Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Asymmetric Aerobic Decarboxylative Povarov Reactions of *N*-Aryl *α*-Amino Acids with Methylenephthalimidines via Cooperative Photoredox and Chiral Brønsted Acid Catalysis

Jiangtao Li,[†] Ziwei Gu,[†] Xiaowei Zhao,[†] Baokun Qiao,[†] Zhiyong Jiang[*,‡]

[†]*Henan University, Kaifeng, Henan, P. R. China 475004*

[‡]*Henan Key Laboratory of Organic Functional Molecules and Drug Innovation, School of Chemistry and Chemical Engineering, Henan Normal University, Xinxiang, Henan, P. R. China 453007*

E-mail: jiangzhiyong@htu.edu.cn

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1. General information

General procedures and methods

Experiments involving moisture and/or air sensitive components were performed under a positive pressure of argon in oven-dried glassware equipped with a rubber septum inlet. Dried solvents and liquid reagents were transferred by oven-dried syringes or hypodermic syringe cooled to ambient temperature in a desiccator. Reactions mixtures were stirred in 10 mL sample vial with Teflon-coated magnetic stirring bars unless otherwise stated. Moisture in non-volatile reagents/compounds was removed in high *vacuo* by means of an oil pump and subsequent purging with nitrogen. Solvents were removed *in vacuo* under ~30 mmHg and heated with a water bath at 30–35 ^{o}C using rotary evaporator with aspirator. The condenser was cooled with running water at 0 ^{o}C.

All experiments were monitored by analytical thin layer chromatography (TLC). TLC was performed on pre-coated plates, 60 F_{254}. After elution, plate was visualized under UV illumination at 254 nm for UV active material. Further visualization was achieved by staining $Ce(SO_4)_2$ solution.

Columns for flash chromatography (FC) contained *silica gel* 200–300 mesh. Columns were packed as slurry of *silica gel* in petroleum ether and equilibrated solution using the appropriate solvent system. The elution was assisted by applying pressure of about 2 atm with an air pump.

Instrumentations

Proton nuclear magnetic resonance (^{1}H NMR) and carbon NMR (^{13}C NMR) were recorded in $CDCl_3$ otherwise stated. Chemical shifts are reported in parts per million (ppm), using the residual solvent signal as an internal standard: $CDCl_3$ (^{1}H NMR: δ 7.26, singlet; ^{13}C NMR: δ 77.0, triplet). Multiplicities were given as: *s* (singlet), *d* (doublet), *t* (triplet), *q* (quartet), *quintet*, *m* (multiplets), *dd* (doublet of doublets), *dt* (doublet of triplets). Coupling constants (*J*) were recorded in Hertz (Hz). The number of proton atoms (*n*) for a given resonance was indicated by *n*H. The number of carbon atoms (*n*) for a given resonance was indicated by *n*C. HRMS (Analyzer: TOF) was reported in units of mass of charge ratio (m/z). Mass samples were dissolved in CH_3CN (HPLC Grade) unless otherwise stated. Optical rotations were recorded on a polarimeter with a sodium lamp of wavelength 589 nm and reported as follows;

$[\alpha]_{\lambda}^{T^{\circ}C}$ (c = g/100 mL, solvent). Melting points were determined on a melting point apparatus.

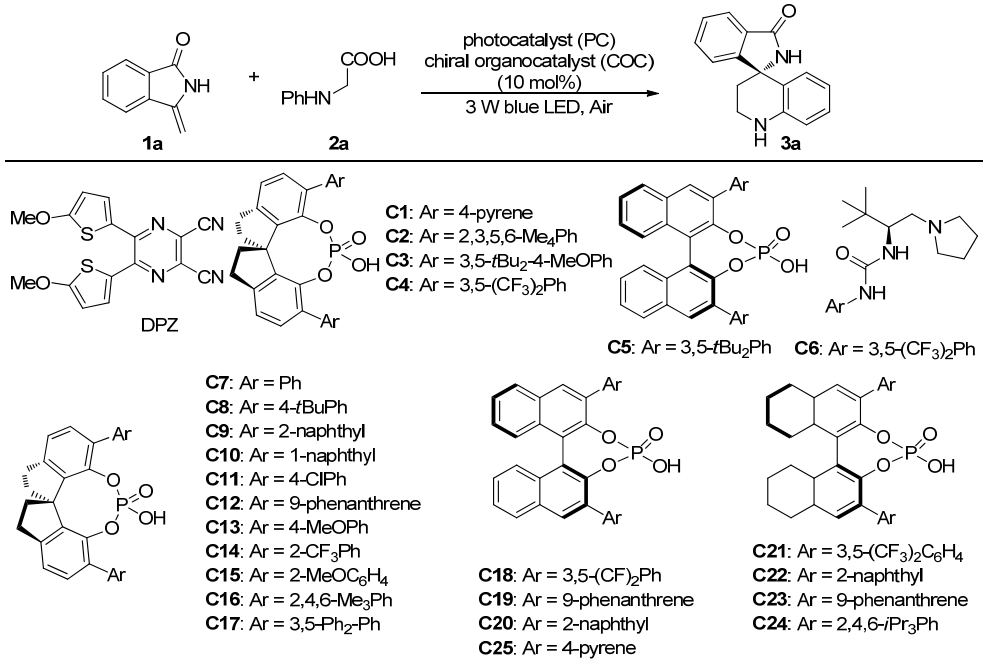
Enantiomeric excesses were determined by chiral High Performance Liquid Chromatography (HPLC) analysis. UV detection was monitored at 254 nm and 210 nm at the same time. HPLC samples were dissolved in HPLC grade isopropanol (IPA) unless otherwise stated.

Materials

All commercial reagents were purchased with the highest purity grade. They were used without further purification unless specified. All solvents used, mainly petroleum ether (PE) and ethyl acetate (EtOAc) were distilled. Anhydrous dichloromethane (DCM), CH_3CN, and DCE were freshly distilled from CaH_2 and stored under N_2 atmosphere. THF, Et_2O, and toluene were freshly distilled from sodium/benzophenone before use. All compounds synthesized were stored in a −20 ^{o}C freezer and light-sensitive compounds were protected with aluminium foil.

2. Optimization of reaction conditions

Table S1. Optimization of Reaction Conditions.



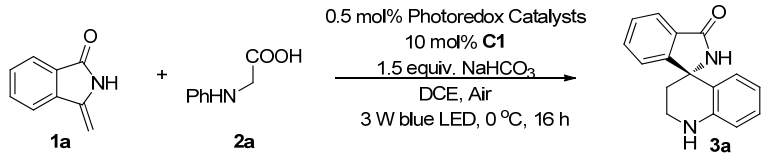
entry	PC (mol%)	COC	Base (1.5 equiv)	solvent (1.0 mL)	*T* (^{o}C)	ee (%)[a]
1	DPZ (0.5)	**C2**	--	CH_2Cl_2	25	74
2	DPZ (0.5)	**C3**	--	CH_2Cl_2	25	60
3	DPZ (0.5)	**C4**	--	CH_2Cl_2	25	22
4	DPZ (0.5)	**C5**	--	CH_2Cl_2	25	36
5	DPZ (0.5)	**C6**	--	CH_2Cl_2	25	N.P.
6	DPZ (0.5)	**C7**	--	CH_2Cl_2	25	32
7	DPZ (0.5)	**C8**	--	CH_2Cl_2	25	51
8	DPZ (0.5)	**C9**	--	CH_2Cl_2	25	55
9	DPZ (0.5)	**C10**	--	CH_2Cl_2	25	50
10	DPZ (0.5)	**C11**	--	CH_2Cl_2	25	35
11	DPZ (0.5)	**C12**	--	CH_2Cl_2	25	54
12	DPZ (0.5)	**C13**	--	CH_2Cl_2	25	57
13	DPZ (0.5)	**C14**	--	CH_2Cl_2	25	30
14	DPZ (0.5)	**C15**	--	CH_2Cl_2	25	46
15	DPZ (0.5)	**C16**	--	CH_2Cl_2	25	38
16	DPZ (0.5)	**C17**	--	CH_2Cl_2	25	59
17	DPZ (0.5)	**C18**	--	CH_2Cl_2	25	27
18	DPZ (0.5)	**C19**	--	CH_2Cl_2	25	34
19	DPZ (0.5)	**C20**	--	CH_2Cl_2	25	39
20	DPZ (0.5)	**C21**	--	CH_2Cl_2	25	28
21	DPZ (0.5)	**C22**	--	CH_2Cl_2	25	25
22	DPZ (0.5)	**C23**	--	CH_2Cl_2	25	40
23	DPZ (0.5)	**C24**	--	CH_2Cl_2	25	35

24	DPZ (0.5)	**C2**	--	toluene	25	59
25	DPZ (0.5)	**C2**	--	Et_2O	25	48
26	DPZ (0.5)	**C2**	--	THF	25	66
27	DPZ (0.5)	**C2**	--	CH_3CN	25	68
28	DPZ (0.5)	**C2**	--	$CHCl_3$	25	70
29	DPZ (0.5)	**C2**	--	DCE	25	85
30	DPZ (0.5)	**C2**	--	DCE	10	87
31	DPZ (0.5)	**C2**	--	DCE	0	89
32	DPZ (0.5)	**C1**	--	DCE	0	93
33	DPZ (0.5)	**C1**	--	DCE	−10	92
34	DPZ (0.5)	**C1**	--	DCE	−20	90
35	DPZ (0.5)	**C1**	$NaHCO_3$	DCE	0	95
36	DPZ (0.5)	**C25**	$NaHCO_3$	DCE	0	40
37	DPZ (0.5)	**C1**	$NaHCO_3$	THF	0	86
38	DPZ (0.5)	**C1**	$NaHCO_3$	toluene	0	86
39	DPZ (0.5)	**C2**	$NaHCO_3$	DCE	0	92
40	DPZ (0.5)	**C1**	$KHCO_3$	DCE	0	92
41	DPZ (0.5)	**C1**	Na_2CO_3	DCE	0	90
42	DPZ (0.5)	**C1**	K_2CO_3	DCE	0	87

Reaction conditions: **1a** (0.10 mmol), **2a** (0.05 mmol). N.P. = no product **3a** obtained.

[a]Determined by HPLC analysis on a chiral stationary phase.

Table S2 Evaluation of Photoredox Catalysts under the Standard Conditions.



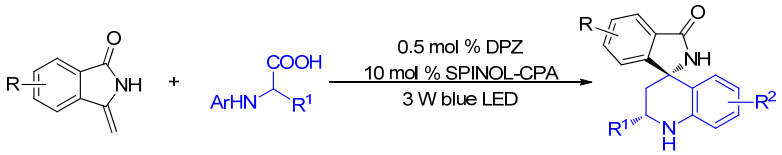
entry	photoredox catalyst	yield (%)[a]	ee (%)[b]
1	Rose Bengal	75	93
2	Eosin Y	65	94
3	Rhodamine B	NP	--
4	$Ru(bpy)_3Cl_2•6H_2O$	72	90

Reaction conditions: **1a** (0.10 mmol), **2a** (0.05 mmol). N.P. = no product **3a** obtained.

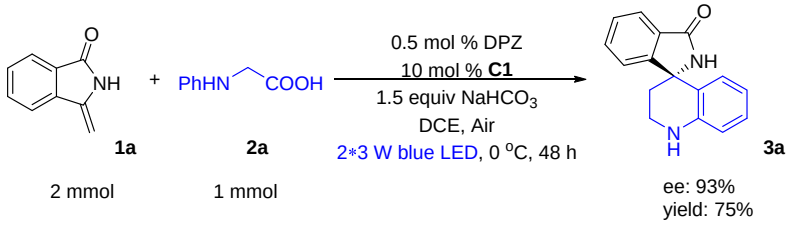
[a]Yields were determined by isolation after chromatographic purification.

[b]Determined by HPLC analysis on a chiral stationary phase.

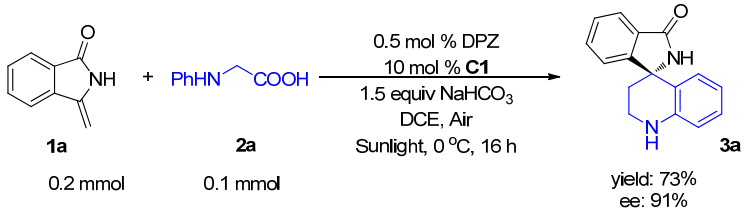
3. General experimental procedures



35.4 μL (0.0002 mmol, 0.002 equiv) of DPZ solution (1.0 mg of DPZ in 200 μL of toluene) was added into a 10 mL reaction flask, and then solvent was removed in *vacuo*. Subsequently, **1** (0.2 mmol, 2.0 equiv), **2** (0.1 mmol, 1.0 equiv), **C1** (0.01 mmol, 0.1 equiv) for **3a** – **3g**, **3i** – **3u**, or **C2** (0.01 mmol, 0.1 equiv) for **3h**, $NaHCO_3$ (0.15 mmol, 1.5 equiv) for **3a** – **3j**, **3m** – **3u**, and DCE (2.0 mL) were sequentially added. The reaction mixture of **3a** – **3g**, **3i** – **3u** was stirred at 0 °C, or **3h** was stirred at −10 °C for 30 min without light, then irradiated by a 3 W blue LED (λ = 450 − 455 nm) from 3.0 cm distance for another 16 h. The reaction mixture was directly loaded onto a short *silica gel* column, followed by gradient elution with DCM/MeOH (200/1–30/1 ratio). Removing the solvent in *vacuo*, afforded products **3a** – **3u**.



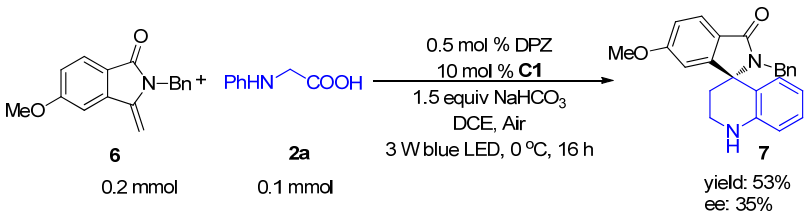
354 μL (0.002 mmol, 0.002 equiv) of DPZ solution (2.0 mg of DPZ in 400 μL of toluene) was added into a 50 mL reaction flask, and then solvent was removed in *vacuo*. Subsequently, **1a** (2.0 mmol, 2.0 equiv), **2a** (1.0 mmol, 1.0 equiv), **C1** (0.1 mmol, 0.1 equiv), $NaHCO_3$ (1.5 mmol, 1.5 equiv), and DCE (20.0 mL) were sequentially added. The reaction mixture of was stirred at 0 °C without light, then irradiated by a 2*3 W blue LED (λ = 450 − 455 nm) from 3.0 cm distance for another 48 h. The reaction mixture was directly loaded onto a short *silica gel* column, followed by gradient elution with DCM/MeOH (200/1–30/1 ratio). Removing the solvent in *vacuo*, afforded products **3a**.



35.4 μL (0.0002 mmol, 0.002 equiv) of DPZ solution (1.0 mg of DPZ in 200 μL of toluene)

was added into a 10 mL reaction flask, and then solvent was removed in *vacuo*. Subsequently, **1a** (0.2 mmol, 2.0 equiv), **2a** (0.1 mmol, 1.0 equiv), **C1** (0.01 mmol, 0.1 equiv), $NaHCO_3$ (0.15 mmol, 1.5 equiv), and DCE (2.0 mL) were sequentially added. The reaction mixture of was stirred at 0 ^{o}C, without light, then irradiated by sunlight for another 16 h (two days, 8 h/day). The reaction mixture was directly loaded onto a short *silica gel* column, followed by gradient elution with DCM/MeOH (200/1–30/1 ratio). Removing the solvent in *vacuo*, afforded product **3a** in 73% yield with 91% ee.

4. Mechanism studies



35.4 μL (0.0002 mmol, 0.002 equiv) of DPZ solution (2.0 mg of DPZ in 400 μL of toluene) was added into a 50 mL reaction flask, and then solvent was removed in *vacuo*. Subsequently, **6** (0.2 mmol, 2.0 equiv), **2a** (0.1 mmol, 1.0 equiv), **C1** (0.01 mmol, 0.1 equiv), $NaHCO_3$ (0.15 mmol, 1.5 equiv), and DCE (2.0 mL) were sequentially added. The reaction mixture of was stirred at 0 ^oC without light, then irradiated by a 3 W blue LED (λ = 450 − 455 nm) from 3.0 cm distance for another 16 h. The reaction mixture was directly loaded onto a short *silica gel* column, followed by gradient elution with DCM/MeOH (200/1–30/1 ratio). Removing the solvent in *vacuo*, afforded product **7** in 53% yield with 35% ee.

Emission quenching experiments

Emission intensities were recorded on a spectrofluorometer. DPZ solution was excited at 448 nm and the emission intensity at 544 nm was observed. A solution of DPZ (5.0×10^{-5} M) in DCE was added to the appropriate amount of quencher in 5.0 mL volumetric flask under N_2. The solution was transferred to a 1.5 mL quartz cell and the emission spectrum of the sample was collected.

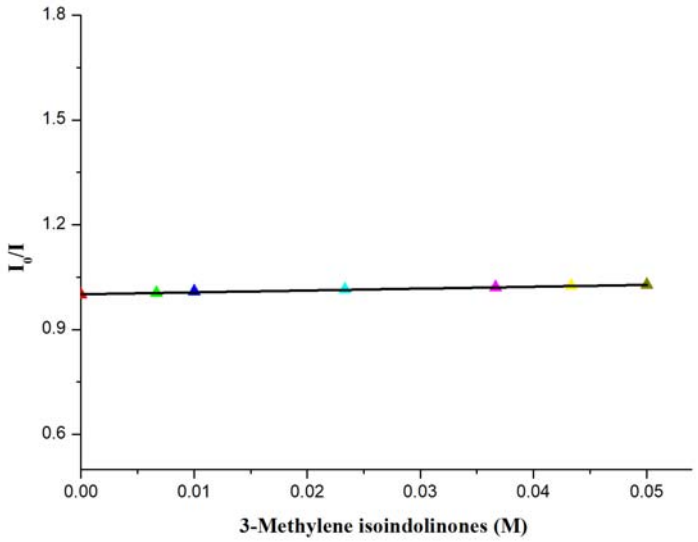


Fig. S1. Stern–Volmer quenching experiment of DPZ and **1a**.

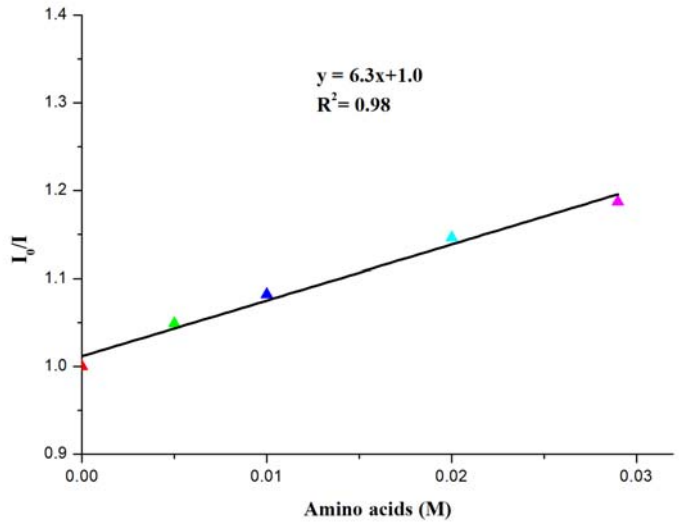


Fig. S2. Stern–Volmer quenching experiment of DPZ and **2a**.

Cyclic voltammetry measurement

Electrochemical potentials were obtained with a standard set of conditions to main internal consistency. Cyclic voltammograms were collected with a potentiostat. Samples were prepared with 0.01 mmol of **1a**, *N*-methyl aniline, or $PhNHCH_2CO_2Na$ in 10 mL of 0.1 M tetrabutylammonium hexafluorophosphate in anhydrous acetonitrile. Measurements employed a radium glassy carbon working electrode, platinum wire counter electrode, saturated KCl silver-silver chloride reference electrode. The obtained value was referenced to Ag/AgCl.

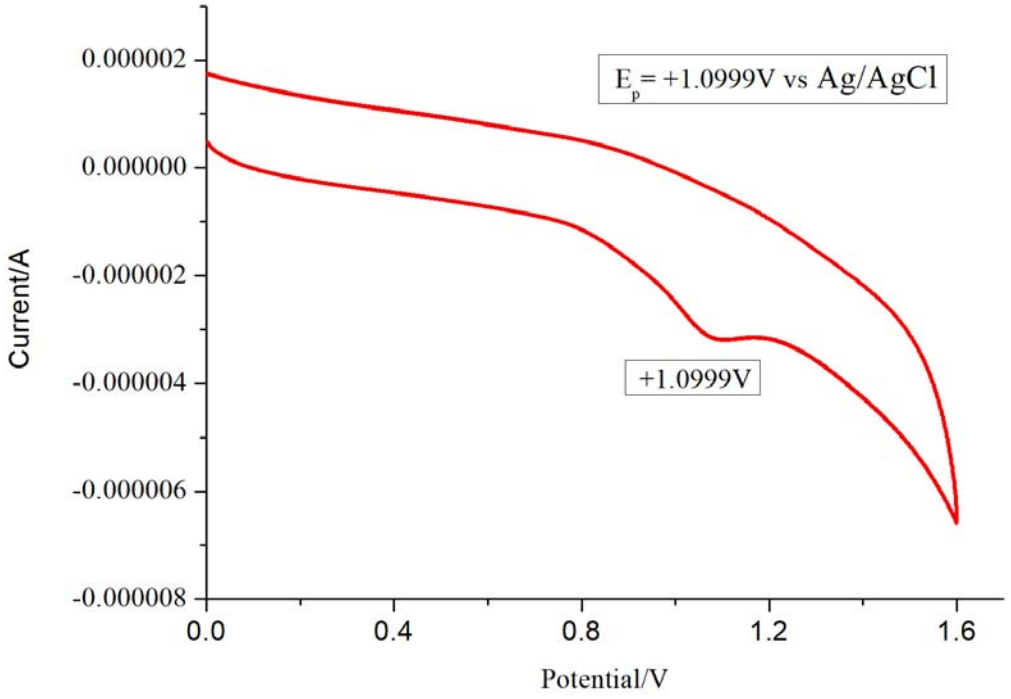
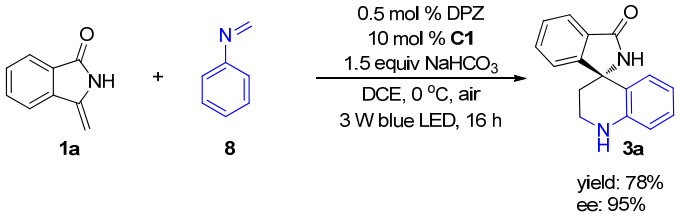


Fig. S3. Cyclic voltammogram of **1a** in MeCN.



Comments: We tried to isolate imine **8** and attempted it directly in the reaction system with **1a** as the partner. As results shown, product **3a** was obtained in 78% yield with 95% ee after 16 hours which are same as the results achieved from the aerobic decarboxylative Povarov reaction between **1a** and **2a** (See Scheme 2 in the manuscript). The results indicate two conclusions: (1) The [4+2] cycloaddition experiences an ionic process including addition of enamines to imines then a Mannich type reaction. Meanwhile, a radical process beginning from addition of α-aminoalkyl radicals to enamines could be excluded. (2) In this strategy, two processes between the formation of imines through aerobic decarboxylation via photoredox catalysis and asymmetric Povarov reaction under chiral Brønsted acid catalysis are well compatible. Meanwhile, H_2O_2 generated in the reaction system did not affect the H-bonding induction of chiral Brønsted acid catalyst to the asymmetric Povarov reaction.

Procedure: 35.4 μL (0.0002 mmol, 0.002 equiv) of DPZ solution (1.0 mg of DPZ in 200 μL of toluene) was added into a 10 mL reaction flask, and then solvent was removed in *vacuo*. Subsequently, **1a** (0.2 mmol, 2.0 equiv), **C1** (0.01 mmol, 0.1 equiv), $NaHCO_3$ (0.15 mmol, 1.5 equiv), and DCE (2.0 mL) were sequentially added. The reaction mixture was stirred at 0 ^oC for 30 min, the imine **8** (0.1 mmol, 1.0 equiv) was added, then irradiated by a 3 W blue LED (λ = 450 − 455 nm) from 3.0 cm distance for another 16 h. The reaction mixture was directly loaded onto a short *silica gel* column, followed by gradient elution with DCM/MeOH (200/1–30/1 ratio). Removing the solvent in *vacuo*, afforded products **3a**.

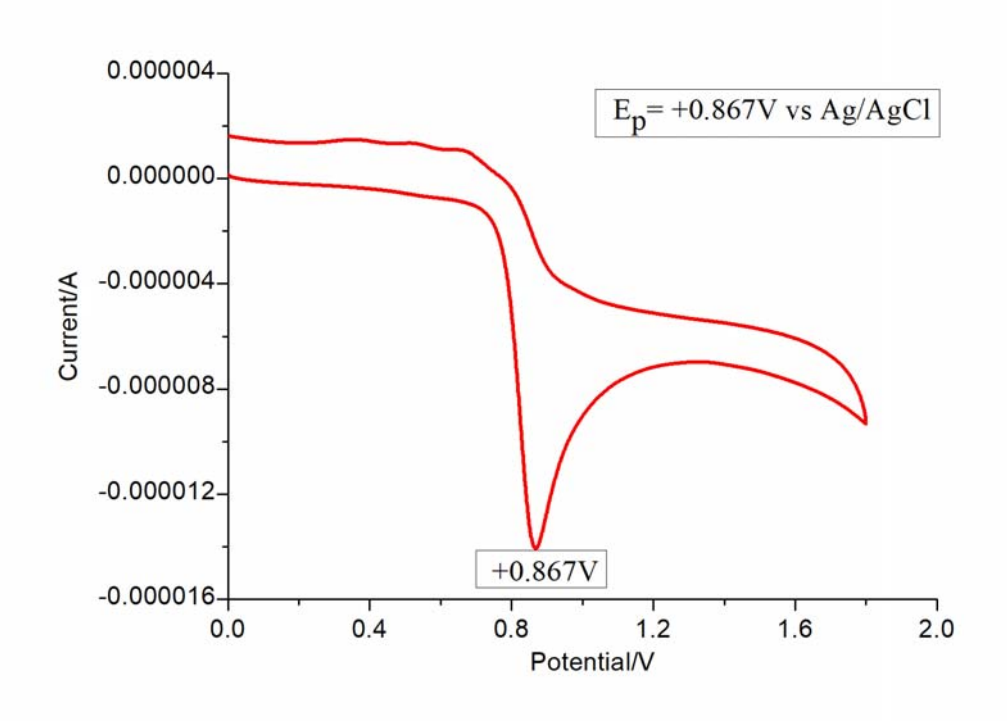


Fig. S4. Cyclic voltammogram of *N*-methyl aniline in MeCN.

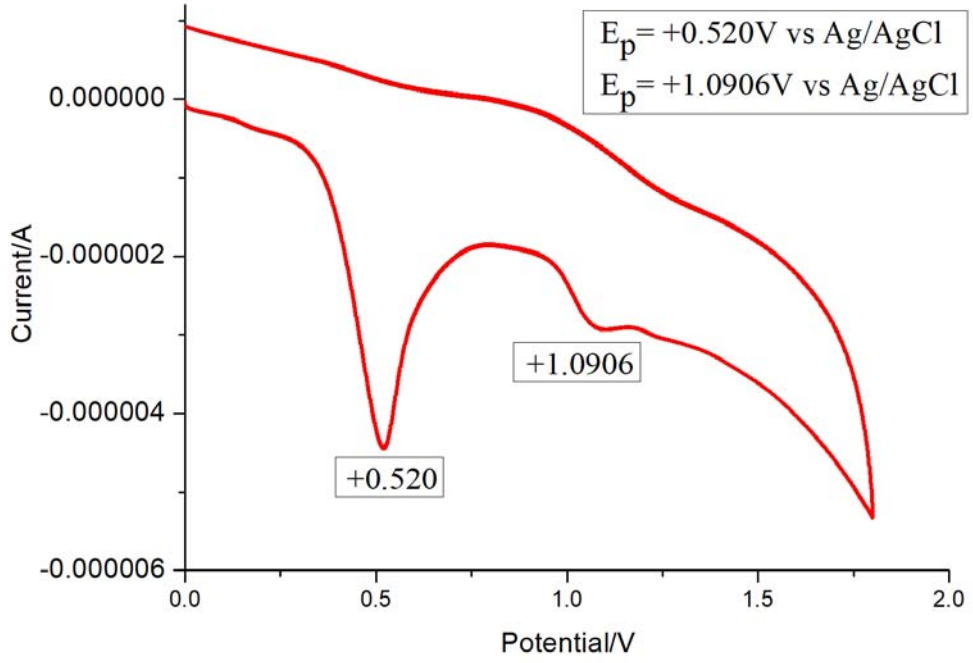


Fig. S5. Cyclic voltammogram of $PhNHCH_2CO_2Na$ in MeCN.

NMR analysis for $NaHCO_3$ with catalyst

$NaHCO_3$ (1.5 mmol, 15 equiv) and catalyst **C1** (0.1 mmol, 1 equiv) were dissolved in DCE (5.0 mL) were sequentially added, The reaction mixture was stirred at rt for 4 h. Catalyst **C1** is stable in the presence of $NaHCO_3$ which was determined by the analyses of ^1H NMR.

The On-Off-Light Experiment

Following the standard procedure, the reaction between **1a** (0.2 mmol, 2.0 eq.) and **2a** (0.1 mmol, 1.0 eq.) was conducted for on-off-light experiment. Aliquots of samples were taken out at various time points during the reaction.

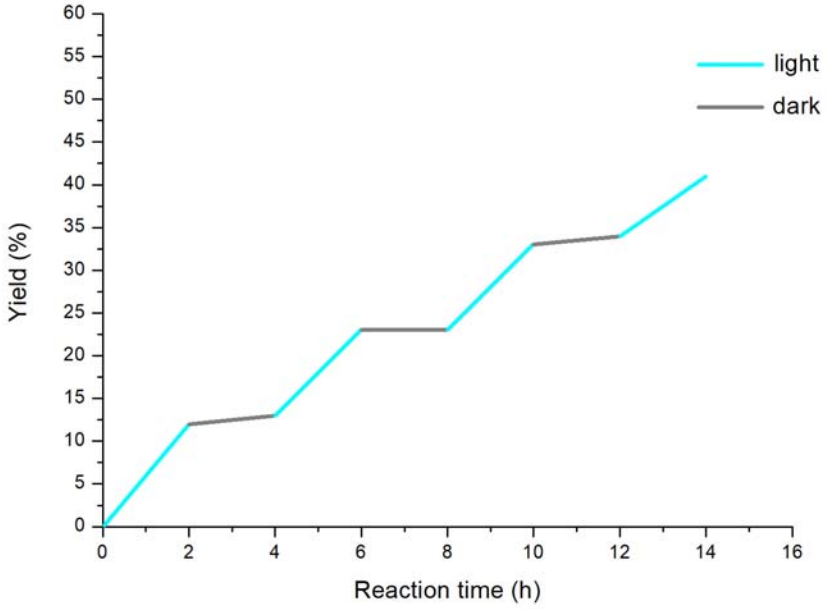
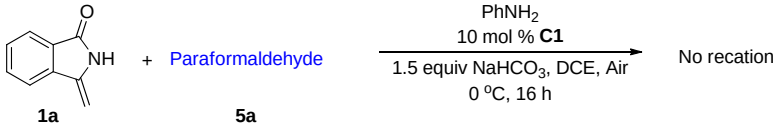


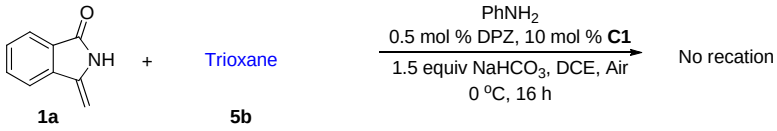
Fig. S6. The on-off-light experiment between **1a** and **2a**.

Comments: The results could roughly exclude the radical chain mechanism.

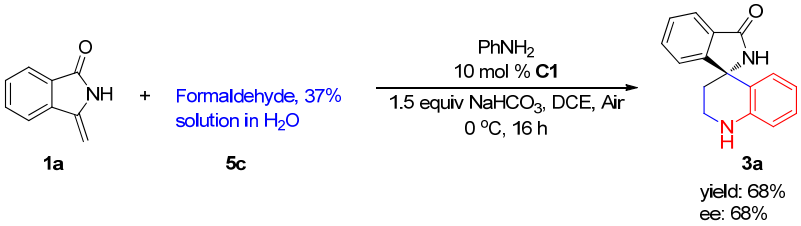
5. Comparison with the traditional povarov reaction protocol



In a 10 mL reaction flask, **1a** (0.2 mmol, 2.0 equiv), aniline (0.1 mmol, 1.0 equiv), **C1** (0.01 mmol, 0.1 equiv), $NaHCO_3$ (0.15 mmol, 1.5 equiv), and DCE (2.0 mL) were sequentially added. The reaction mixture was stirred at 0 °C for 30 min. Then paraformaldehyde **5a** (0.1 mmol, 1.0 equiv) was added. The reaction mixture was stirred at 0 °C for 16 h, but no reaction was observed.



In a 10 mL reaction flask, **1a** (0.2 mmol, 2.0 equiv), aniline (0.1 mmol, 1.0 equiv), **C1** (0.01 mmol, 0.1 equiv), $NaHCO_3$ (0.15 mmol, 1.5 equiv), and DCE (2.0 mL) were sequentially added. The reaction mixture was stirred at 0 °C for 30 min. Then paraformaldehyde **5b** (0.1 mmol, 1.0 equiv) was added. The reaction mixture was stirred at 0 °C for 16 h without light, but no reaction was observed.



In a 10 mL reaction flask, **1a** (0.2 mmol, 2.0 equiv), aniline (0.1 mmol, 1.0 equiv), **C1** (0.01 mmol, 0.1 equiv), $NaHCO_3$ (0.15 mmol, 1.5 equiv), and DCE (2.0 mL) were sequentially added. The reaction mixture was stirred at 0 °C for 30 min. Then formaldehyde **5c** (37% solution in H_2O, 0.1 mmol, 1.0 equiv) was added. The reaction mixture was stirred at 0 °C for 16 h, The reaction mixture was directly loaded onto a short *silica gel* column, followed by gradient elution with DCM/MeOH (200/1–30/1 ratio). Removing the solvent in *vacuo*, afforded products **3a** in 68% yield with 68% ee.

6. Determination of the absolute configurations

Absolute configurations of **3a**–**3u** are determined by *X*-ray structure analysis of the product **3j**

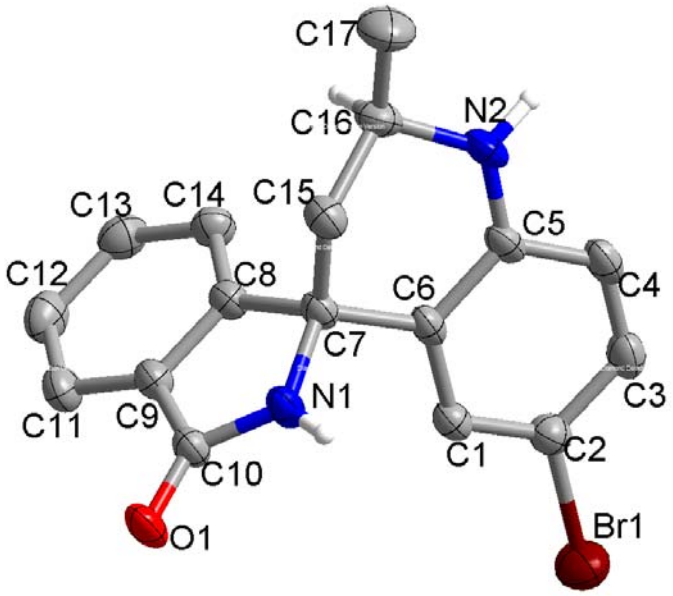


Fig. S7. Absolute configuration of **3j** (CCDC 1945582).

Displacement ellipsoids are drawn at the 30% probability level. (Solvent: ethyl acetate)

Table S3 Crystal data and structure refinement.

Identification code	201903ljt1
Empirical formula	$C_{17}H_{15}BrN_2O$
Formula weight	343.21
Temperature/K	293(2)
Crystal system	orthorhombic
Space group	$P2_12_12_1$
a/Å	9.51375(16)
b/Å	16.8250(3)
c/Å	22.3825(6)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	3582.73(13)
Z	4
ρ_{calc}g/cm^3	1.436
μ/mm^{-1}	3.232
F(000)	1584.0
Crystal size/mm^3	0.12 × 0.11 × 0.1

Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	6.572 to 134.136
Index ranges	$-11 \leq h \leq 7$, $-20 \leq k \leq 20$, $-26 \leq l \leq 26$
Reflections collected	30235
Independent reflections	6408 [R_{int} = 0.0470, R_{sigma} = 0.0304]
Data/restraints/parameters	6408/0/453
Goodness-of-fit on F^2	1.061
Final R indexes [I>=2σ (I)]	R_1 = 0.0450, wR_2 = 0.1195
Final R indexes [all data]	R_1 = 0.0505, wR_2 = 0.1262
Largest diff. peak/hole / e Å^{-3}	0.82/-0.34
Flack parameter	-0.035(9)

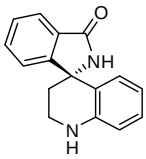
Experimental

The crystal was kept at 293(2) K during data collection. Using Olex2, the structure was solved with the ShelXS structure solution program using Direct Methods and refined with the ShelXL refinement package using Least Squares minimisation.

Crystal structure determination

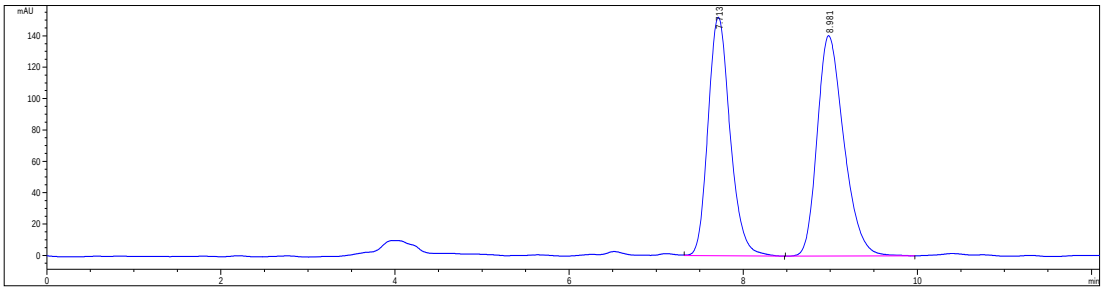
Crystal Data for $C_{17}H_{15}BrN_2O$ (*M* =343.21 g/mol): orthorhombic, space group $P2_12_12_1$ (no. 19), *a* = 9.51375(16) Å, *b* = 16.8250(3) Å, *c* = 22.3825(6) Å, *V* = 3582.73(13) Å^3, *Z* = 4, *T* = 293(2) K, μ(CuKα) = 3.232 mm^{-1}, *Dcalc* = 1.436 g/cm^3, 30235 reflections measured (6.572° ≤ 2Θ ≤ 134.136°), 6408 unique (R_{int} = 0.0470, R_{sigma} = 0.0304) which were used in all calculations. The final R_1 was 0.0450 (I > 2σ(I)) and wR_2 was 0.1262 (all data).

7. Characterization of adducts

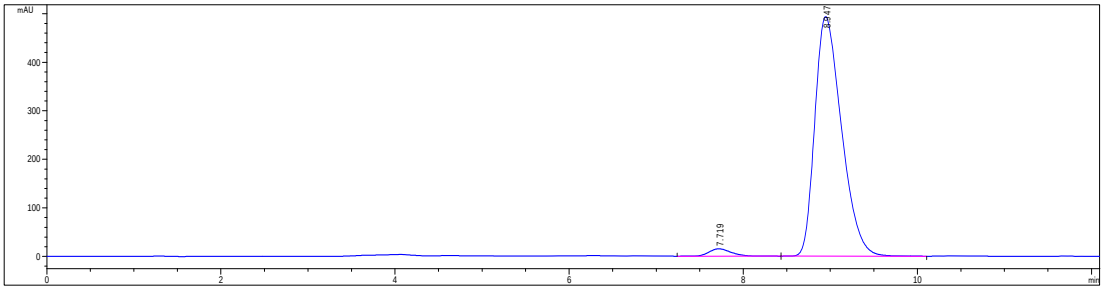


(*R*)-2',3'-Dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3a): white solid, Mp 79.7 − 78.5 °C; 20.0 mg (0.1 mmol), 80% yield; 95% ee; $[\alpha]_D^{22}$ +716.1 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.86 (d, *J* = 7.1 Hz, 1H), 7.61 – 7.39 (m, 2H), 7.27 (d, *J* = 7.5 Hz, 1H), 7.15 (s, 1H), 7.01 (t, *J* = 7.3 Hz, 1H), 6.65 – 6.36 (m, 3H), 3.63 – 3.51 (m, 1H), 3.50 – 3.34 (m, 1H), 2.39 – 2.22 (m, 1H), 2.15 – 1.94 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 152.7, 144.7, 132.4, 131.3, 129.1, 128.3, 128.0, 123.8, 122.8, 120.2, 117.7, 115.0, 60.8, 39.1, 35.6; HRMS (ESI) m/z 251.1176 ($M+H^+$), calc. for $C_{16}H_{15}N_2O$ 251.1179.

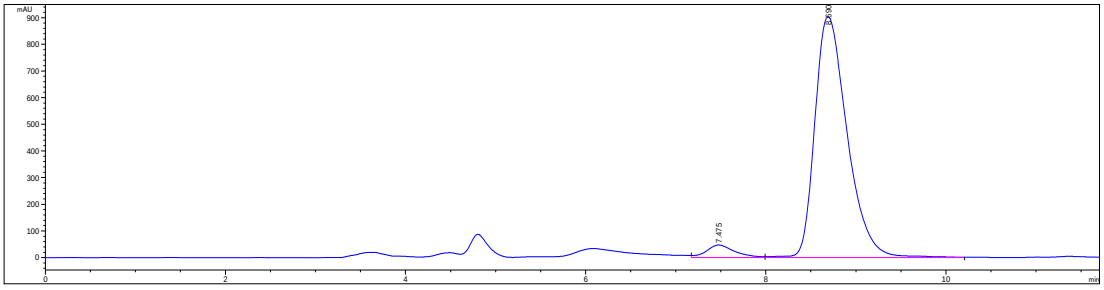
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 70/30; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 7.7 min (minor) and 8.9 min (major).



Entry	Retention Time	Area	Height	%Area
1	7.713	2674.1	152	49.899
2	8.981	2685	140.5	50.101

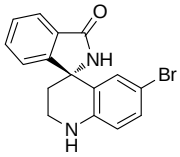


Entry	Retention Time	Area	Height	%Area
1	7.719	276.9	15.4	2.565
2	8.947	10519.2	493.7	97.435



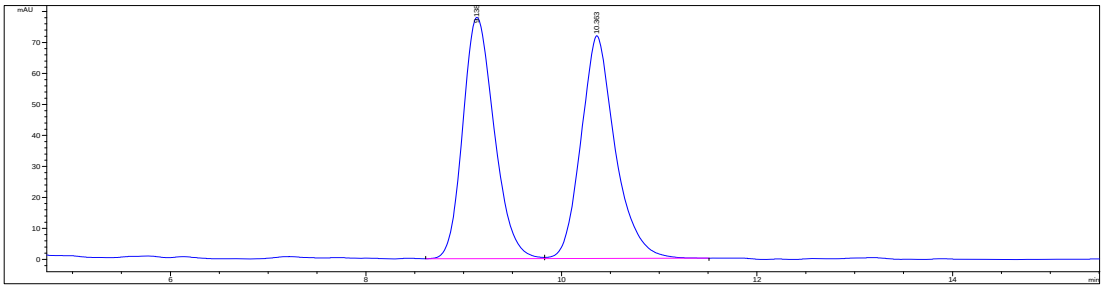
Entry	Retention Time	Area	Height	%Area
1	7.475	870.1	43.5	3.729
2	8.69	22460.5	904.5	96.271

HPLC spectra for compound **3a** (The synthesis of **3a** in a 1.0 mmol scale)

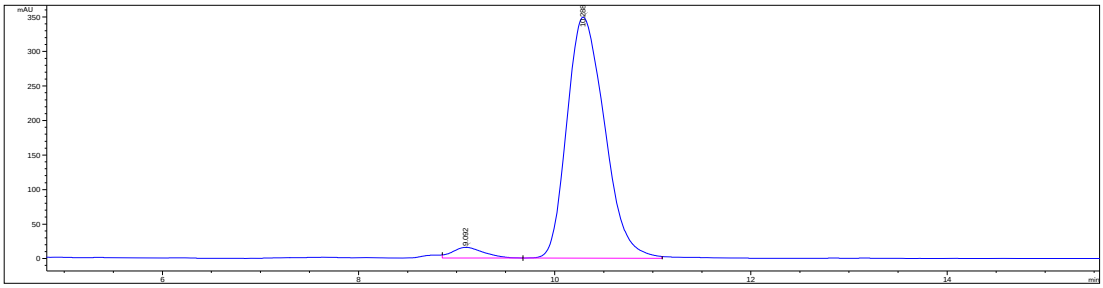


(*R*)-6'-Bromo-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3b): white solid, Mp 79.7 − 78.5 °C; 25.7 mg (0.1 mmol), 78% yield; 92% ee; $[\alpha]_D^{22}$ +716.1 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.86 (d, *J* = 7.0 Hz, 1H), 7.65 – 7.37 (m, 3H), 7.27 (d, *J* = 5.6 Hz, 1H), 7.05 (d, *J* = 7.7 Hz, 1H), 6.66 (s, 1H), 6.43 (d, *J* = 8.4 Hz, 1H), 3.76 – 3.31 (m, 2H), 2.38 – 2.21 (m, 1H), 2.15 – 1.94 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.6, 152.0, 143.8, 132.6, 131.9, 131.1, 130.2, 128.6, 123.9, 122.8, 122.0, 116.6, 108.9, 60.5, 38.9, 35.1; HRMS (ESI) m/z 329.0289 ($M+H^+$), calc. for $C_{16}H_{14}BrN_2O$ 329.0284.

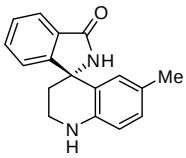
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 9.1 min (minor) and 10.3 min (major).



Entry	Retention Time	Area	Height	%Area
1	9.138	1740.1	77.9	49.953
2	10.363	1743.3	71.9	50.047

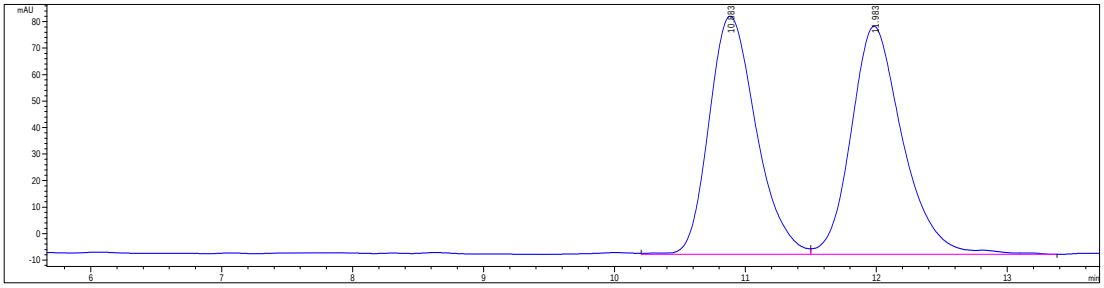


Entry	Retention Time	Area	Height	%Area
1	9.092	367.1	16	3.765
2	10.288	9381.8	349	96.235

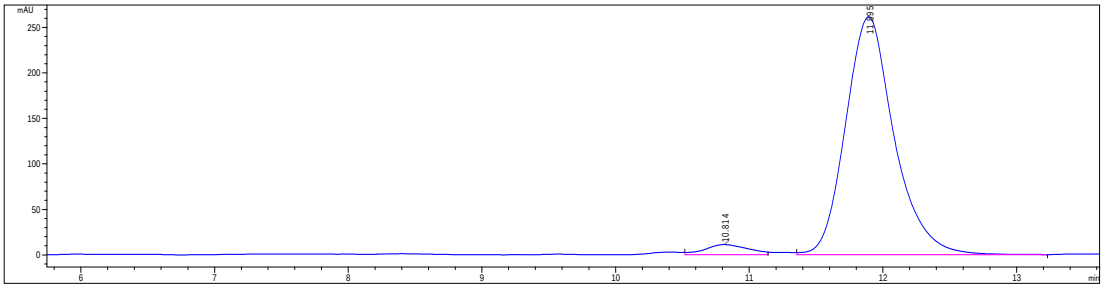


(*R*)-6'-Methyl-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3c): white solid, Mp 79.7 − 78.5 °C; 21.9 mg (0.1 mmol), 83% yield; 93% ee; $[\alpha]_D^{22}$ +716.1 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.1 Hz, 1H), 7.59 – 7.40 (m, 2H), 7.34 – 7.26 (m, 1H), 7.19 (s, 1H), 6.83 (d, *J* = 7.9 Hz, 1H), 6.50 (d, *J* = 8.2 Hz, 1H), 6.36 (s, 1H), 3.65 – 3.50 (m, 1H), 3.50 – 3.34 (m, 1H), 2.41 – 2.22 (m, 1H), 2.18 – 1.92 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.6, 152.9, 142.5, 132.4, 131.2, 129.9, 128.3, 128.1, 127.1, 123.7, 122.8, 120.2, 115.2, 60.8, 39.3, 35.9, 20.2; HRMS (ESI) m/z 265.1337 ($M+H^+$), calc. for $C_{17}H_{17}N_2O$ 265.1335.

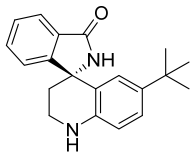
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 10.8 min (minor) and 11.9 min (major).



Entry	Retention Time	Area	Height	%Area
1	10.883	2248.4	89.9	49.333
2	11.983	2309.3	86.1	50.667

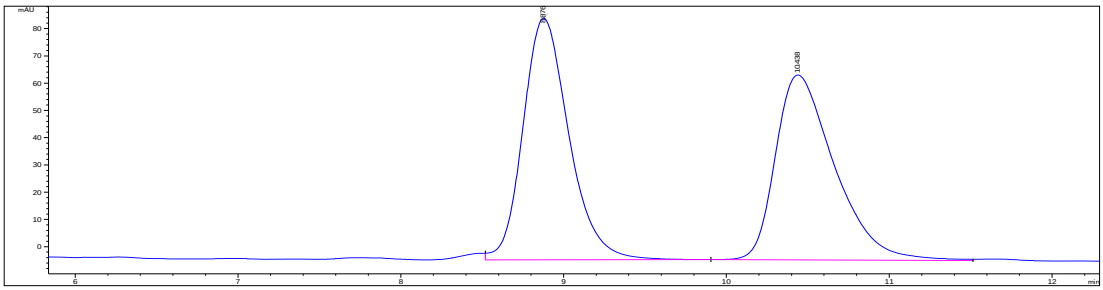


Entry	Retention Time	Area	Height	%Area
1	10.814	253.4	11.2	3.699
2	11.895	6597.6	261.5	96.301

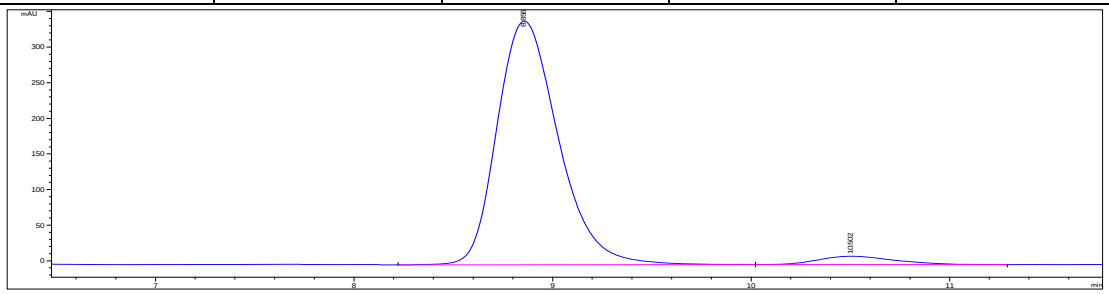


(*R*)-6'-(tert-Butyl)-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3d): white solid, Mp 204.4 − 205.6 °C; 20.0 mg (0.1 mmol), 69% yield; 92% ee; $[\alpha]_D^{22}$ −49.3 (*c* 1.0, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.1 Hz, 1H), 7.59 – 7.41 (m, 2H), 7.31 – 7.21 (m, 1H), 7.07 (d, *J* = 8.3 Hz, 1H), 6.97 (s, 1H), 6.60 – 6.42 (m, 2H), 3.61 – 3.47 (m, 1H), 3.39 (t, *J* = 9.9 Hz, 1H), 2.29 (t, *J* = 10.0 Hz, 1H), 2.12 – 1.95 (m, 1H), 1.05 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.6, 152.8, 142.3, 140.8, 132.3, 131.2, 128.3, 126.4, 124.3, 123.8, 122.8, 119.6, 114.8, 61.1, 39.2, 36.0, 33.8, 31.2; HRMS (ESI) m/z 307.1807 ($M+H^+$), calc. for $C_{20}H_{23}N_2O$ 307.1805.

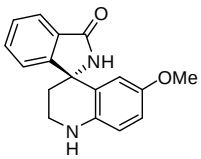
The ee was determined by HPLC analysis: CHIRALPAK INB (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 85/15; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 8.9 min (major) and 10.5 min (minor).



Entry	Retention Time	Area	Height	%Area
1	8.876	1737.3	88.6	50.447
2	10.438	1706.5	67.8	49.553



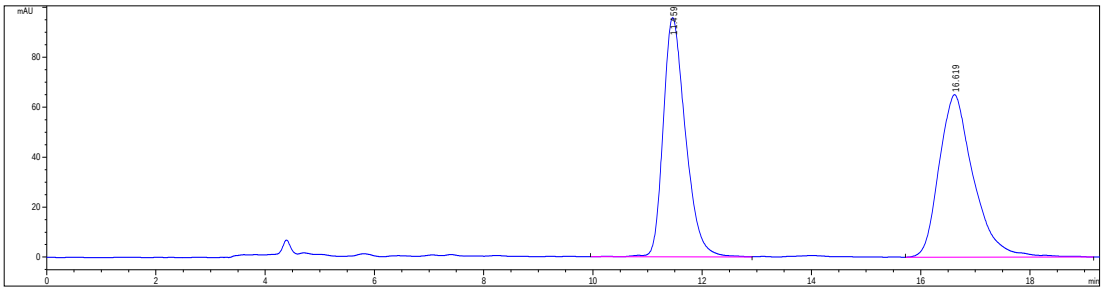
Entry	Retention Time	Area	Height	%Area
1	8.856	7335.3	342.2	95.802
2	10.502	321.5	11.9	4.198



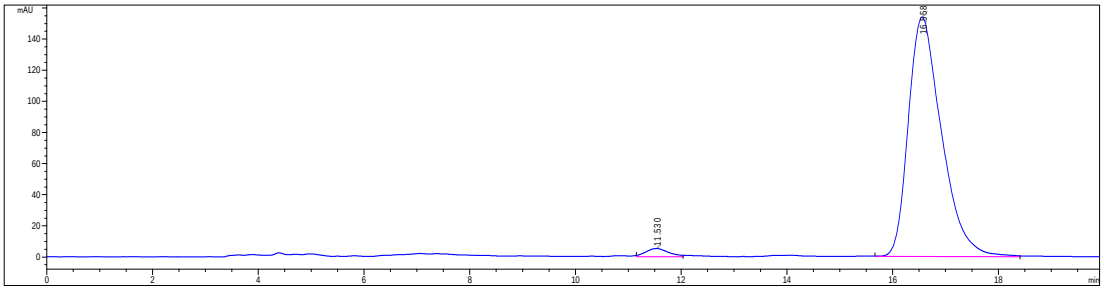
(*R*)-6'-Methoxy-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3e): white solid, Mp 79.7 − 78.5 °C; 21.0 mg (0.1 mmol), 75% yield; 96% ee; $[\alpha]_D^{22}$ +716.1 (*c* 1.0, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.85

(d, *J* = 7.1 Hz, 1H), 7.58 – 7.38 (m, 3H), 7.32 – 7.26 (m, 1H), 6.71 – 6.60 (m, 1H), 6.58 – 6.47 (m, 1H), 6.10 (d, *J* = 2.5 Hz, 1H), 3.62 – 3.31 (m, 5H), 2.39 – 2.22 (m, 1H), 2.15 – 1.99 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.6, 152.7, 152.1, 138.8, 132.4, 131.2, 128.4, 123.7, 122.8, 121.4, 116.5, 116.1, 112.5, 61.0, 55.6, 39.5, 35.9; HRMS (ESI) m/z 281.1275 ($M+H^+$), calc. for $C_{17}H_{17}N_2O_2$ 281.1285.

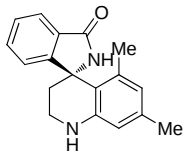
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 70/30; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 11.5 min (minor) and 16.6 min (major).



Entry	Retention Time	Area	Height	%Area
1	11.459	2704.9	95.7	48.877
2	16.619	2829.2	65	51.123

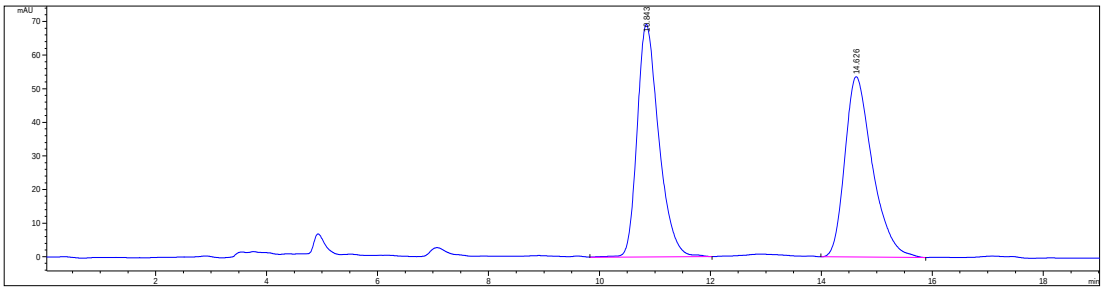


Entry	Retention Time	Area	Height	%Area
1	11.53	152	5.2	2.218
2	16.558	6700.4	153.9	97.782

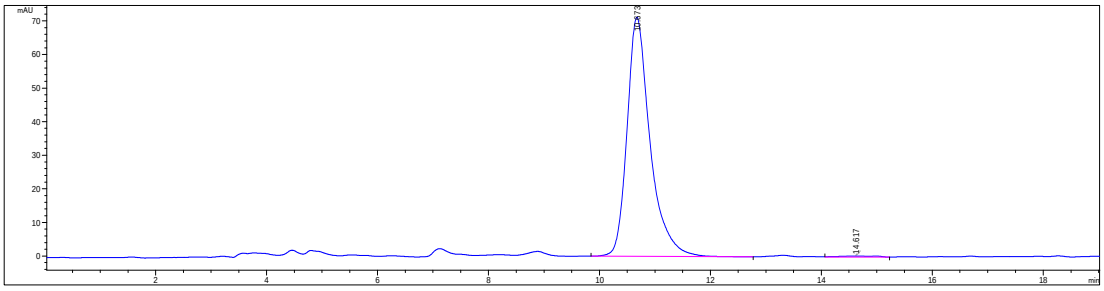


(*R*)-5',7'-Dimethyl-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3f): white solid, Mp 79.7 − 78.5 °C; 19.5 mg (0.1 mmol), 70% yield; 98% ee; $[\alpha]_D^{22}$ +716.1 (*c* 1.0, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.0 Hz, 1H), 7.59 – 7.40 (m, 2H), 7.27 (d, *J* = 7.5 Hz, 1H), 6.82 (s, 1H), 6.34 (s, 1H), 6.23 (s, 1H), 3.53 – 3.38 (m, 1H), 3.28 (t, *J* = 10.5 Hz, 1H), 2.37 – 2.10 (m, 4H), 2.03 – 1.87 (m, 1H), 1.45 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.5, 153.5, 146.4, 139.3, 138.8, 132.3, 131.5, 128.1, 124.1, 123.2, 122.2, 114.4, 114.0, 60.9, 40.71, 39.2, 20.8, 20.3; HRMS (ESI) m/z 279.1491 ($M+H^+$), calc. for $C_{18}H_{19}N_2O$ 279.1492.

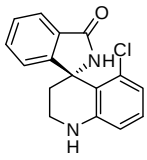
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 10.7 min (minor) and 14.6 min (major).



Entry	Retention Time	Area	Height	%Area
1	10.843	1874.9	69.2	50.255
2	14.626	1855.8	53.7	49.745

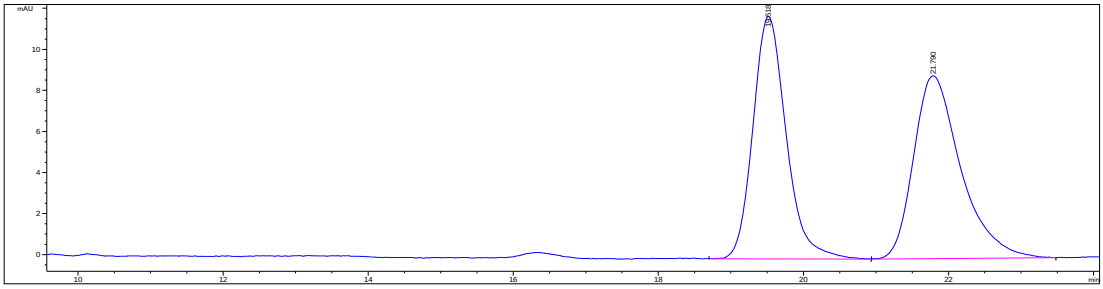


Entry	Retention Time	Area	Height	%Area
1	10.673	2060.9	71.1	99.192
2	14.617	16.8	3.6E-1	0.808

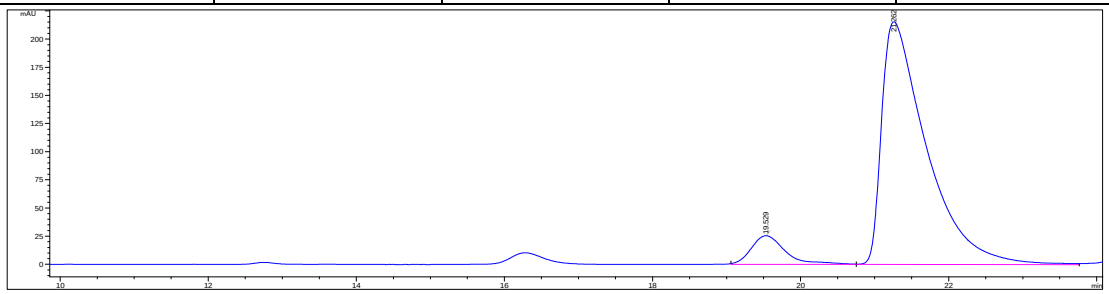


(*R*)-5'-Chloro-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3g): white solid, Mp 152.1 − 153.4 °C; 17.1 mg (0.1 mmol), 60% yield; 85% ee; $[\alpha]_D^{22}$ −118.46 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.83 (d, *J* = 7.2 Hz, 1H), 7.60 – 7.41 (m, 3H), 7.25 (d, *J* = 8.5 Hz, 1H), 6.55 (s, 1H), 6.49 – 6.36 (m, 2H), 3.66 – 3.36 (m, 2H), 2.38 – 2.14 (m, 1H), 2.12 – 1.89 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.7, 152.2, 145.7, 134.5, 132.5, 131.2, 129.2, 128.5, 123.9, 122.7, 118.6, 117.6, 114.2, 60.5, 39.0, 35.2; HRMS (ESI) m/z 285.0790 ($M+H^+$), calc. for $C_{16}H_{14}ClN_2O$ 285.0789.

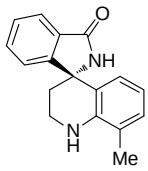
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 90/10; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 19.5 min (minor) and 21.3 min (major).



Entry	Retention Time	Area	Height	%Area
1	19.518	375.9	11.8	49.077
2	21.79	390	8.9	50.923

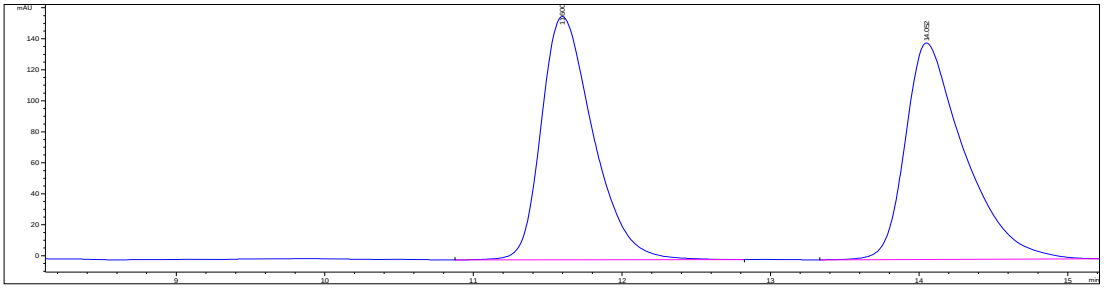


Entry	Retention Time	Area	Height	%Area
1	19.529	755.5	25.6	7.687
2	21.262	9072.4	215.3	92.313

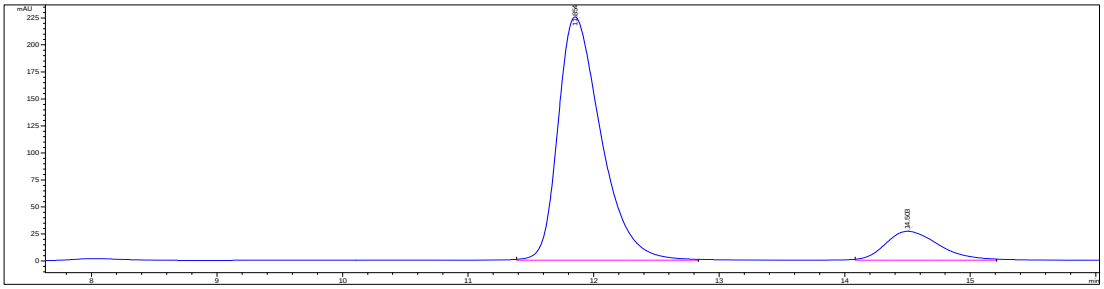


(*R*)-8'-Methyl-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3h): white solid, Mp 140.0 − 141.8 °C; 19.8 mg (0.1 mmol), 75% yield; 75% ee; $[\alpha]_D^{22}$ −41.3 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.86 (d, *J* = 6.9 Hz, 1H), 7.67 – 7.37 (m, 2H), 7.367.26 (m, 1H), 7.26 – 7.07 (m, 1H), 7.01 – 6.83 (m, 1H), 6.58 – 6.29 (m, 2H), 4.07 (s, 1H), 3.76 – 3.62 (m, 1H), 3.51 (t, *J* = 10.2 Hz, 1H), 2.43 – 2.26 (m, 1H), 2.21 – 1.97 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.6, 152.9, 142.9, 132.4, 131.3, 130.0, 128.3, 125.9, 123.7, 122.8, 121.9, 119.6, 117.0, 61.0, 39.3, 35.6, 17.3; HRMS (ESI) m/z265.1331 ($M+H^+$), calc. for$C_{17}H_{17}N_2O$ 265.1335.

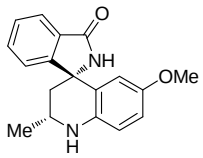
The ee was determined by HPLC analysis: CHIRALPAK INB (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 90/10; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 11.8 min (major) and 14.5 min (minor).



Entry	Retention Time	Area	Height	%Area
1	11.6	3797.3	157	49.651
2	14.052	3850.7	139.6	50.349

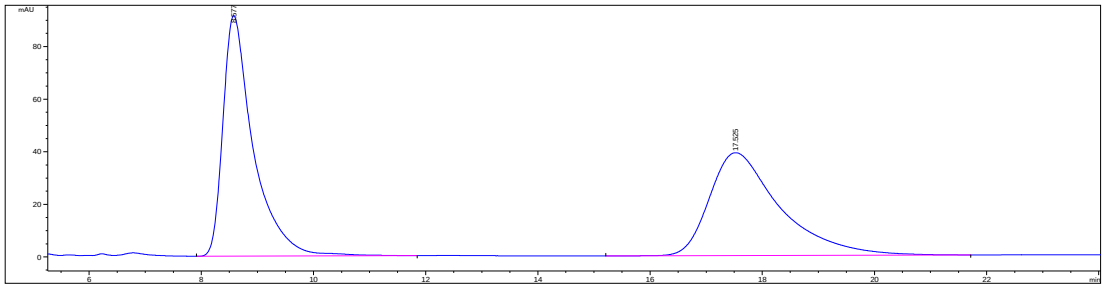


Entry	Retention Time	Area	Height	%Area
1	11.854	5345.1	225.2	87.462
2	14.503	766.2	26.7	12.538

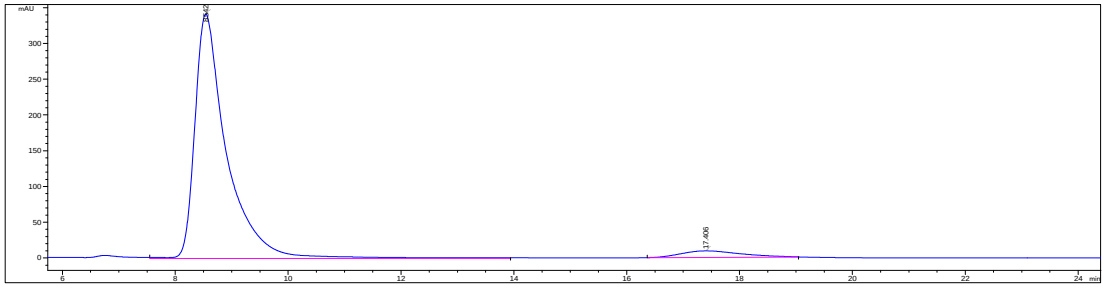


(1*R*,2′*R*)-6'-Methoxy-2'-methyl-2',3'-dihydro-1'H-spiro[isoindoline-1, 4'-quinolin]-3-one (3i): white solid, Mp 216.9 − 218.8 °C; 19.7 mg (0.1 mmol), 67% yield; 90% ee;>20:1 dr; $[\alpha]_D^{22}$ +51.4 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.86 (d, *J* = 6.9 Hz, 1H), 7.54 – 7.39 (m, 2H), 7.35 (d, *J* = 7.3 Hz, 1H), 6.67 (d, *J* = 6.5 Hz, 1H), 6.60 – 6.46 (m, 2H), 6.44 – 6.36 (m, 1H), 4.00 – 3.86 (m, 1H), 3.56 (s, 3H), 2.16 – 2.02 (m, 1H), 1.93 – 1.84 (m, 1H), 1.26 (d, *J* = 5.6 Hz, 4H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.1, 154.1, 152.3, 138.9, 132.2, 129.6, 128.2, 123.9, 123.4, 120.6, 116.2, 116.1, 111.2, 61.5, 55.7, 45.5, 42.8, 22.4; HRMS (ESI) m/z 295.1434 ($M+H^+$), calc. for $C_{18}H_{19}N_2O_2$ 295.1441.

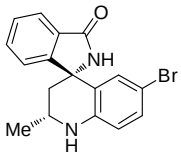
The ee was determined by HPLC analysis: CHIRALPAK INA (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 85/15; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 8.5 min (major) and 17.4 min (minor).



Entry	Retention Time	Area	Height	%Area
1	8.577	3448.6	91.5	50.331
2	17.525	3403.2	39.1	49.669

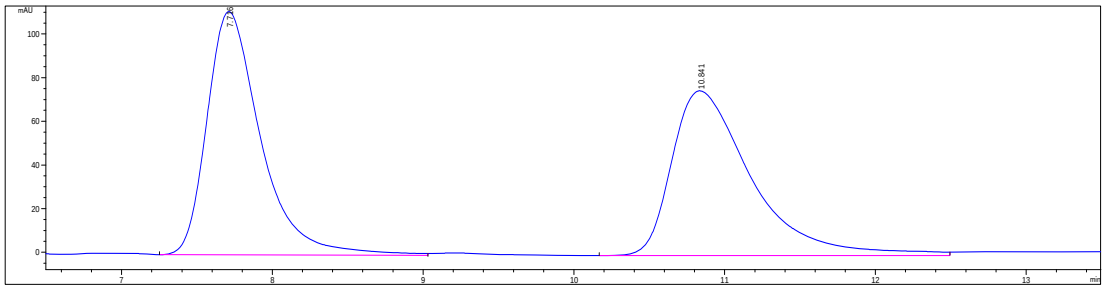


Entry	Retention Time	Area	Height	%Area
1	8.542	13410.4	341.8	95.234
2	17.406	671.2	9.1	4.766

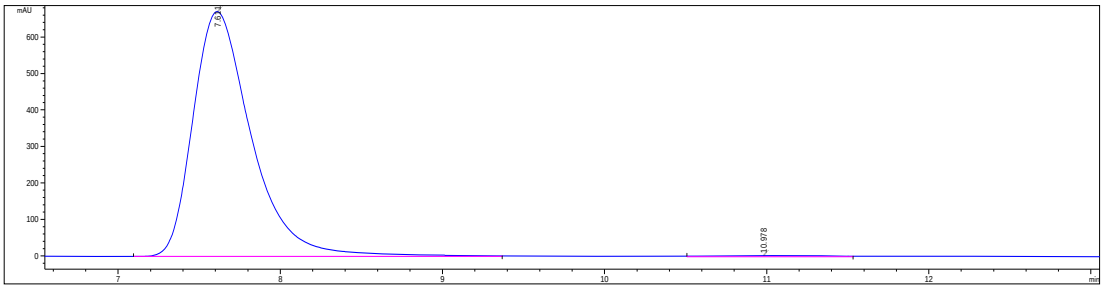


(1*R*,2'*R*)-6'-Bromo-2'-methyl-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3j): white solid, Mp 134.5 − 136.0 °C; 24.0 mg (0.1 mmol), 70% yield; 98% ee; $[\alpha]_D^{22}$ +36.8 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.87 (d, *J* = 6.1 Hz, 1H), 7.61 – 7.39 (m, 2H), 7.31 (d, *J* = 6.6 Hz, 1H), 7.08 (d, *J* = 7.8 Hz, 1H), 6.99 (s, 1H), 6.69 (s, 1H), 6.45 (d, *J* = 8.5 Hz, 1H), 4.39 – 3.72 (m, 2H), 2.11 (t, *J* = 12.3 Hz, 1H), 1.87 (d, *J* = 12.0 Hz, 1H), 1.29 (d, *J* = 5.4 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.1, 153.5, 143.4, 132.4, 131.8, 129.5, 129.2, 128.5, 124.0, 123.4, 121.5, 116.1, 109.1, 61.0, 45.0, 41.9, 22.3; HRMS (ESI) m/z 343.0426 ($M+H^+$), calc. for $C_{17}H_{16}BrN_2O$ 343.0441.

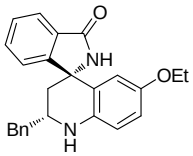
The ee was determined by HPLC analysis: CHIRALPAK INA (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 7.6 min (major) and 11.0 min (minor).



Entry	Retention Time	Area	Height	%Area
1	7.716	2755.8	111.2	49.859
2	10.841	2771.4	75.3	50.141

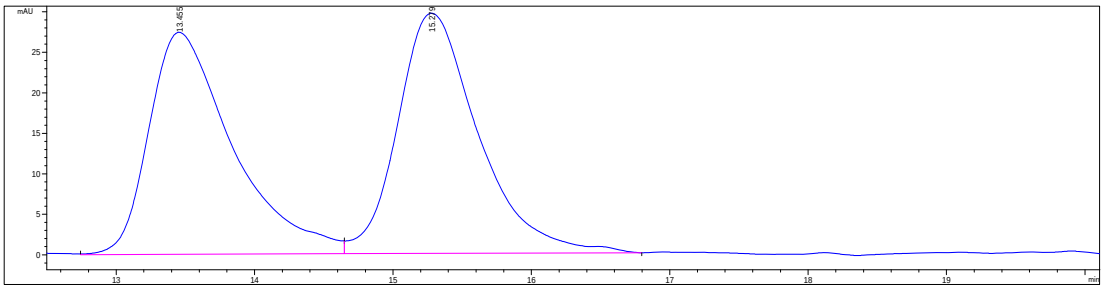


Entry	Retention Time	Area	Height	%Area
1	7.611	16872.2	673.2	99.193
2	10.978	137.2	3.1	0.807

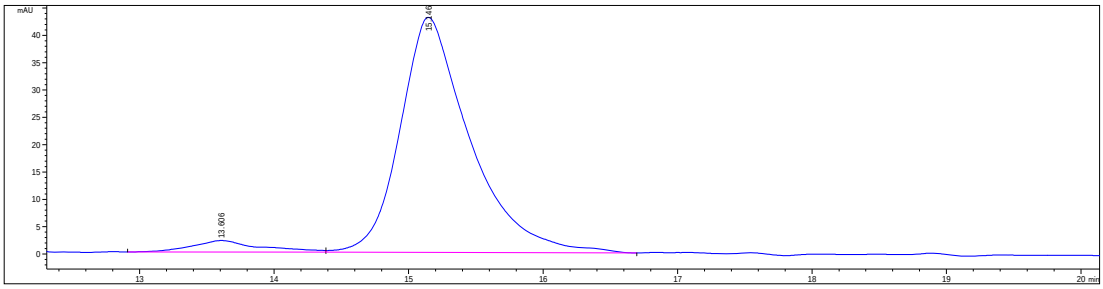


(1*R*,2'*R*)-2'-Benzyl-6'-ethoxy-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3k): white solid, Mp 168.2 − 169.0 °C; 24.2 mg (0.1 mmol), 63% yield; 91% ee; >20:1 dr; $[\alpha]_D^{22}$ +113.2 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.82 (d, *J* = 6.4 Hz, 2H), 7.53 – 7.28 (m, 6H), 7.26 – 7.17 (m, 2H), 6.77 (s, 1H), 6.60 (d, *J* = 7.1 Hz, 1H), 6.52 – 6.28 (m, 2H), 4.05 – 3.87 (m, 1H), 3.84 – 3.62 (m, 2H), 2.89 – 2.78 (m, 1H), 2.75 – 2.61 (m, 1H), 2.25 – 2.06 (m, 1H), 1.99 – 1.84 (m, 1H), 1.23 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.0, 154.0, 151.7, 138.2, 137.4, 132.3, 129.6, 129.2, 128.8, 128.2, 126.9, 123.8, 123.3, 121.0, 116.5, 116.2, 112.1, 63.9, 61.4, 51.0, 42.9, 41.1, 14.8; HRMS (ESI) m/z 385.1905 ($M+H^+$), calc. for $C_{25}H_{25}N_2O_2$ 385.1911.

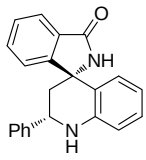
The ee was determined by HPLC analysis: CHIRALPAK INB (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 13.6 min (minor) and 15.1 min (major).



Entry	Retention Time	Area	Height	%Area
1	13.455	1151.5	27.4	49.246
2	15.279	1186.8	29.7	50.754

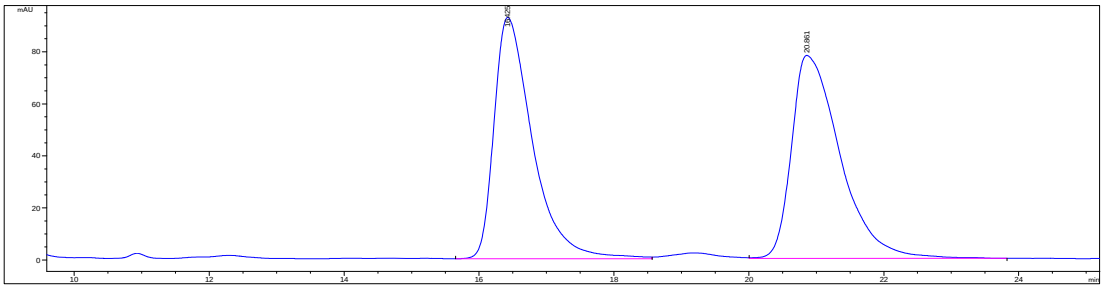


Entry	Retention Time	Area	Height	%Area
1	13.606	74.4	2.1	4.580
2	15.146	1551.1	43	95.420

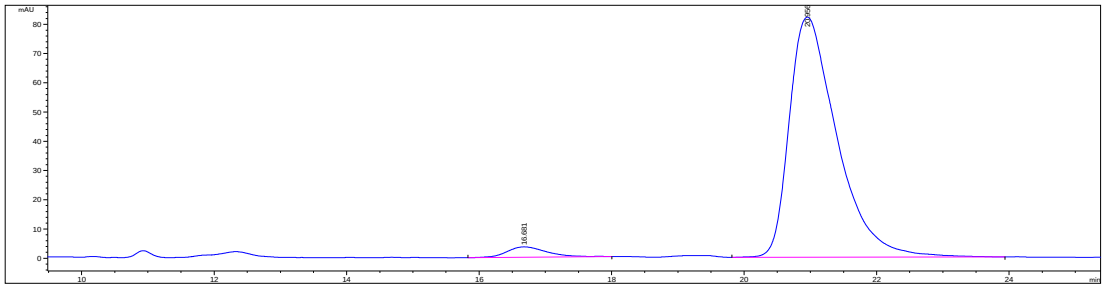


(1*R*,2′*S*)-2'-Phenyl-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3l): white solid, Mp 150.7 − 151.9 °C; 23.2 mg (0.1 mmol),71% yield; 93% ee; >20:1 dr; $[\alpha]_D^{22}$ −57.9 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.88 (m, 1H), 7.59 – 7.40 (m, 8H), 7.09 (t, *J* = 7.4 Hz, 1H), 6.87 (d, *J* = 7.8 Hz, 1H), 6.68 (d, *J* = 7.9 Hz, 1H), 6.60 (t, *J* = 7.5 Hz, 1H), 6.29 (s, 1H), 4.97 (dd, *J* = 10.9, 2.9 Hz, 1H), 2.57 – 2.41 (m, 1H), 2.20 (dd, *J* = 13.0, 3.0 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.9, 153.7, 144.5, 142.5, 132.4, 129.9, 129.2, 129.0, 128.4, 128.2, 126.9, 126.5, 123.9, 123.3, 119.7, 118.1, 114.7, 61.3, 54.5, 43.2; HRMS (ESI) m/z 327.1477 ($M+H^+$), calc. for $C_{22}H_{19}N_2O$ 327.1492.

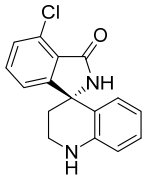
The ee was determined by HPLC analysis: CHIRALPAK INB (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 16.7 min (minor) and 21.0 min (major).



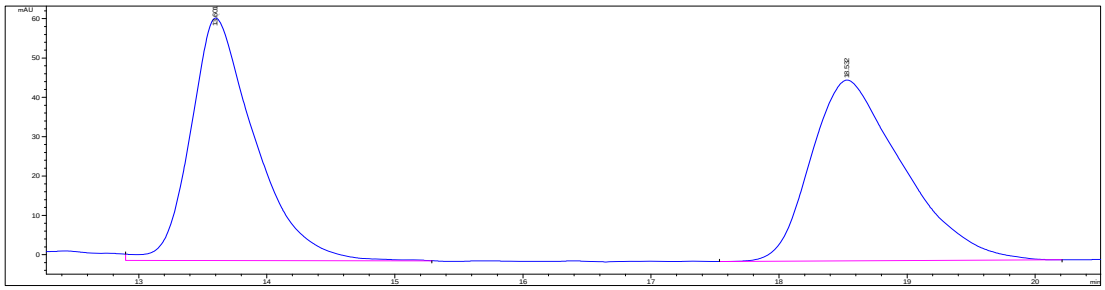
Entry	Retention Time	Area	Height	%Area
1	16.425	3665.1	92.7	49.379
2	20.851	3757.3	78	50.621



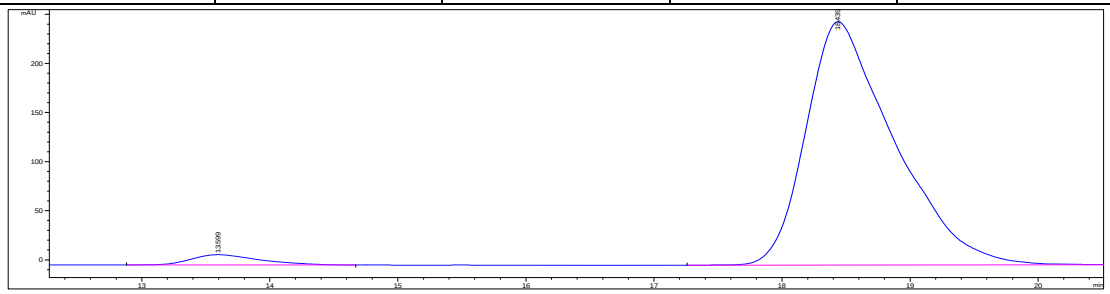
Entry	Retention Time	Area	Height	%Area
1	16.681	146.9	3.5	3.454
2	20.956	4107.9	82.1	96.546



(*R*)-4-Chloro-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3m): white solid, Mp 205.2 − 206.9 °C; 21.4 mg (0.1 mmol), 75% yield; 94% ee; $[\alpha]_D^{22}$ +32.9 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.54 – 7.36 (m, 2H), 7.24 – 7.08 (m, 2H), 7.02 (t, *J* = 7.5 Hz, 1H), 6.68 – 6.44 (m, 3H), 4.21 (s, 1H), 3.69 – 3.54 (m, 1H), 3.52 – 3.38 (m, 1H), 2.40 – 2.24 (m, 1H), 2.19 – 2.02 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 167.1, 155.2, 144.7, 133.2, 131.5, 129.9, 129.3, 128.0, 127.2, 121.5, 119.7, 117.8, 115.1, 59.6, 39.0, 35.8; HRMS (ESI) m/z 285.0792 ($M+H^+$), calc. for $C_{16}H_{14}ClN_2O$ 285.0789. The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 13.6 min (minor) and 18.4 min (major).

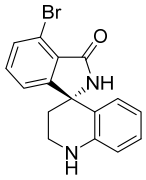


Entry	Retention Time	Area	Height	%Area
1	13.601	2161.1	61.7	49.285
2	18.532	2223.8	46	50.715



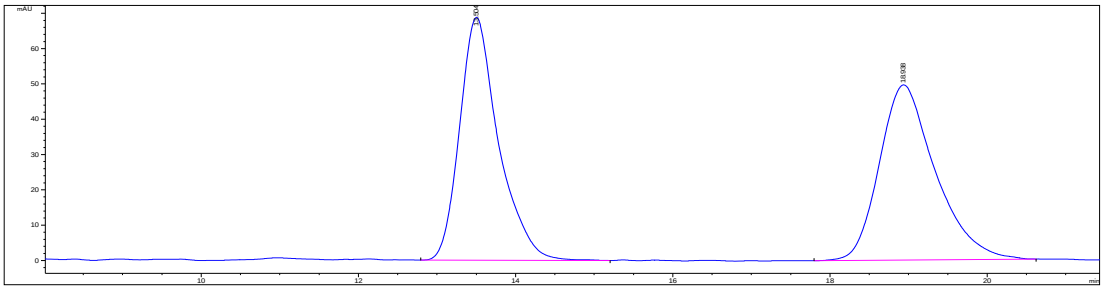
Entry	Retention Time	Area	Height	%Area
1	13.599	388.5	10.5	3.182

2	18.439	11821.6	247.8	96.818

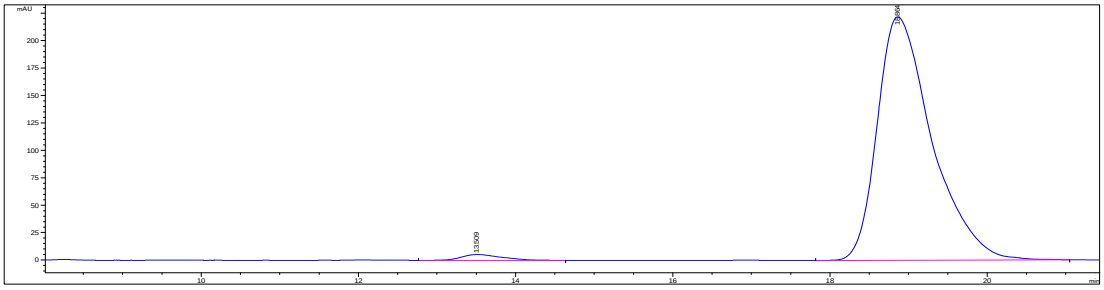


(*R*)-4-Bromo-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3n): white solid, Mp 172.6 − 173.0 °C; 23.7 mg (0.1 mmol), 72% yield; 96% ee; $[\alpha]_D^{22}$ −10.8 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.60 (d, *J* = 7.8 Hz, 1H), 7.35 (t, *J* = 7.7 Hz, 1H), 7.21 (d, *J* = 7.6 Hz, 1H), 7.13 – 6.91 (m, 2H), 6.66 – 6.41 (m, 3H), 3.60 – 3.48 (m, 1H), 3.46 – 3.33 (m, 1H), 2.34 – 2.18 (m, 1H), 2.10 – 1.96 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 167.3, 155.3, 144.7, 133.3, 133.2, 129.3, 128.7, 128.0, 122.1, 119.7, 118.9, 117.8, 115.1, 59.3, 39.0, 35.8; HRMS (ESI) m/z 329.0287 ($M+H^+$), calc. for $C_{16}H_{14}BrN_2O$ 329.0284.

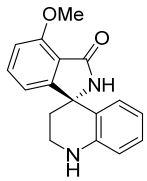
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 13.5 min (minor) and 18.9 min (major).



Entry	Retention Time	Area	Height	%Area
1	13.504	2365.6	68.7	49.078
2	18.938	2454.4	49.6	50.922



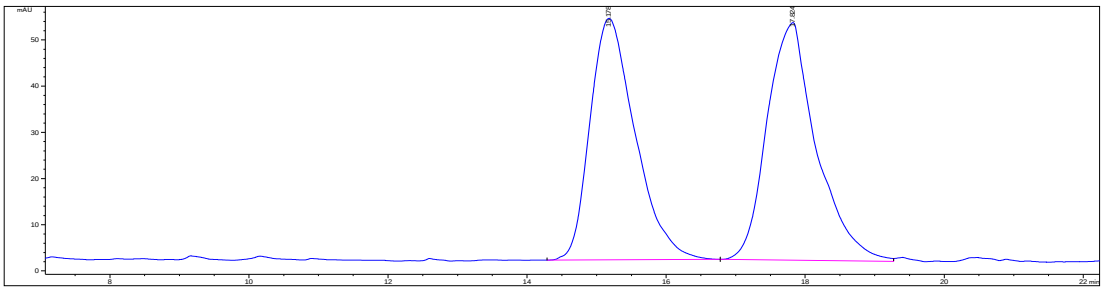
Entry	Retention Time	Area	Height	%Area
1	13.509	194.7	5.3	1.787
2	18.864	10699.9	221.9	98.213



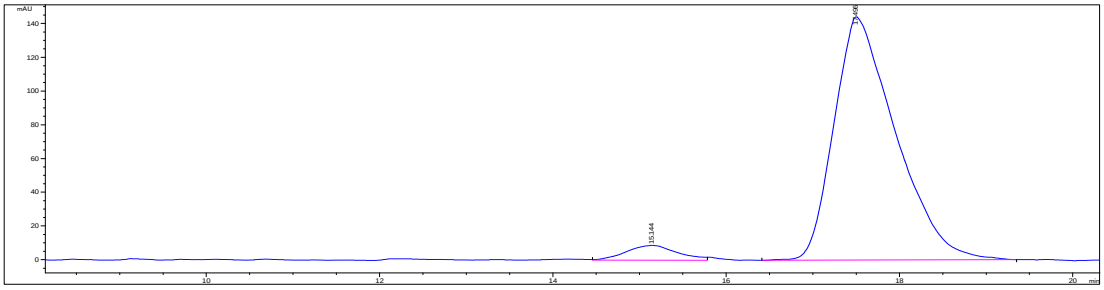
(*R*)-4-Methoxy-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3o): white solid, Mp 242.4 − 243.0 °C; 19.6 mg (0.1 mmol), 70% yield; 90% ee; $[\alpha]_D^{22}$ +25.7 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, CD_2Cl_2) δ 7.48 (t, J = 7.6 Hz, 1H), 7.00 (t, J = 7.5 Hz, 1H), 6.93 (d, J = 8.3 Hz, 1H), 6.82 (d, J = 7.6 Hz, 1H), 6.73 (s,

1H), 6.58 (t, J = 6.5 Hz, 2H), 6.48 (t, J = 7.2 Hz, 1H), 3.97 (s, 3H), 3.64 – 3.51 (m, 1H), 3.47 – 3.31 (m, 1H), 2.35 – 2.20 (m, 1H), 2.14 – 1.98 (m, 1H); ^{13}C NMR (75 MHz, CD_2Cl_2) δ 168.6, 158.0, 156.4, 145.6, 134.6, 129.5, 128.5, 121.2, 119.0, 117.9, 115.4, 115.4, 110.9, 60.2, 56.4, 39.5, 36.4; HRMS (ESI) m/z 281.1285 ($M+H^+$), calc. for $C_{17}H_{17}N_2O_2$ 281.1285.

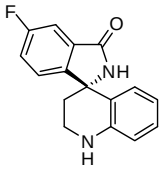
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 60/40; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 15.1 min (minor) and 17.5 min (major).



Entry	Retention Time	Area	Height	%Area
1	15.178	2358.2	52.2	49.132
2	17.824	2441.5	51.4	50.868



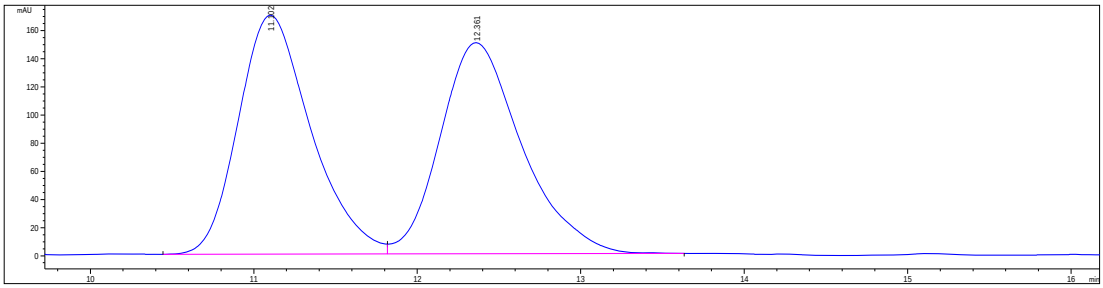
Entry	Retention Time	Area	Height	%Area
1	15.144	355.4	8.7	4.752
2	17.496	7124.9	144.2	95.248



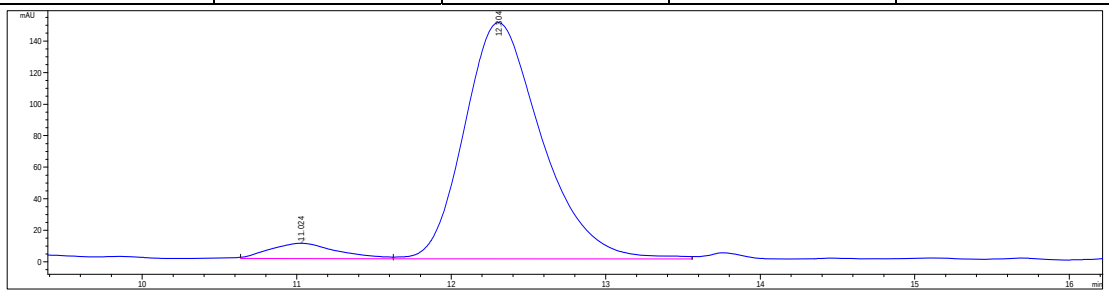
(*R*)-5-Fluoro-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3p): white solid, Mp 163.6 − 164.8 °C; 19.3 mg (0.1 mmol), 72% yield; 90% ee; $[\alpha]_D^{22}$ −85.175 (*c* 1.0, $CHCl_3$); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.62 (s, 1H), 7.47 (d, *J* = 7.4 Hz, 1H), 7.21 (d, *J* = 6.6 Hz, 2H), 7.05 – 6.19 (m, 1H), 6.62 – 6.42 (m, 3H), 4.05 (s, 1H), 3.60 – 3.29 (m, 2H), 2.24 (t, *J* = 9.8 Hz, 1H), 2.10 – 1.89 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 168.3, 164.4, 161.1, 148.1, 148.0, 144.6, 133.5, 133.4, 129.2, 127.8, 124.4, 124.3, 112.0, 119.7, 119.6, 117.8, 115.1, 110.5, 110.2, 60.7, 39.0, 35.5; HRMS (ESI) m/z 269.1076 ($M+H^+$), calc. for $C_{16}H_{14}FN_2O$ 269.1085.

The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm);

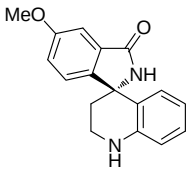
Hexane/2-propanol = 85/15; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 11.0 min (minor) and 12.3 min (major).



Entry	Retention Time	Area	Height	%Area
1	11.102	5246.4	169.3	50.159
2	12.361	5213.2	149.8	49.841

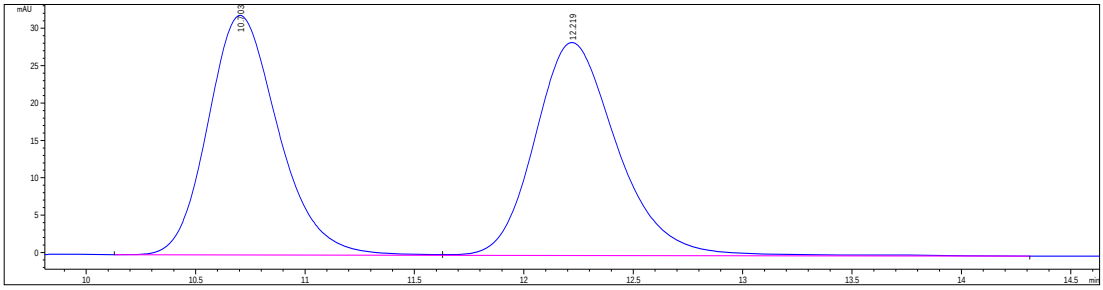


Entry	Retention Time	Area	Height	%Area
1	11.024	286.2	9.7	5.223
2	12.304	5193.2	149.7	94.777

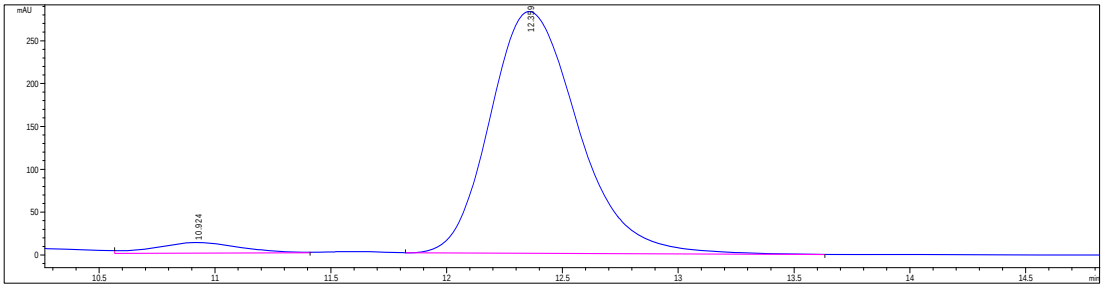


(*R*)-5-Methoxy-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3q): white solid, Mp 207.4 − 208.0 °C; 19.1 mg (0.1 mmol), 68% yield; 92% ee; $[\alpha]_D^{22}$ −27.323 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.39 – 7.29 (m, 1H), 7.19 – 6.87 (m, 4H), 6.63 – 6.47 (m, 2H), 3.87 (s, 3H), 3.60 – 3.46 (m, 1H), 3.39 (t, J = 10.3 Hz, 1H), 2.28 (t, J = 10.1 Hz, 1H), 2.04 (d, J = 12.4 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.5, 160.1, 144.9, 132.59, 129.1, 127.9, 123.7, 120.8, 118.2, 115.3, 106.3, 60.3, 55.1, 39.2, 35.5; HRMS (ESI) m/z 281.1285 ($M+H^+$), calc. for $C_{17}H_{17}N_2O_2$ 281.1285.

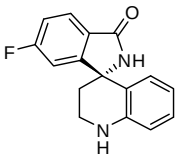
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 10.9 min (minor) and 12.4 min (major).



Entry	Retention Time	Area	Height	%Area
1	10.703	715.4	32	49.680
2	12.219	724.6	28.6	50.320

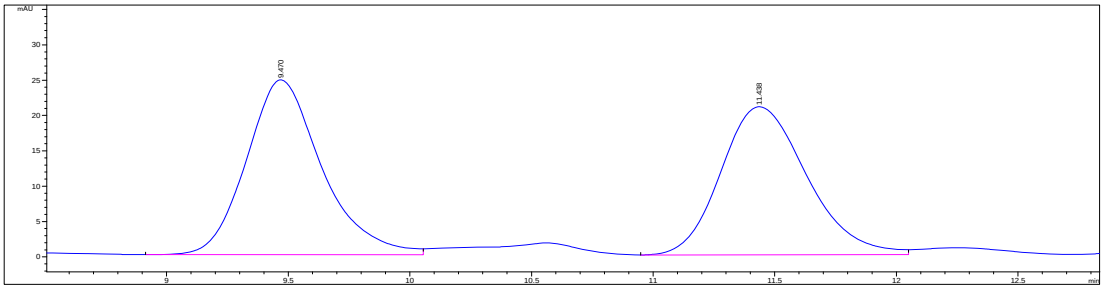


Entry	Retention Time	Area	Height	%Area
1	10.924	315	12.4	4.058
2	12.359	7445.9	281.2	95.942

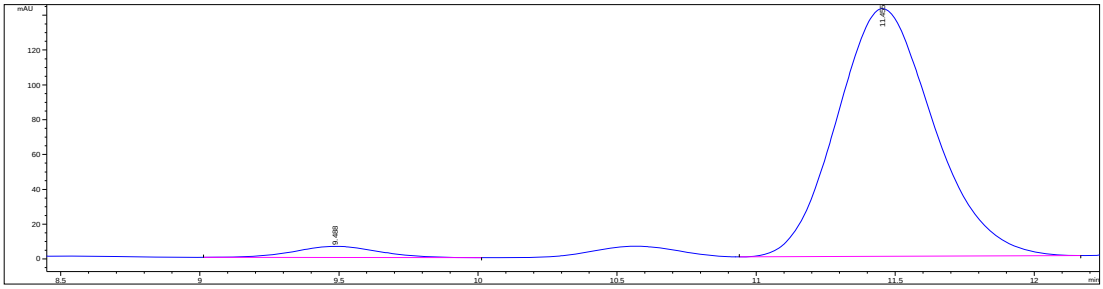


(*R*)-6-Fluoro-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3r): white solid, Mp 127.3 − 128.8 °C; 17.2 mg (0.1 mmol), 64% yield; 93% ee; $[\alpha]_D^{22}$ +126.6 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.89 – 7.70 (m, 1H), 7.15 (t, *J* = 8.2 Hz, 1H), 7.03 (t, *J* = 7.0 Hz, 1H), 6.98 – 6.80 (m, 2H), 6.68 – 6.36 (m, 3H), 3.61 – 3.32 (m, 2H), 2.34 – 2.16 (m, 1H), 2.11 – 1.95 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.7, 157.1, 154.0, 152.2, 141.1, 132.6, 131.2, 128.6, 123.9, 122.8, 121.4, 121.3, 116.6, 116.3, 116.2, 116.1, 114.0, 113.7, 60.7, 39.3, 35.4; HRMS (ESI) m/z 269.1076 ($M+H^+$), calc. for $C_{16}H_{14}FN_2O$ 269.1085.

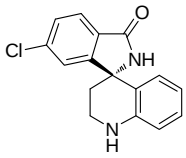
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 9.4 min (minor) and 11.5 min (major).



Entry	Retention Time	Area	Height	%Area
1	9.47	534.5	24.7	50.893
2	11.438	515.7	20.9	49.107

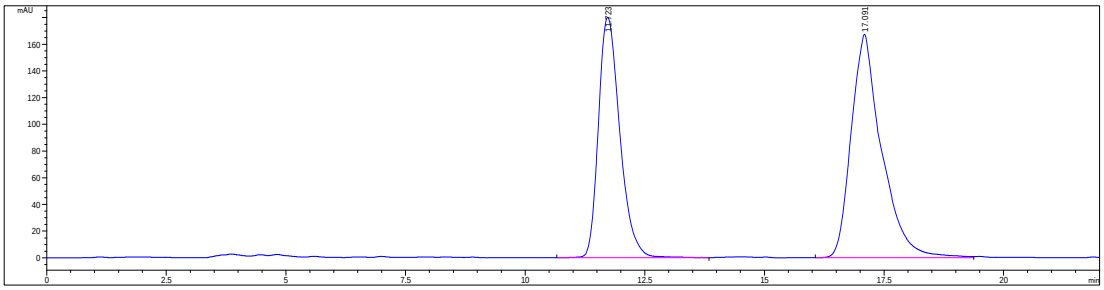


Entry	Retention Time	Area	Height	%Area
1	9.488	132.5	6.4	3.719
2	11.455	3430.9	142.2	96.281

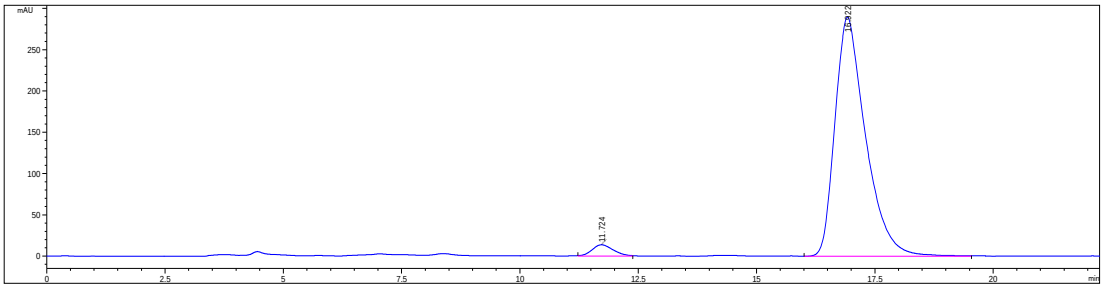


(*R*)-6-Chloro-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3s): white solid, Mp 150.3 − 152.1 °C; 18.5 mg (0.1 mmol), 65% yield; 93% ee; $[\alpha]_D^{22}$ −50.1 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.68 (d, J = 8.1 Hz, 1H), 7.36 (d, J = 7.4 Hz, 1H), 7.08 (s, 1H), 6.96 (t, J = 6.9 Hz, 1H), 6.61 – 6.33 (m, 3H), 3.55 – 3.42 (m, 1H), 3.35 (t, J = 9.5 Hz, 1H), 2.19 (t, J = 9.6 Hz, 1H), 2.00 (d, J = 12.0 Hz, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 154.3, 144.7, 138.7, 129.4, 129.0, 127.9, 125.1, 123.3, 119.4, 117.9, 115.1, 60.6, 39.0, 35.5; HRMS (ESI) m/z 285.0790 ($M+H^+$), calc. for $C_{16}H_{14}ClN_2O$ 285.0789.

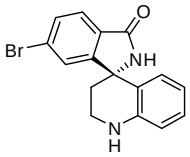
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 80/20; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 11.7 min (minor) and 16.9 min (major).



Entry	Retention Time	Area	Height	%Area
1	11.723	5592.5	179.8	49.370
2	17.091	5735.3	167.2	50.630

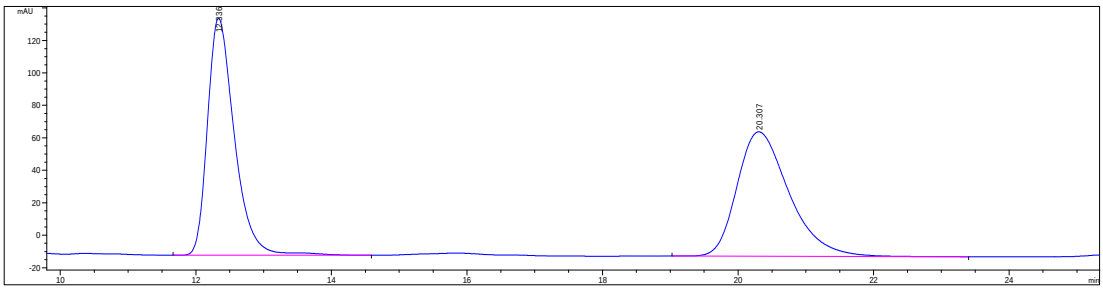


Entry	Retention Time	Area	Height	%Area
1	11.724	428.6	13.7	3.186
2	16.922	13022.5	289.7	96.814

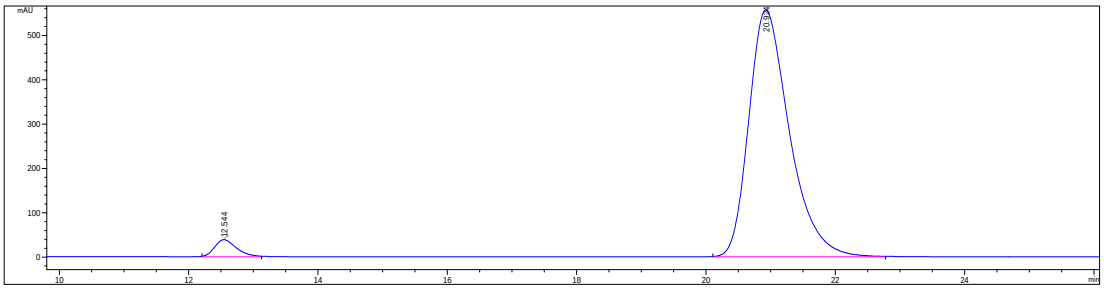


(*R*)-6-Bromo-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3t): white solid, Mp 165.7 − 166.9 °C; 21.7 mg (0.1 mmol), 66% yield; 94% ee; $[\alpha]_D^{22}$ −48.9 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.69 (d, *J* = 7.9 Hz, 1H), 7.60 (d, *J* = 7.9 Hz, 1H), 7.41 (s, 1H), 7.13 – 6.96 (m, 1H), 6.87 (s, 1H), 6.68 – 6.43 (m, 3H), 3.56 – 3.43 (m, 1H), 3.42 – 3.25 (m, 1H), 2.27 – 2.11 (m, 1H), 2.08 – 1.88 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.7, 152.0, 143.3, 132.7, 131.1, 129.2, 128.7, 127.4, 123.9, 122.8, 122.1, 121.6, 116.3, 60.6, 39.0, 35.2; HRMS (ESI) m/z 329.0294 ($M+H^+$), calc. for $C_{16}H_{14}BrN_2O$ 329.0284.

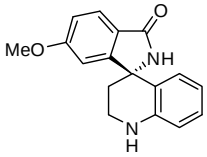
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 85/15; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 12.5 min (minor) and 20.9 min (major).



Entry	Retention Time	Area	Height	%Area
1	12.336	4042.3	146	49.753
2	20.307	4082.5	76.6	50.247

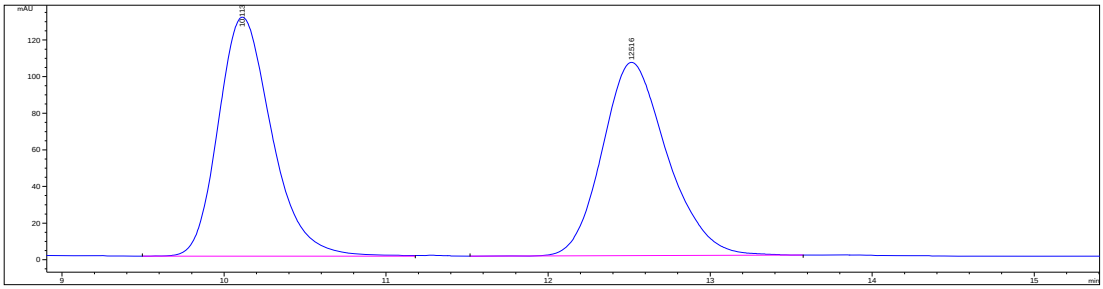


Entry	Retention Time	Area	Height	%Area
1	12.544	912	38.5	3.614
2	20.924	24320.4	557.3	96.386

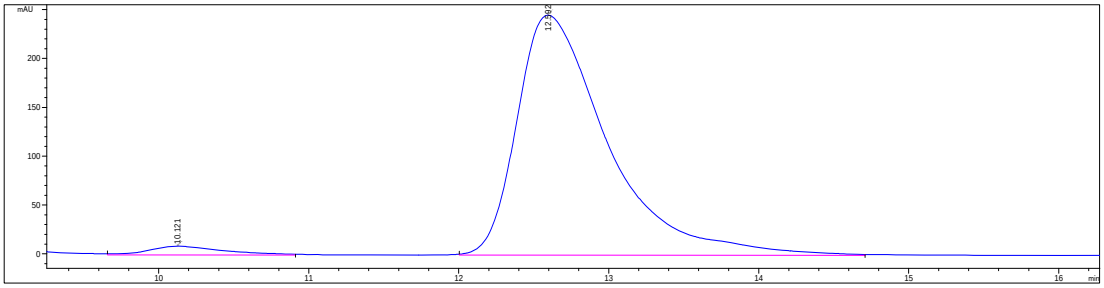


(*R*)-6-Methoxy-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (3u): white solid, Mp 139.4 − 140.1 °C;18.8 mg (0.1 mmol), 67% yield; 94% ee; $[\alpha]_D^{22}$ −90.4 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 7.76 (d, *J* = 8.4 Hz, 1H), 7.09 – 6.93 (m, 2H), 6.85 (s, 1H), 6.72 (s, 1H), 6.63 – 6.42 (m, 3H), 3.80 (s, 3H), 3.62 – 3.49 (m, 1H), 3.41 (t, *J* = 10.3 Hz, 1H), 2.37 – 2.22 (m, 1H), 2.09 – 1.94 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.4, 163.4, 155.0, 144.7, 129.1, 128.2, 125.2, 123.9, 120.4, 117.9, 115.1, 115.0, 107.4, 60.4, 55.7, 39.1, 35.8; HRMS (ESI) m/z 281.1285 ($M+H^+$), calc. for $C_{17}H_{17}N_2O_2$ 281.1285.

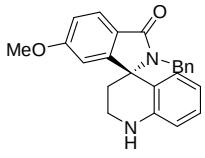
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 70/30; flow rate 1.0 mL/min; 25 °C; 254 nm; retention time: 10.1 min (minor) and 12.6 min (major).



Entry	Retention Time	Area	Height	%Area
1	10.113	2992.2	130.4	50.454
2	12.516	2938.4	105.5	49.546



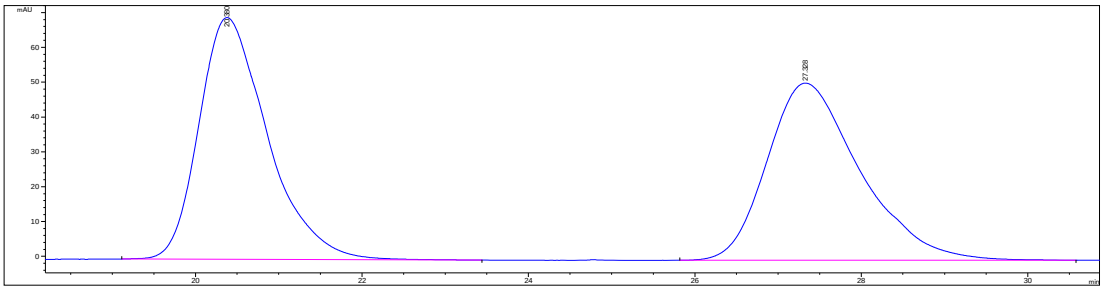
Entry	Retention Time	Area	Height	%Area
11	10.121	316.4	8.8	2.961
2	12.593	10369.3	245.8	97.039



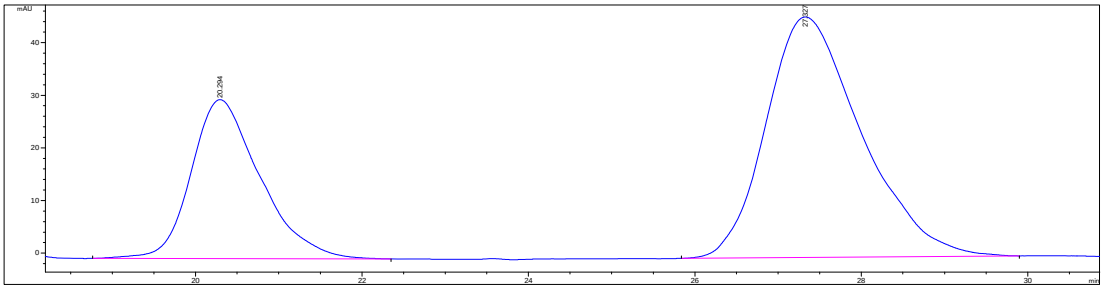
(*R*)-2-benzyl-6-methoxy-2',3'-dihydro-1'H-spiro[isoindoline-1,4'-quinolin]-3-one (7): white solid, Mp 142.1 – 143.6 °C; 19.6 mg (0.1 mmol), 53% yield; 35% ee; $[\alpha]_D^{22}$ +38.2 (*c* 1.0, $CHCl_3$); ^1H NMR (300 MHz,

$CDCl_3$) δ 7.97 (d, *J* = 8.4 Hz, 1H), 7.43 – 7.25 (m, 5H), 7.20 – 6.99 (m, 2H), 6.89 (d, *J* = 1.8 Hz, 1H), 6.75 (d, *J* = 8.1 Hz, 1H), 6.67 – 6.53 (m, 2H), 5.21 (d, *J* = 16.2 Hz, 1H), 4.07 (d, *J* = 16.2 Hz, 1H), 3.88 (s, 3H), 3.73 – 3.54 (m, 1H), 3.42 – 2.62 (m, 1H), 2.40 – 2.21 (m, 1H), 2.07 – 1.85 (m, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.0, 163.1, 155.2, 145.4, 138.7, 128.9, 128.3, 127.4, 127.3, 126.8, 125.0, 122.7, 118.6, 118.2, 115.4, 114.1, 108.4, 65.3, 55.6, 44.0, 38.8, 33.2.

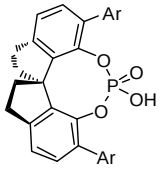
The ee was determined by HPLC analysis: CHIRALPAK IC (4.6 mm i.d. x 250 mm); Hexane/2-propanol = 70/30; flow rate 1.0 mL/min; 25 ^{o}C; 254 nm; retention time: 20.3 min (minor) and 27.3 min (major).



Entry	Retention Time	Area	Height	%Area
1	20.38	3970.7	69.4	50.184
2	27.328	3941.6	50.9	49.816

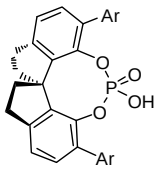


Entry	Retention Time	Area	Height	%Area
1	20.294	1739.1	30.2	32.417
2	27.327	3625.7	45.7	67.583



^{1}H NMR (600 MHz, CDCl3) δ 8.29 – 7.67 (m, 15H), 7.65 – 7.27 (m, 5H), 3.46 – 3.19 (m, 2H), 3.13 – 2.94 (m, 2H), 2.85 – 2.37 (m, 4H).

C1: Ar = 4-pyrenyl

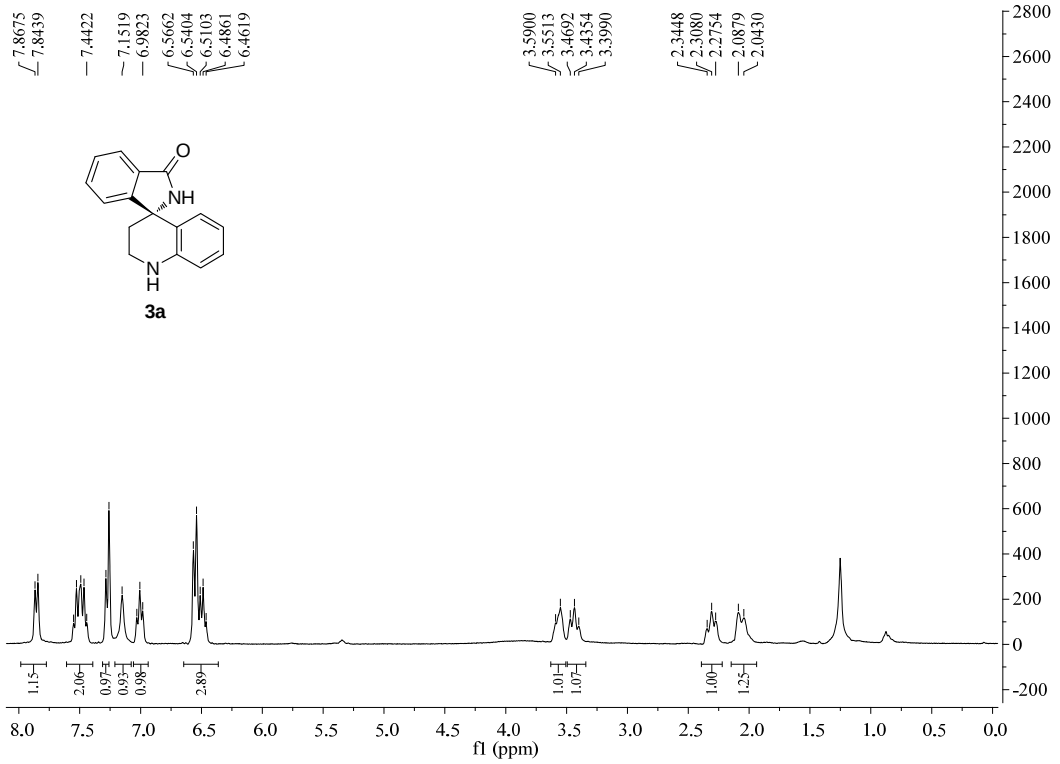


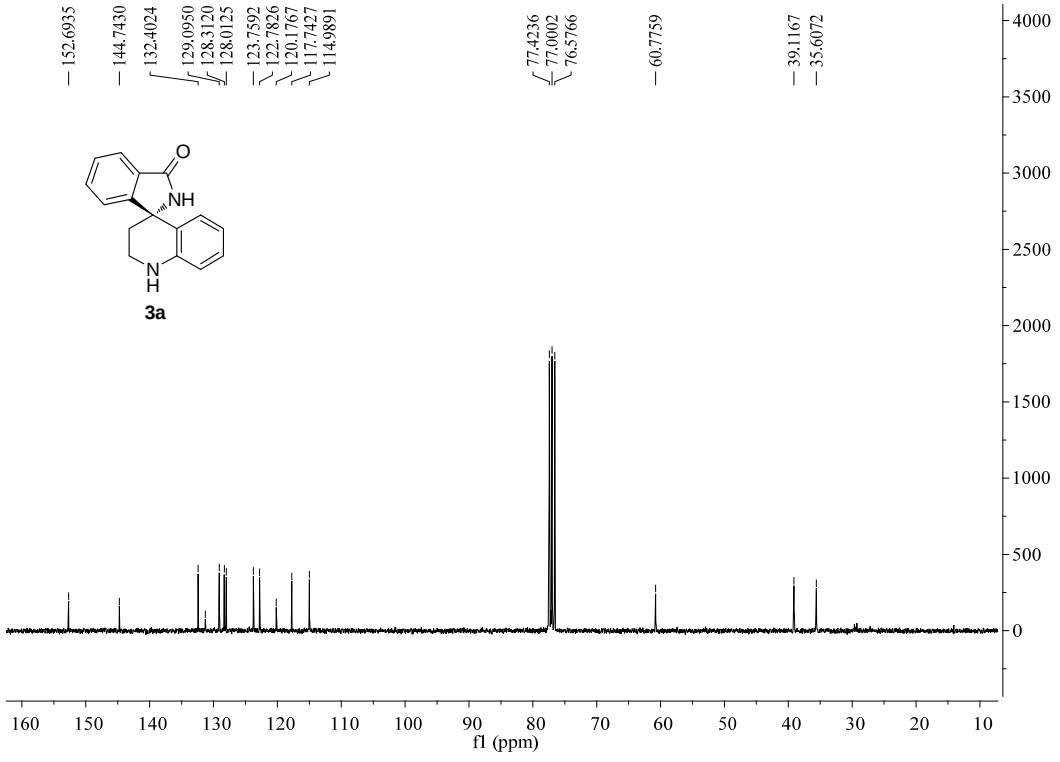
+ $NaHCO_3$

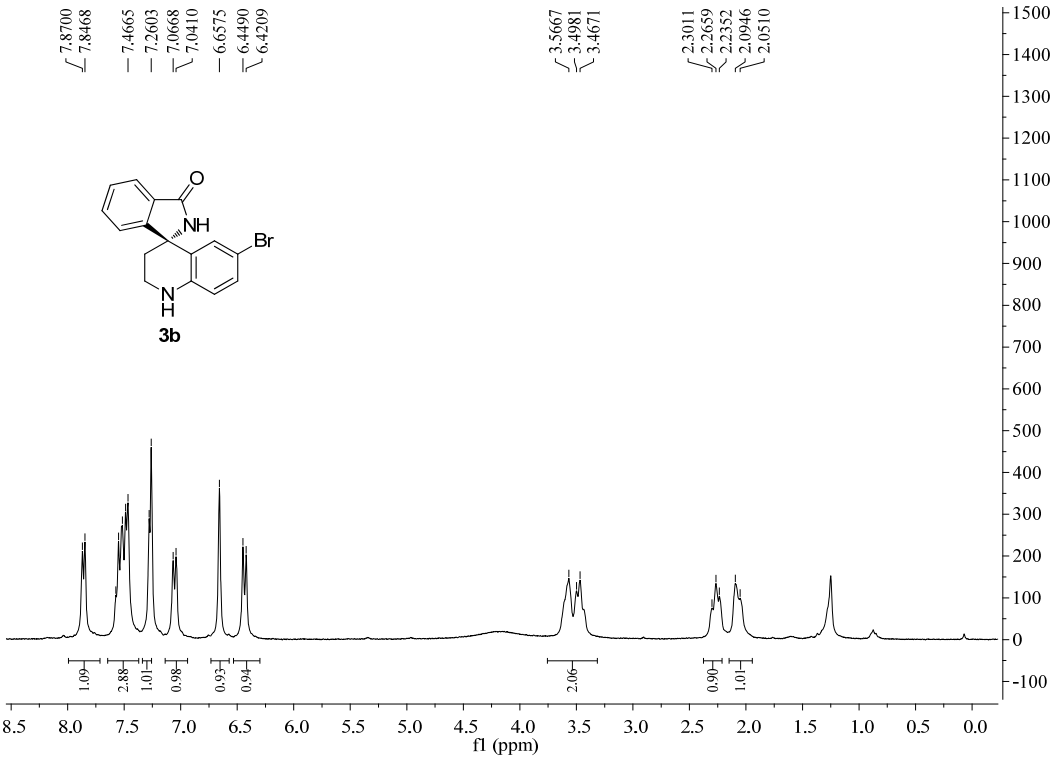
^{1}H NMR (600 MHz, CDCl3) δ 8.29 – 7.63 (m, 15H), 7.62 – 7.26 (m, 5H), 3.40 – 3.20 (m, 2H), 3.16 – 2.88 (m, 2H), 2.84 – 2.39 (m, 4H).

C1: Ar = 4-pyrenyl

8. Copies of NMR spectra



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7.0668
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6.6575
6.4490
6.4209
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3.4671
2.3011
2.2659
2.2352
2.0946
2.0510
O
NH
Br
N
H
3b
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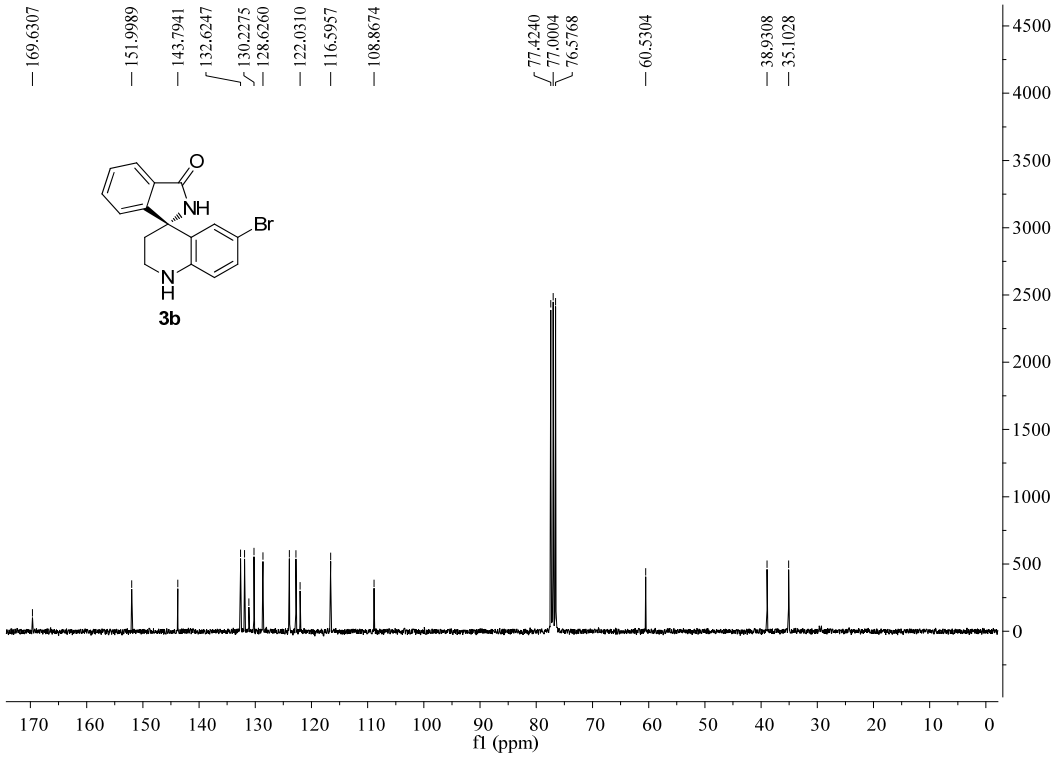
2.88
1.01
0.98
0.93
0.94
2.06
0.90
1.01
f1 (ppm)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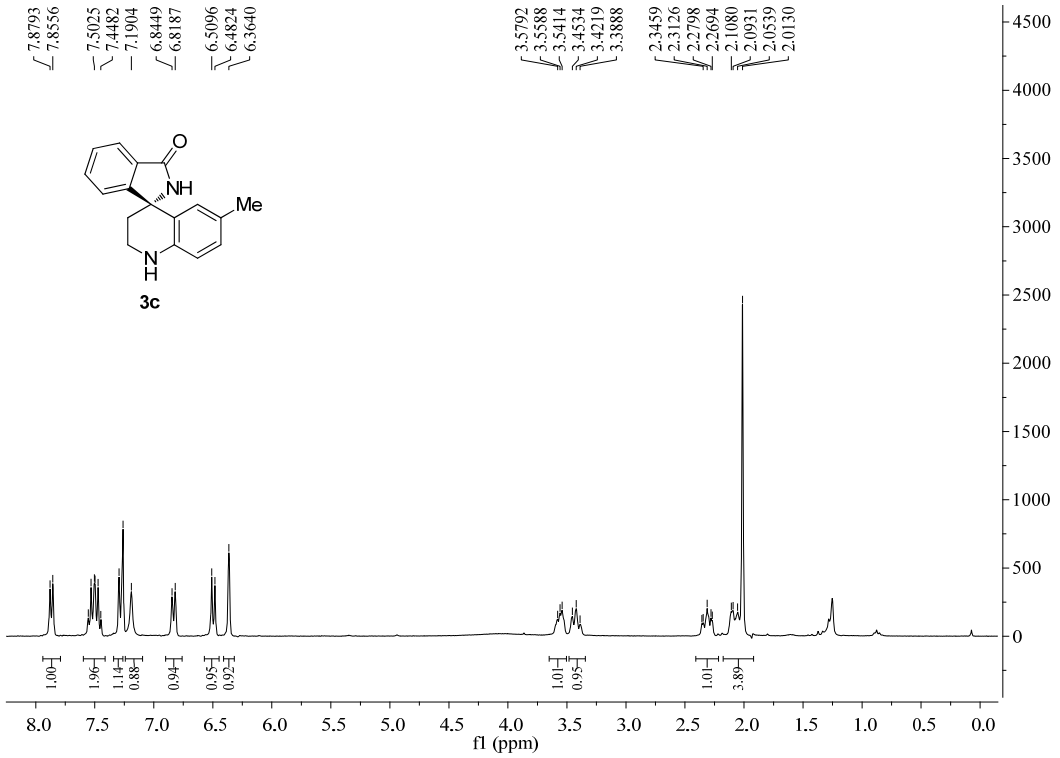
NH
Br
N
H
3b
f1 (ppm)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2.0931
2.0539
2.0130
O
NH
Me
N
H
3c
1.00
1.96
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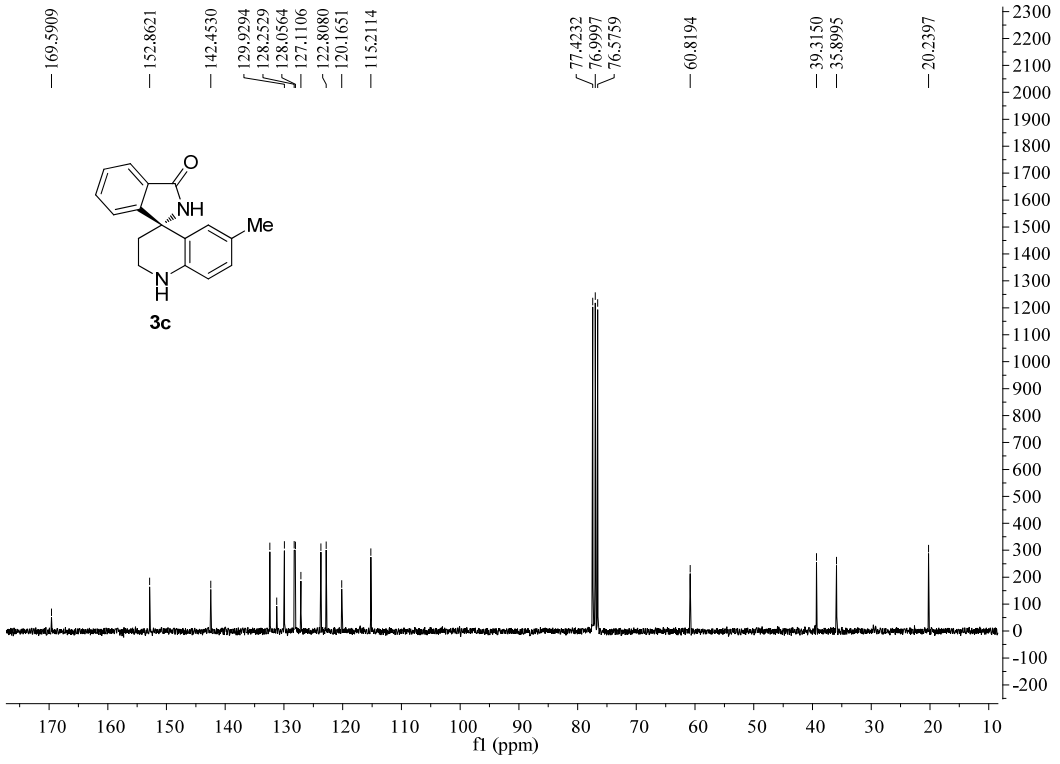
0.88
0.94
0.95
0.92
1.01
0.95
1.01
3.89
f1 (ppm)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120.1651
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39.3150
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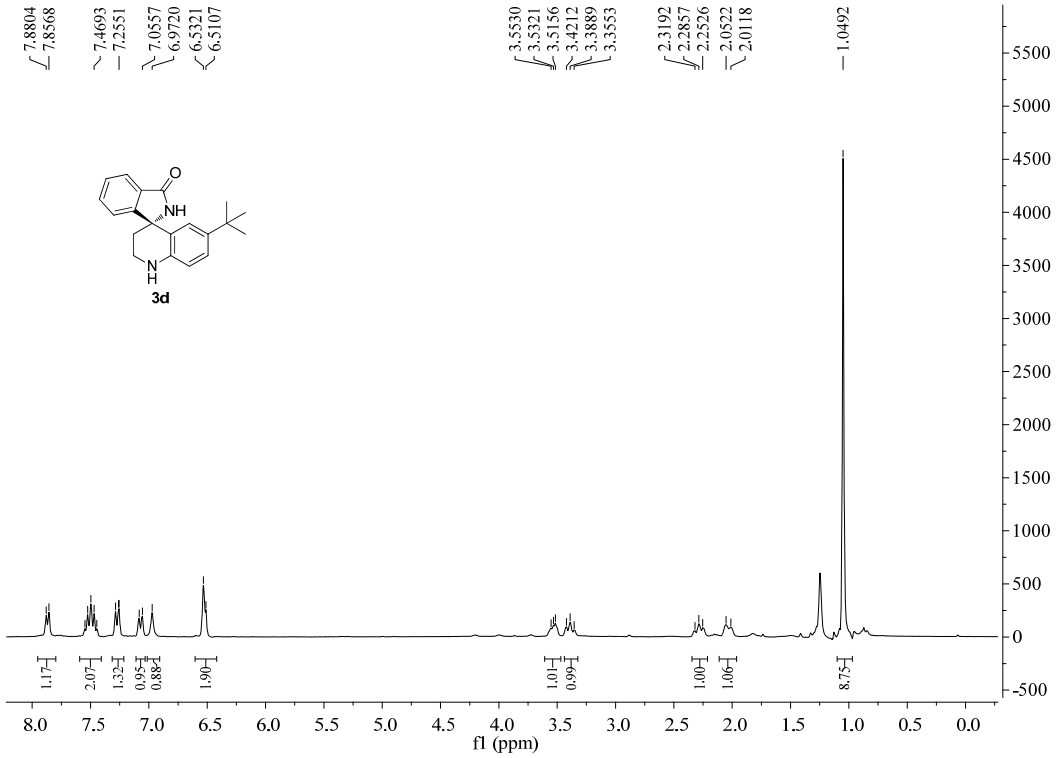
O
NH
Me
N
H
3c
f1 (ppm)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3.4212
3.3889
3.3553
2.3192
2.2857
2.2526
2.0522
2.0118
1.0492
1.17
2.07
1.32
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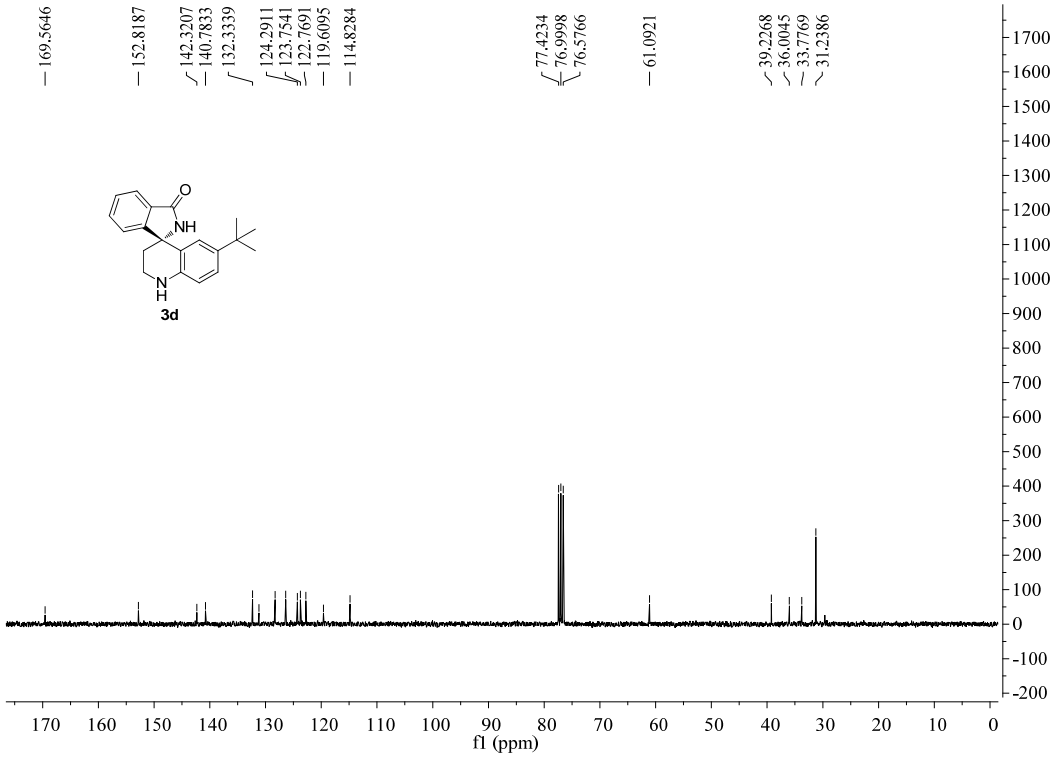
0.88
1.90
1.01
0.99
1.00
1.06
8.75
f1 (ppm)
3d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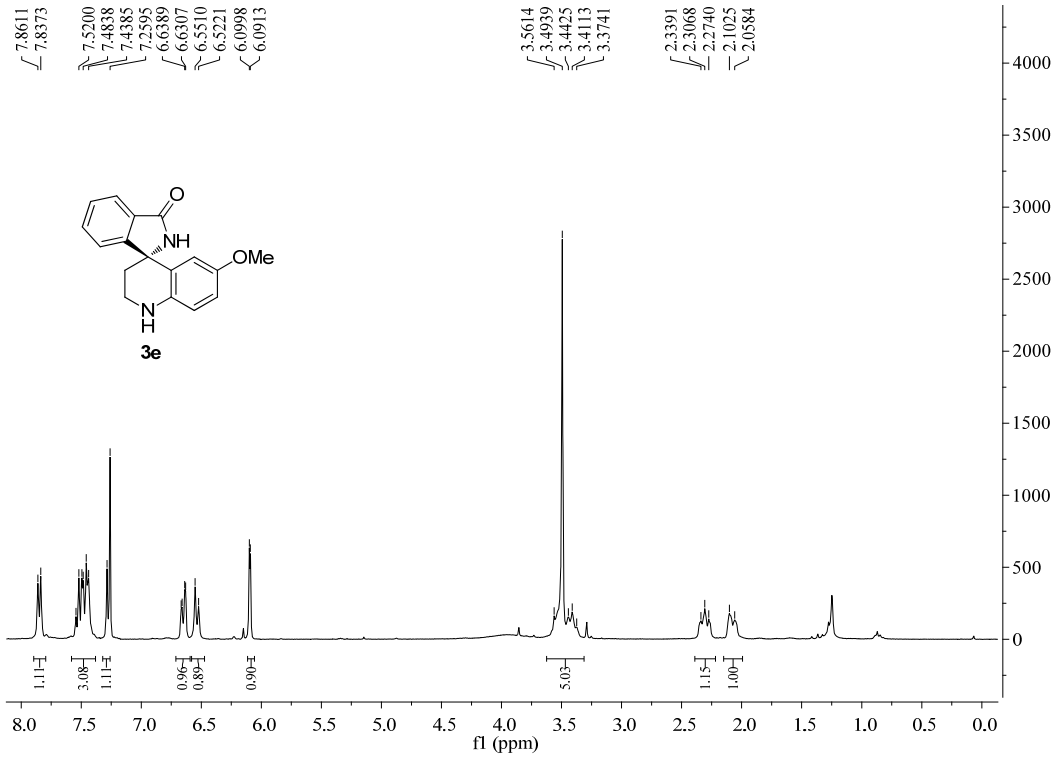
76.5766
61.0921
39.2268
36.0045
33.7769
31.2386
f1 (ppm)
3d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6.5221
6.0998
6.0913
3.5614
3.4939
3.4425
3.4113
3.3741
2.3391
2.3068
2.2740
2.1025
2.0584
O
NH
OMe
N
H
3e
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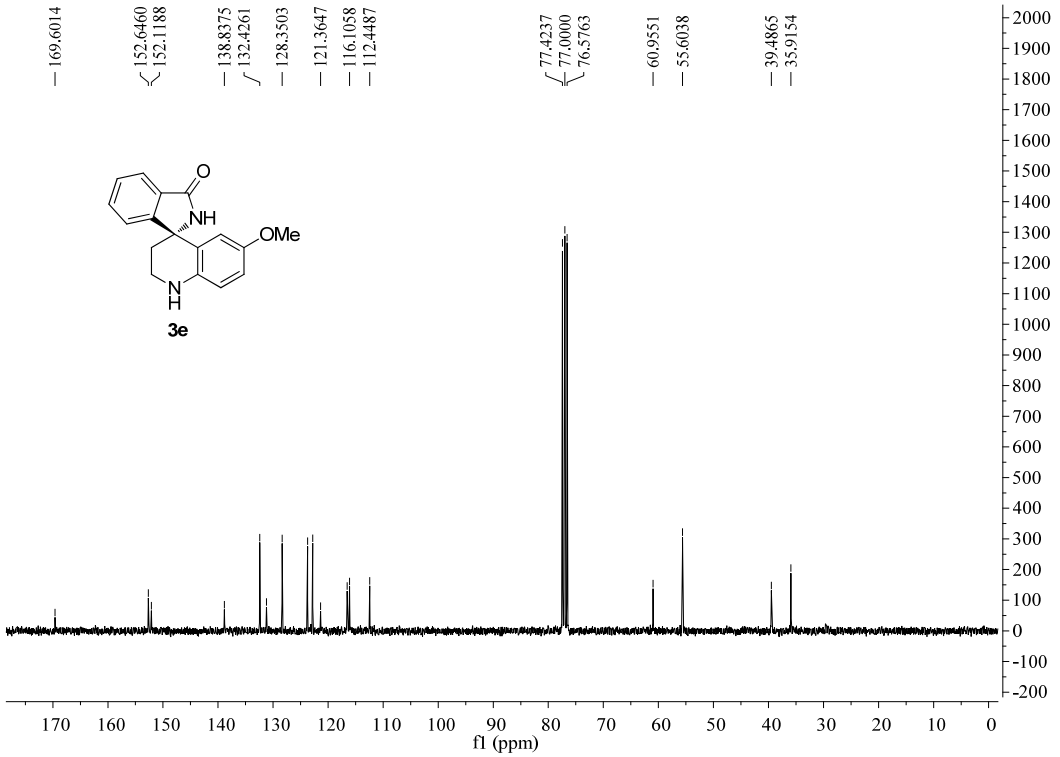
3.08
1.11
0.96
0.89
0.90
5.03
1.15
1.00
fl (ppm)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60.9551
55.6038
39.4865
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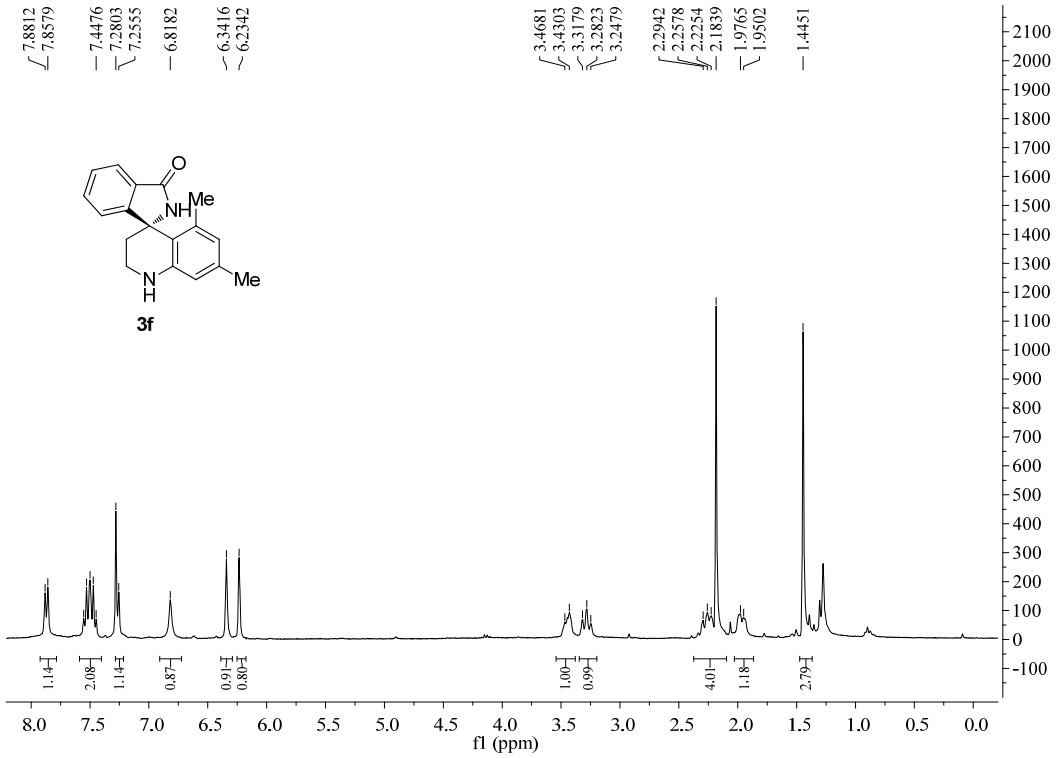
NH
OMe
N
H
3e
fl (ppm)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6.2342
3.4681
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3.3179
3.2823
3.2479
2.2942
2.2578
2.2254
2.1839
1.9765
1.9502
1.4451
1.14
2.08
1.14
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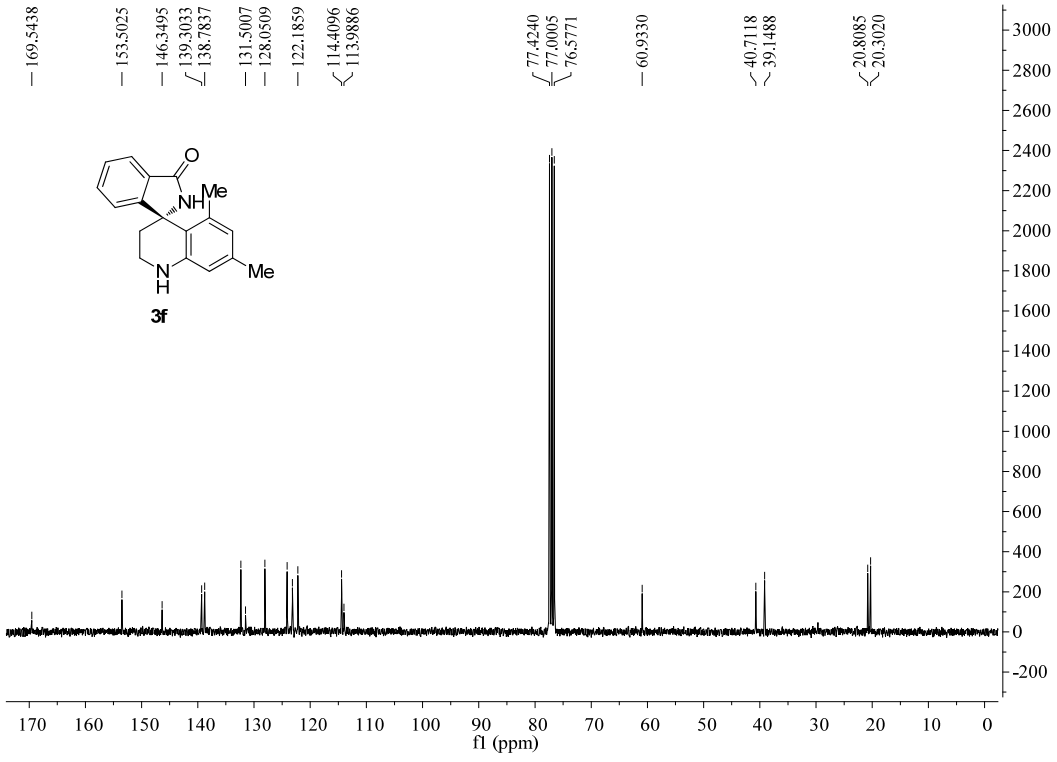
0.91
0.80
1.00
0.99
4.01
1.18
2.79
f1 (ppm)

3f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114.4096
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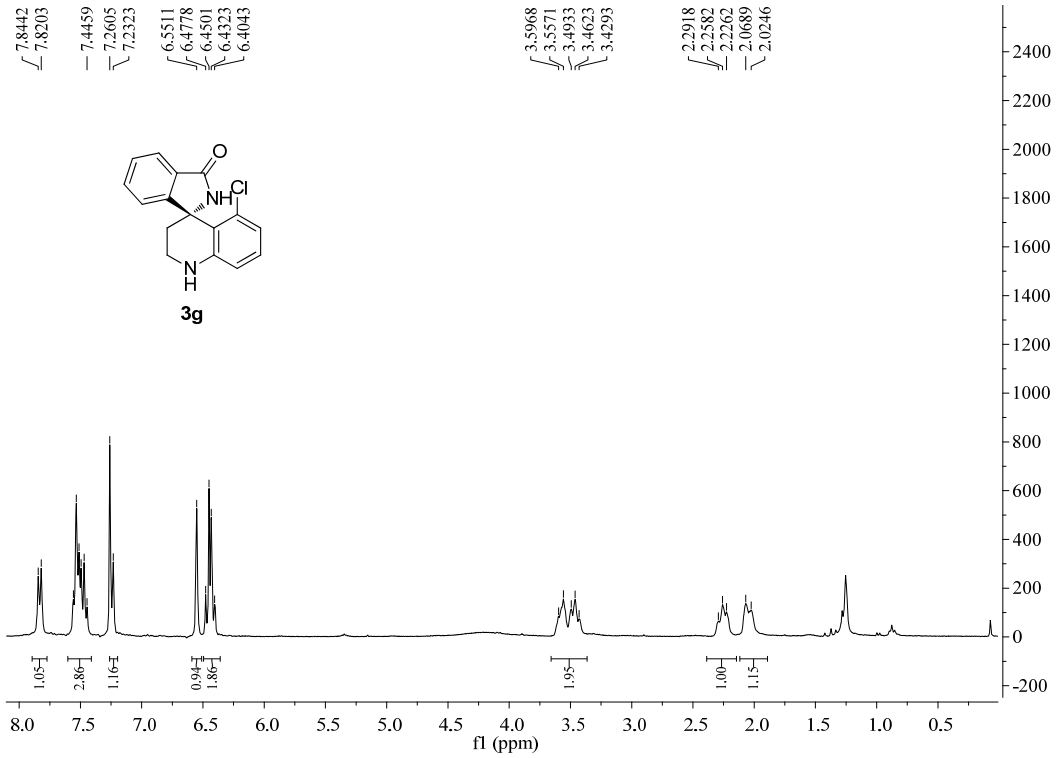
76.5771
60.9330
40.7118
39.1488
20.8085
20.3020
f1 (ppm)

3f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7.2323
6.5511
6.4778
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3.5968
3.5571
3.4933
3.4623
3.4293
2.2918
2.2582
2.2262
2.0689
2.0246
O
NH
Cl
N
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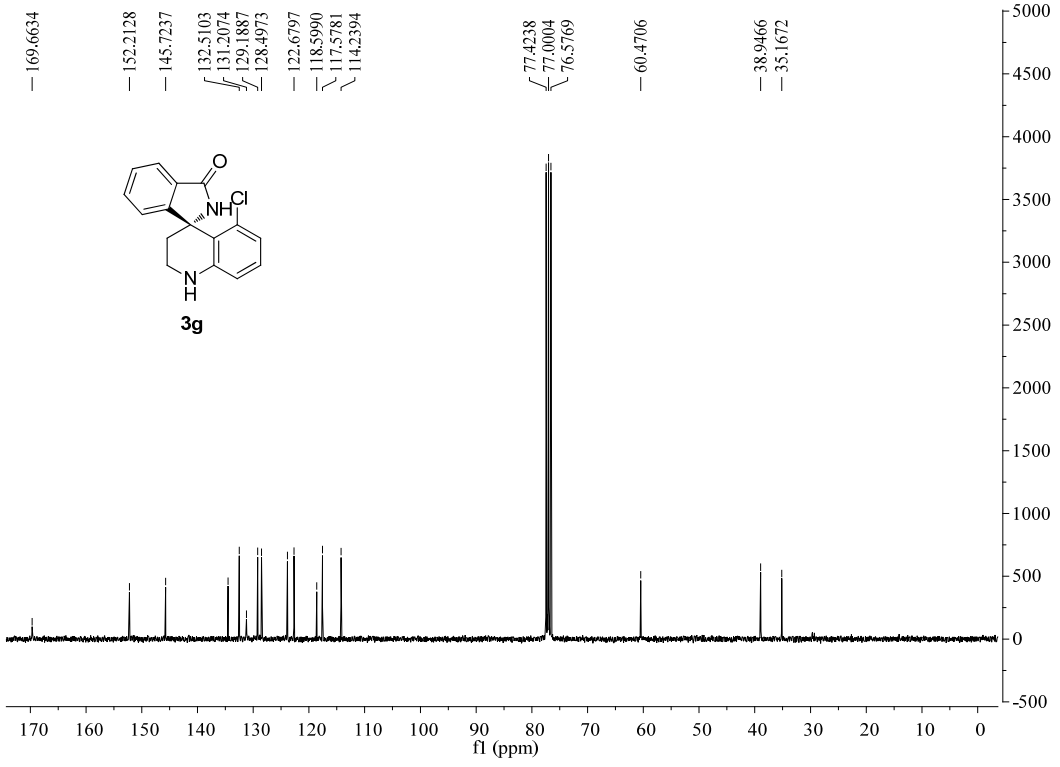
3g
1.05
2.86
1.16
0.94
1.86
1.95
1.00
1.15
f1 (ppm)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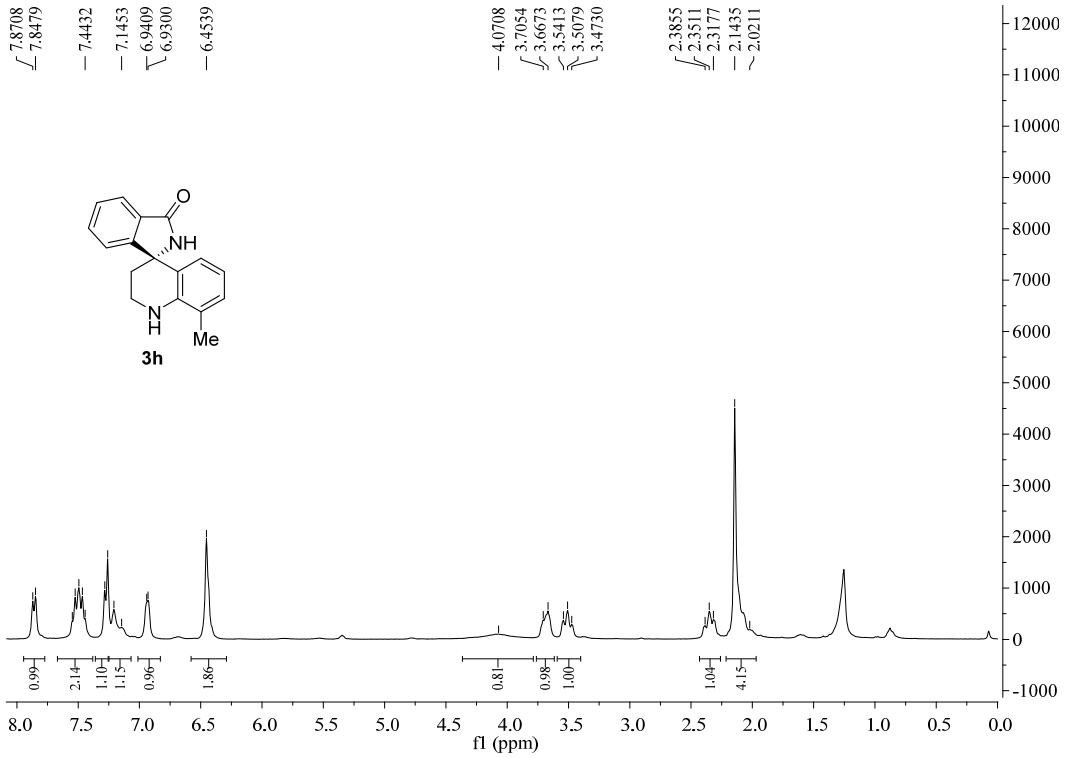
NH
Cl
N
H
3g
f1 (ppm)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6.4539
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3.5079
3.4730
2.3855
2.3511
2.3177
2.1435
2.0211
O
NH
N
H
Me
3h
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2.14
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1.15
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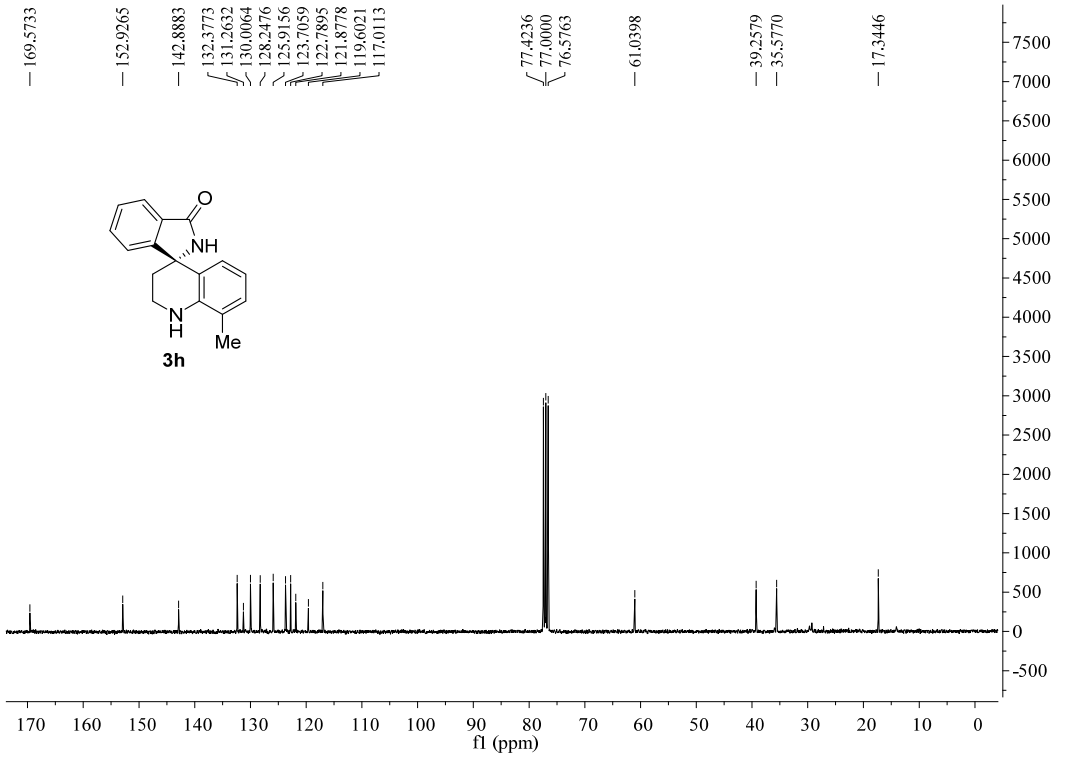
1.86
0.81
0.98
1.00
1.04
4.15
f1 (ppm)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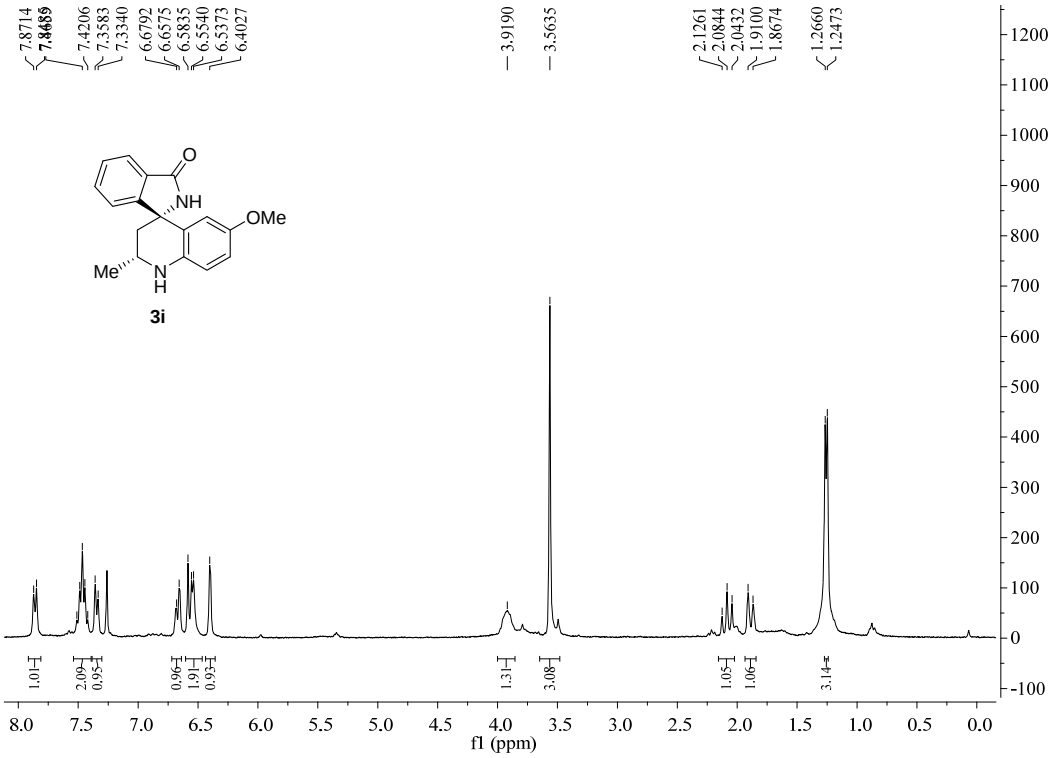
125.9156
123.7059
122.7895
121.8778
119.6021
117.0113
77.4236
77.0000
76.5763
61.0398
39.2579
35.5770
17.3446
O
NH
N
H
Me
3h
f1 (ppm)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7.3340
6.6792
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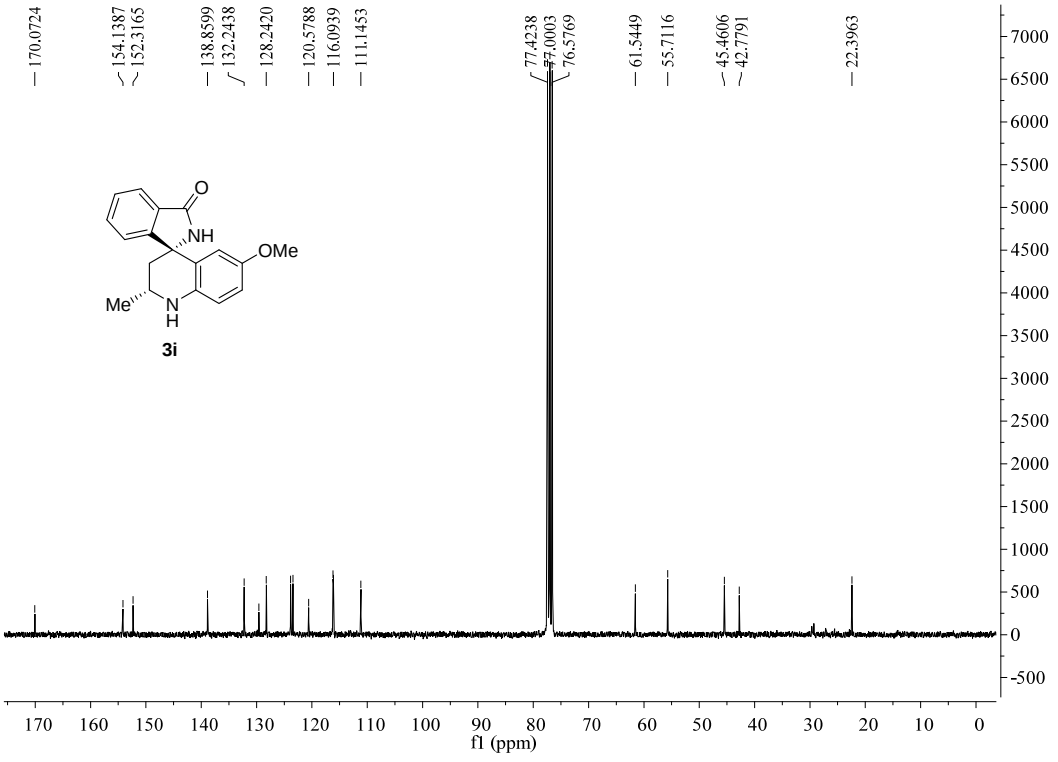
6.5835
6.5540
6.5373
6.4027
3.9190
3.5635
2.1261
2.0844
2.0432
1.9100
1.8674
1.2660
1.2473
O
NH
OMe
Me
N
H
3i
1.01
2.09
0.95
0.96
1.91
0.93
1.31
3.08
1.05
1.06
3.14
fl (ppm)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128.2420
120.5788
116.0939
111.1453
77.4238
77.0003
76.5769
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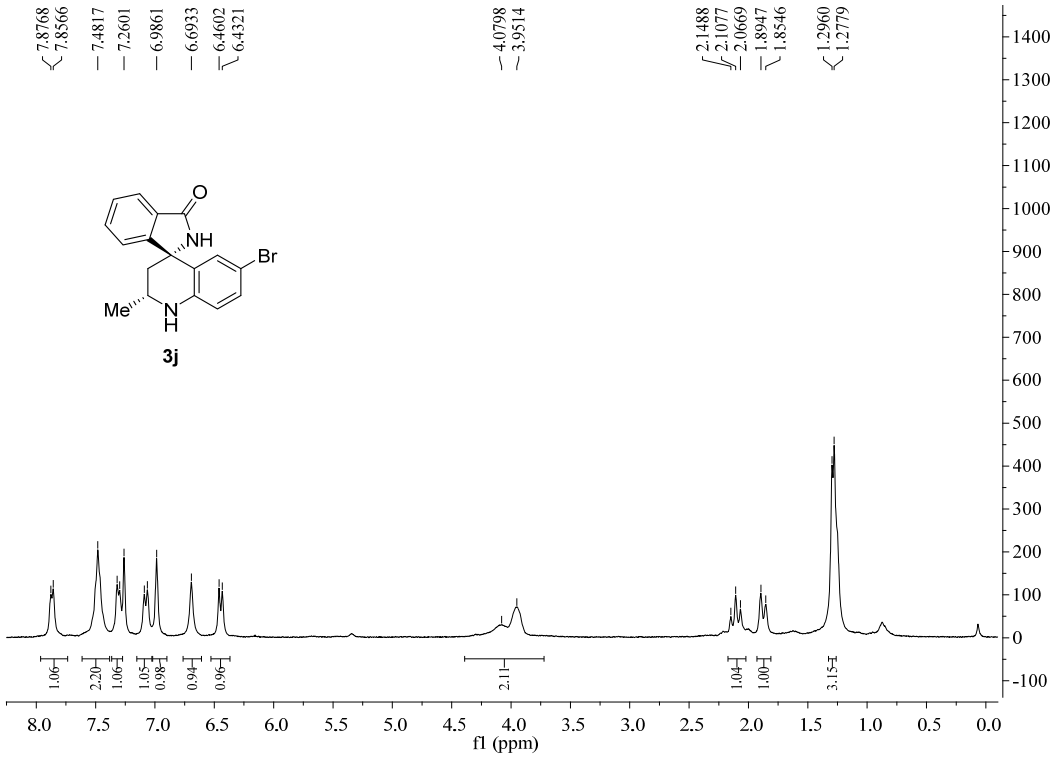
45.4606
42.7791
22.3963
O
NH
OMe
Me
N
H
3i
fl (ppm)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6.4602
6.4321
4.0798
3.9514
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1.8546
1.2960
1.2779
O
NH
Br
Me
N
H
3j
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2.20
1.06
1.05
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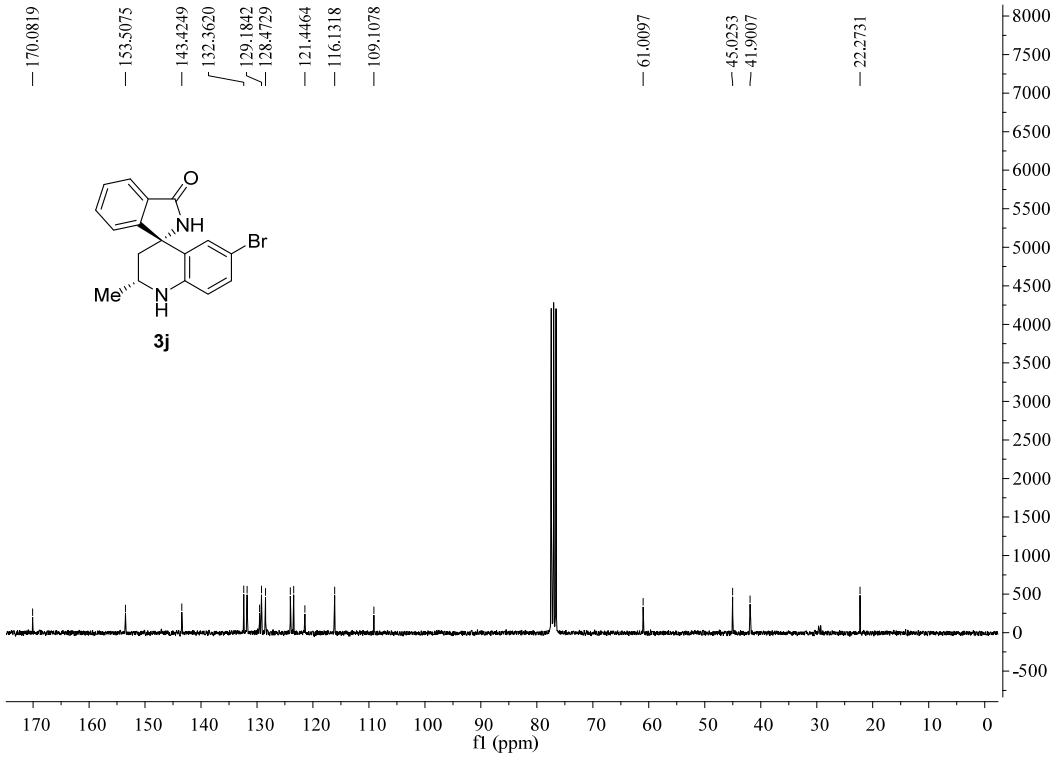
0.94
0.96
2.11
1.04
1.00
3.15
f1 (ppm)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22.2731
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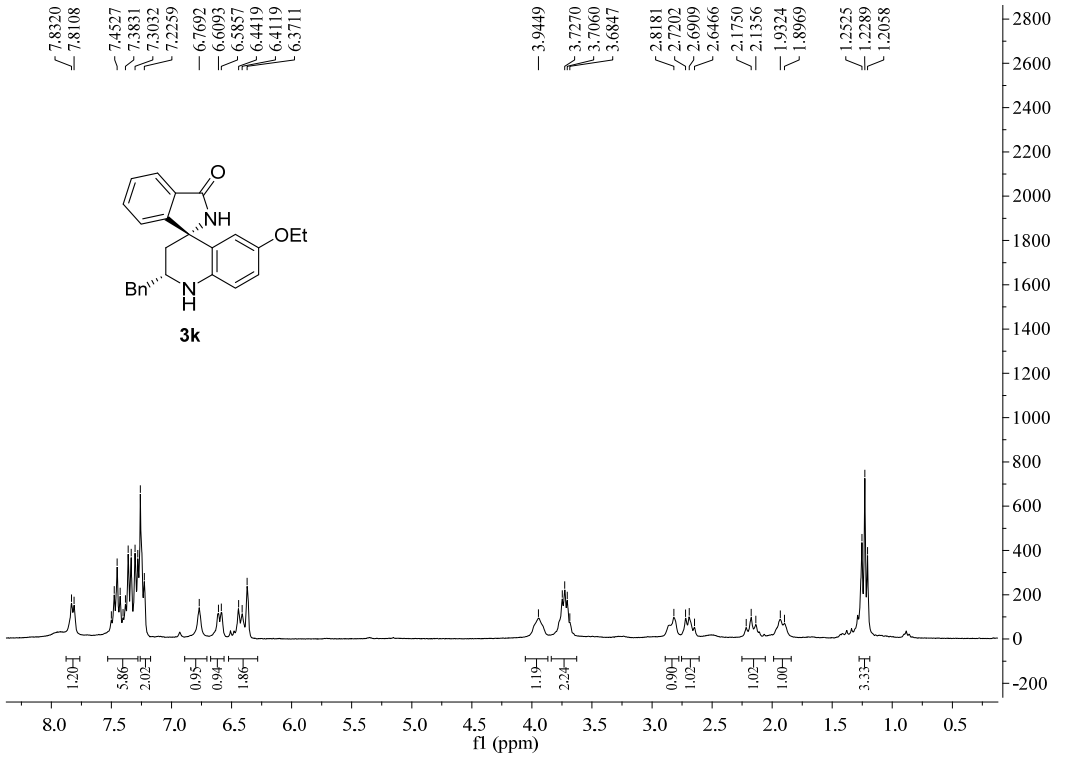
NH
Br
Me
N
H
3j
f1 (ppm)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6.3711
3.9449
3.7270
3.7060
3.6847
2.8181
2.7202
2.6909
2.6466
2.1750
2.1356
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1.2525
1.2289
1.2058
O
NH
OEt
Bn
N
H
3k
1.20
5.86
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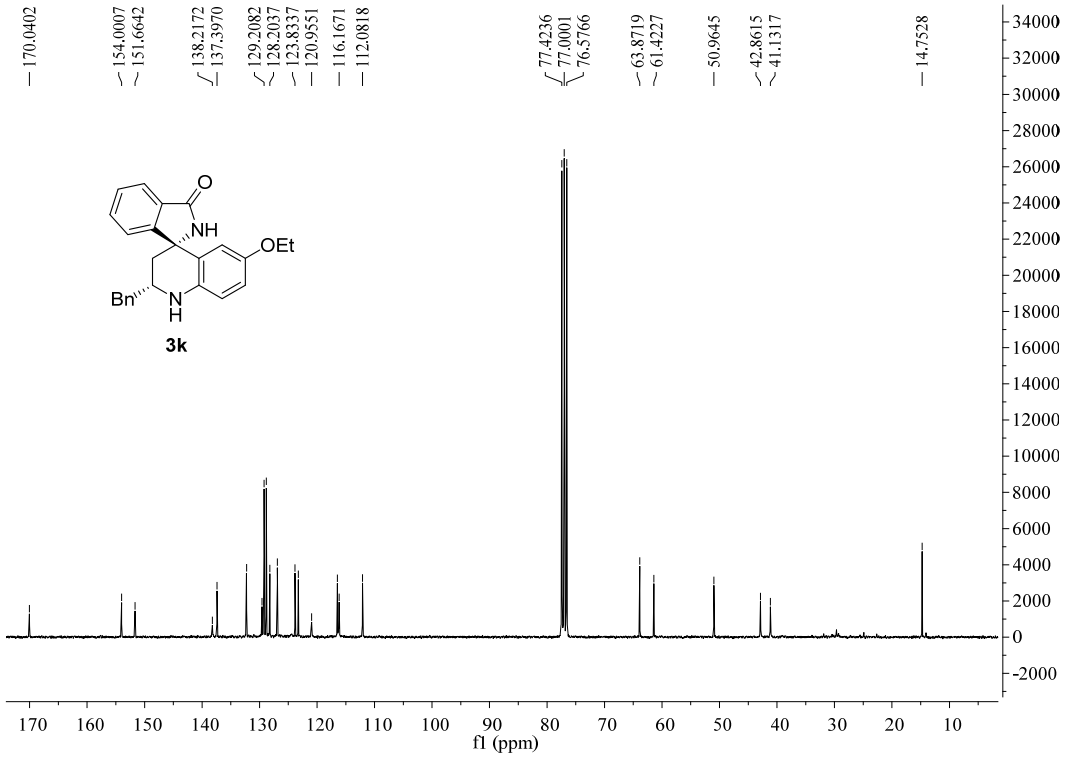
0.94
1.86
1.19
2.24
0.90
1.02
1.02
1.00
3.33
f1 (ppm)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77.4236
77.0001
76.5766
63.8719
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14.7528
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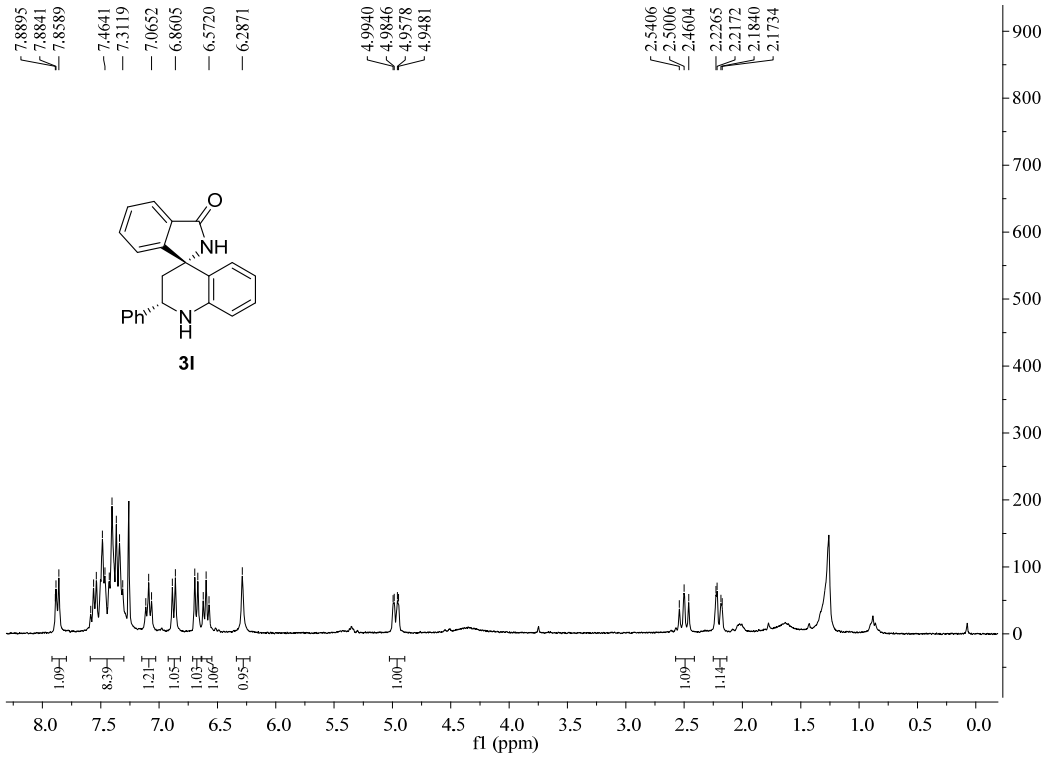
NH
OEt
Bn
N
H
3k
f1 (ppm)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4.9578
4.9481
2.5406
2.5006
2.4604
2.2265
2.2172
2.1840
2.1734
O
NH
Ph
N
H
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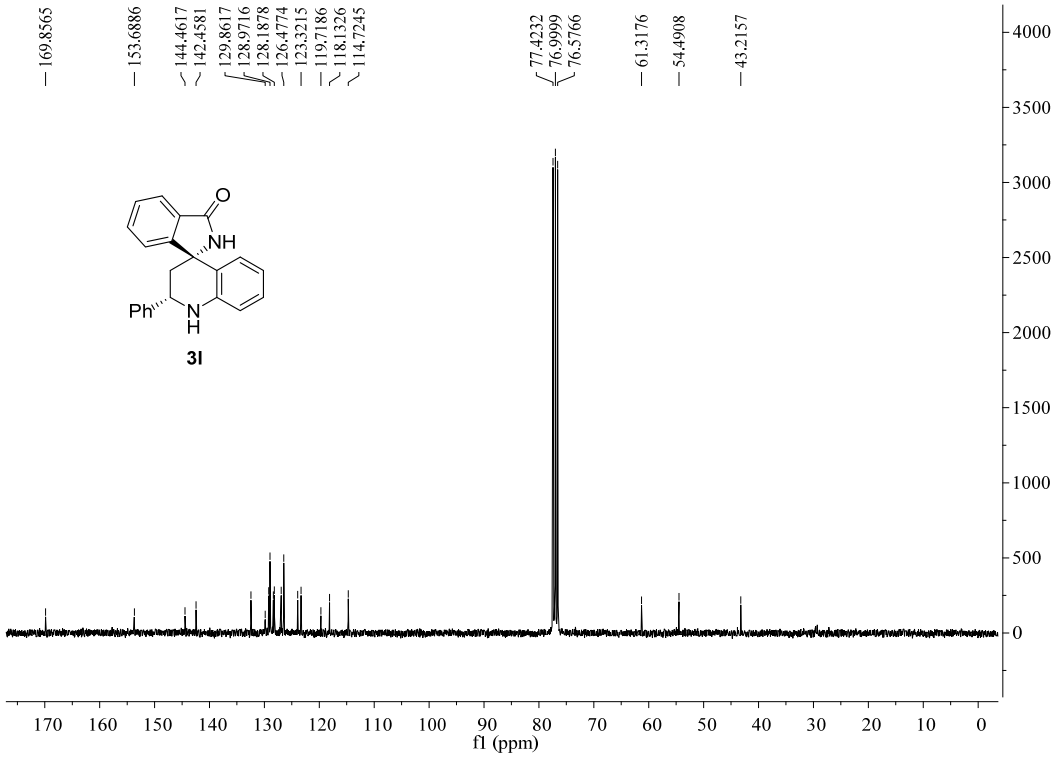
1.21
1.05
1.03
1.06
0.95
1.00
1.09
1.14
f1 (ppm)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128.1878
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114.7245
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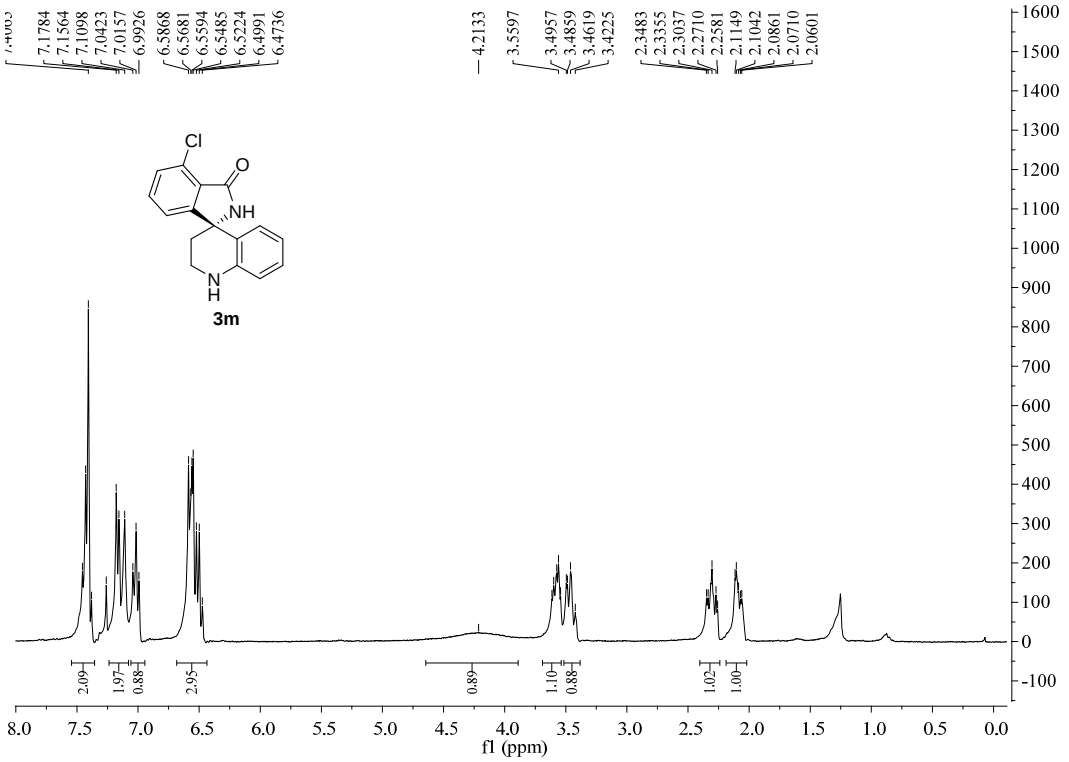
61.3176
54.4908
43.2157
O
NH
Ph
N
H
3l
f1 (ppm)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6.5224
6.4991
6.4736
4.2133
3.5597
3.4957
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3.4225
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2.3355
2.3037
2.2710
2.2581
2.1149
2.1042
2.0861
2.0710
2.0601
Cl
O
NH
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H
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0.88
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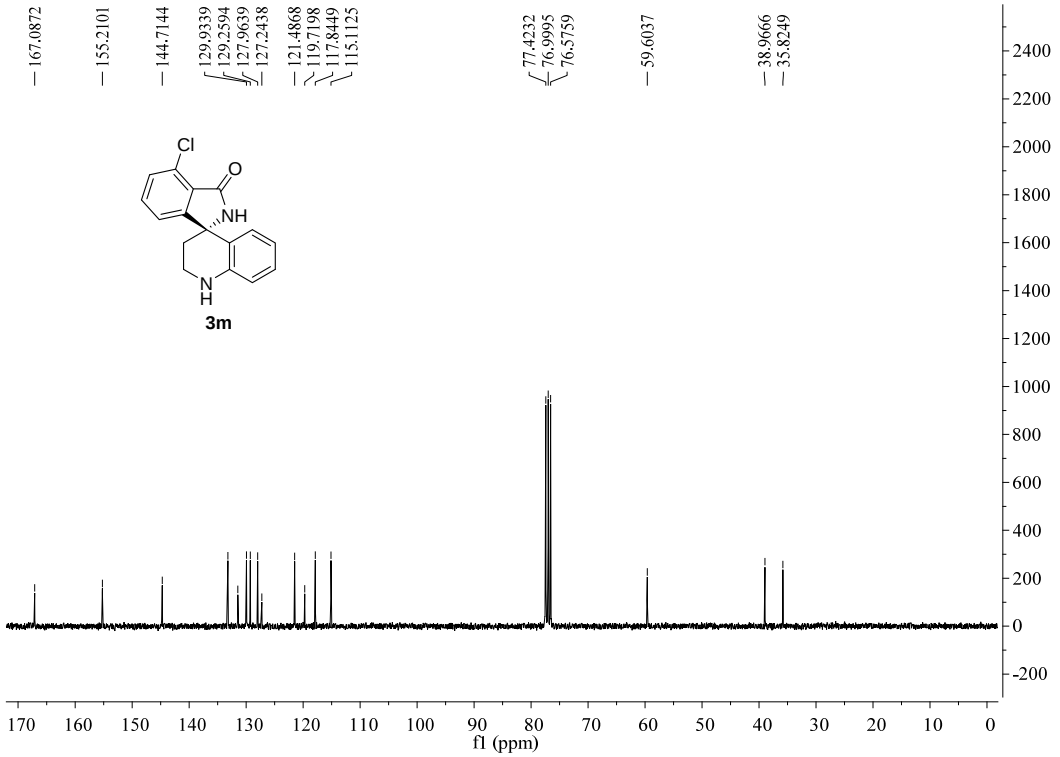
1.00
f1 (ppm)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115.1125
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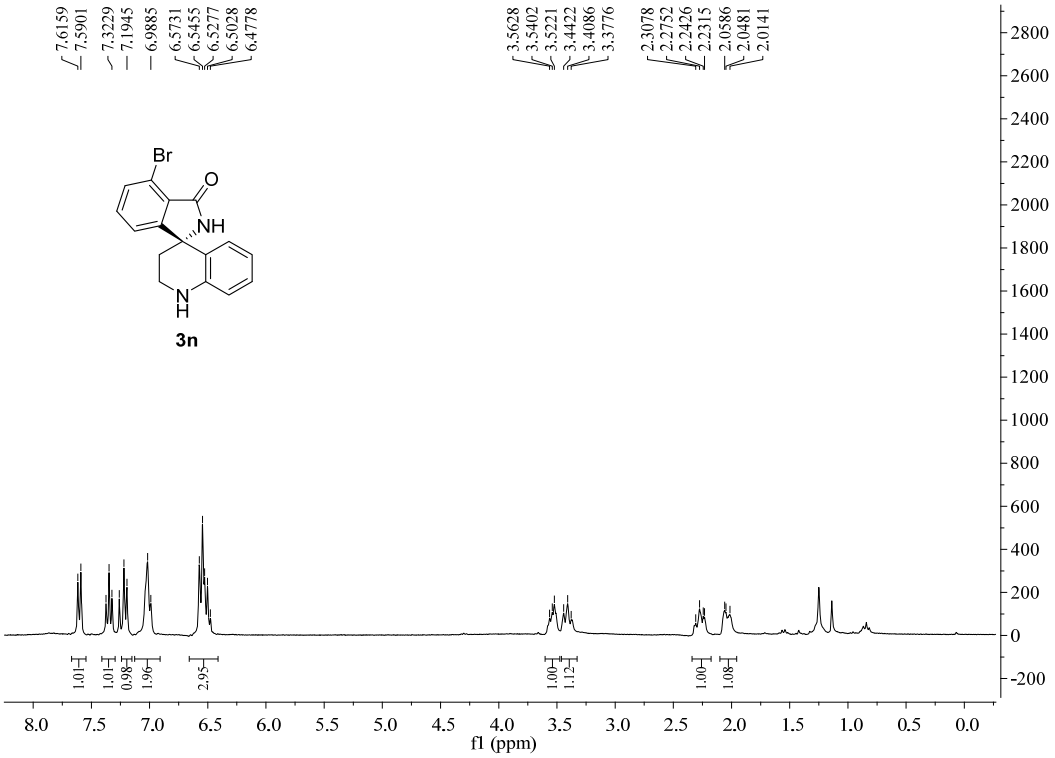
59.6037
38.9666
35.8249
Cl
O
NH
N
H
3m
f1 (ppm)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3.5402
3.5221
3.4422
3.4086
3.3776
2.3078
2.2752
2.2426
2.2315
2.0586
2.0481
2.0141
Br
O
NH
N
H
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1.01
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1.96
2.95
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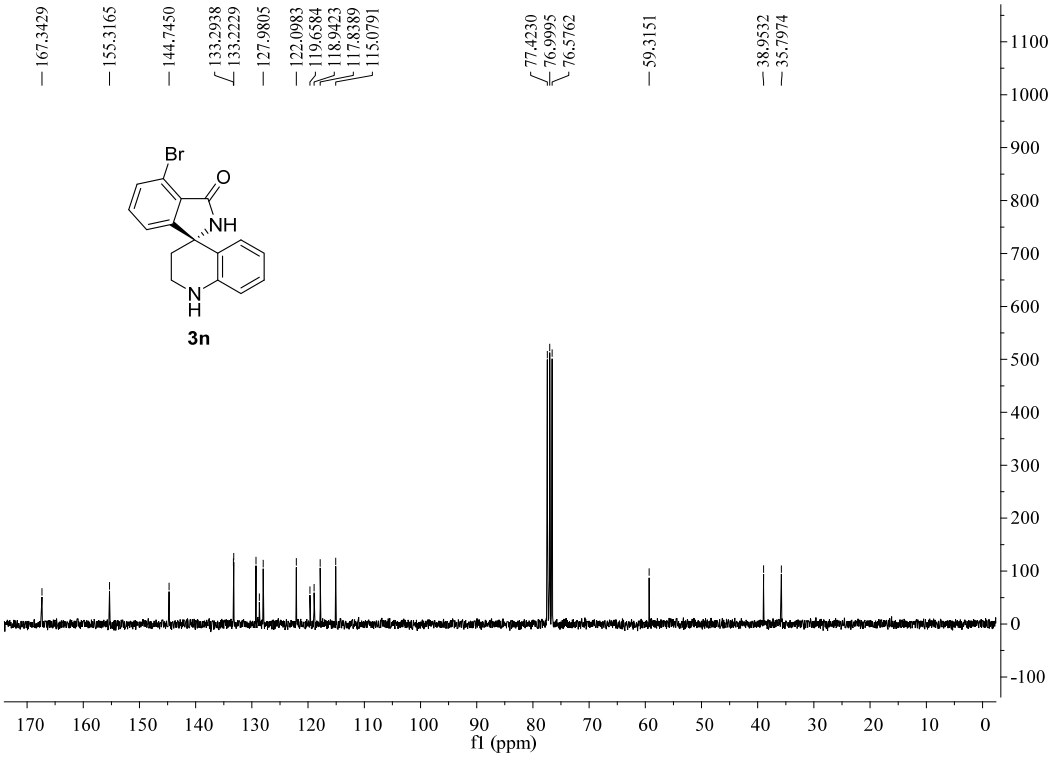
1.12
1.00
1.08
f1 (ppm)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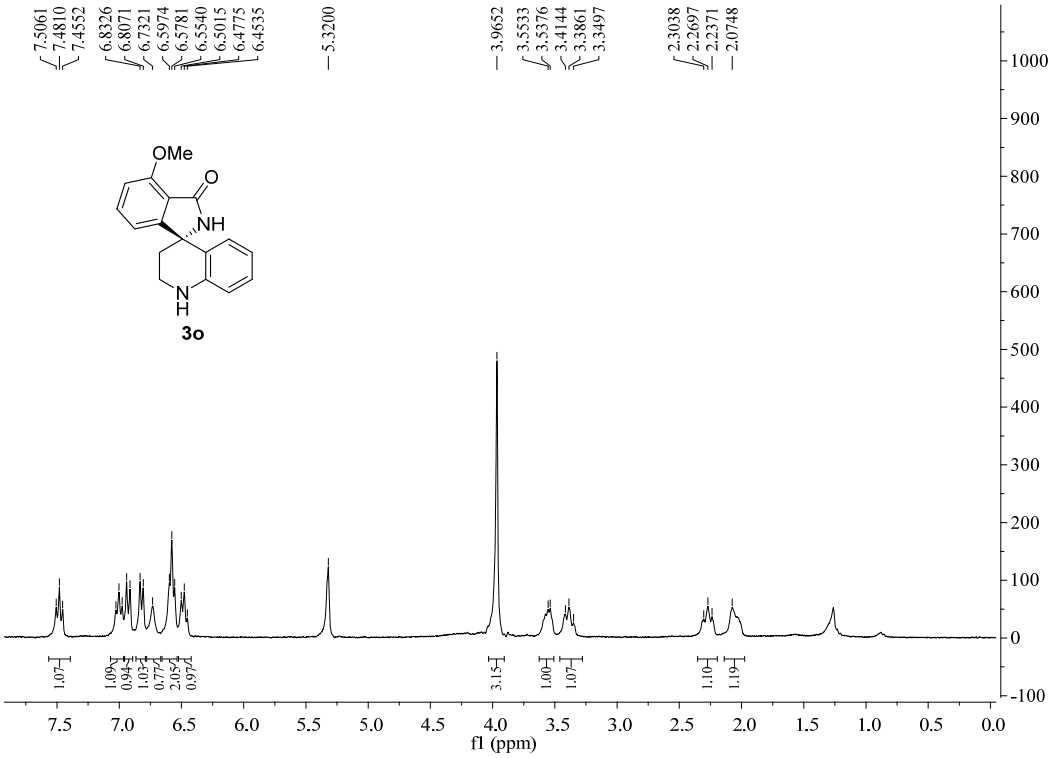
35.7974
Br
O
NH
N
H
3n
f1 (ppm)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6.4535
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3.4144
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3.3497
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2.2697
2.2371
2.0748
OMe
O
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N
H
3o
1.07
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0.97
3.15
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1.07
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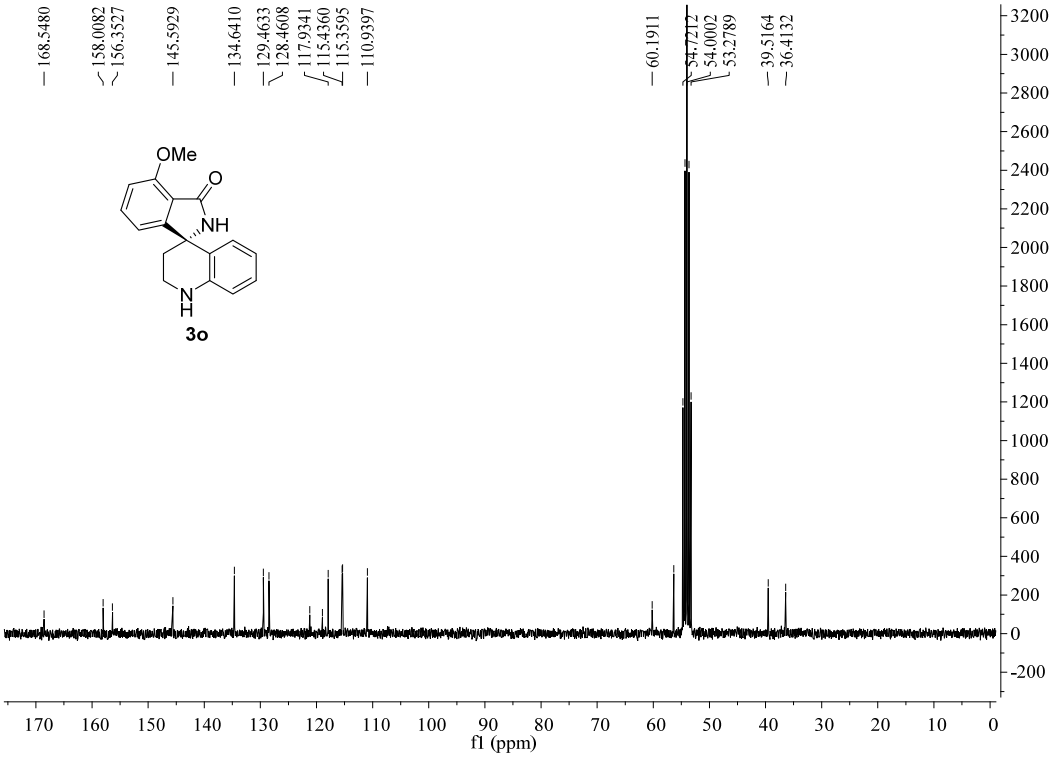
1.19
f1 (ppm)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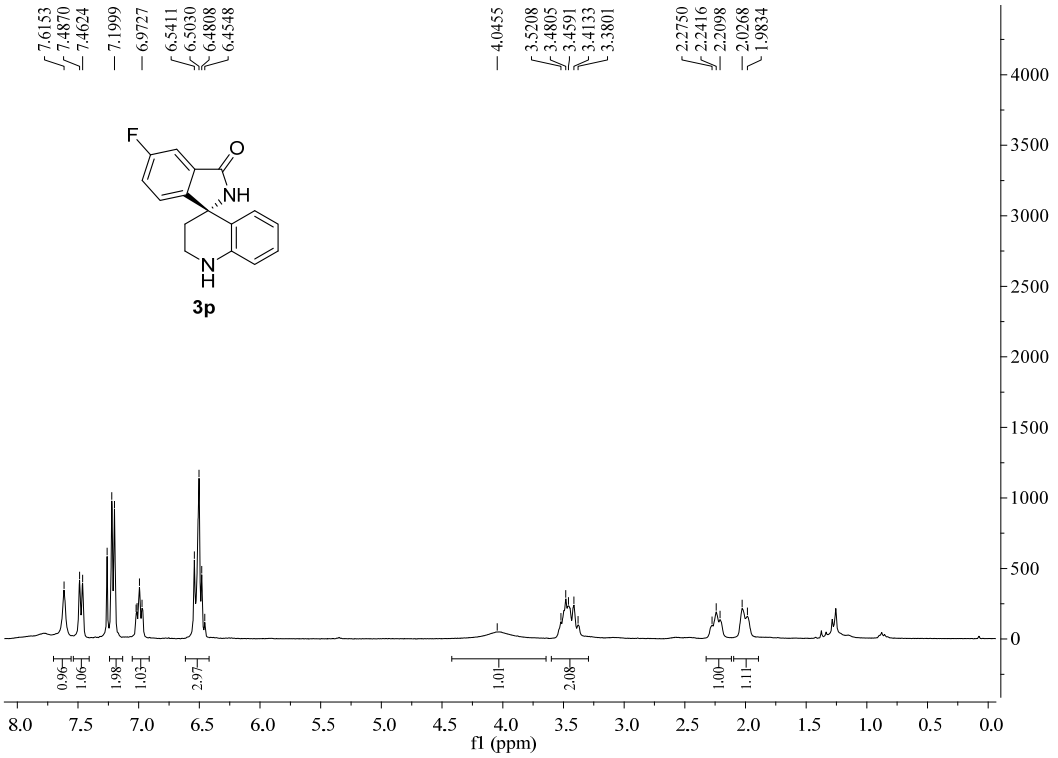
N
H
3o
f1 (ppm)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3.4133
3.3801
2.2750
2.2416
2.2098
2.0268
1.9834
F
O
NH
N
H
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2.08
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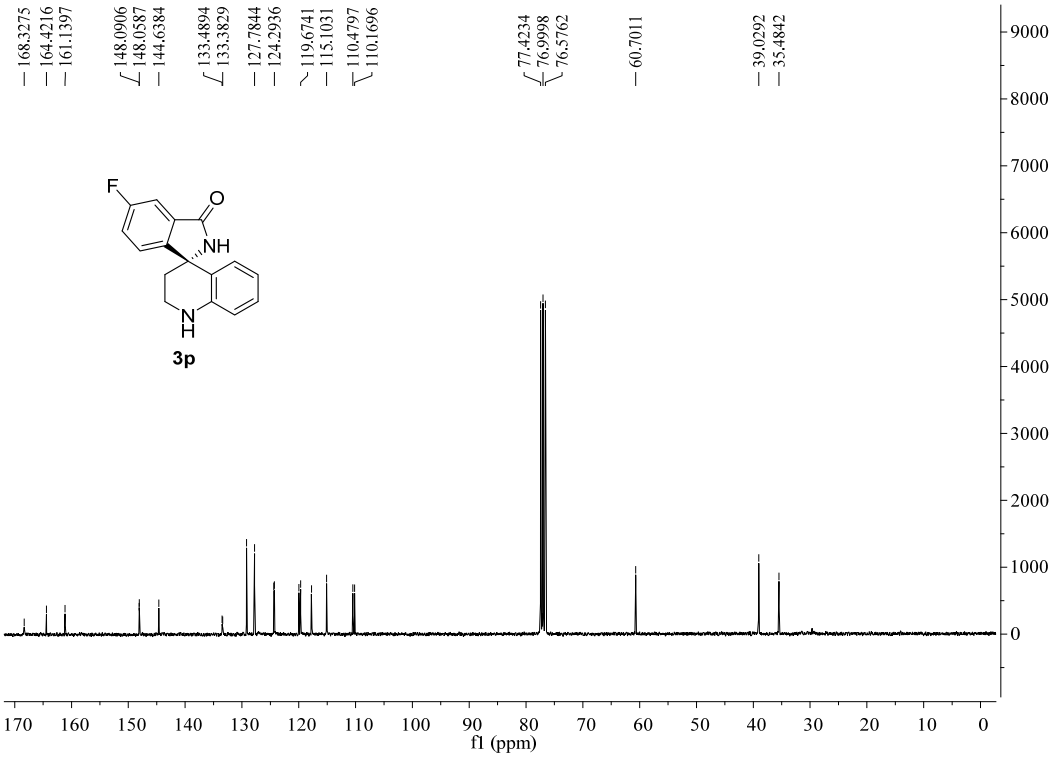
1.11
f1 (ppm)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115.1031
110.4797
110.1696
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60.7011
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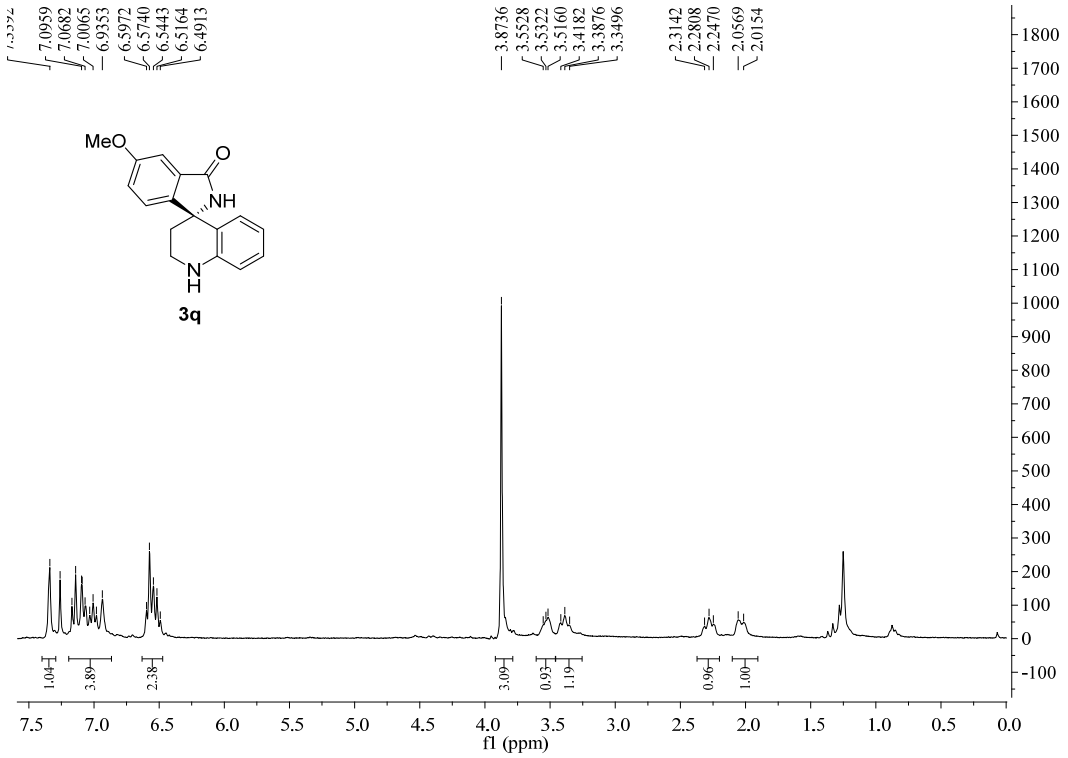
35.4842
F
O
NH
N
H
3p
f1 (ppm)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3.4182
3.3876
3.3496
2.3142
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2.2470
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2.0154
MeO
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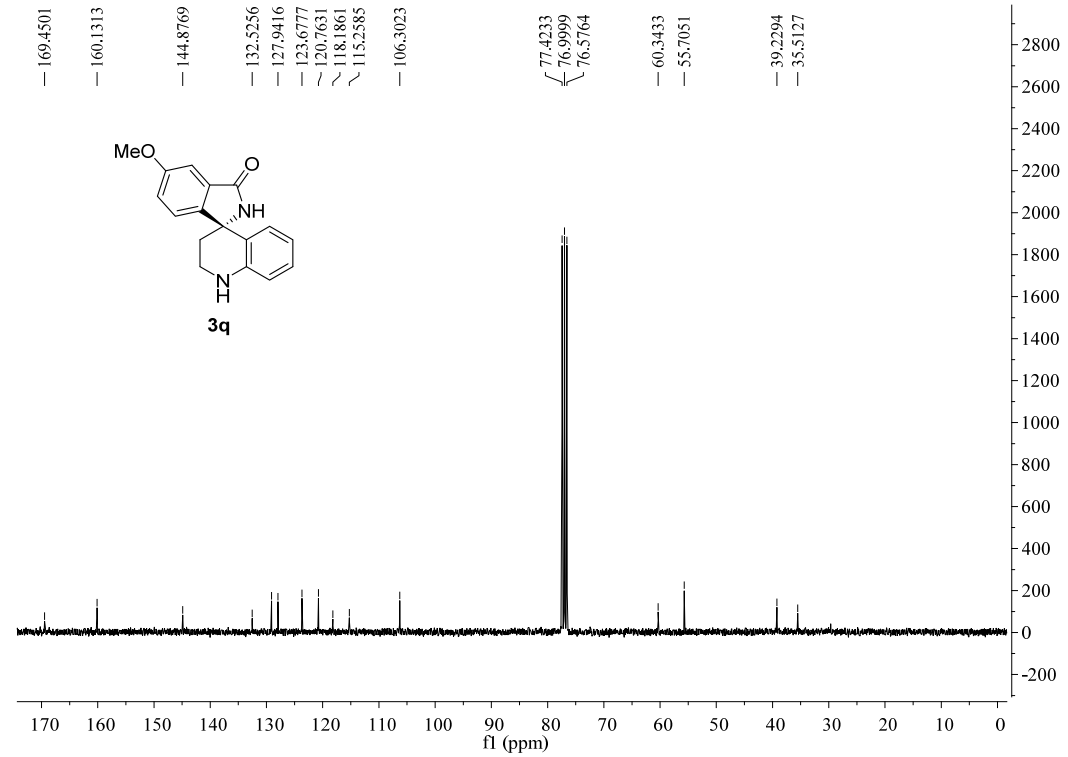
1.00
f1 (ppm)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77.4233
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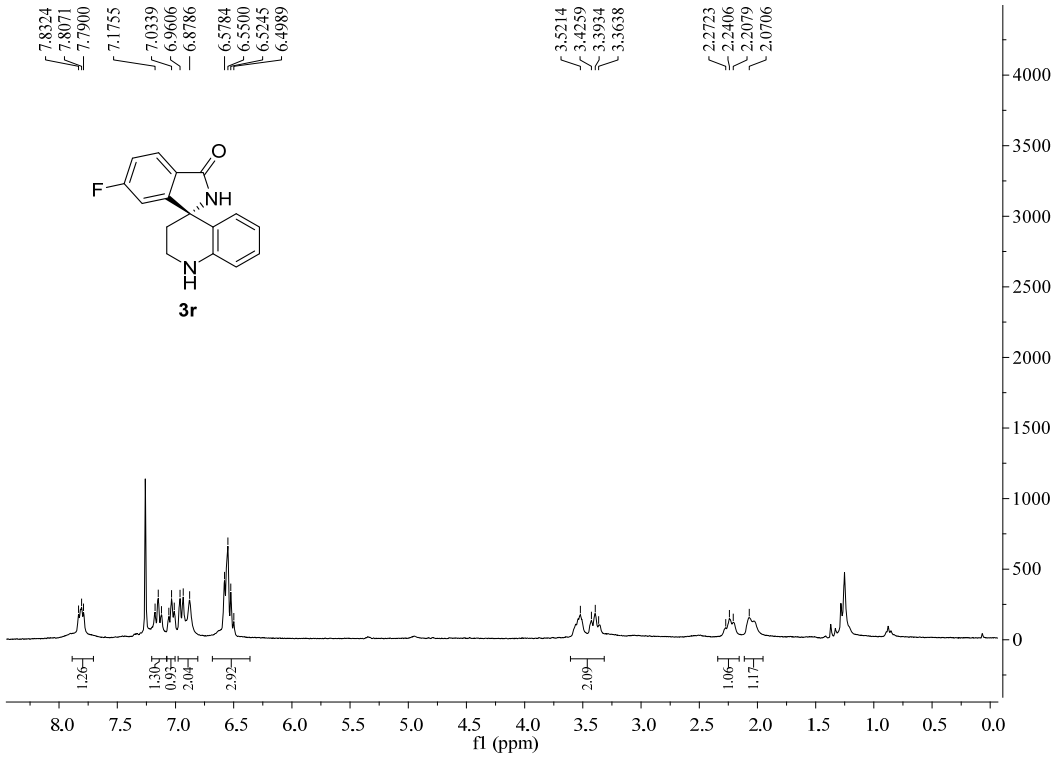
35.5127
MeO
O
NH
N
H
3q
f1 (ppm)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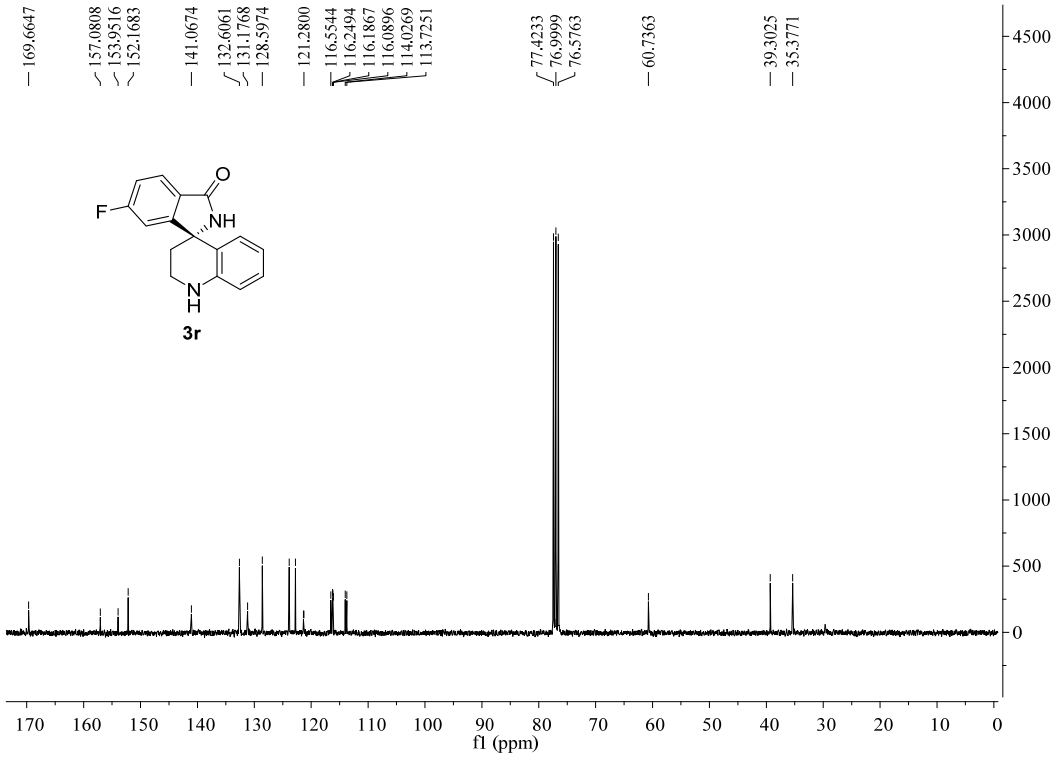
3.3638
2.2723
2.2406
2.2079
2.0706
O
F
NH
N
H
3r
1.26
1.30
0.93
2.04
2.92
2.09
1.06
1.17
fl (ppm)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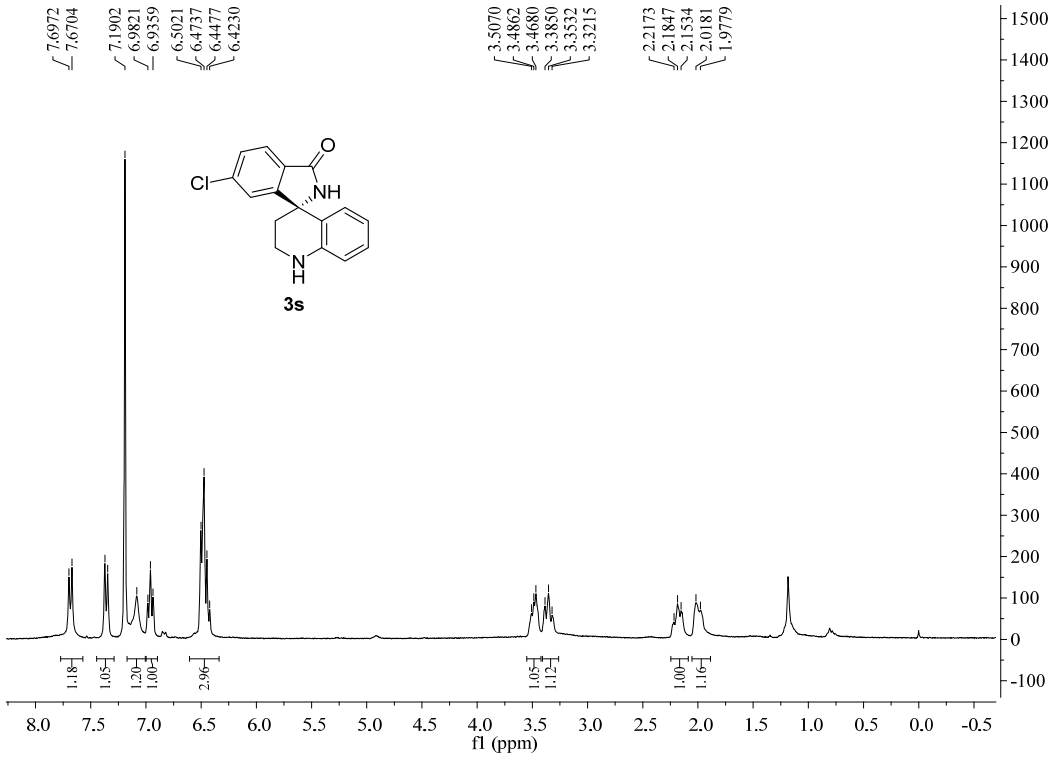
153.9516
152.1683
141.0674
132.6061
131.1768
128.5974
121.2800
116.5544
116.2494
116.1867
116.0896
114.0269
113.7251
77.4233
76.9999
76.5763
60.7363
39.3025
35.3771
O
F
NH
N
H
3r
fl (ppm)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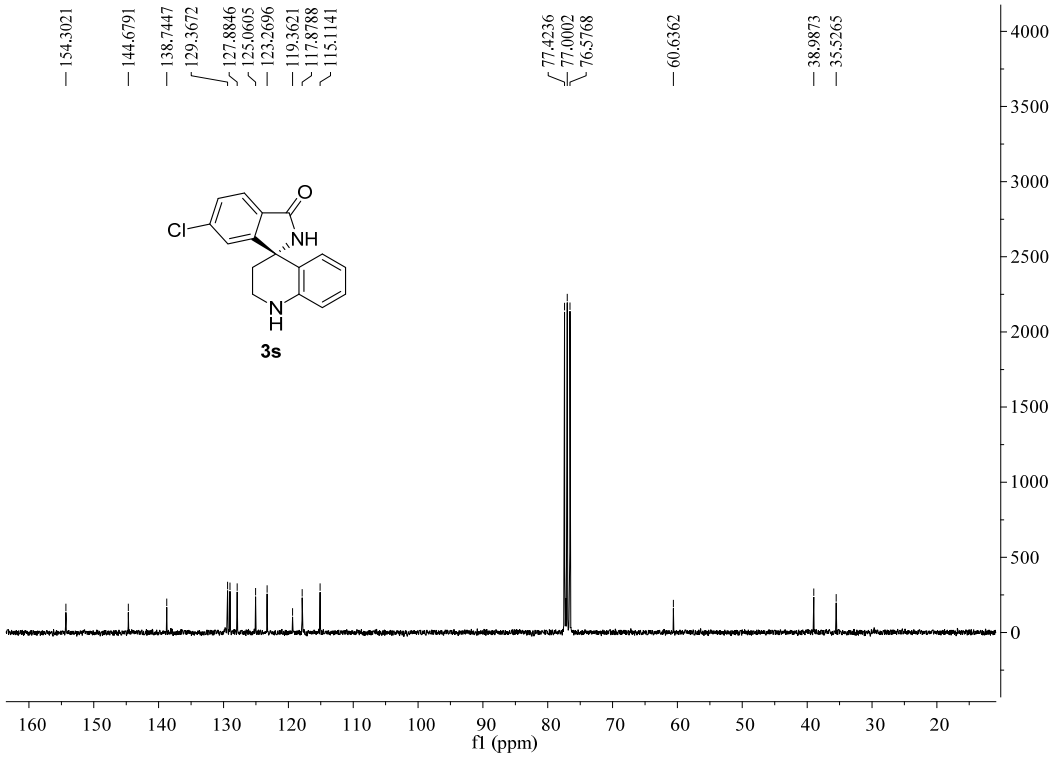
7.1902
6.9821
6.9359
6.5021
6.4737
6.4477
6.4230
3.5070
3.4862
3.4680
3.3850
3.3532
3.3215
2.2173
2.1847
2.1534
2.0181
1.9779
1.18
1.05
1.20
1.00
2.96
1.05
1.12
1.00
1.16
Cl
O
NH
N
H
3s
fl (ppm)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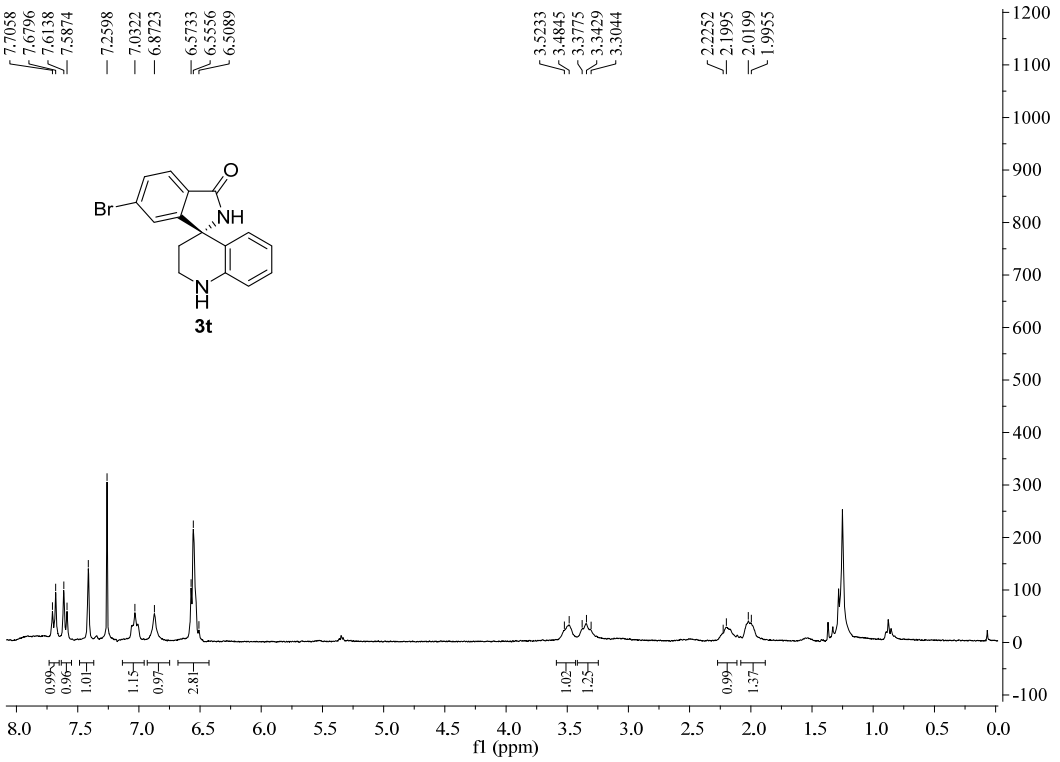
144.6791
138.7447
129.3672
127.8846
125.0605
123.2696
119.3621
117.8788
115.1141
77.4236
77.0002
76.5768
60.6362
38.9873
35.5265
Cl
O
NH
N
H
3s
fl (ppm)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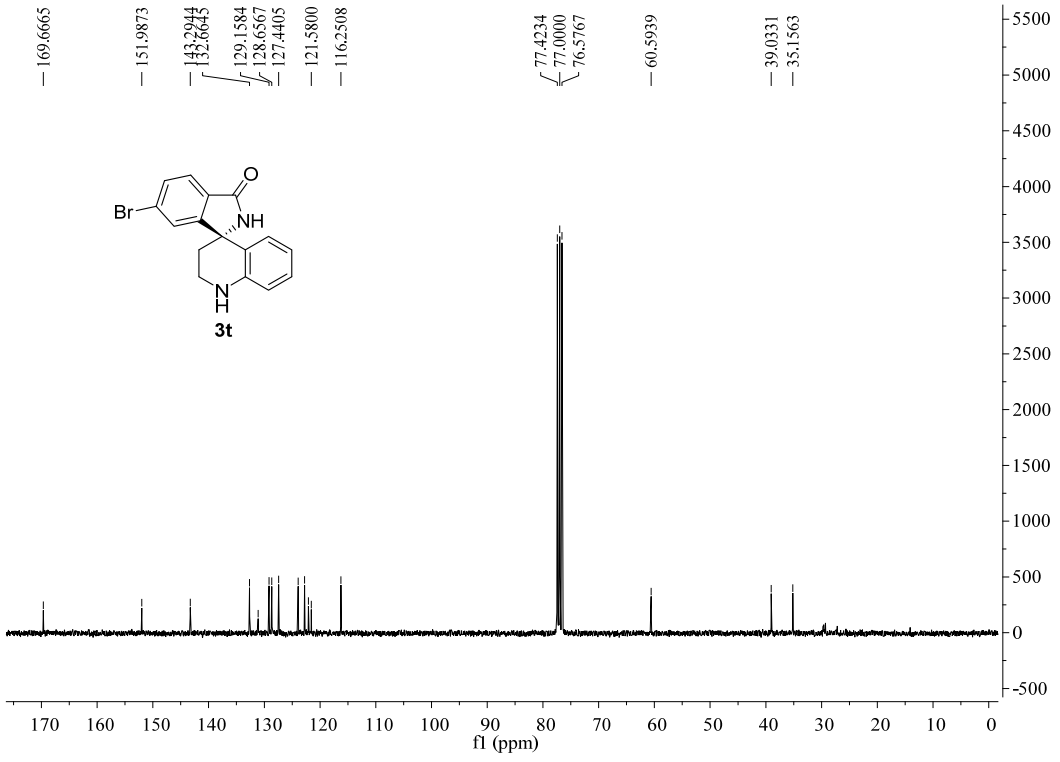
7.6796
7.6138
7.5874
7.2598
7.0322
6.8723
6.5733
6.5556
6.5089
3.5233
3.4845
3.3775
3.3429
3.3044
2.2252
2.1995
2.0199
1.9955
Br
O
NH
N
H
3t
0.99
0.96
1.01
1.15
0.97
2.81
1.02
1.25
0.99
1.37
f1 (ppm)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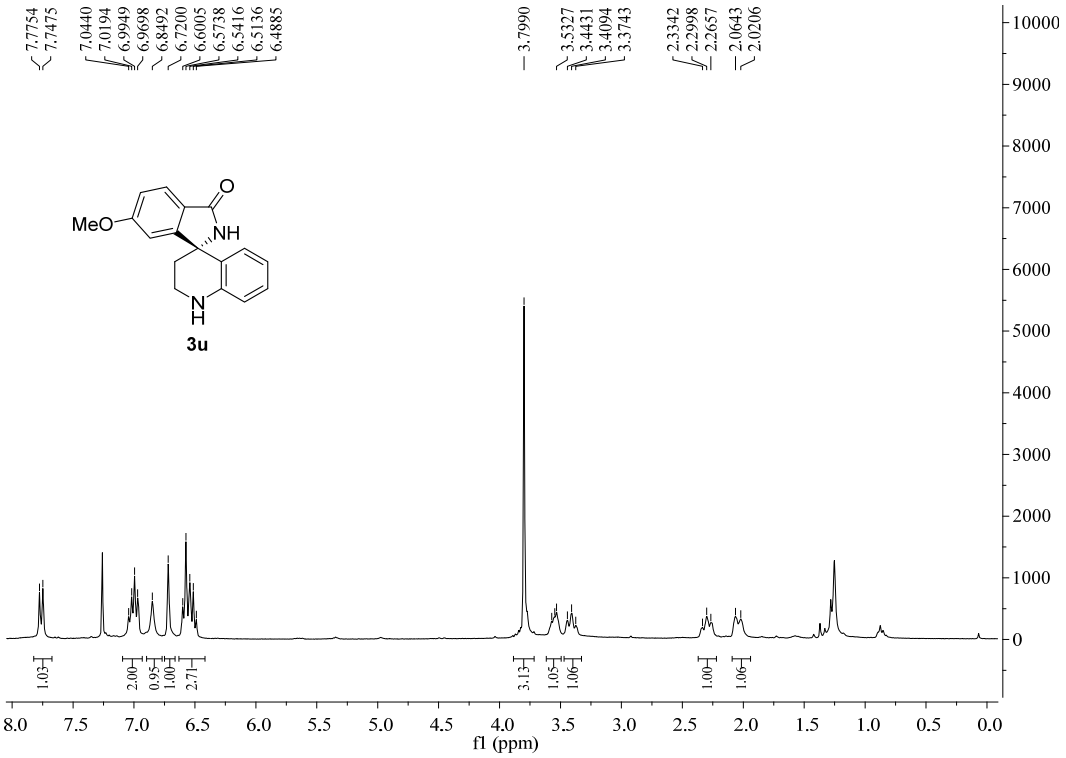
143.2944
132.8645
129.1584
128.6567
127.4405
121.5800
116.2508
77.4234
77.0000
76.5767
60.5939
39.0331
35.1563
Br
O
NH
N
H
3t
f1 (ppm)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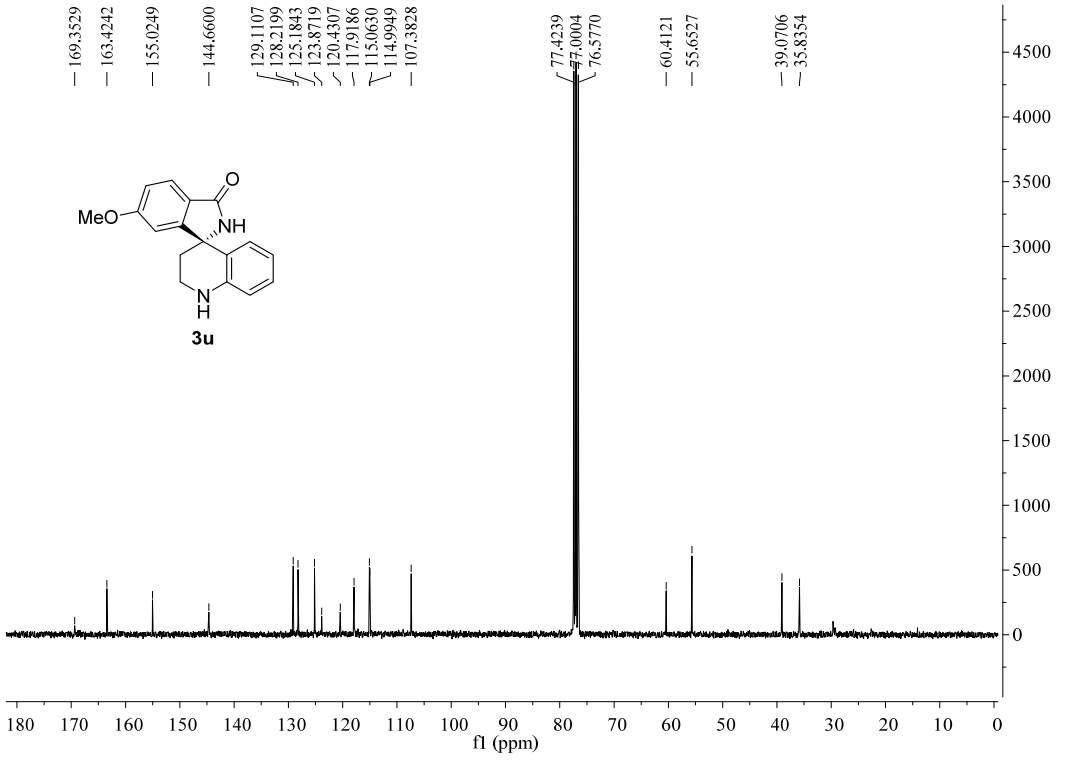
7.7475
7.0440
7.0194
6.9949
6.9698
6.8492
6.7200
6.6005
6.5738
6.5416
6.5136
6.4885
3.7990
3.5327
3.4431
3.4094
3.3743
2.3342
2.2998
2.2657
2.0643
2.0206
MeO
O
NH
N
H
3u
1.03
2.00
0.95
1.00
2.71
3.13
1.05
1.06
1.00
1.06
f1 (ppm)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144.6600
129.1107
128.2199
125.1843
123.8719
120.4307
117.9186
115.0630
114.9949
107.3828
77.4239
77.0004
76.5770
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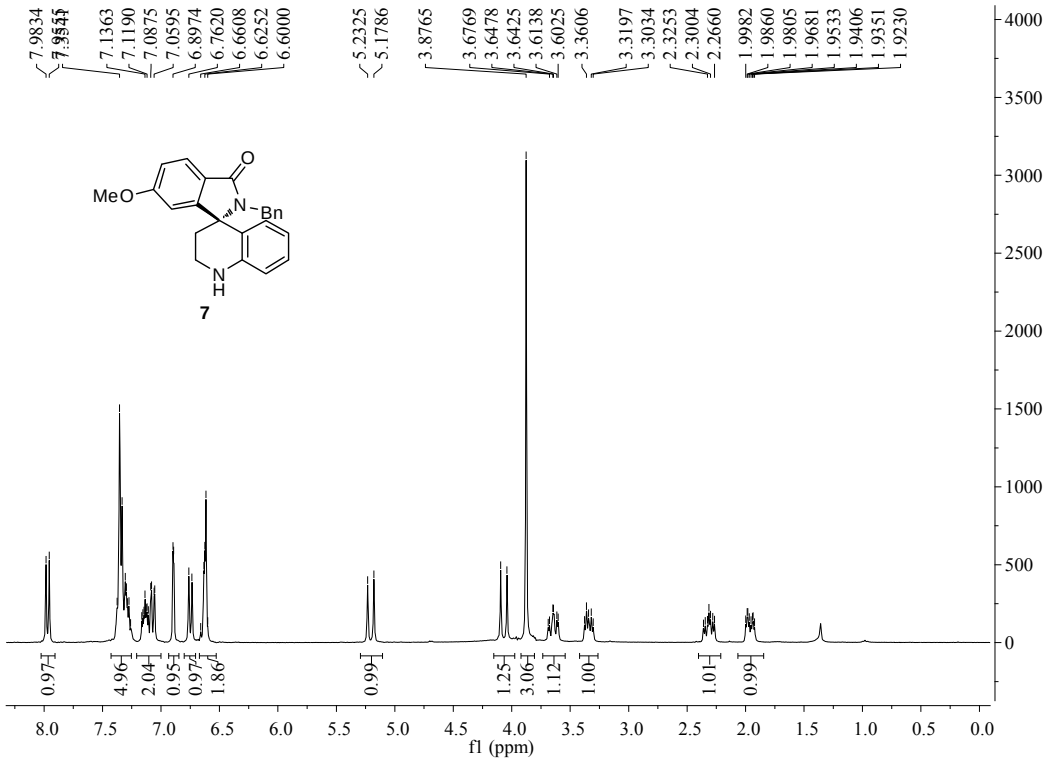
55.6527
39.0706
35.8354
MeO
O
NH
N
H
3u
f1 (ppm)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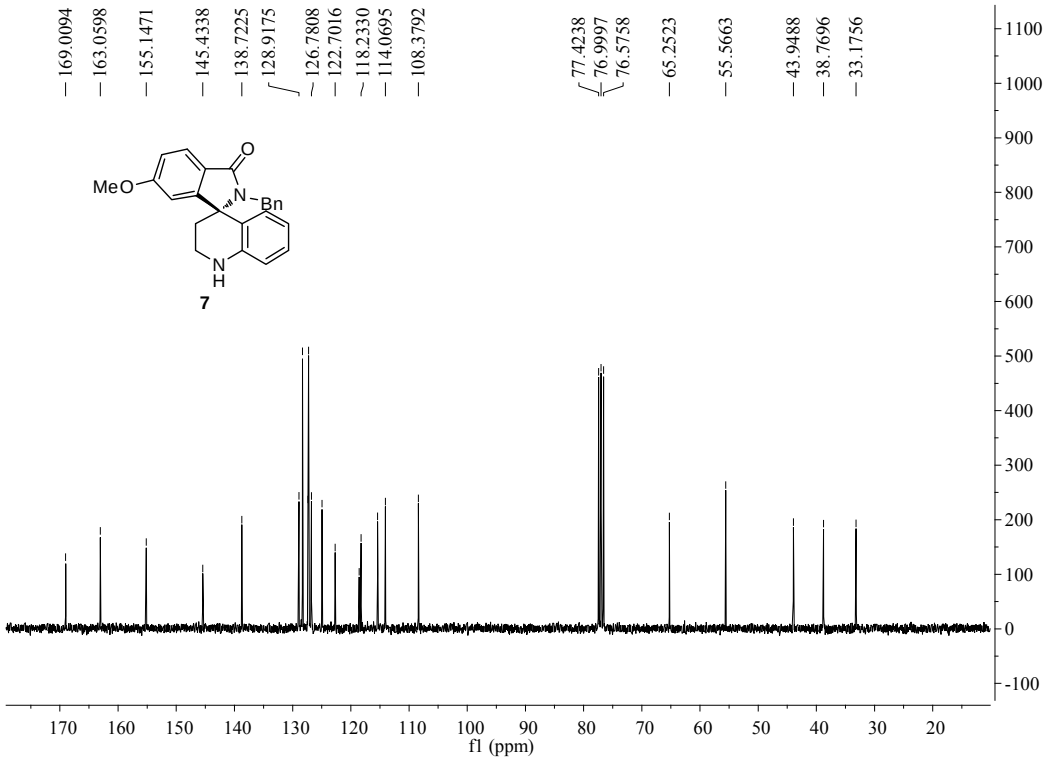
7.9551
7.1363
7.1190
7.0875
7.0595
6.8974
6.7620
6.6608
6.6252
6.6000
5.2325
5.1786
3.8765
3.6769
3.6478
3.6425
3.6138
3.6025
3.3606
3.3197
3.3034
2.3253
2.3004
2.2660
1.9982
1.9860
1.9805
1.9681
1.9533
1.9406
1.9351
1.9230
MeO
O
N
Bn
N
H
7
0.97
4.96
2.04
0.95
0.97
1.86
0.99
1.25
3.06
1.12
1.00
1.01
0.99
fl (ppm)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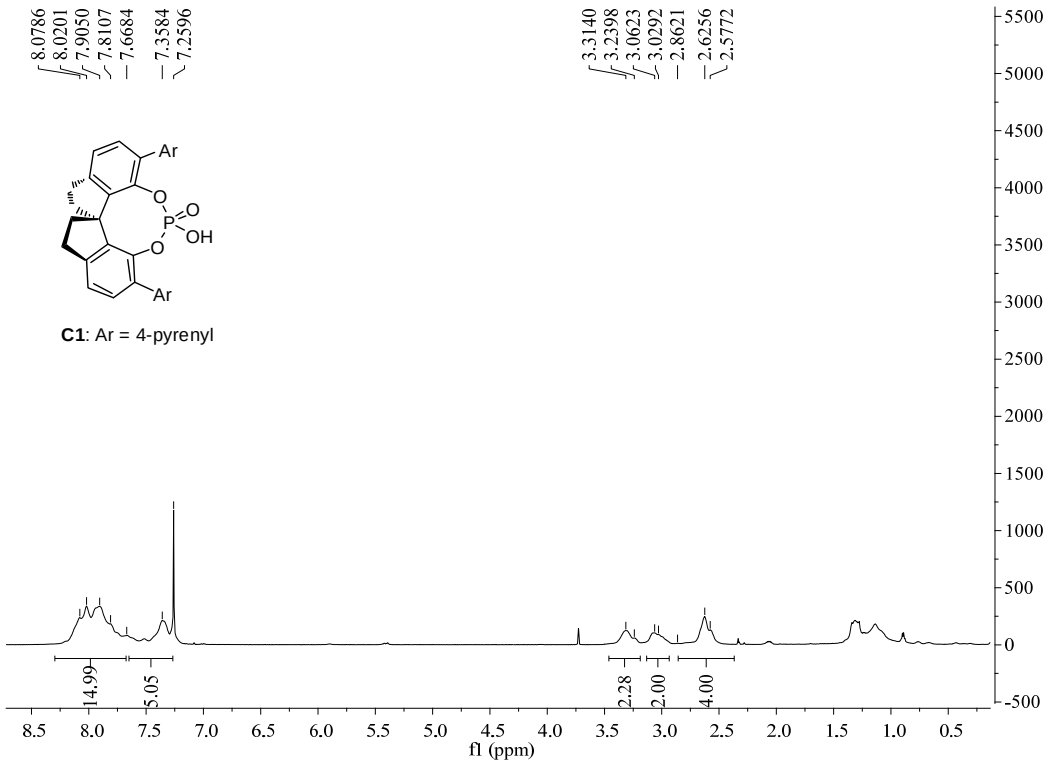
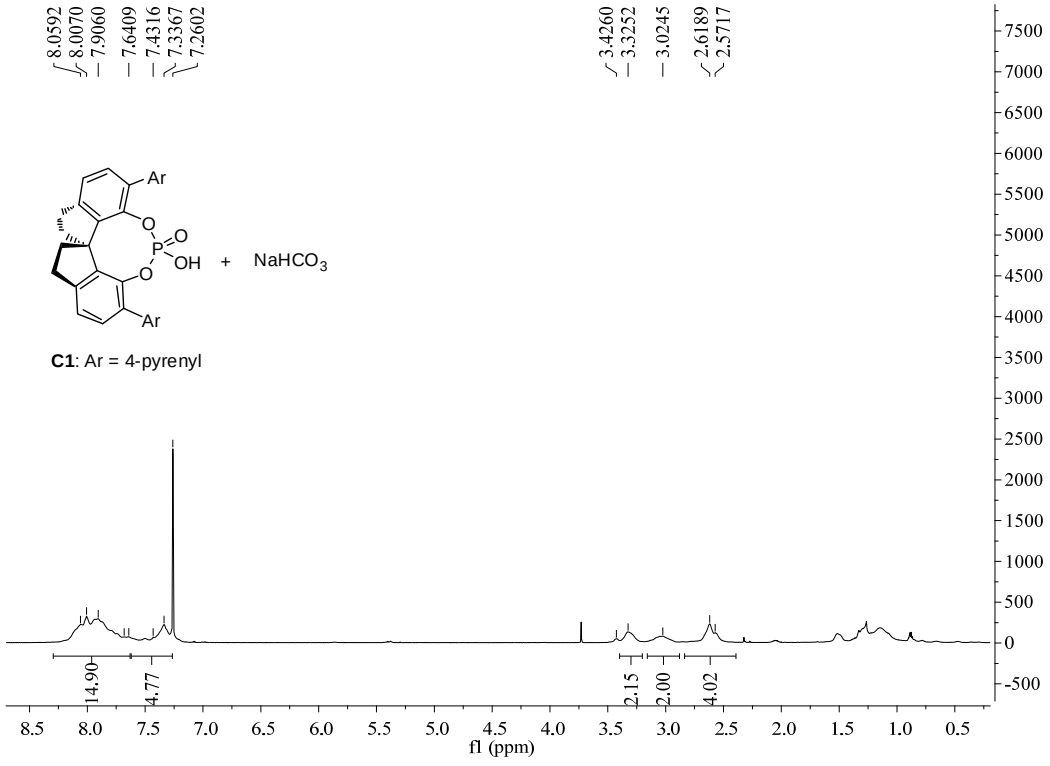
163.0598
155.1471
145.4338
138.7225
128.9175
126.7808
122.7016
118.2330
114.0695
108.3792
77.4238
76.9997
76.5758
65.2523
55.5663
43.9488
38.7696
33.1756
MeO
O
N
Bn
N
H
7
fl (ppm)



C1: Ar = 4-pyrenyl



C1: Ar = 4-pyrenyl