Development and Mechanistic Interrogation of Interrupted Chain-Walking in the Enantioselective Relay Heck Reaction

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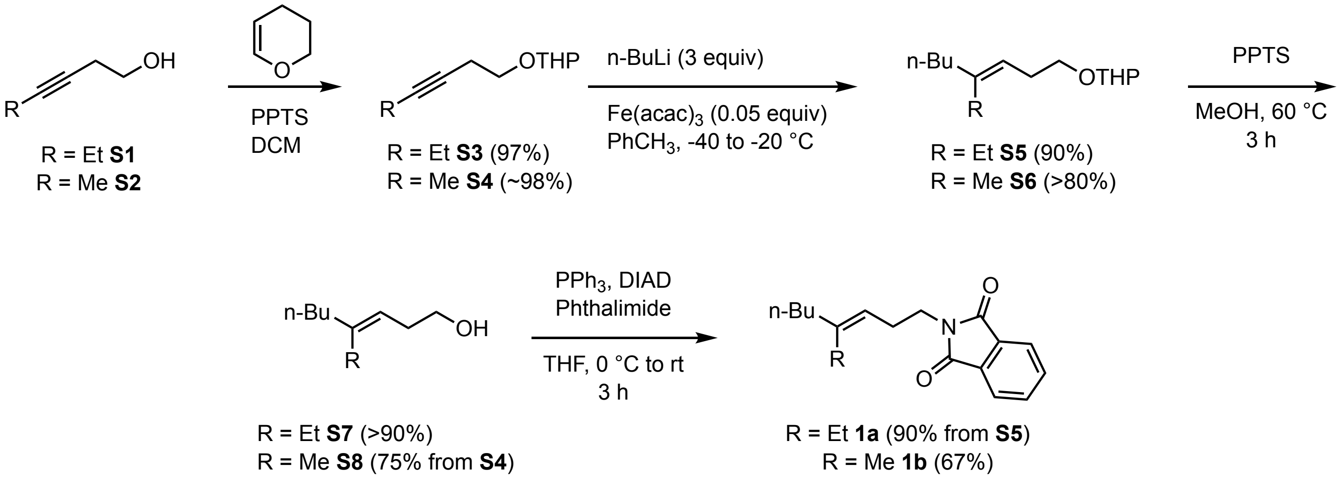
1. General Considerations:

All reactions were performed using oven-dried or flame-dried glassware equipped with a magnetic stir bar under an atmosphere of nitrogen unless otherwise noted. All reagents were purchased from commercial suppliers and used without further purification with the following exceptions: triethylamine was distilled from CaH_2 immediately prior to use, *N*,*N*-diisopropylethylamine was distilled from CaH_2 immediately prior to use, zinc chloride was dried under vacuum (~1 torr) at 100 °C for 24 h, and 3 Å molecular sieves were crushed with a mortar and pestle to give a fine powder. Dichloromethane (DCM), tetrahydrofuran (THF), and toluene ($PhCH_3$) were passed through a column of activated alumina immediately prior to use. **^{1}H NMR** spectra were obtained in $CDCl_3$ at 500 MHz. The resonances are reported using the following format: [chemical shift (ppm), multiplicity (see below for details), coupling constant (in Hz, if applicable), integral (to the nearest integer (or half integer in the case of rotomers)), and assignment of the location in the structure (indicated proton in italics)]. Chemical shifts are reported in ppm and referenced to the tetramethylsilane (TMS) at 0.00 ppm or $CHCl_3$ at 7.26 ppm. The abbreviations s, d, t, pent, dd, ddd, dt, and m stand for the resonance multiplicities singlet, doublet, triplet, pentet, doublet of doublets, doublet of doublet of doublets, doublet of triplets, and multiplet, respectively. The abbreviation br (multiplicity) refers to a broad resonance of the corresponding multiplicity type. The abbreviation nfom refers to a non-first order multiplet. Diastereotopic protons are assigned using "H_a" or "H_b" where H_a and H_b refer to the downfield and upfield resonances, respectively. In the cases where rotomers (rotational isomers) are present, the assignment of the proton resonances for each rotomer are indicated with "H_{ra}" and "H_{rb}" where (unless otherwise confirmed through additional 2-D NMR experiments, see assignment for **2p**) "H_{ra}" is downfield respective to "H_{rb}". **^{13}C NMR** spectra were obtained in $CDCl_3$ at 125 MHz and referenced to the center peak of the $CDCl_3$ triplet at 77.16 ppm. **Thin-layer chromatography** (TLC) was performed with EMD silica gel 60 F_{254} plates eluting with solvents indicated, visualized by a 254 nm UV lamp and stained with either phosphomolybdic acid (PMA), or basic potassium permanganate ($KMnO_4$). **Flash chromatography** was performed using EM reagent silica 60 (230-400 mesh). **MPLC** (medium-pressure (25–200 psi) liquid chromatography) was performed using Redisep Rf Gold® normal phase silica (20–40 microns) hand packed into glass columns. The device is constructed of a Waters (510) HPLC pump and Waters (R401) refractive index detector. **IR** spectra were recorded using a Thermo Nicolet FT-IR. **HRMS** data were obtained on a Waters LCP Premier XE instrument by ESI/TOF. **SFC** (supercritical fluid chromatography) analysis was performed at 40 °C, using a waters UPC^2 instrument fitted with the indicated columns at the specified pressures (PSI), flow rate (mL/min) and solvent ratios (IPA or MeOH/CO_2). **Optical Rotations** were measured (Na D line) on a Perkin Elmer Model 343 Polarimeter fitted with a microcell with a 1 dm path length. Concentrations are reported in g/100 mL.

2. Substrate Preparation

2a. Preparation of homoallylic phthalimides 1a and 1b:

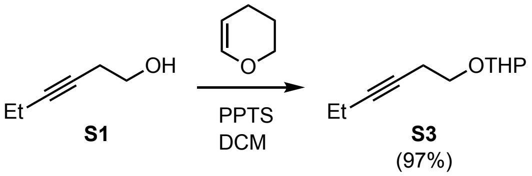
The homoallylic phthalimides **1a** and **1b** were prepared from commercially available homopropargyl alcohols **S1** and **S2**, respectively, following the sequence shown in **Scheme S1**.



Scheme S1: Preparation of substrates **1a** and **1b**

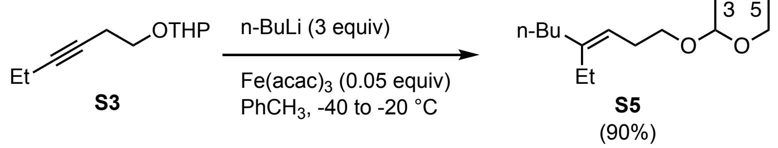
Synthesis of **1a**

2-(Hex-3-yn-1-yloxy)tetrahydro-2*H*-pyran (S3):



Propargyl alcohol **S1** (4.91 g, 50.0 mmol), dihydropyran (8.5 mL, 100 mmol, 2.0 equiv), PPTS (1.26 g, 5.0 mmol, 0.10 equiv) and CH_2Cl_2 (125 mL) were added to a 250 mL round-bottom flask, placed under nitrogen, and stirred for 1 h at room temperature. The solution was concentrated under reduced pressure, suspended in 15:1 Hex:EtOAc and filtered. The resulting oil was further purified by flash column chromatography (SiO_2, 15:1 Hex:EtOAc) to give THP protected alcohol **S3** (8.84 g, 48.5 mmol, 97%) as a pale-yellow liquid. The NMR data matches the literature values.[1]

(*E*)-2-((4-Ethyloct-3-en-1-yl)oxy)tetrahydro-2*H*-pyran (S5)[2]:



Homopropargyl THP ether **S3** (4.56 g, 25.0 mmol) and Fe(acac)$_3$ (442 mg, 1.25 mmol, 0.05 equiv) were added to a flame-dried 3-neck round-bottom flask equipped with a dropping funnel and internal thermometer (-50 to 30 °C), dissolved in toluene (250 mL), and cooled to -50 °C (internal temperature). To this solution n-BuLi (30 mL, 2.5 M in hexanes, 3 equiv) was added dropwise via additional funnel so as to keep the internal temperature below -40 °C (~ 20 min). The -50 °C cooling bath was replaced with a -20 °C cooling bath and the reaction was stirred for 1.5 h while keeping the reaction mixture between -20 and -15 °C. The reaction mixture was cooled to -50 °C and acetic acid (5 mL) in toluene (20 mL) was added dropwise while keeping the reaction mixture below -25 °C. To this 1.2 M HCl (100 mL) was added and the mixture was allowed to warm to room temperature. The mixture was transferred to a separatory funnel with ether (200 mL). The aqueous layer was extracted with additional ether (100 mL) and the combined organic layers were washed with $NaHCO_3$ (100 mL x 3) and brine (100 mL), dried ($MgSO_4$), filtered, and concentrated to give crude **S5** as an orange oil. Purification by flash column chromatography (SiO_2, 20:1 to 15:1 Hex:EtOAc) gave trisubstituted alkene **S5** (5.41 g, 22.5 mmol, 90%) as a pale-yellow oil.

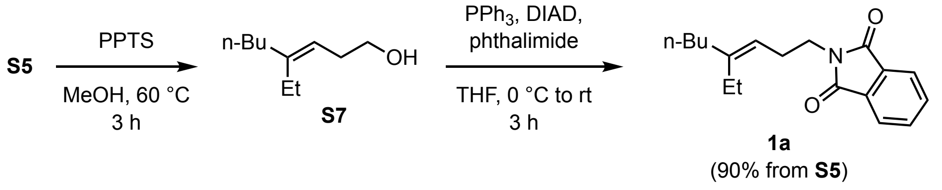
^{1}H NMR (500 MHz, $CDCl_3$): δ 5.09 (t, *J* = 7.2 Hz, 1H, C=C*H*), 4.60 (dd, *J* = 4.4, 2.9 Hz, 1H, CH$_2$OC*H*O), 3.88 (m, 1H, CH$_2$OCHOC*H*$_a$H$_b$), 3.71 (ddd, *J* = 9.4, 7.5, 7.5 Hz, 1H, C*H*$_a$H$_b$OCHO), 3.50 (m, 1H, CH$_2$OCHOCH$_a$*H*$_b$), 3.38 (ddd, *J* = 9.2, 7.3, 7.3 Hz, CH$_a$*H*$_b$OCHO), 2.32 (app q, *J* = 7.2 Hz, 2H, C=CHC*H*$_2$CH$_2$OTHP), 2.04 (q, *J* = 7.7 Hz, 2H, CH$_3$C*H*$_2$C=CH), 1.99 (br t, *J* = 7.3 Hz, 2H, CH$_3$CH$_2$CH$_2$C*H*$_2$C=CH), 1.83 (m, 1H, C4*H*$_a$), 1.71 (m, 1H, C3*H*$_a$), 1.61–1.50 (m, 4H, C3*H*$_b$, C4*H*$_b$, C5*H*$_2$), 1.35 (m, 2H, CH$_3$C*H*$_2$CH$_2$CH$_2$C=CH), 1.29 (m, 2H, CH$_3$CH$_2$C*H*$_2$CH$_2$C=CH), 0.96 (t, *J* = 7.7 Hz, 3H, C*H*$_3$CH$_2$C=CH), and 0.89 (t, *J* = 7.4 Hz, 3H, C*H*$_3$CH$_2$CH$_2$CH$_2$C=CH).

^{13}C NMR (125 MHz, $CDCl_3$): δ 143.6, 119.5, 98.9, 67.7, 62.4, 36.4, 30.9, 30.5, 28.5, 25.7, 23.3, 22.6, 19.8, 14.2, and 13.4.

IR (neat): 2957, 2926, 2871, 1466, 1137, 1119, 1072, and 1030 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{15}H_{28}O_2Na^+$ $(M+Na)^+$: 263.1982, found 263.1990.

(*E*)-2-(4-Ethyloct-3-en-1-yl)isoindoline-1,3-dione (1a):



The THP protected alcohol **S5** (5.41 g, 22.52 mmol) and PPTS (565 mg, 2.25 mmol, 0.1 equiv) were added to a 500 mL round-bottom flask and dissolved in MeOH (200 mL). A reflux condenser was attached to the flask and the mixture was heated at 60 °C for 3 h, at which time TLC (5:1 Hex:EtOAc) indicated the reaction was complete. The mixture was cooled to room temperature and concentrated under reduced pressure. The resulting residue was partitioned between Et_2O (200 mL) and NH_4Cl (100 mL) and the resulting organic layer was washed with additional NH_4Cl (75 mL), $NaHCO_3$ (3 x 50 mL), brine (50 mL), dried ($MgSO_4$), filtered, and concentrated to give impure homoallylic alcohol **S7** (3.58 g, >100 % yield) which was used for the following step without further purification.

The alcohol **S7** (3.58 g, ~22.5 mmol), phthalimide (3.98 g, 27.02 mmol, 1.2 equiv), and triphenylphosphine (7.09 g, 27.02 mmol, 1.2 equiv) were added to a 250 mL round bottom flask, dissolved in THF (120 mL) and cooled to 0 °C. To this solution DIAD (5.30 mL, 27.02 mmol, 1.2 equiv) was added dropwise over ~10 min. The cooling bath was removed and the mixture was stirred for an additional 2 h at ambient temperature. The reaction mixture was then concentrated under reduced pressure and the resulting residue was purified by flash column chromatography (SiO_2, 15:1 to 9:1 to 5:1 Hex:EtOAc) to give pure **1a** (5.80 g, 20.3 mmol, 90 % over two steps) as a colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.82 (nfom, 2H, NPhthH_o), 7.70 (nfom, 2H, NPhthH_m), 5.07 (t, J = 7.4 Hz, 1H, C=CH), 3.69 (t, J = 7.4 Hz, 2H, $C{=}CHCH_2CH_2NPhth$), 2.39 (app q, J = 7.4 Hz, 2H, $C{=}CHCH_2CH_2NPhth$), 1.97 (t, J = 7.6 Hz, 2H, $CH_3CH_2C{=}C$), 1.93 (t, J = 8.1 Hz, 2H, $PrCH_2C{=}C$), 1.26 (m, 2H, $CH_3CH_2CH_2CH_2C{=}C$), 1.19 (m, 2H, $CH_3CH_2CH_2CH_2C{=}C$), 0.88 (t, J = 7.5 Hz, 3H, $C{=}CCH_2CH_3$), and 0.82 (t, J = 7.3 Hz, 3H, $C{=}CCH_2CH_2CH_2CH_3$).

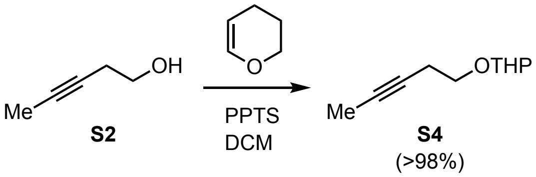
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 144.9, 133.9, 132.3, 123.2, 119.2, 38.1, 36.3, 30.4, 27.0, 23.0, 22.6, 14.1, and 13.4.

IR (neat): 2960, 2930, 2871, 1773, 1710, 1394, 1358, and 719 cm^{-1}.

HRMS (ESI-TOF): m/z calcd for $C_{18}H_{24}NO_2^+$ $(M+H)^+$: 286.1802, found 286.1811.

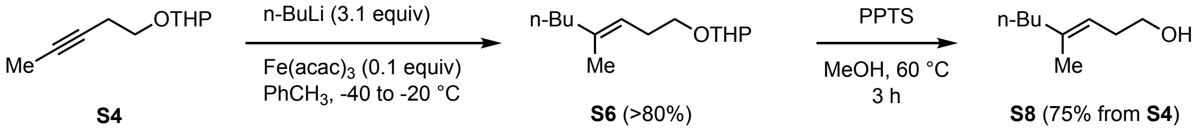
Synthesis of **1b**

2-(Pent-3-yn-1-yloxy)tetrahydro-2*H*-pyran (S4):



Homopropargyl alcohol **S2** (~21 g, ~250 mmol), dihydropyran (33 mL, 357 mmol, 1.5 equiv), PPTS (5.98 g, 23.8 mmol, 0.10 equiv) and CH_2Cl_2 (500 mL) were added to a 1 L round-bottom flask, and stirred for 6 h at room temperature. The solution was concentrated under reduced pressure, and transferred to a separatory funnel with NH_4Cl (300 mL) and Et_2O (600 mL). The aqueous layer was drained, and the organic layer was washed with NH_4Cl (2 x 300 mL), $NaHCO_3$ (3 x 300 mL), brine (200 mL), dried ($MgSO_4$), filtered, and concentrated to give pure **S4** (42.20 g, 250 mmol, >98%). The NMR is consistent with literature reports[3]

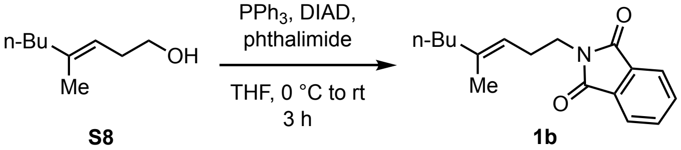
(*E*)-4-Methyloct-3-en-1-ol (S8):



Homopropargyl THP ether **S4** (13.5 g, 80.2 mmol) and $Fe(acac)_3$ (2.83 g, 8.0 mmol, 0.1 equiv) were added to a 2 L flame-dried 3-neck round-bottom flask equipped with a dropping funnel and internal thermometer (-50 to 30 °C) and dissolved in toluene (800 mL). The solution was sparged with argon (balloon, 45 min) then placed under nitrogen and cooled to -40 °C (internal temperature). To this solution n-BuLi (100 mL, 2.5 M in hexanes, 3.1 equiv) was added dropwise via cannula so as to keep the internal temperature below -30 °C (~ 40 min). The -40 °C cooling bath was replaced with a -20 °C cooling bath and the reaction was stirred for 1.5 h while keeping the reaction mixture between -20 and -15 °C. The reaction mixture was cooled to -50 °C and acetic acid (15 mL) was added dropwise while keeping the reaction mixture below –25 °C. To this 1.2 M HCl (300 mL) was added and the mixture was allowed to warm to room temperature. The mixture was transferred to a separatory funnel with ether (600 mL). The aqueous layer was extracted with additional ether (300 mL) and the combined organic layers were washed with 1.2 M HCl (100 mL x 2), $NaHCO_3$ (100 mL x 3), brine (100 mL), dried ($MgSO_4$), filtered, and concentrated to give crude **S6** as an orange oil. This material was diluted in 9:1 Hex:EtOAc and SiO_2 (~60 g) was added. The resulting suspension was passed through a plug of SiO_2 eluting with additional 9:1 Hex:EtOAc to give partly purified **S6**, which was used in the next step without additional purification.

The THP ether **S6** from the previous step was added to a 1 L round bottom flask, dissolved in MeOH (500 mL), PPTS (2.00 g, 8.0 mmol, 0.1 equiv based on **S4**) was added, and the mixture was heated to 60 °C for 3 h. The mixture was cooled to room temperature and concentrated under reduced pressure and the resulting residue was transferred to a separatory funnel with NH_4Cl (100 mL) and Et_2O (500 mL). The aqueous layer was drained, and the organic layer was washed with NH_4Cl (2 x 100 mL), $NaHCO_3$ (3 x 100 mL), brine (100 mL), dried ($MgSO_4$), filtered, and concentrated to give crude **S8**. Crude **S8** was purified by vacuum distillation (1 torr, bp = ~60 °C) to give pure **S8** (8.57 g, 60.2 mmol, 75%) as a colorless oil. The NMR data is consistent with literature results[4]

(*E*)-2-(4-Methyloct-3-en-1-yl)isoindoline-1,3-dione (1b):



Homoallylic alcohol **S8** (1.22 g, 8.6 mmol), phthalimide (1.47 g, 9.96 mmol, 1.2 equiv), and triphenylphosphine (2.61 g, 9.96 mmol, 1.2 equiv) were added to a 100 mL round bottom flask, dissolved in THF (40 mL), and cooled to 0 °C in an ice bath. To this solution DIAD (1.96 mL, 9.96 mmol, 1.2 equiv) was added dropwise over 10 min. The ice bath was removed and the reaction mixture was allowed to warm to ambient temperature. After 1.5 h TLC (6:1 Hex:EtOAc) indicated the reaction was complete. The reaction mixture was concentrated under reduced pressure and the resulting residue was purified by flash column chromatography (SiO_2, 30:1 to 15:1 to 9:1 Hex:EtOAc) to give pure **1b** (1.56 g, 5.75 mmol, 67%) as a colorless oil that slowly solidified at ~4 °C (melting point < 25 °C).**^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.82 (nfom, 2H, NPhthH_o), 7.69 (nfom, 2H, NPhthH_m), 5.11 (tq, J = 7.3, 1.2 Hz, 1H, C=CH), 3.68 (t, J = 7.3 Hz, 2H, $C{=}CHCH_2CH_2NPhth$), 2.38 (q, J = 7.3 Hz, 2H, $C{=}CHCH_2CH_2NPhth$), 1.91 (t, J = 7.4 Hz, 2H, $PrCH_2C{=}C$), 1.52 (d, J = 1.0 Hz, 3H, $C{=}CCH_3$), 1.25 (m, 2H, $CH_3CH_2CH_2CH_2C{=}C$), 1.17 (m, 2H, $CH_3CH_2CH_2CH_2C{=}C$), and 0.81 (t, J = 7.3 Hz, 3H, $C{=}CCH_2CH_2CH_2CH_3$).

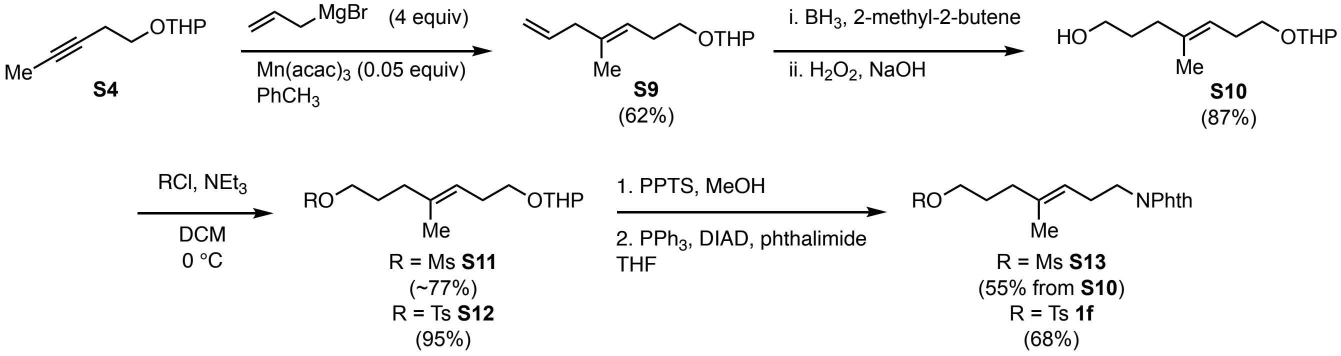
^{13}C NMR (125 MHz, $CDCl_3$) δ 168.5, 139.1, 133.9, 132.2, 123.2, 119.6, 39.4, 37.8, 30.1, 27.2, 22.4, 16.0, and 14.1.

IR (neat): 2928, 2858, 1773, 1706, 1392, 1356, and 717 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{17}H_{22}NO_2^+$ $(M+H)^+$: 272.1645, found 272.1659.

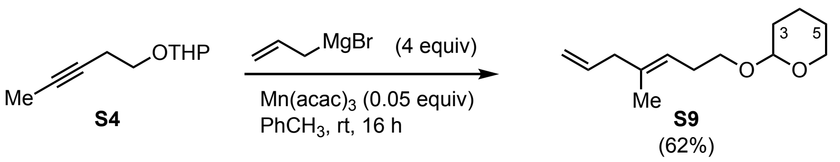
2b. Synthesis of homoallylic phthalimides 1c–1j (Table 2):

The substrates **1c–1j** were prepared starting from mesylate **S13** or tosylate **1f**, which were prepared in five steps starting from the known THP protected homoallylic alcohol **S4** following the synthetic sequence shown in **Scheme S2**.



Scheme S2: Synthesis of precursors **S13** and **1f**.

((E)-2-((4-Methylhepta-3,6-dien-1-yl)oxy)tetrahydro-2H-pyran (S9)[5]:



Homopropargyl THP ether **S4** (20.72 g, 123 mmol), and Mn(acac)$_3$ (80% (technical grade), 2.71 g, 6.15 mmol, 0.05 equiv) were added to a flame dried three liter three-neck round-bottom flask equipped with an internal thermometer (-50 to 30 °C) and additional funnel and dissolved in toluene (1.23 L). The solution was purged with argon for 45 min and placed in a ~20 °C water bath (internal temperature). To this solution allylmagnesium bromide (493 mL, 1 M in ether, 493 mmol, 4 equiv) was added dropwise via additional funnel so as to keep the internal temperature below 25 °C (50 min). The reaction was stirred at room temperature for an additional 16 h. The reaction mixture was then cooled to 0 °C and 2 M HCl (300 mL) was added dropwise at such a rate that the temperature did not rise above 10 °C. The mixture was transferred to a separatory funnel with ether (800 mL). The aqueous layer was extracted with ether (200 mL) and the combined organic layers were washed with NaHCO$_3$ (200 mL x 3) and brine (100 mL). The combined organic layers were dried (MgSO$_4$), filtered, concentrated, and passed through a plug of silica (SiO$_2$, Et$_2$O). The resulting residue was purified by a fractional vacuum distillation (~2 torr, 66–71 °C fraction) to give pure **S9** (14.16 g, 67.3 mmol, 55% yield). The distillation residue was also purified by flash column chromatography (SiO$_2$, 20:1 Hex:EtOAc) to give additional **S9** (1.68 g, 8.0 mmol, 7 % yield) to give a total yield of 62% yield.

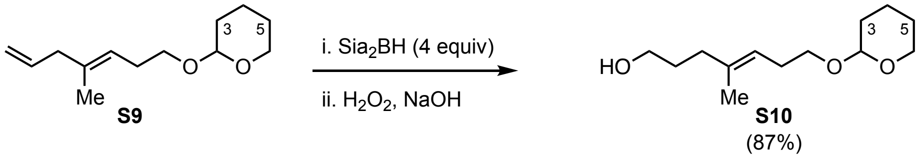
^{1}H NMR (500 MHz, CDCl$_3$): δ 5.77 (dddd, *J* = 17.1, 10.3, 6.9, 6.9 Hz, 1H, CH$_t$CH$_c$=C*H*CH$_2$), 5.20 (dd, *J* = 6.9, 6.9 Hz, 1H, CH$_2$CH$_3$=C*H*CH$_2$), 5.02 (d, *J* = ~17 Hz, 1H, C*H*$_t$CH$_c$=CHCH$_2$), 5.00 (d, *J* = ~10 Hz, 1H, CH$_t$C*H*$_c$=CHCH$_2$), 4.60 (t, *J* = 3.2 Hz, 1H, CH$_2$OC*H*O), 3.87 (ddd, *J* = 11.0, 7.8, 3.0 1H, CH$_2$OCHOC*H*$_a$H$_b$), 3.71 (ddd, *J* = 9.6, 7.4, 7.4 Hz, 1H, C*H*$_a$H$_b$OCHO), 3.49 (m, 1H, CH$_2$OCHOCH$_a$*H*$_b$), 3.39 (ddd, *J* = 9.5, 7.0, 7.0 Hz, CH$_a$*H*$_b$OCHO), 2.72 (d, *J* = 6.8 Hz, 2H, CH$_2$=CHC*H*$_2$), 2.32 (app q, *J* = 7.2 Hz, 2H, C*H*$_2$CH$_2$OCHO), 1.83 (m, 1H, C4*H*$_a$), 1.71 (m, 1H, C3*H*$_a$), 1.62 (s, 3H, C*H*$_3$C=CHCH$_2$), and 1.61–1.50 (m, 4H, C3*H*$_b$, C4*H*$_b$, C5*H*$_2$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 137.0, 135.8, 121.4, 115.8, 98.9, 67.3, 62.4, 44.3, 30.9, 28.9, 25.6, 19.8, and 16.3.

IR (neat): 2940, 2870, 1636, 1440, 1351, 1136, 1119, 1072, 1030, 958, and 908 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{13}H_{22}O_2Na^+$ $(M+Na)^+$: 233.1512, found 233.1524.

(E)-4-Methyl-7-((tetrahydro-2H-pyran-2-yl)oxy)hept-4-en-1-ol (S10):



Borane in tetrahydrofuran (1 M, 100 mL, 100 mmol, 4 equiv) was transferred to a flame-dried 500 mL RBF via cannula and cooled to 0 °C. 2-Methyl-2-butene (23.3 mL, 220 mmol, 2.2 equiv relative to borane) was added dropwise over 30 min and then stirred at 0 °C for 2 h. To this solution of Sia$_2$BH a 0 °C solution of alkene **S9** (5.25 g, 25 mmol, 1 equiv) in THF (50 mL) was added dropwise over 30 min and slowly warmed to room temp over 2 h and the solution was then stirred at ambient temperature overnight (~16 h). The solution was then cooled to 0 °C and NaOH (3 M, 20 mL) was added dropwise over 10 min followed by the dropwise addition of H$_2$O$_2$ (30%, 20 mL) over 30 min. The biphasic mixture was then stirred for 3 h (a significant amount of white precipitate was formed). The mixture was then transferred to a separatory funnel and diluted with Et$_2$O (450 mL) and washed with water (100 mL). The aqueous layer was extracted with Et$_2$O (100 mL) and the combined organic layers were washed with brine (100 mL), dried (MgSO$_4$), filtered, and concentrated (60 °C at ~20 torr followed by 30 °C at ~1 torr). The crude reaction mixture was then purified by flash column chromatography (SiO$_2$, 4:1 to 2:1 to 1:1 Hex:EtOAc) to give pure alcohol **S10** (4.974 g, 21.7 mmol, 87%) as a colorless oil.

^{1}H NMR (500 MHz, CDCl$_3$): δ 5.21 (br t, *J* = 7 Hz, 1H, CH$_2$CH$_3$=C*H*CH$_2$), 4.58 (br t, *J* = 2 Hz, 1H, CH$_2$OC*H*O), 3.87 (ddd, *J* = 10.8, 7.5, 3.0 Hz, 1H, CH$_2$OCHOC*H*$_a$H$_b$), 3.71 (ddd, *J* = 9.3, 7.1, 7.1 Hz, 1H, C*H*$_a$H$_b$OCHO), 3.63 (t, *J* = 6.3 Hz, 2H, HOC*H*$_2$CH$_2$CH$_2$C=), 3.49 (m, 1H, CH$_2$OCHOCH$_a$*H*$_b$), 3.38 (ddd,

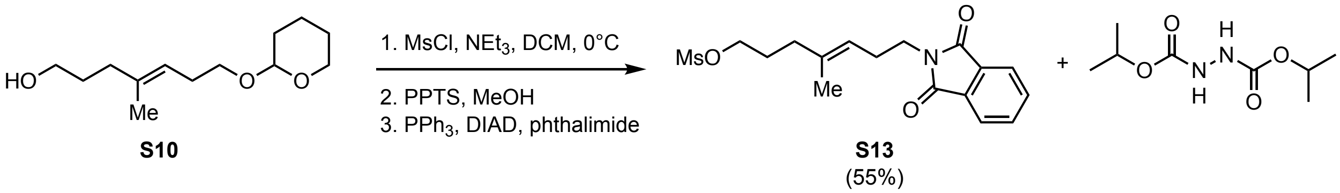
J = 9.2, 7.0, 7.0 Hz, CH_aH_bOCHO), 2.30 (q, J = 7.1 Hz, 2H, CH_2CH_2OCHO), 2.08 (t, J = 7.3 Hz, 2H, $HOCH_2CH_2CH_2C{=}C$), 1.81 (m, 1H, C4H_a), 1.71 (m, 1H, C3H_a), 1.67, (m, 2H, $HOCH_2CH_2CH_2C{=}C$), 1.64 (s, 3H, $CH_3C{=}CHCH_2$), and 1.61–1.50 (m, 4H, C3H_b, C4H_b, C5H_2).

^{13}C NMR (125 MHz, $CDCl_3$): δ 137.0, 121.1, 99.0, 67.3, 62.9, 62.5, 36.3, 30.9, 30.8, 28.8, 25.6, 19.8, and 16.1.

IR (neat): 3400 (br), 2938, 2868, 1119, 1067, and 1029 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{13}H_{24}O_3Na^+$ (M+Na)$^+$: 251.1618, found 251.1628.

(*E*)-7-(1,3-Dioxoisoindolin-2-yl)-4-methylhept-4-en-1-yl methanesulfonate (S13):



(55%)
(isolated as a 1:0.12 ratio of **S13** to hydrazine)

Mesylation of primary alcohol: The primary alcohol **S10** (1.57 g, 6.87 mmol) and triethyl amine (2.9 mL, 20.61 mmol, 3 equiv) were added to a 100 mL round bottom flask, dissolved in DCM (50 mL), and cooled to 0 °C in an ice bath. To this solution MsCl (0.61 mL, 7.90 mmol, 1.15 equiv) was added dropwise over 15 min and stirred at 0 °C for an additional 30 min. To this $NaHCO_3$ (25 mL) was added, the ice bath was removed and the mixture was stirred for 30 min. The biphasic mixture was transferred to a separatory funnel with DCM (~20 mL) and the layers were separated. The Aq. layer was extracted with additional DCM (20 mL) and the combined organic layer was dried ($MgSO_4$), filtered, and concentrated to give crude mesylate **S11** (1.62 g, ~5.29 mmol) which was carried forward without additional purification.

THP deprotection: The crude mesylate (1.62 g, ~5.29 mmol) and PPTS (133 mg, 0.53 mmol, 0.1 equiv) were dissolved in MeOH (53 mL) and heated to 55 °C for 2 h. The mixture was cooled to room temperature, concentrated, and transferred to a separatory funnel with NH_4Cl (50 mL) and Et_2O (150 mL). The layers were separated and the organic layer was washed with additional NH_4Cl (50 mL x 2), $NaHCO_3$ (50 mL x 3), and brine (50 mL). The organic layer was then dried ($MgSO_4$), filtered, and concentrated to give the corresponding alcohol which was used in the next step without further purification.

Mitsunobu reaction: To the crude alcohol from the previous step in a 50 mL round bottom flask was added phthalimide (934 mg, 6.35 mmol, 1.2 equiv) and triphenylphosphine (1.67 g, 6.35 mmol, 1.2 equiv). The resulting mixture was dissolved in THF (25 mL) and cooled to 0 °C. To this DIAD (1.25 mL, 6.35 mmol, 1.2 equiv) was added dropwise over 10 min after which the cooling bath was removed and the mixture was stirred at ambient temperature for an additional 1 h at which time the reaction was determined to be complete by TLC. The reaction mixture was concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 6:1 to 5:1 to 4:1 to 3:1 Hex:EtOAc) to give a 8.3:1 mixture of **S13** : diisopropyl hydrazine-1,2-dicarboxylate (1.43 g (94% by mass **S13**), 3.83 mmol, 55% from **S10**) as a colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (nfom, 2H, NPhthArH_m), 7.72 (nfom, 2H, NPhthArH_o), 5.19 (br t, *J* = 8 Hz, 1H, C=C*H*), 4.16 (t, *J* = 6.3 Hz, 2H, CH_2OMs), 3.71 (t, *J* = 7.1 Hz, 2H, CH_2NPhth), 3.01 (s, 3H, OSO_2CH_3), 2.41 (app q, *J* = 6.7 Hz, 2H, C=CHC$H_2$$CH_2$NPhth), 2.06 [t, *J* = 7.6 Hz, 2H, C=C(Me)(C$H_2$$CH_2$$CH_2$OMs)], 1.79 [pent, *J* = 6.8 Hz, 2H, C=C(Me)(CH_2C$H_2$$CH_2$OMs)], and 1.57 [br s, 3H, C=C(CH_3)].

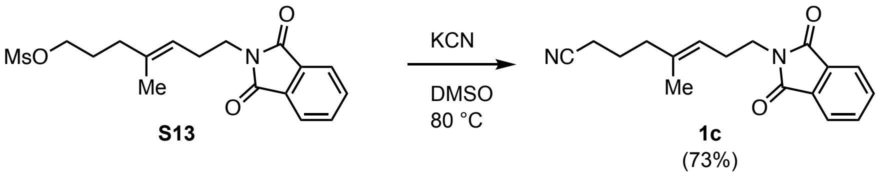
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 136.7, 134.0, 132.2, 123.3, 121.4, 69.7, 37.7, 37.4, 35.2, 27.3, 27.2, and 16.0.

IR (neat): 3339 (br, hydrazine), 2940, 1771, 1704, 1394, 1251, 1171, 957, 916, and 718 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{21}NNaO_5S$ $(M+Na)^+$: 374.1038, found 374.1045.

Synthesis of 1c–1j

(*E*)-8-(1,3-Dioxoisoindolin-2-yl)-5-methyloct-5-enenitrile (**1c**):



The mesylate **S13** (264 mg, 0.751 mmol) and KCN (98 mg, 1.50 mmol, 2 equiv) were added to a scintillation vial and dissolved in DMSO (3 mL). The vial was sealed with a Teflon-lined cap and the mixture was heated to 80 °C for 18 h. The mixture was cooled to room temperature and partitioned between Et$_2$O (20 mL) and water (10 mL). The aqueous layer was extracted with additional Et$_2$O (20 mL) and the combined organic layers were washed with water (15 mL x 5), brine (15 mL), dried (MgSO$_4$), filtered, concentrated, and passed through a plug of silica (1:1 Hex:EtOAc). The resulting residue was purified by MPLC (SiO$_2$, 6:1 Hex:EtOAc) to give pure cyanide **1c** (155 mg, 0.55 mmol, 73%) as an amorphous white solid.

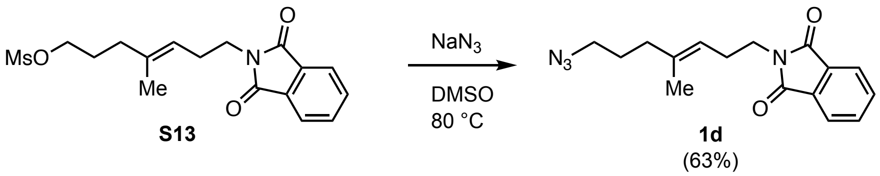
^{1}H NMR (500 MHz, CDCl$_3$): δ 7.83 (nfom, 2H, NPhthArH_m), 7.70 (nfom, 2H, NPhthArH_o), 5.19 (t, *J* = 7.6 Hz, 1H, C=CH), 3.70 (t, *J* = 7.2 Hz, 2H, CH$_2$CH_2NPhth), 2.40 (ddd, *J* = 7.1 Hz, 2H, MeC=CHCH_2), 2.23 (t, *J* = 7.2 Hz, 2H, NCCH_2CH$_2$CH$_2$), 2.07 (t, *J* = 7.4 Hz, 2H, HC=CCH_2CH$_2$CH$_2$CN), 1.68 (m, 2H, NCCH$_2$CH_2CH$_2$), and 1.54 (s, 3H, CH_3C=C).

^{13}C NMR (125 MHz, CDCl$_3$): δ 168.5, 136.1, 134.1, 132.1, 123.3, 122.1, 119.8, 38.3, 37.6, 27.3, 23.4, 16.4, and 15.8.

IR (neat): 2940, 2249, 1771, 1705, 1393, 1357, 911, and 717 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{19}N_2O_2^+$ (M+H)$^+$: 283.1441, found 283.1453.

(*E*)-2-(7-Azido-4-methylhept-3-en-1-yl)isoindoline-1,3-dione (1d):



The mesylate **S13** (529 mg, 1.5 mmol) and NaN$_3$ (195 mg, 3.0 mmol, 2 equiv) were added to a scintillation vial and dissolved in DMSO (10 mL). The vial was sealed with a Teflon-lined cap and the mixture was heated to 80 °C for 24 h. The mixture was cooled to room temperature and partitioned between Et$_2$O (100 mL) and water (150 mL). The aqueous layer was extracted with additional Et$_2$O (100 mL) and the combined organic layers were washed with water (4 x 50 mL) and brine (50 mL). The solution was dried

($MgSO_4$), filtered, concentrated, and the resulting residue was passed through a plug of silica (Et_2O). The product was purified by MPLC (SiO_2, 5:1 Hex:EtOAc) to give pure azide **1d** (283 mg, 0.95 mmol, 63%) as a colorless oil.

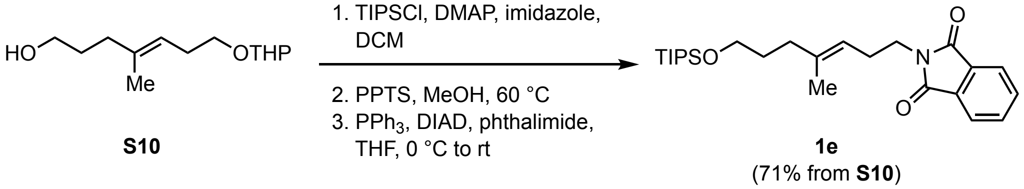
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (nfom, 2H, NPhthArH_m), 7.71 (nfom, 2H, NPhthArH_o), 5.18 (tq, *J* = 7.4, 1.3 Hz, 1H, C=C*H*), 3.71 (t, *J* = 7.1 Hz, 2H, CH_2CH_2NPhth), 3.18 (t, *J* = 7.0 Hz, 2H, $CH_2CH_2CH_2N_3$), 2.41 (app q, *J* = 7.3 Hz, 2H, C=CHCH_2CH_2NPhth), 2.02 (t, *J* = 7.4 Hz, 2H, C=C(Me)$CH_2CH_2CH_2N_3$), 1.62 (pent, *J* = 7.2 Hz, 2H, C=C(Me)$CH_2CH_2CH_2N_3$), and 1.56 (d, *J* = 0.9 Hz, 3H, C=CCH_3).

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 137.2, 134.0, 132.3, 123.3, 121.2, 51.0, 37.7, 36.6, 27.3, 27.0, and 16.0.

IR (neat): 2940, 2867, 2093, 1771, 1705, 1392, 1357, 1255, and 717 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{16}H_{18}N_4O_2Na^+$ $(M+Na)^+$: 321.1322, found 321.1335.

(E)-7-(1,3-Dioxoisoindolin-2-yl)-4-methylhept-4-en-1-yl methanesulfonate (1e):



TIPS protection: The primary alcohol **S10** (609 mg, 2.67 mmol), DMAP (49 mg, 0.40 mmol, 0.15 equiv), and imidazole (364 mg, 5.34 mmol, 2.0 equiv) were added to a scintillation vial equipped with a stir bar and septum and dissolved in DCM (10 mL). To this solution TIPSCl (0.9 mL, 4.00 mmol, 1.5 equiv) was added dropwise over 5 min and the resulting mixture was stirred at room temperature for an additional 45 min. The mixture was then transferred to a separatory funnel using DCM (10 mL) and washed with $NaHCO_3$ (20 mL). The aqueous layer was extracted with DCM (15 mL) and the combined DCM layers were dried ($MgSO_4$), filtered, and concentrated, and passed through a plug of SiO_2 (20:1 Hex:EtOAc). The resulting partially purified THP ether **S10** (1.04 g) was carried onto the next step without additional purification.

THP deprotection: The crude THP ether (1.04 g) was dissolved in MeOH (25 mL), PPTS (33 mg, 0.13 mmol, 0.05 equiv) was added, and the mixture was heated to 55 °C for 5 h. The mixture was then cooled to room temperature, concentrated and partitioned between Et_2O (50 mL) and NH_4Cl (25 mL). The aqueous layer was extracted with additional Et_2O (2 x 50 mL) and the combined organic layers were washed with NH_4Cl (2 x 50 mL), $NaHCO_3$ (3 x 50 mL), brine (1 x 50 mL), filtered, and concentrated to give the corresponding alcohol (726 mg, ~2.42 mmol, ~90%) which was carried onto the next step without additional purification.

Mitsunobu reaction: To the crude alcohol from the previous step in a scintillation was added phthalimide (427 mg, 2.90 mmol, 1.2 equiv) and triphenylphosphine (761 mg, 2.90 mmol, 1.2 equiv). The resulting mixture was dissolved in THF (12 mL) and cooled to 0 °C. To this solution DIAD (0.57 mL, 2.90 mmol, 1.2 equiv) was added dropwise over 10 min, after which the cooling bath was removed and the mixture was stirred at ambient temperature for an additional 45 min at which time the reaction was determined to be complete by TLC. The reaction mixture was concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 15:1 Hex:EtOAc) to give pure **1e** (816 mg, 1.90 mmol, 79% from **S10**) as a colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.83 (nfom, 2H, NPhthArH_m), 7.70 (nfom, 2H, NPhthArH_o), 5.15 (t, J = 7.6 Hz, 1H, C=CH), 3.68 (t, J = 7.6 Hz, 2H, CH_2CH_2NPhth), 3.62 [t, J = 6.3 Hz, 2H, $CH_2OSi(CH(CH_3)_2)_3$], 2.38 (app q, J = 7.6 Hz, 2H, MeC=CHCH_2), 2.00 (t, J = 7.6 Hz, 2H, HC=C$CH_2CH_2CH_2$OTIPS), 1.57 (s, 3H, CH_3C=C), 1.56 (m, 2H, TIPSO$CH_2CH_2CH_2$), and 1.11–1.02 [m, 21H, $CH_2OSi(CH(CH_3)_2)_3$ and $CH_2OSi(CH(CH_3)_2)_3$].

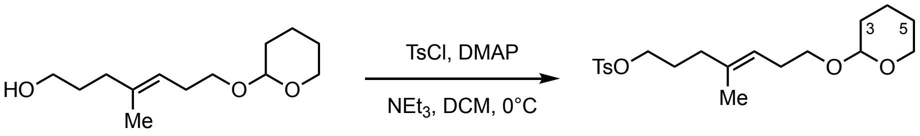
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 138.7, 134.0, 132.3, 123.3, 119.8, 63.2, 37.8, 36.0, 31.5, 27.4, 18.2, 16.2, and 12.1.

IR (neat): 2941, 2864, 1773, 1710, 1392, 1358, 1104, 882, 718, and 680 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{25}H_{39}NO_3SiNa^+$ $(M+Na)^+$: 452.2591, found 452.2599.

Synthesis of 1f

(*E*)-4-Methyl-7-((tetrahydro-2*H*-pyran-2-yl)oxy)hept-4-en-1-yl 4-methylbenzenesulfonate (S12):



S12
(95%)

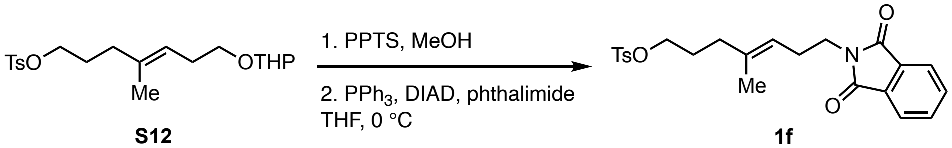
The primary alcohol **S10** (4.97 g, 21.7 mmol), DMAP (265 mg, 2.17 mmol, 0.1 equiv) and triethylamine (4.6 mL, 33.0 mmol, 1.5 equiv) were added to a 250 mL round bottom flask, dissolved in DCM (100 mL), and cooled to 0 °C in an ice bath. To this solution TsCl (5.17 g, 27.1 mmol, 1.25 equiv) in DCM (25 mL) was added dropwise over 20 min and stirred at 0–10 °C for an additional 4 h. To this $NaHCO_3$ (50 mL) was added, the ice bath was removed, and the mixture was stirred for 30 min. The biphasic mixture was transferred to a separatory funnel with DCM (~50 mL), the layers were separated, and the Aq. layer was extracted with additional DCM (50 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (SiO_2, 9:1 to 4:1 Hex:EtOAc) to give pure **S12** (7.87 g, 20.6 mmol, 95%).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.79 (d, *J* = 8.2 Hz, 2H, SO_2ArH_o), 7.34 (d, *J* = 8.1 Hz, 2H, SO_2ArH_m), 5.08 (tq, *J* = 7.0, 1.5 Hz, 1H, C=C*H*CH_2CH_2OTHP), 4.58 (dd, *J* = 4.6, 2.8 Hz, 1H, OC*H*O), 4.00 (t, *J* = 6.5 Hz, 2H, $CH_2CH_2CH_2$OTs), 3.89–3.84 (m, 1H, C6H_a), 3.67 (ddd, *J* = 9.3, 7.3, 7.3 Hz, 1H, $CH_2CH_aH_b$OTHP), 3.52–3.48 (m, 1H, C6H_b), 3.34 (ddd, *J* = 9.4, 7.3, 7.3 Hz, 1H, $CH_2CH_aH_b$OTHP), 2.45 (s, 3H, SO_2ArCH_3), 2.25 (app q, *J* = 7.1 Hz, 2H, C=CHCH_2CH_2OTHP), 2.00 (t, *J* = 7.4 Hz, 2H, $CH_2CH_2CH_2$OTs), 1.81 (m, 1H, C4H_a), 1.71 (m, 1H, C3H_a), 1.74 (m, 2H, HO$CH_2CH_2CH_2$C=C), 1.64 (d, *J* = ~1 Hz, 3H, CH_3C=$CHCH_2$), and 1.61–1.50 (m, 4H, C3H_b, C4H_b, C5H_2).

^{13}C NMR (125 MHz, $CDCl_3$): δ 144.8, 135.3, 133.3, 130.0, 128.0, 121.8, 99.0, 70.3, 67.2, 62.5, 35.3, 30.9, 28.7, 27.1, 25.6, 21.8, 19.8, and 16.0.

IR and **HRMS** was not collected for this compound.

(*E*)-7-(1,3-Dioxoisoindolin-2-yl)-4-methylhept-4-en-1-yl 4-methylbenzenesulfonate (1f):



S12

1f
(68%)

THP deprotection: The THP ether **S12** (7.87 g, 20.6 mmol) and PPTS (259 mg, 1.09 mmol, 0.05 equiv) were dissolved in MeOH (200 mL) and heated to 55 °C for 2 h. The mixture was cooled to room temperature, concentrated, and transferred to a separatory funnel with NH_4Cl (100 mL) and Et_2O (250 mL). The layers were separated and the organic layer was washed with additional NH_4Cl (50 mL x 2), $NaHCO_3$ (50 mL x 3), and brine (50 mL). The organic layer was then dried ($MgSO_4$), filtered, and concentrated to give the corresponding alcohol which was used in the next step without further purification.

Mitsunobu reaction: To the crude alcohol from the previous step in a 250 mL round bottom flask was added phthalimide (3.64 g, 24.72 mmol, 1.2 equiv) and triphenylphosphine (6.48 g, 24.72 mmol, 1.2 equiv). The resulting mixture was dissolved in THF (100 mL) and cooled to 0 °C. To this DIAD (4.85 mL, 24.72 mmol, 1.2 equiv) was added dropwise over 10 min. The mixture was stirred an additional 30 min at 0 °C at which time the reaction was determined to be complete by TLC. The reaction mixture was concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 2:1 Hex:EtOAc) to give, in order of elution, a mixture of **1f** and phthalimide (~2 g) and a mixture of **1f** and hydrazine byproduct (4.54 g, 91% by mass, 9.66 mmol). The mixture of **1f** and phthalimide was further purified by MPLC (SiO_2, 3:1 Hex:EtOAc) to give pure **1f** (1.84 g, 4.3 mmol). The combined yield of **1f** is 68% from **S12**.

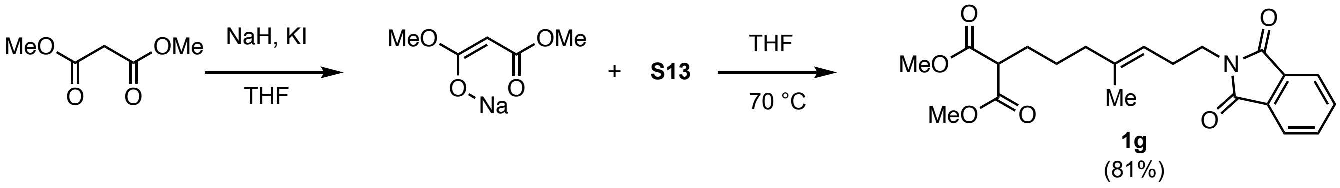
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.83 (nfom, 2H, NPhthArH_m), 7.78 (d, J = 8.2 Hz, 2H, OSO_2ArH_o), 7.71 (nfom, 2H, NPhthArH_o), 7.35 (d, J = 8.1 Hz, 2H, OSO_2ArH_m), 5.05 (tq, J = 7.4, 1.3 Hz, 1H, C=CH), 3.97 (t, J = 6.4 Hz, 2H, CH_2OTs), 3.64 (t, J = 7.3 Hz, 2H, CH_2NPhth), 2.45 (s, 3H, OSO_2ArCH_3), 2.34 (app q, J = 7.2 Hz, 2H, C=C(H)(C$H_2$$CH_2$NPhth), 1.95 (t, J = 7.3 Hz, 2H, C$H_2$$CH_2CH_2$OTs), 1.68 (pent, J = 7.0 Hz, 2H, CH_2C$H_2$$CH_2$OTs), and 1.50 [d, J = 1.1 Hz, 3H, C=C(CH_3)].

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 144.8, 136.8, 134.0, 133.4, 132.2, 130.0, 128.0, 123.3, 121.1, 70.2, 37.7, 35.2, 27.3, 27.1, 21.8, and 16.0.

IR (neat): 2943, 1771, 1706, 1436, 1394, 1355, 1188, 1174, 914, 718, 663, and 553 cm^{-1}.

HRMS (ESI-TOF): m/z calcd for $C_{23}H_{26}NO_5S^+$ $(M+H)^+$: 428.1526, found 428.1530.

Dimethyl (*E*)-2-(7-(1,3-dioxoisoindolin-2-yl)-4-methylhept-4-en-1-yl)malonate (1g):



Sodium hydride (60% in oil, 125 mg, 3.13 mmol, 1.25 equiv) and potassium iodide (42 mg, 0.25 mmol, 0.1 equiv) were placed into a 3-neck 25 mL round-bottom flask equipped with a stir bar and reflux condenser and suspended/dissolved in THF (3 mL). To this dimethyl malonate (0.39 mL, 3.44 mmol, 1.58 equiv) was added dropwise over 10 min and then stirred for an additional 10 min. The mixture was then warmed to 70 °C and mesylate **S13** (874 mg, 2.5 mmol) in THF (5 mL) was added in one portion and stirred at 70 °C for 18 h. The mixture was then cooled to room temperature and NH_4Cl (10 mL) was added. The mixture was transferred to a separatory funnel with Et_2O (50 mL) and the aqueous layer was removed and extracted with additional Et_2O (15 mL). The combined organic layers were dried ($MgSO_4$), filtered, concentrated, and passed through a plug of silica (Et_2O). The resulting residue was further purified by MPLC (SiO_2, 3:1 Hex:EtOAc) to give pure malonate **1g** (780 mg, 2.01 mmol, 81%) as a colorless oil.

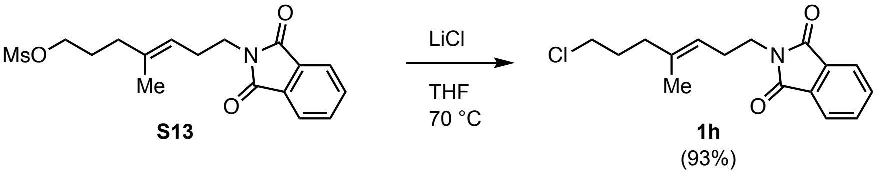
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (nfom, 2H, NPhthArH_m), 7.71 (nfom, 2H, NPhthArH_o), 5.15 (t, J = 7.4 Hz, 1H, C=CH), 3.74 (s, 6H, $CH(CO_2CH_3)_2$), 3.69 (t, J = 7.3 Hz, 2H, CH_2CH_2NPhth), 3.34 (t, J = 7.7 Hz, 1H, $CH_2CH(CO_2Me)_2$), 2.38 (app q, J = 7.3 Hz, 2H, MeC=CHCH_2), 1.97 (t, J = 7.5 Hz, 2H, HC=C$CH_2CH_2CH_2CH(CO_2Me)_2$), 1.83 (q, J = 7.6 Hz, 2H, $CH_2CH_2CH_2CH(CO_2Me)_2$), 1.54 (s, 3H, C=CCH_3), and 1.34 (pent, J = 7.9 Hz, 2H, $CH_2CH_2CH_2CH(CO_2Me)_2$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 170.0, 168.5, 137.9, 134.0, 132.2, 123.3, 120.5, 52.6, 51.7, 39.1, 37.8, 28.5, 27.3, 25.5, and 15.9.

IR (neat): 2954, 1708, 1436, 1395, 905, 718, and 648 cm^{-1}.

HRMS (ESI-TOF): m/z calcd for $C_{21}H_{26}NO_6^+$ $(M+H)^+$: 388.1755, found 388.1763.

(*E*)-2-(7-Chloro-4-methylhept-3-en-1-yl)isoindoline-1,3-dione (1h):



The mesylate **S13** (707 mg, 2.01 mmol) and LiCl (171 mg, 4.02 mmol, 2 equiv) were added to a scintillation vial and dissolved in THF (10 mL). The vial was sealed with a Teflon-lined cap and the mixture was heated to 70 °C for 24 h. The mixture was cooled to room temperature and partitioned between Et_2O (20 mL) and water (10 mL). The aqueous layer was extracted with additional Et_2O (20 mL) and the combined organic layers were washed with brine (15 mL), dried ($MgSO_4$), filtered, concentrated, and passed through a plug of silica (Et_2O). The resulting residue was purified by MPLC (SiO_2, 6:1 Hex:EtOAc) to give pure chloride **1h** (544 mg, 1.86 mmol, 93%) as a colorless oil.

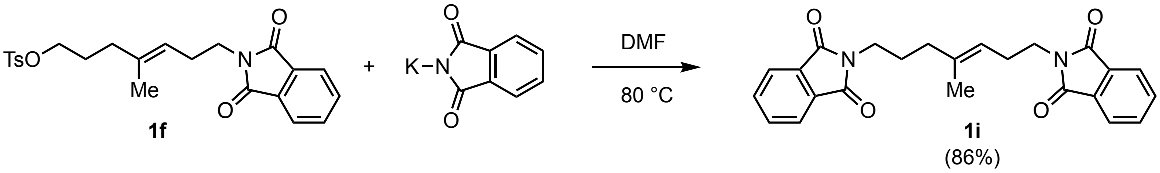
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (nfom, 2H, NPhthArH_m), 7.72 (nfom, 2H, NPhthArH_o), 5.19 (t, J = 7.4 Hz, 1H, C=CH), 3.71 (t, J = 7.2 Hz, 2H, CH_2CH_2NPhth), 3.44 (t, J = 6.6 Hz, 2H, $ClCH_2CH_2CH_2$), 2.41 (app q, *J* = 7.1 Hz, 2H, MeC=CHC*H*$_2$), 2.08 (t, *J* = 7.0 Hz, 2H, HC=CC*H*$_2$CH$_2$CH$_2$Cl), 1.79 (pent, *J* = 6.9 Hz, 2H, ClCH$_2$C*H*$_2$CH$_2$), and 1.56 (s, 3H, C*H*$_3$C=C).

^{13}C NMR (125 MHz, CDCl$_3$): δ 168.5, 137.0, 134.0, 132.2, 123.3, 121.2, 44.6, 37.7, 36.7, 30.7, 27.3, and 16.0.

IR (neat): 2983, 2942, 1773, 1736, 1711, 1394, 1372, 1235, 1044, and 720 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{16}H_{19}ClNO_2^+$ (M+H)$^+$: 292.1099, found 292.1108.

(*E*)-2,2'-(4-Methylhept-3-ene-1,7-diyl)bis(isoindoline-1,3-dione) (1i):



Tosylate **1f** (943 mg, 91% by mass, 2.01 mmol) and potassium phthalimide (465 mg, 2.51 mmol, 1.25 equiv) were added to a scintillation vial and dissolved in DMF (10 mL). The vial was sealed with a Teflon-lined cap and heated at 80 °C for 18 h. The mixture was then cooled to room temperature the mixture was transferred to a separatory funnel with Et$_2$O (50 mL) and water (50 mL). The aqueous layer was removed and extracted with additional Et$_2$O (50 mL). The combined organic layers were washed with water (4 x 50 mL), brine (50 mL), dried (MgSO$_4$), filtered, concentrated, and passed through a plug of silica (Et$_2$O). The resulting residue was further purified by MPLC (SiO$_2$, 3:1 Hex:EtOAc) to give pure phthalimide **1i** (693 mg, 1.72 mmol, 86%) as a waxy white solid.

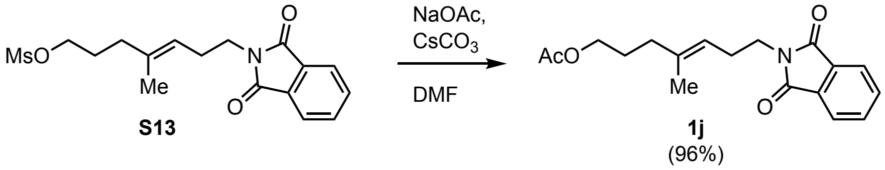
^{1}H NMR (500 MHz, CDCl$_3$): δ 7.83 (nfom, 2H, NPhthAr$_a$*H*$_m$), 7.82 (nfom, 2H, NPhthAr$_b$*H*$_m$), 7.71 (nfom, 2H, NPhthAr$_a$*H*$_o$), 7.66 (nfom, 2H, NPhthAr$_b$*H*$_o$), 5.19 (tq, *J* = 7.4, 1.3 Hz, 1H, C=C*H*CH$_2$), 3.68 (t, *J* = 7.2 Hz, 2H, C*H*$_2$NPhth), 3.59 (t, *J* = 7.4 Hz, 2H, C*H*$_2$NPhth), 2.38 (app q, *J* = 7.3 Hz, C=CC*H*$_2$CH$_2$NPhth), 2.02 (t, *J* = 7.5 Hz, 2H, C=CC*H*$_2$CH$_2$CH$_2$NPhth), 1.72 (m, 2H, HC=CCH$_2$C*H*$_2$CH$_2$NPhth), and 1.57 [d, *J* = 1.3 Hz, 3H, HC=C(C*H$_3$*)].

^{13}C NMR (125 MHz, CDCl$_3$): δ 168.5, 168.4, 137.4, 134.0, 134.0, 132.3, 132.3, 123.3 (2C, phthalimide), 120.7, 37.8, 37.7, 36.9, 27.3, 26.6, and 15.9.

IR (neat): 3027, 2926, 2853, 1770, 1704, 15001, 1393, 1358, 1260, 1065, and 718 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{24}H_{23}N_2O_4^+$ (M+H)$^+$: 403.1652, found 403.1658.

(*E*)-7-(1,3-Dioxoisoindolin-2-yl)-4-methylhept-4-en-1-yl acetate (1j):



Mesylate **S13** (1.02 g, 2.91 mmol), sodium acetate (2.95 g, 36 mmol), and cesium carbonate (5.86 g, 18 mmol) were added to a 100 mL round bottom flask and dissolved/suspended in DMF (30 mL) and stirred at room temperature overnight. The mixture was transferred to a separatory funnel with water (150 mL) and Et_2O (100 mL). The aqueous layer was drained and extracted with additional Et_2O (100 mL). The combined organic layers were washed with water (4 x 100 mL), brine (100 mL), dried ($MgSO_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (SiO_2, 9:1 to 6:1 to 3:1 Hex:EtOAc) to give pure acetate **1j** (876 mg, 2.78 mmol, 96%) as a pale-yellow oil.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (nfom, 2H, NPhthAr$_a$$H_m$), 7.71 (nfom, 2H, NPhthAr$_a$$H_o$), 5.17 (tq, *J* = 7.3, 1.4 Hz, 1H, C=C*H*CH$_2$), 3.99 (t, *J* = 6.7 Hz, 2H, C*H*$_2$OAc), 3.70 (t, *J* = 7.1 Hz, 2H, C*H*$_2$NPhth), 2.40 (app q, *J* = 7.4 Hz, 2H, (Me)C=CHC*H*$_2$CH$_2$NPhth), 2.03 (s, 3H, OCOCC*H*$_3$), 2.01 (t, *J* = 8.0 Hz, 2H, HC=C(CH$_3$)C*H*$_2$CH$_2$CH$_2$OAc), 1.66 (m, 2H, HC=C(CH$_3$)CH$_2$C*H*$_2$CH$_2$OAcc), and 1.57 [d, *J* = 1.3 Hz, 3H, HC=C(C*H*$_3$)].

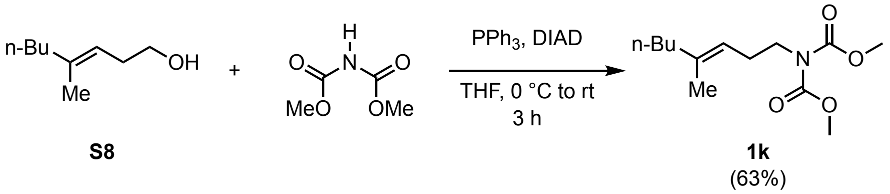
^{13}C NMR (125 MHz, $CDCl_3$): δ 171.2, 168.5, 137.5, 134.0, 132.3, 123.3, 120.7, 64.2, 37.7, 35.9, 27.3, 26.8, 21.1, and 16.0.

IR (neat): 2941, 1772, 1735, 1705, 1436, 1393, 1359, 1235, 1037, and 718 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{18}H_{21}NO_4Na^+$ $(M+Na)^+$: 338.1363, found 338.1370.

2c. Synthesis of homoallylic amides, imides, sulfonamides, and carbamates (1k–w, Tables 3–4)

Methyl (*E*)-carbomethoxy(4-methyloct-3-en-1-yl)carbamate (1k):



Homoallylic alcohol **S8** (705 mg, 4.96 mmol), dimethyl iminodicarbonate[6] (799 mg, 6.0 mmol, 1.2 equiv), and triphenylphosphine (1.57 g, 6.0 mmol, 1.2 equiv) were added to a 50 mL round bottom flask equipped with a stir bar, dissolved in THF (25 mL), and cooled to 0 °C in an ice bath. To this solution DIAD (1.2 mL, 6.0 mmol, 1.2 equiv) was added dropwise over 10 min. The ice bath was removed and the solution was stirred at ambient temperature for 3 h. The reaction mixture was concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 15:1 to 9:1 to 6:1 Hex:EtOAc) to give **1k** (810 mg, 3.15 mmol, 63%) as a colorless oil.

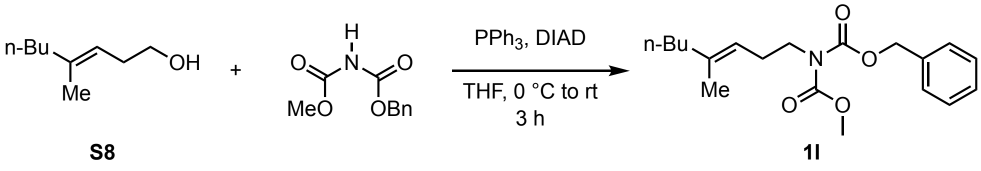
^{1}H NMR (500 MHz, $CDCl_3$): δ 5.09 (tq, *J* = 7.6, 0.9 Hz, 1H, MeBuC=C*H*), 3.82 [s, 6H, $N(COCH_3)_2$], 3.67 [dd, *J* = 7.5, 6.1 Hz, 2H, $C{=}HCH_2CH_2N(CO_2CH_3)_2$], 2.29 (app q, *J* = 7.6 Hz, 2H, $C{=}HCH_2CH_2N(CO_2CH_3)_2$, 1.97 (br t, *J* = 7.3 Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.60 (d, *J* = 1.3 Hz, 3H, $CH_3C{=}CH$), 1.39–1.33 (m, 2H, $CH_3CH_2CH_2CH_2C{=}C$), 1.30–1.23 (m, 2H, $CH_3CH_2CH_2CH_2C{=}C$), and 0.89 (t, *J* = 7.3 Hz, 3H, $CH_3CH_2CH_2CH_2C{=}C$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 154.2, 138.8, 119.3, 53.7, 46.4, 39.4, 30.1, 27.5, 22.4, 15.8, and 14.0.

IR (neat): 2957, 2930, 2860, 1794, 1728, 1700, 1436, 1360, 1285, 1191, 1171, 1104, 778, and 731 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{13}H_{24}NO_4^+$ $(M+H)^+$: 258.1700, found 258.1711.

Methyl (*E*)-carbomethoxy(4-methyloct-3-en-1-yl)carbamate (1l):



Homoallylic alcohol **S8** (427 mg, 3.0 mmol), benzyl methyl iminodicarbonate[7] (753 mg, 3.6 mmol, 1.2 equiv), and triphenylphosphine (944 mg, 3.6 mmol, 1.2 equiv) were added to a 25 mL round bottom flask equipped with a stir bar, dissolved in THF (10 mL), and cooled to 0 °C in an ice bath. To this solution DIAD (0.71 mL, 3.6 mmol, 1.2 equiv) was added dropwise over 10 min. The ice bath was removed and the solution was stirred at ambient temperature for 3 h. The reaction mixture was concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 15:1 to 9:1 to 6:1 Hex:EtOAc) to give impure **1l**. This material was further purified by MPLC (SiO_2, 15:1 Hex:EtOAc) to give pure **1l** (804 mg, 2.41 mmol, 80%) as a colorless oil.

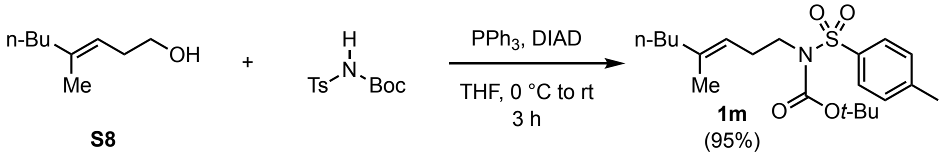
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.41–7.31 (m, 5H, $COOCH_2C_6\mathit{H}_5$), 5.24 (s, 2H, $COOC\mathit{H}_2Ph$), 5.07 (tq, *J* = 7.4, 1.4 Hz, 1H, $C{=}C\mathit{H}CH_2CH_2N$), 3.82 (s, 3H, $CO_2C\mathit{H}_3$), 3.68 (m, 2H, $CH_2C\mathit{H}_2N$), 2.27 (app q, *J* = 7.6 Hz, 2H, $C{=}CC\mathit{H}_2CH_2N$), 1.93 (t, *J* = 7.2 Hz, 2H, $C\mathit{H}_2CH_2CH_2CH_3$), 1.53 [d, *J* = 0.8 Hz, 3H, $C{=}C(Bu)(C\mathit{H}_3)$], 1.36–1.29 (m, 2H, $CH_2C\mathit{H}_2CH_2CH_3$), 1.29–1.21 (m, 2H, $CH_2CH_2C\mathit{H}_2CH_3$), and 0.88 (t, *J* = 7.2 Hz, 3H, $CH_2CH_2CH_2C\mathit{H}_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 154.4, 153.6, 138.9, 135.6, 128.7, 128.5, 128.2, 119.4, 68.6, 53.9, 46.5, 39.5, 30.2, 27.7, 22.5, 15.9, and 14.1.

IR (neat): 2956, 2927, 2858, 1794, 1751, 1724, 1700, 1437, 1355, 1282, 1169, 1098, 732, and 696 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{19}H_{28}NO_4^+$ $(M+H)^+$: 334.2013, found 234.2019.

***tert*-Butyl (*E*)-(4-methyloct-3-en-1-yl)(tosyl)carbamate (1m):**



Homoallylic alcohol **S8** (471 mg, 3.3 mmol), *tert*-butyl tosylcarbamate (1.07 g, 3.96 mmol, 1.2 equiv), and triphenylphosphine (1.04 g, 3.96 mmol, 1.2 equiv) were added to a 25 mL round bottom flask equipped with a stir bar, dissolved in THF (10 mL), and cooled to 0 °C in an ice bath. To this solution DIAD (0.80 mL, 3.96 mmol, 1.2 equiv) was added dropwise over 10 min. The ice bath was removed and the solution was stirred at ambient temperature for 3 h. The reaction mixture was concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 30:1 to 20:1 to 15:1 to 9:1 Hex:EtOAc) to give **1m** (1.25 g, 3.15 mmol, 95%) as a yellow oil.

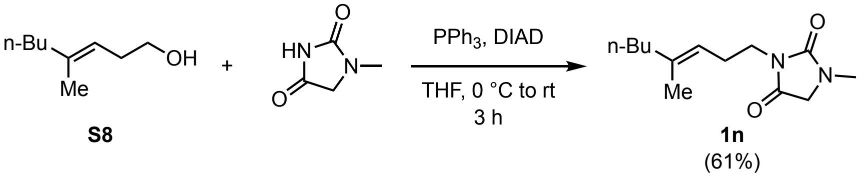
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.78 (d, *J* = 8.3 Hz, 2H, $SO_2Ar\mathit{H}_o$), 7.29 (d, *J* = 8.1 Hz, 2H, SO2ArH_m), 5.14 (tq, *J* = 7.5, 1.3 Hz, 1H, (n-Bu)(Me)C=C*H*), 3.78 (dd, *J* = 7.7, 5.9 Hz, 2H, $CH_2C\mathit{H}_2NTsBoc$), 2.46 (app q, *J* = 7.5 Hz, 2H, $CH_3CH_2CH_2C\mathit{H}_2$), 2.43 (s, 3H, $NSO_2ArC\mathit{H}_3$), 1.99 (t, *J* = 7.4 Hz, 2H, $C{=}CHC\mathit{H}_2CH_2$), 1.65 (d, *J* = 1.3 Hz, 3H, (n-Bu)($C\mathit{H}_3$)C), 1.41–1.34 (m, 2H, $CH_2C\mathit{H}_2CH_2CH_3$), 1.34 (s, 9H, $COOC(C\mathit{H}_3)_3$), 1.31–1.24 (m, 2H, $CH_2CH_2C\mathit{H}_2CH_3$), and 0.89 (t, *J* = 7.3 Hz, 3H, $CH_2CH_2CH_2C\mathit{H}_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 151.1, 144.1, 139.1, 137.8, 129.3, 127.9, 119.4, 84.1, 46.8, 39.5, 30.2, 29.1, 28.0, 22.5, 21.7, 16.2, and 14.2.

IR (neat): 2958, 1929, 2872, 1723, 1353, 1153, 1087, 671 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{21}H_{33}NO_4SNa^+$ (M+Na)$^+$: 418.2023, found 418.2017.

(*E*)-1-Methyl-3-(4-methyloct-3-en-1-yl)imidazolidine-2,4-dione (1n):



Homoallylic alcohol **S8** (356 mg, 2.5 mmol), 1-methylhydantoin (357 mg, 3.13 mmol, 1.25 equiv), and triphenylphosphine (818 mg, 3.13 mmol, 1.25 equiv) were added to a 25 mL round bottom flask equipped with a stir bar, dissolved in THF (10 mL), and cooled to 0 °C in an ice bath. To this solution DIAD (0.82 mL, 3.13 mmol, 1.25 equiv) was added dropwise over 10 min. The ice bath was removed and the solution was stirred at ambient temperature for 3 h. The reaction mixture was concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 6:1 to 3:1 to 1:1 to 1:3 Hex:EtOAc) to give impure **1n**. This material was further purified by MPLC (SiO_2, 1:1 Hex:EtOAc) to give pure **1n** (361 mg, 1.55 mmol, 61%) as a colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.09 (tq, *J* = 7.3, 1.3 Hz, 1H, MeBuC=C*H*), 3.82 (s, 2H, COCH_2NMe), 3.50 [br t, *J* = 7.4 Hz, 2H, C=HCH_2CH_2N(CO)$_2$], 2.99 (s, 3H, NCH_3), 2.32 (app q, *J* = 7.4 Hz, 2H, C=HC$H_2$$CH_2$N(CO)$_2$), 1.96 [br t, *J* = 7.3 Hz, 2H, $CH_3(CH_2)_2$CH_2C=CH], 1.58 (d, *J* = 1.3 Hz, 3H, CH_3C=CH), 1.37–1.31 (m, 2H, CH_3CH_2C$H_2$$CH_2$C=C), 1.29–1.22 (m, 2H, CH_3C$H_2$$CH_2CH_2$C=C), and 0.88 (t, *J* = 7.4 Hz, 3H, C$H_3$$CH_2CH_2CH_2$C=C).

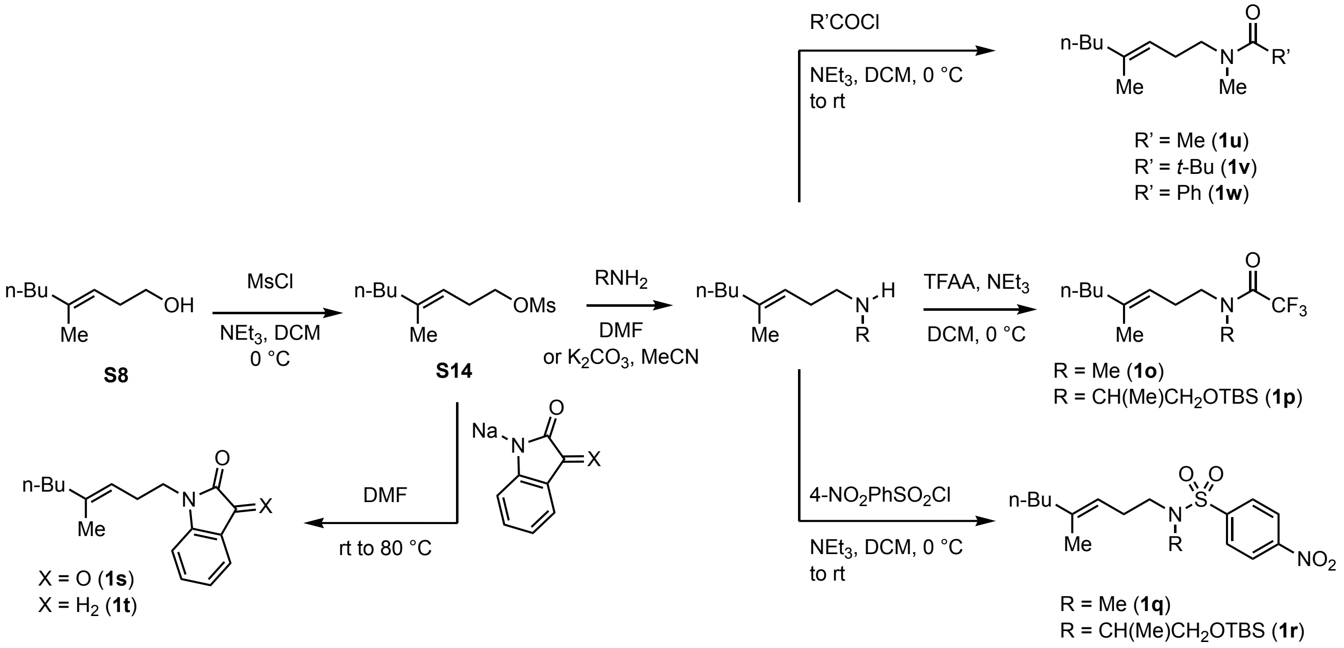
^{13}C NMR (125 MHz, $CDCl_3$): δ 169.9, 157.1, 139.0, 119.5, 51.7, 39.4, 38.8, 30.2, 29.7, 26.8, 22.4, 16.0, and 14.1.

IR (neat): 2955, 2828, 2859, 1772, 1703, 1485, 1451, 1410, 1381, 1240, 1136, and 756 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{13}H_{23}N_2O_2^+$ (M+H)$^+$: 239.1754, found 239.1755.

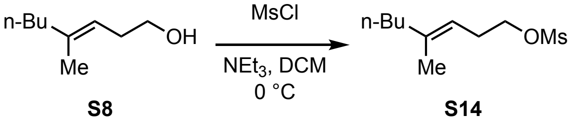
Preparation of substrates **1o–1w**

The substrates **1o**–**1w** were prepared via the mesylate **S14**. The N–alkyl substituted substrates **1o**–**1r** and **1u**–**w** were prepared via displacement of the mesylate with the corresponding amine followed by either trifluoroactylation (**1o** and **1p**), nosyl protection (**1q** and **1r**), or amide formation (**1u**–**1w**). Alternatively, **1s** and **1t** were prepared by displacement of the mesylate **S14** by the corresponding sodium amide derivative.



Scheme S3: Synthesis of substrates **1o**–**1w**.

(*E*)-4-Methyloct-3-en-1-yl methanesulfonate (S14):



Homoallylic alcohol **S8** (5.29 g, 37.2 mmol) and triethylamine (15.6 mL, 112 mmol, 3 equiv) were added to a 250 mL round bottom flask, dissolved in DCM (150 mL), and the solution was cooled to 0 °C in an ice bath. To this methanesulfonyl chloride (3.46 mL, 44.7 mmol, 1.2 equiv) in DCM (10 mL total volume) was added dropwise over 30 min. The solution was stirred at 0 °C for an additional 45 min and $NaHCO_3$ (50 mL) was added. The resulting mixture was warmed to room temperature and transferred to a separatory funnel with DCM (50 mL). The DCM layer was drained and the aqueous layer was extracted with additional DCM (2 x 100 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (SiO_2, 9:1 Hex:EtOAc) to give mesylate **S14** (6.24 g, 28.3 mmol, 76% yield). This material was found to be unstable to long-term storage at room temperature, and slowly decomposed in $CDCl_3$.

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.10 (tq, *J* = 7.2, 1.3 Hz, 1H, $C{=}C\mathit{H}$), 4.18 (t, *J* = 7.1 Hz, 2H, $CH_2C\mathit{H}_2OMs$), 2.99 (s, 3H, $OSO_2C\mathit{H}_3$), 2.46 (app q, *J* = 7.1 Hz, 2H, $C\mathit{H}_2CH_2OMs$), 2.00 (t, *J* = 7.3 Hz, 2H, $C\mathit{H}_2CH_2CH_2CH_3$), 1.63 (s, 3H, $CC\mathit{H}_3$), 1.40–1.34 (m, 2H, $CH_2C\mathit{H}_2CH_2CH_3$), 1.31–1.24 (m, 2H, $CH_2CH_2C\mathit{H}_2CH_3$), and 0.89 (t, *J* = 7.3 Hz, 3H, $CH_2CH_2CH_2C\mathit{H}_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 140.2, 117.3, 69.7, 39.4, 37.6, 30.1, 28.2, 22.4, 16.2, and 14.1.

IR (neat): 2958, 2928, 2860, 1467, 1351, 1170, 951, and 913 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{10}H_{20}O_3Na$ $(M+Na)^+$: 243.1025, found 243.1034.

(*E*)-2,2,2-Trifluoro-*N*-methyl-*N*-(4-methyloct-3-en-1-yl)acetamide (1o):

S14 **1o** (79%)

Homoallylic mesylate **S14** (1.26 g, 5.7 mmol) was added to a scintillation vial and dissolved in DMF (6 mL). To this methylamine (40% in water, 9 mL, ~116 mmol) was added and the mixture was stirred vigorously overnight. The mixture was transferred to a separatory funnel with water (60 mL) and Et_2O (60 mL). The aqueous layer was drained and extracted with Et_2O (2 x 60 mL). The combined organic layers were washed with water (60 mL x 4), brine (60 mL), dried ($MgSO_4$), filtered, and concentrated. The resulting residue was then dissolved in DCM (30 mL) and cooled to 0 °C. To this was added triethylamine (2.38 mL, 17.1 mmol, 3.0 equiv) followed by trifluoroacetic anhydride (1.21 mL, 8.55 mmol, 1.5 equiv) and the resulting mixture was stirred for an additional 3 h. To this solution $NaHCO_3$ (30 mL) was added and the mixture was allowed to warm to room temperature. The mixture was transferred to a separatory funnel with additional DCM (30 mL), the organic layer was drained and the aqueous layer was extracted with additional DCM (2 x 30 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (SiO_2, 50:1 to 30:1 to 25:1 Hex:EtOAc) to give pure trifluoacetamide **1o** (1.13g, 4.5 mmol, 79% from **S14**) as a colorless oil.

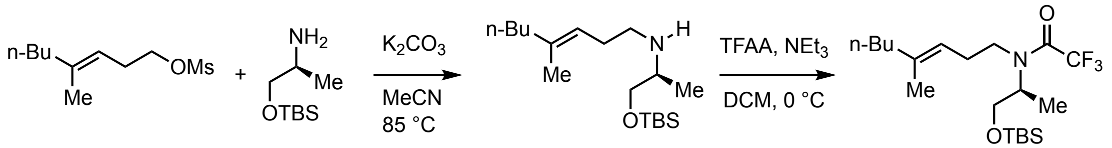
^{1}H NMR (500 MHz, $CDCl_3$): δ 5.08 (tq, *J* = 7.4, 1.4 Hz, 0.6 H, $C{=}C\mathit{H}_{ra}$), 5.04 (tq, *J* = 7.4, 1.3 Hz, 0.4 H, $C{=}C\mathit{H}_{rb}$), 3.42 (t, *J* = 7.3 Hz, 1.2 H, $CH_2C\mathit{H}_{2ra}NMeCOCF_3$), 3.37 (ddq, *J* = ~7.5, ~7.5, 1.2 Hz, 0.8 H, $CH_2C\mathit{H}_{2rb}NMeCOCF_3$), 3.11 (q, *J* = 1.6 Hz, 1.7 H, $NC\mathit{H}_{3ra}$), 3.03 (br s, 1.3 H, $NC\mathit{H}_{3rb}$), 2.34–2.29 (m, 2H, $C\mathit{H}_2CH_2NCOCF_3$), 2.00–1.96 (m, 2H, $C\mathit{H}_2CH_2CH_2CH_3$), 1.61 (d, *J* = 0.8 Hz, 3H, $CC\mathit{H}_3$), 1.39–1.32 (m, 2H, CH$_2$C*H*$_2$CH$_2$CH$_3$), 1.31–1.23 (m, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 0.90 (t, *J* = 7.30 Hz, 1.3 H, CH$_2$CH$_2$CH$_2$C*H*$_{3\mathrm{ra}}$), and 0.89 (t, *J* = 7.2 Hz, 1.7 H, CH$_2$CH$_2$CH$_2$C*H*$_{3\mathrm{rb}}$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 157.0 (q, *J* = 35.7 Hz), 156.9 (q, *J* = 36.0), 139.6, 139.2, 119.3, 118.4, 116.8 (q, *J* = 286.9 Hz), 116.7 (q, *J* = 288.7 Hz), 49.6, 49.4, 39.5, 35.4, 35.3, 34.7, 30.2, 30.1, 27.2, 25.5, 22.5, 16.0, and 14.1. (additional carbon resonances due to presence of rotomers)

IR (neat): 2957, 2931, 2681, 1688, 1248, 1188, 1138, and 1092 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{12}H_{21}F_3NO^+$ (M+H)$^+$: 252.1570, found 252.1576.

(*S*,*E*)-*N*-(1-((*tert*-Butyldimethylsilyl)oxy)propan-2-yl)-2,2,2-trifluoro-*N*-(4-methyloct-3-en-1-yl)acetamide (1p):



S14

1p
(52%)

Preparation of OTBS-L-alaninol[8]: L-alaninol (751 mg, 10 mmol) and imidazole (2.38 g, 35 mmol, 3.5 equiv) were added to a 100 mL round bottom flask and dissolved in DCM (50 mL). To this TBSCl (4.67 g, 31 mmol, 3.1 equiv) in DCM (10 mL) was added dropwise over 5 min. The resulting mixture was stirred at ambient temperature overnight. To this mixture NaHCO$_3$ (25 mL) was added and stirred for 30 min. The resulting mixture was transferred to a separatory funnel with additional DCM (~50 mL), the organic layer was drained, and the aqueous layer was extracted with additional DCM (50 mL). The combined organic layers were dried (MgSO$_4$), filtered, and concentrated to give impure OTBS-L-alaninol which was used for the next step without further purification.

Mesylate displacement: OTBS-L-alaninol from the previous step (4.57 g) and K$_2$CO$_3$ (691 mg, 5 mmol, 2 equiv relative to **S14**) were added to a 100 mL round bottom flask equipped with a reflux condenser. To this mesylate **S14** (526 mg, 2.4 mmol) in MeCN (25 mL) was added and the resulting mixture was heated to reflux for 16 h. The mixture was then cooled to room temperature, diluted with Et$_2$O (75 mL), filtered (celite) and concentrated to give impure N-alkylated amine which was carried forward to the next step without additional purification.

Trifluoracetylation: The crude amine from the previous step and triethylamine (14 mL, 100 mmol) were dissolved in DCM (100 mL) and cooled to 0 °C. To this trifluoroacetic anhydride (10.5 mL, 75 mmol) was added dropwise over 30 min and the resulting mixture was stirred overnight at ambient temperature. To this mixture NaHCO$_3$ (50 mL) was added and stirred for 30 min. The resulting mixture was transferred to a separatory funnel with additional DCM (~100 mL), the organic layer was drained, and the aqueous layer was extracted with additional DCM (50 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (99:1 to 98:2 to 97:3 to 96:4 to 95:5 Hex:EtOAc) to give pure trifluoroacetamide **1p** (510 mg, 1.25 mmol, 52% from **S14**) as a pale-yellow oil.

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.08 (tq, J = 7.4, 1.3 Hz, 0.5H, C=CH_{ra}), 5.03 (tq, J = 7.3, 1.3 Hz, 0.5H, C=CH_{rb}), 4.10–4.04 (m, 0.5H, NCH_{ra}CH$_3$), 4.01 (dd, J = 10.3, 8.0 Hz, 0.5H, CH_{ara}H$_b$OTBS), 3.83–3.76 (m, 0.5H, NCH_{rb}CH$_3$), 3.66 (dd, J = 10.2, 5.2 Hz, 0.5H, CH$_a$$H_{bra}$OTBS), 3.62 (dd, J = 10.7, 7.3 Hz, 0.5H, CH_{arb}H$_b$OTBS), 3.57 (dd, J = 10.7, 5.0 Hz, 0.5H, CH$_a$$H_{brb}$OTBS), 3.39–3.32 (m, 0.5H, C=CHCH$_2$CH_{ara}H$_b$N), 3.31–3.25 (m, 0.5H, C=CHCH$_2$CH_{arb}H$_b$N), 3.27 (ddd, J = 13.1, 10.5, 5.7 Hz, 0.5H, C=CHCH$_2$CH$_a$$H_{bra}$N), 3.16 (ddd, J = 13.3, 10.1, 6.3 Hz, 0.5H, C=CHCH$_2$CH$_a$$H_{brb}$N), 2.38–2.26 (m, 2H, C=CHCH_2CH$_2$N), 2.00–1.96 (m, 2H, CH_2CH$_2$CH$_2$CH$_3$), 1.63 (d, J = 1.0 Hz, 1.5H, C=C(Bu)CH_{3ra}), 1.61 (d, J = 1.0 Hz, 1.5H, C=C(Bu)CH_{3rb}), 1.40–1.35 (m, 2H, CH$_2$CH_2CH$_2$CH$_3$), 1.33 (d, J = 7.0 Hz, 1.5H, NCHCH_{3ra}), 1.30–1.24 (m, 2H, CH$_2$CH$_2$CH_2CH$_3$), 1.21 (d, J = 6.7 Hz, 1.5H, NCHCH_{3rb}), 0.91–0.85 [m, 12H, CH$_2$CH$_2$CH$_2$CH_3 and Si(CH$_3$)$_2$(C(CH_3)$_3$)], and 0.04 [s, 6H, Si(CH_3)$_2$(C(CH$_3$)$_3$)].

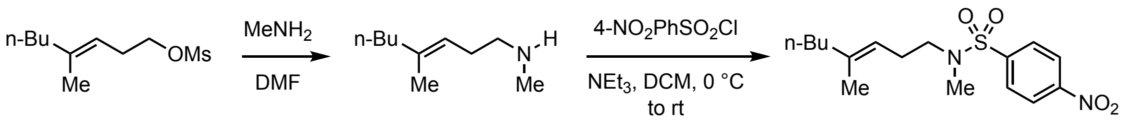
^{13}C NMR (125 MHz, $CDCl_3$): δ 157.3 (q, J = 34.7 Hz, C_{ra}OCF$_3$), 156.7 (q, J = 35.4 Hz, C_{rb}OCF$_3$), 139.0, 138.6, 120.2, 116.8 (q, J = 289.6 Hz, COC_{ra}F$_3$), 116.5 (q, J = 287.6 Hz, COC_{rb}F$_3$), 64.3, 63.6, 58.6, 54.2, 48.2, 42.7, 39.4, 30.1, 30.0, 28.7, 26.5, 25.8, 25.8, 25.7, 22.4, 22.3, 18.2, 18.1, 16.0, 15.4, 14.3, 14.0, -5.5, -5.56, -5.63, and -5.7. The additional carbon resonances in this spectrum are presumably due to the presence of both rotomers. For a detailed listing of the carbon resonances for each rotomer for a similar compound see **2p**.

IR (neat): 2956, 2929, 2859, 1689, 1464, 1213, 1189, 1144, 838, and 778 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{20}H_{39}F_3NO_2Si^+$ $(M+H)^+$: 410.2697, found 410.2699.

Optical Rotation: $[\alpha]_D^{20} = +9.1$ (c = 0.5, $CHCl_3$).

(*E*)-*N*-Methyl-*N*-(4-methyloct-3-en-1-yl)-4-nitrobenzenesulfonamide (1q):



S14

1q
(77% from **S14**)

Homoallylic mesylate **S14** (661 mg, 3.0 mmol) was added to a scintillation vial and dissolved in DMF (6 mL). To this methylamine (40% in water, 4 mL, ~50 mmol) was added and the mixture was stirred vigorously overnight. The mixture was transferred to a separatory funnel with water (60 mL) and Et_2O (60 mL). The aqueous layer was drained and extracted with Et_2O (2 x 60 mL). The combined organic layers were washed with water (60 mL x 4), brine (60 mL), dried ($MgSO_4$), filtered, and concentrated. The resulting residue was dissolved in DCM (10 mL), DMAP (37 mg, 0.3 mmol, 0.1 equiv) was added and the mixture was cooled to 0 °C. To this 4-nitrophenylsulfonyl chloride (997 mg, 4.5 mmol, 1.5 equiv) was added in one portion and allowed to warm to room temperature over an hour. The resulting mixture was then stirred at ambient temperature overnight. The resulting mixture was transferred to a separatory funnel with DCM (50 mL) and washed with $NaHCO_3$ (20 mL x 3) and brine (20 mL). The organic layer was dried ($MgSO_4$), filtered, concentrated, and passed through a plug of SiO_2 (Et_2O). The resulting residue was further purified by MPLC (SiO_2, 9:1 Hex:EtOAc) to give pure **1q** (783 mg, 2.29, 77%) as a colorless oil.

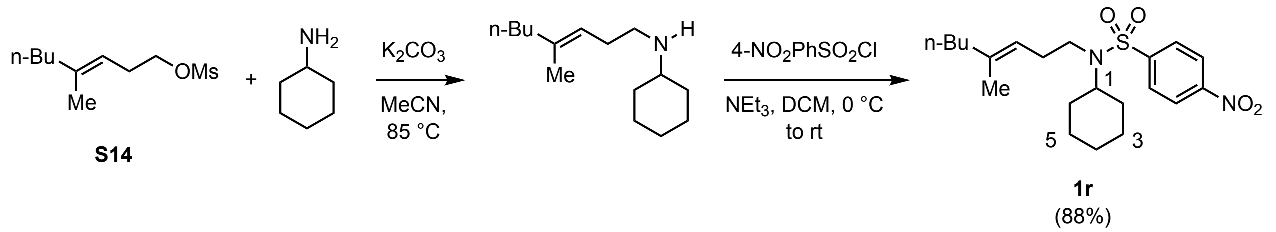
^{1}H NMR (500 MHz, $CDCl_3$): δ 8.37 (d, *J* = 8.9 Hz, 2H, SO_2ArH_m), 7.97 (*J* = 8.8 Hz, 2H, SO_2ArH_o), 5.04 (qt, *J* = 1.3, 7.2 Hz, 1H, C=C*H*), 3.07 (t, *J* = 7.4 Hz, 2H, $CH_2CH_2NMeSO_2Ar$), 2.82 (s, 3H, NCH_3), 2.26 (app qq, *J* = 7.5, 0.8 Hz, 2H, $C{=}CHCH_2CH_2NMeSO_2Ar$), 1.96 (t, *J* = 7.5 Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.59 (q, *J* = 0.8 Hz, 3H, $HC{=}CCH_3$), 1.38–1.32 (m, 2H, $CH_2CH_2CH_2CH_3$), 1.30–1.25 (m, 2H, $CH_2CH_2CH_2CH_3$), and 0.89 (t, *J* = 7.3 Hz, 3H, $CH_2CH_2CH_2CH_3$).

^{13}C NMR (125 MHz, $CDCl_3$) δ 150.1, 144.4, 139.1, 128.6, 124.5, 119.1, 50.2, 39.5, 34.9, 30.2, 26.9, 22.5, 16.2, and 14.1.

IR (neat): 3105, 2956, 2927, 2859, 1528, 1457, 1346, 1310, 1160, 1088, 960, 854, 740, and 599 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{16}H_{24}N_2O_4S^+$ $(M+H)^+$: 341.1530, found 341.1537.

(*E*)-*N*-Methyl-*N*-(4-methyloct-3-en-1-yl)-4-nitrobenzenesulfonamide (1r):



Homoallylic mesylate **S14** (901 mg, 4.09 mmol), freshly distilled (over CaH_2) cyclohexylamine (4.6 mL, 40.9 mmol, 10 equiv), and K_2CO_3 (707 mg, 5.11 mmol, 1.25 equiv) were added to a scintillation vial, dissolved/suspended in MeCN (10 mL), the vial was sealed with a Teflon-lined cap, and the resulting mixture was heated to 85 °C for 16 h. The mixture was then cooled and transferred to a separatory funnel with water (~50 mL) and Et_2O (~100 mL). The aqueous layer was extracted with additional Et_2O (50 mL) and the combined organic layers were washed with brine (50 mL). The resulting organic layer was dried

($MgSO_4$), filtered, and concentrated (~60 torr at 40 °C, then ~1 torr at 40 °C). The resulting residue (in a 50 mL round bottom flask) was dissolved in DCM (20 mL), DMAP (49 mg, 0.4 mmol, 0.1 equiv) and triethylamine (1.71 mL, 12.3 mmol, 3 equiv) were added, and the resulting mixture was cooled to 0 °C. To this 4-nitrophenylsulfonyl chloride (1.36 g, 6.14 mmol, 1.5 equiv) was added and the mixture was allowed to warm to room temperature overnight. $NaHCO_3$ (20 mL) was added and the mixture was stirred for 30 min. The resulting mixture was transferred to a separatory funnel with DCM (100 mL) and the aqueous layer was extracted with additional DCM (50 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated. The resulting solid was dissolved in DCM (20 mL) celite (~10 g) was added and the mixture was concentrated. The resulting solid was purified by flash column chromatography (SiO_2, 20:1 to 9:1 to 6:1 Hex:EtOAc) to give impure **1r**, which was further purified by MPLC (9:1 Hex:EtOAc) to give pure **1r** (1.47 g, 3.61 mmol, 88%) as an off-white amorphous solid.

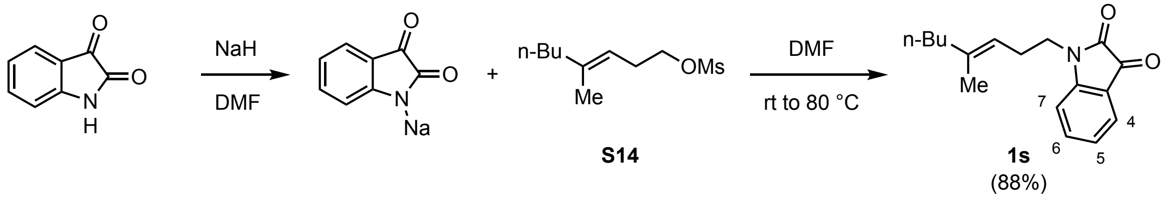
^{1}H NMR (500 MHz, $CDCl_3$): δ 8.33 (d, J = 8.9 Hz, 2H, $SO_2Ar\mathit{H}_m$), 8.02 (d, J = 8.7 Hz, 2H, $SO_2Ar\mathit{H}_o$), 5.05 (qt, J = 1.3, 7.3 Hz, 1H, C=C*H*), 3.65 (tt, J = 11.8, 3.6 Hz, 1H, CyHex*H*1), 3.10 (m, 2H, $C{=}CHCH_2C\mathit{H}_2NSO_2Ar$), 2.35 (br q, J = 9 Hz, 2H, $C{=}CHC\mathit{H}_2CH_2N$), 1.97 (br t, J = 7.3 Hz, 2H, $C\mathit{H}_2CH_2CH_2CH_3$), 1.77 (br d, J = 13 Hz, 2H, CyHexC3,5-H_a), 1.62–1.59 (m, 2H, CyHexC3,5-H_b), 1.63 (d, J = 1.0 Hz, 3H, $C{=}CC\mathit{H}_3$), 1.43–1.23 (m, 9H, $CH_2C\mathit{H}_2CH_2CH_3$, $CH_2CH_2C\mathit{H}_2CH_3$, CyHexC2,6$\mathit{H}_2$, and CyHexC4$\mathit{H}_a$), 1.04 (qt, J = 13.2, 3.4 Hz, 1H, CyHexC4H_b), and 0.89 (t, J = 7.4 Hz, 3H, $CH_2CH_2CH_2C\mathit{H}_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 149.8, 147.8, 138.9, 128.1, 124.4, 119.4, 58.7, 44.0, 39.4, 32.0, 30.9, 30.2, 26.2, 25.3, 22.5, 16.3, and 14.1.

IR (neat): 2931, 2857, 1529, 1349, 1168, and 1156 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{21}H_{32}N_2O_4SNa^+$ $(M+Na)^+$: 431.1975, found 431.1983.

(*E*)-1-(4-Methyloct-3-en-1-yl)indoline-2,3-dione (1s):



Isatin (883 mg, 6 mmol, 2 equiv) was added to a scintillation vial, dissolved in dry DMF (10 mL), sealed with an inverted 24/40 septum, and cooled to 0 °C. To this solution NaH (216 mg, 60% in mineral oil, 5.4 mmol, 1.8 equiv) was added in one portion and stirred at 0 °C for 30 minutes. To this **S14** (661 mg, 3.0 mmol, 1 equiv) in MeCN (5 mL) was added. The mixture was warmed to room temperature, the septum was replaced with a Teflon-lined cap, and the mixture was heated to 70 °C overnight. The resulting mixture was transferred to a separatory funnel with Et_2O (50 mL) and water (150 mL). The aqueous layer was extracted with additional Et_2O (50 mL x 2), and the combined ether layers were washed with water (4 x 100 mL), brine (100 mL), dried ($MgSO_4$), filtered and concentrated. The resulting residue was dissolved in DCM (50 mL) and SiO_2 (10 g) was added and the mixture was concentrated. The resulting residue was purified by flash column chromatography (9:1 to 6:1 to 5:1 Hex:EtOAc) to give pure **1s** (720 mg, 2.65 mmol, 88%) as a bright orange oil.

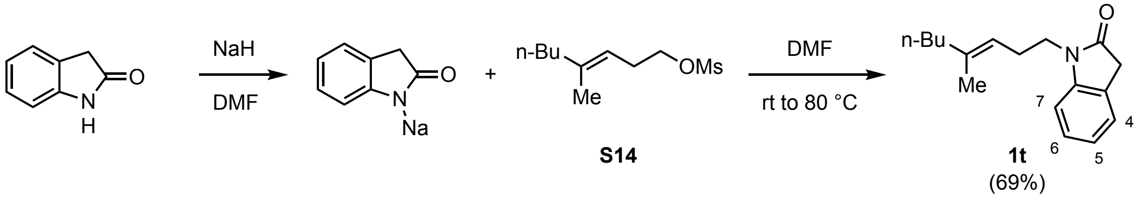
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.59 (ddd, *J* = 7.5, 1.4, 0.6 Hz, 1H, Ar*H*4), 7.58 (ddd, *J* = 7.8, 7.8, 1.4 Hz, 1H, Ar*H*6), 7.10 (ddd, *J* = 7.6, 7.6, 0.9 Hz, 1H, Ar*H*5), 6.92 (ddd, *J* = 8.0, 0.7, 0.7 Hz, 1H, Ar*H*7), 5.13 (qt, *J* = 1.3, 7.3 Hz, 1H, C=C*H*), 3.73 (t, *J* = 7.1 Hz, 2H, C=CHCH$_2$C*H*$_2$N), 2.42 (app q, *J* = 7.3 Hz, 2H, C*H*$_2$CH$_2$N), 1.93 (t, *J* = 7.2 Hz, 2H, C*H*$_2$CH$_2$CH$_2$CH$_3$), 1.54 (d, *J* = 1.4 Hz, 3H, C=CC*H*$_3$), 1.32–1.74 (m, 4H, CH$_2$C*H*$_2$CH$_2$CH$_3$ and CH$_2$CH$_2$C*H*$_2$CH$_3$), and 0.86 (t, *J* = 7.3 Hz, 3H, CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, $CDCl_3$) δ 183.8, 158.3, 151.4, 139.7, 138.3, 125.5, 123.7, 119.1, 117.7, 110.4, 40.2, 39.5, 30.1, 26.2, 22.5, 16.2, and 14.1.

IR (neat): 3057, 2954, 2927, 2857, 1709, 1614, 1489, 1466, 1350, 1154, and 746 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{21}NO_2Na^+$ $(M+Na)^+$: 294.1465, found 294.1476.

(*E*)-1-(4-Methyloct-3-en-1-yl)indolin-2-one (1t):



2-Indolone (799 mg, 6 mmol, 2 equiv) was added to a scintillation vial, dissolved in dry DMF (10 mL), sealed with an inverted 24/40 septum, and cooled to 0 °C. To this solution NaH (216 mg, 60% in mineral oil, 5.4 mmol, 1.8 equiv) was added in one portion and stirred at 0 °C for 30 minutes. To this **S14** (661 mg, 3.0 mmol, 1 equiv) in MeCN (5 mL) was added. The mixture was warmed to room temperature, the septum was replaced with a Teflon-lined cap, and the mixture was heated to 70 °C overnight. The resulting mixture was transferred to a separatory funnel with Et_2O (50 mL) and water (150 mL). The aqueous layer was extracted with additional Et_2O (50 mL x 2), and the combined ether layers were washed with water (4 x 100 mL), brine (100 mL), dried ($MgSO_4$), filtered and concentrated. The resulting residue was purified by flash column chromatography (9:1 to 6:1 to 5:1 Hex:EtOAc) to give pure **1t** (531 mg, 2.06 mmol, 69%) as a pale-yellow oil.

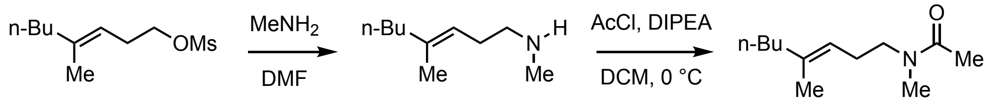
^{1}**H NMR** (500 MHz, $CDCl_3$): δ 7.26 (ddd, *J* = 7.8, 7.8, 1.1 Hz, 1H, Ar*H*5 or Ar*H*6), 7.23 (d, *J* = 8.1 Hz, 1H, Ar*H*7 or Ar*H*4), 7.01 (ddd, *J* = 7.6, 7.6, 0.9 Hz, ArH5 or ArH6), 6.84 (d, *J* = 7.8 Hz, 1H, Ar*H*7 or Ar*H*4), 5.15 (qt, *J* = 1.2, 7.3 Hz, 1H, C=C*H*), 3.70 (dd, *J* = 7.5, 6.4 Hz, 2H, $CH_2C\mathit{H}_2NCO$), 3.49 (s, 3H, $NC\mathit{H}_2Ar$), 2.38 (qq, *J* =7.5, 0.8 Hz, 2H, $C\mathit{H}_2CH_2NCO$), 1.94 (t, *J* = 7.4 Hz, 2H, $C\mathit{H}_2CH_2CH_2CH_3$), 1.54 (q, *J* = 0.9 Hz, 3H, $C{=}CC\mathit{H}_3$), 1.34–1.28 (m, 2H, $CH_2C\mathit{H}_2CH_2CH_3$), 1.27–1.20 (m, 2H, $CH_2CH_2C\mathit{H}_2CH_3$), and 0.87 (t, *J* = 7.3 Hz, 3H, $CH_2CH_2CH_2C\mathit{H}_3$).

^{13}**C NMR** (125 MHz, $CDCl_3$) δ 175.0, 144.9, 138.8, 127.9, 124.8, 124.5, 122.1, 119.7, 108.5, 39.9, 39.5, 35.9, 30.1, 26.3, 22.5, 16.1, and 14.1.

IR (neat): 3057, 2954, 2927, 2857, 1709, 1614, 1489, 1466, 1350, 1154, and 746 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{24}NO^+$ $(M+H)^+$: 258.1852, found 258.1857.

(*E*)-*N*-Methyl-*N*-(4-methyloct-3-en-1-yl)acetamide (1u):



S14

1u
(73%)

Homoallylic mesylate **S14** (802 mg, 3.64 mmol) was added to a scintillation vial and dissolved in DMF (4 mL). To this methylamine (40% in water, 6 mL, ~77 mmol) was added and the mixture was stirred vigorously overnight. The mixture was transferred to a separatory funnel with water (60 mL) and Et_2O (60 mL). The aqueous layer was drained and extracted with Et_2O (2 x 60 mL). The combined organic layers were washed with water (60 mL x 4), brine (60 mL), dried ($MgSO_4$), filtered, and concentrated. The resulting residue was then dissolved in DCM (30 mL) and cooled to 0 °C. To this was added *N*,*N*-diisopropylethylamine (0.95 mL, 5.46 mmol, 1.5 equiv) followed by acetyl chloride (0.47 mL, 5.46 mmol, 1.5 equiv) and the resulting mixture was warmed to room temperature and stirred for 6 h. To this mixture $NaHCO_3$ (5 mL) was added and stirred for 20 min. The mixture was transferred to a separatory funnel with additional DCM (30 mL), the organic layer was drained and the aqueous layer was extracted with additional DCM (2 x 30 mL). The combined organic layers were dried ($MgSO_4$), filtered, concentrated, and passed through a plug of SiO_2 (1:3 Hex:EtOAc). The resulting residue was purified by MPLC (SiO_2, 2:3 Hex:EtOAc) to give pure acetamide **1u** (524 mg, 2.66 mmol, 73% from **S14**).

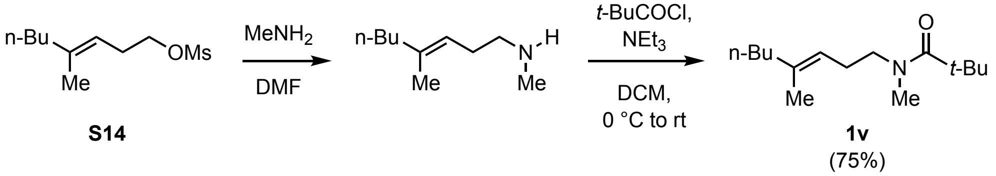
^{1}**H NMR** (500 MHz, $CDCl_3$): δ 5.10 (qt, *J* = 1.4, 7.4 Hz, 0.5H, $C{=}C\mathit{H}_{ra}CH_2CH_2N$), 5.08 (qt , *J* = 1.4, 7.4 Hz, 0.5H, $C{=}C\mathit{H}_{rb}CH_2CH_2N$), 3.35 (br t, *J* = 7 Hz, 1H, $CH_2C\mathit{H}_{2ra}NMeCOCH_3$), 3.26 (br t, *J* = 8 Hz, 1H, $CH_2C\mathit{H}_{rb2}NMeCOCH_3$), 2.98 (s, 1.5H, $NC\mathit{H}_{3ra}$), 2.92 (s, 1.5H, $NC\mathit{H}_{3ra}$), 2.26 (app q, *J* = 7.4 Hz, 1H, $C\mathit{H}_{2ra}CH_2NCOMe$), 2.23 (app q, *J* = 7.4 Hz, 1H, $C\mathit{H}_{2rb}CH_2NCOMe$), 2.09 (s, 1.5H, $COC\mathit{H}_{3ra}$), 2.06 (s, 1.5H, COC*H*$_{3rb}$), 1.98 (t, *J* = 6.9 Hz, 1H, C*H*$_{2ra}$CH$_2$CH$_2$CH$_3$), 1.97 (t, *J* = 6.7 Hz, 1H, C*H*$_{2rb}$CH$_2$CH$_2$CH$_3$), 1.61 (d, *J* = 1.2 Hz, 1.5H, HC=CC*H*$_{3ra}$), 1.61 (d, *J* = 1.2 Hz, 1.5H, HC=CC*H*$_{3rb}$), 1.39–1.33 (m, 2H, CH$_2$C*H*$_2$CH$_2$CH$_3$), 1.31–1.23 (m, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 0.90 (t, *J* = 7.1 Hz, 1.5H, CH$_2$CH$_2$CH$_2$C*H*$_{3ra}$), and 0.89 (t, *J* = 7.1 Hz, 1.5H, CH$_2$CH$_2$CH$_2$C*H*$_{3rb}$).

^{13}C NMR (125 MHz, CDCl$_3$) δ 170.5, 170.4, 138.9, 137.9, 120.5, 119.4, 50.8, 47.7, 39.50, 39.48, 36.6, 33.4, 30.22, 30.15, 27.2, 26.2, 22.5, 22.4, 22.1, 21.4, 16.1, 16.0, and 14.1.

IR (neat): 2957, 2927, 2858, 1643, 1435, 1398, 1007, and 731 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{12}H_{24}NO^+$ $(M+H)^+$: 198.1852, found 198.1856.

(*E*)-*N*-Methyl-*N*-(4-methyloct-3-en-1-yl)pivalamide (1v):



Homoallylic mesylate **S14** (661 mg, 3.0 mmol) was added to a scintillation vial and dissolved in DMF (3 mL). To this methylamine (40% in water, 6 mL, ~77 mmol) was added and the mixture was stirred vigorously overnight. The mixture was transferred to a separatory funnel with water (60 mL) and Et$_2$O (60 mL). The aqueous layer was drained and extracted with Et$_2$O (2 x 60 mL). The combined organic layers were washed with water (60 mL x 4), brine (60 mL), dried (MgSO$_4$), filtered, and concentrated. The resulting residue was then dissolved in DCM (30 mL) and cooled to 0 °C. To this was added triethylamine (1.25 mL, 9.0 mmol, 3.0 equiv) followed by pivaloyl chloride (0.56 mL, 4.5 mmol, 1.5 equiv) and the resulting mixture was warmed to room temperature and stirred for 6 h. To this NaHCO$_3$ (5 mL) was added and stirred for 20 min. The mixture was transferred to a separatory funnel with additional DCM (30 mL), the organic layer was drained and the aqueous layer was extracted with additional DCM (2 x 30 mL). The combined organic layers were dried (MgSO$_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (SiO$_2$, 15:1 to 9:1 Hex:EtOAc) to give pure pivalamide **1v** (542 mg, 2.26 mmol, 75% from **S14**).

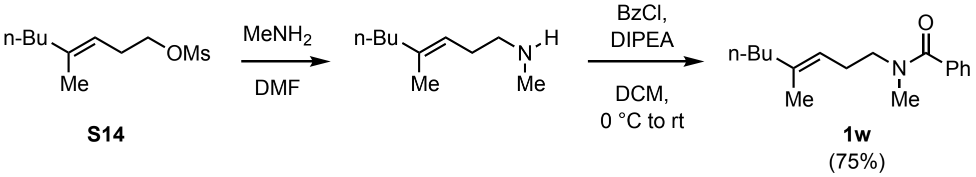
^{1}H NMR (500 MHz, CDCl$_3$): δ 5.08 (br t, *J* = 7 Hz, 1H, C=C*H*CH$_2$CH$_2$N), 3.34 (br t, *J* = 7.7 Hz, 2H, CH$_2$C*H*$_2$NCO*t*-Bu), 3.02 (br s, 3H, NC*H*$_3$), 2.26 (app q, *J* = 7.5 Hz, 2H, C=CHC*H*$_2$CH$_2$NCO), 1.97 (t, *J* = 7.4 Hz, 2H, C*H*$_2$CH$_2$CH$_2$CH$_3$), 1.62 (br s, 3H, C=CC*H*$_3$), 1.40–1.33 (m, 2H, CH$_2$C*H*$_2$CH$_2$CH$_3$), 1.31–1.25 (m, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.28 (s, 9H, NCOC(C*H*$_3$)$_3$), and 0.89 (t, *J* = 7.4 Hz, 3H, CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 177.3, 138.0, 120.2, 50.3, 39.5, 38.9, 36.5, 30.2, 28.5, 26.6, 22.5, 16.2, and 14.1.

IR (neat): 2957, 2927, 2872, 1627, 1481, 1402, 1363, and 1096 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{15}H_{30}NO^+$ $(M+H)^+$: 240.2322, found 240.2331.

(*E*)-*N*-Methyl-*N*-(4-methyloct-3-en-1-yl)benzamide (1w):



Homoallylic mesylate **S14** (800 mg, 3.63 mmol) was added to a scintillation vial and dissolved in DMF (4 mL). To this methylamine (40% in water, 6 mL, ~77 mmol) was added and the mixture was stirred vigorously overnight. The mixture was transferred to a separatory funnel with water (60 mL) and Et_2O (60 mL). The aqueous layer was drained and extracted with Et_2O (2 x 60 mL). The combined organic layers were washed with water (60 mL x 4), brine (60 mL), dried ($MgSO_4$), filtered, and concentrated. The resulting residue was then dissolved in DCM (30 mL) and cooled to 0 °C. To this was added *N*,*N*-diisopropylethylamine (0.95 mL, 5.46 mmol, 1.5 equiv) followed by benzoyl chloride (0.63 mL, 5.46 mmol, 1.5 equiv) and the resulting mixture was warmed to room temperature and stirred for 6 h. To this aqueous $NaHCO_3$ (5 mL) was added and stirred for 20 min. The mixture was transferred to a separatory funnel with additional DCM (30 mL), the organic layer was drained and the aqueous layer was extracted with additional DCM (2 x 30 mL). The combined organic layers were dried ($MgSO_4$), filtered, concentrated, and passed through a plug of silica (1:3 Hex:EtOAc). The resulting residue was purified by MPLC (SiO_2, 3:1 Hex:EtOAc) to give pure benzamide **1w** (724 mg, 2.79 mmol, 77% from **S14**).

^{1}H NMR (500 MHz, $CDCl_3$, 60 °C): δ 7.36 (s, 5H, COC_6H_5), 5.03 (br s, 1H, $C{=}CHCH_2$), 3.36 (br s, 2H, CH_2CH_2NCOPh), 3.00 (br s, 3H, NCH_3COPh), 2.28 (br s, 2H, $C{=}CHCH_2CH_2N$), 1.96 (br t, $J = 6$ Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.56 (br s, 3H, $C{=}CCH_3$), 1.35 (br pent, $J = 7$ Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.27 (br sext, $J = 7$ Hz, 2H, $CH_2CH_2CH_2CH_3$), and 0.88 (t, $J = 7.4$ Hz, 3H, $CH_2CH_2CH_2CH_3$).

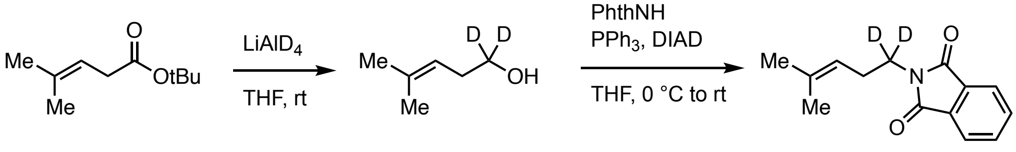
^{13}C NMR (125 MHz, $CDCl_3$, 60 °C): δ 171.5, 138.2, 137.1, 129.0, 128.1, 126.8, 119.8, 39.2, 52–46 (br), 30.0, 26.6, 22.2, 15.8, and 13.7. There are two carbon resonances missing for the aliphatic carbons. The two missing carbons are likely the aliphatic carbons (NCH_2, NCH_3) attached to the benzamide.

IR (neat): 3060, 3026, 2954, 2926, 2858, 1630, 1445, 1398, 1069, and 698 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{26}NO^+$ $(M+H)^+$: 260.2009, found 260.2018.

2d. Synthesis of deuterium labelled substrates 1x–z

2-(4-Methylpent-3-en-1-yl-1,1-*d*2)isoindoline-1,3-dione (1x):



S16

1x
(47% over 2 steps)

To a flame-dried 100 mL 3-necked round-bottomed flask fitted with a reflux condenser was added $LiAlD_4$ (247 mg, 5.88 mmol) followed by THF (10 mL). To this suspension **S16** (500 mg, 2.94 mmol) in THF (10 mL) was added dropwise over 5 min and the mixture was stirred at room temperature for 16 hours. The reaction mixture was then cooled to 0 °C and water (2 mL) then 20 wt% KOH solution (20 mL) were cautiously added. The resulting mixture was warmed to room temperature and stirred for 1 hour. The layers were separated and the aqueous layer was extracted with Et_2O (3 x 10 mL). The combined organic layers were washed with brine (3 x 10 mL), dried (Na_2SO_4), and concentrated (care is required when concentrating due to product volatility) to afford 4-methylpent-3-en-1,1-*d*2-1-ol (~185 mg, ~1.81 mmol) as a colorless liquid.

The alcohol 4-methylpent-3-en-1,1-*d*2-1-ol (~185 mg, 1.81 mmol), triphenylphosphine (713 mg, 2.72 mmol, 1.50 equiv), and phthalimide (400 mg, 2.72 mmol, 1.50 equiv) were added to a scintillation vial, dissolved in THF (8 mL), and cooled to 0 °C. To this solution DIAD (0.53 mL, 2.72 mmol, 1.50 equiv) was added dropwise over 5 minutes. The reaction mixture was allowed to warm to ambient temperature and stirred for 3 h. The mixture was then concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 10:1 Hex:EtOAc) to give pure **1x** (317 mg, 1.37 mmol, 47% over 2 steps).

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.83 (nfom, 2H, NPhthH_o), 7.70 (nfom, 2H, NPhthH_m), 5.13 (t-hept, J = 7.3, 1.5 Hz, 1H, C=CH), 2.37 (d, J = 7.3 Hz, 2H, C=CHC$H_2$$CD_2$NPhth), 1.66 (q, J = 1.3 Hz, 3H, HC=$CC_{cis}H_3$ or HC=$CC_{trans}H_3$), and 1.57 (d, J = 1.2 Hz, 3H, HC=$CC_{cis}H_3$ or HC=$CC_{trans}H_3$).

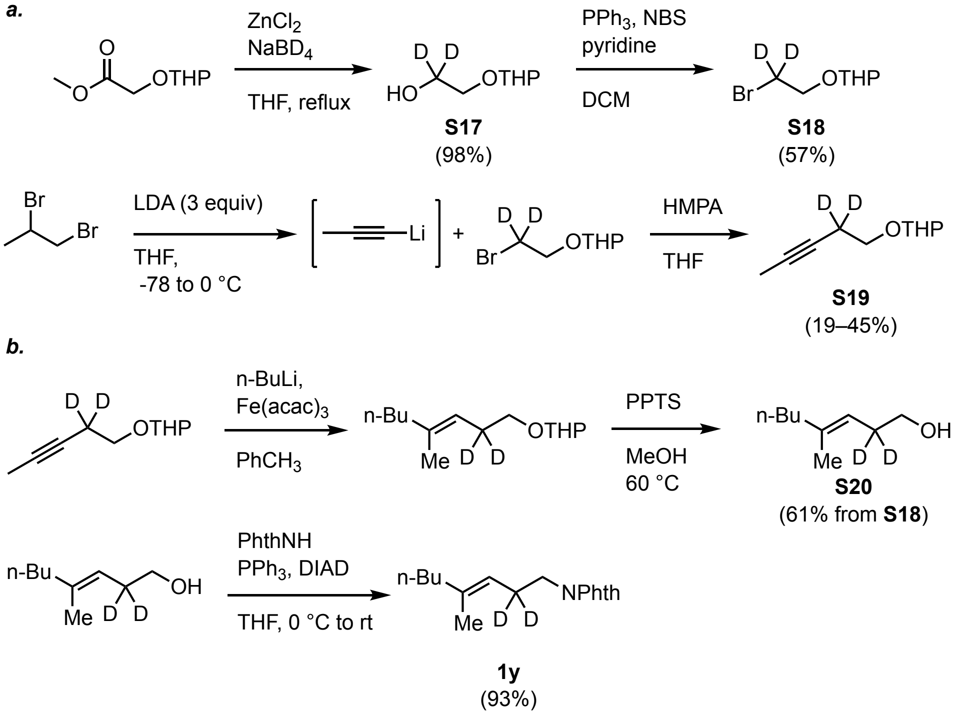
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 135.0, 133.9, 132.3, 123.2, 120.0, 37.4 (pent, J = 21 Hz, CD_2NPhth), 27.2, 25.8, and 17.8.

IR (neat): 2968, 2914, 2859, 1770, 1705, 1386, 1197, 919, and 714 cm^{-1}.

HRMS (ESI-TOF): m/z calcd for $C_{14}H_{14}D_2NO_2^+$ $(M+H)^+$: 232.1301, found 232.1302.

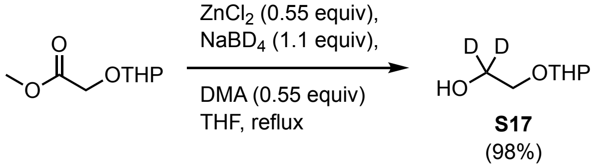
2e. Synthesis of deuterium labelled substrate 1y

Deuterated substrate **1y** was prepared utilizing the 6-step sequence shown in **Scheme S3**. The deuterated homopropargyl analogue of **S4** (**S19**) was prepared in three steps (**Scheme S3a**).[9] Due to difficulties in sourcing LAD, $Zn(BD_4)_2$ was used to introduce the CD_2 subunit of **1y**.[10] The deuterated analogue of **1b** was then prepared in 3 steps (**Scheme S3b**).



Scheme S4: Preparation of substrate **1y**

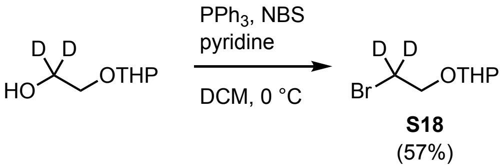
2-((Tetrahydro-2*H*-pyran-2-yl)oxy)ethan-1,1-*d*2-1-ol (S17)[10]:



Zinc chloride (1.64 g, 12 mmol, 0.55 equiv) and sodium borodeuteride (1.00 g, 24 mmol, 1.1 equiv) were added to a flame-dried 250 mL Schlenk flask in a glove box. The flask was sealed with a septum, and brought out the glove box and placed under nitrogen. To this THF (100 mL) was added followed by freshly distilled *N,N*-dimethylaniline (DMA, 1.52 mL, 12 mmol, 0.55 equiv), and the resulting slurry was stirred for 30 min at room temperature. To this mixture methyl 2-((tetrahydro-2*H*-pyran-2-yl)oxy)acetate (3.80 g, 21.8 mmol, 1 equiv) in THF (20 mL) was added, the septum was replaced with a reflux condenser and the mixture was heated to reflux for 1.5 h, at which time TLC (9:1 Hex:EtOAc, vanillin) indicated complete consumption of starting material. The mixture was cooled to room temperature, then 0 °C. The excess hydride was quenched by the slow addition of NH_4Cl (~50 mL total added) and the mixture was transferred to a separatory funnel. The aqueous layer was extracted with DCM (3 x 100 mL) and the combined organic layers were dried ($MgSO_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (SiO_2, 1:1 to 1:3 Hex:EtOAc) to give pure **S17** (3.17 g, 21.4 mmol, 98% yield) as a pale-yellow liquid. The NMR of **S17** matches the literature values[9]. This procedure could also be performed on a 5 times larger scale in 64% yield (10.02 g of **S17**).

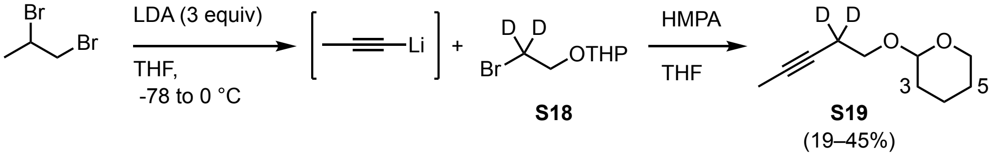
It was noted that prolonged storage (~1–2 weeks) of this material lead to a small amount (~10%) of the isomeric CH_2OTHP ether. This is presumably due to trace acid catalyzing the isomerization. This could be avoided by performing the following bromination within 24 h.

2-(2-Bromoethoxy-2,2-*d*2)tetrahydro-2*H*-pyran (S18)[9]:



Triphenylphosphine (24.8 g, 94.6 mmol, 1.4 equiv) was added to a 2 L 3-neck round bottom flask, dissolved in DCM (788 mL) and cooled to 0 °C. To this NBS (16.8 g, 94.6 mmol, 1.40 equiv) was added in portions over ~10 min, followed by freshly distilled pyridine (9.28 mL, 115 mmol, 1.70 equiv) and the resulting mixture was stirred at 0 °C for 45 min. To this alcohol **S17** (10.02 g, 67.6 mmol, 1 equiv) was added, and the mixture was stirred at 0 °C for 2 h. Water (300 mL) was added resulting in an emulsion. The whole mixture was filtered through a sintered glass funnel and the layers were separated. The aqueous layer was extracted with additional DCM (3 x 300 mL) and the combined organic layers were washed with sodium thiosulfate (3 x 300 mL) and brine (1 x 300 mL). The solution was then dried ($MgSO_4$), filtered, and concentrated to give a thick oil. The resulting oil was suspended in 30% Et_2O/pentane and filtered through silica (eluting with additional 30% Et_2O/pentane) to give crude **S18** as a yellow oil. This material was further purified by flash column chromatography (SiO_2, 5% to 10% to 15% Et_2O/pentane) to give pure **S18** (8.06 g, 38.2 mmol, 57% yield) as a colorless oil. The NMR of this material was consistent with the literature value.[9]

2-((Pent-3-yn-1-yl-2,2-*d*2)oxy)tetrahydro-2*H*-pyran:



Generation of LDA: Freshly distilled *N,N*-diisopylamine (28.0 mL, 200 mmol, 3.52 equiv relative to dibromide), was added to a 500 mL 3-neck round bottom flask equipped with an additional funnel, dissolved in THF (220 mL), and cooled to -78 °C. To this n-BuLi (75 mL, 2.5 M, 187.5 mmol, 3.30 equiv relative to dibromide) was transferred to the additional funnel and added over 30 min. The resulting mixture and stirred at -78 °C for 30 min, and then warmed to 0 °C for 30 min.

Generation of propynyl lithium: In a separate 1 L 3-neck round bottom flask 1,2-dibromopropane (5.91 mL, 56.8 mmol) was added, dissolved in THF (120 mL), and cooled to -78 °C. To this solution the LDA solution described above was added via cannula over 1 h. The solution was stirred at -78 °C for an additional 30 min then warmed to 0 °C for 1 h. To this solution HMPA (48 mL) was added followed by bromide **S18** (8.06 g, 38.2 mmol). The resulting mixture was then warmed to ambient temperature and stirred overnight (~12 h). To this mixture citric acid (10% w/v, 300 mL) was added and stirred for 30 min. The mixture was transferred to a separatory funnel, diluted with Et_2O (500 mL), and the layers were separated. The aqueous layer was extracted with additional Et_2O (200 mL x 2) and the combined organic layers were washed with 1.2 M HCl (200 mL x 3), $NaHCO_3$ (200 mL x 3), and brine (200 mL). The resulting ether solution was dried ($MgSO_4$), filtered, and concentrated. The resulting residue was purified by flash column chromatography (SiO_2, 1% to 2% to 3% to 4% to 5% EtOAc/Hexanes) to give pure **S19** (1.23 g, 7.22 mmol 19% yield). Performing this reaction on ~1/6th of this scale resulted in 45% yield. In both instances the major byproduct is the elimination of HBr from bromide **S18**.

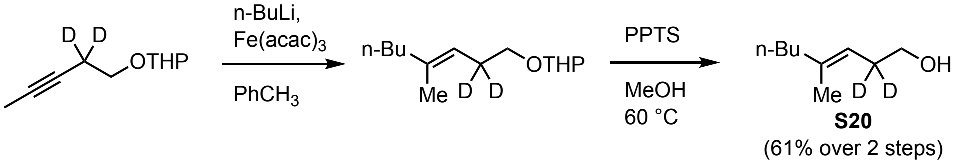
^{1}H NMR (500 MHz, $CDCl_3$): δ 4.63 (dd, *J* = 4.3, 3.1 Hz, 1H, $CH_2OC\textit{H}O$), 3.88 (ddd, *J* = 11.3, 7.9, 3.2 Hz, 1H, $CH_2OCHOC\textit{H}_aH_b$), 3.78 (d, *J* = 9.7 Hz, 1H, $CD_2C\textit{H}_aH_bOTHP$), 3.51 (d, *J* = 9.6 Hz, 1H, $CD_2CH_a\textit{H}_bOTHP$), 3.51 (m, 1H, $CH_2OCHOCH_a\textit{H}_b$), 1.87–1.80 (m, 1H, C4$\textit{H}_a$), 1.77 (s, 3H, $C\equiv CC\textit{H}_3$), 1.74–1.69 (m, 1H, C3$\textit{H}_a$), and 1.62–1.48 (m, 4H, C3$\textit{H}_b$, C4$\textit{H}_b$, C5$\textit{H}_2$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 98.8, 75.9, 66.0, 65.9, 62.2, 30.6, 25.3, 19.4 (CD_2), 19.3, and 3.3.

IR (neat): 2941, 2921, 2870, 1441, 1351, 1122, 1060, 1034, 905, 869, and 816 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{10}H_{14}D_2O_2Na^+$ $(M+Na)^+$: 193.1168, found 193.1172.

(*E*)-4-methyloct-3-en-2,2-*d*2-1-ol (S20):



S20

(61% over 2 steps)

Alkyne **S19** (1.23 g, 7.22 mmol, 1 equiv) and $Fe(acac)_3$ (256 mg, 0.72 mmol, 0.1 equiv) were added to a 100 mL flame-dried Schlenk flask, dissolved in $PhCH_3$ (75 mL), and the solution was purged with argon for 20 min. The mixture was then cooled to -40 °C and n-BuLi (10 mL, 2.5 M in hexanes, 25 mmol, 3.5 equiv) was added dropwise over ~10 min. The mixture was then warmed to between -20 and -15 °C for

1 h at which time TLC (20:1 Hex:EtOAc) indicated complete consumption of alkyne **S19**. The mixture was cooled to -50 °C and acetic acid (glacial, 1.6 mL) was added followed by 1.2 M HCl (25 mL) and the mixture was allowed to warm to room temperature. The mixture was transferred to a separatory funnel with Et_2O (75 mL) and layers were separated. The organic layer was washed with 1.2 M HCl (2 x 25 mL), $NaHCO_3$ (3 x 25 mL), and brine (25 mL). The resulting solution was dried ($MgSO_4$), filtered, and concentrated. The resulting residue was passed through silica gel (9:1 Hex:Et_2O) to give crude (*E*)-2-((4-methyloct-3-en-1-yl-2,2-*d*2)oxy)tetrahydro-2*H*-pyran, which was carried forward without additional purification.

The OTHP ether from the previous step and PPTS (90 mg, 0.36 mmol, 0.05 equiv based on **S19**) were dissolved in MeOH (75 mL) in a 250 mL round bottom flask and heated to 60 °C for 6 h. The mixture was concentrated under reduced pressure and the resulting residue was filtered through silica (Et_2O). The resulting residue was purified by MPLC (6:1 Hex:EtOAc) to give pure **S20** (630 mg, 4.37 mmol, 61% over two steps) as a colorless oil.

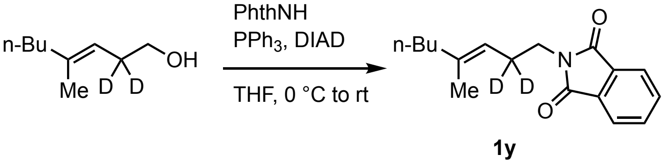
^{1}H NMR (500 MHz, $CDCl_3$): δ 5.11 (br s, 1H, C=C*H*CD_2CH_2OH), 3.61 (d, *J* = 5.4 Hz, 2H, CD_2CH_2OH), 2.01 (t, *J* = 7.5 Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.63 [d, *J* = 1.2 Hz, 3H, C=C(Bu)(CH_3)], 1.41–1.35 (m, 2H, $CH_2CH_2CH_2CH_3$), 1.32 (t, *J* = 5.9 Hz, 1H, CH_2OH), 1.32–1.25 (m, 2H, $CH_2CH_2CH_2CH_3$), and 0.90 (t, *J* = 7.3 Hz, 3H, $CH_2CH_2CH_2CH_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 139.2, 119.4, 62.3, 39.5, 30.6 (CD_2), 29.9, 22.2, 15.9, and 13.8

IR (neat): 3330 (br), 2956, 2926, 2872, 2859, 1456, 1379, and 1026 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_9H_{17}D_2O^+$ $(M+H)^+$: 145.1556, found 145.1561.

(*E*)-2-(4-methyloct-3-en-1-yl-2,2-*d*2)isoindoline-1,3-dione (1y):



1y
(93%)

Alcohol **S20** (144 mg, 1 mmol), triphenylphosphine (315 mg, 1.2 mmol, 1.2 equiv), and phthalimide (177 mg, 1.2 mmol, 1.2 equiv) were added to a scintillation vial, dissolved in THF (5 mL), and cooled to 0 °C. To this solution DIAD (0.24 mL, 1.2 mmol, 1.2 equiv) was added dropwise over 1 minute, warmed to ambient temperature, and stirred for 3 h. The reaction mixture was then concentrated and the resulting residue was purified by flash column chromatography (SiO_2, 15:1 to 9:1 to 6:1 Hex:EtOAc) to give pure **1y** (255 mg, 0.93 mmol, 93% yield) as a colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.83 (nfom, 2H, NPhthAr*H*$_o$), 7.70 (nfom, 2H, NPhthAr*H*$_m$), 5.11 (br s, 1H, C=C*H*), 3.68 (br s, 2H, CD_2CH_2NPhth), 1.93 (t, *J* = 7.3 Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.54 (d, *J* = 1.3 Hz, 3H, C=CCH_3), 1.31–1.25 (m, 2H, $CH_2CH_2CH_2CH_3$), 1.22–1.51 (m, 2H, $CH_2CH_2CH_2CH_3$), and 0.83 (t, *J* = 7.2 Hz, 3H, $CH_2CH_2CH_2CH_3$).

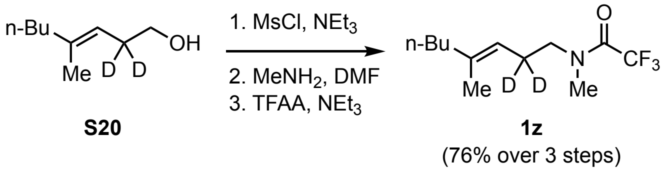
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 139.1, 133.9, 132.3, 123.2, 119.6, 39.4, 37.7, 30.1, 26.6, 22.4, 16.0, and 14.1.

IR (neat): 2956, 2927, 2858, 1772, 1707, 1439, 1390, 1350, 991, and 711 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{17}H_{20}D_2NO_2^+$ $(M+H)^+$: 274.1771, found 274.1780.

2f. Synthesis of deuterium labelled substrate 1z

(*E*)-2,2,2-trifluoro-*N*-methyl-*N*-(4-methyloct-3-en-1-yl-2,2-*d*2)acetamide (1z):



Alcohol **S20** (380 mg, 2.63 mmol) and triethylamine (0.76 mL, 5.26 mmol, 2.0 equiv) were added to a scintillation vial, dissolved in DCM (10 mL) and cooled to 0 °C. To this solution methanesulfonyl chloride (0.24 mL, 3.16 mmol, 1.2 equiv) was added dropwise over 10 min and the resulting mixture was stirred at 0 °C for 1 h. To this $NaHCO_3$ (5 mL) was added, the ice bath was removed, and the resulting mixture was stirred for 20 min then transferred to a separatory funnel with additional DCM (20 mL) and $NaHCO_3$ (10 mL). The organic layer was drained and the aqueous layer was extracted with additional DCM (20 mL). The combined organic layer was washed with $NaHCO_3$ (20 mL), dried ($MgSO_4$), filtered, concentrated, and the resulting residue was passed through a plug of SiO_2 (Et_2O) to give the corresponding mesylate, which was carried onto the next step without additional purification.

The mesylate was added to a scintillation vial, dissolved in DMF (3 mL), and methylamine (40% in water, 3.5 mL) was added. The vial was sealed with a Teflon-lined cap, and the resulting mixture was stirred for 18 h. This solution was transferred to a separatory funnel containing 0.1 M NaOH (30 mL) with Et_2O (30 mL). The aqueous layer was extracted with Et_2O (30 mL) and the combined organic layers were washed with 0.1 M NaOH (3 x 20 mL), brine (20 mL), dried ($MgSO_4$), filtered, and concentrated to give the corresponding N-methylamine, which was carried onto the next step without additional purification.

The amine from the previous step and triethylamine (0.76 mL, 5.26 mmol, 2.0 equiv based on **S20**) were added to a 25 mL round bottom flask, dissolved in DCM (12 mL), and cooled to 0 °C. To this trifluoroacetic anhydride (TFAA, 0.46 mL, 3.29 mmol, 1.25 equiv) was added dropwise over 5 min and the resulting solution was stirred at 0 °C for an additional hour. To this $NaHCO_3$ (10 mL) was added, the ice bath was removed, and the resulting mixture was stirred for 30 min then transferred to a separatory funnel with additional DCM (20 mL) and $NaHCO_3$ (10 mL). The organic layer was drained and the aqueous layer was extracted with additional DCM (20 mL). The combined organic layer was washed with $NaHCO_3$ (20 mL), dried ($MgSO_4$), filtered, concentrated, and passed through a plug of SiO_2 (Et_2O). The resulting residue was further purified by MPLC (15:1 Hex:EtOAc) to give trifluoroacetamide **1z** (503 mg, 1.99 mmol, 76% yield based on **S20**) as a colorless oil.

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.08 (br s, 0.6H, $C{=}C\mathit{H}_{ra}CD_2CH_2$), 5.04 (br s, 0.4H, $C{=}C\mathit{H}_{rb}CD_2CH_2$), 3.41 (s, 1.2H, $CD_2C\mathit{H}_{2ra}NMe$), 3.36 (s, 0.8H, $CD_2C\mathit{H}_{2rb}NMe$), 3.11 (q, *J* = 1.7 Hz, 1.8H, $NC\mathit{H}_{3ra}$), 3.03 (q, *J* = 0.8 Hz, 1.2H, $NC\mathit{H}_{3rb}$), 1.99–1.96 (m, 2H, $C\mathit{H}_2CH_2CH_2CH_3$), 1.615 (s, 1.5H, $C{=}CC\mathit{H}_{3ra}$), 1.612 (s, 1.5H, $C{=}CC\mathit{H}_{3rb}$), 1.39–1.32 (m, 2H, $CH_2C\mathit{H}_2CH_2CH_3$), 1.31–1.23 (m, 2H, $CH_2CH_2C\mathit{H}_2CH_3$), 0.90 (t, *J* = 7.4 Hz, 1.5H, $CH_2CH_2CH_2C\mathit{H}_{3ra}$), and 0.89 (t, *J* = 7.2 Hz, 1.5H, $CH_2CH_2CH_2C\mathit{H}_{3rb}$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 157.0 (q, *J* = 36 Hz), 156.9 (q, *J* = 35 Hz), 139.7, 139.2, 119.2, 118.3, 116.8 (q, *J* = 288 Hz), 116.7 (q, *J* = 289 Hz), 49.5, 49.3 (br q, *J* = 2.7 Hz), 39.5, 35.4 (q, *J* = 4.3 Hz), 34.7, 30.18, 30.12, 26.6 (app pent, *J* = 19.8 Hz), 24.8 (app pent, *J* = 19.9 Hz), 22.46, 16.04, and 14.07.

IR (neat): 2958, 2930, 2861, 1689, 1248, 1185, 1138, and 1095 cm^{-1}.

LRMS (ESI): *m/z* calcd for $C_{12}H_{19}D_2F_3NO^+$ $(M+H)^+$: 254.2, found 254.2.

3. General comments on the relay Heck reaction:

Determination of conversion:

The term “conversion” throughout the manuscript refers to conversion relative to remaining starting material. This was determined by taking an NMR of the crude reaction mixture prior to purification. For example, if a 3:1 ratio of product: starting material was present by NMR, this would be considered 75% conversion. It is not quantified against an internal standard for simplicity sake, and is simply used to give a sense of the amount of remaining starting material at the end of each reaction.

Optimization from previously published conditions:

The optimization for the reported reaction began with the previously published conditions for the arylation of trisubstituted homoallylic alcohols.[11] It was found that in the case of electron neutral (e.g. phenyl) or electron rich (4-methoxyphenyl) no deviation was needed. However, when 4-chlorophenylboronic acid was used at room temperature a significantly lower conversion was observed (41% conversion). When the reaction was heated to 40 °C (with two additions of boronic acid) a slightly increased conversion was observed (50%). To determine the cause for the decreased conversion, aliquots were taken out of the reaction conducted at 40 °C and monitored by HPLC. It was found that the conversion plateaus at about the 4 h mark, and additional boronic acid added after this point did not lead to higher conversions. Adding the boronic acid over 3 portions at t_0, 3 h, and 6 h at 40 °C resulted in 58% conversion. Adding the same amount of boronic acid by syringe pump (1 equiv at t_0, 2 additional equiv added over 6 h) resulted in essentially identical conversions (~60%).

Typical byproducts and impurities:

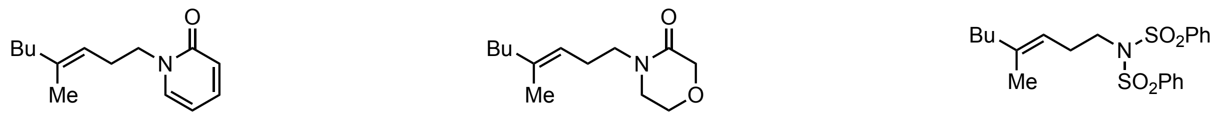
It was found that the typical byproducts arising from the boronic acids were the corresponding phenols and homocoupled biaryls (reductive coupling of the boronic acid). This second pathway is predominant, with typically nearly one full equivalent of biaryl being present in the crude reaction mixture. It was found that certain pairings of substrate and arylboronic acid resulted in the biaryl byproduct and the desired product, or the corresponding phenol and desired product, being inseparable by MPLC. The inclusion of the NaOH wash in the aqueous workup was included to remove any phenol present in the reaction mixture. Additionally, it was found in some cases the excess ligand and desired product were inseparable by MPLC. The inclusion of the 1.2 M HCl wash in the aqueous workup was included to remove any excess ligand from the reaction mixture. The reaction mixtures prior to purification for the listed entries consisted of mainly remaining starting material (if any), biaryl byproduct, desired product, and doubly arylated byproducts arising from the arylation of the product.

4. Limitations of the transformation

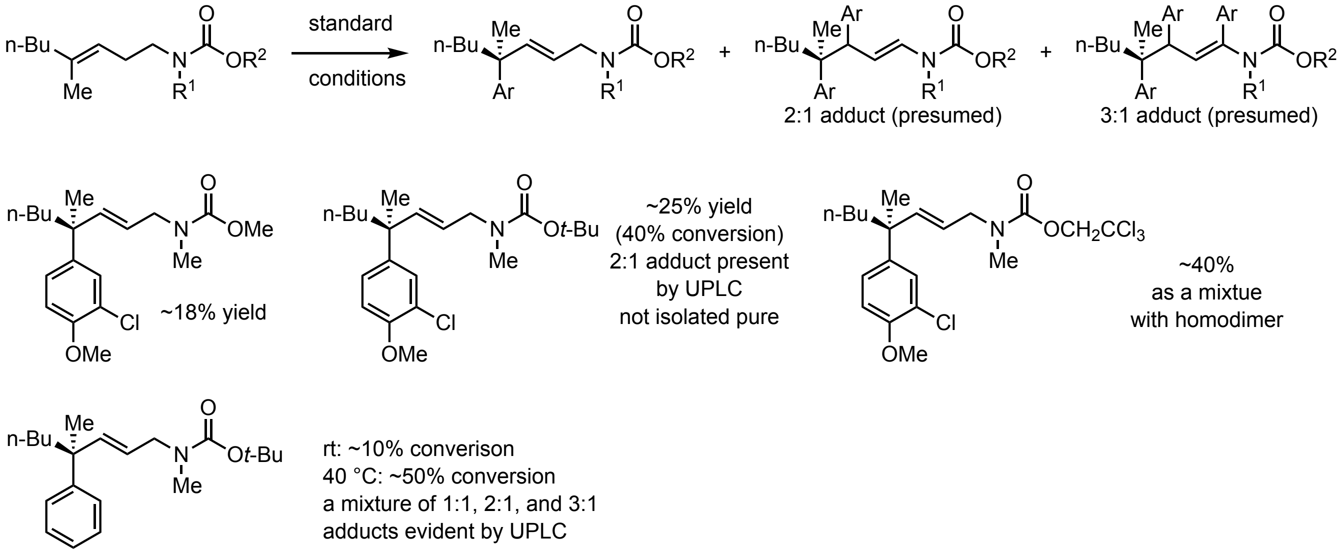
Incompatible acceptors:

A small number of additional acceptors were found to result in no conversion (**panel a**). When *N*-alkyl carbamates were investigated they were found to result in low conversions and yields (**panel b**). In all cases there was evidence for double (and in some cases triple) addition products by NMR and UPLC-MS. These results suggest that the carbamate group may be accelerating the addition of a second equivalent of arylboronic acid relative to the first. However, due to the low conversion and complex nature of the reaction mixtures, these substrates were not pursued further.

a. Redox acceptors resulting in low to no conversion



b. Use of carbamates leads to complicated mixtues



2:1 adduct (presumed)

3:1 adduct (presumed)

~18% yield

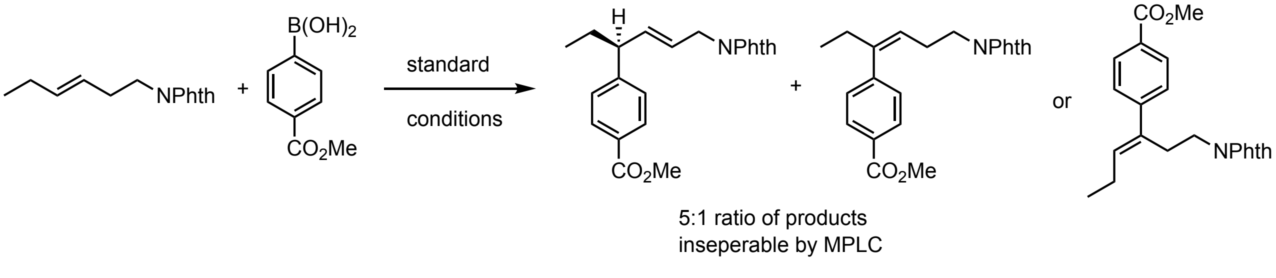
~25% yield
(40% conversion)
2:1 adduct present
by UPLC
not isolated pure

~40%
as a mixtue
with homodimer

rt: ~10% converison
40 °C: ~50% conversion
a mixture of 1:1, 2:1, and 3:1
adducts evident by UPLC

Disubstituted alkenes:

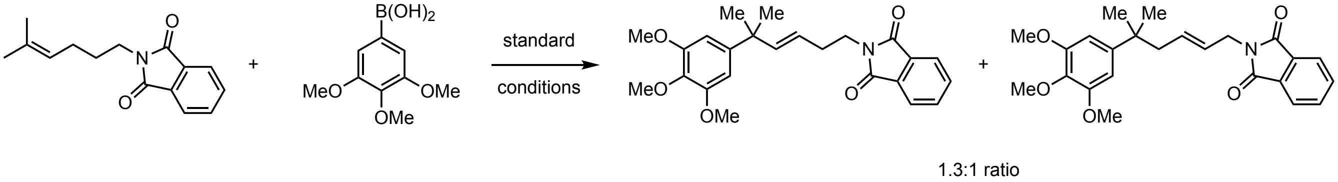
Initial trial reactions using disubstituted alkenes and phenylboronic acid revealed a complicated mixture of products. However, when 4-carbomethoxyphenylboronic acid was used the allylic product was isolated as a mixture with the trisubstituted alkene arising from a "normal" Heck reaction. Due to these observations, disubstituted alkenes were not pursued further.



5:1 ratio of products
inseperable by MPLC

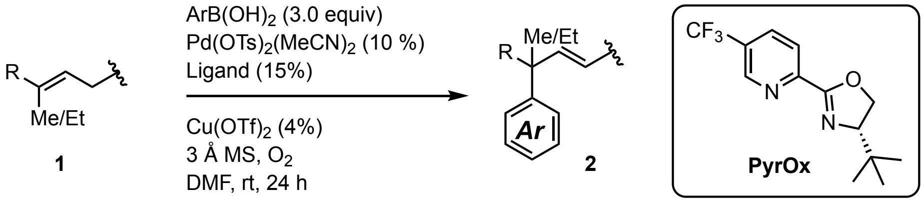
Bishomoallylic phthalimides:

We were interested in seeing if this method could be extended to bishomoallylic substrates. However, when the bishomoallyic substrate was exposed to the standard reaction conditions with 3,4,5-trimethoxyphenyl boronic acid a 1.3:1 ratio of the allylic and homoallyic alkenes were observed. While this is not useful from a preparative point of view, this result does show that the system is not undergoing a 1C isomerization, and the chain-walking process is being interrupted.



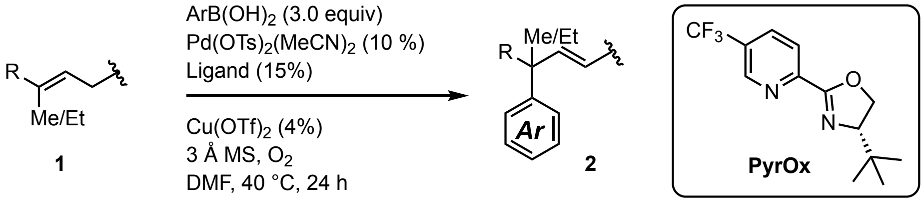
5. General Procedures

Enantioselective Relay Heck Reaction at room temperature (General Procedure A):



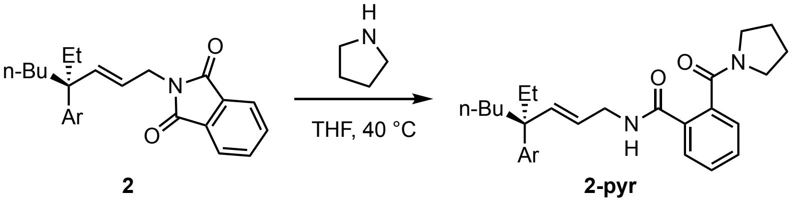
Pd(CH3CN)2(OTs)2 (19 mg, 0.0354 mmol), Cu(OTf)2 (5 mg, 0.014 mmol), **PyrOx** (15 mg, 0.0531 mmol), and 3 Å MS (89 mg) were added to a scintillation vial containing a stir bar and suspended/dissolved in DMF (2.5 mL). The vial was sealed with an inverted 24/40 septum and an oxygen balloon was connected via an 18-gauge needle and a 14-gauge vent needle was added to the septum. The mixture was stirred while purging the headspace with oxygen for at least 10 minutes, at which time the alkene (0.37 or 0.35 mmol) in DMF (1 mL) was added followed by aryl boronic acid (0.56 mmol, 1.5 equiv). The vent needle was removed, and the mixture was stirred for 6 h, at which time additional aryl boronic acid (0.56 mmol, 1.5 equiv) was added and the mixture was stirred for an additional 18 h. The resulting mixture was diluted with Et2O (10 mL) and filtered through celite into a separatory funnel containing 30 mL of water. The vial was rinsed with an additional 20 mL of Et2O through the celite. After mixing and separating the layers the aqueous layer was extracted with additional Et2O (30 mL). The combined organic layers were washed with additional water (4 x 30 mL), 1 M sodium hydroxide (3 x 30 mL), 1.2 M HCl (3 x 30 mL), NaHCO3 (30 mL), and brine (30 mL). The organic layer was dried (MgSO4), filtered, concentrated, and passed through a plug of SiO2 (Et2O). The resulting residue was used to determine the ratio of product to starting materials, and was then purified by MPLC (SiO2, Hex:EtOAc) to give the product **2**.

Enantioselective Relay Heck Reaction at 40 °C (General Procedure B):



Pd(CH3CN)2(OTs)2 (19 mg, 0.0354 mmol), Cu(OTf)2 (5 mg, 0.014 mmol), **PyrOx** (15 mg, 0.0531 mmol), and 3 Å MS (89 mg) were added to a scintillation vial containing a stir bar and suspended/dissolved in DMF (2.5 mL). The vial was sealed with an inverted 24/40 septum and an oxygen balloon was connected via an 18-gauge needle and a 14-gauge vent needle was added. The mixture was stirred while purging the headspace with oxygen for at least 10 minutes, at which time the alkene (0.37 mmol) in DMF (1 mL) was added followed by aryl boronic acid (0.37 mmol, 1.0 equiv). The vent needle was removed, and the mixture was heated to 40 °C. Additional boronic acid (0.37 mmol, 1.0 equiv) was added at 3 h and 6 h (for a total of 3 equiv of boronic acid), after which the mixture was stirred for an additional 18 h. The resulting mixture was diluted with Et_2O (10 mL) and filtered through celite into a separatory funnel containing 30 mL of water. The vial was rinsed with an additional 20 mL of Et_2O through the celite. After mixing and separating the layers the aqueous layer was extracted with additional Et_2O (30 mL). The combined organic layers were washed with additional water (4 x 30 mL), 1 M sodium hydroxide (3 x 30 mL), 1.2 M HCl (3 x 30 mL), $NaHCO_3$ (30 mL), and brine (30 mL). The organic layer was dried ($MgSO_4$), filtered, concentrated, and passed through a plug of SiO_2 (Et_2O). The resulting residue was used to determine the ratio of product to starting materials, and was then purified by MPLC (SiO_2, Hex:EtOAc) to give the product **2**.

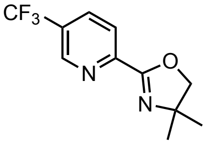
Derivatization of phthalimide product to determine enantioselectivity (General Procedure C)[12]:



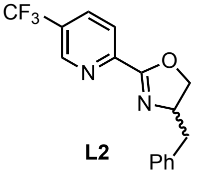
The allylic phthalimide **2** was added to a scintillation vial and dissolved in THF (5 mL). To this freshly distilled pyrrolidine (0.5 mL) was added and the solution was heated to 40 °C for 18–36 h (typically done in 18 h, but could be left for longer). The solution was concentrated under reduced pressure to give pure **2-pyr**.

Racemic Relay Heck Reaction at room temperature or 40 °C:

The racemic analogues of the products **2** were prepared using **General Procedure A** or **General Procedure B** on a 1/5th scale using either achiral ligand **L1** or racemic ligand **L2** in place of **PyrOx**.



L1

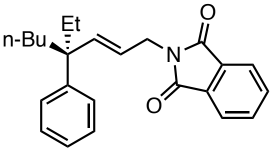


L2

6. Product Purification/Characterization Data:

6a. Substrate scope of aryl boronic acids (Table 1)

(*S*,*E*)-2-(4-Ethyl-4-phenyloct-2-en-1-yl)isoindoline-1,3-dione (**2aa**):



The **General Procedure A** was followed using phenylboronic acid (65 mg x 2, 0.53 x 2 mmol) and **1a** (100 mg, 0.35 mmol). Purification of this material by MPLC (15:1 hexanes:EtOAc) afforded product **2aa** as a colorless oil (run 1: 101 mg, 0.29 mmol, 83% yield (>95% conversion); run 2: 100 mg, 0.29 mmol, 83% yield (>95% conversion); average yield 83%, average conversion >95%).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.86 (nfom, 2H, $\mathrm{N_{phth}Ar}\mathit{H}_o$), 7.72 (nfom, 2H, $\mathrm{N_{phth}Ar}\mathit{H}_m$), 7.28 (t, *J* = 8.1 Hz, 1H, $\mathrm{Ar}\mathit{H}_m$), 7.24 (d, *J* = 8.1 Hz, 2H, $\mathrm{Ar}\mathit{H}_o$), 7.16 (t, *J* = 7.0 Hz, 1H, $\mathrm{Ar}\mathit{H}_p$), 5.84 (d, *J* = 16.0 Hz, 1H, $\mathit{H}\mathrm{C{=}CHCH_2NPhth}$), 5.54 (dt, *J* = 16.0, 6.3 Hz, 1H, $\mathrm{HC{=}C}\mathit{H}\mathrm{CH_2CH_2NPhth}$), 4.37 (dd, *J* = 15.6, 5.9 Hz, 1H, $\mathrm{HC{=}CHC}\mathit{H}\mathrm{aH_bCH_2NPhth}$), 4.32 (dd, *J* = 15.6, 5.9 Hz, 1H, $\mathrm{HC{=}CHCHa}\mathit{H}\mathrm{bCH_2NPhth}$), 1.76 (m, 2H, $\mathrm{(Ph)(Bu)CC}\mathit{H}_2\mathrm{CH_3}$), 1.69 (t, *J* = 8.7 Hz, 2H, $\mathrm{(Ph)(Et)CC}\mathit{H}_2\mathrm{CH_2CH_2CH_3}$), 1.21 (m, 2H, $\mathrm{(Ph)(Et)CCH_2C}\mathit{H}_2\mathrm{CH_2CH_3}$), 1.08–0.91 (m, 2H, $\mathrm{(Ph)(Et)CCH_2CH_2C}\mathit{H}_2\mathrm{CH_3}$), 0.80 (t, *J* = 7.4 Hz, 3H, $\mathrm{(Ph)(Bu)CCH_2C}\mathit{H}_3$), and 0.67 (t, *J* = 7.4 Hz, 3H, $\mathrm{(Ph)(Et)CCH_2CH_2CH_2C}\mathit{H}_3$).

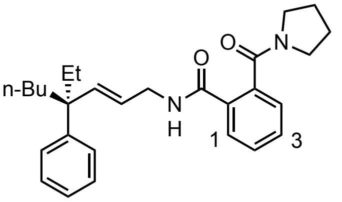
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.2, 146.1, 142.3, 134.0, 132.3, 128.0, 127.5, 125.8, 123.4, 121.7, 47.2, 40.2, 37.1, 30.1, 26.2, 14.2, and 8.7.

IR (neat) 2958, 2931, 2870, 1771, 1709, 1391, 1349, 910, 718, and 700 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{24}H_{28}NO_2^+$ $(M+H)^+$: 362.2115, found 362.2119.

Optical Rotation: $[\alpha]_D^{20}$ = -4.3 (c = 0.5, $CHCl_3$).

(*S*,*E*)-*N*-(4-Ethyl-4-phenyloct-2-en-1-yl)-2-(pyrrolidine-1-carbonyl)benzamide (**2aa-pyr**):



The **General Procedure C** was followed using **2aa** (50 mg, 0.14 mmol) to give **2aa-pyr**.

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.78 (dd, *J* = 7.8, 1.6 Hz, 1H, *H1*), 7.45 (ddd, *J* = 7.3, 7.3, 1.5 Hz, 1H, *H2* or *H3*), 7.41 (ddd, *J* = 7.5, 7.5, 1.5 Hz, 1H, *H2* or *H3*), 7.29–7.23 (m, 5H, PhH_o, PhH_m, *H4*), 7.21 (br t, *J* = 5.4 Hz, 1H, N*H*CO), 7.15 (m, 1H, PhH_p), 5.73 (dt, *J* = 15.8, 1.6 Hz, 1H, *H*C=CHCH$_2$N), 5.52 (dd, *J* = 15.9, 6.1 Hz, 1H, HC=C*H*CH$_2$N), 4.06 (ddd, *J* = 5.9, 5.9, 1.5 Hz, 2H, HC=CHCH_2N), 3.56 (t, *J* = 7.0 Hz, 2H, N(CH_aH$_b$CH$_2$)$_2$), 3.13 (t, *J* = 6.7 Hz, 2H, N(CH$_a$$H_bCH_2$)$_2$), 1.87–1.70 (m, 8H, N(CH$_2$CH_2)$_2$, CH_2CH$_2$CH$_2$CH$_3$, CH_2CH$_3$), 1.25 (hex, *J* = 7.5 Hz, 2H, CH$_2$CH$_2$CH_2CH$_3$), 1.13–1.05 (m, 1H, CH$_2$CH_aH$_b$CH$_2$CH$_3$), 1.04–0.95 (m, 1H, CH$_2$CH$_a$$H_bCH_2CH_3$), 0.84 (t, *J* = 7.5 Hz, 3H, C(Ph)(Bu)CH$_2$CH_3), and 0.72 (t, *J* = 7.3 Hz, 3H, C(Ph)(Et)CH$_2$CH$_2$CH$_2$CH_3).

^{13}C NMR (125 MHz, CDCl$_3$): δ 169.9, 167.4, 146.2, 140.7, 136.1, 132.8, 130.8, 129.3, 129.2, 127.9, 127.4, 126.1, 125.7, 123.7, 48.9, 46.9, 45.8, 42.5, 36.9, 29.9, 26.1, 25.9, 24.6, 23.5, 14.1, and 8.6.

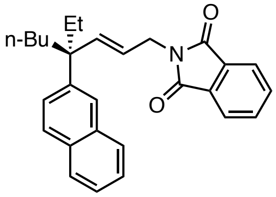
IR (neat) 3282 (br), 3057, 2950, 2931, 2872, 2237, 1618, 1536, 1492, 1428, 1305, 728, and 699 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{28}H_{37}N_2O_2^+$ (M+H)$^+$: 433.2850, found 433.2853.

SFC (UV/Vis and ESI-MS): 98.2:1.8 er (analytical SFC, OZ-H column, 40 °C, *i*-PrOH:CO$_2$ = 1:99 → 20:80 (30 min), 2 mL/min, 2320 psi) major retention time: 12.43 min, minor retention time: 12.82 min.

Optical Rotation: $[\alpha]_D^{20}$ = -3.8 (c = 0.5, CHCl$_3$).

(*S*,*E*)-2-(4-Ethyl-4-(naphthalen-2-yl)oct-2-en-1-yl)isoindoline-1,3-dione (2ab):



The **General Procedure A** was followed using 2-napthylboronic acid (91 mg x 2, 0.53 x 2 mmol) and **1a** (100 mg, 0.35 mmol). Purification of this material by MPLC (9:1 hexanes:EtOAc) afforded product **2ab** as a colorless oil (run 1: 81 mg, 0.197 mmol, 56% yield (59% conversion); run 2: 91 mg, 0.221 mmol, 63% yield (65% conversion); average yield 60%, average conversion 60%).

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.86 (nfom, 2H N$_{\text{phth}}$ArH_m), 7.79 (m, 2H, Napth*H*5 and Napth*H*8), 7.74 (d, *J* = 8.5 Hz, 1H, Napth*H*4), 7.71 (nfom, 2H, N$_{\text{phth}}$ArH_o), 7.66 (d, *J* = 1.6 Hz, 1H, Napth*H*1), 7.44 (dt, *J* = 6.8, 1.7 Hz, 1H, Napth*H*6 or Napth*H*7), 7.41 (dt, *J* = 6.8, 1.7 Hz, 1H, Napth*H*6 or Napth*H*7), 7.38 (dd, *J* = 8.7, 1.9 Hz, 1H, Napth*H*3), 5.91 (dt, *J* = 15.9, 1.3, Hz, 1H, HC=C*H*CH$_2$NPhth), 5.58 (dt, *J* = 15.9, 6.1 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.40 (ddd, *J* = 16.0, 6.2, 1.4 Hz, 1H, HC=CHCH_aH$_b$NPhth), 4.37 (ddd, *J* = 16.0, 6.1, 1.4 Hz, 1H, HC=CHCH$_a$$H_b$NPhth), 1.90 (m, 2H, (Ar)(Bu)CCH_aH$_b$CH$_3$), 1.84 (m, 2H, (Ar)(Bu)CCH$_a$*H*$_b$CH$_3$), 1.79 (m, 2H, (Ar)(Et)CC*H*$_2$CH$_2$CH$_2$CH$_3$), 1.22 (app pent, *J* = 7.2 Hz, 2H, (Ar)(Et)CCH$_2$C*H*$_2$CH$_2$CH$_3$), 1.11–0.94 (m, 2H, (Ar)(Et)CCH$_2$CH$_2$C*H*$_2$CH$_3$), 0.80 (t, *J* = 7.4 Hz, 3H, (Ar)(Bu)CCH$_2$C*H*$_3$), and 0.71 (t, *J* = 7.2 Hz, 3H, (Ar)(Et)CCH$_2$CH$_2$CH$_2$C*H*$_3$).

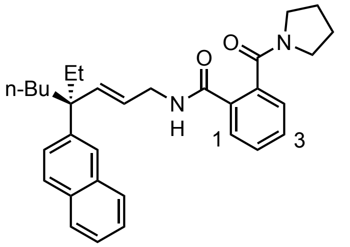
^{13}C NMR (125 MHz, CDCl$_3$): δ 168.1, 143.7, 142.3, 134.0, 133.3, 132.4, 131.9, 128.1, 127.5, 127.4, 126.3, 125.84, 125.81, 125.5, 123.4, 122.1, 47.3, 40.2, 36.9, 30.0, 26.3, 23.5, 14.2, and 8.7.

IR (neat) 2932, 2254, 1771, 1711, 1398, 904, 720, and 649 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{28}H_{30}NO_2$ (M+H)$^+$: 412.2271, found 412.2272.

Optical Rotation: $[\alpha]_D^{20}$ = -3.2 (c = 0.5, CHCl$_3$).

(*S*,*E*)-*N*-(4-Ethyl-4-(naphthalen-2-yl)oct-2-en-1-yl)-2-(pyrrolidine-1-carbonyl)benzamide (2ab-pyr):



The **General Procedure C** was followed using **2ab** (44 mg, 0.11 mmol) to give **2ab-pyr**.

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.84–7.78 (m, 3H, *H*1, Napth*H*5, and Napth*H*8), 7.77 (d, *J* = 9.0 Hz, 1H, Napth*H*4), 7.71 (d, *J* = 1.3 Hz, 1H, Napth*H*1), 7.48–7.40 (m, 5H, *H*2, *H*3, Napth*H*3, Napth*H*6, and Napth*H*7), 7.26 (dd, *J* = 7.6, 1.5 Hz, 1H, *H*4), 7.22 (br t, *J* = 5.2 Hz, 1H, N*H*COAr), 5.81 (dt, *J* = 16.1, 1.4 Hz, 1H, *H*C=CHCH$_2$N), 5.57 (dt, *J* = 16.1, 6.2 Hz, 1H, HC=C*H*CH$_2$N), 4.09 (ddd, *J* = 5.9, 5.9, 1.5 Hz, 2H, HC=CHC*H*$_2$N), 3.50 (t, *J* = 7.1 Hz, 2H, N(C*H*$_a$H$_b$CH$_2$)$_2$), 3.10 (t, *J* = 6.0 Hz, 2H, N(CH$_a$*H*$_b$CH$_2$)$_2$), 1.99–1.75 (m, 8H, N(CH$_2$C*H*$_2$)$_2$, C*H*$_2$CH$_2$CH$_2$CH$_3$, and C*H*$_2$CH$_3$), 1.27 (Hex, *J* = 7.1 Hz, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.16–1.07 (m, 1H, CH$_2$C*H*$_a$H$_b$CH$_2$CH$_3$), 1.06–0.97 (m, 1H, CH$_2$CH$_a$*H*$_b$CH$_2$CH$_3$), 0.84 (t, *J* = 7.4 Hz, 3H, C(Ph)(Bu)CH$_2$C*H*$_3$), and 0.72 (t, *J* = 7.4 Hz, 3H, C(Ph)(Et)CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 169.9, 167.4, 143.8, 140.6, 136.1, 133.3, 132.8, 131.9, 130.9, 129.4, 129.2, 128.1, 127.5, 127.4, 126.4, 126.1, 125.8, 125.7, 125.5, 124.1, 49.0, 47.1, 45.8, 42.5, 36.8, 29.8, 26.2, 25.9, 24.5, 23.5, 14.2, and 8.7.

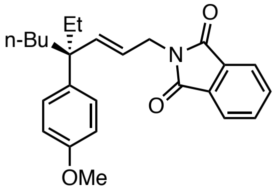
IR (neat): 3266 (br), 3051, 2957, 2931, 2871, 2239, 1716, 1617, 1595, 1535, 1427, 1305, and 728 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{32}H_{39}N_2O_2^+$ (M+H)$^+$: 483.3006, found 483.3009.

SFC (UV/Vis and ESI-MS): 99.4:0.6 er (analytical SFC, OZ-H column, 40 °C, *i*-PrOH:CO_2 = 15:85 → 25:75 (20 min), 2 mL/min, 2320 psi), major retention time: 17.44 min, minor retention time: 15.76 min.

Optical Rotation: $[\alpha]_D^{20}$ = -4.0 (c = 0.5, $CHCl_3$).

(*S*,*E*)-2-(4-Ethyl-4-(4-methoxyphenyl)oct-2-en-1-yl)isoindoline-1,3-dione (2ac):



The **General Procedure A** was followed using 4-methoxyphenylboronic acid (81 mg x 2, 0.53 x 2 mmol) and **1a** (100 mg, 0.35 mmol). Purification of this material by MPLC (6:1 hexanes:EtOAc) afforded product **2ac** as a colorless oil (run 1: 91 mg, 0.232 mmol, 66% yield (82% conversion); run 2: 96 mg, 0.245 mmol, 70% yield (87% conversion); average yield 68%).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.86 (nfom, 2H, $N_{phth}ArH_o$), 7.72 (nfom, 2H, $N_{phth}ArH_m$), 7.15 (d, *J* = 8.4 Hz, 2H, $MeOArH_m$), 6.82 (d, *J* = 8.4 Hz, 2H, $MeOArH_o$), 5.81 (d, *J* = 16.0 Hz, 1H, $HC{=}CHCH_2NPhth$), 5.51 (dt, *J* = 16.0, 6.0 Hz, 1H, $HC{=}CHCH_2NPhth$), 4.37 (dd, *J* = 15.4, 5.8 Hz, 1H, $HC{=}CHCH_aH_bNPhth$), 4.32 (dd, *J* = 15.4, 5.8 Hz, 1H, $HC{=}CHCH_aH_bNPhth$), 3.79 (s, 3H, $ArOCH_3$), 1.72 (m, 2H, $(MeOPh)(Bu)CCH_2CH_3$), 1.65 (t, *J* = 8.7 Hz, 2H, $(MeOPh)(Et)CCH_2CH_2CH_2CH_3$), 1.21 (m, 2H, $(MeOPh)(Et)CCH_2CH_2CH_2CH_3$), 1.08–0.91 (m, 2H, $(MeOPh)(Et)CCH_2CH_2CH_2CH_3$), 0.81 (t, *J* = 7.2 Hz, 3H, $(MeOPh)(Bu)CCH_2CH_3$), and 0.67 (t, *J* = 7.2 Hz, 3H, $(MeOPh)(Et)CCH_2CH_2CH_2CH_3$).

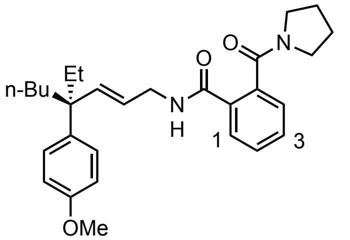
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.2, 157.6, 142.6, 138.2, 134.0, 132.4, 128.5, 123.4, 121.5, 113.3, 55.3, 46.5, 40.2, 37.1, 30.2, 26.3, 23.5, 14.2, and 8.7.

IR (neat): 2931, 2870, 1771, 1711, 1609, 1510, 1391, 1246, 1182, 1035, 909, 830, and 719 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{25}H_{30}NO_3$ $(M+H)^+$: 392.2220, found 392.2219.

Optical Rotation: $[\alpha]_D^{20}$ = -5.5 (c = 0.5, $CHCl_3$).

(*S*,*E*)-*N*-(4-Ethyl-4-(4-methoxyphenyl)oct-2-en-1-yl)-2-(pyrrolidine-1-carbonyl)benzamide (2ac-pyr):



The **General Procedure C** was followed using **2ac** (59 mg, 0.15 mmol) to give **2ac-pyr**.

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.79 (dd, *J* = 7.6, 1.5 Hz, 1H, *H*1), 7.47 (ddd, *J* = 7.3, 7.3, 1.5 Hz, 1H, *H*2 or *H*3), 4.32 (ddd, *J* = 7.2, 7.2, 1.5 Hz, 1H, *H*2 or *H*3), 7.26 (dd, *J* = 7.4, 1.4 Hz, 1H, *H*4), 7.19 (nfod, *J* = 9.1 Hz, 2H, MeOAr*H*$_m$), 7.19 (m, 1H, N*H*CO), 6.83 (nfod, *J* = 9.0 Hz, 2H, MeOAr*H*$_o$), 5.71 (dt, *J* = 16.0, 1.7 Hz, 1H, *H*C=CHCH$_2$N), 5.50 (dt, *J* = 16.0, 6.3 Hz, 1H, HC=C*H*CH$_2$N), 4.05 (ddd, *J* = 5.9, 5.9, 1.6 Hz, 1H, HC=CHC*H*$_2$N), 3.78 (s, 3H, ArOC*H*$_3$), 3.56 (t, *J* = 6.9 Hz, 2H, N(C*H*$_a$H$_b$CH$_2$)$_2$), 3.13 (t, *J* = 6.8 Hz, 2H, N(CH$_a$*H*$_b$CH$_2$)$_2$), 1.91–1.65 (m, 8H, N(CH$_2$C*H*$_2$)$_2$, C*H*$_2$CH$_2$CH$_2$CH$_3$, and C*H*$_2$CH$_3$), 1.25 (Hex, *J* = 7.4 Hz, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.13–1.03 (m, 1H, CH$_2$C*H*$_a$H$_b$CH$_2$CH$_3$), 1.03–0.95 (m, 1H, CH$_2$CH$_a$*H*$_b$CH$_2$CH$_3$), 0.84 (t, *J* = 7.4 Hz, 3H, C(Ph)(Bu)CH$_2$C*H*$_3$), and 0.71 (t, *J* = 7.5 Hz, 3H, C(Ph)(Et)CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 169.9, 167.4, 157.5, 141.1, 138.2, 136.1, 132.8, 130.8, 129.3, 129.2, 128.4, 126.1, 123.5, 113.2, 55.2, 48.9, 46.3, 45.8, 42.5, 36.9, 29.9, 26.2, 25.9, 24.6, 23.5, 14.2, and 8.6.

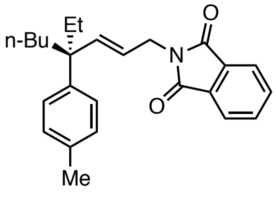
IR (neat): 3273, 3051, 3039, 2955, 2931, 2873, 2236, 1617, 1596, 1510, 1428, 1246, and 727 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{29}H_{39}N_2O_3^+$ (M+H)$^+$: 463.2955, found 463.2955.

SFC (UV/Vis and ESI-MS): 91.6:8.4 er (analytical SFC, OJ-H column, 40 °C, *i*-PrOH:CO$_2$ = 3:97 → 6:94 (45 min), 2 mL/min, 2320 psi), major retention time: 23.38 min, minor retention time: 28.10 min.

Optical Rotation: $[\alpha]_D^{20}$ = -2.4 (c = 0.5, CHCl$_3$).

(*S*,*E*)-2-(4-Ethyl-4-(*p*-tolyl)oct-2-en-1-yl)isoindoline-1,3-dione (2ad):



The **General Procedure A** was followed using 4-methylphenylboronic acid (72 mg x 2, 0.53 x 2 mmol) and **1a** (100 mg, 0.35 mmol). Purification of this material by MPLC (15:1 hexanes:EtOAc) afforded product **2ad** as a colorless oil (run 1: 67 mg, 0.178 mmol, 50% yield (58% conversion); run 2: 56 mg, 0.149 mmol, 43% yield (54% conversion); average yield 47%).

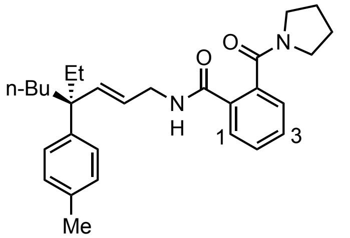
^{1}H NMR (500 MHz, CDCl$_3$): δ 7.85 (nfom, 2H, N$_{\mathrm{phth}}$Ar*H*$_m$), 7.71 (nfom, 2H, N$_{\mathrm{phth}}$Ar*H*$_o$), 7.12 (d, *J* = 8.3 Hz, 2H, MeAr*H*$_{\mathrm{m}}$), 7.08 (d, *J* = 8.3 Hz, 2H, MeAr*H*$_{\mathrm{o}}$), 5.81 (dt, *J* = 15.9, 1.3, Hz, 1H, HC=C*H*CH$_2$NPhth), 5.52 (dt, *J* = 15.9, 6.2 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.36 (ddd, *J* = 16.0, 6.1, 1.4 Hz, 1H, HC=CHC*H*$_{\mathrm{a}}$H$_{\mathrm{b}}$NPhth), 4.32 (dd, *J* = 16.0, 6.1, 1.4 Hz, 1H, HC=CHCH$_{\mathrm{a}}$*H*$_{\mathrm{b}}$NPhth), 2.30 (s, 3H, ArC*H*$_3$), 1.76 (m, 2H, (Ar)(Bu)CC*H*$_{\mathrm{a}}$H$_{\mathrm{b}}$CH$_3$), 1.70 (m, 2H, (Ar)(Bu)CCH$_{\mathrm{a}}$*H*$_{\mathrm{b}}$CH$_3$), 1.66 (m, 2H, (Ar)(Et)CC*H*$_2$CH$_2$CH$_2$CH$_3$), 1.20 (app pent, *J* = 7.2 Hz, 2H, (Ar)(Et)CCH$_2$C*H*$_2$CH$_2$CH$_3$), 1.08–0.90 (m, 2H, (Ar)(Et)CCH$_2$CH$_2$C*H*$_2$CH$_3$), 0.80 (t, *J* = 7.3 Hz, 3H, (Ar)(Bu)CCH$_2$C*H*$_3$), and 0.67 (t, *J* = 7.4 Hz, 3H, (Ar)(Et)CCH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 168.1, 143.1, 142.5, 135.2, 134.0, 132.4, 128.8, 127.4, 123.4, 121.5, 46.8, 40.2, 37.1, 30.1, 26.2, 23.5, 21.0, 14.2, and 8.7.

IR (neat) 2932, 2871, 1771, 1710, 1393, 905, and 720 cm^{-1}.

Optical Rotation: $[\alpha]_D^{20}$ = -5.5 (c = 0.5, CHCl$_3$).

(*S*,*E*)-*N*-(4-Ethyl-4-(*p*-tolyl)oct-2-en-1-yl)-2-(pyrrolidine-1-carbonyl)benzamide (2ad-pyr):



The **General Procedure C** was followed using **2ad** (40 mg, 0.11 mmol) to give **2ad-pyr**.

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.79 (dd, *J* = 7.5, 1.5 Hz, 1H, *H*1), 7.47 (ddd, *J* = 7.5, 7.5, 1.4 Hz, 1H, *H*2 or *H*3), 4.32 (ddd, *J* = 7.6, 7.6, 1.5 Hz, 1H, *H*2 or *H*3), 7.26 (dd, *J* = 7.3, 1.2 Hz, 1H, *H*4), 7.15 (d, *J* = 8.3 Hz, 2H, CH$_3$Ar$_{\mathrm{m}}$), 7.12 (br t, *J* = 6 Hz, 1H, N*H*CO), 7.10 (d, *J* = 8.0 Hz, 2H, CH$_3$Ar*H*$_{\mathrm{o}}$), 5.71 (dt, *J* = 16.1, 1.6 Hz, 1H, *H*C=CHCH$_2$N), 5.50 (dt, *J* = 16.2, 5.9 Hz, 1H, HC=C*H*CH$_2$N), 4.05 (ddd, *J* = 5.9, 5.9, 1.4 Hz, 1H, HC=CHC*H*$_2$N), 3.56 (t, *J* = 6.9 Hz, 2H, N(C*H*$_{\mathrm{a}}$H$_{\mathrm{b}}$CH$_2$)$_2$), 3.13 (t, *J* = 6.9 Hz, 2H, N(CH$_{\mathrm{a}}$*H*$_{\mathrm{b}}$CH$_2$)$_2$), 2.31 (s, 3H, ArC*H*$_3$), 1.91–1.65 (m, 8H, N(CH$_2$C*H*$_2$)$_2$, C*H*$_2$CH$_2$CH$_2$CH$_3$, and C*H*$_2$CH$_3$), 1.24 (Hex, *J* = 7.3 Hz, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.13–1.03 (m, 1H, CH$_2$C*H*$_{\mathrm{a}}$H$_{\mathrm{b}}$CH$_2$CH$_3$), 1.03–0.95 (m, 1H, CH$_2$CH$_{\mathrm{a}}$*H*$_{\mathrm{b}}$CH$_2$CH$_3$), 0.84 (t, *J* = 7.4 Hz, 3H, C(Ph)(Bu)CH$_2$C*H*$_3$), and 0.71 (t, *J* = 7.4 Hz, 3H, C(Ph)(Et)CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 169.9, 167.4, 143.2, 141.1, 136.1, 135.1, 132.9, 130.9, 129.4, 129.2, 128.7, 127.4, 126.2, 123.5, 49.0, 46.6, 45.8, 42.6, 36.8, 29.9, 26.2, 25.9, 24.6, 23.5, 21.0, 14.2, and 8.6.

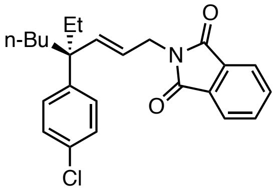
IR (neat): 3265 (br), 3051, 2958, 2931, 2872, 2239, 1619, 1595,1428, 1306, and 727 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{29}H_{39}N_2O_2^+$ $(M+H)^+$: 447.3006, found 447.3012.

SFC (UV/Vis and ESI-MS): 97.2:2.8 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO_2 = 5:95 → 10:90 (45 min), 2 mL/min, 3000 psi), major retention time: 32.93 min, minor retention time: 30.67 min.

Optical Rotation: $[\alpha]_D^{20} = -3.8$ (c = 0.5, $CHCl_3$).

(*S*,*E*)-2-(4-(4-Chlorophenyl)-4-ethyloct-2-en-1-yl)isoindoline-1,3-dione (2ae):



The **General Procedure B** was followed using 4-chlorophenylboronic acid (55 mg x 3, 0.35 x 3 mmol) and **1a** (100 mg, 0.35 mmol) at 40 °C. Purification of this material by MPLC (15:1 hexanes:EtOAc) afforded product **2ae** as a colorless oil (run 1: 71 mg, 0.179 mmol, 51% yield (58% conversion), run 2: 73 mg, 0.179 mmol, 53% yield (57% conversion), average yield 52%, average conversion 58%.

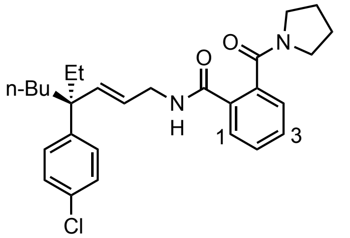
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.86 (nfom, 2H, $N_{phth}ArH_o$), 7.72 (nfom, 2H, $N_{phth}ArH_m$), 7.24 (d, J = 8.2 Hz, 2H, $ClArH_o$), 7.16 (d, J = 8.2 Hz, 2H, $ClArH_m$), 5.79 (d, J = 16.0 Hz, 1H, $HC=CHCH_2NPhth$), 5.52 (dt, J = 16.0, 6.1 Hz, 1H, $HC=CHCH_2NPhth$), 4.37 (dd, J = 15.4, 6.1 Hz, 1H, $HC=CHCH_aH_bNPhth$), 4.32 (dd, J = 15.4, 6.1 Hz, 1H, $HC=CHCH_aH_bNPhth$), 1.73 (m, 2H, $(ClPh)(Bu)CCH_2CH_3$), 1.65 (t, J = 8.7 Hz, 2H, $(ClPh)(Et)CCH_2CH_2CH_2CH_3$), 1.21 (m, 2H, $(ClPh)(Et)CCH_2CH_2CH_2CH_3$), 1.06–0.91 (m, 2H, $(ClPh)(Et)CCH_2CH_2CH_2CH_3$), 0.80 (t, J = 7.5 Hz, 3H, $(ClPh)(Bu)CCH_2CH_3$), and 0.67 (t, J = 7.4 Hz, 3H, $(ClPh)(Et)CCH_2CH_2CH_2CH_3$).

^{13}C NMR (125 MHz, $CDCl_3$) δ 168.1, 144.7, 141.8, 134.1, 132.3, 131.6, 129.0, 128.1, 123.4, 122.2, 47.0, 40.2, 37.1, 30.1, 26.2, 23.5, 14.2, and 8.6.

IR (neat): 2959, 2932, 2871, 1772, 1712, 1392, and 720 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{24}H_{27}ClNO_2^+$ $(M+H)^+$: 396.1725, found 396.1726.

(*S*,*E*)-*N*-(4-(4-Chlorophenyl)-4-ethyloct-2-en-1-yl)-2-(pyrrolidine-1-carbonyl)benzamide (2ae-pyr):



The **General Procedure C** was followed using **2ae** (70 mg, 0.18 mmol) to give **2ae-pyr**.

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.81 (dd, *J* = 7.3, 1.3 Hz, 1H, COAr*H*1), 7.48 (ddd, *J* = 7.3, 7.3, 1.5 Hz, 1H, COAr*H*2 or COAr*H*3), 7.45 (ddd, *J* = 7.5, 7.5, 1.5 Hz, 1H, COAr*H*2 or COAr*H*3), 7.27 (dd, *J* = ~7, 1.5 Hz, 1H, COAr*H*4), 7.25 (d, *J* = ~8.6 Hz, 2H, ClAr*H*$_o$), 7.20 (d, *J* = 8.6, 2H, ClAr*H*$_m$), 7.10 (br t, *J* = 5.4 Hz, 1H, N*H*COAr), 5.70 (dt, *J* = 16.0, 1.3 Hz, 1H, *H*C=CHCH$_2$N), 5.50 (dt, *J* = 15.9, 5.6 Hz, 1H, HC=C*H*CH$_2$N), 4.05 (ddd, *J* = 5.9, 5.9, 1.2 Hz, 2H, C=CHC*H*$_2$NH), 3.55 (t, *J* = 7.0 Hz, 2H, N(C*H*$_a$H$_b$CH$_2$)$_2$), 3.12 (t, *J* = 6.8 Hz, 2H, N(CH$_a$*H*$_b$C*H*$_2$)$_2$), 1.91–1.66 (m, 8H, N(CH$_2$C*H*$_2$)$_2$, C*H*$_2$CH$_2$CH$_2$CH$_3$, C*H*$_2$CH$_3$), 1.24 (Hex, *J* = 7.2 Hz, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.11–1.02 (m, 1H, CH$_2$C*H*$_a$H$_b$CH$_2$CH$_3$), 1.02–0.94 (m, 1H, CH$_2$CH$_a$*H*$_b$CH$_2$CH$_3$), 0.84 (t, *J* = 7.2 Hz, 3H, C(Ph)(Bu)CH$_2$C*H*$_3$), and 0.71 (t, *J* = 7.4 Hz, 3H, C(Ph)(Et)CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 170.0, 167.5, 144.9, 140.3, 136.1, 133.0, 131.6, 131.0, 129.6, 129.4, 129.1, 128.2, 126.2, 124.3, 49.1, 46.9, 45.9, 42.5, 37.1, 30.1, 26.2, 26.0, 24.7, 23.5, 14.2, and 8.6.

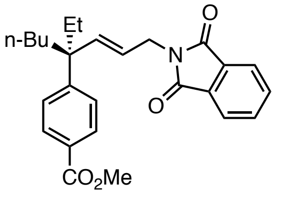
IR (neat): 3267 (br), 3055, 2960, 2932, 2871, 1620, 1537, 1491, and 1429 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{28}H_{36}ClN_2O_2^+$ (M+H)$^+$: 467.2460, found 467.2458.

SFC (UV/Vis and ESI-MS): 95.35:4.65 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO$_2$ = 12:88, 2 mL/min, 2320 psi) major retention time: 26.30 min, minor retention time: 23.08 min.

Optical Rotation: $[\alpha]_D^{20}$ = -2.8 (c = 0.5, CHCl$_3$).

Methyl (*S*,*E*)-4-(1-(1,3-dioxoisoindolin-2-yl)-4-ethyloct-2-en-4-yl)benzoate (2af):



The **General Procedure B** was followed using 4-carbomethoxyphenylboronic acid (95 mg x 3, 0.35 x 3 mmol) and **1a** (100 mg, 0.35 mmol) at 40 °C. Purification of this material by MPLC (9:1 hexanes:EtOAc) afforded product **2af** as a colorless oil [run 1: 43 mg, 0.103 mmol, 29% yield (36% conversion); run 2: 65 mg, 0.155 mmol, 44% yield (46% conversion); average yield 37%, average conversion 41%].

^{1}**H NMR** (500 MHz, CDCl$_3$): δ 7.94 (d, J = 8.7 Hz, 2H, CO$_2$MeArH_o), 7.86 (nfom, 2H, N$_{\mathrm{phfth}}$ArH_o), 7.72 (nfom, 2H, N$_{\mathrm{phth}}$ArH_m), 7.31 (d, J = 8.7 Hz, 2H, CO$_2$MeArH_m), 5.85 (dt, J = 15.9, 1.3 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.51 (dt, J = 15.9, 5.9 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.36 (ddd, J = 15.6, 6.3, 1.6 Hz, 1H, HC=CHCH_aH$_b$NPhth), 4.36 (dd, J = 15.4, 5.8, 1.6 Hz, 1H, HC=CHCH$_a$$H_b$NPhth), 3.89 (s, 3H, ArCOOCH_3), 1.81 (m, 1H, (Ar)(Bu)CCH_aH$_b$CH$_3$), 1.75 (m, 1H, (Ar)(Bu)CCH$_a$$H_bCH_3$), 1.71 (dd, J = 8.2, 6.8 Hz, 2H, (Ar)(Et)CCH_2CH$_2$CH$_2$CH$_3$), 1.20 (app pent, J = 7.0 Hz, 2H, (Ar)(Et)CCH$_2$CH$_2$CH_2CH$_3$), 1.06–0.90 (m, 2H, (Ar)(Et)CCH$_2$CH_2CH$_2$CH$_3$), 0.79 (t, J = 7.2 Hz, 3H, (Ar)(Bu)CCH$_2$CH_3), and 0.67 (t, J = 7.4 Hz, 3H, (Ar)(Et)CCH$_2$CH$_2$CH$_2$CH_3).

^{13}**C NMR** (125 MHz, CDCl$_3$): δ 168.1, 167.3, 151.8, 141.5, 134.1, 132.3, 129.4, 127.8, 127.6, 123.4, 122.4, 52.1, 47.6, 40.1, 37.1, 30.2, 26.2, 23.4, 14.1, and 8.6.

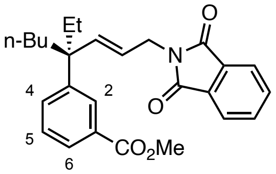
IR (neat): 2933.5, 1771, 1712, 1609, 1394, 1282, 904, 720 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{26}H_{30}NO_4^+$ (M+H)$^+$: 420.2169, found 420.2168.

SFC (UV/Vis and ESI-MS): 97.25:2.75 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO$_2$ = 8:92 → 10:90 (30 min), 2 mL/min, 2320 psi), major retention time: 17.71 min, minor retention time: 20.03 min.

Optical Rotation: $[\alpha]_D^{20}$ = -4.0 (c = 0.5, CHCl$_3$).

Methyl (*S*,*E*)-3-(1-(1,3-dioxoisoindolin-2-yl)-4-ethyloct-2-en-4-yl)benzoate (2ag):



The **General Procedure B** was followed using 3-carbomethoxyphenylboronic acid (63 mg x 3, 0.35 x 3 mmol) and **1a** (100 mg, 0.35 mmol) at 40 °C. Purification of this material by MPLC (6:1 hexanes:EtOAc) afforded product **2ag** as a colorless oil (run 1: 64 mg, 0.153 mmol, 43% yield (51% conversion); run 2: 64 mg, 0.153 mmol, 43% yield (48% conversion), average yield 43%, average conversion 50%).

^{1}**H NMR** (500 MHz, CDCl$_3$): δ 7.92 (t, J = 1.7 Hz, 1H, CO$_2$MeAr*H*2), 7.86 (nfom, 2H, N$_{\mathrm{phth}}$ArH_m), 7.85 (dt containing J = 1.7, 1H, CO$_2$MeAr*H*6), 7.72 (nfom, 2H, N$_{\mathrm{phth}}$ArH_o), 7.43 (ddd, J = 7.8, 1.9, 1.3 Hz, 1H, CO$_2$MeAr*H*4), 7.35 (t, J = 7.8 Hz, 1H, CO$_2$MeAr*H*5), 5.84 (dt, J = 16.0, 1.3, Hz, 1H, HC=C*H*CH$_2$NPhth), 5.55 (dt, *J* = 15.9, 6.3 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.38 (ddd, *J* = 16.0, 6.1, 1.2 Hz, 1H, HC=CHC*H*$_a$H$_b$NPhth), 4.34 (dd, *J* = 16.0, 6.1, 1.2 Hz, 1H, HC=CHCH$_a$*H*$_b$NPhth), 3.89 (s, 3H, ArCOOC*H*$_3$), 1.82 (m, 1H, (Ar)(Bu)CC*H*$_a$H$_b$CH$_3$), 1.77 (m, 1H, (Ar)(Bu)CCH$_a$*H*$_b$CH$_3$), 1.72 (m, 2H, (Ar)(Et)CC*H*$_2$CH$_2$CH$_2$CH$_3$), 1.21 (app pent, *J* = 7.0 Hz, 2H, (Ar)(Et)CCH$_2$CH$_2$C*H*$_2$CH$_3$), 1.07–0.90 (m, 2H, (Ar)(Et)CCH$_2$C*H*$_2$CH$_2$CH$_3$), 0.80 (t, *J* = 7.3 Hz, 3H, (Ar)(Bu)CCH$_2$C*H*$_3$), and 0.68 (t, *J* = 7.5 Hz, 3H, (Ar)(Et)CCH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 168.1, 167.6, 146.7, 142.0, 134.0, 132.5, 132.4, 129.9, 128.4, 128.2, 127.3, 123.4, 122.3, 52.2, 47.3, 40.2, 36.9, 30.0, 26.2, 23.4, 14.2, and 8.6.

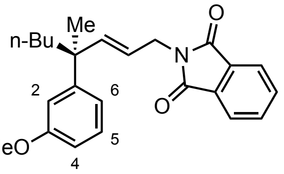
IR (neat): 2933, 2872, 1771, 1709, 1430, 1393, 1274, 906, and 719 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{26}H_{30}NO_4^+$ (M+H)$^+$: 420.2169, found 420.2163.

SFC (UV/Vis and ESI-MS): 96.4:3.6 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO$_2$ = 3:97 → 6:94 (60 min), 2 mL/min, 2320 psi, major retention time: 23.59 min, minor retention time: 26.51 min.

Optical Rotation: $[\alpha]_D^{20}$ = -3.3 (c = 0.5, CHCl$_3$).

(*S*,*E*)-2-(4-(3-Methoxyphenyl)-4-methyloct-2-en-1-yl)isoindoline-1,3-dione (2ba):



The **General Procedure A** was followed using 3-methoxyphenylboronic acid (84 mg x 2, 0.56 x 2 mmol) and **1b** (100 mg, 0.35 mmol) at 40 °C. Purification of this material by MPLC (5:1 hexanes:EtOAc) afforded product **2ba** as a colorless oil (run 1: 86 mg, 0.228 mmol, 62% yield (86% conversion); run 2: 91 mg, 0.241 mmol, 65% yield (87% conversion), average yield 64%, average conversion 87%).

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.84 (nfom, 2H N$_{\text{phth}}$Ar*H*$_m$), 7.71 (nfom, 2H, N$_{\text{phth}}$Ar*H*$_o$), 7.19 (t, *J* = 7.7 Hz, 1H, Ar*H*5), 6.86 (d, *J* = 7.9 Hz, 1H, Ar*H*4 or Ar*H*6), 6.81 (s, 1H, Ar*H*2), 6.71 (d, *J* = 8.1 Hz, 1H, Ar*H*4 or Ar*H*6), 5.96 (dt, *J* = 15.5, 1.3 Hz, 1H, CH$_2$CH=C*H*), 5.51 (dt, *J* = 15.2, 6.2 Hz, 1H, CH$_2$C*H*=CH), 4.32 (dd, *J* = 6.3, 1.3 Hz, 2H, HC=CHC*H*$_2$NPhth), 3.78 (s, 3H, ArOC*H*$_3$), 1.72 (ddd, *J* = 12.7, 12.7, 4.9 Hz, 1H, C(Ar)(Me)C*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.65 (ddd, *J* = 13.1, 13.7, 4.6 Hz, 1H, C(Ar)(Me)CH$_a$*H*$_b$CH$_2$CH$_2$CH$_3$), 1.31 (s, 3H, C(n-Bu)C*H*$_3$), 1.23 (Hex, *J* = 7.0 Hz, 2H, C(Ar)(Me)CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.15–1.00 (m, 2H, C(Ar)(Me)CH$_2$C*H*$_2$CH$_2$CH$_3$), and 0.82 (t, *J* = 7.7 Hz, 3H, C(Ar)(Me)CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 159.5, 149.5, 143.4, 134.0, 132.4, 129.1, 123.4, 120.8, 119.1, 113.0, 110.9, 55.3, 43.8, 41.3, 40.0, 26.8, 25.6, 23.5, and 14.1.

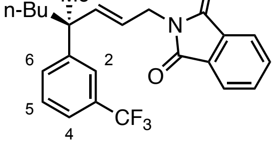
IR (neat): 2933, 1772, 1711, 1393, 904, 720 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{24}H_{28}NO_3^+$ $(M+H)^+$: 378.2064, found 378.2069;

SFC (UV/Vis and ESI-MS): 97.0:3.0 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO_2 = 5:95, 2 mL/min, 2600 psi), major retention time: 10.62 min, minor retention time: 12.02 min.

Optical Rotation: $[\alpha]_D^{20} = +7.01$ (c = 0.5, $CHCl_3$).

(*S*,*E*)-2-(4-Methyl-4-(3-(trifluoromethyl)phenyl)oct-2-en-1-yl)isoindoline-1,3-dione (2bb):



The **General Procedure B** was followed using 3-trifluoromethylphenylboronic acid (70 mg x 3, 0.37 x 3 mmol) and **1b** (100 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (9:1 hexanes:EtOAc) afforded product **2bb** as a colorless oil [run 1: 66 mg, 0.159 mmol, 43% yield (52% conversion); run 2: 65 mg, 0.155 mmol, 44% yield (46% conversion); average yield 44%, average conversion 49%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.86 (nfom, 2H $N_{phth}ArH_m$), 7.72 (nfom, 2H, $N_{phth}ArH_o$), 7.49 (br s, 1H, CF_3ArH2), 7.46–7.37 (m, 3H, CF_3ArH4–6), 5.95 (dt, *J* = 15.9, 1.2 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.53 (dt, *J* = 15.6, 6.3 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.35 (ddd, *J* = 15.0, 6.5, 1.3 Hz, 1H, HC=CHCH_aH$_b$NPhth), 4.31 (ddd, *J* = 15.0, 6.5, 1.3 Hz, 1H, HC=CHCH$_a$$H_b$NPhth), 1.75 (ddd, *J* = 13.6, 11.9, 5.0 Hz, 1H, (Ar)(Me)CCH_aH$_b$CH$_2$CH$_2$CH$_3$), 1.68 (ddd, *J* = 13.4, 12.0, 4.7 Hz, 1H, (Ar)(Me)CCH$_a$$H_bCH_2CH_2CH_3$), 1.35 (s, 3H, BuC$H_3$C=CH), 1.23 (app pent, *J* = 7.1 Hz, 2H, (Ar)(Me)CCH$_2$CH$_2$CH_2CH$_3$), 1.15–1.08 (m, 1H, (Ar)(Et)CCH$_2$CH_aH$_b$CH$_2$CH$_3$), 1.06–0.98 (m, 1H, (Ar)(Me)CCH$_2$CH$_a$$H_bCH_2CH_3$), and 0.83 (t, *J* = 7.4 Hz, 3H, (Ar)(Me)CCH$_2$CH$_2$CH$_2$CH_3).

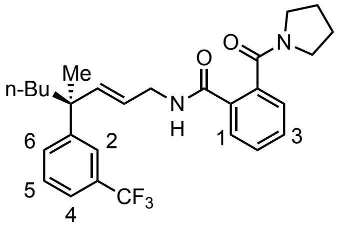
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 148.8, 142.8, 134.1, 134.0*, 132.3, 130.6*, 130.33*, 130.28, 130.1*, 128.6, 125.5*, 123.42, 123.36 (q, 4.1 Hz), 123.3*, 122.8 (q, 3.5 Hz), 121.7, 43.9, 41.2, 39.9, 26.7, 25.5, 23.4, and 14.1. The carbon resonances marked with an "*" are likely a result of additional coupling to the CF_3 carbon. The expected quartet of the CF_3 carbon was not observed in the NMR spectrum of **2bb**.

IR (neat) 2932, 2863, 1772, 1711, 1431, 1327, 907, 718, and 703 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{24}H_{25}F_3NO_2^+$ $(M+H)^+$: 416.1832, found 416.1841.

Optical Rotation: $[\alpha]_D^{20}$ = +6.3 (c = 0.5, CHCl$_3$).

(*S*,*E*)-*N*-(4-Methyl-4-(3-(trifluoromethyl)phenyl)oct-2-en-1-yl)-2-(pyrrolidine-1-carbonyl)benzamide (2bb-pyr):



The **General Procedure C** was followed using **2bb** (65 mg, 0.16 mmol) to give **2bb-pyr**.

^{1}**H NMR** (500 MHz, CDCl$_3$): δ 7.80 (dd, *J* = 7.5, 1.6 Hz, 1H, COAr*H*1), 7.52 (br s, 1H, CF$_3$Ar*H*2), 7.49 br dt, *J* = 7.5, 2 Hz, 1H, CF$_3$Ar*H*4), 7.48 (ddd, *J* = 7.4, 7.4, 1.5 Hz, 1H, COAr*H*2 or COAr*H*3), 7.45 (ddd, *J* = 7.2, 7.2, 1.6 Hz, 1H COAr*H*2 or COAr*H*3), 7.43–7.39 (m, 2H, CF$_3$Ar*H*6 and CF$_3$Ar*H*5), 7.26 (dd, *J* = 7.3, 1.7 Hz, 1H, COAr*H*4), 7.06 (br t, *J* = 5 Hz, 1H, CH$_2$N*H*COAr), 5.85 (dt, *J* = 15.8, 1.2, Hz, 1H, *H*C=CHCH$_2$NHCO), 5.49 (dt, *J* = 15.8, 6.1 Hz, 1H, HC=C*H*CH$_2$NHCO), 4.04 (ddd, *J* = 6.0, 6.0, 1.3 Hz, 2H, CHC*H*$_2$NHCO), 3.54 (t, *J* = 6.9 Hz, 2H, N(C*H*$_a$H$_b$CH$_2$)$_2$), 3.12 (t, *J* = 6.8 Hz, 2H, N(CH$_a$*H*$_b$CH$_2$)$_2$), 1.90–1.67 (m, 6H, N(CH$_2$C*H*$_2$)$_2$, and C*H*$_2$CH$_2$CH$_2$CH$_3$), 1.39 (s, 3H, C(Bu)(Ar)(C*H*$_3$)), 1.29–1.23 (m, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.20–1.11 (m, 1H, CH$_2$C*H*$_a$H$_b$CH$_2$CH$_3$), 1.07–0.98 (m, 1H, CH$_2$CH$_a$*H*$_b$CH$_2$CH$_3$), and 0.85 (t, *J* = 7.3 Hz, 3H, CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}**C NMR** (125 MHz, CDCl$_3$) δ 170.0, 167.5, 148.8, 141.3, 136.2, 134.1*, 132.9, 131.0, 130.62*, 130.57, 130.4*, 130.1*, 129.5, 129.3, 128.7, 126.2, 125.6*, 123.8, 123.4*, 123.22 (q, *J* = 4.6 Hz), 122.9 (q, *J* = 3.8 Hz), 49.0, 45.9, 43.8, 42.2, 41.4, 26.7, 26.0, 25.4, 24.7, 23.4, and 14.1. The carbon resonances marked with an "*" are likely due to additional splitting by the CF$_3$ group. The expected quartet of the CF$_3$ carbon was not observed in the NMR spectrum of **2bb-pyr**.

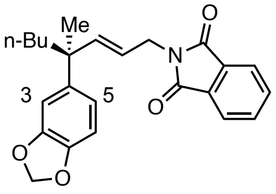
IR (neat): 3267 (br), 3055, 2960, 2932, 2871, 1620, 1537, 1491, and 1429 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{28}H_{34}F_3N_2O_2^+$ $(M+H)^+$: 487.2567, found 487.2565.

SFC (UV/Vis and ESI-MS): 97.4:2.6 er (analytical SFC, AY-H column, 40 °C, MeOH:CO$_2$ = 1:99 → 10:90 (30 min), 2 mL/min, 2000 psi) major retention time: 21.86 min, minor retention time: 28.68 min.

Optical Rotation: $[\alpha]_D^{20}$ = -2.8 (c = 0.5, CHCl$_3$).

(*S*,*E*)-2-(4-(Benzo[*d*][1,3]dioxol-5-yl)-4-methyloct-2-en-1-yl)isoindoline-1,3-dione (2bc):



The **General Procedure B** was followed using 3,4-(methylenedioxy)phenylboronic acid (61 mg x 3, 0.37 x 3 mmol) and **1b** (100 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (6:1 hexanes:EtOAc) afforded product **2bc** as a colorless oil [run 1: 88 mg, 0.225 mmol, 61% yield (~90% conversion); run 2: 93 mg, 0.237 mmol, 64% yield (~90% conversion), average yield 63%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.85 (nfom, 2H, $N_{phth}ArH_m$), 7.71 (nfom, 2H, $N_{phth}ArH_o$), 6.77 (dd, *J* = 1.6, 0.8 Hz, 1H, Ar*H*3), 6.72 (dd, *J* = 8.1, 0.8 Hz, 1H, Ar*H*6), 6.70 (dd, *J* = 8.2, 1.6 Hz, 1H, Ar*H*5), 5.91 (s, 2H, OC*H*2O), 5.91 (dt, *J* = 15.7, 1.2 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.47 (dt, *J* = 15.7, 6.2 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.33 (ddd, *J* = 15.0, 6.2, 1.2 Hz, 1H, HC=CHCH_aH$_b$NPhth), 4.29 (dd, *J* = 15.0, 6.2, 1.2 Hz, 1H, HC=CHCH$_a$$H_b$NPhth), 1.68 (ddd, *J* = 13.4, 12.0, 5.0 Hz, 1H, (Ar)(Me)CCH_aH$_b$CH$_2$CH$_2$CH$_3$), 1.60 (ddd, *J* = 13.4, 12.0, 4.7 Hz, 1H, (Ar)(Me)CCH$_a$$H_bCH_2CH_2CH_3$), 1.28 (s, 3H, C$H_3$C=CH), 1.22 (app Hex, *J* = 7.1 Hz, 2H, (Ar)(Me)CCH$_2$CH$_2$CH_2CH$_3$), 1.15–0.98 (m, 2H, (Ar)(Et)CCH$_2$CH_2CH$_2$CH$_3$), and 0.82 (t, *J* = 7.4 Hz, 3H, (Ar)(Me)CCH$_2$CH$_2$CH$_2$CH_3).

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 147.6, 145.5, 143.8, 141.7, 134.0, 132.3, 123.4, 120.6, 119.6, 107.8, 107.6, 100.9, 43.6, 41.5, 40.1, 26.8, 25.8, 23.4, and 14.2.

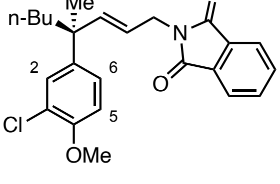
IR (neat) 2932, 1771, 1711, 1394, 1242, 904, 719, and 648 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{24}H_{26}NO_4^+$ $(M+H)^+$: 392.1856, found 392.1857.

SFC (UV/Vis and ESI-MS): 97.2:2.8 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO$_2$ = 2:98 → 8:92 (40 min), 2 mL/min, 2320 psi, major retention time: 23.40 min, minor retention time: 25.24 min.

Optical Rotation: $[\alpha]_D^{20}$ = +7.0 (c = 0.5, $CHCl_3$).

(*S*,*E*)-2-(4-(3-Chloro-4-methoxyphenyl)-4-methyloct-2-en-1-yl)isoindoline-1,3-dione (2bd):



The **General Procedure B** was followed using 3-chloro-4-methoxyphenylboronic acid (69 mg x 3, 0.37 x 3 mmol) and **1b** (100 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (6:1 hexanes:EtOAc) afforded product **2bc** as a colorless oil [run 1: 94 mg, 0.23 mmol, 62% yield (94% conversion); run 2: 107 mg, 0.26 mmol, 70% yield (95% conversion), average yield 66%, average conversion 95%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.86 (nfom, 2H, N$_{phth}$Ar*H$_m$*), 7.72 (nfom, 2H, N$_{phth}$Ar*H$_o$*), 7.24 (d, *J* = 2.4 Hz, 1H, Ar*H*2), 7.10 (dd, *J* = 8.7, 2.4 Hz, 1H, Ar*H*6), 6.84 (d, *J* = 8.6 Hz, 1H, Ar*H*5), 5.90 (dt, *J* = 15.7, 1.3 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.47 (dt, *J* = 15.7, 6.2 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.34 (ddd, *J* = 15.0, 6.2, 1.2 Hz, 1H, HC=CHC*H*$_a$H$_b$NPhth), 4.30 (dd, *J* = 15.0, 6.2, 1.2 Hz, 1H, HC=CHCH$_a$*H*$_b$NPhth), 3.87 (s, 3H, ArOC*H*$_3$), 1.69 (ddd, *J* = 13.5, 12.1, 5.1 Hz, 1H, (Ar)(Me)CC*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.61 (ddd, *J* = 13.4, 12.0, 4.6 Hz, 1H, (Ar)(Me)CCH$_a$*H*$_b$CH$_2$CH$_2$CH$_3$), 1.29 (s, 3H, C*H*$_3$C=CH), 1.23 (app Hex, *J* = 7.3 Hz, 2H, (Ar)(Me)CCH$_2$CH$_2$C*H*$_2$CH$_3$), 1.14–0.97 (m, 2H, (Ar)(Me)CCH$_2$C*H*$_2$CH$_2$CH$_3$), and 0.82 (t, *J* = 7.4 Hz, 3H, (Ar)(Me)CCH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 168.1, 153.0, 143.3, 141.0, 134.0, 132.3, 128.6, 126.0, 123.4, 122.0, 121.1, 111.8, 56.2, 43.1, 41.3, 40.0, 26.7, 25.5, 23.4, and 14.2.

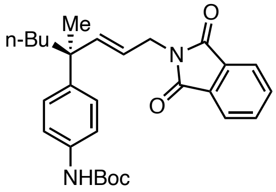
IR (neat): 2931, 28671, 1771, 1709, 1498, 1391, 1256, 1065, 909, and 717 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{24}H_{27}ClNO_3^+$ (M+H)$^+$: 412.1674, found 412.1674.

SFC (UV/Vis and ESI-MS): 97.8:2.2 er (analytical SFC, AY-H column, 40 °C, *i*-PrOH:CO$_2$ = 5:95 → 10:90 (20 min), 2 mL/min, 2320 psi), major retention time: 14.86 min, minor retention time: 13.85 min;

Optical Rotation: $[\alpha]_D^{20}$ = +9.0 (c = 0.5, CHCl$_3$).

***tert*-Butyl (*S*,*E*)-(4-(1-(1,3-dioxoisoindolin-2-yl)-4-methyloct-2-en-4-yl)phenyl)carbamate (2be):**



The **General Procedure B** was followed using 4-(tert-butoxycarbonylamino)phenylboronic acid (88 mg x 3, 0.37 x 3 mmol) and **1b** (100 mg, 0.37 mmol) at 40 °C. The resulting oily solid was suspended in 6:1 hexanes:EtOAc and filtered through celite. Purification of this material by MPLC (6:1 hexanes:EtOAc) afforded product **2be** as a colorless oil [run 1: 102 mg, 0.22 mmol, 62% yield (88% conversion); run 2: 94 mg, 0.20 mmol, 55% yield (60% conversion), average yield 59%, average conversion 74%].

^{1}**H NMR** (500 MHz, CDCl$_3$): δ 7.85 (nfom, 2H, N$_{\mathrm{phth}}$ArH_m), 7.71 (nfom, 2H, N$_{\mathrm{phth}}$ArH_o), 7.25 (br d, J = 8 Hz, 2H, NHBocArH_{o}), 7.16 (d, J = 8.7 Hz, 2H, NHBocArH_{m}), 6.41 (br s, 1H, ArN*H*Boc), 5.92 (dt, J = 15.7, 1.3 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.46 (dt, J = 15.7, 6.2 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.31 (dd, J = 6.4, 1.0 Hz, 2H, HC=CHCH_2NPhth), 1.70 (ddd, J = 13.3, 12.1, 4.9 Hz, 1H, (Ar)(Me)CCH_{a}H$_{\mathrm{b}}$CH$_2$CH$_2$CH$_3$), 1.62 (ddd, J = 13.4, 12.0, 4.6 Hz, 1H, (Ar)(Me)CCH$_{\mathrm{a}}$$H_{\mathrm{b}}CH_2CH_2CH_3$), 1.50 [s, 9H, ArNHCOOC(CH_3)$_3$], 1.29 (s, 3H, BuCH_3C=CH), 1.21 (Hex, J = 7.4 Hz, 2H, (Ar)(Me)CCH$_2$CH$_2$CH_2CH$_3$), 1.13–0.96 (m, 2H, (Ar)(Me)CCH$_2$CH_2CH$_2$CH$_3$), and 0.81 (t, J = 7.2 Hz, 3H, (Ar)(Me)CCH$_2$CH$_2$CH$_2$CH_3).

^{13}**C NMR** (125 MHz, CDCl$_3$): δ 168.1, 153.0, 143.7, 142.3, 136.1, 134.0, 132.3, 127.3, 123.4, 120.6, 118.4, 80.4, 43.3, 41.3, 40.0, 28.5, 26.7, 25.6, 23.4, and 14.2.

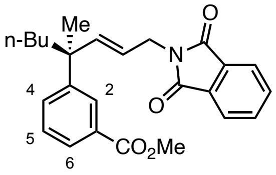
IR (neat): 3357 (br), 3050, 2962, 2931, 2872, 1771, 1707, 1591, 1520, 1392, 1231, 1156, and 733 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{28}H_{35}N_2O_4^+$ (M+H)$^+$: 463.2591, found 463.2610.

SFC (UV/Vis and ESI-MS): 94.6:5.4 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO$_2$ = 10:90 → 20:80 (10 min), 2 mL/min, 2320 psi, major retention time: 14.44 min, minor retention time: 18.95 min.

Optical Rotation: $[\alpha]_{\mathrm{D}}^{20}$ = +10.3 (c = 0.5, CHCl$_3$).

Methyl (*S*,*E*)-3-(1-(1,3-dioxoisoindolin-2-yl)-4-methyloct-2-en-4-yl)benzoate (2bf):



The **General Procedure B** was followed using 3-carbomethoxyphenylboronic acid (67 mg x 3, 0.37 x 3 mmol) and **1b** (100 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (6:1 hexanes:EtOAc) afforded product **2bf** as a colorless oil [run 1: 77 mg, 0.19 mmol, 51% yield (69% conversion); run 2: 72 mg, 0.18 mmol, 48% yield (65% conversion), average yield 50%, average conversion 67%].

^{1}**H NMR** (500 MHz, CDCl$_3$): δ 7.95 (t, J = 1.7 Hz, 1H, CO$_2$MeAr*H*2), 7.86–7.84 (m, 3H, NPhthArH_{o} and CO$_2$MeAr*H*6), 7.71 (nfom, 2H, NPhthArH_{m}), 7.46 (br d, J = 8 Hz, 1H, CO$_2$MeAr*H*4), 7.35 (t, J = 7.6 Hz, 2H, CO$_2$MeAr*H*5), 5.97 (dt, J = 15.7, 1.3 Hz, 1H, *H*C=CHCH$_2$N), 5.50 (dt, J = 15.7, 6.3 Hz, 1H, HC=C*H*CH$_2$N), 4.33 (br d, J = 7 Hz, 2H, C=CHCH_2N), 3.90 (s, 3H, OCH_3), 1.77 (ddd, J = 13.4, 13.4, 4.7

Hz, 1H, $C\mathit{H}_aH_bCH_2CH_2CH_3$), 1.68 (ddd, *J* = 13.4, 13.4, 4.4 Hz, 1H, $CH_a\mathit{H}_bCH_2CH_2CH_3$), 1.36 (s, 3H, C(Ar)(Bu)($C\mathit{H}_3$)), 1.23 (hex, *J* = 7.3 Hz, 2H, $CH_2CH_2C\mathit{H}_2CH_3$), 1.15–1.06 (m, 1H, $CH_2C\mathit{H}_aH_bCH_2CH_3$), 1.05–0.96 (m, 1H, $CH_2CH_a\mathit{H}_bCH_2CH_3$), and 0.82 (t, *J* = 7.3 Hz, 3H, $CH_2CH_2CH_2C\mathit{H}_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 167.5, 148.1, 143.3, 134.1, 132.4, 131.6, 130.1, 128.3, 127.7, 127.3, 123.4, 121.4, 52.2, 43.8, 41.2, 40.0, 26.7, 25.4, 23.4, and 14.1.

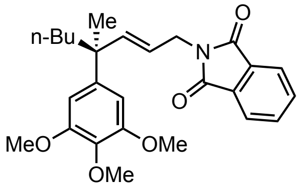
IR (neat): 2932, 1771, 1709, 1393, 1278, 905, and 719 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{25}H_{28}NO_4^+$ $(M+H)^+$: 406.2013, found 406.2013.

SFC (UV/Vis and ESI-MS): 93.5:6.5 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO_2 = 3:97 → 6:94 (10 min), 2 mL/min, 2320 psi), major retention time: 17.15 min, minor retention time: 20.68 min.

Optical Rotation: $[\alpha]_D^{20} = +7.03$ (c = 0.5, $CHCl_3$).

(*S*,*E*)-2-(4-Methyl-4-(3,4,5-trimethoxyphenyl)oct-2-en-1-yl)isoindoline-1,3-dione (2bg):



The **General Procedure B** was followed using 3,4,5-trimethoxyphenylboronic acid (78 mg x 3, 0.37 x 3 mmol) and **1b** (100 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (3:1 hexanes:EtOAc) afforded product **2bf** as a colorless oil [run 1: 95 mg, 0.22 mmol, 59% yield (62% conversion); run 2: 69 mg, 0.16 mmol, 43% yield (48% conversion), average yield 51%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (nfom, 2H $N_{phth}Ar\mathit{H}_m$), 7.72 (nfom, 2H, $N_{phth}Ar\mathit{H}_o$), 6.47 (s, 2H, MeOAr*H*), 5.94 (dt, *J* = 15.7, 1.3 Hz, 1H, *H*C=$CHCH_2$NPhth), 5.53 (dt, *J* = 15.7, 6.2 Hz, 1H, HC=C*H*CH_2NPhth), 4.37 (ddd, *J* = 15.0, 5.9, 1.5 Hz, 1H, HC=$CHC\mathit{H}_aH_b$NPhth), 4.33 (ddd, *J* = 15.0, 6.3, 1.3 Hz, 1H, HC=$CHCH_a\mathit{H}_b$NPhth), 3.83 (s, 6H, Ar3-$OC\mathit{H}_3$ and Ar5-$OC\mathit{H}_3$), 3.82 (s, 3H, Ar4-$OC\mathit{H}_3$), 1.67 (m, 2H, (Ar)(Me)$CC\mathit{H}_2CH_2CH_2CH_3$), 1.30 (s, 3H, (Ar)(n-Bu)$C\mathit{H}_3$), 1.25 (app Hex, *J* = 7.3 Hz, 2H, (Ar)(Me)$CCH_2CH_2C\mathit{H}_2CH_3$), 1.17–1.05 (m, 2H, (Ar)(Me)$CCH_2C\mathit{H}_2CH_2CH_3$), and 0.85 (t, *J* = 7.2 Hz, 3H, (Ar)(Me)$CCH_2CH_2CH_2C\mathit{H}_3$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 152.9, 143.9, 143.0, 136.2, 134.1, 132.4, 123.4, 121.1, 104.1, 60.9, 56.2, 44.0, 41.4, 40.0, 26.9, 25.9, 23.5, and 14.2.

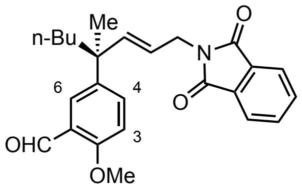
IR (neat) 2934, 1772, 1712, 1587, 1393, 1325, 1126, 905, 720, and 647 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{26}H_{32}NO_5^+$ $(M+H)^+$: 438.2275, found 438.2277.

SFC (UV/Vis and ESI-MS): 96.3:3.7 er (analytical SFC, AY-H column, 40 °C, *i*-PrOH:CO$_2$ = 10:90 → 15:85 (20 min), 2 mL/min, 2320 psi), major retention time: 12.08 min, minor retention time: 14.83 min.

Optical Rotation: $[\alpha]_D^{20} = +6.43$ (c = 0.5, CHCl$_3$).

(*S*,*E*)-5-(1-(1,3-Dioxoisoindolin-2-yl)-4-methyloct-2-en-4-yl)-2-methoxybenzaldehyde (2bh):



The **General Procedure B** was followed using 3-formyl-4-methoxyphenylboronic acid (66 mg x 3, 0.37 x 3 mmol) and **1b** (100 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (3:1 hexanes:EtOAc) afforded product **2bh** as a colorless oil [run 1: 95 mg, 0.22 mmol, 63% yield (>95% conversion); run 2: 82 mg, 0.20 mmol, 55% yield (>95% conversion), average yield 59%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 10.43 (s, 1H, ArC*H*O), 7.85 (nfom, 2H, N$_{\text{phth}}$Ar*H$_m$*), 7.73 (d, *J* = 2.6 Hz, 1H, Ar*H*6), 7.71 (nfom, 2H, N$_{\text{phth}}$Ar*H*$_o$), 7.45 (dd, *J* = 8.7, 2.6 Hz, 1H, Ar*H*4), 6.92 (d, *J* = 8.8 Hz, 1H, Ar*H*3), 5.92 (dt, *J* = 15.7, 1.3 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.47 (dt, *J* = 15.7, 6.3 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.33 (ddd, *J* = 15.0, 6.2, 1.4 Hz, 1H, HC=CHC*H$_a$*H$_b$NPhth), 4.29 (ddd, *J* = 15.1, 6.4, 1.5 Hz, 1H, HC=CHC$\underline{\text{H}_a}$*H$_b$*NPhth), 3.90 (s, 3H, ArOC*H$_3$*), 1.74 (ddd, *J* = 13.4, 12.0, 4.8 Hz, 1H, C(Ar)(Me)C*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.65 (ddd, *J* = 13.4, 12.1, 4.5 Hz, 1H, C(Ar)(Me)CH$_a$*H$_b$*CH$_2$CH$_2$CH$_3$), 1.32 (s, 3H, C(Ar)(n-Bu)C*H*$_3$), 1.22 (app hex, *J* = 7.2 Hz, 2H, C(Ar)(Me)CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.15–1.06 (m, 1H, C(Ar)(Me)CH$_2$C*H*$_a$H$_b$CH$_2$CH$_3$), 1.04–0.94 (m, 1H, C(Ar)(Me)CH$_2$CH$_a$*H$_b$*CH$_2$CH$_3$), and 0.81 (t, *J* = 7.3 Hz, 3H, C(Ar)(Me)CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 190.1, 168.1, 160.2, 143.5, 140.0, 134.8, 134.1, 132.4, 126.4, 124.4, 123.4, 121.2, 111.6, 55.8, 43.2, 41.2, 40.0, 26.7, 25.4, 23.4, and 14.1.

IR (neat): 2933, 1772, 1711, 1680, 1495, 1393, 1254, 905, 720, and 648 cm^{-1}.

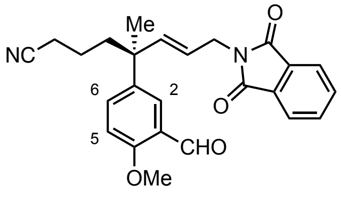
HRMS (ESI-TOF): *m/z* calcd for $C_{25}H_{28}NO_4^+$ $(M+H)^+$: 406.2013, found 406.2016.

SFC (UV/Vis and ESI-MS): 97.1:2.9 er (analytical SFC, AY-H column, 40 °C, *i*-PrOH:CO$_2$ = 10:90 → 15:85 (45 min), 2 mL/min, 2320 psi), major retention time: 14.69 min, minor retention time: 13.78 min.

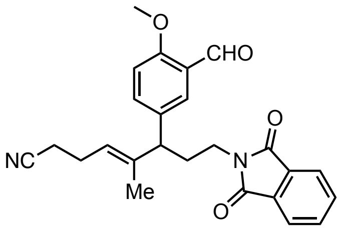
Optical Rotation: $[\alpha]_D^{20}$ = +7.1 (c = 0.5, $CHCl_3$).

6b. Substrate scope of non-participating functional groups (Table 2)

(*S*,*E*)-8-(1,3-Dioxoisoindolin-2-yl)-5-(3-formyl-4-methoxyphenyl)-5-methyloct-6-enenitrile (2c):



2c



iso-2c

The **General Procedure B** was followed using 3-formyl-4-methoxyphenylboronic acid (66 mg x 3, 0.37 x 3 mmol) and **1c** (104 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (1:1 hexanes:EtOAc) afforded product **2c** as a colorless oil [run 1: 68 mg, 0.16 mmol, 44% yield (59% conversion); run 2: 46 mg, 0.11 mmol, 29% yield (60% conversion), average yield 37%, average conversion 60%].

The NMR spectrum of **2c** shows evidence for ~10% of the regioisomer **iso-2c** based on the presence of a triplet at 5.47 ppm (see NMR spectrum). This isomer presumably arises from migratory insertion occurring with the opposite selectivity.

^{1}H NMR (500 MHz, $CDCl_3$): δ 10.44 (s, 1H, O=CH), 7.86 (nfom, 2H, NPhthArH_o), 7.72 (nfom, 2H, NPhthArH_m), 7.71 (d, J = 2.8 Hz, 1H, MeOArH2), 7.46 (dd, J = 8.8 Hz, 1H, MeOArH6), 6.95 (d, J = 8.8 Hz, 1H, MeOArH5), 5.91 (dt, J = 15.7, 1.2 Hz, 1H, HC=CHCH$_2$NPhth), 5.51 (dt, J = 15.7, 6.3 Hz, 1H, HC=CHCH$_2$NPhth), 4.34 (ddd, J = 15.0, 6.2, 1.4 Hz, 1H, C=CHCH_aH$_b$NPhth), 4.30 (ddd, J = 15.2, 6.4, 1.2 Hz, 1H, C=CHCH$_a$$H_b$NPhth), 3.91 (s, 3H, OC$H_3$), 2.27 (t, J = 7.1 Hz, 2H, CH$_2$CH$_2$CH_2CN), 1.90 (ddd, J = 13.2, 13.2, 4.8 Hz, 1H, CH_aH$_b$CH$_2$CH$_2$CN), 1.80 (ddd, J = 13.1, 13.1, 4.6 Hz, 1H, CH$_a$$H_bCH_2CH_2$CN), 1.57–1.49 (m, 1H, CH$_2$CH_aH$_b$CH$_2$CN), 1.46–1.38 (m, 1H, CH$_2$CH$_a$$H_bCH_2$CN), and 1.36 [s, 3H, C(CH_3)].

^{13}C NMR (125 MHz, $CDCl_3$): δ 189.9, 168.1, 160.5, 142.2, 138.8, 134.6, 134.1, 132.3, 126.1, 124.5, 123.5, 122.1, 119.6, 112.0, 55.9, 43.0, 40.3, 39.9, 25.3, 21.0, and 17.7.

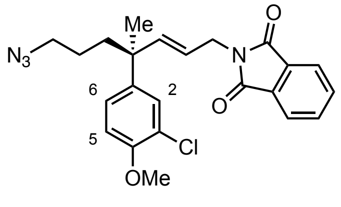
IR (neat): 2925, 2854, 2246, 1771, 1707, 1680, 1607, 1495, 1392, 1254, and 721 cm^{-1}.

HRMS (ESI-TOF) *m/z* calcd for $C_{25}H_{25}N_2O_4$ $(M+H)^+$: 417.1809, found 417.1815.

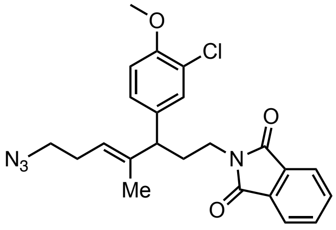
SFC (UV/Vis and ESI-MS): 96.3:3.7 er (analytical SFC, AY-H column, 40 °C, *i*-PrOH:CO_2 = 10:90 → 20:80 (30 min), 2 mL/min, 2320 psi), major retention time: 23.83 min, minor retention time: 22.06 min.

Optical Rotation: $[\alpha]_D^{20}$ = +0.73 (c = 0.5, $CHCl_3$).

(*S*,*E*)-2-(7-Azido-4-(3-chloro-4-methoxyphenyl)-4-methylhept-2-en-1-yl)isoindoline-1,3-dione (2d):



2d



iso-2d

The **General Procedure B** was followed using 3-chloro-4-methoxyphenylboronic acid (69 mg x 3, 0.37 x 3 mmol) and **1d** (110 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (4:1 hexanes:EtOAc) afforded product **2d** as a colorless oil [run 1: 98 mg, 0.22 mmol, 60% yield (72% conversion); run 2: 99 mg, 0.22 mmol, 60% yield (86% conversion), average yield 60%, average conversion 79%].

The NMR spectrum of **2d** shows evidence for ~5% of the regioisomer **iso-2d** based on the presence of a triplet at 5.42 ppm (see NMR spectrum).

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.86 (nfom, 2H, NPhthArH_o), 7.72 (nfom, 2H, NPhthArH_m), 7.25 (d, *J* = 2.4 Hz, 1H, OMeAr*H*2), 7.11 (dd, *J* = 8.6, 2.4 Hz, 1H, OMeAr*H*6), 6.86 (d, *J* = 8.6 Hz, 1H, OMeAr*H*5), 5.89 (dt, *J* = 15.7, 1.3 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.51 (dt, *J* = 15.7, 6.3 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.34 (*J* = 15.1, 6.2, 1.3 Hz, 1H, C=CHCH_aH$_b$N), 4.31 (ddd, *J* = 15.2, 6.2, 1.4 Hz, 1H, C=CHCH$_a$$H_b$N), 3.87 (s, 3H, ArOC$H_3$), 3.20 (t, *J* = 6.8 Hz, 2H, CH$_2$CH$_2$CH_2N$_3$), 1.78 (ddd, *J* = 13.4, 11.9, 5.0 Hz, 1H, CH_aH$_b$CH$_2$CH$_2$N$_3$), 1.70 (ddd, *J* = 13.4, 11.9, 4.6 Hz, 1H, CH$_a$$H_bCH_2CH_2N_3$), 1.49–1.42 (m, 1H, CH$_2CH_aH_bCH_2N_3$), 1.41–1.34 (m, 1H, CH$_2CH_a$$H_bCH_2N_3$), and 1.32 [s, 3H, C(Ar)(Bu)(CH_3)].

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 153.3, 142.4, 140.2, 134.1, 132.3, 128.5, 125.9, 123.4, 122.3, 121.8, 112.0, 56.3, 51.9, 42.9, 39.9, 38.4, 25.5, and 24.3.

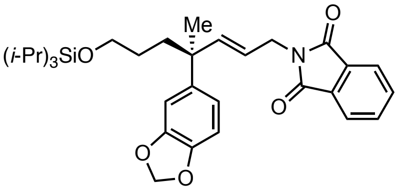
IR (neat): 3050, 2940, 2871, 2094, 1770, 1710, 1499, 1392, 1264, 1065, 733, and 719 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{23}H_{24}Cl^{35}N_4O_3^+$ $(M+H)^+$: 439.1531, found 439.1544.

SFC (UV/Vis and ESI-MS): 96.4:3.6 er (analytical SFC, CEL-1 column, 40 °C, *i*-PrOH:CO$_2$ = 1:99 → 20:80 (30 min), 2 mL/min, 2320 psi, major retention time: 8.46 min, minor retention time: 9.53 min.

Optical Rotation: $[\alpha]_D^{20}$ = -8.0 (c = 0.5, $CHCl_3$).

(*S*,*E*)-2-(4-(Benzo[*d*][1,3]dioxol-5-yl)-4-methyl-7-((triisopropylsilyl)oxy)hept-2-en-1-yl)isoindoline-1,3-dione (2e):



The **General Procedure B** was followed using 3,4-(methylenedioxy)phenylboronic acid (61 mg x 3, 0.37 x 3 mmol) and **1e** (159 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (9:1 hexanes:EtOAc) afforded product **2e** as a colorless oil [run 1: 102 mg, 0.19 mmol, 50% yield (72% conversion); run 2: 109 mg, 0.20 mmol, 54% yield (70% conversion), average yield 52%, average conversion 71%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.85 (nfom, 2H, NPhthAr$_o$*H*), 7.71 (nfom, 2H, NPhthAr$_m$*H*), 6.78 (d, *J* = 1.5 Hz, 1H, OCH_2OAr*H*4), 6.73 (dd, *J* = 8.2, 1.6 Hz, 1H, OCH_2OAr*H*6), 6.71 (d, *J* = 8.1 Hz, 1H, OCH_2OAr*H*7), 5.92 (dt, *J* = ~15, 1.2 Hz, 1H, C*H*=CHCH$_2$NPhth), 5.90 (s, 2H, OC*H*$_2$O), 5.49 (dt, *J* = 15.7, 6.3 Hz, 1H, CH=C*H*CH$_2$NPhth), 4.31 (dd, *J* = 6.3, 1.0 Hz, 2H, C=CHC*H*$_2$NPhth), 3.59 (t, *J* = 6.5 Hz, 2H, CH_2CH_2C*H*$_2$OSi), 1.79–1.67 (m, 2H, C*H*$_2$$CH_2CH_2$OSi), 1.43–1.28 (m, 2H, CH_2C*H*$_2$$CH_2$OSi), 1.30 (s, 3H, C*H*$_3$), and 1.06–1.00 [m, 21H, OSi(C*H*$(CH_3)_2)_3$ and OSi(CH(C*H*$_3)_2)_3$].

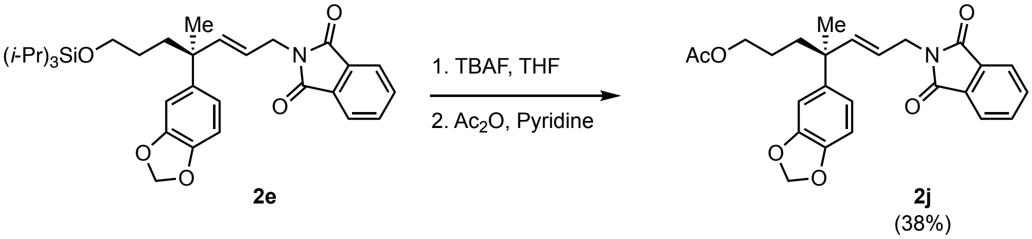
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 147.6, 145.6, 143.5, 141.5, 134.0, 132.4, 123.4, 120.9, 119.7, 107.8, 107.7, 100.9, 63.9, 43.4, 40.1, 37.7, 28.3, 26.1, 18.2, and 12.1.

IR (neat): 2942, 2865, 1772, 1716, 1487, 1393, 1241, 1100, and 720 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{32}H_{44}NO_5Si^+$ $(M+H)^+$: 550.2983, found 550.2985.

Optical Rotation: $[\alpha]_D^{20}$ = +4.4 (c = 0.5, $CHCl_3$).

Conversion of 2e to 2j for e.r. determination



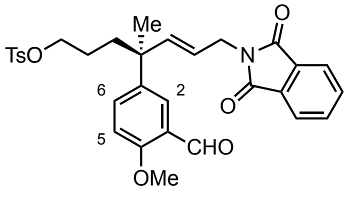
The silyl ether **2e** (109 mg, 0.2 mmol) was dissolved in THF (5 mL) and cooled to 0 °C. TBAF (0.25 mL, 0.25 mmol, 1.25 equiv) was added in one portion, and the mixture was warmed to rt and stirred overnight.

The mixture was diluted with Et_2O (60 mL), transferred to a separatory funnel, washed with $NaHCO_3$ (20 mL), and brine (20 mL). The organic layer was dried ($MgSO_4$), filtered, and concentrated. The resulting residue was passed through a plug of silica (SiO_2, 4:1 to 0:1 Hex:EtOAc) to give the corresponding alcohol (29 mg) which was carried onto the next step without further purification.

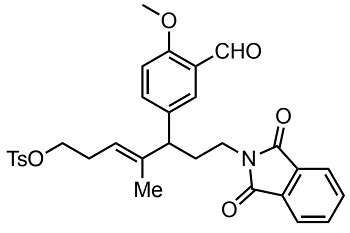
The alcohol from the previous step and DMAP (9 mg, 0.007 mmol, 0.1 equiv) were dissolved in pyridine (5 mL). To this acetic anhydride (0.07 mL, 0.74 mmol, 10 equiv) was added and the resulting mixture was stirred overnight. The solution was then transferred to a separatory funnel with Et_2O (60 mL) and water (30 mL), washed with $CuSO_4$ (20 x 4 mL), and brine (20 mL). The organic layer was dried ($MgSO_4$), filtered, concentrated, and passed through a plug of silica (Et_2O) to give pure **2j** (33 mg, 0.076 mmol, 38% yield from **2c**).

SFC (UV/Vis and ESI-MS): 93.5:6.5 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO_2 = 1:99 → 20:80 (30 min), 2 mL/min, 2320 psi), major retention time: 18.84 min, minor retention time: 20.54 min.

(*S*,*E*)-7-(1,3-Dioxoisoindolin-2-yl)-4-(3-formyl-4-methoxyphenyl)-4-methylhept-5-en-1-yl 4-methylbenzenesulfonate (2f):



2f



iso-2f

The **General Procedure B** was followed using 3-formyl-4-methoxyphenylboronic acid (67 mg x 3, 0.37 x 3 mmol) and **1f** (158 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (3:2 hexanes:EtOAc) afforded product **2f** as a colorless oil [run 1: 111 mg, 0.20 mmol, 53% yield (74% conversion); run 2: 117 mg, 0.21 mmol, 56% yield (71% conversion), average yield 55%, average conversion 73%].

The NMR spectrum of **2f** shows evidence for ~10% of the regioisomer **iso-2f** based on the presence of a triplet at 5.32 ppm (see NMR spectrum).

^{1}**H NMR** (500 MHz, $CDCl_3$): δ 10.42 (s, 1H, O=C*H*), 7.86 (nfom, 2H, NPhthArH_o), 7.75 (d, J = 8.3 Hz, 2H, OSO_2ArH_o), 7.72 (nfom, 2H, NPhthArH_m), 7.65 (d, J = 2.6 Hz, 1H, MeOAr*H*2), 7.41 (dd, J = 8.7, 2.6 Hz, 1H, MeOAr*H*6), 7.33 (d, J = 8.2 Hz, 2H, OSO_2ArH_m), 6.92 (d, J = 8.8 Hz, 1H, MeOAr*H*5), 5.85 (dt, J = 15.6, 1.2 Hz, 1H, *H*C=CHCH_2NPhth), 5.45 (dt, J = 15.7, 6.3 Hz, 1H, HC=C*H*CH_2NPhth), 4.31

(ddd, J = 15.2, 6.2, 1.5 Hz, 1H, C=CHCH_aH$_b$NPhth), 4.28 (ddd, J = 15.0, 6.3, 1.4 Hz, 1H, C=CHCH$_a$$H_b$NPhth), 3.93 (t, J = 6.4 Hz, 2H, $CH_2CH_2CH_2$OTs), 3.91 (s, 3H, OCH_3), 2.44 (s, 3H, ArCH_3), 1.75 (ddd, J = 13.2, 12.2, 4.7 Hz, 1H, CH_aH$_b$CH$_2$CH$_2$OTs), 1.64 (ddd, J = 13.4, 12.1, 4.3 Hz, 1H, CH$_2$CH$_a$$H_bCH_2$OTs), 1.54–1.45 (m, 1H, CH$_2$CH_aH$_b$CH$_2$OTs), 1.43–1.34 (m, 1H, CH$_2$CH$_a$$H_bCH_2$OTs), and 1.28 [s, 3H, C(Ar)(CH_3)].

^{13}C NMR (125 MHz, CDCl$_3$): δ 189.9, 168.1, 160.4, 144.9, 142.4, 139.0, 134.6, 134.1, 133.2, 132.3, 130.0, 128.0, 126.2, 124.4, 123.5, 121.9, 111.9, 71.0, 55.9, 42.8, 39.9, 37.0, 25.2, 24.4, and 21.8.

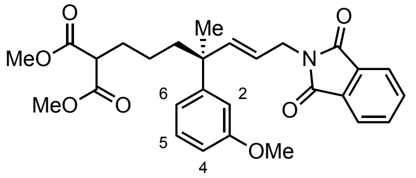
IR (neat): 2962, 2859, 1771, 1710, 1681, 1606, 1495, 1393, 1354, 1175, and 722 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{31}H_{32}NO_7S^+$ (M+H)$^+$: 562.1894, found 562.1898.

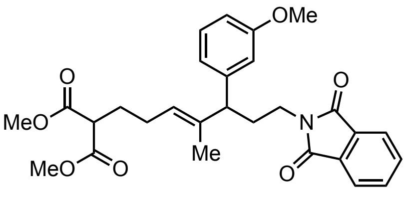
SFC (UV/Vis and ESI-MS): 97.0:3.0 er (analytical SFC, CEL-1 column, 40 °C, *i*-PrOH:CO$_2$ = 5:95 → 20:80 (30 min), 2 mL/min, 2320 psi), major retention time: 16.36 min, minor retention time: 17.15 min.

Optical Rotation: $[\alpha]_D^{20}$ = +4.1 (c = 0.5, CHCl$_3$).

Dimethyl (*S*,*E*)-2-(7-(1,3-dioxoisoindolin-2-yl)-4-(3-methoxyphenyl)-4-methylhept-5-en-1-yl)-malonate (2g):



2g



iso-2g

The **General Procedure A** was followed using 3-methoxyphenylboronic acid (85 mg x 2, 0.56 x 2 mmol) and **1g** (143 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (3:2 hexanes:EtOAc) afforded product **2g** as a colorless oil [run 1: 117 mg, 0.24 mmol, 64% yield (90% conversion); run 2: 131 mg, 0.27 mmol, 72% yield (85% conversion), average yield 68%, average conversion 88%].

The NMR spectrum of **2f** shows evidence for ~15% of the regioisomer **iso-2g** based on the presence of a triplet at 5.39 ppm (see NMR spectrum).

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.85 (nfom, 2H, NPhthArH_m), 7.71 (nfom, 2H, NPhthArH_o), 7.19 (t, J = 8.0 Hz, 1H, OMeAr$H5$), 6.83 (ddd, J = 7.8, 1.8, 0.9 Hz, 1H, MeOAr$H6$), 6.78 (br t, J = 2 Hz, 1H, MeOAr$H2$), 6.71 (ddd, J = 8.1, 2.5, 0.8 Hz, 1H, MeOAr$H4$), 5.92 (dt, J = 15.7, 1.4 Hz, 1H, HC=CHCH$_2$N), 5.49 (dt, J = 15.7, 6.2 Hz, 1H, HC=CHCH$_2$N), 4.31 (dd, J = 6.2, 1.4 Hz, 2H, C=CHCH_2N), 3.78 (s, 3H,

$\mathrm{ArOC}\mathit{H}_3$), 3.69 (s, 3H, $\mathrm{CO_2C_a}\mathit{H}_3$), 3.68 (s, 3H, $\mathrm{CO_2C_b}\mathit{H}_3$), 3.30 (t, *J* = 7.6 Hz, 1H, $\mathrm{CH_2C}\mathit{H}\mathrm{(CO_2Me)_2}$), 1.86–1.81 (m, 2H, $\mathrm{CH_2CH_2C}\mathit{H}_2\mathrm{CH(CO_2Me)_2}$), 1.75 (ddd, *J* = 13.4, 11.9, 4.9 Hz, 1H, $\mathrm{C}\mathit{H}_\mathrm{a}\mathrm{H_bCH_2CH_2CH(CO_2Me_2)_2}$), 1.68 (ddd, *J* = 13.4, 11.8, 4.7 Hz, 1H, $\mathrm{CH_a}\mathit{H}_\mathrm{b}\mathrm{CH_2CH_2CH(CO_2Me_2)_2}$), 1.30 (s, 3H, $\mathrm{C(Ar)(C}\mathit{H}_3\mathrm{))}$, and 1.22–1.05 (m, 2H, $\mathrm{CH_2C}\mathit{H}_2\mathrm{CH_2CH(CO_2Me)_2}$).

^{13}C NMR (125 MHz, $\mathrm{CDCl_3}$): δ 169.9, 168.1, 159.6, 149.0, 142.9, 134.0, 132.4, 129.2, 123.4, 121.2, 119.0, 112.9, 111.2, 55.3, 52.5, 51.6, 43.7, 41.0, 40.0, 29.5, 25.5, and 22.4.

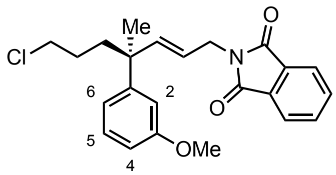
IR (neat): 2953, 1771, 1752, 1733, 1711, 1598, 1582, 1432, 1393, 1253, and 722 $\mathrm{cm^{-1}}$.

HRMS (ESI-TOF): *m/z* calcd for $\mathrm{C_{28}H_{32}NO_7^+}$ $\mathrm{(M+H)^+}$: 494.2173, found 494.2177.

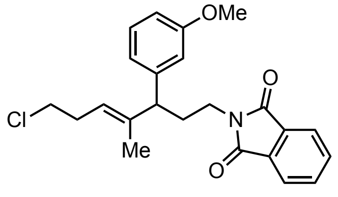
SFC (UV/Vis and ESI-MS): 1.2:98.8 er (analytical SFC, CEL-1 column, 40 °C, *i*-PrOH:$\mathrm{CO_2}$ = 5:95 → 25:75 (30 min), 2 mL/min, 2320 psi, major retention time: 5.85 min, minor retention time: 5.22 min.

Optical Rotation: $[\alpha]_\mathrm{D}^{20} = +1.1$ (c = 0.5, $\mathrm{CHCl_3}$).

(*S*,*E*)-2-(7-Chloro-4-(3-methoxyphenyl)-4-methylhept-2-en-1-yl)isoindoline-1,3-dione (2h):



2h



iso-2h

The **General Procedure A** was followed using 3-methoxyphenylboronic acid (85 mg x 2, 0.56 x 2 mmol) and **1h** (108 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (5:1 hexanes:EtOAc) afforded product **2h** as a colorless oil [run 1: 39 mg, 0.01 mmol, 27% yield (42% conversion); run 2: 56 mg, 0.14 mmol, 38% yield (40% conversion), average yield 33%, average conversion 41%].

The NMR spectrum of **2h** shows evidence for ~4% of the regioisomer **iso-2h** based on the presence of a triplet at 5.49 ppm (see NMR spectrum).

^{1}H NMR (500 MHz, $\mathrm{CDCl_3}$): δ 7.85 (nfom, 2H, $\mathrm{NPhthAr}\mathit{H}_\mathrm{o}$), 7.71 (nfom, 2H, $\mathrm{NPhthAr}\mathit{H}_\mathrm{m}$), 7.21 (t, *J* = 8.0 Hz, 1H, MeOAr*H*5), 6.85 (ddd, *J* = 7.8, 1.8, 0.9 Hz, 1H, MeOAr*H*6), 6.80 (dd, *J* = 2.4, 1.9 Hz, 1H, MeOAr*H*2), 6.72 (ddd, *J* = 8.2, 2.5, 0.9 Hz, 1H, MeOAr*H*4), 5.95 (dt, *J* = 15.7, 1.3 Hz, 1H, $\mathit{H}\mathrm{C{=}CHCH_2NPhth}$), 5.53 (dt, *J* = 15.7, 6.2 Hz, 1H, $\mathrm{HC{=}C}\mathit{H}\mathrm{CH_2NPhth}$), 4.33 (dd, *J* = 6.2, 1.4 Hz, 2H, $\mathrm{C{=}CHC}\mathit{H}_2\mathrm{NPhth}$), 3.78 (s, 3H, $\mathrm{OC}\mathit{H}_3$), 3.45 (t, *J* = 6.5 Hz, 2H, $\mathrm{CH_2CH_2C}\mathit{H}_2\mathrm{Cl}$), 1.88 (ddd, *J* = 13.4, 11.9, 5.1 Hz, 1H, $\mathrm{C}\mathit{H}_\mathrm{a}\mathrm{H_bCH_2CH_2Cl}$), 1.81 (ddd, *J* = 13.4, 11.8, 4.6 Hz, 1H, $\mathrm{CH_a}\mathit{H}_\mathrm{b}\mathrm{CH_2CH_2Cl}$), 1.68–1.53 (m, 2H, $\mathrm{CH_2C}\mathit{H}_2\mathrm{CH_2Cl}$), and 1.34 [s, 3H, $\mathrm{C(Ar)(C}\mathit{H}_3\mathrm{)}$].

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.11, 159.7, 148.7, 142.6, 134.1, 132.4, 129.3, 123.4, 121.5, 119.0, 112.9, 111.3, 55.3, 45.8, 43.5, 40.0, 38.7, 28.0, and 25.7.

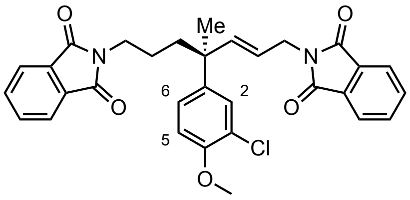
IR (neat): 2959, 2925, 2856, 1770, 1709, 1598, 1581, 1428, 1392, 1048, and 720 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{23}H_{25}ClNO_3^+$ $(M+H)^+$: 398.1517, found 398.1524.

SFC (UV/Vis and ESI-MS): 95.45:4.55 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO_2 = 5:95, 2 mL/min, 2320 psi), major retention time: 21.81 min, minor retention time: 25.80 min.

Optical Rotation: $[\alpha]_D^{20}$ = -1.1 (c = 0.5, $CHCl_3$).

(*S*,*E*)-2,2'-(4-(3-Chloro-4-methoxyphenyl)-4-methylhept-2-ene-1,7-diyl)bis(isoindoline-1,3-dione) (2i):



The **General Procedure B** was followed using 3-chloro-4-methoxyphenylboronic acid (69 mg x 3, 0.37 x 3 mmol) and **1i** (149 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (2:1 hexanes:EtOAc) afforded product **2i** as a colorless oil [run 1: 132 mg, 0.24 mmol, 65% yield (86% conversion); run 2: 118 mg, 0.13 mmol, 58% yield (88% conversion), average yield 62%, average conversion 87%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (nfom, 2H, NPhthAr$_a$*H*$_o$), 7.81 (nfom, 2H, NPhthAr$_b$*H*$_o$), 7.72–7.68 (m, 4H, NPhthAr*H*$_m$), 7.21 (d, *J* = 2.2 Hz, 1H, Ar*H*2), 7.08 (dd, *J* = 8.6, 2.2 Hz, 1H, Ar*H*6), 6.81 (d, *J* = 8.6 Hz, 1H, Ar*H*5), 5.89 (dt, *J* = 15.7, 1.2 Hz, 1H, *H*C=CHCH$_2$NPhth), 5.46 (dt, *J* = 15.6, 6.3 Hz, 1H, HC=C*H*CH$_2$NPhth), 4.30 (dd, *J* = 6.4, 1.2 Hz, 2H, HC=CHC*H*$_2$NPhth), 3.85 (s, 3H, OC*H*$_3$), 3.61 (t, *J* = 7.1 Hz, 2H, CH$_2$CH$_2$C*H*$_2$NPhth), 1.77 (ddd, *J* = 13.1, 13.1, 5.0 Hz, 1H, CH$_2$C*H*$_a$H$_b$CH$_2$NPhth), 1.69 (ddd, *J* = 13.3, 13.3, 4.5 Hz, 1H, CH$_2$CH$_a$*H*$_b$CH$_2$NPhth), 1.59–1.43 (m, 2H, C*H*$_2$CH$_2$CH$_2$NPhth), and 1.29 [s, 3H, C(Ar)(C*H*$_3$)].

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 168.1, 153.3, 142.6, 140.2, 134.0, 134.0, 132.4, 132.3, 128.6, 126.0, 123.4, 123.4, 122.2, 121.7, 112.0, 56.2, 43.0, 40.0, 38.4, 25.5, and 24.0.

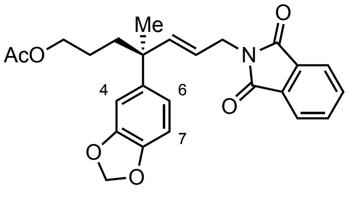
IR (neat): 3027, 2926, 2853, 1770, 1703, 1501, 1393, 1260, 1065, and 718 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{31}H_{28}ClN_2O_5^+$ $(M+H)^+$: 543.1681, found 543.1683.

SFC (UV/Vis and ESI-MS): 91.0:8.97 er (analytical SFC, CEL-1 column, 40 °C, *i*-PrOH:CO_2 = 2:98 → 10:90 (45 min), 2 mL/min, 2320 psi), major retention time: 30.13 min, minor retention time: 31.27 min.

Optical Rotation: $[\alpha]_D^{20}$ = +1.9 (c = 0.5, $CHCl_3$).

(*S*,*E*)-4-(Benzo[*d*][1,3]dioxol-5-yl)-7-(1,3-dioxoisoindolin-2-yl)-4-methylhept-5-en-1-yl acetate (2j):



The **General Procedure B** was followed using 3,4-(methylenedioxy)phenylboronic acid (61 mg x 3, 0.37 x 3 mmol) and **1j** (149 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (3:1 hexanes:EtOAc) afforded product **2j** as a colorless oil [run 1: 97 mg, 0.22 mmol, 60% yield (81% conversion); run 2: 98 mg, 0.22 mmol, 60% yield (84% conversion), average yield 60%, average conversion 83%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.86 (nfom, 2H, NPhthArH_o), 7.72 (nfom, 2H, NPhthArH_m), 6.77 (d, *J* = 1.6 Hz, 1H, OCH_2OAr*H*4), 6.72 (d, *J* = 8.0 Hz, 1H, OCH_2OAr*H*7), 6.70 (dd, *J* = 8.2, 1.6 Hz, 1H, OCH_2OAr*H*6), 5.92 (s, 2H, OCH_2O), 5.91 (dt, *J* = 15.8, 1.3 Hz, 1H, *H*C=$CHCH_2$NPhth), 5.50 (dt, *J* = 15.7, 6.2 Hz, 1H, C=C*H*CH_2NPhth), 4.31 (dd, *J* = 6.2, 1.0 Hz, 2H, C=CHCH_2NPhth), 3.97 (t, J = 6.6 Hz, 2H, $CH_2CH_2CH_2$OAc), 2.01 (s, 3H, $OCOCH_3$), 1.75 (ddd, *J* = 13.3, 11.9, 5.0 Hz, 1H, $CH_2CH_aH_bCH_2$OAc), 1.68 (ddd, *J* = 13.3, 11.9, 4.7 Hz, 1H, $CH_2CH_aH_bCH_2$OAc), 1.52–1.35 (m, 2H, $CH_2CH_2CH_2$OAc), and 1.30 [s, 3H, C(Ar)(CH_3)].

^{13}C NMR (125 MHz, $CDCl_3$): δ 171.2, 168.1, 147.8, 145.8, 143.1, 140.9, 134.1, 132.4, 123.4, 121.2, 119.6, 107.9, 107.5, 101.0, 64.9, 43.3, 40.0, 37.8, 25.8, 24.1, and 21.1.

IR (neat): 3027, 2926, 2853, 1770, 1703, 1501, 1393, 1260, 1065, and 718 cm^{-1}.

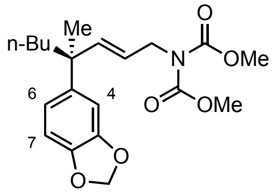
HRMS (ESI-TOF): *m/z* calcd for $C_{25}H_{25}NO_6Na^+$ $(M+Na)^+$: 458.1574, found 458.1582.

SFC (UV/Vis and ESI-MS): 95.9:4.1 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO_2 = 1:99 → 20:80 (30 min), 2 mL/min, 2320 psi), major retention time: 18.65 min, minor retention time: 20.34 min.

Optical Rotation: $[\alpha]_D^{20}$ = +5.5 (c = 0.5, $CHCl_3$).

6c. Substrate scope of terminal groups (Table 3)

Methyl (*S*,*E*)-(4-(benzo[*d*][1,3]dioxol-5-yl)-4-methyloct-2-en-1-yl)(methoxycarbonyl)carbamate (2k):



The **General Procedure B** was followed using 3,4-(methylenedioxy)phenylboronic acid (61 mg x 3, 0.37 x 3 mmol) and **1k** (95 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (3:1 hexanes:EtOAc) afforded product **2k** as a colorless oil [run 1: 100 mg, 0.27 mmol, 72% yield (95% conversion); run 2: 91 mg, 0.24 mmol, 65% yield (>95% conversion), average yield 69%, average conversion >95%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 6.75 (d, *J* = 1.6 Hz, 1H, Ar*H*4), 6.71 (d, *J* = 7.9 Hz, 1H, Ar*H*7), 6.71 (dd, *J* = 8.2, 1.7 Hz, 1H, Ar*H*6), 5.91 (s, 2H, OCH_2O), 5.79 (dt, *J* = 15.7, 1.3 Hz, 1H, *H*C=CHCH$_2$N), 5.45 (dt, *J* = 15.7, 6.2 Hz, 1H, HC=C*H*CH$_2$N), 4.31 (dd, *J* = 6.2, 1.3 Hz, 2H, HC=CHCH_2N), 3.82 (s, 6H, N(CO$_2$CH_3)$_2$), 1.68 (ddd, *J* = 13.5, 11.6, 5.2 Hz, 1H, CH_aH$_b$CH$_2$CH$_2$CH$_3$), 1.62 (ddd, *J* = 13.4, 11.5, 4.8 Hz, 1H, CH$_a$$H_bCH_2CH_2CH_3$), 1.28 (s, 3H, C(Ar)(C$H_3$)), 1.25 (hex, *J* = 7.3 Hz, 2H, CH$_2$CH$_2$CH_2CH$_3$), 1.16–1.01 (m, 2H, CH$_2$CH_2CH$_2$CH$_3$), and 0.85 (t, *J* = 7.3 Hz, 3H, CH$_2$CH$_2$CH$_2$CH_3).

^{13}C NMR (125 MHz, CDCl$_3$): δ 154.2, 147.6, 145.5, 143.2, 142.1, 121.6, 119.4, 107.8, 107.6, 100.9, 53.9, 48.7, 43.5, 41.4, 26.9, 25.8, 23.5, and 14.2.

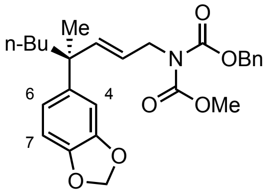
IR (neat): 2956, 2932, 2872, 1794, 1754, 1729, 1701, 1487, 1437, 1356, 1212, 1106, and 1040 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{20}H_{28}NO_6^+$ (M+H)$^+$: 378.1911, found 378.1912.

SFC (UV/Vis and ESI-MS): 96.4:3.6 er (analytical SFC, OZ-H column, 40 °C, *i*-PrOH:CO$_2$ = 2:98, 3 mL/min, 2320 psi), major retention time: 33.68 min, minor retention time: 32.20 min.

Optical Rotation: $[\alpha]_D^{20}$ = +7.6 (c = 0.5, CHCl$_3$).

Benzyl (*S*,*E*)-(4-(benzo[*d*][1,3]dioxol-5-yl)-4-methyloct-2-en-1-yl)(methoxycarbonyl)carbamate (2l):



The **General Procedure B** was followed using 3,4-(methylenedioxy)phenylboronic acid (61 mg x 3, 0.37 x 3 mmol) and **1l** (123 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (6:1 hexanes:EtOAc) afforded product **2l** as a colorless oil [run 1: 115 mg, 0.25 mmol, 69% yield (>95% conversion); run 2: 104 mg, 0.23 mmol, 62% yield (>95% conversion), average yield 66%, average conversion >95%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.38–7.30 (m, 5H, COOCH$_2$C$_6$*H*$_5$), 6.74 (dd, *J* = 1.7, 0.7 Hz, 1H, OCH$_2$OAr*H*4), 6.70 (dd, *J* = 8.2, 0.6 Hz, 1H, OCH$_2$OAr*H*7), 6.67 (dd, *J* = 8.2, 1.7 Hz, 1H, OCH$_2$OAr*H*6), 5.90 (s, 2H, OCH$_2$O), 5.77 (dt, *J* = 15.7, 1.3 Hz, 1H, *H*C=CHCH$_2$N), 5.44 (dt, *J* = 15.7, 6.2 Hz, 1H, HC=C*H*CH$_2$N), 5.23 (s, 2H, COOC*H*$_2$Ph), 4.31 (dd, *J* = 6.2, 1.3 Hz, 2H, HC=CHC*H*$_2$N), 3.83 (s, 3H, COOC*H*$_3$), 1.64 (ddd, *J* = 13.4, 11.8, 5.1 Hz, 1H, C*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.59 (ddd, *J* = 13.3, 11.8, 4.8 Hz, 1H, CH$_a$*H*$_b$CH$_2$CH$_2$CH$_3$), 1.25 [s, 3H, C(Bu)(Ar)(C*H*$_3$)], 1.23 (hex, *J* = 7.2 Hz, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.14–0.98 (m, 2H, CH$_2$C*H*$_2$CH$_2$CH$_3$), and 0.84 (t, *J* = 7.3 Hz, 3H, CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$) δ 154.2, 153.4, 147.6, 145.5, 143.3, 141.9, 135.5, 128.7, 128.5, 128.2, 121.5, 119.5, 107.8, 107.6, 100.9, 68.7, 54.0, 48.6, 43.5, 41.4, 26.8, 25.7, 23.5, and 14.2.

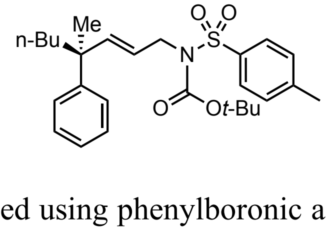
IR (neat): 3032, 2955, 2932, 1793, 1751, 1726, 1701, 1487, 1444, 1353, 1293, 1209, and 1103 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{26}H_{31}NO_6Na^+$ $(M+Na)^+$: 476.2044, found 476.2057.

SFC (UV/Vis and ESI-MS): >99:1 er (analytical SFC, AD-H column, 40 °C, *i*-PrOH:CO$_2$ = 2:98 → 7:93 (180 min), 2 mL/min, 2320 psi), major retention time: 77.78 min, minor retention time: 75.55 min.

Optical Rotation: $[\alpha]_D^{20}$ = +3.3 (c = 0.5, CHCl$_3$).

***tert*-Butyl (*S*,*E*)-(4-methyl-4-phenyloct-2-en-1-yl)(tosyl)carbamate (2m)**



The **General Procedure B** was followed using phenylboronic acid (45 mg x 3, 0.37 x 3 mmol) and **1m** (146 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (20:1 hexanes:EtOAc) afforded product **2m** as a colorless oil [run 1: 100 mg, 0.21 mmol, 57% yield (89% conversion); run 2: 87 mg, 0.18 mmol, 49% yield (90% conversion), average yield 53%, average conversion 90%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.76 (d, J = 8.3 Hz, 2H, NSO$_2$ArH_o), 7.31–7.26 (m, 4H, PhH_o, PhH_m), 7.23 (d, J = 8.2 Hz, 2H, NSO$_2$ArH_m), 7.17 (tt, J = 6.4, 2.1 Hz, 1H, PhH_p), 5.99 (dt, J = 15.7, 1.3 Hz, 1H, CH=CHCH$_2$N), 5.57 (dt, J = 15.7, 6.3 Hz, 1H, CH=CHCH$_2$N), 4.46 (dd, J = 6.3, 1.2 Hz, 1H, CH=CHCH_2NTsBoc), 2.42 (s, 3H, NSO$_2$PhCH_3), 1.77 (ddd, J = 13.4, 12.0, 5.0 Hz, 1H, CH_aH$_b$CH$_2$CH$_2$CH$_3$), 1.70 (ddd, J = 13.5, 11.9, 4.5 Hz, 1H, CH$_a$$H_bCH_2CH_2CH_3$), 1.38 (s, 3H, C(Ar)(Bu)CH_3), 1.32 [s, 9H, CO$_2$C(CH_3)$_3$], 1.28–1.22 (m, 2H, CH$_2$CH$_2$CH_2CH$_3$), 1.21–1.03 (m, 2H, CH$_2$CH_2CH$_2$CH$_3$), and 0.84 (t, J = 7.2 Hz, 3H, CH$_2$CH$_2$CH$_2$CH_3).

^{13}C NMR (125 MHz, CDCl$_3$): δ 150.9, 147.7, 144.1, 144.0, 137.5, 129.3, 128.2, 128.2, 126.7, 125.9, 122.2, 84.2, 48.7, 43.7, 41.5, 28.0, 26.8, 25.5, 23.5, 21.8, and 14.2.

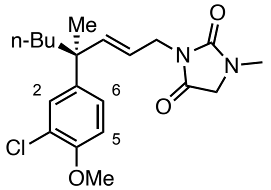
IR (neat): 2959, 2932, 2861, 1724, 1354, 1152, 907, and 727 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{27}H_{37}NO_4SNa^+$ (M+Na)$^+$: 494.2336, found 494.2346.

SFC (UV/Vis and ESI-MS): 97.2:2.8 er (analytical SFC, OZ-H column, 40 °C, *i*-PrOH:CO$_2$ = 1:99 → 10:90 (30 min), 2 mL/min, 2320 psi), major retention time: 21.77 min, minor retention time: 19.15 min.

Optical Rotation: $[\alpha]_D^{20}$ = +12.0 (c = 0.5, CHCl$_3$).

(*S*,*E*)-3-(4-(3-chloro-4-methoxyphenyl)-4-methyloct-2-en-1-yl)-1-methylimidazolidine-2,4-dione (2n):



The **General Procedure B** was followed using 3-chloro-4-methoxyphenylboronic acid (69 mg x 3, 0.37 x 3 mmol) and **1n** (88 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (1:1 hexanes:EtOAc) afforded product **2n** as a colorless oil [run 1: 73 mg, 0.19 mmol, 52% yield (91% conversion); run 2: 58 mg, 0.15 mmol, 41% yield (not determined), average yield 47%, average conversion ~91%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.25 (d, J = 2.3 Hz, 1H, Ar$H2$), 7.11 (dd, J = 8.6, 2.4 Hz, 1H, Ar$H6$), 6.85 (d, J = 8.7 Hz, 1H, Ar$H5$), 5.90 (dt, J = 15.7, 1.4 Hz, 1H, HC=CHCH$_2$N), 5.43 (dt, J = 15.7, 6.4 Hz, 1H, HC=C*H*CH$_2$N), 4.13 (dd, *J* = 6.6, 1.1 Hz, 2H, HC=CHC*H*$_2$N), 3.87 (s, 3H, ArOC*H*$_3$), 3.86 (s, 2H, CONC*H*$_2$NMe), 3.00 (s, 3H, NCONC*H*$_3$), 1.69 (ddd, *J* = 13.5, 12.0, 4.9 Hz, 1H, C*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.62 (ddd, *J* = 13.3, 11.9, 4.6 Hz, 1H, CH$_a$*H*$_b$CH$_2$CH$_2$CH$_3$), 1.29 (s, 3H, NC*H*$_3$), 1.24 (m, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.17–0.98 (m, 2H, CH$_2$C*H*$_2$CH$_2$CH$_3$), and 0.84 (t, *J* = 7.3 Hz, 3H, CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 169.6, 156.7, 153.0, 143.6, 141.0, 128.7, 126.0, 122.0, 120.7, 111.8, 56.2, 51.8, 43.1, 41.3, 41.0, 29.8, 26.7, 25.5, 23.4, and 14.2.

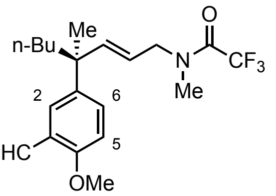
IR (neat): 2954, 2931, 2860, 1774, 1707, 1499, 1450, 1410, 1258, 1065, and 766 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{20}H_{28}Cl^{35}N_2O_3^+$ (M+H)$^+$: 379.1783, found 379.1791.

SFC (UV/Vis and ESI-MS): 97.1:2.9 er (analytical SFC, AY-H column, 40 °C, *i*-PrOH:CO$_2$ = 5:95 → 10:90 (45 min), 2 mL/min, 2320 psi), major retention time: 20.49 min, minor retention time: 17.36 min.

Optical Rotation: $[\alpha]_D^{20}$ = +14.3 (c = 0.5, CHCl$_3$).

(*S*,*E*)-2,2,2-Trifluoro-*N*-(4-(3-formyl-4-methoxyphenyl)-4-methyloct-2-en-1-yl)-*N*-methylacetamide (2o):



The **General Procedure B** was followed using 3-formyl-4-methoxyphenylboronic acid (66 mg x 3, 0.37 x 3 mmol) and **1o** (93 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (4:1 hexanes:EtOAc) afforded product **2o** as a colorless oil [run 1: 84 mg, 0.22 mmol, 59% yield (91% conversion); run 2: 88 mg, 0.23 mmol, 62% yield (91% conversion), average yield 61%, average conversion 91%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 10.45 (s, 0.5H, ArC*H*O$_{ra}$), 10.45 (s, 0.5H, ArC*H*O$_{rb}$), 7.73 (d, *J* = 2.7 Hz, 0.5H, OMeAr*H*2$_{ra}$), 7.73 (d, *J* = 2.7 Hz, 0.5H, OMeAr*H*2$_{rb}$), 7.45 (dd, *J* = 8.7, 2.7 Hz, 0.5H, OMeAr*H*6$_{ra}$), 7.43 (dd, *J* = 8.8, 2.6 Hz, 0.5H, OMeAr*H*6$_{rb}$), 6.94 (d, *J* = 8.9 Hz, 0.5H, OMeAr*H*5$_{ra}$), 6.93 (d, *J* = 8.8 Hz, 0.5H, OMeAr*H*5$_{rb}$), 5.83 (dt, *J* = 15.6, 1.1 Hz, 0.5H, C*H*$_{ra}$=CHCH$_2$N), 5.82 (dt, *J* = 15.6, 1.5 Hz, 0.5H, C*H*$_{rb}$=CHCH$_2$N), 5.36 (dt, *J* = 15.7, 6.5 Hz, 0.5H, CH=C*H*$_{ra}$CH$_2$N), 5.34 (dt, *J* = 15.7, 6.2 Hz, 0.5H, CH=C*H*$_{rb}$CH$_2$N), 4.05 (dd, *J* = 6.5, 1.0 Hz, 1H, CH=CHC*H*$_{2ra}$N), 4.01 (br t, *J* = 5 Hz, 1H, CH=CHC*H*$_{2rb}$N), 3.91 (s, 1.5H, ArOC*H*$_{3ra}$), 3.91 (s, 1.5H, ArOC*H*$_{3rb}$), 3.06 (q, *J* = 1.7 Hz, 1.5H, NC*H*$_{3ra}$), 2.97 (s, 1.5H,

NCH_{3rb}), 1.76 (ddd, *J* = 13.0, 13.0, 4.7 Hz, 1H, $CH_aH_bCH_2CH_2CH_2CH_3$), 1.68 (ddd, *J* = 13.4, 12.0, 4.5 Hz, 0.5H, $CH_aH_{bra}CH_2CH_2CH_3$), 1.67 (ddd, *J* = 13.3, 12.1, 4.5 Hz, 0.5H, $CH_aH_{brb}CH_2CH_2CH_3$), 1.36 [s, 1.5H, C(Bu)(Ar)(CH_{3ra})], 1.35 [s, 1.5H, C(Bu)(Ar)(CH_{3rb})], 1.25 (hex, *J* = 7.1 Hz, 1H, $CH_2CH_2CH_{2ra}CH_3$), 1.25 (hex, *J* = 7.1 Hz, 1H, $CH_2CH_2CH_{2rb}CH_3$), 1.15–1.07 (m, 1H, $CH_2CH_aH_bCH_2CH_3$), 1.06–0.95 (m, 1H, $CH_2CH_aH_bCH_2CH_3$), 0.83 (t, *J* = 7.1 Hz, 1.5H, $CH_2CH_2CH_2CH_{3ra}$), and 0.83 (t, *J* = 7.1 Hz, 1.5H, $CH_2CH_2CH_2CH_{3rb}$).

^{13}C NMR (125 MHz, $CDCl_3$) δ 190.01, 189.96, 160.4, 160.3, 156.91 (q, *J* = 35.8 Hz, $COCF_{3ra}$), 156.87 (q, *J* = 35.7 Hz, $COCF_{3rb}$), 144.9, 144.6, 139.7, 139.5, 134.4, 134.3, 126.21, 126.18, 124.4, 124.3, 120.9, 120.4, 116.7 (*J* = 287.2 Hz, $COCF_{3ra}$), 116.6 (*J* = 287.2 Hz, $COCF_{3rb}$), 111.71, 111.69, 55.8, 51.73, 51.70, 51.2, 43.32, 43.28, 41.1, 41.0, 34.2, 34.12, 34.06, 26.79, 26.77, 25.3, 25.2, 23.3, and 14.1.

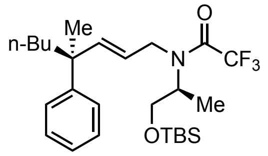
IR (neat): 2959, 2932, 2861, 1682, 1607, 1494, 1253, 1180, 1139, and 1091 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{20}H_{27}F_3NO_3^+$ $(M+H)^+$: 386.1938, found 386.1948.

SFC (UV/Vis and ESI-MS): 94.8:5.2 er (analytical SFC, AY-H column, 40 °C, *i*-PrOH:CO_2 = 2:98 → 8:92 (20 min), 1 mL/min, 2320 psi), major retention time: 17.61 min, minor retention time: 16.66 min.

Optical Rotation: $[\alpha]_D^{20} = +3.2$ (c = 0.5, $CHCl_3$).

***N*-((*S*)-1-((*tert*-Butyldimethylsilyl)oxy)propan-2-yl)-2,2,2-trifluoro-*N*-((*S*,*E*)-4-methyl-4-phenyloct-2-en-1-yl)acetamide (2p):**



The **General Procedure B** was followed using phenylboronic acid (49 mg x 3, 0.37 x 3 mmol) and **1p** (152 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (30:1 hexanes:EtOAc) afforded product **2p** as a colorless oil [run 1: 104 mg, 0.21 mmol, 59% yield (>95% conversion); run 2: 135 mg, 0.28 mmol, 75% yield (>95% conversion), average yield 67%, average conversion >95%]. Note: performing this reaction using **General Procedure A** resulted in a lower yield (64 mg, 0.13 mmol, 36% yield, 82% conversion) due to difficulties separating the product from residual starting material.

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.32–7.25 (m, 4H, PhH_m, PhH_o), 7.20–7.15 (m, 1H, PhH_p), 5.85 (dt, *J* = 15.8, 1.5 Hz, 0.5H, $CH_{ra}{=}CHCH_2$), 5.84 (dt, *J* = 15.8, 1.3 Hz, 0.5H, $CH_{rb}{=}CHCH_2$), 5.51 (ddd, *J* = 15.8, 6.8, 5.6 Hz, 0.5H, $CH{=}CH_{ra}CH_2$), 5.39 (ddd, *J* = 15.8, 6.3, 6.3 Hz, 0.5H, $CH{=}CH_{rb}CH_2$), 4.18 (m, 0.5H, $C{=}CHCH_{ara}H_b$), 4.12 (m, 0.5H, $C{=}CHCH_{arb}H_b$), 4.11 [m, 0.5H, NCH_{ra}(Me)], 3.96 (m, 0.5H,

$CH_{ara}H_{b}OTBS$), 3.94 (m, 0.5H, $C{=}CHCH_{a}H_{bra}$), 3.88 (m, 0.5H, $NCH_{rb}(Me)$], 3.87 (m, 0.5H, $C{=}CHCH_{a}H_{brb}$), 3.64 (m, 0.5H, $CH_{arb}H_{b}OTBS$), 3.61 (m, 1H, $CH_{a}H_{b}OTBS$), 1.77 (m, 1H, $CH_{a}H_{b}CH_2CH_2CH_3$), 1.68 (m, 1H, $CH_{a}H_{b}CH_2CH_2CH_3$), 1.37 [s, 1.5H, $C(CH_{ra3})(Ph)(Bu)$], 1.34 [s, 1.5H, $C(CH_{rb3})(Ph)(Bu)$], 1.26 [d, J = 6.9 Hz, 1.5H, $NCH(CH_{ra3})$], 1.25 (m, 2H, $CH_2CH_2CH_2CH_3$), 1.22, [d, J = 6.7 Hz, 1.5 H, $NCH(CH_{rb3})$], 1.18–1.10 (m, 1H, $CH_2CH_{a}H_{b}CH_2CH_3$), 1.08–1.00 (m, 1H, $CH_2CH_{a}H_{b}CH_2CH_3$), 0.87 [s, 9H, $Si(CH_3)_2(C(CH_3)_3)$], 0.84 (t, J = 7.3 Hz, 3H, $CH_2CH_2CH_2CH_3$), 0.03 [s, 3H, $Si(CH_3)_a(CH_3)_b(C(CH_3)_3)$], and 0.03 [s, 3H, $Si(CH_3)_a(CH_3)_b(C(CH_3)_3)$].

^{13}C NMR (125 MHz, $CDCl_3$): 157.3, 156.9, 147.7, 147.2, 144.1, 143.0, 128.3, 128.2, 126.7, 126.6, 126.1, 125.9, 122.5, 122.1, 116.9, 116.6, 64.6, 63.8, 57.4, 54.6, 54.6, 50.5, 50.4, 44.9, 43.8, 43.7, 41.3, 41.2, 26.9, 26.8, 25.9, 25.9, 25.4, 25.4, 23.5, 18.3, 18.2, 16.0, 14.4, 14.2, -5.4, -5.5, and -5.5.

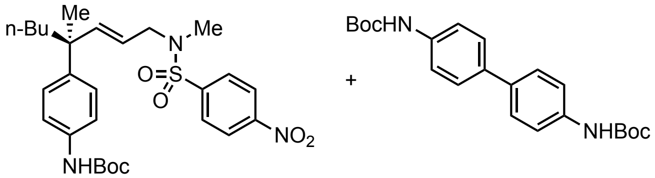
IR (neat): 2956, 1930, 2859, 1689, 1436, 1191, 1142, and 837 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{26}H_{43}F_3NO_2Si$ $(M+H)^+$: 486.3010, found 486.3008.

SFC (UV/Vis and ESI-MS): 96.9:3.1 er (analytical SFC, OZ-H column, 40 ºC, *i*-PrOH:CO_2 = 1:99, 2 mL/min, 2000 psi), major retention time: 6.68 min, minor retention time: 8.85 min.

Optical Rotation: $[\alpha]_D^{20}$ = +8.6 (c = 0.5, $CHCl_3$).

***tert*-Butyl (*S*,*E*)-(4-(4-methyl-1-((*N*-methyl-4-nitrophenyl)sulfonamido)oct-2-en-4-yl)phenyl)carbamate (2q):**



The **General Procedure B** was followed using 4-(tert-butoxycarbonylamino)phenylboronic acid (88 mg x 3, 0.37 x 3 mmol) and **1q** (93 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (4:1 hexanes:EtOAc) afforded product **2q** as a 3.7:1 mixture (84% by mass **2q**) of **2q** and the homodimer of the boronic acid used (di-*tert*-butyl [1,1'-biphenyl]-4,4'-diyldicarbamate). The adjusted yields for the runs are: [run 1: 121 mg (102 mg), 0.19 mmol, 52% yield (>95% conversion); run 2: 123 mg (103 mg), 0.19 mmol, 53% yield (>95% conversion), average yield 53%, average conversion >95%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.33 (d, J = 8.9 Hz, 2H, NO_2ArH_o), 7.95 (d, J = 8.9 Hz, 2H, NO_2ArH_m), 7.25 (d, J = 8.8 Hz, 2H, $NHBocArH_o$), 7.10 (d, J = 8.8 Hz, 2H, $NHBocArH_m$), 6.41 (br s, 1H, ArN*H*Boc), 5.76 (dt, J = 15.7, 1.3 Hz, 1H, $HC{=}CHCH_2N$), 5.23 (dt, J = 15.6, 6.6 Hz, 1H, $HC{=}CHCH_2N$), 3.74 (ddd, *J* = 14.3, 6.7, 1.2 Hz, 1H, HC=CHC*H*$_a$H$_b$N), 3.70 (ddd, *J* = 14.2, 6.7, 1.2 Hz, 1H, HC=CHCH$_a$*H*$_b$N), 2.73 (s, 3H, NC*H*$_3$SO$_2$Ar), 1.69 (ddd, *J* = 13.4, 12.0, 4.7 Hz, 1H, C*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.59 (ddd, *J* = 13.3, 12.1, 4.6 Hz, 1H, CH$_a$*H*$_b$CH$_2$CH$_2$CH$_3$), 1.52 (s, 9H, NHCO$_2$C(C*H*$_3$)$_3$), 1.28 (s, 3H, C(Ar)(C*H*$_3$)), 1.21 (hex, *J* = 7.4 Hz, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.12–1.04 (m, 1H, CH$_2$C*H*$_a$H$_b$CH$_2$CH$_3$), 1.04–0.93 (m, 1H, CH$_2$CH$_a$*H*$_b$CH$_2$CH$_3$), and 0.82 (t, *J* = 7.3 Hz, 3H, CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): 153.0, 150.2, 146.1, 144.2, 141.6, 136.4, 128.7, 127.2, 124.5, 120.4, 118.5, 81.3, 52.8, 43.4, 41.3, 34.2, 28.5, 26.8, 25.3, 23.4, and 14.1.

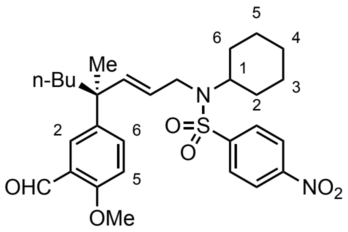
IR (neat): 3367 (br), 3104, 2961, 2931, 2861, 1722, 1528, 1348, 1159, and 756 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{27}H_{37}N_3O_6SNa^+$ (M+Na)$^+$: 554.2295, found 554.2302.

SFC (UV/Vis and ESI-MS): 93.2:6.8 er (analytical SFC, AY-H column, 40 °C, *i*-PrOH:CO$_2$ = 15:85 → 25:75 (20 min), 2 mL/min, 2320 psi), major retention time: 12.76 min, minor retention time: 14.16 min.

Optical Rotation: $[\alpha]_D^{20}$ = +2.4 (c = 0.5, CHCl$_3$).

(*S*,*E*)-*N*-Cyclohexyl-*N*-(4-(3-formyl-4-methoxyphenyl)-4-methyloct-2-en-1-yl)-4-nitrobenzenesulfonamide (2r):



The **General Procedure B** was followed using 3-formyl-4-methoxyphenylboronic acid (66 mg x 3, 0.37 x 3 mmol) and **1r** (151 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (5:1 hexanes:EtOAc) afforded product **2r** as an off white amorphous solid containing 4 % by mass EtOAc [run 1: 157 mg (151 mg), 0.28 mmol, 75% yield (>95% conversion); run 2: 157 mg (151 mg), 0.28 mmol, 75% yield (>95% conversion), average yield 75%, average conversion >95%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 10.46 (s, 1H, ArC*H*O), 8.28 (d, *J* = 8.8 Hz, 2H, NO$_2$Ar*H*$_o$), 7.98 (d, *J* = 8.6 Hz, 2H, NO$_2$Ar*H*$_m$), 7.70 (d, *J* = 2.4 Hz, 1H, OMeAr*H*2), 7.44 (dd, *J* = 8.9, 2.5 Hz, 1H, OMeAr*H*6), 6.92 (d, *J* = 8.8 Hz, 1H, OMeAr*H*5), 5.78 (dt, *J* = 15.8, 1.1 Hz, 1H, *H*C=CHCH$_2$N), 5.38 (dt, *J* = 15.8, 6.4 Hz, 1H, C=C*H*CH$_2$N), 3.93 (ddd, *J* = 16.0, 6.3, 1.3 Hz, 1H, C=CHC*H*$_a$H$_b$N), 3.92 (s, 3H, OC*H*$_3$), 3.91 (ddd, *J* = 16.0, 6.3, 1.3 Hz, 1H, C=CHCH$_a$*H*$_b$N), 3.68 (tt, *J* = 12.0, 3.6 Hz, 1H, CyHex*H*1), 1.76 (m, 2H, CyHexC3,5*H*$_a$), 1.73 (m, 1H, C*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.64 (m, 1H, CH$_a$*H*$_b$CH$_2$CH$_2$CH$_3$), 1.63–1.57 (m, 4H, CyHexC3,5*H*$_b$ and CyHexC2,6*H*$_a$), 1.44 (ddddd, *J* = 12.3, 12.3, 12.3, 5.0, 3.8 Hz, 2H, CyHexC2,6H$_b$), 1.32 (s, 3H, C(Ar)(Bu)(C*H*$_3$)), 1.30–1.21 (m, 3H, CH$_2$C*H*$_2$CH$_2$CH$_3$ and CyHexC4*H*$_a$), 1.15–1.06 (m, 1H, CH$_2$C*H*$_a$H$_b$CH$_2$CH$_3$), 1.05–0.96 (m, 2H, CH$_2$CH$_a$*H*$_b$CH$_2$CH$_3$ and CyHexC4*H*$_b$), and 0.84 (t, *J* = 7.3 Hz, 3H, CH$_2$CH$_2$CH$_2$C*H*$_3$).

^{13}C NMR (125 MHz, CDCl$_3$): 189.9, 160.3, 149.8, 147.8, 142.4, 139.8, 134.3, 128.1, 126.3, 124.9, 124.39, 124.36, 111.6, 58.9, 55.8, 46.4, 43.1, 41.4, 32.2, 32.1, 26.8, 26.2, 25.3, 25.1, 23.4, 14.3, and 14.1.

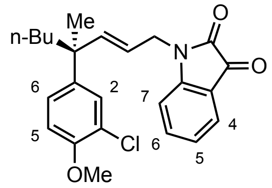
IR (neat): 3104, 2932, 2858, 1681, 1606, 1529, 1348, 1155, and 612 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{29}H_{39}N_2O_6S^+$ (M+H)$^+$: 543.2523, found 543.2532.

SFC (UV/Vis and ESI-MS): 91.4:8.6 er (analytical SFC, CEL-1 column, 40 °C, *i*-PrOH:CO$_2$ = 4:96, 2 mL/min, 2000 psi, major retention time: 22.00 min, minor retention time: 19.68 min.

Optical Rotation: $[\alpha]_D^{20} = +3.2$ (c = 0.5, CHCl$_3$).

(*S*,*E*)-1-(4-(3-Chloro-4-methoxyphenyl)-4-methyloct-2-en-1-yl)indoline-2,3-dione (2s):



The **General Procedure B** was followed using 3-chloro-4-methoxyphenylboronic acid (69 mg x 3, 0.37 x 3 mmol) and **1s** (100 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (5:1 hexanes:EtOAc) afforded product **2s** as an orange amorphous solid [run 1: 103 mg, 0.25 mmol, 68% yield (>95% conversion); run 2: 123 mg, 0.30 mmol, 94% yield (>95% conversion), average yield 81%, average conversion >95%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.61 (dd, *J* = 7.4, 1.3 Hz, 1H, NAr*H*4), 7.57 (ddd, *J* = 7.8, 7.8, 1.4 Hz, 1H, NAr*H*6), 7.19 (d, *J* = 2.4 Hz, 1H, MeOAr*H*2), 7.12 (ddd, *J* = 7.6, 7.6, 0.5 Hz, 1H, NAr*H*5), 7.07 (dd, *J* = 8.6, 2.4 Hz, 1H, MeOAr*H*6), 6.89 (d, *J* = 7.9, Hz, 1H, NAr*H*7), 6.84 (d, *J* = 8.6 Hz, 1H, MeOAr*H*5), 5.91 (dt, *J* = 15.8, 1.5 Hz, 1H, *H*C=CHCH$_2$N), 5.43 (dt, *J* = 15.8, 5.9 Hz, 1H, HC=C*H*CH$_2$N), 4.41 (ddd, *J* = 15.8, 5.9, 1.6 Hz, 1H, C=CHC*H*$_a$H$_b$N), 4.37 (ddd, *J* = 15.7, 6.0, 1.5 Hz, 1H, C=CHCH$_a$*H*$_b$N), 3.88 (s, 3H, ArOC*H*$_3$), 1.71 (ddd, *J* = 13.3, 12.0, 4.8 Hz, 1H, C*H*$_a$H$_b$CH$_2$CH$_2$CH$_3$), 1.64 (ddd, *J* = 13.3, 12.0, 4.5 Hz, 1H, CH$_a$*H*$_b$CH$_2$CH$_2$CH$_3$), 1.31 (s, 3H, C(Ar)C*H*$_3$), 1.24 (hex, *J* = 7.2 Hz, 2H, CH$_2$CH$_2$C*H*$_2$CH$_3$), 1.15–

1.07 (m, 1H, $CH_2CH_aH_bCH_2CH_3$), 1.06–0.96 (m, 1H, $CH_2CH_aH_bCH_2CH_3$), and 0.83 (t, J = 7.3 Hz, 3H, $CH_2CH_2CH_2CH_3$).

^{13}C NMR (125 MHz, $CDCl_3$): 183.5, 158.0, 153.2, 151.0, 144.2, 140.5, 138.4, 128.7, 125.8, 125.5, 123.9, 122.2, 119.8, 117.8, 111.9, 111.1, 56.3, 43.3, 42.4, 41.0, 26.8, 25.3, 23.4, and 14.1.

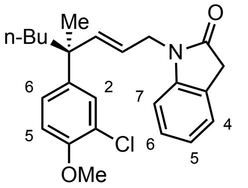
IR (neat): 2957, 2932, 2861, 1738, 1612, 1500, 1470, 1349, 1258, 1065, and 755 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{24}H_{26}ClNO_3Na$ $(M+Na)^+$: 434.1493, found 434.1497.

SFC (UV/Vis and ESI-MS): 95.9:4.1 er (analytical SFC, CEL-1 column, 40 °C, *i*-PrOH:CO_2 = 8:92, 2 mL/min, 3000 psi), major retention time: 30.88 min, minor retention time: 28.73 min.

Optical Rotation: $[\alpha]_D^{20}$ = +9.6 (c = 0.5, $CHCl_3$).

(*S*,*E*)-1-(4-(3-Chloro-4-methoxyphenyl)-4-methyloct-2-en-1-yl)indoline-2,3-dione (2t):



The **General Procedure B** was followed using 3-chloro-4-methoxyphenylboronic acid (69 mg x 3, 0.37 x 3 mmol) and **1t** (95 mg, 0.37 mmol) at 40 °C. Purification of this material by MPLC (3:1 hexanes:EtOAc) afforded product **2t** as pale yellow oil [run 1: 50 mg, 0.13 mmol, 34% yield (>95% conversion); run 2: 58 mg, 0.15 mmol, 39% yield (>95% conversion), average yield 37%, average conversion >95%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.26–7.23 (m, 2H, NAr*H*4 or NAr*H*7 and NAr*H*5 or NAr*H*6), 7.22 (d, J = 2.4 Hz, 1H, MeOAr*H*2), 7.07 (dd, J = 8.6, 2.4 Hz, 1H, MeOAr*H*6), 7.03 (ddd, J = 7.6, 7.6, 1.0 Hz, 1H, NAr*H*5 or NAr*H*6), 6.83 (dd, J = 8.1, 0.9 Hz, 1H, NAr*H*4 or NAr*H*7), 6.82 (d, J = 8.7 Hz, 1H, MeOAr*H*2), 5.84 (dt, J = 15.8, 1.5 Hz, 1H, *H*C=$CHCH_2N$), 5.43 (dt, J = 15.8, 5.9 Hz, 1H, HC=C*H*CH_2N), 4.40 (ddd, J = 15.6, 5.9, 1.5 Hz, 1H, $HC{=}CHCH_aH_bN$), 4.36 (ddd, J = 15.6, 5.9, 1.5 Hz, 1H, $HC{=}CHCH_aH_bN$), 3.87 (s, 3H, $ArOCH_3$), 3.55 (s, 2H, $NCOCH_2Ar$), 1.68 (ddd, J = 13.3, 11.7, 4.9 Hz, 1H, $CH_aH_bCH_2CH_2CH_3$), 1.62 (ddd, J = 13.3, 11.8, 4.5 Hz, 1H, $CH_aH_bCH_2CH_2CH_3$), 1.29 [s, 3H, $C(Ar)(Bu)(CH_3)$], 1.22 (hex, J = 7.3 Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.16–1.07 (m, 1H, $CH_2CH_aH_bCH_2CH_3$), 1.05–0.96 (m, 1H, $CH_2CH_aH_bCH_2CH_3$), and 0.82 (t, J = 7.3 Hz, 3H, $CH_2CH_2CH_2CH_3$).

^{13}C NMR (125 MHz, $CDCl_3$): 174.9, 153.1, 144.6, 142.9, 141.0, 128.7, 127.9, 125.9, 124.7, 124.5, 122.4, 122.1, 121.2, 111.8, 109.2, 56.3, 43.3, 42.2, 41.1, 35.9, 26.8, 25.5, 23.4, and 14.2.

IR (neat): 2956, 2930, 2860, 1714, 1615, 1497, 1466, 1345, 1259, 1066, and 751 cm^{-1}.

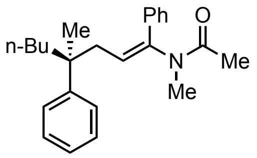
HRMS (ESI-TOF): *m/z* calcd for $C_{24}H_{29}ClNO_2Na^+$ $(M+Na)^+$: 398.1881, found 398.1882.

SFC (UV/Vis and ESI-MS): 97.1:2.9 er (analytical SFC, AY-H column, 40 ^oC, *i*-PrOH:CO_2 = 10:90 → 15:85 (20 min), 2 mL/min, 2320 psi), major retention time: 11.23 min, minor retention time: 10.26 min.

Optical Rotation: $[\alpha]_D^{20}$ = +5.5 (c = 0.5, $CHCl_3$).

6d. N-Me amide substrate scope (Table 4)

(*S*,*E*)-*N*-Methyl-*N*-(4-methyl-1,4-diphenyloct-1-en-1-yl)acetamide (2u):



The **General Procedure A** was followed using phenylboronic acid (90 mg x 3, 0.74 x 3 mmol, 6 equiv total) and **1u** (73 mg, 0.37 mmol). Purification of this material by MPLC (3:1 hexanes:EtOAc) afforded product **2u** as pale yellow oil [run 1: 91 mg, 0.26 mmol, 70% yield (>95% conversion); run 2: 83 mg, 0.24 mmol, 64% yield (>95% conversion), average yield 67%, average conversion >95%].

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.36–7.16 [m, 10H, C(Me)(Bu)(C$_6\mathit{H}_5$) and C=C(C$_6\mathit{H}_5$)], 5.87 (dd, *J* = 7.8, 6.5 Hz, 0.5H, C=CH_{ra}), 5.80 (dd, *J* = 9.2, 5.2 Hz, 0.5H, C=CH_{rb}), 2.96 (s, 1.5H, NC$\mathit{H}_{3\mathrm{ra}}$), 2.92 (s, 1.5H, NC$\mathit{H}_{3\mathrm{rb}}$), 2.57 (dd, *J* = 15.2, 7.7 Hz, 0.5H, C$\mathit{H}_{\mathrm{ara}}H_{\mathrm{b}}$CH=CN), 2.50 (dd, *J* = 14.9, 5.3 Hz, 0.5H, C$\mathit{H}_{\mathrm{arb}}H_{\mathrm{b}}$CH=CN), 2.40 (dd, *J* = 14.9, 9.3 Hz, 0.5H, CH$_{\mathrm{a}}\mathit{H}_{\mathrm{bra}}$CH=CN), 2.36 (dd, *J* = 15.1, 6.4 Hz, 0.5H, CH$_{\mathrm{a}}\mathit{H}_{\mathrm{brb}}$CH=CN), 1.89 (s, 1.5H, NCOC$\mathit{H}_{3\mathrm{ra}}$), 1.86 (s, 1.5H, NCOC$\mathit{H}_{3\mathrm{rb}}$), 1.86 (dt, *J* = 12.3, 4.1 Hz, 0.5H, C$\mathit{H}_{\mathrm{ara}}H_{\mathrm{b}}CH_2CH_2CH_3$), 1.84 (dt, *J* = 12.3, 4.1 Hz, 0.5H, C$\mathit{H}_{\mathrm{arb}}H_{\mathrm{b}}CH_2CH_2CH_3$), 1.61 (dt, *J* = 12.4, 4.5 Hz, 0.5H, CH$_{\mathrm{a}}\mathit{H}_{\mathrm{bra}}CH_2CH_2CH_3$), 1.59 (dt, *J* = 12.4, 4.3 Hz, 0.5H, CH$_{\mathrm{a}}\mathit{H}_{\mathrm{brb}}CH_2CH_2CH_3$), 1.40 [s, 1.5H, C(Ph)(Bu)(C$\mathit{H}_{3\mathrm{ra}}$)], 1.36 [s, 1.5H, C(Ph)(Bu)(C$\mathit{H}_{3\mathrm{rb}}$)], 1.29–1.22 (m, 2H, CH$_2CH_2C\mathit{H}_2CH_3$), 1.21–1.11 (m, 1H, CH$_2C\mathit{H}_{\mathrm{a}}H_{\mathrm{b}}CH_2CH_3$), 1.04–0.91 (m, 1H, CH$_2CH_{\mathrm{a}}\mathit{H}_{\mathrm{b}}CH_2CH_3$), 0.84 (t, *J* = 7.2 Hz, 1.5H, CH$_2$CH$_2$CH$_2$C$\mathit{H}_{3\mathrm{ra}}$), and 0.83 (t, *J* = 7.4 Hz, 1.5H, CH$_2$CH$_2$CH$_2$C$\mathit{H}_{3\mathrm{rb}}$).

^{13}C NMR (125 MHz, CDCl$_3$): δ 171.5, 171.4, 146.8, 146.7, 142.2, 136.6, 136.4, 129.0, 128.5, 128.40, 128.36, 126.5, 126.01, 125.99, 125.3, 125.21, 125.17, 43.3, 42.8, 42.2, 42.0, 41.40, 41.36, 34.8, 34.7, 26.53, 26.51, 24.6, 24.3, 23.5, 23.4, 21.33, 21.25, and 14.1.

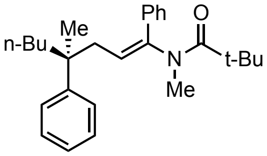
IR (neat): 3085, 3060, 3033, 2957, 2931, 2871, 1662, 1376, 765, and 700 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for C$_{24}$H$_{32}$NO$^+$ (M+H)$^+$: 350.2478, found 350.2477.

SFC (UV/Vis and ESI-MS): 99.05:0.95 er (analytical SFC, OZ-H column, 40 °C, *i*-PrOH:CO$_2$ = 1:99 → 20:80 (30 min), 2 mL/min, 2320 psi), major retention time: 18.69 min, minor retention time: 19.56 min.

Optical Rotation: $[\alpha]_D^{20}$ = +6.0 (c = 0.5, CHCl$_3$).

(*S*,*E*)-*N*-Methyl-*N*-(4-methyl-1,4-diphenyloct-1-en-1-yl)pivalamide (2v):



The **General Procedure A** was followed using phenylboronic acid (90 mg x 3, 0.74 x 3 mmol, 6 equiv total) and **1v** (89 mg, 0.37 mmol). Purification of this material by MPLC (9:1 hexanes:EtOAc) afforded product **2v** as pale yellow oil [run 1: 72 mg, 0.18 mmol, 50% yield (70% conversion); run 2: 71 mg, 0.18 mmol, 49% yield (69% conversion), average yield 50%, average conversion 70%].

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.36–7.12 [m, 10H, C(Me)(Bu)(C_6H_5) and C=C(C_6H_5)], 5.90 (dd, *J* = 7.7, 6.0 Hz, 0.5H, C=CH_{ra}), 5.82 (dd, *J* = 9.8, 4.3 Hz, 0.5H, C=CH_{rb}), 3.04 (s, 1.5H, NCH_{3ra}), 2.99 (s, 1.5H, NCH_{3rb}), 2.59 (dd, *J* = 16.0, 7.9 Hz, 0.5H, C$H_{ara}$$H_b$CH=CN), 2.52 (dd, *J* = 15.3, 4.3 Hz, 0.5H, C$H_{arb}$$H_b$CH=CN), 2.45 (dd, *J* = 15.2, 9.8 Hz, 0.5H, C$H_a$$H_{bra}$CH=CN), 2.43 (dd, *J* = 16.0, 5.9 Hz, 0.5H, C$H_a$$H_{brb}$CH=CN), 1.87 (br dt, *J* = 13, 5 Hz, 0.5H, C$H_{ara}$$H_b$$CH_2CH_2CH_3$), 1.84 (br dt, *J* = 13, 5 Hz, 0.5H, C$H_{arb}$$H_b$$CH_2CH_2CH_3$), 1.63–1.55 (m, 1H, C$H_a$$H_b$$CH_2CH_2CH_3$), 1.40 [s, 1.5 H, C(Ph)(Bu)(CH_{3ra})], 1.33 [s, 1.5 H, C(Ph)(Bu)(CH_{3rb})], 1.27–1.19 (m, 2H, $CH_2CH_2CH_2CH_3$), 1.19–1.10 (m, 1H, $CH_2C$$H_a$$H_b$$CH_2CH_3$), 1.07 (s, 4.5H, NCOC($CH_{3ra}$)$_3$), 1.06 (s, 4.5 H, NCOC($CH_{3rb}$)$_3$), 1.01–0.88 (m, 1H, $CH_2CH_a$$H_b$$CH_2CH_3$), 0.84 (t, *J* = 6.9 Hz, 1.5H, $CH_2CH_2CH_2C$$H_{3ra}$), and 0.82 (t, *J* = 7.3 Hz, 1.5H, $CH_2CH_2CH_2C$$H_{3rb}$).

^{13}C NMR (125 MHz, $CDCl_3$): δ 179.28, 179.25, 146.8, 146.7, 143.3, 143.1, 138.4, 137.8, 128.9, 128.5, 128.4, 128.0, 126.53, 126.52, 126.00, 125.97, 125.1, 125.0, 43.6, 43.4, 42.8, 41.4, 41.3, 41.20, 41.17, 39.61, 39.55, 29.32, 29.28, 28.2, 26.6, 26.5, 24.9, 24.3, 23.5, 23.4, and 14.2.

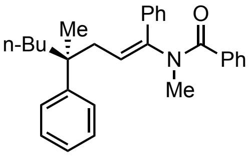
IR (neat): 3060, 3031, 2957, 2931, 2870, 1627, 1481, 1446, 1357, 1331, 765 and 699 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{27}H_{38}NO^+$ $(M+H)^+$: 392.2948, found 392.2952.

SFC (UV/Vis and ESI-MS): 98.7:1.3 er (analytical SFC, OZ-H column, 40 °C, *i*-PrOH:CO_2 = 5:95 → 25:75 (30 min), 2 mL/min, 2320 psi), major retention time: 13.16 min, minor retention time: 16.97 min.

Optical Rotation: $[\alpha]_D^{20}$ = +7.2 (c = 0.5, $CHCl_3$).

(*S*,*E*)-*N*-Methyl-*N*-(4-methyl-1,4-diphenyloct-1-en-1-yl)benzamide (2w):



The **General Procedure A** was followed using phenylboronic acid (90 mg x 3, 0.74 x 3 mmol, 6 equiv total) and **1w** (89 mg, 0.37 mmol). Purification of this material by MPLC (9:1 hexanes:EtOAc) afforded product **2w** as pale yellow oil [run 1: 70 mg, 0.17 mmol, 46% yield (not determined); run 2: 66 mg, 0.16 mmol, 43% yield (not determined), average yield 45%, average conversion not determined]. The broad resonances of residual **1w** in the crude reaction mixture made it difficult to determine with certainty the amount of remaining starting material.

^{1}H NMR (500 MHz, $\mathrm{CDCl_3}$, 60 °C): δ 7.50 (d, J = 8.0 Hz, 2H, $\mathrm{NCOPh}H_\mathrm{o}$), 7.36–7.12 (m, 13H, C(Me)(Bu)($\mathrm{C_6}H_5$), C=C($\mathrm{C_6}H_5$), $\mathrm{NCOPh}H_\mathrm{m}$, and $\mathrm{NCOPh}H_\mathrm{p}$), 5.56 (dd, J = 8.8, 5.3 Hz, 0.5H, $\mathrm{C{=}C}H_\mathrm{ra}$), 5.46 (dd, J = 9.7, 4.2 Hz, 0.5H, $\mathrm{C{=}C}H_\mathrm{rb}$), 3.15 (s, 1.5H, $\mathrm{NC}H_\mathrm{3ra}$), 3.08 (s, 1.5H, $\mathrm{NC}H_\mathrm{3rb}$), 2.46 (dd, J = 15.6, 8.8 Hz, 0.5H, $\mathrm{C}H_\mathrm{ara}\mathrm{H_bCH{=}CN}$), 2.28 (dd, J = 15.4, 9.7 Hz, 0.5H, $\mathrm{C}H_\mathrm{arb}\mathrm{H_bCH{=}CN}$), 1.96 (dd, J = 15.5, 4.3 Hz, 0.5H, $\mathrm{CH_a}H_\mathrm{bra}\mathrm{CH{=}CN}$), 1.86 (dd, J = 15.4, 5.2 Hz, 0.5H, $\mathrm{CH_a}H_\mathrm{brb}\mathrm{CH{=}CN}$), 1.76 (dt, J = 13.0, 4.2 Hz, 0.5H, $\mathrm{C}H_\mathrm{ara}\mathrm{H_bCH_2CH_2CH_3}$), 1.71 (dt, J = 12.8, 4.2 Hz, 0.5H, $\mathrm{C}H_\mathrm{arb}\mathrm{H_bCH_2CH_2CH_3}$), 1.52 (dt, J = 12.7 Hz, 1H, $\mathrm{CH_a}H_\mathrm{b}\mathrm{CH_2CH_2CH_3}$), 1.29 [s, 1.5H, C(Bu)(Ph)($\mathrm{C}H_\mathrm{3ra}$)], 1.27–1.19 (m, 2H, $\mathrm{CH_2CH_2C}H_2\mathrm{CH_3}$), 1.23 [s, 1.5H, C(Bu)(Ph)($\mathrm{C}H_\mathrm{3rb}$)], 1.17–1.03 (m, 1H, $\mathrm{CH_2C}H_\mathrm{a}\mathrm{H_bCH_2CH_3}$), 0.99–0.87 (m, 1H, $\mathrm{CH_2CH_a}H_\mathrm{b}\mathrm{CH_2CH_3}$), 0.85 (t, J = 7.1 Hz, 1.5H, $\mathrm{CH_2CH_2CH_2CH_{3ra}}$), and 0.84 (t, J = 7.3 Hz, 1.5H, $\mathrm{CH_2CH_2CH_2CH_{3rb}}$).

^{13}C NMR (125 MHz, $\mathrm{CDCl_3}$, 60 °C): δ 171.6, 171.5, 147.0, 142.2, 137.2, 136.8, 135.98, 135.96, 130.2, 129.0, 128.9, 128.3, 128.2, 127.7, 127.6, 126.41, 126.38, 125.8, 124.2, 123.9, 43.5, 42.6, 42.0, 41.8, 41.1, 35.8, 35.7, 26.5, 26.4, 24.6, 24.4, 23.5, 23.4, and 14.2.

IR (neat): 3058, 2957, 2931, 2861, 1641, 1446, 1371, 765 and 700 cm^{-1}.

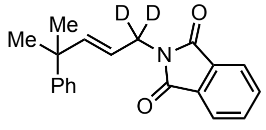
HRMS (ESI-TOF): *m/z* calcd for $\mathrm{C_{29}H_{33}NONa^+}$ $\mathrm{(M+Na)^+}$: 434.2454, found 434.2451.

SFC (UV/Vis and ESI-MS): 99.6:0.4 er (analytical SFC, AS-H column, 40 °C, *i*-PrOH:$\mathrm{CO_2}$ = 15:85 → 25:75 (20 min), 2 mL/min, 2320 psi), major retention time: 3.64 min, minor retention time: 3.32 min.

Optical Rotation: $[\alpha]_D^{20}$ = -3.9 (c = 0.5, $\mathrm{CHCl_3}$).

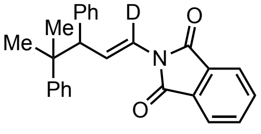
6e. Deuterium labelling experiments (Figure 3)

(*E*)-2-(4-Methyl-4-phenylpent-2-en-1-yl-1,1-*d*2)isoindoline-1,3-dione (2x) and **(*E*)-2-(4-methyl-3,4-diphenylpent-1-en-1-yl-1-*d*)isoindoline-1,3-dione (S21):**



2x

+



S21

The **General Procedure A** was followed using phenylboronic acid (54 mg x 2, 0.56 x 2 mmol, 3 equiv total) and **1x** (86 mg, 0.37 mmol) at room temperature. Purification of this material by MPLC (9:1 hexanes:EtOAc) gave, in order of elution, **S21** (24 mg, 0.063 mmol, 17% yield) as a pale-yellow oil and **2x** (59 mg, 0.192 mmol, 52% yield) as a colorless oil.

Characterization data for S21

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.82 (nfom, 2H, NPhthArH_o), 7.70 (nfom, 2H, NPhthArH_m), 7.29–7.21 (m, 4H), 7.19–7.13 (m, 4H), 6.99 (d, J = 10.6 Hz, 1H, PhCHCH=CDN), 6.86 (m, 2H, PhH_o), 3.46 (d, J = 10.7 Hz, 1H, PhCHCH=CDN), 1.39 (s, 3H, C(Ph)C_aH_3), and 1.38 (s, 3H, C(Ph)C_bH_3).

^{13}C NMR (125 MHz, $CDCl_3$): δ 166.4, 146.9, 141.3, 134.3, 131.2, 129.4, 127.6, 127.5, 127.3, 125.9, 123.3, 122.0, 118.6, 59.9, 41.5, and 26.6.

IR (neat): 3088, 3059, 3029, 2964, 1773, 1710, 1376, 1139, 909, 722, and 697 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{26}H_{23}DNO_2^+$ $(M+H)^+$: 383.1864, found 383.1872.

Characterization data for 2x

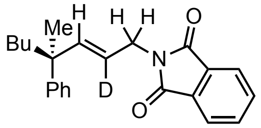
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.85 (nfom, 2H, NPhthArH_o), 7.70 (nfom, 2H, NPhthArH_m), 7.31–7.25 (m, 4H, PhH_o and PhH_m), 7.16 (br t, J = 7 Hz, 1H, PhH_p), 5.96 (d, J = 15.6 Hz, 1H, HC=CHCD_2NPhth), 5.53 (d, J = 15.6 Hz, 1H, HC=C$H$$CD_2$NPhth), and 1.37 (s, 6H, C(CH_3)$_2$)

^{13}C NMR (125 MHz, $CDCl_3$): δ 168.1, 148.5, 144.3, 134.0, 132.4, 128.3, 126.2, 126.0, 123.4, 120.0, 40.6, 39.4 (pent, J = 21.6 Hz, CD_2), and 28.8.

IR (neat): 3057, 2966, 2929, 2870, 1770, 1706, 1384, 1194, 919, 715, and 698 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{20}H_{18}D_2NO_2^+$ $(M+H)^+$: 308.1614, found 308.1619.

(*S*,*E*)-2-(4-Methyl-4-phenyloct-2-en-1-yl-2-*d*)isoindoline-1,3-dione (2y):



The **General Procedure A** was followed using phenylboronic acid (54 mg x 2, 0.56 x 2 mmol, 3 equiv total) and **1y** (101 mg, 0.37 mmol) at room temperature. Purification of this material by MPLC (20:1 hexanes:EtOAc) gave **2y** (67 mg, 0.19 mmol, 52%) as a colorless oil.

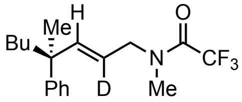
^{1}H NMR (500 MHz, CDCl$_3$): δ 7.84 (nfom, 2H, NPhthArH_o), 7.70 (nfom, 2H, NPhthArH_m), 7.29–7.25 (m, 4H, PhH_o and PhH_m), 7.16 (m, 1H, PhH_p), 5.96 (s, 1H, *H*C=CDCH$_2$N), 4.32 (s, 2H, HC=CDCH_2N), 1.74 (ddd, *J* = 13.3, 13.3, 4.7 Hz, 1H, CH_aCH$_b$CH$_2$CH$_2$CH$_3$), 1.66 (ddd, *J* = 13.1, 13.1, 4.3 Hz, 1H, CH$_a$CH_bCH$_2$CH$_2$CH$_3$), 1.33 (s, 3H, C(Ar)CH_3), 1.22 (hex, *J* = 7.3 Hz, 2H, CH$_2$CH$_2$CH_2CH$_3$), 1.16–0.99 (m, 2H, CH$_2$CH_2CH$_2$CH$_3$), and 0.81 (t, *J* = 7.2 Hz, 3H, CH$_2$CH$_2$CH$_2$CH_3).

^{13}C NMR (125 MHz, CDCl$_3$): δ 168.1, 147.7, 143.5, 134.0, 132.4, 128.2, 126.7, 125.9, 123.4, 120.5 (t, *J* = 24.0 Hz, C=*C*D), 43.7, 41.4, 40.0, 26.8, 25.6, 23.5, and 14.1.

IR (neat): 2959, 2930, 2859, 1771, 1709, 1428, 1390, 989, 715 and 698 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{23}H_{25}DNO_2^+$ (M+H)$^+$: 349.2021, found 349.2024.

(*S*,*E*)-2,2,2-trifluoro-*N*-methyl-*N*-(4-methyl-4-phenyloct-2-en-1-yl-2-*d*)acetamide (2z):



The **General Procedure A** was followed using phenylboronic acid (54 mg x 2, 0.56 x 2 mmol, 3 equiv total) and **1z** (94 mg, 0.37 mmol) at room temperature. Purification of this material by MPLC (20:1 hexanes:EtOAc) gave a 1: 2.56 mixture of **1z**:**2z** (84 mg, 77% by mass **2z**, 0.20 mmol, 53%) as a colorless oil.

^{1}H NMR (500 MHz, CDCl$_3$): δ 7.32–7.25 (m, 4H, PhH_m and PhH_o), 7.20–7.16 (m, 1H, PhH_p), 5.89 (s, 0.5H, H_{ra}C=CDCH$_2$N), 5.87 (s, 0.5H, H_{rb}C=CDCH$_2$N), 4.06 (s, 1H, CH_{2ra}NCOCF$_3$), 4.04 (d, *J* = ~15 Hz, 1H, C$_{rb}H_a$H$_b$N), 3.99 (d, *J* = ~15 Hz, 1H, C$_{rb}$H$_a$$H_b$N), 3.06 (q, *J* = 1.5 Hz, 1.5H, NCH_{3ra}), 2.97 (s, 1.5H, NCH_{3rb}), 1.79 (ddd, *J* = 12.1, 12.1, 4.8 Hz, 1H, CH_aH$_b$CH$_2$CH$_2$CH$_3$), 1.72 (ddd, *J* = 11.9, 4.8, 2.5 Hz, 0.5H, CH$_a$H$_{bra}$CH$_2$CH$_2$CH$_3$), 1.69 (ddd, *J* = 12.1, 4.5, 2.4 Hz, 0.5H, CH$_a$$H_{brb}CH_2CH_2CH_3$), 1.37 (s, 3H, C(Ph)(Bu)(CH_3)), 1.31–1.23 (m, 2H, CH$_2$CH$_2$CH_2CH$_3$), 1.19–1.01 (m, 2H, CH$_2$CH_2CH$_2$CH$_3$), 0.851 (t, *J* = 7.4 Hz, 1.5H, CH$_2$CH$_2$CH$_2$CH_{3ra}), and 0.847 (t, *J* = 7.4 Hz, 1.5H, CH$_2$CH$_2$CH$_2$CH_{3rb}).

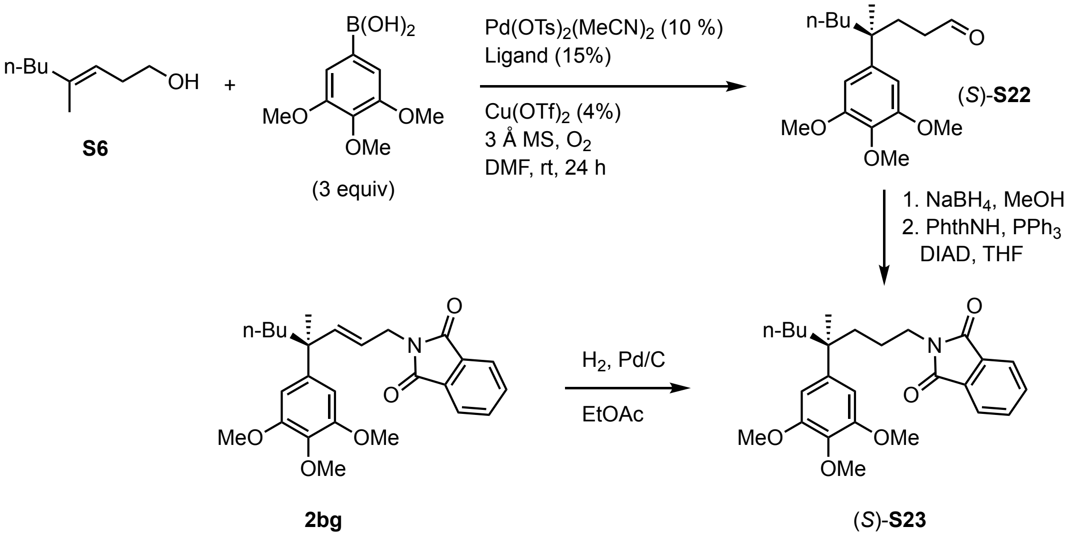
^{13}C NMR (125 MHz, $CDCl_3$): δ 156.92 (q, J = 35.8 Hz, $C_{ra}OCF_3$), 156.85 (q, J = 35.8 Hz, $C_{rb}OCF_3$), 147.3, 147.1, 145.3, 145.2, 128.33, 128.29, 126.6, 126.5, 126.1, 126.0, 120.1, 120.1 (t, J = 23.9 Hz, $C_{rb}D{=}CH$), 119.6 (t, J = 23.9 Hz, $C_{ra}D{=}CH$), 116.73 (q, J = 287.7 Hz, $C_{ra}F_3$), 116.67 (q, J = 288.3 Hz, $C_{rb}F_3$), 51.7 (q, J = 3.3 Hz), 51.2, 43.83, 43.80, 41.2, 41.1, 34.02 (q, J = 4.2), 33.97, 26.83, 26.81, 25.4, 25.3, 23.4, and 14.1.

IR (neat): 2959, 2933, 2862, 1690, 1245, 1190, 1140, 1092, 909, and 731 cm^{-1}.

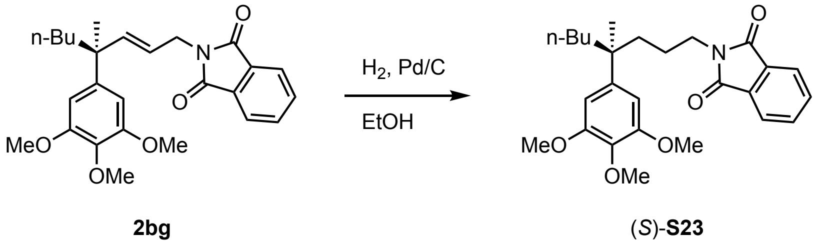
HRMS (ESI-TOF): *m/z* calcd for $C_{28}H_{24}DF_3NO^+$ $(M+H)^+$: 329.1946, found 329.1955.

7. Confirmation of Absolute Configuration

The absolute configuration of these products was confirmed by comparison of the absolute rotation of (*S*)-**S23**. Authentic (*S*)-**S23** was formed via the conversion of aldehyde (*S*)-**S22** to the phthalimide by reduction of the aldehyde followed by conversion of the alcohol to the phthalimide via a Mitsunobu reaction. The allylic phthalimide **2bg** was converted to (*S*)-**S23** via hydrogenation using Pd on carbon. The optical rotations of the material formed through these two independent paths was found to be identical, indicating that the relay Heck reaction of homoallylic phthalimides proceeds through the same sense of enantioselectivity as that of the homoallylic alcohols.



(*S*)-2-(4-Methyl-4-(3,4,5-trimethoxyphenyl)octyl)isoindoline-1,3-dione (S23):



Pd/C (10% by weight, 70 mg) was placed into a 15 mL round bottom flask, suspended in EtOH (3 mL) and the solution was flushed with H_2 (balloon). To this solution phthalimide **17g** (69 mg, 0.158 mmol) in EtOH (1 mL x 2) was added and the solution was stirred for 20 h. The solution was flushed with nitrogen and the resulting suspension was filtered through celite and the resulting solution was concentrated. The resulting residue was purified by MPLC (3:1 Hex:EtOAc) to give **S22** (35 mg, 50% yield) as a colorless oil.

^{1}**H NMR** (500 MHz, $CDCl_3$) δ 7.82 (nfom, 2H, NphthArH_o), 7.79 (nfom, 2H, NphhtArH_m), 6.44 (s, 2H, MeOAr*H*), 3.83 (s, 3H, Ar4-OCH_3), 3.81 (s, 6H, Ar3,5-OCH_3), 3.60 (t, *J* = 6.8 Hz, 2H,

$CH_2CH_2CH_2NPhth$), 1.73–1.34 (m, 6H), 1.26–1.17 (m, 2H), 1.24 (s, 3H, C(Ar)(Bu)(CH_3)), 1.15–1.07 (m, 1H), 0.97–0.89 (m, 1H), 0.82 (t, J = 7.1 Hz, 3H, $CH_2CH_2CH_2CH_3$).

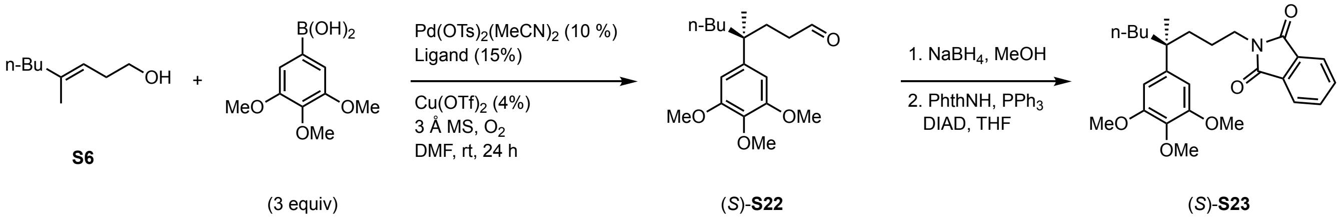
^{13}C NMR (125 MHz, $CDCl_3$): δ 168.5, 152.8, 143.5, 136.0, 134.0, 132.2, 123.3, 103.9, 60.9, 56.2, 43.3, 41.0, 40.6, 38.6, 26.5, 24.0, 23.8, 23.5, and 14.1.

IR (neat): 2932, 2870, 1774, 1711, 1586, 1396, 1127 and 721 cm^{-1}.

HRMS (ESI-TOF): *m/z* calcd for $C_{26}H_{34}NO_5^+$ $(M+H)^+$: 440.2431, found 440.2430.

Optical Rotation: $[\alpha]_D^{20}$ = +4.7 (c = 0.5, $CHCl_3$).

(*S*)-2-(4-Methyl-4-(3,4,5-trimethoxyphenyl)octyl)isoindoline-1,3-dione (S23):



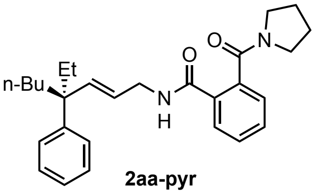
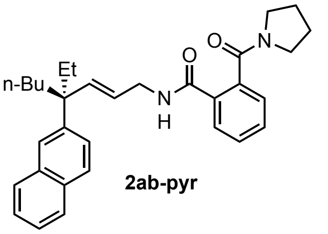
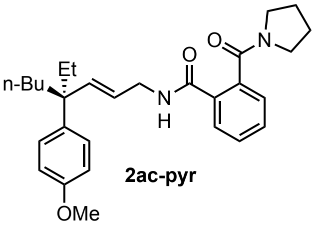
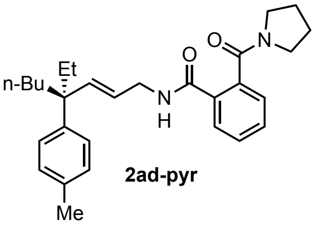
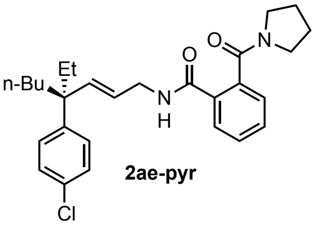
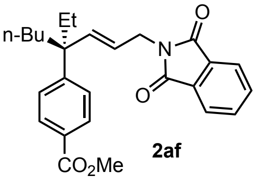
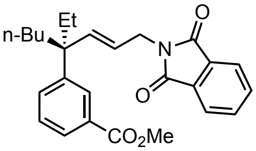
The **General Procedure A** was followed using 3,4,5-trimethoxyphenylboronic acid (159 mg x 2, 0.75 x 2 mmol, 3 equiv total) and **S6** (71 mg, 0.50 mmol) at room temperature. Purification of this material by MPLC (2:1 hexanes:EtOAc) gave impure **S22**, which was carried onto the next step without additional purification.

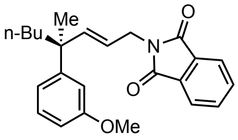
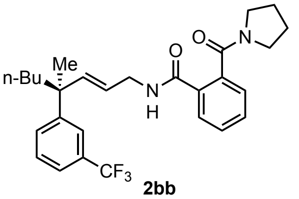
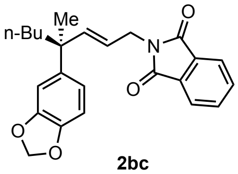
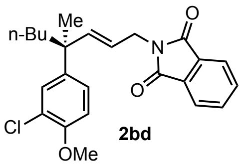
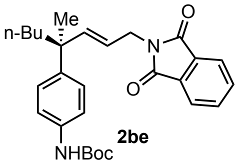
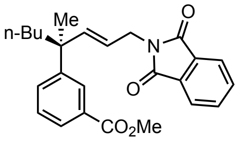
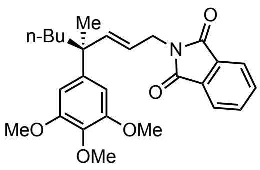
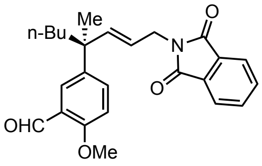
The aldehyde from the previous step was dissolved in MeOH (5 mL) and cooled to 0 °C. To this solution $NaBH_4$ (70 mg, excess) was added in one portion and stirred at 0 °C for 3 h. To this $NaHCO_3$ (5 mL) was added and the resulting mixture was transferred to a separatory funnel with Et_2O (50 mL). The layers were separated and the aqueous layer was extracted with additional Et_2O (50 mL). The combined organic layers were washed with brine (20 mL), dried ($MgSO_4$), filtered, and concentrated to give slightly impure alcohol which was carried forward to the next step without purification.

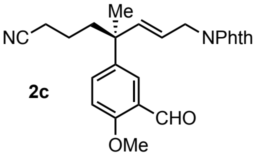
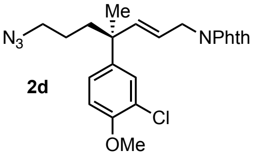
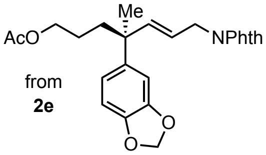
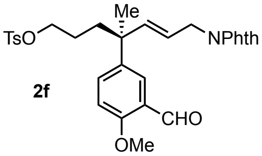
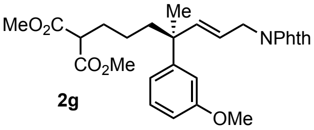
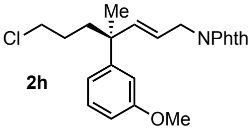
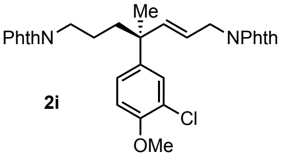
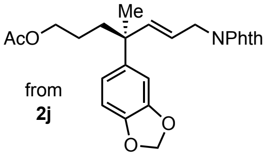
The alcohol from the previous step, phthalimide (104 mg, 0.6 mmol, 1.2 equiv based on **S6**), and triphenylphosphine (157 mg, 0.6 mmol, 1.2 equiv based on **S6**) were added to a scintillation vial, dissolved in THF (3 mL) and cooled to 0 °C. To this DIAD (124 µL, 0.6 mmol, 1.2 equiv based on **S6**) was added dropwise over ~1 min and the solution was warmed to room temperature. After 3 h the reaction mixture was concentrated and passed through a plug of silica (1:1 Hex:EtOAc). The resulting residue was purified by MPLC (3:1 Hex:EtOAc) to give a coeluting mixture of excess phthalimide and **S23** (97 mg total, 83% by mass, 80.5 mg **S22**, 0.18 mmol, 37% from **S6**).

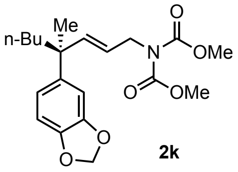
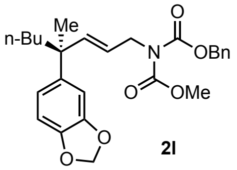
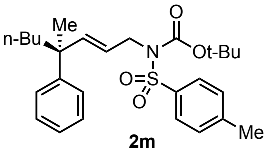
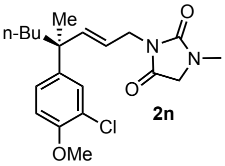
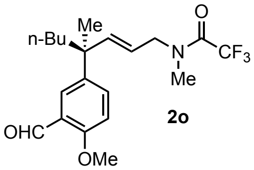
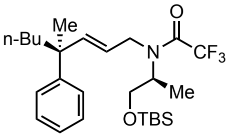
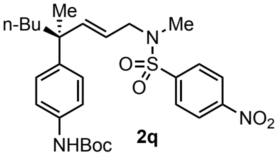
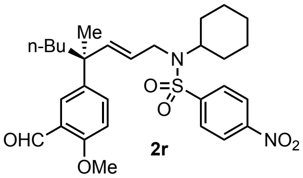
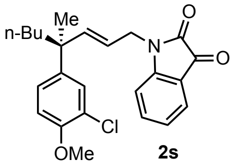
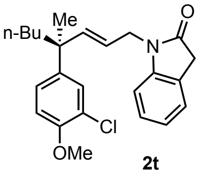
Optical Rotation: $[\alpha]_D^{20}$ = +3.9 (c = 0.5, $CHCl_3$).

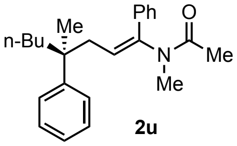
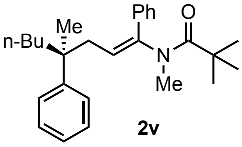
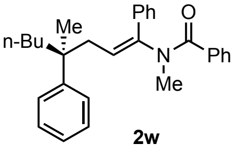
8. Summary of SFC conditions

Structure	SFC conditions	retention times
 **2aa-pyr**	OZ-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	12.43, 12.82 min (98.2:1.8)
 **2ab-pyr**	OZ-H [85:15 to 75:25 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	17.44, 15.76 min (99.4:0.6)
 **2ac-pyr**	OJ-H [97:3 to 94:6 CO_2:IPA, 45 min, 2 mL/min, 2320 psi]	23.38, 28.10 min (91.6:8.4)
 **2ad-pyr**	AD-H [95:5 to 90:10 CO_2:IPA, 45 min, 2 mL/min, 3000 psi]	32.93, 30.67 min (97.2:2.8)
 **2ae-pyr**	AD-H [88:12 CO_2:IPA, 2 mL/min, 2320 psi]	26.30, 23.08 min (95.35:4.65)
 **2af**	AD-H [92:8 to 90:10 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	17.71, 20.03 min (97.25:2.75)
 **2ag**	AD-H [97:3 to 94:6 CO_2:IPA, 60 min, 2 mL/min, 2320 psi]	23.59, 26.51 min (96.42:3.58)

Structure	SFC conditions	retention times
 **2ba**	AD-H [95:5 CO_2:IPA, 2 mL/min, 2600 psi]	10.62, 12.02 min (96.99:3.01)
 **2bb**	AY-H [99:1 to 90:10 CO_2:MeOH, 30 min, 2 mL/min, 2000 psi]	21.86, 28.68 min (97.4:2.6)
 **2bc**	AD-H [98:2 to 92:8 CO_2:IPA, 40 min, 2 mL/min, 2320 bar]	23.40, 25.24 min (97.24:2.76)
 **2bd**	AY-H [95:5 to 90:10 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	14.86, 13.85 min (97.8:2.2)
 **2be**	AD-H [90:10 to 80:20 CO_2:IPA, 10 min, 2 mL/min, 2320 psi]	14.44, 18.95 min (94.62:5.38)
 **2bf**	AD-H [97:3 to 94:6 CO2:IPA, 10 min, 2 mL/min, 2320 psi]	17.15, 20.68 min (93.51:6.49)
 **2bg**	AY-H [90:10 to 85:15 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	12.08, 14.83 min (96.27:3.73)
 **2bh**	AY-H [90:10 to 85:15 CO_2:IPA, 45 min, 2 mL/min, 2320 psi]	14.69, 13.78 min (97.10:2.90)

Structure	SFC conditions	retention times
 **2c**	AY-H [90:10 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	23.83, 22.06 min (96.3:3.7)
 **2d**	CEL-1 [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	8.46, 9.53 min (96.4:3.61)
 from **2e**	AD-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	18.84, 20.54 min (93.5:6.5)
 **2f**	CEL-1 [95:5 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	16.36, 17.15 min (97.03:2.97)
 **2g**	CEL-1 [95:5 to 75:25 CO_2:IPA, 30 min, 2 mL/min]	5.85, 5.22 min (98.8:1.2)
 **2h**	AD-H [95:5 CO_2:IPA, 2 mL/min, 2320 psi]	21.81, 25.80 min (95.45:4.55)
 **2i**	CEL-1 [98:2 to 90:10 CO_2:IPA, 45 min, 2 mL/min]	30.13 31.27 min (91.03:8.97)
 from **2j**	AD-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	18.65, 20.34 min (95.89:4.11)

Structure	SFC conditions	retention times
 **2k**	OZ-H [98:2 CO$_2$:IPA, 3 mL/min, 2320 psi]	33.68, 32.20 min (>99:1)
 **2l**	AD-H [98:2 to 93:7 CO$_2$:IPA, 180 min, 2 mL/min, 2320 psi]	77.78, 75.55 min (>99:1)
 **2m**	OZ-H [99:1 to 90:10 CO$_2$:IPA, 30 min, 2 mL/min, 2320 psi]	21.77, 19.15 min (97.17:2.83)
 **2n**	AY-H [95:5 to 90:10 CO$_2$:IPA, 45 min, 2 mL/min, 2320 psi]	17.36, 20.49 min (2.89:97.11)
 **2o**	AY-H [98:2 to 92:8 CO$_2$:IPA, 20 min, 1 mL/min, 2320 psi]	17.61, 16.66 min (94.78:5.22)
 **2p**	OZ-H [99:1 CO$_2$:IPA, 2 mL/min, 2000 psi]	6.68, 8.85 min (96.91:3.09)
 **2q**	AY-H [85:15 to 75:25 CO$_2$:IPA, 20 min, 2 mL/min, 2320 psi]	12.76, 14.16 min (93.24:6.76)
 **2r**	CEL-1 [96:4 CO$_2$:IPA, 2 mL/min, 2000 psi]	22.00, 19.68 min (91.42, 8.58)
 **2s**	CEL-1 [92:8 CO$_2$:IPA, 2 mL/min, 3000 psi]	30.88, 28.73 min (95.90, 4.10)
 **2t**	AY-H [90:10 to 85:15 CO$_2$:IPA, 20 min, 2 mL/min, 2320 psi]	11.23, 10.26 min (97.10:2.90)

Structure	SFC conditions	retention times
 **2u**	OZ-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	18.69, 19.56 min (99.05:0.95)
 **2v**	OZ-H [95:5 to 75:25 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	13.16, 16.97 min (98.71:1.29)
 **2w**	AS-H [85:15 to 75:25 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	3.64, 3.32 min (99.58, 0.42)

9. Computational methods

The study of the reaction pathway for the phthalimide, acetamide, and trifluoroacetamide were carried out by first performing a conformational search of each structure using Macromodel version 11.7[13] and the OPLS_2005 force field[14]. Those conformers below 10 kJ/mol of the minimum were optimized in DFT. The conformational search resulted in typically 3–30 conformers. The quantum mechanical calculations were performed using Gaussian 09 (revision D.01)[15]. All geometries of the stationary points were obtained from the unconstrained optimizations using the M06 density functional,[16] with the SDD basis set for Pd and 6-31+G(d) for all other atoms. All of the optimized geometries were verified by frequency computations as minima (zero imaginary frequencies) or maxima (one imaginary frequency). Single point calculations were performed with the M06 functional, with the SDD basis set for Pd and 6-311+G(d,p) for all other atoms with the polarizable continuum model (IEFPCM) with DMF (n,n-dimethylformamide) as the solvent. The single point calculations were used to correct the gas phase energy. Intrinsic reaction coordinate (IRC) calculations were carried out on each transition state structure to verify the connectivity between each ground state.

9a. Optimization of stationary and transition geometries

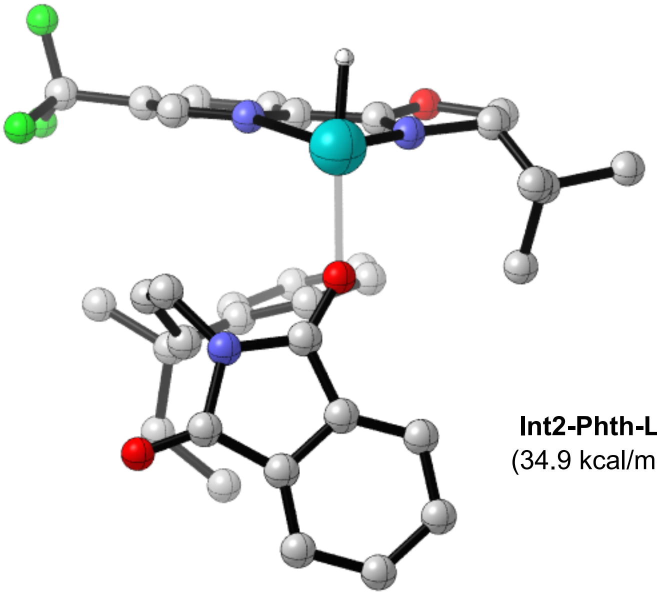
An initial optimization of the conformers obtained from the conformational search for each stationary point was first performed at the IEFPCM(DMF)-M06/6-31G(d)//M06/SDD-6-31G(d,p) level of theory. The lowest energy conformer from this initial set of results were further optimized at the IEFPCM(DMF)-M06/6-31+G(d)//M06/SDD-6-311+G(d,p) level of theory to give the results presented here.

9b: Intermolecular deprotonation of Pd–H by DMF

The lowest energy conformer of **Int2-Phth** and **Int2-TFA** were used as a starting point to determine the lowest energy conformer of the DMF solvated complex **DMF-PdH-Phth** and **DMF-PdH-TFA**. The lowest energy conformer of **DMF-PdH-Phth** was obtained as previously described. A scan of the Pd–H---O bond length was then performed using the gaussian software package to give an initial guess of the structures **DMFH-Pd-Phth** and **DMFH-Pd-TFA**. These were then further optimized at the IEFPCM(DMF)-M06/6-31+G(d)//M06/SDD-6-311+G(d,p) level of theory. We were unable to locate a minimum in the case of **DMFH-Pd-TFA**. In this case the geometry located with a scan of the Pd–H–DMF revealed a minimum, however when this geometry was further optimized without constraints we consistently found the protonated pyridine isomer (**DMF-Pd-TFA-PyH**). The protonated pyridine isomer (**DMF-Pd-TFA-PyH**) was used for the free energy difference (ΔG in Scheme 5). The electronic energy for the constrained geometry (IEFPCM(DMF)-M06/SDD-6-311+G(d,p)) is provided for reference below.

9c: Ligand exchange between alkene and phthalimide

The lowest energy conformer of **Int2-Phth** was used as a starting point of a bond scan between the Pd and phthalimide carbonyl bond. The structure **Int2-Phth-LE** was identified as the lowest energy structure along this scanning coordinate and was further optimized at the IEFPCM(DMF)-M06/6-31+G(d)//M06/SDD-6-311+G(d,p) level of theory.



Int2-Phth-LE
(34.9 kcal/mol)

M06/6-31+G(d) Energy = -2133.819326

M06/6-31+G(d) Free Energy = -2133.244348

M06/6-311+G(d,p) Energy in solution = -2134.373032

M06/6-311+G(d,p) Derived free energy in solution = -2133.798054

C	4.06658	0.91135	0.23193

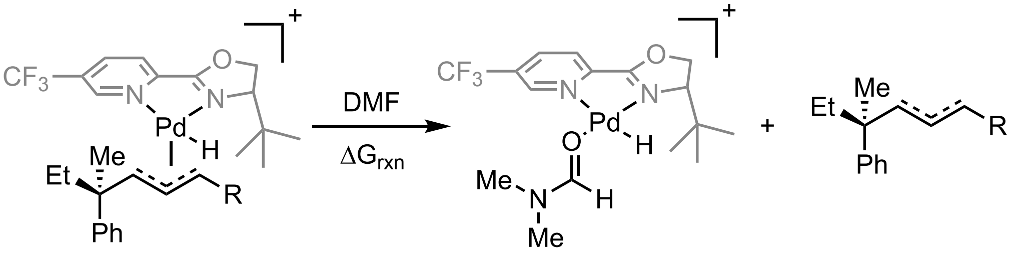
C	3.04922	1.76607	0.63865
C	1.90034	1.83734	-0.14424
C	2.69835	0.30824	-1.64560
C	3.89094	0.17342	-0.93207
H	4.97861	0.81663	0.81827
H	3.12809	2.34858	1.55335
H	2.53403	-0.25640	-2.56379
C	0.80790	2.75890	0.21605
C	-1.07818	3.97601	0.20897
C	-0.17845	4.37518	1.39158
H	-1.06282	4.76199	-0.56648
H	0.07408	5.43807	1.42594
H	-0.57614	4.06591	2.36685
N	-0.34695	2.82116	-0.34698
O	1.04973	3.63674	1.18244
N	1.72205	1.11872	-1.26066
C	-2.55372	3.71452	0.56577
C	-3.35703	3.45973	-0.70938
H	-4.42851	3.39947	-0.47235
H	-3.22639	4.27097	-1.44064
H	-3.07698	2.51208	-1.19243
C	-2.71517	2.52583	1.51168
H	-2.33432	1.59446	1.06651
H	-2.21255	2.67818	2.47776
H	-3.78110	2.37902	1.73685
C	-3.08913	4.98851	1.22630
H	-2.59047	5.21377	2.17971
H	-2.97561	5.86219	0.56748
H	-4.15988	4.87994	1.44401
C	4.98318	-0.72107	-1.45316
F	5.81416	-0.04282	-2.25200
F	4.48099	-1.73848	-2.16617
F	5.70865	-1.23896	-0.45832
C	1.56198	0.98604	3.87129

C	0.55669	0.83370	2.92279
C	0.52160	-0.29041	2.09908
C	1.47952	-1.30570	2.21243
C	2.47985	-1.13941	3.17934
C	2.52868	-0.01003	3.99251
H	1.58803	1.86320	4.51652
H	-0.22202	1.59190	2.82160
H	-0.27782	-0.36911	1.36131
H	3.23968	-1.90887	3.31537
H	3.31914	0.08351	4.73603
Pd	-0.78112	1.60782	-2.01008
C	1.43661	-2.58446	1.36712
C	0.42376	-2.44011	0.25958
C	2.82248	-2.89462	0.79791
H	3.54997	-3.09362	1.59351
H	2.78964	-3.78785	0.15924
H	3.21041	-2.05791	0.20216
C	1.01385	-3.77940	2.26519
H	1.01352	-4.68278	1.63433
H	1.80613	-3.92969	3.01538
C	-0.32221	-3.64474	2.97882
H	-1.17036	-3.59464	2.28058
H	-0.49716	-4.51297	3.62530
C	0.65593	-2.37749	-1.05069
C	-0.40079	-2.20632	-2.10302
C	-3.62578	-1.66011	-0.37867
C	-3.64391	-3.04637	-0.52423
N	-1.74793	-2.22419	-1.56877
C	-2.43015	-3.44443	-1.27434
C	-2.40539	-1.14836	-1.02906
O	-2.03122	-4.53202	-1.59704
O	-2.04474	0.02797	-1.07014
H	-0.35493	-2.74854	3.61374
C	-4.67275	-3.81433	-0.01266

C	-5.69694	-3.13938	0.66133
H	-6.52513	-3.70606	1.08223
C	-5.67978	-1.74977	0.80414
H	-6.49576	-1.25912	1.33122
C	-4.63526	-0.98160	0.28009
H	-4.67967	-4.89618	-0.13189
H	-4.61263	0.10333	0.37790
H	-0.06867	2.75924	-2.68950
H	-0.26267	-1.24718	-2.63170
H	-0.61459	-2.38781	0.59955
H	1.67206	-2.45110	-1.44412
H	-0.33745	-3.00155	-2.85749

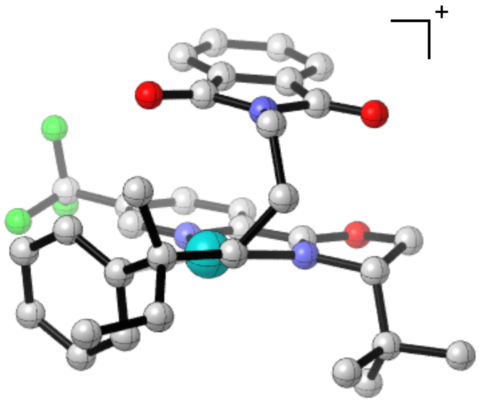
9d: ligand exchange between Int2 and Int4 and DMF

In order to determine the ease by which DMF could displace the ligated Pd–H, the thermodynamics of the following reactions were computed. In each case the dissociation was found to be more endergonic for **Int4**. The cartesian coordinates and energies for the DMF-Pyrox-PdH and the free alkene products are provided in section **9e**.



Starting material	ΔG_{rxn}
Int2-Phth	9.4 kcal/mol
Int4-Phth	4.8 kcal/mol
Int2-Acet	5.2 kcal/mol
Int4-Acet	2.0 kcal/mol
Int2-TFA	6.3 kcal/mol
Int4-TFA	5.0 kcal/mol

9e: Cartesian coordinates of the stationary points relevant to the potential energy surface calculations



Int1-Phth
(0 kcal/mol)

M06/6-31+G(d) Energy = -2133.905077

M06/6-31+G(d) Free Energy = -2133.317382

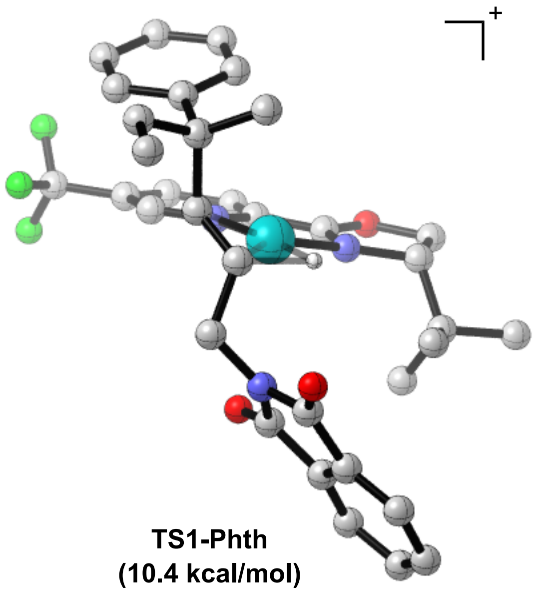
M06/6-311+G(d,p) Energy in solution = -2134.441346

M06/6-311+G(d,p) Derived free energy in solution = -2133.853651

C	3.82824	-0.67036	-1.38383
C	2.79460	-1.60020	-1.34248
C	1.50810	-1.14171	-1.08976
C	2.20532	1.03828	-0.91880
C	3.52798	0.66651	-1.15958
H	4.85220	-0.98410	-1.57965
H	2.97557	-2.66259	-1.48767
H	1.93660	2.07810	-0.73563
C	0.36242	-2.05293	-0.98951
C	-1.71110	-2.85031	-0.89860
C	-0.68938	-3.99587	-0.86978
H	-2.38267	-2.91869	-0.03006
H	-0.58250	-4.44255	0.12571
H	-0.84695	-4.77703	-1.61754
N	-0.83682	-1.66305	-0.73194
O	0.57466	-3.34682	-1.18758
N	1.21089	0.15791	-0.90477
C	-2.57143	-2.78694	-2.18449
C	-3.44540	-4.04272	-2.22299

H	-4.10591	-4.01332	-3.09980
H	-2.86170	-4.97043	-2.29518
H	-4.08372	-4.11418	-1.33021
C	-3.49038	-1.56845	-2.14108
H	-4.11908	-1.57109	-1.23717
H	-2.91742	-0.63107	-2.16793
H	-4.16338	-1.57430	-3.00916
C	-1.70600	-2.71023	-3.44171
H	-1.07581	-1.80856	-3.44705
H	-2.34731	-2.66253	-4.33205
H	-1.05472	-3.58688	-3.56550
C	4.61660	1.70103	-1.08968
F	5.11392	1.76903	0.15595
F	4.16078	2.91801	-1.40429
F	5.62706	1.40918	-1.90888
C	0.27146	3.88637	-1.60128
C	0.34062	3.95909	-0.20373
C	-0.60295	3.31798	0.58222
C	-1.68277	2.60829	-0.00368
C	-1.70873	2.52049	-1.42239
C	-0.73396	3.14845	-2.20792
H	1.01027	4.40753	-2.20929
H	1.13752	4.52860	0.27305
H	-0.52298	3.38287	1.66428
H	-2.55893	2.05769	-1.92307
H	-0.79621	3.08437	-3.29260
Pd	-0.98763	0.47093	-0.27282
C	-2.90506	2.10936	0.81166
C	-2.83014	0.59420	0.59750
H	-3.50049	0.30165	-0.22301
C	-2.82392	2.55490	2.26670
H	-2.86990	3.64874	2.33685
H	-3.67741	2.15661	2.83269
H	-1.90043	2.24025	2.76065

C	-4.22173	2.64624	0.20401
H	-4.34765	2.23834	-0.81058
H	-5.04978	2.21774	0.79386
C	-4.34311	4.16149	0.15387
H	-3.47629	4.62269	-0.34256
H	-4.43398	4.60874	1.15132
C	-3.00456	-0.41474	1.71677
H	-4.00126	-0.22751	2.16149
H	-3.08800	-1.41355	1.26264
C	-2.03187	-0.51548	2.89424
H	-2.39610	-1.31282	3.55536
H	-1.98911	0.40429	3.48371
C	1.64107	-0.77689	2.37832
C	1.25026	-2.10359	2.21256
N	-0.65725	-0.85271	2.55257
C	-0.22833	-2.16622	2.32980
C	0.42432	0.03982	2.61328
O	-0.95981	-3.13008	2.24240
O	0.34115	1.23210	2.81564
H	-5.23527	4.45483	-0.41192
C	2.17473	-3.11219	2.00521
C	3.52330	-2.74328	1.96084
H	4.28494	-3.50743	1.81388
C	3.91389	-1.40992	2.11810
H	4.97329	-1.15775	2.09022
C	2.97115	-0.39921	2.33514
H	1.86046	-4.14951	1.89624
H	3.26409	0.63985	2.48189



TS1-Phth
(10.4 kcal/mol)

M06/6-31+G(d) Energy = -2133.872478

M06/6-31+G(d) Free Energy = -2133.292337

M06/6-311+G(d,p) Energy in solution = -2134.417255

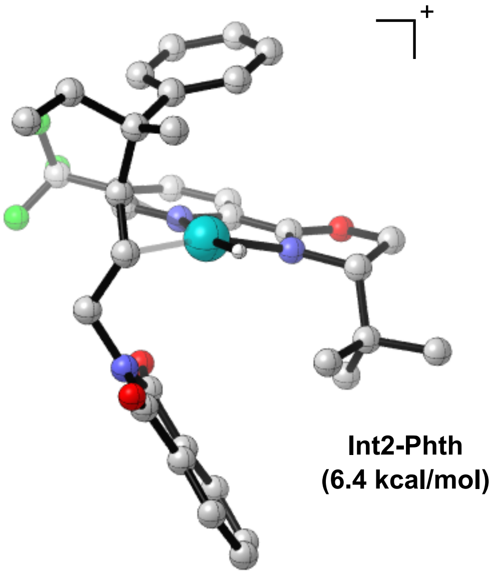
M06/6-311+G(d,p) Derived free energy in solution = -2133.837114

Number of Imaginary Frequencies = 1 (-551.80)

C	-3.54948	-2.79121	1.10641
C	-2.51173	-3.17881	0.26566
C	-1.57403	-2.22347	-0.09809
C	-2.61193	-0.57978	1.13079
C	-3.59516	-1.47528	1.54572
H	-4.31157	-3.50344	1.42024
H	-2.42222	-4.19799	-0.10167
H	-2.63260	0.45707	1.45585
C	-0.42657	-2.53371	-0.95624
C	1.49416	-2.35615	-2.08194
C	0.84309	-3.73731	-2.32300
H	1.54978	-1.78535	-3.02265
H	0.52089	-3.89771	-3.35663
H	1.45384	-4.58651	-2.00340
N	0.50586	-1.68711	-1.20966
O	-0.34851	-3.74067	-1.49547
N	-1.62755	-0.94161	0.31398
C	2.91737	-2.40855	-1.48287

C	2.90148	-3.01653	-0.08242
H	3.92812	-3.09246	0.30244
H	2.32417	-2.39911	0.62077
H	2.48128	-4.03327	-0.07063
C	3.79783	-3.24204	-2.41769
H	4.84172	-3.20132	-2.07904
H	3.77276	-2.85624	-3.44785
H	3.51609	-4.30356	-2.44401
C	3.49726	-0.99649	-1.42837
H	3.52475	-0.53316	-2.42642
H	2.91120	-0.34461	-0.76777
H	4.52725	-1.02187	-1.04387
C	-4.71144	-1.04060	2.45578
F	-4.66134	-1.70248	3.61570
F	-4.65939	0.26751	2.72160
F	-5.90175	-1.30158	1.90071
C	-4.99817	0.04418	-1.39812
C	-3.94470	-0.07649	-2.30022
C	-2.88065	0.82279	-2.26806
C	-2.83216	1.86398	-1.33075
C	-3.90430	1.97095	-0.43561
C	-4.97459	1.07968	-0.46842
H	-5.83545	-0.65225	-1.42473
H	-3.95473	-0.86806	-3.04902
H	-2.08593	0.70024	-3.00194
H	-3.92381	2.76360	0.31097
H	-5.79293	1.20181	0.24067
Pd	0.02438	0.29689	-0.51390
C	-1.62474	2.81358	-1.24469
C	-0.70572	2.28413	-0.15076
C	-0.91628	2.93325	-2.59489
H	-0.11744	3.68190	-2.56884
H	-0.46063	1.99068	-2.92185
H	-1.63276	3.24928	-3.36471

C	-2.09250	4.22798	-0.79429
H	-2.91122	4.52891	-1.46724
H	-2.53720	4.15811	0.20873
C	-1.02799	5.31425	-0.75926
H	-0.16148	5.03374	-0.14242
H	-1.44579	6.22837	-0.32119
C	0.69821	2.39636	-0.13804
C	1.42217	2.44026	1.18980
H	0.79241	2.02009	1.98445
H	1.62183	3.49719	1.42494
C	4.91683	1.24561	1.07532
N	2.67640	1.73326	1.22935
C	2.84509	0.47818	1.83221
C	3.88347	2.25135	0.72937
O	3.97918	3.30220	0.13736
H	-0.65807	5.58110	-1.75638
O	1.94510	-0.19391	2.28963
H	1.19202	2.94270	-0.94678
H	-1.18845	2.20930	0.83377
H	1.29149	1.07329	-1.04453
C	4.29604	0.19033	1.74347
C	5.01069	-0.90566	2.19159
C	6.27623	1.24376	0.82193
C	7.00812	0.13821	1.26893
C	6.38713	-0.91627	1.94365
H	8.08184	0.09990	1.09516
H	6.75124	2.07311	0.30060
H	6.98855	-1.75712	2.28447
H	4.51492	-1.71996	2.71865



Int2-Phth
(6.4 kcal/mol)

M06/6-31+G(d) Energy = -2133.878843

M06/6-31+G(d) Free Energy = -2133.300054

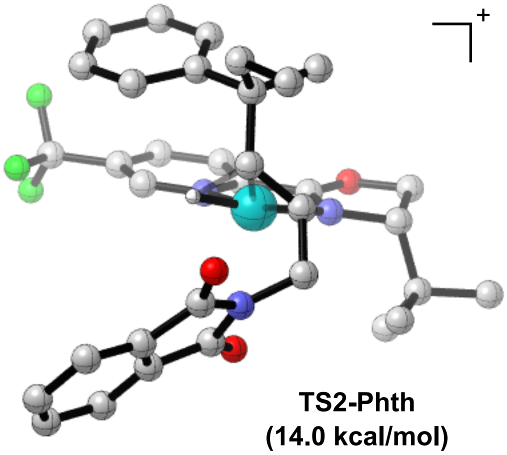
M06/6-311+G(d,p) Energy in solution = -2134.422258

M06/6-311+G(d,p) Derived free energy in solution = -2133.843469

C	-2.87445	-2.82100	1.77106
C	-1.97553	-3.16608	0.76384
C	-1.19505	-2.16410	0.20794
C	-2.10742	-0.55566	1.56080
C	-2.93533	-1.49716	2.17439
H	-3.51332	-3.57132	2.23185
H	-1.88231	-4.19012	0.41091
H	-2.14246	0.48765	1.87578
C	-0.21348	-2.42469	-0.84925
C	1.48969	-2.15119	-2.27143
C	0.83096	-3.52997	-2.46078
H	1.47060	-1.57446	-3.20829
H	0.24031	-3.60522	-3.38055
H	1.51402	-4.38061	-2.39598
N	0.56383	-1.51194	-1.31686
O	-0.10323	-3.64348	-1.35031
N	-1.26154	-0.87285	0.59288
C	2.94776	-2.18713	-1.75662
C	3.05952	-2.96754	-0.44759

H	4.10703	-2.98200	-0.11564
H	2.46970	-2.50394	0.35754
H	2.74164	-4.01523	-0.54765
C	3.80741	-2.84492	-2.83815
H	4.86195	-2.84156	-2.53213
H	3.74024	-2.30053	-3.79148
H	3.53496	-3.89271	-3.02678
C	3.45592	-0.76314	-1.53799
H	3.36397	-0.15266	-2.44894
H	2.91157	-0.25496	-0.73009
H	4.51796	-0.78497	-1.25540
C	-3.90706	-1.00709	3.21245
F	-4.53403	-2.00790	3.82445
F	-3.28863	-0.26782	4.13797
F	-4.83589	-0.22508	2.63838
C	-4.08626	-1.08632	-2.38220
C	-3.11120	-0.62617	-3.26145
C	-2.43588	0.56719	-3.00666
C	-2.72365	1.33812	-1.87412
C	-3.71871	0.86379	-1.00680
C	-4.38994	-0.33013	-1.25189
H	-4.62230	-2.01175	-2.58752
H	-2.87819	-1.19041	-4.16401
H	-1.68215	0.89700	-3.71900
H	-3.99607	1.43271	-0.11845
H	-5.16984	-0.65856	-0.56510
Pd	0.06994	0.42711	-0.70272
C	-1.94046	2.62039	-1.54335
C	-1.08501	2.29244	-0.33328
C	-1.11353	3.12202	-2.72326
H	-0.57590	4.04155	-2.46615
H	-0.36525	2.39529	-3.06169
H	-1.77017	3.35315	-3.57272
C	-2.93002	3.74102	-1.11501

H	-3.65761	3.85999	-1.93321
H	-3.51147	3.40004	-0.24667
C	-2.29971	5.08309	-0.77295
H	-1.49269	4.98406	-0.03172
H	-3.05243	5.75321	-0.34142
C	0.24845	2.57341	-0.10233
C	0.81503	2.60869	1.29391
H	0.12500	2.15110	2.01482
H	0.96193	3.66159	1.57919
C	4.33317	1.46624	1.28706
N	2.08663	1.93629	1.42944
C	2.24984	0.65162	1.96070
C	3.29758	2.47726	0.96371
O	3.39549	3.54724	0.40810
H	-1.88631	5.59312	-1.65095
O	1.35012	-0.05356	2.37010
H	0.84302	3.08815	-0.85920
H	-1.67802	2.02863	0.55200
H	1.01604	1.06820	-1.73967
C	3.70511	0.37399	1.88497
C	4.41952	-0.73677	2.29582
C	5.69890	1.49125	1.07344
C	6.43067	0.37165	1.48455
C	5.80218	-0.72227	2.08491
H	7.50936	0.35280	1.34047
H	6.17804	2.35085	0.60781
H	6.40258	-1.57436	2.39908
H	3.92098	-1.58072	2.77089



TS2-Phth
(14.0 kcal/mol)

M06/6-31+G(d) Energy = -2133.869024

M06/6-31+G(d) Free Energy = -2133.288817

M06/6-311+G(d,p) Energy in solution = -2134.411631

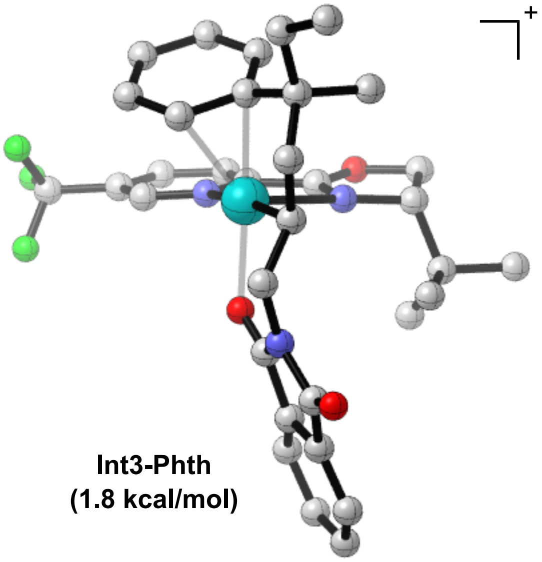
M06/6-311+G(d,p) Derived free energy in solution = -2133.831424

Number of Imaginary Frequencies = 1 (-429.81)

C	-4.30866	-1.19765	-1.25883
C	-4.10483	0.15466	-1.00842
C	-2.81647	0.57853	-0.71550
C	-1.96303	-1.56074	-0.88646
C	-3.22323	-2.06364	-1.20054
H	-5.30205	-1.57616	-1.49658
H	-4.92153	0.87141	-1.03941
H	-1.09270	-2.20881	-0.81079
C	-2.48590	1.98012	-0.42910
C	-1.35038	3.84782	-0.02616
C	-2.86641	4.10742	0.04724
H	-0.86014	4.12326	0.92142
H	-3.23497	4.26448	1.06739
H	-3.22614	4.91659	-0.59337
N	-1.29309	2.37752	-0.16432
O	-3.46528	2.87498	-0.43539
N	-1.76522	-0.26291	-0.65640
C	-0.61766	4.58410	-1.17079
C	-0.69919	6.08613	-0.89390
H	-0.15037	6.63930	-1.66758

H	-1.72881	6.46995	-0.89892
H	-0.24696	6.34063	0.07614
C	0.85021	4.16584	-1.17740
H	1.40979	4.76482	-1.90884
H	1.31421	4.33512	-0.19203
H	0.96966	3.11002	-1.45605
C	-1.23249	4.26110	-2.53141
H	-1.16624	3.18809	-2.76039
H	-2.28466	4.57033	-2.60923
H	-0.68550	4.79277	-3.32143
C	-3.44108	-3.52832	-1.47102
F	-4.30701	-4.04599	-0.59013
F	-3.95888	-3.70906	-2.68996
F	-2.30796	-4.22811	-1.39528
C	-2.20333	-3.34361	2.19342
C	-2.65600	-2.11219	2.65370
C	-1.75099	-1.09101	2.94663
C	-0.37365	-1.27633	2.79615
C	0.06462	-2.52682	2.33572
C	-0.83312	-3.54562	2.03261
H	-2.90778	-4.14560	1.97879
H	-3.72248	-1.94128	2.79990
H	-2.14682	-0.14076	3.29951
H	1.13064	-2.72158	2.20804
H	-0.46054	-4.50635	1.67908
Pd	0.02061	0.64060	0.17462
C	0.64327	-0.16222	3.08835
C	1.45651	0.12518	1.82258
C	-0.03543	1.09967	3.61808
H	0.69994	1.87402	3.86387
H	-0.74653	1.53054	2.89831
H	-0.58204	0.87570	4.54305
C	1.64950	-0.67883	4.15389
H	1.06987	-0.91256	5.06041

H	2.06660	-1.63706	3.81149
C	2.79910	0.26050	4.48907
H	3.41018	0.49905	3.60599
H	3.46885	-0.21170	5.21718
C	1.70192	1.39399	1.26492
C	2.91922	1.66402	0.41108
H	3.76131	1.93034	1.06854
H	2.73600	2.51420	-0.25693
C	4.49870	-1.30042	-1.14849
N	3.34851	0.54333	-0.39259
C	2.82245	0.24105	-1.65544
C	4.35337	-0.36421	-0.00818
O	4.92183	-0.34384	1.06010
H	2.45836	1.20381	4.93455
O	1.91176	0.84544	-2.18499
H	1.32063	2.27915	1.78157
H	2.20716	-0.64433	1.60955
H	0.72877	-0.73040	0.45812
C	3.58007	-0.93817	-2.13387
C	3.48094	-1.63492	-3.32475
C	5.35349	-2.37508	-1.31346
C	5.26195	-3.08534	-2.51496
C	4.34280	-2.72157	-3.50251
H	5.92027	-3.93449	-2.68783
H	6.06820	-2.64725	-0.53882
H	4.30178	-3.29438	-4.42707
H	2.76507	-1.33889	-4.08974



Int3-Phth
(1.8 kcal/mol)

M06/6-31+G(d) Energy = -2133.897906

M06/6-31+G(d) Free Energy = -2133.315536

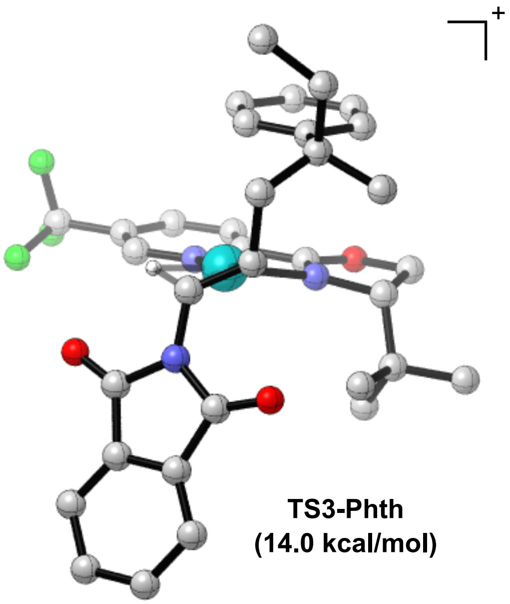
M06/6-311+G(d,p) Energy in solution = -2134.433126

M06/6-311+G(d,p) Derived free energy in solution = -2133.850756

C	3.64405	-2.76630	1.06727
C	2.72404	-2.20991	1.95146
C	1.78738	-1.30492	1.46378
C	2.61119	-1.48500	-0.67356
C	3.57656	-2.40736	-0.26998
H	4.39349	-3.47294	1.41705
H	2.72431	-2.47251	3.00577
H	2.54120	-1.17542	-1.71697
C	0.75913	-0.73498	2.35214
C	-1.05862	0.20283	3.17980
C	-0.18622	-0.34825	4.32376
H	-1.23078	1.28361	3.31108
H	0.28999	0.43775	4.92155
H	-0.69250	-1.04775	4.99591
N	-0.21688	0.00280	1.98565
O	0.86252	-1.07492	3.64744
N	1.75178	-0.92995	0.17152
C	-2.44328	-0.46566	3.02270
C	-2.31489	-1.97300	2.81010

H	-3.31097	-2.41994	2.68177
H	-1.73069	-2.20235	1.90664
H	-1.83996	-2.48118	3.66174
C	-3.26816	-0.17578	4.27686
H	-2.83244	-0.61532	5.18496
H	-3.37660	0.90616	4.44374
H	-4.27753	-0.59616	4.17180
C	-3.15393	0.14892	1.81860
H	-3.24267	1.24266	1.91551
H	-2.60602	-0.07180	0.89360
H	-4.16963	-0.26085	1.71941
C	4.51369	-2.95152	-1.31047
F	3.84346	-3.62808	-2.25103
F	5.42899	-3.76494	-0.78683
F	5.15716	-1.95061	-1.93267
C	3.99458	1.40541	-0.49990
C	3.17110	1.55291	-1.59589
C	1.90553	2.16632	-1.46130
C	1.47000	2.67568	-0.20215
C	2.33764	2.46368	0.90954
C	3.56137	1.84631	0.76530
H	4.98199	0.95861	-0.61169
H	3.50293	1.22716	-2.58157
H	1.37635	2.43453	-2.37502
H	2.03685	2.83099	1.88988
H	4.20951	1.72264	1.63201
Pd	0.32819	0.69525	-0.50093
C	0.37149	3.74519	-0.12916
C	-0.70835	3.39527	-1.15501
H	-1.56783	4.07925	-1.05189
C	-0.25521	3.81301	1.26845
H	0.41029	4.30391	1.99150
H	-1.18362	4.39838	1.24526
H	-0.49849	2.81427	1.65679

C	1.04563	5.09222	-0.47338
H	1.87150	5.24904	0.24028
H	1.51804	5.00054	-1.46507
C	0.12849	6.30556	-0.46094
H	-0.32963	6.46882	0.52340
H	0.69432	7.21169	-0.70799
C	-1.18582	1.97277	-0.97800
H	-1.79298	1.86014	-0.06319
C	-1.93104	1.45092	-2.18253
H	-1.24944	1.30186	-3.03580
H	-2.68835	2.18542	-2.50465
C	-3.21522	-1.92374	-1.35178
C	-4.39244	-1.30038	-1.76623
N	-2.67165	0.23134	-1.92318
C	-4.07109	0.09625	-2.14175
C	-2.12805	-0.93073	-1.43056
O	-4.78316	0.97928	-2.54638
O	-0.95349	-1.07517	-1.09092
H	-0.67907	6.22007	-1.20033
C	-5.60186	-1.96875	-1.77456
C	-5.59688	-3.30311	-1.35217
H	-6.52734	-3.86752	-1.34790
C	-4.41804	-3.92703	-0.93719
H	-4.44988	-4.96708	-0.61838
C	-3.19963	-3.24012	-0.92752
H	-6.51511	-1.47268	-2.09829
H	-2.27592	-3.71854	-0.60598
H	-0.33511	3.55255	-2.18053



TS3-Phth
(14.0 kcal/mol)

M06/6-31+G(d) Energy = -2133.867901

M06/6-31+G(d) Free Energy = -2133.28975

M06/6-311+G(d,p) Energy in solution = -2134.40942

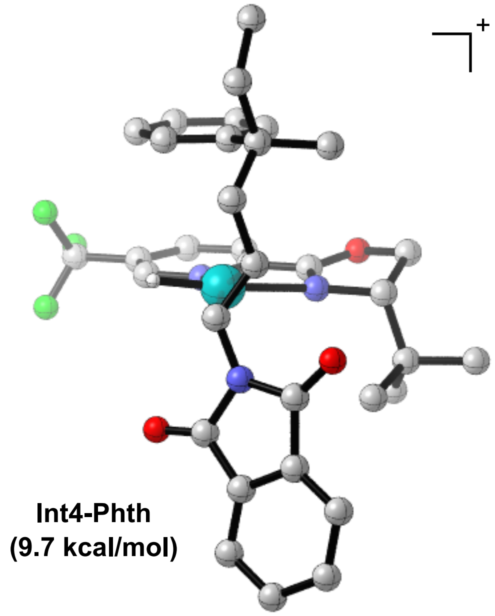
M06/6-311+G(d,p) Derived free energy in solution = -2133.831269

Number of Imaginary Frequencies = 1 (-567.92)

C	-3.58869	2.89026	1.25319
C	-3.29683	1.65793	1.82768
C	-2.18349	0.96742	1.37247
C	-1.64277	2.63140	-0.13373
C	-2.74638	3.38410	0.26446
H	-4.45488	3.46466	1.57639
H	-3.91926	1.23057	2.60993
H	-0.95602	2.99287	-0.89765
C	-1.77563	-0.33177	1.91711
C	-0.54677	-2.11540	2.39030
C	-1.84302	-2.11699	3.21905
H	-0.47218	-3.04246	1.80341
H	-2.56247	-2.87357	2.88466
H	-1.70442	-2.19981	4.30056
N	-0.76747	-0.98578	1.46706
O	-2.43816	-0.81910	2.95911
N	-1.36844	1.44515	0.40956
C	0.76073	-1.95961	3.20130

C	0.74156	-0.69615	4.05959
H	1.66866	-0.62951	4.64483
H	0.68058	0.21344	3.44429
H	-0.09079	-0.68264	4.77740
C	0.91846	-3.19758	4.08530
H	0.12339	-3.29084	4.83817
H	0.92789	-4.11978	3.48539
H	1.87024	-3.15141	4.63117
C	1.94573	-1.89625	2.24013
H	1.99291	-2.78638	1.59408
H	1.89849	-1.00468	1.59839
H	2.89116	-1.85305	2.79814
C	-3.04408	4.69140	-0.42095
F	-3.67120	5.53732	0.39800
F	-3.83635	4.49012	-1.48242
F	-1.92799	5.27989	-0.85493
C	-4.16944	-1.24985	-0.39230
C	-3.77709	-2.48697	0.11438
C	-2.63726	-3.12061	-0.37522
C	-1.84796	-2.54187	-1.37773
C	-2.27267	-1.30449	-1.88775
C	-3.41532	-0.66732	-1.40634
H	-5.06977	-0.76173	-0.02028
H	-4.37506	-2.97359	0.88509
H	-2.36762	-4.09350	0.03463
H	-1.73058	-0.82979	-2.70488
H	-3.72182	0.28521	-1.84057
Pd	0.02168	-0.02278	-0.36680
C	-0.63366	-3.27451	-1.94737
C	0.46774	-2.30778	-2.41811
H	1.22327	-2.92126	-2.94242
C	-0.00995	-4.24235	-0.93539
H	-0.65800	-5.10535	-0.73622
H	0.93374	-4.64219	-1.33252

H	0.21346	-3.76039	0.02581
C	-1.08953	-4.13973	-3.15272
H	-0.22611	-4.75116	-3.46462
H	-1.84139	-4.85125	-2.77532
C	-1.65669	-3.41611	-4.36328
H	-0.92659	-2.74405	-4.83479
H	-2.54885	-2.82791	-4.11096
C	1.21898	-1.52175	-1.37174
H	1.71632	-2.07260	-0.57174
C	1.77856	-0.29196	-1.76534
H	0.53520	0.92209	-1.51991
H	1.62320	0.04261	-2.79524
C	4.46828	1.89487	-0.61841
C	4.95977	0.66585	-0.18043
N	2.92048	0.27819	-1.17690
C	3.98872	-0.39658	-0.51996
C	3.15851	1.67182	-1.25988
O	4.04505	-1.58405	-0.31550
O	2.38198	2.45368	-1.75979
H	-1.95520	-4.14361	-5.12738
C	6.18320	0.55899	0.45683
C	6.90823	1.73925	0.64652
H	7.87634	1.69970	1.14206
C	6.41507	2.97113	0.20809
H	7.00746	3.86950	0.36981
C	5.17779	3.06847	-0.43579
H	6.55897	-0.40631	0.79152
H	4.78658	4.02152	-0.78720
H	0.08792	-1.61201	-3.17943



Int4-Phth
(9.7 kcal/mol)

M06/6-31+G(d) Energy = -2133.873034

M06/6-31+G(d) Free Energy = -2133.294873

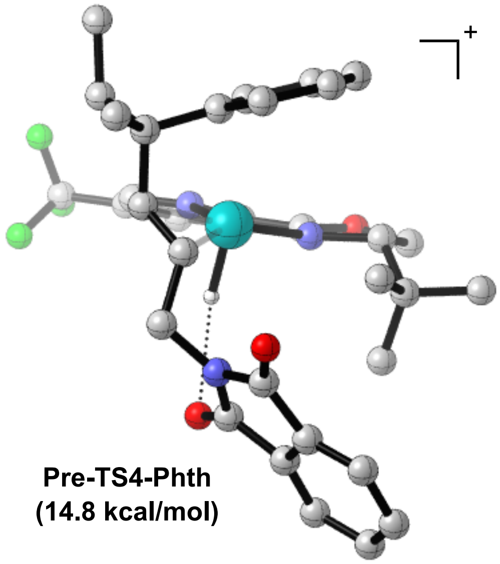
M06/6-311+G(d,p) Energy in solution = -2134.416302

M06/6-311+G(d,p) Derived free energy in solution = -2133.838141

C	3.91173	-2.35682	1.37852
C	3.02565	-1.59213	2.13364
C	1.92708	-1.03509	1.49939
C	2.53085	-1.92264	-0.54026
C	3.66258	-2.51324	0.02452
H	4.78590	-2.81229	1.83859
H	3.18344	-1.41956	3.19549
H	2.31337	-2.02986	-1.60186
C	0.93424	-0.21784	2.20553
C	-0.95946	0.79876	2.74272
C	0.10375	1.03213	3.82450
H	-1.37058	1.75474	2.38225
H	0.53124	2.04258	3.79719
H	-0.20757	0.79482	4.84503
N	-0.15943	0.18129	1.66204
O	1.17236	0.11202	3.46955
N	1.67042	-1.21451	0.18504
C	-2.14518	-0.09828	3.17286

C	-1.67412	-1.43889	3.73492
H	-2.54490	-2.04545	4.01755
H	-1.10764	-2.01855	2.99207
H	-1.05687	-1.33117	4.63764
C	-2.95061	0.65773	4.23124
H	-2.37744	0.85274	5.14833
H	-3.31473	1.62149	3.84641
H	-3.82931	0.06833	4.52570
C	-3.04396	-0.34762	1.96529
H	-3.42044	0.60074	1.55400
H	-2.51081	-0.89083	1.17123
H	-3.91575	-0.95039	2.25644
C	4.58691	-3.27000	-0.89071
F	5.58971	-3.84070	-0.22655
F	5.11183	-2.43950	-1.80343
F	3.92566	-4.22293	-1.55327
C	4.29683	0.99867	-0.28386
C	3.67304	1.61925	0.79477
C	2.52726	2.39060	0.59834
C	1.96861	2.55661	-0.67404
C	2.61535	1.92484	-1.74744
C	3.76005	1.15666	-1.56061
H	5.20414	0.41243	-0.13712
H	4.09211	1.52725	1.79777
H	2.08362	2.89122	1.45896
H	2.23341	2.04954	-2.76148
H	4.24536	0.69232	-2.41877
Pd	0.06580	-0.01702	-0.56325
C	0.78546	3.48575	-0.93549
C	-0.30280	2.79987	-1.79285
H	-1.00926	3.59113	-2.10384
C	0.13760	3.99676	0.35170
H	0.80769	4.65011	0.92306
H	-0.76080	4.58294	0.11151

H	-0.16652	3.17774	1.01958
C	1.28512	4.69955	-1.76197
H	1.53859	4.35169	-2.77648
H	0.43574	5.39176	-1.88433
C	2.47573	5.45011	-1.18701
H	3.36580	4.81058	-1.11526
H	2.27404	5.85633	-0.18663
C	-1.14848	1.74342	-1.14347
H	-1.67455	2.02073	-0.22696
C	-1.64627	0.66736	-1.86009
H	0.51612	-0.26847	-2.01751
H	-1.32446	0.48436	-2.88661
C	-4.45148	-1.64301	-1.51625
C	-5.01288	-0.48429	-0.98165
N	-2.82334	-0.00819	-1.51354
C	-3.99782	0.58977	-0.98113
C	-3.05211	-1.35795	-1.89338
O	-4.09270	1.73831	-0.61957
O	-2.21853	-2.06218	-2.40916
H	2.73392	6.30029	-1.82959
C	-6.32542	-0.44719	-0.54464
C	-7.06914	-1.62505	-0.65968
H	-8.10635	-1.63907	-0.33046
C	-6.50618	-2.78746	-1.19441
H	-7.11467	-3.68649	-1.27055
C	-5.17965	-2.81355	-1.63482
H	-6.75357	0.46610	-0.13457
H	-4.73338	-3.71173	-2.05801
H	0.12701	2.40681	-2.72619



Pre-TS4-Phth
(14.8 kcal/mol)

M06/6-31+G(d) Energy = -2133.865133

M06/6-31+G(d) Free Energy = -2133.288439

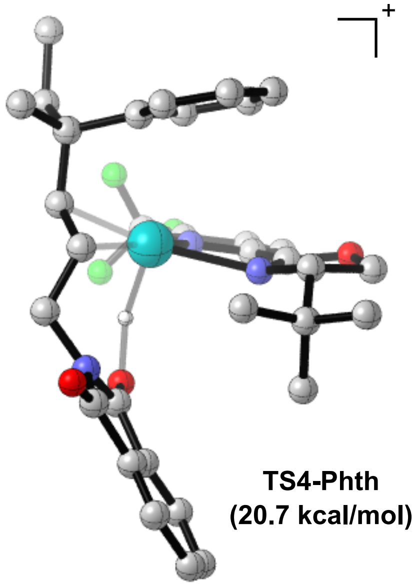
M06/6-311+G(d,p) Energy in solution = -2134.406786

M06/6-311+G(d,p) Derived free energy in solution = -2133.830092

C	4.29857	-2.96093	0.48464
C	3.16257	-2.85624	1.28337
C	2.30053	-1.78743	1.06292
C	3.59358	-0.95491	-0.62778
C	4.51358	-1.99882	-0.49003
H	5.00111	-3.78057	0.61833
H	2.94684	-3.59084	2.05465
H	3.74436	-0.18310	-1.38598
C	1.06697	-1.63627	1.85217
C	-0.88747	-0.93756	2.67721
C	-0.35946	-2.13379	3.48594
H	-0.78488	-0.00392	3.26049
H	-0.26454	-1.94606	4.55862
H	-0.93415	-3.05470	3.32861
N	0.09055	-0.85079	1.57031
O	0.96790	-2.36857	2.95884
N	2.51583	-0.84288	0.13414
C	-2.36465	-1.04355	2.25531
C	-3.18863	-1.23855	3.53144

H	-4.25954	-1.24591	3.28851
H	-2.97030	-2.18886	4.03955
H	-3.01914	-0.42178	4.24917
C	-2.81211	0.26380	1.59958
H	-3.89063	0.23089	1.38630
H	-2.62794	1.12950	2.25555
H	-2.29221	0.44683	0.64667
C	-2.60056	-2.20877	1.29831
H	-2.00082	-2.11646	0.38071
H	-2.37157	-3.18397	1.75095
H	-3.65973	-2.23675	1.00396
C	5.71012	-2.02211	-1.40039
F	6.48478	-3.08407	-1.18443
F	5.32846	-2.03908	-2.68356
F	6.45610	-0.92265	-1.22515
C	-0.17056	2.88638	3.28124
C	-0.83134	3.75861	2.41460
C	-0.40916	3.90364	1.09862
C	0.68792	3.18366	0.60128
C	1.34758	2.30703	1.48760
C	0.92099	2.16865	2.81524
H	-0.49595	2.78884	4.31601
H	-1.68061	4.33993	2.77019
H	-0.93791	4.60302	0.45461
H	2.26482	1.80189	1.18572
H	1.47262	1.50600	3.48312
Pd	0.20201	0.58428	-0.02947
C	1.12288	3.27639	-0.86645
C	0.48910	2.08629	-1.58679
C	0.63220	4.56024	-1.54860
H	1.04163	4.62047	-2.56619
H	-0.46038	4.59779	-1.63668
H	0.95804	5.45396	-1.00079
C	2.65376	3.17814	-1.02360

H	2.99766	2.19496	-0.66492
H	2.86913	3.18463	-2.10444
C	3.44434	4.28357	-0.34262
H	3.24859	5.26464	-0.79301
H	4.52130	4.09903	-0.43199
C	-0.86538	1.78720	-1.53690
C	-1.55727	1.04276	-2.64534
H	-0.85381	0.41459	-3.20628
H	-1.97582	1.79057	-3.33721
C	-4.72536	-0.51874	-1.54588
N	-2.64189	0.19440	-2.20825
C	-2.59953	-1.20588	-2.21558
C	-3.89088	0.68251	-1.79233
O	-4.15888	1.85673	-1.66905
H	3.20921	4.35534	0.72811
O	-1.61415	-1.86789	-2.46608
H	-1.52835	2.39070	-0.90645
H	1.07984	1.64383	-2.39927
H	-0.19790	-0.55576	-0.97662
C	-3.95851	-1.64864	-1.82472
C	-4.47161	-2.92643	-1.69748
C	-6.03462	-0.62097	-1.11056
C	-6.56264	-1.90899	-0.97378
C	-5.79728	-3.04128	-1.26805
H	-7.59082	-2.03435	-0.63927
H	-6.62430	0.26764	-0.89075
H	-6.24423	-4.02794	-1.15994
H	-3.86252	-3.80019	-1.92462


TS4-Phth
(20.7 kcal/mol)

M06/6-31+G(d) Energy = -2133.858468

M06/6-31+G(d) Free Energy = -2133.281821

M06/6-311+G(d,p) Energy in solution = -2134.397289

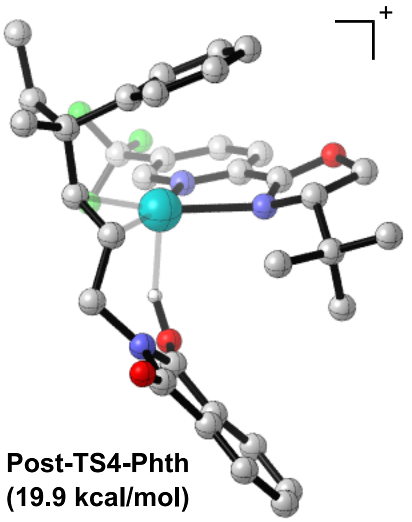
M06/6-311+G(d,p) Derived free energy in solution = -2133.820642

Number of Imaginary Frequencies = 1 (-664.73)

C	3.78575	-3.04934	0.99658
C	2.72030	-2.67027	1.80986
C	1.83962	-1.70706	1.33623
C	2.98969	-1.48390	-0.63942
C	3.91809	-2.45141	-0.24805
H	4.49894	-3.79978	1.32966
H	2.57073	-3.11241	2.79188
H	3.07035	-0.98944	-1.60906
C	0.68358	-1.24474	2.11833
C	-1.11196	-0.13649	2.77453
C	-0.61494	-1.05410	3.90443
H	-0.86201	0.91638	3.00661
H	-0.42210	-0.53943	4.84994
H	-1.26741	-1.91786	4.08759
N	-0.25456	-0.52127	1.63710
O	0.64787	-1.56689	3.41445
N	1.97868	-1.11331	0.13664
C	-2.62073	-0.19082	2.48882

C	-3.36099	0.13811	3.78641
H	-4.44291	0.19212	3.60443
H	-3.20350	-0.62148	4.56561
H	-3.04550	1.11155	4.19074
C	-2.95724	0.87663	1.44854
H	-4.03992	0.90125	1.25484
H	-2.65645	1.87904	1.79090
H	-2.43715	0.68573	0.49975
C	-3.04688	-1.56317	1.97322
H	-2.49392	-1.83941	1.06336
H	-2.89265	-2.36049	2.71426
H	-4.11989	-1.55655	1.73092
C	5.03529	-2.79332	-1.19563
F	5.83188	-3.74302	-0.70787
F	4.54722	-3.22055	-2.36707
F	5.78540	-1.71281	-1.45067
C	0.98355	2.90608	3.10106
C	0.19870	3.79127	2.36485
C	0.35370	3.89182	0.98435
C	1.29026	3.10955	0.29507
C	2.08078	2.23141	1.05712
C	1.93000	2.12985	2.44008
H	0.87704	2.84331	4.18356
H	-0.53174	4.42271	2.86918
H	-0.26337	4.60804	0.44394
H	2.86607	1.64898	0.57637
H	2.57603	1.45538	3.00376
Pd	0.35404	0.49500	-0.36702
C	1.41889	3.15464	-1.23364
C	0.54024	2.05271	-1.83139
C	0.94443	4.49417	-1.81595
H	1.15663	4.52807	-2.89348
H	-0.13550	4.64386	-1.69575
H	1.45778	5.34150	-1.34296

C	2.86841	2.90466	-1.70079
H	3.17585	1.88406	-1.42165
H	2.85616	2.90622	-2.80267
C	3.89875	3.90973	-1.21100
H	3.72085	4.91085	-1.62334
H	4.90699	3.61013	-1.52126
C	-0.81503	1.87202	-1.51434
C	-1.72828	1.27422	-2.55589
H	-1.13834	0.78908	-3.34635
H	-2.33279	2.06269	-3.02546
C	-4.69940	-0.74976	-1.57915
N	-2.68966	0.29003	-2.06769
C	-2.41859	-1.02053	-1.81942
C	-4.08678	0.55590	-1.91573
O	-4.57824	1.64520	-2.04709
H	3.90193	3.99753	-0.11628
O	-1.27557	-1.52081	-1.79245
H	-1.30172	2.53964	-0.79468
H	0.89219	1.66660	-2.79668
H	-0.38184	-0.61521	-1.33101
C	-3.68630	-1.70907	-1.54587
C	-3.94462	-3.03643	-1.25503
C	-6.01427	-1.07863	-1.31091
C	-6.28853	-2.42023	-1.01735
C	-5.27468	-3.38105	-0.99416
H	-7.31262	-2.72262	-0.80722
H	-6.79877	-0.32429	-1.33434
H	-5.52622	-4.41526	-0.76742
H	-3.14604	-3.77598	-1.23041



Post-TS4-Phth
(19.9 kcal/mol)

M06/6-31+G(d) Energy = -2133.861408

M06/6-31+G(d) Free Energy = -2133.281563

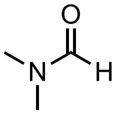
M06/6-311+G(d,p) Energy in solution = -2134.401757

M06/6-311+G(d,p) Derived free energy in solution = -2133.821912

C	3.98277	-2.90639	0.93892
C	2.91147	-2.56744	1.76123
C	1.96012	-1.68054	1.27457
C	3.05543	-1.45140	-0.73053
C	4.05157	-2.34316	-0.32720
H	4.74909	-3.59842	1.28041
H	2.80947	-2.98201	2.76124
H	3.08976	-0.98200	-1.71493
C	0.79935	-1.25835	2.07102
C	-1.02617	-0.21445	2.73735
C	-0.43393	-1.02922	3.89807
H	-0.80300	0.85947	2.88809
H	-0.23658	-0.44291	4.80052
H	-1.02256	-1.91741	4.16585
N	-0.20750	-0.63677	1.58449
O	0.83776	-1.49393	3.38736
N	2.03396	-1.12063	0.05167
C	-2.54306	-0.34212	2.53134
C	-3.23646	-0.01923	3.85620
H	-4.32684	-0.00213	3.72267

H	-3.01905	-0.76258	4.63650
H	-2.93490	0.96920	4.23403
C	-2.97615	0.68870	1.48960
H	-4.06208	0.63262	1.31898
H	-2.74227	1.71281	1.81840
H	-2.45363	0.52900	0.53592
C	-2.93278	-1.74171	2.06124
H	-2.41763	-2.00639	1.12600
H	-2.69593	-2.51857	2.80212
H	-4.01767	-1.78952	1.88202
C	5.17340	-2.64001	-1.28337
F	6.00929	-3.56007	-0.80368
F	4.69429	-3.08425	-2.45291
F	5.88101	-1.53239	-1.54273
C	0.94609	2.87536	3.16063
C	0.12574	3.72671	2.42547
C	0.28416	3.84040	1.04458
C	1.25163	3.09931	0.35513
C	2.07863	2.25881	1.11797
C	1.93135	2.14653	2.49796
H	0.83746	2.80044	4.24256
H	-0.63468	4.32290	2.92894
H	-0.36302	4.53045	0.50478
H	2.87355	1.69310	0.63349
H	2.60282	1.49557	3.05981
Pd	0.34136	0.38427	-0.43507
C	1.36155	3.13739	-1.17414
C	0.49088	2.02779	-1.77699
C	0.86523	4.47258	-1.75094
H	1.06926	4.51145	-2.83015
H	-0.21623	4.60467	-1.62264
H	1.36747	5.32794	-1.28010
C	2.80889	2.90856	-1.65863
H	3.13514	1.89473	-1.37741

H	2.78290	2.90329	-2.76047
C	3.83062	3.93293	-1.19025
H	3.63126	4.92814	-1.60743
H	4.83945	3.64669	-1.51172
C	-0.85904	1.81449	-1.42816
C	-1.78824	1.29146	-2.49226
H	-1.22177	0.81713	-3.30663
H	-2.38814	2.10096	-2.93130
C	-4.84080	-0.66559	-1.54734
N	-2.78279	0.30835	-2.03279
C	-2.58312	-0.98939	-1.78619
C	-4.19225	0.62085	-1.87848
O	-4.63586	1.72499	-2.01105
H	3.84689	4.02991	-0.09645
O	-1.44990	-1.57820	-1.76198
H	-1.33752	2.45445	-0.67789
H	0.80520	1.72823	-2.78592
H	-0.66183	-0.91012	-1.53840
C	-3.85180	-1.65202	-1.51275
C	-4.14076	-2.97105	-1.21049
C	-6.16135	-0.95854	-1.27381
C	-6.46797	-2.29276	-0.97192
C	-5.47943	-3.27835	-0.94366
H	-7.49854	-2.56744	-0.75608
H	-6.92661	-0.18491	-1.29545
H	-5.75566	-4.30375	-0.70700
H	-3.36278	-3.73175	-1.17816



DMF

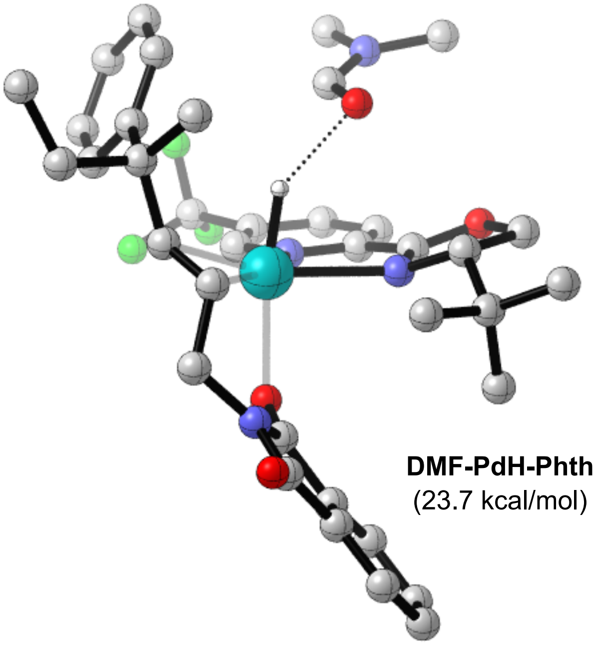
M06/6-31+G(d) Energy = -248.357911

M06/6-31+G(d) Free Energy = -248.285577

M06/6-31+G(d,p) Energy in solution = -248.4272277

M06/6-31+G(d,p) Derived free energy in solution = -248.3548937

C	0.86865	-0.64060	0.00001
O	1.95066	-0.08557	-0.00004
N	-0.34313	-0.02194	0.00008
H	0.76548	-1.74701	0.00007
C	-1.57983	-0.76382	-0.00004
H	-1.36772	-1.83919	-0.00067
H	-2.17888	-0.52712	0.89155
H	-2.17924	-0.52622	-0.89112
C	-0.43461	1.42084	-0.00001
H	-0.97382	1.77148	0.89163
H	0.57696	1.83581	0.00145
H	-0.97139	1.77195	-0.89294


DMF-PdH-Phth
(23.7 kcal/mol)

Note: Energy relative to **Int1-Phth** was calculated by adding the M06/6-311+G(d,p) Derived free energy in solution of **Int1-Phth** and **DMF** and comparing this value to **DMF-PdH-Phth**.

M06/6-31+G(d) Energy = -2382.241397

M06/6-31+G(d) Free Energy = -2381.564922

M06/6-311+G(d,p) Energy in solution = -2382.847202

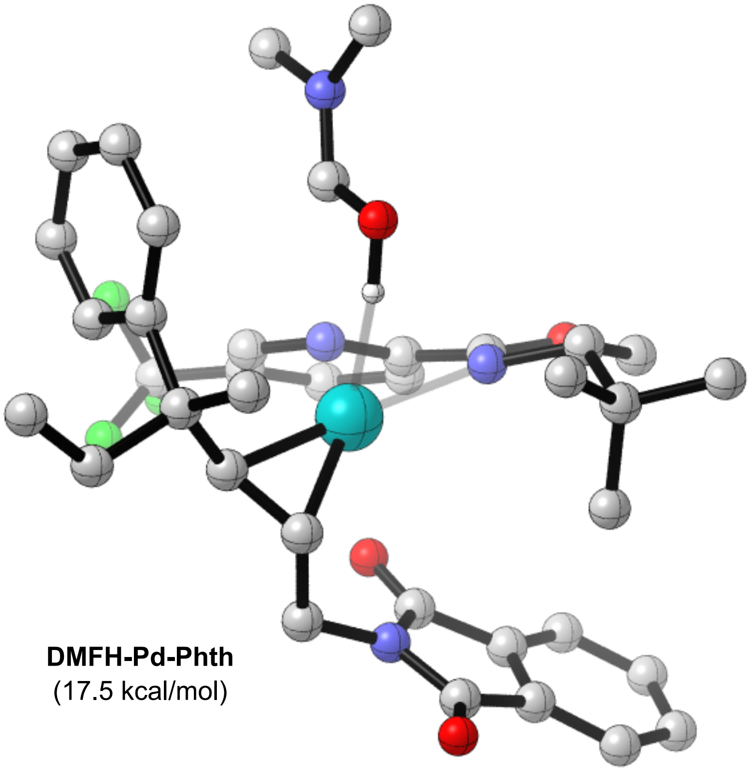
M06/6-311+G(d,p) Derived free energy in solution = -2382.170727

C	2.74309	-3.05518	-1.53999
C	1.69796	-3.28984	-0.65255
C	0.86484	-2.22758	-0.31809
C	1.99855	-0.77874	-1.69945
C	2.90198	-1.77652	-2.06164
H	3.42782	-3.85557	-1.81634
H	1.53493	-4.27014	-0.20987
H	2.09129	0.23162	-2.09647
C	-0.18112	-2.33897	0.70943
C	-1.69883	-1.80572	2.21243
C	-1.25437	-3.26449	2.40996
H	-1.23297	-1.16648	2.98567
H	-0.88831	-3.48763	3.41619
H	-2.01972	-4.00009	2.12818
N	-1.04689	-1.43172	0.94413

O	-0.14674	-3.42300	1.49097
N	1.01023	-0.99925	-0.83937
C	-3.21479	-1.56008	2.25067
C	-3.46371	-0.05357	2.21176
H	-4.53961	0.16510	2.27370
H	-2.97092	0.45392	3.05542
H	-3.07621	0.39026	1.28489
C	-3.91601	-2.22602	1.06924
H	-4.98705	-1.97591	1.07325
H	-3.83920	-3.32251	1.09545
H	-3.49425	-1.88328	0.11322
C	-3.75705	-2.11184	3.57000
H	-3.64495	-3.20302	3.64705
H	-3.24980	-1.65583	4.43335
H	-4.82904	-1.89111	3.66364
C	4.08257	-1.42692	-2.92222
F	4.47997	-2.46238	-3.66299
F	3.81215	-0.40564	-3.74051
F	5.12418	-1.05653	-2.15725
C	5.02989	1.68370	-0.22849
C	4.11759	2.08247	-1.20377
C	2.87409	2.58784	-0.83510
C	2.49405	2.69957	0.51103
C	3.42527	2.29961	1.47434
C	4.67772	1.80299	1.11154
H	6.01026	1.30420	-0.51285
H	4.38206	2.01316	-2.25923
H	2.19716	2.91500	-1.62606
H	3.18468	2.36535	2.53358
H	5.38123	1.50942	1.89107
Pd	-0.38975	0.63644	-0.04933
C	1.14443	3.31587	0.88923
C	0.03343	2.77117	-0.00215
C	0.81420	3.15069	2.37026

H	-0.12824	3.65930	2.61159
H	0.72787	2.09573	2.67068
H	1.58018	3.60641	3.00650
C	1.18048	4.83835	0.55039
H	1.32045	4.95143	-0.53627
H	0.18491	5.25537	0.77699
C	2.25203	5.64236	1.26886
H	2.10227	5.65983	2.35575
H	2.23534	6.68347	0.92511
C	-1.29798	2.51788	0.36834
C	-2.39064	2.80389	-0.63822
H	-1.93820	3.09807	-1.59662
H	-3.00155	3.64739	-0.28718
C	-5.28913	0.58654	-1.31158
N	-3.32830	1.72761	-0.90320
C	-2.98515	0.57420	-1.57578
C	-4.72942	1.81471	-0.69763
O	-5.28078	2.72511	-0.13318
H	3.25660	5.24549	1.07037
O	-1.82896	0.23020	-1.81821
C	-4.23980	-0.14149	-1.87400
C	-4.45610	-1.33956	-2.53089
C	-6.59640	0.14271	-1.37760
C	-6.82620	-1.06797	-2.04091
C	-5.77627	-1.79310	-2.61013
H	-7.84164	-1.45137	-2.12054
H	-7.40709	0.71765	-0.93343
H	-5.99307	-2.72692	-3.12540
H	-3.63050	-1.89993	-2.96658
H	-1.59570	2.54850	1.41914
H	0.17703	3.01657	-1.06140
O	1.60367	-0.79982	2.45695
C	2.68436	-1.01819	1.91669
N	3.46979	-2.09404	2.13492

H	3.11418	-0.32307	1.16580
H	0.46736	0.71591	1.20264
C	3.08212	-3.13149	3.06954
H	2.88190	-4.07181	2.53464
H	3.88630	-3.30459	3.79648
H	2.17728	-2.81668	3.59642
C	4.72296	-2.27459	1.43403
H	5.55749	-2.34343	2.14517
H	4.70413	-3.20086	0.83928
H	4.90377	-1.42849	0.76014



DMFH-Pd-Phth
(17.5 kcal/mol)

M06/6-31+G(d) Energy = -2382.243001

M06/6-31+G(d) Free Energy = -2381.567658

M06/6-31+G(d,p) Energy in solution = -2382.856046

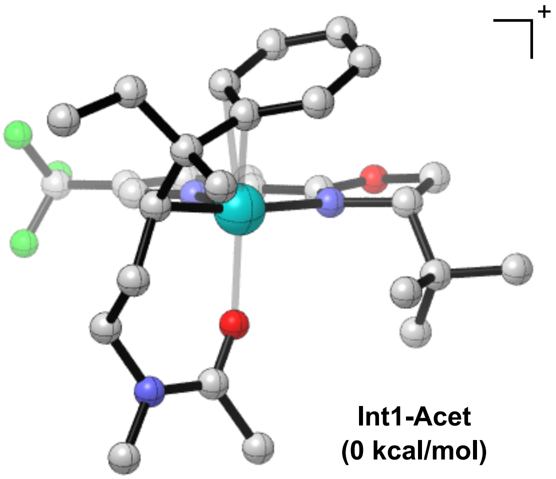
M06/6-31+G(d,p) Derived free energy in solution = -2382.180703

C	-0.08209	4.30297	0.73575
C	0.68253	3.38978	1.45663
C	0.32480	2.04933	1.40889
C	-1.47351	2.46953	0.05450
C	-1.17055	3.83179	0.01595
H	0.17172	5.36053	0.72592
H	1.55494	3.70296	2.02537
H	-2.33416	2.07091	-0.48912
C	1.13220	0.99965	2.04658
C	1.89027	-0.97014	2.70080
C	2.73274	0.15135	3.31673
H	1.18327	-1.35316	3.46281
H	2.86044	0.08541	4.39994
H	3.71326	0.27128	2.83456
N	1.07176	-0.23664	1.71182

O	1.96650	1.34989	3.03172
N	-0.75093	1.59075	0.73933
C	2.65554	-2.18922	2.16387
C	1.65147	-3.25952	1.73402
H	2.18010	-4.16430	1.40368
H	0.98563	-3.54580	2.56271
H	1.03331	-2.91015	0.89166
C	3.53502	-1.83062	0.97277
H	4.06980	-2.72213	0.61470
H	4.29397	-1.07092	1.21320
H	2.92137	-1.45502	0.14196
C	3.51280	-2.73844	3.30559
H	4.29652	-2.03142	3.61507
H	2.90329	-2.98055	4.18955
H	4.01762	-3.66187	2.99153
C	-2.05434	4.73440	-0.79633
F	-1.64566	6.00212	-0.76712
F	-2.09548	4.34122	-2.07562
F	-3.31731	4.69983	-0.33853
C	-5.55655	-0.39997	0.06927
C	-4.84155	0.31432	-0.89177
C	-3.73960	-0.26204	-1.51736
C	-3.30530	-1.56001	-1.20483
C	-4.02904	-2.25441	-0.22868
C	-5.14226	-1.68711	0.39560
H	-6.44056	0.03519	0.53483
H	-5.16000	1.31701	-1.17762
H	-3.22533	0.31065	-2.28977
H	-3.74216	-3.26796	0.04843
H	-5.70345	-2.27535	1.12385
Pd	-0.03382	-0.57428	-0.25322
C	-2.14940	-2.19242	-1.98435
C	-0.98380	-1.21166	-2.07843
C	-1.70573	-3.53158	-1.40093

H	-0.93602	-3.98394	-2.03879
H	-1.28221	-3.42746	-0.39150
H	-2.52860	-4.25371	-1.34819
C	-2.62114	-2.41939	-3.45106
H	-2.80489	-1.43682	-3.91371
H	-1.77180	-2.85742	-4.00005
C	-3.85848	-3.28539	-3.62643
H	-3.71068	-4.30873	-3.25819
H	-4.11908	-3.36178	-4.68903
C	0.37794	-1.53226	-2.12383
C	1.29152	-0.64924	-2.94833
H	0.76695	0.27138	-3.23491
H	1.57727	-1.17922	-3.86836
C	4.72027	-0.19583	-1.59682
N	2.53008	-0.24340	-2.30777
C	2.66331	0.89914	-1.52186
C	3.72831	-0.97234	-2.38517
O	3.86142	-2.02570	-2.96367
H	-4.72814	-2.86129	-3.10562
O	1.77198	1.68630	-1.26399
C	4.07579	0.91945	-1.06828
C	4.72762	1.80717	-0.23169
C	6.04681	-0.46674	-1.31775
C	6.71838	0.42686	-0.47602
C	6.07019	1.54294	0.06015
H	7.76525	0.25215	-0.23393
H	6.53908	-1.34394	-1.73479
H	6.62506	2.21923	0.70824
H	4.21354	2.67889	0.17257
H	0.73732	-2.55382	-1.96537
H	-1.25329	-0.28380	-2.59918
O	-1.65765	-1.92552	1.93868
C	-2.45976	-0.93266	2.09985
N	-3.32359	-0.90839	3.07402

H	-2.38592	-0.07148	1.42372
H	-1.03905	-1.72586	1.14155
C	-3.51591	-2.03971	3.97688
H	-3.47920	-1.68316	5.01193
H	-4.50140	-2.48319	3.78578
H	-2.73966	-2.78949	3.81494
C	-4.22937	0.22325	3.24458
H	-5.26382	-0.12289	3.13172
H	-4.09469	0.64894	4.24545
H	-4.02781	0.98688	2.48720



Int1-Acet
(0 kcal/mol)

M06/6-31+G(d) Energy = -1869.478508

M06/6-31+G(d) Free Energy = -1868.908825

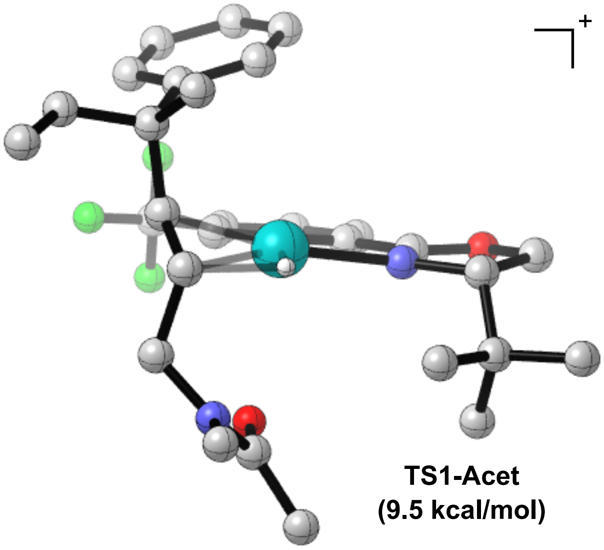
M06/6-311+G(d,p) Energy in solution = -1869.957372

M06/6-311+G(d,p) Derived free energy in solution = -1869.387689

C	4.38581	1.56877	-0.33717
C	3.21094	2.31562	-0.33631
C	1.99567	1.63839	-0.27938
C	3.02400	-0.40199	-0.23847
C	4.29156	0.18667	-0.28652
H	5.35799	2.05523	-0.38010
H	3.23486	3.40117	-0.37801
H	2.92471	-1.49007	-0.20510
C	0.72417	2.38614	-0.27292
C	-1.41194	2.99834	-0.14919
C	-0.52973	4.21147	-0.50195
H	-2.14503	2.80898	-0.95193
H	-0.68398	4.57951	-1.52354
H	-0.60864	5.05318	0.19263
N	-0.44655	1.88499	-0.14822
O	0.82352	3.71245	-0.42177
N	1.90248	0.30028	-0.23376
C	-2.19435	3.11469	1.17800
C	-1.24108	3.27338	2.36019
H	-1.81206	3.35717	3.29623

H	-0.57278	2.40495	2.44290
H	-0.62094	4.17869	2.28386
C	-3.12750	4.32368	1.08424
H	-3.75806	4.38143	1.98186
H	-2.58717	5.27779	1.01356
H	-3.79837	4.24851	0.21526
C	-3.05606	1.86585	1.37396
H	-3.77459	1.74211	0.54889
H	-2.44738	0.95272	1.43735
H	-3.63411	1.95040	2.30575
C	5.49908	-0.70611	-0.27797
F	5.45914	-1.57222	-1.30047
F	5.54315	-1.43342	0.84783
F	6.63607	-0.01678	-0.36653
C	-1.48505	1.51443	-3.43130
C	-0.43002	0.65721	-3.19746
C	-0.63905	-0.54808	-2.49819
C	-1.93133	-0.90113	-2.01877
C	-2.98462	0.02242	-2.25037
C	-2.76738	1.19098	-2.95237
H	-1.33143	2.43293	-3.99666
H	0.56718	0.88787	-3.57077
H	0.17445	-1.27351	-2.47843
H	-3.98836	-0.20626	-1.89830
H	-3.60235	1.86336	-3.14688
Pd	-0.76714	-0.33987	-0.15787
C	-2.15418	-2.31216	-1.43442
C	-1.07225	-2.35105	-0.34996
H	-0.10852	-2.70791	-0.75683
C	-3.56007	-2.45093	-0.85725
H	-3.68430	-3.41202	-0.34581
H	-3.79185	-1.65932	-0.13012
H	-4.31513	-2.41344	-1.65437
C	-1.93531	-3.35963	-2.54522

H	-2.67717	-3.16333	-3.33813
H	-0.95047	-3.18859	-3.00591
C	-2.02154	-4.81107	-2.09882
H	-1.82257	-5.48237	-2.94247
H	-3.01310	-5.07202	-1.70687
C	-1.35887	-3.01645	0.96943
H	-2.25257	-2.58234	1.44510
H	-1.61409	-4.07443	0.77819
C	-0.17917	-2.93869	1.95195
H	0.68631	-2.45248	1.48254
H	0.14454	-3.93770	2.26626
C	-0.90780	-0.08697	4.35660
N	-0.50781	-2.20341	3.16944
C	-0.90815	-3.01094	4.31114
C	-0.57335	-0.85959	3.11135
O	-0.35303	-0.23800	2.05263
H	-1.27790	-5.04314	-1.32291
H	-0.74561	0.97507	4.15730
H	-1.96295	-0.22606	4.62887
H	-0.29478	-0.38406	5.21516
H	-0.06974	-3.63577	4.64449
H	-1.74260	-3.66819	4.02766
H	-1.23347	-2.39038	5.14758



TS1-Acet
(9.5 kcal/mol)

M06/6-31+G(d) Energy = -1869.455231

M06/6-31+G(d) Free Energy = -1868.884823

M06/6-311+G(d,p) Energy in solution = -1869.942932

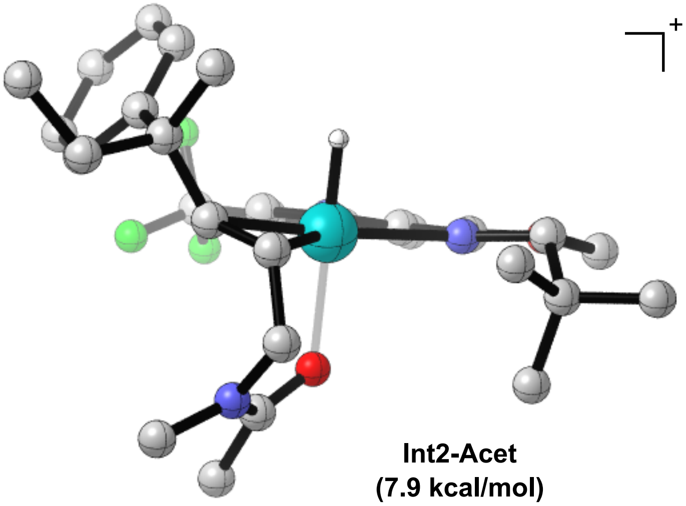
M06/6-311+G(d,p) Derived free energy in solution = -1869.372524

Number of Imaginary Frequencies = 1 (-557.88)

C	-2.53947	-3.14938	0.78109
C	-1.34434	-3.34602	0.09825
C	-0.54004	-2.24122	-0.14200
C	-2.00882	-0.81012	0.89835
C	-2.87055	-1.86474	1.19083
H	-3.20415	-3.98477	0.99723
H	-1.03237	-4.33148	-0.23816
H	-2.25454	0.20666	1.19532
C	0.75344	-2.34106	-0.82500
C	2.76228	-1.82779	-1.64930
C	2.38241	-3.28424	-2.00066
H	2.88546	-1.22874	-2.56533
H	2.21971	-3.44909	-3.07076
H	3.08000	-4.03784	-1.62476
N	1.55389	-1.34487	-0.95347
O	1.11430	-3.51043	-1.33364
N	-0.87010	-0.99239	0.23796
C	4.05588	-1.67855	-0.81593

C	5.20671	-2.28763	-1.62118
H	6.15666	-2.13459	-1.09190
H	5.10120	-3.37057	-1.77246
H	5.30208	-1.81434	-2.60990
C	4.36347	-0.19546	-0.60697
H	3.62295	0.28854	0.04307
H	4.38682	0.35002	-1.56286
H	5.35201	-0.07920	-0.13886
C	3.92538	-2.37195	0.53897
H	3.12099	-1.93043	1.14617
H	3.73261	-3.45053	0.44511
H	4.86436	-2.27155	1.10141
C	-4.15909	-1.63728	1.93240
F	-4.34055	-0.34986	2.23887
F	-5.20387	-2.03667	1.19606
F	-4.18271	-2.34060	3.06845
C	-3.82943	-0.49105	-2.26729
C	-2.57799	-0.35271	-2.86218
C	-1.75832	0.72381	-2.53368
C	-2.15335	1.68987	-1.59582
C	-3.41898	1.53810	-1.01660
C	-4.24864	0.46769	-1.35029
H	-4.47876	-1.32538	-2.52872
H	-2.23868	-1.07869	-3.60075
H	-0.79388	0.80546	-3.03227
H	-3.79384	2.26161	-0.29456
H	-5.23640	0.39445	-0.89697
Pd	0.66866	0.51164	-0.29677
C	-1.19585	2.82325	-1.18353
C	-0.40024	2.33136	0.01989
C	-0.29761	3.23108	-2.35381
H	0.30895	4.11114	-2.11171
H	0.39625	2.43752	-2.65645
H	-0.91436	3.49047	-3.22444

C	-1.99921	4.06447	-0.70716
H	-2.71653	4.31949	-1.50327
H	-2.60286	3.78596	0.16835
C	-1.18557	5.29394	-0.33236
H	-0.42400	5.07105	0.42966
H	-1.84488	6.06006	0.09236
C	0.95076	2.63352	0.30254
C	1.38966	2.65209	1.75595
H	0.63731	2.13132	2.35888
H	1.41521	3.70631	2.07945
C	3.99901	0.24474	3.07557
N	2.67753	2.06393	2.05965
C	3.83888	2.91344	1.87977
C	2.69731	0.77177	2.52932
O	1.68131	0.08093	2.51382
H	-0.68062	5.75052	-1.19218
H	4.74533	0.10312	2.28215
H	4.43180	0.91547	3.82789
H	3.79978	-0.72674	3.53579
H	3.88574	3.27839	0.84232
H	4.76173	2.36369	2.07571
H	3.80247	3.78300	2.55196
H	1.47236	3.32585	-0.36566
H	-1.02743	2.11496	0.89648
H	1.86700	1.51715	-0.55184



Int2-Acet
(7.9 kcal/mol)

M06/6-31+G(d) Energy = -1869.461962

M06/6-31+G(d) Free Energy = -1868.89244

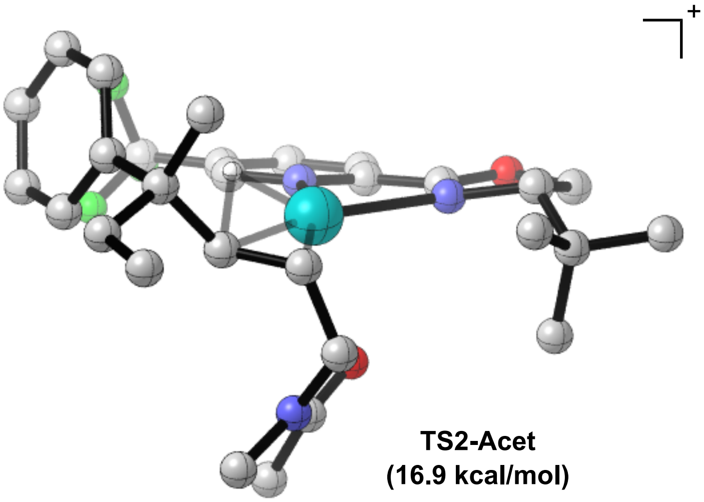
M06/6-311+G(d,p) Energy in solution = -1869.944669

M06/6-311+G(d,p) Derived free energy in solution = -1869.375147

C	-1.57819	-4.01580	0.29011
C	-0.24237	-3.92185	-0.08588
C	0.28814	-2.65509	-0.29324
C	-1.70576	-1.61729	0.18477
C	-2.31659	-2.84822	0.43663
H	-2.03621	-4.98552	0.47559
H	0.38087	-4.80419	-0.20706
H	-2.25897	-0.67875	0.26981
C	1.69166	-2.44545	-0.67317
C	3.60026	-1.51019	-1.29758
C	3.77343	-3.03133	-1.15363
H	3.58620	-1.23074	-2.36659
H	4.17604	-3.52571	-2.04144
H	4.36489	-3.32219	-0.27577
N	2.23353	-1.29174	-0.78407
O	2.42787	-3.52410	-0.94074
N	-0.42921	-1.52885	-0.17032
C	4.68121	-0.65486	-0.61501
C	6.05066	-1.13105	-1.10330
H	6.83853	-0.46637	-0.72372

H	6.29341	-2.14573	-0.75749
H	6.11290	-1.12018	-2.20183
C	4.49084	0.79778	-1.05008
H	5.19940	1.45515	-0.52606
H	4.66504	0.91549	-2.12972
H	3.46986	1.14595	-0.83898
C	4.59774	-0.76043	0.90624
H	3.63094	-0.40348	1.28836
H	4.73365	-1.79155	1.26337
H	5.39433	-0.15810	1.36555
C	-3.76864	-2.90817	0.82056
F	-4.14228	-1.81985	1.50233
F	-4.54910	-2.99161	-0.26547
F	-4.02684	-3.97625	1.58117
C	-4.55356	0.17222	-1.23309
C	-3.68290	0.25791	-2.31422
C	-2.58807	1.12230	-2.27418
C	-2.33304	1.91839	-1.15420
C	-3.21308	1.80717	-0.06760
C	-4.31220	0.95456	-0.10545
H	-5.41442	-0.49364	-1.26749
H	-3.85921	-0.34258	-3.20554
H	-1.93515	1.16905	-3.14386
H	-3.06097	2.41447	0.82532
H	-4.98444	0.90273	0.74998
Pd	0.85264	0.46669	-0.27745
C	-1.13661	2.87376	-1.08589
C	-0.16448	2.35260	-0.03557
C	-0.48335	3.09680	-2.44738
H	0.27257	3.89159	-2.38929
H	0.00817	2.19649	-2.83889
H	-1.22598	3.41192	-3.18973
C	-1.57554	4.26511	-0.54046
H	-1.95417	4.15460	0.48753

H	-0.66664	4.88496	-0.45715
C	-2.61599	4.98682	-1.38255
H	-2.21864	5.28508	-2.36058
H	-2.94996	5.90057	-0.87667
C	1.22656	2.54289	-0.02411
C	2.02042	2.69791	1.25513
H	2.33246	3.74845	1.34734
H	2.94474	2.10361	1.21885
C	0.46599	0.72130	4.10998
N	1.29382	2.37306	2.48014
C	0.88045	3.50221	3.30235
C	1.01943	1.08138	2.76318
O	1.22015	0.18110	1.92258
H	-3.50101	4.35972	-1.55441
H	0.98953	1.22366	4.93096
H	-0.59891	0.98309	4.17516
H	0.55255	-0.36116	4.23196
H	1.74821	3.99433	3.76105
H	0.19657	3.18450	4.09174
H	0.35256	4.23132	2.67175
H	1.71960	2.96592	-0.90345
H	-0.64576	2.23305	0.94368
H	0.62064	0.66431	-1.77110



TS2-Acet
(16.9 kcal/mol)

M06/6-31+G(d) Energy = -1869.443346

M06/6-31+G(d) Free Energy = -1868.876833

M06/6-311+G(d,p) Energy in solution = -1869.92723

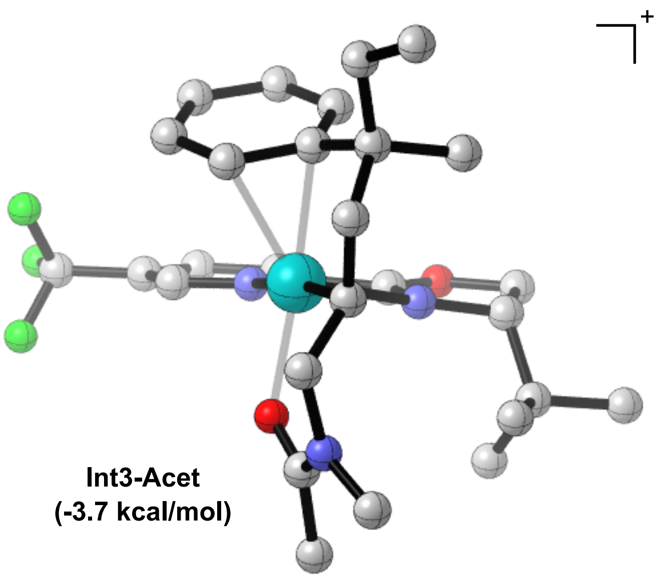
M06/6-311+G(d,p) Derived free energy in solution = -1869.360717

Number of Imaginary Frequencies = 1 (-513.91)

C	-1.85078	-3.97204	0.37162
C	-0.48781	-3.94728	0.08908
C	0.10891	-2.72690	-0.19795
C	-1.88624	-1.59289	0.05793
C	-2.55695	-2.77713	0.35468
H	-2.35413	-4.90830	0.60371
H	0.11101	-4.85438	0.08860
H	-2.41383	-0.63733	0.04074
C	1.53138	-2.60528	-0.54521
C	3.47706	-1.84743	-1.25875
C	3.58099	-3.34339	-0.93116
H	3.44690	-1.70460	-2.35439
H	3.97494	-3.95899	-1.74370
H	4.14191	-3.54902	-0.01017
N	2.12606	-1.49318	-0.76315
O	2.21056	-3.74537	-0.69385
N	-0.58199	-1.57160	-0.21298
C	4.61863	-0.97363	-0.71841
C	5.94288	-1.55071	-1.22441

H	6.77536	-0.89269	-0.93989
H	6.15799	-2.54096	-0.79821
H	5.95404	-1.64033	-2.32105
C	4.45112	0.43204	-1.29313
H	5.19176	1.12057	-0.86215
H	4.59224	0.43225	-2.38378
H	3.44734	0.82846	-1.09134
C	4.62226	-0.93146	0.80873
H	3.66164	-0.58931	1.21803
H	4.83478	-1.91516	1.25147
H	5.41346	-0.25293	1.15887
C	-4.03856	-2.71505	0.60684
F	-4.49007	-3.83190	1.17669
F	-4.34703	-1.68499	1.40571
F	-4.70943	-2.53728	-0.53938
C	-4.71739	0.85048	-0.88779
C	-4.18998	1.45846	0.25120
C	-3.02105	2.20725	0.16716
C	-2.33719	2.36815	-1.04953
C	-2.89465	1.76923	-2.18546
C	-4.06908	1.01851	-2.10581
H	-5.62486	0.25193	-0.82383
H	-4.69207	1.34838	1.21169
H	-2.63806	2.66787	1.07872
H	-2.41310	1.87207	-3.15556
H	-4.47471	0.56444	-3.00860
Pd	0.54304	0.26645	-0.36269
C	-0.98939	3.10716	-1.08453
C	-0.04819	2.39708	-0.10316
C	-0.39755	3.16403	-2.48779
H	0.56335	3.69049	-2.49443
H	-0.22261	2.16296	-2.90468
H	-1.06517	3.70974	-3.16764
C	-1.20211	4.54900	-0.54756

H	-2.00079	5.00434	-1.15332
H	-1.60630	4.49130	0.47485
C	0.01949	5.45489	-0.54972
H	0.88139	4.99554	-0.04243
H	-0.20392	6.39189	-0.02547
C	1.34554	2.25287	-0.19080
C	2.24688	2.30485	1.02887
H	2.74634	3.28685	1.04457
H	3.04383	1.55472	0.94393
C	0.75278	0.71467	4.14121
N	1.57550	2.14620	2.30982
C	1.30022	3.36457	3.05461
C	1.30525	0.88384	2.75272
O	1.50488	-0.09339	2.02401
H	0.33777	5.72570	-1.56362
H	1.35743	1.23129	4.89617
H	-0.27307	1.10048	4.21344
H	0.73332	-0.35385	4.36843
H	0.60424	3.17692	3.87519
H	0.83732	4.10576	2.38805
H	2.22240	3.79805	3.46723
H	1.84660	2.52854	-1.12330
H	-0.45502	2.36296	0.91439
H	-0.76012	0.88185	-0.89202



Int3-Acet
(-3.7 kcal/mol)

M06/6-31+G(d) Energy = -1869.486909

M06/6-31+G(d) Free Energy = -1868.9143

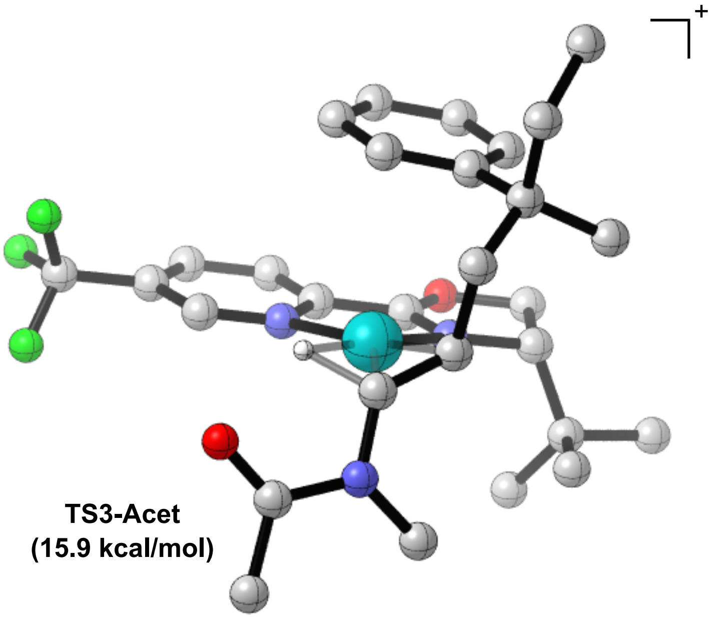
M06/6-311+G(d,p) Energy in solution = -1869.966218

M06/6-311+G(d,p) Derived free energy in solution = -1869.393609

C	-4.04675	-1.51886	-0.94777
C	-2.84585	-1.88162	-1.55228
C	-1.66042	-1.33949	-1.06765
C	-2.77532	-0.14847	0.55068
C	-4.00758	-0.64868	0.13039
H	-4.99421	-1.91512	-1.30703
H	-2.82067	-2.57635	-2.38744
H	-2.71157	0.54042	1.39390
C	-0.35950	-1.73314	-1.63764
C	1.78676	-2.11313	-1.98034
C	0.95383	-2.78015	-3.09321
H	2.49861	-1.38966	-2.41217
H	1.07666	-2.30245	-4.07214
H	1.10989	-3.85786	-3.20356
N	0.78370	-1.37114	-1.20014
O	-0.41497	-2.58106	-2.67888
N	-1.63336	-0.46279	-0.04673
C	2.60301	-3.07752	-1.08964
C	3.64988	-3.77530	-1.95809

H	4.27522	-4.43675	-1.34293
H	3.20232	-4.39962	-2.74352
H	4.31714	-3.04826	-2.44443
C	3.32423	-2.26635	-0.01326
H	3.95384	-1.47762	-0.45597
H	2.60649	-1.78832	0.66787
H	3.98132	-2.91875	0.58100
C	1.69945	-4.10835	-0.41480
H	2.29962	-4.77598	0.21974
H	1.17362	-4.74749	-1.13816
H	0.94710	-3.62352	0.22468
C	-5.23941	-0.18673	0.85497
F	-5.18180	-0.50841	2.15255
F	-6.35182	-0.71318	0.34593
F	-5.34686	1.15117	0.78760
C	-2.37427	2.51673	-1.23953
C	-1.53315	2.07158	-2.27622
C	-0.16663	2.02094	-2.09652
C	0.44133	2.40660	-0.86709
C	-0.43582	2.80360	0.18320
C	-1.83075	2.86976	-0.02159
H	-3.44911	2.59089	-1.40235
H	-1.96165	1.78740	-3.23673
H	0.46808	1.71050	-2.92553
H	-0.03618	3.25842	1.08868
H	-2.46989	3.23179	0.78338
Pd	0.28779	0.57010	0.53093
C	1.92860	2.78490	-0.82362
C	2.43741	2.59337	0.60824
H	3.52822	2.75834	0.64910
C	2.75319	1.91451	-1.77917
H	2.60092	2.20528	-2.82762
H	3.82579	2.02357	-1.57180
H	2.49732	0.84998	-1.68369

C	2.01837	4.26781	-1.24865
H	1.55450	4.36399	-2.24450
H	1.39032	4.86369	-0.56643
C	3.42089	4.85454	-1.28582
H	4.07118	4.32822	-1.99667
H	3.38609	5.90510	-1.59785
C	2.12504	1.20172	1.10659
H	2.75003	0.44610	0.59789
C	2.22912	1.04765	2.60585
H	1.37373	1.52500	3.11085
H	3.12960	1.57192	2.96559
C	1.41752	-2.58238	3.44175
N	2.36171	-0.34029	3.05340
C	3.64576	-0.70925	3.63087
C	1.34473	-1.20218	2.85588
O	0.33267	-0.88407	2.19705
H	3.90564	4.82827	-0.30072
H	2.00365	3.35277	1.28017
H	3.80763	-0.19563	4.58766
H	3.71095	-1.78608	3.79657
H	0.43952	-3.05435	3.31893
H	2.16162	-3.19265	2.91120
H	1.68463	-2.57180	4.50472
H	4.44991	-0.42617	2.93731



TS3-Acet
(15.9 kcal/mol)

M06/6-31+G(d) Energy = -1869.457452

M06/6-31+G(d) Free Energy = -1868.892517

M06/6-311+G(d,p) Energy in solution = -1869.92723

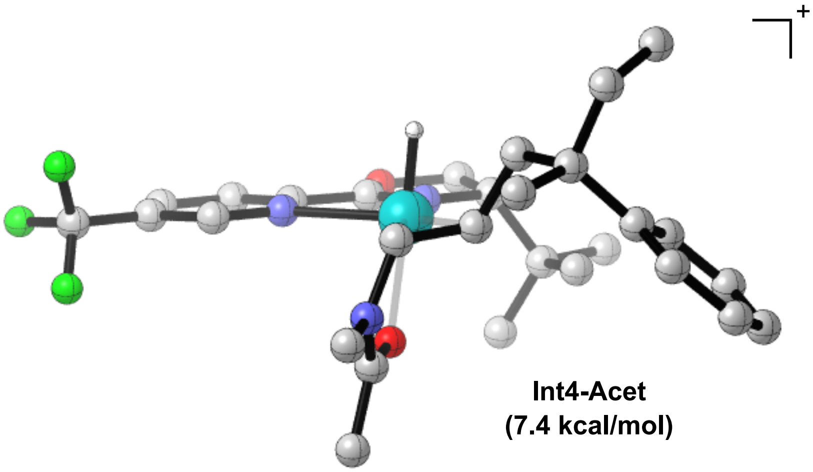
M06/6-311+G(d,p) Derived free energy in solution = -1869.362295

Number of Imaginary Frequencies = 1 (-412.54)

C	-3.77596	-2.16484	0.73803
C	-2.49607	-2.48010	1.18716
C	-1.48977	-1.54165	1.02017
C	-2.92153	-0.03438	0.02420
C	-3.98696	-0.92678	0.14833
H	-4.59470	-2.87276	0.84607
H	-2.27379	-3.43794	1.65107
H	-3.05863	0.94559	-0.43382
C	-0.10542	-1.78269	1.44110
C	2.04606	-1.50723	1.91027
C	1.60335	-2.94750	2.23067
H	2.85169	-1.51888	1.16053
H	2.02385	-3.69047	1.54305
H	1.78466	-3.26700	3.26057
N	0.84161	-0.93136	1.27748
O	0.16881	-2.94073	2.03074
N	-1.69840	-0.33541	0.45326

C	2.54057	-0.68965	3.12514
C	2.96136	0.69953	2.65291
H	2.11197	1.23638	2.21130
H	3.76640	0.64233	1.90341
H	3.33803	1.29331	3.49730
C	1.45022	-0.55271	4.18541
H	0.57801	-0.00604	3.79805
H	1.10261	-1.52425	4.56525
H	1.83392	0.00741	5.04897
C	3.76737	-1.39146	3.70969
H	4.19925	-0.78261	4.51521
H	4.54940	-1.53381	2.94882
H	3.53432	-2.37299	4.14460
C	-5.33068	-0.50366	-0.38280
F	-5.27267	-0.32542	-1.70847
F	-5.70973	0.65844	0.15957
F	-6.27316	-1.40946	-0.12775
C	-0.32930	-3.03489	-1.89647
C	0.94470	-3.28002	-1.38874
C	1.93799	-2.30632	-1.47395
C	1.69558	-1.06069	-2.06589
C	0.40842	-0.84053	-2.58422
C	-0.59016	-1.80862	-2.50157
H	-1.10133	-3.80181	-1.84435
H	1.17350	-4.24763	-0.94117
H	2.92988	-2.54201	-1.08895
H	0.17470	0.09184	-3.09792
H	-1.57327	-1.60477	-2.92672
Pd	0.11603	0.74926	-0.00996
C	2.80207	-0.02587	-2.26328
C	2.29214	1.41753	-2.07765
H	3.13310	2.08494	-2.33911
C	3.99065	-0.23483	-1.32347
H	4.51486	-1.18206	-1.49785

H	4.72817	0.56670	-1.47362
H	3.68656	-0.21467	-0.26715
C	3.29039	-0.11332	-3.73402
H	2.46321	0.20253	-4.39056
H	4.08783	0.63662	-3.86748
C	3.79112	-1.47234	-4.19405
H	3.00621	-2.23820	-4.13522
H	4.12026	-1.42023	-5.23860
C	1.78415	1.87146	-0.72298
H	2.50966	1.88447	0.09555
C	0.76875	2.86224	-0.75550
H	-0.62623	1.91950	-0.79184
H	0.37677	3.14556	-1.73399
C	-0.99997	5.63174	1.01823
N	0.52592	3.84828	0.19529
C	1.26529	3.86678	1.44638
C	-0.68706	4.54325	0.03492
O	-1.43429	4.24326	-0.87761
H	4.64973	-1.82334	-3.60594
H	1.52098	1.63411	-2.83219
H	2.32773	3.68199	1.25668
H	1.17940	4.85015	1.91209
H	0.88615	3.10622	2.14743
H	-0.20033	6.38085	1.07175
H	-1.15295	5.22957	2.02822
H	-1.92266	6.11785	0.69303



Int4-Acet
(7.4 kcal/mol)

M06/6-31+G(d) Energy = -1869.455286

M06/6-31+G(d) Free Energy = -1868.892253

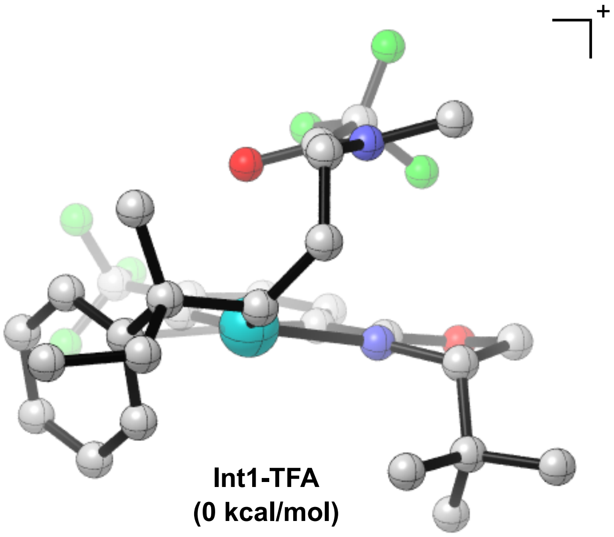
M06/6-311+G(d,p) Energy in solution = -1869.938973

M06/6-311+G(d,p) Derived free energy in solution = -1869.37594

C	5.46992	0.43373	-0.45500
C	4.59029	1.51198	-0.52619
C	3.22769	1.24623	-0.49568
C	3.55908	-1.01496	-0.33883
C	4.94658	-0.84688	-0.35679
H	6.54631	0.58953	-0.47524
H	4.95124	2.53458	-0.60177
H	3.11670	-2.01107	-0.26813
C	2.21702	2.31172	-0.55488
C	0.27495	3.40980	-0.54436
C	1.44922	4.38711	-0.77157
H	-0.39595	3.40076	-1.41867
H	1.44571	4.85779	-1.75982
H	1.54493	5.16254	-0.00566
N	0.95439	2.10217	-0.48807
O	2.63927	3.56304	-0.68976
N	2.72090	0.00708	-0.40708
C	-0.58844	3.70332	0.70273
C	-1.75900	2.72297	0.75747
H	-2.44320	2.99821	1.57199
H	-2.33447	2.73348	-0.18219

H	-1.42397	1.69411	0.94678
C	0.23137	3.58300	1.98566
H	0.59776	2.55725	2.13425
H	1.09488	4.26454	2.00345
H	-0.39236	3.83963	2.85290
C	-1.15800	5.11642	0.55776
H	-0.38304	5.89497	0.57141
H	-1.73225	5.22505	-0.37455
H	-1.83971	5.33360	1.39077
C	5.81483	-2.07179	-0.27945
F	5.57906	-2.88446	-1.31753
F	7.11127	-1.76915	-0.27609
F	5.54799	-2.76993	0.83400
C	-6.50706	0.26781	1.52936
C	-6.61221	-1.09451	1.26544
C	-5.73926	-1.70635	0.36984
C	-4.73774	-0.98264	-0.29015
C	-4.65507	0.38882	-0.01673
C	-5.52315	1.00693	0.88080
H	-7.18861	0.74847	2.22882
H	-7.38101	-1.68871	1.75705
H	-5.85565	-2.77271	0.18142
H	-3.90746	1.00687	-0.51375
H	-5.43306	2.07713	1.06477
Pd	0.25249	0.03618	-0.30750
C	-3.83929	-1.67070	-1.31869
C	-2.47474	-0.95731	-1.48027
H	-1.92719	-1.44660	-2.30264
C	-3.56484	-3.12929	-0.93029
H	-4.45585	-3.75734	-1.05100
H	-2.78905	-3.55674	-1.58291
H	-3.23323	-3.22556	0.11363
C	-4.55120	-1.69512	-2.69347
H	-3.93531	-2.30145	-3.37971

H	-5.49291	-2.25103	-2.56036
C	-4.85595	-0.35143	-3.33336
H	-3.94608	0.21248	-3.58081
H	-5.40325	-0.49603	-4.27259
C	-1.65102	-1.00048	-0.22670
C	-0.56385	-1.86908	-0.02950
C	0.40313	-1.82339	3.63458
N	-0.19025	-2.30528	1.29981
C	-0.55176	-3.67624	1.65124
C	0.22972	-1.39673	2.21221
O	0.48069	-0.22027	1.87631
H	-5.48050	0.27660	-2.68411
H	-2.61627	0.08598	-1.79119
H	0.06513	0.05890	-1.83121
H	-0.26766	-2.57476	-0.81142
H	-2.14073	-0.61030	0.67408
H	-0.50281	-4.29425	0.74844
H	0.15066	-4.08755	2.38163
H	-1.57243	-3.73248	2.05445
H	-0.51854	-2.25744	4.04173
H	1.19402	-2.57897	3.72830
H	0.68363	-0.94977	4.22725



Int1-TFA
(0 kcal/mol)

M06/6-31+G(d) Energy = -2167.135698

M06/6-31+G(d) Free Energy = -2166.586458

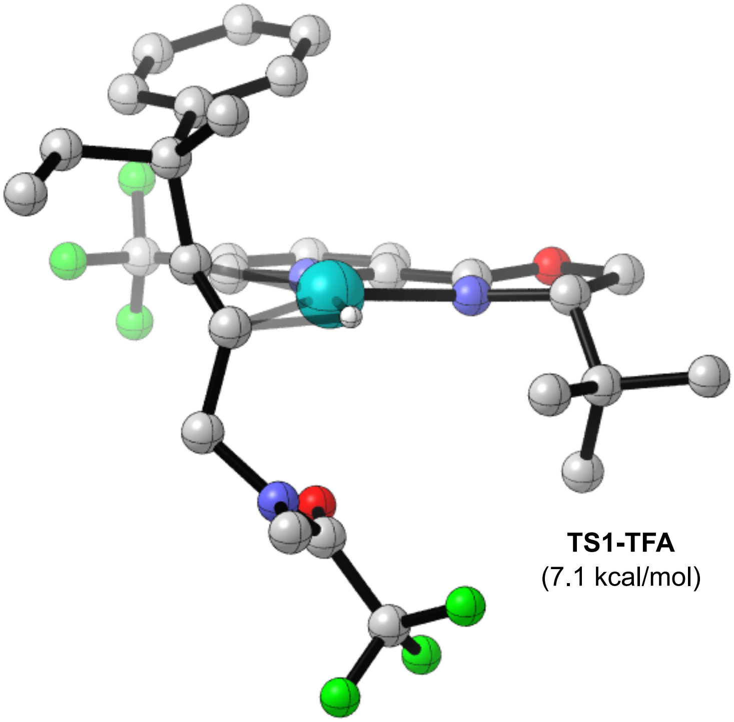
M06/6-311+G(d,p) Energy in solution = -2167.687472

M06/6-311+G(d,p) Derived free energy in solution = -2167.138232

C	3.80234	-1.70929	-0.83713
C	2.56089	-2.31661	-1.01577
C	1.42566	-1.52225	-0.95392
C	2.64402	0.37440	-0.53892
C	3.83943	-0.34638	-0.59022
H	4.72057	-2.29083	-0.87734
H	2.46966	-3.38640	-1.18787
H	2.64197	1.44425	-0.32947
C	0.07500	-2.08114	-1.06665
C	-2.13099	-2.28756	-1.21597
C	-1.45434	-3.66770	-1.22747
H	-2.88470	-2.22816	-0.41423
H	-1.57299	-4.21805	-0.28512
H	-1.73973	-4.31615	-2.05978
N	-0.99886	-1.39970	-0.86878
O	-0.04584	-3.36706	-1.37477
N	1.46273	-0.19269	-0.73487
C	-2.82197	-1.90430	-2.54887
C	-3.99088	-2.86819	-2.76559

H	-4.70492	-2.82875	-1.92948
H	-4.53901	-2.59514	-3.67713
H	-3.67149	-3.91206	-2.88830
C	-3.38255	-0.48696	-2.46117
H	-2.58004	0.25626	-2.36140
H	-3.94746	-0.25028	-3.37297
H	-4.07223	-0.37598	-1.61025
C	-1.85450	-1.97710	-3.72952
H	-1.44651	-2.98461	-3.88849
H	-2.37827	-1.69677	-4.65330
H	-1.01436	-1.27800	-3.60889
C	5.12383	0.40548	-0.37157
F	5.14229	0.97091	0.84154
F	5.24429	1.39511	-1.26853
F	6.19161	-0.38254	-0.47992
C	1.59144	3.64408	-1.49747
C	0.44707	3.20561	-2.14385
C	-0.68869	2.85784	-1.39851
C	-0.68581	2.92533	0.02166
C	0.52044	3.33052	0.64909
C	1.62614	3.70049	-0.09684
H	2.46395	3.94670	-2.07520
H	0.40812	3.16390	-3.23064
H	-1.61610	2.65436	-1.93275
H	0.57322	3.38444	1.73401
H	2.52734	4.04211	0.41123
Pd	-0.60131	0.68269	-0.26253
C	-2.02184	2.75749	0.78917
C	-2.41261	1.31642	0.42978
H	-3.02479	1.32336	-0.48412
C	-1.83846	3.01435	2.28062
H	-1.06612	2.38164	2.73187
H	-1.54847	4.05621	2.46386
H	-2.78361	2.84685	2.81535

C	-3.08594	3.73736	0.24050
H	-3.29180	3.49043	-0.81201
H	-4.02832	3.53987	0.77940
C	-2.72314	5.21128	0.34086
H	-2.69369	5.56889	1.37724
H	-3.46334	5.82265	-0.18849
C	-3.11073	0.40242	1.42330
H	-4.01520	0.95399	1.74574
H	-3.50439	-0.46957	0.87528
C	-2.44132	-0.10532	2.70511
H	-3.23306	-0.39813	3.40780
H	-1.84702	0.66682	3.19581
C	0.66504	-2.32063	2.45502
N	-1.58901	-1.29053	2.54966
C	-2.24736	-2.57002	2.78598
C	-0.26667	-1.08455	2.39357
O	0.24577	0.01222	2.21136
H	-1.74366	5.41886	-0.11503
H	-2.52539	-2.66847	3.84392
H	-1.61506	-3.41398	2.51016
H	-3.16192	-2.61467	2.17996
F	1.92164	-1.95782	2.26763
F	0.36238	-3.21944	1.49133
F	0.56719	-2.94296	3.63030



TS1-TFA
(7.1 kcal/mol)

M06/6-31+G(d) Energy = -2167.109078

M06/6-31+G(d) Free Energy = -2166.568225

M06/6-311+G(d,p) Energy in solution = -2167.667789

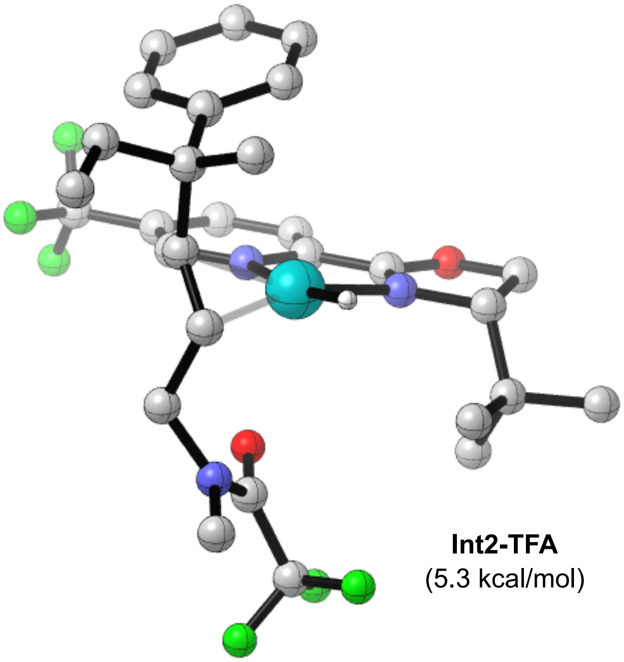
M06/6-311+G(d,p) Derived free energy in solution = -2167.126936

Number of Imaginary Frequencies = 1 (-536.06)

C	-2.97421	-2.89907	1.28203
C	-1.89378	-3.24637	0.47861
C	-1.05397	-2.23318	0.03880
C	-2.26571	-0.60959	1.12729
C	-3.15922	-1.56264	1.61020
H	-3.66509	-3.65692	1.64929
H	-1.69910	-4.27769	0.19555
H	-2.39375	0.44333	1.36658
C	0.11088	-2.49049	-0.81483
C	1.95640	-2.19772	-2.03576
C	1.48982	-3.66979	-2.09587
H	1.86347	-1.72264	-3.02635
H	1.21023	-4.00636	-3.09865
H	2.19986	-4.38172	-1.66383
N	0.94651	-1.57573	-1.15470

O	0.29553	-3.71890	-1.27326
N	-1.23928	-0.93559	0.34808
C	3.41336	-2.00826	-1.56422
C	4.31694	-2.79426	-2.51851
H	5.37033	-2.63260	-2.25423
H	4.14480	-3.87866	-2.47971
H	4.18482	-2.46582	-3.56040
C	3.80082	-0.53303	-1.66597
H	3.26343	0.08398	-0.93347
H	3.59400	-0.13250	-2.67034
H	4.87494	-0.41125	-1.47306
C	3.59694	-2.49665	-0.12949
H	2.95672	-1.94476	0.57409
H	3.37443	-3.56775	-0.01661
H	4.63986	-2.35649	0.18480
C	-4.33373	-1.16832	2.46253
F	-4.38410	0.15147	2.66308
F	-5.48111	-1.54060	1.88084
F	-4.27997	-1.76773	3.65520
C	-4.41666	-0.55195	-1.80148
C	-3.22904	-0.53981	-2.52925
C	-2.34026	0.52447	-2.40611
C	-2.60380	1.60638	-1.55277
C	-3.80602	1.57941	-0.83619
C	-4.70257	0.51789	-0.95934
H	-5.12106	-1.37630	-1.90373
H	-2.99659	-1.35746	-3.21145
H	-1.42772	0.50349	-3.00043
H	-4.07467	2.39562	-0.16796
H	-5.63573	0.53856	-0.39736
Pd	0.29736	0.39364	-0.55284
C	-1.56838	2.73151	-1.37870
C	-0.61440	2.30768	-0.26765
C	-0.84730	3.00938	-2.70027

H	-0.18087	3.87614	-2.62626
H	-0.23792	2.16421	-3.04205
H	-1.58338	3.22985	-3.48446
C	-2.25637	4.03654	-0.89531
H	-3.07270	4.26079	-1.60019
H	-2.73597	3.85081	0.07675
C	-1.35899	5.25594	-0.74367
H	-0.49908	5.06122	-0.08521
H	-1.92385	6.07945	-0.29135
C	0.77750	2.54171	-0.24027
C	1.45649	2.69589	1.10630
H	0.82664	2.25137	1.88556
H	1.54338	3.77404	1.31752
C	4.28048	0.39390	2.20023
N	2.79023	2.12582	1.22758
C	3.89999	2.98841	0.83671
C	2.87128	0.89015	1.78514
O	1.90800	0.17670	2.00795
H	-0.97420	5.62460	-1.70202
H	3.68508	3.41575	-0.15156
H	4.83397	2.43202	0.75745
H	4.03059	3.80612	1.55795
H	1.21476	3.12063	-1.05970
H	-1.10012	2.21489	0.71403
H	1.49822	1.27070	-1.08986
F	4.19015	-0.76355	2.82482
F	5.08108	0.22644	1.13291
F	4.86779	1.27519	3.01691



Int2-TFA
(5.3 kcal/mol)

M06/6-31+G(d) Energy = -2167.115727

M06/6-31+G(d) Free Energy = -2166.573286

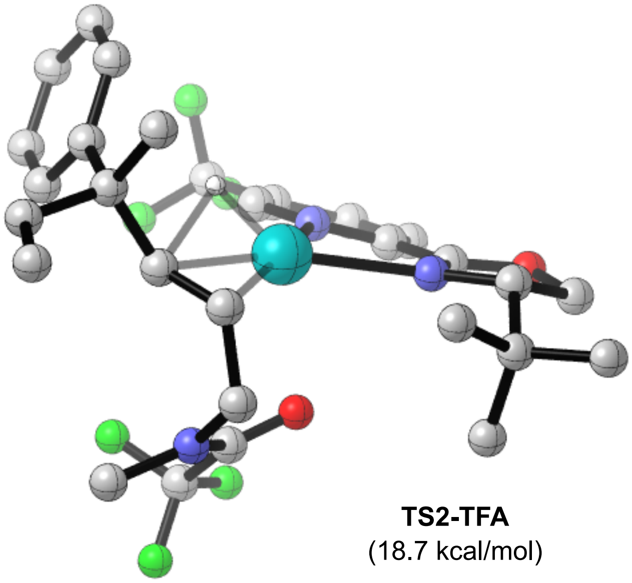
M06/6-311+G(d,p) Energy in solution = -2167.672198

M06/6-311+G(d,p) Derived free energy in solution = -2167.129757

C	-2.58421	-3.00398	1.39643
C	-1.56236	-3.26963	0.49222
C	-0.80774	-2.20165	0.02647
C	-1.97591	-0.68403	1.28938
C	-2.79289	-1.69143	1.79755
H	-3.21361	-3.80493	1.78228
H	-1.35285	-4.27845	0.14556
H	-2.11864	0.34902	1.60006
C	0.27957	-2.37909	-0.94194
C	2.03819	-1.96420	-2.26323
C	1.58165	-3.43161	-2.39825
H	1.98184	-1.44732	-3.23350
H	1.12408	-3.66102	-3.36647
H	2.35625	-4.17140	-2.18060
N	0.99193	-1.40341	-1.38455
O	0.54636	-3.59345	-1.39032
N	-1.00861	-0.92776	0.41340

C	3.46875	-1.77859	-1.70619
C	4.43968	-2.43819	-2.68906
H	5.47334	-2.27769	-2.35543
H	4.30020	-3.52473	-2.77155
H	4.34844	-2.00609	-3.69671
C	3.81250	-0.29122	-1.63627
H	3.22033	0.23514	-0.87497
H	3.64609	0.20768	-2.60340
H	4.87170	-0.16520	-1.37493
C	3.60964	-2.40124	-0.31862
H	2.92605	-1.93973	0.40962
H	3.42686	-3.48580	-0.32125
H	4.63255	-2.25351	0.05406
C	-3.91285	-1.37900	2.75096
F	-4.01749	-0.06672	2.98258
F	-5.08190	-1.80158	2.25339
F	-3.73178	-1.99454	3.92203
C	-4.19907	-0.90619	-1.97920
C	-3.14745	-0.65413	-2.85534
C	-2.38290	0.50502	-2.72750
C	-2.64683	1.44412	-1.72296
C	-3.71834	1.17879	-0.85919
C	-4.48543	0.02320	-0.98240
H	-4.80356	-1.80580	-2.08479
H	-2.92474	-1.35623	-3.65826
H	-1.57370	0.67007	-3.43637
H	-3.97756	1.87860	-0.06487
H	-5.31917	-0.14314	-0.30054
Pd	0.35491	0.48644	-0.73449
C	-1.73539	2.66324	-1.49370
C	-0.86063	2.28937	-0.31139
C	-0.93593	3.03754	-2.73847
H	-0.28583	3.89991	-2.55055
H	-0.29350	2.22417	-3.09352

H	-1.61907	3.31274	-3.55346
C	-2.58354	3.89194	-1.05621
H	-3.37456	4.02345	-1.81126
H	-3.10227	3.66167	-0.11508
C	-1.82194	5.19514	-0.86777
H	-0.96957	5.08138	-0.18091
H	-2.48269	5.95498	-0.43418
C	0.46291	2.59345	-0.04283
C	0.95565	2.60672	1.38332
H	0.30729	1.98128	2.01072
H	0.88345	3.63970	1.76159
C	3.96331	0.47056	2.34208
N	2.33784	2.18363	1.58106
C	3.34448	3.24118	1.55134
C	2.53875	0.87982	1.88850
O	1.66774	0.02437	1.85160
H	-1.44156	5.60389	-1.81149
H	3.15302	3.88341	0.68311
H	4.35090	2.83634	1.44585
H	3.29616	3.85062	2.46346
H	1.05194	3.16135	-0.76674
H	-1.45334	1.98147	0.55962
H	1.29607	1.19072	-1.72979
F	3.97613	-0.79341	2.71948
F	4.85170	0.61430	1.34390
F	4.37255	1.22279	3.36916



TS2-TFA
(18.7 kcal/mol)

M06/6-31+G(d) Energy = -2167.097946

M06/6-31+G(d) Free Energy = -2166.553944

M06/6-311 +G(d,p) Energy in solution = -2167.652414

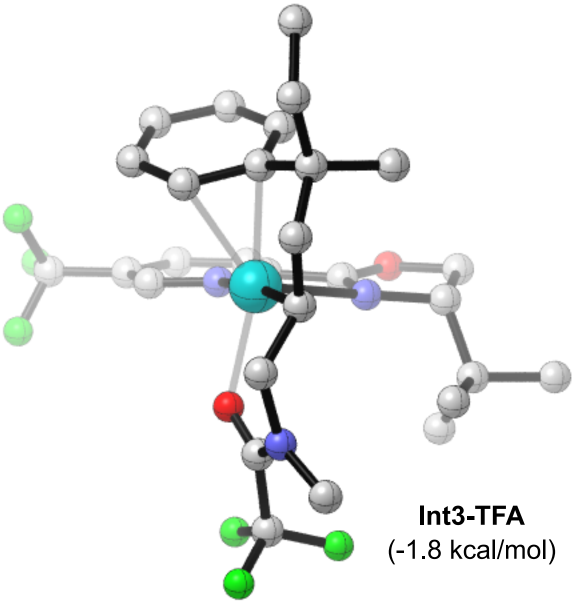
M06/6-311+G(d,p) Derived free energy in solution = -2167.108412

Number of Imaginary Frequencies = 1 (-349.08)

C	-1.61846	-4.05976	0.09921
C	-0.25781	-3.96595	-0.18191
C	0.26920	-2.72545	-0.51100
C	-1.79132	-1.70124	-0.31472
C	-2.39165	-2.90982	0.03333
H	-2.06629	-5.01354	0.36949
H	0.39451	-4.83467	-0.14406
H	-2.37751	-0.78237	-0.37767
C	1.69099	-2.53484	-0.82774
C	3.61942	-1.67669	-1.47461
C	3.77948	-3.17494	-1.18024
H	3.61381	-1.50541	-2.56637
H	4.21581	-3.75325	-1.99853
H	4.32911	-3.38048	-0.25253
N	2.24170	-1.39314	-1.00696
O	2.42238	-3.63986	-0.98145
N	-0.48853	-1.61341	-0.58182

C	4.70699	-0.77014	-0.87938
C	6.06638	-1.26211	-1.38016
H	6.86102	-0.58156	-1.04526
H	6.31743	-2.26143	-0.99716
H	6.10412	-1.29747	-2.47912
C	4.48192	0.64778	-1.40287
H	5.19281	1.35006	-0.94492
H	4.62439	0.69508	-2.49242
H	3.46253	0.99501	-1.19036
C	4.68045	-0.78560	0.64773
H	3.68979	-0.52840	1.04714
H	4.95276	-1.76707	1.06080
H	5.41311	-0.06654	1.04118
C	-3.87439	-2.91619	0.29125
F	-4.27720	-4.06108	0.83969
F	-4.22018	-1.91583	1.11155
F	-4.55265	-2.74279	-0.85063
C	-4.64171	0.82171	-1.63365
C	-4.23126	1.38233	-0.42394
C	-3.05963	2.12808	-0.35978
C	-2.25985	2.33650	-1.49680
C	-2.69804	1.78116	-2.70542
C	-3.87343	1.03122	-2.77285
H	-5.55561	0.23218	-1.68418
H	-4.82652	1.23598	0.47623
H	-2.77239	2.55050	0.60434
H	-2.12335	1.92107	-3.61838
H	-4.18730	0.61382	-3.72823
Pd	0.54868	0.27136	-0.67807
C	-0.93176	3.09739	-1.37786
C	-0.07782	2.38286	-0.33145
C	-0.20945	3.21589	-2.71433
H	0.73671	3.75890	-2.61138
H	0.02192	2.23403	-3.14938

H	-0.82108	3.77586	-3.43415
C	-1.22892	4.51925	-0.82125
H	-1.98348	4.97160	-1.48313
H	-1.71953	4.42179	0.15968
C	-0.03567	5.45462	-0.69523
H	0.79299	5.00318	-0.12830
H	-0.32764	6.37045	-0.16741
C	1.31333	2.26622	-0.29262
C	2.08890	2.23662	1.01396
H	2.56763	3.21743	1.15723
H	2.89717	1.49612	0.97687
C	0.02848	0.40796	3.65795
N	1.26160	1.98772	2.19247
C	0.80852	3.16567	2.93103
C	0.96813	0.69924	2.46656
O	1.35037	-0.24743	1.79002
H	0.36059	5.76175	-1.67078
H	-0.05751	2.94509	3.55556
H	0.51562	3.94107	2.21194
H	1.61442	3.55628	3.56496
H	1.89934	2.60619	-1.15115
H	-0.59335	2.28010	0.62979
H	-0.74802	0.77121	-1.32069
F	0.44979	0.97525	4.79064
F	-0.07484	-0.89152	3.85193
F	-1.19921	0.88757	3.37880



Int3-TFA
(-1.8 kcal/mol)

M06/6-31+G(d) Energy = -2167.137463

M06/6-31+G(d) Free Energy = -2166.590279

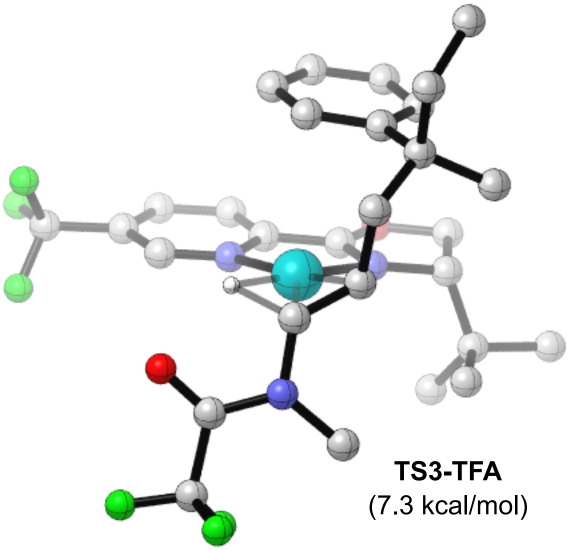
M06/6-311+G(d,p) Energy in solution = -2167.688275

M06/6-311+G(d,p) Derived free energy in solution = -2167.141091

C	3.59252	-2.04130	1.62197
C	2.46897	-1.63473	2.33759
C	1.45368	-0.96658	1.66368
C	2.57666	-1.10770	-0.33799
C	3.63819	-1.78604	0.26043
H	4.41305	-2.55715	2.11658
H	2.37384	-1.83198	3.40196
H	2.58476	-0.88918	-1.40661
C	0.22050	-0.55712	2.35662
C	-1.83914	0.07317	2.84631
C	-1.06016	-0.23008	4.14056
H	-2.20514	1.11300	2.85171
H	-0.83214	0.66535	4.73043
H	-1.52302	-0.97658	4.79293
N	-0.81238	-0.05502	1.79462
O	0.19511	-0.77559	3.67885
N	1.52441	-0.68318	0.34955
C	-3.05648	-0.84123	2.57932

C	-4.08512	-0.61953	3.68852
H	-4.98531	-1.21813	3.49377
H	-3.71386	-0.91690	4.67895
H	-4.39490	0.43454	3.74544
C	-3.68626	-0.44027	1.24687
H	-3.97349	0.62395	1.24421
H	-2.98770	-0.61034	0.41678
H	-4.59260	-1.03173	1.05398
C	-2.64634	-2.31169	2.52695
H	-1.89057	-2.49585	1.74970
H	-2.24159	-2.66888	3.48457
H	-3.51729	-2.93856	2.29172
C	4.80813	-2.16452	-0.60267
F	4.42425	-2.94008	-1.62200
F	5.75054	-2.80951	0.08142
F	5.36519	-1.06321	-1.13497
C	3.38444	2.00679	-0.12178
C	2.67413	2.37751	1.03326
C	1.34945	2.75690	0.94795
C	0.65678	2.78256	-0.29708
C	1.38138	2.33570	-1.43992
C	2.73954	1.97363	-1.34295
H	4.44153	1.75070	-0.05470
H	3.17851	2.39360	1.99870
H	0.82948	3.08383	1.84754
H	0.95688	2.45654	-2.43633
H	3.28373	1.69321	-2.24448
Pd	-0.06459	0.59767	-0.57885
C	-0.61767	3.61801	-0.47557
C	-1.46284	2.98686	-1.58675
H	-2.42660	3.52174	-1.66700
C	-1.44901	3.67450	0.80835
H	-0.97252	4.27208	1.59486
H	-2.42076	4.14337	0.60008

H	-1.63362	2.67193	1.21996
C	-0.23101	5.04931	-0.91888
H	0.17352	4.99558	-1.94263
H	-1.16425	5.63209	-0.99211
C	0.76638	5.78841	-0.04159
H	1.74653	5.29119	-0.02933
H	0.92375	6.80426	-0.42282
C	-1.70452	1.51621	-1.33919
H	-2.42367	1.34629	-0.51922
C	-2.12552	0.77590	-2.58934
H	-1.27707	0.66636	-3.28333
H	-2.88934	1.36385	-3.12338
C	-2.48762	-2.95447	-1.81978
N	-2.73053	-0.54019	-2.34955
C	-4.16235	-0.65266	-2.62271
C	-1.93620	-1.50945	-1.88457
O	-0.76857	-1.33854	-1.51759
H	0.42586	5.88538	0.99813
H	-0.97515	3.12671	-2.56520
H	-4.67678	0.17585	-2.11906
H	-4.34949	-0.59263	-3.70156
F	-1.52590	-3.79447	-1.49547
F	-2.99686	-3.32031	-2.99918
F	-3.45793	-3.05205	-0.89809
H	-4.57311	-1.58631	-2.24025



TS3-TFA
(7.3 kcal/mol)

M06/6-31+G(d) Energy = -2167.107007

M06/6-31+G(d) Free Energy = -2166.566565

M06/6-311+G(d,p) Energy in solution = -2167.666992

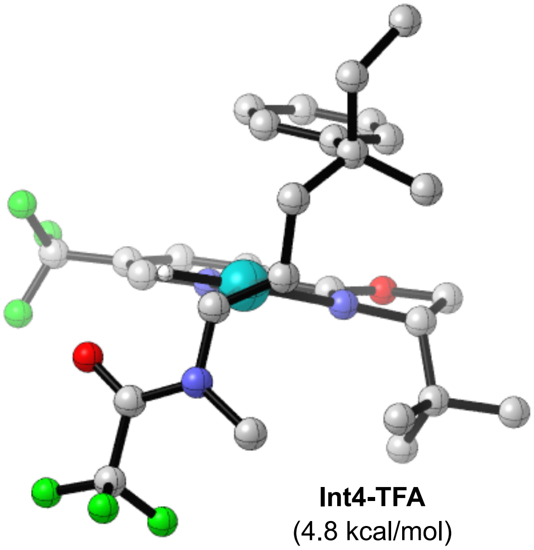
M06/6-311+G(d,p) Derived free energy in solution = -2167.12655

Number of Imaginary Frequencies = 1 (-362.68)

C	1.70863	4.11343	0.93058
C	0.52836	3.58598	1.44943
C	0.20572	2.27238	1.14981
C	2.11511	1.98658	-0.11248
C	2.50926	3.30133	0.14117
H	1.99841	5.14038	1.14131
H	-0.13693	4.18006	2.07124
H	2.72629	1.32576	-0.72757
C	-1.00949	1.62024	1.64893
C	-2.52040	0.07872	2.16201
C	-2.94985	1.45574	2.70139
H	-3.28400	-0.31670	1.47429
H	-3.80405	1.88596	2.16573
H	-3.14852	1.48496	3.77624
N	-1.31483	0.40401	1.37338
O	-1.80802	2.31347	2.45048
N	0.98781	1.48211	0.38414
C	-2.25060	-0.98623	3.24815

C	-1.77169	-2.27230	2.58031
H	-0.81741	-2.10905	2.06085
H	-2.50951	-2.64805	1.85289
H	-1.61890	-3.05976	3.33132
C	-1.18926	-0.51380	4.24004
H	-0.22358	-0.33753	3.74448
H	-1.47849	0.40897	4.76288
H	-1.02727	-1.27948	5.01058
C	-3.56749	-1.27398	3.97070
H	-3.42569	-2.07172	4.71200
H	-4.34437	-1.61013	3.26768
H	-3.95697	-0.40208	4.51418
C	3.79687	3.78581	-0.47269
F	3.71462	3.75425	-1.80849
F	4.81588	2.99869	-0.11581
F	4.08323	5.03281	-0.10484
C	-2.10297	3.17255	-1.27859
C	-3.22242	2.55699	-0.72328
C	-3.48398	1.21111	-0.97137
C	-2.64575	0.43960	-1.78548
C	-1.53802	1.08692	-2.35738
C	-1.26518	2.43024	-2.10574
H	-1.90452	4.22756	-1.09233
H	-3.90902	3.13640	-0.10550
H	-4.37920	0.76865	-0.53454
H	-0.87982	0.54997	-3.04026
H	-0.39896	2.89937	-2.57332
Pd	0.05949	-0.37377	-0.20447
C	-2.97200	-1.01018	-2.13881
C	-1.70494	-1.87928	-2.26496
H	-2.03823	-2.86983	-2.62397
C	-3.90023	-1.67814	-1.12308
H	-4.88177	-1.19539	-1.05439
H	-4.08098	-2.72251	-1.41539

H	-3.46279	-1.68475	-0.11375
C	-3.63613	-1.03375	-3.54152
H	-2.88945	-0.69766	-4.27958
H	-3.85866	-2.08516	-3.78914
C	-4.89555	-0.19886	-3.70285
H	-4.70414	0.86729	-3.52362
H	-5.28330	-0.29479	-4.72387
C	-0.84637	-2.13990	-1.04627
H	-1.31783	-2.64652	-0.20040
C	0.52854	-2.33839	-1.28170
H	1.24058	-0.73066	-1.18701
H	0.89086	-2.20309	-2.30228
C	3.75662	-3.70570	0.08361
N	1.39650	-3.13956	-0.51673
C	0.87008	-4.01474	0.53218
C	2.73162	-2.86979	-0.71738
O	3.12123	-2.00140	-1.46911
H	-5.69954	-0.51646	-3.02560
H	-1.06527	-1.49239	-3.07220
H	-0.09081	-4.41911	0.20139
H	1.54345	-4.85657	0.69465
H	0.73870	-3.47449	1.47782
F	4.97965	-3.33257	-0.21825
F	3.56668	-3.52928	1.39982
F	3.62684	-5.01011	-0.18509



Int4-TFA
(4.8 kcal/mol)

Note: Optimization of **Int4-TFA** was performed using loose convergence criteria with an ultrafine grid. Attempts to reoptimize this geometry with standard convergence criteria were unsuccessful.

M06/6-31+G(d) Energy = -2167.108319

M06/6-31+G(d) Free Energy = -2166.570818

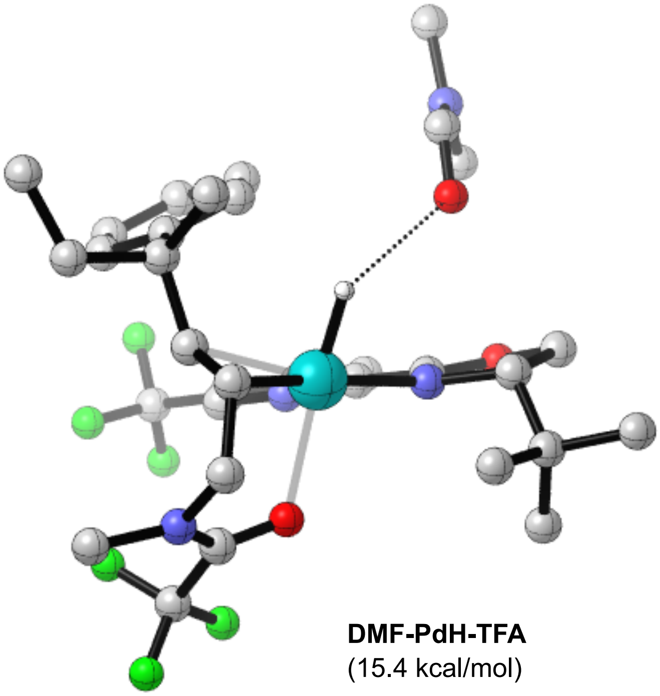
M06/6-311+G(d,p) Energy in solution = -2167.668054

M06/6-311+G(d,p) Derived free energy in solution = -2167.130553

C	-2.68135	-3.44770	1.18534
C	-1.44899	-3.11794	1.75005
C	-0.80258	-1.97274	1.30932
C	-2.51866	-1.46759	-0.18651
C	-3.21362	-2.61116	0.21057
H	-3.21853	-4.33781	1.49528
H	-0.98665	-3.73186	2.51460
H	-2.91715	-0.79428	-0.93907
C	0.47880	-1.52871	1.83236
C	2.27343	-0.25836	2.32625
C	2.38601	-1.62105	3.04784
H	3.14826	-0.08239	1.68773
H	3.14454	-2.28037	2.61895
H	2.51118	-1.55453	4.12850
N	1.07469	-0.44682	1.44261
O	1.06890	-2.26350	2.80236
N	-1.32893	-1.15905	0.35155

C	2.10870	0.95686	3.27246
C	1.91104	2.21756	2.42614
H	0.97633	2.14788	1.85504
H	2.75035	2.36391	1.72814
H	1.85615	3.10208	3.07393
C	0.90504	0.78935	4.20614
H	-0.03488	0.72994	3.64126
H	0.98563	-0.09986	4.84444
H	0.83422	1.65887	4.87121
C	3.40103	1.10586	4.08800
H	3.33690	1.99926	4.72095
H	4.27409	1.22221	3.43107
H	3.58143	0.25178	4.75295
C	-4.53426	-2.87569	-0.42861
F	-4.42380	-2.84897	-1.79972
F	-5.45064	-1.91214	-0.08371
F	-5.04203	-4.09371	-0.06670
C	1.24056	-3.68383	-0.86125
C	2.42771	-3.29642	-0.23748
C	3.05922	-2.10371	-0.59652
C	2.52867	-1.26608	-1.58978
C	1.34346	-1.68599	-2.22322
C	0.70535	-2.87538	-1.86441
H	0.76149	-4.62235	-0.59578
H	2.87909	-3.94123	0.51293
H	3.99534	-1.84379	-0.10881
H	0.92547	-1.10131	-3.03971
H	-0.20051	-3.17602	-2.38590
Pd	-0.00055	0.32176	-0.36747
C	3.25457	-0.00545	-2.06260
C	2.27493	1.15073	-2.38046
H	2.88903	1.96506	-2.80412
C	4.27929	0.51205	-1.04552
H	5.09027	-0.20061	-0.86468

H	4.74007	1.43365	-1.42501
H	3.80815	0.74133	-0.07960
C	3.97869	-0.32880	-3.40490
H	3.21025	-0.55763	-4.15995
H	4.48238	0.59152	-3.74073
C	4.98348	-1.47341	-3.35288
H	4.50698	-2.41479	-3.05416
H	5.43044	-1.62821	-4.34064
C	1.46762	1.75809	-1.25390
H	2.01037	2.13105	-0.38284
C	0.21416	2.28163	-1.56174
H	-1.02916	0.60353	-1.48753
H	-0.19841	2.10876	-2.55407
C	-2.62251	4.31917	-0.19184
N	-0.46640	3.30189	-0.85492
C	0.29293	4.28419	-0.05665
C	-1.83532	3.27249	-0.97183
O	-2.43770	2.42055	-1.63806
H	5.80614	-1.27205	-2.65570
H	1.59249	0.85344	-3.18974
H	1.28015	4.39856	-0.50878
H	-0.20627	5.25228	-0.08637
H	0.39547	3.96683	0.98378
F	-3.95179	4.10309	-0.30058
F	-2.28544	4.27418	1.14602
F	-2.35021	5.59086	-0.64521



DMF-PdH-TFA
(15.4 kcal/mol)

M06/6-31+G(d) Energy = -2415.486946

M06/6-31+G(d) Free Energy = -2414.849995

M06/6-311+G(d,p) Energy in solution = -2416.105576

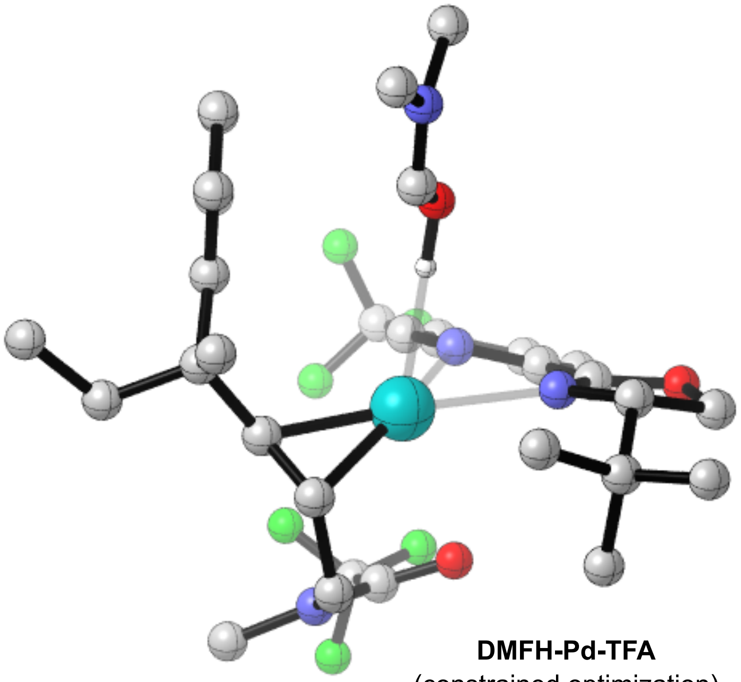
M06/6-311+G(d,p) Derived free energy in solution = -2415.468625

C	1.44150	2.35682	-2.87185
C	1.95542	1.09567	-2.59729
C	1.25001	0.27942	-1.71466
C	-0.37294	1.85467	-1.38498
C	0.25555	2.74192	-2.25891
H	1.94975	3.03150	-3.55998
H	2.87190	0.74279	-3.06383
H	-1.30026	2.13499	-0.88479
C	1.72469	-1.07989	-1.40385
C	1.93594	-3.16350	-0.61406
C	3.17320	-2.77339	-1.44262
H	2.22428	-3.34807	0.43269
H	4.07284	-2.65602	-0.83037
H	3.38020	-3.42997	-2.29320
N	1.13561	-1.92473	-0.63769
O	2.85412	-1.46786	-1.98439
N	0.11264	0.65039	-1.11729

C	1.15729	-4.39217	-1.12935
C	0.66927	-4.18496	-2.56176
H	0.12218	-5.07416	-2.90392
H	-0.01559	-3.32823	-2.63401
H	1.49355	-4.02516	-3.27168
C	2.08881	-5.60339	-1.05292
H	1.55625	-6.51023	-1.36975
H	2.96862	-5.50664	-1.70425
H	2.44523	-5.77021	-0.02558
C	-0.04634	-4.65462	-0.22418
H	0.25177	-4.73260	0.83284
H	-0.79852	-3.85803	-0.31547
H	-0.53111	-5.59971	-0.50641
C	-0.31023	4.10324	-2.54120
F	0.52767	5.06607	-2.12355
F	-0.49128	4.28655	-3.85420
F	-1.48403	4.29758	-1.93332
C	1.50404	3.55332	1.00196
C	2.04794	2.34705	1.43250
C	1.26569	1.42727	2.12636
C	-0.08178	1.68328	2.40451
C	-0.61697	2.89515	1.95069
C	0.16378	3.82281	1.26373
H	2.11871	4.28022	0.47229
H	3.09592	2.11654	1.23482
H	1.72381	0.48911	2.43712
H	-1.66004	3.14508	2.14305
H	-0.27858	4.76345	0.93628
Pd	-0.42927	-1.37744	0.66151
C	-0.94559	0.64094	3.12642
C	-1.65160	-0.20375	2.07552
C	-0.13212	-0.18978	4.12028
H	-0.79339	-0.78012	4.76975
H	0.56193	-0.88613	3.63347

H	0.46361	0.46526	4.76699
C	-2.11901	1.29426	3.91167
H	-2.78094	1.83306	3.21601
H	-2.73197	0.47257	4.31855
C	-1.70135	2.22003	5.04470
H	-1.20328	1.67307	5.85466
H	-2.58058	2.71139	5.47843
C	-1.98177	-1.54760	2.16982
C	-3.16578	-2.18345	1.47582
H	-3.91191	-2.45997	2.23434
H	-2.87107	-3.11330	0.97117
C	-3.97720	-0.26673	-1.72718
N	-3.84776	-1.31239	0.51858
C	-5.08881	-0.69644	0.98828
C	-3.23954	-1.10470	-0.65879
O	-2.11457	-1.52213	-0.93770
H	-1.01692	3.00665	4.70134
F	-5.21429	-0.71653	-1.94460
F	-4.06066	1.00937	-1.30976
F	-3.31425	-0.28488	-2.86471
H	-5.86947	-1.45907	1.09535
H	-5.44216	0.07852	0.30907
H	-4.89876	-0.23448	1.96641
H	-1.59219	-2.13781	3.00298
H	-2.23331	0.41186	1.37373
H	0.65454	-1.45867	1.73316
O	3.55411	-0.98242	1.02778
C	4.37728	-0.28529	1.60754
N	5.20293	0.61295	1.02588
H	4.51391	-0.33045	2.70783
C	6.08634	1.45506	1.80543
C	5.17920	0.83563	-0.40522
H	7.12655	1.33373	1.47549
H	5.80674	2.51344	1.69611

H	6.02158	1.18518	2.86510
H	4.82045	1.85242	-0.63032
H	6.18985	0.72603	-0.82042
H	4.51101	0.10542	-0.87313



DMFH-Pd-TFA
(constrained optimization)

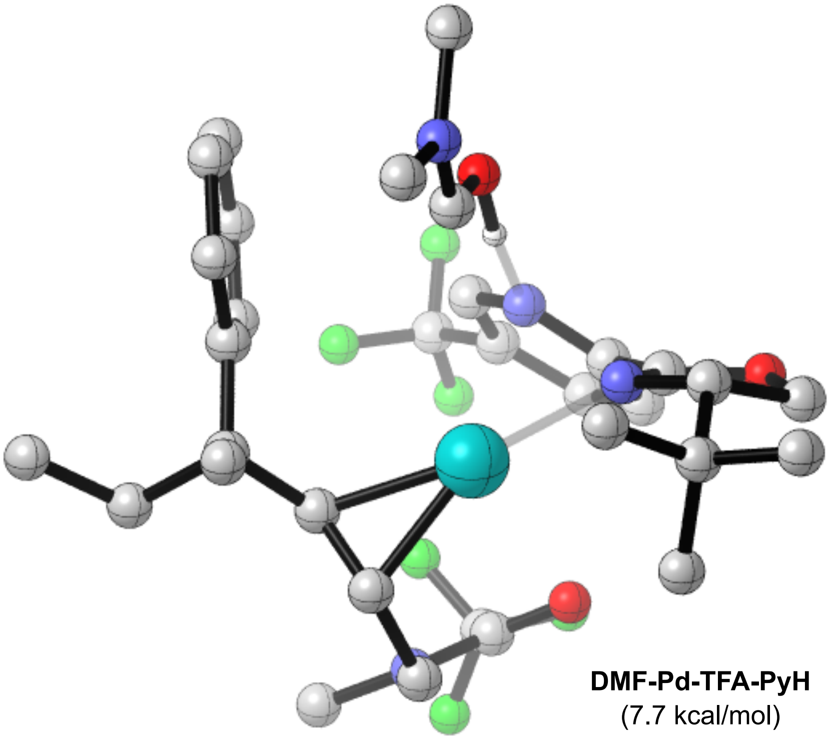
M06/6-311+G(d,p) Derived free energy in solution = -2416.1166725

C	-3.18992	-0.64038	-2.86850
C	-2.24777	-1.65746	-2.74061
C	-1.10941	-1.41386	-1.98501
C	-1.77155	0.72895	-1.49918
C	-2.94470	0.56981	-2.23727
H	-4.09910	-0.79073	-3.44627
H	-2.39241	-2.62801	-3.20814
H	-1.54948	1.67142	-0.99642
C	-0.07445	-2.43549	-1.77813
C	1.73803	-3.49835	-1.09508
C	0.90876	-4.40668	-2.02027
H	2.65367	-3.16131	-1.61813
H	1.46150	-4.80851	-2.87389
H	0.41078	-5.22934	-1.49137
N	0.87716	-2.31402	-0.93267
O	-0.13000	-3.53831	-2.53220
N	-0.86622	-0.23605	-1.37464
C	2.18679	-4.13232	0.23196
C	0.98790	-4.50233	1.10364
H	1.33435	-4.83702	2.09185

H	0.30863	-3.64974	1.24327
H	0.39972	-5.32825	0.67937
C	3.01199	-5.37924	-0.08852
H	3.39960	-5.82637	0.83710
H	2.42093	-6.15529	-0.59603
H	3.87629	-5.13878	-0.72637
C	3.07425	-3.13156	0.97200
H	3.95412	-2.85958	0.36585
H	2.52153	-2.21042	1.21078
H	3.44334	-3.56732	1.91112
C	-3.89722	1.72824	-2.31048
F	-3.28314	2.81634	-2.80519
F	-4.95017	1.46678	-3.08412
F	-4.34713	2.05653	-1.09323
C	1.26168	4.35952	-1.58255
C	2.50757	4.02746	-1.06593
C	2.61079	3.27623	0.10757
C	1.47626	2.83731	0.79953
C	0.22858	3.20063	0.27084
C	0.11823	3.94572	-0.89822
H	1.17586	4.95592	-2.48926
H	3.41552	4.37985	-1.55888
H	3.60578	3.06844	0.50147
H	-0.68314	2.90889	0.79503
H	-0.86789	4.22207	-1.27191
Pd	0.49847	-0.51569	0.52327
C	1.55235	2.07043	2.12005
C	0.55210	0.90705	2.13703
C	2.96841	1.58510	2.42562
H	3.00970	1.14252	3.42898
H	3.30757	0.81541	1.71348
H	3.69887	2.40170	2.41792
C	1.10414	3.02242	3.26634
H	0.05445	3.30634	3.08774

H	1.10558	2.43281	4.19898
C	1.93163	4.28459	3.45035
H	2.97008	4.06656	3.73253
H	1.50683	4.90533	4.24855
C	0.84075	-0.37679	2.62462
C	-0.17772	-1.25547	3.33346
H	0.01232	-1.22687	4.41777
H	-0.08013	-2.30322	3.02198
C	-3.53843	-0.57851	1.66562
N	-1.56336	-0.82796	3.14064
C	-2.10756	0.03982	4.17850
C	-2.18823	-1.24696	2.01929
O	-1.73026	-2.06060	1.23008
H	1.94980	4.89451	2.53650
F	-4.49439	-0.84583	2.56075
F	-3.39532	0.75879	1.59708
F	-3.95536	-0.99326	0.47867
H	-2.19677	-0.52237	5.11745
H	-3.09172	0.42758	3.91746
H	-1.43106	0.88980	4.34025
H	1.86472	-0.63511	2.90652
H	-0.48722	1.24384	2.23401
H	1.22814	0.36084	-1.30248
O	1.86403	0.70236	-2.02586
C	3.04602	0.76371	-1.52902
N	4.06424	1.18026	-2.22685
H	3.20047	0.42311	-0.49762
C	5.38708	1.28754	-1.62142
C	3.92347	1.67688	-3.59386
H	6.11303	0.73018	-2.22361
H	5.68487	2.34309	-1.58527
H	5.37105	0.88193	-0.60501
H	2.88999	1.56907	-3.92741
H	4.20728	2.73597	-3.61791

H	4.59071	1.10939	-4.25213



DMF-Pd-TFA-PyH
(7.7 kcal/mol)

M06/6-31+G(d) Energy = -2415.49187

M06/6-31+G(d) Free Energy = -2414.856023

M06/6-311+G(d,p) Energy in solution = -2416.116671

M06/6-311+G(d,p) Derived free energy in solution = -2415.480828

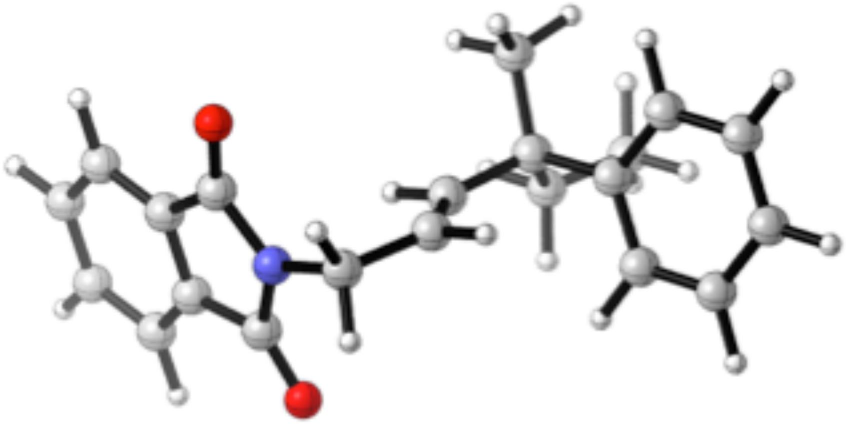
C	-3.07781	-1.19840	-2.21853
C	-1.96929	-2.02186	-2.04718
C	-0.72049	-1.43060	-1.92039
C	-1.59135	0.68017	-2.19148
C	-2.88726	0.17493	-2.26089
H	-4.07787	-1.62079	-2.28738
H	-2.07172	-3.10055	-1.96347
H	-1.39529	1.75028	-2.27150
C	0.47966	-2.24086	-1.64634
C	2.49065	-2.94282	-1.04010
C	1.70987	-4.08346	-1.70564
H	3.25012	-2.55289	-1.74487
H	2.23027	-4.56470	-2.53754
H	1.36449	-4.84826	-0.99771
N	1.46584	-1.87786	-0.90782
O	0.53131	-3.43350	-2.23820

N	-0.53217	-0.10313	-2.02251
C	3.23603	-3.31971	0.25094
C	2.28240	-3.73415	1.36923
H	2.85568	-3.97818	2.27429
H	1.58404	-2.91912	1.62003
H	1.68564	-4.62108	1.11516
C	4.17941	-4.47755	-0.08552
H	4.79527	-4.73076	0.78782
H	3.63740	-5.39066	-0.37057
H	4.86321	-4.21682	-0.90762
C	4.07383	-2.12631	0.71145
H	4.76380	-1.79658	-0.08251
H	3.43235	-1.27625	1.00156
H	4.68037	-2.39980	1.58595
C	-4.02923	1.14068	-2.40080
F	-4.09212	1.63405	-3.64481
F	-5.19932	0.57041	-2.12257
F	-3.86908	2.18567	-1.57293
C	0.91114	4.36132	-1.66495
C	2.09098	4.20107	-0.94877
C	2.09167	3.52224	0.27131
C	0.92050	2.98053	0.81099
C	-0.26118	3.15714	0.07493
C	-0.26993	3.84013	-1.13704
H	0.90203	4.90733	-2.60673
H	3.02062	4.63277	-1.32314
H	3.03015	3.44285	0.81861
H	-1.20785	2.77521	0.46134
H	-1.21410	3.99338	-1.66152
Pd	0.97109	-0.58151	0.81770
C	0.88020	2.30692	2.18433
C	0.13968	0.97543	2.09528
C	2.26985	2.12981	2.78998
H	2.19291	1.74491	3.81499

H	2.87812	1.41850	2.21112
H	2.81526	3.07808	2.85668
C	0.03136	3.19368	3.14230
H	-1.00396	3.22619	2.76584
H	-0.01368	2.67321	4.11387
C	0.53048	4.61629	3.34112
H	1.52372	4.64704	3.80764
H	-0.15046	5.17076	3.99822
C	0.41845	-0.16231	2.84443
C	-0.61004	-1.17852	3.29685
H	-0.67519	-1.15145	4.39693
H	-0.31196	-2.19714	3.02259
C	-3.81798	-1.39380	1.23535
N	-1.95812	-0.94098	2.79151
C	-2.76214	0.01162	3.55577
C	-2.36073	-1.63203	1.70406
O	-1.66942	-2.40403	1.05700
H	0.58691	5.16361	2.39009
F	-4.70595	-1.46821	2.22832
F	-3.92657	-0.17270	0.67103
F	-4.15981	-2.28960	0.31989
H	-3.31038	-0.48968	4.36351
H	-3.46922	0.55166	2.92224
H	-2.08170	0.75021	3.99344
H	1.33078	-0.19814	3.44721
H	-0.89167	1.07549	1.73301
H	0.86193	0.56351	-2.20681
O	1.75521	1.02957	-2.51527
C	2.65117	1.05705	-1.60514
N	3.86443	1.47859	-1.85649
H	2.40945	0.69130	-0.58806
C	4.86111	1.55182	-0.79723
C	4.25135	2.01096	-3.15877
H	5.76079	1.00453	-1.10195

H	5.12687	2.60120	-0.61353
H	4.46479	1.11067	0.12289
H	3.44478	1.85977	-3.87816
H	4.46001	3.08408	-3.06279
H	5.15803	1.50018	-3.50200

(*S*,*E*)-2-(4-Methyl-4-phenylhex-2-en-1-yl)isoindoline-1,3-dione



M06/6-31+G(d) Energy = -1017.4103

M06/6-31+G(d) Free Energy = -1017.0917

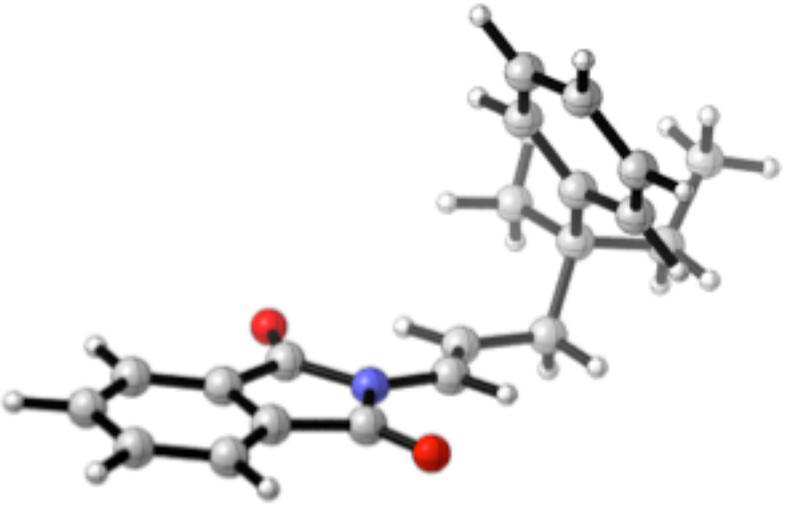
M06/6-311+G(d,p) Energy in solution = -1017.652988

M06/6-311+G(d,p) Derived free energy in solution = -1017.3344

C	5.64847	-1.11503	-0.41032
C	4.65789	-1.04301	-1.38895
C	3.46056	-0.38954	-1.12567
C	3.21424	0.21247	0.11709
C	4.21658	0.12968	1.08502
C	5.42112	-0.52661	0.82709
C	1.89843	0.94512	0.35251
C	0.70717	0.01760	0.23761
C	1.81157	1.56839	1.75221
C	1.71877	2.06155	-0.70708
C	2.83426	3.09328	-0.76388
C	0.70270	-1.31307	0.26707
C	-0.51901	-2.18100	0.20982
C	-3.58456	-0.14627	0.62650
C	-3.47463	-0.17521	-0.76024
N	-1.75885	-1.44273	0.10016
C	-2.29108	-1.00074	-1.11715
C	-2.47256	-0.95018	1.19938
O	-1.84750	-1.26143	-2.21252

O	-2.20519	-1.15881	2.36108
C	-4.37275	0.49039	-1.57384
C	-5.40126	1.19833	-0.94577
C	-5.51239	1.22689	0.44667
C	-4.59888	0.54928	1.25888
H	6.58809	-1.62632	-0.61443
H	4.81816	-1.50029	-2.36476
H	2.69401	-0.35588	-1.90058
H	4.07002	0.58100	2.06462
H	6.18293	-0.57485	1.60424
H	-0.25065	0.55021	0.17707
H	2.60841	2.30172	1.93448
H	0.84924	2.08642	1.86626
H	1.86183	0.79864	2.53324
H	0.75969	2.56481	-0.49899
H	1.59925	1.59646	-1.69751
H	3.80539	2.62451	-0.97309
H	2.64174	3.82618	-1.55750
H	2.92972	3.65205	0.17672
H	1.64466	-1.86276	0.33589
H	-0.58792	-2.80233	1.11358
H	-0.46687	-2.85792	-0.65408
H	-4.27353	0.45842	-2.65744
H	-6.12928	1.73785	-1.54910
H	-6.32573	1.78680	0.90513
H	-4.67342	0.56235	2.34483

(*S*,*E*)-2-(4-Methyl-4-phenylhex-1-en-1-yl)isoindoline-1,3-dione



M06/6-31+G(d) Energy = -1017.4125

M06/6-31+G(d) Free Energy = -1017.0948

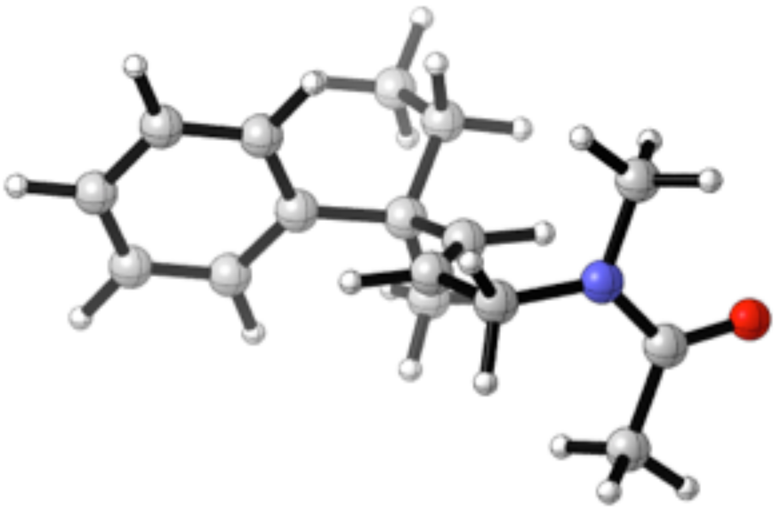
M06/6-311+G(d,p) Energy in solution = -1017.653365

M06/6-311+G(d,p) Derived free energy in solution = -1017.3356

C	-2.28434	3.06634	1.11369
C	-2.30463	2.02669	2.03521
C	-2.60544	0.72760	1.62654
C	-2.89193	0.43294	0.29158
C	-2.86979	1.49598	-0.62215
C	-2.57082	2.79293	-0.22219
C	-3.18806	-0.98397	-0.19242
C	-2.09207	-1.41429	-1.20592
C	-3.21939	-2.00058	0.94862
C	-4.53900	-1.03118	-0.93835
C	-5.75190	-0.61599	-0.12001
C	-0.69868	-1.40724	-0.66809
C	0.21332	-0.53348	-1.10108
C	3.55017	-0.59312	0.46738
C	3.71592	0.35754	-0.53261
N	1.54194	-0.41999	-0.65517
C	2.43599	0.48895	-1.26518
C	2.15799	-1.10655	0.40777
O	2.16687	1.20794	-2.19863

O	1.64212	-1.94391	1.11265
C	4.92092	1.00634	-0.72849
C	5.97390	0.66740	0.12540
C	5.80737	-0.28677	1.13250
C	4.58355	-0.93577	1.31945
H	-2.04668	4.08111	1.42930
H	-2.08298	2.22121	3.08405
H	-2.60650	-0.06491	2.37282
H	-3.08294	1.31299	-1.67618
H	-2.55757	3.59434	-0.95999
H	-2.14695	-0.76616	-2.09451
H	-2.34826	-2.43129	-1.55024
H	-3.44778	-2.99825	0.54653
H	-2.25994	-2.06911	1.47697
H	-3.98623	-1.76192	1.69654
H	-4.67872	-2.05972	-1.31170
H	-4.47729	-0.39787	-1.83712
H	-5.94395	-1.30620	0.71173
H	-5.62447	0.39004	0.30294
H	-6.65470	-0.60276	-0.74368
H	-0.43485	-2.12571	0.10589
H	-0.00856	0.20153	-1.87568
H	5.03468	1.74736	-1.51783
H	6.94139	1.15182	0.00529
H	6.64807	-0.52886	1.78036
H	4.44035	-1.68244	2.09861

(***S***,***E***)-***N***-Methyl-***N***-(4-methyl-4-phenylhex-2-en-1-yl)acetamide



M06/6-31+G(d) Energy = -752.98695

M06/6-31+G(d) Free Energy = -752.67868

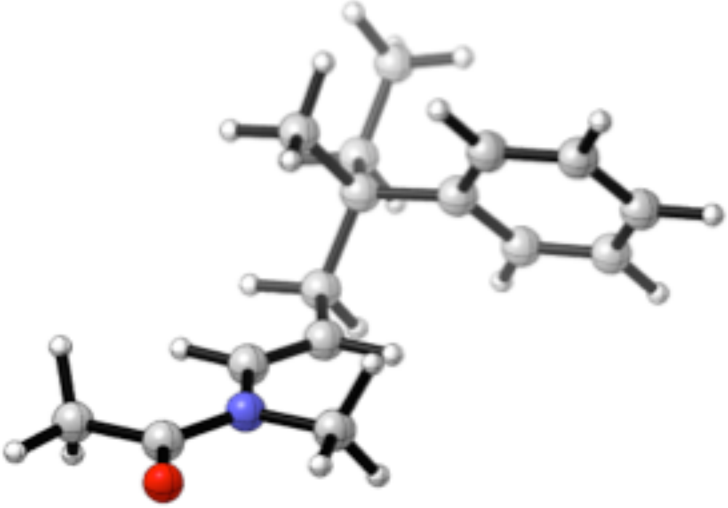
M06/6-311+G(d,p) Energy in solution = -753.1675

M06/6-311+G(d,p) Derived free energy in solution = -752.85923

C	0.83967	0.98076	0.19450
C	-0.46999	0.26082	-0.05061
C	0.98280	2.06952	-0.89759
C	0.69062	1.66469	1.56095
C	2.23886	2.92134	-0.80584
C	-0.69768	-1.05216	-0.02922
C	-2.04526	-1.69538	-0.19362
N	-3.12642	-0.78845	-0.52805
C	-3.84226	-0.08637	0.40728
C	-3.26869	-0.36657	-1.91217
C	-3.65000	-0.46154	1.85781
O	-4.61409	0.80335	0.07143
C	2.02469	0.02254	0.14397
C	2.34060	-0.62726	-1.05798
C	3.40913	-1.51021	-1.14636
C	4.19776	-1.77208	-0.02666
C	3.90098	-1.13702	1.17241
C	2.82682	-0.24975	1.25376
H	-1.31988	0.93786	-0.20326

H	0.09170	2.71633	-0.84136
H	0.93575	1.58969	-1.88714
H	0.47982	0.93223	2.35188
H	1.58724	2.23096	1.84607
H	-0.15344	2.36795	1.53184
H	3.14715	2.30363	-0.82471
H	2.26288	3.52306	0.11227
H	2.29390	3.61899	-1.65078
H	0.12967	-1.74959	0.12976
H	-2.30259	-2.24831	0.72128
H	-1.99338	-2.46352	-0.98107
H	-2.88740	0.65226	-2.07039
H	-2.70824	-1.05688	-2.55115
H	-4.32448	-0.37348	-2.20293
H	-3.94431	-1.50150	2.05082
H	-2.60456	-0.34476	2.17480
H	-4.28031	0.19816	2.45919
H	1.72816	-0.44834	-1.94214
H	3.62738	-1.99874	-2.09536
H	5.03617	-2.46376	-0.09255
H	4.50622	-1.32889	2.05755
H	2.62183	0.23096	2.20845

(*S*,*E*)-*N*-methyl-*N*-(4-methyl-4-phenylhex-1-en-1-yl)acetamide



M06/6-31+G(d) Energy = -752.99504

M06/6-31+G(d) Free Energy = -752.68558

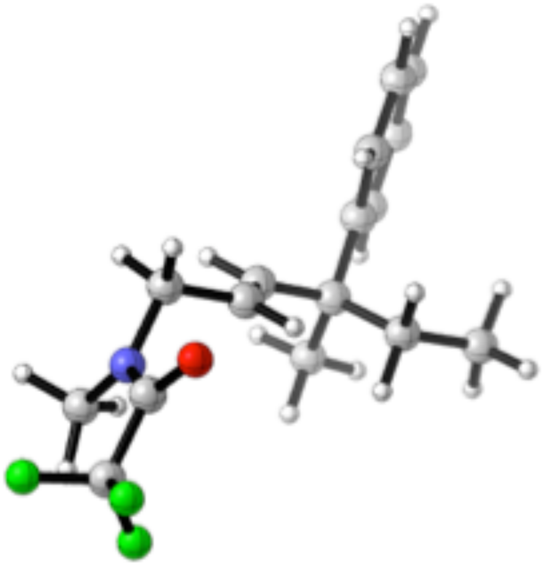
M06/6-311+G(d,p) Energy in solution = -753.17453

M06/6-311+G(d,p) Derived free energy in solution = -752.86506

C	-1.38732	-1.22339	0.00640
C	-0.21997	-1.20635	-1.01784
C	-2.41426	-2.26826	-0.47820
C	-0.82601	-1.66287	1.35740
C	-3.64153	-2.43183	0.40494
C	0.81605	-0.16154	-0.75959
C	2.08056	-0.45810	-0.43163
N	3.08838	0.46683	-0.14597
C	4.40250	0.11359	0.12404
C	2.73154	1.87378	-0.12758
C	4.75379	-1.35355	0.08599
O	5.24706	0.95583	0.38249
C	-2.02629	0.16251	0.05762
C	-2.60039	0.70840	-1.09916
C	-3.16610	1.97809	-1.10191
C	-3.17475	2.74464	0.06155
C	-2.61212	2.22068	1.21908
C	-2.04501	0.94601	1.21413

H	-0.64345	-1.06676	-2.02653
H	0.24531	-2.20671	-1.01847
H	-1.89182	-3.23573	-0.56947
H	-2.73619	-2.00844	-1.49898
H	-0.42313	-2.68300	1.27190
H	-0.00553	-1.01308	1.68961
H	-1.58817	-1.67534	2.14684
H	-4.35438	-3.13467	-0.04432
H	-3.38470	-2.82190	1.39861
H	-4.16242	-1.47474	0.54670
H	0.48780	0.87668	-0.82909
H	2.38049	-1.50279	-0.36467
H	2.37842	2.19105	-1.11784
H	1.93119	2.04850	0.60442
H	3.61681	2.44954	0.14636
H	5.82330	-1.43670	0.29302
H	4.20347	-1.92632	0.84312
H	4.54524	-1.80196	-0.89326
H	-2.60608	0.13308	-2.02568
H	-3.60104	2.37159	-2.02003
H	-3.61580	3.74017	0.06290
H	-2.60950	2.80497	2.13854
H	-1.60914	0.56734	2.13691

(*S*,*E*)-2,2,2-trifluoro-*N*-methyl-*N*-(4-methyl-4-phenylhex-2-en-1-yl)acetamide



M06/6-31+G(d) Energy = -1050.64905

M06/6-31+G(d) Free Energy = -1050.3662

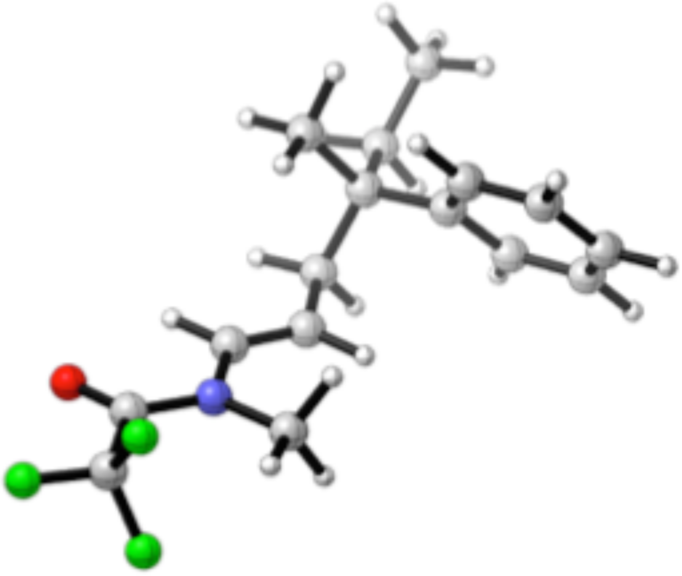
M06/6-311+G(d,p) Energy in solution = -1050.894961

M06/6-311+G(d,p) Derived free energy in solution = -1050.612124

C	5.73735	-1.44945	-0.11823
C	4.61892	-1.79785	-0.87313
C	3.43343	-1.08613	-0.73395
C	3.33315	-0.00640	0.15280
C	4.46011	0.32685	0.90639
C	5.65151	-0.38617	0.77291
C	2.01643	0.76894	0.23023
C	0.91550	-0.22182	0.53532
C	1.99937	1.77885	1.38511
C	1.76727	1.50260	-1.10286
C	2.85800	2.47947	-1.51407
C	-0.19066	-0.46613	-0.16919
C	-1.24297	-1.43789	0.26040
C	-4.70560	0.13374	-0.16595
N	-2.50807	-0.75174	0.55878
C	-2.61242	-0.20169	1.89985
C	-3.36665	-0.58260	-0.47285
O	-3.16456	-0.96388	-1.61136

F	-5.36718	-0.45885	0.84191
F	-4.50360	1.41798	0.18174
F	-5.48943	0.12202	-1.22748
H	6.66770	-2.00536	-0.22384
H	4.66894	-2.63213	-1.57170
H	2.56271	-1.37566	-1.32409
H	4.42398	1.15816	1.60890
H	6.51661	-0.10312	1.37136
H	1.07231	-0.78290	1.46659
H	2.13642	1.28162	2.35572
H	2.78034	2.54347	1.28829
H	1.02882	2.29370	1.40544
H	0.80530	2.03534	-1.02739
H	1.64288	0.75557	-1.90165
H	2.61967	2.93166	-2.48470
H	2.97523	3.30134	-0.79535
H	3.83135	1.97961	-1.61112
H	-0.39785	0.05772	-1.10557
H	-0.93690	-1.97282	1.17074
H	-1.44660	-2.17672	-0.52327
H	-3.44795	0.49091	1.99600
H	-2.73660	-1.01008	2.63311
H	-1.68805	0.34665	2.12977

(*S*,*E*)-2,2,2-trifluoro-*N*-methyl-*N*-(4-methyl-4-phenylhex-1-en-1-yl)acetamide



M06/6-31+G(d) Energy = -1050.653897

M06/6-31+G(d) Free Energy = -1050.3697

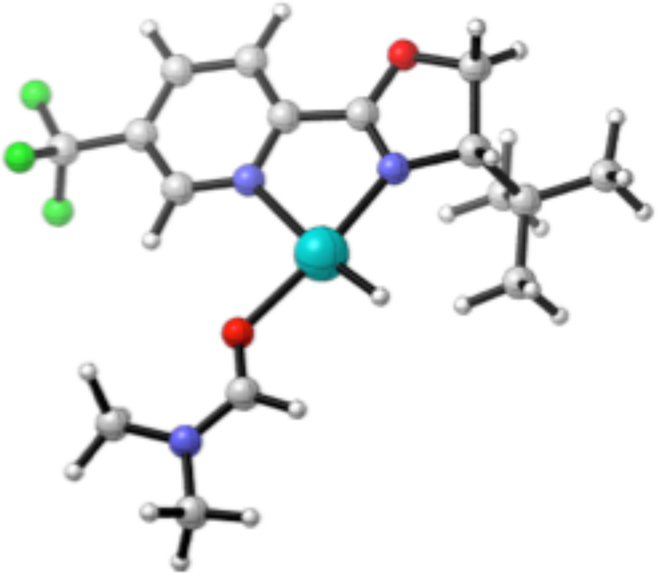
M06/6-311+G(d,p) Energy in solution = -1050.899078

M06/6-311+G(d,p) Derived free energy in solution = -1050.614908

C	-3.59196	2.99981	0.08861
C	-3.80820	2.21413	-1.04181
C	-3.44899	0.87103	-1.04044
C	-2.86569	0.26840	0.08278
C	-2.65751	1.07222	1.20676
C	-3.01521	2.42073	1.21247
C	-2.44317	-1.19780	0.02565
C	-1.33684	-1.35859	-1.05409
C	-1.88753	-1.70318	1.35608
C	-3.62941	-2.08907	-0.39622
C	-4.82146	-2.07280	0.54752
C	-0.17573	-0.43442	-0.88593
C	1.04232	-0.86076	-0.53831
C	4.59012	0.23824	0.16739
N	2.16081	-0.03129	-0.32223
C	1.94894	1.40770	-0.39892
C	3.34902	-0.65907	-0.06346

O	3.49606	-1.86222	-0.00414
F	5.65779	-0.50703	0.37993
F	4.83833	1.02062	-0.89630
F	4.42839	1.04028	1.23420
H	-3.87328	4.05168	0.09114
H	-4.26035	2.64971	-1.93217
H	-3.62740	0.28297	-1.94140
H	-2.20401	0.65104	2.10207
H	-2.83914	3.01745	2.10676
H	-1.79055	-1.19577	-2.04579
H	-0.99179	-2.40526	-1.03829
H	-1.66046	-2.77618	1.27579
H	-0.95656	-1.19184	1.63377
H	-2.59878	-1.57665	2.18208
H	-3.25149	-3.11990	-0.50121
H	-3.96191	-1.79210	-1.40318
H	-5.64933	-2.66456	0.13734
H	-4.57640	-2.49660	1.53016
H	-5.19149	-1.05041	0.70675
H	-0.37873	0.62707	-1.03834
H	1.26249	-1.91646	-0.39143
H	2.83768	1.96351	-0.10864
H	1.67432	1.69053	-1.42317
H	1.13022	1.68435	0.27764

Pyrox-PdH-DMF



M06/6-31+G(d) Energy = -1364.8249

M06/6-31+G(d) Free Energy = -1364.5004

M06/6-311+G(d,p) Energy in solution = -1365.187036

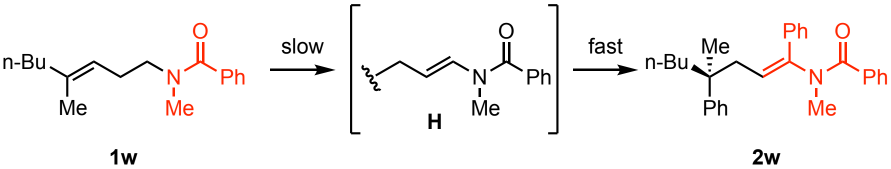
M06/6-311+G(d,p) Derived free energy in solution = -1364.8625

C	-1.69849	-3.37039	-0.11846
C	-0.33235	-3.19135	-0.33791
C	0.16448	-1.89866	-0.32914
C	-1.91034	-0.98359	0.08119
C	-2.49360	-2.25419	0.09317
H	-2.13644	-4.36613	-0.11500
H	0.33244	-4.03341	-0.51445
H	-2.50050	-0.07925	0.23709
C	1.57809	-1.57136	-0.53989
C	3.49402	-0.41237	-0.61655
C	3.70617	-1.86773	-1.07532
H	3.80110	0.29511	-1.40032
H	3.86441	-1.96480	-2.15498
H	4.49318	-2.40674	-0.54285
N	2.02046	-0.36000	-0.50043
O	2.44837	-2.53716	-0.77235
N	-0.61206	-0.81467	-0.12047
C	4.22333	-0.02967	0.69443

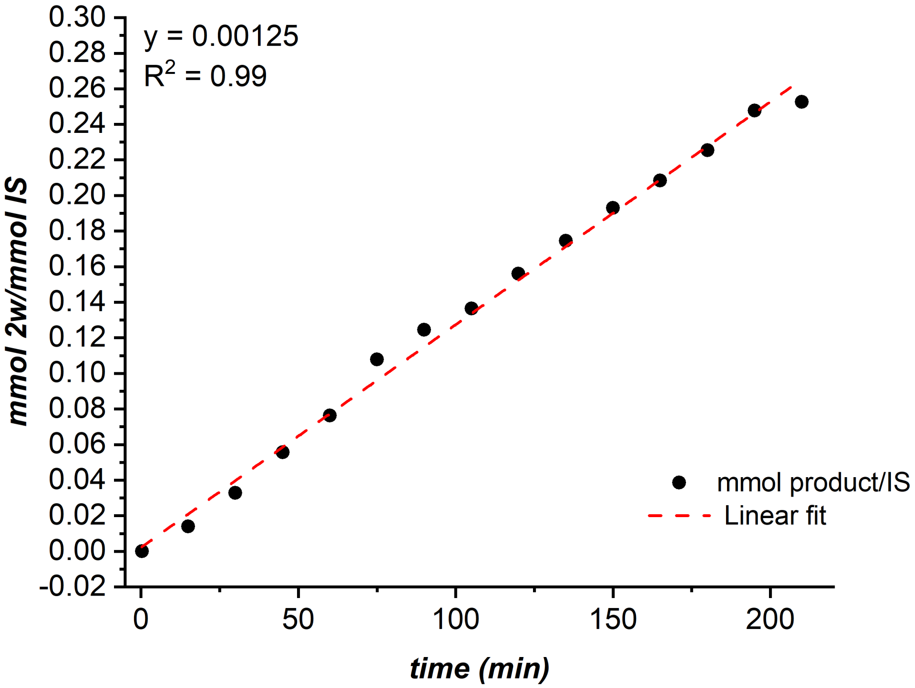
C	3.91208	1.41875	1.06651
H	4.52001	1.71748	1.93130
H	4.14606	2.10785	0.24124
H	2.85740	1.55960	1.33626
C	3.81718	-0.94474	1.84854
H	4.37209	-0.66757	2.75475
H	2.74715	-0.85053	2.08394
H	4.03621	-2.00429	1.65235
C	5.72774	-0.14342	0.43484
H	6.05286	-1.17070	0.21985
H	6.04083	0.49533	-0.40404
H	6.28455	0.18495	1.32231
C	-3.97747	-2.35189	0.32623
F	-4.64491	-1.69691	-0.63214
F	-4.39812	-3.61439	0.33823
F	-4.30904	-1.78900	1.49462
Pd	0.55828	1.05767	-0.31097
O	-1.08258	2.31157	-0.11777
C	-1.08880	3.56284	-0.16306
N	-2.19788	4.27108	-0.01793
H	-0.16744	4.13896	-0.32713
C	-2.19229	5.72539	-0.08620
C	-3.46794	3.58417	0.19814
H	-1.17263	6.08675	-0.25177
H	-2.82687	6.06645	-0.91260
H	-2.56892	6.14715	0.85299
H	-4.24958	4.33336	0.34768
H	-3.72211	2.96602	-0.67074
H	-3.40847	2.94297	1.08448
H	1.52178	2.25028	-0.53853

10. Ex-situ Monitoring of 2w by UPLC/MS

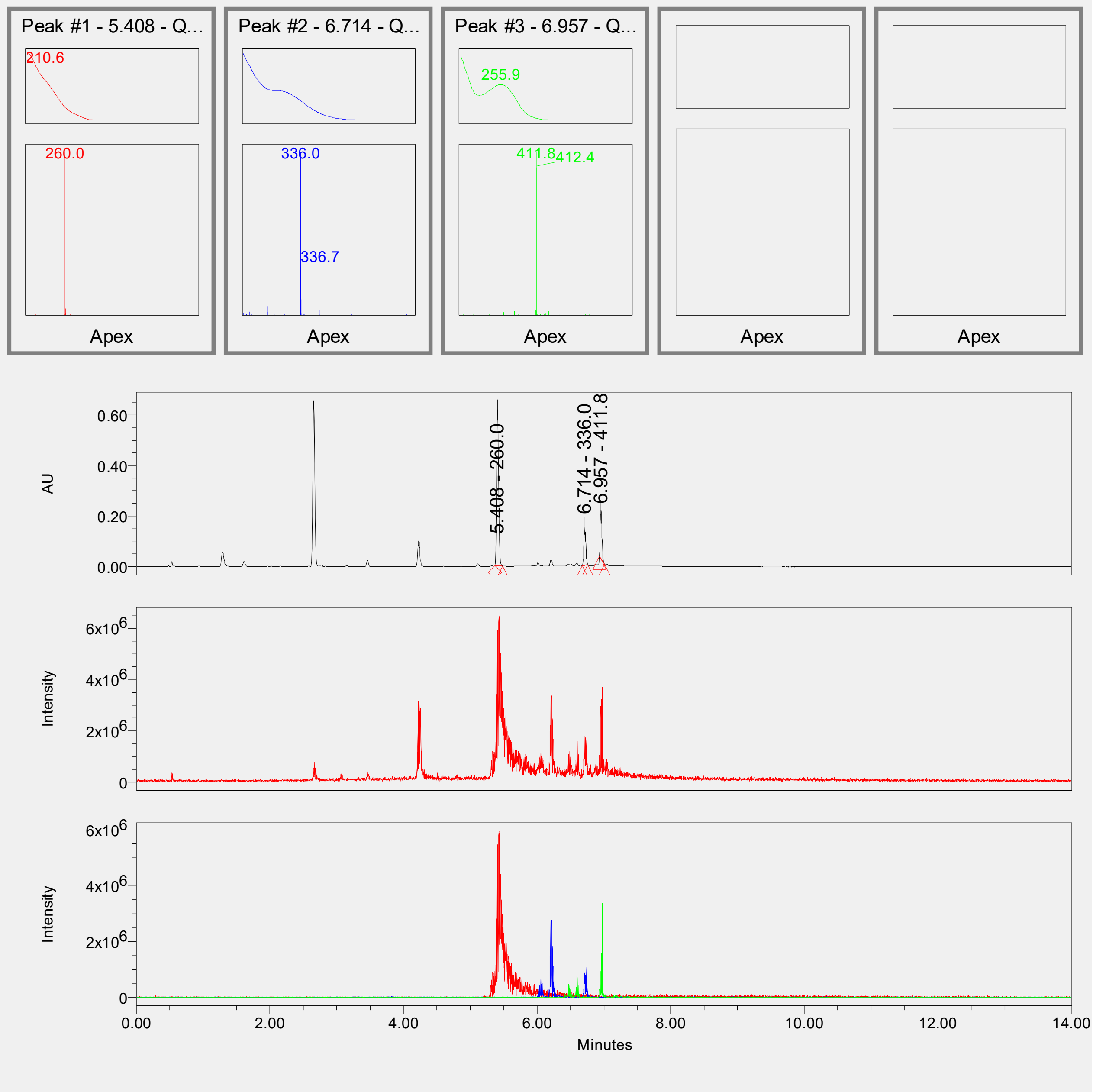
In order to determine the relative rate of the arylation of **1w** and **H** the reaction was performed according to **General Procedure A** using 0.37 mmol of **1w** and 0.37 mmol of an internal standard (dimethyl phthalate) and aliquots were taken every 15 minutes for 3.5 h. The aliquots were prepared by removing 0.1 mL of the reaction mixture, filtering the mixture through silica eluting with Et_2O, concentration, dissolving the mixture in 1 mL of acetonitrile, and filtration through a 100-micron filter.



To quantify the amount of **2w** present at each time point a calibration curve was constructed between product **2w** and dimethyl phthalate to give a response factor between internal standard and product **2w** of 2.08. Using this response factor the amount of product could be determined in each aliquot to give the following plot. Since the amount of internal standard was equal to the starting amount of **1w** the ratio (y axis) is also equivalent to the percent conversion.



As a representative example, the recorded UPLC/MS data for the 45 min timepoint is shown below. Peak 1 corresponds to remaining starting material **1w**, Peak 2 corresponds to what is presumed to be **H**, and Peak 3 corresponds to product **2w**. Although the amount of **H** cannot be quantified, it is evident that even at ~5% conversion a significant amount of **2w** is present. This suggests that the conversion of **H** to **2w** is faster than the conversion of **1w** to **H**.



Peak #1 - 5.408 - Q...
210.6
260.0
Apex
Peak #2 - 6.714 - Q...
336.0
336.7
Apex
Peak #3 - 6.957 - Q...
255.9
411.8
412.4
Apex
Apex
Apex
AU
0.60
0.40
0.20
0.00
5.408 - 260.0
6.714 - 336.0
6.957 - 411.8
Intensity
6x10^6
4x10^6
2x10^6
0
Intensity
6x10^6
4x10^6
2x10^6
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Minutes

11. References:

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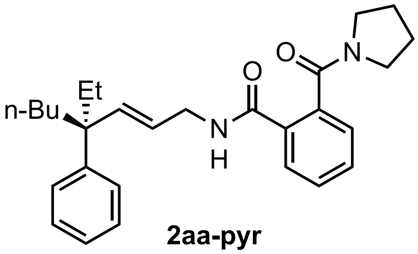
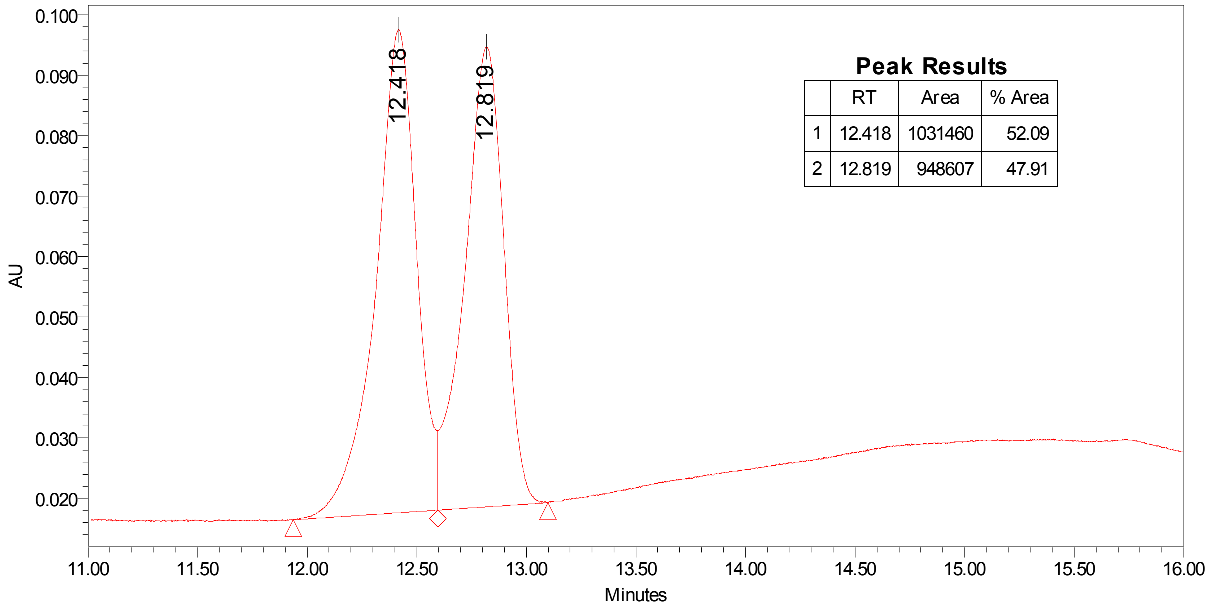
12. SFC Traces

Structure	SFC conditions	retention times
 **2aa-pyr**	OZ-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	12.43, 12.82 min (98.2:1.8)

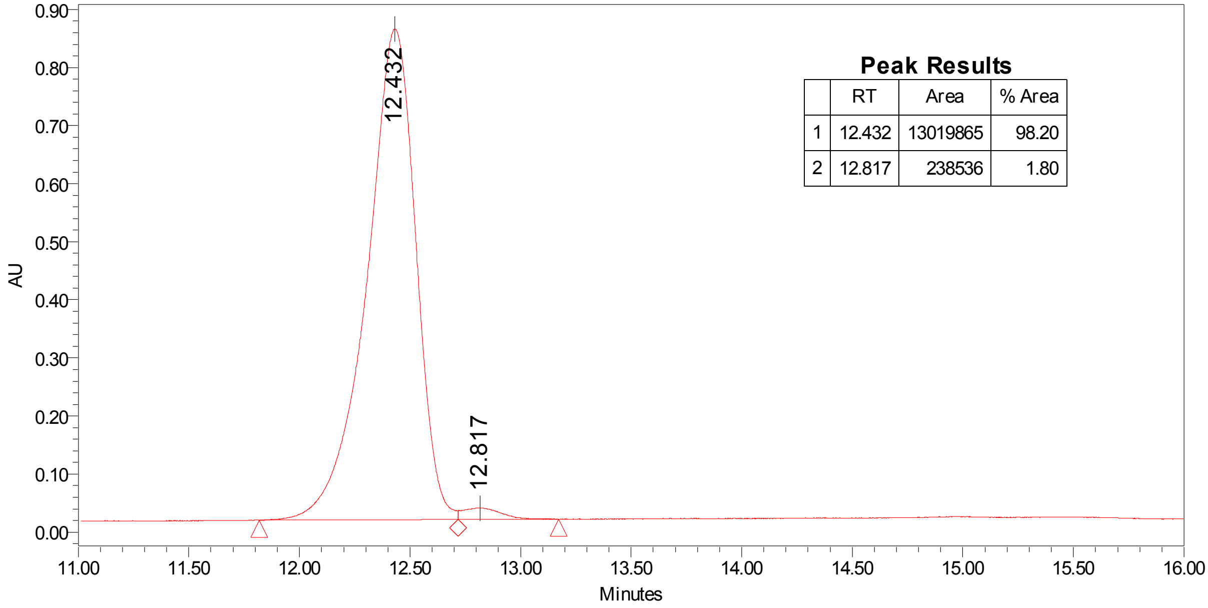
Racemic



Peak Results

	RT	Area	% Area
1	12.418	1031460	52.09
2	12.819	948607	47.91

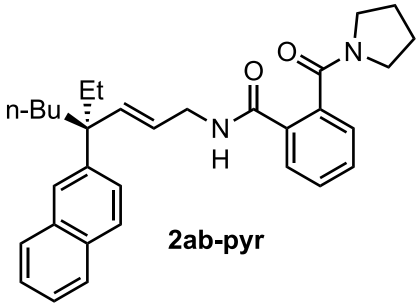
Enantioenriched

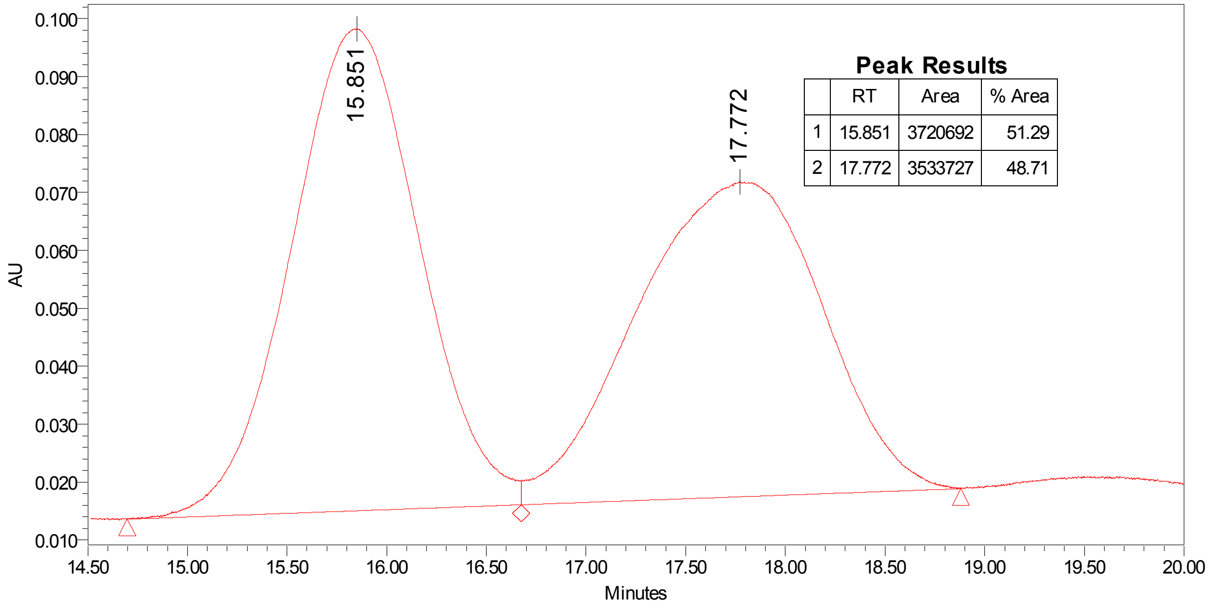


Peak Results

	RT	Area	% Area
1	12.432	13019865	98.20
2	12.817	238536	1.80

12. SFC Traces

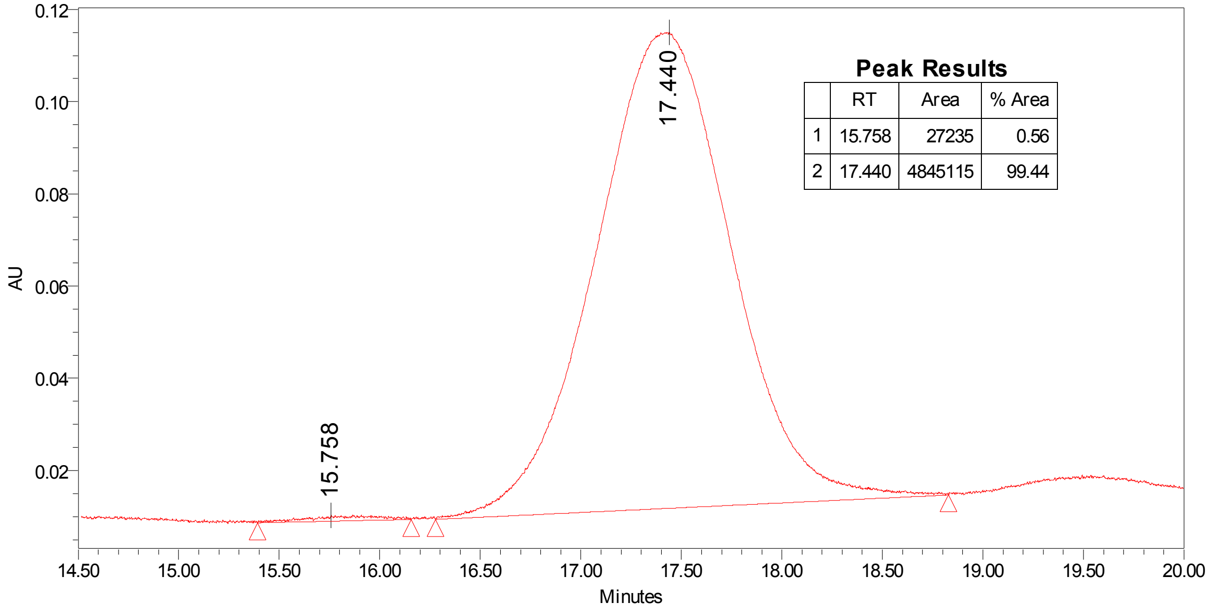
Structure	SFC conditions	retention times
 **2ab-pyr**	OZ-H [85:15 to 75:25 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	17.44, 15.76 min (99.4:0.6)



Racemic

Peak Results

	RT	Area	% Area
1	15.851	3720692	51.29
2	17.772	3533727	48.71

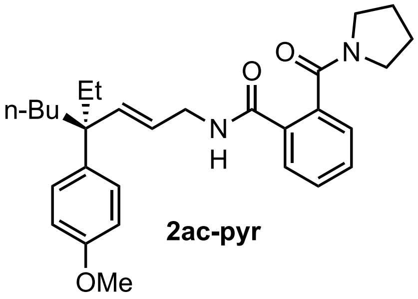


Enantioenriched

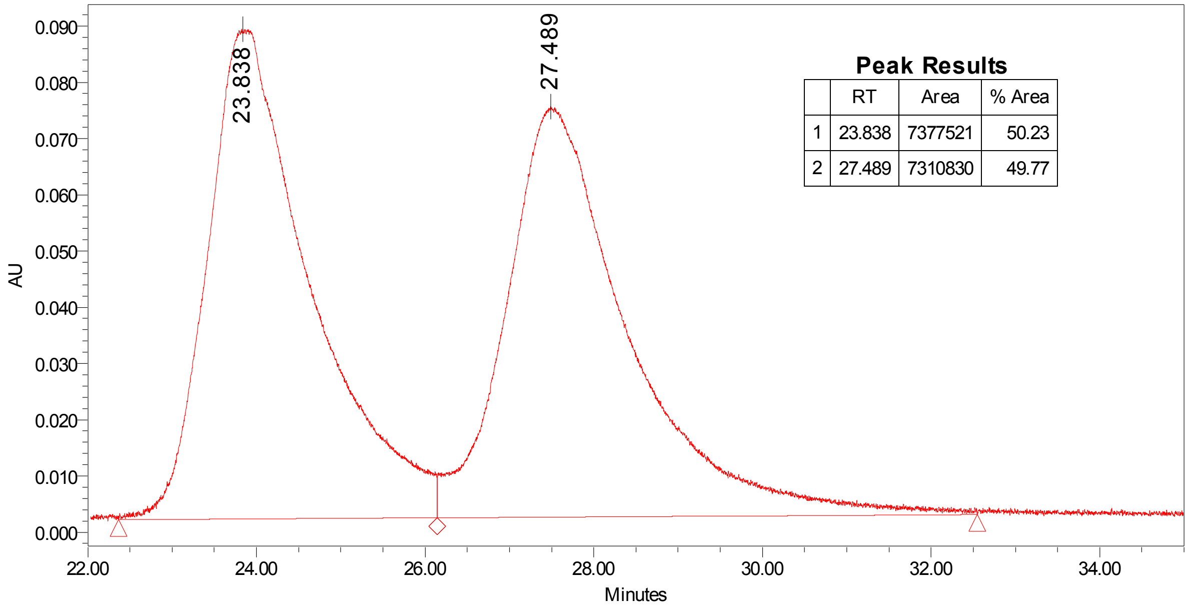
Peak Results

	RT	Area	% Area
1	15.758	27235	0.56
2	17.440	4845115	99.44

12. SFC Traces

Structure	SFC conditions	retention times
 **2ac-pyr**	OJ-H [97:3 to 94:6 CO_2:IPA, 45 min, 2 mL/min, 2320 psi]	23.38, 28.10 min (91.6:8.4)

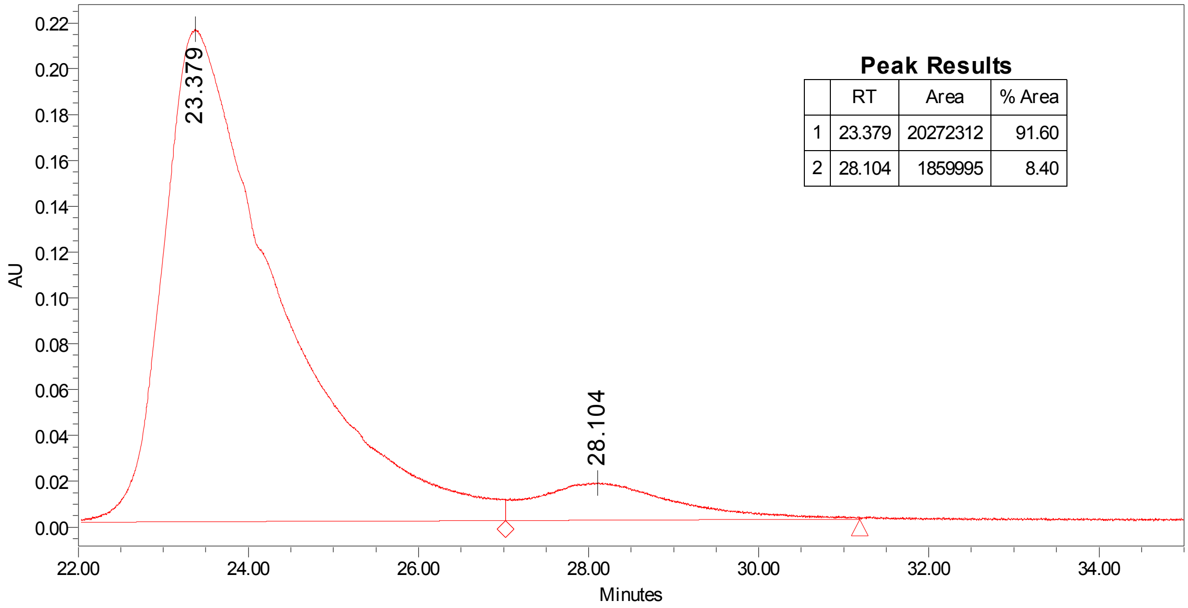
Racemic



Peak Results

	RT	Area	% Area
1	23.838	7377521	50.23
2	27.489	7310830	49.77

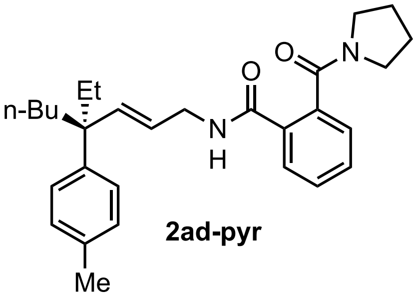
Enantioenriched



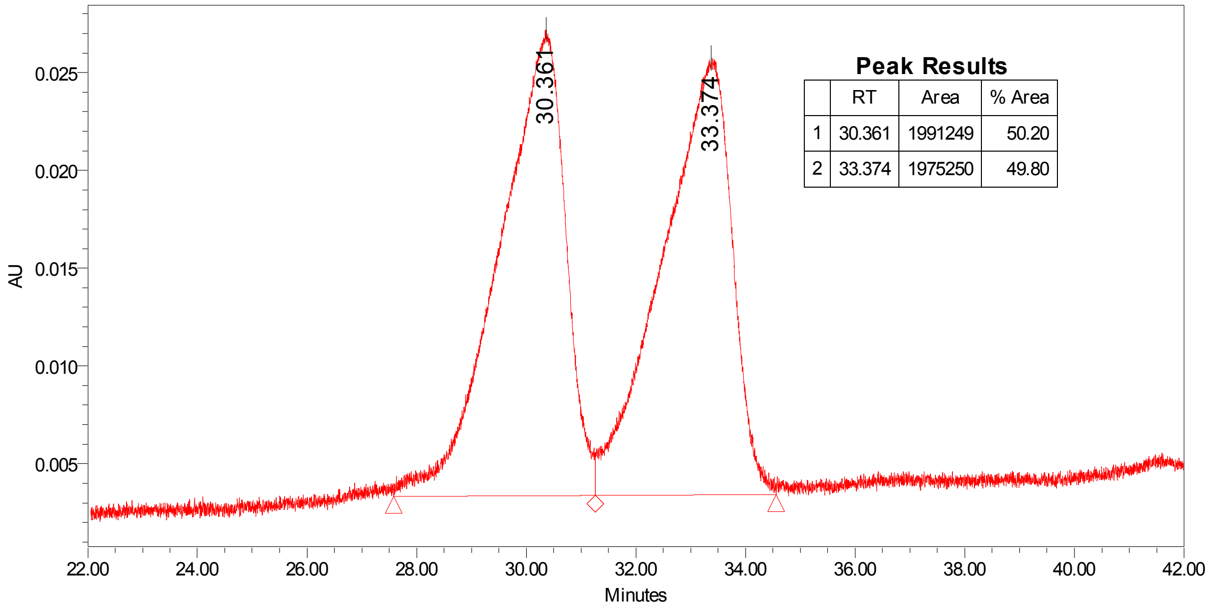
Peak Results

	RT	Area	% Area
1	23.379	20272312	91.60
2	28.104	1859995	8.40

12. SFC Traces

Structure	SFC conditions	retention times
 **2ad-pyr**	AD-H [95:5 to 90:10 CO_2:IPA, 45 min, 2 mL/min, 3000 psi]	32.93, 30.67 min (97.2:2.8)

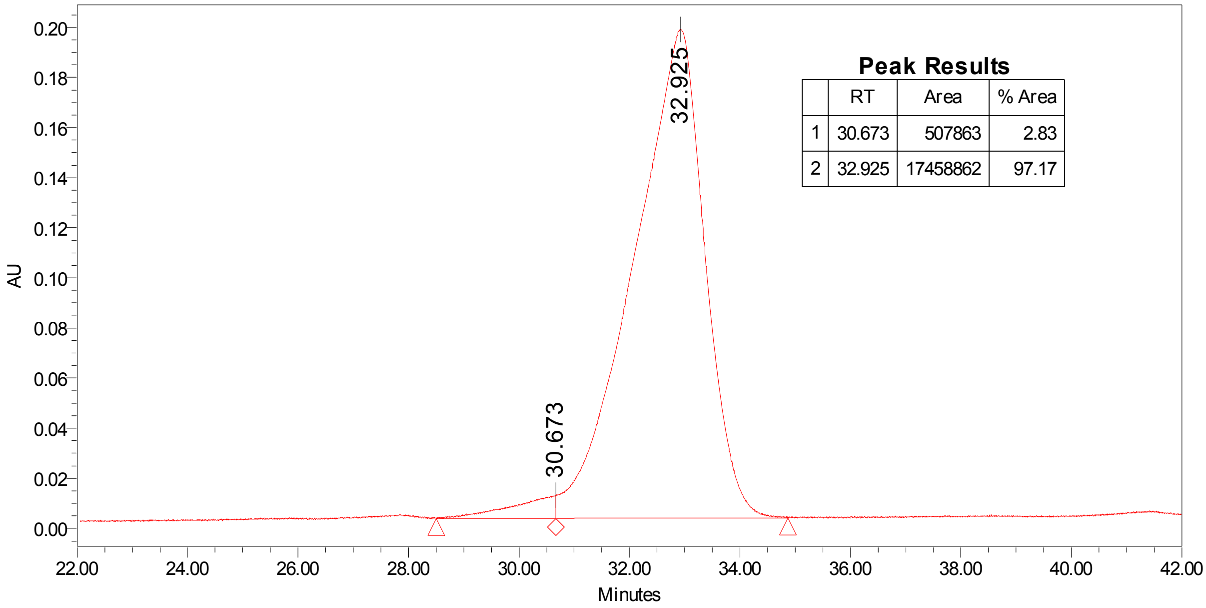
Racemic



Peak Results

	RT	Area	% Area
1	30.361	1991249	50.20
2	33.374	1975250	49.80

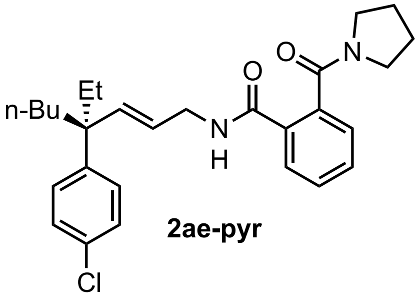
Enantioenriched



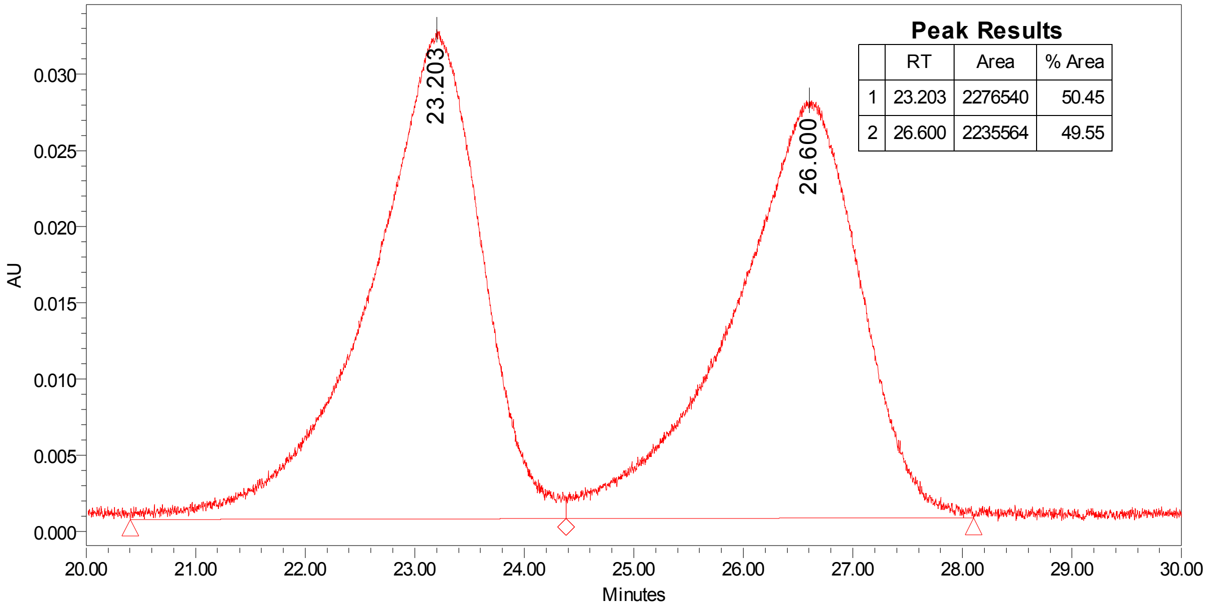
Peak Results

	RT	Area	% Area
1	30.673	507863	2.83
2	32.925	17458862	97.17

12. SFC Traces

Structure	SFC conditions	retention times
 **2ae-pyr**	AD-H [88:12 CO$_2$:IPA, 2 mL/min, 2320 psi]	26.30, 23.08 min (95.35:4.65)

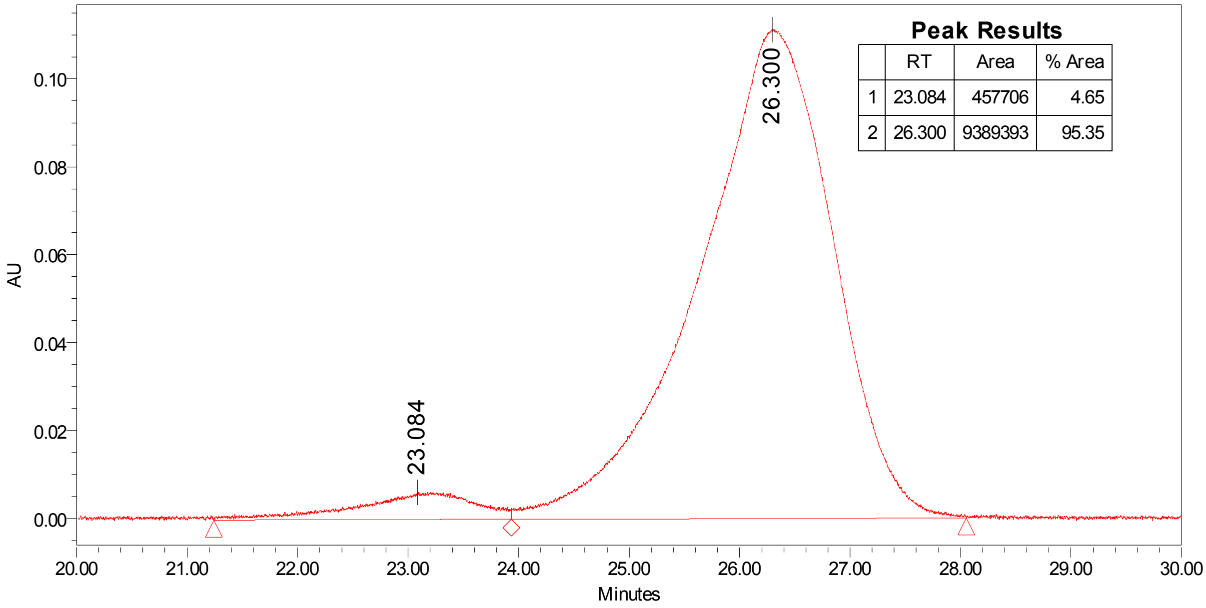
Racemic



Peak Results

	RT	Area	% Area
1	23.203	2276540	50.45
2	26.600	2235564	49.55

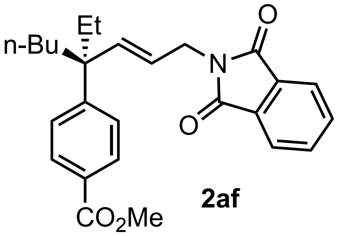
Enantioenriched



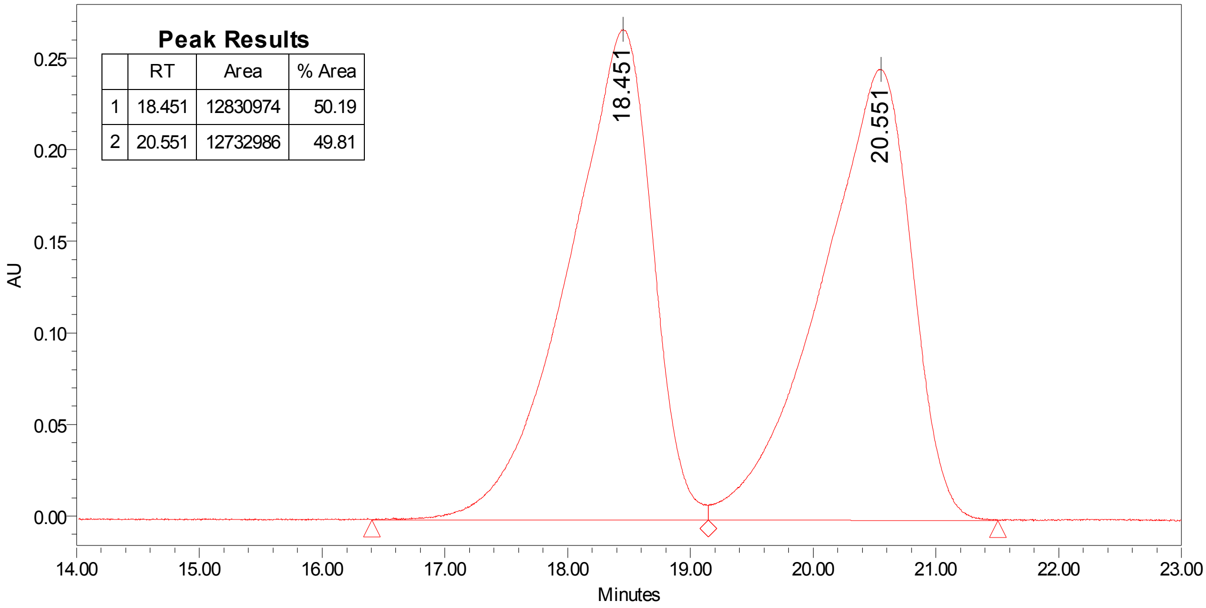
Peak Results

	RT	Area	% Area
1	23.084	457706	4.65
2	26.300	9389393	95.35

12. SFC Traces

Structure	SFC conditions	retention times
 **2af**	AD-H [92:8 to 90:10 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	17.71, 20.03 min (97.25:2.75)

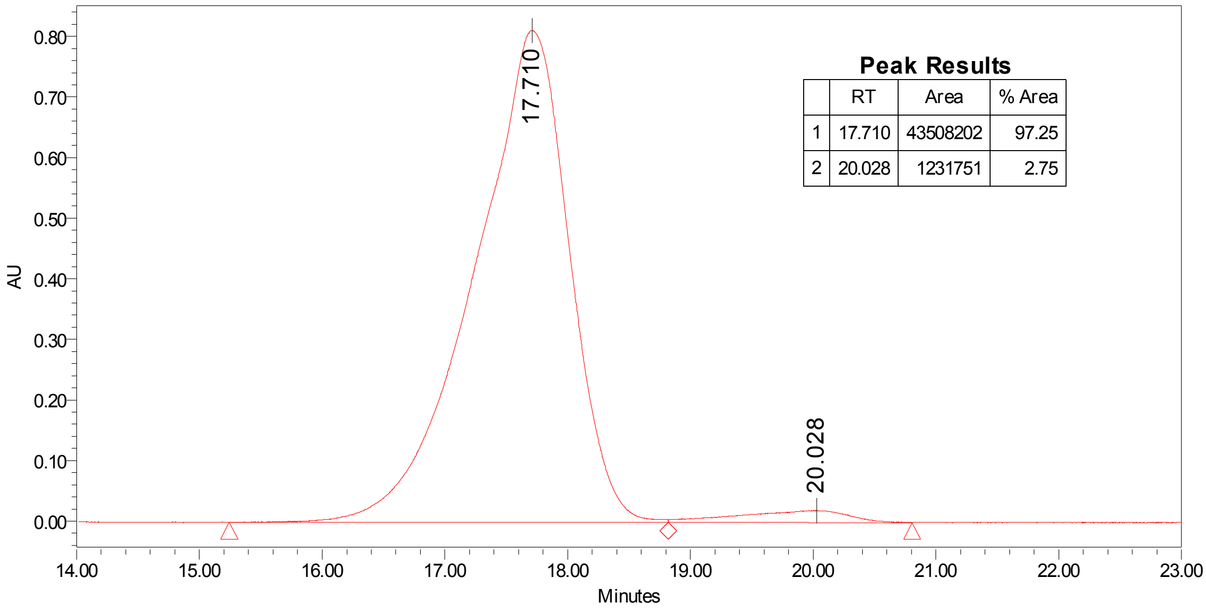
Racemic



Peak Results

	RT	Area	% Area
1	18.451	12830974	50.19
2	20.551	12732986	49.81

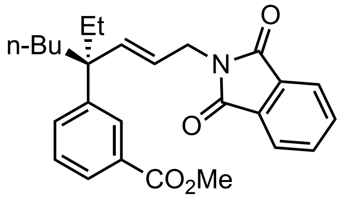
Enantioenriched

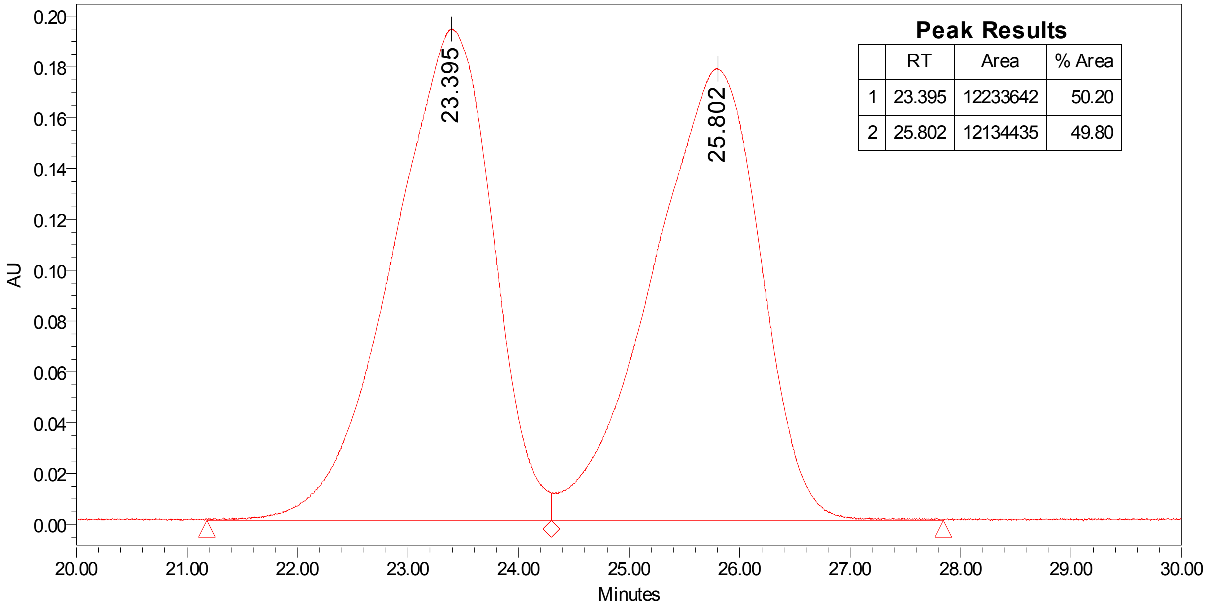


Peak Results

	RT	Area	% Area
1	17.710	43508202	97.25
2	20.028	1231751	2.75

12. SFC Traces

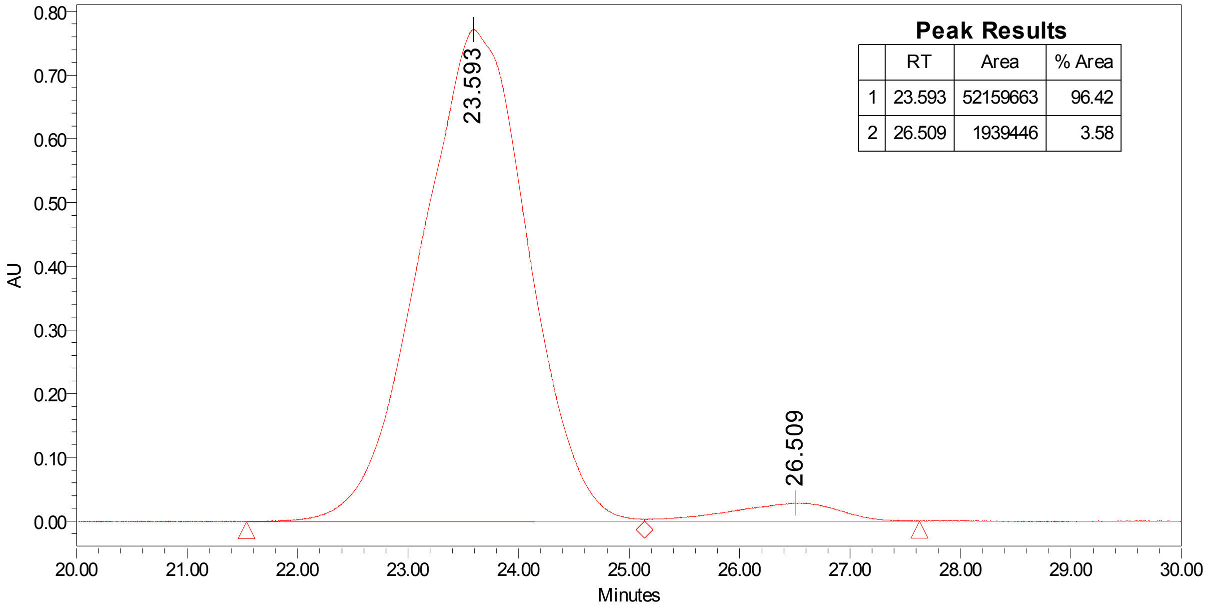
Structure	SFC conditions	retention times
 **2ag**	AD-H [97:3 to 94:6 CO_2:IPA, 60 min, 2 mL/min, 2320 psi]	23.59, 26.51 min (96.42:3.58)



Racemic

Peak Results

	RT	Area	% Area
1	23.395	12233642	50.20
2	25.802	12134435	49.80

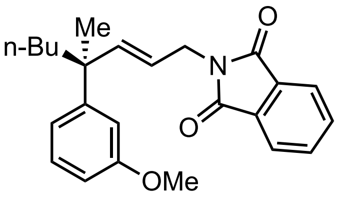


Enantioenriched

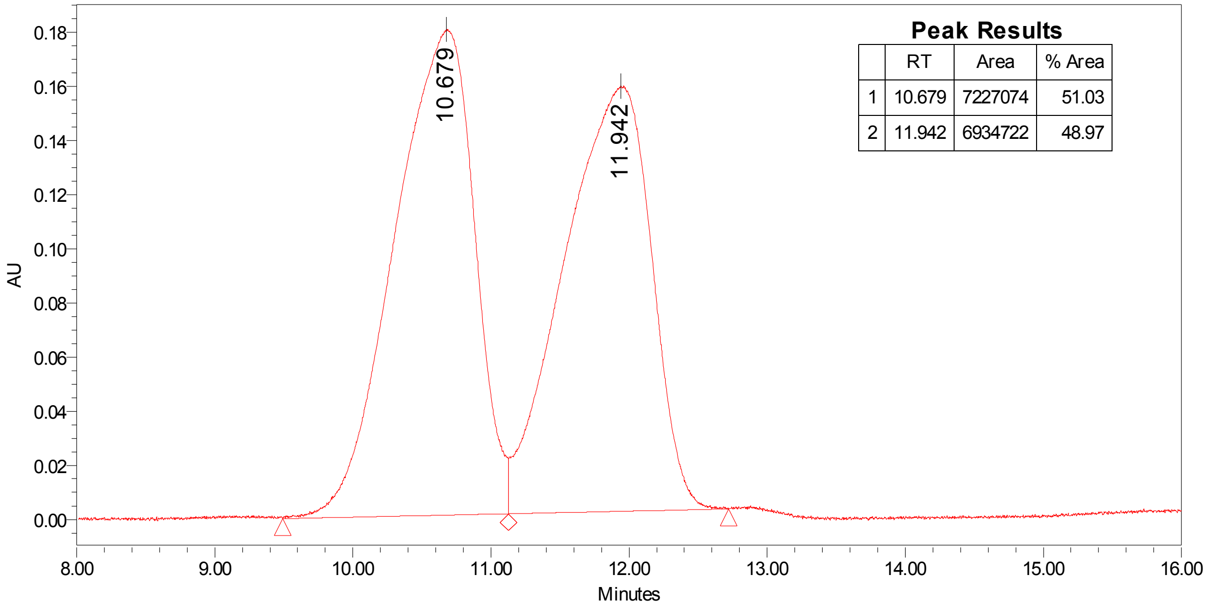
Peak Results

	RT	Area	% Area
1	23.593	52159663	96.42
2	26.509	1939446	3.58

12. SFC Traces

Structure	SFC conditions	retention times
 **2ba**	AD-H [95:5 CO_2:IPA, 2 mL/min, 2600 psi]	10.62, 12.02 min (96.99:3.01)

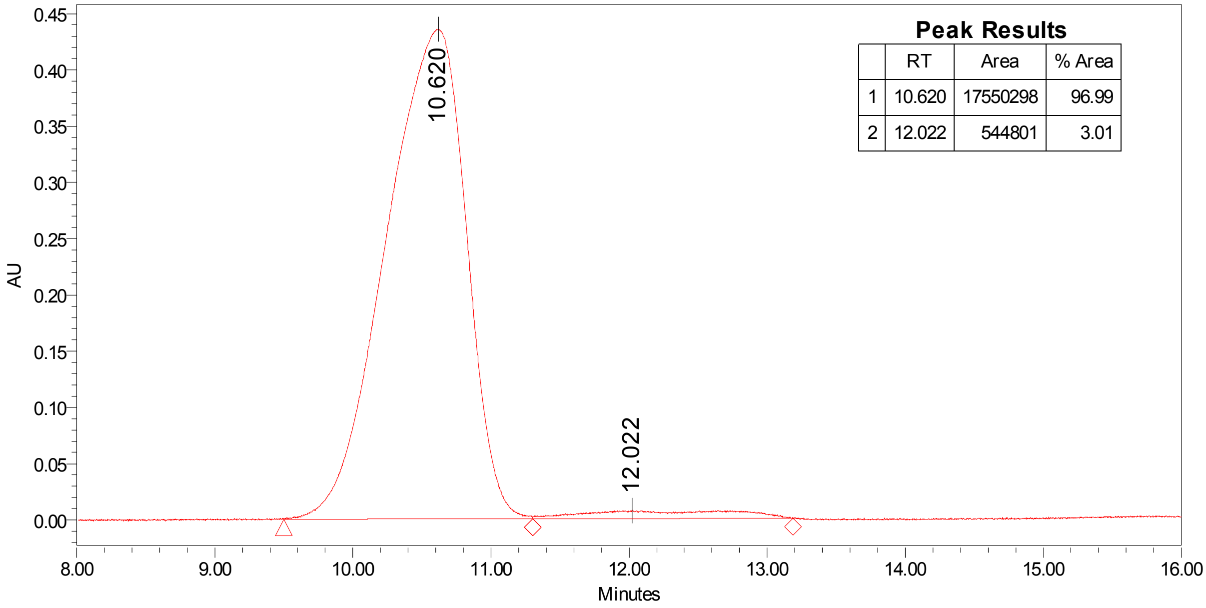
Racemic



Peak Results

	RT	Area	% Area
1	10.679	7227074	51.03
2	11.942	6934722	48.97

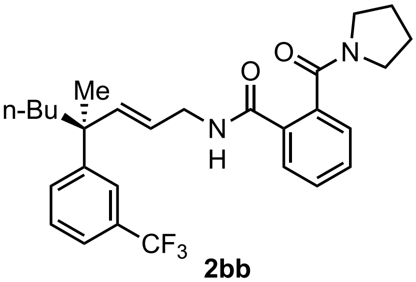
Enantioenriched



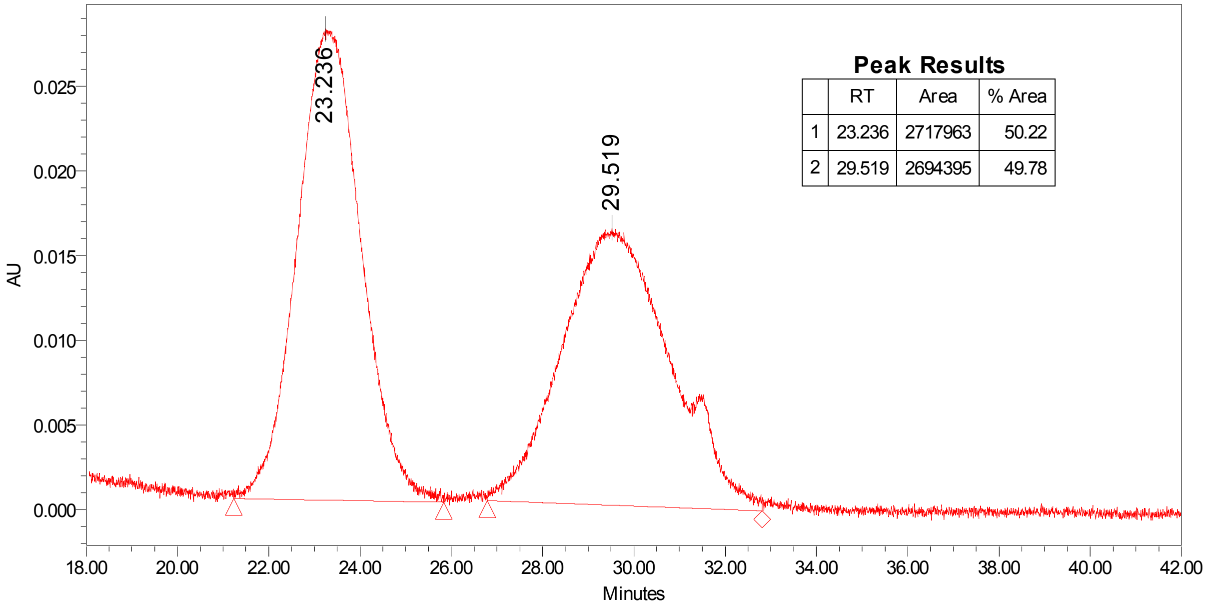
Peak Results

	RT	Area	% Area
1	10.620	17550298	96.99
2	12.022	544801	3.01

12. SFC Traces

Structure	SFC conditions	retention times
 **2bb**	AY-H [99:1 to 90:10 CO_2:MeOH, 30 min, 2 mL/min, 2000 psi]	21.86, 28.68 min (97.4:2.6)

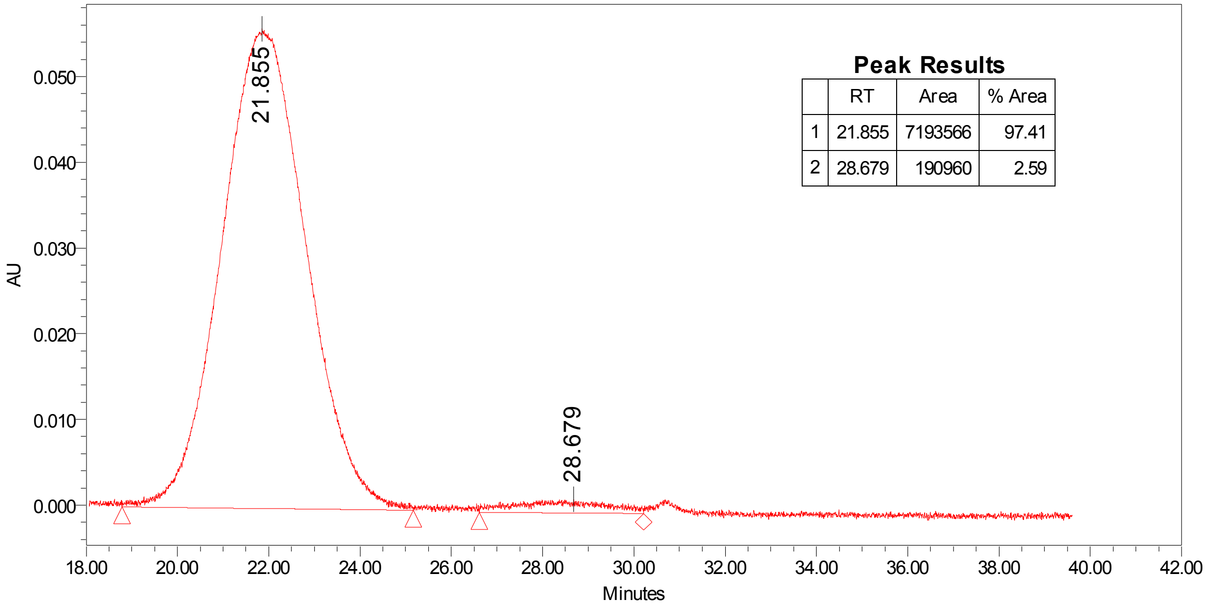
Racemic



Peak Results

	RT	Area	% Area
1	23.236	2717963	50.22
2	29.519	2694395	49.78

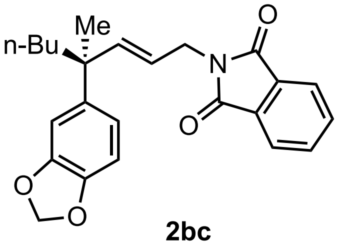
Enantioenriched



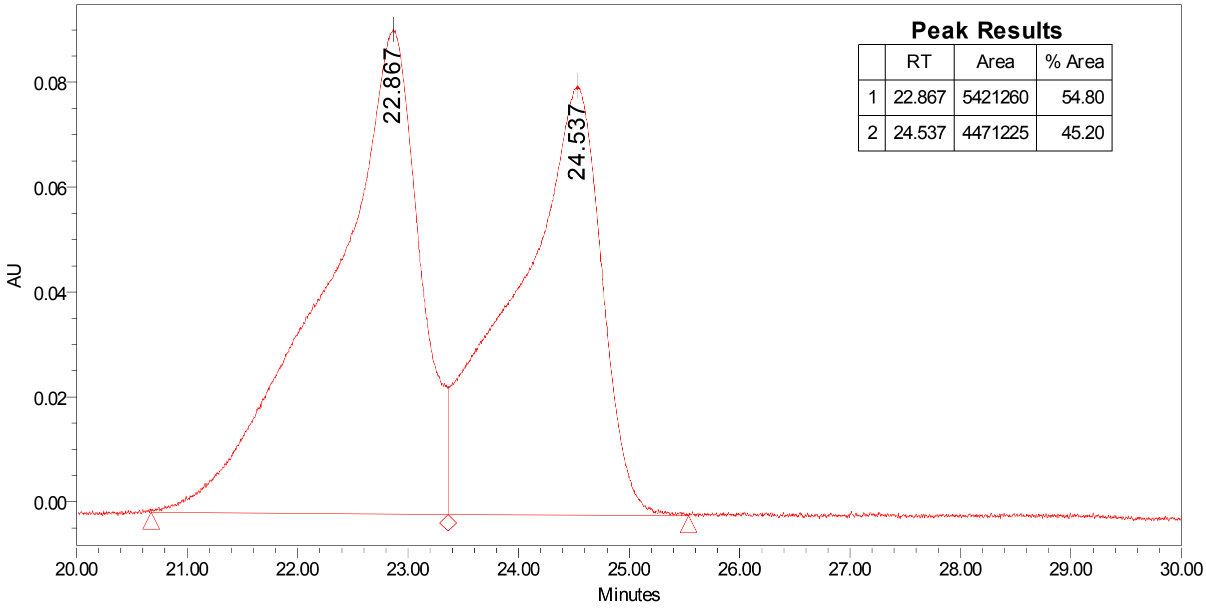
Peak Results

	RT	Area	% Area
1	21.855	7193566	97.41
2	28.679	190960	2.59

12. SFC Traces

Structure	SFC conditions	retention times
 **2bc**	AD-H [98:2 to 92:8 CO_2:IPA, 40 min, 2 mL/min, 2320 bar]	23.40, 25.24 min (97.24:2.76)

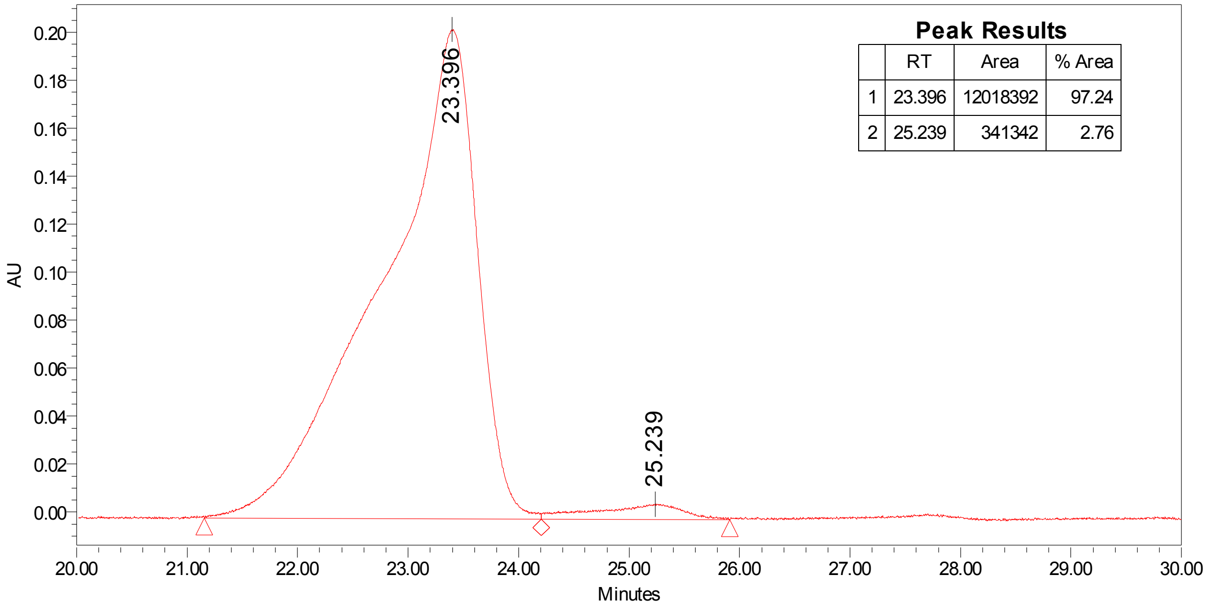
Racemic



Peak Results

	RT	Area	% Area
1	22.867	5421260	54.80
2	24.537	4471225	45.20

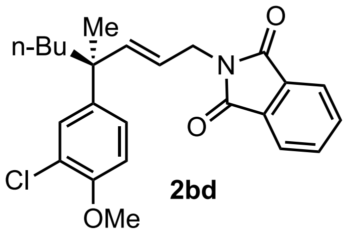
Enantioenriched



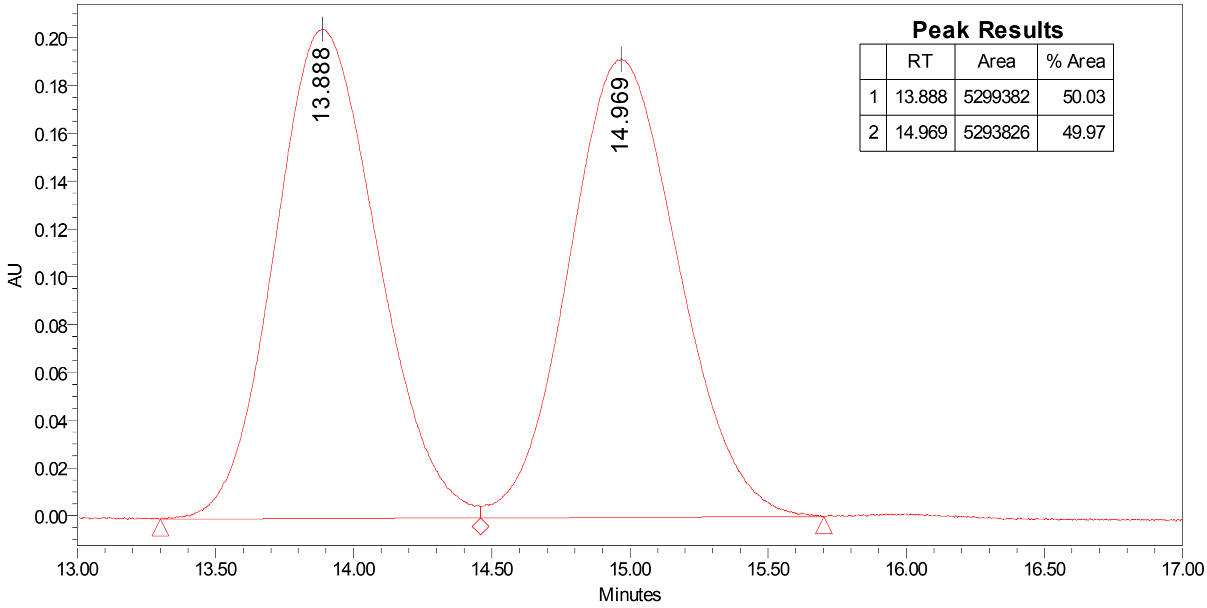
Peak Results

	RT	Area	% Area
1	23.396	12018392	97.24
2	25.239	341342	2.76

12. SFC Traces

Structure	SFC conditions	retention times
 **2bd**	AY-H [95:5 to 90:10 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	14.86, 13.85 min (97.8:2.2)

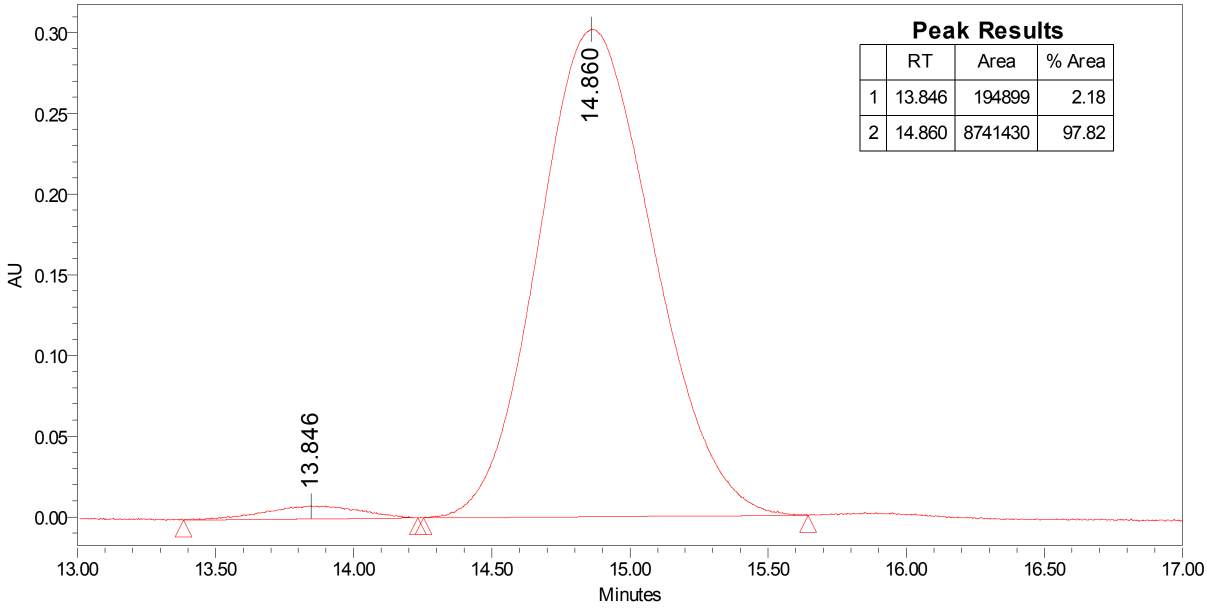
Racemic



Peak Results

	RT	Area	% Area
1	13.888	5299382	50.03
2	14.969	5293826	49.97

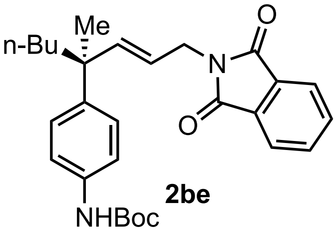
Enantioenriched



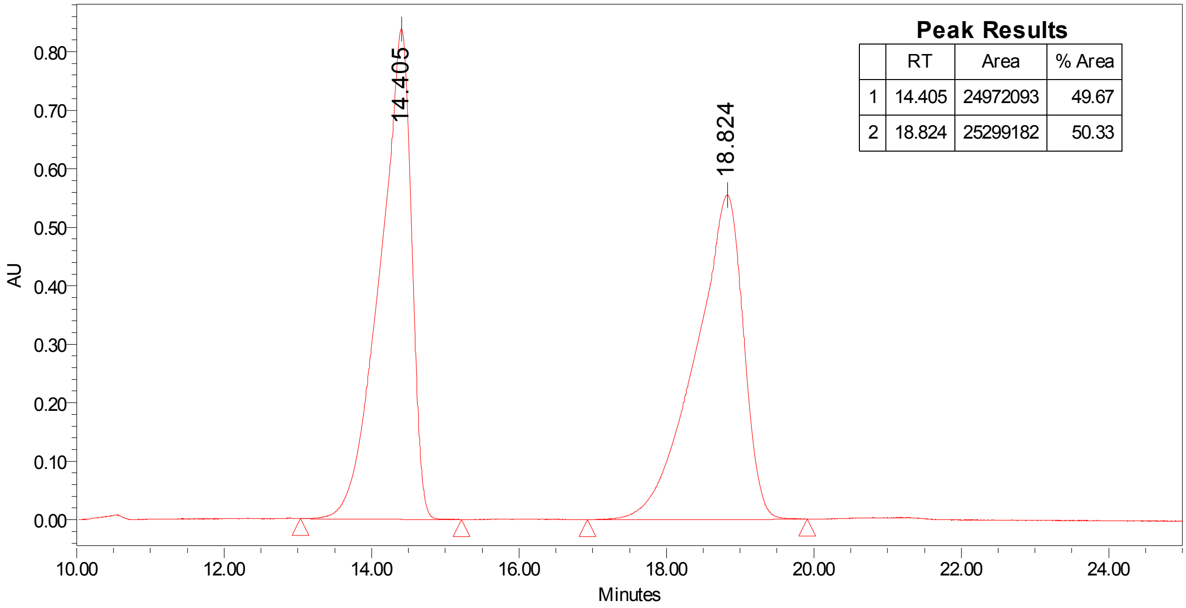
Peak Results

	RT	Area	% Area
1	13.846	194899	2.18
2	14.860	8741430	97.82

12. SFC Traces

Structure	SFC conditions	retention times
 **2be**	AD-H [90:10 to 80:20 CO_2:IPA, 10 min, 2 mL/min, 2320 psi]	14.44, 18.95 min (94.62:5.38)

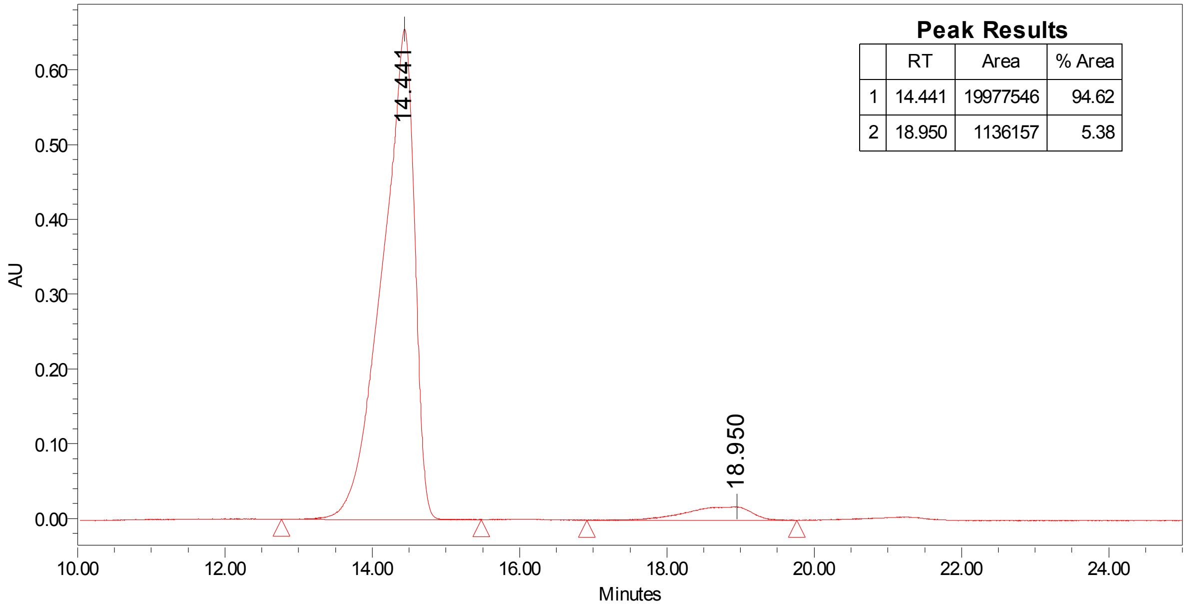
Racemic



Peak Results

	RT	Area	% Area
1	14.405	24972093	49.67
2	18.824	25299182	50.33

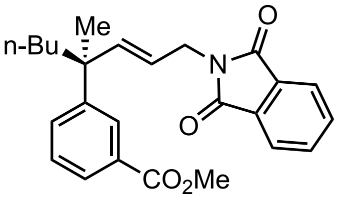
Enantioenriched



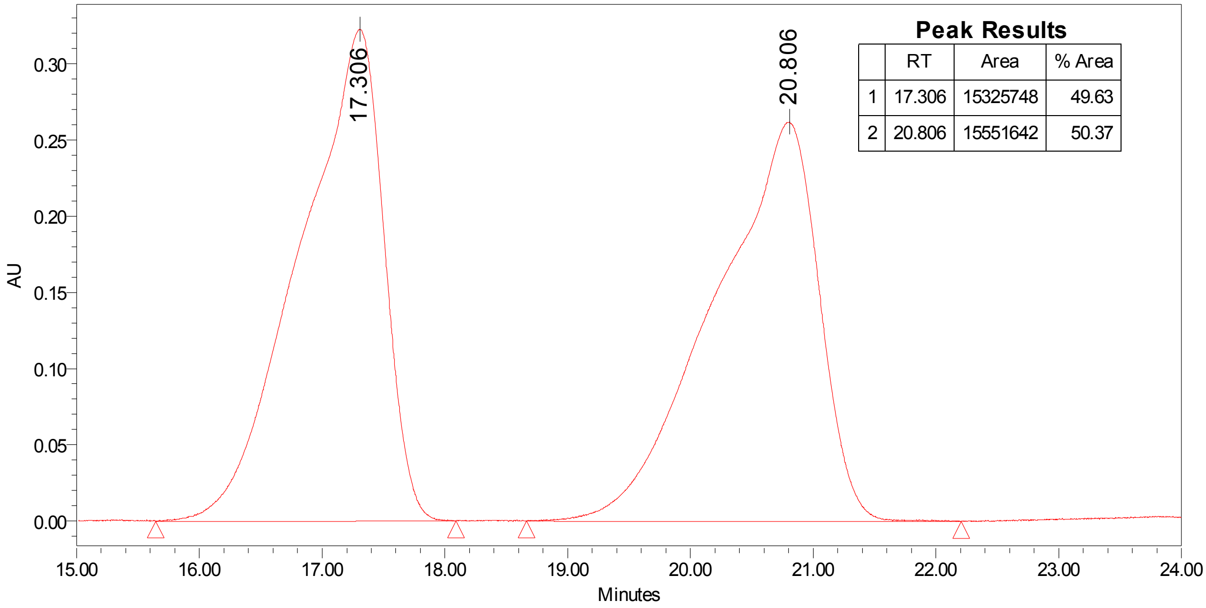
Peak Results

	RT	Area	% Area
1	14.441	19977546	94.62
2	18.950	1136157	5.38

12. SFC Traces

Structure	SFC conditions	retention times
 **2bf**	AD-H [97:3 to 94:6 CO2:IPA, 10 min, 2 mL/min, 2320 psi]	17.15, 20.68 min (93.51:6.49)

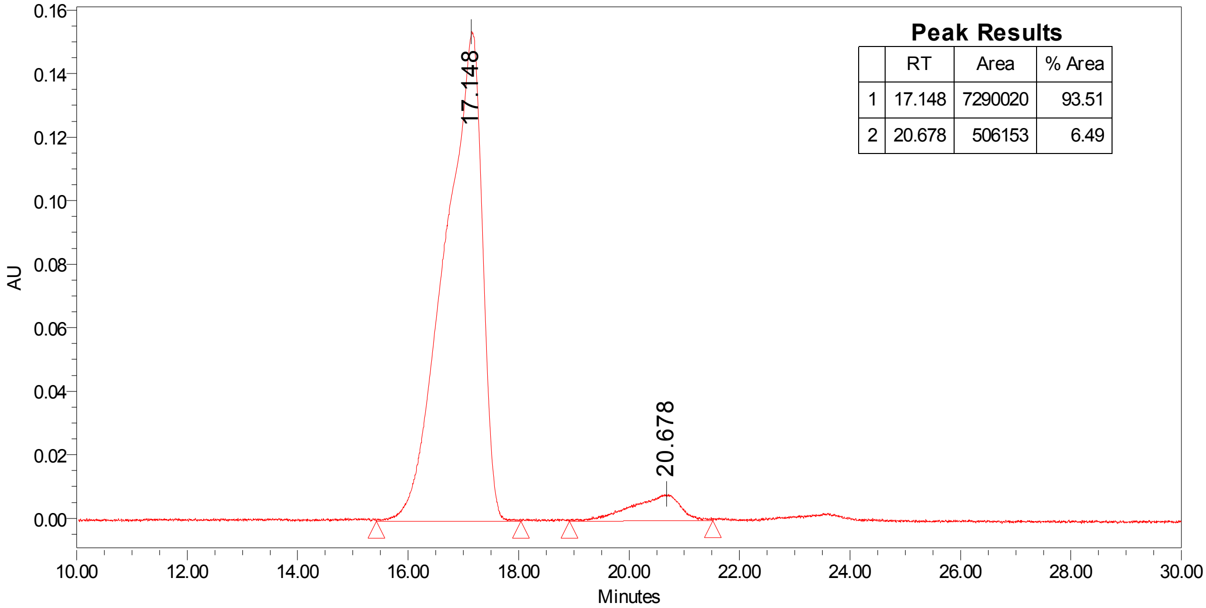
Racemic



Peak Results

	RT	Area	% Area
1	17.306	15325748	49.63
2	20.806	15551642	50.37

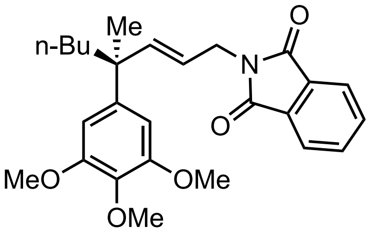
Enantioenriched



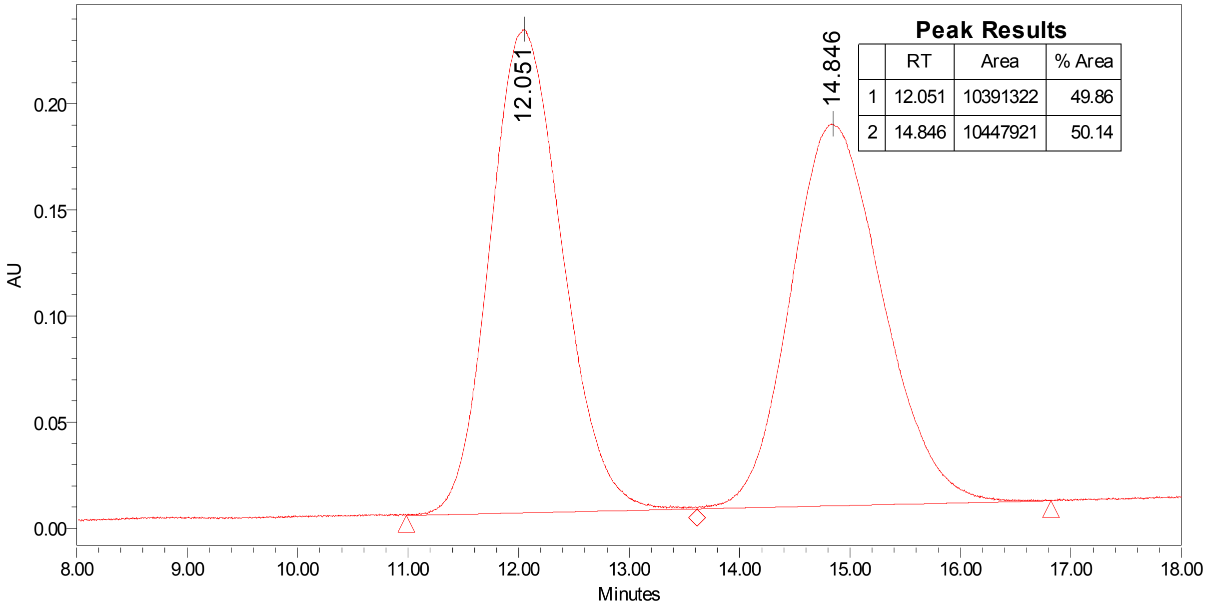
Peak Results

	RT	Area	% Area
1	17.148	7290020	93.51
2	20.678	506153	6.49

12. SFC Traces

Structure	SFC conditions	retention times
 **2bg**	AY-H [90:10 to 85:15 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	12.08, 14.83 min (96.27:3.73)

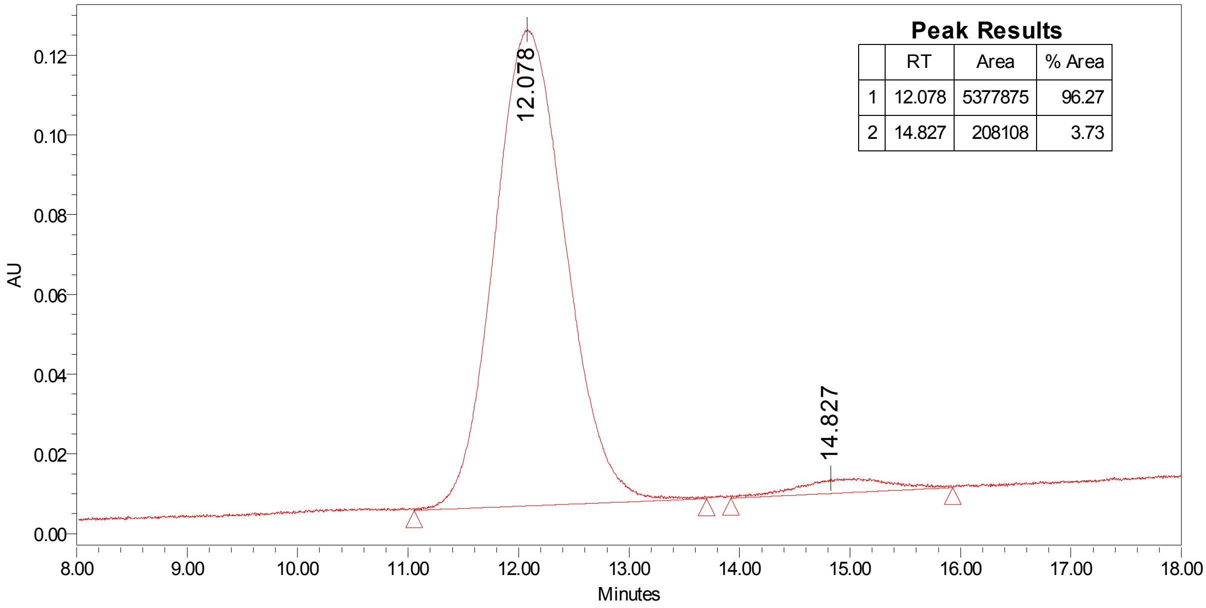
Racemic



Peak Results

	RT	Area	% Area
1	12.051	10391322	49.86
2	14.846	10447921	50.14

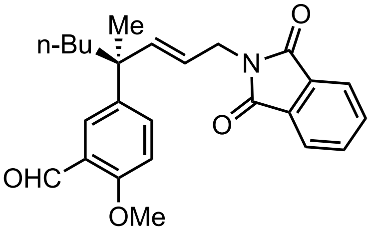
Enantioenriched

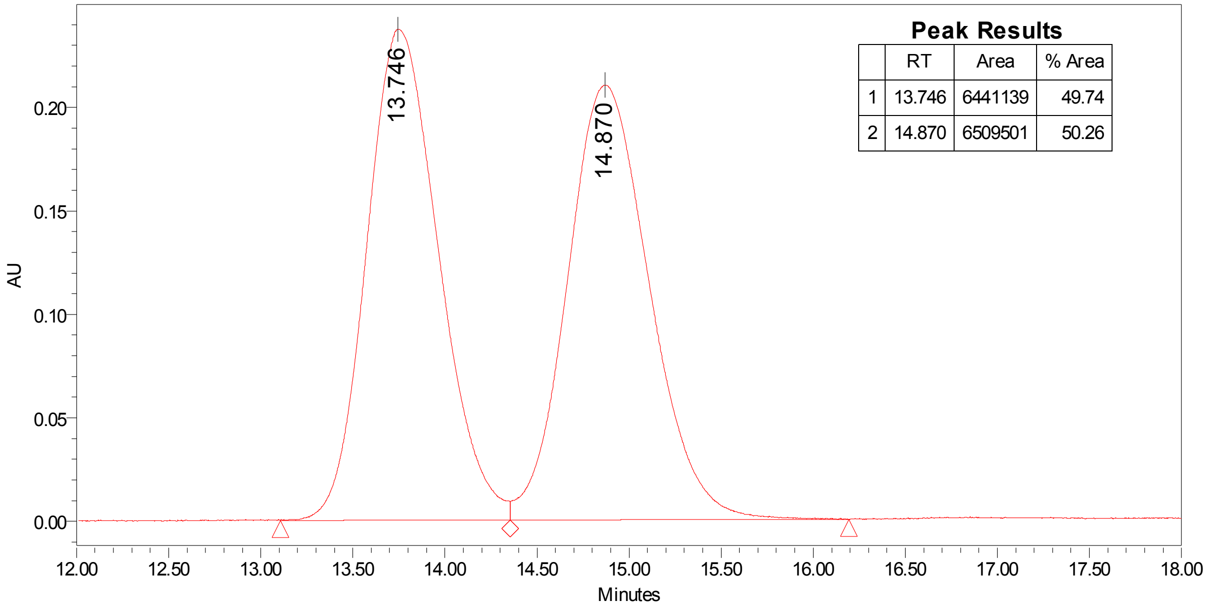


Peak Results

	RT	Area	% Area
1	12.078	5377875	96.27
2	14.827	208108	3.73

12. SFC Traces

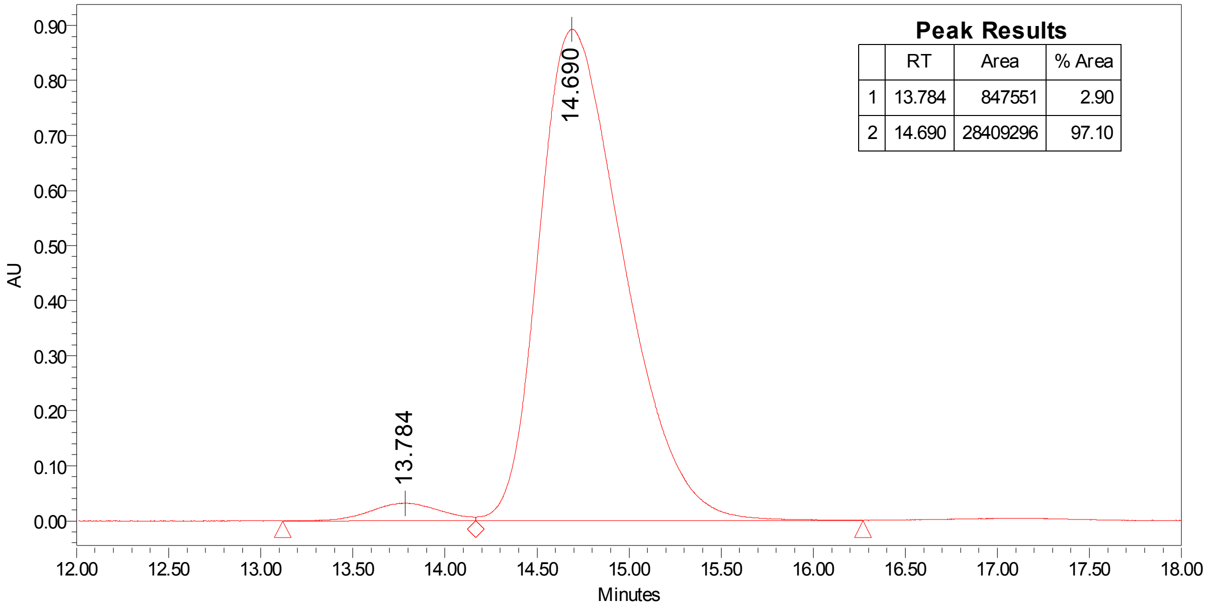
Structure	SFC conditions	retention times
 **2bh**	AY-H [90:10 to 85:15 CO_2:IPA, 45 min, 2 mL/min, 2320 psi]	14.69, 13.78 min (97.10:2.90)



Racemic

Peak Results

	RT	Area	% Area
1	13.746	6441139	49.74
2	14.870	6509501	50.26

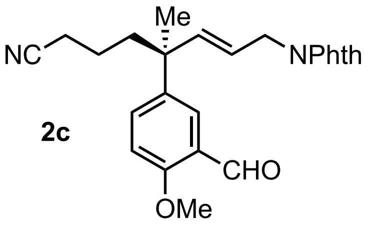


Enantioenriched

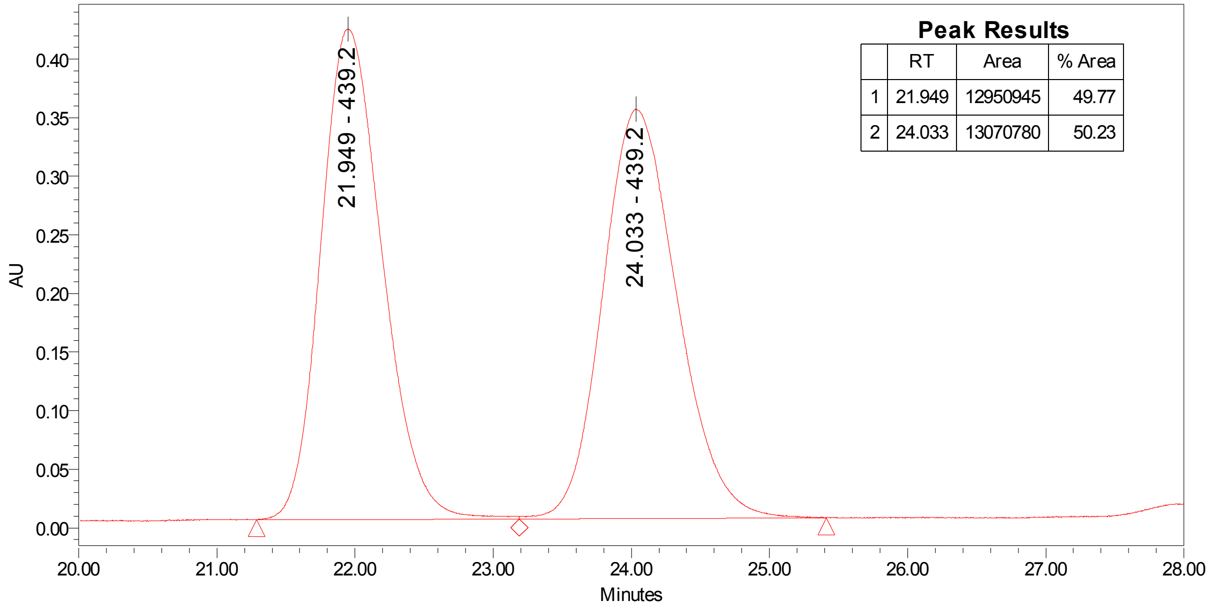
Peak Results

	RT	Area	% Area
1	13.784	847551	2.90
2	14.690	28409296	97.10

12. SFC Traces

Structure	SFC conditions	retention times
 **2c**	AY-H [90:10 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	23.83, 22.06 min (96.3:3.7)

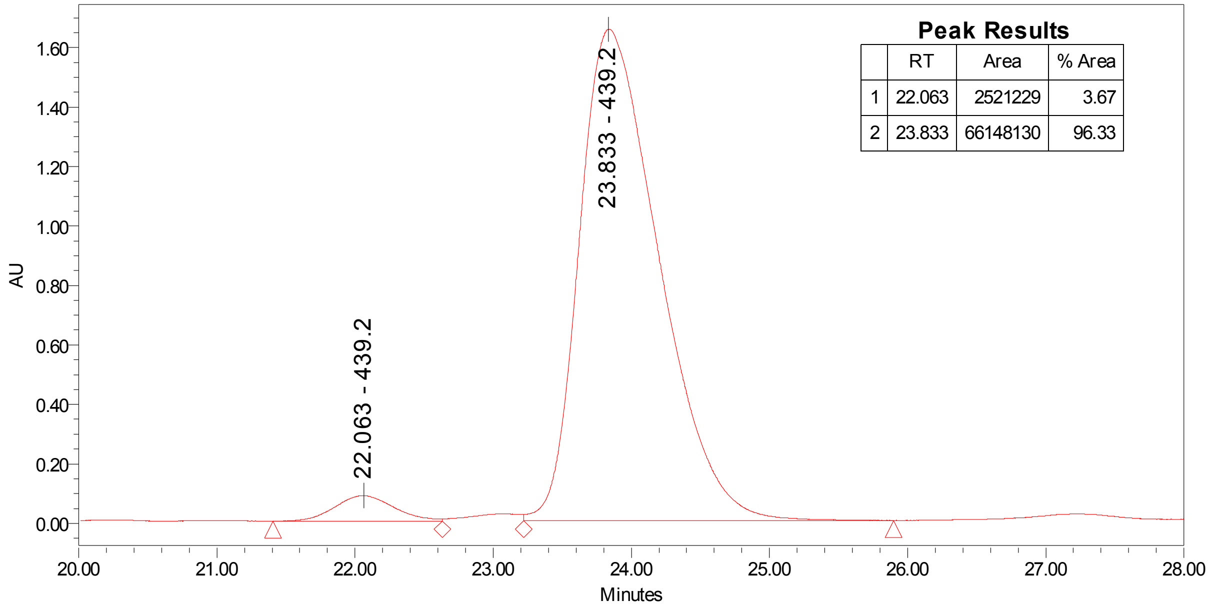
Racemic



Peak Results

	RT	Area	% Area
1	21.949	12950945	49.77
2	24.033	13070780	50.23

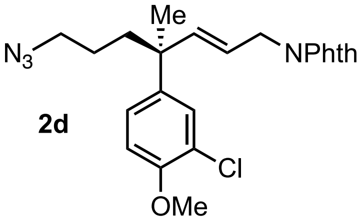
Enantioenriched



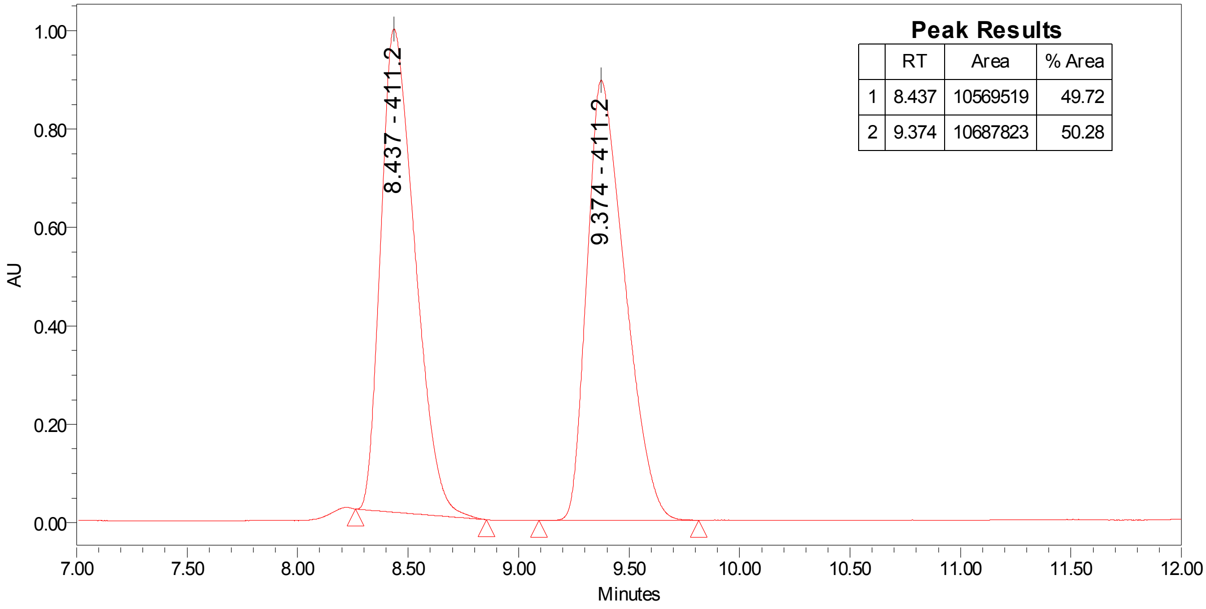
Peak Results

	RT	Area	% Area
1	22.063	2521229	3.67
2	23.833	66148130	96.33

12. SFC Traces

Structure	SFC conditions	retention times
 **2d**	CEL-1 [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	8.46, 9.53 min (96.4:3.61)

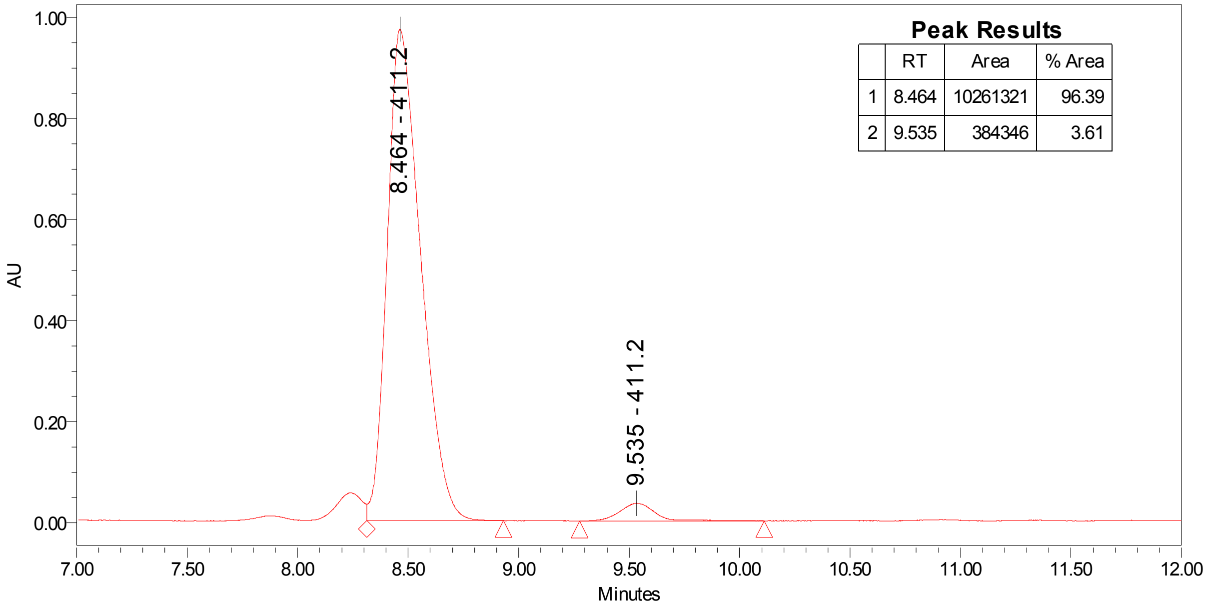
Racemic



Peak Results

	RT	Area	% Area
1	8.437	10569519	49.72
2	9.374	10687823	50.28

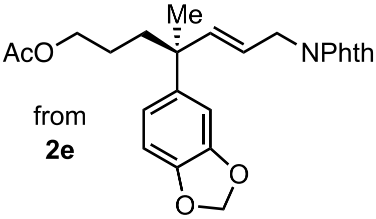
Enantioenriched



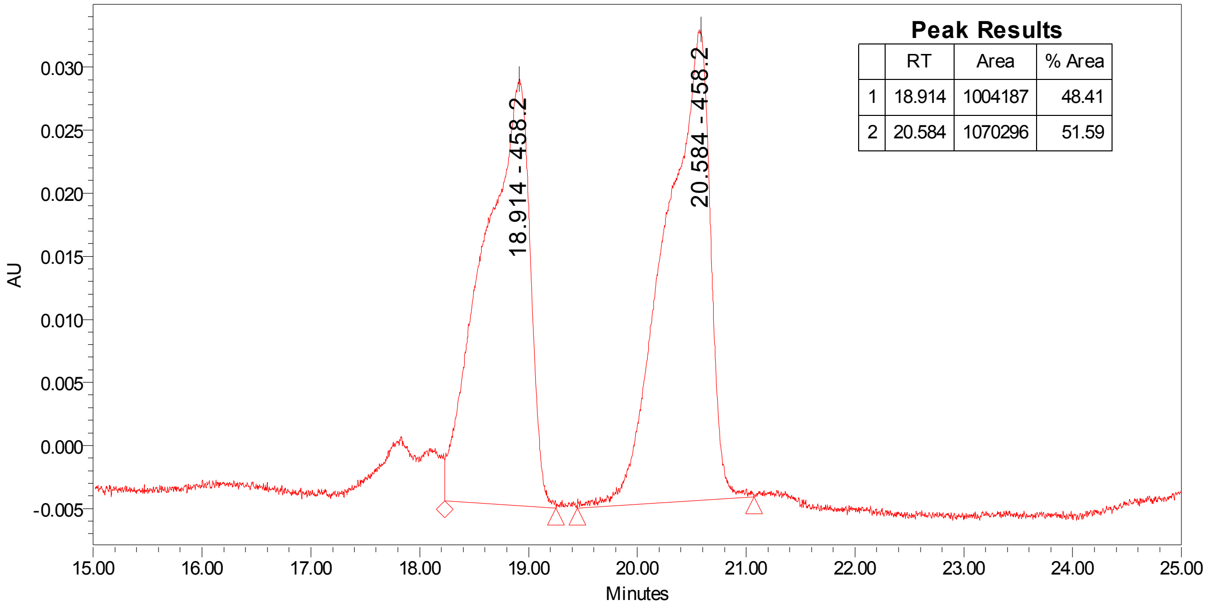
Peak Results

	RT	Area	% Area
1	8.464	10261321	96.39
2	9.535	384346	3.61

12. SFC Traces

Structure	SFC conditions	retention times
 from **2e**	AD-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	18.84, 20.54 min (93.5:6.5)

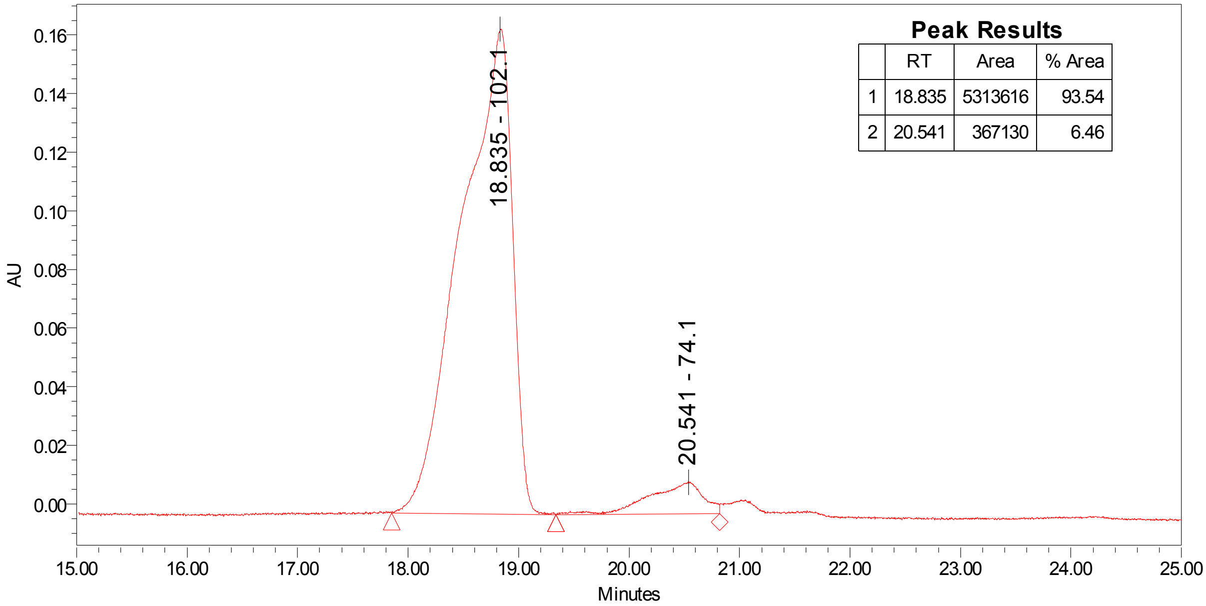
Racemic



Peak Results

	RT	Area	% Area
1	18.914	1004187	48.41
2	20.584	1070296	51.59

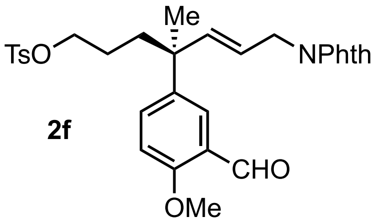
Enantioenriched



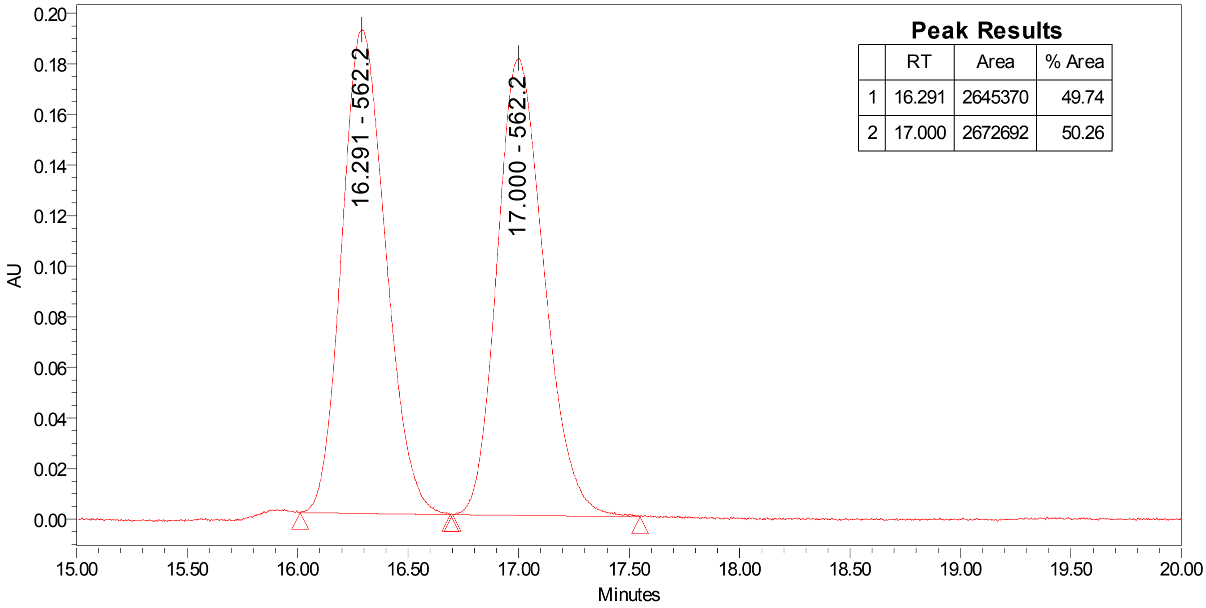
Peak Results

	RT	Area	% Area
1	18.835	5313616	93.54
2	20.541	367130	6.46

12. SFC Traces

Structure	SFC conditions	retention times
 **2f**	CEL-1 [95:5 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	16.36, 17.15 min (97.03:2.97)

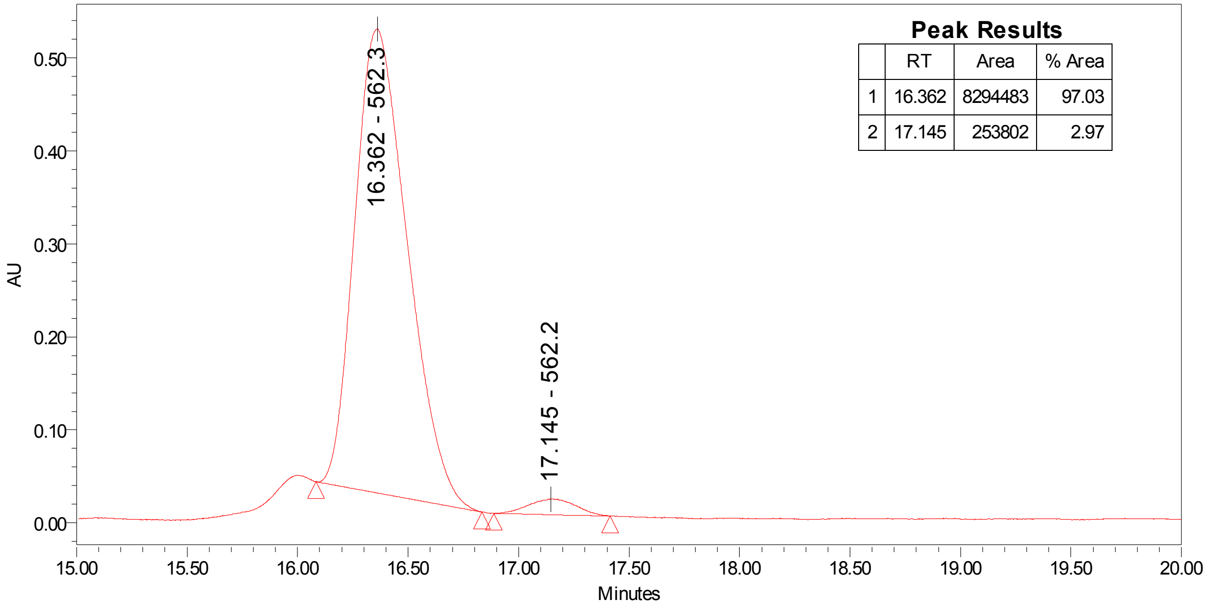
Racemic



Peak Results

	RT	Area	% Area
1	16.291	2645370	49.74
2	17.000	2672692	50.26

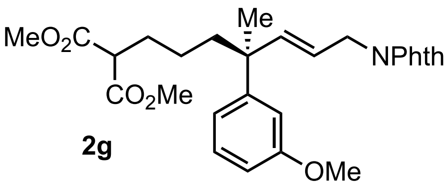
Enantioenriched



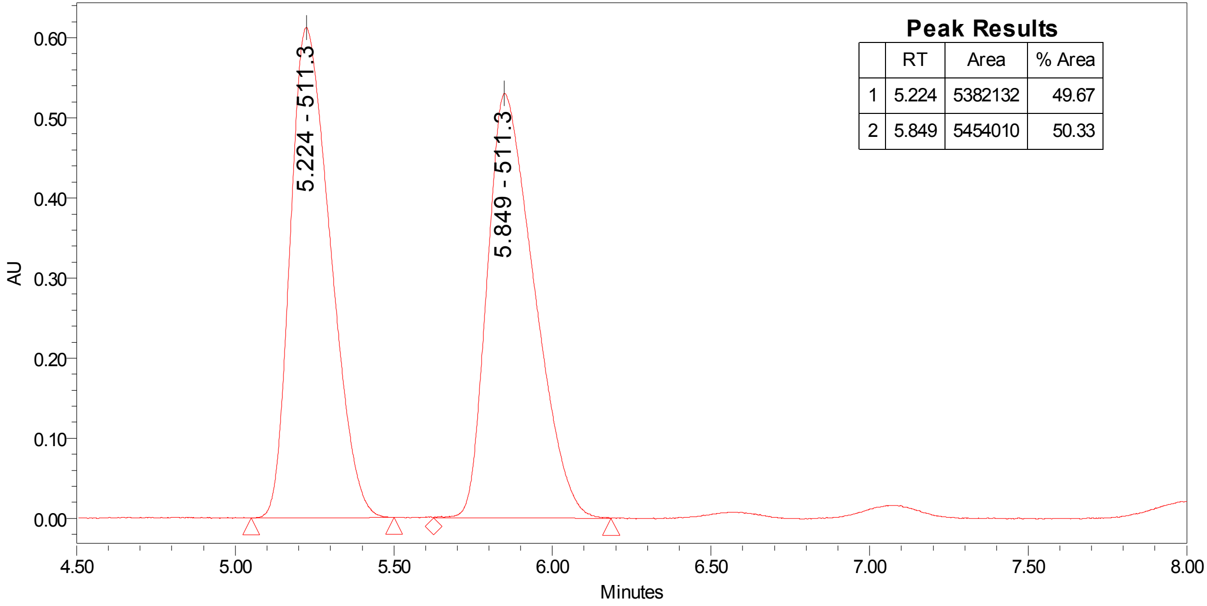
Peak Results

	RT	Area	% Area
1	16.362	8294483	97.03
2	17.145	253802	2.97

12. SFC Traces

Structure	SFC conditions	retention times
 **2g**	CEL-1 [95:5 to 75:25 CO$_2$:IPA, 30 min, 2 mL/min]	5.85, 5.22 min (98.8:1.2)

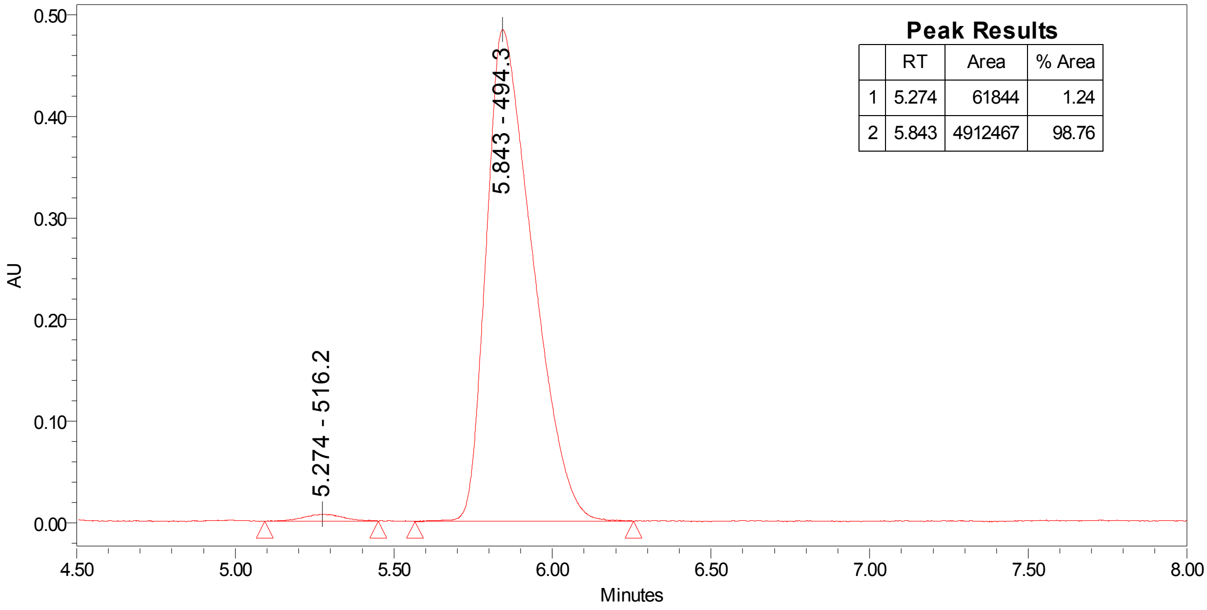
Racemic



Peak Results

	RT	Area	% Area
1	5.224	5382132	49.67
2	5.849	5454010	50.33

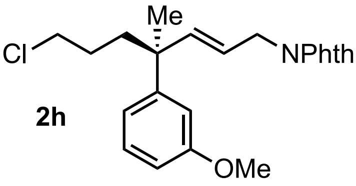
Enantioenriched



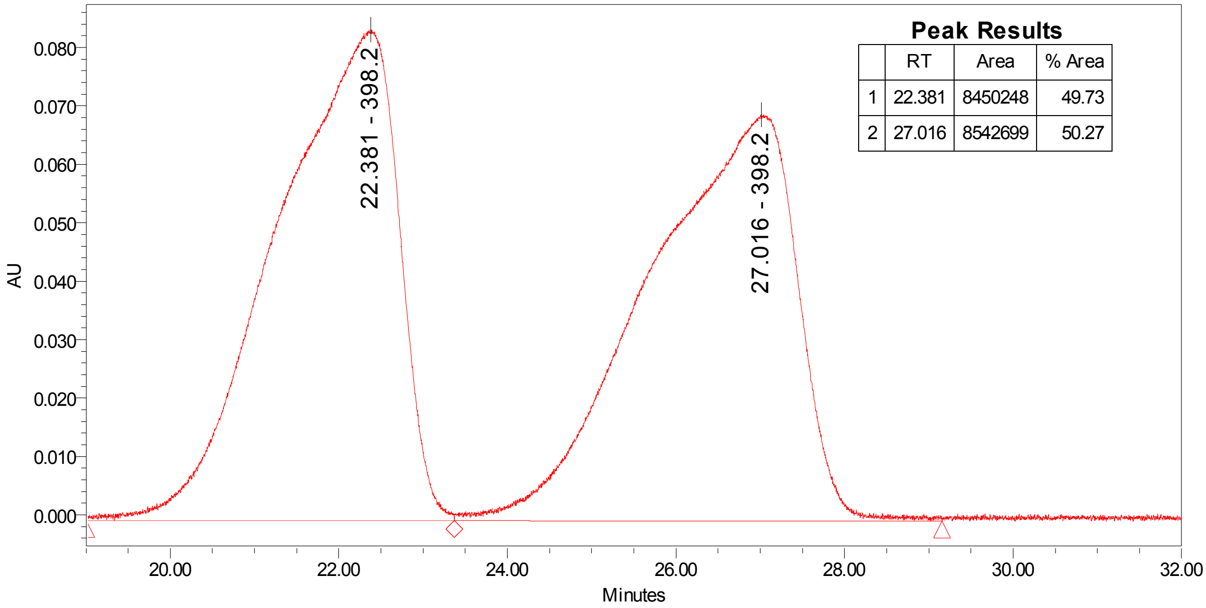
Peak Results

	RT	Area	% Area
1	5.274	61844	1.24
2	5.843	4912467	98.76

12. SFC Traces

Structure	SFC conditions	retention times
 **2h**	AD-H [95:5 CO_2:IPA, 2 mL/min, 2320 psi]	21.81, 25.80 min (95.45:4.55)

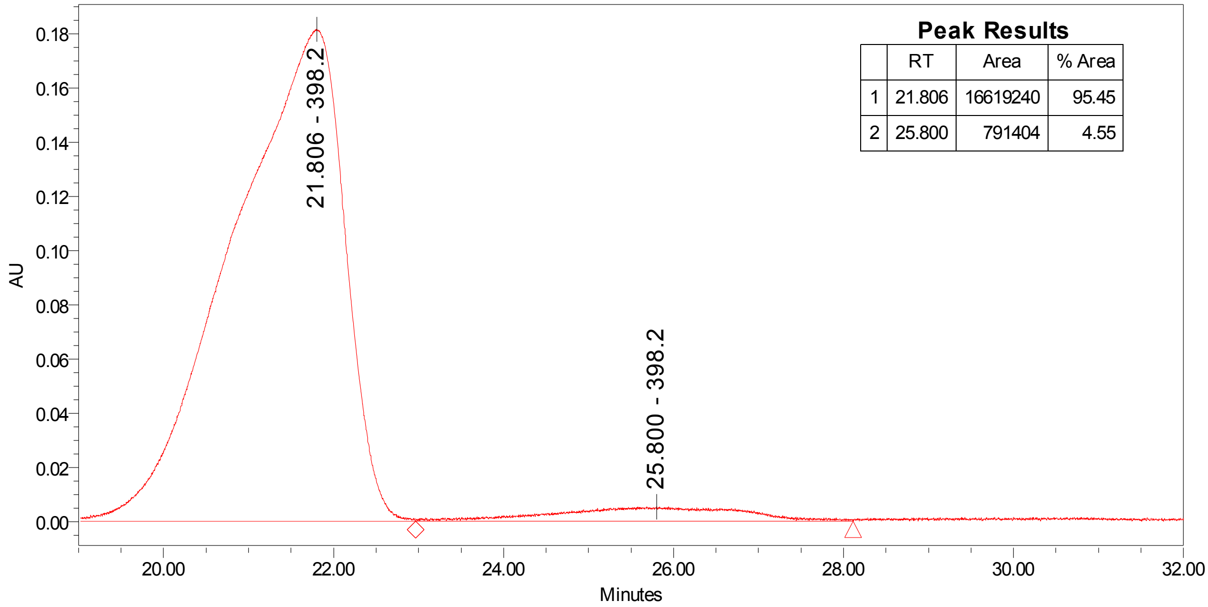
Racemic



Peak Results

	RT	Area	% Area
1	22.381	8450248	49.73
2	27.016	8542699	50.27

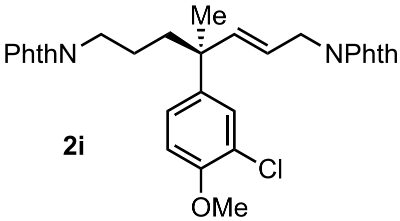
Enantioenriched



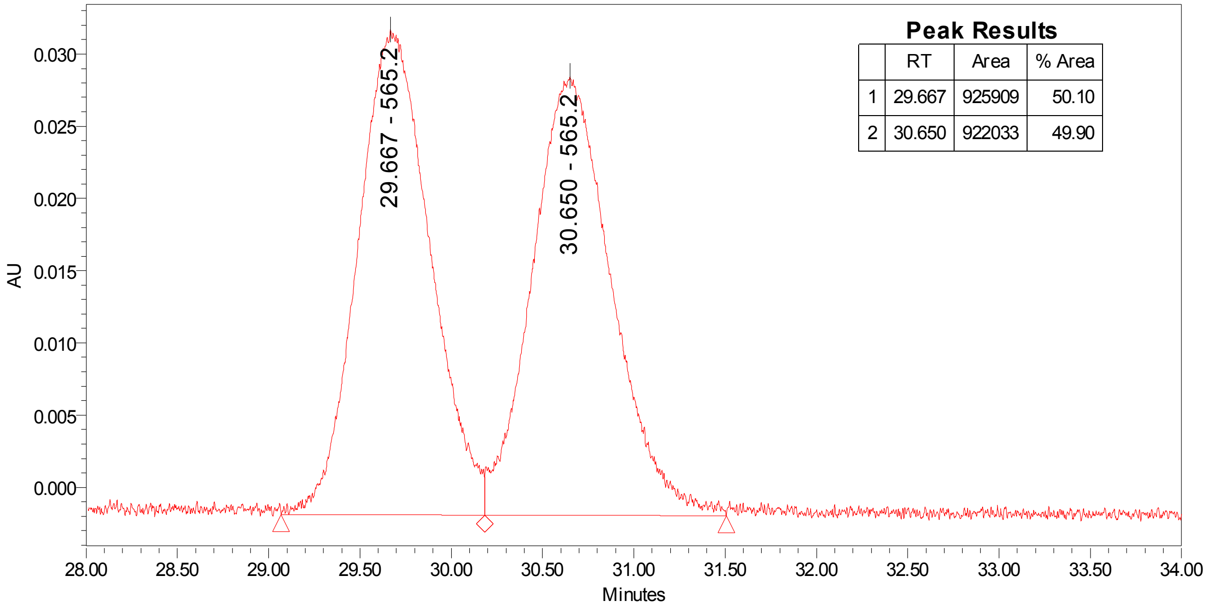
Peak Results

	RT	Area	% Area
1	21.806	16619240	95.45
2	25.800	791404	4.55

12. SFC Traces

Structure	SFC conditions	retention times
2i 	CEL-1 [98:2 to 90:10 CO_2:IPA, 45 min, 2 mL/min]	30.13 31.27 min (91.03:8.97)

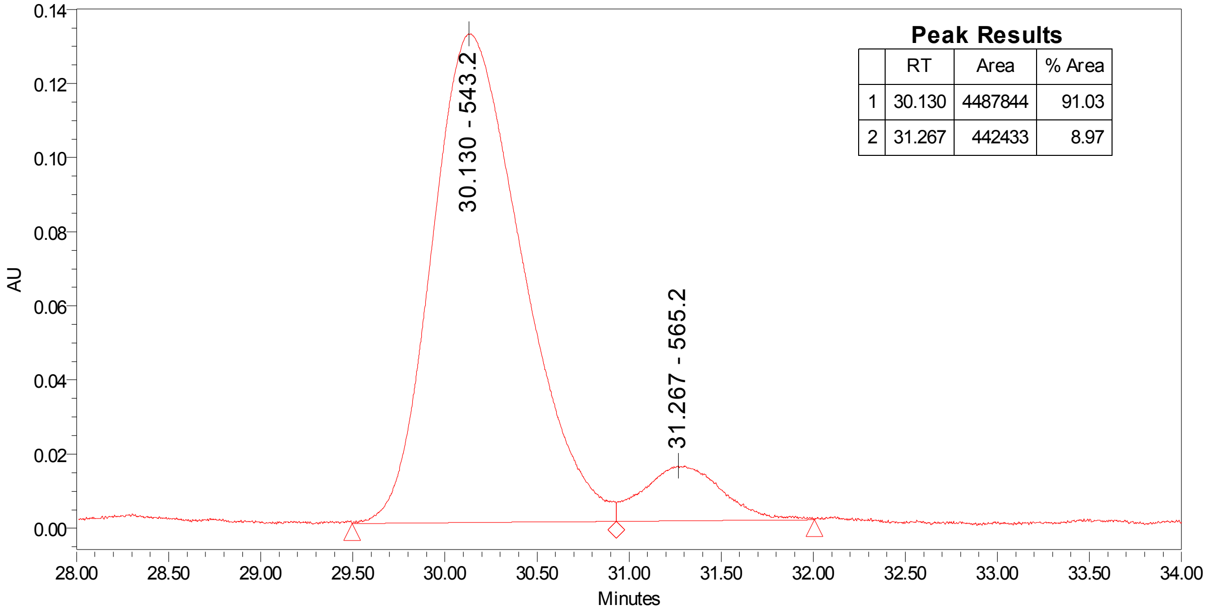
Racemic



Peak Results

	RT	Area	% Area
1	29.667	925909	50.10
2	30.650	922033	49.90

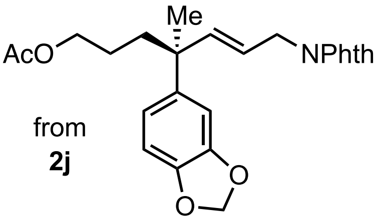
Enantioenriched



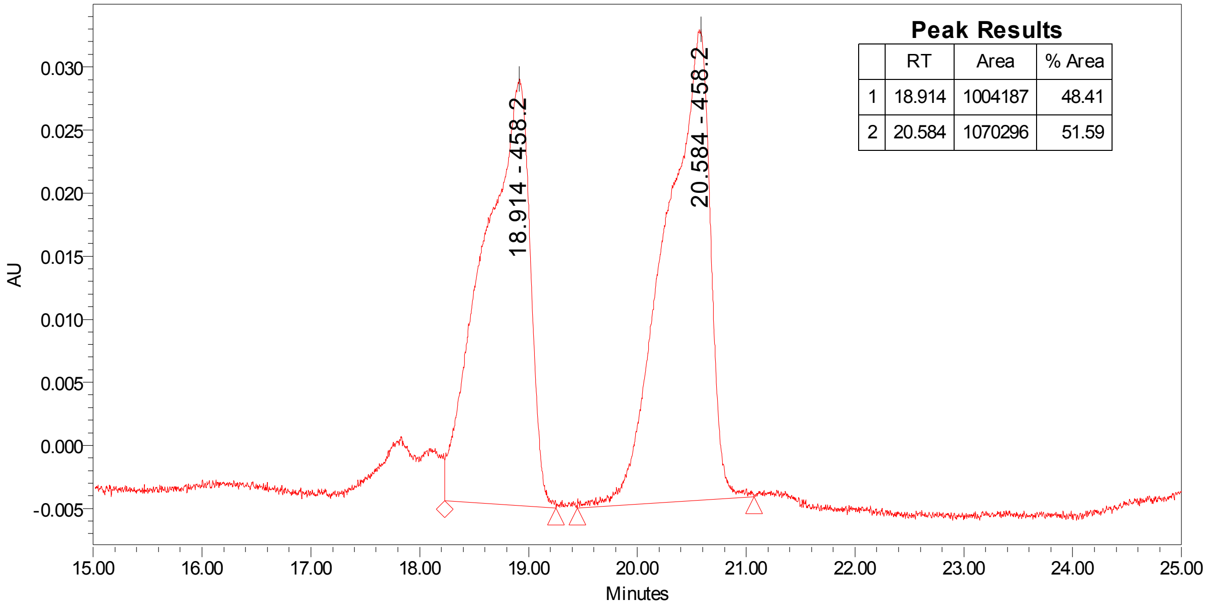
Peak Results

	RT	Area	% Area
1	30.130	4487844	91.03
2	31.267	442433	8.97

12. SFC Traces

Structure	SFC conditions	retention times
 from **2j**	AD-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	18.65, 20.34 min (95.89:4.11)

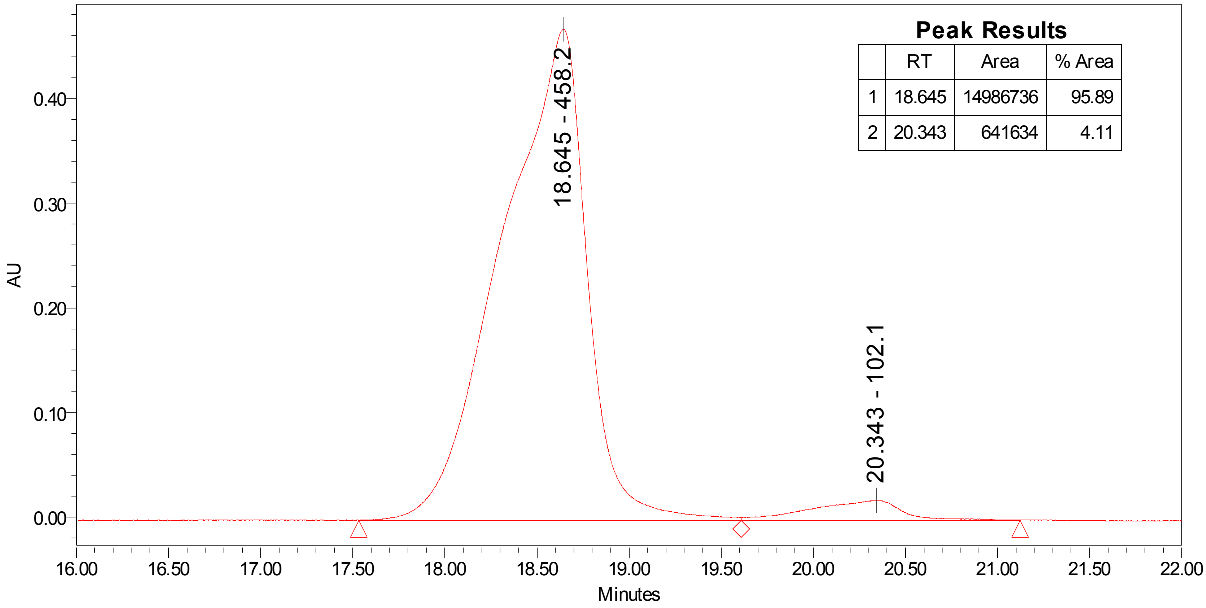
Racemic



Peak Results

	RT	Area	% Area
1	18.914	1004187	48.41
2	20.584	1070296	51.59

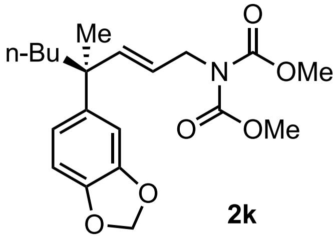
Enantioenriched



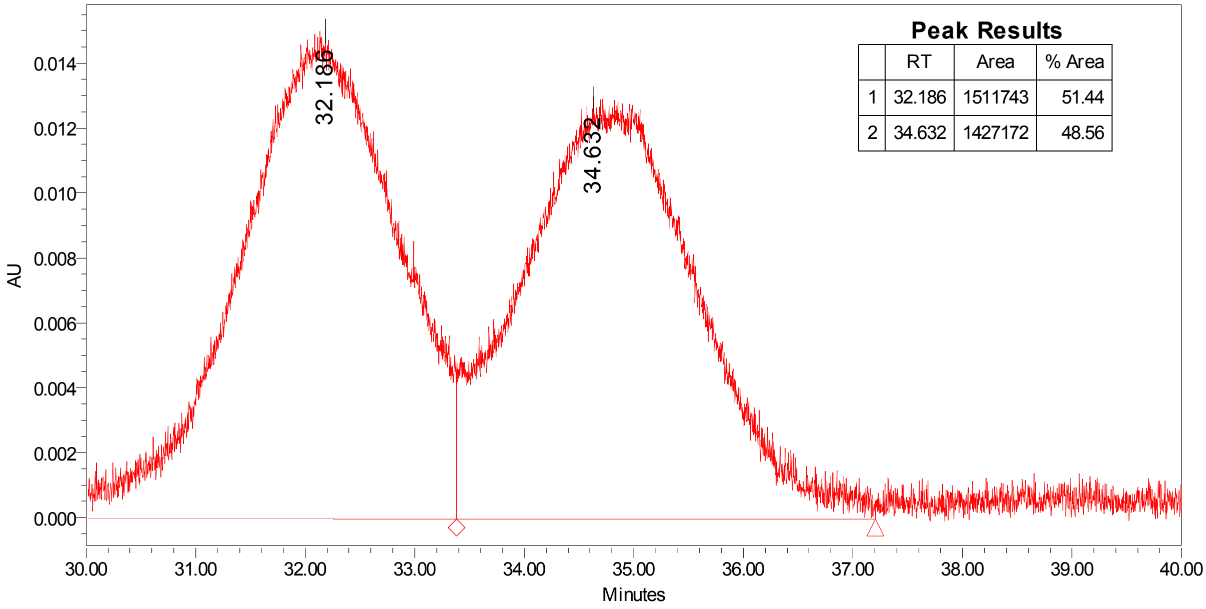
Peak Results

	RT	Area	% Area
1	18.645	14986736	95.89
2	20.343	641634	4.11

12. SFC Traces

Structure	SFC conditions	retention times
 **2k**	OZ-H [98:2 CO_2:IPA, 3 mL/min, 2320 psi]	33.68, 32.20 min (>99:1)

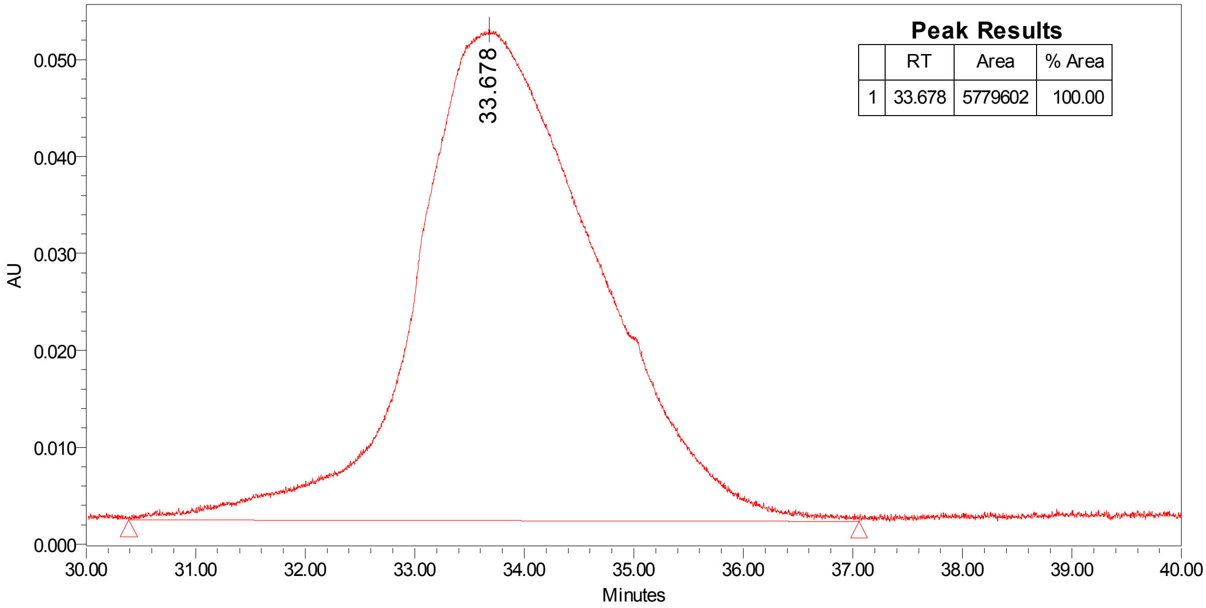
Racemic



Peak Results

	RT	Area	% Area
1	32.186	1511743	51.44
2	34.632	1427172	48.56

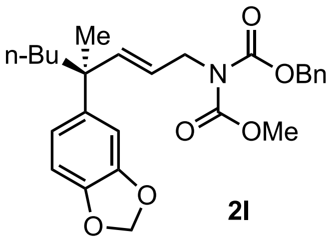
Enantioenriched



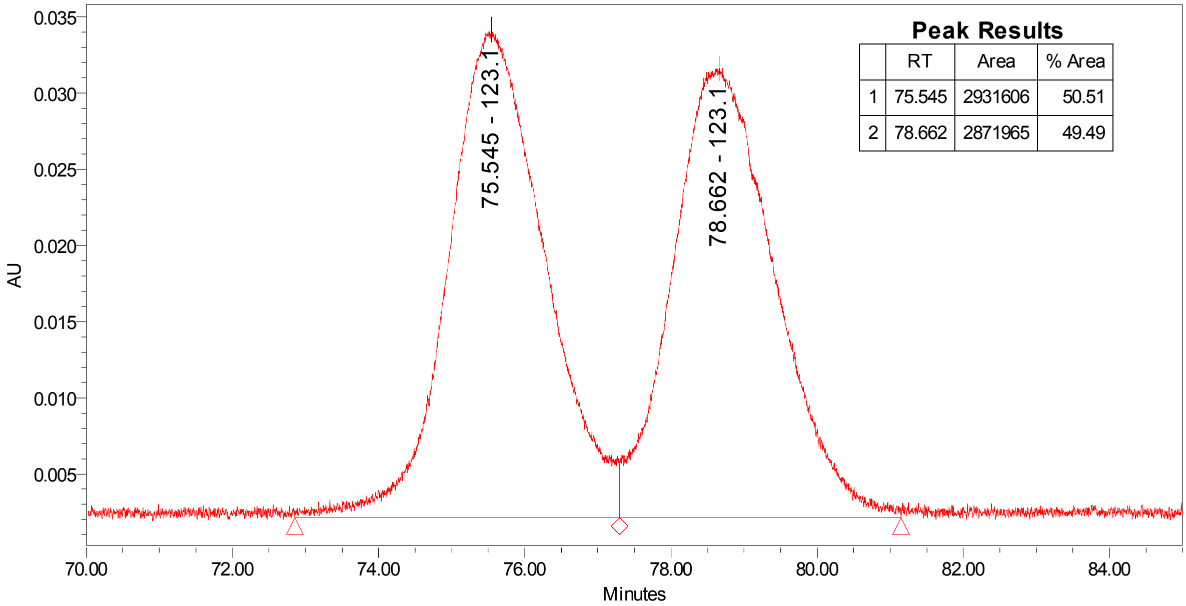
Peak Results

	RT	Area	% Area
1	33.678	5779602	100.00

12. SFC Traces

Structure	SFC conditions	retention times
 **2l**	AD-H [98:2 to 93:7 CO_2:IPA, 180 min, 2 mL/min, 2320 psi]	77.78, 75.55 min (>99:1)

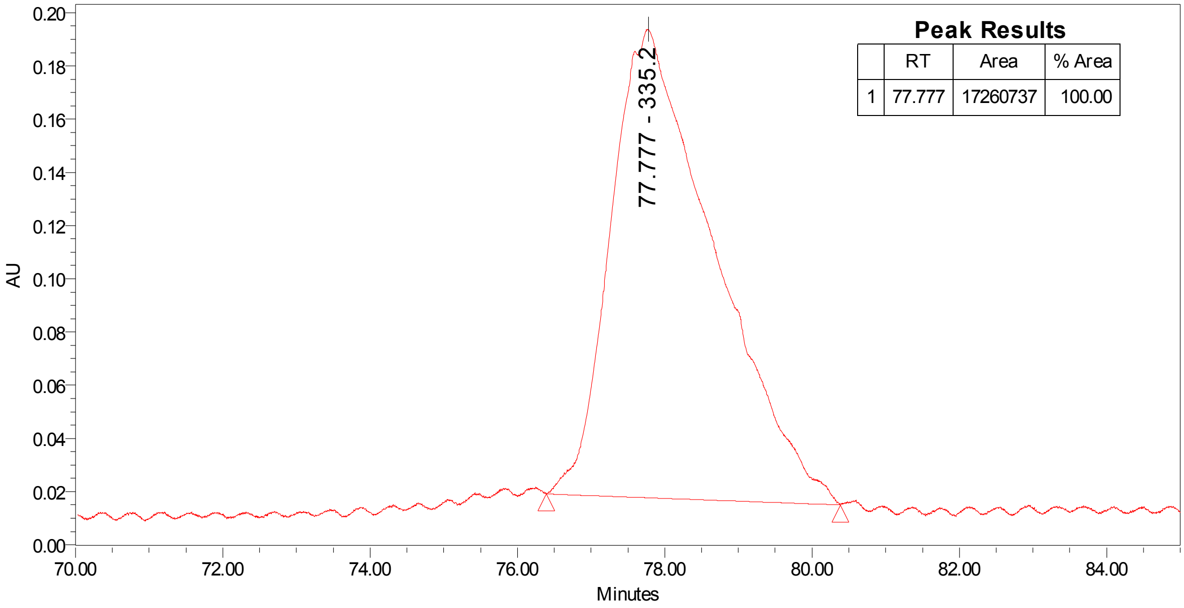
Racemic



Peak Results

	RT	Area	% Area
1	75.545	2931606	50.51
2	78.662	2871965	49.49

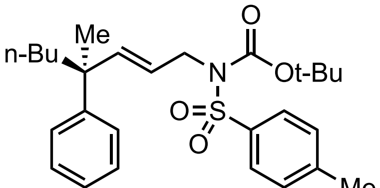
Enantioenriched



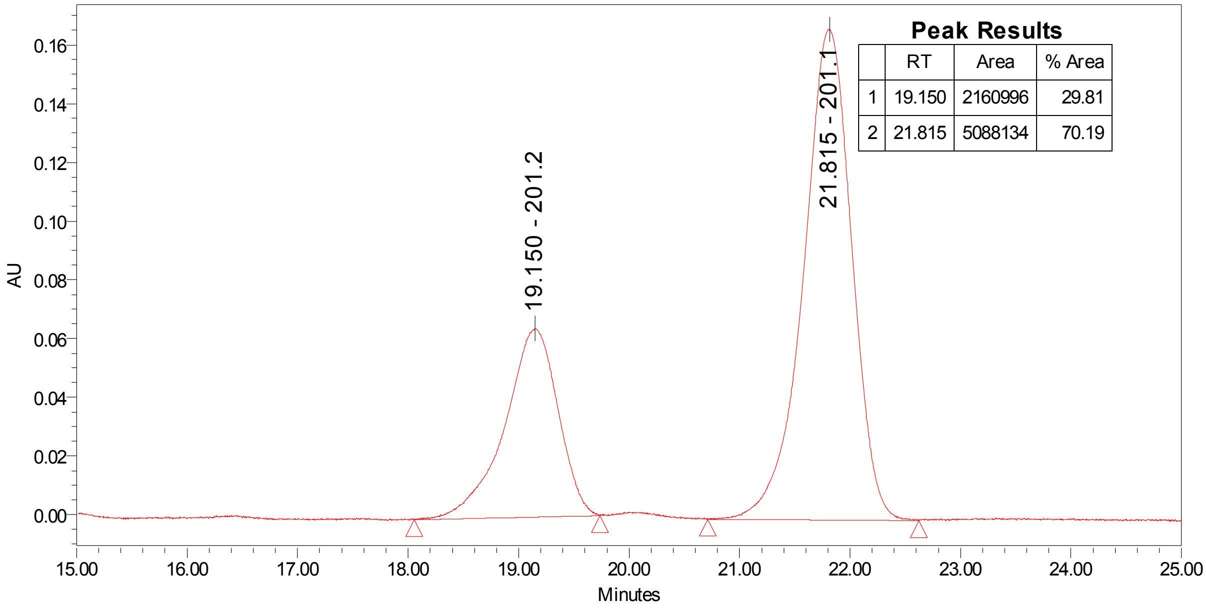
Peak Results

	RT	Area	% Area
1	77.777	17260737	100.00

12. SFC Traces

Structure	SFC conditions	retention times
 **2m**	OZ-H [99:1 to 90:10 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	21.77, 19.15 min (97.17:2.83)

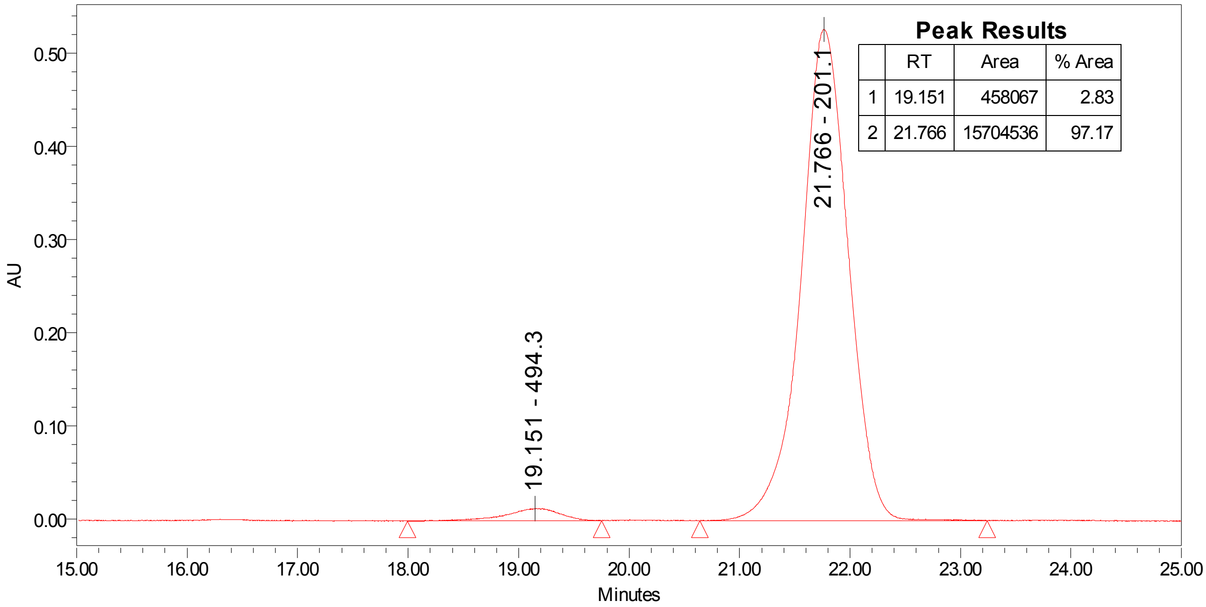
Racemic



Peak Results

	RT	Area	% Area
1	19.150	2160996	29.81
2	21.815	5088134	70.19

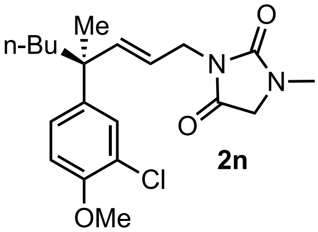
Enantioenriched



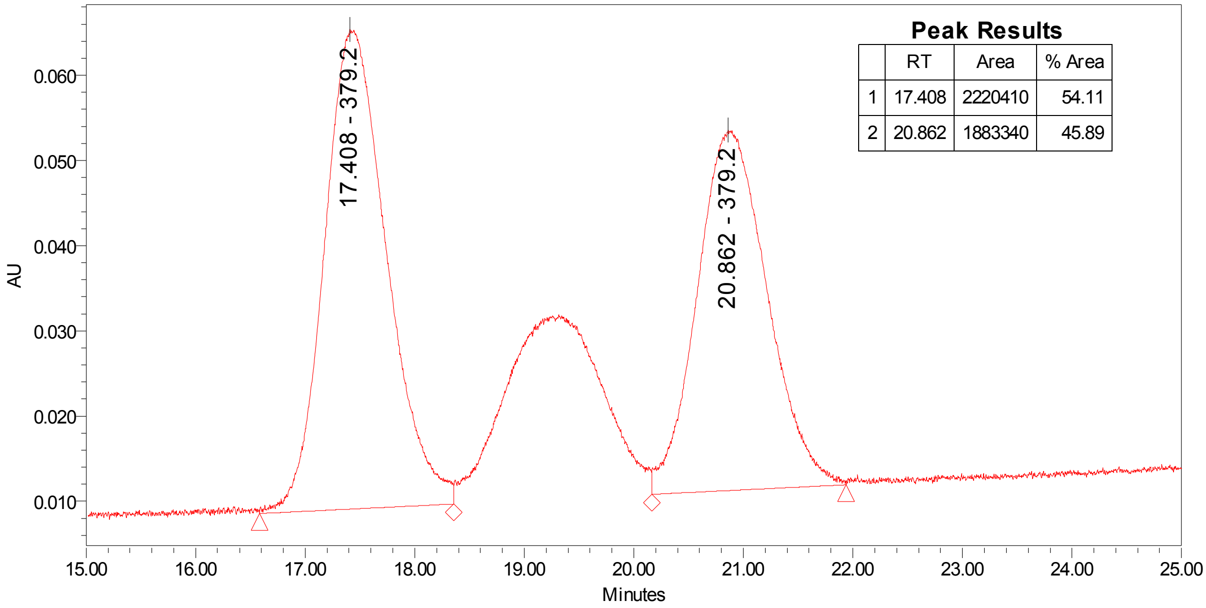
Peak Results

	RT	Area	% Area
1	19.151	458067	2.83
2	21.766	15704536	97.17

12. SFC Traces

Structure	SFC conditions	retention times
 **2n**	AY-H [95:5 to 90:10 CO_2:IPA, 45 min, 2 mL/min, 2320 psi]	17.36, 20.49 min (2.89:97.11)

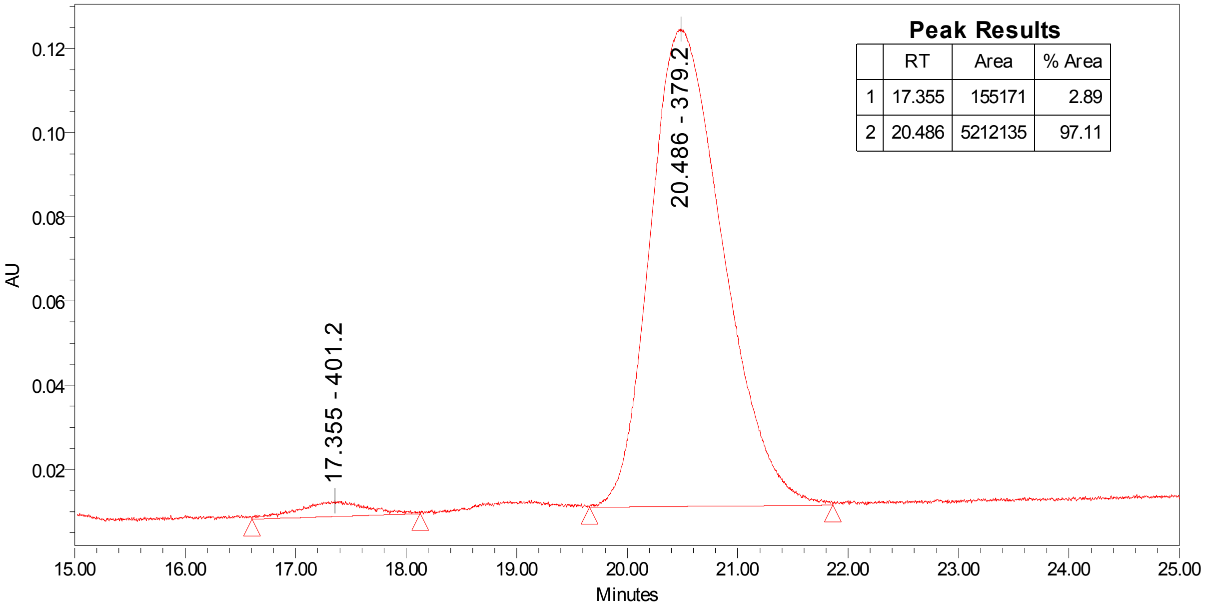
Racemic



Peak Results

	RT	Area	% Area
1	17.408	2220410	54.11
2	20.862	1883340	45.89

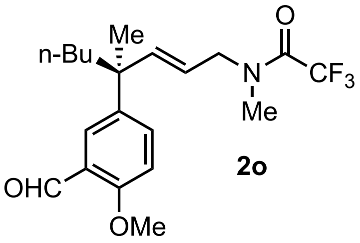
Enantioenriched



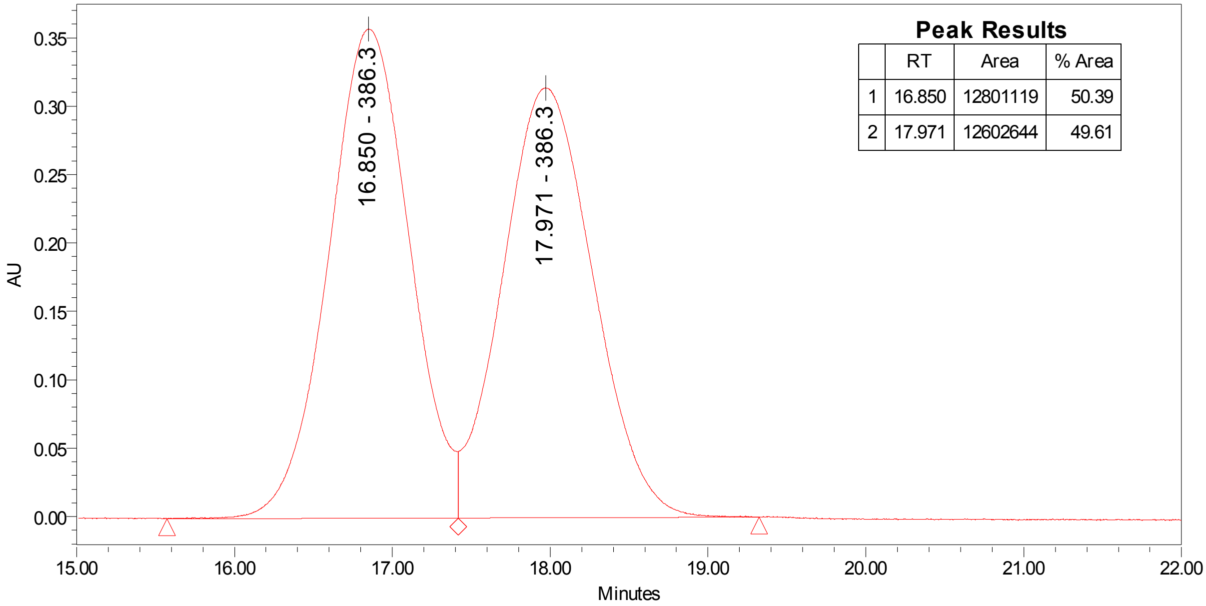
Peak Results

	RT	Area	% Area
1	17.355	155171	2.89
2	20.486	5212135	97.11

12. SFC Traces

Structure	SFC conditions	retention times
 **2o**	AY-H [98:2 to 92:8 CO_2:IPA, 20 min, 1 mL/min, 2320 psi]	17.61, 16.66 min (94.78:5.22)

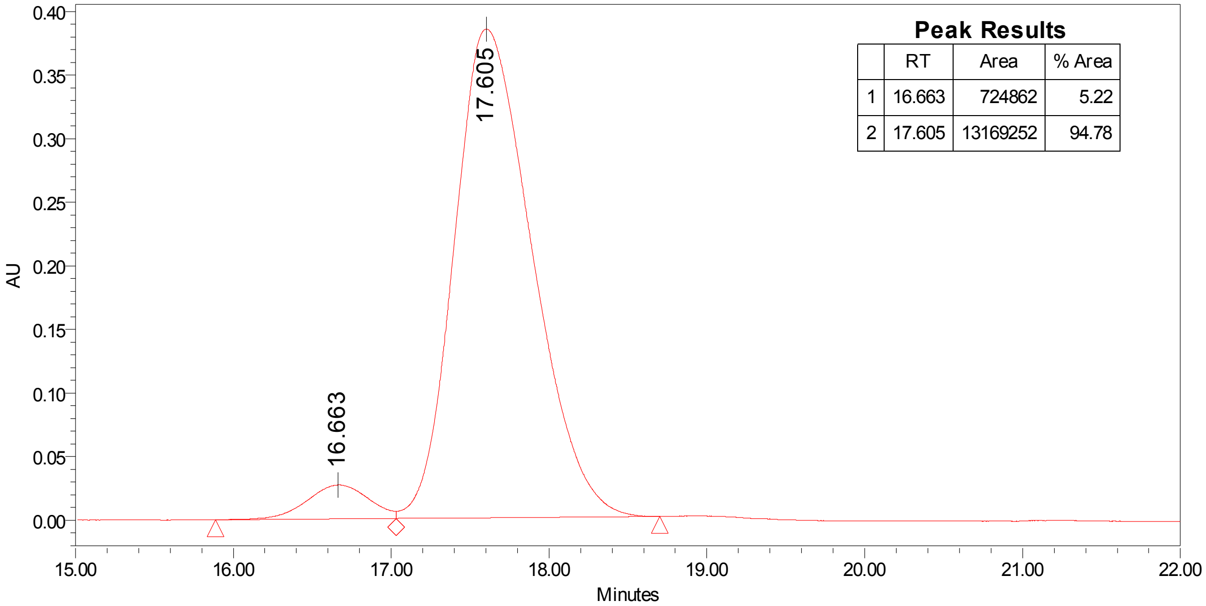
Racemic



Peak Results

	RT	Area	% Area
1	16.850	12801119	50.39
2	17.971	12602644	49.61

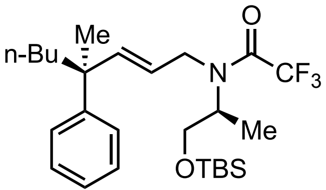
Enantioenriched



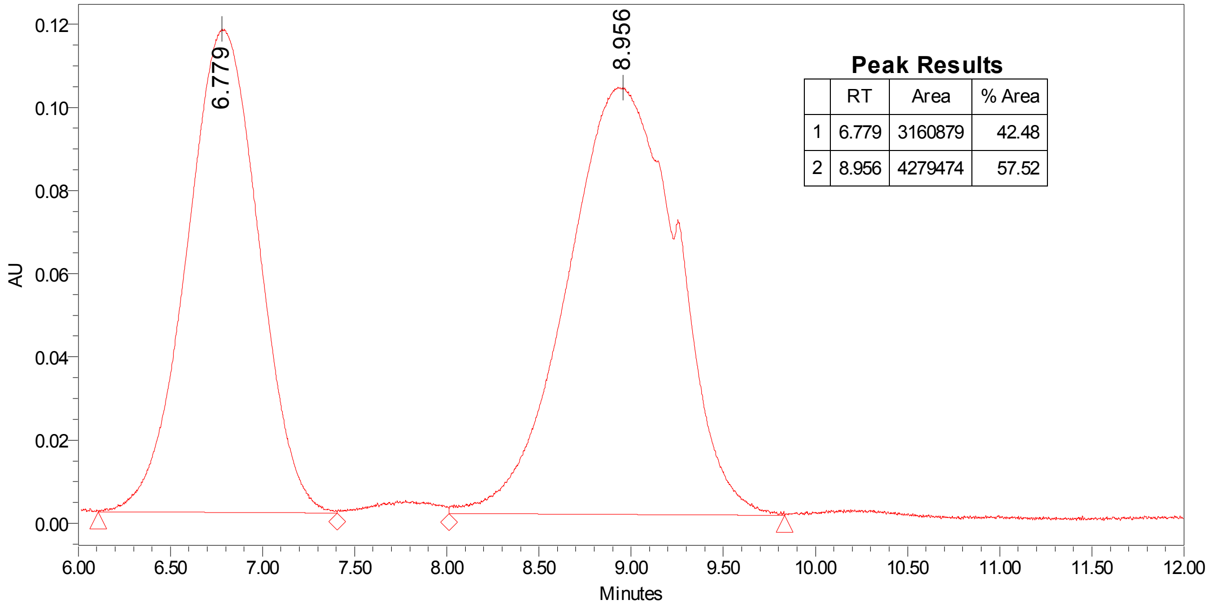
Peak Results

	RT	Area	% Area
1	16.663	724862	5.22
2	17.605	13169252	94.78

12. SFC Traces

Structure	SFC conditions	retention times
 **2p**	OZ-H [99:1 CO_2:IPA, 2 mL/min, 2000 psi]	6.68, 8.85 min (96.91:3.09)

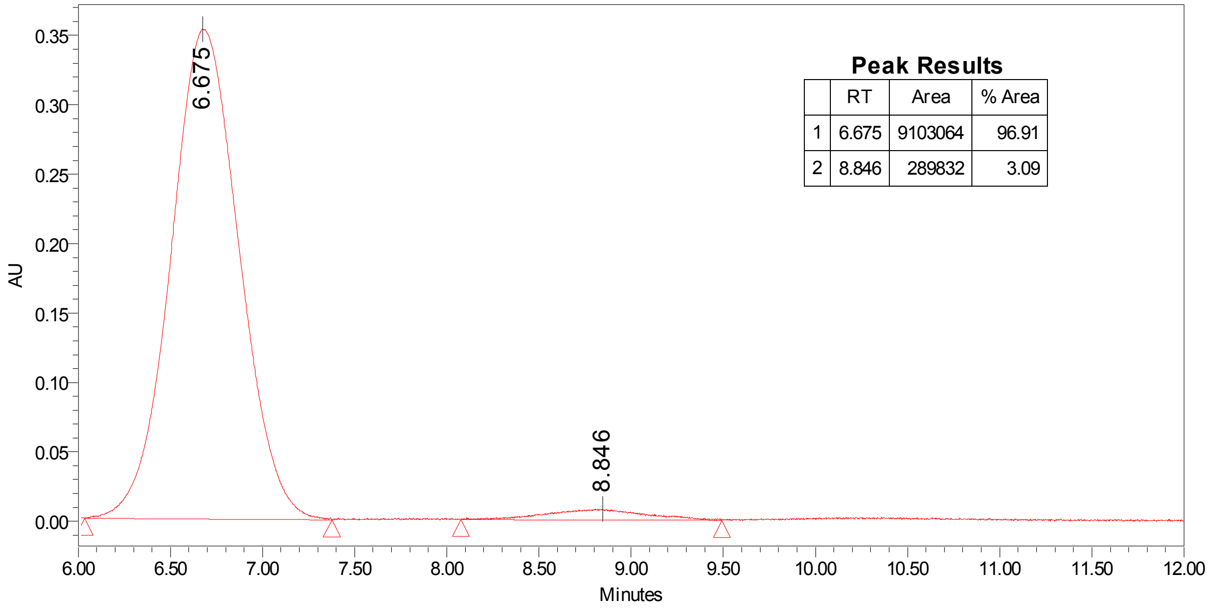
~1:1 mixture of diastereomers



Peak Results

	RT	Area	% Area
1	6.779	3160879	42.48
2	8.956	4279474	57.52

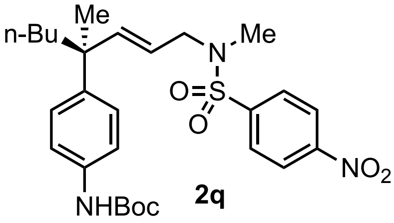
Diastereoselective



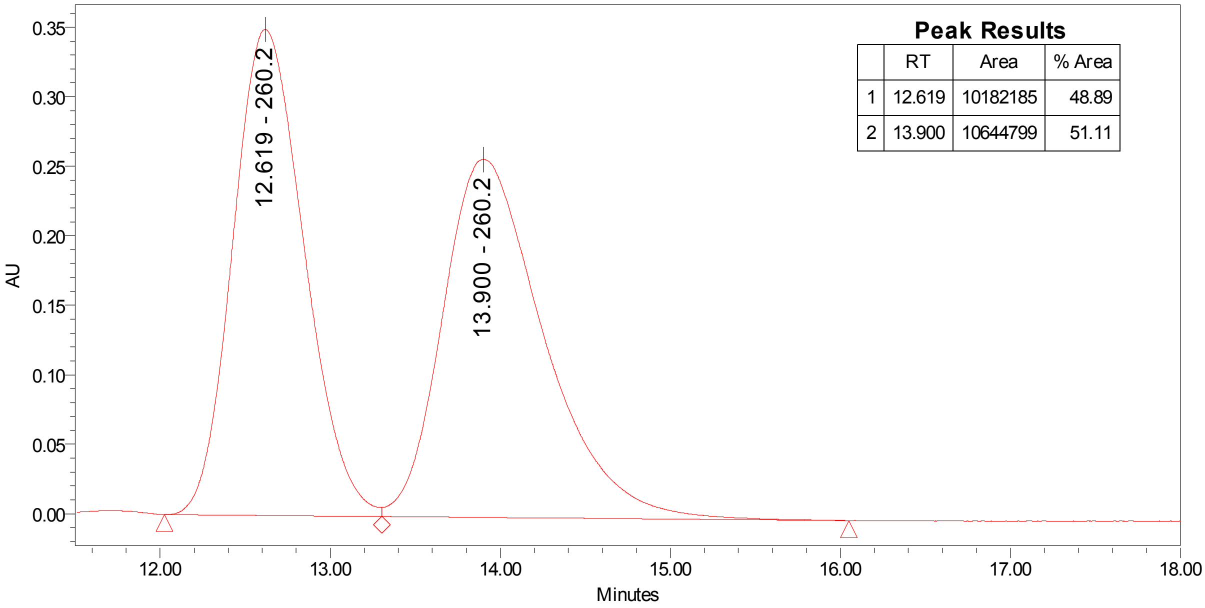
Peak Results

	RT	Area	% Area
1	6.675	9103064	96.91
2	8.846	289832	3.09

12. SFC Traces

Structure	SFC conditions	retention times
 **2q**	AY-H [85:15 to 75:25 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	12.76, 14.16 min (93.24:6.76)

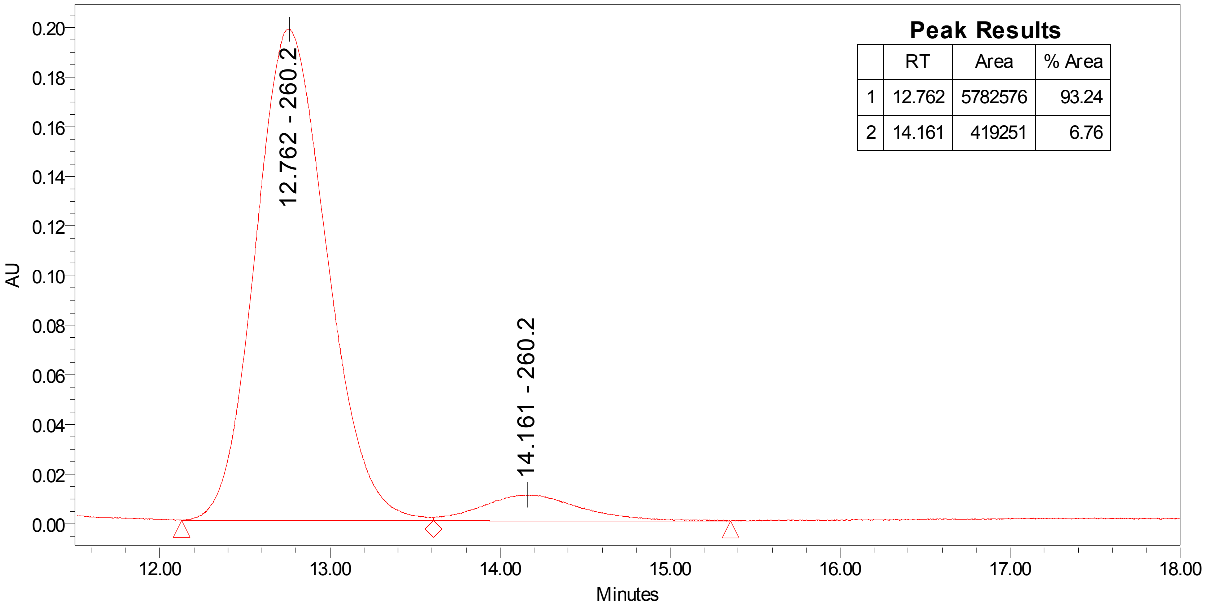
Racemic



Peak Results

	RT	Area	% Area
1	12.619	10182185	48.89
2	13.900	10644799	51.11

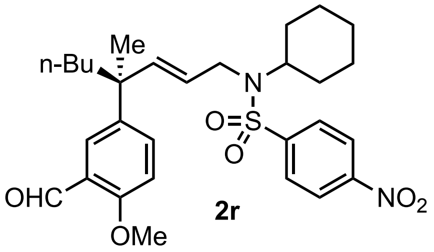
Enantioenriched



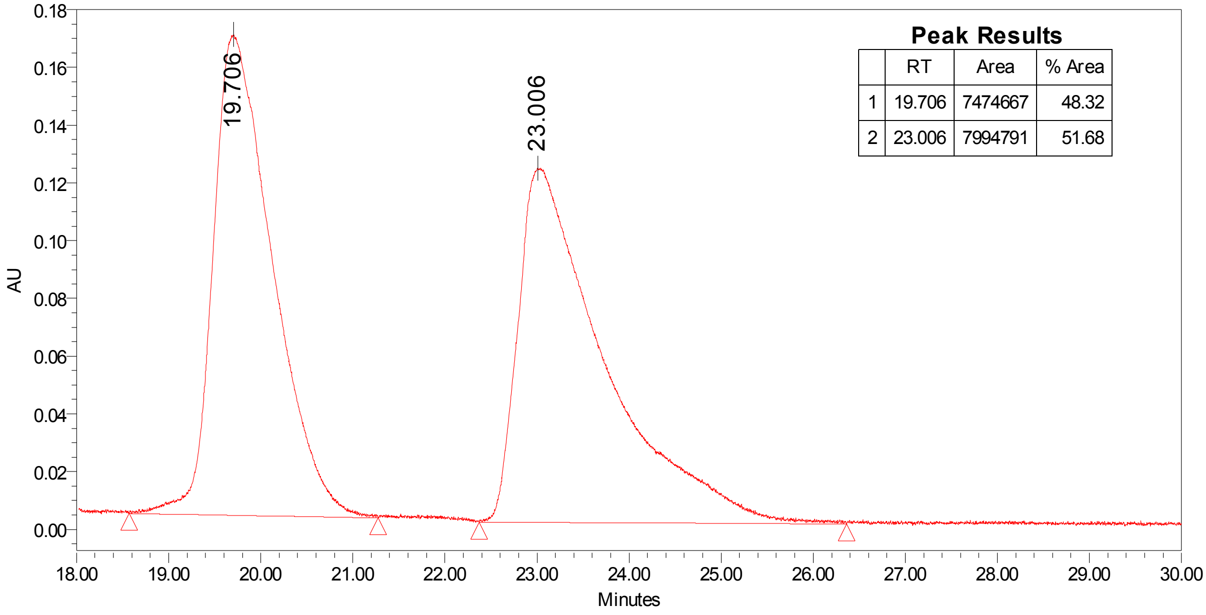
Peak Results

	RT	Area	% Area
1	12.762	5782576	93.24
2	14.161	419251	6.76

12. SFC Traces

Structure	SFC conditions	retention times
 **2r**	CEL-1 [96:4 CO_2:IPA, 2 mL/min, 2000 psi]	22.00, 19.68 min (91.42, 8.58)

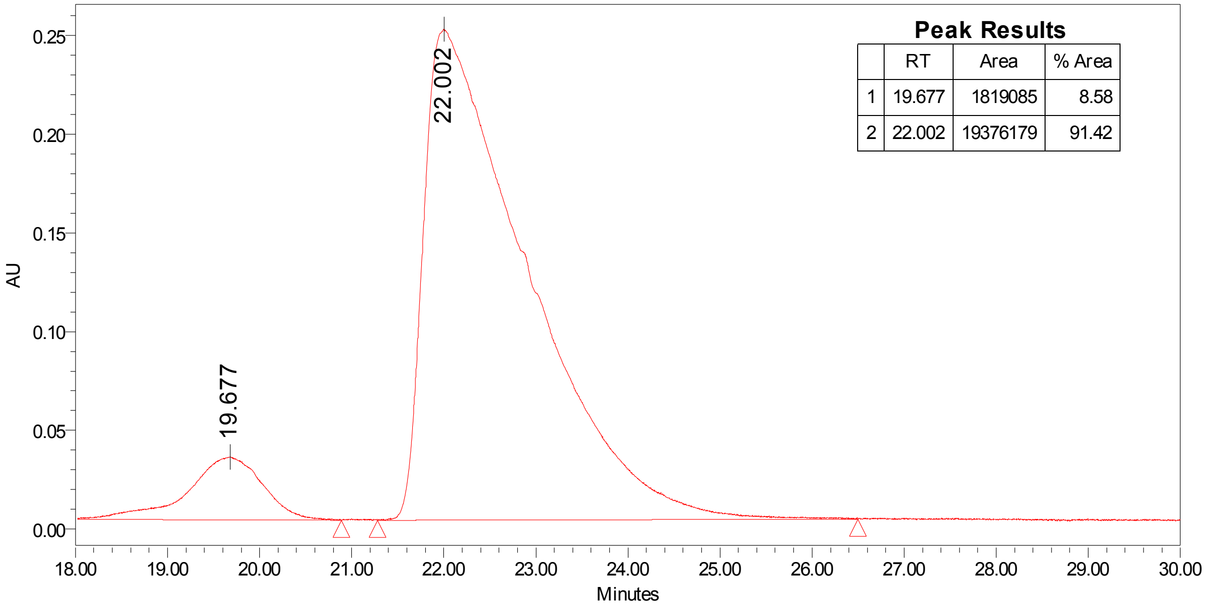
Racemic



Peak Results

	RT	Area	% Area
1	19.706	7474667	48.32
2	23.006	7994791	51.68

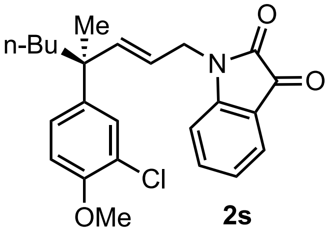
Enantioenriched



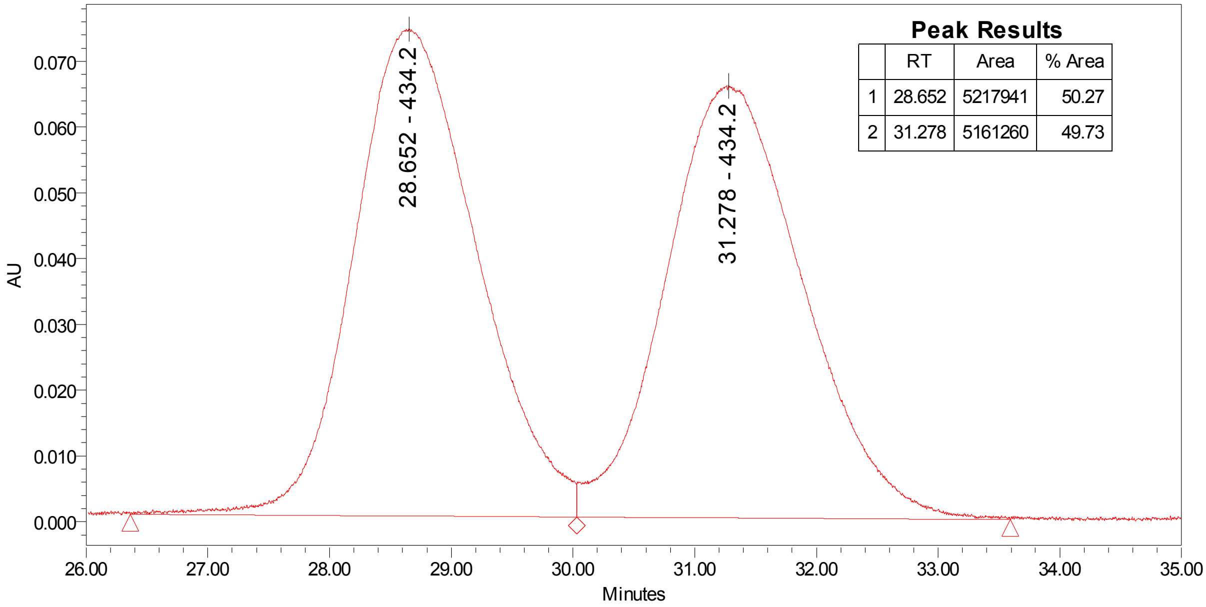
Peak Results

	RT	Area	% Area
1	19.677	1819085	8.58
2	22.002	19376179	91.42

12. SFC Traces

Structure	SFC conditions	retention times
 **2s**	CEL-1 [92:8 CO_2:IPA, 2 mL/min, 3000 psi]	30.88, 28.73 min (95.90, 4.10)

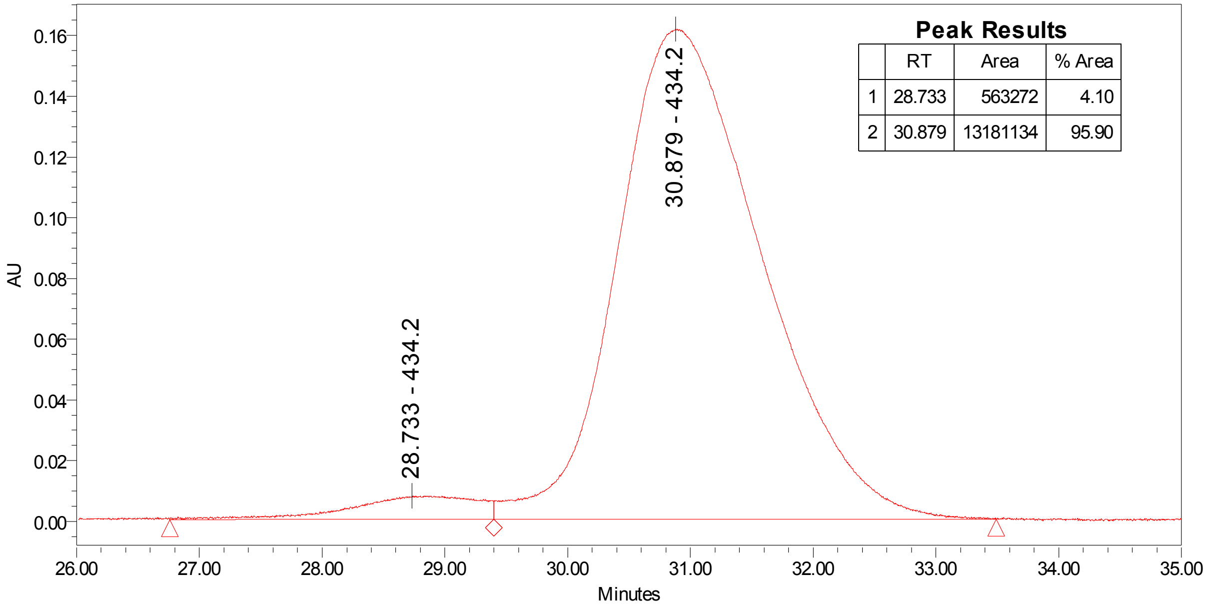
Racemic



Peak Results

	RT	Area	% Area
1	28.652	5217941	50.27
2	31.278	5161260	49.73

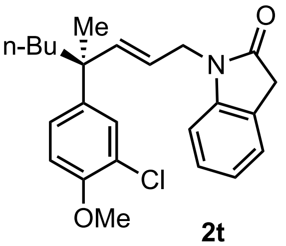
Enantioenriched



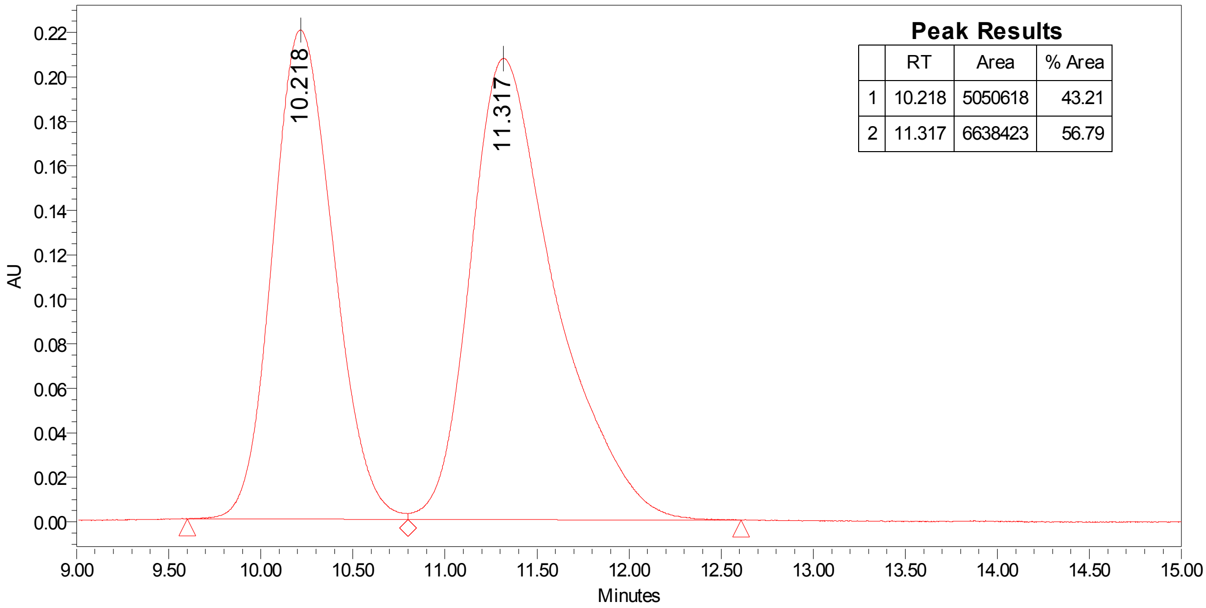
Peak Results

	RT	Area	% Area
1	28.733	563272	4.10
2	30.879	13181134	95.90

12. SFC Traces

Structure	SFC conditions	retention times
 **2t**	AY-H [90:10 to 85:15 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	11.23, 10.26 min (97.10:2.90)

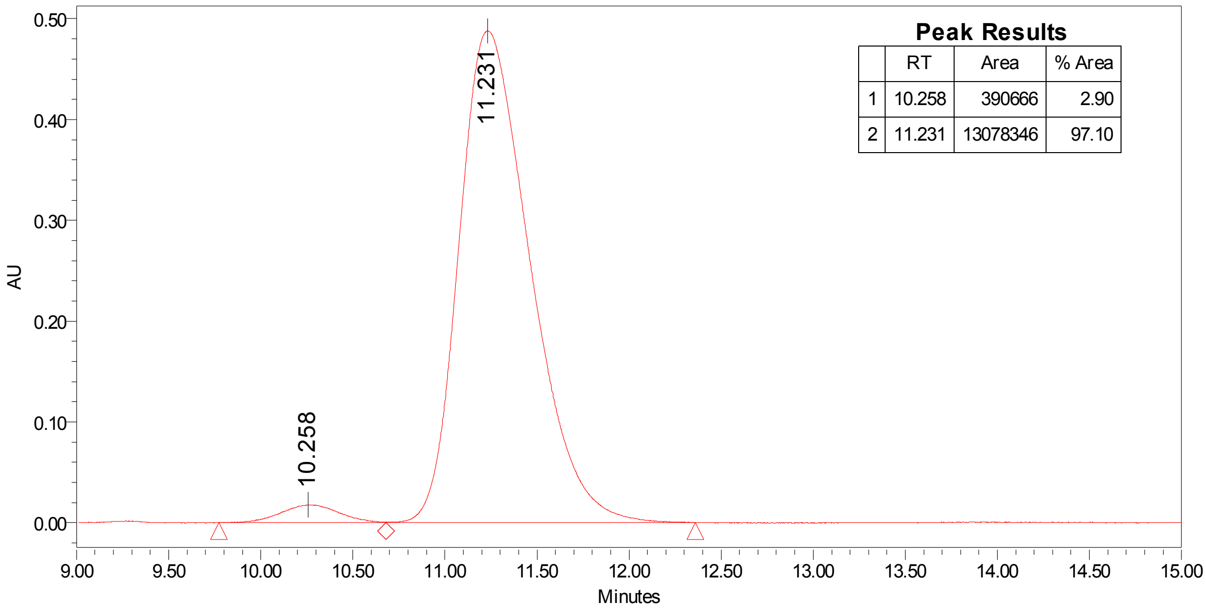
Racemic



Peak Results

	RT	Area	% Area
1	10.218	5050618	43.21
2	11.317	6638423	56.79

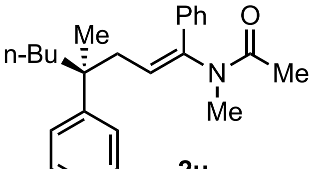
Enantioenriched



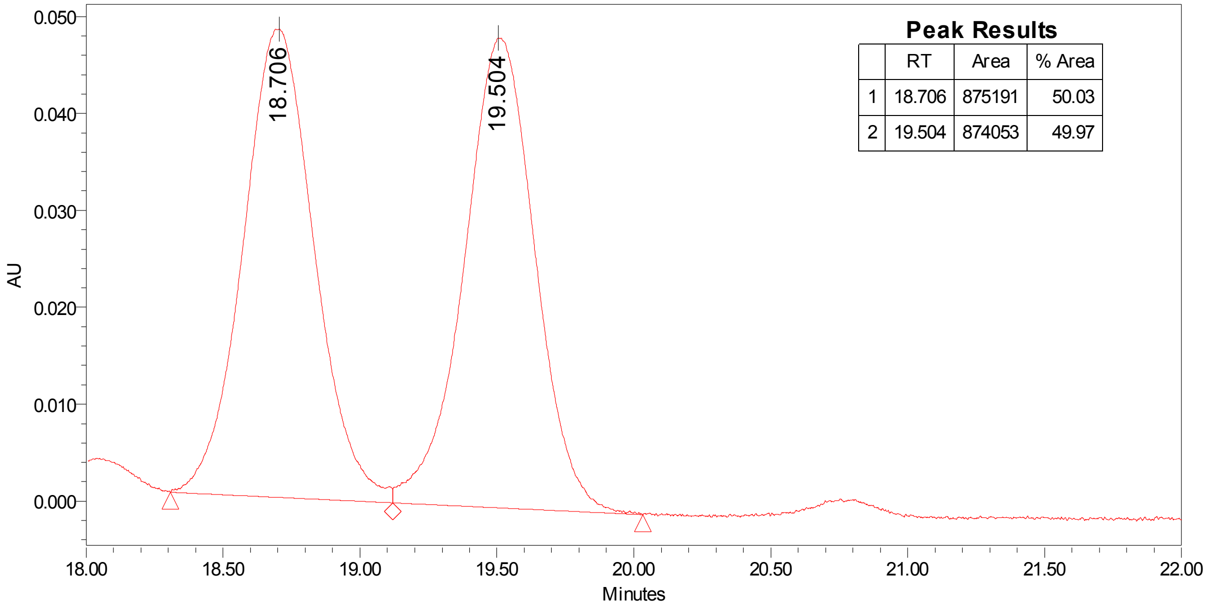
Peak Results

	RT	Area	% Area
1	10.258	390666	2.90
2	11.231	13078346	97.10

12. SFC Traces

Structure	SFC conditions	retention times
 **2u**	OZ-H [99:1 to 80:20 CO_2:IPA, 30 min, 2 mL/min, 2320 psi]	18.69, 19.56 min (99.05:0.95)

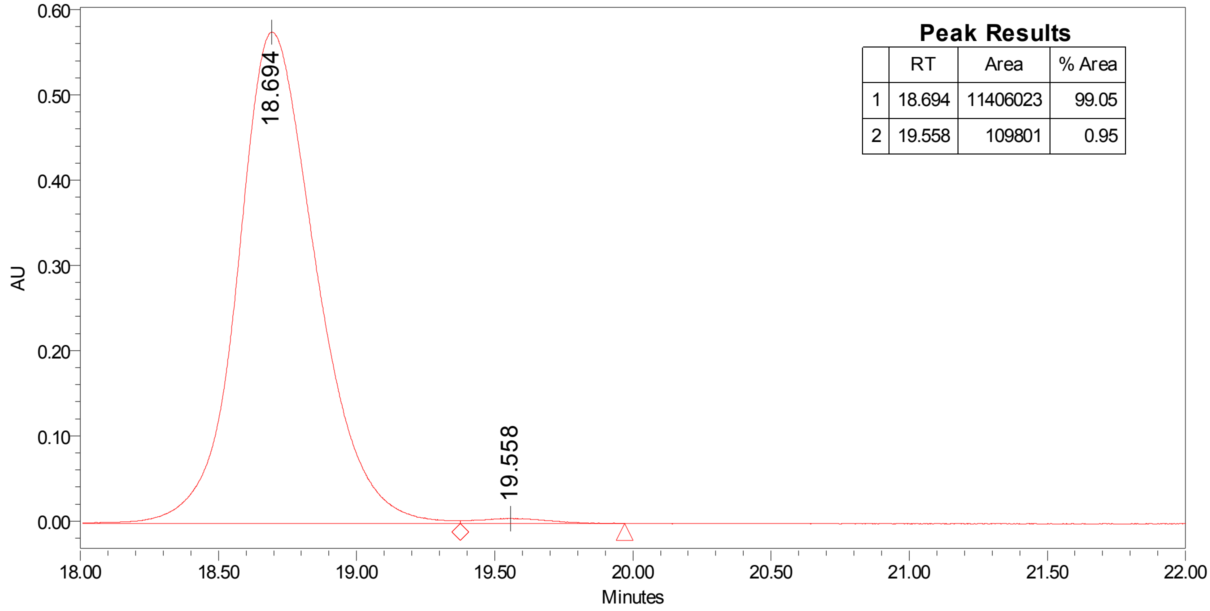
Racemic



Peak Results

	RT	Area	% Area
1	18.706	875191	50.03
2	19.504	874053	49.97

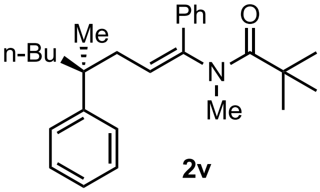
Enantioenriched



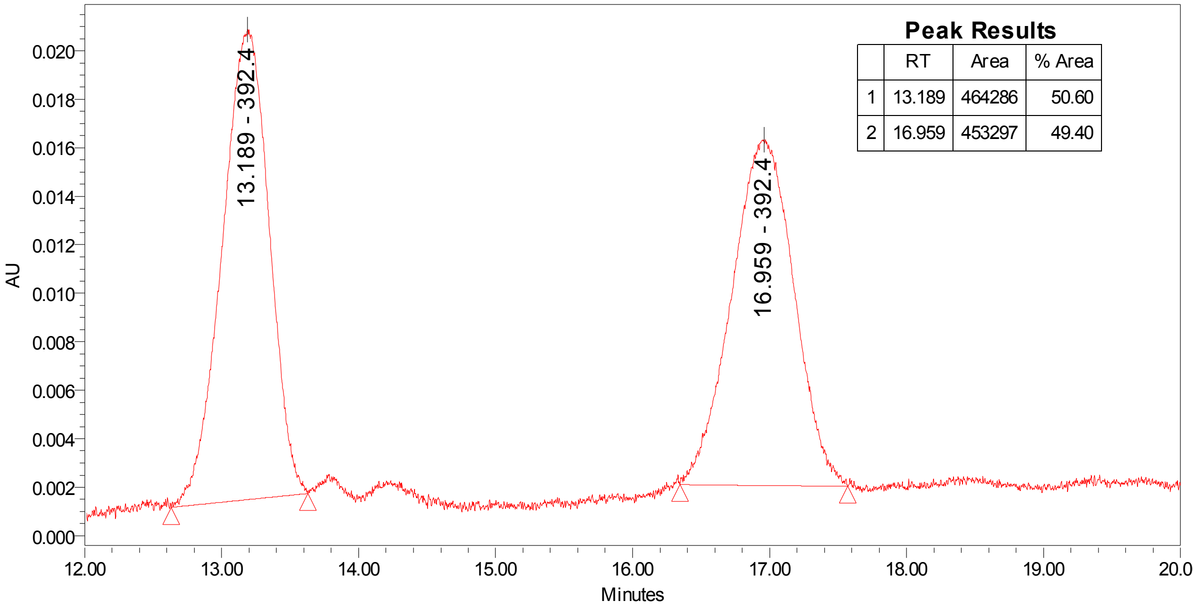
Peak Results

	RT	Area	% Area
1	18.694	11406023	99.05
2	19.558	109801	0.95

12. SFC Traces

Structure	SFC conditions	retention times
 **2v**	OZ-H [95:5 to 75:25 CO$_2$:IPA, 30 min, 2 mL/min, 2320 psi]	13.16, 16.97 min (98.71:1.29)

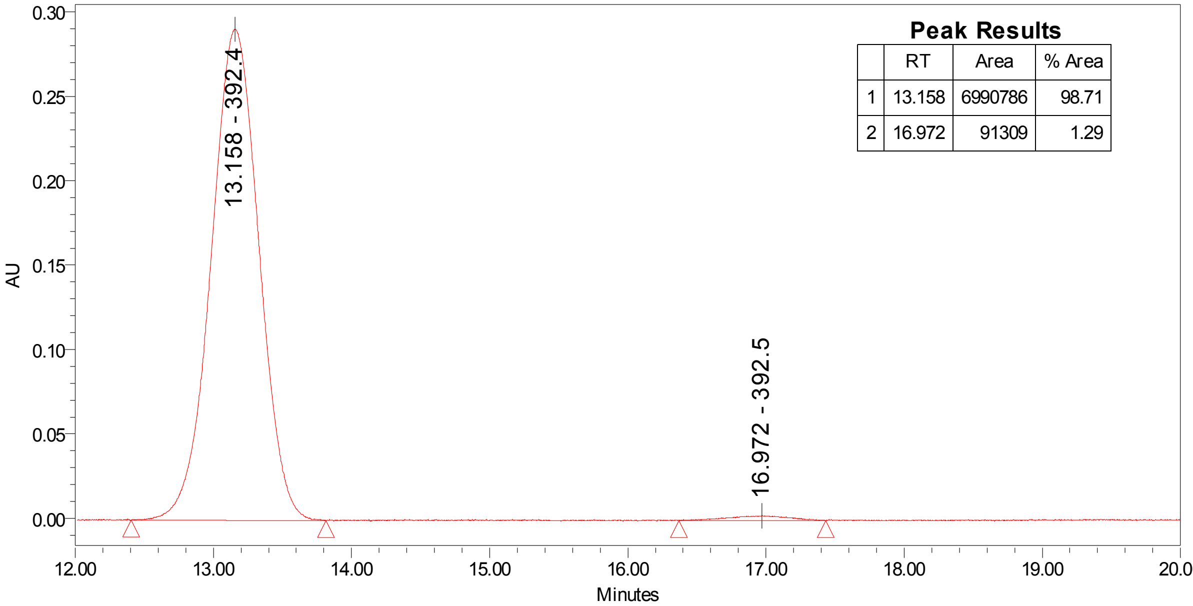
Racemic



Peak Results

	RT	Area	% Area
1	13.189	464286	50.60
2	16.959	453297	49.40

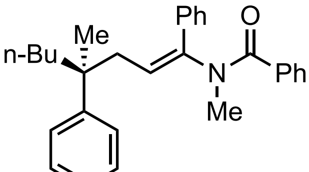
Enantioenriched



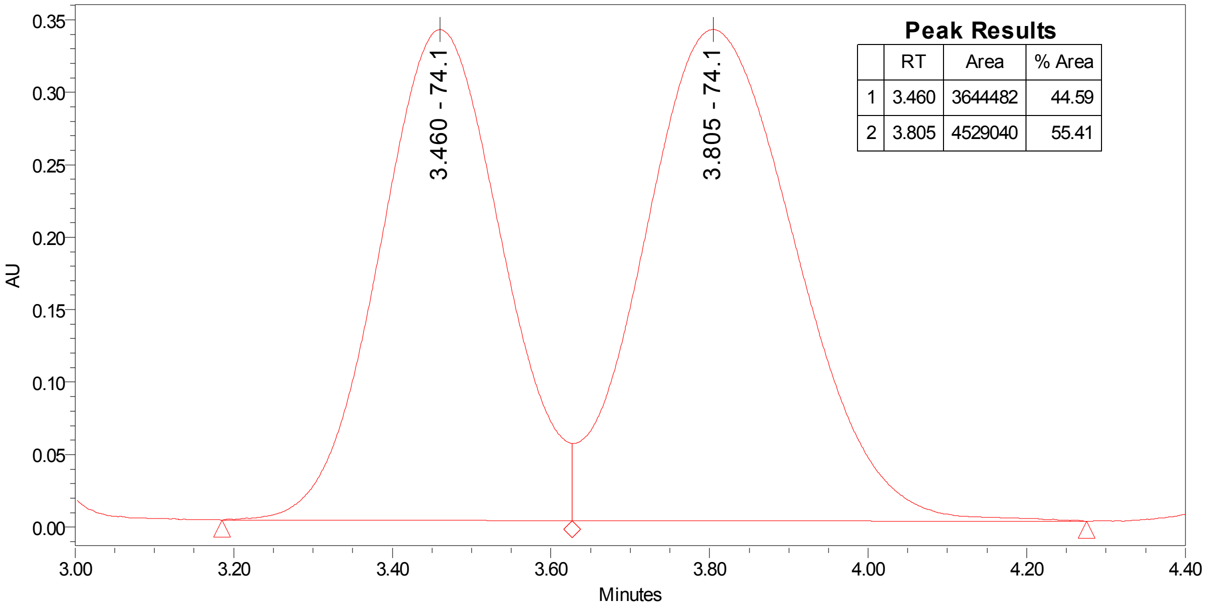
Peak Results

	RT	Area	% Area
1	13.158	6990786	98.71
2	16.972	91309	1.29

12. SFC Traces

Structure	SFC conditions	retention times
 **2w**	AS-H [85:15 to 75:25 CO_2:IPA, 20 min, 2 mL/min, 2320 psi]	3.64, 3.32 min (99.58, 0.42)

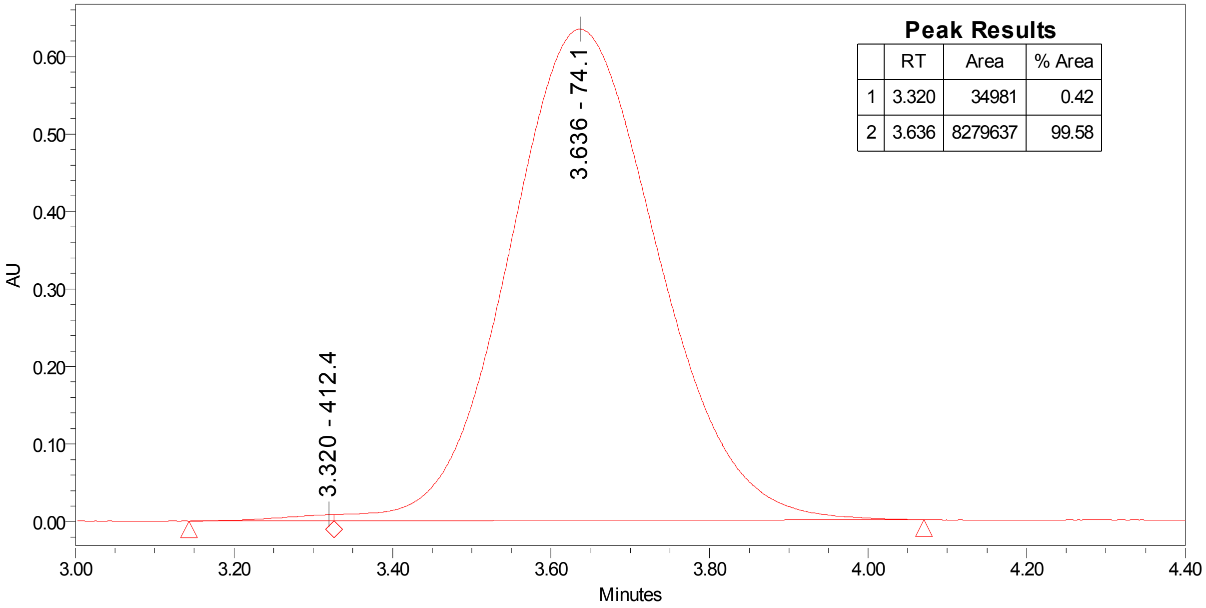
Racemic



Peak Results

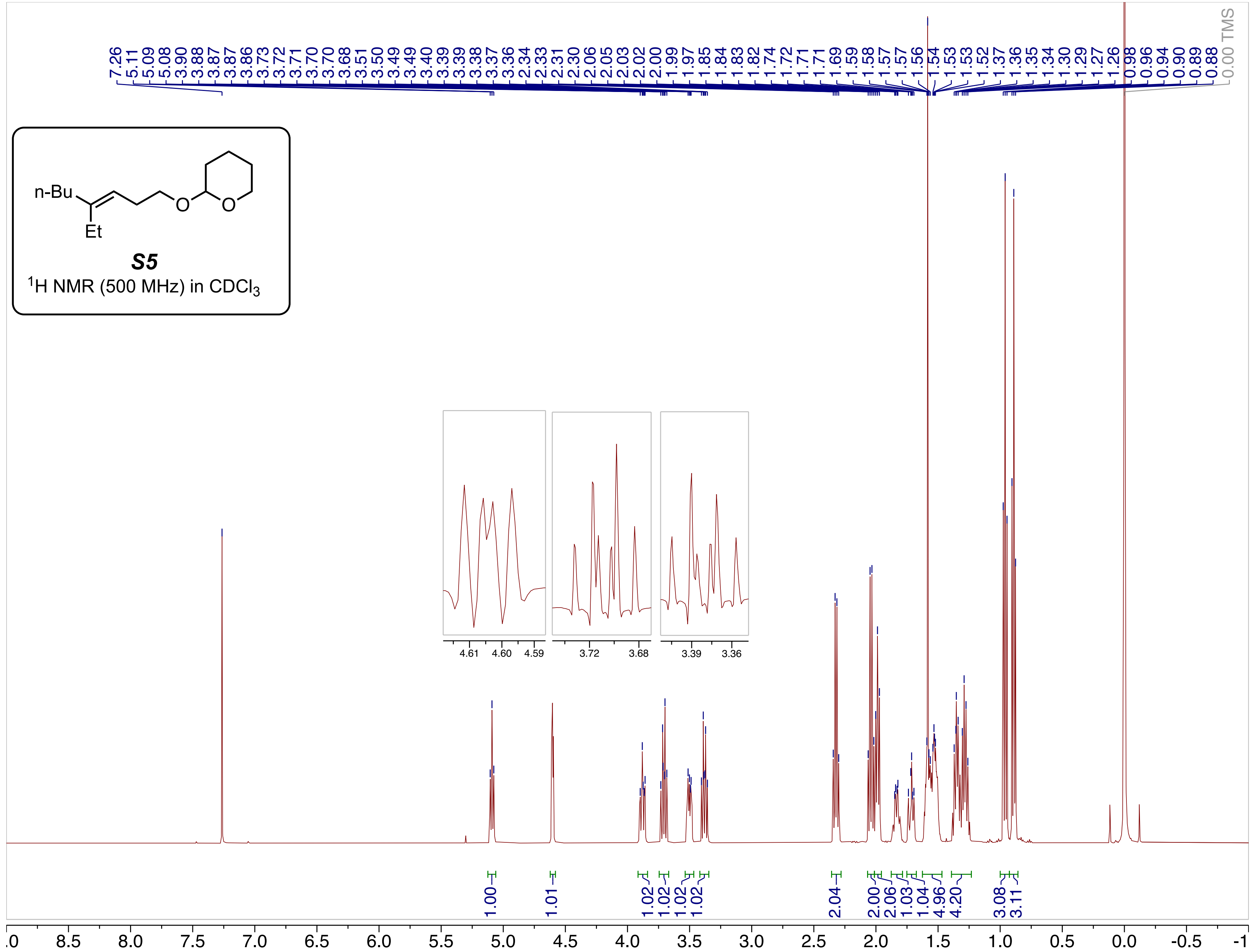
	RT	Area	% Area
1	3.460	3644482	44.59
2	3.805	4529040	55.41

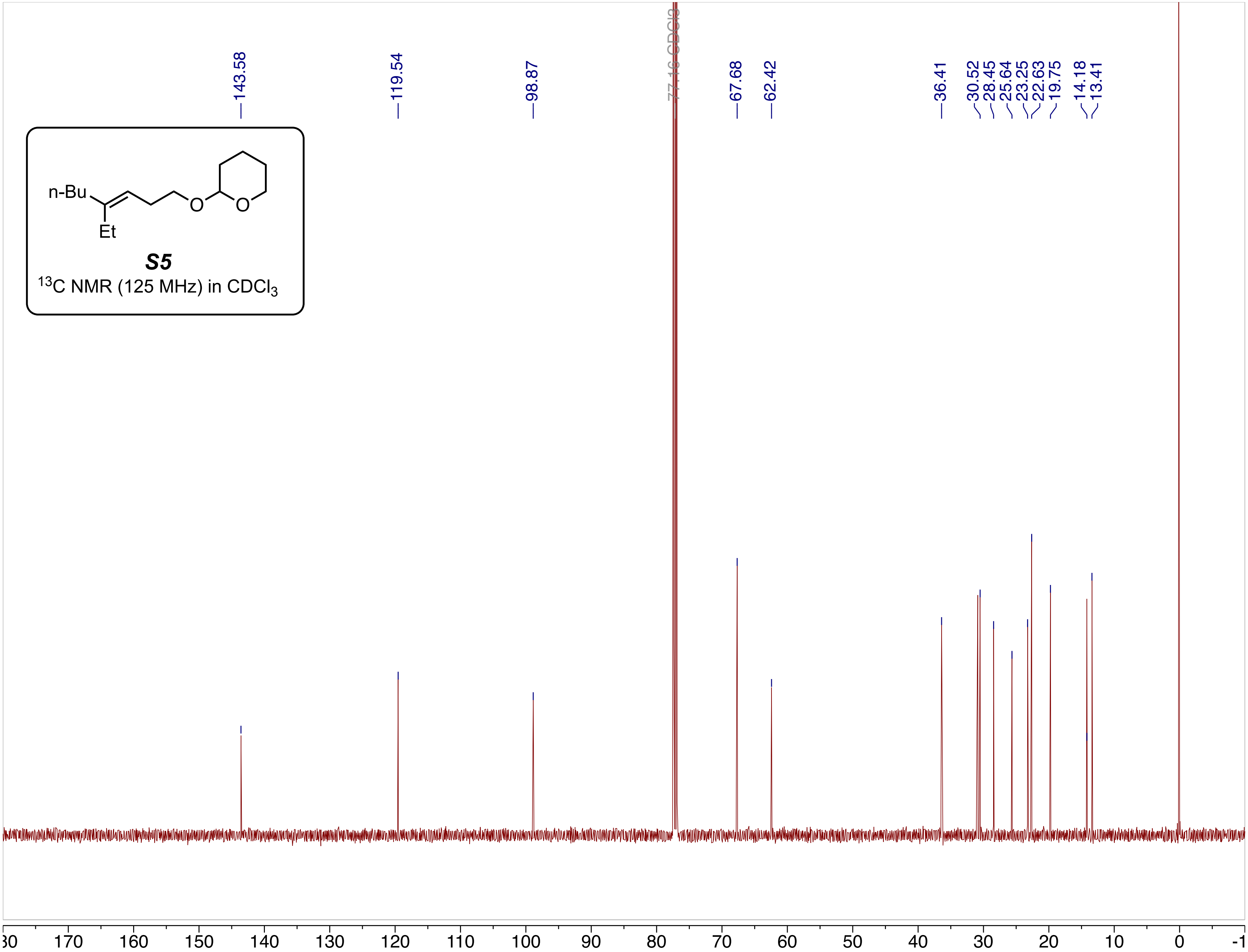
Enantioenriched

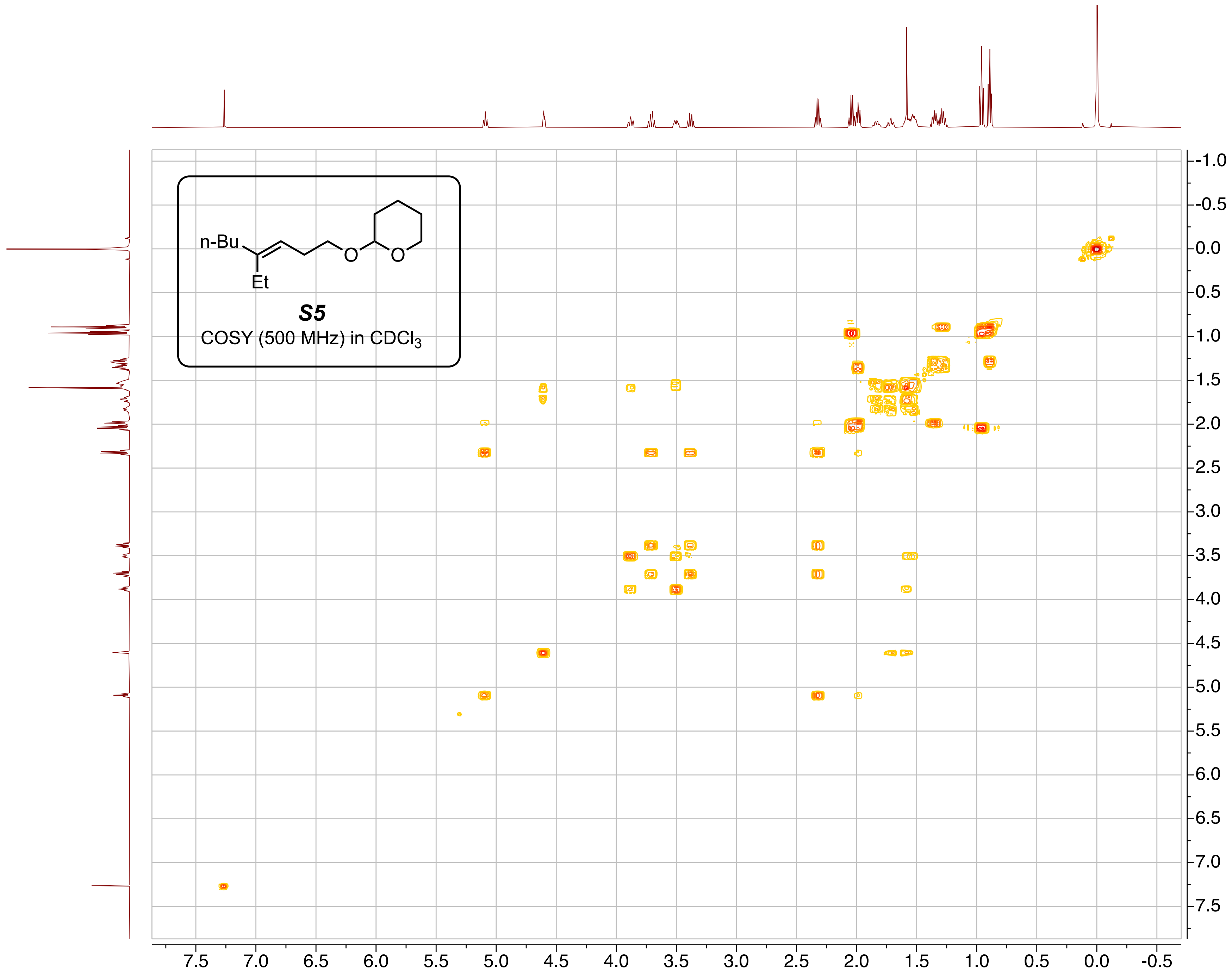


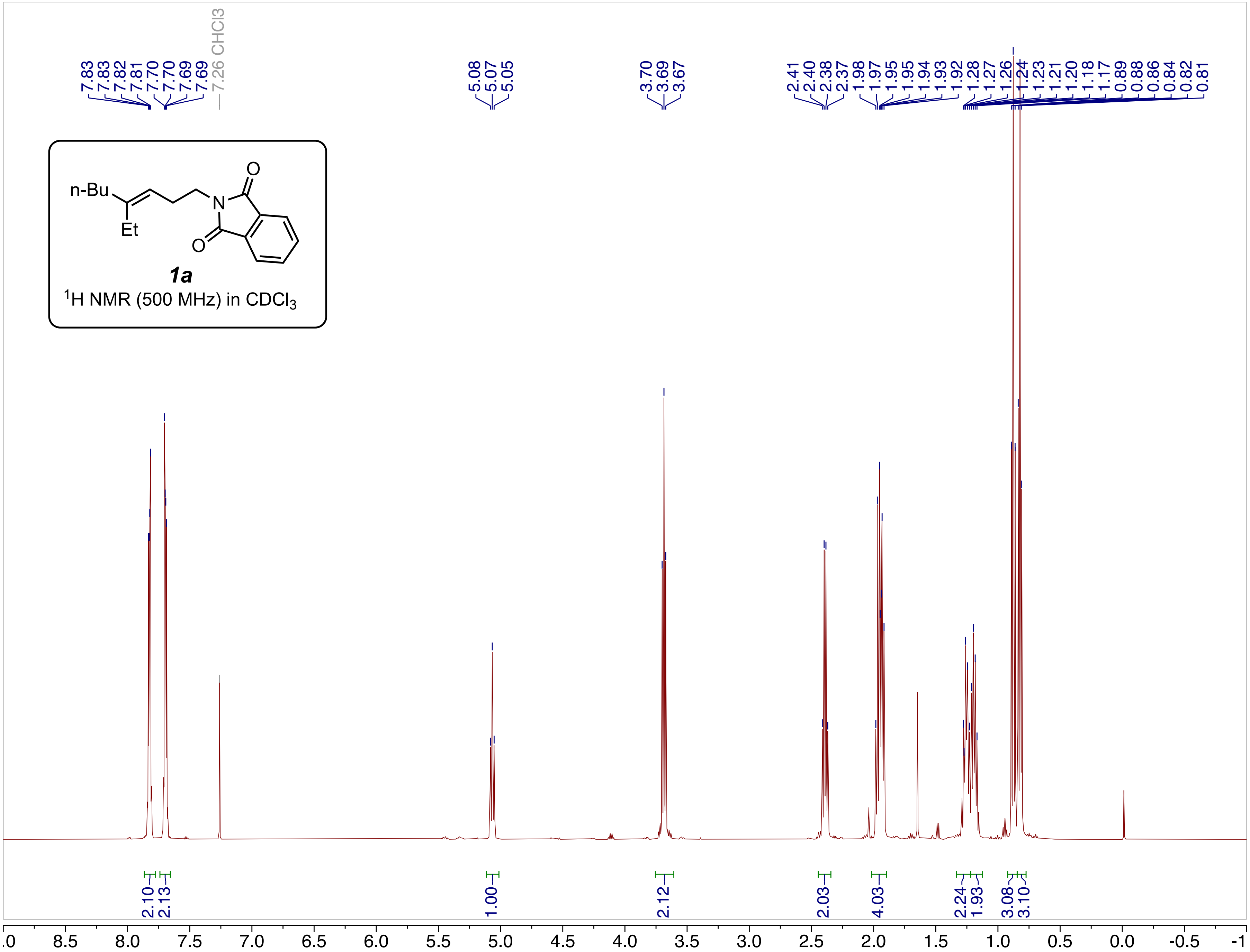
Peak Results

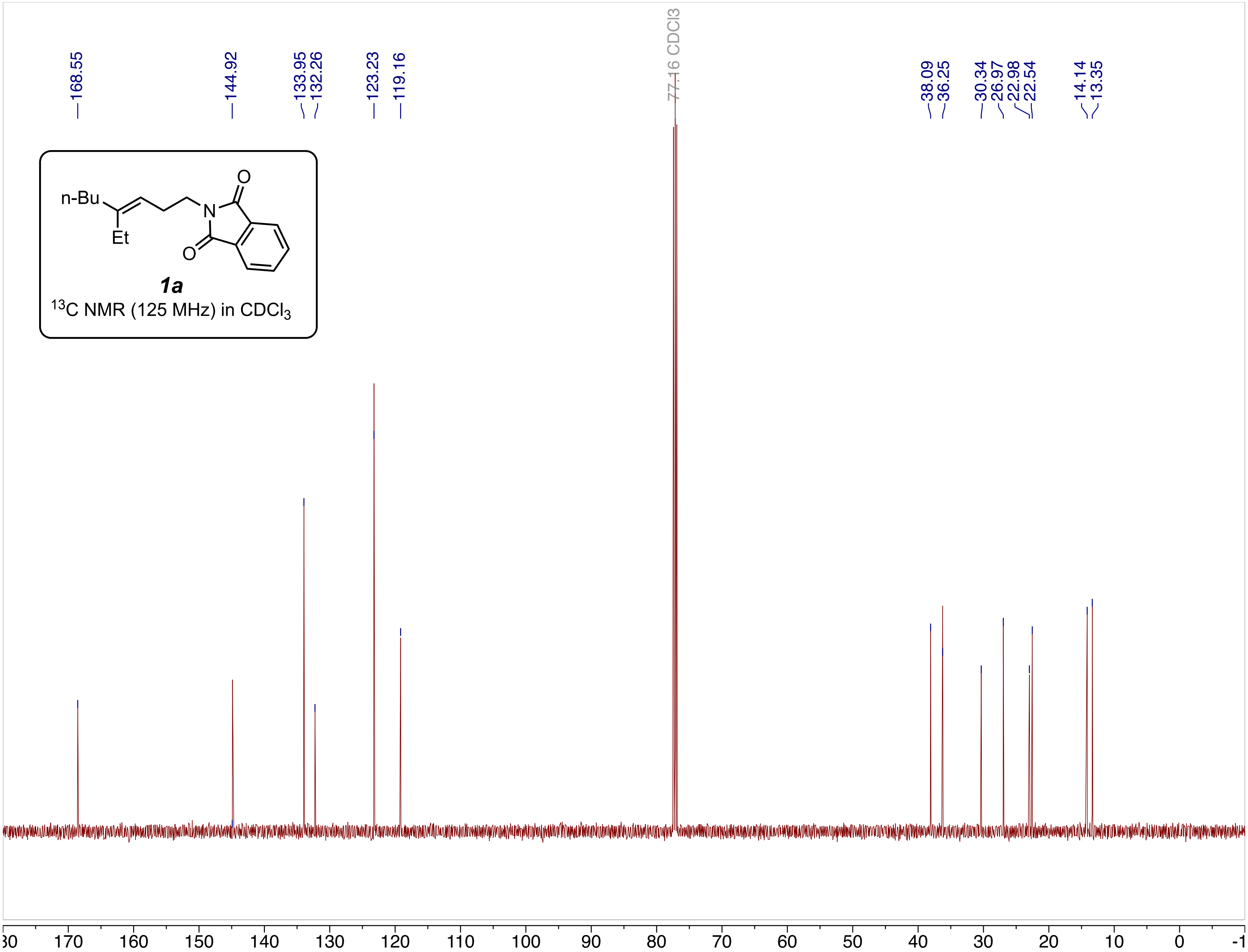
	RT	Area	% Area
1	3.320	34981	0.42
2	3.636	8279637	99.58

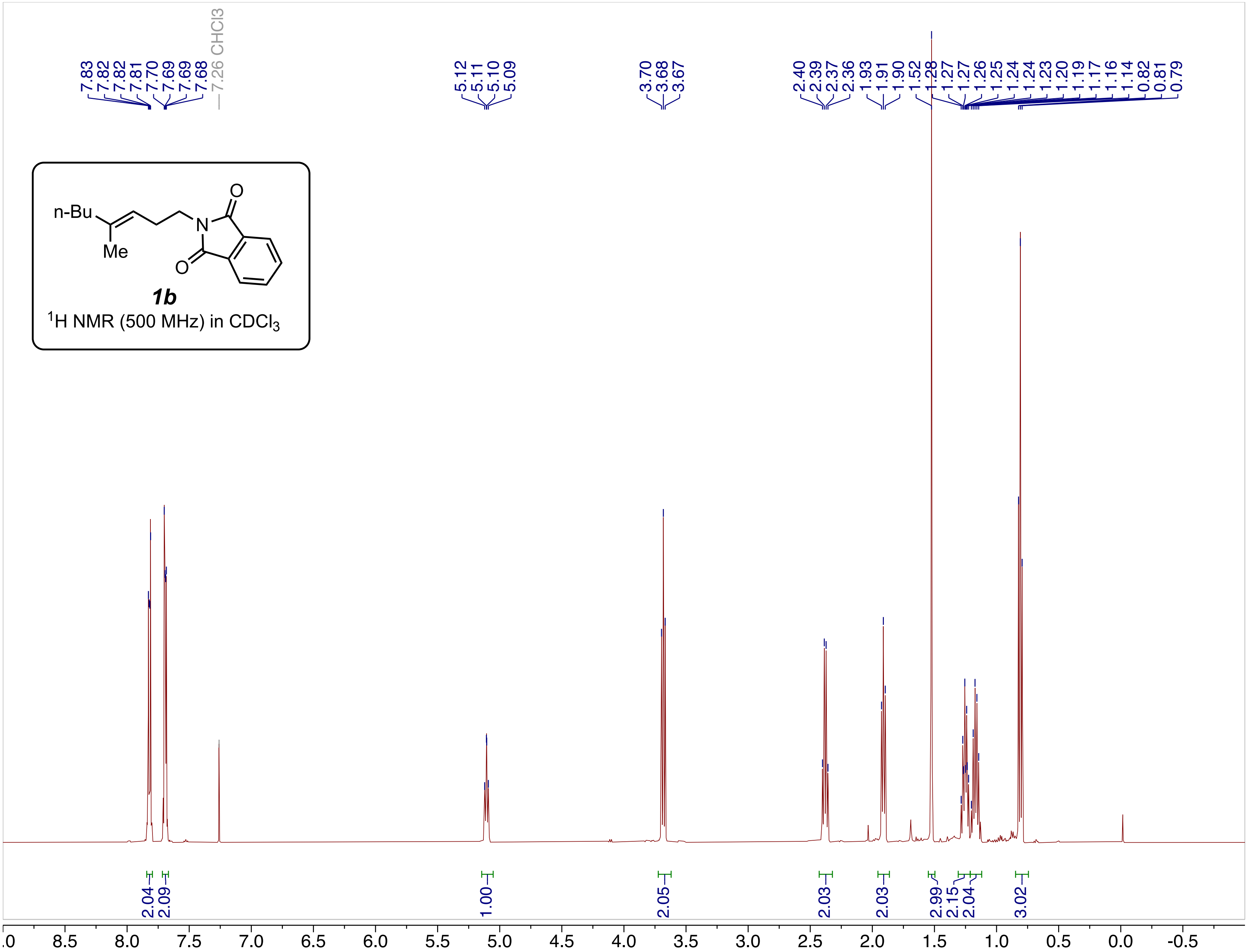
7.26
5.11
5.09
5.08
3.90
3.88
3.87
3.86
3.73
3.72
3.71
3.70
3.70
3.68
3.51
3.50
3.49
3.49
3.40
3.39
3.39
3.38
3.37
3.36
2.34
2.33
2.31
2.30
2.06
2.05
2.03
2.02
2.00
1.99
1.97
1.85
1.84
1.83
1.82
1.74
1.72
1.71
1.71
1.69
1.59
1.58
1.57
1.57
1.56
1.54
1.53
1.53
1.52
1.37
1.36
1.35
1.34
1.30
1.29
1.27
1.26
0.98
0.96
0.94
0.90
0.89
0.88
0.00 TMS
n-Bu
Et
O
O
S5
^{1}H NMR (500 MHz) in CDCl$_3$
4.61
4.60
4.59
3.72
3.68
3.39
3.36
1.00
1.01
1.02
1.02
1.02
1.02
2.04
2.00
2.06
1.03
1.04
4.96
4.20
3.08
3.11
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


143.58
119.54
98.87
77.16 CDCl3
67.68
62.42
36.41
30.52
28.45
25.64
23.25
22.63
19.75
14.18
13.41
n-Bu
Et
O
O
S5
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


n-Bu
Et
O
O
S5
COSY (500 MHz) in CDCl3
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5

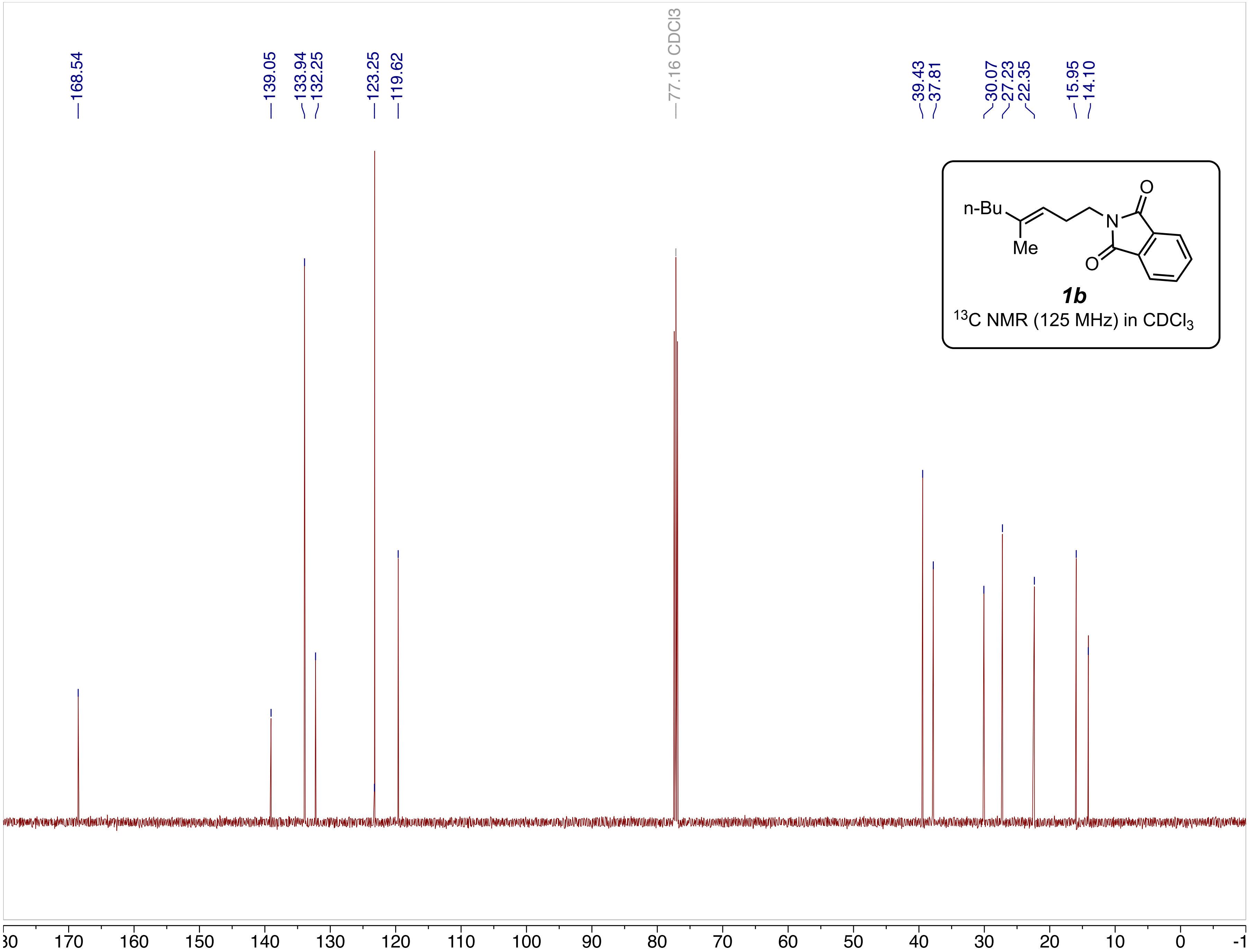

7.83
7.83
7.82
7.81
7.70
7.70
7.69
7.69
7.26 CHCl3
5.08
5.07
5.05
3.70
3.69
3.67
2.41
2.40
2.38
2.37
1.98
1.97
1.95
1.95
1.94
1.93
1.92
1.28
1.27
1.26
1.24
1.23
1.21
1.20
1.18
1.17
0.89
0.88
0.86
0.84
0.82
0.81
n-Bu
Et
N
O
O
1a
^{1}H NMR (500 MHz) in CDCl$_3$
2.10
2.13
1.00
2.12
2.03
4.03
2.24
1.93
3.08
3.10
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

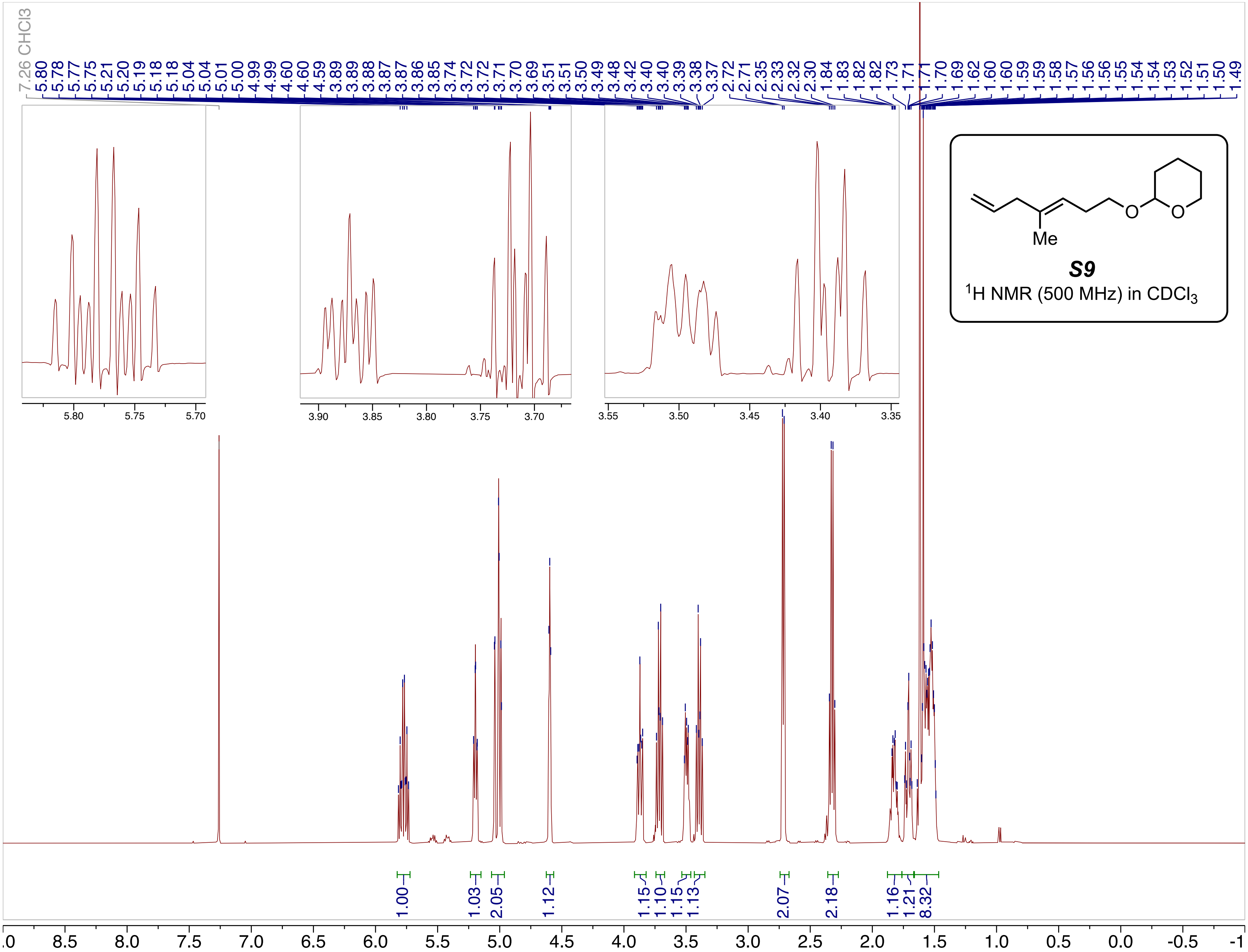

168.55
144.92
133.95
132.26
123.23
119.16
77.16 CDCl3
38.09
36.25
30.34
26.97
22.98
22.54
14.14
13.35
n-Bu
Et
N
O
O
1a
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

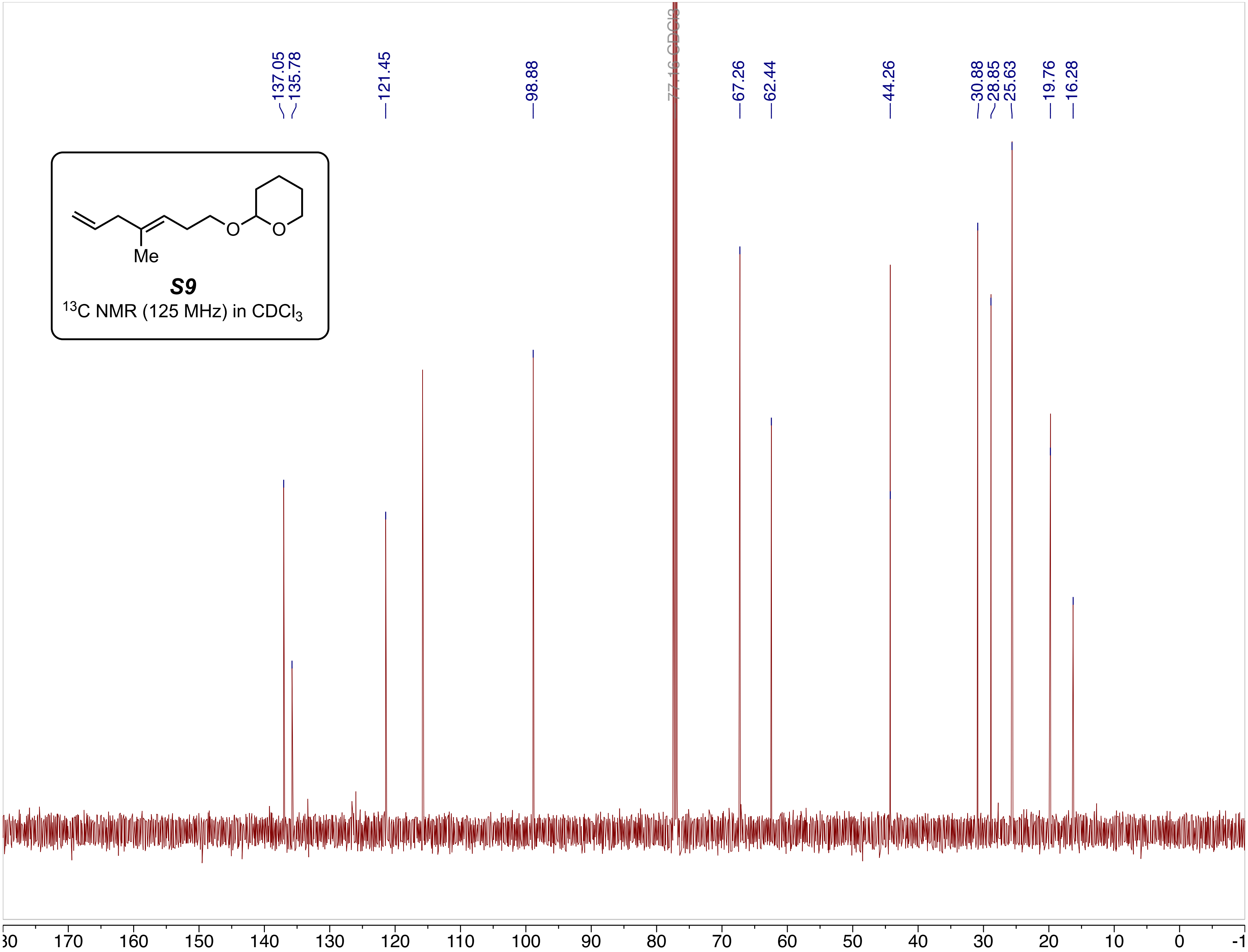


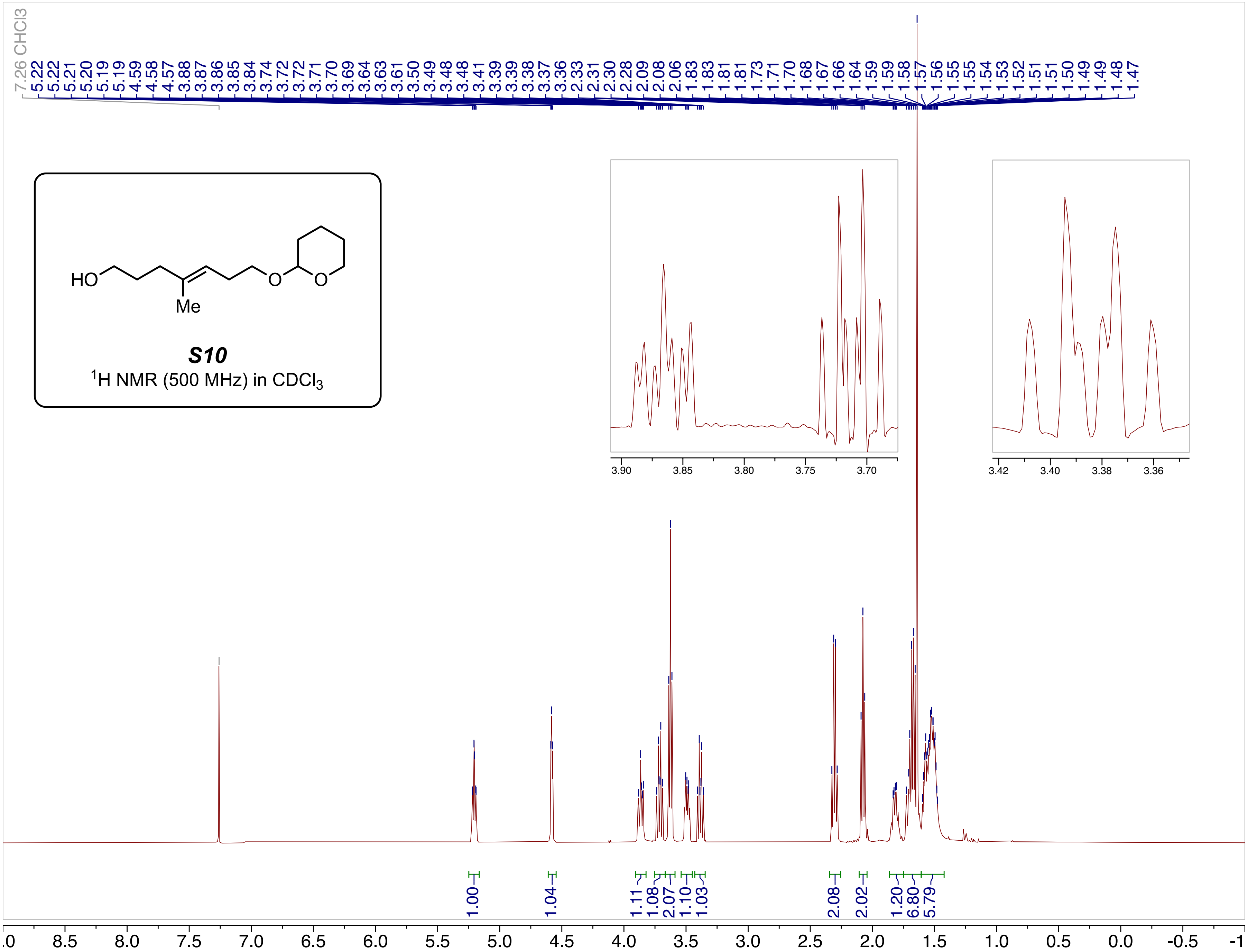
1b

^{1}H NMR (500 MHz) in $CDCl_3$


168.54
139.05
133.94
132.25
123.25
119.62
77.16 CDCl3
39.43
37.81
30.07
27.23
22.35
15.95
14.10
n-Bu
Me
N
O
O
1b
^{13}C NMR (125 MHz) in $CDCl_3$
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

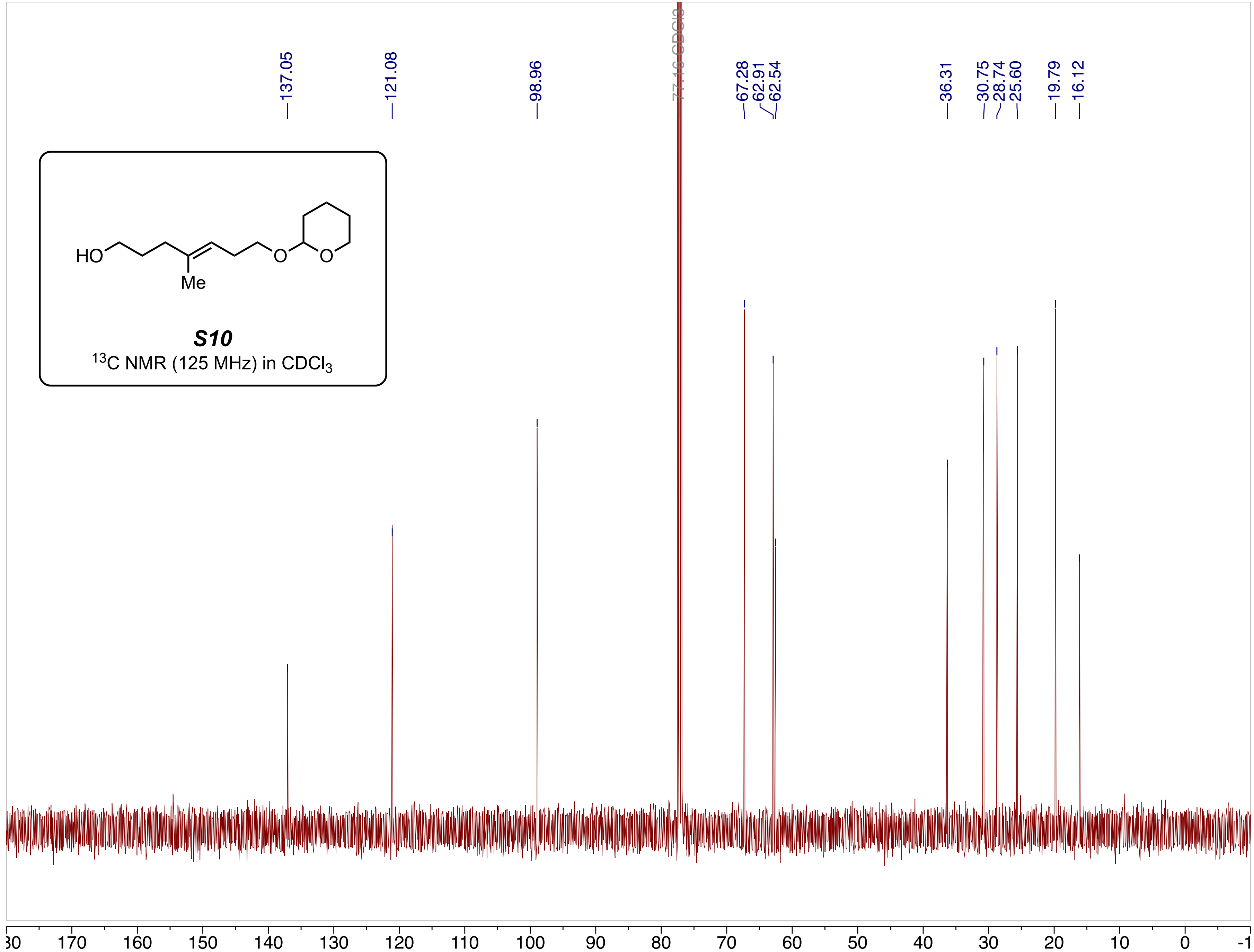

7.26 CHCl3
5.80 5.78 5.77 5.75 5.21 5.20 5.19 5.18 5.18 5.04 5.04 5.01 5.00 4.99 4.99 4.60 4.60 4.59 3.89 3.89 3.88 3.87 3.87 3.86 3.85 3.74 3.72 3.72 3.71 3.70 3.69 3.51 3.51 3.50 3.49 3.48 3.42 3.40 3.40 3.39 3.38 3.37 2.72 2.71 2.35 2.33 2.32 2.30 1.84 1.83 1.82 1.82 1.73 1.71 1.71 1.70 1.69 1.62 1.60 1.60 1.59 1.59 1.58 1.57 1.56 1.56 1.55 1.54 1.54 1.53 1.52 1.51 1.50 1.49
5.80 5.75 5.70
3.90 3.85 3.80 3.75 3.70
3.55 3.50 3.45 3.40 3.35
Me
O
O
S9
^{1}H NMR (500 MHz) in CDCl$_3$
1.00 1.03 2.05 1.12 1.15 1.10 1.15 1.13 2.07 2.18 1.16 1.21 8.32
.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1


137.05
135.78
121.45
98.88
77.16 CDCl3
67.26
62.44
44.26
30.88
28.85
25.63
19.76
16.28
Me
O
O
S9
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



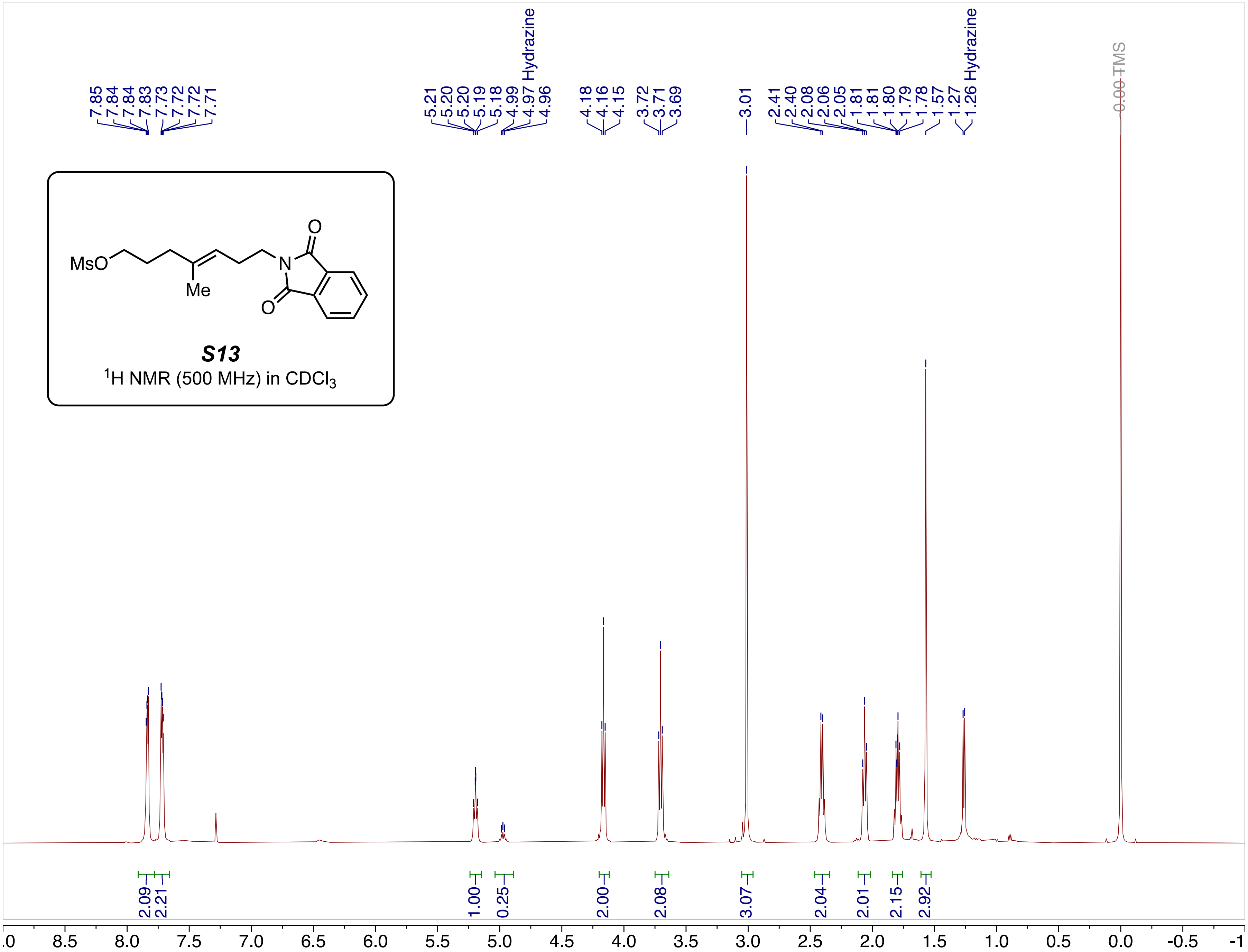
S10

^{1}H NMR (500 MHz) in CDCl$_3$



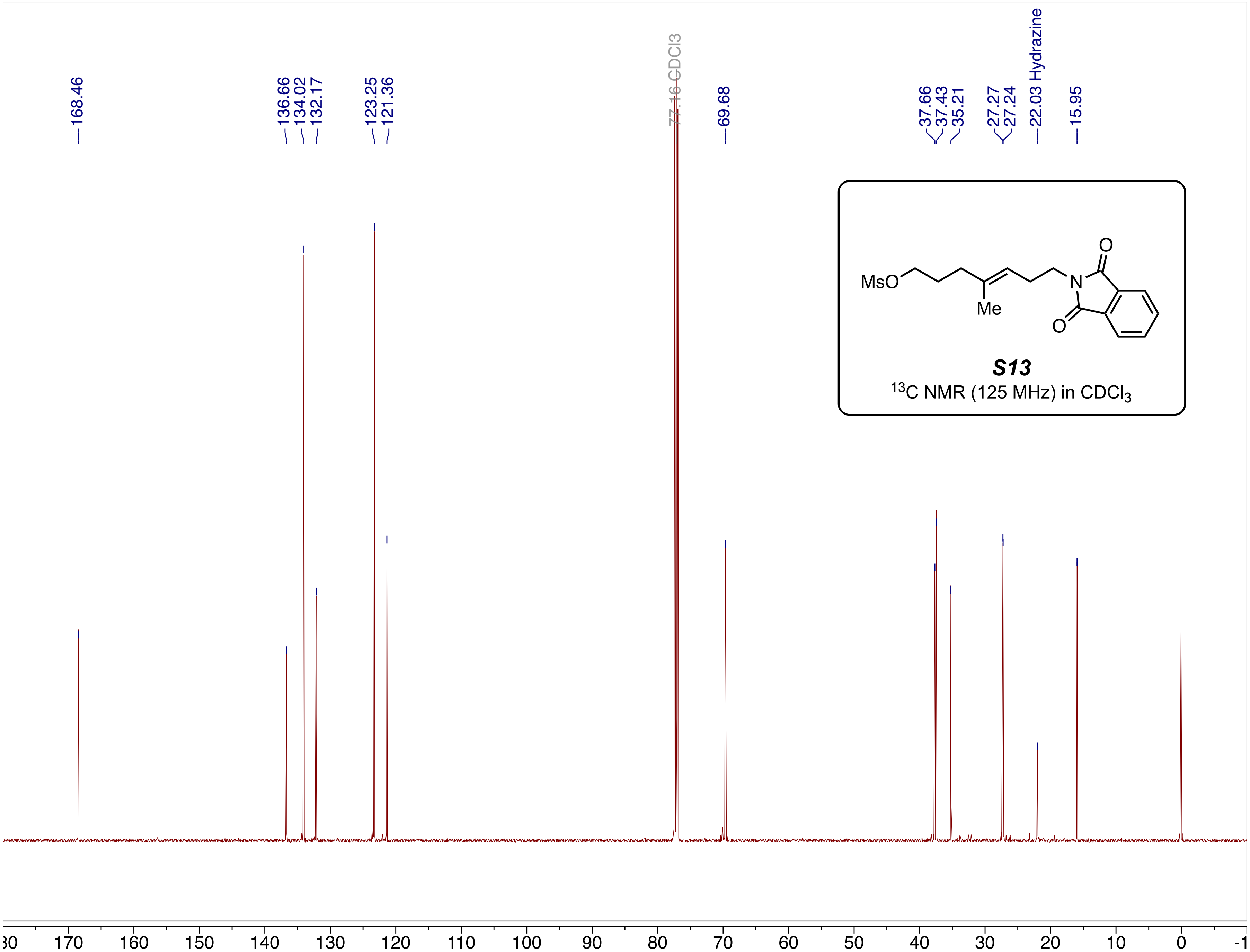
S10

^{13}C NMR (125 MHz) in $CDCl_3$

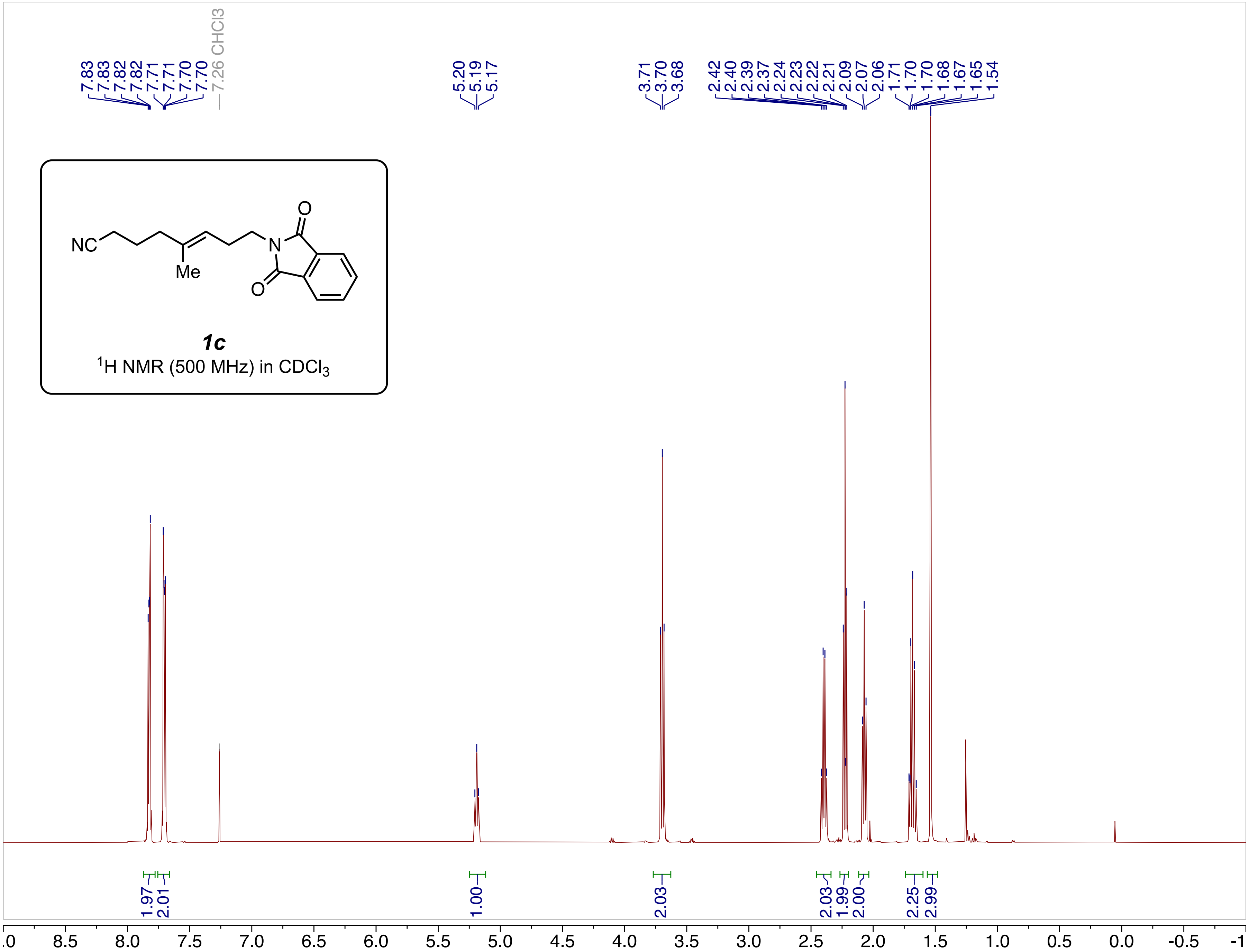


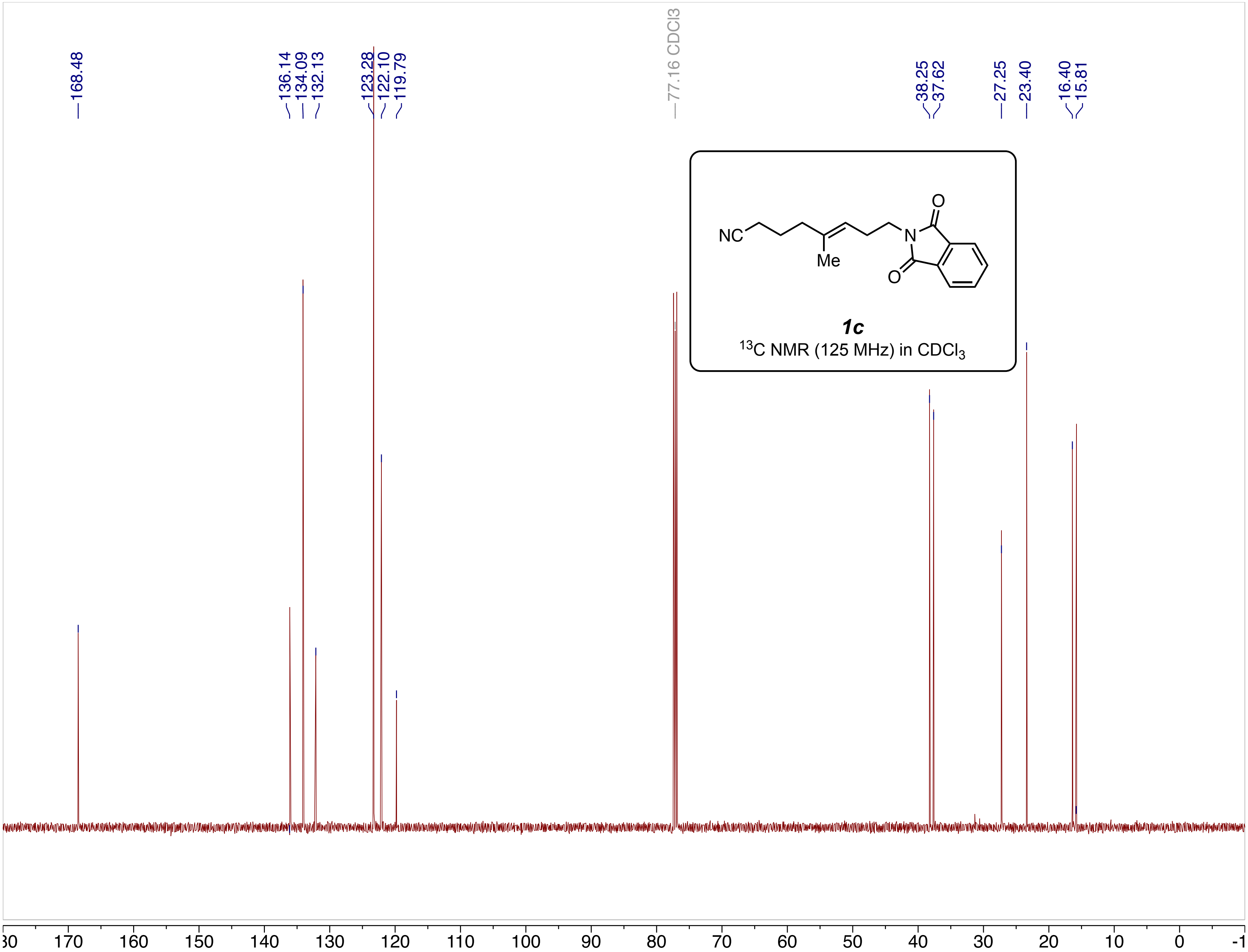
S13

^{1}H NMR (500 MHz) in $CDCl_3$



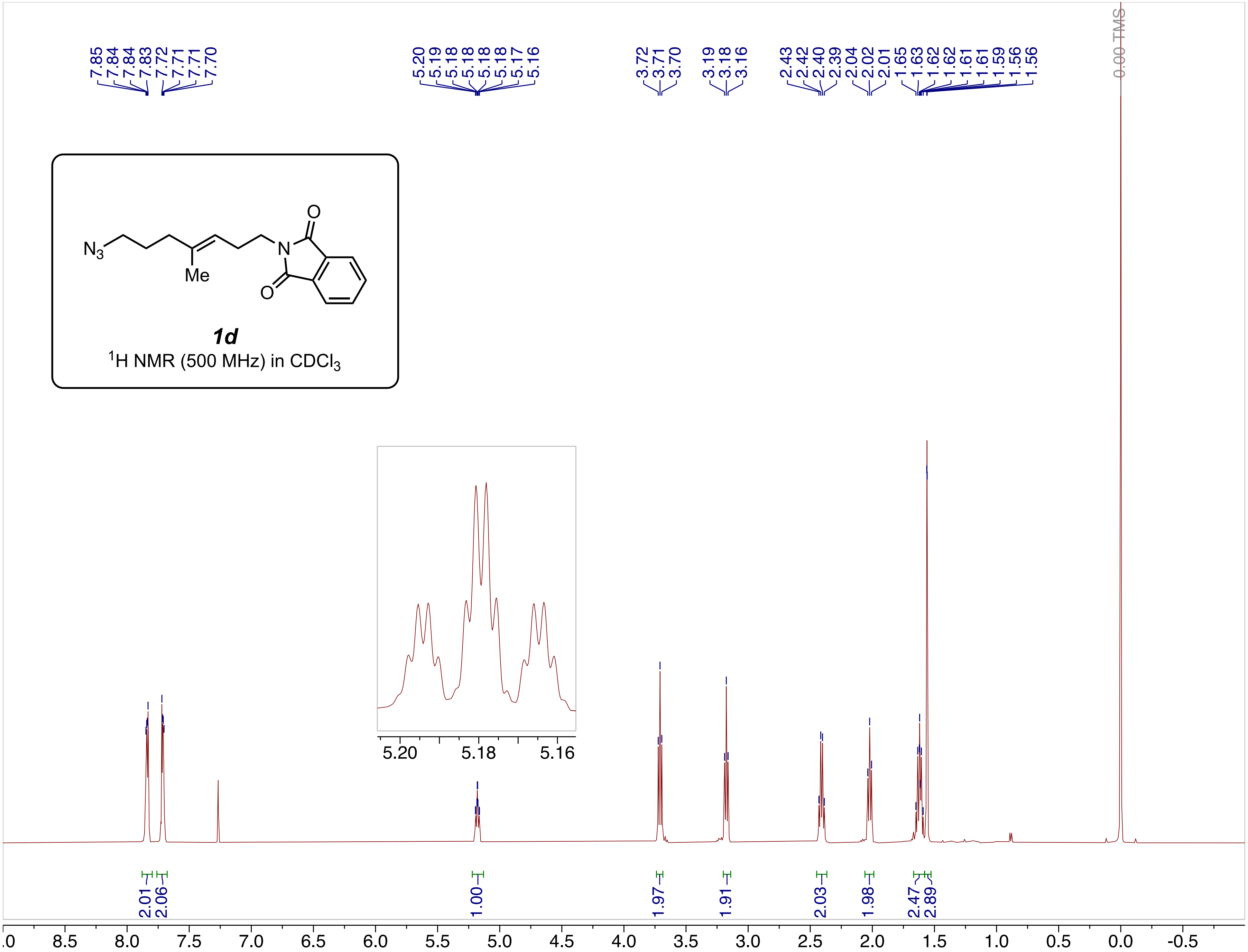
13. NMR Spectra

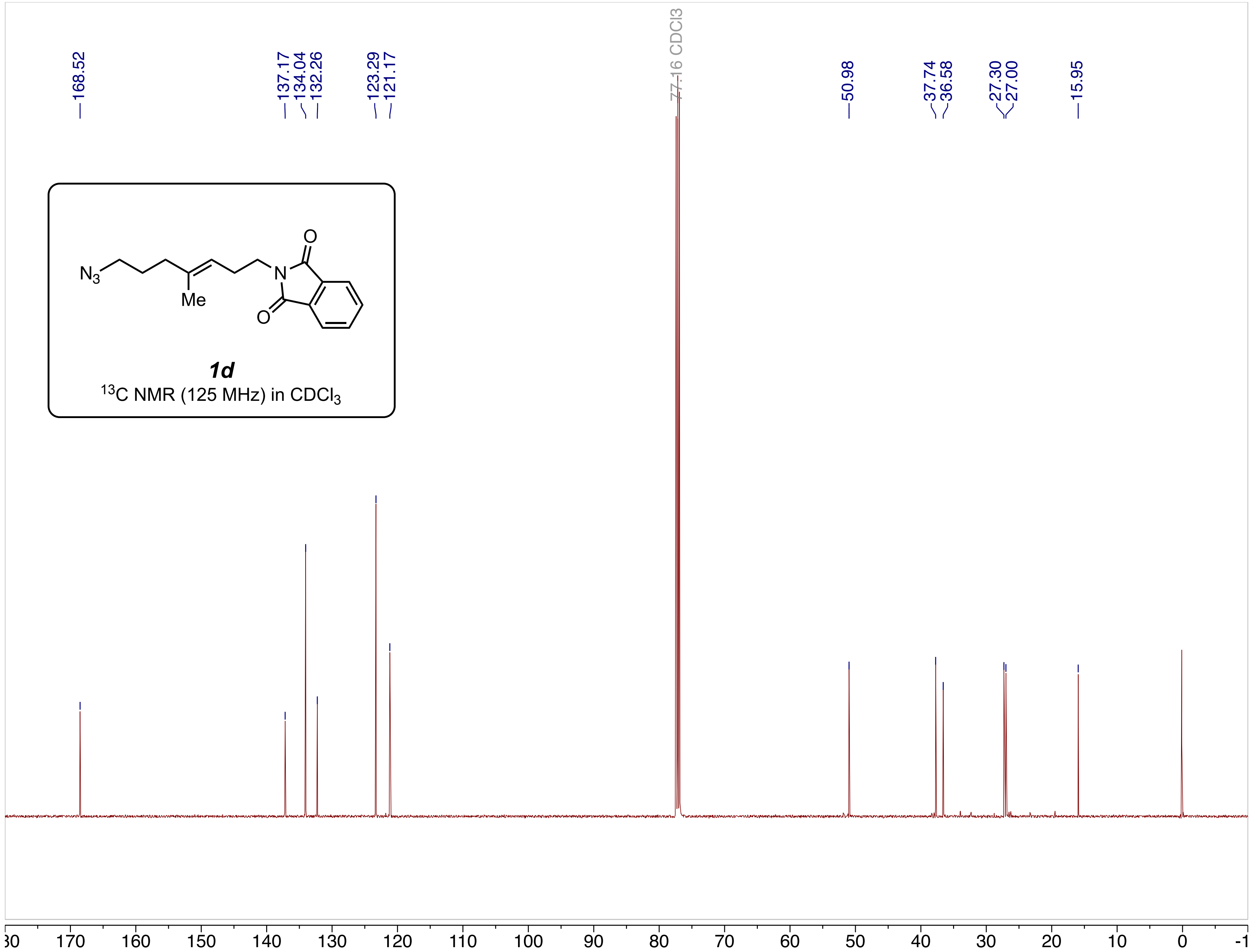

7.83
7.83
7.82
7.82
7.71
7.71
7.70
7.70
7.26 CHCl3
5.20
5.19
5.17
3.71
3.70
3.68
2.42
2.40
2.39
2.37
2.24
2.23
2.22
2.21
2.09
2.07
2.06
1.71
1.70
1.70
1.68
1.67
1.65
1.54
NC
Me
N
O
O
1c
^{1}H NMR (500 MHz) in CDCl$_3$
1.97
2.01
1.00
2.03
2.03
1.99
2.00
2.25
2.99
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



1c

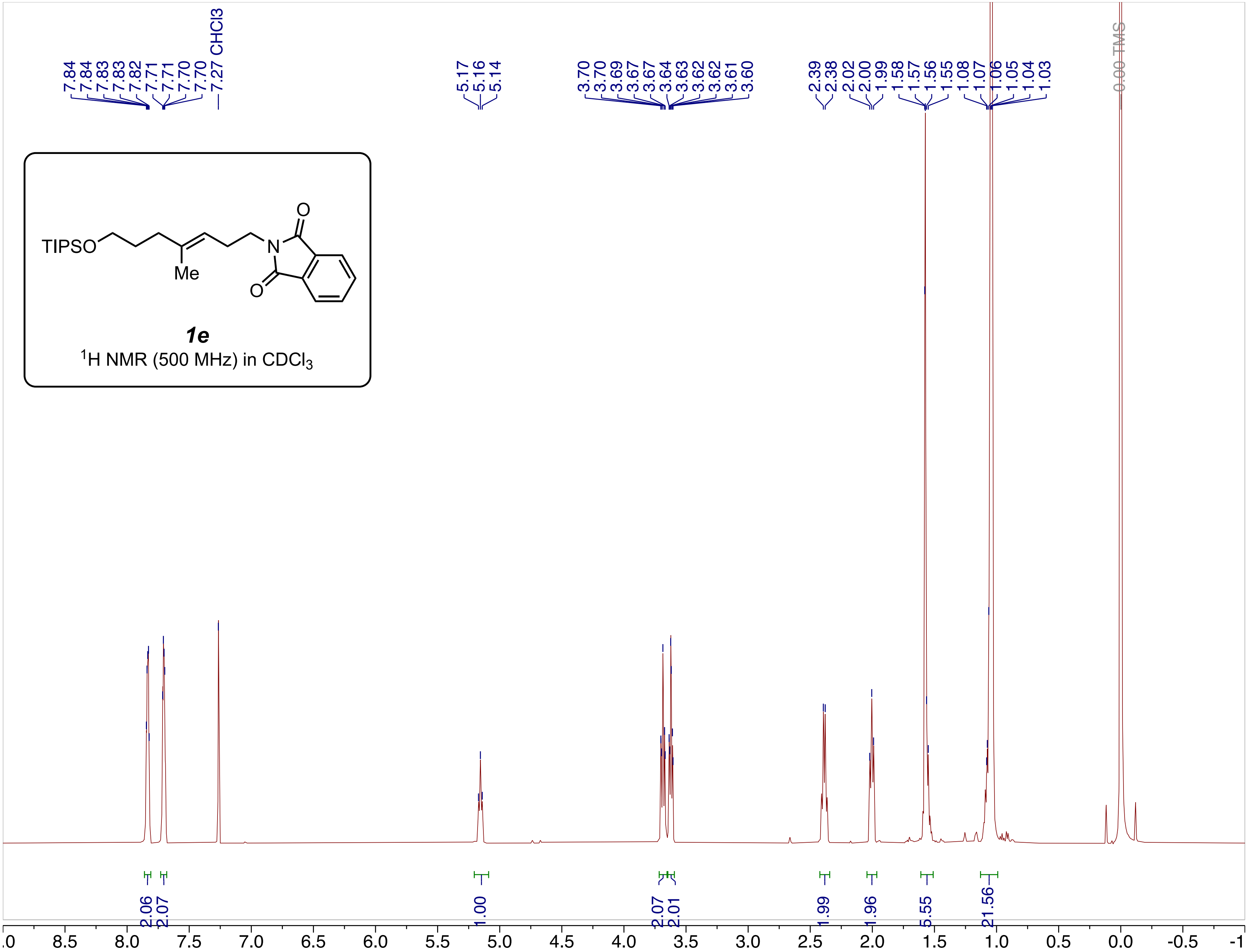
^{13}C NMR (125 MHz) in $CDCl_3$


7.85
7.84
7.84
7.83
7.72
7.71
7.71
7.70
5.20
5.19
5.18
5.18
5.18
5.18
5.17
5.16
3.72
3.71
3.70
3.19
3.18
3.16
2.43
2.42
2.40
2.39
2.04
2.02
2.01
1.65
1.63
1.62
1.62
1.61
1.61
1.59
1.56
1.56
0.00 TMS
N3
Me
N
O
O
1d
1H NMR (500 MHz) in CDCl3
5.20
5.18
5.16
2.01
2.06
1.00
1.97
1.91
2.03
1.98
2.47
2.89
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5



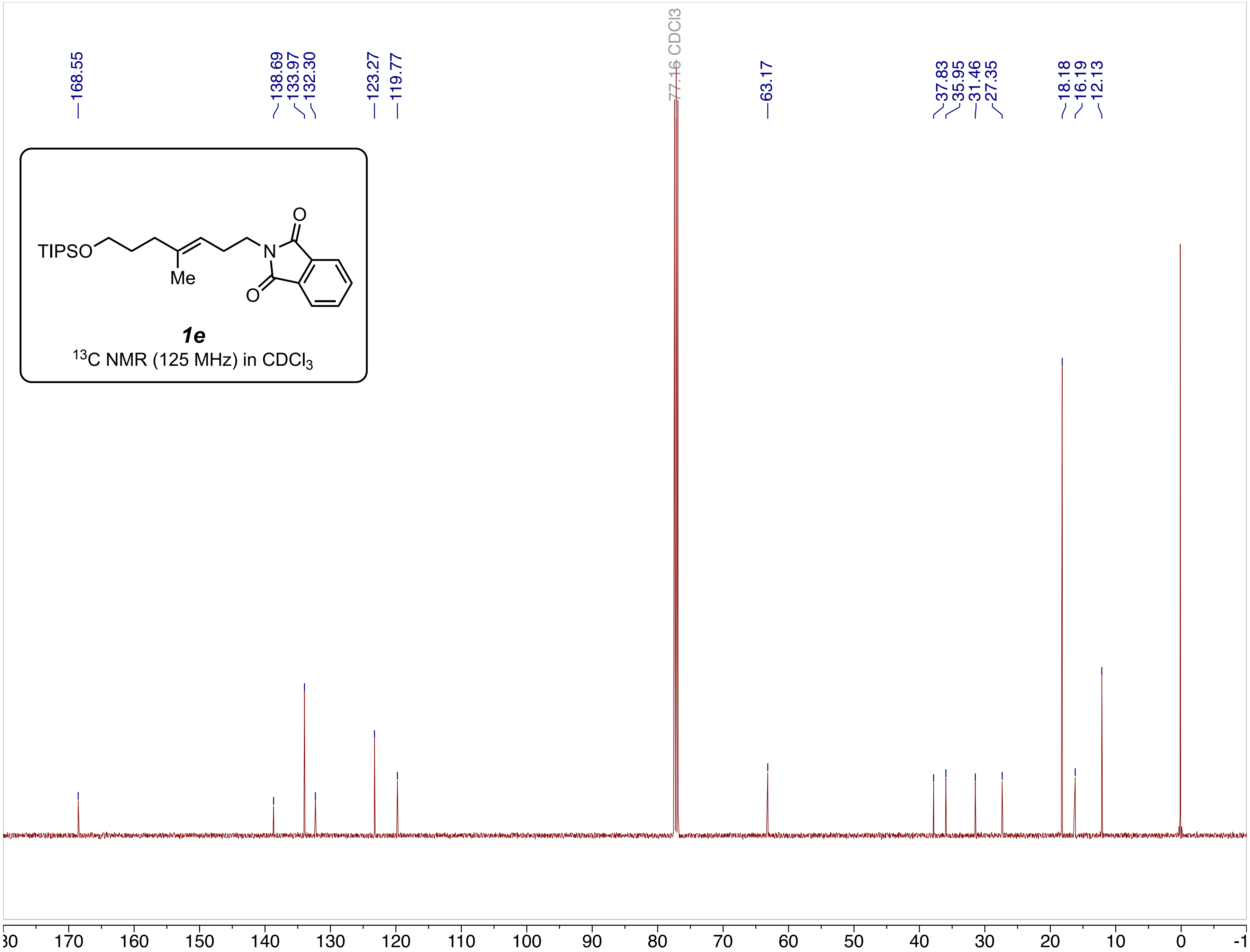
1d

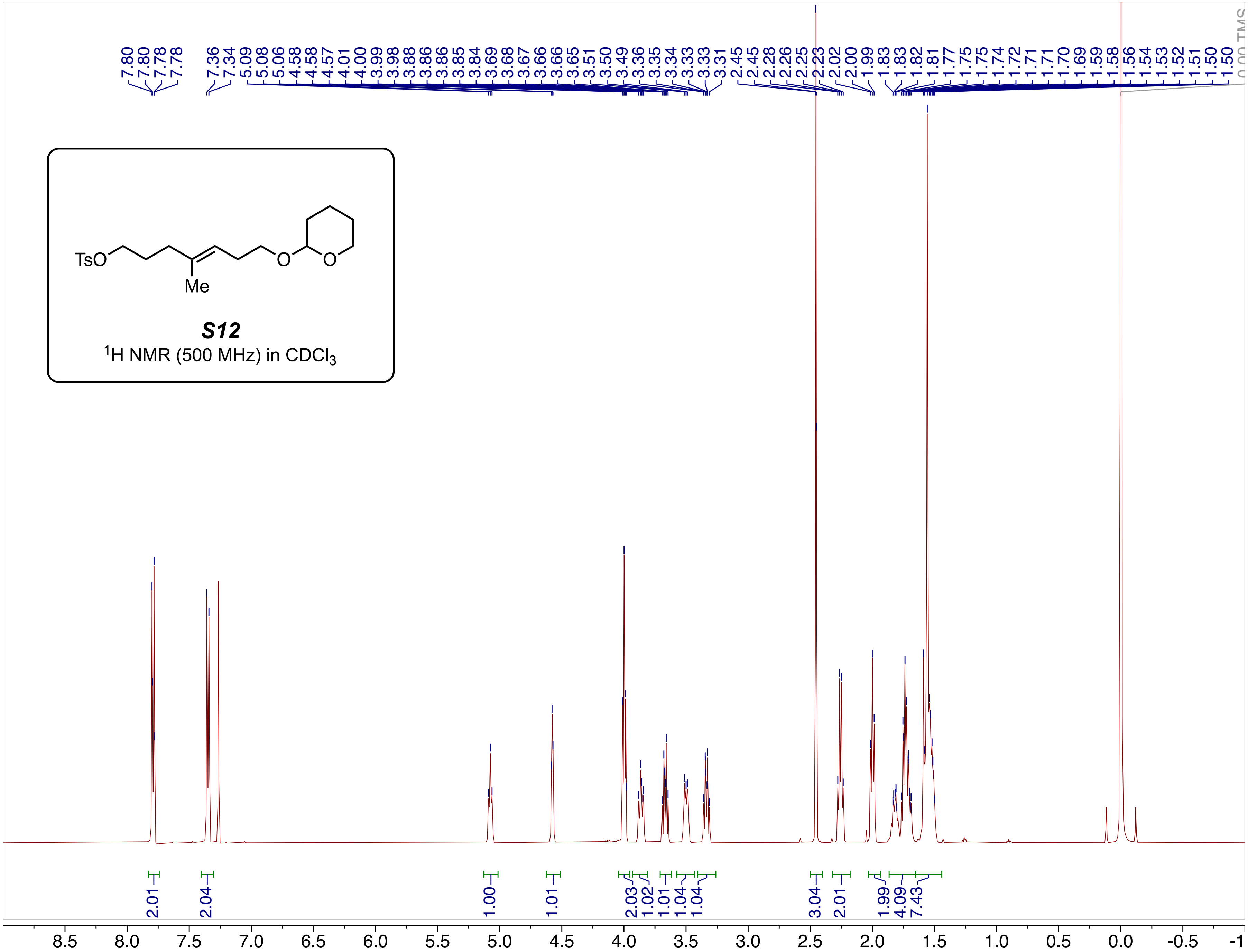
^{13}C NMR (125 MHz) in $CDCl_3$

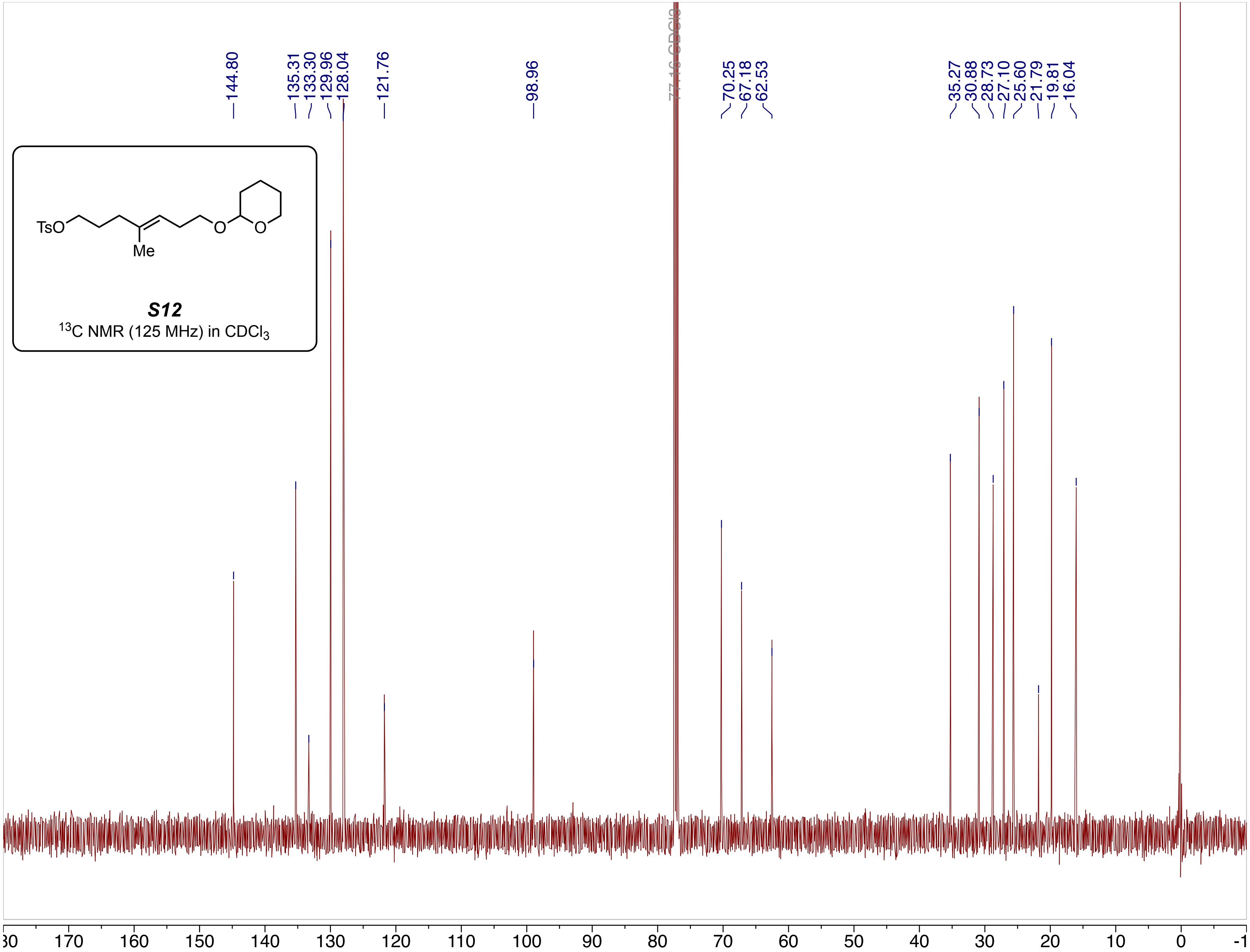


1e

^{1}H NMR (500 MHz) in $CDCl_3$

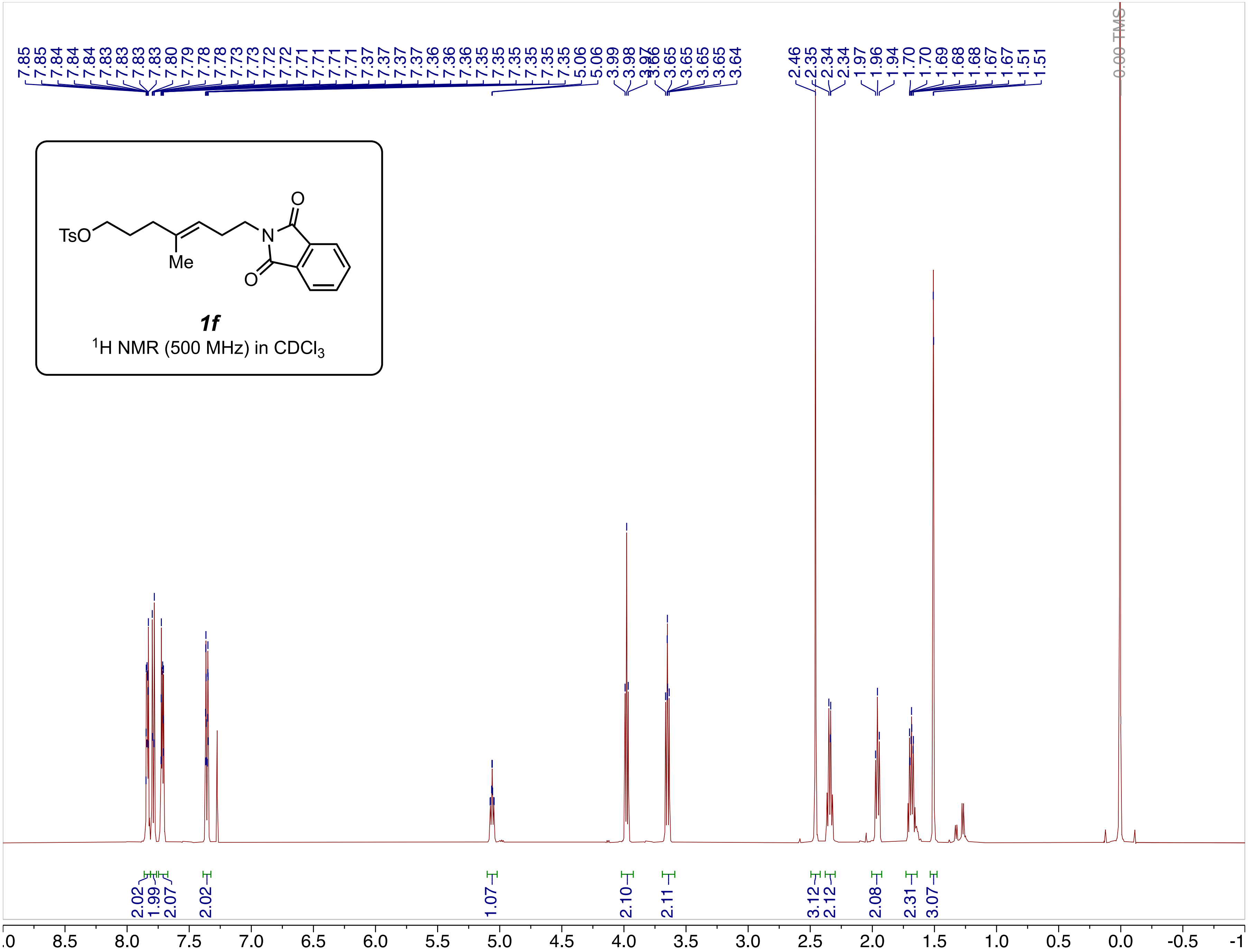

168.55
138.69
133.97
132.30
123.27
119.77
77.16 CDCl3
63.17
37.83
35.95
31.46
27.35
18.18
16.19
12.13
TIPSO
Me
N
O
O
1e
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.80
7.80
7.78
7.78
7.36
7.34
5.09
5.08
5.06
4.58
4.58
4.57
4.01
4.00
3.99
3.98
3.88
3.86
3.86
3.85
3.84
3.69
3.68
3.67
3.66
3.66
3.65
3.51
3.50
3.49
3.36
3.35
3.34
3.33
3.33
3.31
2.45
2.45
2.28
2.26
2.25
2.23
2.02
2.00
1.99
1.83
1.83
1.82
1.81
1.77
1.75
1.75
1.74
1.72
1.71
1.71
1.70
1.69
1.59
1.58
1.56
1.54
1.53
1.52
1.51
1.50
1.50
0.00 TMS
TsO
Me
O
O
S12
^{1}H NMR (500 MHz) in CDCl$_3$
2.01
2.04
1.00
1.01
2.03
1.02
1.01
1.04
1.04
3.04
2.01
1.99
4.09
7.43
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



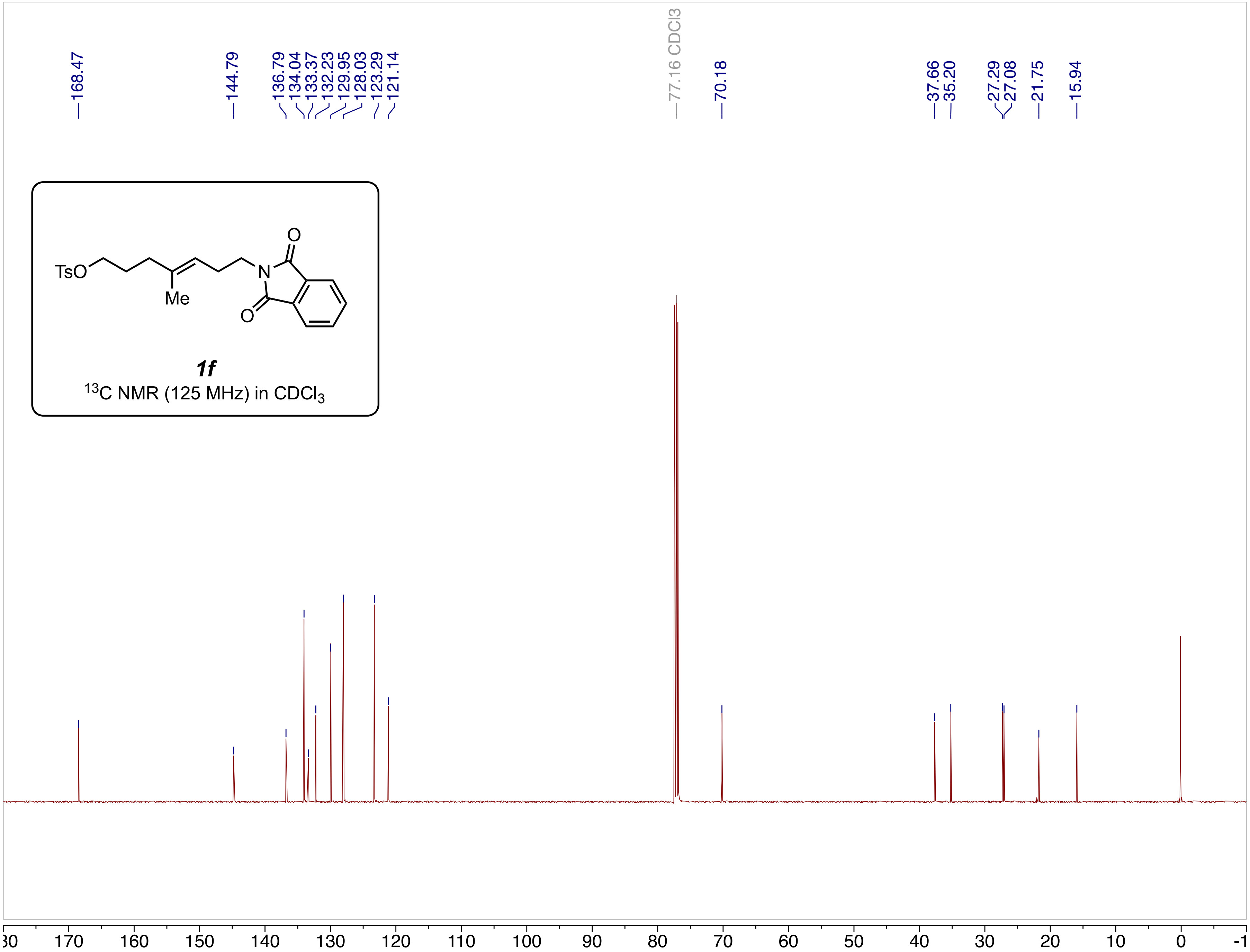
S12

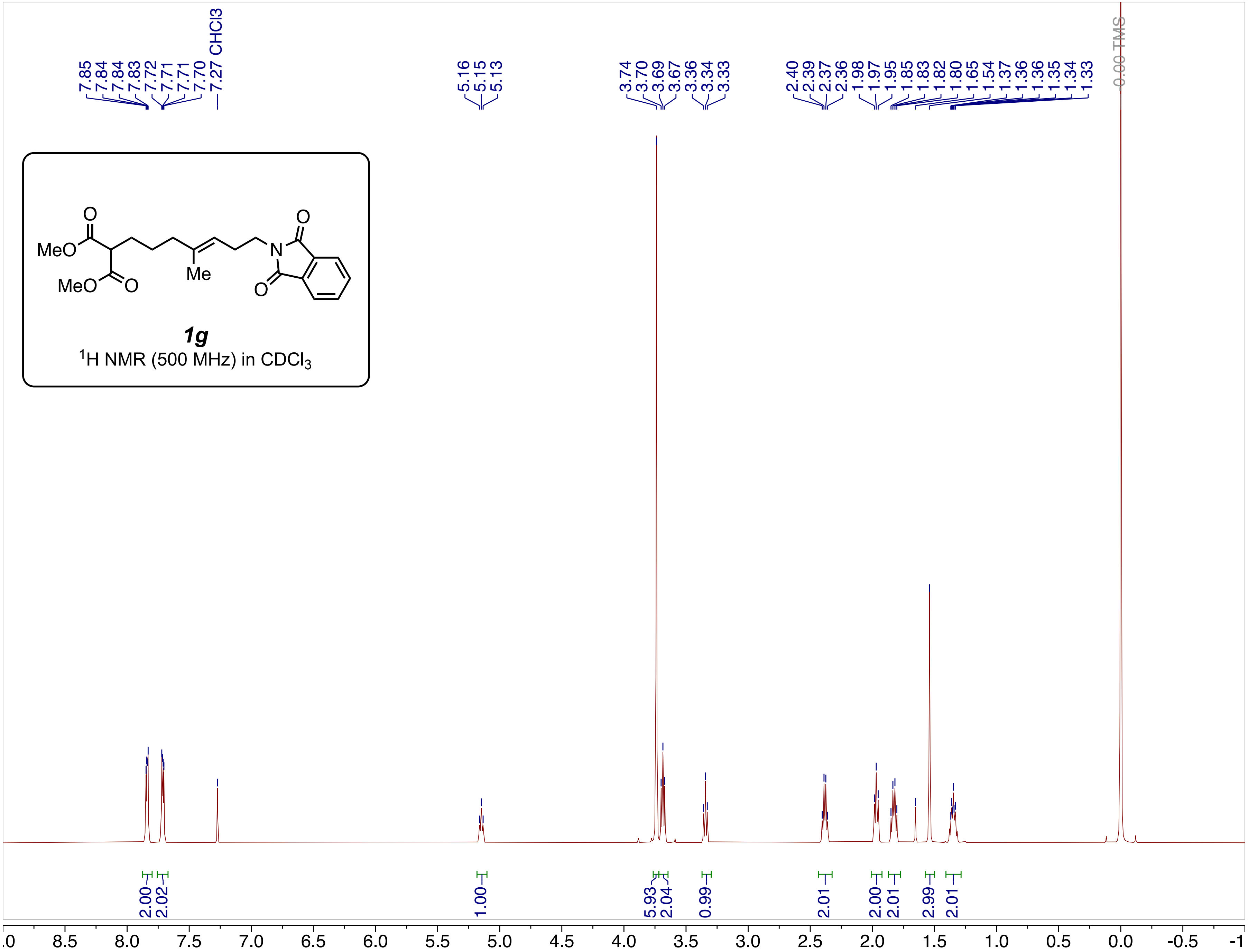
^{13}C NMR (125 MHz) in CDCl$_3$



1f

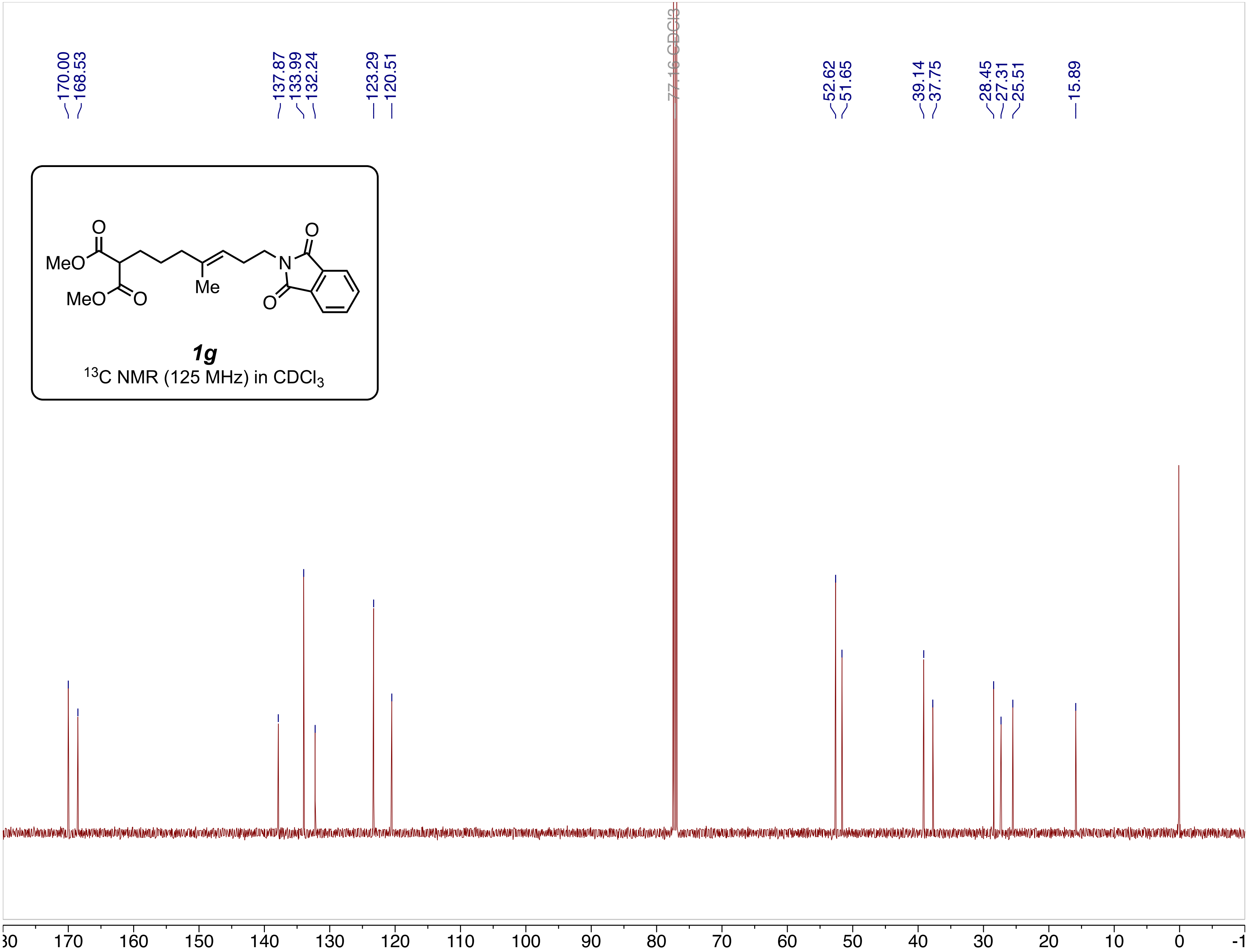
^{1}H NMR (500 MHz) in $CDCl_3$

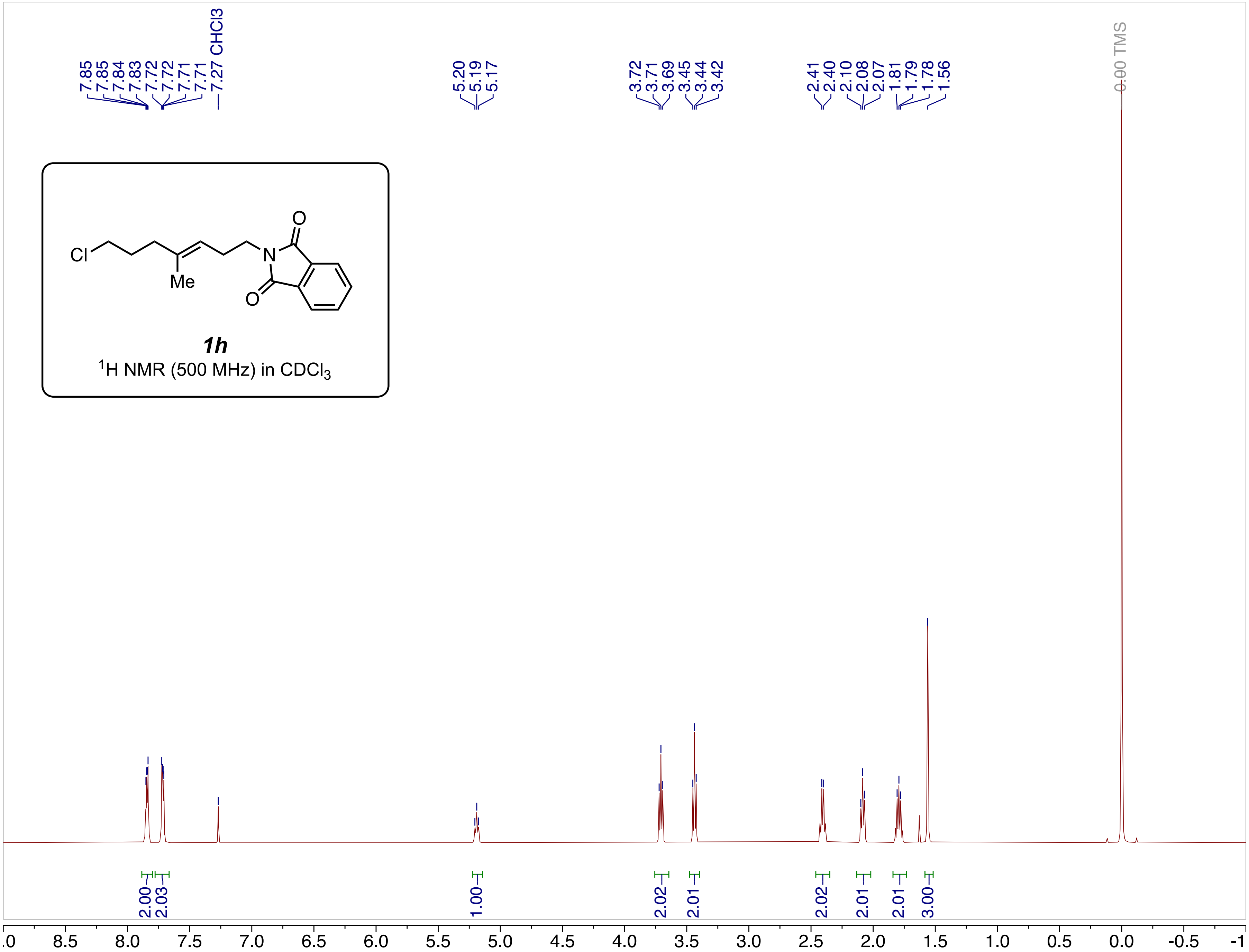
168.47
144.79
136.79
134.04
133.37
132.23
129.95
128.03
123.29
121.14
77.16 CDCl3
70.18
37.66
35.20
27.29
27.08
21.75
15.94
TsO
Me
N
O
O
1f
^{13}C NMR (125 MHz) in CDCl$_3$
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

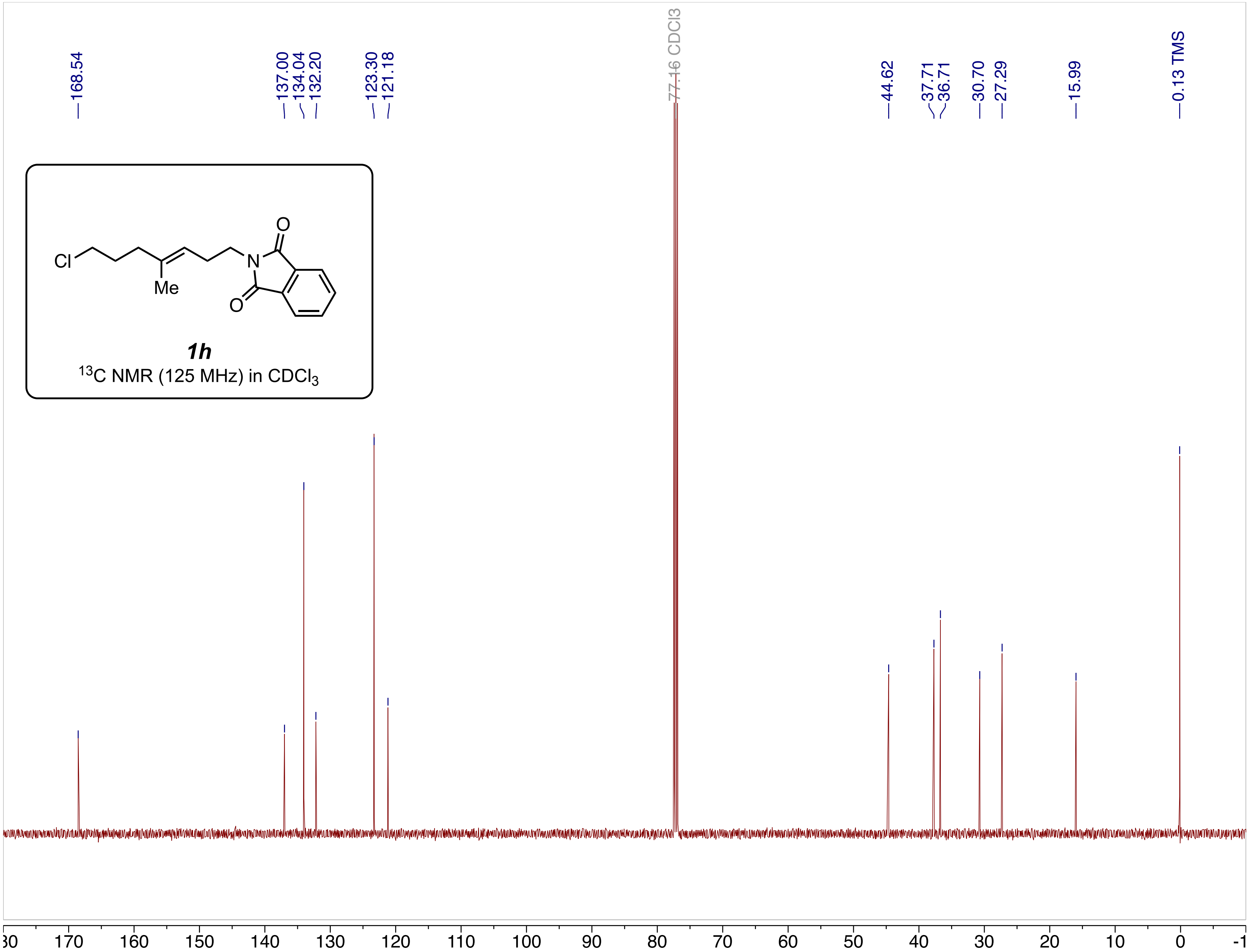


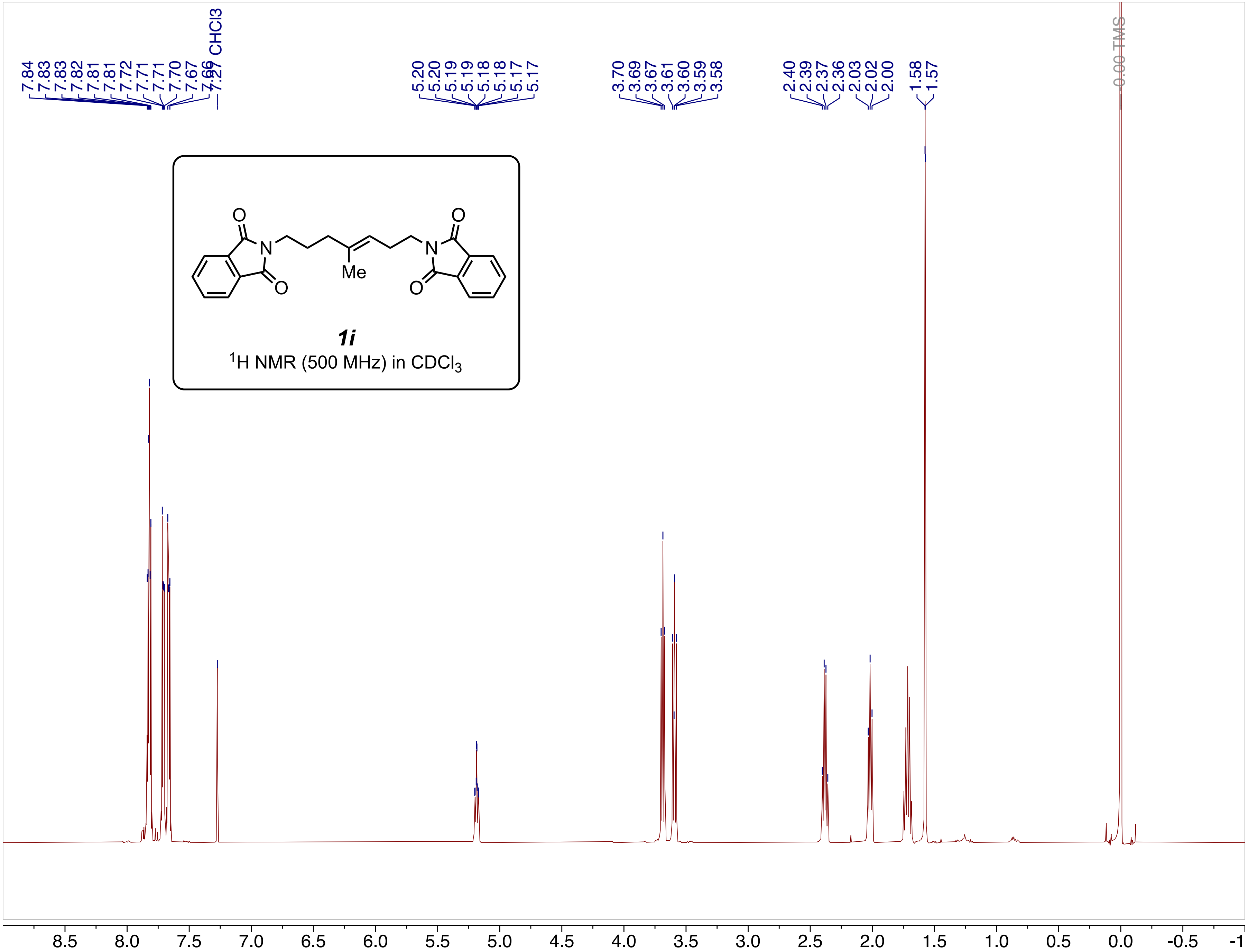
1g

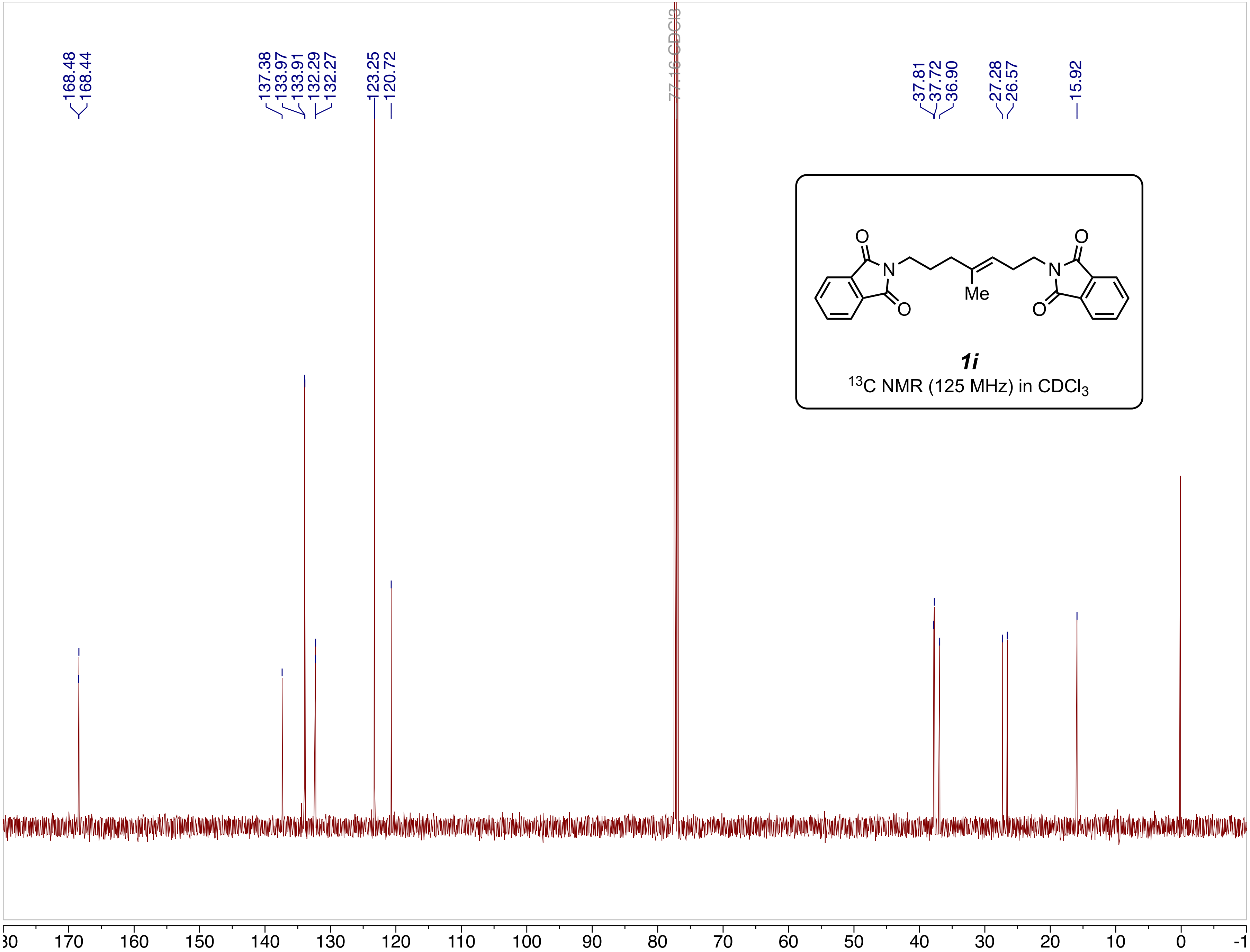
^{1}H NMR (500 MHz) in $CDCl_3$

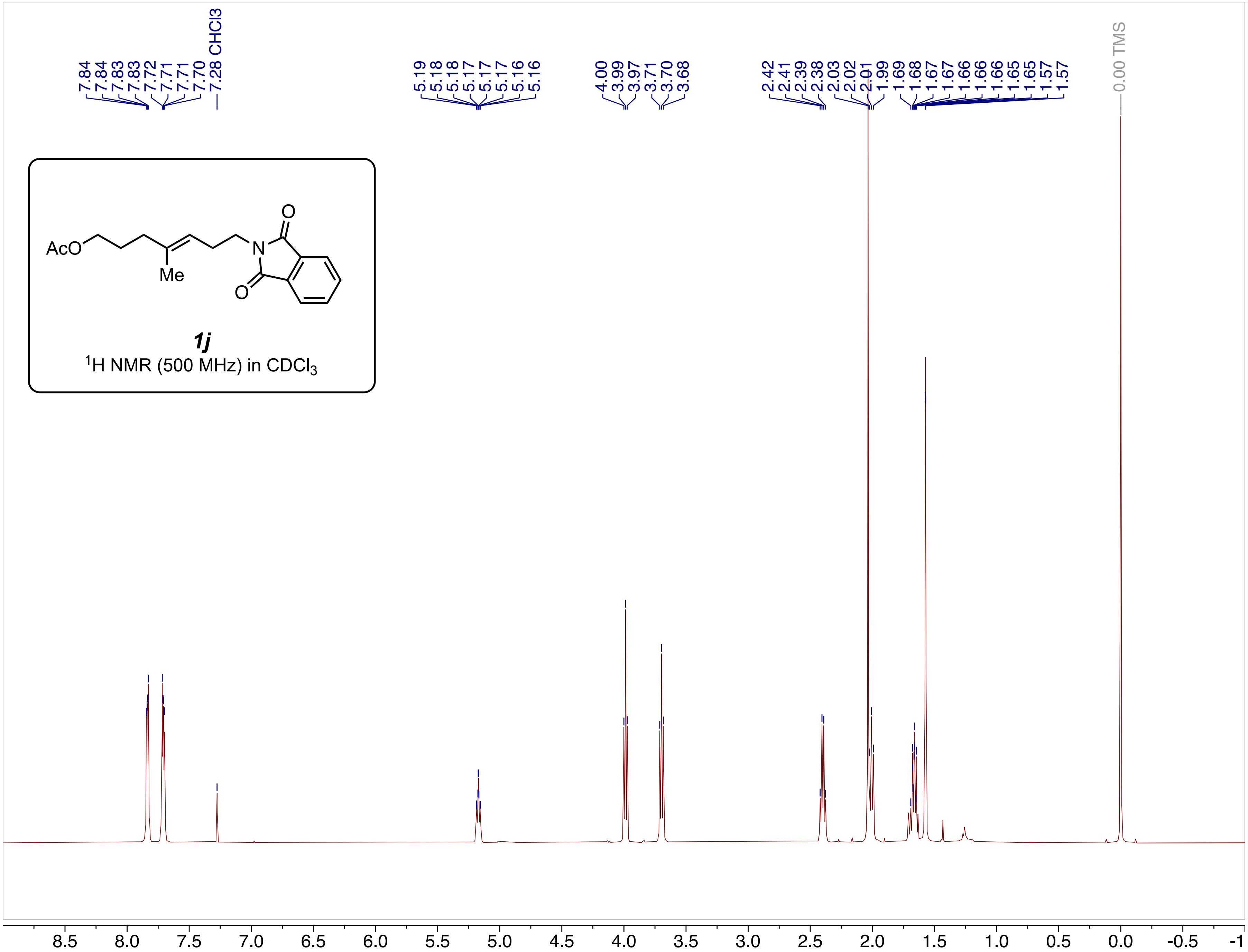

170.00
168.53
137.87
133.99
132.24
123.29
120.51
77.16 CDCl3
52.62
51.65
39.14
37.75
28.45
27.31
25.51
15.89
MeO
MeO
O
O
Me
N
O
O
1g
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.85
7.85
7.84
7.83
7.72
7.72
7.71
7.71
7.27 CHCl3
5.20
5.19
5.17
3.72
3.71
3.69
3.45
3.44
3.42
2.41
2.40
2.10
2.08
2.07
1.81
1.79
1.78
1.56
0.00 TMS
Cl
Me
N
O
O
1h
^{1}H NMR (500 MHz) in CDCl$_3$
2.00
2.03
1.00
2.02
2.01
2.02
2.01
2.01
3.00
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

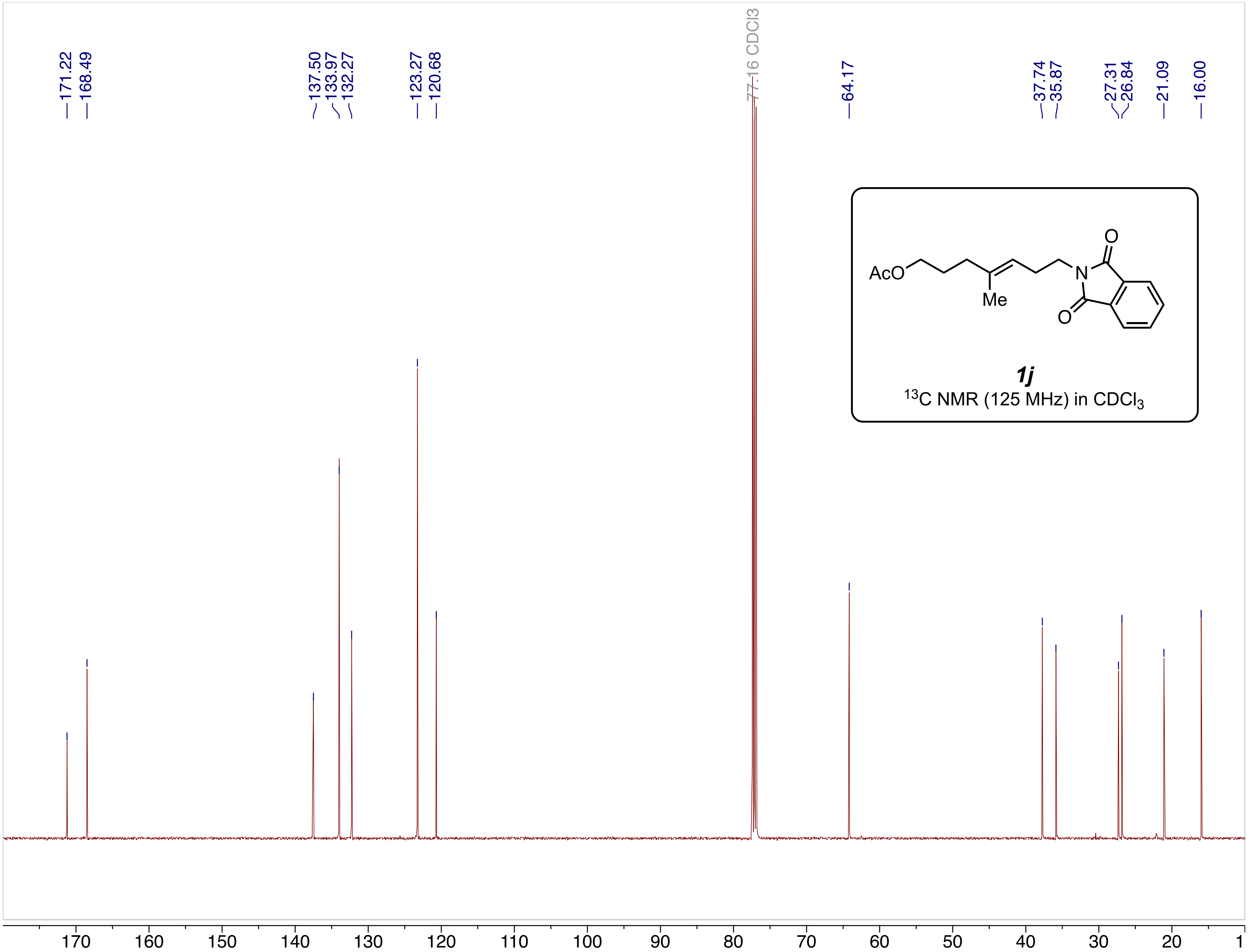

168.54
137.00
134.04
132.20
123.30
121.18
77.16 CDCl3
44.62
37.71
36.71
30.70
27.29
15.99
0.13 TMS
Cl
Me
N
O
O
1h
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.84
7.83
7.83
7.82
7.81
7.81
7.72
7.71
7.71
7.70
7.67
7.66
7.27 CHCl3
5.20
5.20
5.19
5.19
5.18
5.18
5.17
5.17
3.70
3.69
3.67
3.61
3.60
3.59
3.58
2.40
2.39
2.37
2.36
2.03
2.02
2.00
1.58
1.57
0.00 TMS
O
N
O
Me
O
N
O
1i
^{1}H NMR (500 MHz) in CDCl$_3$
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


168.48
168.44
137.38
133.97
133.91
132.29
132.27
123.25
120.72
77.16 CDCl3
37.81
37.72
36.90
27.28
26.57
15.92
O
N
O
Me
O
N
O
1i
^{13}C NMR (125 MHz) in $CDCl_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

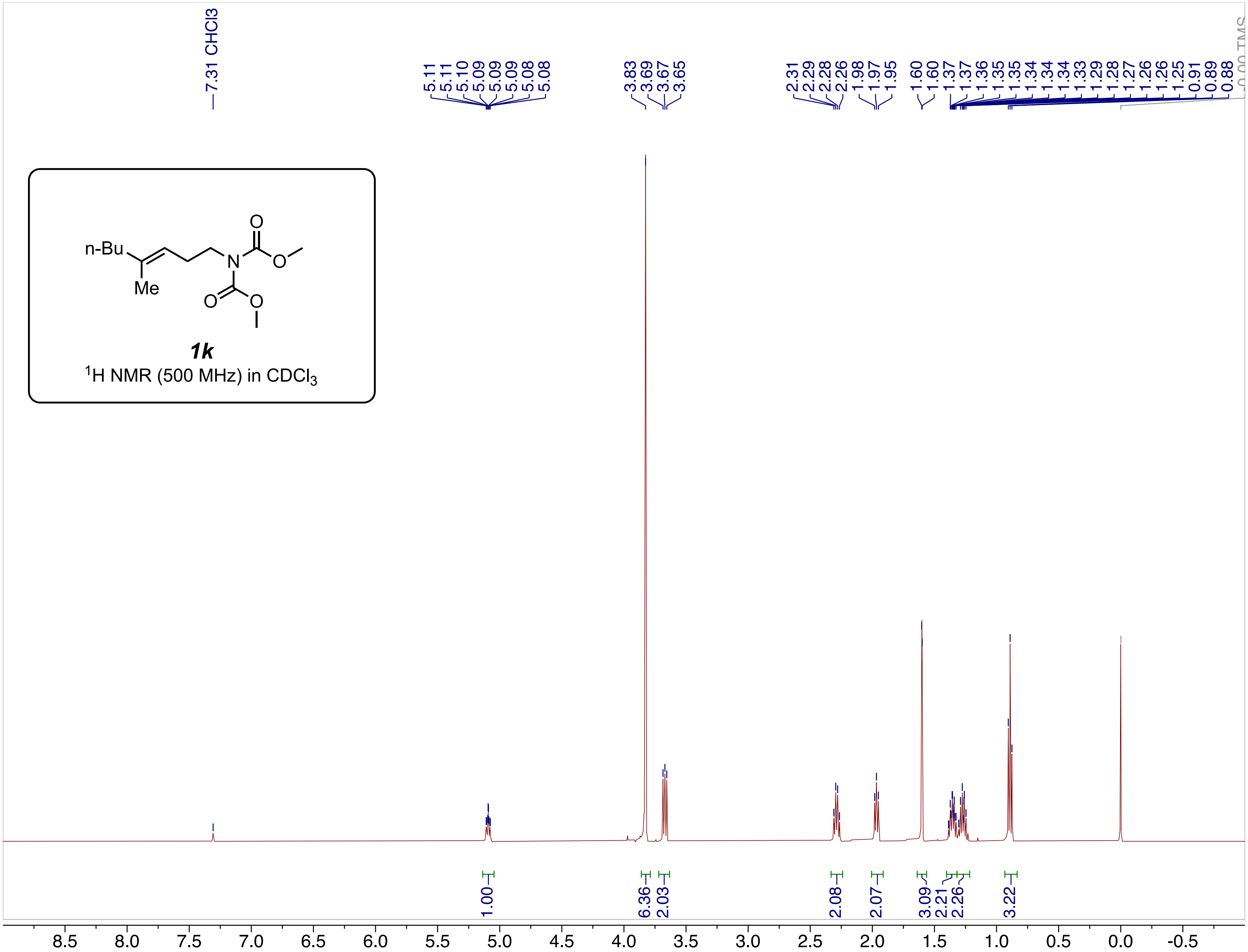


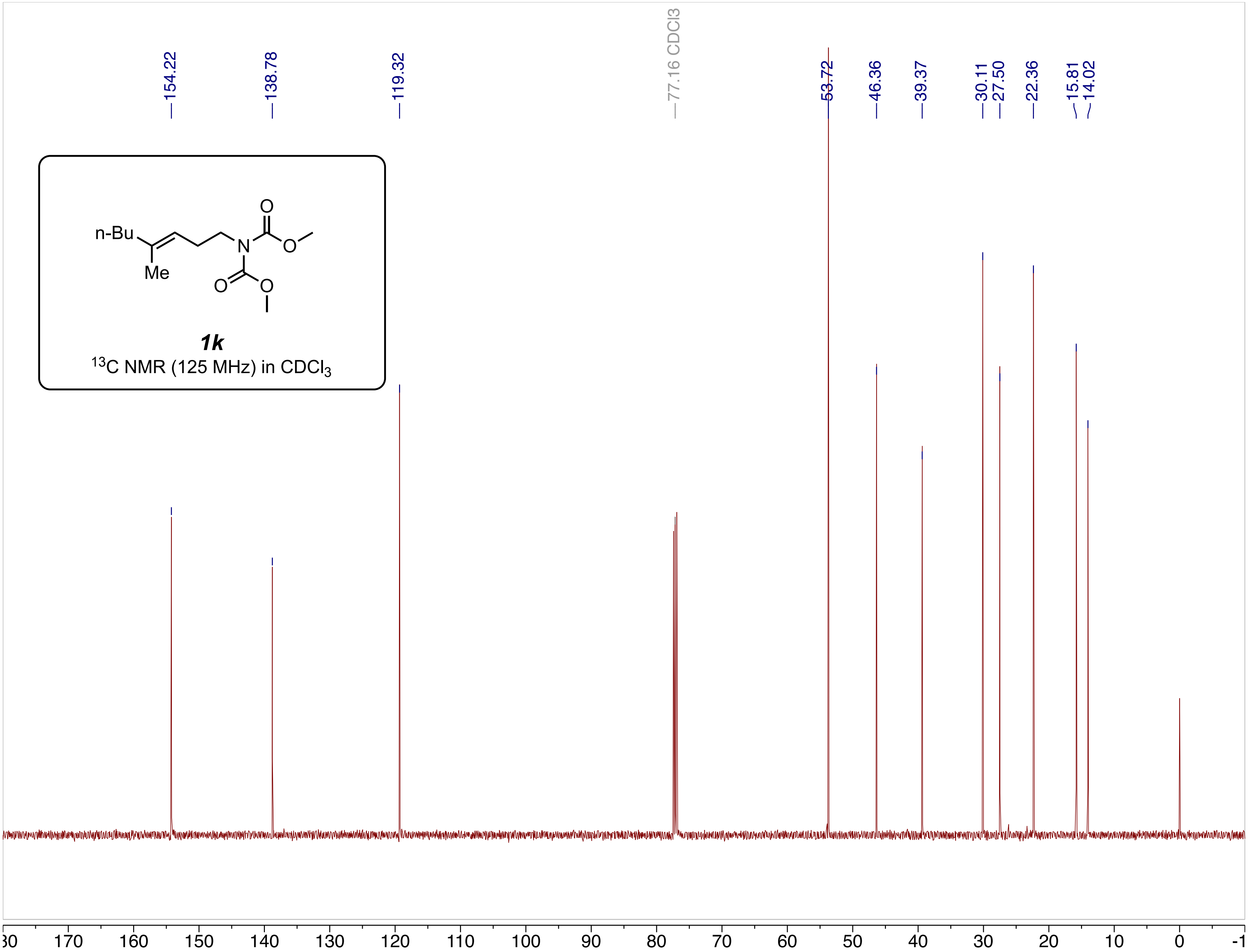
13. NMR Spectra



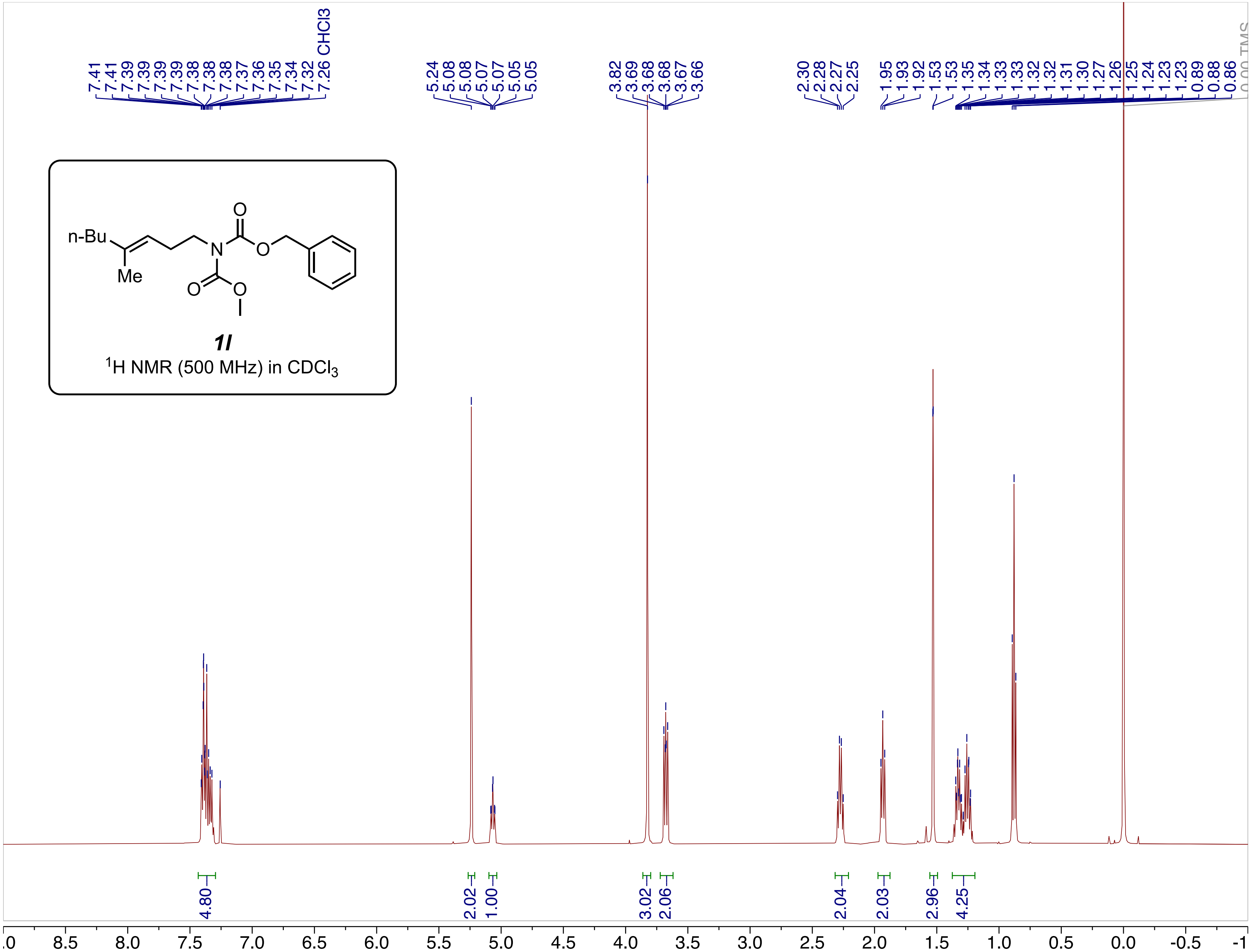
1j

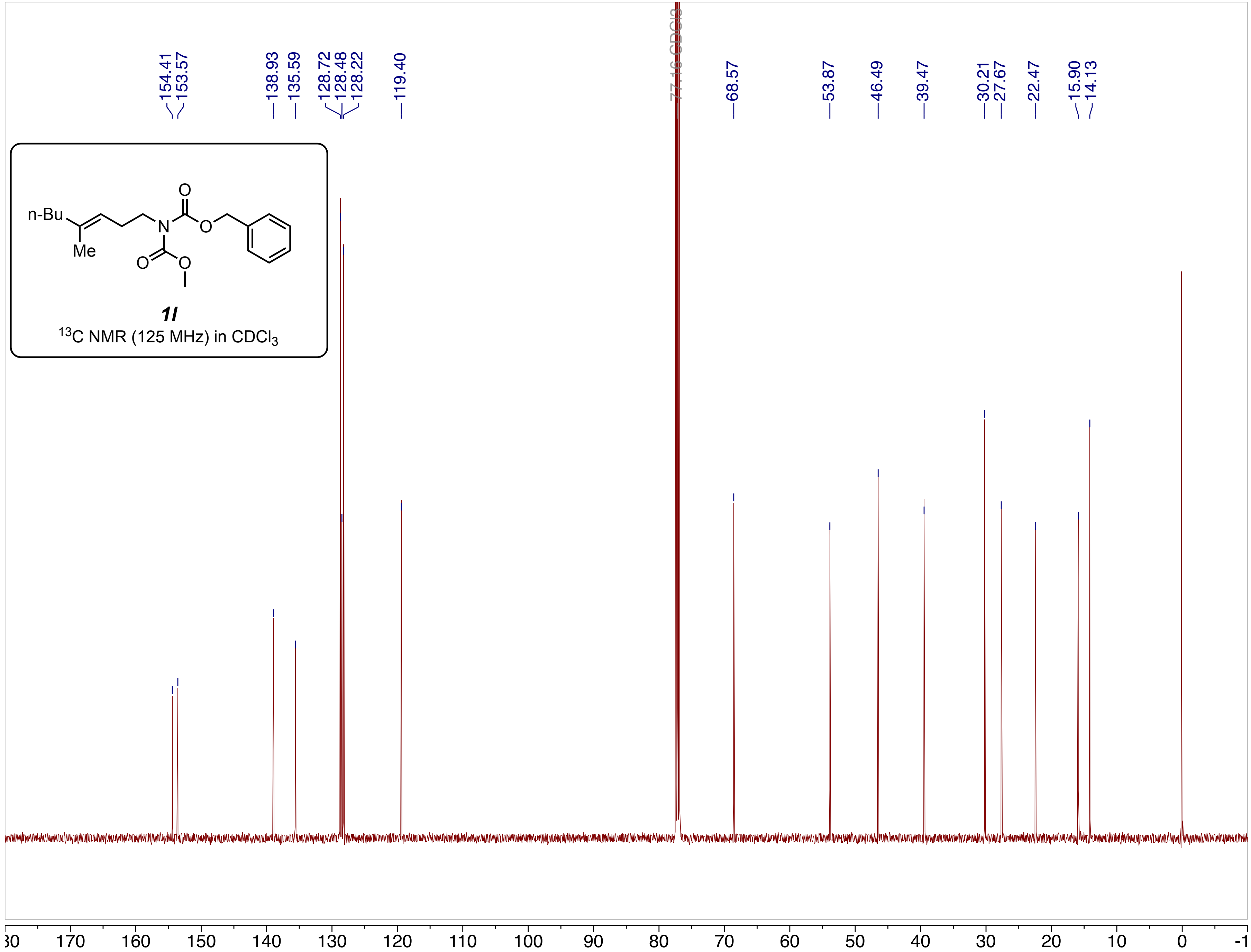
^{13}C NMR (125 MHz) in $CDCl_3$

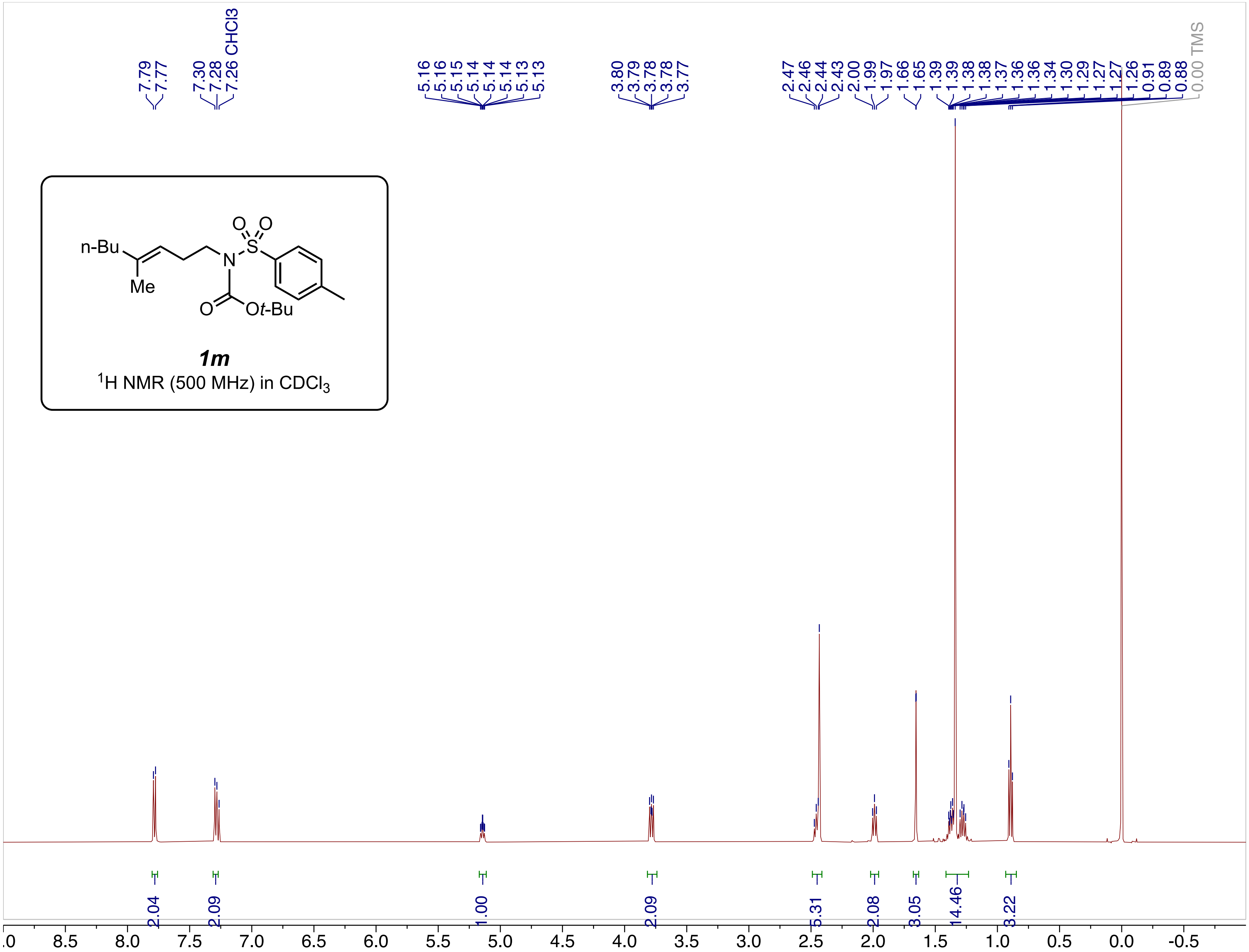

7.31 CHCl3
5.11
5.11
5.10
5.09
5.09
5.09
5.08
5.08
3.83
3.69
3.67
3.65
2.31
2.29
2.28
2.26
1.98
1.97
1.95
1.60
1.60
1.37
1.37
1.36
1.35
1.35
1.34
1.34
1.34
1.33
1.29
1.28
1.27
1.26
1.26
1.25
0.91
0.89
0.88
-0.00 TMS
n-Bu
Me
N
O
O
O
O
1k
^{1}H NMR (500 MHz) in CDCl$_3$
1.00
6.36
2.03
2.08
2.07
3.09
2.21
2.26
3.22
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5

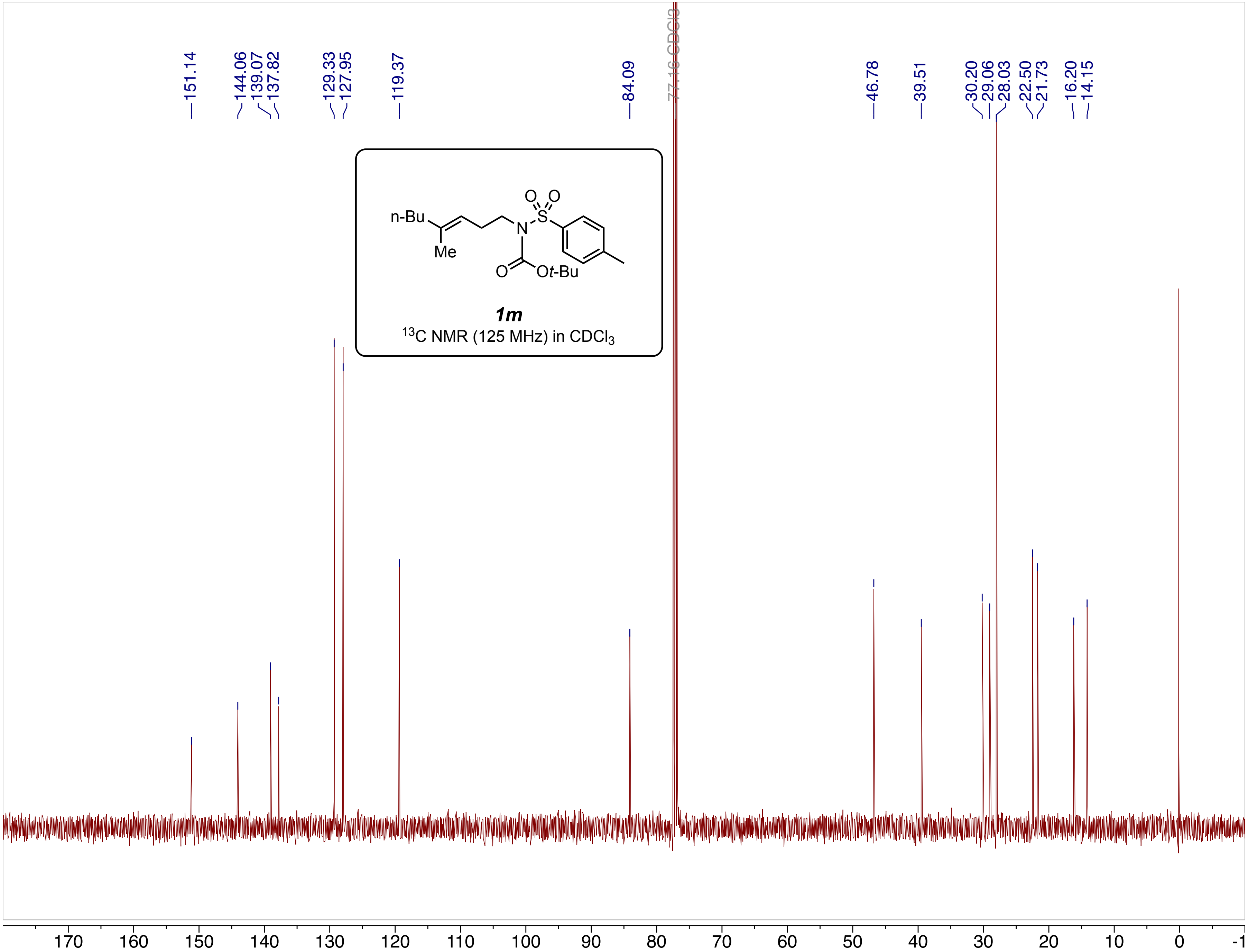


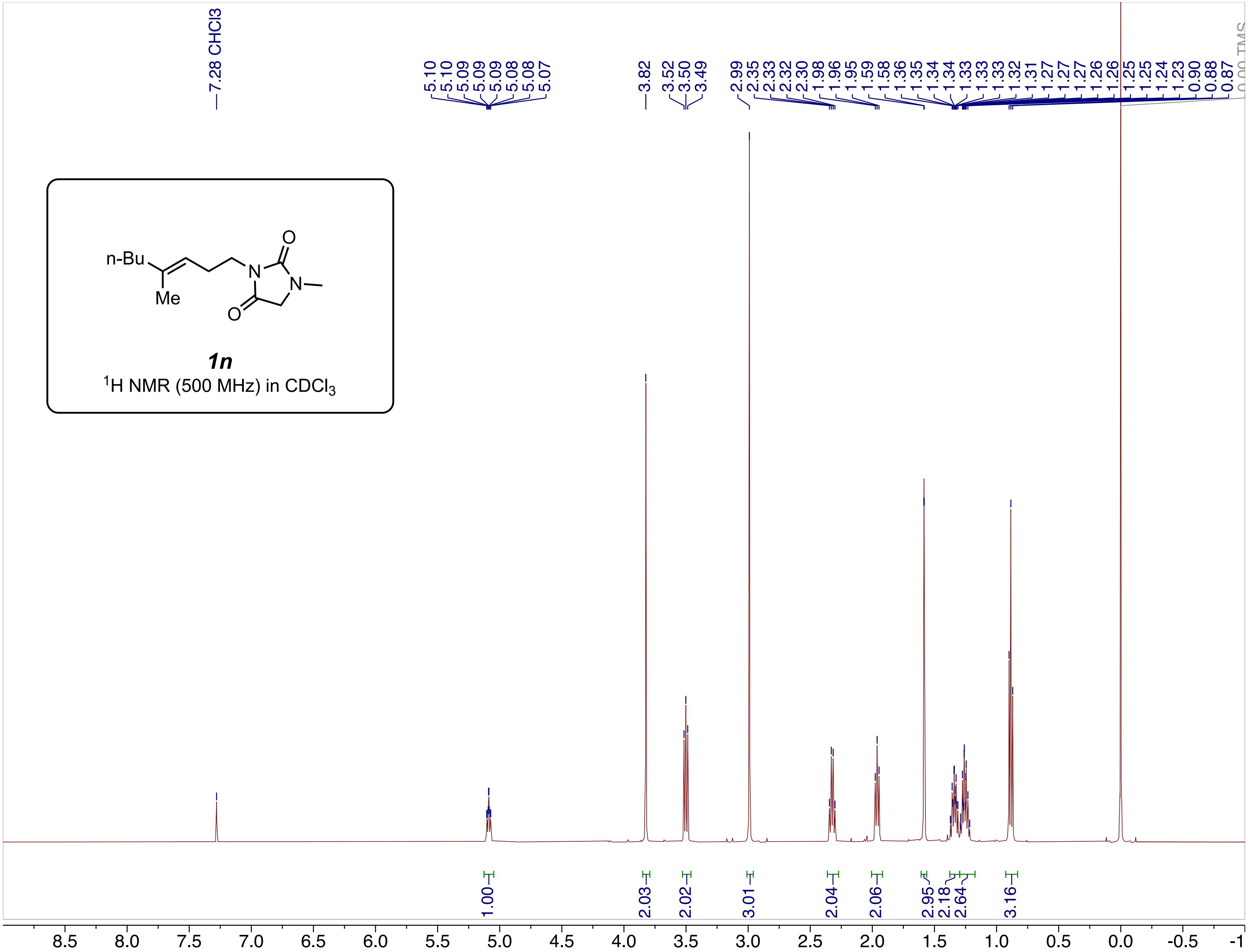
13. NMR Spectra


7.41
7.41
7.39
7.39
7.39
7.38
7.38
7.38
7.37
7.36
7.35
7.34
7.32
7.26 CHCl3
5.24
5.08
5.08
5.07
5.07
5.05
5.05
3.82
3.69
3.68
3.68
3.67
3.66
2.30
2.28
2.27
2.25
1.95
1.93
1.92
1.53
1.53
1.35
1.34
1.33
1.33
1.32
1.32
1.31
1.30
1.27
1.26
1.25
1.24
1.23
1.23
0.89
0.88
0.86
0.00 TMS
n-Bu
Me
N
O
O
O
O
1l
^{1}H NMR (500 MHz) in CDCl$_3$
4.80
2.02
1.00
3.02
2.06
2.04
2.03
2.96
4.25
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

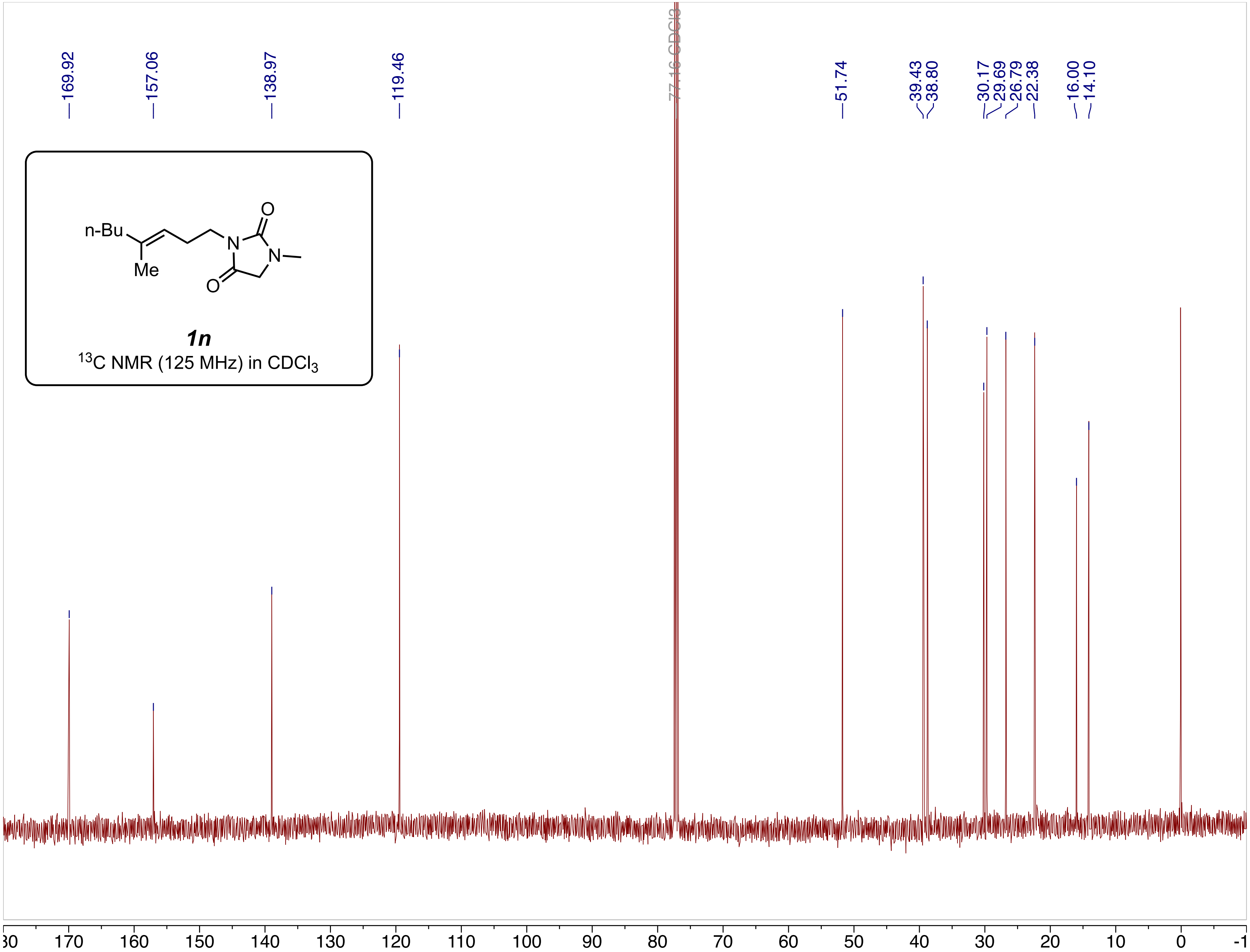
154.41
153.57
138.93
135.59
128.72
128.48
128.22
119.40
77.16 CDCl3
68.57
53.87
46.49
39.47
30.21
27.67
22.47
15.90
14.13
n-Bu
Me
N
O
O
O
O
O
1l
^{13}C NMR (125 MHz) in CDCl$_3$
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.79
7.77
7.30
7.28
7.26 CHCl3
5.16
5.16
5.15
5.14
5.14
5.14
5.13
5.13
3.80
3.79
3.78
3.78
3.77
2.47
2.46
2.44
2.43
2.00
1.99
1.97
1.66
1.65
1.39
1.39
1.38
1.38
1.37
1.36
1.36
1.34
1.30
1.29
1.27
1.27
1.26
0.91
0.89
0.88
0.00 TMS
n-Bu
Me
O
O
S
N
O
Ot-Bu
1m
^{1}H NMR (500 MHz) in CDCl$_3$
2.04
2.09
1.00
2.09
5.31
2.08
3.05
14.46
3.22
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5


151.14
144.06
139.07
137.82
129.33
127.95
119.37
84.09
77.16 CDCl3
46.78
39.51
30.20
29.06
28.03
22.50
21.73
16.20
14.15
n-Bu
Me
N
S
O
O
O
Ot-Bu
1m
^{13}C NMR (125 MHz) in $CDCl_3$
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

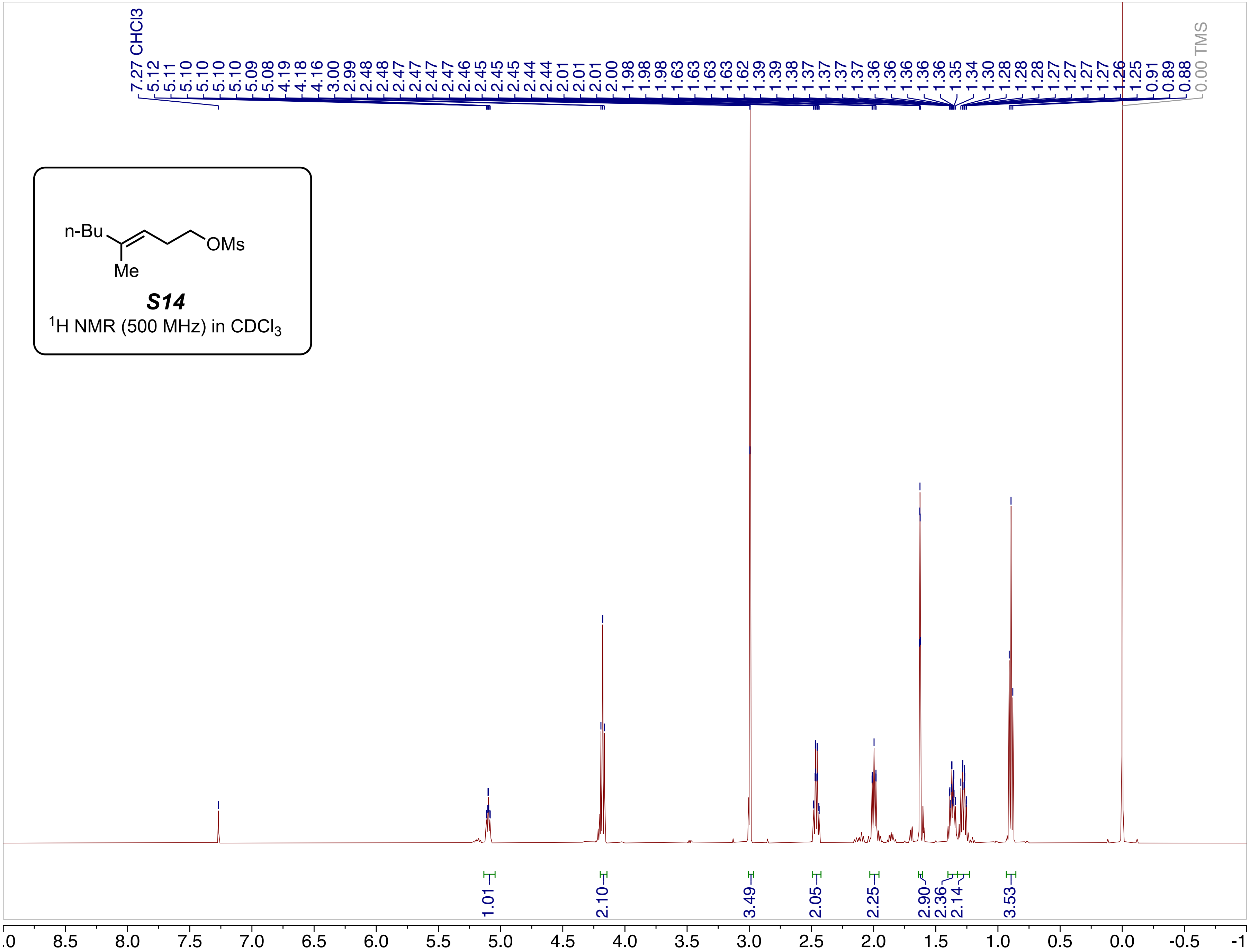


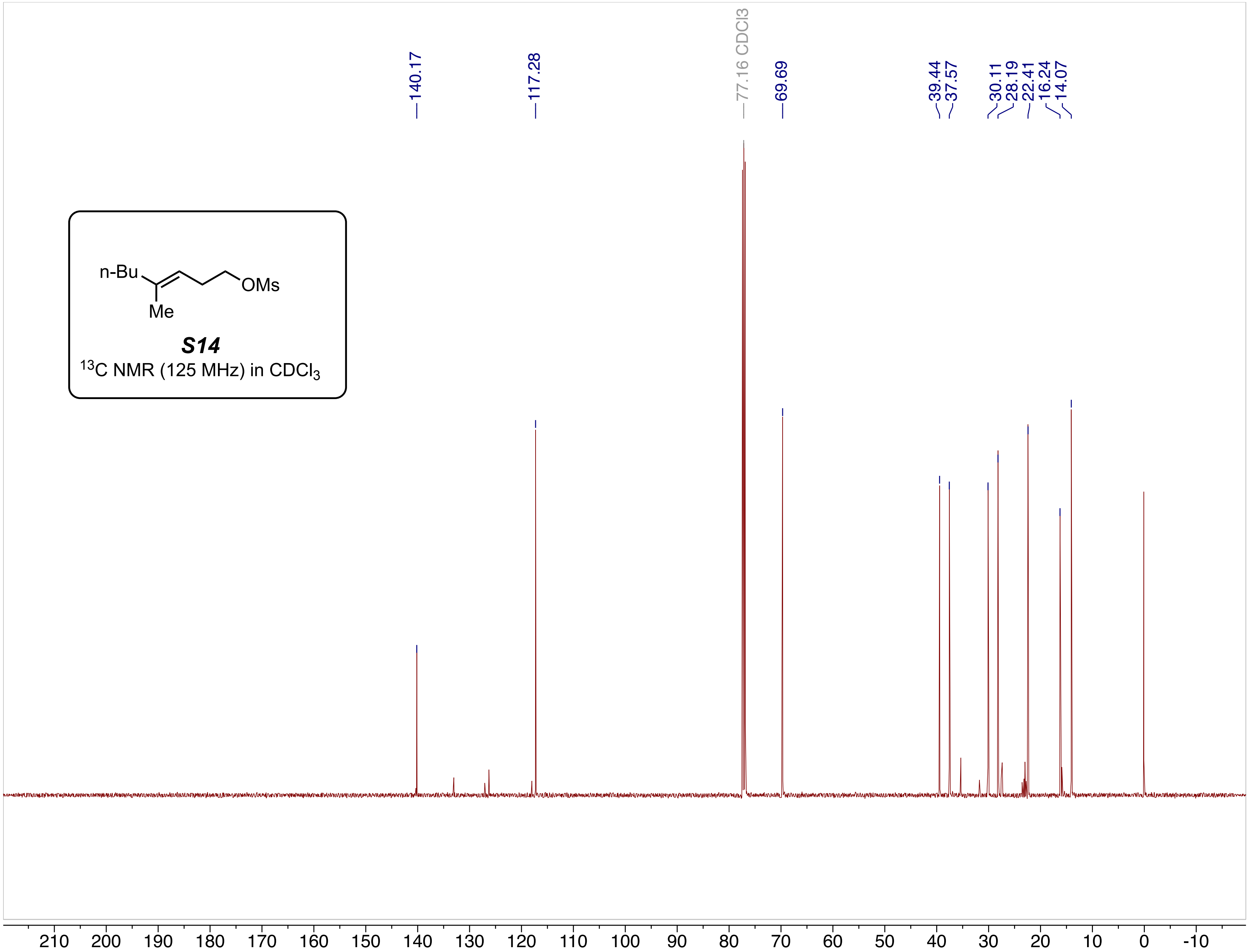
7.28 CHCl3
5.10
5.10
5.09
5.09
5.09
5.08
5.08
5.07
3.82
3.52
3.50
3.49
2.99
2.35
2.33
2.32
2.30
1.98
1.96
1.95
1.59
1.58
1.36
1.35
1.34
1.34
1.33
1.33
1.33
1.32
1.31
1.27
1.27
1.27
1.26
1.26
1.25
1.25
1.24
1.23
0.90
0.88
0.87
0.00 TMS
n-Bu
Me
N
N
O
O
1n
^{1}H NMR (500 MHz) in CDCl$_3$
1.00
2.03
2.02
3.01
2.04
2.06
2.95
2.18
2.64
3.16
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



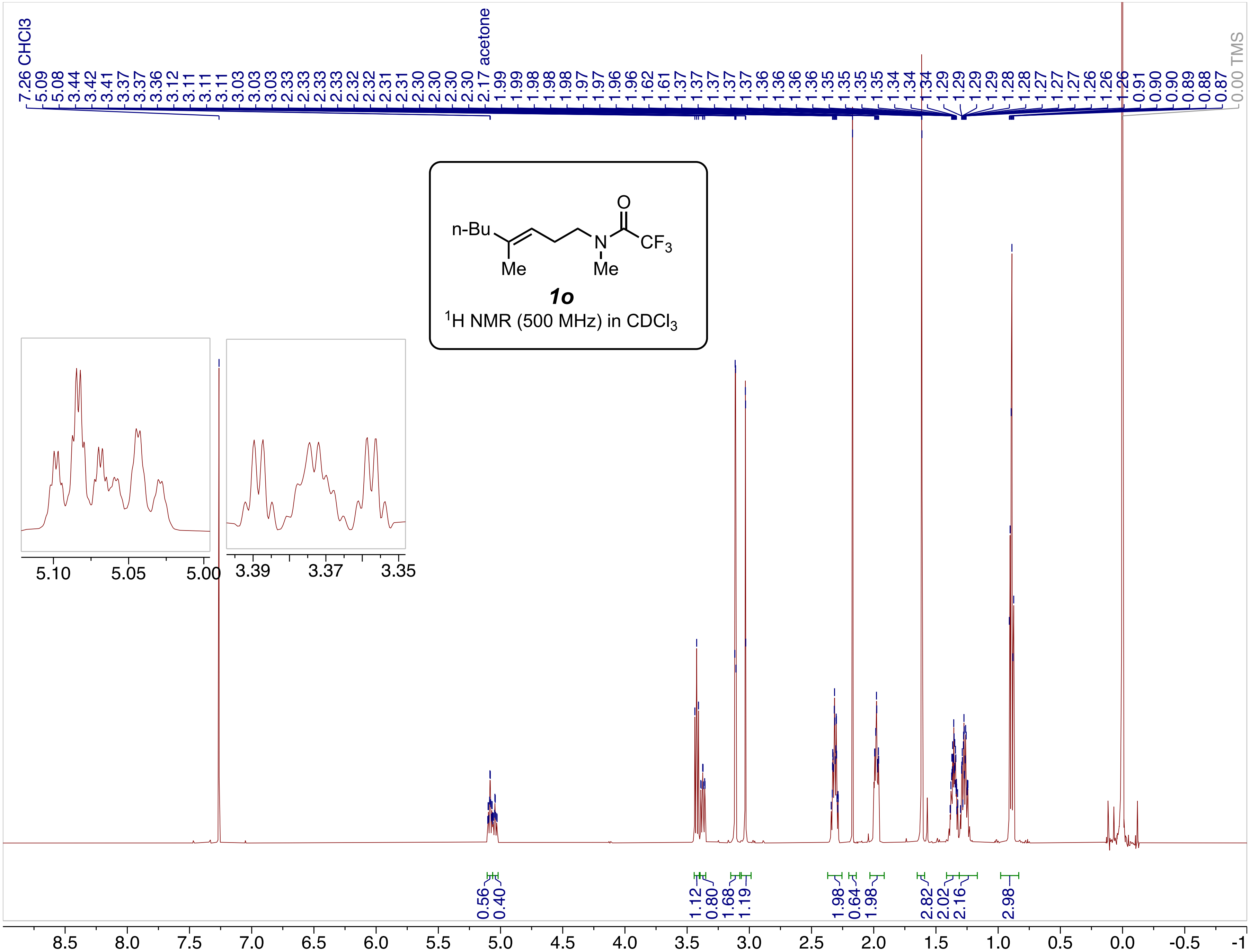
1n

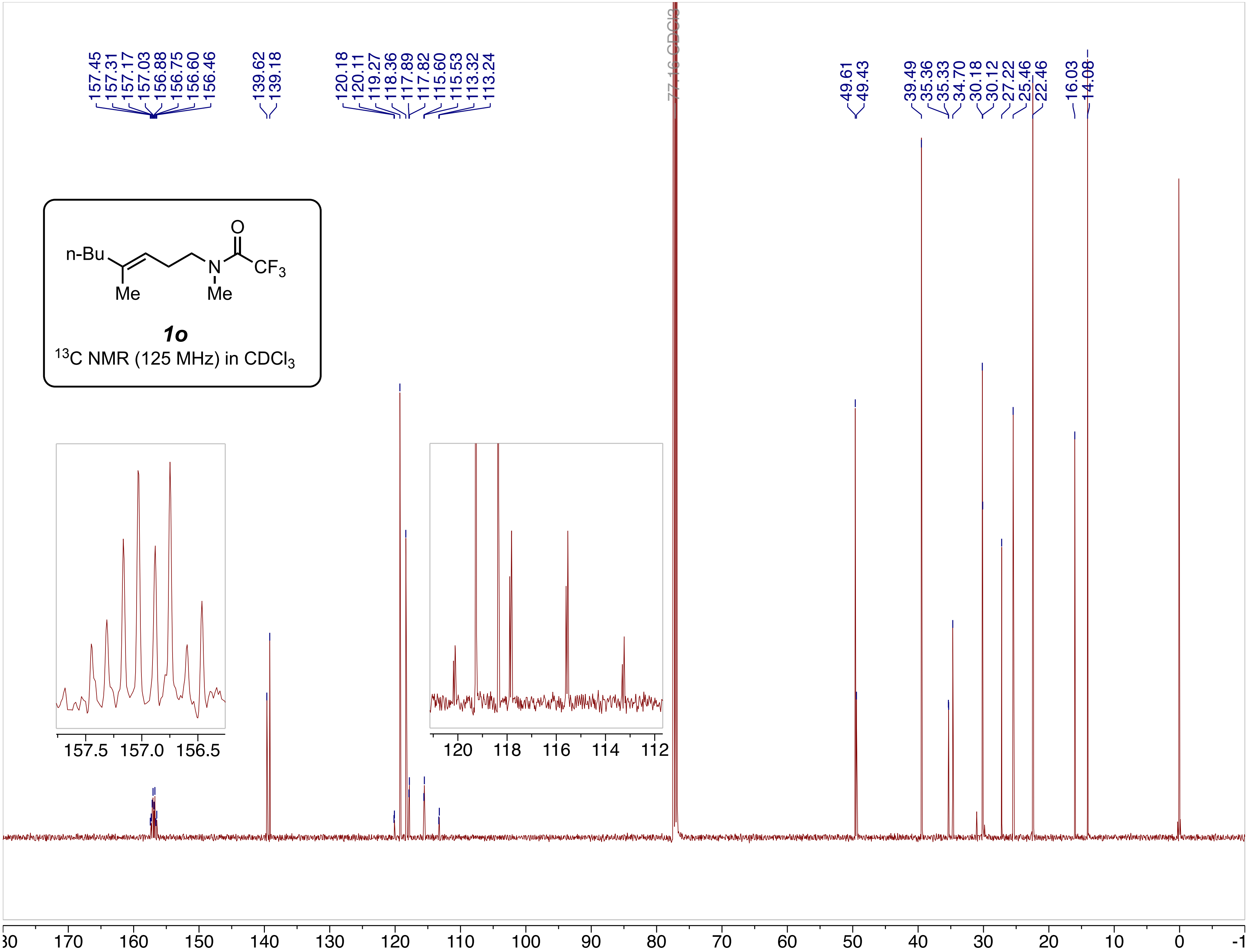
^{13}C NMR (125 MHz) in $CDCl_3$


7.27 CHCl3
5.12
5.11
5.10
5.10
5.10
5.10
5.09
5.08
4.19
4.18
4.16
3.00
2.99
2.48
2.48
2.47
2.47
2.47
2.46
2.45
2.45
2.45
2.44
2.44
2.01
2.01
2.01
2.00
1.98
1.98
1.98
1.63
1.63
1.63
1.63
1.62
1.39
1.39
1.38
1.37
1.37
1.37
1.37
1.36
1.36
1.36
1.36
1.36
1.35
1.34
1.30
1.28
1.28
1.28
1.27
1.27
1.27
1.27
1.26
1.25
0.91
0.89
0.88
0.00 TMS
n-Bu
OMs
Me
S14
^{1}H NMR (500 MHz) in CDCl$_3$
1.01
2.10
3.49
2.05
2.25
2.90
2.36
2.14
3.53
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

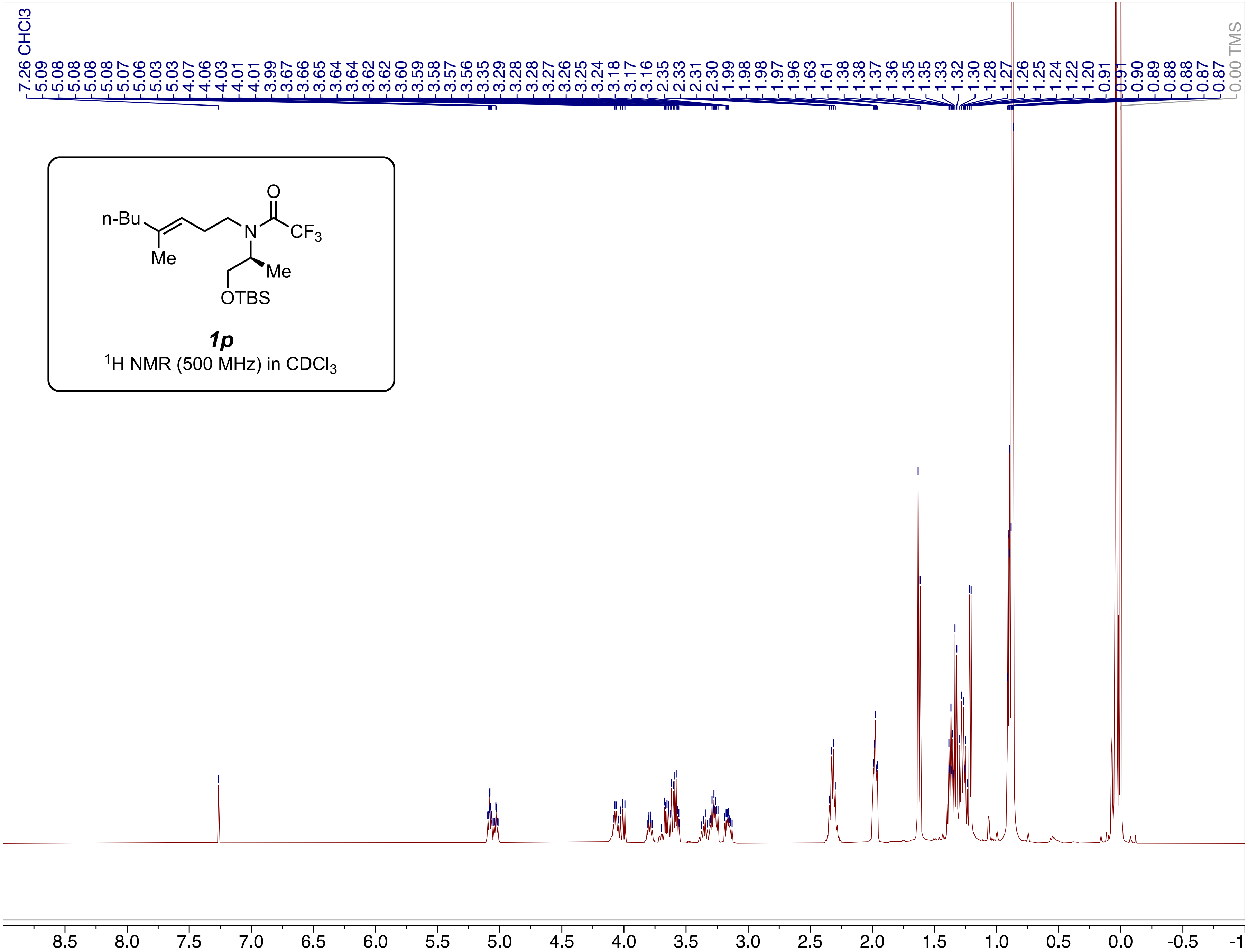

S14

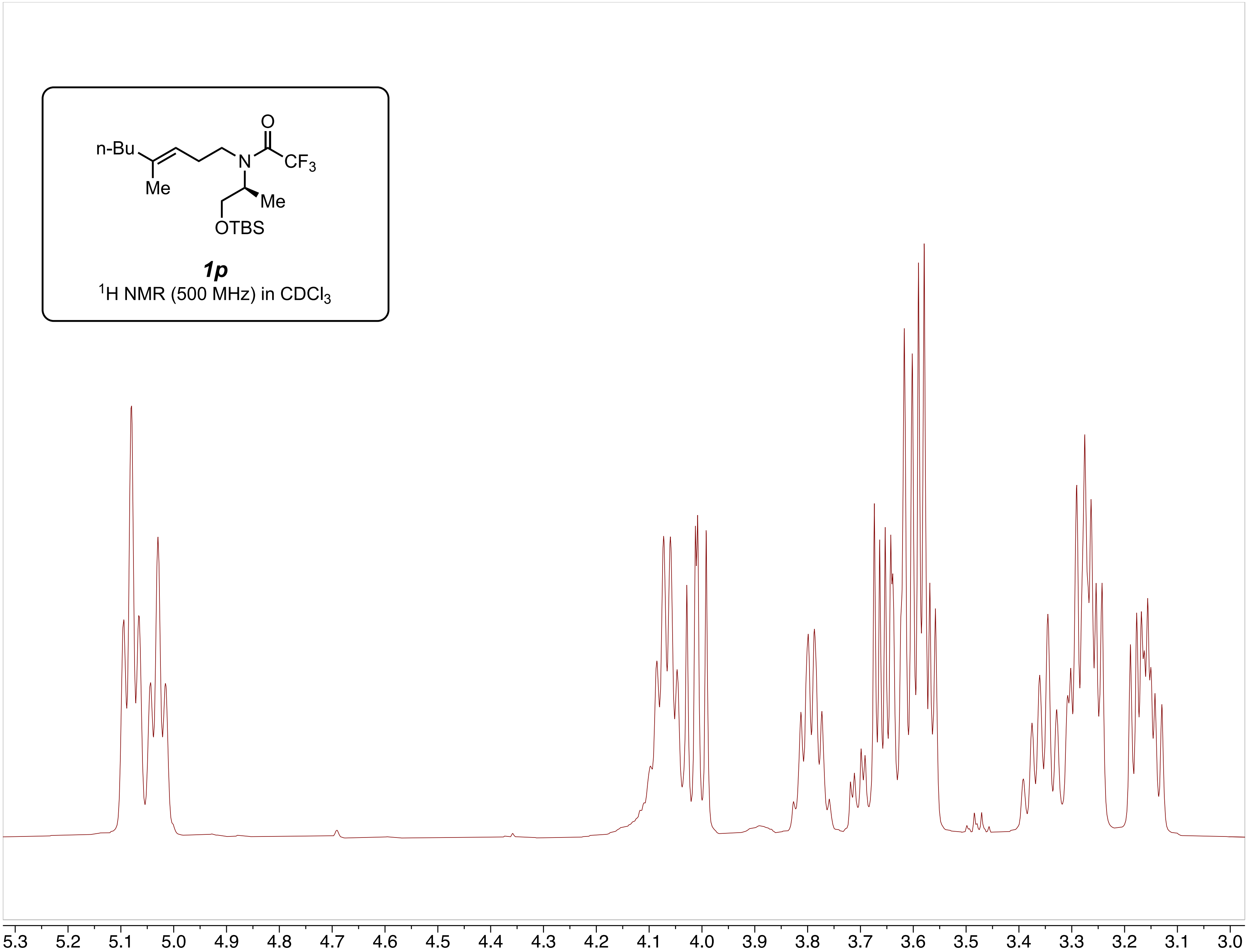
^{13}C NMR (125 MHz) in $CDCl_3$

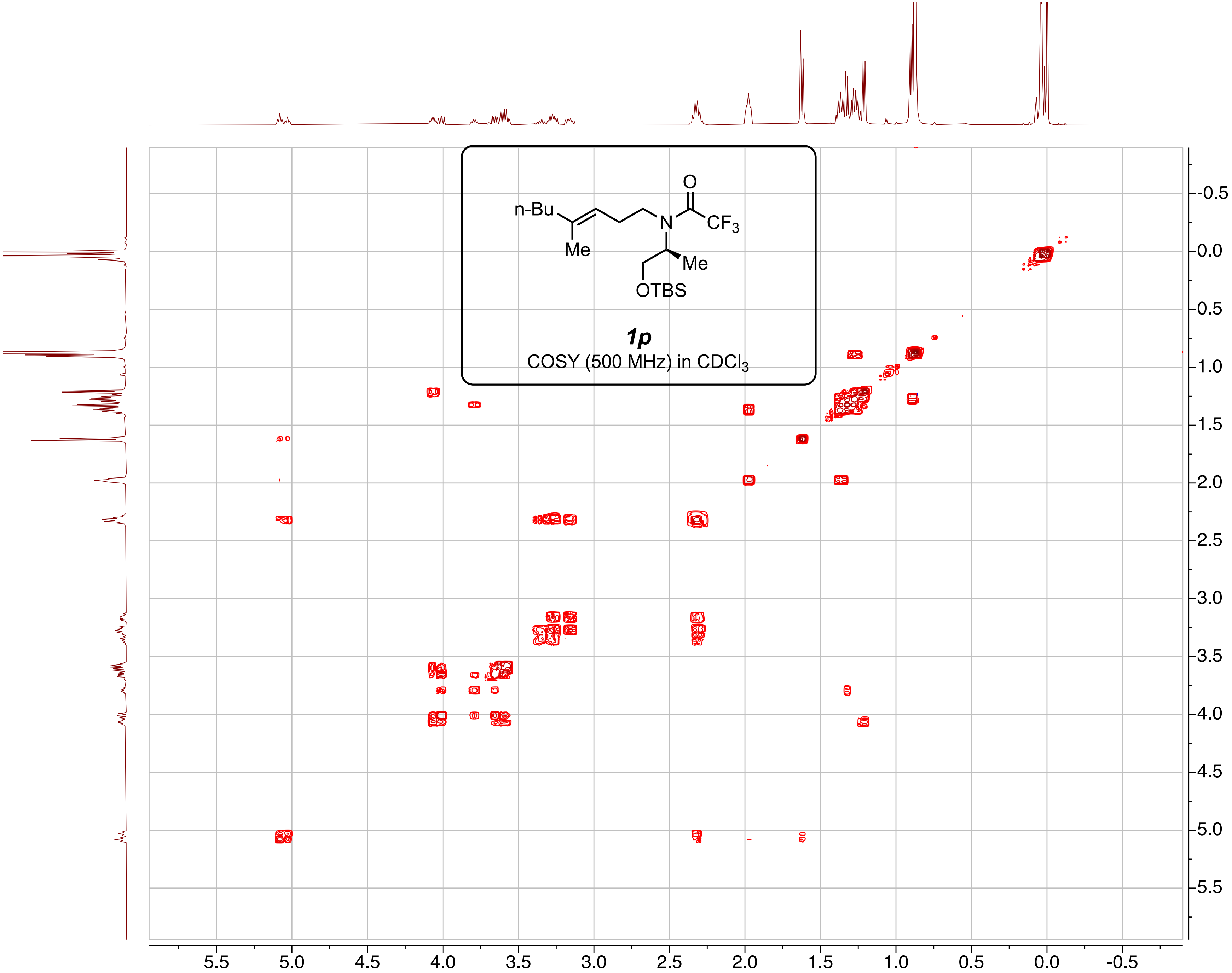

7.26 CHCl3
5.09
5.08
3.44
3.42
3.41
3.37
3.37
3.36
3.12
3.11
3.11
3.11
3.03
3.03
3.03
2.33
2.33
2.33
2.33
2.32
2.32
2.31
2.31
2.30
2.30
2.30
2.30
2.17 acetone
1.99
1.99
1.98
1.98
1.98
1.97
1.97
1.96
1.96
1.62
1.61
1.37
1.37
1.37
1.37
1.37
1.36
1.36
1.36
1.36
1.35
1.35
1.35
1.35
1.34
1.34
1.34
1.29
1.29
1.29
1.29
1.28
1.28
1.27
1.27
1.27
1.26
1.26
1.26
0.91
0.90
0.90
0.89
0.88
0.87
0.00 TMS
n-Bu
Me
N
Me
O
CF3
1o
1H NMR (500 MHz) in CDCl3
5.10
5.05
5.00
3.39
3.37
3.35
0.56
0.40
1.12
0.80
1.68
1.19
1.98
0.64
1.98
2.82
2.02
2.16
2.98
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



13. NMR Spectra

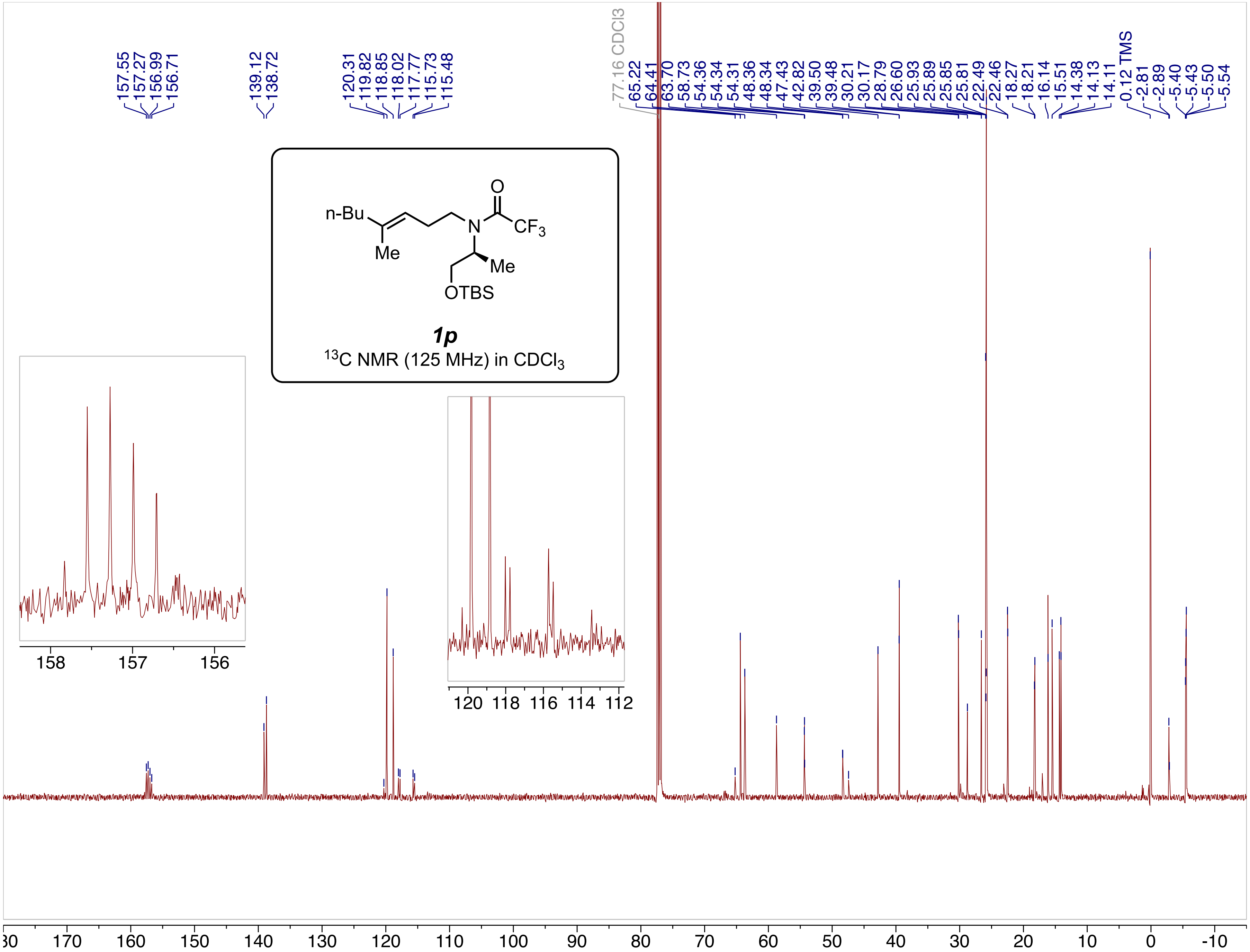
7.26 CHCl3
5.09
5.08
5.08
5.08
5.07
5.06
5.03
5.03
4.07
4.06
4.03
4.01
4.01
3.99
3.67
3.66
3.65
3.64
3.64
3.62
3.62
3.60
3.59
3.58
3.57
3.56
3.35
3.29
3.28
3.28
3.27
3.26
3.25
3.24
3.18
3.17
3.16
2.35
2.33
2.31
2.30
1.99
1.98
1.98
1.97
1.96
1.63
1.61
1.38
1.38
1.37
1.36
1.35
1.35
1.33
1.32
1.30
1.28
1.27
1.26
1.25
1.24
1.22
1.20
0.91
0.91
0.90
0.89
0.88
0.88
0.87
0.87
0.00 TMS
n-Bu
Me
N
O
CF3
Me
OTBS
1p
1H NMR (500 MHz) in CDCl3
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

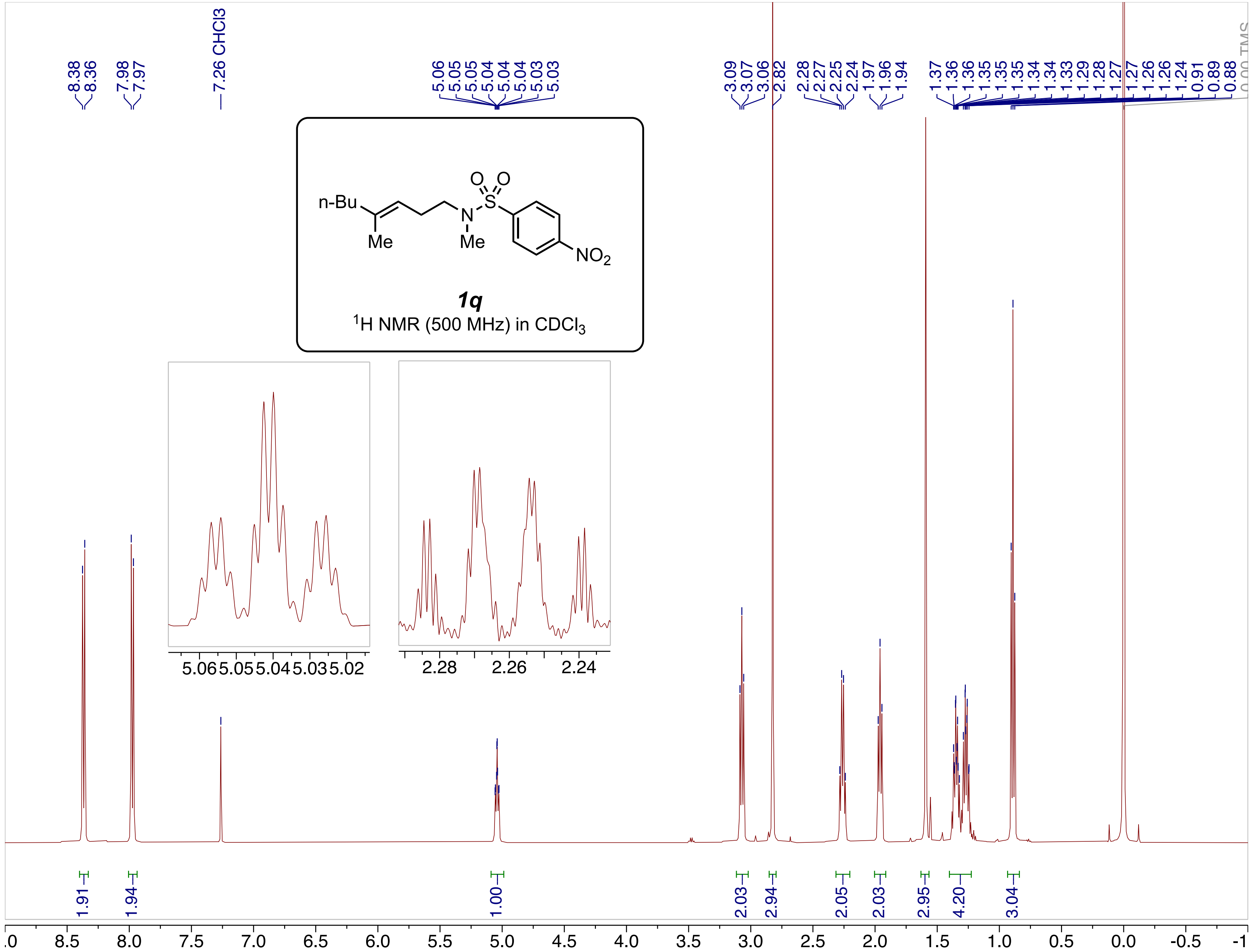

n-Bu
Me
N
O
CF3
Me
OTBS
1p
1H NMR (500 MHz) in CDCl3
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0

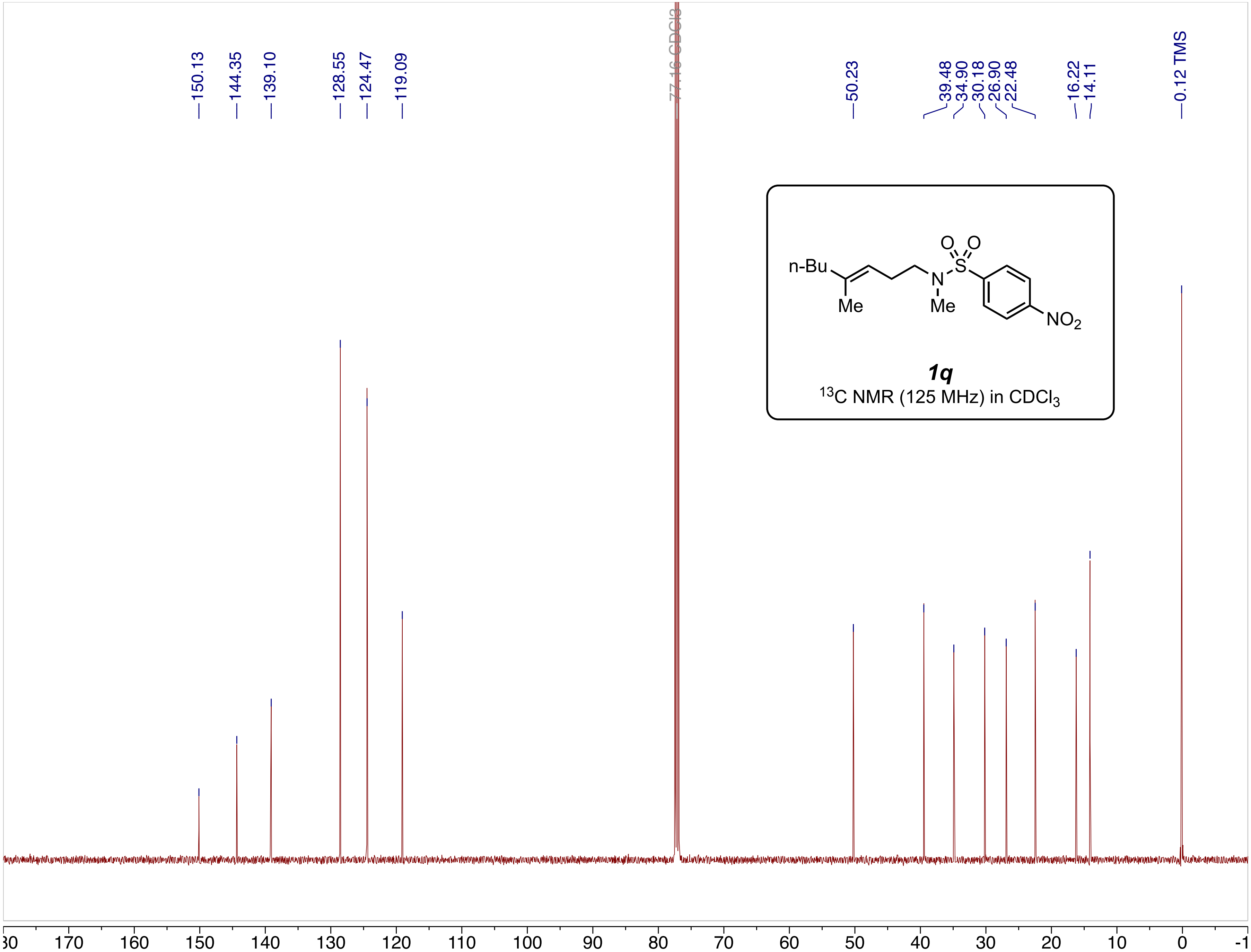


1p

COSY (500 MHz) in CDCl$_3$

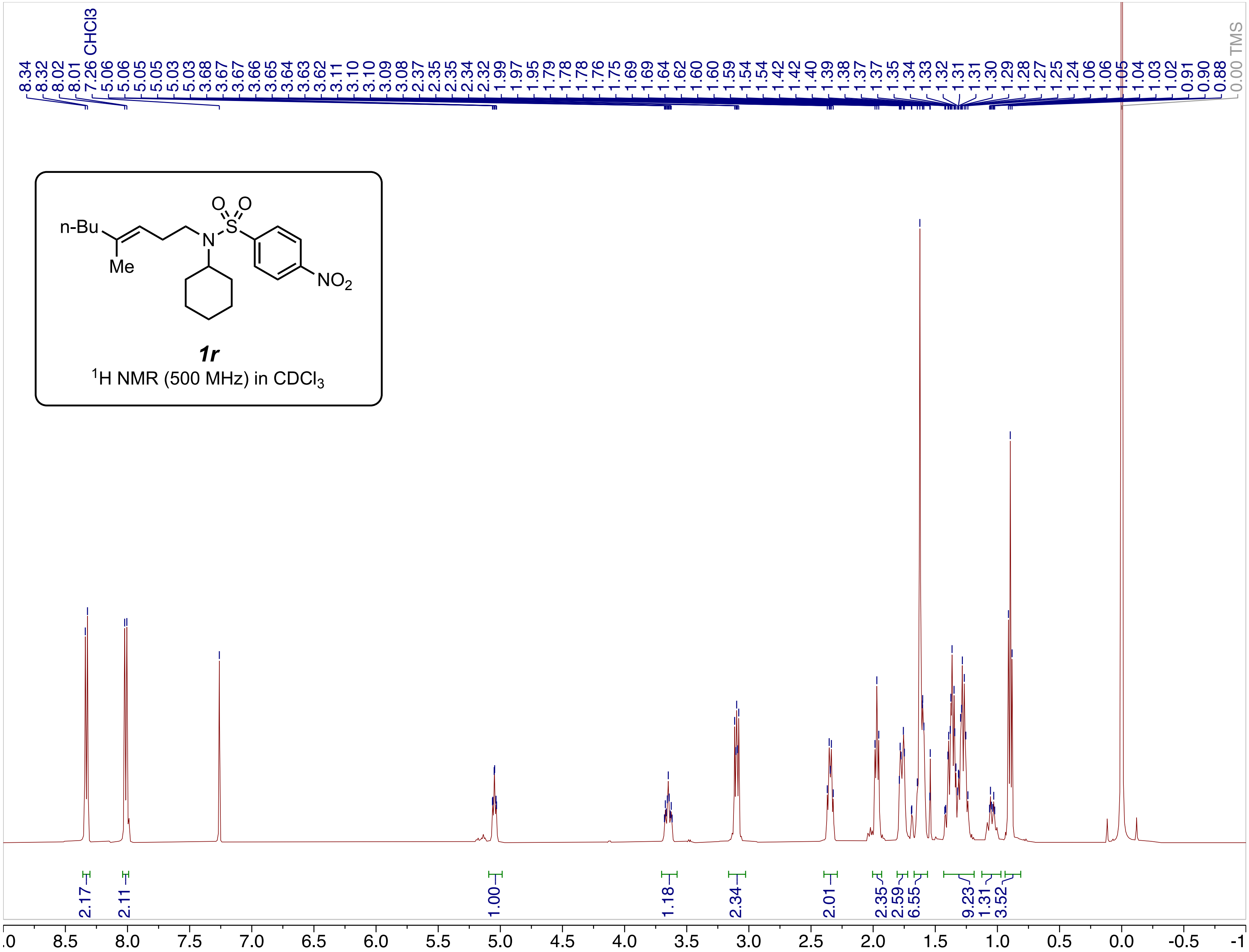

157.55
157.27
156.99
156.71
139.12
138.72
120.31
119.82
118.85
118.02
117.77
115.73
115.48
77.16 CDCl3
65.22
64.41
63.70
58.73
54.36
54.34
54.31
48.36
48.34
47.43
42.82
39.50
39.48
30.21
30.17
28.79
26.60
25.93
25.89
25.85
25.81
22.49
22.46
18.27
18.21
16.14
15.51
14.38
14.13
14.11
0.12 TMS
-2.81
-2.89
-5.40
-5.43
-5.50
-5.54
n-Bu
Me
N
O
CF3
Me
OTBS
1p
13C NMR (125 MHz) in CDCl3
158
157
156
120
118
116
114
112
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10


8.38
8.36
7.98
7.97
7.26 CHCl3
5.06
5.05
5.05
5.04
5.04
5.04
5.03
5.03
3.09
3.07
3.06
2.82
2.28
2.27
2.25
2.24
1.97
1.96
1.94
1.37
1.36
1.36
1.35
1.35
1.35
1.34
1.34
1.33
1.29
1.28
1.27
1.27
1.26
1.26
1.24
0.91
0.89
0.88
0.00 TMS
n-Bu
Me
N
Me
S
O
O
NO2
1q
1H NMR (500 MHz) in CDCl3
5.06
5.05
5.04
5.03
5.02
2.28
2.26
2.24
1.91
1.94
1.00
2.03
2.94
2.05
2.03
2.95
4.20
3.04
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

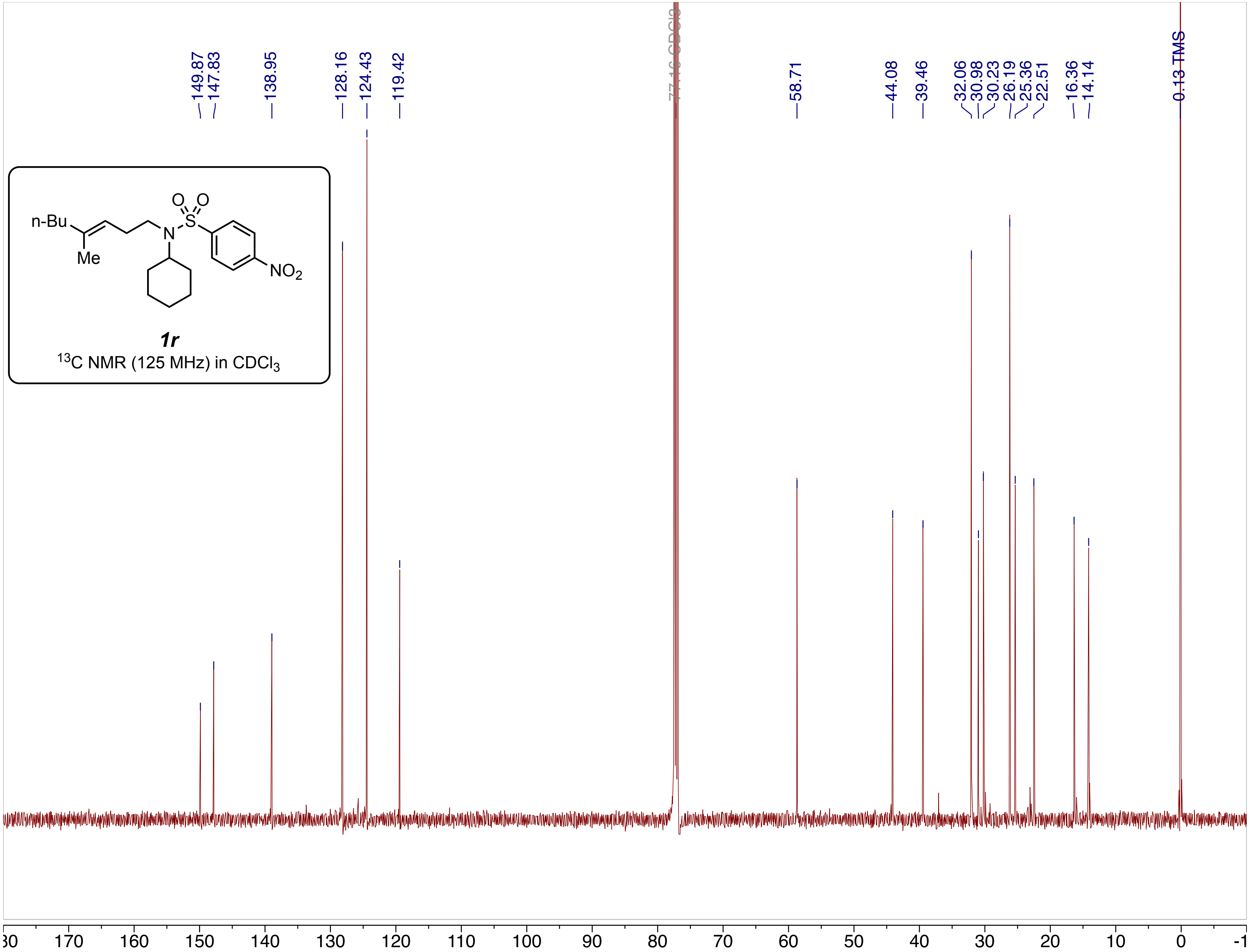


1q

^{13}C NMR (125 MHz) in $CDCl_3$

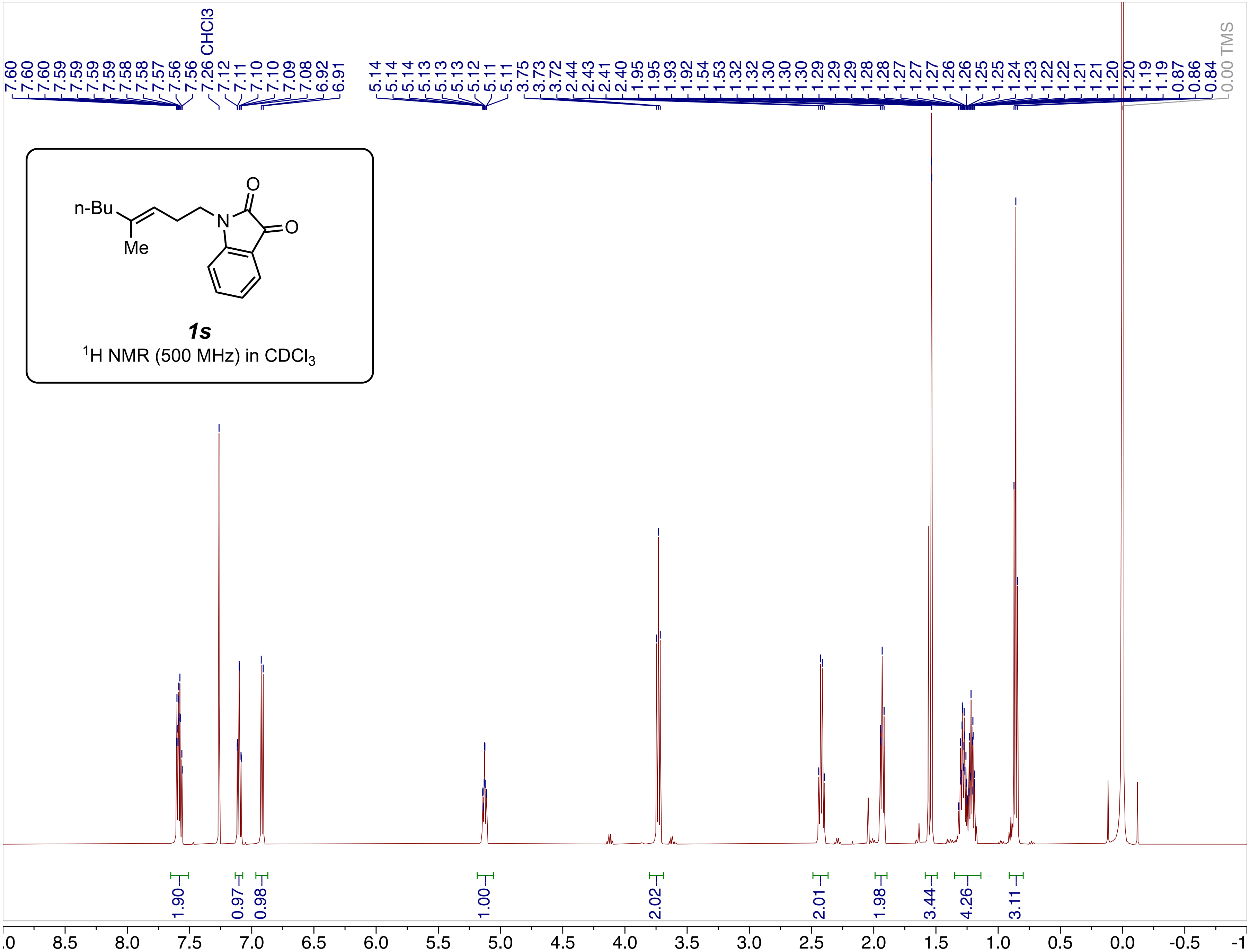

1r

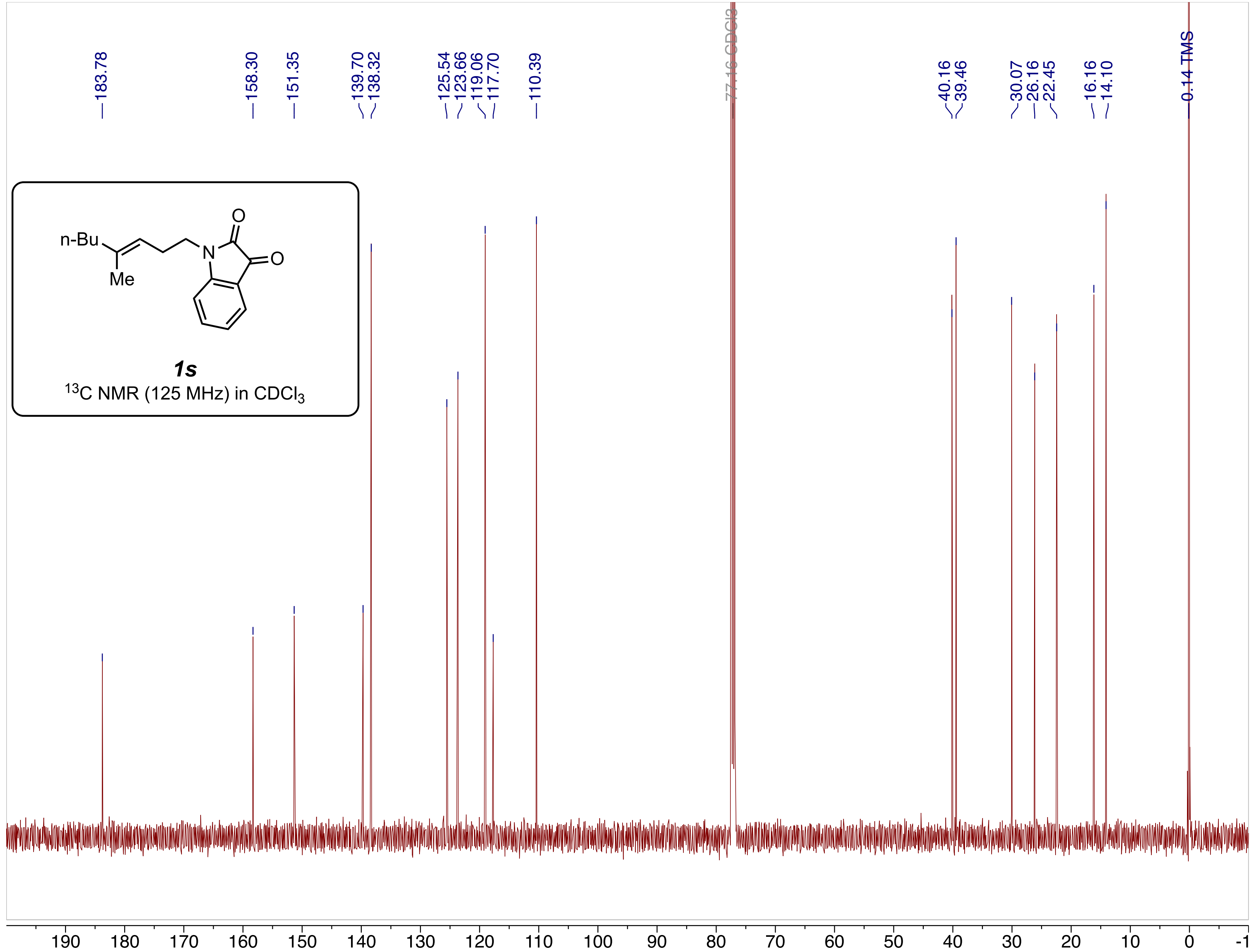
^{1}H NMR (500 MHz) in $CDCl_3$

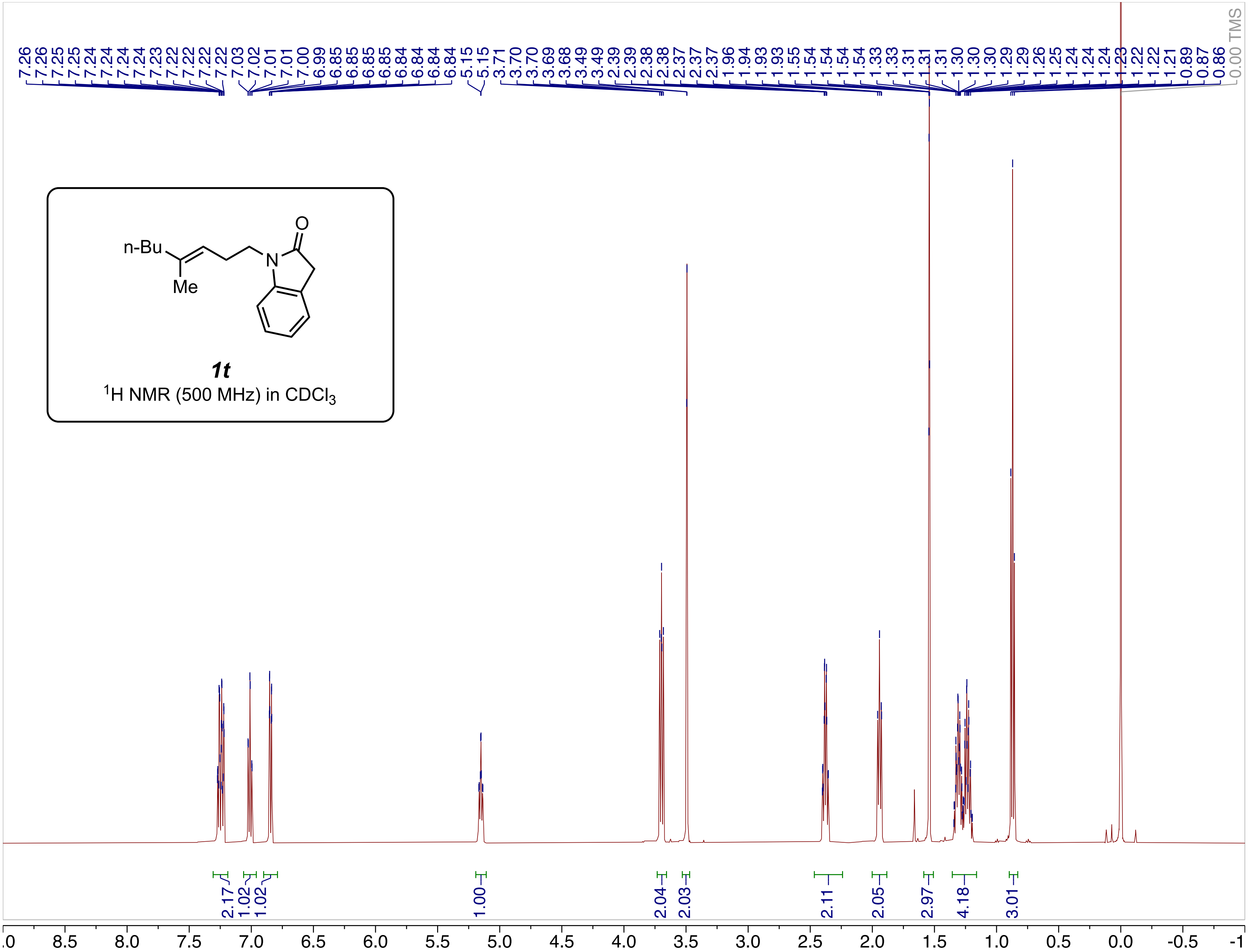


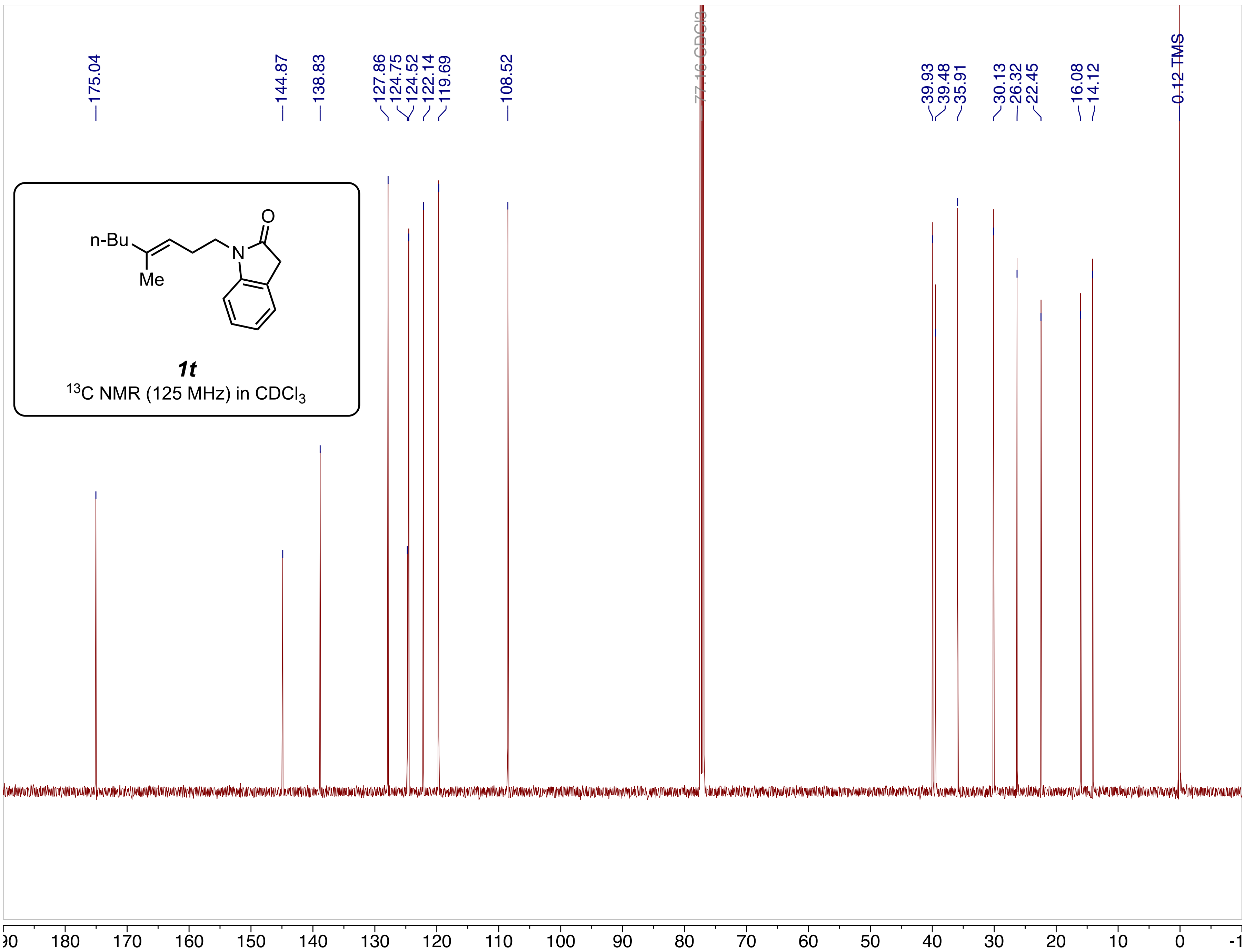
1r

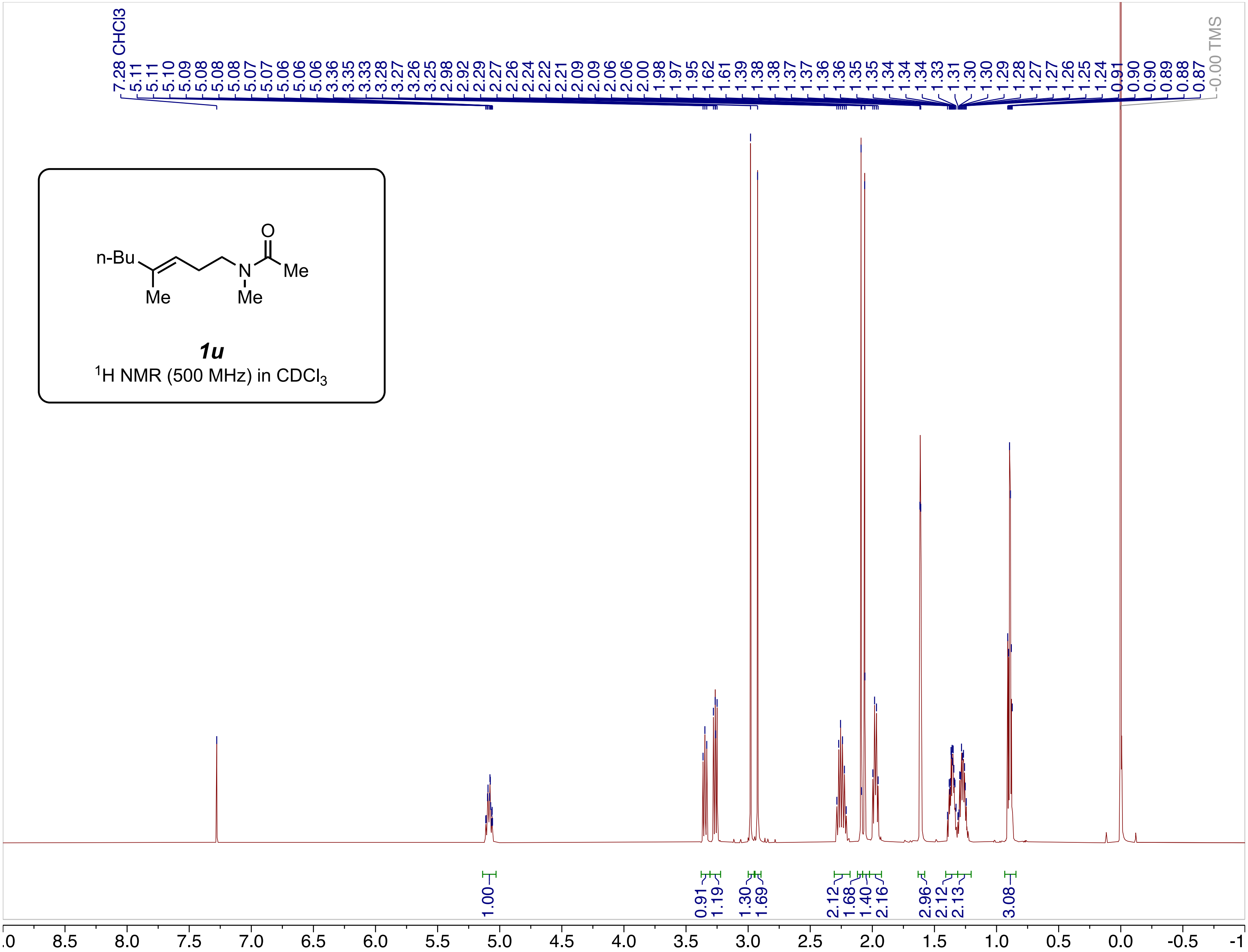
^{13}C NMR (125 MHz) in $CDCl_3$

7.60
7.60
7.60
7.59
7.59
7.59
7.58
7.58
7.57
7.56
7.56
7.26 CHCl3
7.12
7.11
7.10
7.10
7.09
7.08
6.92
6.91
5.14
5.14
5.14
5.13
5.13
5.13
5.12
5.11
5.11
3.75
3.73
3.72
2.44
2.43
2.41
2.40
1.95
1.95
1.93
1.92
1.54
1.53
1.32
1.32
1.30
1.30
1.30
1.29
1.29
1.29
1.28
1.28
1.27
1.27
1.27
1.26
1.26
1.25
1.25
1.24
1.23
1.22
1.22
1.21
1.21
1.20
1.20
1.19
1.19
0.87
0.86
0.84
0.00 TMS
n-Bu
Me
N
O
O
1s
¹H NMR (500 MHz) in CDCl3
1.90
0.97
0.98
1.00
2.02
2.01
1.98
3.44
4.26
3.11
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


183.78
158.30
151.35
139.70
138.32
125.54
123.66
119.06
117.70
110.39
77.16 CDCl3
40.16
39.46
30.07
26.16
22.45
16.16
14.10
0.14 TMS
n-Bu
Me
N
O
O
1s
^{13}C NMR (125 MHz) in CDCl$_3$
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

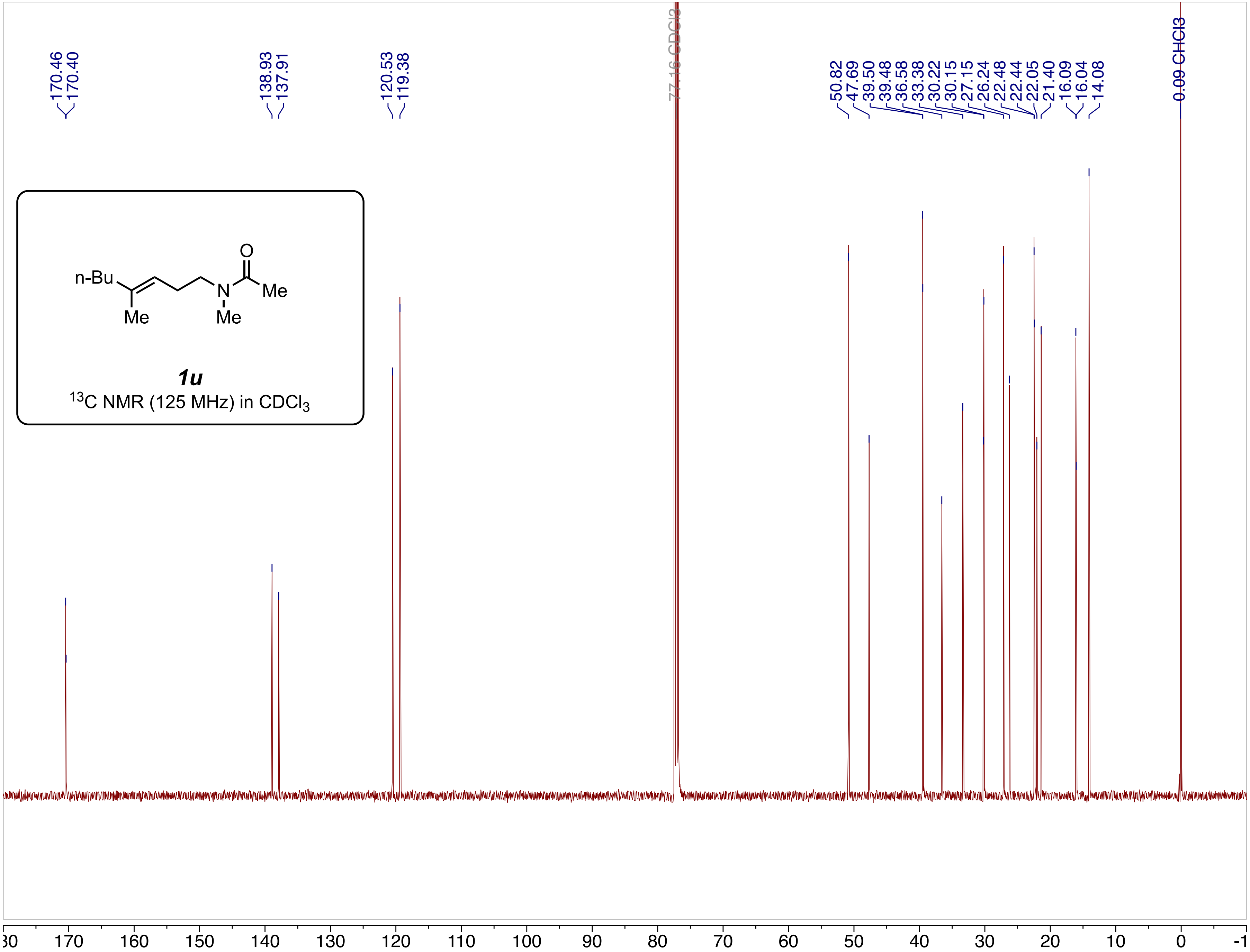

7.26
7.26
7.25
7.25
7.24
7.24
7.24
7.24
7.23
7.22
7.22
7.22
7.22
7.03
7.02
7.01
7.01
7.00
6.99
6.85
6.85
6.85
6.84
6.84
6.84
6.84
5.15
5.15
3.71
3.70
3.70
3.69
3.68
3.49
2.39
2.39
2.38
2.38
2.37
2.37
2.37
1.96
1.94
1.93
1.93
1.55
1.54
1.54
1.54
1.33
1.33
1.31
1.31
1.31
1.30
1.30
1.30
1.29
1.29
1.26
1.25
1.24
1.24
1.24
1.23
1.22
1.22
1.21
0.89
0.87
0.86
0.00 TMS
n-Bu
Me
N
O
1t
^{1}H NMR (500 MHz) in $CDCl_3$
2.17
1.02
1.02
1.00
2.04
2.03
2.11
2.05
2.97
4.18
3.01
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

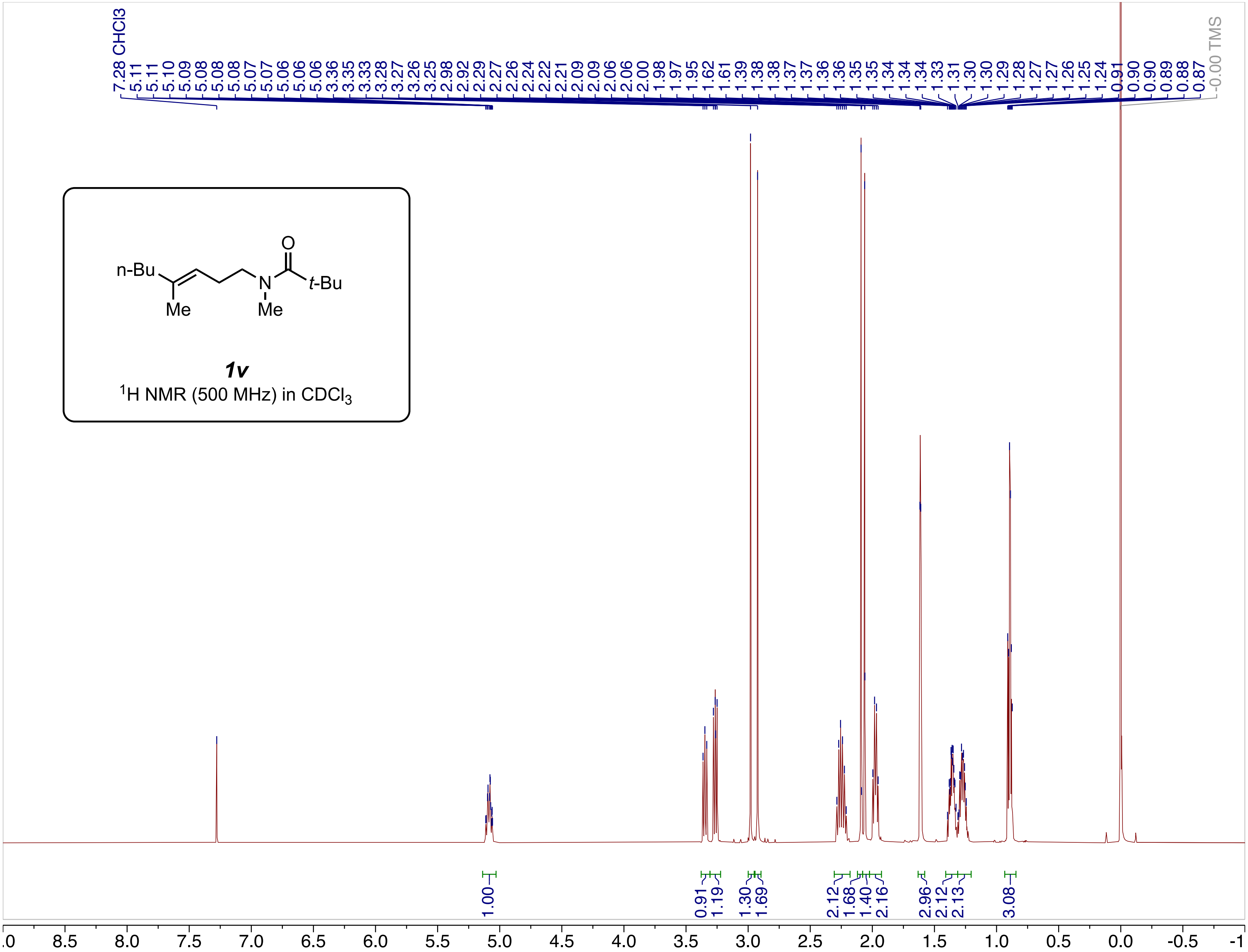

175.04
144.87
138.83
127.86
124.75
124.52
122.14
119.69
108.52
77.16 CDCl3
39.93
39.48
35.91
30.13
26.32
22.45
16.08
14.12
0.12 TMS
n-Bu
Me
N
O
1t
^{13}C NMR (125 MHz) in CDCl$_3$
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

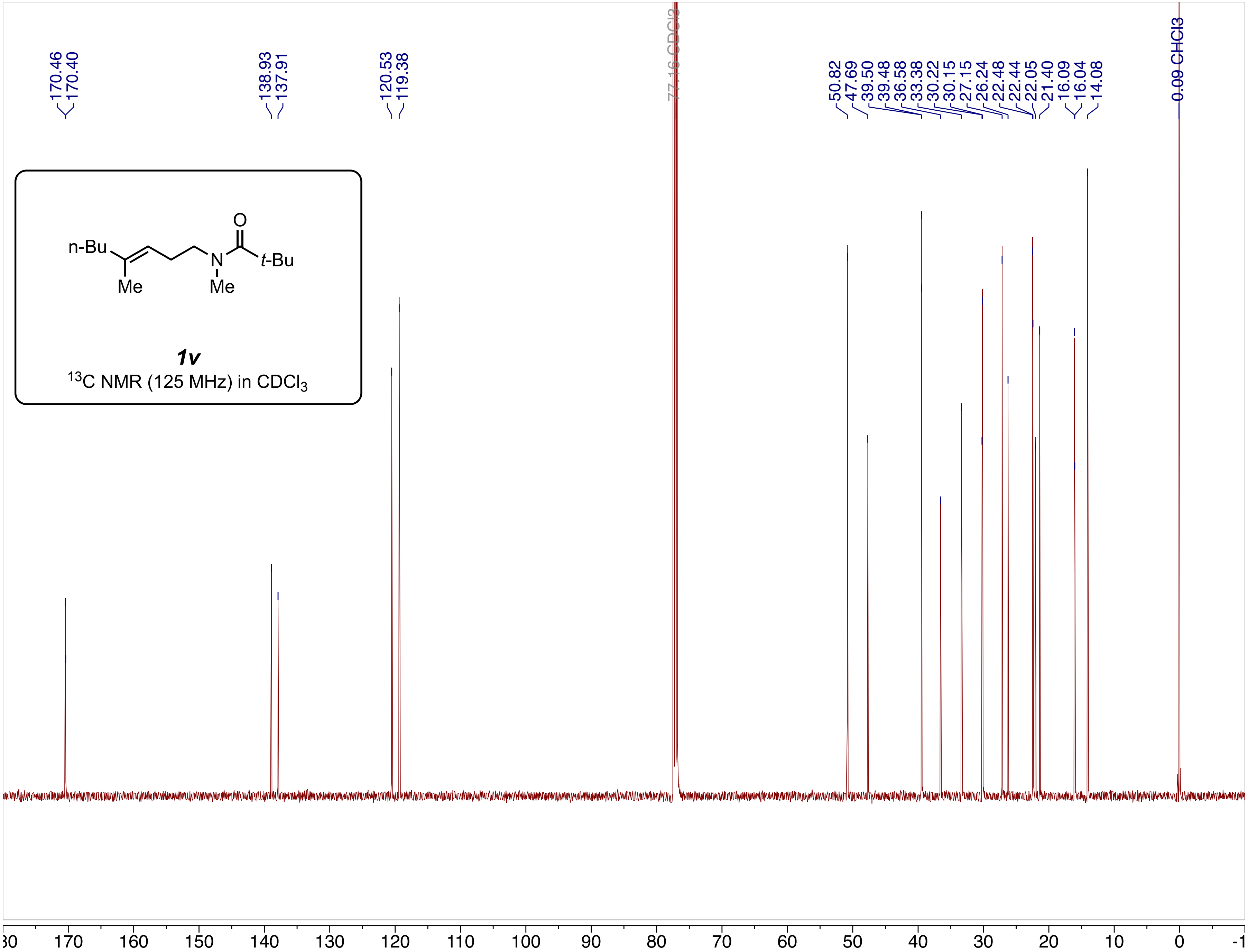


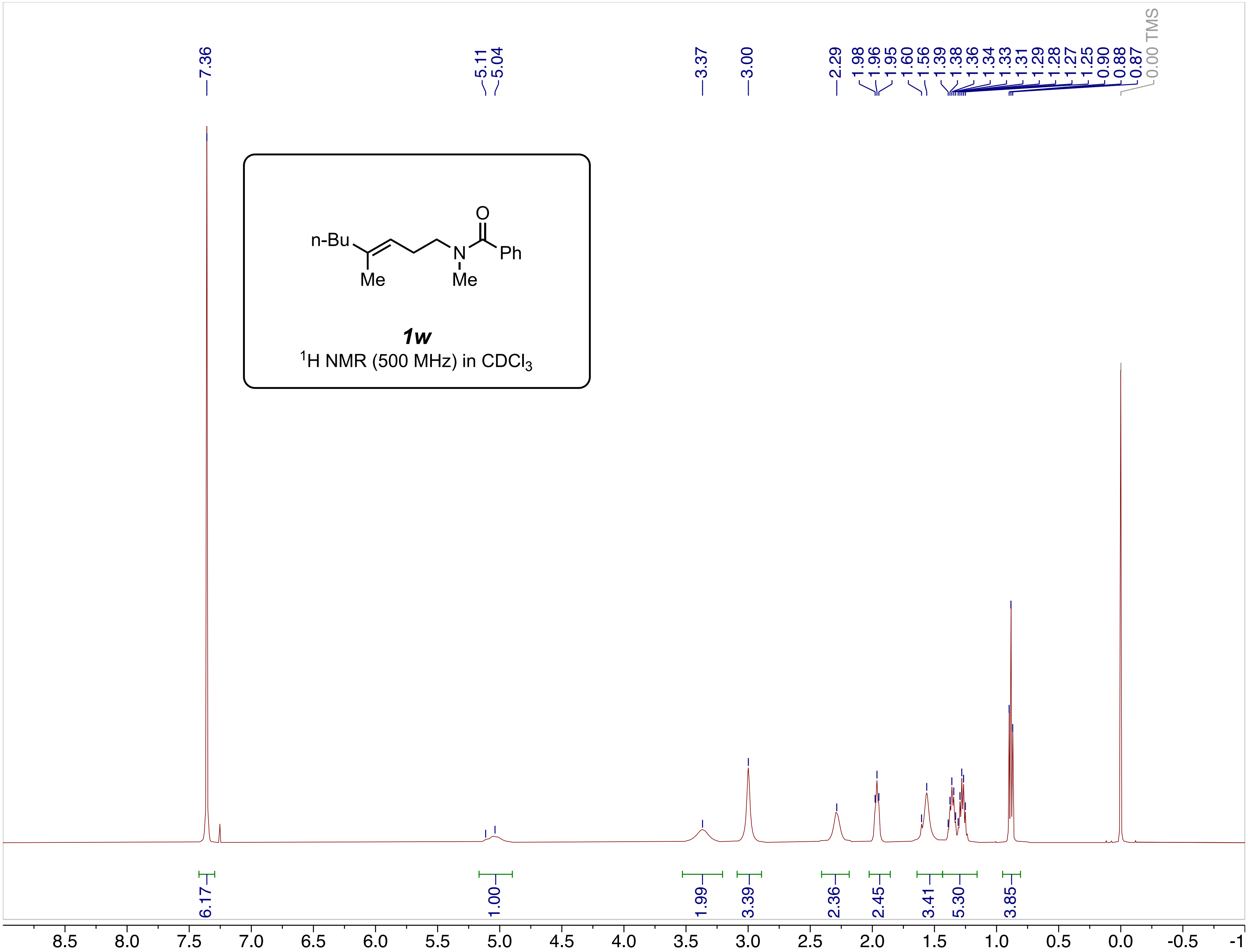
1u

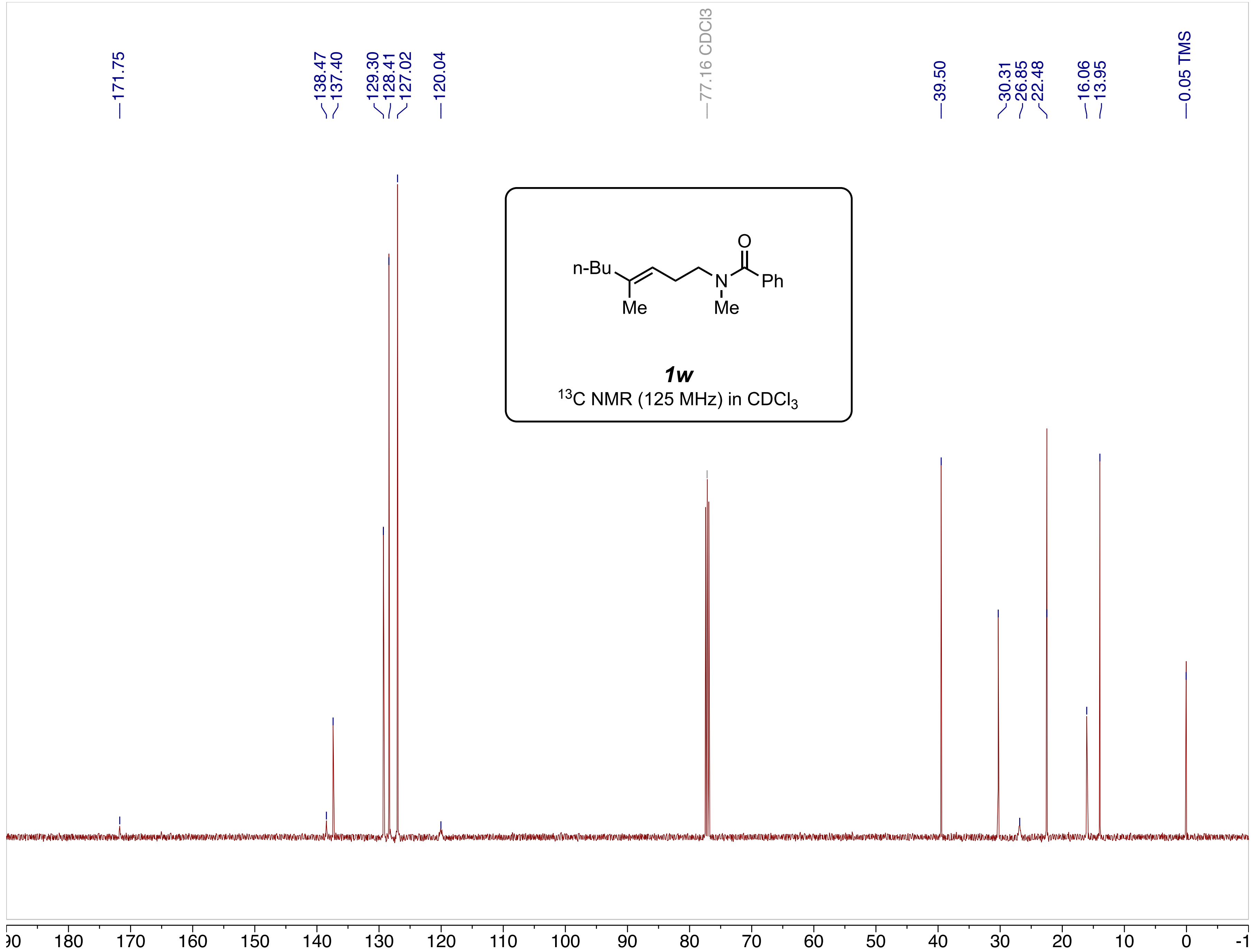
^{1}H NMR (500 MHz) in CDCl$_3$

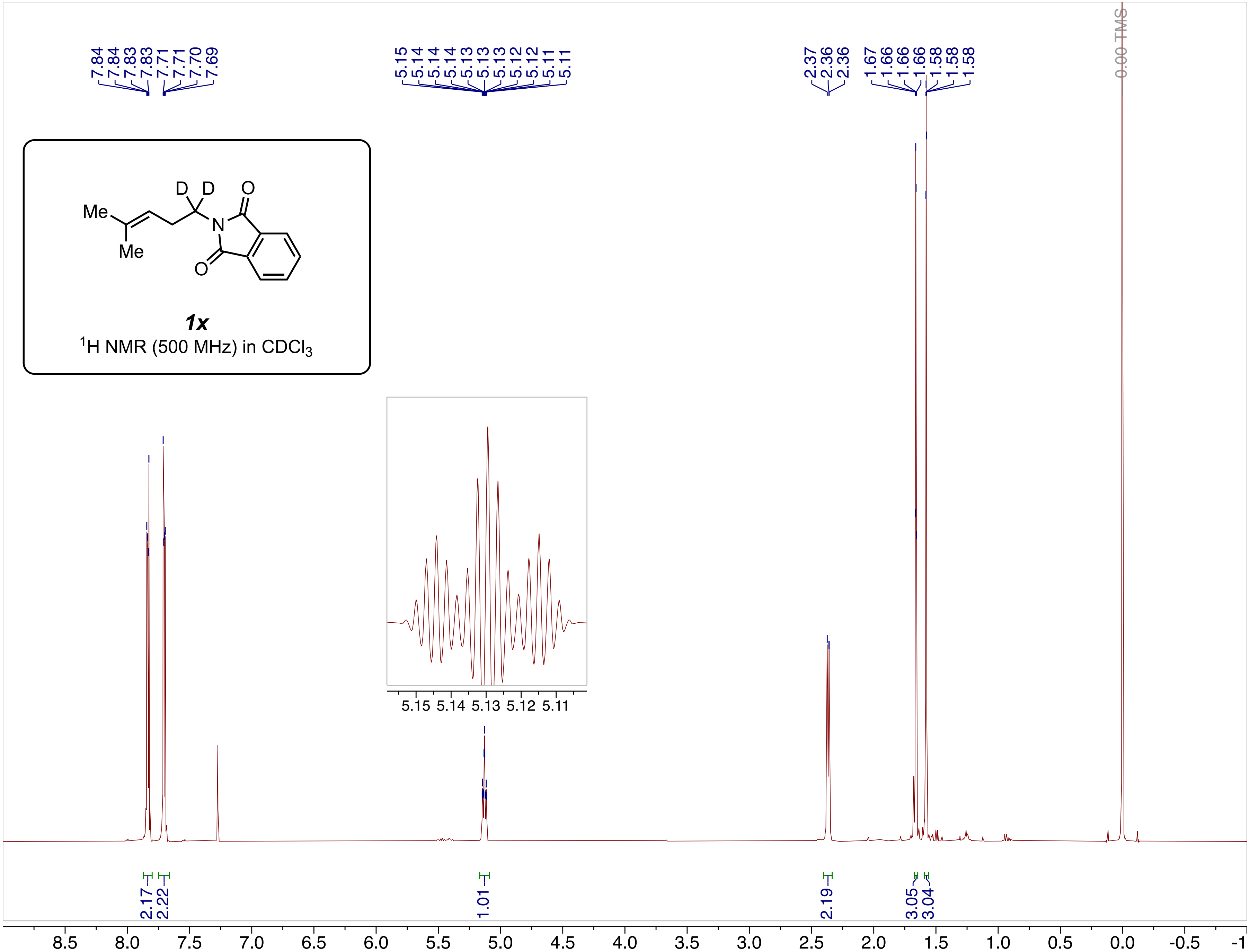

170.46
170.40
138.93
137.91
120.53
119.38
77.16 CDCl3
50.82
47.69
39.50
39.48
36.58
33.38
30.22
30.15
27.15
26.24
22.48
22.44
22.05
21.40
16.09
16.04
14.08
0.09 CHCl3
n-Bu
O
N
Me
Me
Me
1u
13C NMR (125 MHz) in CDCl3
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.28 CHCl3
5.11
5.11
5.10
5.09
5.08
5.08
5.07
5.07
5.06
5.06
5.06
3.36
3.35
3.33
3.28
3.27
3.26
3.25
2.98
2.92
2.29
2.27
2.26
2.24
2.22
2.21
2.09
2.09
2.06
2.06
2.00
1.98
1.97
1.95
1.62
1.61
1.39
1.38
1.38
1.37
1.37
1.36
1.36
1.35
1.35
1.34
1.34
1.34
1.33
1.31
1.30
1.30
1.29
1.28
1.27
1.27
1.26
1.25
1.24
0.91
0.90
0.90
0.89
0.88
0.87
-0.00 TMS
n-Bu
Me
N
Me
O
t-Bu
1v
^{1}H NMR (500 MHz) in CDCl$_3$
1.00
0.91
1.19
1.30
1.69
2.12
1.68
1.40
2.16
2.96
2.12
2.13
3.08
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


170.46
170.40
138.93
137.91
120.53
119.38
77.16 CDCl3
50.82
47.69
39.50
39.48
36.58
33.38
30.22
30.15
27.15
26.24
22.48
22.44
22.05
21.40
16.09
16.04
14.08
0.09 CHCl3
n-Bu
O
N
t-Bu
Me
Me
1v
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

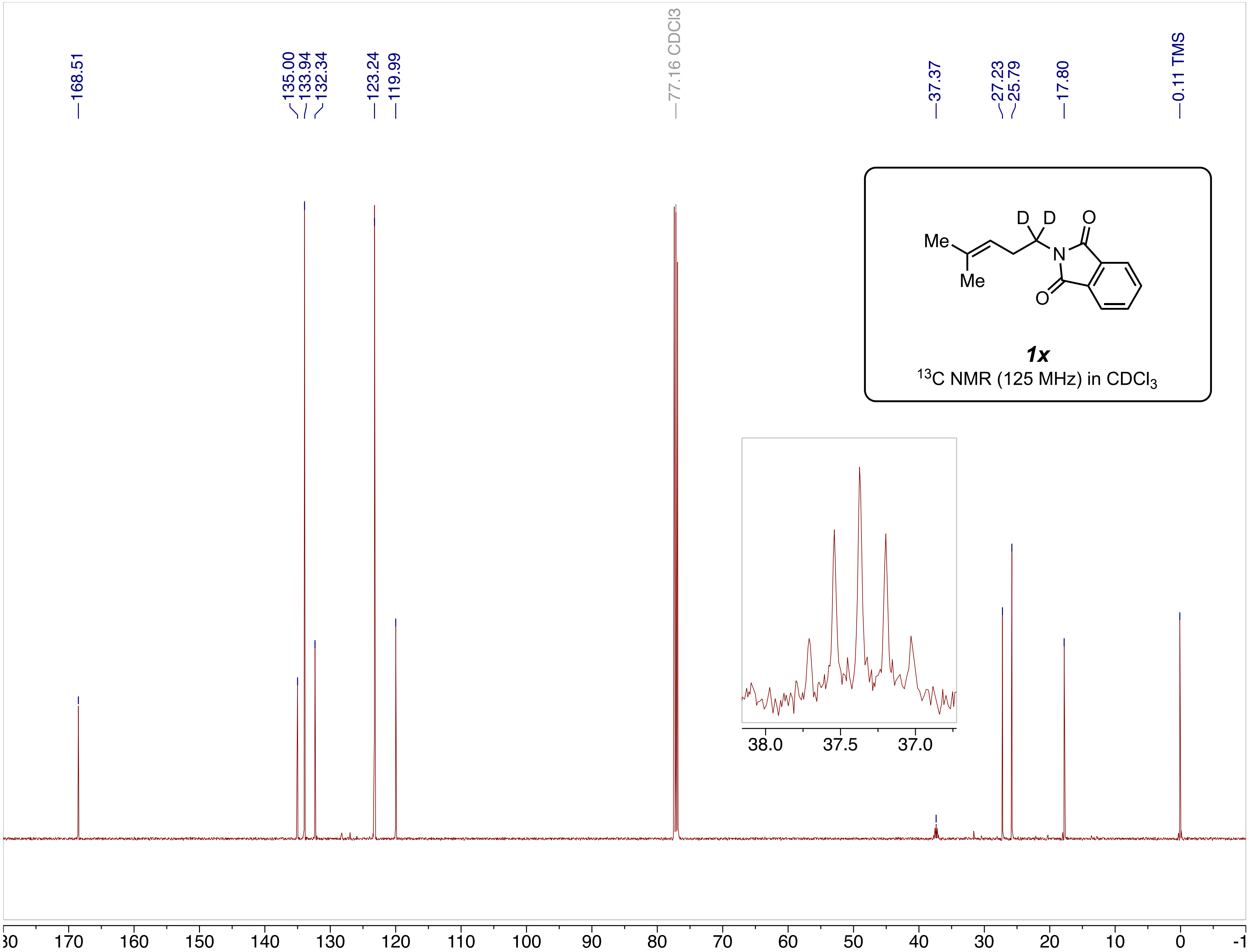

7.36
5.11
5.04
3.37
3.00
2.29
1.98
1.96
1.95
1.60
1.56
1.39
1.38
1.36
1.34
1.33
1.31
1.29
1.28
1.27
1.25
0.90
0.88
0.87
0.00 TMS
n-Bu
O
N
Ph
Me
Me
1w
^{1}H NMR (500 MHz) in CDCl$_3$
6.17
1.00
1.99
3.39
2.36
2.45
3.41
5.30
3.85
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


171.75
138.47
137.40
129.30
128.41
127.02
120.04
77.16 CDCl3
39.50
30.31
26.85
22.48
16.06
13.95
0.05 TMS
n-Bu
Me
O
N
Ph
Me
1w
^{13}C NMR (125 MHz) in CDCl$_3$
90
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



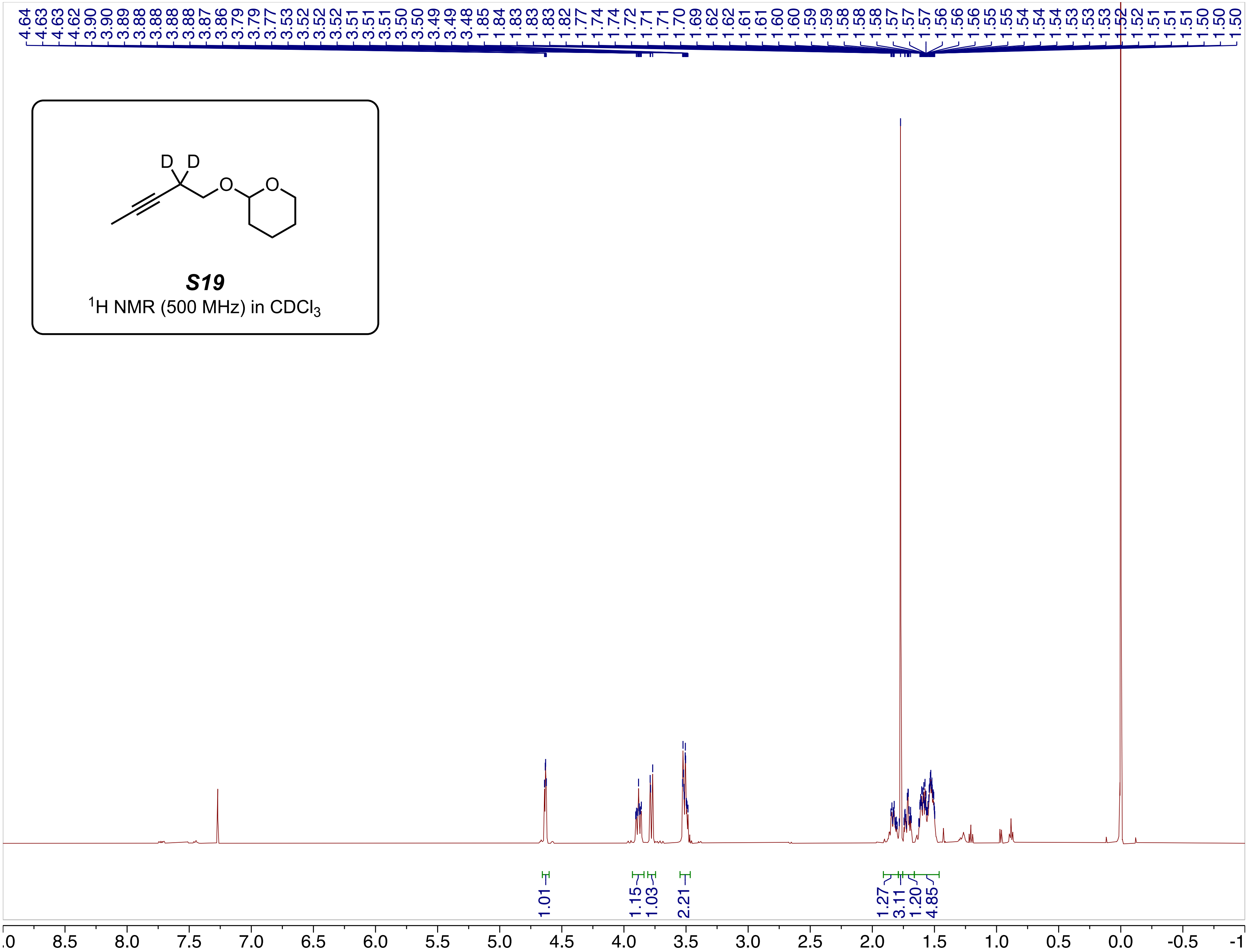
1x

^{1}H NMR (500 MHz) in CDCl$_3$



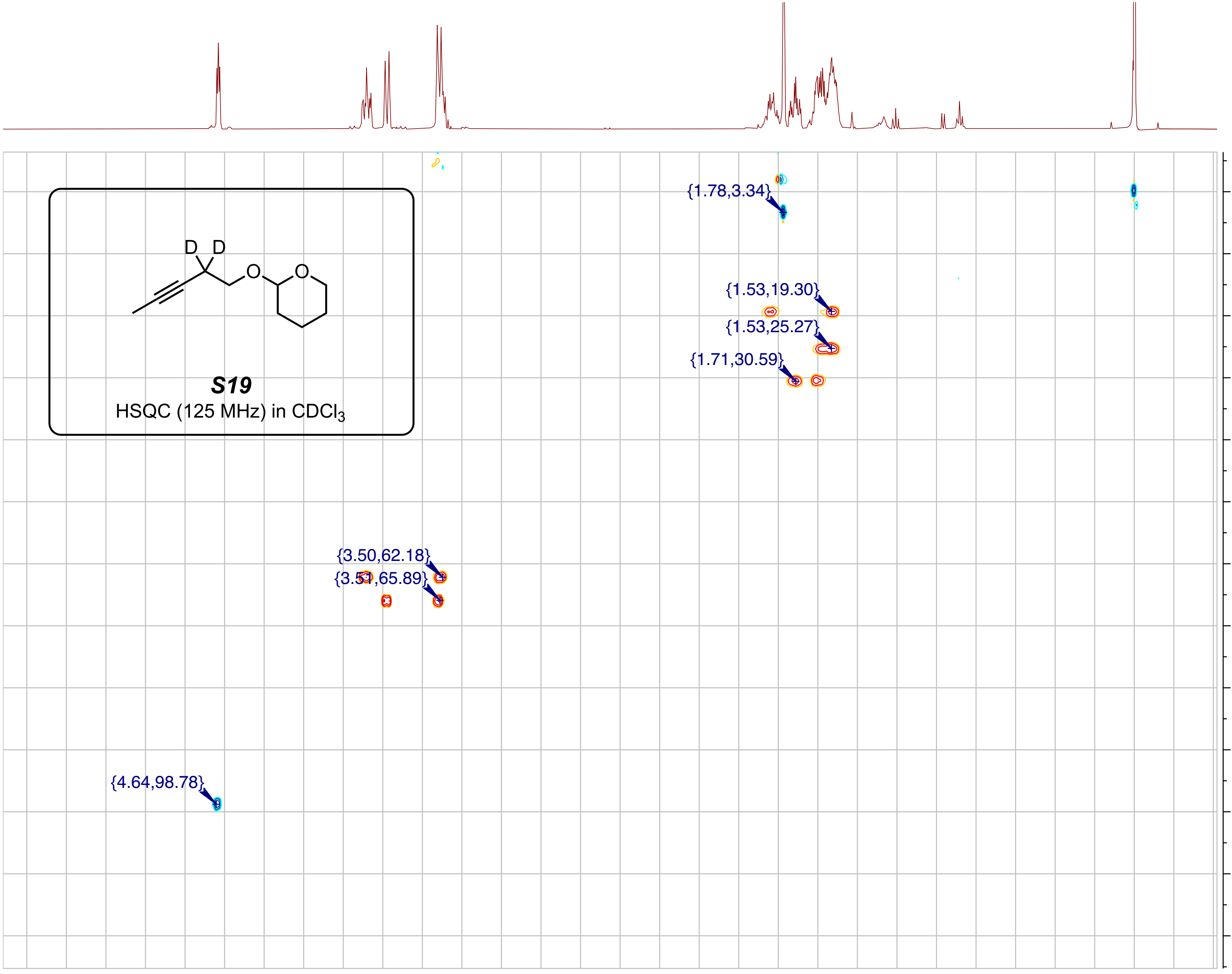
1x

^{13}C NMR (125 MHz) in CDCl$_3$



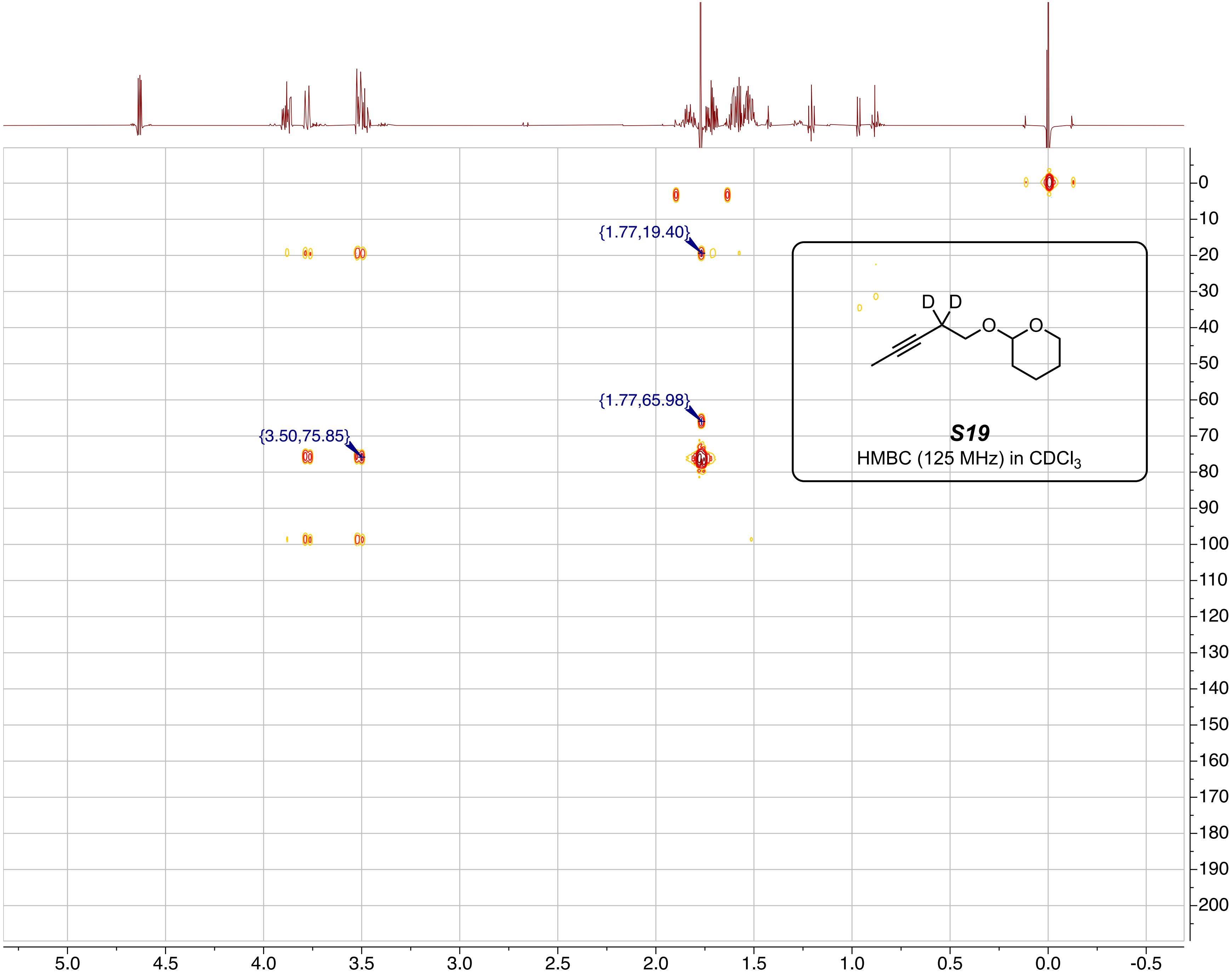
S19

^{1}H NMR (500 MHz) in $CDCl_3$



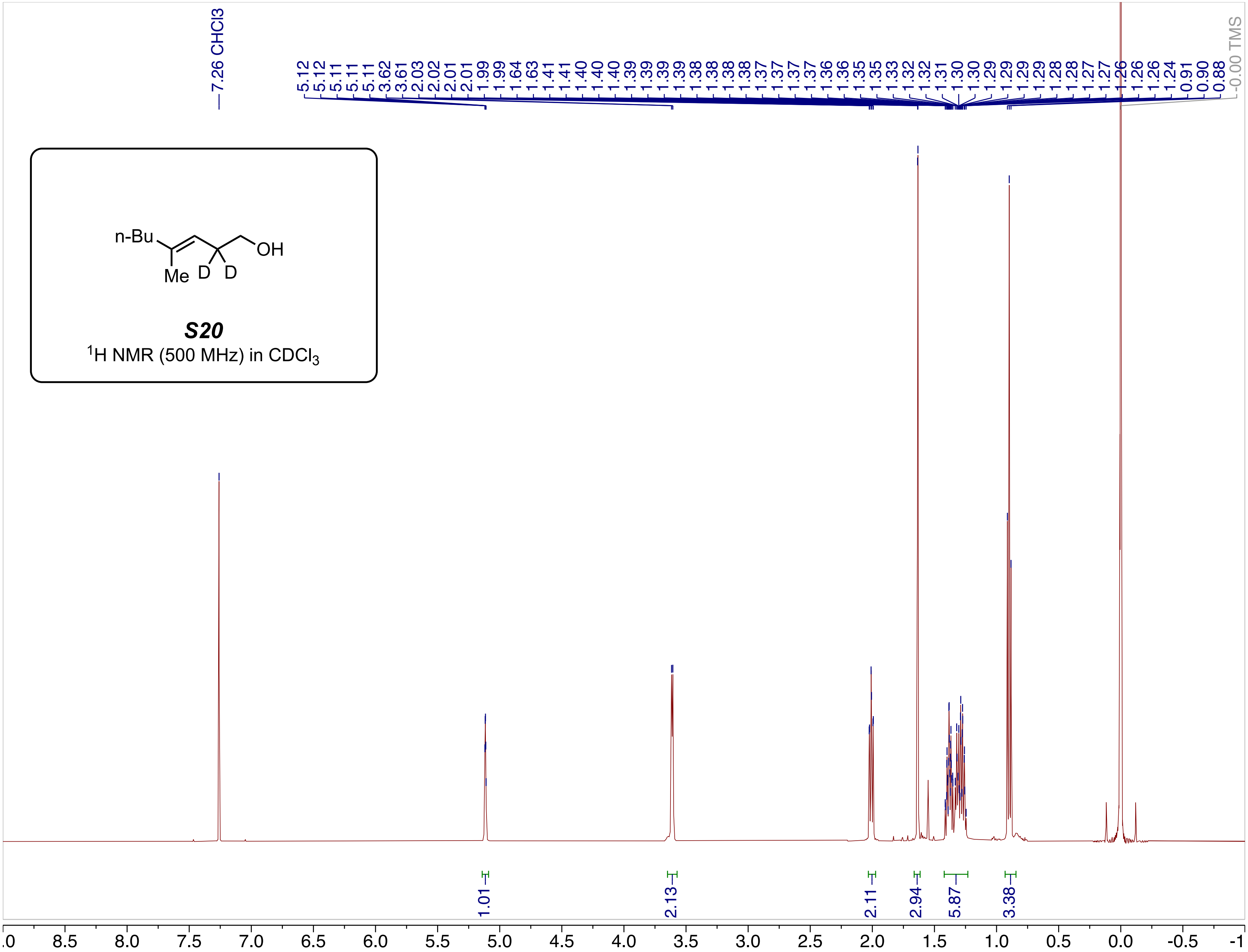
S19

HSQC (125 MHz) in $CDCl_3$

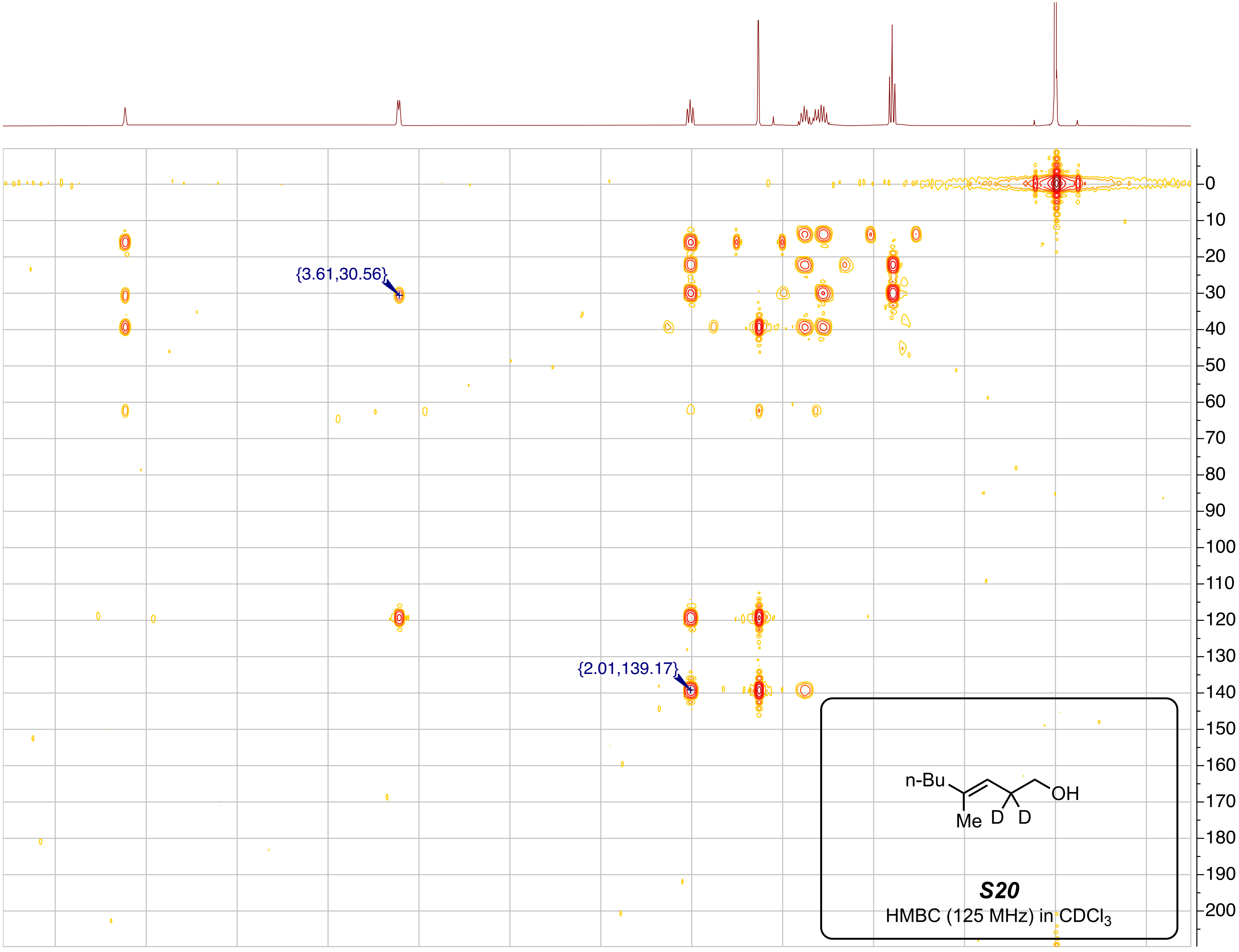


S19

HMBC (125 MHz) in CDCl$_3$

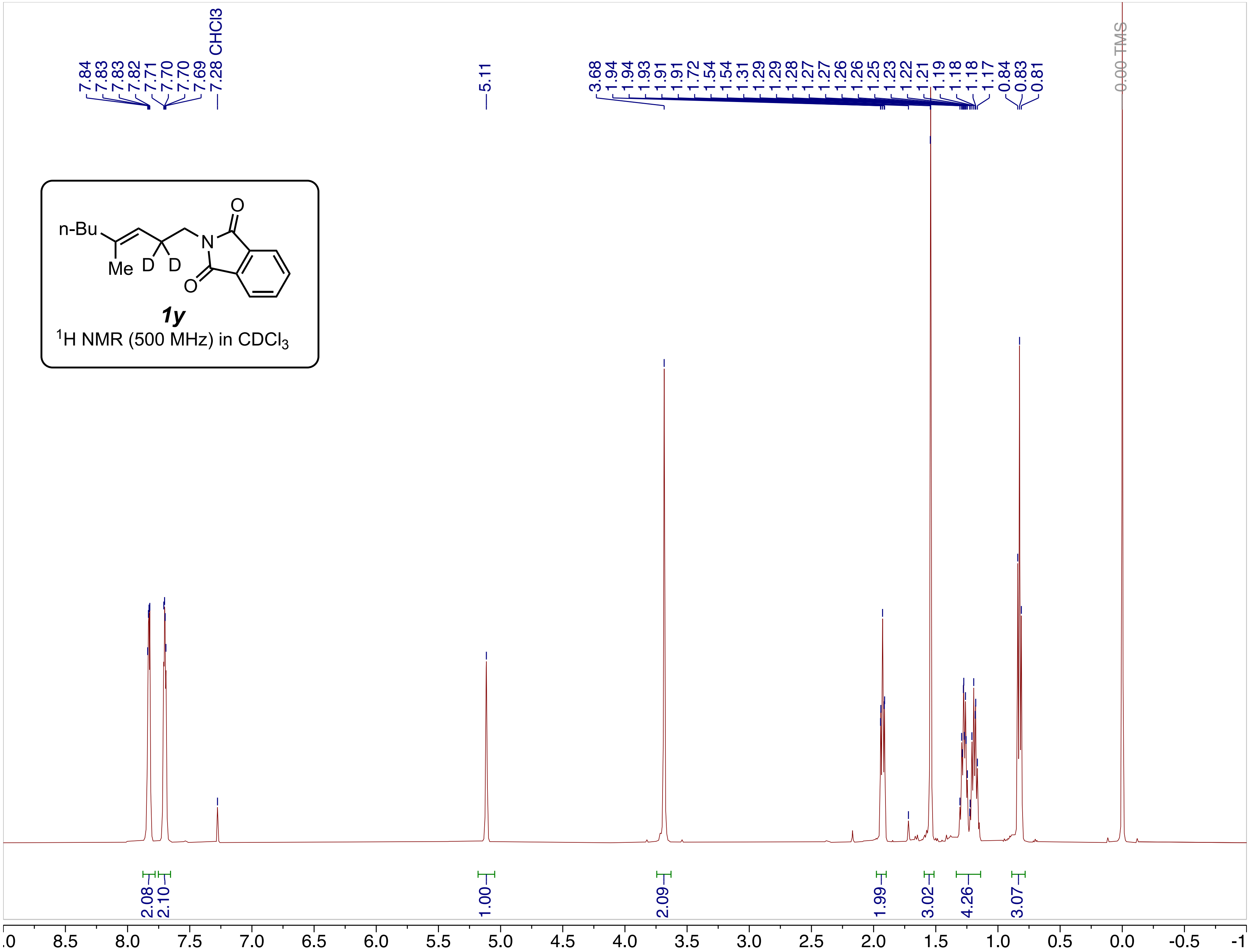

7.26 CHCl3
5.12
5.12
5.11
5.11
5.11
3.62
3.61
2.03
2.02
2.01
2.01
1.99
1.99
1.64
1.63
1.41
1.41
1.40
1.40
1.40
1.39
1.39
1.39
1.39
1.38
1.38
1.38
1.38
1.37
1.37
1.37
1.37
1.36
1.36
1.35
1.35
1.33
1.32
1.32
1.31
1.30
1.30
1.29
1.29
1.29
1.28
1.28
1.27
1.27
1.26
1.26
1.26
1.24
0.91
0.90
0.88
-0.00 TMS
n-Bu
OH
Me
D
D
S20
¹H NMR (500 MHz) in CDCl₃
1.01
2.13
2.11
2.94
5.87
3.38
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

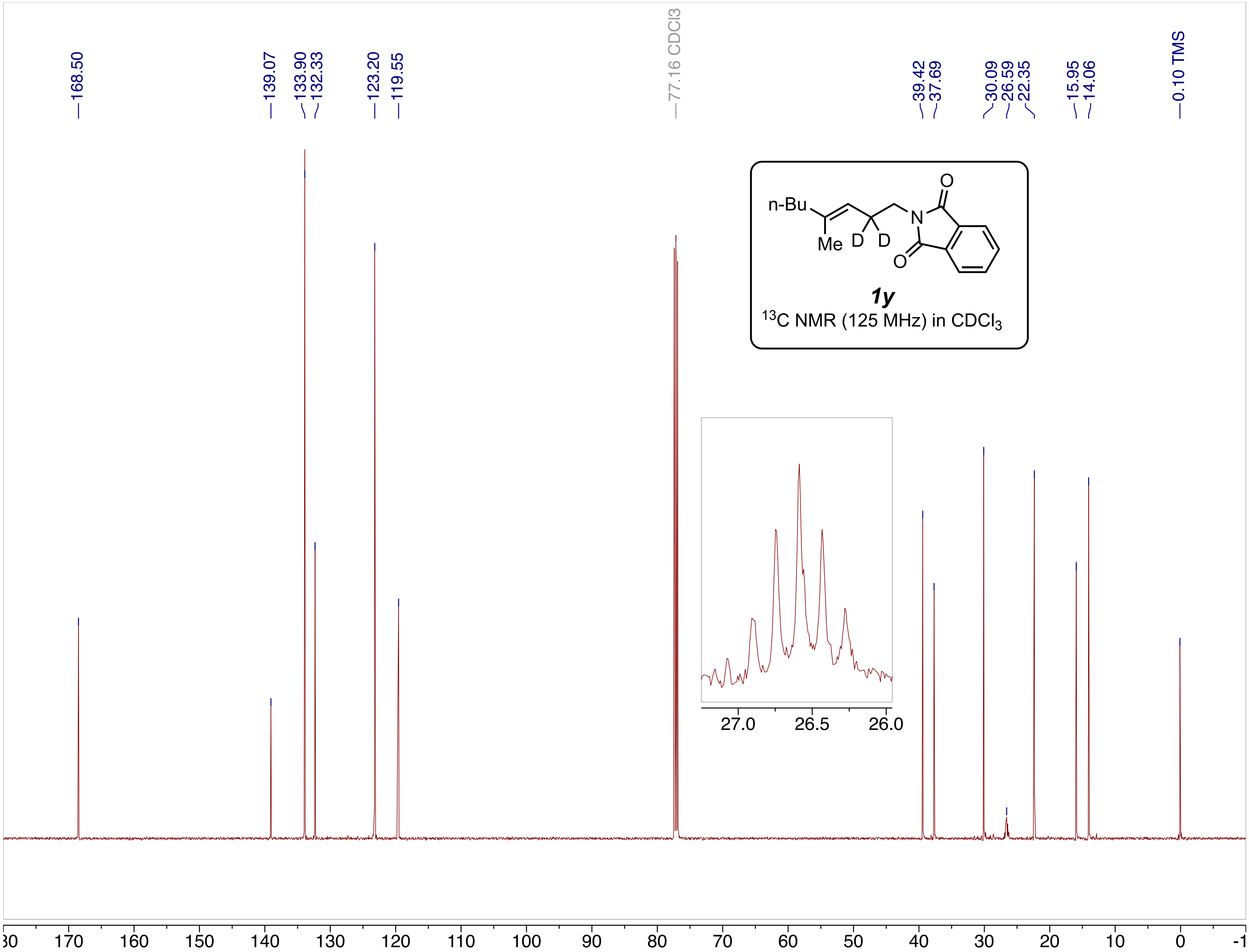

n-Bu
OH
Me
D
D
S20
HSQC (125 MHz) in CDCl3
{1.63,15.92}
{0.90,13.82}
{1.27,22.20}
{1.38,29.94}
{2.01,39.45}
{3.61,62.34}
{5.12,119.41}
{0.01,138.90}
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5



S20

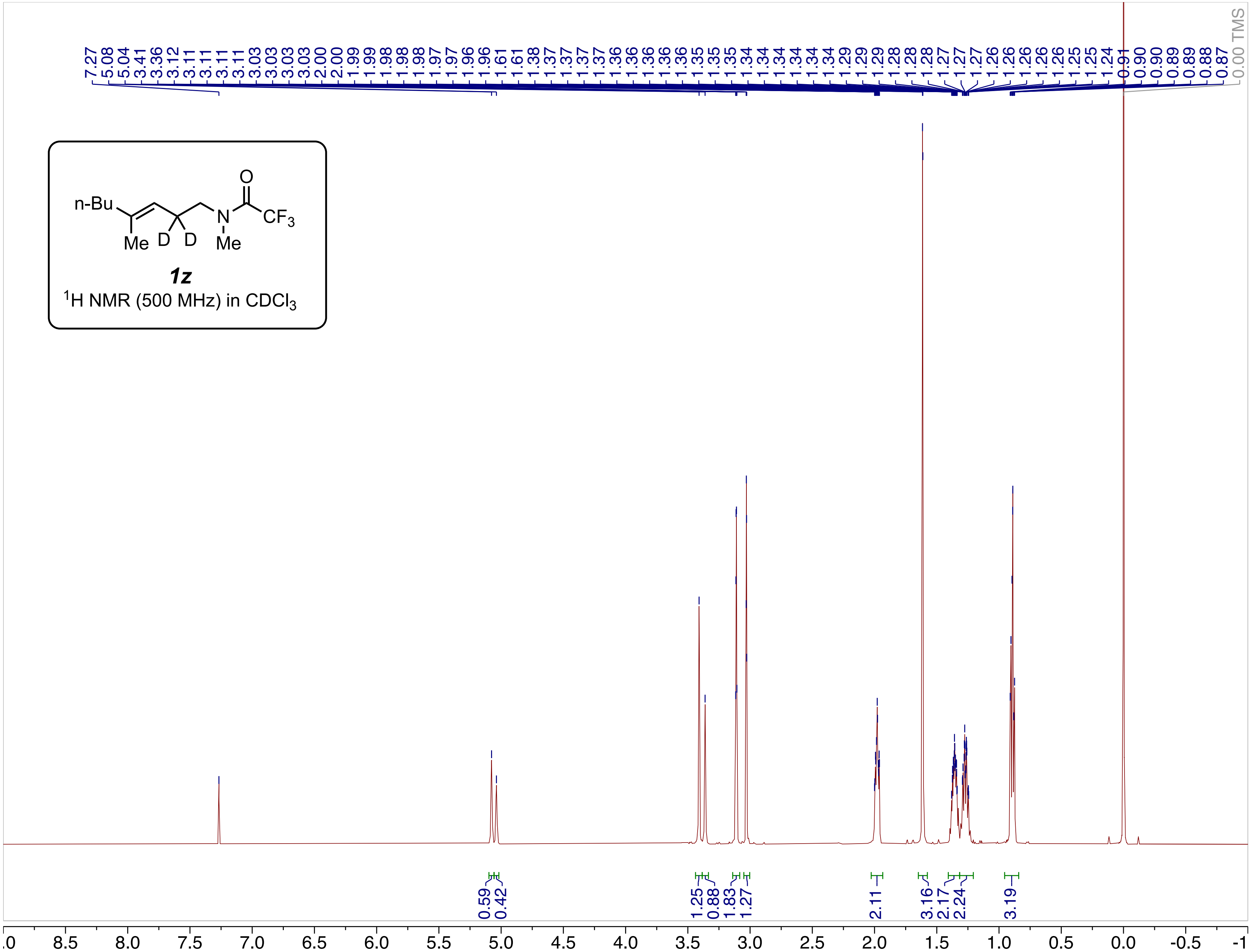
HMBC (125 MHz) in $CDCl_3$

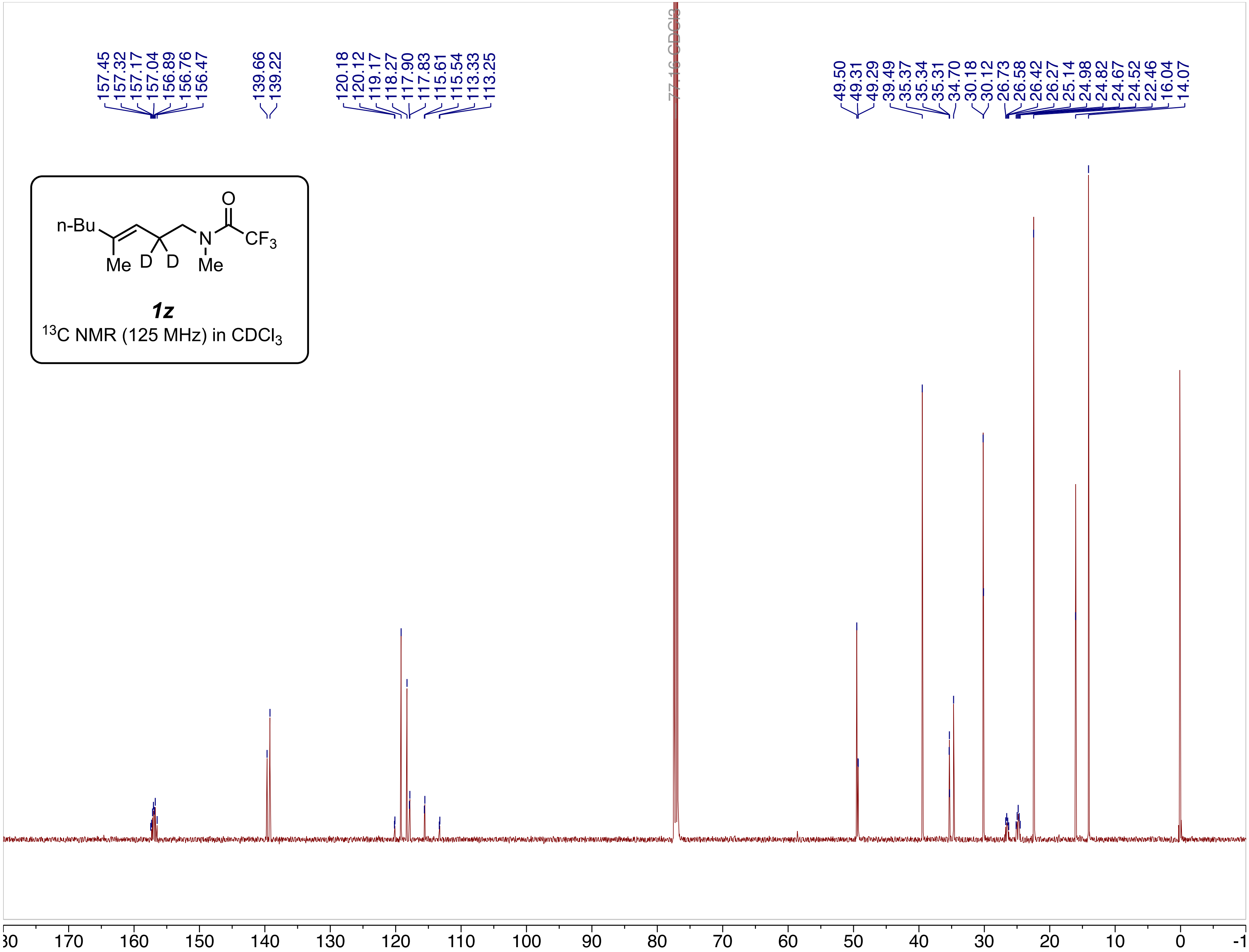
7.84
7.83
7.83
7.82
7.71
7.70
7.70
7.69
7.28 CHCl3
5.11
3.68
1.94
1.94
1.93
1.91
1.91
1.72
1.54
1.54
1.31
1.29
1.29
1.28
1.27
1.27
1.26
1.26
1.25
1.23
1.22
1.21
1.19
1.18
1.18
1.17
0.84
0.83
0.81
0.00 TMS
n-Bu
Me
D
D
N
O
O
1y
^{1}H NMR (500 MHz) in $CDCl_3$
2.08
2.10
1.00
2.09
1.99
3.02
4.26
3.07
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

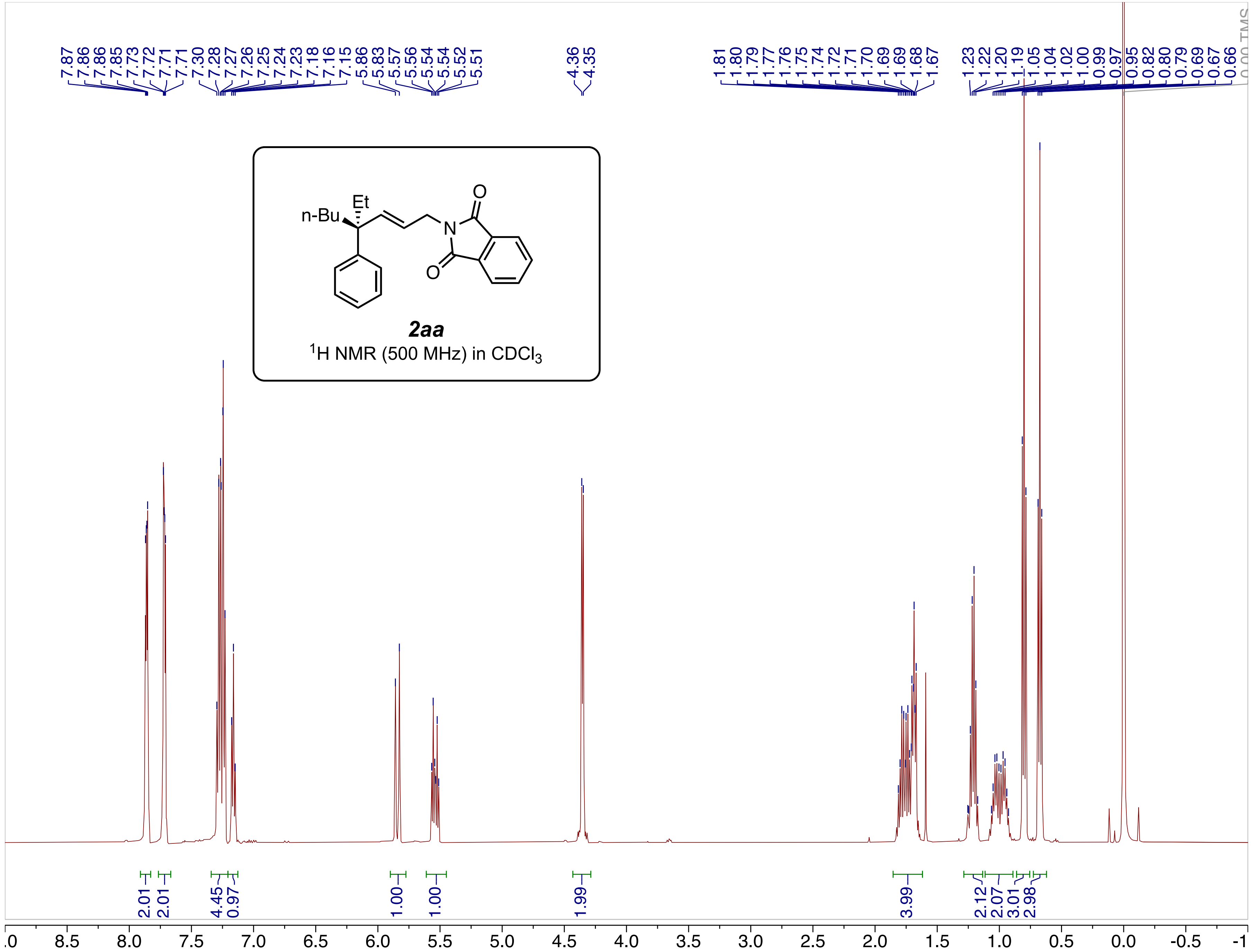


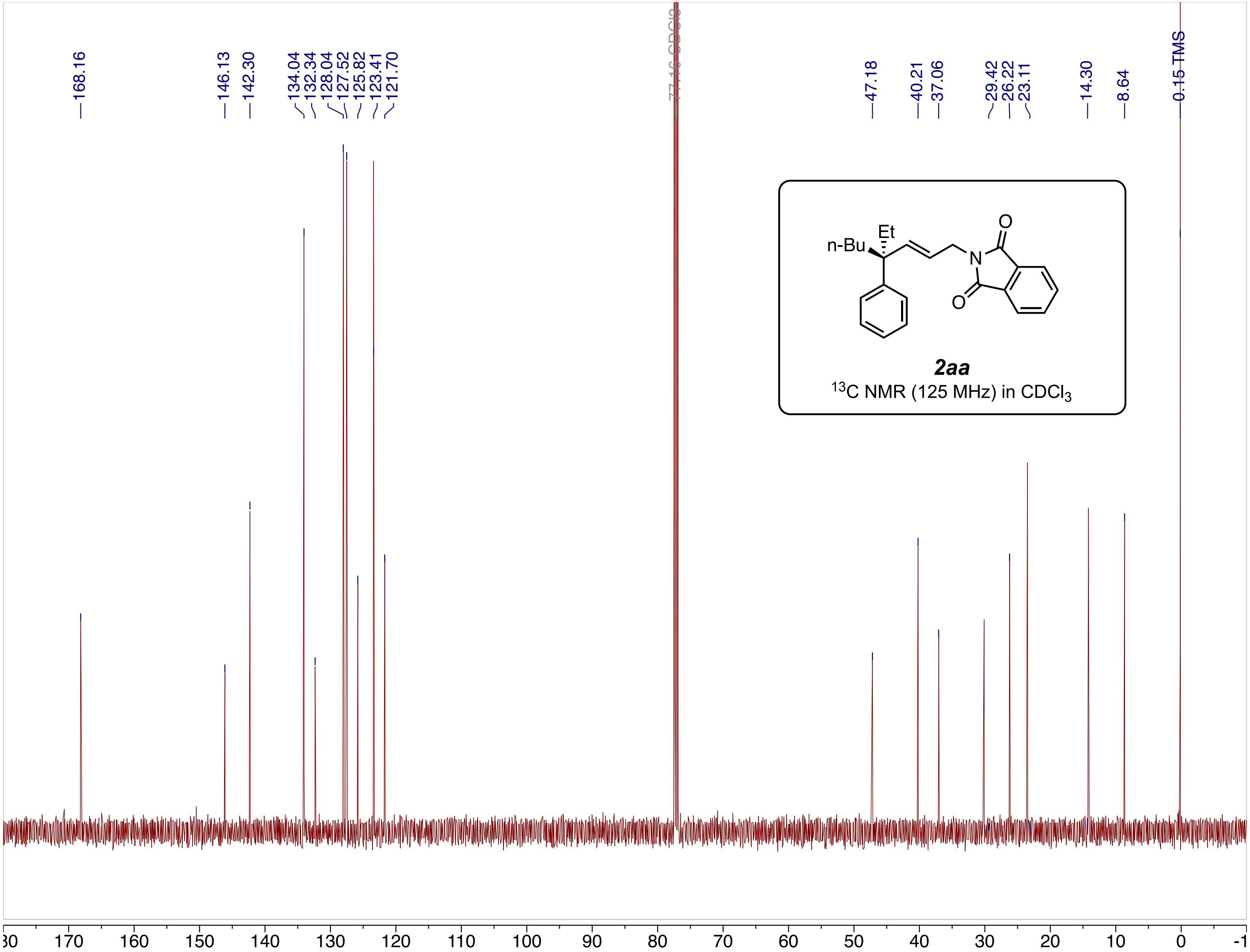
1y

^{13}C NMR (125 MHz) in $CDCl_3$

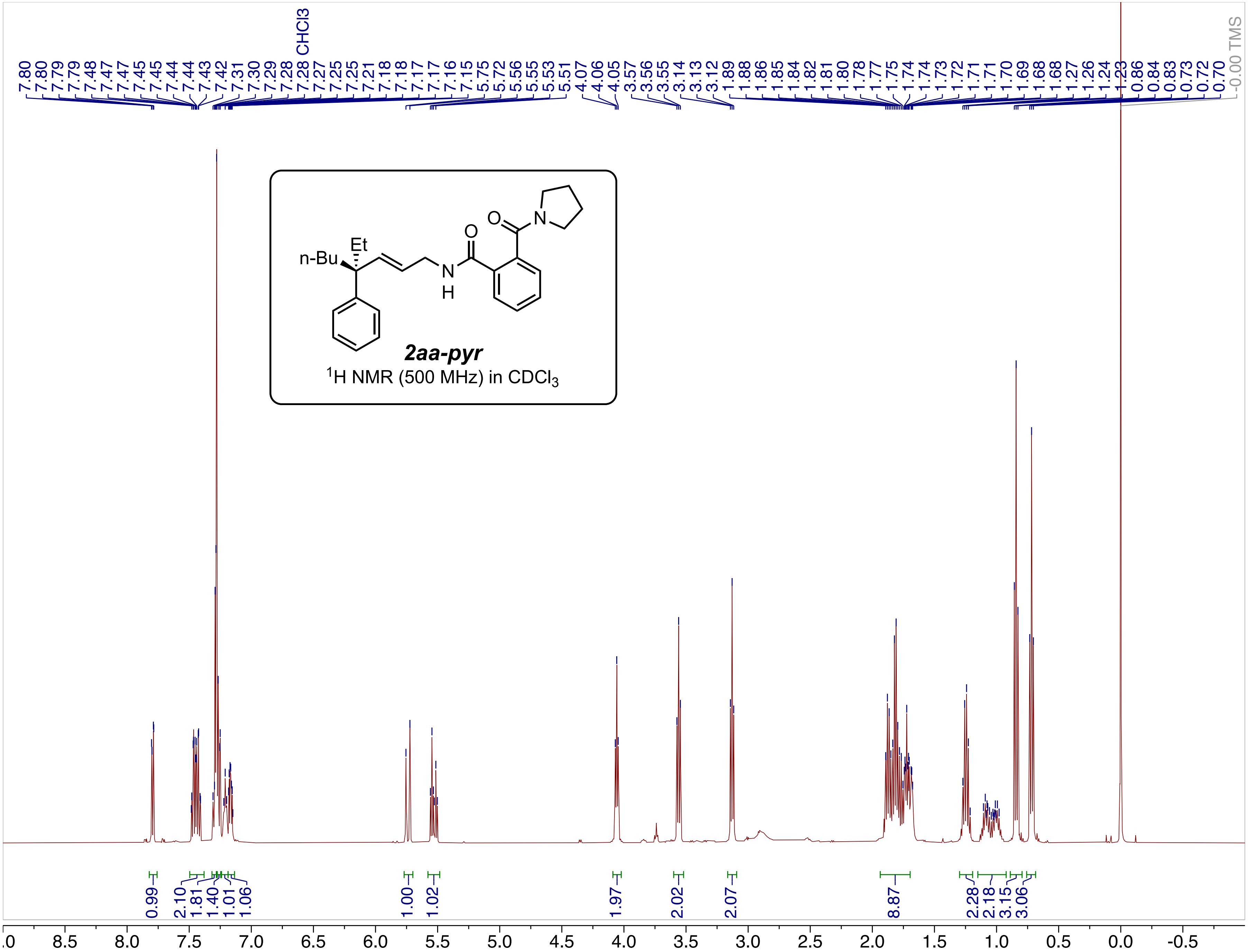

n-Bu
Me
D
D
N
Me
O
CF3
1z
1H NMR (500 MHz) in CDCl3
7.27
5.08
5.04
3.41
3.36
3.12
3.11
3.11
3.11
3.11
3.03
3.03
3.03
3.03
2.00
2.00
1.99
1.99
1.98
1.98
1.98
1.97
1.96
1.96
1.61
1.61
1.38
1.37
1.37
1.37
1.37
1.36
1.36
1.36
1.36
1.35
1.35
1.35
1.34
1.34
1.34
1.34
1.34
1.29
1.29
1.29
1.28
1.28
1.28
1.27
1.27
1.27
1.26
1.26
1.26
1.26
1.25
1.25
1.24
0.91
0.90
0.90
0.89
0.88
0.87
0.00 TMS
0.59
0.42
1.25
0.88
1.83
1.27
2.11
3.16
2.17
2.24
3.19
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


157.45
157.32
157.17
157.04
156.89
156.76
156.47
139.66
139.22
120.18
120.12
119.17
118.27
117.90
117.83
115.61
115.54
113.33
113.25
77.16 CDCl3
49.50
49.31
49.29
39.49
35.37
35.34
35.31
34.70
30.18
30.12
26.73
26.58
26.42
26.27
25.14
24.98
24.82
24.67
24.52
22.46
16.04
14.07
n-Bu
Me
D
D
N
Me
O
CF3
1z
13C NMR (125 MHz) in CDCl3
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.87
7.86
7.86
7.85
7.73
7.72
7.71
7.71
7.30
7.28
7.27
7.26
7.25
7.24
7.23
7.18
7.16
7.15
5.86
5.83
5.57
5.56
5.54
5.54
5.52
5.51
4.36
4.35
1.81
1.80
1.79
1.77
1.76
1.75
1.74
1.72
1.71
1.70
1.69
1.69
1.68
1.67
1.23
1.22
1.20
1.19
1.05
1.04
1.02
1.00
0.99
0.97
0.95
0.82
0.80
0.79
0.69
0.67
0.66
0.00 TMS
n-Bu
Et
N
O
O
2aa
^{1}H NMR (500 MHz) in CDCl$_3$
2.01
2.01
4.45
0.97
1.00
1.00
1.99
3.99
2.12
2.07
3.01
2.98
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

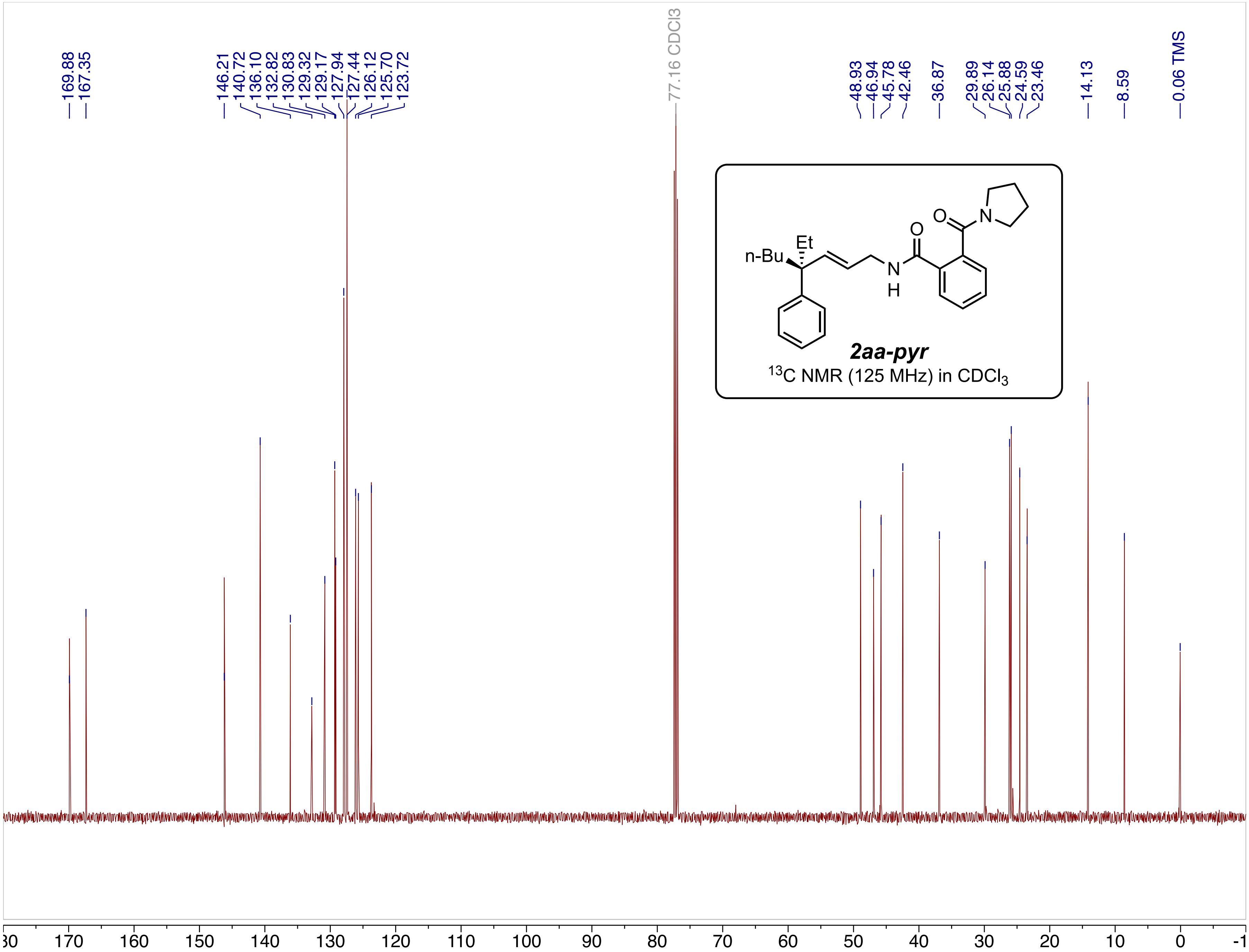


168.16
146.13
142.30
134.04
132.34
128.04
127.52
125.82
123.41
121.70
77.16 CDCl3
47.18
40.21
37.06
29.42
26.22
23.11
14.30
8.64
0.15 TMS
n-Bu
Et
N
O
O
2aa
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



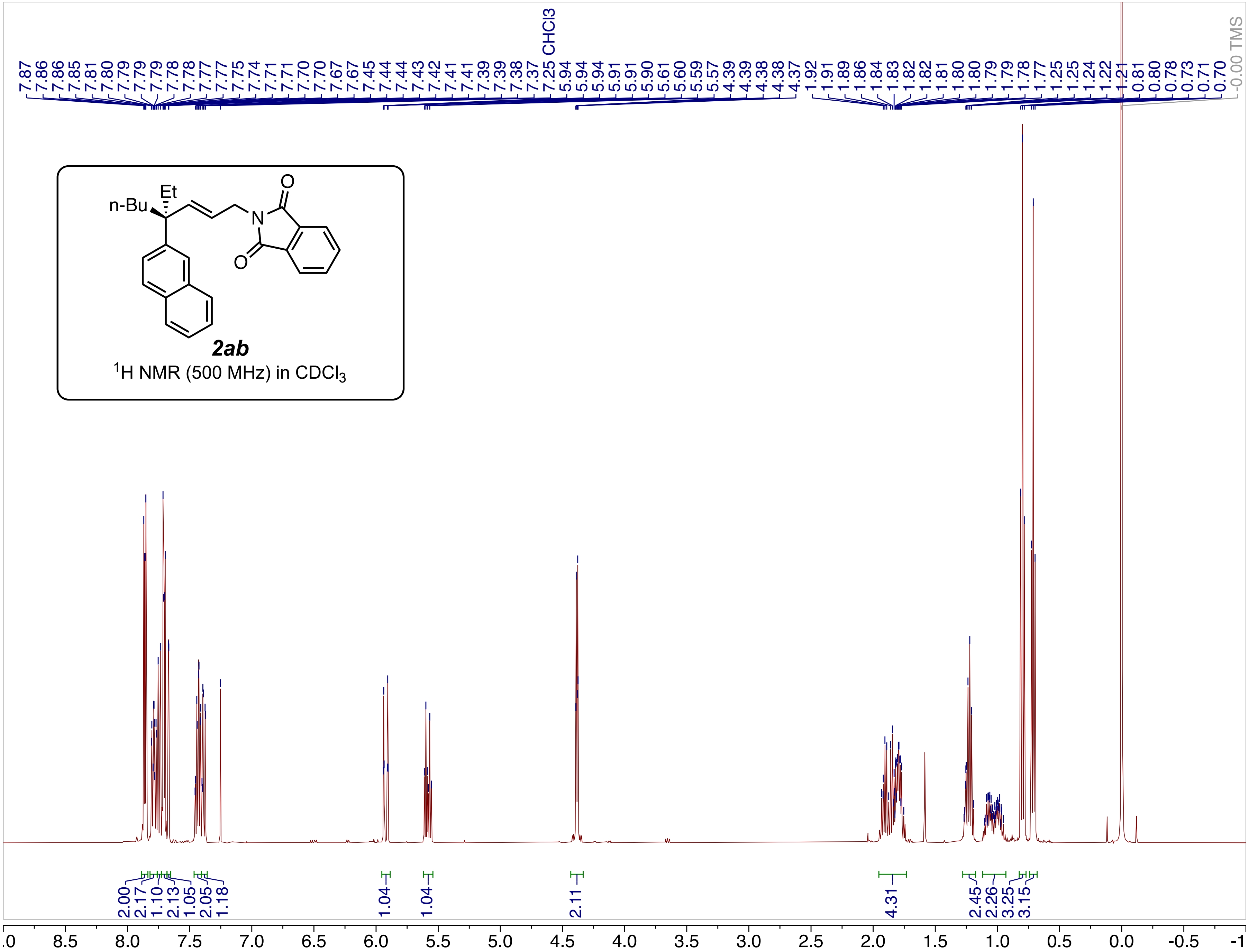
2aa-pyr

^{1}H NMR (500 MHz) in $CDCl_3$

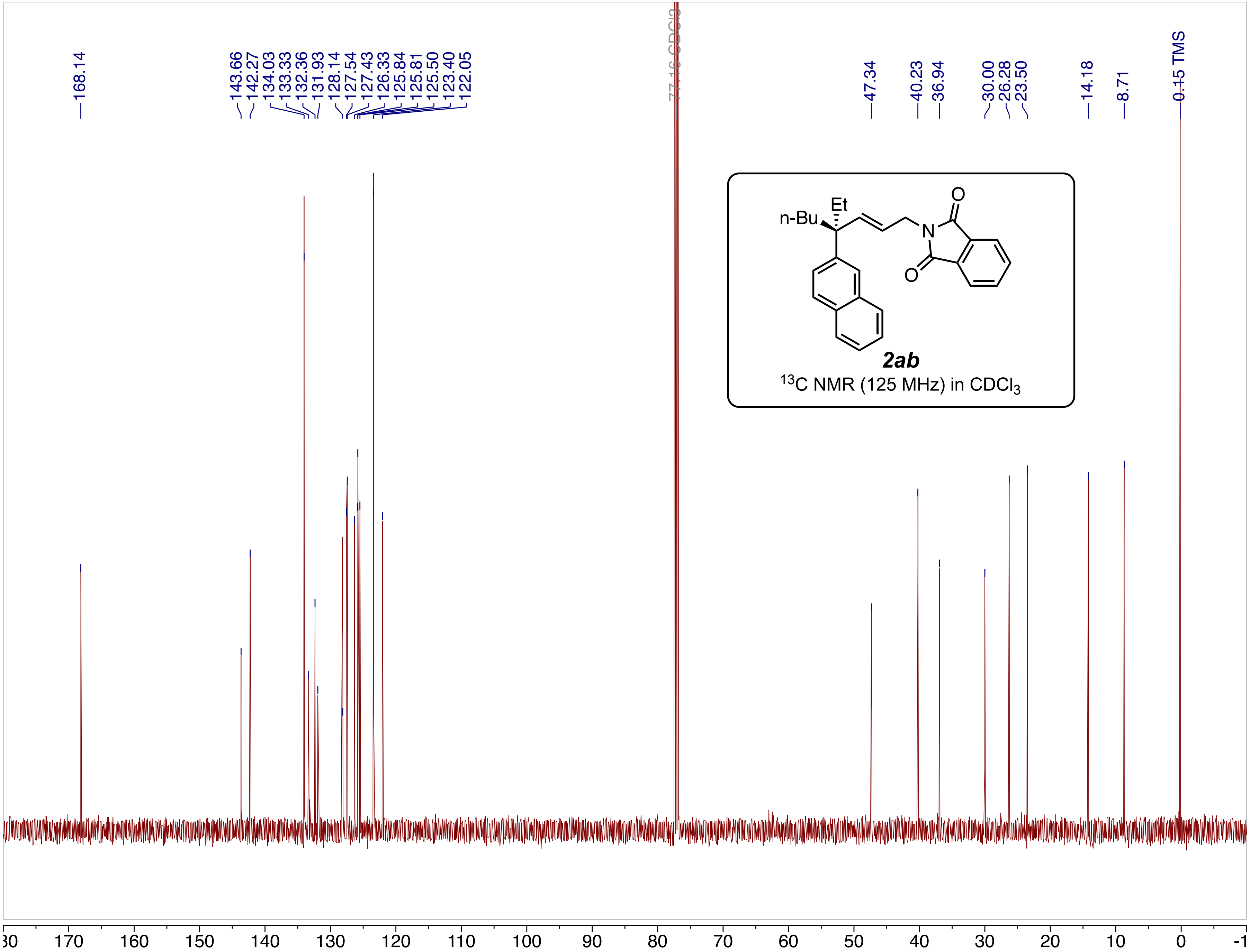


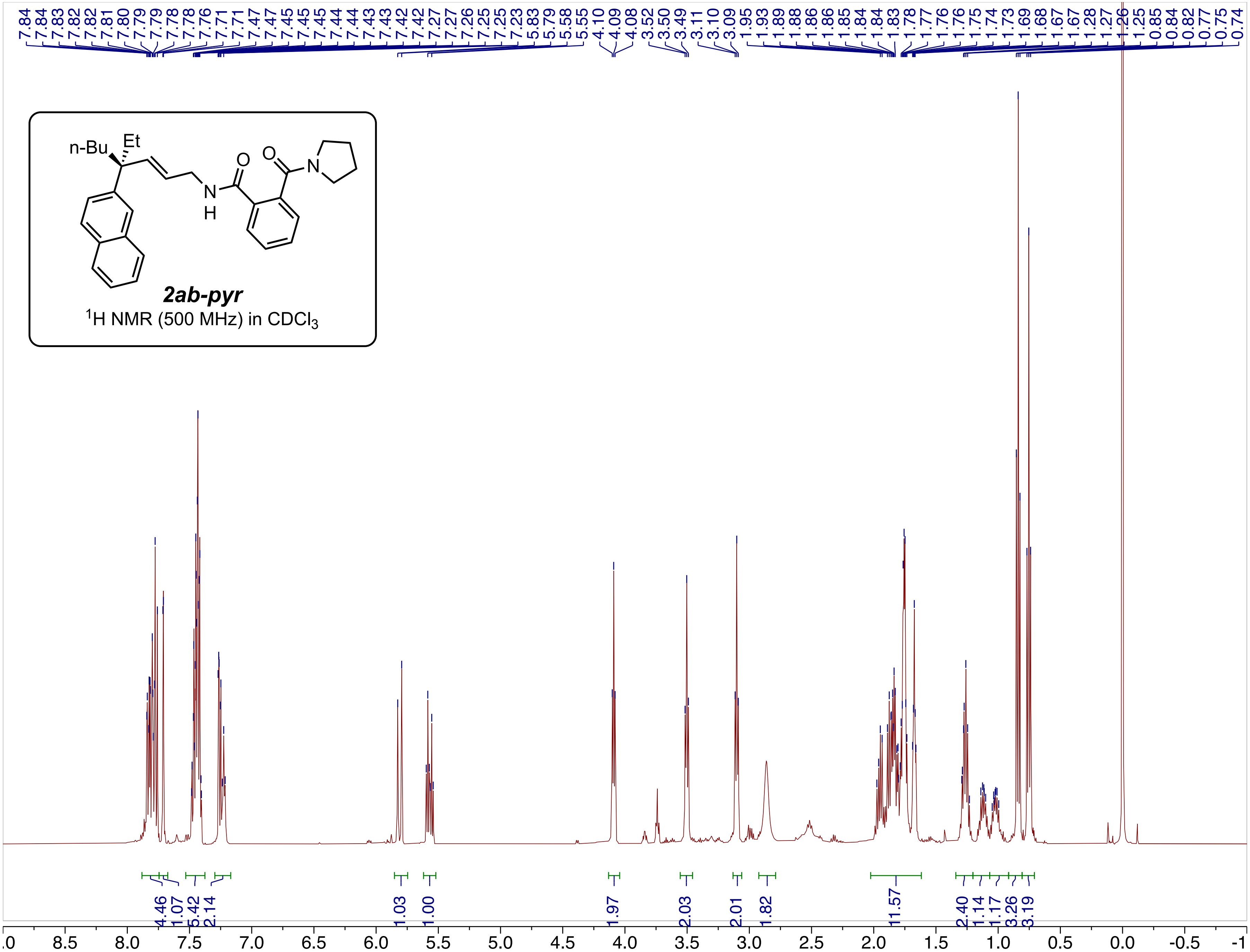
2aa-pyr

^{13}C NMR (125 MHz) in $CDCl_3$



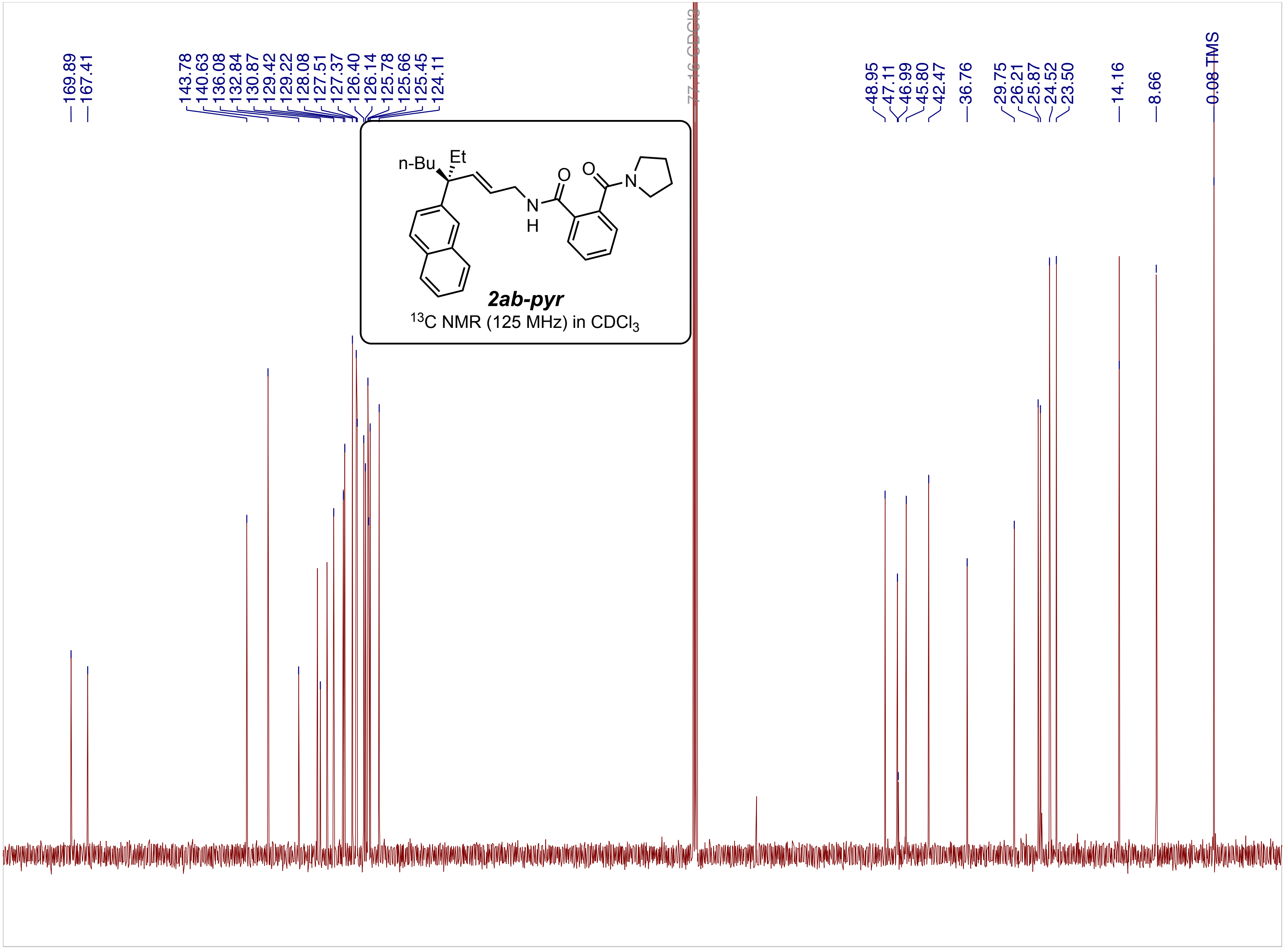
13. NMR Spectra


168.14
143.66
142.27
134.03
133.33
132.36
131.93
128.14
127.54
127.43
126.33
125.84
125.81
125.50
123.40
122.05
77.16 CDCl3
47.34
40.23
36.94
30.00
26.28
23.50
14.18
8.71
0.15 TMS
n-Bu
Et
N
O
O
2ab
^{13}C NMR (125 MHz) in CDCl$_3$
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

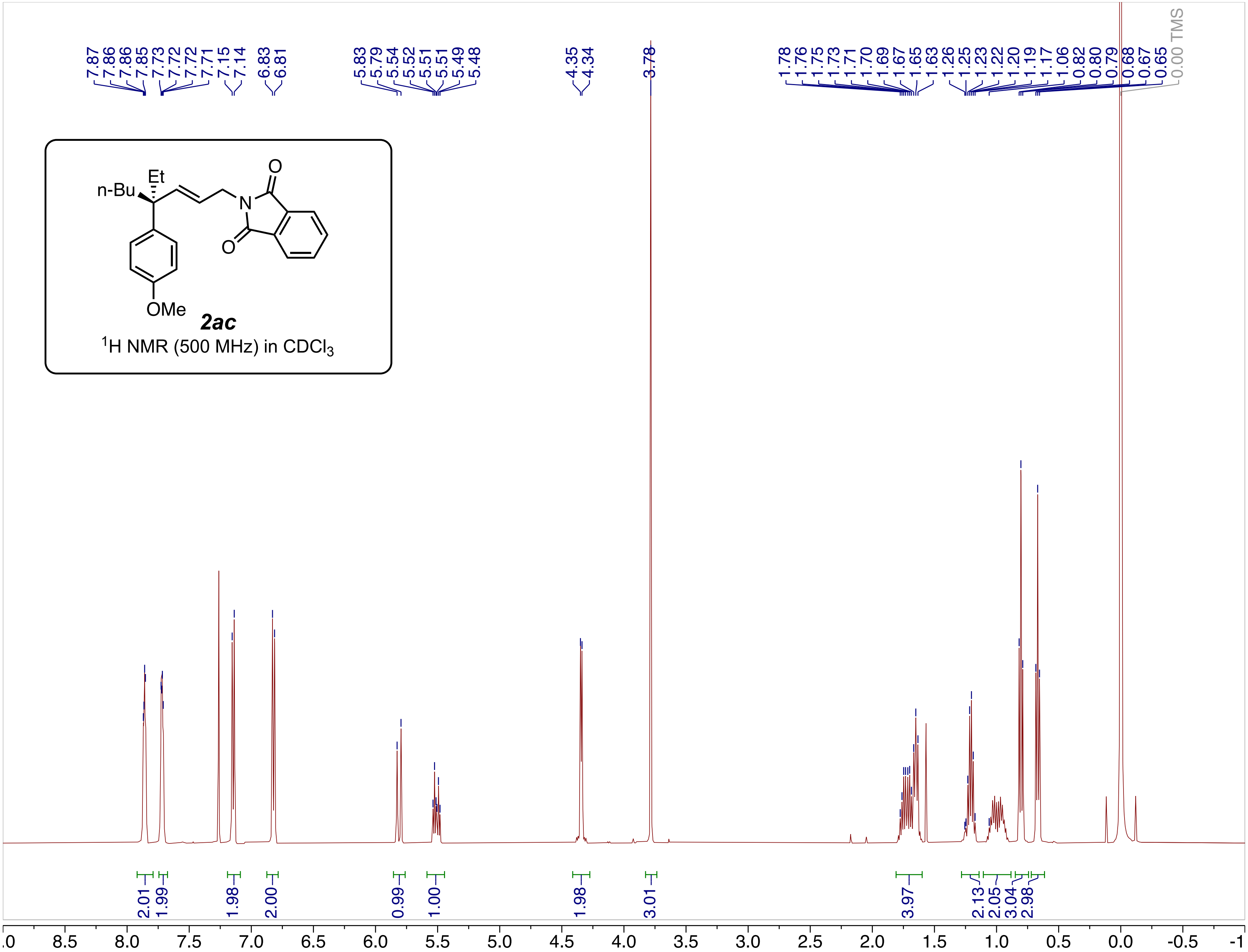


2ab-pyr

^{1}H NMR (500 MHz) in CDCl$_3$

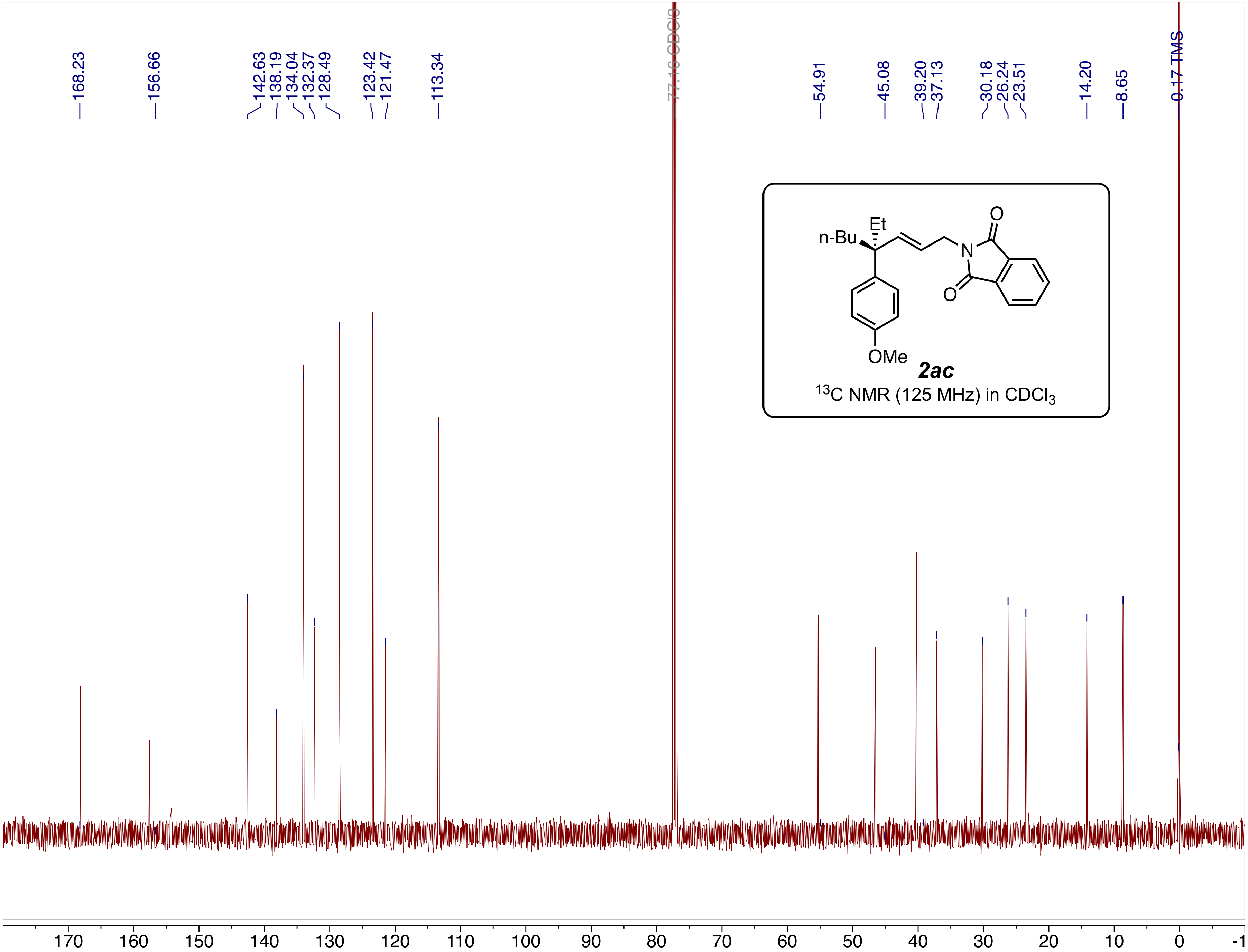


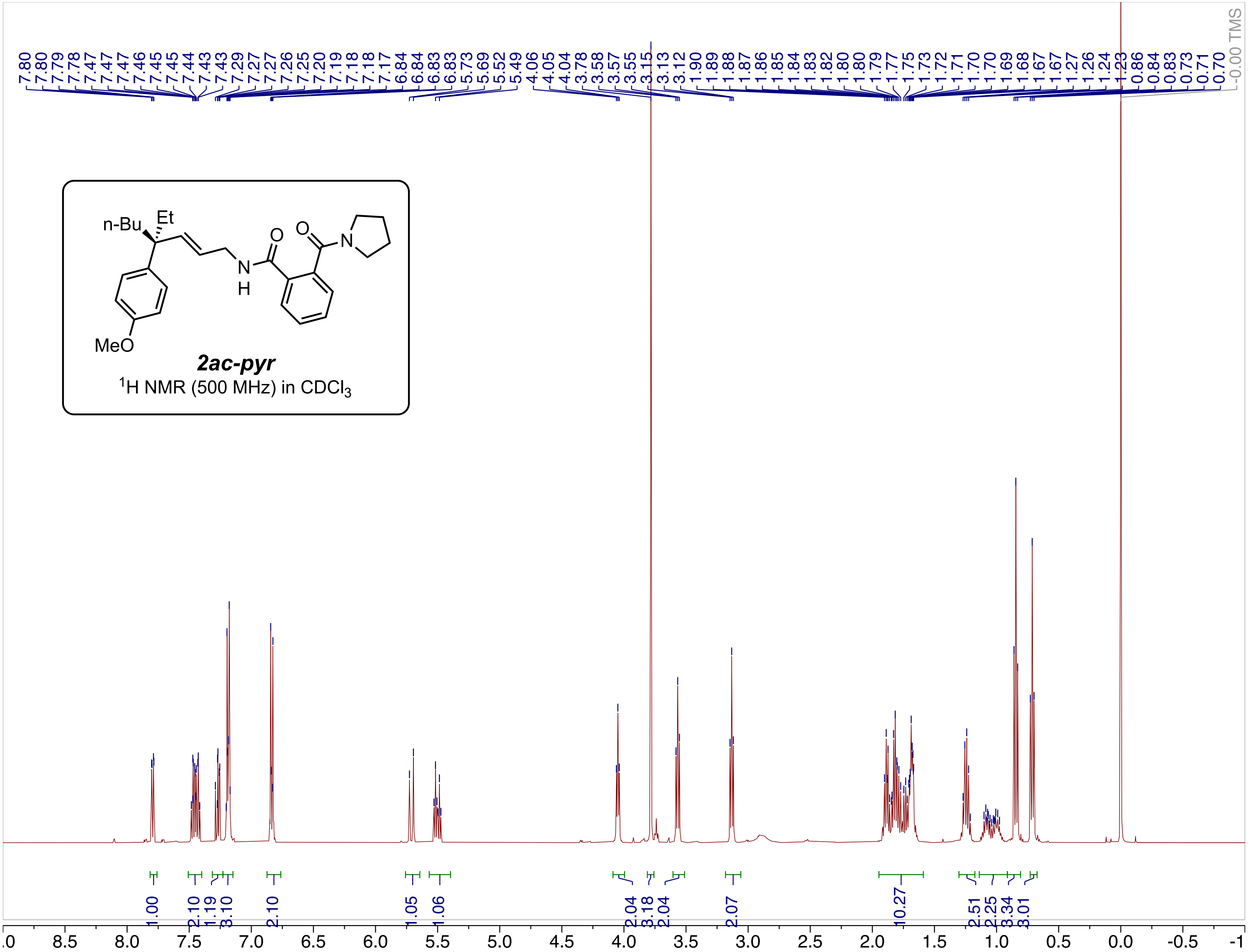
13. NMR Spectra

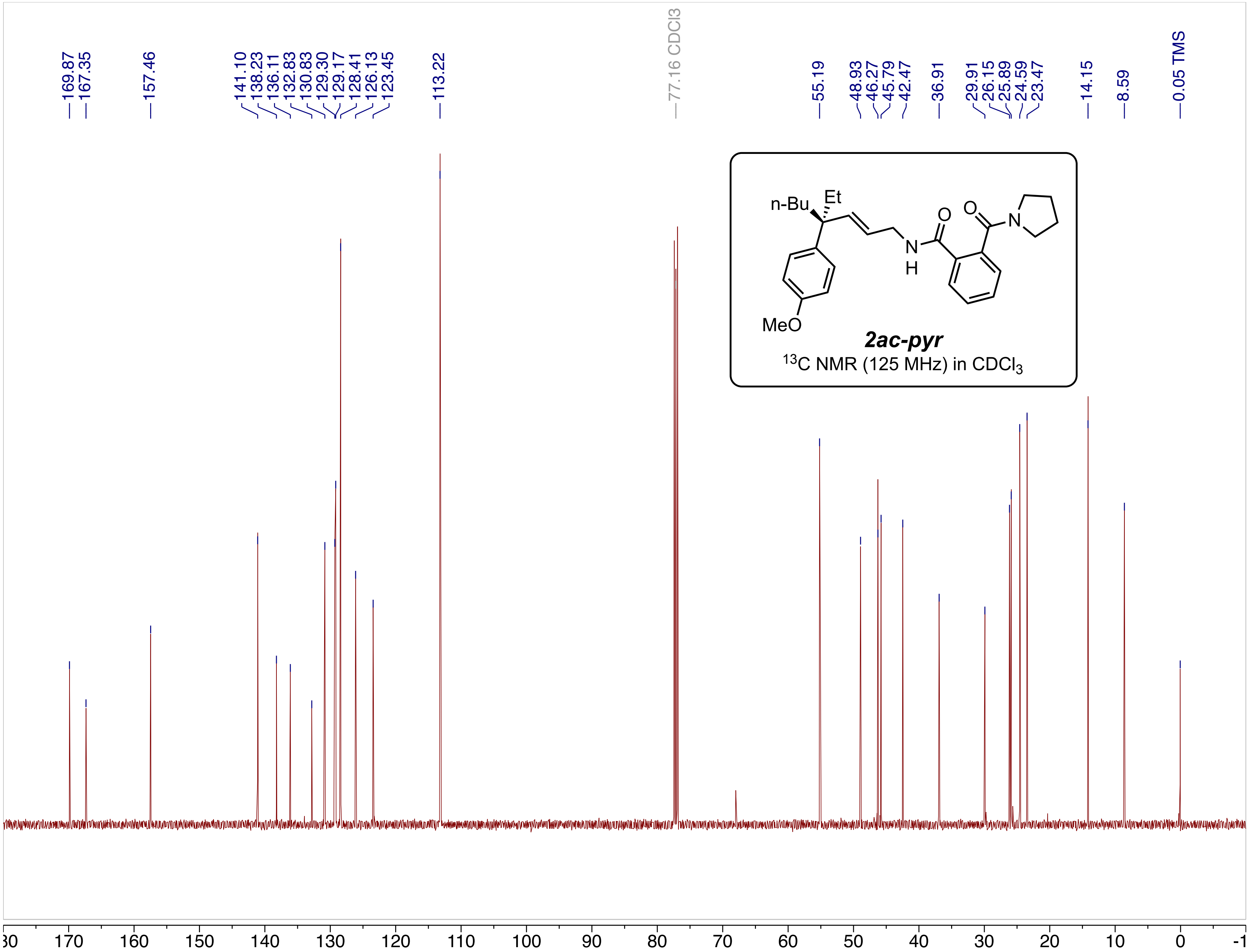


2ac

^{1}H NMR (500 MHz) in $CDCl_3$

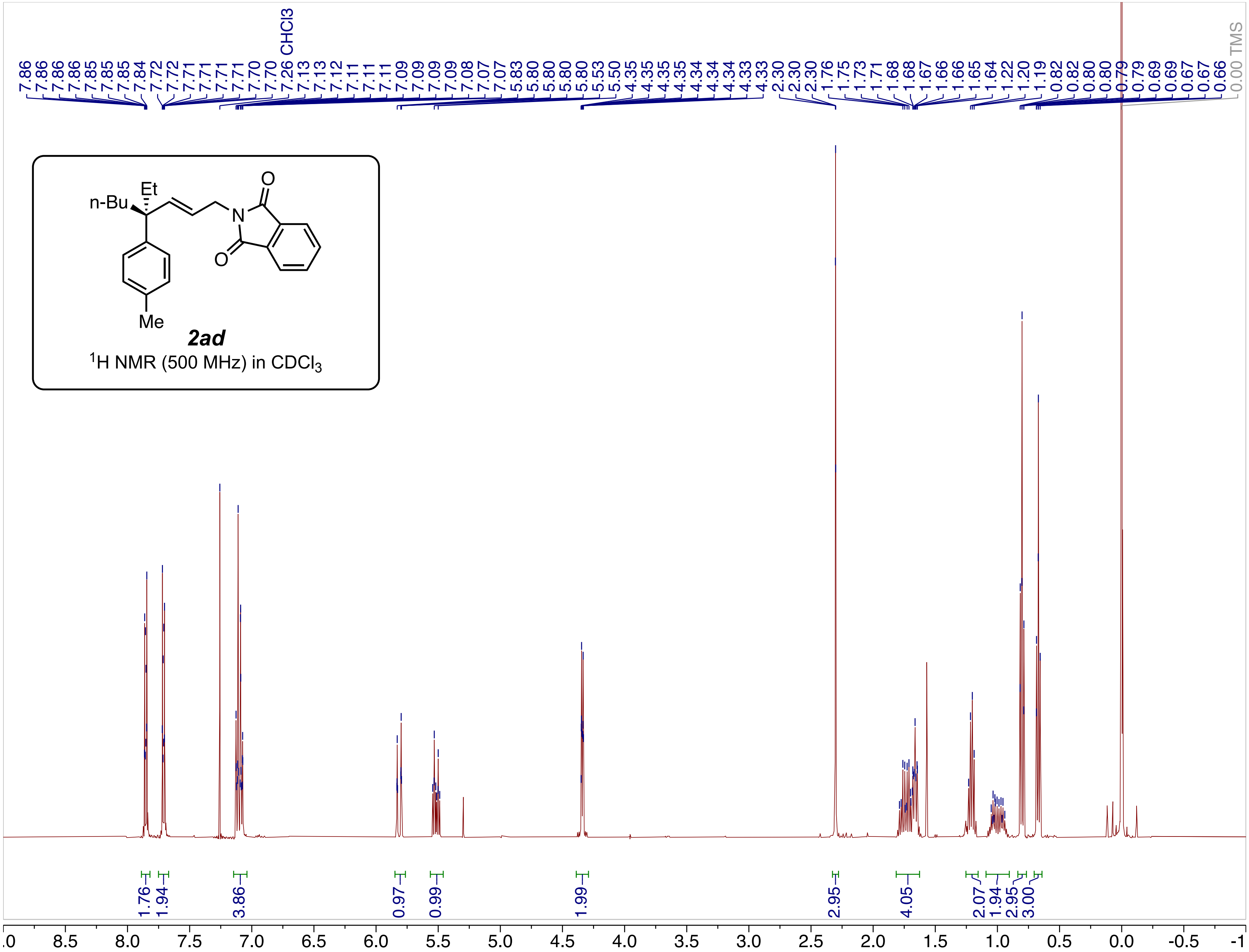

168.23
156.66
142.63
138.19
134.04
132.37
128.49
123.42
121.47
113.34
77.16 CDCl3
54.91
45.08
39.20
37.13
30.18
26.24
23.51
14.20
8.65
0.17 TMS
n-Bu
Et
N
O
O
OMe
2ac
^{13}C NMR (125 MHz) in CDCl$_3$
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

7.80
7.80
7.79
7.78
7.47
7.47
7.47
7.46
7.45
7.45
7.44
7.43
7.43
7.29
7.27
7.27
7.26
7.25
7.20
7.19
7.18
7.18
7.17
6.84
6.84
6.83
6.83
5.73
5.69
5.52
5.49
4.06
4.05
4.04
3.78
3.58
3.57
3.55
3.15
3.13
3.12
1.90
1.89
1.88
1.87
1.86
1.85
1.84
1.83
1.82
1.80
1.80
1.79
1.77
1.75
1.73
1.72
1.71
1.70
1.70
1.69
1.68
1.67
1.67
1.27
1.26
1.24
1.23
0.86
0.84
0.83
0.73
0.71
0.70
-0.00 TMS
n-Bu
Et
O
O
N
N
H
MeO
2ac-pyr
^{1}H NMR (500 MHz) in CDCl$_3$
1.00
2.10
1.19
3.10
2.10
1.05
1.06
2.04
3.18
2.04
2.07
10.27
2.51
2.25
3.34
3.01
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



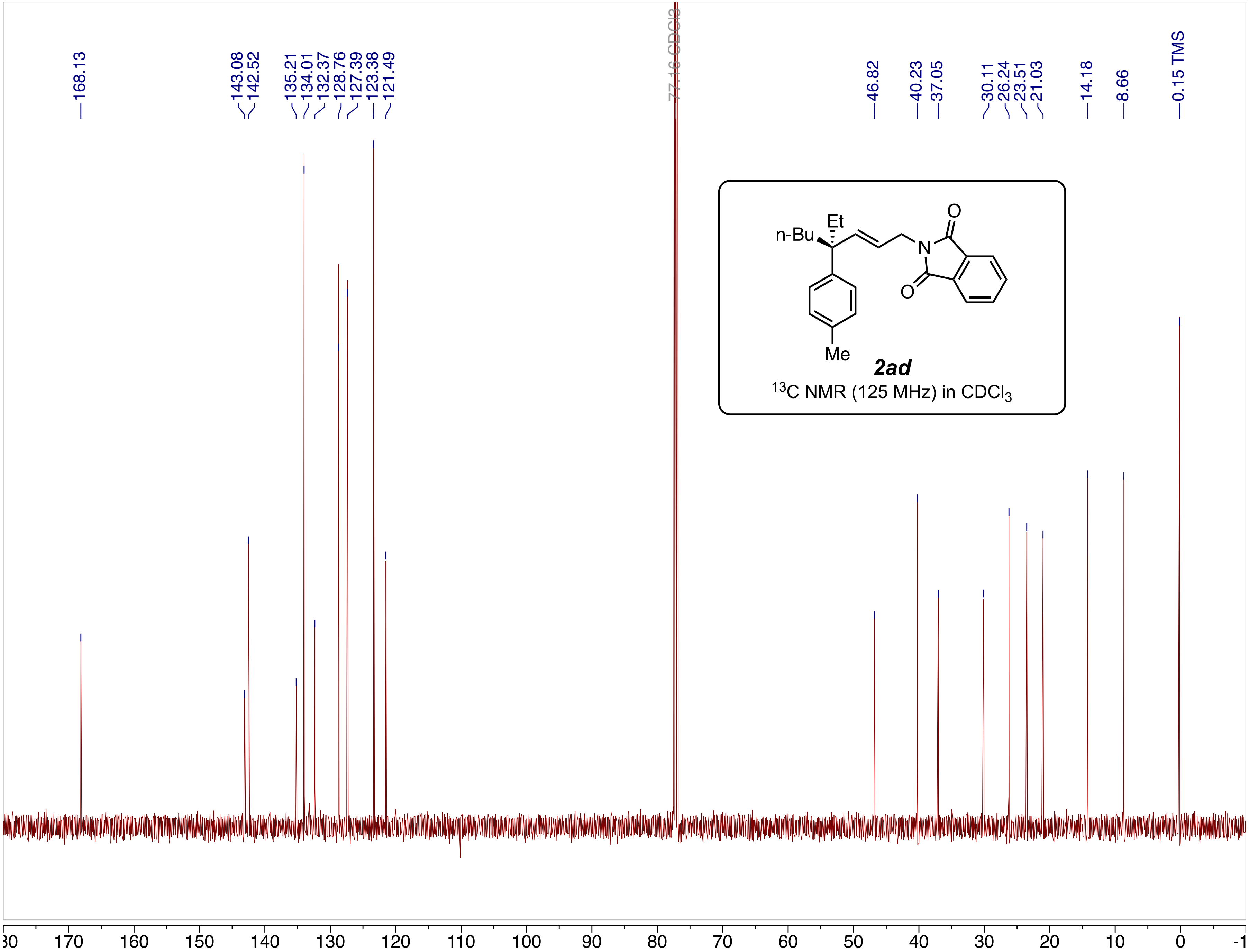
2ac-pyr

^{13}C NMR (125 MHz) in CDCl$_3$

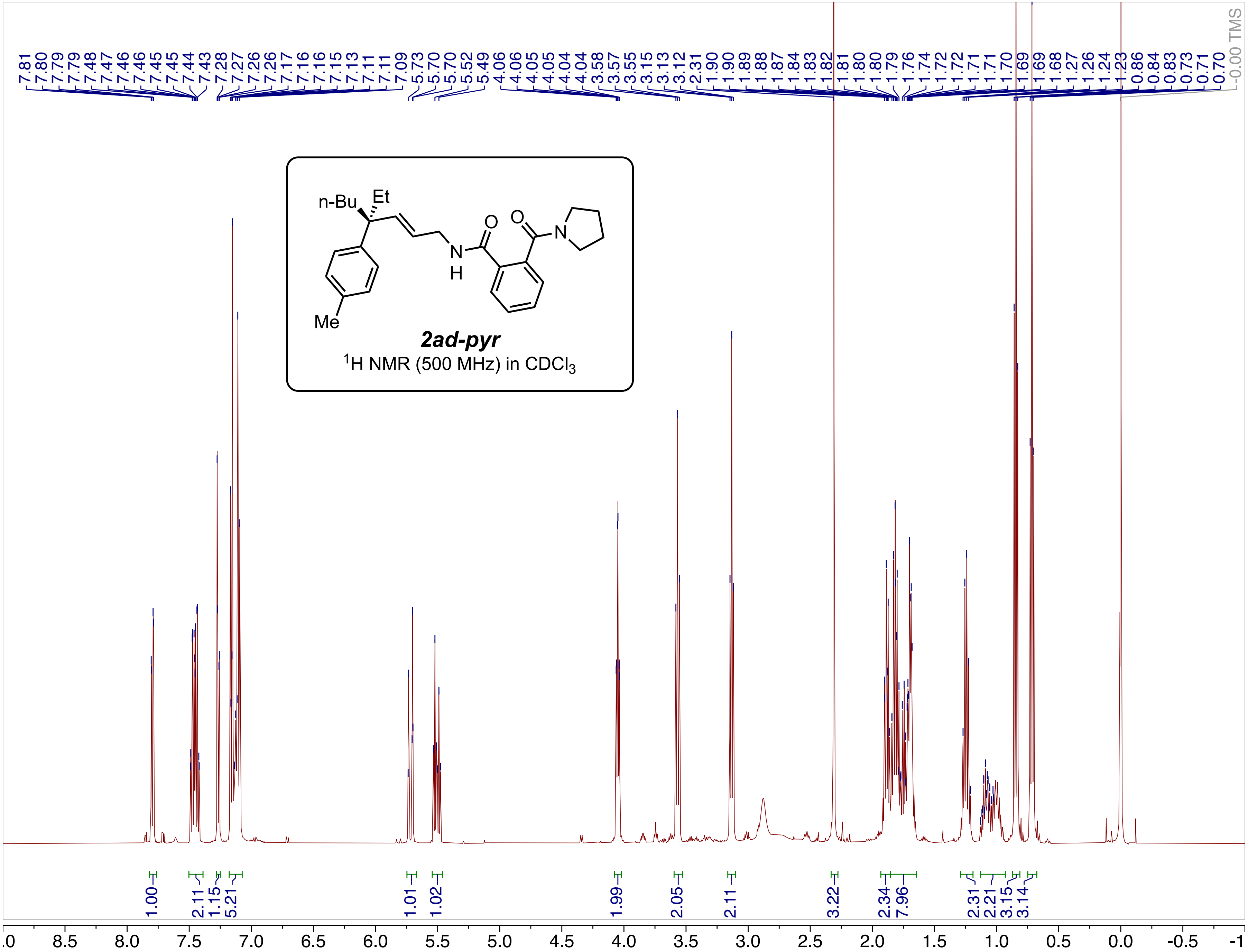


2ad

^{1}H NMR (500 MHz) in $CDCl_3$

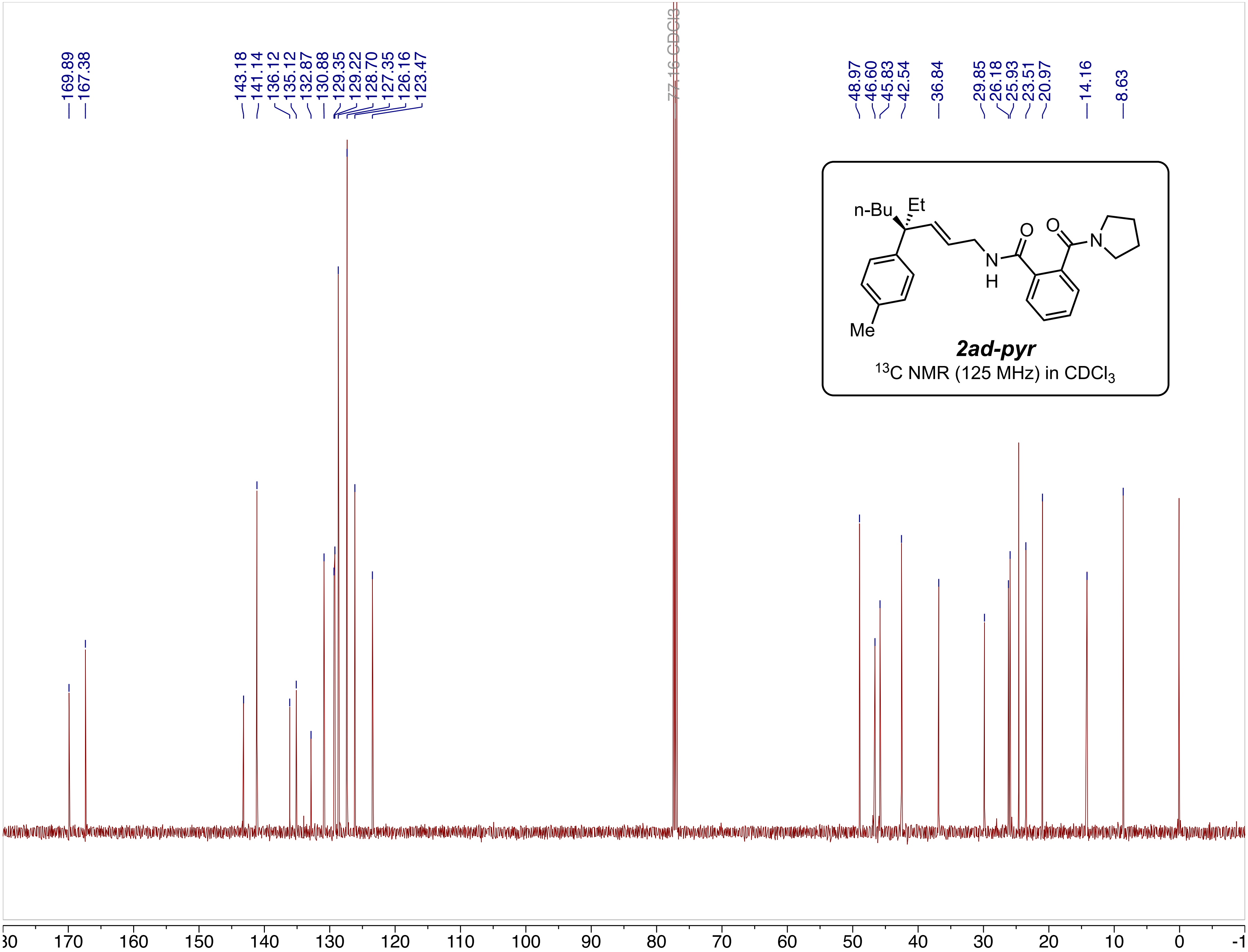


168.13
143.08
142.52
135.21
134.01
132.37
128.76
127.39
123.38
121.49
77.16 CDCl3
46.82
40.23
37.05
30.11
26.24
23.51
21.03
14.18
8.66
0.15 TMS
Et
n-Bu
O
N
O
Me
2ad
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



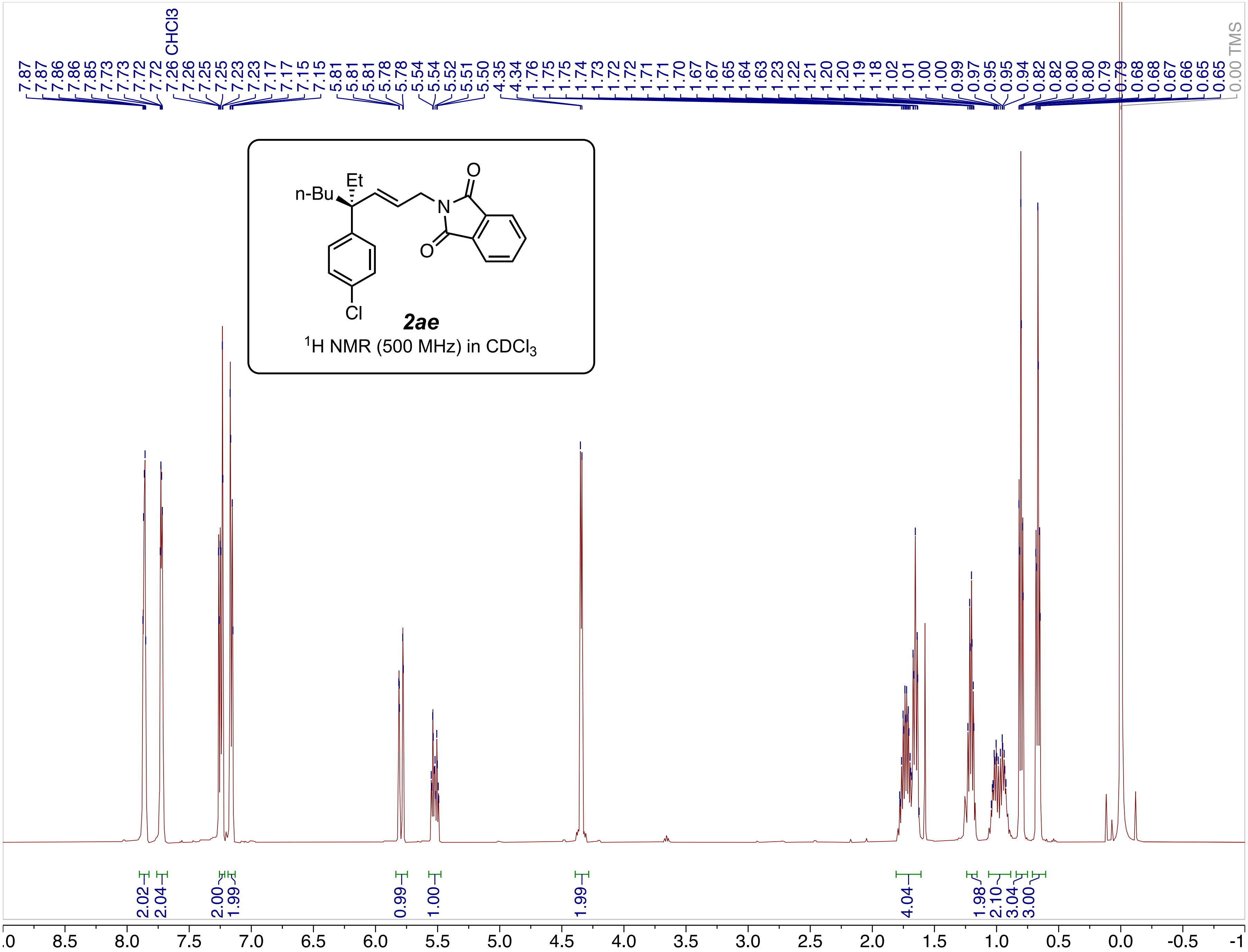
2ad-pyr

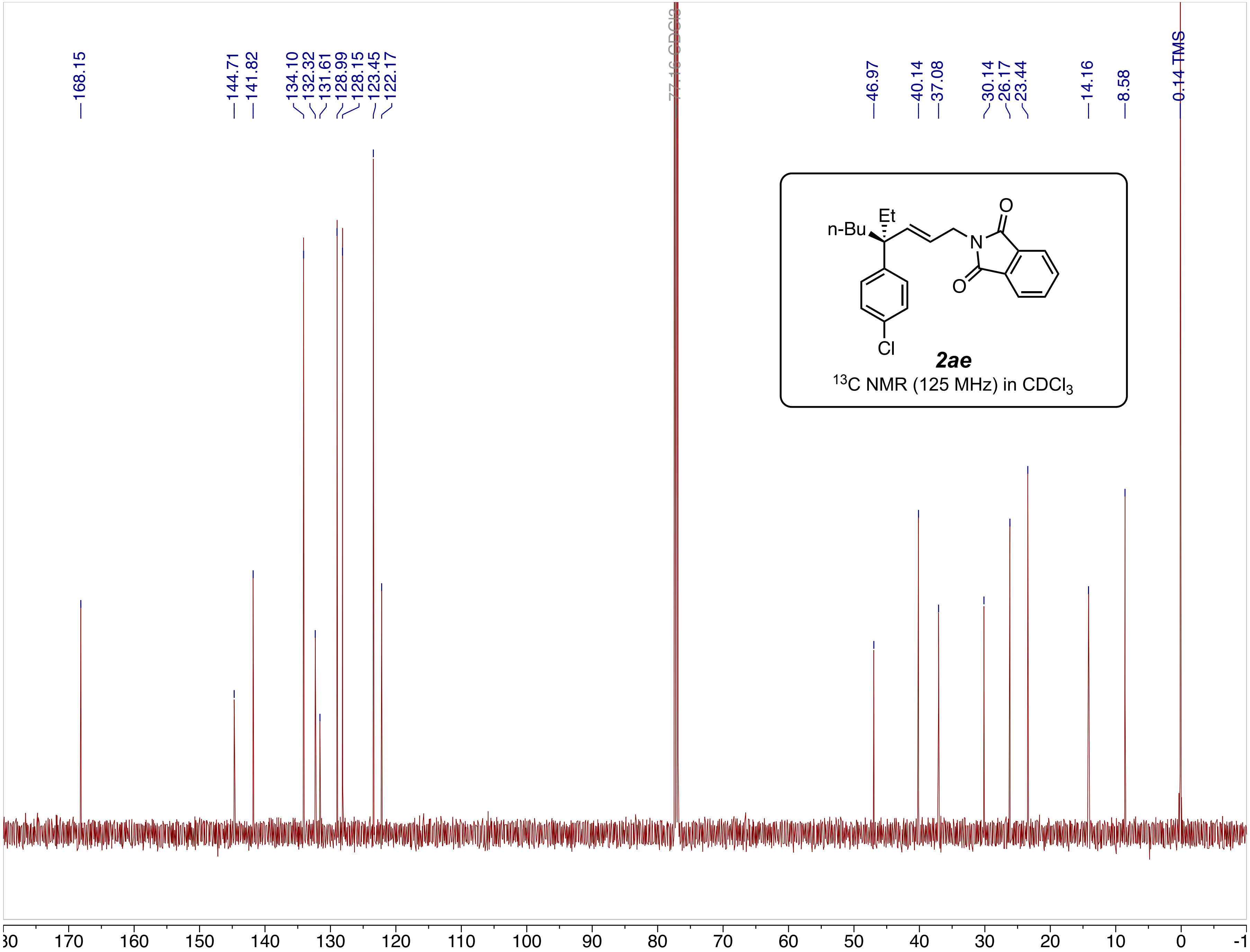
^{1}H NMR (500 MHz) in $CDCl_3$



2ad-pyr

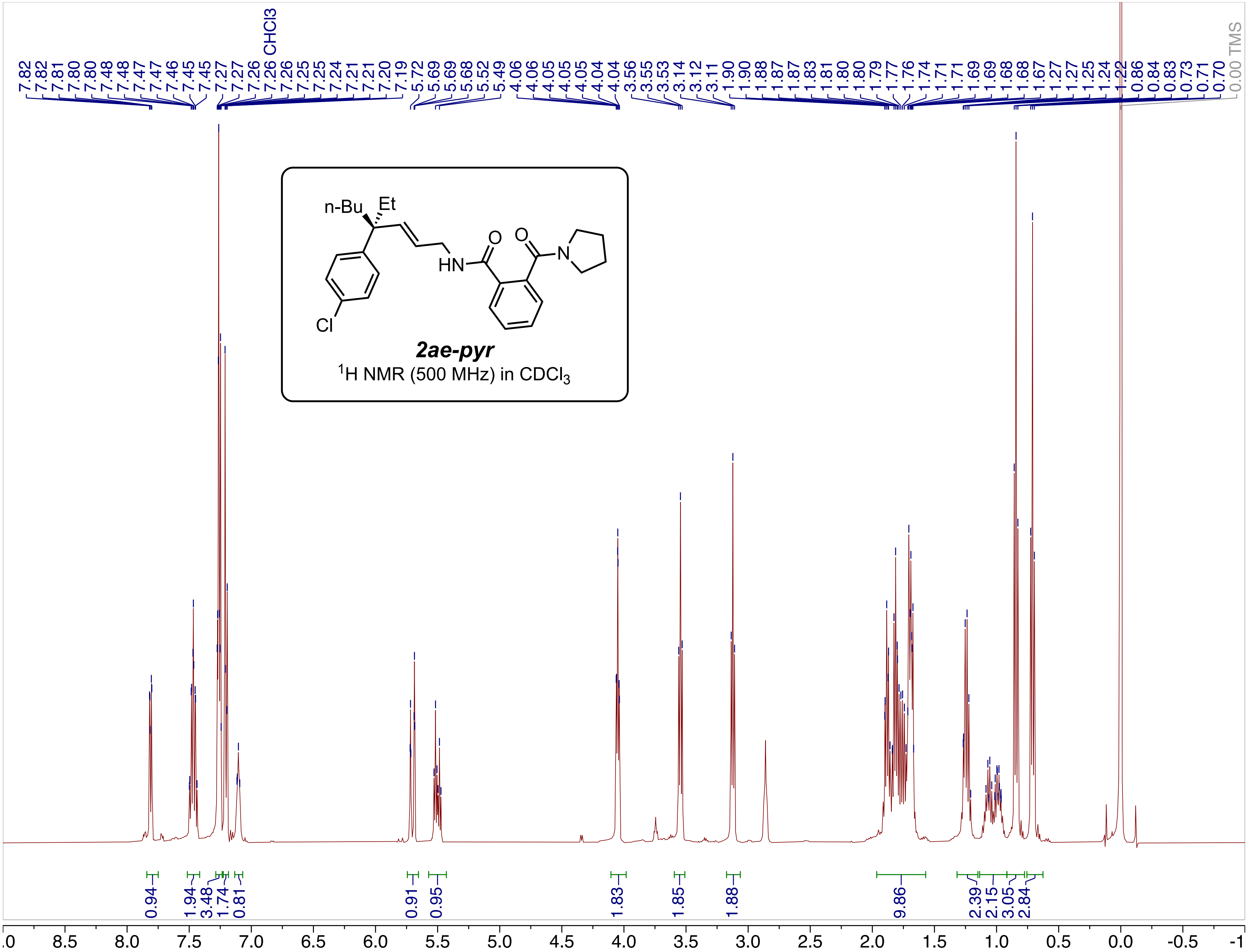
^{13}C NMR (125 MHz) in $CDCl_3$


7.87
7.87
7.86
7.86
7.85
7.73
7.73
7.72
7.72
7.26 CHCl3
7.26
7.25
7.25
7.23
7.23
7.17
7.17
7.15
7.15
5.81
5.81
5.81
5.78
5.78
5.54
5.54
5.52
5.51
5.50
4.35
4.34
1.76
1.75
1.75
1.74
1.73
1.72
1.71
1.71
1.71
1.70
1.67
1.67
1.65
1.64
1.63
1.23
1.22
1.21
1.20
1.20
1.19
1.18
1.02
1.01
1.00
1.00
0.99
0.97
0.95
0.95
0.94
0.82
0.82
0.80
0.80
0.79
0.79
0.68
0.68
0.67
0.66
0.65
0.65
0.00 TMS
n-Bu
Et
N
O
O
Cl
2ae
^{1}H NMR (500 MHz) in $CDCl_3$
2.02
2.04
2.00
1.99
0.99
1.00
1.99
4.04
1.98
2.10
3.04
3.00
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



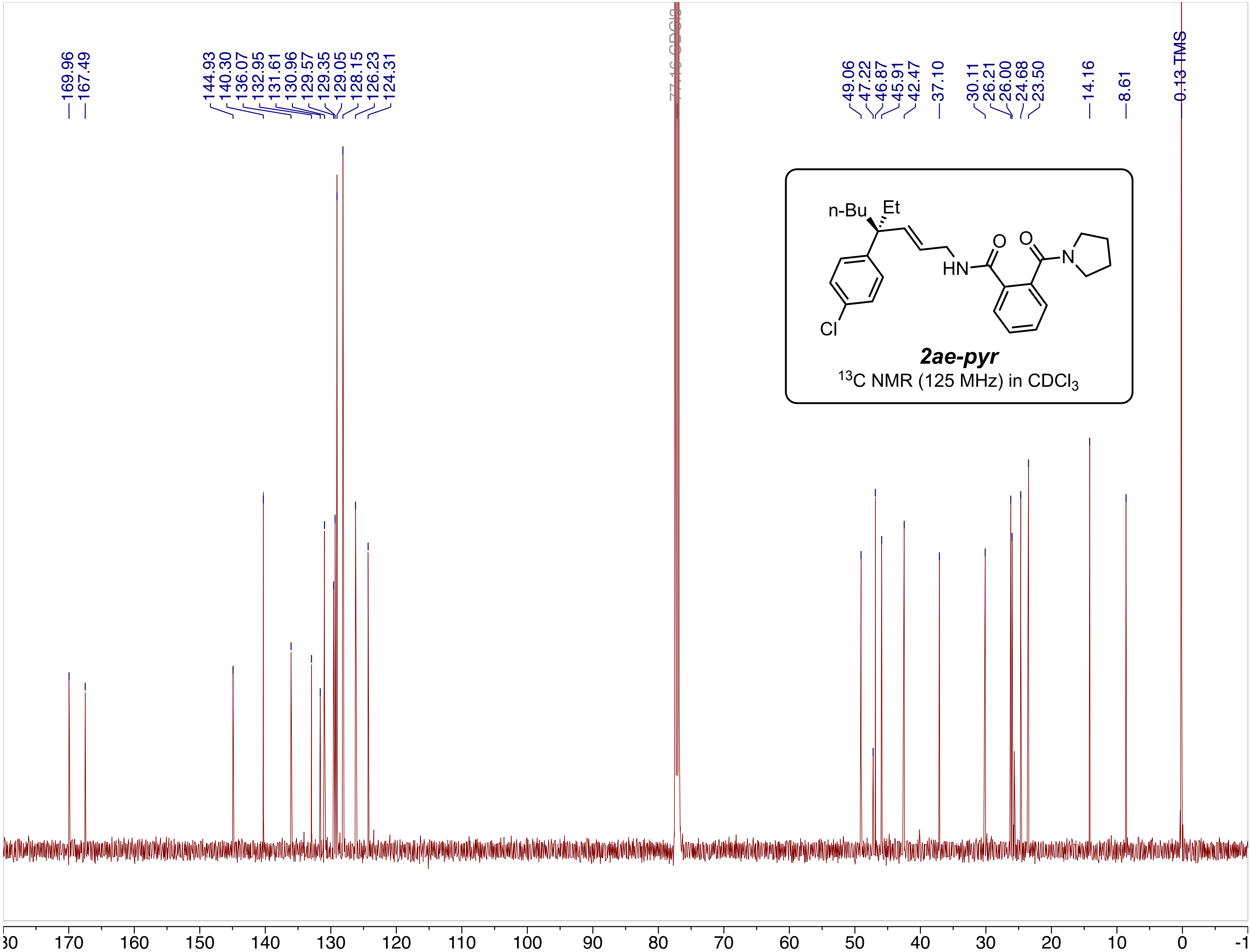
2ae

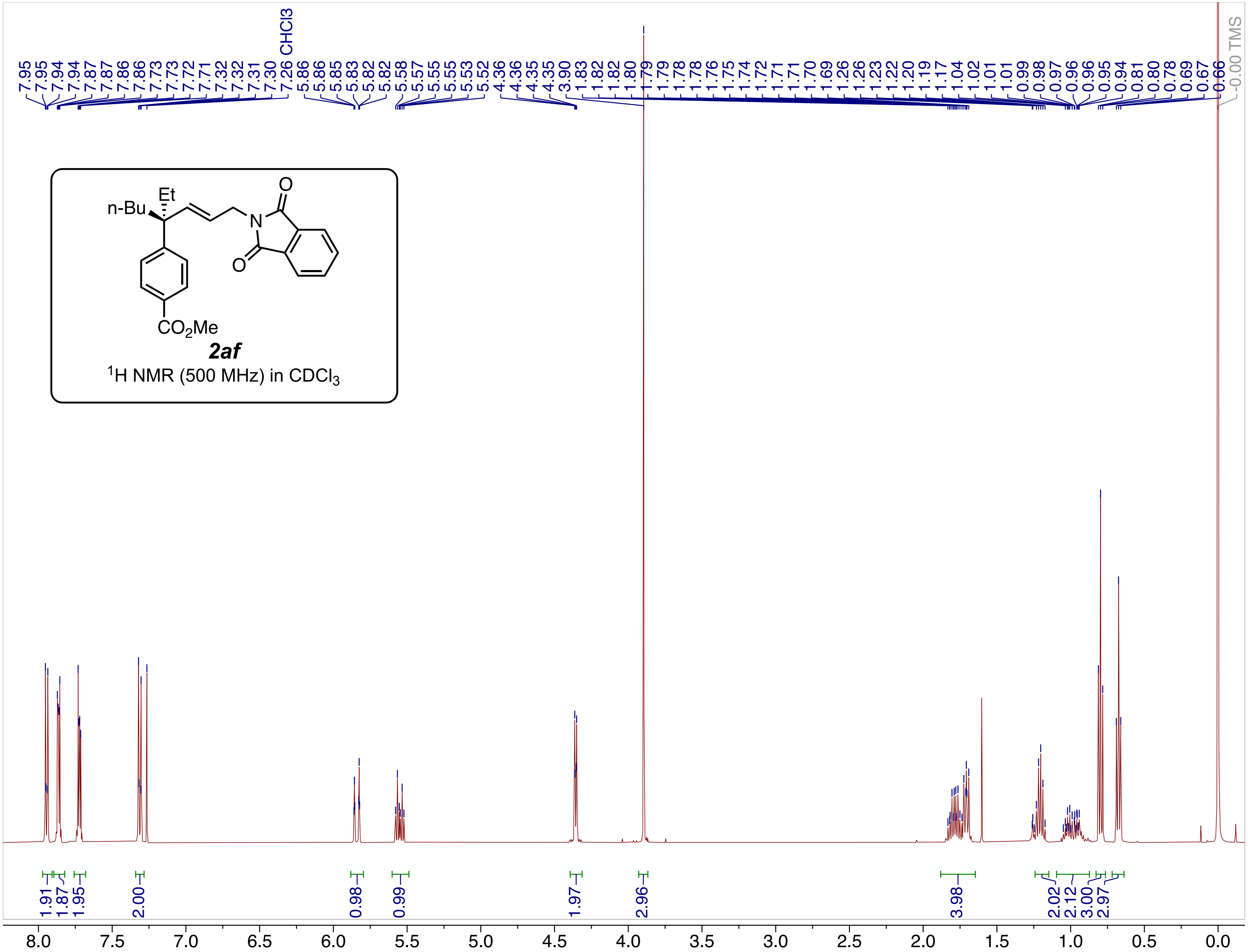
^{13}C NMR (125 MHz) in CDCl$_3$



2ae-pyr

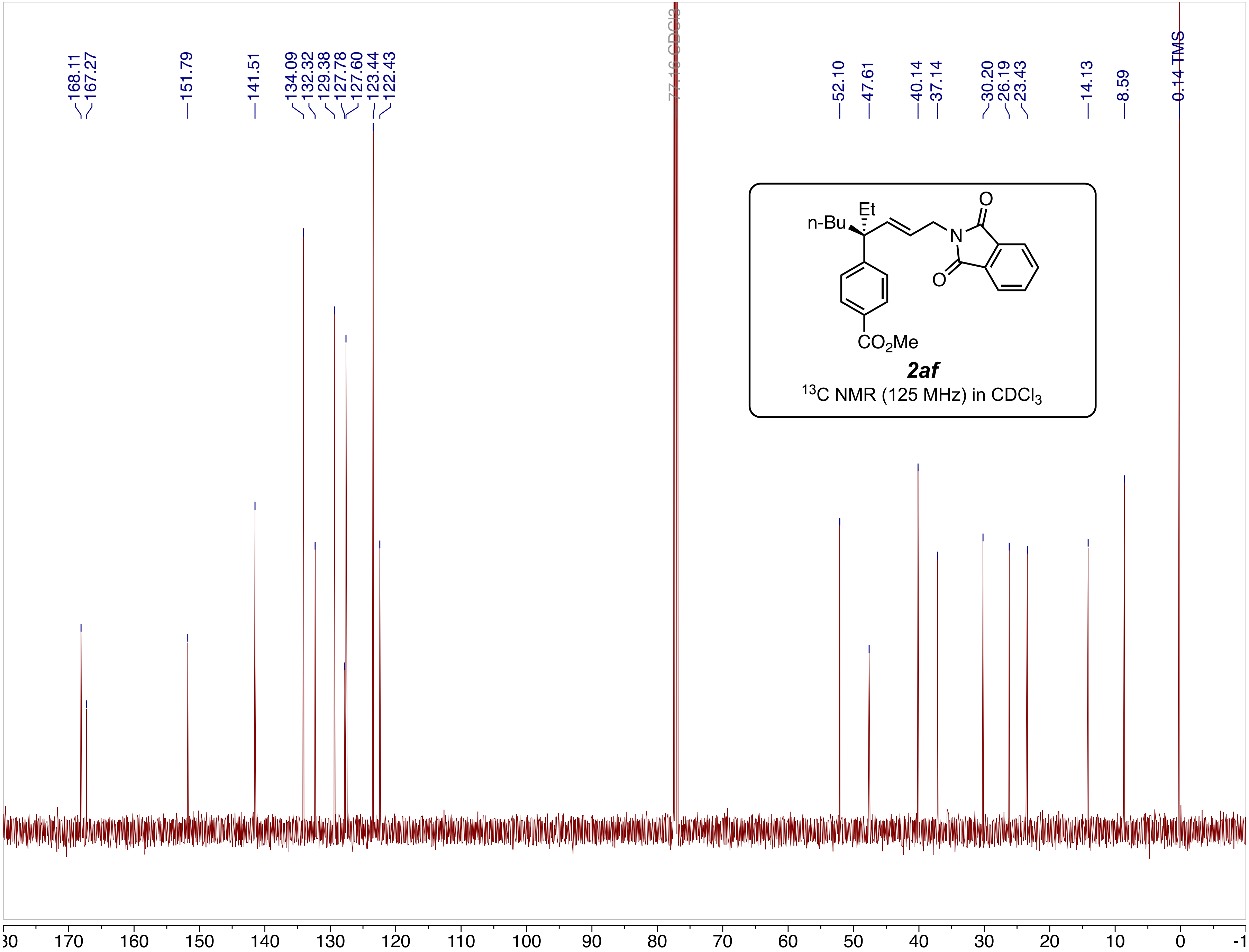
^{1}H NMR (500 MHz) in $CDCl_3$

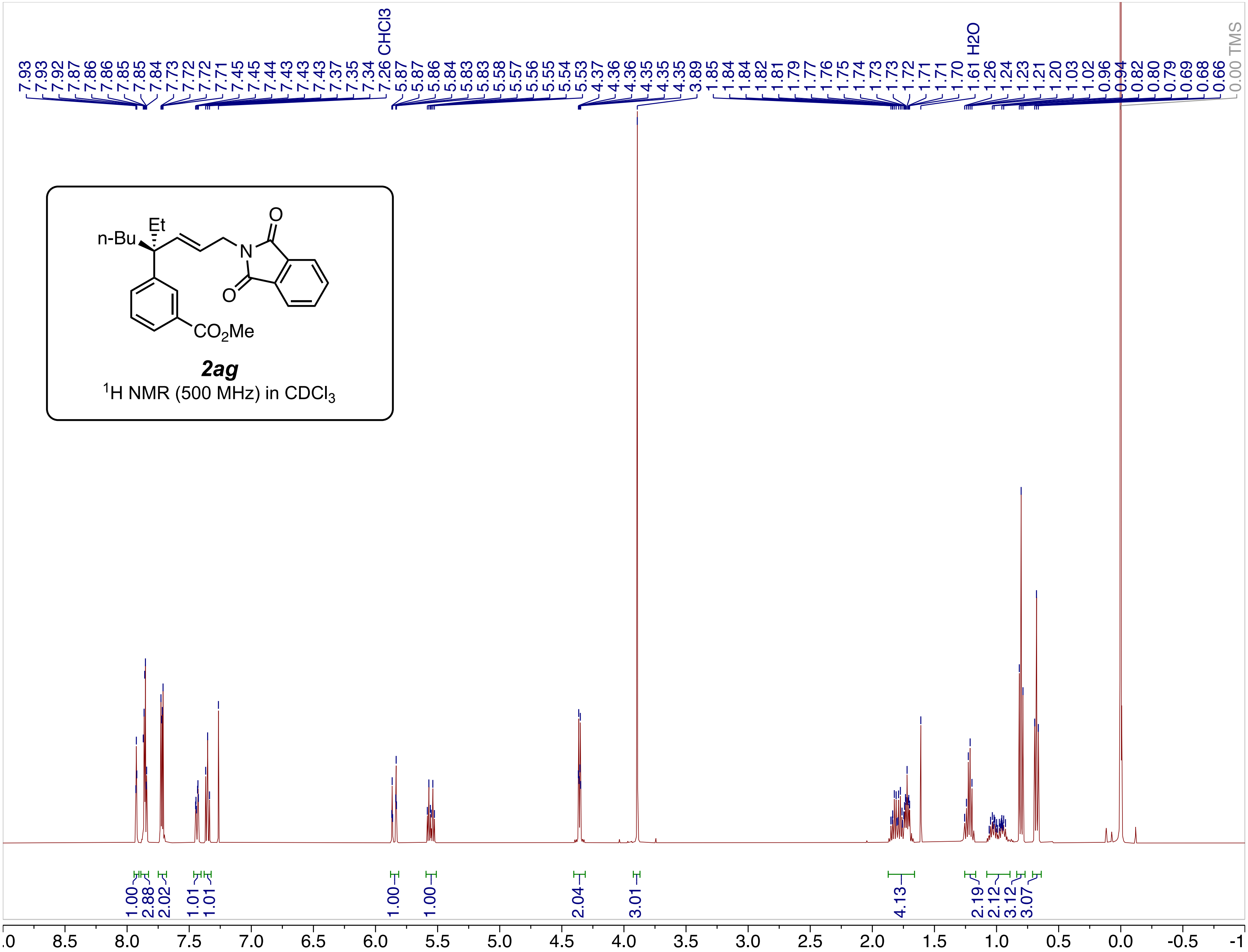
169.96
167.49
144.93
140.30
136.07
132.95
131.61
130.96
129.57
129.35
129.05
128.15
126.23
124.31
77.16 CDCl3
49.06
47.22
46.87
45.91
42.47
37.10
30.11
26.21
26.00
24.68
23.50
14.16
8.61
0.13 TMS
n-Bu
Et
HN
O
O
N
Cl
2ae-pyr
13C NMR (125 MHz) in CDCl3
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



2af

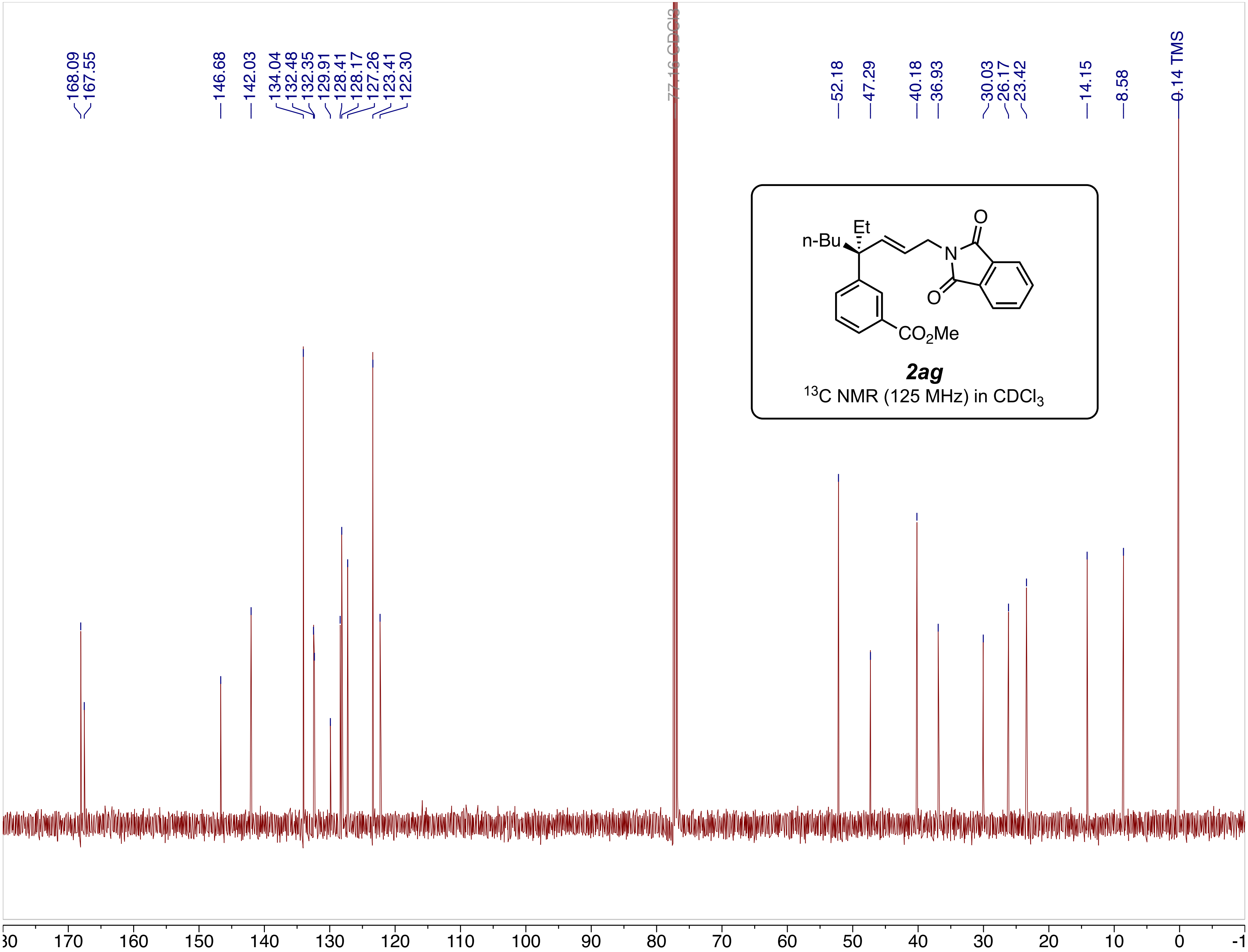
^{1}H NMR (500 MHz) in $CDCl_3$

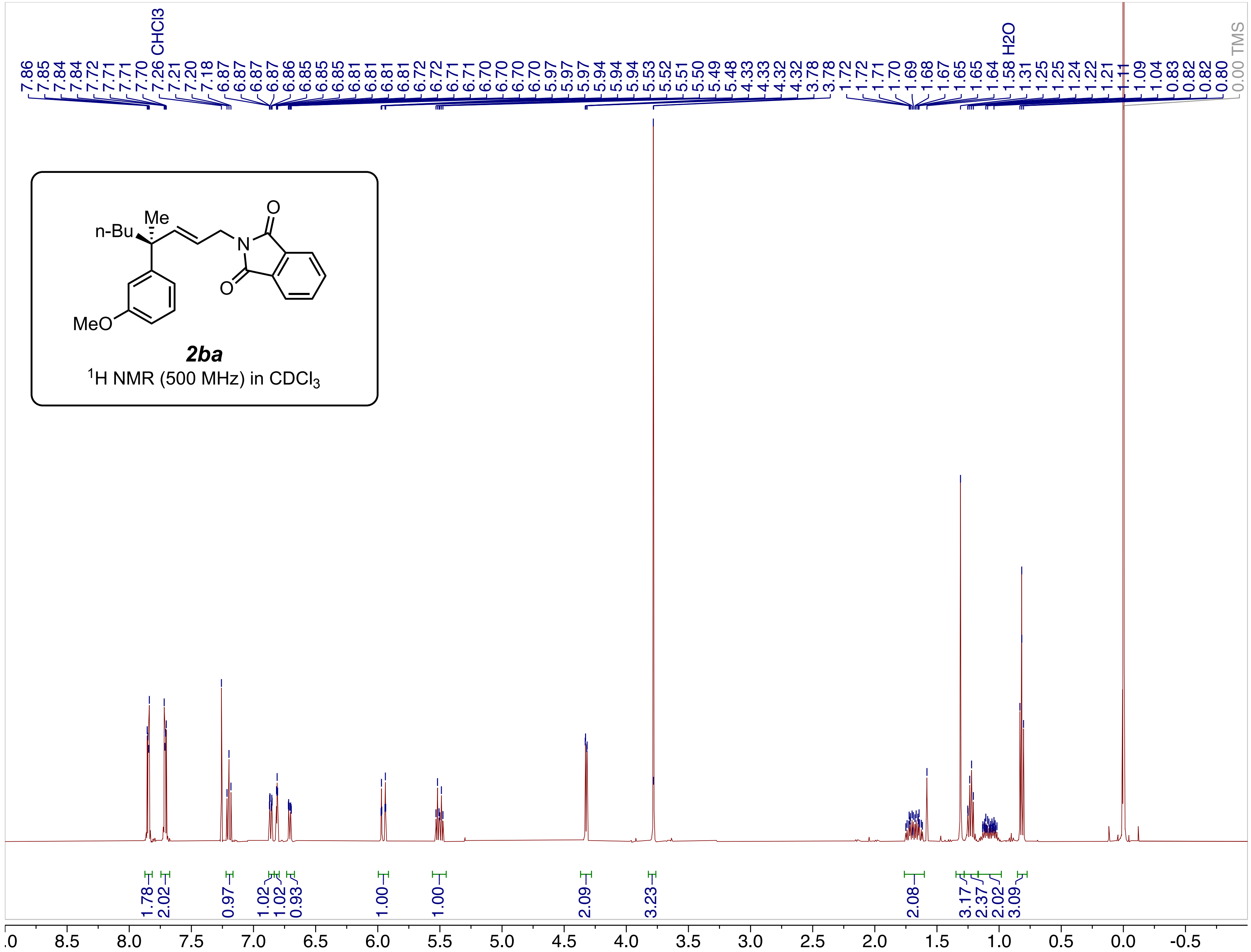

168.11
167.27
151.79
141.51
134.09
132.32
129.38
127.78
127.60
123.44
122.43
77.16 CDCl3
52.10
47.61
40.14
37.14
30.20
26.19
23.43
14.13
8.59
0.14 TMS
n-Bu
Et
N
O
O
CO2Me
2af
13C NMR (125 MHz) in CDCl3
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



2ag

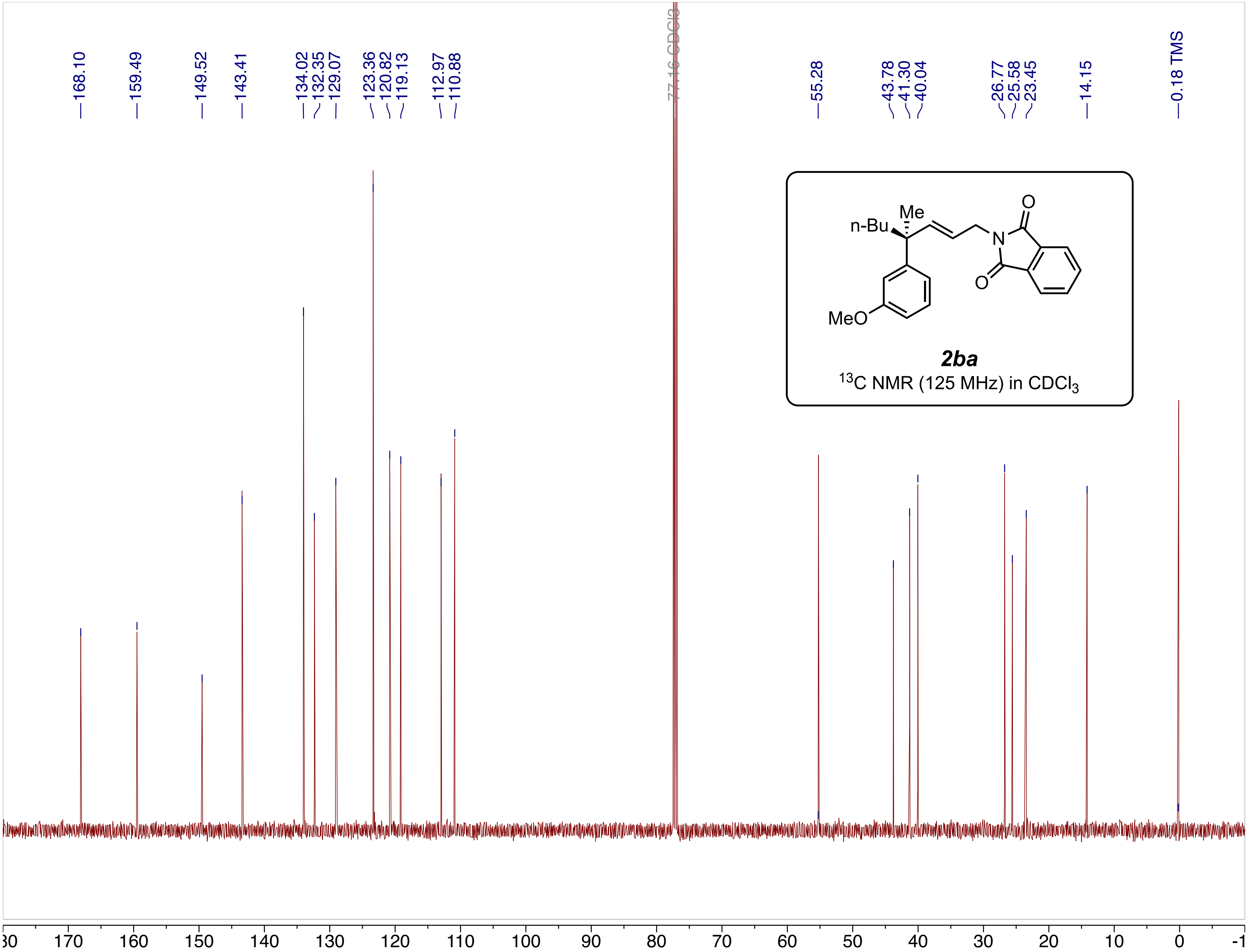
^{1}H NMR (500 MHz) in CDCl$_3$


168.09
167.55
146.68
142.03
134.04
132.48
132.35
129.91
128.41
128.17
127.26
123.41
122.30
77.16 CDCl3
52.18
47.29
40.18
36.93
30.03
26.17
23.42
14.15
8.58
0.14 TMS
Et
n-Bu
N
O
O
CO₂Me
2ag
13C NMR (125 MHz) in CDCl3
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



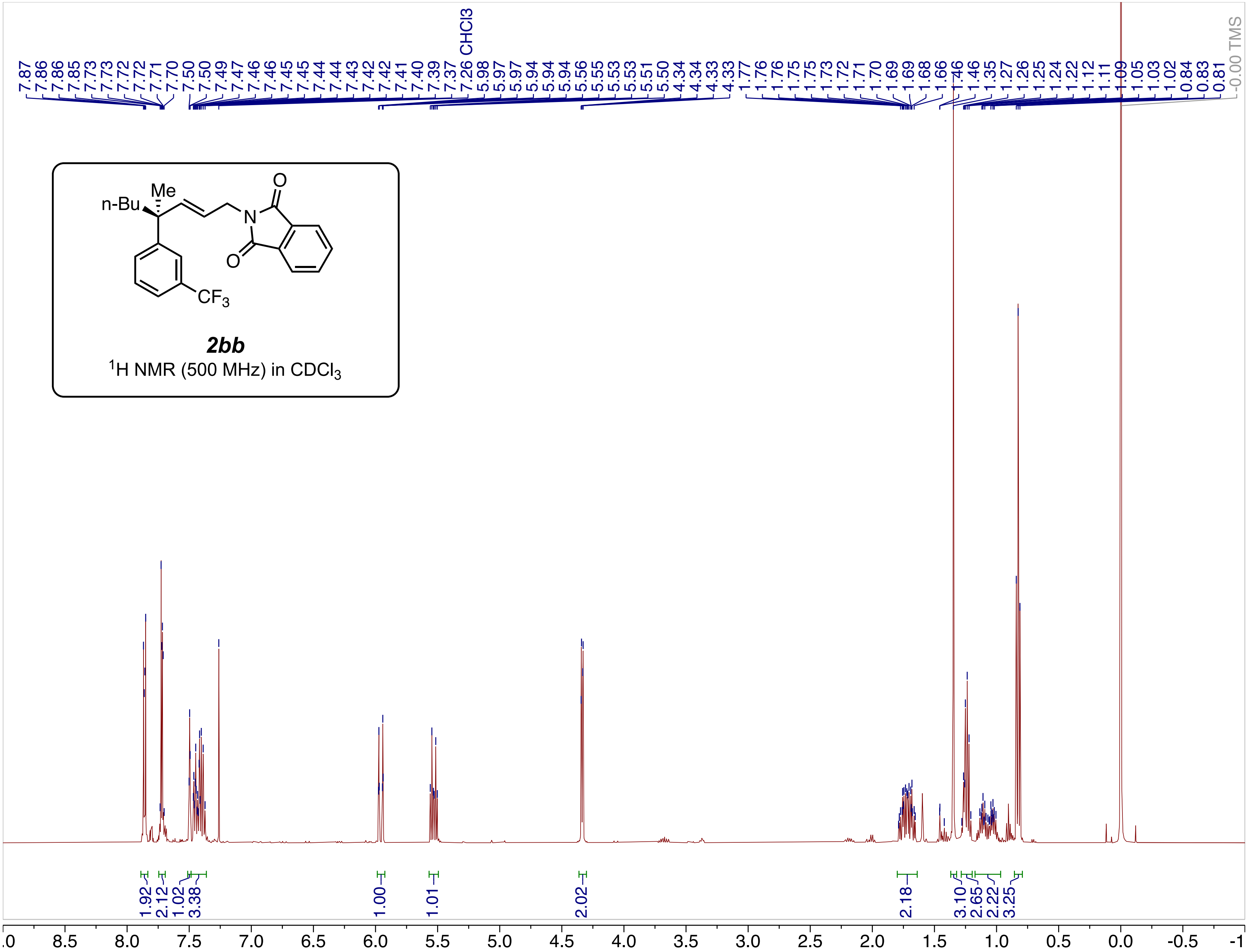
2ba

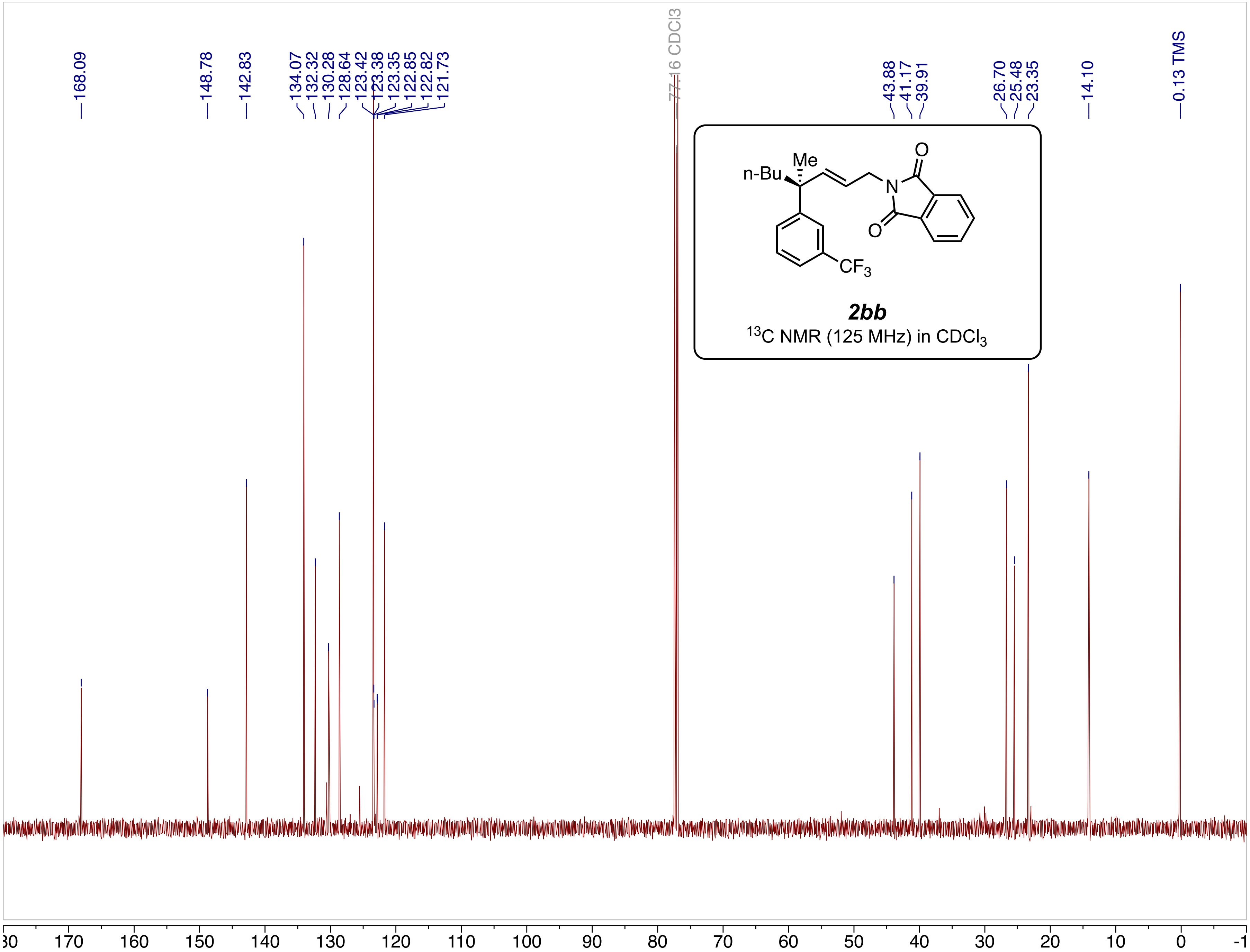
^{1}H NMR (500 MHz) in $CDCl_3$



2ba

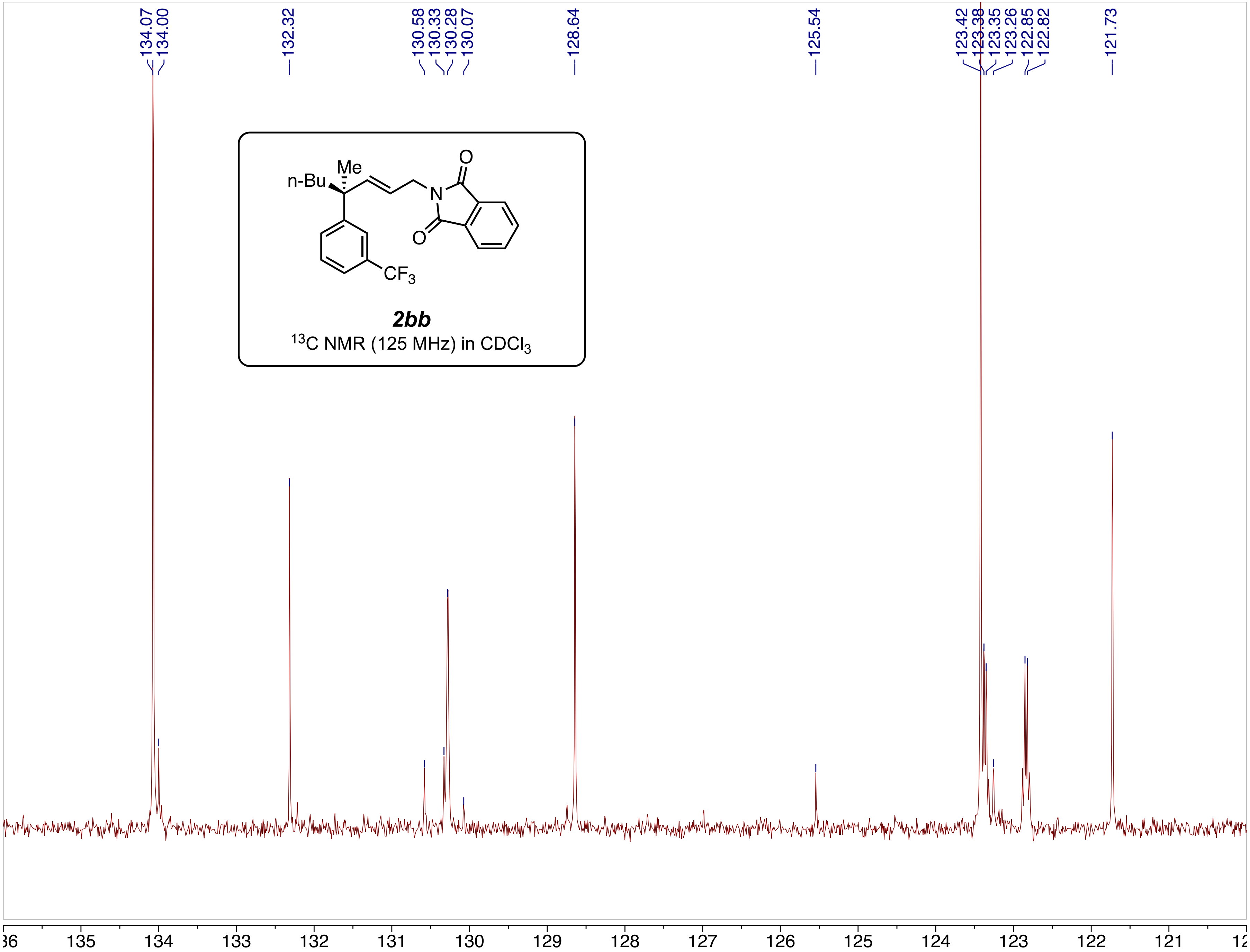
^{13}C NMR (125 MHz) in $CDCl_3$


2bb
^1H NMR (500 MHz) in $CDCl_3$
n-Bu
Me
N
O
O
CF_3
7.87
7.86
7.86
7.85
7.73
7.73
7.72
7.72
7.71
7.70
7.50
7.50
7.49
7.47
7.46
7.46
7.45
7.45
7.44
7.44
7.43
7.42
7.42
7.41
7.40
7.39
7.37
7.26 CHCl3
5.98
5.97
5.97
5.94
5.94
5.94
5.56
5.55
5.53
5.53
5.51
5.50
4.34
4.34
4.33
4.33
1.77
1.76
1.76
1.75
1.75
1.73
1.72
1.71
1.70
1.69
1.69
1.68
1.66
1.46
1.46
1.35
1.27
1.26
1.25
1.24
1.22
1.12
1.11
1.09
1.05
1.03
1.02
0.84
0.83
0.81
-0.00 TMS
1.92
2.12
1.02
3.38
1.00
1.01
2.02
2.18
3.10
2.65
2.22
3.25
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



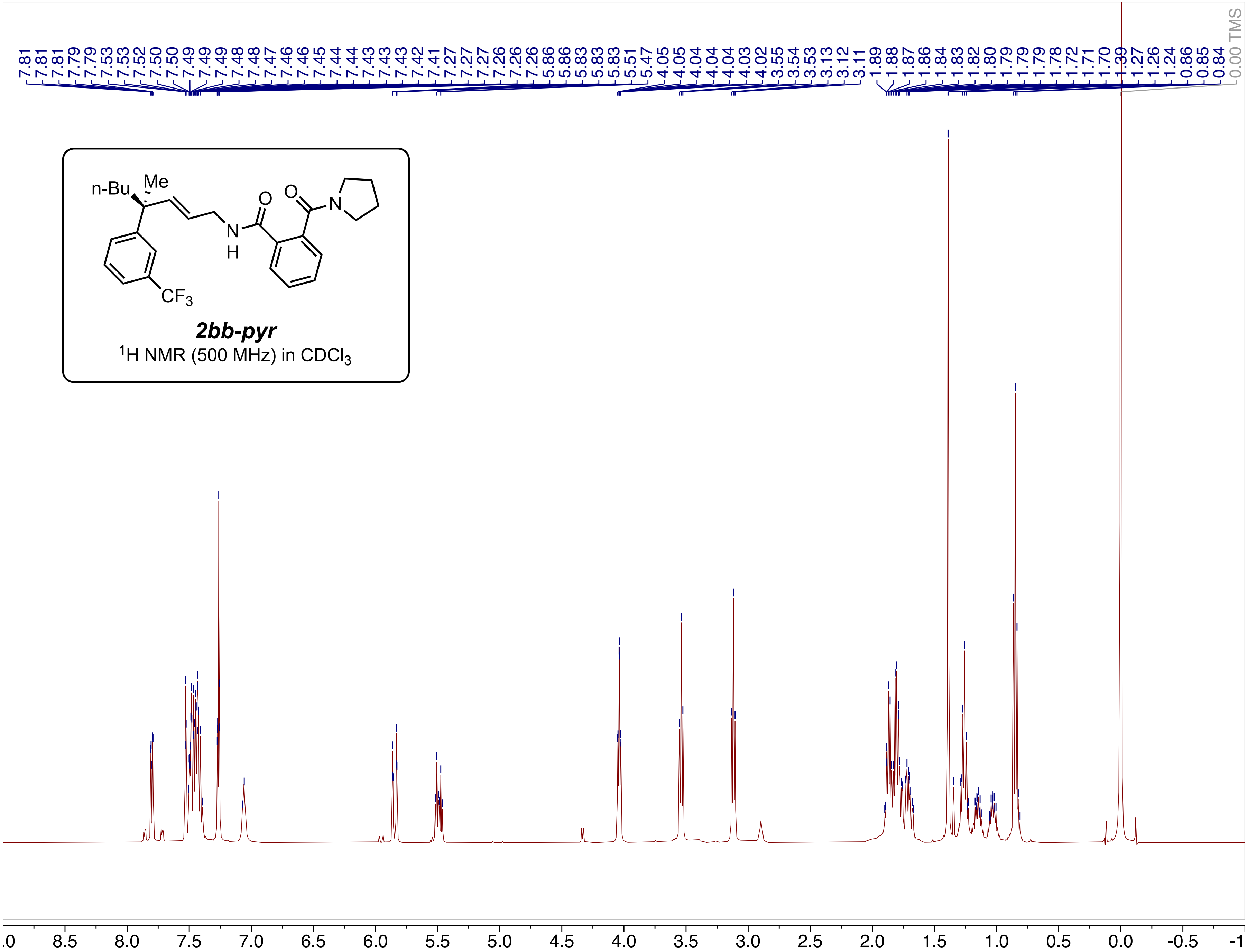
2bb

^{13}C NMR (125 MHz) in $CDCl_3$



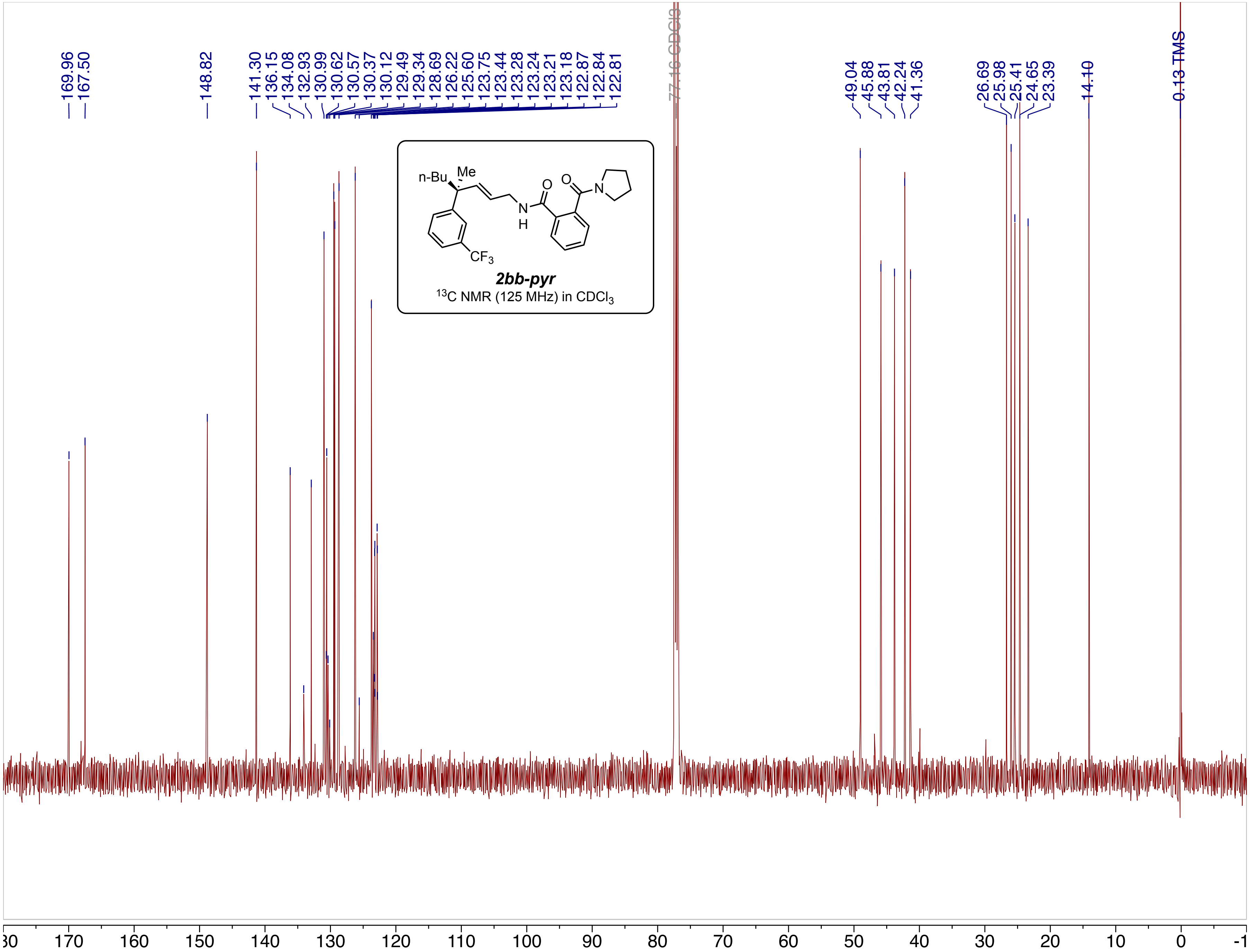
2bb

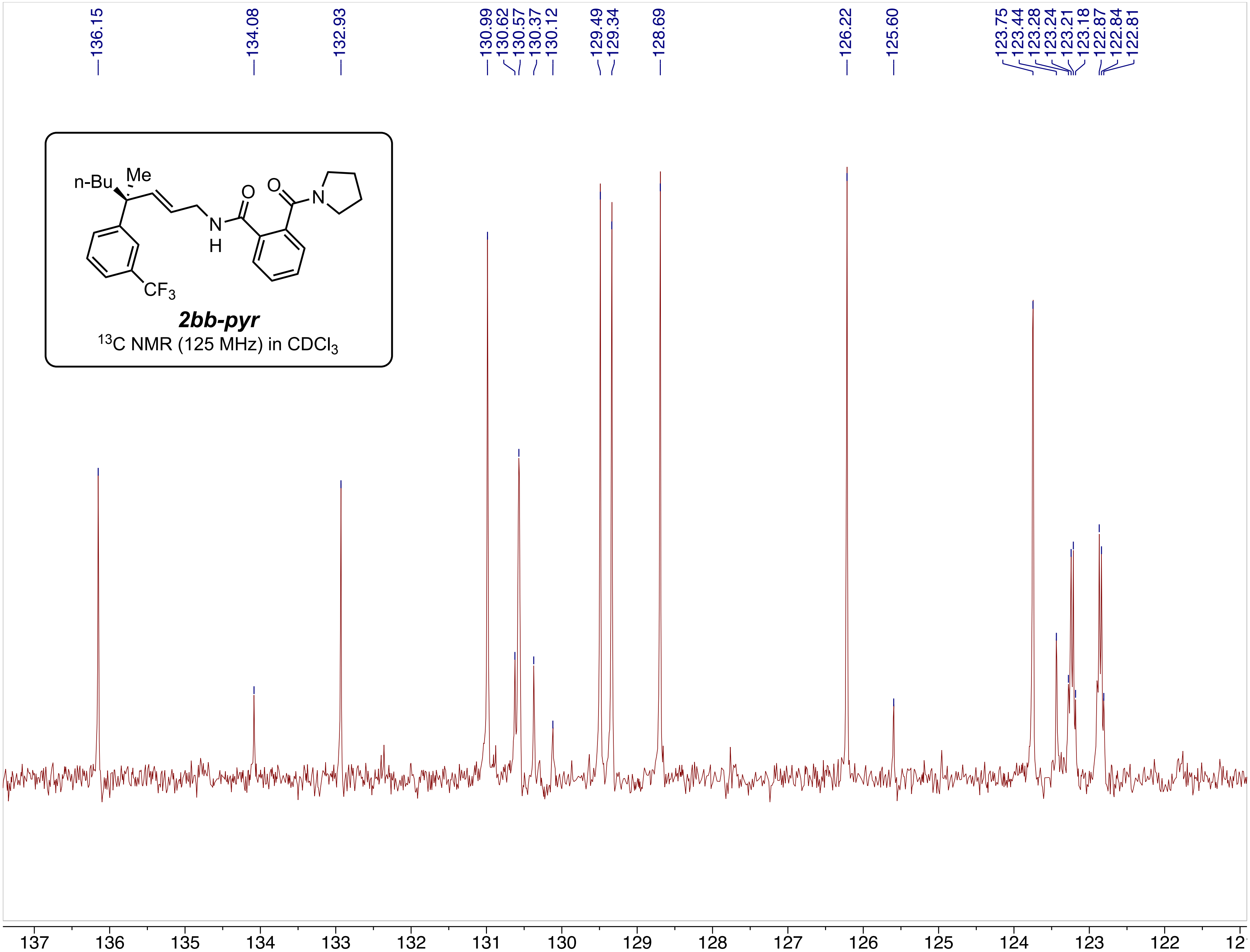
^{13}C NMR (125 MHz) in CDCl$_3$



2bb-pyr

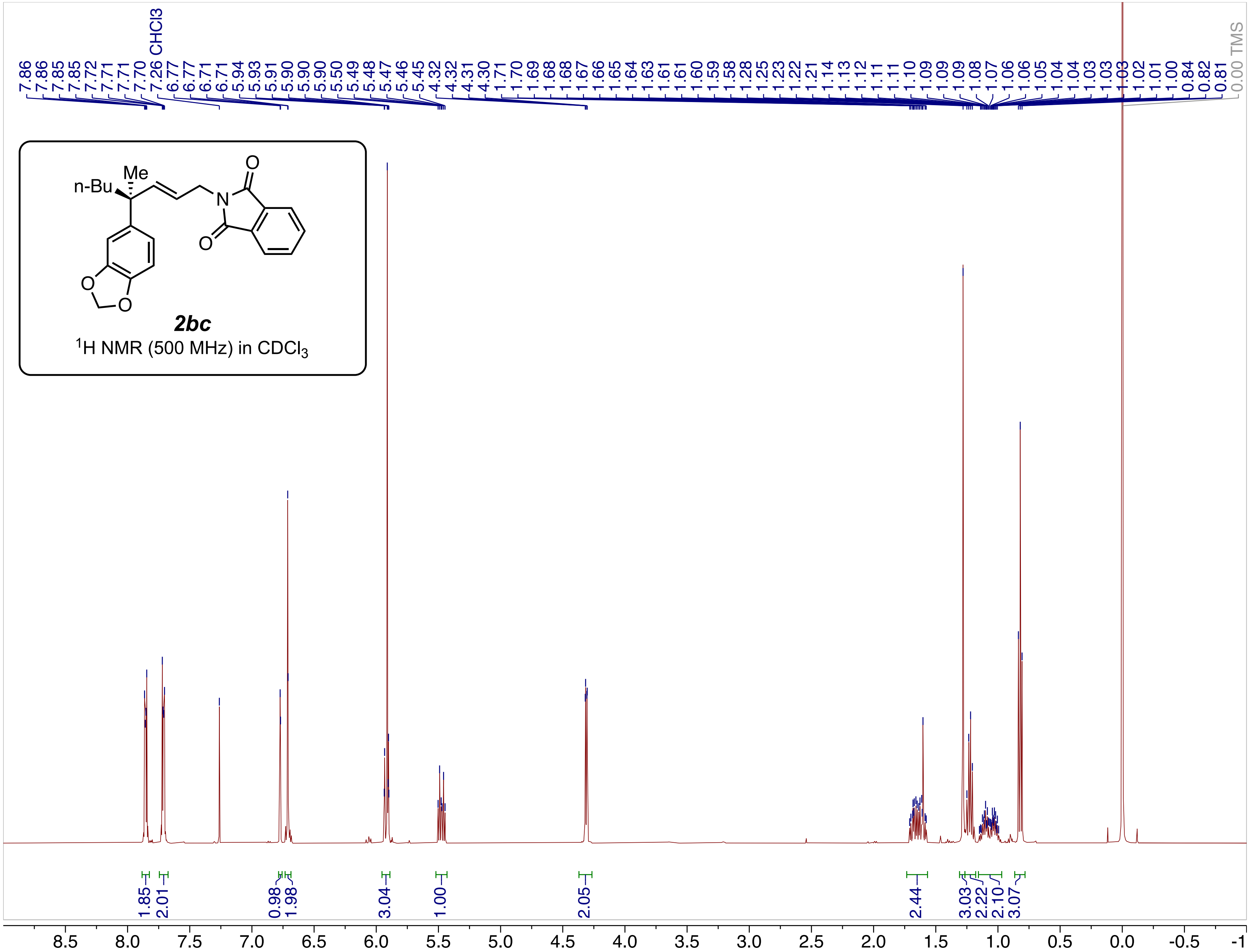
^{1}H NMR (500 MHz) in $CDCl_3$

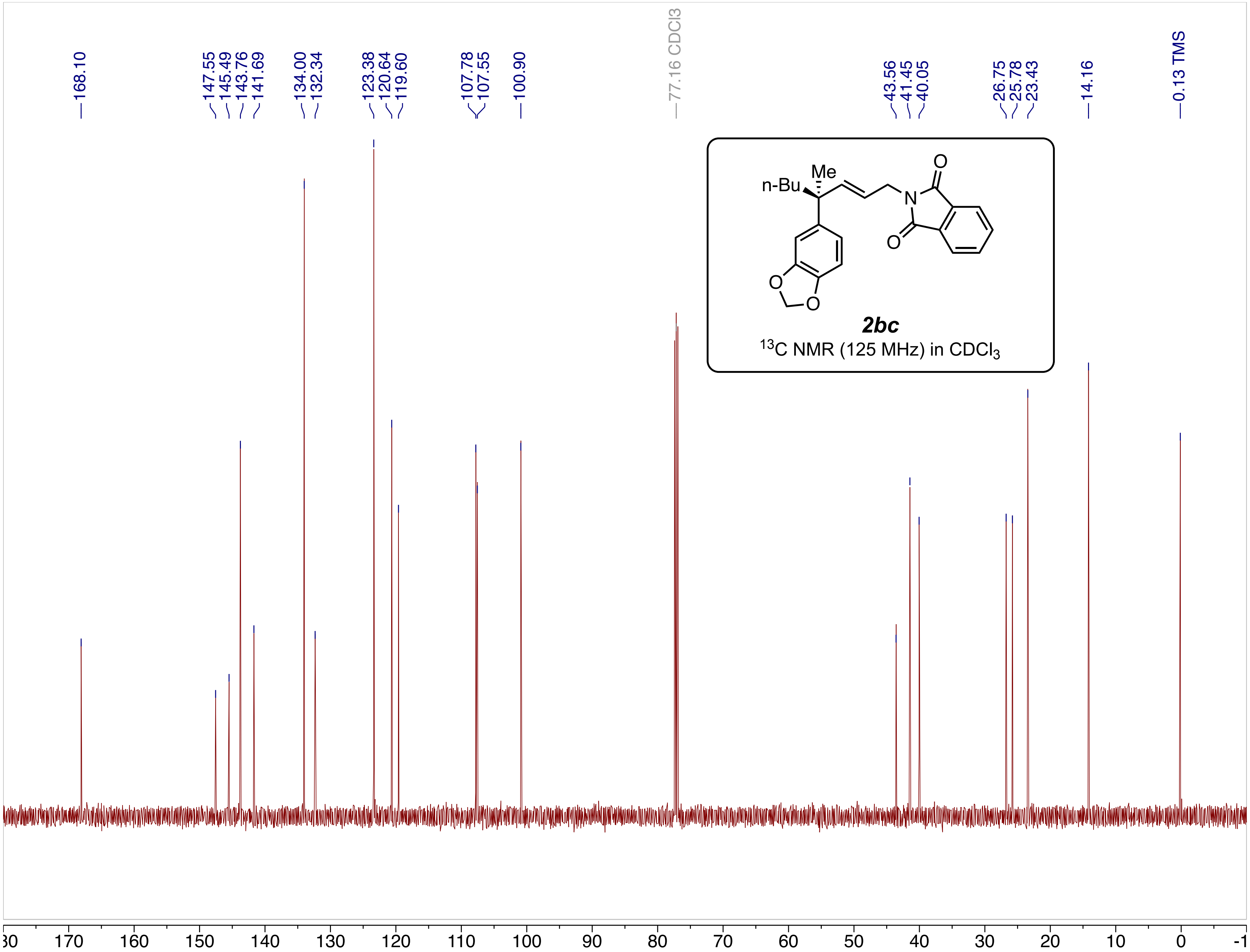

169.96
167.50
148.82
141.30
136.15
134.08
132.93
130.99
130.62
130.57
130.37
130.12
129.49
129.34
128.69
126.22
125.60
123.75
123.44
123.28
123.24
123.21
123.18
122.87
122.84
122.81
77.16 CDCl3
49.04
45.88
43.81
42.24
41.36
26.69
25.98
25.41
24.65
23.39
14.10
0.13 TMS
n-Bu
Me
O
O
N
N
H
CF3
2bb-pyr
13C NMR (125 MHz) in CDCl3
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



2bb-pyr

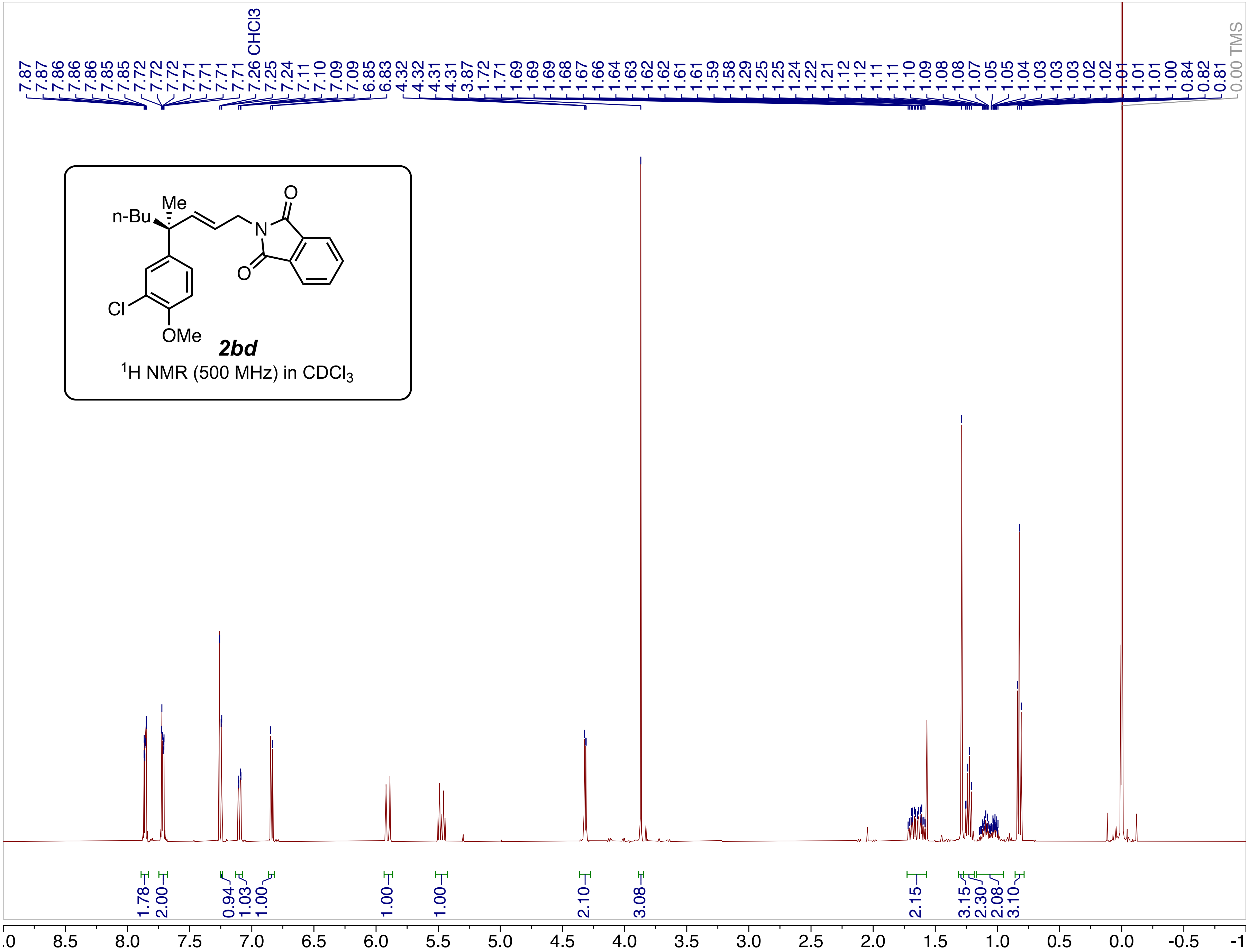
^{13}C NMR (125 MHz) in $CDCl_3$

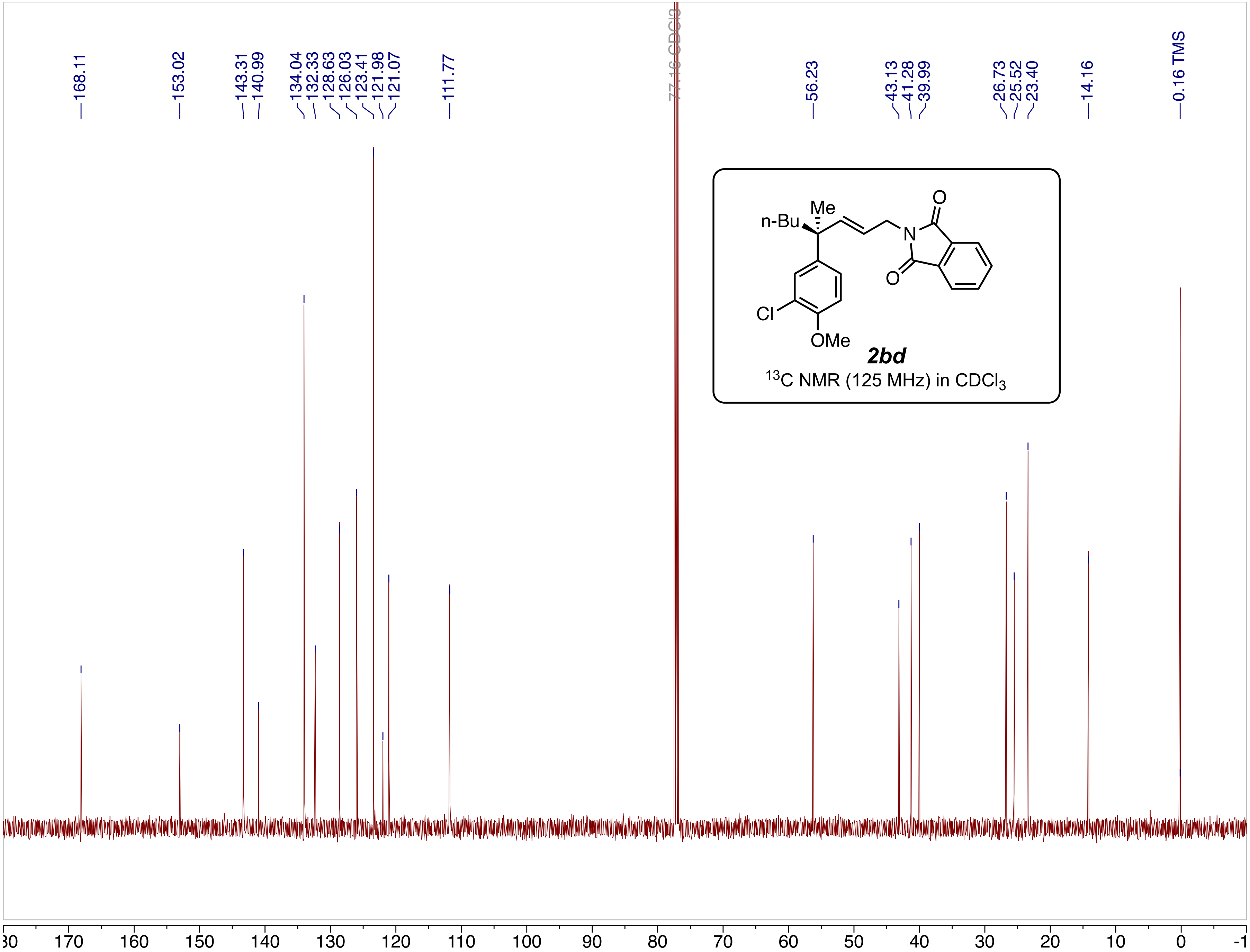

7.86
7.86
7.85
7.85
7.72
7.71
7.71
7.70
7.26 CHCl3
6.77
6.77
6.71
6.71
5.94
5.93
5.91
5.90
5.90
5.90
5.50
5.49
5.48
5.47
5.46
5.45
4.32
4.32
4.31
4.30
1.71
1.70
1.69
1.68
1.68
1.67
1.66
1.65
1.64
1.63
1.61
1.61
1.60
1.59
1.58
1.28
1.25
1.23
1.22
1.21
1.14
1.13
1.12
1.11
1.11
1.10
1.09
1.09
1.09
1.08
1.07
1.06
1.06
1.05
1.04
1.04
1.03
1.03
1.03
1.02
1.01
1.00
0.84
0.82
0.81
0.00 TMS
n-Bu
Me
N
O
O
O
O
2bc
^{1}H NMR (500 MHz) in CDCl$_3$
1.85
2.01
0.98
1.98
3.04
1.00
2.05
2.44
3.03
2.22
2.10
3.07
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



2bc

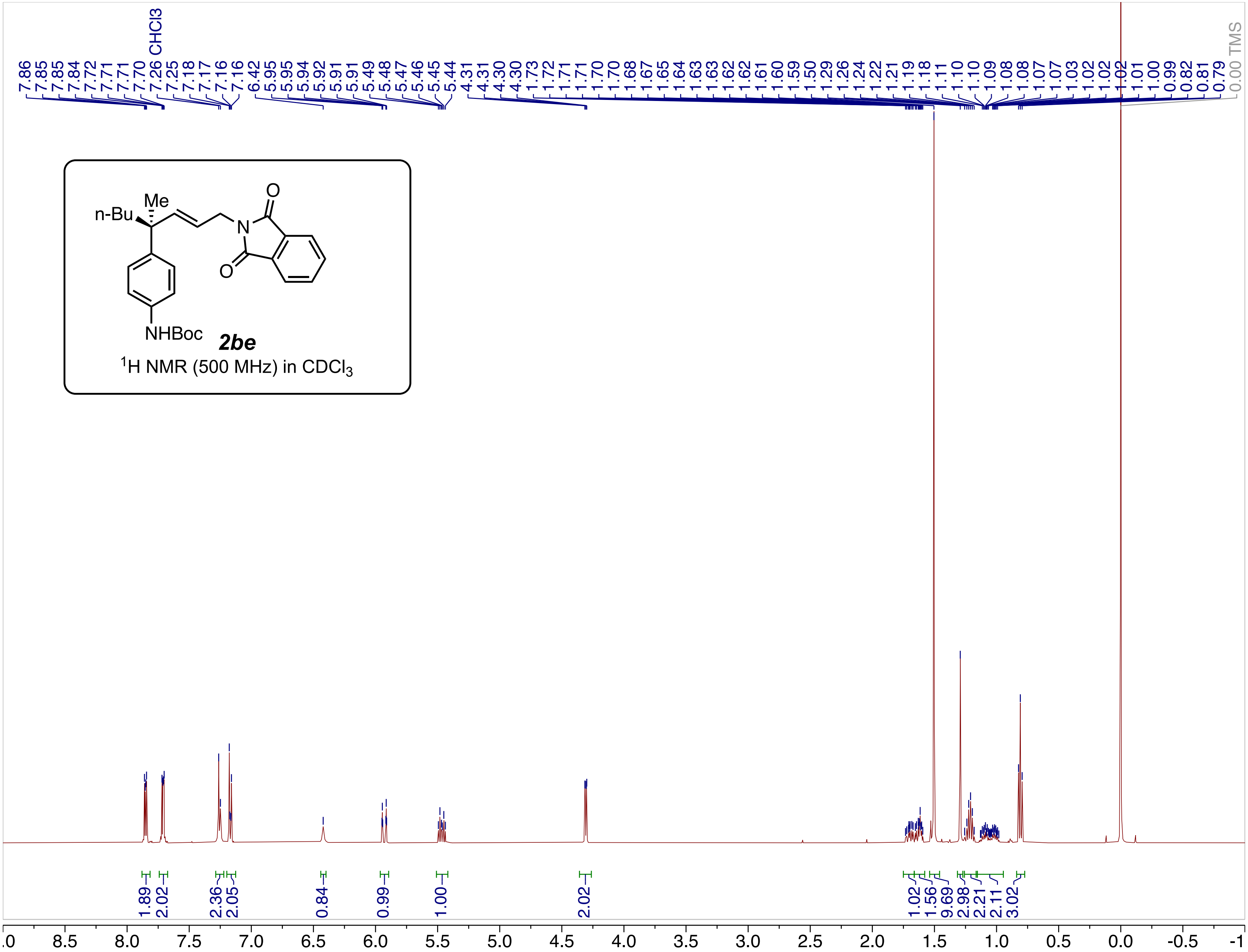
^{13}C NMR (125 MHz) in $CDCl_3$

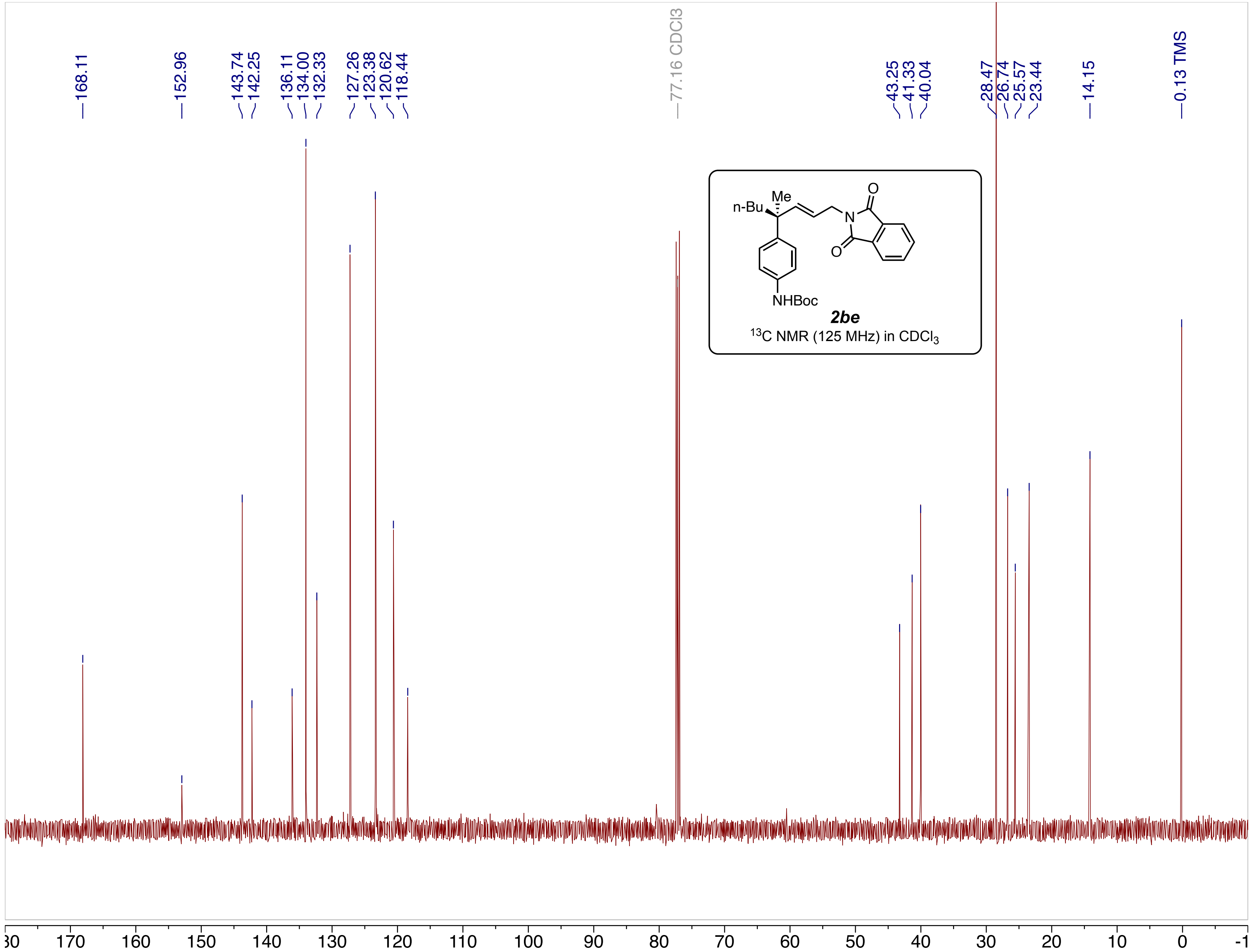

7.87
7.87
7.86
7.86
7.86
7.85
7.85
7.72
7.72
7.72
7.71
7.71
7.71
7.71
7.26 CHCl3
7.25
7.24
7.11
7.10
7.09
7.09
6.85
6.83
4.32
4.32
4.31
4.31
3.87
1.72
1.71
1.69
1.69
1.69
1.68
1.67
1.66
1.64
1.63
1.62
1.62
1.61
1.61
1.59
1.58
1.29
1.25
1.25
1.24
1.22
1.21
1.12
1.12
1.11
1.11
1.10
1.09
1.08
1.08
1.07
1.05
1.05
1.04
1.03
1.03
1.03
1.02
1.02
1.01
1.01
1.01
1.00
0.84
0.82
0.81
0.00 TMS
Me
n-Bu
N
O
O
Cl
OMe
2bd
^{1}H NMR (500 MHz) in CDCl$_3$
1.78
2.00
0.94
1.03
1.00
1.00
1.00
2.10
3.08
2.15
3.15
2.30
2.08
3.10
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

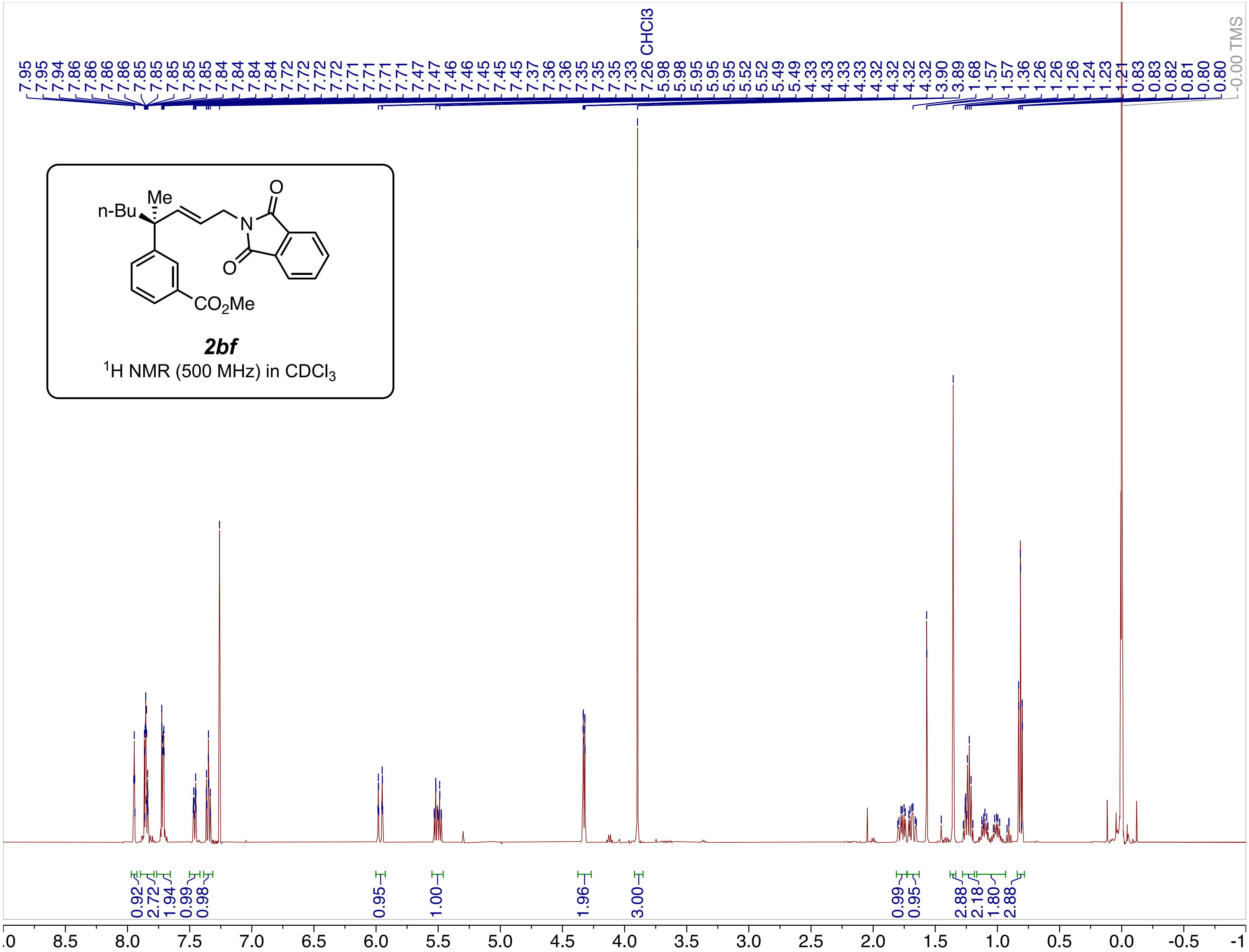


2bd

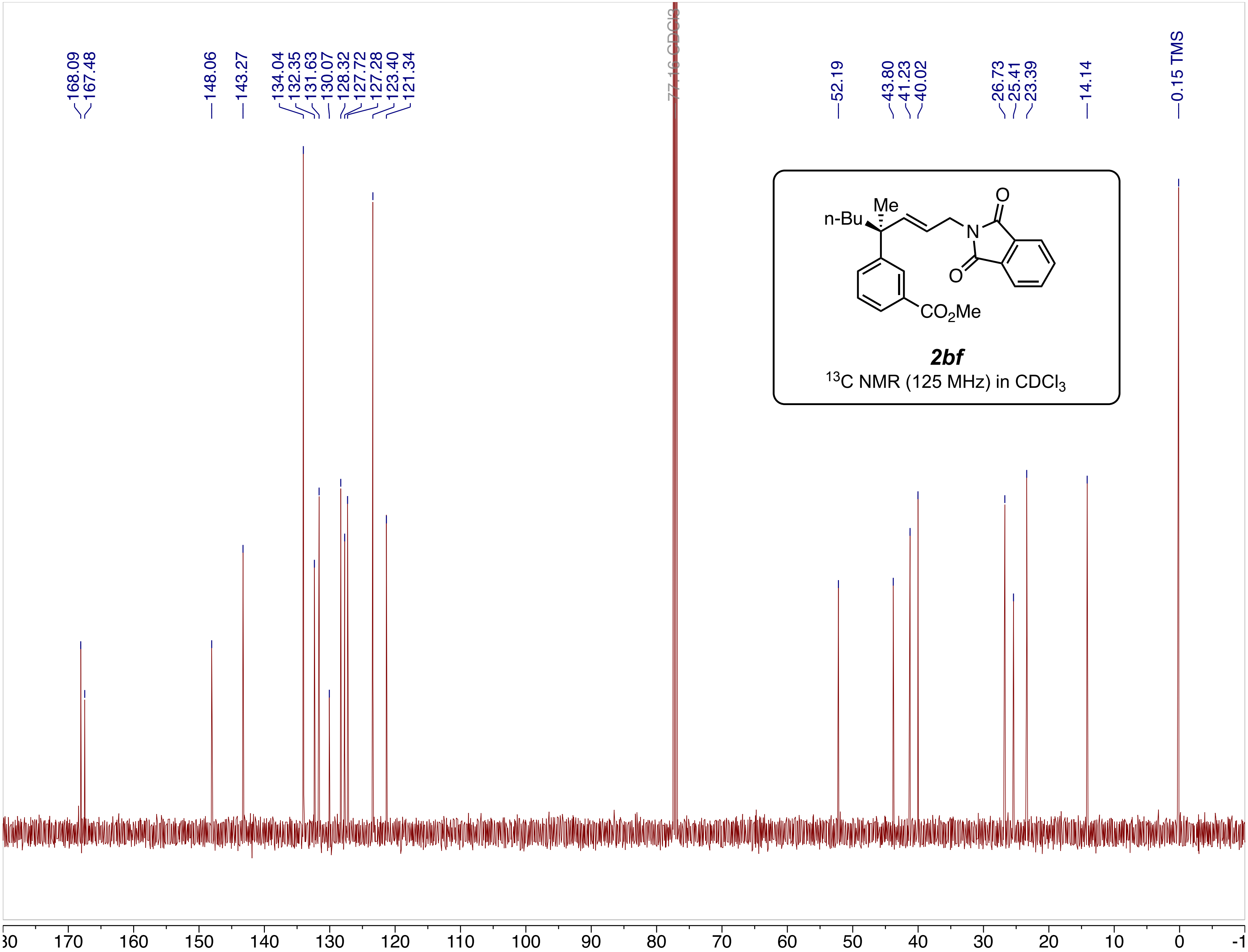
^{13}C NMR (125 MHz) in $CDCl_3$


7.86
7.85
7.85
7.84
7.72
7.71
7.71
7.70
7.26 CHCl3
7.25
7.18
7.17
7.16
7.16
6.42
5.95
5.95
5.94
5.92
5.91
5.91
5.49
5.48
5.47
5.46
5.45
5.44
4.31
4.31
4.30
4.30
1.73
1.72
1.71
1.71
1.70
1.70
1.68
1.67
1.65
1.64
1.63
1.63
1.62
1.62
1.61
1.60
1.59
1.50
1.29
1.26
1.24
1.22
1.21
1.19
1.18
1.11
1.10
1.10
1.09
1.08
1.08
1.07
1.07
1.03
1.02
1.02
1.02
1.01
1.00
0.99
0.82
0.81
0.79
0.00 TMS
Me
n-Bu
N
O
O
NHBoc
2be
^{1}H NMR (500 MHz) in CDCl$_3$
1.89
2.02
2.36
2.05
0.84
0.99
1.00
2.02
1.02
1.56
9.69
2.98
2.21
2.11
3.02
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


168.11
152.96
143.74
142.25
136.11
134.00
132.33
127.26
123.38
120.62
118.44
77.16 CDCl3
43.25
41.33
40.04
28.47
26.74
25.57
23.44
14.15
0.13 TMS
Me
n-Bu
N
O
O
NHBoc
2be
^{13}C NMR (125 MHz) in $CDCl_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

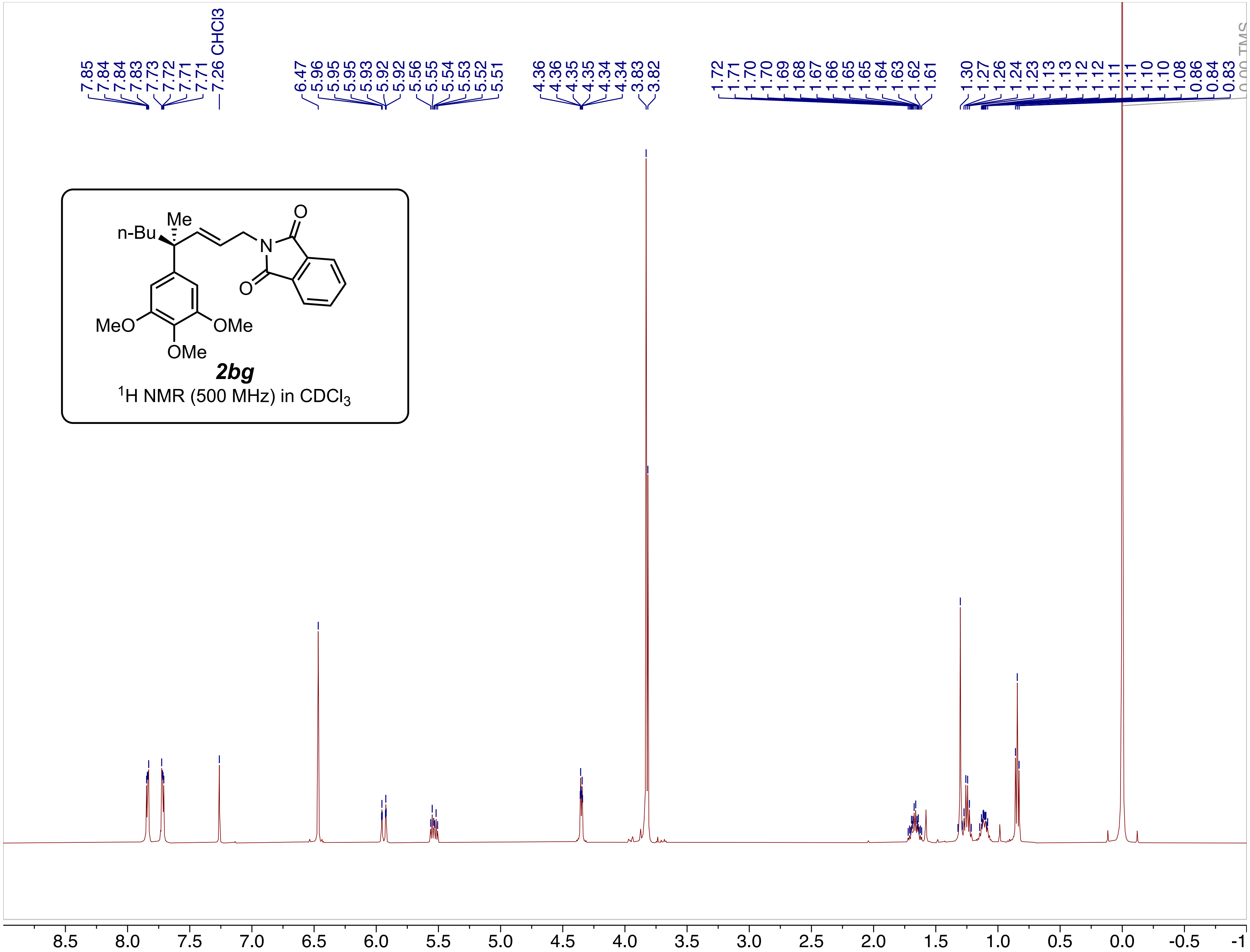

2bf

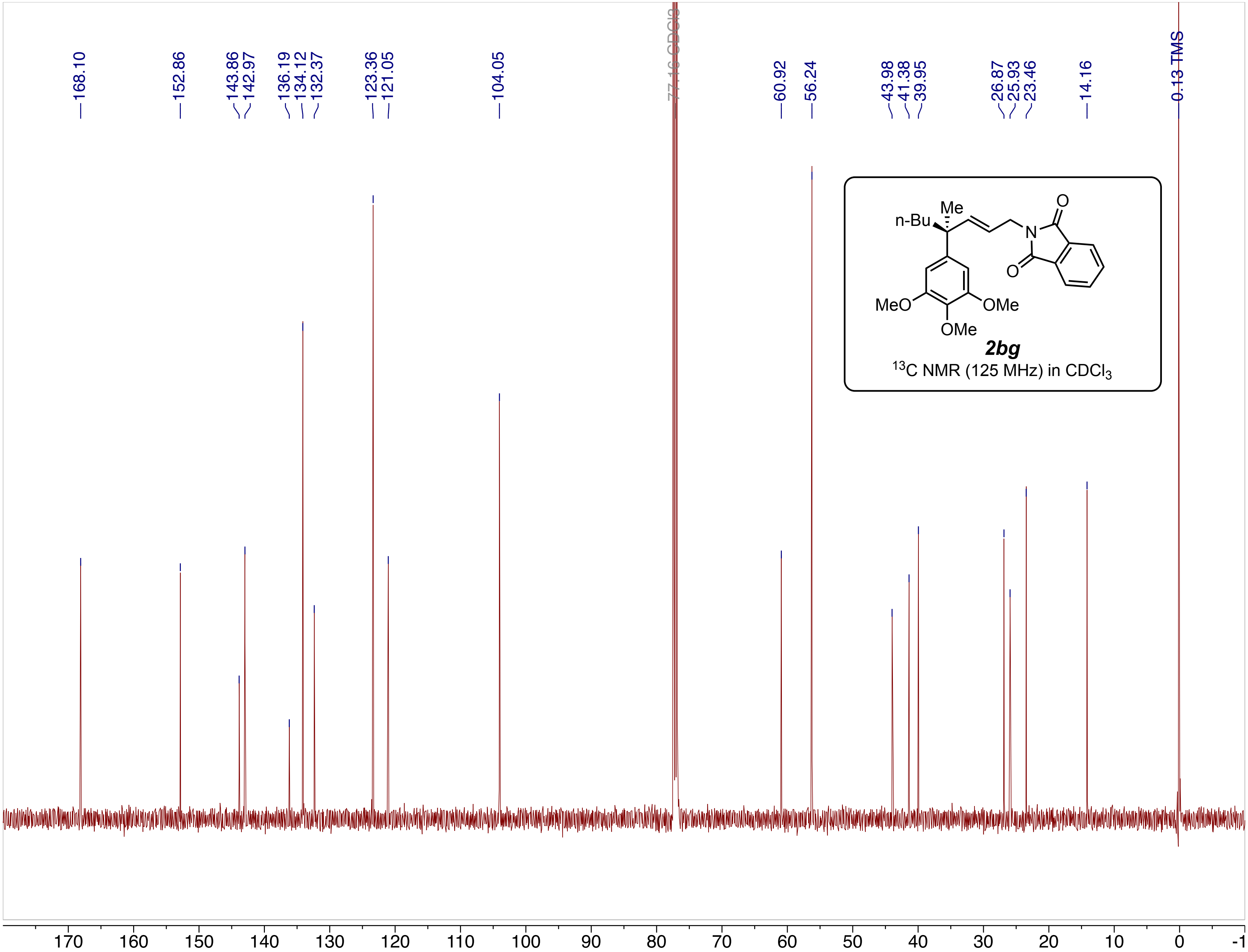
^{1}H NMR (500 MHz) in $CDCl_3$



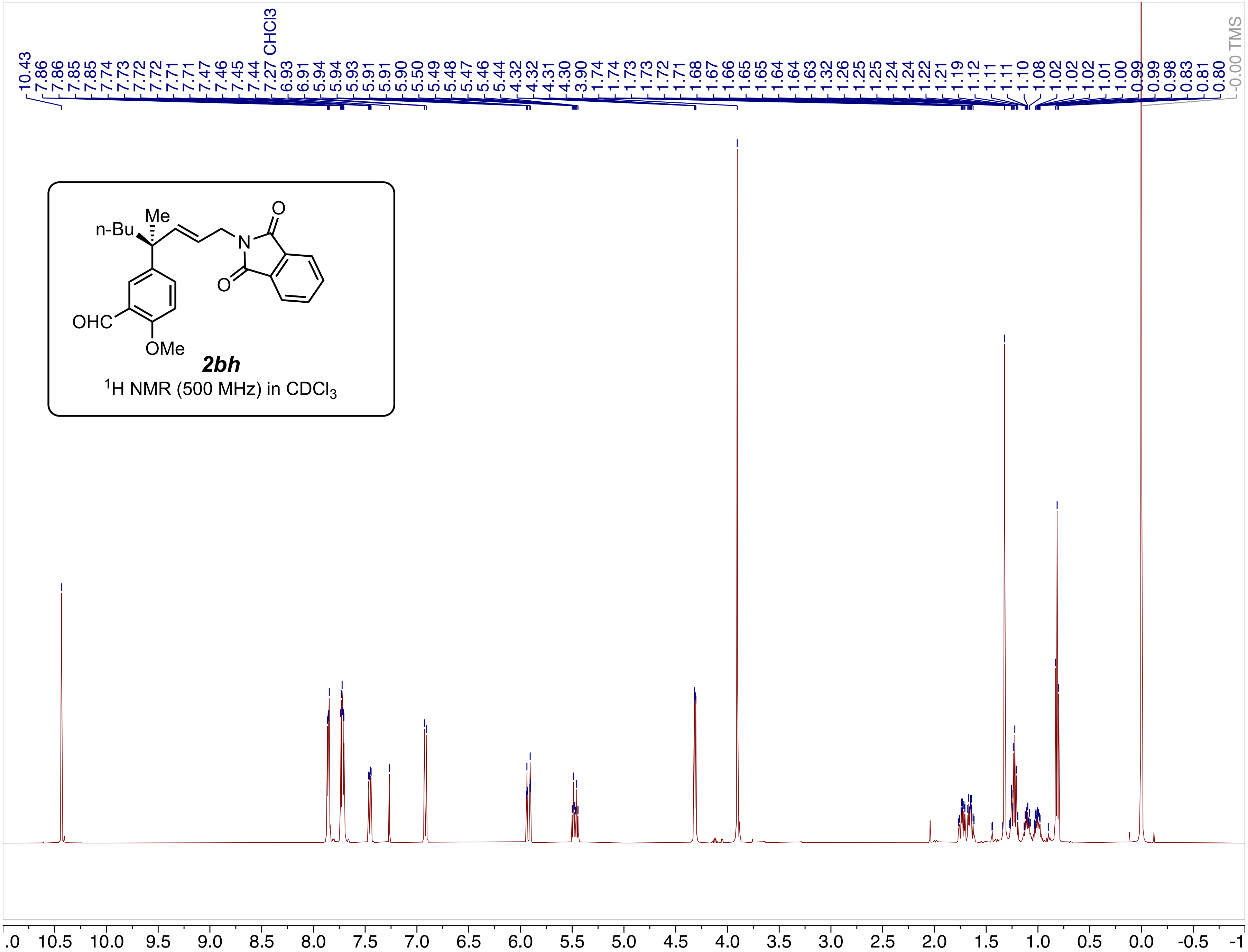
2bf

^{13}C NMR (125 MHz) in $CDCl_3$


7.85
7.84
7.84
7.83
7.73
7.72
7.71
7.71
7.26 CHCl3
6.47
5.96
5.95
5.95
5.93
5.92
5.92
5.56
5.55
5.54
5.53
5.52
5.51
4.36
4.36
4.35
4.35
4.34
4.34
3.83
3.82
1.72
1.71
1.70
1.69
1.68
1.67
1.66
1.65
1.65
1.64
1.63
1.62
1.61
1.30
1.27
1.26
1.24
1.23
1.13
1.13
1.12
1.12
1.11
1.11
1.10
1.10
1.08
0.86
0.84
0.83
0.00 TMS
n-Bu
Me
O
N
O
MeO
OMe
OMe
2bg
^{1}H NMR (500 MHz) in CDCl$_3$
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

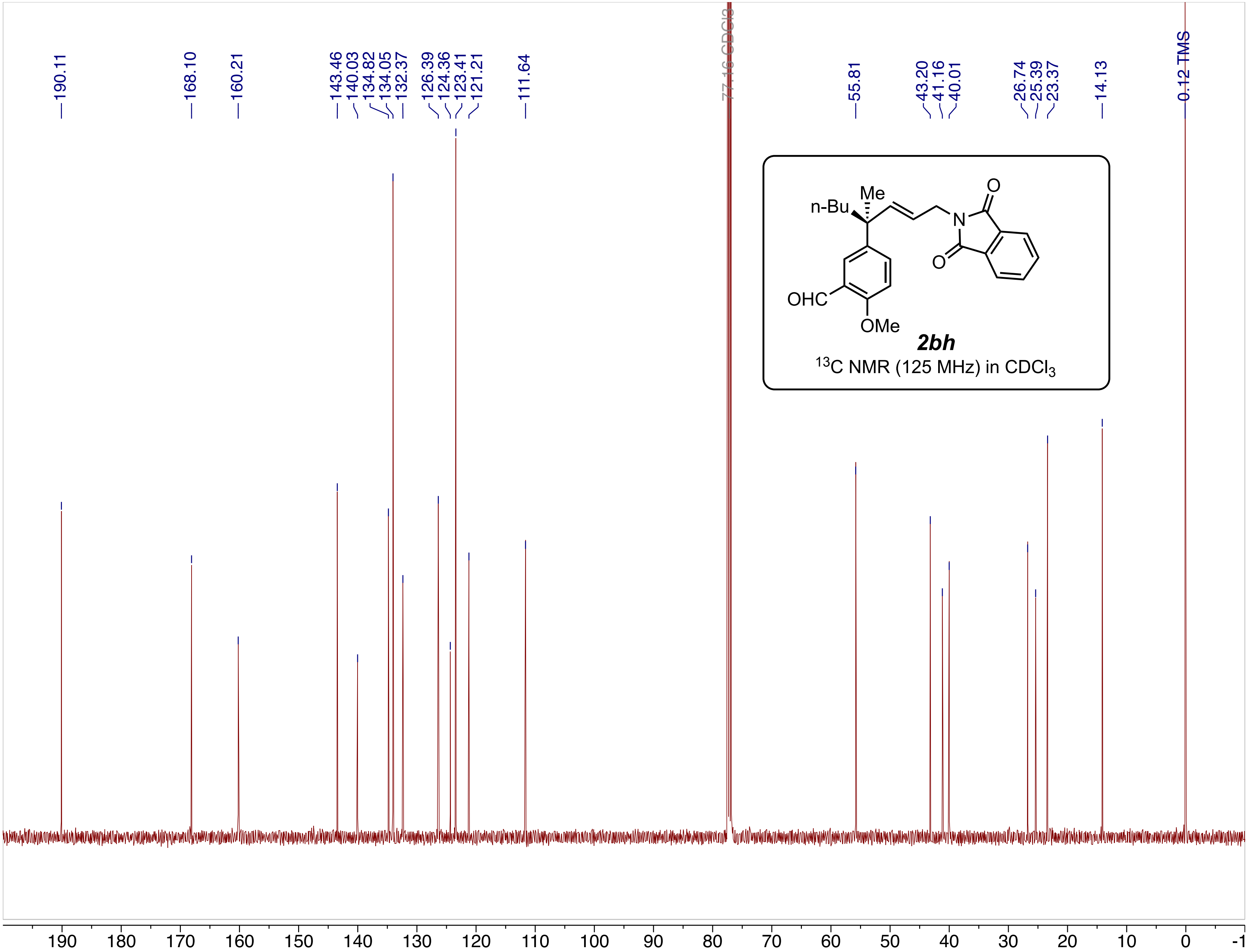


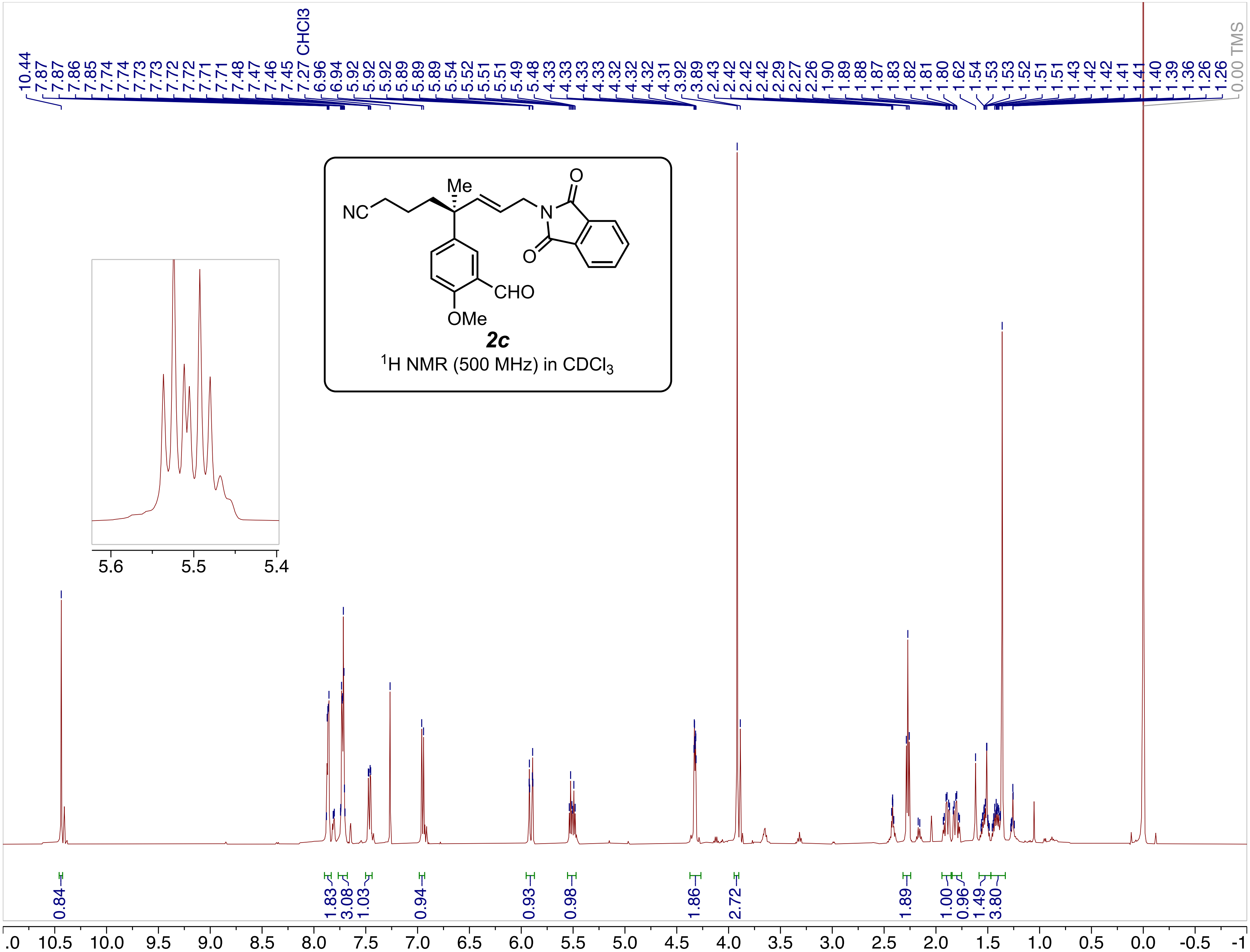
13. NMR Spectra

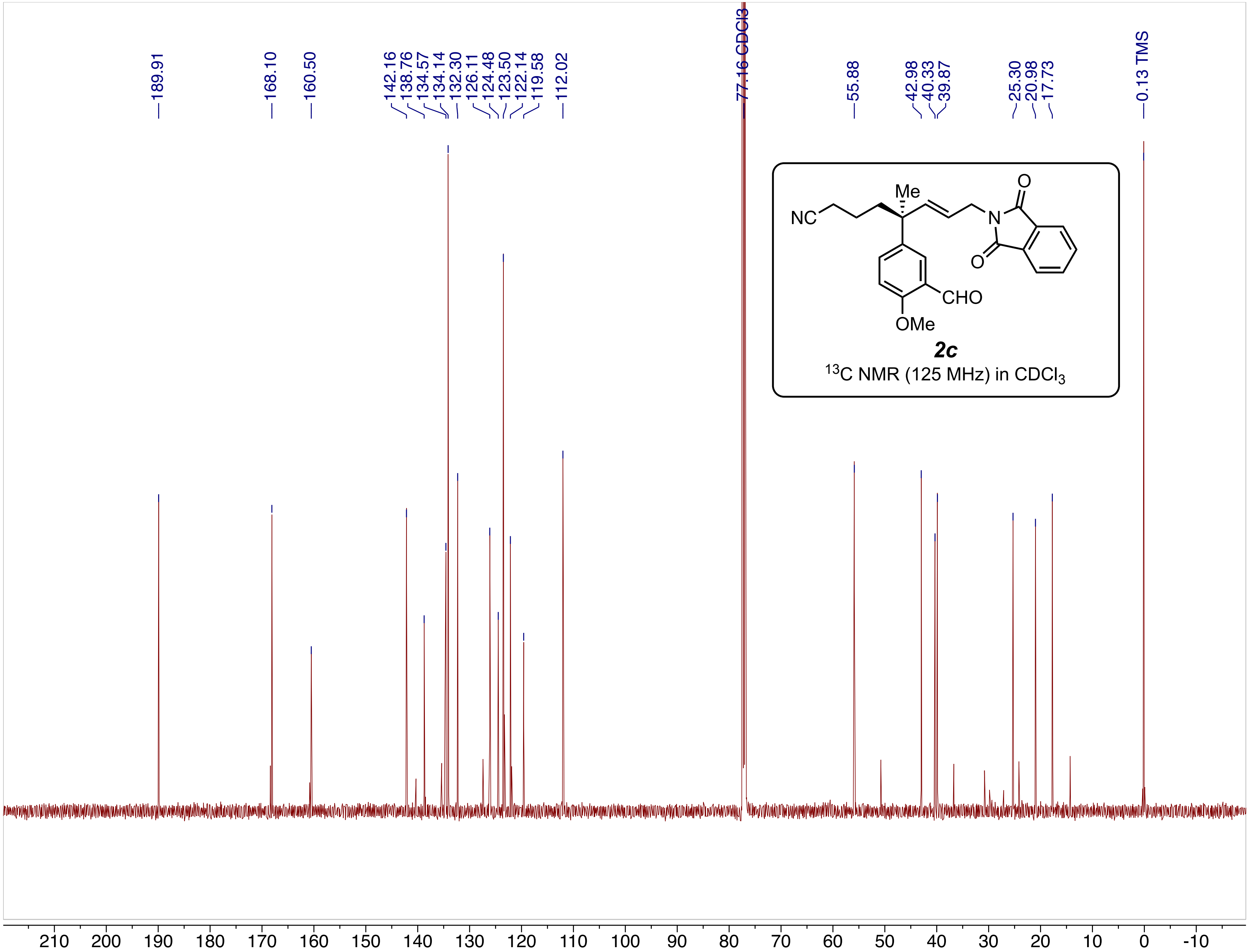


2bh

^{1}H NMR (500 MHz) in CDCl$_3$

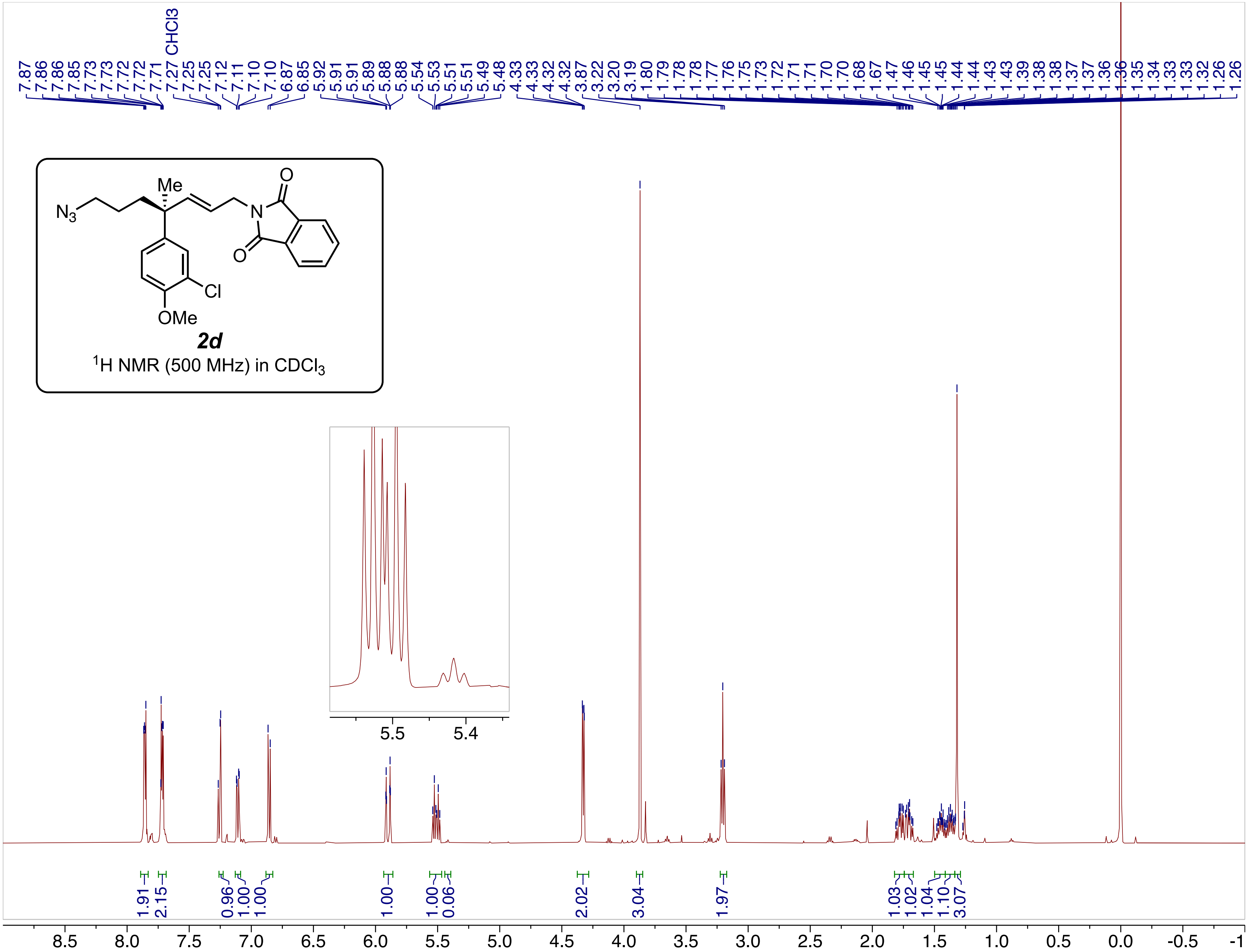

190.11
168.10
160.21
143.46
140.03
134.82
134.05
132.37
126.39
124.36
123.41
121.21
111.64
77.16 CDCl3
55.81
43.20
41.16
40.01
26.74
25.39
23.37
14.13
0.12 TMS
Me
n-Bu
N
O
O
OHC
OMe
2bh
13C NMR (125 MHz) in CDCl3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


10.44
7.87
7.87
7.86
7.85
7.74
7.74
7.73
7.73
7.72
7.72
7.71
7.71
7.48
7.47
7.46
7.45
7.27 CHCl3
6.96
6.94
5.92
5.92
5.92
5.89
5.89
5.89
5.54
5.52
5.51
5.51
5.49
5.48
4.33
4.33
4.33
4.33
4.32
4.32
4.32
4.31
3.92
3.89
2.43
2.42
2.42
2.42
2.29
2.27
2.26
1.90
1.89
1.88
1.87
1.83
1.82
1.81
1.80
1.62
1.54
1.53
1.53
1.52
1.51
1.51
1.43
1.42
1.42
1.41
1.41
1.40
1.39
1.36
1.26
1.26
0.00 TMS
Me
NC
N
O
O
CHO
OMe
2c
^{1}H NMR (500 MHz) in CDCl$_3$
5.6
5.5
5.4
0.84
1.83
3.08
1.03
0.94
0.93
0.98
1.86
2.72
1.89
1.00
0.96
1.49
3.80
.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



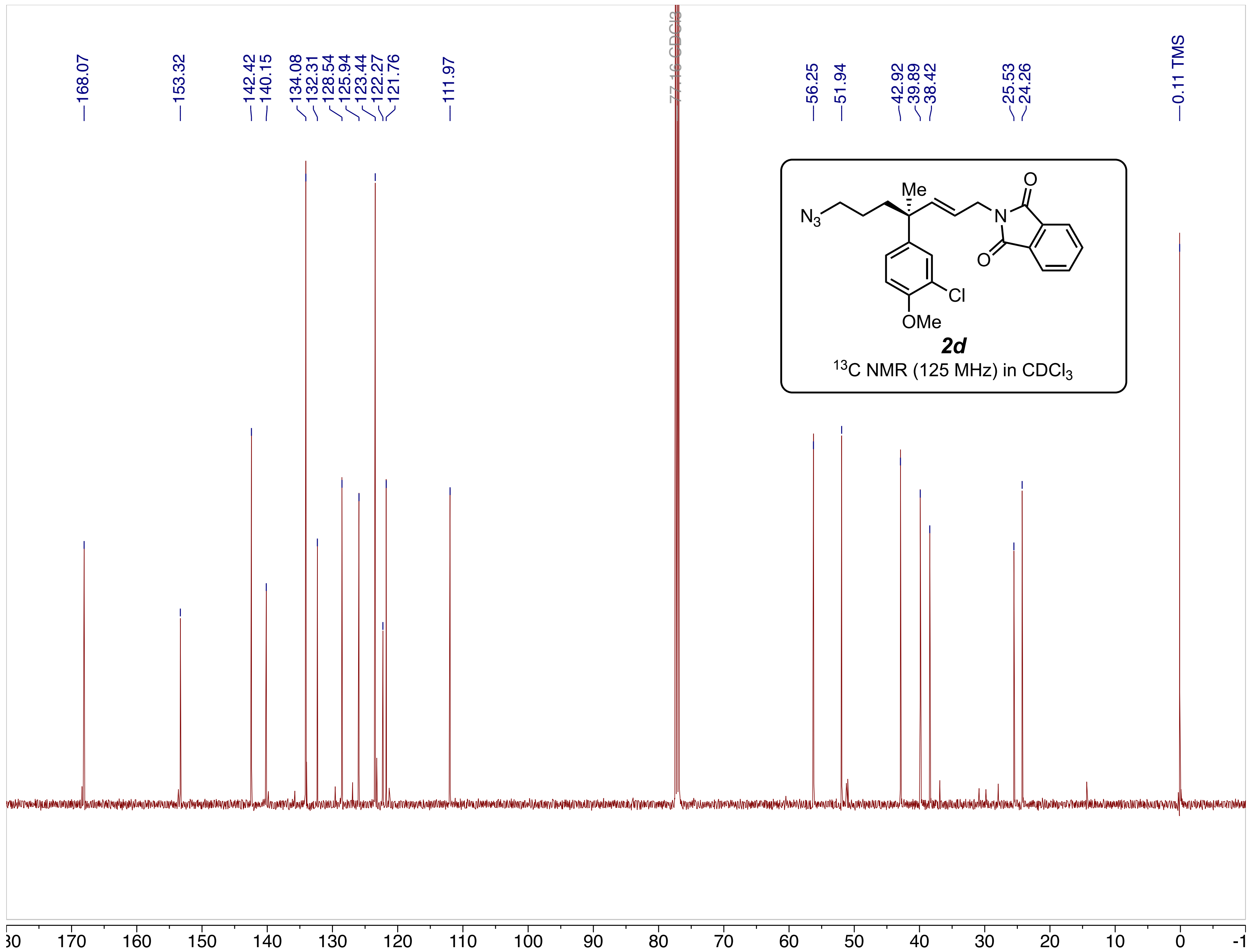
2c

^{13}C NMR (125 MHz) in CDCl$_3$

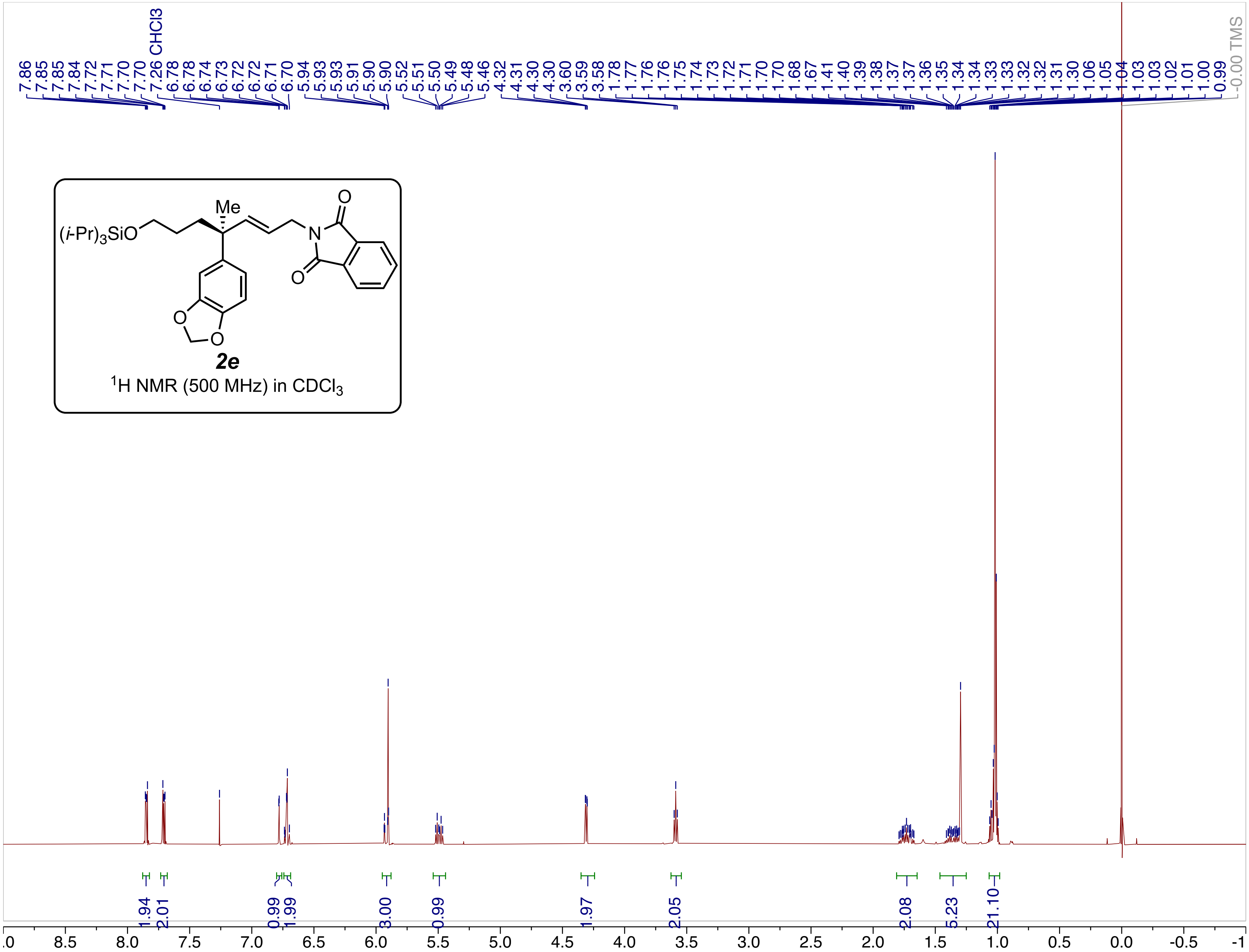


2d

^{1}H NMR (500 MHz) in CDCl$_3$

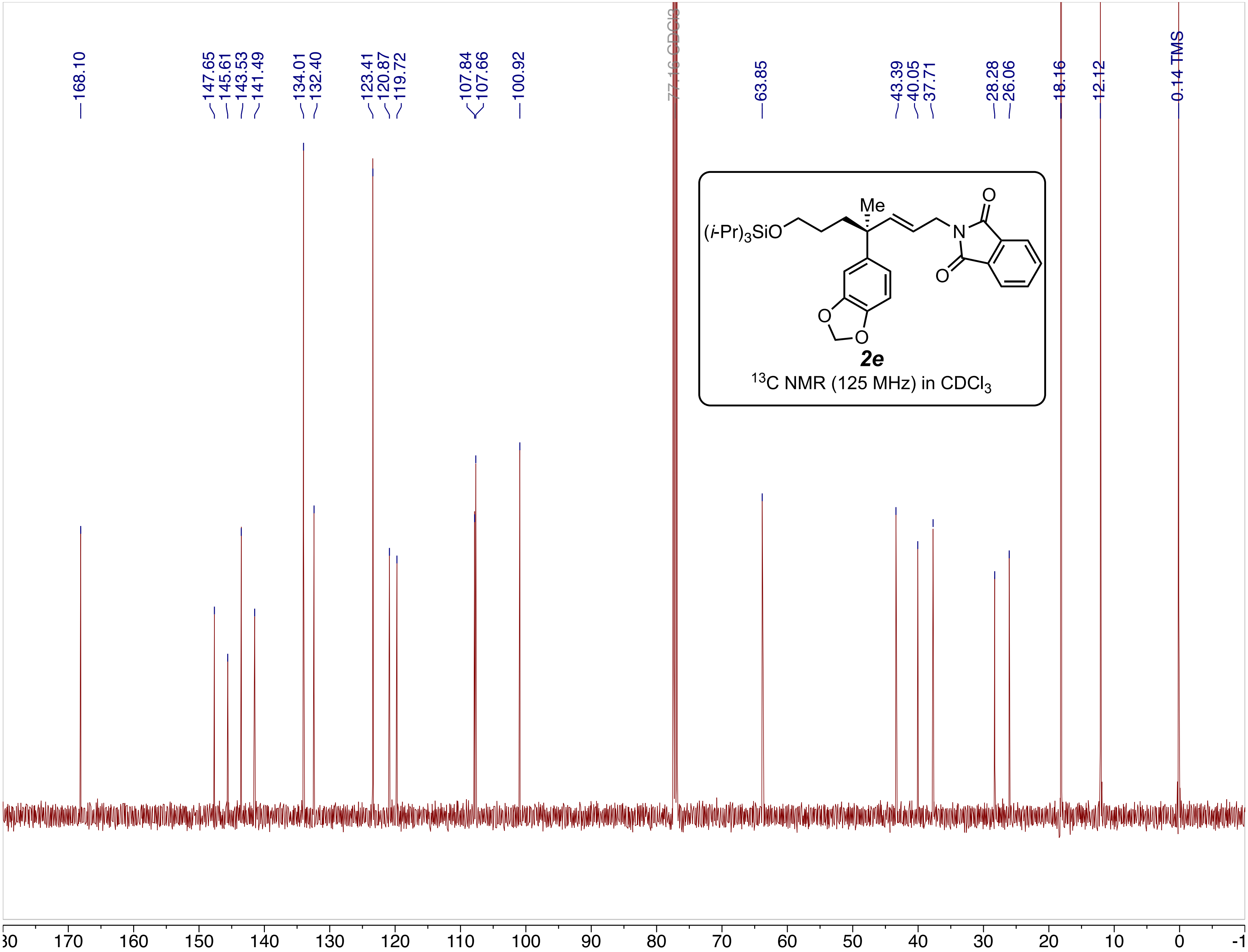


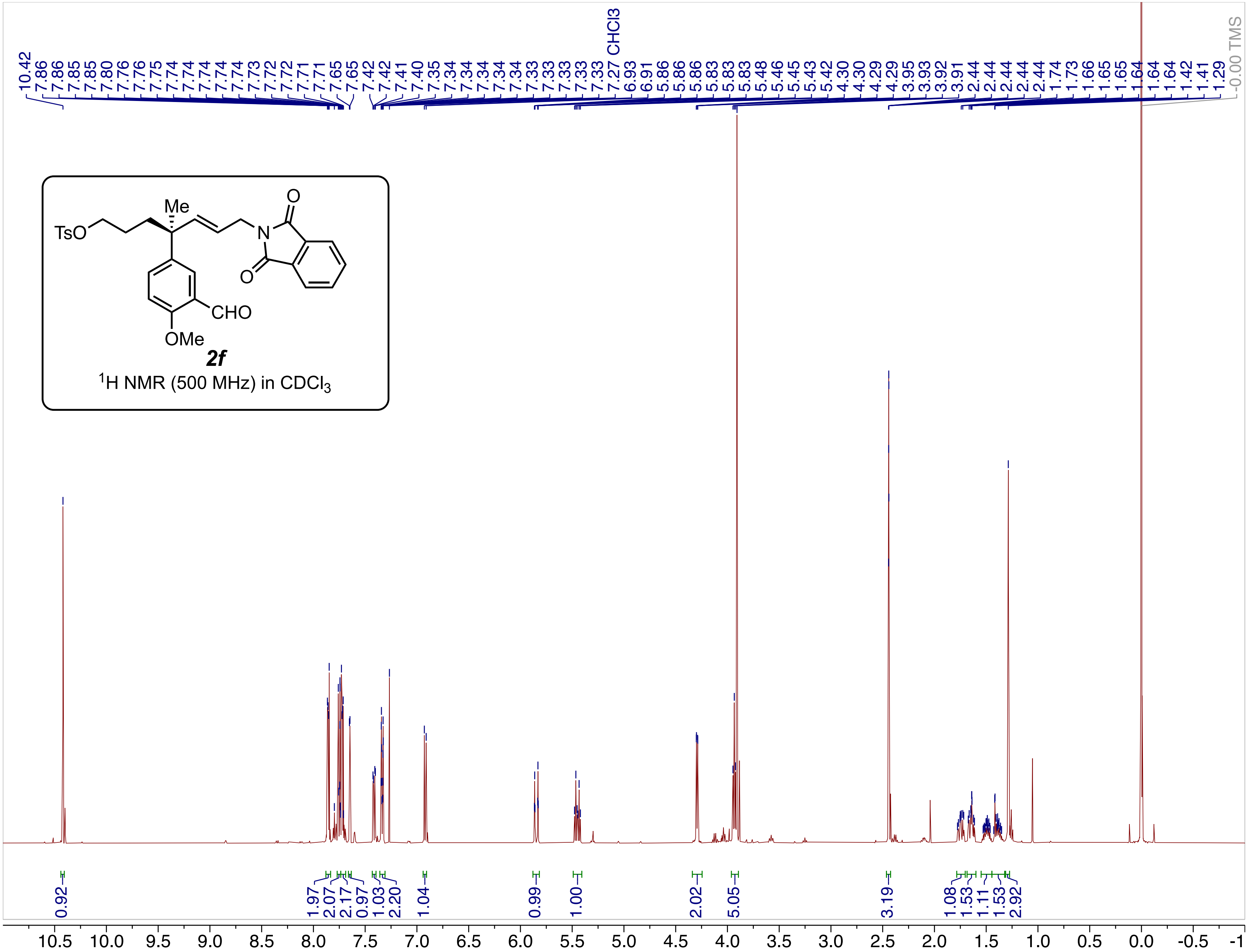
13. NMR Spectra



2e

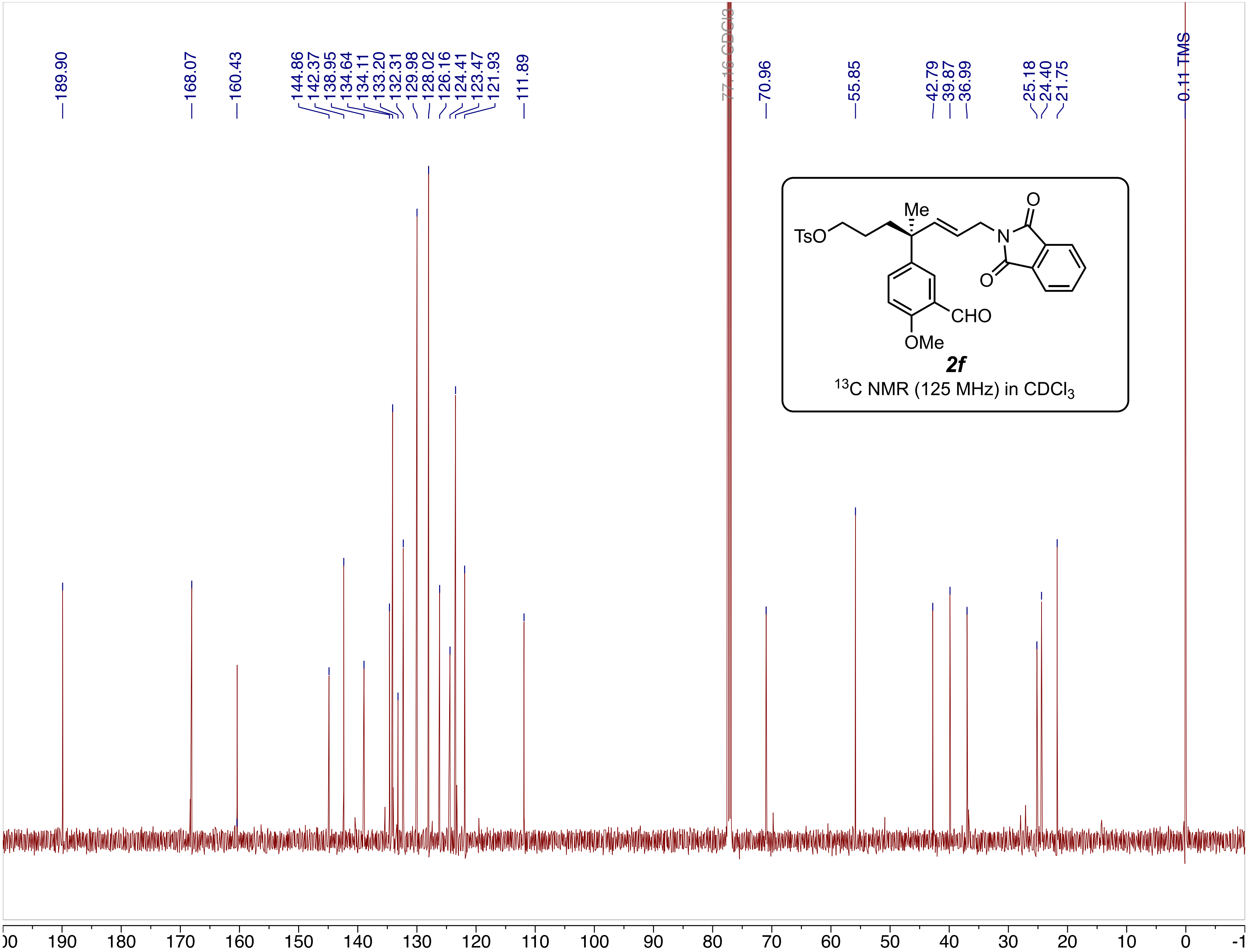
^{1}H NMR (500 MHz) in CDCl$_3$

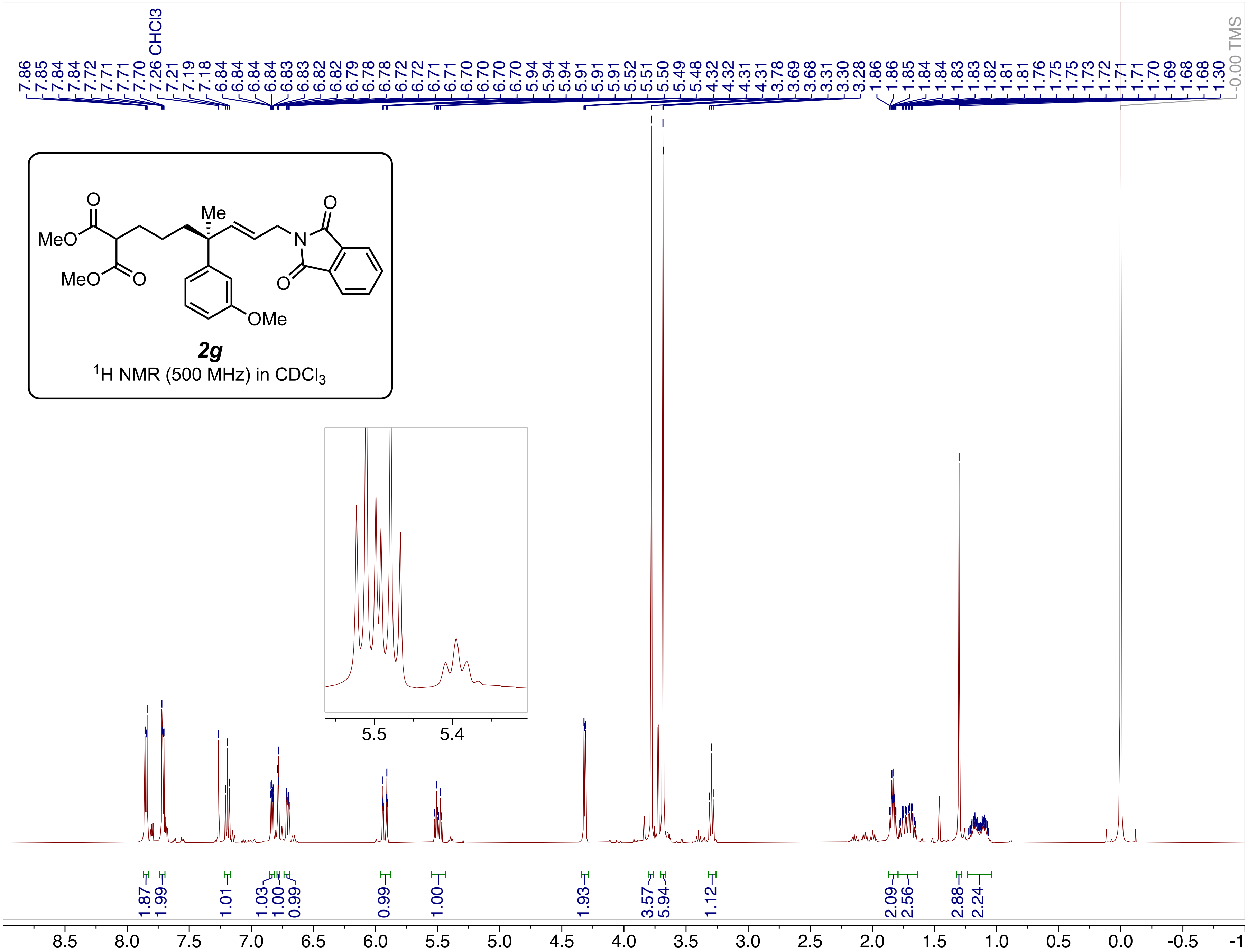

168.10
147.65
145.61
143.53
141.49
134.01
132.40
123.41
120.87
119.72
107.84
107.66
100.92
77.16 CDCl3
63.85
43.39
40.05
37.71
28.28
26.06
18.16
12.12
0.14 TMS
Me
O
(i-Pr)3SiO
N
O
O
O
2e
13C NMR (125 MHz) in CDCl3
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

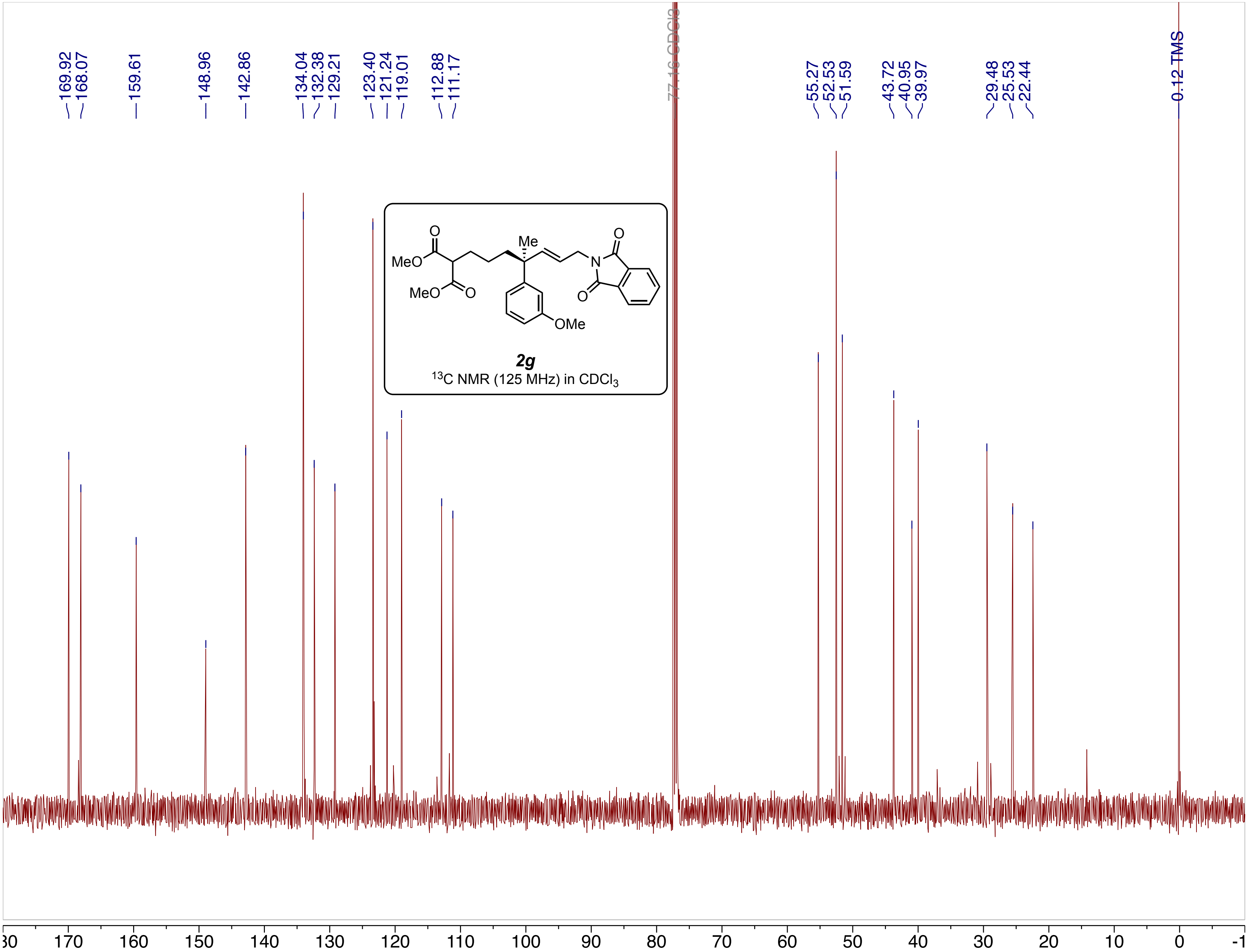


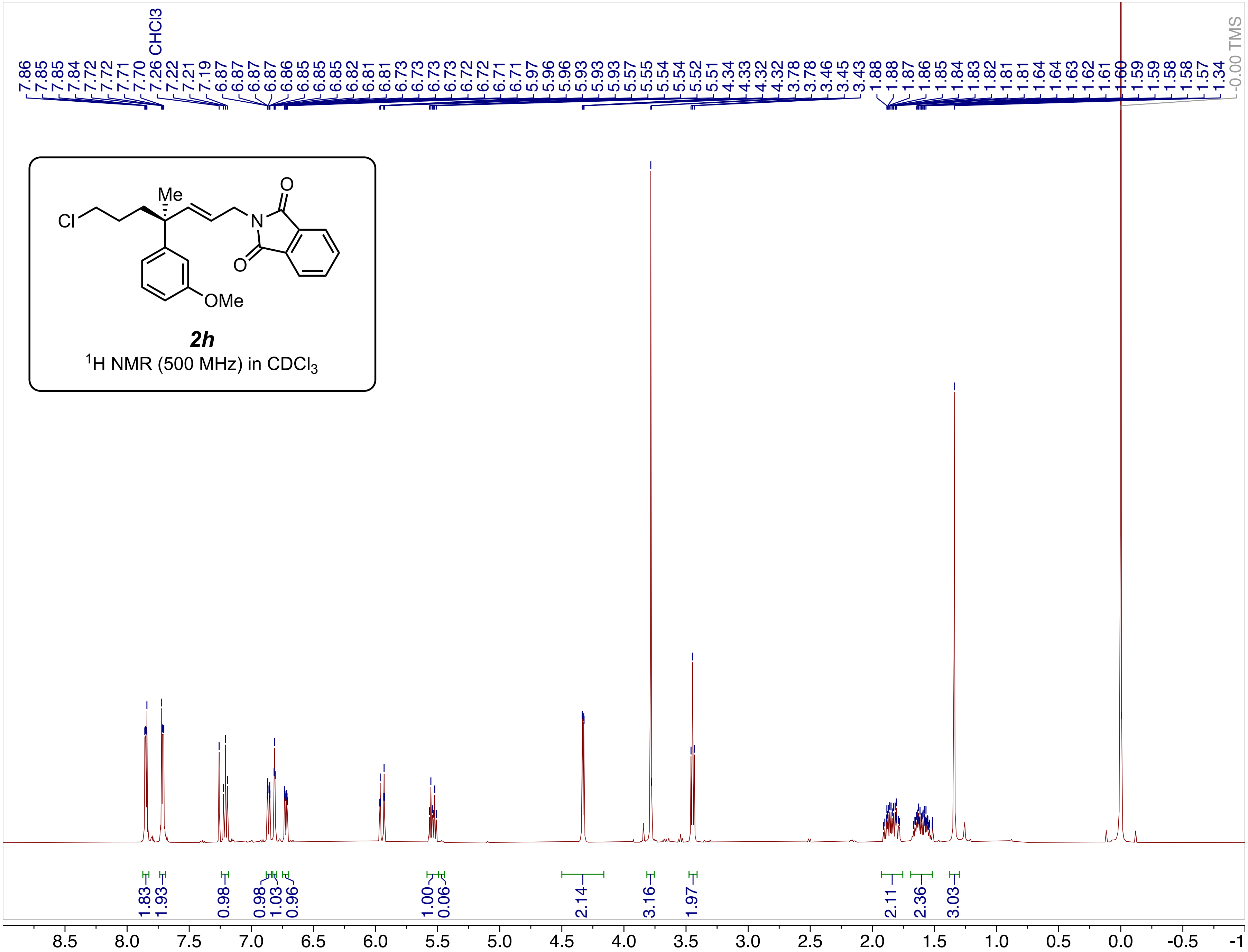
2f

^{1}H NMR (500 MHz) in CDCl$_3$


189.90
168.07
160.43
144.86
142.37
138.95
134.64
134.11
133.20
132.31
129.98
128.02
126.16
124.41
123.47
121.93
111.89
77.16 CDCl3
70.96
55.85
42.79
39.87
36.99
25.18
24.40
21.75
0.11 TMS
Me
TsO
N
O
O
CHO
OMe
2f
^{13}C NMR (125 MHz) in CDCl$_3$
00
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

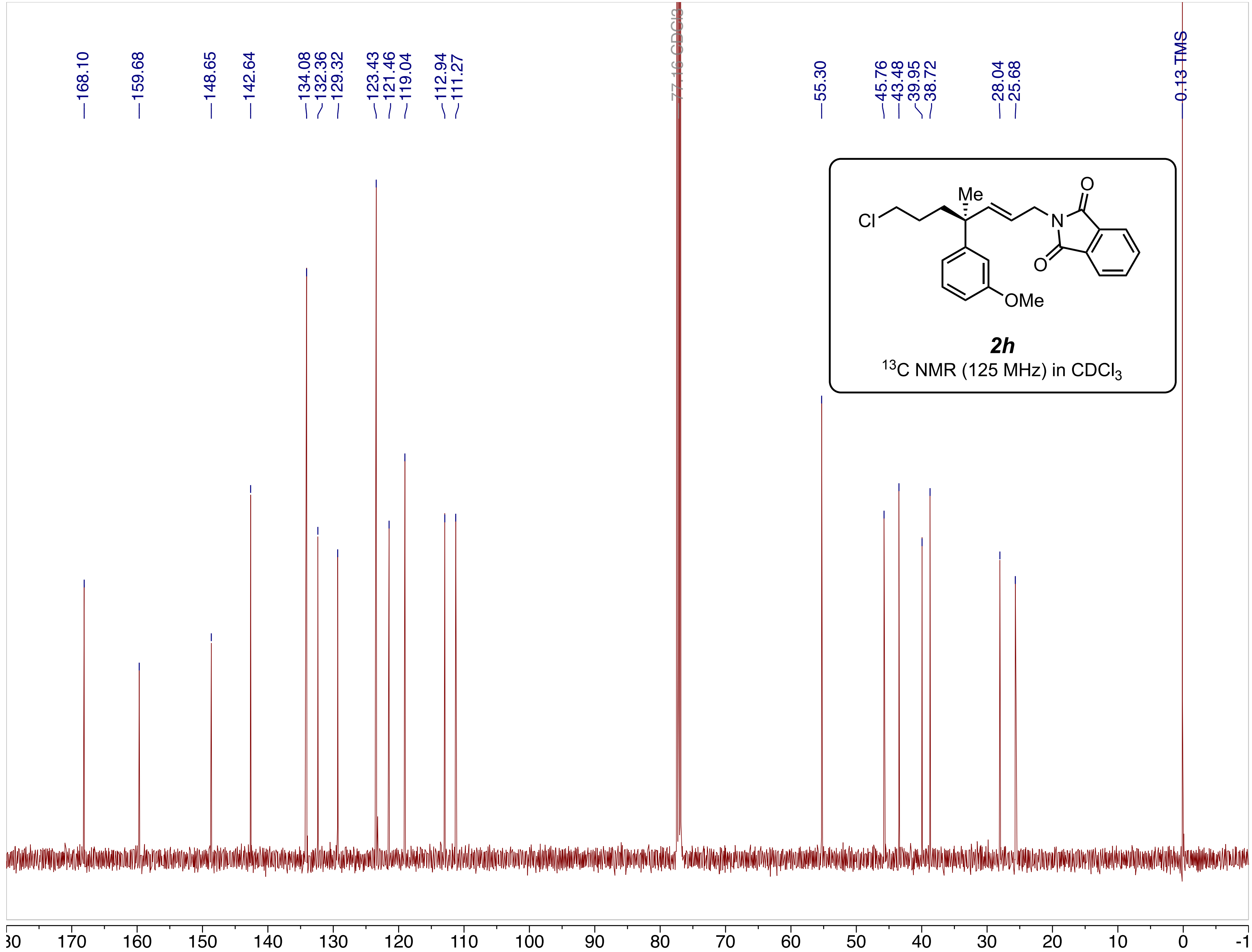

7.86
7.85
7.84
7.84
7.72
7.71
7.71
7.70
7.26 CHCl3
7.21
7.19
7.18
6.84
6.84
6.84
6.84
6.83
6.83
6.82
6.82
6.79
6.78
6.78
6.72
6.72
6.71
6.71
6.70
6.70
6.70
6.70
5.94
5.94
5.94
5.91
5.91
5.91
5.52
5.51
5.50
5.49
5.48
4.32
4.32
4.31
4.31
3.78
3.69
3.68
3.31
3.30
3.28
1.86
1.86
1.85
1.84
1.84
1.83
1.83
1.82
1.81
1.81
1.76
1.75
1.75
1.73
1.72
1.71
1.71
1.70
1.69
1.68
1.68
1.30
-0.00 TMS
MeO
O
MeO
O
Me
N
O
O
OMe
2g
^{1}H NMR (500 MHz) in CDCl$_3$
5.5
5.4
1.87
1.99
1.01
1.03
1.00
0.99
0.99
1.00
1.93
3.57
5.94
1.12
2.09
2.56
2.88
2.24
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


169.92
168.07
159.61
148.96
142.86
134.04
132.38
129.21
123.40
121.24
119.01
112.88
111.17
77.16 CDCl3
55.27
52.53
51.59
43.72
40.95
39.97
29.48
25.53
22.44
0.12 TMS
Me
O
MeO
MeO
O
O
N
O
OMe
2g
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



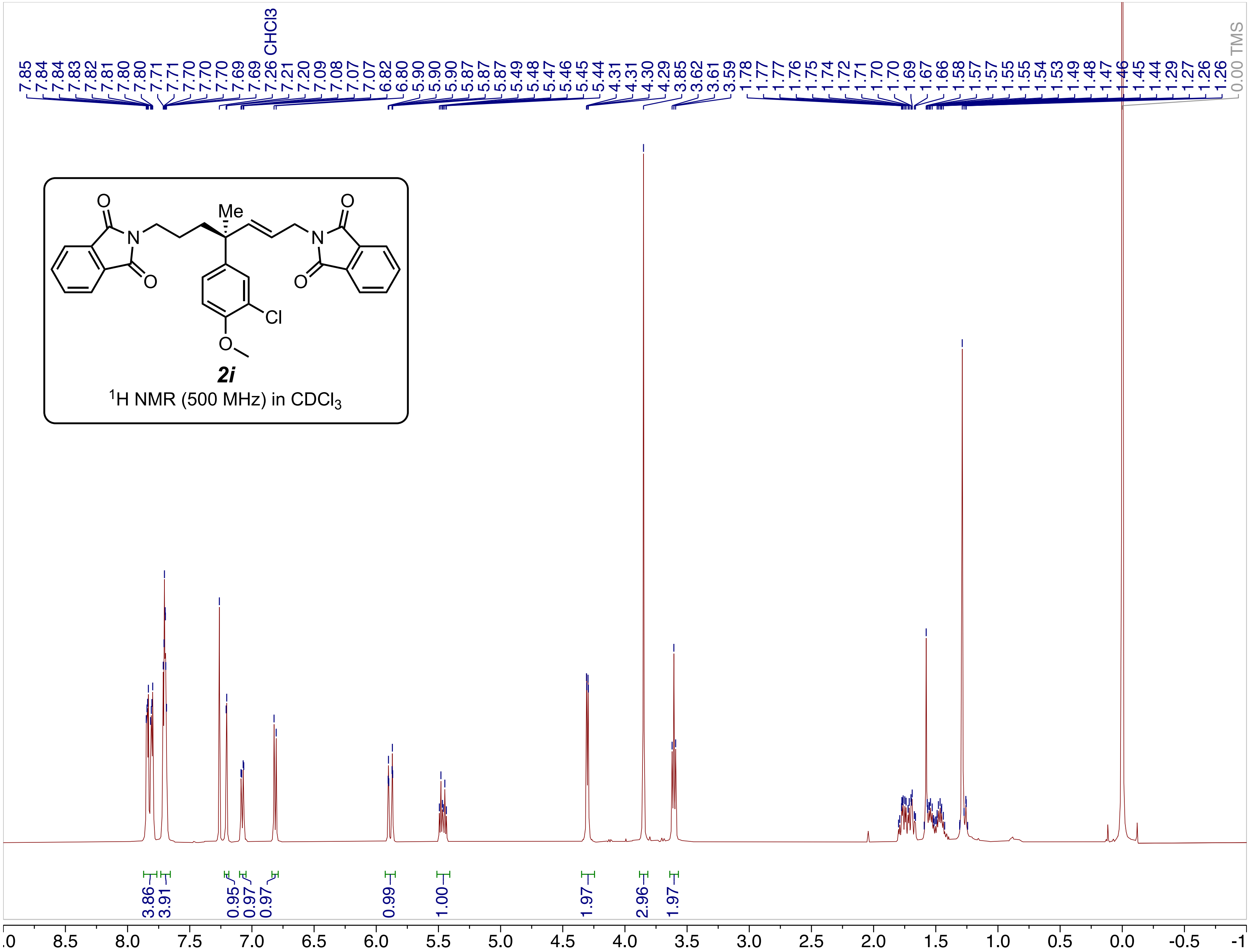
2h

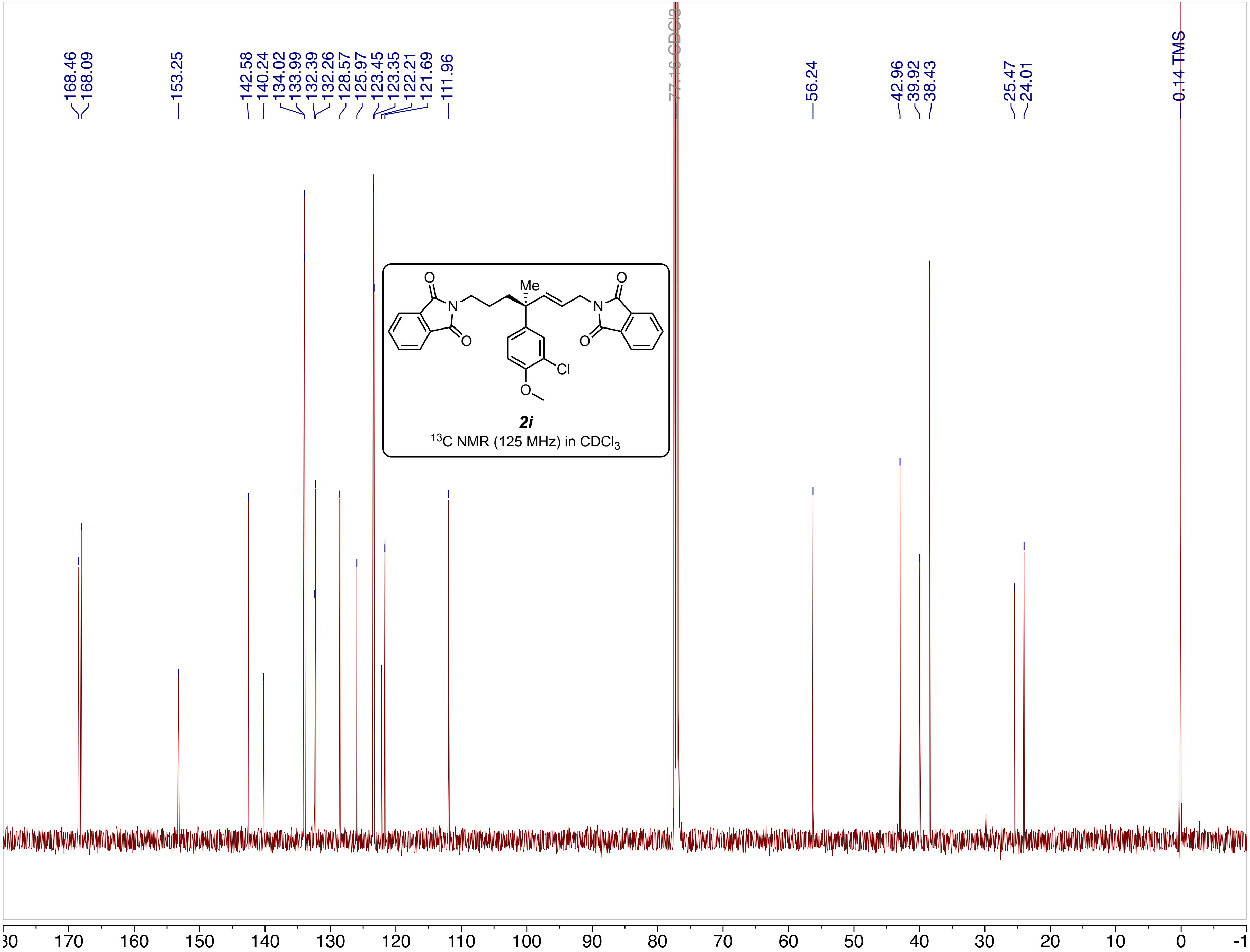
^{1}H NMR (500 MHz) in $CDCl_3$



2h

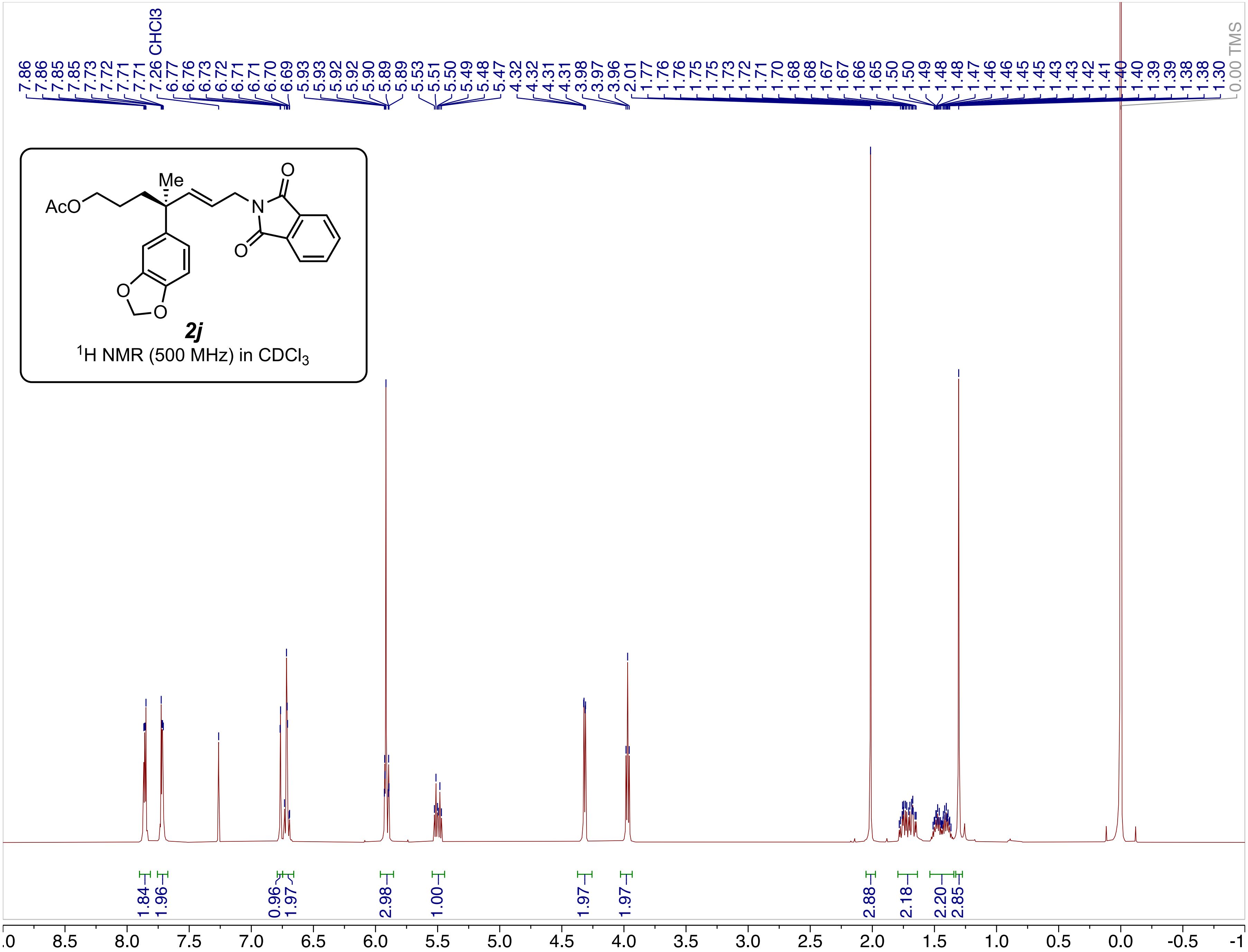
^{13}C NMR (125 MHz) in CDCl$_3$


7.85
7.84
7.84
7.83
7.82
7.81
7.80
7.80
7.71
7.71
7.70
7.70
7.70
7.69
7.69
7.26 CHCl3
7.21
7.20
7.09
7.08
7.07
7.07
6.82
6.80
5.90
5.90
5.90
5.87
5.87
5.87
5.49
5.48
5.47
5.46
5.45
5.44
4.31
4.31
4.30
4.29
3.85
3.62
3.61
3.59
1.78
1.77
1.77
1.76
1.75
1.74
1.72
1.71
1.70
1.70
1.69
1.67
1.66
1.58
1.57
1.57
1.55
1.55
1.54
1.53
1.49
1.48
1.47
1.46
1.45
1.44
1.29
1.27
1.26
1.26
0.00 TMS
O
O
N
Me
O
O
N
Cl
O
_2i_
^{1}H NMR (500 MHz) in CDCl$_3$
3.86
3.91
0.95
0.97
0.97
0.99
1.00
1.97
2.96
1.97
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



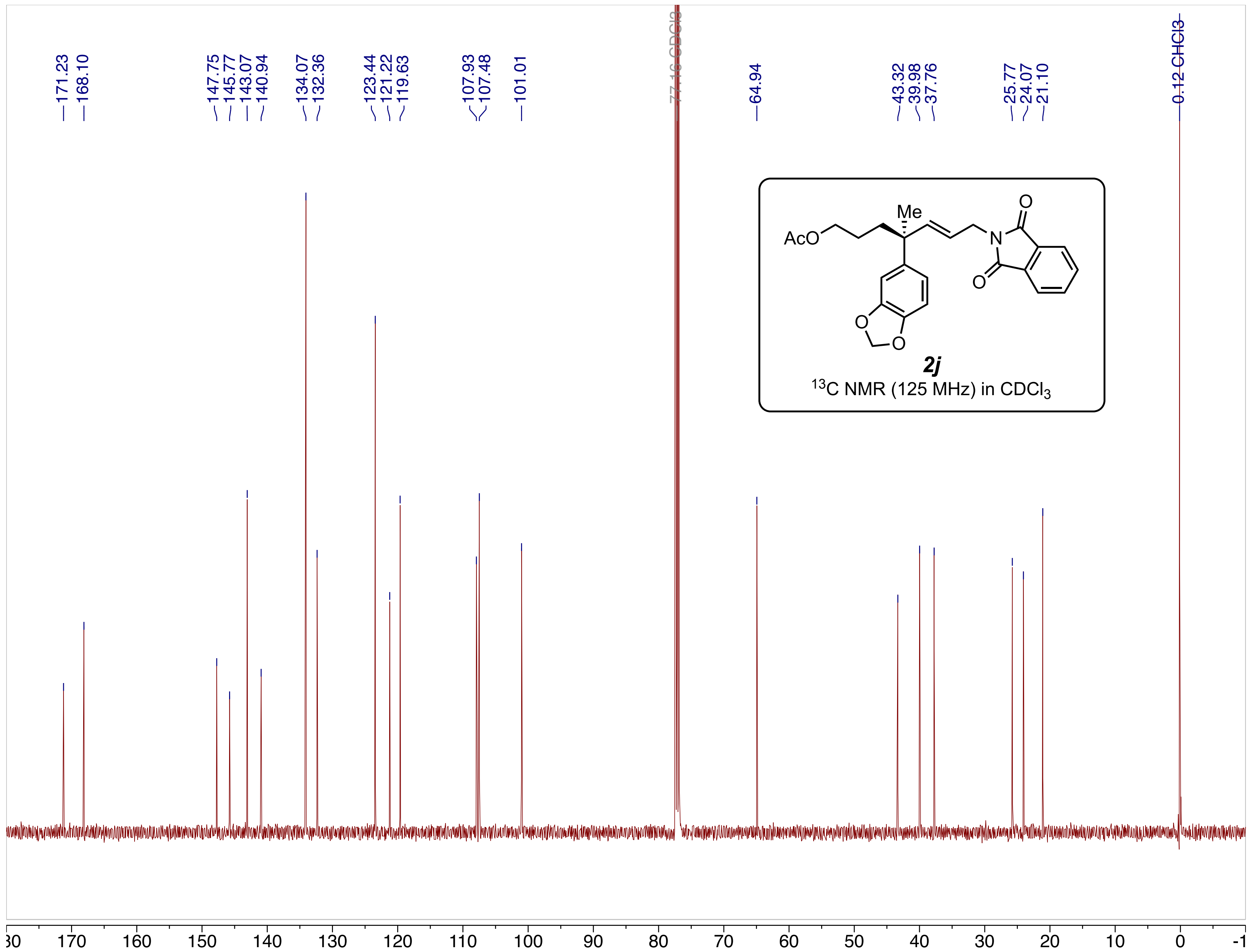
2i

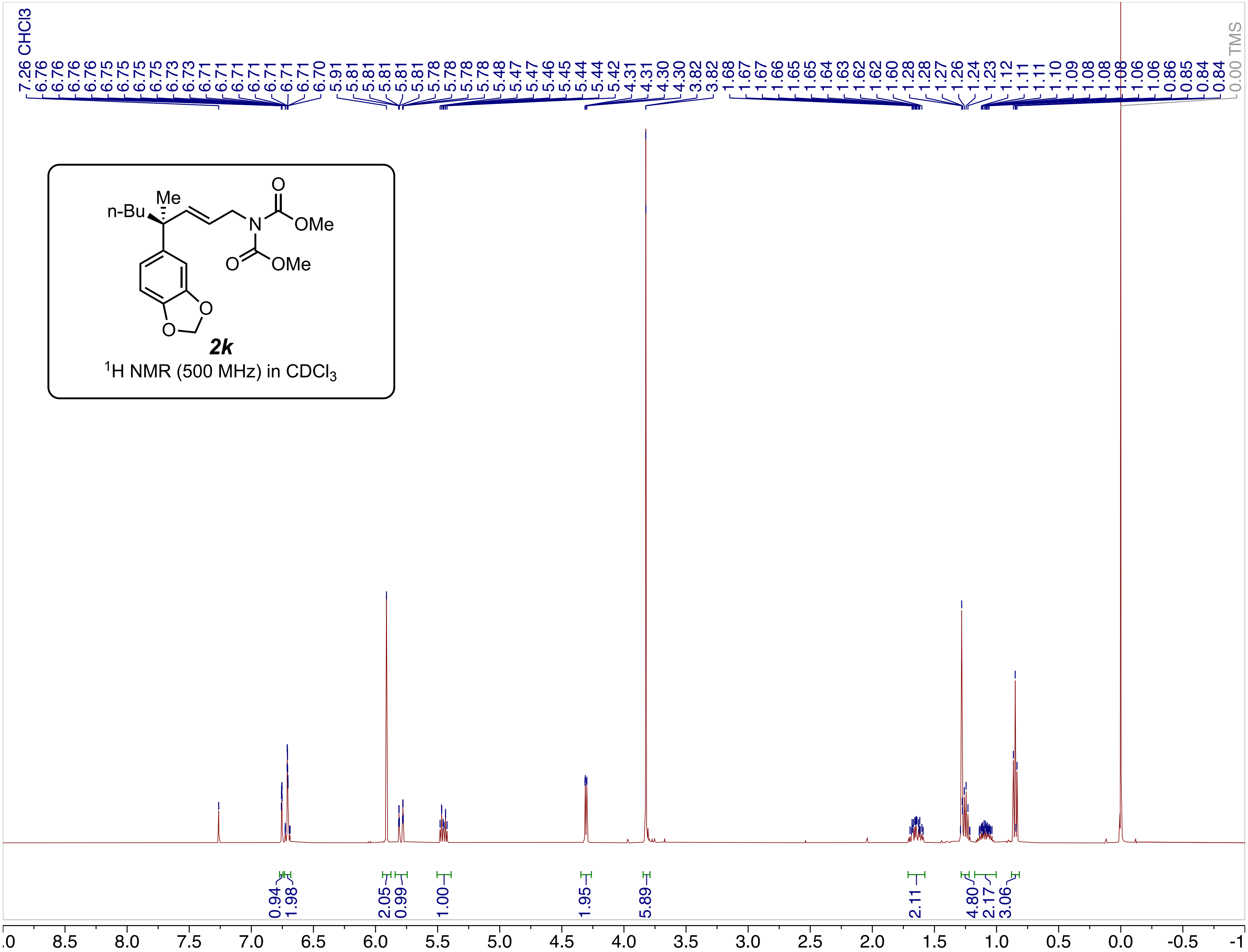
^{13}C NMR (125 MHz) in CDCl$_3$

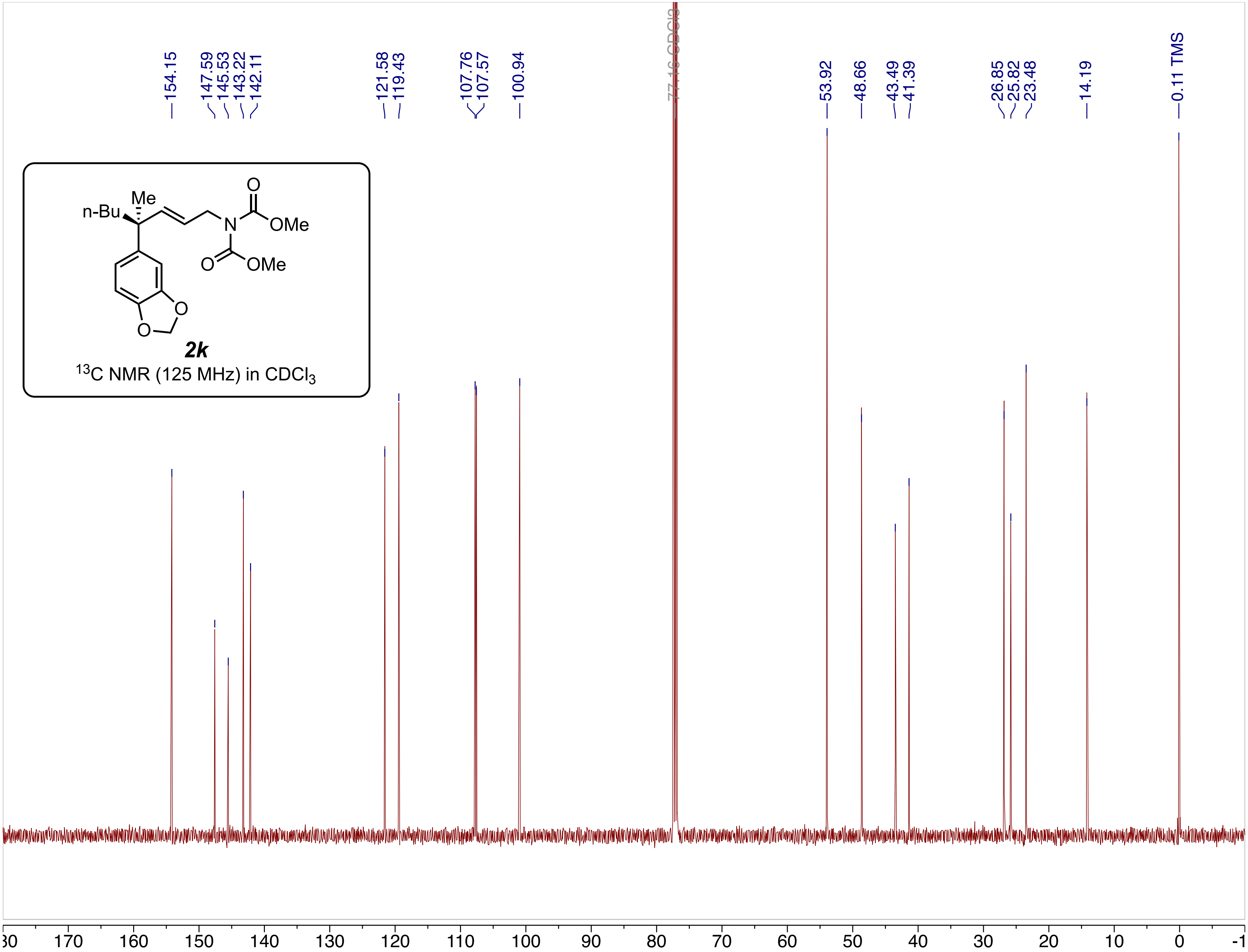


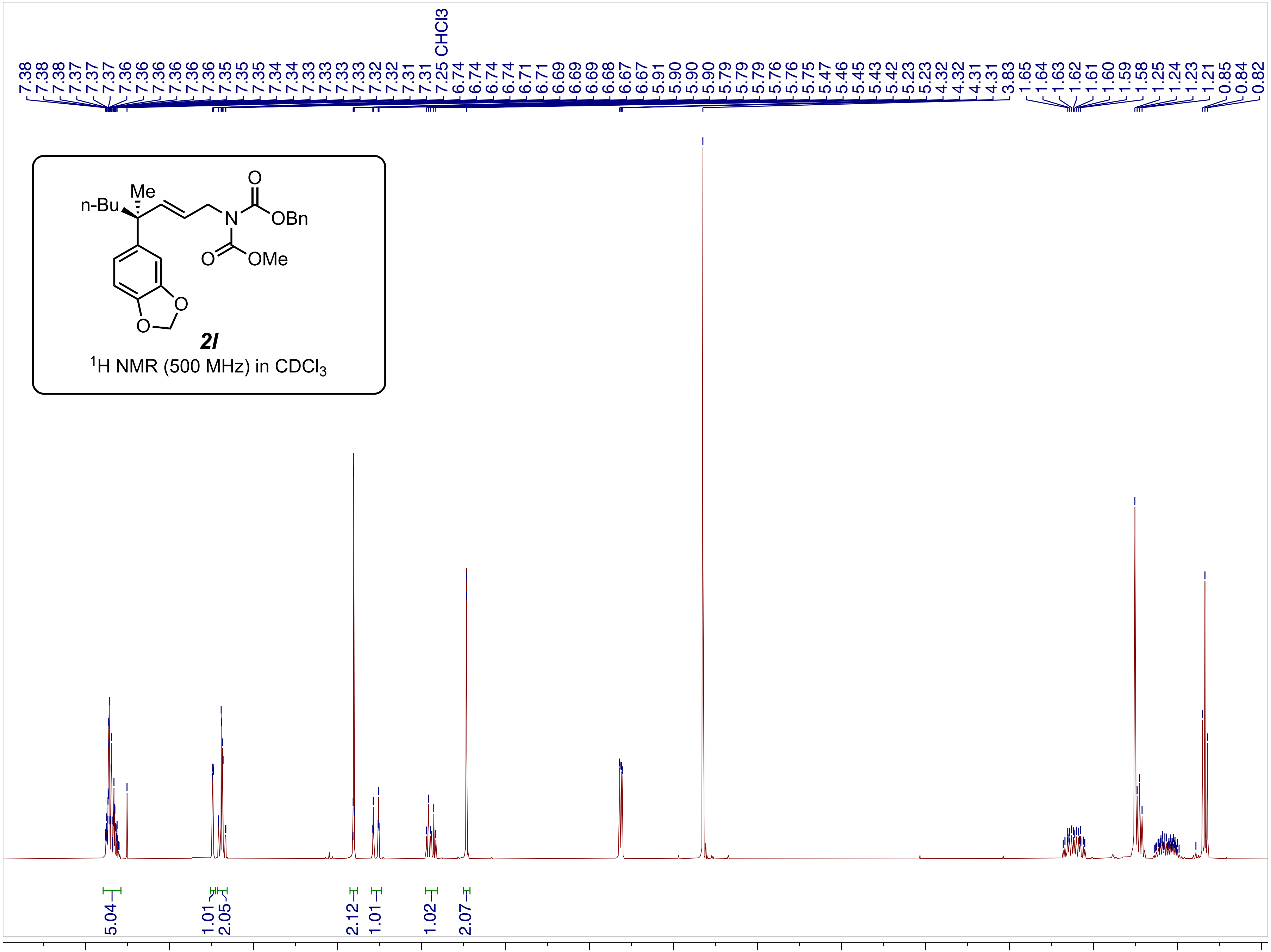
2j

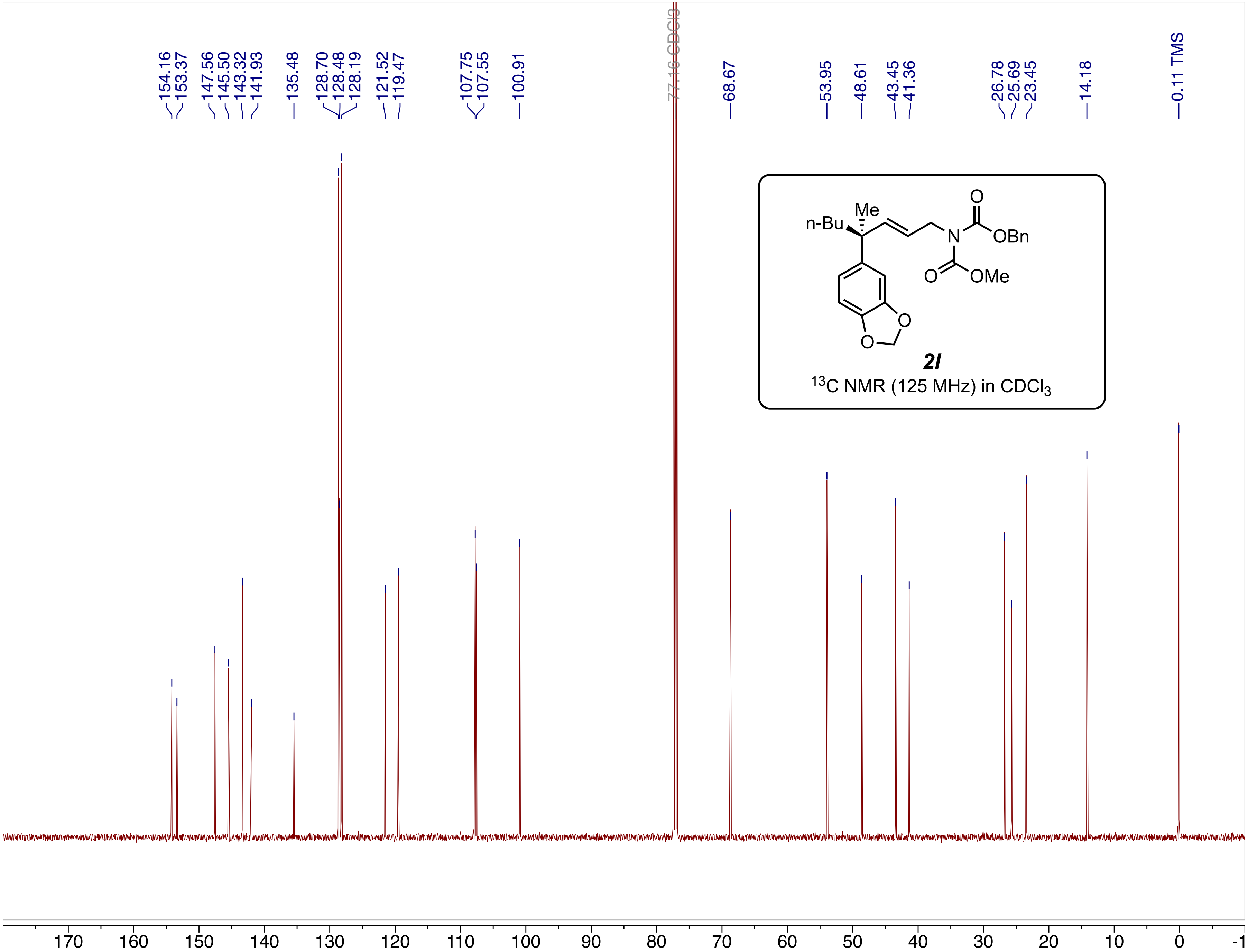
^{1}H NMR (500 MHz) in CDCl$_3$


171.23
168.10
147.75
145.77
143.07
140.94
134.07
132.36
123.44
121.22
119.63
107.93
107.48
101.01
77.16 CDCl3
64.94
43.32
39.98
37.76
25.77
24.07
21.10
0.12 CHCl3
Me
O
AcO
N
O
O
O
2j
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.26 CHCl3
6.76
6.76
6.76
6.75
6.75
6.75
6.73
6.73
6.71
6.71
6.71
6.71
6.71
6.71
6.70
5.91
5.81
5.81
5.81
5.81
5.78
5.78
5.78
5.48
5.47
5.47
5.46
5.45
5.44
5.44
5.42
4.31
4.31
4.30
3.82
3.82
1.68
1.67
1.67
1.66
1.65
1.65
1.64
1.63
1.62
1.62
1.60
1.28
1.28
1.27
1.26
1.24
1.23
1.12
1.11
1.11
1.10
1.09
1.08
1.08
1.08
1.06
1.06
0.86
0.85
0.84
0.84
0.00 TMS
n-Bu
Me
O
N
OMe
O
OMe
O
O
2k
^{1}H NMR (500 MHz) in CDCl$_3$
0.94
1.98
2.05
0.99
1.00
1.95
5.89
2.11
4.80
2.17
3.06
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

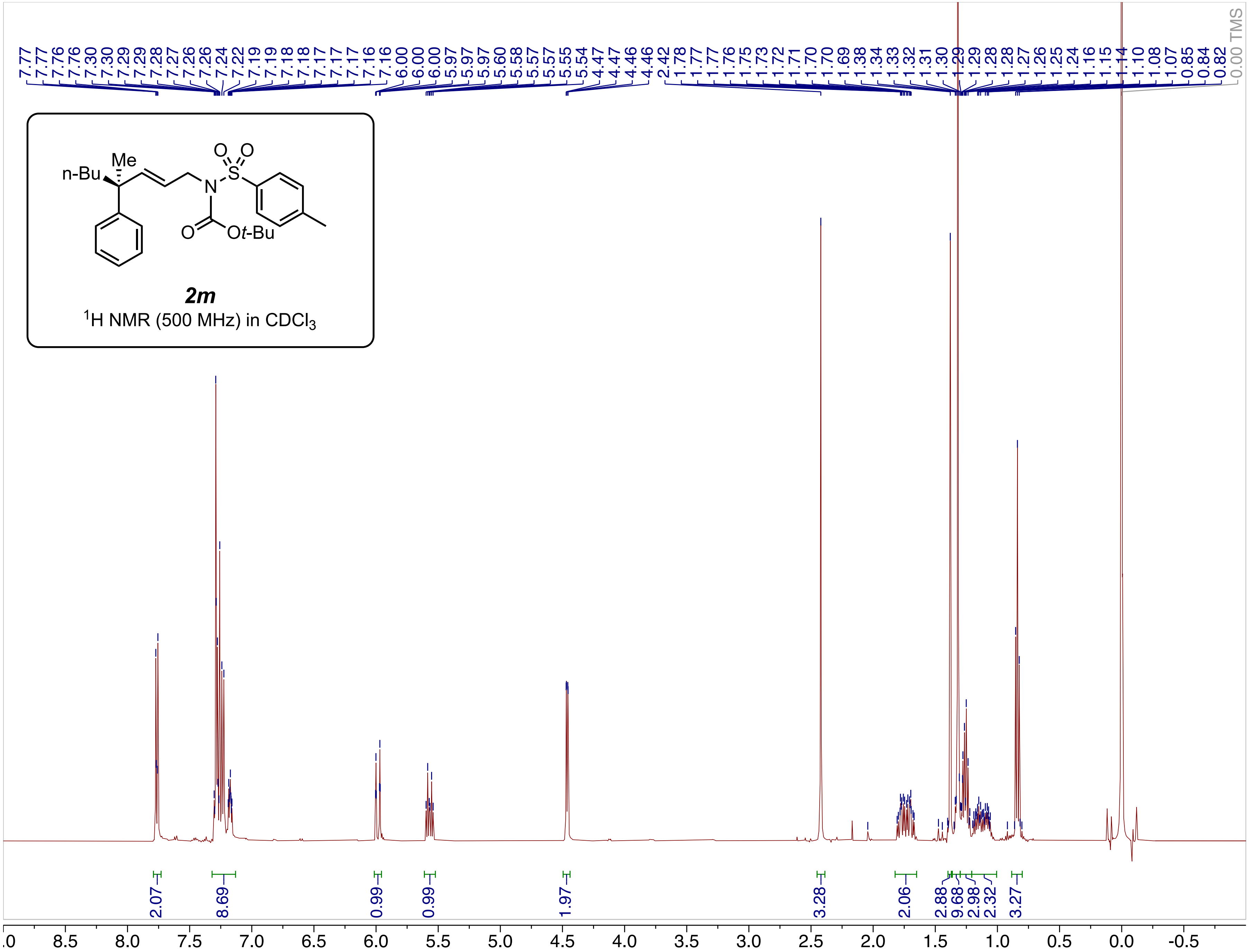

154.15
147.59
145.53
143.22
142.11
121.58
119.43
107.76
107.57
100.94
77.16 CDCl3
53.92
48.66
43.49
41.39
26.85
25.82
23.48
14.19
0.11 TMS
n-Bu
Me
O
N
OMe
O
OMe
O
O
2k
13C NMR (125 MHz) in CDCl3
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


7.38
7.38
7.38
7.37
7.37
7.37
7.36
7.36
7.36
7.36
7.36
7.36
7.35
7.35
7.35
7.34
7.34
7.33
7.33
7.33
7.33
7.33
7.32
7.32
7.31
7.31
7.25 CHCl3
6.74
6.74
6.74
6.74
6.71
6.71
6.69
6.69
6.69
6.68
6.67
6.67
5.91
5.90
5.90
5.90
5.79
5.79
5.79
5.76
5.76
5.75
5.47
5.46
5.45
5.43
5.42
5.23
5.23
4.32
4.32
4.31
4.31
3.83
1.65
1.64
1.63
1.62
1.61
1.60
1.59
1.58
1.25
1.24
1.23
1.21
0.85
0.84
0.82
Me
n-Bu
O
N
OBn
O
OMe
O
O
2l
^{1}H NMR (500 MHz) in CDCl$_3$
5.04
1.01
2.05
2.12
1.01
1.02
2.07
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



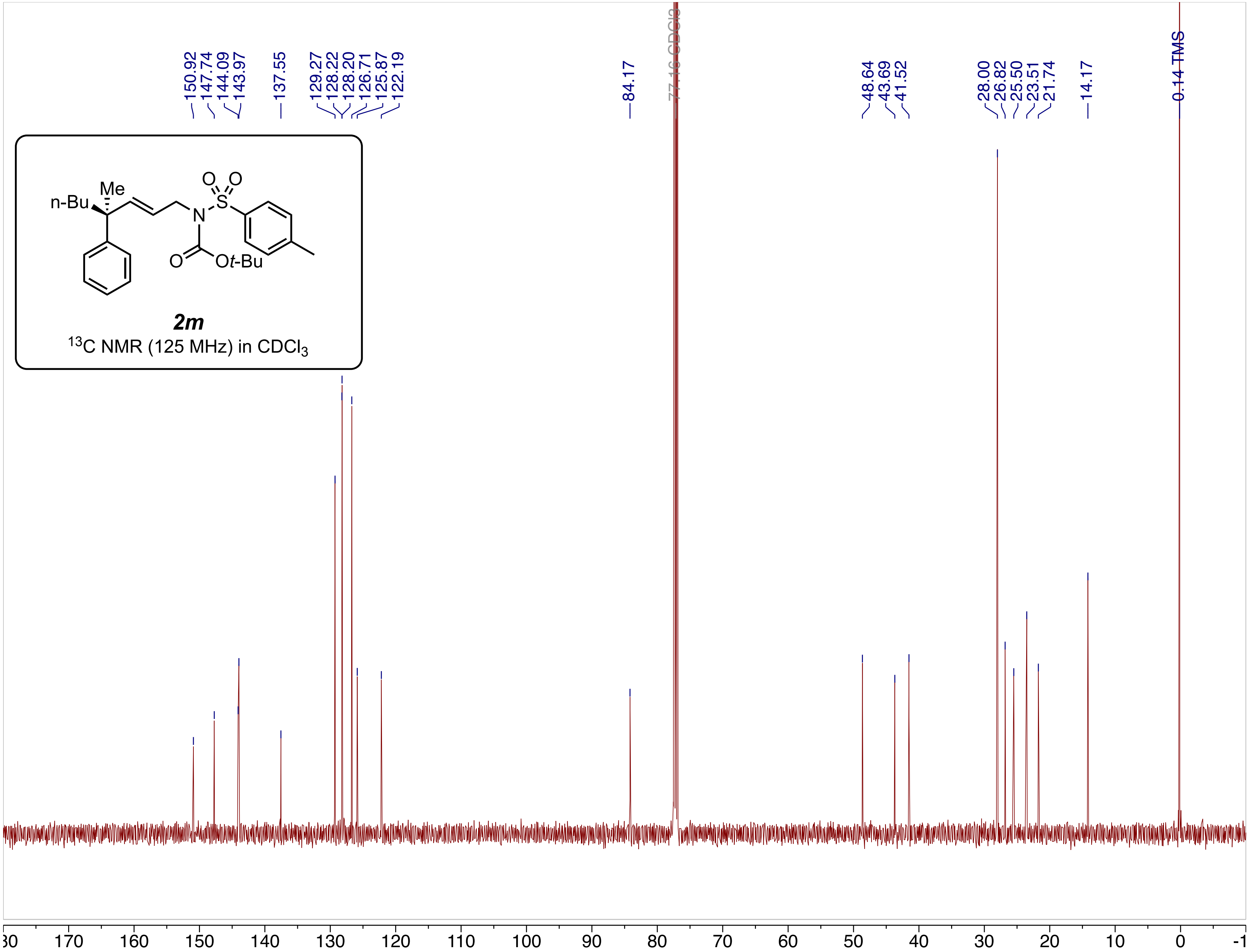
2l

^{13}C NMR (125 MHz) in CDCl$_3$



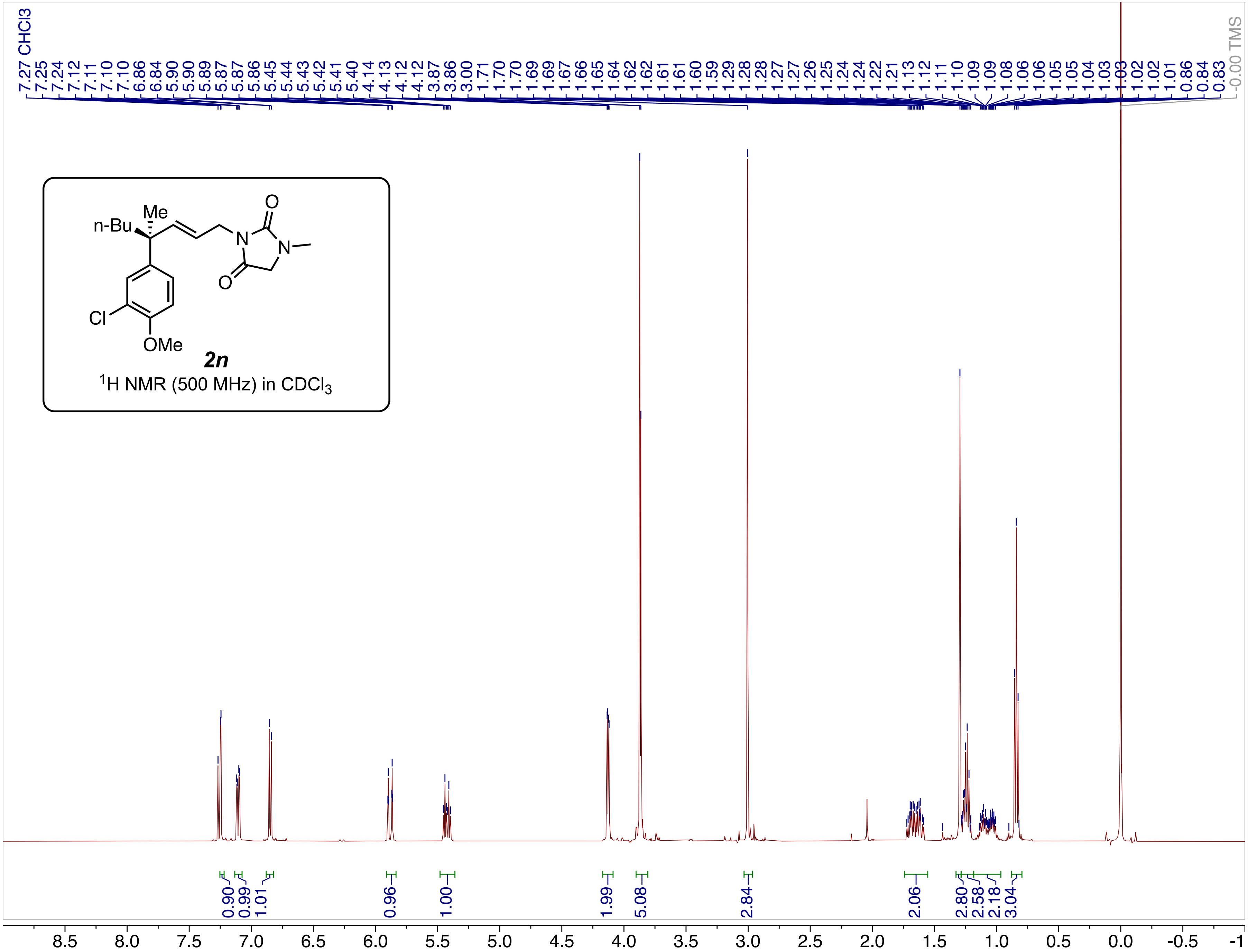
2m

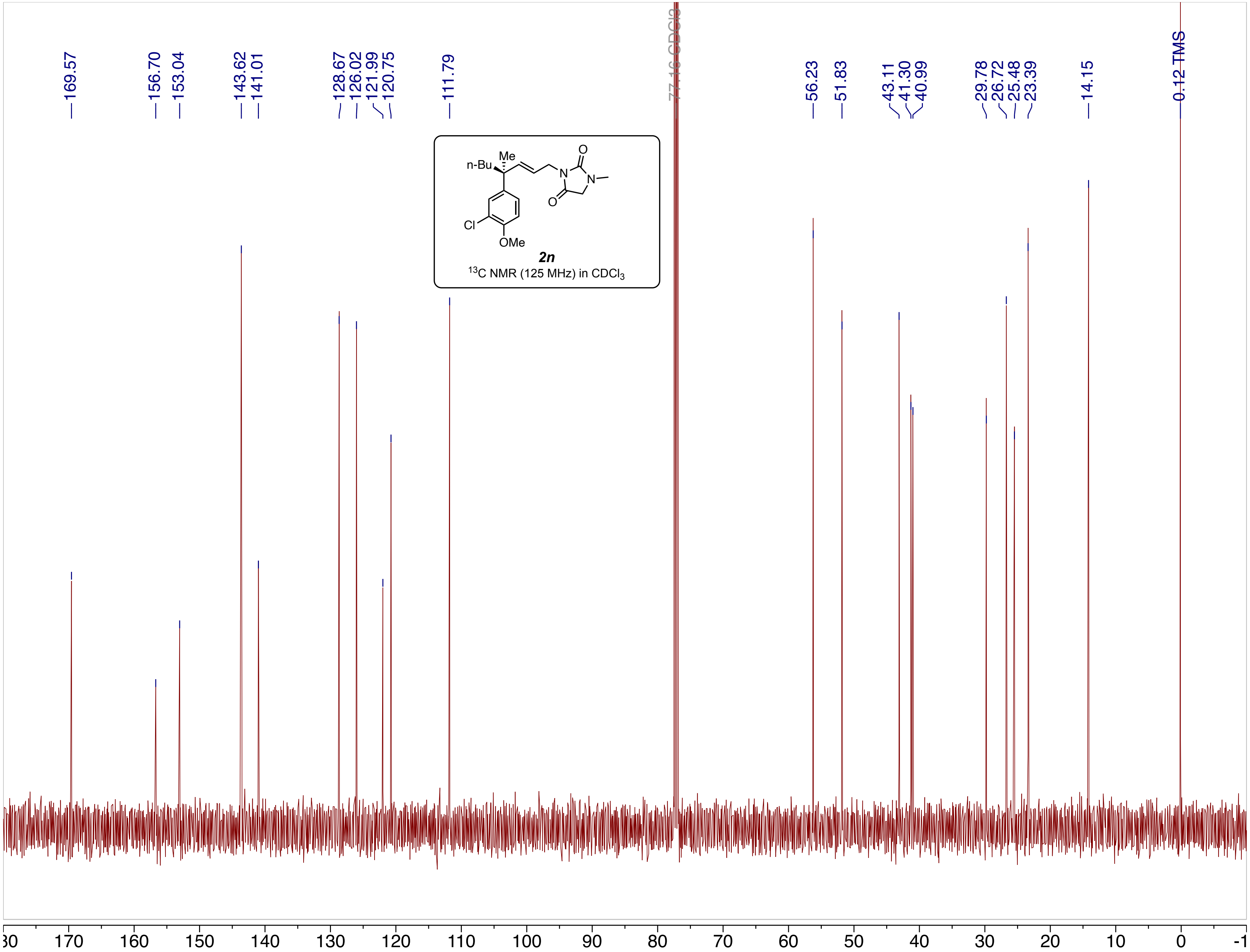
^{1}H NMR (500 MHz) in $CDCl_3$

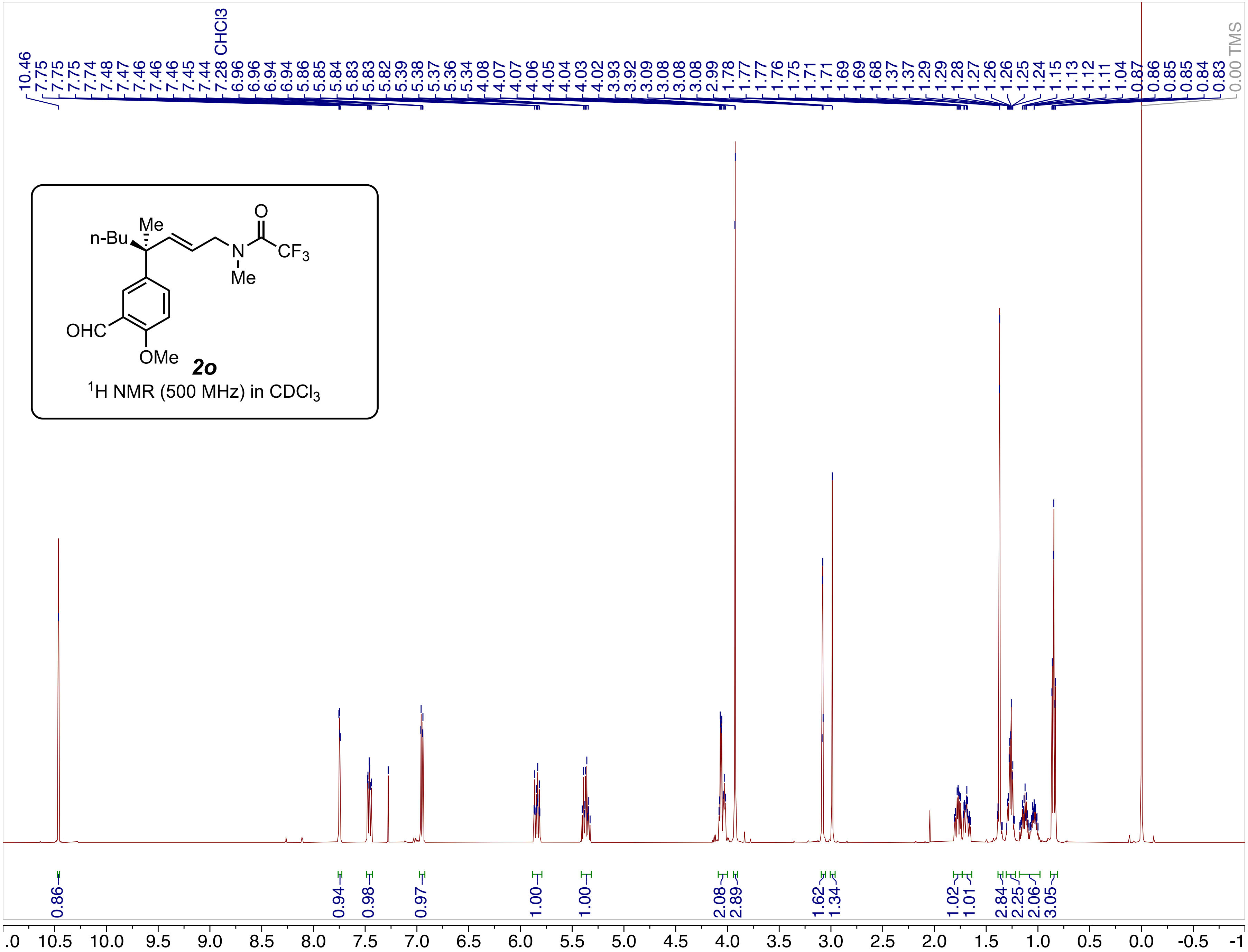


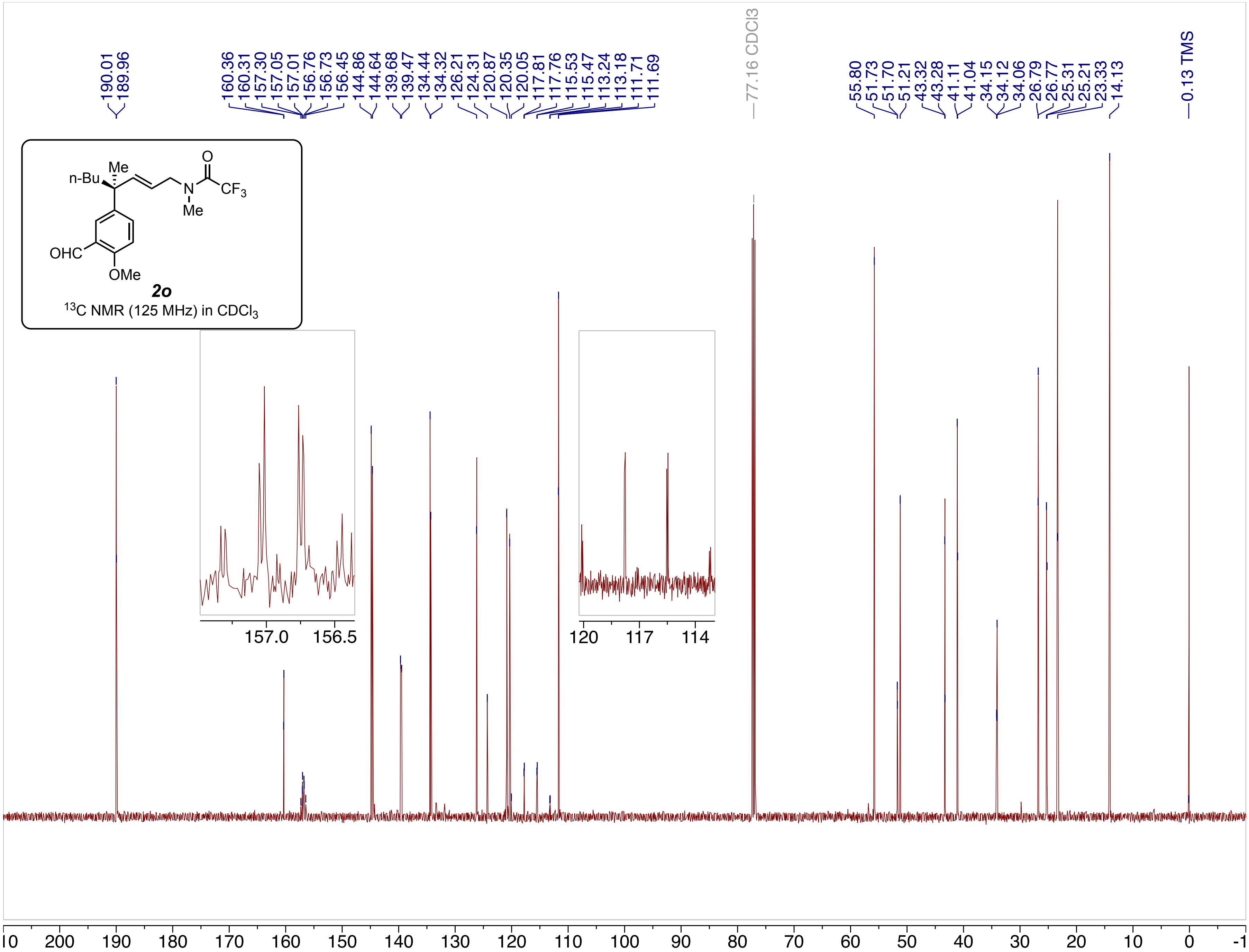
2m

^{13}C NMR (125 MHz) in $CDCl_3$


7.27 CHCl3
7.25 7.24 7.12 7.11 7.10 7.10 6.86 6.84 5.90 5.90 5.89 5.87 5.87 5.86 5.45 5.44 5.43 5.42 5.41 5.40 4.14 4.13 4.12 4.12 3.87 3.86 3.00 1.71 1.70 1.70 1.69 1.69 1.67 1.66 1.65 1.64 1.62 1.62 1.61 1.61 1.60 1.59 1.29 1.28 1.28 1.27 1.27 1.26 1.25 1.24 1.24 1.22 1.21 1.13 1.12 1.11 1.10 1.09 1.09 1.08 1.06 1.06 1.05 1.05 1.04 1.03 1.03 1.02 1.02 1.01 0.86 0.84 0.83
-0.00 TMS
Me
n-Bu
O
N
N
O
Cl
OMe
2n
1H NMR (500 MHz) in CDCl3
0.90 0.99 1.01 0.96 1.00 1.99 5.08 2.84 2.06 2.80 2.58 2.18 3.04
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1

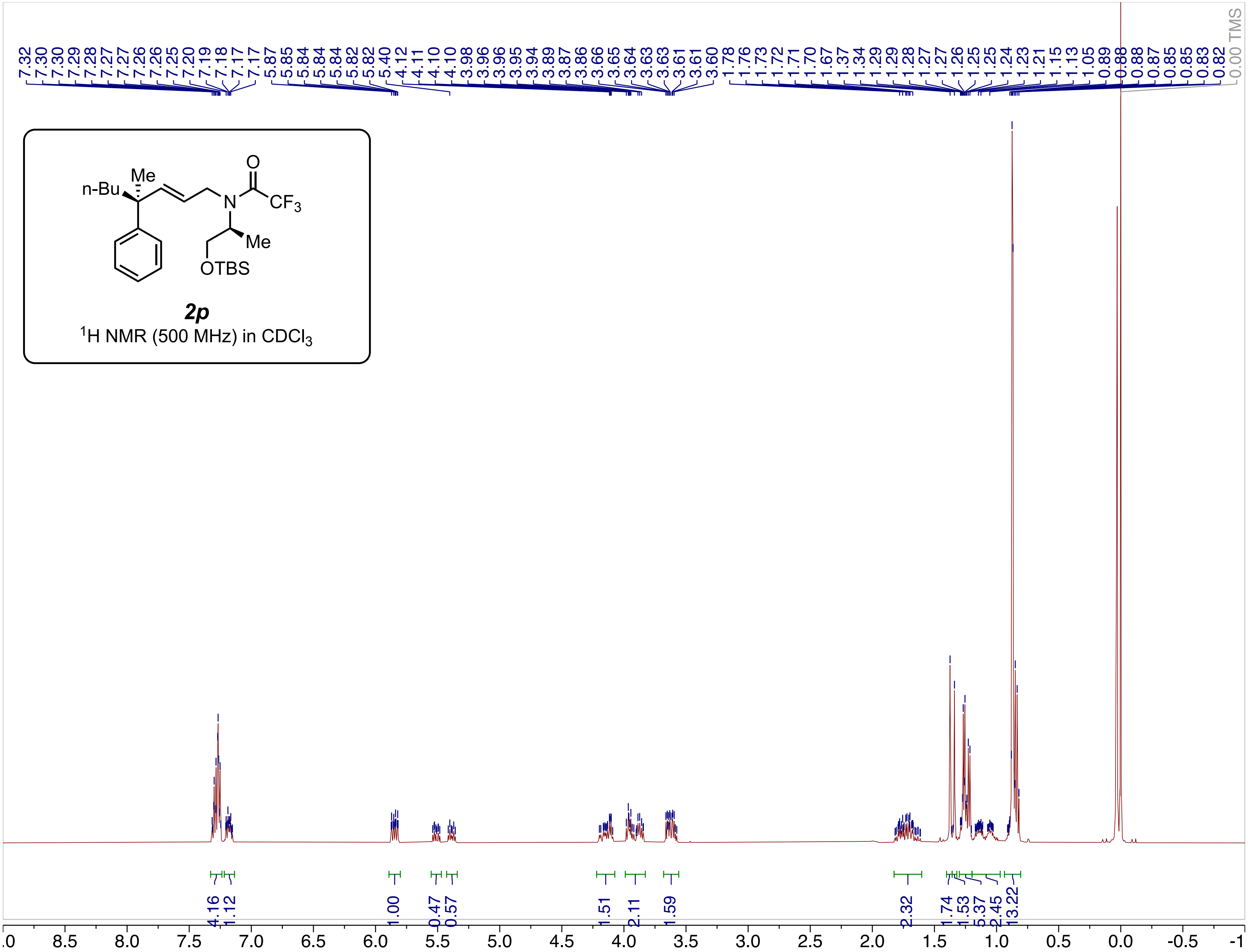

169.57
156.70
153.04
143.62
141.01
128.67
126.02
121.99
120.75
111.79
77.16 CDCl3
56.23
51.83
43.11
41.30
40.99
29.78
26.72
25.48
23.39
14.15
0.12 TMS
n-Bu
Me
O
N
N
O
Cl
OMe
2n
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


10.46
7.75
7.75
7.74
7.48
7.47
7.46
7.46
7.46
7.45
7.44
7.28 CHCl3
6.96
6.96
6.94
6.94
5.86
5.85
5.84
5.83
5.83
5.82
5.39
5.38
5.37
5.36
5.34
4.08
4.07
4.07
4.06
4.05
4.04
4.03
4.02
3.93
3.92
3.09
3.08
3.08
3.08
2.99
1.78
1.77
1.77
1.76
1.75
1.71
1.71
1.69
1.69
1.68
1.37
1.37
1.29
1.29
1.28
1.27
1.26
1.26
1.25
1.24
1.15
1.13
1.12
1.11
1.04
0.87
0.86
0.85
0.85
0.84
0.83
0.00 TMS
n-Bu
Me
O
N
CF3
Me
OHC
OMe
2o
1H NMR (500 MHz) in CDCl3
0.86
0.94
0.98
0.97
1.00
1.00
2.08
2.89
1.62
1.34
1.02
1.01
2.84
2.25
2.06
3.05
.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1



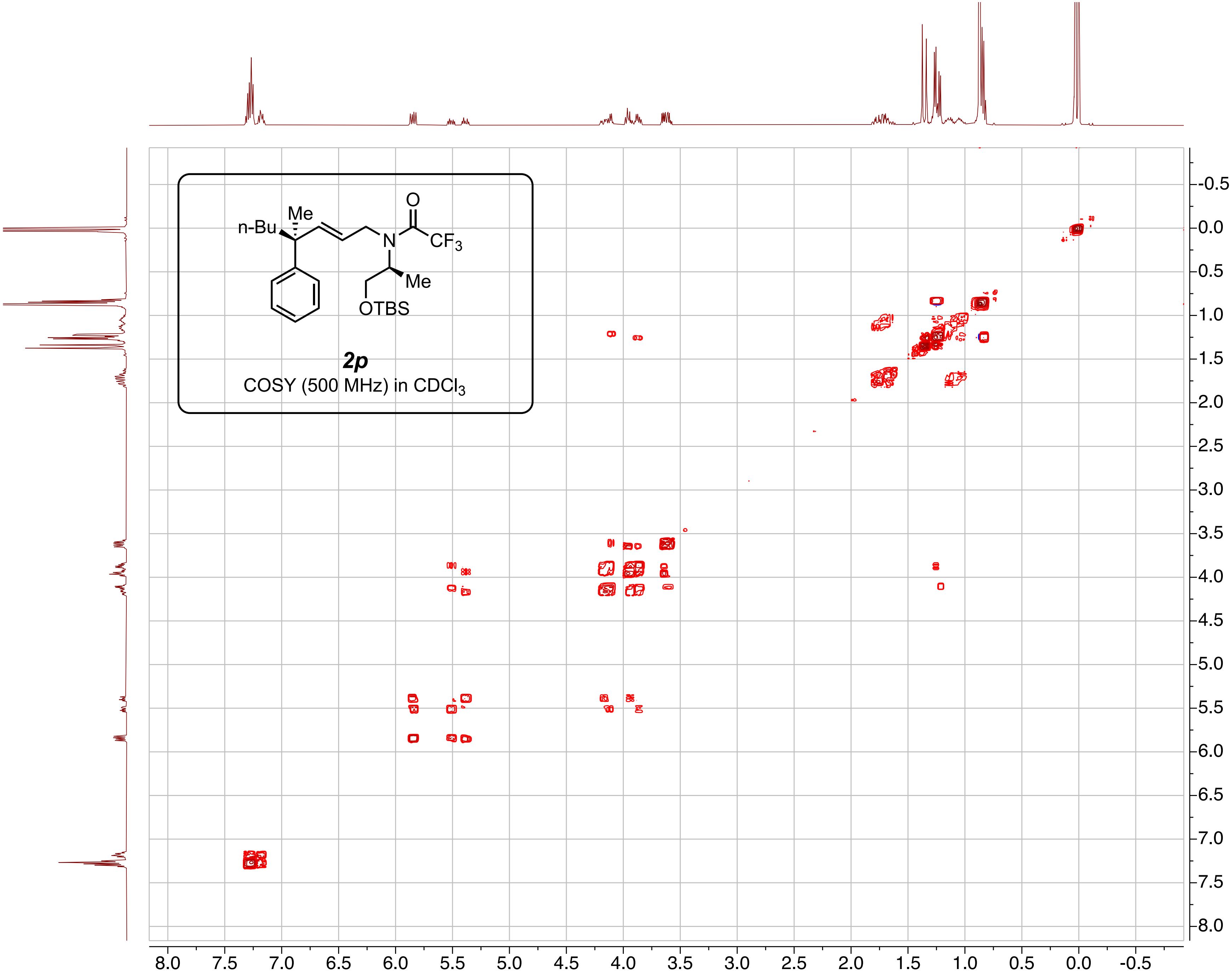
2o

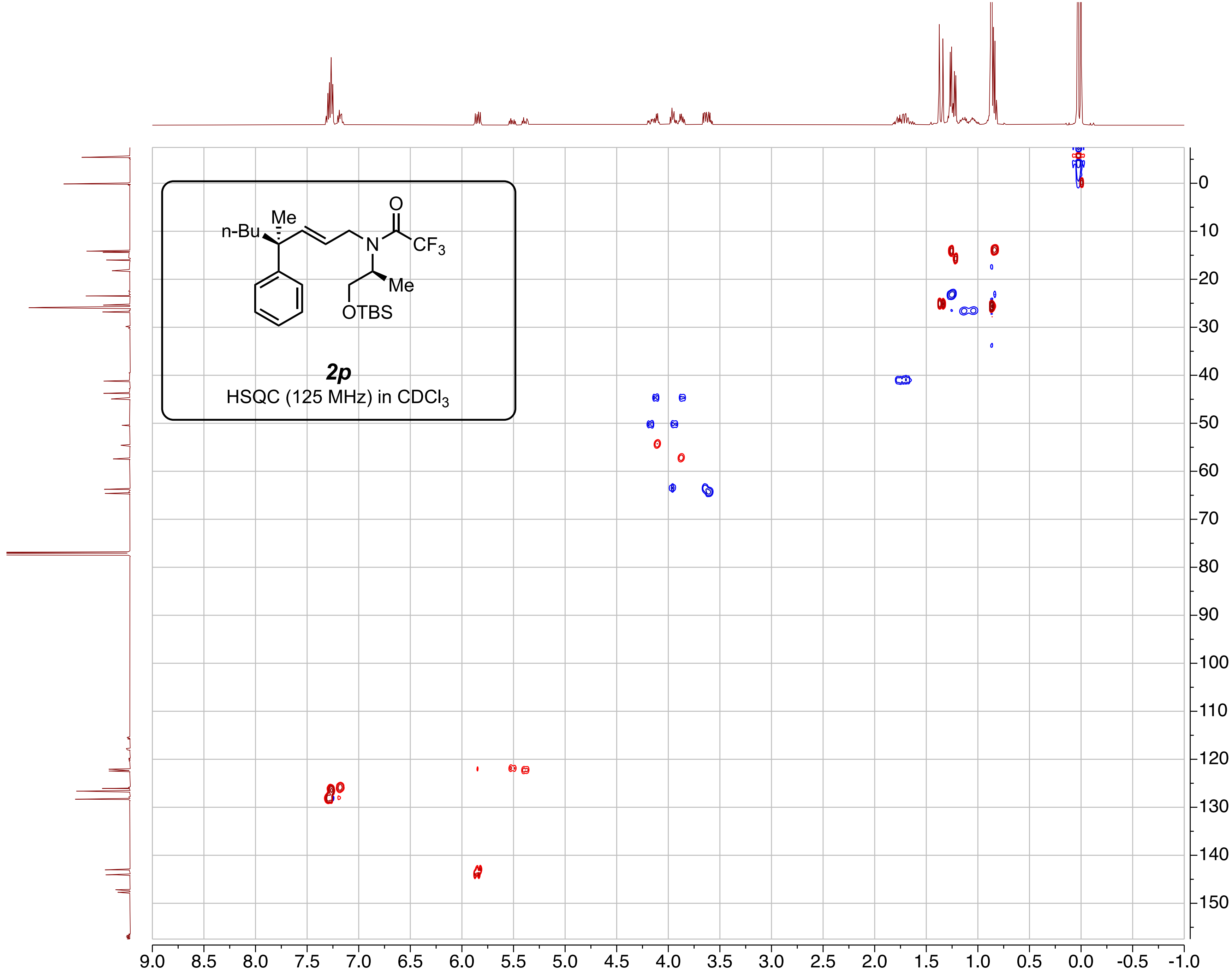
^{13}C NMR (125 MHz) in CDCl$_3$

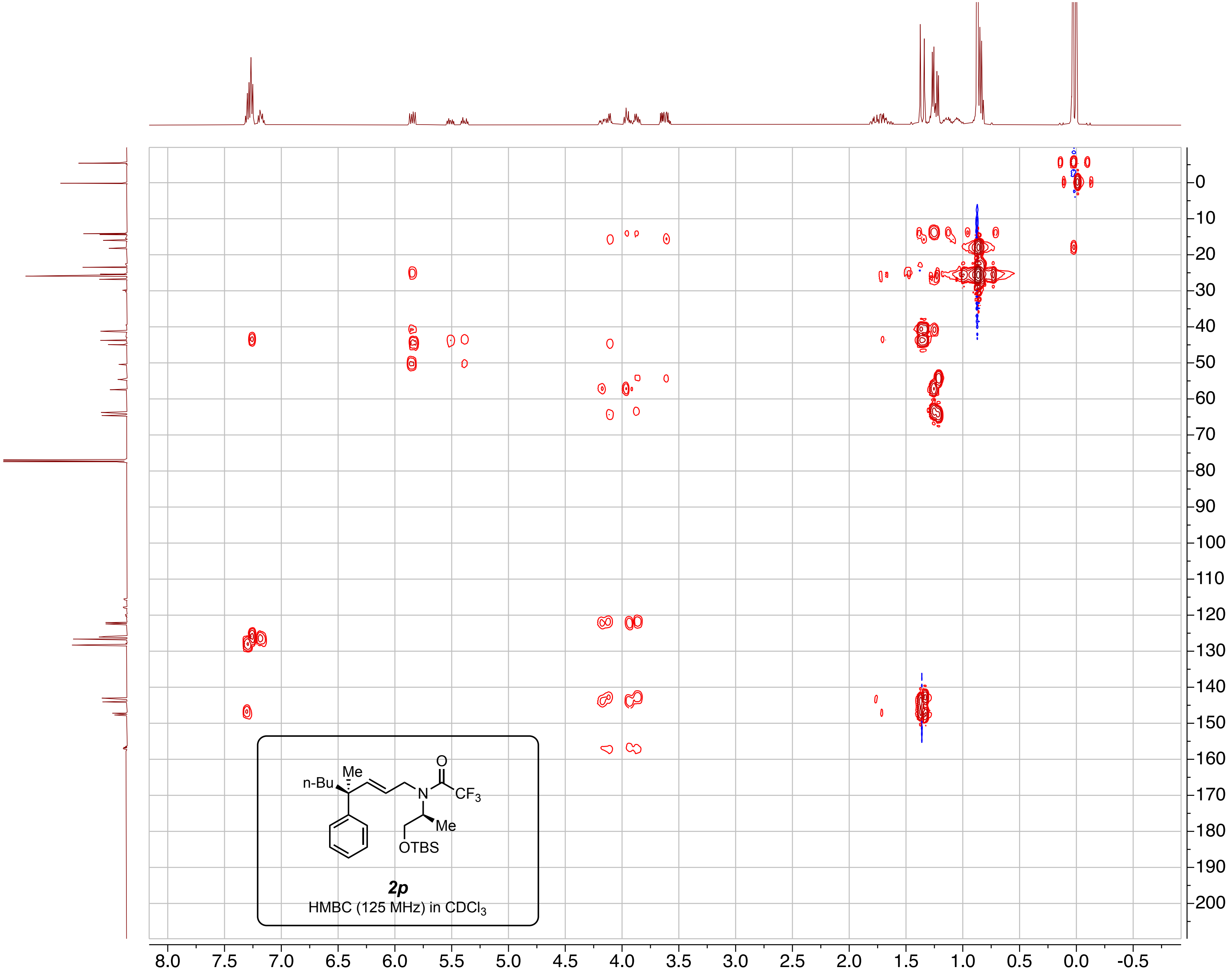


2p

^{1}H NMR (500 MHz) in $CDCl_3$

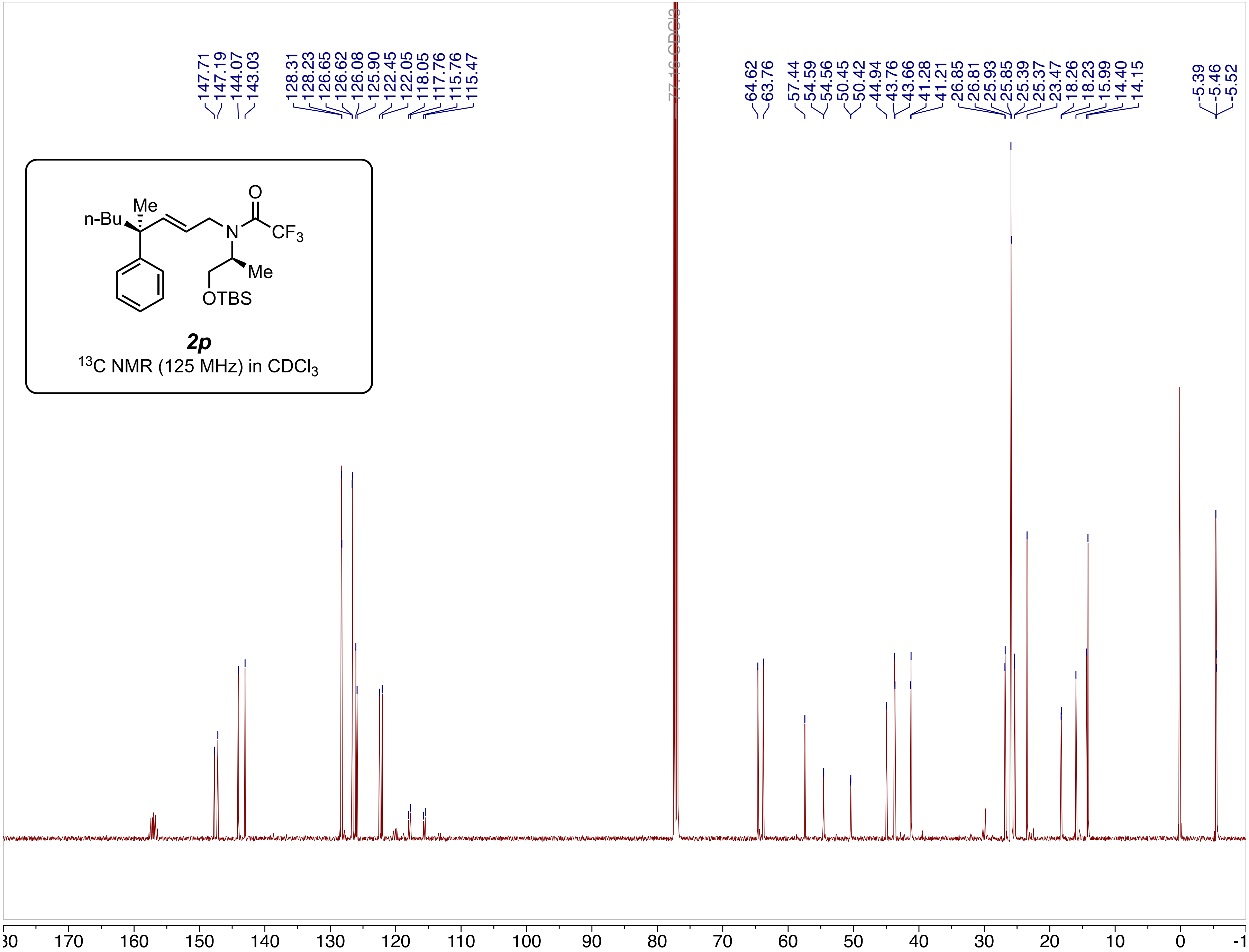

n-Bu
Me
O
N
CF3
Me
OTBS
2p
COSY (500 MHz) in CDCl3
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5


n-Bu
Me
O
N
CF3
Me
OTBS
2p
HSQC (125 MHz) in CDCl3
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0



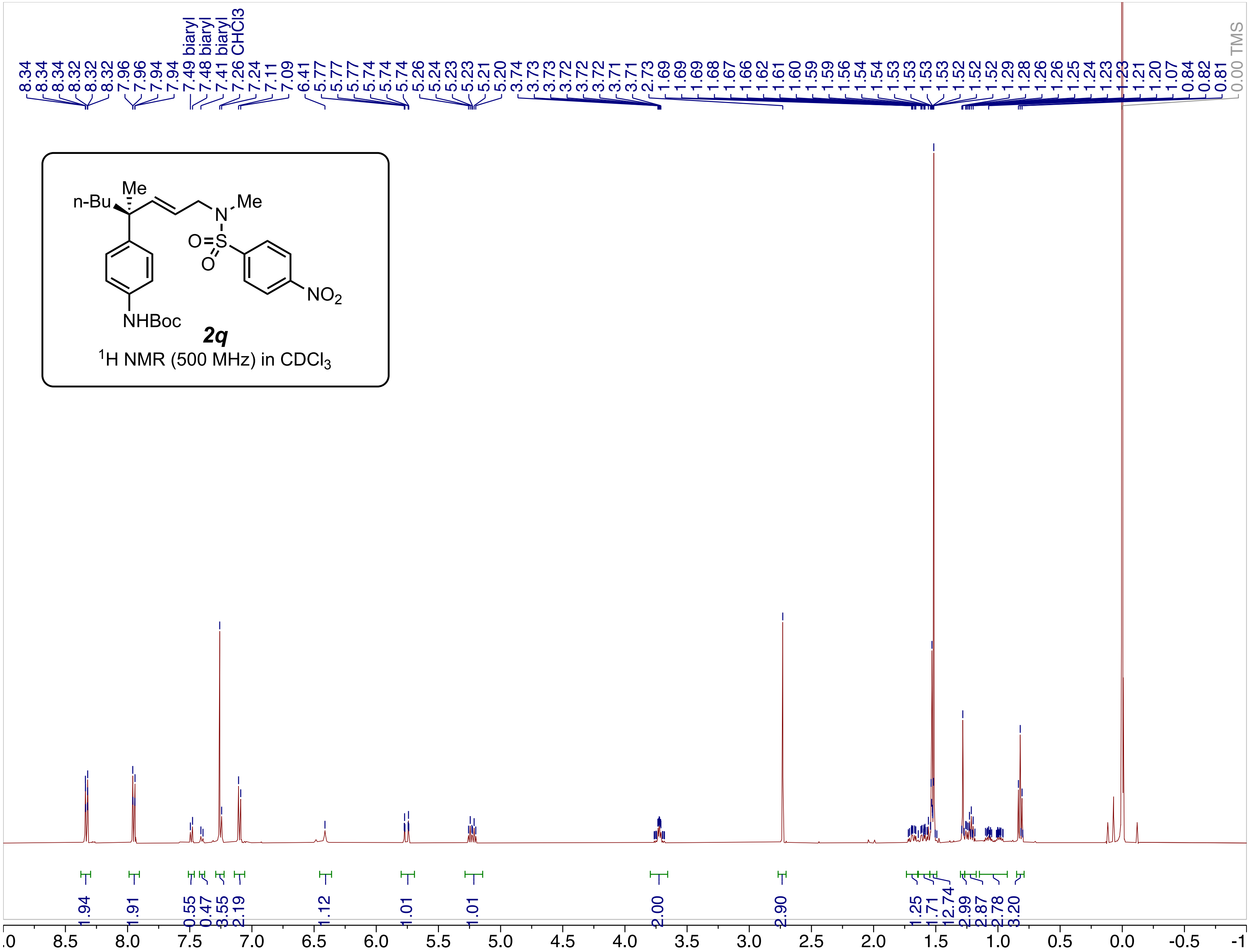
2p

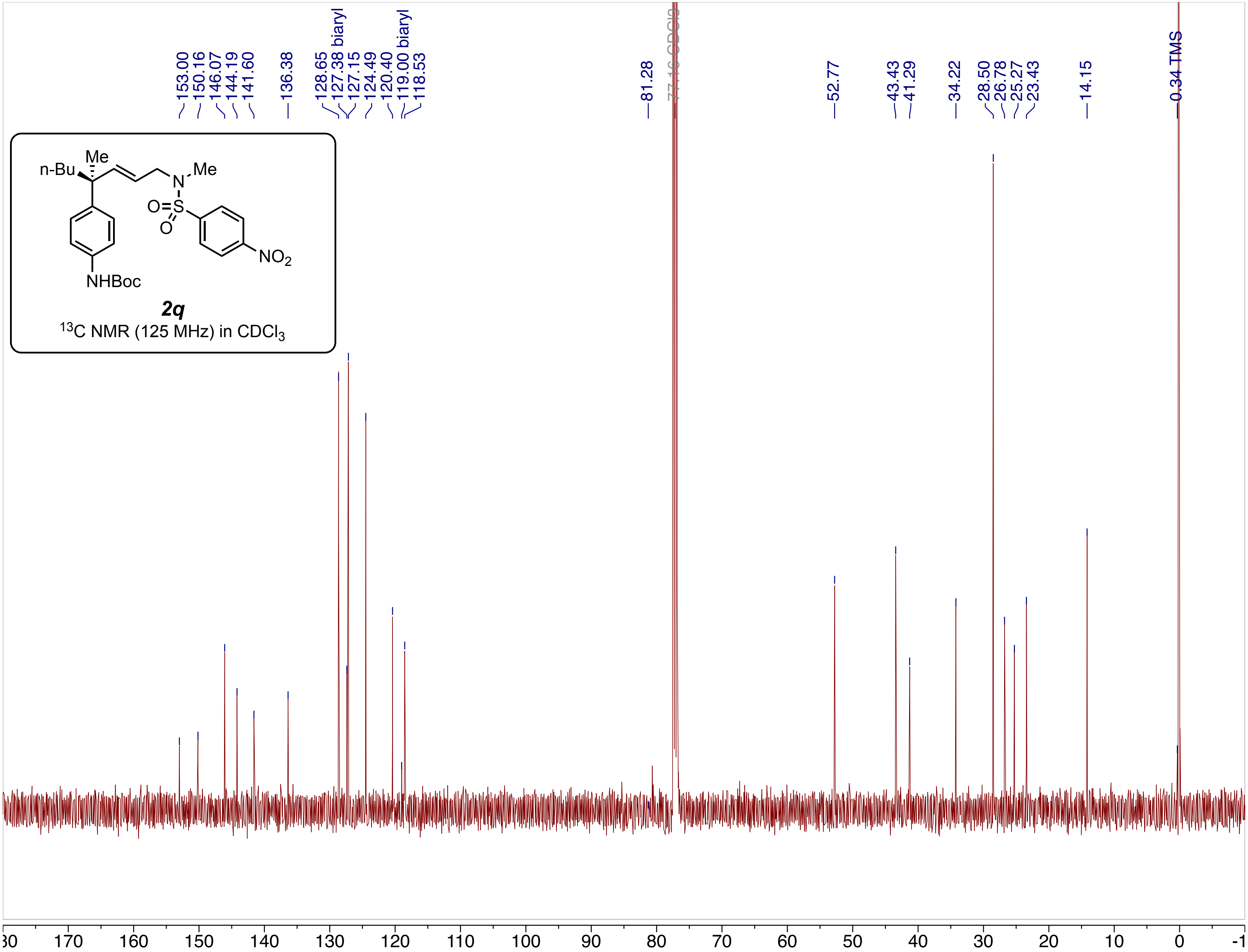
HMBC (125 MHz) in CDCl$_3$

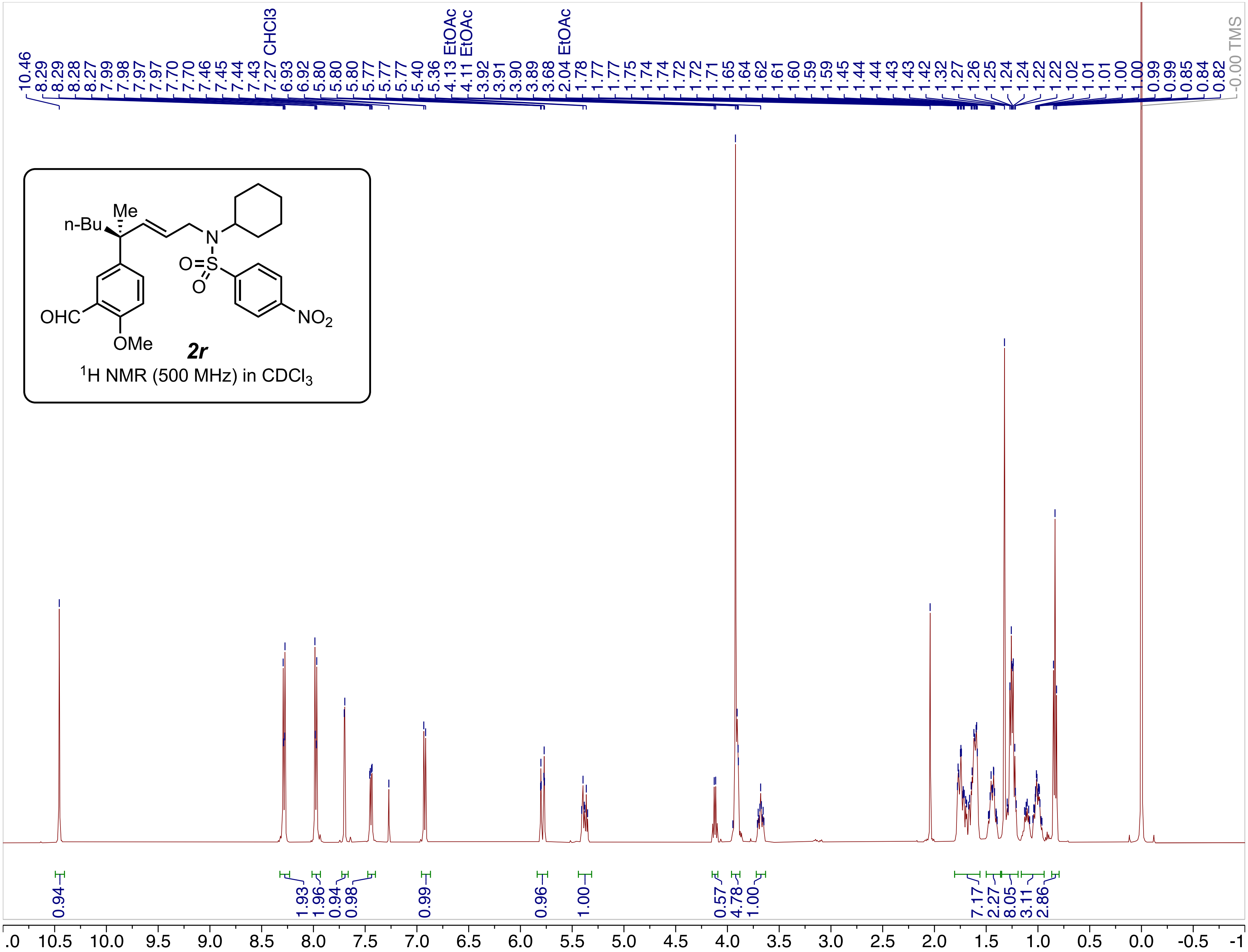


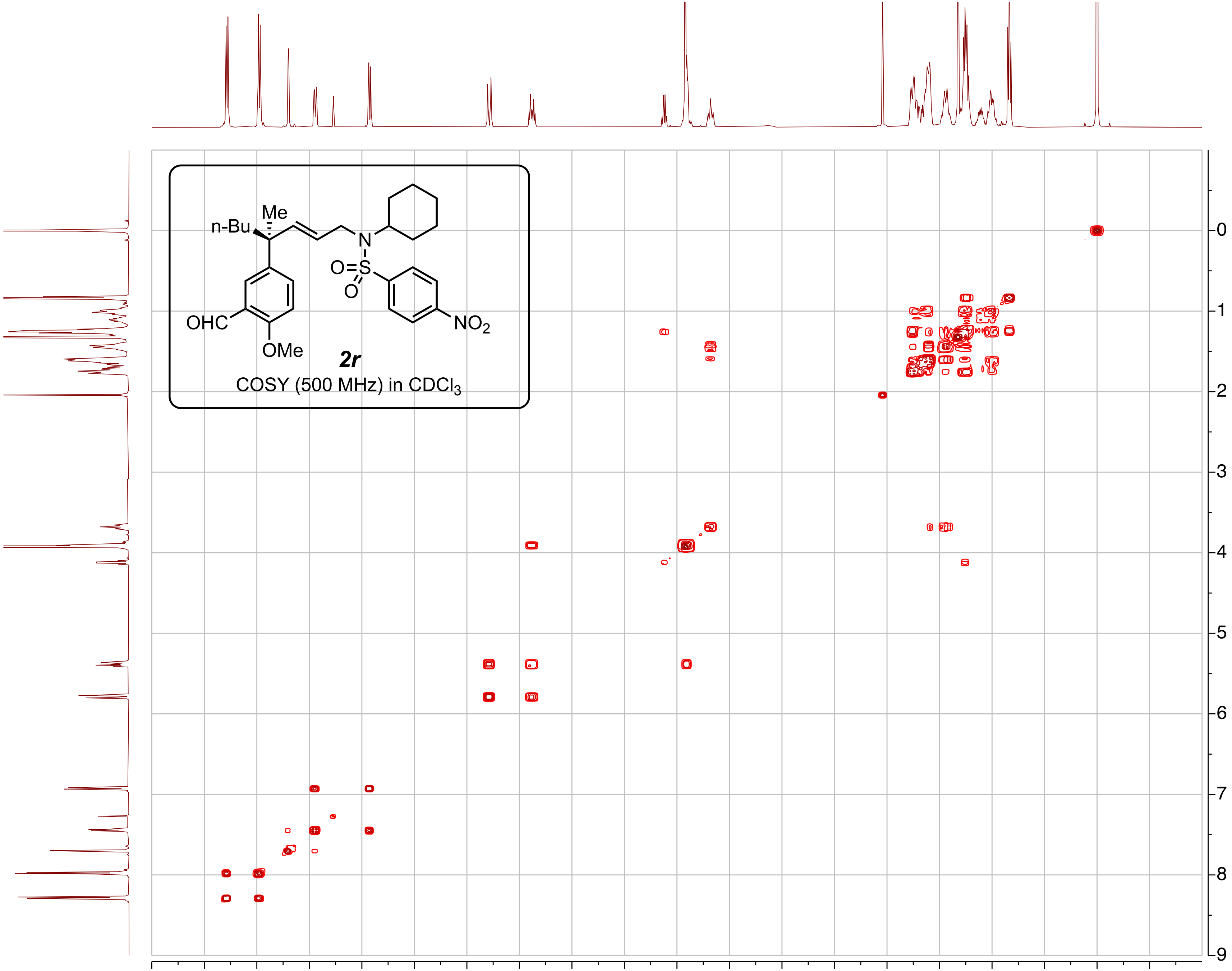
2p

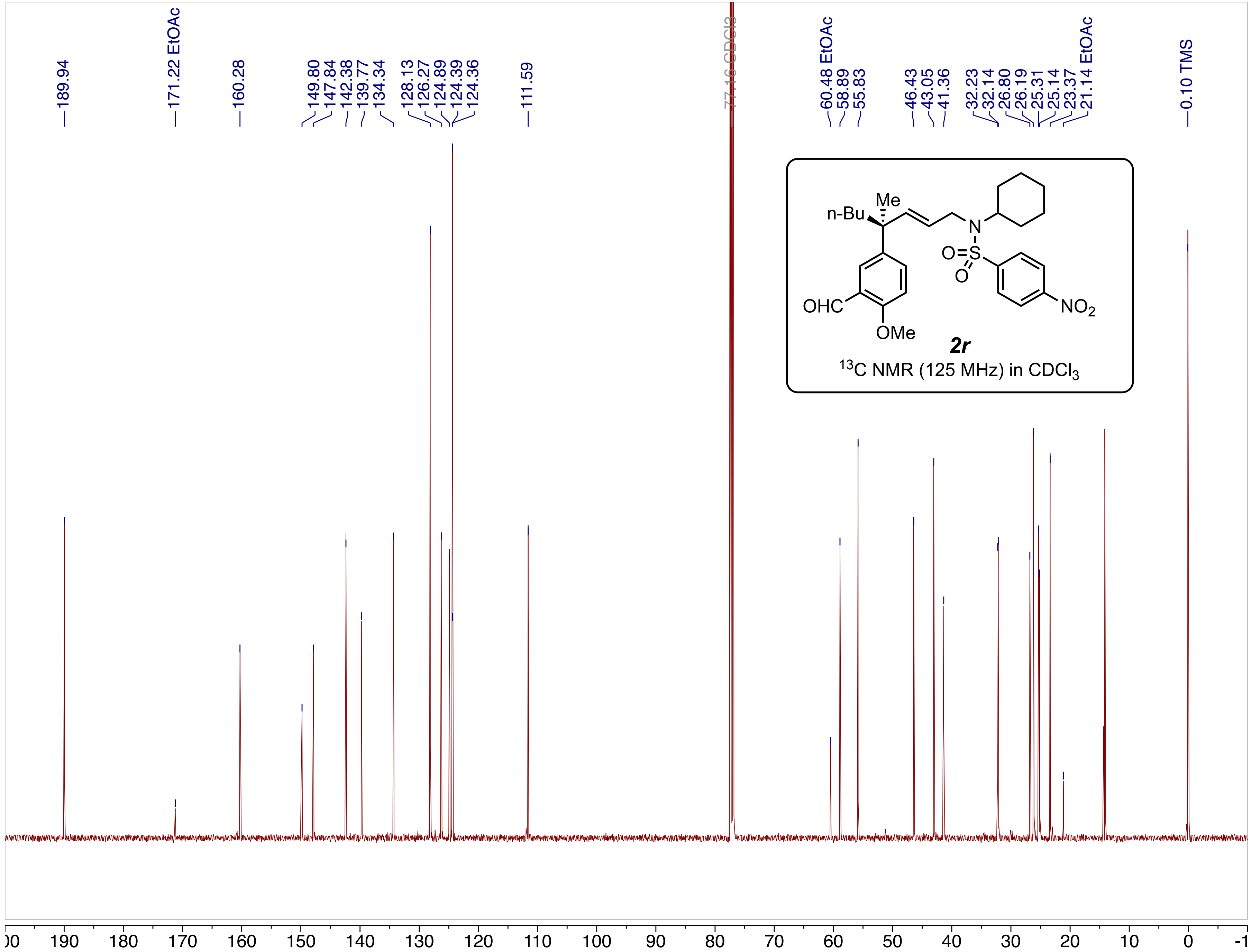
^{13}C NMR (125 MHz) in CDCl$_3$

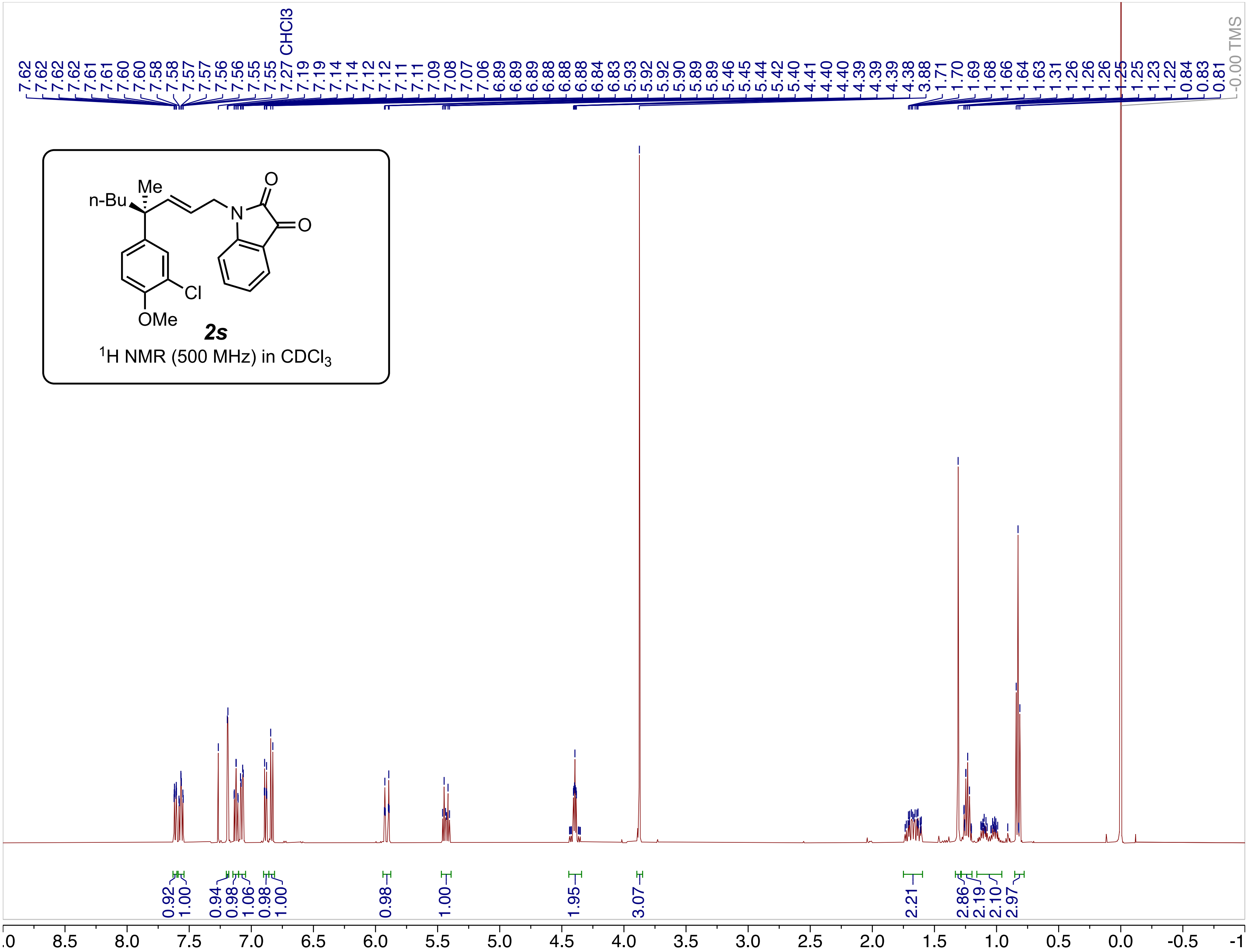

8.34
8.34
8.34
8.32
8.32
8.32
7.96
7.96
7.94
7.94
7.49 biaryl
7.48 biaryl
7.41 biaryl
7.26 CHCl3
7.24
7.11
7.09
6.41
5.77
5.77
5.77
5.74
5.74
5.74
5.26
5.24
5.23
5.23
5.21
5.20
3.74
3.73
3.73
3.72
3.72
3.71
3.71
2.73
1.69
1.69
1.69
1.68
1.67
1.66
1.62
1.61
1.60
1.59
1.59
1.56
1.54
1.54
1.53
1.53
1.53
1.53
1.52
1.52
1.52
1.29
1.28
1.26
1.25
1.24
1.23
1.23
1.21
1.20
1.07
0.84
0.82
0.81
0.00 TMS
Me
n-Bu
Me
N
O=S
O
NO2
NHBoc
2q
1H NMR (500 MHz) in CDCl3
1.94
1.91
0.55
0.47
3.55
2.19
1.12
1.01
1.01
2.00
2.90
1.25
1.71
12.74
2.99
2.87
2.78
3.20
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

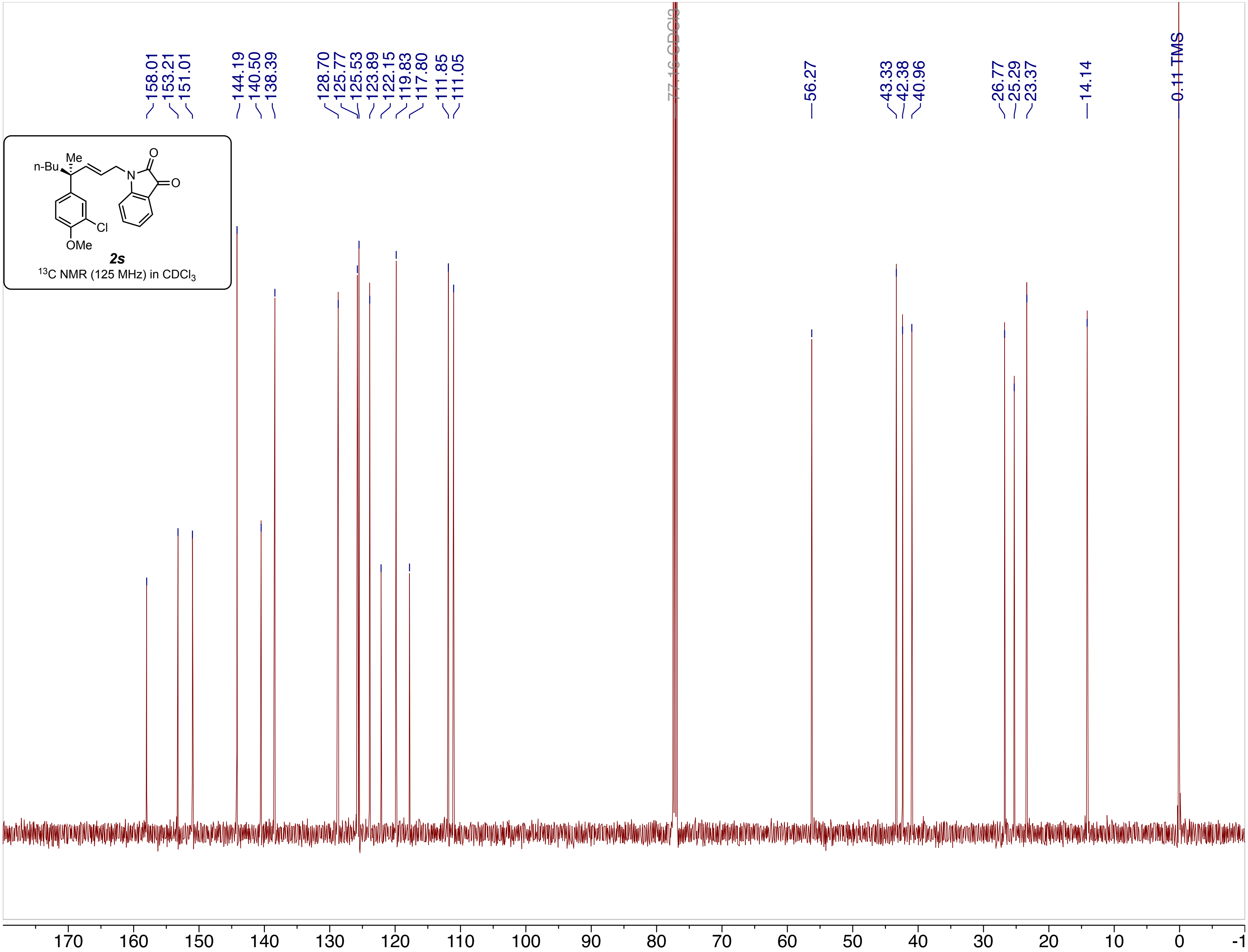

153.00
150.16
146.07
144.19
141.60
136.38
128.65
127.38 biaryl
127.15
124.49
120.40
119.00 biaryl
118.53
81.28
77.16 CDCl3
52.77
43.43
41.29
34.22
28.50
26.78
25.27
23.43
14.15
0.34 TMS
n-Bu
Me
N
Me
O=S
O
NO2
NHBoc
2q
13C NMR (125 MHz) in CDCl3
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

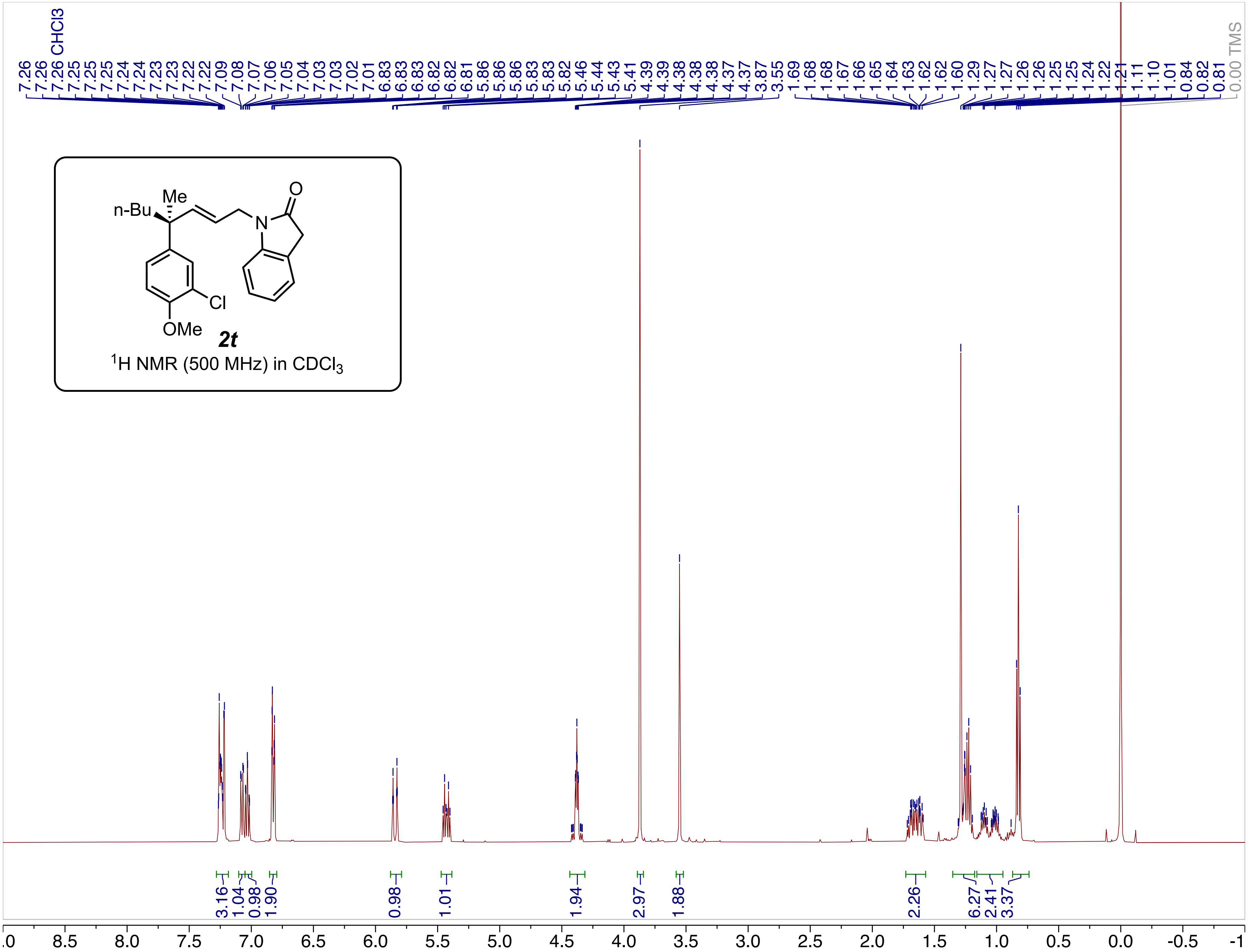

10.46
8.29
8.29
8.28
8.27
7.99
7.98
7.97
7.97
7.70
7.70
7.46
7.45
7.44
7.43
7.27 CHCl3
6.93
6.92
5.80
5.80
5.80
5.77
5.77
5.77
5.40
5.36
4.13 EtOAc
4.11 EtOAc
3.92
3.91
3.90
3.89
3.68
2.04 EtOAc
1.78
1.77
1.77
1.75
1.74
1.74
1.72
1.72
1.71
1.65
1.64
1.62
1.61
1.60
1.59
1.59
1.45
1.44
1.44
1.43
1.43
1.42
1.32
1.27
1.26
1.25
1.24
1.24
1.22
1.22
1.02
1.01
1.01
1.00
1.00
0.99
0.99
0.85
0.84
0.82
-0.00 TMS
Me
n-Bu
N
O=S
O
OHC
OMe
NO2
2r
1H NMR (500 MHz) in CDCl3
0.94
1.93
1.96
0.94
0.98
0.99
0.96
1.00
0.57
4.78
1.00
7.17
2.27
8.05
3.11
2.86
.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

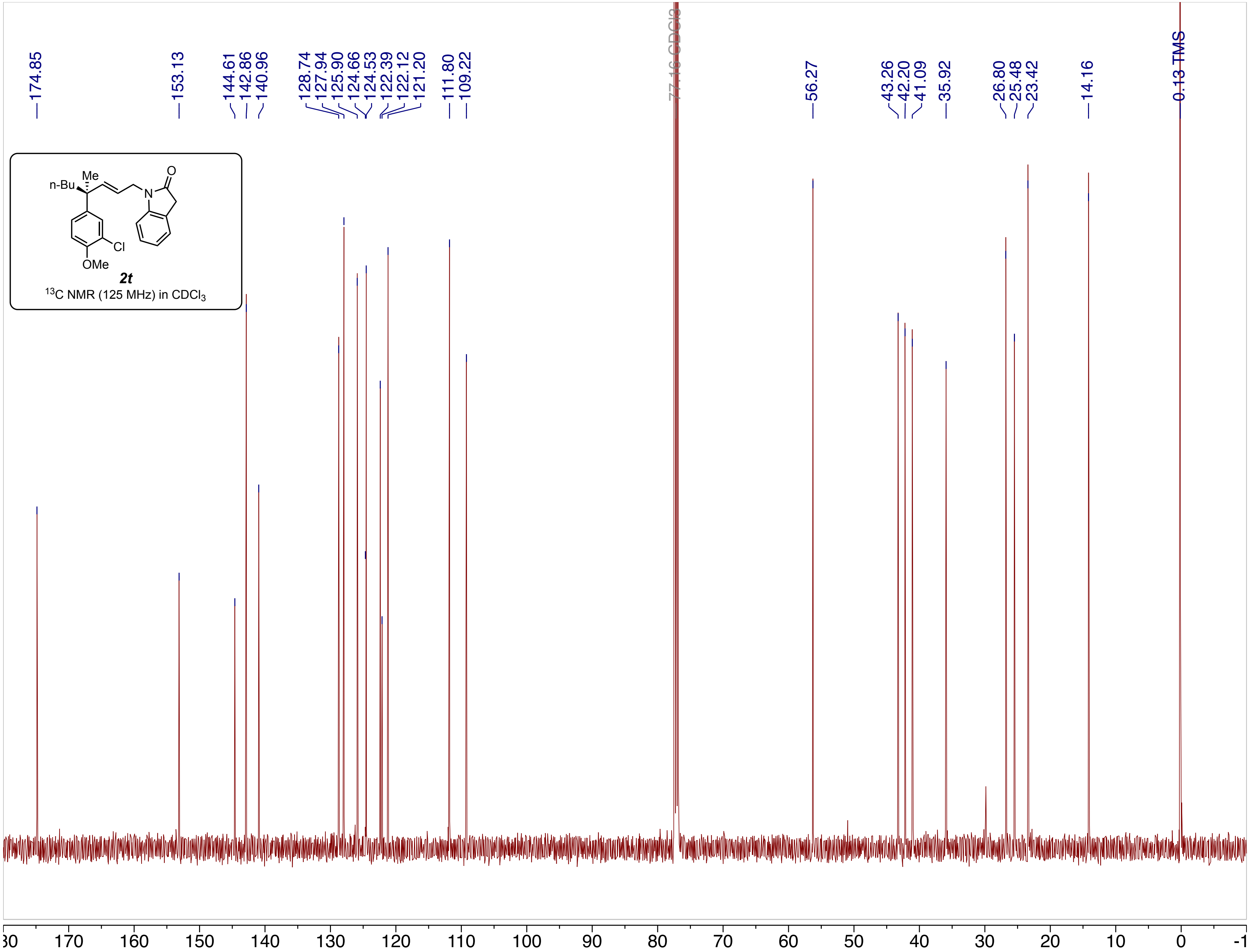

Me
n-Bu
N
O=S
O
OHC
OMe
NO$_2$
2r
COSY (500 MHz) in CDCl$_3$
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0
1
2
3
4
5
6
7
8
9

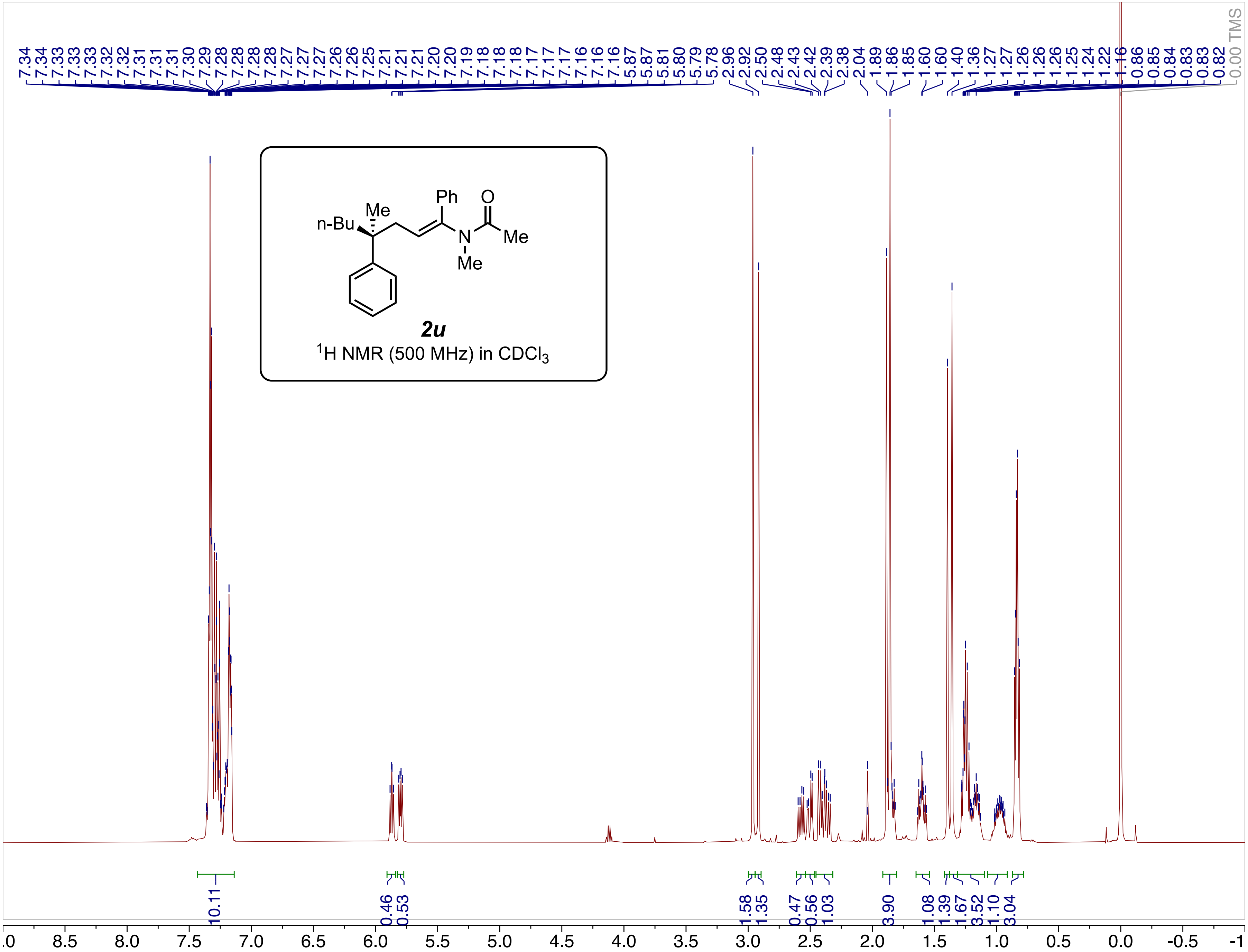

189.94
171.22 EtOAc
160.28
149.80
147.84
142.38
139.77
134.34
128.13
126.27
124.89
124.39
124.36
111.59
77.16 CDCl3
60.48 EtOAc
58.89
55.83
46.43
43.05
41.36
32.23
32.14
26.80
26.19
25.31
25.14
23.37
21.14 EtOAc
0.10 TMS
Me
n-Bu
N
O=S
O
OHC
OMe
NO2
2r
13C NMR (125 MHz) in CDCl3
00
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

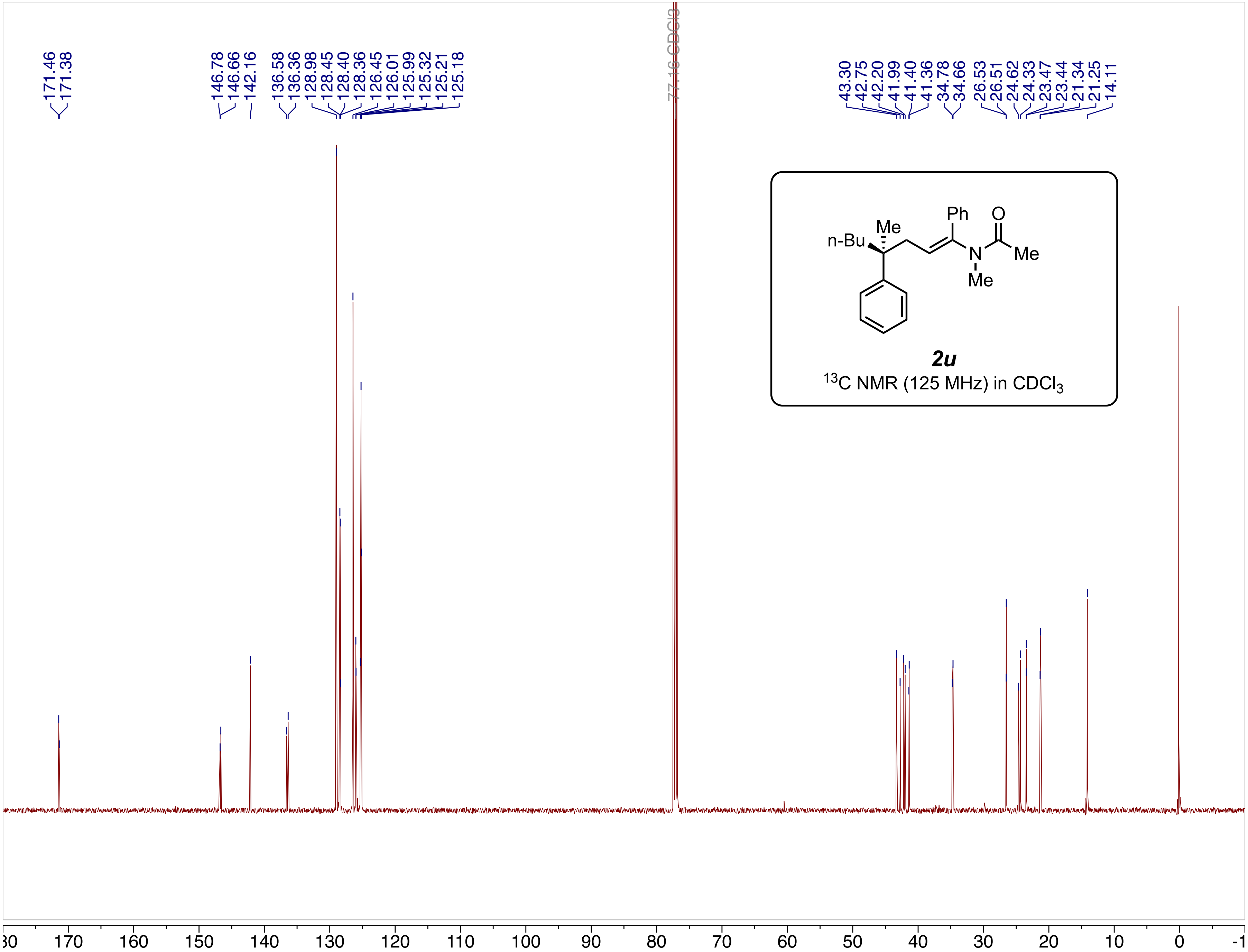

7.62
7.62
7.62
7.61
7.61
7.60
7.60
7.58
7.58
7.57
7.57
7.56
7.56
7.55
7.55
7.27 CHCl3
7.19
7.19
7.14
7.14
7.12
7.12
7.11
7.11
7.09
7.08
7.07
7.06
6.89
6.89
6.89
6.88
6.88
6.88
6.84
6.83
5.93
5.92
5.90
5.89
5.89
5.46
5.45
5.44
5.42
5.40
4.41
4.40
4.40
4.39
4.39
4.39
4.38
3.88
1.71
1.70
1.69
1.68
1.66
1.64
1.63
1.31
1.26
1.26
1.25
1.25
1.23
1.22
0.84
0.83
0.81
-0.00 TMS
Me
n-Bu
N
O
O
Cl
OMe
2s
^{1}H NMR (500 MHz) in CDCl$_3$
0.92
1.00
0.94
0.98
1.06
0.98
1.00
0.98
1.00
1.95
3.07
2.21
2.86
2.19
2.10
2.97
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


158.01
153.21
151.01
144.19
140.50
138.39
128.70
125.77
125.53
123.89
122.15
119.83
117.80
111.85
111.05
77.16 CDCl3
56.27
43.33
42.38
40.96
26.77
25.29
23.37
14.14
0.11 TMS
n-Bu
Me
N
O
O
Cl
OMe
2s
^{13}C NMR (125 MHz) in CDCl$_3$
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.26
7.26 CHCl3
7.25
7.25
7.25
7.24
7.24
7.23
7.23
7.22
7.22
7.09
7.08
7.07
7.06
7.05
7.04
7.03
7.03
7.02
7.01
6.83
6.83
6.83
6.82
6.82
6.81
5.86
5.86
5.86
5.83
5.83
5.82
5.46
5.44
5.43
5.41
4.39
4.39
4.38
4.38
4.38
4.37
4.37
3.87
3.55
1.69
1.68
1.68
1.67
1.66
1.65
1.64
1.63
1.62
1.62
1.60
1.29
1.27
1.27
1.26
1.26
1.25
1.25
1.24
1.22
1.22
1.21
1.11
1.10
1.01
0.84
0.82
0.81
0.00 TMS
Me
n-Bu
O
N
Cl
OMe
2t
^{1}H NMR (500 MHz) in CDCl$_3$
3.16
1.04
0.98
1.90
0.98
1.01
1.94
2.97
1.88
2.26
6.27
2.41
3.37
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

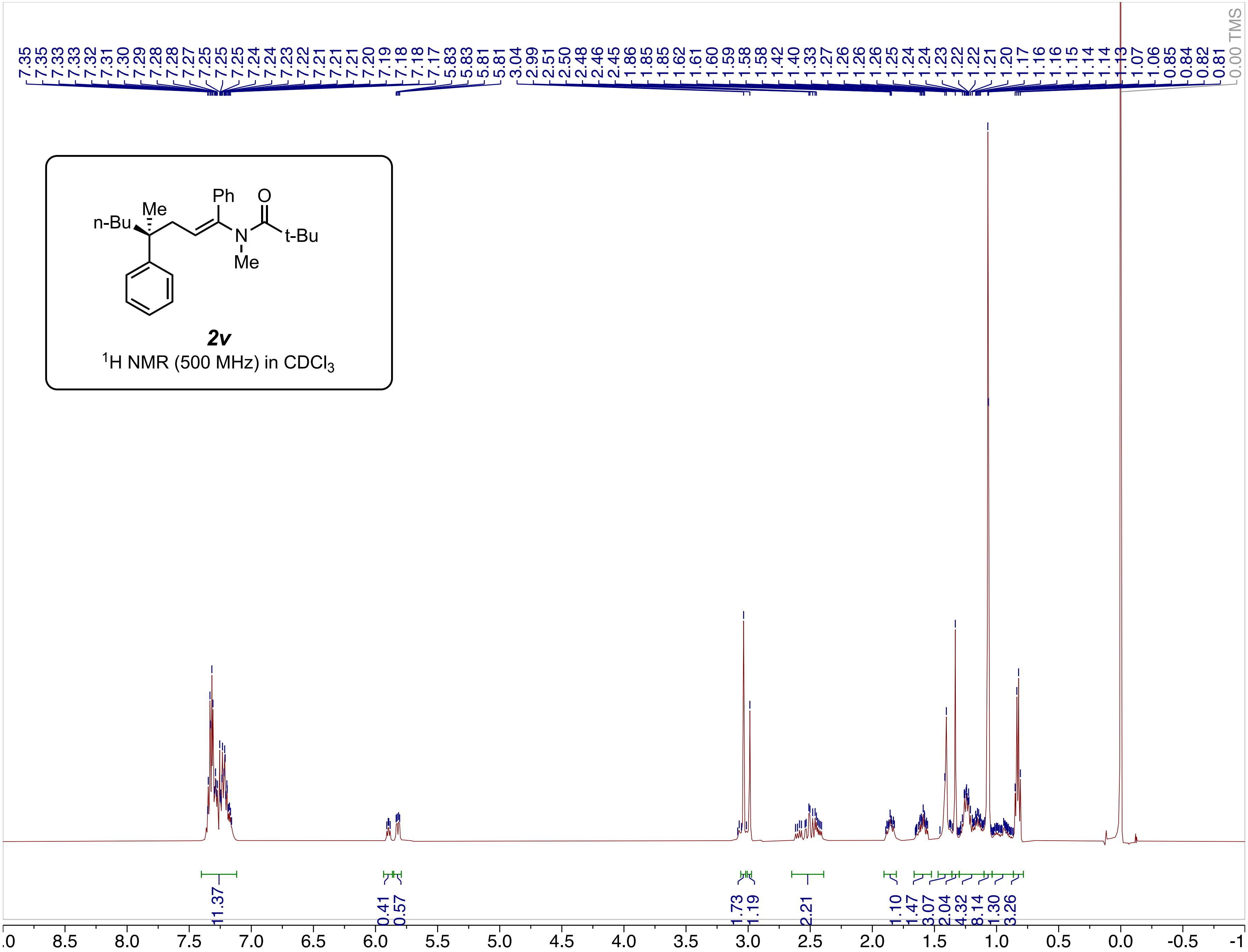

174.85
153.13
144.61
142.86
140.96
128.74
127.94
125.90
124.66
124.53
122.39
122.12
121.20
111.80
109.22
77.16 CDCl3
56.27
43.26
42.20
41.09
35.92
26.80
25.48
23.42
14.16
0.13 TMS
n-Bu
Me
O
N
Cl
OMe
2t
^{13}C NMR (125 MHz) in CDCl$_3$
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

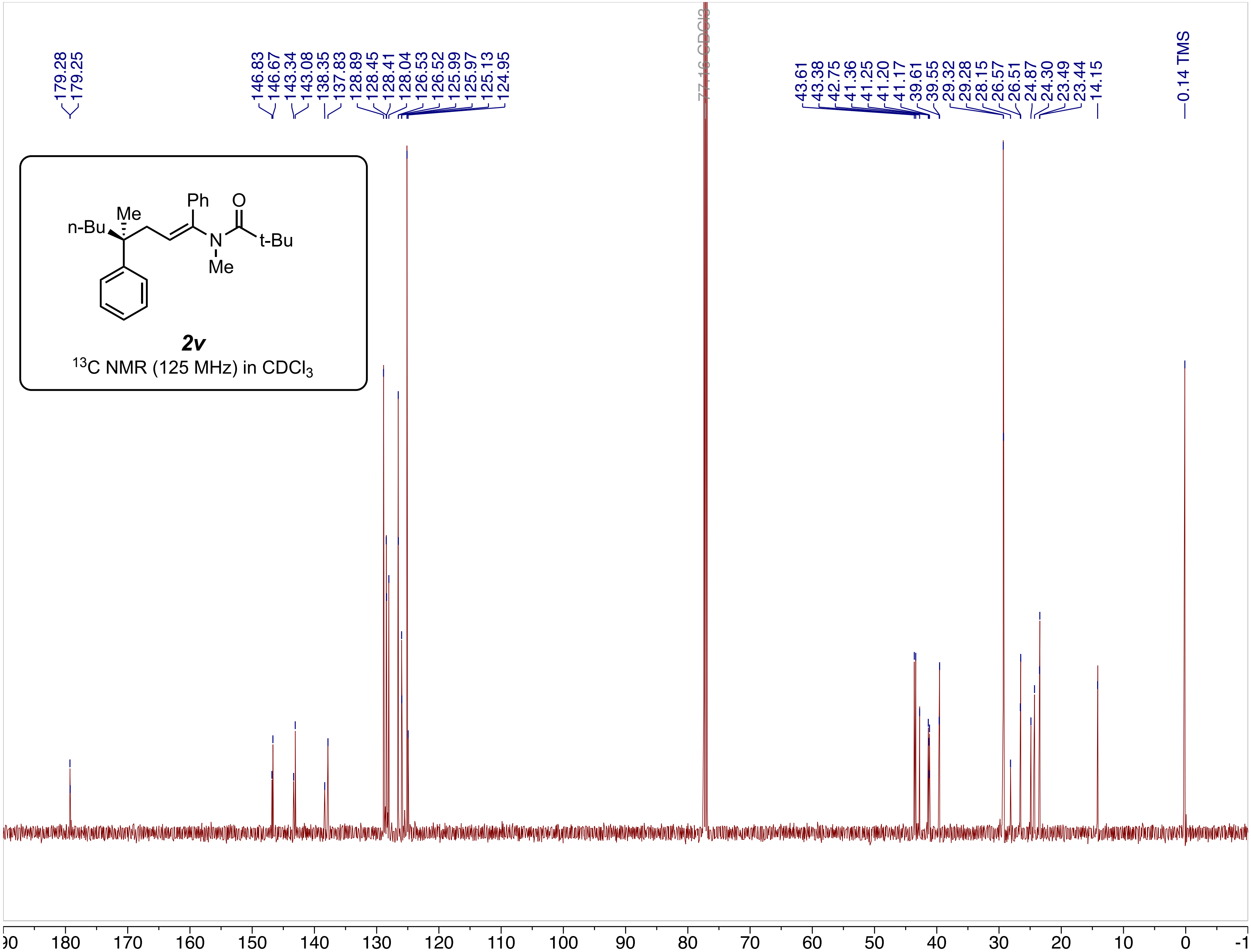

7.34
7.34
7.33
7.33
7.32
7.32
7.31
7.31
7.30
7.29
7.28
7.28
7.28
7.27
7.27
7.26
7.26
7.25
7.21
7.21
7.21
7.20
7.19
7.18
7.18
7.17
7.17
7.16
7.16
5.87
5.87
5.81
5.80
5.79
5.78
2.96
2.92
2.50
2.48
2.43
2.42
2.39
2.38
2.04
1.89
1.86
1.85
1.60
1.60
1.40
1.36
1.27
1.27
1.26
1.26
1.26
1.25
1.24
1.22
1.16
0.86
0.85
0.84
0.83
0.83
0.82
0.00 TMS
n-Bu
Me
Ph
O
N
Me
Me
2u
^{1}H NMR (500 MHz) in CDCl$_3$
10.11
0.46
0.53
1.58
1.35
0.47
0.56
1.03
3.90
1.08
1.39
1.67
3.52
1.10
3.04
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

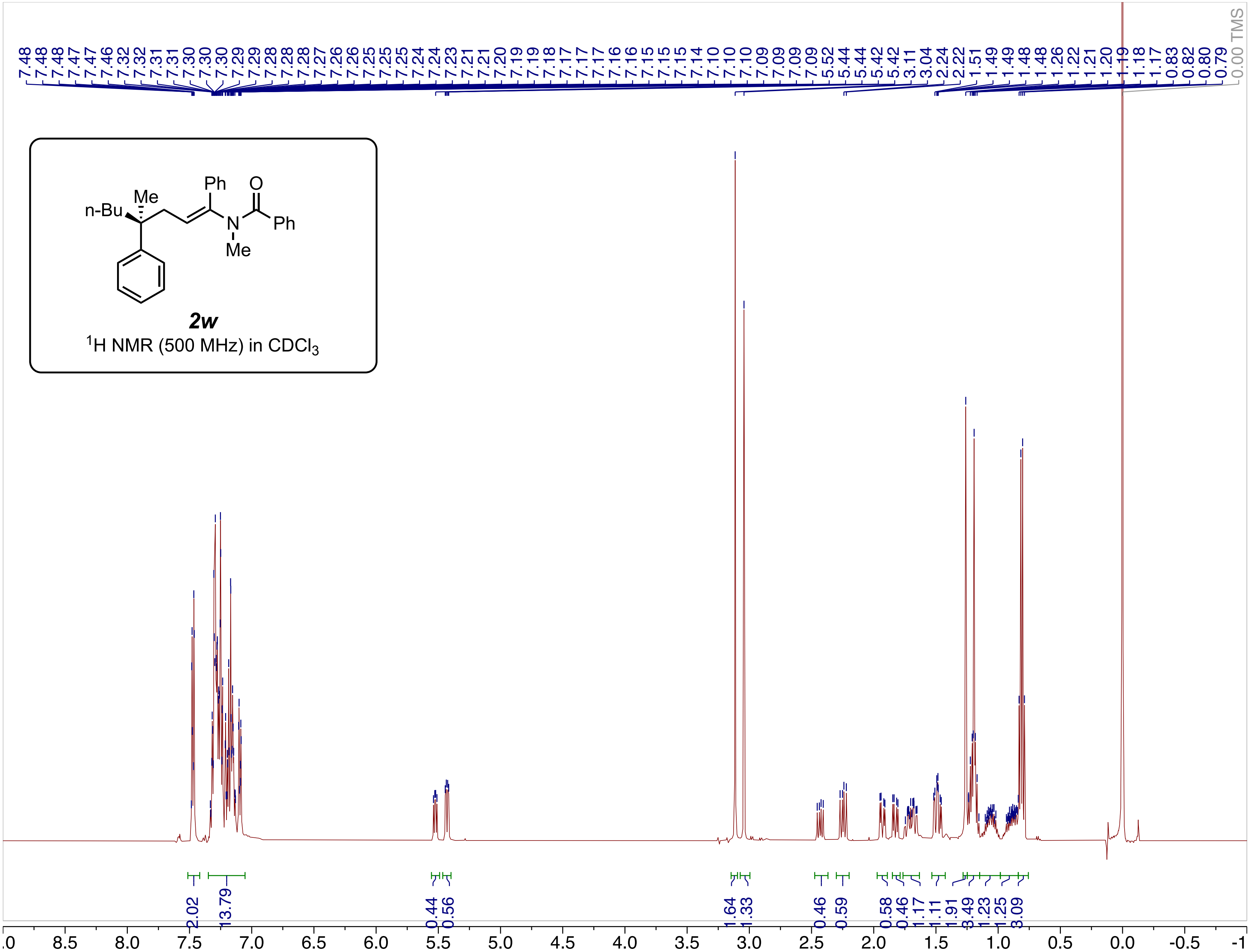


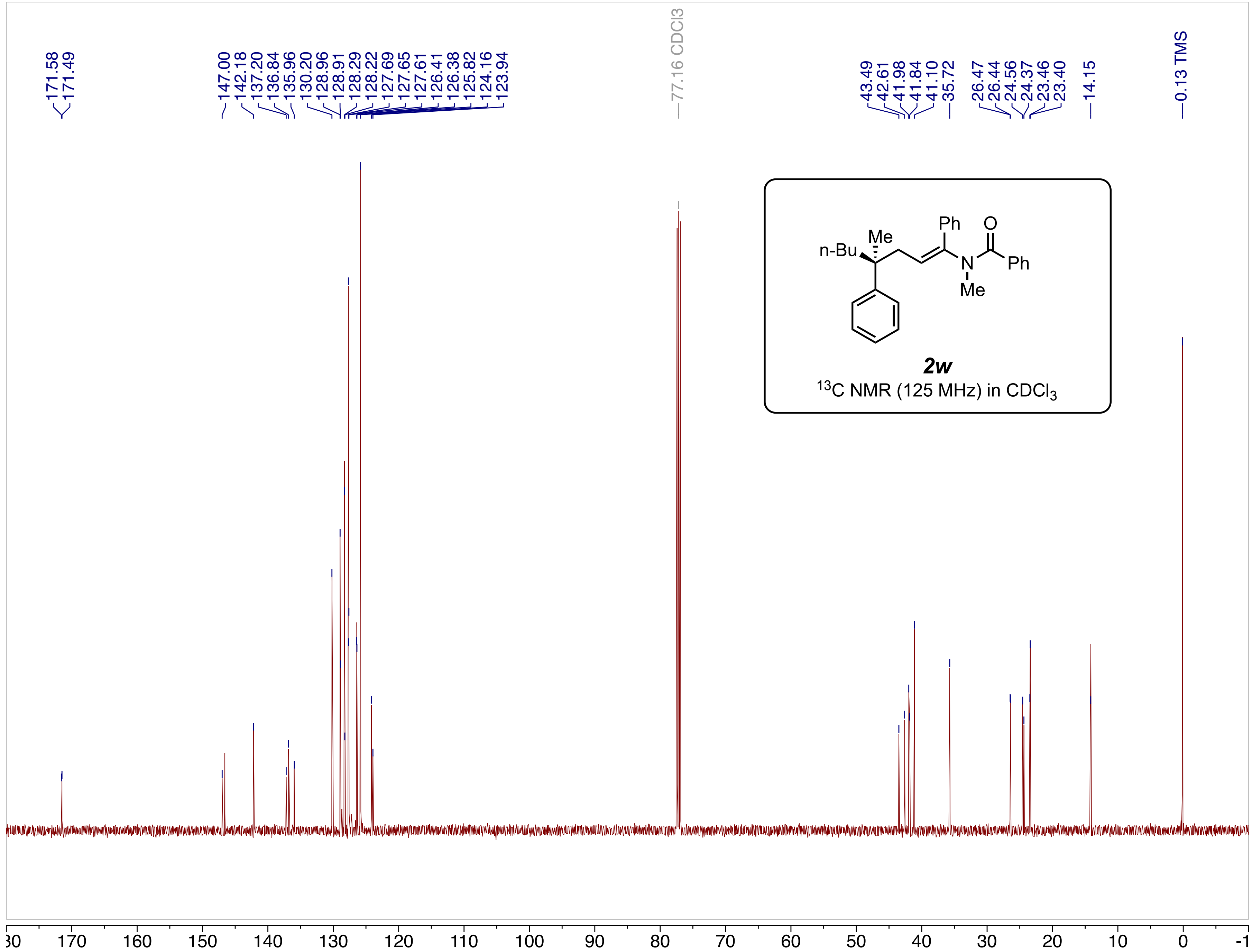
2u

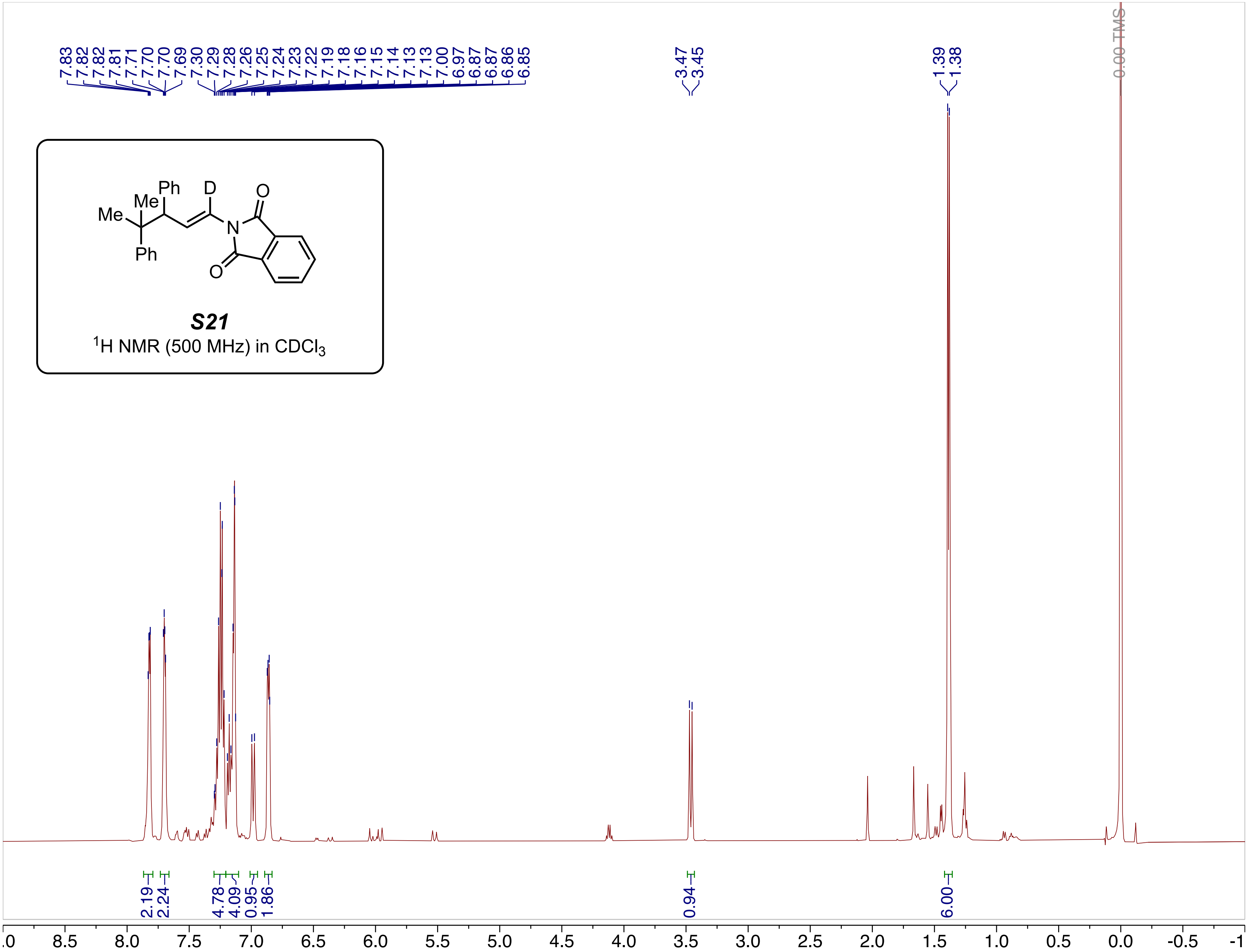
^{13}C NMR (125 MHz) in CDCl$_3$

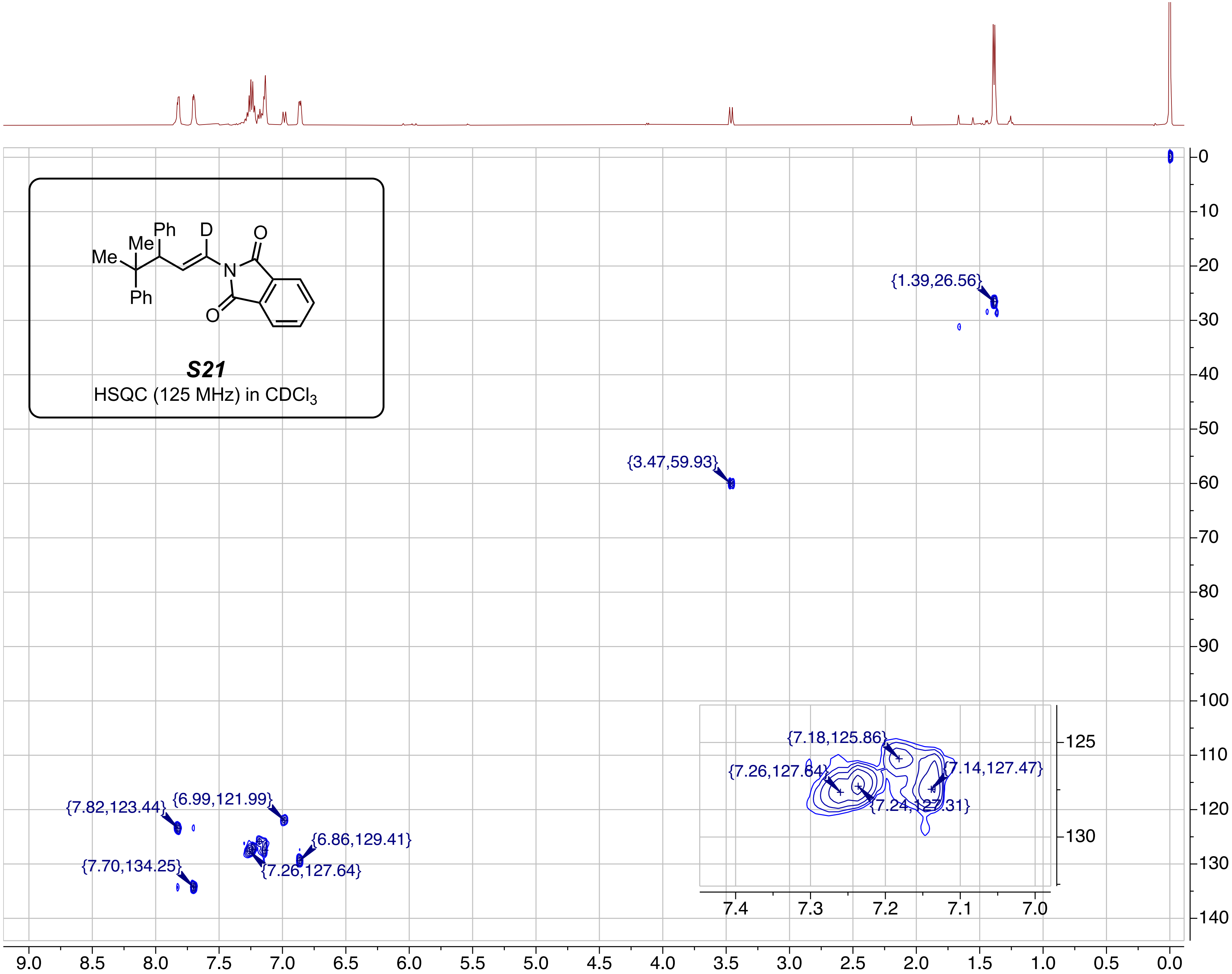

7.35
7.35
7.33
7.33
7.32
7.31
7.30
7.29
7.28
7.28
7.27
7.25
7.25
7.25
7.24
7.24
7.23
7.22
7.21
7.21
7.21
7.20
7.19
7.18
7.18
7.17
5.83
5.83
5.81
5.81
3.04
2.99
2.51
2.50
2.48
2.46
2.45
1.86
1.85
1.85
1.62
1.61
1.60
1.59
1.58
1.58
1.42
1.40
1.33
1.27
1.26
1.26
1.26
1.25
1.24
1.24
1.23
1.22
1.22
1.21
1.20
1.17
1.16
1.16
1.15
1.14
1.14
1.13
1.07
1.06
0.85
0.84
0.82
0.81
0.00 TMS
Ph
O
Me
n-Bu
N
t-Bu
Me
2v
^{1}H NMR (500 MHz) in CDCl$_3$
11.37
0.41
0.57
1.73
1.19
2.21
1.10
1.47
3.07
2.04
4.32
8.14
1.30
3.26
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

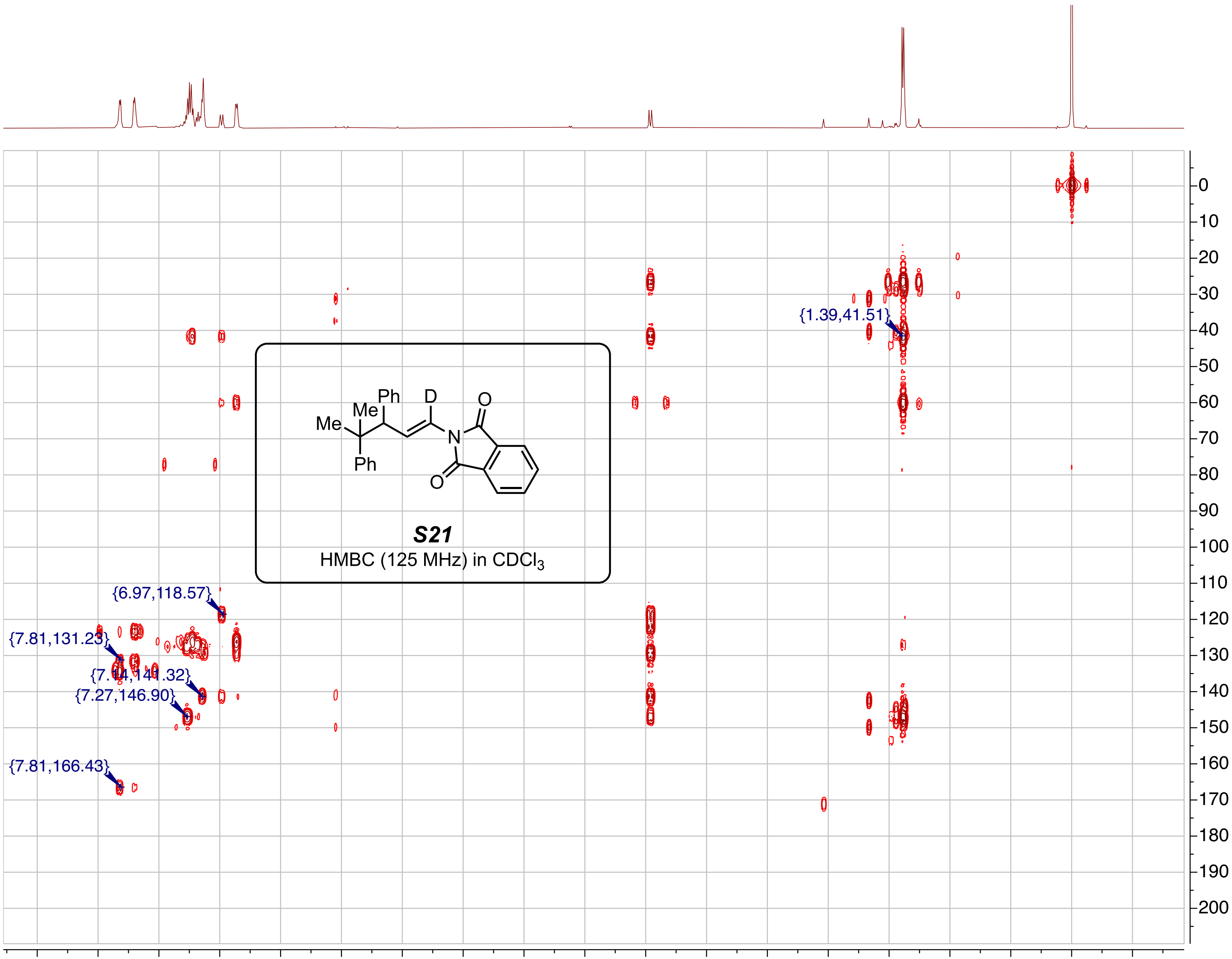

179.28
179.25
146.83
146.67
143.34
143.08
138.35
137.83
128.89
128.45
128.41
128.04
126.53
126.52
125.99
125.97
125.13
124.95
77.16 CDCl3
43.61
43.38
42.75
41.36
41.25
41.20
41.17
39.61
39.55
29.32
29.28
28.15
26.57
26.51
24.87
24.30
23.49
23.44
14.15
0.14 TMS
n-Bu
Me
Ph
O
N
t-Bu
Me
2v
13C NMR (125 MHz) in CDCl3
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1

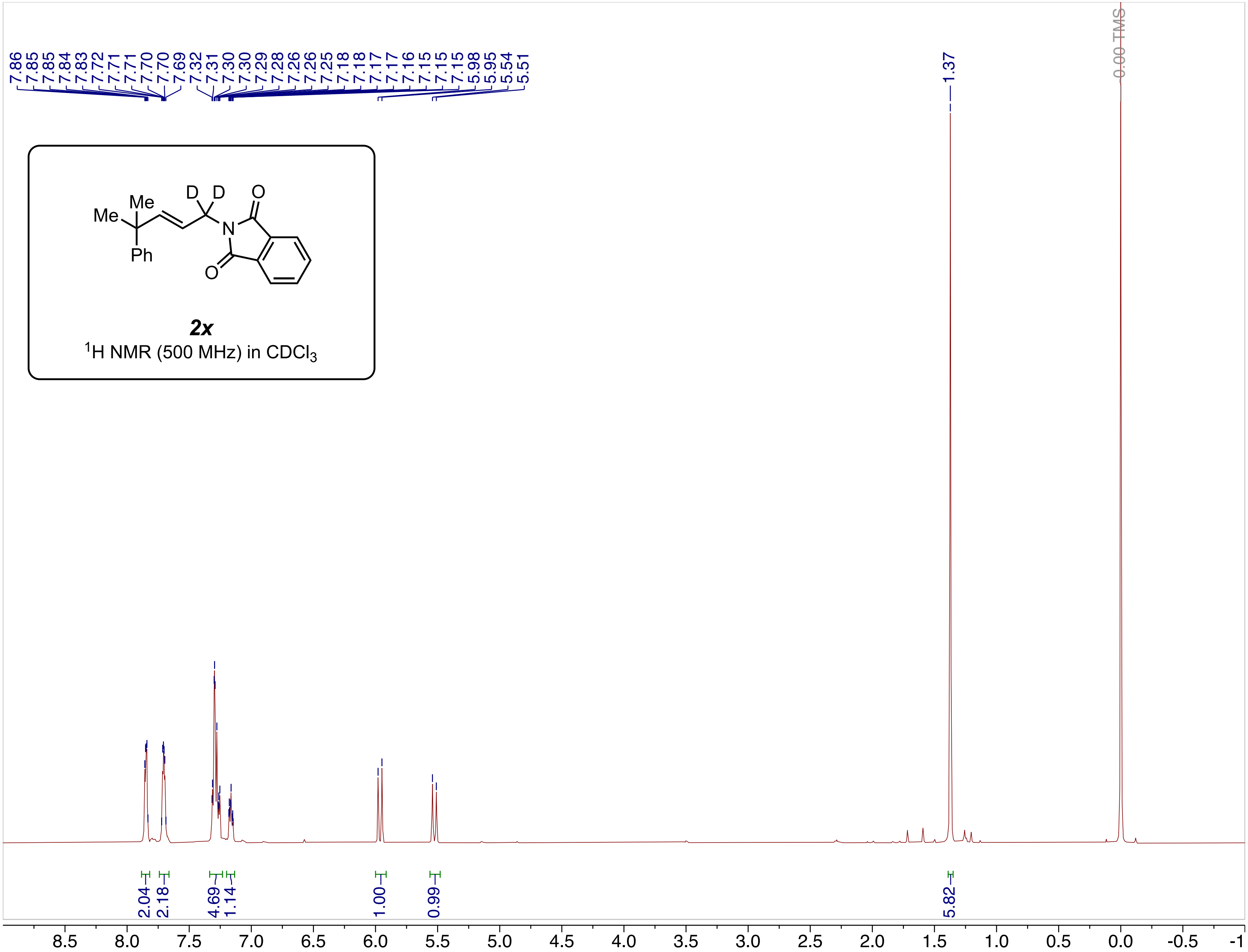

7.48
7.48
7.47
7.47
7.46
7.32
7.32
7.31
7.31
7.30
7.30
7.30
7.29
7.29
7.28
7.28
7.28
7.27
7.26
7.26
7.25
7.25
7.24
7.24
7.23
7.21
7.21
7.20
7.19
7.19
7.18
7.17
7.17
7.16
7.16
7.15
7.15
7.15
7.14
7.10
7.10
7.09
7.09
7.09
5.52
5.44
5.44
5.42
5.42
3.11
3.04
2.24
2.22
1.51
1.49
1.49
1.48
1.48
1.26
1.22
1.21
1.20
1.19
1.18
1.17
0.83
0.82
0.80
0.79
0.00 TMS
Me
n-Bu
Ph
O
N
Ph
Me
2w
^{1}H NMR (500 MHz) in CDCl$_3$
2.02
13.79
0.44
0.56
1.64
1.33
0.46
0.59
0.58
0.46
1.17
1.11
1.91
3.49
1.23
1.25
3.09
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


171.58
171.49
147.00
142.18
137.20
136.84
135.96
130.20
128.96
128.91
128.29
128.22
127.69
127.65
127.61
126.41
126.38
125.82
124.16
123.94
77.16 CDCl3
43.49
42.61
41.98
41.84
41.10
35.72
26.47
26.44
24.56
24.37
23.46
23.40
14.15
0.13 TMS
Me
Ph
O
n-Bu
N
Ph
Me
2w
13C NMR (125 MHz) in CDCl3
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.83
7.82
7.82
7.81
7.71
7.70
7.70
7.69
7.30
7.29
7.28
7.26
7.25
7.24
7.23
7.22
7.19
7.18
7.16
7.15
7.14
7.13
7.13
7.00
6.97
6.87
6.87
6.86
6.85
3.47
3.45
1.39
1.38
0.00 TMS
Ph
Me
Me
Ph
D
O
N
O
S21
^{1}H NMR (500 MHz) in CDCl$_3$
2.19
2.24
4.78
4.09
0.95
1.86
0.94
6.00
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1

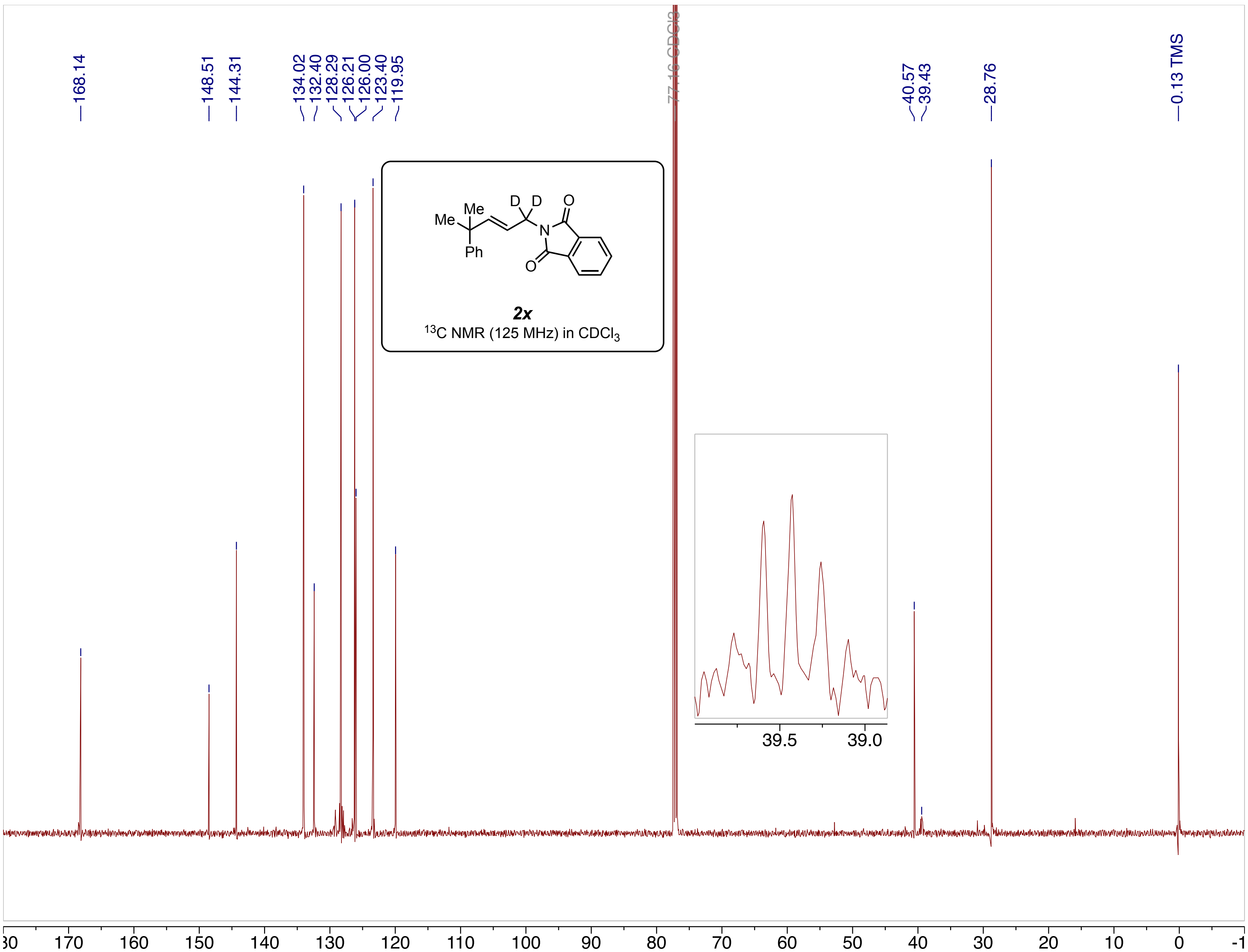
Ph
D
O
Me
Me
N
Ph
O
S21
HSQC (125 MHz) in $CDCl_3$
{1.39,26.56}
{3.47,59.93}
{7.82,123.44}
{6.99,121.99}
{6.86,129.41}
{7.70,134.25}
{7.26,127.64}
{7.18,125.86}
{7.26,127.64}
{7.14,127.47}
{7.24,127.31}
125
130
7.4
7.3
7.2
7.1
7.0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

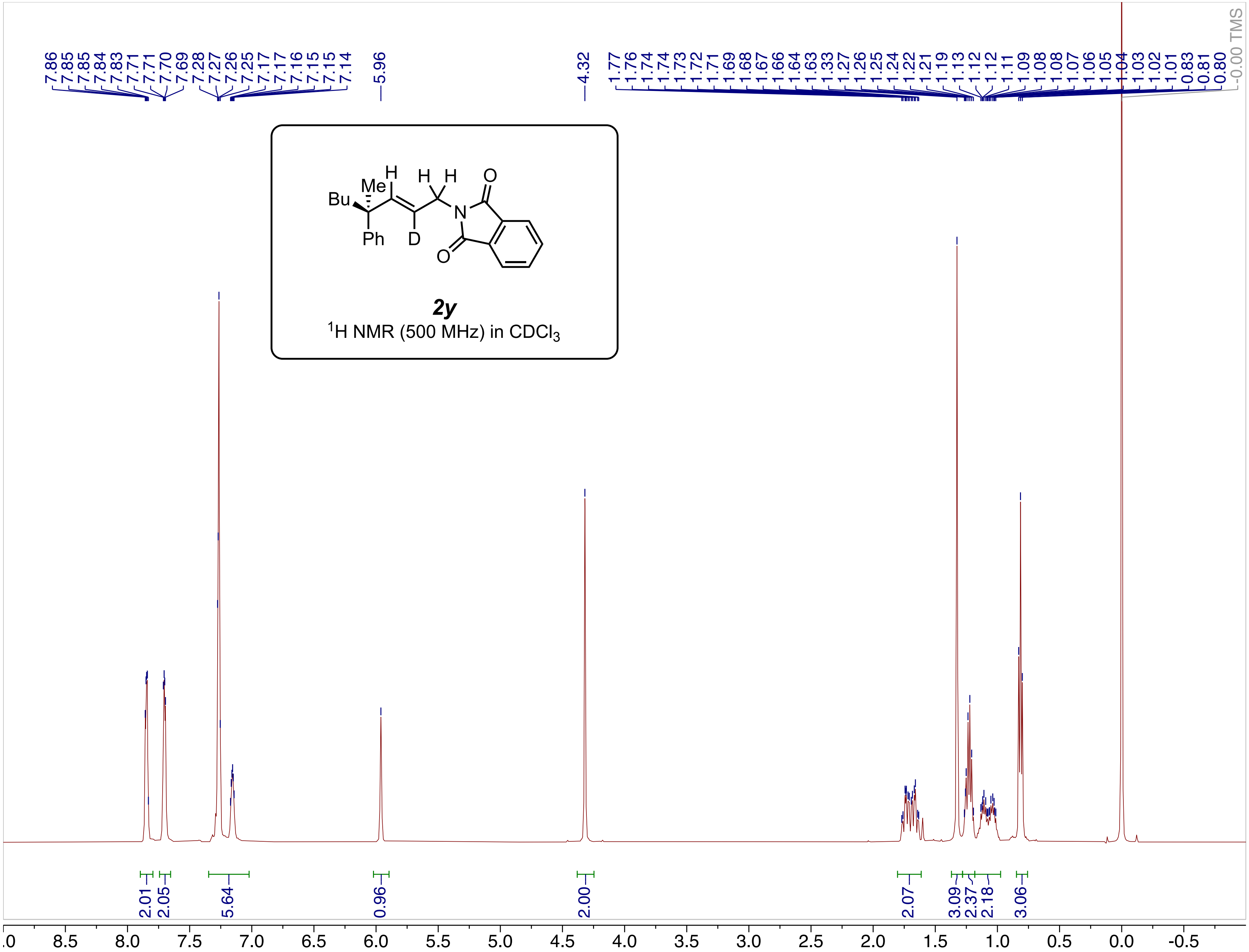

Ph
D
O
Me
Me
N
Ph
O
S21
HMBC (125 MHz) in CDCl3
{1.39,41.51}
{6.97,118.57}
{7.81,131.23}
{7.14,141.32}
{7.27,146.90}
{7.81,166.43}
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200



2x

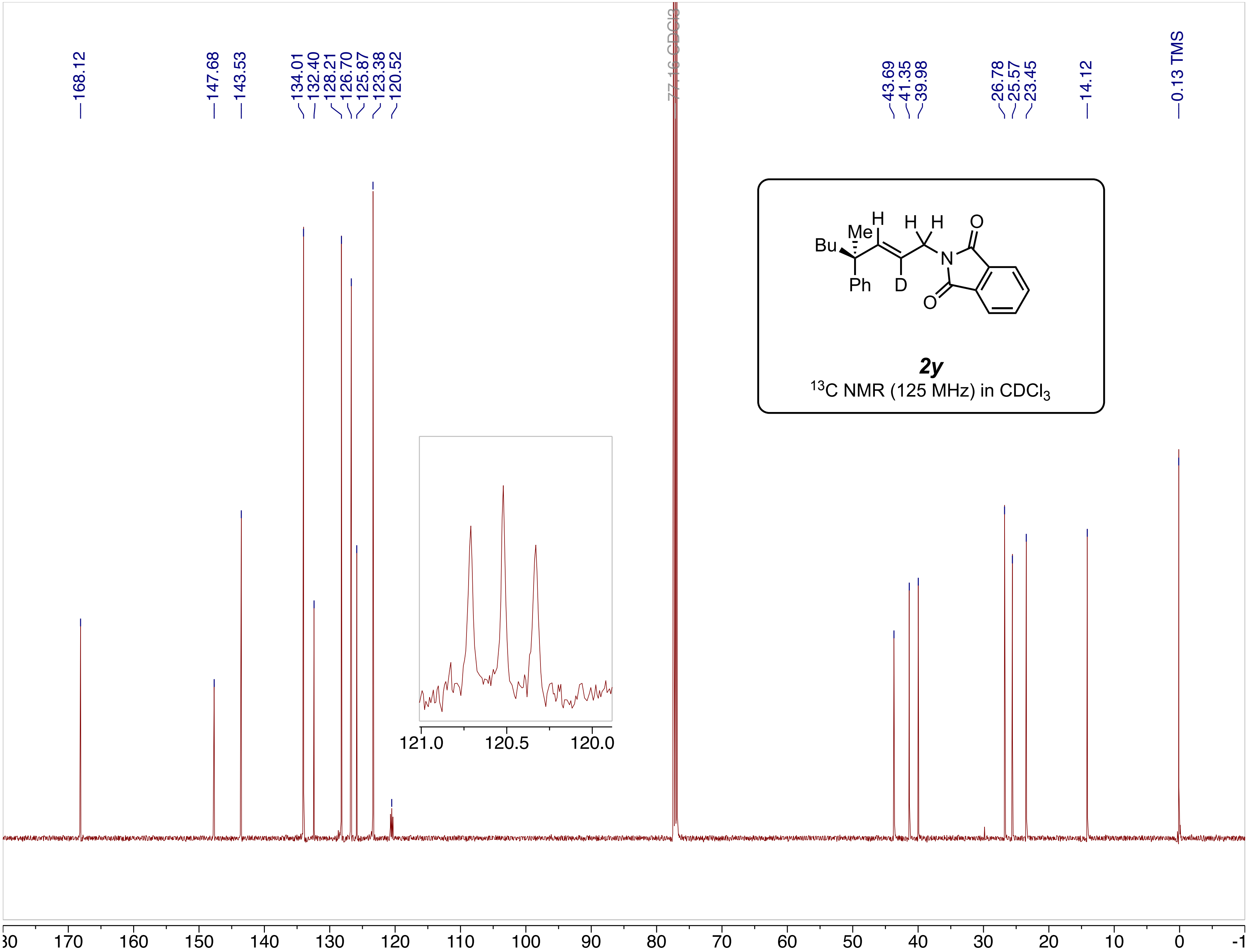
^{1}H NMR (500 MHz) in $CDCl_3$


168.14
148.51
144.31
134.02
132.40
128.29
126.21
126.00
123.40
119.95
77.16 CDCl3
40.57
39.43
28.76
0.13 TMS
Me
Me
Ph
D
D
O
N
O
2x
^{13}C NMR (125 MHz) in CDCl$_3$
39.5
39.0
30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1



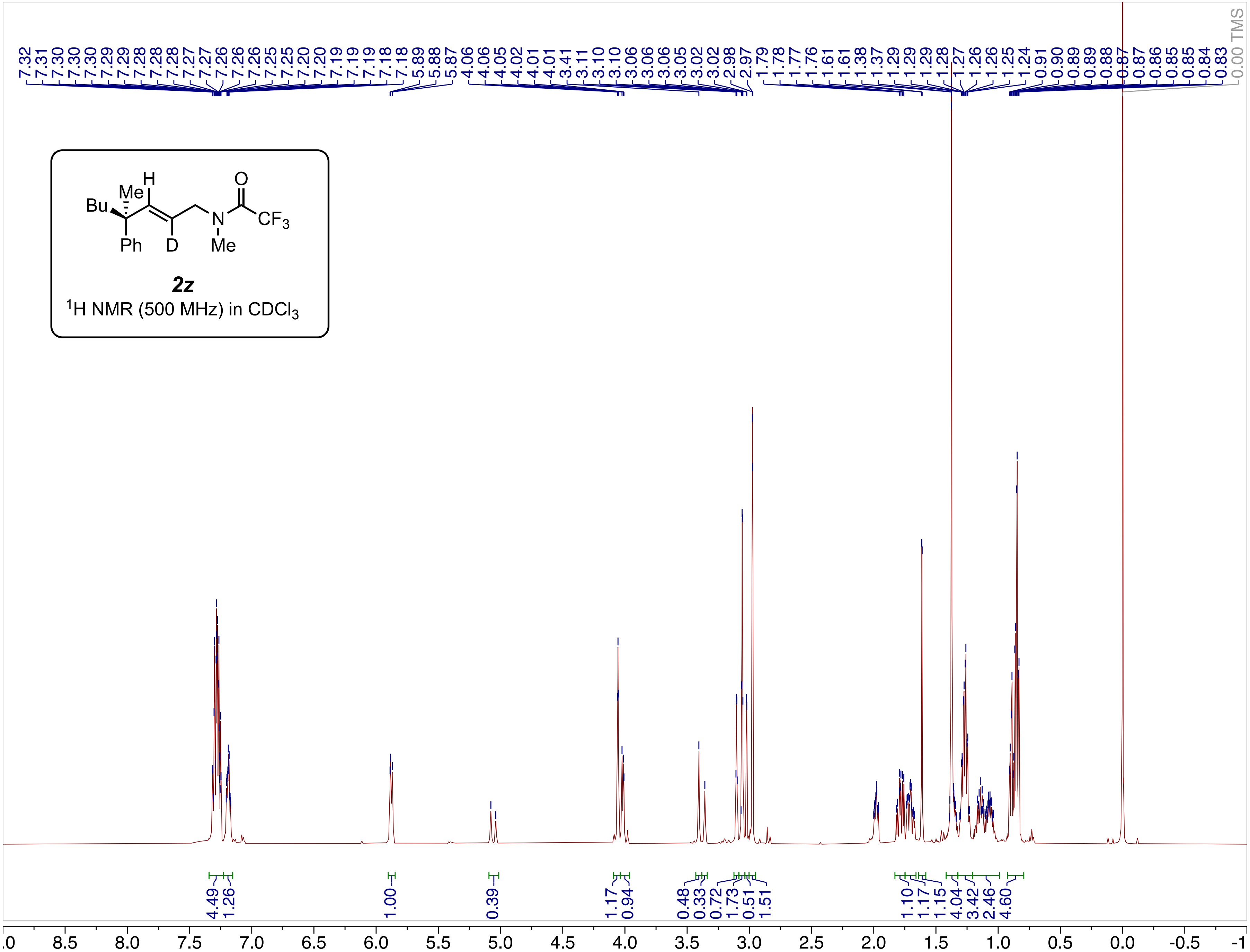
2y

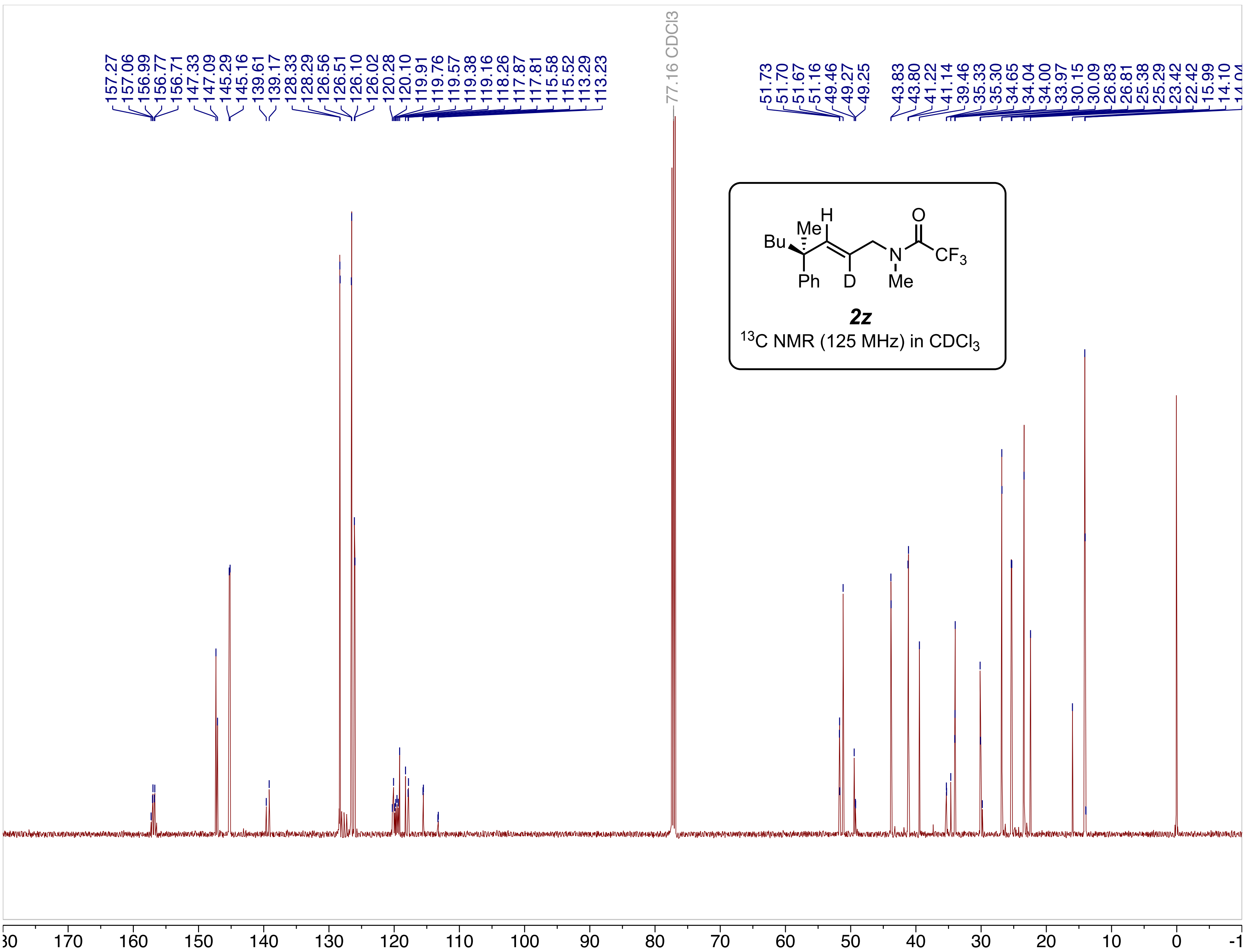
^{1}H NMR (500 MHz) in $CDCl_3$

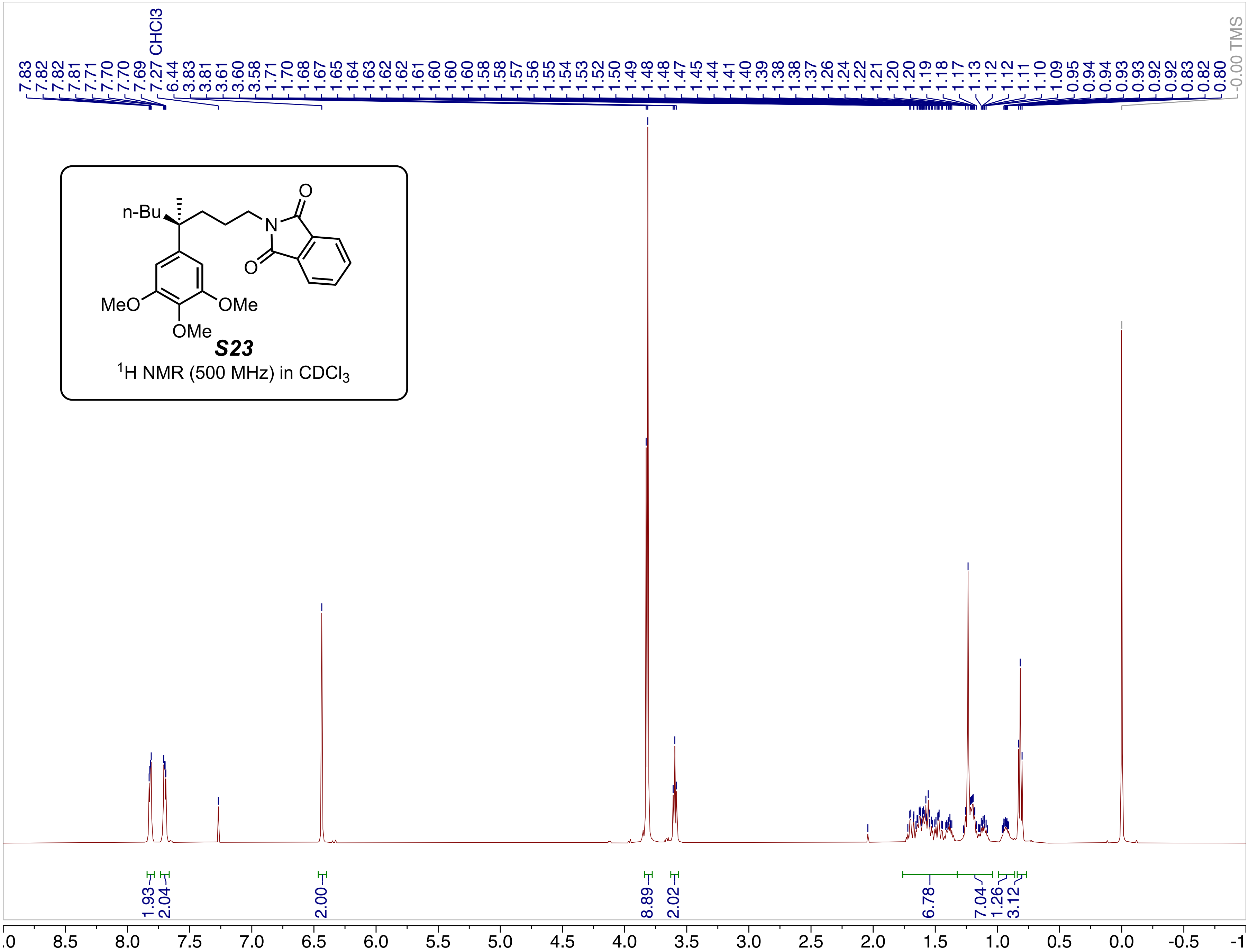


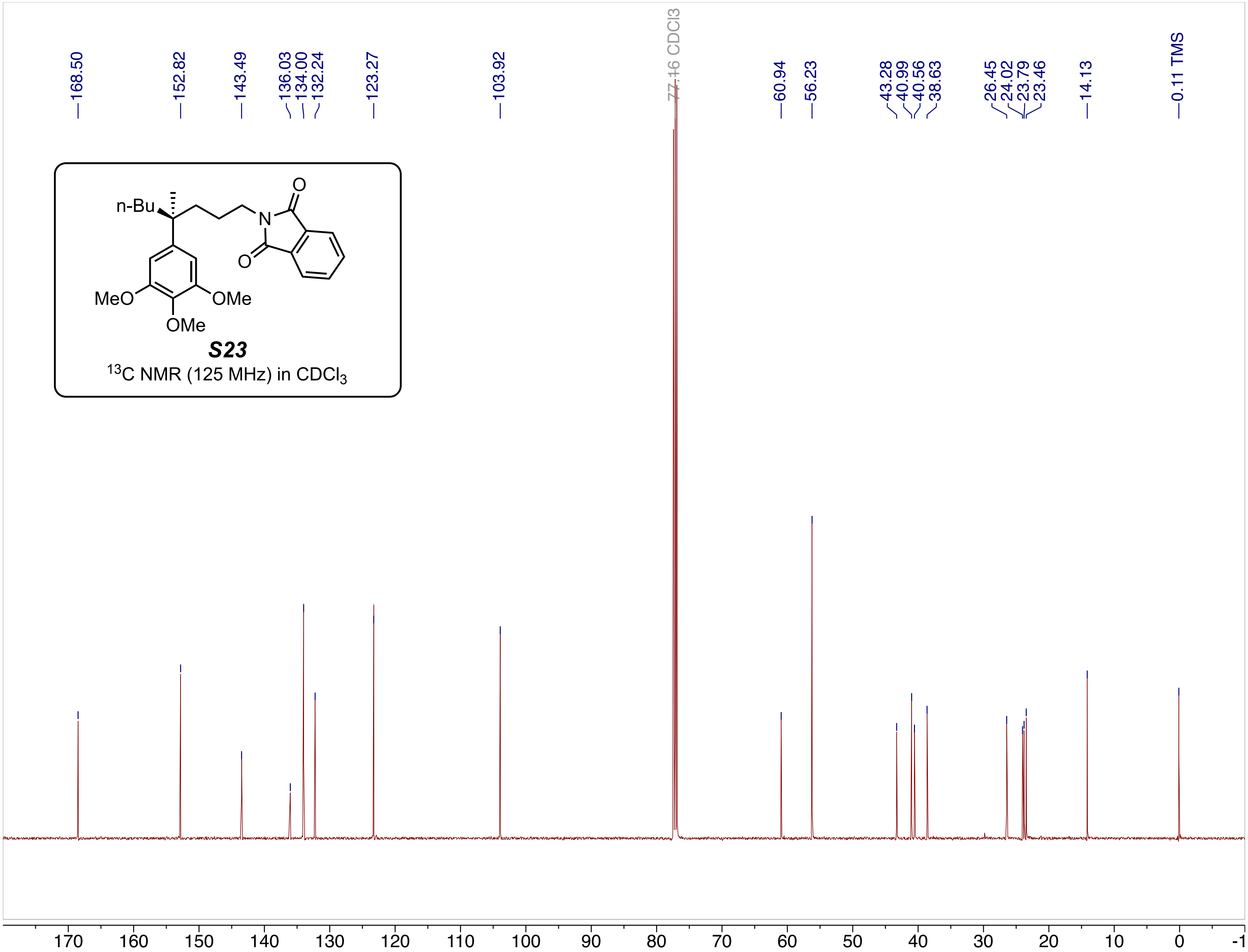
2y

^{13}C NMR (125 MHz) in CDCl$_3$

7.32
7.31
7.30
7.30
7.29
7.29
7.28
7.28
7.28
7.27
7.27
7.26
7.26
7.26
7.25
7.25
7.20
7.20
7.19
7.19
7.19
7.18
7.18
5.89
5.88
5.87
4.06
4.05
4.02
4.01
4.01
3.41
3.11
3.10
3.10
3.06
3.06
3.06
3.05
3.02
3.02
2.98
2.97
1.79
1.78
1.77
1.76
1.61
1.61
1.38
1.37
1.29
1.29
1.29
1.28
1.27
1.26
1.26
1.25
1.24
0.91
0.90
0.89
0.89
0.88
0.87
0.87
0.86
0.85
0.85
0.84
0.83
0.00 TMS
H
Me
Bu
O
N
CF3
Ph
D
Me
2z
1H NMR (500 MHz) in CDCl3
4.49
1.26
1.00
0.39
1.17
0.94
0.48
0.33
0.72
1.73
0.51
1.51
1.10
1.17
1.15
4.04
3.42
2.46
4.60
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


157.27
157.06
156.99
156.77
156.71
147.33
147.09
145.29
145.16
139.61
139.17
128.33
128.29
126.56
126.51
126.10
126.02
120.28
120.10
119.91
119.76
119.57
119.38
119.16
118.26
117.87
117.81
115.58
115.52
113.29
113.23
77.16 CDCl3
51.73
51.70
51.67
51.16
49.46
49.27
49.25
43.83
43.80
41.22
41.14
39.46
35.33
35.30
34.65
34.04
34.00
33.97
30.15
30.09
26.83
26.81
25.38
25.29
23.42
22.42
15.99
14.10
14.0
Bu
Me
H
Ph
D
N
Me
O
CF_3
2z
^{13}C NMR (125 MHz) in $CDCl_3$
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1


7.83
7.82
7.82
7.81
7.71
7.70
7.70
7.69
7.27 CHCl3
6.44
3.83
3.81
3.61
3.60
3.58
1.71
1.70
1.68
1.67
1.65
1.64
1.63
1.62
1.62
1.61
1.60
1.60
1.60
1.58
1.58
1.57
1.56
1.55
1.54
1.53
1.52
1.50
1.49
1.48
1.48
1.47
1.45
1.44
1.41
1.40
1.39
1.38
1.38
1.37
1.26
1.24
1.22
1.21
1.20
1.20
1.19
1.18
1.17
1.13
1.12
1.12
1.11
1.10
1.09
0.95
0.94
0.94
0.93
0.93
0.92
0.92
0.83
0.82
0.80
-0.00 TMS
n-Bu
N
O
O
MeO
OMe
OMe
S23
¹H NMR (500 MHz) in CDCl₃
1.93
2.04
2.00
8.89
2.02
6.78
7.04
1.26
3.12
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1


168.50
152.82
143.49
136.03
134.00
132.24
123.27
103.92
77.16 CDCl3
60.94
56.23
43.28
40.99
40.56
38.63
26.45
24.02
23.79
23.46
14.13
0.11 TMS
n-Bu
N
O
O
MeO
OMe
OMe
S23
^{13}C NMR (125 MHz) in CDCl$_3$
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1