

Supporting Information

Synthesis of C₃-alkylated benzofurans via palladium-catalyzed regiocontrolled hydro-furanization of unactivated alkenes

Chi-Fan Zhu,^a Cong-Hui Gao,^b Wen-Juan Hao,^b Yi-Long Zhu,^{*a} Shu-Jiang Tu,^b De-Cai Wang,^{*a} Bo Jiang^{*b}

^aSchool of Pharmaceutical, Nanjing Tech University, Nanjing, 210009, Jiangsu, P. R. China. E-mail: dcwang@njtech.edu.cn, zhuyilong_88@njtech.edu.cn

^bSchool of Chemistry & Materials Science, Jiangsu Key Laboratory of Green Synthetic Chemistry for Functional Materials, Jiangsu Normal University, Xuzhou 221116, P. R. China. E-mail: jiangchem@jnsu.edu.cn (BJ) Fax: +8651683500065; Tel: +8651683500065

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General Information

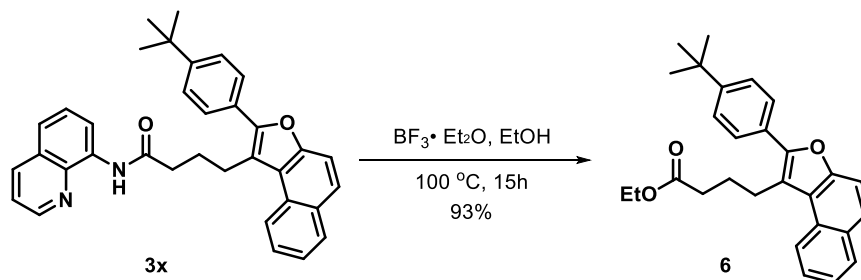
^1H NMR (^{13}C NMR) spectra were measured on a Bruker DPX 400 MHz spectrometer in CDCl_3 ($\text{DMSO-}d_6$) with chemical shift (δ) given in ppm relative to TMS as internal standard [(s = singlet, d = doublet, t = triplet, brs = broad singlet, m = multiplet), coupling constant (Hz)]. HRMS (ESI) was determined by using microTOF-QII HRMS/MS instrument (BRUKER). X-Ray crystallographic analysis was performed with a Siemens SMART CCD and a Siemens P4 diffractometer.

General procedure for the synthesis of compounds 3

Example for the synthesis of **3**:

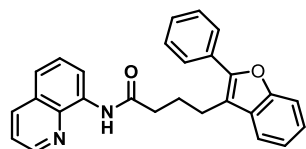
In a flame-dried Schlenk tube along with a stir bar under argon conditions, alkene (**1a**, 0.2 mmol, 42.4 mg), 2-(phenylethynyl)phenol (**2a**, 0.24 mmol, 46.6 mg) or 1-(phenylethynyl)naphthalen-2-ol (**4a**, 0.24 mmol, 58.6 mg) and $\text{Pd}(\text{OAc})_2$ (4.48 mg, 0.02 mmol) was added into the tube and then dry DCE (1 mL) was injected into the reaction system. Subsequently, the tube was stirred at room temperature. After stirring for 12 hours, the reaction mixture was concentrated by vacuum distillation and was purified by flash column chromatography (ethyl acetate/petroleum ether = 1:10 (V/V)) to afford the desired pure product **3a**.

The procedure for the synthesis of compound 6:



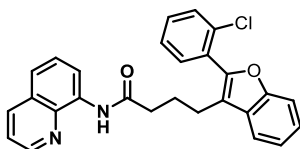
To a dry tube was added a mixture of **3x** (51.2 mg, 0.10 mmol, 1.0 equiv), anhydrous EtOH (1.0 mL), followed by the addition of $\text{BF}_3 \cdot \text{Et}_2\text{O}$ (75 μL , 0.60 mmol, 6.0 equiv) at ambient temperature. The mixture was degassed three times with argon, and then allowed to stir at 100 °C. After 15 h, the reaction was cooled to ambient temperature. The mixture was diluted with dichloromethane and then quenched by Et_3N (0.14 mL, 1.0 mmol, 10 equiv). Rotary evaporation of the organic solvent and further purification by flash column chromatography (PE/EA = 20:1) afforded the desired products **6** in 93% (42.9 mg, 0.09 mmol) yield as colourless oil. ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 8.39 (d, $J = 8.4$ Hz, 1H), 7.97 (d, $J = 8.4$ Hz, 1H), 7.76–7.70 (m, 3H), 7.68–7.59 (m, 2H), 7.55–7.46 (m, 3H), 4.17–4.12 (m, 2H), 3.33–3.25 (m, 2H), 2.59–2.48 (m, 2H), 2.31–2.26 (m, 2H), 1.39 (s, 9H), 1.26–1.24 (m, 3H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 173.2, 152.0, 151.4, 151.3, 130.9, 129.3, 128.6, 128.4, 127.1, 126.4, 125.7, 125.6, 124.0, 123.1, 117.1, 112.4, 60.4, 34.8, 34.1, 31.3, 30.4, 29.7, 25.2, 22.7, 14.3.

4-(2-phenylbenzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3a)



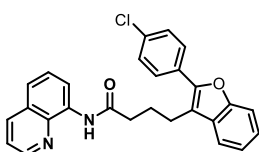
Yellowish oil; 71.5 mg, 88% yield; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 9.78 (s, 1H), 8.85–8.76 (m, 2H), 8.18–8.12 (m, 2H), 7.81 (d, $J = 7.6$ Hz, 2H), 7.67 (d, $J = 7.6$ Hz, 1H), 7.63–7.53 (m, 2H), 7.52–7.42 (m, 4H), 7.39 (d, $J = 8.0$ Hz, 1H), 7.30 (m, 1H), 3.27–2.97 (m, 2H), 2.85–2.53 (m, 2H), 2.43–2.08 (m, 2H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 171.3, 154.0, 151.1, 148.1, 138.3, 136.5, 134.4, 133.7, 131.2, 130.5, 130.2, 128.7, 128.5, 128.1, 128.0, 127.5, 126.9, 124.4, 122.5, 121.6, 119.8, 116.7, 115.4, 111.1, 37.5, 25.3, 23.7. IR (KBr, ν , cm^{-1}): 2341, 1772, 1558, 1207, 1108, 959, 833, 750; HRMS (ESI -TOF) m/z calcd for $\text{C}_{27}\text{H}_{21}\text{N}_2\text{O}_2$ [$\text{M}-\text{H}$] $^-$ 405.1603, found 5405.1610;

4-(2-(2-chlorophenyl)benzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3b)



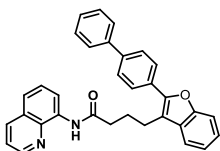
Yellowish oil; 63.4 mg, 72% yield; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.70 (s, 1H), 8.78–8.80 (m, 1H), 8.70–8.72 (m, 1H), 8.15–8.18 (m, 1H), 7.75–7.69 (m, 1H), 7.55–7.48 (m, 4H), 7.48–7.40 (m, 2H), 7.35–7.26 (m, 3H), 7.23–7.25 (m, 1H), 2.90–2.82 (m, 2H), 2.53–2.57 (m, 2H), 2.24–2.16 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.2, 154.7, 149.7, 148.1, 134.6, 132.4, 130.5, 130.1, 130.1, 129.2, 128.0, 127.5, 126.7, 126.7, 126.7, 124.6, 122.6, 121.6, 121.4, 120.2, 117.6, 111.4, 111.4, 37.3, 25.0, 23.6. IR (KBr, ν, cm⁻¹): 2342, 1765, 1563, 1211, 1101, 949, 836, 757; HRMS (ESI -TOF) m/z calcd for C₂₇H₂₀ClN₂O₂ [M-H]⁻ 439.1213, found 439.1209;

4-(2-(4-chlorophenyl)benzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3c)



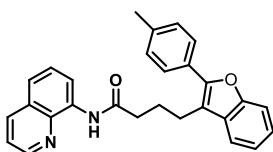
Yellowish oil; 78.3 mg, 89% yield; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.80 (s, 1H), 8.83–8.76 (m, 2H), 8.21 (d, *J* = 8.0 Hz, 1H), 7.77–7.72 (m, 2H), 7.66 (d, *J* = 7.6 Hz, 1H), 7.53–7.60 (m, 2H), 7.47–7.50 (m, 2H), 7.34–7.28 (m, 3H), 7.23 (d, *J* = 7.2 Hz, 1H), 3.11–3.06 (m, 2H), 2.68–2.71 (m, 2H), 2.32–2.24 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.2, 154.7, 149.7, 148.1, 134.6, 132.4, 130.5, 130.1, 130.1, 129.2, 128.0, 127.5, 126.7, 126.7, 126.7, 124.6, 122.6, 121.6, 121.4, 120.2, 117.6, 111.4, 111.4, 37.3, 25.0, 23.6. IR (KBr, ν, cm⁻¹): 2366, 1753, 1591, 1233, 1023, 966, 811, 763; HRMS (ESI -TOF) m/z calcd for C₂₇H₂₀ClN₂O₂ [M-H]⁻ 439.1213, found 439.1210;

4-(2-([1,1'-biphenyl]-4-yl)benzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3d)



Yellowish oil; 82.9 mg, 86% yield; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.78 (s, 1H), 8.82 (d, *J* = 7.2 Hz, 1H), 8.76–8.77 (m, 1H), 8.12–8.14 (m, 1H), 7.89 (d, *J* = 8.4 Hz, 2H), 7.68 (d, *J* = 7.2 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 2H), 7.53–7.57 (m, 3H), 7.52–7.49 (m, 1H), 7.48–7.36 (m, 5H), 7.32–7.27 (m, 1H), 7.24 (s, 1H), 3.20–3.12 (m, 2H), 2.70–2.73 (m, 2H), 2.39–2.29 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.2, 154.0, 150.9, 148.0, 140.6, 140.4, 138.2, 136.5, 134.4, 130.5, 130.1, 128.8, 128.0, 127.5, 127.3, 127.2, 127.0, 124.5, 122.6, 121.6, 121.5, 119.7, 116.7, 115.6, 111.1, 37.4, 25.3, 23.7. IR (KBr, ν, cm⁻¹): 2310, 1769, 1539, 1194, 1133, 926, 822, 737; HRMS (ESI -TOF) m/z calcd for C₃₃H₂₅N₂O₂ [M-H]⁻ 481.1916, found 481.1911;

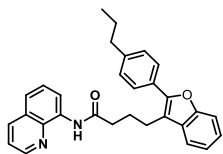
N-(quinolin-8-yl)-4-(2-(p-tolyl)benzofuran-3-yl)butanamide(3e)



Yellowish oil; 73.9 mg, 88% yield; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.81 (s, 1H), 8.78–8.82 (m, 2H), 8.21 (d, *J* = 8.0 Hz, 1H), 7.64–7.70 (m, 3H), 7.52–7.60 (m, 2H), 7.46–7.49 (m, 2H), 7.28–7.30 (m, 1H), 7.21–7.24 (m, 1H), 7.18 (d, *J* = 8.0 Hz, 2H), 3.14–3.06 (m, 2H), 2.68–2.71 (m, 2H), 2.34–2.24 (m, 5H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.4, 154.0, 151.4, 138.2, 130.6, 129.4, 128.4, 128.2, 126.9, 124.2, 122.5, 121.6, 119.7, 114.7, 111.0, 37.4, 25.3, 23.7, 21.3. IR

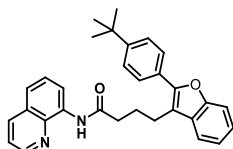
(KBr, ν , cm^{-1}): 2344, 1776, 1463, 1250, 1201, 966, 783, 693; HRMS (ESI -TOF) m/z calcd for $\text{C}_{28}\text{H}_{23}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 419.1760, found 419.1753;

4-(2-(4-propylphenyl)benzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3f)



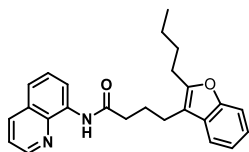
Yellowish oil; 72.6 mg, 81% yield; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): δ 9.77 (s, 1H), 8.82–8.84 (m, 1H), 8.77–8.78 (m, 1H), 8.10–8.16 (m, 1H), 7.74 (d, $J = 8.2$ Hz, 2H), 7.70–7.63 (m, 1H), 7.54–7.58 (m, 1H), 7.49–7.52 (m, 2H), 7.42–7.45 (m, 1H), 7.28–7.32 (m, 1H), 7.20–7.25 (m, 3H), 3.18–2.99 (m, 2H), 2.68–2.71 (m, 2H), 2.61–2.51 (m, 2H), 2.40–2.23 (m, 2H), 1.70–1.58 (m, 2H), 0.94–.98 (m, 3H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 171.3, 154.0, 151.5, 148.2, 143.0, 138.4, 136.5, 134.6, 130.6, 128.9, 128.7, 128.0, 127.5, 126.9, 124.2, 122.5, 121.7, 121.5, 119.7, 116.6, 114.8, 111.1, 37.9, 37.5, 25.3, 24.4, 23.8, 13.9. IR (KBr, ν , cm^{-1}): 2336, 1768, 1566, 1287, 1401, 955, 888, 766; HRMS (ESI -TOF) m/z calcd for $\text{C}_{30}\text{H}_{27}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 447.2073, found 447.2069;

4-(2-(4-(tert-butyl)phenyl)benzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3g)



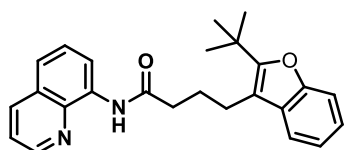
Yellowish oil; 79.5 mg, 86% yield; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 9.87 (s, 1H), 8.90 (d, $J = 7.6$ Hz, 1H), 8.83 (d, $J = 4.0$ Hz, 1H), 8.20 (d, $J = 8.4$ Hz, 1H), 7.83 (d, $J = 8.4$ Hz, 2H), 7.73 (d, $J = 7.6$ Hz, 1H), 7.64–7.54 (m, 3H), 7.51–7.47 (m, 3H), 7.38–7.30 (m, 2H), 3.20–3.14 (m, 2H), 2.79–2.74 (m, 2H), 2.43–2.35 (m, 2H), 1.39 (s, 9H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 165.3, 165.3, 148.1, 145., 145.44, 145.4, 142.3, 132.5, 130.5, 128.7, 124.7, 122.5, 122.1, 121.6, 120.8, 119.8, 118.3, 116.6, 115.8, 115.6, 113.8, 110.7, 108.9, 105.2, 31.7, 28.8, 25.4, 19.5, 17.9. IR (KBr, ν , cm^{-1}): 2336, 1766, 1586, 1209, 1114, 999, 812, 740; HRMS (ESI -TOF) m/z calcd for $\text{C}_{31}\text{H}_{29}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 461.2229, found 461.2228;

4-(2-butylbenzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3h)



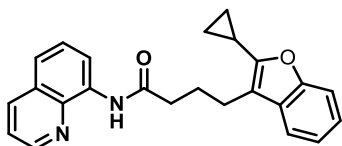
Yellowish oil; 68.7 mg, 89% yield; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 9.84 (s, 1H), 8.79–8.82 (m, 2H), 8.22–8.16 (m, 1H), 7.50–7.58 (m, 3H), 7.45–7.48 (m, 1H), 7.38–7.40 (m, 1H), 7.16–7.22 (m, 2H), 2.72–2.81 (m, 4H), 2.61–2.65 (m, 2H), 2.15–2.23 (m, 2H), 1.66–1.73 (m, 2H), 1.30–1.40 (m, 2H), 0.89 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 171.4, 155.1, 154.0, 147.9, 136.8, 134.4, 129.6, 128.1, 127.6, 123.0, 122.1, 121.6, 121.5, 119.0, 116.9, 113.3, 110.7, 37.3, 30.6, 26.2, 25.5, 23.0, 22.4, 13.8. IR (KBr, ν , cm^{-1}): 2220, 1742, 1556, 1247, 1156, 943, 823, 767; HRMS (ESI -TOF) m/z calcd for $\text{C}_{25}\text{H}_{25}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 385.1916, found 385.1909;

4-(2-(tert-butyl)benzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3i)



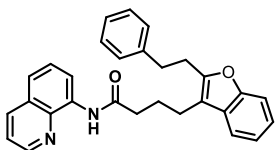
Yellow oil; 69.5 mg, 90% yield; $^1\text{H NMR}$ (400 MHz, CDCl_3) (δ , ppm): 9.83 (s, 1H), 8.85–8.78 (m, 2H), 8.19–8.14 (m, 1H), 7.58–7.49 (m, 3H), 7.48–7.43 (m, 1H), 7.39 (d, $J = 7.6$ Hz, 1H), 7.24–7.15 (m, 2H), 2.99–2.91 (m, 2H), 2.73–2.66 (m, 2H), 2.24–2.13 (m, 2H), 1.47 (s, 9H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) (δ , ppm): 171.3, 160.2, 153.0, 148.2, 138.4, 136.5, 134.6, 130.9, 128.0, 127.6, 123.2, 122.0, 121.7, 121.5, 119.1, 116.6, 112.1, 110.6, 37.9, 34.6, 29.9, 26.6, 23.7. IR (KBr, v, cm^{-1}): 2451, 1745, 1543, 1223, 1145, 968, 821, 771; HRMS (ESI -TOF) m/z calcd for $\text{C}_{25}\text{H}_{25}\text{N}_2\text{O}_2$ $[\text{M-H}]^-$ 385.1916, found 385.1908;

4-(2-cyclopropylbenzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3j)



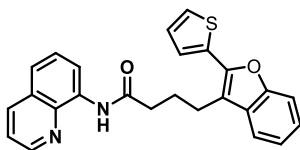
Yellow oil; 50.3 mg, 68% yield; $^1\text{H NMR}$ (400 MHz, CDCl_3) (δ , ppm): 9.79 (s, 1H), 8.83–8.76 (m, 2H), 8.19–8.14 (m, 1H), 7.56–7.43 (m, 4H), 7.35–7.28 (m, 1H), 7.22–7.04 (m, 2H), 3.04–2.81 (m, 2H), 2.71–2.53 (m, 2H), 2.32–2.12 (m, 2H), 2.09–1.99 (m, 1H), 1.13–0.99 (m, 2H), 0.97–0.82 (m, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) (δ , ppm): 171.4, 154.8, 153.3, 148.1, 138.3, 136.4, 134.5, 130.0, 128.0, 127.5, 122.8, 122.1, 121.6, 121.4, 118.5, 116.5, 113.1, 110.5, 37.1, 25.3, 22.6, 7.8, 6.9, 6.8(9). IR (KBr, v, cm^{-1}): 2332, 1772, 1558, 1247, 1128, 933, 836, 725; HRMS (ESI -TOF) m/z calcd for $\text{C}_{24}\text{H}_{21}\text{N}_2\text{O}_2$ $[\text{M-H}]^-$ 369.1603, found 369.1598;

4-(2-phenethylbenzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3k)



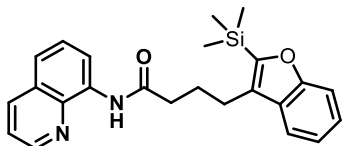
Yellowish oil; 67.7 mg, 78% yield; $^1\text{H NMR}$ (400 MHz, CDCl_3) (δ , ppm): 9.83 (s, 1H), 8.85–8.87 (m, 2H), 8.24 (d, $J = 8.4$ Hz, 1H), 7.60 (m, 3H), 7.53–7.47 (m, 2H), 7.31–7.22 (m, 4H), 7.19 (m, 3H), 3.10 (s, 4H), 2.69 (m, 2H), 2.50 (m, 2H), 2.09–2.01 (m, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) (δ , ppm): 171.4, 154.1, 153.6, 147.9, 141.1, 134.4, 129.5, 128.5, 128.4, 128.1, 127.6, 126.2, 123.3, 122.2, 121.6, 121.5, 119.3, 114.2, 110.7, 37.1, 34.6, 28.7, 25.2, 22.8. IR (KBr, v, cm^{-1}): 2344, 1782, 1558, 1265, 1172, 942, 882, 714; HRMS (ESI -TOF) m/z calcd for $\text{C}_{29}\text{H}_{25}\text{N}_2\text{O}_2$ $[\text{M-H}]^-$ 433.1916, found 433.1924;

N-(quinolin-8-yl)-4-(2-(thiophen-2-yl)benzofuran-3-yl)butanamide(3l)



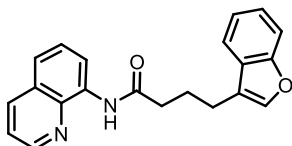
Yellow oil; 42.0 mg, 51% yield; $^1\text{H NMR}$ (400 MHz, CDCl_3) (δ , ppm): 9.80 (s, 1H), 8.77–8.82 (m, 2H), 8.18 (d, $J = 8.0$ Hz, 1H), 7.62 (d, $J = 7.6$ Hz, 1H), 7.59–7.49 (m, 3H), 7.44–7.48 (m, 2H), 7.29 (d, $J = 5.6$ Hz, 1H), 7.21–7.30 (m, 1H), 7.06–7.07 (m, 1H), 3.09–3.13 (m, 2H), 2.69–2.73 (m, 2H), 2.27–2.33 (m, 2H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3) (δ , ppm): 171.2, 153.8, 148.0, 147.0, 134.4, 133.0, 130.2, 128.0, 127.6, 127.5, 125.6, 125.2, 124.5, 122.7, 121.6, 121.5, 119.6, 114.8, 111.0, 37.4, 24.9, 23.6. IR (KBr, v, cm^{-1}): 2347, 1768, 1675, 1547 1447, 1352, 1175, 975, 833, 745; HRMS (ESI -TOF) m/z calcd for $\text{C}_{25}\text{H}_{19}\text{N}_2\text{O}_2\text{S}$ $[\text{M-H}]^-$ 411.1167, found 411.1157;

N-(quinolin-8-yl)-4-(2-(trimethylsilyl)benzofuran-3-yl)butanamide(3m)



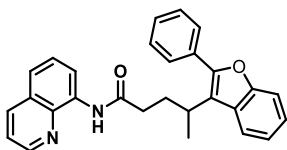
Yellowish oil; 69.9 mg, 87% yield; mp: 301-302 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.82 (s, 1H), 8.80 (m, 2H), 8.17 (d, *J* = 8.0 Hz, 1H), 7.64 (d, *J* = 8.4 Hz, 1H), 7.56–7.64 (m, 2H), 7.48–7.52 (m, 2H), 7.27–7.31 (m, 1H), 7.17–7.20 (m, 1H), 2.98–2.87 (m, 2H), 2.67–2.71 (m, 2H), 2.26–2.15 (m, 2H), 0.39 (s, 9H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.2, 154.7, 149.7, 148.1, 134.6, 132.4, 130.5, 130.1, 130.1, 129.2, 128.0, 127.5, 126.7, 126.7, 126.7, 124.6, 122.6, 121.6, 121.4, 120.2, 117.6, 111.4, 111.40, 37.3, 25.0, 23.6. IR (KBr, ν, cm⁻¹): 2323, 1752, 1558, 1264 1201, 957, 833, 776; HRMS (ESI -TOF) *m/z* calcd for C₂₄H₂₅N₂O₂Si [M-H]⁻ 401.1685, found 401.1677;

4-(benzofuran-3-yl)-N-(quinolin-8-yl)butanamide(3n)



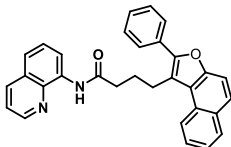
Yellowish oil; 46.9 mg, 71% yield; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.81 (s, 1H), 8.83–8.73 (m, 2H), 8.18–8.10 (m, 1H), 7.64–7.57 (m, 1H), 7.55–7.44 (m, 5H), 7.26–7.12 (m, 2H), 2.98–2.81 (m, 2H), 2.70–2.62 (m, 2H), 2.32–2.21 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.3, 158.3, 155.5, 148.2, 141.5, 138.4, 136.5, 134.5, 133.7, 130.2, 128.5, 128.1, 128.0, 127.5, 124.2, 123.3, 122.5, 122.3, 121.7, 121.5, 120.3, 119.7, 119.6, 116.6, 111.5, 110.9, 102.7, 37.3, 37.0, 27.8, 24.8, 23.6, 23.0. IR (KBr, ν, cm⁻¹): 2341, 1762, 1551, 1082, 1156, 976, 835, 765; HRMS (ESI -TOF) *m/z* calcd for C₂₁H₁₇N₂O₂ [M-H]⁻ 329.1290, found 329.1294;

4-(2-phenylbenzofuran-3-yl)-N-(quinolin-8-yl)pentanamide(3o)



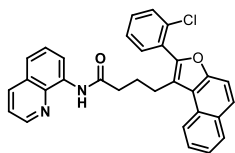
Yellowish oil; 67.2 mg, 80% yield; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.56 (s, 1H), 8.73 (d, *J* = 3.6 Hz, 1H), 8.65 (d, *J* = 6.4 Hz, 1H), 8.14–8.11 (m, 1H), 7.80 (d, *J* = 7.6 Hz, 1H), 7.63 (d, *J* = 7.2 Hz, 2H), 7.50 (m, 3H), 7.42 (m, 1H), 7.30 (m, 1H), 7.25–7.21 (m, 2H), 7.18 (m, 1H), 3.49 (m, 1H), 2.55–2.32 (m, 4H), 1.59 (d, *J* = 6.8 Hz, 3H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 165.5, 165.5, 148.8, 148.7, 145.6, 145.6, 142.2, 142.1, 130.5, 128.5, 125.1, 125.1, 124.4, 122.6, 122.6, 122.4, 122.0, 121.6, 121.6, 118.4, 118.3, 116.5, 116.5, 115.7, 115.7, 115.5, 115.5, 115.4, 113.5, 113.4, 110.7, 105.6, 105.6, 30.5, 25.7, 24.6, 15.1. IR (KBr, ν, cm⁻¹): 2342, 1757, 1545, 1212, 1156, 974, 855, 775; HRMS (ESI -TOF) *m/z* calcd for C₂₈H₂₃N₂O₂ [M-H]⁻ 419.1760, found 419.1763;

4-(2-phenylnaphtho[2,1-b]furan-1-yl)-N-(quinolin-8-yl)butanamide(3p)



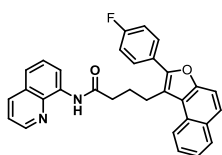
Yellowish solid; 75.7 mg, 83% yield; mp: 193-194 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.80 (s, 1H), 8.92–8.65 (m, 2H), 8.46 (d, *J* = 8.0 Hz, 1H), 8.21–8.11 (m, 1H), 7.96 (d, *J* = 8.4 Hz, 1H), 7.81 (d, *J* = 7.6 Hz, 2H), 7.76–7.64 (m, 2H), 7.63–7.53 (m, 2H), 7.53–7.43 (m, 3H), 7.4–7.32 (m, 2H), 7.28 (d, *J* = 7.6 Hz, 1H), 3.54–3.35 (m, 2H), 2.87–2.70 (m, 2H), 2.58–2.28 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.1, 152.1, 151.3, 148.1, 138.3, 136.4, 134.5, 131.2, 130.9, 129.3, 128.7, 128.0, 127.5, 127.4, 126.6, 125.9, 124.1, 123.2, 123.0, 121.6, 121.5, 117.7, 116.5, 112.4, 37.6, 25.7, 25.2. IR (KBr, ν, cm⁻¹): 2312, 1754, 1528, 1247, 1108, 955, 887, 757; HRMS (ESI -TOF) *m/z* calcd for C₃₁H₂₃N₂O₂ [M-H]⁻ 455.1760, found 455.1751;

4-(2-(2-chlorophenyl)naphtho[2,1-b]furan-1-yl)-N-(quinolin-8-yl)butanamide(3q)



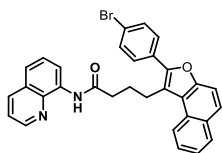
Yellowish solid; 67.6 mg, 69% yield; mp: 163-164 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.78 (s, 1H), 8.94–8.75 (m, 2H), 8.45 (d, *J* = 8.4 Hz, 1H), 8.20–8.13 (m, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.87–7.80 (m, 1H), 7.78–7.63 (m, 3H), 7.63–7.42 (m, 5H), 7.29 (d, *J* = 8.0 Hz, 1H), 7.24–7.11 (m, 1H), 3.53–3.35 (m, 2H), 2.85–2.69 (m, 2H), 2.54–2.31 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 170.9, 152.3, 149.6, 148.2, 138.3, 136.4, 134.8, 134.5, 132.9, 130.9, 123.0, 129.4, 128.6, 127.9, 127.5, 127.2, 126.8, 126.4, 125.3, 124.3, 123.2, 121.6, 121.5, 118.8, 116.6, 112.4, 37.2, 25.4, 25.1. IR (KBr, v, cm⁻¹): 2344, 1777, 1575, 1251, 1175, 943, 8368, 725; HRMS (ESI -TOF) *m/z* calcd for C₃₁H₂₂ClN₂O₂ [M-H]⁻ 489.1370, found 489.1376;

4-(2-(4-fluorophenyl)naphtho[2,1-b]furan-1-yl)-N-(quinolin-8-yl)butanamide(3r)



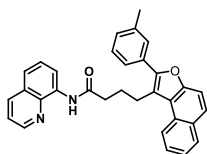
White solid; 79.6mg, 84% yield; mp: 187-188 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 10.14 (s, 1H), 8.94– 881 (m, 2H), 8.49–8.34 (m, 2H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.79–7.82 (m, 2H), 7.73 (d, *J* = 8.8 Hz, 1H), 7.60–7.66 (m, 5H), 7.46–7.50 (m, 1H), 7.07–7.11 (m, 2H), 3.42–3.34 (m, 2H), 2.89 (m, 2H), 2.43 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 150.4(⁴*J*_{CF} = 240.0 Hz), 130.9, 129.3(²*J*_{CF} = 8.3Hz), 128.6, 124.2, 122.9(³*J*_{CF} = 22.1 Hz), 122.0, 121.4, 117.5, 115.9, 115.7, 112.3, 37.3, 25.5, 25.1. IR (KBr, v, cm⁻¹): 2296, 1786, 1575, 1245, 1127, 975, 836, 724; HRMS (ESI-TOF) *m/z* calcd for C₃₁H₂₂FN₂O₂ [M-H]⁻ 473.1665, found 473.1671;

4-(2-(4-bromophenyl)naphtho[2,1-b]furan-1-yl)-N-(quinolin-8-yl)butanamide(3s)



Yellowish solid; 87.6 mg, 82% yield; mp: 161-162 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.78 (s, 1H), 8.88–8.72 (m, 2H), 8.43 (d, *J* = 8.4 Hz, 1H), 8.23–8.15 (m, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.82–7.63 (m, 4H), 7.62–7.51 (m, 3H), 7.47 (m, 4H), 3.49–3.35 (m, 2H), 2.83–2.66 (m, 2H), 2.51–2.32 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 170.9, 152.3, 149.6, 148.2, 138.3, 136.4, 134.8, 134.5, 132.9, 130.9, 130.0, 129.4, 128.6, 127.9, 127.5, 127.2, 126.8, 126.4, 125.3, 124.3, 123.2, 121.6, 121.5, 118.8, 116.6, 112.4, 37.2, 25.4, 25.1. IR (KBr, v, cm⁻¹): 2346, 1747, 1568, 1225, 1148, 985, 812, 774; HRMS (ESI -TOF) *m/z* calcd for C₃₁H₂₂BrN₂O₂ [M-H]⁻ 533.0865, found 533.0869;

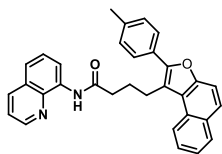
N-(quinolin-8-yl)-4-(2-(*m*-tolyl)naphtho[2,1-b]furan-1-yl)butanamide(3t)



Yellowish solid; 80.8 mg, 86% yield; mp: 181-182 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.79 (s, 1H), 8.85 (d, *J* = 7.6 Hz, 1H), 8.78–8.73 (m, 1H), 8.47 (d, *J* = 8.4 Hz, 1H), 8.17–8.10 (m, 1H), 7.97 (d, *J* = 8.0 Hz, 1H), 7.77–7.65 (m, 3H), 7.65–7.53 (m, 3H), 7.53–7.46 (m, 2H), 7.45–7.40 (m, 1H), 7.33–7.27 (m, 1H), 7.08 (d, *J* = 7.6 Hz, 1H), 3.50–3.38 (m, 2H), 2.84–2.71 (m, 2H), 2.50–2.42 (m, 2H), 2.40 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 170.9, 152.3, 149.6, 148.2, 138.3, 136.4, 134.8, 134.5, 132.9, 130.9, 130.0, 129.4, 128.6, 127.9, 127.5, 127.2, 126.8, 126.4, 125.3, 124.3, 123.2, 121.6,

121.5, 118.8, 116.6, 112.4, 37.2, 25.4, 25.1. IR (KBr, ν , cm^{-1}): 2333, 1777, 1664, 1278, 1112, 9586, 893, 735; HRMS (ESI -TOF) m/z calcd for $\text{C}_{32}\text{H}_{25}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 469.1916, found 469.1909;

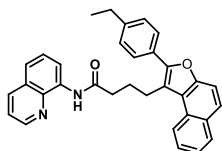
***N*-(quinolin-8-yl)-4-(2-(*p*-tolyl)naphtho[2,1-*b*]furan-1-yl)butanamide(3u)**



Yellowish solid; 80.8 mg, 86% yield; mp: 198-199 °C; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 9.75 (s, 1H), 8.84–8.74 (m, 2H), 8.45 (d, $J = 8.0$ Hz, 1H), 8.17 (d, $J = 8.4$ Hz, 1H), 7.95 (d, $J = 8.0$ Hz, 1H), 7.75–7.64 (m, 4H), 7.60–7.49 (m, 3H), 7.49–7.40 (m, 2H), 7.16 (d, $J = 8.0$ Hz, 2H), 3.47–3.36 (m, 2H), 2.81–2.67 (m, 2H), 2.48–2.40 (m, 2H), 2.26 (s, 3H).

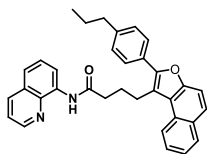
^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 170.9, 152.3, 149.6, 148.2, 138.3, 136.4, 134.8, 134.5, 132.9, 130.9, 130.0, 129.4, 128.6, 127.9, 127.5, 127.2, 126.8, 126.4, 125.3, 124.3, 123.2, 121.6, 121.5, 118.8, 116.6, 112.4, 37.2, 25.4, 25.1. IR (KBr, ν , cm^{-1}): 2336, 1775, 1585, 1214, 1172, 996, 842, 753; HRMS (ESI -TOF) m/z calcd for $\text{C}_{32}\text{H}_{25}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 469.1916, found 469.1910;

***4*-(2-(4-ethylphenyl)naphtho[2,1-*b*]furan-1-yl)-*N*-(quinolin-8-yl)butanamide(3v)**



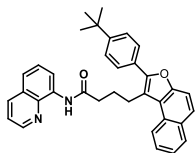
White solid; 82.3 mg, 85% yield; mp: 190-191 °C; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 9.88 (s, 1H), 8.79–8.84 (m, 2H), 8.46 (d, $J = 8.4$ Hz, 1H), 8.22 (d, $J = 8.0$ Hz, 1H), 7.95 (d, $J = 8.4$ Hz, 1H), 3.49–3.31 (m, 2H), 2.80–2.83 (m, 2H), 2.57–2.63 (m, 2H), 2.50–2.38 (m, 2H), 1.22 (t, $J = 7.6$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 171.3, 152.0, 151.6, 144.3, 130.9, 129.3, 128.6, 128.2, 128.1, 127.8, 127.4, 126.5, 125.5, 124.1, 123.2, 123.0, 121.6, 121.5, 117.1, 112.4, 37.5, 28.6, 25.7, 25.2, 15.4. IR (KBr, ν , cm^{-1}): 2323, 1786, 1534, 1207, 1186, 953, 839, 735; HRMS (ESI -TOF) m/z calcd for $\text{C}_{33}\text{H}_{27}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 483.2073, found 483.2076;

***4*-(2-(4-propylphenyl)naphtho[2,1-*b*]furan-1-yl)-*N*-(quinolin-8-yl)butanamide(3w)**



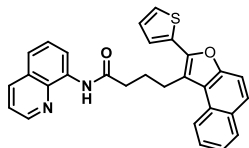
White solid; 84.7 mg, 85% yield; mp: 181-182 °C; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 10.20 (s, 1H), 9.02–8.83 (m, 2H), 8.53 (d, $J = 8.0$ Hz, 1H), 8.42 (d, $J = 6.4$ Hz, 1H), 8.00 (d, $J = 8.0$ Hz, 1H), 7.82–7.69 (m, 5H), 7.65 (d, $J = 7.6$ Hz, 3H), 7.50–7.53 (m, 1H), 7.28 (d, $J = 7.6$ Hz, 2H), 3.61–3.40 (m, 2H), 2.96 (s, 2H), 2.59–2.62 (m, 2H), 2.49 (s, 2H), 1.64–1.73 (m, 2H), 1.00 (t, $J = 7.2$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 171.8, 151.9, 151.5, 142.8, 130.8, 129.2, 128.9, 128.6(2), 128.5(7), 127.3, 126.6, 125.5, 124.0, 123.3, 123.1, 122.0, 121.3, 117.2, 112.4, 37.8, 37.4, 25.7, 25.3, 24.4, 13.9. IR (KBr, ν , cm^{-1}): 2351, 1744, 1553, 1207, 1143, 986, 843, 788; HRMS (ESI -TOF) m/z calcd for $\text{C}_{34}\text{H}_{29}\text{N}_2\text{O}_2$ $[\text{M}-\text{Na}]^-$ 497.2229, found 497.2236;

***4*-(2-(4-(*tert*-butyl)phenyl)naphtho[2,1-*b*]furan-1-yl)-*N*-(quinolin-8-yl)butanamide(3x)**



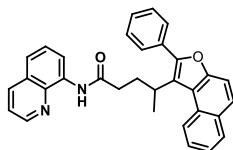
Yellowish solid; 90.1 mg, 88% yield; mp: 189-190 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.86 (s, 1H), 8.89 – 8.75 (m, 2H), 8.46 (d, *J* = 8.4 Hz, 1H), 8.20–8.13 (m, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.78–7.65 (m, 4H), 7.61–7.54 (m, 2H), 7.53–7.40 (m, 5H), 3.46–3.36 (m, 2H), 2.86–2.78 (m, 2H), 2.54–2.41 (m, 2H), 1.31 (s, 9H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 170.9, 152.3, 149.6, 148.2, 138.3, 136.4, 134.8, 134.5, 132.9, 130.9, 130.0, 129.4, 128.6, 127.9, 127.5, 127.2, 126.8, 126.4, 125.3, 124.3, 123.2, 121.6, 121.5, 118.8, 116.6, 112.4, 37.2, 25.4, 25.1. IR (KBr, v, cm⁻¹): 2321, 1771, 1575, 1245, 1423, 985, 845, 793; HRMS (ESI -TOF) *m/z* calcd for C₃₅H₃₁N₂O₂ [M-H]⁻ 5111.2386, found 511.2391;

***N*-(quinolin-8-yl)-4-(2-(thiophen-2-yl)naphtho[2,1-*b*]furan-1-yl)butanamide(3y)**



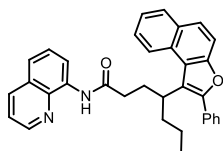
White solid; 62.8 mg, 68% yield; mp: 197-198 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.88 (s, 1H), 8.85 (d, *J* = 7.2 Hz, 1H), 8.77 (d, *J* = 8.0 Hz, 1H), 8.45 (d, *J* = 8.4 Hz, 1H), 8.19 (d, *J* = 8.0 Hz, 1H), 7.94 (d, *J* = 8.0 Hz, 1H), 7.72 (d, *J* = 8.8 Hz, 1H), 7.64 (d, *J* = 8.8 Hz, 1H), 7.51–7.60 (m, 4H), 7.46 (m, 2H), 7.28 (d, *J* = 4.8 Hz, 1H), 7.15–7.01 (m, 1H), 3.55–3.39 (m, 2H), 2.83–2.86 (m, 2H), 2.49–2.35 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.2, 151.9, 147.8, 146.8, 136.9, 134.4, 132.9, 130.9, 129.3, 128.5, 127.7, 126.64, 126.0, 125.4, 125.2, 124.3, 123.1, 122.9, 121.6, 117.4, 37.5, 25.3, 25.2. IR (KBr, v, cm⁻¹): 2331, 1772, 1554, 1227, 1201, 952, 885, 763; HRMS (ESI -TOF) *m/z* calcd for C₂₉H₂₁N₂O₄S [M-H]⁻ 461.1324, found 461.1318;

***4*-(2-phenylnaphtho[2,1-*b*]furan-1-yl)-*N*-(quinolin-8-yl)pentanamide(3z)**



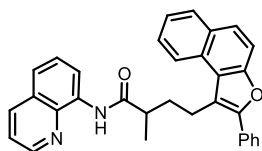
Yellowish solid; 65.8 mg, 70% yield; mp: 196-197 °C; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.49 (s, 1H), 8.71–8.57 (m, 2H), 8.53 (d, *J* = 8.0 Hz, 1H), 8.13–8.09 (m, 1H), 7.95 (d, *J* = 8.0 Hz, 1H), 7.74 (d, *J* = 8.8 Hz, 1H), 7.70–7.58 (m, 4H), 7.57–7.42 (m, 4H), 7.41–7.37 (m, 1H), 7.32 (s, 2H), 3.79 (s, 1H), 2.69–2.28 (m, 4H), 1.75 (d, *J* = 4.4 Hz, 3H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 170.9, 152.3, 149.6, 148.2, 138.3, 136.4, 134.8, 134.5, 132.9, 130.9, 130.0, 129.4, 128.6, 127.9, 127.5, 127.2, 126.8, 126.4, 125.3, 124.3, 123.2, 121.6, 121.5, 118.8, 116.6, 112.4, 37.2, 25.4, 25.1. IR (KBr, v, cm⁻¹): 2421, 1582, 1518, 1258, 1184, 956, 863, 772; HRMS (ESI -TOF) *m/z* calcd for C₃₂H₂₅N₂O₂ [M-H]⁻ 469.1916, found 469.1923;

***4*-(2-phenylnaphtho[2,1-*b*]furan-1-yl)-*N*-(quinolin-8-yl)heptanamide(3aa)**

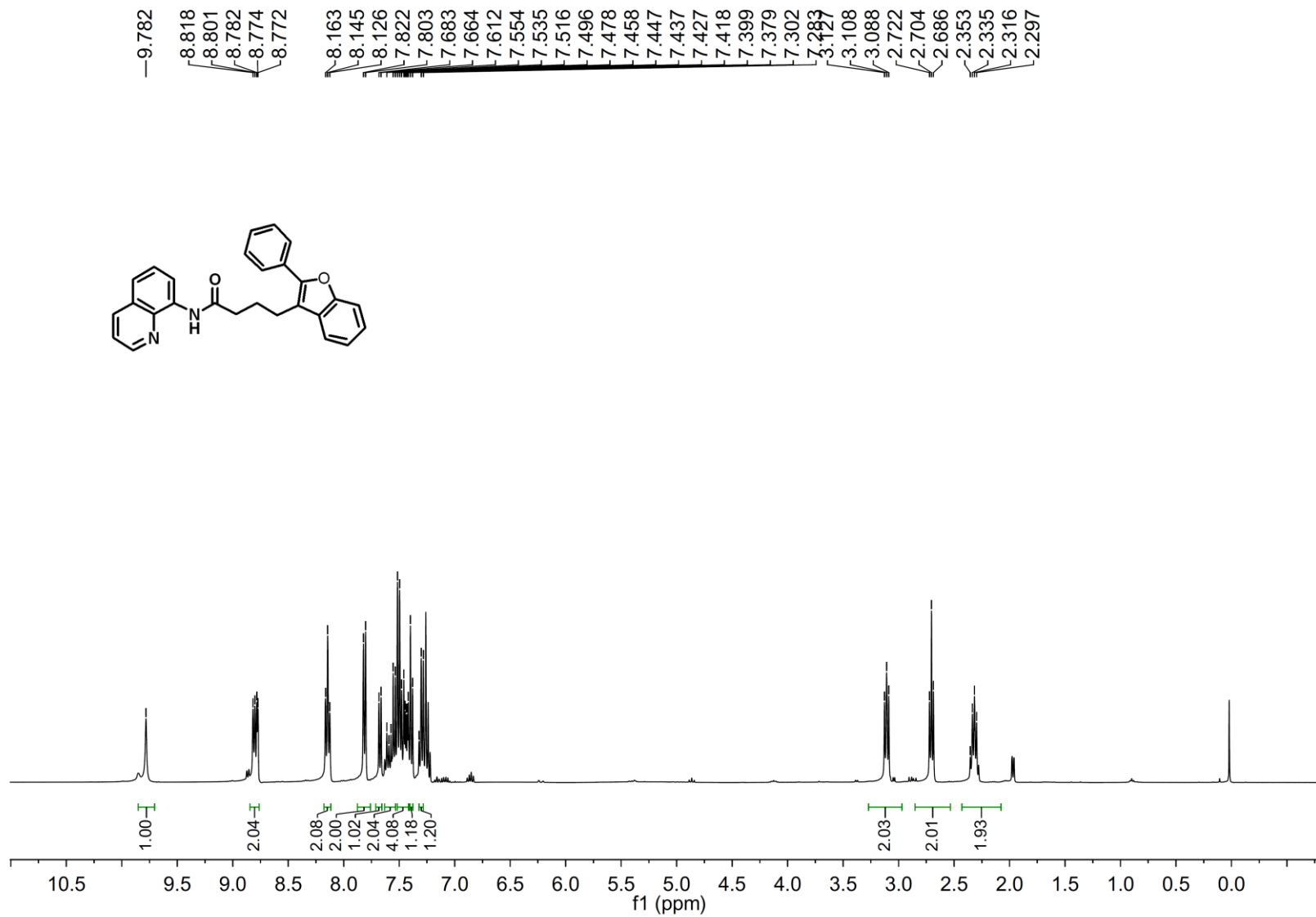


Yellowish oil; 80.7 mg, 81% yield; ¹H NMR (400 MHz, CDCl₃) (δ, ppm): 9.56 (s, 1H), 8.77–8.57 (m, 3H), 8.18 (d, *J* = 7.2 Hz, 2H), 7.83–7.64 (m, 6H), 7.57–7.48 (m, 5H), 7.25 (d, *J* = 6.4 Hz, 1H), 3.72–3.40 (m, 1H), 2.76–2.47 (m, 4H), 2.33–2.08 (m, 2H), 1.55–1.40 (m, 2H), 0.95–0.91 (m, 3H). ¹³C NMR (100 MHz, CDCl₃) (δ, ppm): 171.2, 153.0, 147.9, 136.3, 134.3, 133.6, 130.2, 128.8, 128.5, 128.3, 127.3, 126.1, 123.9, 121.4, 121.3, 116.5, 112.7, 37.1, 36.6, 35.9, 29.7, 21.9, 14.3. IR (KBr, v, cm⁻¹): 2436, 1577, 1501, 1256, 1144, 961, 823, 799; HRMS (ESI -TOF) *m/z* calcd for C₃₄H₂₉N₂O₂ [M-H]⁻ 497.2229, found 497.2221;

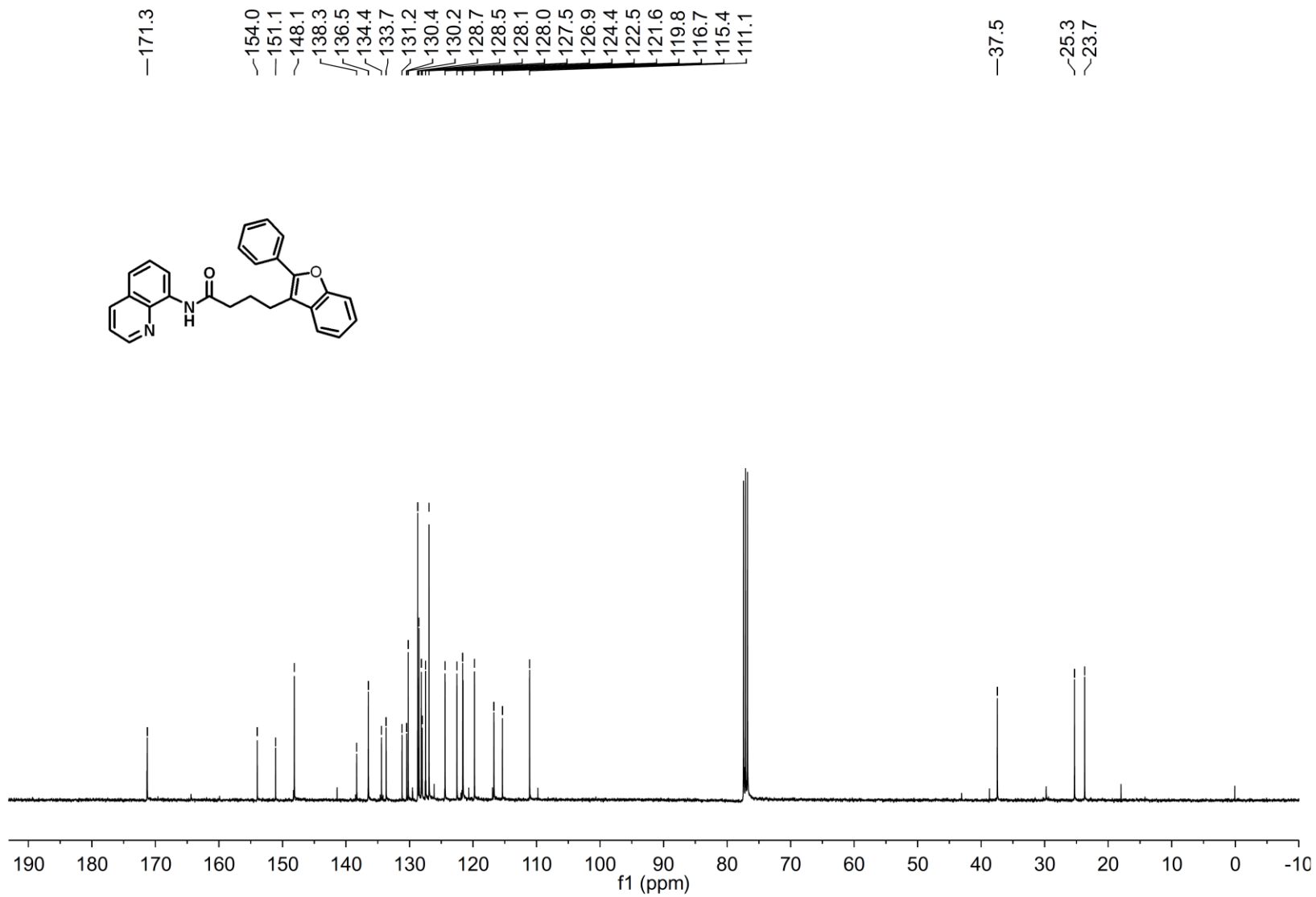
***2*-methyl-4-(2-phenylnaphtho[2,1-*b*]furan-1-yl)-*N*-(quinolin-8-yl)butanamide(3bb)**



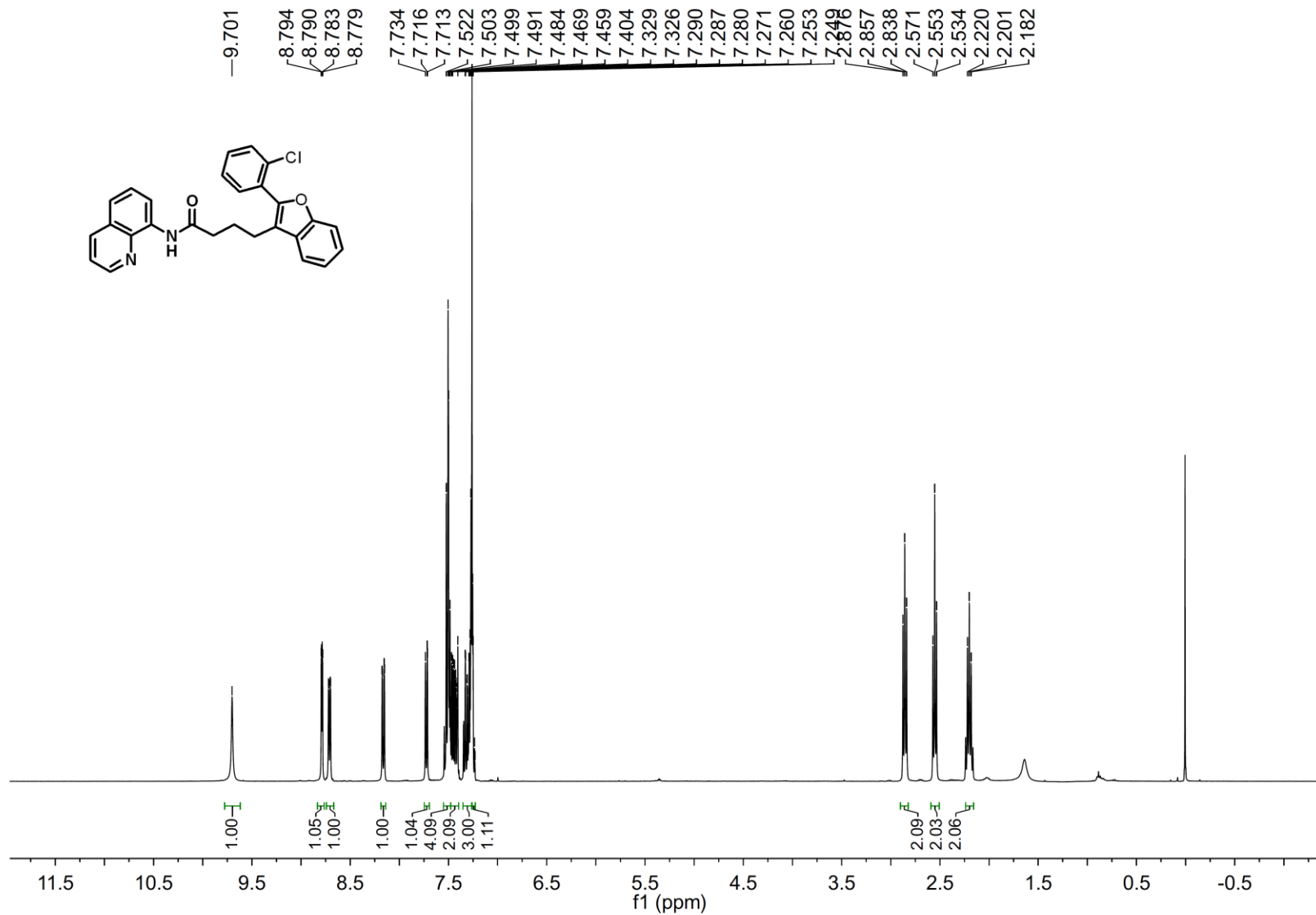
Yellowish oil; 80.8 mg, 86% yield; ^1H NMR (400 MHz, CDCl_3) (δ , ppm): 9.96 (s, 1H), 8.94 (d, $J = 7.6$ Hz, 1H), 8.81–8.76 (m, 1H), 8.46 (d, $J = 8.4$ Hz, 1H), 8.15 (d, $J = 8.4$ Hz, 1H), 7.96 (d, $J = 8.0$ Hz, 1H), 7.81 (d, $J = 7.6$ Hz, 2H), 7.74–7.66 (m, 2H), 7.62–7.56 (m, 2H), 7.55–7.45 (m, 3H), 7.38–7.33 (m, 2H), 7.25–7.22 (m, 1H), 3.46–3.33 (m, 2H), 2.98–2.86 (m, 1H), 2.60–2.47 (m, 1H), 2.26–2.15 (m, 1H), 1.49 (d, $J = 6.8$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) (δ , ppm): 174.7, 152.1, 151.1, 148.2, 138.5, 136.5, 134.5, 133.7, 131.1, 130.9, 130.2, 129.3, 128.7, 128.6, 128.0, 127.9, 127.5, 127.3, 126.5, 125.8, 124.1, 123.2, 123.0, 121.6, 121.6, 117.8, 116.7, 112.4, 43.0, 34.5, 23.8, 18.4. IR (KBr, v , cm^{-1}): 2466, 1564, 1506, 1263, 1180, 973, 866, 729; HRMS (ESI -TOF) m/z calcd for $\text{C}_{32}\text{H}_{25}\text{N}_2\text{O}_2$ $[\text{M}-\text{H}]^-$ 469.1916, found 469.1919.



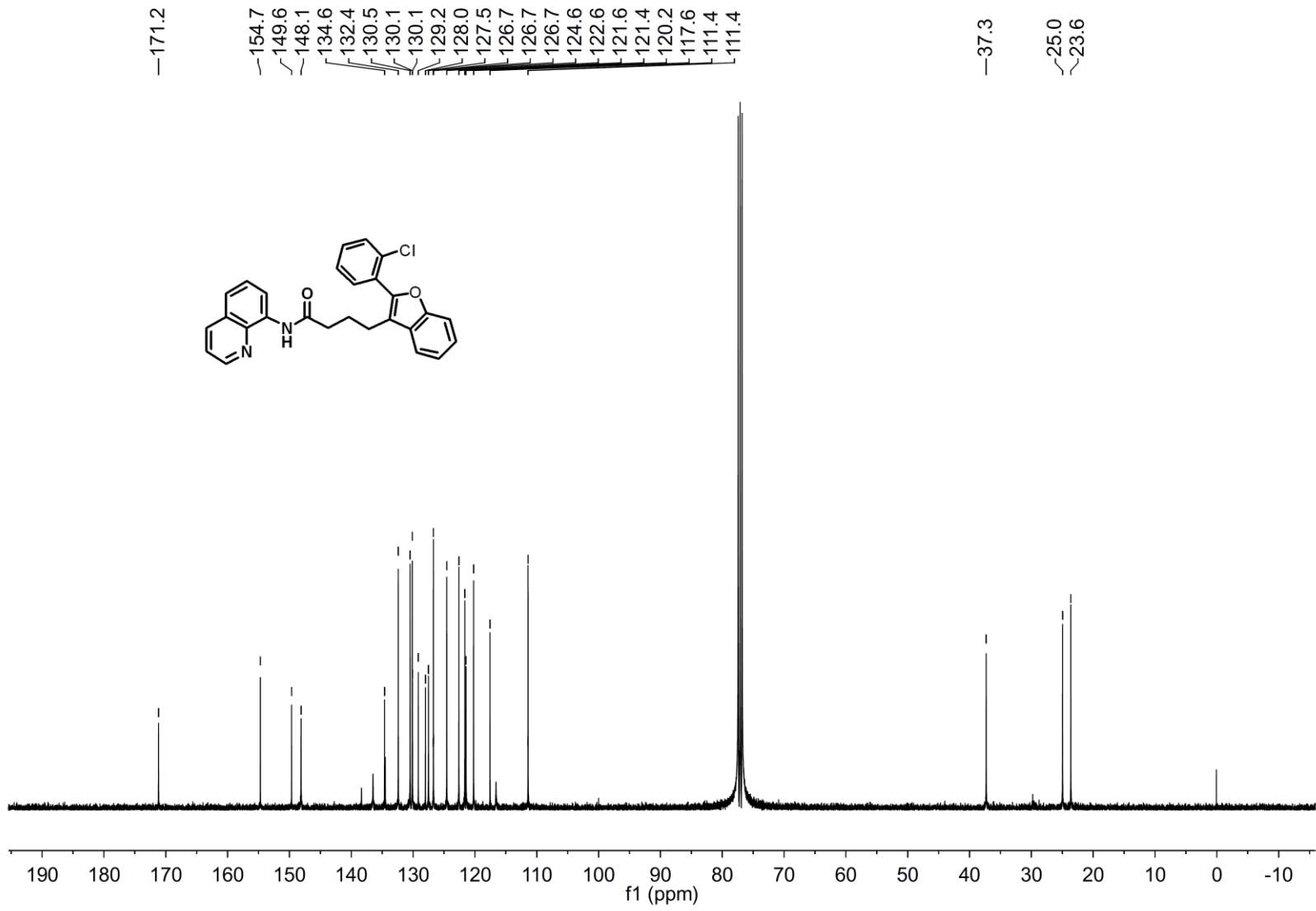
¹H NMR Spectrum of Compound 3a



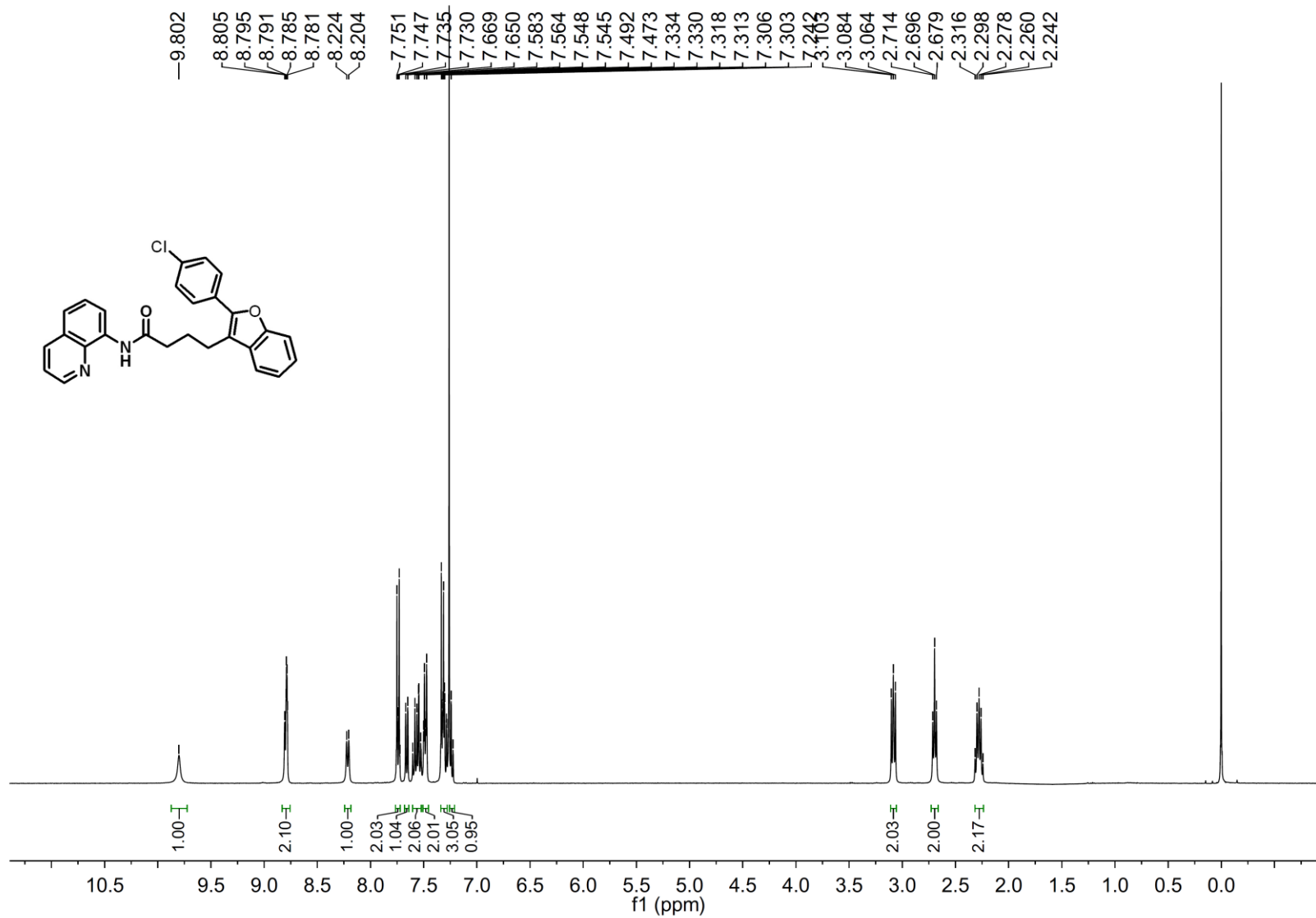
¹³C NMR Spectrum of Compound 3a



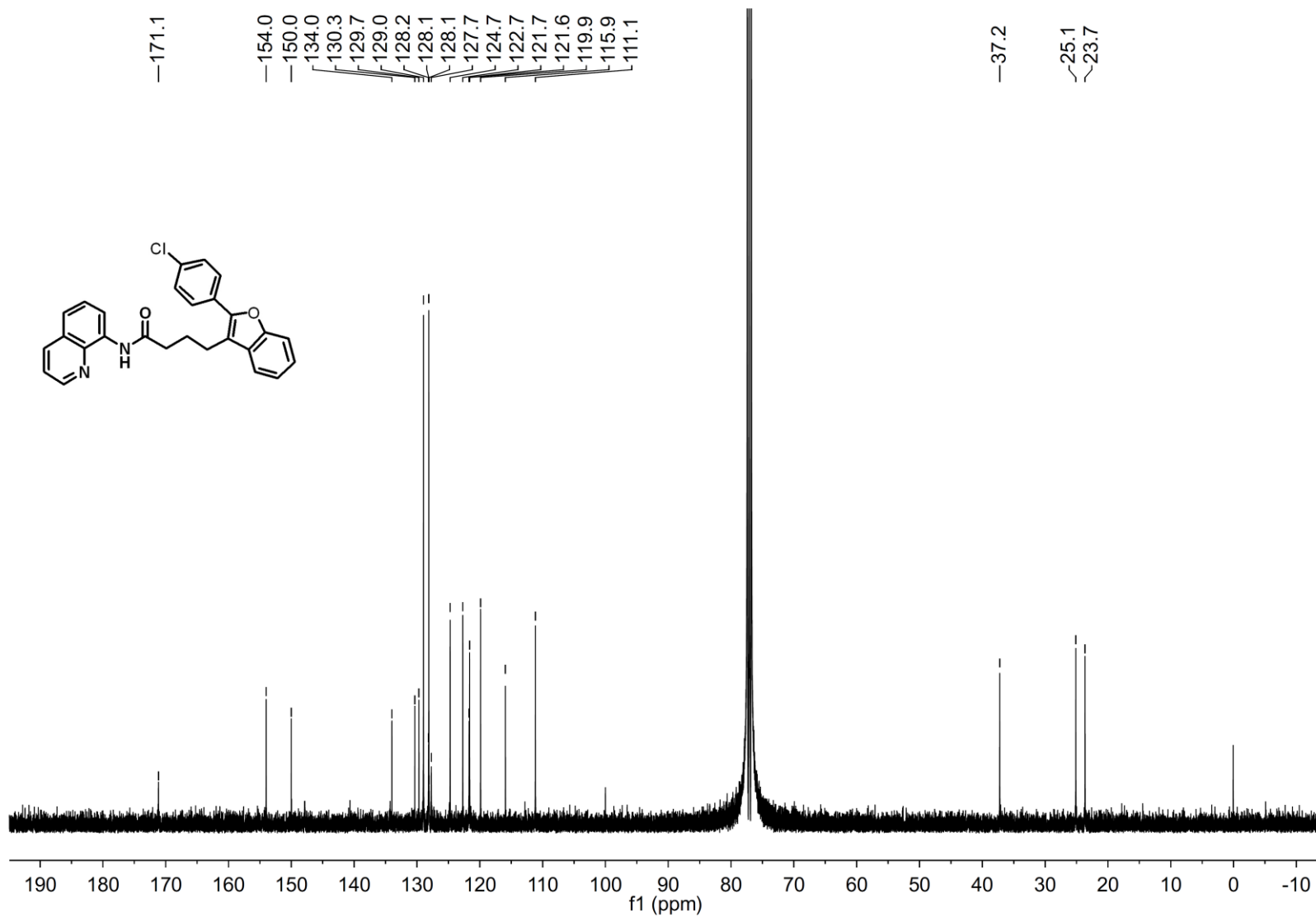
¹H NMR Spectrum of Compound 3b



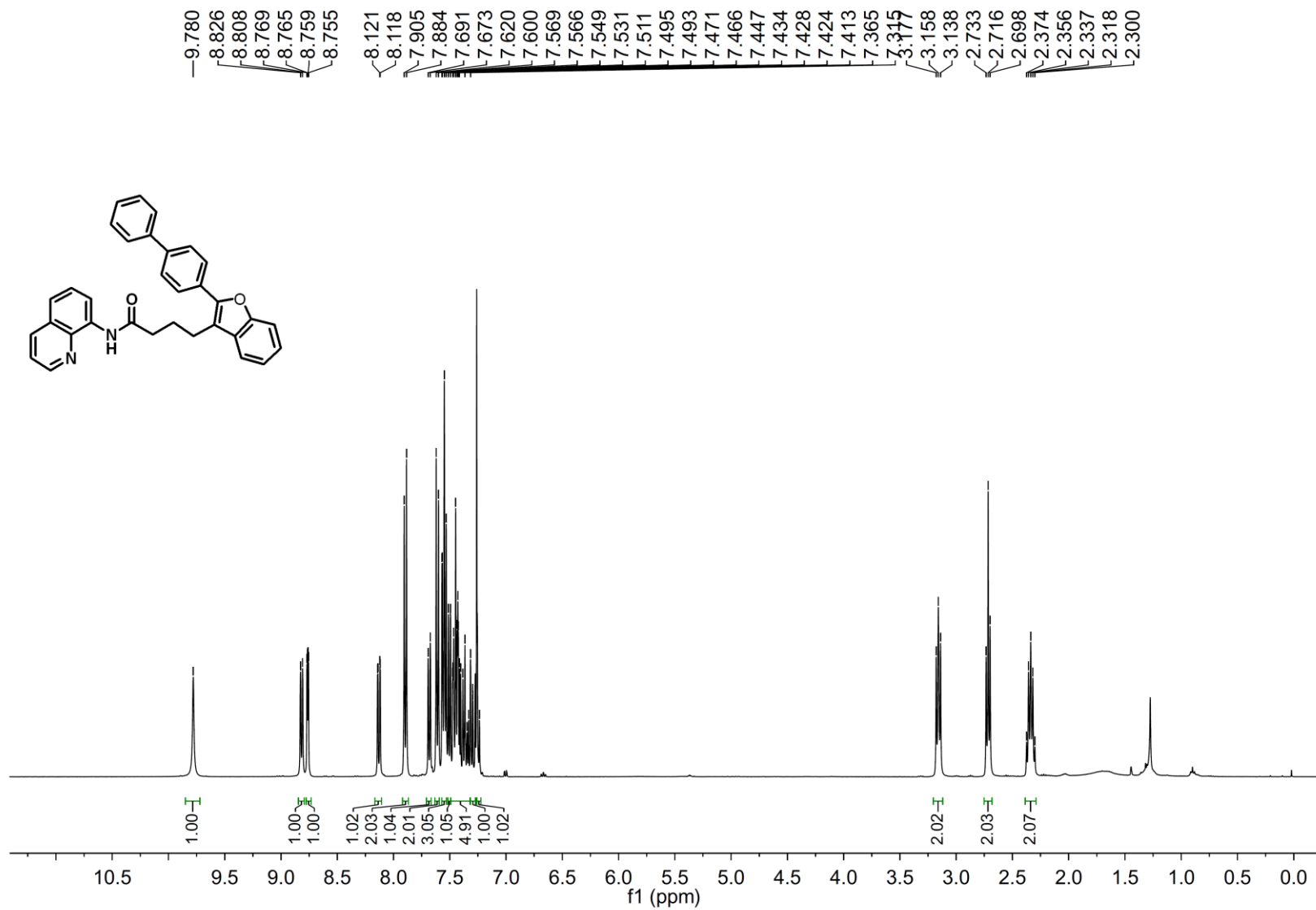
¹³C NMR Spectrum of Compound 3b



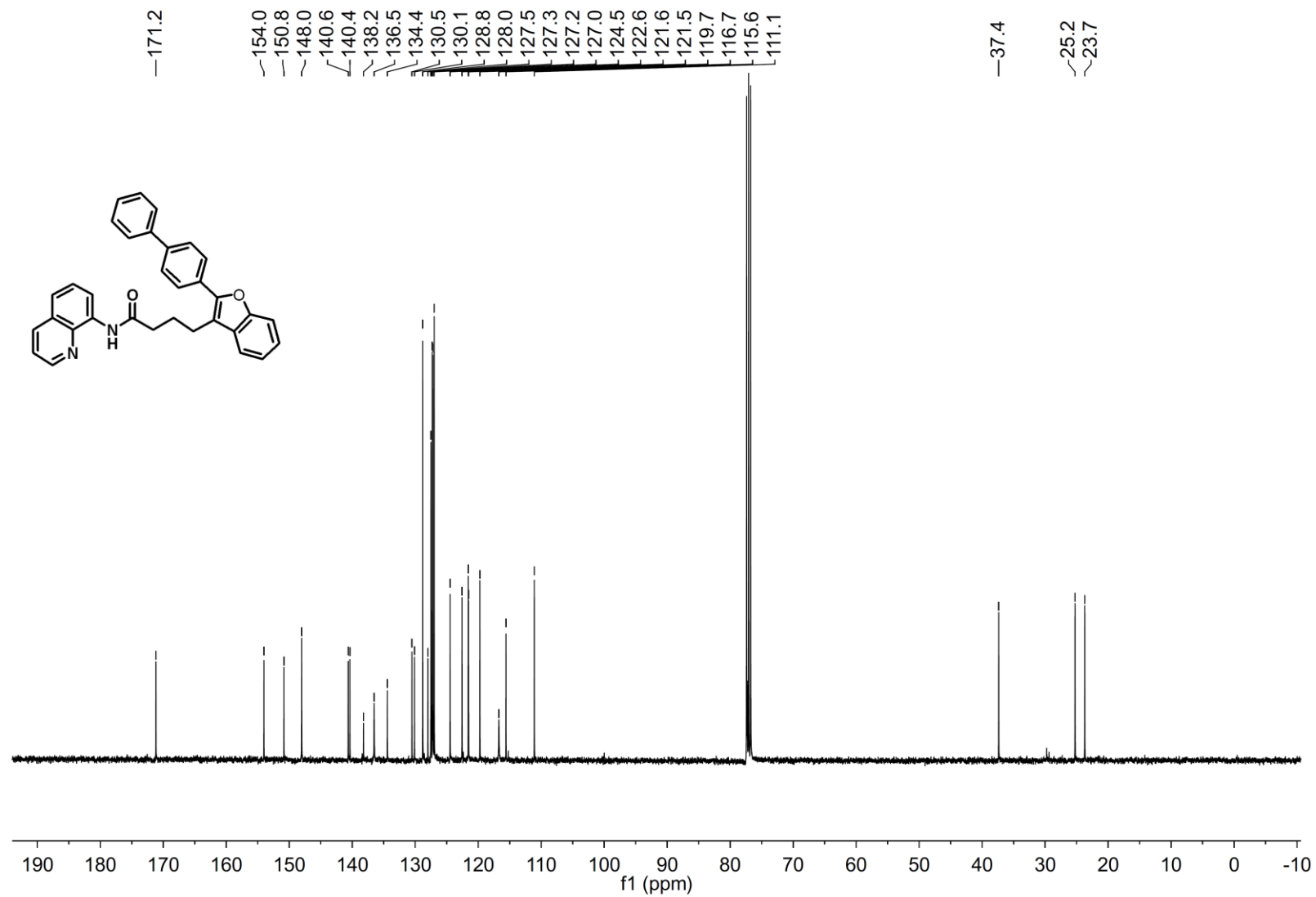
¹H NMR Spectrum of Compound 3c



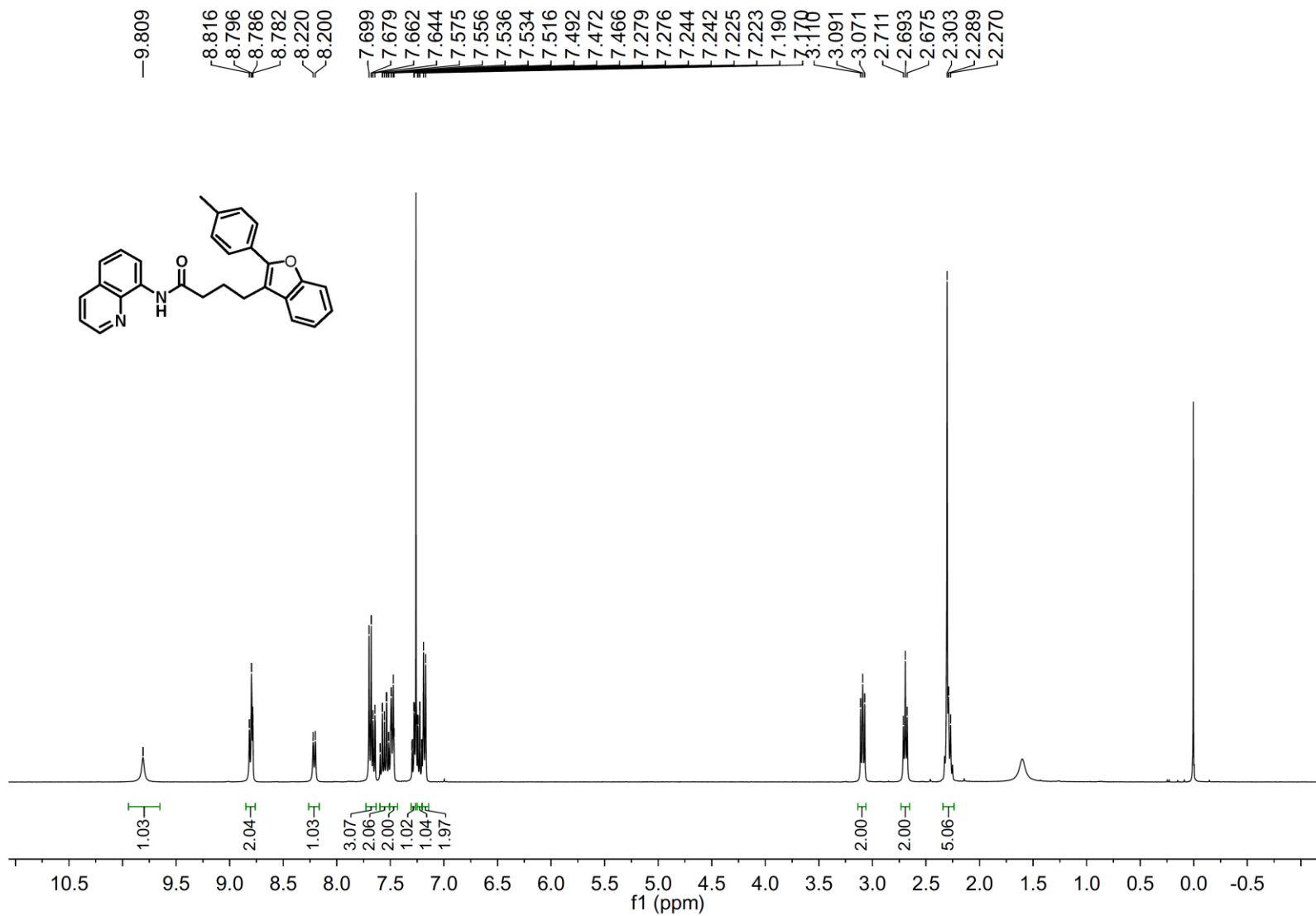
¹³C NMR Spectrum of Compound 3c



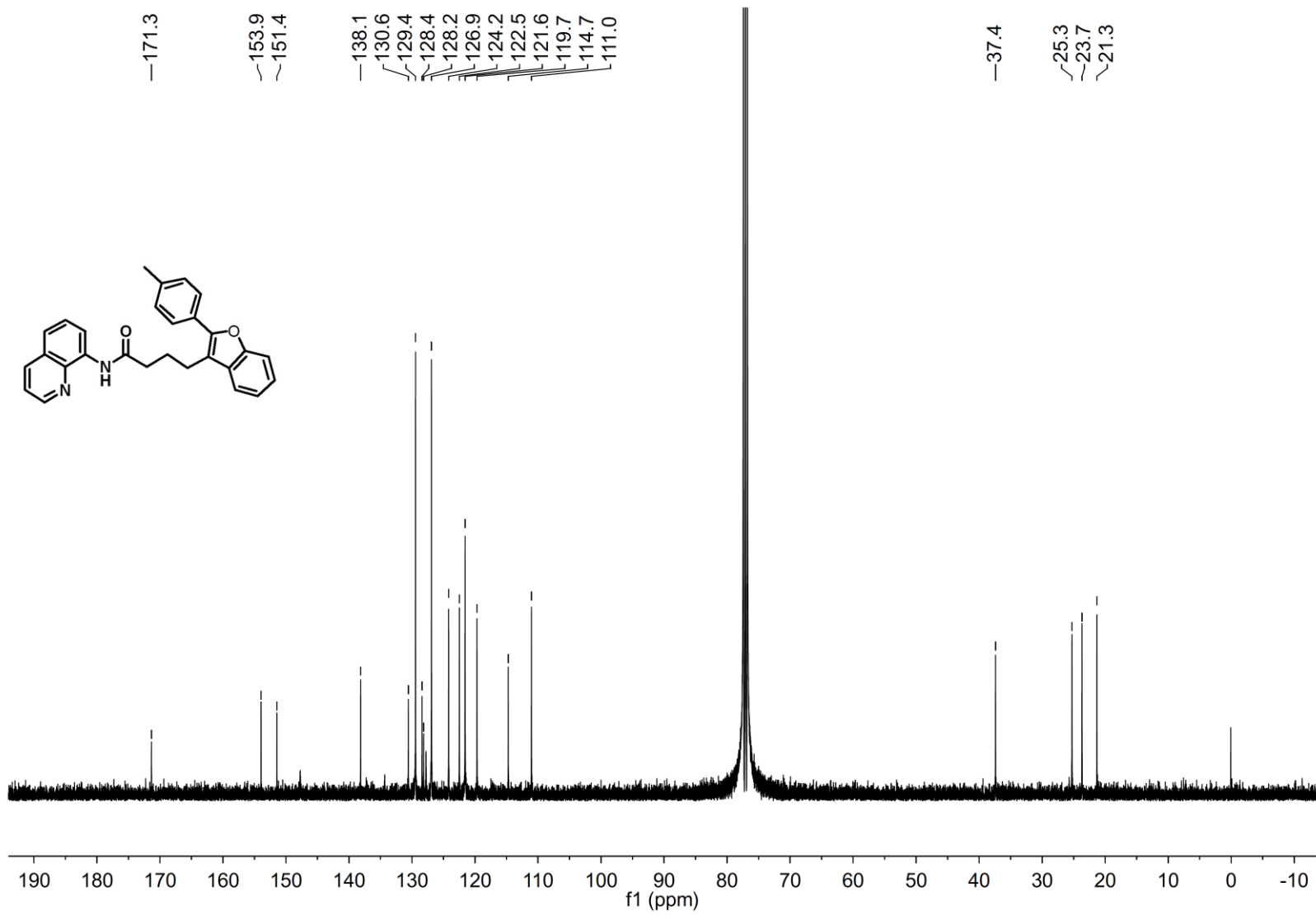
¹H NMR Spectrum of Compound 3d



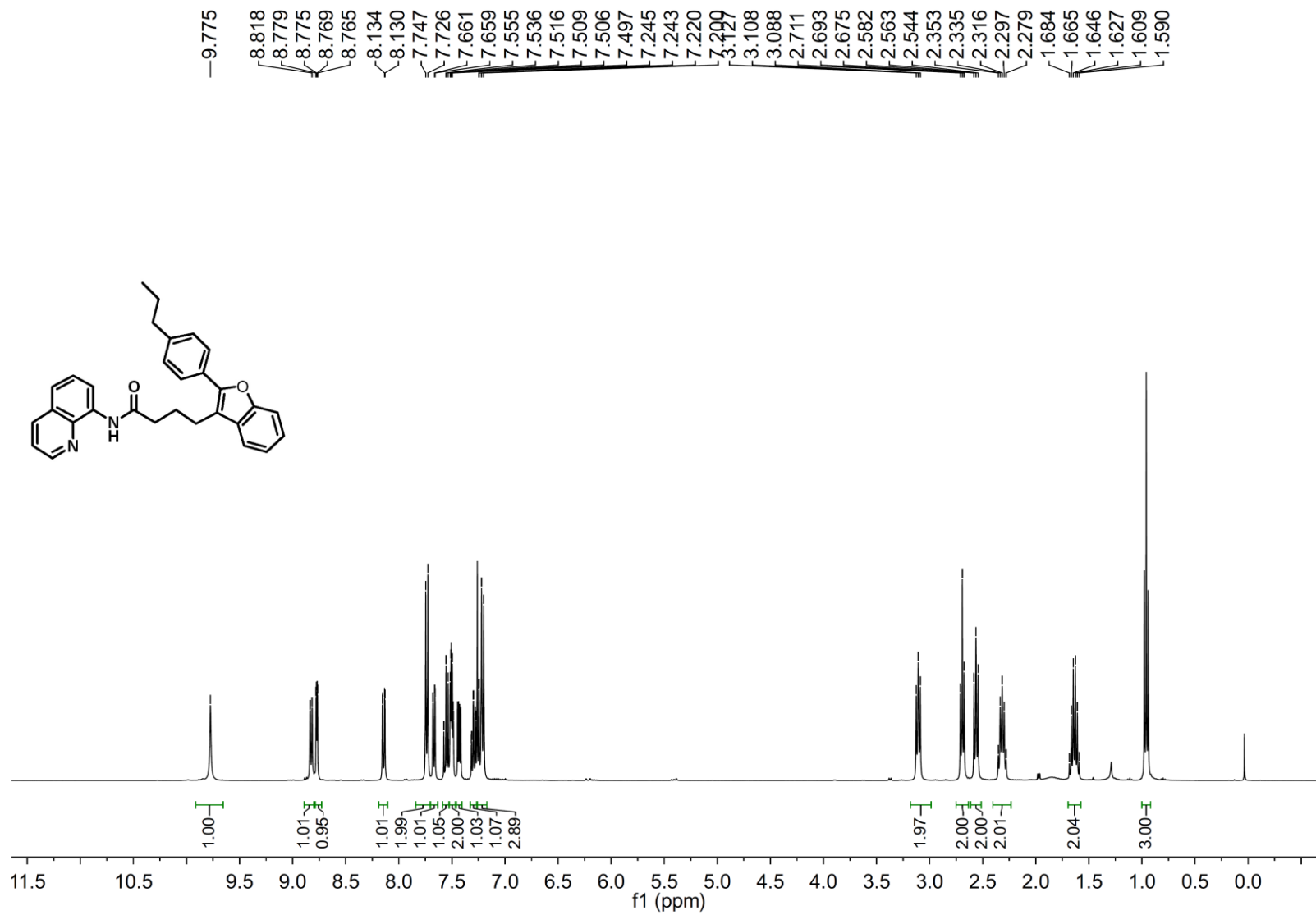
¹³C NMR Spectrum of Compound 3d



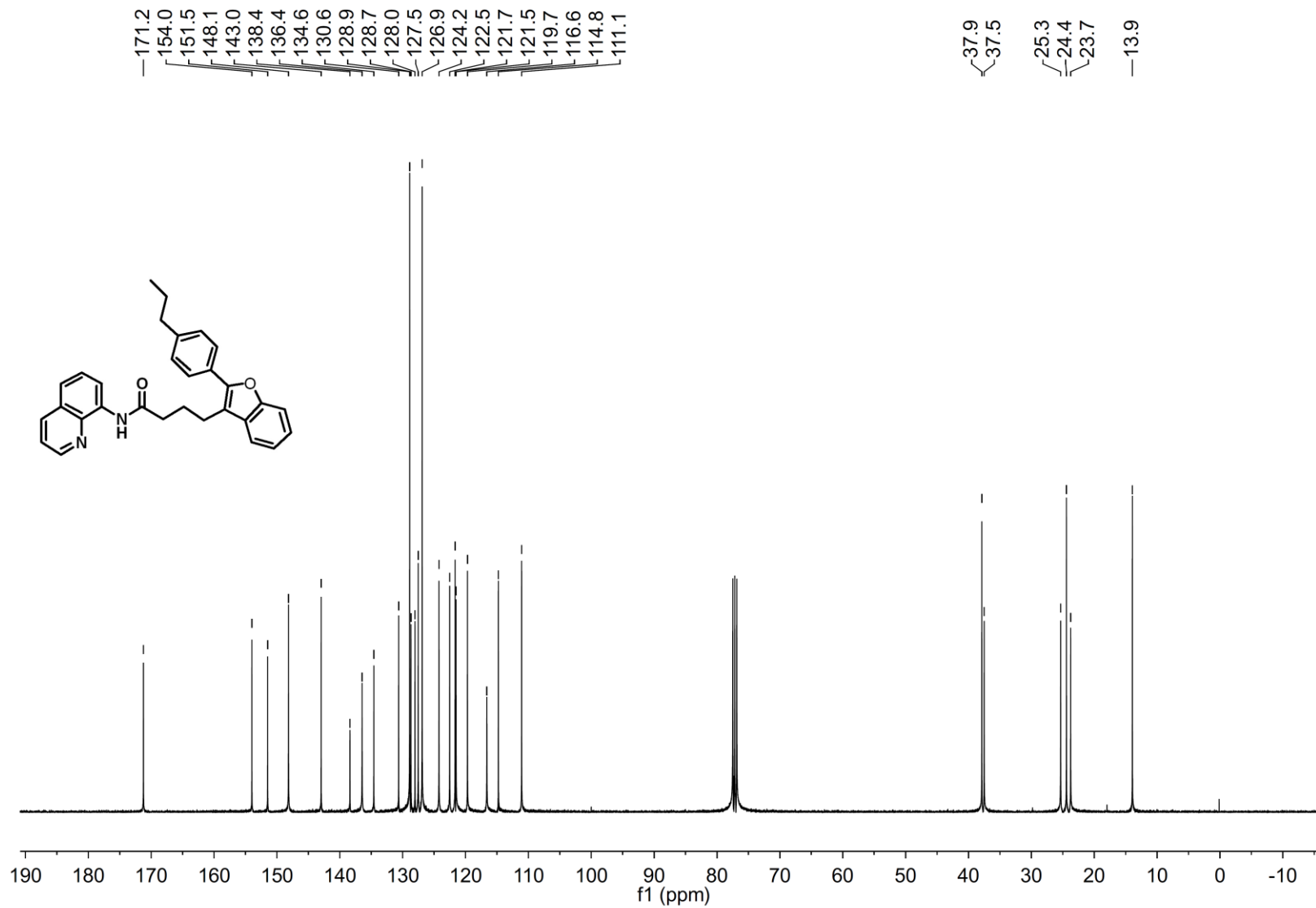
¹H NMR Spectrum of Compound 3e



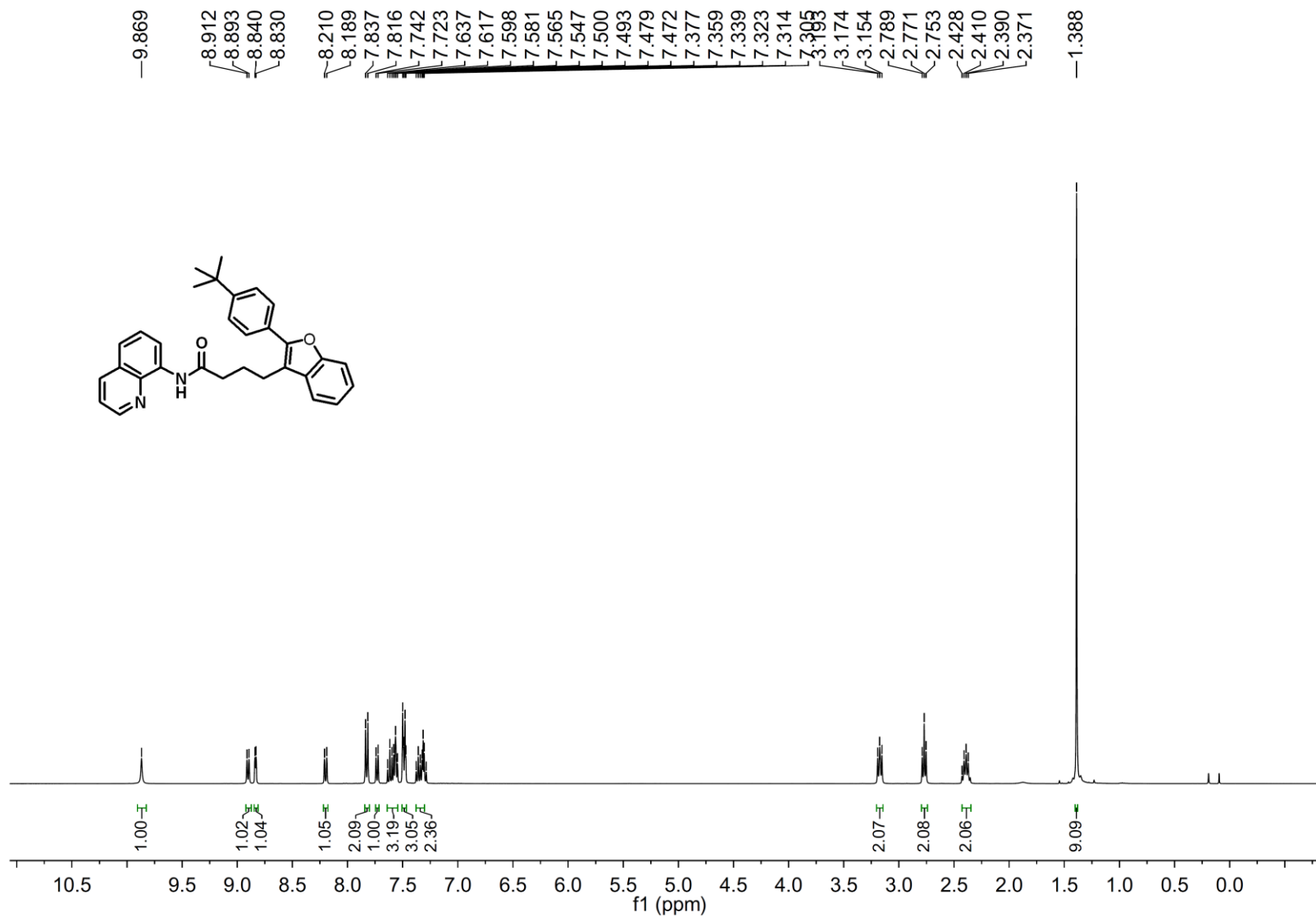
¹³C NMR Spectrum of Compound 3e



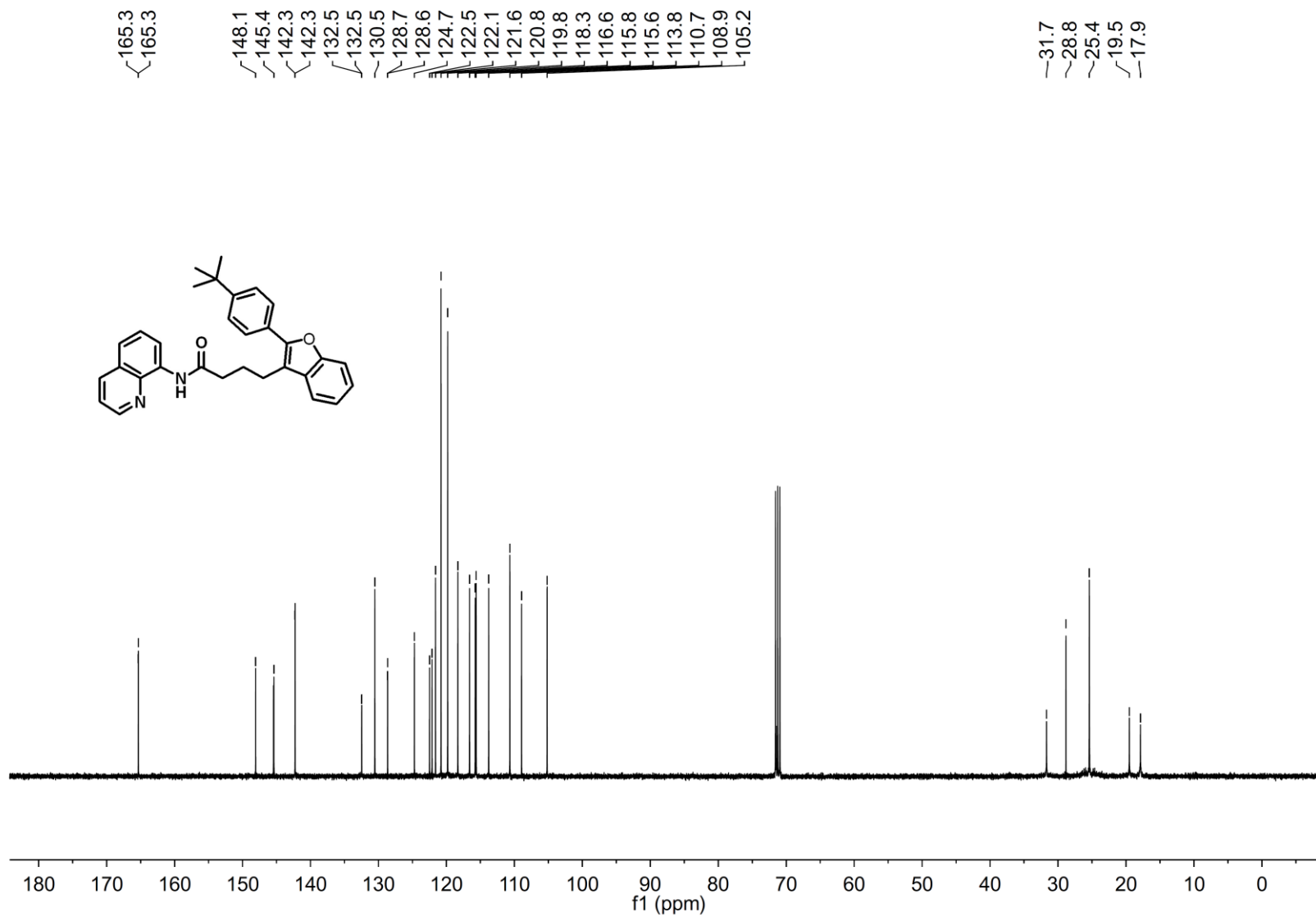
¹H NMR Spectrum of Compound 3f



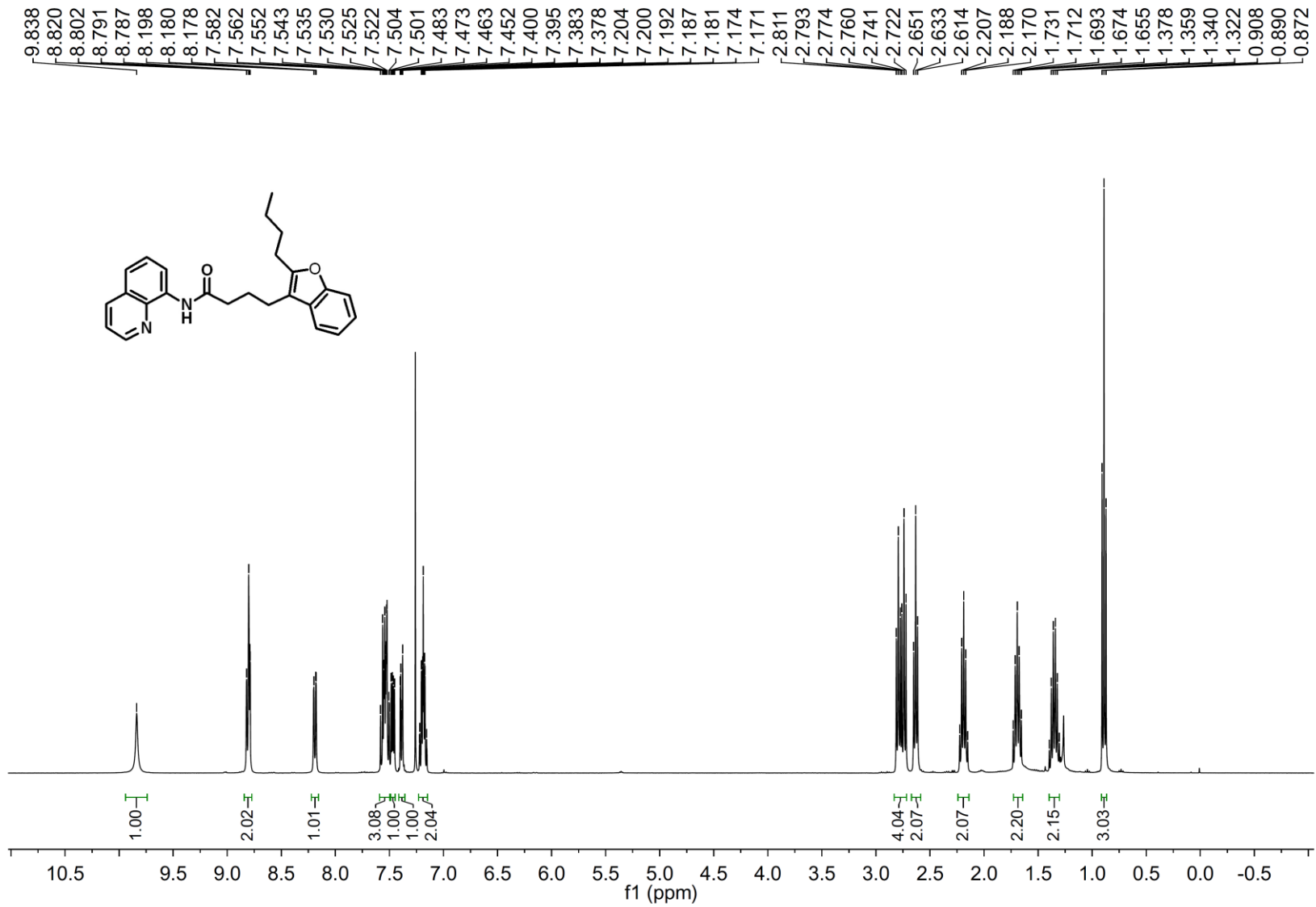
^{13}C NMR Spectrum of Compound 3f



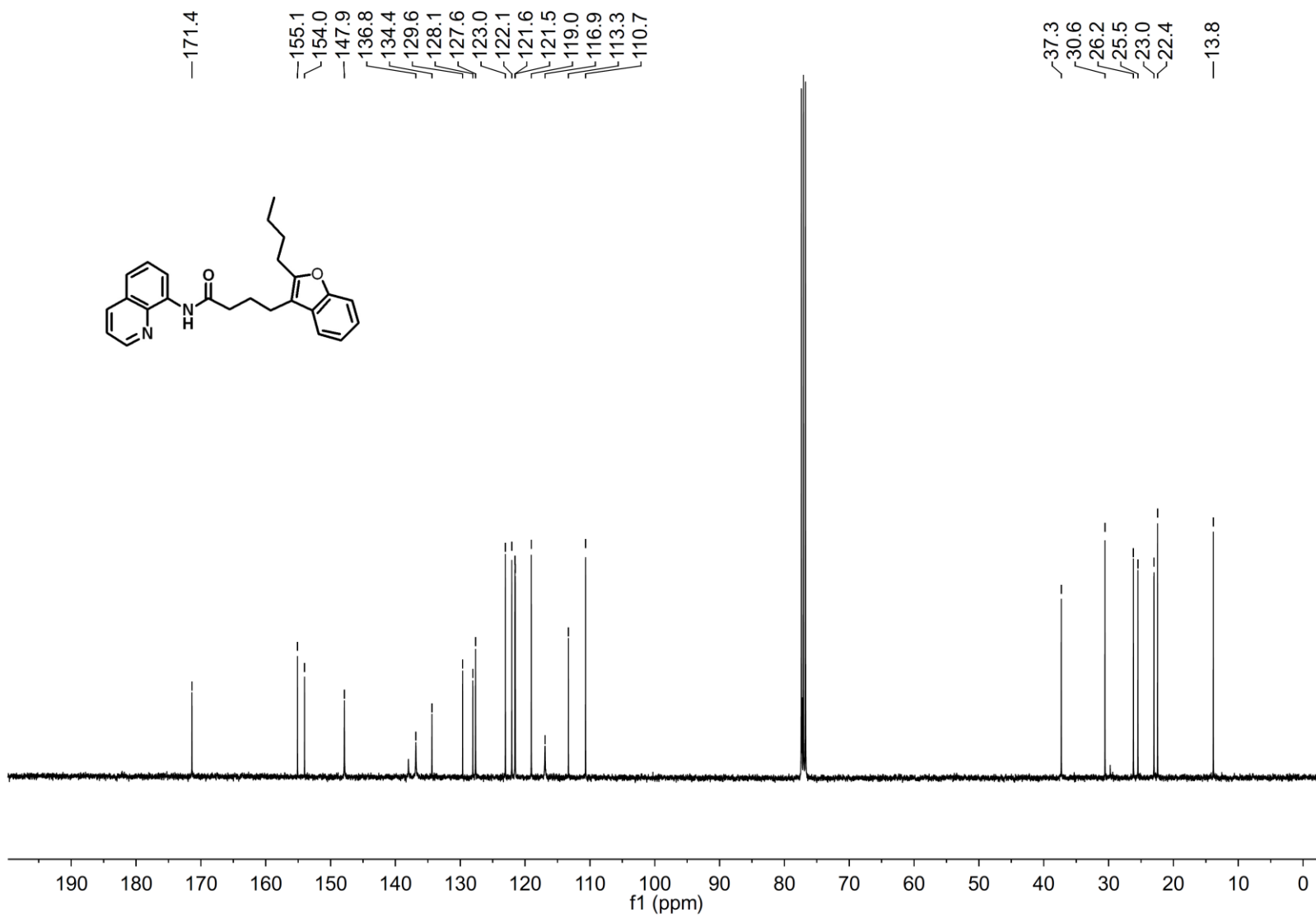
¹H NMR Spectrum of Compound 3g



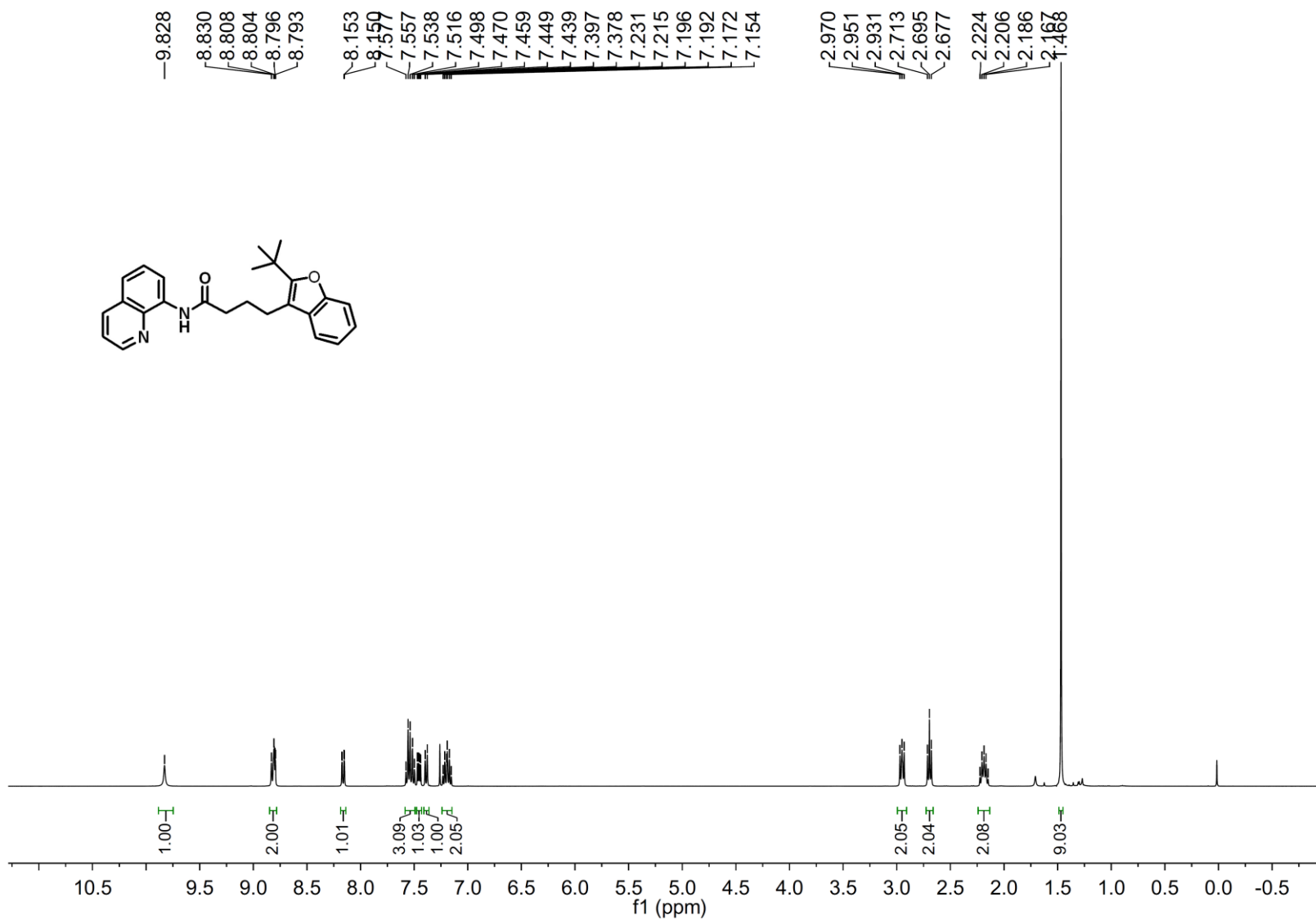
¹³C NMR Spectrum of Compound 3g



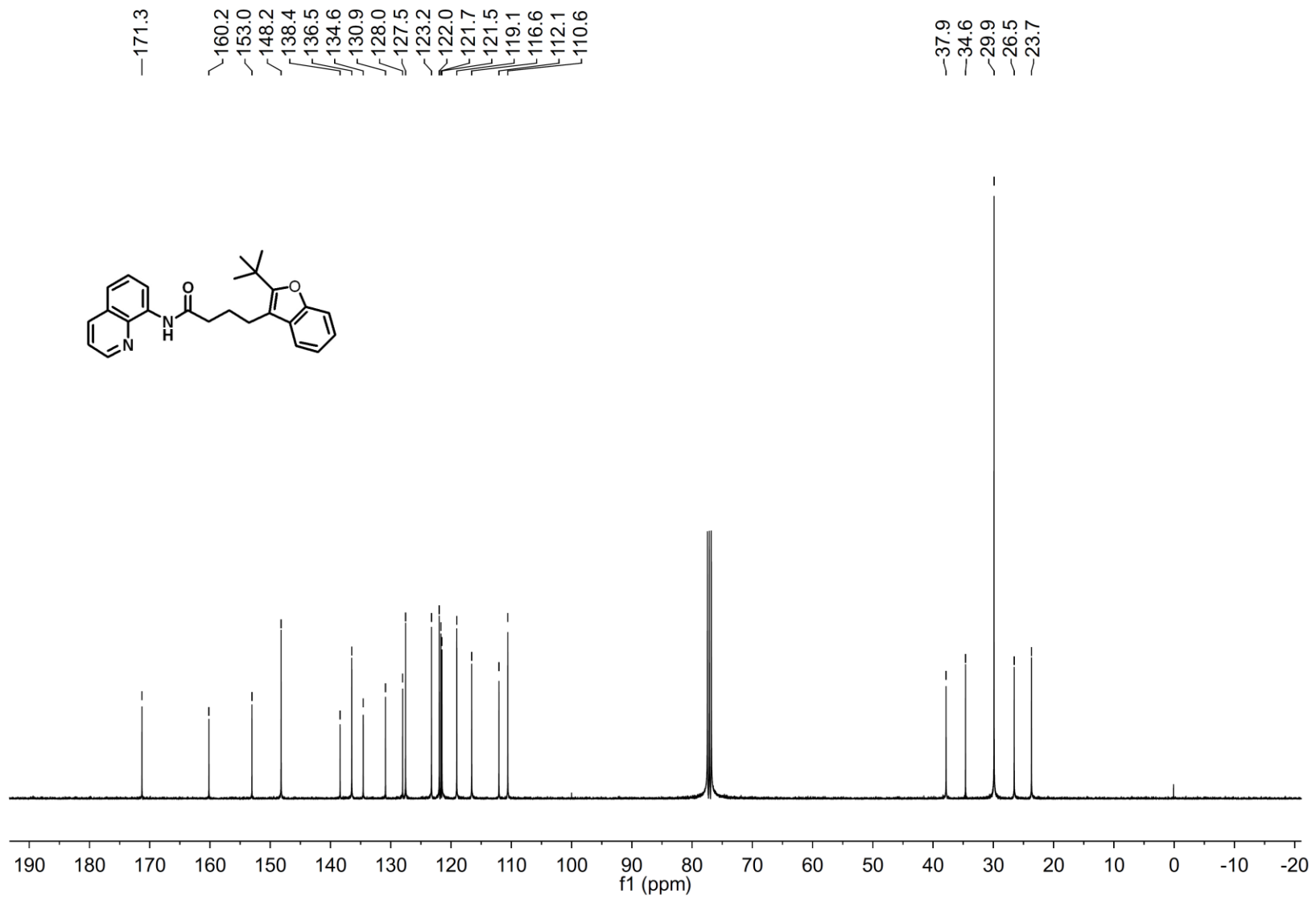
¹H NMR Spectrum of Compound 3h



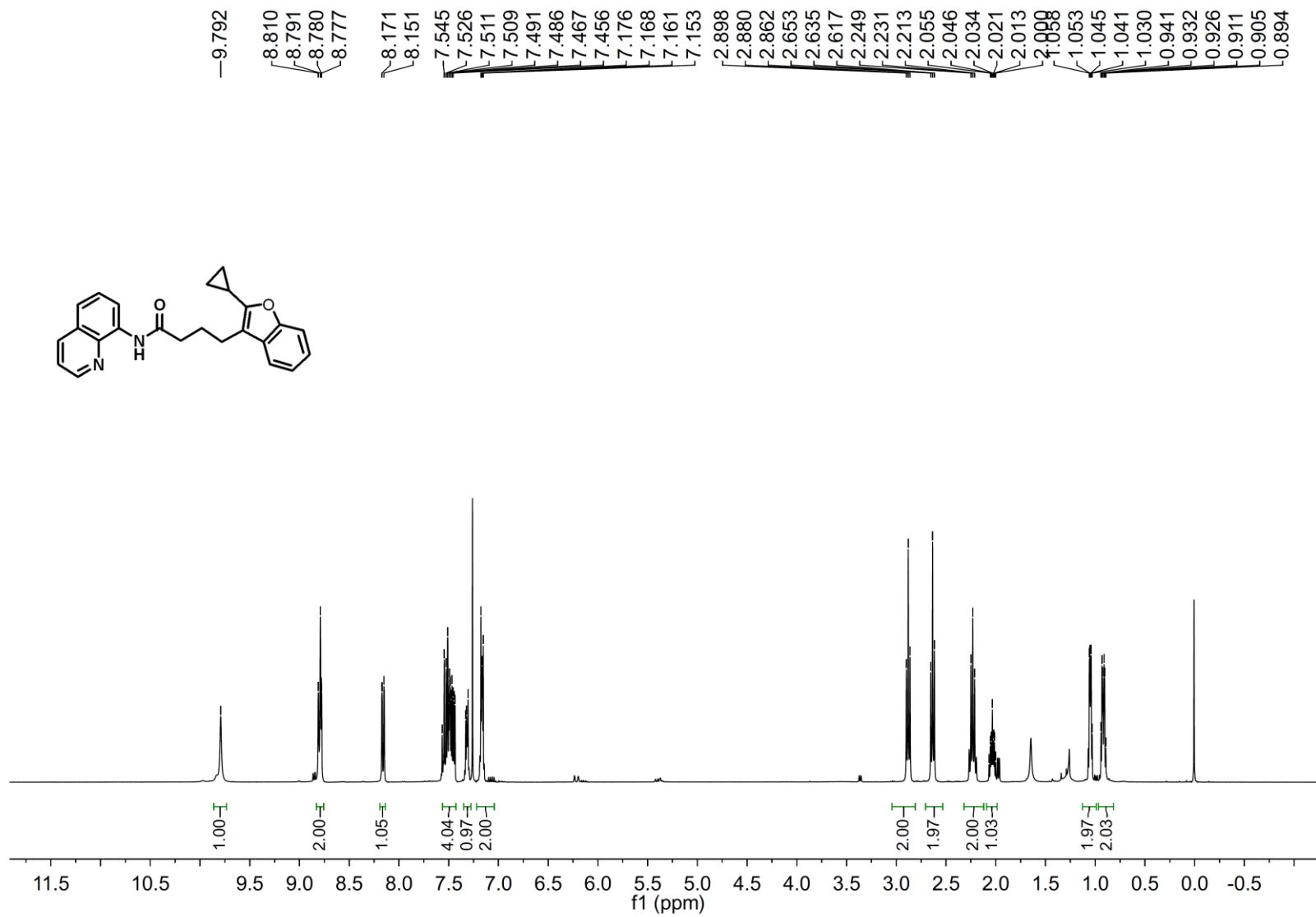
¹³C NMR Spectrum of Compound 3h



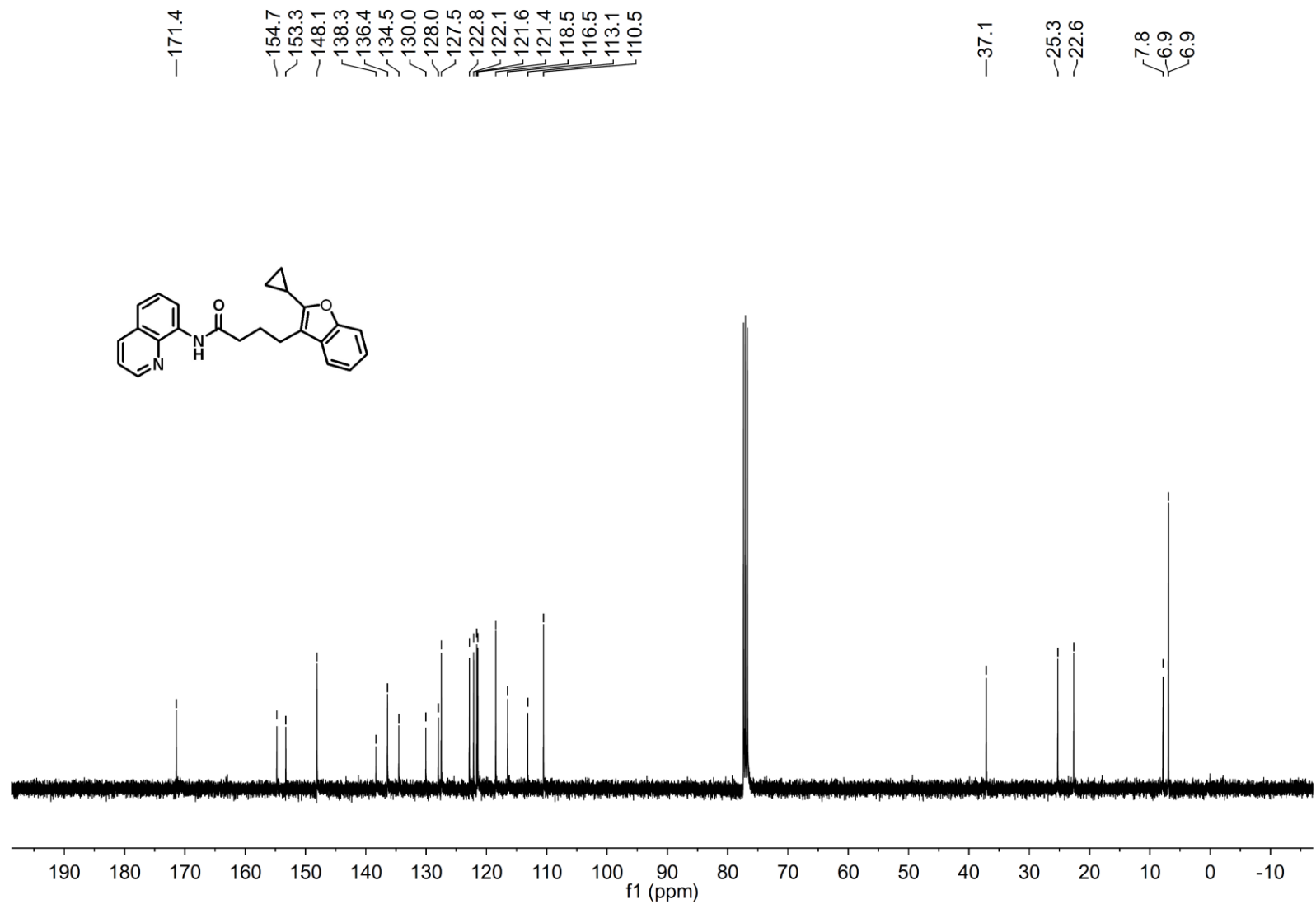
¹H NMR Spectrum of Compound 3i



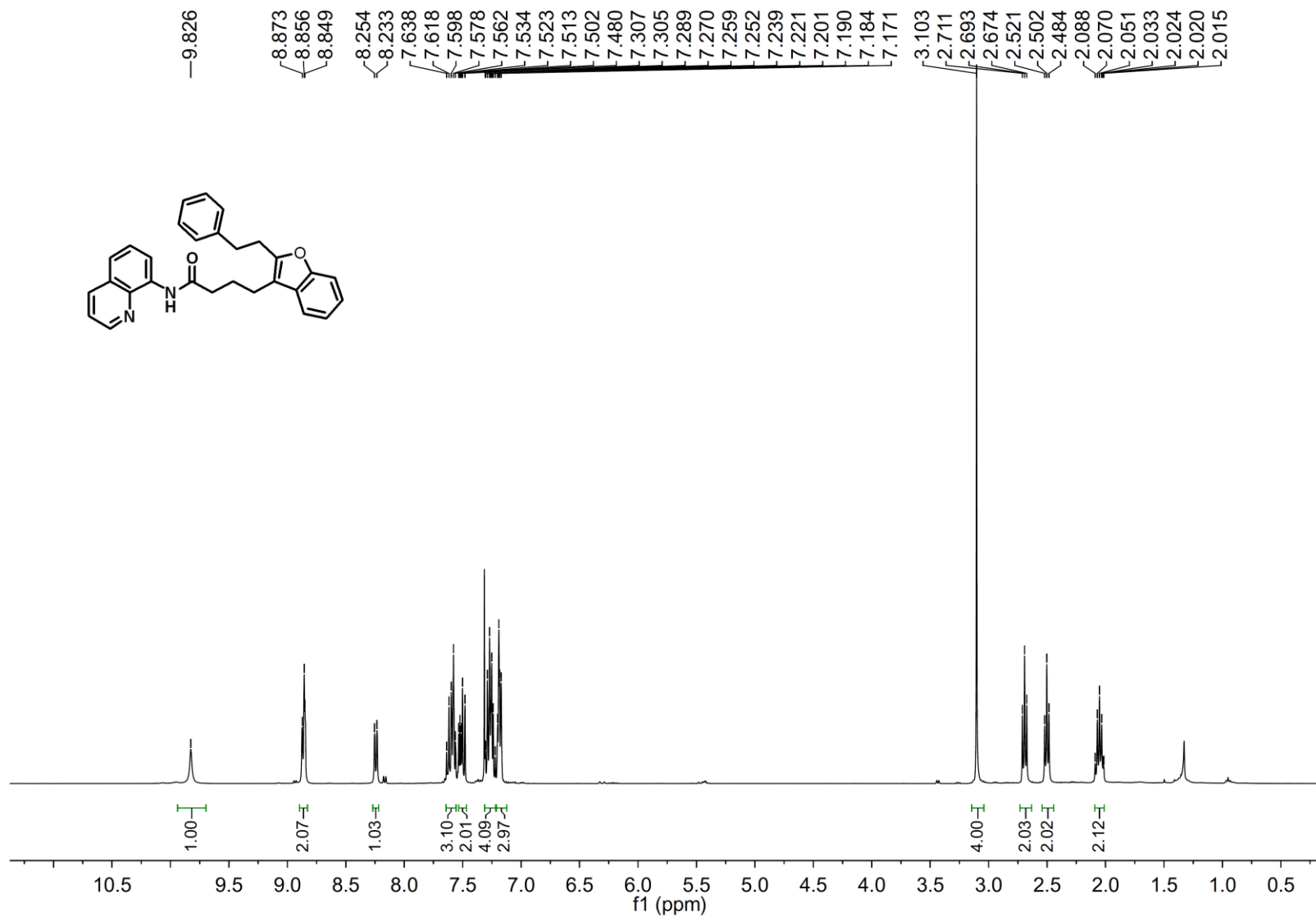
¹³C NMR Spectrum of Compound 3i



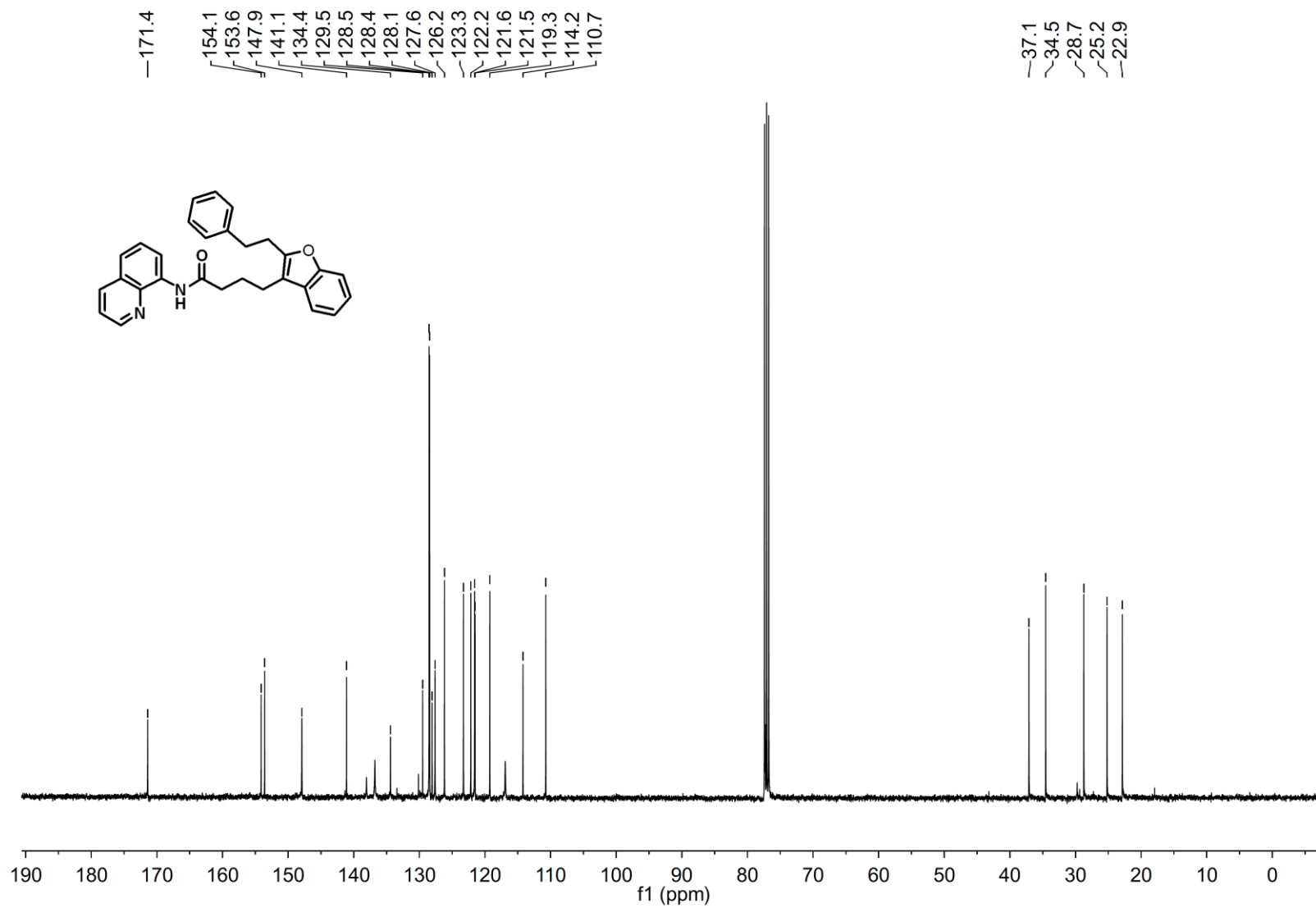
¹H NMR Spectrum of Compound 3j



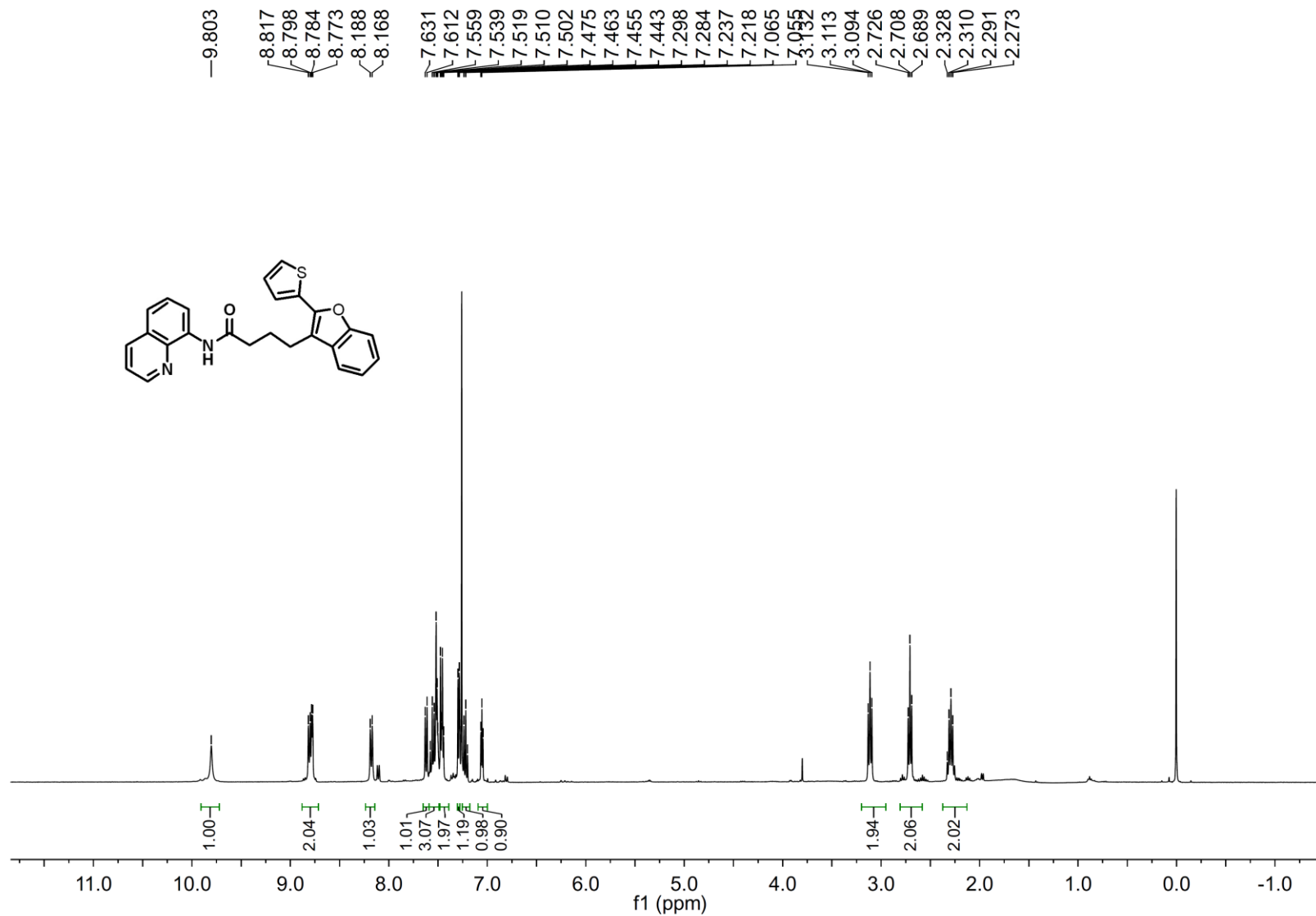
¹³C NMR Spectrum of Compound 3j



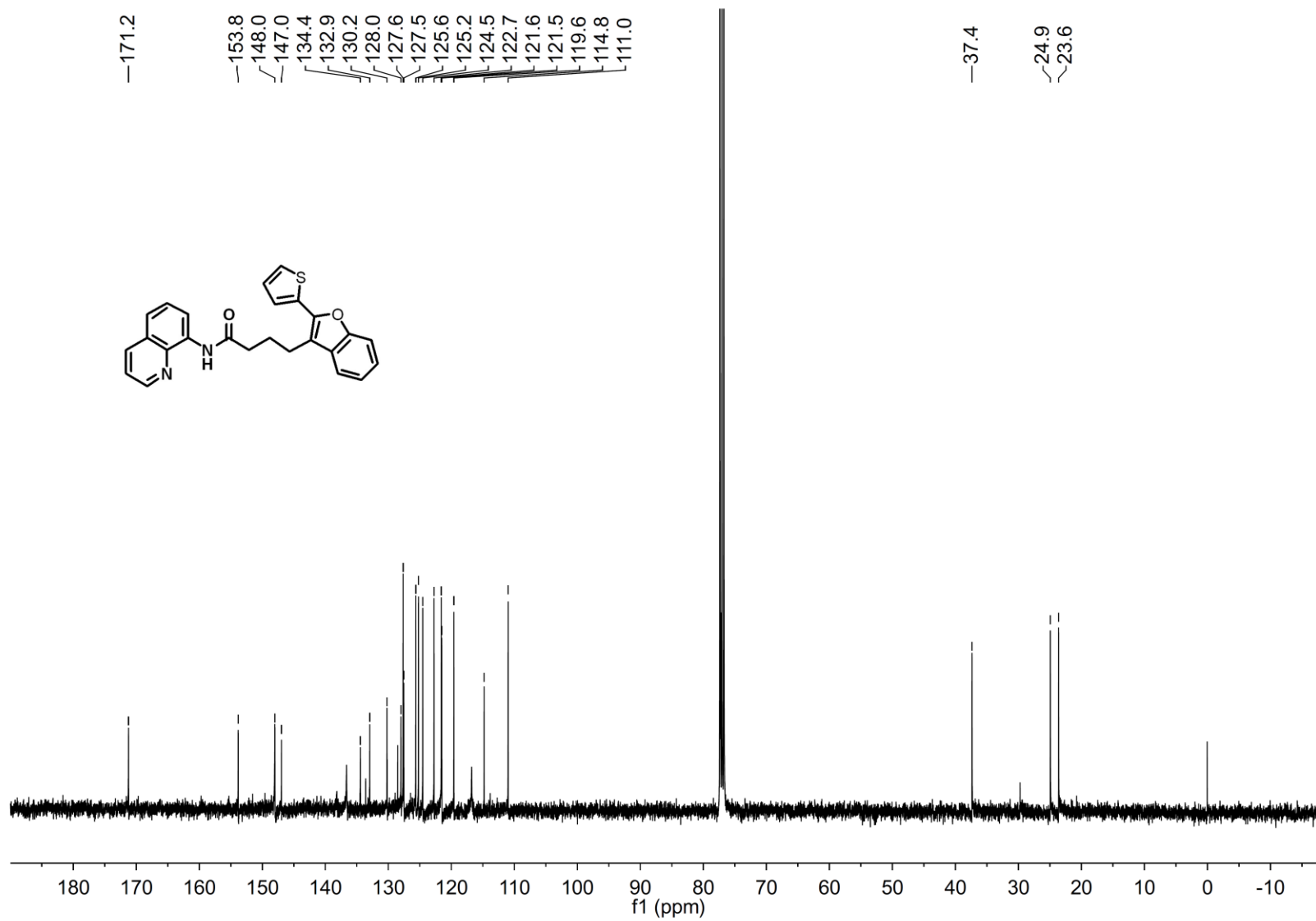
¹H NMR Spectrum of Compound 3k



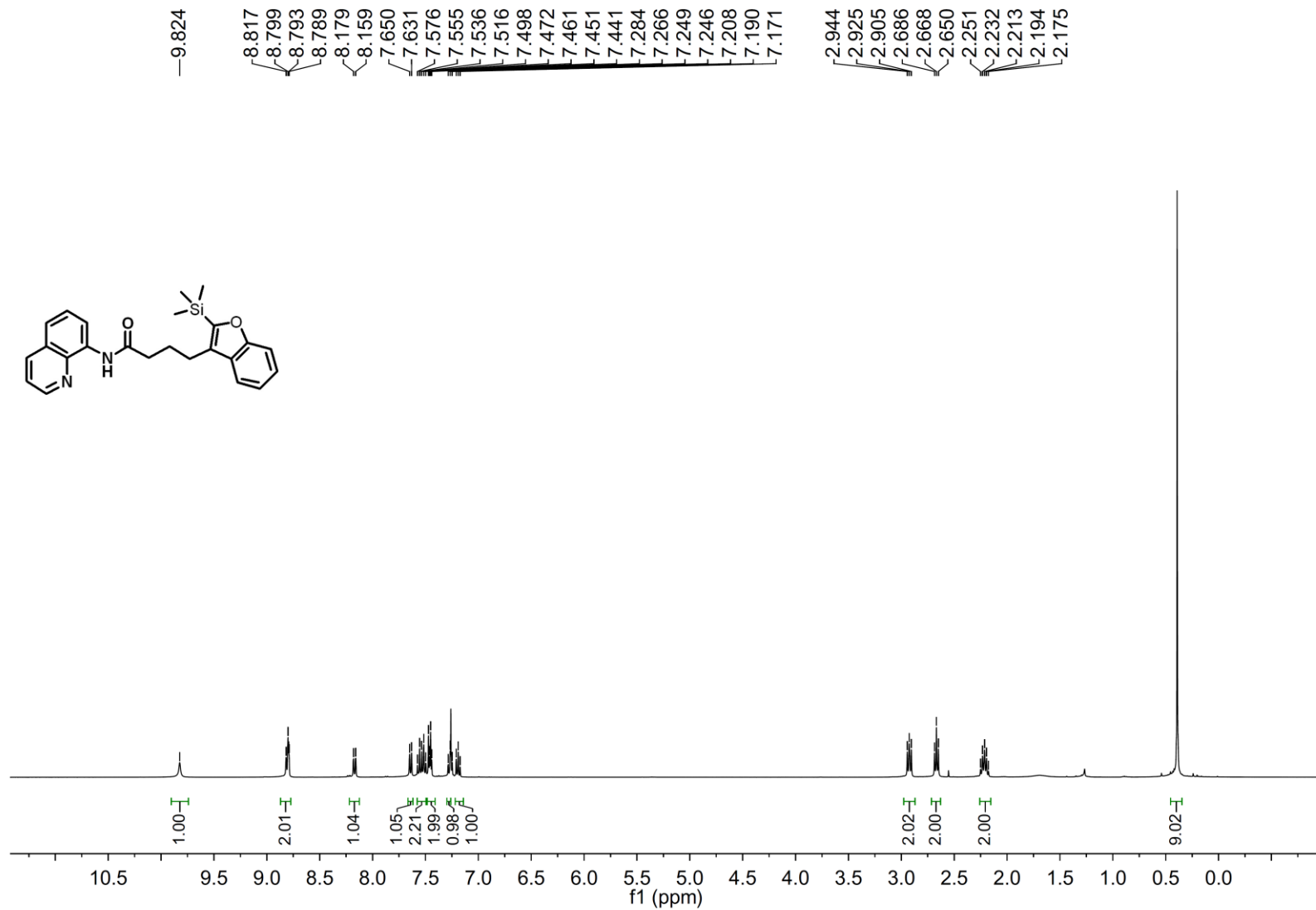
¹³C NMR Spectrum of Compound 3k



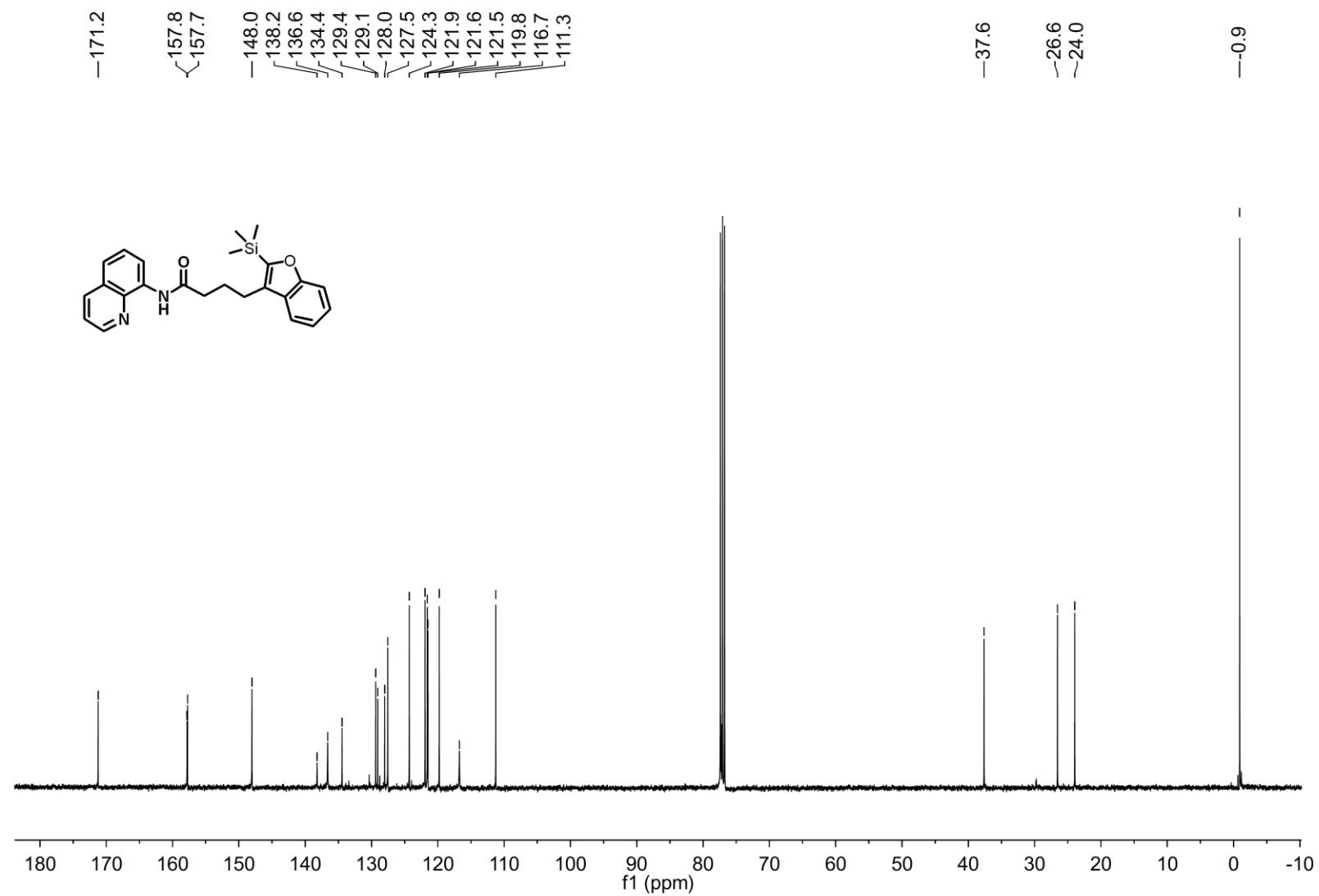
¹H NMR Spectrum of Compound 31



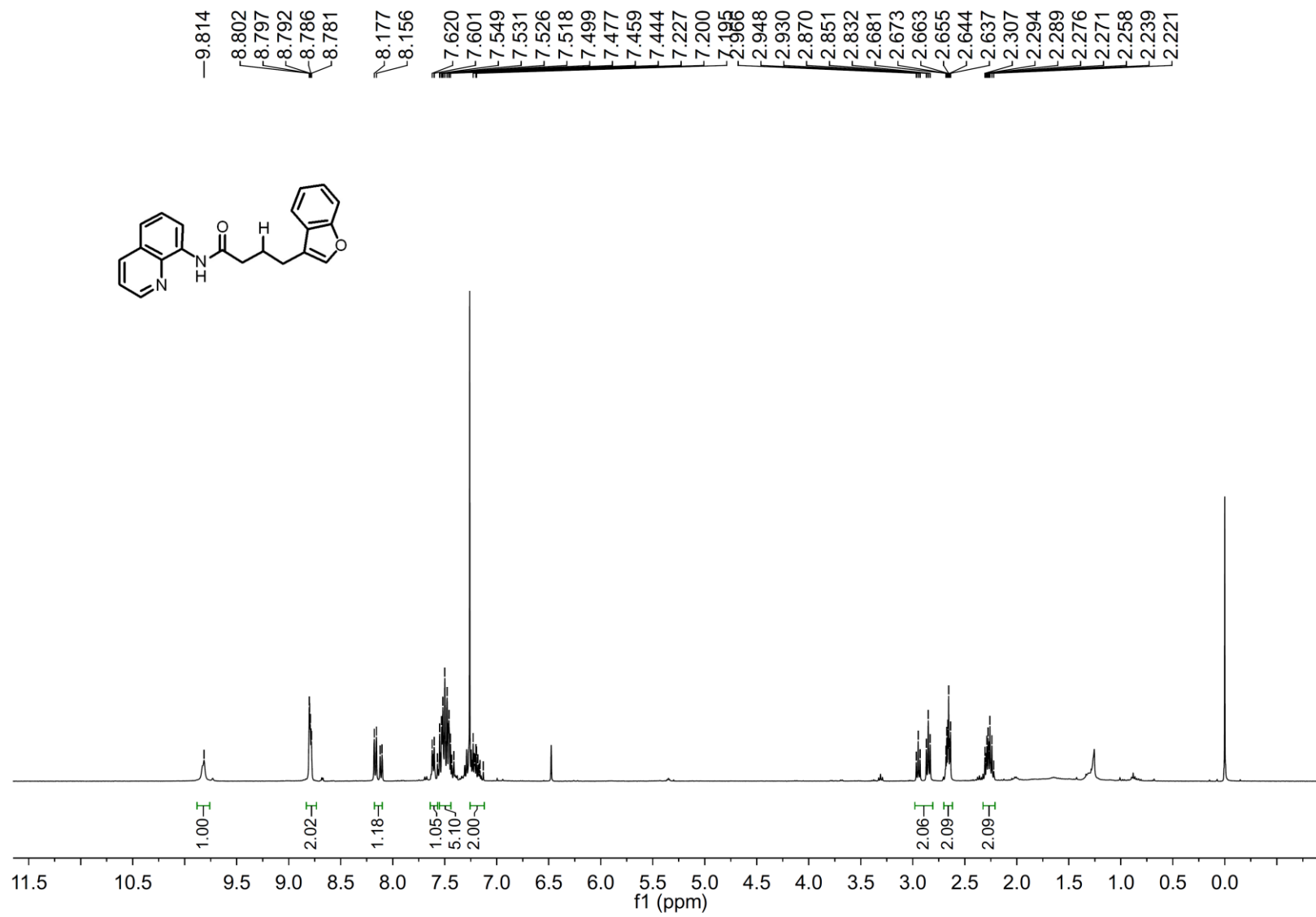
¹³C NMR Spectrum of Compound 31



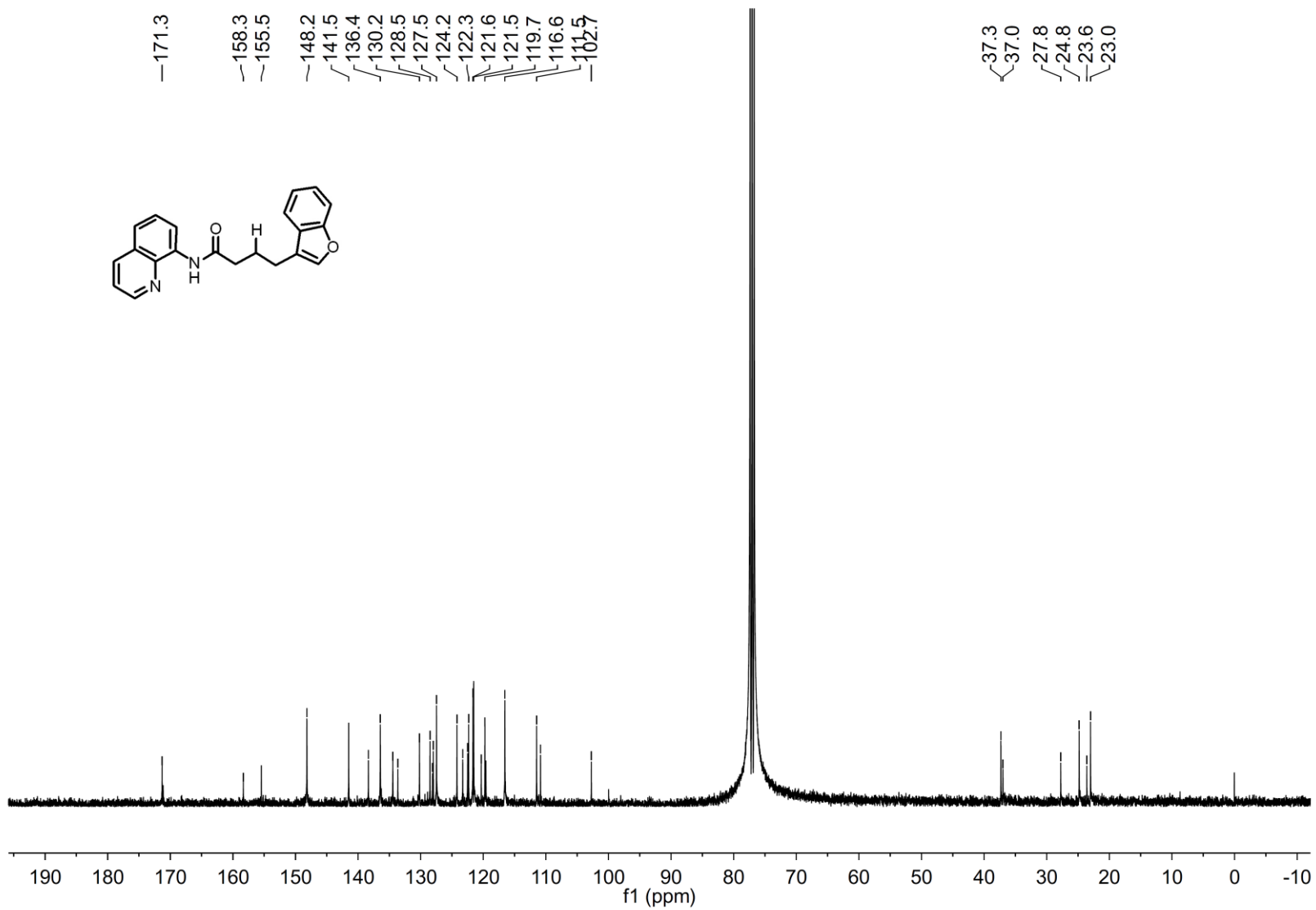
¹H NMR Spectrum of Compound 3m



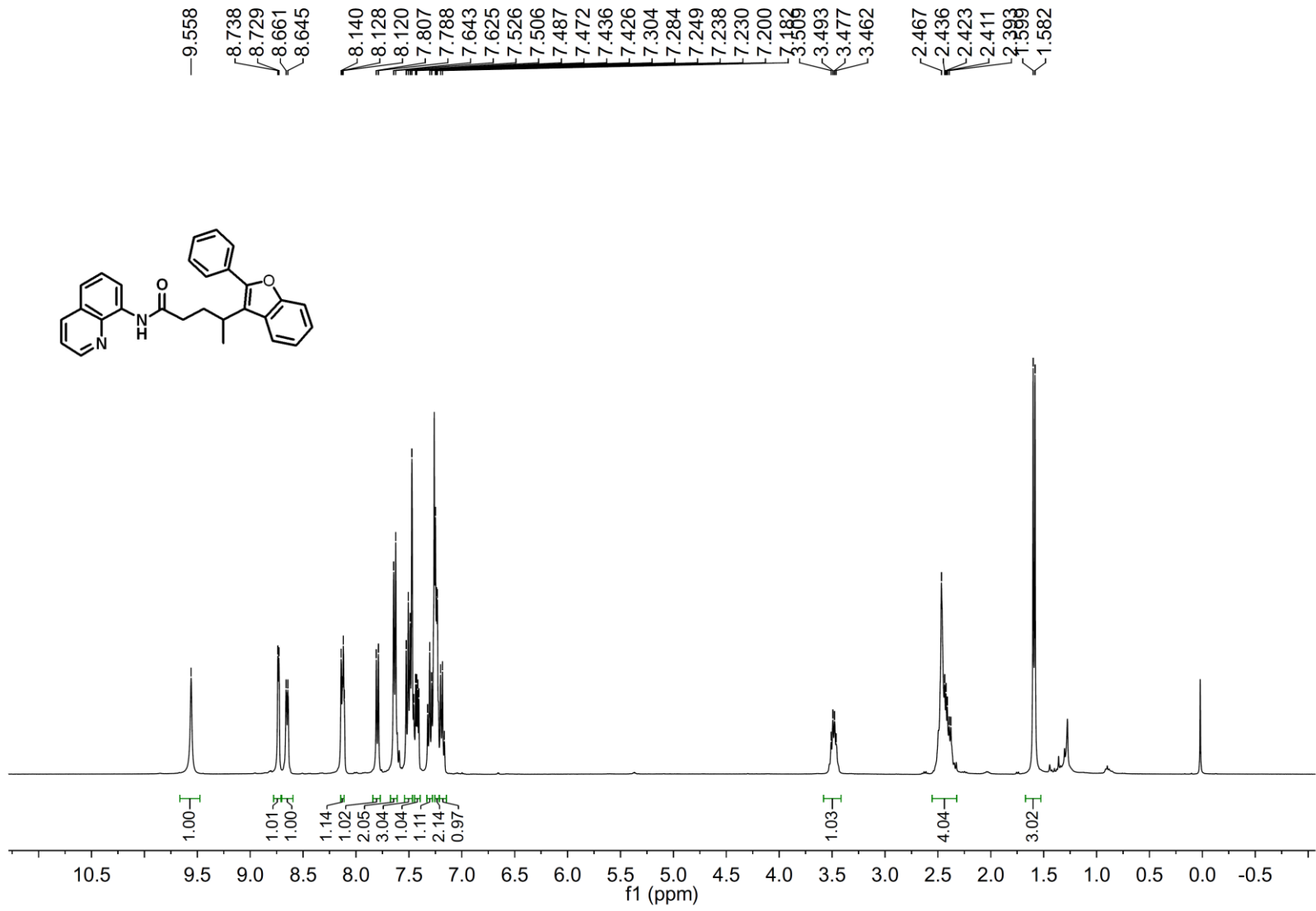
¹³C NMR Spectrum of Compound 3m



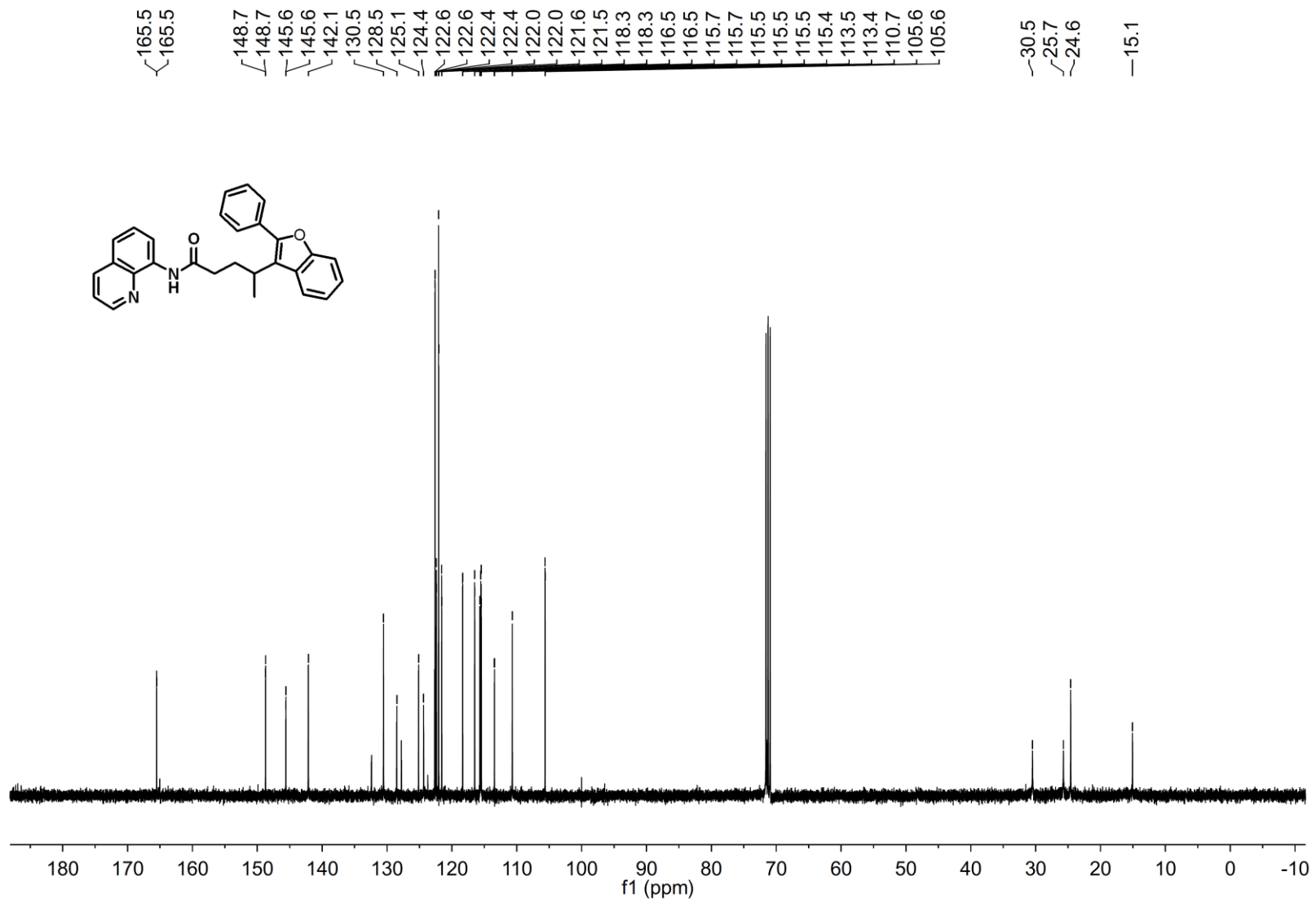
¹H NMR Spectrum of Compound 3n



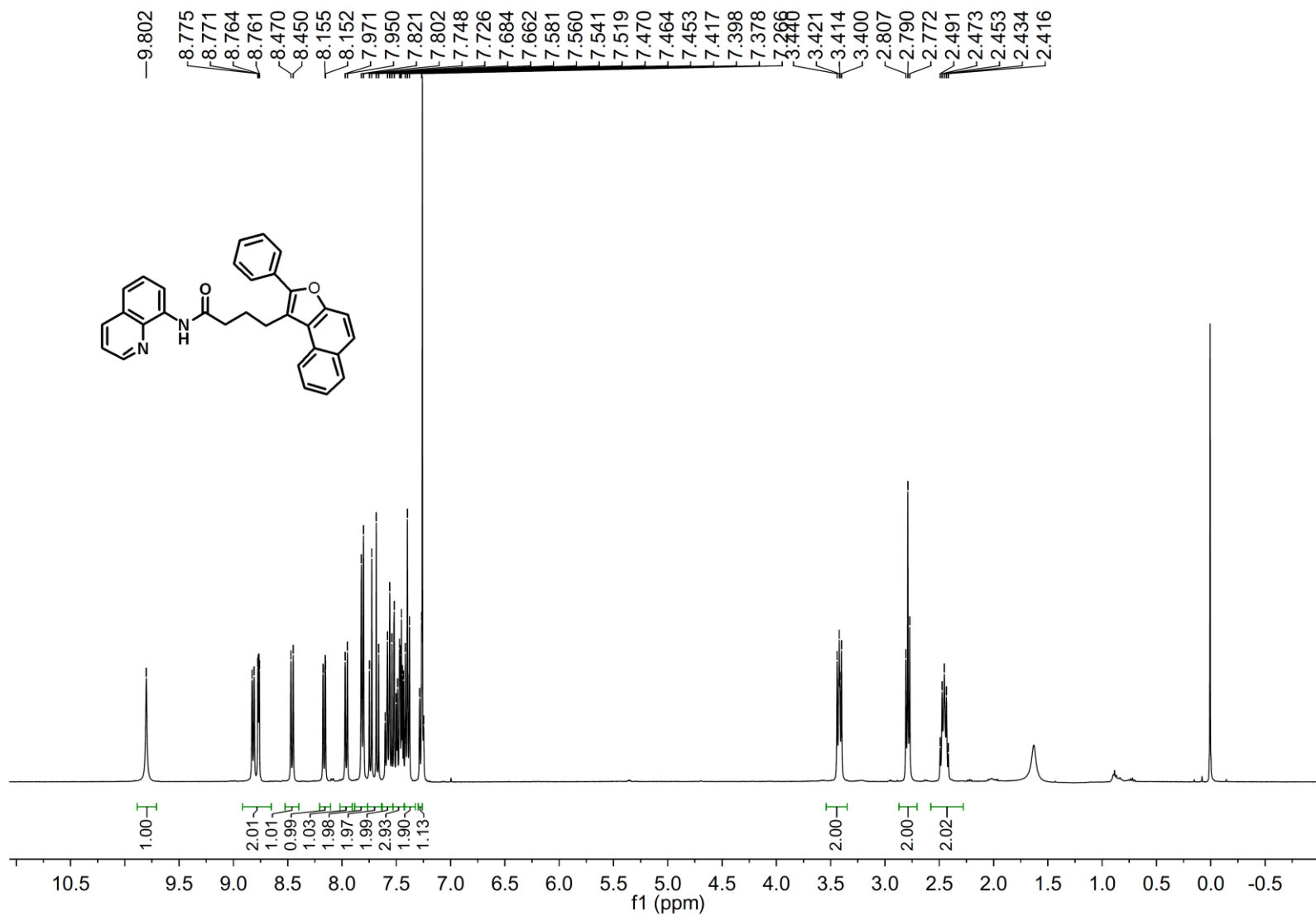
¹³C NMR Spectrum of Compound 3n



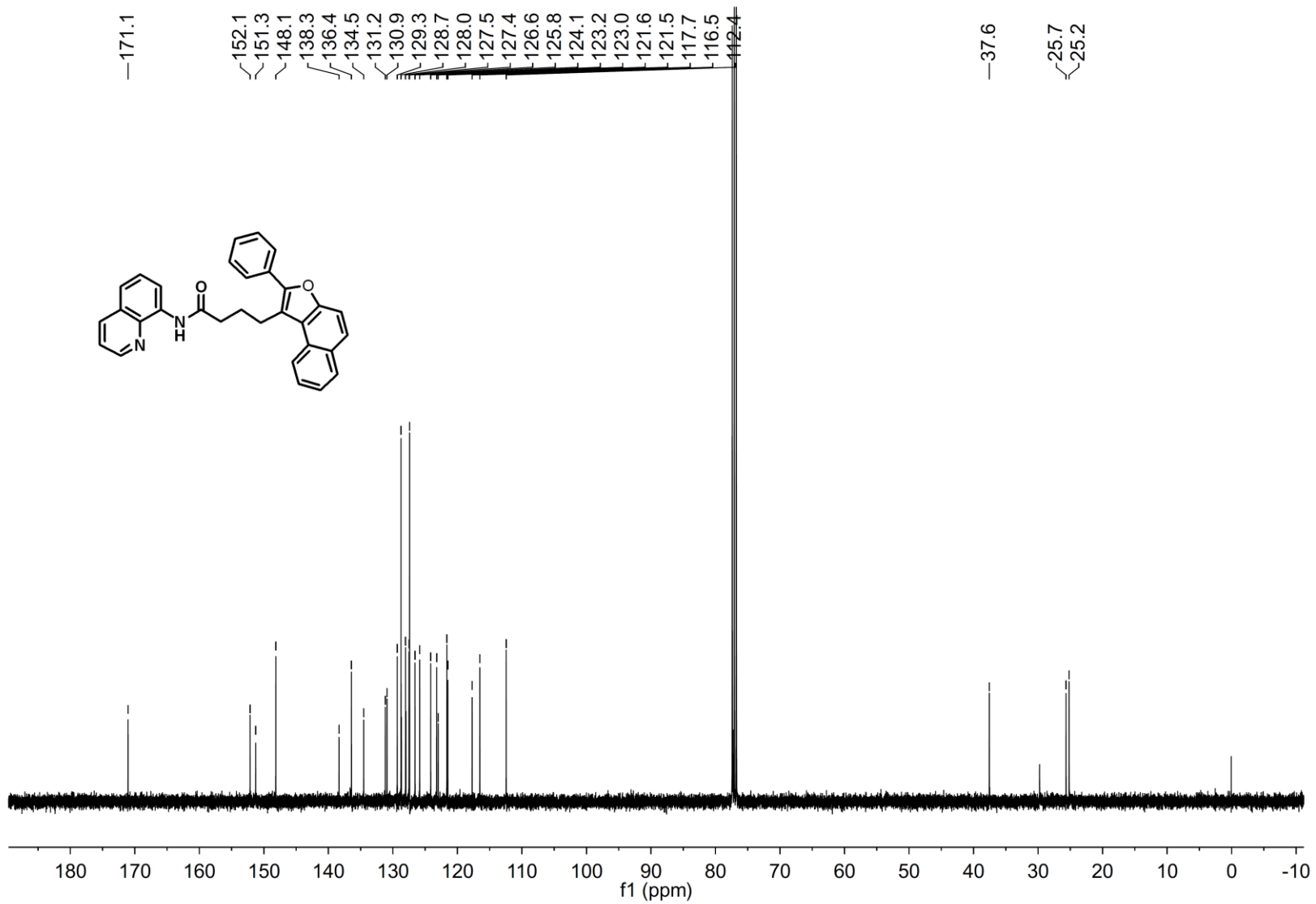
¹H NMR Spectrum of Compound 3o



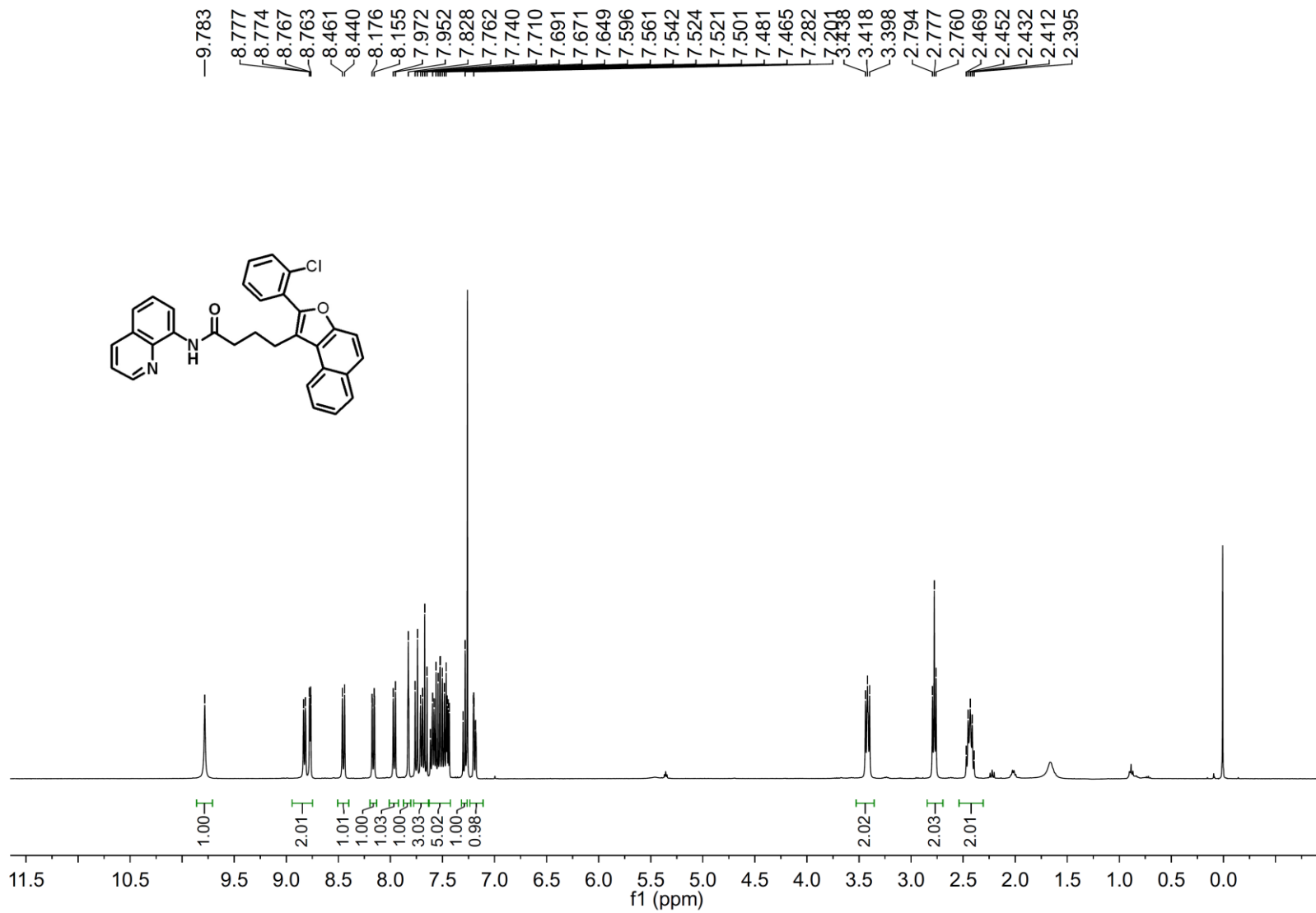
¹³C NMR Spectrum of Compound 3o



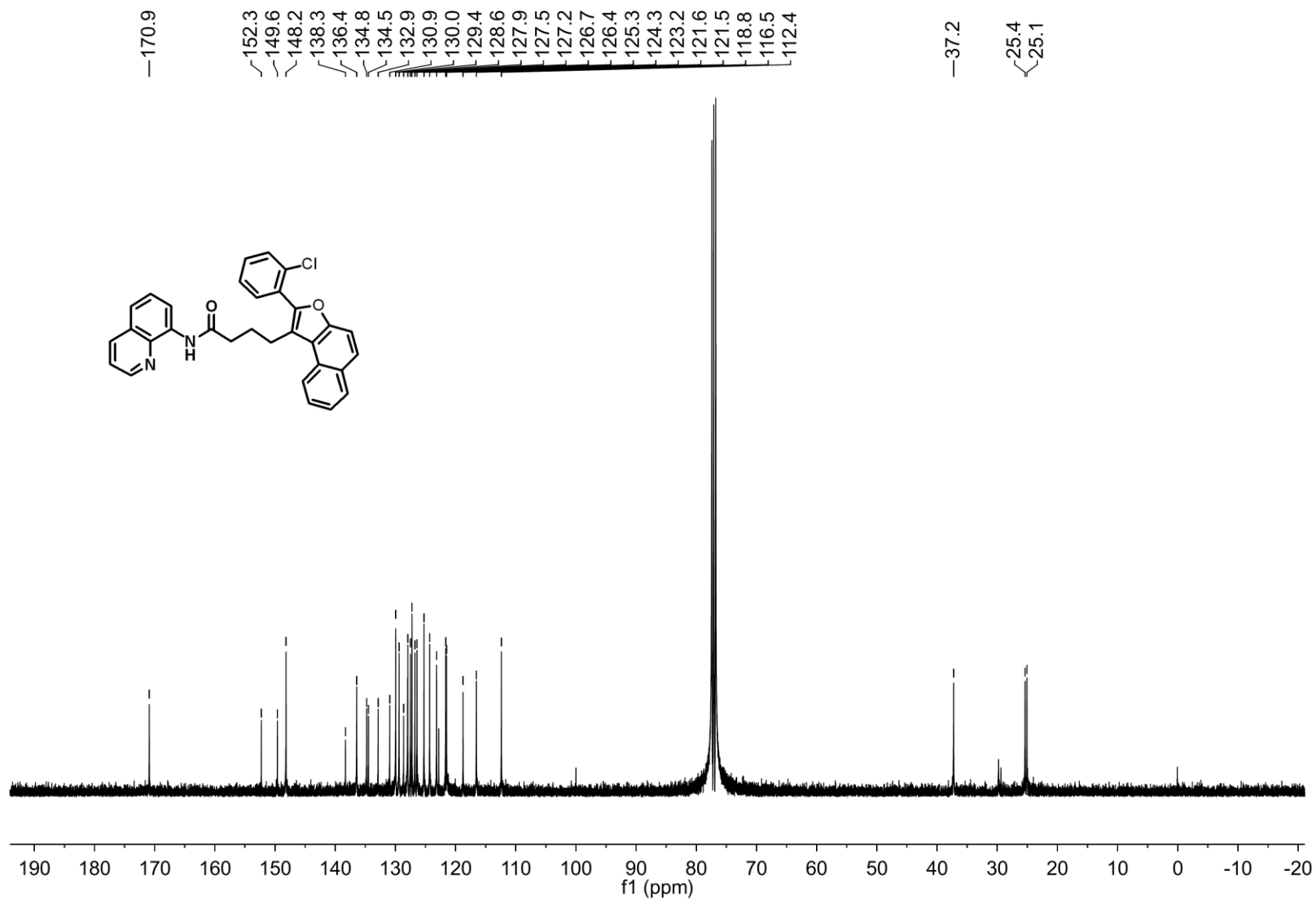
¹H NMR Spectrum of Compound 3p



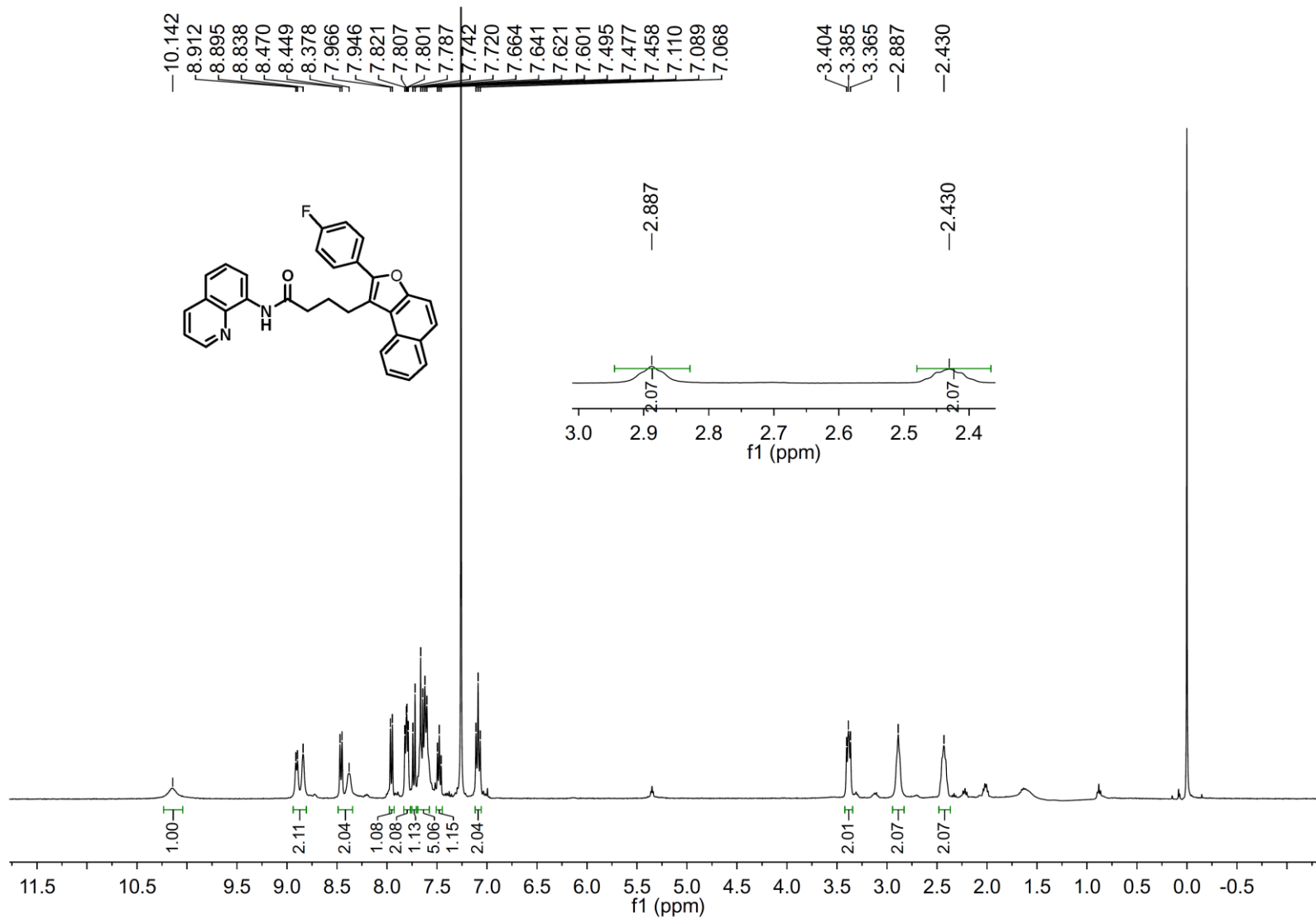
¹³C NMR Spectrum of Compound 3p



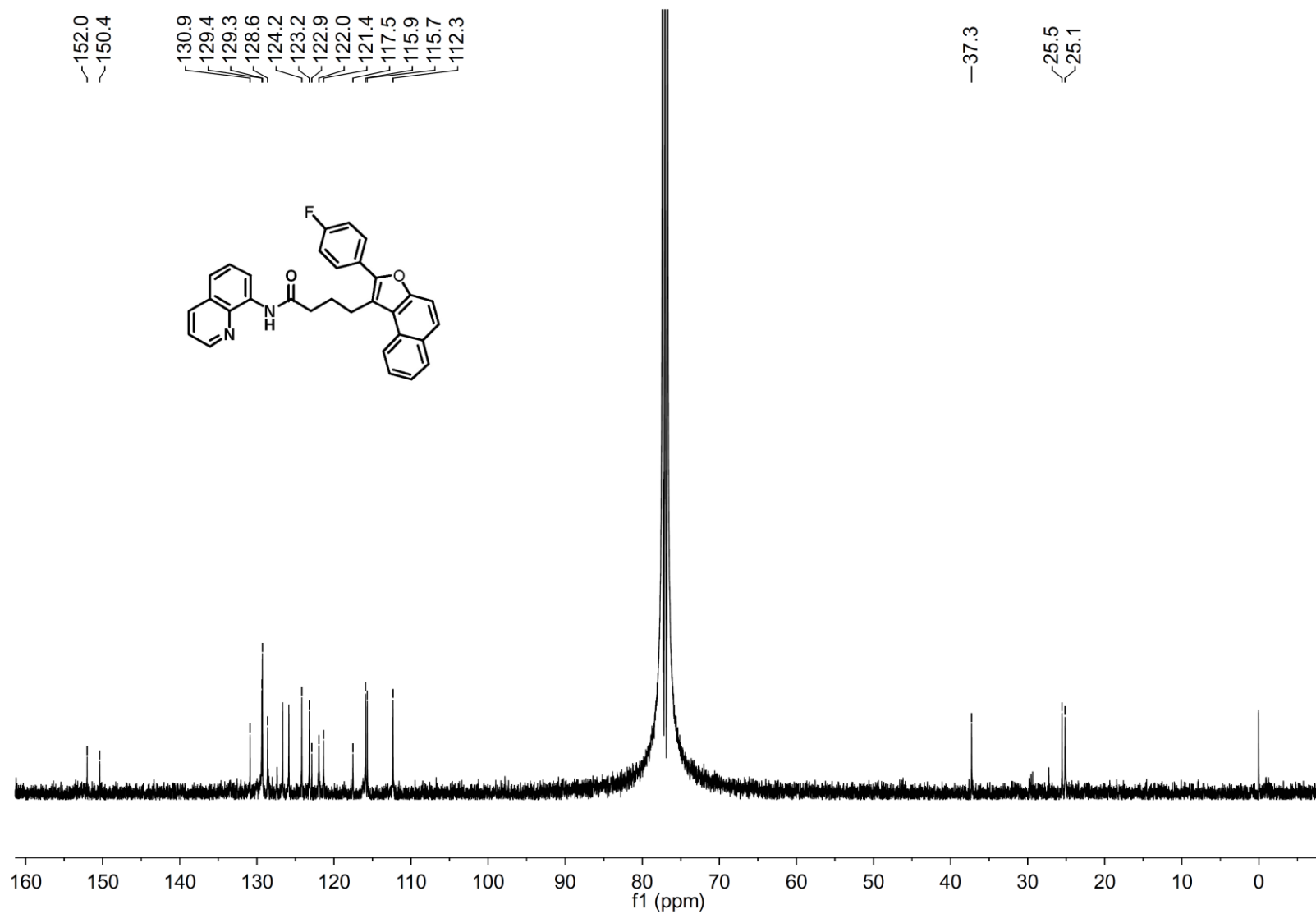
¹H NMR Spectrum of Compound 3q



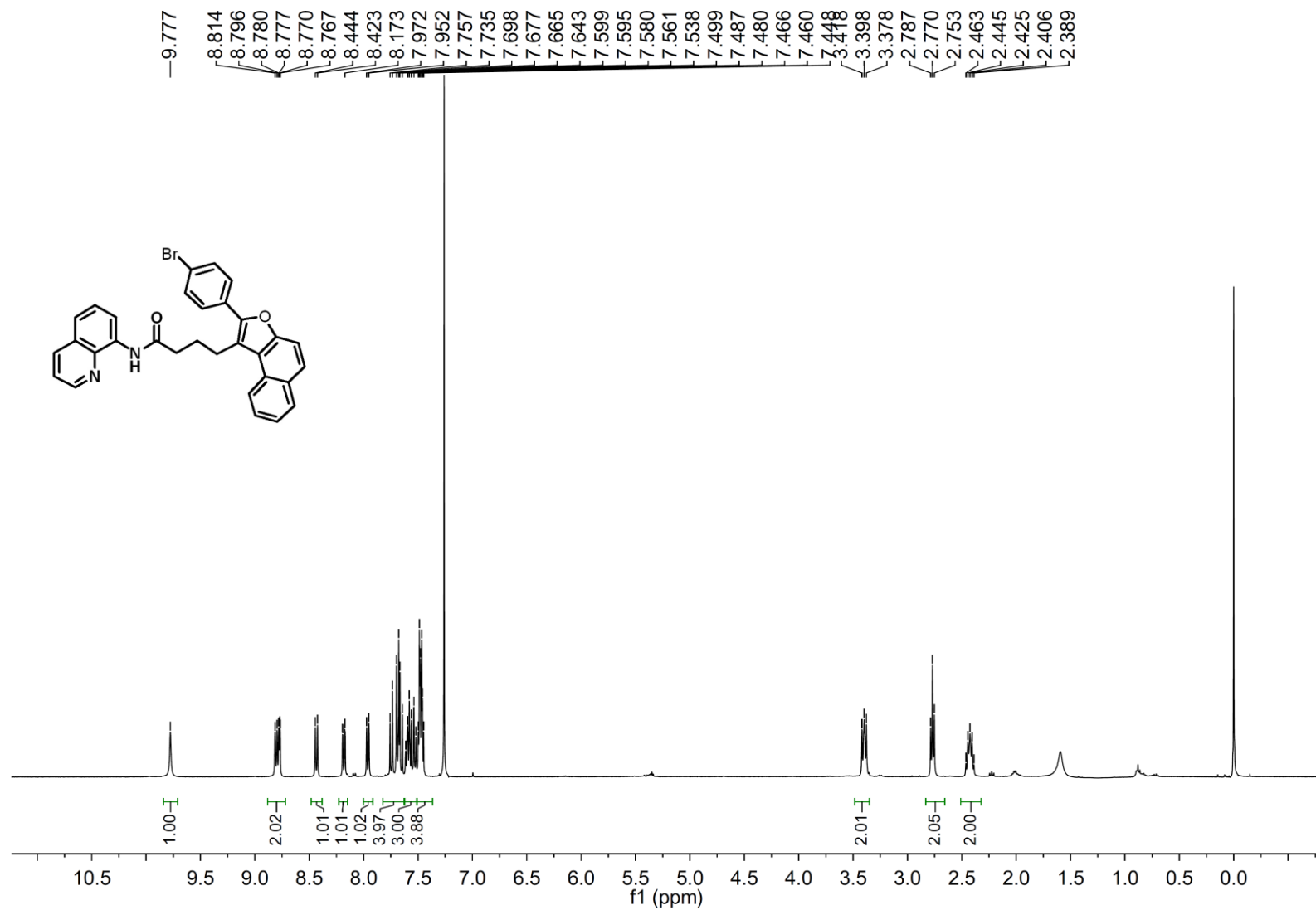
¹³C NMR Spectrum of Compound 3q



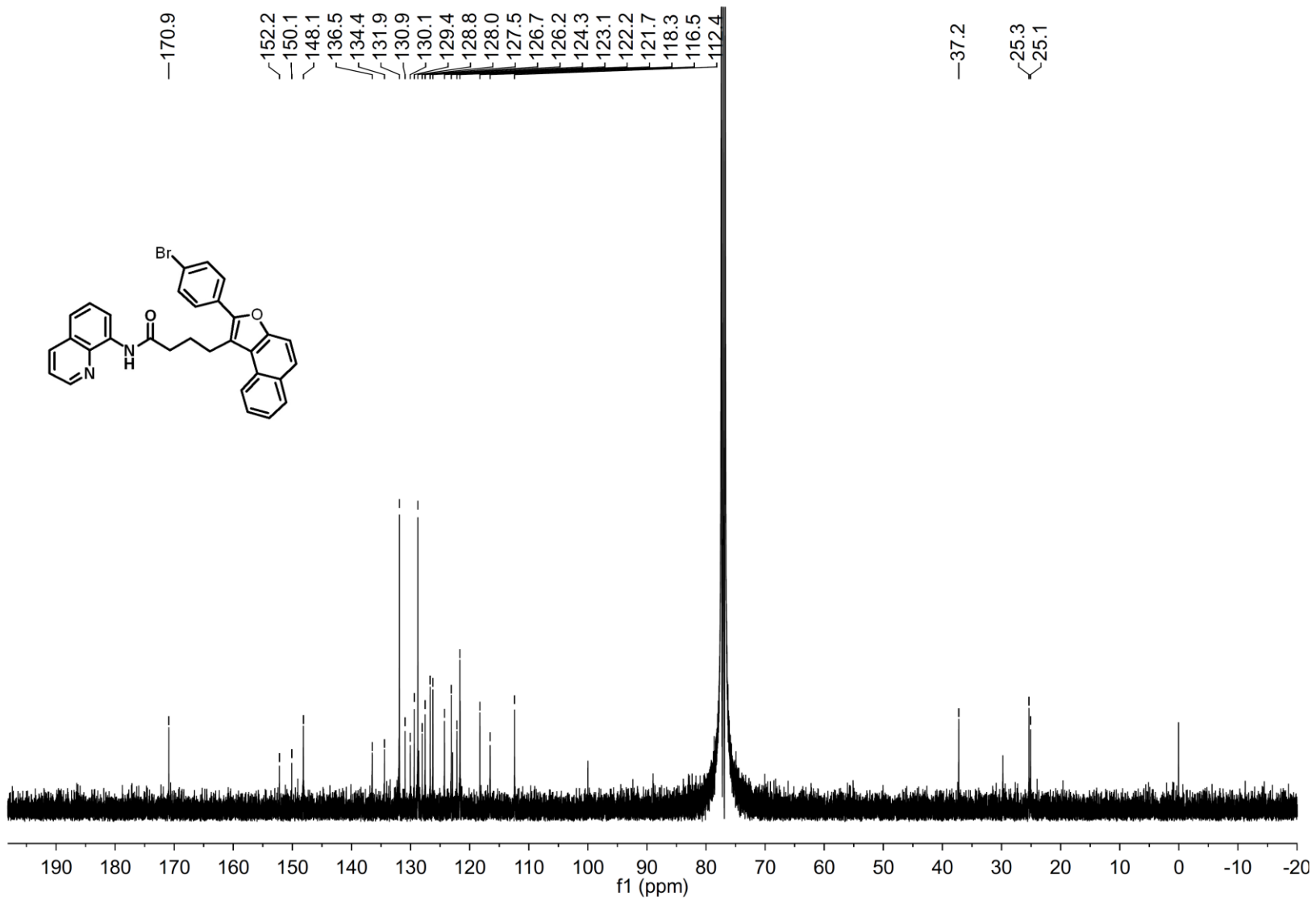
¹H NMR Spectrum of Compound 3r



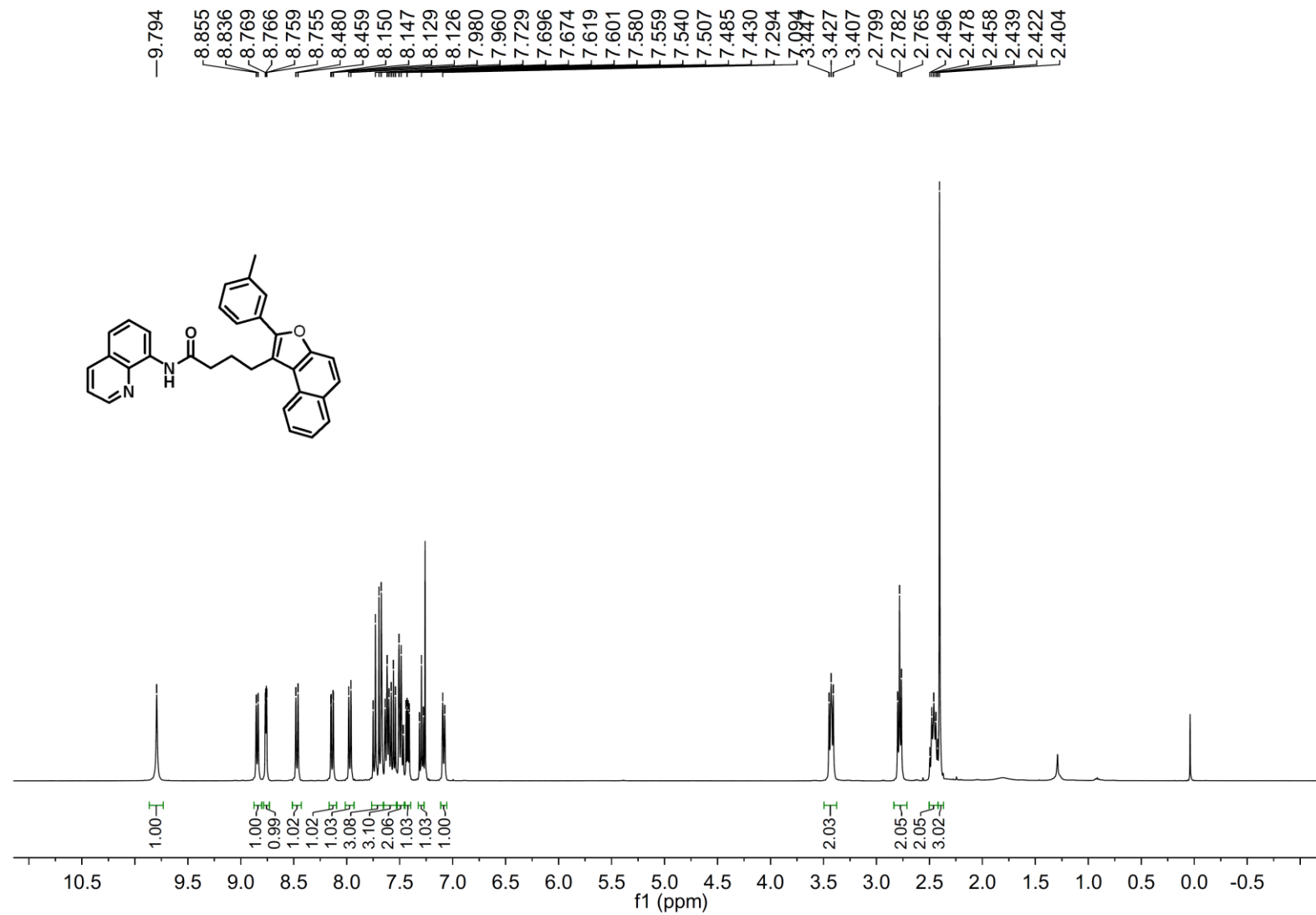
¹³C NMR Spectrum of Compound 3r



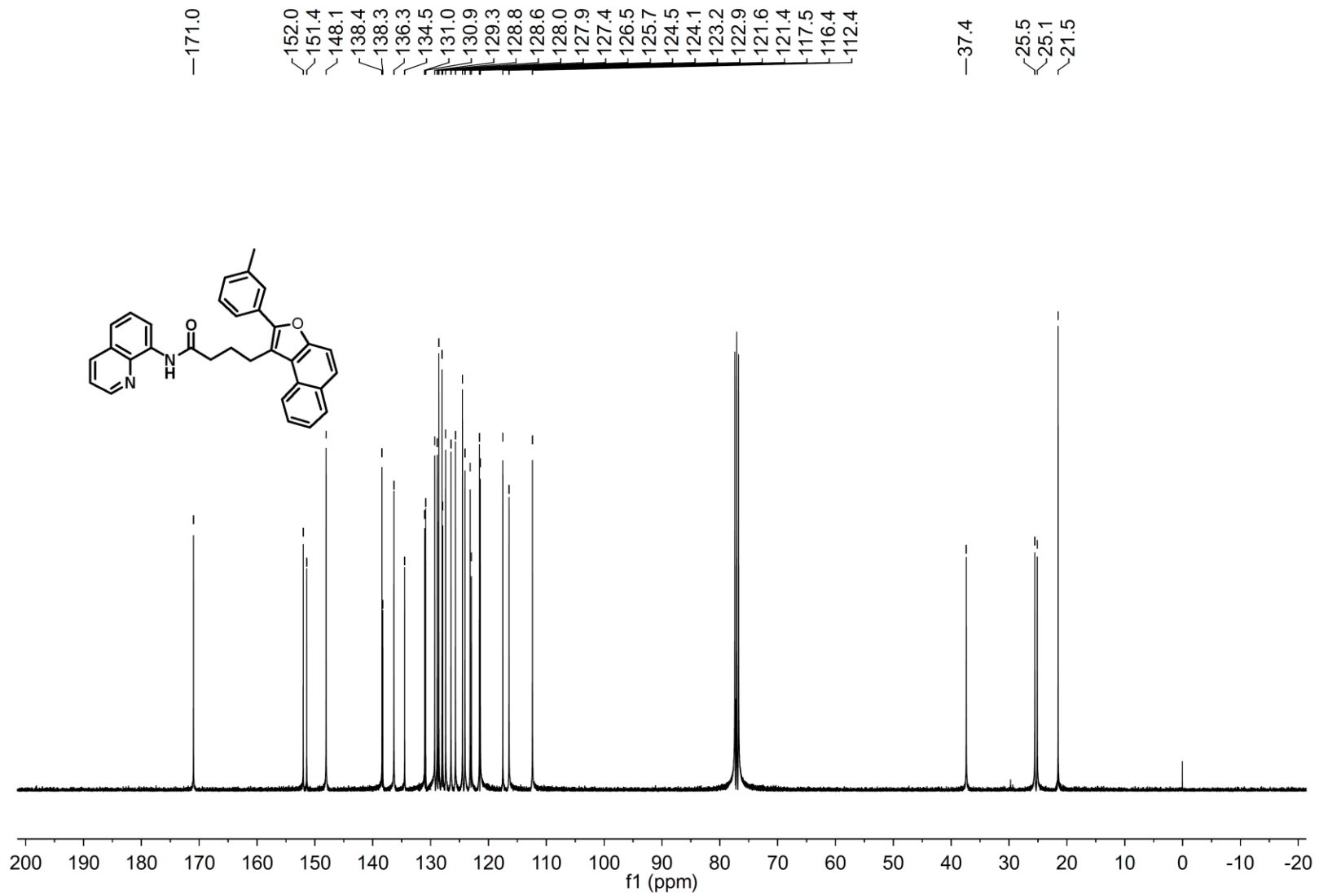
¹H NMR Spectrum of Compound 3s



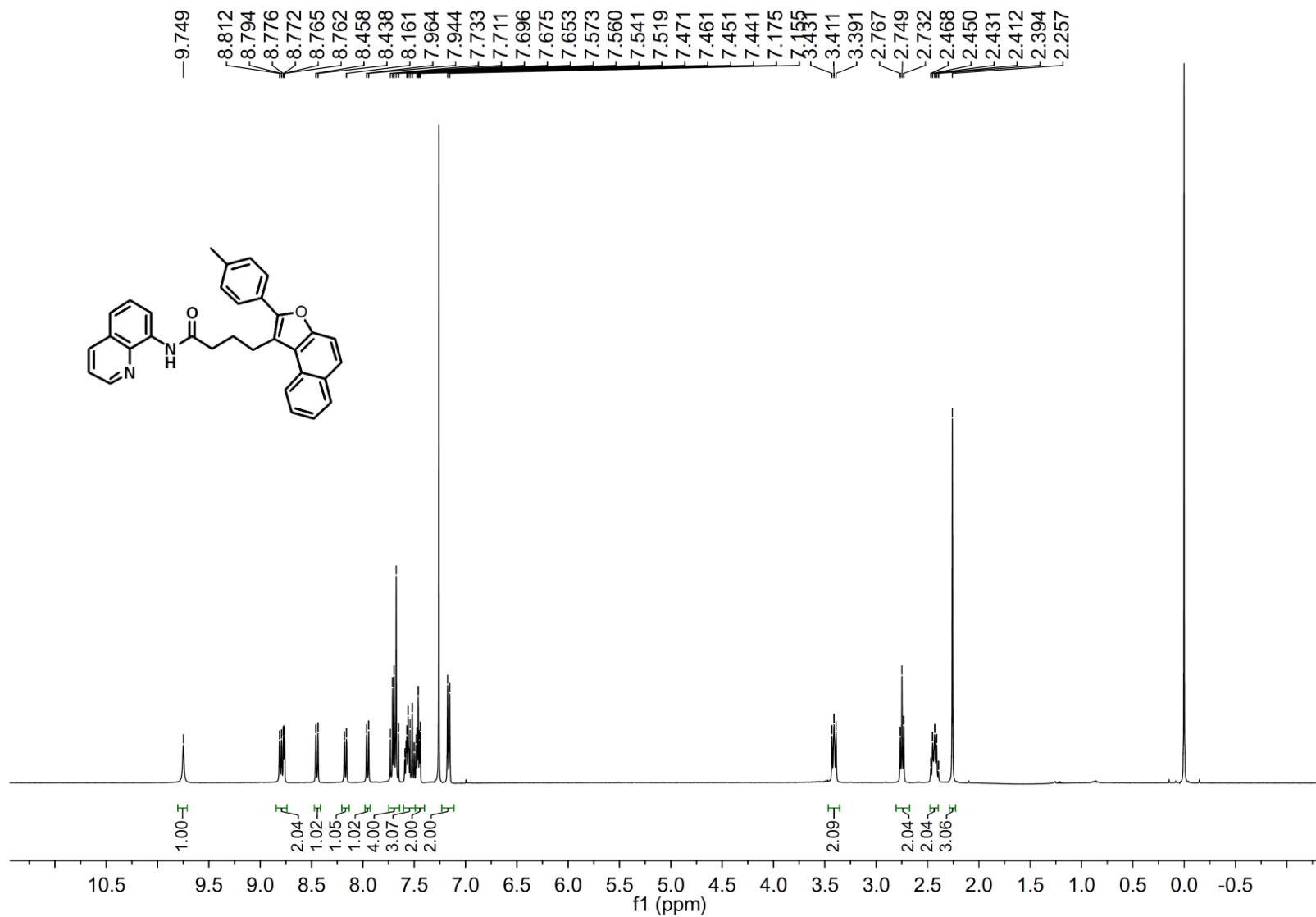
¹³C NMR Spectrum of Compound 3s



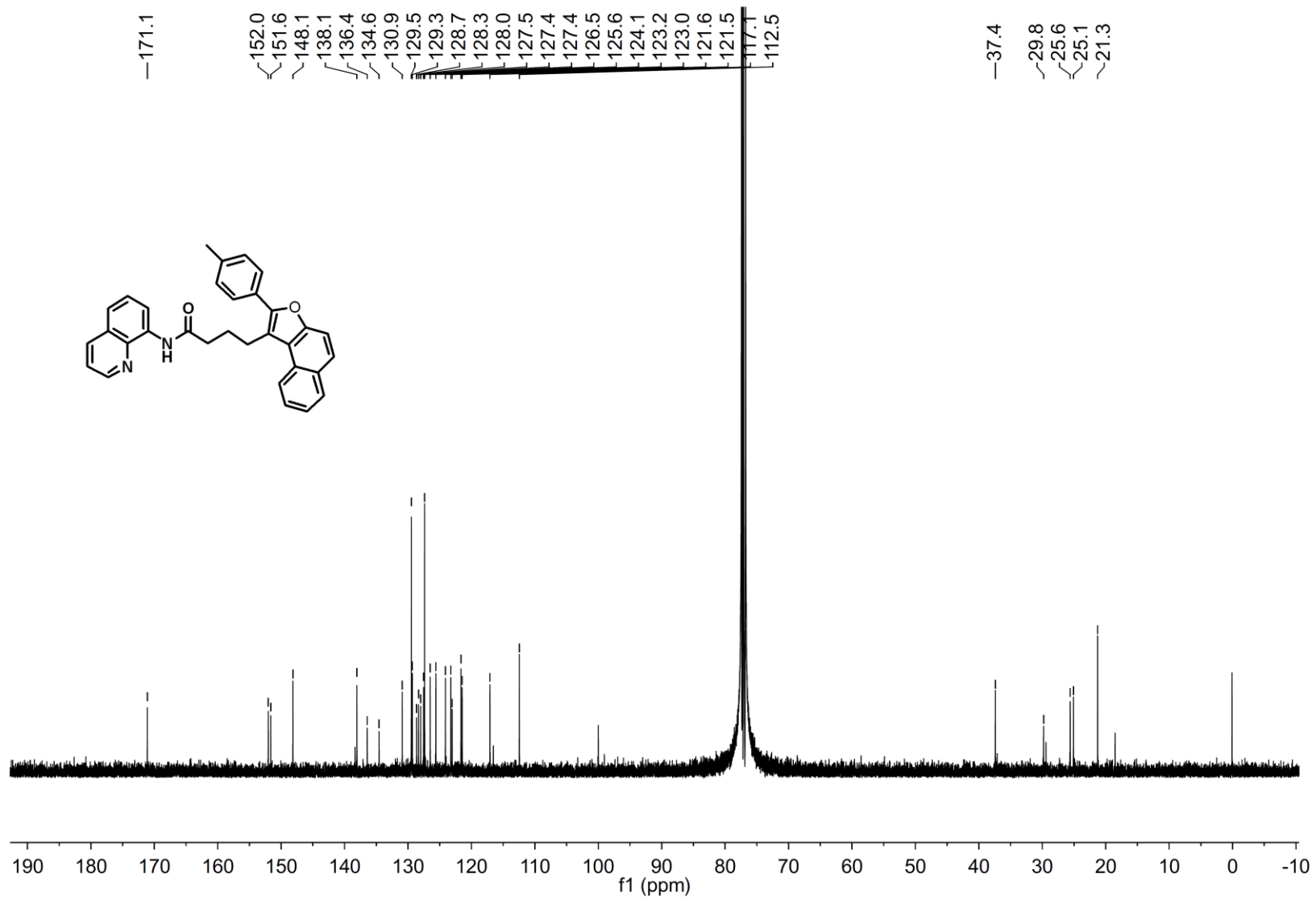
¹H NMR Spectrum of Compound 3t



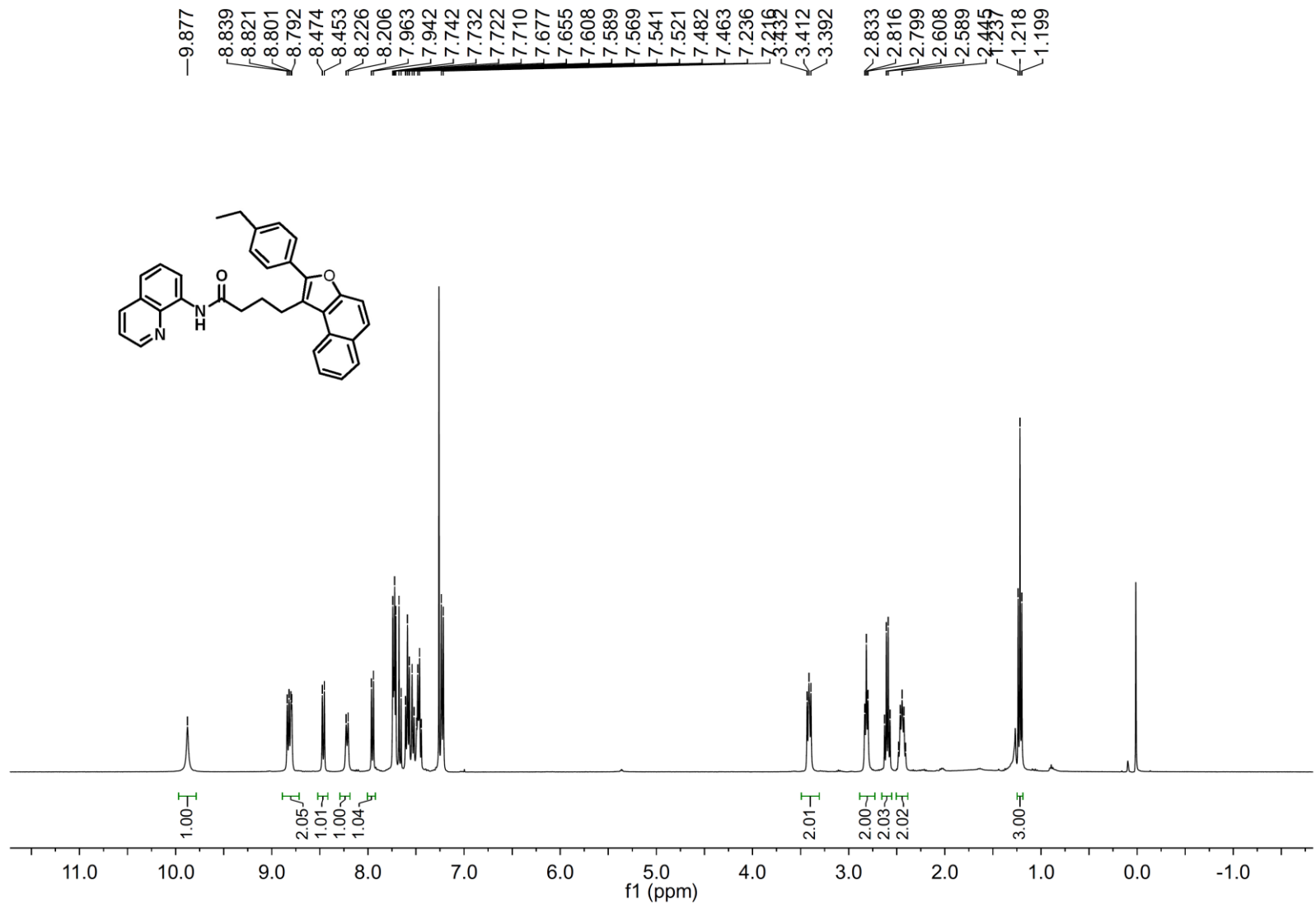
¹³C NMR Spectrum of Compound 3t



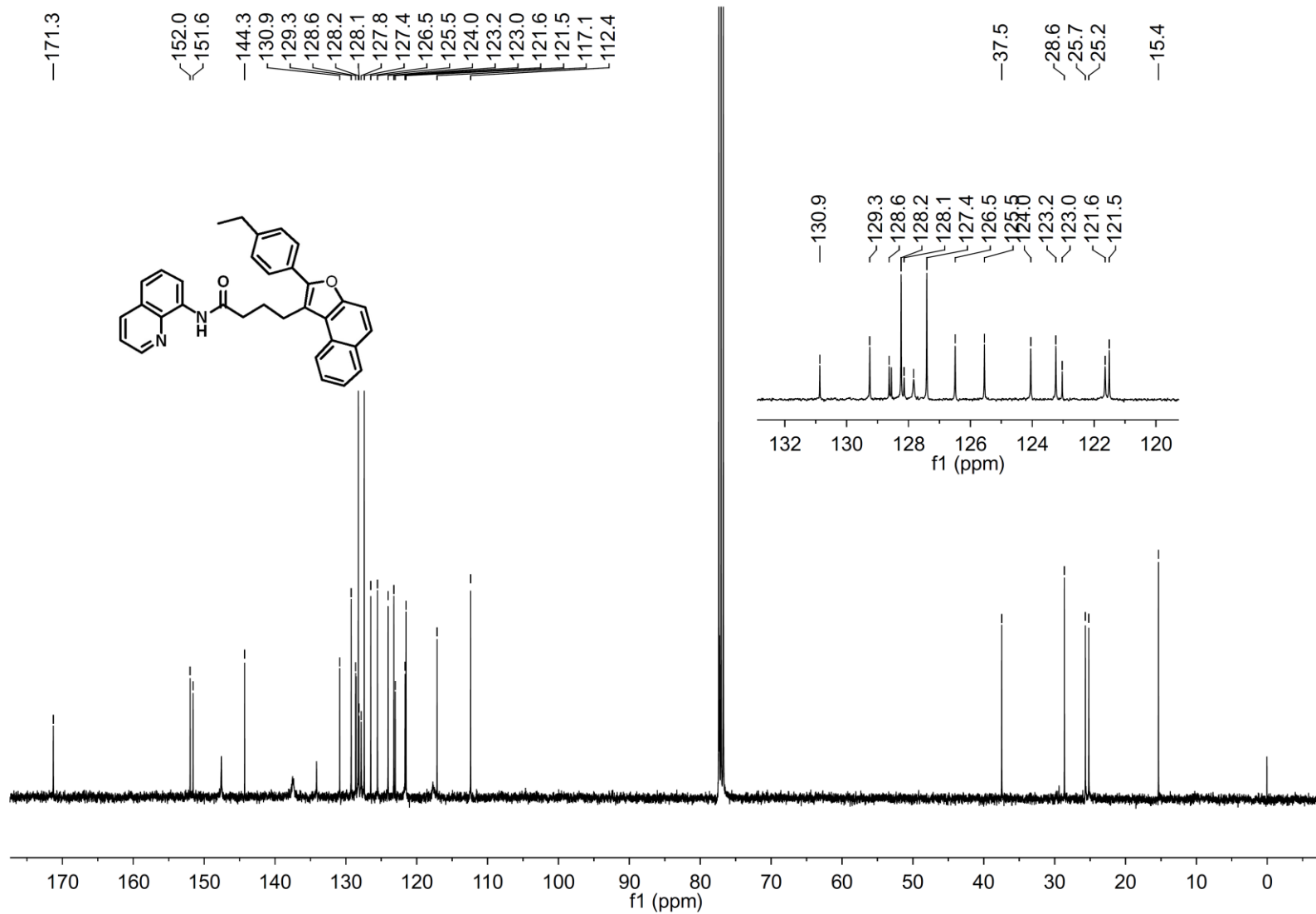
¹H NMR Spectrum of Compound 3u



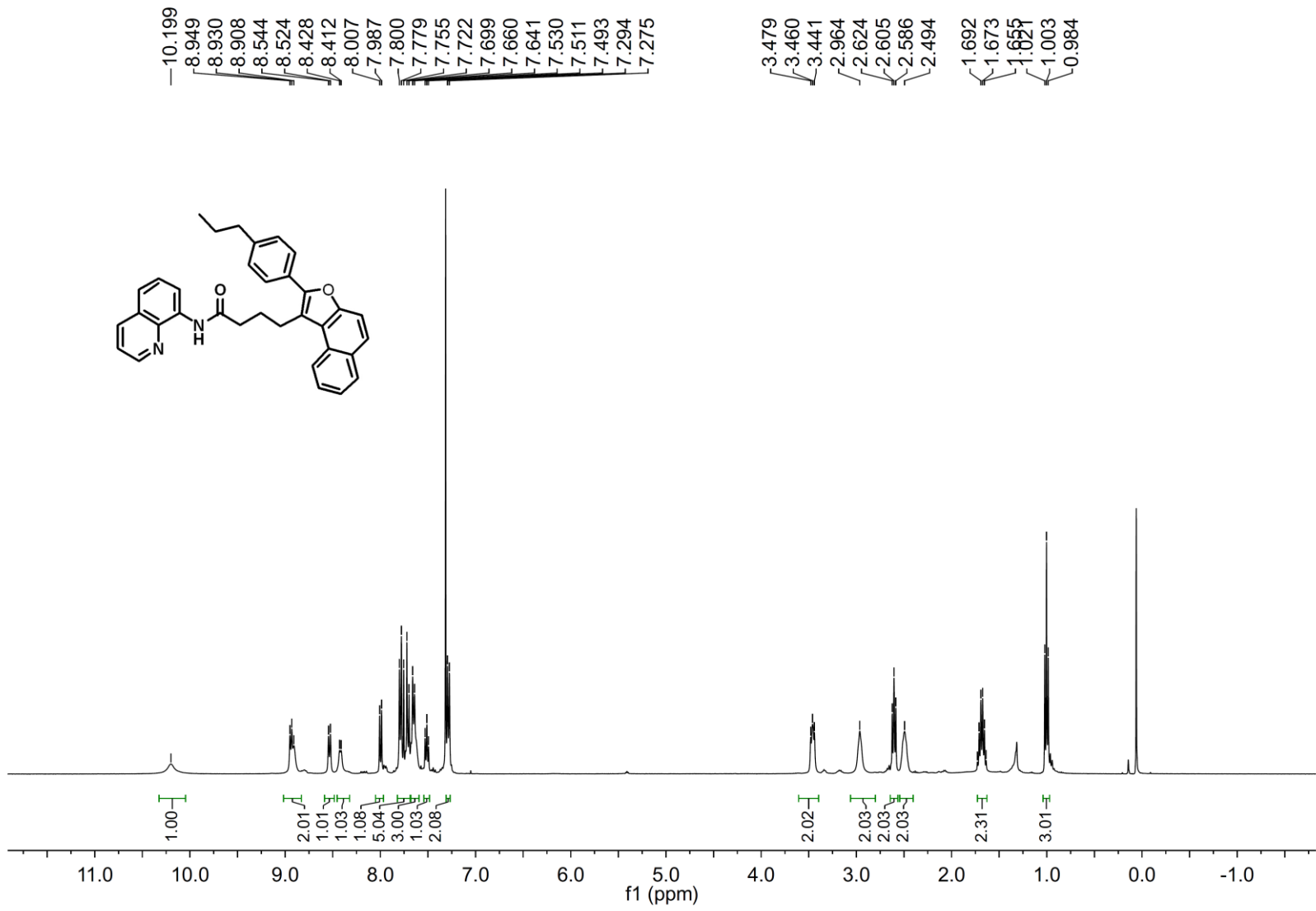
¹³C NMR Spectrum of Compound 3u



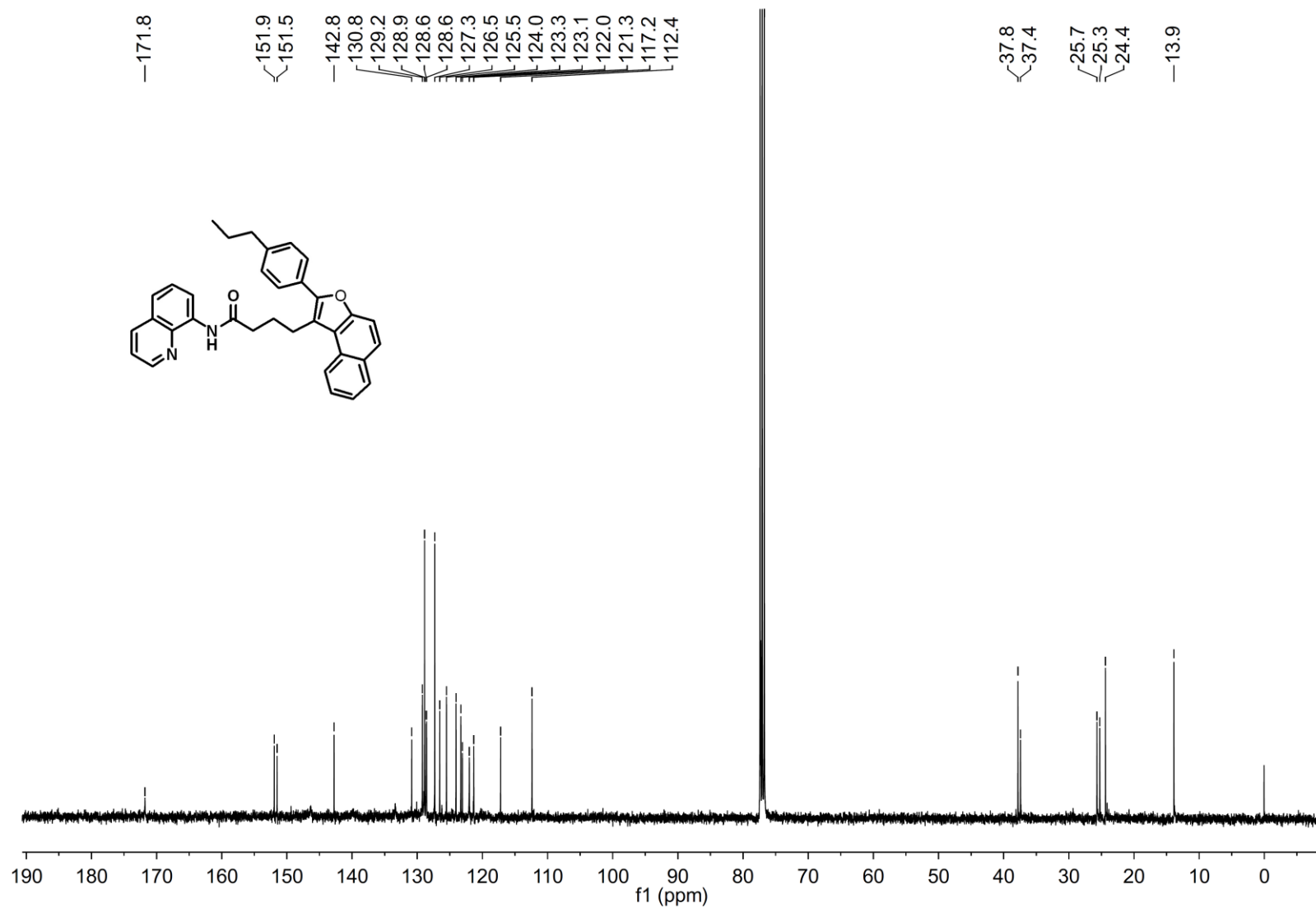
¹H NMR Spectrum of Compound 3v



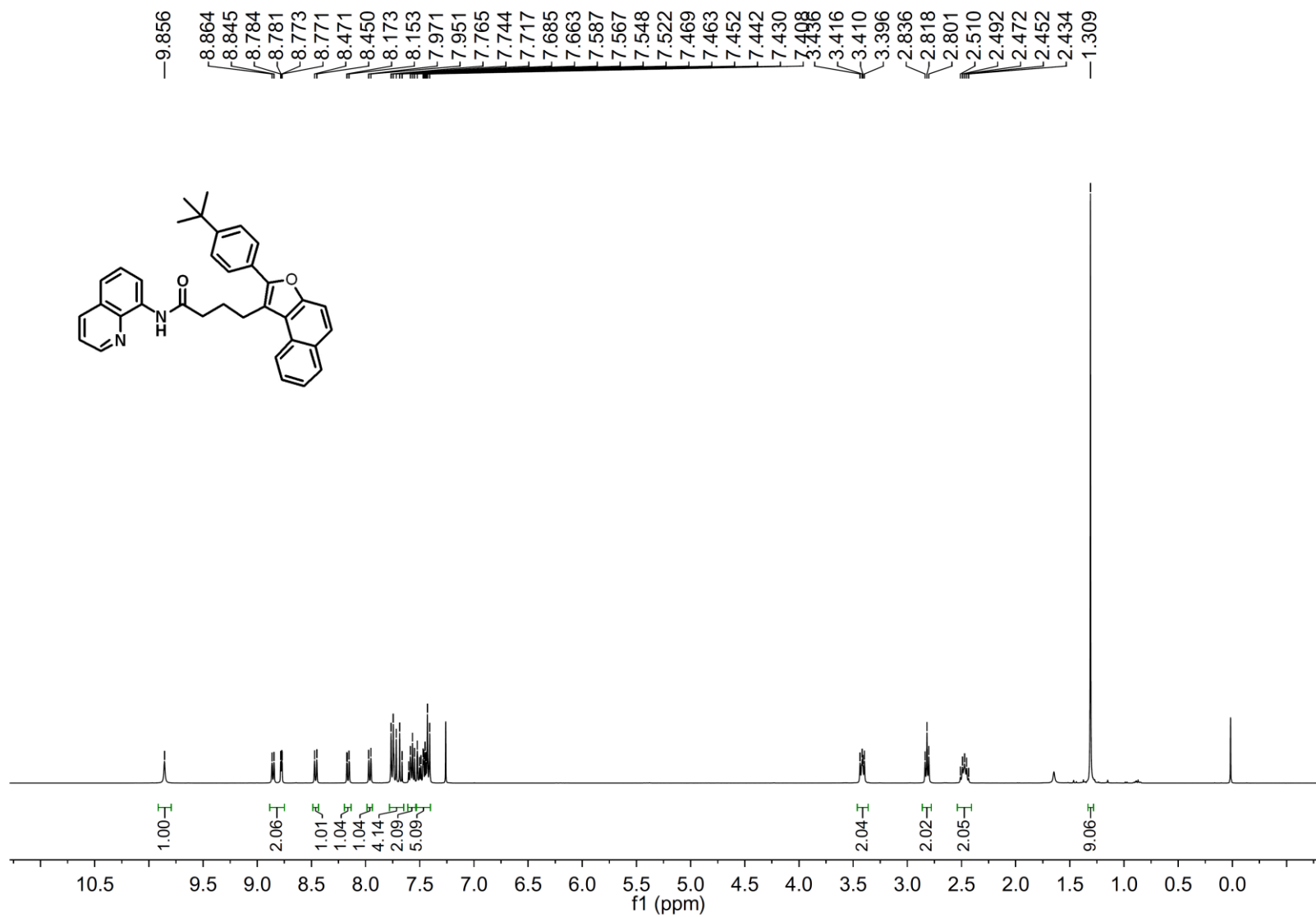
¹³C NMR Spectrum of Compound 3v



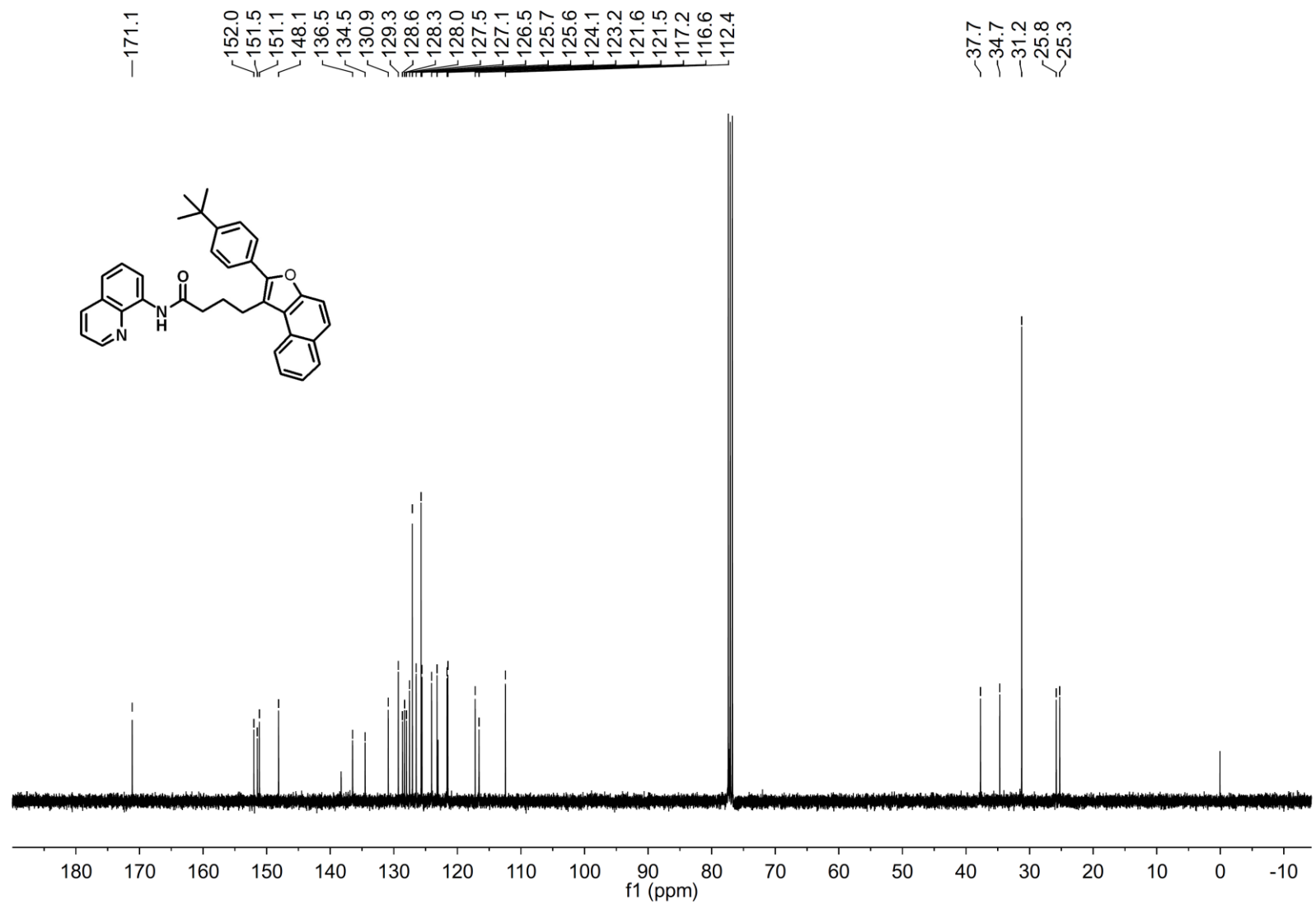
¹H NMR Spectrum of Compound 3w



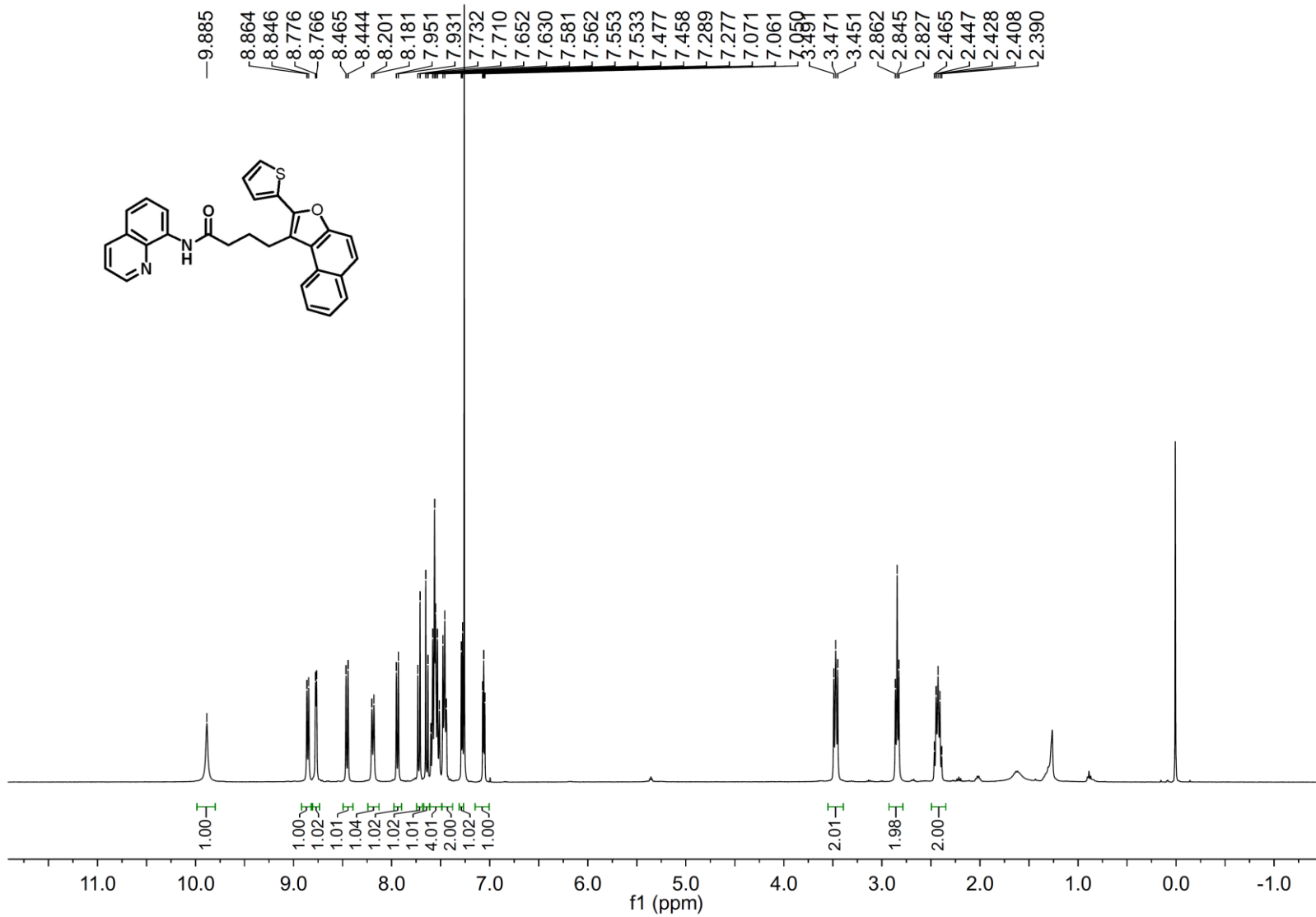
¹³C NMR Spectrum of Compound 3w



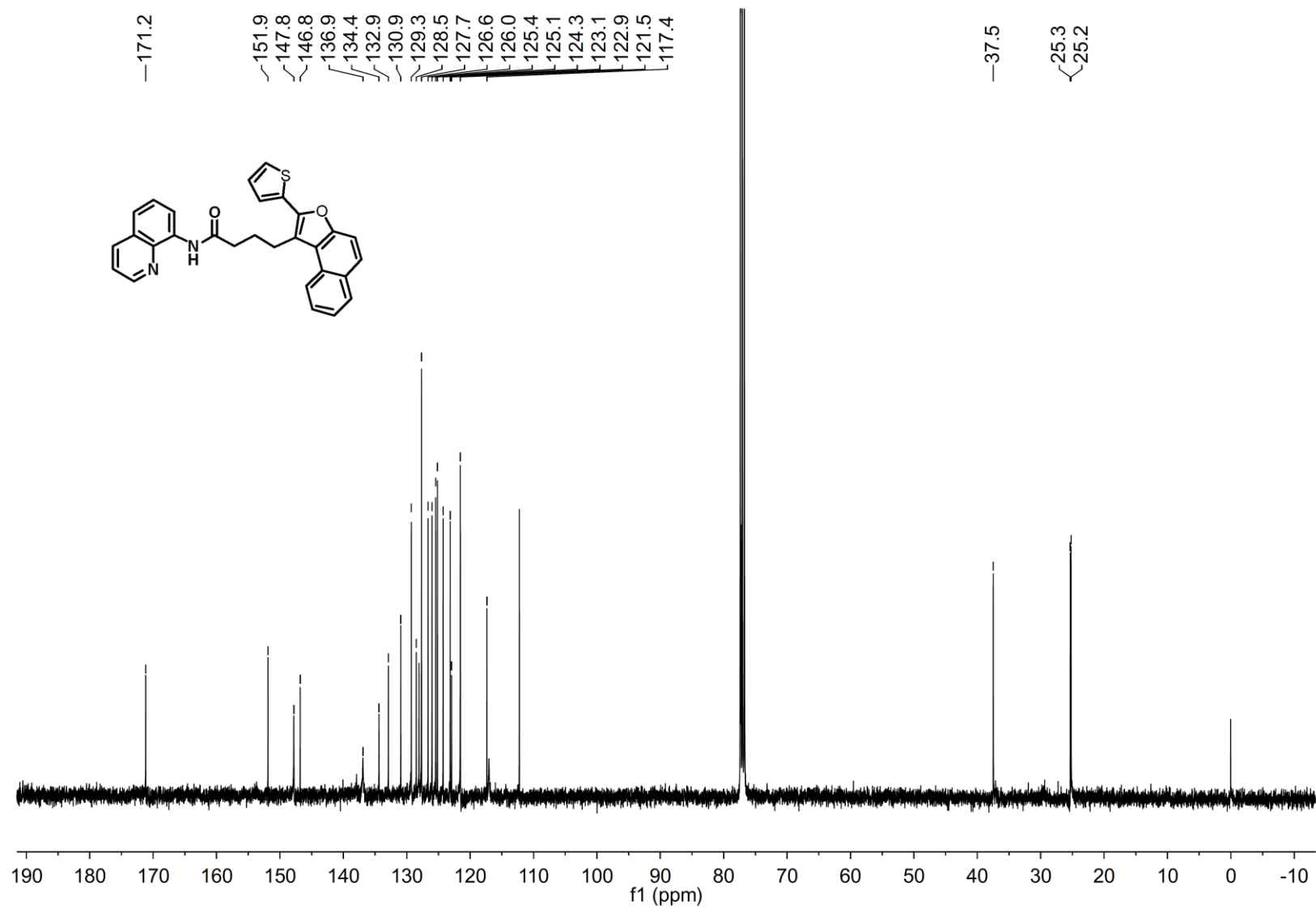
¹H NMR Spectrum of Compound 3x



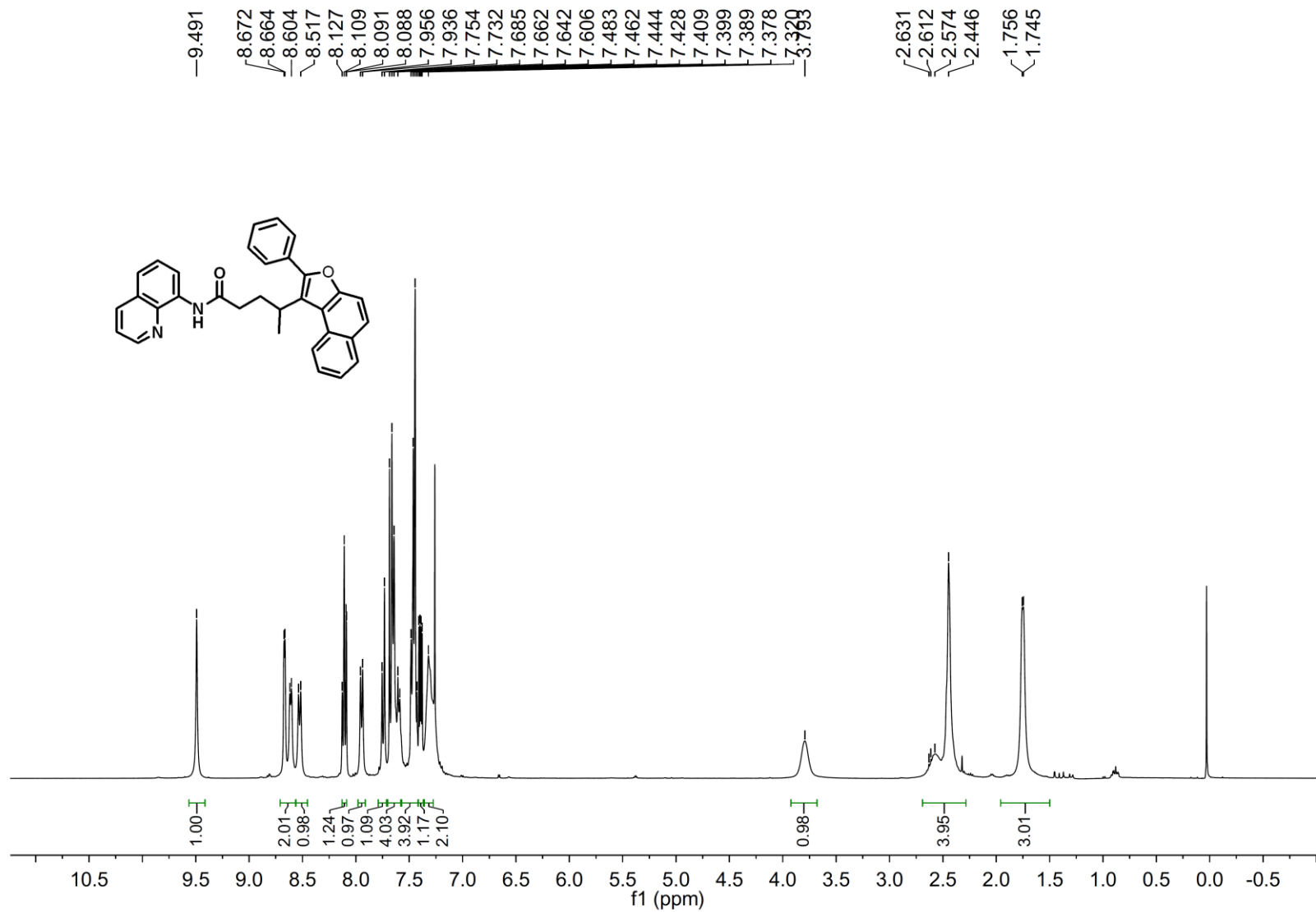
¹³C NMR Spectrum of Compound 3x



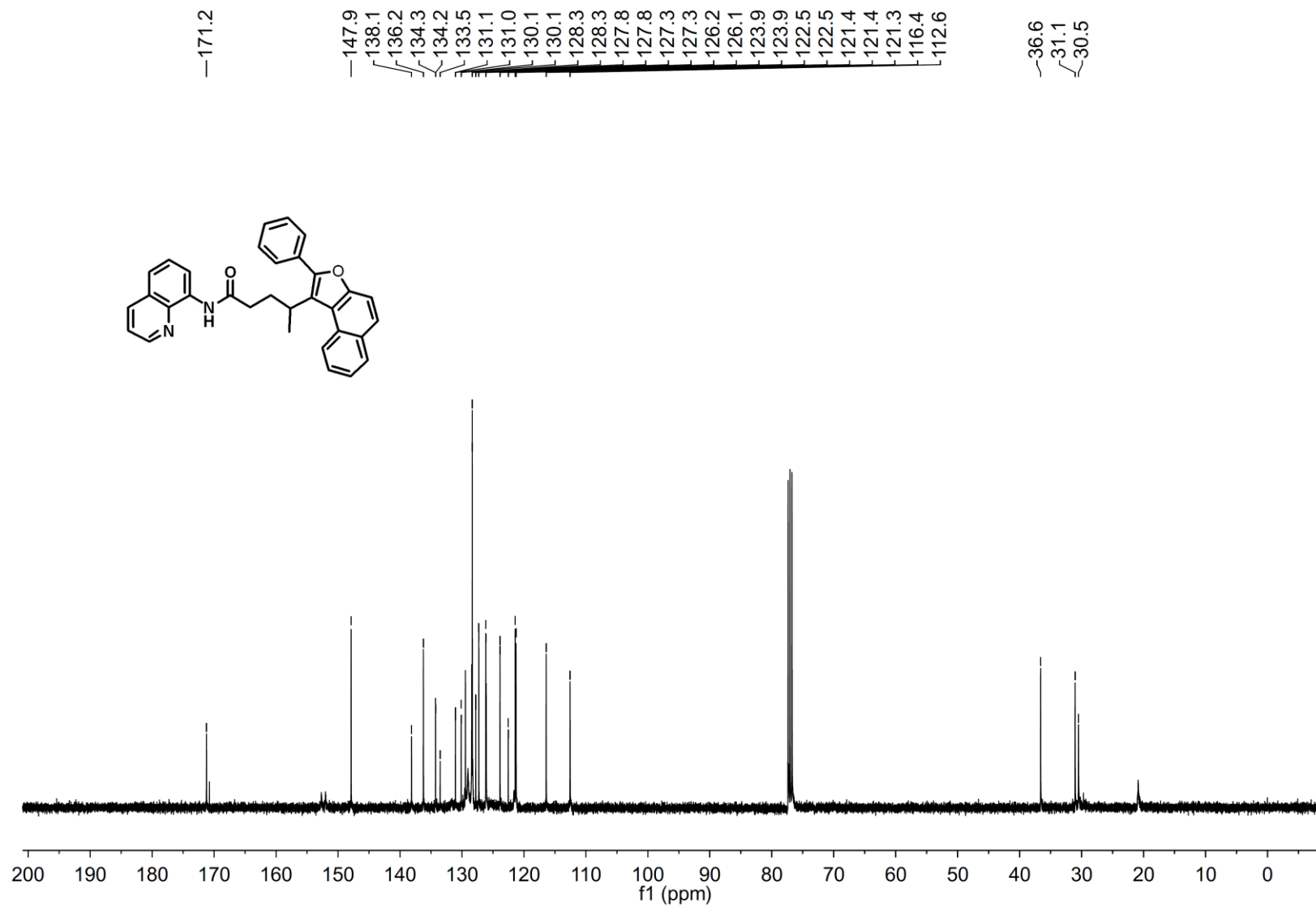
¹H NMR Spectrum of Compound 3y



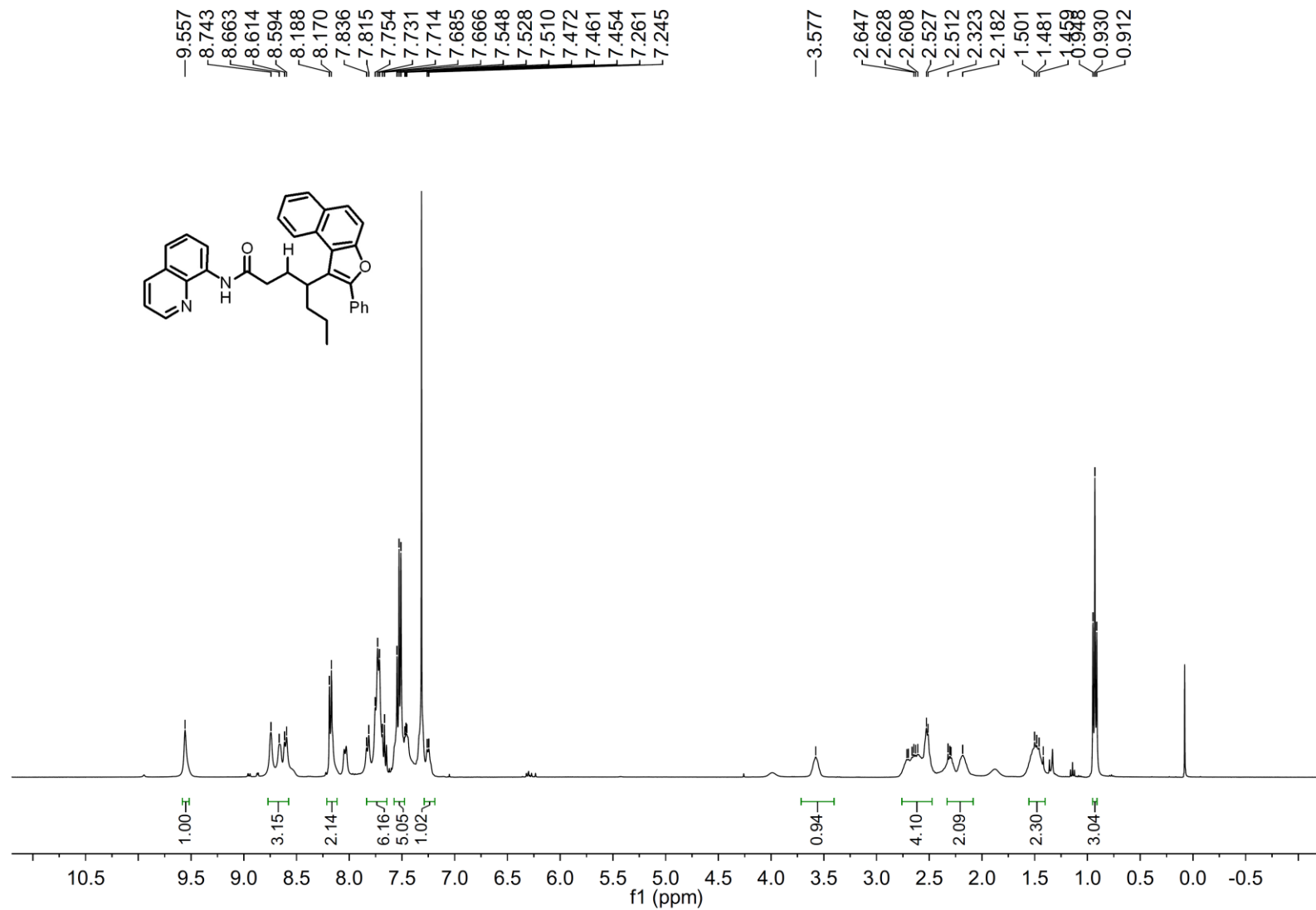
¹³C NMR Spectrum of Compound 3y



¹H NMR Spectrum of Compound 3z



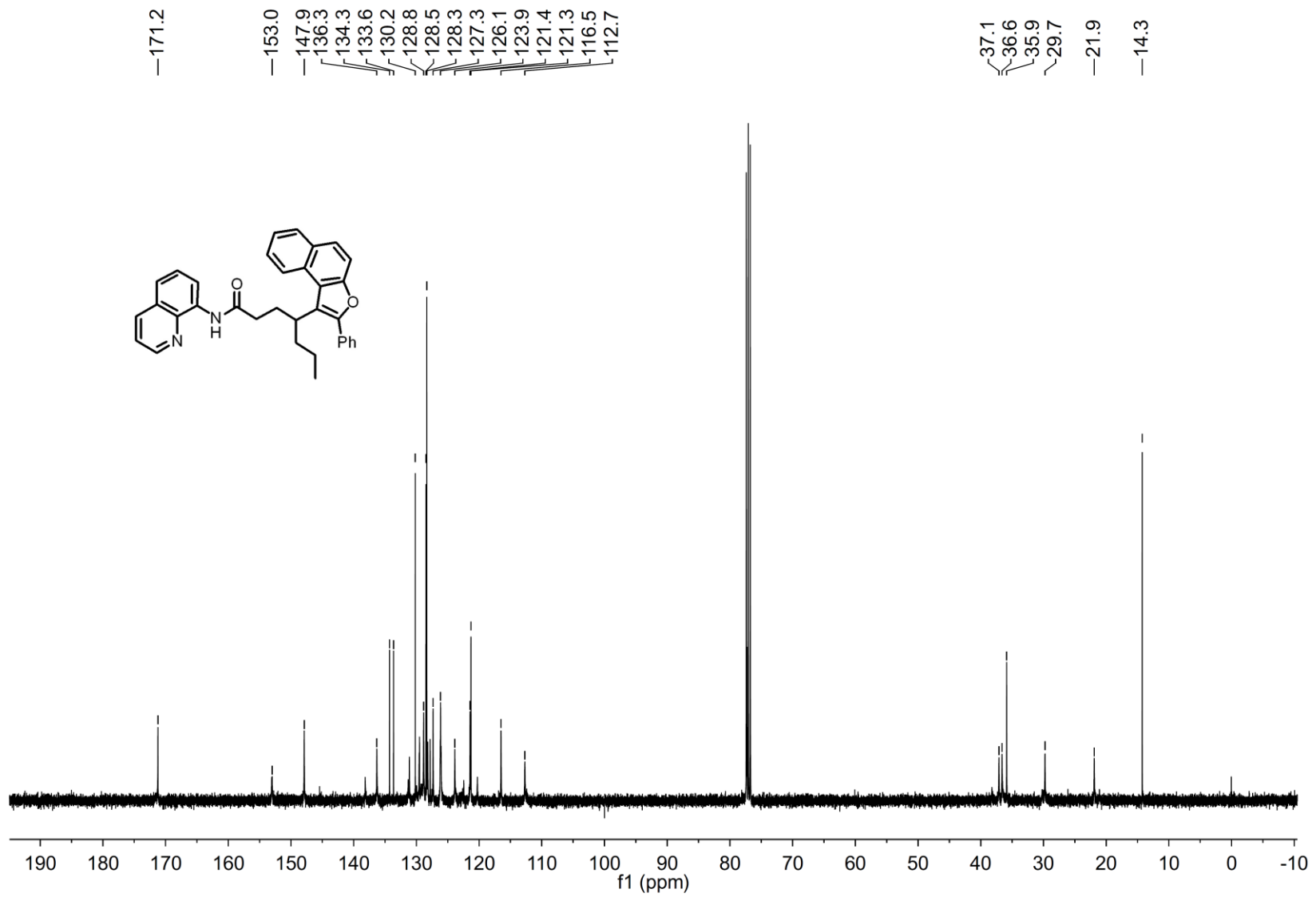
¹³C NMR Spectrum of Compound 3z



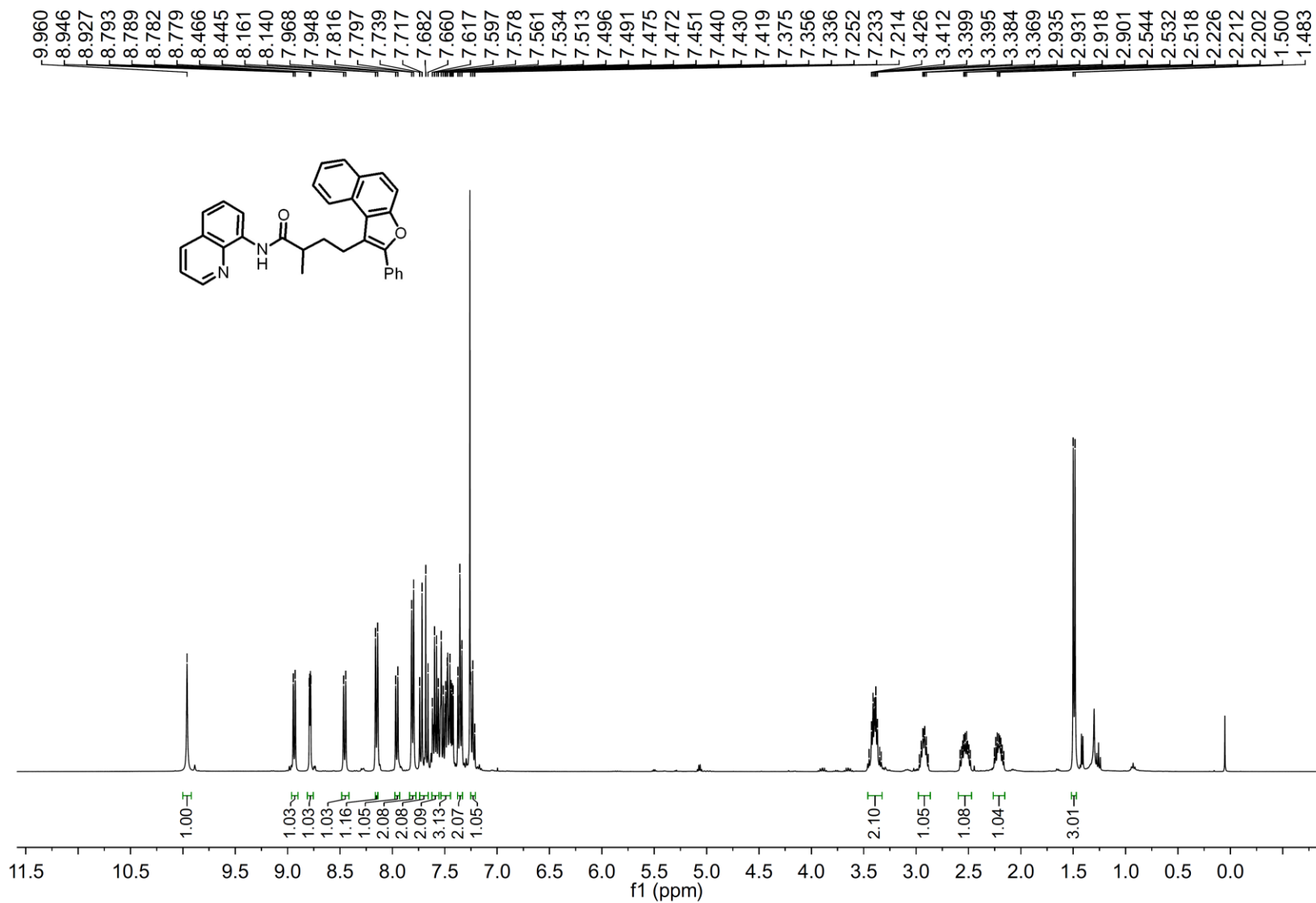
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7.261
7.245

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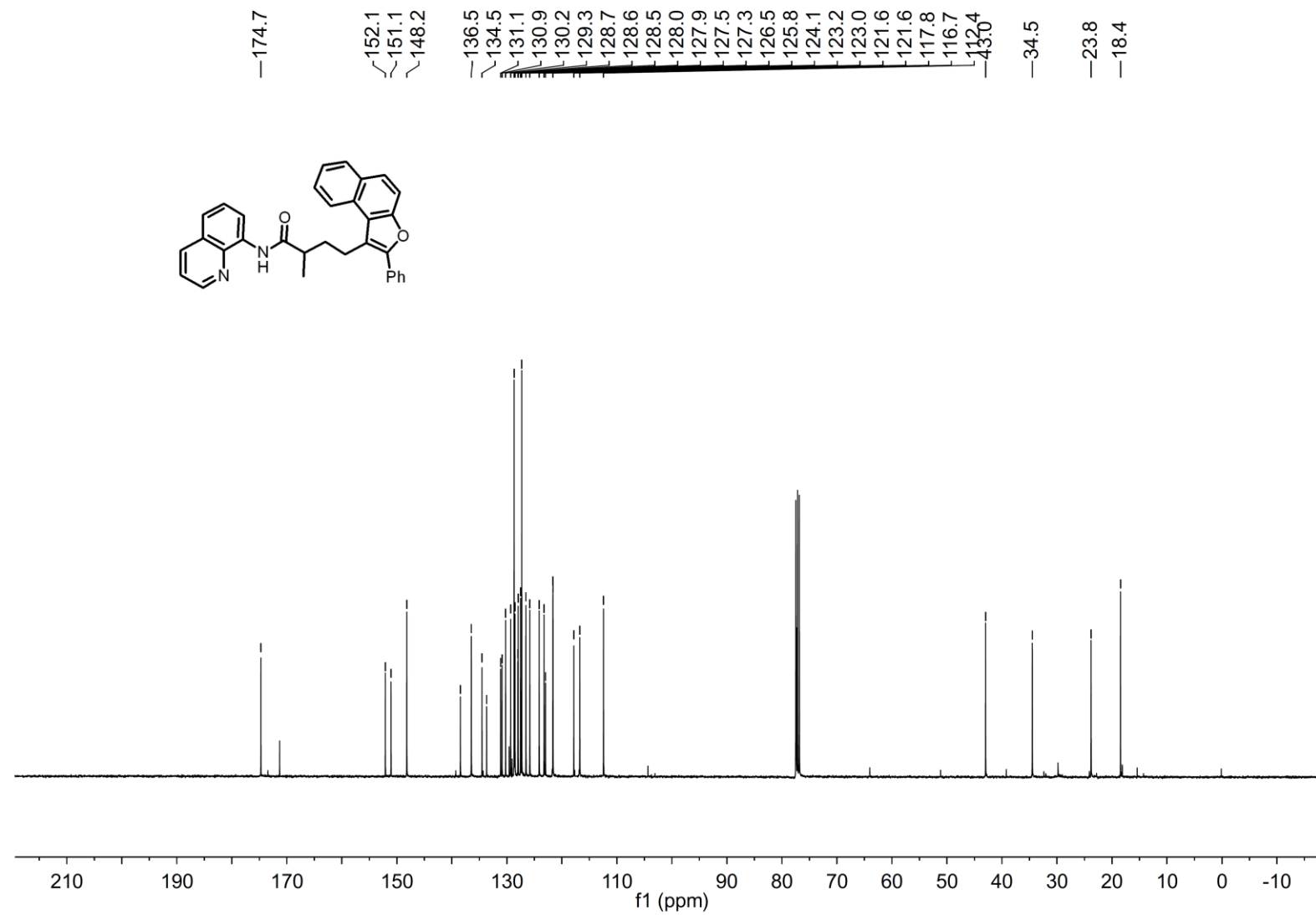
¹H NMR Spectrum of Compound 3aa



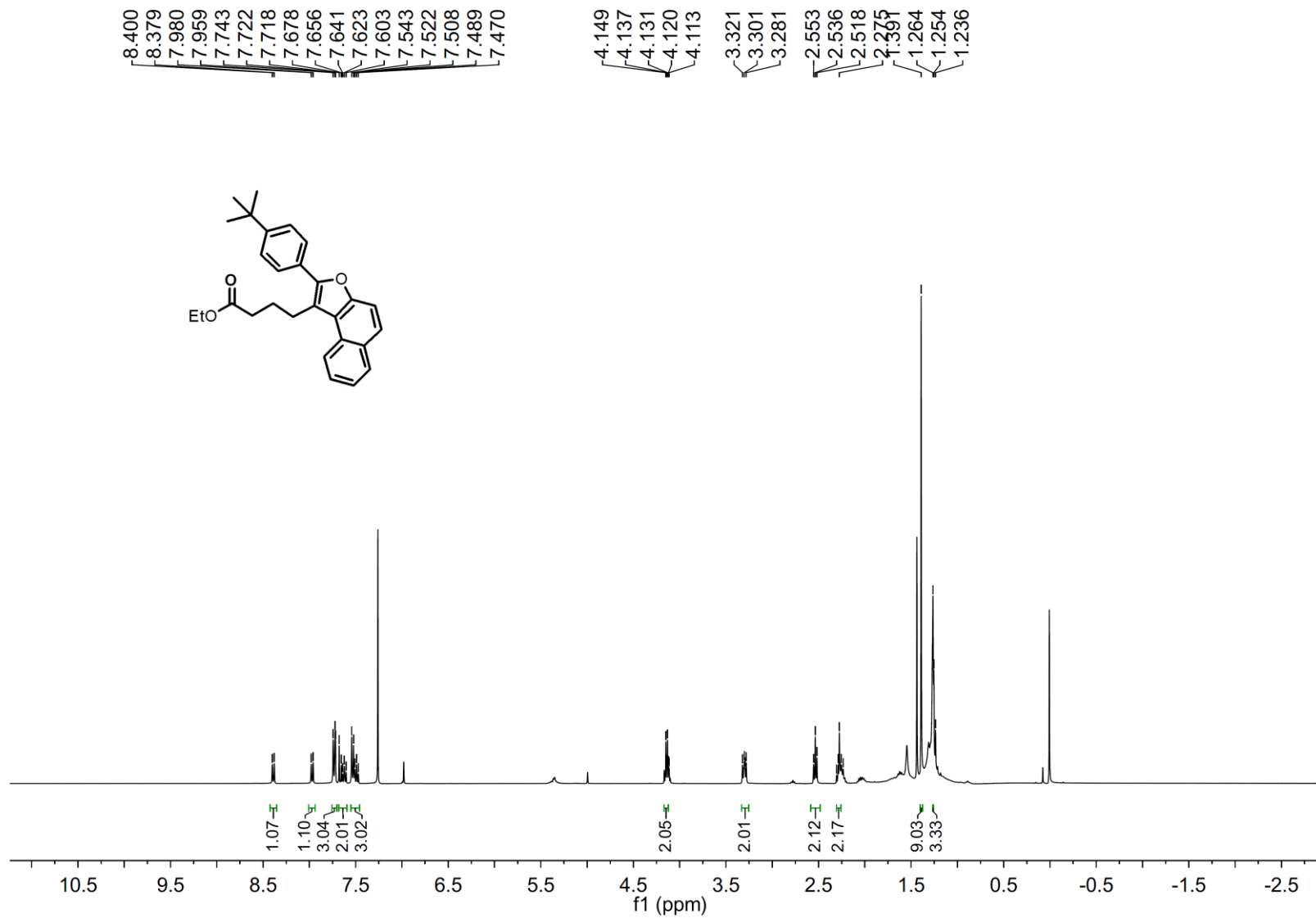
¹³C NMR Spectrum of Compound 3aa



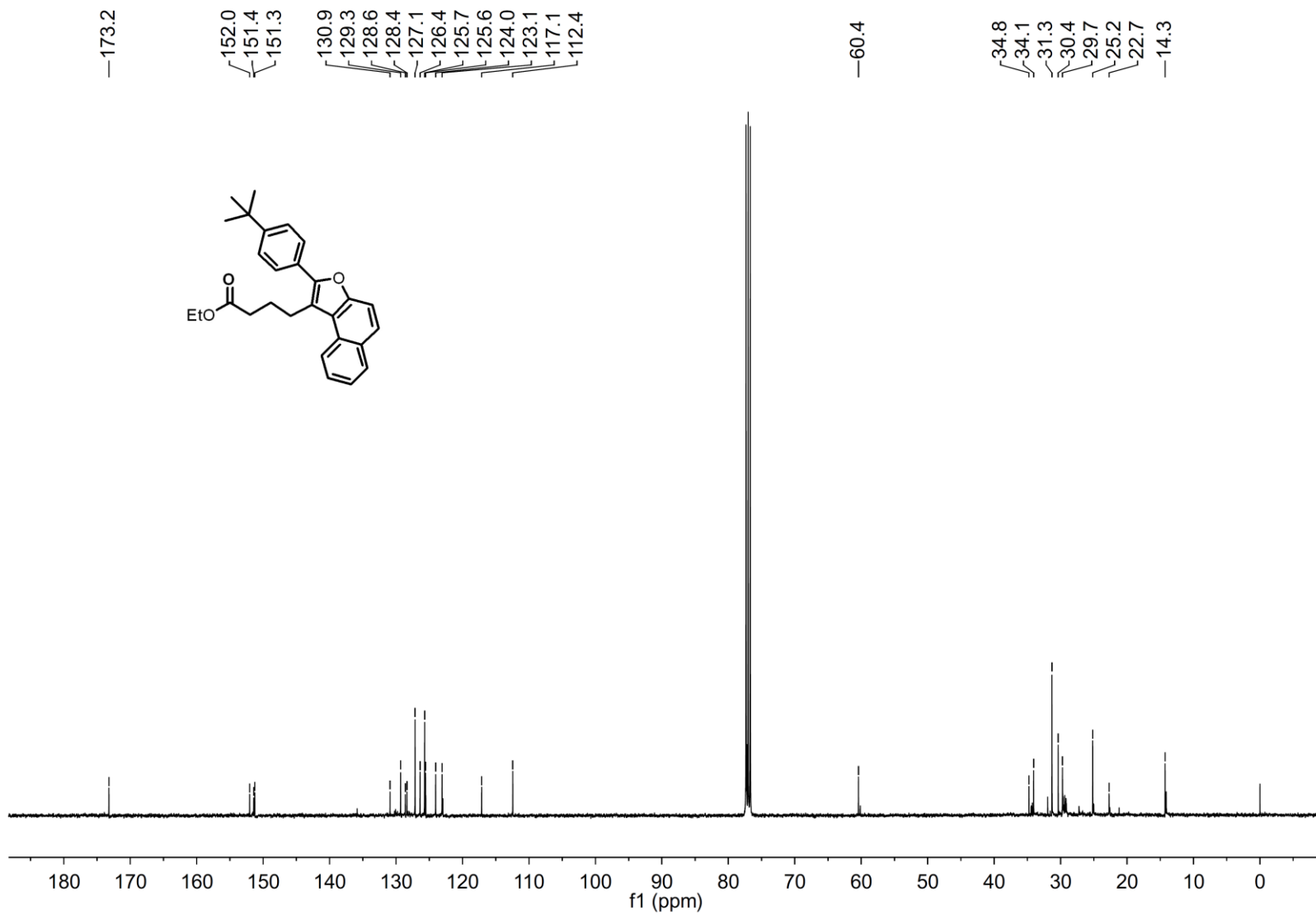
¹H NMR Spectrum of Compound 3bb



¹³C NMR Spectrum of Compound 3bb



¹H NMR Spectrum of Compound 6



¹³C NMR Spectrum of Compound 6