Electronic Supplementary Material (ESI) for ChemComm.

Electronic Supporting Information for

A Deciduous Directing Group Approach for the Addition of Aryl and Vinyl nucleophiles to Maleimides

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General Experimental

NMR spectra were recorded on a 400 MHz spectrometer in $CDCl_3$, Tetramethylsilane (TMS; δ = 0.00 ppm) served as an internal standard for ^1H NMR. The corresponding residual nondeuterated solvent signal ($CDCl_3$; δ = 77.00 ppm) was used as internal standard for $^{13}C\{1H\}$ NMR. IR spectra were measured using a FT-IR spectrometer. Mass spectra were obtained with a Q-TOF Mass Spectrometer (ESI-HRMS). Flash column chromatography was carried out by packing glass columns with commercial silica gel 230-400 mesh (commercial suppliers) and thin-layer chromatography was carried out using silica gel GF-254. All catalysts, reagents, starting materials and coupling partners were procured from commercial suppliers. Dichloroethane solvent was distilled over calcium hydride and stored over molecular sieves and used for all procedures. Other solvents, used for work up and chromatographic procedures were purchased from commercial suppliers and used without any further purification.

Note: Derivatives of *N*-ethyl succinimides are very mildly fluorescent on the TLC plate under a UV lamp. Hence sufficient care must be taken when column purification is performed.

Experimental Procedures

General Experimental Procedure for synthesis of 3-aryl succinimides: (3aa – 3ia)

A pre-dried 8-mL screw cap with a stirring bar was charged with 0.02 mmol (10 mol %, 7 mg) of $RhCp^*(OAc)_2$ complex, 0.2 mmol of aromatic carboxylic acid derivative and 0.4 mmol of *N*-alkyl/phenyl maleimide. To this, 30 mg of AcOH was added via a syringe, followed by 1 mL of dry 1,2-dichloroethane (DCE). The vial was capped tightly under a stream of argon gas, and placed into a pre-heated metal block set to 100 °C. The reaction mixture was left to stir for 4-8 h, until TLC indicated consumption of starting materials, and filtered through a short plug of silica to obtain the crude mixture. The compound was purified by column chromatography using 20% EA/hexane mixture to obtain a yellowish syrupy liquid as the product.

General Experimental Procedure for synthesis of 3-heteroaryl succinimides: (3ja – 3la)

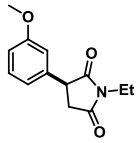
A pre-dried 8-mL screw cap with a stirring bar was charged with 0.02 mmol (10 mol %, 7 mg) of $RhCp^*(OAc)_2$ complex, 0.2 mmol of *N*-alkyl/phenyl maleimide and 0.4 mmol of heteroaromatic carboxylic acid derivative. To this 1 mL of dry 1,2-dichloroethane (DCE) was added. The vial was capped tightly under a stream of argon gas, and placed into a pre-heated metal block set to 100 °C. The reaction mixture was left to stir for 4-8 h, until TLC indicated consumption of starting materials, and filtered through a short plug of silica to obtain the crude mixture. The compound was purified by column chromatography using 10 - 20% EA/hexane mixture to obtain a yellowish syrupy liquid as the product.

General Experimental Procedure for synthesis of 3-alkenyl succinimides: (3ma – 3pa)

A pre-dried 8-mL screw cap with a stirring bar was charged with 0.02 mmol (10 mol %, 7 mg) of $RhCp^*(OAc)_2$ complex, 0.2 mmol of acrylic/atropic acid derivative and 0.4 mmol of *N*-alkyl/phenyl maleimide. To this, 30 mg of AcOH was added via a syringe, followed by 1 mL of dry 1,2-dichloroethane (DCE). The vial was capped tightly under a stream of argon gas, and placed into a pre-heated metal block set to 120 °C. The reaction mixture was left to stir for 4-8 h, until TLC indicated consumption of starting materials, and filtered through a short plug of silica to obtain the crude mixture. The compound was purified by column chromatography using 5-12 % EA/hexane mixture to obtain a yellowish syrupy liquid as the product.

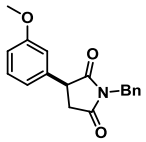
Characterization data for all isolated products:

1. 1-ethyl-3-(3-methoxyphenyl)pyrrolidine-2,5-dione (3aa)



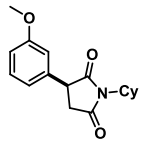
Yield - 37 mg (81%), as a thick yellow liquid; **R_f** - (30% EtOAc/hexane) 0.4; **IR** (Neat, cm^{-1}): 1701, 1596; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.24 (t, *J*= 7.17 Hz, 3 H) 2.82 (dd, *J*= 18.62, 4.58 Hz, 1 H) 3.20 (dd, *J*= 18.31, 9.46 Hz, 1 H) 3.66 (q, *J*= 7.12 Hz, 2 H) 3.82 (s, 3 H) 3.99 (dd, *J*= 9.77, 4.58 Hz, 1 H) 6.73 - 6.83 (m, 2 H) 6.84 - 6.90 (m, 1 H) 7.26 - 7.32 (m, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.0, 34.0, 37.2, 45.8, 55.2, 113.0, 113.5, 119.4, 130.2, 138.8, 160.1, 176.0, 177.4; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{13}H_{15}NO_3$ (M+Na): 256.0950, found (M+Na): 256.0949.

2. 1-benzyl-3-(3-methoxyphenyl)pyrrolidine-2,5-dione (3ab)



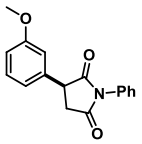
Yield - 44 mg (75%), as a thick yellow liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1703, 1594; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 2.83 (dd, *J*= 18.62, 4.58 Hz, 1 H) 3.21 (dd, *J*= 18.31, 9.46 Hz, 1 H) 3.77 (s, 3 H) 4.01 (dd, *J*= 9.46, 4.58 Hz, 1 H) 4.67 - 4.83 (m, 2 H) 6.7 (s, 1H) 6.76 (d, *J*= 7.63 Hz, 1 H) 6.86 (dd, *J*= 8.32, 2.52, 1 H) 7.24 - 7.39 (m, 4 H) 7.41 - 7.48 (m, 2 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 37.2, 42.7, 45.9, 55.2, 113.1, 113.4, 119.5, 128.0, 128.7, 128.8, 130.2, 135.8, 138.7, 160.1, 175.7, 177.2; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{18}H_{17}NO_3$ (M+Na): 318.1106, found (M+Na): 318.1107.

3. 1-cyclohexyl-3-(3-methoxyphenyl)pyrrolidine-2,5-dione (3ac)



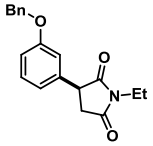
Yield - 42 mg (74%), as a thick yellow liquid; **R_f** - (30% EtOAc/hexane) 0.4; **IR** (Neat, cm^{-1}): 1700, 1597; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.14 - 1.41 (m, 3 H) 1.49 - 1.77 (m, 3 H) 1.85 (d, *J*= 13.14 Hz, 2 H) 2.12 - 2.28 (m, 2 H) 2.76 (dd, *J*= 18.44, 4.55 Hz, 1 H) 3.15 (dd, *J*= 18.44, 9.60 Hz, 1 H) 3.82 (s, 3 H) 3.92 (dd, *J*= 9.60, 4.55 Hz, 1 H) 3.99 - 4.10 (m, 1 H) 6.74 (s, 1 H) 6.78 (d, *J*= 7.83 Hz, 1 H) 6.85 (dd, *J*= 8.21, 2.40 Hz, 1 H) 7.27 - 7.31 (m, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 37.2, 42.7, 45.9, 55.2, 113.1, 113.4, 119.5, 128.0, 128.7, 128.8, 130.2, 135.8, 138.7, 160.1, 175.7, 177.2; **HRMS (ESI-TOF)** *(m/z)***–**Calculated for $C_{17}H_{21}NO_3$ (M+Na): 310.1419, found (M+Na): 310.1419.

4. 3-(3-methoxyphenyl)-1-phenylpyrrolidine-2,5-dione (3ad)



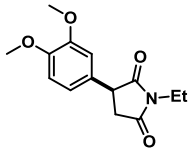
Yield - 38 mg (68%), as a yellow syrupy liquid; **R_f** - (30% EtOAc/hexane) 0.4; **IR** (Neat, cm^{-1}): 1712, 1597; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 3.02 (dd, *J*= 18.46, 4.73 Hz, 1 H) 3.39 (dd, *J*= 18.62, 9.77 Hz, 1 H) 3.85 (s, 3 H) 4.18 (dd, *J*= 9.77, 4.88 Hz, 1 H) 6.86 - 6.96 (m, 3 H) 7.31 - 7.40 (m, 3 H) 7.40 - 7.47 (m, 1 H) 7.47 - 7.58 (m, 2 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 37.2, 45.9, 55.3, 113.2, 113.7, 119.4, 126.5, 128.7, 129.2, 130.3, 131.9, 138.6, 160.2, 175.1, 176.5; **HRMS (ESI-TOF)** *(m/z)***–**Calculated for $C_{17}H_{15}NO_3$ (M+Na): 304.0950, found (M+Na): 304.0954.

5. 3-(3-(benzyloxy)phenyl)-1-ethylpyrrolidine-2,5-dione (3ba)



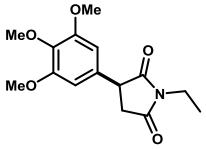
Yield - 38 mg (75%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1700, 1590; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.25 (t, *J*= 7.17 Hz, 3 H) 2.81 (dd, *J*= 18.31, 4.58 Hz, 1 H) 3.20 (dd, *J*= 18.62, 9.46 Hz, 1 H) 3.66 (q, *J*= 7.32 Hz, 2 H) 3.99 (dd, *J*= 9.46, 4.58 Hz, 1 H) 5.09 (s, 2 H) 6.80 - 6.90 (m, 2 H) 6.95 (dd, *J*= 8.24, 1.83 Hz, 1 H) 7.28 - 7.40 (m, 2 H) 7.40 - 7.50 (m, 4 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.1, 37.2, 45.8, 70.1, 113.9, 114.4, 119.8, 127.5, 128.1, 128.6, 130.3, 136.7, 138.9, 159.3, 175.9, 177.3; **HRMS (ESI-TOF)** *(m/z)*– Calculated for $C_{19}H_{19}NO_3$ (M+Na): 332.1263, found (M+Na): 332.1261.

6. 3-(3,4-dimethoxyphenyl)-1-ethylpyrrolidine-2,5-dione (3ca)



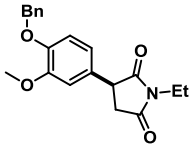
Yield - 29 mg (69%), as a yellow thick liquid; **R_f** - (30% EtOAc/hexane) 0.3; **IR** (Neat, cm^{-1}): 1701, 1599; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.24 (t, *J* = 7.20 Hz, 3 H), 2.82 (dd, *J* = 18.44, 4.55 Hz, 1 H), 3.20 (dd, *J* = 18.69, 9.60 Hz, 1 H), 3.66 (q, *J* = 7.24 Hz, 2 H), 3.89 (s, 3 H), 3.90 (s, 3 H), 3.94 - 3.99 (m, 1 H), 6.74 - 6.77 (m, 1 H), 6.87 (d, *J* = 8.08 Hz, 1 H), 7.28 (s, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.1, 37.2, 45.4, 55.9, 56.0, 76.7, 77.0, 77.2, 77.3, 110.6, 111.6, 119.2, 129.6, 148.8, 149.4, 176.1, 177.7; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{14}H_{17}NO_4$ (M+Na): 286.1055, found (M+Na): 286.1056.

7. 1-ethyl-3-(3,4,5-trimethoxyphenyl)pyrrolidine-2,5-dione (3da)



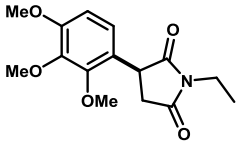
Yield - 36 mg (69%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.3; **IR** (Neat, cm^{-1}): 1701, 1597; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.23 (t, *J*= 7.20 Hz, 3 H) 2.80 (dd, *J*= 18.69, 4.55 Hz, 1 H) 3.18 (dd, *J*= 18.44, 9.35 Hz, 1 H) 3.64 (q, *J*= 7.07 Hz, 2 H) 3.79 (s, 6 H) 3.93 (dd, *J*= 9.47, 4.42 Hz, 1 H) 6.35 (s, 2 H) 6.41 (s, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.1, 37.2, 46.0, 55.4, 99.5, 105.6, 116.1, 139.5, 161.3, 176.1, 177.3; **HRMS (ESI-TOF)** *(m/z)*– Calculated for $C_{14}H_{17}NO_4$ (M+H): 264.1236, found (M+H): 264.1220

8. 3-(4-(benzyloxy)-3-methoxyphenyl)-1-ethylpyrrolidine-2,5-dione (3ea)



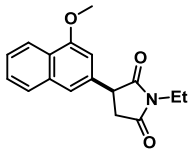
Yield - 40 mg (60%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1701, 1594; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.20 (t, *J*= 7.20 Hz, 3 H) 2.71 (dd, *J*= 18.44, 4.55 Hz, 1 H) 3.14 (dd, *J*= 18.32, 9.47 Hz, 1 H) 3.62 (q, *J*= 7.24 Hz, 2 H) 3.85 - 3.94 (m, 4 H) 5.15 (s, 2 H) 6.74 (s, 1 H) 6.78 (d, *J*= 8.59 Hz, 1 H) 6.89 (d, *J*= 8.34 Hz, 1 H) 7.29 - 7.47 (m, 5 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.0, 37.2, 45.3, 56.1, 71.3, 112.2, 113.4, 120.1, 127.4, 128.0, 128.6, 129.5, 136.8, 148.6, 149.5, 176.1, 177.7; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{20}H_{21}NO_4$ (M+Na): 362.1368, found (M+Na): 362.1369.

9. 1-ethyl-3-(2,3,4-trimethoxyphenyl)pyrrolidine-2,5-dione (3fa)



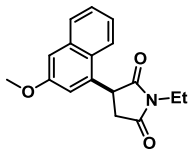
Yield - 39 mg (60%), as a yellowish thick liquid; **R_f** - (30% EtOAc/hexane) 0.4; **IR** (Neat, cm^{-1}): 1701, 1600; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.24 - 1.28 (m, 3 H) 2.69 9 (dd, *J*= 18.57, 4.53 Hz, 1 H) 3.08 (dd, *J*= 18.19, 9.60 Hz, 1 H) 3.67 (q, *J*= 7.16 Hz, 2 H) 3.84 (s, 3 H) 3.85 (s, 3 H) 3.87 (s, 3 H) 6.62 (d, *J*= 8.34 Hz, 1 H) 6.85 (d, *J*= 8.34 Hz, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 33.9, 37.3, 43.5, 56.0, 60.4, 60.7, 106.8, 123.5, 124.6, 142.1, 151.2, 154.1, 176.5, 178.8; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{15}H_{19}NO_5$ (M+Na): 316.1161, found (M+Na): 316.1164.

10. 1-ethyl-3-(4-methoxynaphthalen-2-yl)pyrrolidine-2,5-dione (3ga)



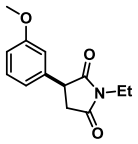
Yield - 29 mg (60%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1701, 1584; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.27 (t, *J*= 7.20 Hz, 3 H) 2.96 (dd, *J*= 18.44, 4.55 Hz, 1 H) 3.27 (dd, *J*= 18.44, 9.60 Hz, 1 H) 3.70 (q, *J*= 7.16 Hz, 2 H) 4.02 (s, 3 H) 4.15 (dd, *J*= 9.60, 4.55 Hz, 1 H) 6.61 (s, 1 H) 7.28 (s, 1 H) 7.43 - 7.57 (m, 2 H) 7.76 (d, *J*= 8.24 Hz, 1 H) 8.25 (d, *J*= 8.24 Hz, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.1, 37.0, 46.3, 55.6, 102.8, 118.6, 122.0, 125.1, 125.7, 127.2, 127.4, 134.3, 134.7, 156.4, 176.2, 177.5; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{17}H_{17}NO_3$ (M+Na): 306.1106, found (M+Na): 306.1104

11. 1-ethyl-3-(3-methoxynaphthalen-1-yl)pyrrolidine-2,5-dione (3ha)



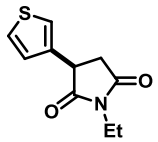
Yield - 34 mg (60%), as a yellowish thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1702, 1603; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.31 (t, *J*= 7.20 Hz, 3 H) 2.79 (dd, *J*= 18.44, 4.80 Hz, 1 H) 3.39 (s, 1 H) 3.74 (q, *J*= 7.07 Hz, 2 H) 3.93 (s, 3 H) 4.69 (dd, *J*= 9.60, 4.80 Hz, 1 H) 6.97 (s, 1 H) 7.13 (s, 1 H) 7.37 - 7.54 (m, 2 H) 7.73 (d, *J*= 8.34 Hz, 1 H) 7.81 (d, *J*= 8.34 Hz, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.2, 34.2, 37.6, 42.8, 55.3, 106.1, 122.7, 124.4, 126.7, 126.8, 128.1, 135.6, 135.7, 156.9, 175.7, 177.6; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{17}H_{17}NO_3$ (M+Na): 306.1106, found (M+Na): 306.1107.

12. 1-ethyl-3-(3-methoxyphenyl)pyrrolidine-2,5-dione (3ia = 3aa)



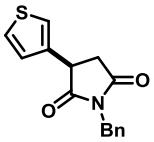
Yield - 23 mg (50%), as a yellowish thick liquid; **R_f** - (30% EtOAc/hexane) 0.4; same data as **3aa**

13. 1-ethyl-3-(thiophen-3-yl)pyrrolidine-2,5-dione (3ja)



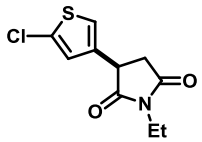
Yield - 28 mg (68%), as a yellowish liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1698, 1587; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.20 (t, *J* = 7.20 Hz, 3 H), 2.84 (dd, *J* = 18.32, 4.93 Hz, 1 H), 3.19 (dd, *J* = 18.32, 9.47 Hz, 1 H), 3.62 (q, *J* = 7.33 Hz, 2 H), 4.12 (dd, *J* = 9.60, 4.80 Hz, 1 H), 7.04 (dd, *J* = 5.05, 1.01 Hz, 1 H), 7.22 (br. s, 1 H), 7.37 (dd, *J* = 5.05, 3.03 Hz, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.0, 34.0, 36.4, 41.2, 122.1, 126.3, 127.1, 136.6, 175.7, 177.0; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{10}H_{11}NO_2S$ (M+Na): 232.0408, found (M+Na): 232.0408

14. 1-benzyl-3-(thiophen-3-yl)pyrrolidine-2,5-dione (3jb)



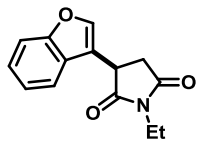
Yield - 37 mg (60%), as a yellowish thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1703, 1525; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 2.86 (dd, *J* = 18.32, 4.93 Hz, 1 H), 3.20 (dd, *J* = 18.32, 9.47 Hz, 1 H), 4.14 (dd, *J* = 9.47, 4.93 Hz, 1 H), 4.66 - 4.79 (m, 2 H), 7.01 (d, *J* = 5.05 Hz, 1 H), 7.19 (br. s, 1 H), 7.29 - 7.37 (m, 4 H), 7.38 - 7.44 (m, 2 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 36.4, 41.2, 42.7, 122.2, 126.3, 127.1, 128.1, 128.7, 128.8, 135.7, 136.4, 175.5, 176.8; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{15}H_{13}NO_2S$ (M+H): 272.0745, found (M+H): 272.0725

15. 3-(5-chlorothiophen-3-yl)-1-ethylpyrrolidine-2,5-dione (3ka)



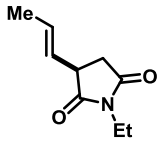
Yield - 26 mg (55%), as a yellowish thick liquid; **R_f** - (20% EtOAc/hexane) 0.4; **IR** (Neat, cm^{-1}): 1700, 1590; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.21 (t, *J* = 7.20 Hz, 3 H), 2.80 (dd, *J* = 18.44, 5.05 Hz, 1 H), 3.16 (dd, *J* = 18.32, 9.47 Hz, 1 H), 3.63 (q, *J* = 7.07 Hz, 2 H), 4.02 (dd, *J* = 9.47, 4.93 Hz, 1 H), 6.90 (s, 1 H), 7.00 (s, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.0, 34.1, 35.8, 41.4, 120.7, 125.4, 131.7, 135.9, 175.3, 176.3; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{10}H_{10}ClNO_2S$ (M+Na): 266.0018, found (M+Na): 266.0017

16. 3-(benzofuran-3-yl)-1-ethylpyrrolidine-2,5-dione (3la)



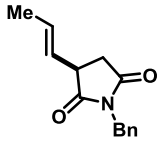
Yield - 25 mg (51%), as a yellowish thick liquid; **R_f** - (20% EtOAc/hexane) 0.4; **IR** (Neat, cm^{-1}): 1701, 1591; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.27 (t, *J* = 7.20 Hz, 3 H), 2.92 (dd, *J* = 18.32, 5.18 Hz, 1 H), 3.28 (dd, *J* = 18.19, 9.60 Hz, 1 H), 3.70 (q, *J* = 7.07 Hz, 2 H), 4.24 (dd, *J* = 9.60, 5.05 Hz, 1 H), 7.24 - 7.31 (m, 1 H), 7.36 (t, *J* = 7.33 Hz, 1 H), 7.43 (d, *J* = 7.83 Hz, 1 H), 7.53 (d, *J* = 8.34 Hz, 1 H), 7.66 (s, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.2, 35.3, 36.7, 112.1, 116.2, 119.4, 123.1, 125.1, 125.9, 142.2, 155.7, 175.5, 176.5; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{14}H_{13}NO_3$ (M+H): 244.0974, found (M+H): 244.0954

17. E-1-ethyl-3-(prop-1-en-1-yl)pyrrolidine-2,5-dione (3ma)



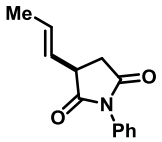
Yield - 20 mg (57%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1699, 1596; **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.18 (t, *J* = 7.20 Hz, 3 H), 1.75 (d, *J* = 6.57 Hz, 3 H), 2.55 (dd, *J* = 18.19, 4.80 Hz, 1 H), 2.93 (dd, *J* = 18.19, 9.35 Hz, 1 H), 3.38 - 3.47 (m, 1 H), 3.54 - 3.60 (m, 2 H), 5.47 (dd, *J* = 15.28, 7.20 Hz, 1 H), 5.67 - 5.79 (m, 1 H); **^{13}C{^{1}H} NMR** (101 MHz, $CDCl_3$) δ 13.0, 18.0, 33.9, 34.9, 43.2, 125.6, 130.2, 176.1, 178.1; **HRMS (ESI-TOF)** *(m/z)*– Calculated for $C_9H_{13}NO_2$ (M+H): 168.1025, found (M+H): 168.1006

18. E-1-benzyl-3-(prop-1-en-1-yl)pyrrolidine-2,5-dione (3mb)



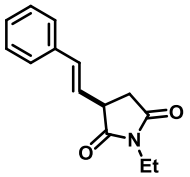
Yield - 30 mg (65%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1706, 1584; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.74 (d, *J* = 6.57 Hz, 3 H), 2.57 (dd, *J* = 18.32, 4.93 Hz, 1 H), 2.94 (dd, *J* = 18.32, 9.22 Hz, 1 H), 3.40 - 3.50 (m, 1 H), 4.67 (d, *J* = 1.77 Hz, 2 H), 5.40 - 5.51 (m, 1 H), 5.66 - 5.79 (m, 1 H), 7.27 - 7.35 (m, 3 H), 7.36 - 7.43 (m, 2 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 18.0, 34.9, 42.5, 43.2, 125.4, 128.0, 128.7, 128.8, 128.9, 130.4, 135.8, 175.8, 177.9; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{14}H_{15}NO_2$ (M+Na): 252.1000, found (M+Na): 252.1000.

19. E-1-phenyl-3-(prop-1-en-1-yl)pyrrolidine-2,5-dione (3md)



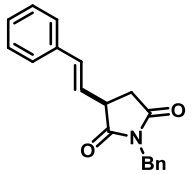
Yield - 26 mg (61%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1713, 1596; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.79 (d, *J* = 6.32 Hz, 2 H), 2.76 (dd, *J* = 18.32, 5.18 Hz, 1 H), 3.11 (dd, *J* = 18.44, 9.35 Hz, 1 H), 3.56 - 3.68 (m, 1 H), 5.59 (ddd, *J* = 15.28, 6.95, 1.26 Hz, 1 H), 5.74 - 5.85 (m, 1 H), 7.30 - 7.45 (m, 3 H), 7.48 (d, *J* = 8.08 Hz, 2 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 12.6, 18.0, 23.4, 32.0, 35.0, 43.3, 125.4, 126.4, 126.5, 128.5, 128.6, 129.1, 129.2, 130.5, 131.9, 141.5, 175.2, 177.2; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{13}H_{13}NO_2$ (M+Na): 238.0844, found (M+Na): 238.0846.

20. E-1-ethyl-3-styrylpyrrolidine-2,5-dione (3na)



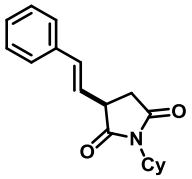
Yield -27 mg (59%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1701, 1593; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.22 (t, *J* = 7.17 Hz, 3 H), 2.72 (dd, *J* = 18.31, 4.88 Hz, 1 H), 3.05 (dd, *J* = 18.31, 9.16 Hz, 1 H), 3.58 - 3.71 (m, 3 H), 6.23 (dd, *J* = 15.87, 7.02 Hz, 1 H), 7.27 - 7.44 (m, 5 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.0, 34.0, 34.7, 43.2, 123.9, 126.4, 128.1, 128.6, 133.8, 136.0, 175.7, 177.4; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{14}H_{15}NO_2$ (M+H): 230.1181, found (M+H): 230.1166

21. E-1-benzyl-3-styrylpyrrolidine-2,5-dione (3nb)



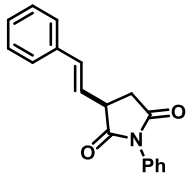
Yield - 35 mg (60%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1704, 1582; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 2.73 (dd, *J* = 18.32, 5.18 Hz, 1 H), 3.06 (dd, *J* = 18.19, 9.35 Hz, 1 H), 3.61 - 3.74 (m, 1 H), 4.65 - 4.76 (m, 2 H), 6.21 (dd, *J* = 15.92, 6.82 Hz, 1 H), 6.61 (d, *J* = 15.92 Hz, 1 H), 7.27 - 7.46 (m, 10 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 34.8, 42.7, 43.3, 123.8, 126.5, 128.1, 128.1, 128.7, 128.7, 128.9, 134.0, 135.7, 136.0, 175.6, 177.3; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{19}H_{17}NO_2$ (M+Na): 314.1157, found (M+Na): 314.1159.

22. E-1-cyclohexyl-3-styrylpyrrolidine-2,5-dione (3nc)



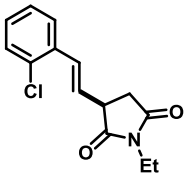
Yield - 38 mg (67%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1701, 1591; **^{1}H NMR** (400 MHz, $CDCl_3$) δ 1.20 - 1.40 (m, 3 H), 1.60 - 1.70 (m, 3 H), 1.85 (d, *J* = 12.88 Hz, 2 H), 2.10 - 2.24 (m, 2 H), 2.67 (dd, *J* = 18.06, 5.18 Hz, 1 H), 2.99 (dd, *J* = 18.19, 9.35 Hz, 1 H), 3.55 - 3.64 (m, 1 H), 4.02 (tt, *J* = 12.28, 3.76 Hz, 1 H), 6.22 (dd, *J* = 15.92, 6.82 Hz, 1 H), 6.61 (d, *J* = 15.92 Hz, 1 H), 7.26 - 7.30 (m, 1 H), 7.34 (t, *J* = 7.45 Hz, 2 H), 7.37 - 7.42 (m, 2 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ 25.0, 25.8, 28.8, 28.9, 34.6, 43.0, 52.0, 124.3, 126.5, 128.1, 128.6, 133.6, 136.1, 176.0, 177.7; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{18}H_{21}NO_2$ (M+H): 284.1651, found (M+H): 284.1634

23. E-1-phenyl-3-styrylpyrrolidine-2,5-dione (3nd)



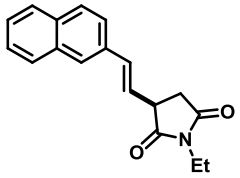
Yield - 30 mg (60%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1713, 1597; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 2.94 (dd, *J* = 18.32, 5.18 Hz, 1 H), 3.24 (dd, *J* = 18.44, 9.35 Hz, 1 H), 3.80 - 3.93 (m, 1 H), 6.35 (dd, *J* = 15.92, 6.82 Hz, 1 H), 6.71 (d, *J* = 15.92 Hz, 1 H), 7.30 - 7.58 (m, 10 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 34.9, 43.4, 123.7, 126.5, 126.5, 128.2, 128.7, 128.7, 129.2, 131.9, 134.1, 136.0, 174.9, 176.5; **HRMS (ESI-TOF)** *(m/z)*– Calculated for $C_{18}H_{15}NO_2$ (M+Na): 300.1000, found (M+Na): 300.1000

24. E-3-(2-chlorostyryl)-1-ethylpyrrolidine-2,5-dione (3oa)

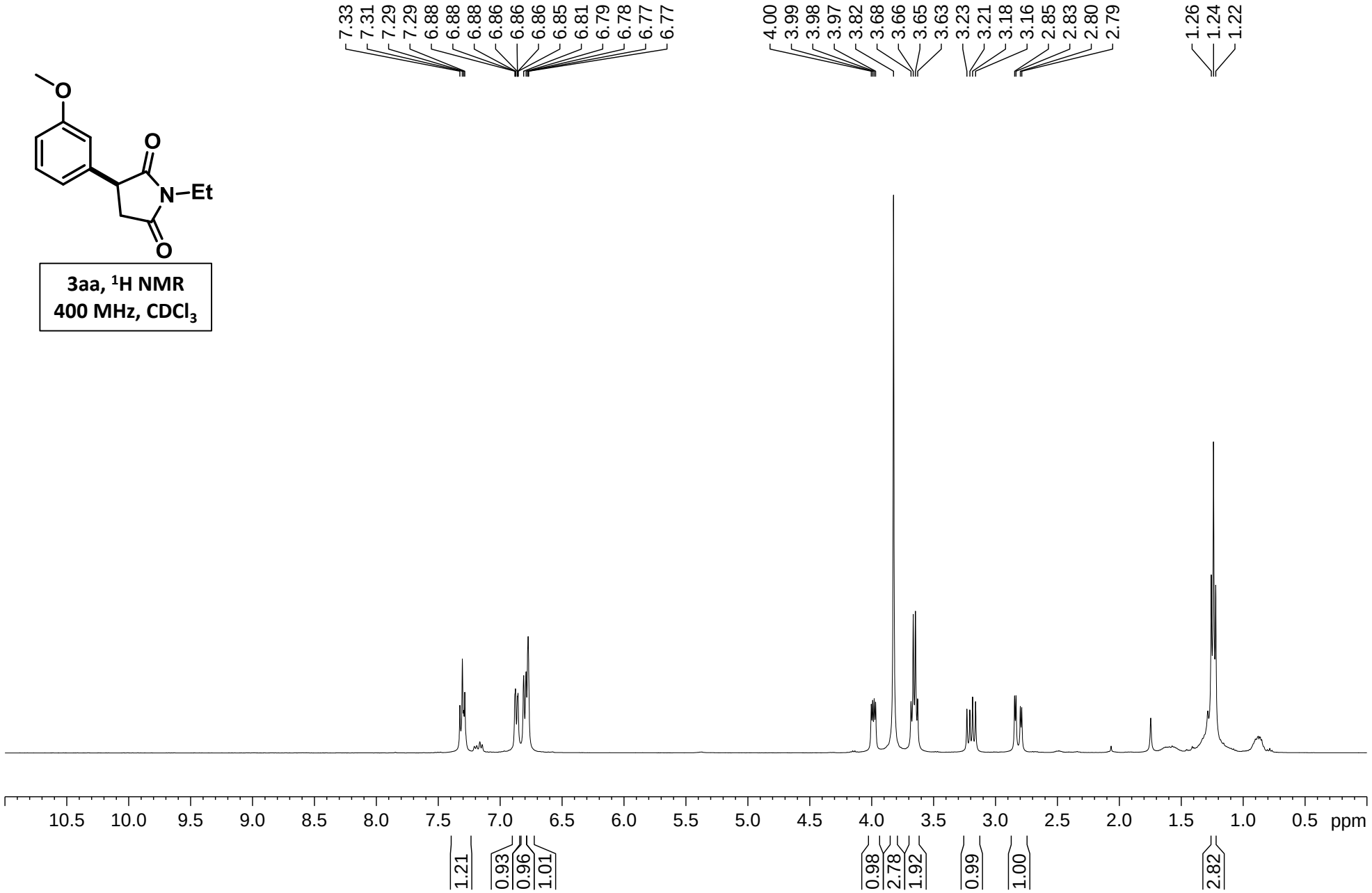


Yield - 40 mg (76%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1701, 1591; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.22 (t, *J* = 7.20 Hz, 3 H), 2.76 (dd, *J* = 18.19, 5.05 Hz, 1 H), 3.08 (dd, *J* = 18.19, 9.09 Hz, 1 H), 3.62 (q, *J* = 7.07 Hz, 2 H), 3.69 - 3.76 (m, 1 H), 6.24 (dd, *J* = 15.92, 7.07 Hz, 1 H), 7.02 (d, *J* = 15.92 Hz, 1 H), 7.18 - 7.27 (m, 2 H), 7.33 - 7.40 (m, 1 H), 7.54 (dd, *J* = 7.07, 2.27 Hz, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.1, 34.6, 43.4, 126.7, 126.9, 126.9, 129.1, 129.8, 130.0, 133.1, 134.2, 175.6, 177.2; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{14}H_{14}ClNO_2$ (M+Na): 286.0611, found (M+Na): 286.0612

25. E-1-ethyl-3-(2-(naphthalen-2-yl)vinyl)pyrrolidine-2,5-dione (3pa)



Yield - 39 mg, (70%), as a colorless thick liquid; **R_f** - (30% EtOAc/hexane) 0.5; **IR** (Neat, cm^{-1}): 1701, 1587; **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm 1.24 (t, *J* = 7.20 Hz, 3 H), 2.80 (dd, *J* = 18.19, 5.05 Hz, 1 H), 3.12 (dd, *J* = 18.19, 9.09 Hz, 1 H), 3.65 (q, *J* = 7.33 Hz, 2 H), 3.75 - 3.83 (m, 1 H), 6.23 (dd, *J* = 15.54, 6.95 Hz, 1 H), 7.41 (d, *J* = 15.66 Hz, 1 H), 7.44 - 7.49 (m, 1 H), 7.51 - 7.57 (m, 2 H), 7.60 (d, *J* = 7.07 Hz, 1 H), 7.82 (d, *J* = 8.08 Hz, 1 H), 7.88 (d, *J* = 7.33 Hz, 1 H), 8.10 (d, *J* = 7.83 Hz, 1 H); **^{13}C{^{1}H} NMR** (100 MHz, $CDCl_3$) δ ppm 13.1, 34.1, 34.9, 43.6, 123.6, 124.1, 125.6, 125.9, 126.3, 127.2, 128.5, 128.6, 131.0, 131.3, 133.6, 133.8, 175.8, 177.4; **HRMS (ESI-TOF)** *(m/z)*–Calculated for $C_{18}H_{17}NO_2$ (M+Na): 302.1157, found (M+Na): 302.1159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7.29
7.29
6.88
6.88
6.88
6.86
6.86
6.86
6.85
6.81
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6.78
6.77
6.77
4.00
3.99
3.98
3.97
3.82
3.68
3.66
3.65
3.63
3.23
3.21
3.18
3.16
2.85
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2.79
1.26
1.24
1.22
O
O
N–Et
O
3aa, ^{1}H NMR
400 MHz, $CDCl_3$
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10.0
9.5
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8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
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0.99
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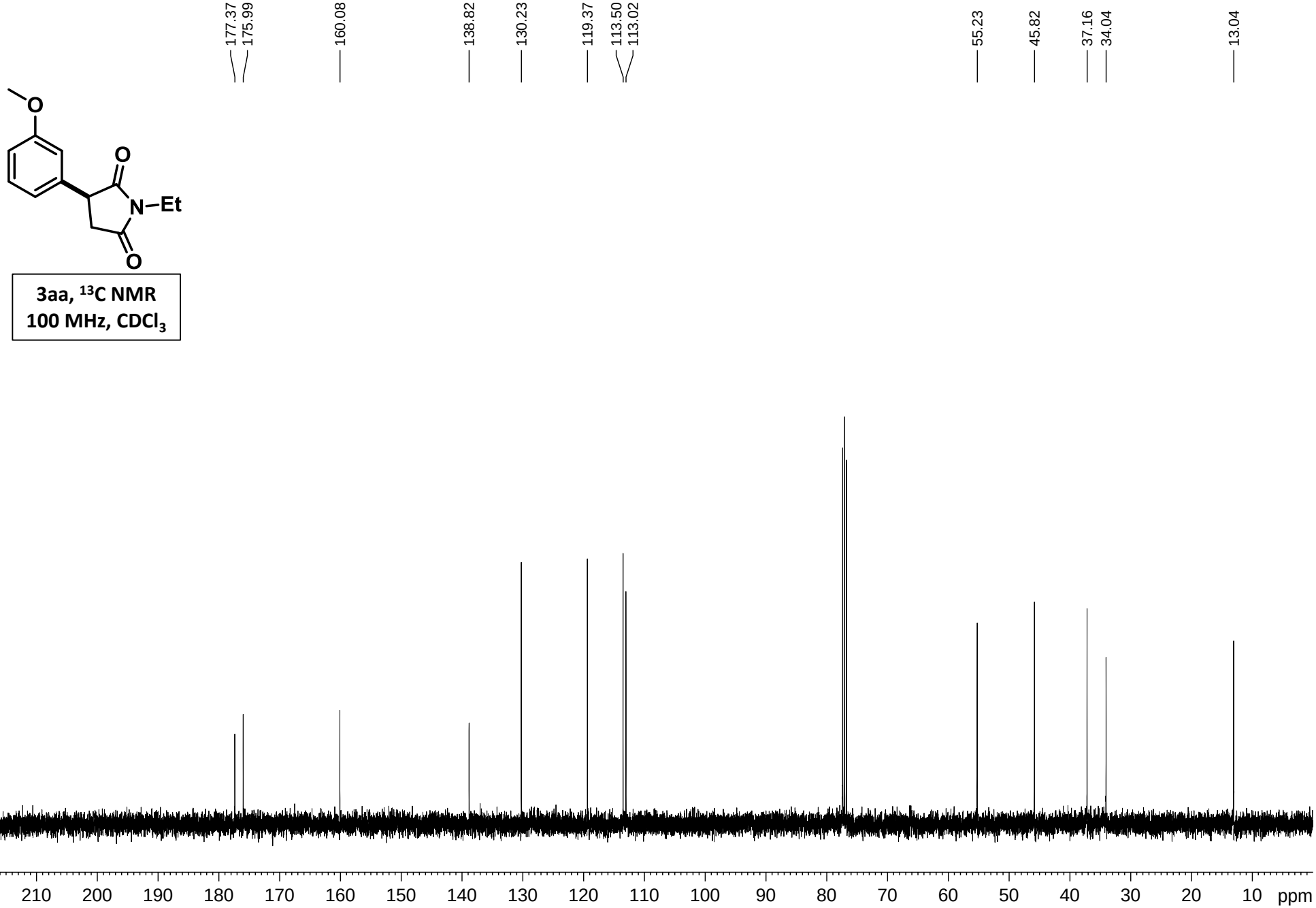
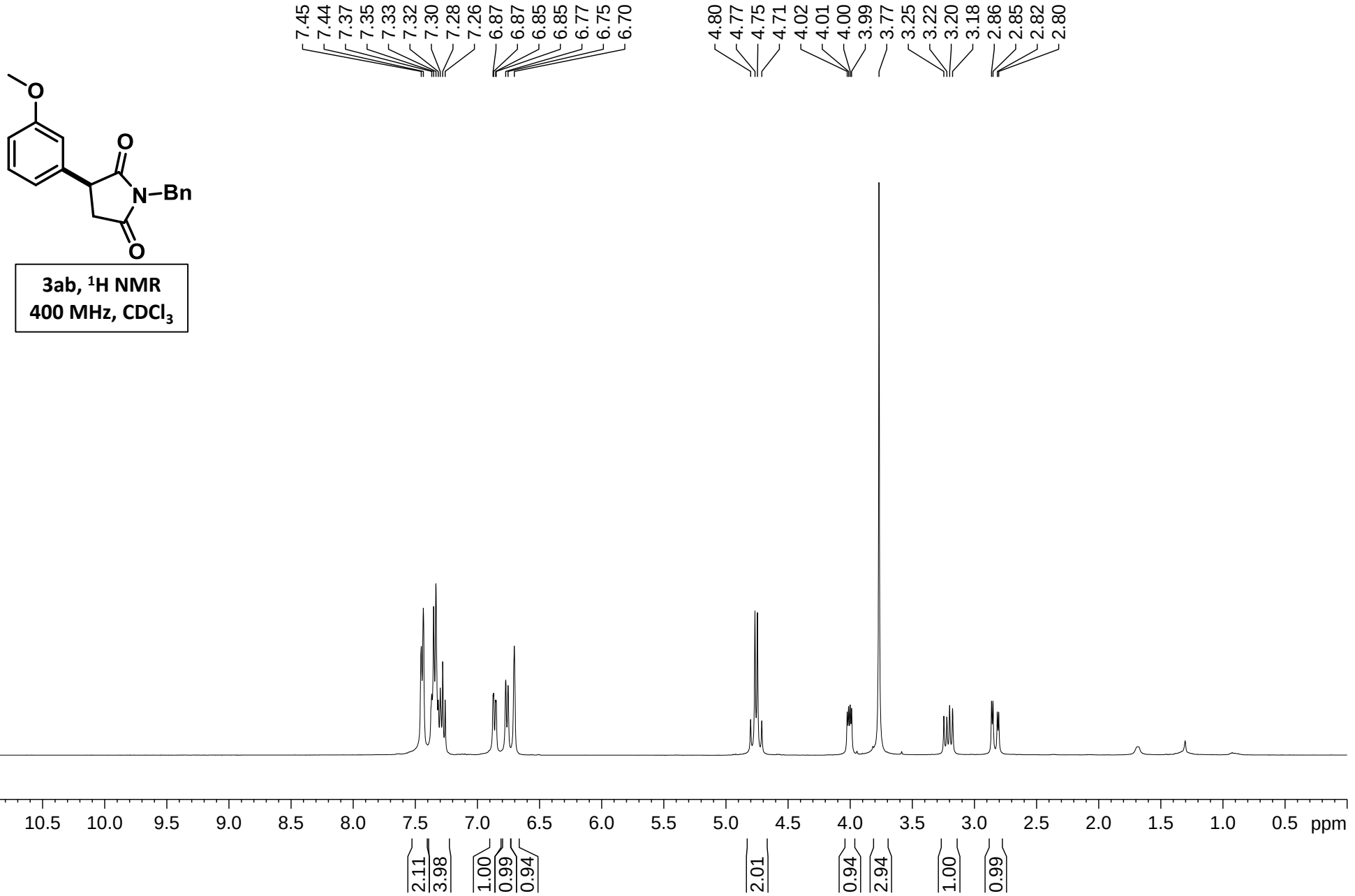
2.82


177.37
175.99
160.08
138.82
130.23
119.37
113.50
113.02
55.23
45.82
37.16
34.04
13.04
O
O
N–Et
O
3aa, ^{13}C NMR
100 MHz, $CDCl_3$
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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6.77
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6.70
4.80
4.77
4.75
4.71
4.02
4.01
4.00
3.99
3.77
3.25
3.22
3.20
3.18
2.86
2.85
2.82
2.80
O
O
N–Bn
O
3ab, ^{1}H NMR
400 MHz, $CDCl_3$
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9.5
9.0
8.5
8.0
7.5
7.0
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6.0
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3.5
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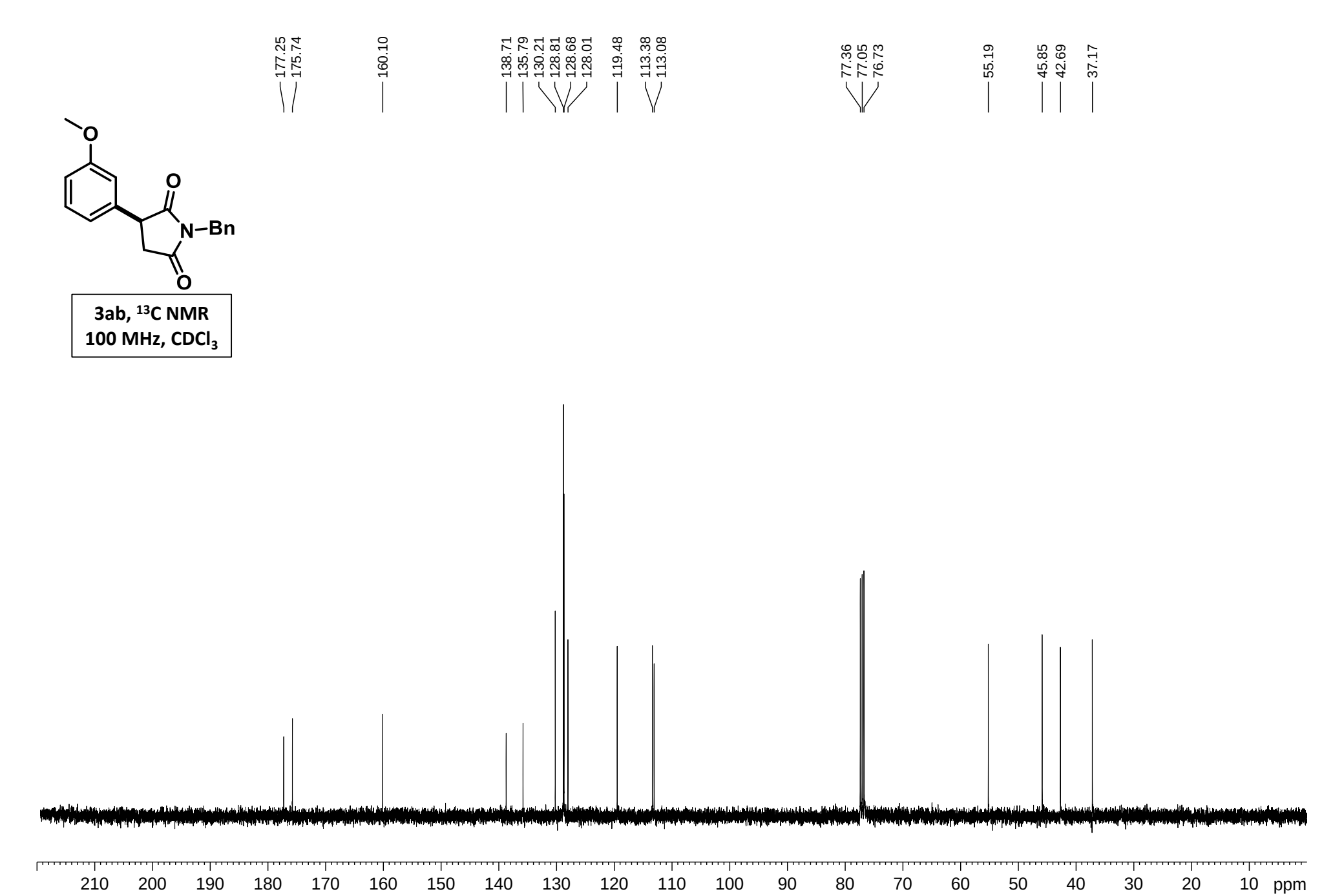
1.00
0.99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77.05
76.73
55.19
45.85
42.69
37.17
O
O
N–Bn
O
3ab, ^{13}C NMR
100 MHz, $CDCl_3$
210
200
190
180
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160
150
140
130
120
110
100
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70
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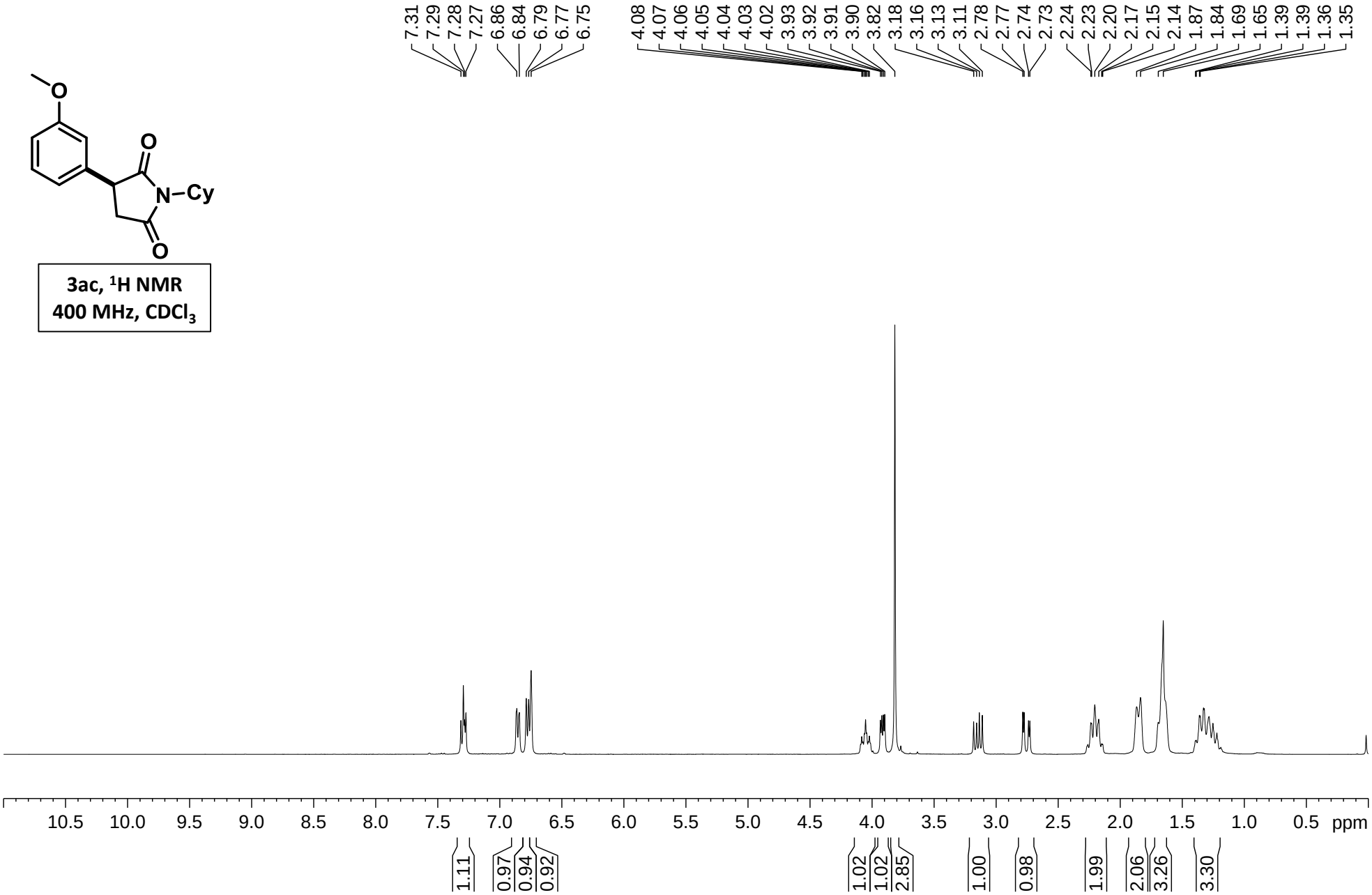
20
10
ppm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4.03
4.02
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3.91
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3.13
3.11
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2.77
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2.73
2.24
2.23
2.20
2.17
2.15
2.14
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1.84
1.69
1.65
1.39
1.39
1.36
1.35
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O
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O
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400 MHz, $CDCl_3$
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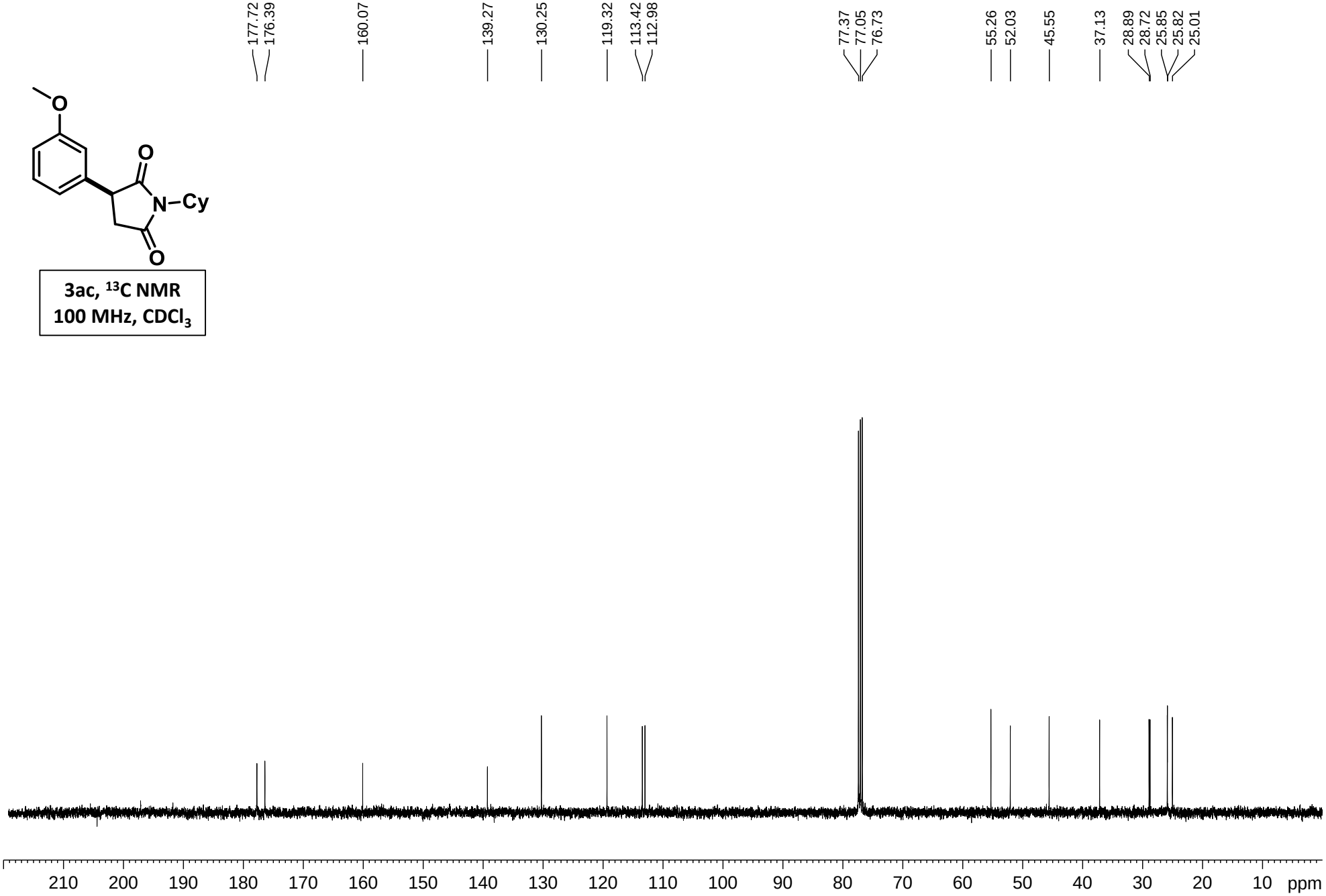
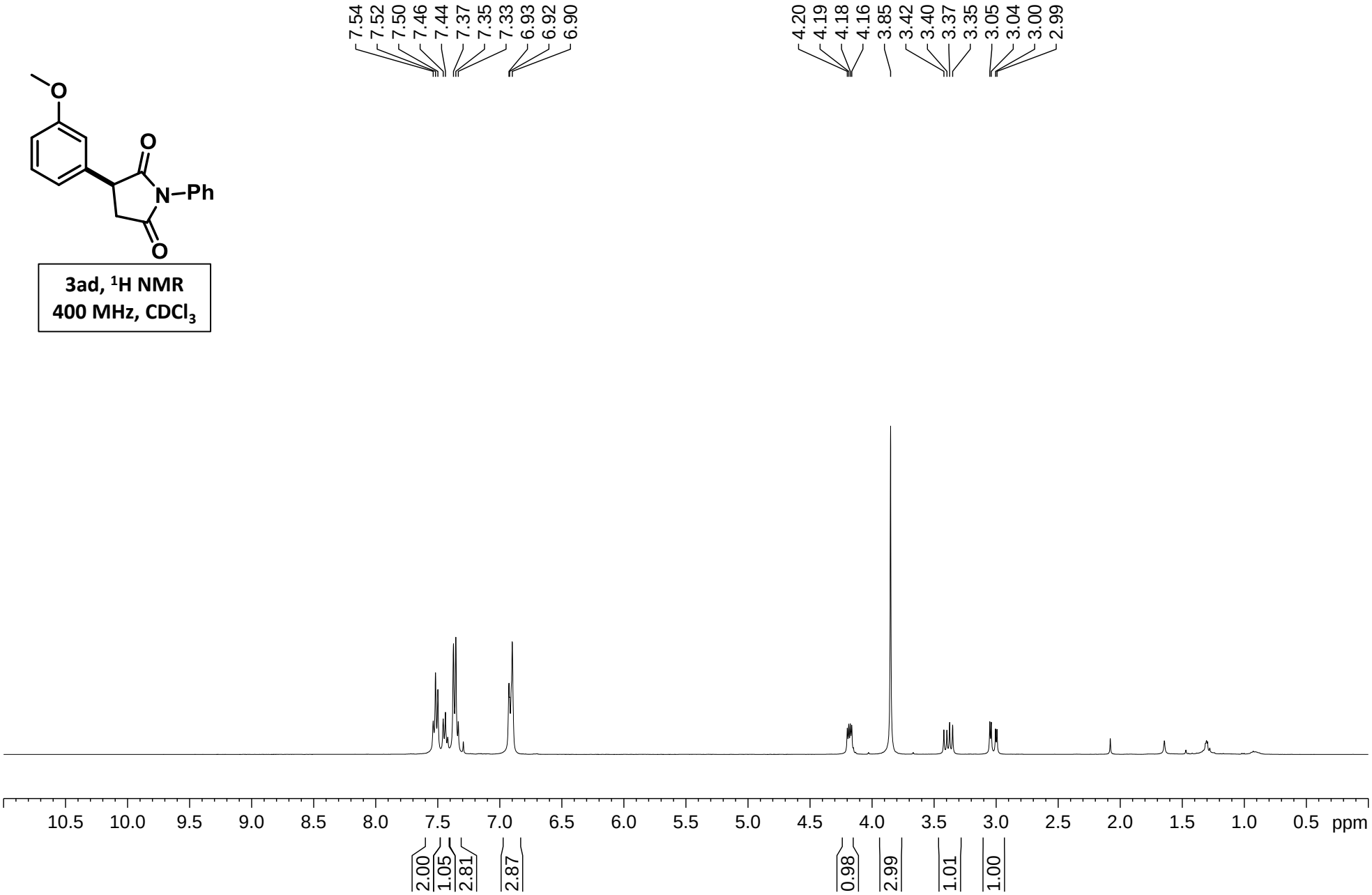
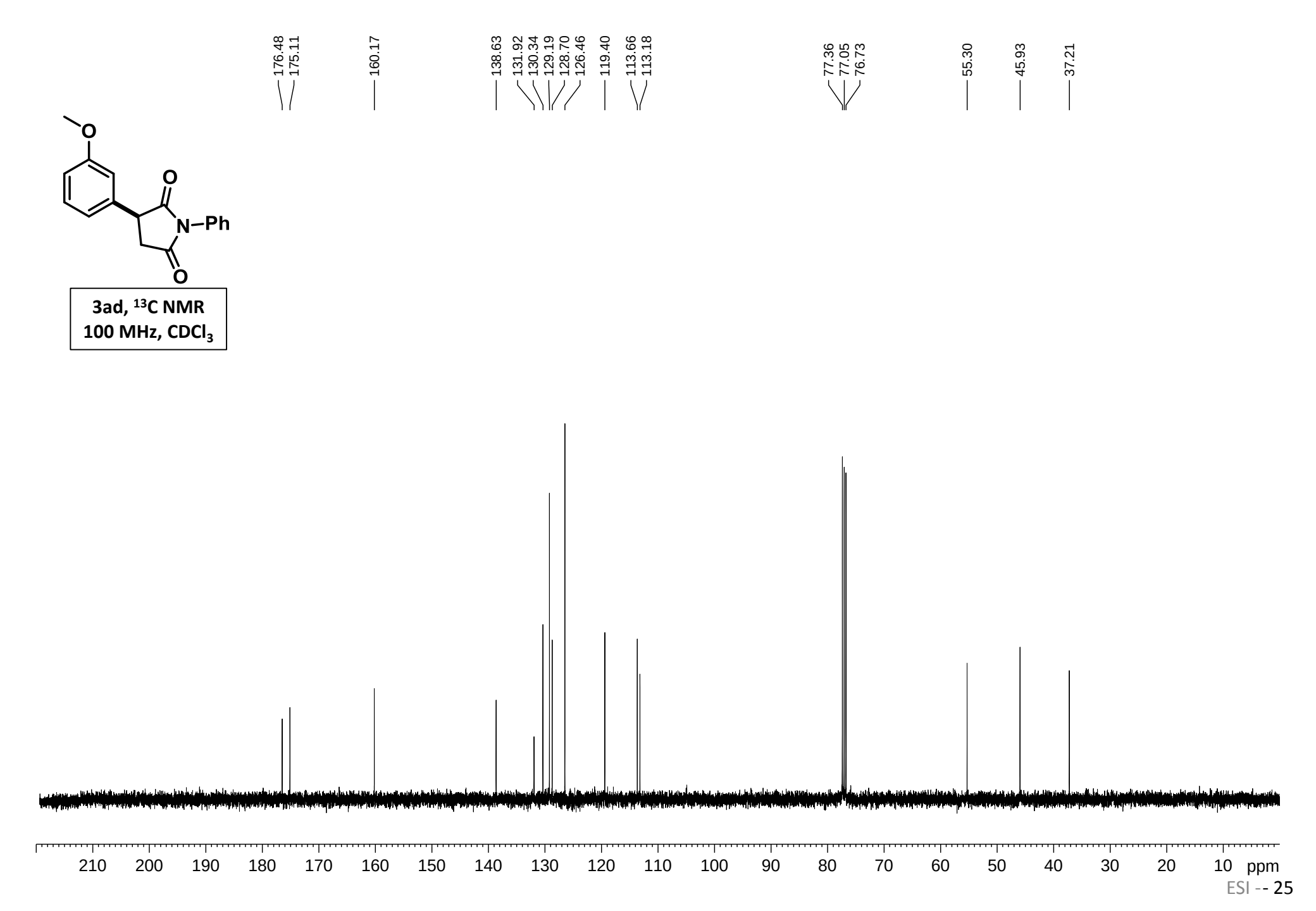
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.11
0.97
0.94
0.92
1.02
1.02
2.85
1.00
0.98
1.99
2.06
3.26
3.30

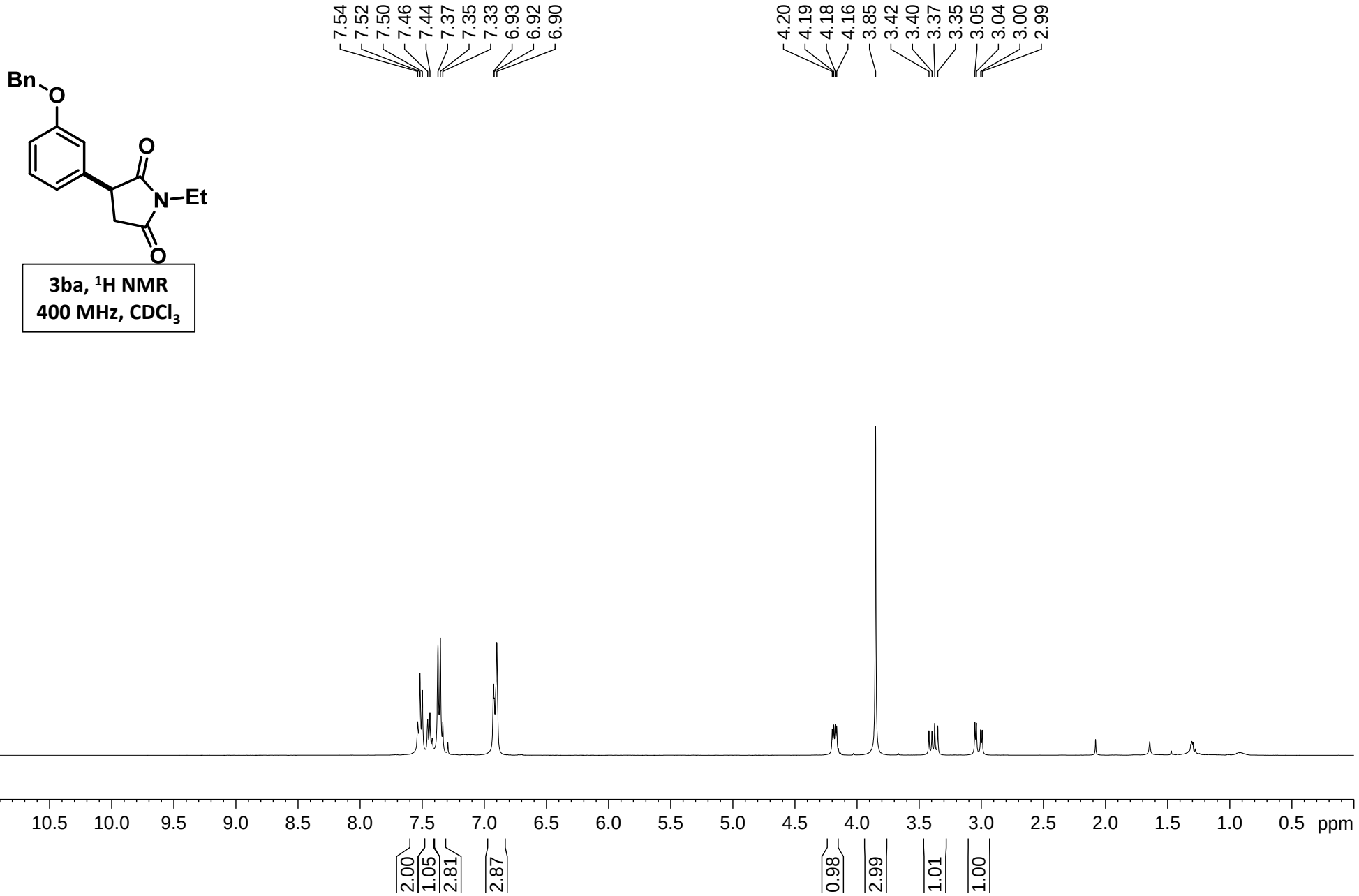
3ac, ^{13}C NMR
100 MHz, $CDCl_3$

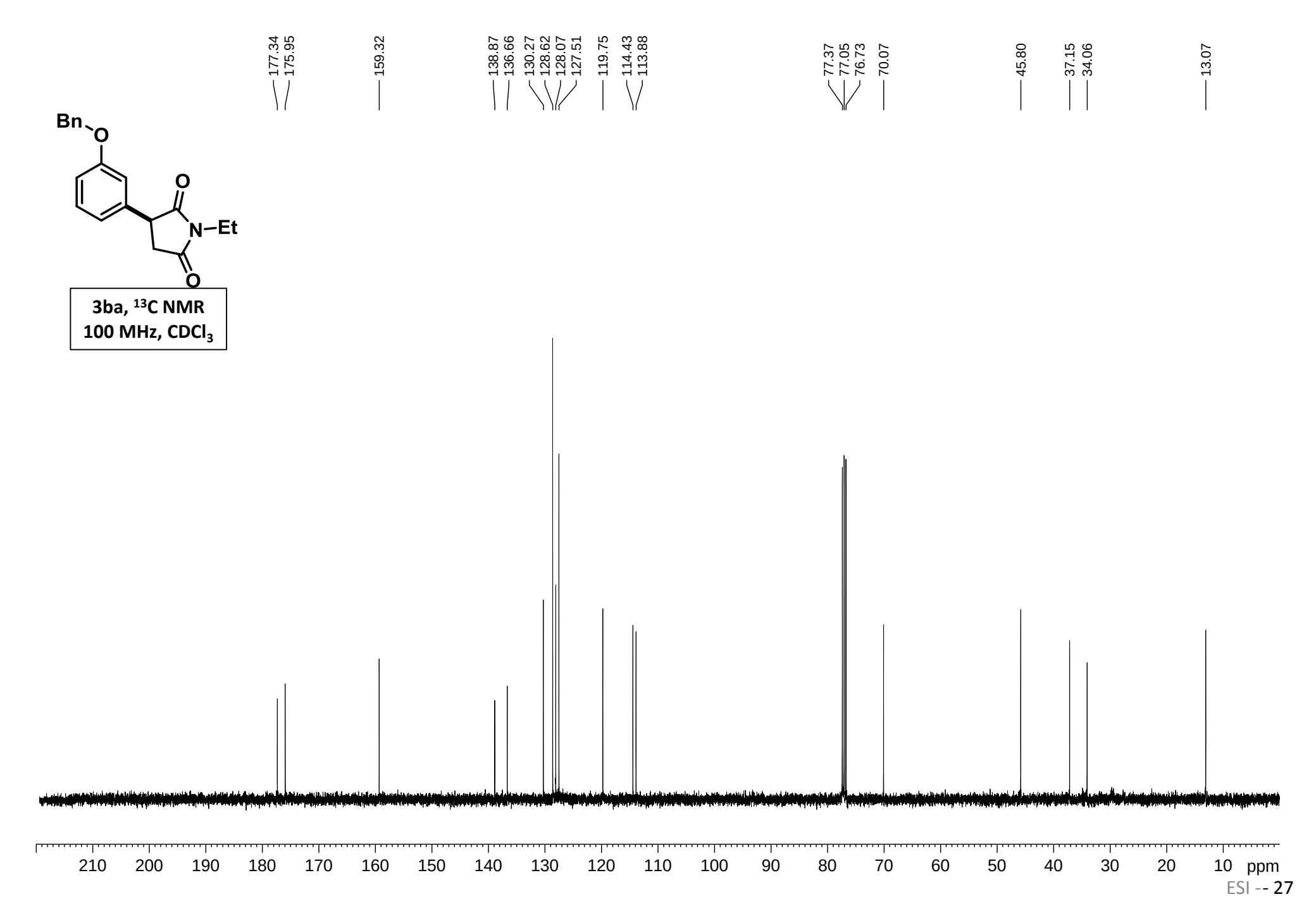


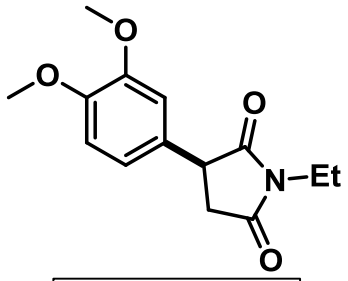
3ad, ^{1}H NMR
400 MHz, $CDCl_3$



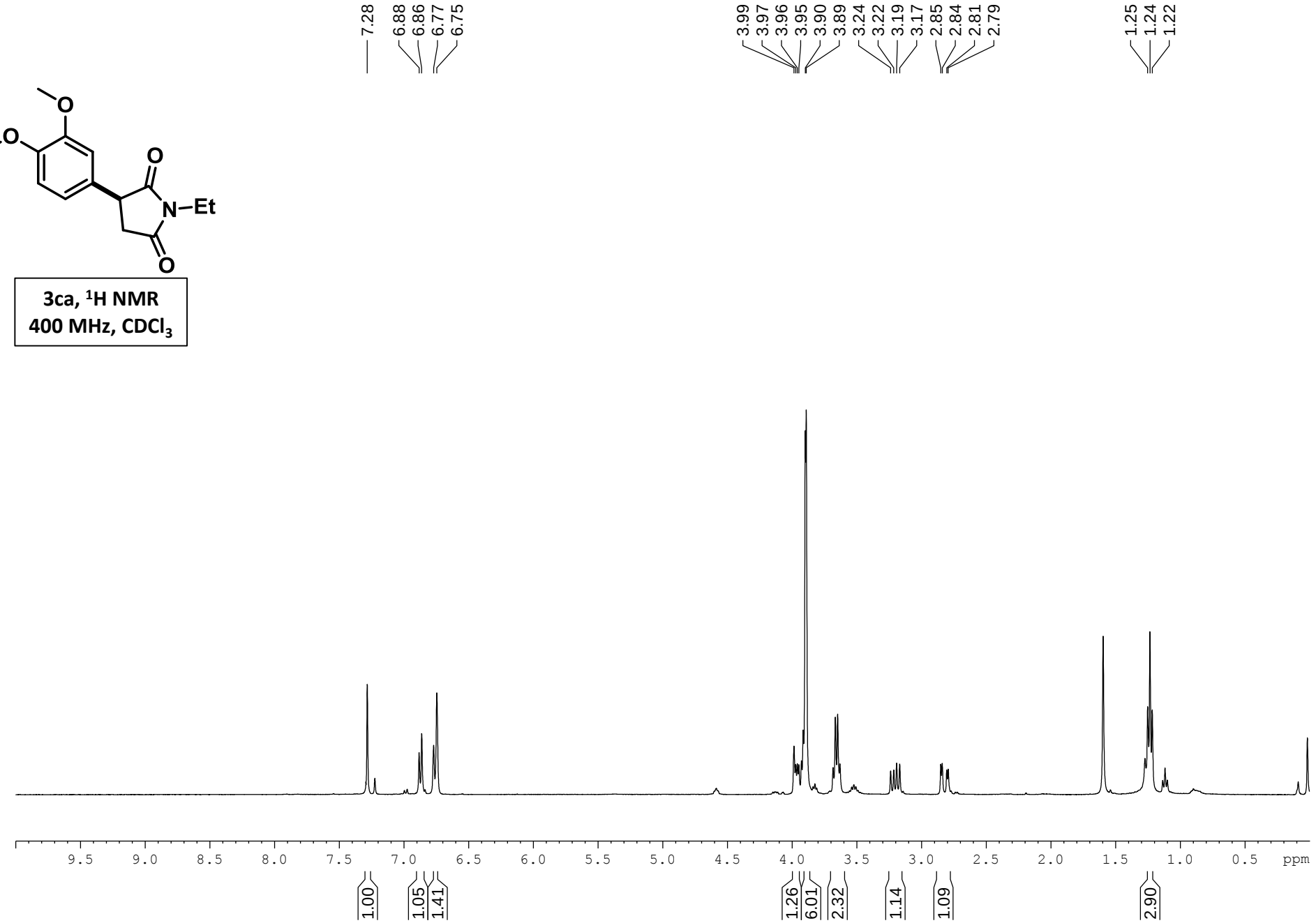

176.48
175.11
160.17
138.63
131.92
130.34
129.19
128.70
126.46
119.40
113.66
113.18
77.36
77.05
76.73
55.30
45.93
37.21
O
O
N–Ph
O
3ad, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

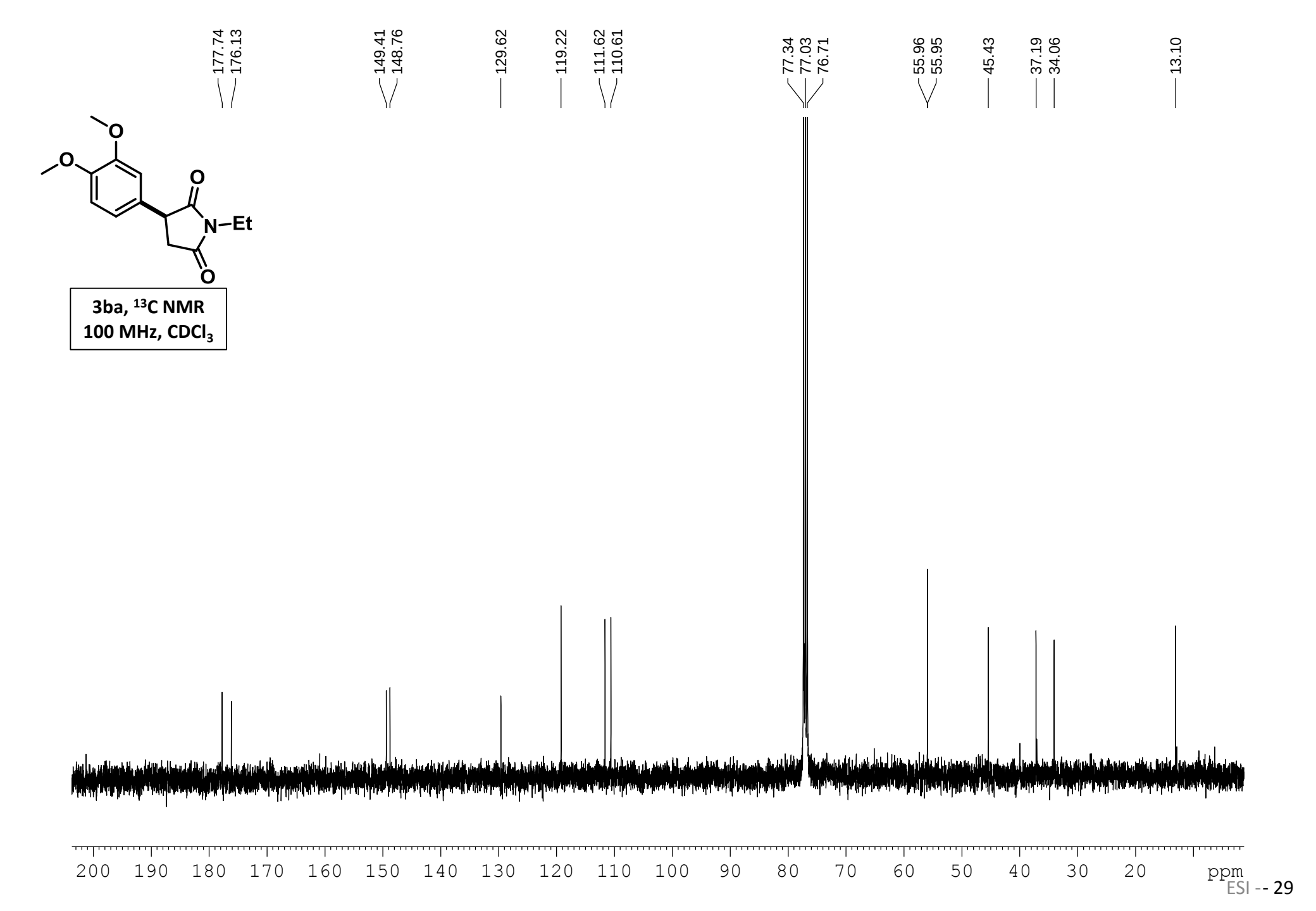

7.54
7.52
7.50
7.46
7.44
7.37
7.35
7.33
6.93
6.92
6.90
4.20
4.19
4.18
4.16
3.85
3.42
3.40
3.37
3.35
3.05
3.04
3.00
2.99
Bn
O
O
N–Et
O
3ba, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
2.00
1.05
2.81
2.87
0.98
2.99
1.01
1.00


177.34
175.95
159.32
138.87
136.66
130.27
128.62
128.07
127.51
119.75
114.43
113.88
77.37
77.05
76.73
70.07
45.80
37.15
34.06
13.07
Bn
O
O
N–Et
O
3ba, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

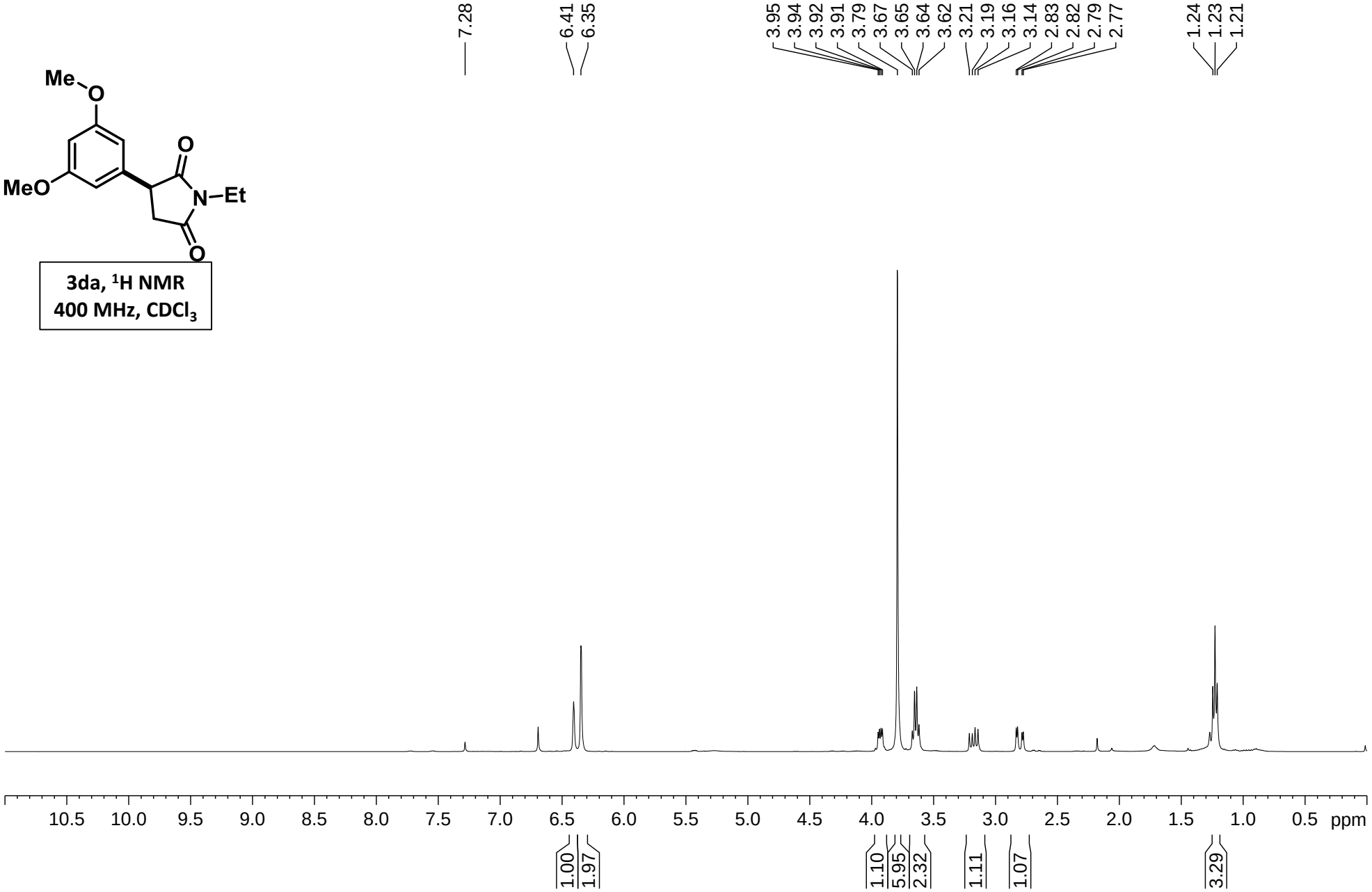


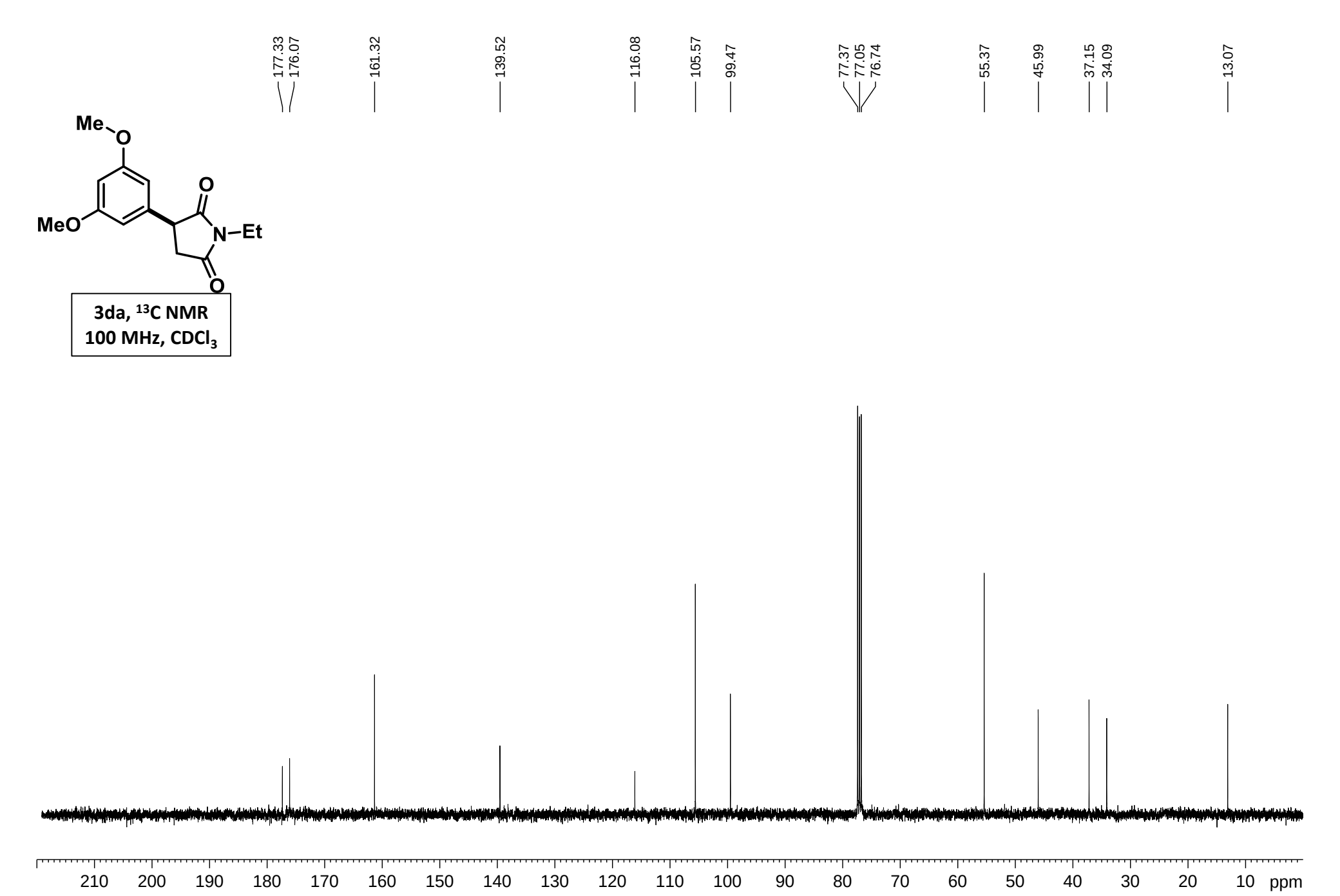
3ca, ^{1}H NMR
400 MHz, $CDCl_3$

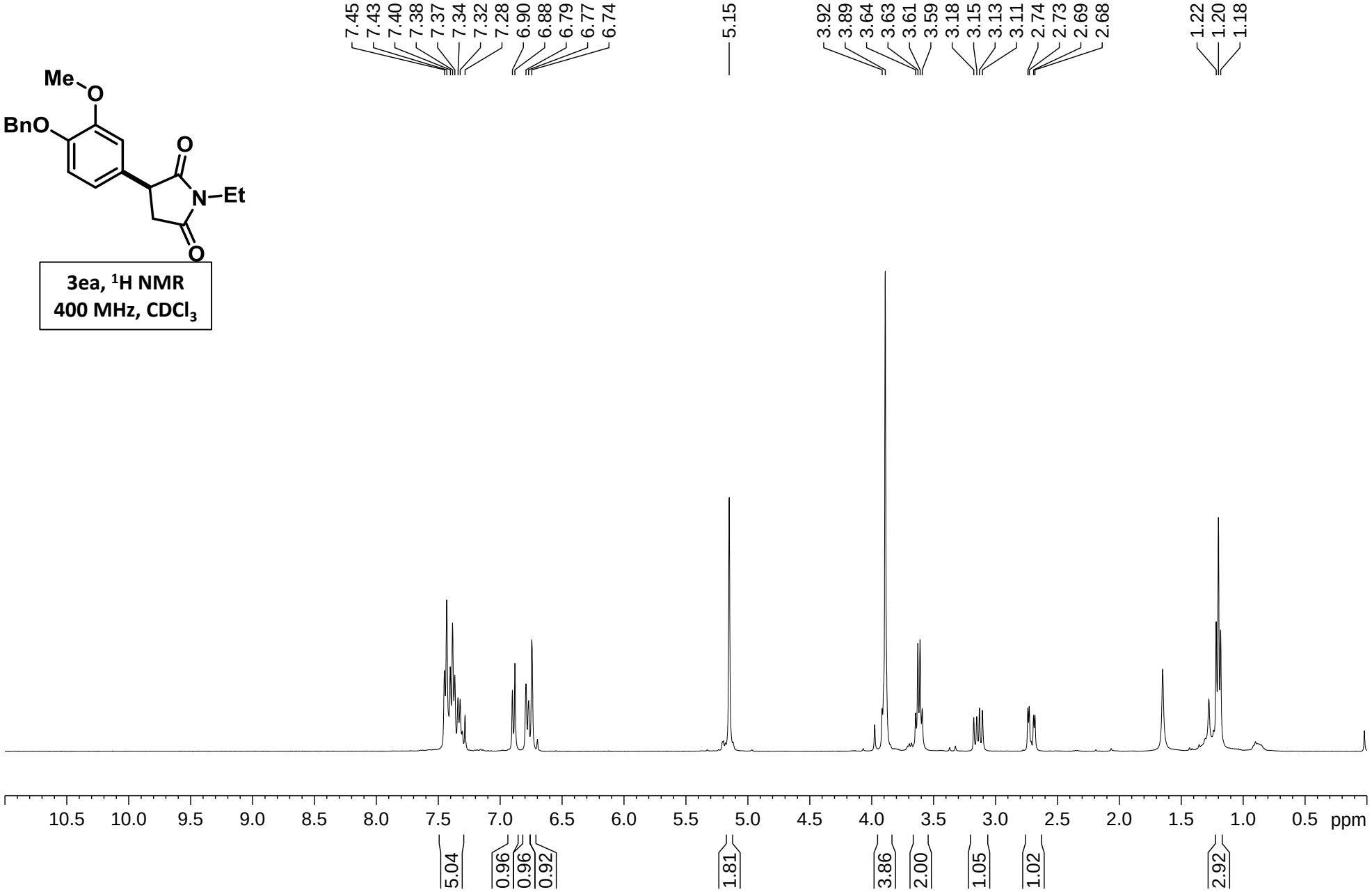


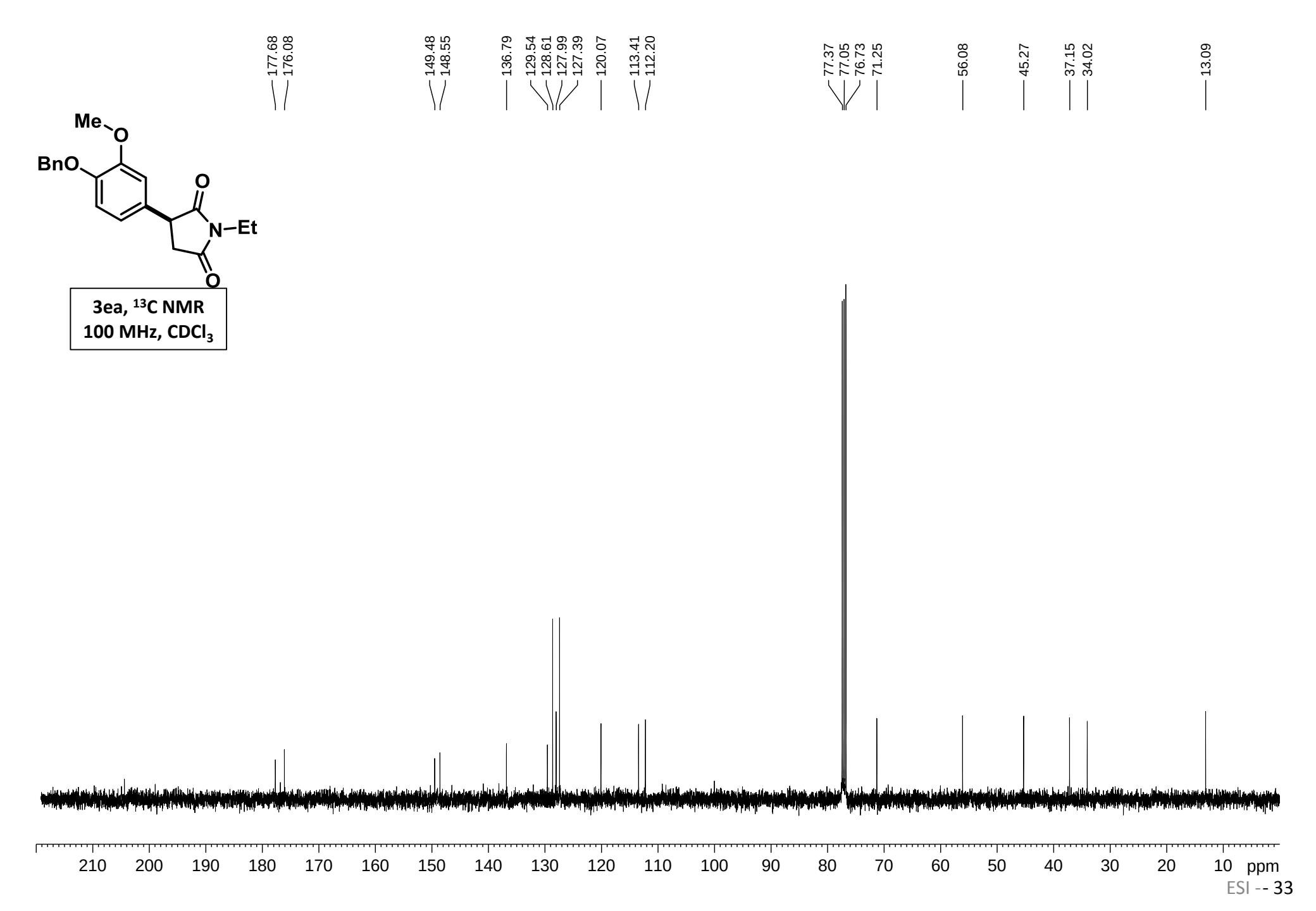

177.74
176.13
149.41
148.76
129.62
119.22
111.62
110.61
77.34
77.03
76.71
55.96
55.95
45.43
37.19
34.06
13.10
O
O
O
N–Et
O
3ba, ^{13}C NMR
100 MHz, $CDCl_3$
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20
ppm

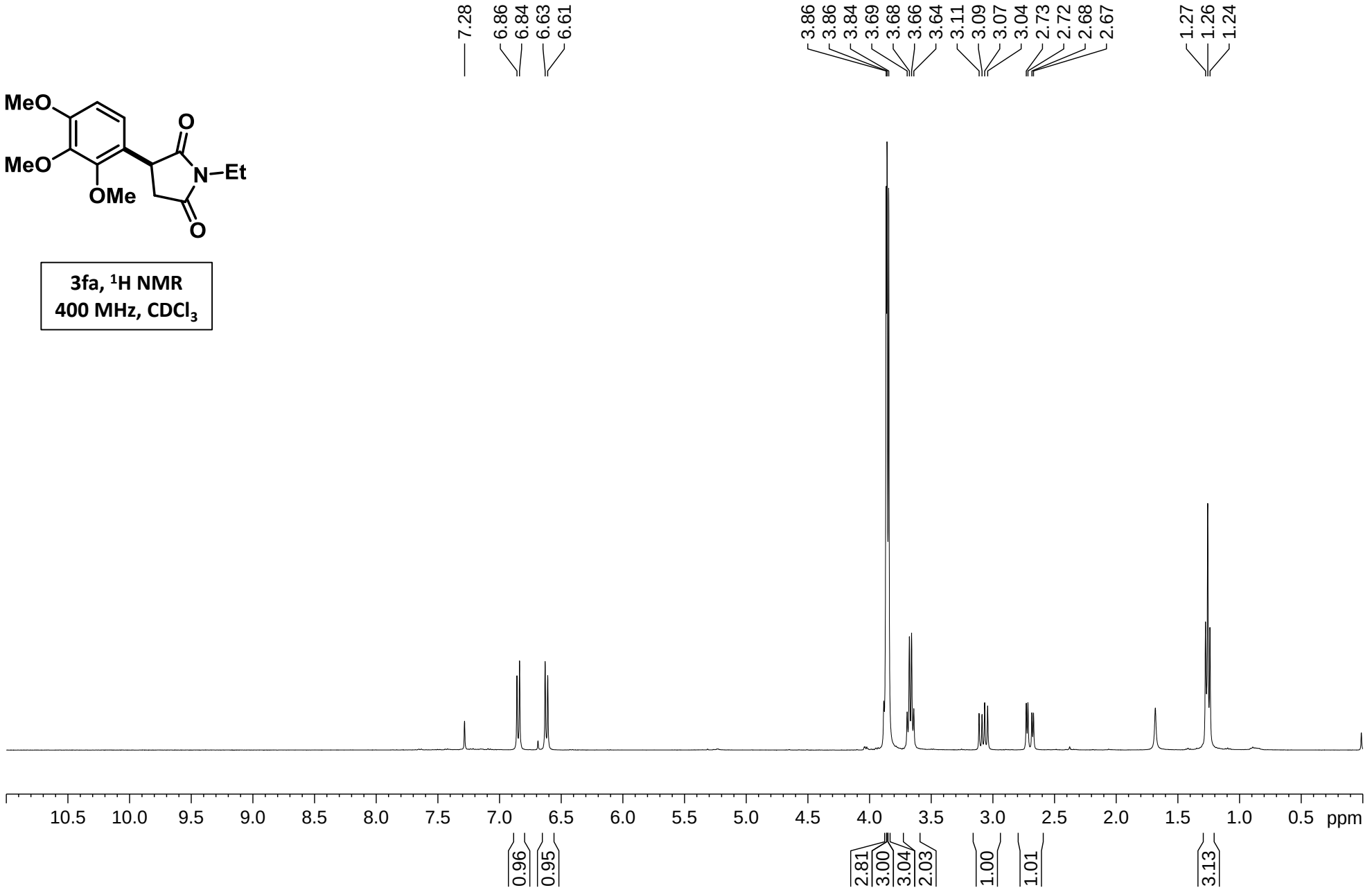
3da, ^{1}H NMR
400 MHz, $CDCl_3$

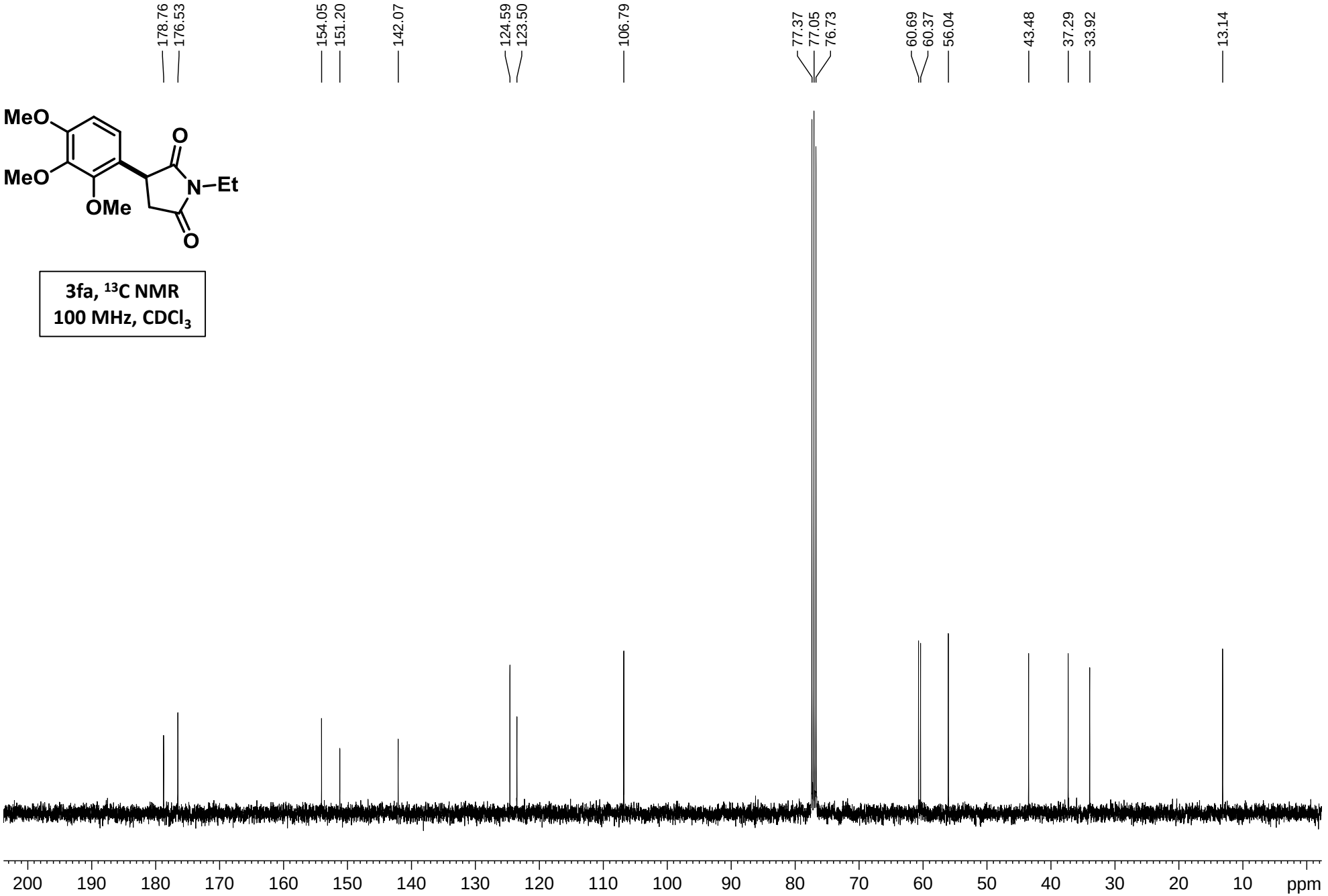


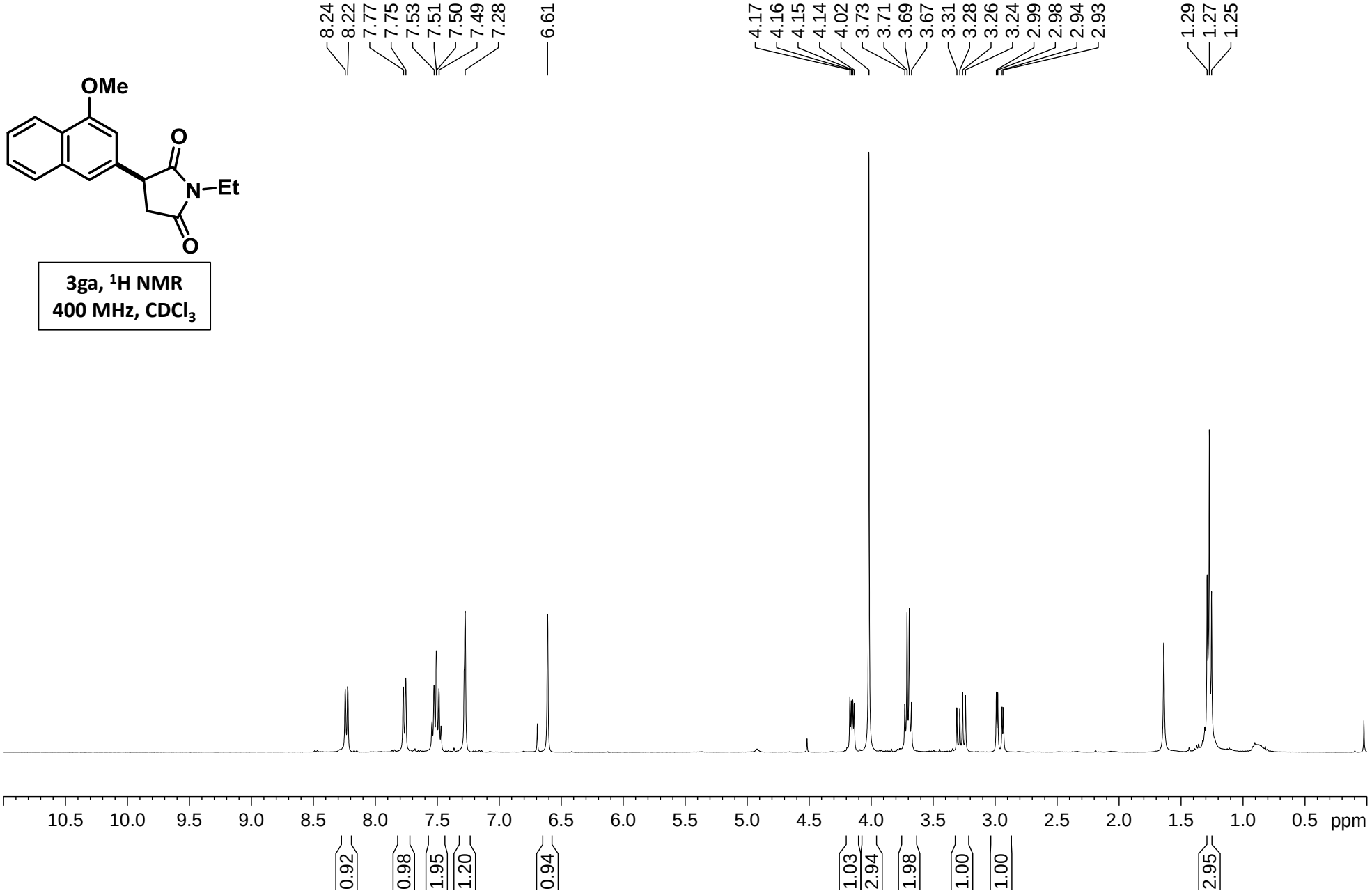

177.33
176.07
161.32
139.52
116.08
105.57
99.47
77.37
77.05
76.74
55.37
45.99
37.15
34.09
13.07
Me
O
MeO
O
N–Et
O
3da, ^{13}C NMR
100 MHz, $CDCl_3$
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

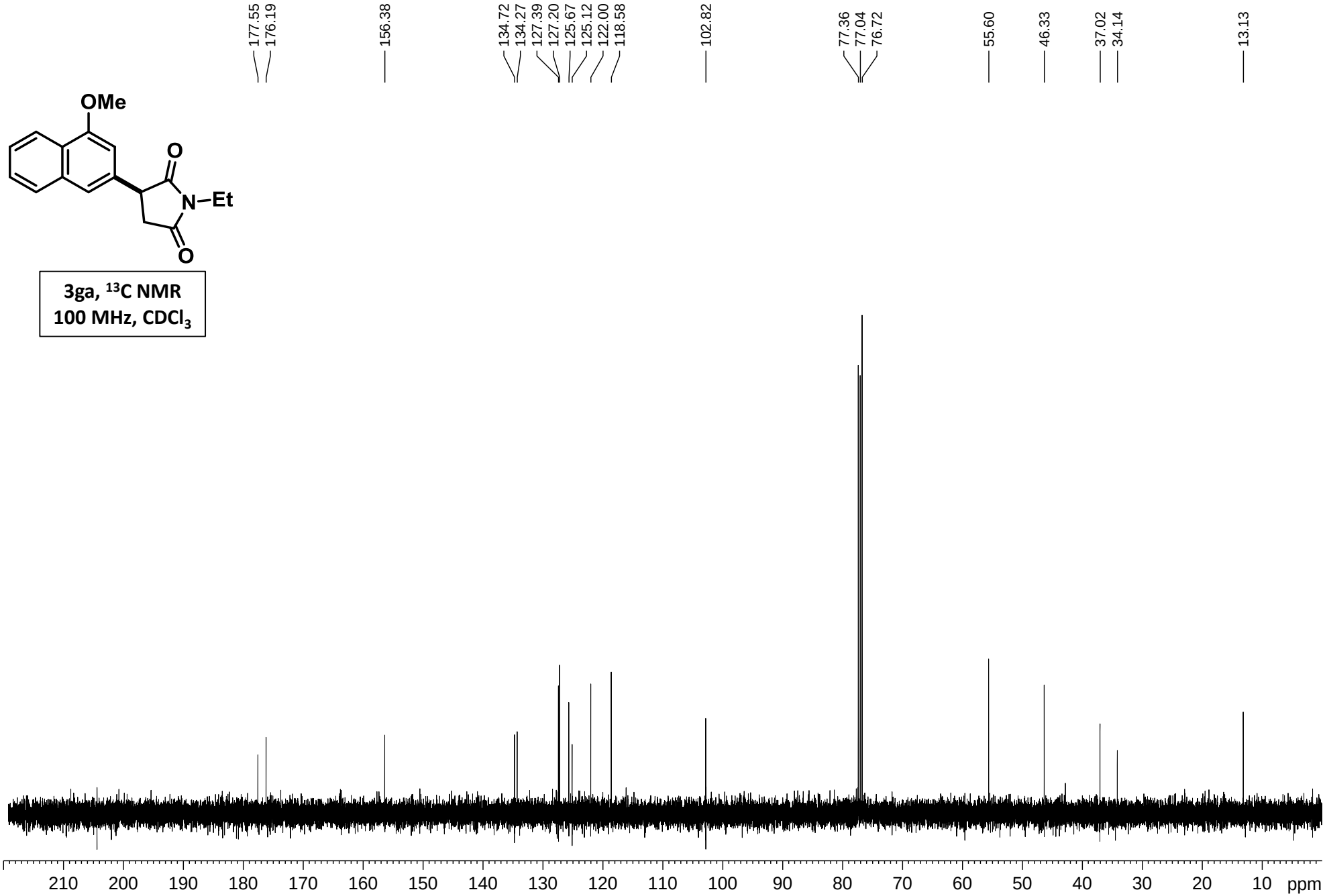

7.45
7.43
7.40
7.38
7.37
7.34
7.32
7.28
6.90
6.88
6.79
6.77
6.74
5.15
3.92
3.89
3.64
3.63
3.61
3.59
3.18
3.15
3.13
3.11
2.74
2.73
2.69
2.68
1.22
1.20
1.18
Me
O
BnO
O
N–Et
O
3ea, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
5.04
0.96
0.96
0.92
1.81
3.86
2.00
1.05
1.02
2.92

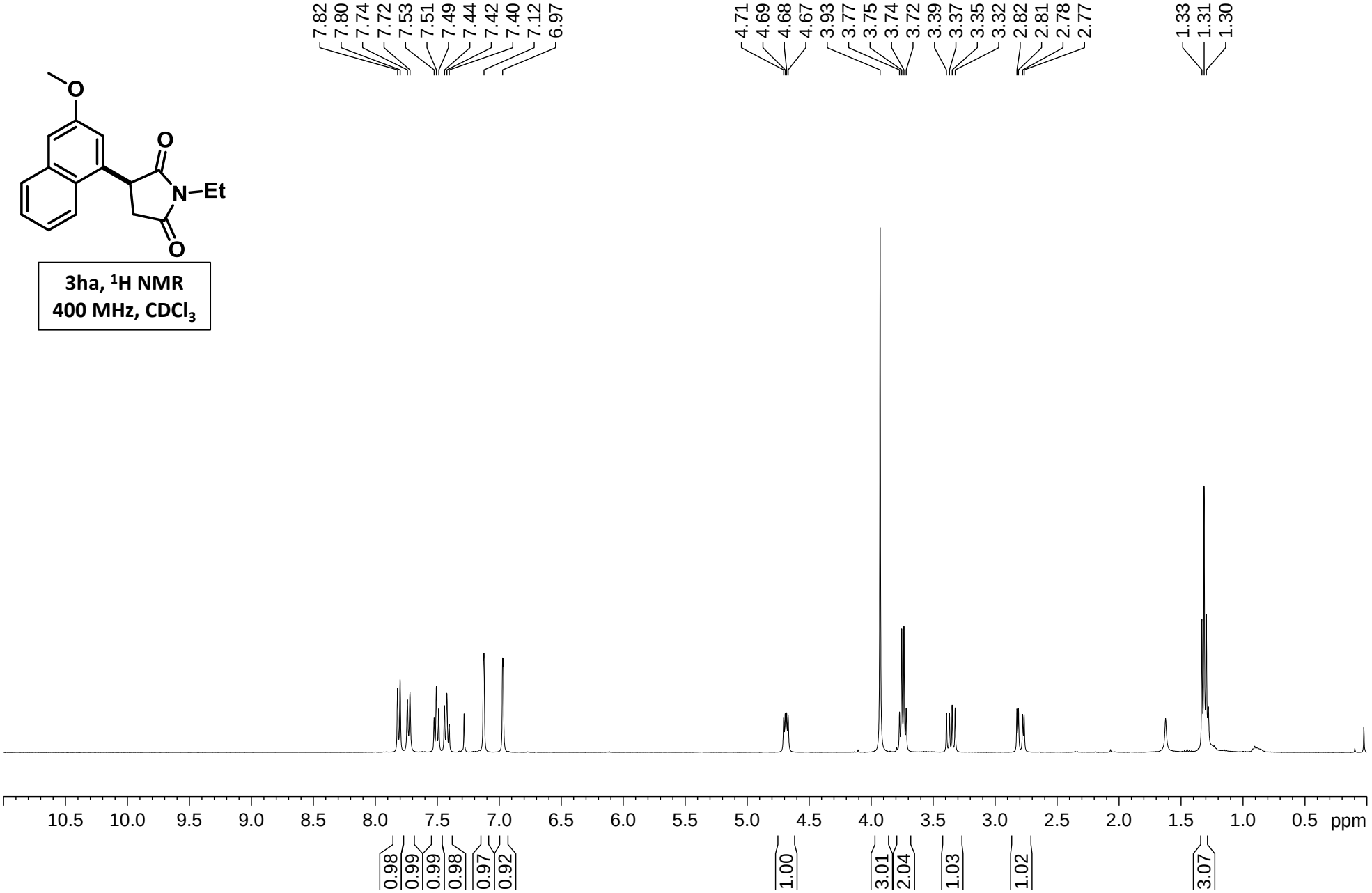

177.68
176.08
149.48
148.55
136.79
129.54
128.61
127.99
127.39
120.07
113.41
112.20
77.37
77.05
76.73
71.25
56.08
45.27
37.15
34.02
13.09
Me
O
BnO
O
N–Et
O
3ea, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

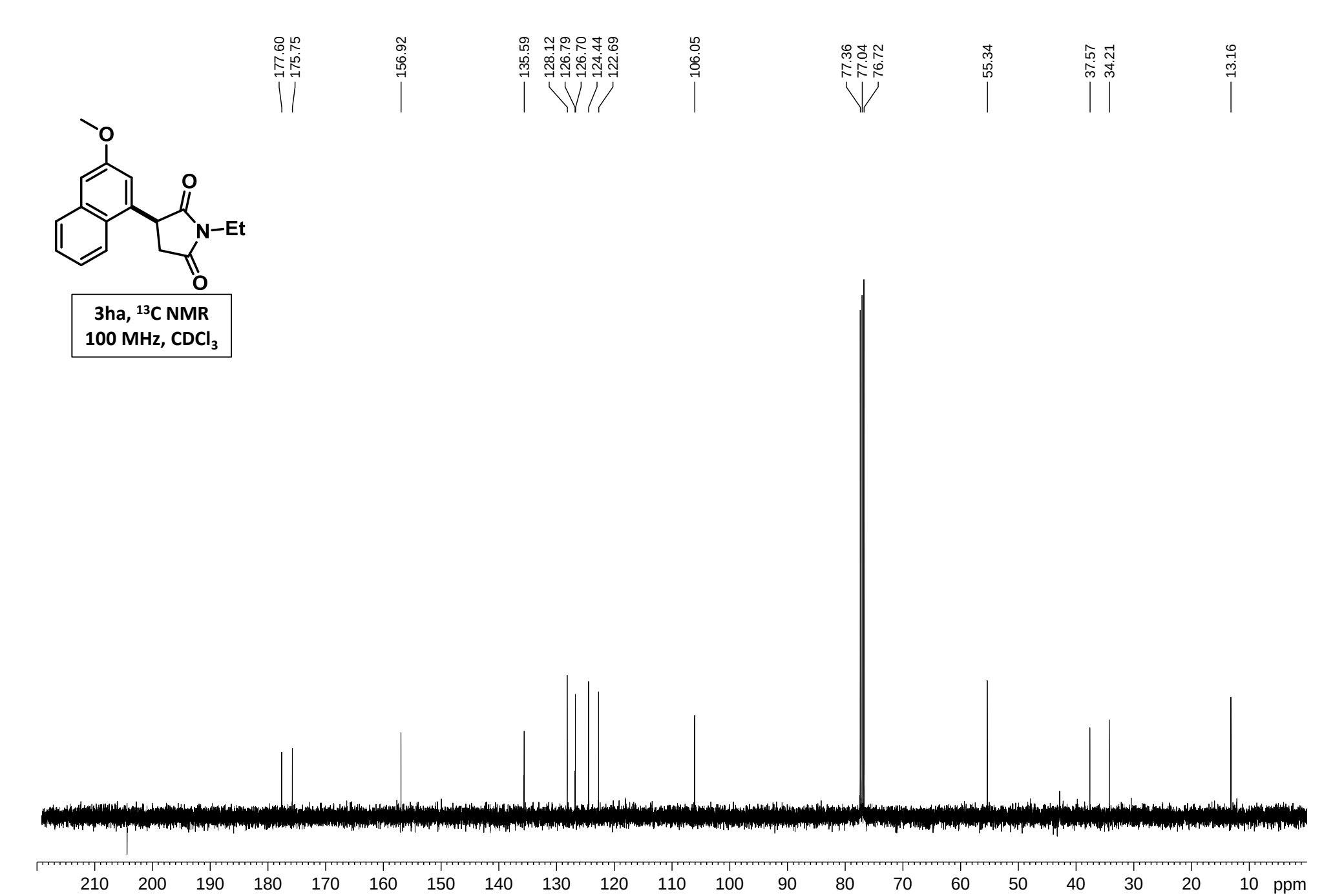

7.28
6.86
6.84
6.63
6.61
3.86
3.86
3.84
3.69
3.68
3.66
3.64
3.11
3.09
3.07
3.04
2.73
2.72
2.68
2.67
1.27
1.26
1.24
MeO
MeO
OMe
O
N–Et
O
3fa, 1H NMR
400 MHz, CDCl3
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
0.96
0.95
2.81
3.00
3.04
2.03
1.00
1.01
3.13

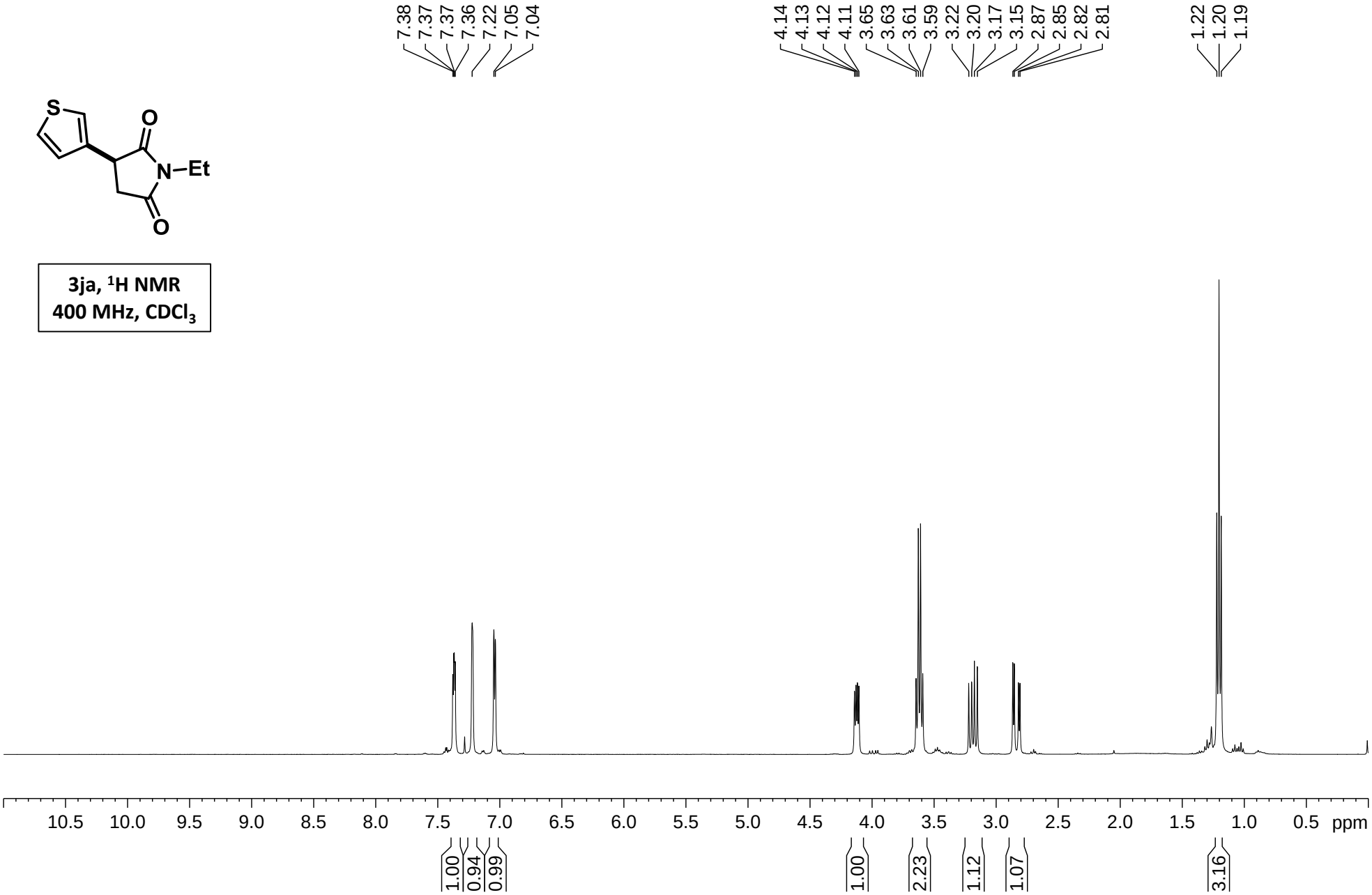

178.76
176.53
154.05
151.20
142.07
124.59
123.50
106.79
77.37
77.05
76.73
60.69
60.37
56.04
43.48
37.29
33.92
13.14
MeO
MeO
OMe
O
N–Et
O
3fa, 13C NMR
100 MHz, CDCl3
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

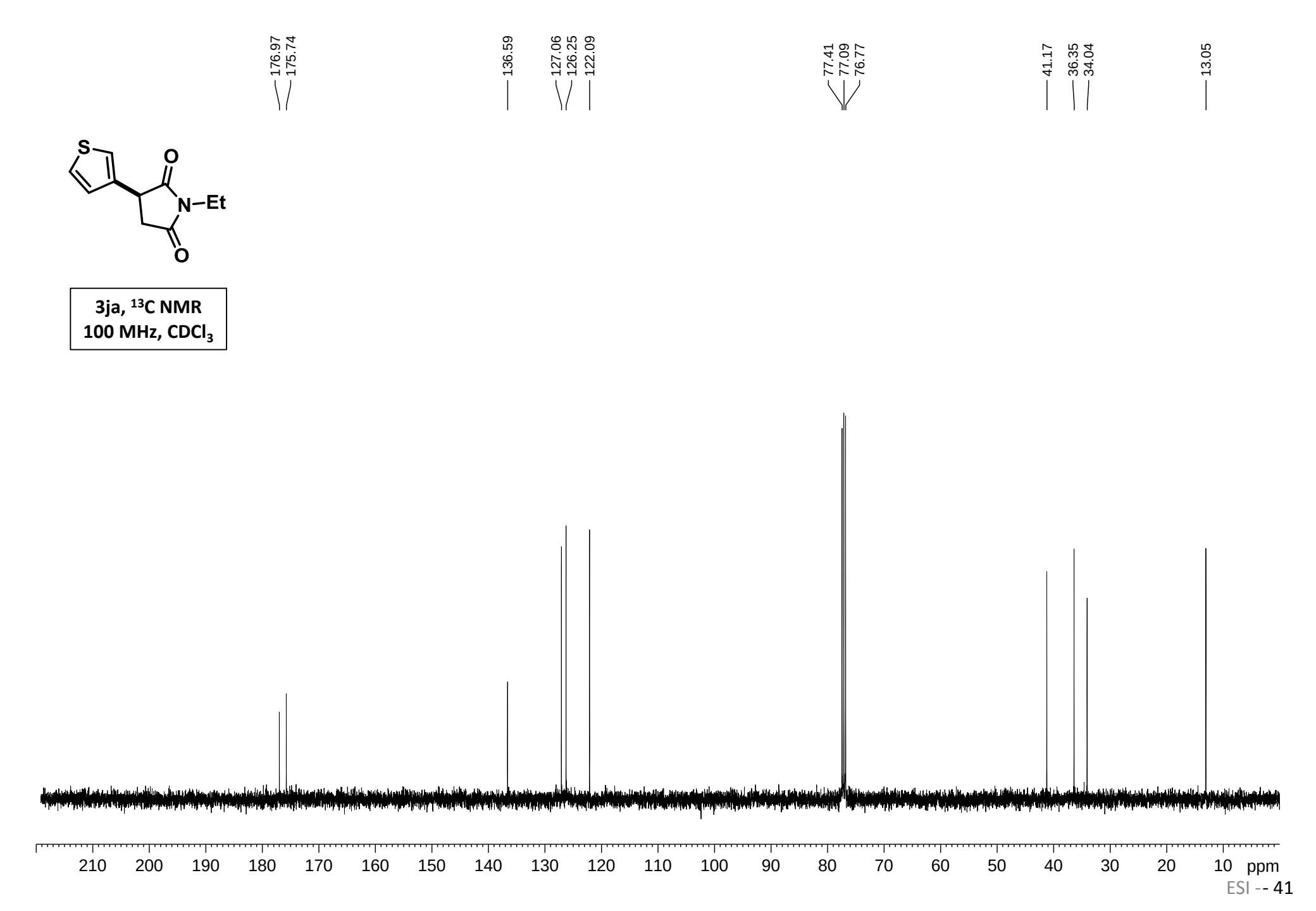

8.24
8.22
7.77
7.75
7.53
7.51
7.50
7.49
7.28
6.61
4.17
4.16
4.15
4.14
4.02
3.73
3.71
3.69
3.67
3.31
3.28
3.26
3.24
2.99
2.98
2.94
2.93
1.29
1.27
1.25
OMe
O
N–Et
O
3ga, ¹H NMR
400 MHz, CDCl₃
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.92
0.98
1.95
1.20
0.94
1.03
2.94
1.98
1.00
1.00
2.95


177.55
176.19
156.38
134.72
134.27
127.39
127.20
125.67
125.12
122.00
118.58
102.82
77.36
77.04
76.72
55.60
46.33
37.02
34.14
13.13
OMe
O
N–Et
O
3ga, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

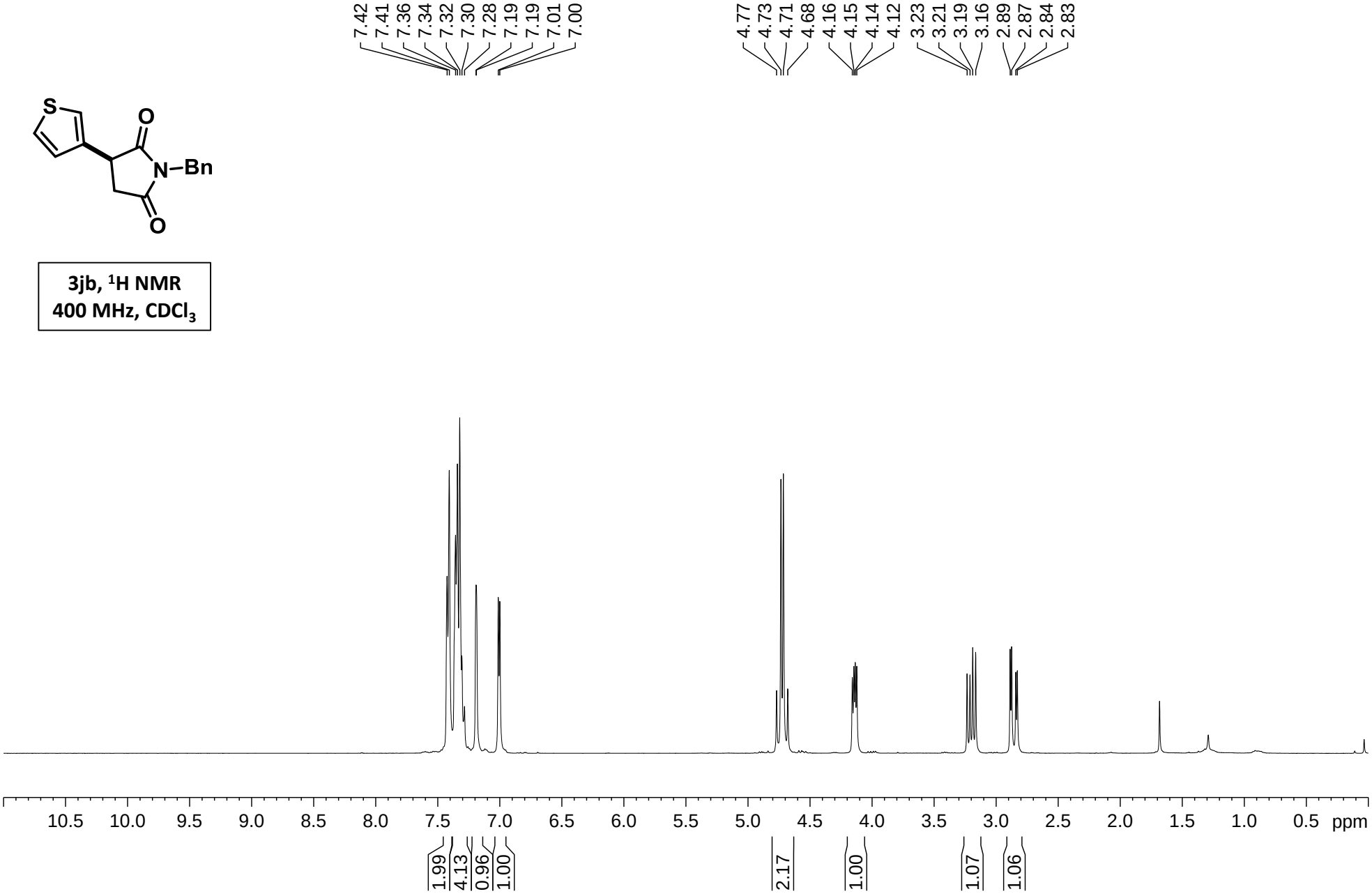

7.82
7.80
7.74
7.72
7.53
7.51
7.49
7.44
7.42
7.40
7.12
6.97
4.71
4.69
4.68
4.67
3.93
3.77
3.75
3.74
3.72
3.39
3.37
3.35
3.32
2.82
2.81
2.78
2.77
1.33
1.31
1.30
O
O
N–Et
O
3ha, ^{1}H NMR
400 MHz, $CDCl_3$
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.98
0.99
0.99
0.98
0.97
0.92
1.00
3.01
2.04
1.03
1.02
3.07

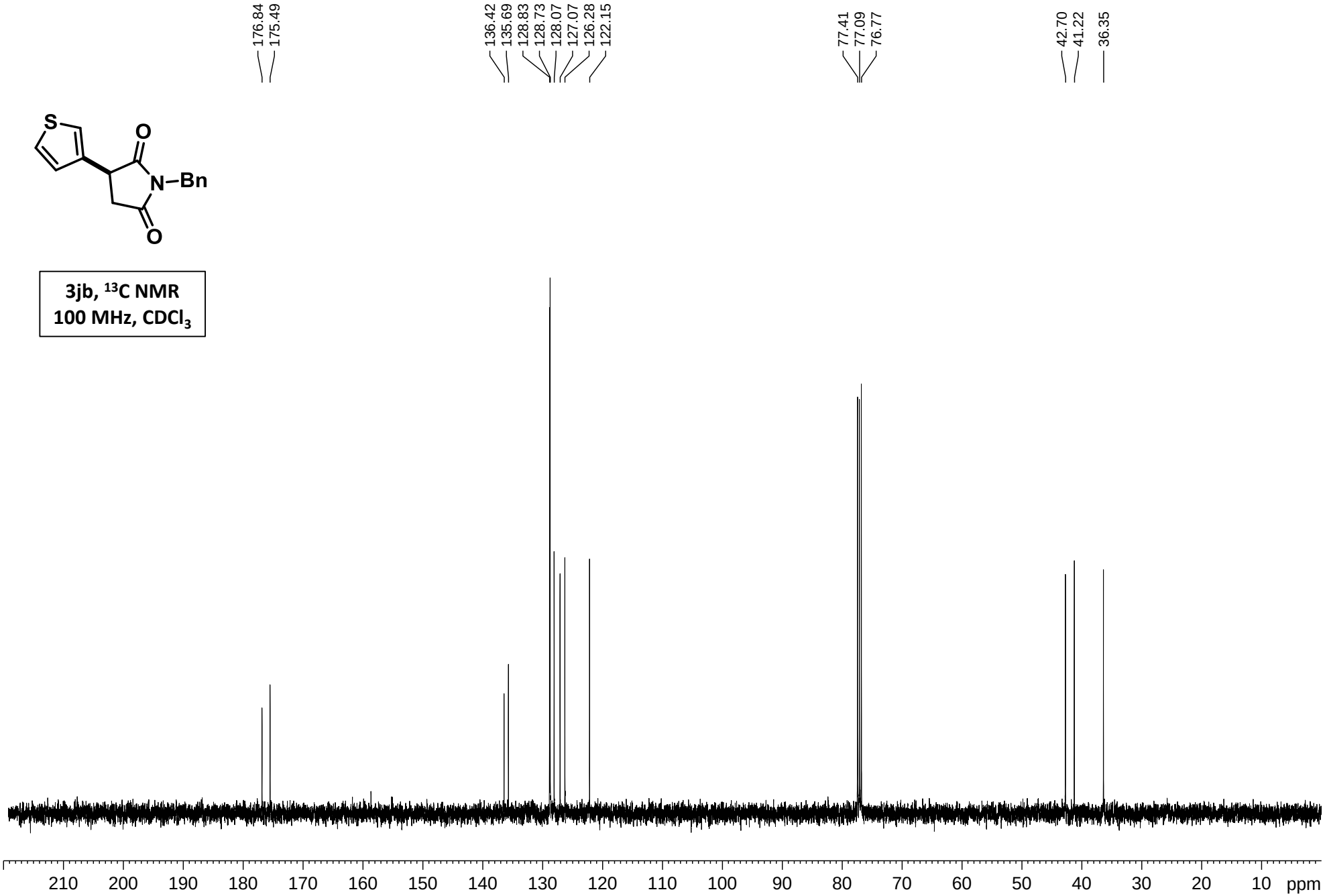

177.60
175.75
156.92
135.59
128.12
126.79
126.70
124.44
122.69
106.05
77.36
77.04
76.72
55.34
37.57
34.21
13.16
O
O
N–Et
O
3ha, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


7.38
7.37
7.37
7.36
7.22
7.05
7.04
4.14
4.13
4.12
4.11
3.65
3.63
3.61
3.59
3.22
3.20
3.17
3.15
2.87
2.85
2.82
2.81
1.22
1.20
1.19
S
O
N–Et
O
3ja, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
0.94
0.99
1.00
2.23
1.12
1.07
3.16

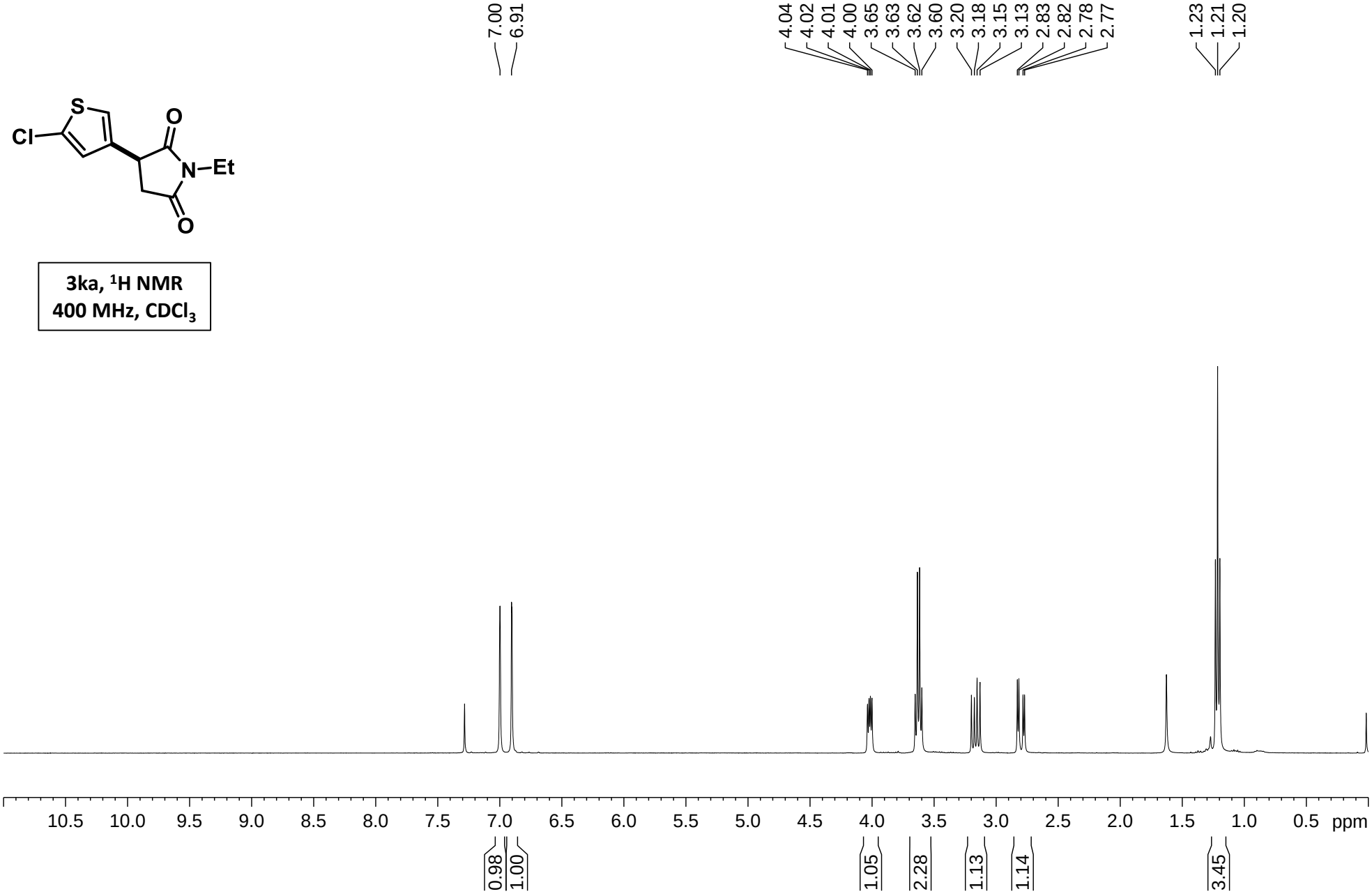

176.97
175.74
136.59
127.06
126.25
122.09
77.41
77.09
76.77
41.17
36.35
34.04
13.05
S
O
N–Et
O
3ja, ^{13}C NMR
100 MHz, $CDCl_3$
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

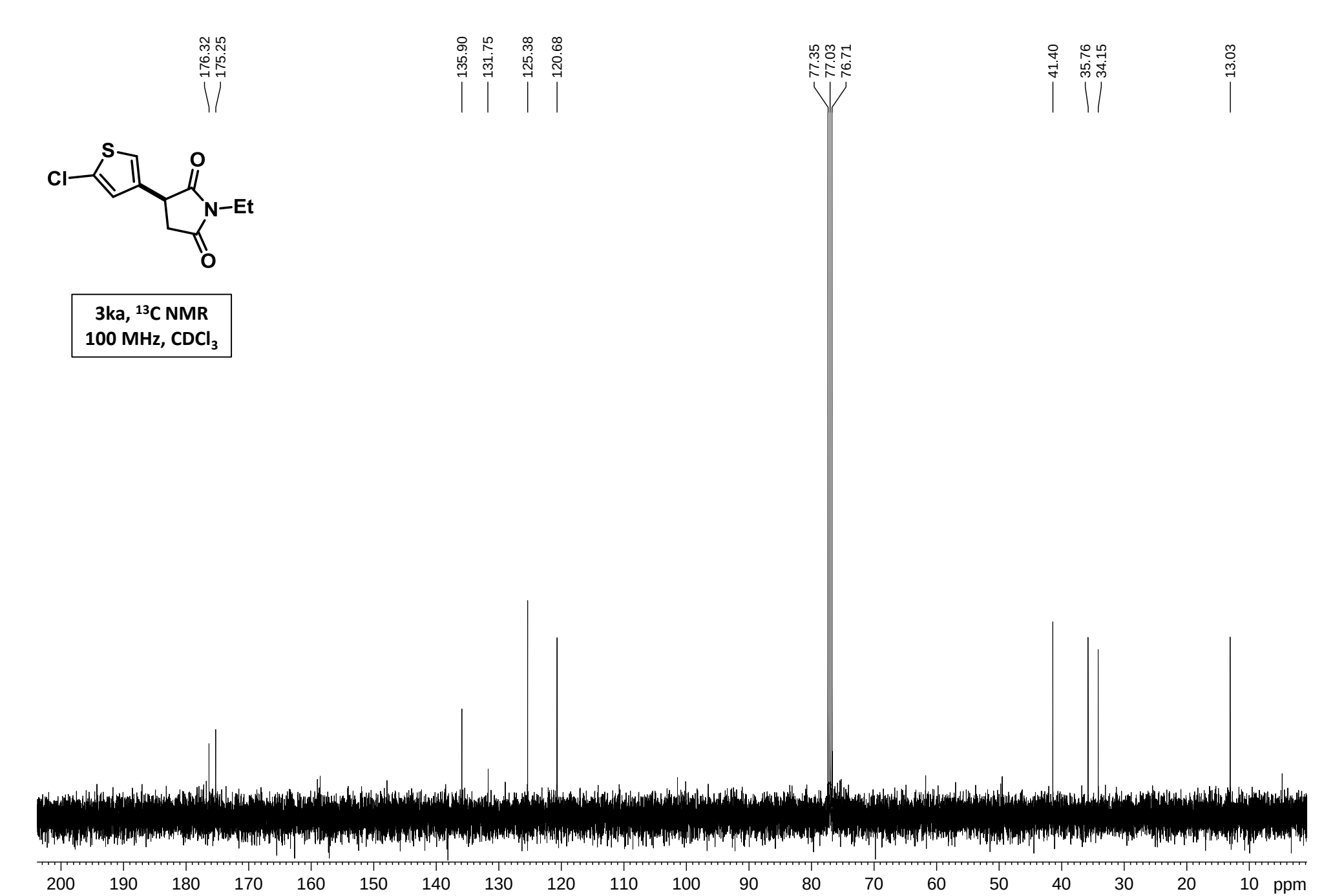
3jb, ^{1}H NMR
400 MHz, $CDCl_3$

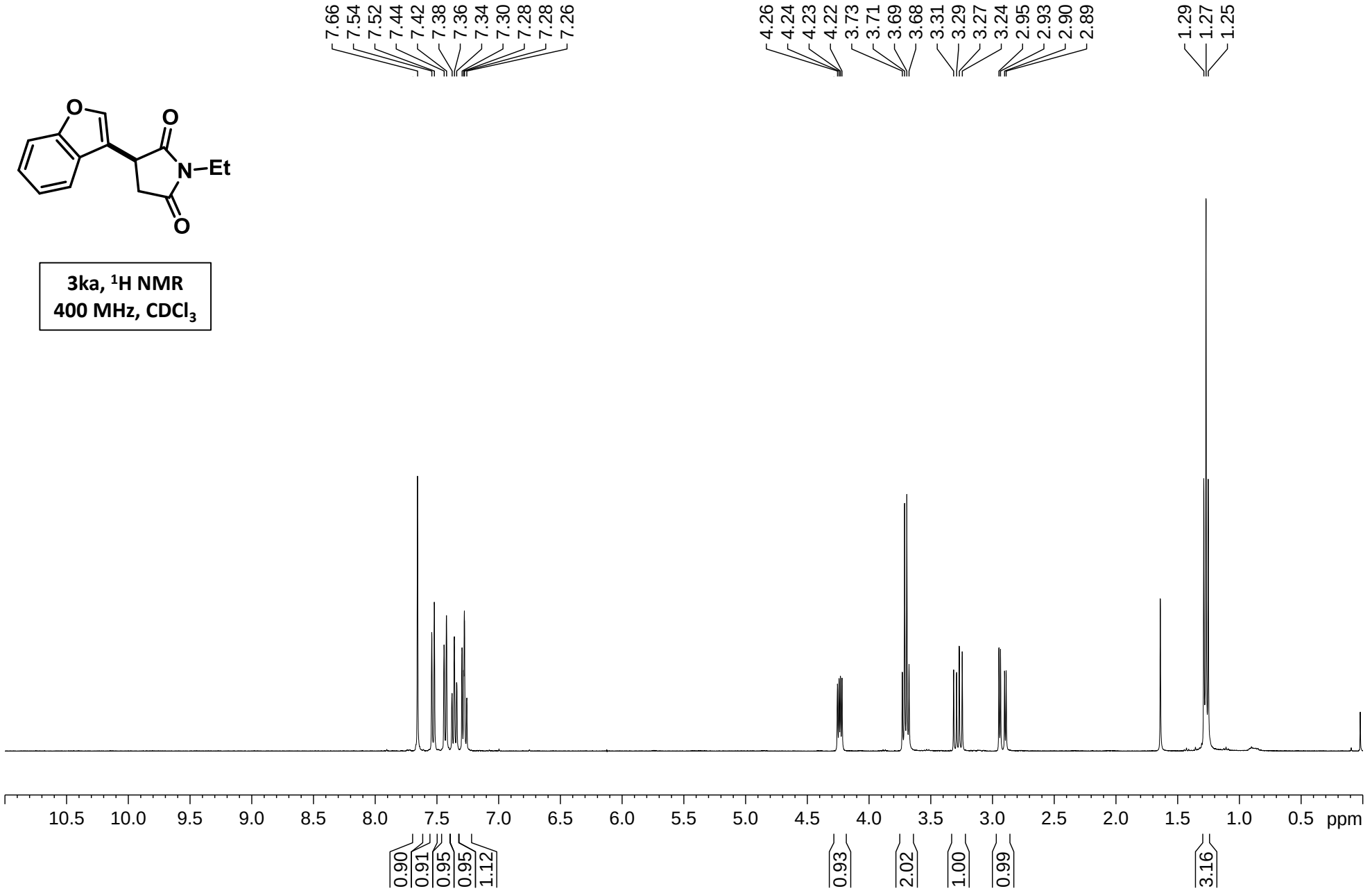


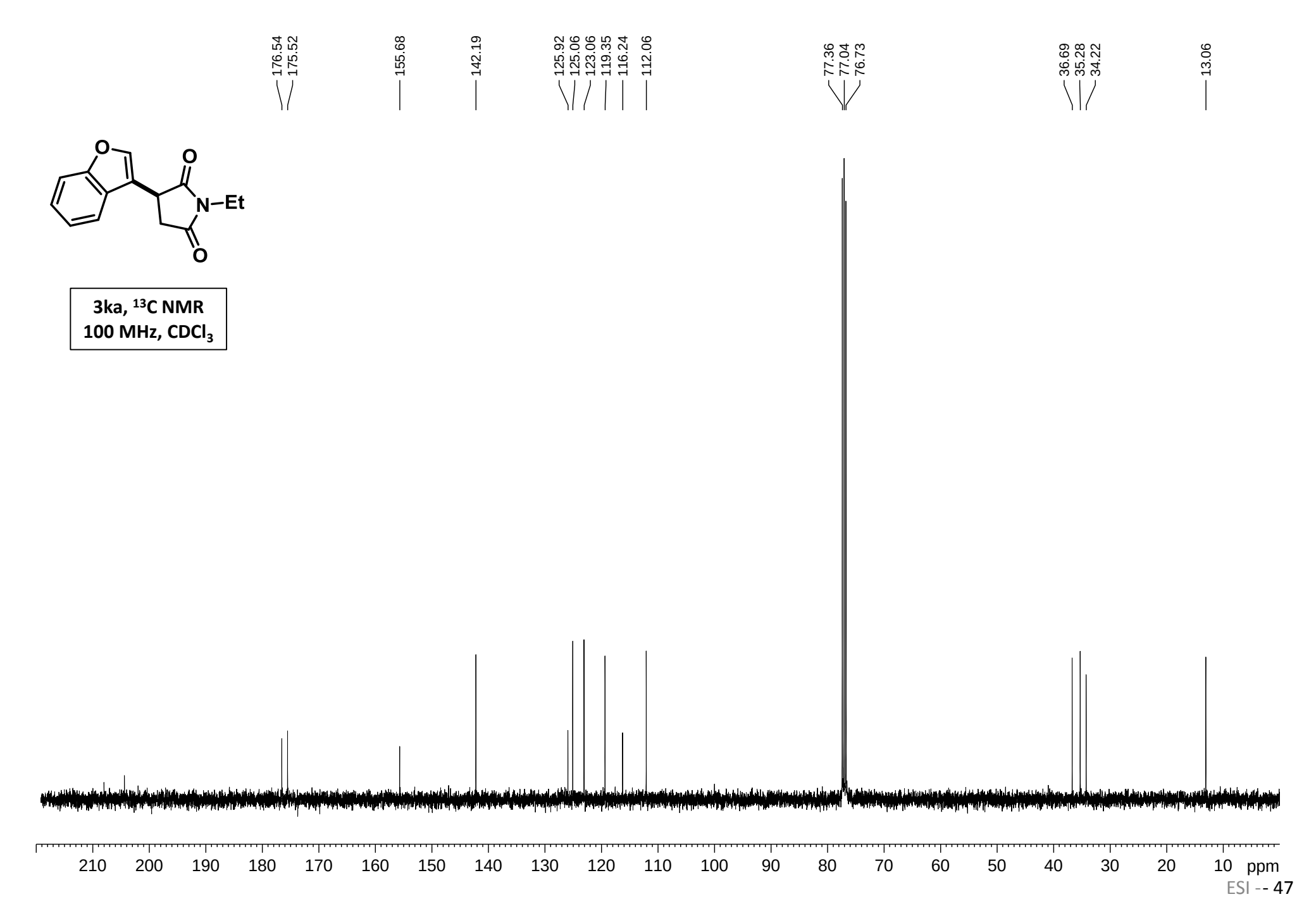

176.84
175.49
136.42
135.69
128.83
128.73
128.07
127.07
126.28
122.15
77.41
77.09
76.77
42.70
41.22
36.35
S
O
N–Bn
O
3jb, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

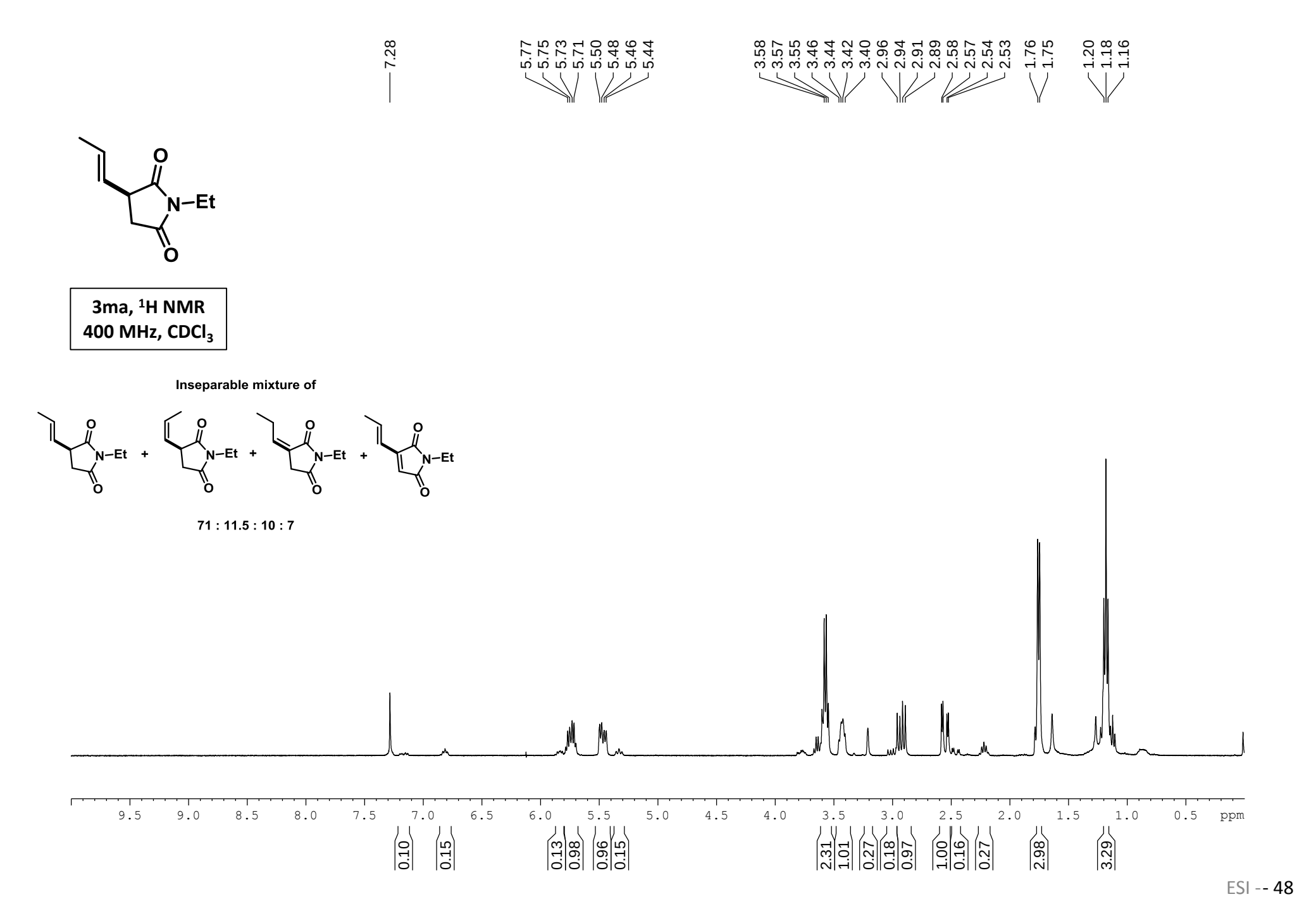
3ka, ^{1}H NMR
400 MHz, $CDCl_3$

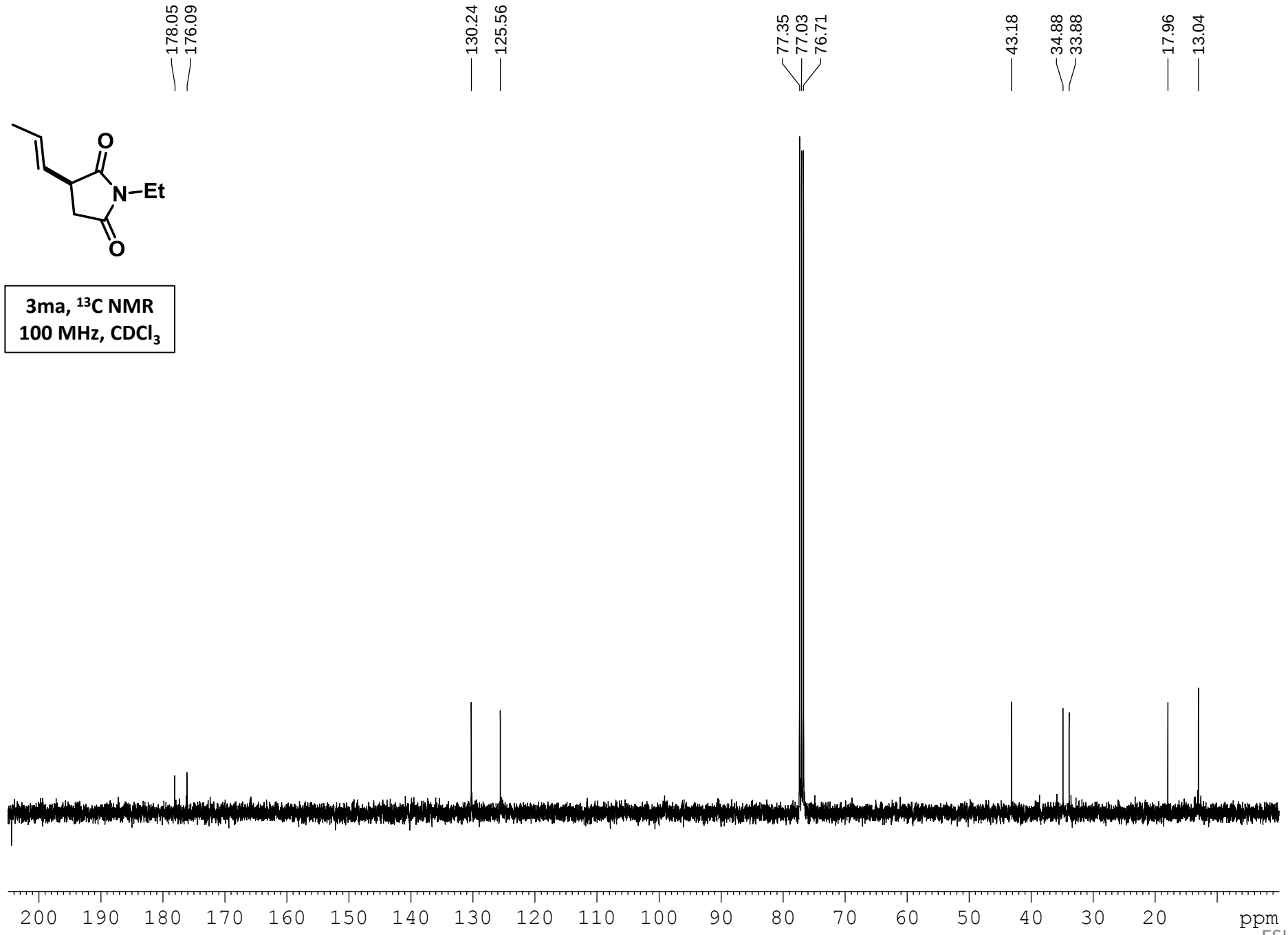


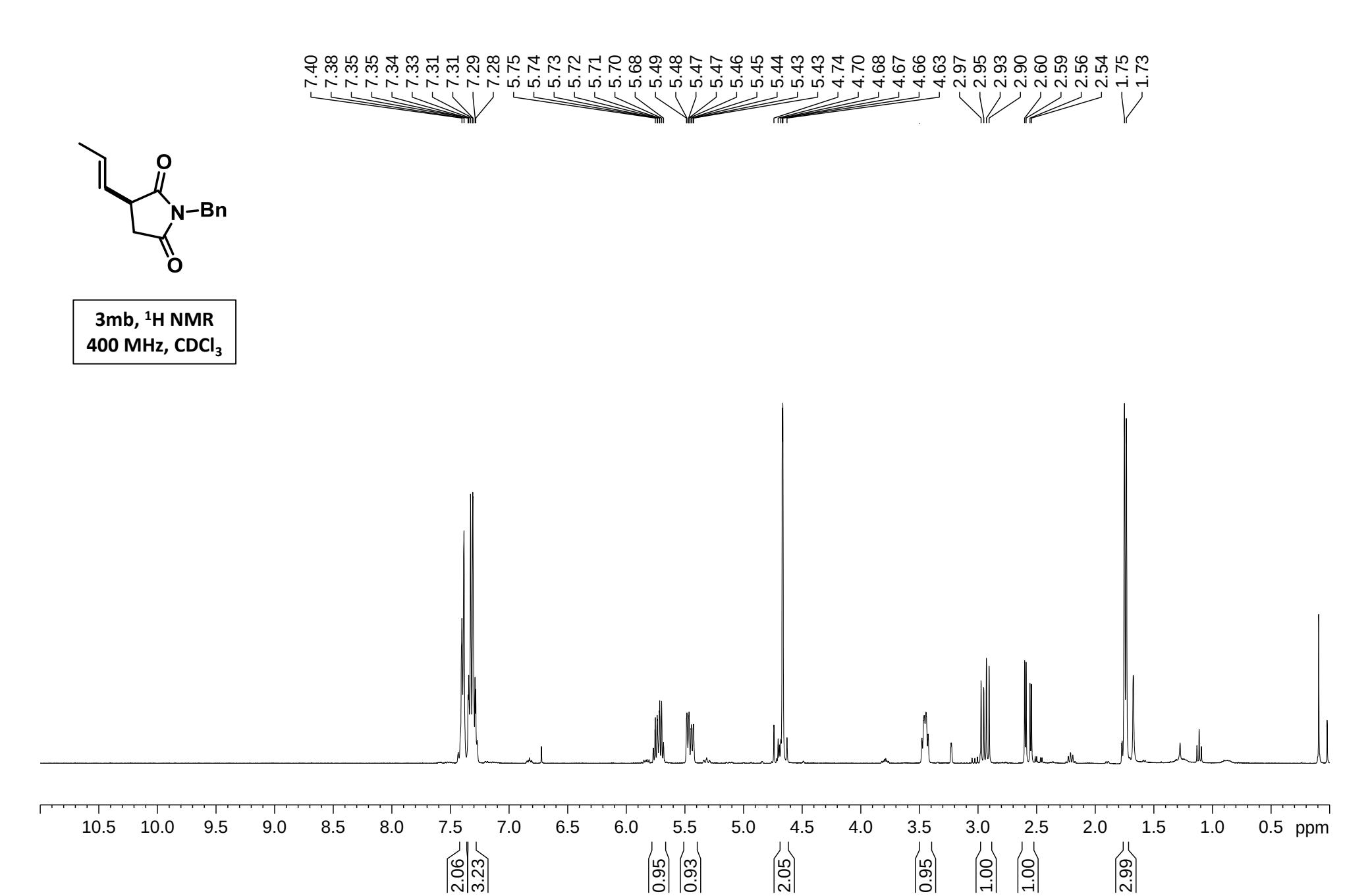

176.32
175.25
135.90
131.75
125.38
120.68
77.35
77.03
76.71
41.40
35.76
34.15
13.03
S
Cl
O
N–Et
O
3ka, ^{13}C NMR
100 MHz, $CDCl_3$
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

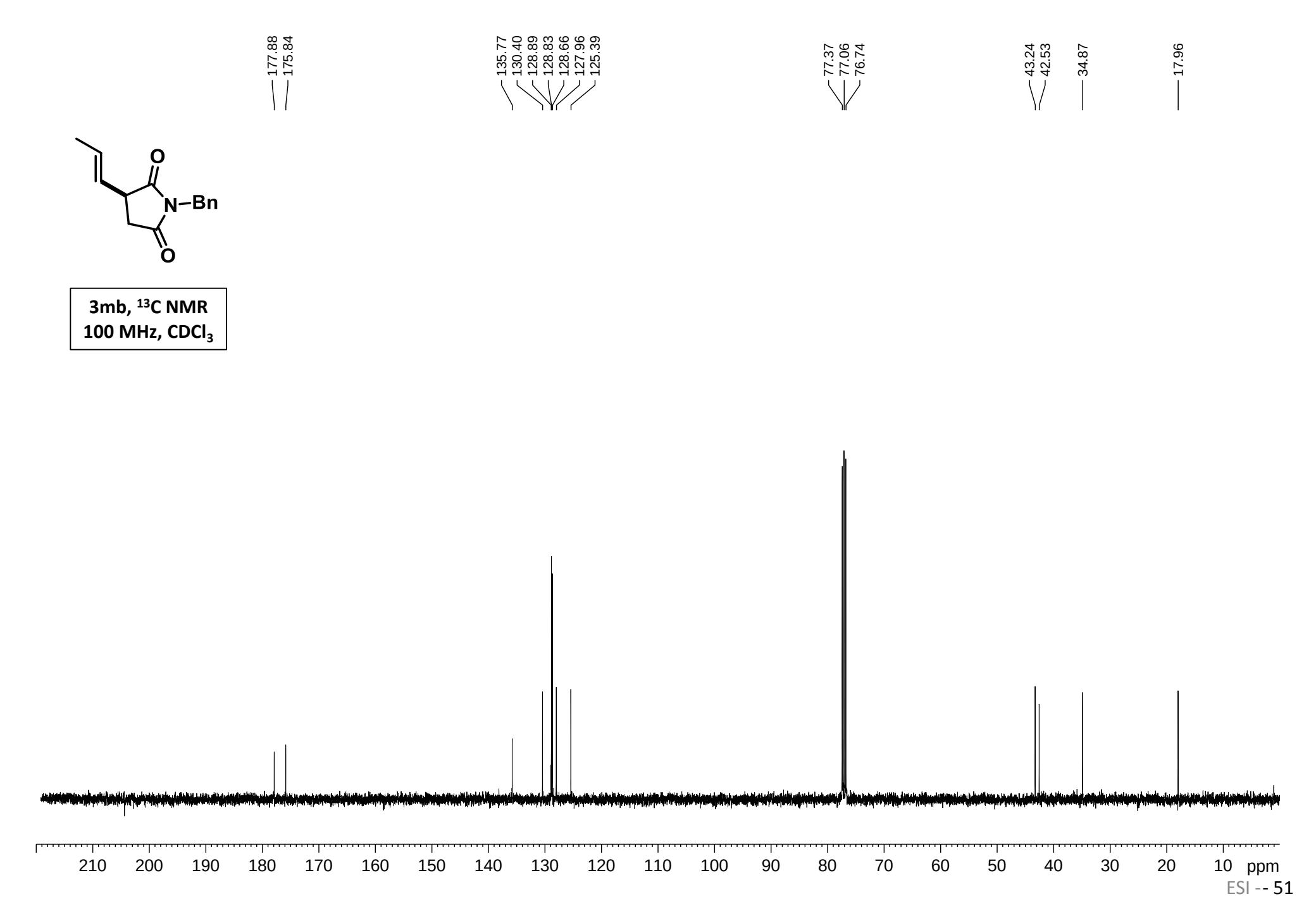

7.66
7.54
7.52
7.44
7.42
7.38
7.36
7.34
7.30
7.28
7.28
7.26
4.26
4.24
4.23
4.22
3.73
3.71
3.69
3.68
3.31
3.29
3.27
3.24
2.95
2.93
2.90
2.89
1.29
1.27
1.25
O
O
N–Et
O
3ka, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.90
0.91
0.95
0.95
1.12
0.93
2.02
1.00
0.99
3.16

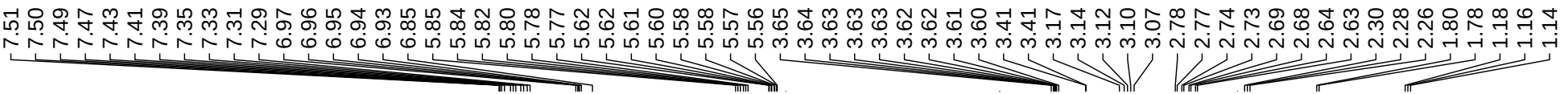

176.54
175.52
155.68
142.19
125.92
125.06
123.06
119.35
116.24
112.06
77.36
77.04
76.73
36.69
35.28
34.22
13.06
O
O
N–Et
O
3ka, ^{13}C NMR
100 MHz, $CDCl_3$
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

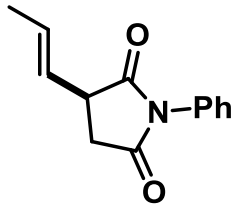

7.28
5.77
5.75
5.73
5.71
5.50
5.48
5.46
5.44
3.58
3.57
3.55
3.46
3.44
3.42
3.40
2.96
2.94
2.91
2.89
2.58
2.57
2.54
2.53
1.76
1.75
1.20
1.18
1.16
N–Et
O
3ma, ^{1}H NMR
400 MHz, $CDCl_3$
Inseparable mixture of
71 : 11.5 : 10 : 7
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.10
0.15
0.13
0.98
0.96
0.15
2.31
1.01
0.27
0.18
0.97
1.00
0.16
0.27
2.98
3.29


178.05
176.09
130.24
125.56
77.35
77.03
76.71
43.18
34.88
33.88
17.96
13.04
O
N–Et
O
3ma, ^{13}C NMR
100 MHz, $CDCl_3$
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

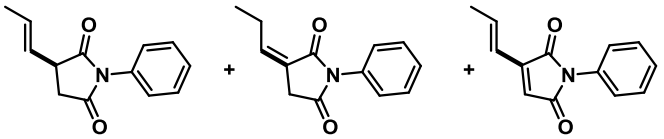

7.40
7.38
7.35
7.35
7.34
7.33
7.31
7.31
7.29
7.28
5.75
5.74
5.73
5.72
5.71
5.70
5.68
5.49
5.48
5.47
5.47
5.46
5.45
5.44
5.43
5.43
4.74
4.70
4.68
4.67
4.66
4.63
2.97
2.95
2.93
2.90
2.60
2.59
2.56
2.54
1.75
1.73
O
N–Bn
O
3mb, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
2.06
3.23
0.95
0.93
2.05
0.95
1.00
1.00
2.99


177.88
175.84
135.77
130.40
128.89
128.83
128.66
127.96
125.39
77.37
77.06
76.74
43.24
42.53
34.87
17.96
O
N–Bn
O
3mb, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm



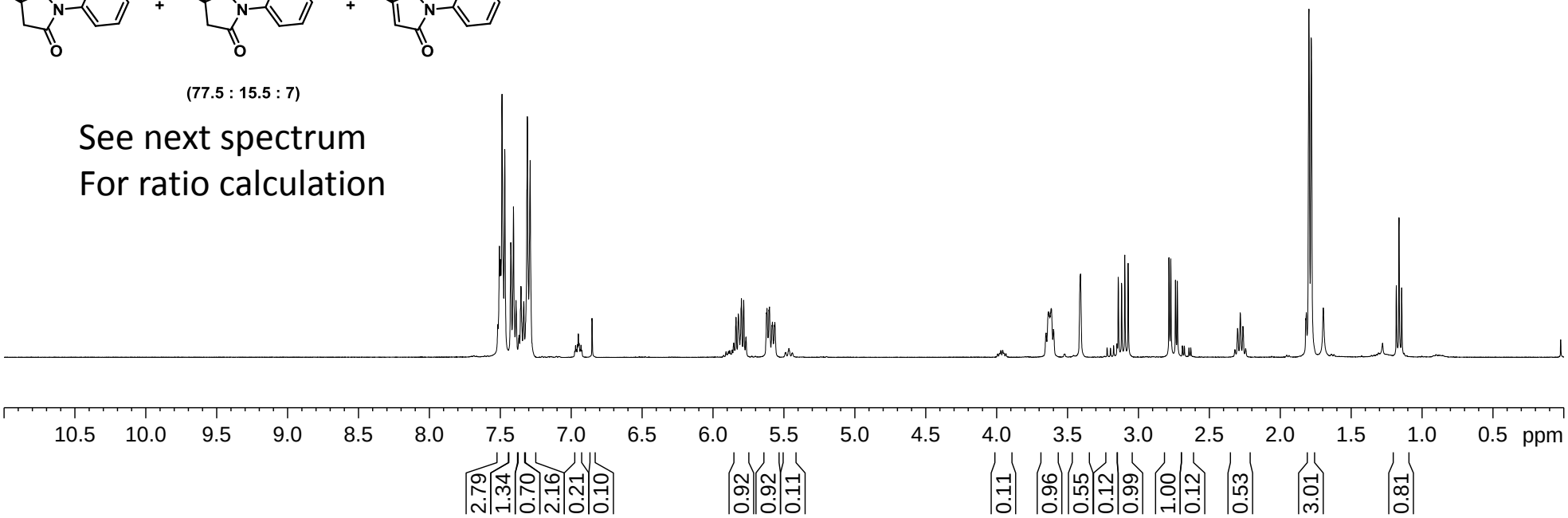


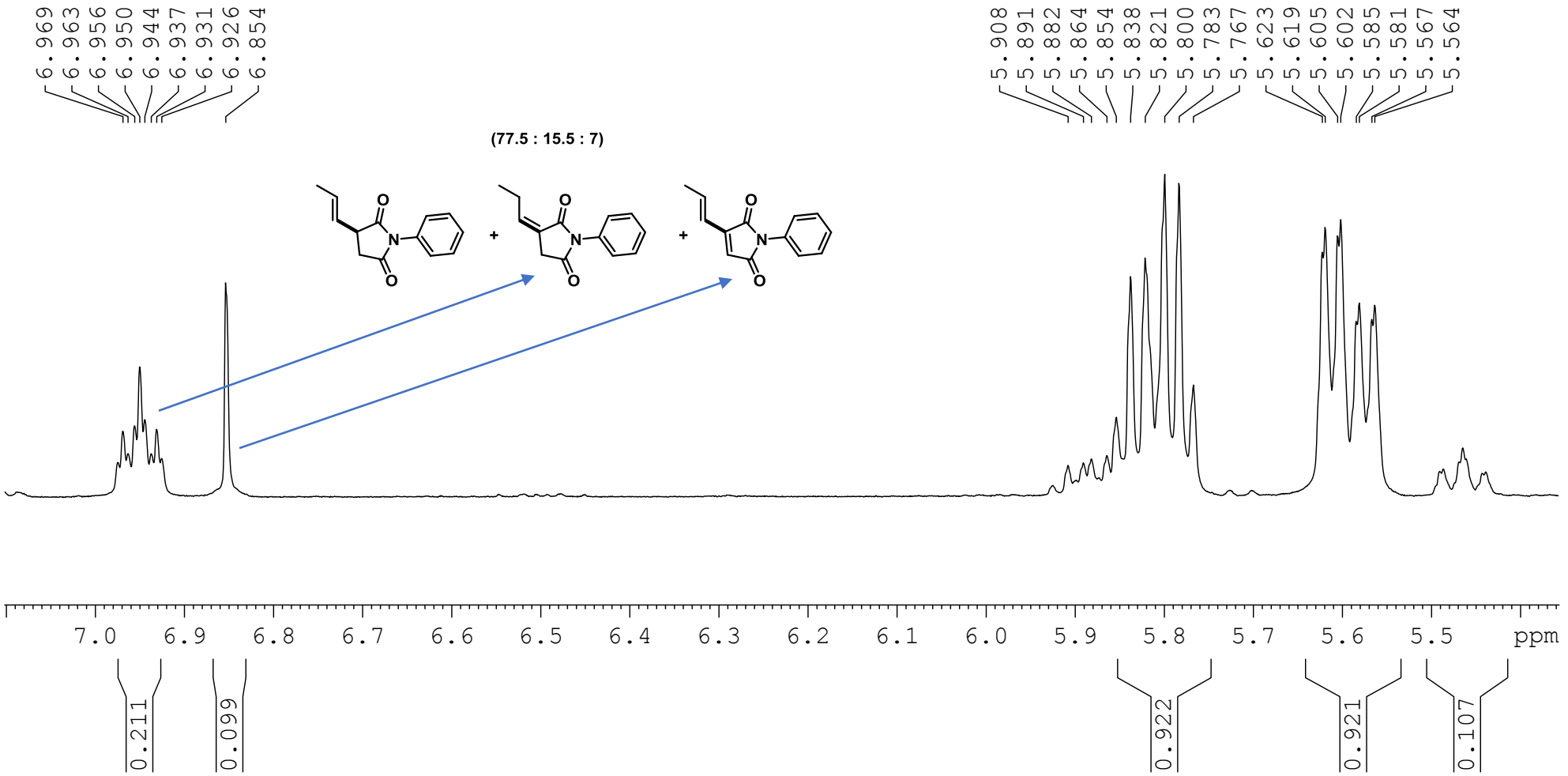
3md, ^{1}H NMR
400 MHz, $CDCl_3$

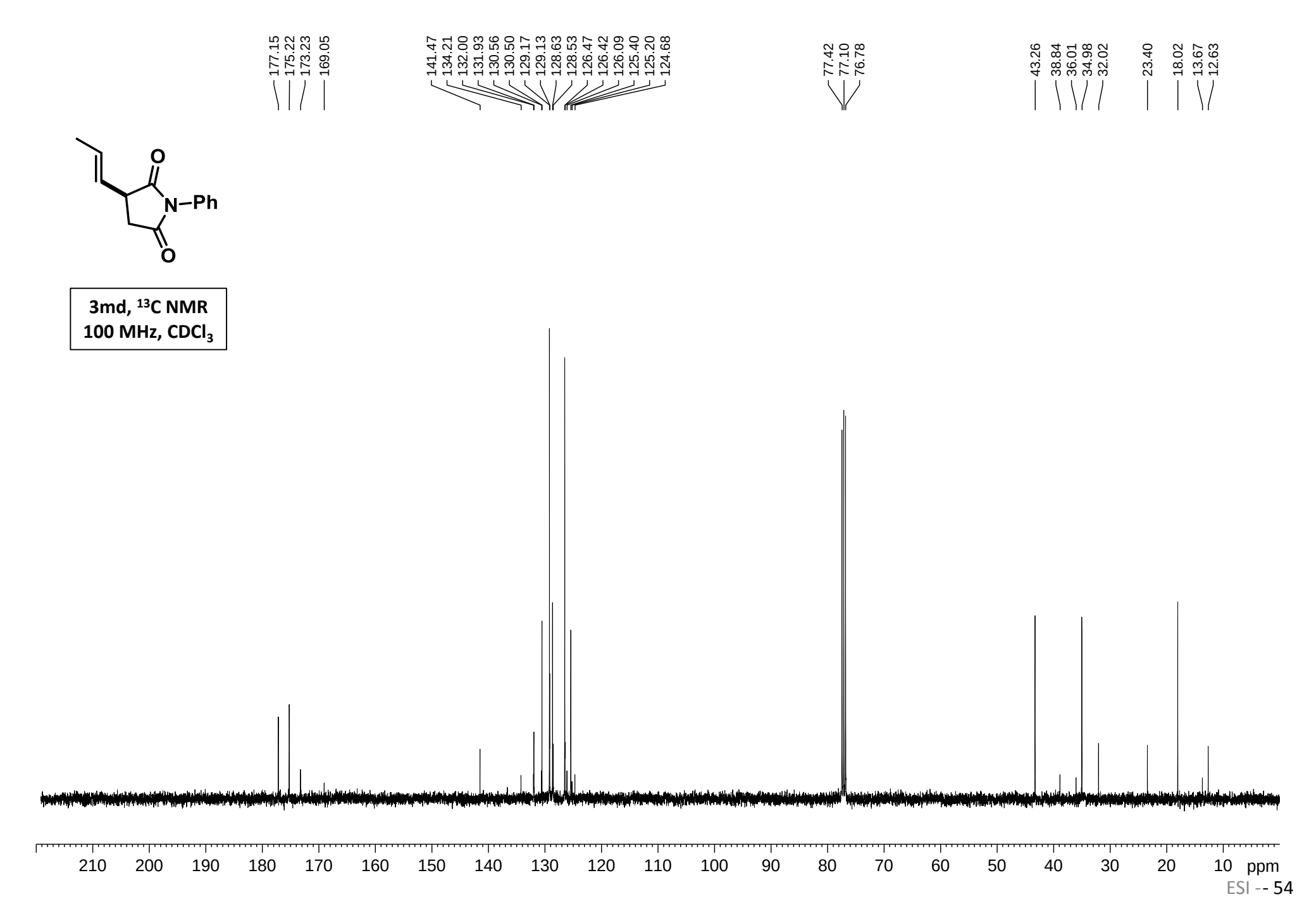


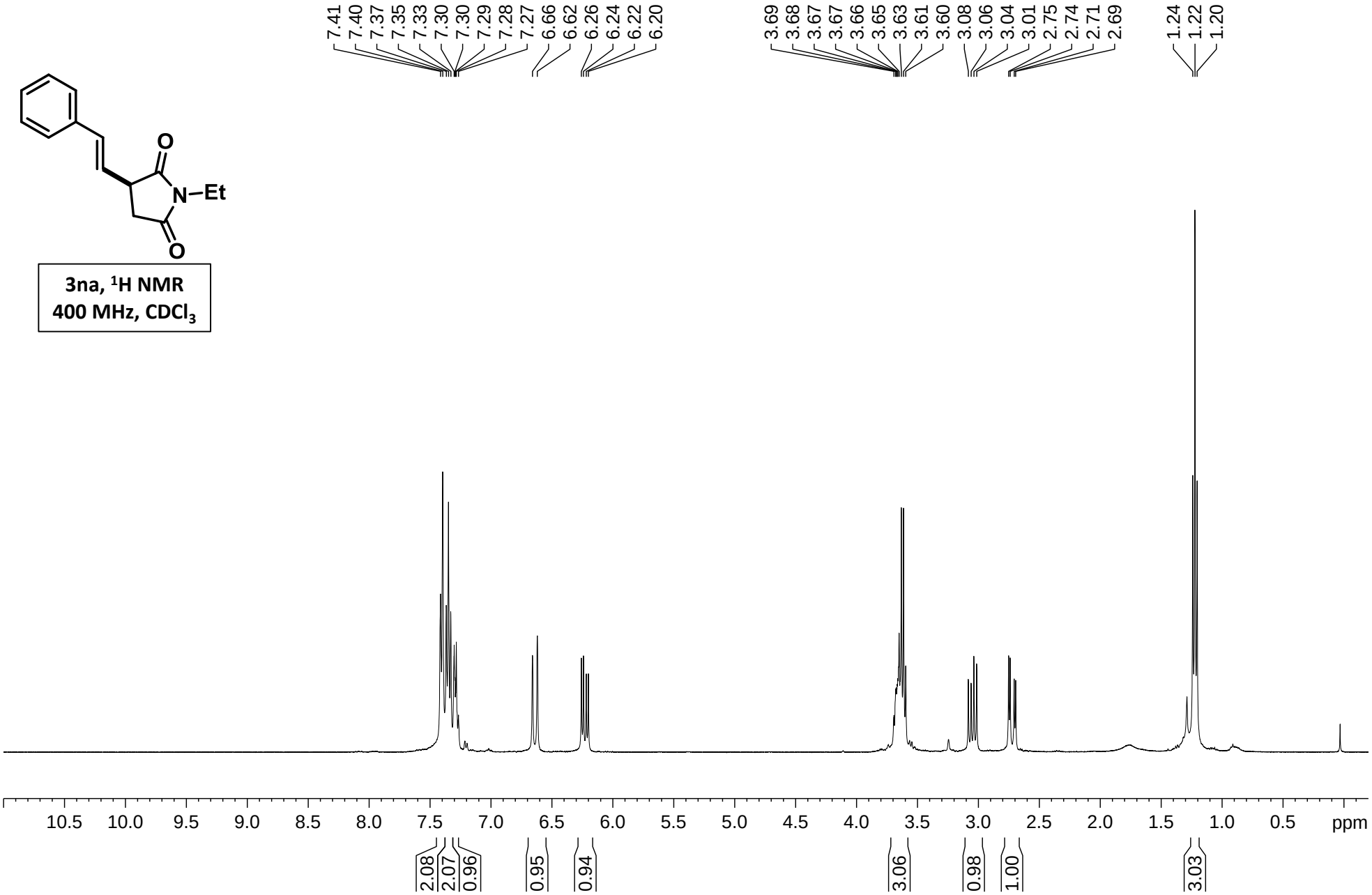
(77.5 : 15.5 : 7)

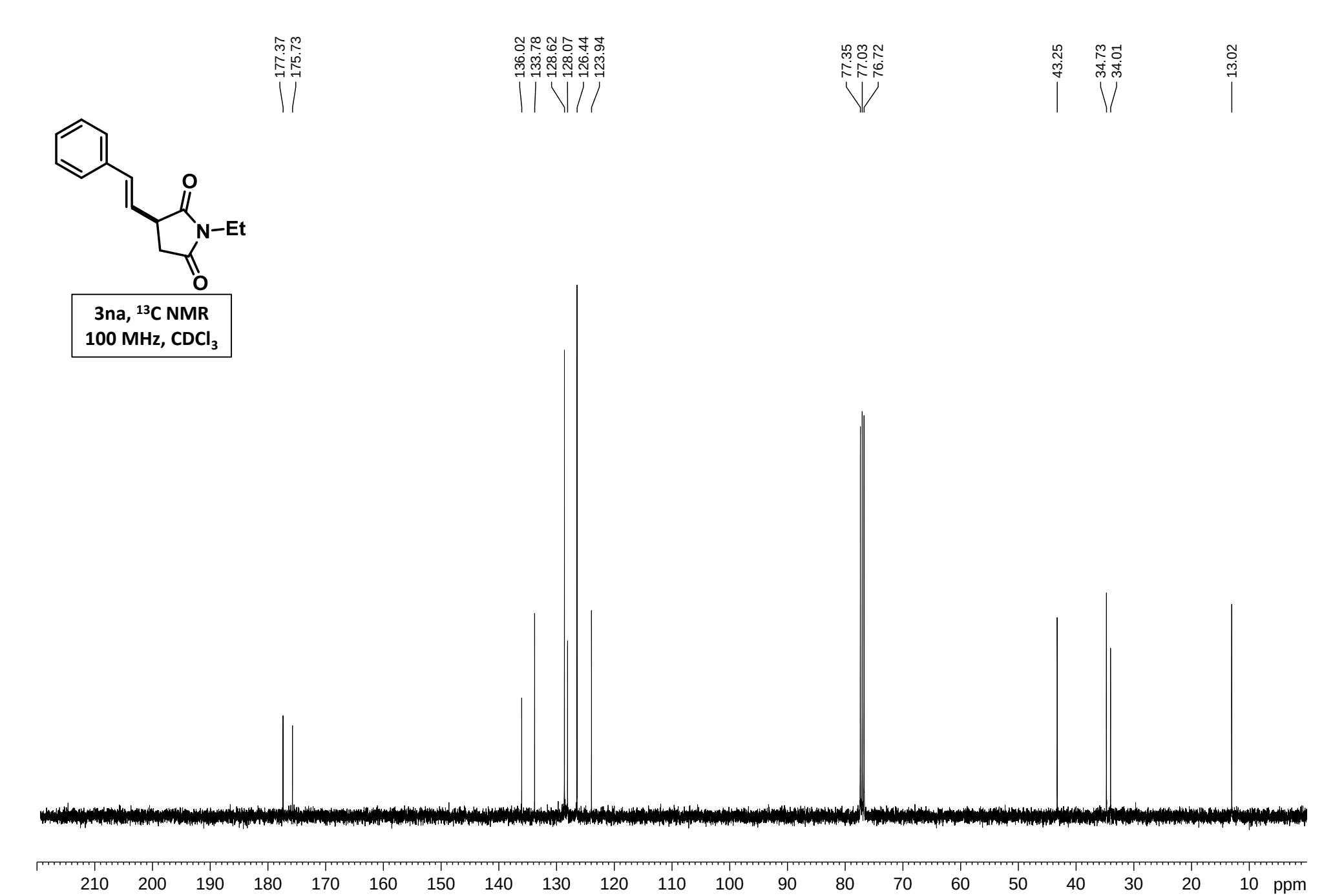
See next spectrum
For ratio calculation

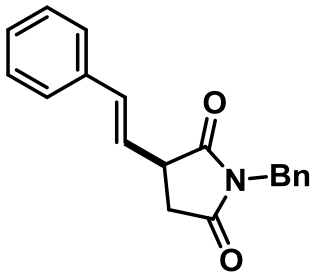



6.969
6.963
6.956
6.950
6.944
6.937
6.931
6.926
6.854
5.908
5.891
5.882
5.864
5.854
5.838
5.821
5.800
5.783
5.767
5.623
5.619
5.605
5.602
5.585
5.581
5.567
5.564
(77.5 : 15.5 : 7)
O
N
O
+
7.0
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6.0
5.9
5.8
5.7
5.6
5.5
ppm
0.211
0.099
0.922
0.921
0.107

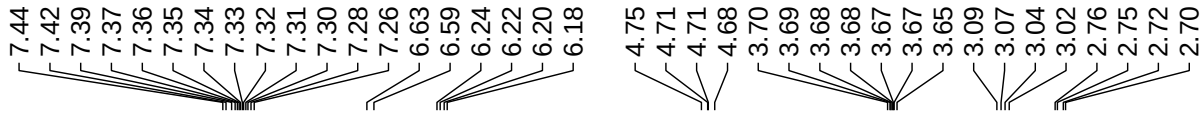

177.15
175.22
173.23
169.05
141.47
134.21
132.00
131.93
130.56
130.50
129.17
129.13
128.63
128.53
126.47
126.42
126.09
125.40
125.20
124.68
77.42
77.10
76.78
43.26
38.84
36.01
34.98
32.02
23.40
18.02
13.67
12.63
O
N–Ph
O
3md, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

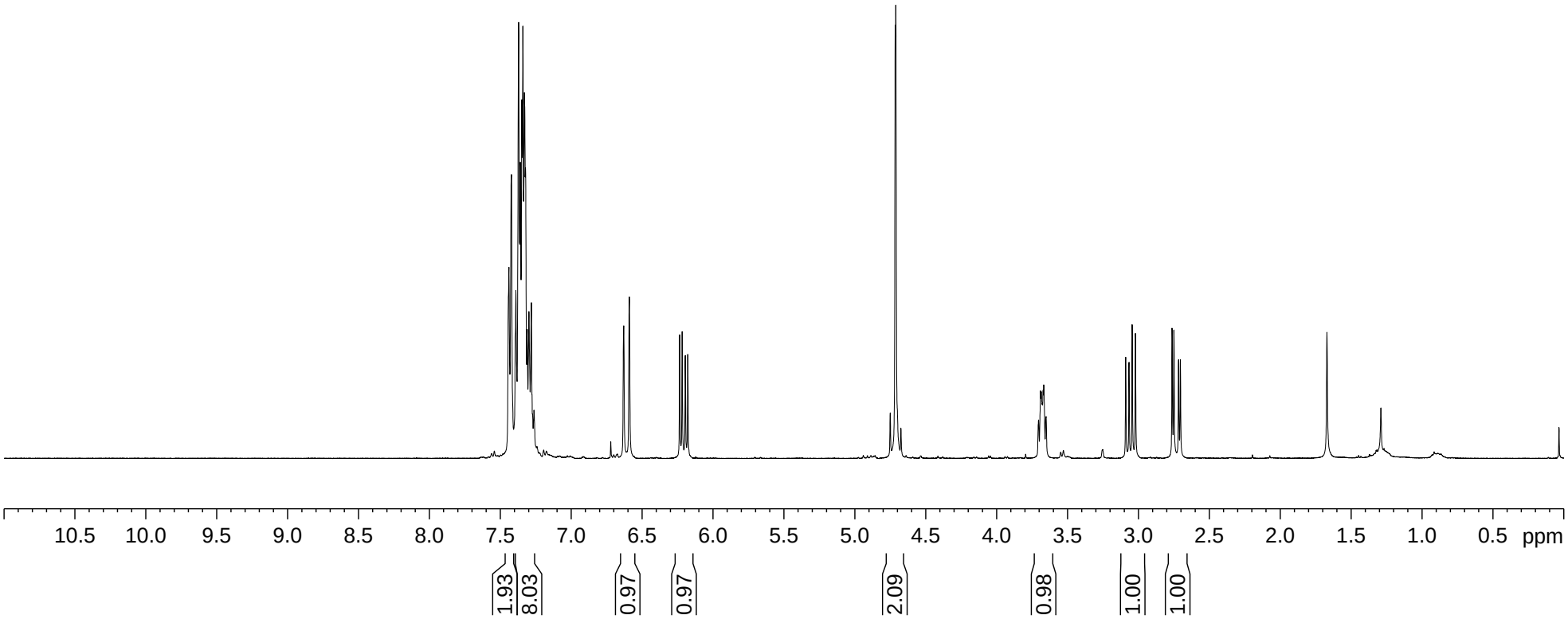

7.41
7.40
7.37
7.35
7.33
7.30
7.30
7.29
7.28
7.27
6.66
6.62
6.26
6.24
6.22
6.20
3.69
3.68
3.67
3.67
3.66
3.65
3.63
3.61
3.60
3.08
3.06
3.04
3.01
2.75
2.74
2.71
2.69
1.24
1.22
1.20
O
N–Et
O
3na, ¹H NMR
400 MHz, CDCl₃
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
2.08
2.07
0.96
0.95
0.94
3.06
0.98
1.00
3.03

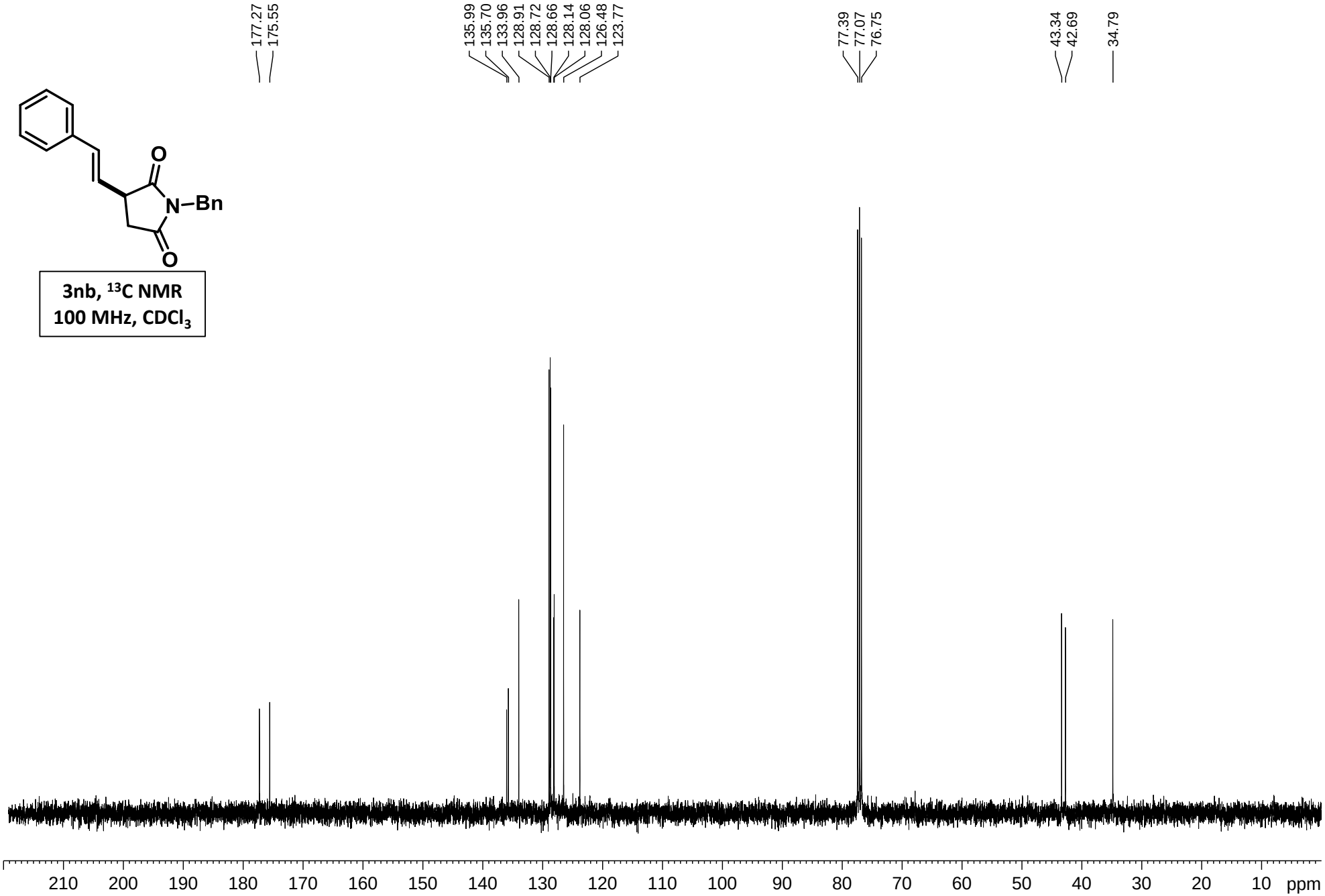

177.37
175.73
136.02
133.78
128.62
128.07
126.44
123.94
77.35
77.03
76.72
43.25
34.73
34.01
13.02
O
N–Et
O
3na, ^{13}C NMR
100 MHz, $CDCl_3$
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

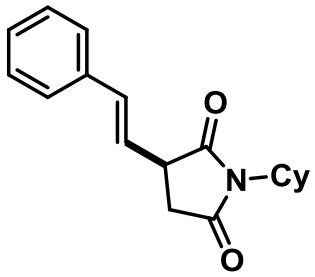


3nb, ^{1}H NMR
400 MHz, $CDCl_3$

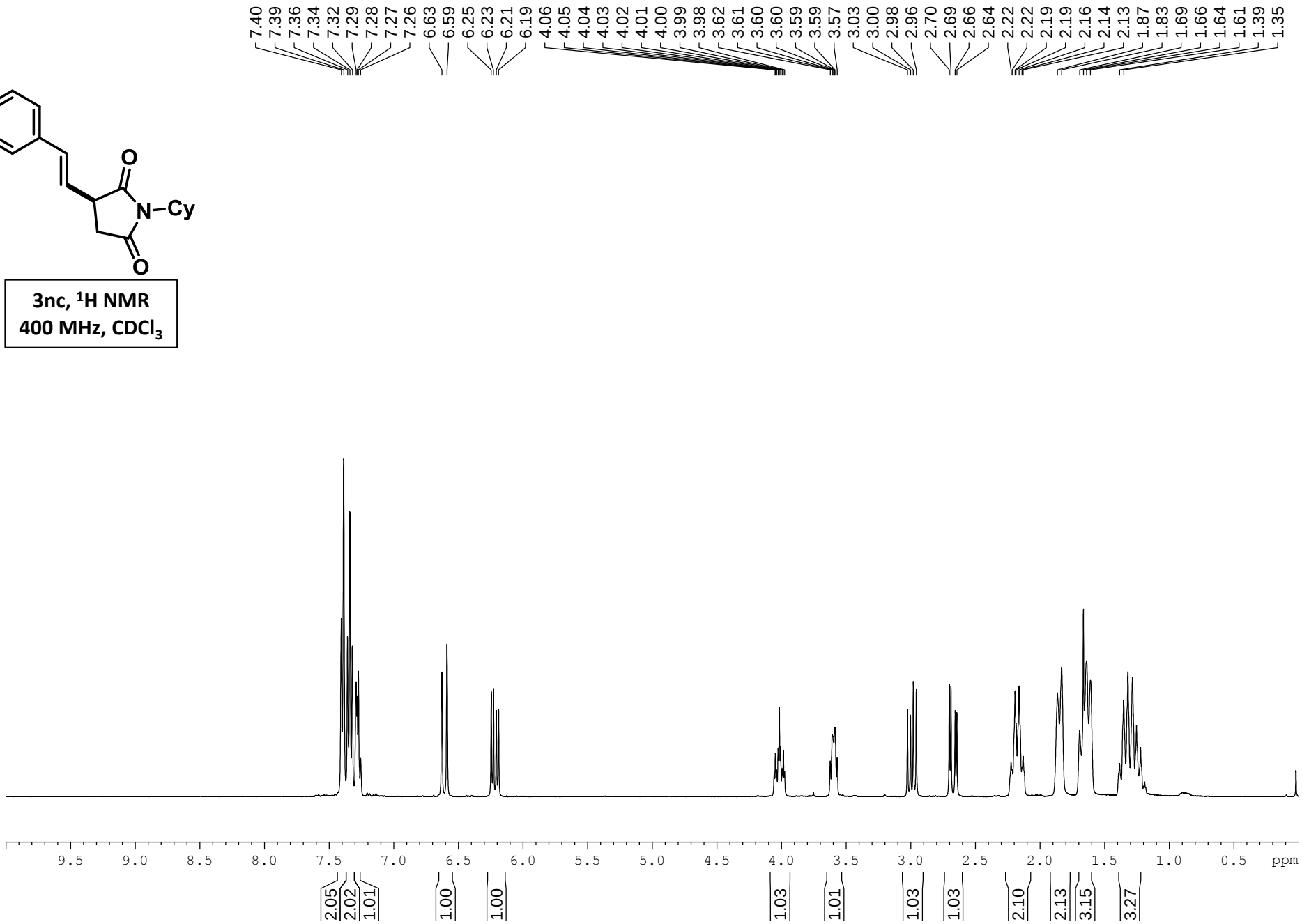


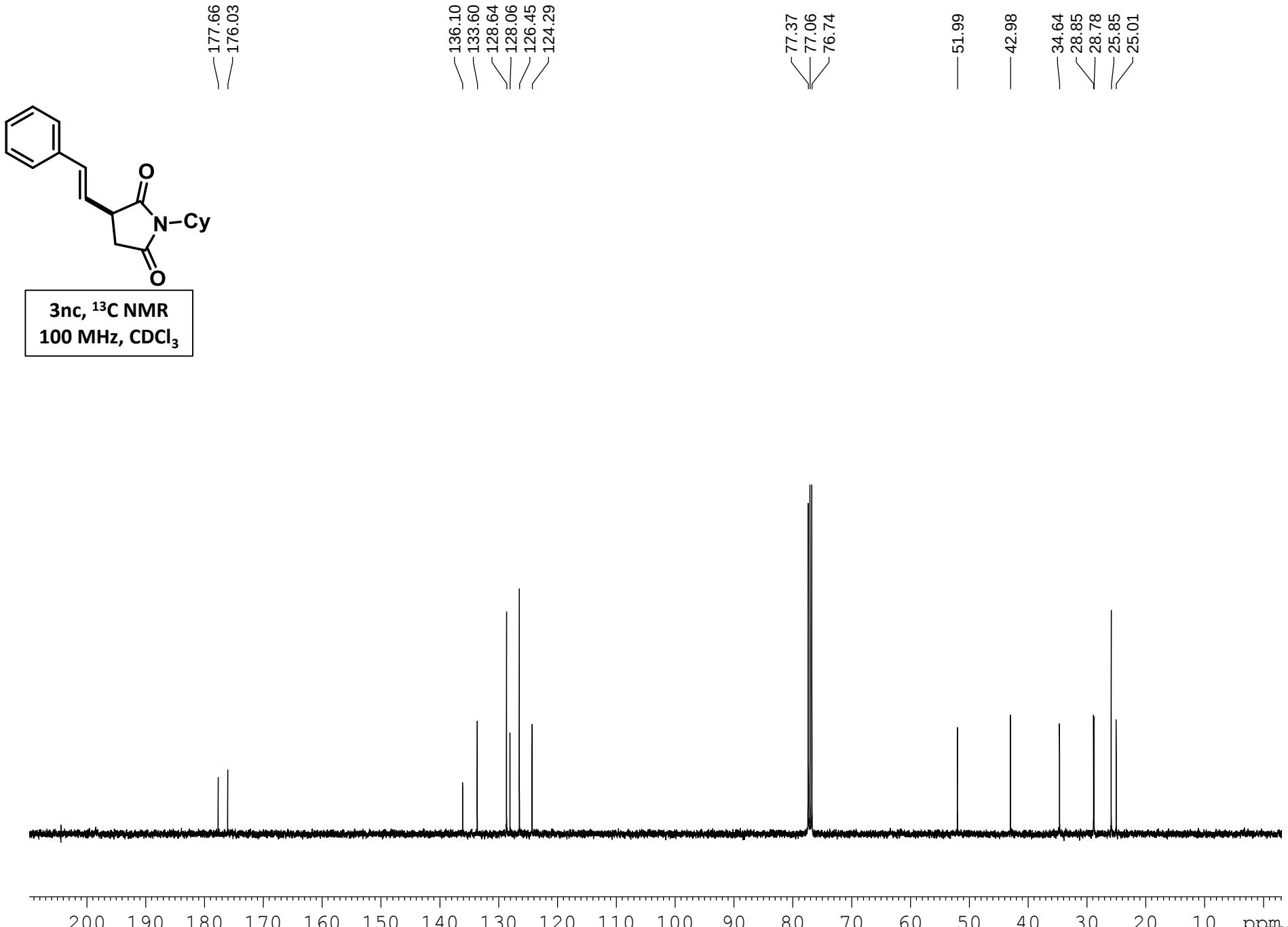


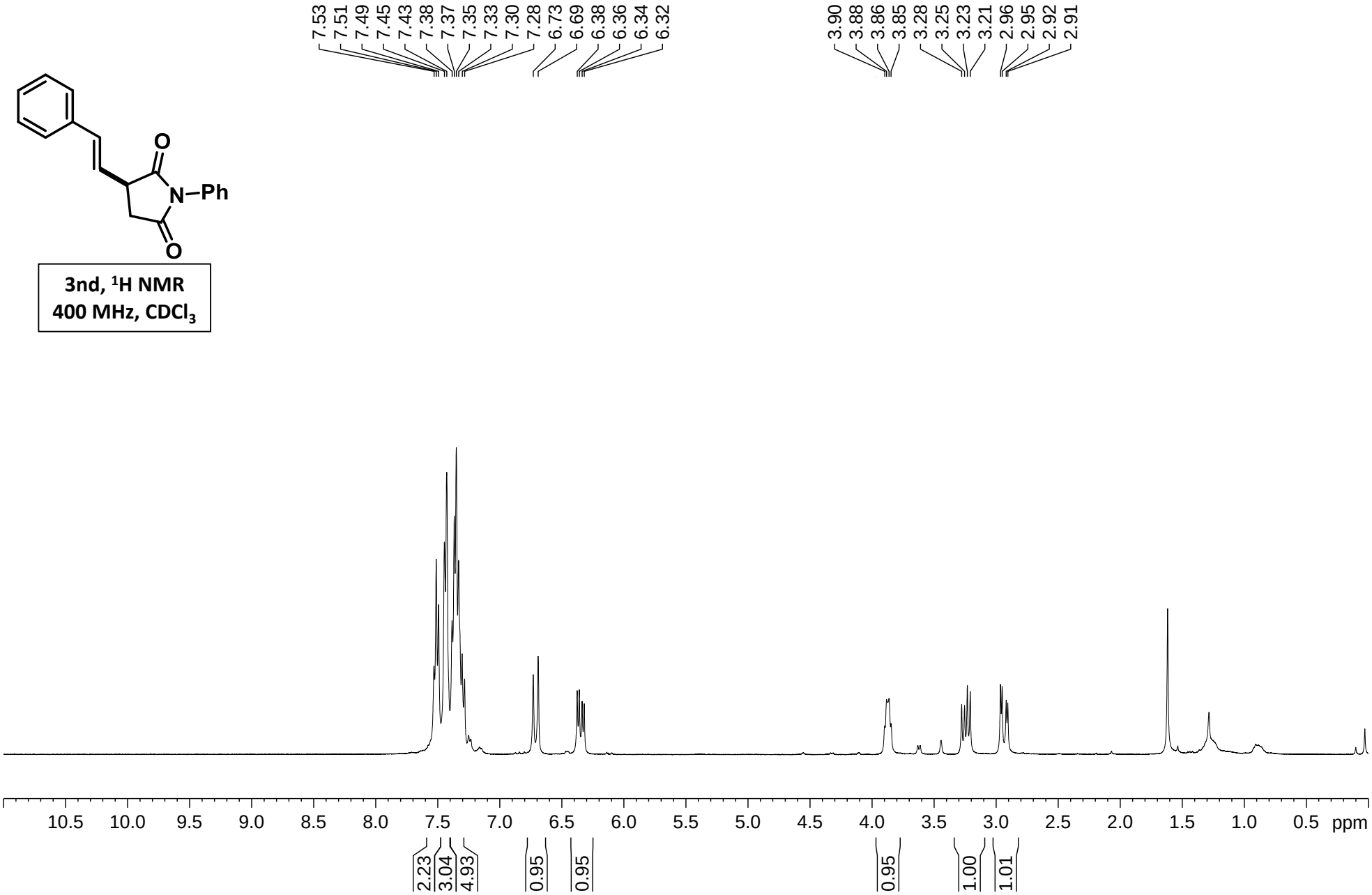

177.27
175.55
135.99
135.70
133.96
128.91
128.72
128.66
128.14
128.06
126.48
123.77
77.39
77.07
76.75
43.34
42.69
34.79
O
N–Bn
O
3nb, 13C NMR
100 MHz, CDCl3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

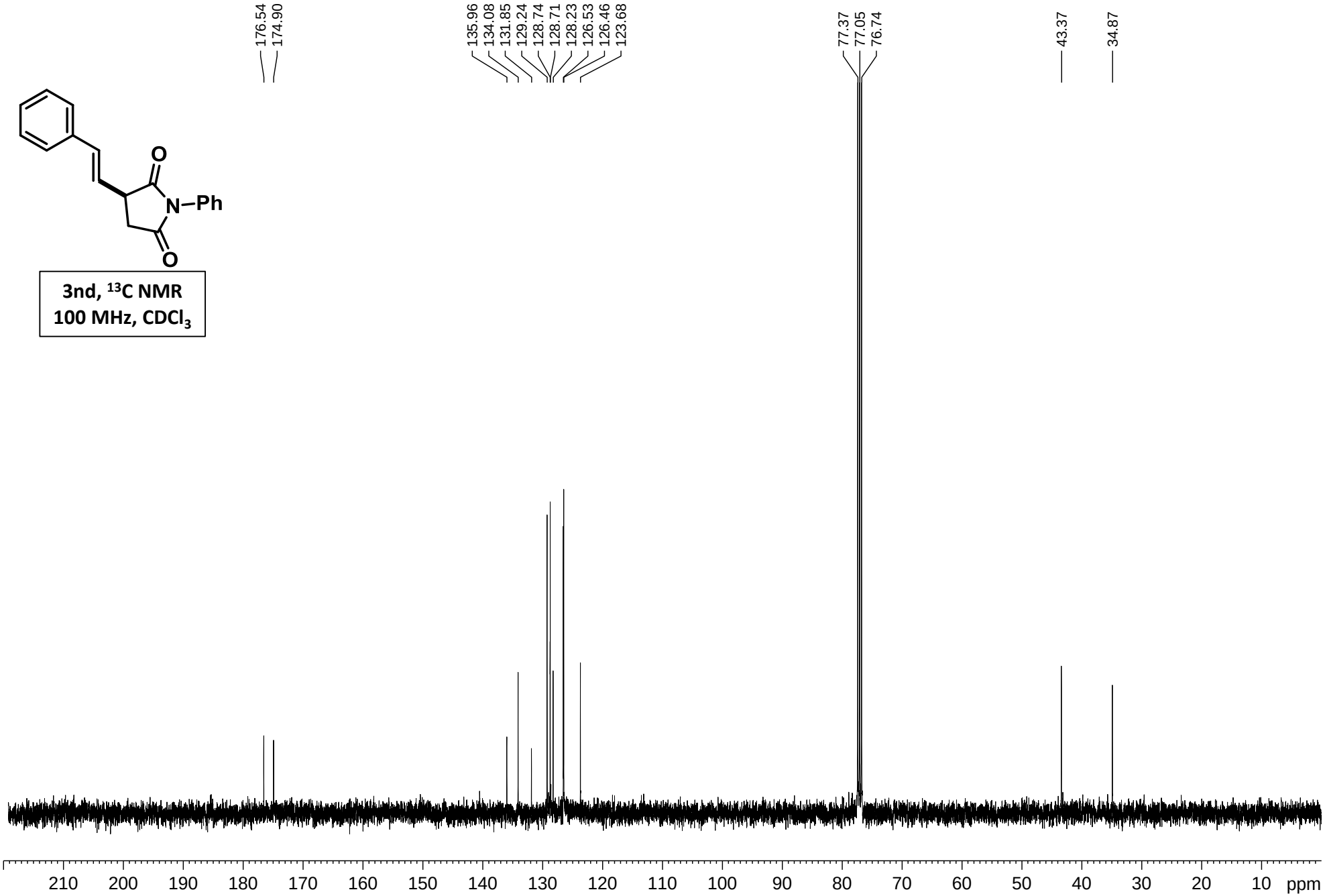


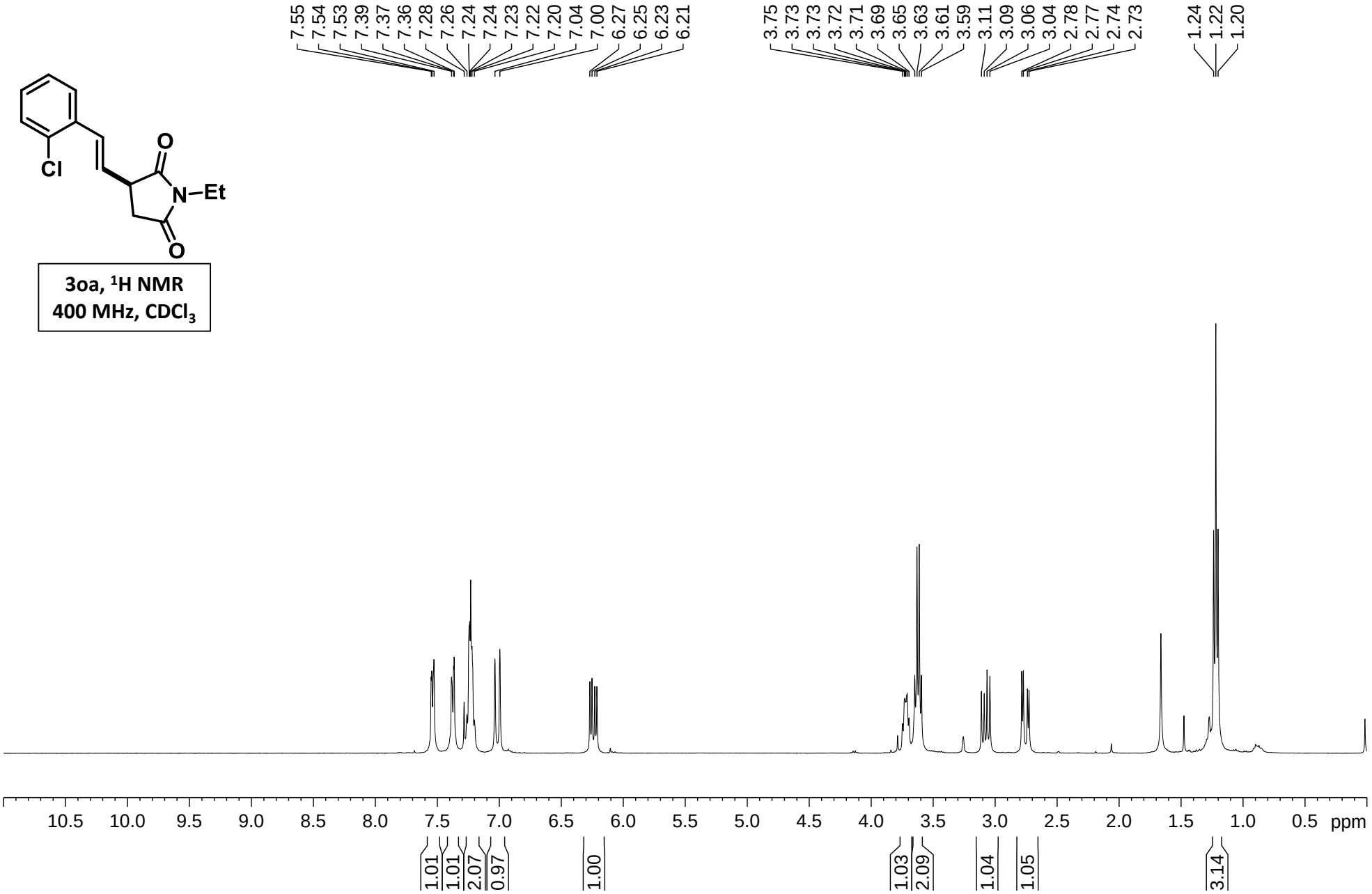
3nc, ^{1}H NMR
400 MHz, $CDCl_3$

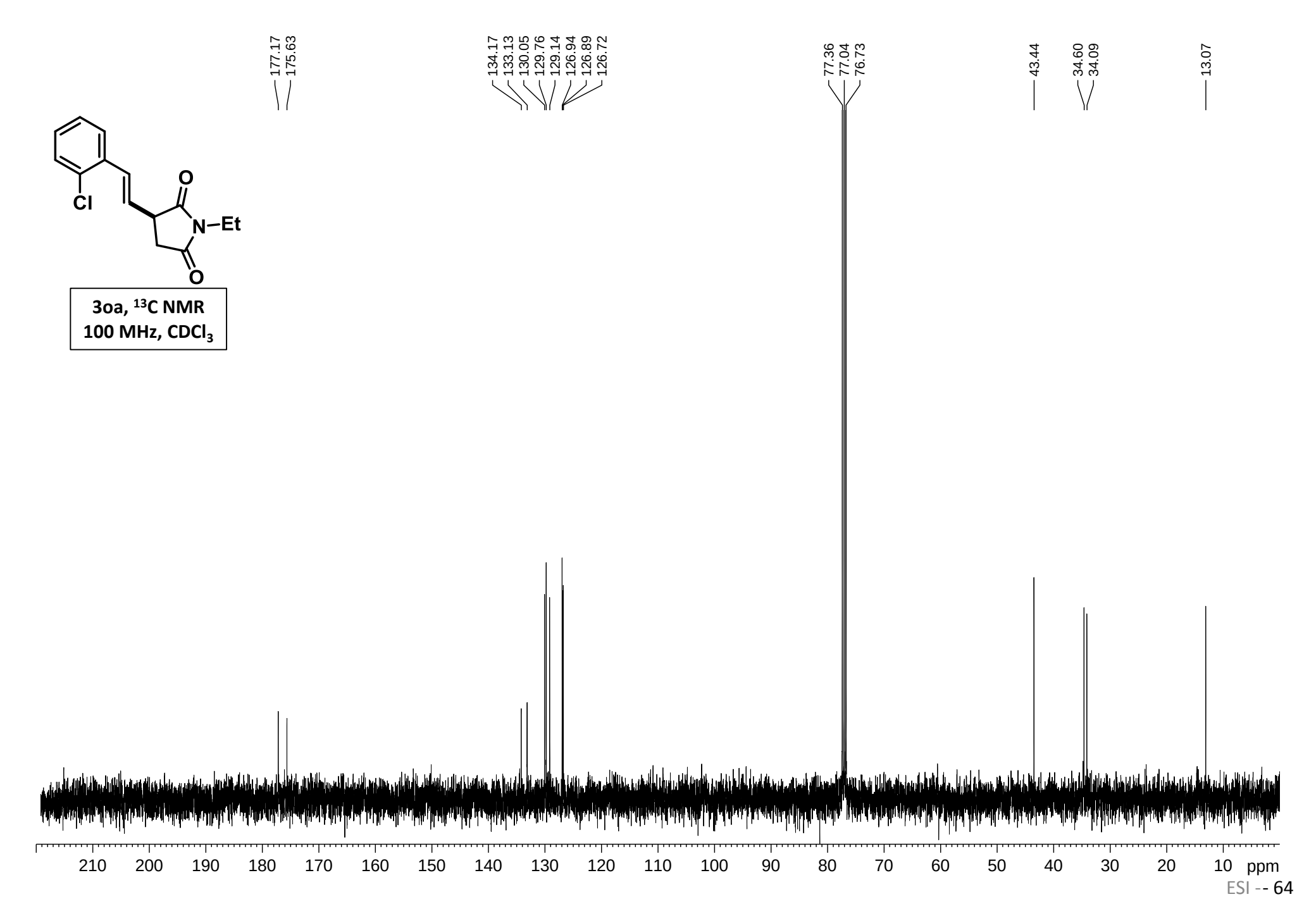


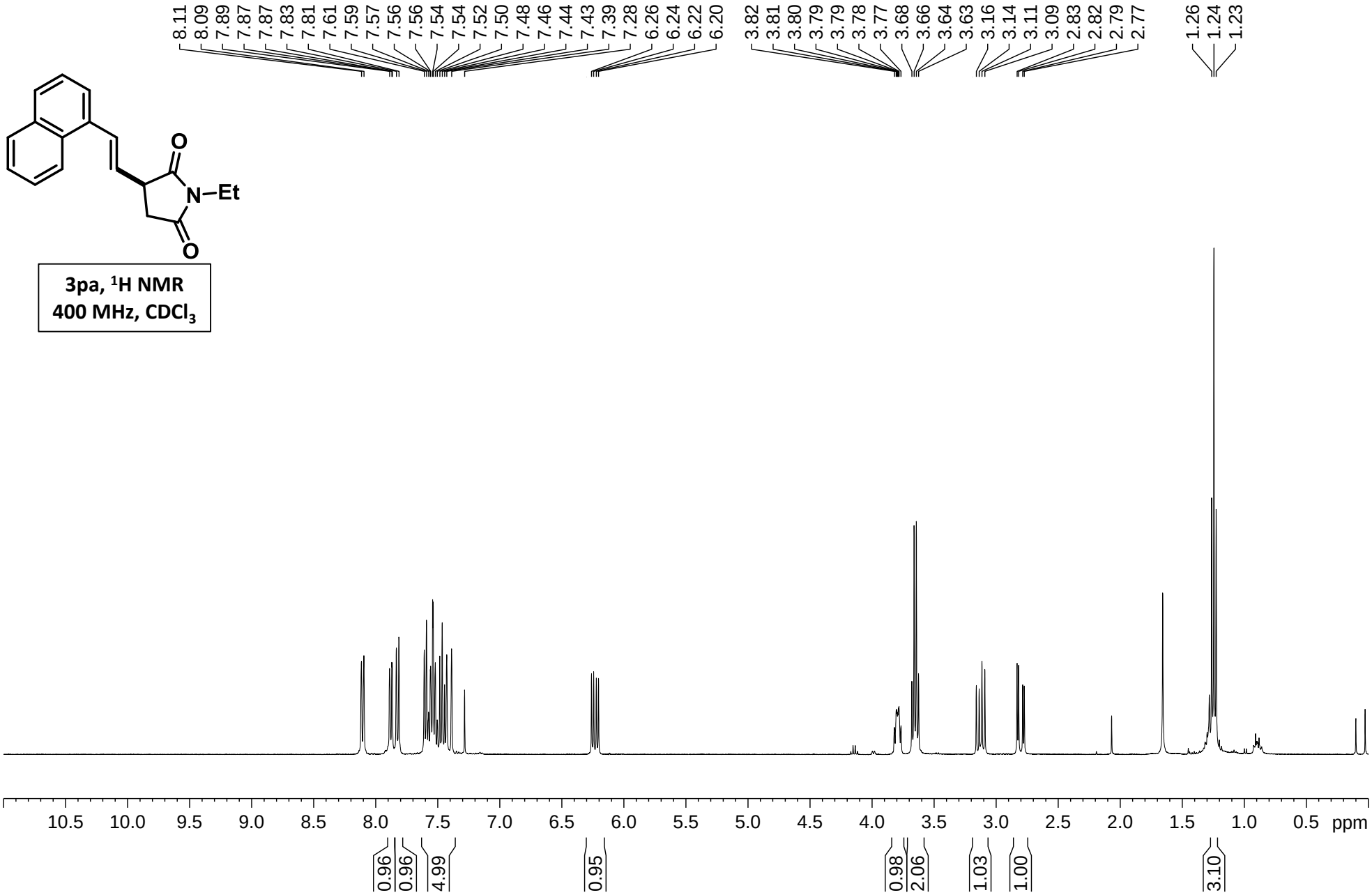

177.66
176.03
136.10
133.60
128.64
128.06
126.45
124.29
77.37
77.06
76.74
51.99
42.98
34.64
28.85
28.78
25.85
25.01
O
N–Cy
O
3nc, 13C NMR
100 MHz, CDCl3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

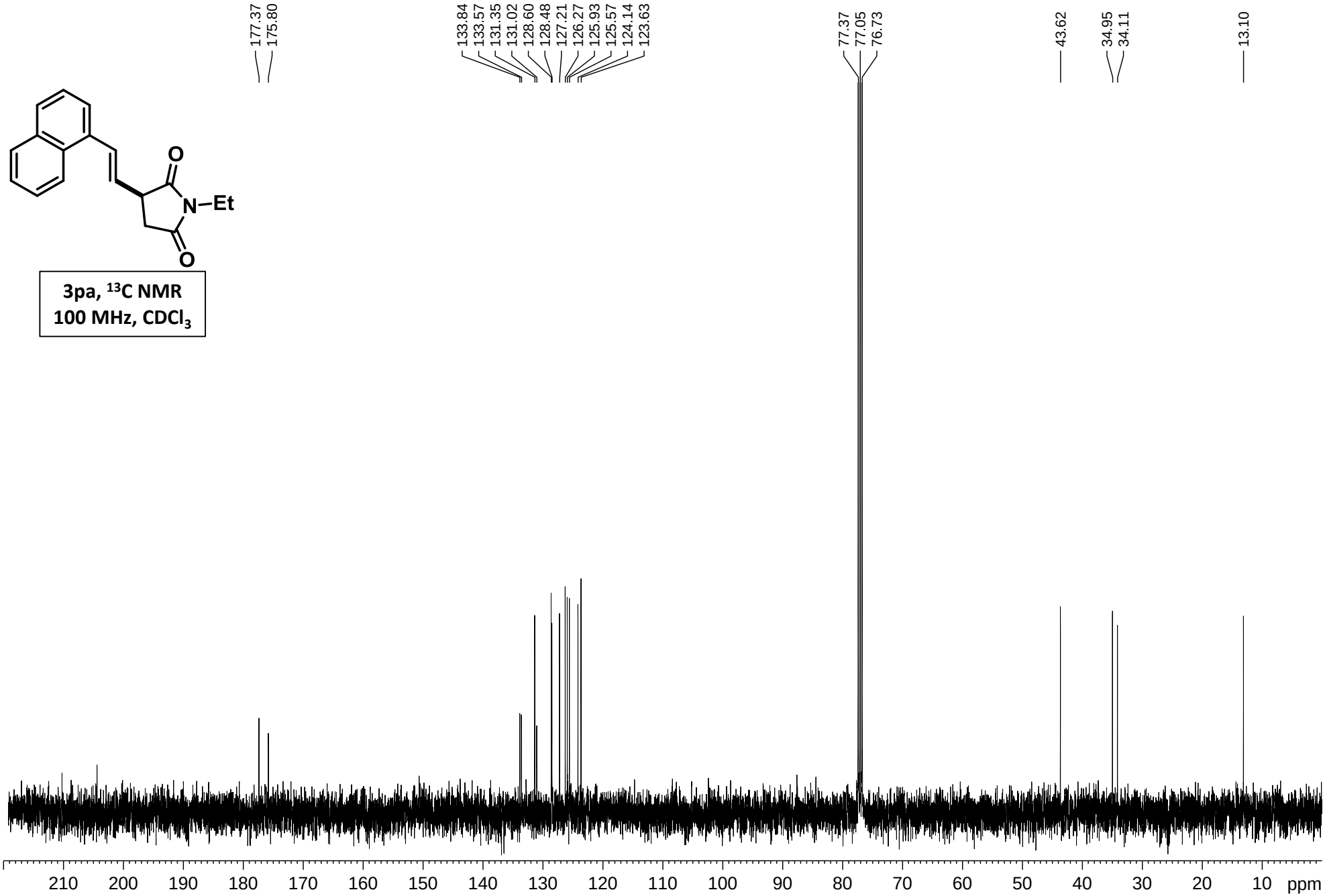

7.53
7.51
7.49
7.45
7.43
7.38
7.37
7.35
7.33
7.30
7.28
6.73
6.69
6.38
6.36
6.34
6.32
3.90
3.88
3.86
3.85
3.28
3.25
3.23
3.21
2.96
2.95
2.92
2.91
O
N–Ph
O
3nd, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
2.23
3.04
4.93
0.95
0.95
0.95
1.00
1.01


176.54
174.90
135.96
134.08
131.85
129.24
128.74
128.71
128.23
126.53
126.46
123.68
77.37
77.05
76.74
43.37
34.87
O
N–Ph
O
3nd, ^{13}C NMR
100 MHz, $CDCl_3$
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


7.55
7.54
7.53
7.39
7.37
7.36
7.28
7.26
7.24
7.24
7.23
7.22
7.20
7.04
7.00
6.27
6.25
6.23
6.21
3.75
3.73
3.73
3.72
3.71
3.69
3.65
3.63
3.61
3.59
3.11
3.09
3.06
3.04
2.78
2.77
2.74
2.73
1.24
1.22
1.20
Cl
O
N–Et
O
3oa, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.01
1.01
2.07
0.97
1.00
1.03
2.09
1.04
1.05
3.14


177.17
175.63
134.17
133.13
130.05
129.76
129.14
126.94
126.89
126.72
77.36
77.04
76.73
43.44
34.60
34.09
13.07
Cl
O
N–Et
O
3oa, ^{13}C NMR
100 MHz, $CDCl_3$
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


8.11
8.09
7.89
7.87
7.87
7.83
7.81
7.61
7.59
7.57
7.56
7.56
7.54
7.54
7.52
7.50
7.48
7.46
7.44
7.43
7.39
7.28
6.26
6.24
6.22
6.20
3.82
3.81
3.80
3.79
3.79
3.78
3.77
3.68
3.66
3.64
3.63
3.16
3.14
3.11
3.09
2.83
2.82
2.79
2.77
1.26
1.24
1.23
O
N–Et
O
3pa, 1H NMR
400 MHz, CDCl3
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.96
0.96
4.99
0.95
0.98
2.06
1.03
1.00
3.10


177.37
175.80
133.84
133.57
131.35
131.02
128.60
128.48
127.21
126.27
125.93
125.57
124.14
123.63
77.37
77.05
76.73
43.62
34.95
34.11
13.10
O
N–Et
O
3pa, ^{13}C NMR
100 MHz, $CDCl_3$
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm