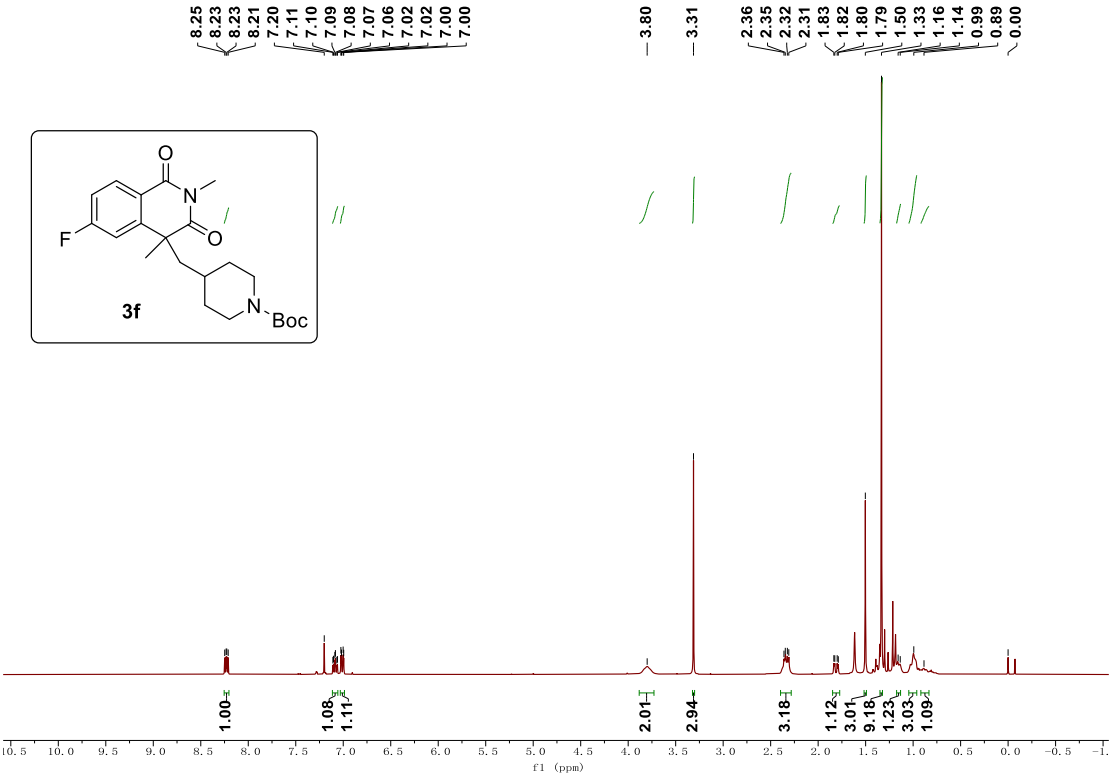
^{13}C NMR Spectra of **3d** ($CDCl_3$, 101 MHz)



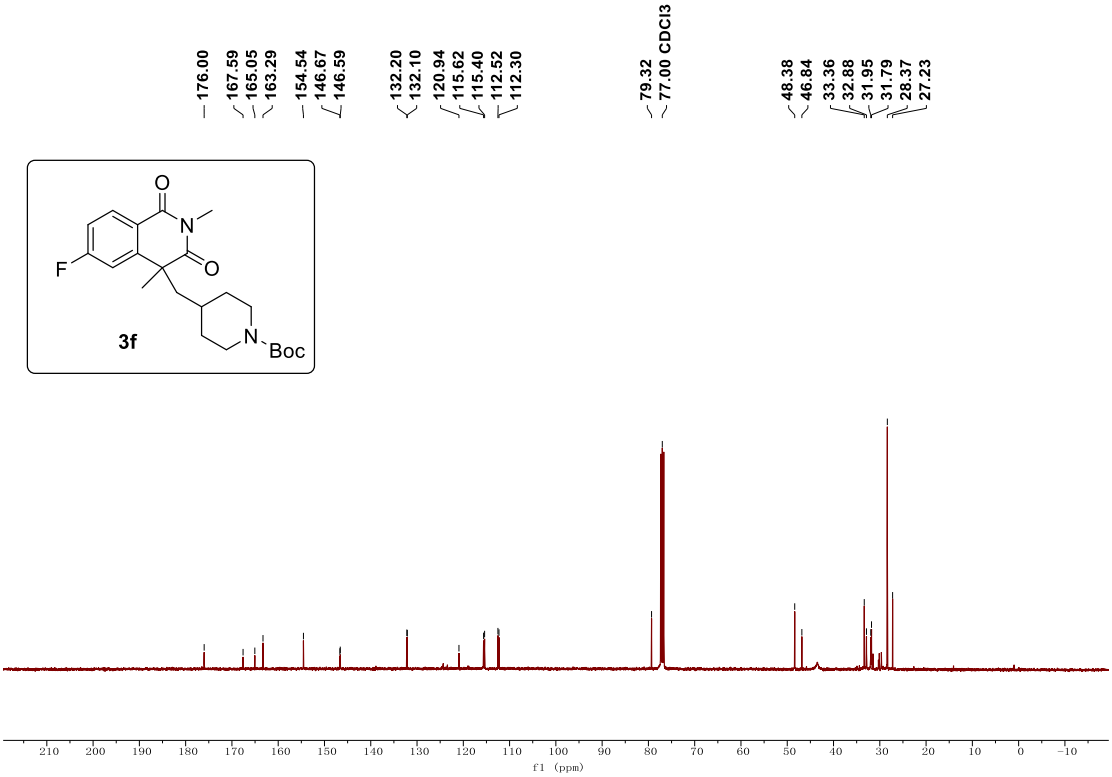
^{1}H NMR Spectra of **3e** ($CDCl_3$, 400 MHz)



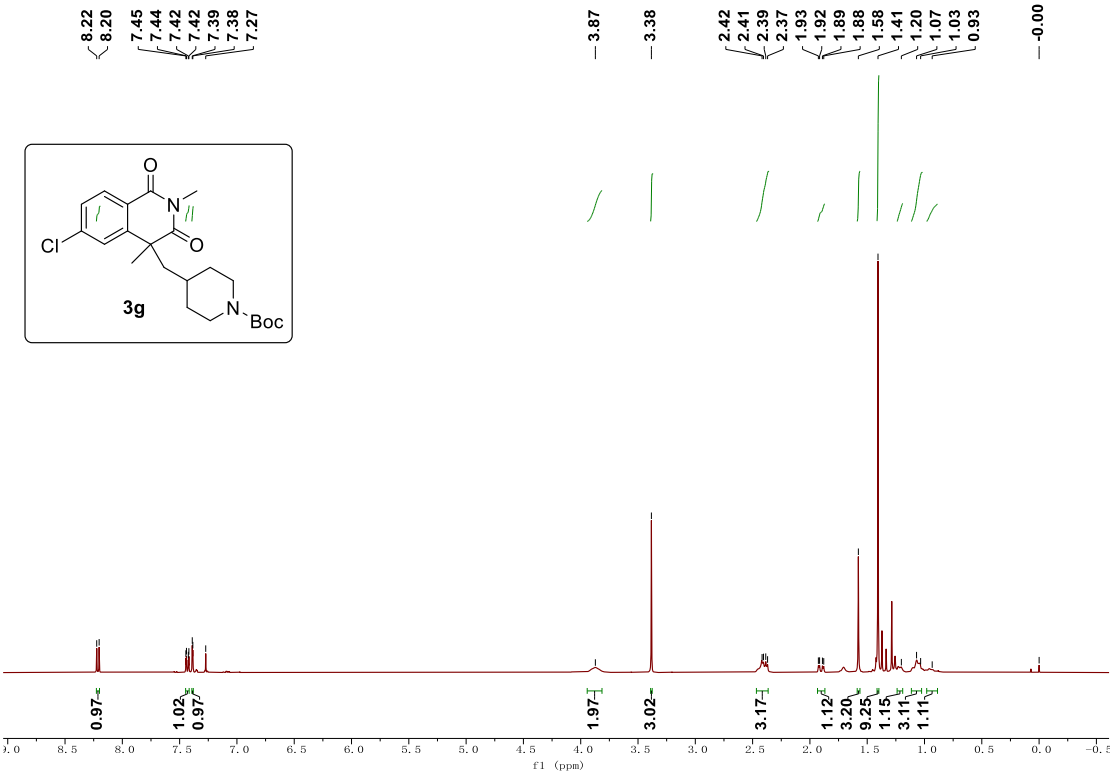
^{13}C NMR Spectra of **3e** ($CDCl_3$, 101 MHz)



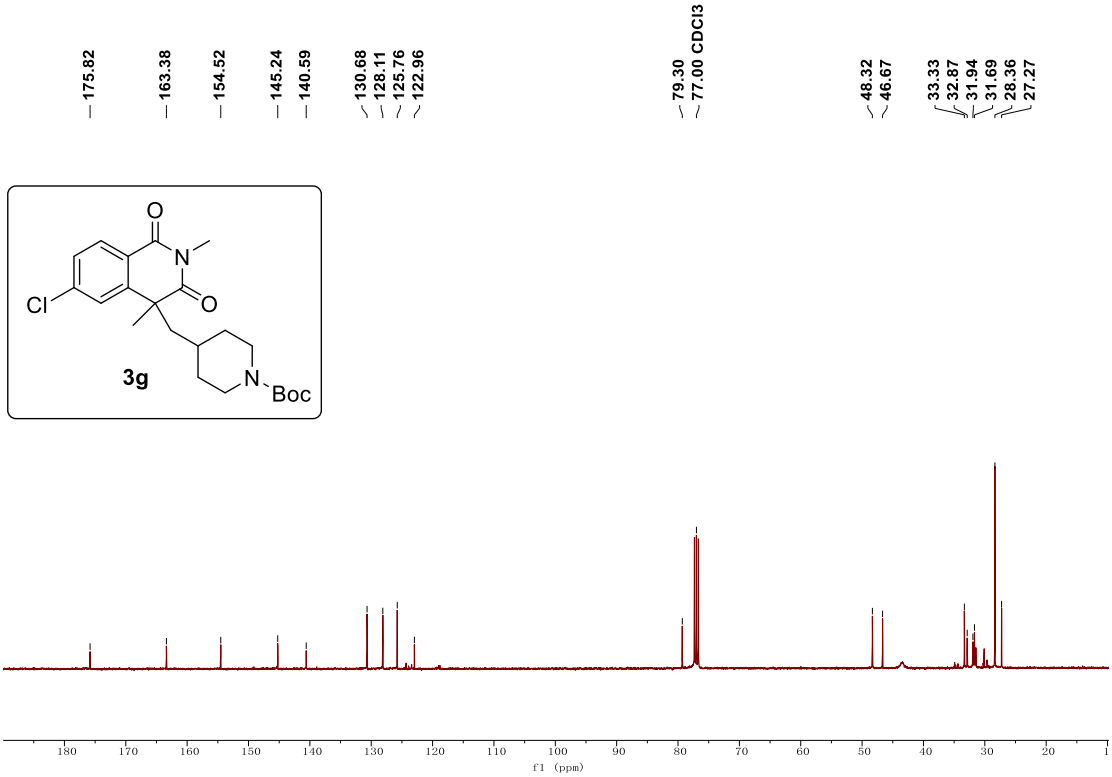
^{1}H NMR Spectra of **3f** ($CDCl_3$, 400 MHz)



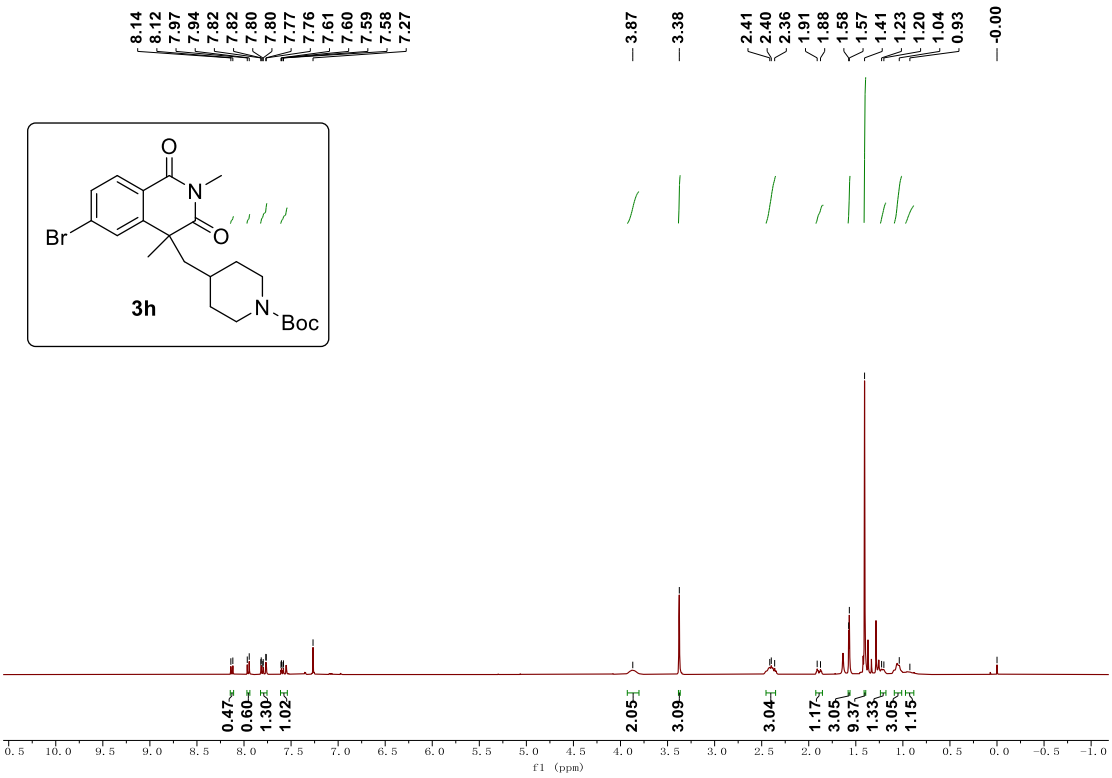
^{13}C NMR Spectra of **3f** ($CDCl_3$, 101 MHz)



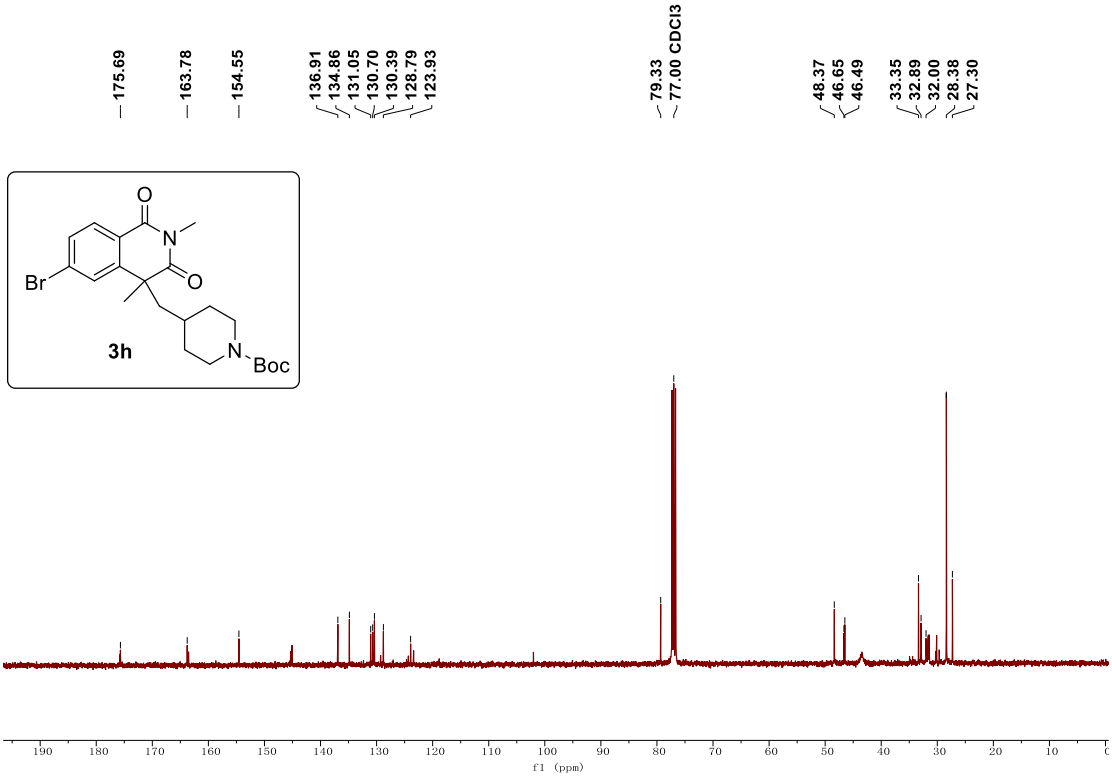
^{1}H NMR Spectra of **3g** ($CDCl_3$, 400 MHz)



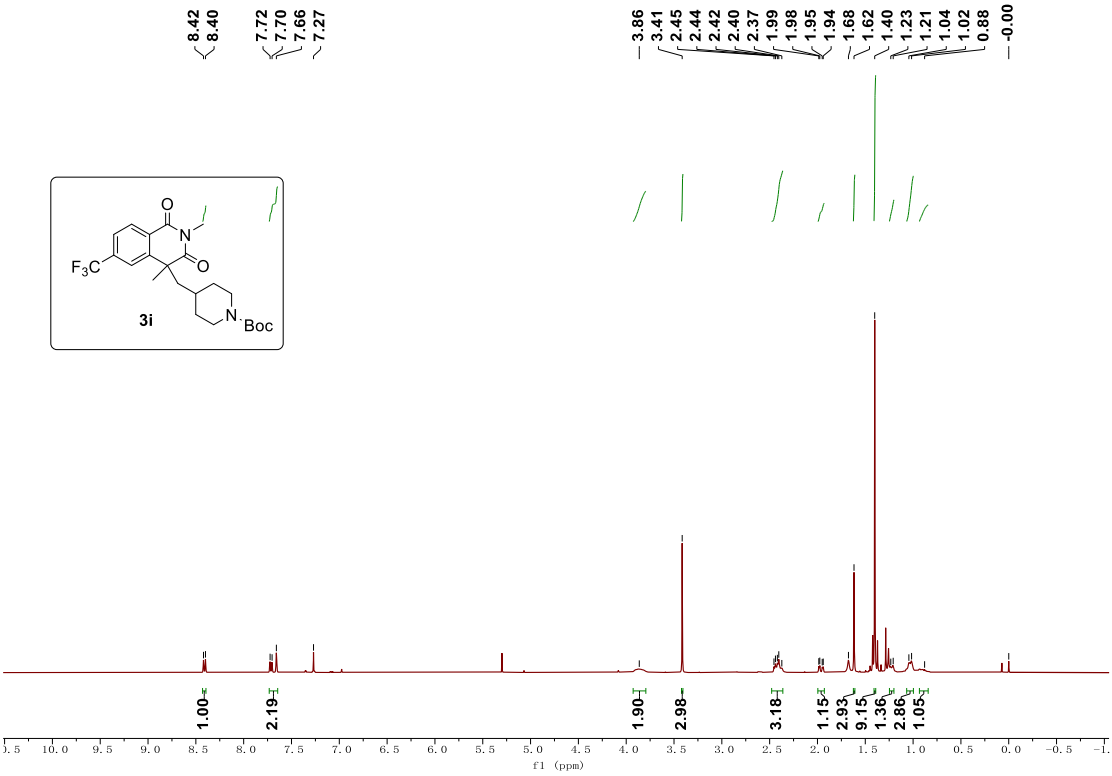
^{13}C NMR Spectra of **3g** ($CDCl_3$, 101 MHz)



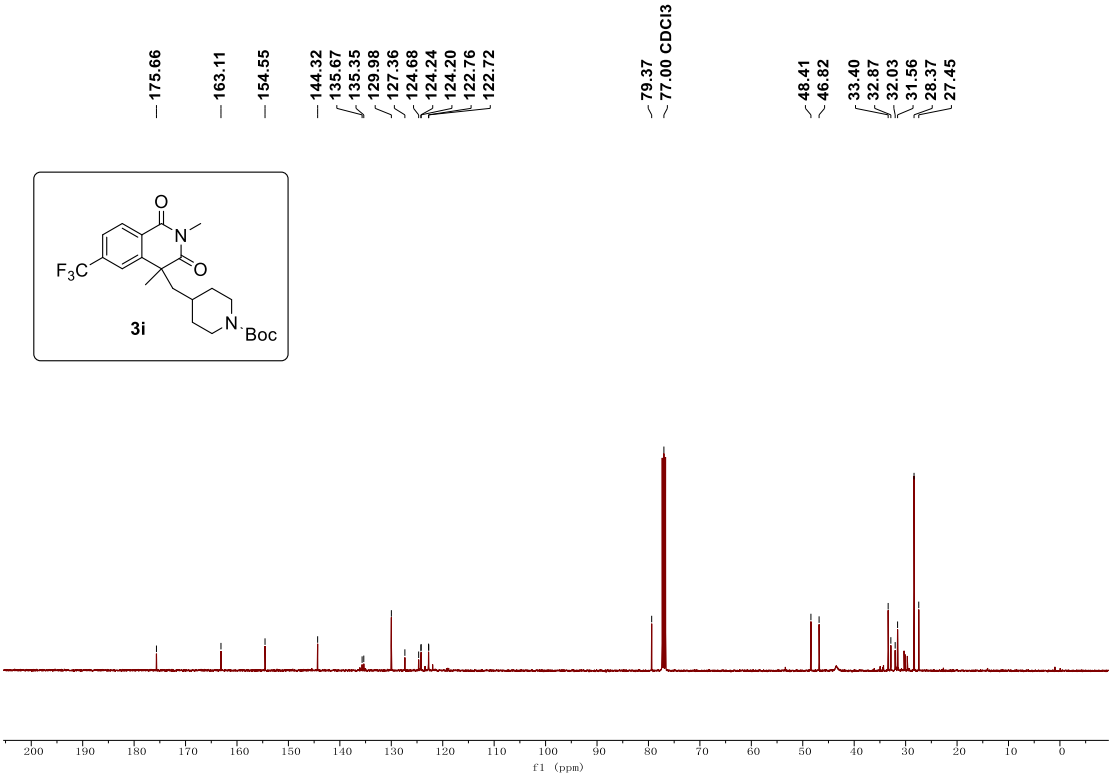
^{1}H NMR Spectra of **3h** ($CDCl_3$, 400 MHz)



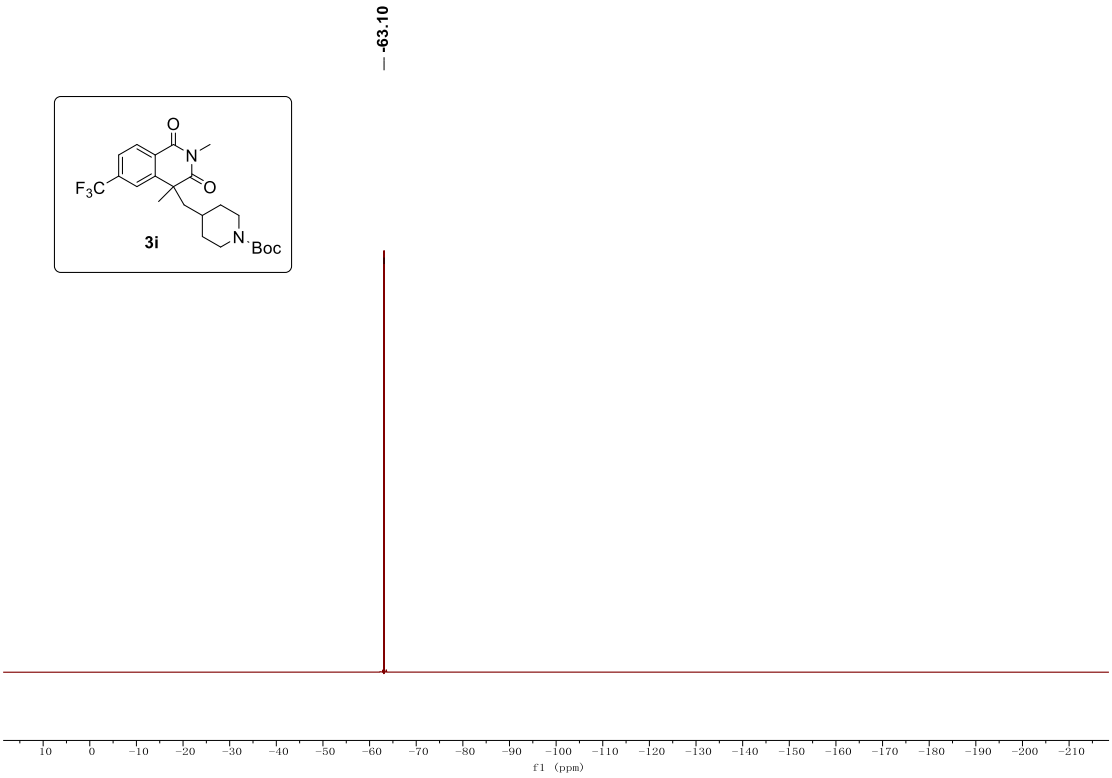
^{13}C NMR Spectra of **3h** ($CDCl_3$, 101 MHz)



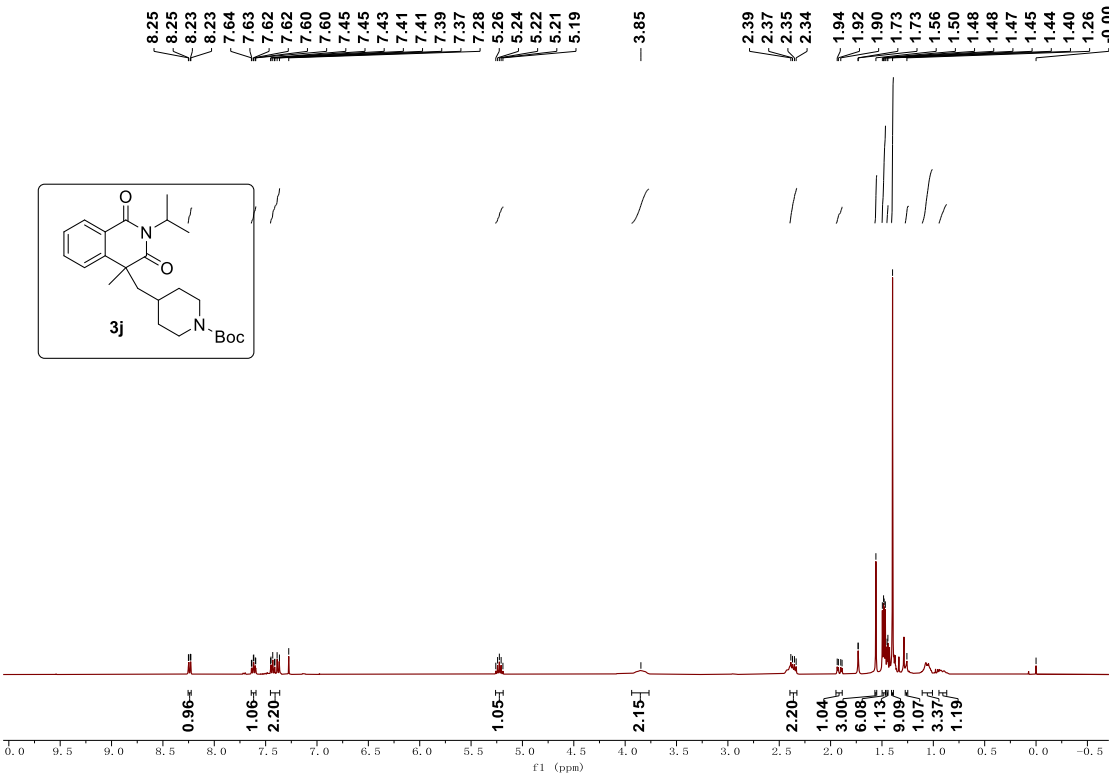
^{1}H NMR Spectra of **3i** ($CDCl_3$, 400 MHz)



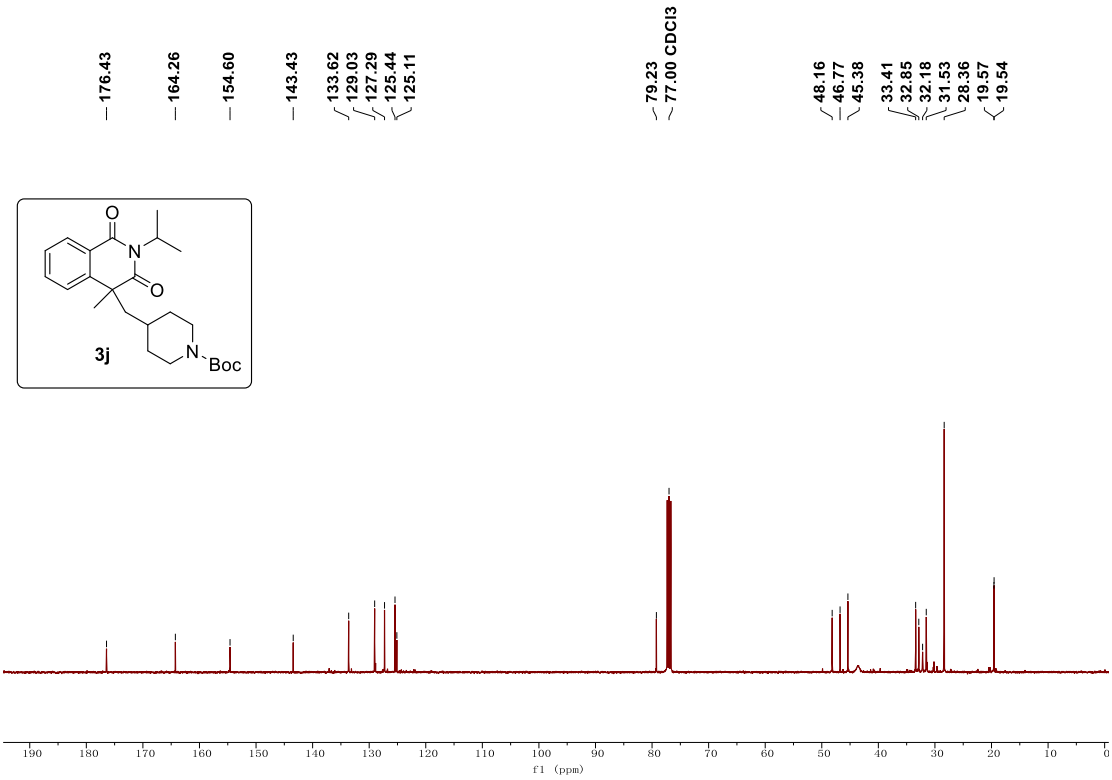
^{13}C NMR Spectra of **3i** ($CDCl_3$, 101 MHz)



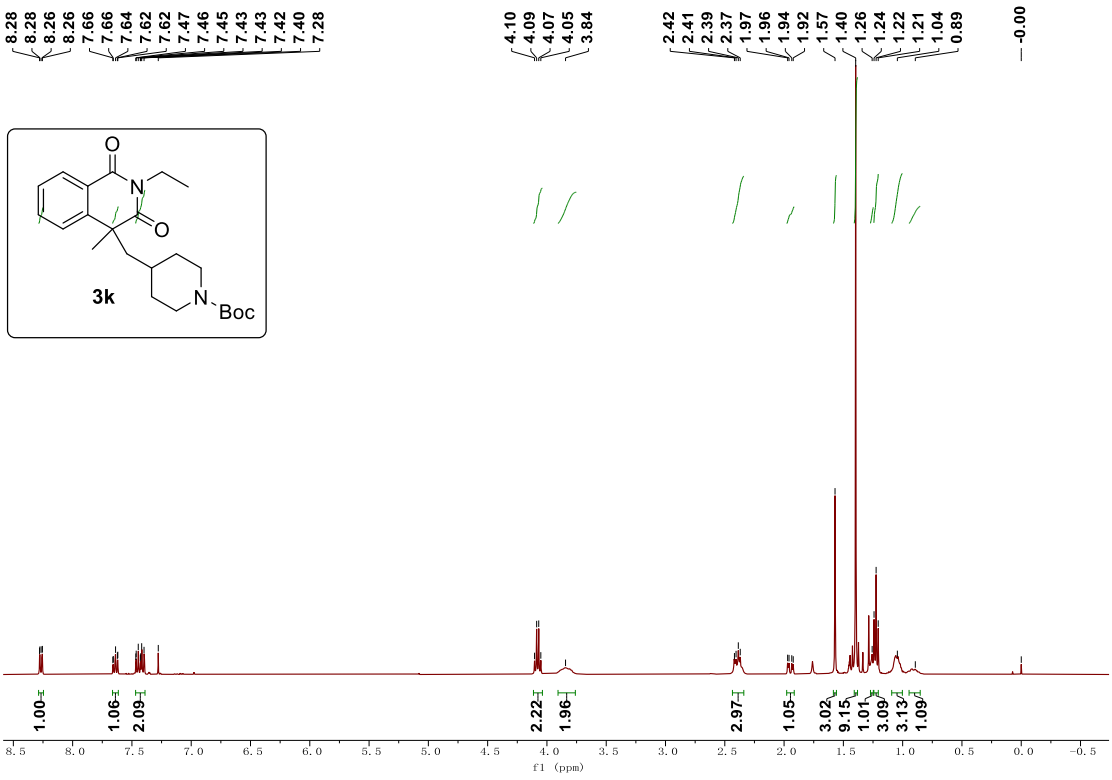
^{19}F NMR Spectra of **3i** (376 MHz, $CDCl_3$)



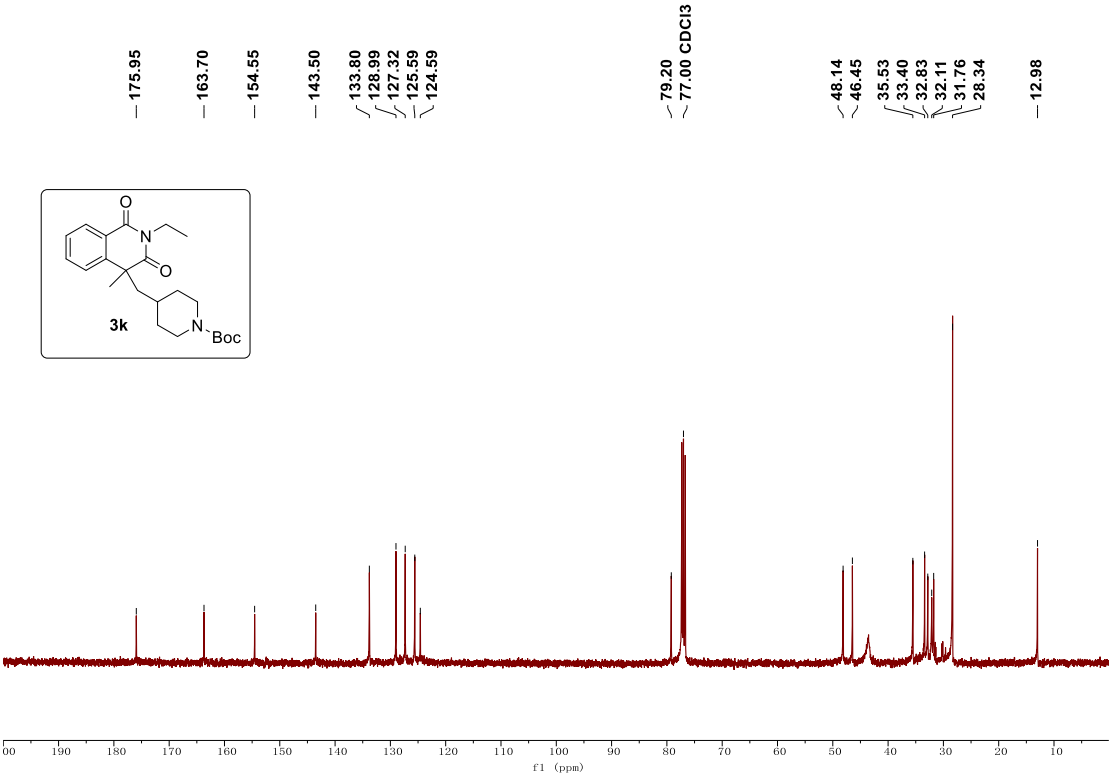
^{1}H NMR Spectra of **3j** ($CDCl_3$, 400 MHz)



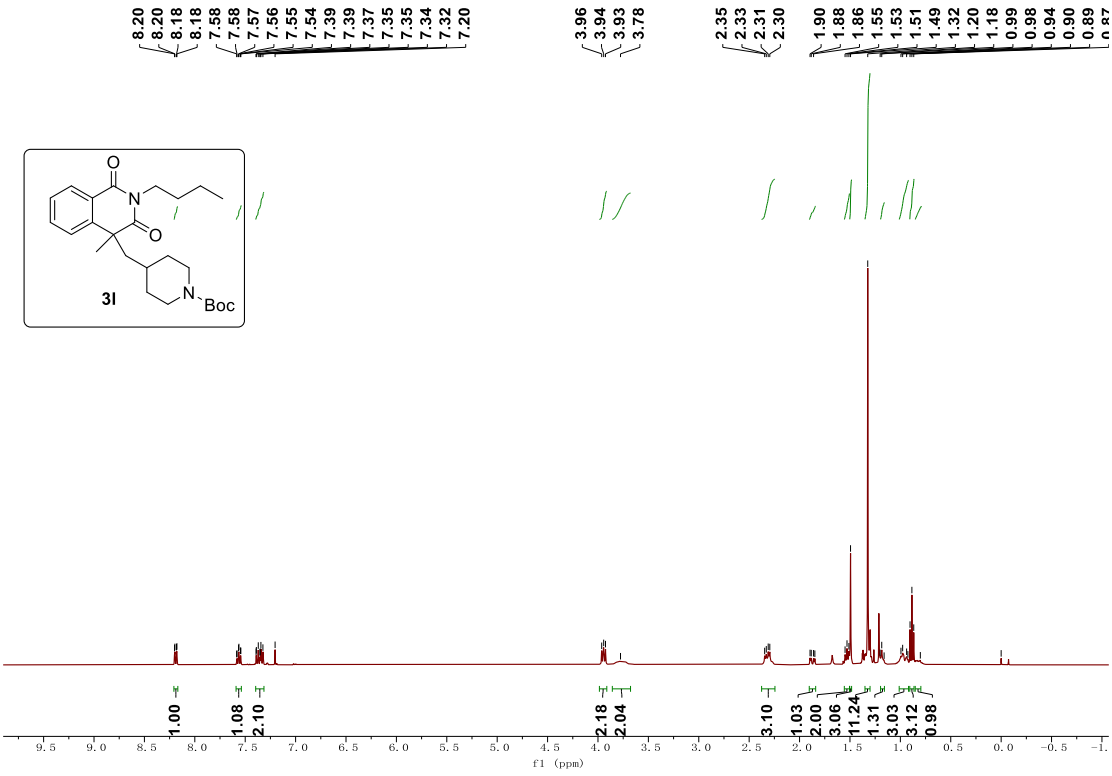
^{13}C NMR Spectra of **3j** ($CDCl_3$, 101 MHz)



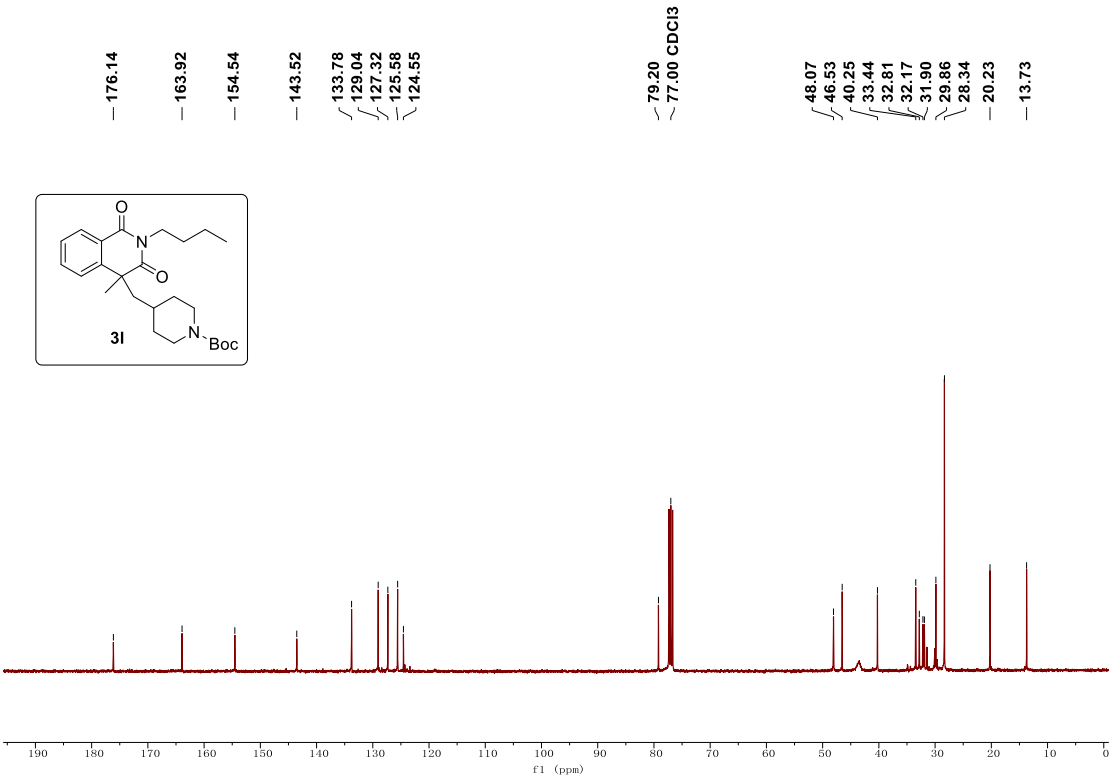
^{1}H NMR Spectra of **3k** ($CDCl_3$, 400 MHz)



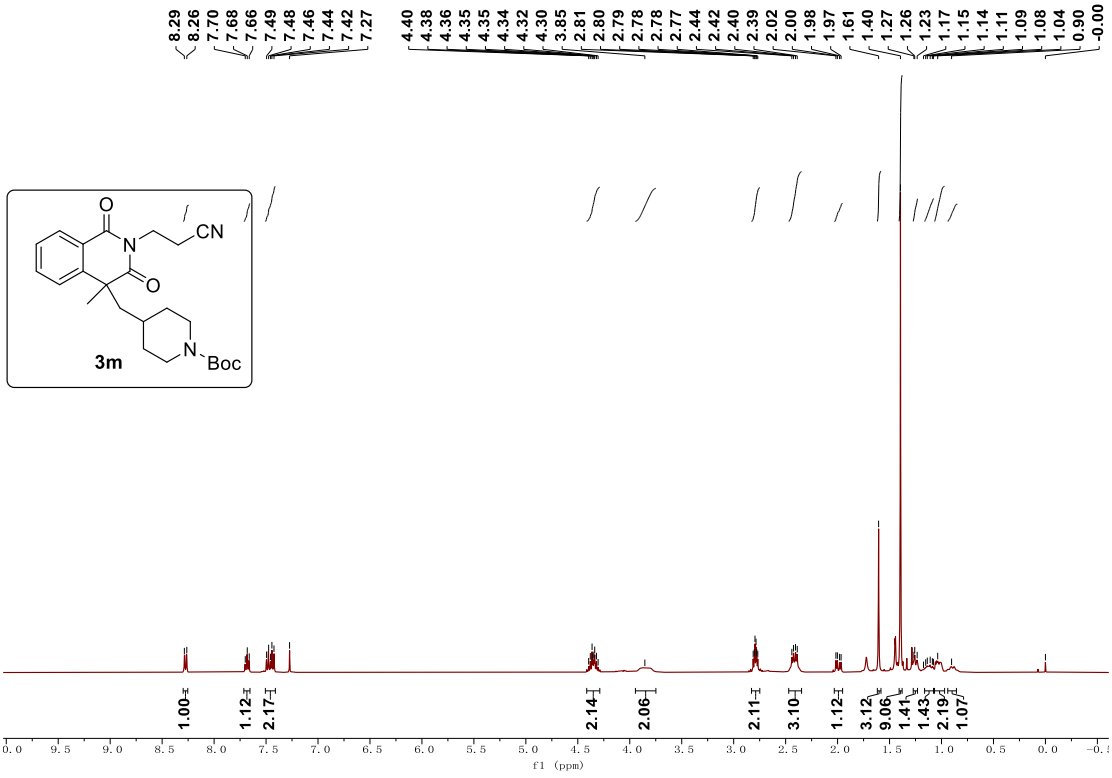
^{13}C NMR Spectra of **3k** ($CDCl_3$, 101 MHz)



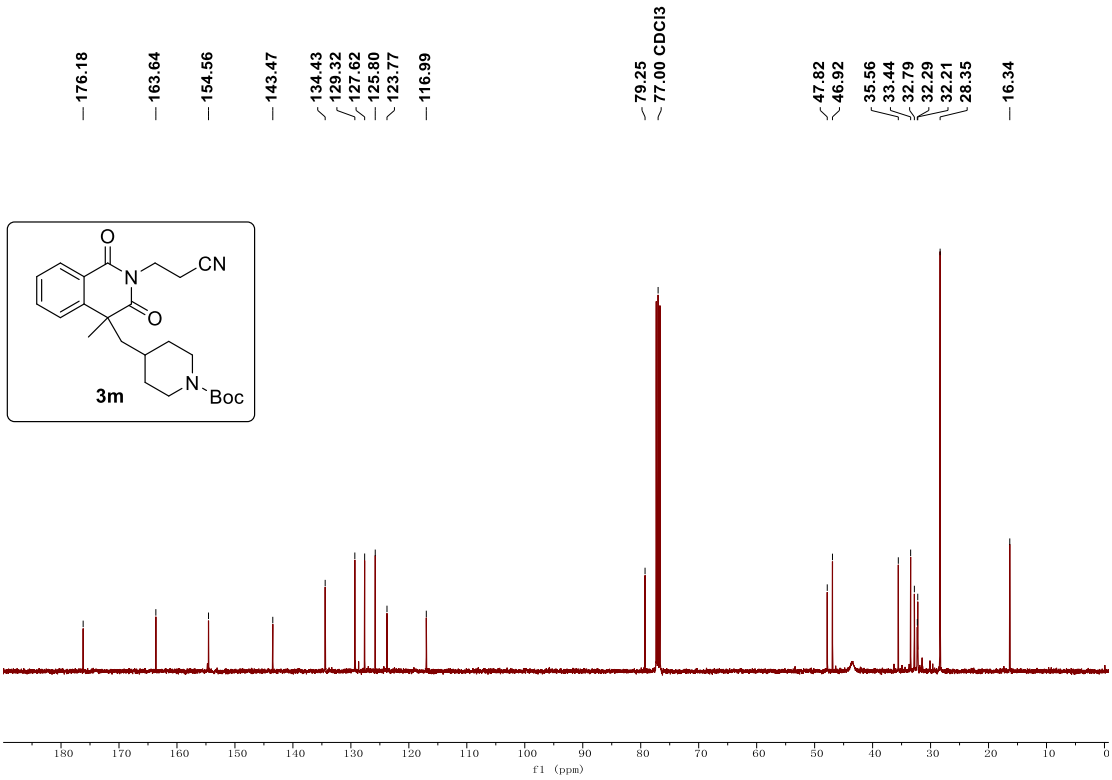
^{1}H NMR Spectra of **3l** ($CDCl_3$, 400 MHz)



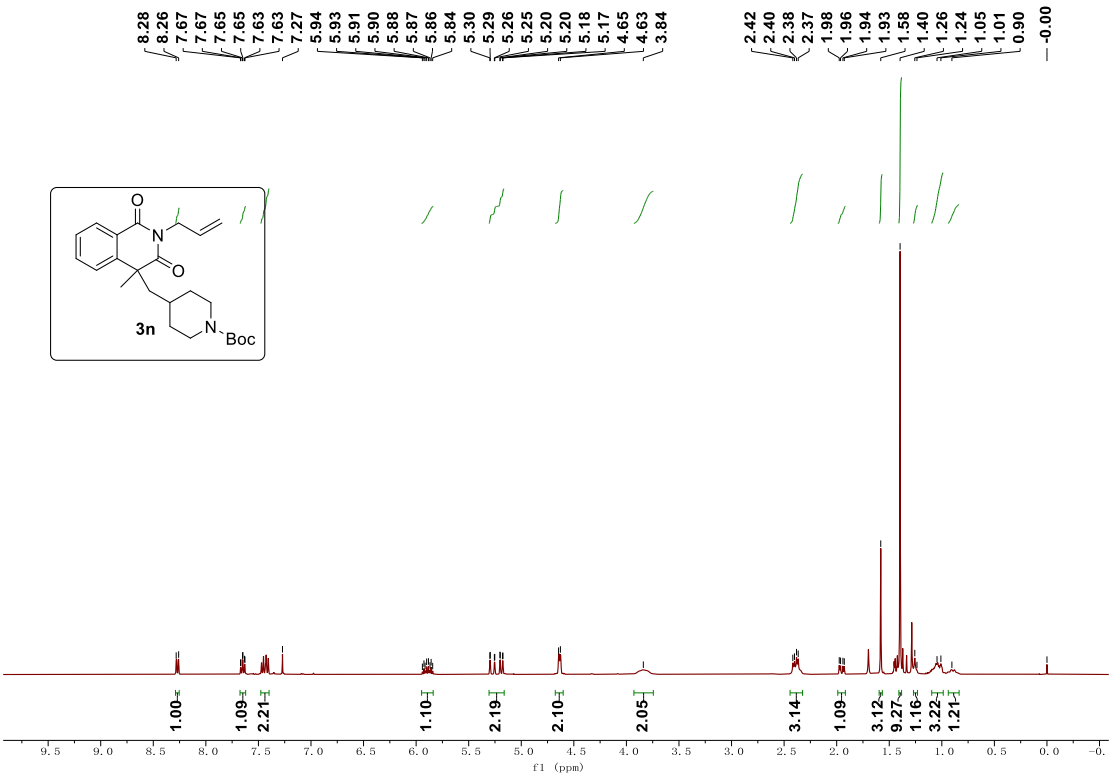
^{13}C NMR Spectra of **3l** ($CDCl_3$, 101 MHz)



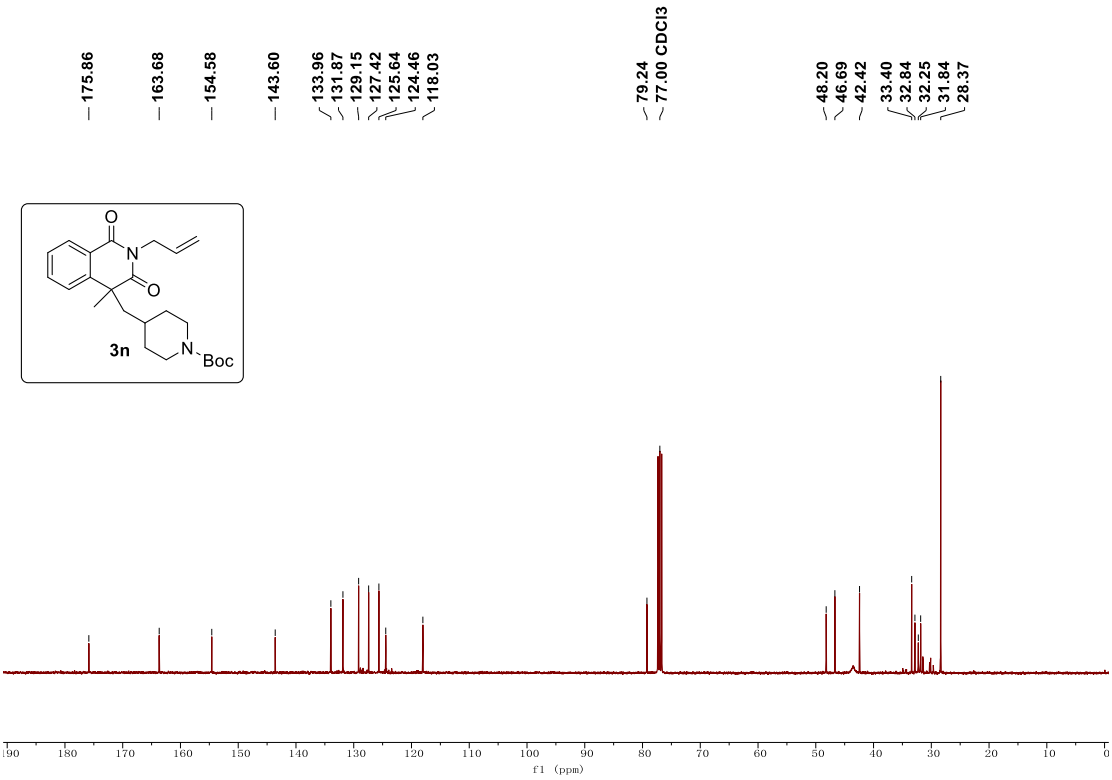
^{1}H NMR Spectra of **3m** ($CDCl_3$, 400 MHz)



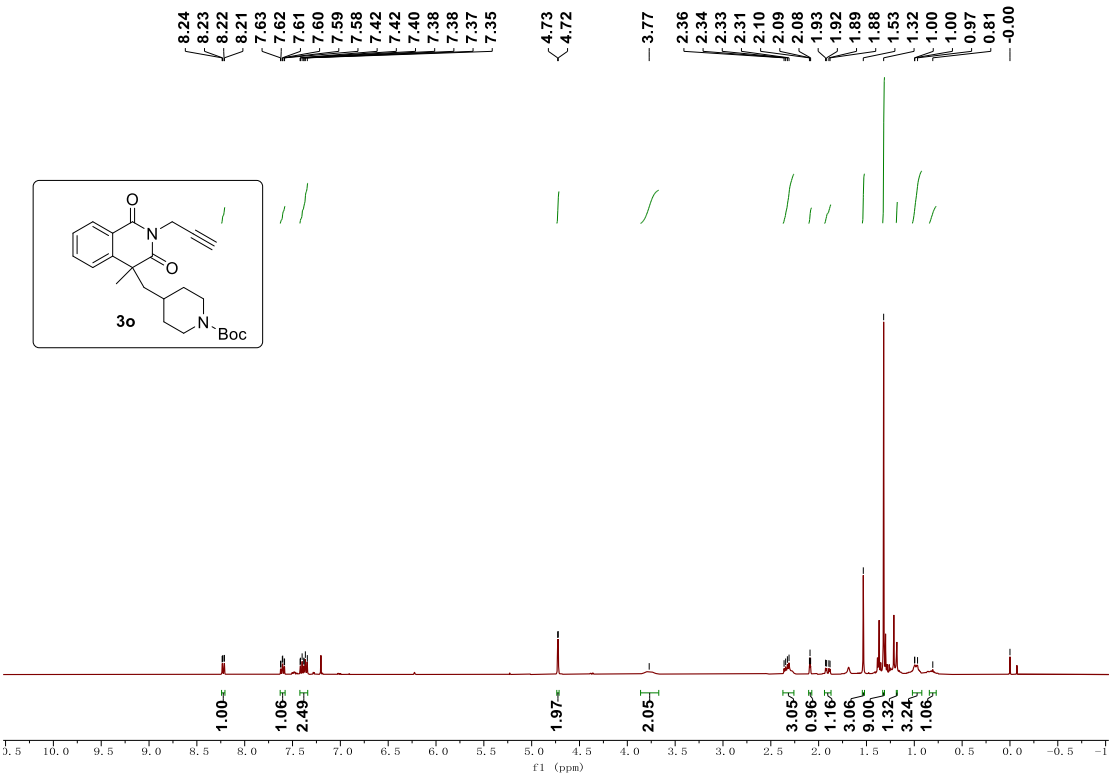
^{13}C NMR Spectra of **3m** ($CDCl_3$, 101 MHz)



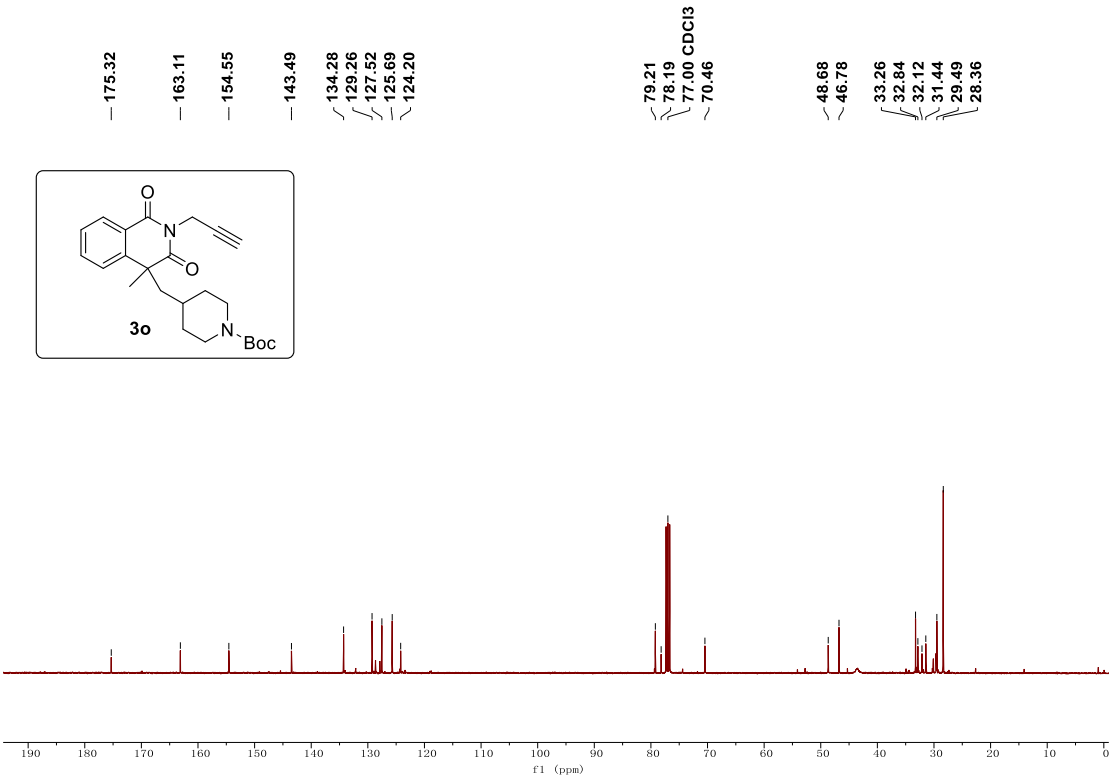
^{1}H NMR Spectra of **3n** ($CDCl_3$, 400 MHz)



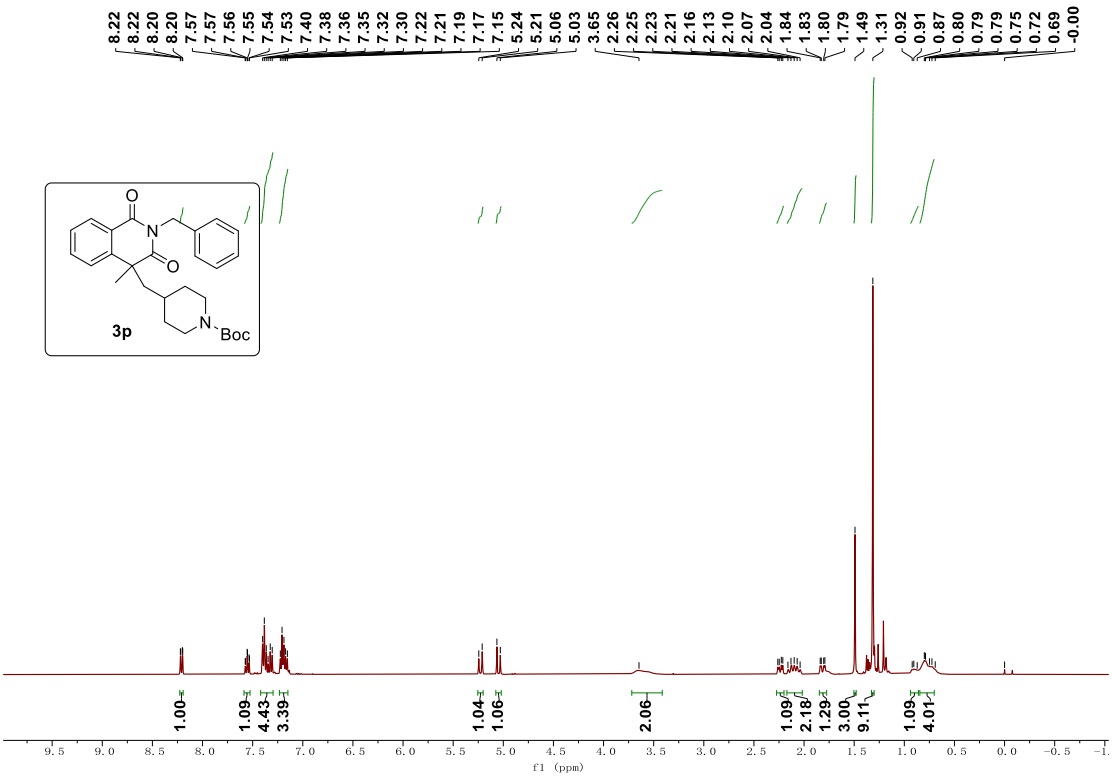
^{13}C NMR Spectra of **3n** ($CDCl_3$, 101 MHz)



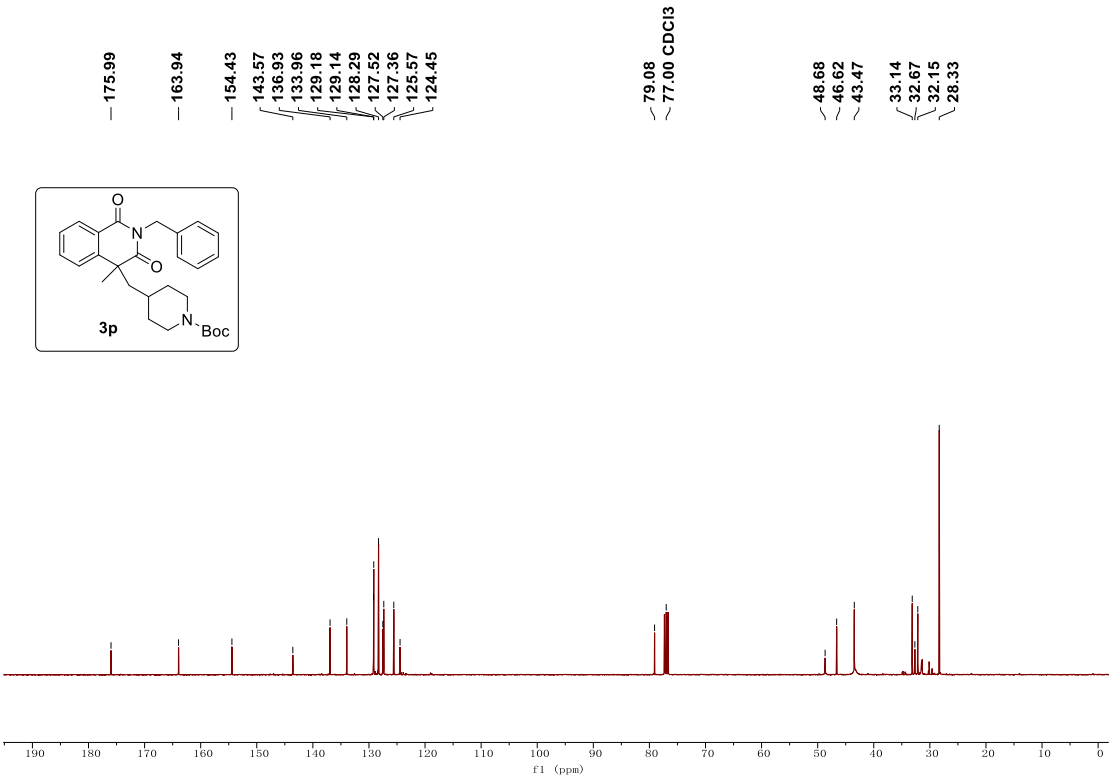
^{1}H NMR Spectra of **3o** ($CDCl_3$, 400 MHz)



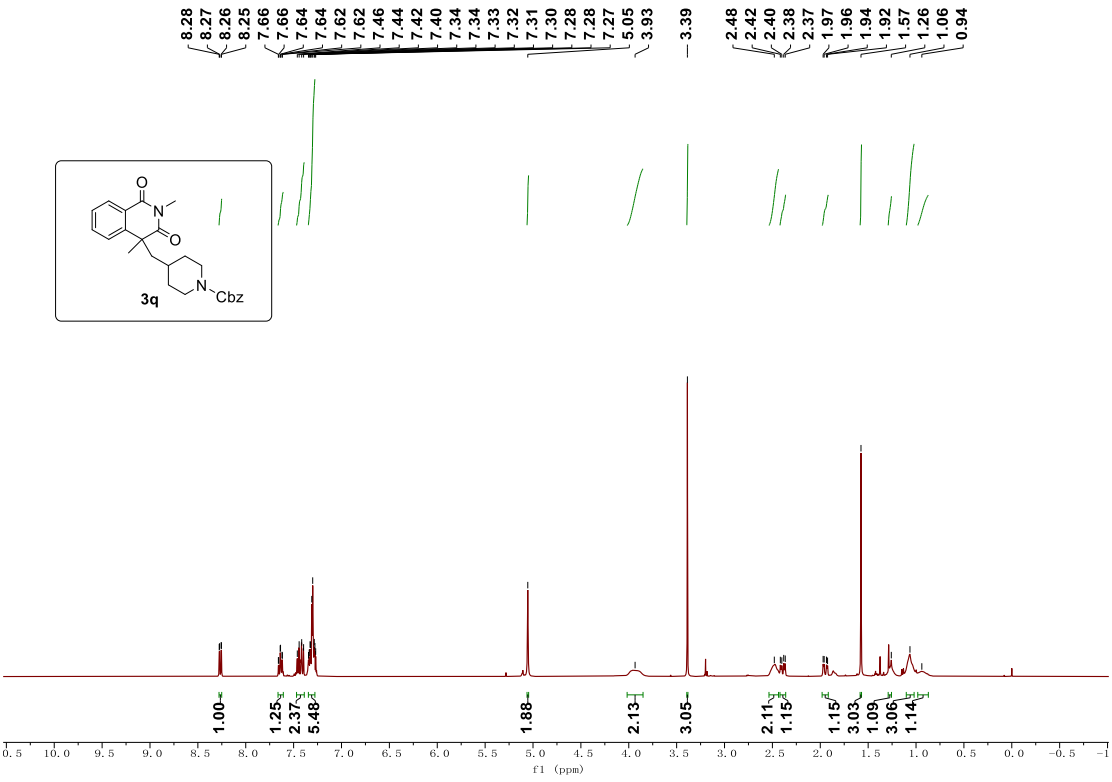
^{13}C NMR Spectra of **3o** ($CDCl_3$, 101 MHz)



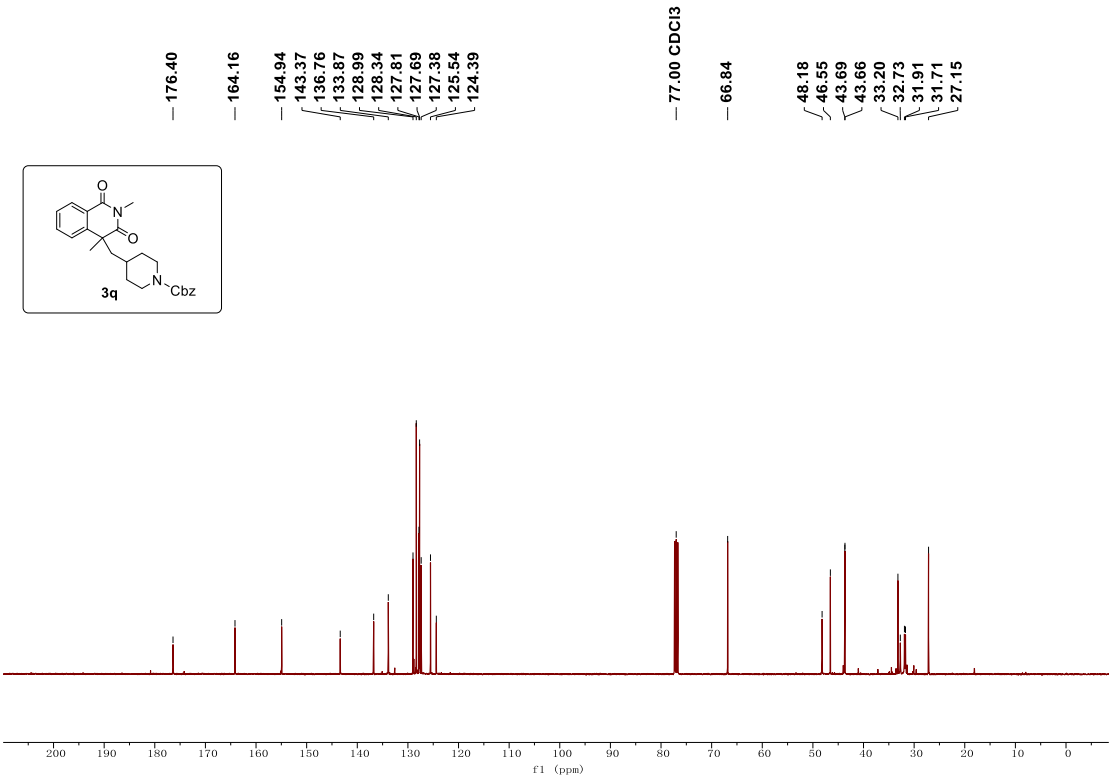
^{1}H NMR Spectra of **3p** ($CDCl_3$, 400 MHz)



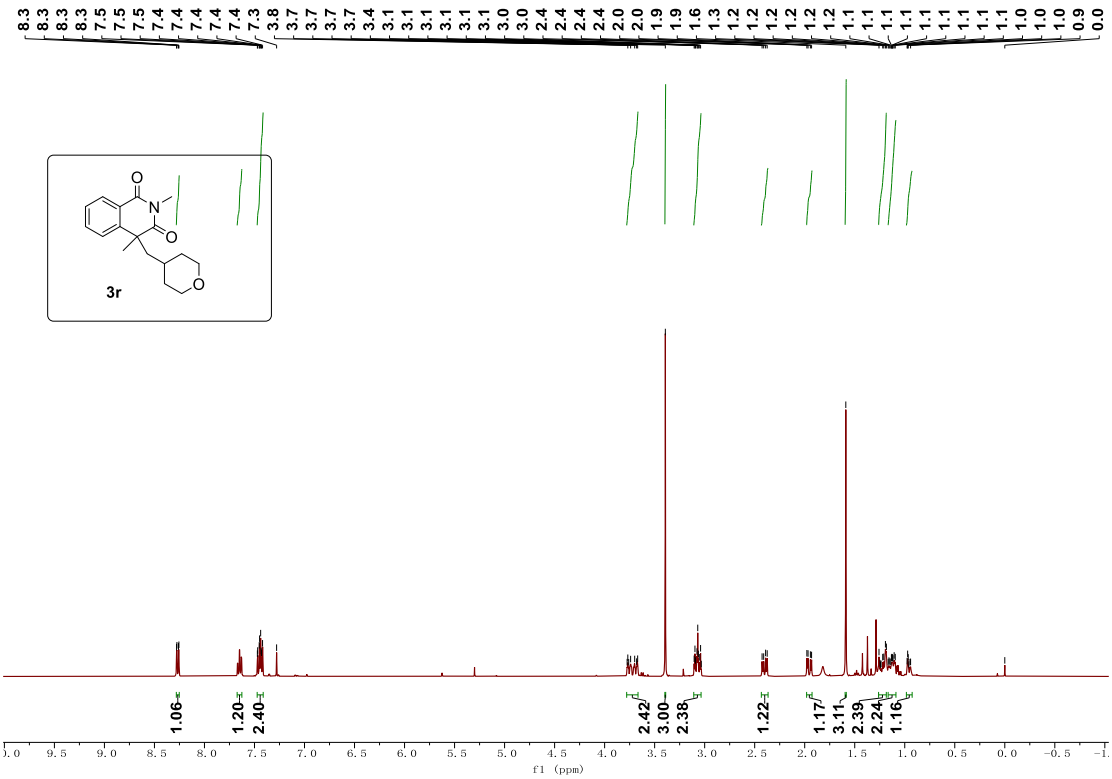
^{13}C NMR Spectra of **3p** ($CDCl_3$, 101 MHz)



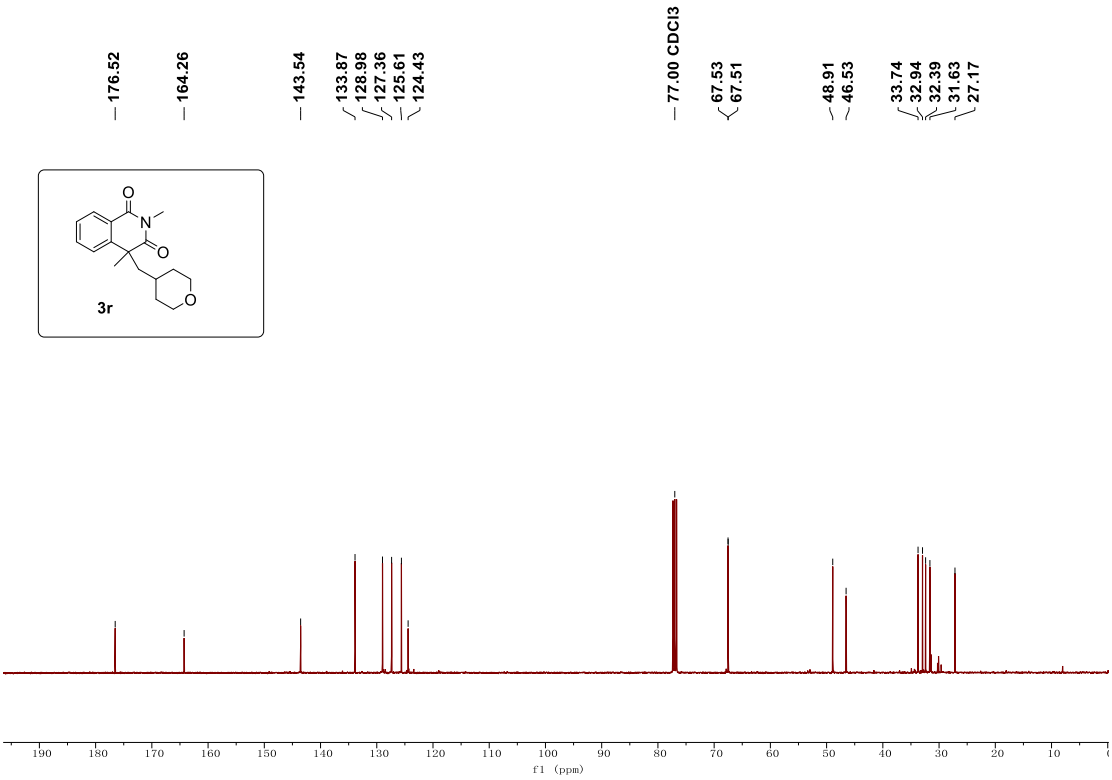
^{1}H NMR Spectra of **3q** ($CDCl_3$, 400 MHz)



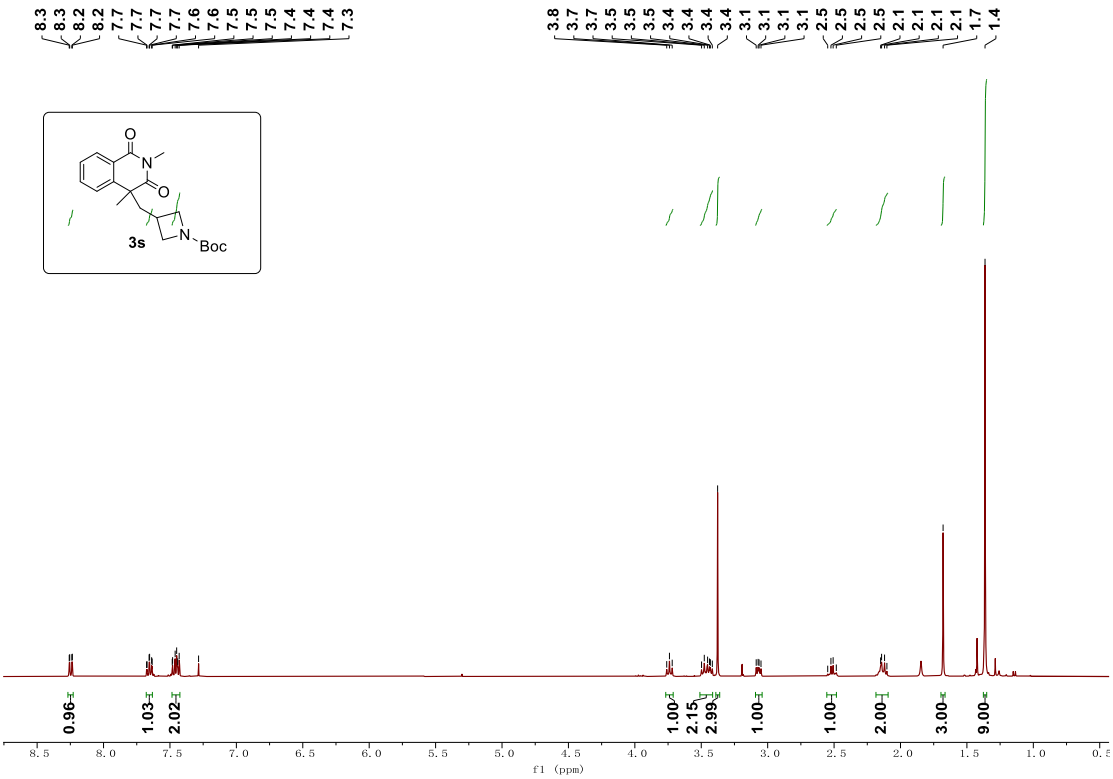
^{13}C NMR Spectra of **3q** ($CDCl_3$, 101 MHz)



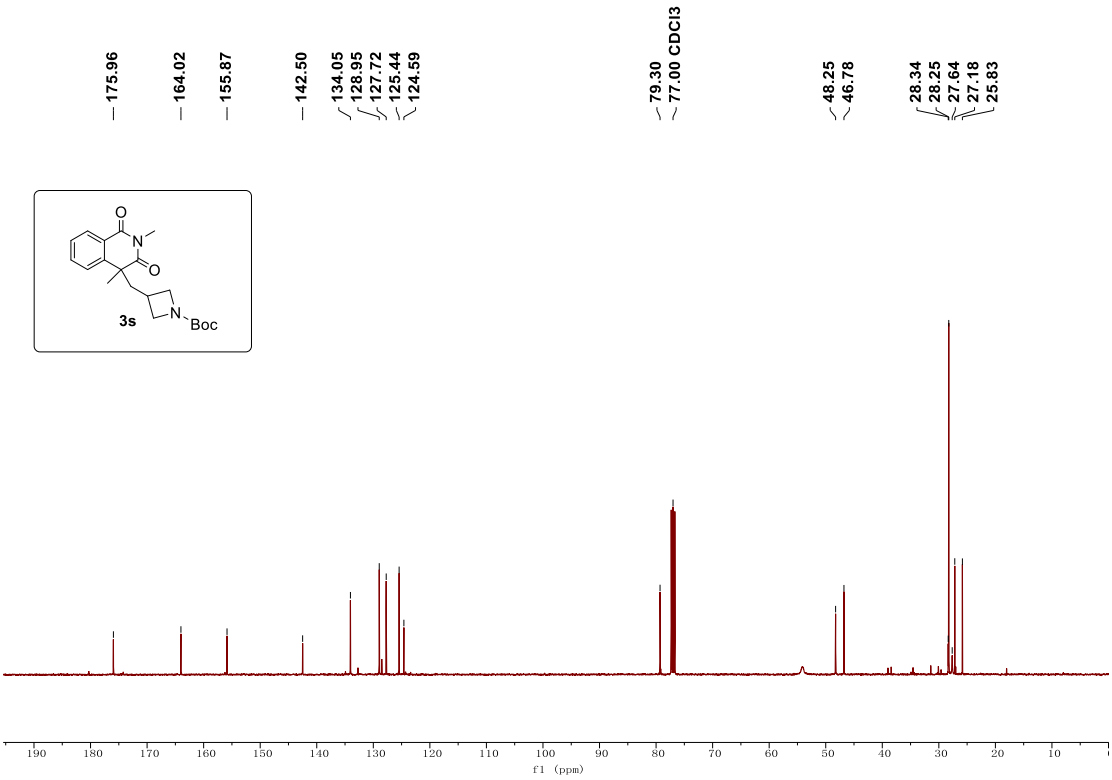
^{1}H NMR Spectra of **3r** ($CDCl_3$, 400 MHz)



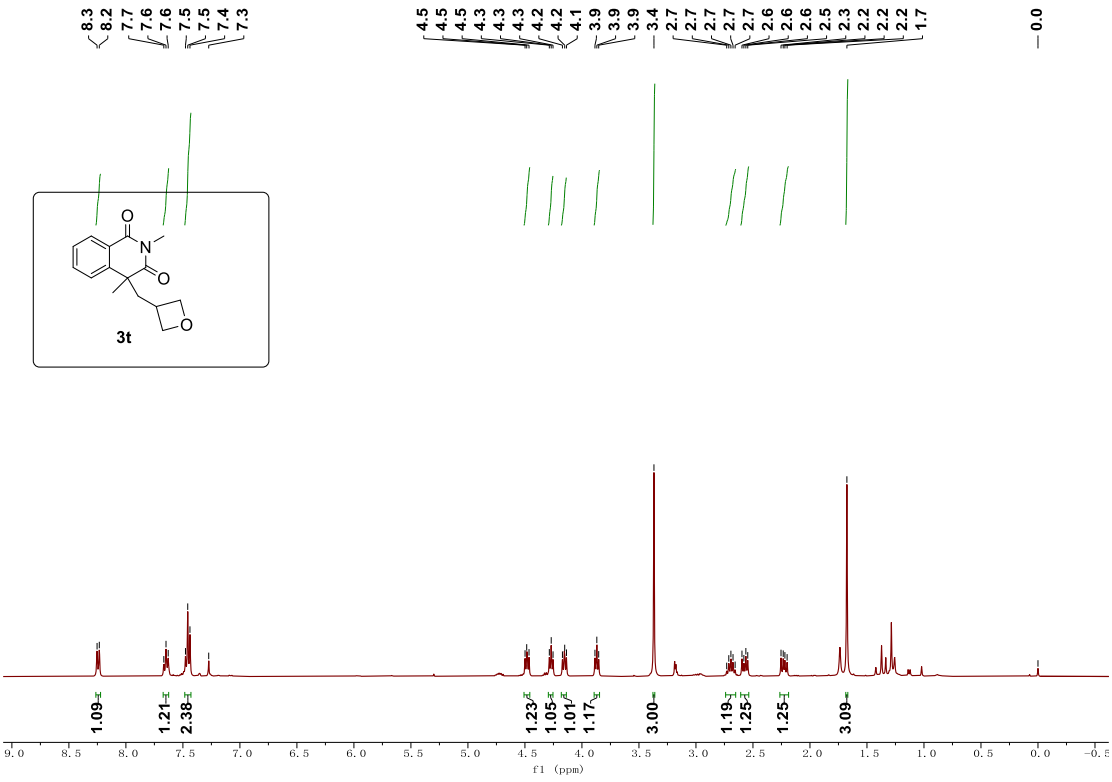
^{13}C NMR Spectra of **3r** ($CDCl_3$, 101 MHz)



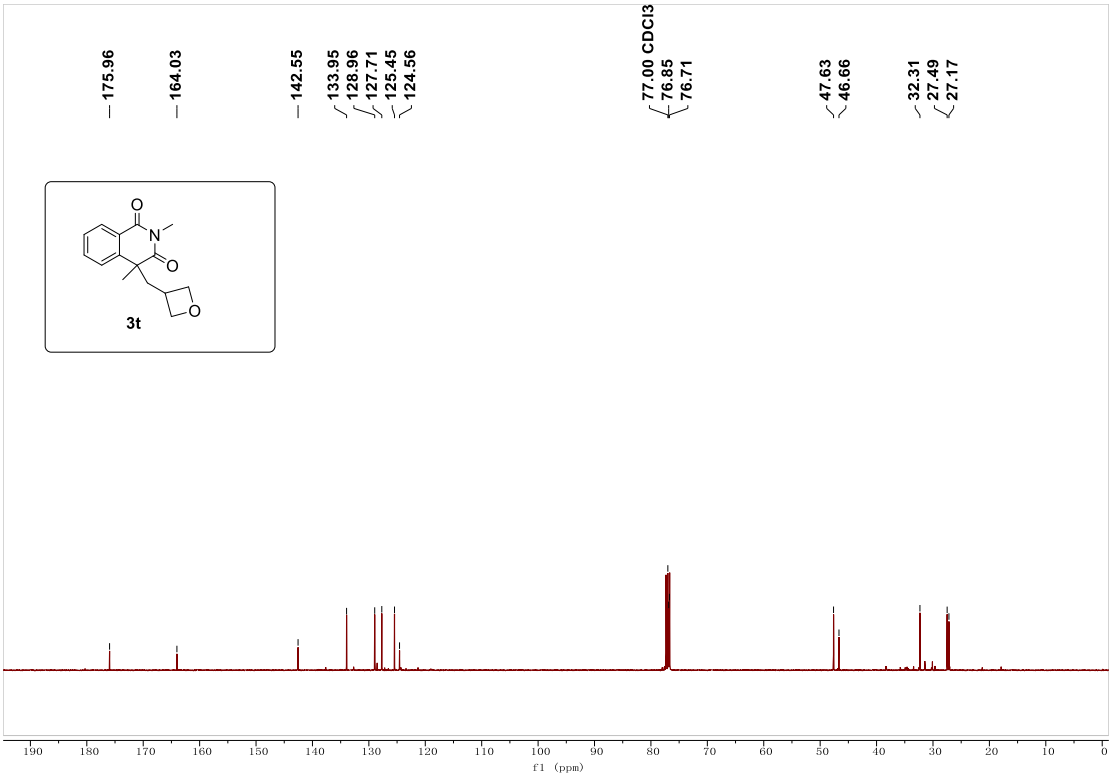
^{1}H NMR Spectra of **3s** ($CDCl_3$, 400 MHz)



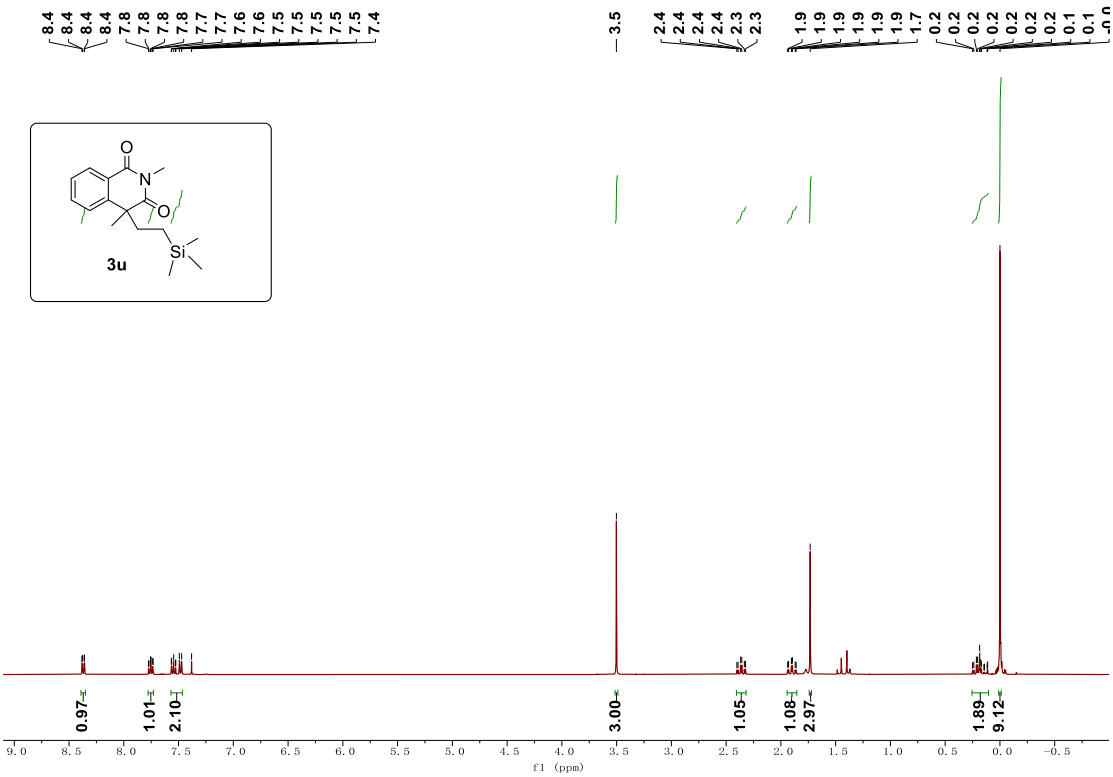
^{13}C NMR Spectra of **3s** ($CDCl_3$, 101 MHz)



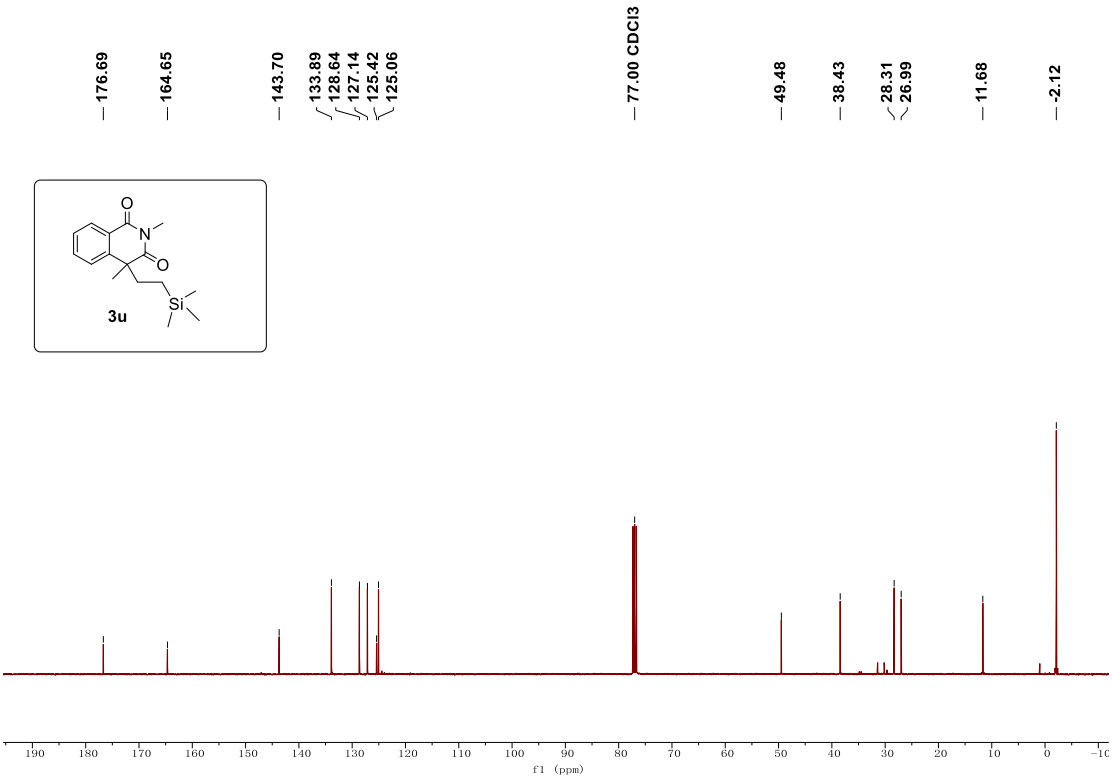
^{1}H NMR Spectra of **3t** ($CDCl_3$, 400 MHz)



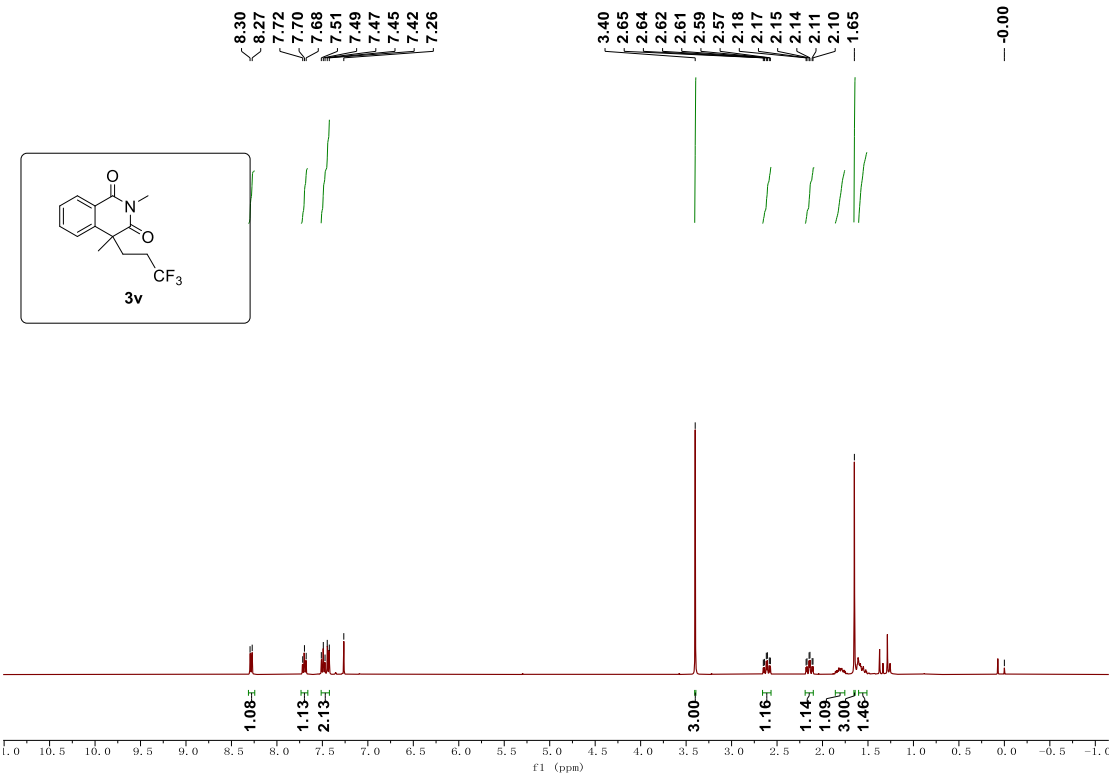
^{13}C NMR Spectra of **3t** ($CDCl_3$, 101 MHz)



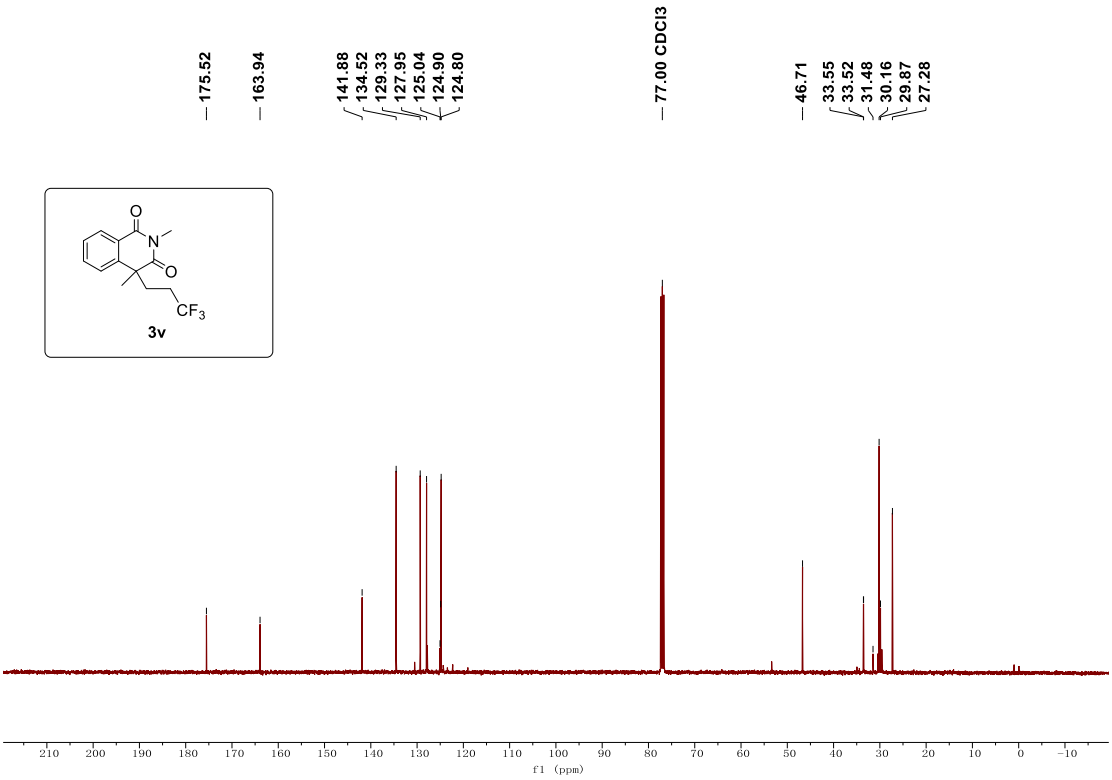
^{1}H NMR Spectra of **3u** ($CDCl_3$, 400 MHz)



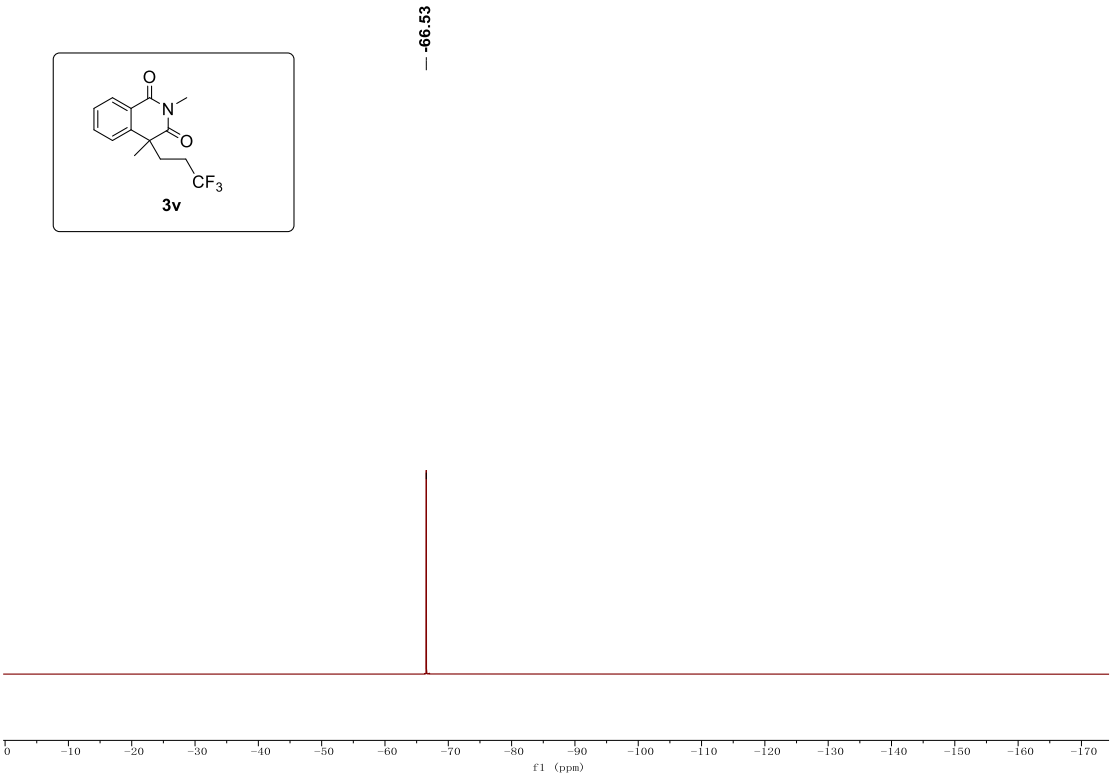
^{13}C NMR Spectra of **3u** ($CDCl_3$, 101 MHz)



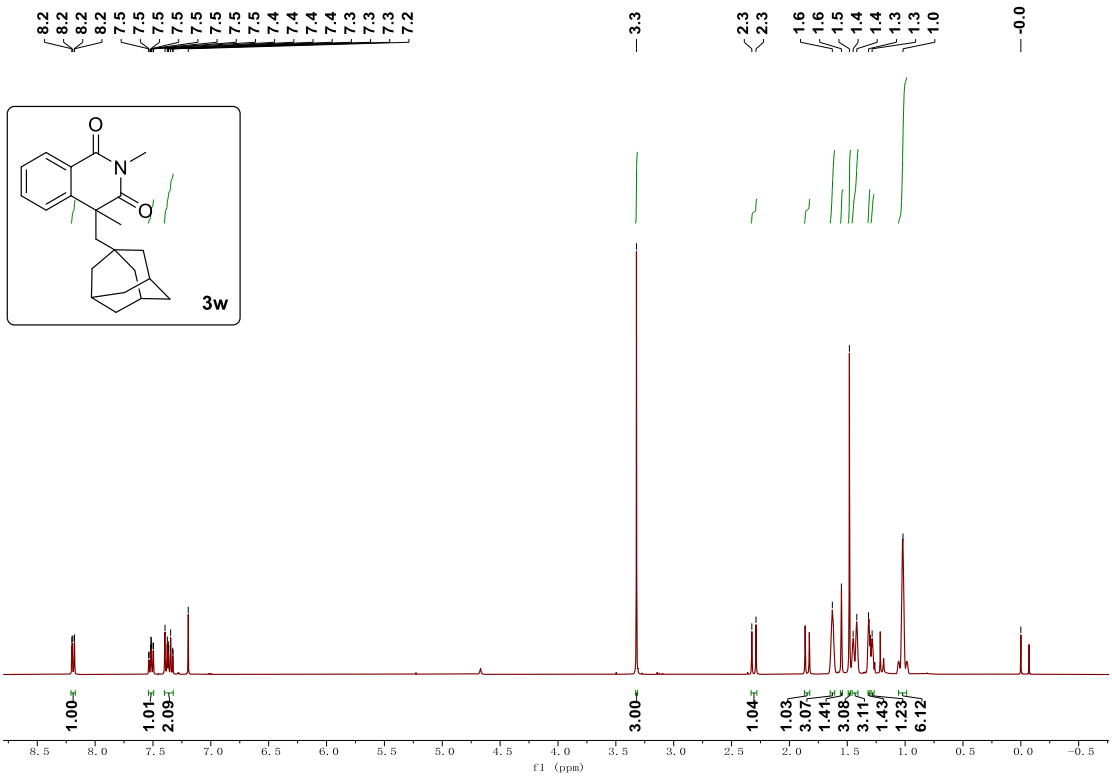
^{1}H NMR Spectra of **3v** ($CDCl_3$, 400 MHz)



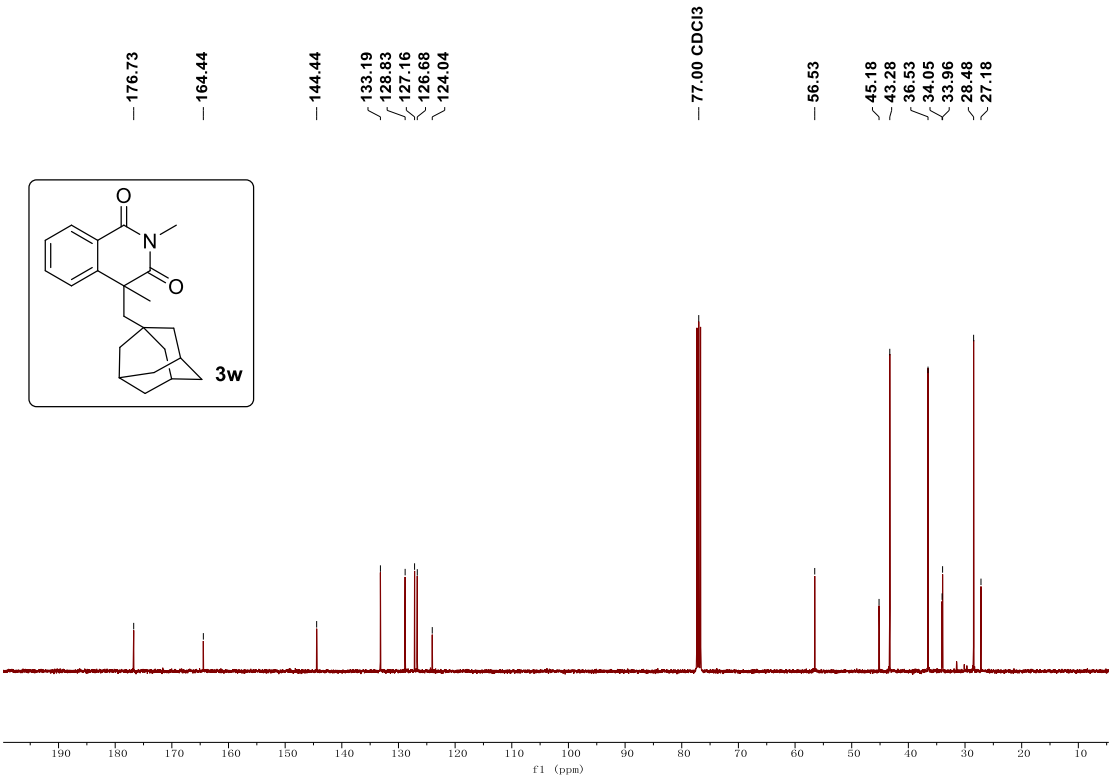
^{13}C NMR Spectra of **3v** ($CDCl_3$, 101 MHz)



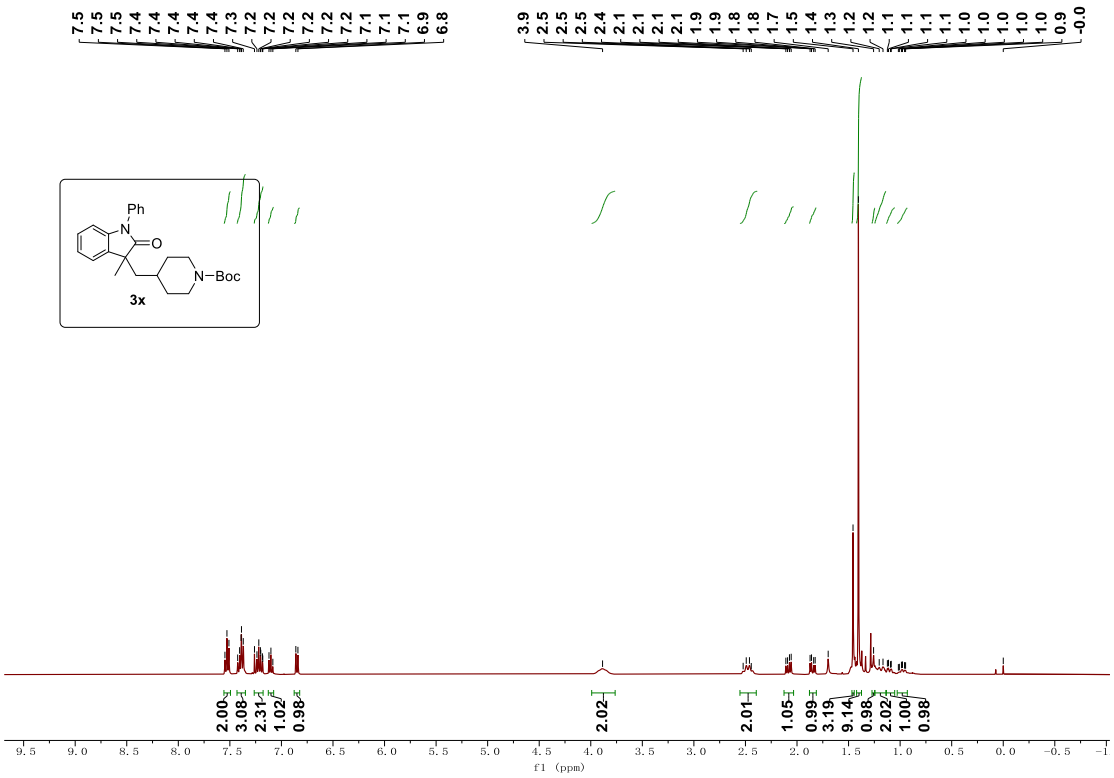
^{19}F NMR Spectra of **3v** (376 MHz, $CDCl_3$)



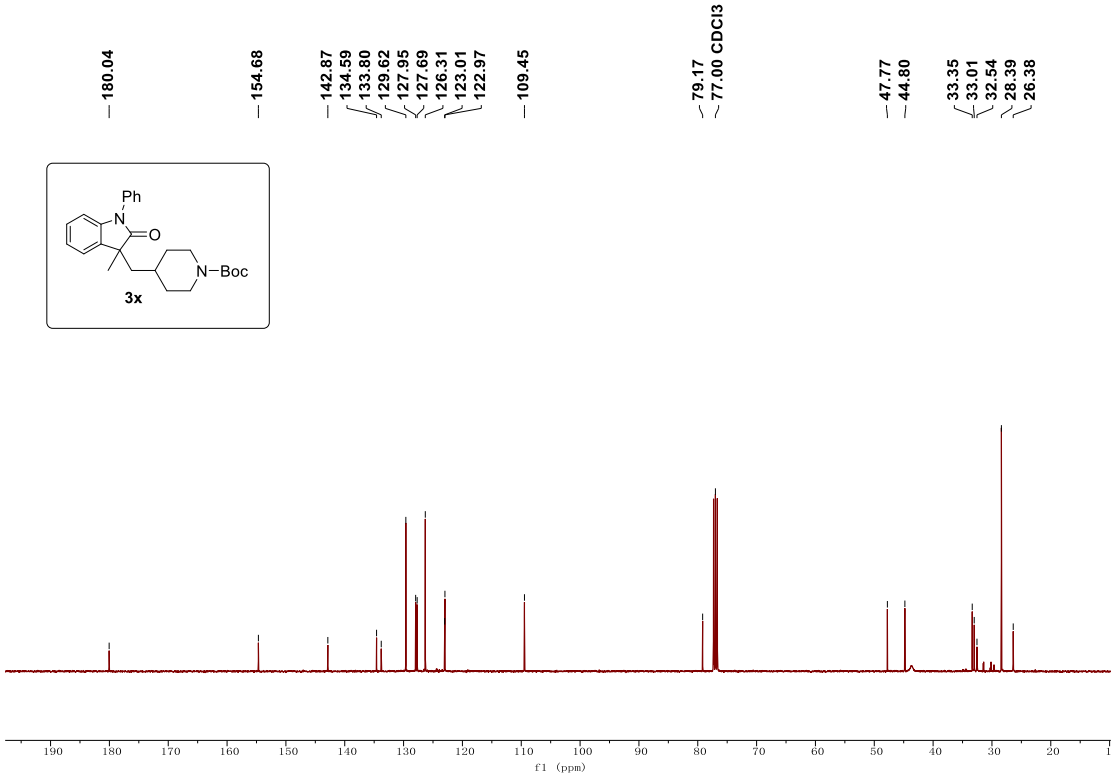
^{1}H NMR Spectra of **3w** ($CDCl_3$, 400 MHz)



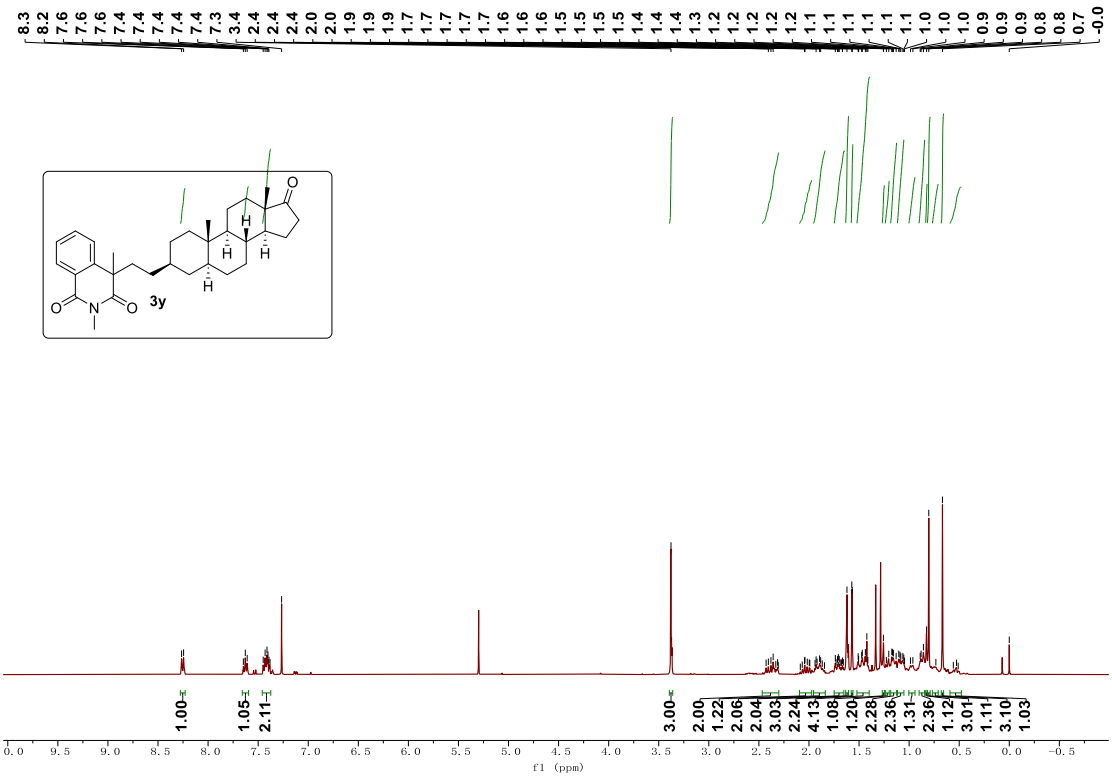
^{13}C NMR Spectra of **3w** ($CDCl_3$, 101 MHz)



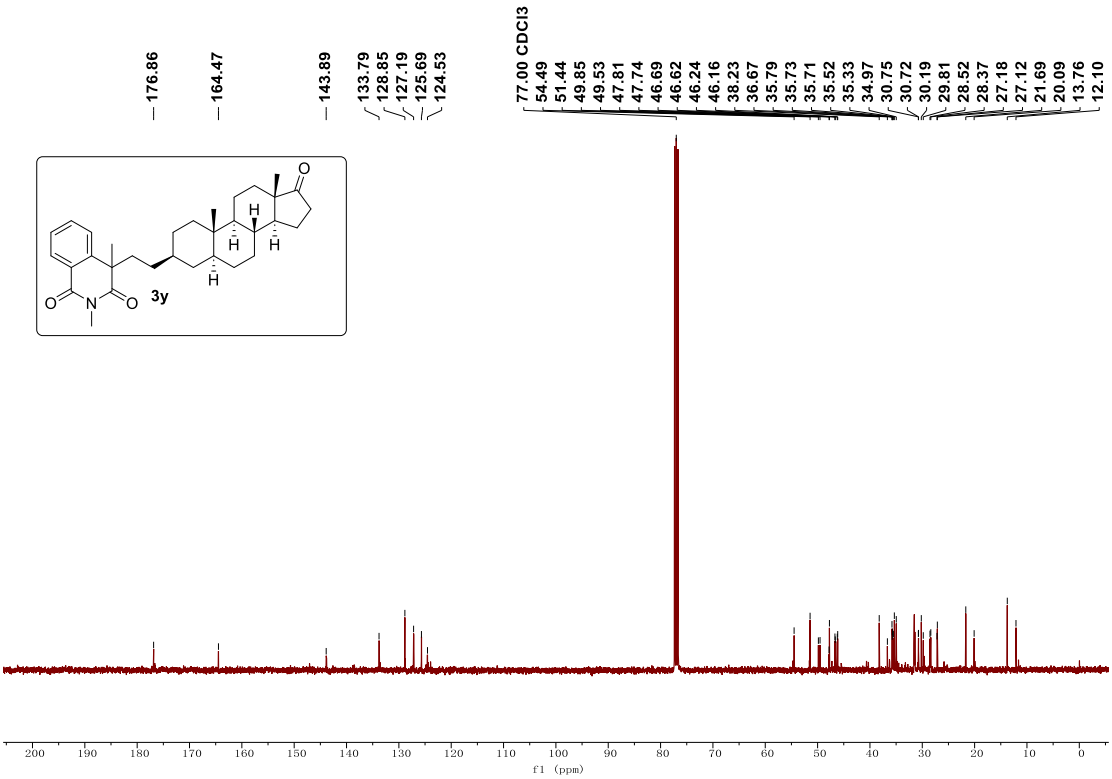
^{1}H NMR Spectra of **3x** ($CDCl_3$, 400 MHz)



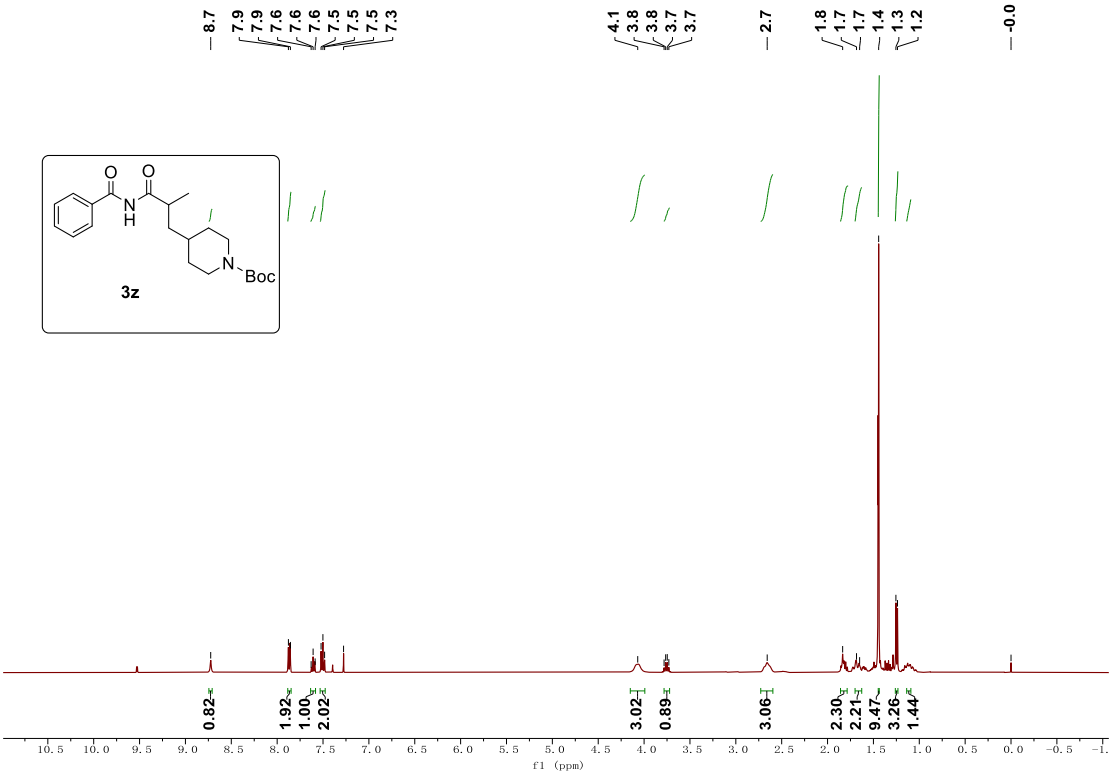
^{13}C NMR Spectra of **3x** ($CDCl_3$, 101 MHz)



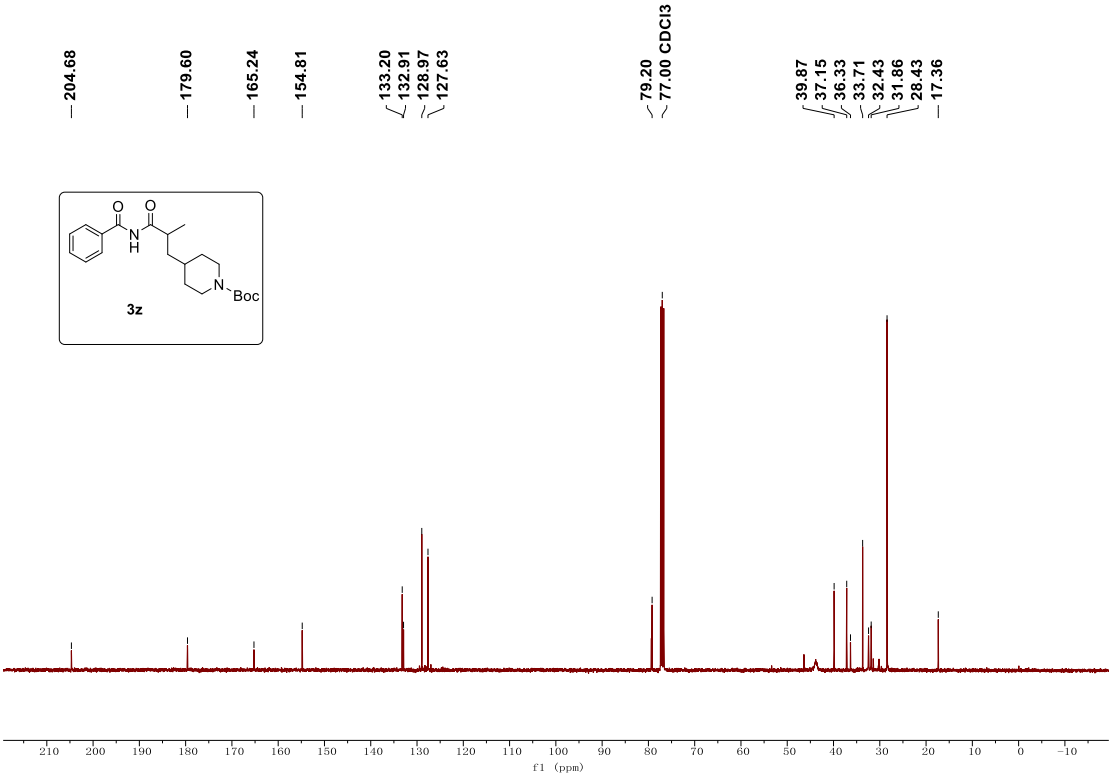
^{1}H NMR Spectra of **3y** ($CDCl_3$, 400 MHz)



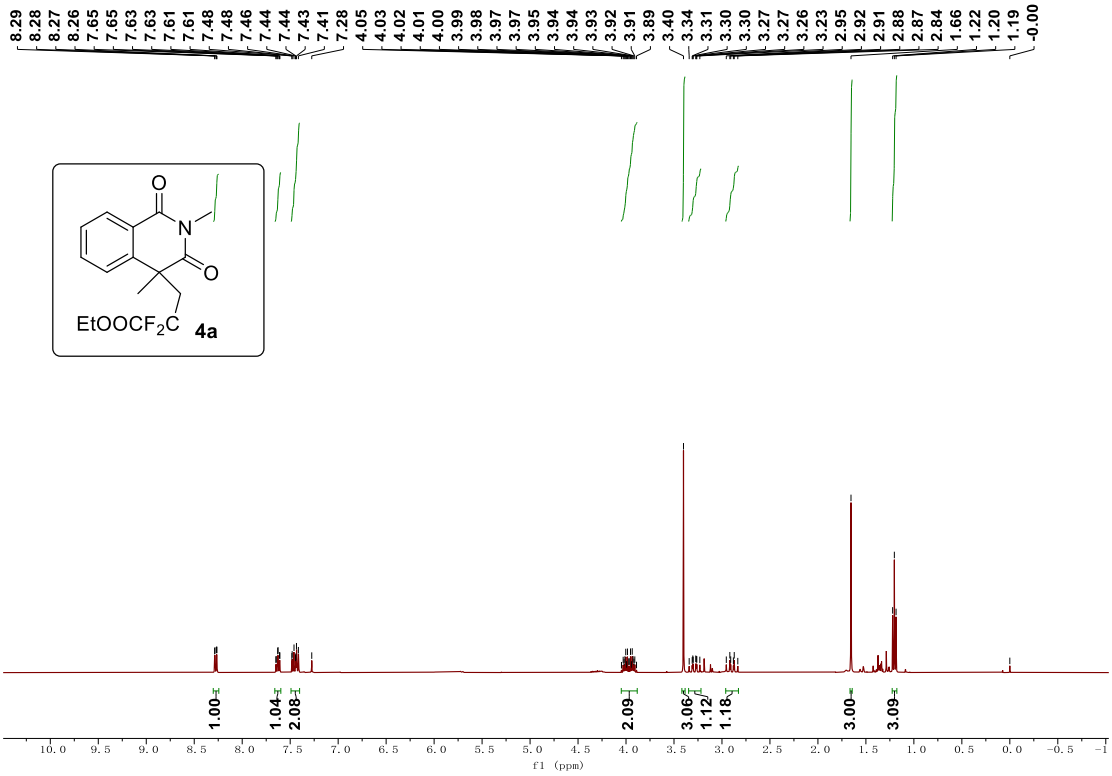
^{13}C NMR Spectra of **3y** ($CDCl_3$, 101 MHz)



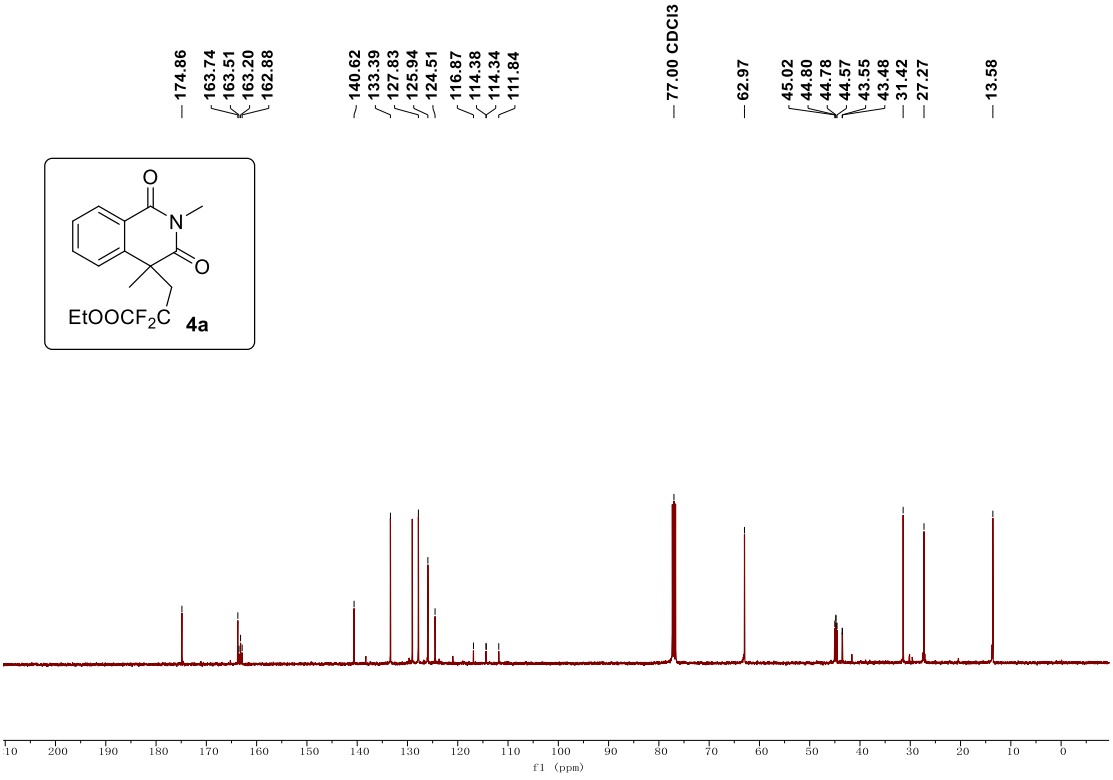
^{1}H NMR Spectra of **3z** ($CDCl_3$, 400 MHz)



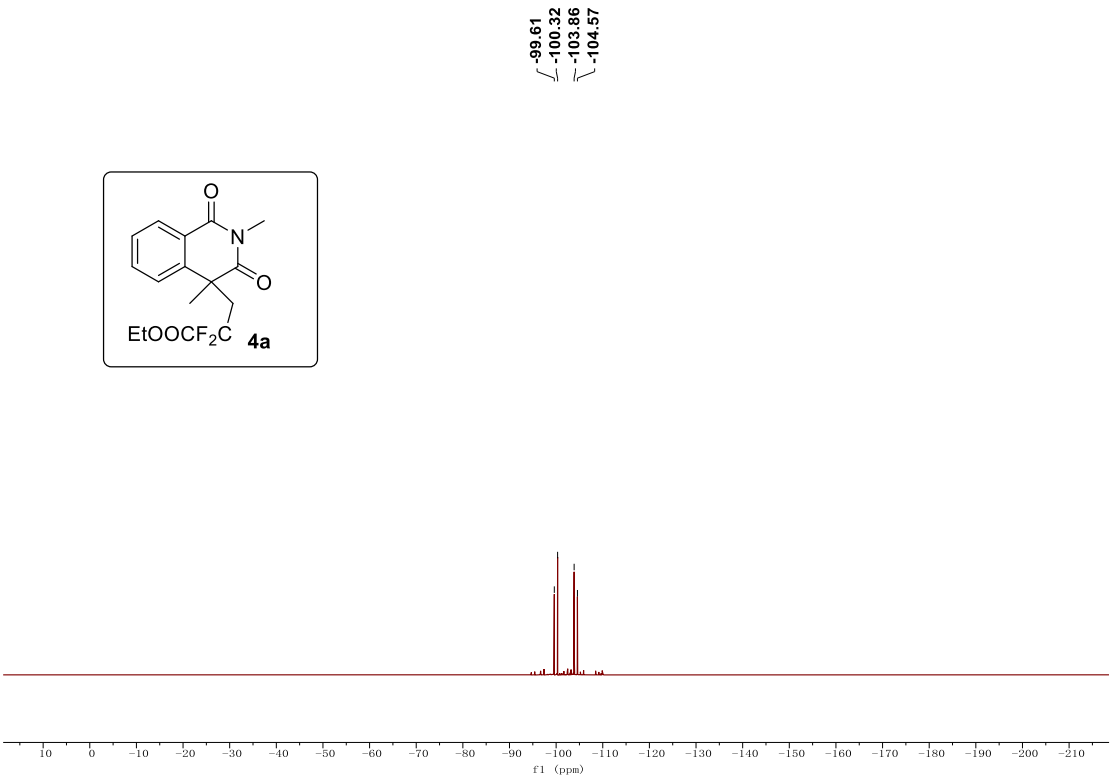
^{13}C NMR Spectra of **3z** ($CDCl_3$, 101 MHz)



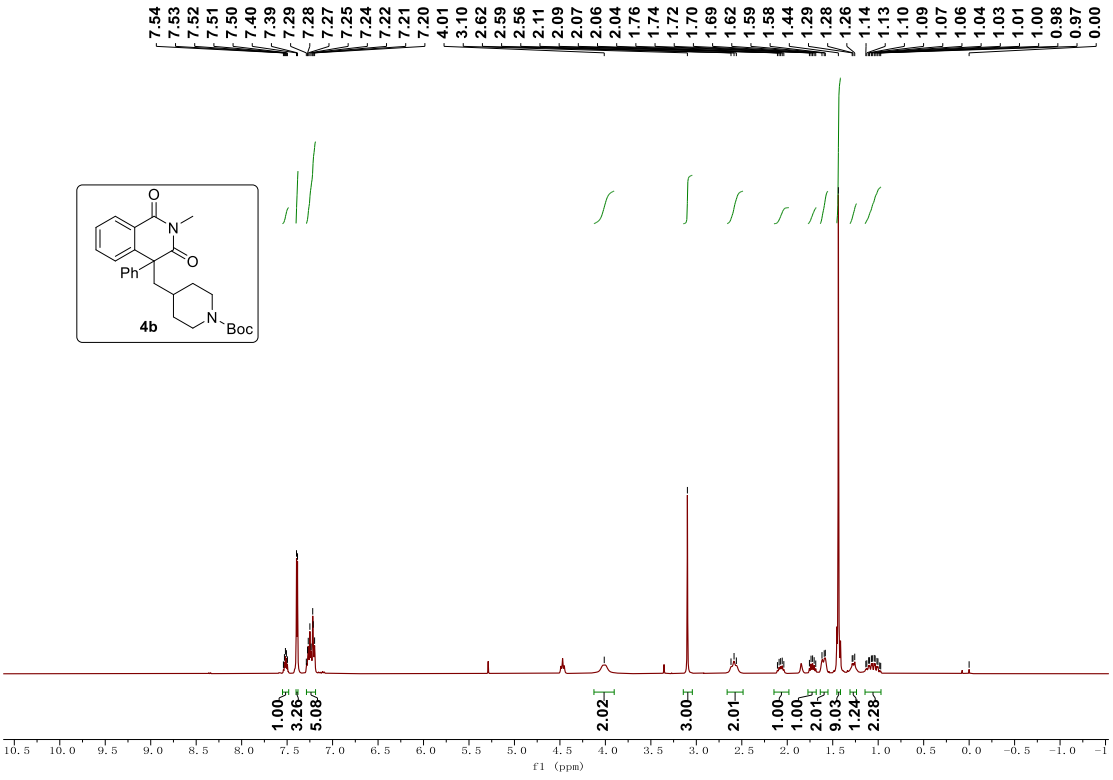
^{1}H NMR Spectra of **4a** ($CDCl_3$, 400 MHz)



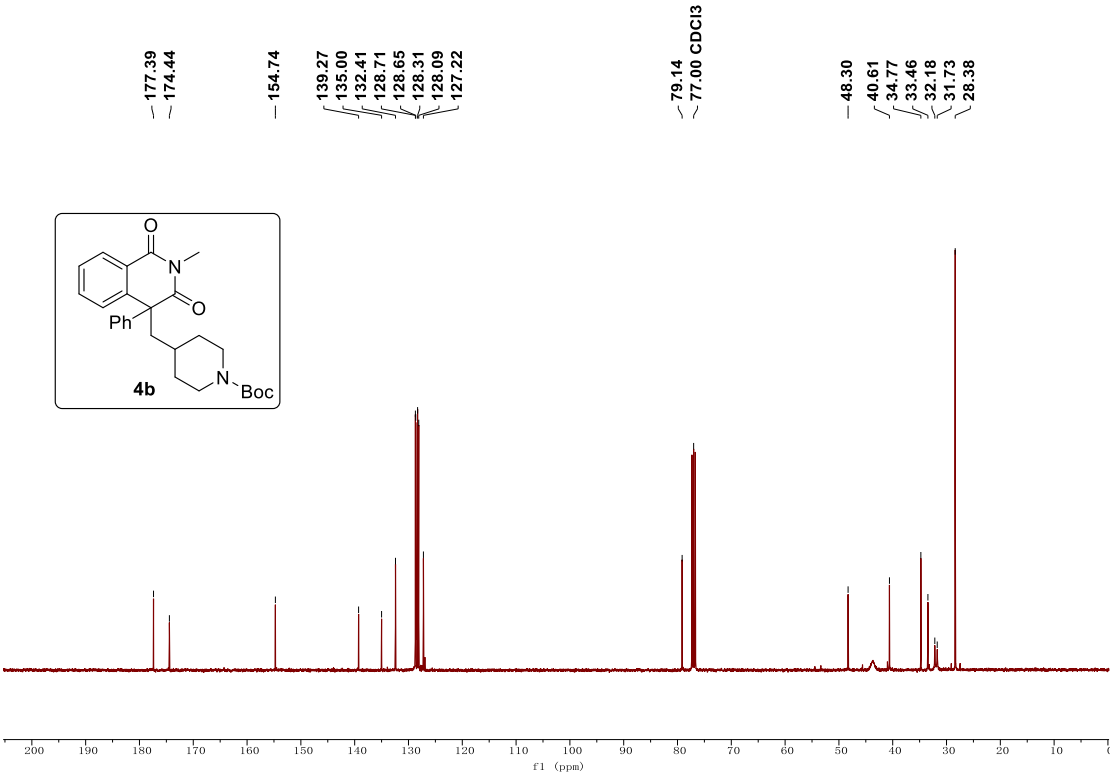
^{13}C NMR Spectra of **4a** ($CDCl_3$, 101 MHz)



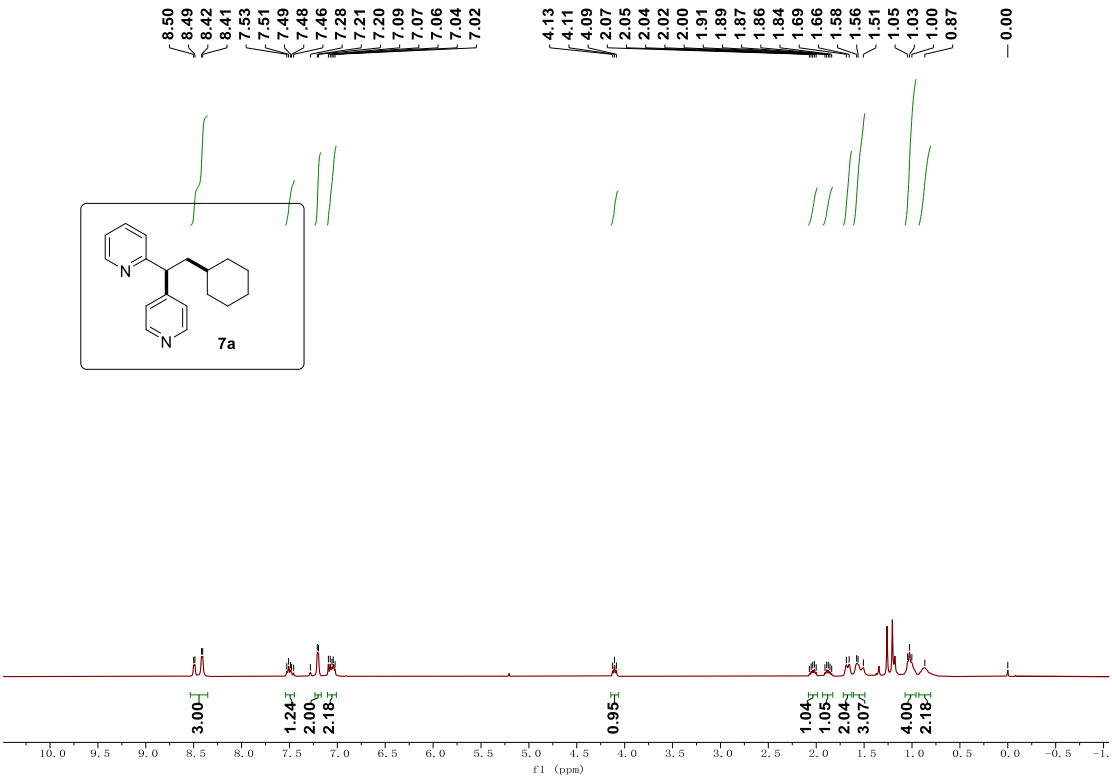
^{19}F NMR Spectra of **4a** ($CDCl_3$, 376 MHz)



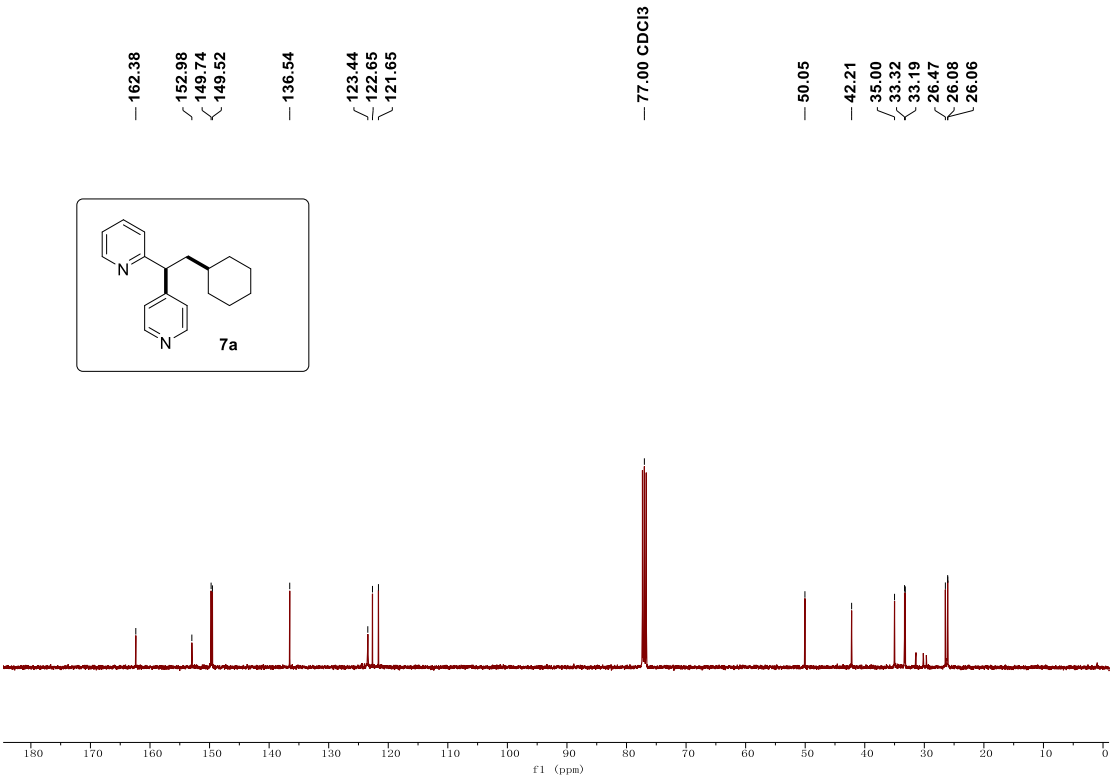
^{1}H NMR Spectra of **4b** ($CDCl_3$, 400 MHz)



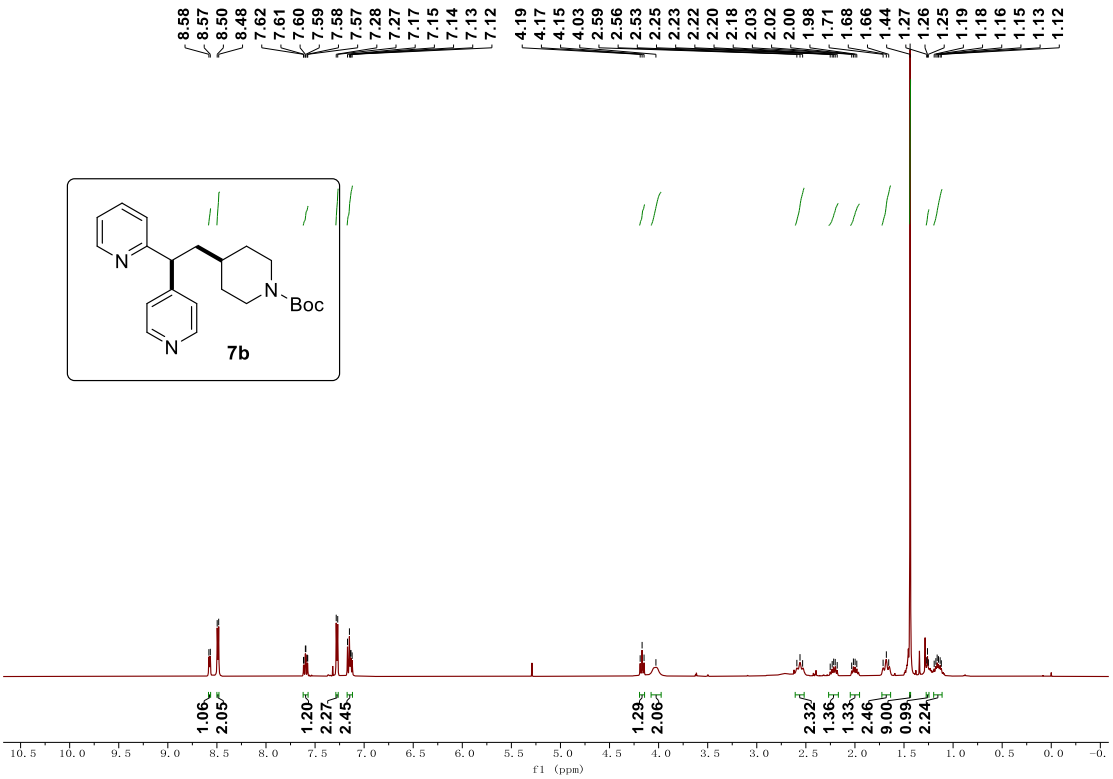
^{13}C NMR Spectra of **4b** ($CDCl_3$, 101 MHz)



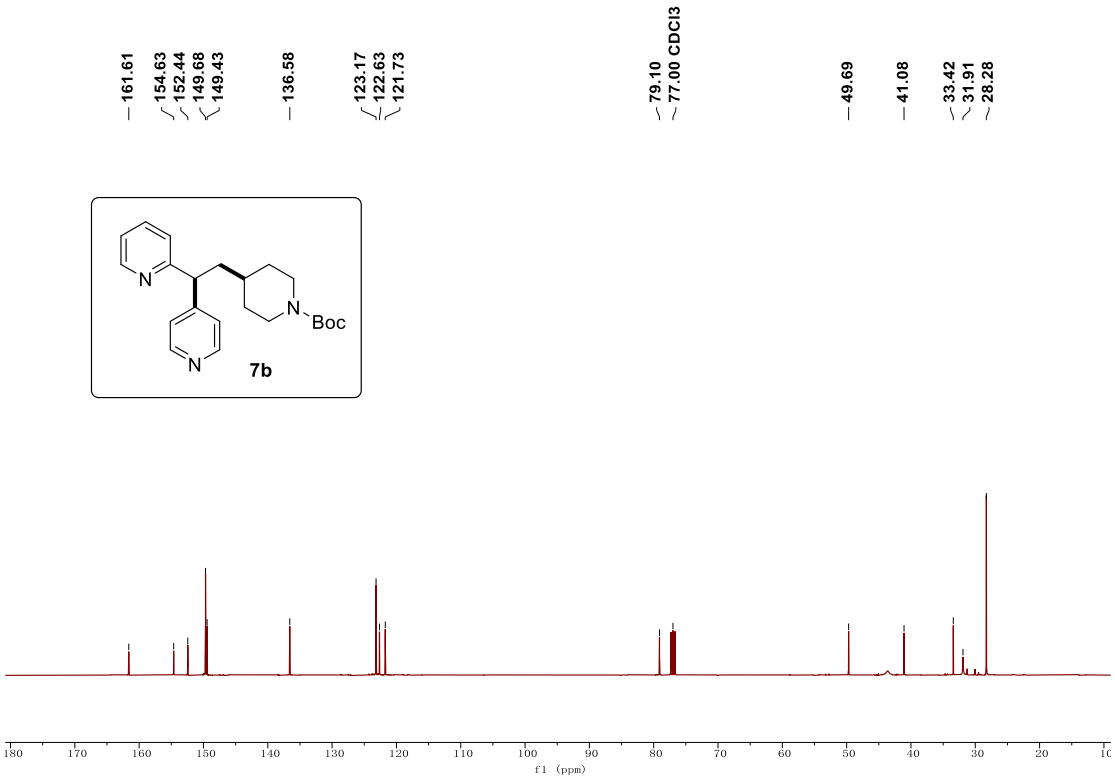
^{1}H NMR Spectra of **7a** ($CDCl_3$, 400 MHz)



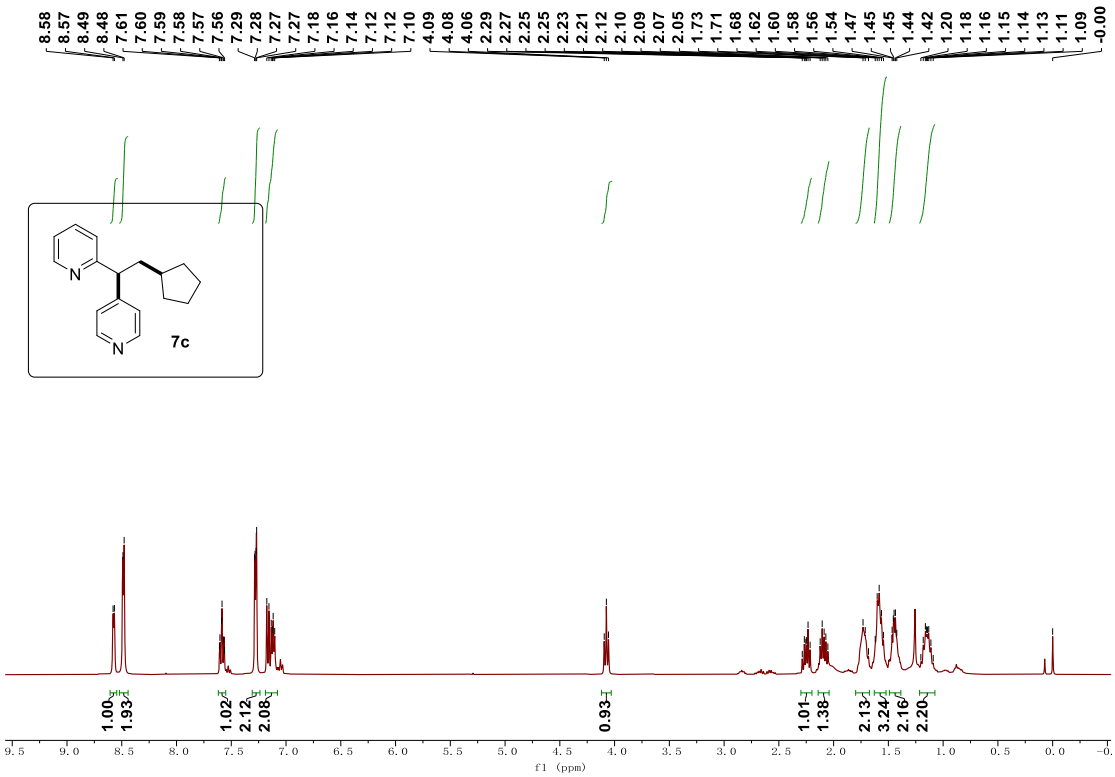
^{13}C NMR Spectra of **7a** ($CDCl_3$, 101 MHz)



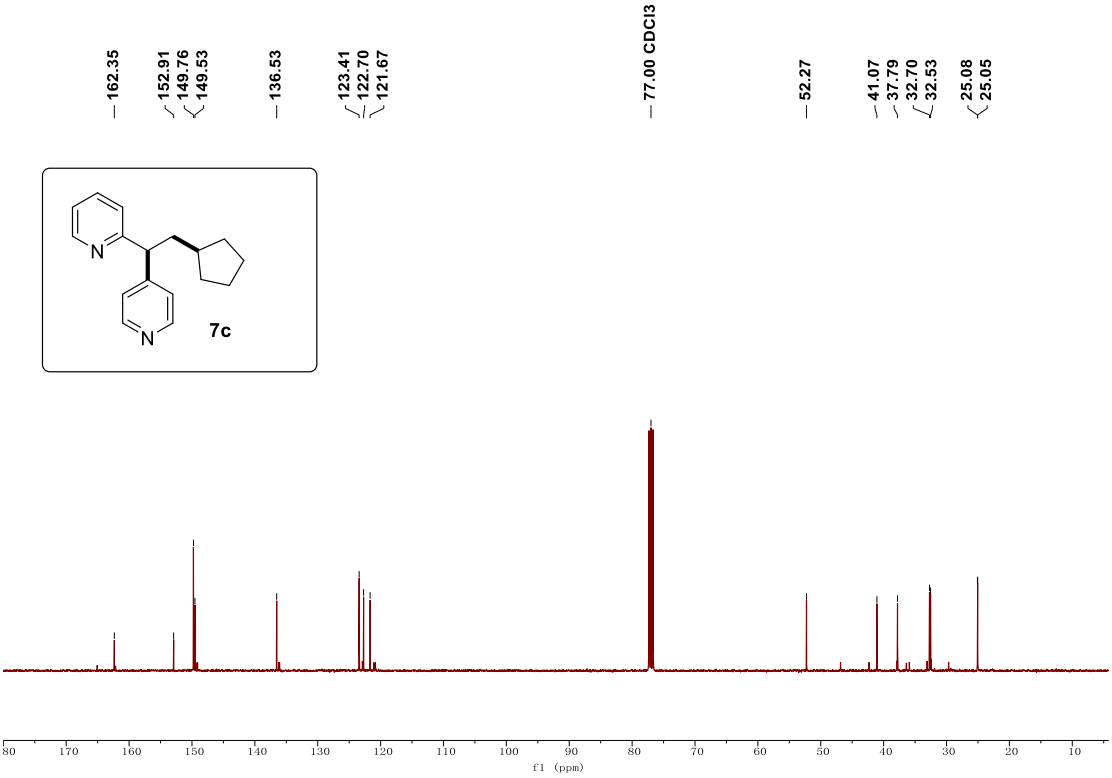
^{1}H NMR Spectra of **7b** ($CDCl_3$, 400 MHz)



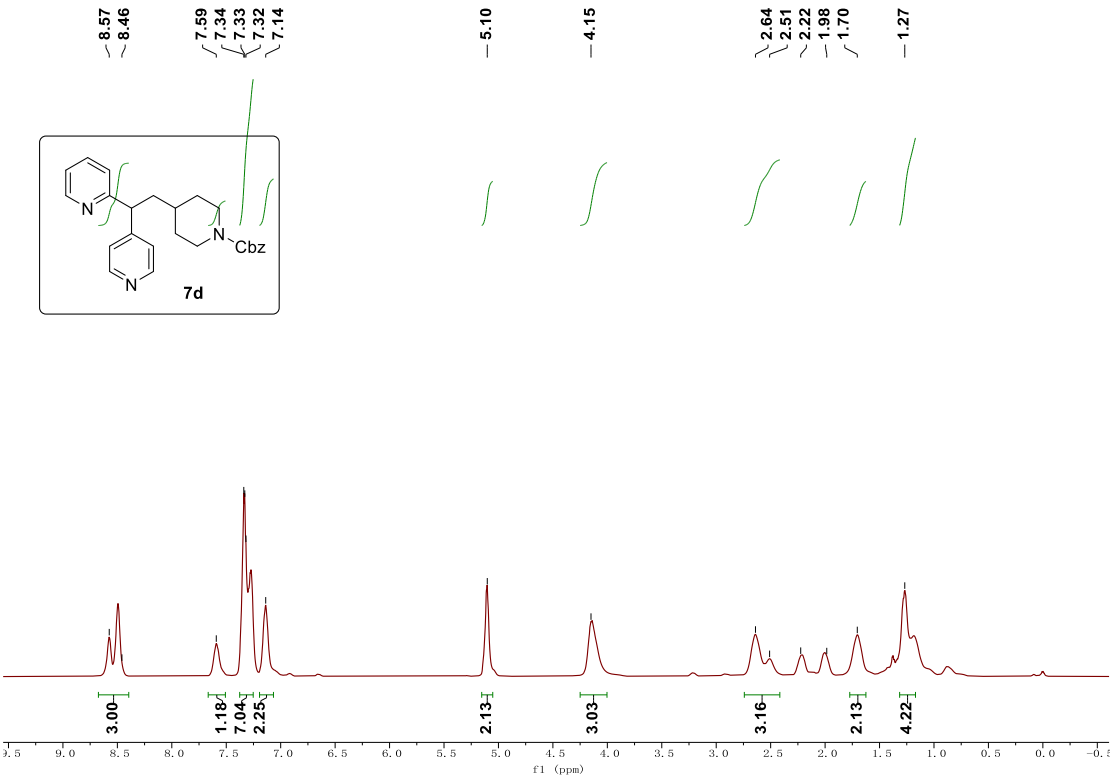
^{13}C NMR Spectra of **7b** ($CDCl_3$, 101 MHz)



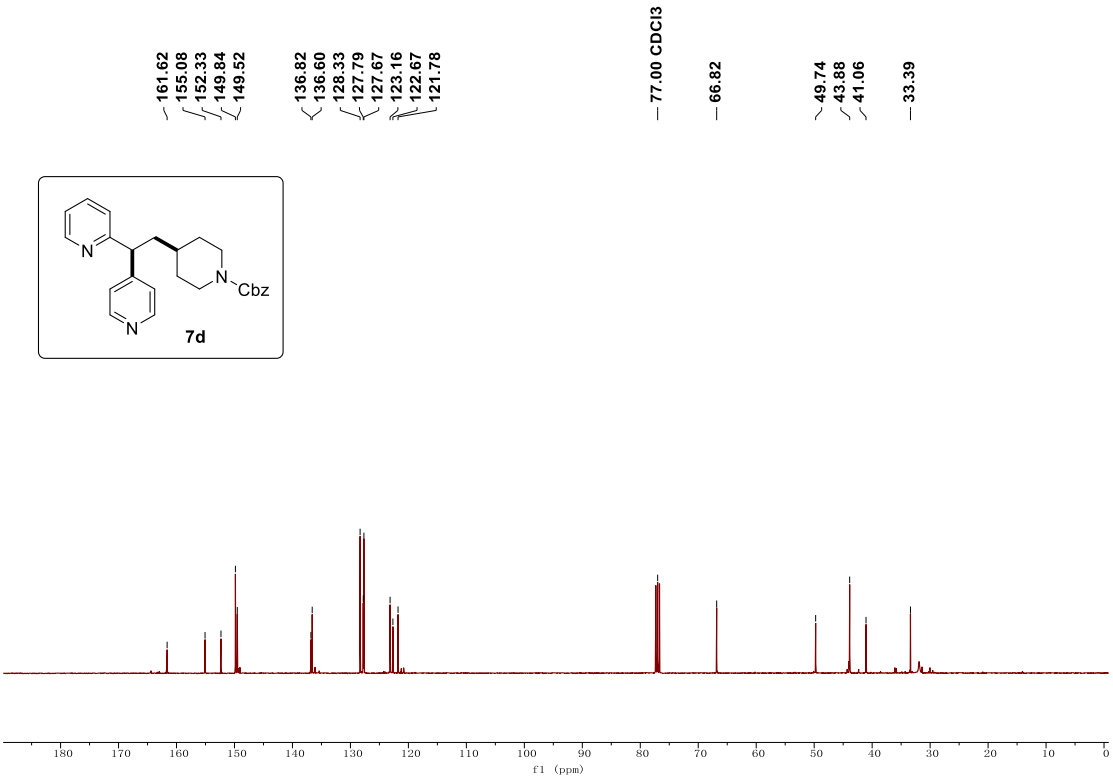
^{1}H NMR Spectra of **7c** ($CDCl_3$, 400 MHz)



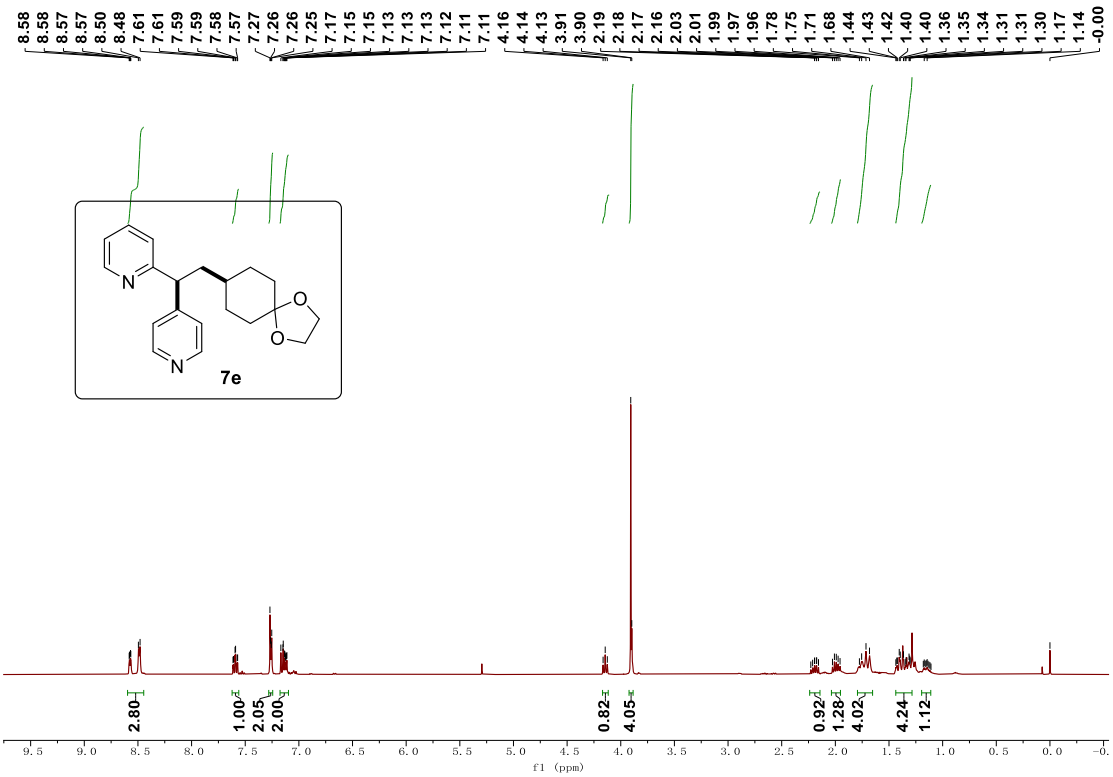
^{13}C NMR Spectra of **7c** ($CDCl_3$, 101 MHz)



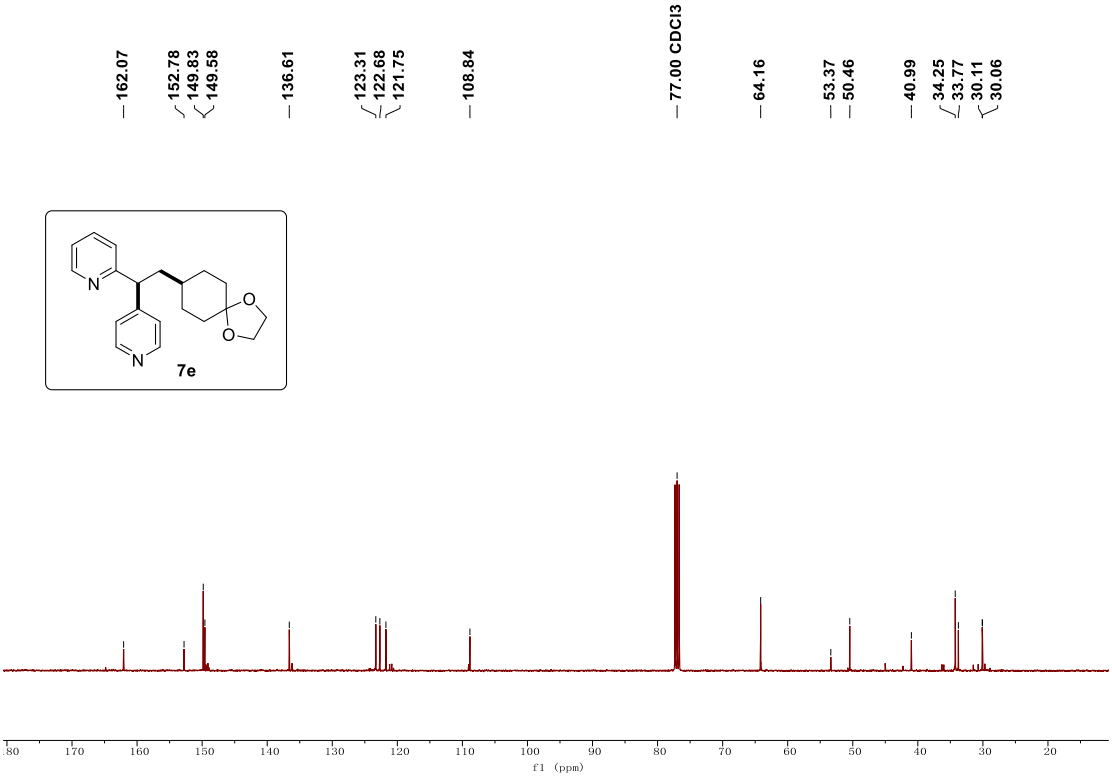
^{1}H NMR Spectra of **7d** ($CDCl_3$, 400 MHz)



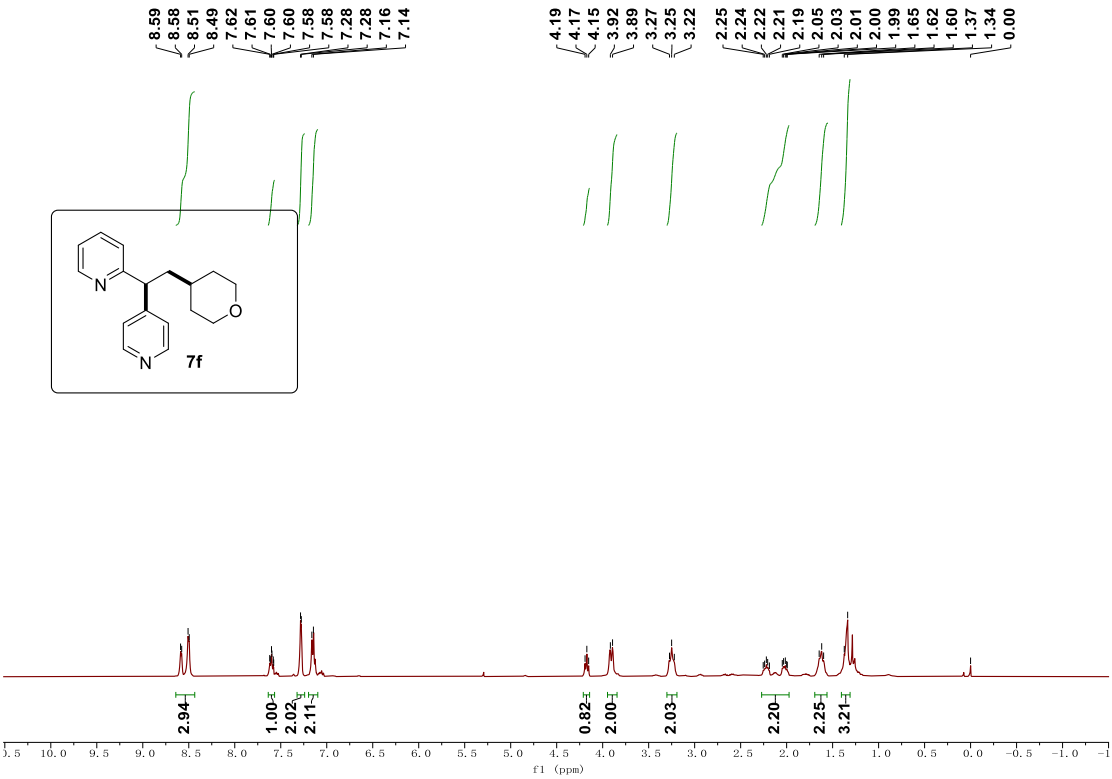
^{13}C NMR Spectra of **7d** ($CDCl_3$, 101 MHz)



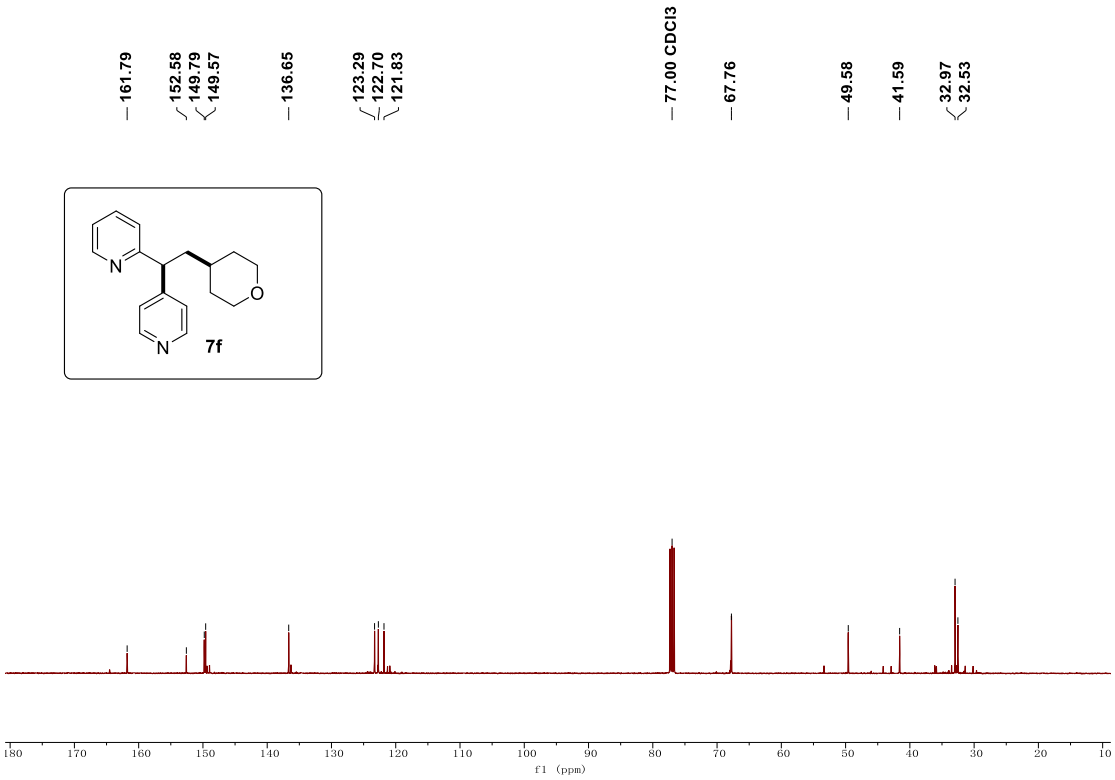
^{1}H NMR Spectra of **7e** ($CDCl_3$, 400 MHz)



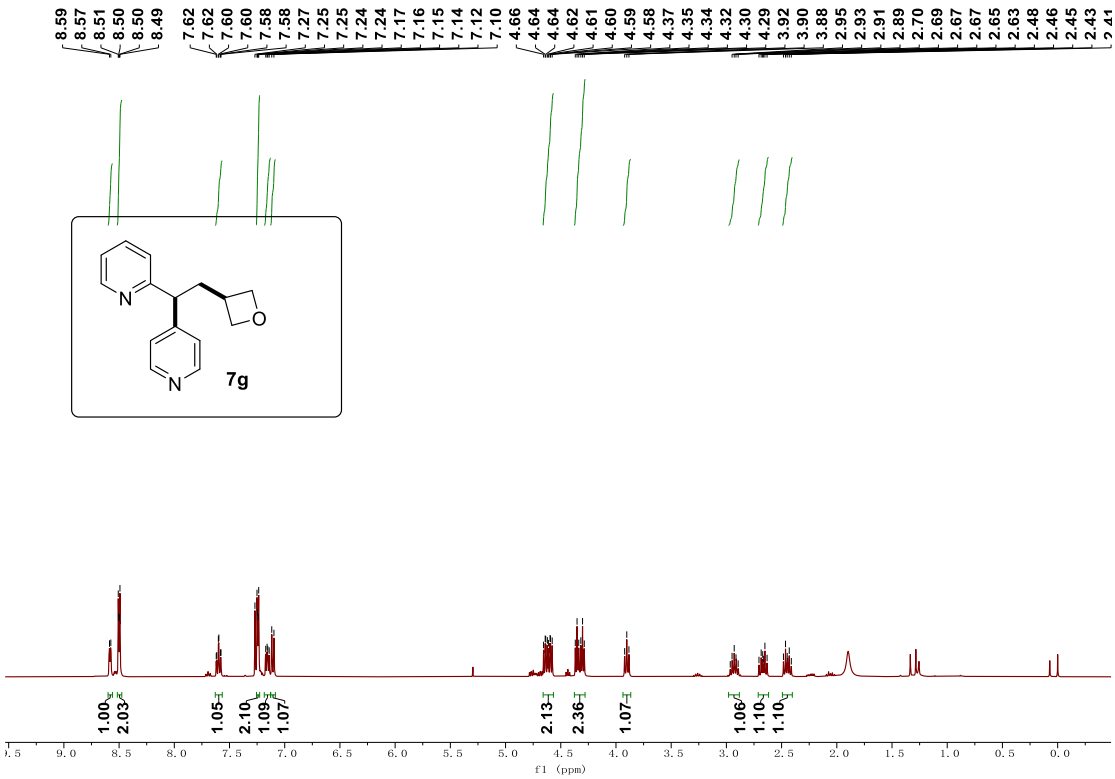
^{13}C NMR Spectra of **7e** ($CDCl_3$, 101 MHz)



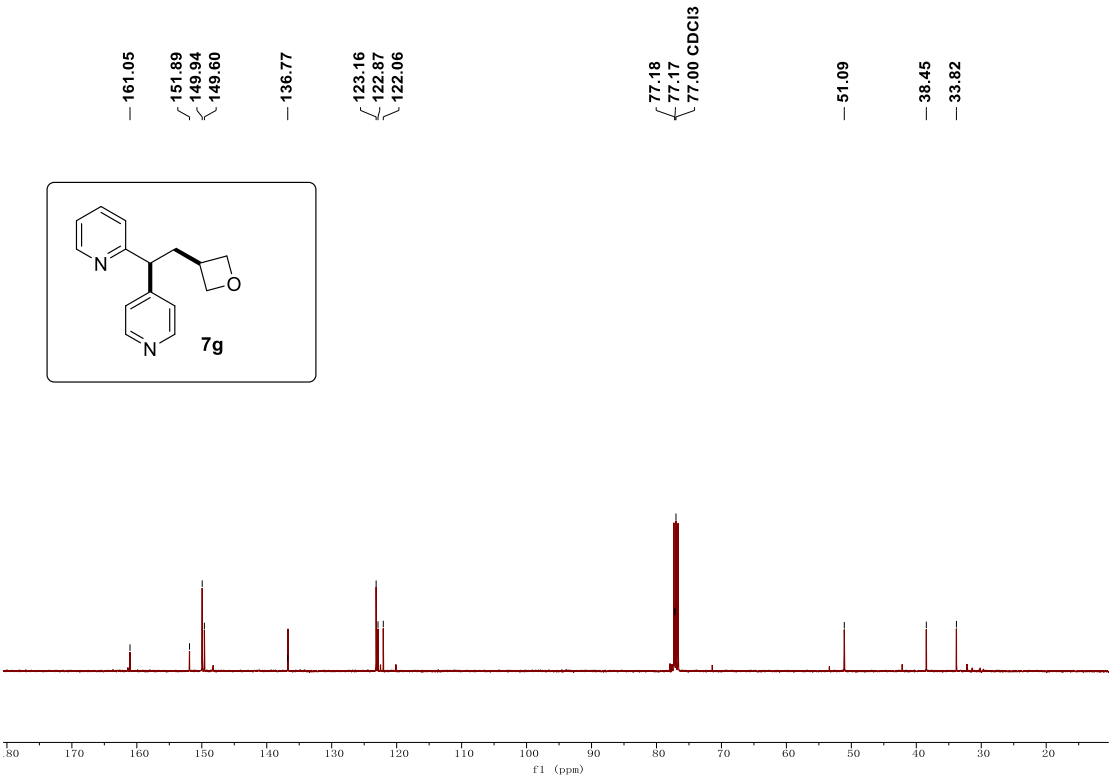
^{1}H NMR Spectra of **7f** ($CDCl_3$, 400 MHz)



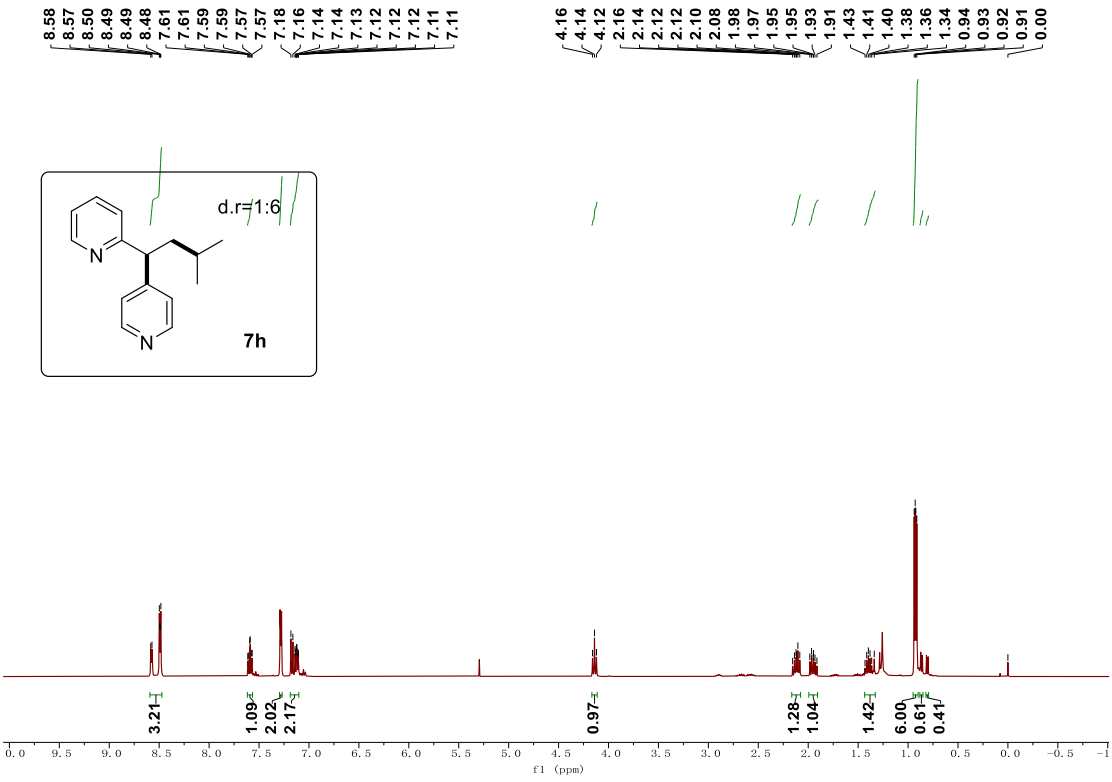
^{13}C NMR Spectra of **7f** ($CDCl_3$, 101 MHz)



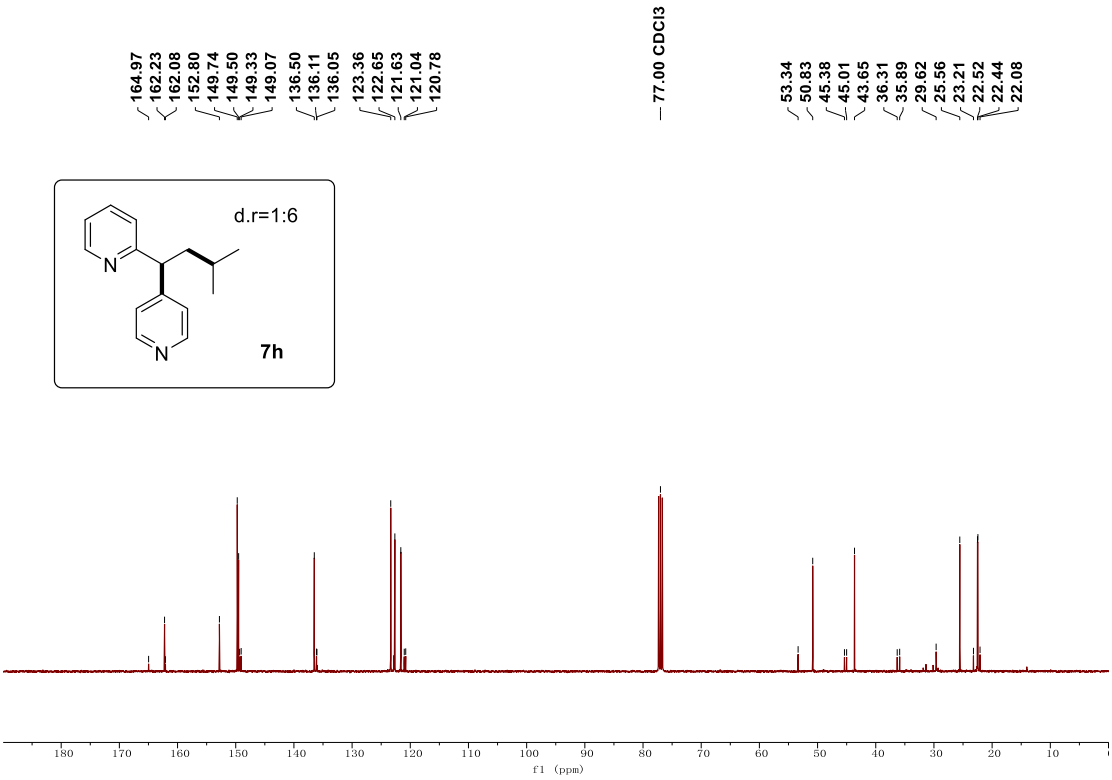
^{1}H NMR Spectra of **7g** ($CDCl_3$, 400 MHz)



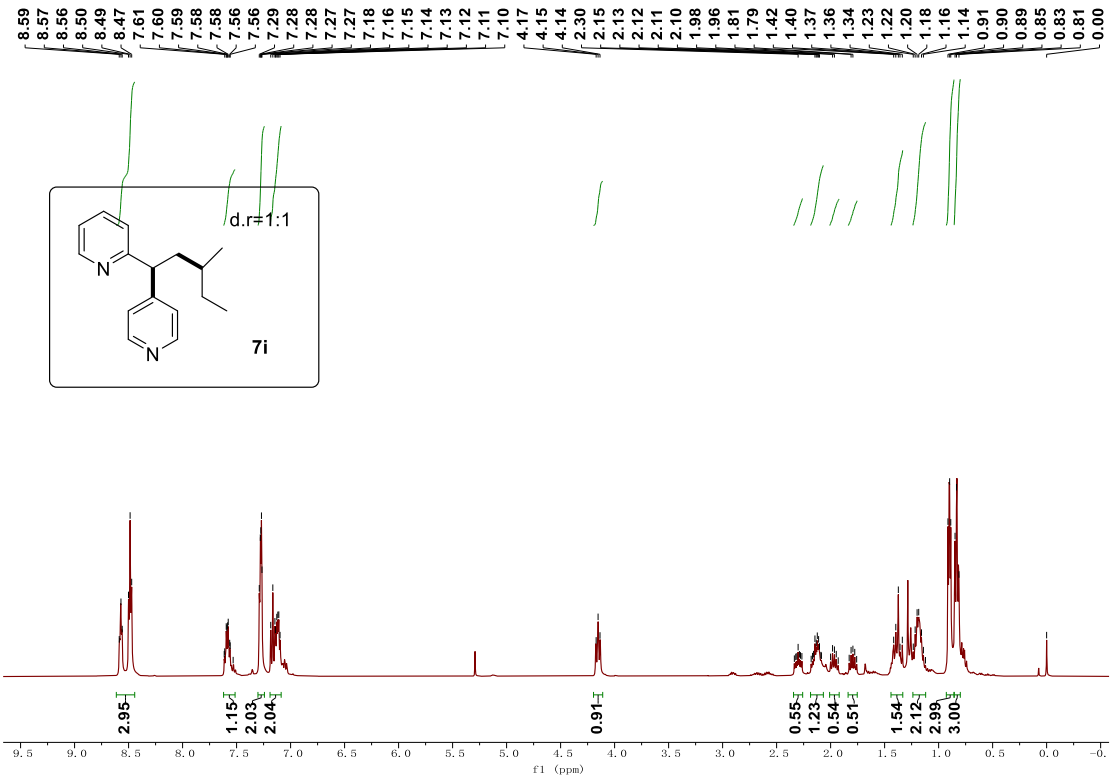
^{13}C NMR Spectra of **7g** ($CDCl_3$, 101 MHz)



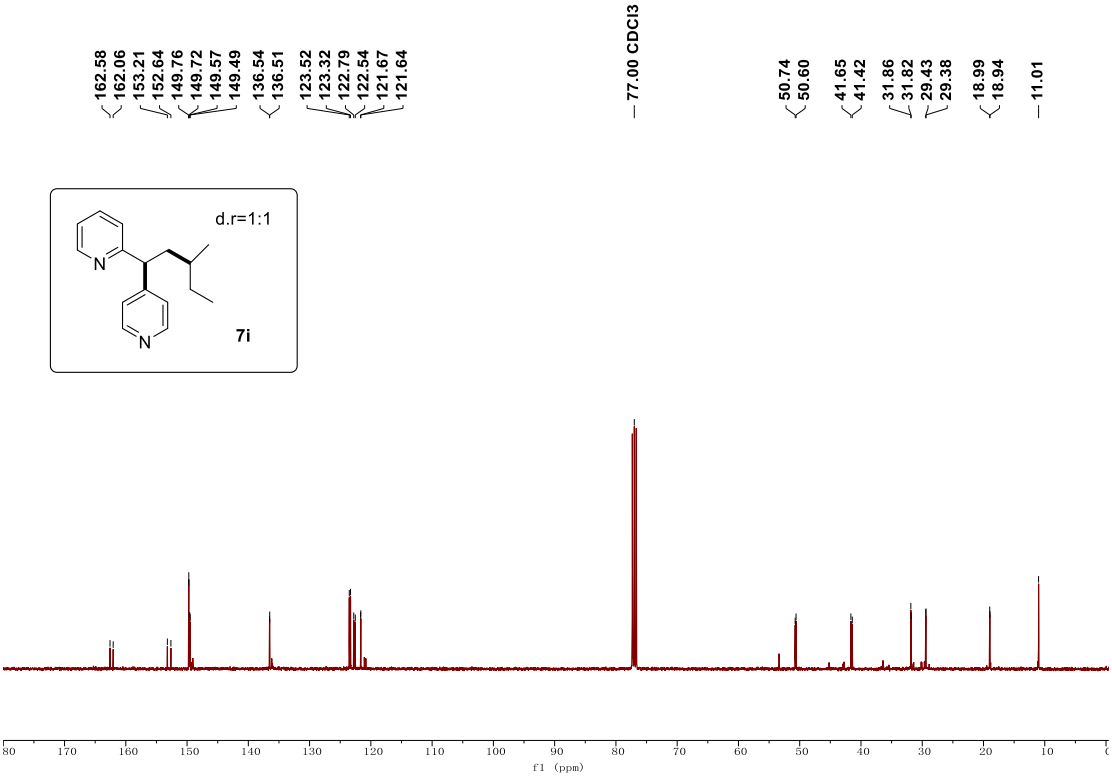
^{1}H NMR Spectra of **7h** ($CDCl_3$, 400 MHz)



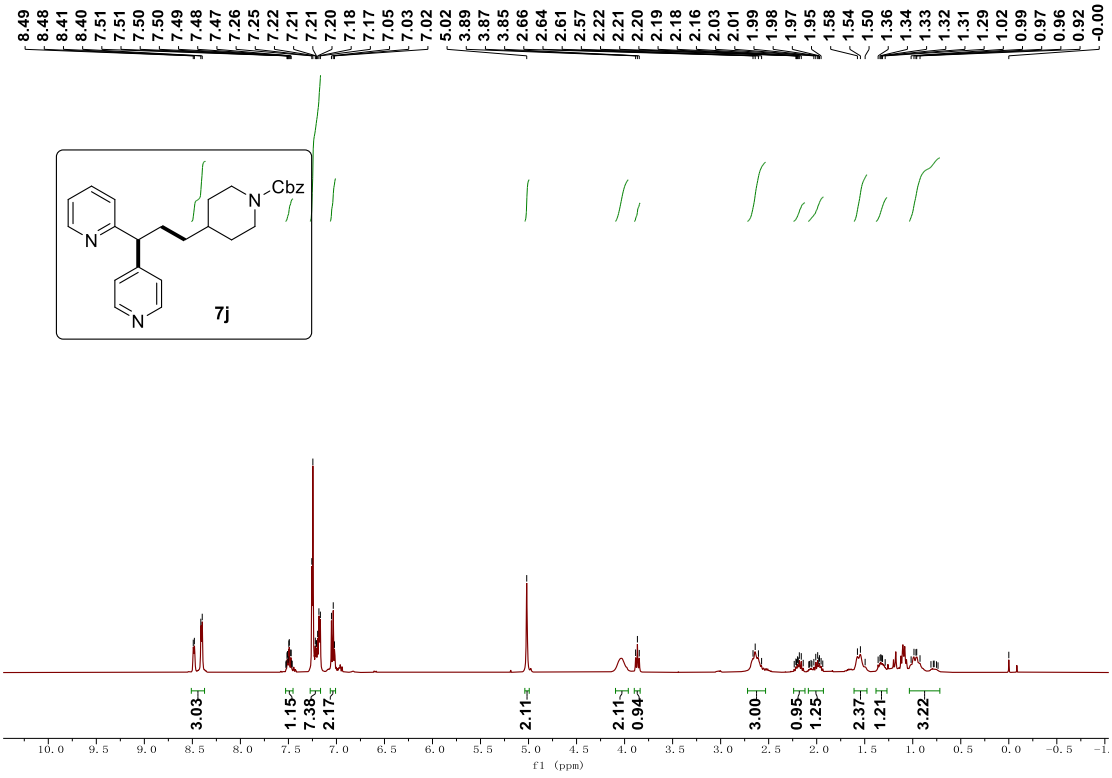
^{13}C NMR Spectra of **7h** ($CDCl_3$, 101 MHz)



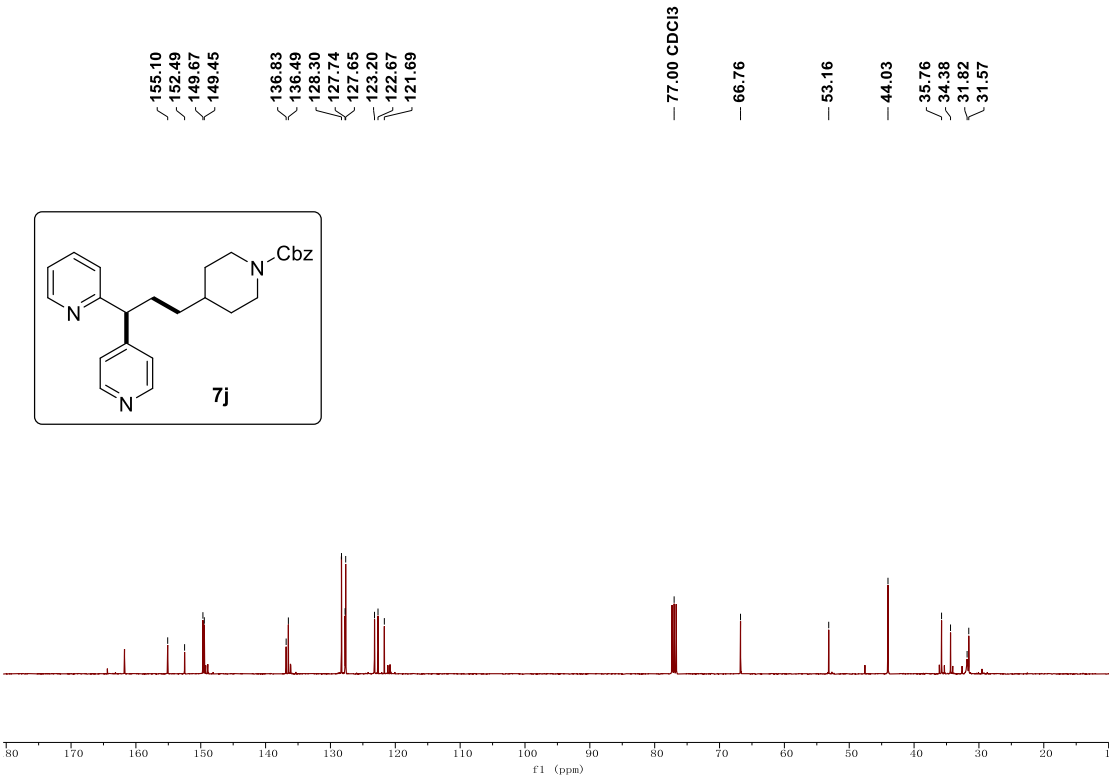
^{1}H NMR Spectra of **7i** ($CDCl_3$, 400 MHz)



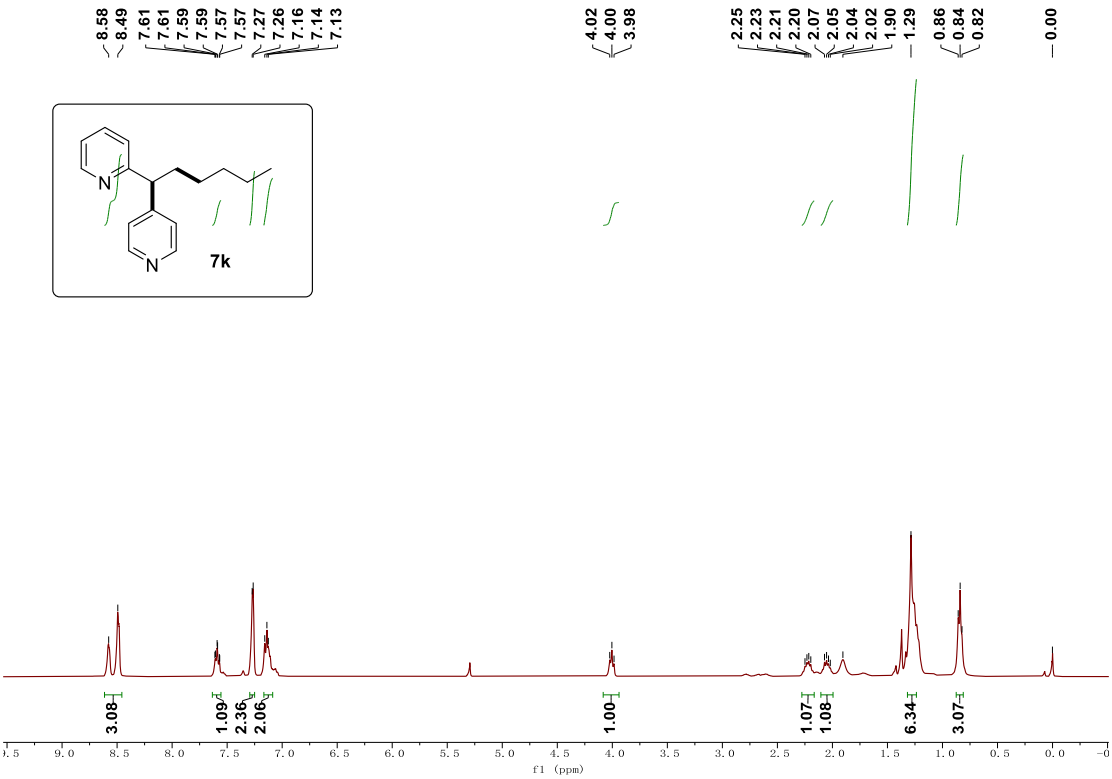
^{13}C NMR Spectra of **7i** ($CDCl_3$, 101 MHz)



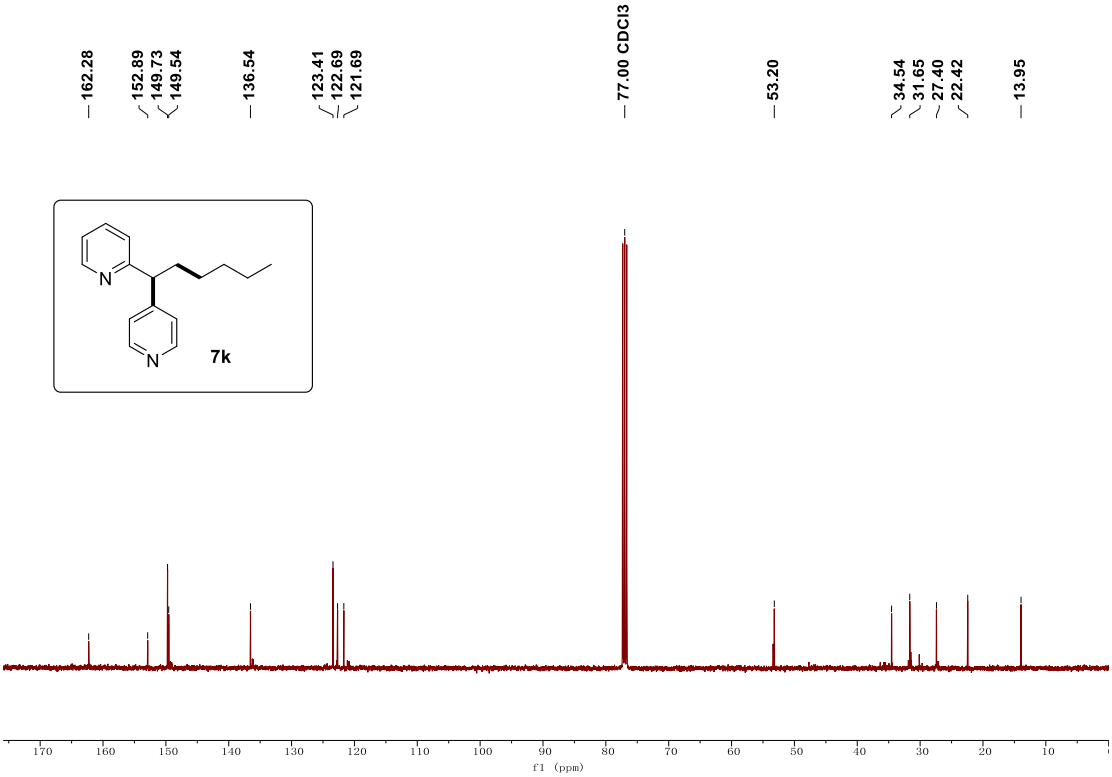
^{1}H NMR Spectra of **7j** ($CDCl_3$, 400 MHz)



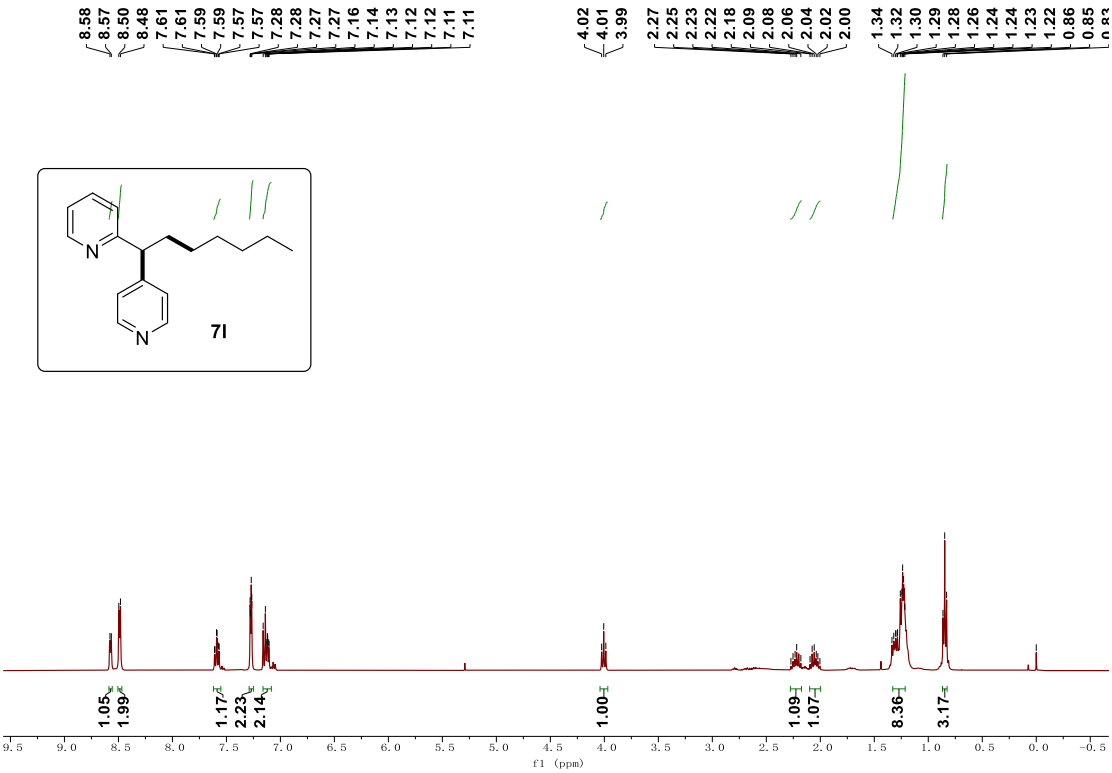
^{13}C NMR Spectra of **7j** ($CDCl_3$, 101 MHz)



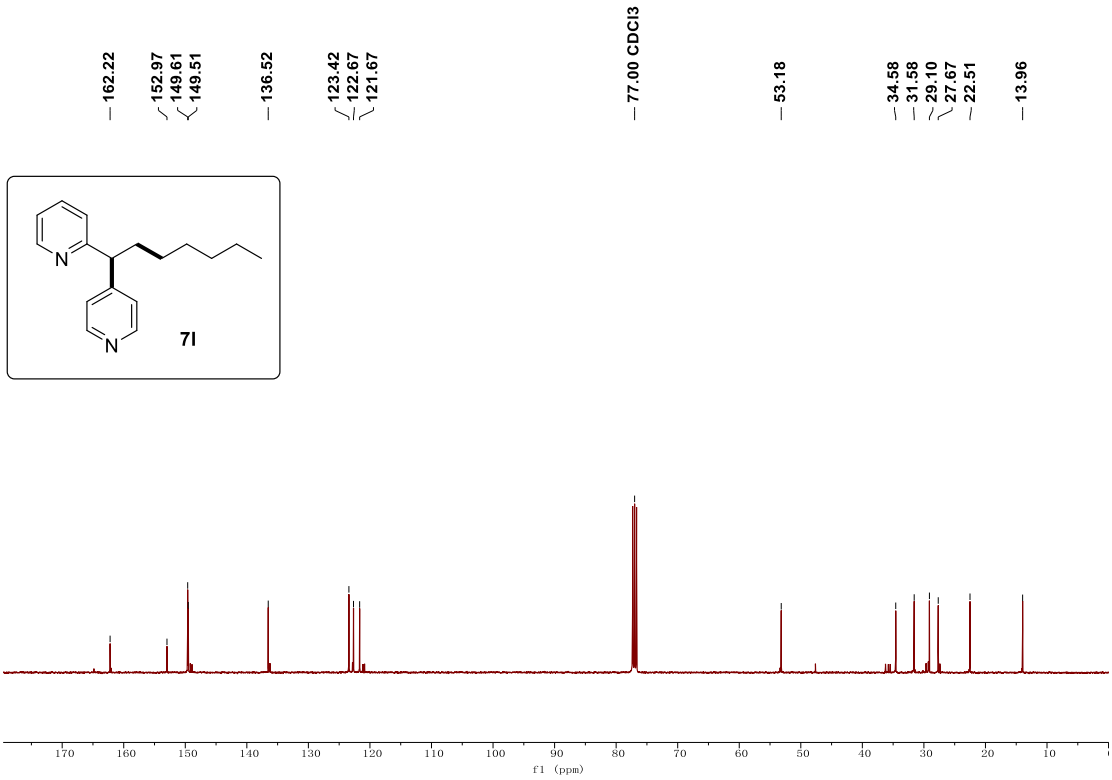
^{1}H NMR Spectra of **7k** ($CDCl_3$, 400 MHz)



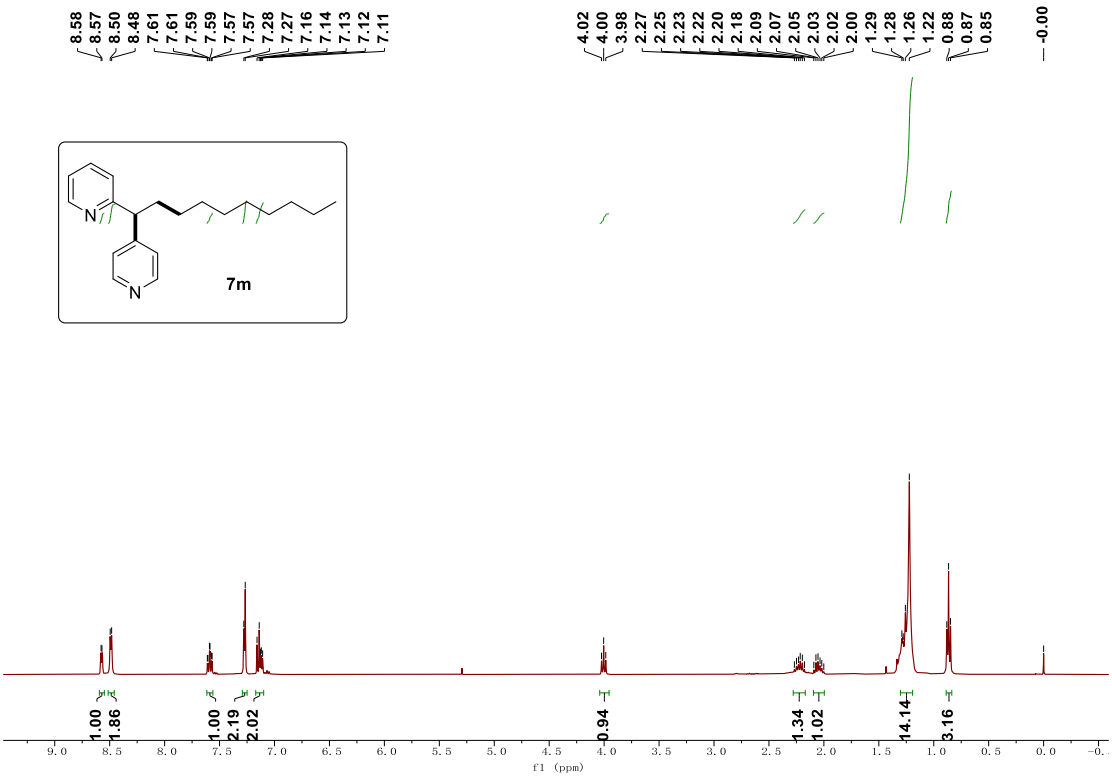
^{13}C NMR Spectra of **7k** ($CDCl_3$, 101 MHz)



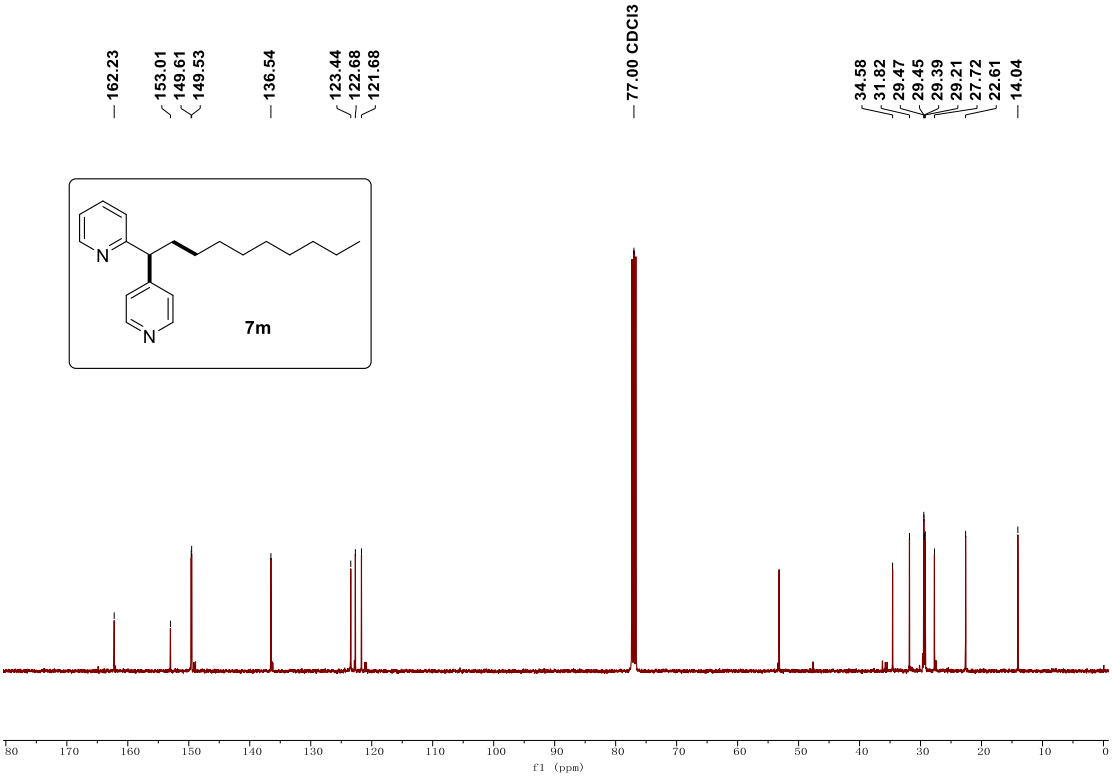
^{1}H NMR Spectra of **7l** ($CDCl_3$, 400 MHz)



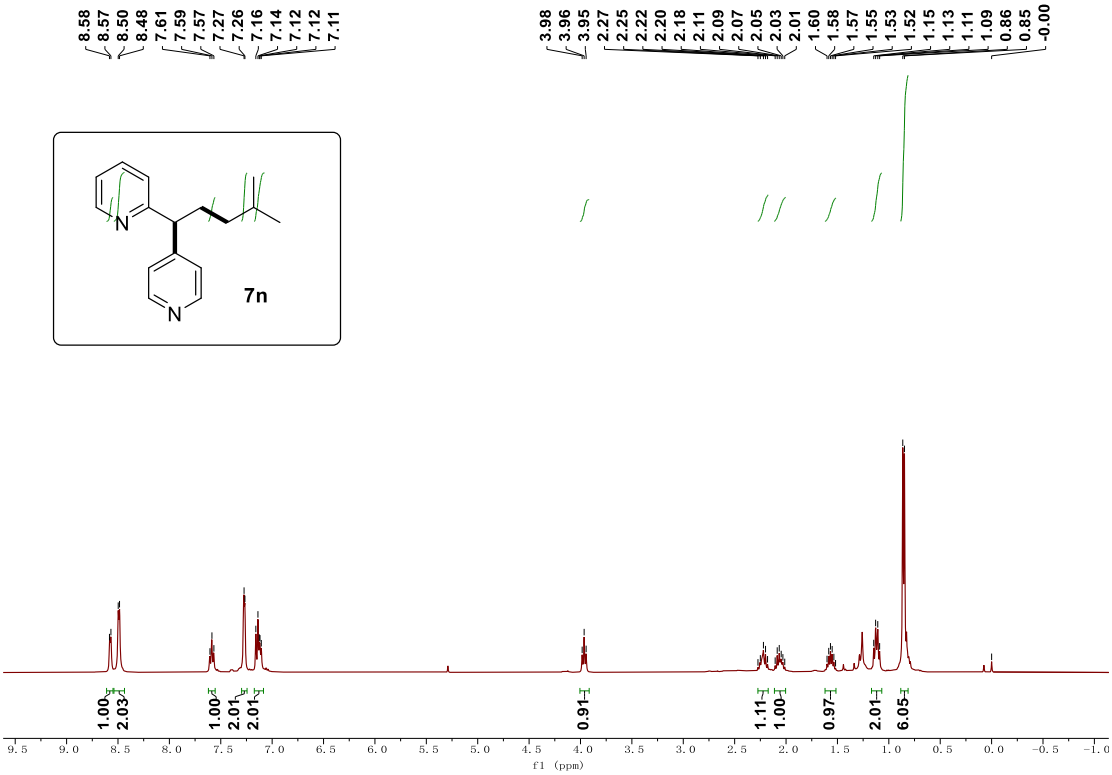
^{13}C NMR Spectra of **7l** ($CDCl_3$, 101 MHz)



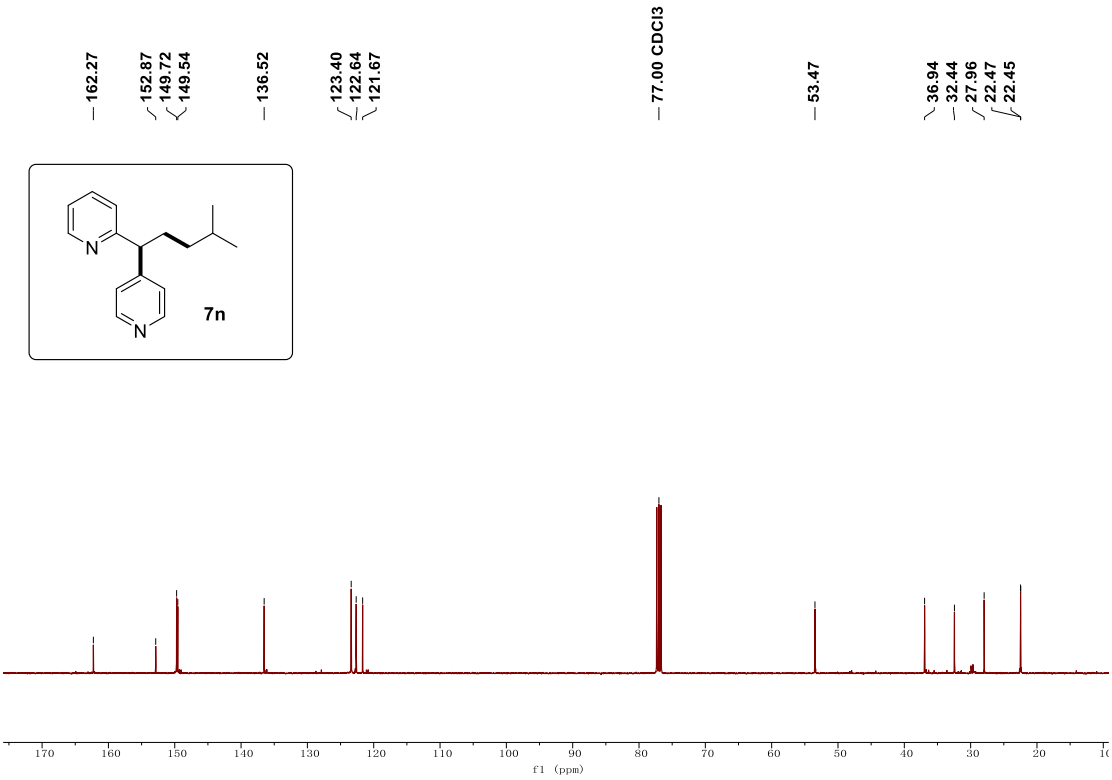
^{1}H NMR Spectra of **7m** ($CDCl_3$, 400 MHz)



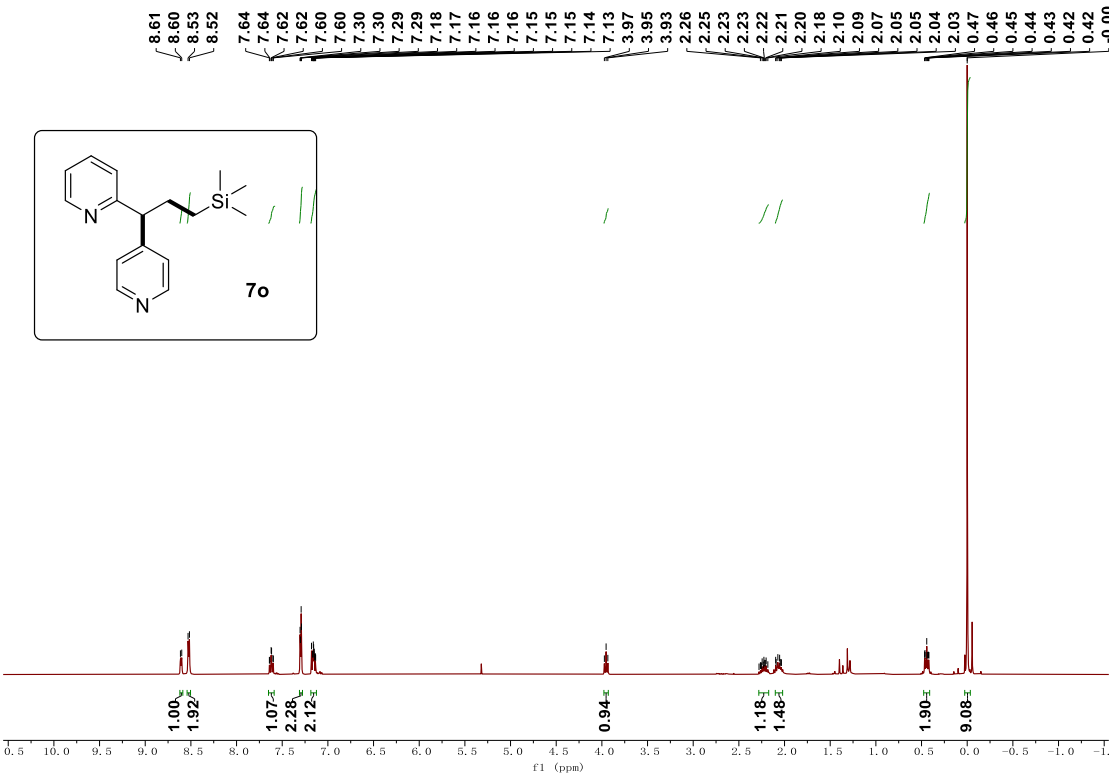
^{13}C NMR Spectra of **7m** ($CDCl_3$, 101 MHz)



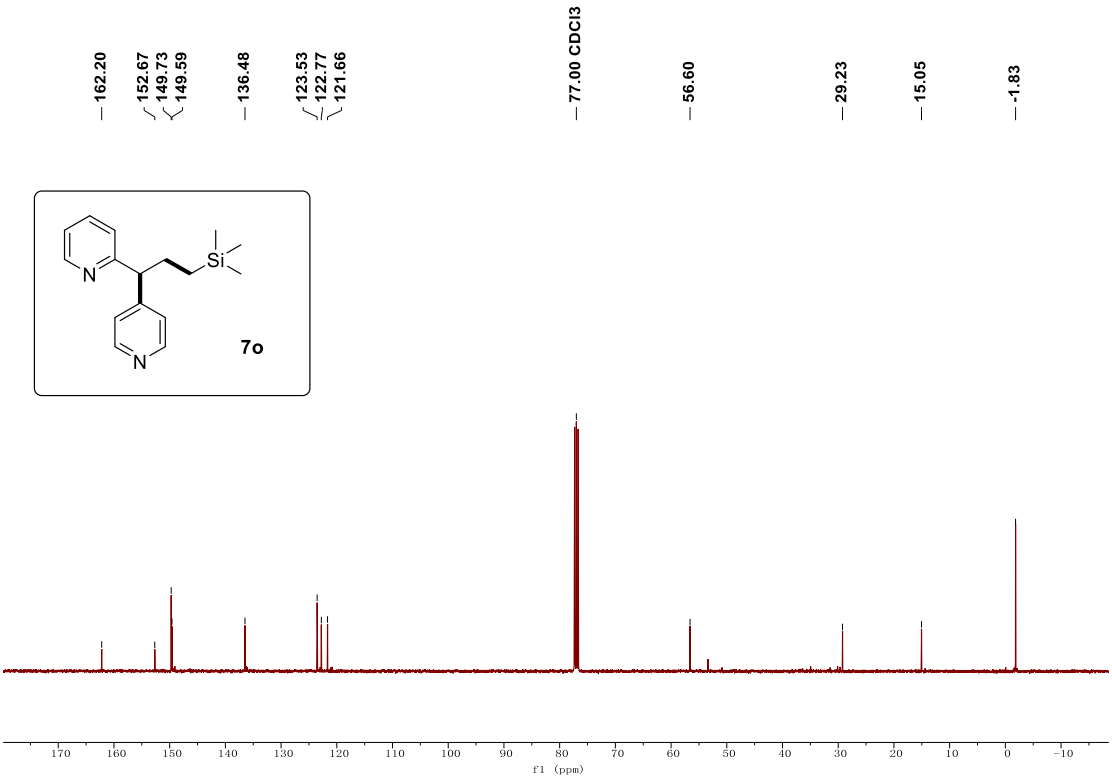
^{1}H NMR Spectra of **7n** ($CDCl_3$, 400 MHz)



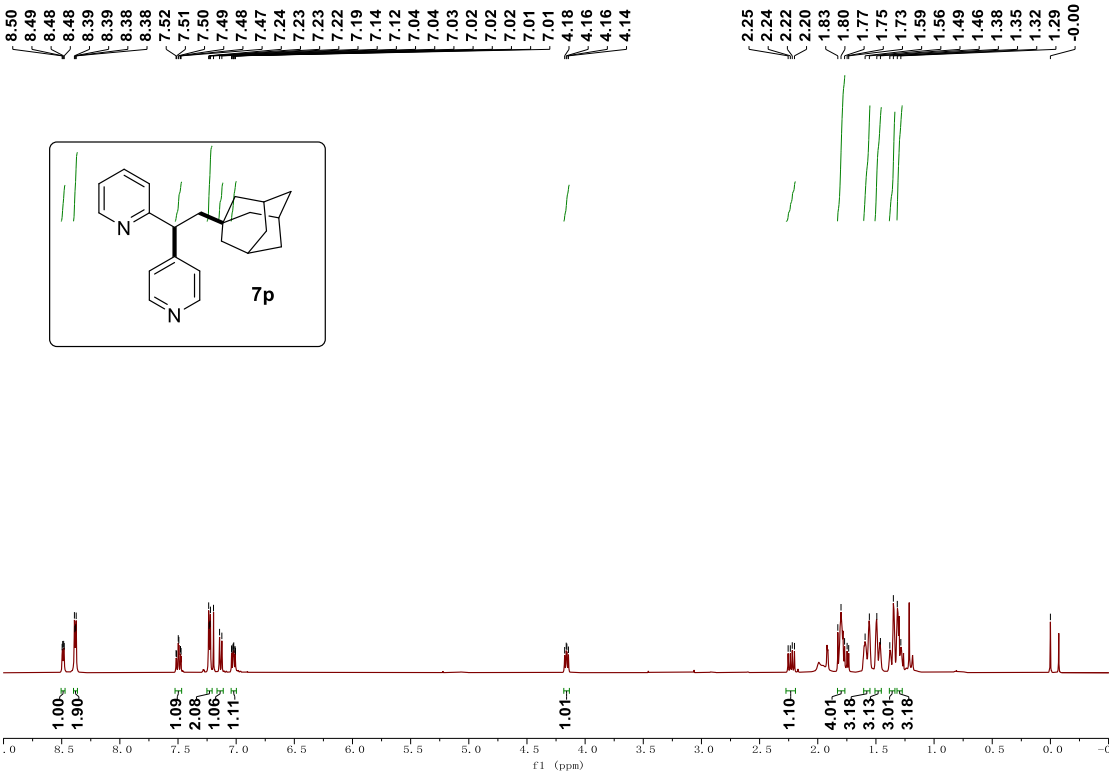
^{13}C NMR Spectra of **7n** ($CDCl_3$, 101 MHz)



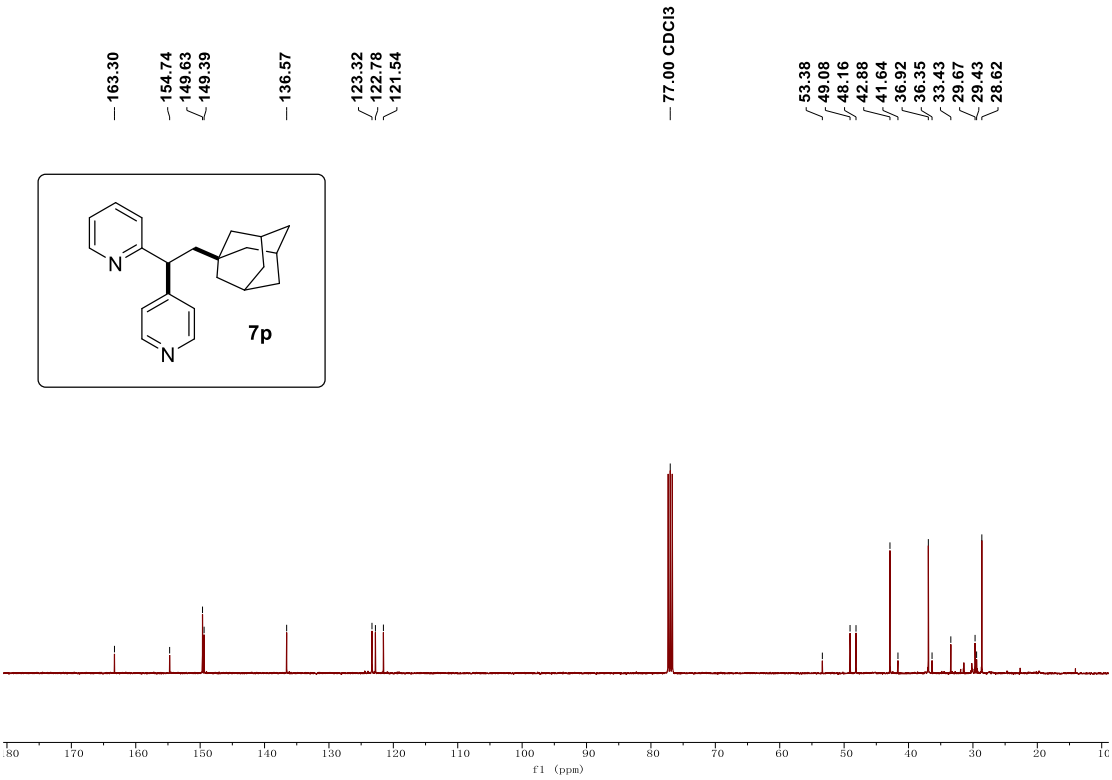
^{1}H NMR Spectra of **7o** ($CDCl_3$, 400 MHz)



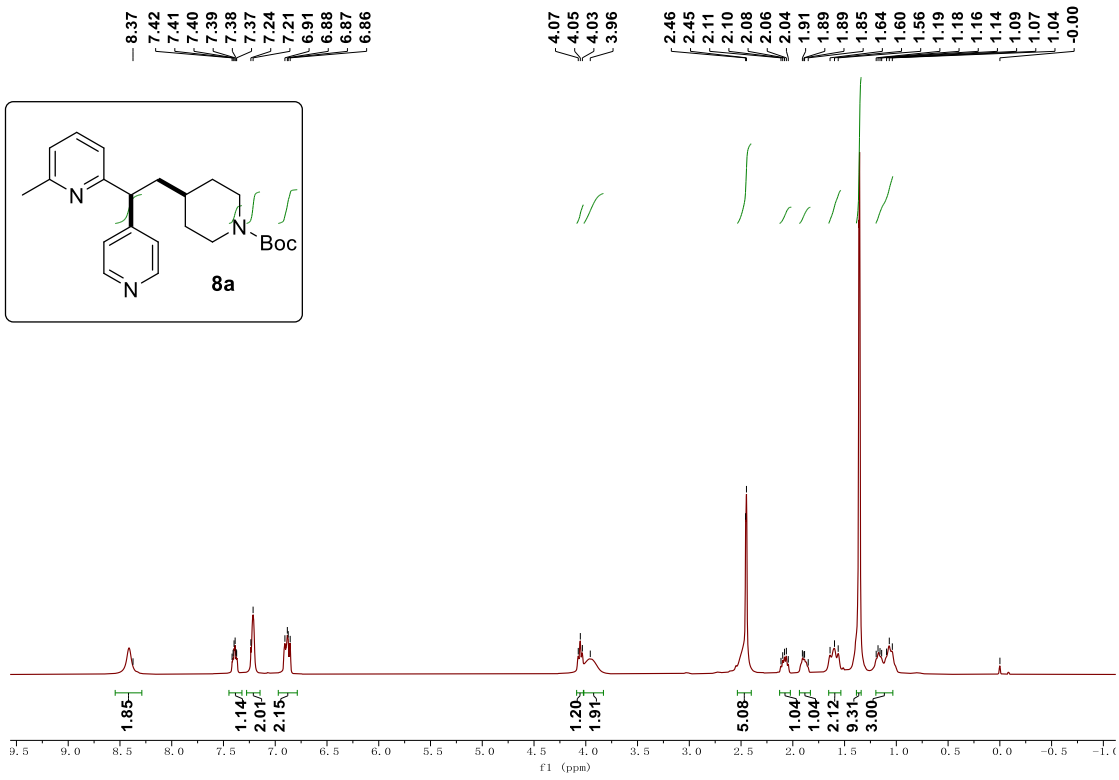
^{13}C NMR Spectra of **7o** ($CDCl_3$, 101 MHz)



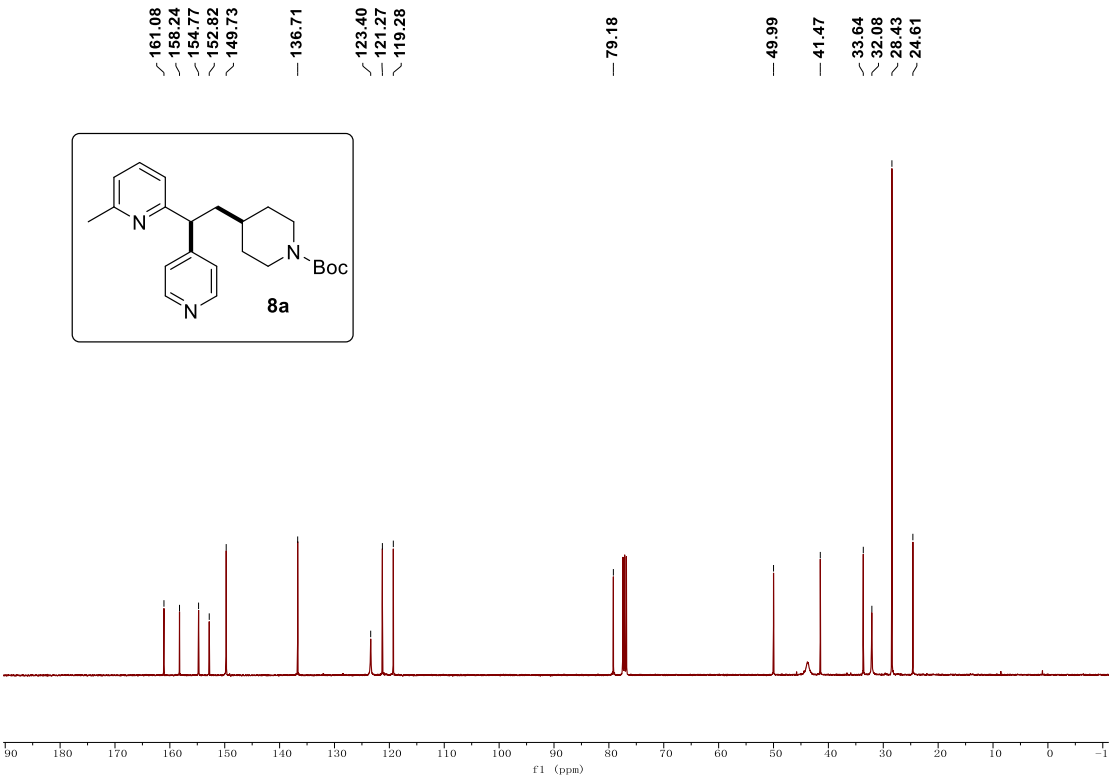
^{1}H NMR Spectra of **7p** ($CDCl_3$, 400 MHz)



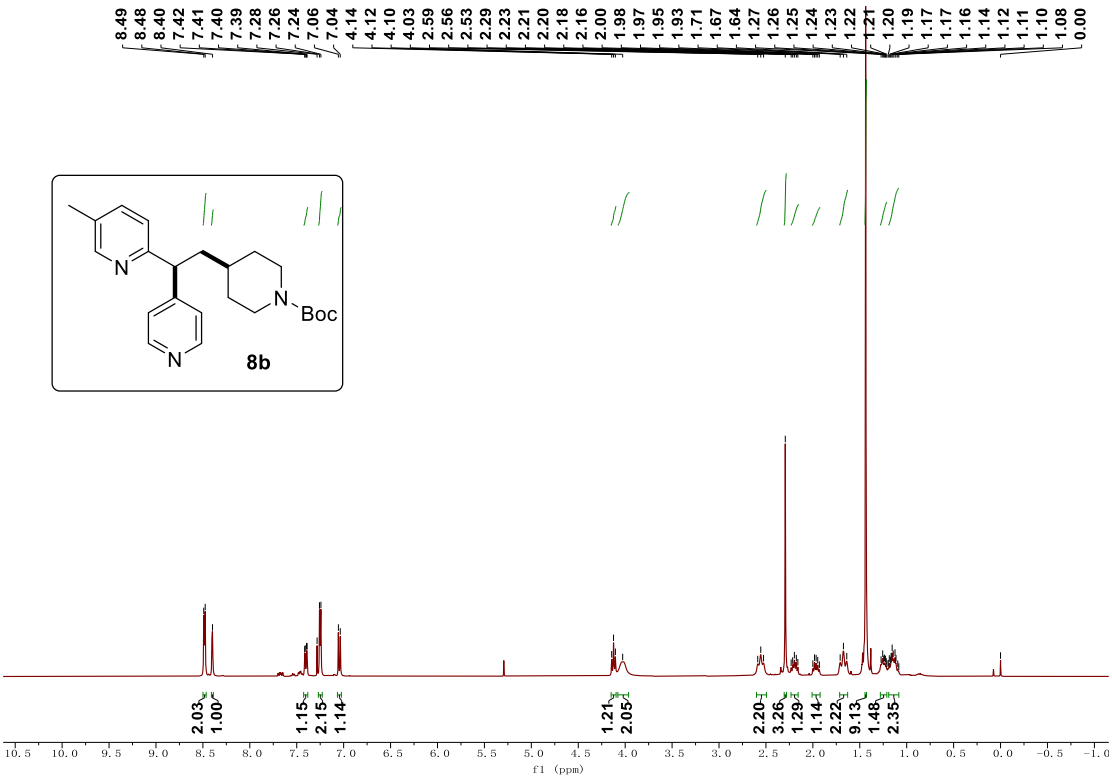
^{13}C NMR Spectra of **7p** ($CDCl_3$, 101 MHz)



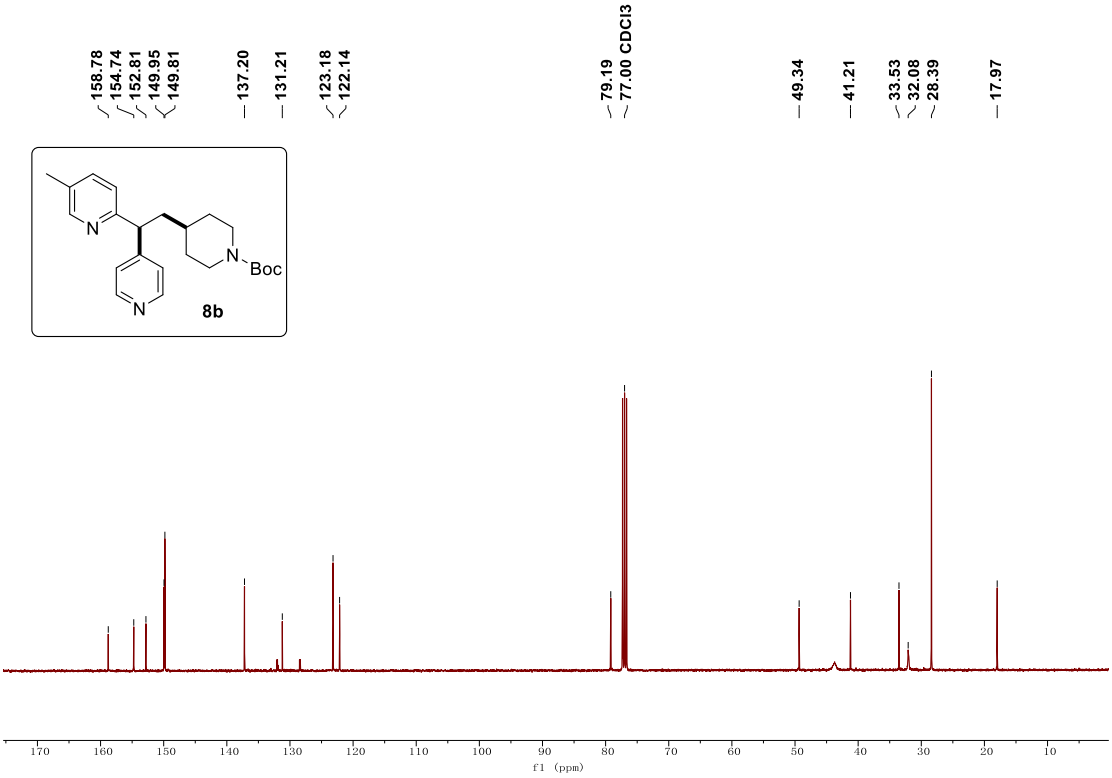
^{1}H NMR Spectra of **8a** ($CDCl_3$, 400 MHz)



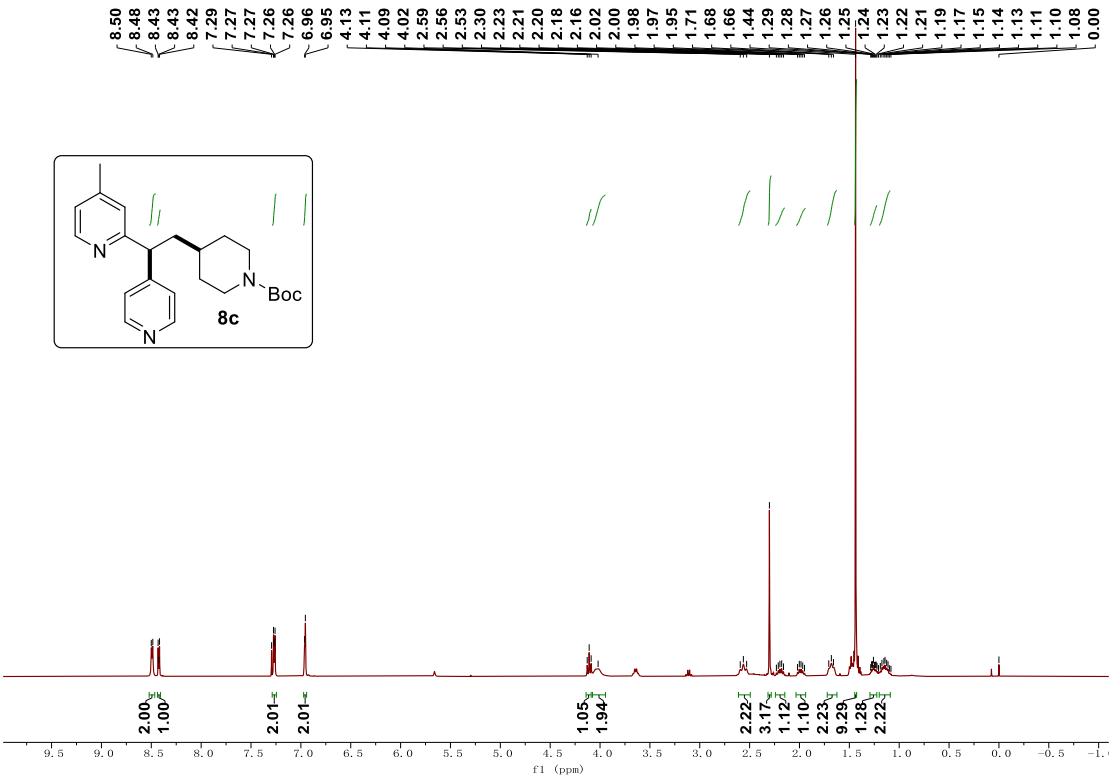
^{13}C NMR Spectra of **8a** ($CDCl_3$, 101 MHz)



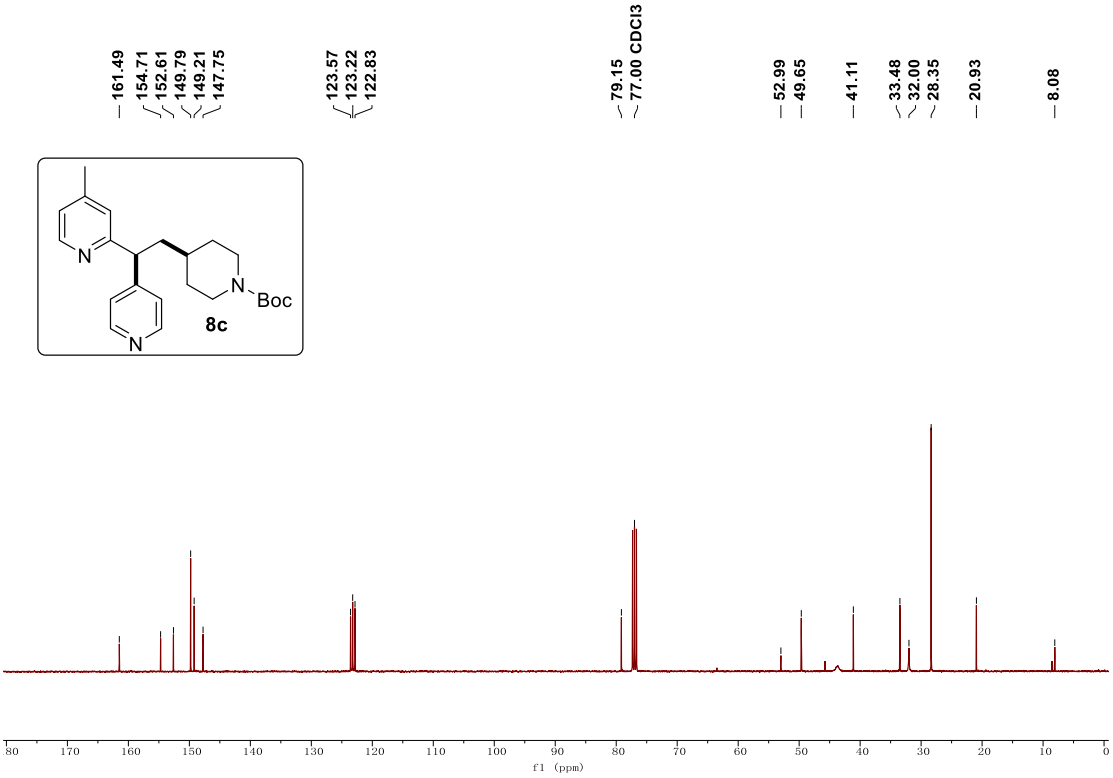
^{1}H NMR Spectra of **8b** ($CDCl_3$, 400 MHz)



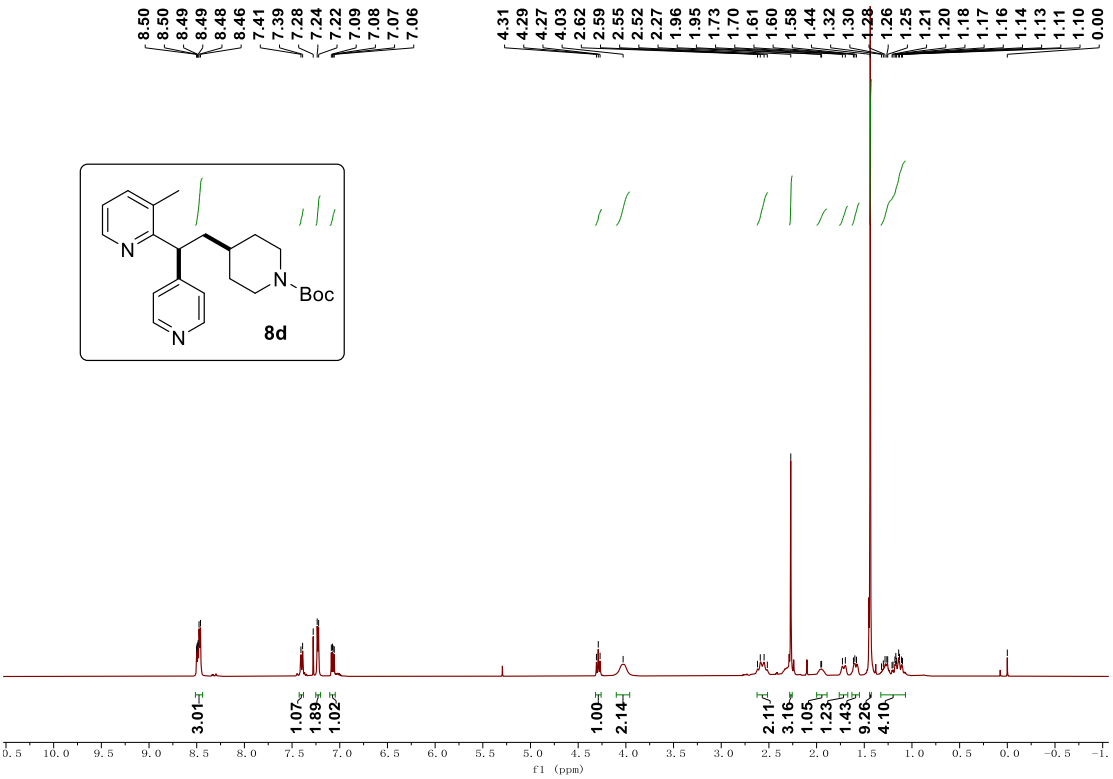
^{13}C NMR Spectra of **8b** ($CDCl_3$, 101 MHz)



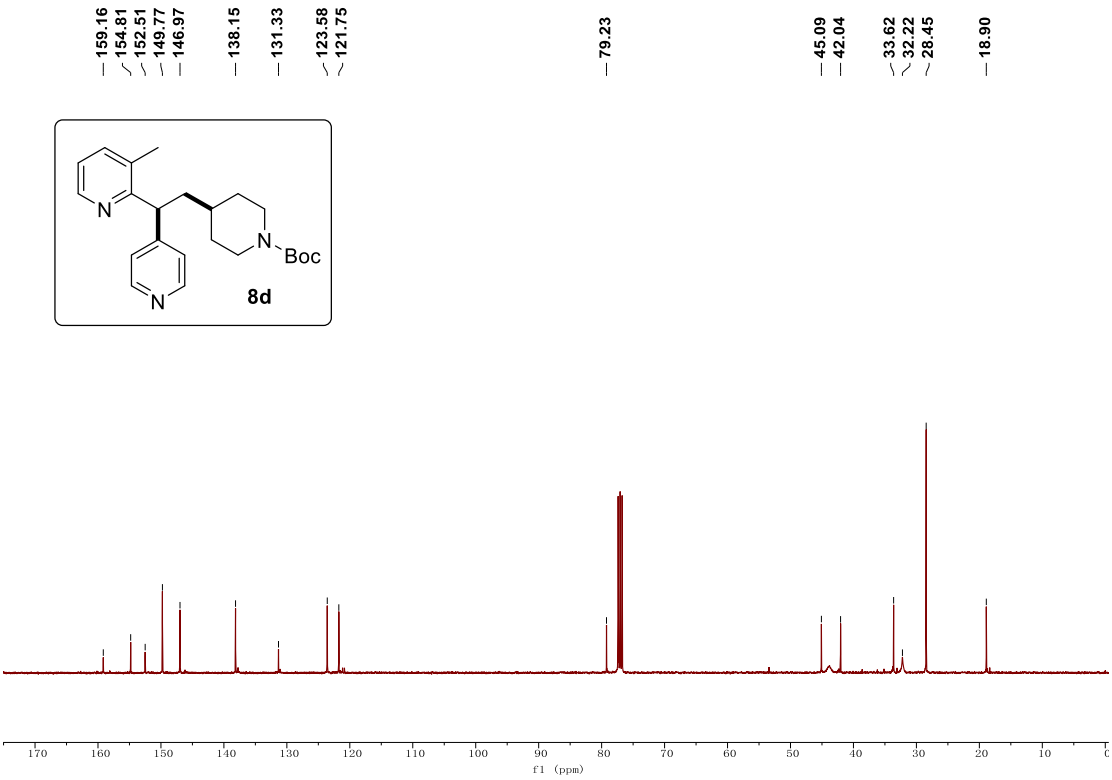
^{1}H NMR Spectra of **8c** ($CDCl_3$, 400 MHz)



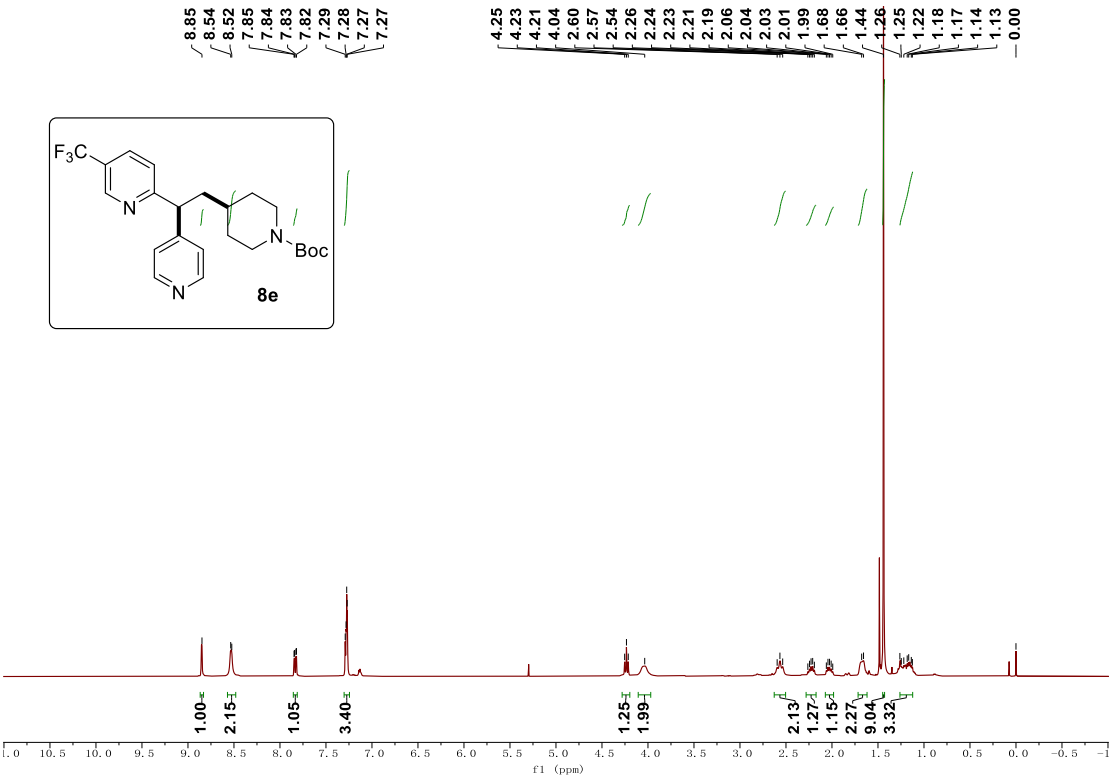
^{13}C NMR Spectra of **8c** ($CDCl_3$, 101 MHz)



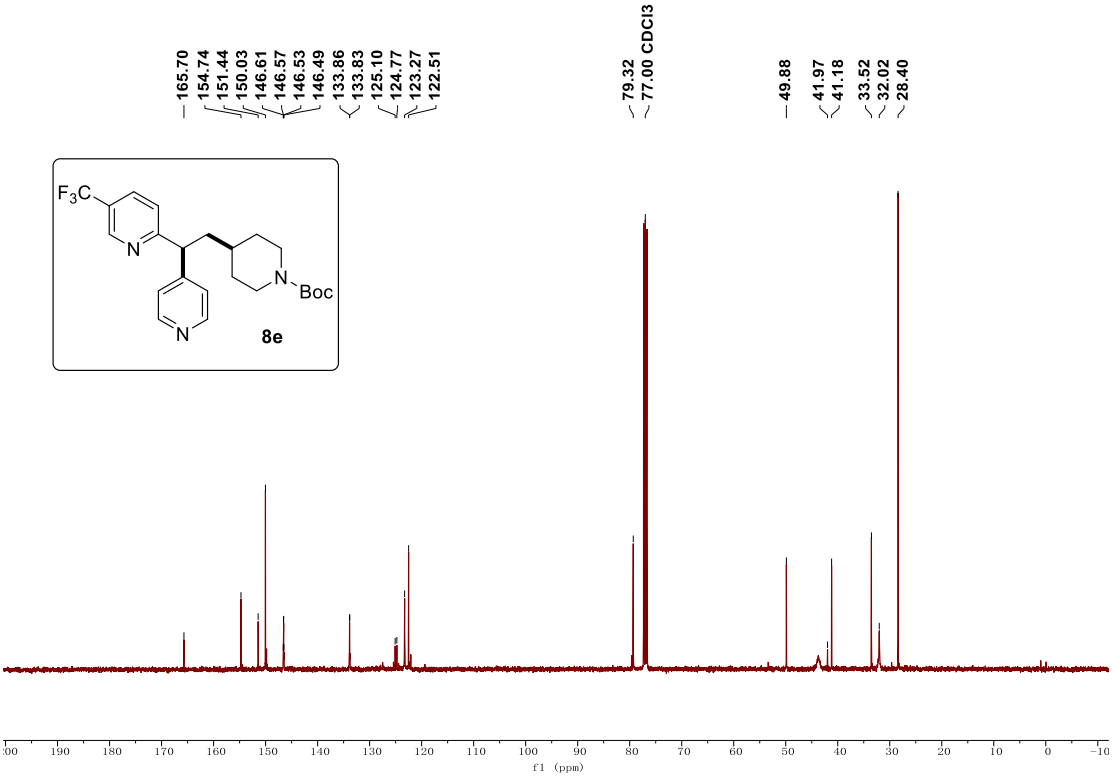
^{1}H NMR Spectra of **8d** ($CDCl_3$, 400 MHz)



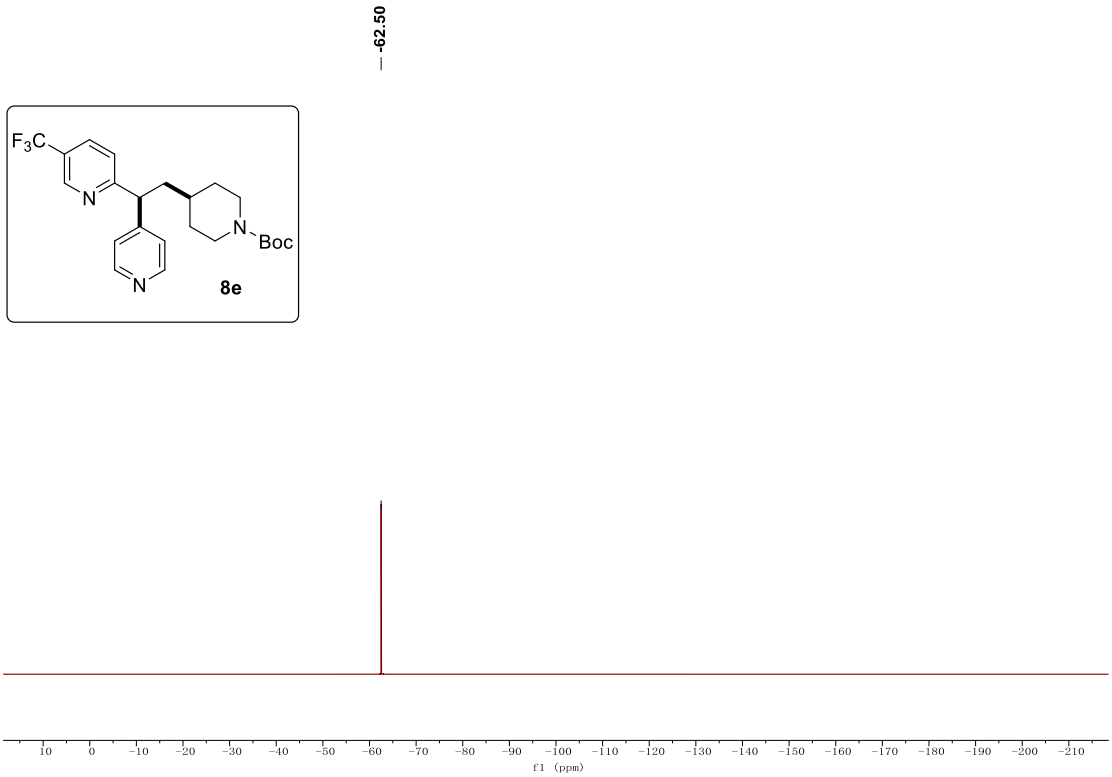
^{13}C NMR Spectra of **8d** ($CDCl_3$, 101 MHz)



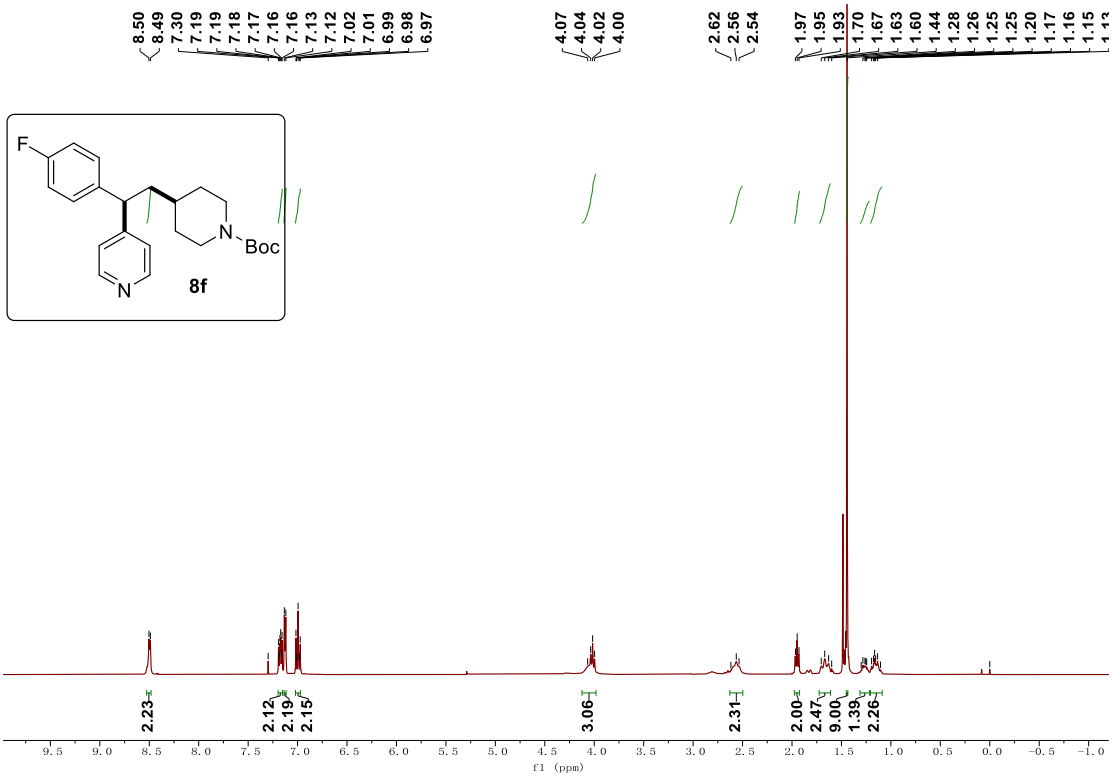
^{1}H NMR Spectra of **8e** ($CDCl_3$, 400 MHz)



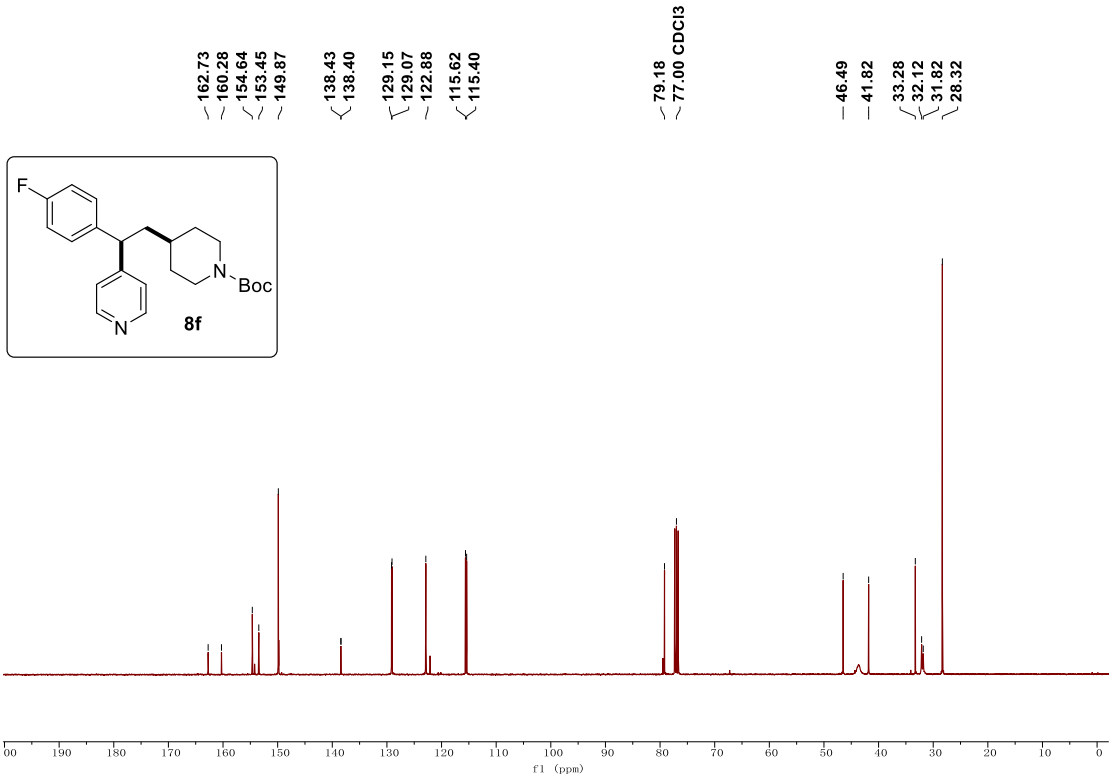
^{13}C NMR Spectra of **8e** ($CDCl_3$, 101 MHz)



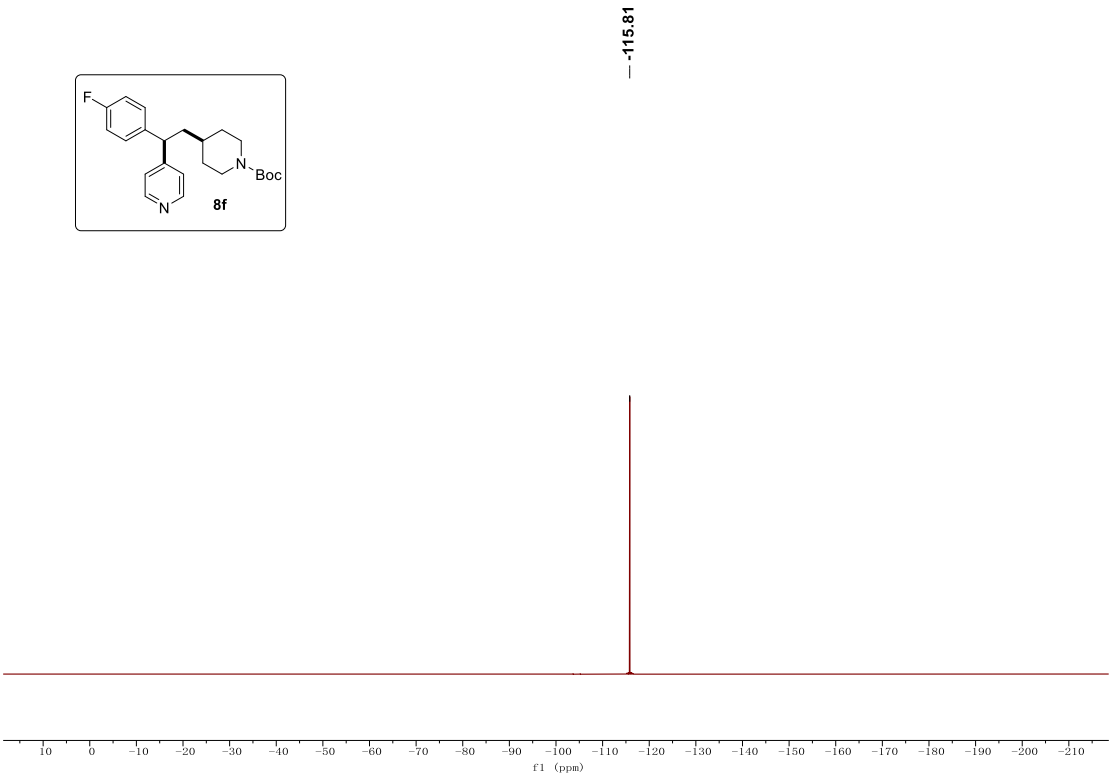
^{19}F NMR Spectra of **8e** (376 MHz, $CDCl_3$)



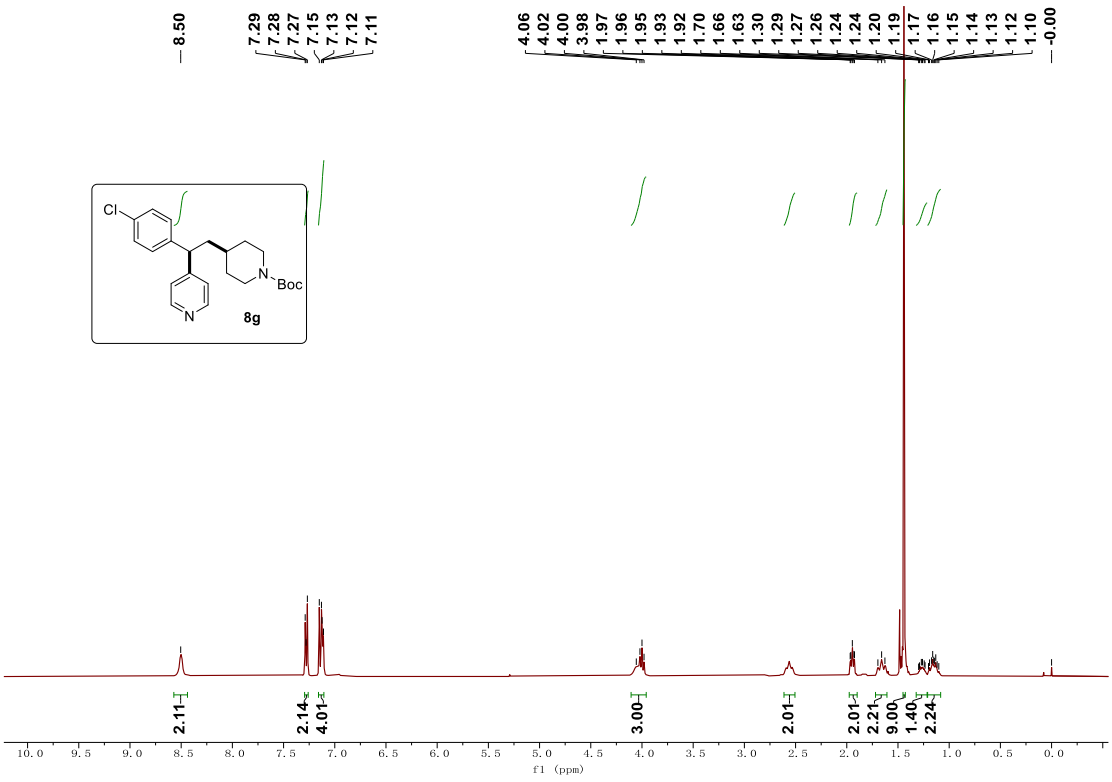
^{1}H NMR Spectra of **8f** ($CDCl_3$, 400 MHz)



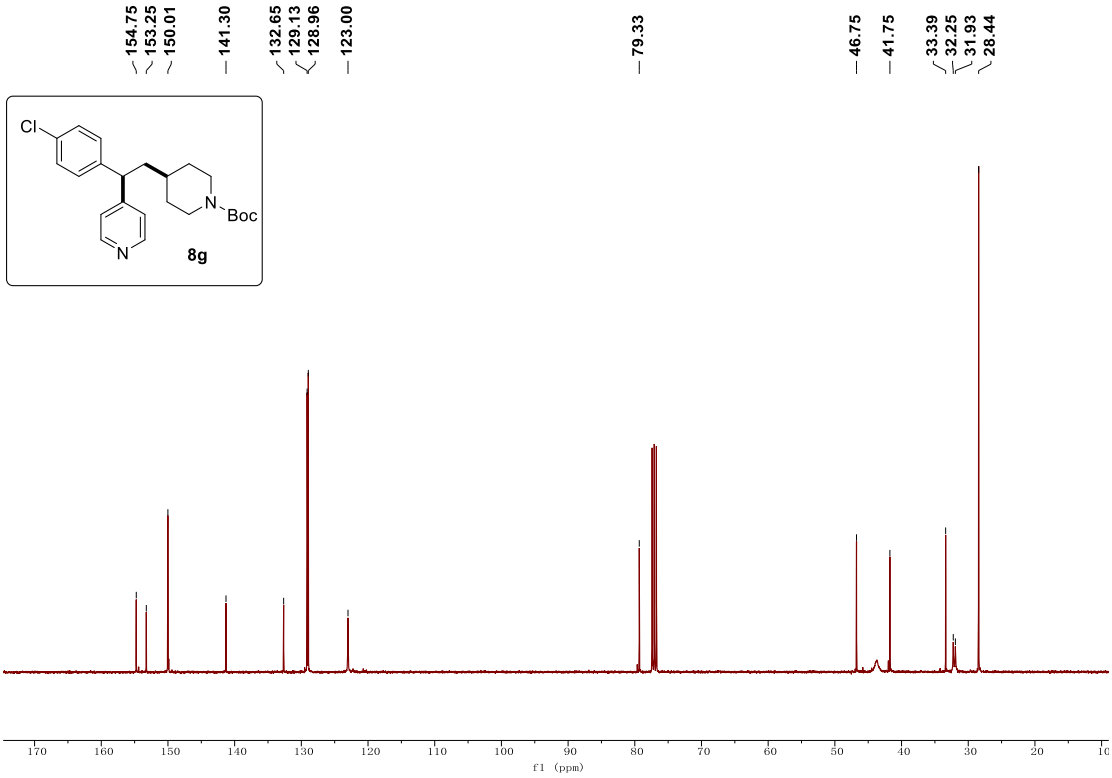
^{13}C NMR Spectra of **8f** ($CDCl_3$, 101 MHz)



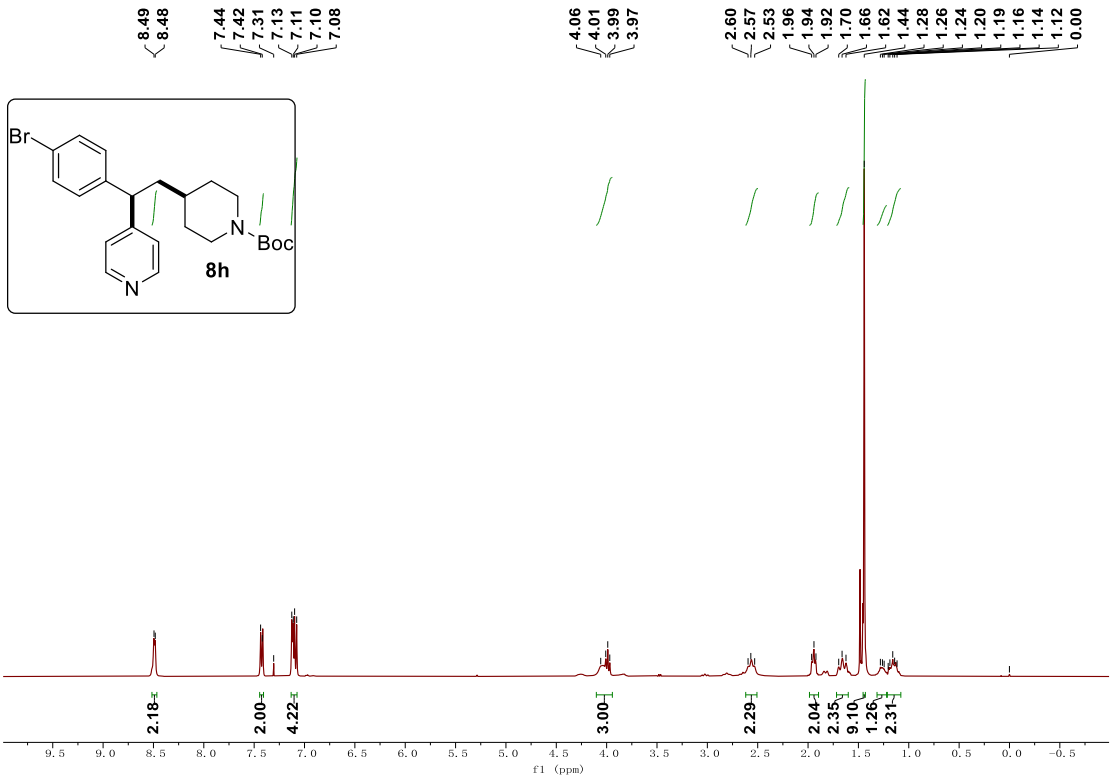
^{19}F NMR Spectra of **8f** (376 MHz, $CDCl_3$)



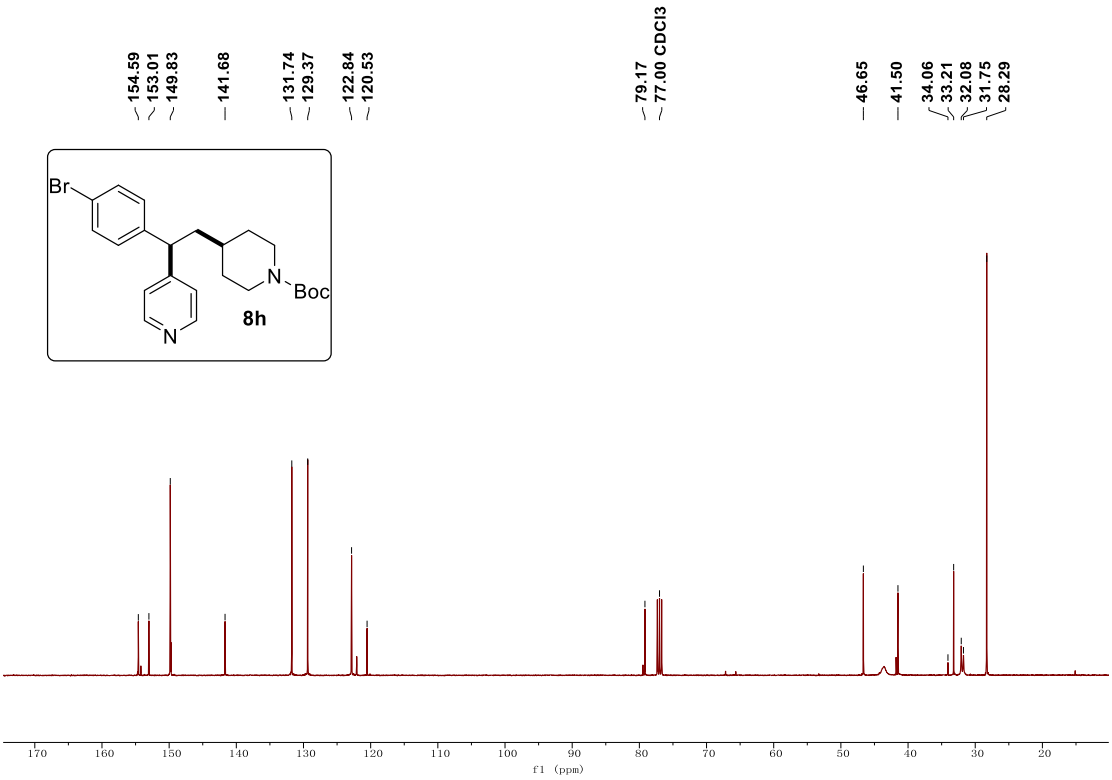
^{1}H NMR Spectra of **8g** ($CDCl_3$, 400 MHz)



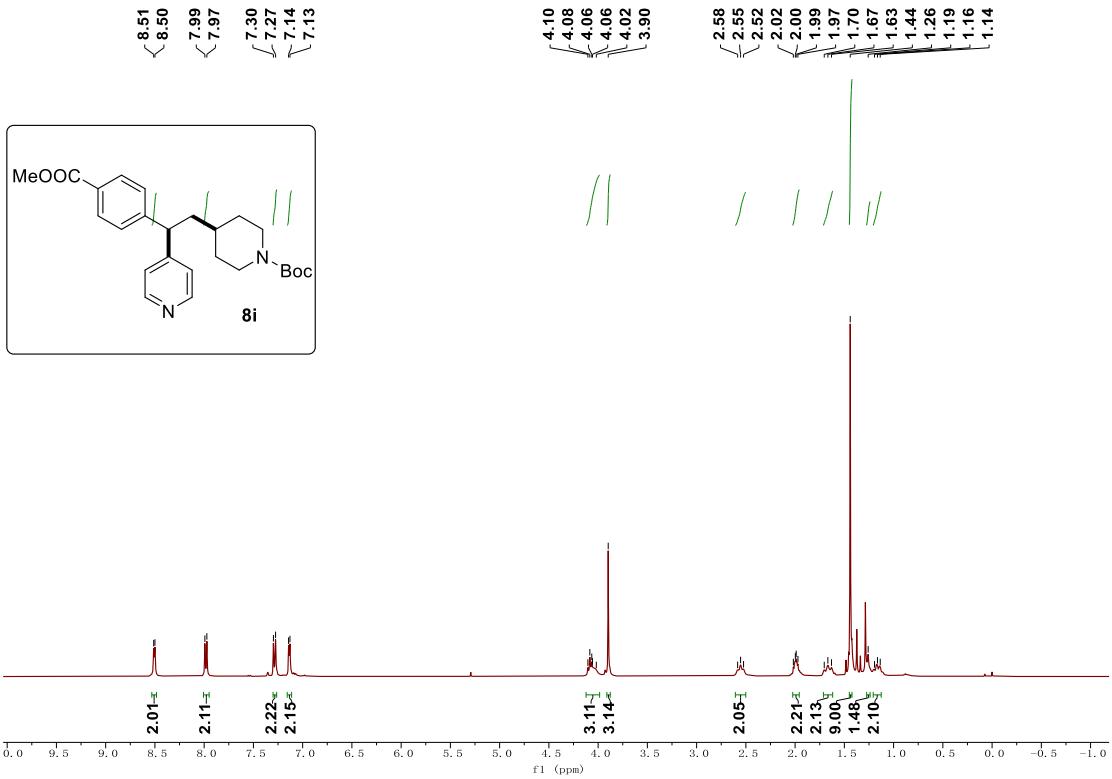
^{13}C NMR Spectra of **8g** ($CDCl_3$, 101 MHz)



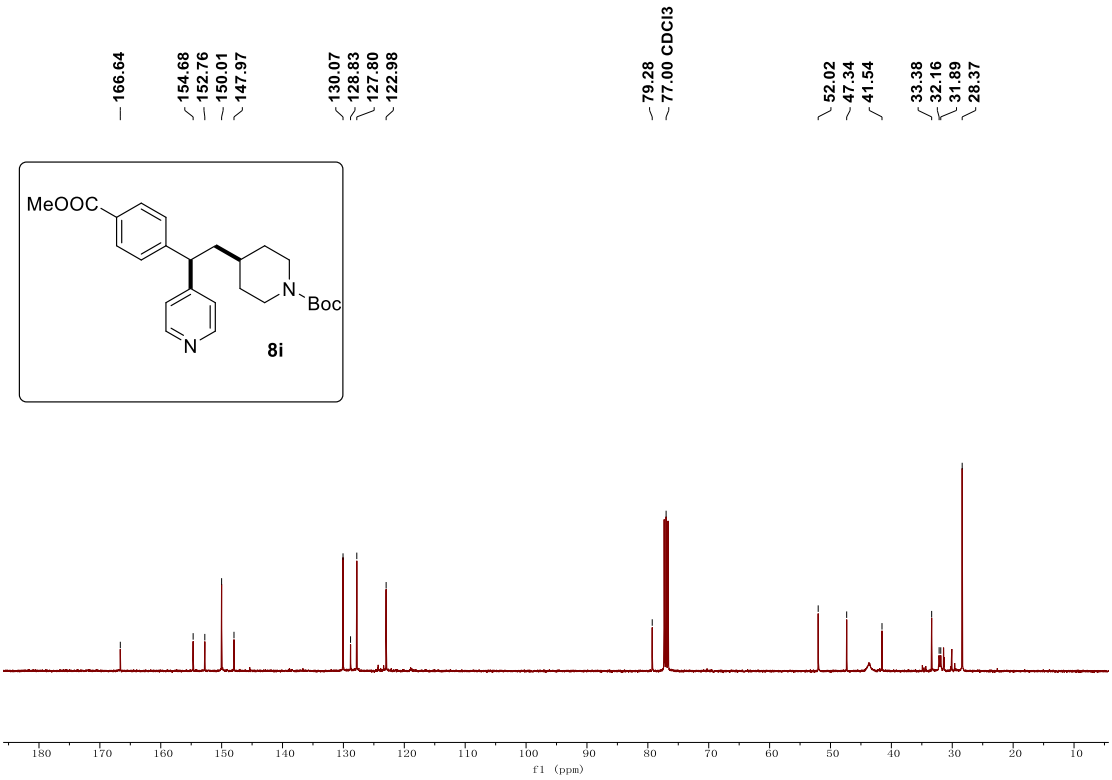
^{1}H NMR Spectra of **8h** ($CDCl_3$, 400 MHz)



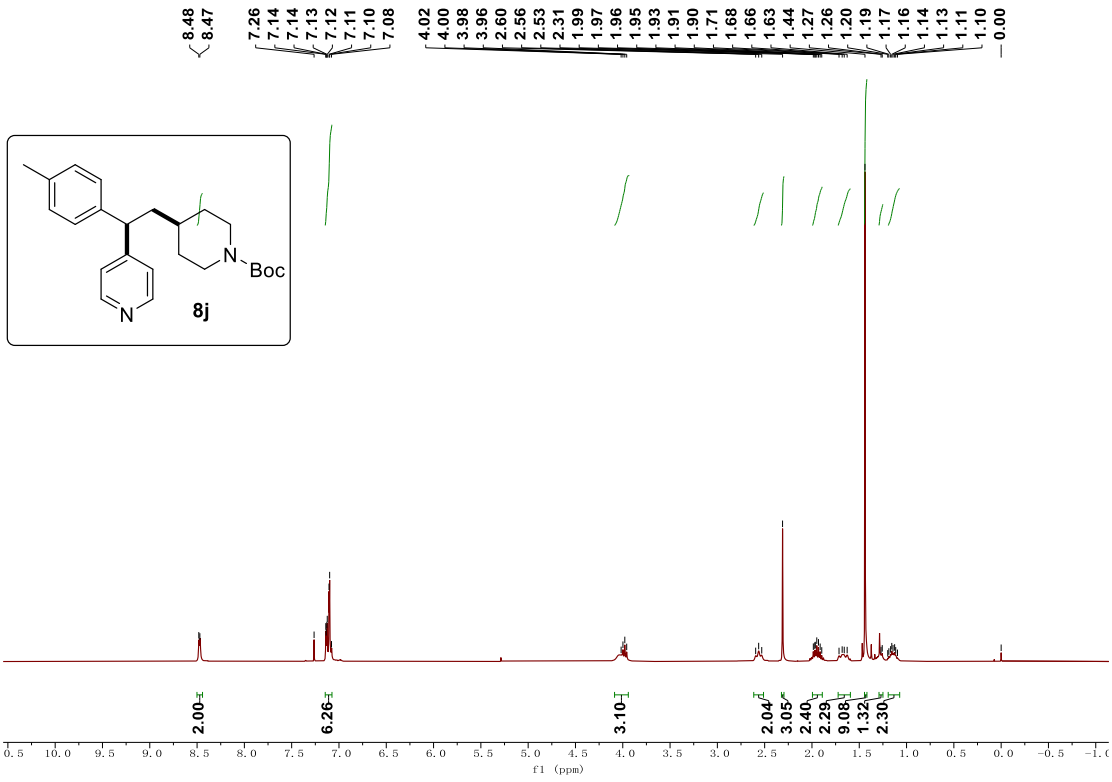
^{13}C NMR Spectra of **8h** ($CDCl_3$, 101 MHz)



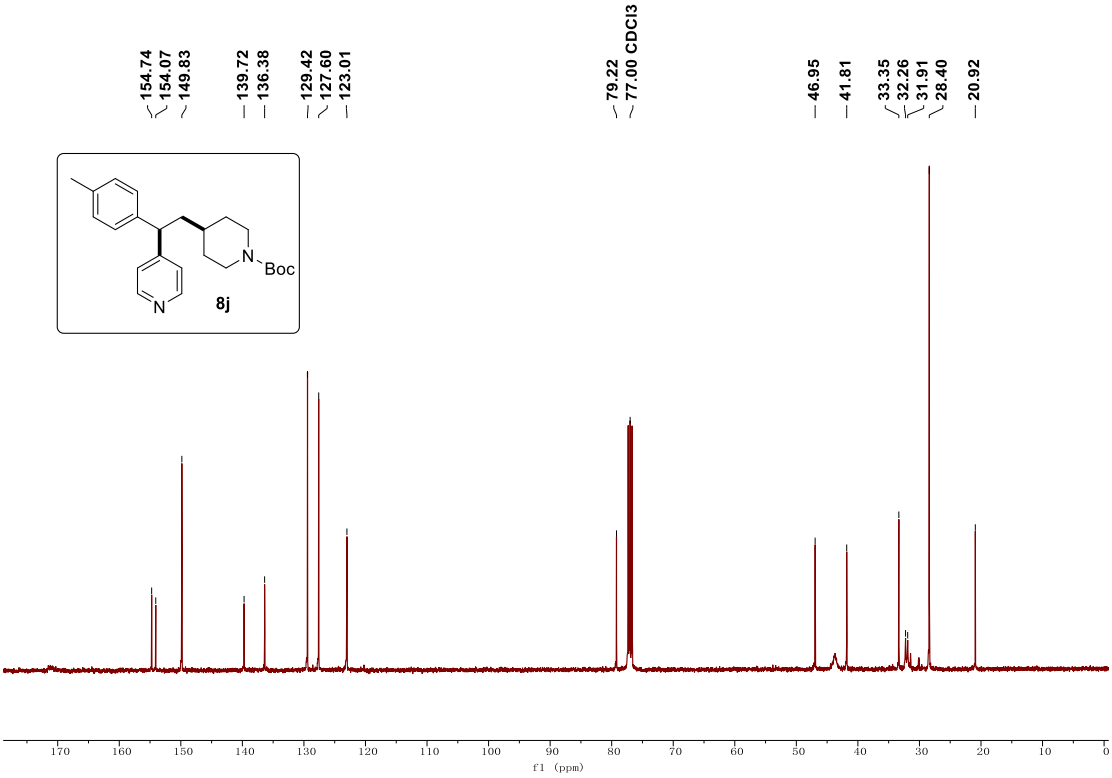
^{1}H NMR Spectra of **8i** ($CDCl_3$, 400 MHz)



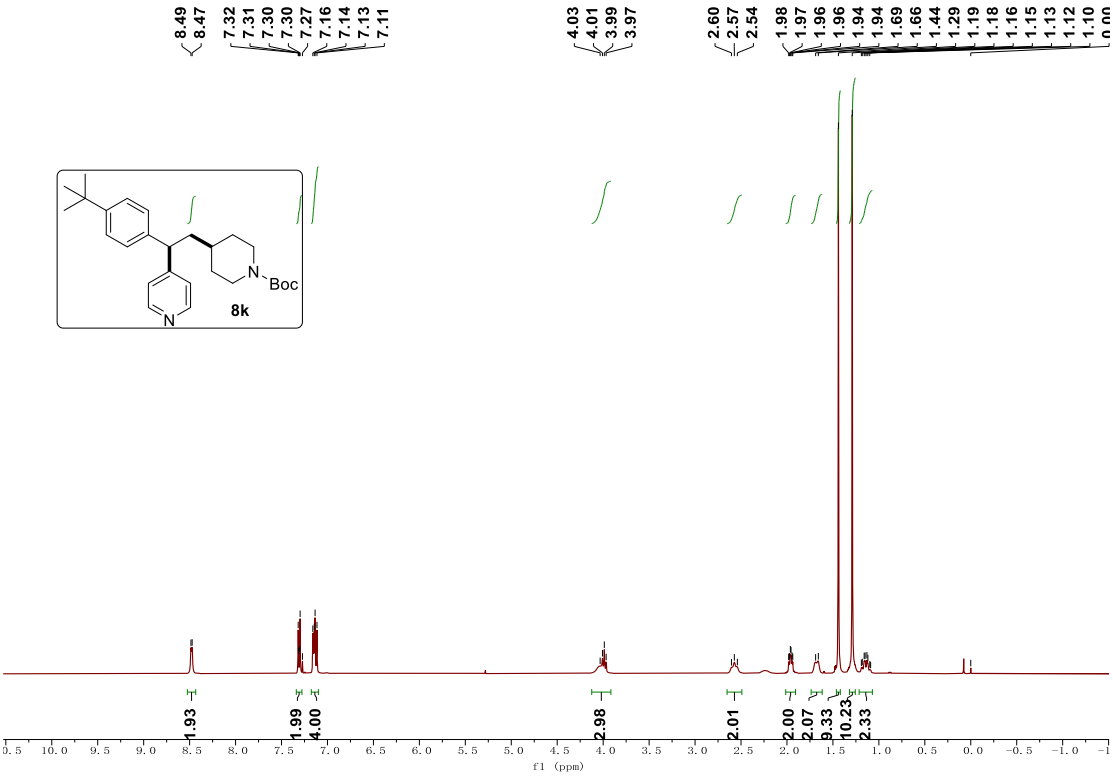
^{13}C NMR Spectra of **8i** ($CDCl_3$, 101 MHz)



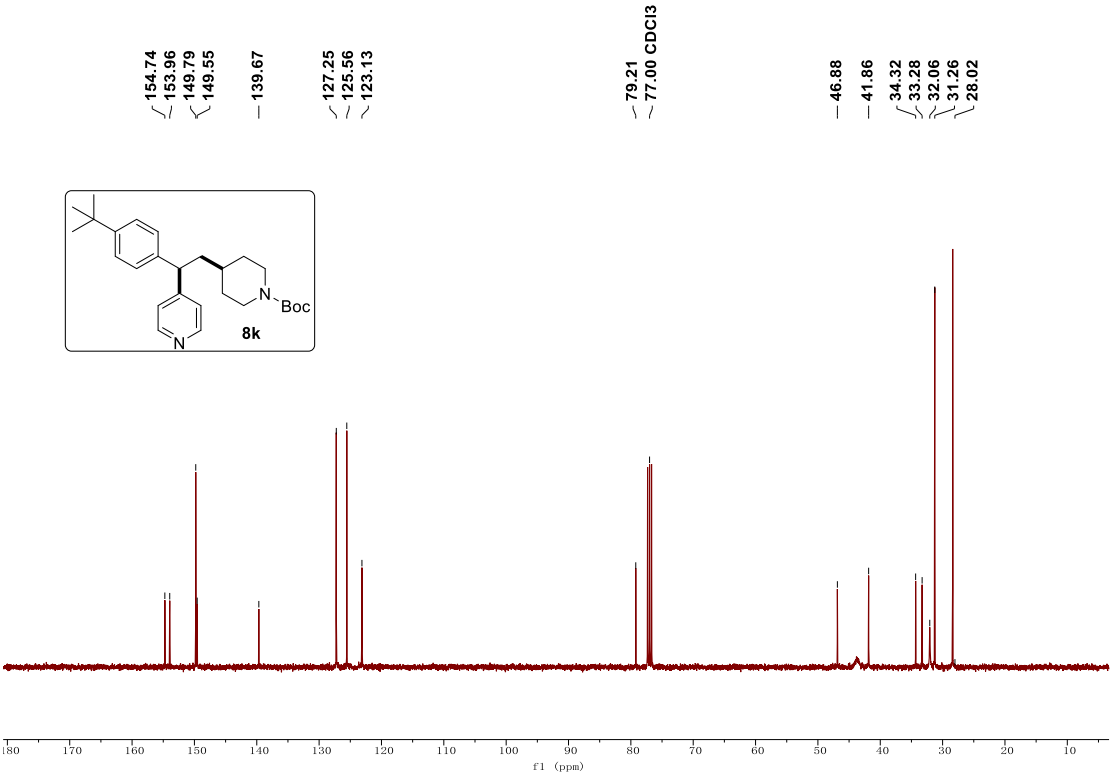
^{1}H NMR Spectra of **8j** ($CDCl_3$, 400 MHz)



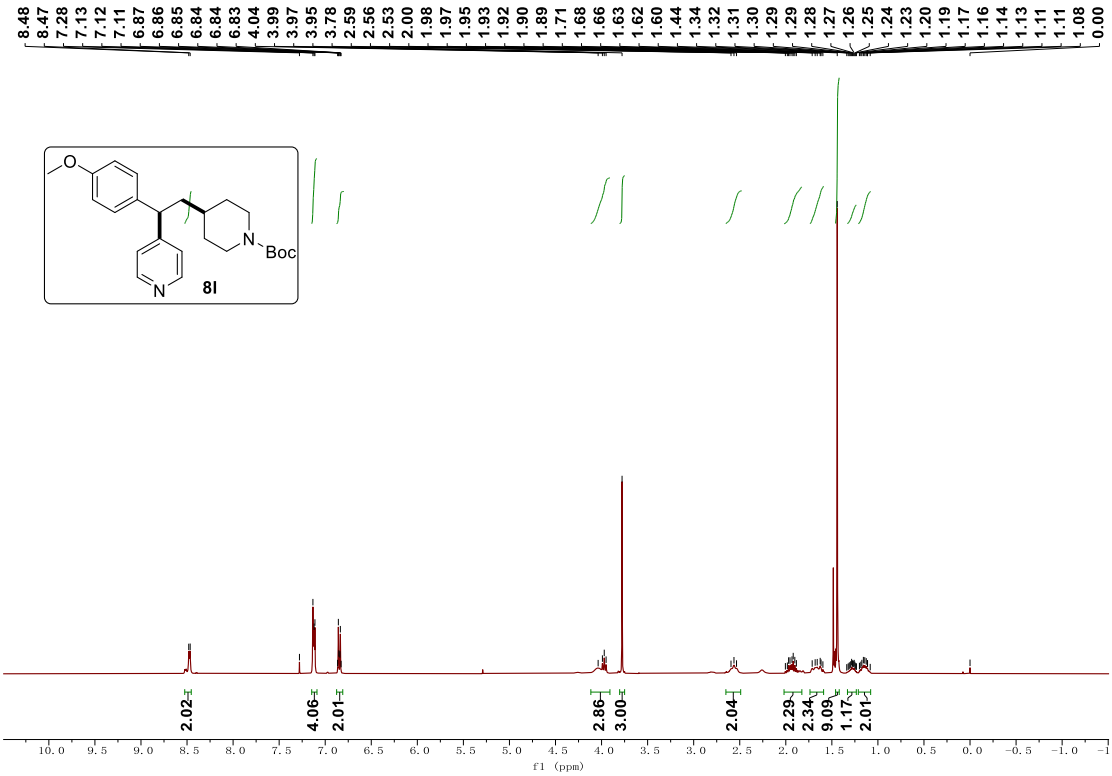
^{13}C NMR Spectra of **8j** ($CDCl_3$, 101 MHz)



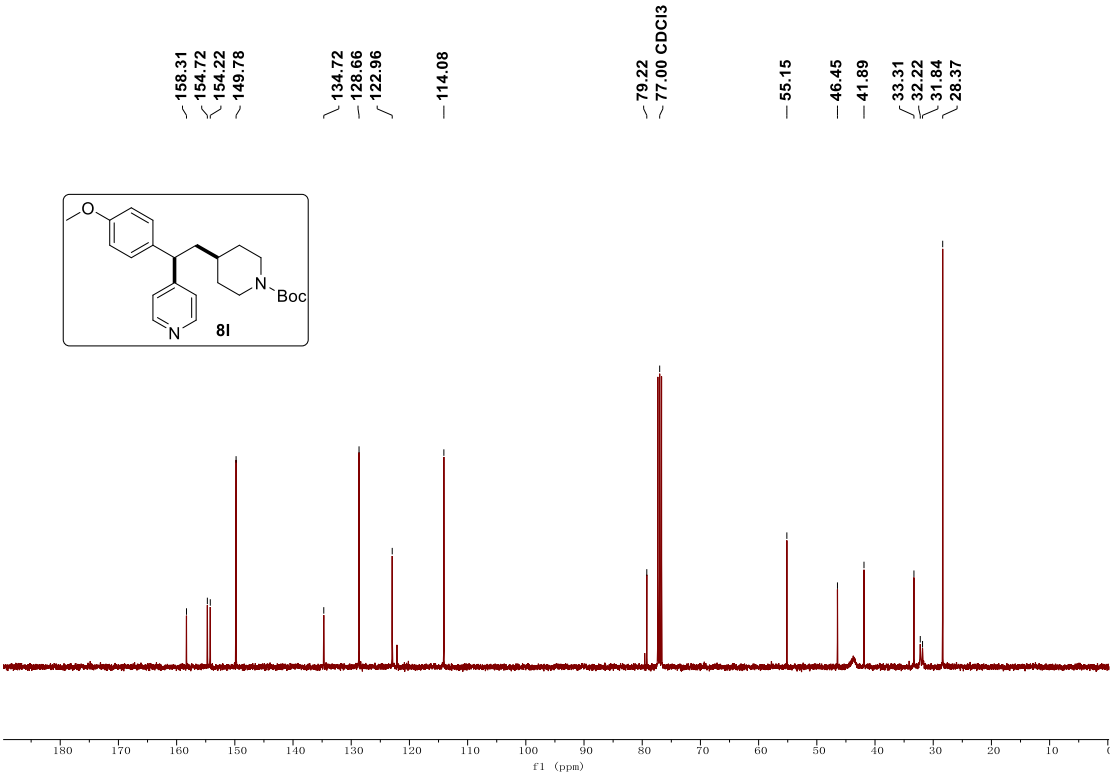
^{1}H NMR Spectra of **8k** ($CDCl_3$, 400 MHz)



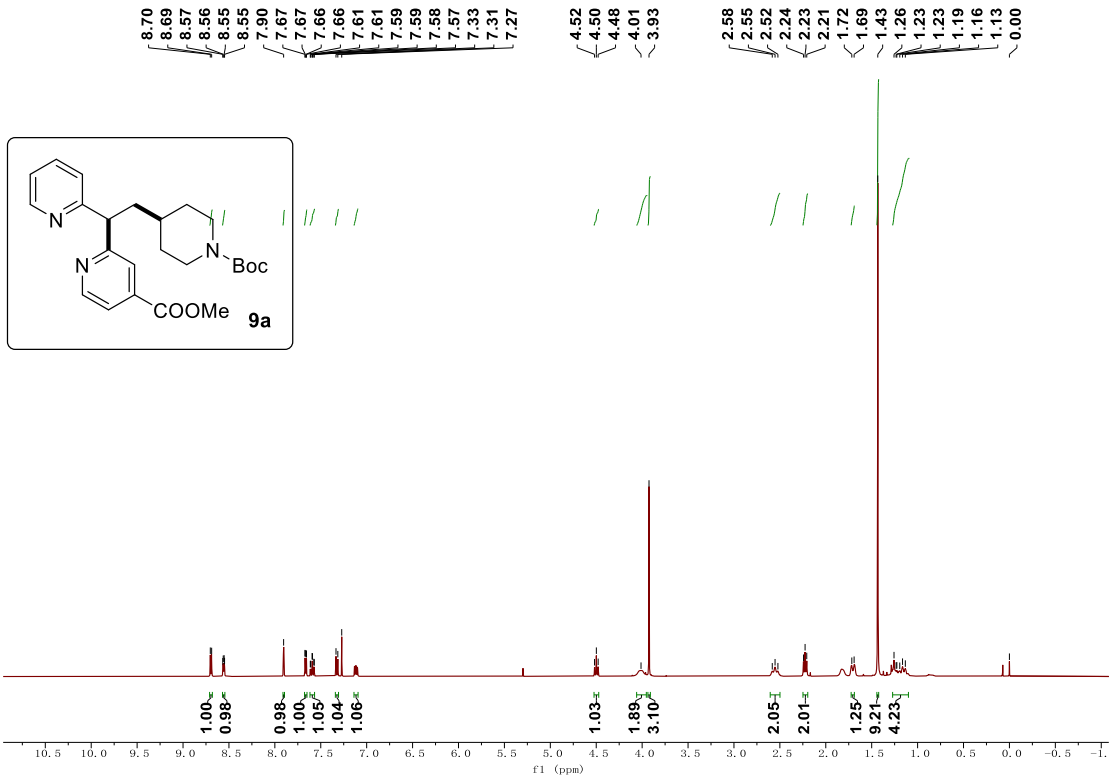
^{13}C NMR Spectra of **8k** ($CDCl_3$, 101 MHz)



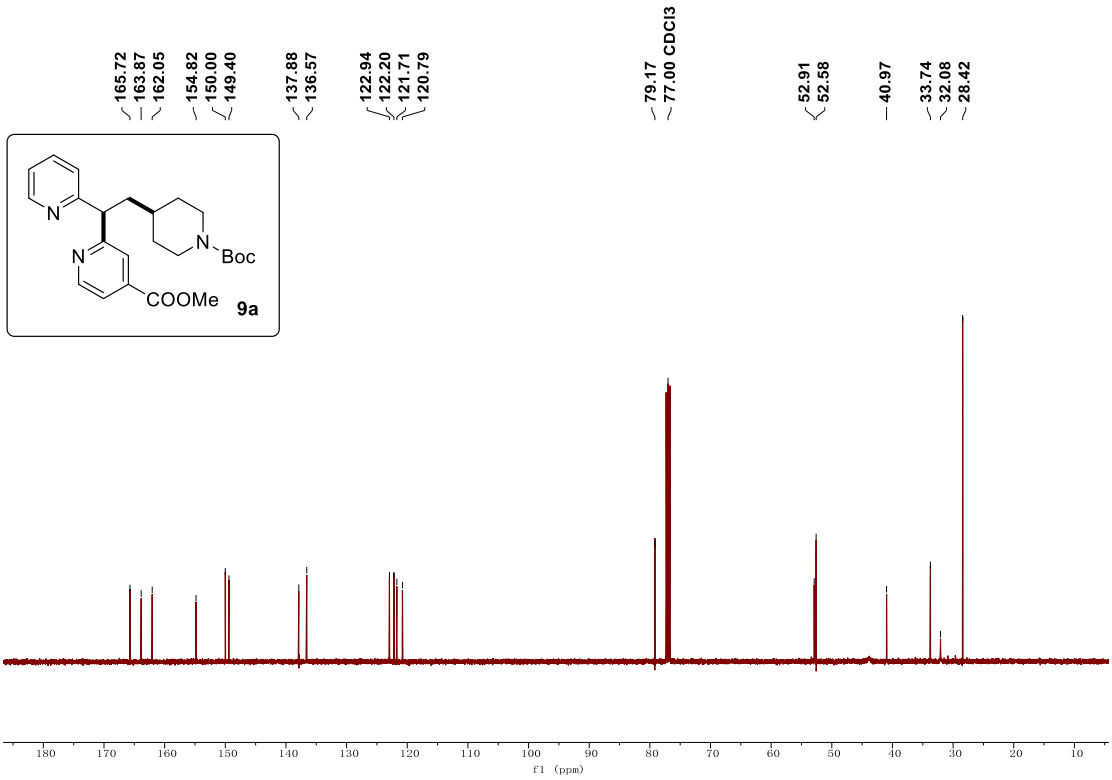
^{1}H NMR Spectra of **8l** ($CDCl_3$, 400 MHz)



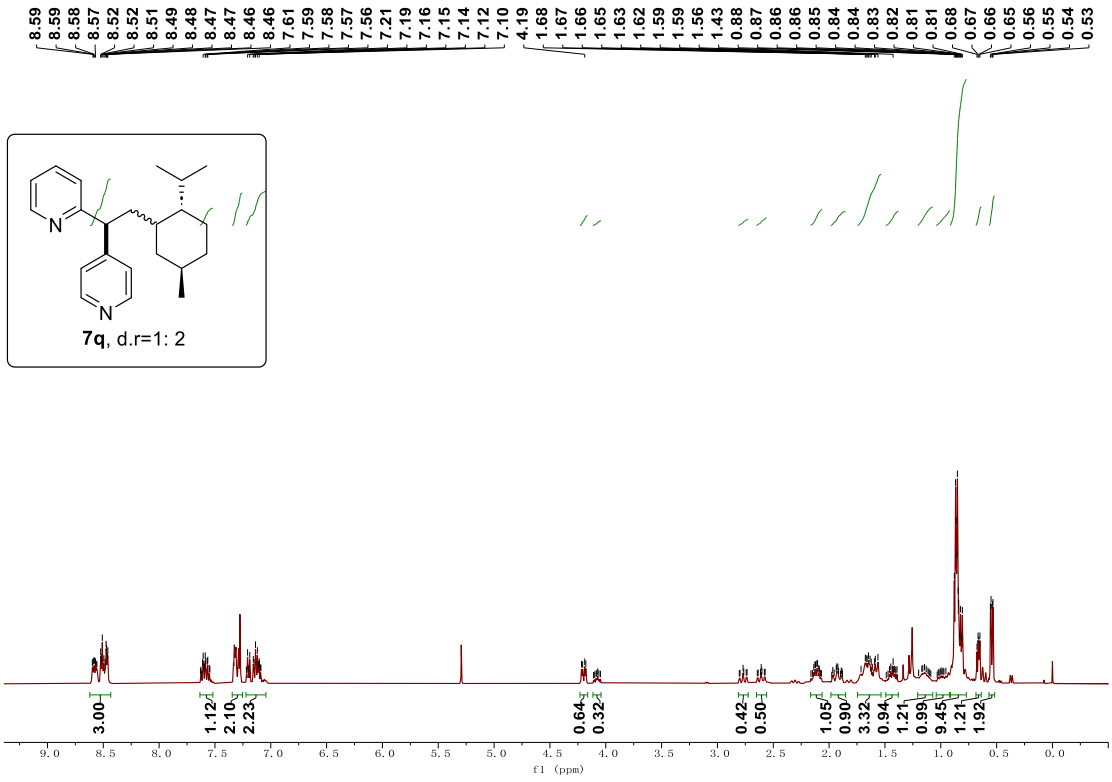
^{13}C NMR Spectra of **8l** ($CDCl_3$, 101 MHz)



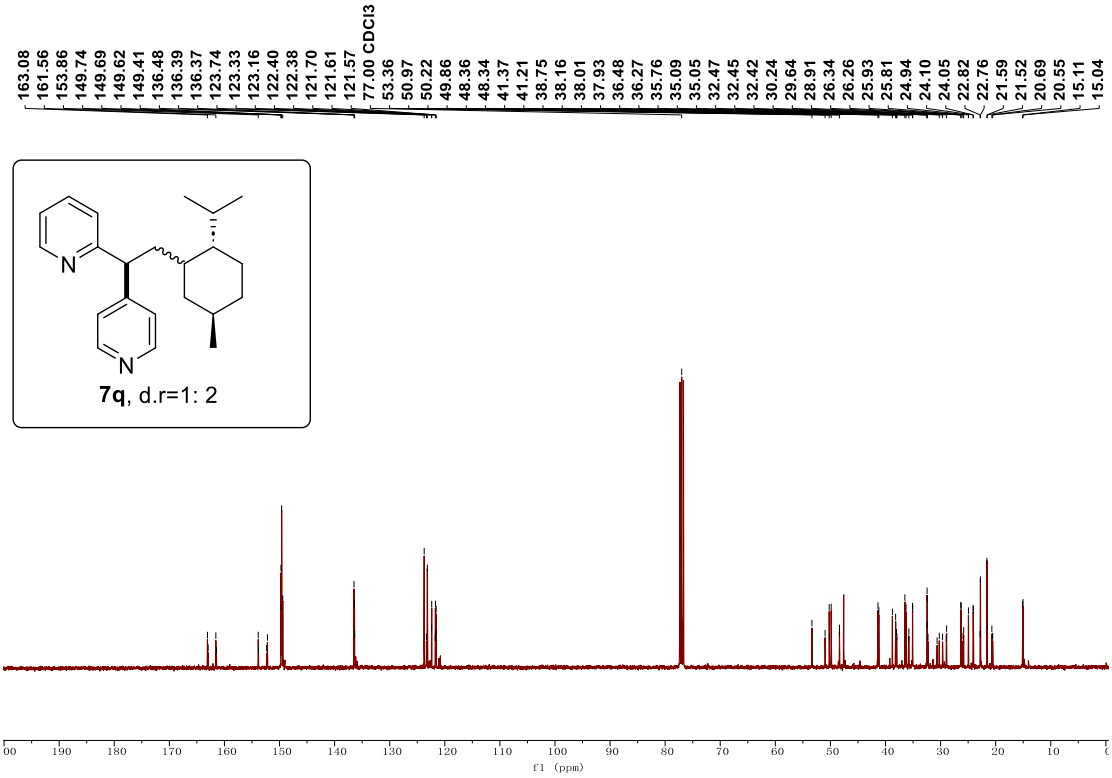
^{1}H NMR Spectra of **9a** ($CDCl_3$, 400 MHz)



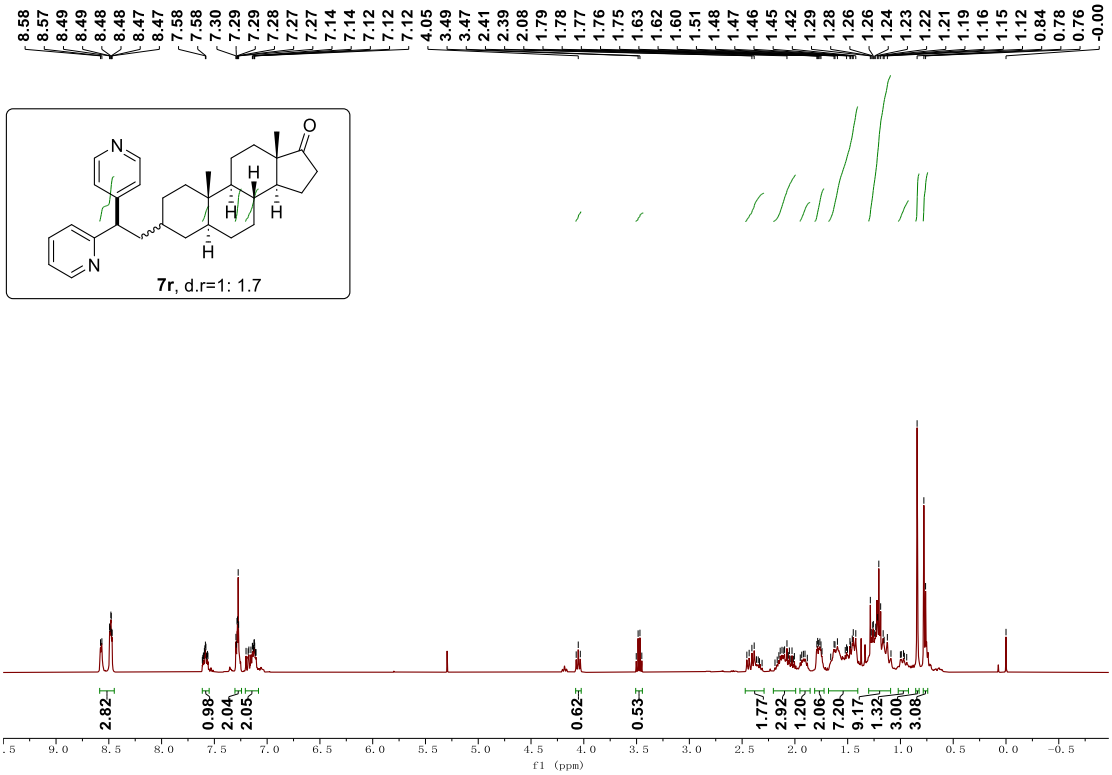
^{13}C NMR Spectra of **9a** ($CDCl_3$, 101 MHz)



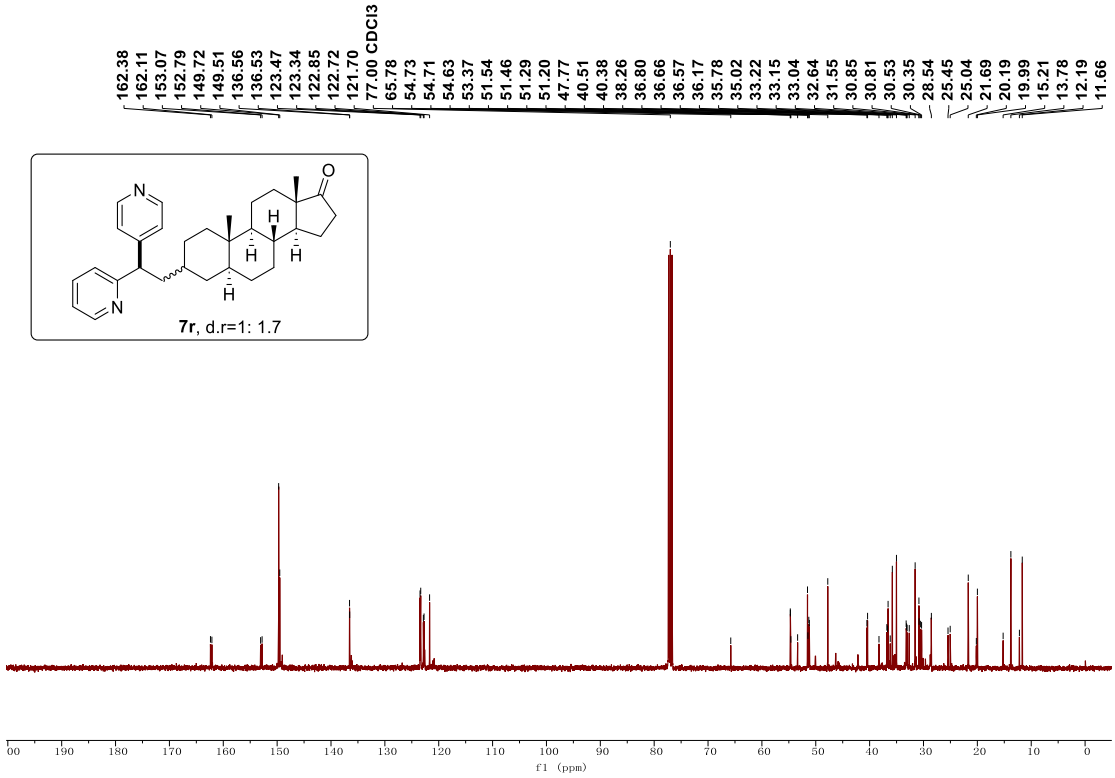
^{1}H NMR Spectra of **7q** ($CDCl_3$, 400 MHz)



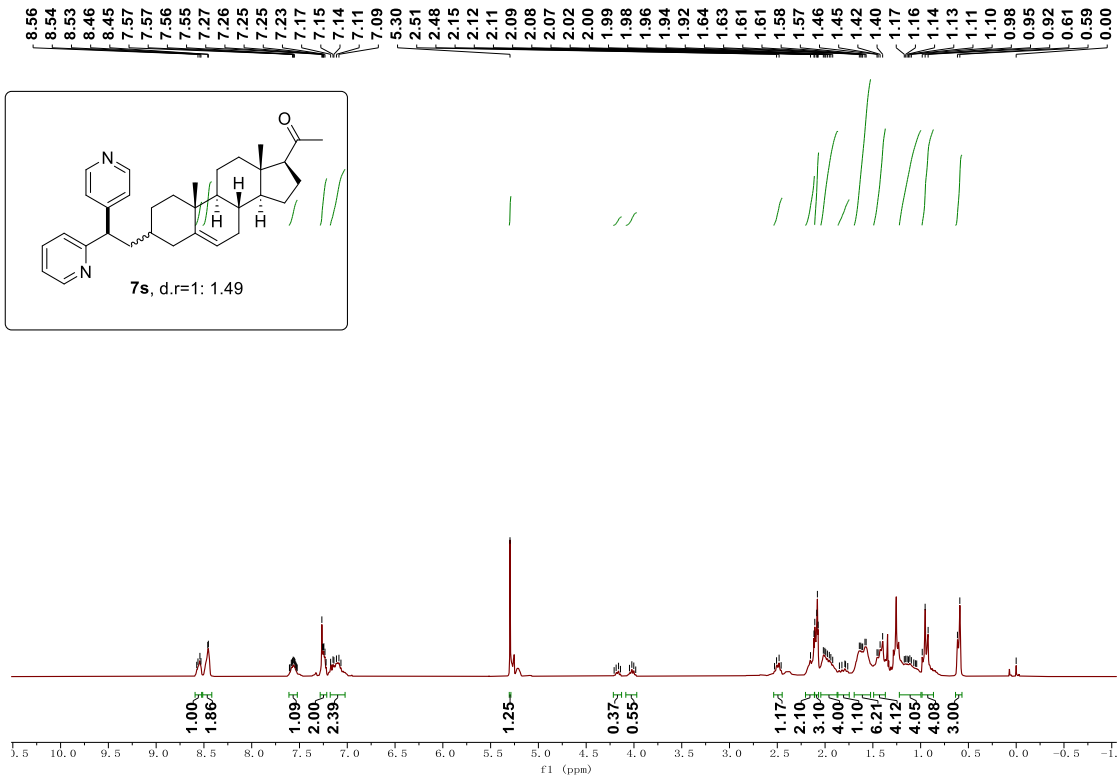
^{13}C NMR Spectra of **7q** ($CDCl_3$, 101 MHz)



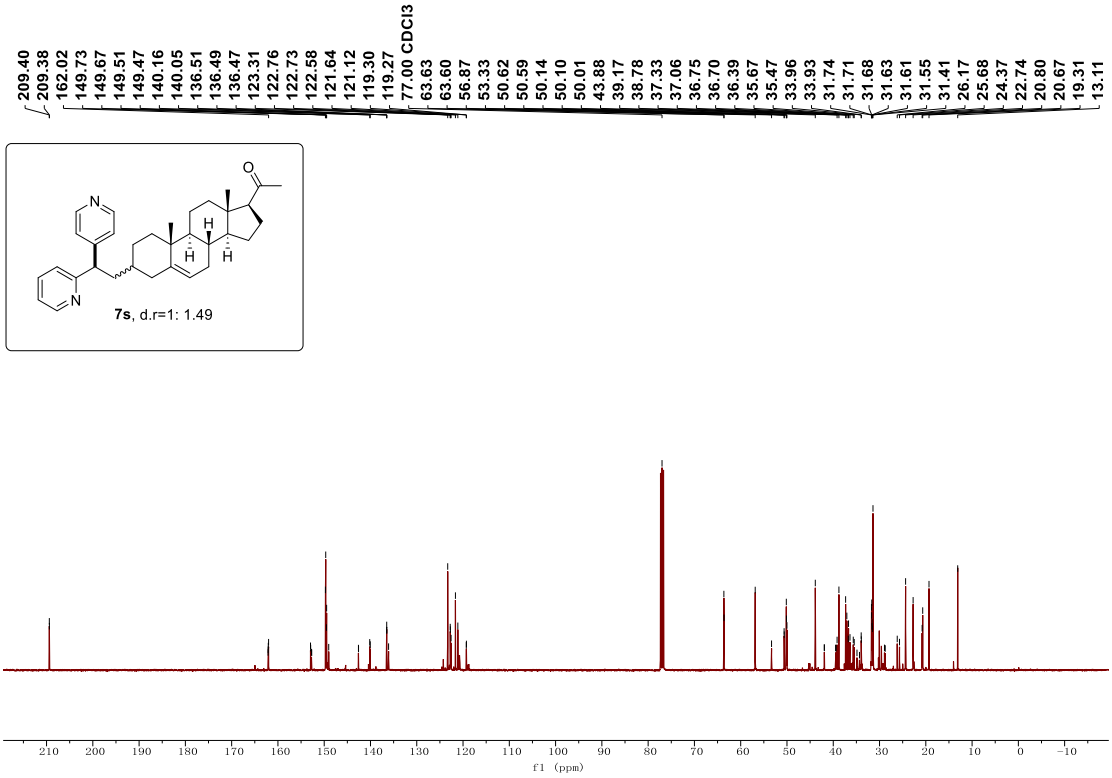
^{1}H NMR Spectra of **7r** ($CDCl_3$, 400 MHz)



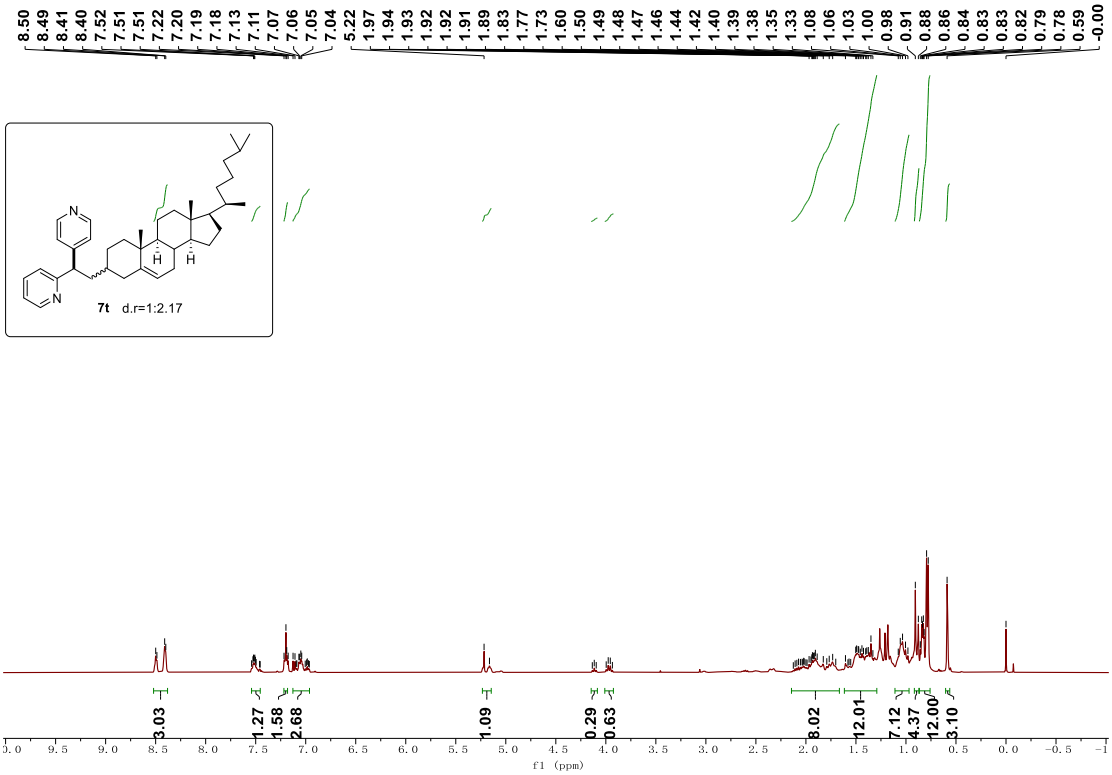
^{13}C NMR Spectra of **7r** ($CDCl_3$, 101 MHz)



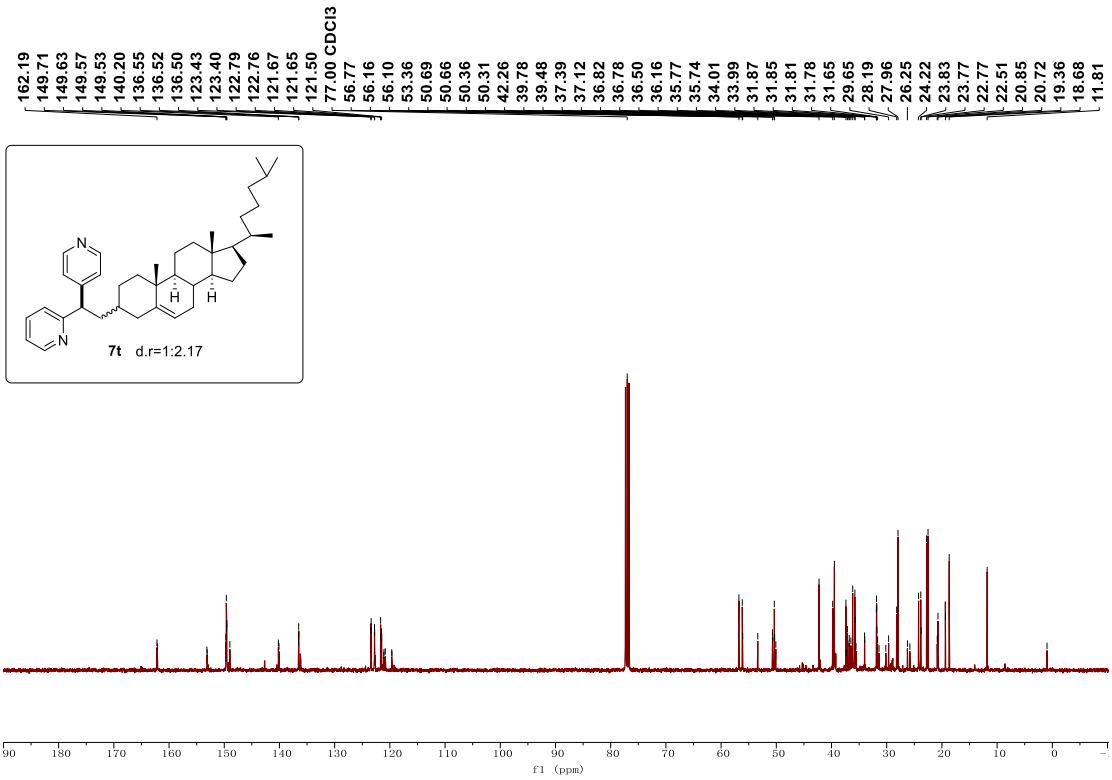
^{1}H NMR Spectra of **7s** ($CDCl_3$, 400 MHz)



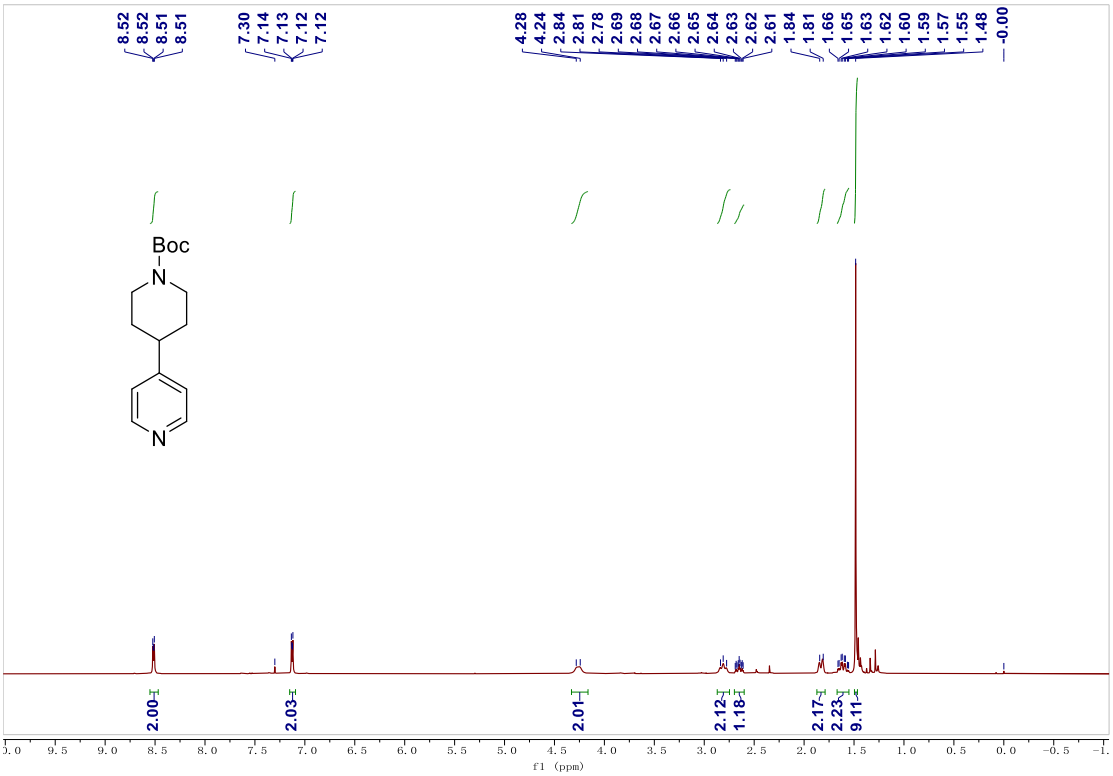
^{13}C NMR Spectra of **7s** ($CDCl_3$, 101 MHz)



^{1}H NMR Spectra of **7t** ($CDCl_3$, 400 MHz)



^{13}C NMR Spectra of **7t** ($CDCl_3$, 101 MHz)



^{1}H NMR Spectra of **by-product** ($CDCl_3$, 400 MHz)