Supporting information

A Facile Method for Rh-Catalyzed Decarbonylative *ortho*-C-H Alkylation of (Hetero)arenes with Alkyl Carboxylic Acids

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I. General Considerations

A. General Information

All reactions were conducted under an atmosphere of nitrogen with dry solvents. Unless otherwise noted, materials were purchased from Aldrich, Alfa Aesar, Adamas, and other commercial suppliers and were used as received. Toluene were distilled from Na and stored under nitrogen. GC data were recorded on Agilent 7820A. Flash chromatography was performed with Sepaflash columns produced by Santai Technologies. NMR spectra were recorded on a Bruker AVANCE 400 spectrometer using $CDCl_3$ as solutions (^1H NMR: 400 MHz, ^{13}C NMR: 100 MHz, ^{19}F NMR: 377 MHz). The chemical shift was calibrated using TMS (0 ppm for 1H NMR) and residual undeuterated solvent $CDCl_3$ (7.26 ppm for ^1H NMR and 77.00 ppm for ^{13}C NMR). HRMS were performed by the Shanghai Mass Spectrometry Center in Shanghai Institute of Organic Chemistry, Chinese Academic of Sciences (Instrument: Thermo Fisher Scientific LTQ FT Ultra, Operation Mode: DART Positive).

B. General Procedures

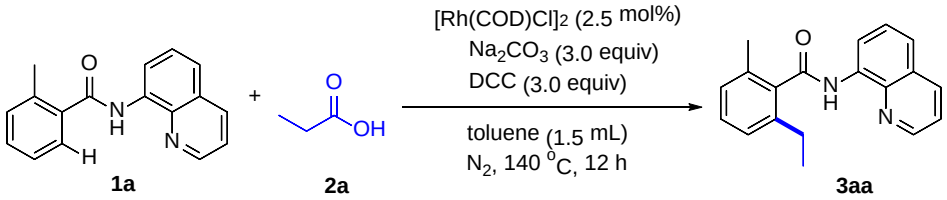
(I): General Experimental Procedure for Amide Formation: The benzamides were prepared following the previous literature procedure[1]: A solution of N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.1 equiv), and carboxylic acid (1.2 equiv) in CH_2Cl_2 (5.0 mL, for 1 mmol of 8-aminoquinoline) was stirred under a nitrogen atmosphere followed by slow addition of 8-aminoquinoline (720 mg, 5 mmol, 1.0 equiv) at room temperature. The resulting reaction mixture was stirred overnight. After completion of the reaction as indicated by TLC, the reaction mixture was quenched with 1 N HCl followed by extraction with a CH_2Cl_2 and brine solution. The organic layer was separated and washed with a saturated aqueous solution of $NaHCO_3$ and brine. The organic layer was dried over Na_2SO_4. The solvent was evaporated under vacuum. The crude residue was purified using column chromatography on silica gel.[1]

(II): The General Procedure for the Reactions of N-(quinoline-8-yl)carboxamides with In-situ Generated Acid anhydrides from Carboxylic Acids. In a nitrogen-filled glovebox, a 35 mL Schlenk tube equipped with a stir bar was charged with amide (1.0 equiv, 0.2 mmol), Na_2CO_3 (3.0 equiv, 0.6 mmol, 63.6mg), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), $[Rh(COD)Cl]_2$ (2.5 mol%, 0.005 mmol, 2.5 mg). The tube was fitted with a rubber septum and moved out of the glovebox. Then carboxylic acid (3 equiv, 0.6mmol) and toluene (1.5 mL) were added in turn to the Schlenk tube through the rubber septum using syringes, and then the septum was replaced with a Teflon screwcap under nitrogen flow (if the carboxylic acid was solid, it was added to the tube in the glovebox). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^oC for 12

h. Upon completion, the reaction mixture was diluted with 10 mL ethyl acetate, filtered through a pad of silica gel, followed by washing the pad of the silica gel with the ethyl acetate (20-50 mL). The filtrate was washed with 30 mL water and then the organic layer was washed again with brine (30 mL). The organic layers were dried over anhydrous Na_2SO_4; solvent was evaporated under reduced pressure to afford a crude residue. The residue was then purified by column to provide the corresponding product.

II. Experimental Data

A. Table S1. Optimization of Reaction Conditions

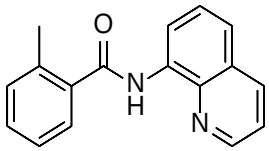


Entry	Catalyst (mmol%)	Base (equiv)	Additive (equiv)	Time/h	Temp./°C	Solvent	Yield[b](%)
1	$[Rh(cod)Cl]_2$ 5%	K_3PO_4 (3.0)	DPCP	24 h	140 °C	toluene	18
2	$[Rh(cod)Cl]_2$ 5%	K_3PO_4 (3.0)	DPCP	24 h	140 °C	1.4-dioxane	45
3	$[Rh(cod)Cl]_2$ 5%	Na_2CO_3 (3.0)	DPCP	24	140	toluene	55
4	$[Rh(cod)Cl]_2$ 5%	Na_2CO_3 (3.0)	DPCP	24	140	1.4-dioxane	53
5	$[Rh(cod)Cl]_2$ 5%	Na_2CO_3 (3.0)	DIC	24	140	toluene	78(57)
6	$[Rh(cod)Cl]_2$ 5%	Na_2CO_3 (3.0)	DCC	24	140	toluene	84(71)
7	$[Rh(cod)Cl]_2$ 2.5%	Na_2CO_3 (3.0)	DCC	24	140	toluene	84(71)
8	**$[Rh(cod)Cl]_2$ 2.5%**	**Na_2CO_3 (3.0)**	**DCC**	**12**	**140**	**toluene**	**84(71)**
9	$Rh(cod)_2(CF_3SO_3)$ 2.5%	Na_2CO_3 (3.0)	DCC	12	140	toluene	7
10	Rh(cod)(acac) 2.5%	Na_2CO_3 (3.0)	DCC	12	140	toluene	58
11	$[Rh(cod)Cl]_2$ 2.5%	K_2CO_3 (3.0)	DCC	12	140	toluene	78
12	$[Rh(cod)Cl]_2$ 2.5%	Li_2CO_3 (3.0)	DCC	12	140	toluene	83
13	$[Rh(cod)Cl]_2$ 2.5%	NaOAC (3.0)	DCC	12	140	toluene	75
14	$[Rh(cod)Cl]_2$ 2.5%	KOAC (3.0)	DCC	12	140	toluene	65
15	$[Rh(cod)Cl]_2$ 2.5%	$NaHCO_3$ (3.0)	DCC	12	140	toluene	83
16	$[Rh(cod)Cl]_2$	Cs_2CO_3	DCC	12	140	toluene	n.d

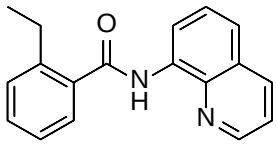
	2.5%	(3.0)					
17	$[Rh(cod)Cl]_2$ 2.5%	K_3PO_4 (3.0)	DCC	12	140	toluene	58
18	$[Rh(cod)Cl]_2$ 2.5%	Na_3PO_4 (3.0)	DCC	12	140	toluene	72
19	$[Rh(cod)Cl]_2$ 2.5%	NaO^tBu (3.0)	DCC	12	140	toluene	n.d
20	$[Rh(cod)Cl]_2$ 2.5%	KO^tBu (3.0)	DCC	12	140	toluene	n.d
21	$[Rh(cod)Cl]_2$ 2.5%	Na_2CO_3 (3.0)	DCC	12	130	toluene	52
22	$[Rh(cod)Cl]_2$ 2.5%	Na_2CO_3 (3.0)	DCC	12	120	toluene	31
23	-	Na_2CO_3 (3.0)	DCC	12	140	toluene	n.d
24	$[Rh(cod)Cl]_2$ 2.5%	-	DCC	12	140	toluene	n.d
25	$[Rh(cod)Cl]_2$ 2.5%	Na_2CO_3 (3.0)	-	12	140	toluene	n.d

Standard Conditions: 1a (0.2 mmol), **2a** (0.6 mmol), $[Rh(cod)Cl]_2$ (2.5 mol%), Na_2CO_3 (3.0 equiv), DCC (3.0 equiv), toluene (1.5 ml), 140 ^oC, N_2, 12 h. Determined by NMR spectroscopy using dibromomethane as internal standard (yield of isolated product in parentheses). [c] no detected.

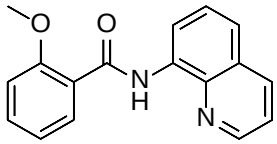
B. Products Data



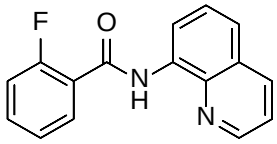
2-methyl-N-(quinolin-8-yl)benzamide (1a): Following the general procedure (I) with 2-methylbenzoic acid (7.4 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(7.4 mmol, 1.1 g, 1 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (9.6 mmol, 1.8 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.74 mmol, 90.4 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight. White solid (90% yield, 2.1 g, eluent = petroleum ether/ ethyl acetate (20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.23 (s, 1H), 8.95 (d, *J* = 7.4 Hz, 1H), 8.78 (d, *J* = 4.1 Hz, 1H), 8.19 (d, *J* = 8.1 Hz, 1H), 7.69 (d, *J* = 7.6 Hz, 1H), 7.65 – 7.52 (m, 2H), 7.46 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.41 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.8 Hz, 2H), 2.61 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 168.2, 148.2, 138.5, 136.7, 136.6, 136.4, 134.7, 131.3, 130.3, 128.0, 127.4, 127.2, 126.0, 121.8, 121.62, 116.6, 20.2.



2-ethyl-N-(quinolin-8-yl)benzamide(1b)： Following the general procedure (I) with 2-ethylbenzoic acid (6.7 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(6.7 mmol, 1.0 g, 1 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (8.7 mmol, 1.7 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.67 mmol, 81.9 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.
White solid (85% yield, 1.6 g, eluent = petroleum ether/ ethyl acetate (20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.22 (s, 1H), 8.98 (dd, J = 7.4, 1.5 Hz, 1H), 8.80 (dd, J = 4.2, 1.7 Hz, 1H), 8.22 (dd, J = 8.3, 1.7 Hz, 1H), 7.68 (dd, J = 7.6, 1.4 Hz, 1H), 7.66 – 7.61 (m, 1H), 7.59 (dd, J = 8.3, 1.6 Hz, 1H), 7.52 – 7.48 (m, 1H), 7.48 – 7.44 (m, 1H), 7.41 – 7.33 (m, 2H), 2.98 (q, J = 7.5 Hz, 2H), 1.34 (t, J = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.4, 148.2, 142.7, 138.4, 136.3, 134.7, 130.3, 129.7, 127.9, 127.4, 127.1, 125.9, 121.8, 121.6, 116.5, 26.5, 16.0.

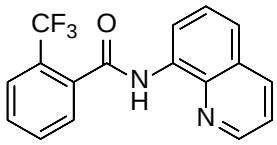


2-methoxy-N-(quinolin-8-yl)benzamide(1c)： Following the general procedure (I) with 2-methoxybenzoic acid (6.6 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(6.6 mmol, 952 mg, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (8.6 mmol, 1.6 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.66 mmol, 81.0 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.
White solid (85% yield, 1.5 g, eluent = petroleum ether/ ethyl acetate (10: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 12.32 (s, 1H), 9.04 (dd, J = 7.6, 1.4 Hz, 1H), 8.88 (dd, J = 4.2, 1.7 Hz, 1H), 8.35 (dd, J = 7.8, 1.8 Hz, 1H), 8.18 (dd, J = 8.3, 1.7 Hz, 1H), 7.59 (t, J = 7.9 Hz, 1H), 7.52 (ddd, J = 8.4, 7.7, 1.6 Hz, 2H), 7.47 (dd, J = 8.2, 4.2 Hz, 1H), 7.15 (ddd, J = 8.1, 7.4, 1.0 Hz, 1H), 7.08 (dd, J = 8.3, 1.0 Hz, 1H), 4.21 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 163.6, 157.6, 148.1, 139.1, 136.2, 135.6, 133.1, 132.2, 128.0, 127.5, 122.2, 121.4, 121.4, 121.2, 117.3, 111.5, 56.0.

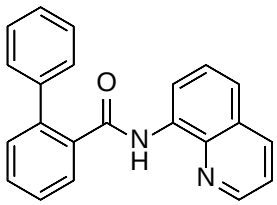


2-fluoro-N-(quinolin-8-yl)benzamide(1d)： Following the general procedure (I) with 2-fluorobenzoic acid (7.2 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(7.2 mmol, 1.1 mg 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (9.4 mmol, 1.8 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP)

(0.72 mmol, 88.0 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.
White solid (85% yield, 1.6 g, eluent = petroleum ether/ ethyl acetate (20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 11.16 (d, J = 12.1 Hz, 1H), 8.99 (dd, J = 7.2, 1.8 Hz, 1H), 8.89 (dd, J = 4.3, 1.7 Hz, 1H), 8.26 – 8.18 (m, 2H), 7.64 – 7.57 (m, 2H), 7.57 – 7.52 (m, 1H), 7.49 (dd, J = 8.3, 4.3 Hz, 1H), 7.34 (td, J = 7.6, 1.1 Hz, 1H), 7.29 – 7.22 (m, 1H). 19F NMR (376 MHz, CDCl3) δ -112.10. **^{13}C NMR** (101 MHz, $CDCl_3$) δ 161.5 (d, J = 4 Hz), 160.4 (d, J = 248 Hz), 148.3, 138.6, 136.12, 134.7, 133.4 (d, J = 9 Hz), 131.9 (d, J = 2 Hz), 127.8, 127.2, 124.7(d, J = 3 Hz), 121.9, 121.9 (d, J = 11 Hz), 121.5, 117.1, 116.2 (d, J = 25 Hz).

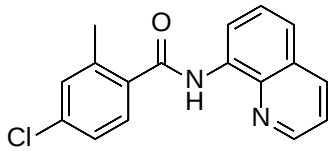


N-(quinolin-8-yl)-2-(trifluoromethyl)benzamide (1e): Following the general procedure (I) with 2-(trifluoromethyl)benzoic acid (5.3 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(5.3 mmol, 764.3mg, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (6.9 mmol, 1.3 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.53mmol, 64.8 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.
White solid (80% yield, 1.3 g, eluent = petroleum ether/ ethyl acetate (10: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.18 (s, 1H), 8.93 (dd, J = 6.9, 2.1 Hz, 1H), 8.76 (dd, J = 4.3, 1.7 Hz, 1H), 8.19 (dd, J = 8.3, 1.6 Hz, 1H), 7.78 (dd, J = 12.6, 7.6 Hz, 2H), 7.69 (t, J = 7.2 Hz, 1H), 7.65 – 7.56 (m, 3H), 7.46 (dd, J = 8.3, 4.2 Hz, 1H). 19F NMR (376 MHz, CDCl3) δ -58.87. **^{13}C NMR** (101 MHz, $CDCl_3$) δ 165.9, 148.3, 138.3, 136.3, 136.0 (q, J = 2 Hz), 134.2, 132.1, 130.1, 128.4, 127.9, 127.5 (q, J = 32 Hz), 127.3, 126.6 (q, J = 5 Hz), 123.6 (q, J = 272 Hz), 122.3, 121.7, 116.8.



N-(quinolin-8-yl)-[1,1'-biphenyl]-2-carboxamide(1f): Following the general procedure (I) with [1,1'-biphenyl]-2-carboxylic acid (5.1 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(5.1 mmol, 735.3 mg, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (6.6 mmol, 1.3 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.51 mmol, 62.3 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.
White solid (72% yield, 1.2 g, eluent = petroleum ether/ ethyl acetate (20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.84 (dd, J = 7.6, 1.4 Hz, 1H), 8.53 (dd, J = 4.2, 1.7 Hz, 1H), 8.06 (dd, J = 8.3, 1.7 Hz, 1H), 7.93 (dd, J = 7.9, 1.4 Hz, 1H), 7.60 – 7.54 (m, 2H), 7.53 (td, J = 3.4, 1.8 Hz, 2H), 7.51 – 7.48 (m, 2H), 7.45 (dd, J = 8.3, 1.5 Hz, 1H), 7.34 (dd, J = 8.3, 4.2 Hz, 1H), 7.29 (dd, J = 8.4, 7.0 Hz, 2H), 7.20 – 7.14 (m,

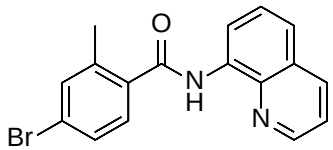
1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 167.8, 147.6, 140.2, 139.9, 138.2, 136.0, 136.0, 134.4, 130.6, 130.4, 129.1, 128.9, 128.3, 127.6, 127.6, 127.5, 127.2, 121.5, 121.3, 116.2.



4-chloro-2-methyl-N-(quinolin-8-yl)benzamide (1g): Following the general procedure (I) with 4-chloro-2-methylbenzoic acid (5.9 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(5.9 mmol, 850.7 mg, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (7.7 mmol, 1.5 mg, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.59 mmol, 72.1 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.

White solid (85% yield, 1.5 g, eluent = petroleum ether/ ethyl acetate (20: 1));

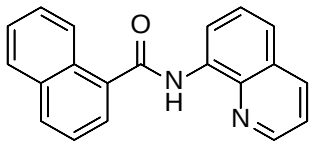
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.23 (s, 1H), 8.91 (dd, J = 7.3, 1.7 Hz, 1H), 8.79 (dd, J = 4.3, 1.6 Hz, 1H), 8.22 (dt, J = 8.3, 1.8 Hz, 1H), 7.68 – 7.55 (m, 3H), 7.49 (dd, J = 8.3, 4.3 Hz, 1H), 7.31 (d, J = 6.7 Hz, 2H), 2.59 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 167.1, 148.3, 138.8, 138.4, 136.4, 136.1, 134.9, 134.4, 131.3, 128.6, 127.9, 127.4, 126.1, 122.0, 121.7, 116.6, 20.1.



4-bromo-2-methyl-N-(quinolin-8-yl)benzamide(1h): Following the general procedure (I) with 4-bromo-2-methylbenzoic acid (4.7 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(4.7 mmol, 677.6mg, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (6.1 mmol, 1.2 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.47 mmol, 47.4 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.

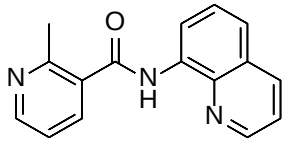
White solid (80% yield, 1.3 g, eluent = petroleum ether/ ethyl acetate (20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.26 (s, 1H), 8.92 (dd, J = 7.2, 1.8 Hz, 1H), 8.80 (dd, J = 4.3, 1.7 Hz, 1H), 8.24 (dd, J = 8.3, 1.7 Hz, 1H), 7.66 – 7.55 (m, 3H), 7.53 – 7.44 (m, 3H), 2.58 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 167.1, 148.3, 139.0, 138.4, 136.4, 135.3, 134.4, 134.2, 129.1, 128.7, 127.9, 127.3, 124.5, 120.0, 121.7, 116.5, 20.0.

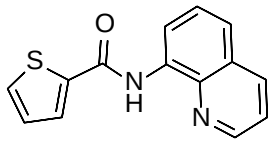


N-(quinolin-8-yl)-1-naphthamide(1i): Following the general procedure (I) with 1-naphthoic acid (5.8 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(5.8 mmol, 836.2 mg, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (7.5 mmol, 1.4 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP)

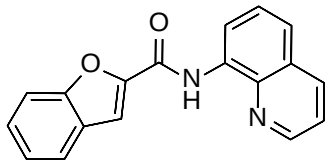
(0.58mmol, 70.9 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight. White solid (85% yield, 1.5 g, eluent = petroleum ether/ ethyl acetate (20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.45 (s, 1H), 9.08 (dd, J = 7.6, 1.4 Hz, 1H), 8.75 (dd, J = 4.3, 1.6 Hz, 1H), 8.59 – 8.51 (m, 1H), 8.19 (dd, J = 8.3, 1.7 Hz, 1H), 8.01 (dt, J = 8.2, 1.0 Hz, 1H), 7.97 – 7.91 (m, 2H), 7.69 – 7.63 (m, 1H), 7.62 – 7.54 (m, 4H), 7.45 (dd, J = 8.3, 4.2 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 167.7, 148.2, 138.5, 136.4, 134.7, 134.6, 133.8, 131.1, 130.3, 128.3, 128.0, 127.4, 127.3, 126.5, 125.5, 124.8, 121.9, 121.6, 116.8.



2-methyl-N-(quinolin-8-yl)nicotinamide(1j): Following the general procedure (I) with 2-methylnicotinic acid (7.3 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(7.3 mmol, 1.1 g, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (9.5 mmol, 1.8 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.73 mmol, 89.2 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight. White solid (80% yield, 1.5 g, eluent = petroleum ether/ ethyl acetate (1: 1))
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.25 (s, 1H), 8.91 (dd, J = 6.8, 2.2 Hz, 1H), 8.79 (dd, J = 4.2, 1.6 Hz, 1H), 8.65 (dd, J = 4.9, 1.8 Hz, 1H), 8.20 (dd, J = 8.3, 1.7 Hz, 1H), 7.99 (dd, J = 7.7, 1.8 Hz, 1H), 7.64 – 7.57 (m, 2H), 7.48 (dd, J = 8.3, 4.3 Hz, 1H), 7.32 – 7.27 (m, 1H), 2.85 (s, 3H). **^{13}C NMR** (400 MHz, $CDCl_3$) δ 166.5, 156.6, 150.4, 148.4, 138.4, 136.4, 135.3, 134.2, 132.0, 127.9, 127.4, 122.2, 121.8, 121.1, 116.7, 23.4.



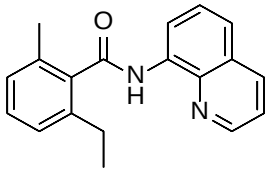
N-(quinolin-8-yl)thiophene-2-carboxamide(1k): Following the general procedure (I) with thiophene-2-carboxylic acid (7.8 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(7.8 mmol, 1.1 g, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (10.2 mmol, 1.9 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.78 mmol, 95.3 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.
White solid (60% yield, 1.2 g, eluent = petroleum ether/ ethyl acetate (15: 1))
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.60 (s, 1H), 8.84 (dt, J = 5.8, 1.6 Hz, 2H), 8.18 (dd, J = 8.2, 1.7 Hz, 1H), 7.85 (dd, J = 3.7, 1.1 Hz, 1H), 7.61 – 7.50 (m, 3H), 7.47 (dd, J = 8.3, 4.3 Hz, 1H), 7.18 (dd, J = 5.0, 3.7 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 160.0, 148.2, 140.0, 138.3, 136.5, 134.2, 130.9, 128.4, 127.9, 127.8, 127.4, 121.7, 116.6.



N-(quinolin-8-yl)benzofuran-2-carboxamide(1l): Following the general procedure (I) with benzofuran-2-carboxylic acid (6.2 mmol, 1.0 g, 1.0 equiv), 8-aminoquinoline(6.2 mmol, 893.9 mg, 1.0 equiv), N'-(3-(dimethylamino)propyl)-N-ethyl-carbodimide, hydrochloride salt (EDC·HCl) (8.1 mmol, 1.6 g, 1.3equiv), 4-(N,N-dimethylamino) pyridine (DMAP) (0.62 mmol, 75.7 mg, 0.1 equiv), The resulting reaction mixture was stirred overnight.

White solid (53% yield, 0.9 g, eluent = petroleum ether/ ethyl acetate (10: 1))

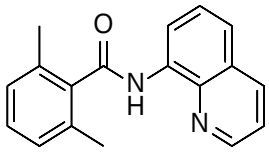
^{1}H NMR (400 MHz, $CDCl_3$) δ 11.04 (s, 1H), 8.96 (ddd, J = 9.0, 5.6, 1.9 Hz, 2H), 8.25 (dd, J = 8.3, 1.6 Hz, 1H), 7.77 – 7.67 (m, 3H), 7.67 – 7.58 (m, 2H), 7.54 (dd, J = 8.3, 4.3 Hz, 1H), 7.48 (ddd, J = 8.5, 7.2, 1.3 Hz, 1H), 7.34 (td, J = 7.5, 0.9 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 156.9, 155.0, 149.0, 148.4, 138.5, 136.5, 133.9, 128.0, 127.7, 127.4, 127.1, 123.7, 122.7, 122.2, 121.7, 117.2, 112.2, 111.3.



2-ethyl-6-methyl-N-(quinolin-8-yl)benzamide (3a): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

White solid (71% yield, 41.3 mg, eluent = petroleum ether/ ethyl acetate (20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.98 (s, 1H), 9.01 (dd, *J* = 7.4, 1.4 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.4 Hz, 1H), 7.66 – 7.56 (m, 2H), 7.46 (dd, *J* = 8.3, 4.3 Hz, 1H), 7.30 (t, *J* = 7.6 Hz, 1H), 7.15 (dd, *J* = 17.6, 7.6 Hz, 2H), 2.76 (q, *J* = 7.6 Hz, 2H), 2.44 (s, 3H), 1.27 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.2, 140.8, 138.4, 137.5, 136.4, 134.4, 134.4, 129.1, 128.0, 127.7, 127.4, 126.1, 121.9, 121.6, 116.8, 26.5, 19.5, 16.0. This compound is known.[2] The ^{1}H and ^{13}C NMR spectral data are in good agreement with the literature data.

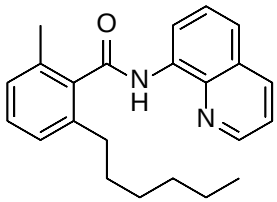


2,6-dimethyl-N-(quinolin-8-yl)benzamide (3b): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Acetic

acid **2** (0.6 mmol, 36.1 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

White solid (57% yield, 31.5 mg, eluent = petroleum ether/ ethyl acetate (20: 1))

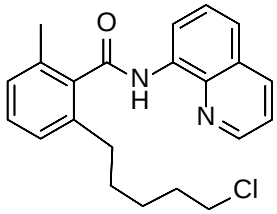
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 9.01 (dd, *J* = 7.4, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.68 – 7.54 (m, 2H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.28 – 7.22 (m, 1H), 7.12 (d, *J* = 7.6 Hz, 2H), 2.44 (s, 6H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.1, 138.3, 138.0, 136.5, 134.5, 134.3, 129.0, 128.0, 127.7, 127.4, 121.9, 121.6, 116.9, 19.4. This compound is known.[3] The ^{1}H and ^{13}C NMR spectral data are in good agreement with the literature data.



2-hexyl-6-methyl-N-(quinolin-8-yl)benzamide (3c): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Heptanoic acid **2** (0.6 mmol, 78.1 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Yellow oil (61% yield, 42.3 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.96 (s, 1H), 9.01 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.66 – 7.55 (m, 2H), 7.46 (dd, *J* = 8.3, 4.3 Hz, 1H), 7.31 – 7.25 (m, 1H), 7.13 (dd, *J* = 11.8, 7.5 Hz, 2H), 2.75 – 2.66 (m, 2H), 2.43 (s, 3H), 1.72 – 1.61 (m, 2H), 1.28 – 1.21 (m, 2H), 1.16 (dt, *J* = 7.3, 3.7 Hz, 4H), 0.76 – 0.67 (m, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.2, 139.5, 138.5, 137.7, 136.3, 134.5, 134.4, 128.9, 128.0, 127.7, 127.4, 126.7, 121.9, 121.6, 116.7, 33.4, 31.6, 31.5, 29.2, 22.4, 19.5, 13.9. This compound is known.[4] The ^{1}H and ^{13}C NMR spectral data are in good agreement with the literature data.

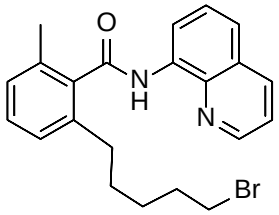


2-(5-chloropentyl)-6-methyl-N-(quinolin-8-yl)benzamide (3d): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), 6-Chlorohexanoic Acid **2** (0.6 mmol, 90.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-

Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Colorless oil (69% yield, 50.6 mg, eluent = petroleum ether/ ether acetate(20: 1));

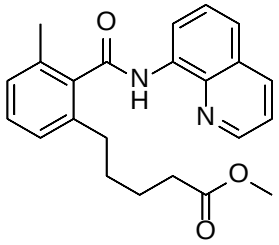
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.97 (s, 1H), 9.00 (dd, *J* = 7.3, 1.4 Hz, 1H), 8.75 (d, *J* = 3.9 Hz, 1H), 8.22 (d, *J* = 8.1 Hz, 1H), 7.67 – 7.57 (m, 2H), 7.47 (dd, *J* = 8.4, 3.7 Hz, 1H), 7.29 (t, *J* = 7.6 Hz, 1H), 7.14 (dd, *J* = 7.4, 2.8 Hz, 2H), 3.40 (t, *J* = 6.8 Hz, 2H), 2.76 – 2.69 (m, 2H), 2.44 (s, 3H), 1.76 – 1.64 (m, 4H), 1.42 (tt, *J* = 9.2, 6.2 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.1, 138.9, 138.1, 137.7, 136.8, 134.6, 134.2, 129.0, 128.1, 127.9, 127.6, 126.7, 122.0, 121.7, 117.1, 44.8, 33.3, 32.3, 30.8, 26.7, 19.5. **HRMS:** Calcd for $C_{22}H_{24}ON_2Cl$ [M+H$^+$]: 367.1573; Found: 367.1574.



2-(5-bromopentyl)-6-methyl-N-(quinolin-8-yl)benzamide (3e): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), 6-Bromohexanoic acid **2** (0.6 mmol, 117.1 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Yellow oil (42% yield, 34.6 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 8.99 (dd, *J* = 7.4, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.66 – 7.56 (m, 2H), 7.46 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.29 (t, *J* = 7.6 Hz, 1H), 7.13 (dd, *J* = 7.8, 2.1 Hz, 2H), 3.26 (t, *J* = 6.9 Hz, 2H), 2.77 – 2.68 (m, 2H), 2.43 (s, 3H), 1.81 – 1.74 (m, 2H), 1.74 – 1.66 (m, 2H), 1.41 (tt, *J* = 9.7, 6.4 Hz, 2H). **^{13}C NMR** (400 MHz, $CDCl_3$) δ 168.8, 148.2, 138.9, 138.3, 137.7, 136.5, 134.6, 134.2, 129.0, 128.0 (d, *J* = 56.4 Hz), 127.5, 126.7, 122.0, 121.7, 116.9, 33.6, 33.2, 32.5, 30.7, 28.0, 19.5. **HRMS:** Calcd for $C_{22}H_{24}ON_2Br$ [M+H$^+$]: 411.1067; Found: 411.1068.



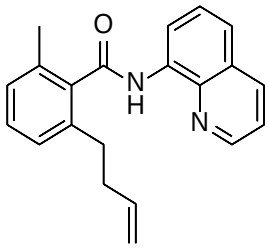
methyl 5-(3-methyl-2-(quinolin-8-ylcarbamoyl)phenyl)pentanoate (3f): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol,

52.5 mg, 1.0 equiv), Monomethyl adipate **2** (0.6 mmol, 96.1 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Colorless oil (64% yield, 48.2mg, eluent = petroleum ether/ ether acetate(10: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.92 (s, 1H), 8.98 (dd, *J* = 7.4, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.66 – 7.54 (m, 2H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.28 (t, *J* = 7.6 Hz, 1H), 7.16 – 7.10 (m, 2H), 3.56 (s, 3H), 2.78 – 2.69 (m, 2H), 2.43 (s, 3H), 2.24 (t, *J* = 7.4 Hz, 2H), 1.76 – 1.68 (m, 2H), 1.66 – 1.58 (m, 2H).

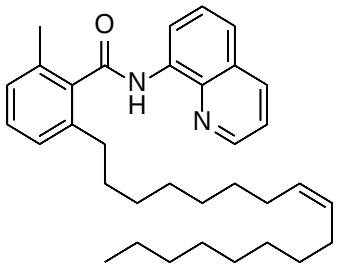
^{13}C NMR (101 MHz, $CDCl_3$) δ 173.9, 168.7, 148.2, 138.7, 138.4, 137.7, 136.4, 134.5, 134.3, 129.0, 128.0, 127.9, 127.4, 126.7, 121.9, 121.6, 116.8, 51.3, 33.8, 33.0, 31.0, 24.7, 19.5. This compound is known.[5] The ^{1}H and ^{13}C NMR spectral data are in good agreement with the literature data.



2-(but-3-en-1-yl)-6-methyl-N-(quinolin-8-yl)benzamide (3g): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Allylacetic acid **2** (0.6 mmol, 60.1 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Yellow oil (66% yield, 41.8 mg, eluent = petroleum ether/ ether acetate(20: 1));

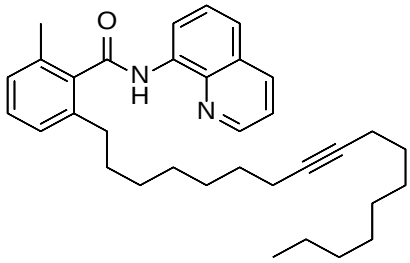
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.96 (s, 1H), 9.00 (dd, *J* = 7.3, 1.6 Hz, 1H), 8.74 (dd, *J* = 4.3, 1.6 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.66 – 7.56 (m, 2H), 7.46 (dd, *J* = 8.3, 4.1 Hz, 1H), 7.29 (t, *J* = 7.6 Hz, 1H), 7.15 (t, *J* = 7.9 Hz, 2H), 5.79 (ddt, *J* = 16.9, 10.2, 6.6 Hz, 1H), 4.98 – 4.84 (m, 2H), 2.88 – 2.78 (m, 2H), 2.50 – 2.38 (m, 5H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.8, 148.1, 138.4, 138.2, 137.9, 137.8, 136.7, 134.5, 134.2, 129.0, 128.0, 127.9, 127.5, 126.8, 122.0, 121.6, 117.1, 115.0, 35.5, 32.9, 19.5. This compound is known.[5] The ^{1}H and ^{13}C NMR spectral data are in good agreement with the literature data.



(Z)-2-(heptadec-8-en-1-yl)-6-methyl-N-(quinolin-8-yl)benzamide (3h): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Oleic acid **2** (0.6 mmol, 169.5 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^oC for 12 h.

Colorless oil (80% yield, 79.8 mg, eluent = petroleum ether/ ether acetate(25: 1));

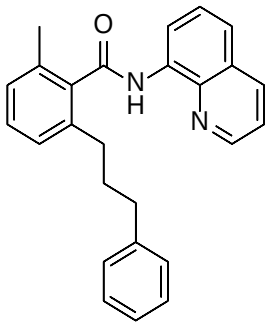
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 9.01 (s, 1H), 8.73 (s, 1H), 8.18 (d, *J* = 4.6 Hz, 1H), 7.67 – 7.53 (m, 2H), 7.44 (s, 1H), 7.27 (d, *J* = 9.3 Hz, 1H), 7.13 (t, *J* = 10.1 Hz, 2H), 5.30 (tt, *J* = 12.8, 7.6 Hz, 2H), 2.77 – 2.67 (m, 2H), 2.44 (s, 3H), 2.03 – 1.93 (m, 2H), 1.93 – 1.84 (m, 2H), 1.73 – 1.63 (m, 2H), 1.21 (d, *J* = 37.4 Hz, 22H), 0.87 (d, *J* = 6.7 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.1, 139.4, 138.4, 137.7, 136.3, 134.4, 134.3, 129.8, 128.9, 128.0, 127.6, 127.4, 126.7, 121.9, 121.6, 116.8, 33.4, 31.9, 31.6, 29.7, 29.6, 29.5, 29.3, 29.2, 29.0, 27.1, 27.1, 22.6, 19.5, 14.1. **HRMS:** Calcd for $C_{33}H_{47}ON_2$ [M+H$^+$]: 499.3683; Found: 499.3685.



2-(heptadec-8-yn-1-yl)-6-methyl-N-(quinolin-8-yl)benzamide (3i): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), 9-Octadecynoic Acid **2** (0.6 mmol, 168.3 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^oC for 12 h.

Colorless oil (63% yield, 62.6 mg, eluent = petroleum ether/ ether acetate(25: 1));

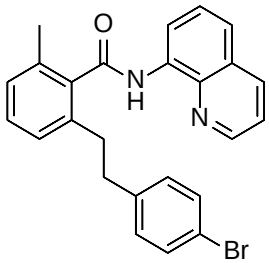
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 9.01 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.65 – 7.60 (m, 1H), 7.57 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.28 (t, *J* = 7.8 Hz, 1H), 7.13 (dd, *J* = 10.4, 7.6 Hz, 2H), 2.74 – 2.68 (m, 2H), 2.44 (s, 3H), 2.12 (tt, *J* = 7.1, 2.5 Hz, 2H), 2.00 (tt, *J* = 7.1, 2.4 Hz, 2H), 1.74 – 1.63 (m, 2H), 1.46 (p, *J* = 6.9 Hz, 2H), 1.40 – 1.08 (m, 20H), 0.92 – 0.83 (m, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.1, 139.4, 138.3, 137.7, 136.4, 134.5, 134.3, 128.9, 128.0, 127.7, 127.4, 126.7, 121.9, 121.6, 116.8, 80.1, 33.4, 31.8, 31.6, 29.4, 29.2, 29.1, 29.1, 29.0, 28.8, 28.8, 28.6, 22.6, 19.5, 18.7, 18.6, 14.1. **HRMS:** Calcd for $C_{34}H_{45}ON_2$ [M+H$^+$]: 497.3525; Found: 497.3528.



2-methyl-6-(3-phenylpropyl)-N-(quinolin-8-yl)benzamide (3j): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), 4-Phenylbutyric Acid **2** (0.6 mmol, 98.5 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Yellow oil (77% yield, 58.6 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 8.97 (d, *J* = 7.1 Hz, 1H), 8.71 (s, 1H), 8.22 (d, *J* = 7.9 Hz, 1H), 7.62 (dt, *J* = 11.1, 8.0 Hz, 2H), 7.51 – 7.42 (m, 1H), 7.29 (dd, *J* = 7.8, 2.1 Hz, 1H), 7.15 (d, *J* = 7.0 Hz, 2H), 7.12 – 6.98 (m, 5H), 2.76 (t, *J* = 8.1 Hz, 2H), 2.60 (t, *J* = 8.0 Hz, 2H), 2.44 (s, 3H), 2.08 – 1.97 (m, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.8, 148.1, 141.9, 138.9, 138.2, 137.7, 136.6, 134.6, 134.2, 129.0, 128.2, 128.0, 128.0, 127.9, 127.5, 126.8, 125.4, 122.0, 121.6, 117.1, 35.7, 33.2, 19.5. This compound is known.[4] The ^{1}H and ^{13}C NMR spectral data are in good agreement with the literature data.

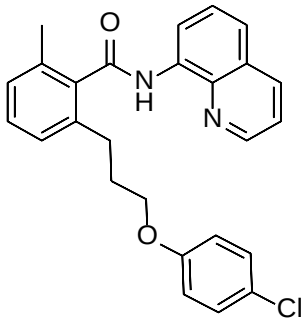


2-(4-bromophenethyl)-6-methyl-N-(quinolin-8-yl)benzamide (3k): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), 3-(4-Bromophenyl)propionic Acid **2** (0.6 mmol, 137.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Yellow oil (65% yield, 57.5 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.91 (s, 1H), 8.99 (dd, *J* = 7.4, 1.6 Hz, 1H), 8.73 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.66 – 7.56 (m, 2H), 7.44 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.30 – 7.25 (m, 1H), 7.24 – 7.20 (m, 2H), 7.15 (d, *J* = 7.6 Hz, 1H), 7.08 (d, *J* = 7.6 Hz, 1H), 6.96 – 6.90 (m, 2H), 2.99 (ddd, *J* = 9.3, 5.4, 2.3 Hz, 2H), 2.93

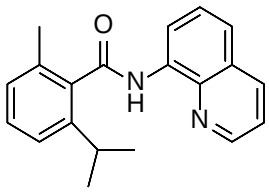
(ddd, *J* = 10.3, 5.3, 2.2 Hz, 2H), 2.45 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.6, 148.3, 140.5, 138.3, 138.0, 137.8, 136.4, 134.6, 134.2, 131.2, 130.2, 129.1, 128.2, 128.0, 127.4, 126.9, 122.1, 121.7, 119.5, 116.8, 37.4, 35.6, 19.5. HRMS: Calcd for $C_{25}H_{22}ON_2Br$ [M+H$^+$]: 445.0910; Found: 445.0913.



2-(3-(4-chlorophenoxy)propyl)-6-methyl-N-(quinolin-8-yl)benzamide (3l): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), 4-(4-Chlorophenoxy)butanoic acid **2** (0.6 mmol, 128.8 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

Colorless oil (68% yield, 58.6 mg, eluent = petroleum ether/ ether acetate(20: 1));

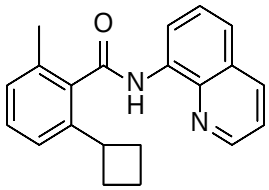
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 8.97 (dd, *J* = 7.2, 1.8 Hz, 1H), 8.69 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.65 – 7.55 (m, 2H), 7.44 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.30 (t, *J* = 7.6 Hz, 1H), 7.16 (t, *J* = 7.9 Hz, 2H), 7.08 – 6.98 (m, 2H), 6.66 – 6.54 (m, 2H), 3.87 (t, *J* = 6.2 Hz, 2H), 2.93 (dd, *J* = 8.5, 6.7 Hz, 2H), 2.44 (s, 3H), 2.16 (dq, *J* = 8.6, 6.4 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.6, 157.3, 148.1, 138.2, 138.1, 137.9, 136.5, 134.7, 134.2, 129.1, 128.9, 128.1, 128.0, 127.4, 126.9, 125.0, 122.02, 121.6, 116.9, 115.5, 67.0, 30.9, 29.6, 19.5. **HRMS:** Calcd for $C_{26}H_{24}O_2N_2Cl$ [M+H$^+$]: 431.1522; Found: 431.1524.



2-isopropyl-6-methyl-N-(quinolin-8-yl)benzamide (3m): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Isobutyric acid **2** (0.6 mmol, 52.9 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

White solid (53% yield, 32.3 mg, eluent = petroleum ether/ ethyl acetate (20: 1));

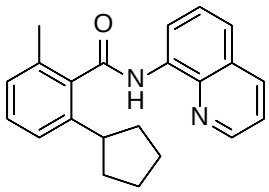
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.01 (s, 1H), 9.02 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.75 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.22 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.67 – 7.57 (m, 2H), 7.47 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.35 (t, *J* = 7.7 Hz, 1H), 7.28 (d, *J* = 3.3 Hz, 1H), 7.13 (d, *J* = 7.4 Hz, 1H), 3.17 (p, *J* = 6.8 Hz, 1H), 2.44 (s, 3H), 1.30 (d, *J* = 6.8 Hz, 6H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.1, 148.1, 145.5, 138.2, 137.0, 136.6, 134.3, 134.3, 129.3, 128.1, 127.7, 127.5, 123.1, 122.0, 121.6, 117.1, 31.1, 24.5, 19.5. **HRMS:** Calcd for $C_{20}H_{21}ON_2$ [M+H$^+$]: 304.1648; Found: 304.1649.



2-cyclobutyl-6-methyl-N-(quinolin-8-yl)benzamide (3n): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Cyclobutanecarboxylic acid **2** (0.6 mmol, 60.1 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

White solid: (80% yield, 50.6 mg, eluent = petroleum ether/ ether acetate(20: 1));

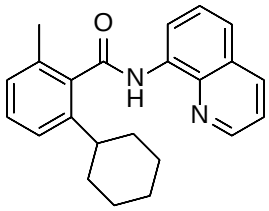
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.93 (s, 1H), 9.01 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.67 – 7.55 (m, 2H), 7.46 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.34 (t, *J* = 7.6 Hz, 1H), 7.28 (d, *J* = 7.7 Hz, 1H), 7.12 (d, *J* = 7.4 Hz, 1H), 3.80 (p, *J* = 8.9 Hz, 1H), 2.43 (s, 3H), 2.25 (ddddd, *J* = 17.1, 10.3, 8.7, 6.4, 2.1 Hz, 4H), 1.87 (qt, *J* = 10.0, 8.3 Hz, 1H), 1.79 – 1.66 (m, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.1, 142.4, 138.3, 136.6, 136.5, 134.4, 134.4, 129.1, 128.0, 127.8, 127.5, 123.7, 121.9, 121.6, 116.8, 38.2, 29.9, 19.3, 18.2. **HRMS:** Calcd for $C_{21}H_{21}ON_2$ [M+H$^+$]: 317.1648; Found: 317.1648.



2-cyclopentyl-6-methyl-N-(quinolin-8-yl)benzamide (3o): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Cyclopentanecarboxylic acid **2** (0.6 mmol, 68.5 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

White solid (74% yield, 48.9 mg, eluent = petroleum ether/ ether acetate(20: 1));

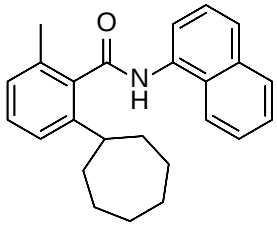
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.97 (s, 1H), 9.02 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.67 – 7.53 (m, 2H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 1H), 7.29 – 7.23 (m, 1H), 7.16 – 7.07 (m, 1H), 3.30 – 3.10 (m, 1H), 2.43 (s, 3H), 2.19 – 2.03 (m, 2H), 1.84 – 1.72 (m, 2H), 1.71 – 1.61 (m, 2H), 1.57 (dp, *J* = 9.0, 3.1 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.2, 148.2, 143.5, 138.4, 137.8, 136.4, 134.4, 134.2, 129.2, 128.0, 127.6, 127.4, 123.6, 121.9, 121.6, 116.8, 42.8, 35.7, 25.9, 19.5. **HRMS:** Calcd for $C_{22}H_{23}ON_2$ [M+H$^+$]: 331.1805; Found: 331.1805.



2-cyclohexyl-6-methyl-N-(quinolin-8-yl)benzamide (3p): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Cyclohexanecarboxylic acid **2** (0.6 mmol, 76.9 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

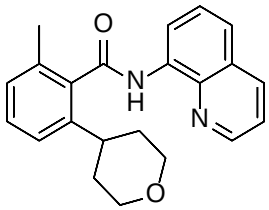
White solid (60% yield, 41.3 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 9.00 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.73 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.67 – 7.55 (m, 2H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 1H), 7.24 (d, *J* = 7.8 Hz, 1H), 7.12 (d, *J* = 7.4 Hz, 1H), 2.74 (tt, *J* = 11.9, 3.4 Hz, 1H), 2.43 (s, 3H), 1.99 (d, *J* = 12.7 Hz, 2H), 1.72 (d, *J* = 7.3 Hz, 2H), 1.66 – 1.59 (m, 1H), 1.49 (qd, *J* = 13.2, 12.7, 4.3 Hz, 2H), 1.21 (d, *J* = 6.5 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.0, 148.2, 144.5, 138.4, 137.2, 136.3, 134.3, 134.3, 129.1, 128.0, 127.7, 127.4, 123.8, 121.9, 121.6, 116.9, 41.7, 34.7, 26.7, 26.0, 19.5. **HRMS:** Calcd for $C_{23}H_{25}ON_2$ [M+H$^+$]: 345.1961; Found: 345.1961.

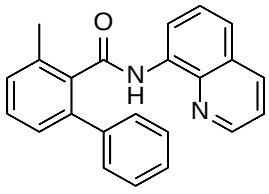


2-cycloheptyl-6-methyl-N-(quinolin-8-yl)benzamide (3q): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Cycloheptanecarboxylic acid **2** (0.6 mmol, 85.3 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5

mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.
Yellow oil (46% yield, 32.7 mg, eluent = petroleum ether/ ether acetate(20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.96 (s, 1H), 9.00 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.73 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.21 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.67 – 7.61 (m, 1H), 7.58 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.46 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.30 (t, *J* = 7.7 Hz, 1H), 7.21 (d, *J* = 7.8 Hz, 1H), 7.09 (dd, *J* = 7.3, 1.1 Hz, 1H), 2.88 (tt, *J* = 10.4, 3.6 Hz, 1H), 2.42 (s, 3H), 2.08 – 1.96 (m, 2H), 1.69 (dtd, *J* = 13.7, 10.6, 3.4 Hz, 4H), 1.56 – 1.44 (m, 4H), 1.39 (d, *J* = 25.1 Hz, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 169.1, 148.1, 146.5, 138.3, 136.6, 136.4, 134.3, 134.2, 129.2, 128.0, 127.5, 127.4, 123.9, 121.9, 121.6, 117.1, 43.5, 37.0, 27.7, 27.2, 19.6. **HRMS:** Calcd for $C_{24}H_{27}ON_2$ [M+H$^+$]: 359.2118; Found: 359.2115.



2-methyl-N-(quinolin-8-yl)-6-(tetrahydro-2H-pyran-4-yl)benzamide (3r): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Tetrahydro-2H-pyran-4-carboxylic acid **2** (0.6 mmol, 78.1 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.
White solid (57% yield, 39.5 mg, eluent = petroleum ether/ ether acetate(10: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.95 (s, 1H), 8.99 (dd, *J* = 7.3, 1.7 Hz, 1H), 8.73 (dd, *J* = 4.3, 1.6 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.68 – 7.57 (m, 2H), 7.46 (dd, *J* = 8.3, 4.1 Hz, 1H), 7.36 (t, *J* = 7.7 Hz, 1H), 7.29 – 7.23 (m, 1H), 7.16 (d, *J* = 7.4 Hz, 1H), 4.05 – 3.92 (m, 2H), 3.48 – 3.26 (m, 2H), 3.00 (tt, *J* = 10.8, 4.9 Hz, 1H), 2.44 (s, 3H), 1.89 (dqd, *J* = 14.8, 9.8, 8.2, 3.4 Hz, 4H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.7, 148.2, 142.4, 138.4, 137.3, 136.5, 134.5, 134.2, 129.4, 128.2, 128.0, 127.4, 123.9, 122.1, 121.7, 117.0, 68.3, 38.8, 34.2, 19.5. **HRMS:** Calcd for $C_{22}H_{23}O_2N_2$ [M+H$^+$]: 347.1754; Found: 347.1754.

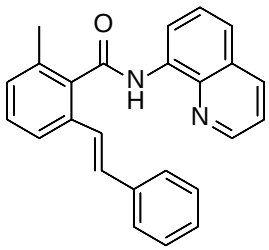


3-methyl-N-(quinolin-8-yl)-[1,1'-biphenyl]-2-carboxamide (3s): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), Benzoic acid **2** (0.6 mmol, 73.3 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-

Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

Yellow oil（61% yield, 41.3 mg, eluent = petroleum ether/ ether acetate(20: 1));

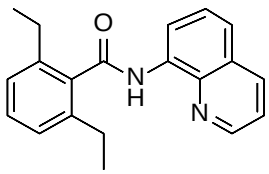
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.66 (s, 1H), 8.78 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.61 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.08 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.59 – 7.44 (m, 4H), 7.42 (t, *J* = 7.6 Hz, 1H), 7.36 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.31 (dd, *J* = 7.8, 2.7 Hz, 2H), 7.22 (dd, *J* = 8.4, 7.0 Hz, 2H), 7.14 – 7.06 (m, 1H), 2.54 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.3, 147.9, 140.3, 139.6, 138.2, 136.8, 136.1, 135.8, 134.3, 129.4, 129.2, 128.6, 128.1, 127.7, 127.58, 127.23, 127.2, 121.6, 121.4, 116.5, 19.8. This compound is known.[6] The ^{1}H and ^{13}C NMR spectral data are in good agreement with the literature data.



(E)-2-methyl-N-(quinolin-8-yl)-6-styrylbenzamide (3t): Following the general procedure (II) with 2-methy-N-(quinoline-8-yl)benzamide **1** (0.2 mmol, 52.5 mg, 1.0 equiv), trans-Cinnamic acid **2** (0.6 mmol, 88.9 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.

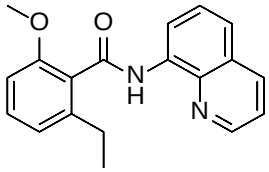
Colorless oil (41% yield, 29.9 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.00 (s, 1H), 9.04 (dd, *J* = 7.5, 1.5 Hz, 1H), 8.67 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.17 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.68 – 7.61 (m, 2H), 7.58 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.44 – 7.35 (m, 4H), 7.31 (d, *J* = 16.1 Hz, 1H), 7.25 – 7.19 (m, 3H), 7.19 – 7.10 (m, 2H), 2.47 (s, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.4, 148.3, 138.5, 137.0, 136.9, 136.3, 135.1, 134.7, 134.3, 131.3, 129.5, 129.2, 128.5, 128.0, 127.7, 127.3, 126.7, 125.5, 122.9, 122.1, 121.6, 116.9, 19.5. **HRMS:** Calcd for $C_{25}H_{21}ON_2$ $[M+H^+]$: 365.1648; Found: 365.1647.

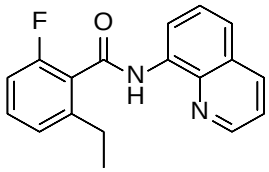


2,6-diethyl-N-(quinolin-8-yl)benzamide (4b): Following the general procedure (II) with 2-ethyl-N-(quinolin-8-yl)benzamide **1** (0.2 mmol, 55.3 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0

equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.
White solid (75% yield, 45.7 mg, eluent = petroleum ether/ ether acetate(20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.98 (s, 1H), 9.02 (d, *J* = 7.2 Hz, 1H), 8.73 (s, 1H), 8.19 (d, *J* = 8.1 Hz, 1H), 7.61 (dt, *J* = 15.7, 8.0 Hz, 2H), 7.48 – 7.42 (m, 1H), 7.36 (t, *J* = 7.6 Hz, 1H), 7.18 (d, *J* = 7.6 Hz, 2H), 2.77 (q, *J* = 7.4 Hz, 4H), 1.27 (t, *J* = 7.5 Hz, 6H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.9, 148.2, 140.6, 138.3, 137.0, 136.4, 134.4, 129.3, 128.0, 127.4, 126.1, 121.9, 121.6, 116.8, 26.5, 15.9. **HRMS:** Calcd for $C_{20}H_{21}ON_2$ [M+H$^+$]: 305.1648; Found: 305.1647.

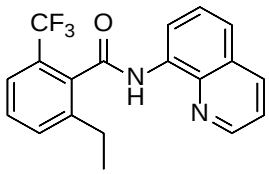


2-ethyl-6-methoxy-N-(quinolin-8-yl)benzamide (4c): Following the general procedure (II) with 2-methoxy-N-(quinolin-8-yl)benzamide **1** (0.2 mmol, 55.7 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.
White solid (62% yield, 38.0 mg, eluent = petroleum ether/ ether acetate(10: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.12 (s, 1H), 9.07 – 8.99 (m, 1H), 8.79 – 8.72 (m, 1H), 8.26 – 8.16 (m, 1H), 7.62 (t, *J* = 7.9 Hz, 1H), 7.58 – 7.54 (m, 1H), 7.49 – 7.43 (m, 1H), 7.38 – 7.32 (m, 1H), 6.94 (d, *J* = 7.7 Hz, 1H), 6.85 (d, *J* = 8.3 Hz, 1H), 3.83 (s, 3H), 2.77 (q, *J* = 7.6 Hz, 2H), 1.26 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 166.6, 156.3, 148.0, 143.3, 138.4, 136.3, 134.7, 130.2, 128.0, 127.5, 126.7, 121.6, 121.5, 121.1, 116.8, 108.5, 55.8, 26.4, 15.8. **HRMS:** Calcd for $C_{19}H_{19}N_2O_2$ [M+H$^+$]: 307.1441; Found: 307.1440.



2-ethyl-6-fluoro-N-(quinolin-8-yl)benzamide (4d): Following the general procedure (II) with 2-fluoro-N-(quinolin-8-yl)benzamide **1** (0.2 mmol, 53.3 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 12 h.
White solid (53% yield, 31.2 mg, eluent = petroleum ether/ ether acetate(20: 1));

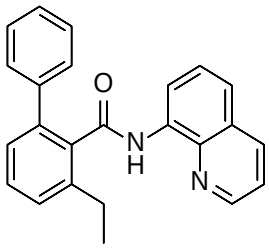
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.16 (s, 1H), 9.03 – 8.93 (m, 1H), 8.77 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.67 – 7.55 (m, 2H), 7.46 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.37 (td, *J* = 8.0, 5.9 Hz, 1H), 7.13 (d, *J* = 7.5 Hz, 1H), 7.03 (t, *J* = 8.8 Hz, 1H), 2.85 (q, *J* = 7.6 Hz, 2H), 1.29 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 163.67, 159.23(d, *J* = 246.0 Hz), 148.2, 144.8(d, J = 2.0 Hz), 138.2, 136.6, 134.2, 130.9 (d, J = 9.0 Hz), 128.0, 127.5, 125.1 (d, *J* = 17.0 Hz), 124.7 (d, *J* = 3.0 Hz), 122.1, 121.7, 117.1, 113.2 (d, *J* = 22.0 Hz), 26.3 (d, *J* = 2.0 Hz), 15.7. **HRMS:** Calcd for $C_{18}H_{16}ON_2F$ [M+H$^+$]: 295.1241; Found: 295.1242.



2-ethyl-N-(quinolin-8-yl)-6-(trifluoromethyl)benzamide (4e): Following the general procedure (II) with N-(quinolin-8-yl)-2-(trifluoromethyl)benzamide **1** (0.2 mmol, 63.3 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

White solid (74% yield, 51.0 mg, eluent = petroleum ether/ ether acetate(20: 1));

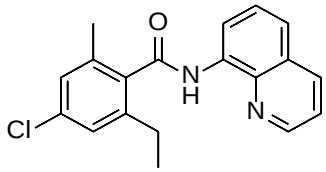
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.03 (s, 1H), 8.97 (dd, *J* = 7.1, 1.9 Hz, 1H), 8.74 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.18 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.63 (d, *J* = 8.3 Hz, 1H), 7.60 – 7.57 (m, 2H), 7.57 – 7.49 (m, 2H), 7.44 (dd, *J* = 8.3, 4.2 Hz, 1H), 2.83 (q, *J* = 7.6 Hz, 2H), 1.29 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 165.7, 148.3, 142.8, 138.3, 136.4, 134.9(q, *J* = 2.02 Hz), 134.1, 132.6, 129.4, 127.8, 127.7(q, *J* = 31.31 Hz), 127.4, 123.8(q, *J* = 274.72 Hz), 123.7(q, *J* = 5.05 Hz), 122.3, 121.7, 117.0, 26.3, 15.7. **HRMS:** Calcd for $C_{19}H_{16}ON_2F_3$ [M+H$^+$]: 345.1209; Found: 345.1210.



3-ethyl-N-(quinolin-8-yl)-[1,1'-biphenyl]-2-carboxamide (4f): Following the general procedure (II) with N-(quinolin-8-yl)-[1,1'-biphenyl]-2-carboxamide **1** (0.2 mmol, 64.9 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

White solid (53% yield, 37.4 mg, eluent = petroleum ether/ ether acetate(20: 1));

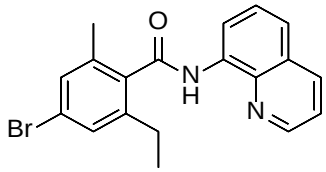
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.66 (s, 1H), 8.77 (dd, *J* = 7.4, 1.5 Hz, 1H), 8.61 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.08 (dd, *J* = 8.2, 1.4 Hz, 1H), 7.57 – 7.43 (m, 5H), 7.39 – 7.29 (m, 3H), 7.21 (t, *J* = 7.6 Hz, 2H), 7.09 (t, *J* = 7.4 Hz, 1H), 2.89 (q, *J* = 7.5 Hz, 2H), 1.32 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.2, 147.8, 141.9, 140.4, 139.6, 138.2, 136.4, 136.2, 134.3, 129.3, 128.7, 128.1, 127.9, 127.7, 127.6, 127.3, 127.2, 121.6, 121.4, 116.6, 26.6, 15.9. **HRMS:** Calcd for $C_{24}H_{21}ON_2$ [M+H$^+$]: 353.1648; Found: 353.1649.



4-chloro-2-ethyl-6-methyl-N-(quinolin-8-yl)benzamide (4g): Following the general procedure (II) with 4-chloro-2-methyl-N-(quinolin-8-yl)benzamide **1** (0.2 mmol, 59.4 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

White solid (81% yield, 52.6 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.96 (s, 1H), 8.97 (dd, *J* = 7.1, 1.9 Hz, 1H), 8.75 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.21 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.66 – 7.57 (m, 2H), 7.47 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.15 (d, *J* = 1.7 Hz, 1H), 7.12 (d, *J* = 1.6 Hz, 1H), 2.73 (q, *J* = 7.6 Hz, 2H), 2.41 (s, 3H), 1.26 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 167.9, 148.2, 142.7, 138.2, 136.6, 136.5, 135.9, 134.7, 134.0, 128.0, 127.7, 127.4, 126.1, 122.2, 121.7, 117.0, 26.4, 19.4, 15.6. **HRMS:** Calcd for $C_{19}H_{18}ON_2Cl$ [M+H$^+$]: 325.1102; Found: 325.1103.

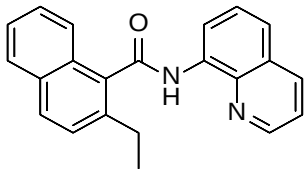


4-bromo-2-ethyl-6-methyl-N-(quinolin-8-yl)benzamide (4h): Following the general procedure (II) with 4-bromo-2-methyl-N-(quinolin-8-yl)benzamide **1** (0.2 mmol, 68.2 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.

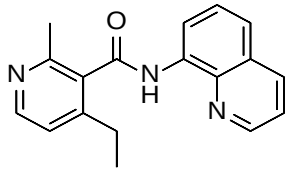
White solid (80% yield, 59.1 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.96 (s, 1H), 8.96 (dd, *J* = 7.1, 1.9 Hz, 1H), 8.75 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.21 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.65 – 7.57 (m, 2H), 7.47 (dd, *J* =

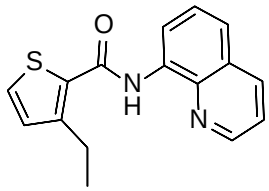
8.3, 4.2 Hz, 1H), 7.30 (dd, *J* = 11.0, 1.3 Hz, 2H), 2.73 (q, *J* = 7.6 Hz, 2H), 2.41 (s, 3H), 1.26 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 167.9, 148.2, 143.0, 138.2, 136.7, 136.6, 136.4, 134.1, 130.6, 129.1, 128.0, 127.5, 123.1, 122.2, 121.7, 117.0, 26.3, 19.3, 15.6. **HRMS:** Calcd for $C_{19}H_{18}ON_2Br$ [M+H$^+$]: 369.0597; Found: 369.0598.



2-ethyl-N-(quinolin-8-yl)-1-naphthamide (4i): Following the general procedure (II) with N-(quinolin-8-yl)-1-naphthamide **1** (0.2 mmol, 59.7 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.
White solid (82% yield, 53.6 mg, eluent = petroleum ether/ ether acetate(20: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.19 (s, 1H), 9.16 (dd, *J* = 7.6, 1.3 Hz, 1H), 8.67 (dd, *J* = 4.2, 1.5 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.4 Hz, 1H), 8.03 – 7.97 (m, 1H), 7.94 – 7.84 (m, 2H), 7.68 (t, *J* = 7.9 Hz, 1H), 7.61 (dd, *J* = 8.3, 1.3 Hz, 1H), 7.51 – 7.41 (m, 4H), 2.94 (q, *J* = 7.6 Hz, 2H), 1.37 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 168.4, 148.2, 138.5, 138.3, 136.4, 134.4, 133.6, 131.8, 130.2, 129.5, 128.0, 127.9, 127.4, 127.0, 127.0, 125.6, 124.9, 122.1, 121.6, 116.9, 27.1, 16.1. **HRMS:** Calcd for $C_{22}H_{19}ON_2$ [M+H$^+$]: 327.1492; Found: 327.1491.



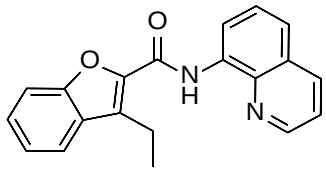
4-ethyl-2-methyl-N-(quinolin-8-yl)nicotinamide (4j): Following the general procedure (II) with 2-methyl-N-(quinolin-8-yl)nicotinamide **1** (0.2 mmol, 52.7 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^{o}C for 12 h.
White solid (83% yield, 48.4 mg, eluent = petroleum ether/ ether acetate(1: 1));
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.99 (s, 1H), 8.95 (dd, *J* = 6.5, 2.4 Hz, 1H), 8.82 – 8.69 (m, 1H), 8.51 (d, *J* = 4.3 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.1 Hz, 1H), 7.66 – 7.56 (m, 2H), 7.47 (dd, *J* = 8.3, 4.1 Hz, 1H), 7.14 (d, *J* = 4.0 Hz, 1H), 2.77 (q, *J* = 7.5 Hz, 2H), 2.68 (s, 3H), 1.28 (t, *J* = 7.5 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 166.7, 154.4, 150.7, 149.1, 148.4, 138.4, 136.4, 134.0, 133.0, 128.0, 127.3, 122.4, 121.8, 121.2, 116.9, 26.0, 22.4, 14.7. **HRMS:** Calcd for $C_{18}H_{18}ON_3$ [M+H$^+$]: 292.1444; Found: 292.1443.



3-ethyl-N-(quinolin-8-yl)thiophene-2-carboxamide (4k): Following the general procedure (II) with N-(quinolin-8-yl)thiophene-2-carboxamide **1** (0.2 mmol, 50.9 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^oC for 12 h.

White solid (93% yield, 52.5 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.45 (s, 1H), 8.89 – 8.80 (m, 2H), 8.18 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.61 – 7.55 (m, 1H), 7.53 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.46 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.41 (d, *J* = 5.0 Hz, 1H), 7.05 (d, *J* = 5.0 Hz, 1H), 3.17 (q, *J* = 7.6 Hz, 2H), 1.39 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 161.2, 148.2, 148.1, 138.5, 136.4, 134.6, 131.9, 130.6, 127.9, 127.7, 127.4, 121.6, 121.6, 116.6, 23.1, 15.1. **HRMS:** Calcd for $C_{16}H_{15}ON_2S$ $[M+H^+]$: 283.0900; Found: 283.0898.



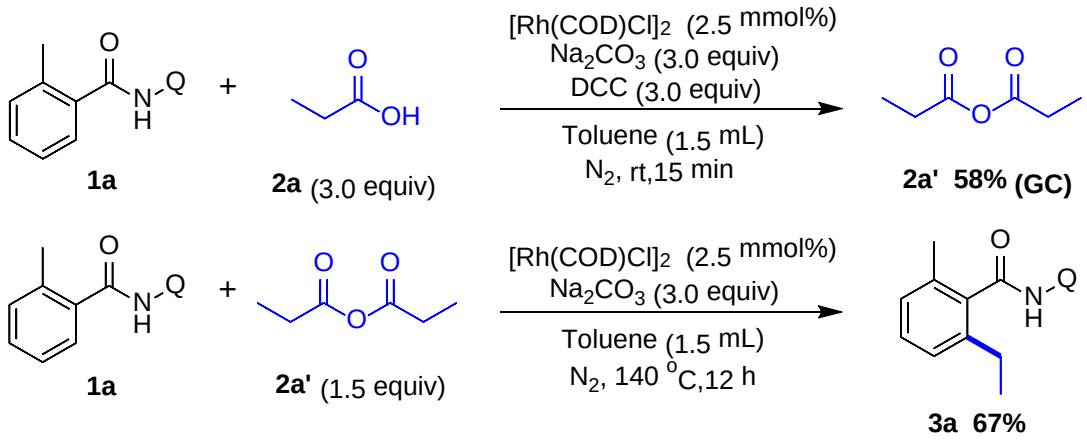
3-ethyl-N-(quinolin-8-yl)benzofuran-2-carboxamide (4l): Following the general procedure (II) with N-(quinolin-8-yl)benzofuran-2-carboxamide **1** (0.2 mmol, 57.7 mg, 1.0 equiv), propionic acid **2** (0.6 mmol, 44.4 mg, 3.0 equiv), $[Rh(cod)Cl]_2$ (0.005 mmol, 2.5 mg, 2.5 mol%), Na_2CO_3 (0.6 mmol, 63.6 mg, 3.0 equiv), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), and toluene (1.5 mL). The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 ^oC for 12 h.

White solid (41% yield, 26.0 mg, eluent = petroleum ether/ ether acetate(20: 1));

^{1}H NMR (400 MHz, $CDCl_3$) δ 11.02 (s, 1H), 9.01 – 8.88 (m, 2H), 8.20 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.76 – 7.64 (m, 2H), 7.63 – 7.54 (m, 2H), 7.54 – 7.44 (m, 2H), 7.38 – 7.29 (m, 1H), 3.29 (q, *J* = 7.6 Hz, 2H), 1.41 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 158.3, 153.6, 148.4, 142.4, 138.6, 136.6, 134.2, 129.8, 129.0, 128.1, 127.4, 127.2, 123.1, 122.0, 121.7, 121.0, 117.0, 112.2, 17.4, 14.4. **HRMS:** Calcd for $C_{20}H_{17}O_2N_2$ $[M+H^+]$: 317.1285; Found: 317.1286.

III. **Experimental Procedures for Mechanistic Studies**

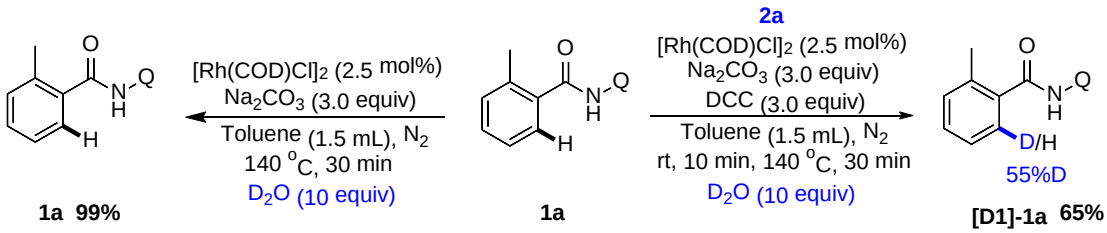
A. Control experments



1). In a nitrogen-filled glovebox, a 35 mL Schlenk tube equipped with a stir bar was charged with amide **1a** (52.5mg, 1.0 equiv, 0.2 mmol), Na_2CO_3 (3.0 equiv, 0.6 mmol, 63.6mg), DCC (3.0 equiv 0.6 mmol, 123.7mg), [Rh(COD)Cl]2 (2.5 mol%, 0.005 mmol, 2.5 mg), The tube was fitted with a rubber septum and moved out of the glovebox. Then propionic acid **2a** (44.4 mg, 3 equiv, 0.6mmol) and toluene (1.5 mL) were added in turn to the Schlenk tube through the rubber septum using syringes, and then the septum was replaced with a Teflon screwcap under nitrogen flow. The reaction mixture was stirred under room temperature for 15 min. Then the reaction mixture was immediately quenched with 10 mL ethyl acetate, dodecane was added as an internal standard, and 58% yield of **2a'** was crudely detected by GC.

2). In a nitrogen-filled glovebox, a 35 mL Schlenk tube equipped with a stir bar was charged with amide **1a** (52.5mg, 1.0 equiv, 0.2 mmol), Na_2CO_3 (3.0 equiv, 0.6 mmol, 63.6mg), [Rh(COD)Cl]2 (2.5 mol%, 0.005 mmol, 2.5 mg), The tube was fitted with a rubber septum and moved out of the glovebox. Then propionic anhydride **2a'** (39 mg, 1.5equiv, 0.3mmol) and toluene (1.5 mL) were added in turn to the Schlenk tube through the rubber septum using syringes, and then the septum was replaced with a Teflon screwcap under nitrogen flow. The reaction mixture was heated at 140 °C for 12 h. Upon completion, the reaction mixture was diluted with 10 mL ethyl acetate, filtered through a pad of silica gel, followed by washing the pad of the silica gel with the ethyl acetate (20-50 mL). The filtrate was washed with 30 mL water and then the organic layer was washed again with brine (30 mL). The organic layers were dried over anhydrous Na_2SO_4; solvent was evaporated under reduced pressure to afford a crude residue. The residue was then purified by column to provide the corresponding product **3a** with 67% yield.

B. Deuterium incorporation



1). With carboxylic acid and DCC: In a nitrogen-filled glovebox, a 35 mL Schlenk tube equipped with a stir bar was charged with amide (52.5 mg, 1.0 equiv, 0.2 mmol), Na_2CO_3 (3.0 equiv, 0.6 mmol, 63.6mg), N,N'-Dicyclohexylcarbodiimide (DCC) (3.0 equiv, 0.6 mmol, 123.7mg), [Rh(COD)Cl]2 (2.5 mol%, 0.005 mmol, 2.5 mg), The tube was fitted with a rubber septum and moved out of the glovebox. Then propionic acid **2a** (44.4 mg, 3 equiv, 0.6mmol), D_2O (2.0 mmol, 36 mg, 10.0equiv) and toluene (1.5 mL) were added in turn to the Schlenk tube through the rubber septum using syringes, and then the septum was replaced with a Teflon screwcap under nitrogen flow. The reaction mixture was firstly stirred under room temperature for 15 min and then was heated at 140 °C for 30 min. Upon completion, the reaction mixture was diluted with 10 mL ethyl acetate, filtered through a pad of silica gel, followed by washing the pad of the silica gel with the ethyl acetate (20-50 mL). The filtrate was washed with 30 mL water and then the organic layer was washed again with brine (30 mL). The organic layers were dried over anhydrous Na_2SO_4; solvent was evaporated under reduced pressure to afford a crude residue. The residue was then purified by column to provide the corresponding product. The amount of deuterium atoms incorporated into product was determined by ^{1}H NMR spectrum.

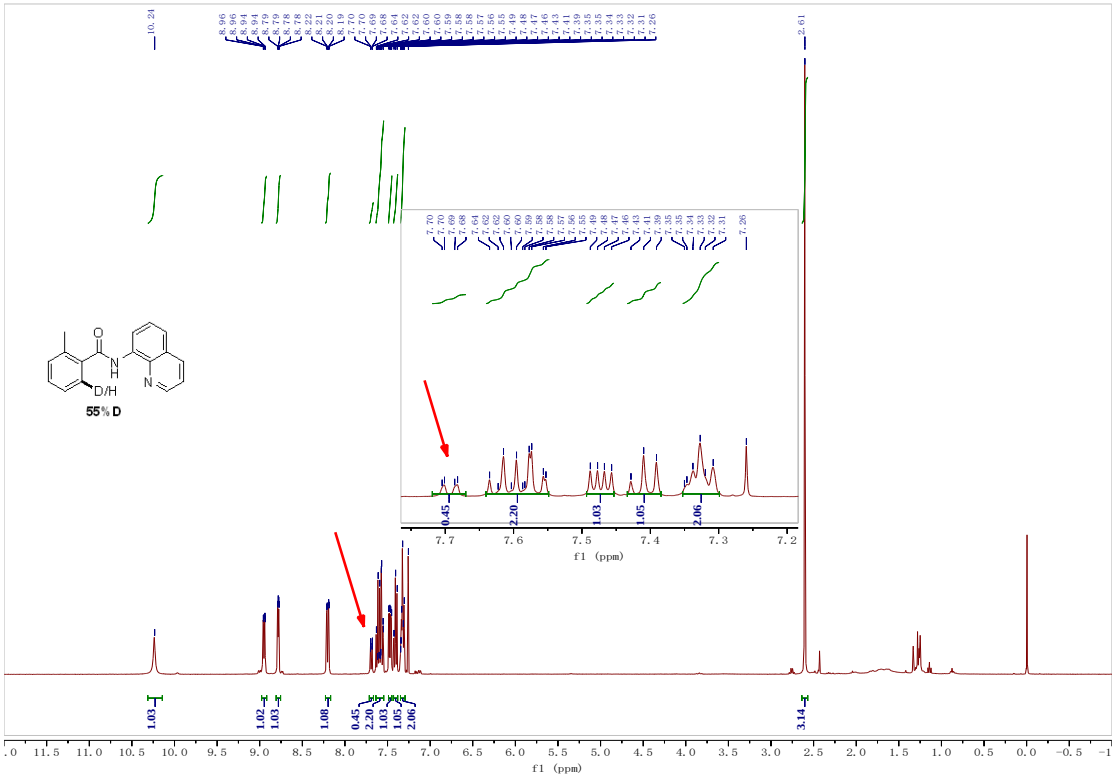


Figure S1. ^{1}H-NMR spectra observed from H/D exchange experiment

2). Without carboxylic acid and DCC: the above experiment (1) procedure was followed except that no carboxylic acid and no DCC was added to the reaction mixture.

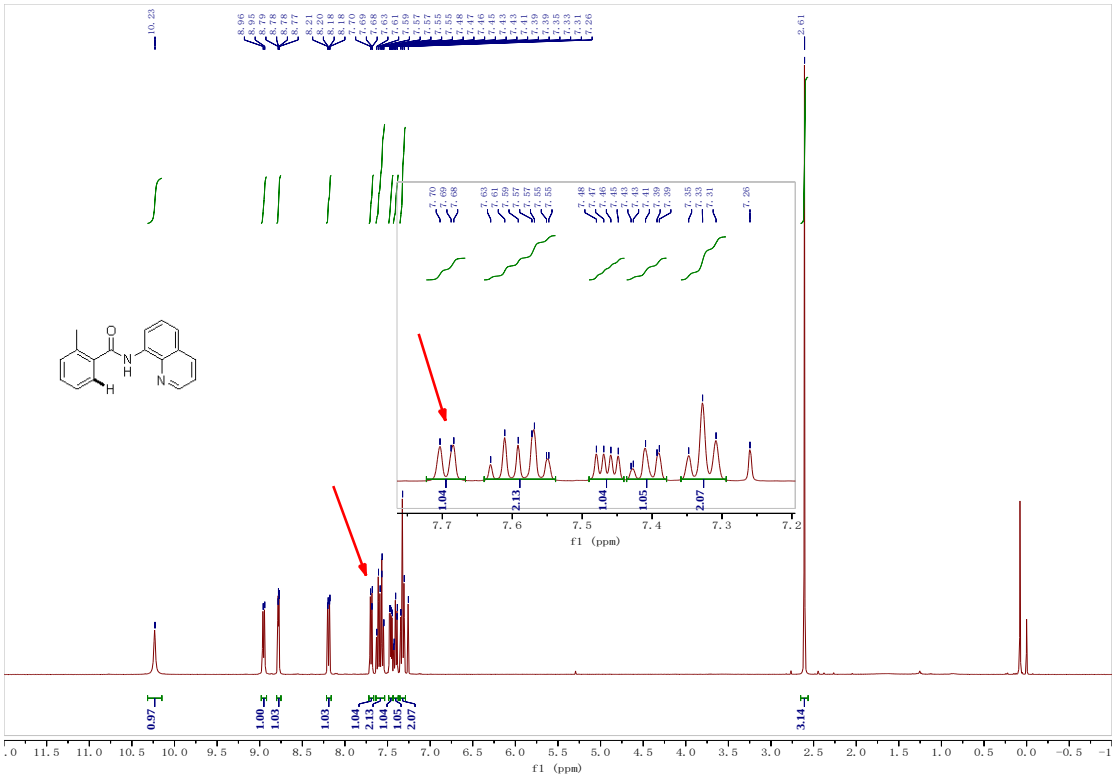
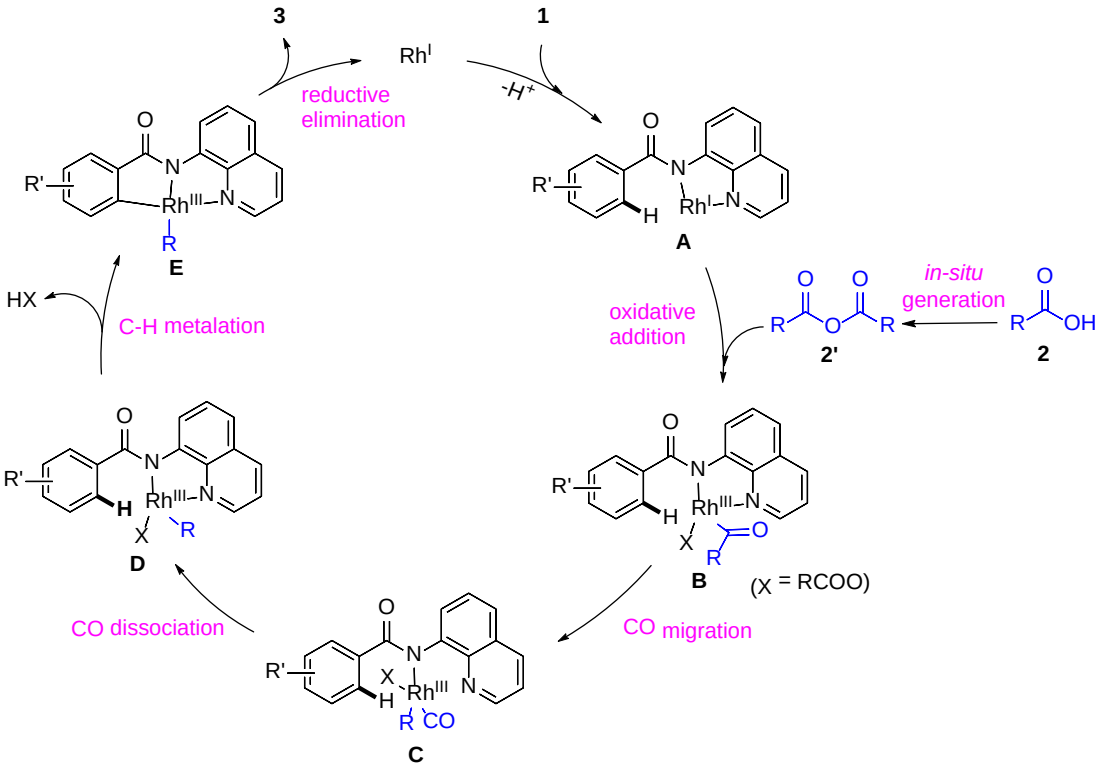


Figure S2. ^{1}H-NMR spectra observed from H/D exchange experiment without carboxylic acid and DCC

C. Plausible mechanism



IV. References

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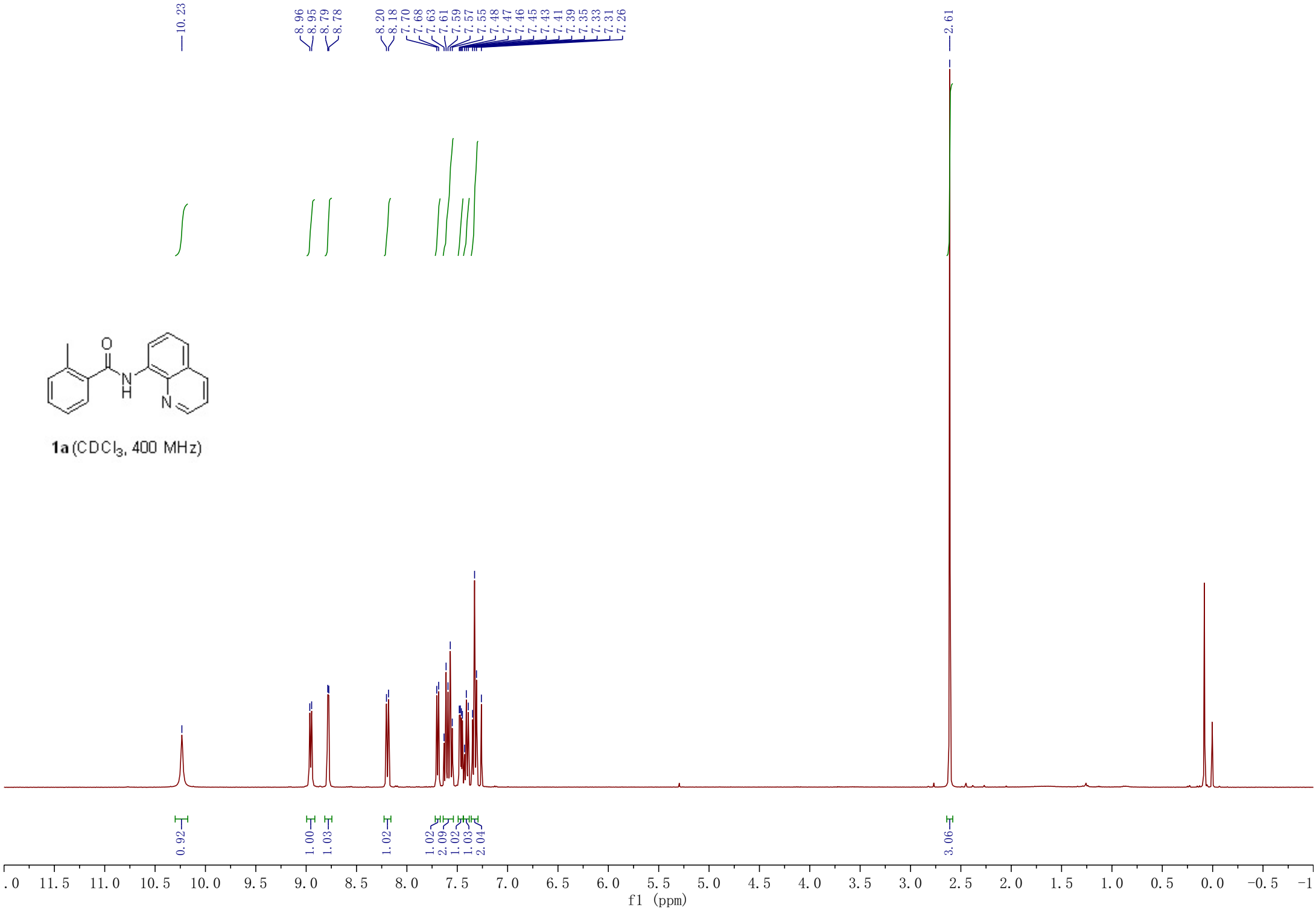
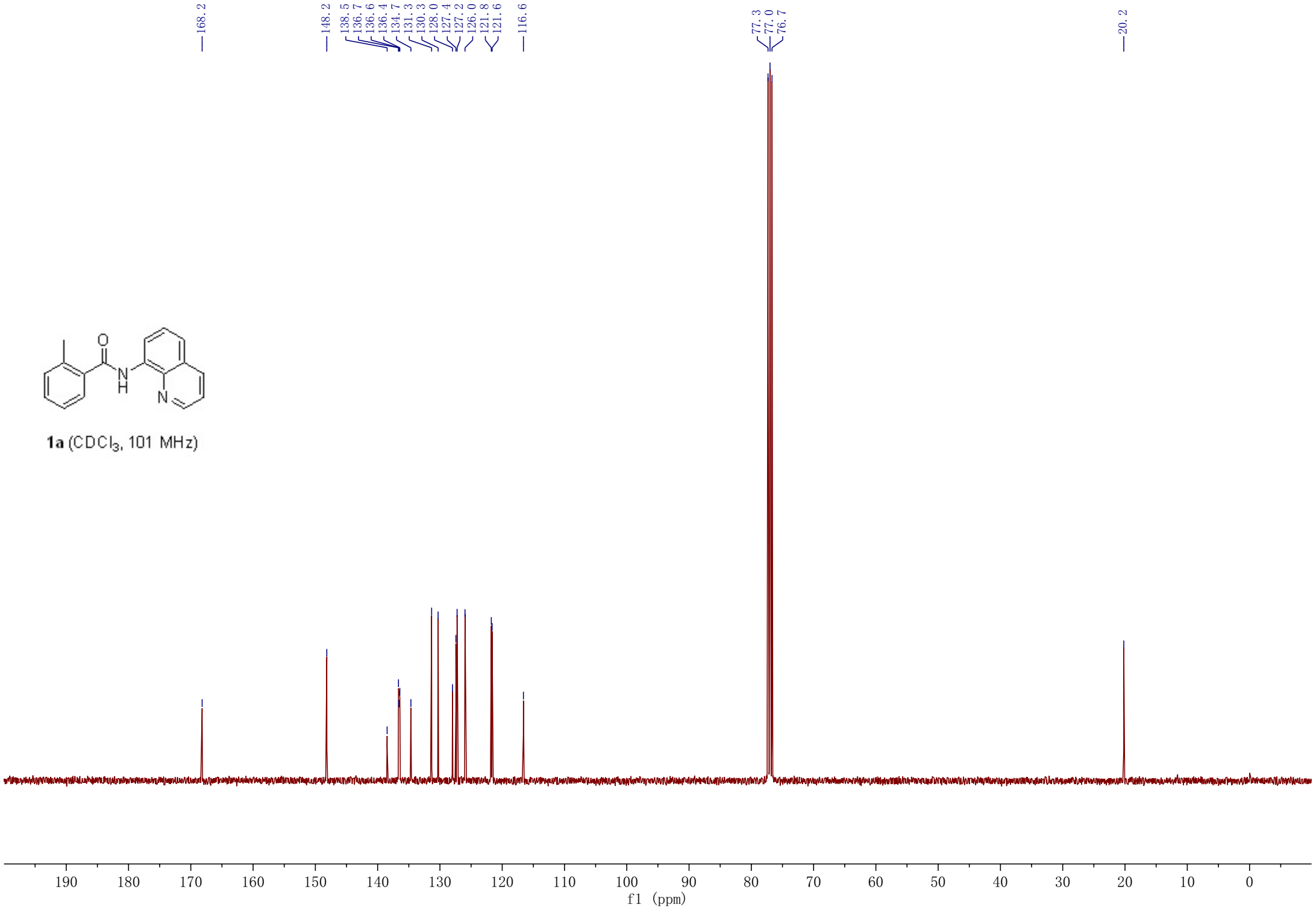
2. S. Y. Zhang, Q. Li, G. He, W. A. Nack and G. Chen, *J Am Chem Soc*, 2015, **137**, 531.
3. R. Shang, L. Ilies and E. Nakamura, *J Am Chem Soc*, 2015, **137**, 7660.
4. J. Tang, P. Liu and X. Zeng, *Chem Commun (Camb)*, 2018, **54**, 9325.
5. Y. Aihara and N. Chatani, *J Am Chem Soc*, 2013, **135**, 5308.
6. A. Yokota, Y. Aihara and N. Chatani, *J. Org. Chem.*, 2014, **79**, 11922.

V. ^{1}H, ^{13}C and ^{19}F NMR Spectra of Compounds



1a ($CDCl_3$, 400 MHz)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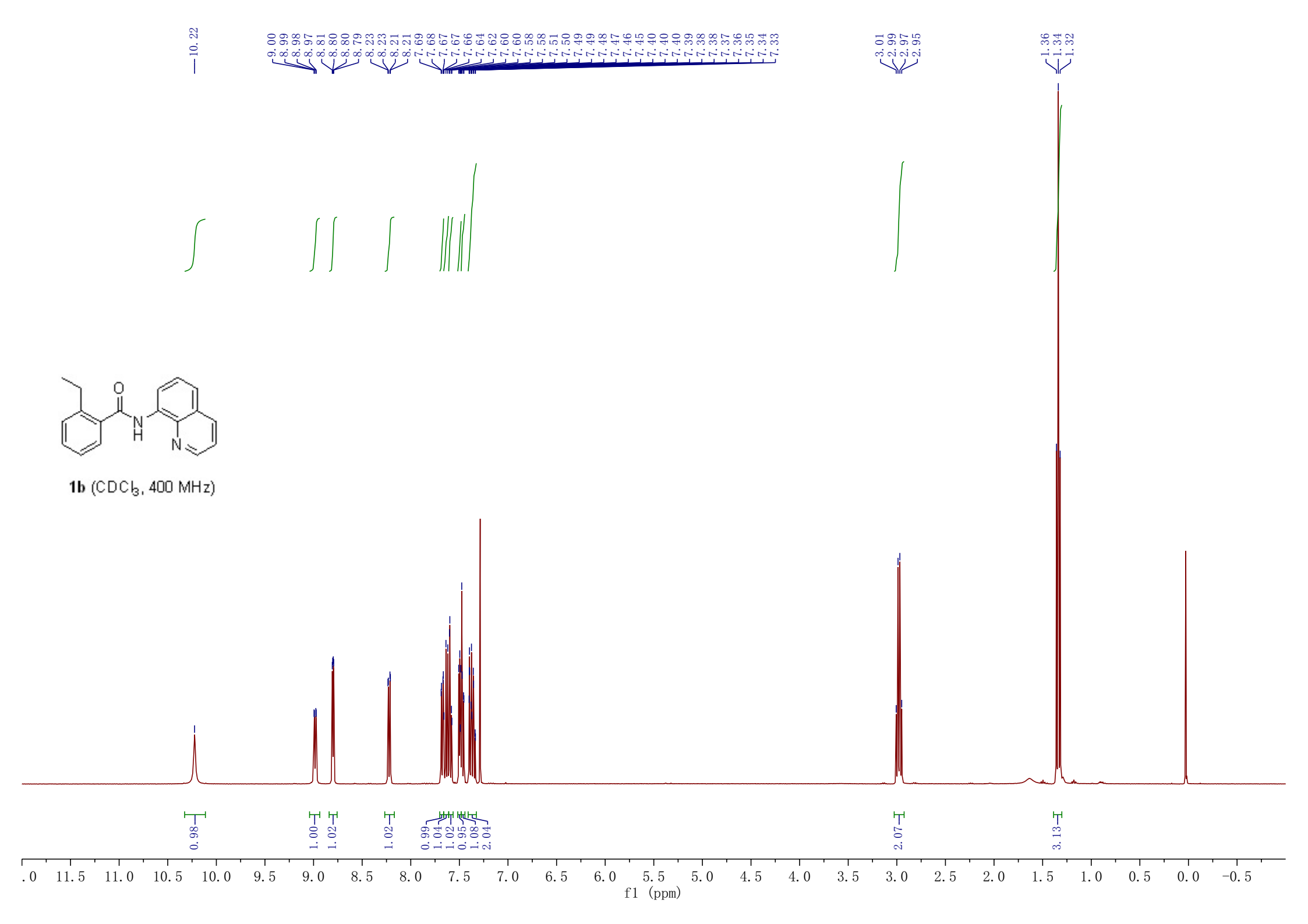
148.2
138.5
136.7
136.6
136.4
134.7
131.3
130.3
128.0
127.4
127.2
126.0
121.8
121.6
116.6
77.3
77.0
76.7
20.2
O
N
H
N
1a (CDCl3, 101 MHz)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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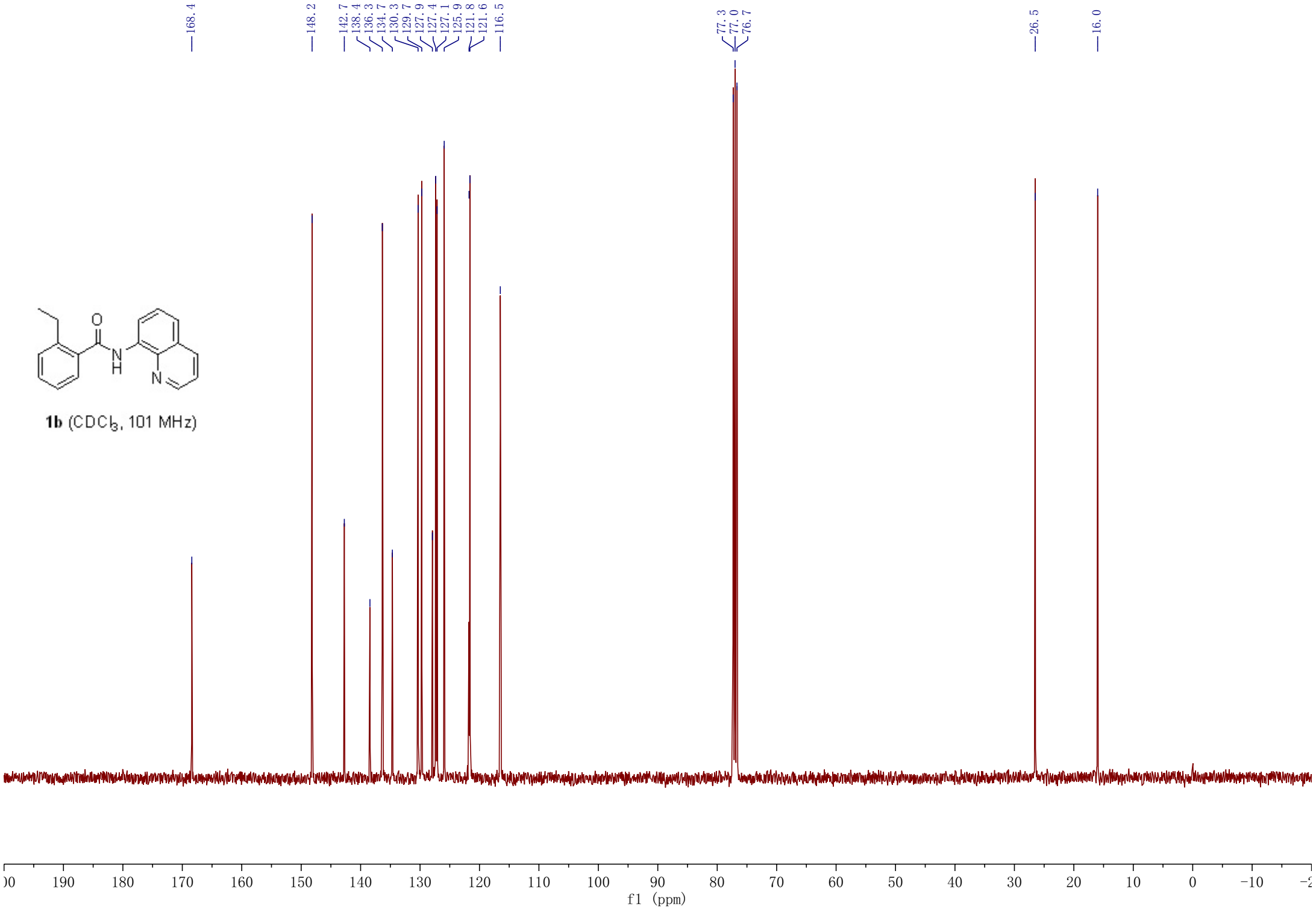
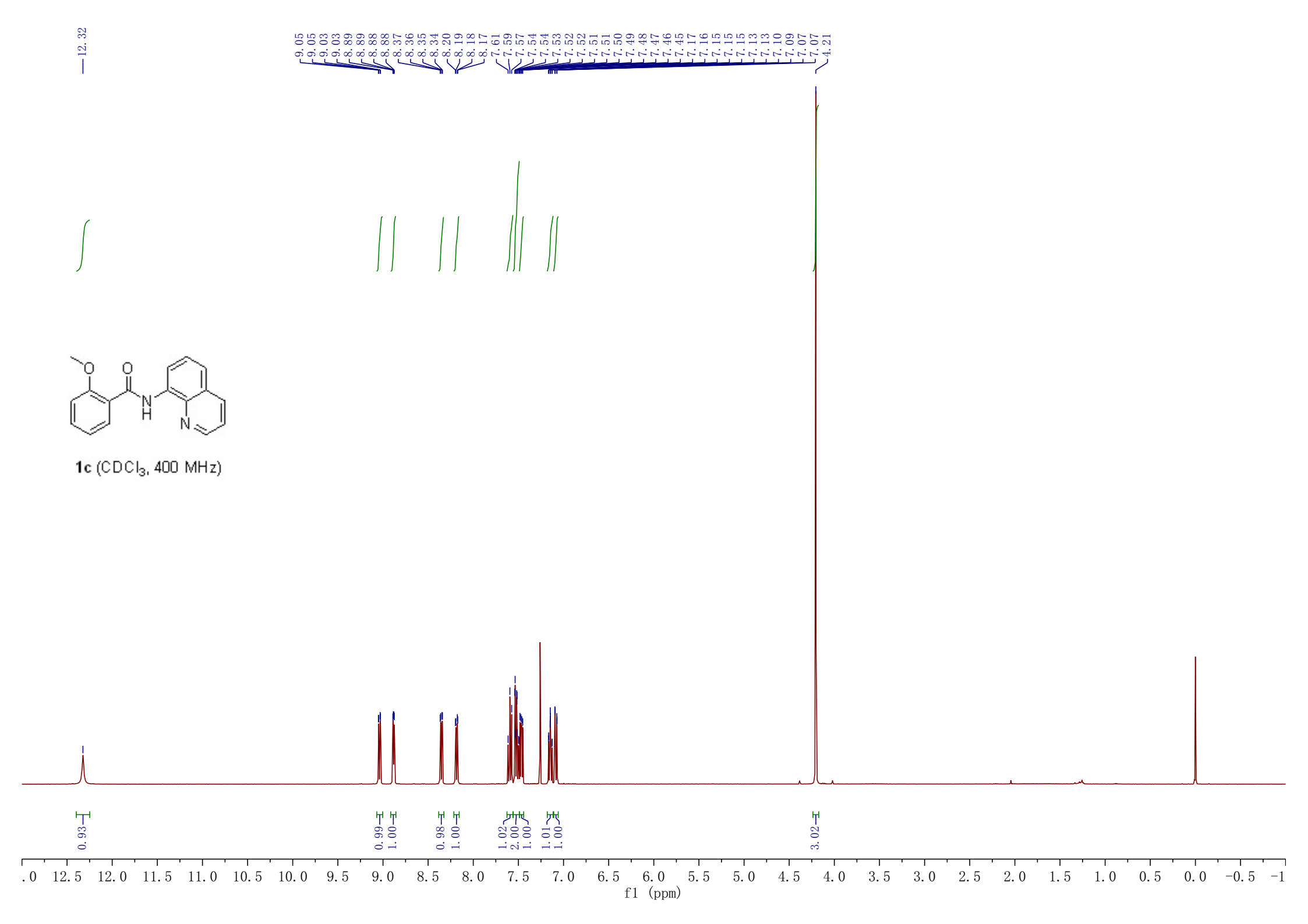
9.00
8.99
8.98
8.97
8.81
8.80
8.80
8.79
8.23
8.23
8.21
8.21
7.69
7.68
7.67
7.67
7.66
7.64
7.62
7.60
7.60
7.58
7.58
7.51
7.50
7.49
7.49
7.48
7.47
7.46
7.45
7.40
7.40
7.40
7.39
7.38
7.38
7.37
7.36
7.35
7.34
7.33
3.01
2.99
2.97
2.95
1.36
1.34
1.32
O
N
H
N
1b (CDCl3, 400 MHz)
0.98
1.00
1.02
1.02
0.99
1.04
1.02
0.95
1.08
2.04
2.07
3.13
f1 (ppm)


168.4
148.2
142.7
138.4
136.3
134.7
130.3
129.7
127.9
127.4
127.1
125.9
121.8
121.6
116.5
77.3
77.0
76.7
26.5
16.0
O
N
H
N
1b (CDCl3, 101 MHz)
f1 (ppm)


12.32
9.05
9.05
9.03
9.03
8.89
8.89
8.88
8.88
8.37
8.36
8.35
8.34
8.20
8.19
8.18
8.17
7.61
7.59
7.57
7.54
7.54
7.53
7.52
7.52
7.51
7.51
7.50
7.49
7.48
7.47
7.46
7.45
7.17
7.16
7.15
7.15
7.15
7.13
7.13
7.10
7.09
7.07
7.07
4.21
O
O
N
H
N
1c (CDCl3, 400 MHz)
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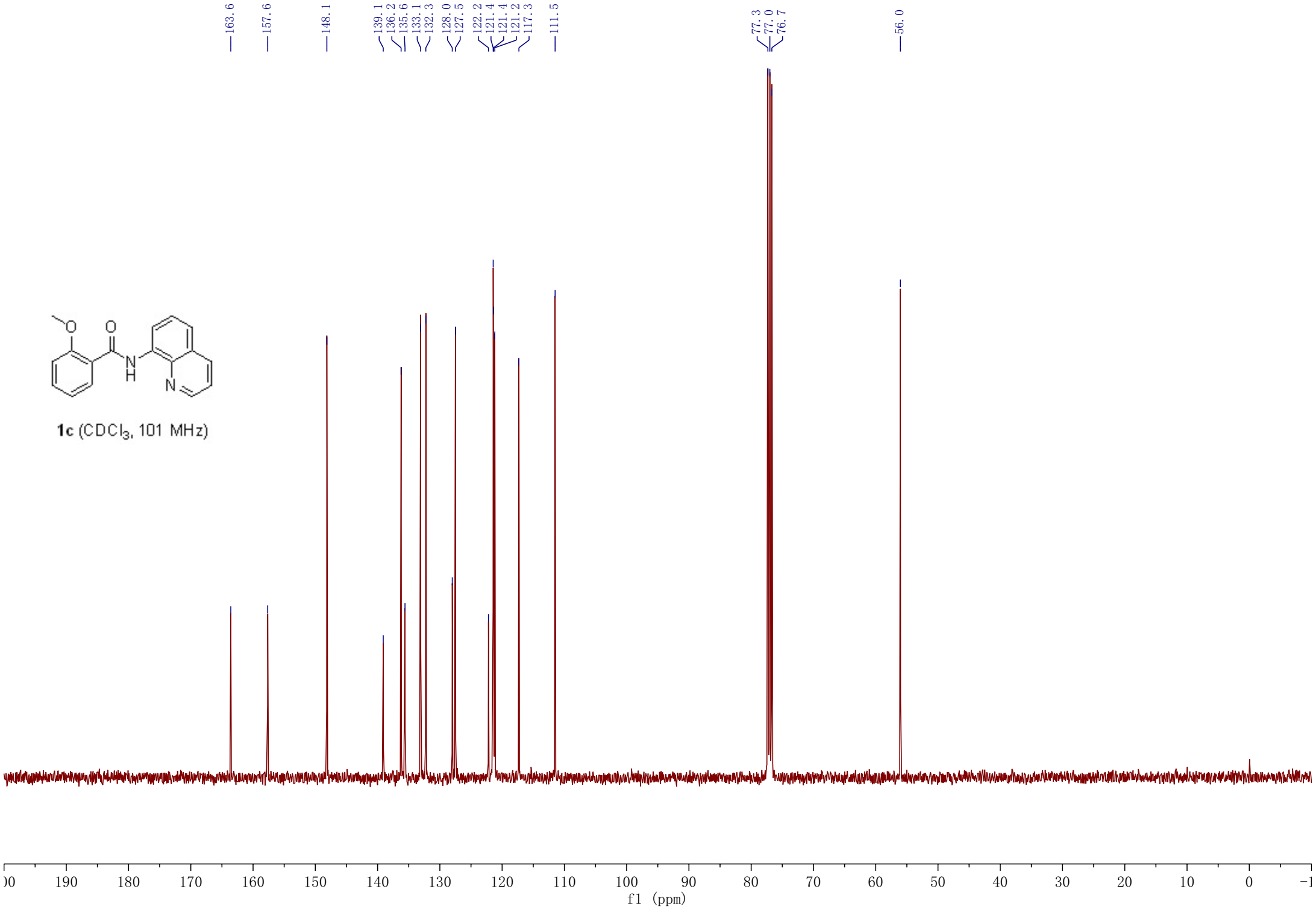
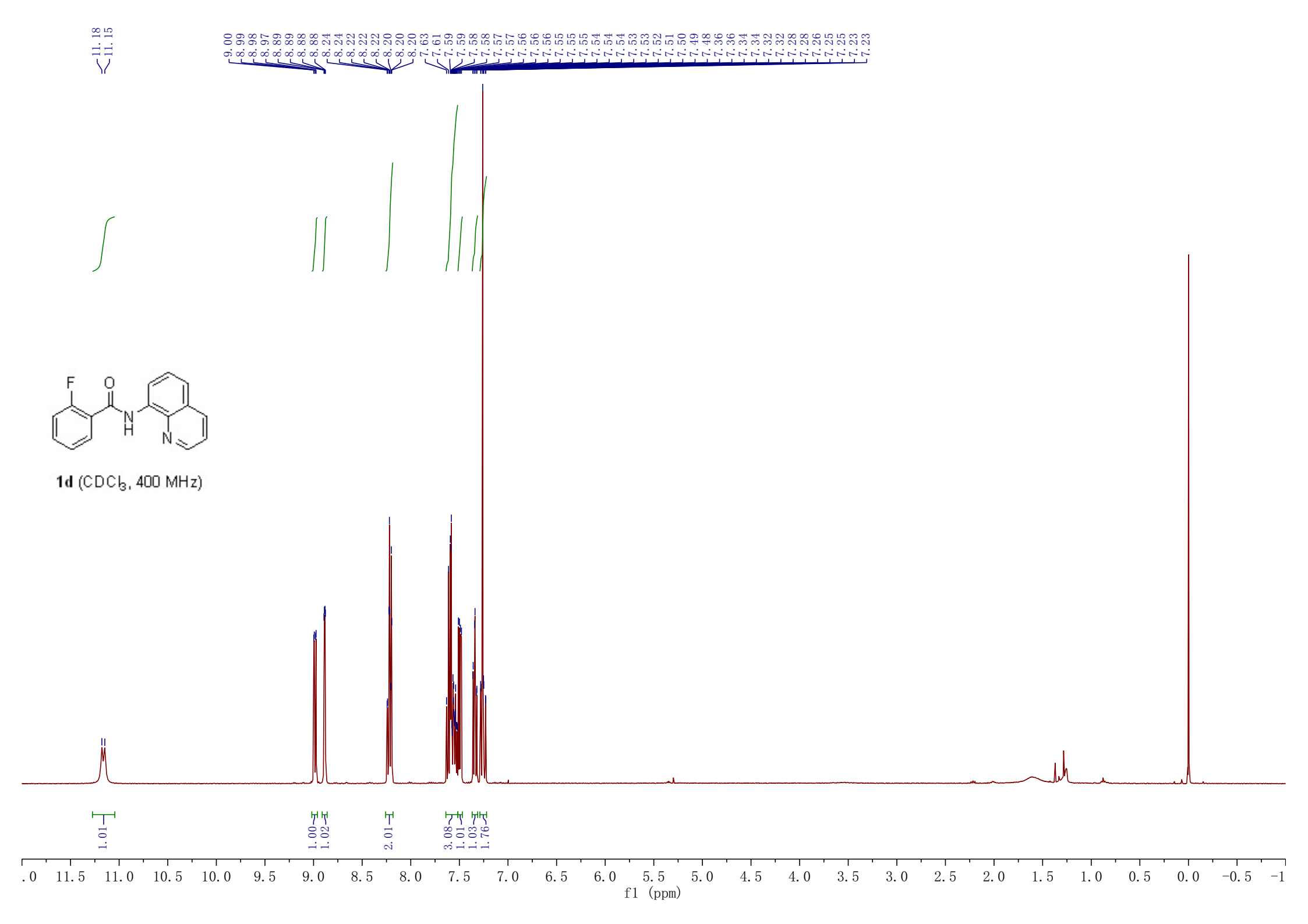
0.98
1.00
1.02
2.00
1.00
1.01
1.00
3.02
f1 (ppm)


163.6
157.6
148.1
139.1
136.2
135.6
133.1
132.3
128.0
127.5
122.2
121.4
121.4
121.2
117.3
111.5
77.3
77.0
76.7
56.0
O
O
N
H
N
1c (CDCl3, 101 MHz)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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8.97
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8.89
8.88
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8.24
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8.22
8.22
8.22
8.20
8.20
8.20
7.63
7.61
7.59
7.59
7.58
7.58
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7.57
7.56
7.56
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7.55
7.55
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7.48
7.36
7.36
7.34
7.34
7.32
7.32
7.28
7.28
7.26
7.25
7.25
7.23
7.23
F
O
N
H
N
1d (CDCl3, 400 MHz)
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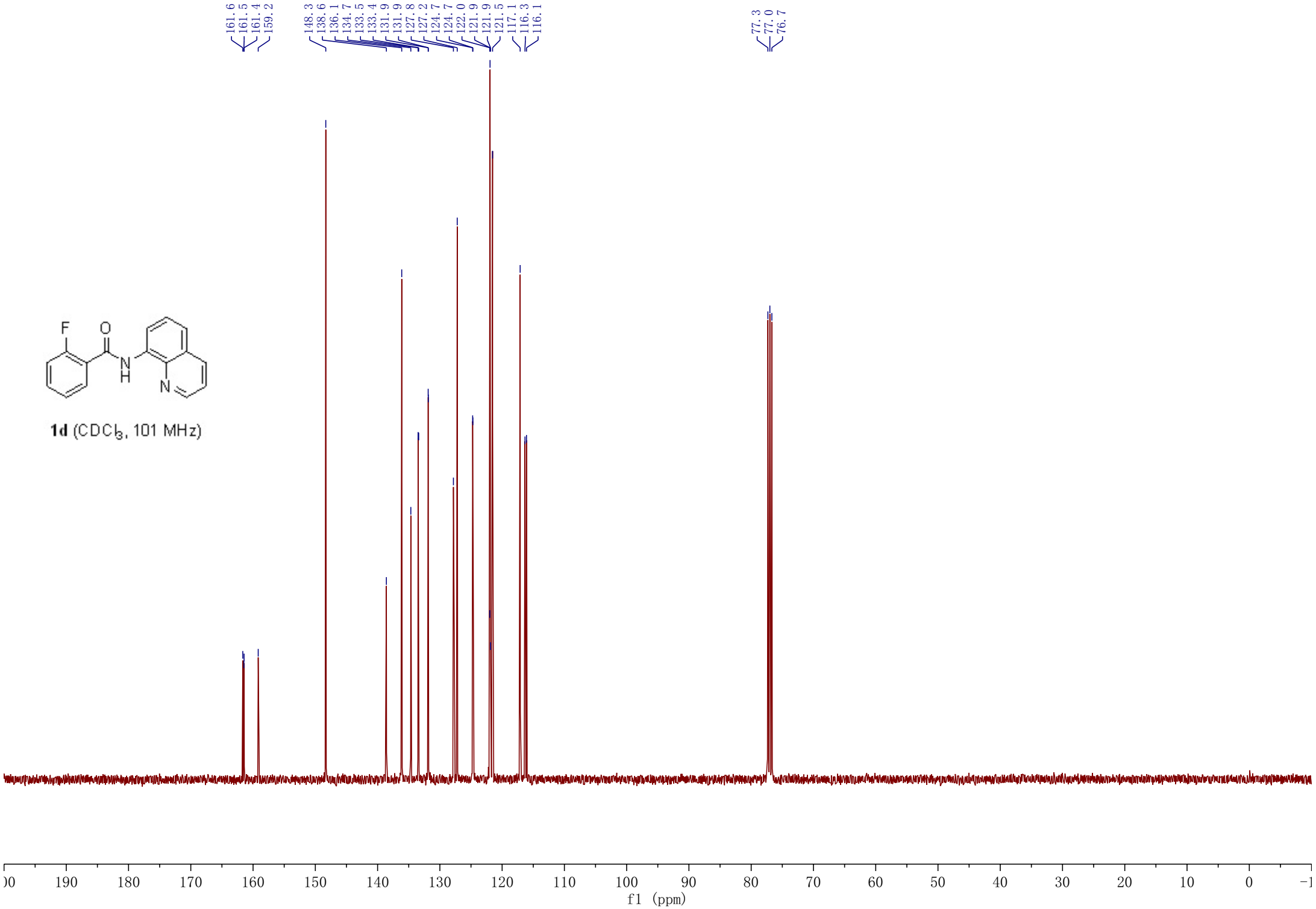
1.00
1.02
2.01
3.08
1.01
1.03
1.76
f1 (ppm)


161.6
161.5
161.4
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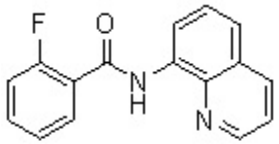
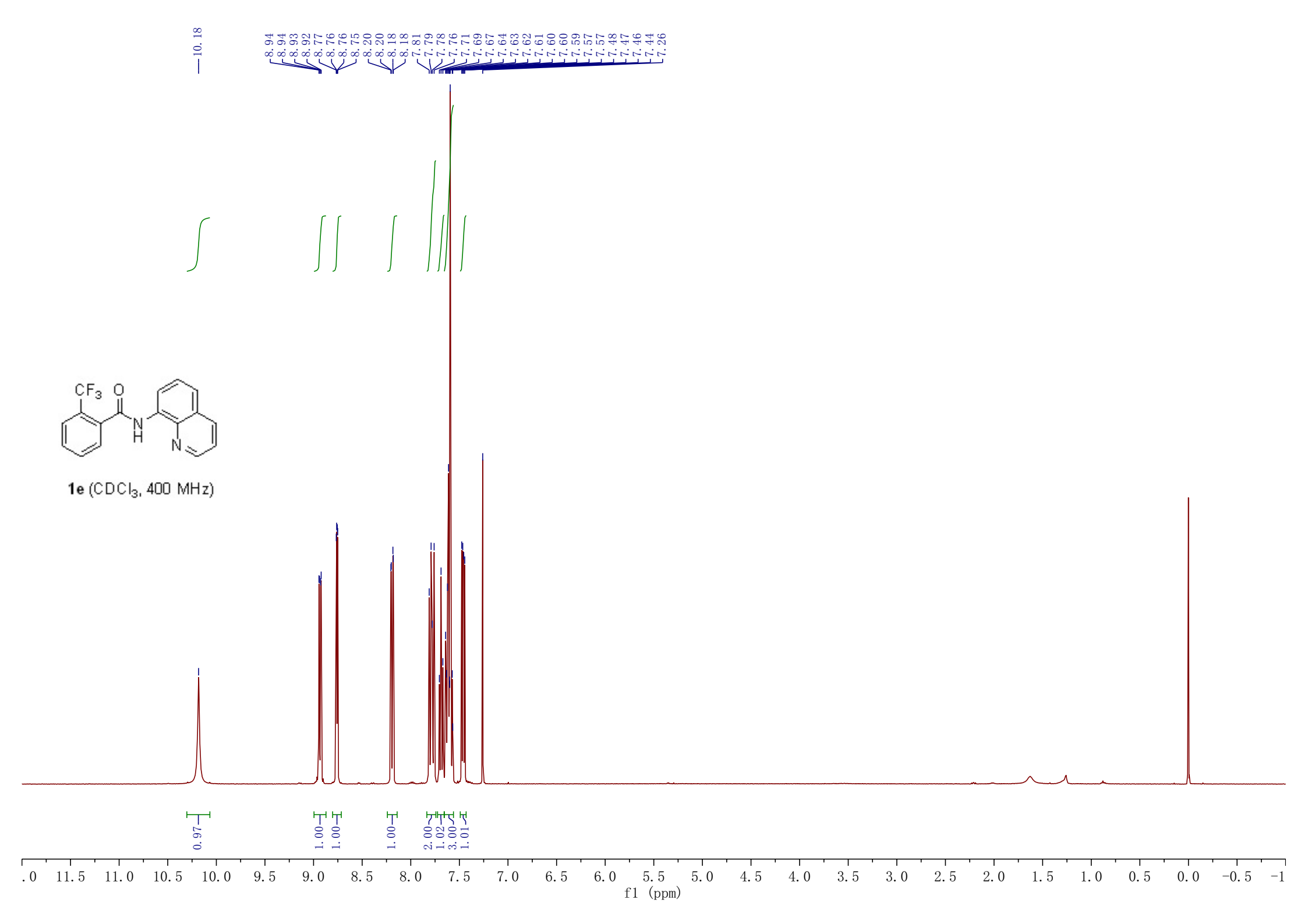
148.3
138.6
136.1
134.7
133.5
133.4
131.9
131.9
127.8
127.2
124.7
124.7
122.0
121.9
121.9
121.5
117.1
116.3
116.1
77.3
77.0
76.7
F
O
N
H
N
1d (CDCl3, 101 MHz)
f1 (ppm)



1d ($CDCl_3$, 376 MHz)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8.92
8.77
8.76
8.76
8.75
8.20
8.20
8.18
8.18
7.81
7.79
7.78
7.76
7.71
7.69
7.67
7.64
7.63
7.62
7.61
7.60
7.60
7.59
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7.57
7.48
7.47
7.46
7.44
7.26
CF3
O
N
H
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1.00
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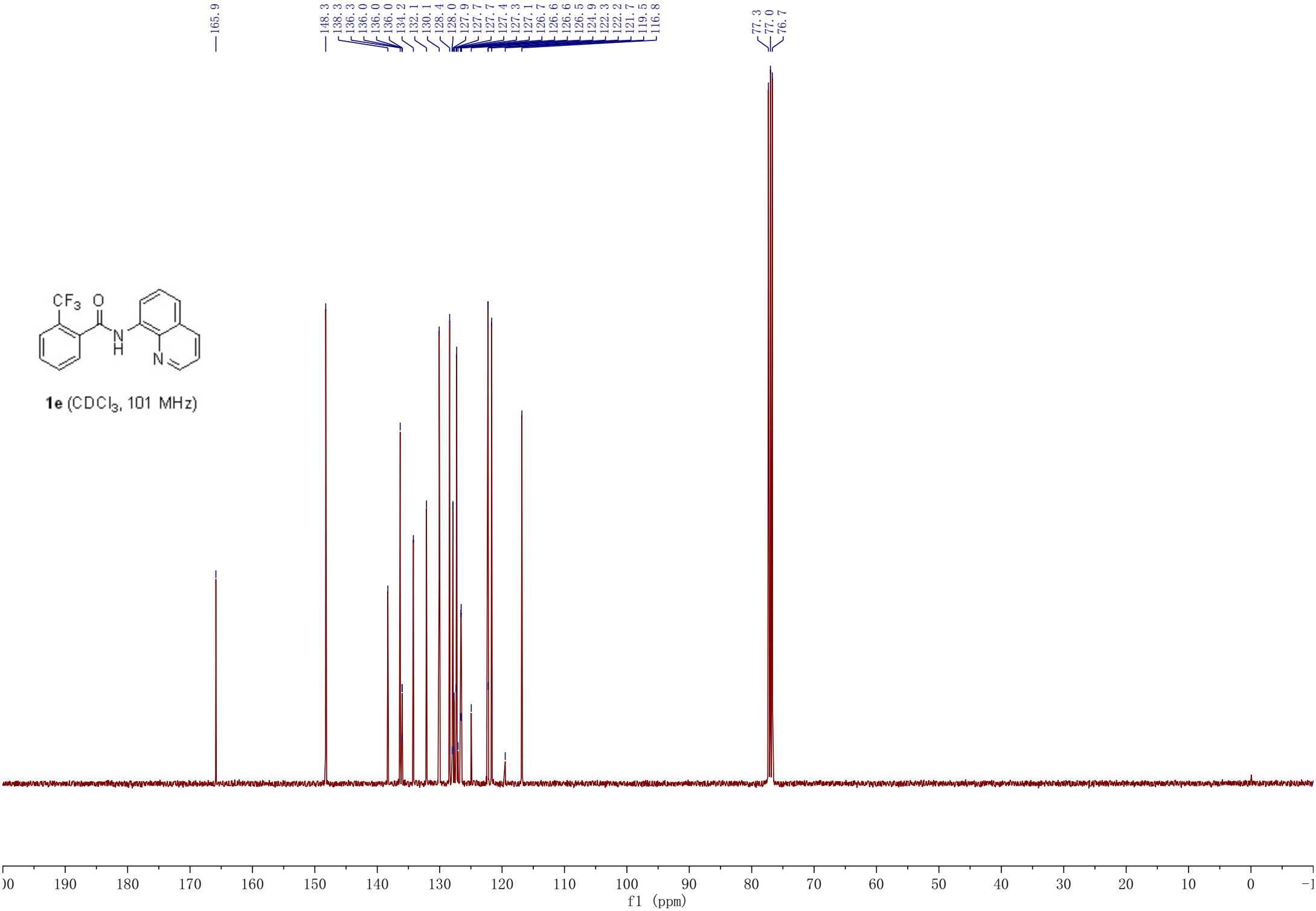
1.02
3.00
1.01
f1 (ppm)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134.2
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127.7
127.7
127.4
127.3
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126.7
126.6
126.6
126.5
124.9
122.3
122.2
121.7
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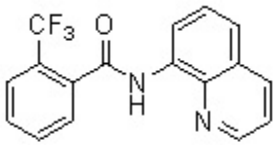
O
N
H
N
1e (CDCl3, 101 MHz)
f1 (ppm)



1e ($CDCl_3$, 376 MHz)

-58.87

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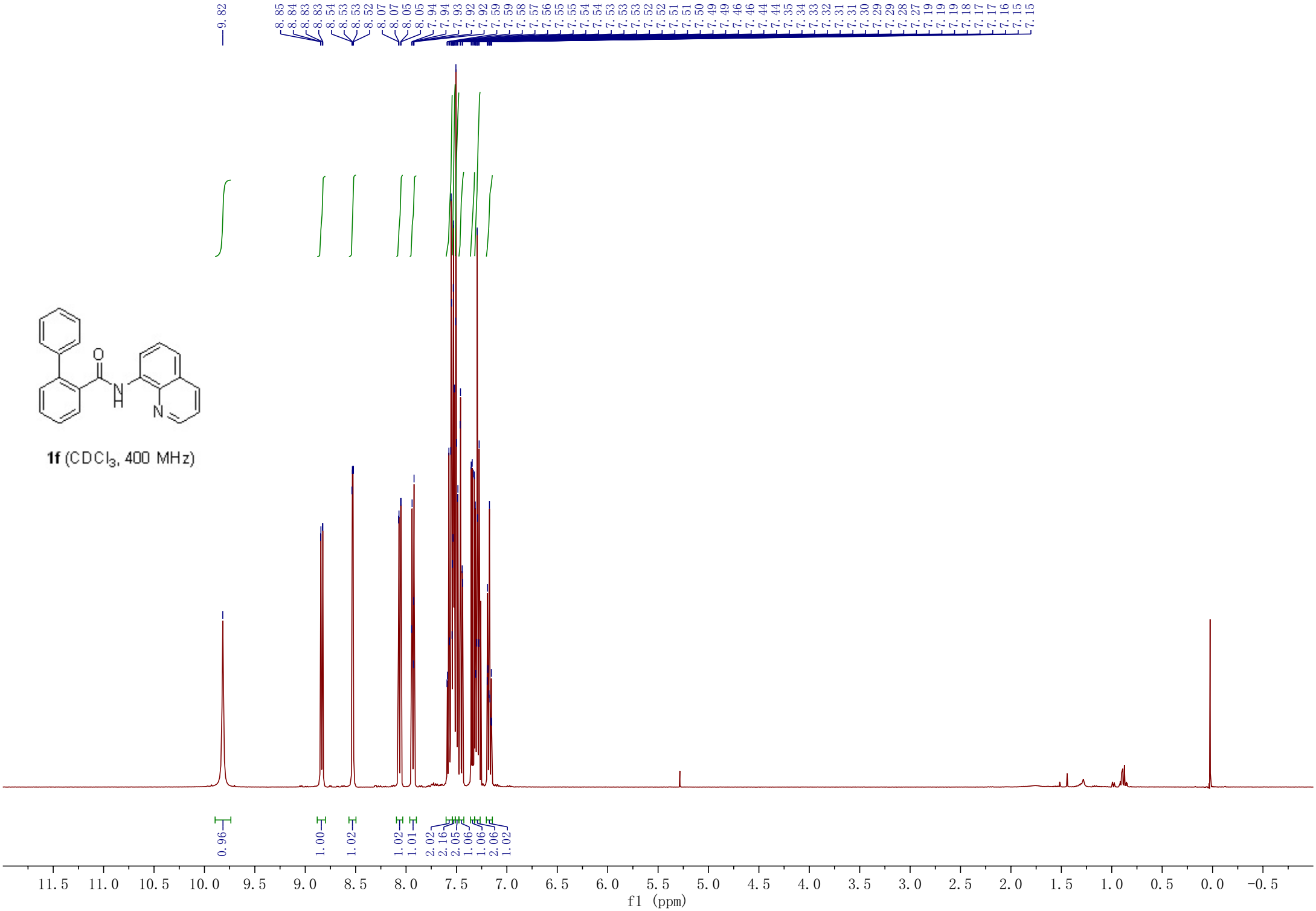
f1 (ppm)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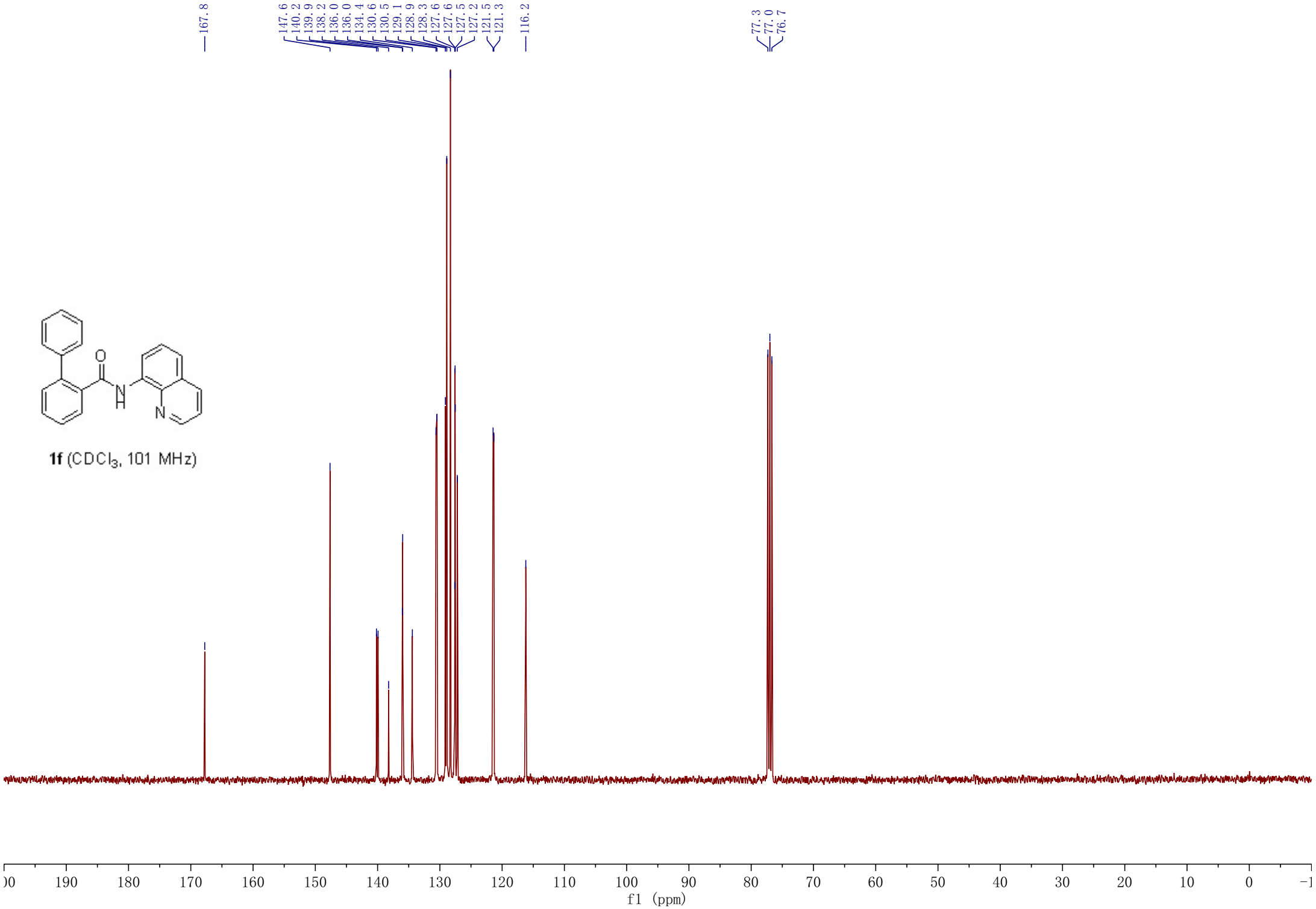
8.85 8.84 8.83 8.83 8.54 8.53 8.53 8.52 8.07 8.07 8.05 8.05 7.94 7.94 7.93 7.92 7.92 7.59 7.58 7.57 7.56 7.55 7.55 7.54 7.54 7.53 7.53 7.52 7.52 7.51 7.51 7.50 7.49 7.49 7.46 7.46 7.44 7.44 7.35 7.34 7.33 7.32 7.31 7.31 7.30 7.29 7.29 7.28 7.27 7.19 7.19 7.19 7.18 7.17 7.17 7.16 7.15 7.15
O
N
H
N
1f (CDCl3, 400 MHz)
0.96 1.00 1.02 1.02 1.01 2.02 2.16 2.05 1.06 1.06 2.06 1.02
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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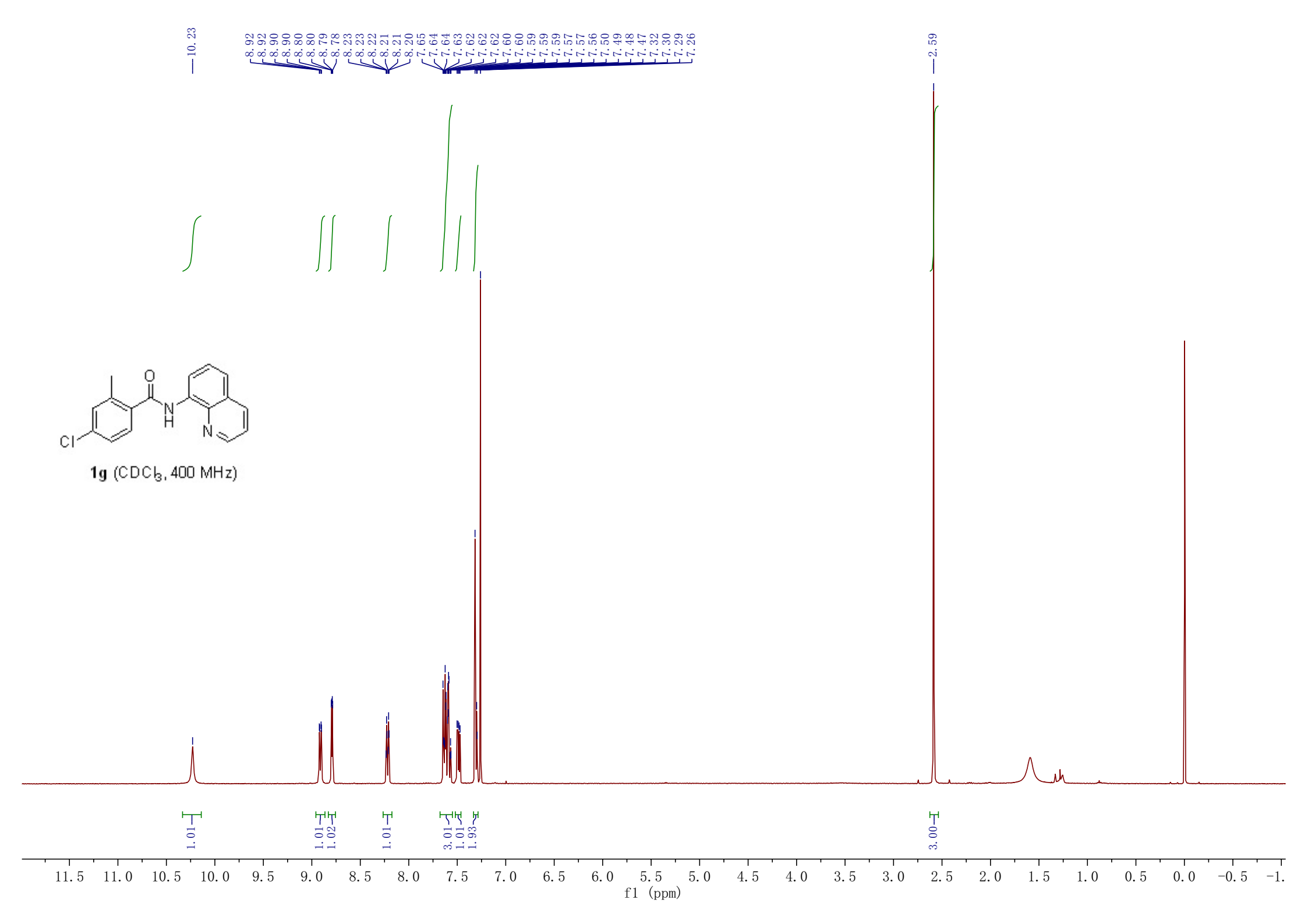
128.3
127.6
127.6
127.5
127.2
121.5
121.3
116.2
77.3
77.0
76.7
O
N
H
N
1f (CDCl3, 101 MHz)
f1 (ppm)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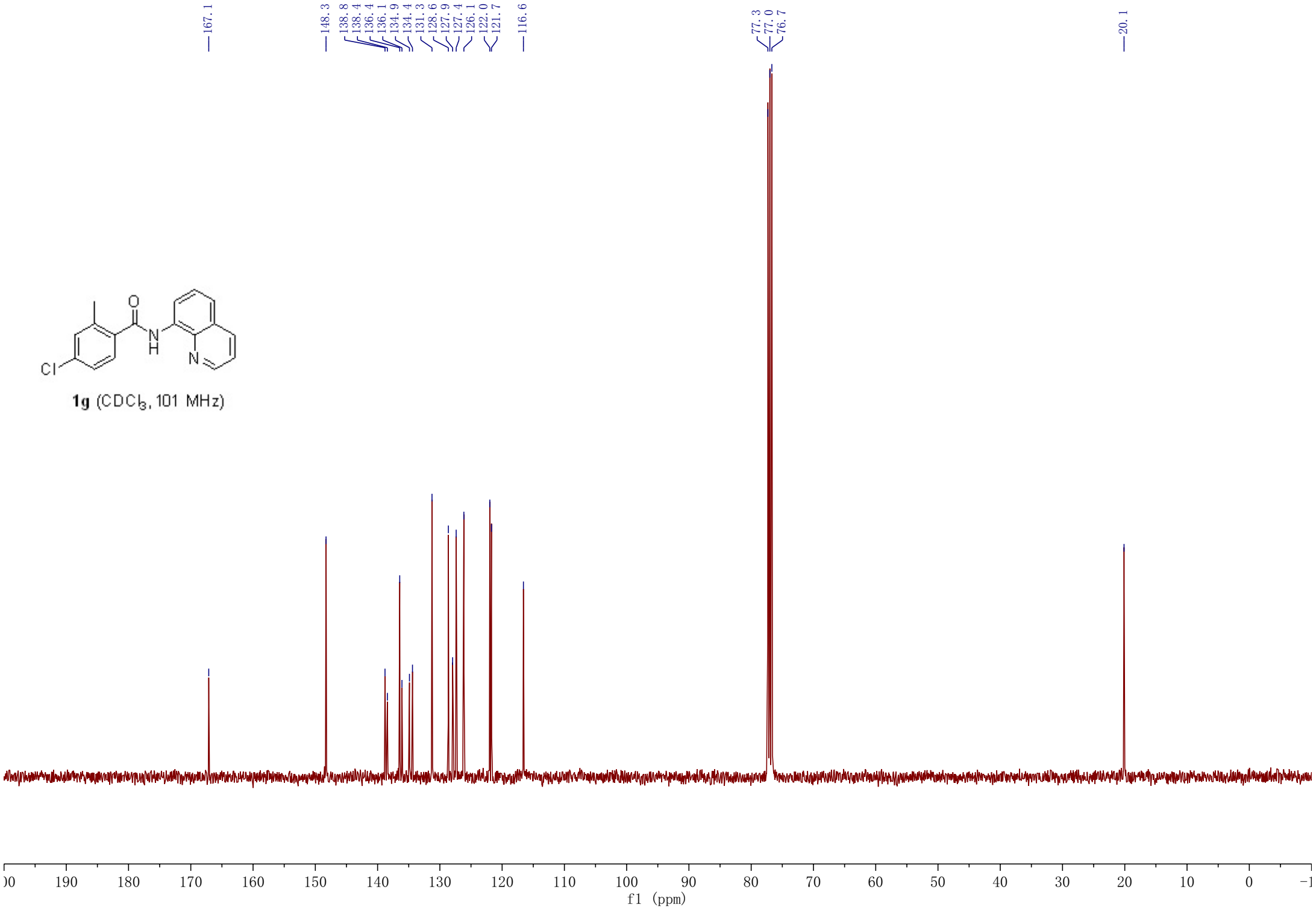
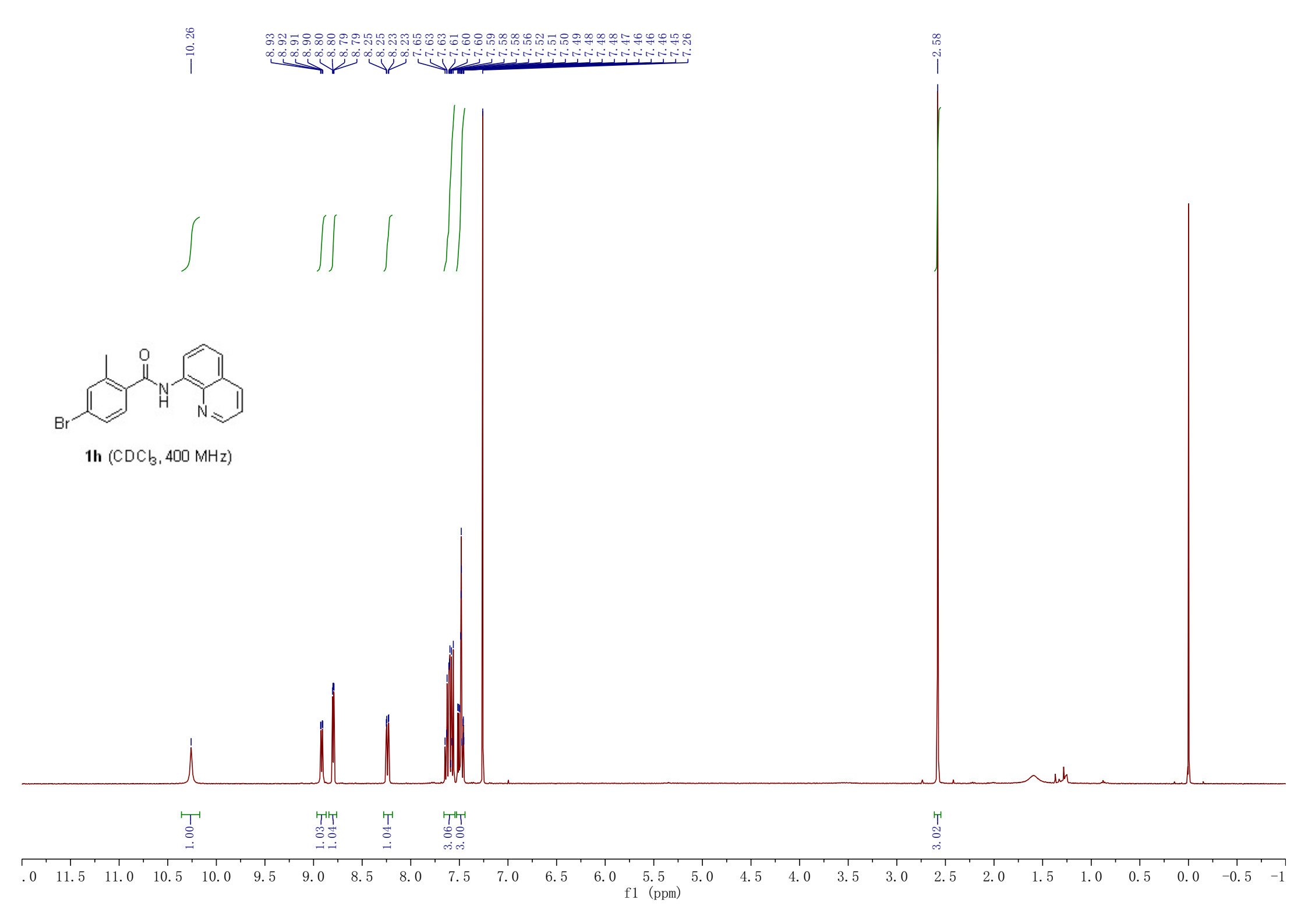
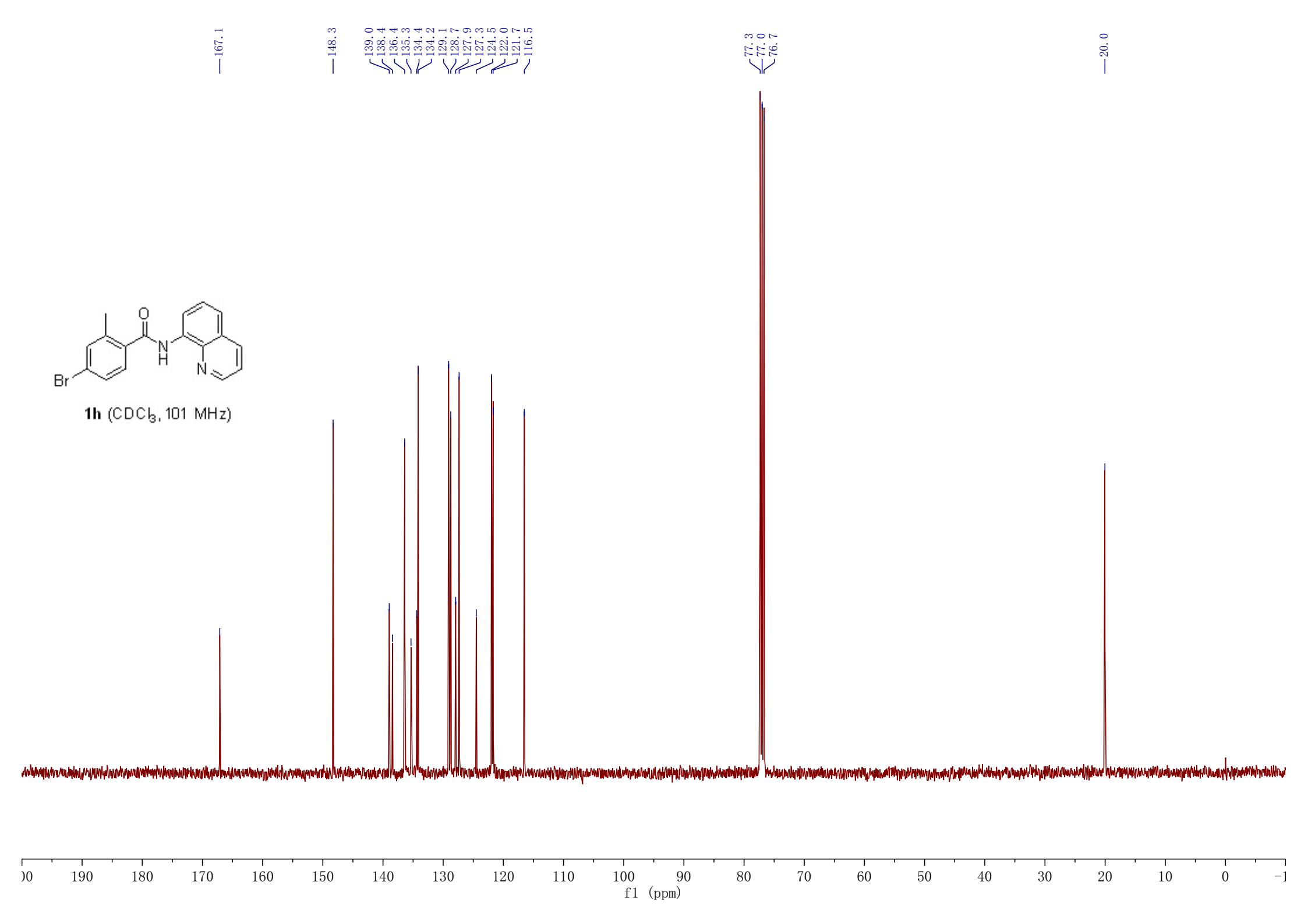
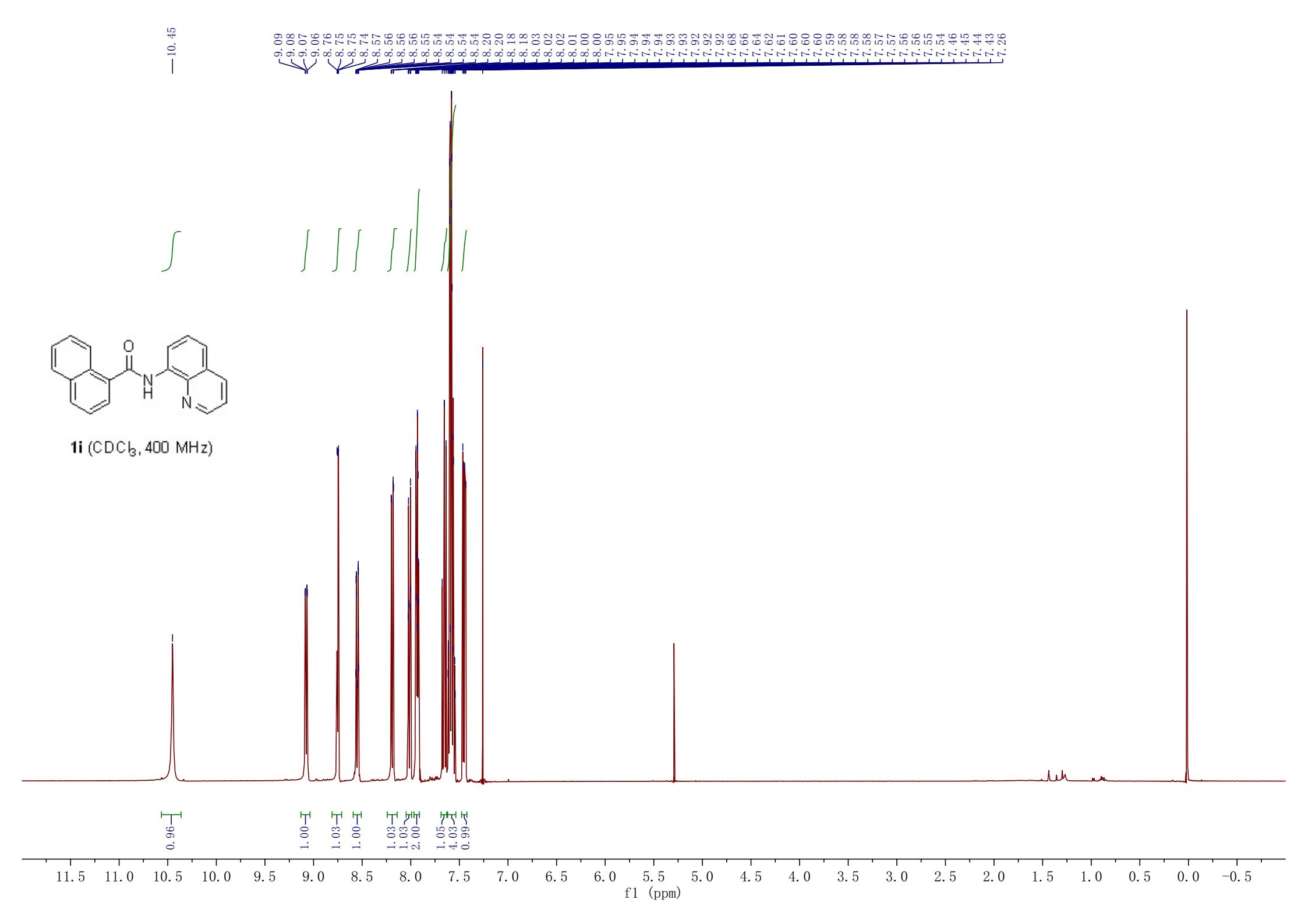
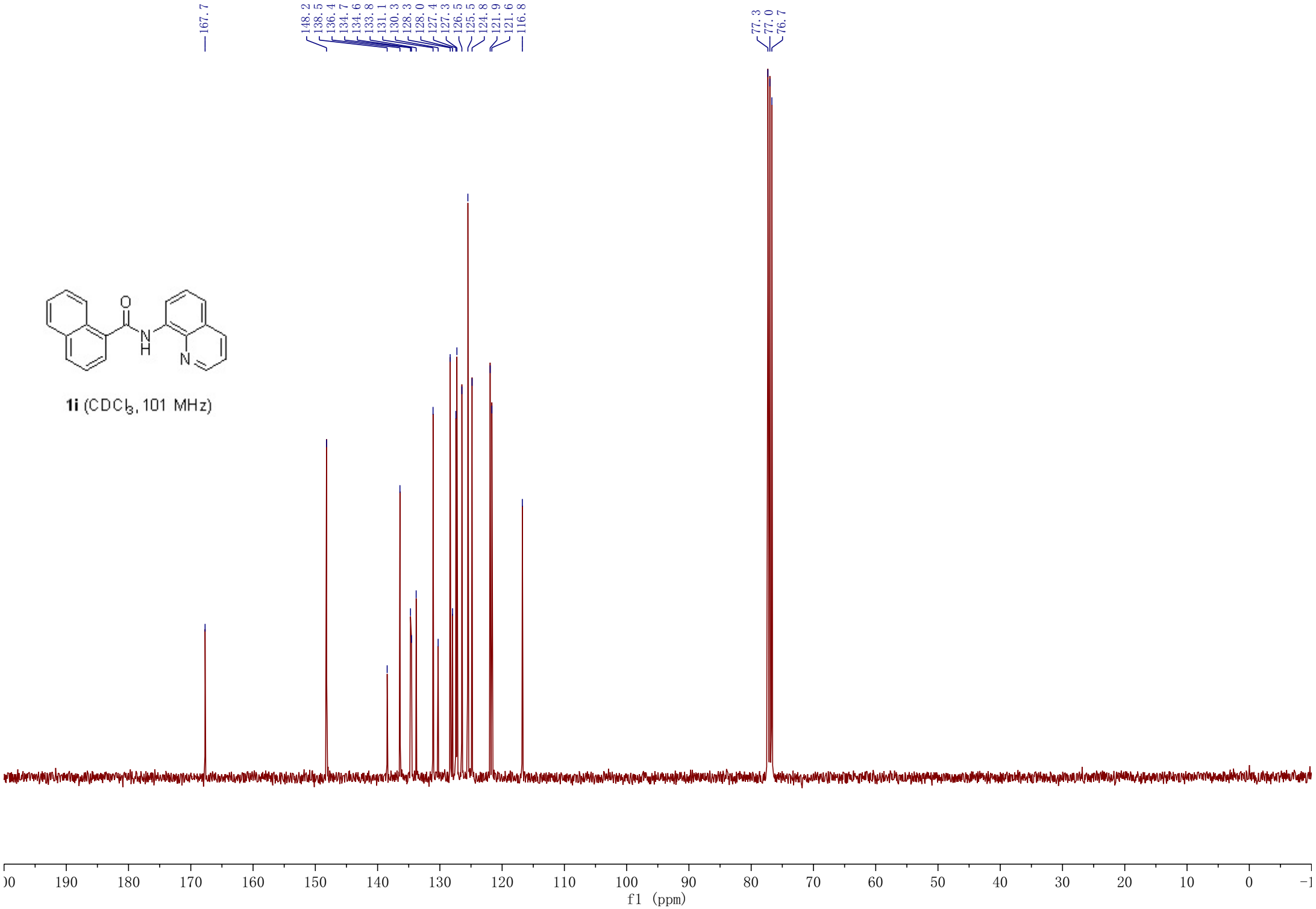
8.92
8.90
8.90
8.80
8.80
8.79
8.78
8.23
8.23
8.22
8.21
8.21
8.20
7.65
7.64
7.64
7.63
7.62
7.62
7.62
7.60
7.60
7.59
7.59
7.59
7.57
7.57
7.56
7.50
7.49
7.48
7.47
7.32
7.30
7.29
7.26
2.59
O
N
H
N
Cl
1g (CDCl3, 400 MHz)
1.01
1.01
1.02
1.01
3.01
1.01
1.93
3.00
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.
f1 (ppm)

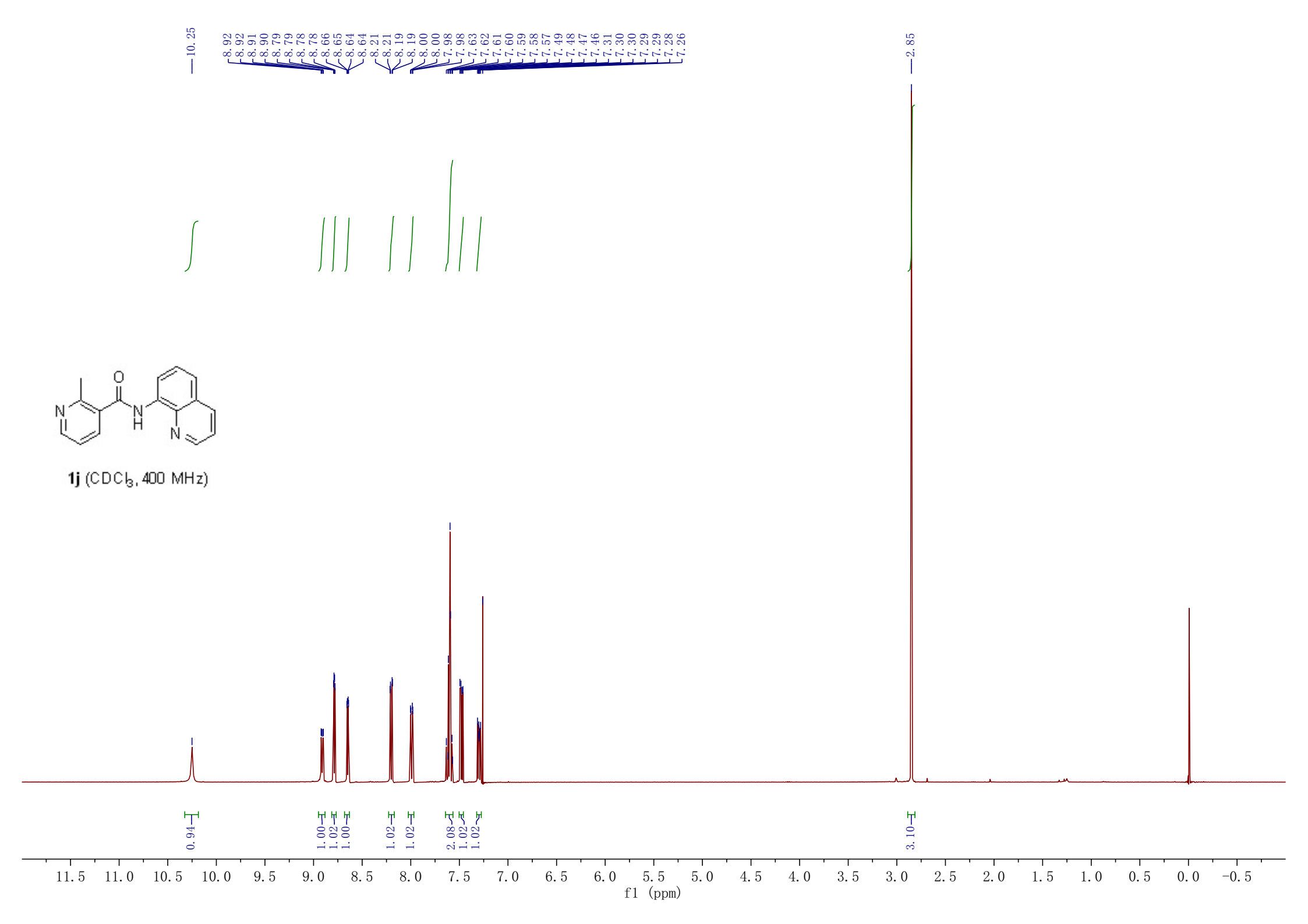

167.1
148.3
138.8
138.4
136.4
136.1
134.9
134.4
131.3
128.6
127.9
127.4
126.1
122.0
121.7
116.6
77.3
77.0
76.7
20.1
O
N
H
N
Cl
1g (CDCl3, 101 MHz)
f1 (ppm)

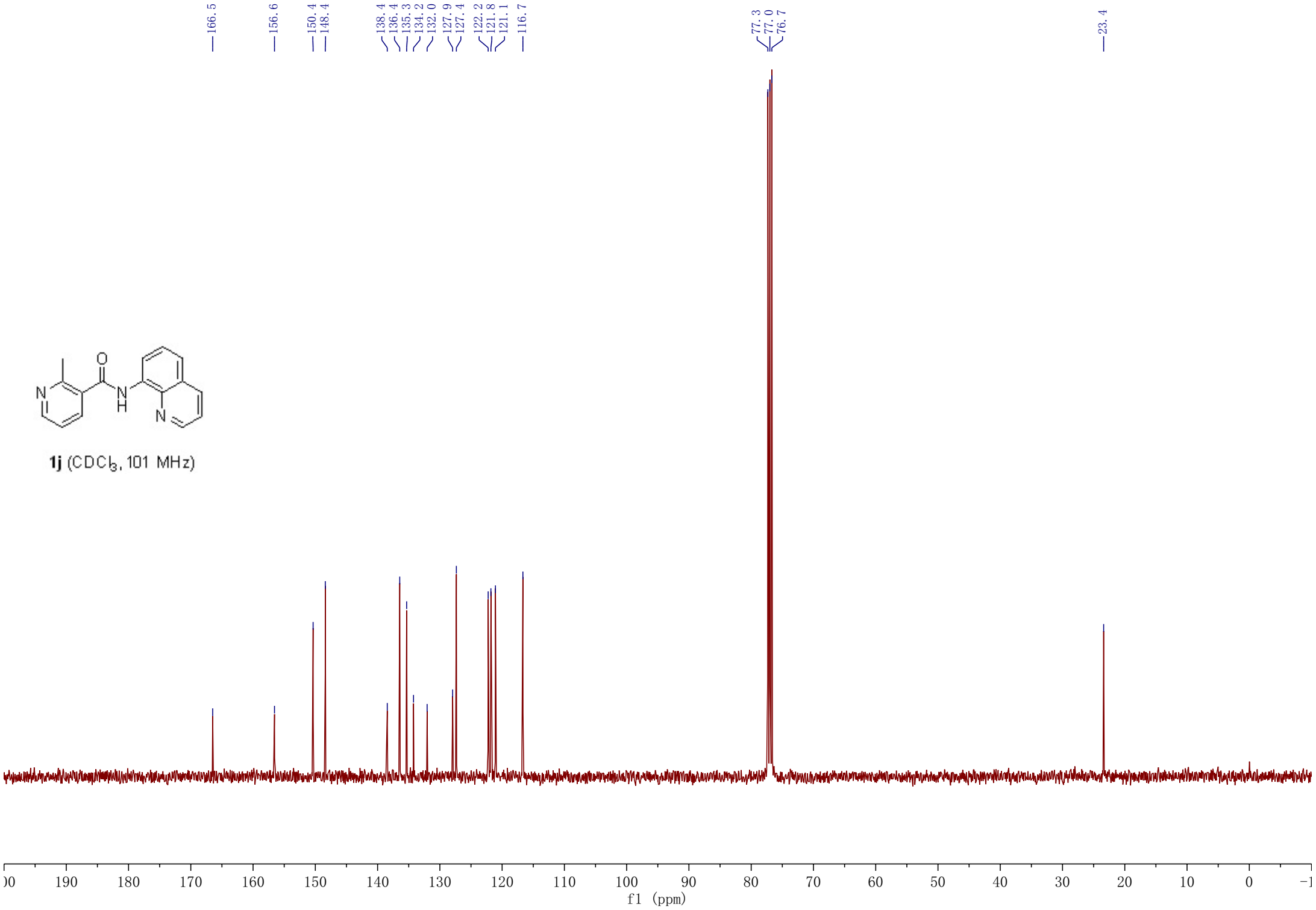

10.26
8.93
8.92
8.91
8.90
8.80
8.80
8.79
8.79
8.25
8.25
8.23
8.23
7.65
7.63
7.63
7.61
7.60
7.60
7.59
7.58
7.58
7.56
7.52
7.51
7.50
7.49
7.48
7.48
7.48
7.47
7.46
7.46
7.46
7.45
7.26
2.58
O
N
H
N
Br
1h (CDCl3, 400 MHz)
1.00
1.03
1.04
1.04
3.06
3.00
3.02
f1 (ppm)

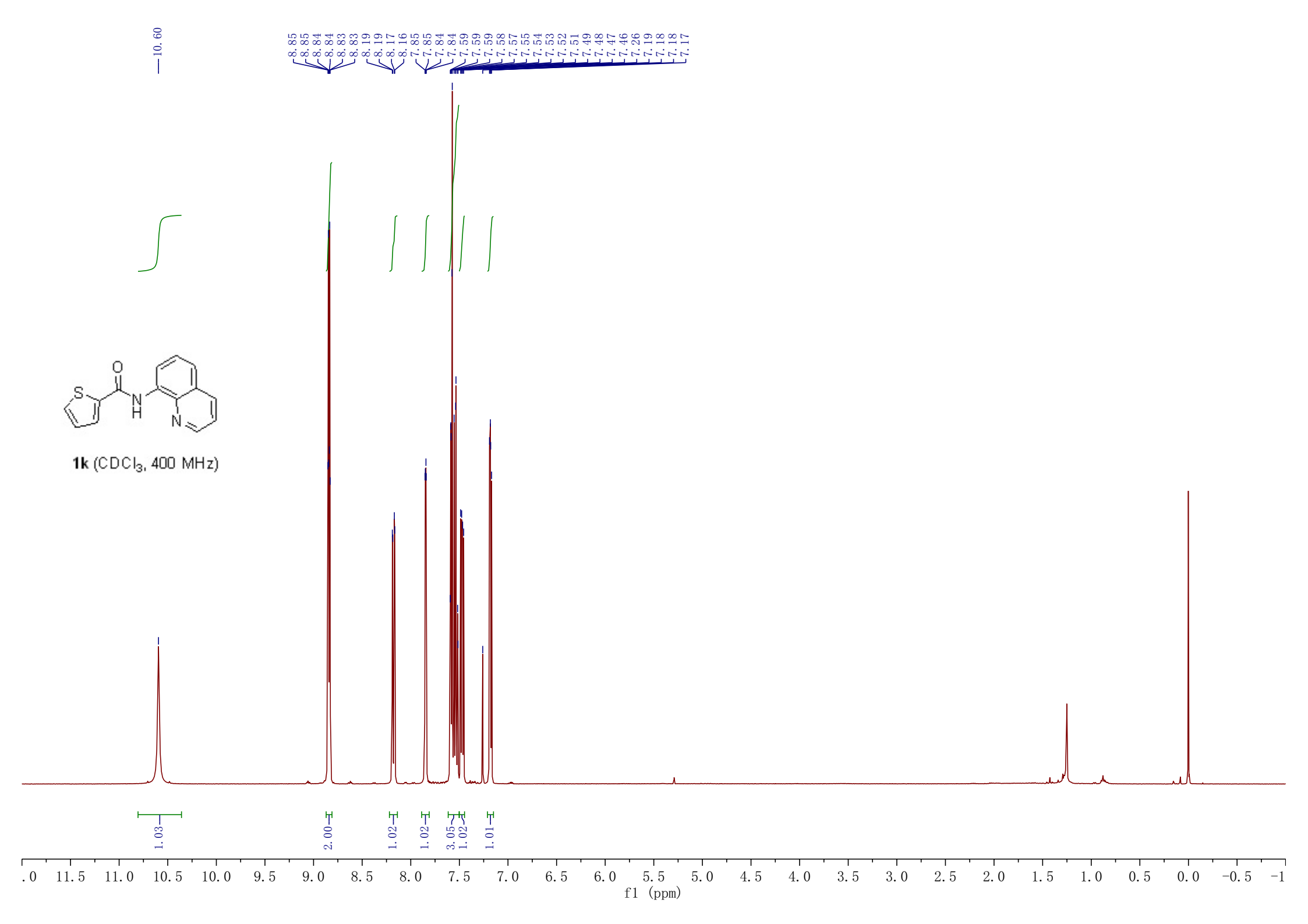

167.1
148.3
139.0
138.4
136.4
135.3
134.4
134.2
129.1
128.7
127.9
127.3
124.5
122.0
121.7
116.5
77.3
77.0
76.7
20.0
O
N
H
N
Br
1h (CDCl3, 101 MHz)
f1 (ppm)

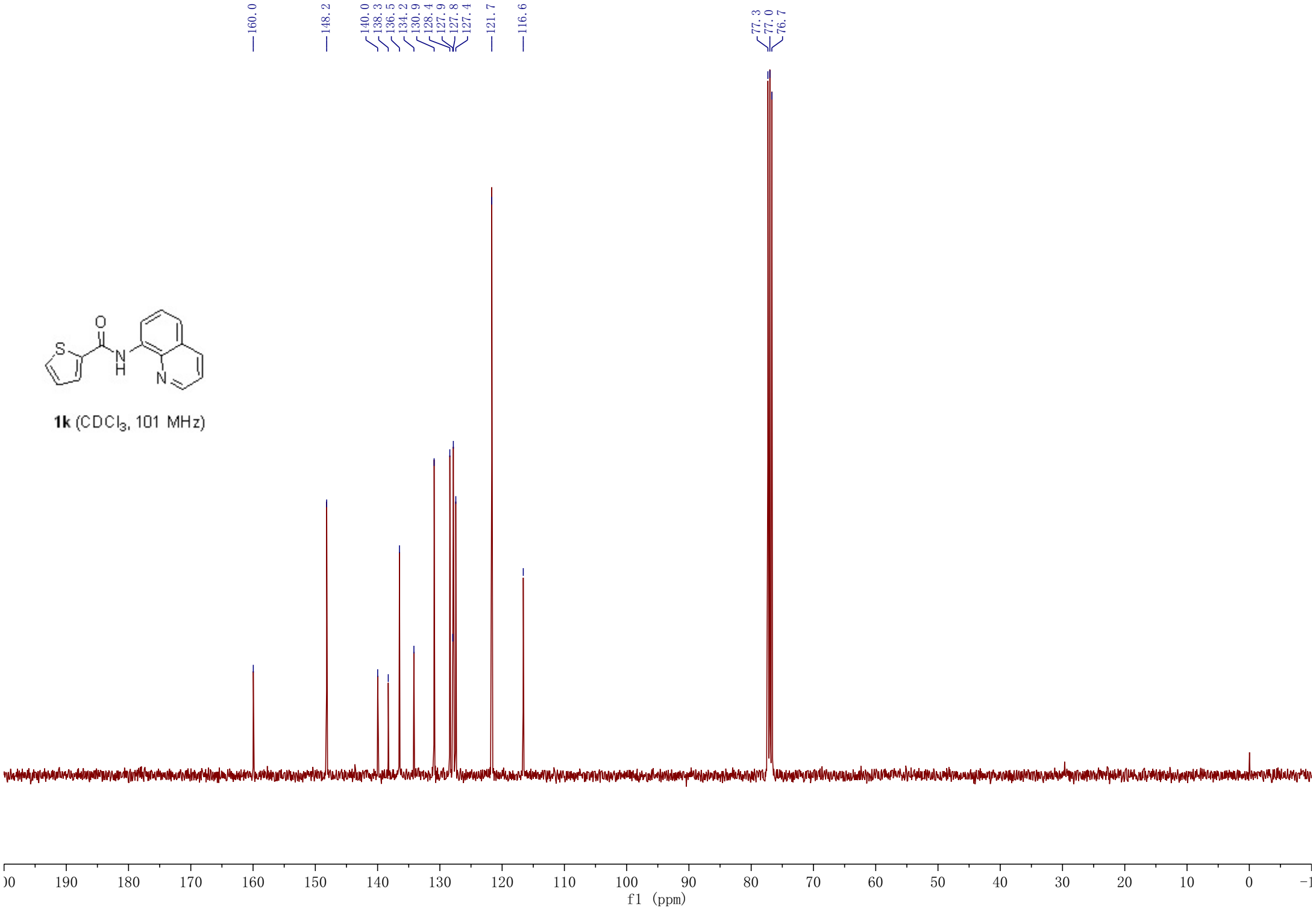

10.45
9.09
9.08
9.07
9.06
8.76
8.75
8.75
8.74
8.57
8.56
8.56
8.56
8.55
8.54
8.54
8.54
8.54
8.20
8.20
8.18
8.18
8.03
8.02
8.02
8.01
8.00
8.00
7.95
7.94
7.94
7.94
7.93
7.93
7.92
7.92
7.92
7.68
7.66
7.64
7.62
7.61
7.60
7.60
7.60
7.59
7.58
7.58
7.58
7.57
7.57
7.56
7.56
7.55
7.54
7.46
7.45
7.44
7.43
7.26
O
N
H
N
1i (CDCl3, 400 MHz)
0.96
1.00
1.03
1.00
1.03
1.03
2.00
1.05
4.03
0.99
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

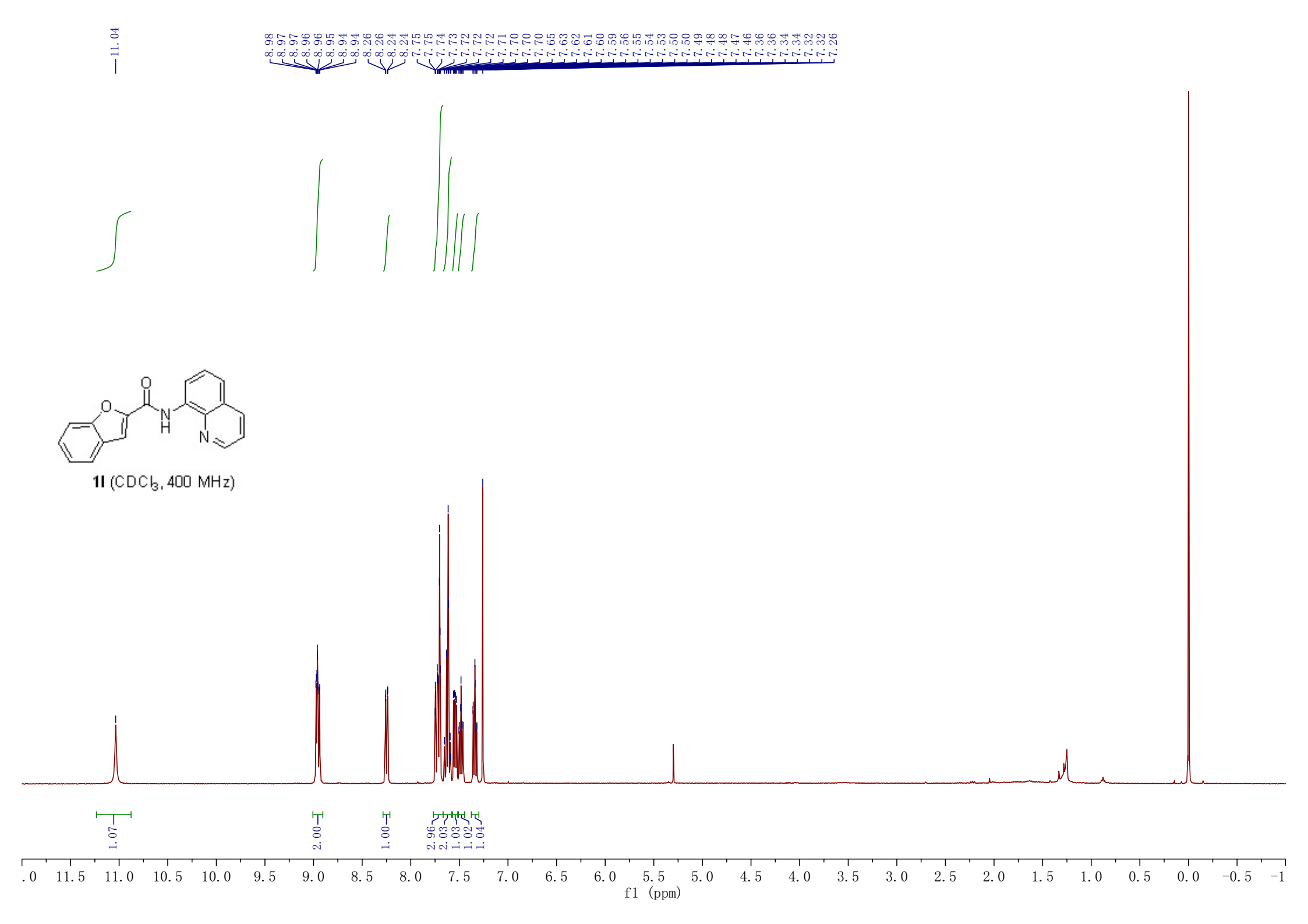

167.7
148.2
138.5
136.4
134.7
134.6
133.8
131.1
130.3
128.3
128.0
127.4
127.3
126.5
125.5
124.8
121.9
121.6
116.8
77.3
77.0
76.7
O
N
H
N
1i (CDCl3, 101 MHz)
f1 (ppm)

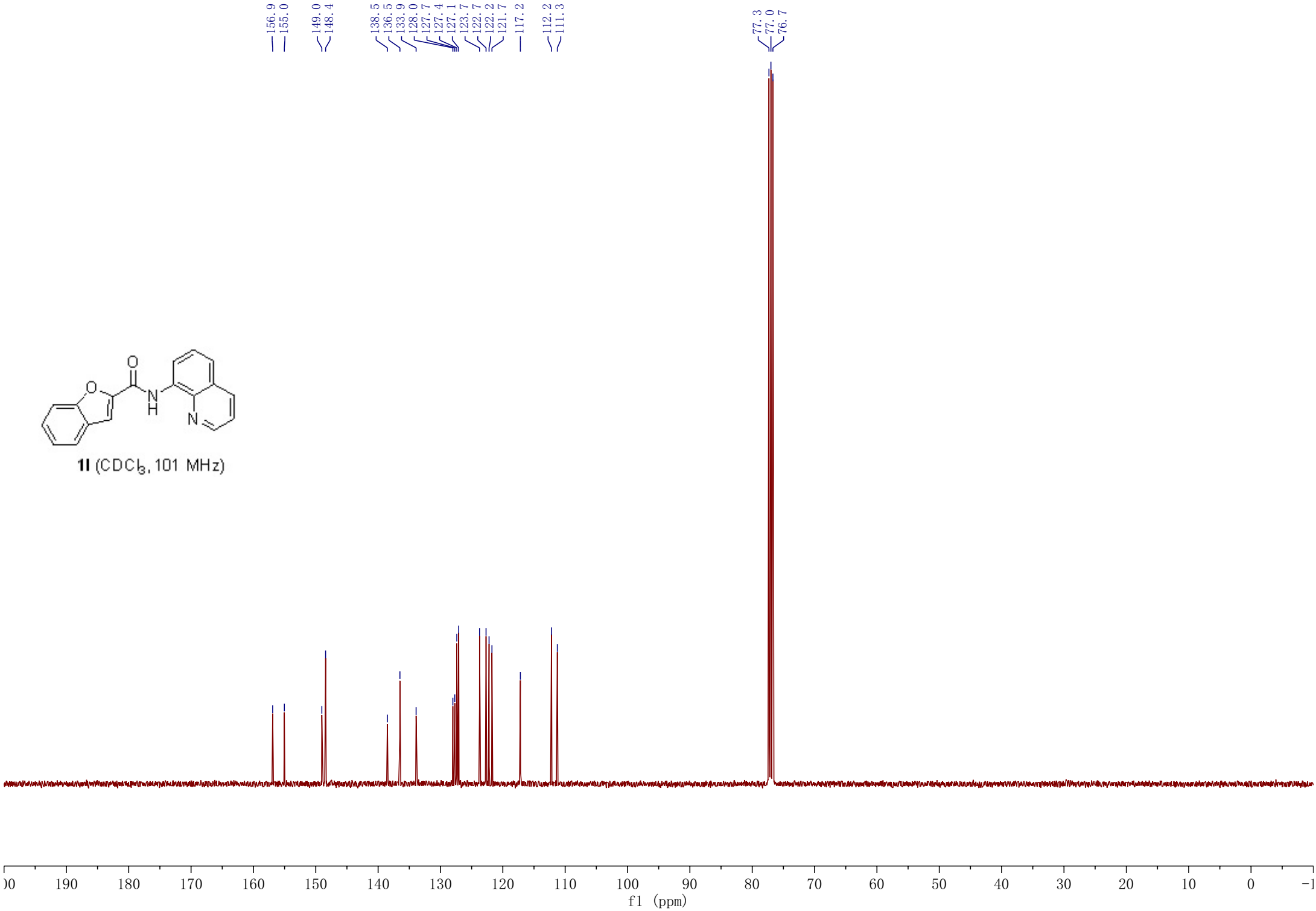

10.25
8.92
8.92
8.91
8.90
8.79
8.79
8.78
8.78
8.66
8.65
8.64
8.64
8.21
8.21
8.19
8.19
8.00
8.00
7.98
7.98
7.63
7.62
7.61
7.60
7.59
7.58
7.57
7.49
7.48
7.47
7.46
7.31
7.30
7.30
7.29
7.29
7.28
7.26
2.85
O
N
H
N
N
1j (CDCl3, 400 MHz)
0.94
1.00
1.02
1.00
1.02
1.02
2.08
1.02
1.02
3.10
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

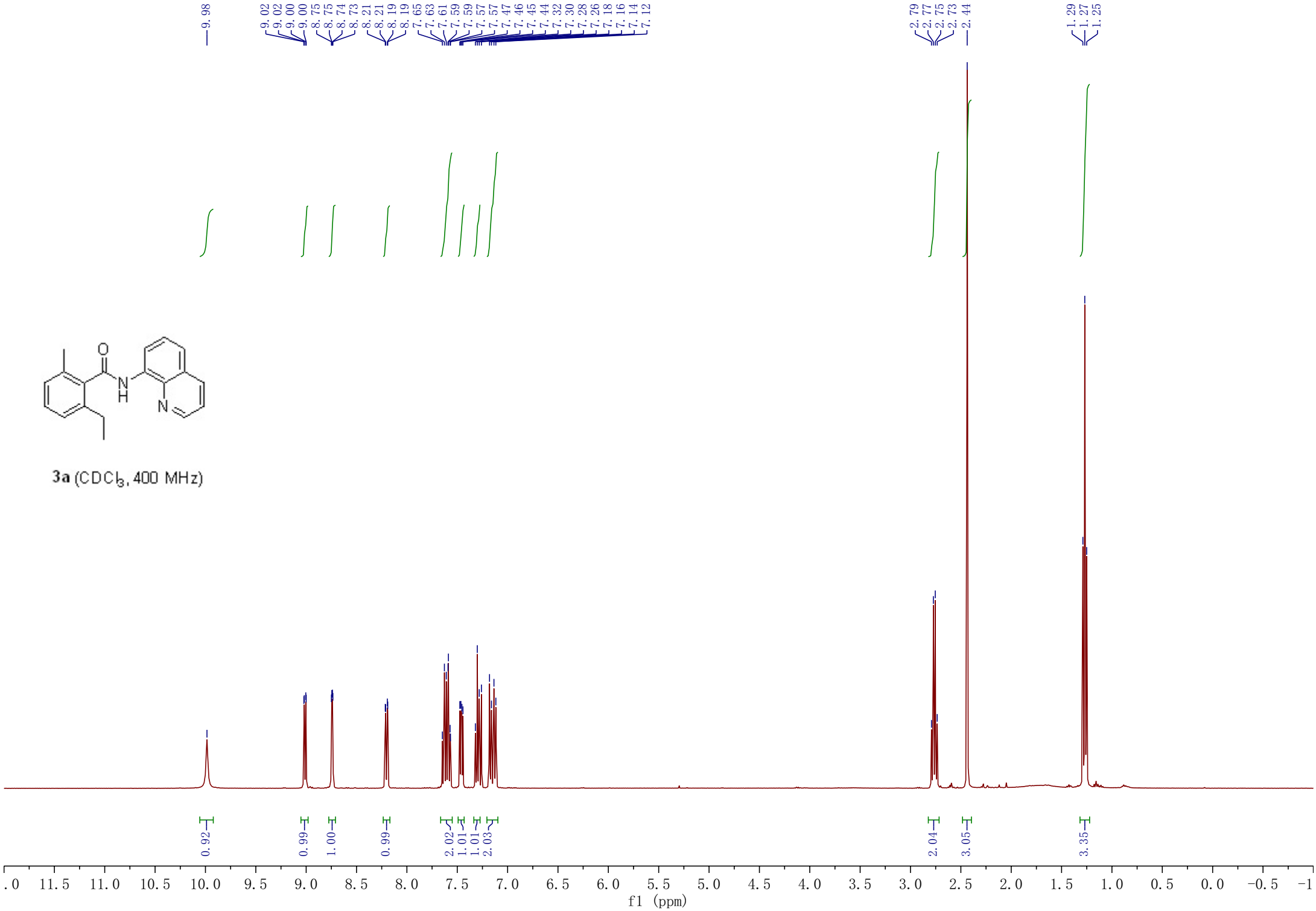

166.5
156.6
150.4
148.4
138.4
136.4
135.3
134.2
132.0
127.9
127.4
122.2
121.8
121.1
116.7
77.3
77.0
76.7
23.4
O
N
H
N
1j (CDCl3, 101 MHz)
f1 (ppm)

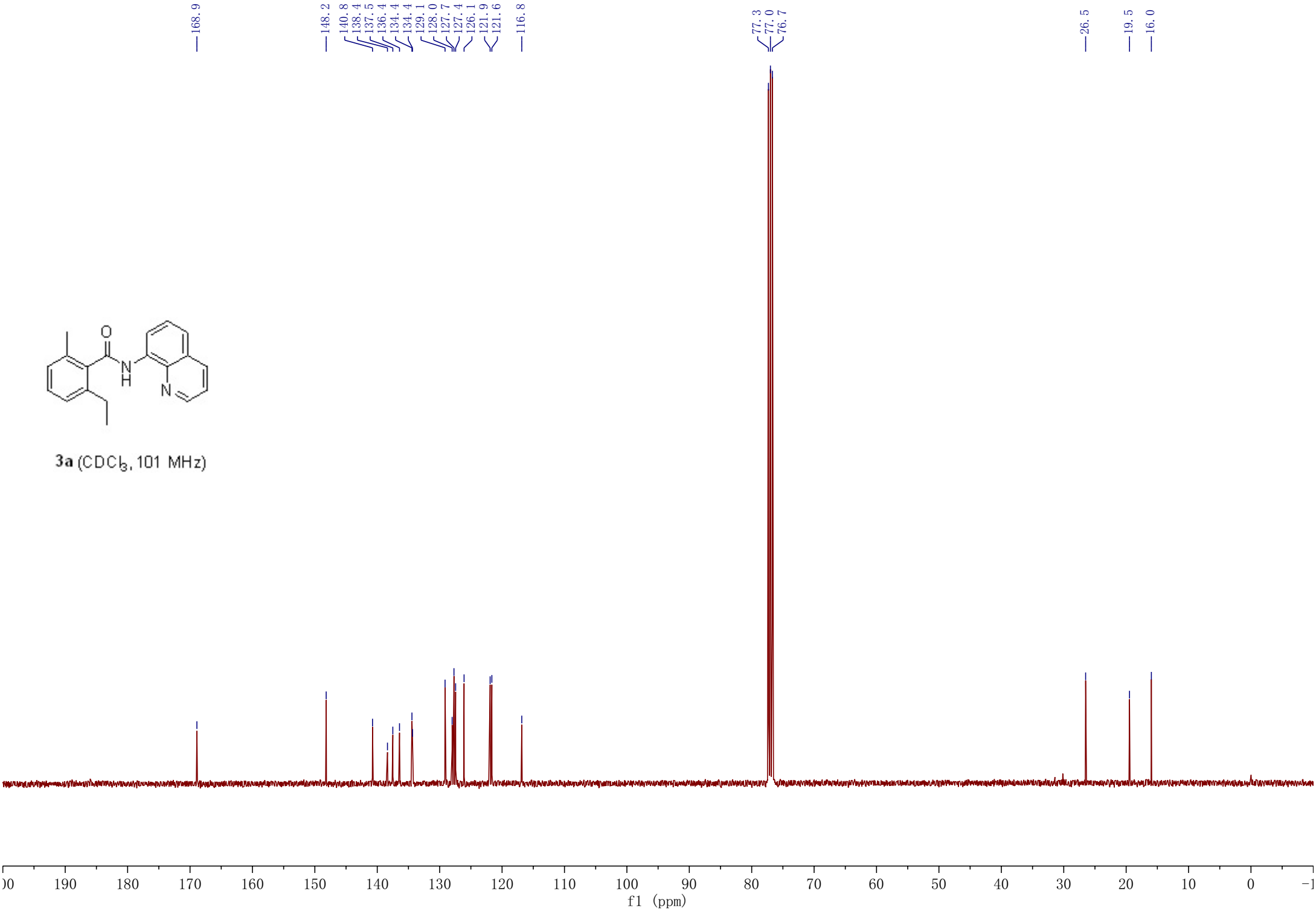

10.60
8.85
8.85
8.84
8.84
8.83
8.83
8.19
8.19
8.17
8.16
7.85
7.85
7.84
7.84
7.59
7.59
7.59
7.58
7.57
7.55
7.54
7.53
7.52
7.51
7.49
7.48
7.47
7.46
7.26
7.19
7.18
7.18
7.17
O
S
N
H
N
1k (CDCl3, 400 MHz)
1.03
2.00
1.02
1.02
3.05
1.02
1.01
f1 (ppm)

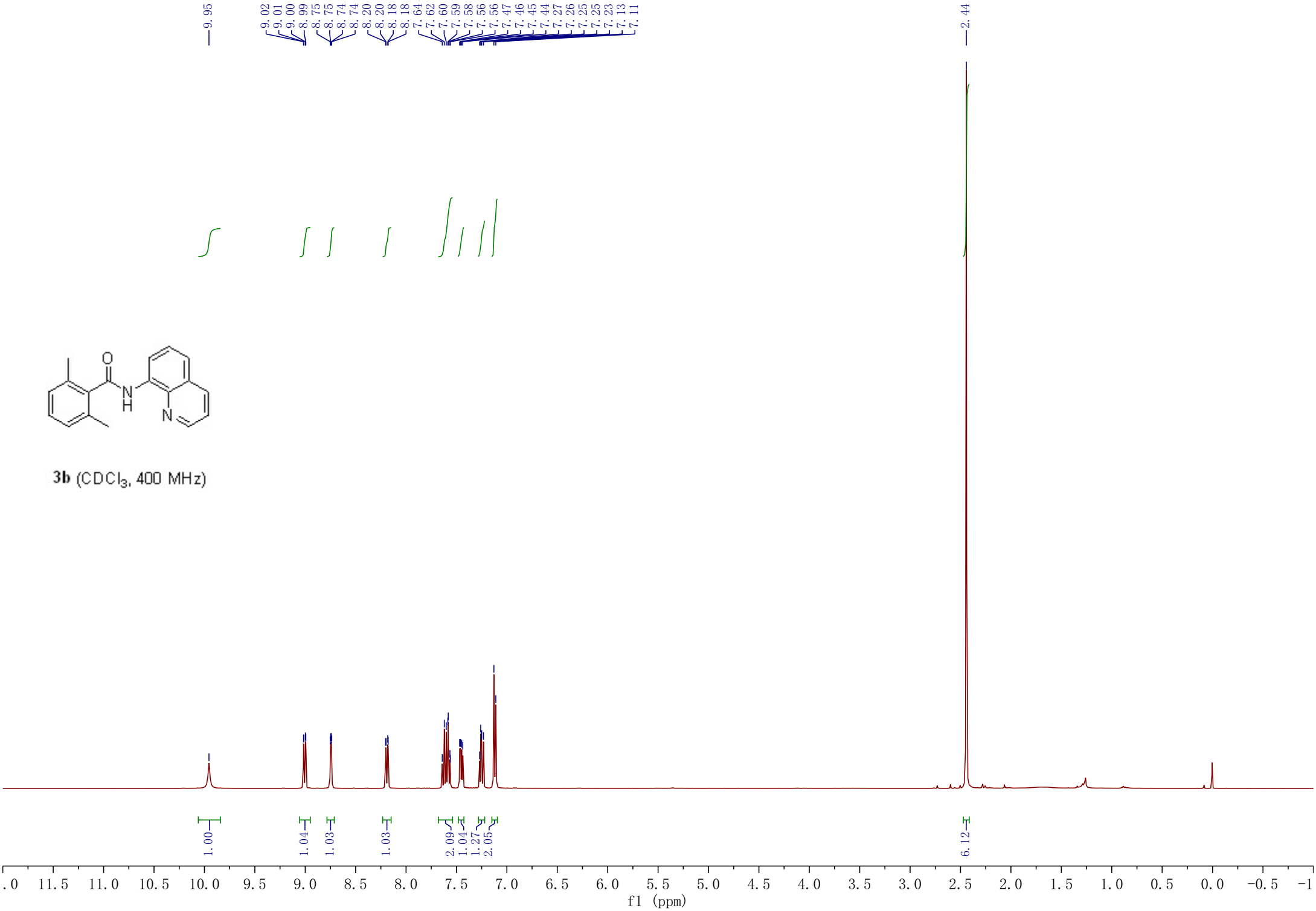

160.0
148.2
140.0
138.3
136.5
134.2
130.9
128.4
127.9
127.8
127.4
121.7
116.6
77.3
77.0
76.7
O
S
N
H
N
1k (CDCl3, 101 MHz)
f1 (ppm)

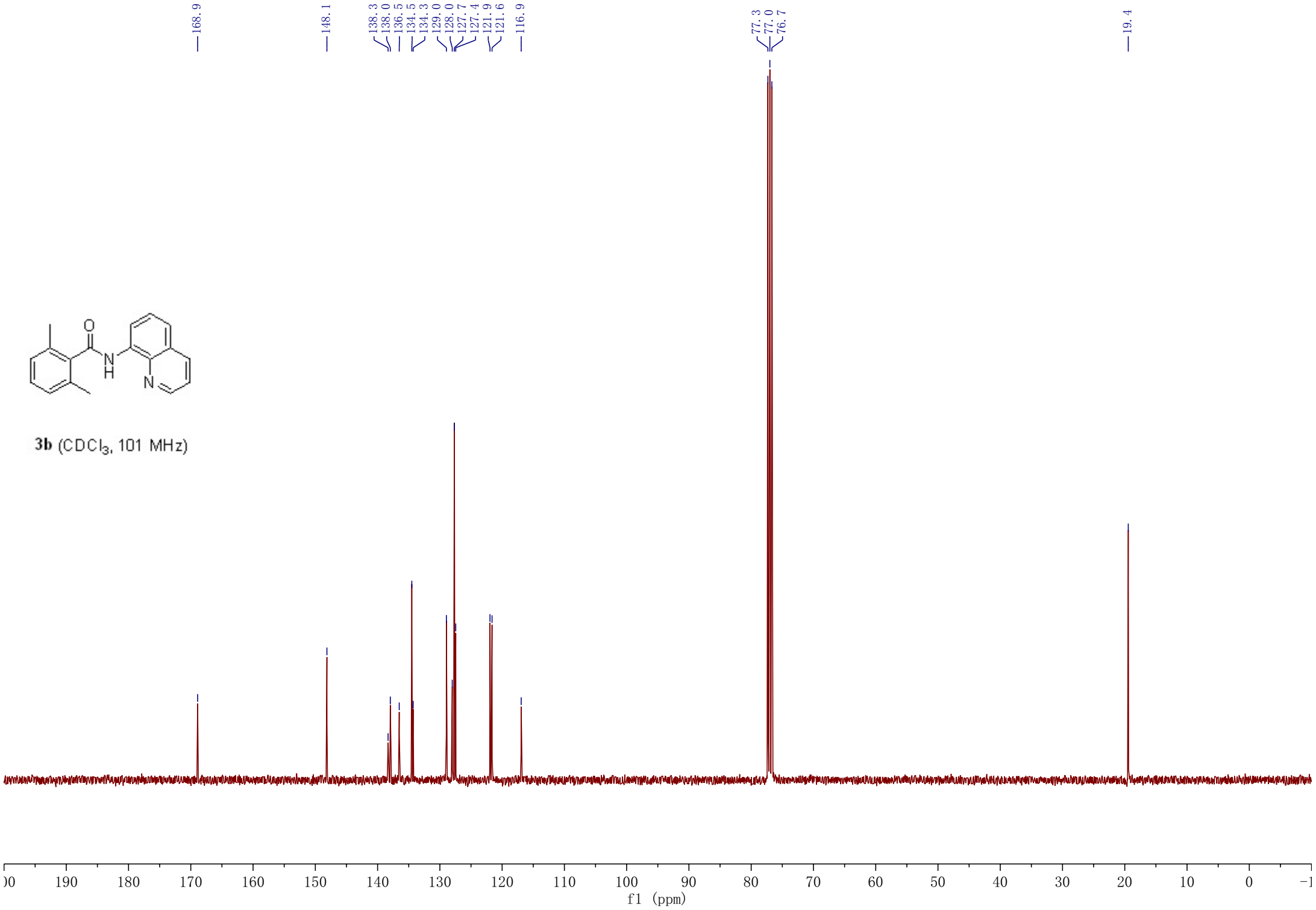

11.04
8.98
8.97
8.97
8.96
8.96
8.95
8.94
8.94
8.26
8.26
8.24
8.24
7.75
7.74
7.74
7.73
7.72
7.72
7.72
7.71
7.70
7.70
7.70
7.65
7.63
7.62
7.61
7.60
7.59
7.56
7.55
7.54
7.53
7.50
7.50
7.49
7.48
7.48
7.47
7.46
7.36
7.36
7.34
7.34
7.32
7.32
7.26
O
O
N
H
N
1l (CDCl3, 400 MHz)
1.07
2.00
1.00
2.96
2.03
1.03
1.02
1.04
.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1
f1 (ppm)

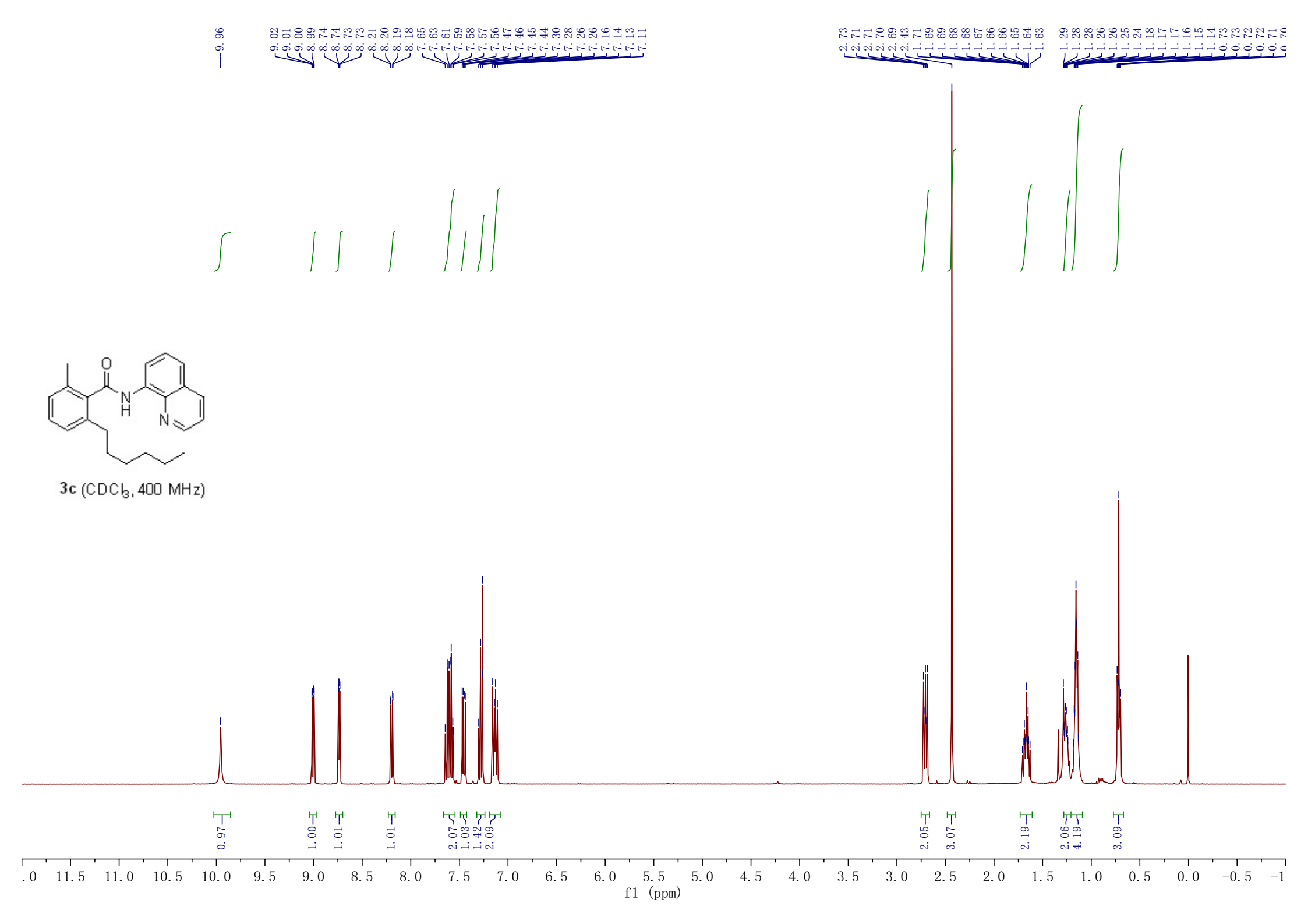

156.9
155.0
149.0
148.4
138.5
136.5
133.9
128.0
127.7
127.4
127.1
123.7
122.7
122.2
121.7
117.2
112.2
111.3
77.3
77.0
76.7
O
O
N
H
N
1l (CDCl3, 101 MHz)
f1 (ppm)

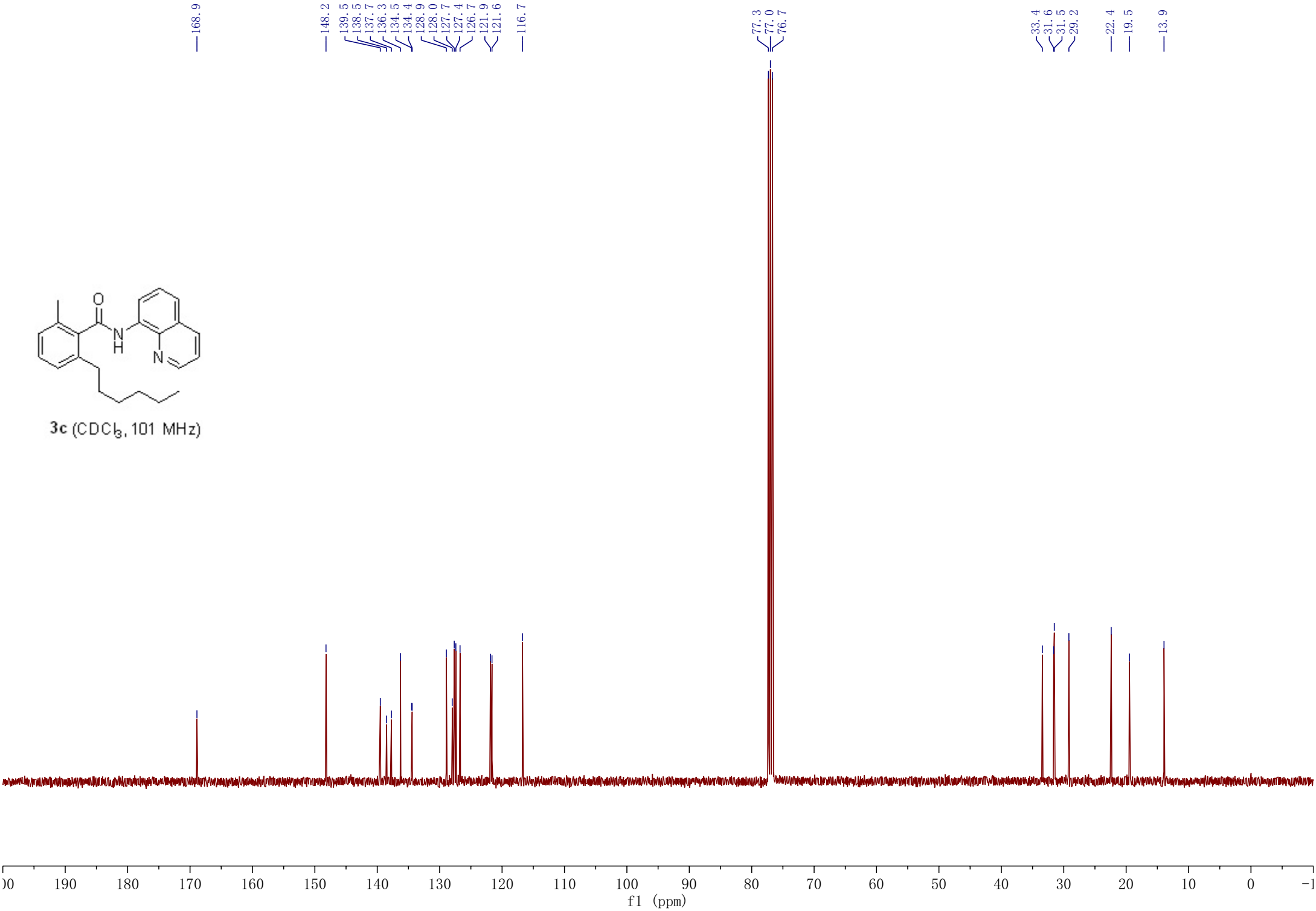

9.98
9.02
9.02
9.00
9.00
8.75
8.75
8.74
8.73
8.21
8.21
8.19
8.19
7.65
7.63
7.61
7.59
7.59
7.57
7.57
7.47
7.46
7.45
7.44
7.32
7.30
7.28
7.26
7.18
7.16
7.14
7.12
2.79
2.77
2.75
2.73
2.44
1.29
1.27
1.25
O
N
H
N
3a (CDCl3, 400 MHz)
0.92
0.99
1.00
0.99
2.02
1.01
1.01
2.03
2.04
3.05
3.35
f1 (ppm)

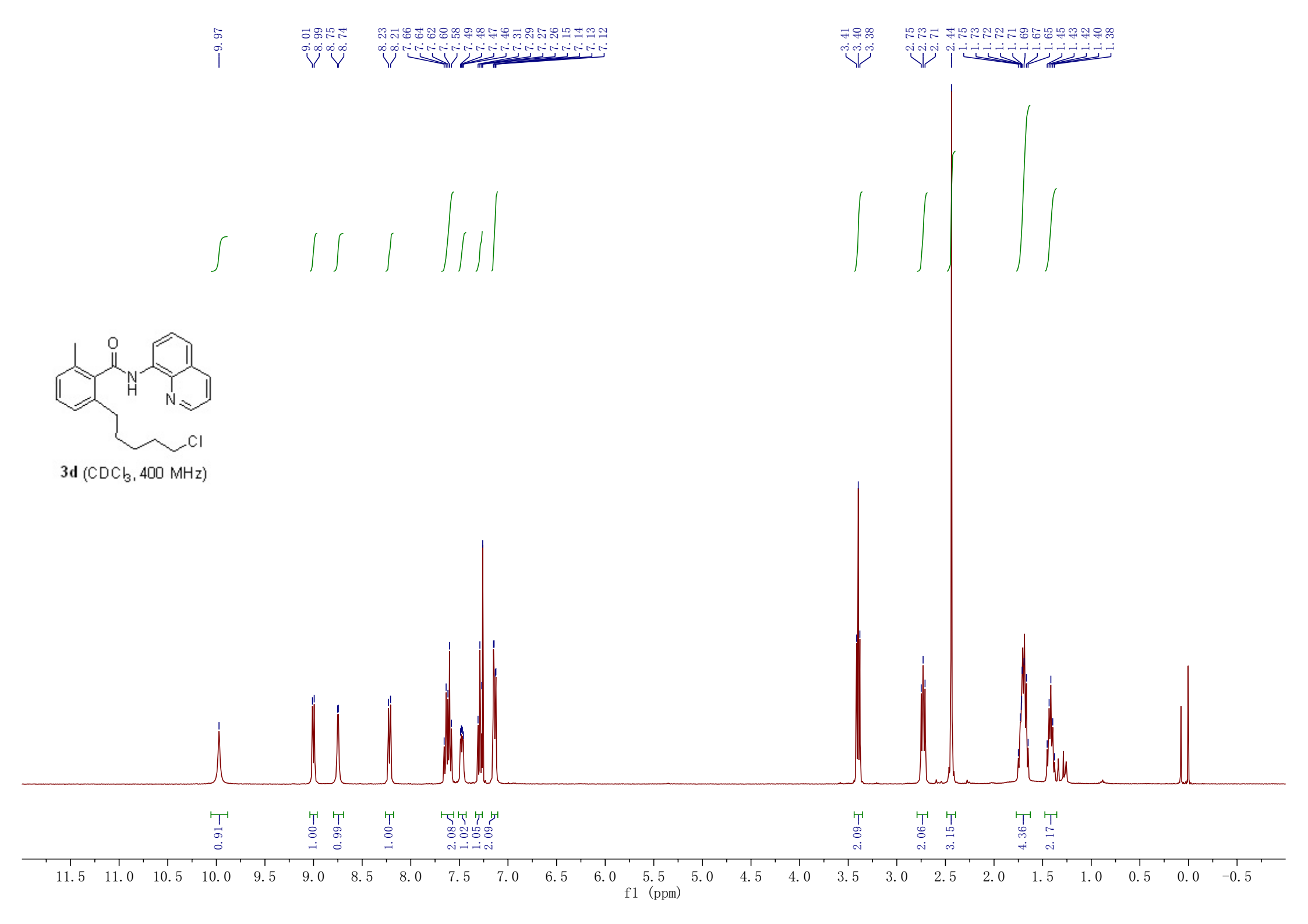

168.9
148.2
140.8
138.4
137.5
136.4
134.4
134.4
129.1
128.0
127.7
127.4
126.1
121.9
121.6
116.8
77.3
77.0
76.7
26.5
19.5
16.0
O
N
H
N
3a (CDCl3, 101 MHz)
f1 (ppm)


9.95
9.02
9.01
9.00
8.99
8.75
8.75
8.74
8.74
8.20
8.20
8.18
8.18
7.64
7.62
7.60
7.59
7.58
7.56
7.56
7.47
7.46
7.45
7.44
7.27
7.26
7.25
7.25
7.23
7.13
7.11
2.44
O
N
H
N
3b (CDCl3, 400 MHz)
1.00
1.04
1.03
1.03
2.09
1.04
1.27
2.05
6.12
f1 (ppm)

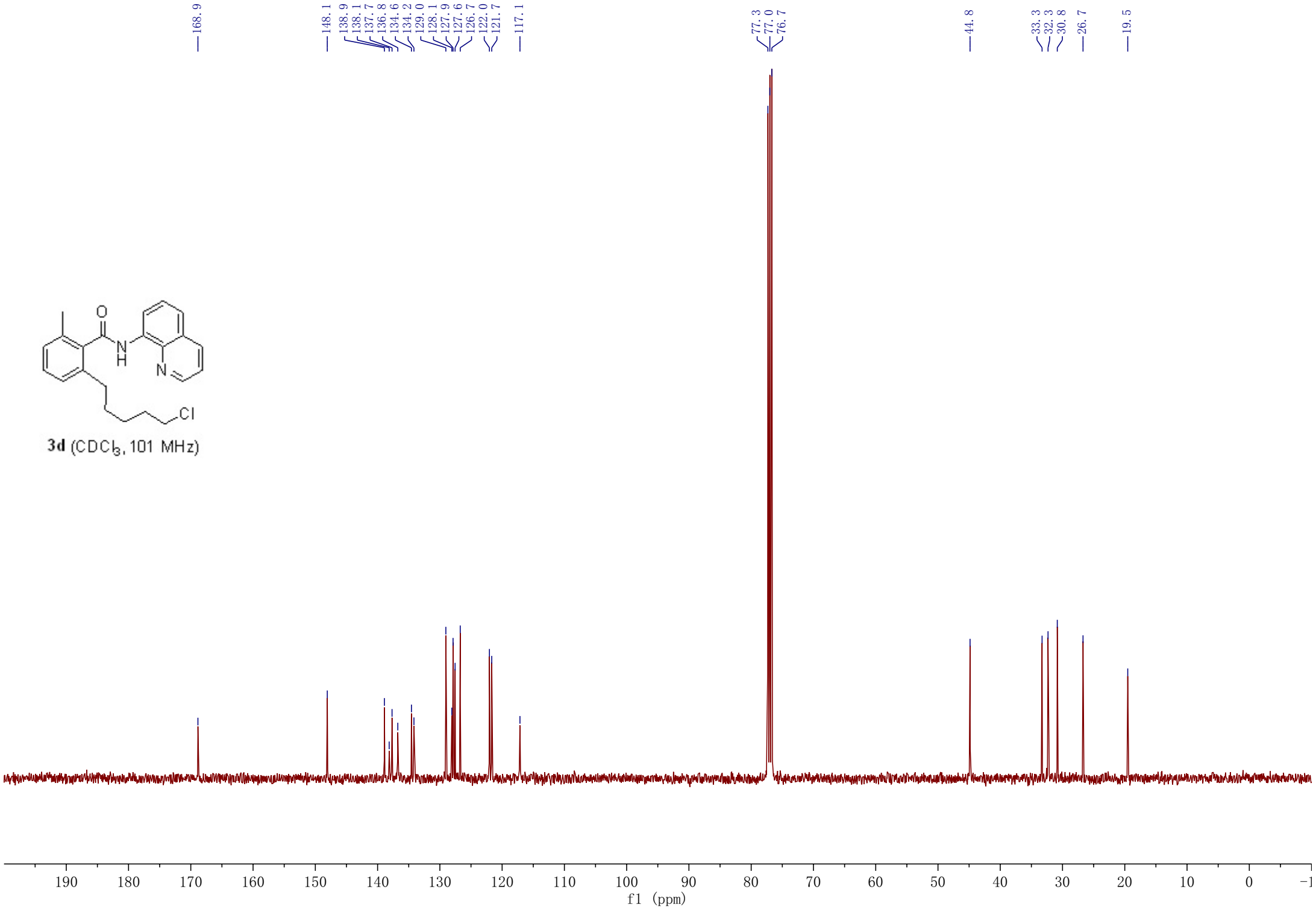

168.9
148.1
138.3
138.0
136.5
134.5
134.3
129.0
128.0
127.7
127.4
121.9
121.6
116.9
77.3
77.0
76.7
19.4
O
N
H
N
3b (CDCl3, 101 MHz)
f1 (ppm)

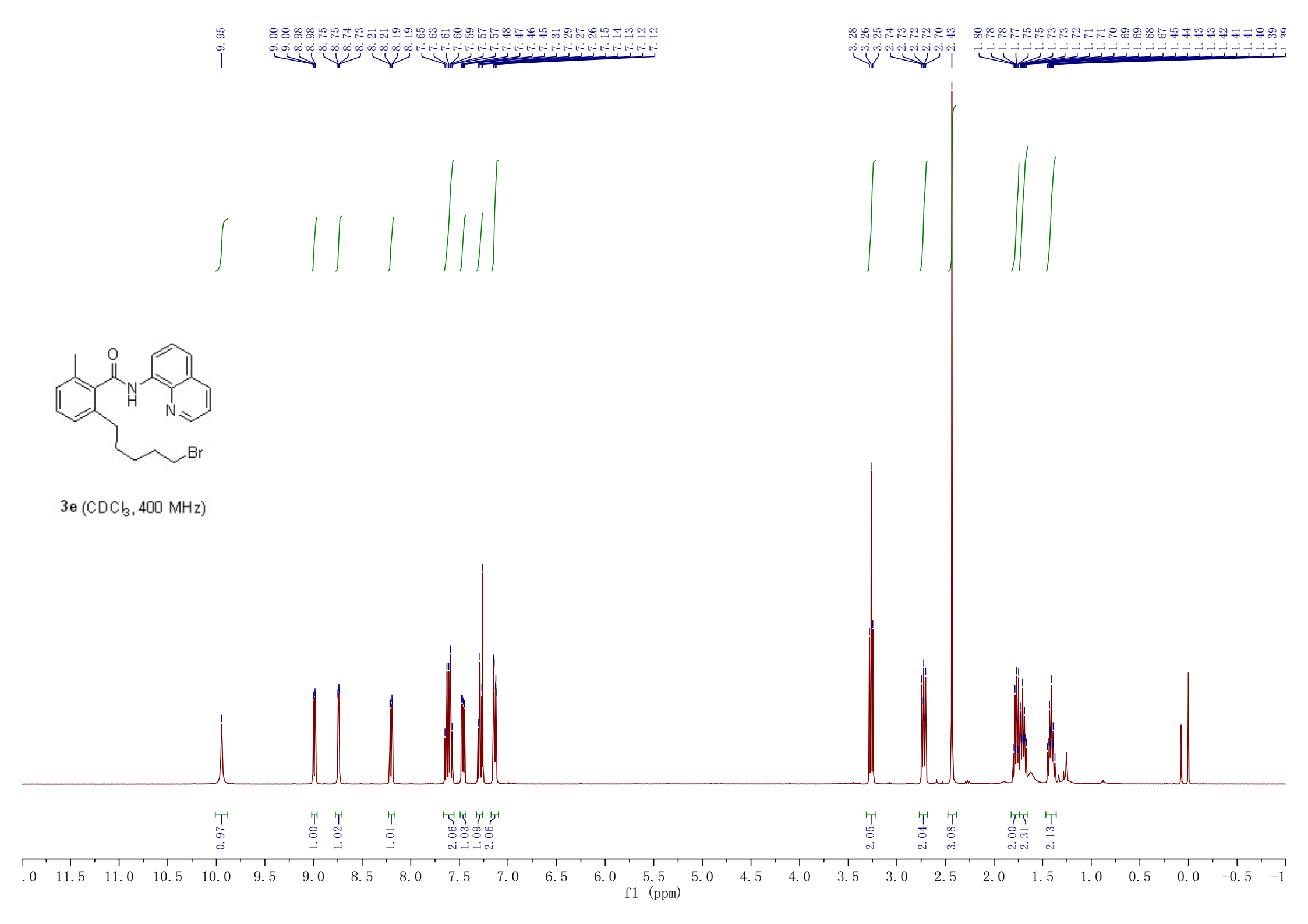

9.96
9.02
9.01
9.00
8.99
8.74
8.74
8.73
8.73
8.21
8.20
8.19
8.18
7.65
7.63
7.61
7.59
7.58
7.57
7.56
7.47
7.46
7.45
7.44
7.30
7.28
7.26
7.26
7.16
7.14
7.13
7.11
2.73
2.71
2.71
2.70
2.69
2.43
1.71
1.69
1.69
1.68
1.68
1.67
1.66
1.66
1.65
1.64
1.63
1.29
1.28
1.28
1.26
1.26
1.25
1.24
1.18
1.17
1.17
1.16
1.15
1.14
0.73
0.73
0.72
0.72
0.71
O
N
H
N
3c (CDCl3, 400 MHz)
0.97
1.00
1.01
1.01
2.07
1.03
1.42
2.09
2.05
3.07
2.19
2.06
4.19
3.09
f1 (ppm)

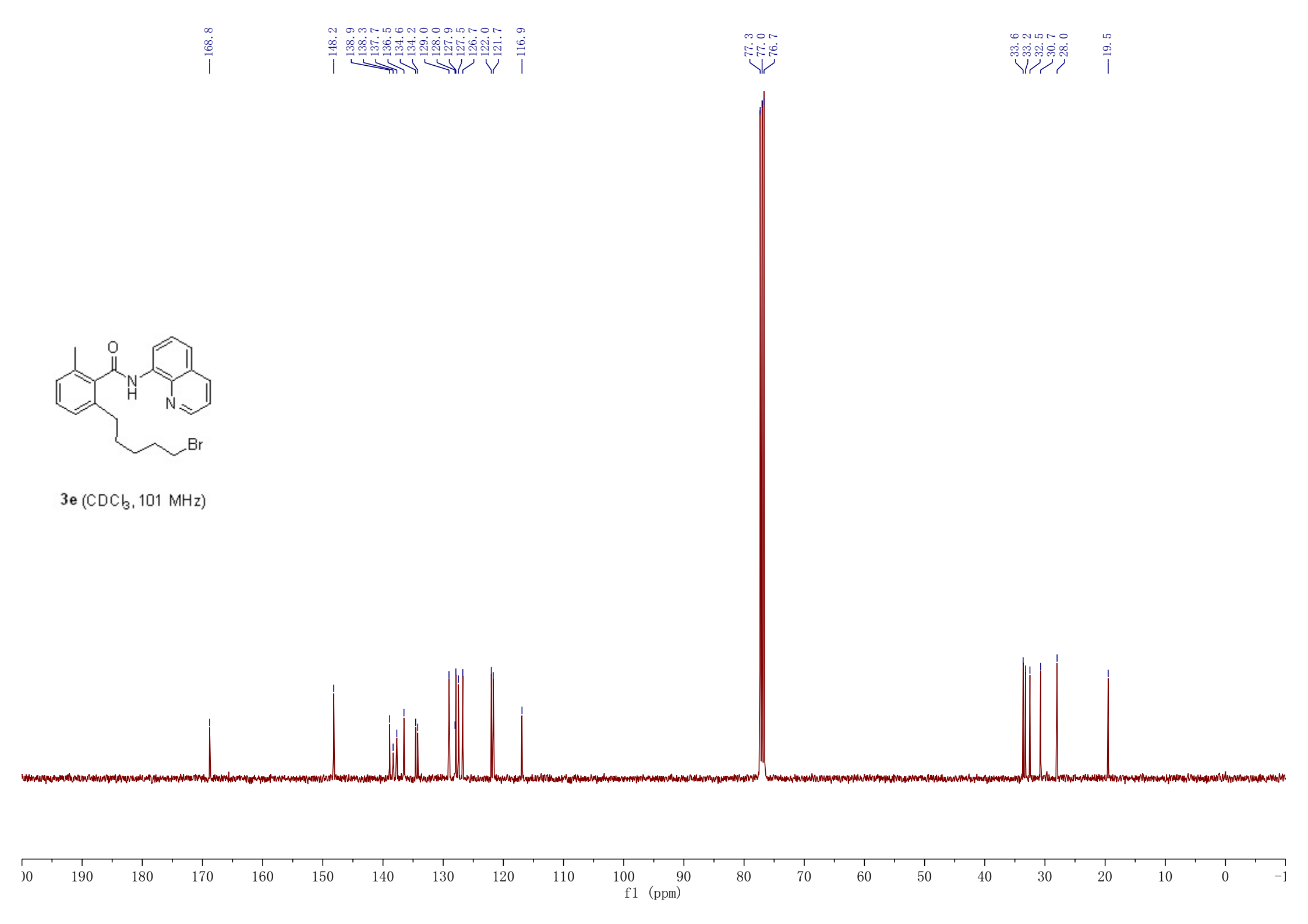

168.9
148.2
139.5
138.5
137.7
136.3
134.5
134.4
128.9
128.0
127.7
127.4
126.7
121.9
121.6
116.7
77.3
77.0
76.7
33.4
31.6
31.5
29.2
22.4
19.5
13.9
O
N
H
N
3c (CDCl3, 101 MHz)
f1 (ppm)

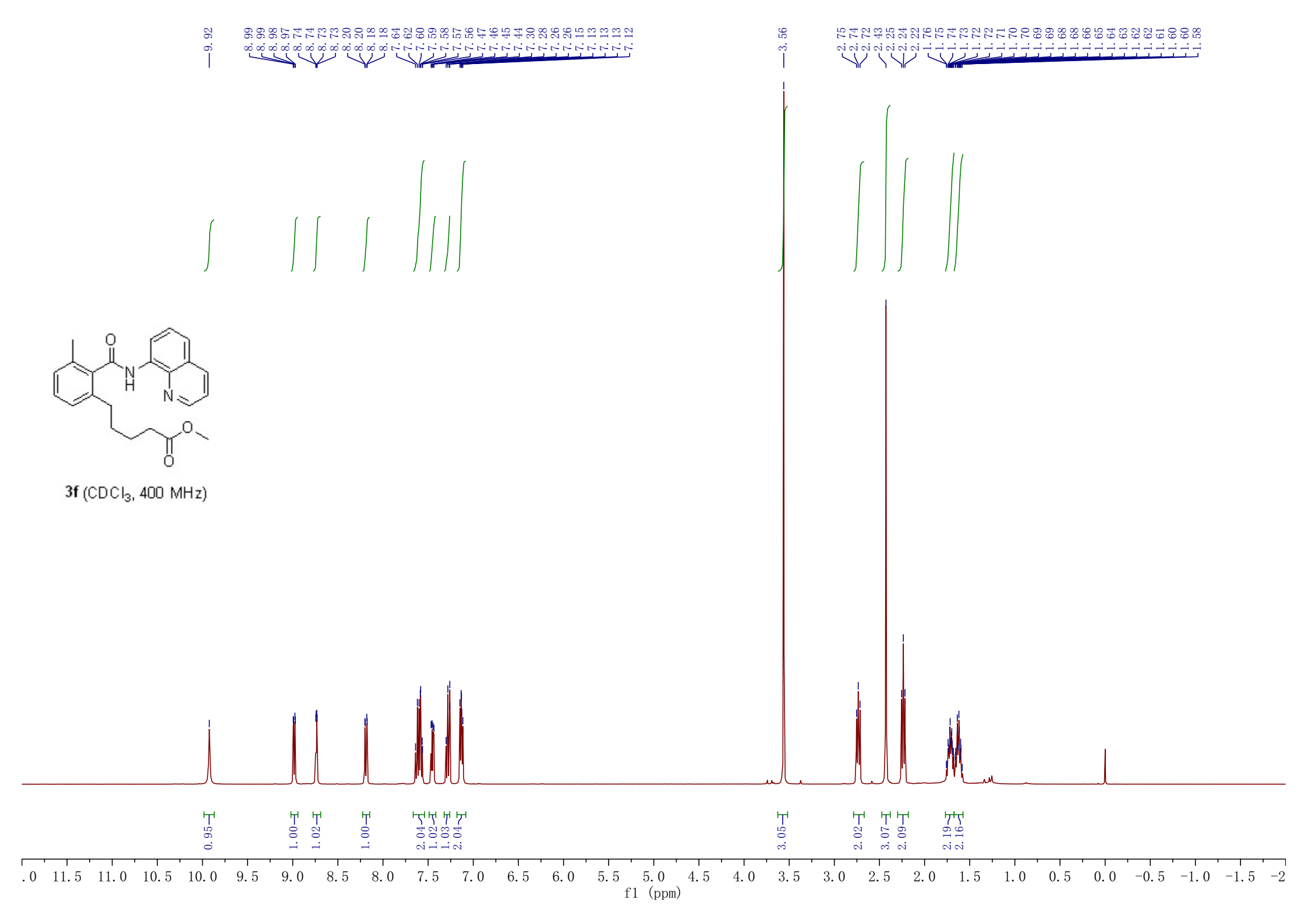


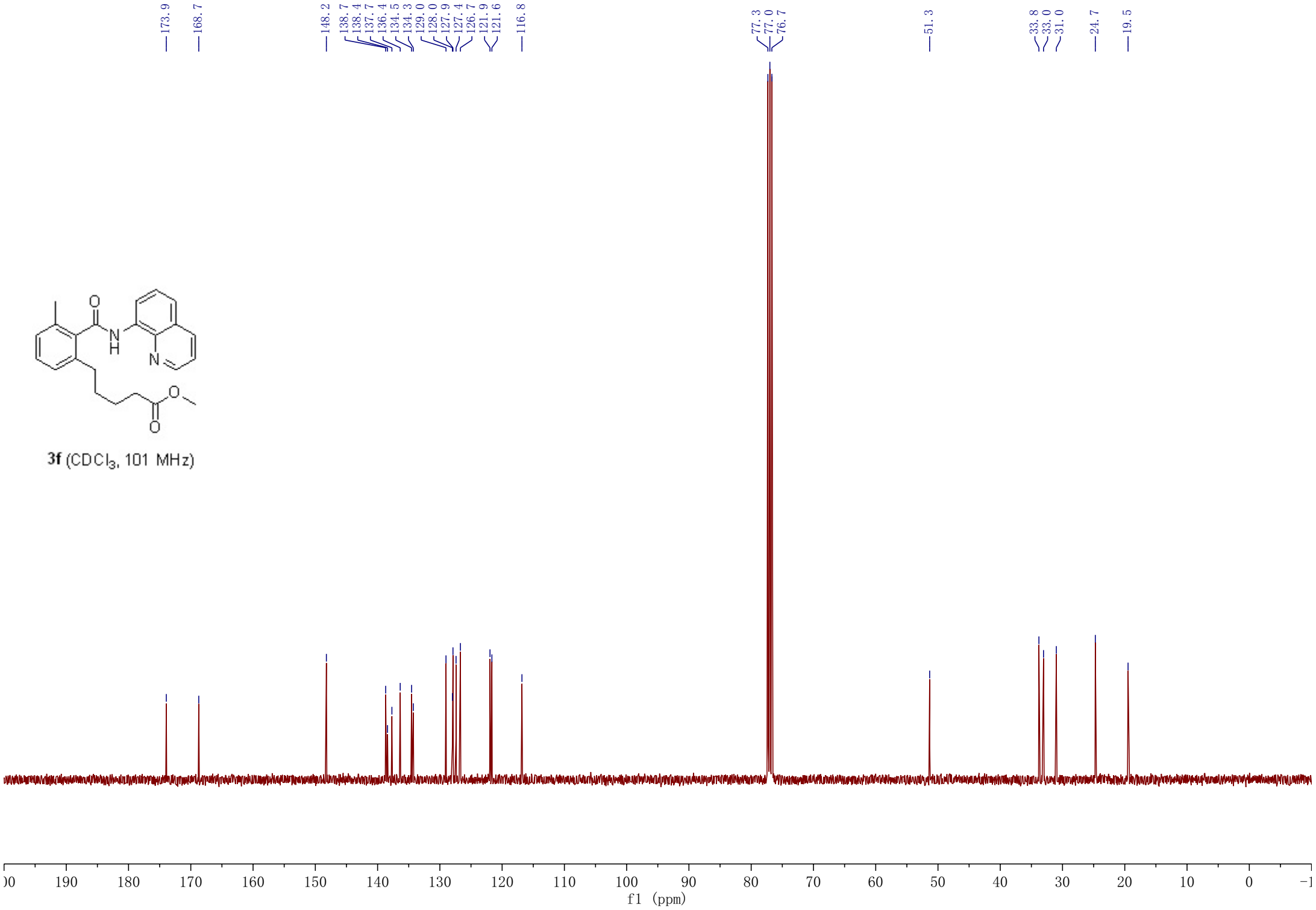
3d ($CDCl_3$, 400 MHz)


168.9
148.1
138.9
138.1
137.7
136.8
134.6
134.2
129.0
128.1
127.9
127.6
126.7
122.0
121.7
117.1
77.3
77.0
76.7
44.8
33.3
32.3
30.8
26.7
19.5
O
N
H
N
Cl
3d (CDCl3, 101 MHz)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1
f1 (ppm)

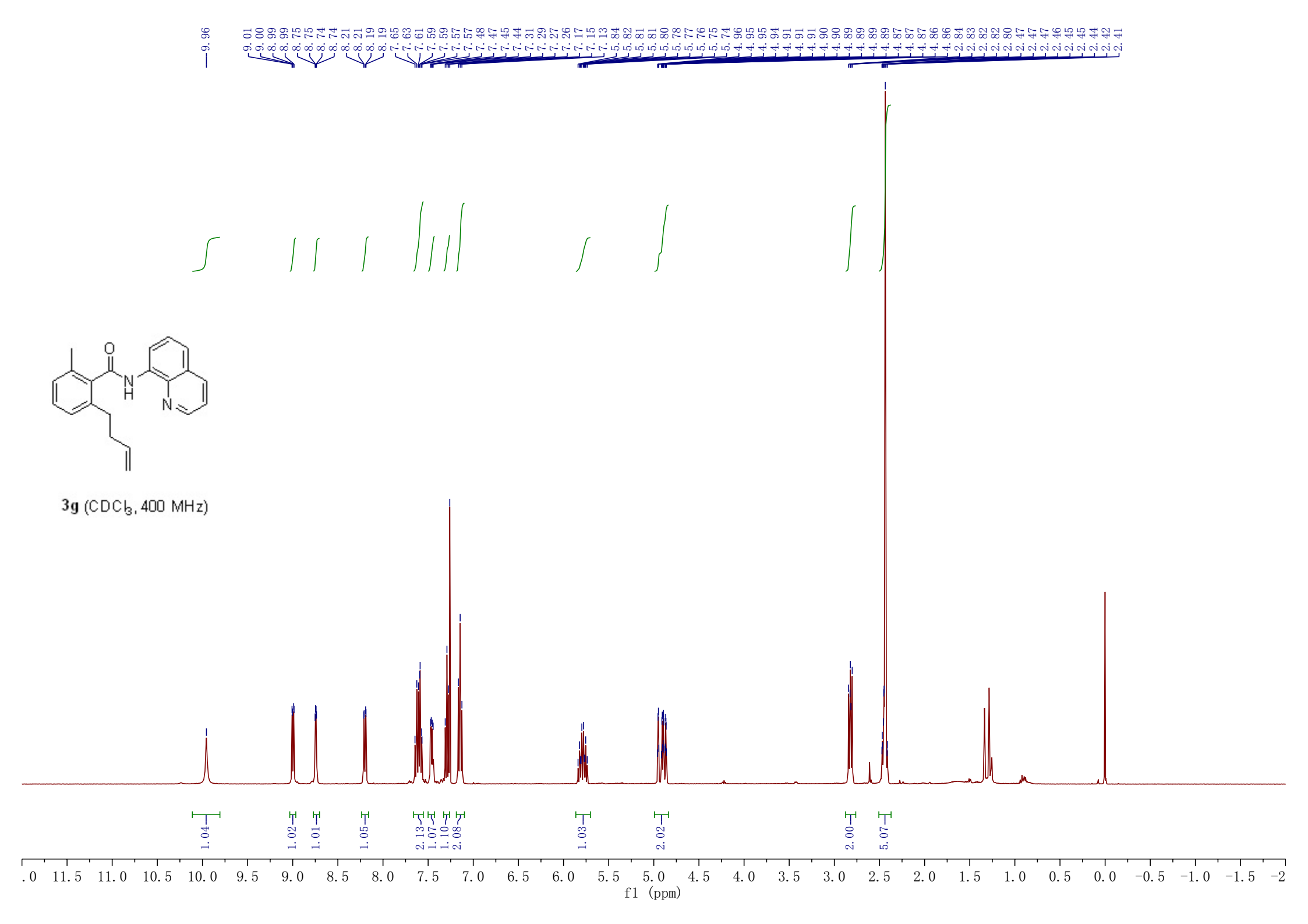

9.95
9.00
9.00
8.98
8.98
8.75
8.75
8.74
8.73
8.21
8.21
8.19
8.19
7.65
7.63
7.61
7.60
7.59
7.57
7.57
7.48
7.47
7.46
7.45
7.31
7.29
7.27
7.26
7.15
7.14
7.13
7.12
7.12
3.28
3.26
3.25
2.74
2.73
2.72
2.72
2.70
2.43
1.80
1.78
1.78
1.77
1.75
1.75
1.73
1.73
1.72
1.71
1.71
1.70
1.69
1.69
1.68
1.67
1.45
1.44
1.43
1.43
1.42
1.41
1.41
1.40
1.39
O
N
H
N
Br
3e (CDCl3, 400 MHz)
0.97
1.00
1.02
1.01
2.06
1.03
1.09
2.06
2.05
2.04
3.08
2.00
2.31
2.13
f1 (ppm)

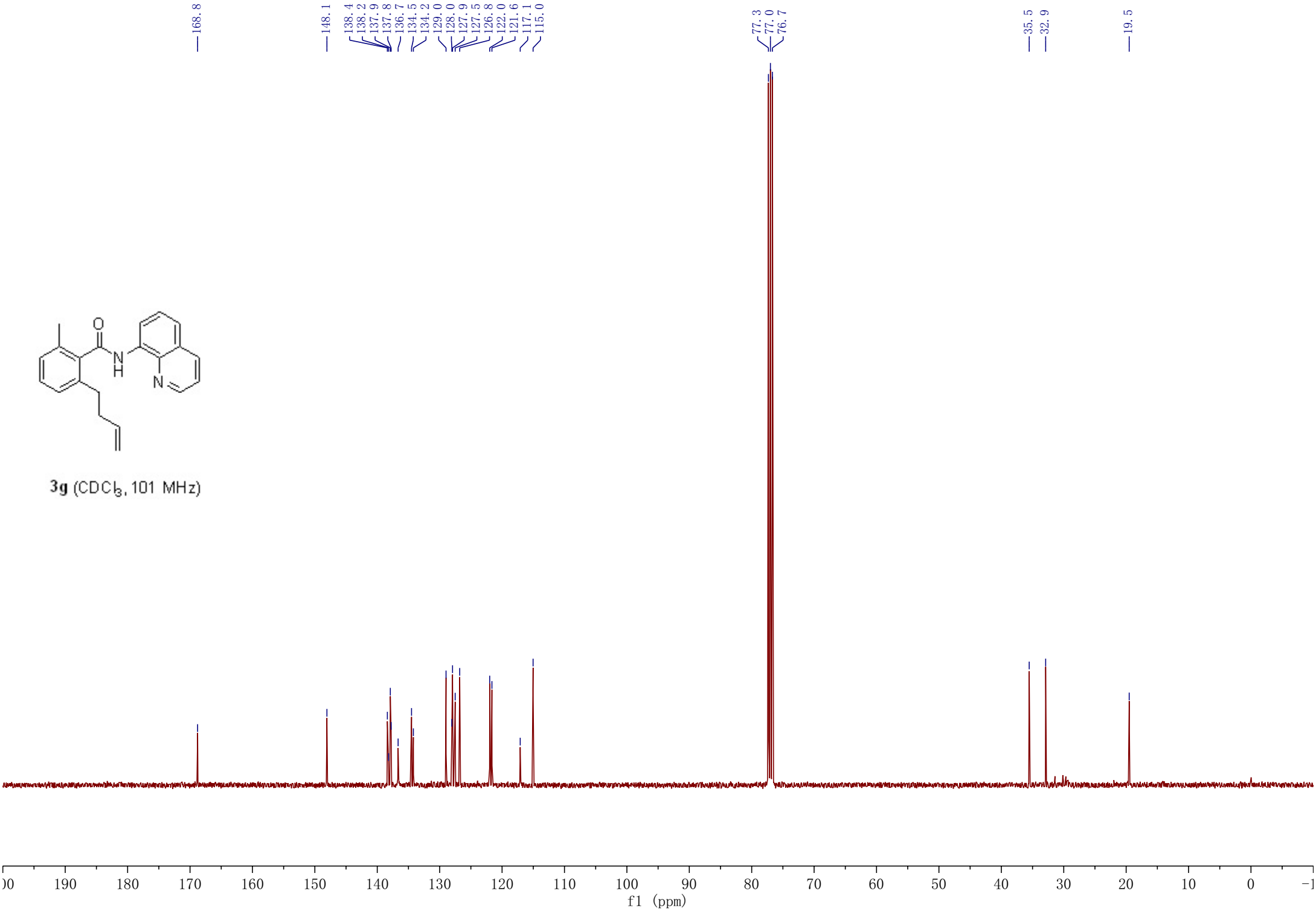

168.8
148.2
138.9
138.3
137.7
136.5
134.6
134.2
129.0
128.0
127.9
127.5
126.7
122.0
121.7
116.9
77.3
77.0
76.7
33.6
33.2
32.5
30.7
28.0
19.5
O
N
H
N
Br
3e (CDCl3, 101 MHz)
f1 (ppm)

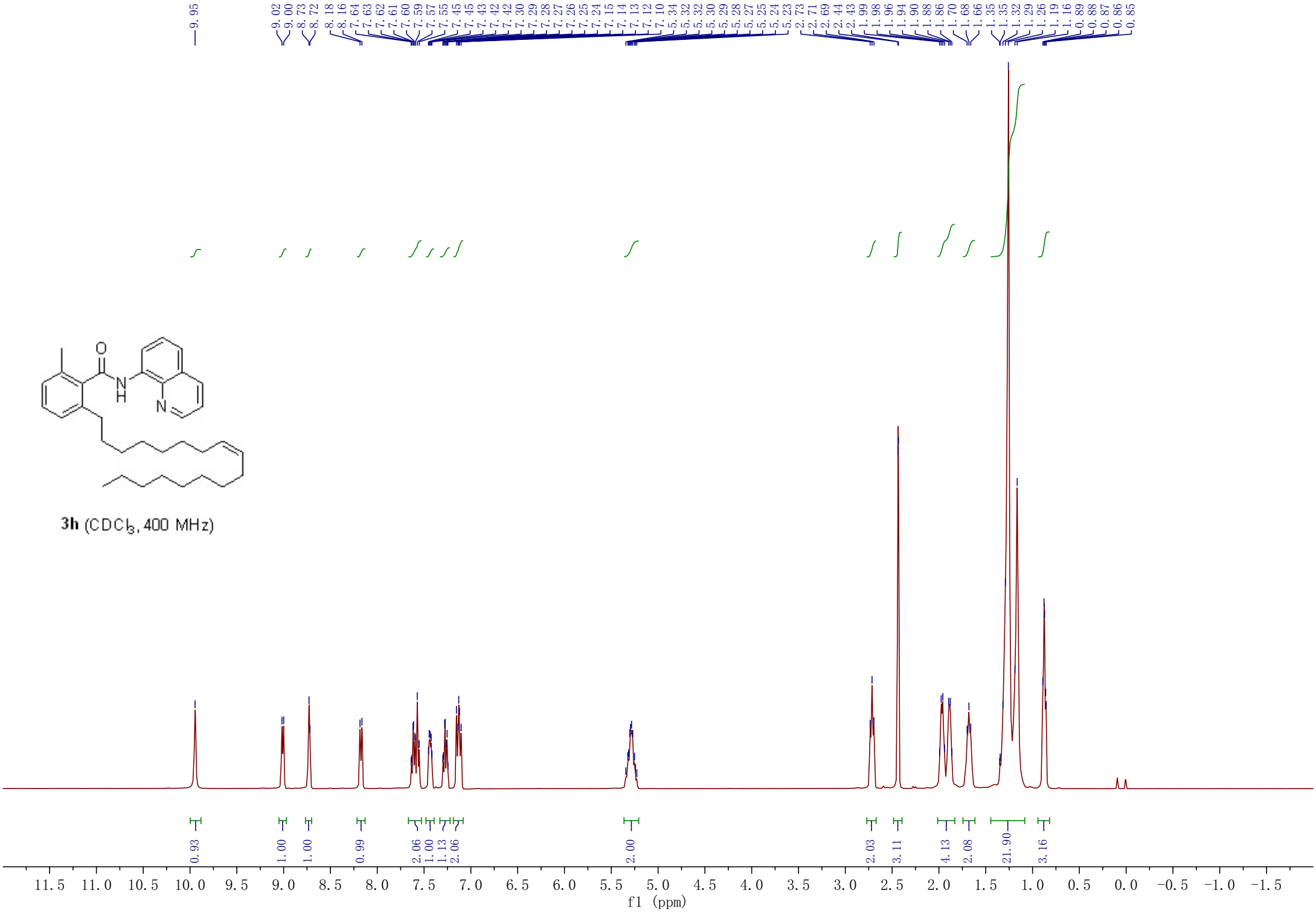

9.92
8.99
8.99
8.98
8.97
8.74
8.74
8.73
8.73
8.20
8.20
8.18
8.18
7.64
7.62
7.60
7.59
7.58
7.57
7.56
7.47
7.46
7.45
7.44
7.30
7.28
7.26
7.26
7.15
7.13
7.13
7.12
3.56
2.75
2.74
2.72
2.43
2.25
2.24
2.22
1.76
1.75
1.74
1.73
1.72
1.72
1.71
1.70
1.70
1.69
1.69
1.68
1.68
1.66
1.65
1.64
1.63
1.62
1.62
1.61
1.60
1.60
1.58
O
N
H
N
O
O
3f (CDCl3, 400 MHz)
0.95
1.00
1.02
1.00
2.04
1.02
1.03
2.04
3.05
2.02
3.07
2.09
2.19
2.16
f1 (ppm)

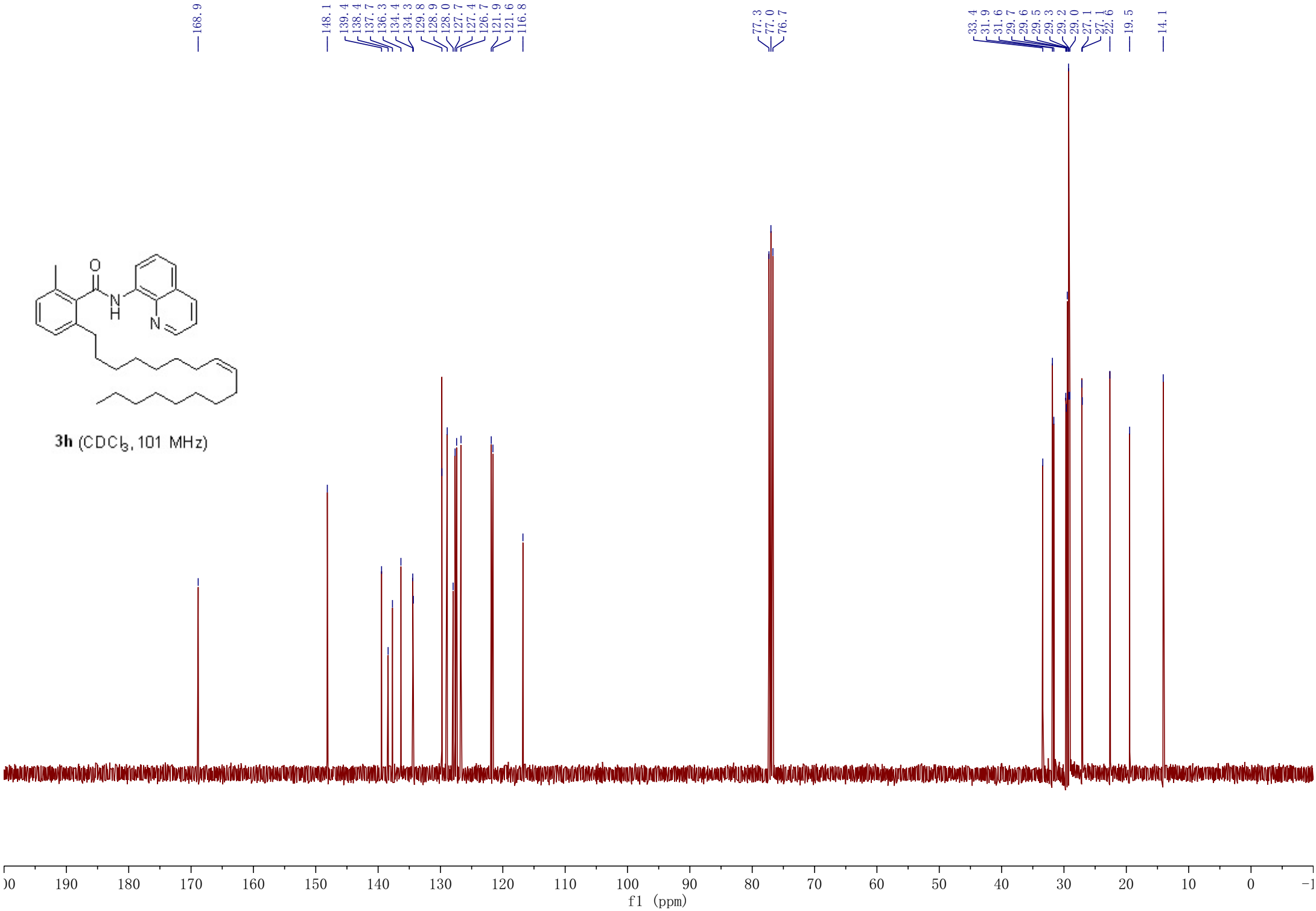


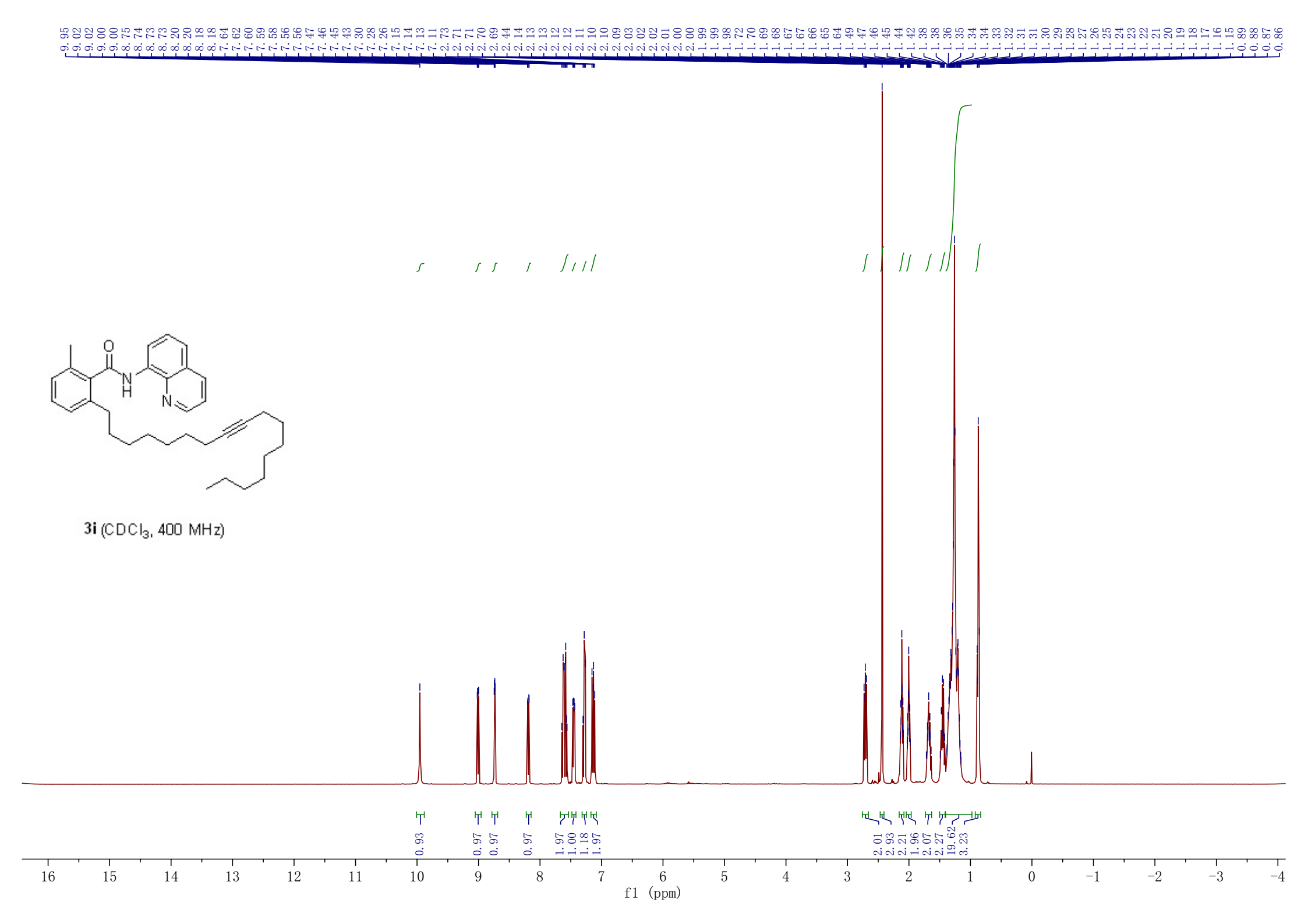
3f ($CDCl_3$, 101 MHz)

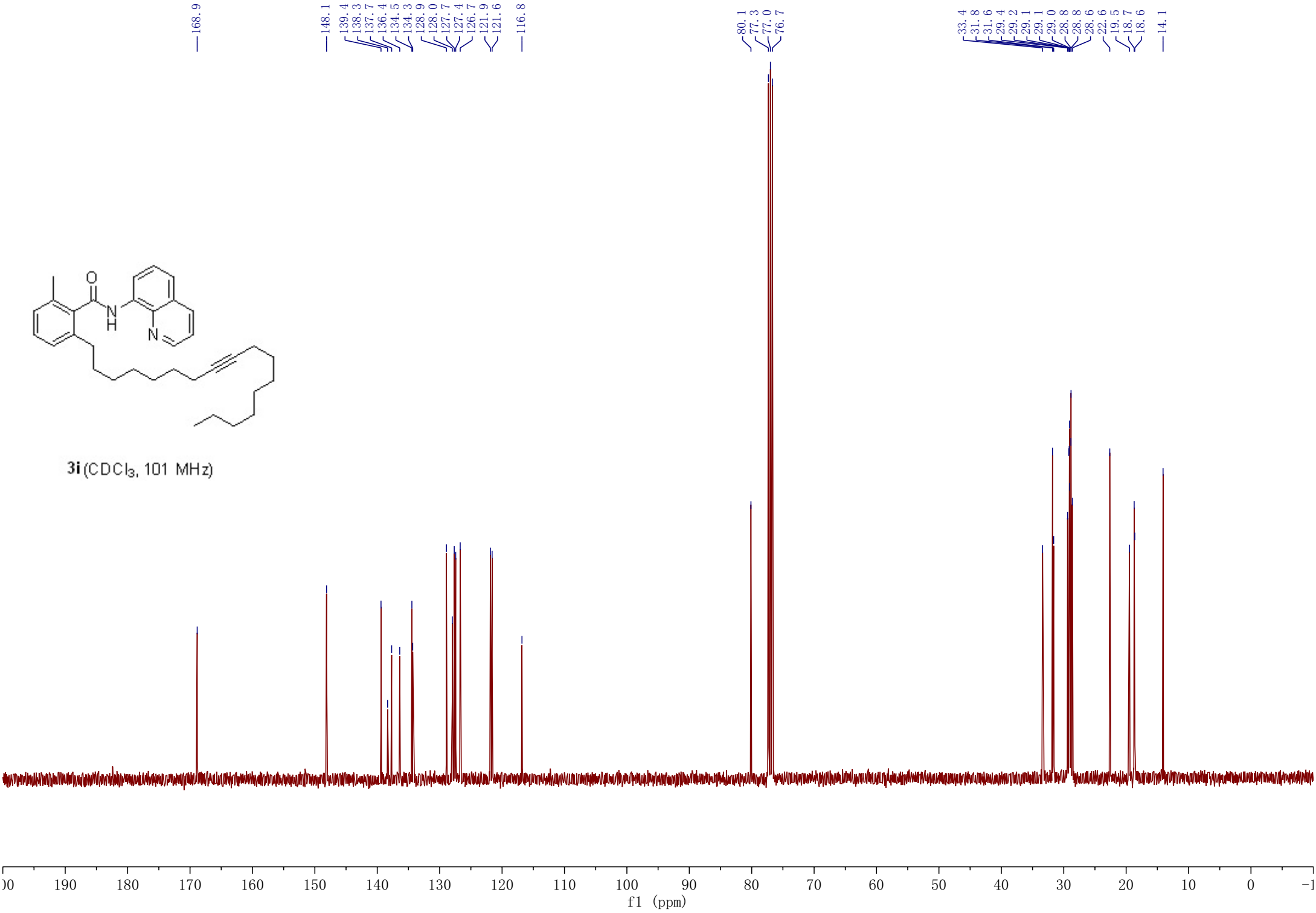

9.96
9.01
9.00
8.99
8.99
8.75
8.75
8.74
8.74
8.21
8.19
8.19
7.65
7.63
7.61
7.59
7.59
7.57
7.57
7.48
7.47
7.45
7.44
7.31
7.29
7.27
7.26
7.17
7.15
7.13
5.84
5.82
5.81
5.81
5.80
5.78
5.77
5.76
5.75
5.74
4.96
4.95
4.95
4.94
4.91
4.91
4.90
4.90
4.89
4.89
4.89
4.89
4.87
4.87
4.87
4.86
4.86
2.84
2.83
2.82
2.82
2.80
2.47
2.47
2.47
2.46
2.45
2.45
2.44
2.42
2.41
O
N
H
N
3g (CDCl3, 400 MHz)
1.04
1.02
1.01
1.05
2.13
1.07
1.10
2.08
1.03
2.02
2.00
5.07
.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2
f1 (ppm)

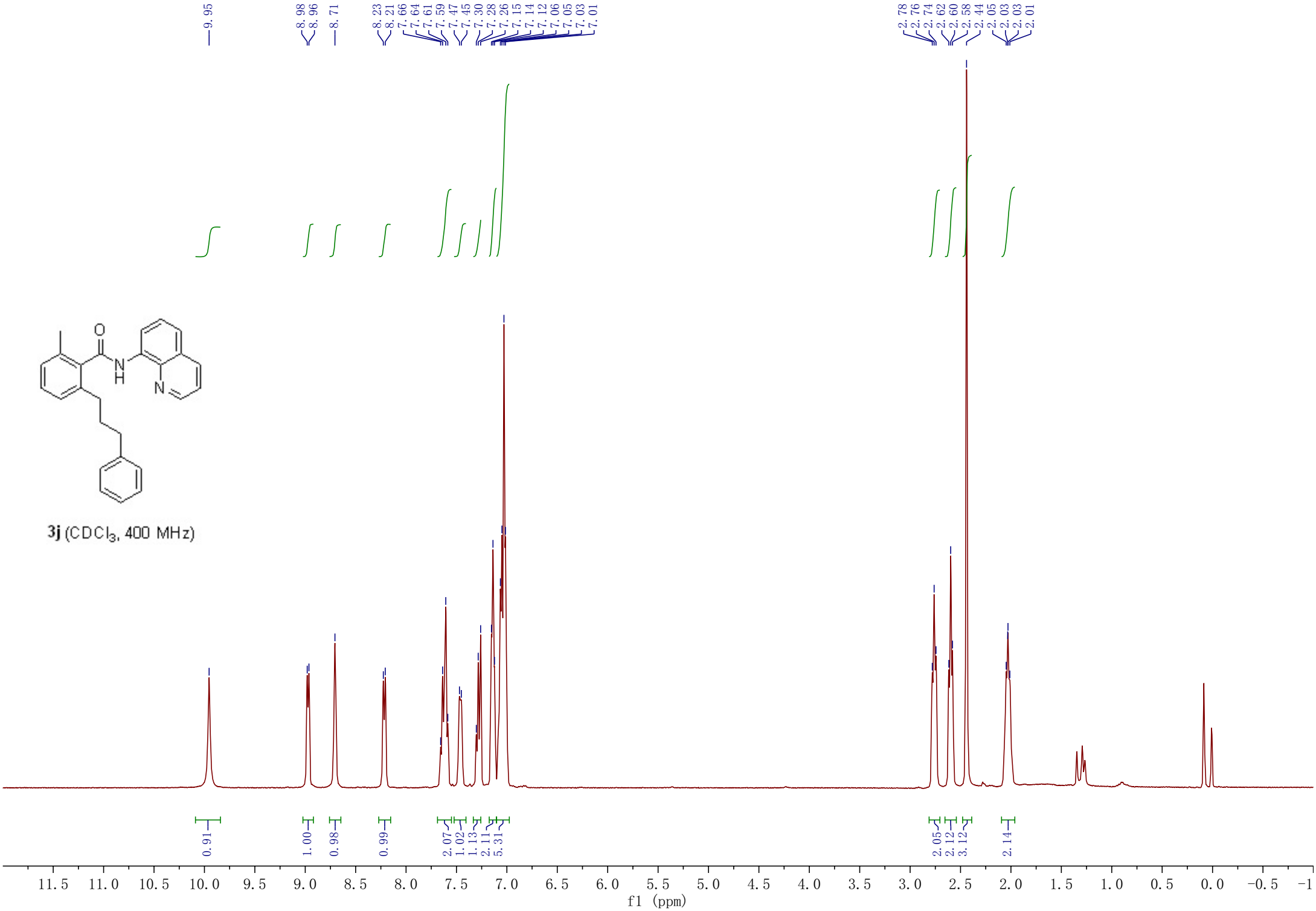

168.8
148.1
138.4
138.2
137.9
137.8
136.7
134.5
134.2
129.0
128.0
127.9
127.5
126.8
122.0
121.6
117.1
115.0
77.3
77.0
76.7
35.5
32.9
19.5
O
N
H
N
3g (CDCl3, 101 MHz)
f1 (ppm)

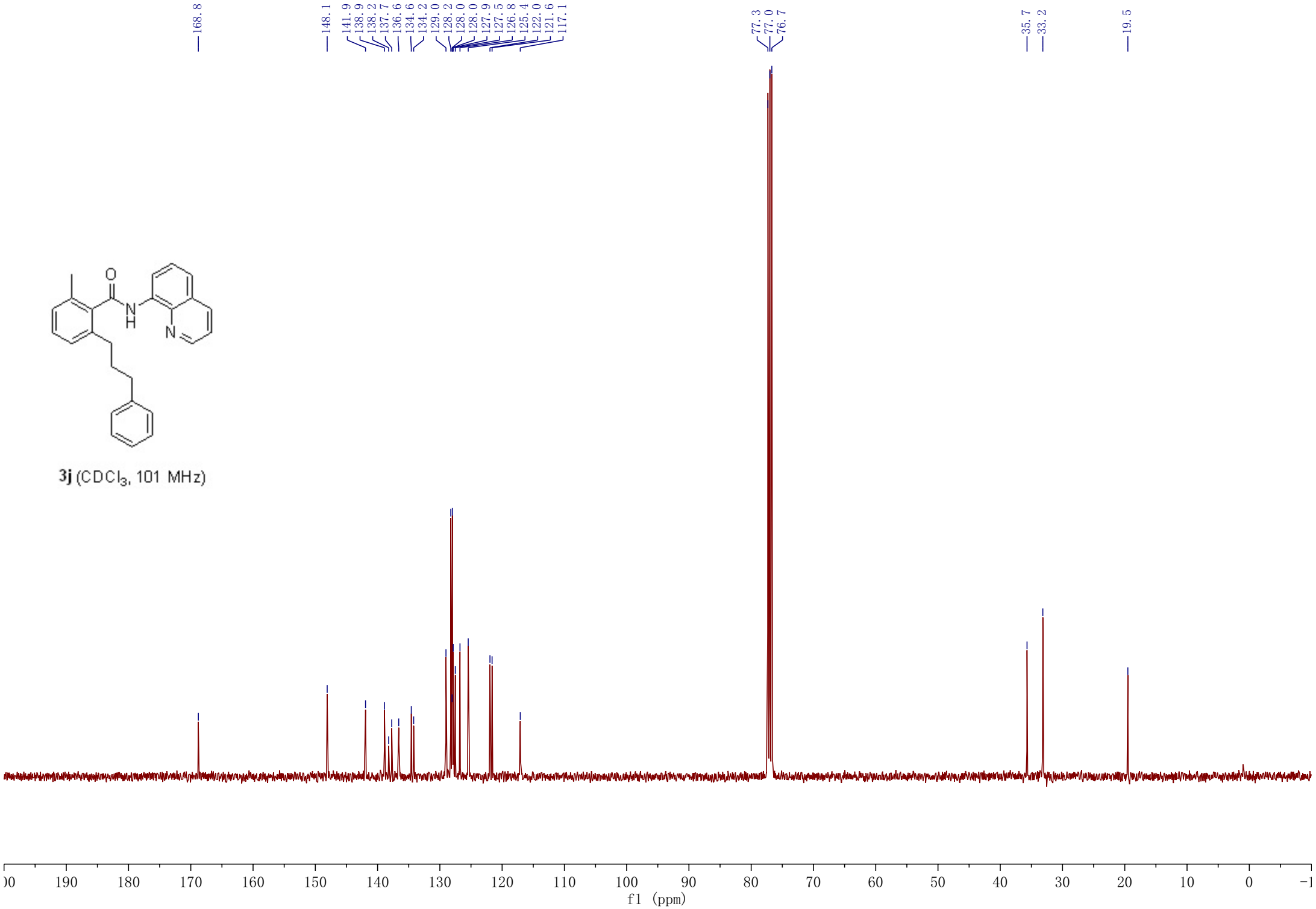

9.95
9.02
9.00
8.73
8.72
8.18
8.16
7.64
7.63
7.62
7.61
7.60
7.59
7.57
7.55
7.45
7.43
7.42
7.42
7.30
7.29
7.28
7.27
7.26
7.25
7.24
7.15
7.14
7.13
7.12
7.10
5.34
5.32
5.32
5.30
5.29
5.28
5.27
5.25
5.24
5.23
2.73
2.71
2.69
2.44
2.43
1.99
1.98
1.96
1.94
1.90
1.88
1.86
1.70
1.68
1.66
1.35
1.35
1.32
1.29
1.26
1.19
1.16
0.89
0.88
0.87
0.86
0.85
O
N
H
N
3h (CDCl3, 400 MHz)
0.93
1.00
1.00
0.99
2.06
1.00
1.13
2.06
2.00
2.03
3.11
4.13
2.08
21.90
3.16
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5
f1 (ppm)

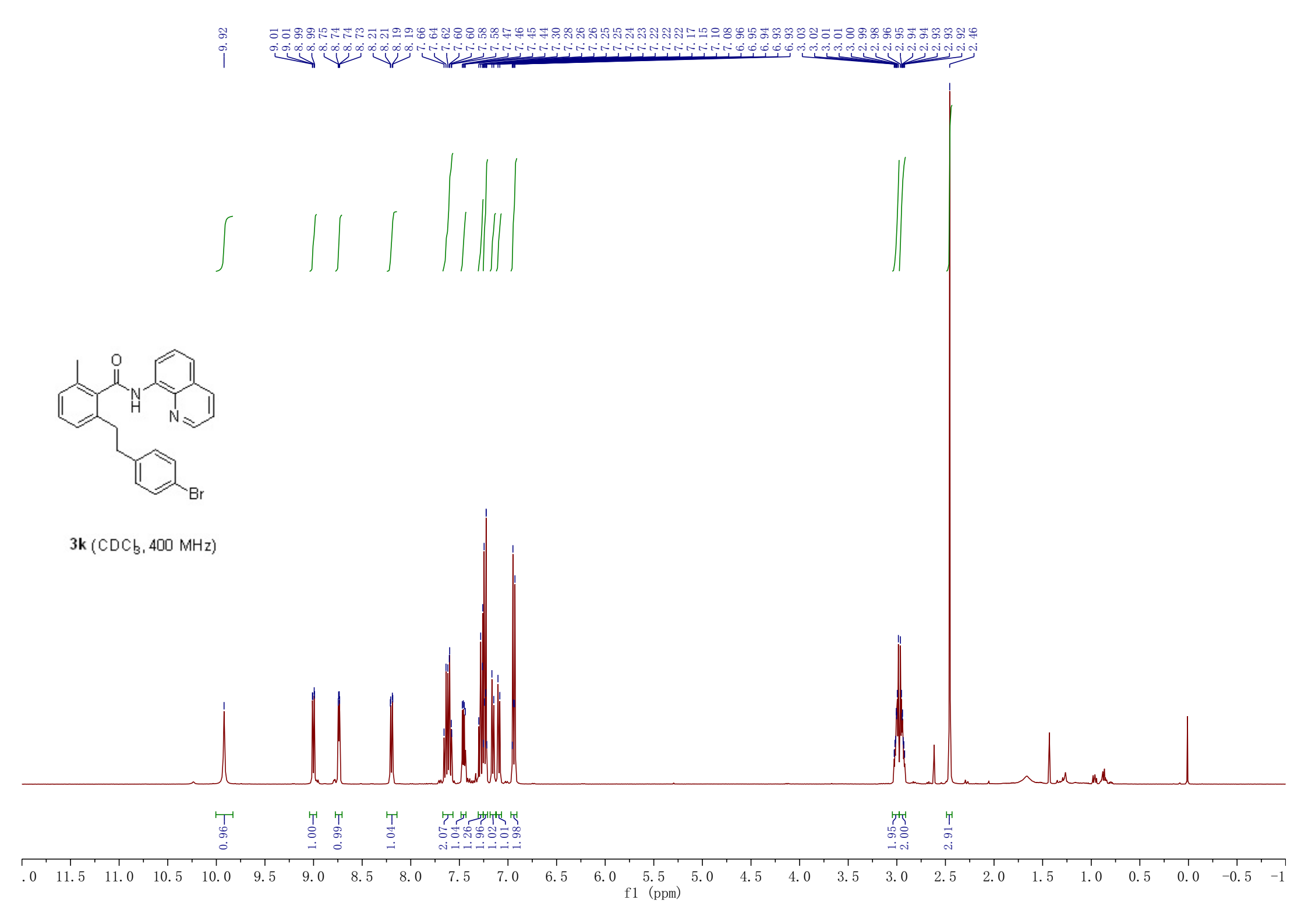

168.9
148.1
139.4
138.4
137.7
136.3
134.4
134.3
129.8
128.9
128.0
127.7
127.4
126.7
121.9
121.6
116.8
77.3
77.0
76.7
33.4
31.9
31.6
29.7
29.6
29.5
29.3
29.2
29.0
27.1
27.1
22.6
19.5
14.1
O
N
H
N
3h (CDCl3, 101 MHz)
f1 (ppm)

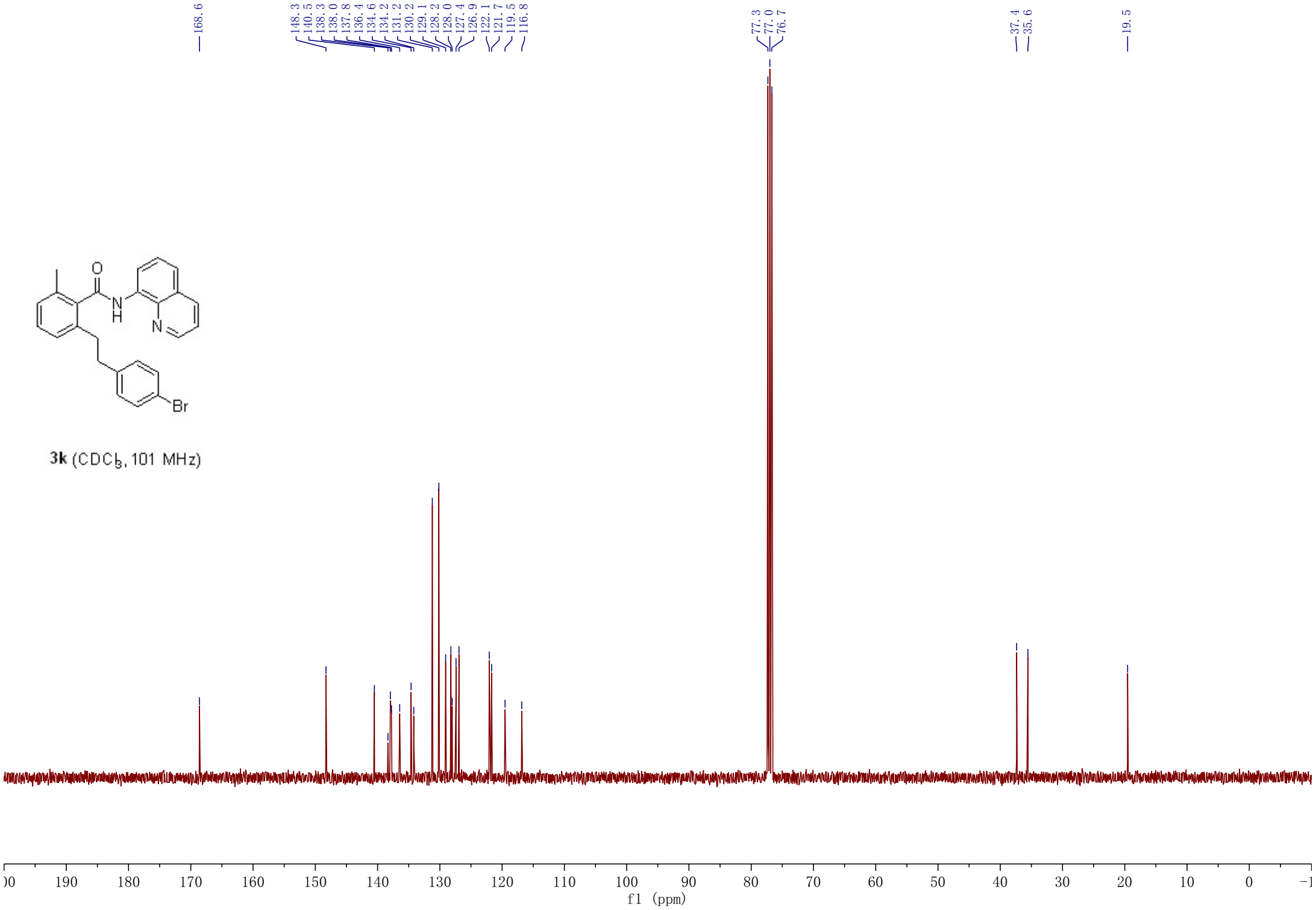

9.95 9.02 9.02 9.00 9.00 8.75 8.74 8.73 8.73 8.20 8.20 8.18 8.18 7.64 7.62 7.60 7.59 7.58 7.56 7.56 7.47 7.46 7.45 7.43 7.30 7.28 7.26 7.15 7.14 7.13 7.11 2.73 2.71 2.71 2.70 2.69 2.44 2.14 2.13 2.12 2.12 2.11 2.10 2.10 2.09 2.03 2.02 2.02 2.01 2.00 2.00 1.99 1.99 1.98 1.72 1.70 1.69 1.68 1.67 1.67 1.66 1.65 1.64 1.49 1.47 1.46 1.45 1.44 1.42 1.38 1.38 1.36 1.35 1.34 1.34 1.33 1.32 1.31 1.31 1.30 1.29 1.28 1.27 1.26 1.25 1.24 1.23 1.22 1.21 1.20 1.19 1.18 1.17 1.16 1.15 0.89 0.88 0.87 0.86
O
N
H
N
3i (CDCl3, 400 MHz)
0.93 0.97 0.97 0.97 1.97 1.00 1.18 1.97 2.01 2.93 2.21 1.96 2.07 2.27 19.62 3.23
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3 −4
f1 (ppm)

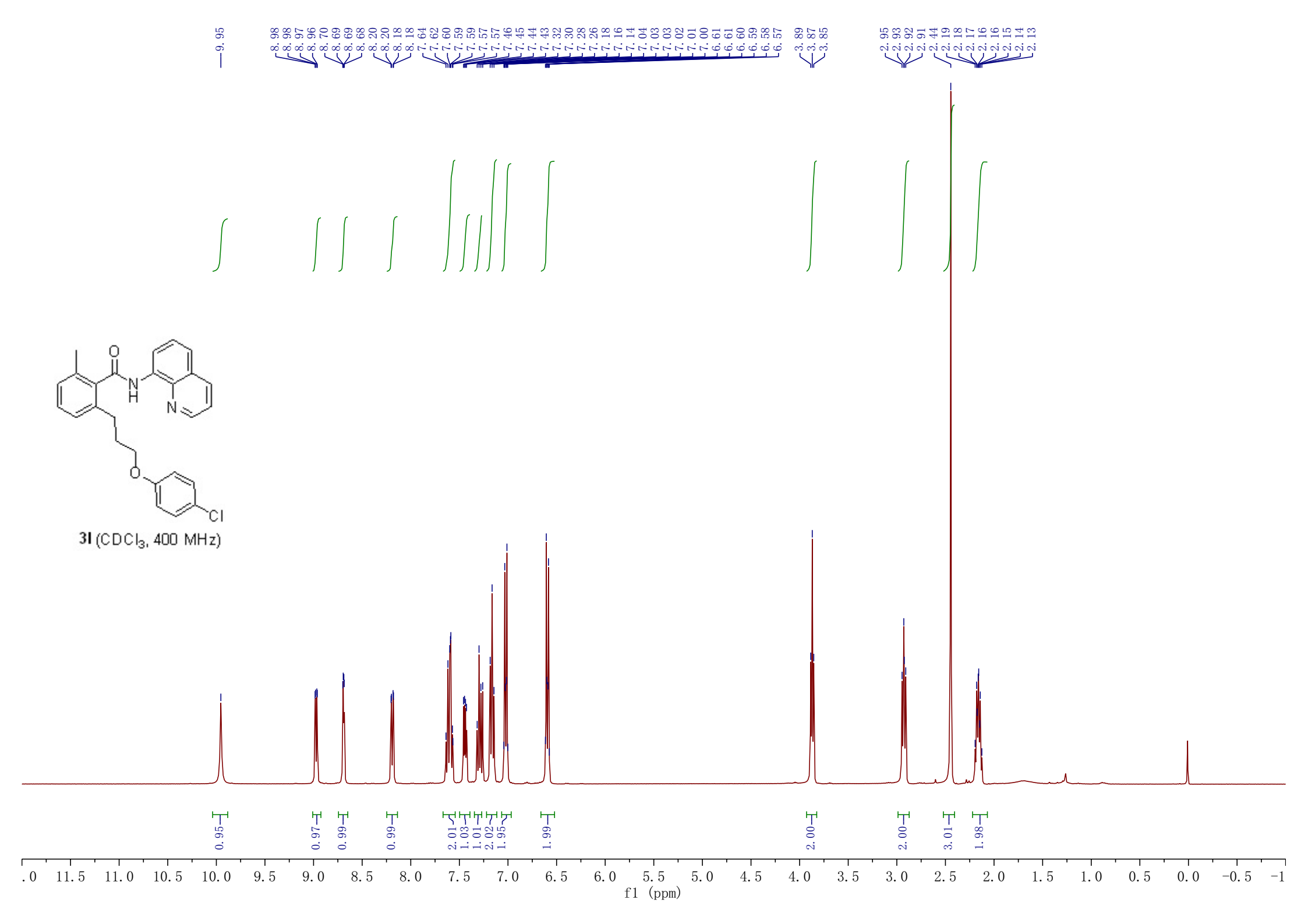

168.9
148.1
139.4
138.3
137.7
136.4
134.5
134.3
128.9
128.0
127.7
127.4
126.7
121.9
121.6
116.8
80.1
77.3
77.0
76.7
33.4
31.8
31.6
29.4
29.2
29.1
29.1
29.0
28.8
28.8
28.6
22.6
19.5
18.7
18.6
14.1
O
N
H
N
3i (CDCl3, 101 MHz)
f1 (ppm)

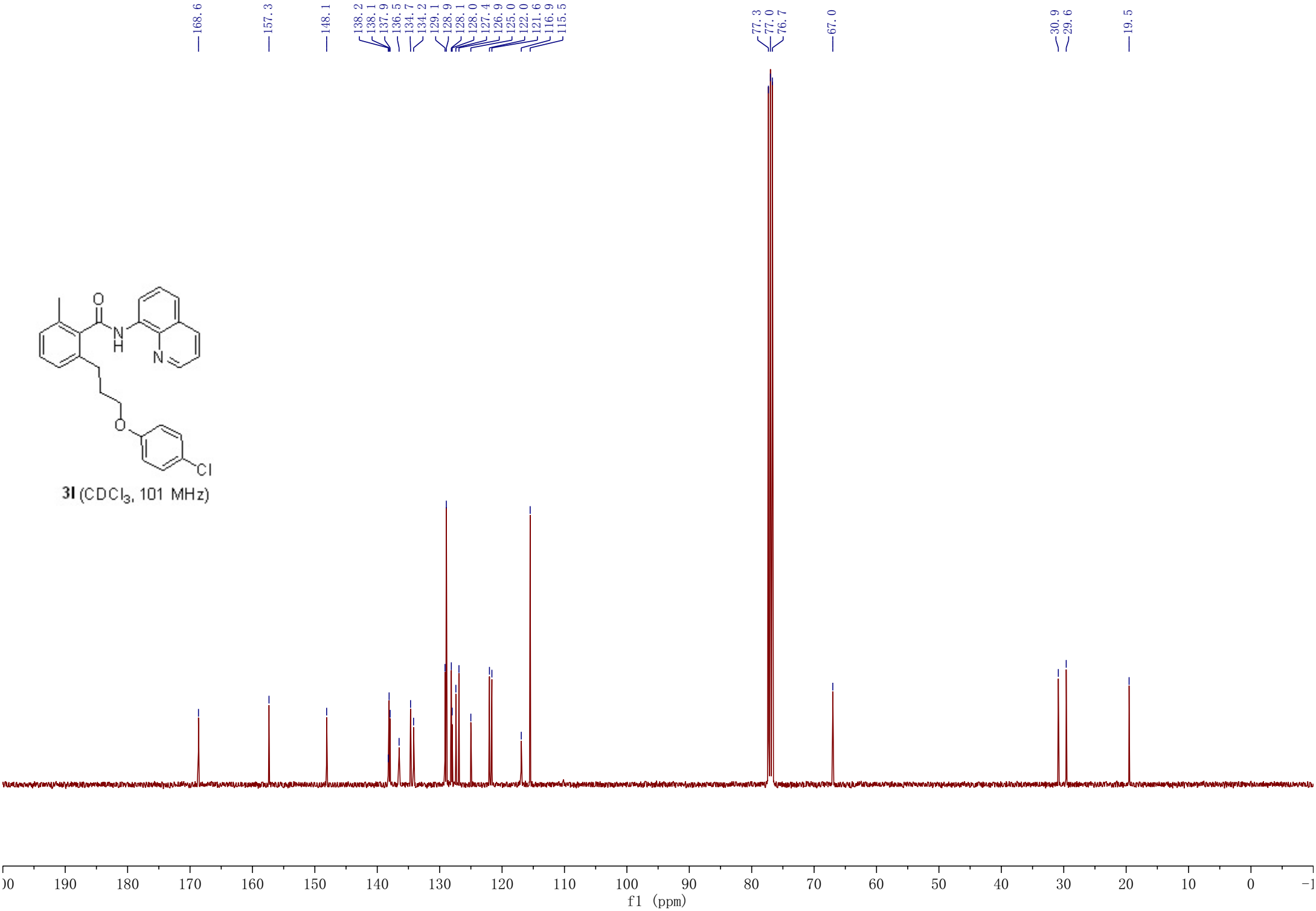

9.95
8.98
8.96
8.71
8.23
8.21
7.66
7.64
7.61
7.59
7.47
7.45
7.30
7.28
7.26
7.15
7.14
7.12
7.06
7.05
7.03
7.01
2.78
2.76
2.74
2.62
2.60
2.58
2.44
2.05
2.03
2.03
2.01
O
N
H
N
3j (CDCl3, 400 MHz)
0.91
1.00
0.98
0.99
2.07
1.02
1.13
2.11
5.31
2.05
2.12
3.12
2.14
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1
f1 (ppm)

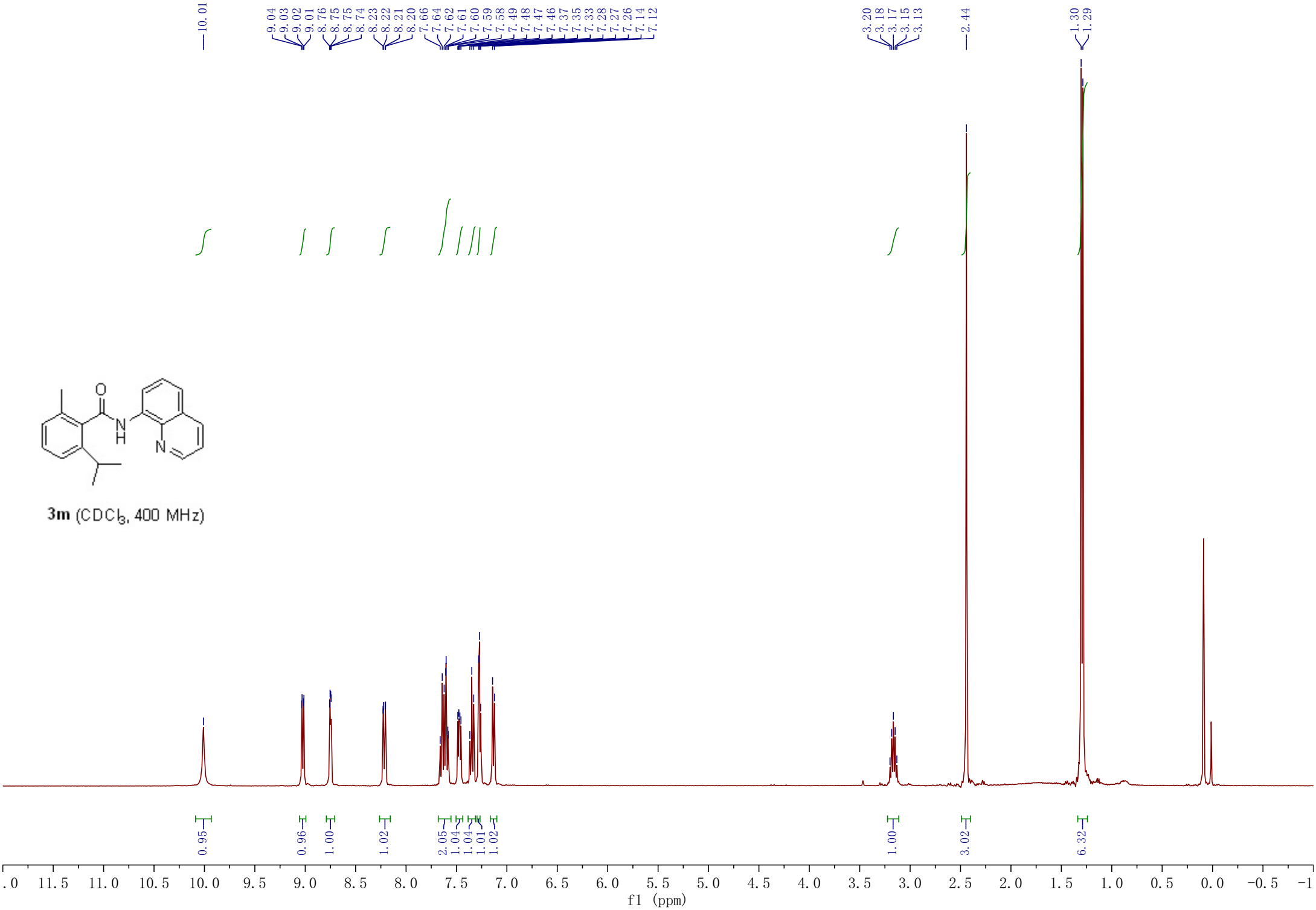

168.8
148.1
141.9
138.9
138.2
137.7
136.6
134.6
134.2
129.0
128.2
128.0
128.0
127.9
127.5
126.8
125.4
122.0
121.6
117.1
77.3
77.0
76.7
35.7
33.2
19.5
O
N
H
N
3j (CDCl3, 101 MHz)
f1 (ppm)

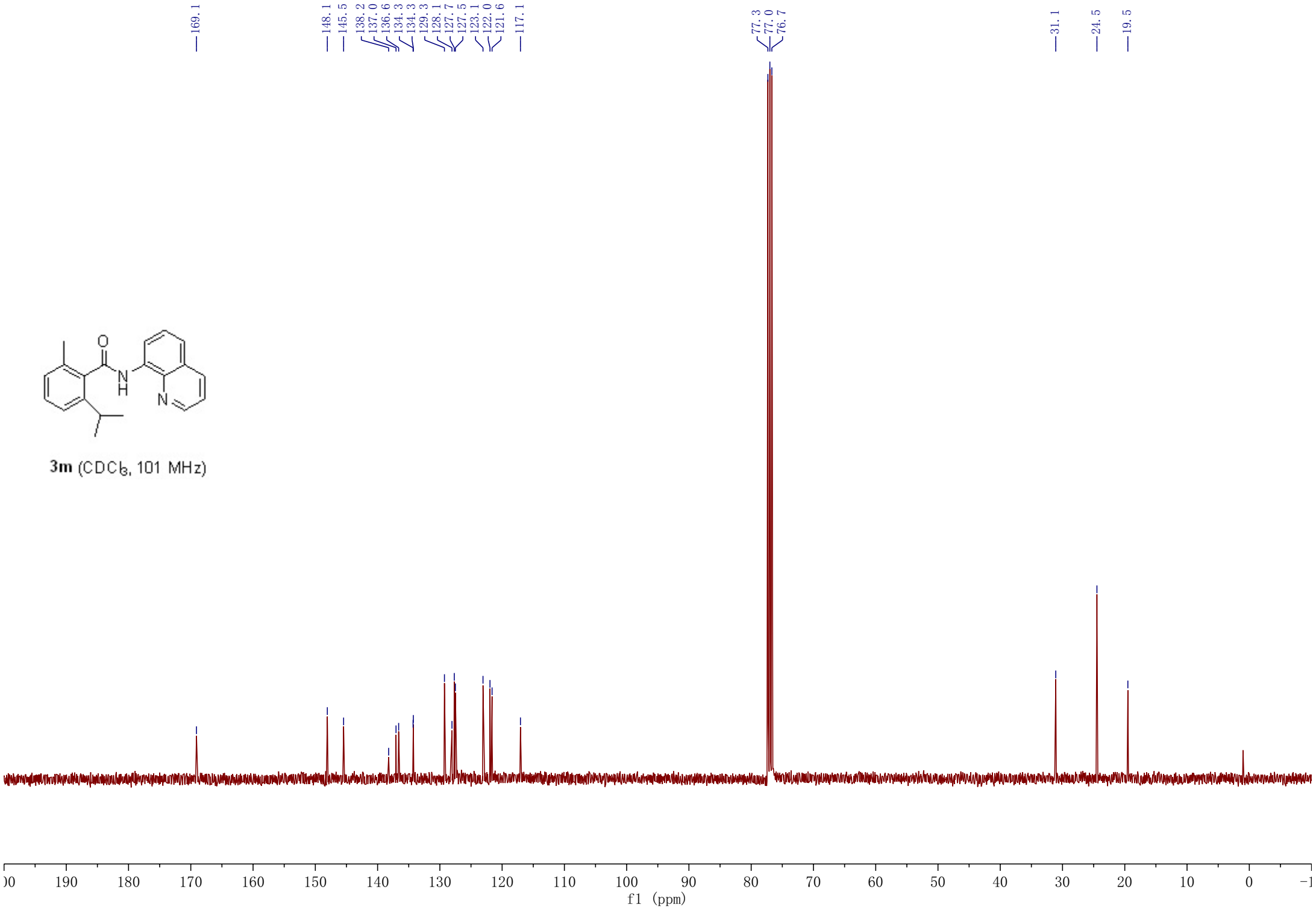

9.92
9.01
9.01
8.99
8.99
8.75
8.74
8.74
8.73
8.21
8.21
8.19
8.19
7.66
7.64
7.62
7.60
7.60
7.58
7.58
7.47
7.46
7.45
7.44
7.30
7.28
7.26
7.26
7.25
7.25
7.24
7.23
7.22
7.22
7.22
7.17
7.15
7.10
7.08
6.96
6.95
6.94
6.93
6.93
3.03
3.02
3.01
3.01
3.00
2.99
2.98
2.96
2.95
2.94
2.94
2.93
2.92
2.46
O
N
H
N
Br
3k (CDCl3, 400 MHz)
0.96
1.00
0.99
1.04
2.07
1.04
1.26
1.96
1.02
1.01
1.98
1.95
2.00
2.91
f1 (ppm)

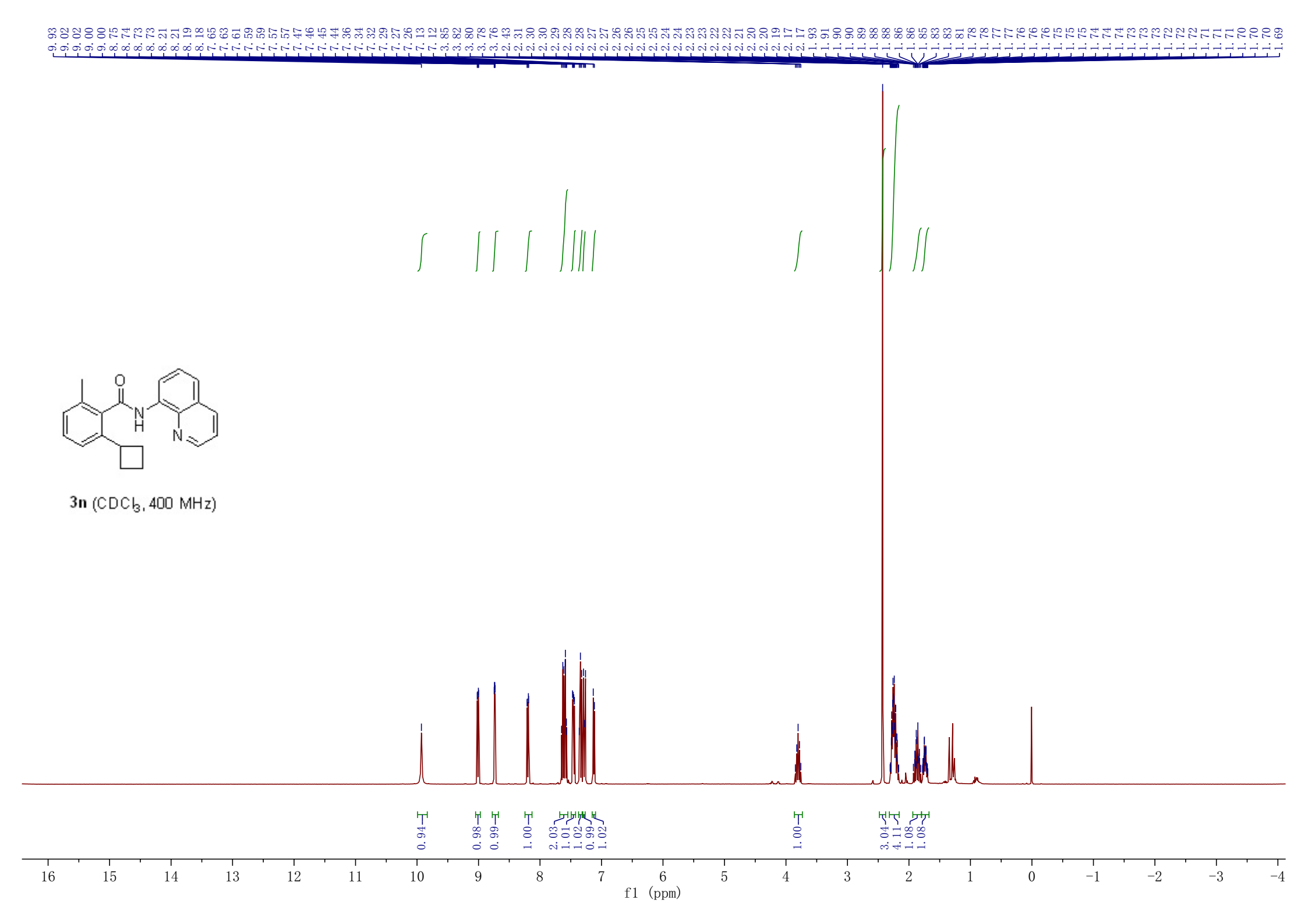

168.6
148.3
140.5
138.3
138.0
137.8
136.4
134.6
134.2
131.2
130.2
129.1
128.2
128.0
127.4
126.9
122.1
121.7
119.5
116.8
77.3
77.0
76.7
37.4
35.6
19.5
O
N
H
N
Br
3k (CDCl3, 101 MHz)
f1 (ppm)

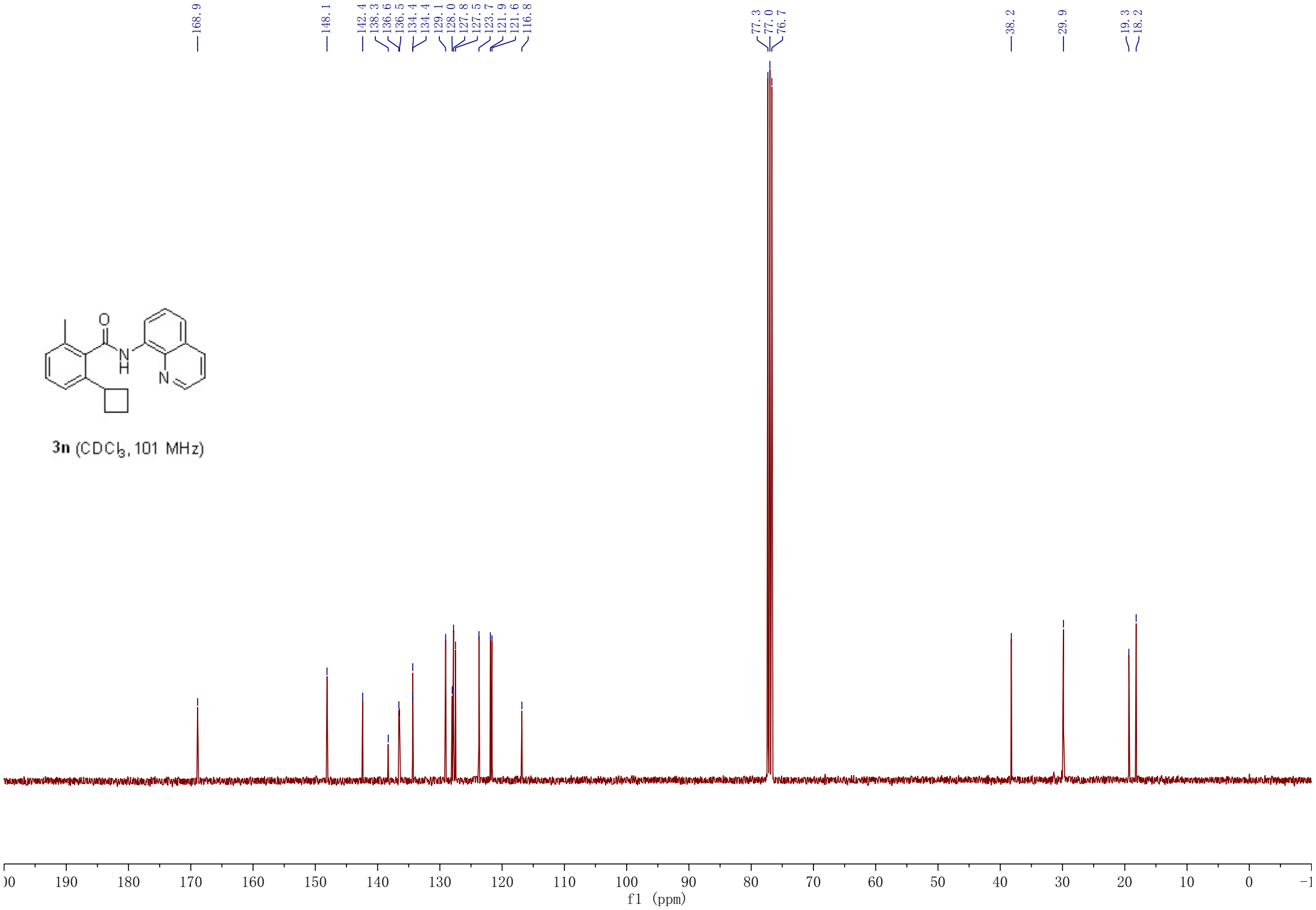

9.95
8.98
8.98
8.97
8.96
8.70
8.69
8.69
8.68
8.20
8.20
8.18
8.18
7.64
7.62
7.60
7.59
7.59
7.57
7.57
7.46
7.45
7.44
7.43
7.32
7.30
7.28
7.26
7.18
7.16
7.14
7.04
7.03
7.03
7.02
7.01
7.00
6.61
6.61
6.60
6.59
6.58
6.57
3.89
3.87
3.85
2.95
2.93
2.92
2.91
2.44
2.19
2.18
2.17
2.16
2.16
2.15
2.14
2.13
O
N
H
N
O
Cl
3l (CDCl3, 400 MHz)
0.95
0.97
0.99
0.99
2.01
1.03
1.01
2.02
1.95
1.99
2.00
2.00
3.01
1.98
f1 (ppm)

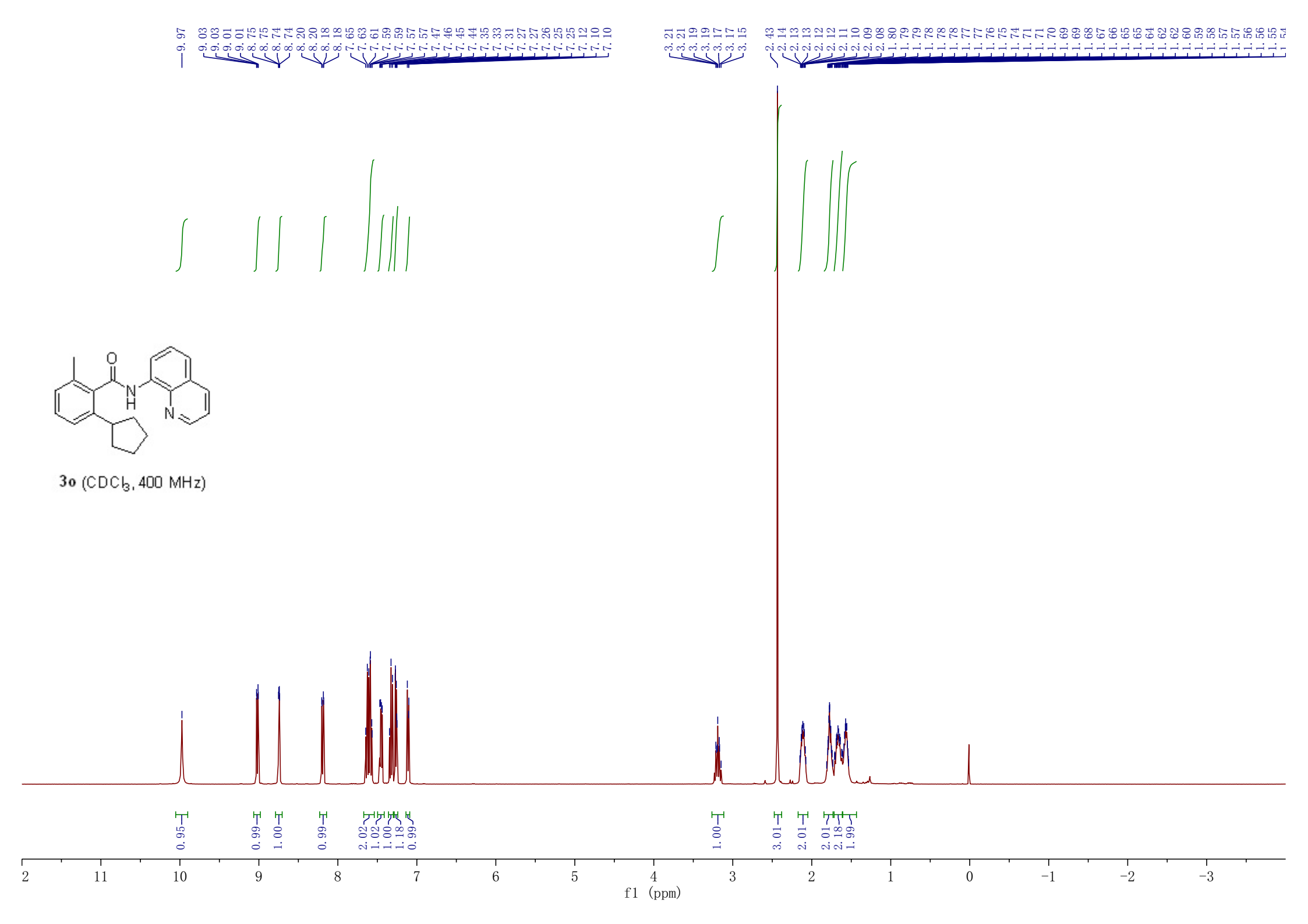

168.6
157.3
148.1
138.2
138.1
137.9
136.5
134.7
134.2
129.1
128.9
128.1
128.0
127.4
126.9
125.0
122.0
121.6
116.9
115.5
77.3
77.0
76.7
67.0
30.9
29.6
19.5
O
N
H
N
O
Cl
3l (CDCl3, 101 MHz)
f1 (ppm)

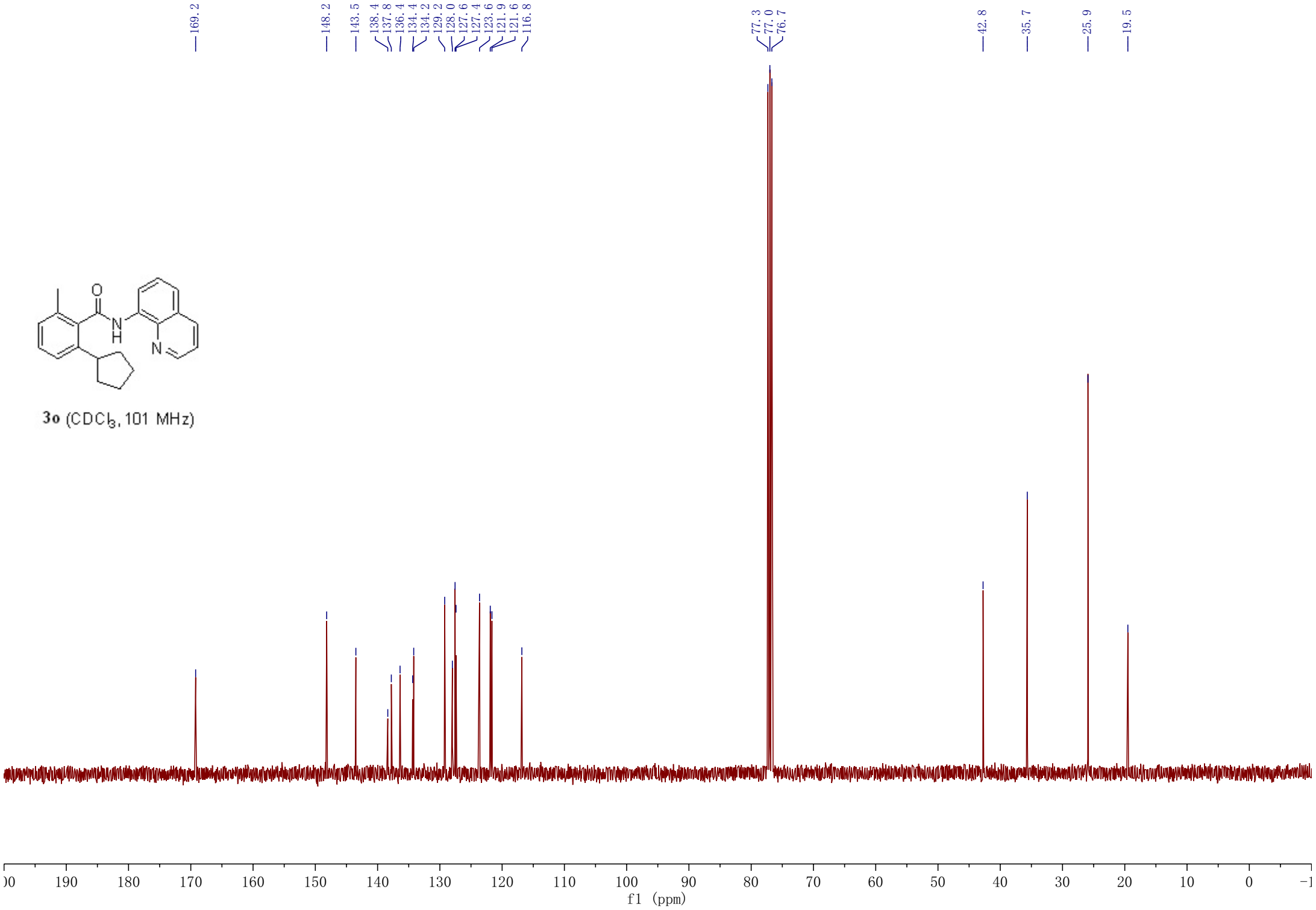

10.01
9.04
9.03
9.02
9.01
8.76
8.75
8.75
8.74
8.23
8.22
8.21
8.20
7.66
7.64
7.62
7.61
7.60
7.59
7.58
7.49
7.48
7.47
7.46
7.37
7.35
7.33
7.28
7.27
7.26
7.14
7.12
3.20
3.18
3.17
3.15
3.13
2.44
1.30
1.29
O
N
H
N
3m (CDCl3, 400 MHz)
0.95
0.96
1.00
1.02
2.05
1.04
1.04
1.01
1.02
1.00
3.02
6.32
f1 (ppm)

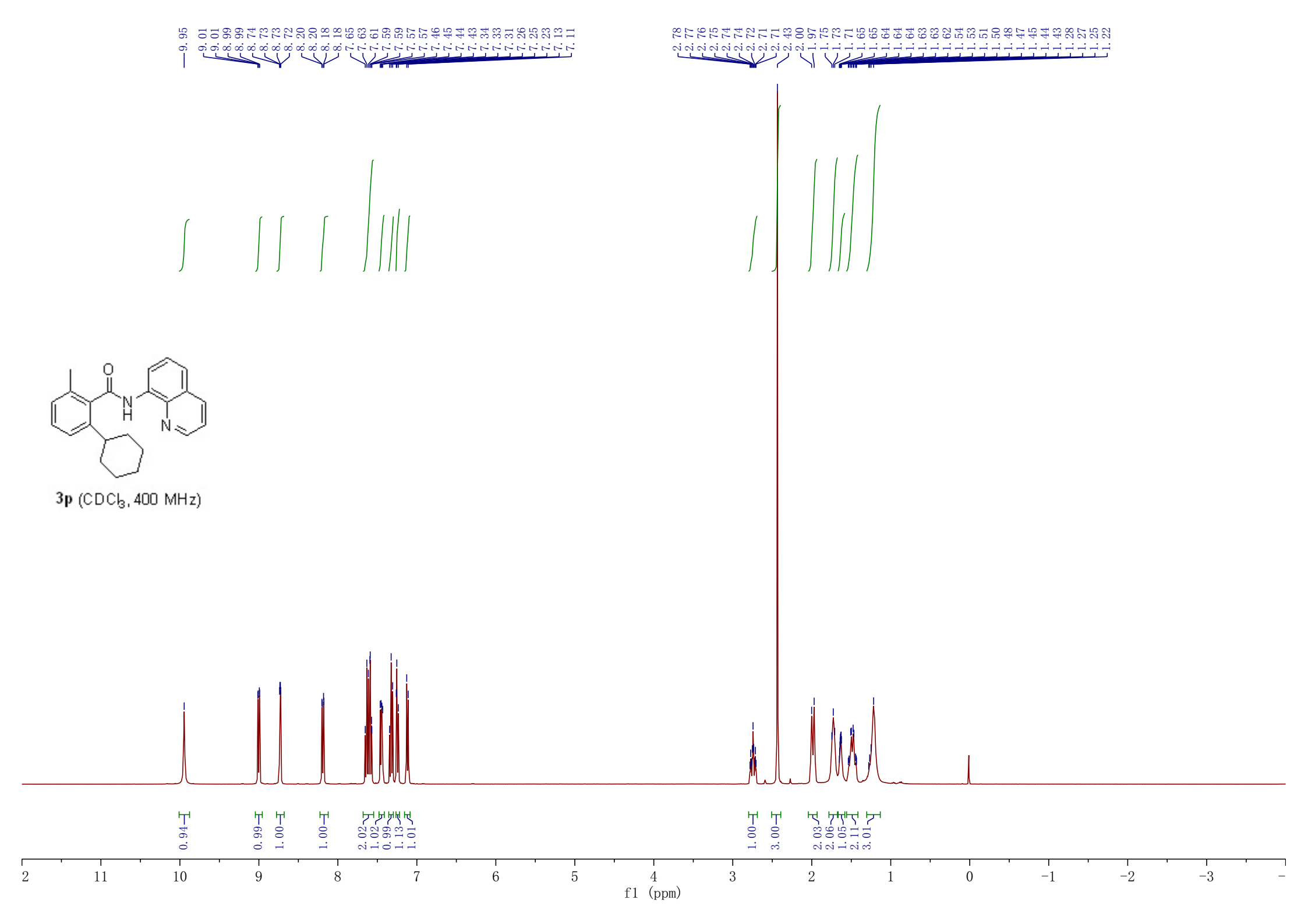

169.1
148.1
145.5
138.2
137.0
136.6
134.3
134.3
129.3
128.1
127.7
127.5
123.1
122.0
121.6
117.1
77.3
77.0
76.7
31.1
24.5
19.5
O
N
H
N
3m (CDCl3, 101 MHz)
f1 (ppm)

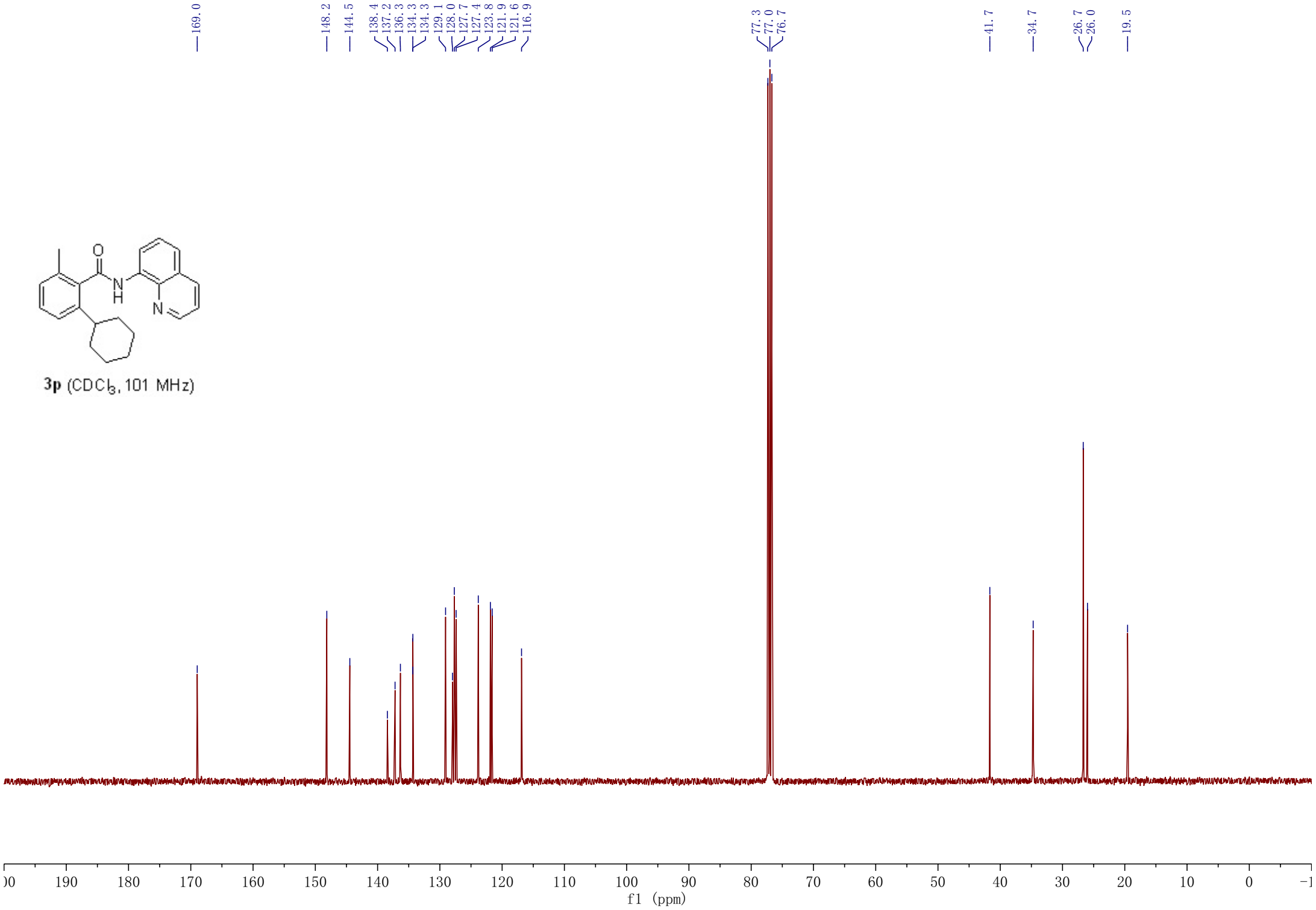

9.93 9.02 9.02 9.00 9.00 8.75 8.74 8.73 8.73 8.21 8.21 8.19 8.18 7.65 7.63 7.61 7.59 7.59 7.57 7.57 7.47 7.46 7.45 7.44 7.36 7.34 7.32 7.29 7.27 7.26 7.13 7.12 3.85 3.82 3.80 3.78 3.76 2.43 2.31 2.30 2.30 2.29 2.28 2.28 2.27 2.27 2.26 2.26 2.25 2.25 2.24 2.24 2.23 2.23 2.22 2.22 2.21 2.20 2.20 2.19 2.17 2.17 1.93 1.91 1.90 1.90 1.89 1.88 1.88 1.86 1.86 1.85 1.83 1.81 1.78 1.78 1.77 1.77 1.76 1.76 1.76 1.75 1.75 1.75 1.74 1.74 1.74 1.73 1.73 1.73 1.72 1.72 1.72 1.71 1.71 1.71 1.70 1.70 1.70 1.70 1.69
O
N
H
N
3n (CDCl3, 400 MHz)
0.94
0.98
0.99
1.00
2.03
1.01
1.02
0.99
1.02
1.00
3.04
4.11
1.08
1.08
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3 −4
f1 (ppm)

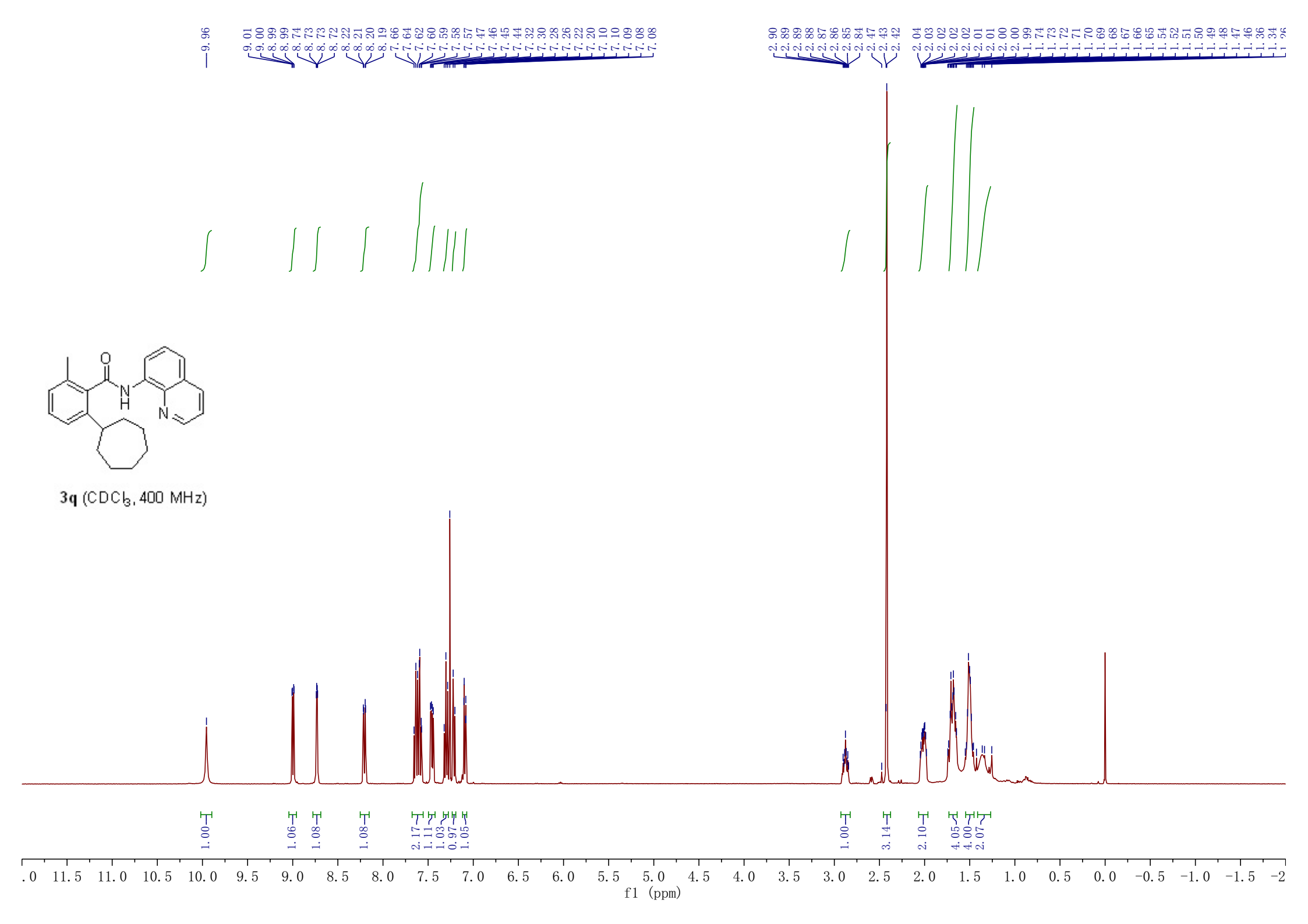

168.9
148.1
142.4
138.3
136.6
136.5
134.4
134.4
129.1
128.0
127.8
127.5
123.7
121.9
121.6
116.8
77.3
77.0
76.7
38.2
29.9
19.3
18.2
O
N
H
N
3n (CDCl3, 101 MHz)
f1 (ppm)

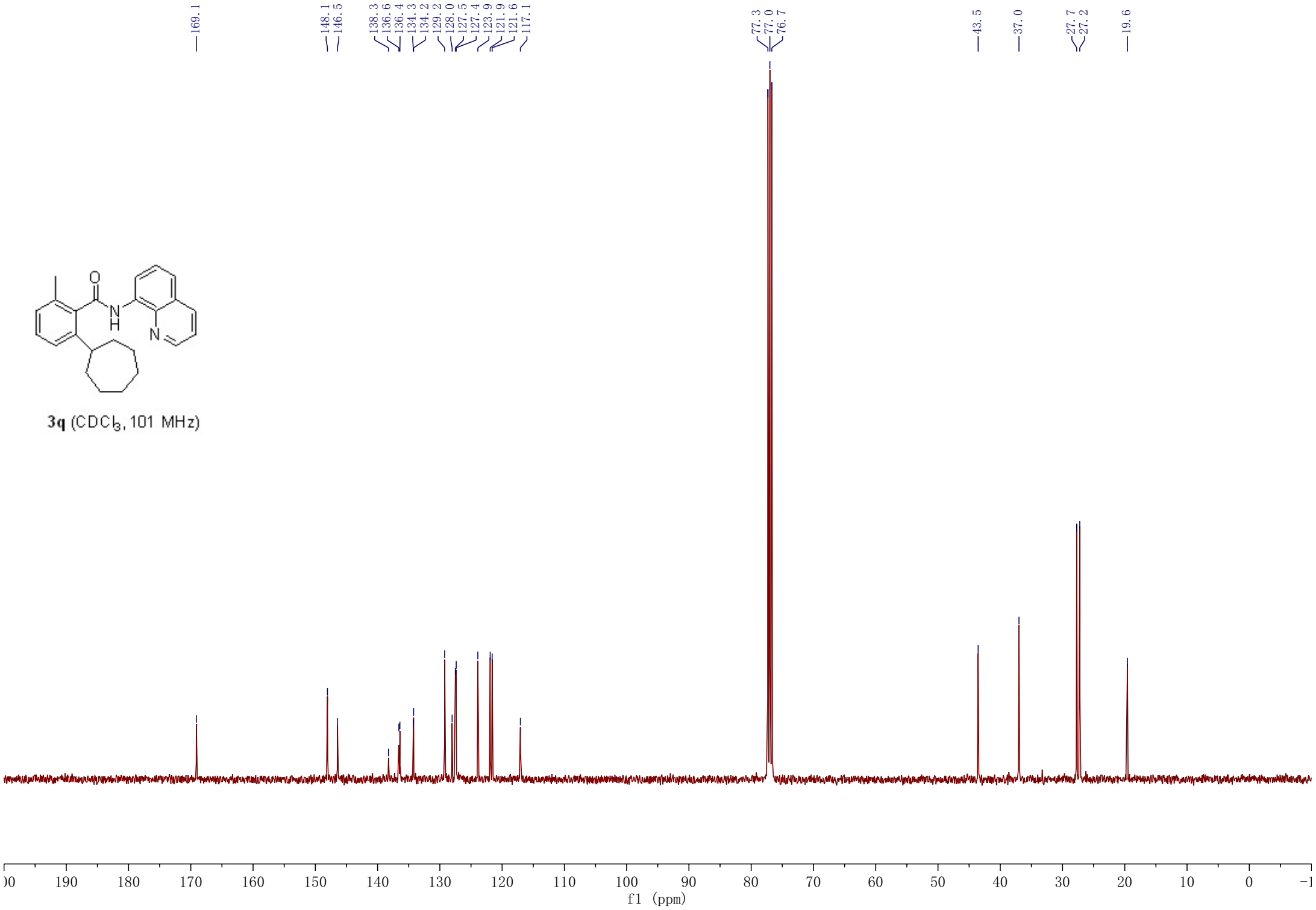

9.97
9.03
9.03
9.01
9.01
8.75
8.75
8.74
8.74
8.20
8.20
8.18
8.18
7.65
7.63
7.61
7.59
7.59
7.57
7.57
7.47
7.46
7.45
7.44
7.35
7.33
7.31
7.27
7.27
7.26
7.25
7.25
7.12
7.10
7.10
3.21
3.21
3.19
3.19
3.17
3.17
3.15
2.43
2.14
2.13
2.13
2.12
2.12
2.11
2.10
2.09
2.08
1.80
1.79
1.79
1.78
1.78
1.78
1.77
1.77
1.76
1.75
1.74
1.71
1.71
1.70
1.69
1.69
1.68
1.67
1.66
1.65
1.65
1.64
1.62
1.62
1.60
1.59
1.58
1.57
1.57
1.56
1.56
1.55
O
N
H
N
3o (CDCl3, 400 MHz)
0.95
0.99
1.00
0.99
2.02
1.02
1.00
1.18
0.99
1.00
3.01
2.01
2.01
2.18
1.99
2
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)

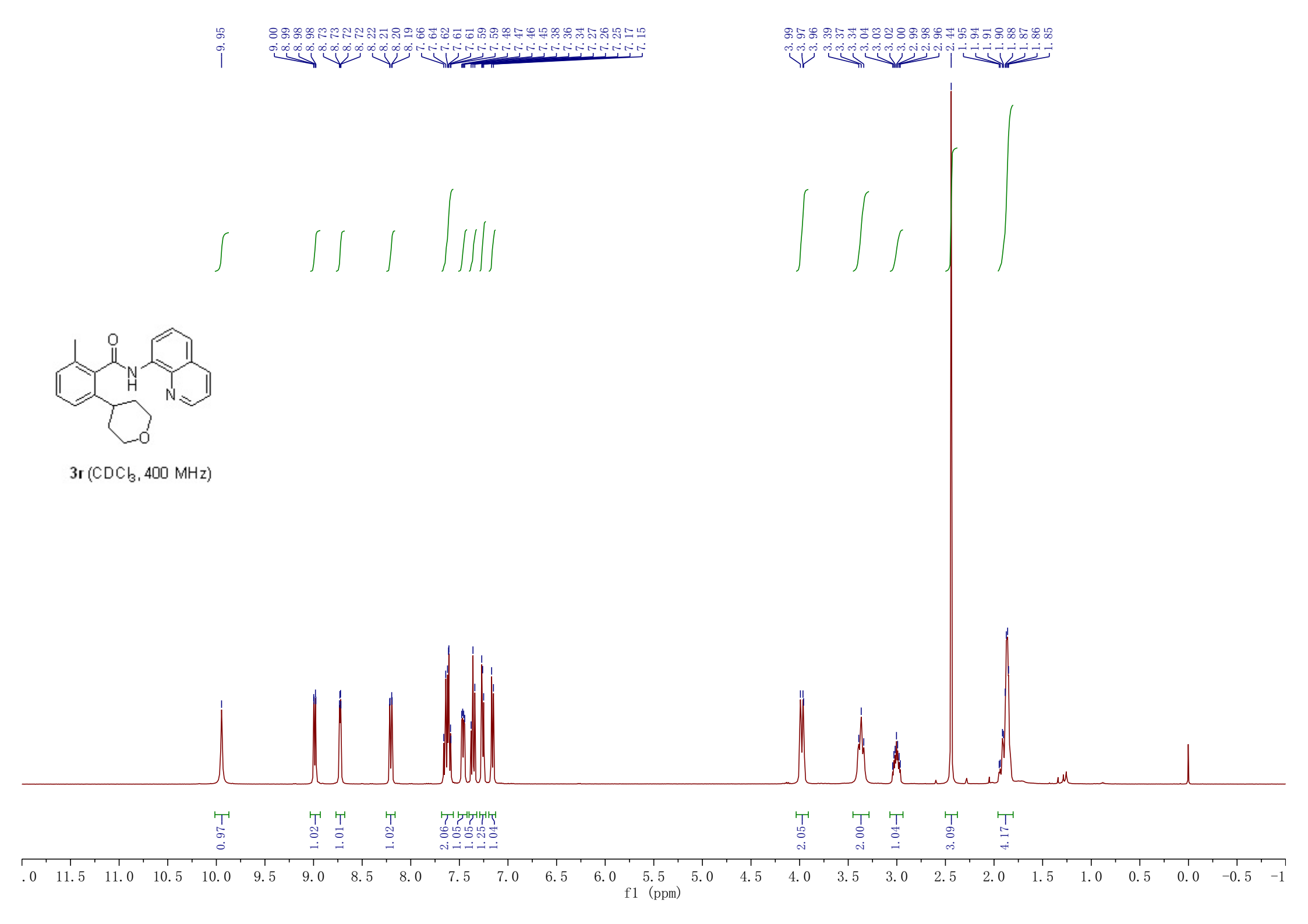

169.2
148.2
143.5
138.4
137.8
136.4
134.4
134.2
129.2
128.0
127.6
127.4
123.6
121.9
121.6
116.8
77.3
77.0
76.7
42.8
35.7
25.9
19.5
O
N
H
N
3o (CDCl3, 101 MHz)
f1 (ppm)

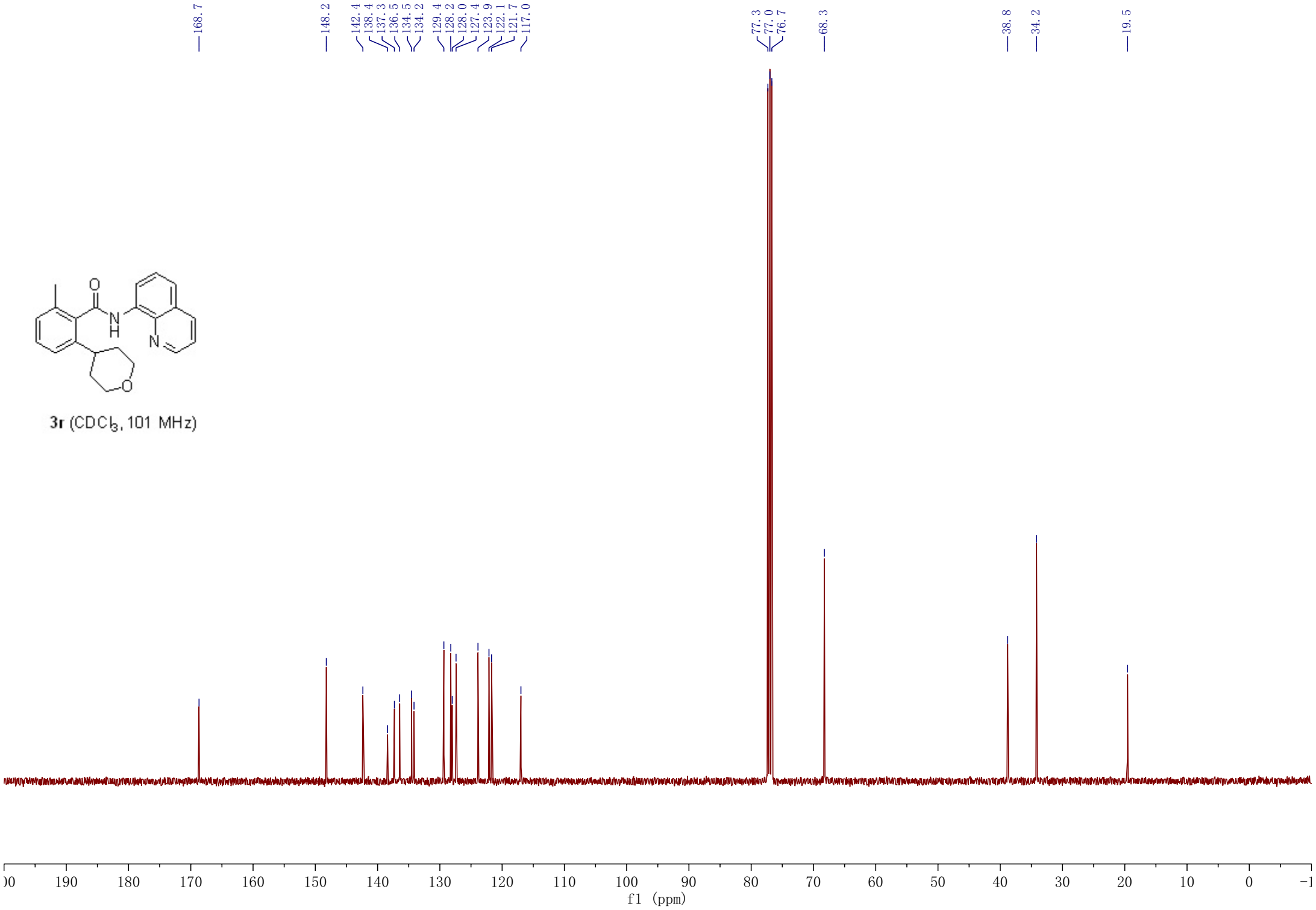

9.95
9.01
9.01
8.99
8.99
8.74
8.73
8.73
8.72
8.20
8.20
8.18
8.18
7.65
7.63
7.61
7.59
7.59
7.57
7.57
7.46
7.45
7.44
7.43
7.34
7.33
7.31
7.26
7.25
7.23
7.13
7.11
2.78
2.77
2.76
2.75
2.74
2.74
2.72
2.71
2.71
2.43
2.00
1.97
1.75
1.73
1.71
1.65
1.65
1.64
1.64
1.64
1.63
1.63
1.62
1.54
1.53
1.51
1.50
1.48
1.47
1.45
1.44
1.43
1.28
1.27
1.25
1.22
O
N
H
N
3p (CDCl3, 400 MHz)
0.94
0.99
1.00
1.00
2.02
1.02
0.99
1.13
1.01
1.00
3.00
2.03
2.06
1.05
2.11
3.01
2
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)

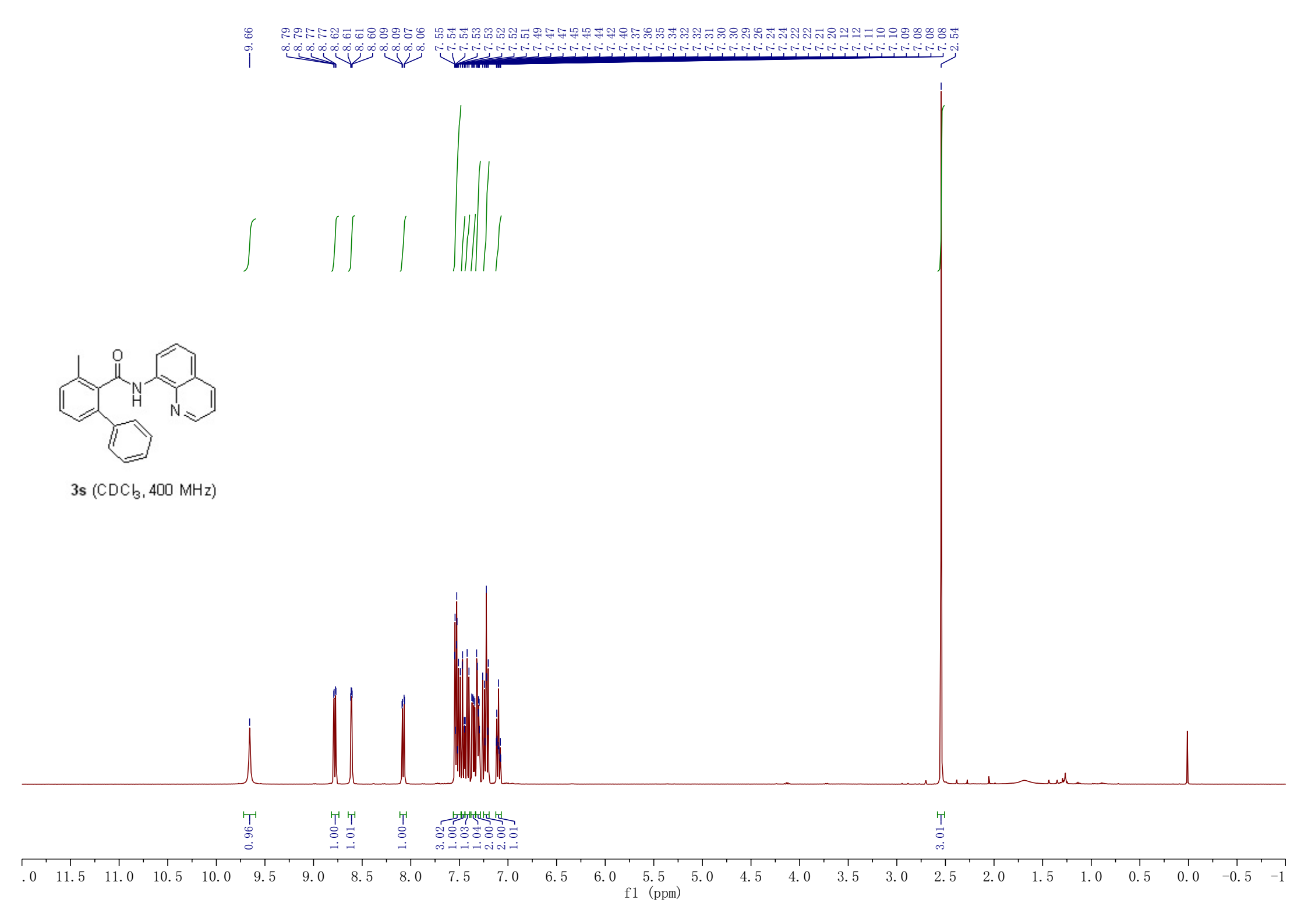

169.0
148.2
144.5
138.4
137.2
136.3
134.3
134.3
129.1
128.0
127.7
127.4
123.8
121.9
121.6
116.9
77.3
77.0
76.7
41.7
34.7
26.7
26.0
19.5
O
N
H
N
3p (CDCl3, 101 MHz)
f1 (ppm)

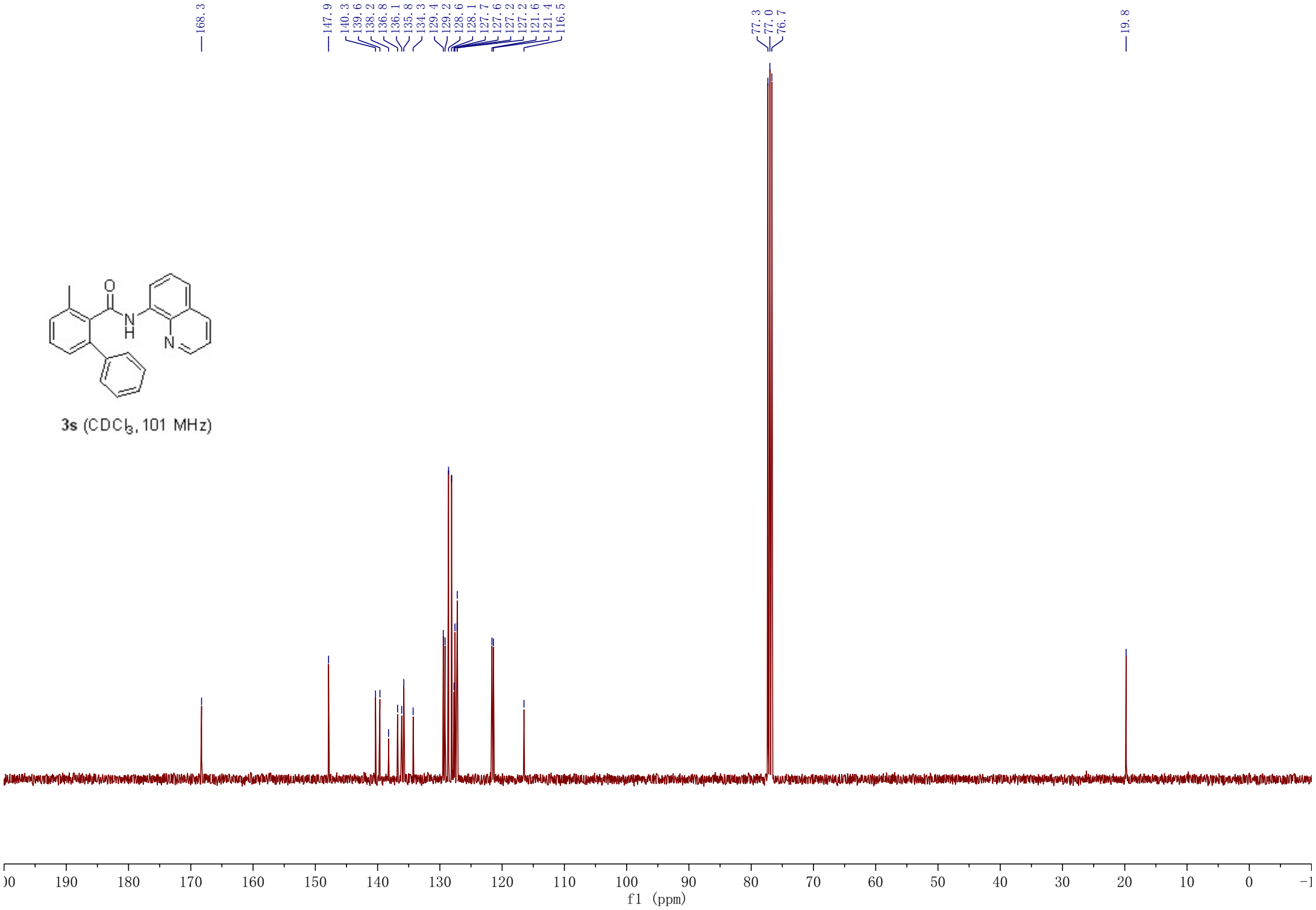

9.96
9.01
9.00
8.99
8.99
8.74
8.73
8.73
8.72
8.22
8.21
8.20
8.19
7.66
7.64
7.62
7.60
7.59
7.58
7.57
7.47
7.46
7.45
7.44
7.32
7.30
7.28
7.26
7.22
7.20
7.10
7.10
7.09
7.08
7.08
2.90
2.89
2.89
2.88
2.87
2.86
2.85
2.84
2.47
2.43
2.42
2.04
2.03
2.02
2.02
2.02
2.01
2.01
2.00
2.00
1.99
1.74
1.73
1.72
1.71
1.70
1.69
1.68
1.67
1.66
1.65
1.54
1.52
1.51
1.50
1.49
1.48
1.47
1.46
1.36
1.34
O
N
H
N
3q (CDCl3, 400 MHz)
1.00
1.06
1.08
1.08
2.17
1.11
1.03
0.97
1.05
1.00
3.14
2.10
4.05
4.00
2.07
f1 (ppm)

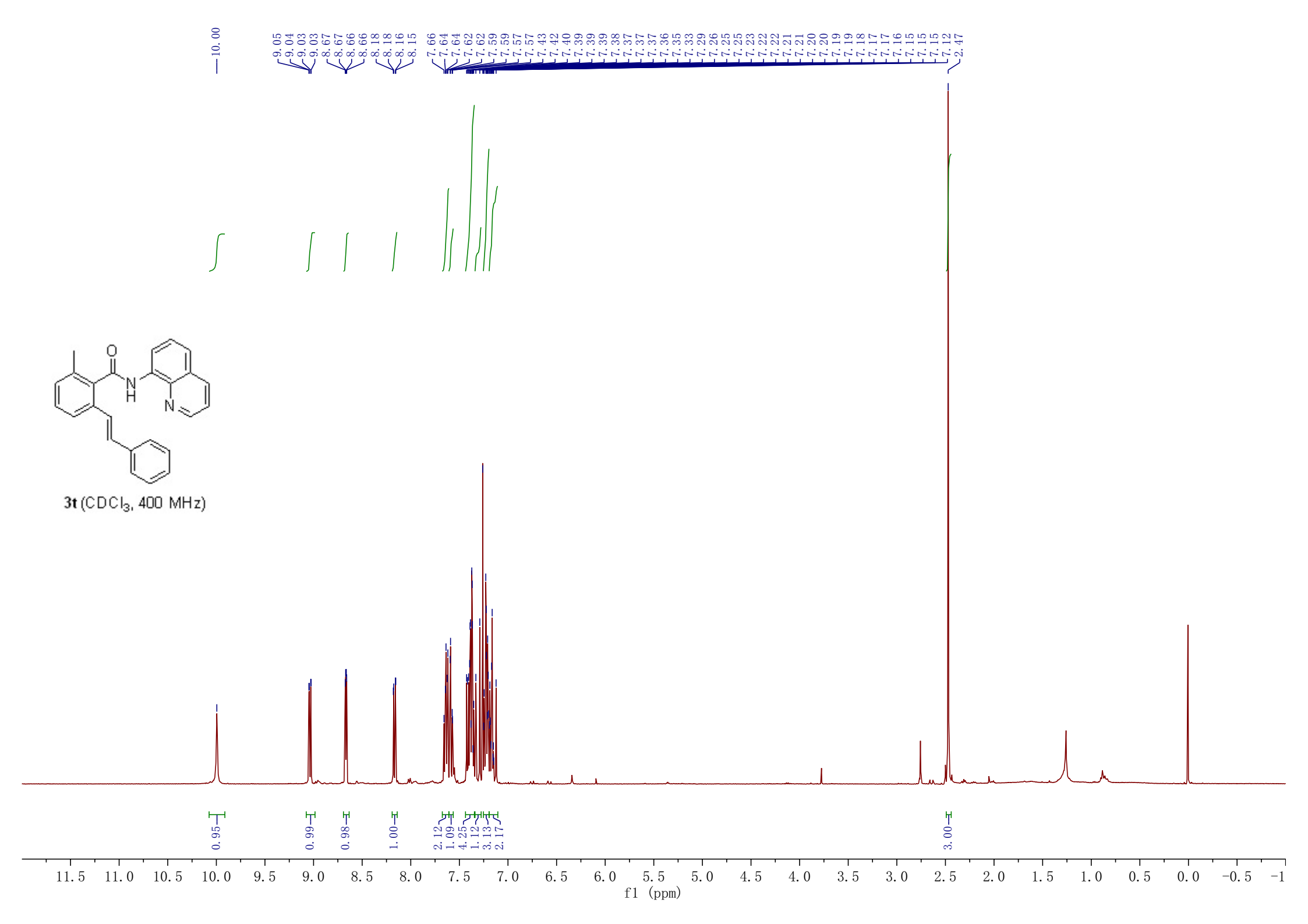

169.1
148.1
146.5
138.3
136.6
136.4
134.3
134.2
129.2
128.0
127.5
127.4
123.9
121.9
121.6
117.1
77.3
77.0
76.7
43.5
37.0
27.7
27.2
19.6
O
N
H
N
3q (CDCl3, 101 MHz)
f1 (ppm)

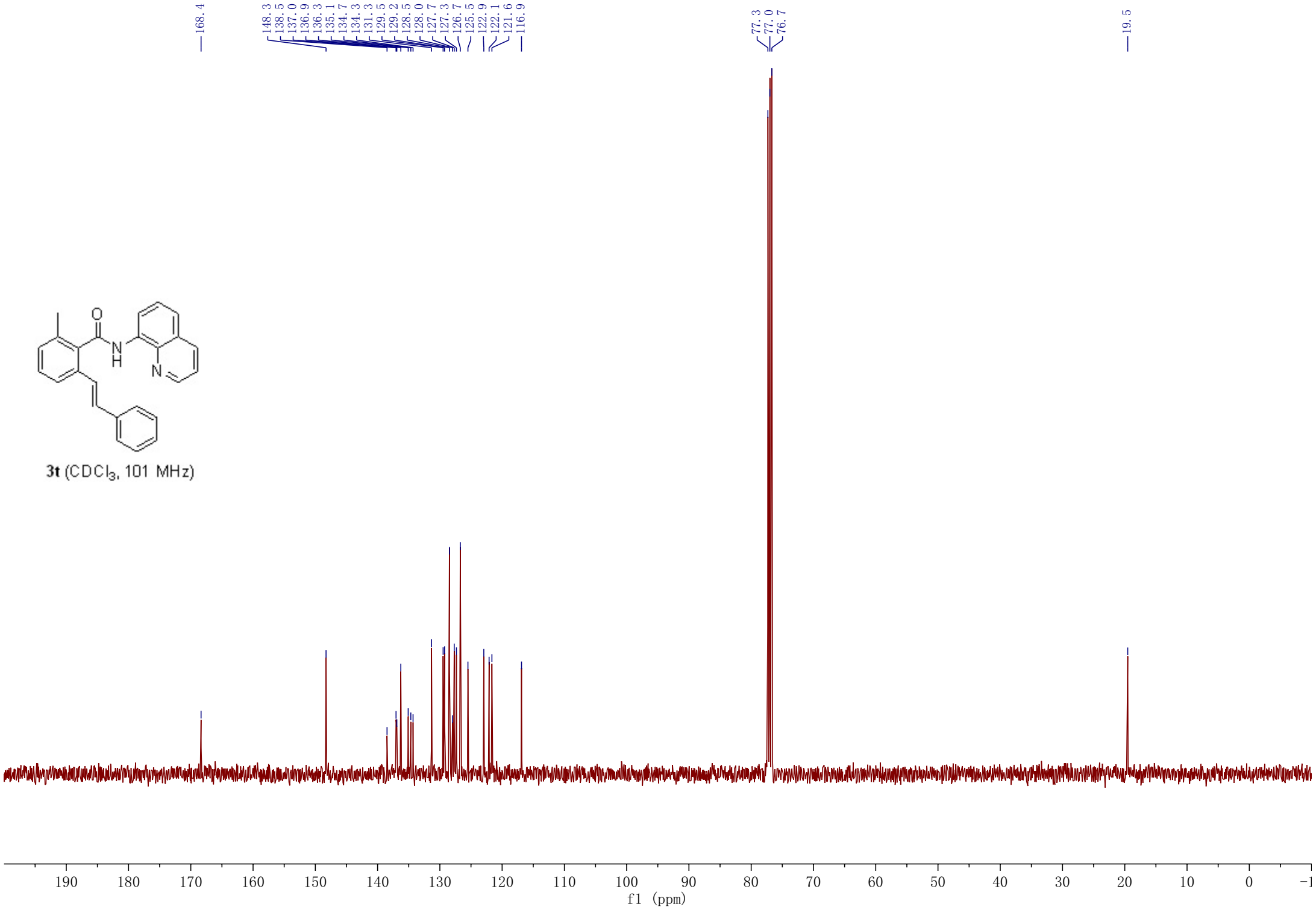

9.95
9.00
8.99
8.98
8.98
8.73
8.73
8.72
8.72
8.22
8.21
8.20
8.19
7.66
7.64
7.62
7.61
7.61
7.59
7.59
7.48
7.47
7.46
7.45
7.38
7.36
7.34
7.27
7.26
7.25
7.17
7.15
3.99
3.97
3.96
3.39
3.37
3.34
3.04
3.03
3.02
3.00
2.99
2.98
2.96
2.44
1.95
1.94
1.91
1.90
1.88
1.87
1.86
1.85
O
N
H
N
O
3r (CDCl3, 400 MHz)
0.97
1.02
1.01
1.02
2.06
1.05
1.05
1.25
1.04
2.05
2.00
1.04
3.09
4.17
f1 (ppm)

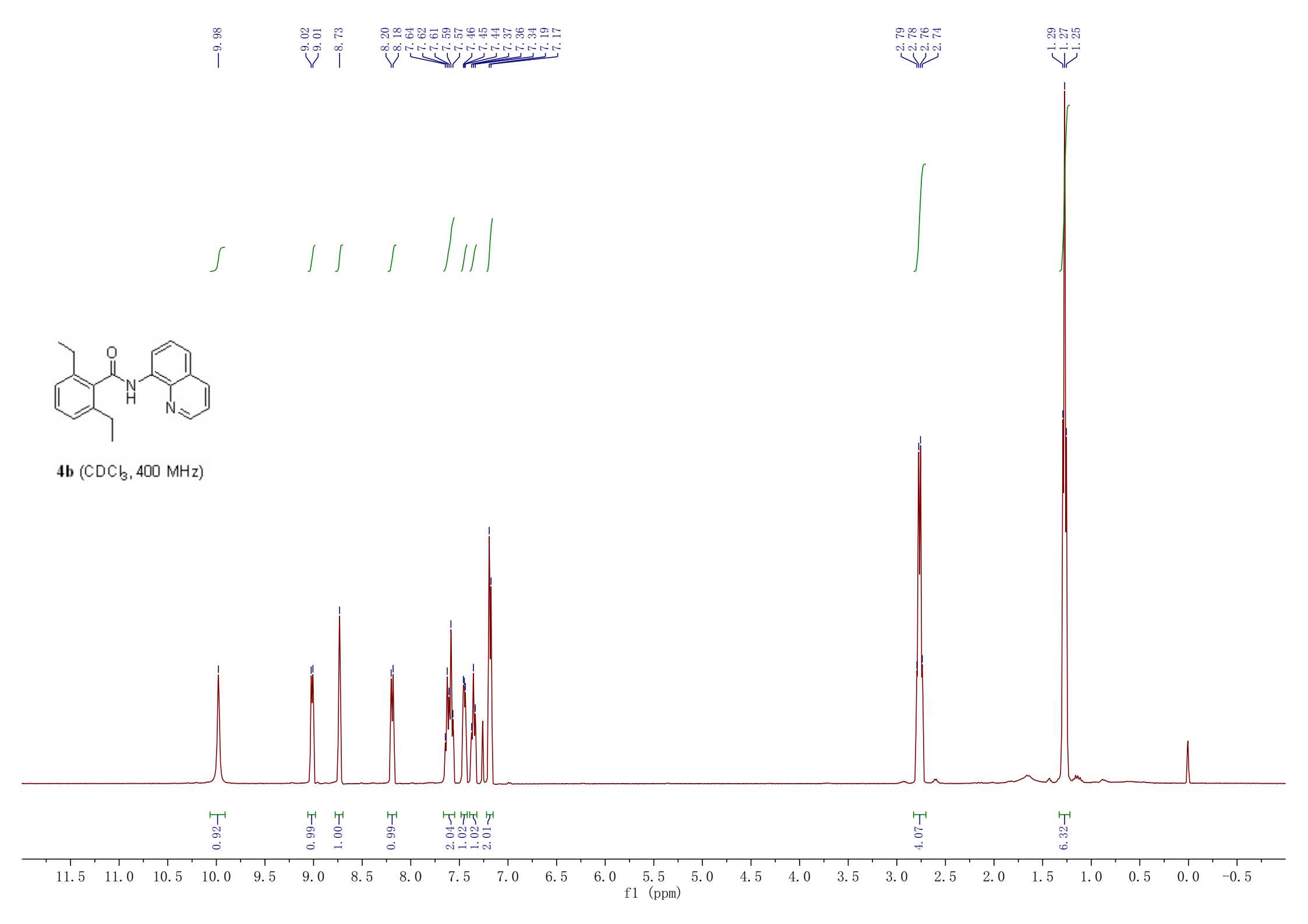

168.7
148.2
142.4
138.4
137.3
136.5
134.5
134.2
129.4
128.2
128.0
127.4
123.9
122.1
121.7
117.0
77.3
77.0
76.7
68.3
38.8
34.2
19.5
O
N
H
N
O
3r (CDCl3, 101 MHz)
f1 (ppm)

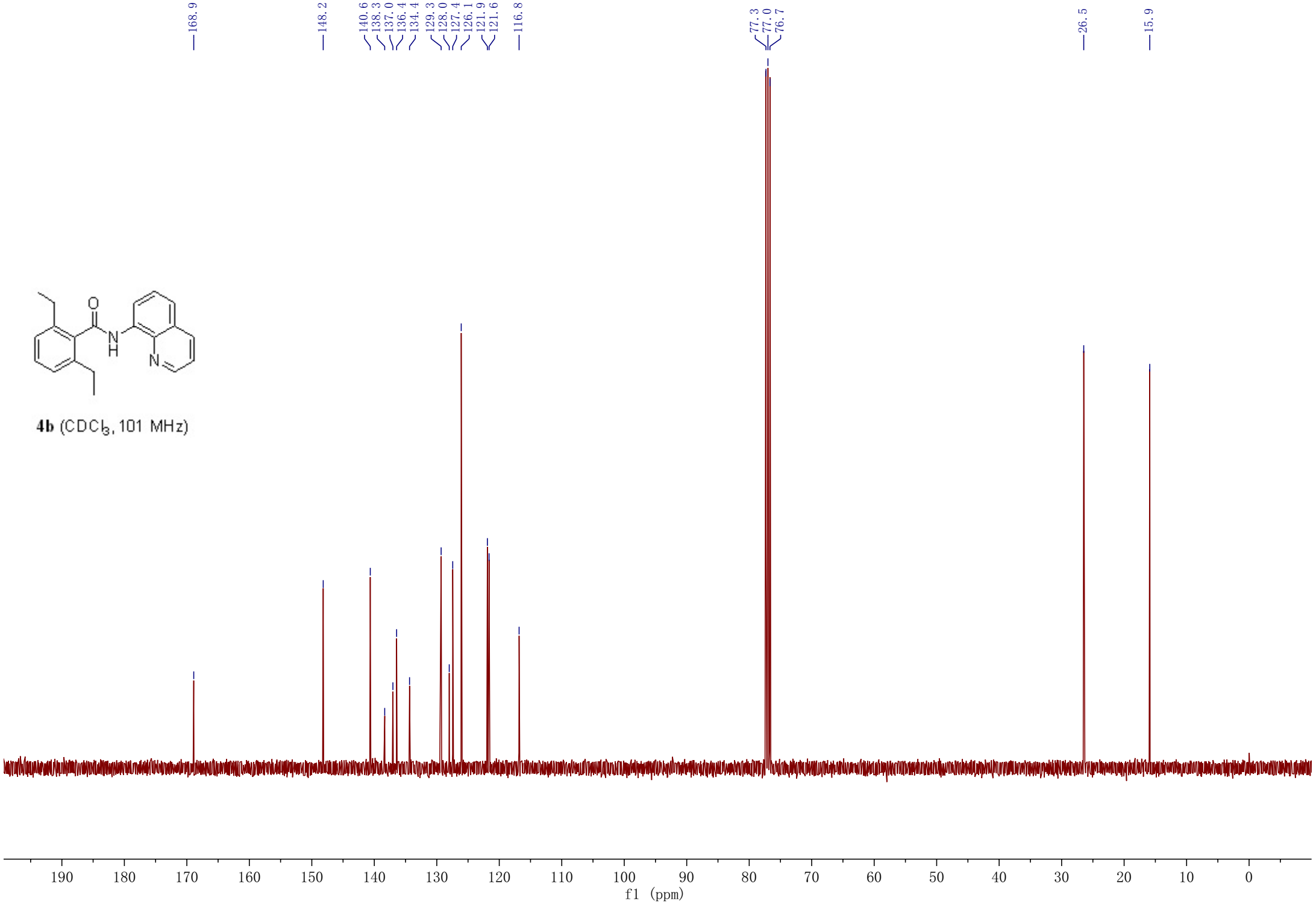

9.66
8.79
8.79
8.77
8.77
8.62
8.61
8.61
8.60
8.09
8.09
8.07
8.06
7.55
7.54
7.54
7.53
7.53
7.52
7.52
7.51
7.49
7.47
7.47
7.45
7.45
7.44
7.42
7.40
7.37
7.36
7.35
7.34
7.32
7.32
7.31
7.30
7.30
7.29
7.26
7.24
7.24
7.22
7.22
7.21
7.20
7.12
7.12
7.11
7.10
7.10
7.09
7.08
7.08
2.54
O
N
H
N
3s (CDCl3, 400 MHz)
0.96
1.00
1.01
1.00
3.02
1.00
1.03
1.04
2.00
2.00
1.01
3.01
f1 (ppm)

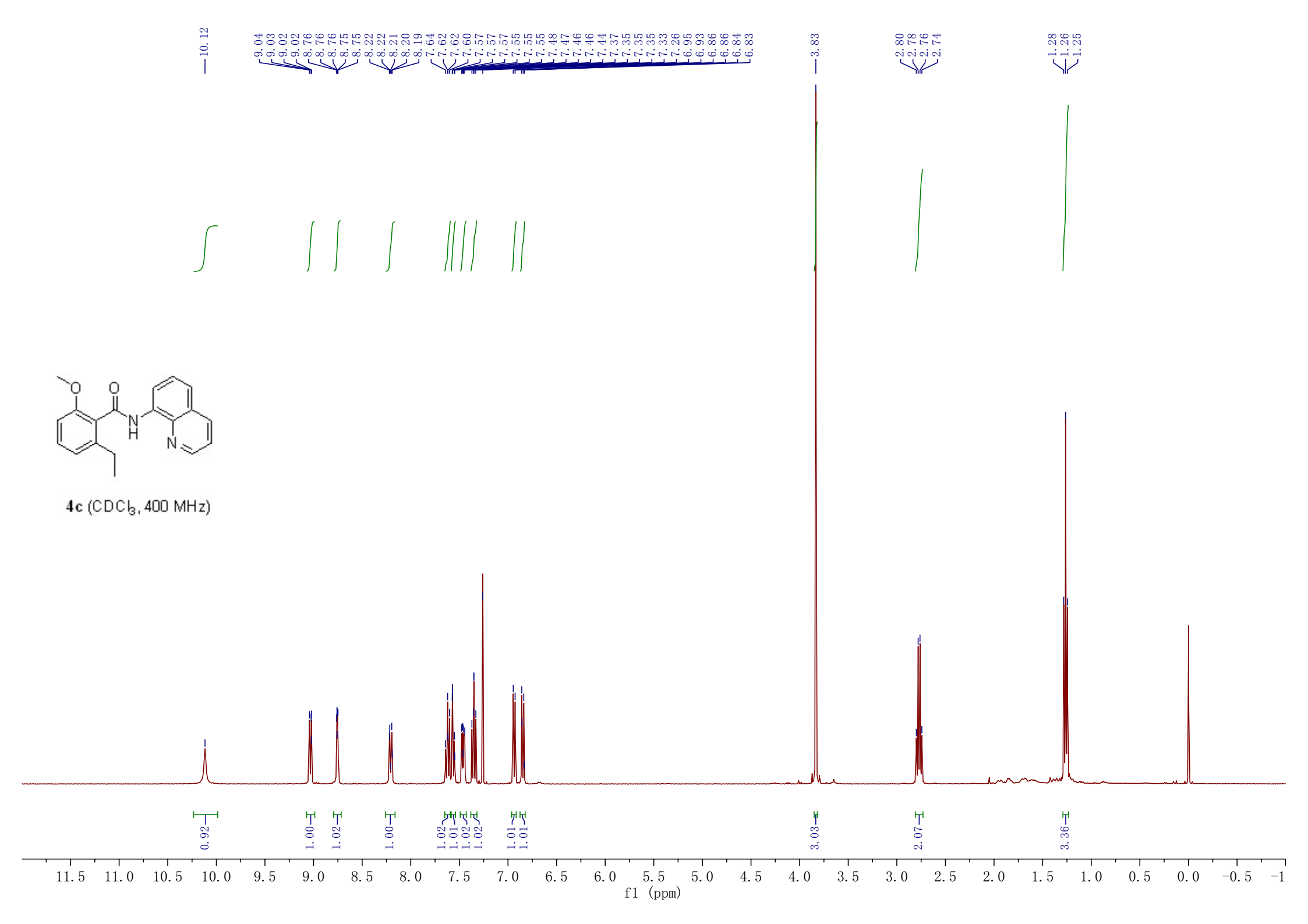

168.3
147.9
140.3
139.6
138.2
136.8
136.1
135.8
134.3
129.4
129.2
128.6
128.1
127.7
127.6
127.2
127.2
121.6
121.4
116.5
77.3
77.0
76.7
19.8
O
N
H
N
3s (CDCl3, 101 MHz)
f1 (ppm)

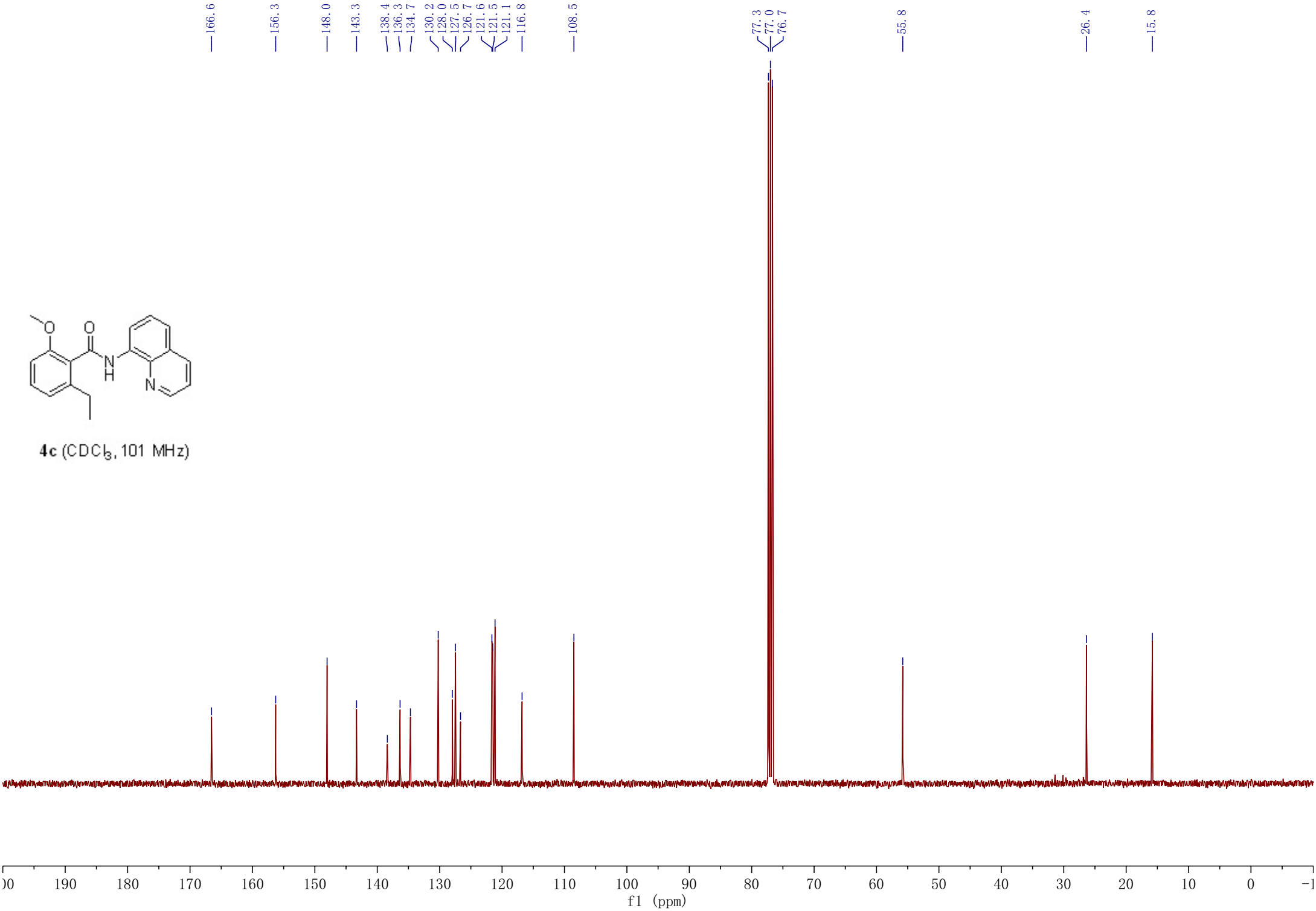

10.00
9.05
9.04
9.03
9.03
8.67
8.67
8.66
8.66
8.18
8.18
8.16
8.15
7.66
7.64
7.64
7.62
7.62
7.59
7.59
7.57
7.57
7.43
7.42
7.40
7.39
7.39
7.39
7.38
7.37
7.37
7.37
7.36
7.35
7.33
7.29
7.26
7.25
7.25
7.23
7.22
7.22
7.21
7.21
7.20
7.20
7.19
7.19
7.18
7.17
7.17
7.16
7.15
7.15
7.12
2.47
O
N
H
N
3t (CDCl3, 400 MHz)
0.95
0.99
0.98
1.00
2.12
1.09
4.25
1.12
3.13
2.17
3.00
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1
f1 (ppm)


168.4
148.3
138.5
137.0
136.9
136.3
135.1
134.7
134.3
131.3
129.5
129.2
128.5
128.0
127.7
127.3
126.7
125.5
122.9
122.1
121.6
116.9
77.3
77.0
76.7
19.5
O
N
H
N
3t (CDCl3, 101 MHz)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1
f1 (ppm)

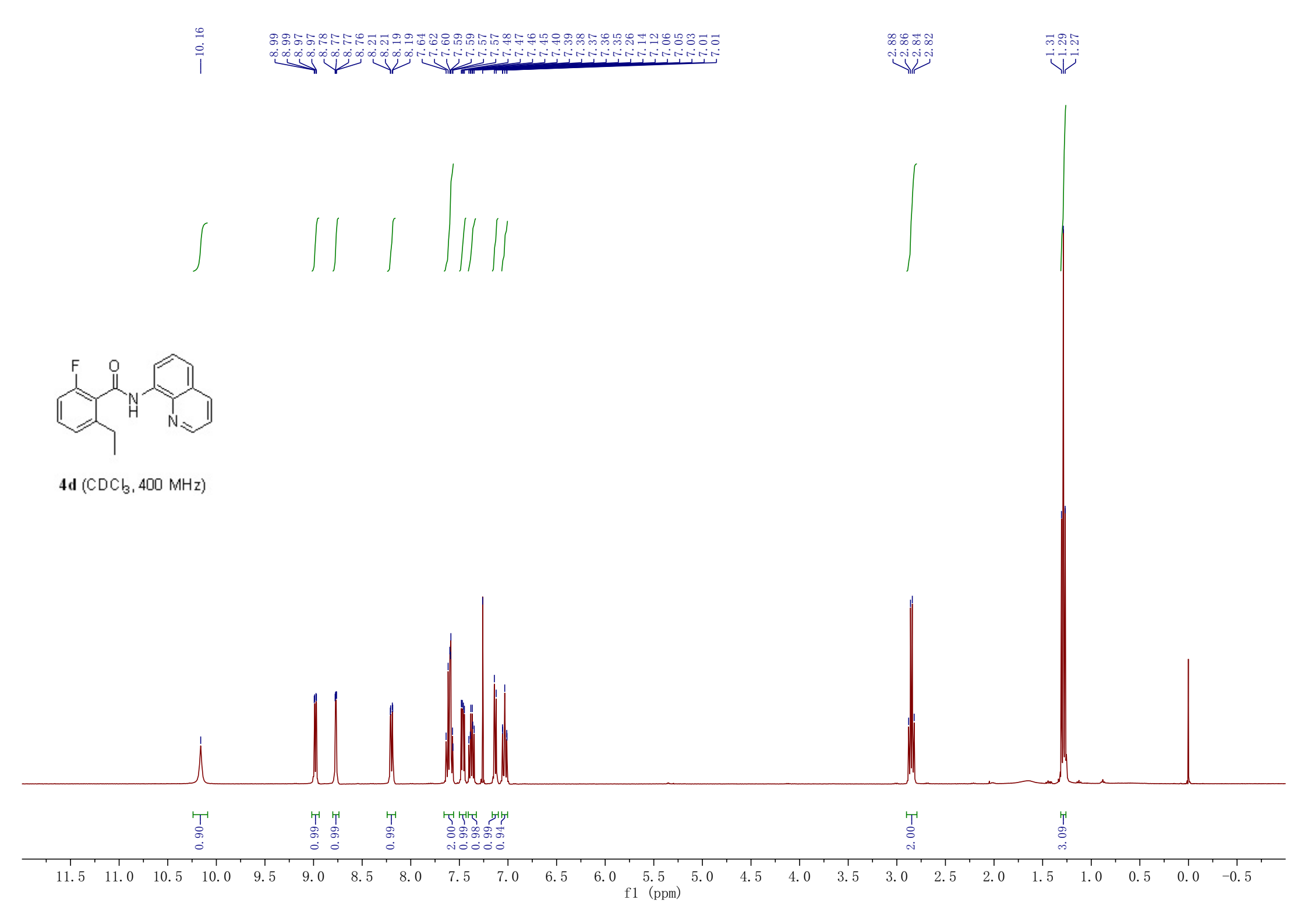

9.98
9.02
9.01
8.73
8.20
8.18
7.64
7.62
7.61
7.59
7.57
7.46
7.45
7.44
7.37
7.36
7.34
7.19
7.17
2.79
2.78
2.76
2.74
1.29
1.27
1.25
O
N
H
N
4b (CDCl3, 400 MHz)
0.92
0.99
1.00
0.99
2.04
1.02
1.02
2.01
4.07
6.32
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

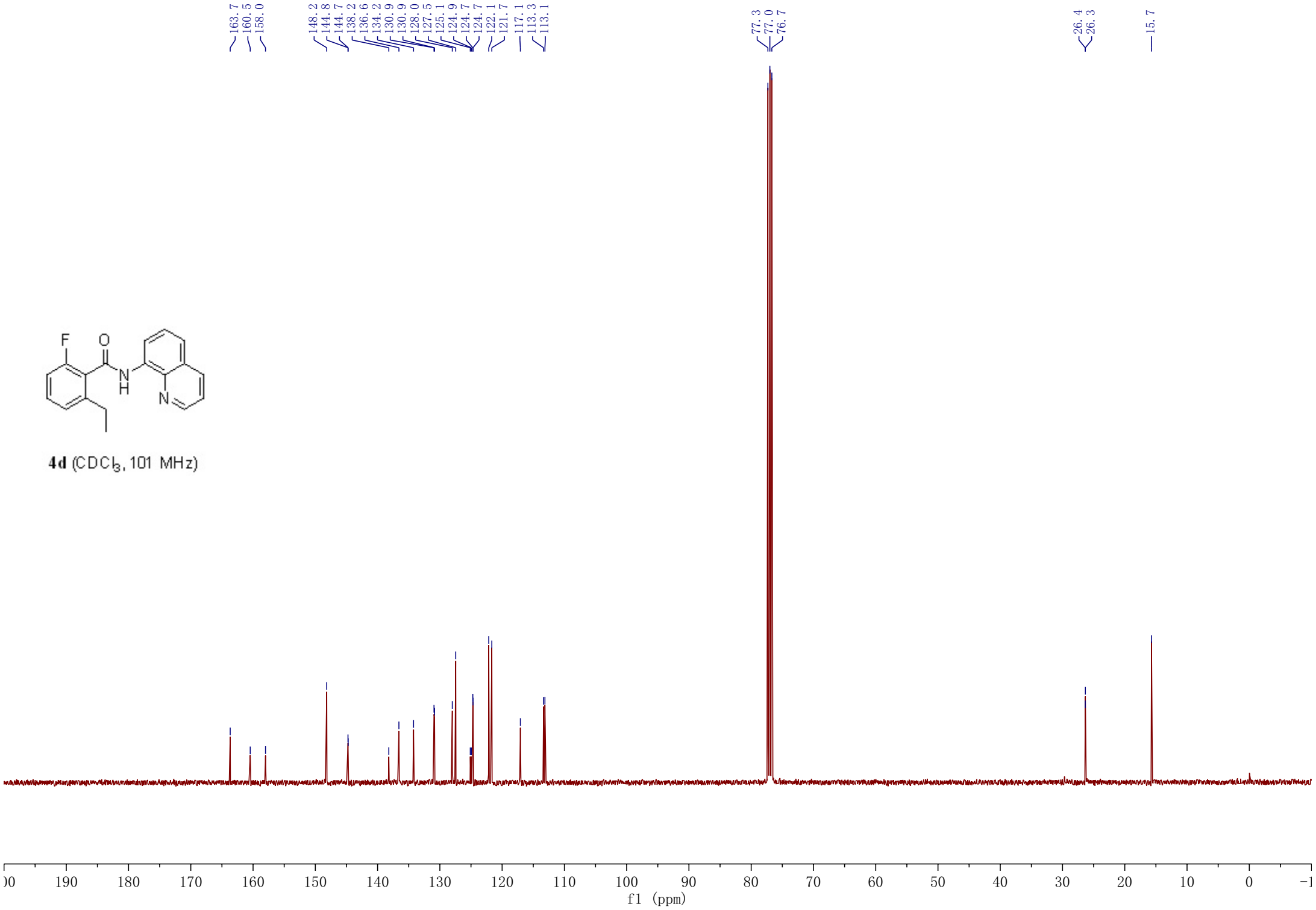

168.9
148.2
140.6
138.3
137.0
136.4
134.4
129.3
128.0
127.4
126.1
121.9
121.6
116.8
77.3
77.0
76.7
26.5
15.9
O
N
H
N
4b (CDCl3, 101 MHz)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

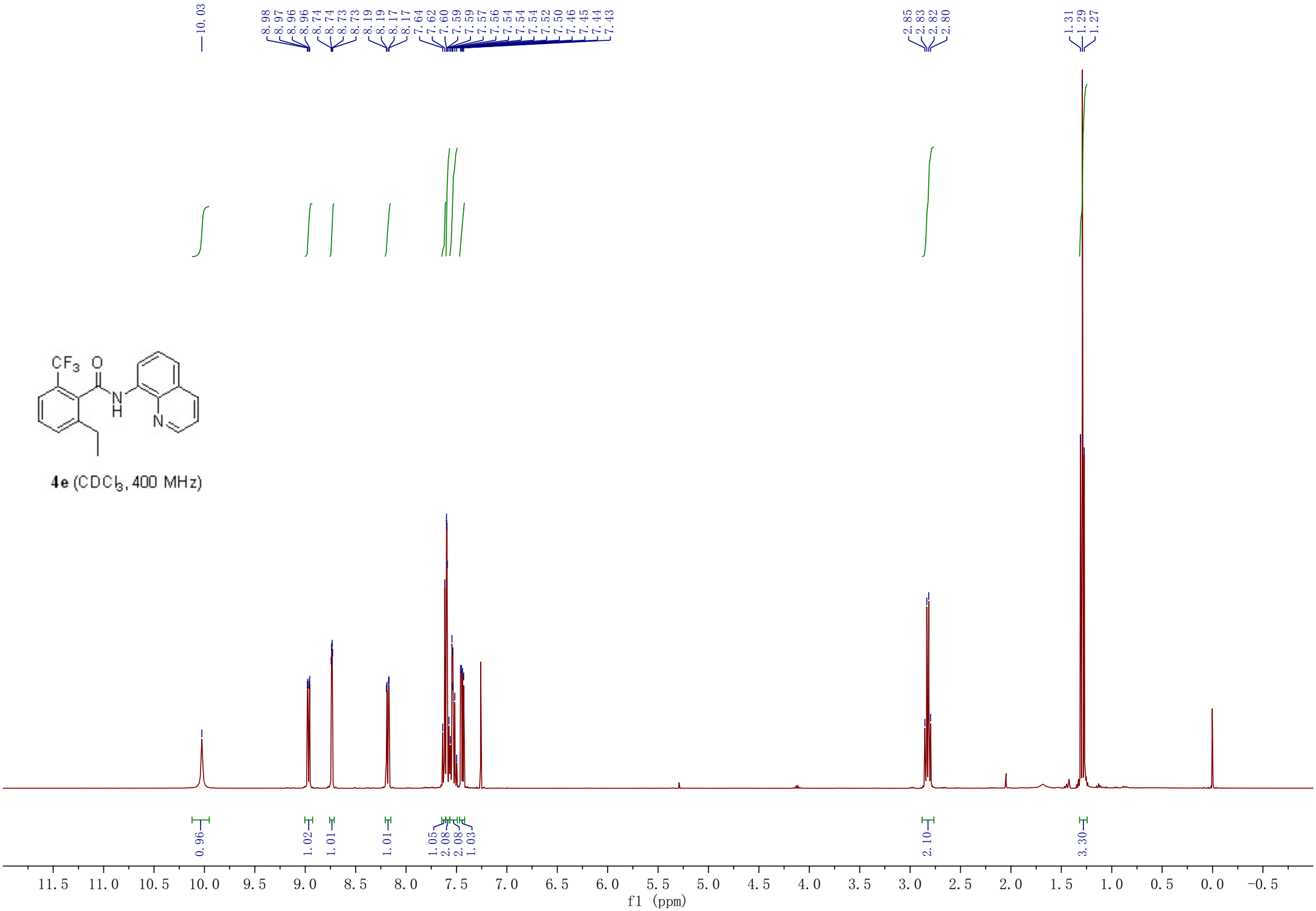

10.12
9.04
9.03
9.02
9.02
8.76
8.76
8.76
8.75
8.75
8.22
8.22
8.21
8.20
8.19
7.64
7.62
7.62
7.60
7.57
7.57
7.57
7.55
7.55
7.55
7.48
7.47
7.46
7.46
7.44
7.37
7.35
7.35
7.33
7.26
6.95
6.93
6.86
6.86
6.84
6.83
3.83
2.80
2.78
2.76
2.74
1.28
1.26
1.25
O
O
N
H
N
4c (CDCl3, 400 MHz)
0.92
1.00
1.02
1.00
1.02
1.01
1.02
1.02
1.01
1.01
3.03
2.07
3.36
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1
f1 (ppm)

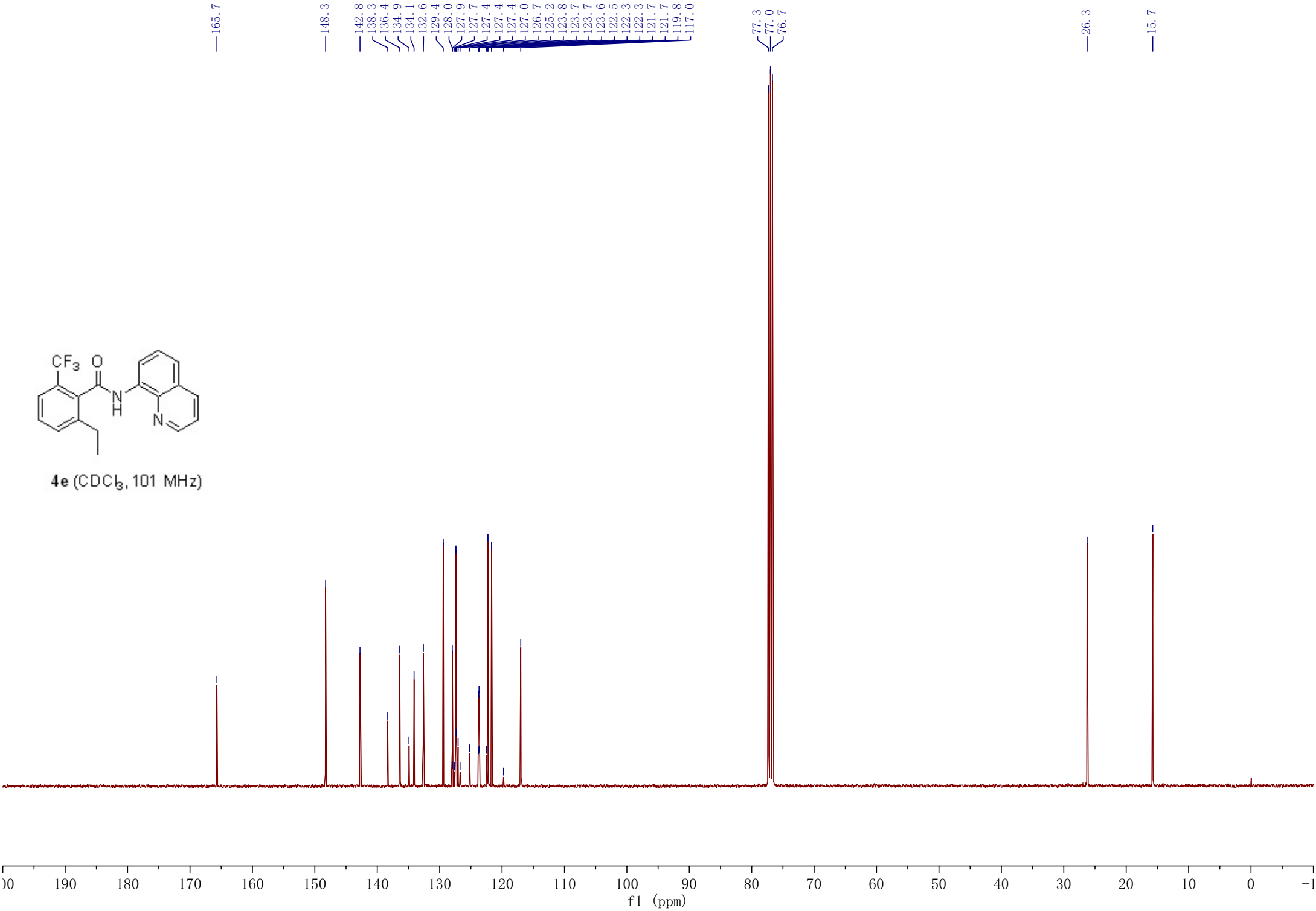


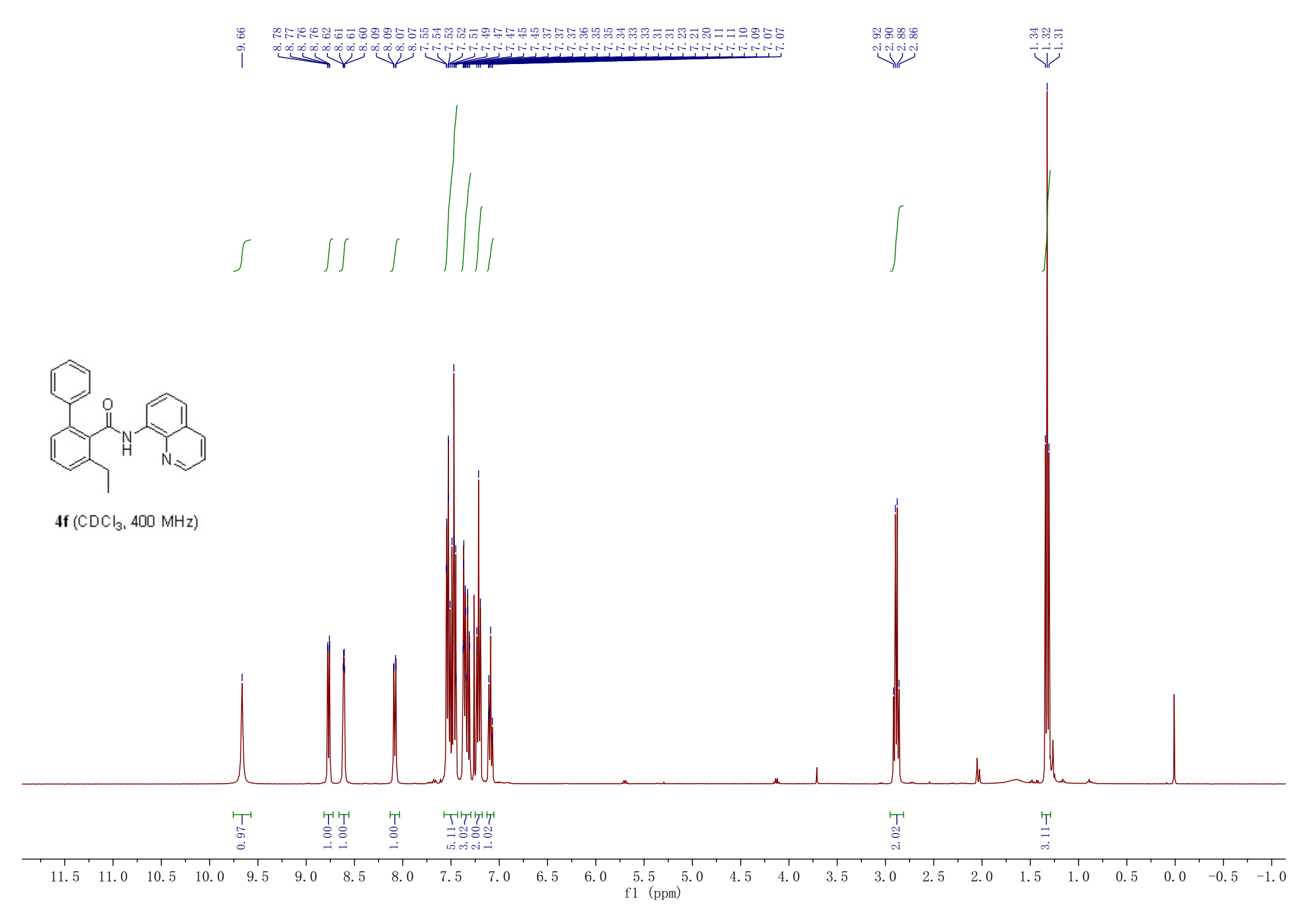
4c ($CDCl_3$, 101 MHz)

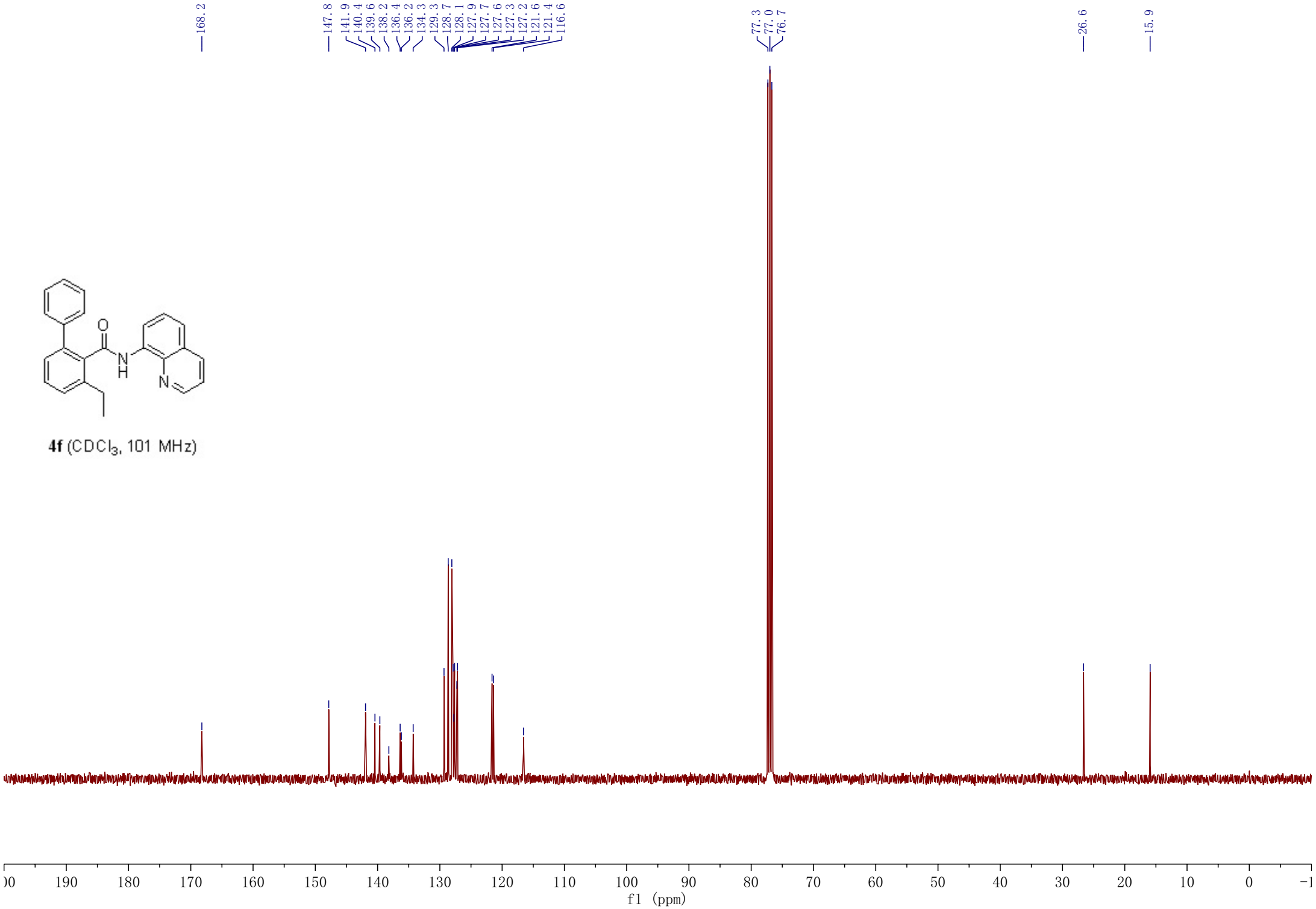

10.16
8.99
8.99
8.97
8.97
8.78
8.77
8.77
8.76
8.21
8.21
8.19
8.19
7.64
7.62
7.60
7.59
7.59
7.57
7.57
7.48
7.47
7.46
7.45
7.40
7.39
7.38
7.37
7.36
7.35
7.26
7.14
7.12
7.06
7.05
7.03
7.01
7.01
2.88
2.86
2.84
2.82
1.31
1.29
1.27
F
O
N
H
N
4d (CDCl3, 400 MHz)
0.90
0.99
0.99
0.99
2.00
0.99
0.98
0.99
0.94
2.00
3.09
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


163.7
160.5
158.0
148.2
144.8
144.7
138.2
136.6
134.2
130.9
130.9
128.0
127.5
125.1
124.9
124.7
124.7
122.1
121.7
117.1
113.3
113.1
77.3
77.0
76.7
26.4
26.3
15.7
F
O
N
H
N
4d (CDCl3, 101 MHz)
f1 (ppm)

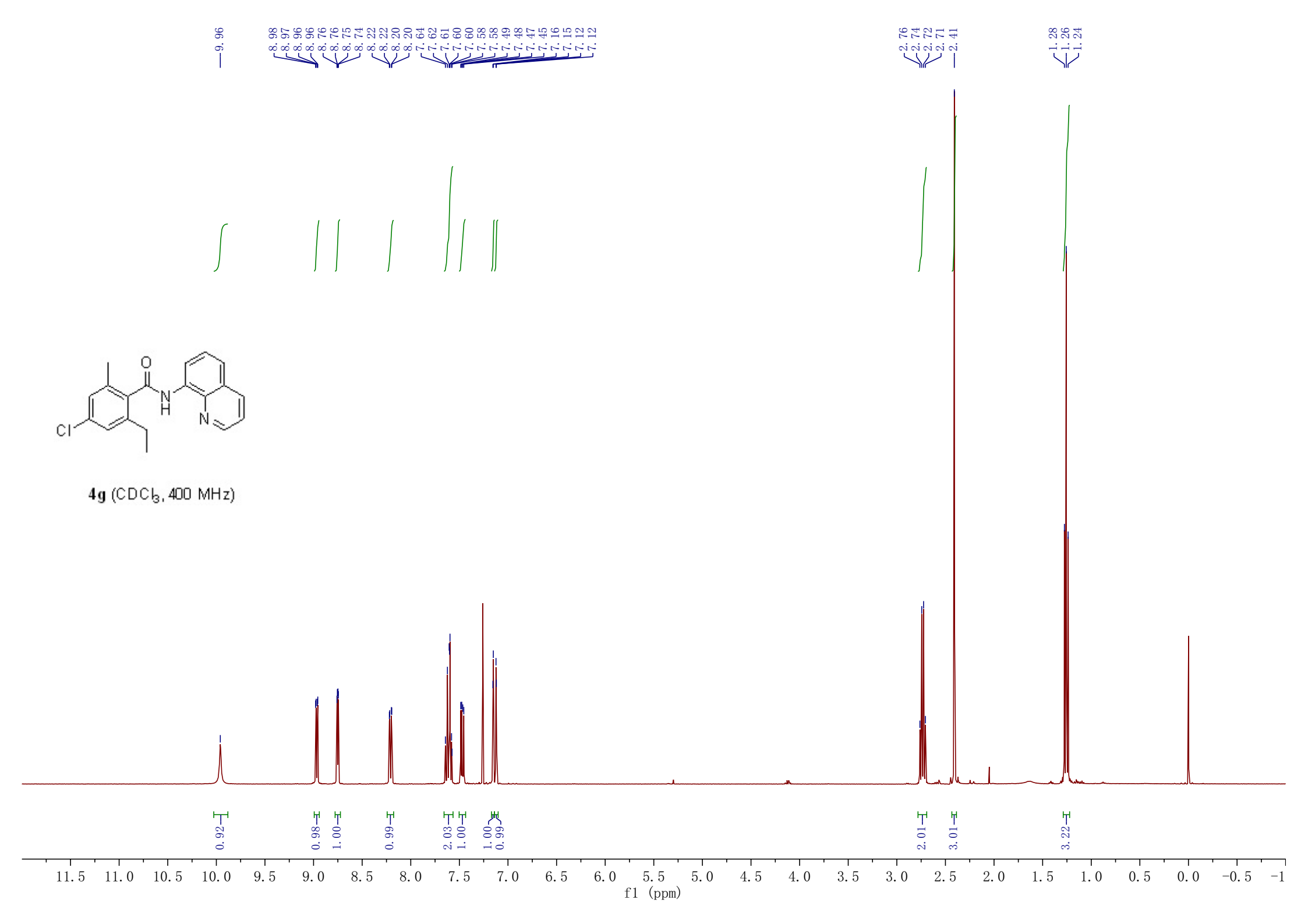

10.03
8.98
8.97
8.96
8.96
8.74
8.74
8.73
8.73
8.19
8.19
8.17
8.17
7.64
7.62
7.60
7.59
7.59
7.57
7.56
7.54
7.54
7.54
7.52
7.50
7.46
7.45
7.44
7.43
2.85
2.83
2.82
2.80
1.31
1.29
1.27
CF3
O
N
H
N
4e (CDCl3, 400 MHz)
0.96
1.02
1.01
1.01
1.05
2.08
2.08
1.03
2.10
3.30
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

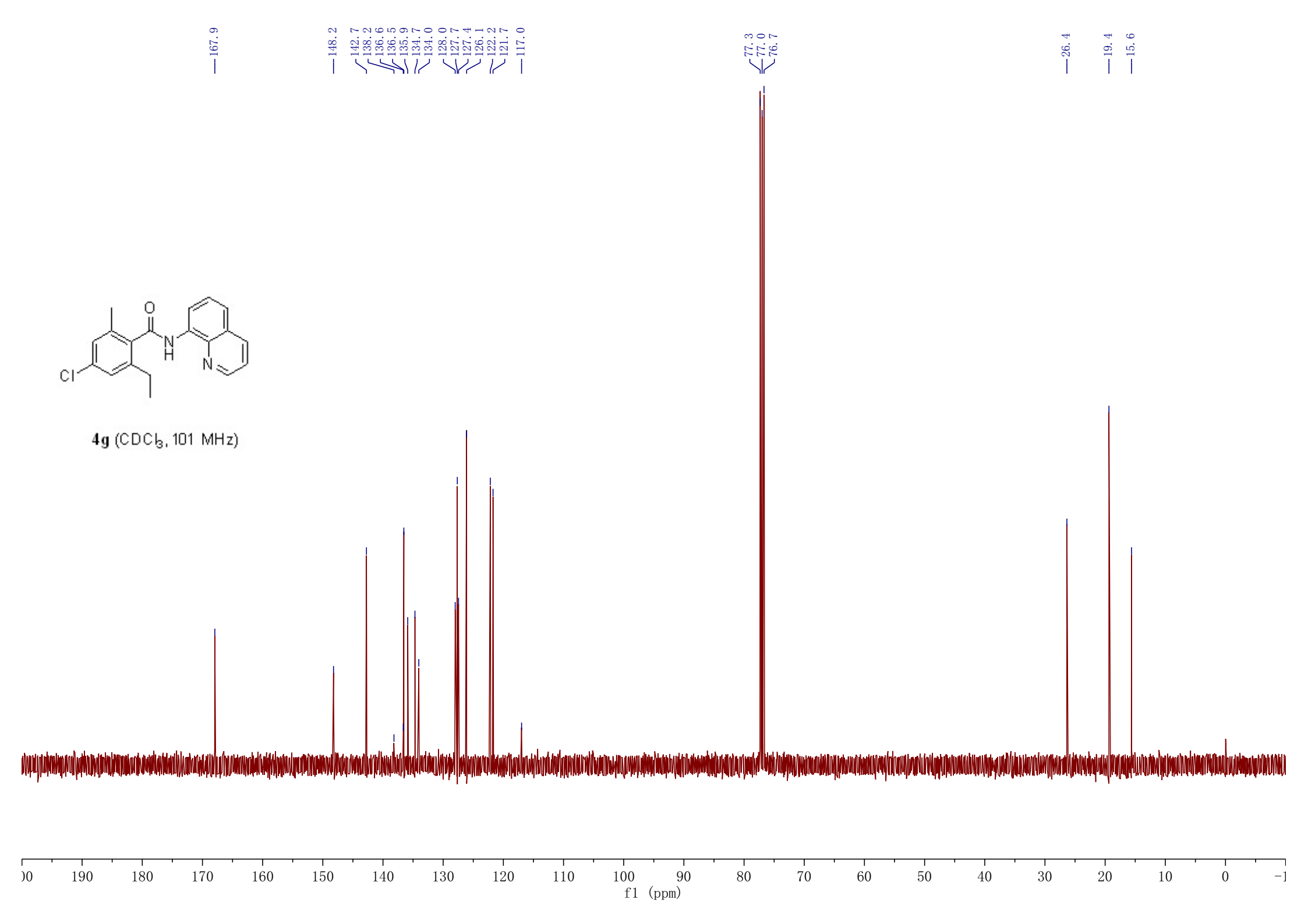

165.7
148.3
142.8
138.3
136.4
134.9
134.1
132.6
129.4
128.0
127.9
127.7
127.4
127.4
127.4
127.0
126.7
125.2
123.8
123.7
123.7
123.6
122.5
122.3
122.3
121.7
121.7
119.8
117.0
77.3
77.0
76.7
26.3
15.7
CF3
O
N
H
N
4e (CDCl3, 101 MHz)
f1 (ppm)

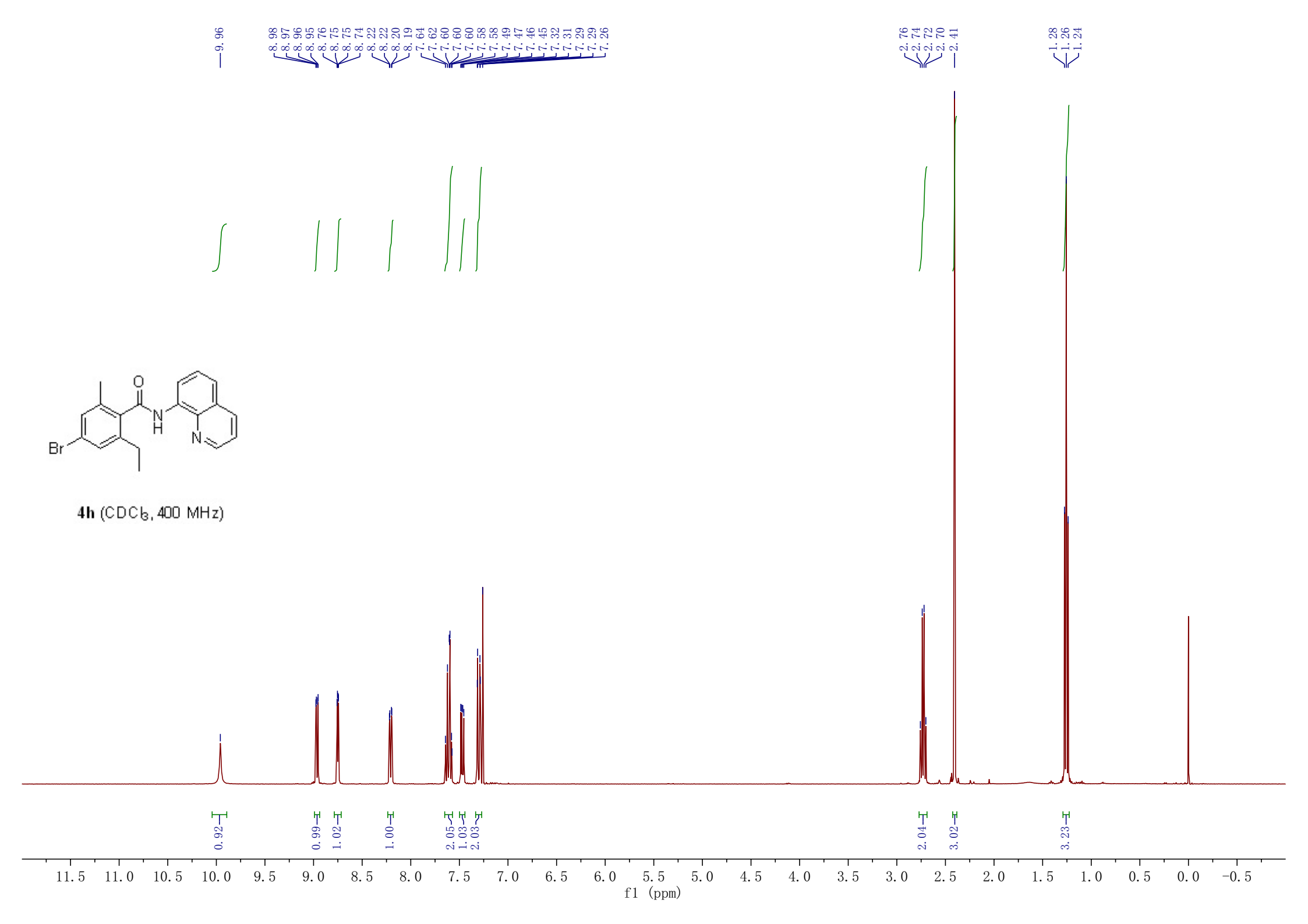

9.66
8.78
8.77
8.76
8.76
8.62
8.61
8.61
8.60
8.09
8.09
8.07
8.07
7.55
7.54
7.53
7.52
7.51
7.49
7.47
7.47
7.45
7.45
7.37
7.37
7.37
7.36
7.35
7.35
7.34
7.33
7.33
7.31
7.31
7.23
7.21
7.20
7.11
7.11
7.10
7.09
7.07
7.07
2.92
2.90
2.88
2.86
1.34
1.32
1.31
O
N
H
N
4f (CDCl3, 400 MHz)
0.97
1.00
1.00
1.00
5.11
3.02
2.00
1.02
2.02
3.11
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)

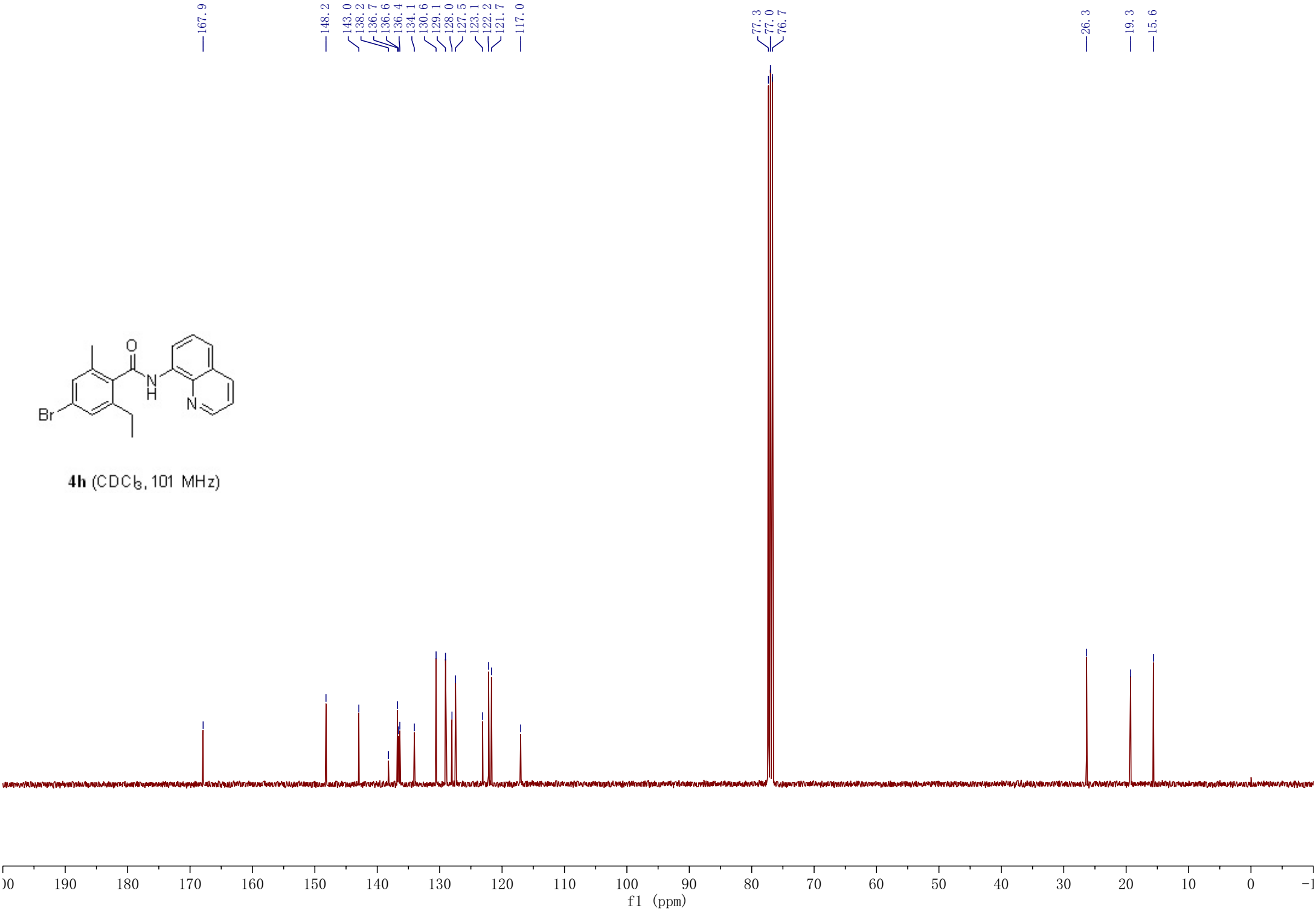


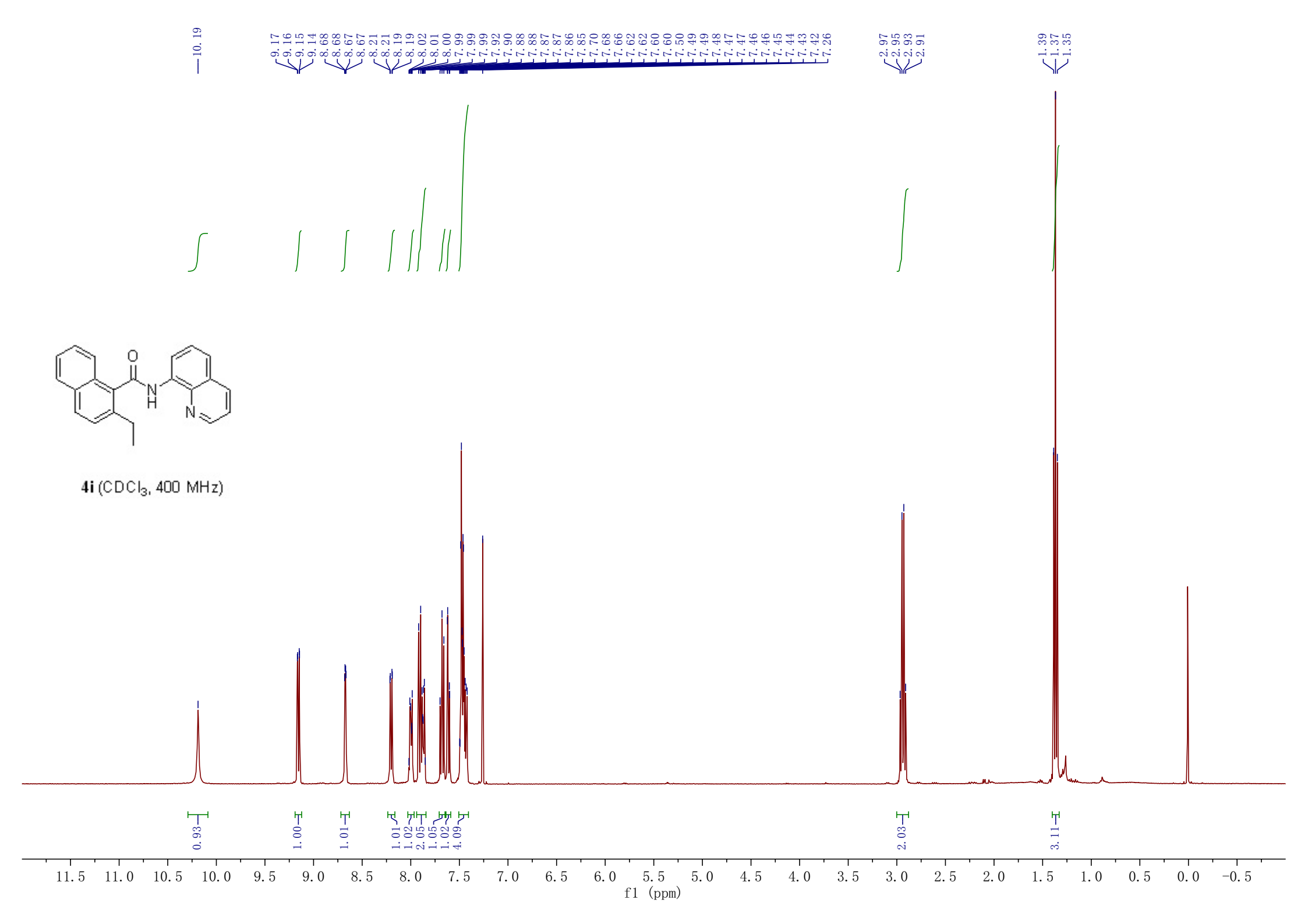
4f ($CDCl_3$, 101 MHz)

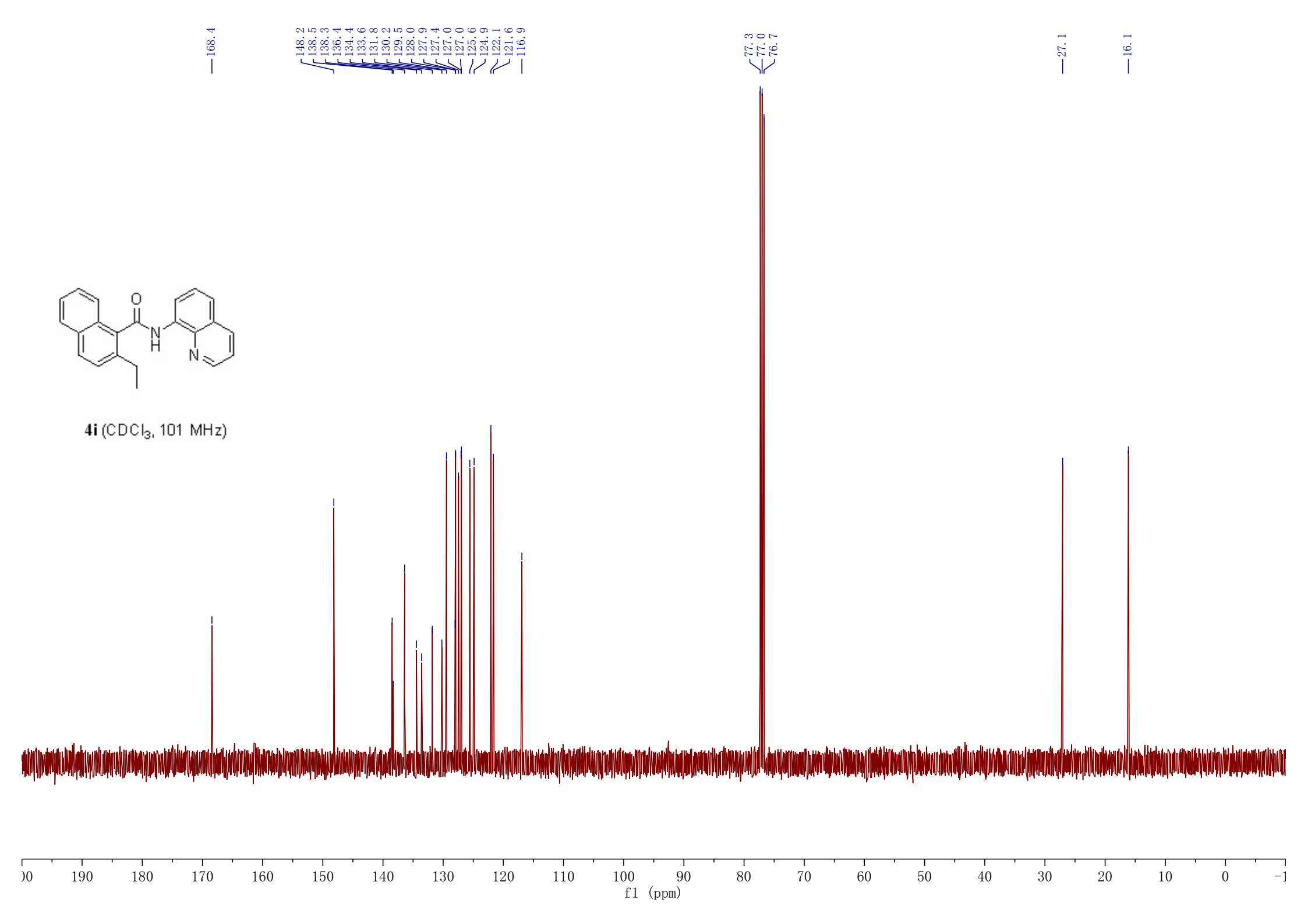

9.96
8.98
8.97
8.96
8.96
8.76
8.76
8.75
8.74
8.22
8.22
8.20
8.20
7.64
7.62
7.61
7.60
7.60
7.58
7.58
7.49
7.48
7.47
7.45
7.16
7.15
7.12
7.12
2.76
2.74
2.72
2.71
2.41
1.28
1.26
1.24
O
N
H
N
Cl
4g (CDCl3, 400 MHz)
0.92
0.98
1.00
0.99
2.03
1.00
1.00
0.99
2.01
3.01
3.22
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

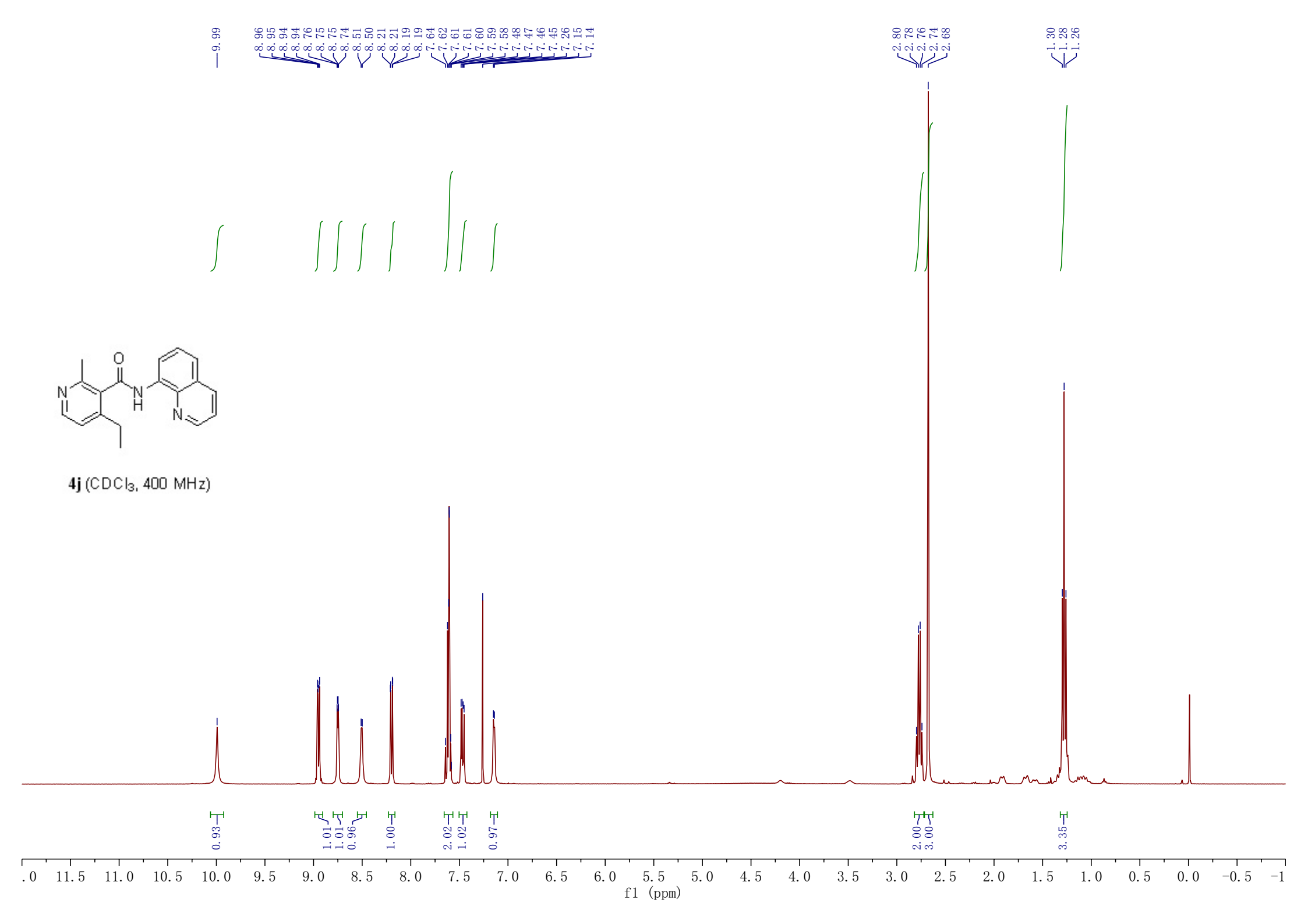

167.9
148.2
142.7
138.2
136.6
136.5
135.9
134.7
134.0
128.0
127.7
127.4
126.1
122.2
121.7
117.0
77.3
77.0
76.7
26.4
19.4
15.6
O
N
H
N
Cl
4g (CDCl3, 101 MHz)
f1 (ppm)

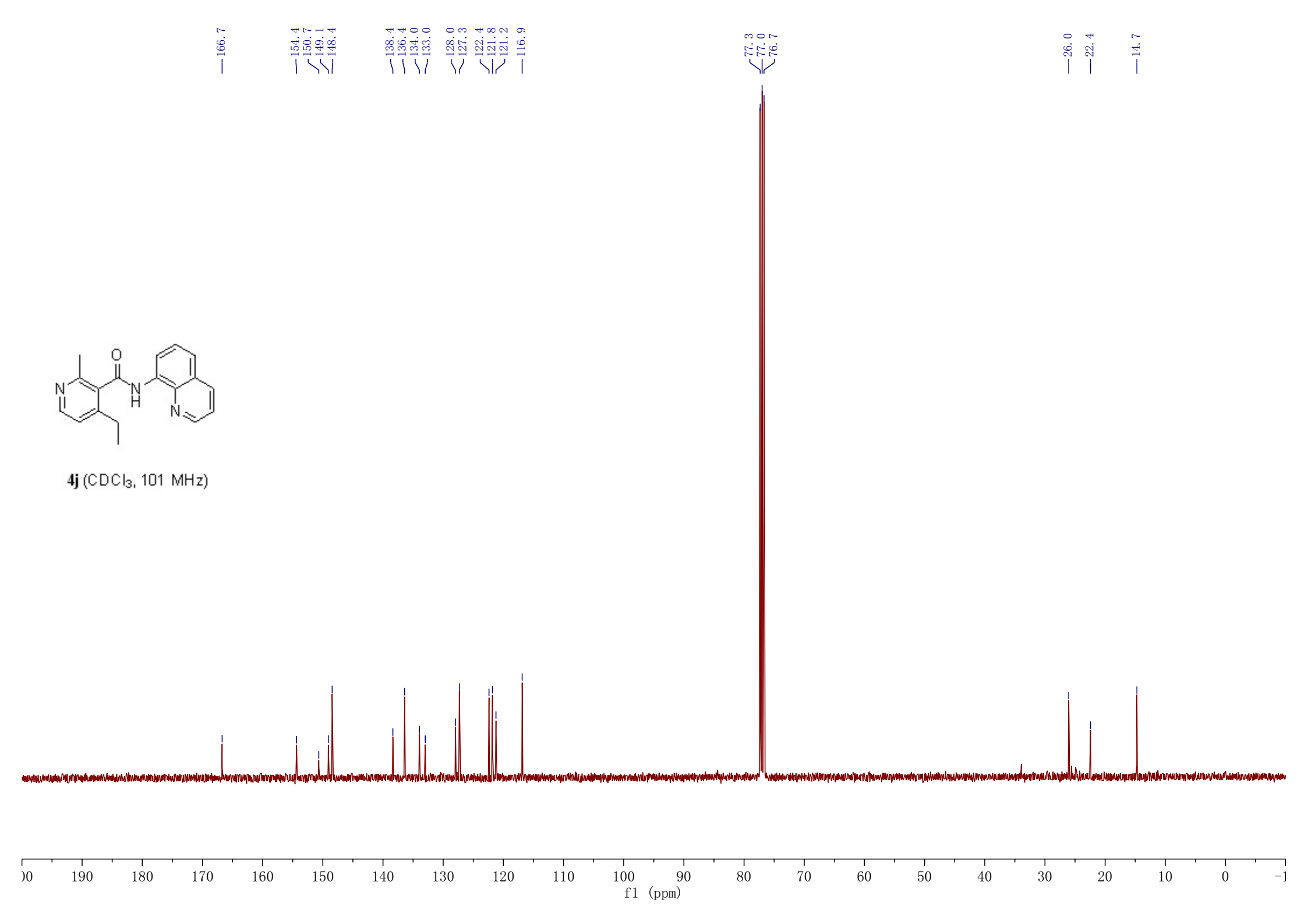

9.96
8.98
8.97
8.96
8.95
8.76
8.75
8.75
8.74
8.22
8.22
8.20
8.19
7.64
7.62
7.60
7.60
7.60
7.58
7.49
7.47
7.46
7.45
7.32
7.31
7.29
7.29
7.26
2.76
2.74
2.72
2.70
2.41
1.28
1.26
1.24
O
N
H
N
Br
4h (CDCl3, 400 MHz)
0.92
0.99
1.02
1.00
2.05
1.03
2.03
2.04
3.02
3.23
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

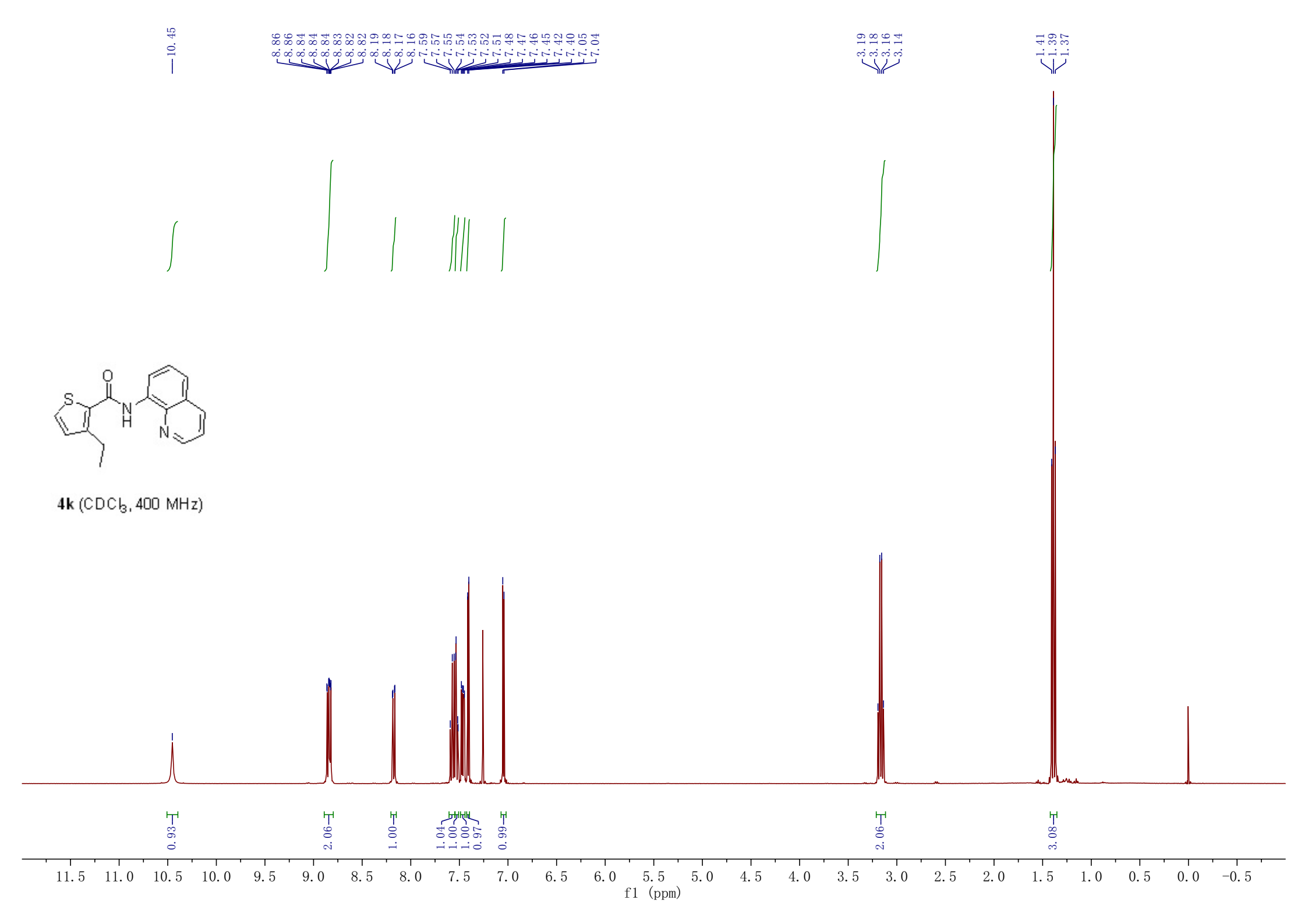

167.9
148.2
143.0
138.2
136.7
136.6
136.4
134.1
130.6
129.1
128.0
127.5
123.1
122.2
121.7
117.0
77.3
77.0
76.7
26.3
19.3
15.6
O
N
H
N
Br
4h (CDCl3, 101 MHz)
f1 (ppm)

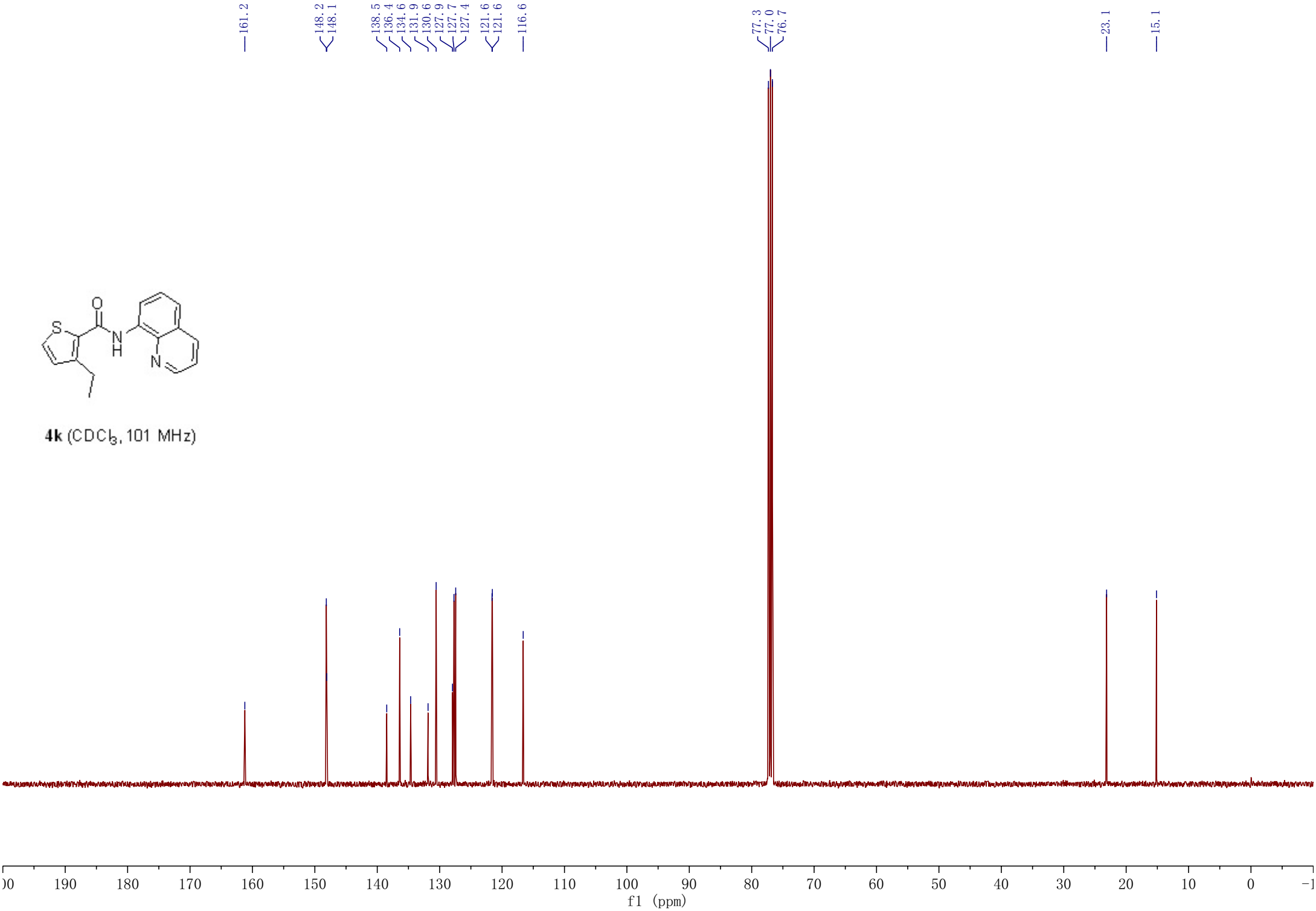

10.19
9.17
9.16
9.15
9.14
8.68
8.68
8.67
8.67
8.21
8.21
8.19
8.19
8.02
8.01
8.00
7.99
7.99
7.99
7.92
7.90
7.88
7.88
7.87
7.87
7.86
7.85
7.70
7.68
7.66
7.62
7.62
7.60
7.60
7.50
7.49
7.49
7.48
7.47
7.47
7.46
7.46
7.45
7.44
7.43
7.42
7.26
2.97
2.95
2.93
2.91
1.39
1.37
1.35
O
N
H
N
4i (CDCl3, 400 MHz)
0.93
1.00
1.01
1.01
1.02
2.05
1.05
1.02
4.09
2.03
3.11
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

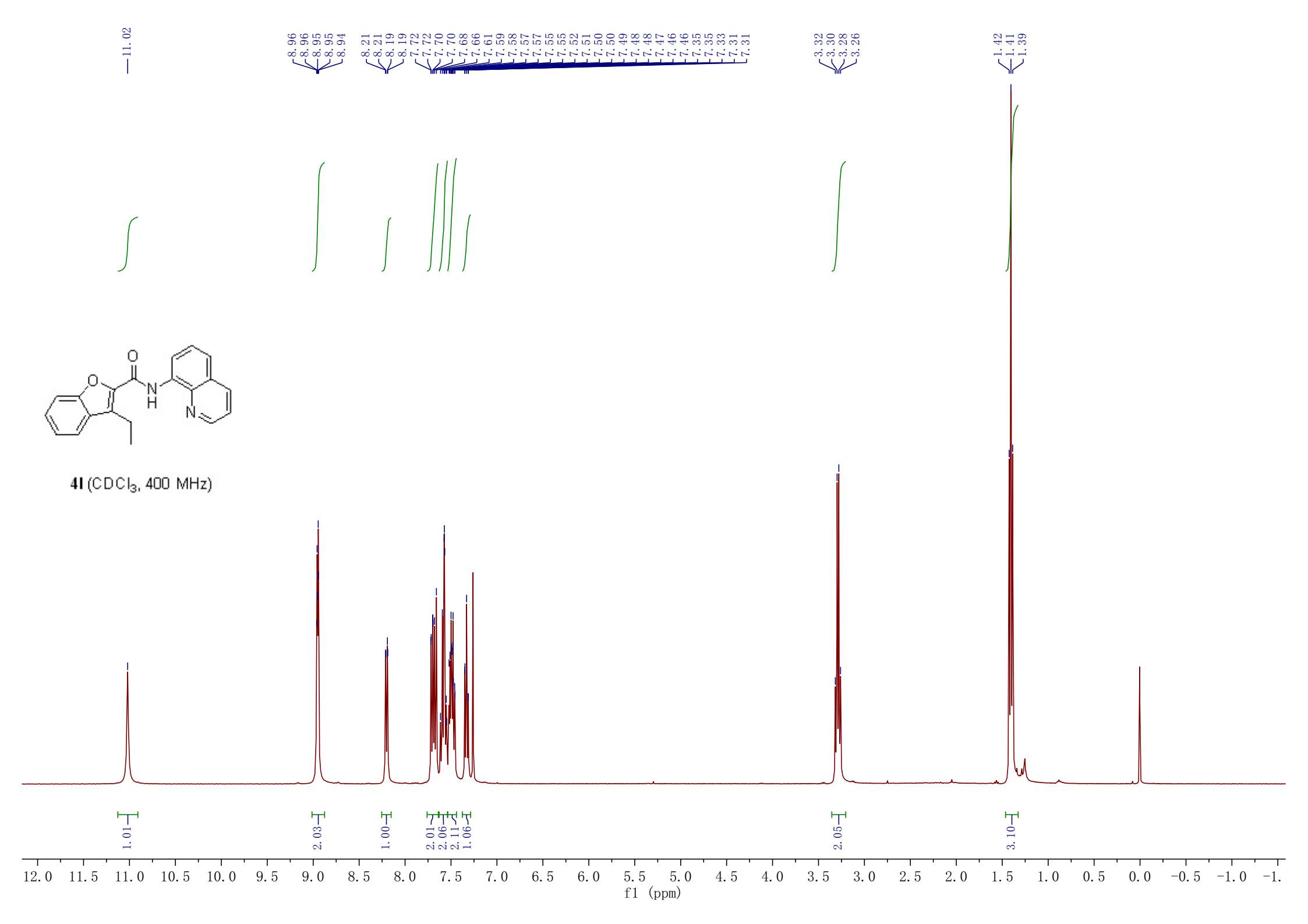

168.4
148.2
138.5
138.3
136.4
134.4
133.6
131.8
130.2
129.5
128.0
127.9
127.4
127.0
127.0
125.6
124.9
122.1
121.6
116.9
77.3
77.0
76.7
27.1
16.1
O
N
H
N
4i (CDCl3, 101 MHz)
f1 (ppm)

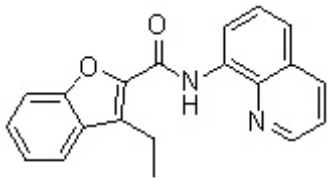

9.99
8.96
8.95
8.94
8.94
8.76
8.75
8.75
8.74
8.51
8.50
8.21
8.19
8.19
7.64
7.62
7.61
7.61
7.60
7.59
7.58
7.48
7.47
7.46
7.45
7.26
7.15
7.14
2.80
2.78
2.76
2.74
2.68
1.30
1.28
1.26
O
N
H
N
N
4j (CDCl3, 400 MHz)
0.93
1.01
1.01
0.96
1.00
2.02
1.02
0.97
2.00
3.00
3.35
f1 (ppm)


166.7
154.4
150.7
149.1
148.4
138.4
136.4
134.0
133.0
128.0
127.3
122.4
121.8
121.2
116.9
77.3
77.0
76.7
26.0
22.4
14.7
O
N
H
N
4j (CDCl3, 101 MHz)
f1 (ppm)


10.45
8.86
8.86
8.84
8.84
8.84
8.83
8.82
8.82
8.19
8.18
8.17
8.16
7.59
7.57
7.55
7.54
7.53
7.52
7.51
7.48
7.47
7.46
7.45
7.42
7.40
7.05
7.04
3.19
3.18
3.16
3.14
1.41
1.39
1.37
O
S
N
H
N
4k (CDCl3, 400 MHz)
0.93
2.06
1.00
1.04
1.00
1.00
0.97
0.99
2.06
3.08
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


161.2
148.2
148.1
138.5
136.4
134.6
131.9
130.6
127.9
127.7
127.4
121.6
121.6
116.6
77.3
77.0
76.7
23.1
15.1
O
S
N
H
N
4k (CDCl3, 101 MHz)
f1 (ppm)


11.02
8.96
8.96
8.95
8.95
8.94
8.21
8.21
8.19
8.19
7.72
7.70
7.70
7.68
7.66
7.61
7.59
7.58
7.57
7.57
7.55
7.55
7.52
7.51
7.50
7.50
7.49
7.48
7.48
7.47
7.46
7.46
7.35
7.35
7.33
7.31
7.31
3.32
3.30
3.28
3.26
1.42
1.41
1.39
O
O
N
H
N
4l (CDCl3, 400 MHz)
1.01
2.03
1.00
2.01
2.06
2.11
1.06
2.05
3.10
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.
f1 (ppm)



4l ($CDCl_3$, 101 MHz)

158.3
153.6
148.4
142.4
138.6
136.6
134.2
129.8
129.0
128.1
127.4
127.2
123.1
122.0
121.7
121.0
117.0
112.2
77.3
77.0
76.7
17.4
14.4

f1 (ppm)