

Supporting Information

Rhodium(III)-Catalyzed C(sp³)–H Alkylation of 8-Methylquinolines with Maleimides

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General methods

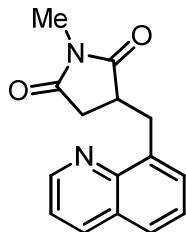
Commercially available reagents were used without additional purification, unless otherwise stated. Sealed tubes ($13 \times 100 \text{ mm}^2$) were purchased from Fischer Scientific and dried in oven for overnight and cooled at room temperature prior to use. Thin layer chromatography was carried out using plates coated with Kieselgel 60F₂₅₄ (Merck). For flash column chromatography, E. Merck Kieselgel 60 (230–400 mesh) was used. Nuclear magnetic resonance spectra (¹H and ¹³C NMR) were recorded on a Bruker Unity 400, 500 spectrometers in CDCl₃ solution and chemical shifts are reported as parts per million (ppm). Resonance patterns are reported with the notations s (singlet), d (doublet), t (triplet), q (quartet), and m (multiplet). In addition, the notation br is used to indicate a broad signal. Coupling constants (*J*) are reported in hertz (Hz). IR spectra were recorded on a Varian 2000 Infrared spectrophotometer and are reported as cm⁻¹. High-resolution mass spectra (HRMS) were recorded on a JEOL JMS-600 spectrometer.

General procedure for the C(sp³)–H alkylation of 8-methylquinolines to maleimides (3a**–**3t** and **4b**–**4j'**)**

To an oven-dried sealed tube charged with 8-methylquinoline (**1a**) (28.6 mg, 0.2 mmol, 100 mol %), [RhCp*Cl₂]₂ (3.1 mg, 0.005 mmol, 2.5 mol %), AdCO₂H (108.2 mg, 0.6 mmol, 300 mol %) and *N*-methylmaleimide (**2a**) (44.0 mg, 0.4 mmol, 200 mol %) was added AgSbF₆ (6.9 mg, 0.02 mmol, 10 mol %) and DCE (1 mL) under air at room temperature. The reaction mixture was allowed to stir at 70 °C for 24 h, and cooled to room temperature. The reaction mixture was diluted with EtOAc (3 mL) and concentrated in vacuo. The residue was purified by flash column chromatography (*n*-hexanes/EtOAc = 2:1) to afford 43.4 mg of **3a** in 85% yield.

Characterization data for all products (3a–3t and 4b–4j')

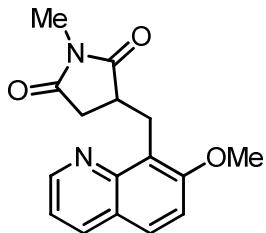
1-Methyl-3-(quinolin-8-ylmethyl)pyrrolidine-2,5-dione (3a)



3a

43.4 mg (85%); Yellow solid; mp = 115.2–116.8 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.85 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.07 (dd, *J* = 8.2, 1.8 Hz, 1H), 7.74 (d, *J* = 9.0 Hz, 1H), 7.33 (d, *J* = 9.0 Hz, 1H), 7.27–7.24 (m, 1H), 3.98 (s, 3H), 3.78 (dd, *J* = 12.7, 5.2 Hz, 1H), 2.63 (dd, *J* = 12.6, 10.4 Hz, 1H), 3.50–3.43 (m, 1H), 3.01 (s, 3H), 2.71 (dd, *J* = 18.4, 4.4 Hz, 1H), 2.41 (dd, *J* = 18.4, 8.9 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 180.1, 177.2, 149.9, 147.1, 136.7, 136.6, 130.2, 128.7, 127.5, 126.5, 121.4, 41.6, 34.0, 32.4, 25.0; IR (KBr) ν 2927, 1773, 1690, 1433, 1381, 1276, 1119, 1074, 956, 811, 796, 691 cm⁻¹; HRMS (orbitrap, ESI) calcd for C₁₅H₁₅N₂O₂ [M+H]⁺ 255.1134, found 255.1127.

3-((7-Methoxyquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3b)

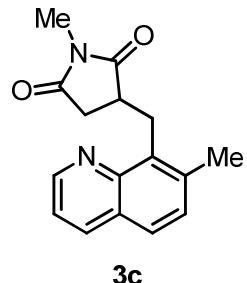


3b

51.2 mg (90%); Light yellow sticky oil; ¹H NMR (400 MHz, CDCl₃) δ 8.85 (dd, *J* = 4.1, 1.8 Hz, 1H), 8.07 (dd, *J* = 8.2, 1.8 Hz, 1H), 7.74 (d, *J* = 9.0 Hz, 1H), 7.33 (d, *J* = 9.0 Hz, 1H), 7.27–7.24 (m, 1H), 3.98 (s, 3H), 3.78 (dd, *J* = 12.7, 5.2 Hz, 1H), 3.63 (dd, *J* = 12.6, 10.7 Hz, 1H), 3.50–3.43 (m, 1H), 3.01 (s, 3H), 2.71 (dd, *J* = 18.4, 4.4 Hz, 1H), 2.41 (dd, *J* = 18.4, 4.4 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 180.5, 177.8, 157.8, 150.6, 147.8, 136.4, 128.1, 123.6, 121.7, 119.1, 113.4, 56.4, 40.2, 34.0, 25.6, 25.0; IR (KBr) ν 2934, 1774, 1694, 1612, 1504, 1432, 1381,

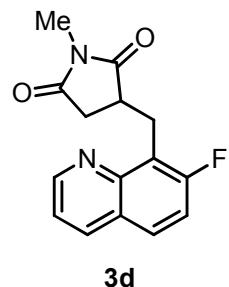
1263, 1120, 1085, 957, 810, 698 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{N}_2\text{O}_3$ [$\text{M}+\text{H}]^+$ 285.1239, found 285.1234.

1-Methyl-3-((7-methylquinolin-8-yl)methyl)pyrrolidine-2,5-dione (3c)



49.4 mg (92%); Light yellow solid; mp = 120.7–121.9 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.85 (dd, J = 4.1, 1.8 Hz, 1H), 8.09 (dd, J = 8.2, 1.8 Hz, 1H), 7.64 (d, J = 8.3 Hz, 1H), 7.39 (d, J = 8.3 Hz, 1H), 7.34 (dd, J = 8.2, 4.2 Hz, 1H), 3.89 (dd, J = 13.3, 10.9 Hz, 1H), 3.64 (dd, J = 13.2, 4.8 Hz, 1H), 3.36–3.29 (m, 1H), 3.02 (s, 3H), 2.89 (dd, J = 18.5, 4.6 Hz, 1H), 2.60 (s, 3H), 2.43 (dd, J = 18.5, 9.0 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 180.2, 177.6, 149.7, 147.3, 137.8, 136.4, 134.5, 130.1, 127.0, 126.6, 120.5, 40.9, 34.2, 28.4, 25.0, 20.4; IR (KBr) ν 2923, 1774, 1691, 1501, 1433, 1381, 1277, 1120, 1073, 967, 809, 699 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{N}_2\text{O}_2$ [$\text{M}+\text{H}]^+$ 269.1290, found 269.1284.

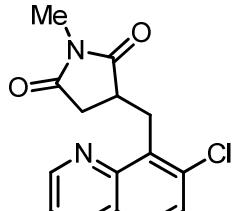
3-((7-Fluoroquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3d)



43.6 mg (80%); Light yellow solid; mp = 118.3–119.7 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.91 (dd, J = 4.2, 1.7 Hz, 1H), 8.14 (dd, J = 8.3, 1.8 Hz, 1H), 7.74 (dd, J = 9.0, 6.0 Hz, 1H), 7.41–7.33 (m, 2H), 3.85–3.80 (m, 1H), 3.58–3.44 (m, 2H), 3.01 (s, 3H), 2.67 (dd, J = 18.5, 4.6 Hz, 1H), 2.53 (dd, J = 18.4, 8.5 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.7, 177.1, 161.2 (d,

$J_{C-F} = 246.4$ Hz), 150.8, 147.8 (d, $J_{C-F} = 9.2$ Hz), 136.6 (d, $J_{C-F} = 0.9$ Hz), 128.7 (d, $J_{C-F} = 10.6$ Hz), 125.6, 121.2 (d, $J_{C-F} = 14.5$ Hz), 120.6 (d, $J_{C-F} = 2.6$ Hz), 117.0 (d, $J_{C-F} = 26.7$ Hz), 40.3, 34.2, 25.3 (d, $J_{C-F} = 2.4$ Hz), 25.1; IR (KBr) ν 2930, 1775, 1693, 1502, 1432, 1381, 1277, 1120, 1066, 965, 832, 690 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{FN}_2\text{O}_2$ [M+H]⁺ 273.1039, found 273.1034.

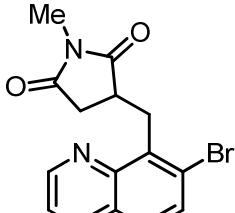
3-((7-Chloroquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3e)



3e

55.4 mg (96%); Light orange solid; mp = 128.5–130.0 °C; ¹H NMR (400 MHz, CDCl_3) δ 8.90 (dd, $J = 4.2, 1.8$ Hz, 1H), 8.13 (dd, $J = 8.2, 1.8$ Hz, 1H), 7.68 (d, $J = 8.8$ Hz, 1H), 7.53 (d, $J = 8.8$ Hz, 1H), 7.41 (dd, $J = 8.2, 4.2$ Hz, 1H), 3.89–3.82 (m, 2H), 3.57–3.50 (m, 1H), 3.02 (s, 3H), 2.80 (dd, $J = 18.4, 4.7$ Hz, 1H), 2.45 (dd, $J = 18.3, 9.0$ Hz, 1H); ¹³C NMR (100 MHz, CDCl_3) δ 179.7, 177.3, 150.6, 147.6, 136.6, 135.4, 134.7, 128.4, 128.0, 127.2, 121.5, 40.0, 34.0, 29.5, 25.1; IR (KBr) ν 2932, 1776, 1694, 1589, 1433, 1381, 1277, 1119, 1040, 957, 834, 697 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{ClN}_2\text{O}_2$ [M+H]⁺ 289.0744, found 289.0740.

3-((7-Bromoquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3f)

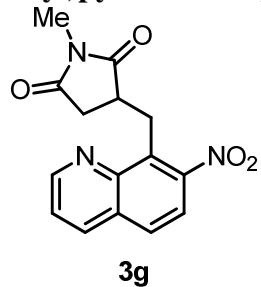


3f

64.0 mg (96%); White solid; mp = 113.4–114.8 °C; ¹H NMR (400 MHz, CDCl_3) δ 8.89 (dd, $J = 4.2, 1.8$ Hz, 1H), 8.12 (dd, $J = 8.2, 1.8$ Hz, 1H), 7.70 (d, $J = 8.8$ Hz, 1H), 7.60 (d, $J = 8.8$

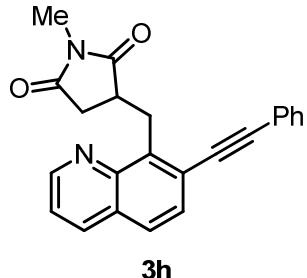
Hz, 1H), 7.43 (dd, J = 8.2, 4.2 Hz, 1H), 3.96–3.84 (m, 2H), 3.61–3.54 (m, 1H), 3.02 (s, 3H), 2.85 (dd, J = 18.4, 4.7 Hz, 1H), 2.45 (dd, J = 18.3, 9.0 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.6, 177.3, 150.6, 147.7, 136.8, 136.6, 131.3, 128.1, 127.6, 126.3, 121.6, 40.0, 33.9, 32.2, 25.1; IR (KBr) ν 2906, 1775, 1694, 1590, 1433, 1381, 1277, 1113, 1076, 957, 832, 697 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{BrN}_2\text{O}_2$ [$\text{M}+\text{H}$] $^+$ 333.0239, found 333.0237.

1-Methyl-3-((7-nitroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (3g)



20.9 mg (35%); Orange solid; mp = 159.2–160.8 °C; ^1H NMR (400 MHz, CDCl_3) δ 9.04 (dd, J = 4.1, 1.8 Hz, 1H), 8.25 (dd, J = 8.3, 1.8 Hz, 1H), 8.00 (d, J = 8.9 Hz, 1H), 7.88 (d, J = 8.9 Hz, 1H), 7.59 (dd, J = 8.2, 4.1 Hz, 1H), 3.99–3.89 (m, 2H), 3.71–3.63 (m, 1H), 2.99 (s, 3H), 2.81 (dd, J = 18.3, 4.7 Hz, 1H), 2.69 (dd, J = 18.2, 8.9 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.2, 176.9, 151.6, 150.0, 146.8, 136.7, 133.2, 130.2, 128.4, 123.7, 121.7, 40.5, 34.8, 28.8, 25.1; IR (KBr) ν 2926, 1775, 1695, 1524, 1435, 1382, 1281, 1123, 1024, 840, 698 cm^{-1} ; HRMS (quadrupole, EI) calcd for $\text{C}_{15}\text{H}_{13}\text{N}_3\text{O}_4$ [$\text{M}]^+$ 299.0906, found 299.0907.

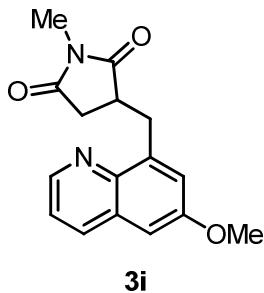
1-Methyl-3-((7-(phenylethynyl)quinolin-8-yl)methyl)pyrrolidine-2,5-dione (3h)



55.3 mg (78%); Yellow solid; mp = 119.1–120.3 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.92 (dd, J = 4.2, 1.8 Hz, 1H), 8.12 (dd, J = 8.2, 1.7 Hz, 1H), 7.72–7.64 (m, 4H), 7.42–7.37 (m, 4H),

4.08–3.94 (m, 2H), 3.67–3.60 (m, 1H), 3.03 (s, 3H), 2.93 (dd, J = 18.4, 4.5 Hz, 1H), 2.45 (dd, J = 18.4, 9.0 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 180.0, 177.5, 150.5, 146.9, 140.0, 136.5, 132.0, 129.6, 129.1, 128.8, 128.4, 127.0, 124.3, 122.9, 121.7, 96.6, 87.9, 41.1, 34.1, 30.8, 25.1; IR (KBr) ν 2928, 1774, 1696, 1497, 1434, 1382, 1279, 1122, 1067, 961, 837, 758, 690 cm^{-1} ; HRMS (quadrupole, EI) calcd for $\text{C}_{23}\text{H}_{18}\text{N}_2\text{O}_2$ [M] $^+$ 354.1368, found 354.1367.

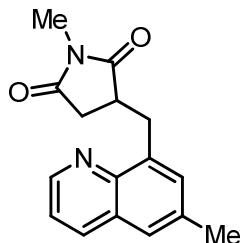
3-((6-Methoxyquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3i)



3i

37.5 mg (66%); Light yellow solid; mp = 143.7–145.4 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.74 (d, J = 3.9 Hz, 1H), 8.02 (d, J = 8.2 Hz, 1H), 7.35 (dd, J = 8.2, 4.1 Hz, 1H), 7.24 (s, 1H), 6.98 (s, 1H), 3.93–3.89 (m, 4H), 3.53–3.46 (m, 1H), 3.39–3.33 (m, 1H), 2.98 (s, 3H), 2.65–2.51 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 180.0, 177.2, 157.4, 147.4, 143.3, 138.5, 135.4, 129.9, 122.8, 121.8, 104.6, 55.6, 41.4, 34.0, 32.3, 25.0; IR (KBr) ν 2929, 1766, 1694, 1592, 1426, 1376, 1221, 1121, 1049, 960, 848, 781, 700, 667 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{N}_2\text{O}_3$ [M+H] $^+$ 285.1239, found 285.1234.

1-Methyl-3-((6-methylquinolin-8-yl)methyl)pyrrolidine-2,5-dione (3j)

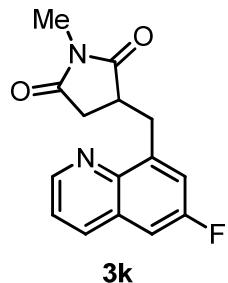


3j

40.2 mg (75%); Light yellow solid; mp = 143.7–145.4 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.82 (dd, J = 4.1, 1.7 Hz, 1H), 8.04 (dd, J = 6.6, 1.3 Hz, 1H), 7.48 (s, 1H), 7.41 (s, 1H), 7.36 (dd,

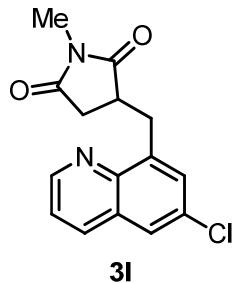
J = 8.2, 4.1 Hz, 1H), 3.92 (dd, *J* = 13.2, 4.8 Hz, 1H), 3.52–3.47 (m, 1H), 3.35 (dd, *J* = 13.2, 9.6 Hz, 1H), 2.98 (s, 3H), 2.64 (dd, *J* = 18.4, 4.6 Hz, 1H), 2.52 (dd, *J* = 18.5, 8.9 Hz, 4H); ^{13}C NMR (125 MHz, CDCl_3) δ 180.1, 177.3, 149.0, 145.6, 136.3, 136.2, 135.9, 132.5, 128.8, 126.3, 121.4, 41.6, 34.0, 32.3, 25.0, 21.7; IR (KBr) ν 2923, 1766, 1693, 1492, 1378, 1279, 1120, 1022, 954, 862, 814, 781, 700, 667 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{N}_2\text{O}_2$ [$\text{M}+\text{H}]^+$ 269.1290, found 269.1286.

3-((6-Fluoroquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3k)



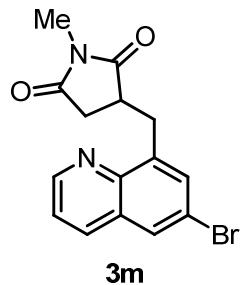
28.3 mg (52%); White solid; mp = 138.8–140.2 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.85 (s, 1H), 8.09 (d, *J* = 8.2 Hz, 1H), 7.44–7.33 (m, 3H), 3.95–3.92 (m, 1H), 3.52–3.41 (m, 2H), 2.99 (s, 3H), 2.64–2.55 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.7, 176.9, 160.0 (d, $J_{\text{C}-\text{F}} = 247.1$ Hz), 149.1 (d, $J_{\text{C}-\text{F}} = 2.6$ Hz), 144.3, 140.2 (d, $J_{\text{C}-\text{F}} = 8.6$ Hz), 136.1 (d, $J_{\text{C}-\text{F}} = 5.6$ Hz), 129.5 (d, $J_{\text{C}-\text{F}} = 10.2$ Hz), 122.2, 120.3 (d, $J_{\text{C}-\text{F}} = 25.6$ Hz), 110.2 (d, $J_{\text{C}-\text{F}} = 21.0$ Hz), 41.4, 34.0, 32.4, 25.0; IR (KBr) ν 2928, 1775, 1692, 1620, 1497, 1434, 1382, 1277, 1121, 955, 860, 781, 698, 667 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{FN}_2\text{O}_2$ [$\text{M}+\text{H}]^+$ 273.1039, found 273.1033.

3-((6-Chloroquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3l)



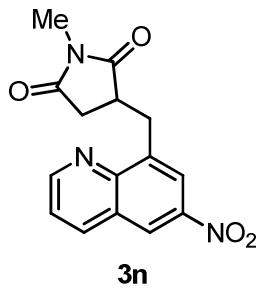
37.0 mg (64%); White solid; mp = 155.8–157.6 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.88 (dd, J = 4.2, 1.8 Hz, 1H), 8.07 (dd, J = 8.3, 1.7 Hz, 1H), 7.72 (d, J = 2.3 Hz, 1H), 7.54 (d, J = 2.3 Hz, 1H), 7.44 (dd, J = 8.3, 4.2 Hz, 1H), 3.91 (dd, J = 13.1, 4.8 Hz, 1H), 3.53–3.46 (m, 1H), 3.39 (dd, J = 13.1, 9.5 Hz, 1H), 2.99 (s, 3H), 2.66–2.53 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.7, 177.0, 150.0, 145.5, 139.1, 135.8, 132.1, 130.9, 129.4, 126.0, 122.3, 41.4, 34.0, 32.3, 25.1; IR (KBr) ν 2928, 1774, 1696, 1488, 1436, 1382, 1280, 1122, 959, 865, 812, 699 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{ClN}_2\text{O}_2$ [M+H] $^+$ 289.0744, found 289.0740.

3-((6-Bromoquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3m)



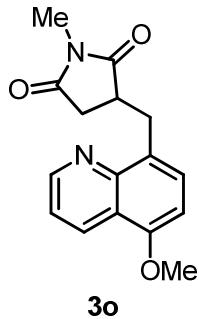
41.3 mg (62%); Light yellow solid; mp = 148.1–149.0 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.90 (dd, J = 4.2, 1.8 Hz, 1H), 8.06 (dd, J = 8.3, 1.7 Hz, 1H), 7.90 (d, J = 2.2 Hz, 1H), 7.67 (d, J = 2.1 Hz, 1H), 7.44 (dd, J = 8.3, 4.2 Hz, 1H), 3.91 (dd, J = 13.1, 4.8 Hz, 1H), 3.52–3.45 (m, 1H), 3.38 (dd, J = 13.1, 9.6 Hz, 1H), 3.00 (s, 3H), 2.66–2.53 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.7, 177.0, 150.2, 145.7, 139.2, 135.7, 133.4, 129.8, 129.4, 122.3, 120.3, 41.4, 34.0, 32.2, 25.1; IR (KBr) ν 2919, 1768, 1691, 1587, 1486, 1432, 1378, 1280, 1120, 1017, 958, 843, 809, 781, 700 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{BrN}_2\text{O}_2$ [M+H] $^+$ 333.0239, found 333.0238.

1-Methyl-3-((6-nitroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (3n)



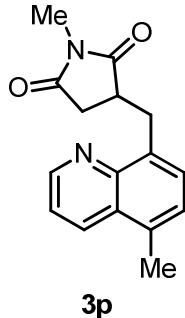
37.7 mg (63%); White solid; mp = 190.1–190.6 °C; ¹H NMR (400 MHz, CDCl₃) δ 9.08 (dd, *J* = 4.1, 1.8 Hz, 1H), 8.71 (d, *J* = 2.5 Hz, 1H), 8.37 (dd, *J* = 8.4, 2.1 Hz, 2H), 7.60 (dd, *J* = 8.3, 4.2 Hz, 1H), 4.01–3.94 (m, 1H), 3.59–3.50 (m, 2H), 3.01 (s, 3H), 2.69–2.58 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) δ 179.4, 176.6, 153.2, 149.1, 145.3, 140.0, 138.6, 127.6, 124.0, 123.3, 123.2, 41.1, 34.2, 33.0, 25.1; IR (KBr) ν 2923, 1774, 1694, 1530, 1492, 1434, 1347, 1278, 1121, 958, 902, 796, 699 cm⁻¹; HRMS (orbitrap, ESI) calcd for C₁₅H₁₄N₃O₄ [M+H]⁺ 300.0984, found 300.0976.

3-((5-Methoxyquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3o)



51.7 mg (91%); Yellow solid; mp = 103.9–104.8 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.88 (dd, *J* = 4.1, 1.8 Hz, 1H), 8.56 (dd, *J* = 8.4, 1.8 Hz, 1H), 7.45 (d, *J* = 7.9 Hz, 1H), 7.38 (dd, *J* = 8.4, 4.1 Hz, 1H), 6.77 (d, *J* = 7.9 Hz, 1H), 3.98 (s, 3H), 3.87 (dd, *J* = 13.4, 5.0 Hz, 1H), 3.50–3.44 (m, 1H), 3.30 (dd, *J* = 13.4, 9.0 Hz, 1H), 2.96 (s, 3H), 2.63 (dd, *J* = 18.5, 4.8 Hz, 1H), 2.53 (dd, *J* = 18.5, 8.8 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 180.3, 177.5, 154.6, 150.1, 147.5, 131.3, 130.1, 128.1, 121.2, 120.4, 104.0, 55.9, 41.6, 33.9, 32.0, 24.9; IR (KBr) ν 2925, 1773, 1694, 1590, 1433, 1381, 1267, 1120, 1087, 953, 802, 781, 697 cm⁻¹; HRMS (orbitrap, ESI) calcd for C₁₆H₁₇N₂O₃ [M+H]⁺ 285.1239, found 285.1234.

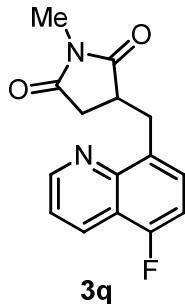
1-Methyl-3-((5-methylquinolin-8-yl)methyl)pyrrolidine-2,5-dione (3p)



3p

36.0 mg (67%); White solid; mp = 129.7–130.6 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.90 (d, *J* = 3.8 Hz, 1H), 8.31 (d, *J* = 8.4 Hz, 1H), 7.46–7.42 (m, 1H), 7.29 (d, *J* = 7.1 Hz, 1H), 3.94 (dd, *J* = 13.2, 4.9 Hz, 1H), 3.53–3.46 (m, 1H), 3.36 (dd, *J* = 13.2, 9.2 Hz, 1H), 2.97 (s, 3H), 2.66–2.60 (m, 4H), 2.53 (dd, *J* = 18.5, 8.7 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 180.2, 177.4, 149.3, 147.3, 134.6, 134.2, 133.0, 130.0, 128.0, 126.9, 121.0, 41.6, 33.9, 32.4, 25.0, 18.8; IR (KBr) ν 2924, 1772, 1693, 1598, 1502, 1432, 1380, 1276, 1119, 952, 805, 779, 697 cm⁻¹; HRMS (orbitrap, ESI) calcd for C₁₆H₁₇N₂O₂ [M+H]⁺ 269.1290, found 269.1284.

3-((5-Fluoroquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3q)

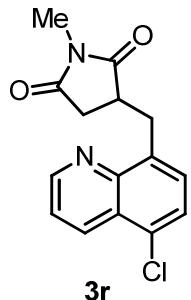


3q

46.3 mg (85%); White solid; mp = 92.1–93.9 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.94 (dd, *J* = 4.1, 1.8 Hz, 1H), 8.43 (dd, *J* = 8.4, 1.8 Hz, 1H), 7.52–7.46 (m, 2H), 7.15 (dd, *J* = 9.4, 8.0 Hz, 1H), 3.91 (dd, *J* = 13.2, 4.9 Hz, 1H), 3.51–3.44 (m, 1H), 3.36 (dd, *J* = 13.2, 9.1 Hz, 1H), 2.97 (s, 3H), 2.66–2.53 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) δ 180.0, 177.2, 157.3 (d, *J*_{C-F} = 253.2 Hz), 150.7, 147.4 (d, *J*_{C-F} = 2.6 Hz), 132.6 (d, *J*_{C-F} = 4.7 Hz), 129.9 (d, *J*_{C-F} = 4.9 Hz), 129.7 (d, *J*_{C-F} = 8.7 Hz), 121.5 (d, *J*_{C-F} = 2.8 Hz), 119.5 (d, *J*_{C-F} = 16.0 Hz), 110.0 (d, *J*_{C-F} = 19.1 Hz), 41.5, 33.9,

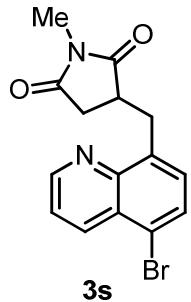
32.1, 25.0; IR (KBr) ν 2908, 1775, 1696, 1596, 1474, 1434, 1383, 1277, 1121, 1051, 956, 804, 781, 698 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{FN}_2\text{O}_2$ [$\text{M}+\text{H}$]⁺ 273.1039, found 273.1034.

3-((5-Chloroquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3r)



46.2 mg (80%); Light orange solid; mp = 133.4–134.7 °C; ¹H NMR (400 MHz, CDCl_3) δ 8.94 (dd, J = 4.1, 1.7 Hz, 1H), 8.58 (dd, J = 8.5, 1.7 Hz, 1H), 7.57–7.49 (m, 3H), 3.92 (dd, J = 13.1, 4.8 Hz, 1H), 3.52–3.45 (m, 1H), 3.39 (dd, J = 13.1, 9.2 Hz, 1H), 2.98 (s, 3H), 2.65–2.53 (m, 2H); ¹³C NMR (100 MHz, CDCl_3) δ 179.9, 177.0, 150.4, 147.6, 136.2, 133.5, 130.7, 130.0, 126.7, 126.6, 122.2, 41.4, 34.0, 32.4, 25.0; IR (KBr) ν 2906, 1775, 1693, 1434, 1383, 1278, 1121, 1082, 934, 804, 669 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{ClN}_2\text{O}_2$ [$\text{M}+\text{H}$]⁺ 289.0744, found 289.0741.

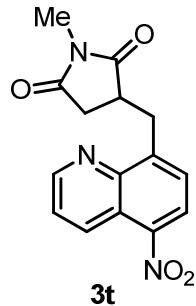
3-((5-Bromoquinolin-8-yl)methyl)-1-methylpyrrolidine-2,5-dione (3s)



51.3 mg (77%); White solid; mp = 131.1–131.9 °C; ¹H NMR (400 MHz, CDCl_3) δ 8.92 (dd, J = 4.1, 1.7 Hz, 1H), 8.55 (dd, J = 8.6, 1.7 Hz, 1H), 7.76 (d, J = 7.7 Hz, 1H), 7.53 (dd, J = 8.6, 4.1 Hz, 1H), 7.45 (d, J = 7.7 Hz, 1H), 3.92 (dd, J = 13.0, 4.8 Hz, 1H), 3.52–3.45 (m, 1H), 3.38 (dd, J = 13.1, 9.2 Hz, 1H), 2.98 (s, 3H), 2.64–2.53 (m, 2H); ¹³C NMR (100 MHz, CDCl_3) δ

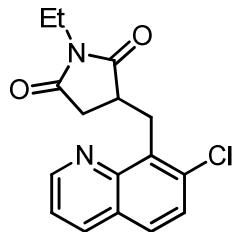
179.8, 177.0, 150.4, 147.7, 137.0, 136.1, 130.5, 130.3, 128.0, 122.5, 121.2, 41.3, 34.0, 32.4, 25.0; IR (KBr) ν 2907, 1775, 1696, 1588, 1435, 1382, 1279, 1122, 957, 916, 804, 697 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{BrN}_2\text{O}_2$ [$\text{M}+\text{H}$]⁺ 333.0239, found 333.0238.

1-Methyl-3-((5-nitroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (3t)



18.6 mg (31%); Light yellow solid; mp = 137.3–139.0 °C; ¹H NMR (400 MHz, CDCl_3) δ 9.06–9.02 (m, 2H), 8.33 (d, J = 7.9 Hz, 1H), 7.71–7.66 (m, 2H), 4.01–3.94 (m, 1H), 3.57–3.49 (m, 2H), 3.00 (s, 3H), 2.69–2.57 (m, 2H); ¹³C NMR (100 MHz, CDCl_3) δ 179.4, 176.6, 150.9, 146.7, 145.2, 145.0, 132.7, 128.5, 124.6, 124.2, 121.6, 41.2, 34.2, 33.4, 25.1; IR (KBr) ν 2921, 1775, 1693, 1517, 1499, 1434, 1327, 1279, 1121, 958, 837, 800, 698 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{14}\text{N}_3\text{O}_4$ [$\text{M}+\text{H}$]⁺ 300.0984, found 300.0979.

3-((7-Chloroquinolin-8-yl)methyl)-1-ethylpyrrolidine-2,5-dione (4b)

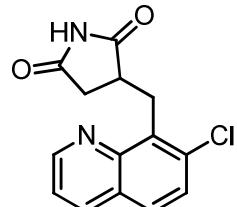


4b

56.3 mg (93%); White solid; mp = 88.7–89.3 °C; ¹H NMR (400 MHz, CDCl_3) δ 8.90 (dd, J = 4.2, 1.7 Hz, 1H), 8.12 (dd, J = 8.2, 1.7 Hz, 1H), 7.67 (d, J = 8.8 Hz, 1H), 7.53 (d, J = 8.8 Hz, 1H), 7.41 (dd, J = 8.2, 4.2 Hz, 1H), 3.90–3.81 (m, 2H), 3.61–3.55 (m, 2H), 3.53–3.47 (m, 1H), 2.79 (dd, J = 18.3, 4.7 Hz, 1H), 2.45 (dd, J = 18.3, 9.0 Hz, 1H), 1.90 (t, J = 7.2 Hz, 3H); ¹³C NMR (100 MHz, CDCl_3) δ 179.4, 177.0, 150.6, 147.6, 136.5, 135.4, 134.8, 128.4, 127.9, 127.2,

121.4, 39.9, 34.1, 33.9, 29.6, 13.3; IR (KBr) ν 2936, 1773, 1692, 1489, 1401, 1348, 1221, 1123, 1040, 835, 811, 689 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{16}\text{H}_{16}\text{ClN}_2\text{O}_2$ [$\text{M}+\text{H}$]⁺ 303.0900, found 303.0899.

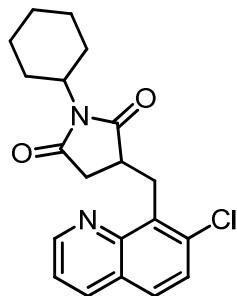
3-((7-Chloroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (4c)



4c

30.2 mg (55%); White solid; mp = 204.4–206.1 °C; ¹H NMR (400 MHz, CDCl_3) δ 8.93 (dd, J = 4.2, 1.7 Hz, 1H), 8.14 (dd, J = 8.2, 1.7 Hz, 1H), 8.06 (br s, 1H), 7.69 (d, J = 8.8 Hz, 1H), 7.55 (d, J = 8.8 Hz, 1H), 7.43 (dd, J = 8.2, 4.2 Hz, 1H), 3.97–3.87 (m, 2H), 3.66–3.59 (m, 1H), 2.89 (dd, J = 18.5, 5.0 Hz, 1H), 2.50 (dd, J = 18.5, 9.1 Hz, 1H); ¹³C NMR (100 MHz, CDCl_3) δ 179.8, 177.2, 150.7, 147.6, 136.6, 135.5, 134.6, 128.4, 128.0, 127.2, 121.5, 41.4, 35.2, 29.3; IR (KBr) ν 2926, 1775, 1711, 1590, 1489, 1352, 1182, 1124, 1018, 960, 835, 793 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{14}\text{H}_{12}\text{ClN}_2\text{O}_2$ [$\text{M}+\text{H}$]⁺ 275.0587, found 275.0583.

3-((7-Chloroquinolin-8-yl)methyl)-1-cyclohexylpyrrolidine-2,5-dione (4d)

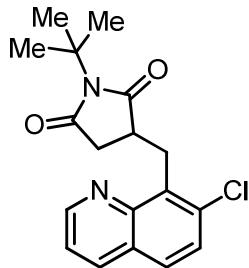


4d

62.8 mg (88%); White solid; mp = 144.7–146.0 °C; ¹H NMR (400 MHz, CDCl_3) δ 8.91 (dd, J = 4.2, 1.8 Hz, 1H), 8.13 (dd, J = 8.2, 1.7 Hz, 1H), 7.68 (d, J = 8.8 Hz, 1H), 7.54 (d, J = 8.8 Hz, 1H), 7.42 (dd, J = 8.2, 4.2 Hz, 1H), 4.03–3.95 (m, 1H), 3.89–3.80 (m, 2H), 3.48–3.41 (m,

1H), 2.75 (dd, J = 18.3, 4.8 Hz, 1H), 2.42 (dd, J = 18.2, 9.1 Hz, 1H), 2.22–2.11 (m, 2H), 1.84–1.81 (m, 2H), 1.67–1.62 (m, 3H), 1.38–1.22 (m, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.6, 177.3, 150.6, 147.7, 136.6, 135.5, 134.9, 128.4, 127.9, 127.2, 121.4, 51.9, 39.6, 34.1, 29.8, 29.1, 29.0, 26.1 (two carbons overlap), 25.3; IR (KBr) ν 2930, 1770, 1695, 1489, 1373, 1258, 1187, 1144, 1040, 835, 797, 677 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{20}\text{H}_{22}\text{ClN}_2\text{O}_2$ [M+H] $^+$ 357.1370, found 357.1367.

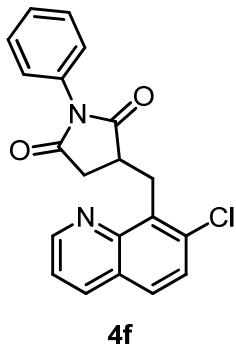
1-(*tert*-Butyl)-3-((7-chloroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (**4e**)



4e

56.9 mg (86%); White sticky oil; ^1H NMR (400 MHz, CDCl_3) δ 8.90 (dd, J = 4.2, 1.8 Hz, 1H), 8.12 (dd, J = 8.3, 1.7 Hz, 1H), 7.66 (d, J = 8.8 Hz, 1H), 7.53 (d, J = 8.8 Hz, 1H), 7.41 (dd, J = 8.2, 4.2 Hz, 1H), 3.87–3.76 (m, 2H), 3.40–3.32 (m, 1H), 2.69 (dd, J = 18.0, 5.2 Hz, 1H), 2.36 (dd, J = 18.0, 9.4 Hz, 1H), 1.59 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 180.6, 178.1, 150.6, 147.7, 136.5, 135.4, 135.1, 128.4, 127.8, 127.2, 121.4, 58.4, 40.0, 34.8, 29.9, 28.6; IR (KBr) ν 2906, 1769, 1697, 1605, 1489, 1343, 1262, 1156, 1077, 834, 795, 661 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{18}\text{H}_{20}\text{ClN}_2\text{O}_2$ [M+H] $^+$ 331.1213, found 331.1215.

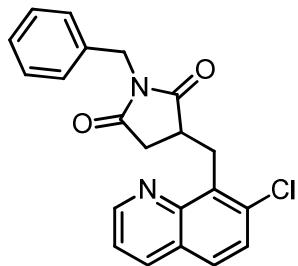
3-((7-Chloroquinolin-8-yl)methyl)-1-phenylpyrrolidine-2,5-dione (**4f**)



4f

63.1 mg (90%); White solid; mp = 174.2–175.3 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.93 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.14 (dd, *J* = 8.2, 1.7 Hz, 1H), 7.70 (d, *J* = 8.8 Hz, 1H), 7.56 (d, *J* = 8.8 Hz, 1H), 7.50–7.33 (m, 6H), 4.04–3.96 (m, 2H), 3.76–3.69 (m, 1H), 2.99 (dd, *J* = 18.4, 5.0 Hz, 1H), 2.67 (dd, *J* = 18.4, 9.2 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 178.4, 176.1, 150.7, 147.6, 136.6, 135.5, 134.5, 132.3, 129.3, 128.6, 128.4, 128.0, 127.2, 126.7, 121.5, 40.0, 34.3, 29.7; IR (KBr) ν 2907, 1777, 1710, 1598, 1499, 1380, 1283, 1178, 1077, 901, 835, 754, 698 cm⁻¹; HRMS (orbitrap, ESI) calcd for C₂₀H₁₆ClN₂O₂ [M+H]⁺ 351.0900, found 351.0897.

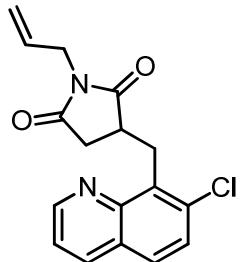
1-Benzyl-3-((7-chloroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (4g)



4g

64.9 mg (89%); Light yellow solid; mp = 125.5–126.9 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.87 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.13 (dd, *J* = 8.2, 1.8 Hz, 1H), 7.68 (d, *J* = 8.8 Hz, 1H), 7.54 (d, *J* = 8.8 Hz, 1H), 7.43–7.40 (m, 3H), 7.34–7.28 (m, 3H), 4.72–4.65 (m, 2H), 3.93–3.83 (m, 2H), 3.58–3.51 (m, 1H), 2.83 (dd, *J* = 18.4, 4.8 Hz, 1H), 2.49 (dd, *J* = 18.4, 9.0 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃) δ 179.2, 176.7, 150.6, 147.6, 136.5, 136.1, 135.4, 134.7, 129.0, 128.8, 128.4, 128.0, 127.9, 127.2, 121.4, 42.6, 40.0, 34.1, 29.5; IR (KBr) ν 2907, 1773, 1698, 1604, 1489, 1395, 1343, 1165, 1124, 1081, 834, 715, 698 cm⁻¹; HRMS (orbitrap, ESI) calcd for C₂₁H₁₈ClN₂O₂ [M+H]⁺ 365.1057, found 365.1054.

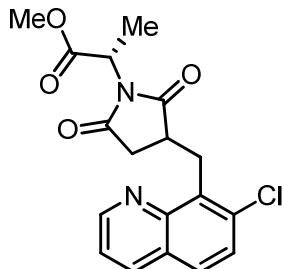
1-Allyl-3-((7-chloroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (4h)



4h

40.9 mg (65%); White solid; mp = 112.1–113.5 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.90 (dd, J = 4.2, 1.8 Hz, 1H), 8.13 (dd, J = 8.2, 1.7 Hz, 1H), 7.68 (d, J = 8.8 Hz, 1H), 7.54 (d, J = 8.8 Hz, 1H), 7.42 (dd, J = 8.2, 4.2 Hz, 1H), 5.87–5.78 (m, 1H), 5.28–5.19 (m, 2H), 4.14 (d, J = 5.8 Hz, 2H), 3.93–3.83 (m, 2H), 3.60–3.52 (m, 1H), 2.83 (dd, J = 18.4, 4.8 Hz, 1H), 2.49 (dd, J = 18.4, 9.0 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.1, 176.7, 150.7, 147.6, 136.6, 135.5, 134.7, 131.1, 128.4, 128.0, 127.2, 121.5, 118.4, 41.1, 40.0, 34.1, 29.6; IR (KBr) ν 2926, 1774, 1698, 1604, 1489, 1425, 1391, 1330, 1174, 1123, 1040, 927, 834, 676 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{17}\text{H}_{16}\text{ClN}_2\text{O}_2$ [M+H] $^+$ 315.0900, found 315.0899.

(2S)-Methyl 2-(3-((7-chloroquinolin-8-yl)methyl)-2,5-dioxopyrrolidin-1-yl)propanoate (4i)

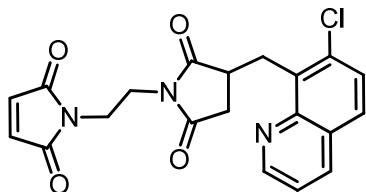


4i

52.0 mg (72%); Diastereomeric ratio = 1:1; White sticky oil; ^1H NMR (400 MHz, CDCl_3) **diastereomer A:** δ 8.93–8.91 (m, 1H), 8.13 (d, J = 8.2 Hz, 1H), 7.69 (d, J = 8.8 Hz, 1H), 7.54 (dd, J = 8.8, 1.2 Hz, 1H), 7.44–7.41 (m, 1H), 4.87–4.81 (m, 1H), 3.92–3.84 (m, 2H), 3.73 (s, 3H), 3.64–3.54 (m, 1H), 2.90–2.82 (m, 1H), 2.58–2.47 (m, 1H), 1.61–1.58 (m, 3H);

diastereomer B: δ 8.93–8.91 (m, 1H), 8.13 (d, J = 8.2 Hz, 1H), 7.69 (d, J = 8.8 Hz, 1H), 7.54 (dd, J = 8.8, 1.2 Hz, 1H), 7.44–7.41 (m, 1H), 4.87–4.81 (m, 1H), 3.92–3.84 (m, 2H), 3.74 (s, 3H), 3.64–3.54 (m, 1H), 2.90–2.82 (m, 1H), 2.58–2.47 (m, 1H), 1.61–1.58 (m, 3H); ^{13}C NMR (100 MHz, CDCl_3) **diastereomer A:** δ 178.4, 176.0, 170.0, 150.6, 147.6, 136.6, 135.5, 134.5, 128.3, 128.0, 127.1, 121.4, 52.9, 48.1, 39.9, 34.0, 29.5, 14.5; **diastereomer B:** δ 178.5, 176.1, 170.0, 150.7, 147.6, 136.6, 135.5, 134.6, 128.4, 128.0, 1272, 121.5, 52.9, 48.1, 40.0, 34.1, 29.6, 14.6; IR (KBr) ν 2924, 1745, 1700, 1489, 1390, 1200, 1116, 1071, 901, 835, 810, 677 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{18}\text{H}_{18}\text{ClN}_2\text{O}_4$ [M+H] $^+$ 361.0955, found 361.0957.

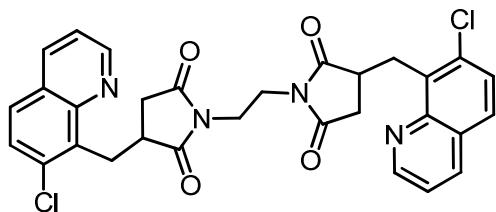
1-(2-((3-((7-Chloroquinolin-8-yl)methyl)-2,5-dioxopyrrolidin-1-yl)ethyl)-1*H*-pyrrole-2,5-dione (4j)



4j

62.0 mg (78%); Light yellow solid; mp = 146.8–148.3 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.90 (dd, J = 4.2, 1.7 Hz, 1H), 8.12 (dd, J = 8.2, 1.7 Hz, 1H), 7.67 (d, J = 8.8 Hz, 1H), 7.53 (d, J = 8.8 Hz, 1H), 7.41 (dd, J = 8.2, 4.2 Hz, 1H), 3.90–3.81 (m, 2H), 3.61–3.55 (m, 2H), 3.53–3.47 (m, 1H), 2.79 (dd, J = 18.3, 4.7 Hz, 1H), 2.45 (dd, J = 18.3, 9.0 Hz, 1H), 1.90 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.6, 177.2, 170.9, 150.7, 147.6, 136.5, 135.4, 134.7, 134.4, 128.4, 127.9, 127.1, 121.4, 40.0, 37.9, 36.1, 33.9, 29.3; IR (KBr) ν 2925, 1771, 1697, 1489, 1432, 1394, 1357, 1221, 1149, 1124, 831, 697 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{20}\text{H}_{17}\text{ClN}_3\text{O}_4$ [M+H] $^+$ 398.0908, found 398.0905.

1,1'-(Ethane-1,2-diyl)bis(3-((7-chloroquinolin-8-yl)methyl)pyrrolidine-2,5-dione) (4j')



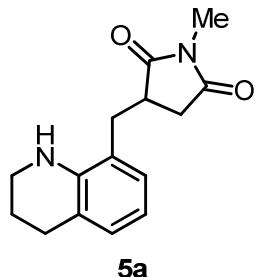
4j'

14.9 mg (13%); Yellow sticky oil; ^1H NMR (400 MHz, CDCl_3) δ 8.93–8.88 (m, 2H), 8.13–8.09 (m, 2H), 7.66 (dd, J = 8.8, 2.1 Hz, 2H), 7.53 (dd, J = 8.8, 3.6 Hz, 2H), 7.42–7.36 (m, 2H), 3.92–3.74 (m, 8H), 3.57–3.48 (m, 2H), 2.85–2.78 (m, 2H), 2.47–2.40 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 180.0, 179.9, 177.6, 177.5, 150.7, 150.7, 147.6 (two carbons overlap), 136.5, 136.4, 135.5 (two carbons overlap), 135.0, 134.9, 128.4 (two carbons overlap), 127.9, 127.9, 127.2 (two carbons overlap), 121.4 (two carbons overlap), 40.2, 40.1, 37.4 (two carbons overlap), 34.0, 33.9, 29.2 (two carbons overlap); IR (KBr) ν 2926, 1772, 1697, 1488, 1392, 1221, 1158, 1014, 901, 834, 805, 696 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{30}\text{H}_{25}\text{Cl}_2\text{N}_4\text{O}_4$ [$\text{M}+\text{H}]^+$ 575.1253, found 575.1250.

Experimental procedure and characterization for reduction of quinoline 3a

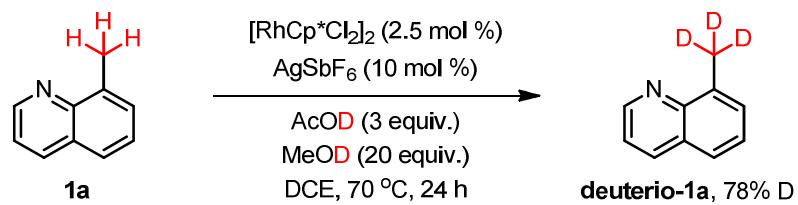
1-Methyl-3-(quinolin-8-ylmethyl)pyrrolidine-2,5-dione (**3a**) (102 mg, 0.4 mmol) and $\text{NiCl}_6 \cdot \text{H}_2\text{O}$ (10 mol %, 9.5 mg) were dissolved in MeOH (4 mL) and CH_2Cl_2 (2 mL). NaBH_4 (121 mg, 3.2 mmol) was added in portions with stirring under cooling for 1 h, then the stirring was continued for another 1 h. After the removal of the solvents, the residue was absorbed to small amounts of silica. The purification was performed by flash column chromatography on silica gel (*n*-hexanes/EtOAc = 1:10) to afford **5a** (41.4 mg, 0.16 mmol) in 40% yield.

1-Methyl-3-((1,2,3,4-tetrahydroquinolin-8-yl)methyl)pyrrolidine-2,5-dione (**5a**)

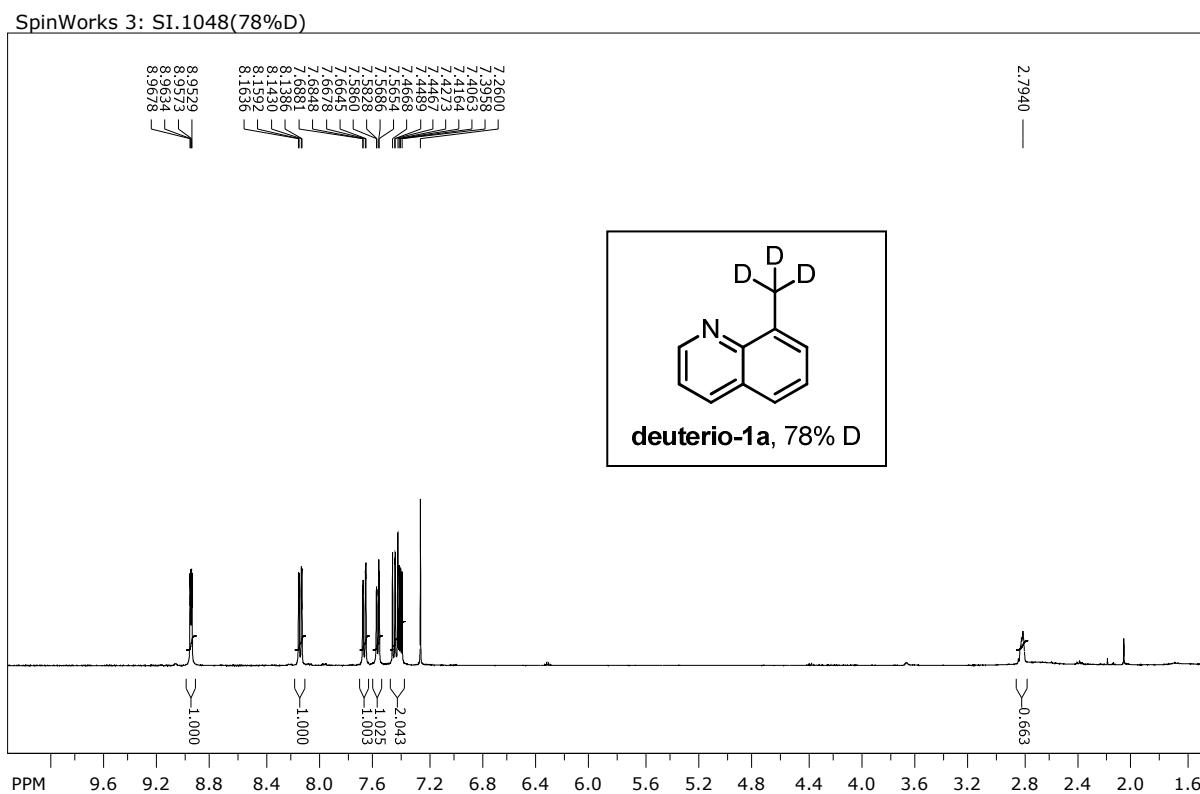


41.4 mg (40%); Orange solid; mp = 151.8–152.9 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.90 (dd, J = 4.2, 1.7 Hz, 1H), 8.12 (dd, J = 8.2, 1.7 Hz, 1H), 7.67 (d, J = 8.8 Hz, 1H), 7.53 (d, J = 8.8 Hz, 1H), 7.41 (dd, J = 8.2, 4.2 Hz, 1H), 3.90–3.81 (m, 2H), 3.61–3.55 (m, 2H), 3.53–3.47 (m, 1H), 2.79 (dd, J = 18.3, 4.7 Hz, 1H), 2.45 (dd, J = 18.3, 9.0 Hz, 1H), 1.90 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 172.3, 171.5, 135.6, 128.0, 126.0, 125.4, 125.2, 122.9, 41.6, 38.1, 37.4, 31.4, 27.2, 26.5, 21.7; IR (KBr) ν 3016, 2927, 1643, 1594, 1472, 1370, 1258, 1159, 1081, 769, 741, 665 cm^{-1} ; HRMS (orbitrap, ESI) calcd for $\text{C}_{15}\text{H}_{19}\text{N}_2\text{O}_2$ [$\text{M}+\text{H}]^+$ 259.1447, found 259.1449.

Mechanistic investigation (H/D exchange reactions)



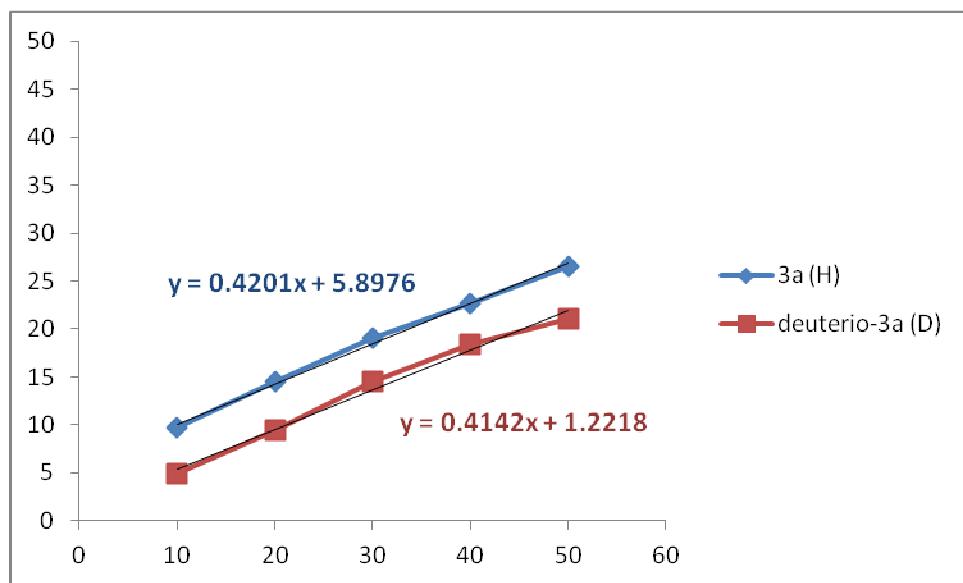
To an oven-dried sealed tube charged with 8-methylquinoline (**1a**) (28.6 mg, 0.2 mmol, 100 mol %), $[\text{RhCp}^*\text{Cl}_2]_2$ (3.1 mg, 0.005 mmol, 2.5 mol %), AcOD (36.6 mg, 0.6 mmol, 300 mol %) and MeOD (144.2 mg, 4.0 mmol, 20.0 equiv.) was added AgSbF_6 (6.9 mg, 0.02 mmol, 10 mol %) and DCE (1 mL) under air at room temperature. The reaction mixture was allowed to stir at 70 °C for 24 h, and cooled to room temperature. The reaction mixture was diluted with EtOAc (3 mL) and concentrated in vacuo. The residue was purified by flash column chromatography (*n*-hexanes/EtOAc = 10:1).



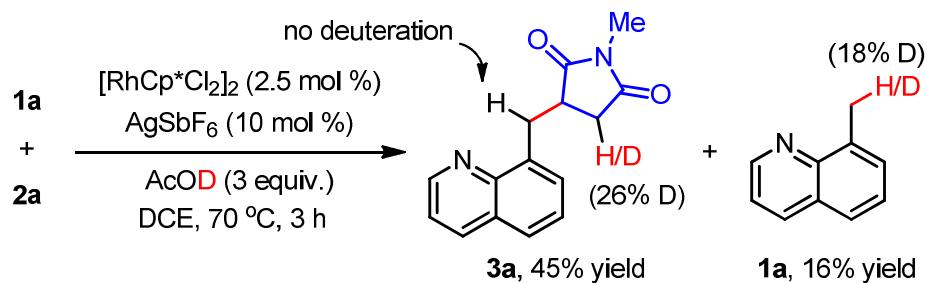
Kinetic Isotope Effect (KIE) experiment

To an oven-dried sealed tube charged with 8-methylquinoline (**1a**) (28.6 mg, 0.2 mmol, 100 mol %), $[\text{RhCp}^*\text{Cl}_2]_2$ (3.1 mg, 0.005 mmol, 2.5 mol %), AdCO₂H (108.2 mg, 0.6 mmol, 300 mol %), *N*-methylmaleimide (**2a**) (44.0 mg, 0.4 mmol, 200 mol %), AgSbF₆ (6.9 mg, 0.02 mmol, 10 mol %) and DCE (1 mL) was added bromobenzene (157.0 mg, 1.0 mmol, 500 mol %) as an internal standard. In another reaction tube, **deutrio-1a** (29.2 mg, 0.2 mmol, 100 mol %, >90% D) was used instead of **1a**. The two reactions were allowed to stir at 70 °C. An aliquot of each reaction mixture was taken at the time of 10 min, 20 min, 30 min, 40 min, and 50 min. The corresponding yield of each product was determined by GC-MS (bromobenzene as an internal standard). A kinetic isotope effect value ($k_{\text{H}}/k_{\text{D}}$) of 1.01 was observed.

	Relative yield (%) based on bromobenzene				
	10	20	30	40	50
3a (H)	9.6795909	14.5086385	19.0203487	22.7122402	26.5830681
deutero-3a (D)	4.8573650	9.4373156	14.4568680	18.4121292	21.0822934

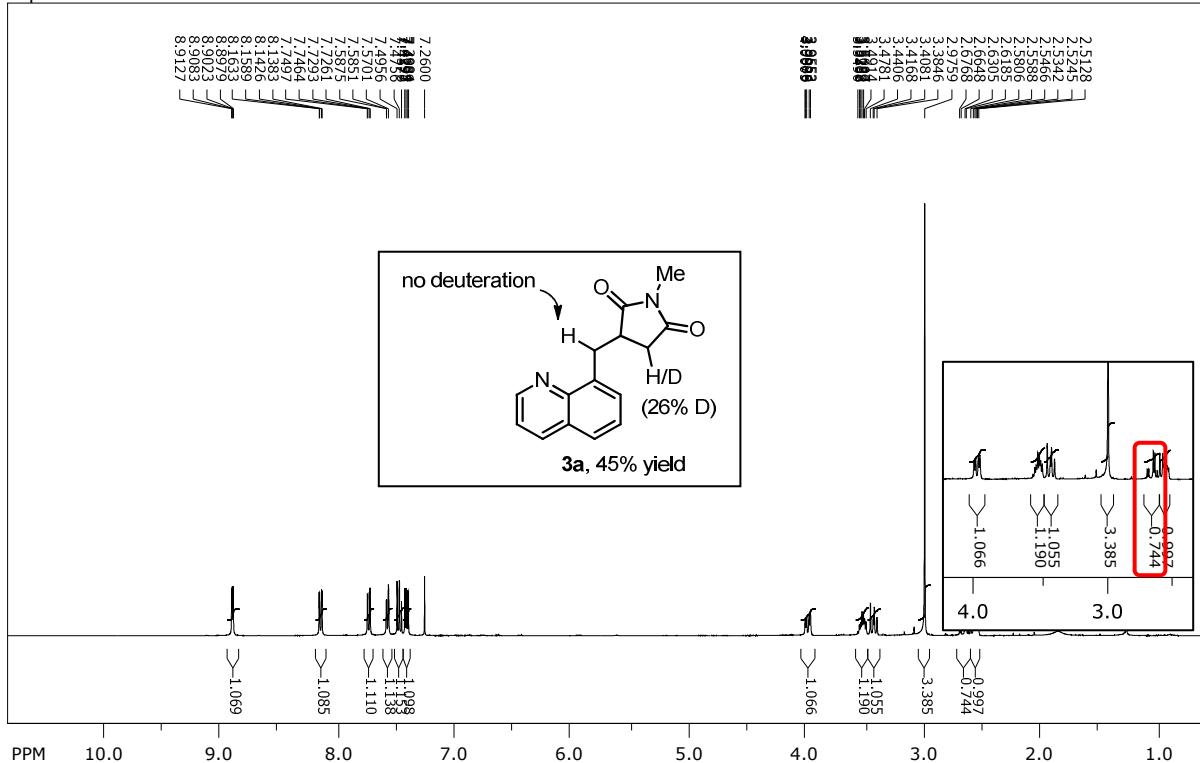


Mechanistic investigation (deuterium incorporation)



To an oven-dried sealed tube charged with 8-methylquinoline (**1a**) (28.6 mg, 0.2 mmol, 100 mol %), $[\text{RhCp}^*\text{Cl}_2]_2$ (3.1 mg, 0.005 mmol, 2.5 mol %), AcOD (36.6 mg, 0.6 mmol, 300 mol %) and *N*-methylmaleimide (**2a**) (44.0 mg, 0.4 mmol, 200 mol %) was added AgSbF_6 (6.9 mg, 0.02 mmol, 10 mol %) and DCE (1 mL) under air at room temperature. The reaction mixture was allowed to stir at 70 °C for 3 h, and cooled to room temperature. The reaction mixture was diluted with EtOAc (3 mL) and concentrated in vacuo. The residue was purified by flash column chromatography (*n*-hexanes/EtOAc = 5:1 to 2:1) to afford **3a** (22.8 mg, 45% yield) and **1a** (4 mg, 16% recovered yield), respectively.

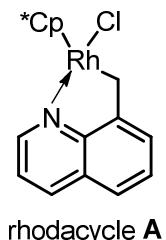
SpinWorks 3: SI.1057



Experimental procedure and characterization for the synthesis of rhodacycle A

A mixture of substituted 8-methylquinoline (**1a**) (85.9 mg, 0.6 mmol), $[\text{Cp}^*\text{RhCl}_2]_2$ (18.6 mg, 0.03 mmol, 5.0 mol %), NaOAc (24.6 mg, 0.3 mmol) and MeOH (1 mL) were weighted in a Schlenk tube equipped with a stir bar. The reaction mixture was stirred at 80 °C for overnight, and concentrated in vacuo. The product was purified by flash column chromatography on silica gel (EtOAc/petroleum ether = 1: 2).

Rhodacycle A^[1]

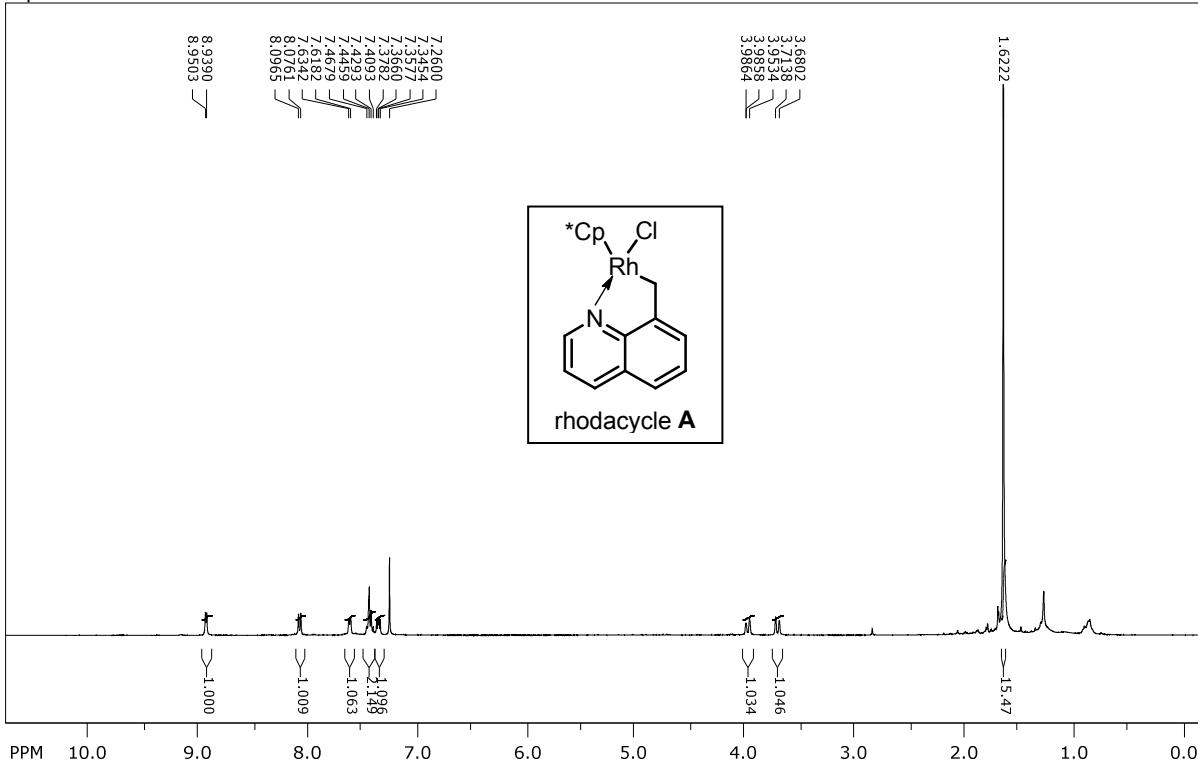


rhodacycle A

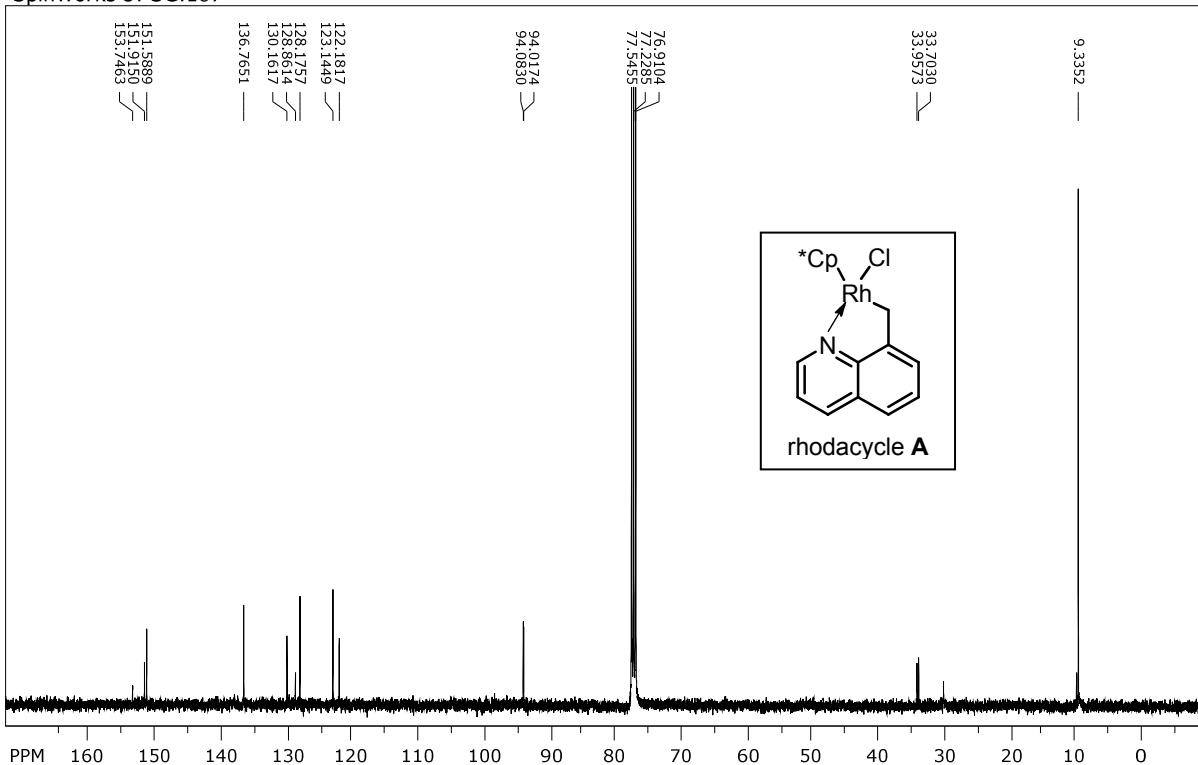
^1H NMR (400 MHz, CDCl_3) δ 8.94 (d, J = 4.5 Hz, 1H), 8.08 (d, J = 8.2 Hz, 1H), 7.62 (d, J = 6.4 Hz, 1H), 7.47–7.41 (m, 2H), 7.36 (dd, J = 8.2, 4.9 Hz, 1H), 3.99 (d, J = 13.2 Hz, 1H), 3.70 (d, J = 13.4 Hz, 1H), 1.62 (s, 15H); ^{13}C NMR (100 MHz, CDCl_3) δ 153.7, 151.9, 151.6, 136.8, 130.2, 128.9, 128.2, 123.1, 122.2, 94.1, 94.0, 34.0, 33.7, 9.3.

[1] Liu, B.; Zhou, T.; Li, B.; Xu, S.; Song, H.; Wang, B. *Angew. Chem., Int. Ed.* **2014**, *53*, 4191.

SpinWorks 3: SG.187

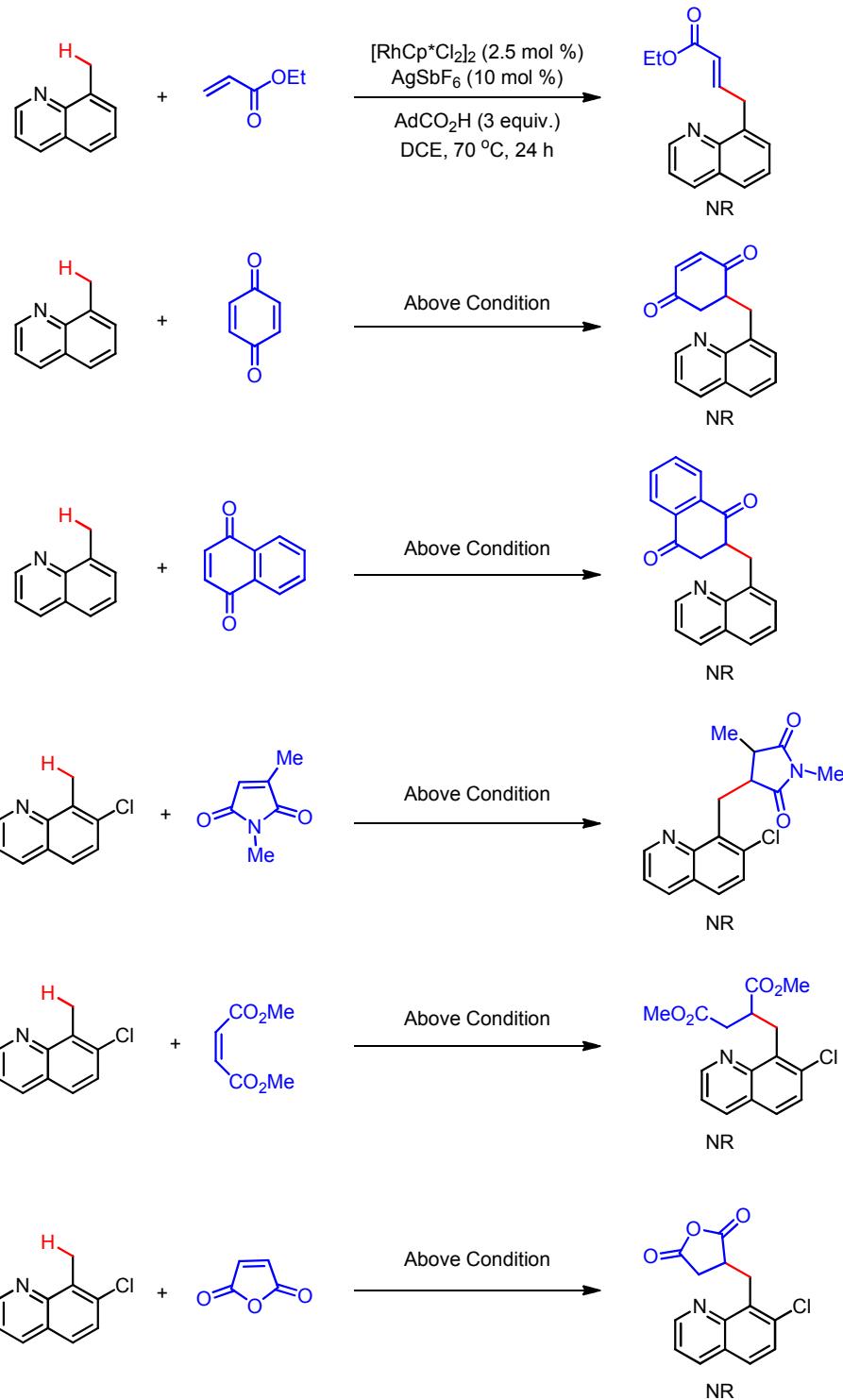


SpinWorks 3: SG.187

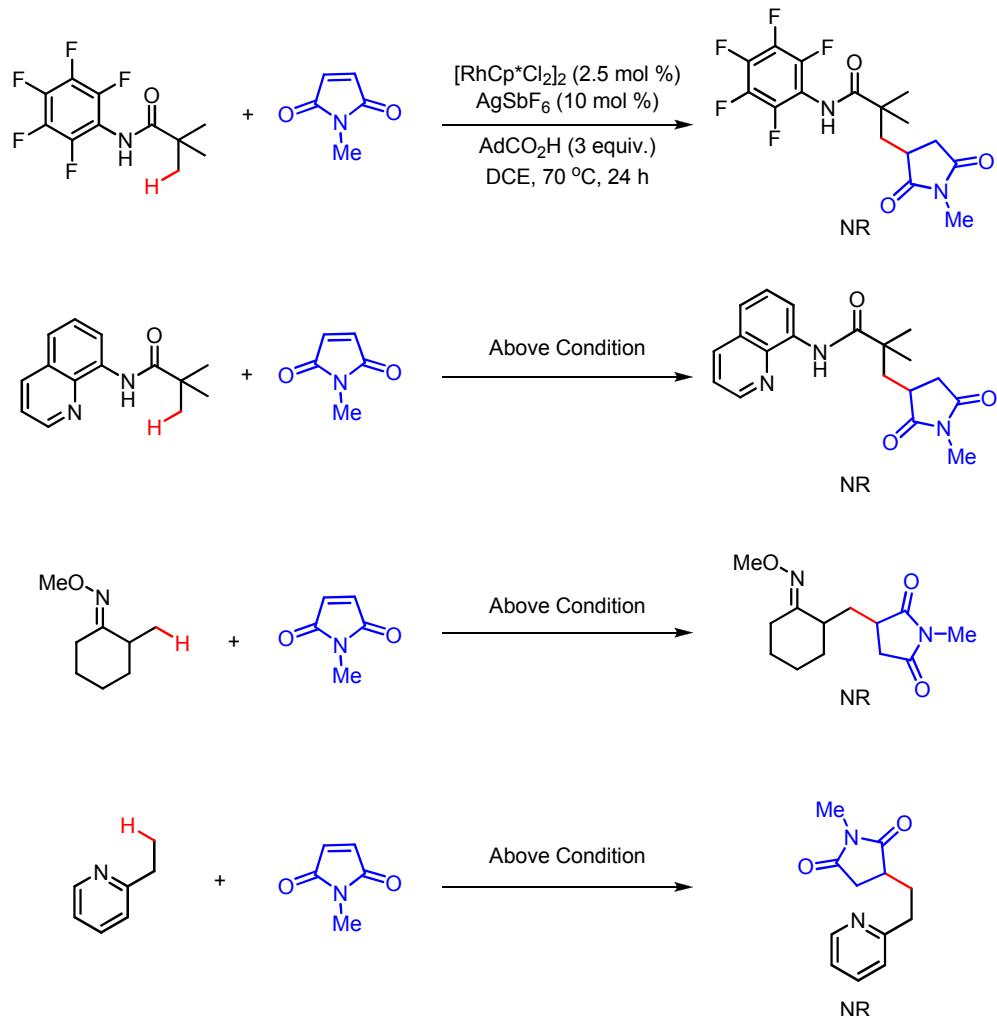


Unsuccessful substrates

< Other olefins >

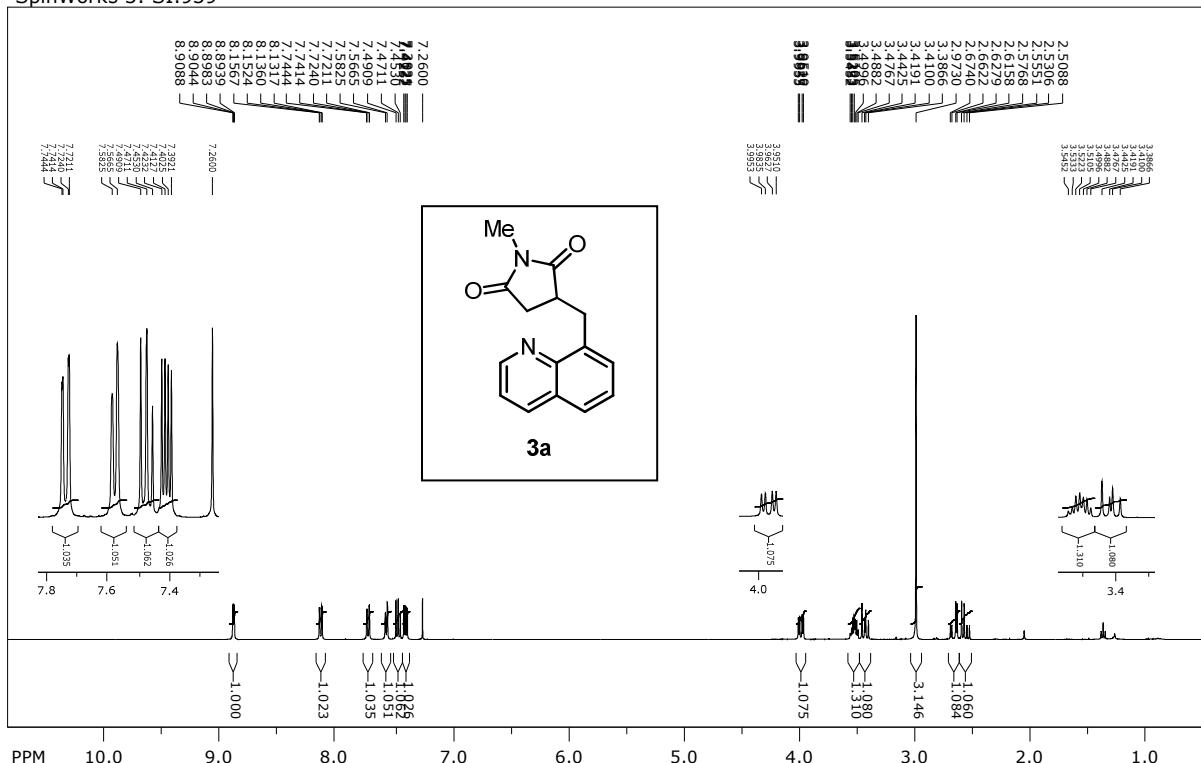


< Other C(sp³)–H bond substrates >

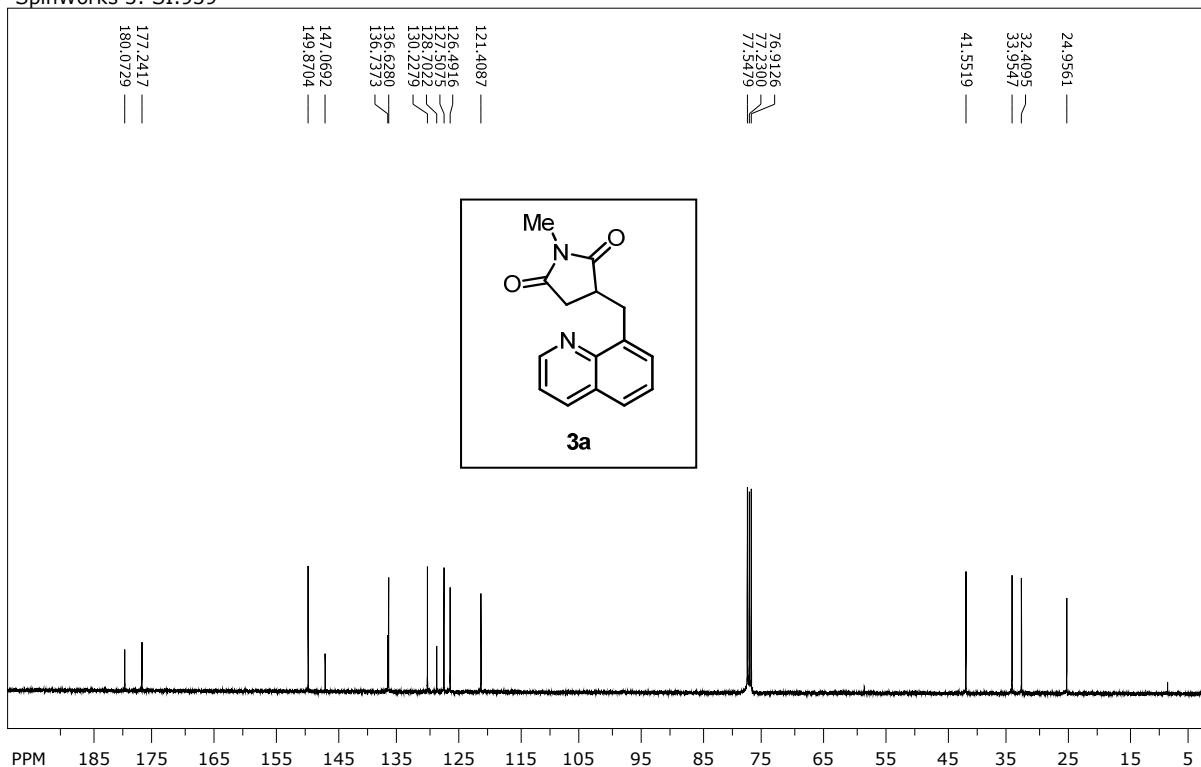


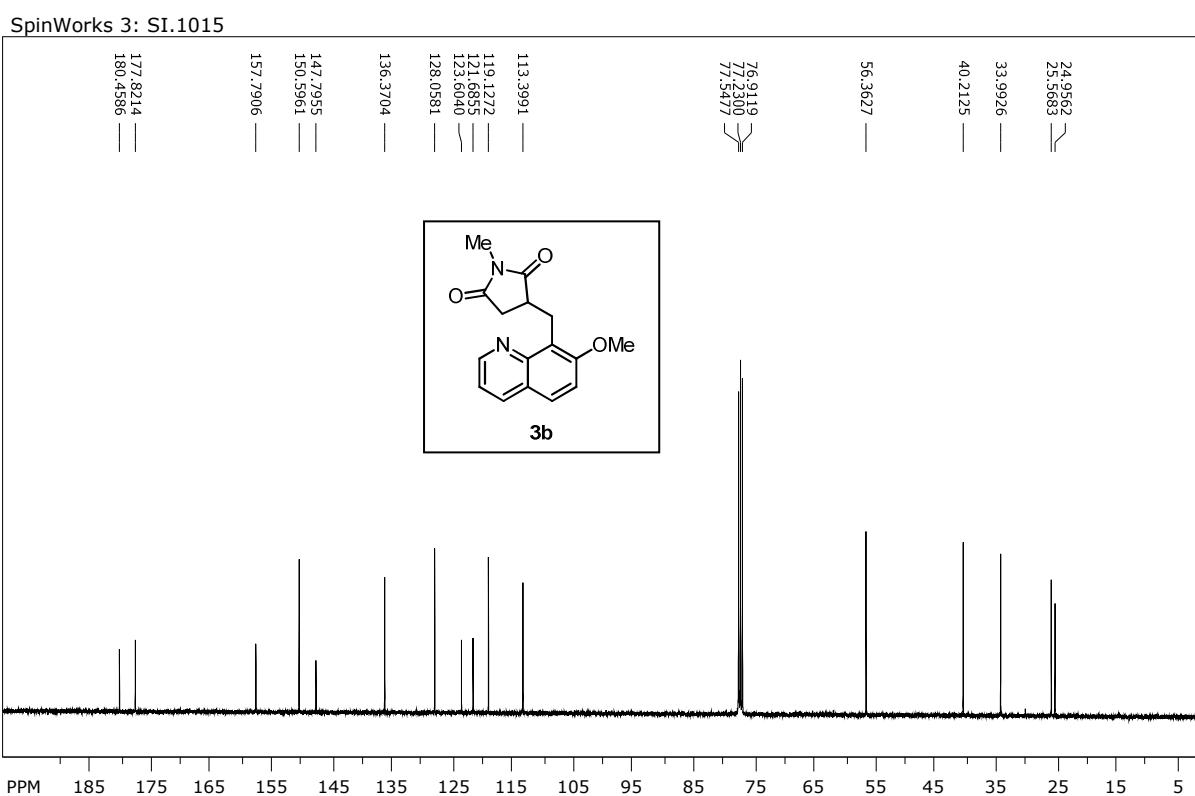
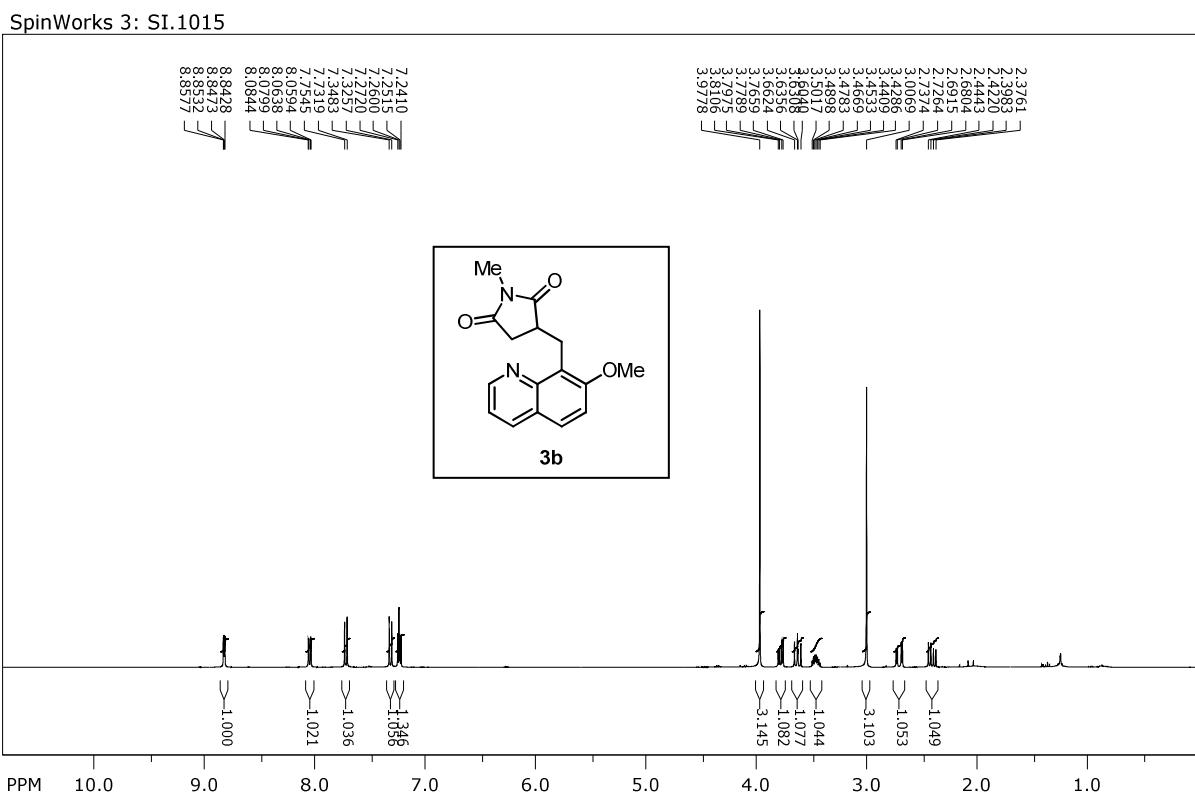
¹H and ¹³C NMR spectra of all compounds

SpinWorks 3: SI.939

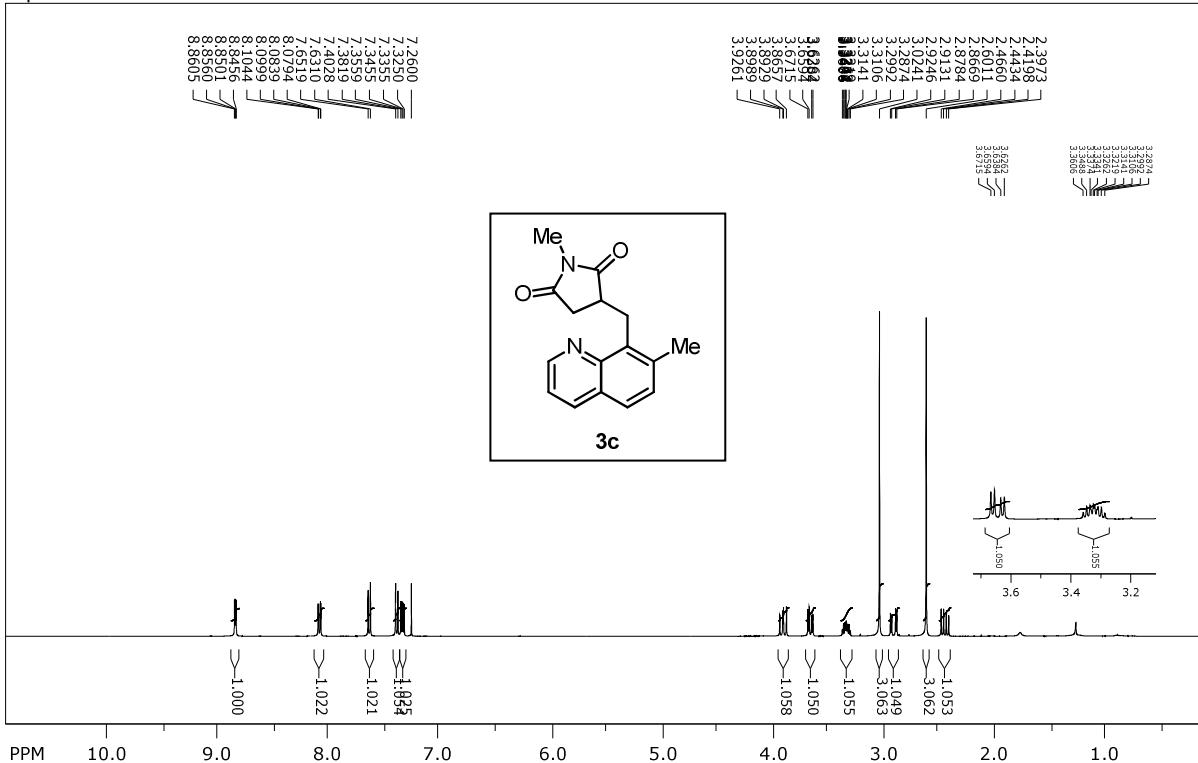


SpinWorks 3: SI.939

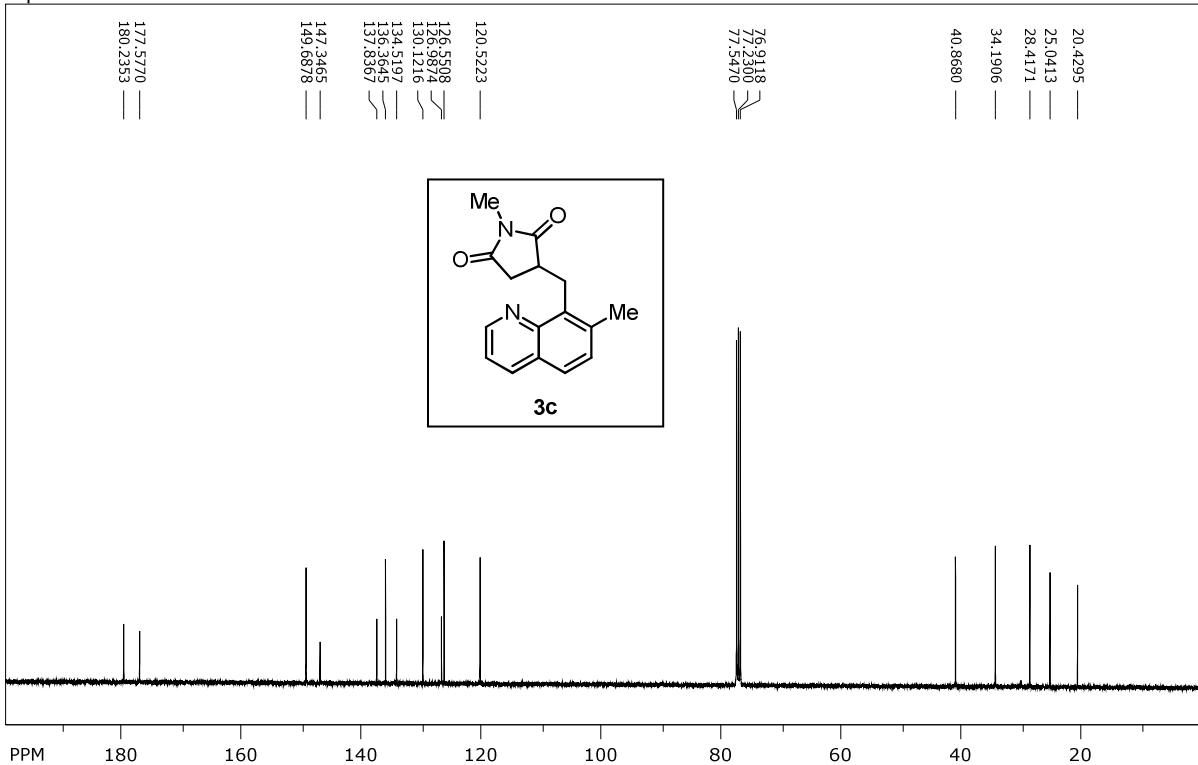


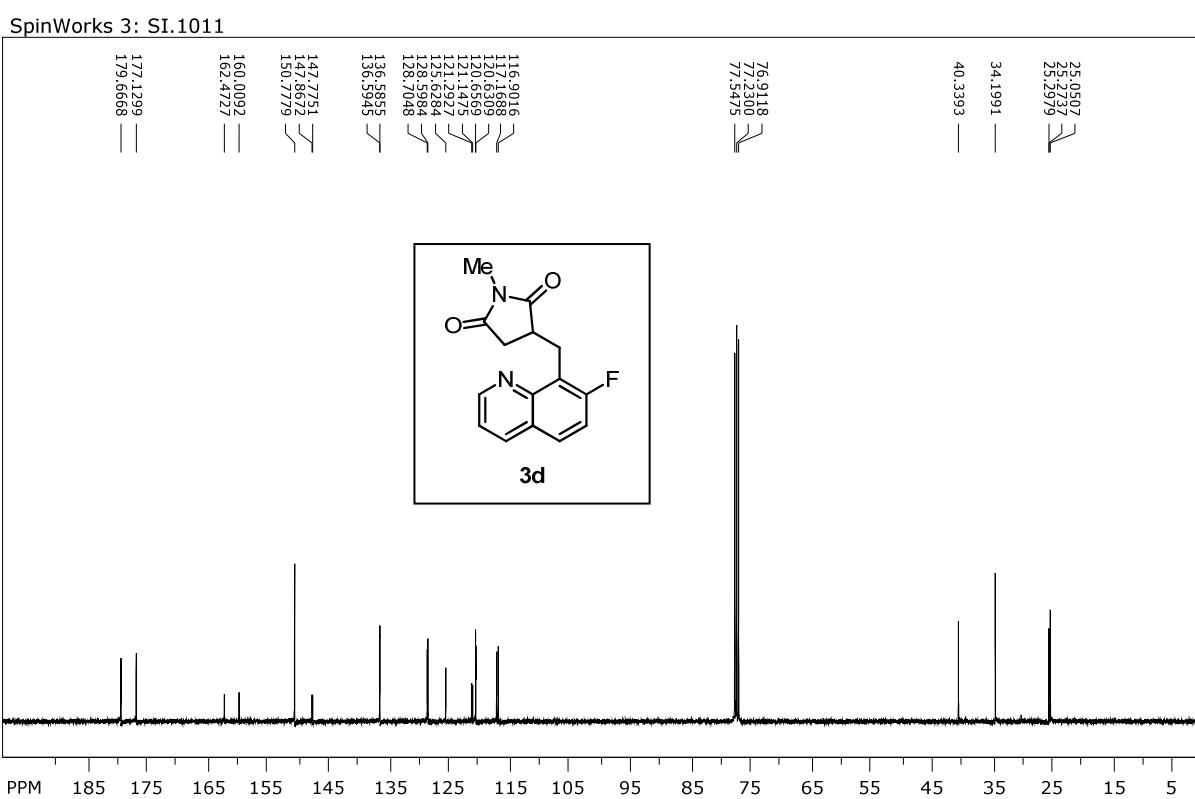
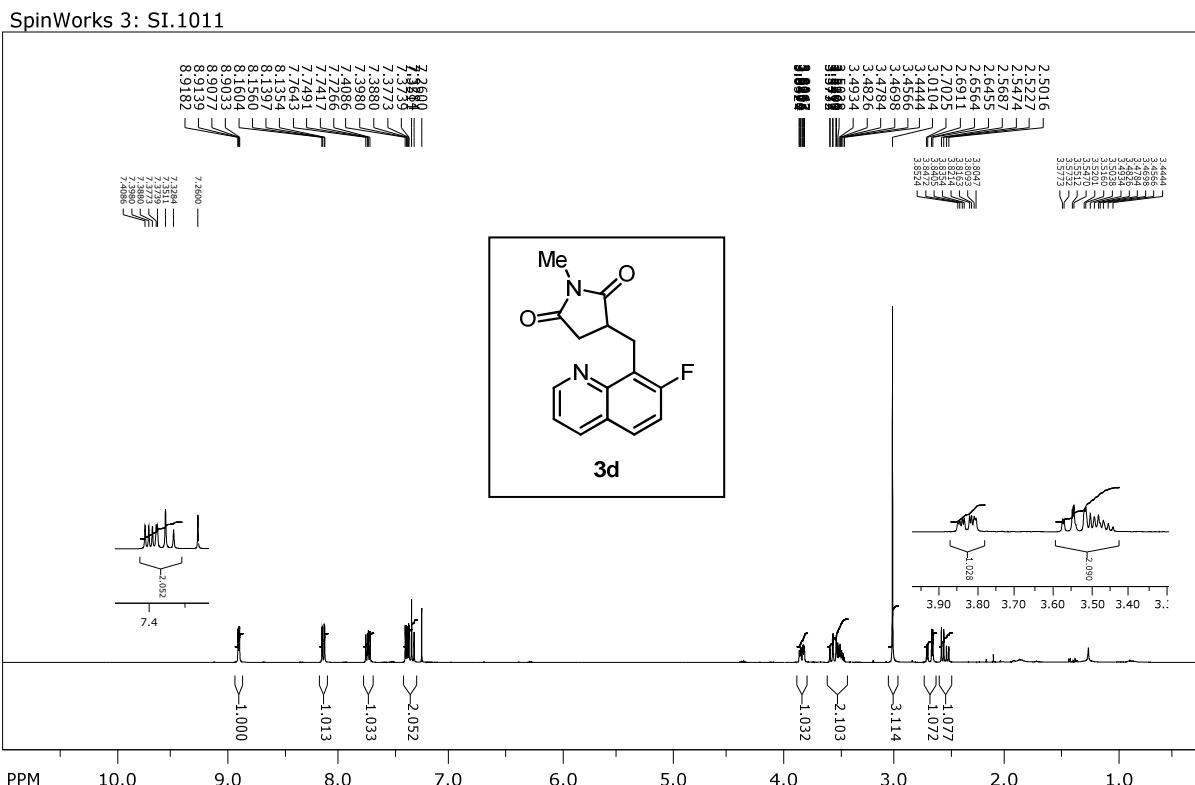


SpinWorks 3: SI.1014

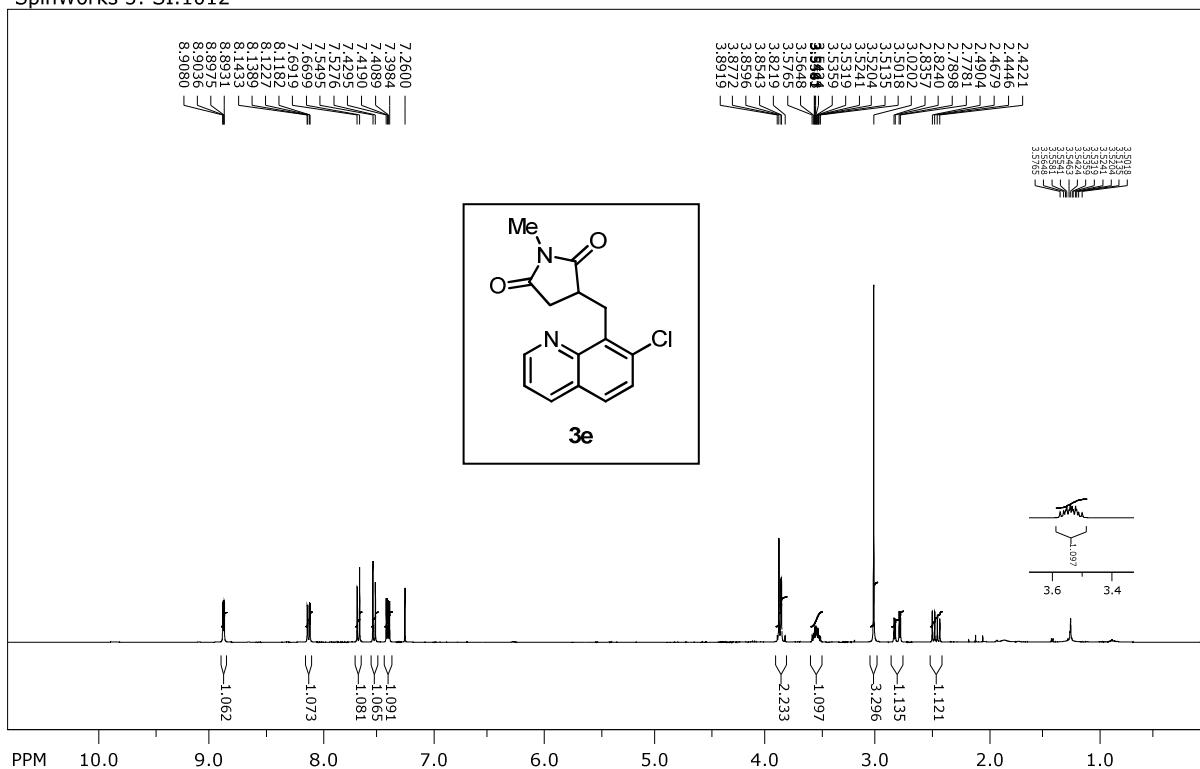


SpinWorks 3: SI.1014

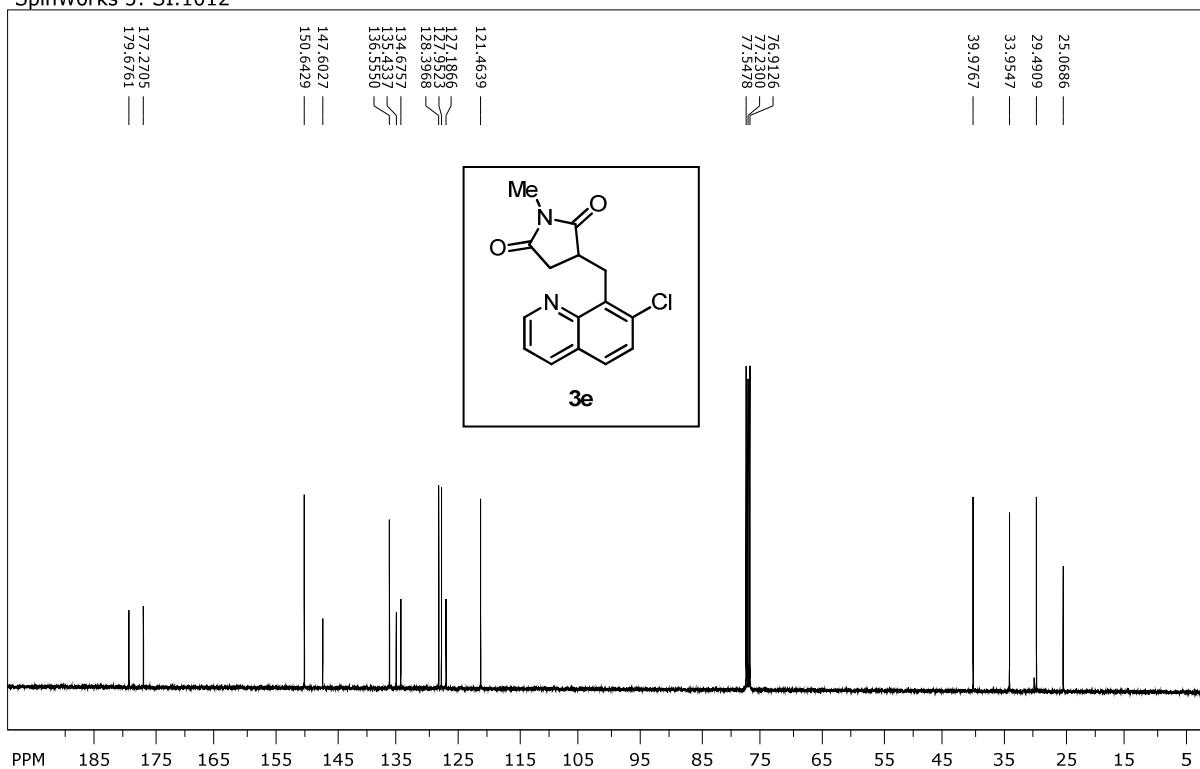




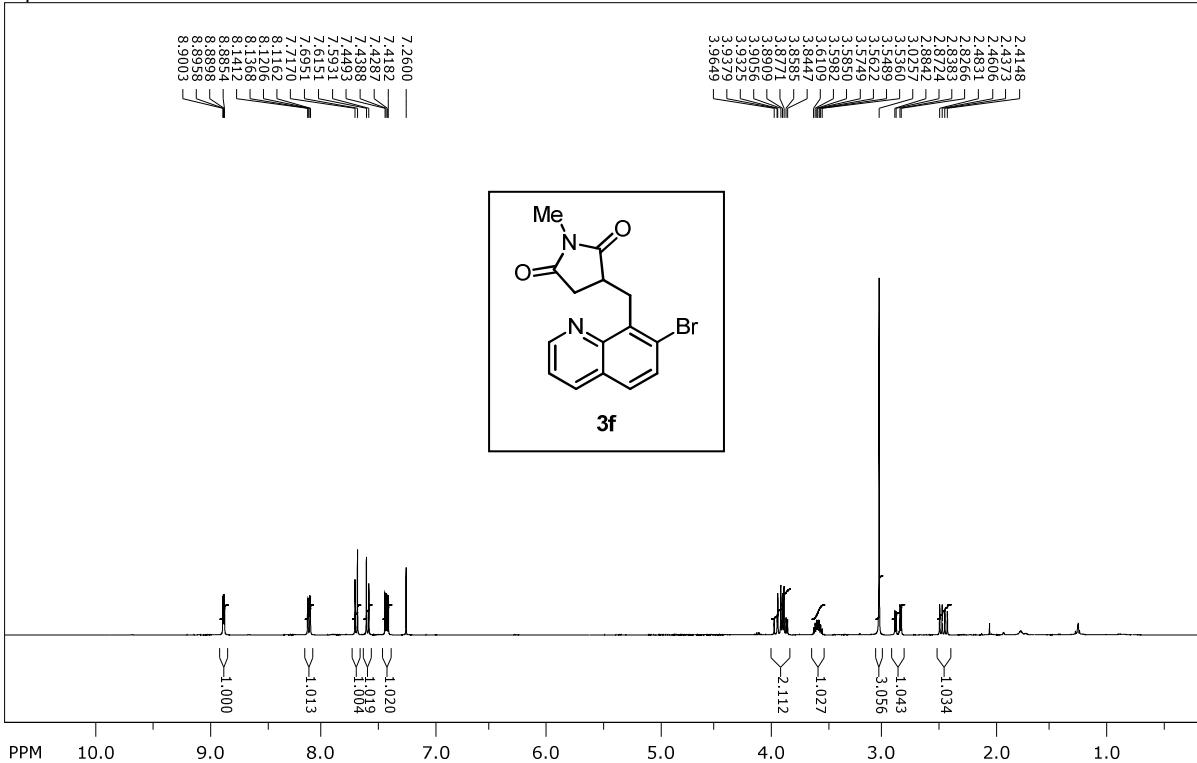
SpinWorks 3: SI.1012



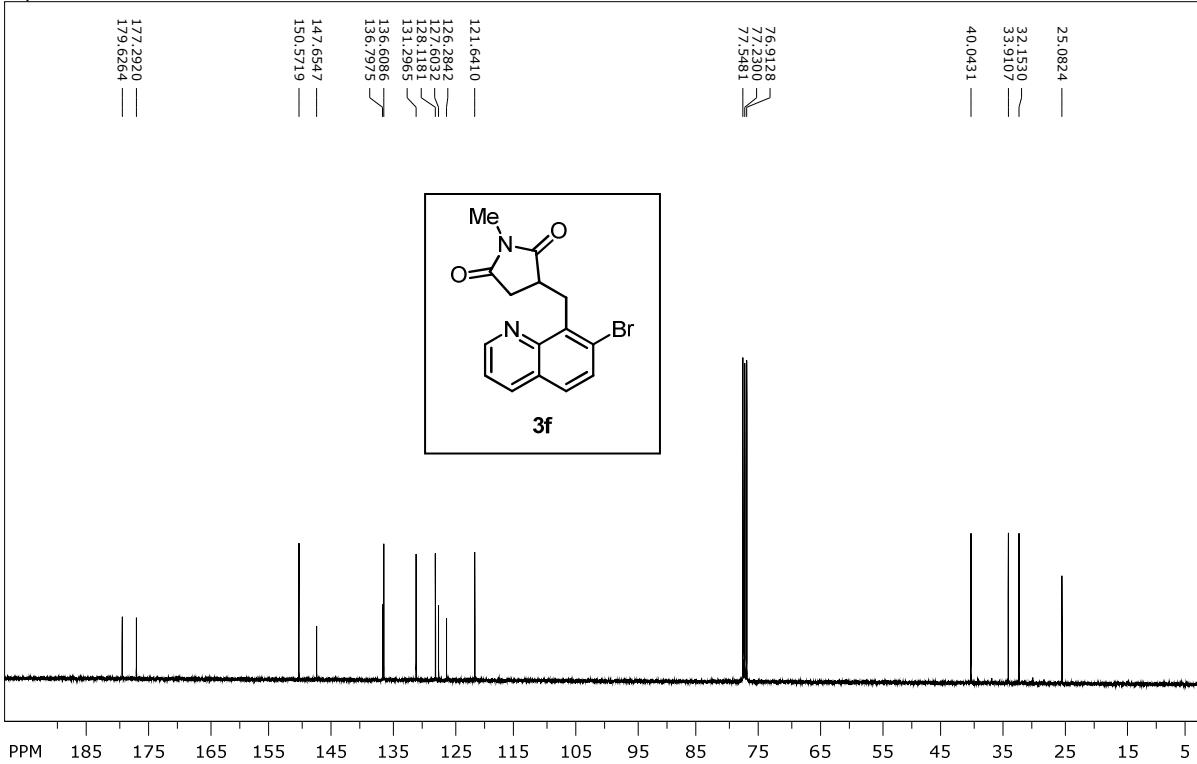
SpinWorks 3: SI.1012

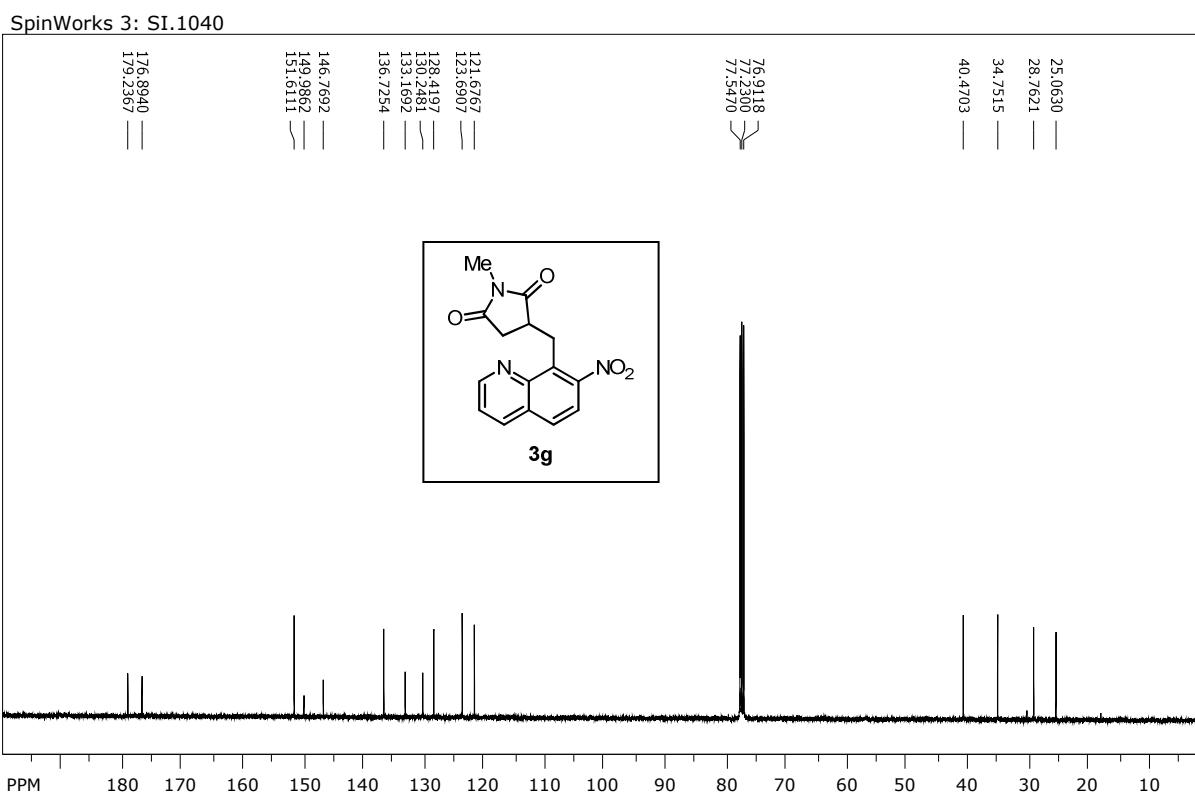
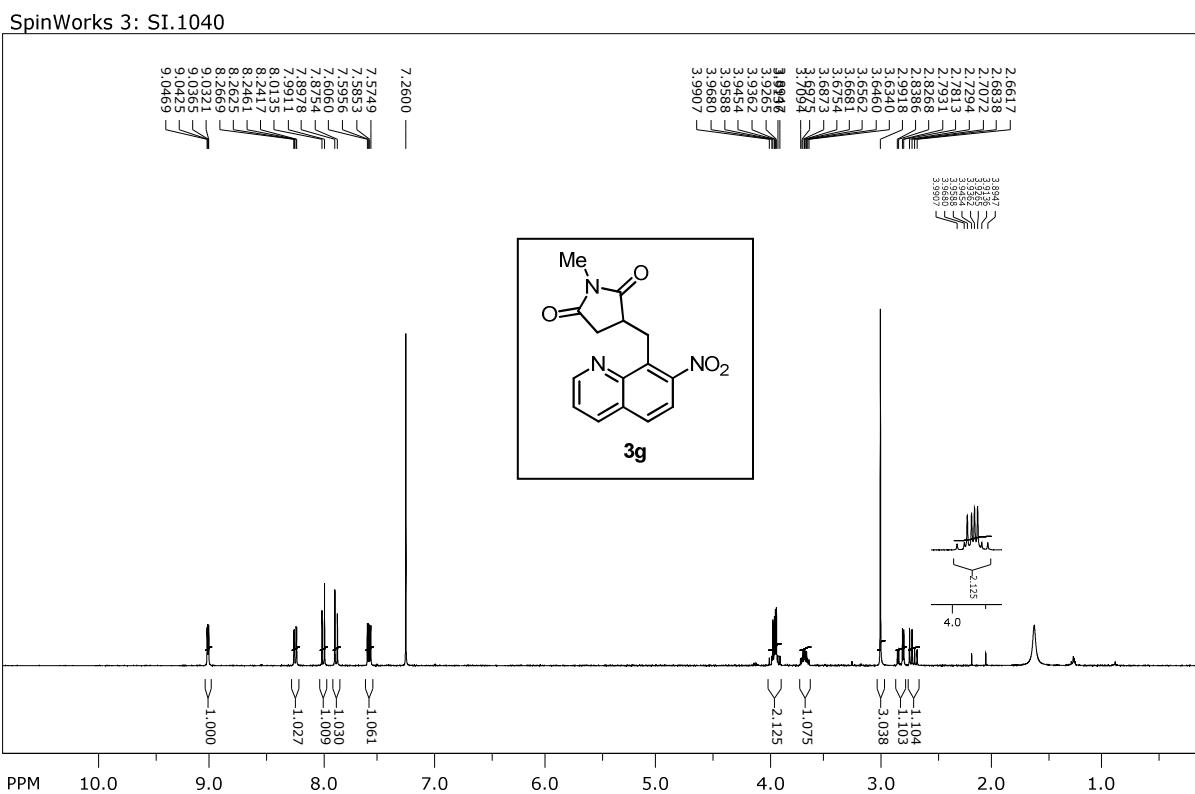


SpinWorks 3: SI.1013

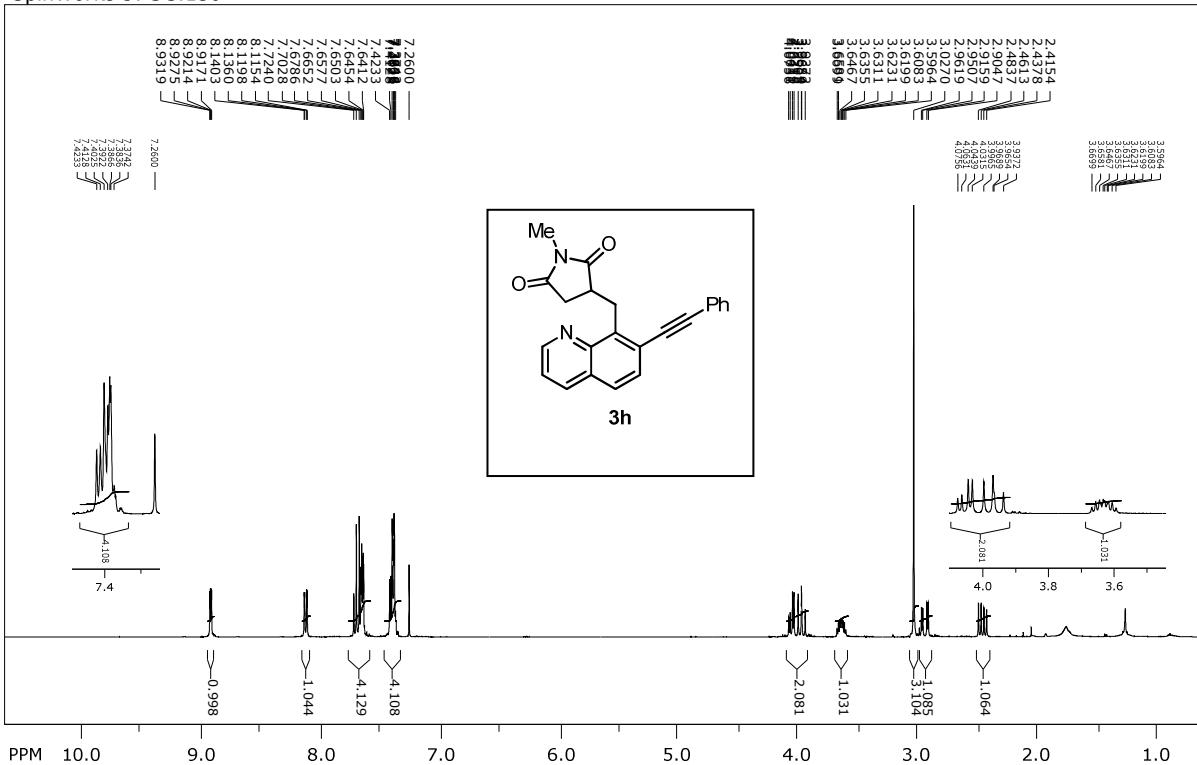


SpinWorks 3: SI.1013

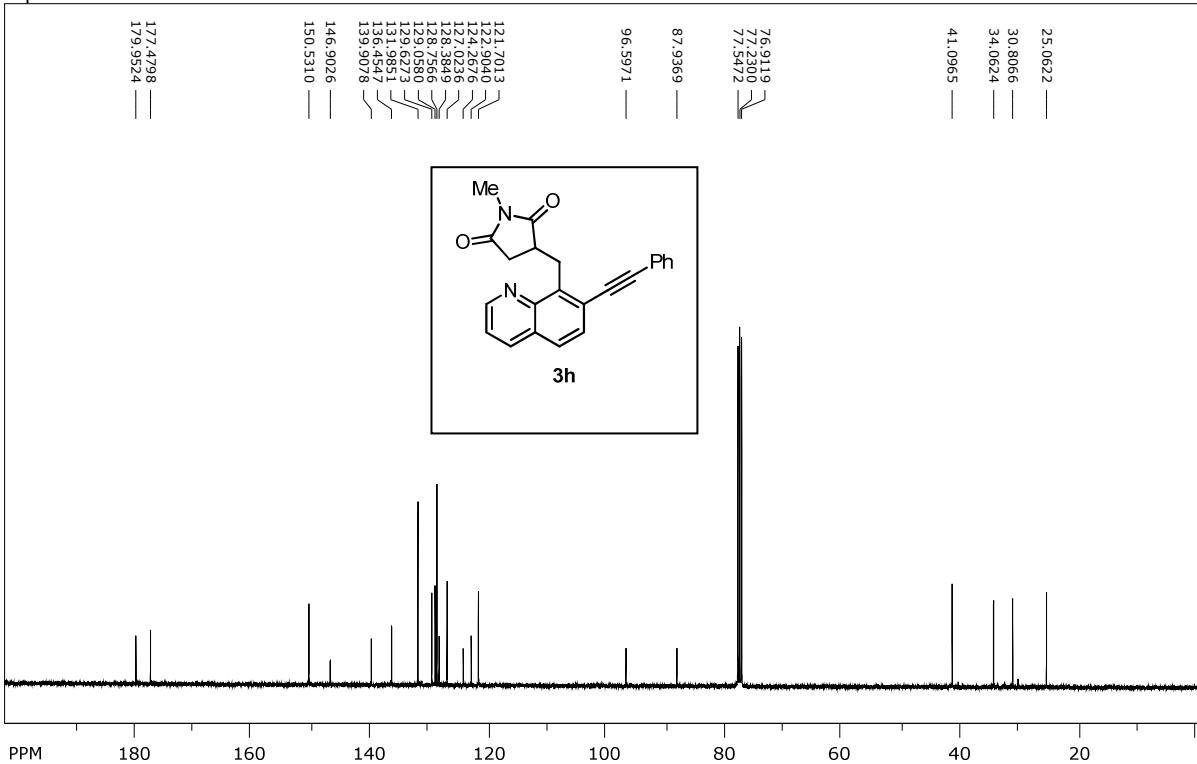




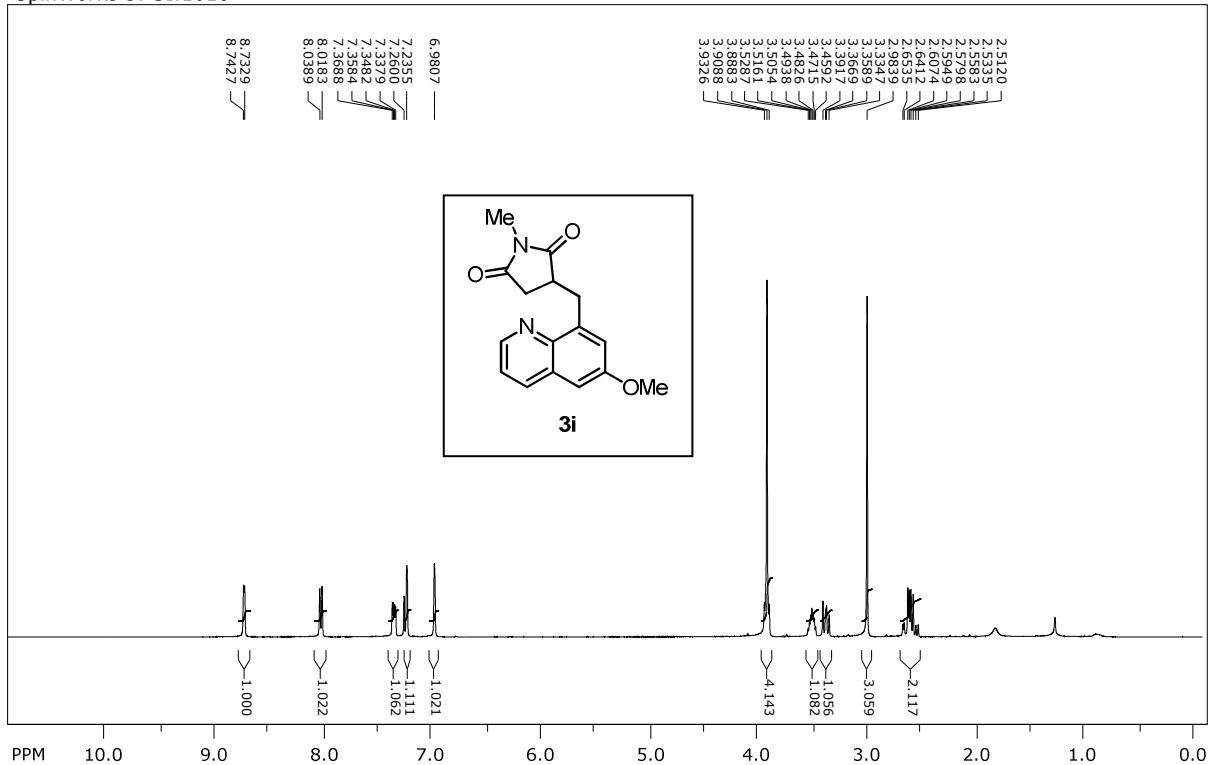
SpinWorks 3: SG.150



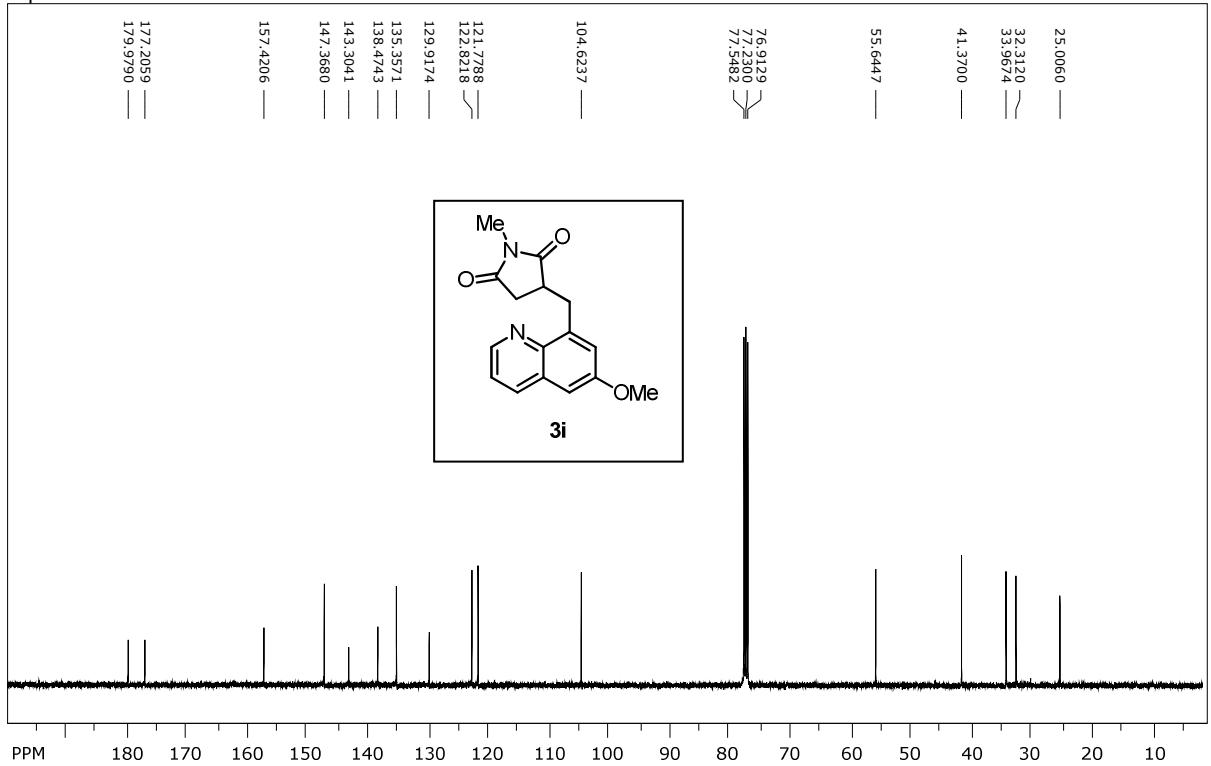
SpinWorks 3: SG.150



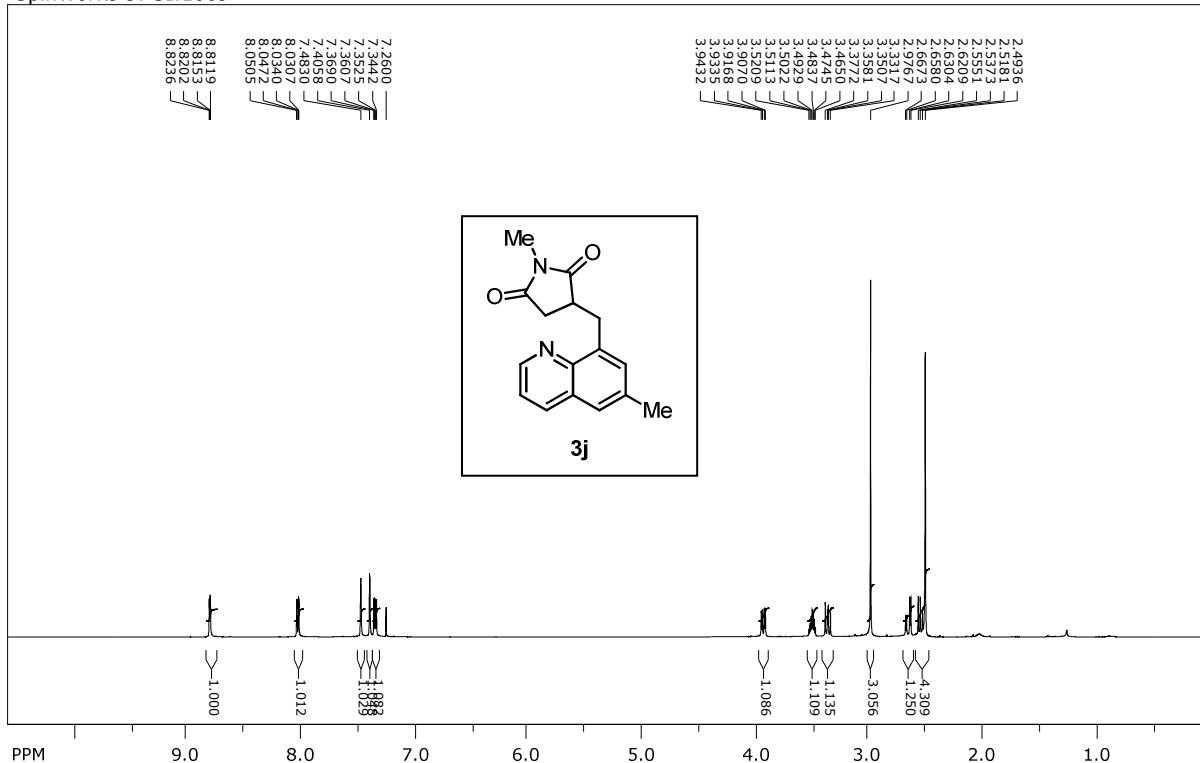
SpinWorks 3: SI.1010



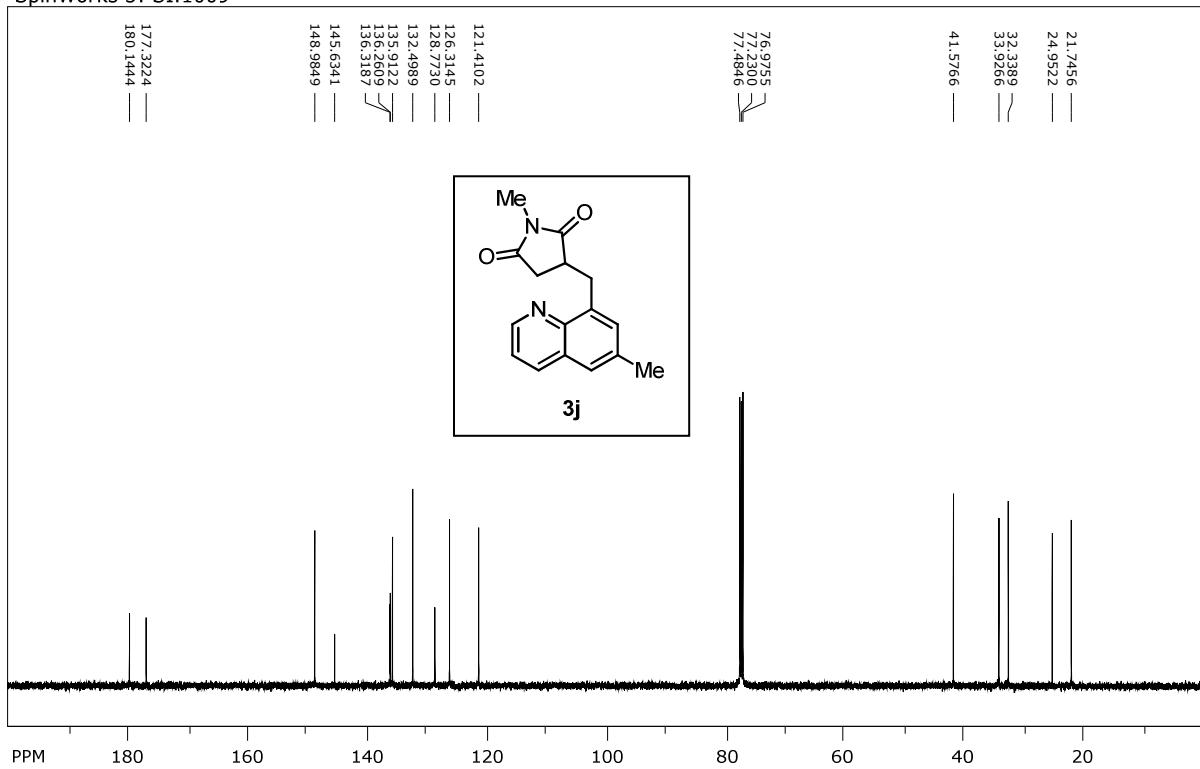
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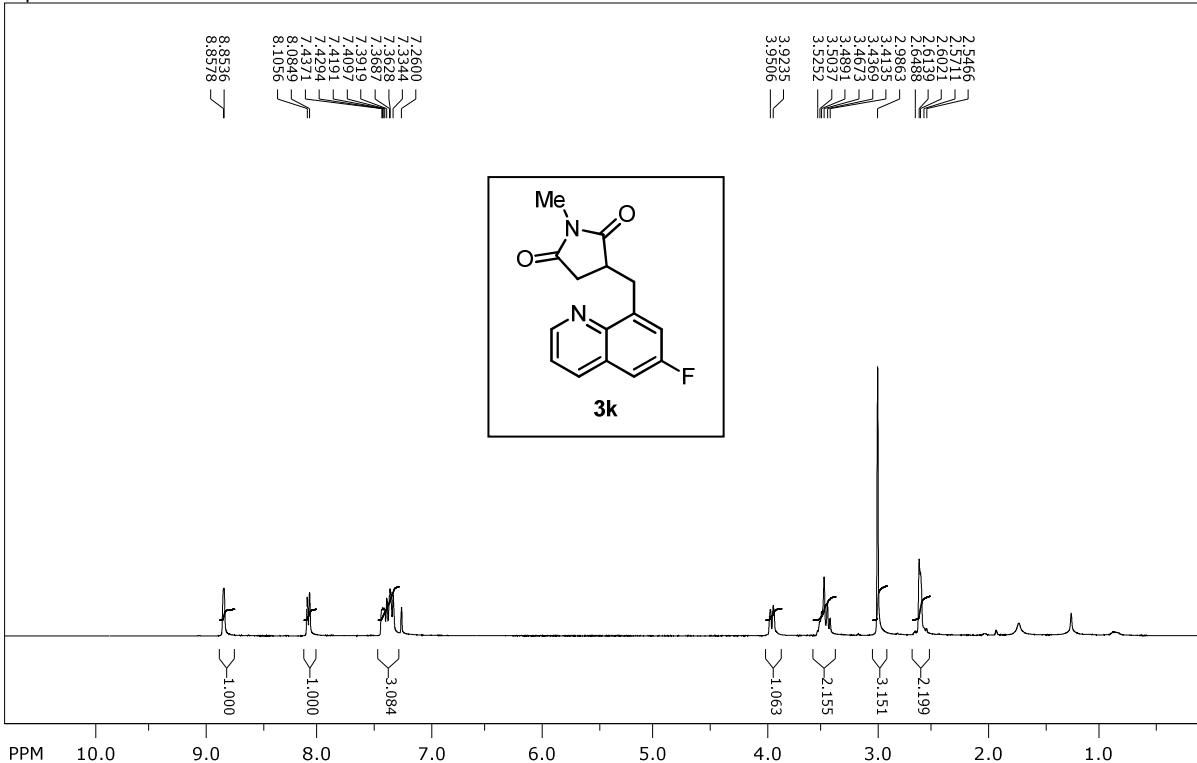
SpinWorks 3: SI.1009



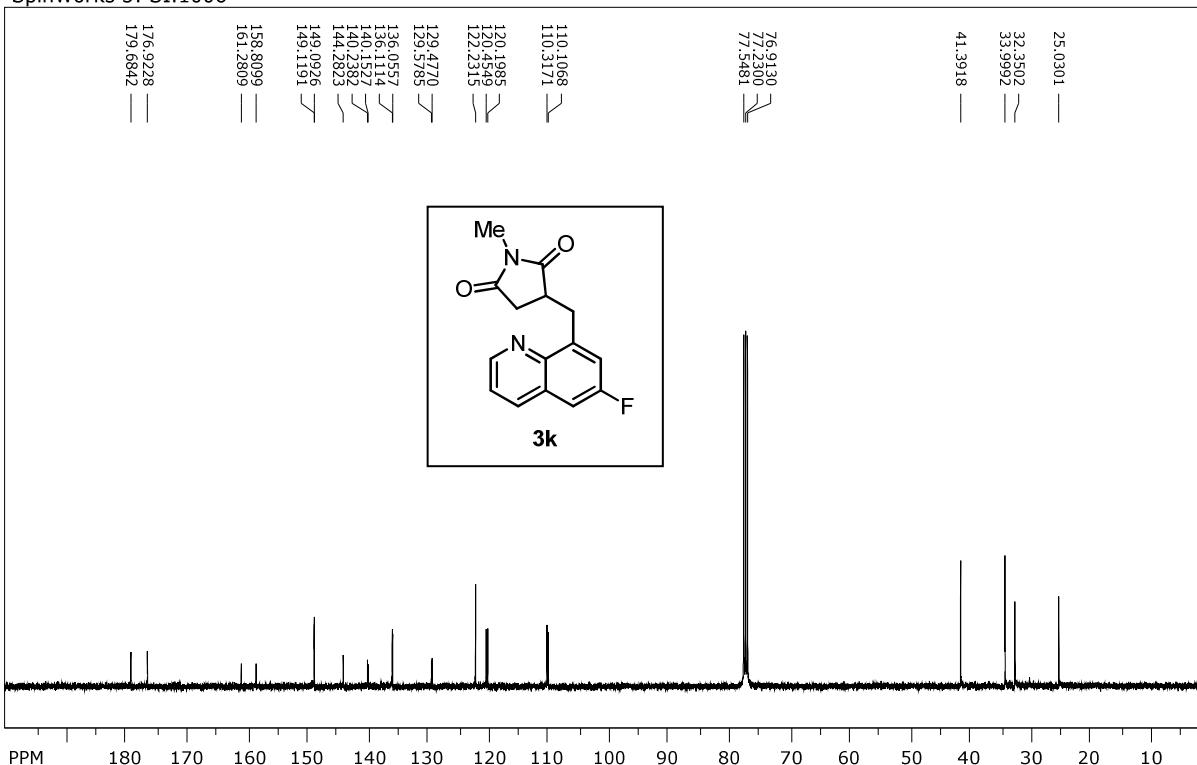
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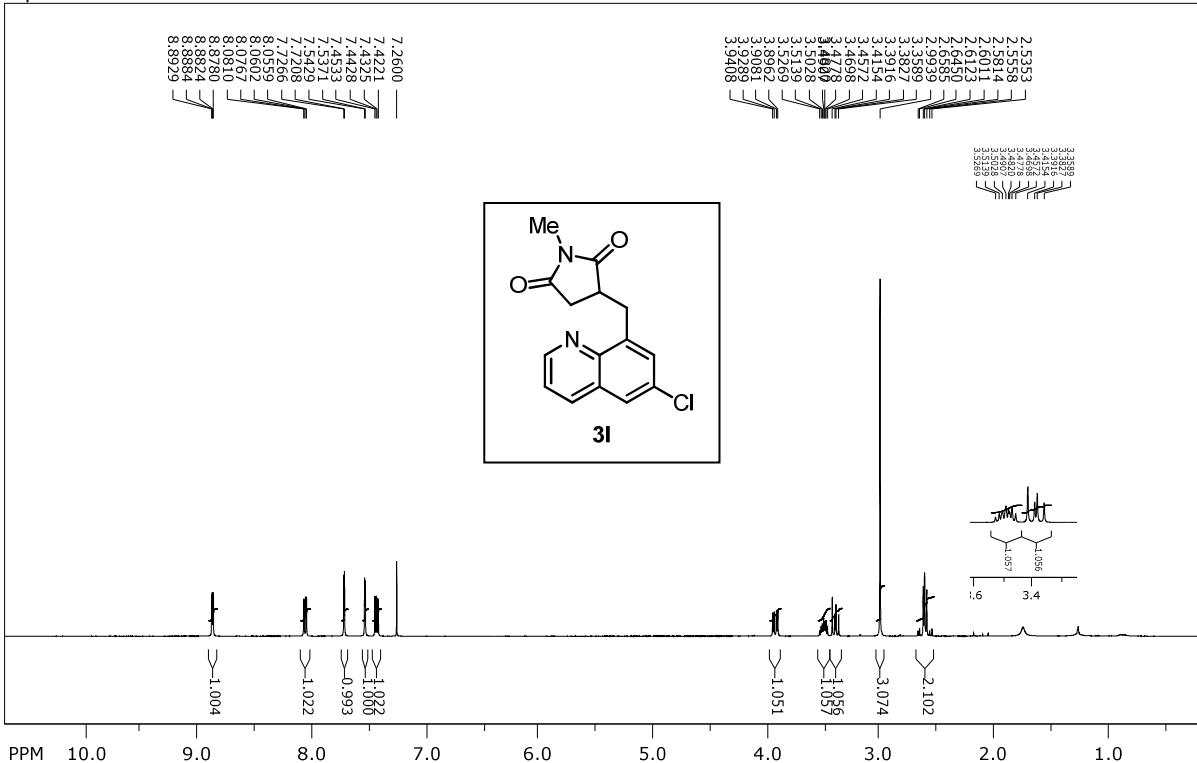
SpinWorks 3: SI.1006



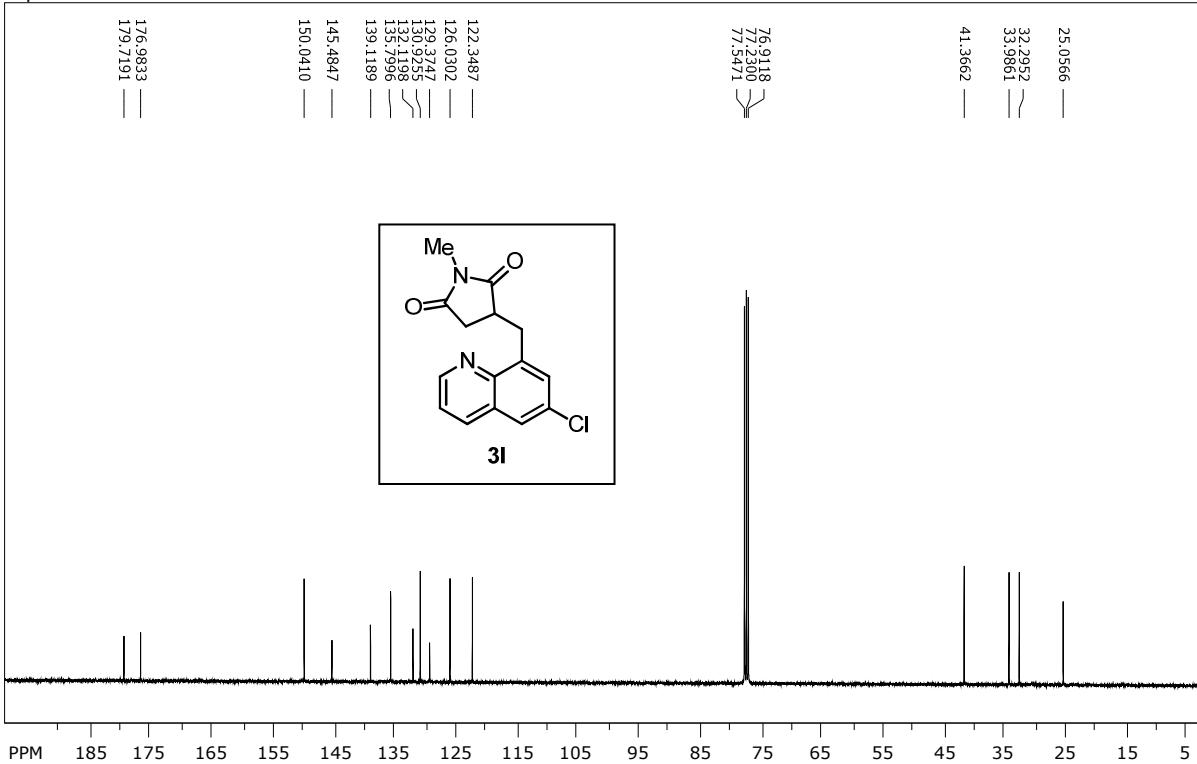
SpinWorks 3: SI.1006

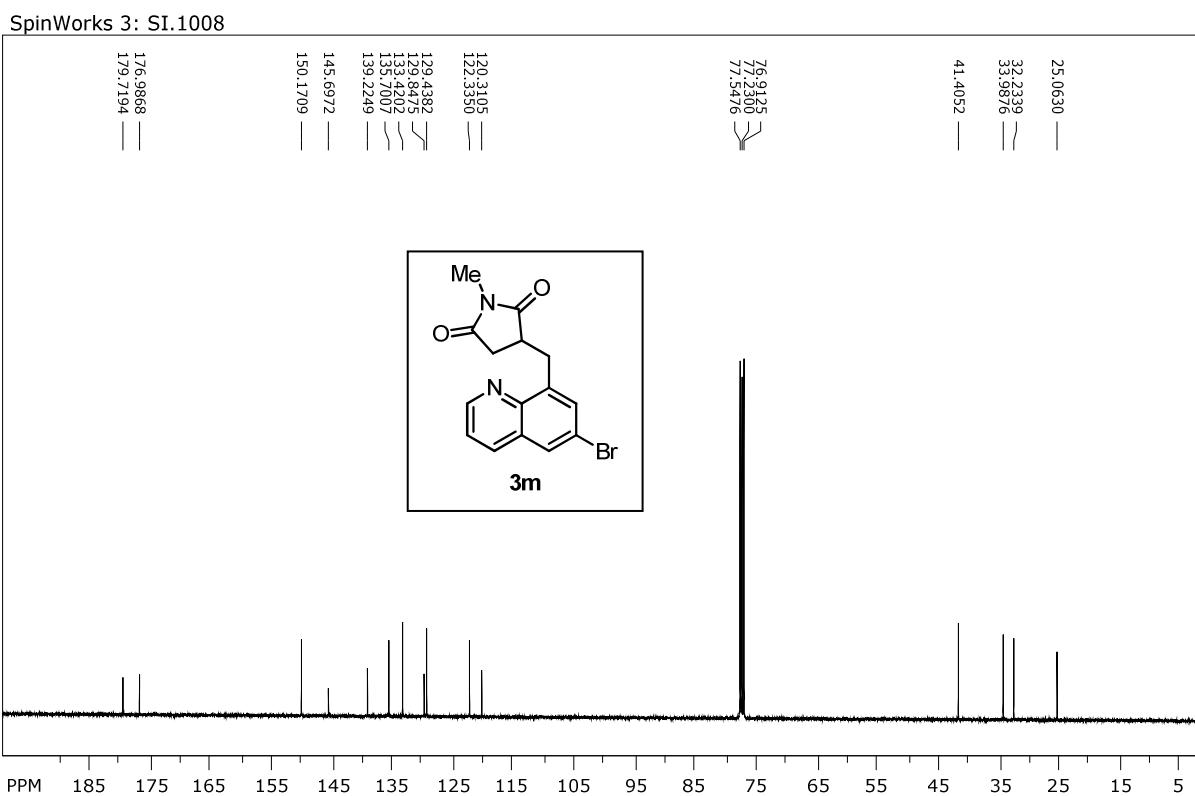
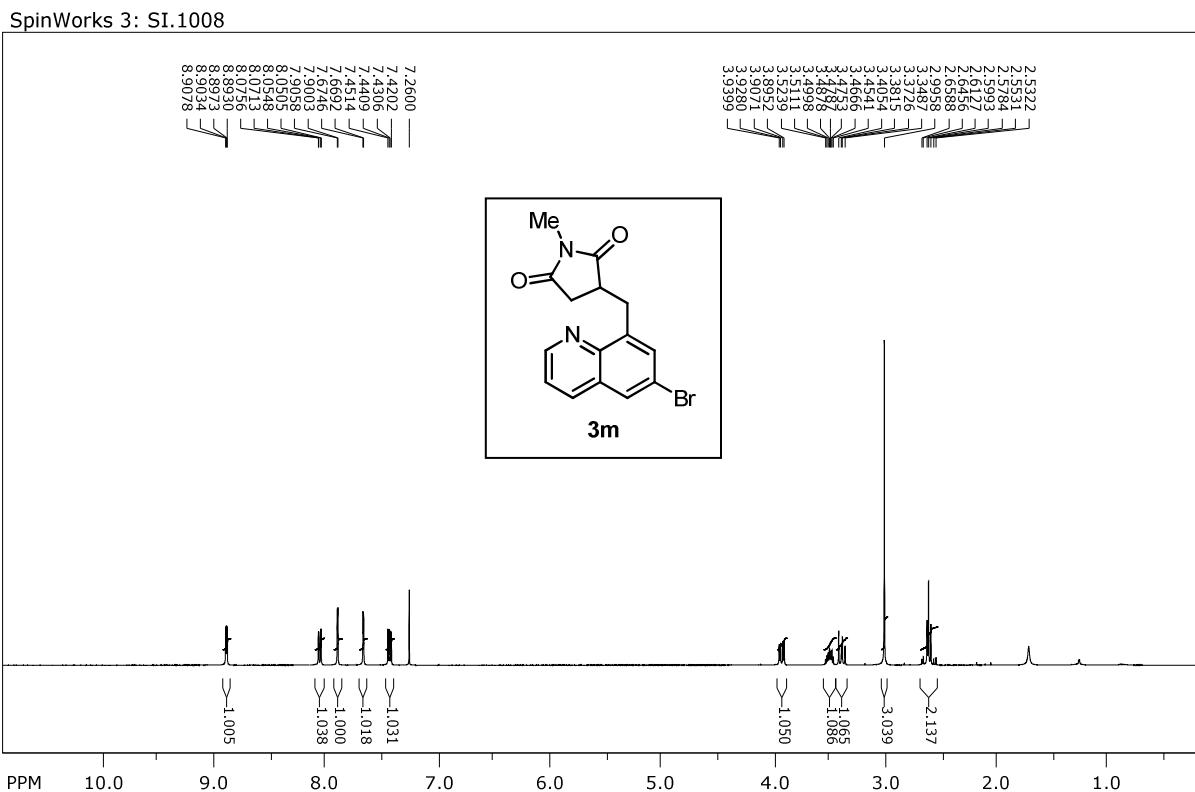


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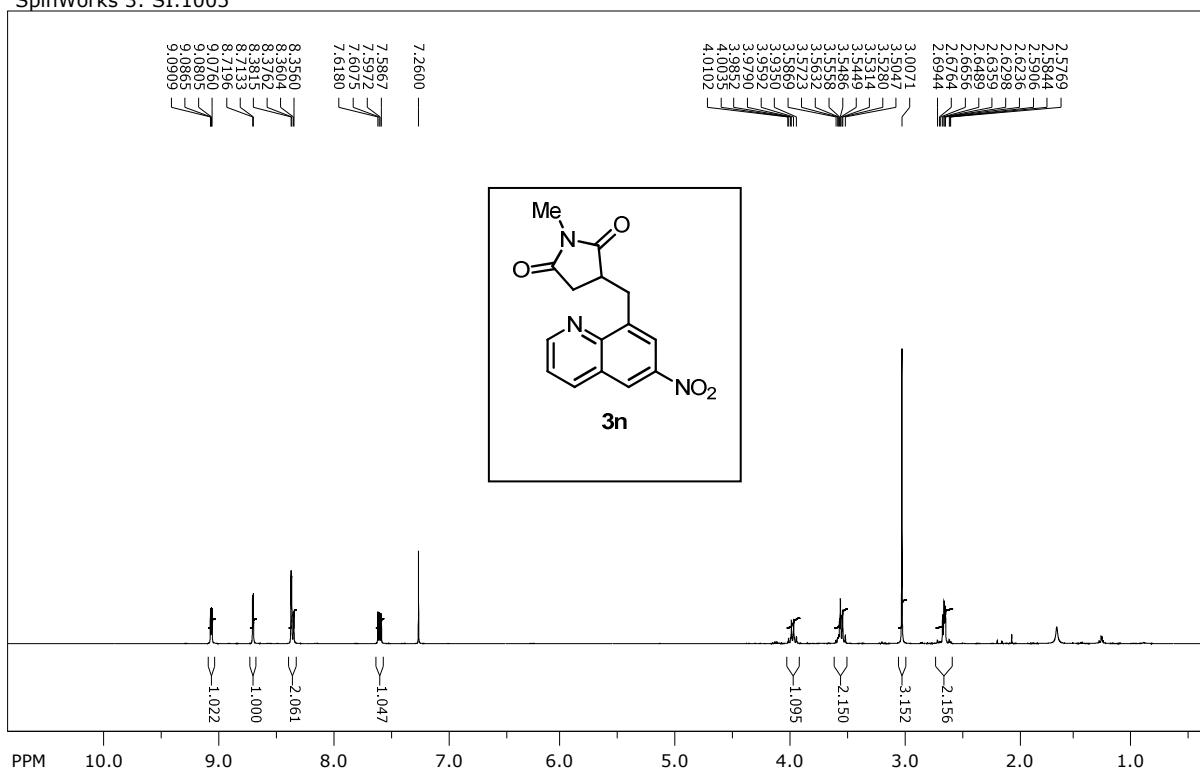


SpinWorks 3: SI.1007

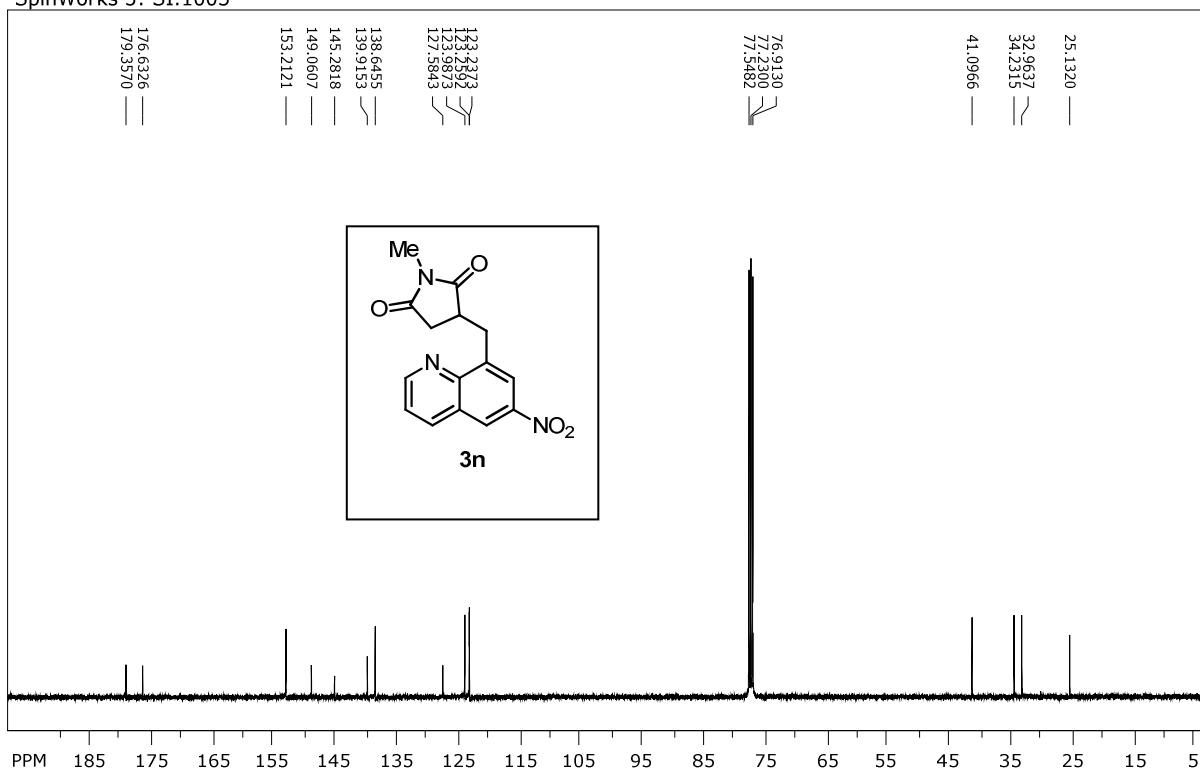


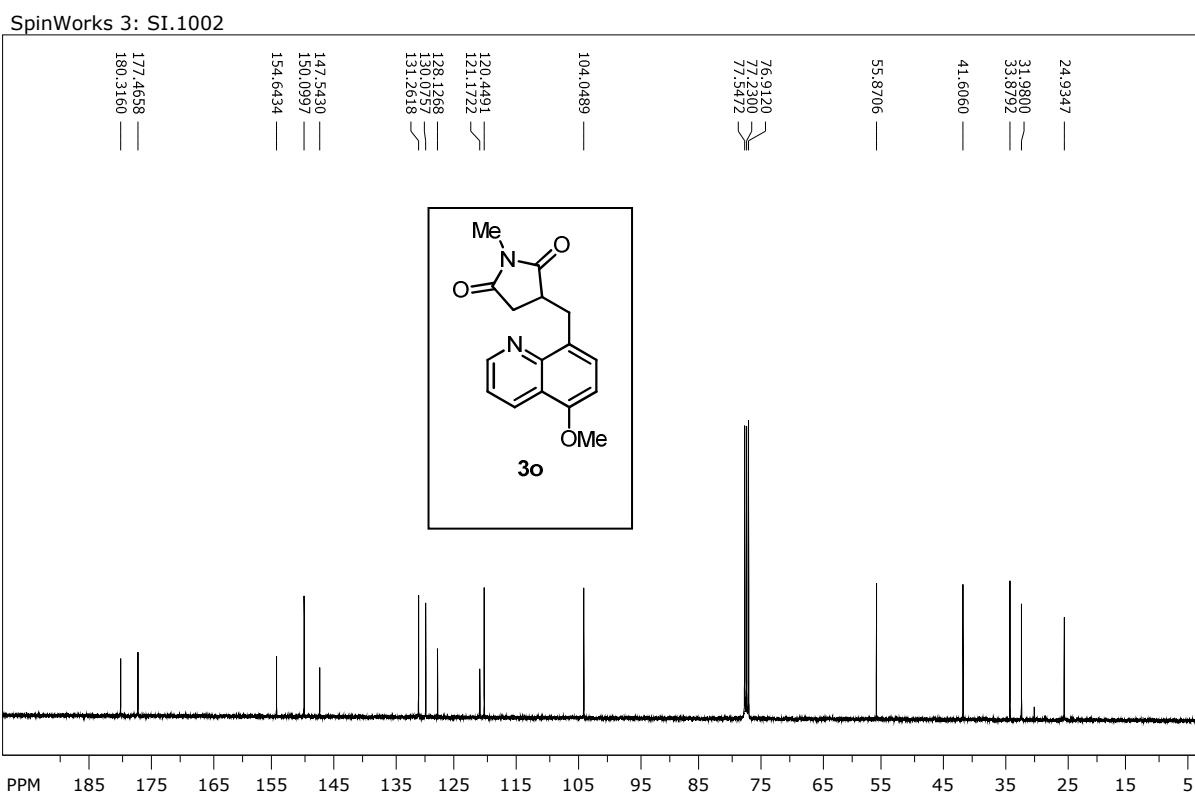
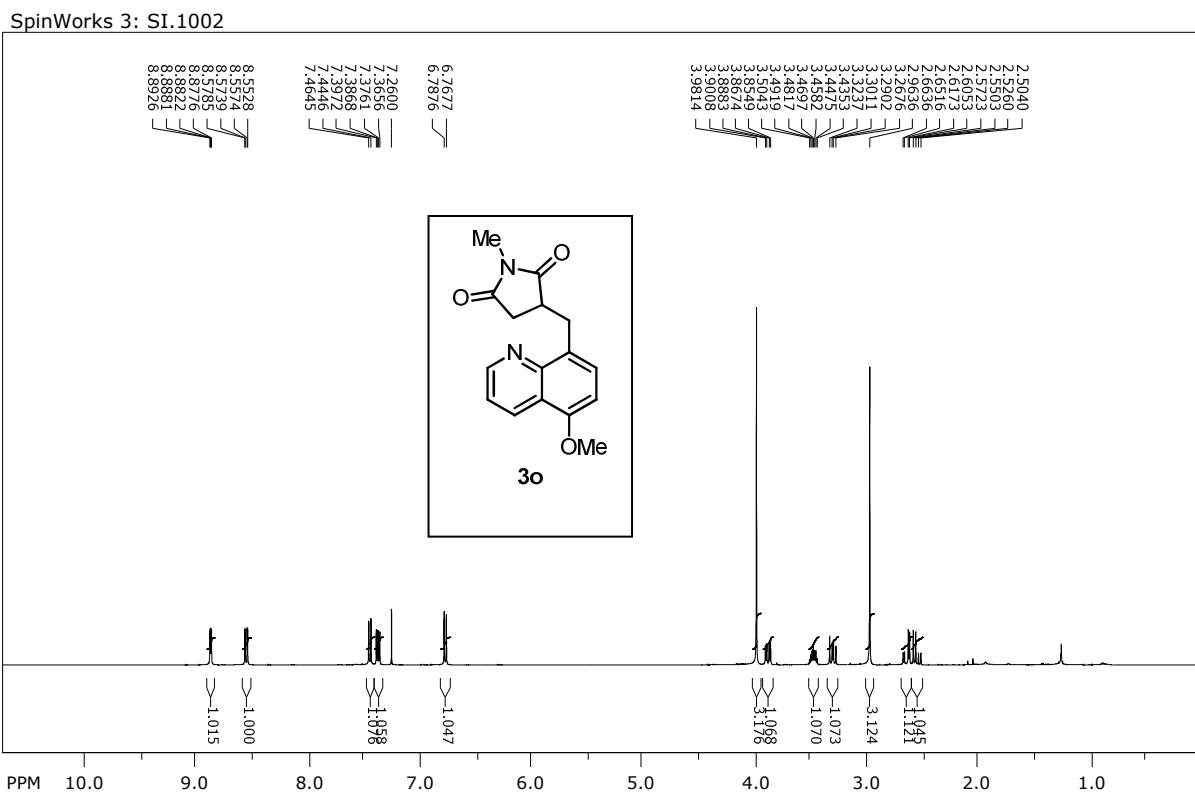


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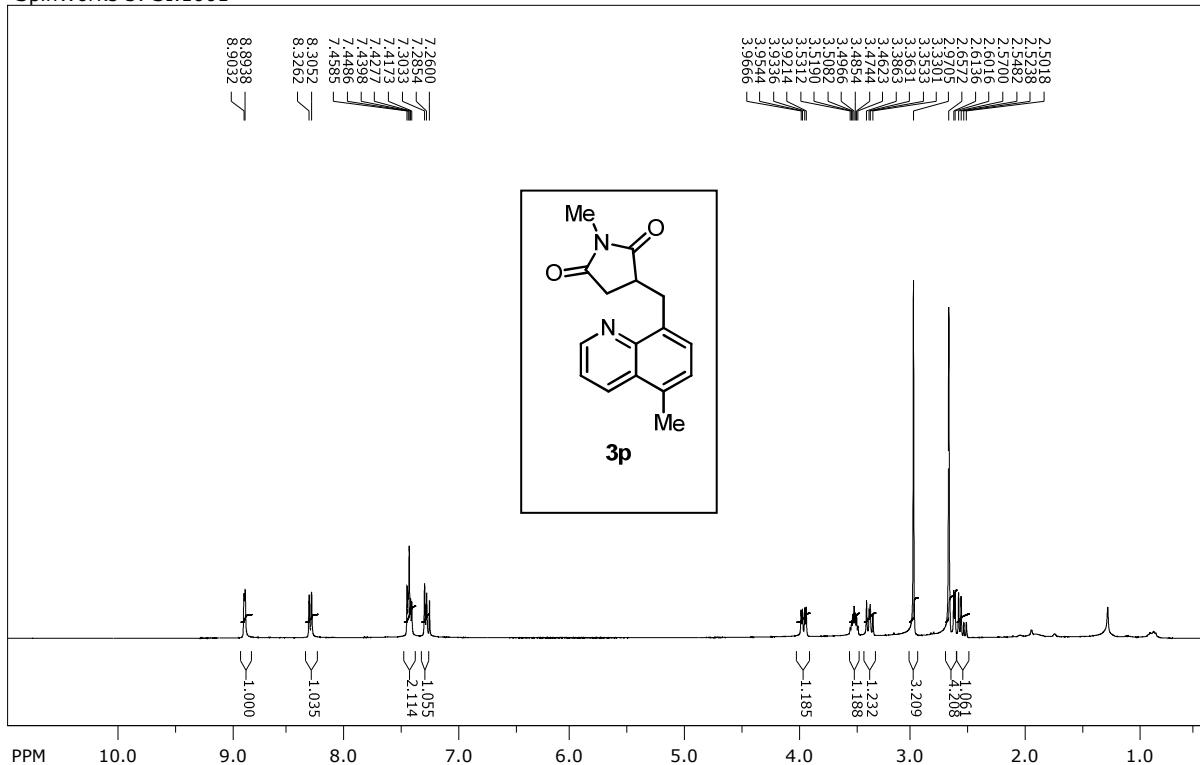


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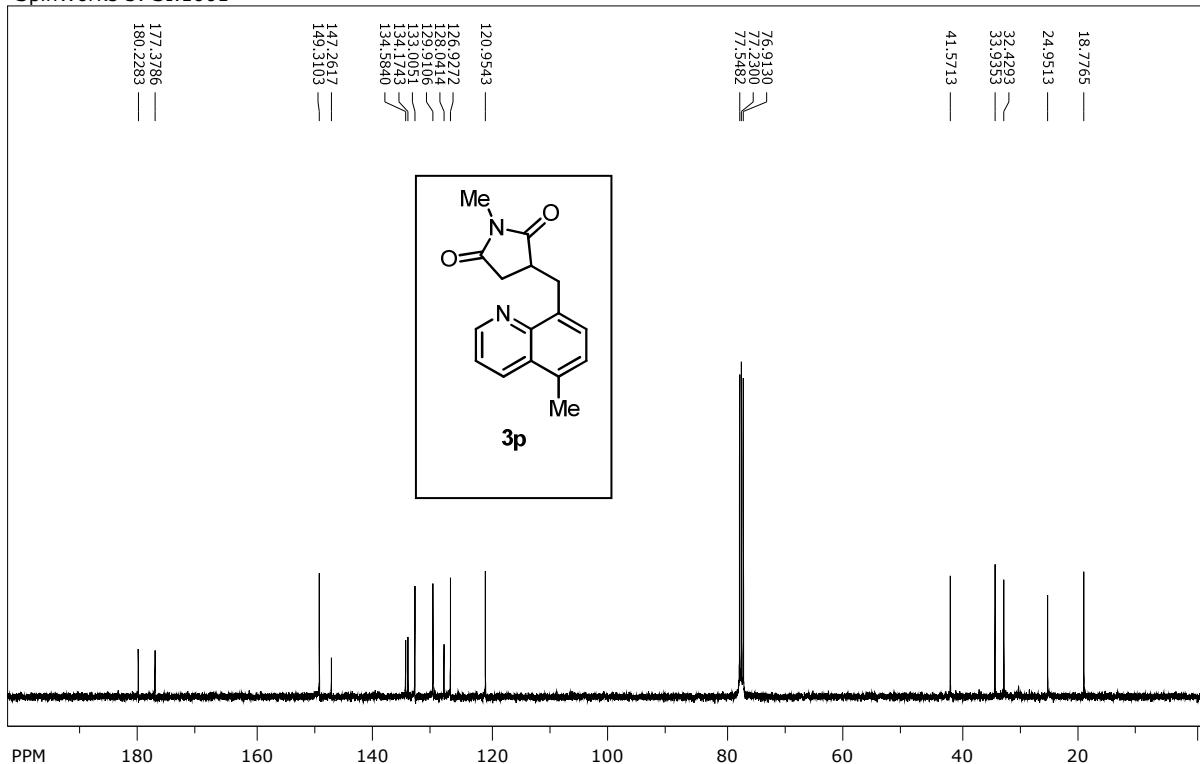




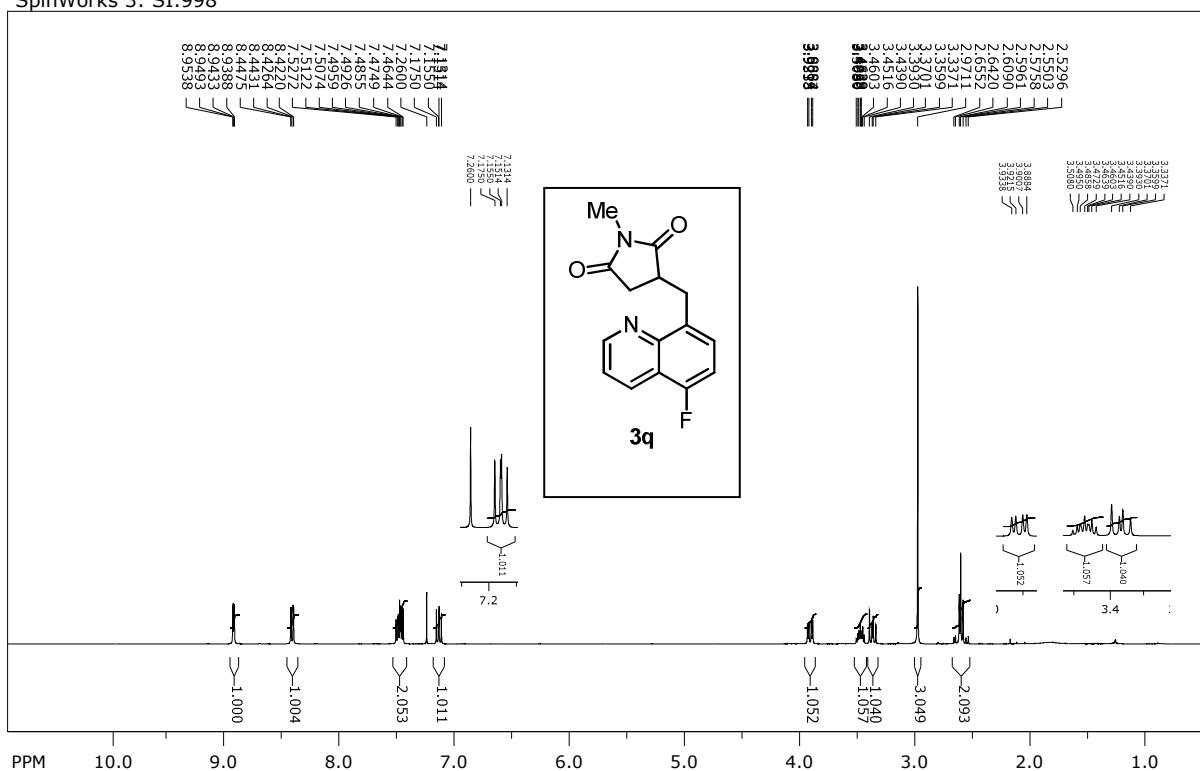
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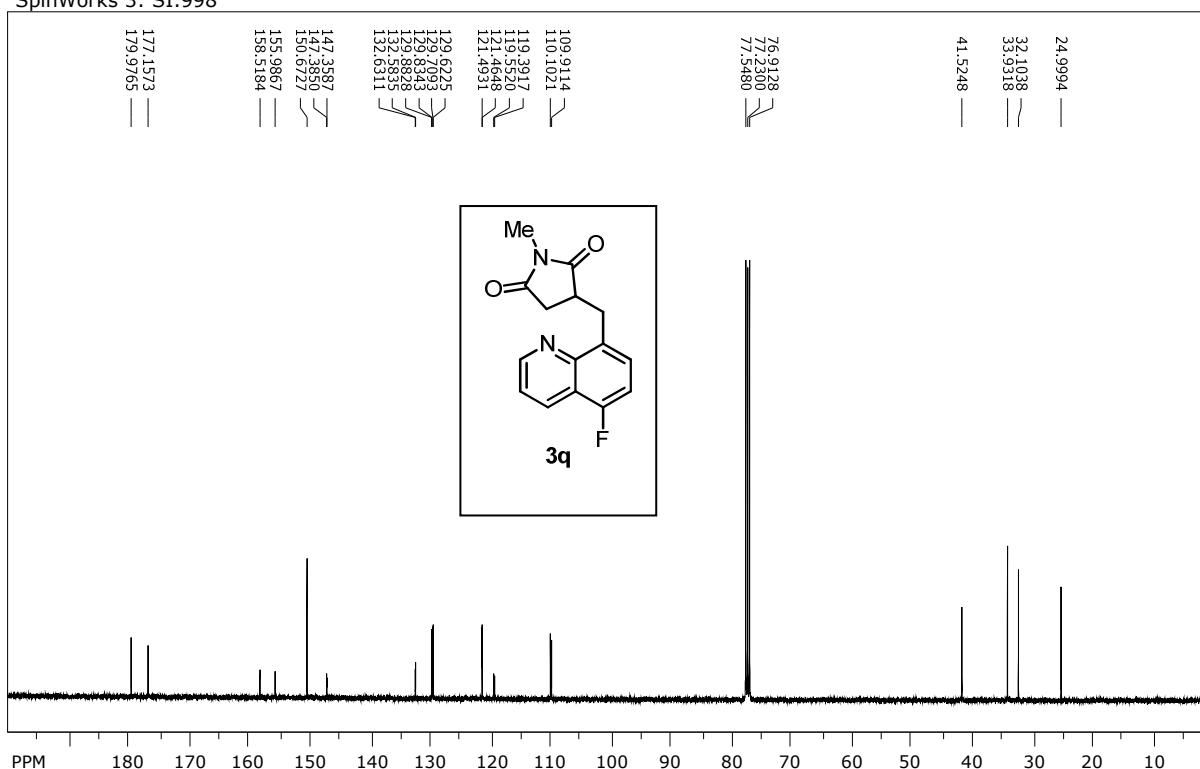
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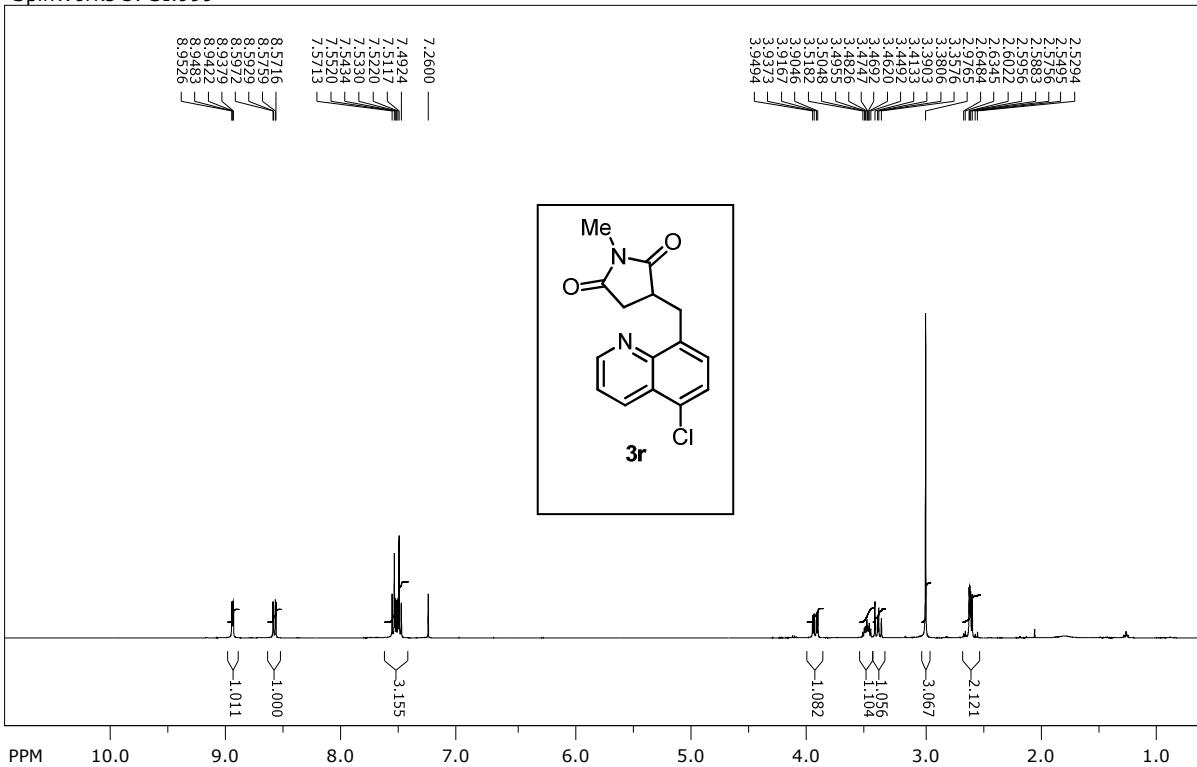
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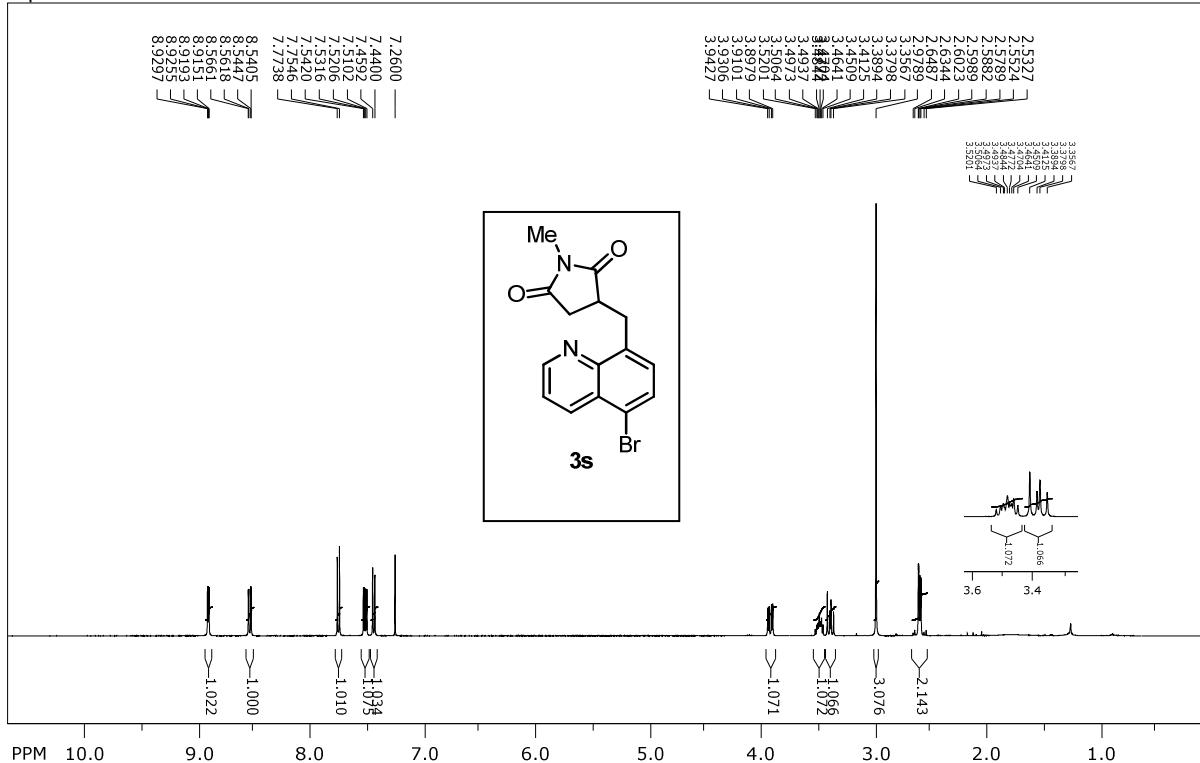
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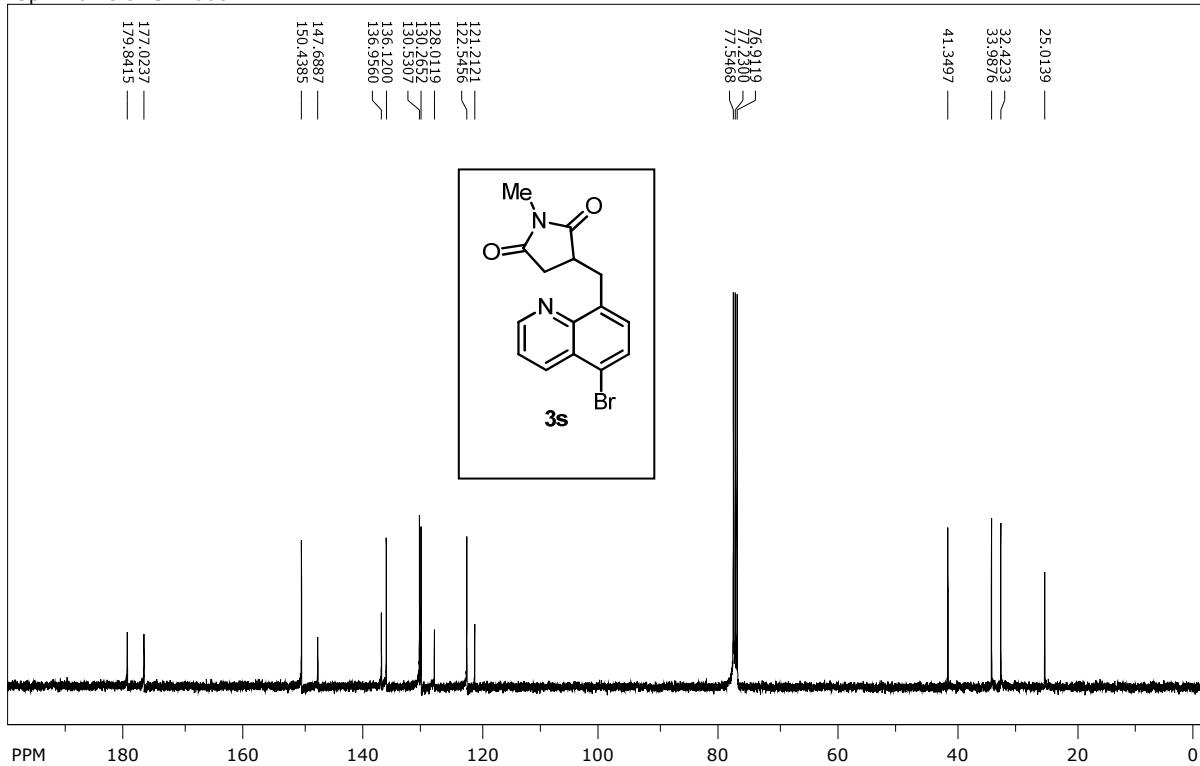
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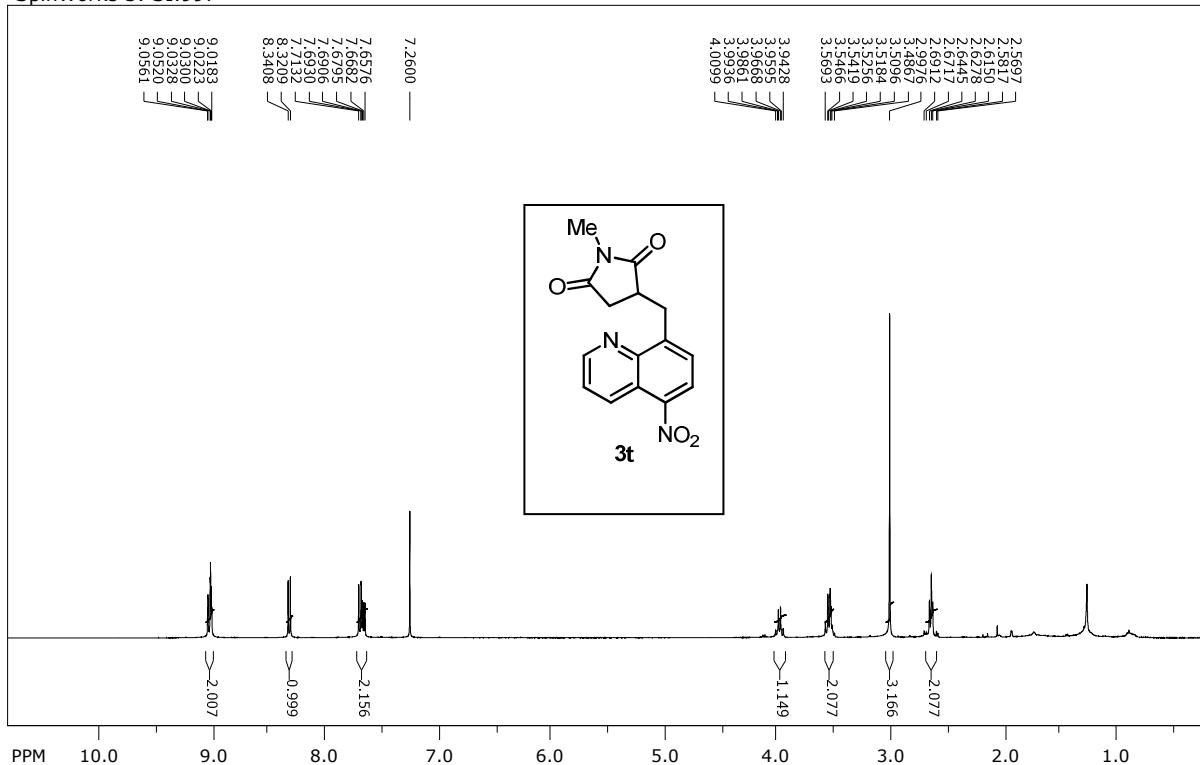
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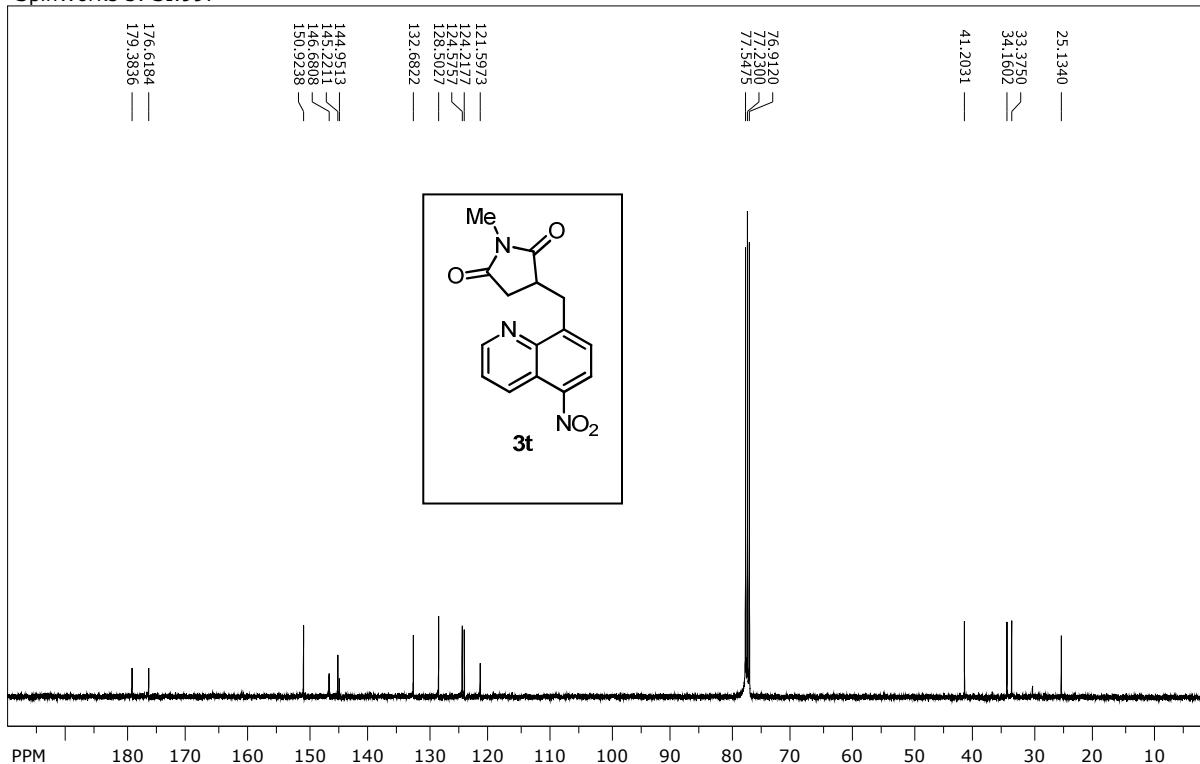
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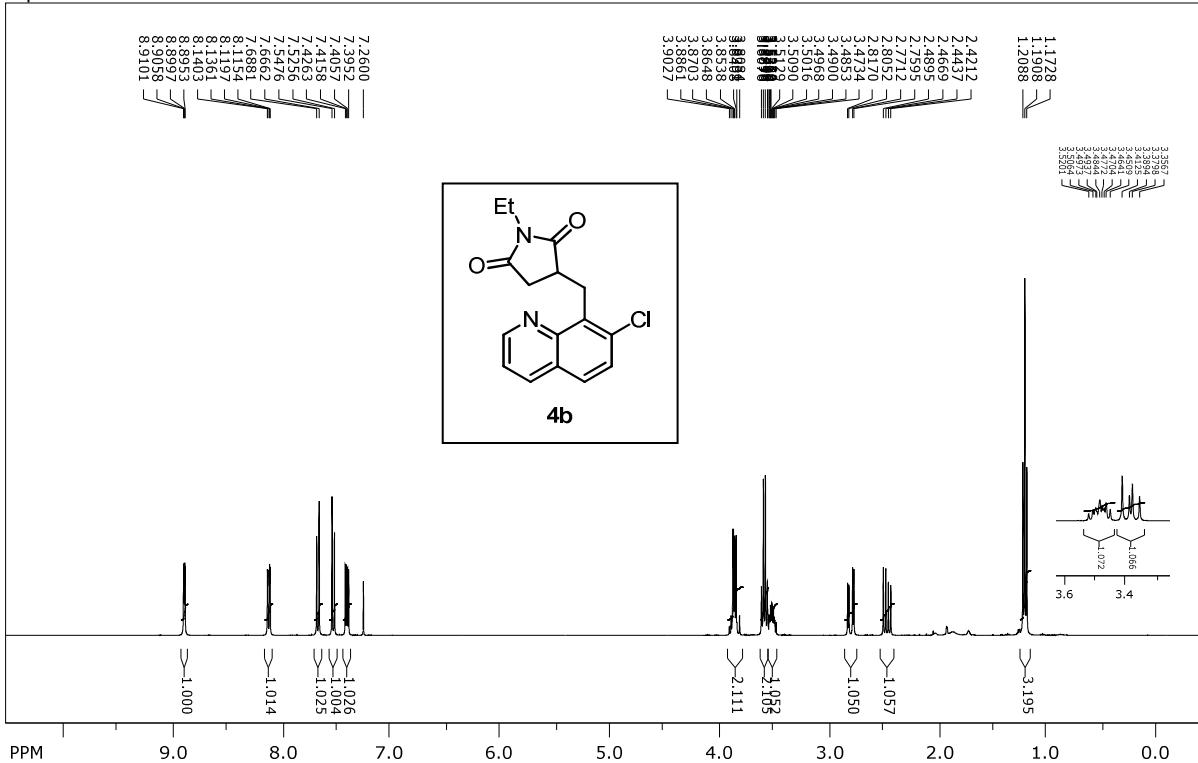
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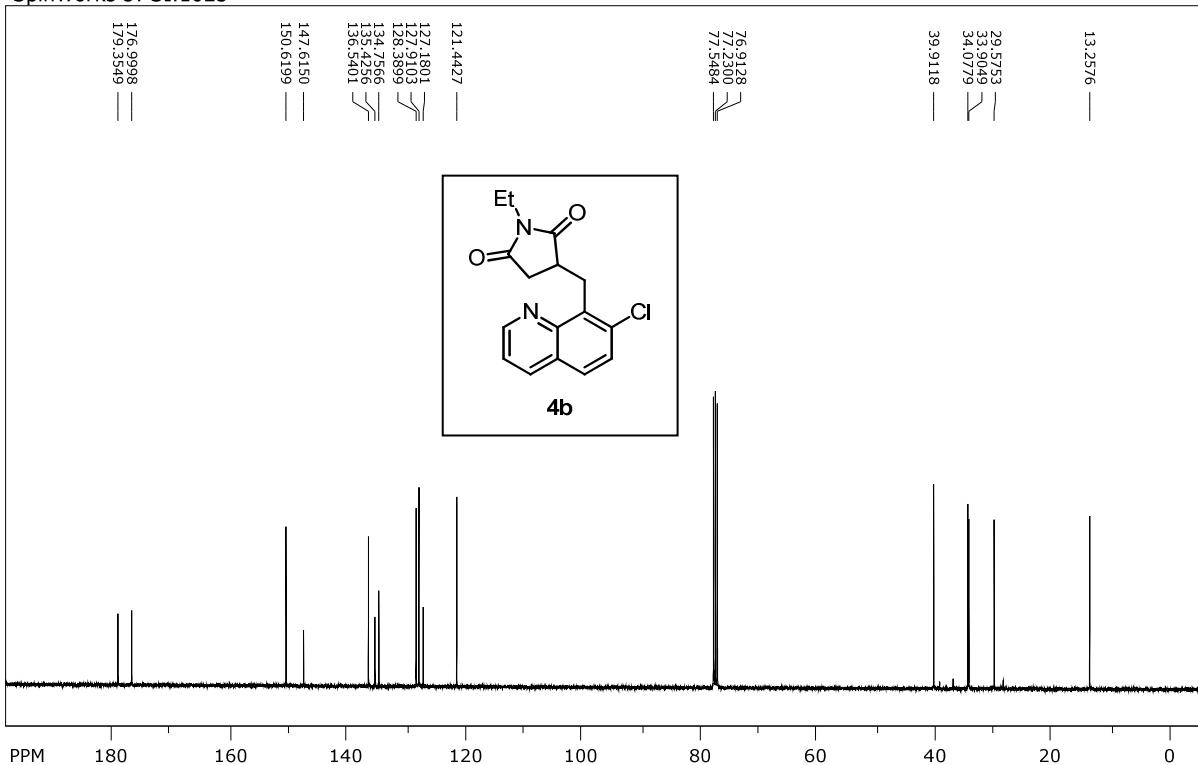
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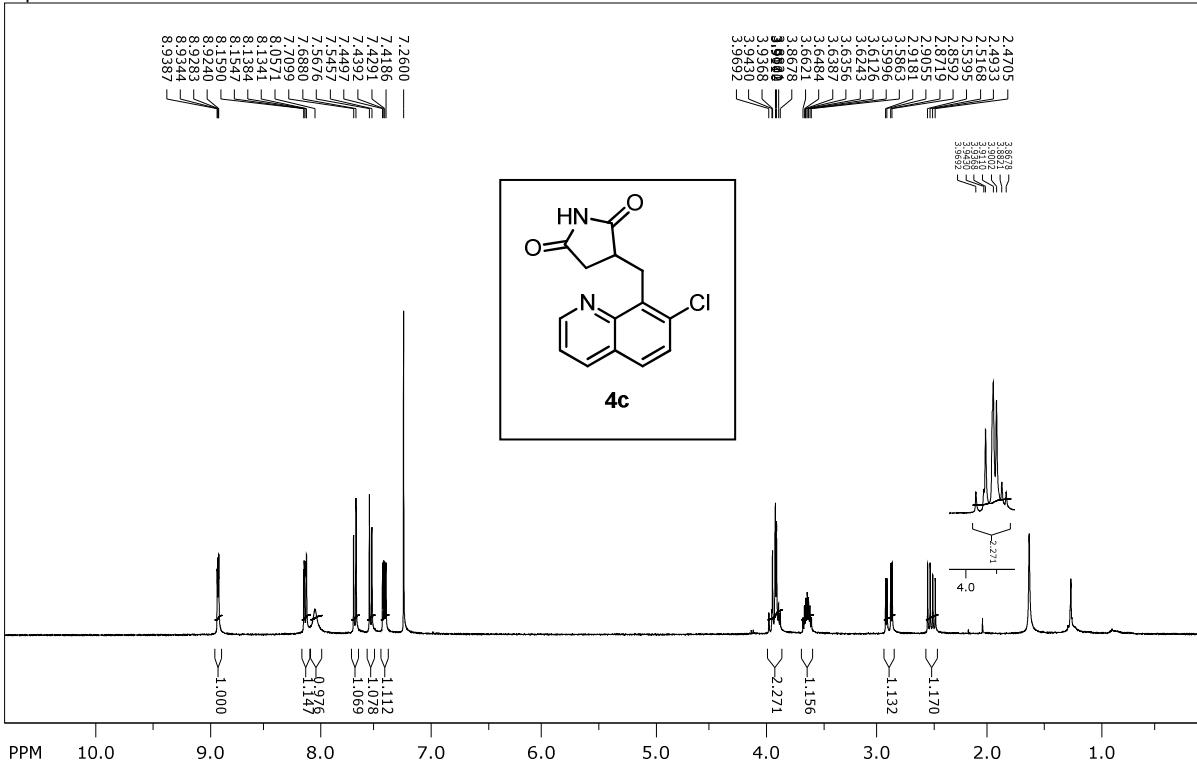
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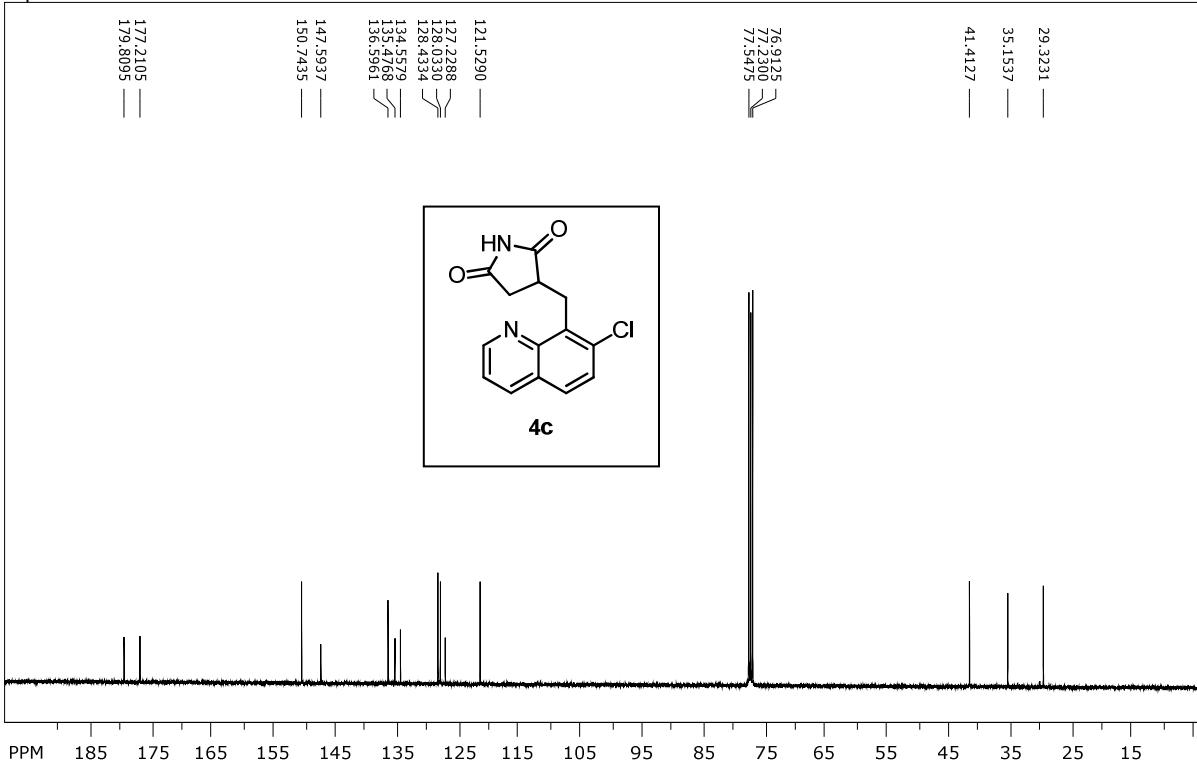
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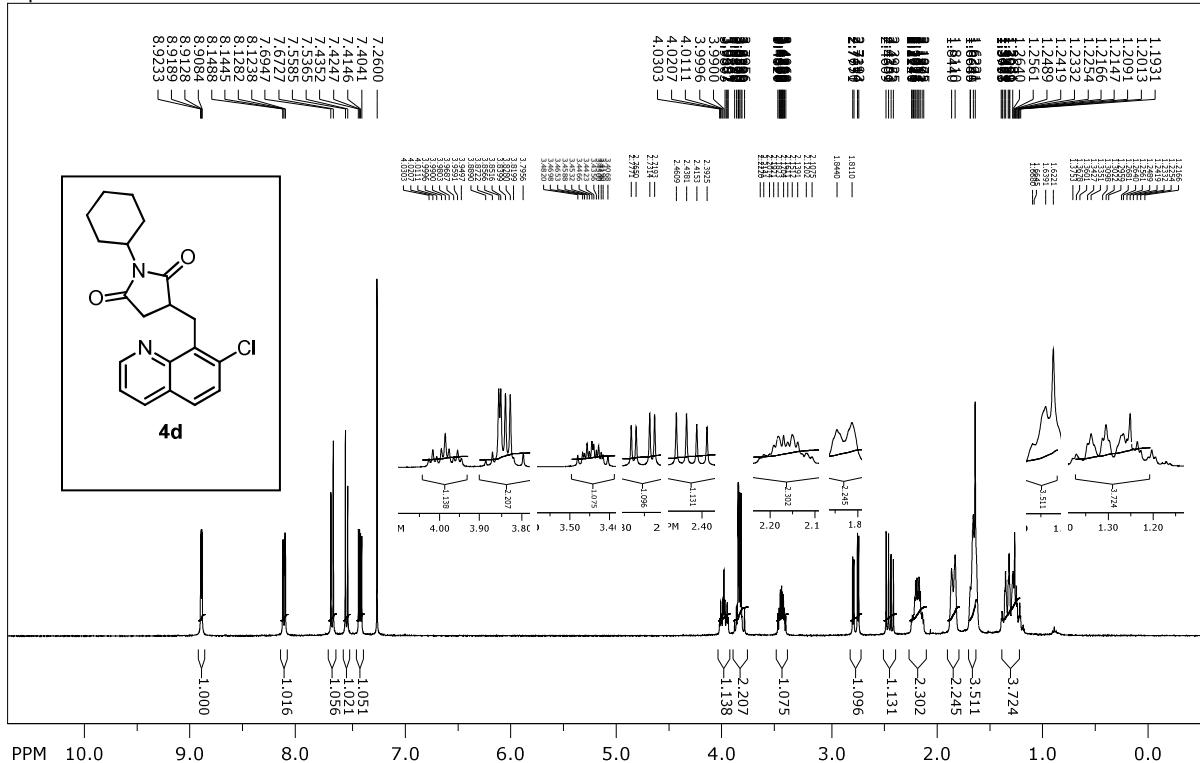
SpinWorks 3: SI.1019



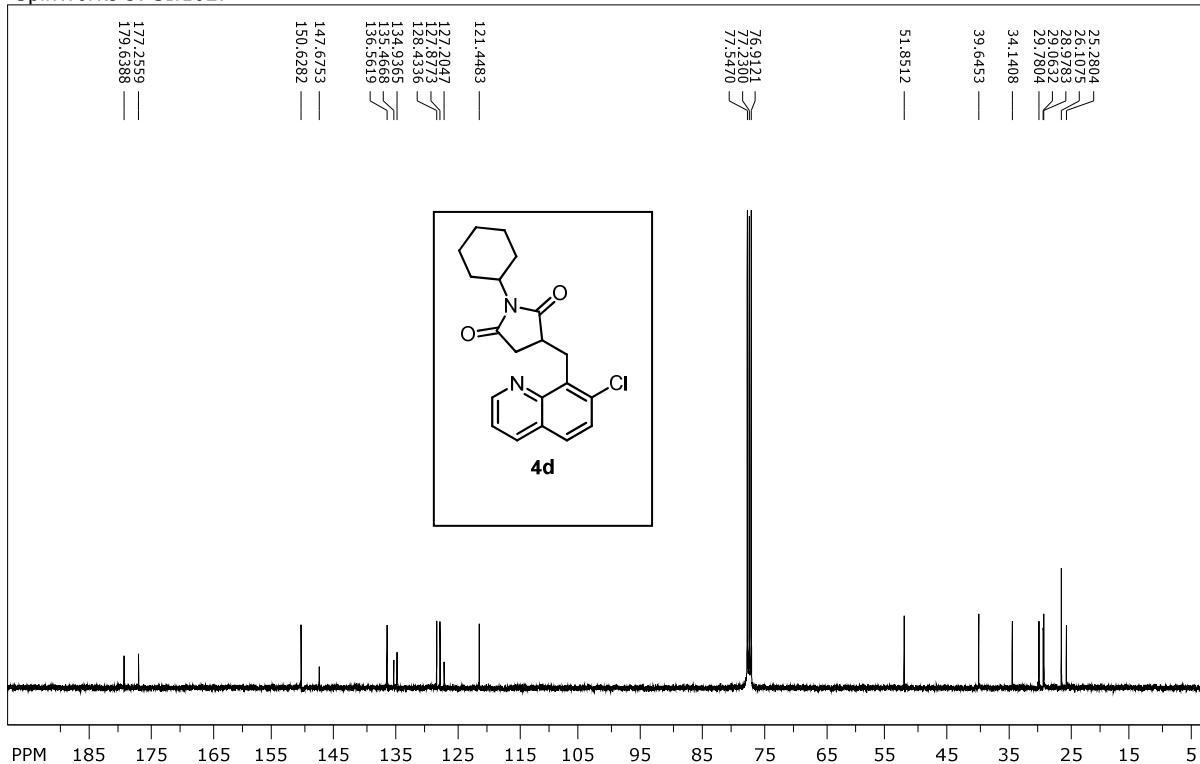
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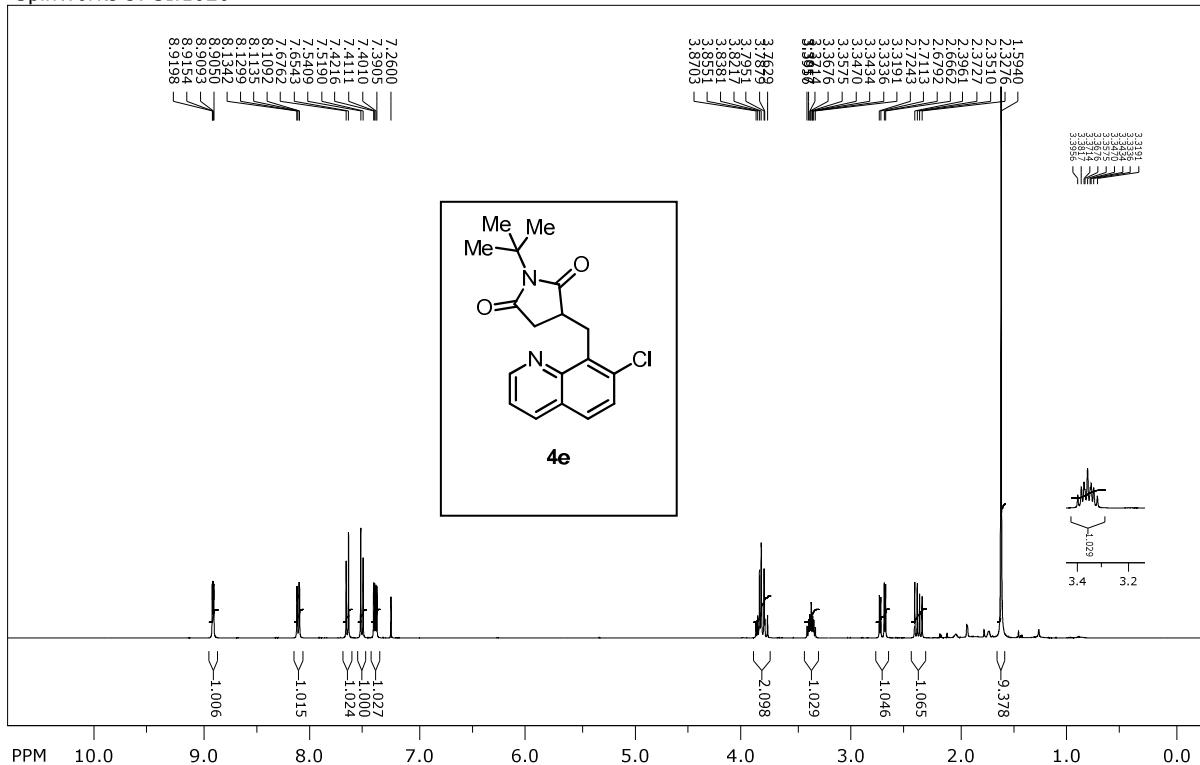
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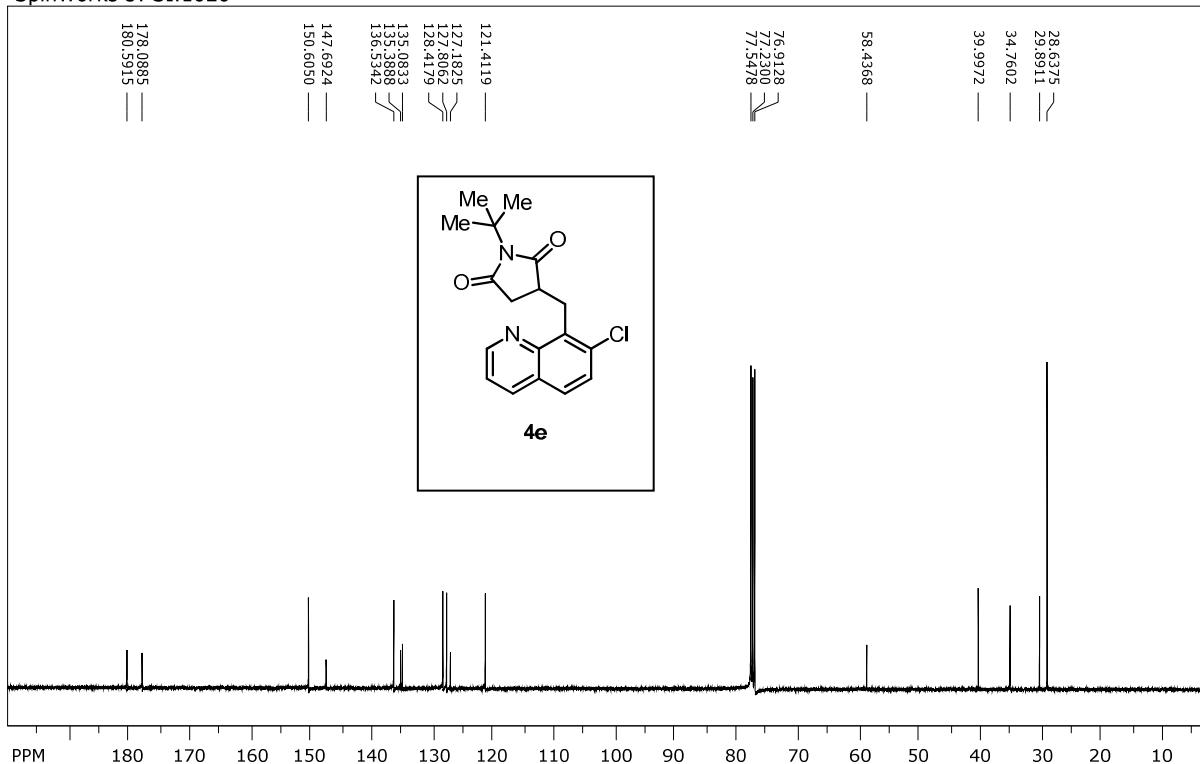
SpinWorks 3: SI.1027



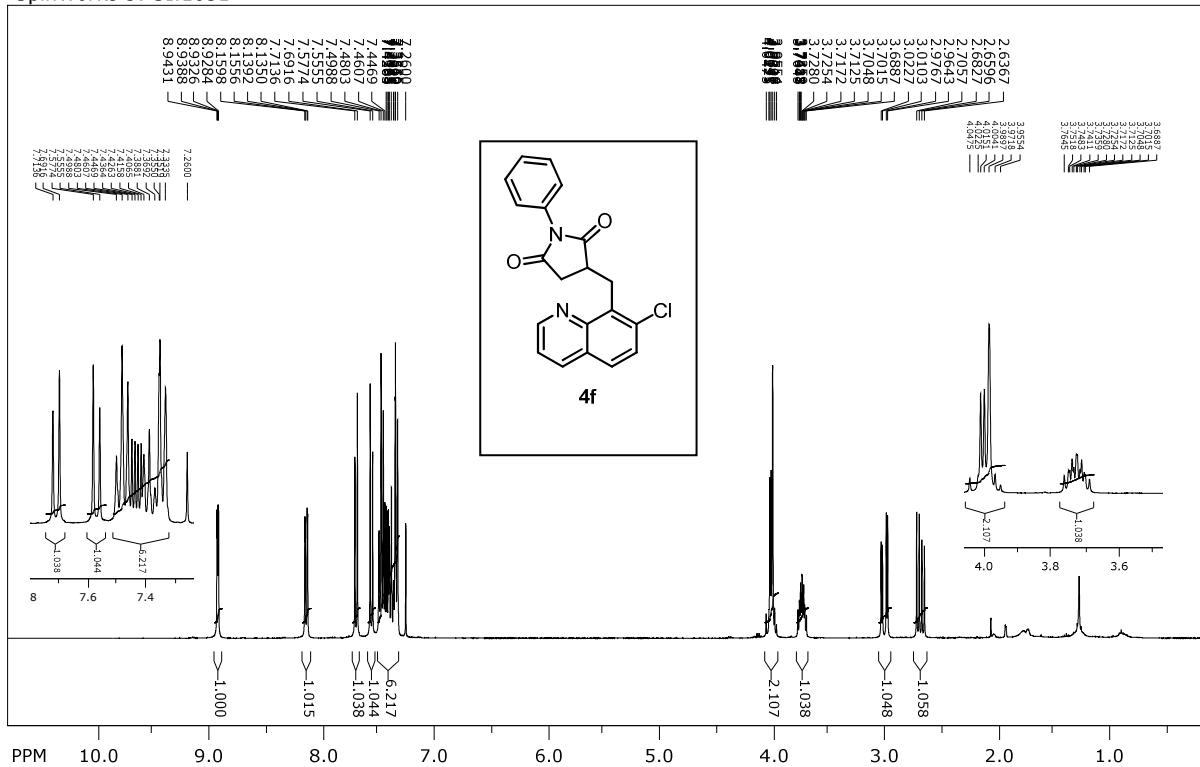
SpinWorks 3: SI.1026



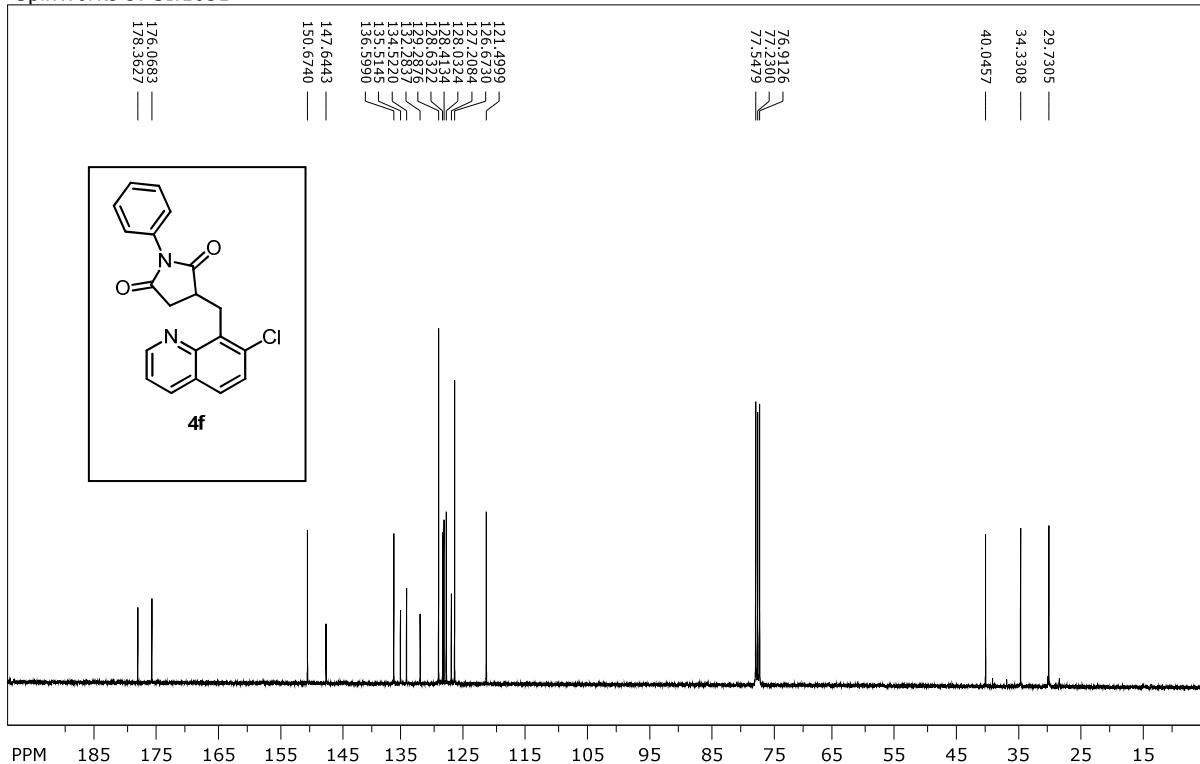
SpinWorks 3: SI.1026



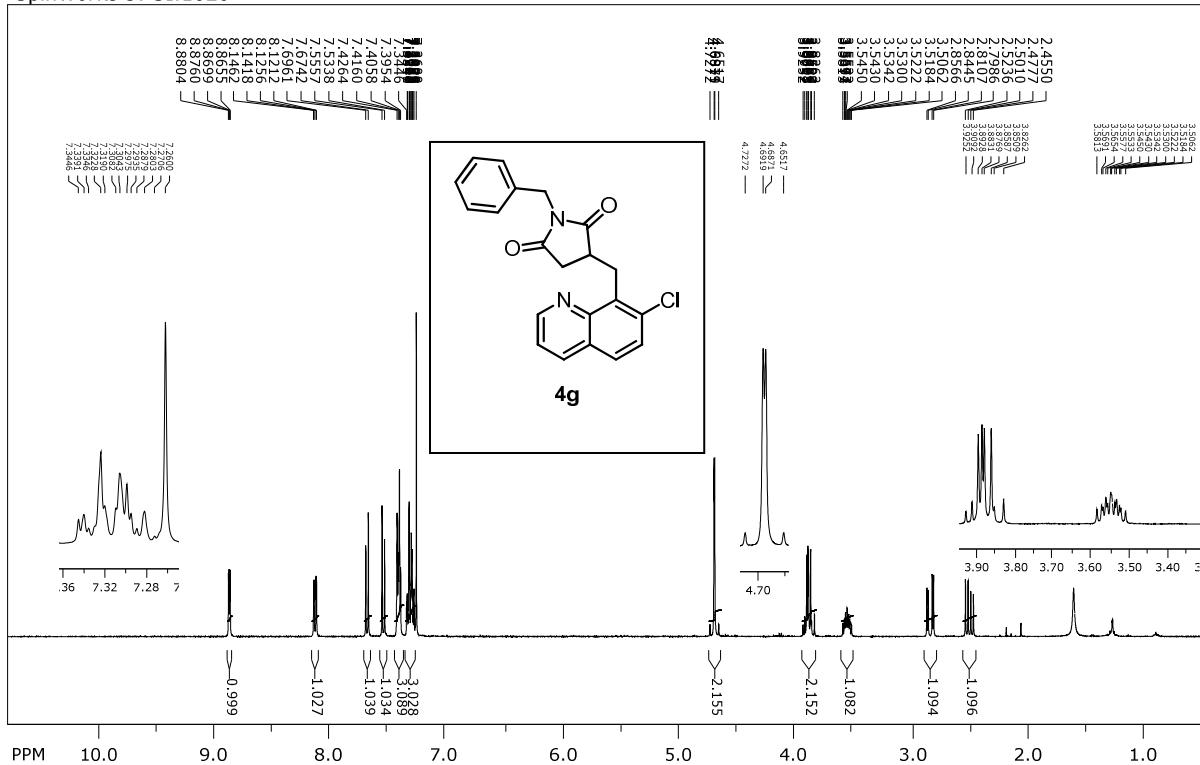
SpinWorks 3: SI.1031



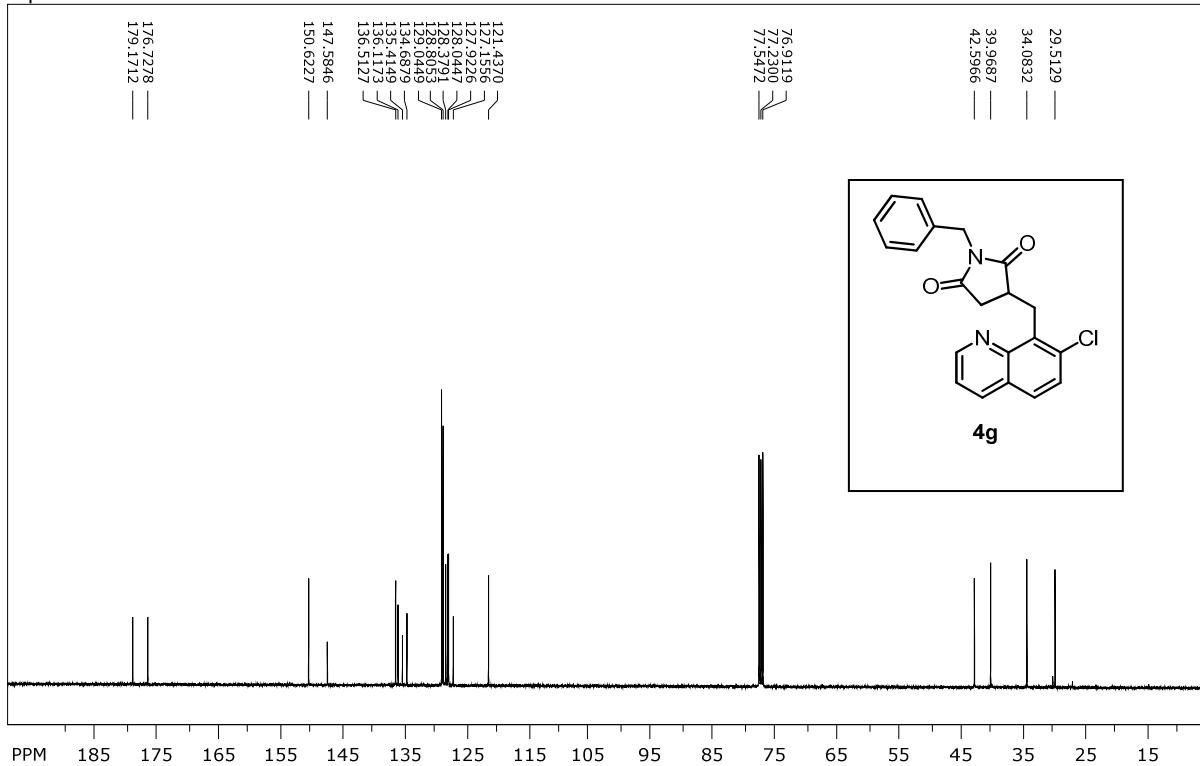
SpinWorks 3: SI.1031

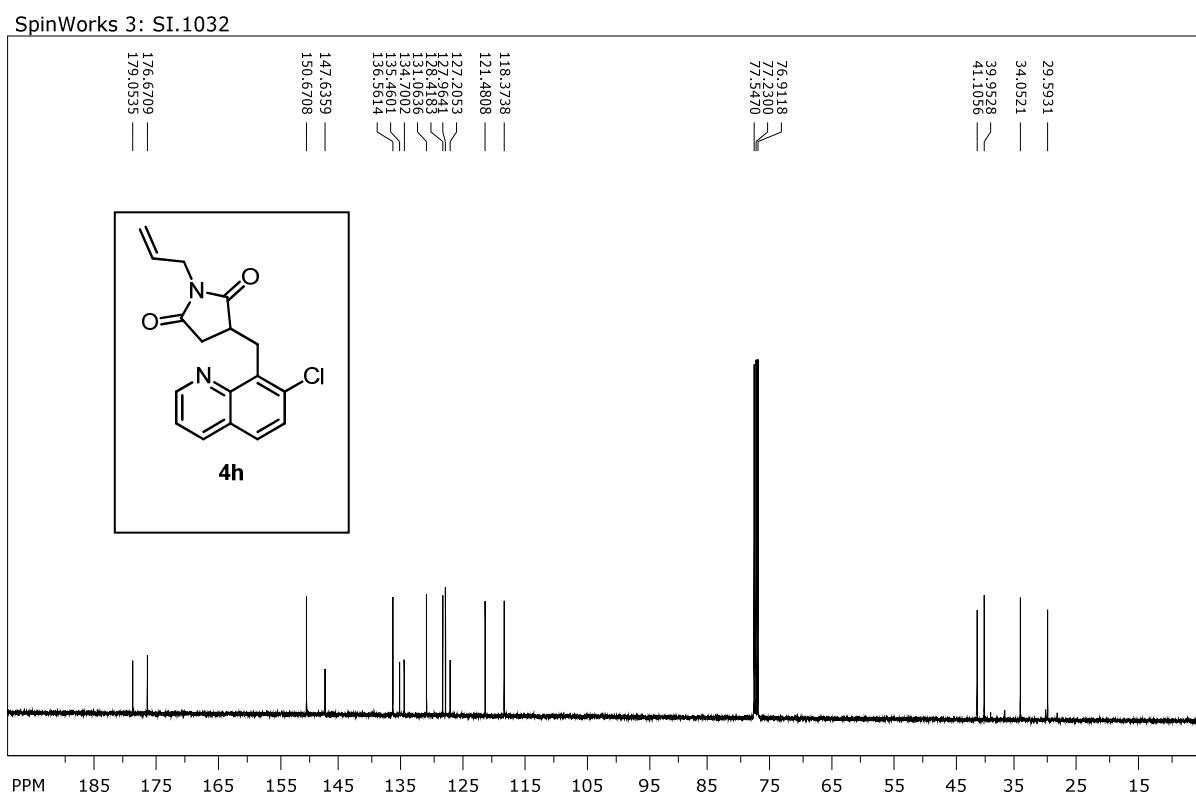
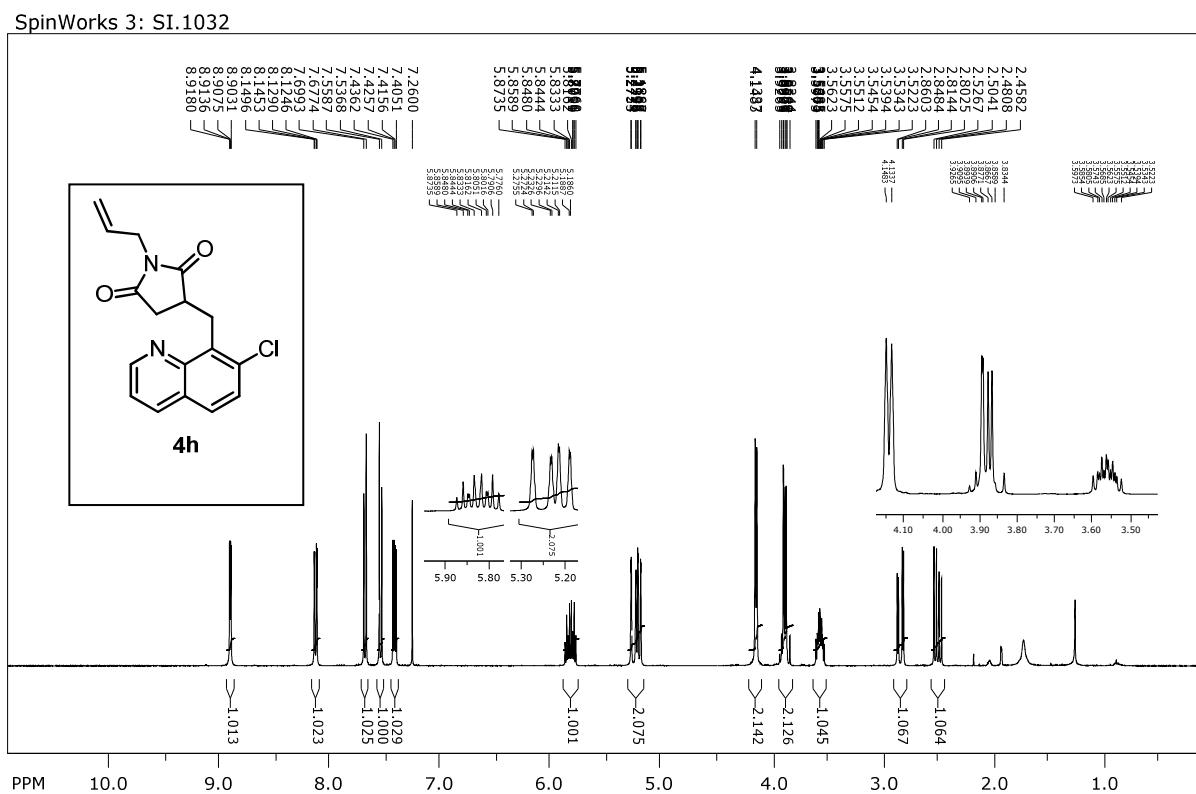


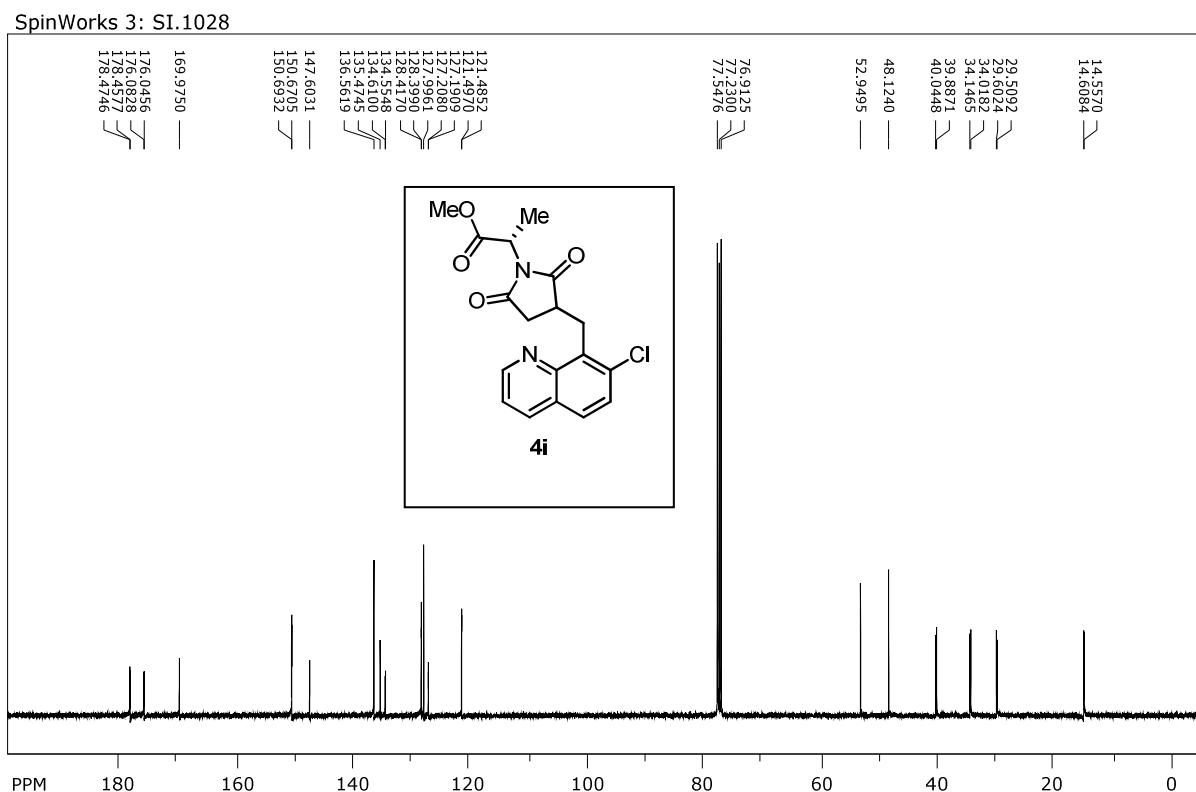
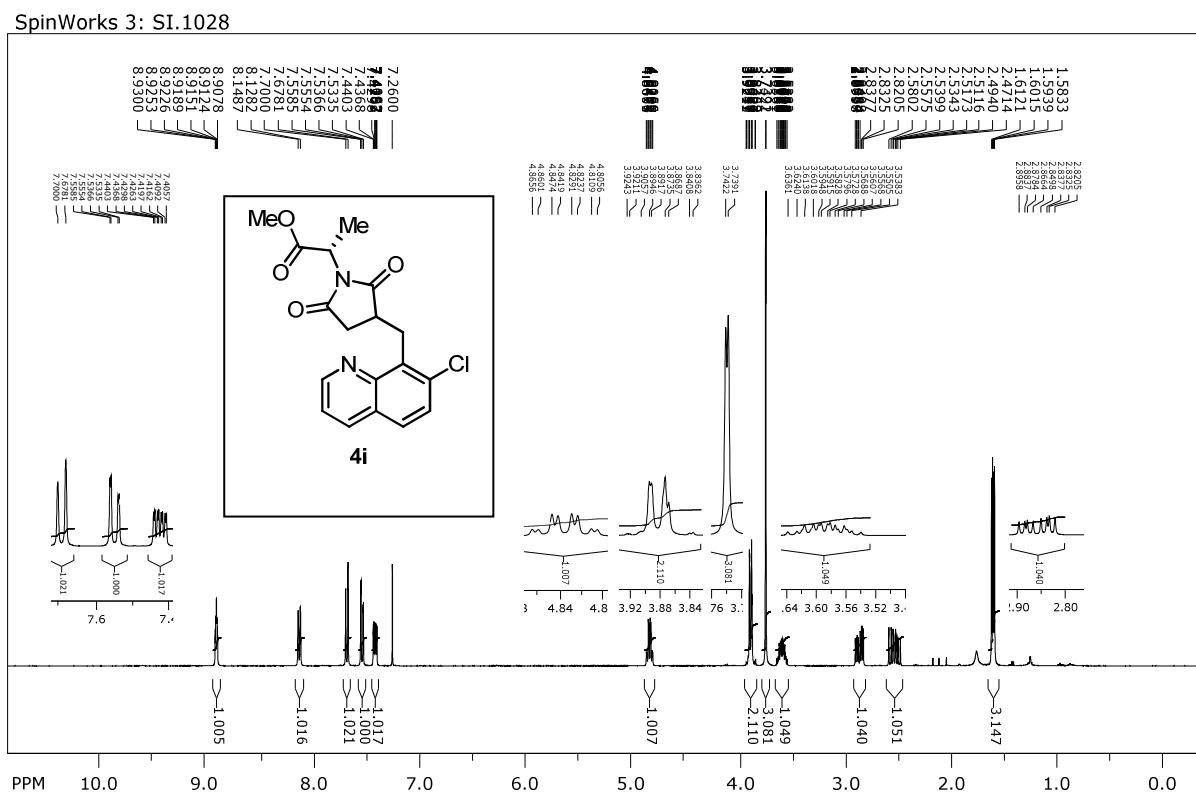
SpinWorks 3: SI.1020

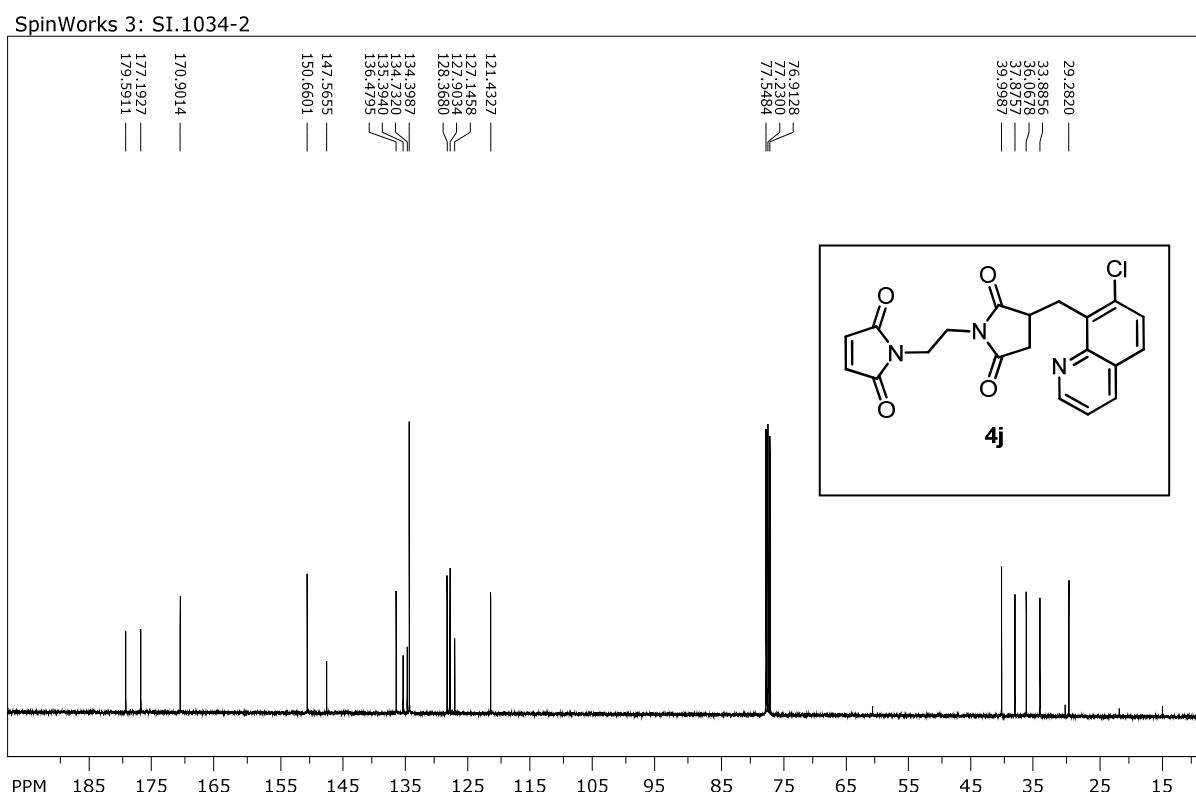
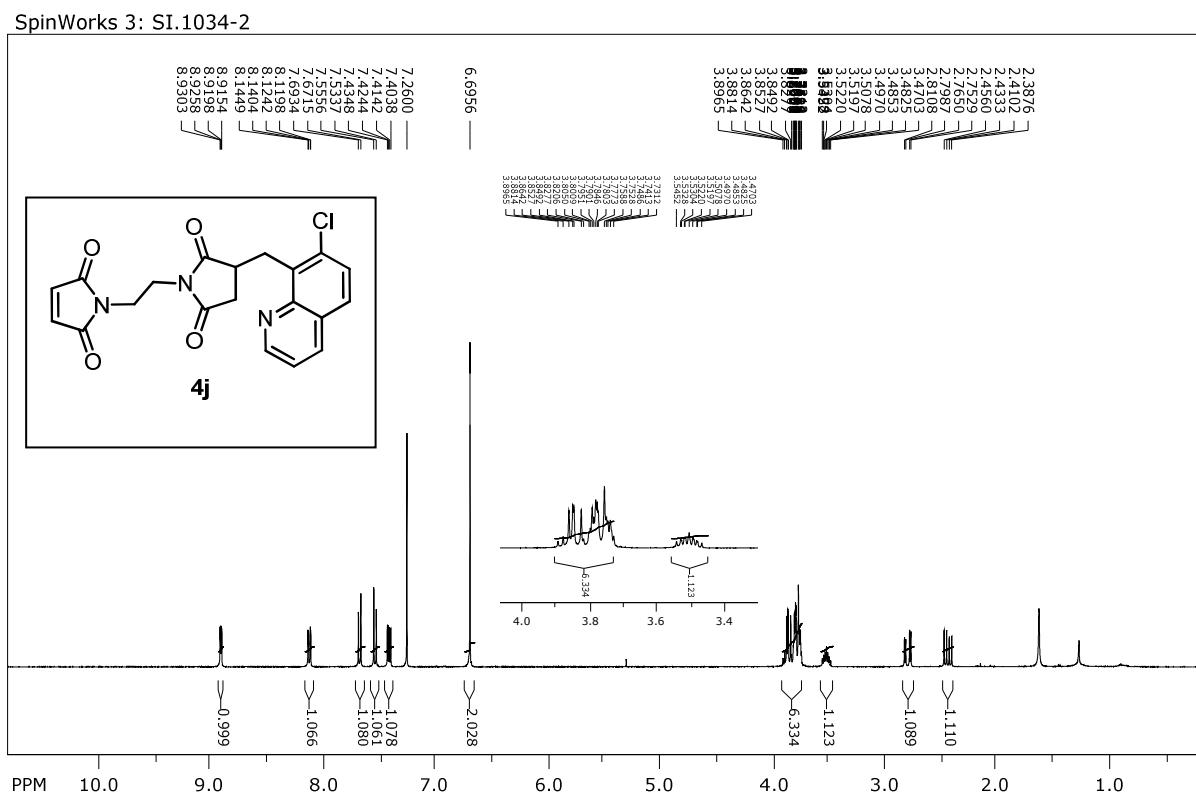


SpinWorks 3: SI.1020

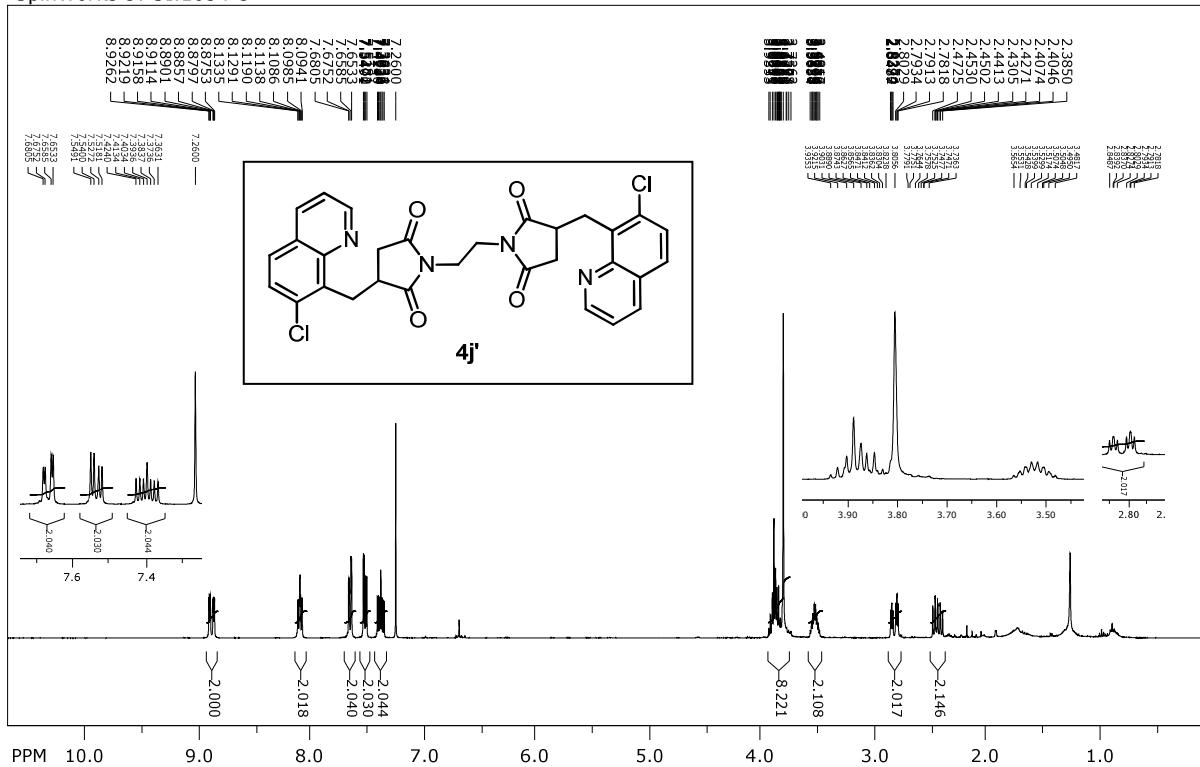




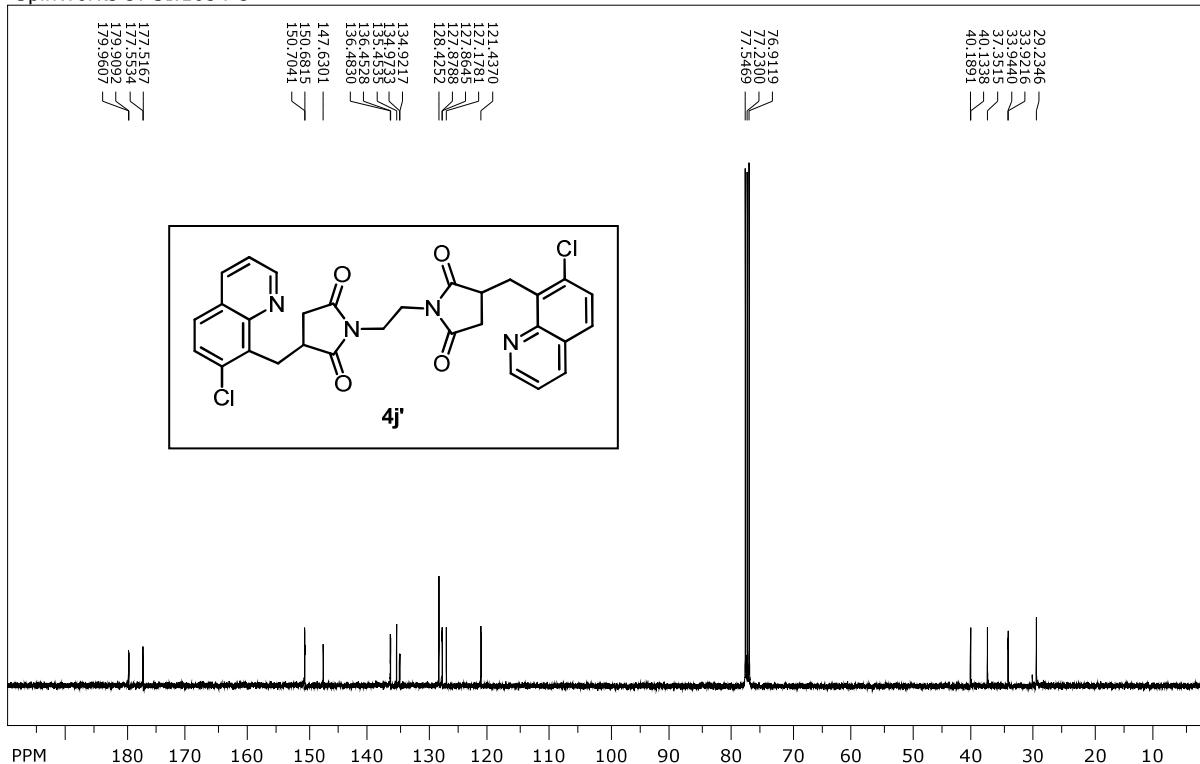


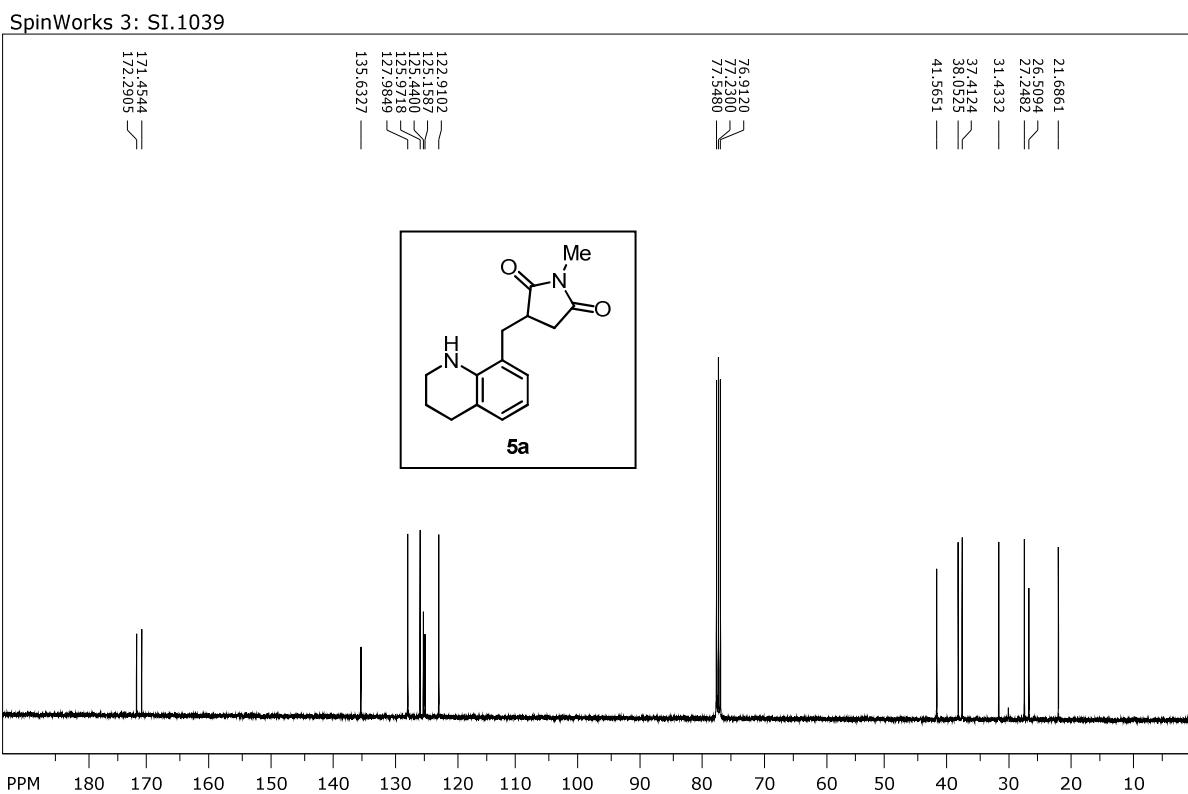
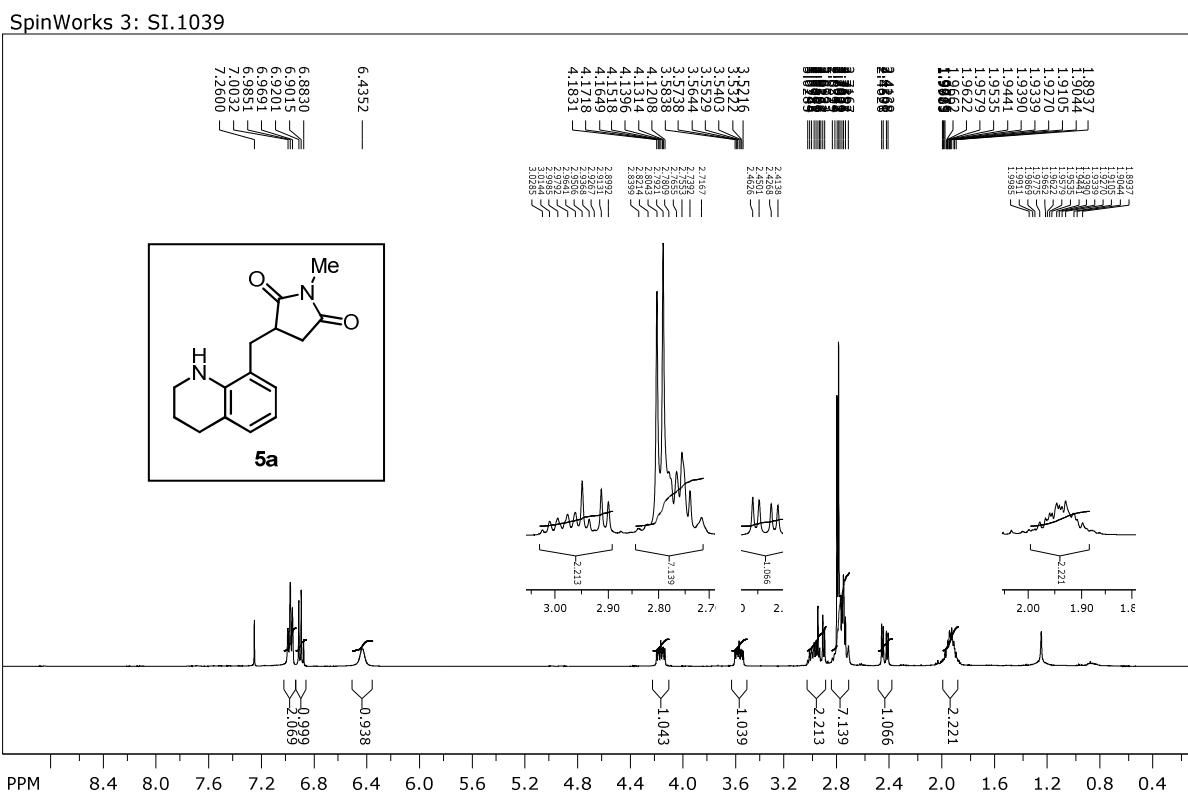


SpinWorks 3: SI.1034-3



SpinWorks 3: SI.1034-3





SpinWorks 3: SI.1048(90%D)

