Electronic Supplementary Information

Silyl-Mediated Photoredox-Catalyzed Giese Reaction: addition of non-activated alkyl bromides

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1. Experimental Procedures

General Techniques: All commercially available reagents and anhydrous solvents including 1,4-dioxane, tetrahydrofuran (THF), *N*,*N*-dimethylformamide (DMF), acetonitrile (MeCN), dimethoxyethane (DME), dimethylsulfoxide (DMSO), dichloromethane, methanol (MeOH) and isopropanol (IPA), were purchased from commercial suppliers and used without further purification. All reactions were performed under an inert nitrogen atmosphere unless otherwise stated. All reactions were monitored by liquid chromatography-mass spectrometry (LC-MS) using a Waters Acquity UPLC. Flash column chromatography was carried out with pre-packed silica gel cartridges (RediSep Rf Gold 24 grams) and performed using a Teledyne ISCO CombiFlash Rf 150. High performance liquid chromatography (HPLC) purification on Gilson PLC 2020 unit with Waters SunFire C18 OBD 5 µm 30 x 150 mm prep column Yields refer to chromatographically and spectroscopically homogenous materials.

Infrared spectra (IR) were recorded on a PerkinElmer Spectrum 100 Optica FT-IR spectrometer. Only the strongest and/or structurally important absorption of infrared (IR) spectra are reported in reciprocal centimeters (υ, cm-1). ^{1}H NMR spectra (500 or 600 MHz) and ^{13}C{1H} NMR spectra (125 or 150 MHz), and were recorded on a Varian Inova 500 MHz NMR spectrometer or a Varian Inova 600 MHz NMR spectrometer in deuterated $CDCl_3$. Chemical shift (δ) values are reported in delta (δ) units, parts per million (ppm). Chemical shifts for ^{1}H NMR spectra are given relative to signals for internal tetramethylsilane (0.00 ppm) and residual non-deuterated $CDCl_3$ (7.26 ppm). Chemical shifts for ^{13}C NMR spectra are given relative to the signal of $CDCl_3$ (77.0 ppm). Multiples are reported by the following abbreviations: s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, m = multiplet or overlap of nonequivalent resonances. Coupling constants (J) are reported in Hertz (Hz). Low and high resolution mass spectra were measured on TOFMS with an EI, FAB or ES spectra using Waters Acquity UPLC / Waters Xevo G2 QTof instrument.

Materials

All aryl halides, Michael acceptors and catalysts $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$, $Ir(ppy)_2(dtbbpy)PF_6$, $Ru(bpz)_3(PF_6)_2$ and $Ru(bpy)_3(PF_6)_2$ were purchased from Sigma Aldrich, Strem Chemicals, or Frontier Scientific. Tris-trimethylsilyldeuterosilane (95.8%) was purchased from EAG Laboratories (2672 Metro Blvd. Maryland Heights, MO-63043).

Light Sources

The light sources used for all photoredox reactions were either the Aldrich® Micro Photochemical Reactor (**ring**), Kessil® A160WE Tuna Blue Light (**lamp**), or the 13.2W Merck Integrated Photoreactor (**reactor**).[1]

General Procedures

General procedure for screening of catalysts and solvents (Table S1).

In a 1-dram vial were added *N*-phenylmetacrylamide (**1**) (20 mg, 0.12 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (33 mg, 0.12 mmol, 1.0 equiv.), Na_2CO_3 (26 mg, 0.25 mmol, 2.0 equiv.) and the appropriate photocatalyst (0.001 mmol, 0.01 equiv.). Solvent was added to the vials (600 µL) followed by tris(trimethylsilyl)silane (40 µL, 0.12 mmol, 1.0 equiv.). Vials were purged with nitrogen and then sealed. The reactions were then set on the Aldrich® Micro Photochemical Reactor overnight (16 h). Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques.

General procedure for screening of bases (Table S2).

A stock solution was prepared containing *N*-phenylmetacrylamide (**1**) (200 mg, 1.2 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (333 mg, 1.2 mmol, 1.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.012 mmol, 0.01 equiv.) in MeOH (6 mL) or MeCN (6 mL). 1/10 (V/V) of the resulting solution was added to a 1-dram vial containing the appropriate base (0.25 mmol, 2.0 equiv.). Tris(trimethylsilyl)silane (40 µL, 0.13 mmol, 1.05 equiv.) was added to the mixture, which was then purged with nitrogen and sealed. Reactions were irradiated on the Aldrich® Micro Photochemical Reactor overnight (16 h). Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques.

General procedure for screening of equivalents of $(Me_3Si)_3SiH$ (Table S3).

A stock solution was prepared containing *N*-phenylmetacrylamide (**1**) (200 mg, 1.2 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (333 mg, 1.2 mmol, 1.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.012 mmol, 0.01 equiv.) in MeOH (6 mL). 1/10 (V/V) of the resulting solution was added to a 1-dram vial containing Na_2CO_3 (0.25 mmol, 2.0 equiv.). The appropiate amount of tris(trimethylsilyl)silane (see Table S3) was added to the mixture, which was then purged with nitrogen and sealed. Reactions were irradiated on the Aldrich® Micro Photochemical Reactor overnight (16 h). Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques.

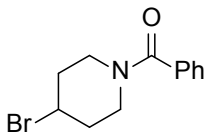
General procedure for screening of equivalents of reactants (Table S4).

In a 1-dram vial were the appropriate amount of *N*-phenylmetacrylamide (**1**) (see Table S4) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (see Table S4) followed by Na_2CO_3 (26 mg, 0.25 mmol, 2.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.012 mmol, 0.01 equiv.). MeOH (600 µL) was added to the vials followed by tris(trimethylsilyl)silane (40 µL, 0.12 mmol, 1.0 equiv.). Vials were purged with nitrogen and then sealed. The reactions were then set on the Aldrich® Micro Photochemical Reactor overnight (16 h). Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques.

Comparison of reaction rates under different light sources (Table S5).

In a 1-dram vial were added *N*-phenylmetacrylamide (**1**) (20 mg, 0.124 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (50 mg, 0.19 mmol, 1.5 equiv.), Na_2CO_3 (26 mg, 0.25 mmol, 2.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.0012 mmol, 0.01 equiv.). MeOH (600 µL) was added to the vials followed by tris(trimethylsilyl)silane (28.7 µL, 0.093 mmol, 0.75 equiv. or 38.3 µL, 0.124 mmol, 1.0 equiv.). Vials were purged with nitrogen and then sealed. The reactions were then exposed to the specified light source and assay yields for desired product and remaining starting materials were determined at the specified time points by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques.

Synthesis of (4-bromopiperidin-1-yl)(phenyl)methanone (2)

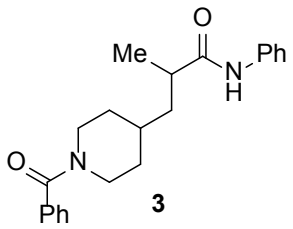


2

To a suspension of 4-bromopiperidine hydrobromide (8.0 g, 32.7 mmol) in THF (80 mL) was added diisopropylethylamine (12.6 mL, 71.8 mmol) and the mixture cooled to 10 ºC with an ice bath. Benzoyl chloride (3.8 mL, 32.7 mmol) was added portionwise over 10 minutes. The resulting slurry was allowed to warm up to ambient temperature and aged overnight. The reaction was quenched with 250 mL of a 5% of $NaHCO_3$ aqueous solution and extracted with 200 mL of ethyl acetate. The organic layer was washed with 200 mL of water, and then with 200 mL of a 20% NaCl aqueous solution. The resulting organic layer was dried with $MgSO_4$, filtered and concentrated at reduced pressure. The resulting pale yellow oil was dissolved in 15 mL of ethyl acetate and 45 mL of hexanes were added slowly over 45 minutes. The resulting white solids were filtered, washed with 10 mL of an ethyl acetate/hexanes mixture (1:3; v/v) and dried overnight at ambient temperature to yield the title compound as a white solid (Yield: 71%, 6.2 g, 23.1 mmol). Analytical data matched reported data.[2]

IR (neat) *υ* 3289, 2929, 1600, 1543, 1499, 1442, 1285, 1171, 757 cm^{-1}. **^{1}H NMR** (500 MHz, CDCl3) δ 7.35 – 7.43 (m, 5H), 4.47 – 4.38 (m, 1H), 3.96 (br s, 1H), 3.70 (br s, 1H), 3.65 (br s, 1H), 3.34 (br s, 1H), 2.19 (br s, 1H), 2.05 (br s, 2H), 1.92 (br s, 1H). **^{13}C NMR** (125MHz, CDCl3): δ 170.3, 135.5, 129.6, 128.4, 126.7, 48.7, 45.7, 40.2, 35.9, 35.2. **HR-MS** (ESI+): m/z calcd. for $C_{12}H_{14}BrNO$ $[M+H]^+$ 268.0337, found 268.0340.

Synthesis of 3-(1-benzoylpiperidin-4-yl)-2-methyl-*N*-phenylpropanamide (3)



3

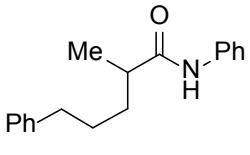
In a 1-dram vial were added *N*-phenylmetacrylamide (**1**) (100 mg, 0.62 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.), sodium carbonate (131 mg, 1.24 mmol, 2.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (7 mg, 0.006 mmol, 0.01 equiv.). MeOH (2 mL) was added followed by tris(trimethylsilyl)silane (145 µL, 0.46 mmol, 0.75 equiv.). The vial was purged with nitrogen and then sealed. The vial was placed in the integrated photoreactor (100% intensity, 6000rpm fan, 1000 rpm stirring) until the starting acceptor was completely consumed (1h). After the reaction was completed, volatiles were removed at reduced pressure. The resulting residue was dissolved in DMSO (1 mL), filtered and purified by HPLC: eluted with a 15 minute gradient of 90% water/MeCN (0.1% TFA) to 5% water/MeCN (both 0.1% TFA) with a flow rate of 25 ml/min. The fractions were concentrated to provide product **3** as a white solid (159 mg, 0.454 mmol, 73% yield).

IR (neat) *υ* 3289, 2929, 1600, 1543, 1499, 1442, 1285, 1171, 757 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.71 (br s, 1H), 7.54 – 7.47 (m, 2H), 7.45 – 7.33 (m, 5H), 7.30 (t, *J* = 7.4 Hz, 2H), 7.10 (t, *J* = 7.3 Hz, 1H), 4.70 (d, *J* = 11.2 Hz, 1H), 3.72 (m, 1H), 2.99 (m, 1H), 2.76 (m, 1H), 2.51 (sextet, *J* = 7.0 Hz, 1H), 1.97 – 1.74 (m, 2H), 1.73 – 1.57 (m, 2H), 1.47 – 1.07 (m, 3H), 1.23 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 174.7, 170.4, 138.2, 136.4, 129.7, 129.1, 128.7, 126.9, 124.3, 120.0, 48.1, 42.5, 40.9, 39.6, 34.2, 33.5, 31.9, 19.2, 18.2 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{22}H_{26}N_2O_2$ $[M+H]^+$ 351.2072, found 351.2074.

General procedure for preparation of compounds 7 – 25:

In a 1-dram vial were added *N*-phenylmetacrylamide (**1**) (100 mg, 0.62 mmol, 1.0 equiv.), the corresponding alkyl bromide, Na_2CO_3 (131 mg, 1.24 mmol, 2.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (7 mg, 0.006 mmol, 0.01 equiv.). MeOH (2 mL) was added followed by $(Me_3Si)_3SiH$ (145 µL, 0.46 mmol, 0.75 equiv.). The vial was purged with nitrogen and then sealed. The vial was placed in the integrated photoreactor (100% intensity, 6000 rpm fan, 1000 rpm stirring) until the starting acceptor was completely consumed (1h for secondary and tertiary bromides or 2h for primary bromides). After the reaction was completed, volatiles were removed at reduced pressure. The resulting residue was dissolved in DMSO (1 mL), filtered and purified by HPLC: eluted with a 15 minute gradient of 90% water/MeCN (0.1% TFA) to 5% water/MeCN (both 0.1% TFA) with a flow rate of 25 ml/min. The fractions were concentrated to provide the final products.

Synthesis of 2-methyl-*N*,5-diphenylpentanamide (7)

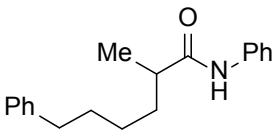


7

Synthesized according to general method using (2-bromoethyl)benzene (171 mg, 0.93 mmol, 1.5 equiv.) to provide product **7** as a white solid (105 mg, 0.393 mmol, 63% yield). **IR** (neat) *υ* 3295, 3061, 3026, 2967, 2933, 2857, 1659, 1600, 1540, 1498, 1441, 1308, 1249, 752 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.52 (d, *J* = 7.9 Hz, 2H), 7.35 – 7.28 (m, 4H),

7.20 – 7.14 (m, 3H), 7.11 – 7.06 (m, 2H), 2.69 – 2.56 (m, 2H), 2.36 – 2.26 (m, 1H), 1.85 – 1.75 (m, 1H), 1.72 – 1.64 (m, 2H), 1.56 – 1.46 (m, 1H), 1.24 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 174.7, 142.2, 138.0, 129.1, 128.6, 128.5, 126.0, 124.3, 119.9, 42.8, 36.0, 34.2, 29.4, 18.1 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{18}H_{21}NO$ $[M+H]^+$ 268.1701, found 268.1700.

Synthesis of 2-methyl-*N*,6-diphenylhexanamide (8)

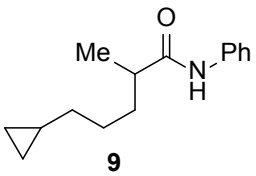


8

Synthesized according to general method using (3-bromopropyl)benzene (184 mg, 0.93 mmol, 1.5 equiv.) to provide product **8** as a white solid (82 mg, 0.292 mmol, 47% yield).

IR (neat) *υ* 3294, 3137, 3061, 3026, 2967, 2931, 2856, 1658, 1599, 1537, 1499, 1453, 1439, 1307, 748 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.51 (d, *J* = 7.9 Hz, 2H), 7.30 (t, *J* = 7.9 Hz, 2H), 7.27 – 7.21 (m, *3*H), 7.18 – 7.13 (m, 3H), 7.09 (t, *J* = 7.4 Hz, 1H), 2.59 (td, *J* = 9.0, 4.5 Hz, 2H), 2.30 (sext, *J* = 6.8 Hz, 1H), 1.82 – 1.73 (m, 1H), 1.63 (qui, *J* = 7.6 Hz, 2H), 1.52 – 1.43 (m, 1H), 1.43 – 1.34 (m, 2H), 1.21 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 174.9, 142.6, 138.1, 129.1, 128.5, 128.4, 125.8, 124.3, 120.0, 42.7, 35.8, 34.3, 31.5, 27.2, 18.0 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{19}H_{23}NO$ $[M+H]^+$ 282.1858, found 282.1867.

Synthesis of 5-cyclopropyl-2-methyl-*N*-phenylpentanamide (9):

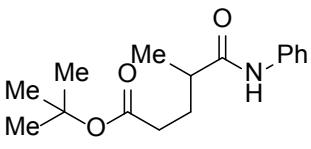


9

Synthesized according to general method using (2-bromoethyl)cyclopropane (138 mg, 0.93 mmol, 1.5 equiv.) to provide product **9** as a white solid (70 mg, 0.303 mmol, 49% yield).

IR (neat) *υ* 3296, 2928, 1660, 1601, 1542, 1500, 1308, 1250, 753 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.54 (d, *J* = 7.9 Hz, 2H), 7.34 – 7.28 (m, 3H), 7.10 (t, *J* = 7.8 Hz, 1H), 2.38 – 2.30 (m, 1H), 1.83 – 1.71 (m, 1H), 1.54 – 1.40 (m, 3H), 1.28 – 1.17 (m, 5H), 0.68 – 0.59 (m, 1H), 0.42 – 0.35 (m, 2H), 0.02 – -0.05 (m, 2H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 175.2, 138.1, 129.2, 124.4, 120.1, 42.9, 34.8, 34.4, 27.7, 18.1, 10.8, 4.6, 4.5 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{15}H_{21}NO$ $[M+H]^+$ 232.1701, found 232.1713.

Synthesis of tert-butyl 4-methyl-5-oxo-5-(phenylamino)pentanoate (10)

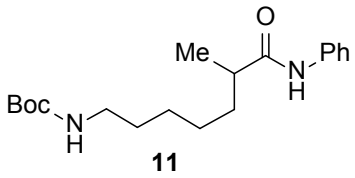


10

Synthesized according to general method using *tert*-butyl 2-bromoacetate (180 mg, 0.93 mmol, 1.5 equiv.) to provide product **10** as a white solid (70 mg, 0.253 mmol, 41% yield).

IR (neat) *υ* 3306, 2976, 1729, 1662, 1601, 1541, 1500, 1442, 1368, 1309, 1251, 1153, 755 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.81 (br s, 1H), 7.54 (d, *J* = 8.0 Hz, 2H), 7.32 (t, *J* = 7.8 Hz, 2H), 7.10 (t, *J* = 7.4 Hz, 1H), 2.52 – 2.43 (m, 1H), 2.39 – 2.25 (m, 2H), 2.04 – 1.94 (m, 1H), 1.80 – 1.70 (m, 1H), 1.46 (s, 9H), 1.24 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 174.4, 174.2, 137.9, 129.0, 124.3, 119.9, 80.9, 41.0, 33.1, 29.8, 28.1, 17.4 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{16}H_{23}NO_3$ [M-H] 276.1600, found 276.1609.

Synthesis of tert-butyl (6-methyl-7-oxo-7-(phenylamino)heptyl)carbamate (11)

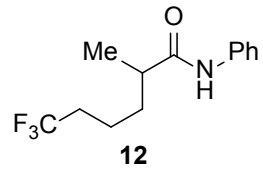


11

Synthesized according to general method using *tert*-butyl (4-bromobutyl)carbamate (233 mg, 0.93 mmol, 1.5 equiv.) to provide product **11** as a white solid (90 mg, 0.269 mmol, 43% yield).

IR (neat) υ 3305, 2974, 2933, 2859, 1665, 1600, 1533, 1500, 1440, 1366, 1248, 1163, 754 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.68 (br s, 1H), 7.57 (d, 7.7 Hz, 2H), 7.31 (t, *J* = 7.9 Hz, 2H), 7.09 (t, *J* = 7.4 Hz, 1H), 4.55 (br, 1H), 3.20 – 3.10 (m, 1H), 3.10 – 3.00 (m, 1H), 2.42 – 2.30 (m, 2H), 1.82 – 1.72 (m, 1H), 1.44 (s, 9H), 1.50 – 1.41 (m, 2H), 1.39 – 1.29 (m, 4H), 1.22 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.2, 156.3, 138.3, 129.0, 124.2, 119.9, 79.3, 42.3, 40.2, 34.4, 30.0, 28.6, 26.9, 26.4, 18.2 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{19}H_{30}N_2O_3$ $[M+H]^+$ 335.2334, found 335.2345.

Synthesis of diethyl 6,6,6-trifluoro-2-methyl-*N*-phenylhexanamide (12)

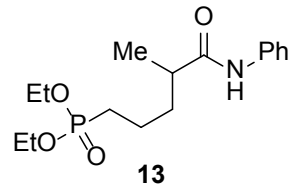


12

Synthesized according to general method using 3-bromo-1,1,1-trifluoropropane (164 mg, 0.93 mmol, 1.5 equiv.) to provide product **12** as a white solid (56 mg, 0.216 mmol, 35% yield).

IR (neat) υ 3289, 2972, 1658, 1600, 1540, 1500, 1387, 1308, 1248, 1150, 1132, 1113, 1043, 754 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.52 (d, J = 7.9 Hz, 2H), 7.35 (br s, 1H), 7.33 (q, J = 9.4, 8.0 Hz, 3H), 7.11 (t, J = 7.4 Hz, 1H), 2.40 – 2.30 (m, 1H), 2.13 – 2.01 (m, 2H), 1.87 – 1.77 (m, 1H), 1.60 (p, J = 7.8 Hz, 2H), 1.57 – 1.47 (m, 1H), 1.25 (d, J = 6.9 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 174.2, 137.7, 129.0, 126.9 (q, J = 274 Hz), 124.4, 120.0, 42.3, 33.7 (q, J = 28.1 Hz), 33.1, 20.0 (q, J = 3.2 Hz), 18.0 ppm. **^{19}F NMR** (470 MHz, $CDCl_3$) δ -66.30 (s, 3F) ppm. **HR-MS** (ESI+): m/z calcd. for $C_{13}H_{16}F_3NO$ $[M+H]^+$ 260.1262, found 260.1265.

Synthesis of diethyl (4-methyl-5-oxo-5-(phenylamino)pentyl)phosphonate (13)

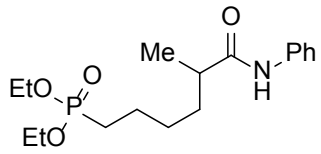


13

Synthesized according to general method using diethyl (2-bromoethyl)phosphonate (226 mg, 0.93 mmol, 1.5 equiv.) to provide product **13** as a white solid (115 mg, 0.352 mmol, 57% yield).

IR (neat) υ 3266, 2980, 2935, 1687, 1665, 1600, 1544, 1497, 1441, 1306, 1208, 1156, 1050, 755 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.23 (br s, 1H), 7.59 (d, *J* = 7.8 Hz, 2H), 7.30 (t, *J* = 7.9 Hz, 2H), 7.08 (t, *J* = 7.4 Hz, 1H), 4.14 – 4.01 (m, 4H), 2.52 – 2.42 (m, 1H), 1.95 – 1.84 (m, 1H), 1.84 – 1.74 (m, 2H), 1.73 – 1.63 (m, 2H), 1.59 – 1.48 (m, 1H), 1.31 (t, *J* = 7.1 Hz, 3H), 1.27 (t, *J* = 7.1 Hz, 3H), 1.21 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 174.8, 138.5, 129.0, 124.1, 119.9, 62.1 (t, *J* = 6.3 Hz), 41.2, 35.0 (d, *J* = 14.2 Hz), 25.0 (d, *J* = 143.7 Hz), 20.2 (d, *J* = 5.3 Hz), 17.7, 16.5 (t, *J* = 5.8 Hz) ppm. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 32.2 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{16}H_{26}NO_4P$ $[M+H]^+$ 328.1677, found 328.1681.

Synthesis of diethyl (5-methyl-6-oxo-6-(phenylamino)hexyl)phosphonate (14)

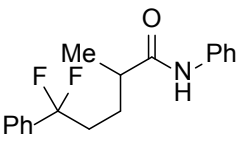


14

Synthesized according to general method using diethyl (3-bromopropyl)phosphonate (240 mg, 0.93 mmol, 1.5 equiv.) to provide product **14** as a white solid (110 mg, 0.322 mmol, 52% yield).

IR (neat) *υ* 3272, 3134, 2980, 2935, 2871, 1687, 1665, 1601, 1543, 1500, 1441, 1306, 1245, 1211, 1158, 1027, 962, 756 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.82 (br s, 1H), 7.56 (d, *J* = 7.9 Hz, 2H), 7.29 (t, *J* = 7.9 Hz, 2H), 7.07 (t, *J* = 7.4 Hz, 1H), 4.13 – 4.00 (m, 4H), 2.41 – 2.33 (m, 1H), 1.81 – 1.68 (m, 3H), 1.68 – 1.55 (m, 2H), 1.48 – 1.38 (m, 3H), 1.30 (t, *J* = 7.1 Hz, 3H), 1.28 (t, *J* = 7.1 Hz, 3H), 1.20 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 175.0, 138.4, 128.9, 124.1, 119.9, 61.9 (d, *J* = 6.5 Hz), 42.0, 33.8, 28.2 (d, *J* = 15.5 Hz), 25.3 (d, *J* = 140.5 Hz), 22.2 (d, *J* = 5.0 Hz), 18.1, 16.5 (d, *J* = 6.2 Hz) ppm. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 32.4 ppm **HR-MS** (ESI+): m/z calcd. for $C_{17}H_{28}NO_4P$ $[M+H]^+$ 342.1834, found 342.1843.

Synthesis of 5,5-difluoro-2-methyl-*N*,5-diphenylpentanamide (15)

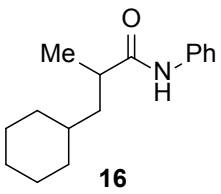


15

Synthesized according to general method using (2-bromo-1,1-difluoroethyl)benzene (205 mg, 0.93 mmol, 1.5 equiv.) to provide product **15** as a white solid (153 mg, 0.505 mmol, 81% yield).

IR (neat) *υ* 3296, 3064, 2968, 1658, 1658, 1600, 1540, 1499, 1441, 1309, 1247, 1175, 1077, 1026, 1002, 755 cm^{-1}. **^{1}H NMR** (500 MHz) *δ* 7.51 (d, *J* = 7.9 Hz, 2H), 7.47 – 7.42 (m, 2H), 7.42 – 7.38 (m, 3H), 7.32 – 7.27 (m, 3H), 7.10 (t, *J* = 7.4 Hz, 1H), 2.43 – 2.34 (m, 1H), 2.11 – 2.25 (m, 2H), 1.93 – 1.84 (m, 1H), 1.70 – 1.60 (m, 1H), 1.23 (d, *J* = 6.9 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 174.0, 137.8, 137.2, 129.8, 129.1, 128.6, 125.0 (t, *J* = 6.3 Hz), 124.4, 123.0, 120.0, 41.8, 36.7 (t, *J* = 28.4 Hz), 27.2 (t, *J* = 4.0 Hz), 18.1 ppm. **^{19}F NMR** (470 MHz, $CDCl_3$) δ -94.4 (dd, *J* = 244.2, 18.1 Hz, 1F), -96.1 (dd, *J* = 244.2, 18.1 Hz, 1F) ppm. **HR-MS** (ESI+): m/z calcd. for $C_{18}H_{19}F_2NO$ [M-H]; theoretical mass : 302.1357 ; found 302.1365.

Synthesis of 3-cyclohexyl-2-methyl-*N*-phenylpropanamide (16)

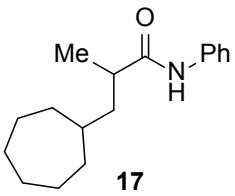


16

Synthesized according to general method using bromocyclohexane (151 mg, 0.93 mmol, 1.5 equiv.) to provide product **16** as a white solid (105 mg, 0.428 mmol, 69% yield).

IR (neat) *υ* 3293, 2921, 2850, 1658, 1600, 1538, 1499, 1440, 1307, 1170, 751 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.61 (br s, 1H), 7.52, (d, *J* = 7.4 Hz, 2H), 7.29 (t, *J* = 7.4 Hz, 2H), 7.10 (t, *J* = 7.4 Hz, 1H), 2.50 (sextet, *J* = 6.8 Hz, 1H), 1.75 (d, *J* = 12.0 Hz, 1H), 1.72 – 1.59 (m, 5H), 1.35 – 1.30 (m, 2H), 1.24 – 1.06 (m, 3H), 1.20 (d, *J* = 7.7 Hz, 3H), 0.95 – 0.81 (m, 2H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 176.0, 138.0, 129.1, 124.5, 120.4, 42.1, 39.8, 35.5, 33.6, 33.4, 26.6, 26.4, 26.3, 18.5 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{16}H_{23}NO$ $[M+H]^+$ 246.1858, found 246.1857.

Synthesis of 3-cycloheptyl-2-methyl-*N*-phenylpropanamide (17)

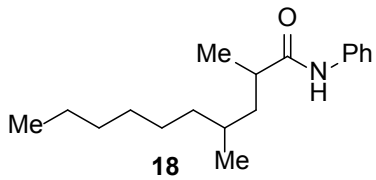


17

Synthesized according to general method using bromocycloheptane (164 mg, 0.93 mmol, 1.5 equiv.) to provide product **17** as a white solid (110 mg, 0.424 mmol, 68% yield).

IR (neat) υ 3295, 2921, 2851, 1659, 1601, 1542, 1499, 1441, 1307, 1250, 753 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.53 (d, J = 7.3 Hz, 2H), 7.37 (b, 1H), 7.30 (t, J = 7.3 Hz, 2H), 7.09 (t, J = 7.3 Hz, 1H), 2.44 (sextet, J = 7.2 Hz, 1H), 1.78 – 1.29 (m, 14H), 1.25 – 1.11 (m, 2H), 1.21 (d, J = 7.3 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.5, 138.1, 129.1, 124.3, 120.1, 42.7, 40.5, 37.0, 34.8, 34.6, 28.7, 28.5, 26.5, 26.4, 18.4 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{17}H_{25}NO$ $[M+H]^+$ 260.2014, found 260.2018.

Synthesis of 2,4-dimethyl-*N*-phenyldecanamide (18)



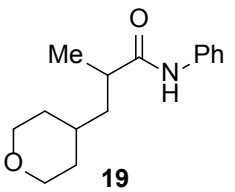
18

Synthesized according to general method using 2-bromooctane (179 mg, 0.93 mmol, 1.5 equiv.) to provide product **18** as a white solid (130 mg, 0.472 mmol, 76% yield, 1:1 dr).

Characterization data for mixture of diastereisomers.

IR (neat) υ 3295, 2926, 1660, 1602, 1543, 1441, 753 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.53 (d, J = 7.8 Hz, 2H+2H), 7.31 (t, J = 7.8 Hz, 2H+2H), 7.20 (br s, 1H+1H), 7.10 (t, J = 7.8 Hz, 1H+1H), 2.50 – 2.39 (m, 1H+1H), 1.85 – 1.76 (m, 1H), 1.62 – 1.54 (m, 1H), 1.53 – 1.41 (m, 1H+2H), 1.36 – 1.06 (m, 14H+13H), 0.95 – 0.83 (m, 6H+6H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.4, 175.2, 138.1, 129.1, 124.4, 120.1, 120.0, 42.1, 41.8, 40.6, 40.5, 37.4, 37.3, 32.0, 32.0, 30.9, 30.7, 29.8, 27.0, 26.9, 22.8, 20.0, 19.8, 18.9, 18.0, 14.2 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{18}H_{29}NO$ $[M+H]^+$ 276.2327, found 276.2324.

Synthesis of 2-methyl-*N*-phenyl-3-(tetrahydro-2H-pyran-4-yl)propanamide (19)

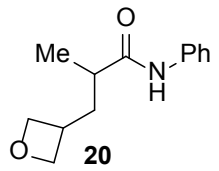


19

Synthesized according to general method using 4-bromotetrahydro-2H-pyran (153 mg, 0.93 mmol, 1.5 equiv.) to provide product **19** as a white solid (133 mg, 0.538 mmol, 87% yield).

IR (neat) υ 3294, 2925, 2843, 1660, 1599, 1540, 1499, 1441, 1306, 1239, 1174, 1153, 1094, 754 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.52 (d, J = 7.4 Hz, 2H), 7.35 – 7.28 (m, 3H), 7.11 (t, J = 7.3 Hz, 1H), 3.95 (m, 2H), 3.36 (tdd, J = 12.0, 5.1, 2.2 Hz, 2H), 2.48 (sextet, J = 8.0 Hz, 1H), 1.77 (m, 1H), 1.66 (m, 1H), 1.62 – 1.55 (m, 2H), 1.40 – 1.28 (m, 3H), 1.25 (d, J = 6.9 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.0, 138.0, 129.2, 124.6, 120.1, 68.0, 41.4, 39.5, 33.3, 33.2, 32.9, 18.7 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{15}H_{21}NO_2$ $[M+H]^+$ 248.1650, found 248.1655.

Synthesis of 2-methyl-3-(oxetan-3-yl)-*N*-phenylpropanamide (20)

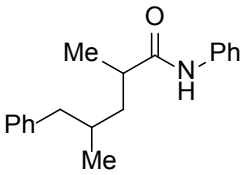


20

Synthesized according to general method using 3-bromooxetane (126 mg, 0.93 mmol, 1.5 equiv.) to provide product **20** as a white solid (75 mg, 0.342 mmol, 55% yield).

IR (neat) 3299, 2964, 2872, 1663, 1600, 1541, 1491, 1441, 1307, 1250, 965, 755 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.50 (d, J = 7.4 Hz, 2H), 7.32 (t, J = 7.4 Hz, 2H), 7.09 – 7.17 (m, 2H), 4.80 (dd, J = 7.4, 6.1 Hz, 1H), 4.76 (dd, J = 7.4, 6.1 Hz, 1H), 4.41 (td, J = 6.2, 1.8 Hz, 2H), 3.06 – 3.17 (m, 1H), 2.24 – 2.33 (m, 1H), 2.11 – 2.19 (m, 1H), 1.85 – 1.93 (m, 1H), 1.23 (d, J = 6.9 Hz, 3H), ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 173.9, 137.8, 129.2, 124.6, 120.0, 77.7, 77.6, 40.9, 38.2, 33.7, 18.1 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{13}H_{17}NO_2$ $[M+H]^+$ 220.1337, found 220.1337.

Synthesis of 2,4-dimethyl-*N*,5-diphenylpentanamide (21)



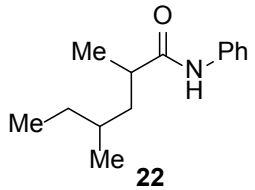
21

Synthesized according to general method using (2-bromopropyl)benzene (184 mg, 0.93 mmol, 1.5 equiv.) to provide product **21** as a white solid (150 mg, 0.533 mmol, 86% yield, 1:1 dr).

Characterization data for mixture of diastereisomers.

IR (neat) υ 3294, 3026, 2965, 2926, 1658, 1599, 1540, 1498, 1440 1307, 1250, 1174, 751 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.44 – 7.51 (m, 2H+2H), 7.24 – 7.33 (m, 4H+4H), 7.08-7.21 (m, 5H+5H), 2.59-2.67 (m, 1H+1H), 2.34 – 2.54 (m, 2H+2H), 1.79 – 1.85 (m, 3H), 1.64 – 1.71 (m, 1H), 1.45-1.52 (m, 1H), 1.24 – 1.31 (m, 1H), 1.24 (d, J = 6.9 Hz, 3H), 1.16 (d, J = 6.8 Hz, 3H), 0.91 (d, J = 6.7 Hz, 3H), 0.89 (d, J = 6.7 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.4, 175.0, 141.1, 140.7, 137.6, 137.6, 129.2, 129.1, 128.9, 128.3, 128.2, 125.9, 125.8, 124.4, 124.3, 120.1, 120.0, 44.0, 43.8, 41.5, 41.4, 40.4, 40.3, 33.0, 32.8, 20.0, 19.7, 18.7, 17.9 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{19}H_{23}NO$ $[M+H]^+$ 282.1858, found 282.1856.

Synthesis of 2,4-dimethyl-*N*-phenylhexanamide (22)



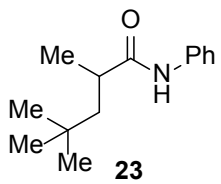
22

Synthesized according to general method using 2-bromobutane (126 mg, 0.93 mmol, 1.5 equiv.) to provide product **22** as a white solid (96 mg, 0.438 mmol, 70% yield, 1:1 dr).

Characterization data for mixture of diastereisomers.

IR (neat) υ 3293, 3138, 3060, 2962, 1658, 1600, 1538, 1499, 1460, 1440, 1307, 1249 1174, 751 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.52 (d, J = 7.9 Hz, 2H+2H), 7.31 (t, J = 7.9 Hz, 2H+2H), 7.29 (br s, 1H+1H), 7.10 (t, J = 7.9 Hz, 1H+1H), 2.40 – 2.50 (m, 1H+1H), 1.84 – 1.77 (m, 1H+1H), 1.61 – 1.53 (m, 1H), 1.49 – 1.31 (m, 1H+2H), 1.25 – 1.10 (m, 5H+5H), 0.95 – 0.84 (m, 6H+6H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.7, 175.4, 138.0, 129.1, 124.4, 120.1, 41.7, 41.2, 40.6, 40.5, 32.4, 32.3, 29.8, 29.7, 19.4, 19.2, 19.0, 18.0, 11.4, 11.3 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{14}H_{21}NO$ $[M+H]^+$ 220.1701, found 220.1701.

Synthesis of 2,4,4-trimethyl-*N*-phenylpentanamide (23)

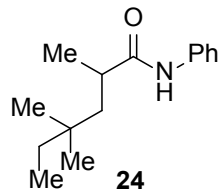


23

Synthesized according to general method using 2-bromo-2-methylpropane (126 mg, 0.93 mmol, 1.5 equiv.) to provide product **23** as a white solid (110 mg, 0.502 mmol, 66% yield).

IR (neat) υ 3291, 2957, 1660, 1601, 1540, 1500, 1441, 1366, 1310, 1249, 1197, 752 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.52 (d, J = 7.9 Hz, 2H), 7.48 (br s, 1H), 7.29 (t, J = 7.9 Hz, 2H), 7.08 (t, J = 7.9 Hz, 1H), 2.47 – 2.39 (m, 1H), 1.99 (dd, J = 14.1, 8.9 Hz, 1H), 1.30 – 1.18 (m, 4H), 0.93 (s, 9H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 176.0, 138.3, 129.0, 124.2, 120.2, 48.0, 39.3, 30.9, 29.7, 21.3 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{14}H_{21}NO$ $[M+H]^+$ 220.1701, found 220.1697.

Synthesis of 2,4,4-trimethyl-*N*-phenylhexanamide (24)

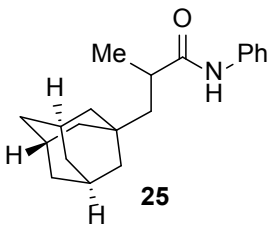


24

Synthesized according to general method using 2-bromo-2-methylbutane (140 mg, 0.93 mmol, 1.5 equiv.) to provide product **24** as a white solid (85 mg, 0.365 mmol, 59% yield).

IR (neat) υ 3293, 3197, 3138, 3060, 2962, 2932, 2876, 1658, 1600, 1538, 1499, 1440, 1308, 1248, 751 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.52 (d, J = 7.8 Hz, 2H), 7.31 (t, J = 7.9 Hz, 2H), 7.20 (br s, 1H), 7.10 (t, J = 7.8 Hz, 1H), 2.43 – 2.35 (m, 1H), 1.97 (dd, J = 14.3, 8.7 Hz, 1H), 1.30 – 1.20 (m, 6H), 0.87 (d, J = 5.1 Hz, 6H), 0.82 (t, J = 7.5 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.9, 138.2, 129.1, 124.3, 120.0, 45.6, 39.0, 34.8, 33.4, 26.9, 26.8, 21.4, 8.6 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{15}H_{23}NO$ $[M+H]^+$ 234.1858, found 234.1854.

Synthesis of 3-((3r,5r,7r)-adamantan-1-yl)-2-methyl-*N*-phenylpropanamide (25)



25

Synthesized according to general method using (3s,5s,7s)-1-bromoadamantane) (199 mg, 0.93 mmol, 1.5 equiv.) to provide product **25** as a white solid (127 mg, 0.427 mmol, 69% yield).

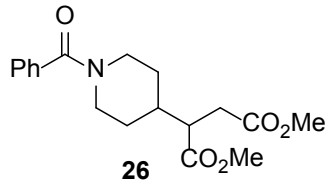
IR (neat) υ 3293, 3060, 2966, 2900, 2846, 1660, 1599, 1539, 1499, 1440, 1311, 1249, 1165, 752 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.51 (d, J = 7.8 Hz, 2H), 7.32 (t, J = 7.9 Hz, 2H), 7.24 (br s, 1H), 7.11 (t, J = 7.8 Hz, 1H), 2.53 – 2.43 (m, 1H), 1.93 (br s, 3H), 1.84 (dd, J = 14.3, 8.7 Hz, 1H), 1.71 – 1.65 (br, 3H), 1.63 – 1.57 (br, 3H), 1.56 – 1.51 (br, 3H), 1.51 – 1.45 (br, 3H), 1.24 (d, J = 7.0 Hz, 3H), 1.11 (dd, J = 14.3, 3.2 Hz, 1H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 176.3, 138.0, 129.1, 124.6, 120.2, 48.8, 42.7, 37.4, 37.1, 32.9, 28.8, 21.4 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{20}H_{27}NO$ $[M+H]^+$ 298.2171, found 298.2168.

General procedure for preparation of compounds 26 – 43:

In a 1-dram vial were added the corresponding Michael acceptor and alkyl bromide, Na_2CO_3 (131 mg, 1.24 mmol, 2.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (7 mg, 0.006 mmol, 0.01 equiv.). MeOH (2 mL) was added followed by tris(trimethylsilyl)silane (145 µL, 0.46 mmol, 0.75 equiv.). The vial was purged with nitrogen and then sealed. The vial was placed in the integrated photoreactor (100% intensity, 6000rpm fan, 1000 rpm stirring) until the

starting acceptor was completely consumed (1h for secondary and tertiary bromides or 2h for primary bromides). After the reaction was completed, volatiles were removed at reduced pressure. The resulting residue was dissolved in DMSO (1 mL), filtered and purified by HPLC eluted with a 15 minute gradient of 90% water/MeCN (0.1% TFA) to 5% water/MeCN (both 0.1% TFA) with a flow rate of 25 ml/min. The fractions were concentrated to provide the final products.

Synthesis of dimethyl 2-(1-benzoylpiperidin-4-yl)succinate (26)

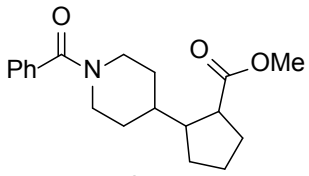


26

Synthesized according to general method using dimethyl maleate (89 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **26** as a white solid (180 mg, 0.540 mmol, 87% yield).

IR (neat) υ 3000, 2944, 2858, 1732, 1627, 1435, 1277, 1161, 708 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.40 – 7.36 (m, 5H), 3.69 (s, 3H), 3.66 (s, 3H), 3.41 – 3.31 (m, 1H), 3.04 – 2.67 (m, 3H), 2.53 – 2.44 (m, 1H), 1.95 – 1.20 (m, 7H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 174.0, 172.2, 170.8, 170.7, 135.6, 135.4, 129.8, 129.7, 128.5, 128.4, 126.8, 126.7, 51.9, 48.9, 47.9, 46.0, 43.4, 42.5, 38.2, 33.2, 30.0, 29.2, 26.5, 25.6, 24.4 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{18}H_{23}NO_5$ $[M+H]^+$ 334.1654, found 334.1656.

Synthesis of methyl 2-(1-benzoylpiperidin-4-yl)cyclopentanecarboxylate (27)

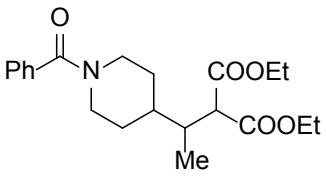


27

Synthesized according to general method using methyl cyclopent-1-ene-1-carboxylate (78 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **27** as a white solid (95 mg, 0.301 mmol, 49% yield, 1.4:1 dr).

IR (neat) υ 2947, 2865, 1728, 1628, 1433, 1281, 1194, 1153, 977, 708 cm^{-1}**. ^{1}H NMR** (500 MHz) δ 7.33 – 7.45 (m, 5H), 4.72 (br, 1H), 3.74 (br, 1H), 3.66 (s, 3H), 2.95 (br, 1H), 2.73 (br, 1H), 2.51 – 2.43 (m, 1H), 2.10 (p, J = 8.4 Hz, 1H), 1.96 – 1.73 (m, 4H), 1.73 – 1.54 (m, 3H), 1.52 – 1.42 (m, 1H), 1.38 – 1.08 (m, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 177.3, 170.6, 135.7, 129.7, 128.4, 126.9, 51.7, 48.8, 48.0, 47.6, 42.7, 41.0, 31.4, 30.3, 25.4 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{19}H_{25}NO_3$ $[M+H]^+$ 316.1912, found 316.1908.

Synthesis of diethyl 2-(1-(1-benzoylpiperidin-4-yl)ethyl)malonate (28)



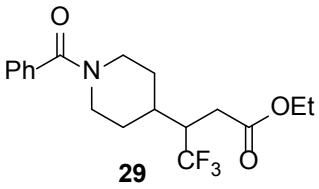
28

Synthesized according to general method using diethyl 2-ethylidenemalonate (115 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **28** as a white solid (170 mg, 0.453 mmol, 73% yield).

IR (neat) υ 2980, 2939, 1749, 1726, 1630, 1440, 1281, 1246, 1201, 1153, 1111, 1095, 1030, 1003, 708, 699 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.45 – 7.35 (m, 5H), 4.79 (br, 1H), 4.25 – 4.14 (m,

4H), 3.79 (br, 1H), 3.41 (d, *J* = 8.3 Hz, 1H), 2.96 (br, 1H), 2.70 (br, 1H), 2.30 – 2.21 (m, 1H), 1.77 (br, 1H), 1.68 – 1.54 (m, 2H), 1.41 – 1.11 (m, 8H), 0.96 (d, *J* = 6.9 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 170.6, 168.9, 168.6, 135.6, 129.7, 128.5 126.8, 61.4, 61.3, 55.3, 48.3, 42.7, 38.8, 37.6, 31.1, 30.1, 28.0, 27.0, 14.1, 13.1 ppm.**HR-MS** (ESI+): m/z calcd. for $C_{21}H_{29}NO_5$ $[M+H]^+$ 376.2124, found 376.2129.

Synthesis of ethyl 3-(1-benzoylpiperidin-4-yl)-4,4,4-trifluorobutanoate (29)

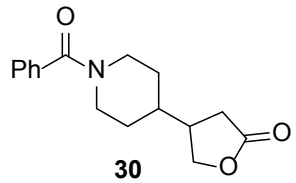


29

Synthesized according to general method using ethyl (Z)-4,4,4-trifluorobut-2-enoate (104 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **29** as a white solid (135 mg, 0.378 mmol, 61% yield).

IR (neat) *υ* 2939, 2864, 1732, 1630, 1437, 1373, 1281, 1255, 1150, 1117, 1077, 1023, 976, 786, 732, 708 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.51 – 7.33 (m, 5H), 4.80 (br s, 1H), 4.20 (m, 2H), 3.82 (br s, 1H), 3.27 (br s, 2H), 3.11 – 2.91 (m, 1H), 2.87 – 2.71 (m, 1H), 2.62 – 2.53 (m, 1H), 2.50 – 2.15 (m, 1H), 1.91 – 1.62 (m, 2H), 1.49 – 1.19 (m, 2H), 1.28 (t, *J* = 7.1 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 172.7, 170.7, 135.4, 129.9, 128.6, 126.8, 126.3 (q, *J* = 277.2 Hz), 61.3, 61.2, 44.4, 38.6, 35.8, 33.6, 33.4, 30.4, 14.1 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{18}H_{22}F_3NO_3$ $[M+H]^+$ 358.1630, found 358.1637.

Synthesis of 4-(1-benzoylpiperidin-4-yl)dihydrofuran-2(3*H*)-one (30)

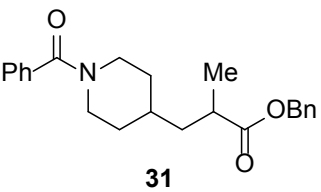


30

Synthesized according to general method using furan-2(5*H*)-one (52 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **30** as a white solid (75 mg, 0.275 mmol, 44% yield).

IR (neat) *υ* 2923, 1771, 1624, 1444, 1164, 1011, 982, 709, 699 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.49 – 7.35 (m, 5H), 4.86 – 4.71 (br, 1H), 4.51 – 4.37 (br, 1H), 4.08 – 3.98 (br, 1H), 3.90 – 3.77 (br, 1H), 3.10 – 2.97 (br, 1H), 2.86 – 2.70 (br, 1H), 2.69 – 2.55 (br, 1H), 2.43 (sext, *J* = 8.4 Hz, 1H), 2.32 – 2.22 (m, 1H), 1.88 – 1.72 (m, 1H), 1.70 – 1.56 (m, 2H), 1.46 – 1.14 (m, 2H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 176.6, 171.4, 134.5, 130.3, 128.7, 126.8, 71.3, 47.8, 42.5, 40.9, 39.6, 32.5 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{16}H_{19}NO_3$ $[M+H]^+$ 274.1443, found 274.1445.

Synthesis of benzyl 3-(1-benzoylpiperidin-4-yl)-2-methylpropanoate (31)



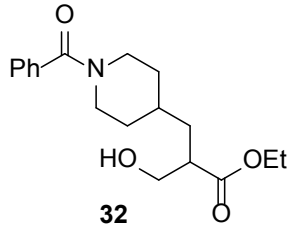
31

Synthesized according to general method using benzyl methacrylate (109 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **31** as a white solid (140 mg, 0.383 mmol, 62% yield).

IR (neat) *υ* 2933, 2853, 1730, 1629, 1442, 1283, 1208, 1159, 1109, 1076, 972, 734, 698 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.45 – 7.29 (m, 10H), 5.20 (d, *J* = 12.2 Hz, 1H), 5.09 (d, *J* = 12.2 Hz, 1H),

4.66 (br s, 1H), 3.68 (br s, 1H), 2.87 (br s, *J* = 9.5 Hz, 1H), 2.77 – 2.55 (m, 2H), 1.89 – 1.41 (m, 4H), 1.35 – 1.28 (m, 1H), 1.18 (d, *J* = 6.9 Hz, 3H), 1.25 – 1.16 (m, 1H), 1.13 – 1.00 (m, 1H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 176.5, 170.9, 136.2, 135.6, 129.9, 128.7, 128.6, 128.4, 126.9, 66.3, 48.1, 42.8, 40.6, 37.0, 34.2, 17.9 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{23}H_{27}NO_3$ $[M+H]^+$ 366.2069, found 366.2064.

Synthesis of ethyl 3-(1-benzoylpiperidin-4-yl)-2-(hydroxymethyl)propanoate (32)

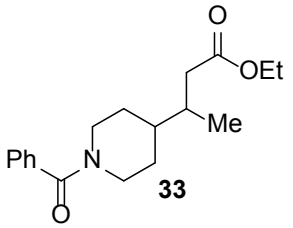


32

Synthesized according to general method using ethyl 2-(hydroxymethyl)acrylate (81 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **32** as a white solid (145 mg, 0.454 mmol, 73% yield).

IR (neat) *υ* 2930, 1729, 1611, 1448, 1281, 1173, 709 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.45 – 7.35 (m, 5H), 4.72 (br s, 1H), 4.25 – 4.13 (m, 2H), 3.75 (d, *J* = 5.7 Hz, 3H), 3.05 – 2.72 (m, 2H), 2.70 – 2.62 (m, 1H), 1.96 – 1.54 (m, 4H), 1.44 (m, 1H), 1.28 (t, *J* = 7.1 Hz, 3H), 1.33 – 1.08 (m, 2H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 175.3, 171.1, 135.3, 130.0, 128.7, 127.0, 63.7, 61.0, 48.2, 44.7, 42.7, 35.0, 34.0, 14.4 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{18}H_{25}NO_4$ $[M+H]^+$ 320.1862, found 320.1861.

Synthesis of ethyl 3-(1-benzoylpiperidin-4-yl)butanoate (33)

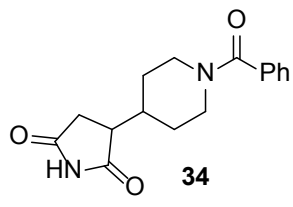


33

Synthesized according to general method using ethyl (*Z*)-but-2-enoate (71 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **33** as a white solid (100 mg, 0.330 mmol, 53% yield).

IR (neat) *υ* 2937, 2856, 1729, 1629, 1577, 1444, 1433, 1371, 1283, 1246, 1175, 1152, 1106, 1074, 1030, 1003, 787, 731, 708 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) *δ* 7.42 – 7.36 (m, 5H), 4.79 (br s, 1H), 4.13 (q, *J* = 7.1 Hz, 2H), 3.78 (br s, 1H), 2.96 (br s, 1H), 2.71 (br s, 1H), 2.37 (dd, *J* = 14.8, 5.4 Hz, 1H), 2.12 (dd, *J* = 14.8, 8.7 Hz, 1H), 2.00 – 1.91 (m, 1H), 1.76 (br s, 1H), 1.59 (br s, 1H), 1.55 – 1.46 (m, 1H), 1.25 (t, *J* = 7.1 Hz, 5H), 1.41 – 1.11 (m, 2H), 0.93 (d, *J* = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) *δ* 173.3, 170.5, 136.2, 129.7, 128.6, 127.0, 60.4, 48.4, 42.9, 41.2, 39.2, 34.7, 16.6, 14.5 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{18}H_{25}NO_3$ $[M+H]^+$ 304.1912, found 304.1904.

Synthesis of 3-(1-benzoylpiperidin-4-yl)pyrrolidine-2,5-dione (34)



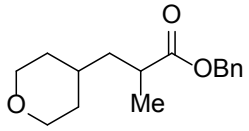
34

Synthesized according to general method using 1*H*-pyrrole-2,5-dione (60 mg, 0.62 mmol, 1.0 equiv.) and (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (250 mg, 0.93 mmol, 1.5 equiv.) to provide product **34** as a white solid (72 mg, 0.252 mmol, 40% yield).

IR (neat) *υ* 3186, 3065, 2937, 1775, 1709, 1599, 1573, 1448, 1353, 1285, 1172, 784,

732, 709 cm^{-1}. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 11.14 (s, 1H), 7.47 – 7.43 (m, 3H), 7.40 – 7.37 (m, 2H), 4.53 (br s, 1H), 3.57 (br s, 1H), 3.00 (br s, 1H), 2.86 (br s, 1H), 2.72 (br s, 1H), 2.64 (m, 1H), 2.55 (d, *J* = 5.09 Hz, 1H), 2.03 (br s, 1H), 1.88 – 1.61 (m, 1H), 1.57 – 1.30 (m, 2H), 1.29 – 1.17 (m, 1H) ppm. **^{13}C NMR** (125 MHz, DMSO-d_6) δ 180.4, 178.2, 168.8, 136.4, 129.3, 128.3, 126.6, 45.2, 41.4, 36.3, 31.9, 26.7 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{16}H_{18}N_2O_3$ $[M+H]^+$ 287.1395, found 287.1403.

Synthesis of benzyl 2-methyl-3-(tetrahydro-2*H*-pyran-4-yl)propanoate (35)

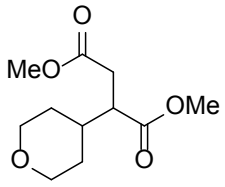


35

Synthesized according to general method using benzyl methacrylate (109 mg, 0.62 mmol, 1.0 equiv.) and 4-bromotetrahydro-2*H*-pyran (153 mg, 0.93 mmol, 1.5 equiv.) to provide product **35** as a white solid (112 mg, 0.427 mmol, 69% yield).

IR (neat) υ 3034, 2925, 2840, 1731, 1455, 1237, 1212, 1166, 1148, 1128, 1095, 1015, 849, 748 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.38 – 7.30 (m, 5H), 5.15 (d, *J* = 12.2 Hz, 1H), 5.09 (d, *J* = 12.2 Hz, 1H), 3.93 – 3.85 (m, 2H), 3.32 – 3.21 (m, 2H), 2.65 – 2.55 (m, 1H), 1.72 – 1.57 (m, 2H), 1.52 – 1.37 (m, 2H), 1.33 – 1.19 (m, 3H), 1.17 (d, *J* = 6.9 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 176.7, 136.3, 128.7, 128.3, 68.0, 66.2, 41.1, 36.7, 33.1, 32.9, 17.8 ppm. **MS** (ESI+): m/z calcd. for $C_{16}H_{22}O_3$ $[M+H]^+$ 263.16 ; found 263.21.

Synthesis of dimethyl 2-(tetrahydro-2*H*-pyran-4-yl)succinate (36)

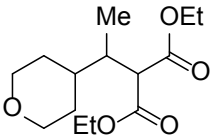


36

Synthesized according to general method using dimethyl maleate (89 mg, 0.62 mmol, 1.0 equiv.) and 4-bromotetrahydro-2*H*-pyran (153 mg, 0.93 mmol, 1.5 equiv.) to provide product **36** as a white solid (83 mg, 0.361 mmol, 58% yield).

IR (neat) υ 2951, 2845, 1729, 1436, 1227, 1192, 1161, 1142, 1093, 1015, 861, 844 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 4.01 – 3.90 (m, 2H), 3.71 (s, 3H), 3.68 (s, 3H), 3.40 – 3.32 (m, 2H), 2.78 – 2.69 (m, 2H), 2.54 – 2.39 (m, 1H), 1.90 – 1.79 (m, 1H), 1.58 – 1.36 (m, 4H) ppm **^{13}C NMR** (125 MHz, $CDCl_3$) δ 174.3, 172.5, 68.0, 67.9, 52.0, 51.9, 46.7, 37.4, 33.3, 30.6, 30.3 ppm. **MS** (ESI+): m/z calcd. for $C_{11}H_{18}O_5$ $[M+H]^+$ 231.12, found 231.15.

Synthesis of diethyl 2-(1-(tetrahydro-2*H*-pyran-4-yl)ethyl)malonate (37)

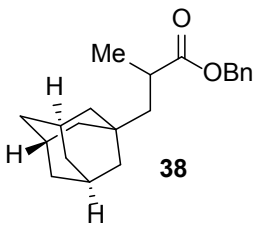


37

Synthesized according to general method using diethyl 2-ethylidenemalonate (115 mg, 0.62 mmol, 1.0 equiv.) and 4-bromotetrahydro-2*H*-pyran (153 mg, 0.93 mmol, 1.5 equiv.) to provide product **37** as a white solid (150 mg, 0.551 mmol, 89% yield).

IR (neat) υ 2945, 2841, 1750, 1727, 1237, 1175, 1139, 1130, 1094, 1030, 861, 846 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 4.18 (p, *J* = 7.0 Hz, 4H), 4.00 – 3.95 (m, 2H), 3.42 (d, *J* = 8.1 Hz, 1H), 3.39 – 3.27 (m, 2H), 2.22 – 2.13 (m, 1H), 1.60 – 1.46 (m, 4H), 1.39 – 1.29 (m, 1H), 1.25 (t, *J* = 7.1 Hz, 6H), 0.94 (d, *J* = 6.9 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 169.2, 168.8, 68.3, 68.2, 61.4, 61.2, 55.0, 38.1, 37.9, 31.2, 28.4, 14.3, 13.1 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{14}H_{24}O_5$ [M-H] 271.1546, found 271.1551.

Synthesis of benzyl 3-((3r,5r,7r)-adamantan-1-yl)-2-methylpropanoate (38)

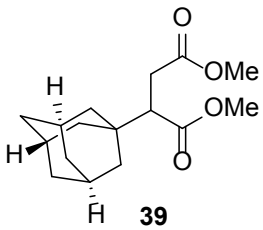


38

Synthesized according to general method using benzyl methacrylate (109 mg, 0.62 mmol, 1.0 equiv.) and (3s,5s,7s)-1-bromoadamantane (199 mg, 0.93 mmol, 1.5 equiv.) to provide product **38** as a white solid (140 mg, 0.448 mmol, 56% yield).

IR (neat) υ 2899, 2846, 1734, 1452, 1180, 1147, 1120, 750 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.40 – 7.27 (m, 5H), 5.13 (d, *J* = 12.4 Hz, 1H), 5.07 (d, *J* = 12.4 Hz, 1H), 2.65 – 2.55 (m, 1H), 1.90 (br s, 3H), 1.75 (dd, *J* = 14.2, 9.3 Hz, 1H), 1.68 – 1.62 (br, 3H), 1.60 – 1.54 (br, 3H), 1.48 – 1.42 (br, 3H), 1.40 – 1.35 (br, 3H), 1.17 (d, *J* = 7.1 Hz, 3H), 1.04 (dd, *J* = 14.2, 3.0 Hz, 1H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 178.0, 136.3, 128.6, 128.4, 128.2, 66.2, 48.7, 42.5, 37.2, 34.5, 32.8, 28.7, 20.6 ppm. **MS** (ESI+): m/z calcd. for $C_{21}H_{28}O_2$ $[M+H]^+$, 313.22; found 313.30.

Synthesis of dimethyl 2-((3r,5r,7r)-adamantan-1-yl)succinate (39)

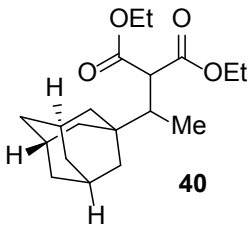


39

Synthesized according to general method using dimethyl maleate (89 mg, 0.62 mmol, 1.0 equiv.) and (3s,5s,7s)-1-bromoadamantane (199 mg, 0.93 mmol, 1.5 equiv.) to provide product **39** as a white solid (125 mg, 0.446 mmol, 72% yield).

IR (neat) υ 2902, 2848, 1730, 1435, 1242, 1193, 1158, 1096, 1012, 844 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 3.67 (s, 3H), 3.63 (s, 3H), 2.79 – 2.69 (m, 1H), 2.52 – 2.44 (m, 2H), 1.96 (br s, 3H), 1.71 – 1.56 (m, 9H), 1.45 (d, *J* = 12.3 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ ^{13}C NMR (126 MHz, $cdcl_3$) δ 174.4, 173.4, 52.4, 51.9, 51.4, 40.1, 36.9, 34.5, 31.1, 28.6 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{16}H_{24}O_4$ $[M+H]^+$ 281.17, found 281.21.

Synthesis of diethyl 2-(1-((3r,5r,7r)-adamantan-1-yl)ethyl)malonate (40)

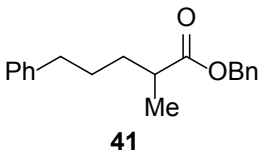


40

Synthesized according to general method using diethyl 2-ethylidenemalonate (115 mg, 0.62 mmol, 1.0 equiv.) and (3s,5s,7s)-1-bromoadamantane (199 mg, 0.93 mmol, 1.5 equiv.) to provide product **40** as a white solid (125 mg, 0.446 mmol, 72% yield).

IR (neat) υ 2980, 2901, 2848, 1752, 1729, 1290, 1218, 1173, 1144, 1096, 1031 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 4.23 – 4.13 (m, 4H), 3.56 (d, *J* = 5.2 Hz, 1H), 2.10 – 2.03 (m, 1H), 1.97 (br s, 3H), 1.72 – 1.65 (br, 3H), 1.64 – 1.58 (br, 3H), 1.57 – 1.46 (br, 6H), 1.27 (q, *J* = 7.2 Hz, 6H), 0.98 (d, *J* = 7.3 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 170.5, 169.9, 61.4, 61.0, 51.9, 43.2, 39.5, 37.2, 35.4, 28.7, 14.2, 14.1 10.5, ppm. **HR-MS** (ESI+): m/z calcd. for $C_{19}H_{30}O_4$ [M-H] 321.2066, found 321.2065.

Synthesis of benzyl 2-methyl-5-phenylpentanoate (41)

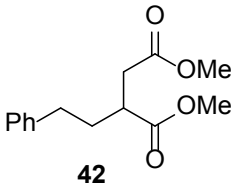


41

Synthesized according to general method using diethyl 2-ethylidenemalonate (115 mg, 0.62 mmol, 1.0 equiv.) and (2-bromoethyl)benzene (171 mg, 0.93 mmol, 1.5 equiv.) to provide product **41** as a white solid (67 mg, 0.237 mmol, 38% yield).

IR (neat) υ 3063, 3028, 2937, 2860, 1730, 1454, 1149, 746 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.38 – 7.09 (m, 10H), 5.11 (s, 2H), 2.63 – 2.58 (m, 2H), 2.57 – 2.47 (m, 1H), 1.78 – 1.68 (m, 1H), 1.64 – 1.56 (m, 2H), 1.55 – 1.44 (m, 1H), 1.18 (d, J = 7.0 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 176.6, 142.3, 136.4, 128.7, 128.5, 128.4, 128.3, 128.2, 125.9, 66.1, 39.6, 36.0, 33.6, 29.2, 17.2 ppm. **MS** (ESI+): m/z calcd. for $C_{19}H_{22}O_2$ $[M+H]^+$ 283.17, found 283.22.

Synthesis of dimethyl 2-phenethylsuccinate (42)

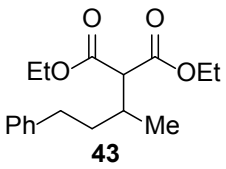


42

Synthesized according to general method using dimethyl maleate (89 mg, 0.62 mmol, 1.0 equiv.) and (2-bromoethyl)benzene (171 mg, 0.93 mmol, 1.5 equiv.) to provide product **42** as a white solid (70 mg, 0.280 mmol, 45% yield).

IR (neat) υ 2952, 1731, 1435, 1260, 1194, 1159, 749 $cm^{-1.}$ **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.34 – 7.26 (m, 2H), 7.21 – 7.15 (m, 3H), 3.71 (s, 3H), 3.66 (s, 3H), 2.93 – 2.85 (m, 1H), 2.76 (dd, J = 16.5, 9.1 Hz, 1H), 2.68 – 2.57 (m, 2H), 2.48 (dd, J = 16.5, 5.3 Hz, 1H), 2.07 – 1.95 (m, 1H), 1.87 – 1.78 (m, 1H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 175.2, 172.3, 141.1, 128.6, 128.5, 126.2, 52.0, 51.9, 40.9, 36.0, 33.7, 33.3 ppm. **MS** (ESI+): m/z calcd. for $C_{14}H_{18}O_4$ $[M+H]^+$ 251.13 found 251.16.

Synthesis of diethyl 2-(4-phenylbutan-2-yl)malonate (43)

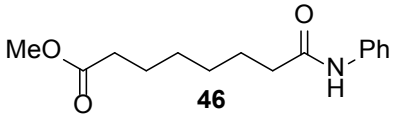


43

Synthesized according to general method using diethyl 2-ethylidenemalonate (115 mg, 0.62 mmol, 1.0 equiv.) and (2-bromoethyl)benzene (171 mg, 0.93 mmol, 1.5 equiv.) to provide product **43** as a white solid (135 mg, 0.462 mmol, 75% yield).

IR (neat) υ 3027, 2980, 2937, 1729, 1301, 1232, 1152, 1030, 747 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.31 – 7.25 (m, 2H), 7.21 – 7.16 (m, 3H), 4.25 – 4.14 (m, 4H), 3.30 (d, J = 7.8 Hz, 1H), 2.77 – 2.69 (m, 1H), 2.64 – 2.55 (m, 1H), 2.37 – 2.29 (m, 1H), 1.84 – 1.74 (m, 1H), 1.61 – 1.50 (m, 1H), 1.25 (q, J = 7.2 Hz, 6H), 1.07 (d, J = 6.8 Hz, 3H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 169.0, 168.8, 142.1, 128.5, 128.4, 125.9, 61.32, 61.27, 57.7, 36.4, 33.4, 33.3, 17.1, 14.3, 14.2 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{17}H_{24}O_4$ $[M+H]^+$ 293.1753, found 293.1748.

Synthesis of methyl 8-oxo-8-(phenylamino)octanoate (46)



46

In a 1-dram vial were added *N*-phenylacrylamide (91 mg, 0.62 mmol, 1.0 equiv.), methyl 5-bromopentanoate (180 mg, 0.93 mmol, 1.5 equiv.), Na_2CO_3 (131 mg, 1.24 mmol, 2.0 equiv.) and $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (7 mg, 0.006 mmol, 0.01 equiv.). MeOH (2 mL) was added followed by tris(trimethylsilyl)silane (145 µL, 0.46 mmol, 0.75

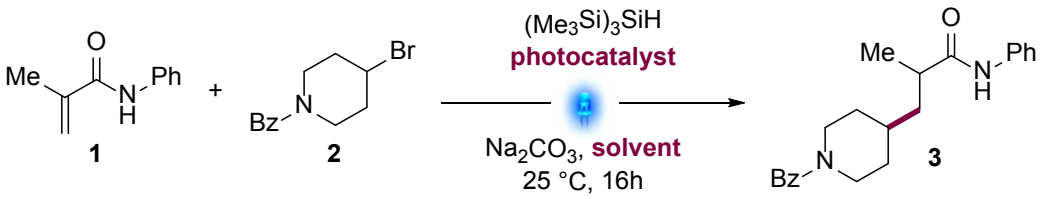
equiv.). The vial was purged with nitrogen and then sealed. The vial was placed in the integrated photoreactor (100% intensity, 6000 rpm fan, 1000 rpm stirring) until the starting acceptor was completely consumed (1h). After the reaction was completed, volatiles were removed at reduced pressure. The resulting residue was dissolved in DMSO (1 mL), filtered and purified by HPLC: eluted with a 15 minute gradient of 90% water/MeCN (0.1% TFA) to 5% water/MeCN (both 0.1% TFA) with a flow rate of 25 ml/min. The fractions were concentrated to provide product **46** as a white solid (81 mg, 0.308 mmol, 49% yield). Analytical data matched reported data.[3] **IR** (neat) υ 3300, 1730, 1655, 1602, 1533, 1447, 1170 cm^{-1}. **^{1}H NMR** (500 MHz) δ 7.52 (d, J = 7.9 Hz, 2H), 7.31 (t, J = 7.9 Hz, 2H), 7.24 (br s, 1H), 7.10 (t, J = 7.6 Hz, 1H), 3.67 (s, 3H), 2.37 – 2.29 (m, 4H), 1.78 – 1.69 (m, 2H), 1.69 – 1.59 (m, 2H), 1.43 – 1.33 (m, 4H) ppm. **^{13}C NMR** (125 MHz, $CDCl_3$) δ 174.3, 171.3, 138.0, 129.0, 124.2, 119.8, 51.5, 37.6, 33.9, 28.74, 28.70, 25.3, 24.7 ppm. **HR-MS** (ESI+): m/z calcd. for $C_{15}H_{21}NO_3$ $[M+H]^+$ 264.1599, found 264.1609.

2. Reaction optimization screening

The optimization of the reaction between amide **1** and alkyl bromide **2** was performed using high-throughput experimentation (HTE) techniques. The results from the different screening are shown below.

2.1. Photocatalyst and solvent screening

Table S1. Screening of photocatalysts and solvents in the conjugate addition of alkyl bromide **2** to amide **1**.



Entry[a]	Catalyst	Solvent	1 (%RSM)[b]	2 (%RSM)[b]	3 (%AY)[b]
1	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	MeCN[c]	100	100	**0**
2	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	MeCN	23	28	**35**
3	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	MeOH	0	0	**38**
4	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	CH_2Cl_2	0	23	**29**
5	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	THF	0	0	**36**
6	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	DME	20	6	**30**
7	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	IPA	17	0	**38**
8	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	DMF	38	73	**4**
9	$Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$	DMSO	37	54	**6**
10	$Ir(ppy)_2(dtbbpy)PF_6$	MeCN	67	71	**8**
11	$Ir(ppy)_2(dtbbpy)PF_6$	MeOH	90	91	**7**
12	$Ir(ppy)_2(dtbbpy)PF_6$	CH_2Cl_2	55	56	**15**
13	$Ir(ppy)_2(dtbbpy)PF_6$	THF	59	61	**20**
14	$Ir(ppy)_2(dtbbpy)PF_6$	DME	55	45	**16**
15	$Ir(ppy)_2(dtbbpy)PF_6$	IPA	97	97	**0**

16	$Ir(ppy)_2(dtbbpy)PF_6$	DMF	16	60	**9**
17	$Ir(ppy)_2(dtbbpy)PF_6$	DMSO	36	52	**5**
18	$Ru(bpz)_3(PF_6)_2$	MeCN	97	97	**0**
19	$Ru(bpz)_3(PF_6)_2$	MeOH	90	90	**10**
20	$Ru(bpz)_3(PF_6)_2$	CH_2Cl_2	35	59	**11**
21	$Ru(bpz)_3(PF_6)_2$	THF	98	99	**0**
22	$Ru(bpz)_3(PF_6)_2$	DME	93	79	**7**
23	$Ru(bpz)_3(PF_6)_2$	IPA	100	99	**0**
24	$Ru(bpz)_3(PF_6)_2$	DMF	56	76	**4**
25	$Ru(bpz)_3(PF_6)_2$	DMSO	59	65	**6**
26	$Ru(bpy)_3(PF_6)_2$	MeCN	100	100	**0**
27	$Ru(bpy)_3(PF_6)_2$	MeOH	100	100	**0**
28	$Ru(bpy)_3(PF_6)_2$	CH_2Cl_2	72	76	**18**
29	$Ru(bpy)_3(PF_6)_2$	THF	100	100	**0**
30	$Ru(bpy)_3(PF_6)_2$	DME	82	78	**7**
31	$Ru(bpy)_3(PF_6)_2$	IPA	100	100	**0**
32	$Ru(bpy)_3(PF_6)_2$	DMF	62	60	**8**
33	**$Ru(bpy)_3(PF_6)_2$**	**DMSO**	**43**	**45**	**12**

[a] *N*-phenylmetacrylamide (**1**) (20 mg, 0.12 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (33 mg, 0.12 mmol, 1.0 equiv.), Na_2CO_3 (26 mg, 0.25 mmol, 2.0 equiv.), $(Me_3Si)_3SiH$ (40 µL, 0.12 mmol, 1.0 equiv.) and the appropriate photocatalyst (0.001 mmol, 0.01 equiv.) and solvent (600 µL), Aldrich® Micro Photochemical Reactor (**ring**) for 16h. [b] Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques. [c] reaction performed in the absence of $(Me_3Si)_3SiH$.

2.2. Base screening

Figure S1. Screening of bases in MeOH and MeCN in the conjugate addition of alkyl bromide **2** to amide **1.**

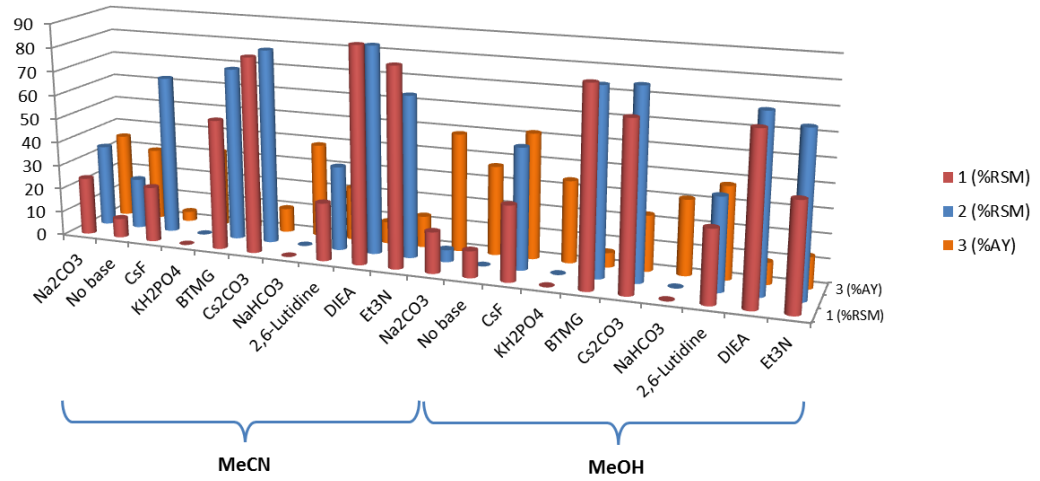


Table S2. Base screening.

Entry[a]	Base	Solvent	**1** (%RSM)[b]	**2** (%RSM)[b]	**3** (%AY) [b]
1	Na_2CO_3	MeCN	24	34	**35**
2	No base	MeCN	8	21	**30**
3	CsF	MeCN	23	66	**4**
4	KH_2PO_4	MeCN	0	0	**32**
5	BTMG[c]	MeCN	54	72	**15**
6	Cs_2CO_3	MeCN	81	81	**10**
7	$NaHCO_3$	MeCN	0	0	**39**
8	2,6-Lutidine	MeCN	24	35	**22**
9	DIEA	MeCN	89	86	**9**
10	Et_3N	MeCN	82	67	**13**
11	Na_2CO_3	MeOH	17	5	**49**

12	No base	MeOH	11	0	**37**
13	CsF	MeOH	31	50	**52**
14	KH_2PO_4	MeOH	0	0	**34**
15	BTMG[c]	MeOH	81	77	**6**
16	Cs_2CO_3	MeOH	69	78	**23**
17	$NaHCO_3$	MeOH	0	0	**31**
18	2,6-Lutidine	MeOH	30	38	**38**
19	DIEA	MeOH	69	72	**9**
20	**Et_3N**	**MeOH**	**44**	**67**	**13**

[a] *N*-phenylmetacrylamide (**1**) (20 mg, 0.12 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (33 mg, 0.12 mmol, 1.0 equiv.),the appropiate base (2.0 equiv.), $(Me_3Si)_3SiH$ (40 µL, 0.12 mmol, 1.0 equiv.), Ir[dF(CF_3)ppy](dtbbpy)PF_6 (0.012 mmol, 0.01 equiv.) and the appropiate solvent (600 µL), Aldrich® Micro Photochemical Reactor (**ring**) for 16h. [b] Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques. [c] BTMG = 2-tert-Butyl-1,1,3,3-tetramethylguanidine.

2.3. Screening of amounts of silane

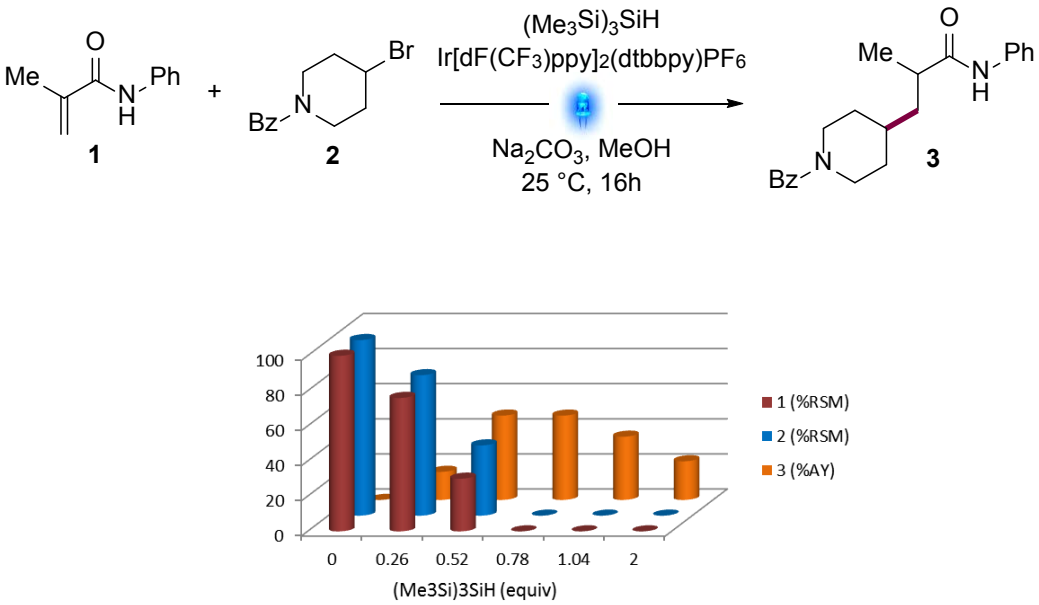


Figure S2. Screening of variable equivalents of silane in the conjugate addition of alkyl bromide **2** to amide **1.**

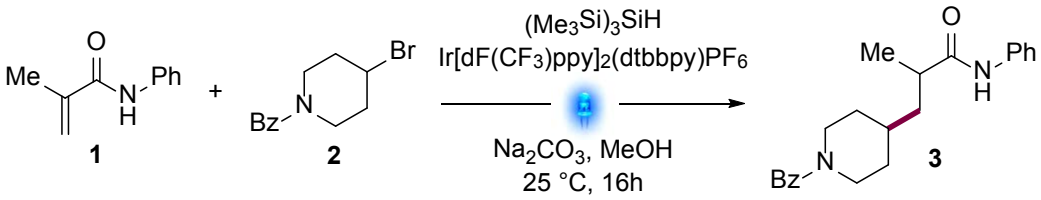
Table S3. Variable Silane screen.

Entry[a]	$(Me_3Si)_3SiH$ (equiv)	**1** (%RSM)[b]	**2** (%RSM)[b]	**Product** (%AY)[b]
1	0	100	100	**0**
2	0.26	76	80	**16**
3	0.52	30	40	**48**
4	0.78	0	0	**48**
5	1.04	0	0	**36**
6	**2.00**	**0**	**0**	**22**

[a] *N*-phenylmetacrylamide (**1**) (20 mg, 0.12 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (33 mg, 0.12 mmol, 1.0 equiv.), Na_2CO_3 (26 mg, 0.25 mmol, 2.0 equiv.), $(Me_3Si)_3SiH$ (see Table), $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.012 mmol, 0.01 equiv.) and MeOH (600 µL), Aldrich® Micro Photochemical Reactor (**ring**) for 16h. [b] Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques.

2.4. Screening of amounts of reactants

Table S4. Variable amounts of reactants



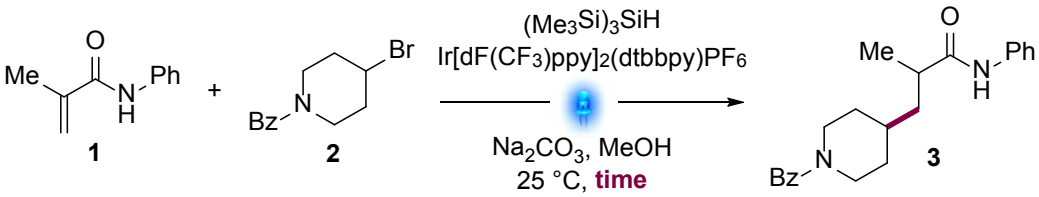
.

Entry[a]	1 (equiv)	2 (equiv)	$(Me_3Si)_3SiH$ (equiv)	1 (%RSM)[b]	2 (%RSM)[b]	3 (%AY)[b]
1	1	3	0.52	12	-[c]	**70**
2	1	1.5	0.52	28	-[c]	**52**
3	1	1	0.52	43	51	**32**
4	1.5	1	0.52	-[c]	76	**21**
5	3	1	0.52	-[c]	89	**11**
6	1	3	0.78	0	-[c]	**74**
7	1	1.5	0.78	0	-[c]	**65**
8	1	1	0.78	13	7	**46**
9	1.5	1	0.78	-[c]	61	**30**
10	3	1	0.78	-[c]	82	**12**
11	1	3	1.04	0	-[c]	**71**
12	1	1.5	1.04	0	0	**70**
13	1	1	1.04	0	0	**39**
14	1.5	1	1.04	-[c]	45	**31**
15	**3**	**1**	**1.04**	**-[c]**	**81**	**18**

[a] *N*-phenylmetacrylamide (**1**) (see Table), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (see Table), Na_2CO_3 (26 mg, 0.25 mmol, 2.0 equiv.), $(Me_3Si)_3SiH$ (see Table), $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.012 mmol, 0.01 equiv.) and MeOH (600 µL), Aldrich® Micro Photochemical Reactor (**ring**) for 16h. [b] Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques. [c] Reagent in excess.

2.5. Comparison of light sources

Table S5. Comparison of light sources.



Entry[a]	$(Me_3Si)_3SiH$ (equiv)	Light source	Time (h)	1 (%RSM)[b]	3 (%AY)[b]
1	0.75	Ring[c]	1	95	**4**
2	0.75	Ring[c]	2	84	**13**
3	0.75	Ring[c]	4	56	**27**
4	0.75	Ring[c]	8	22	**43**
5	0.75	Ring[c]	24	12	**71**
6	1.0	Ring[c]	1	98	**0**
7	1.0	Ring[c]	2	88	**15**
8	1.0	Ring[c]	4	68	**28**
9	1.0	Ring[c]	8	29	**53**
10	1.0	Ring[c]	24	12	**68**
11	0.75	Lamp[d]	1	47	**36**
12	0.75	Lamp[d]	2	45	**43**
13	0.75	Lamp[d]	4	4	**70**
14	1.0	Lamp[d]	1	28	**45**
15	1.0	Lamp[d]	2	4	**62**
16	1.0	Lamp[d]	4	0	**64**

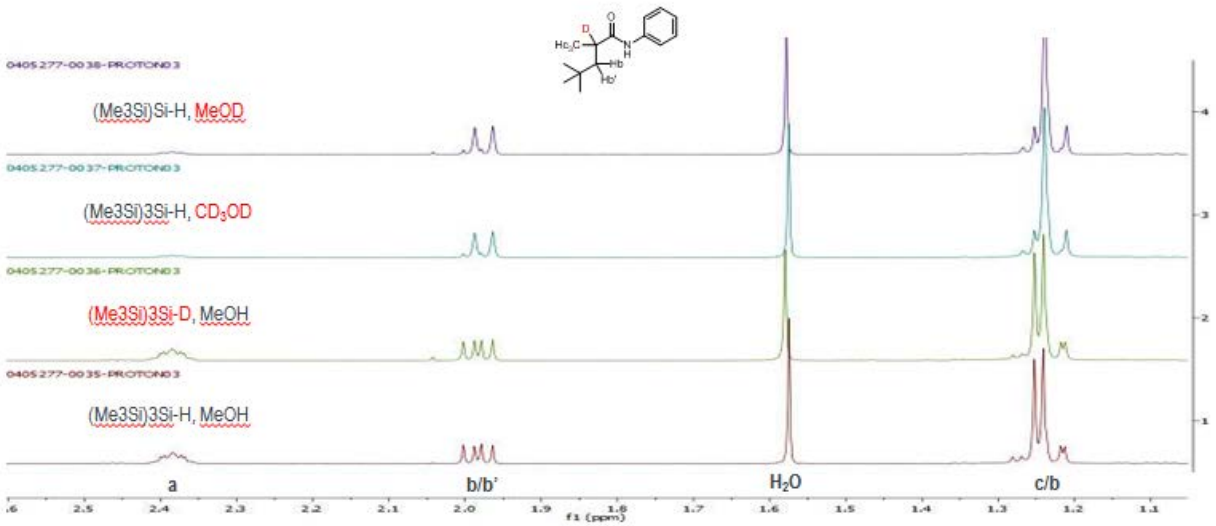
17	0.75	Reactor[e]	1	0	**74**
18	1.0	Reactor[e]	5 min	61	**28**
19	1.0	Reactor[e]	10 min	49	**40**
20	1.0	Reactor[e]	15 min	31	**48**
21	1.0	Reactor[e]	20 min	13	**55**
22	1.0	Reactor[e]	30 min	0	**63**
23	**1.0**	**Reactor[e]**	**1**	**0**	**65**

[a] *N*-phenylmetacrylamide (**1**) (20 mg, 0.12 mmol, 1.0 equiv.), (4-bromopiperidin-1-yl)(phenyl)methanone (**2**) (50 mg, 0.18 mmol, 1.5 equiv.), Na_2CO_3 (26 mg, 0.25 mmol, 2.0 equiv.), $(Me_3Si)_3SiH$ (see Table), $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.012 mmol, 0.01 equiv.) and MeOH (600 µL) [b] Assay yields for desired product and remaining starting materials were determined by measuring its concentrations from a 50-70 mg aliquot of the reaction using standard HPLC techniques. [c] ring = Aldrich® Micro Photochemical Reactor. [d] Lamp = Kessil® A160WE Tuna Blue Light. [e] Reactor = 13.2W Merck Photoreactor.

3. NMR experiments

Reactions were performed using deuterated solvent (MeO**D** and C**D**$_3$O**D**) and deuterated silane [(Me$_3$Si)Si**D**] looking for incorporation of deuterium at the α-position of the amide using ^{t}butyl bromide. All reactions performed similarly to the non-deuterated version and isolated yields of product were between 64% and 67%.

Figure S3. NMR experiments performed of amide **1** with t-butyl bromide



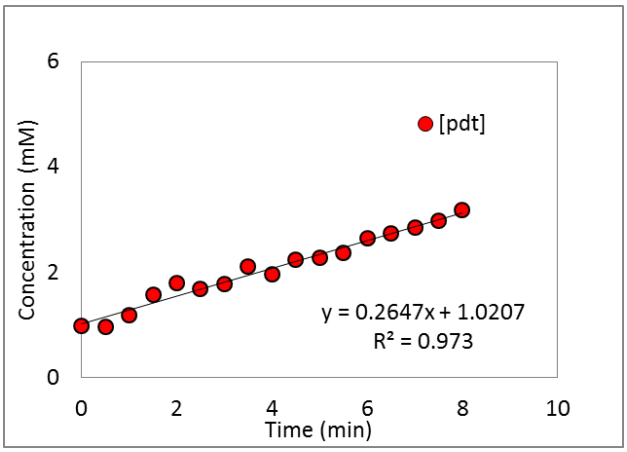
4. Determination of Quantum Yield via LED-NMR.

Determination of quantum yield for the reaction under the standard conditions was not possible because the reaction is both heterogenous (inorganic base) and biphasic ($(Me_3Si)_3SiH$ is inmiscible with MeOH), and does not proceed without stirring. Homogeneous reaction conditions were identified by replacing sodium carbonate with 2,6-lutidine and quantum yield was determined using these modified conditions.

4.1. Light intensity determined with 2,4-dinitrobenzaldehyde as chemical actinometer:

General procedure: 1 M stock solution of 2,4-dinitrobenzaldehyde was prepared in 1 mL volumetric flask. 600 μL was transferred to a 5 mm thin wall NMR tube followed by the placement of the coaxial insert. The joint was parafilmed and the sample was kept with foil to keep out the light. The samples were irradiated at 440 nm using LED-NMR setup. The initial rate was extracted from the data obtained in the first 8 minutes of reaction (lineal region).

Figure S4. Extraction of the initial rate using the data of the first 8 minutes from the temporal concentration profiles monitored by 1H NMR spectroscopy for the transformation of 2,4-dinitrobenzaldehyde (1 M) in ultraviolet light (440 nm)

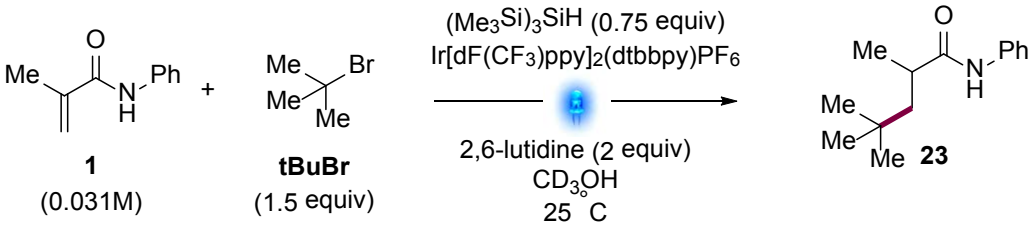


a) Convert k_0 in M/s: 0.2647 mM/min = $4.41*10^{-6}$ M/s
b) Apply $k_0 = \phi * I_0 (1-10^{-\varepsilon*b*C})$ to extract I_0:

$\varepsilon_{(2,4\text{-DNBA, 440 nm})}$ = 23.4 M^{-1} cm^{-1}
C = 1 M
b = 0.11 cm

$4.41*10^{-6}$ M/s = 0.0772*0.997* I_0 (einstein/L*s). Therefore, $\boldsymbol{I_0 = 5.72*10^{-5}}$ **einstein/L*s**

4.2. Quantum yield calculation:



1 (0.031M)

tBuBr (1.5 equiv)

General procedure: In a 1 mL volumetric flask was charged *N*-phenylmethacrylamide (**1**) (50 mg, 0.31 mmol), $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (6.96 mg, 6.2 μmol) and 800 μL of CD_3OH. Then, 2-bromo-2-methylpropane (52 μL, 1.5 equiv), $(Me_3Si)_3SiH$ (72 μL, 0.75 equiv) were added followed by the addition of 2,6-lutidine (72 μL, 2 equiv). The resulting solution was tarred with CD_3OH. Then, 600 μL of the solution was transferred to a 5 mm thin wall NMR tube followed by the placement of the coaxial insert. The joint was parafilmed and the sample was kept with foil to keep out the light. The sample was irradiated at 440 nm using LED-NMR setup.

Catalyst loading effect: Initial rates were obtained using either 2 mol% and 5 mol% catalyst loading as shown in Fig.S5.

Figure S5. Temporal concentration profiles monitored by 1H NMR spectroscopy at two catalyst loadings, 2 mol% and 5 mol%. $[\text{N-phenylmethacrylamide}]_0$ = 0.310 M; [tBuBr] = 0.465 M; $[(Me_3Si)_3SiH]$ = 0.233 M and [2,6-Lutidine] = 0.620 M

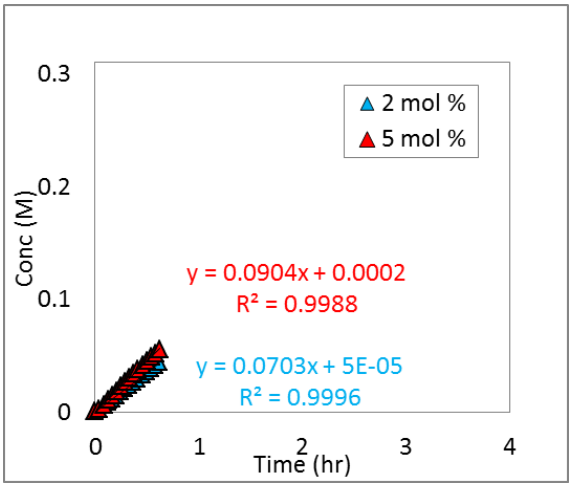


Fig.S5. Temporal concentration profiles monitored by ^{1}H NMR spectroscopy at two catalyst loadings, 2 mol% and 5 mol%. $[\textit{N}\text{-phenylmethacrylamide}]_0$ = 0.310 M; [^{t}BuBr] = 0.465 M; $[(TMS)_3SiH]$ = 0.233 M and [Lutidine] = 0.620 M.

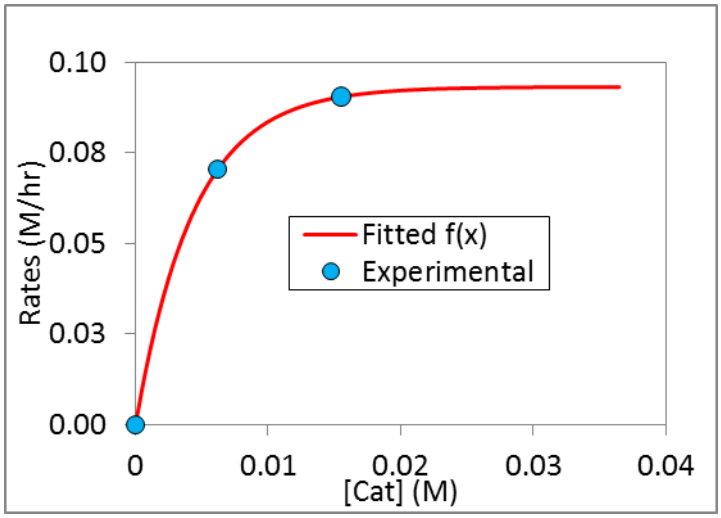
Rate *versus* [catalyst]:

The rate *versus* concentration data was fitted into the formula:

$$(1) \quad -\frac{d[Act]}{dt} = I_0\phi\left(1 - 10^{-\varepsilon b[Act]}\right)$$

Fitting was performed using Gnuplot software. The fitting function was defined as follows:

f(x) = A*(1-exp(-2.3026*z*x)) where A = I_0*ϕ; z = ε*b, ε is molar absorptivity (M^{-1} cm^{-1}) and b (light path length) = 0.11 cm.



A and z values were obtained from the fitting as: A = 0.0931 M/hr and z = 98.7545 M^{-1}.
f(x)=A*(1-exp(-2.3026*z*x)) is maxim when 1-exp(-2.3026*z*x) = 1 and the maxim value is A = 0.0931 M/hr.

a) Convert k_0 in M/s: 0.0931 M/hr = 2.58*10^{-5} M/s

b) Apply k_0 = ϕ*I_0 to extract ϕ: 2.58 *10^{-5} M/s = ϕ * 5.72*10^{-5} einstein/L*s

ϕ = 0.45

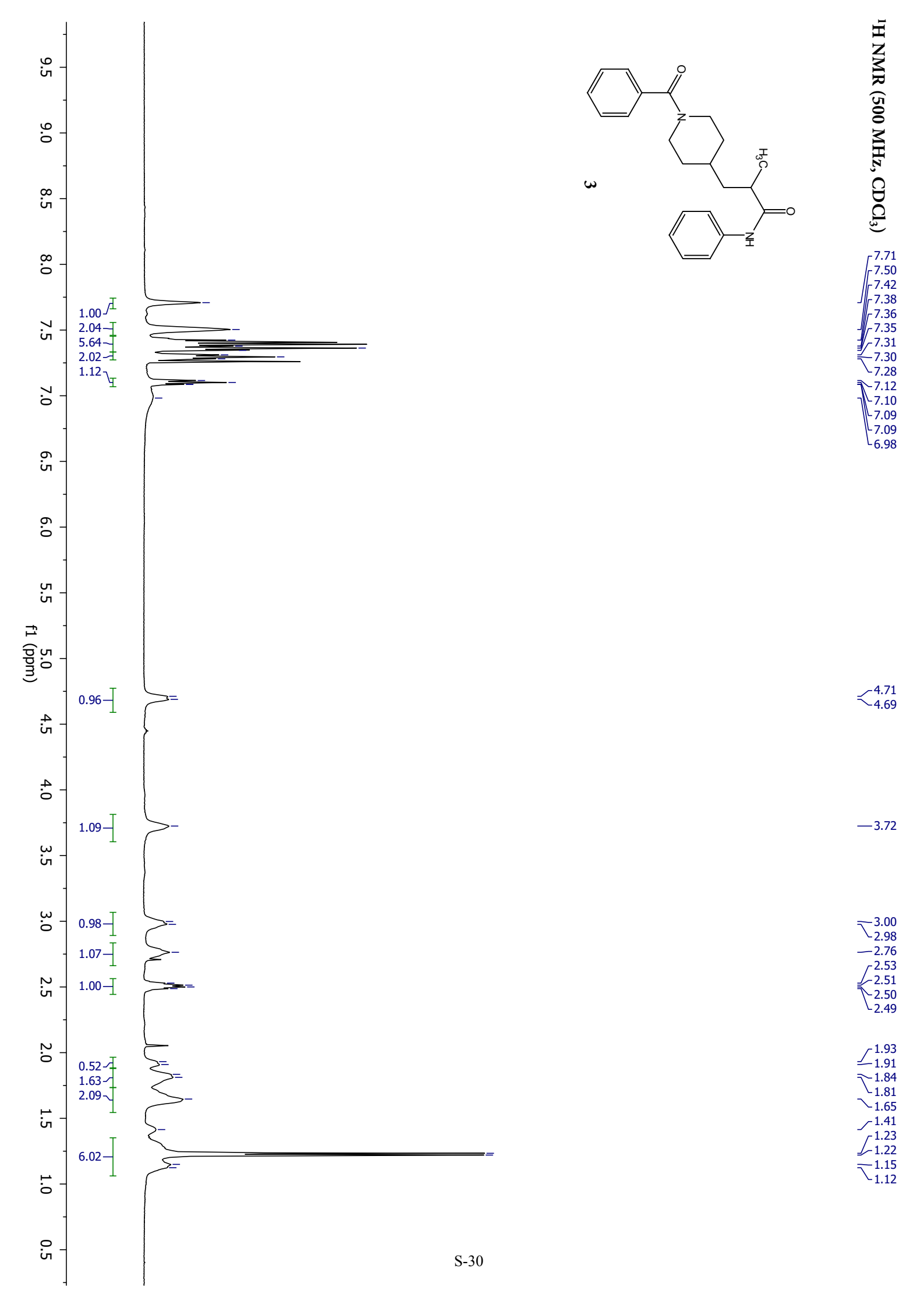
5. References

1 C. C. Le, M. K. Wismer, Z. C. Shi, R. Zhang, D. V. Conway, G. Li, P. Vachal, I. W. Davies and D. W. C. MacMillan, *ACS Cent. Sci.* 2017, **3**, 647.

2 X. Yu, T. Yang, S. Wang, H. Xu and H. Gong, *Org. Lett.* 2011, **13**, 2138.

3 (a) J. C. Stowell, R. I. Huot and L. Van Voast, *J. Med. Chem.*, 1995, **38**, 1411; (b) L. K. Gediya, P. Chopra, P. Purushottamachar, N. Maheshwari and V. C. O. Nja, *J. Med. Chem.*, 2005, **48**, 5047.

6. 1H and 13C NMR spectra


¹H NMR (500 MHz, CDCl₃)
3
f1 (ppm)
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
1.00
2.04
5.64
2.02
1.12
0.96
1.09
0.98
1.07
1.00
0.52
1.63
2.09
6.02
7.71
7.50
7.42
7.38
7.36
7.35
7.31
7.30
7.28
7.12
7.10
7.09
7.09
6.98
4.71
4.69
3.72
3.00
2.98
2.76
2.53
2.51
2.50
2.49
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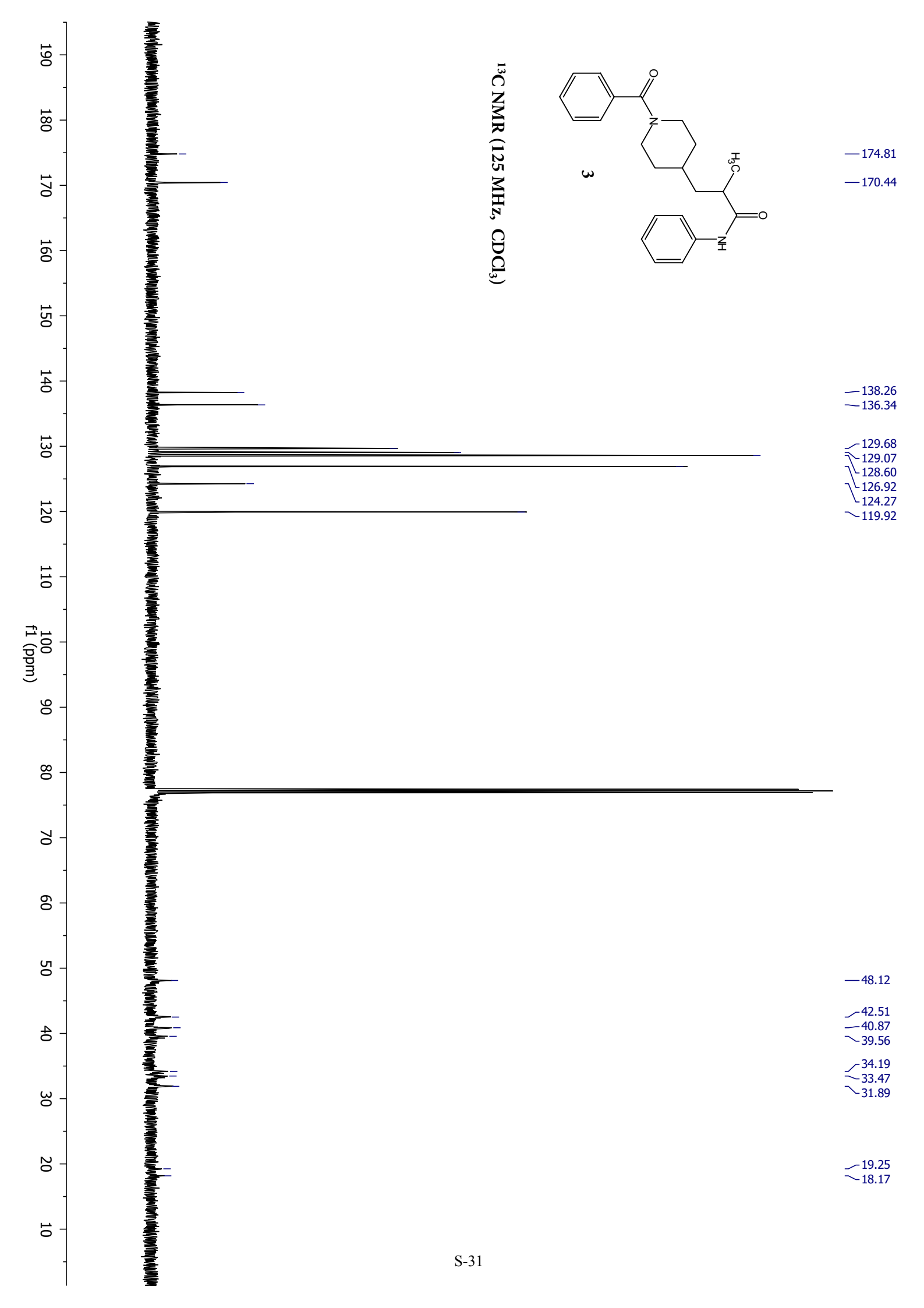
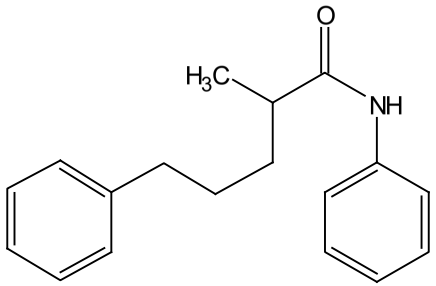
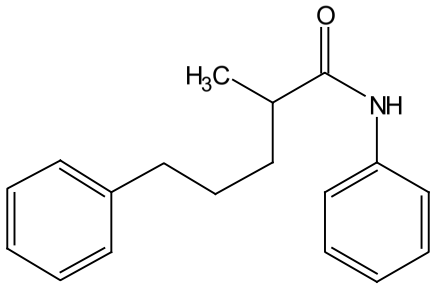
1.65
1.41
1.23
1.22
1.15
1.12


^{13}C NMR (125 MHz, $CDCl_3$)
3
174.81
170.44
138.26
136.34
129.68
129.07
128.60
126.92
124.27
119.92
48.12
42.51
40.87
39.56
34.19
33.47
31.89
19.25
18.17
f1 (ppm)

^{1}H NMR (500 MHz, $CDCl_3$)

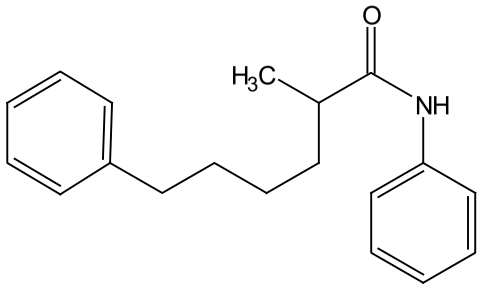


7



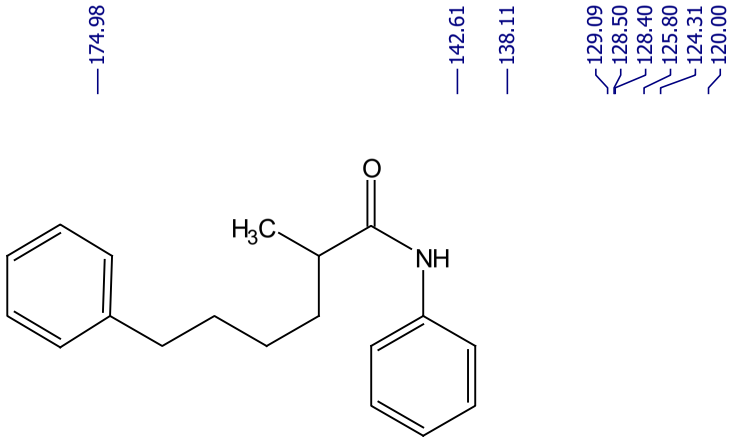
7

^{13}C NMR (125 MHz, $CDCl_3$)



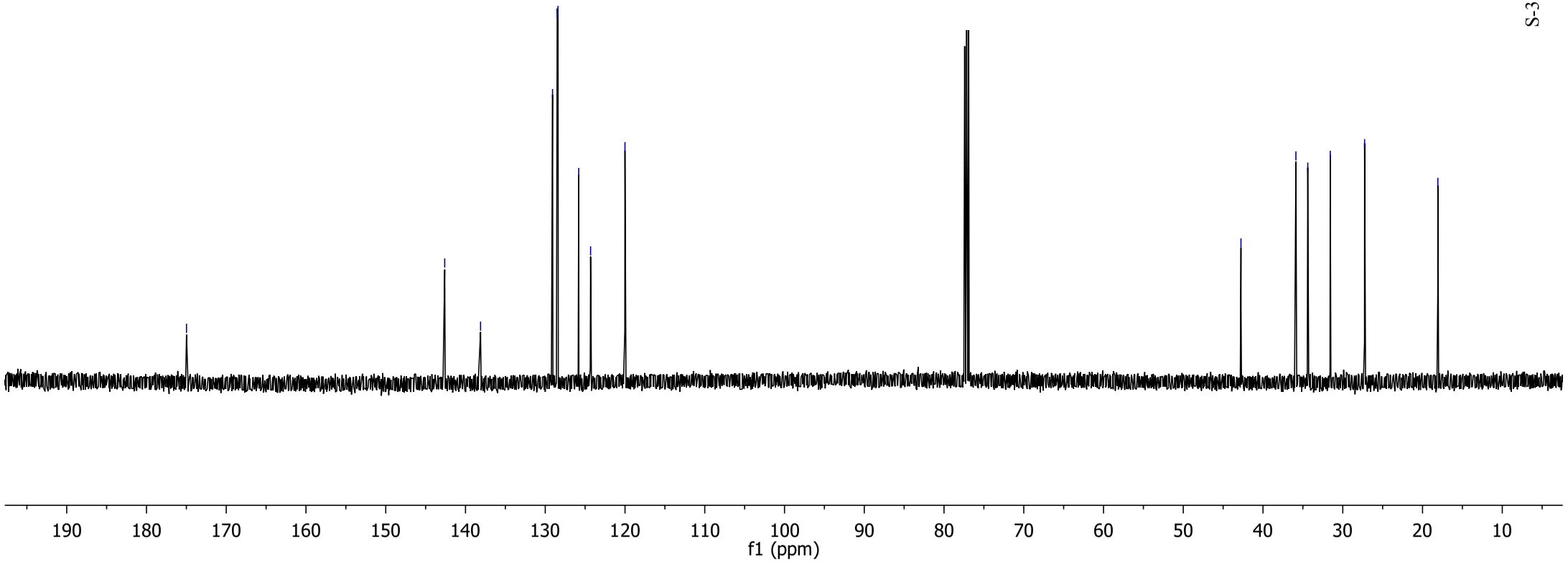
8

^{1}H NMR (500 MHz, $CDCl_3$)

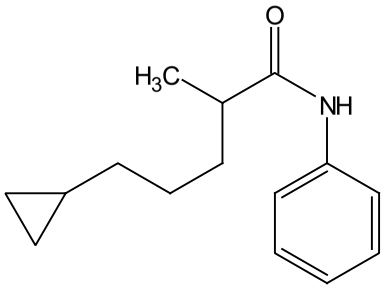


8

^{13}C NMR (125 MHz, $CDCl_3$)



^{1}H NMR (500 MHz, $CDCl_3$)



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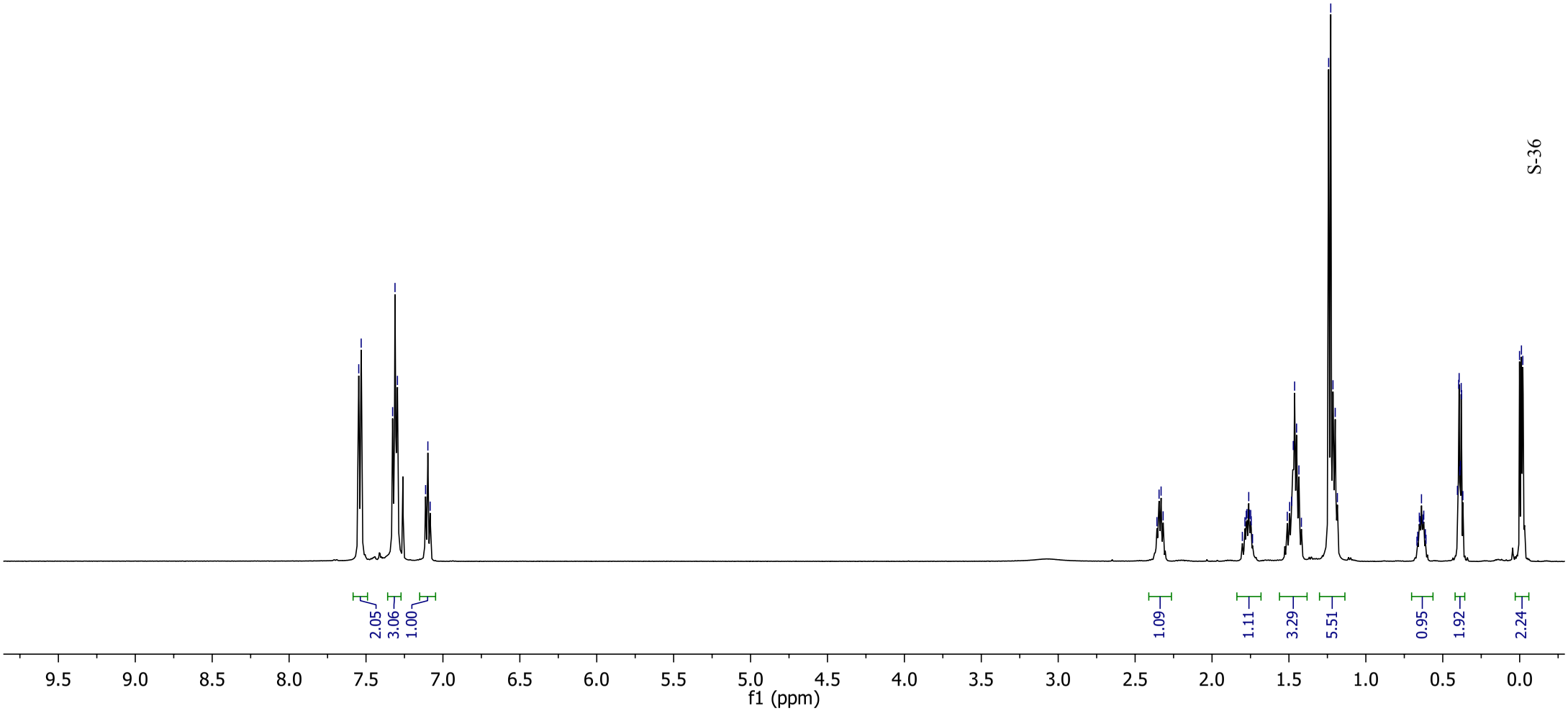
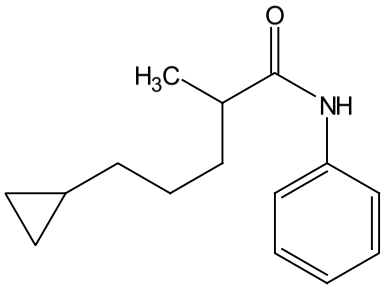
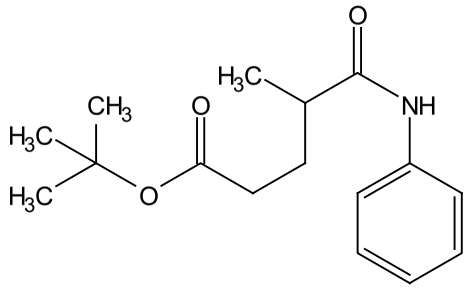




9

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



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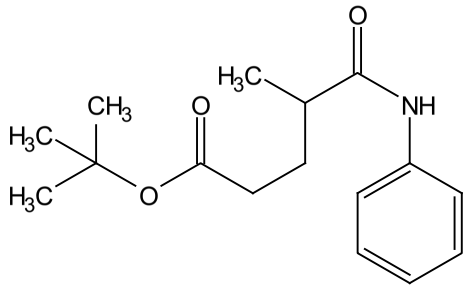
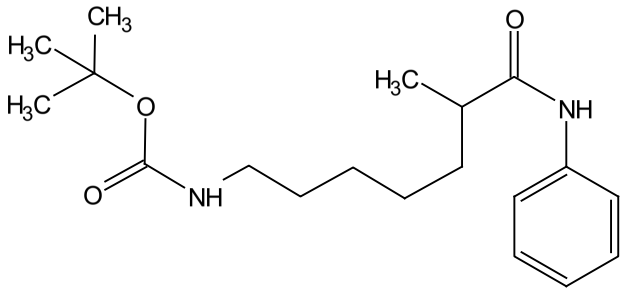


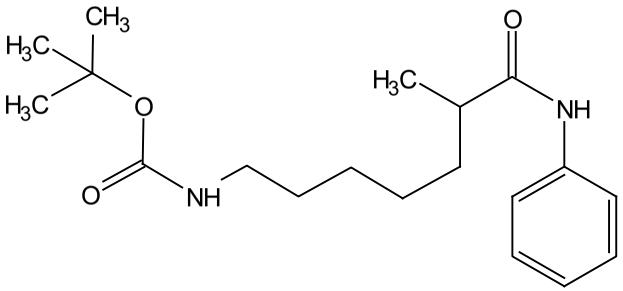
10

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



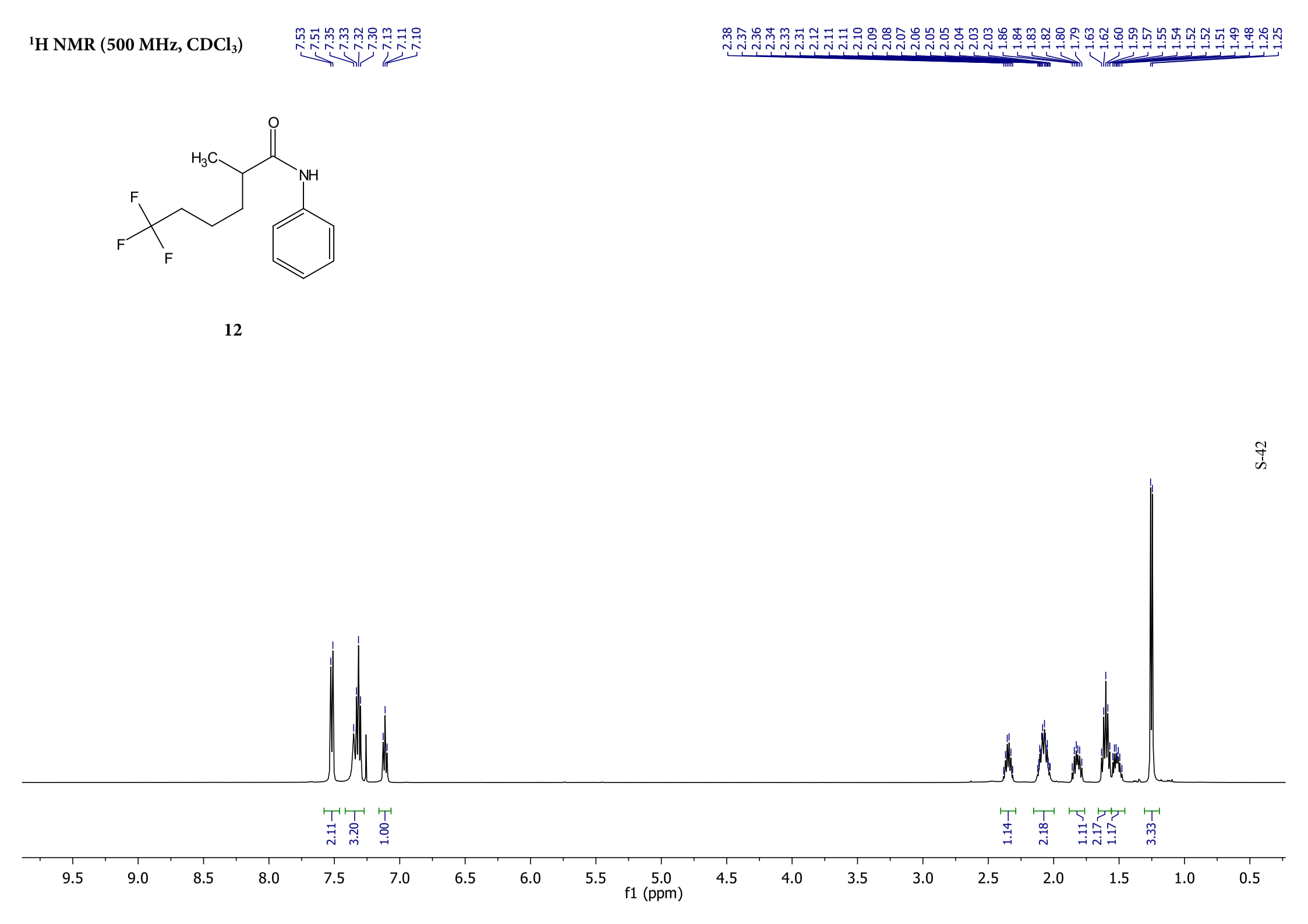
11



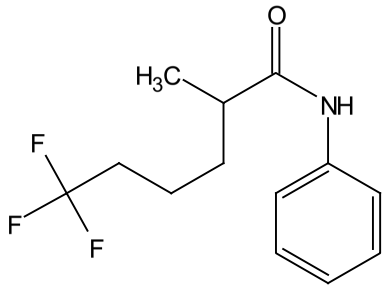
11

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)

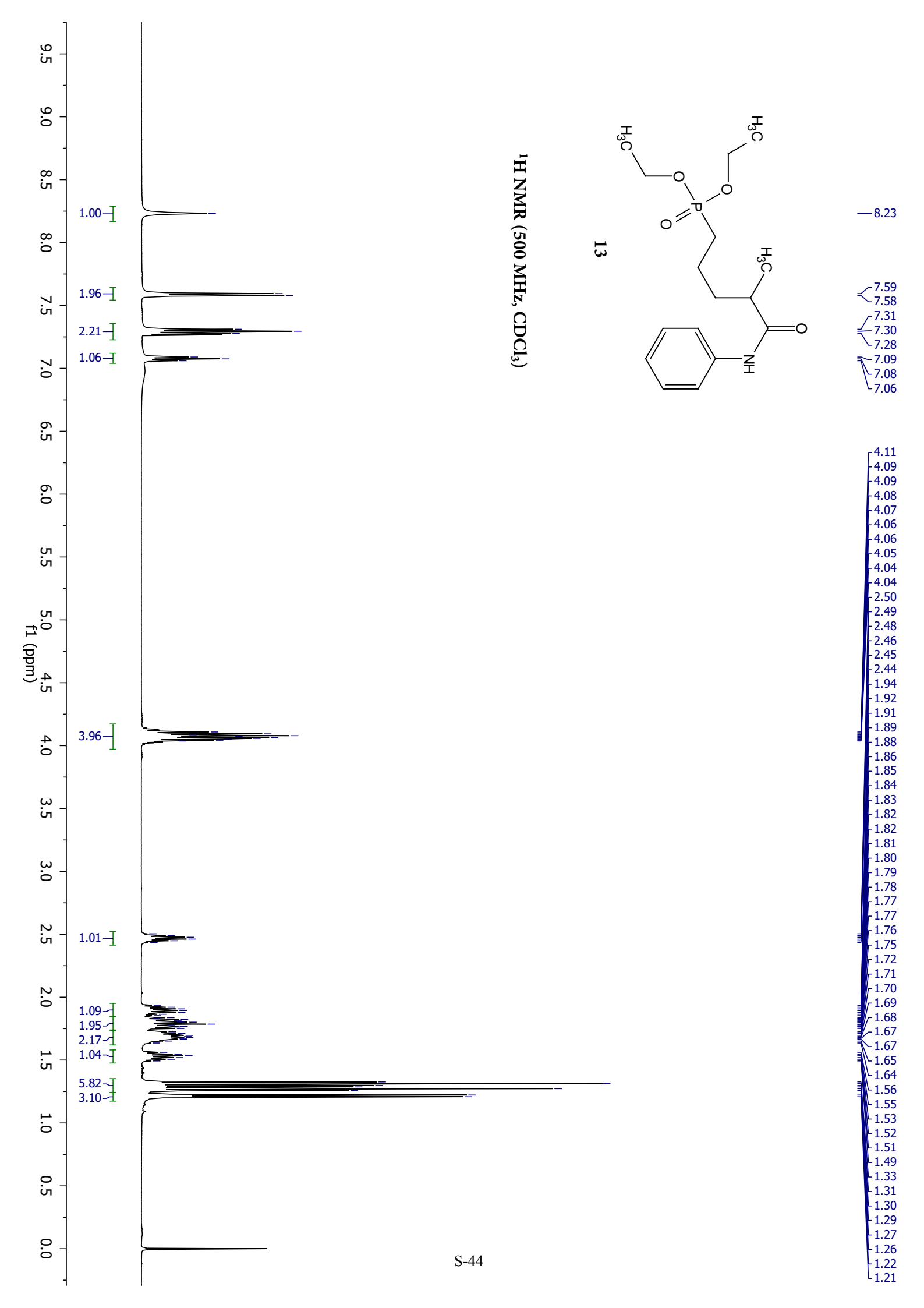


12



12

^{13}C NMR (125 MHz, $CDCl_3$)


^{1}H NMR (500 MHz, CDCl$_3$)
13
f1 (ppm)
1.00
1.96
2.21
1.06
3.96
1.01
1.09
1.95
2.17
1.04
5.82
3.10
8.23
7.59
7.58
7.31
7.30
7.28
7.09
7.08
7.06
4.11
4.09
4.09
4.08
4.07
4.06
4.06
4.05
4.04
4.04
2.50
2.49
2.48
2.46
2.45
2.44
1.94
1.92
1.91
1.89
1.88
1.86
1.85
1.84
1.83
1.82
1.82
1.81
1.80
1.79
1.78
1.77
1.77
1.76
1.75
1.72
1.71
1.70
1.69
1.68
1.67
1.67
1.65
1.64
1.56
1.55
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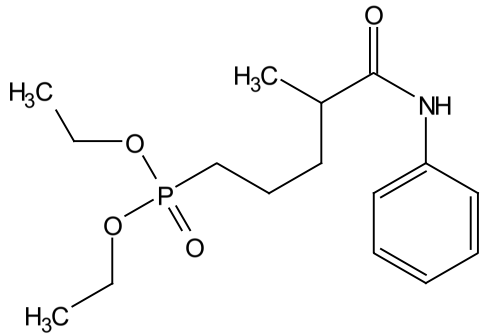
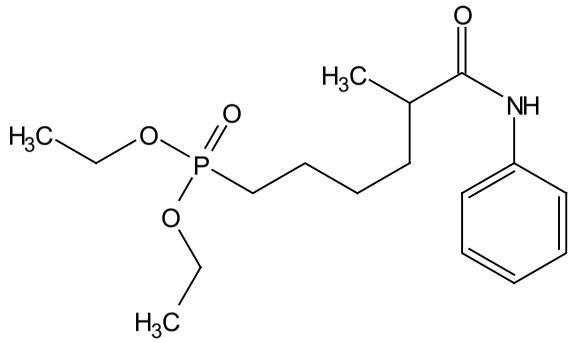
1.30
1.29
1.27
1.26
1.22
1.21



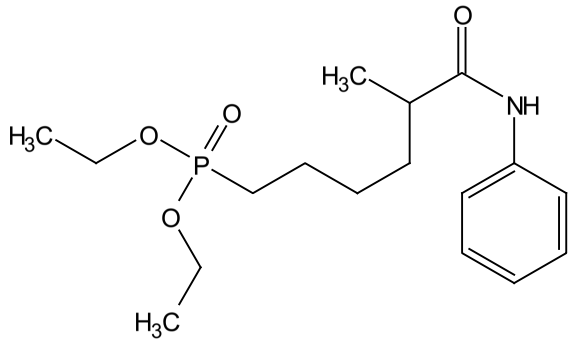
13

^{13}C NMR (125 MHz, $CDCl_3$)



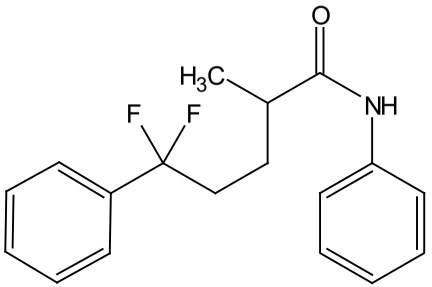
14

^{1}H NMR (500 MHz, $CDCl_3$)



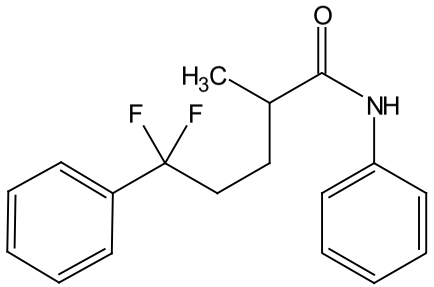
14

^{13}C NMR (125 MHz, $CDCl_3$)



15

^{1}H NMR (500MHz, $CDCl_3$)



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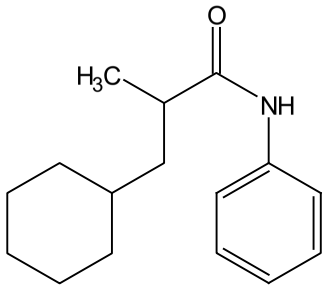
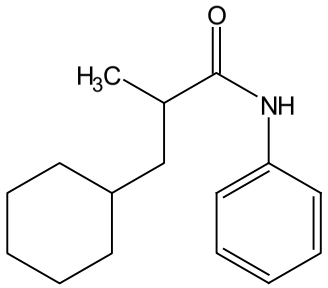
^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



16

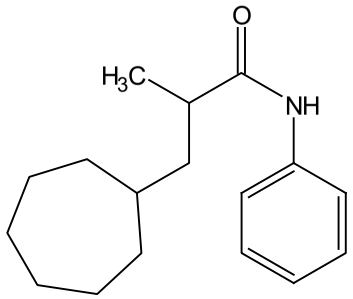
f1 (ppm)



16

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



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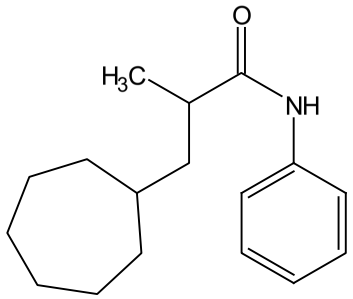
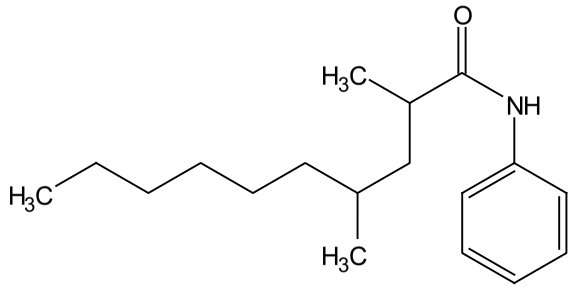


17

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



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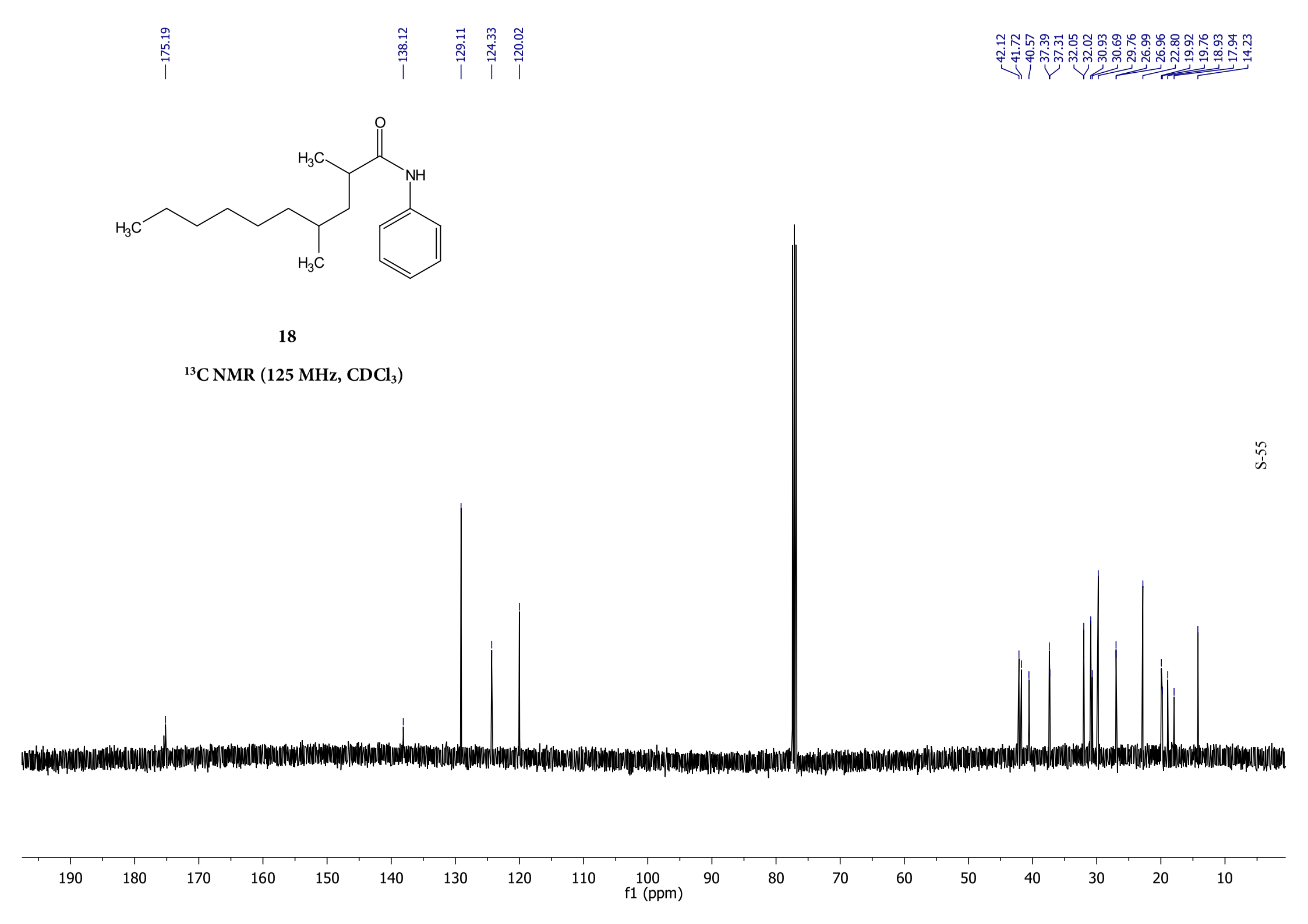
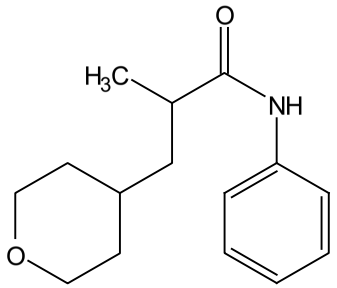


18

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



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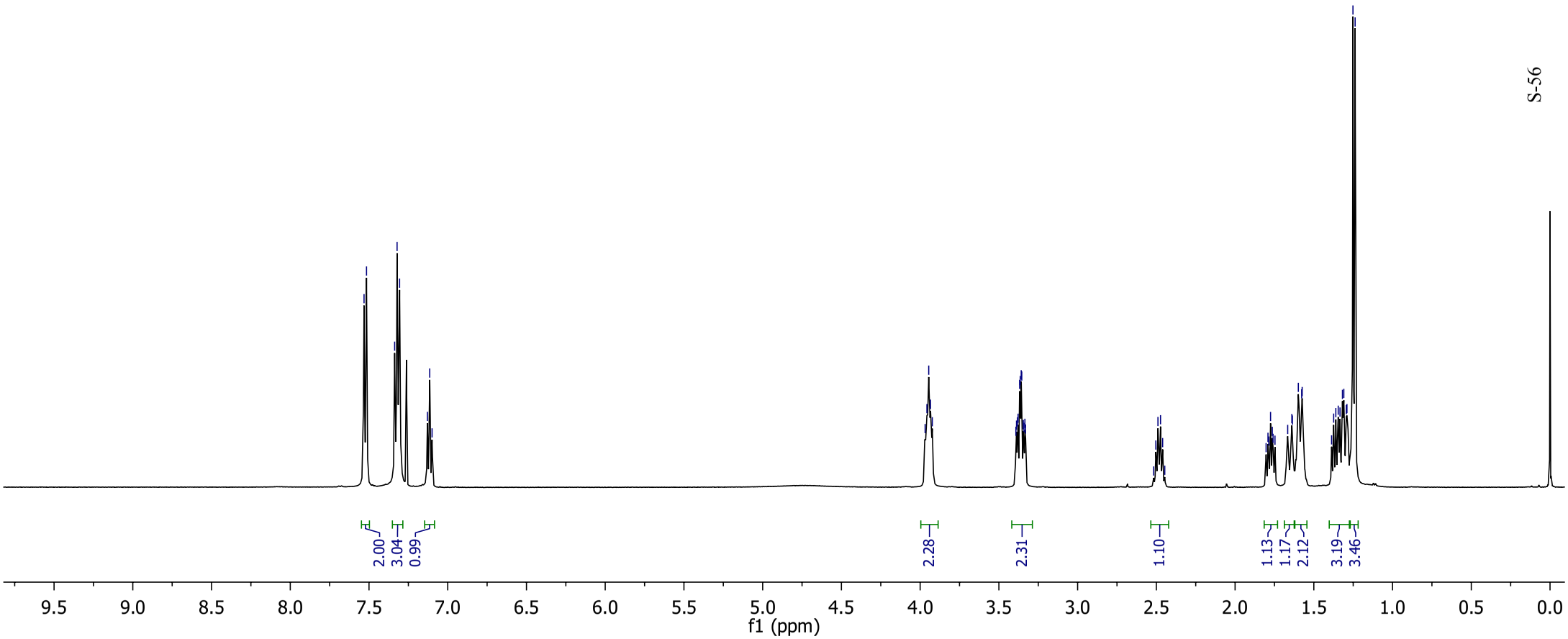
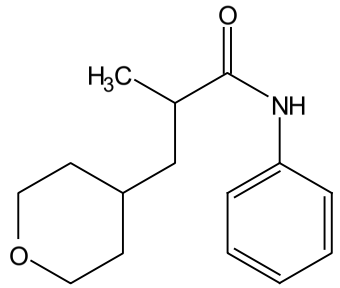
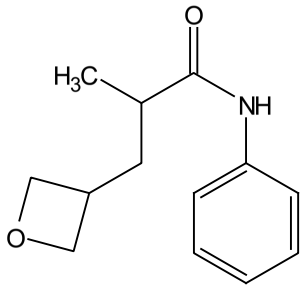




19

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



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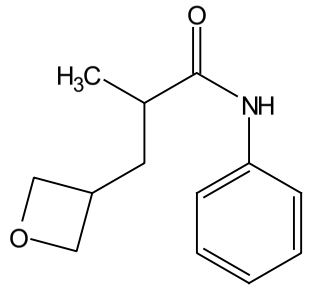

20

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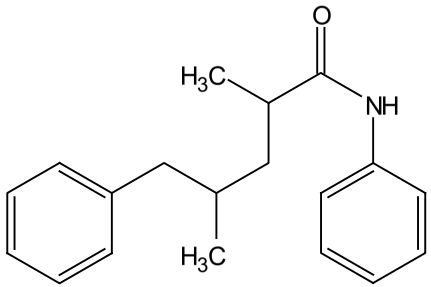
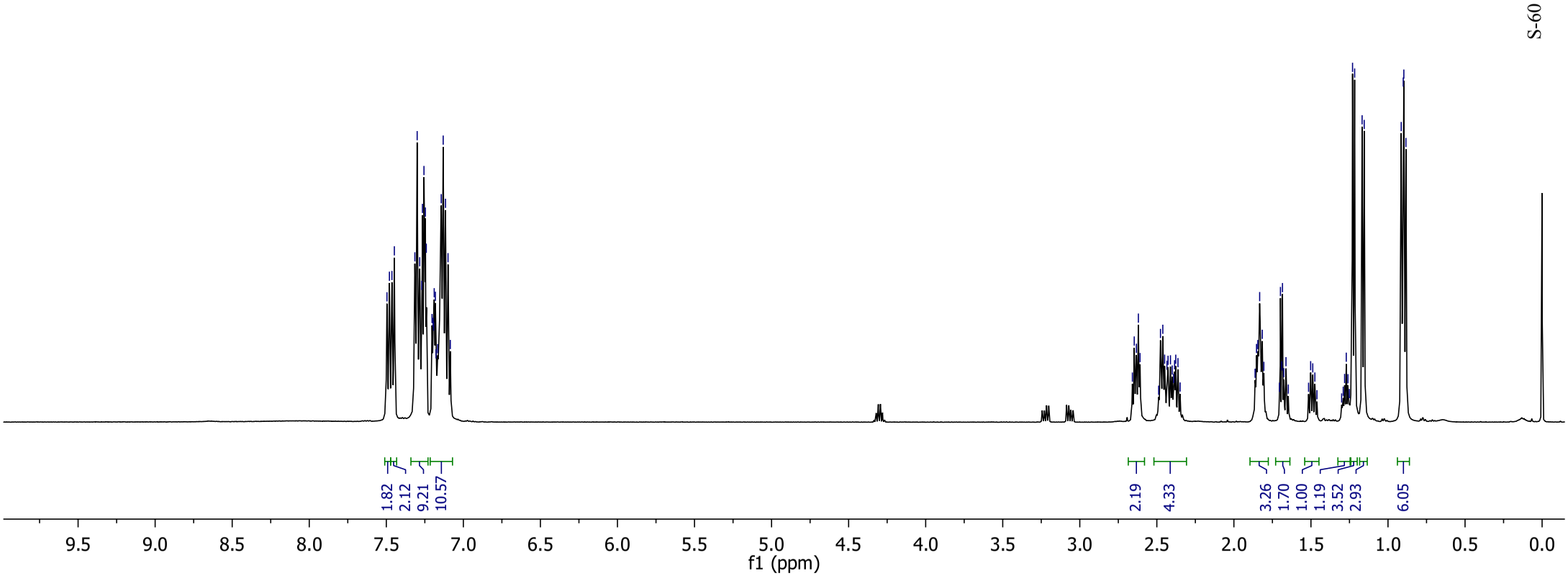
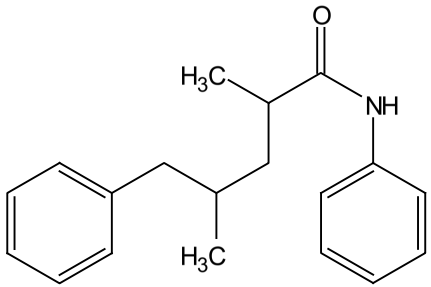


21

^{1}H NMR (500 MHz, $CDCl_3$)

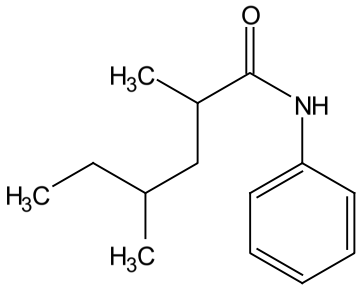




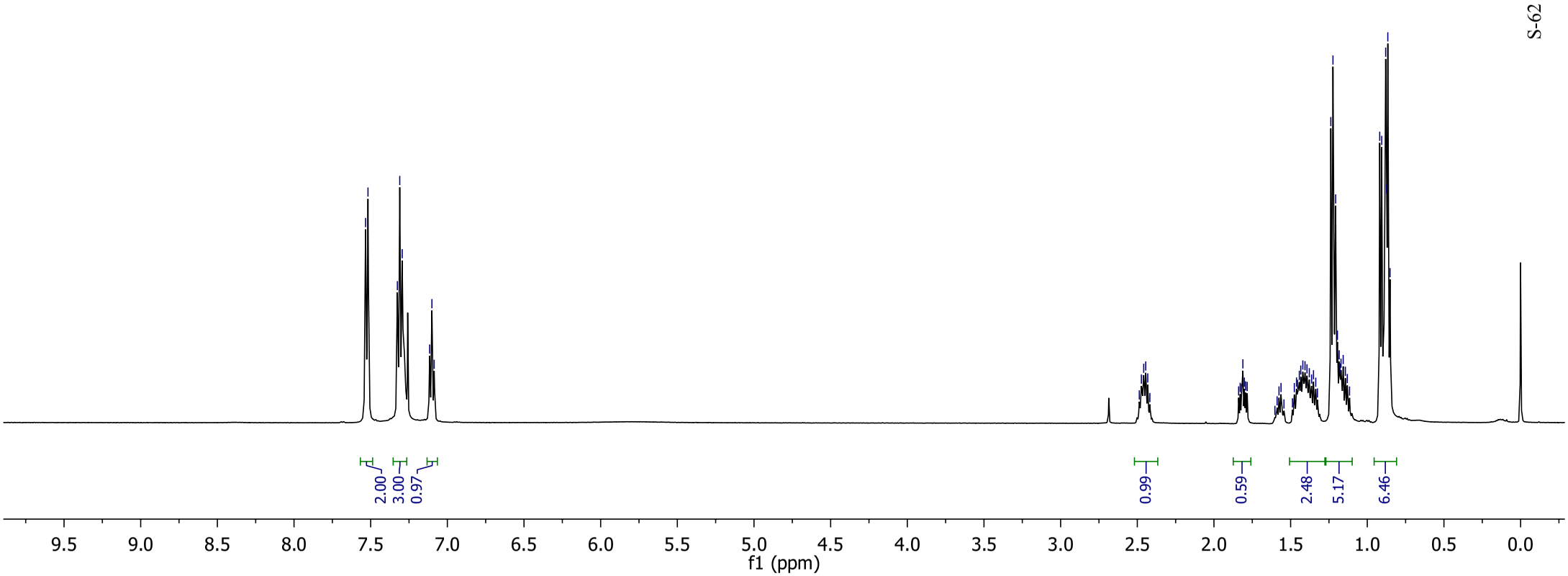
21

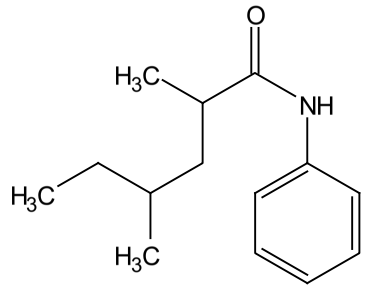
^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



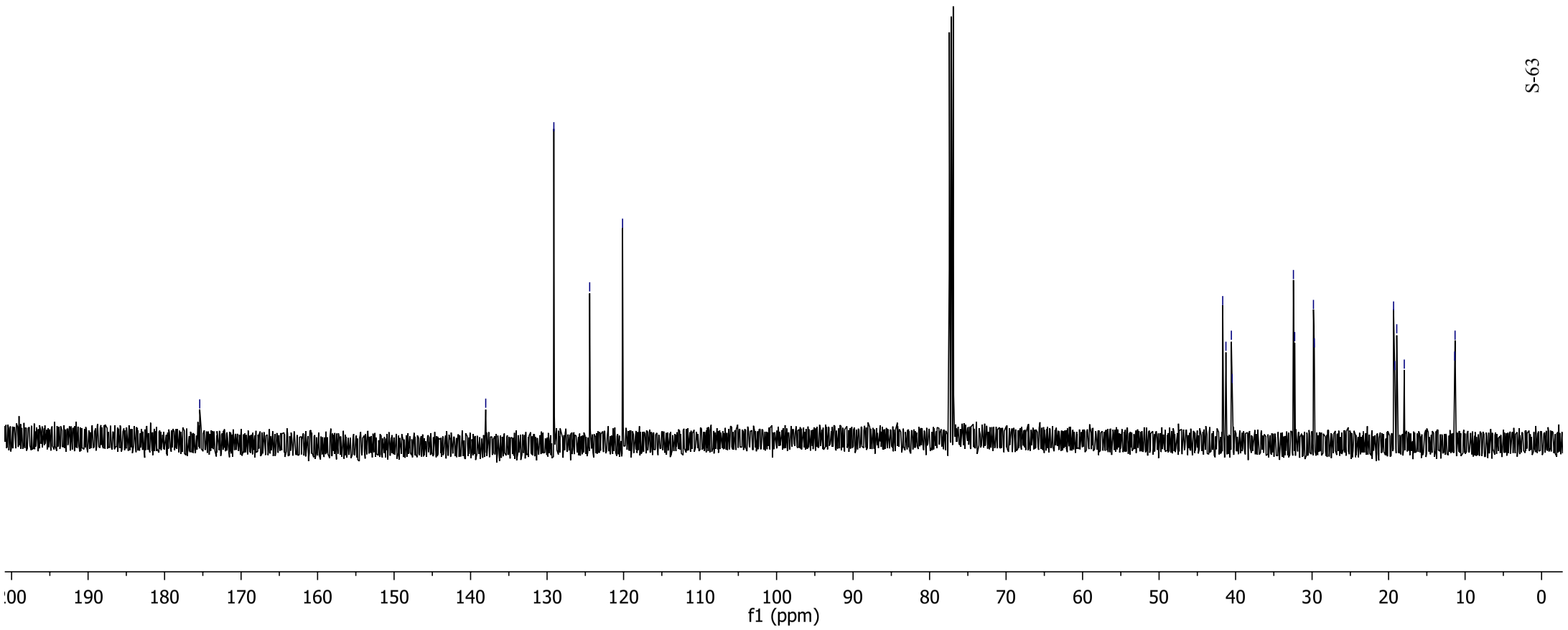
22



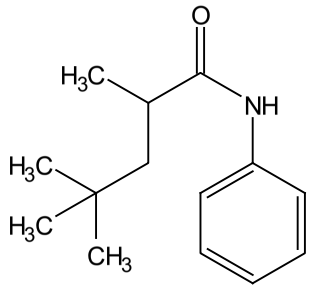


22

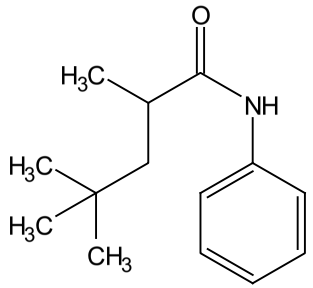
^{13}C NMR (125 MHz, $CDCl_3$)



^{1}H NMR (500 MHz, $CDCl_3$)



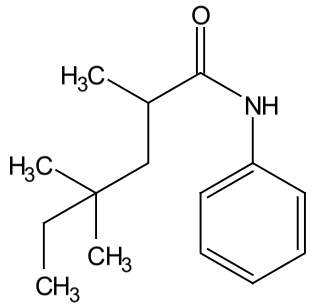
23



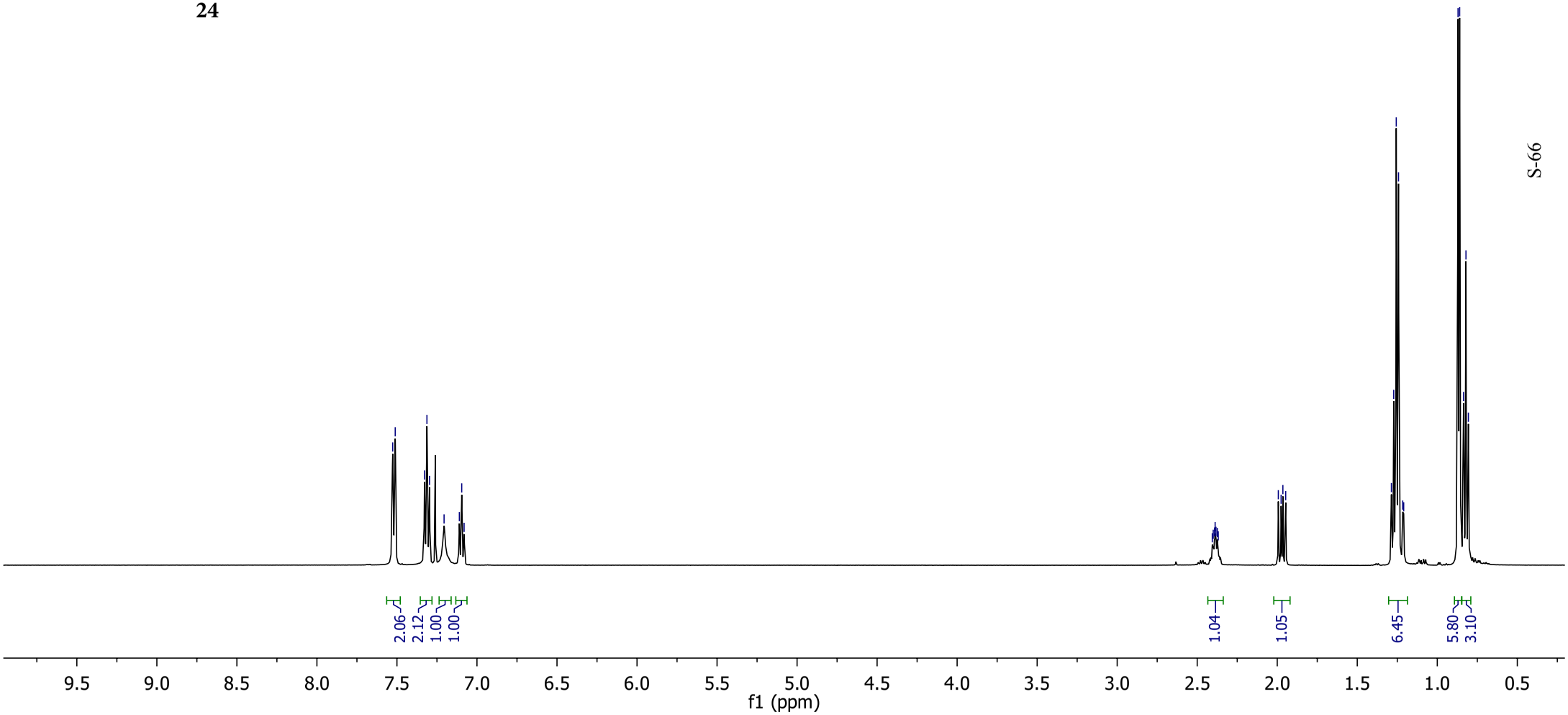
23

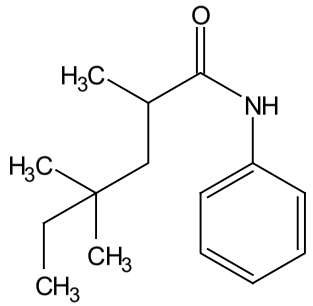
^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



24

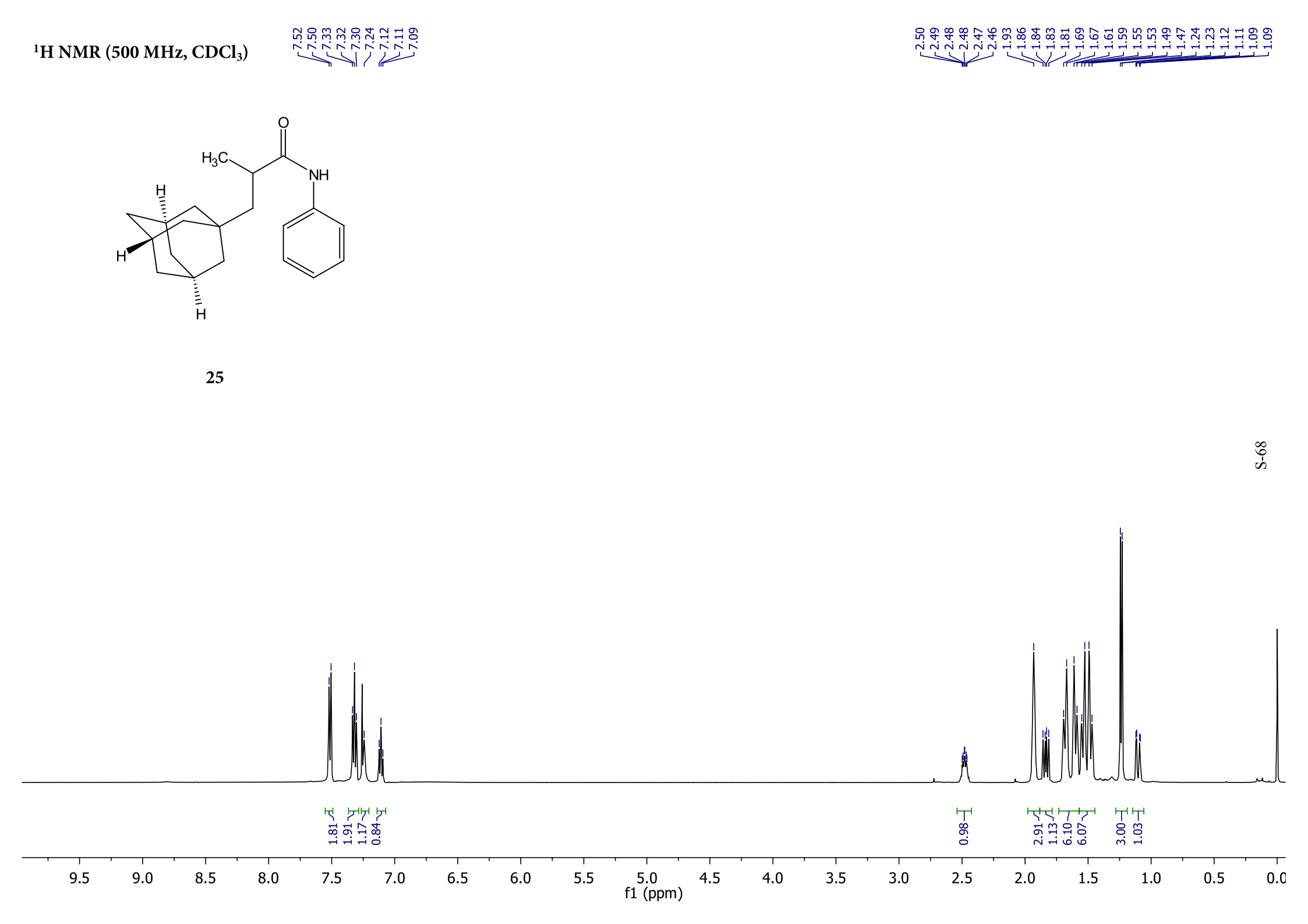




24

^{13}C NMR (125 MHz, $CDCl_3$)

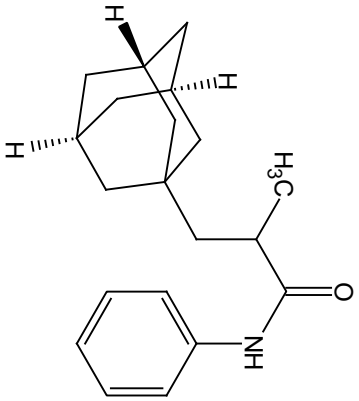
^{1}H NMR (500 MHz, $CDCl_3$)

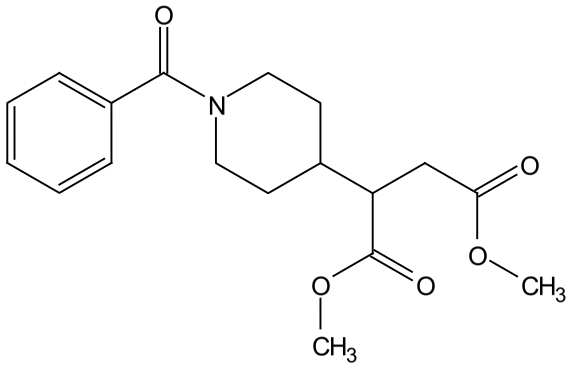


25

^{13}C NMR (125 MHz, $CDCl_3$)

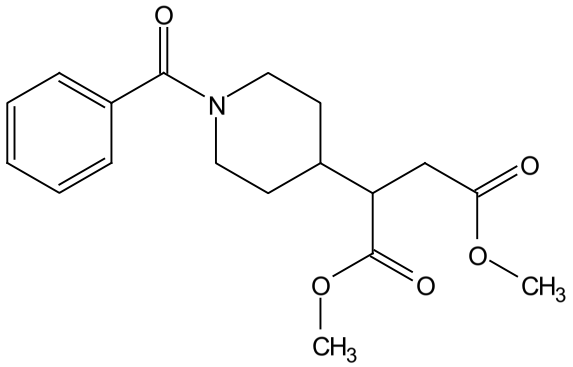
25





26

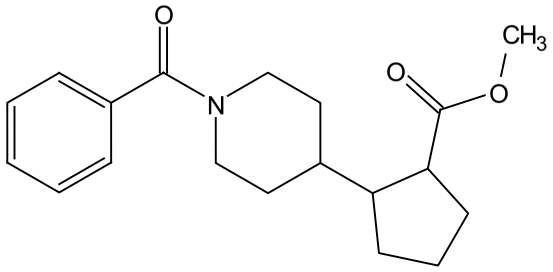
^{1}H NMR (500 MHz, $CDCl_3$)



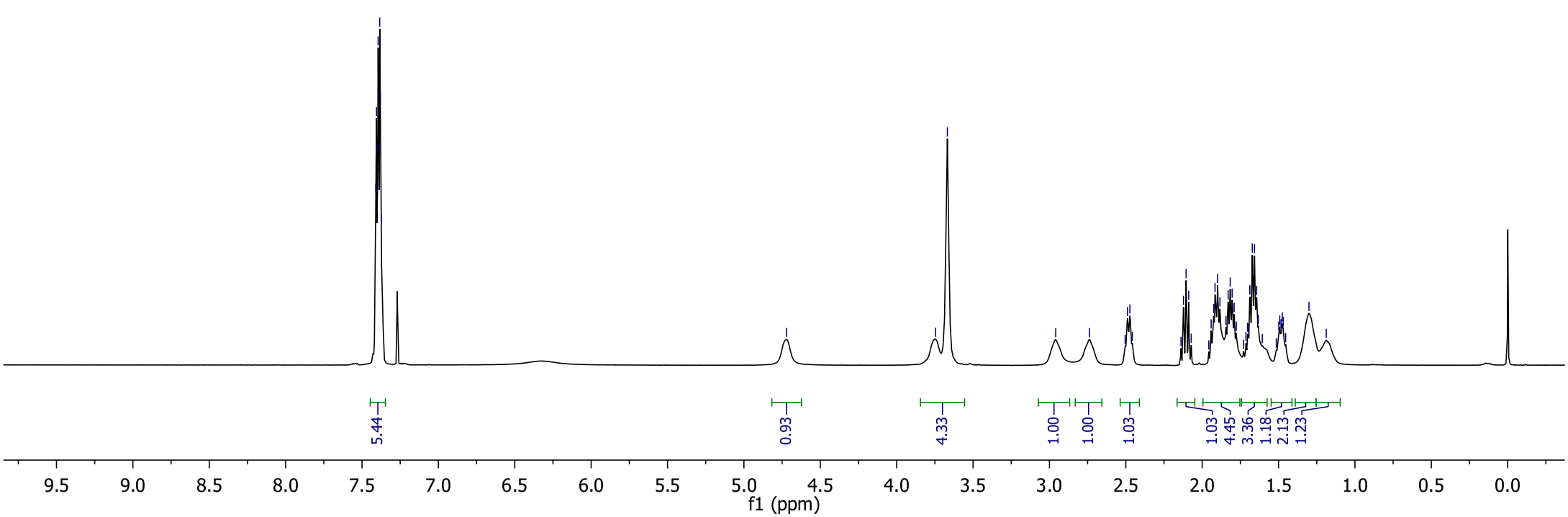
26

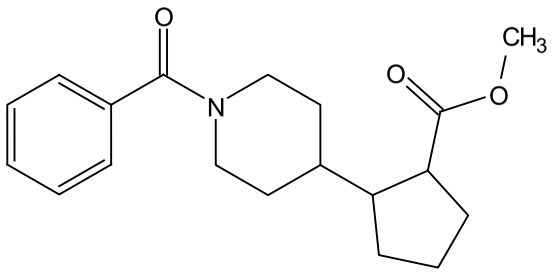
^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



27

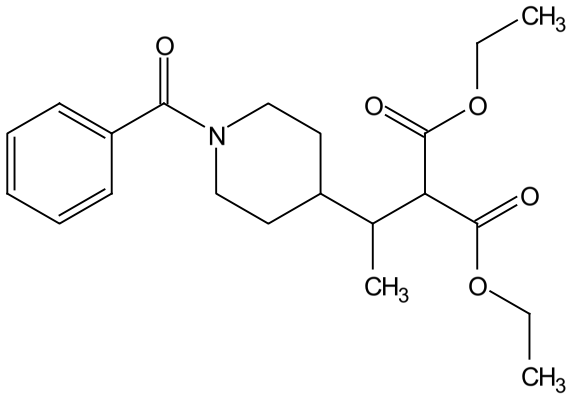




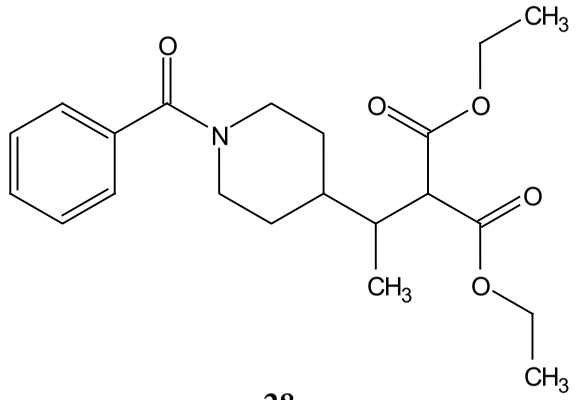
27

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)

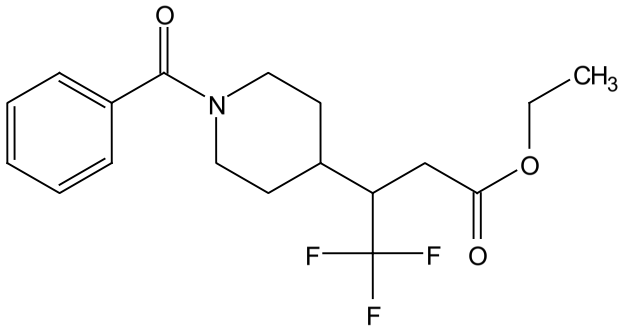


28



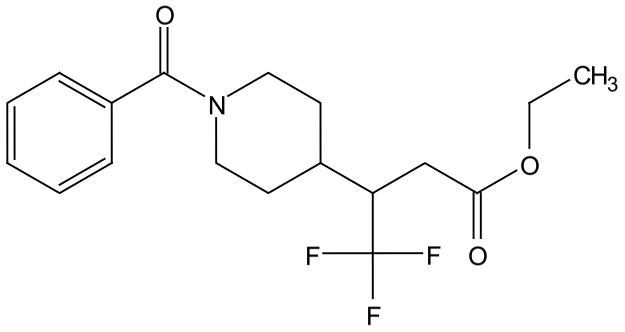
28

^{13}C NMR (125 MHz, $CDCl_3$)



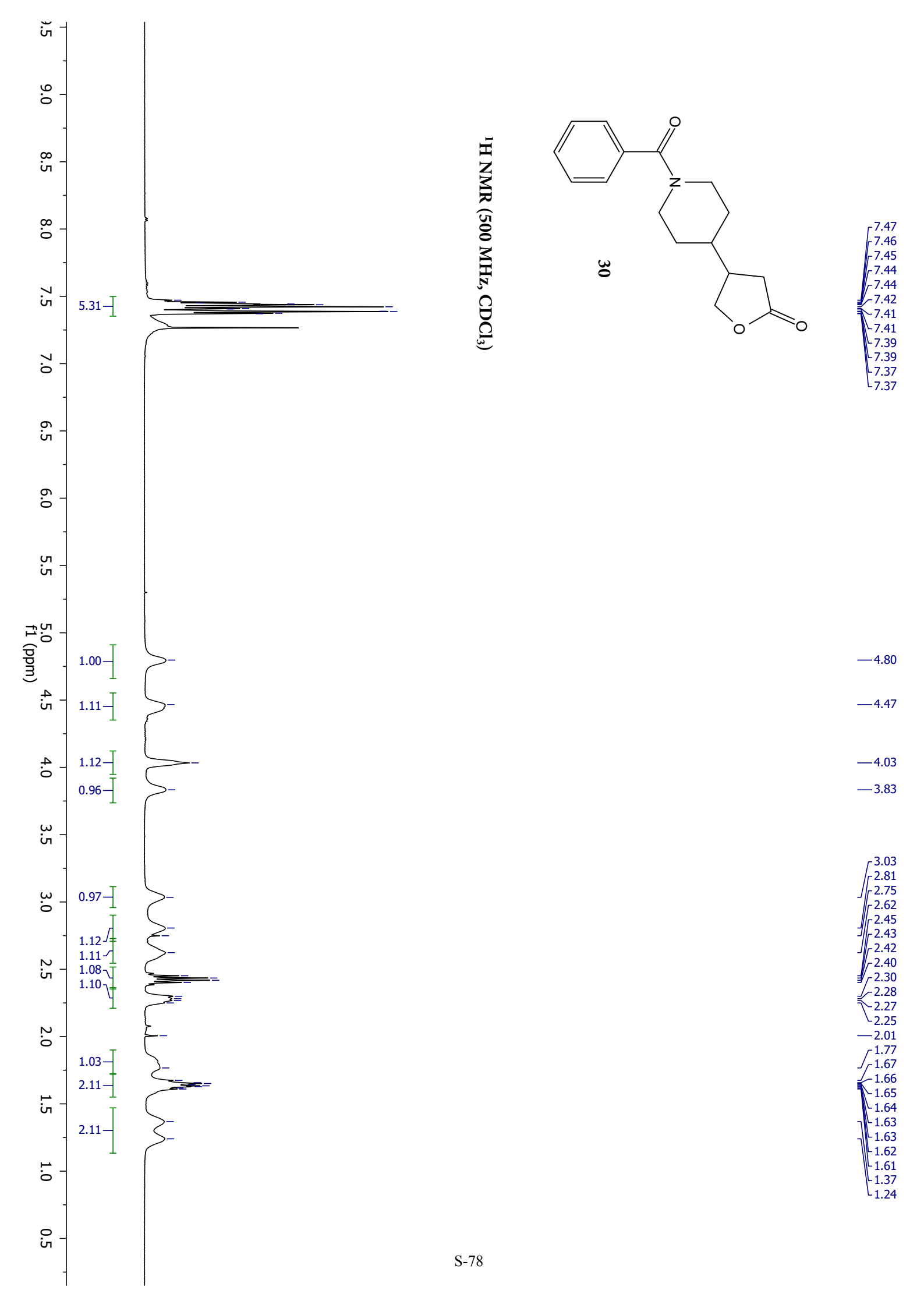
29

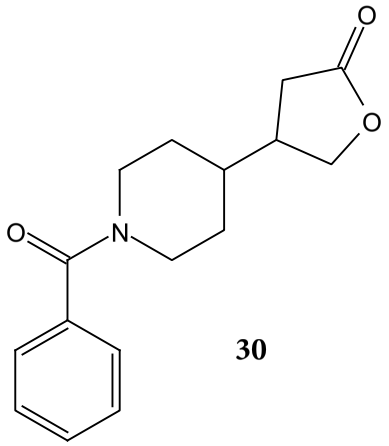
^{1}H NMR (500 MHz, $CDCl_3$)



29

^{13}C NMR (125 MHz, $CDCl_3$)

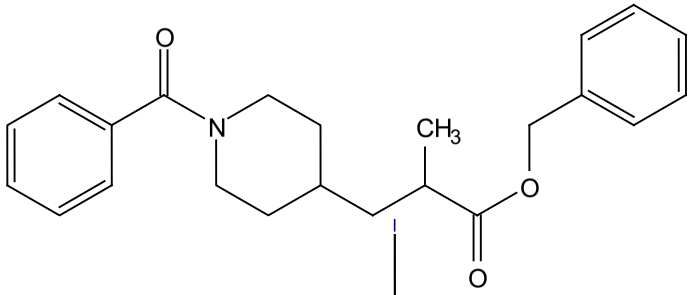

¹H NMR (500 MHz, CDCl₃)
30
f1 (ppm)
5.31
1.00
1.11
1.12
0.96
0.97
1.12
1.11
1.08
1.10
1.03
2.11
2.11
7.47
7.46
7.45
7.44
7.44
7.42
7.41
7.41
7.39
7.39
7.37
7.37
4.80
4.47
4.03
3.83
3.03
2.81
2.75
2.62
2.45
2.43
2.42
2.40
2.30
2.28
2.27
2.25
2.01
1.77
1.67
1.66
1.65
1.64
1.63
1.63
1.62
1.61
1.37
1.24



30

^{13}C NMR (125 MHz, $CDCl_3$)

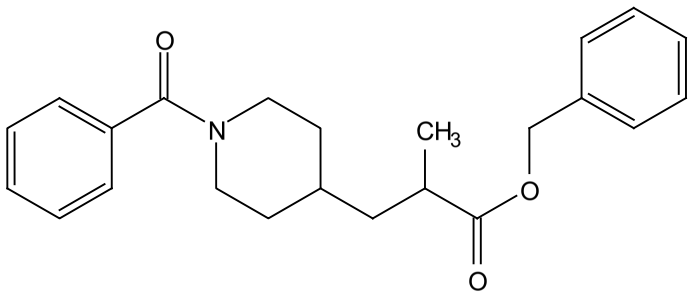
^{1}H NMR (500 MHz, $CDCl_3$)



31

S-80

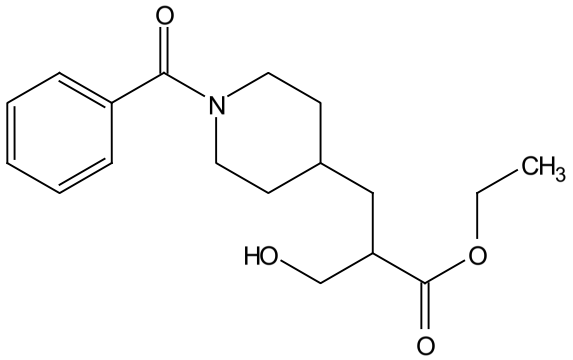
f1 (ppm)



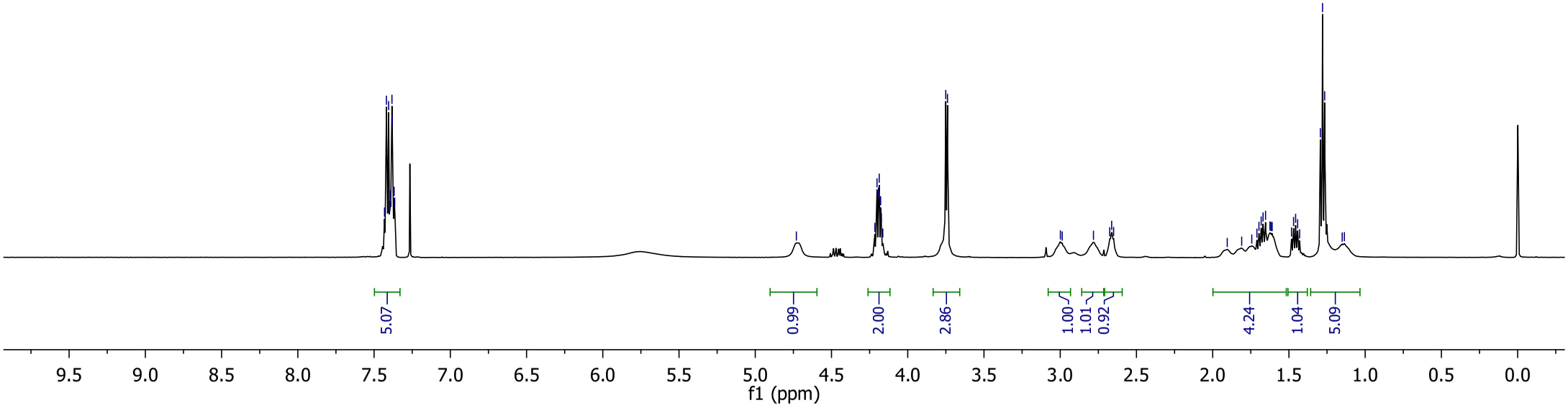
31

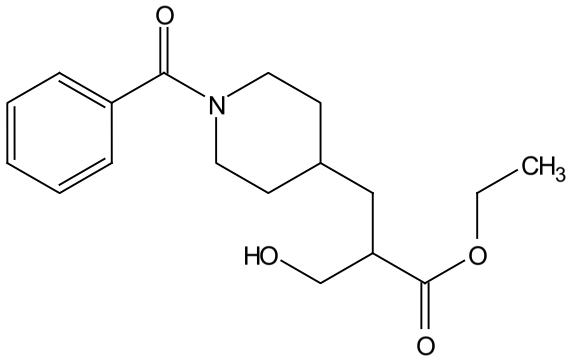
^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



32

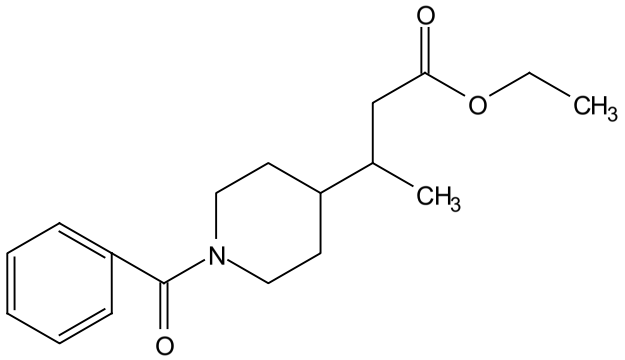




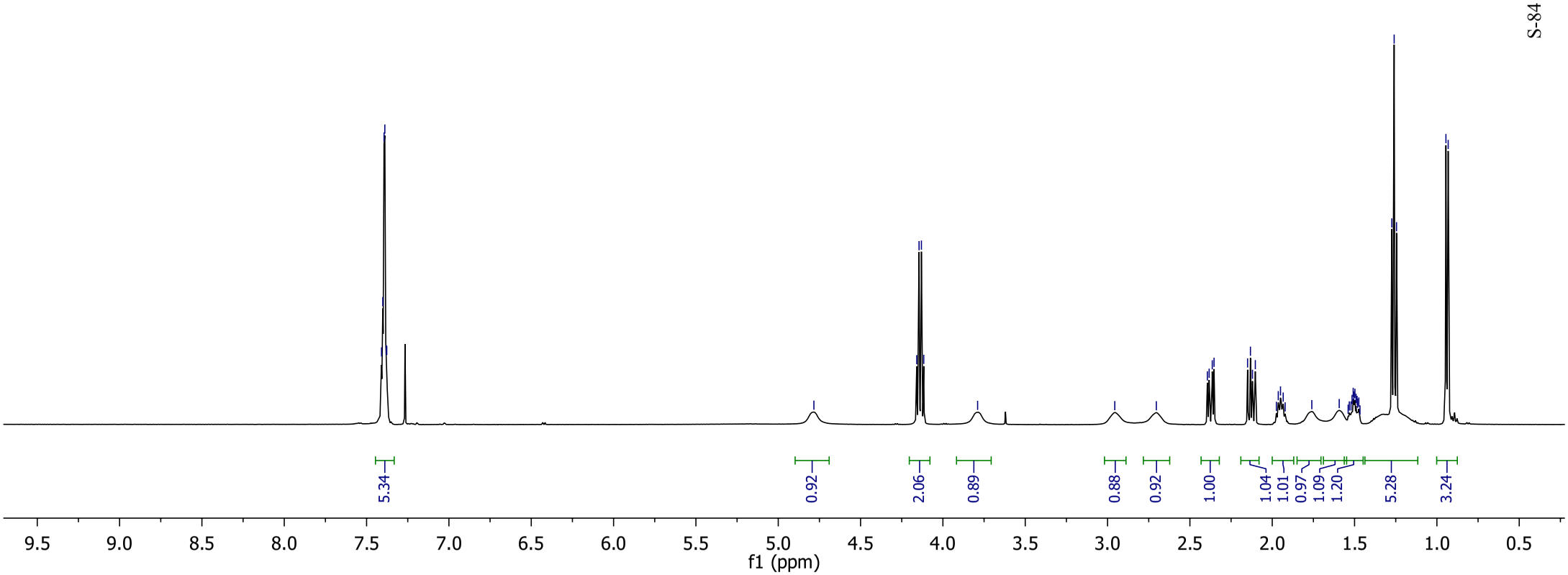
32

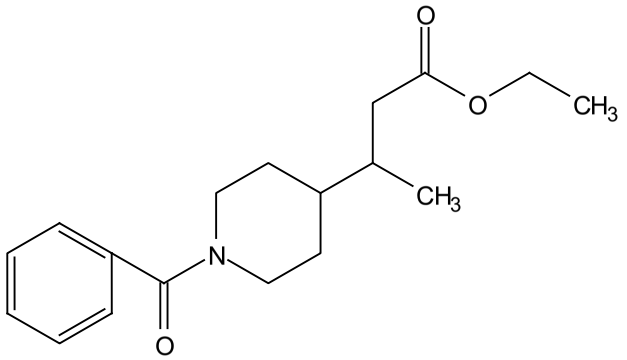
^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



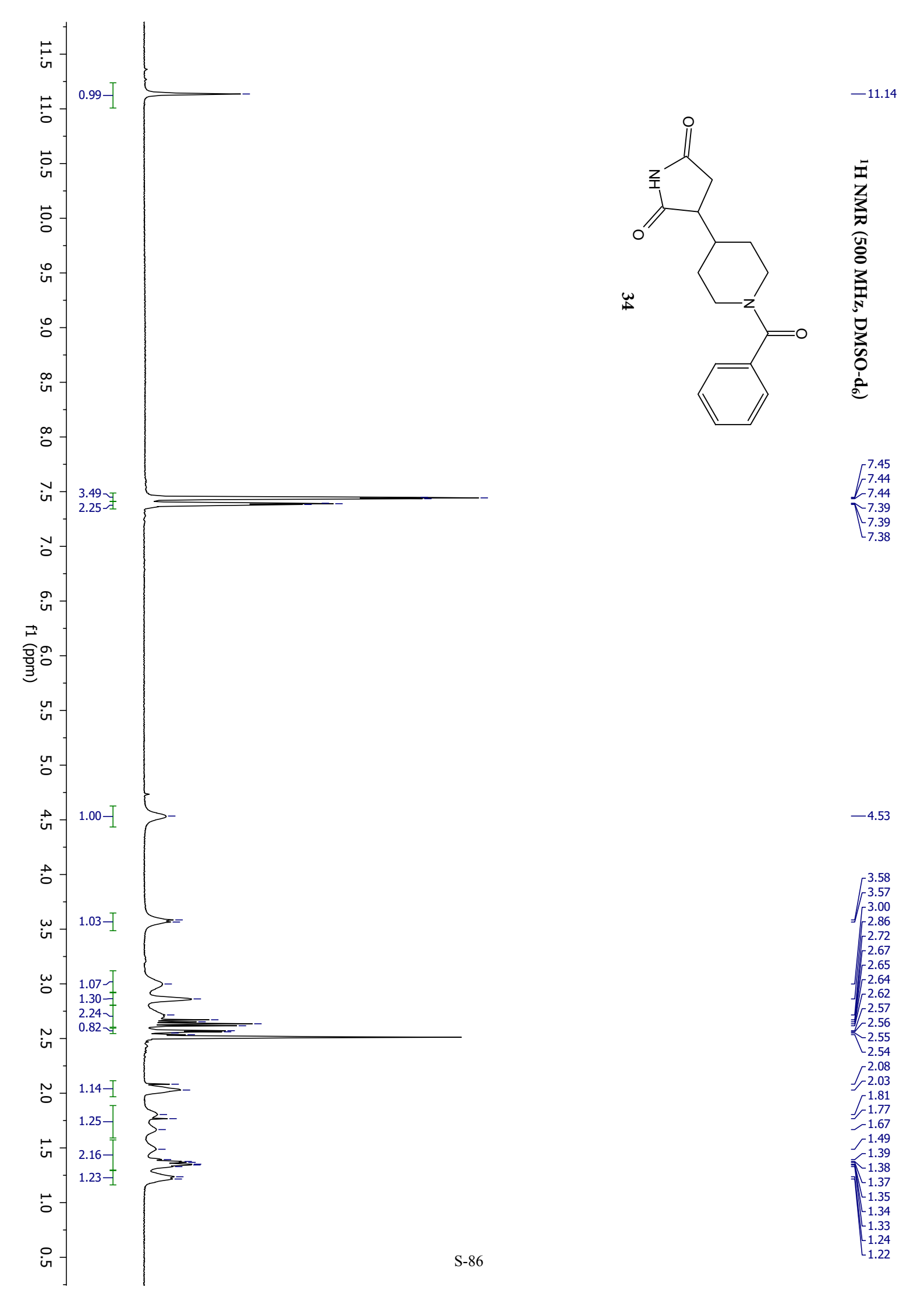
33

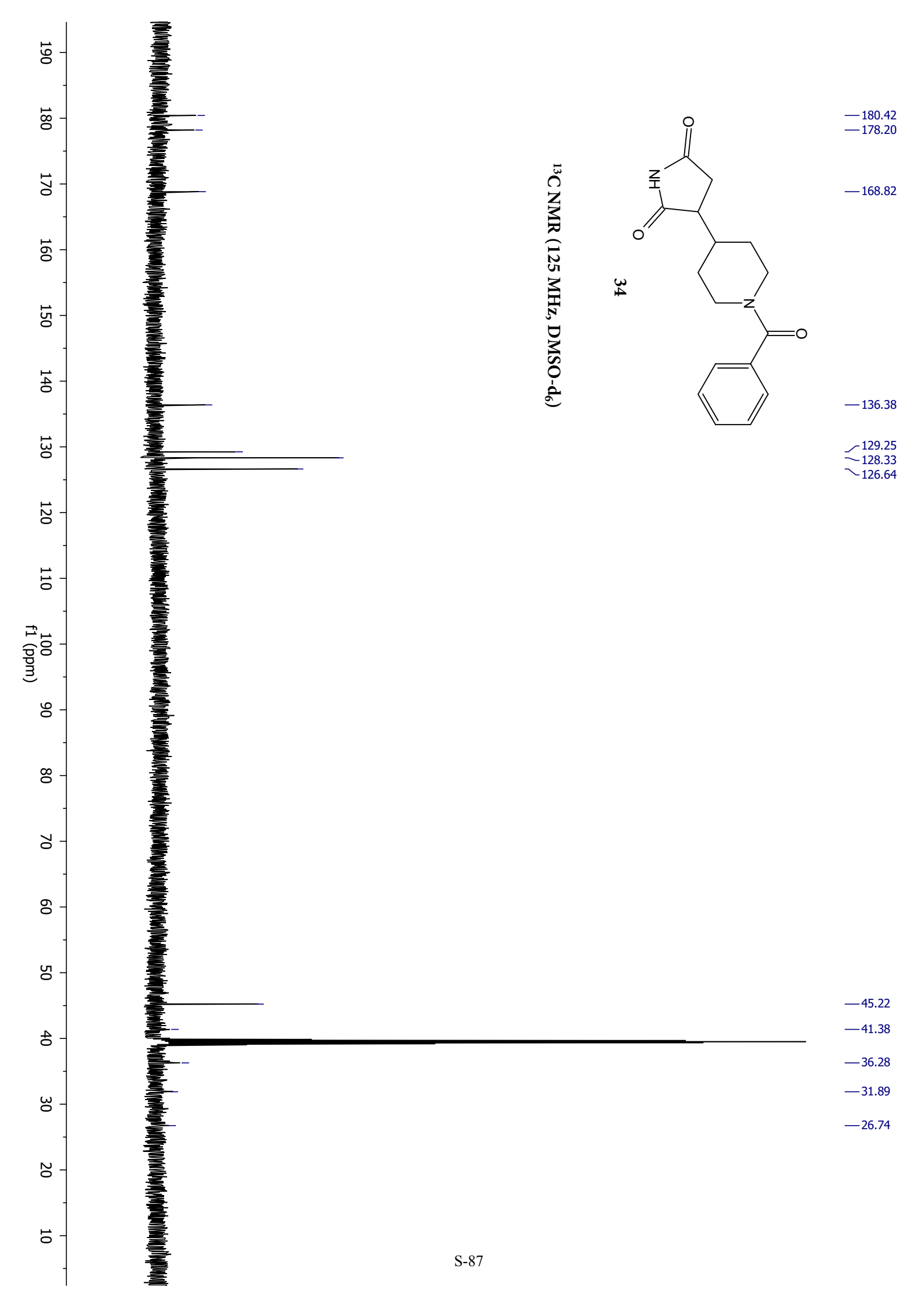




33

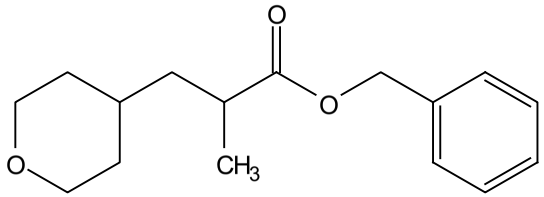
^{13}C NMR (125 MHz, $CDCl_3$)


34
¹H NMR (500 MHz, DMSO-d6)
11.14
7.45
7.44
7.44
7.39
7.39
7.38
4.53
3.58
3.57
3.00
2.86
2.72
2.67
2.65
2.64
2.62
2.57
2.56
2.55
2.54
2.08
2.03
1.81
1.77
1.67
1.49
1.39
1.38
1.37
1.35
1.34
1.33
1.24
1.22
0.99
3.49
2.25
1.00
1.03
1.07
1.30
2.24
0.82
1.14
1.25
2.16
1.23
f1 (ppm)



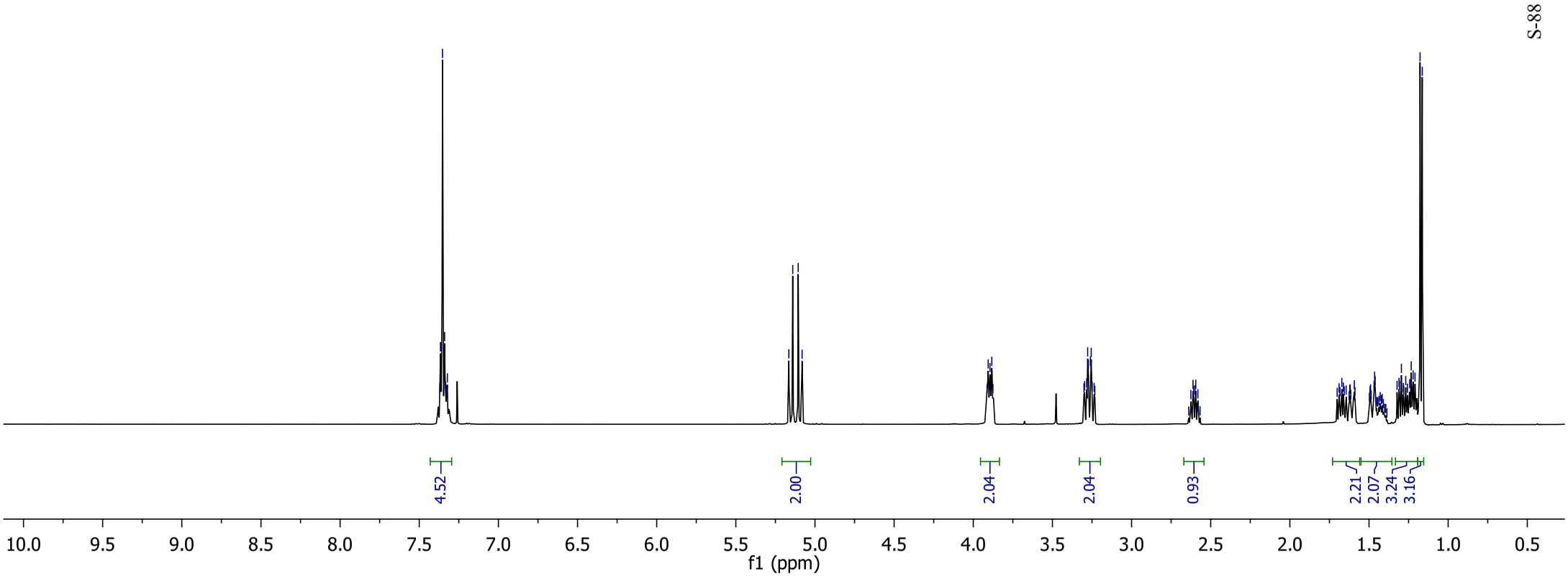
^{13}C NMR (125 MHz, DMSO-d_6)

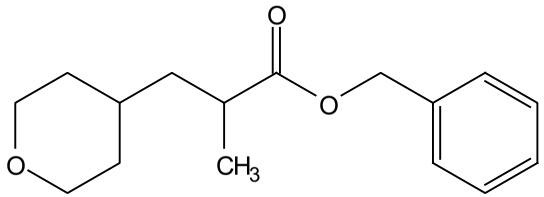
34



35

^{1}H NMR (500 MHz, $CDCl_3$)

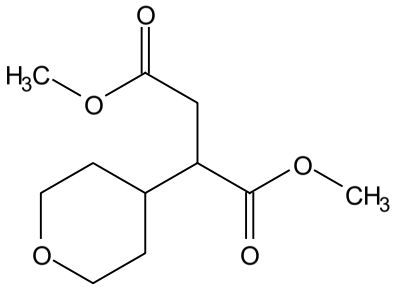




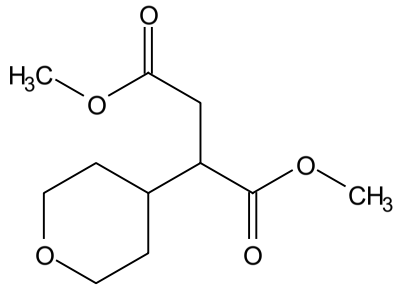
35

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H (500 MHz, $CDCl_3$)



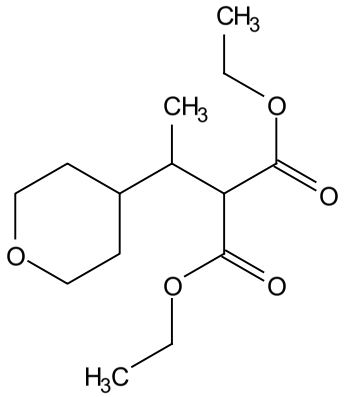
36



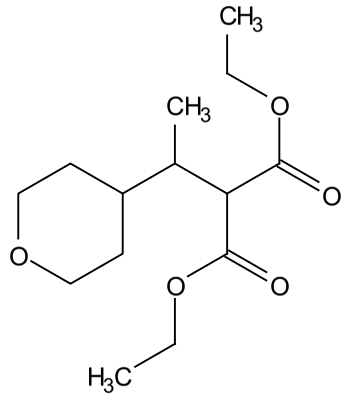
36

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



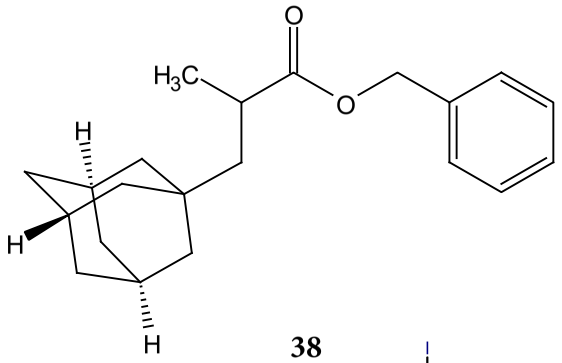
37



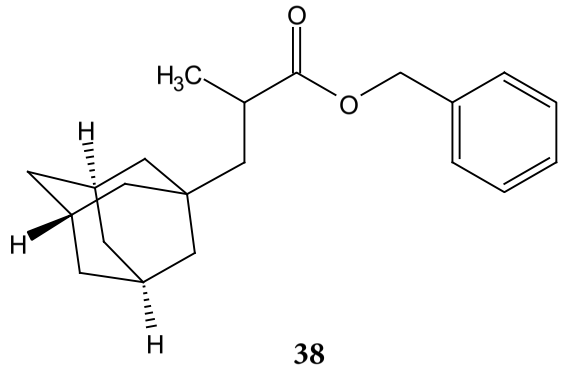
37

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)



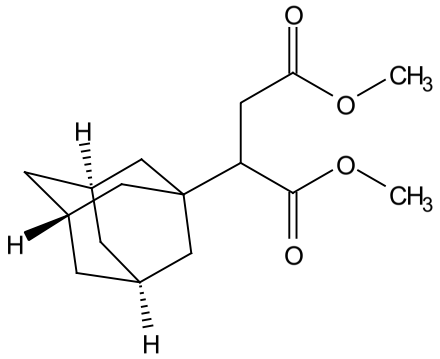
38



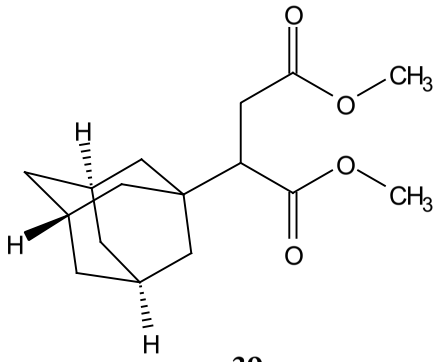
38

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500MHz, $CDCl_3$)

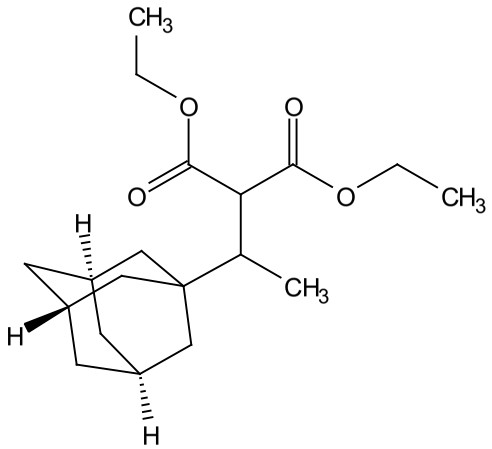


39



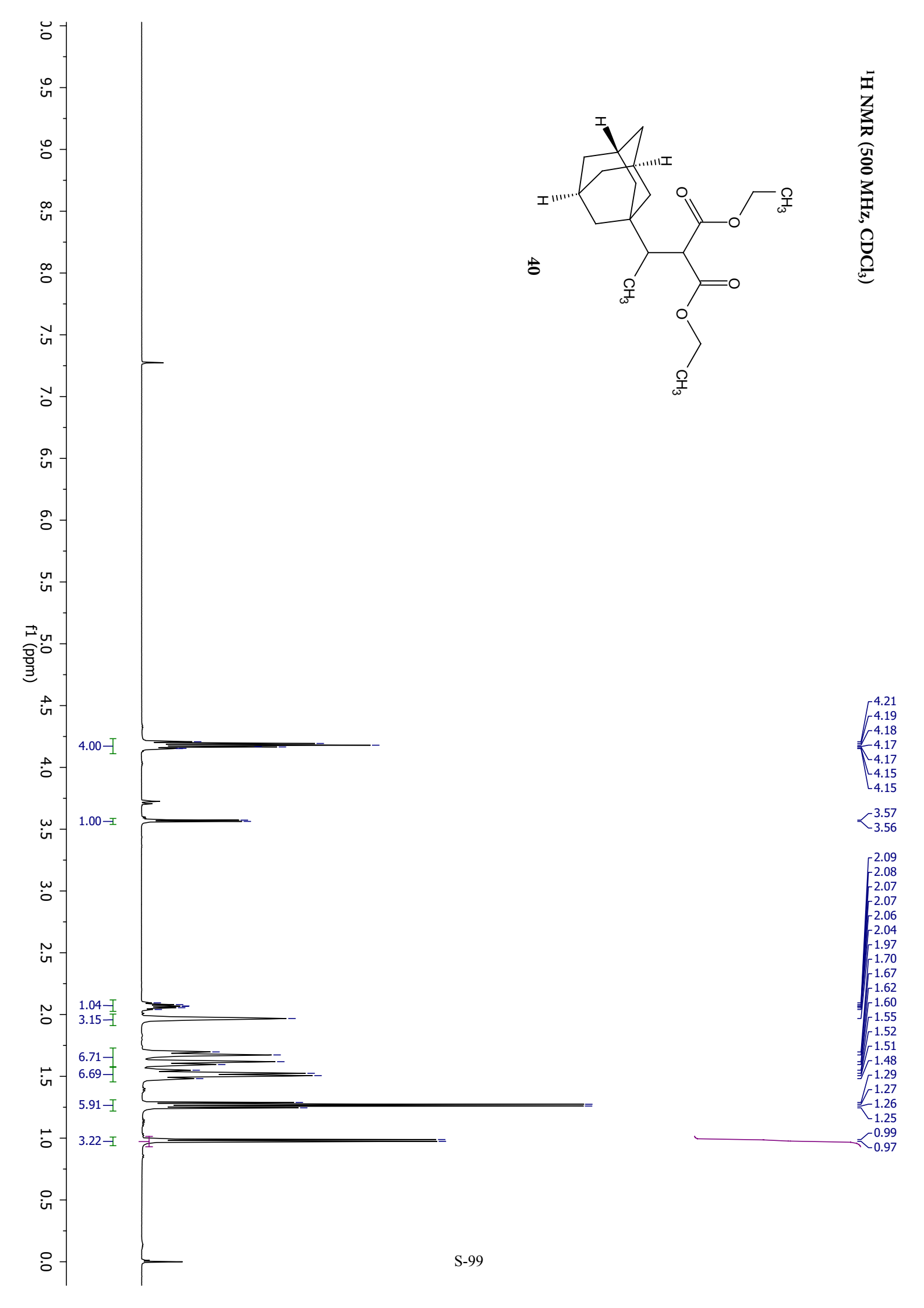
39

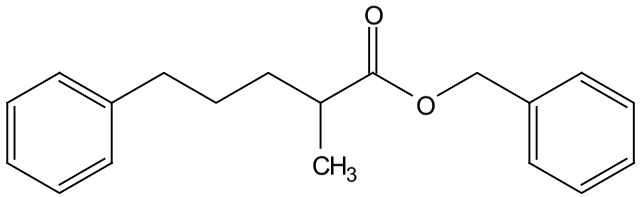
^{13}C NMR (125 MHz, $CDCl_3$)



40

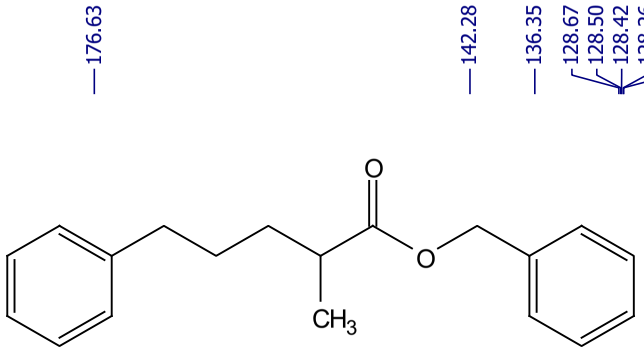
^{13}C NMR (125 MHz, $CDCl_3$)


¹H NMR (500 MHz, CDCl₃)
40
f1 (ppm)
4.00
1.00
1.04
3.15
6.71
6.69
5.91
3.22
4.21
4.19
4.18
4.17
4.17
4.15
4.15
3.57
3.56
2.09
2.08
2.07
2.07
2.06
2.04
1.97
1.70
1.67
1.62
1.60
1.55
1.52
1.51
1.48
1.29
1.27
1.26
1.25
0.99
0.97



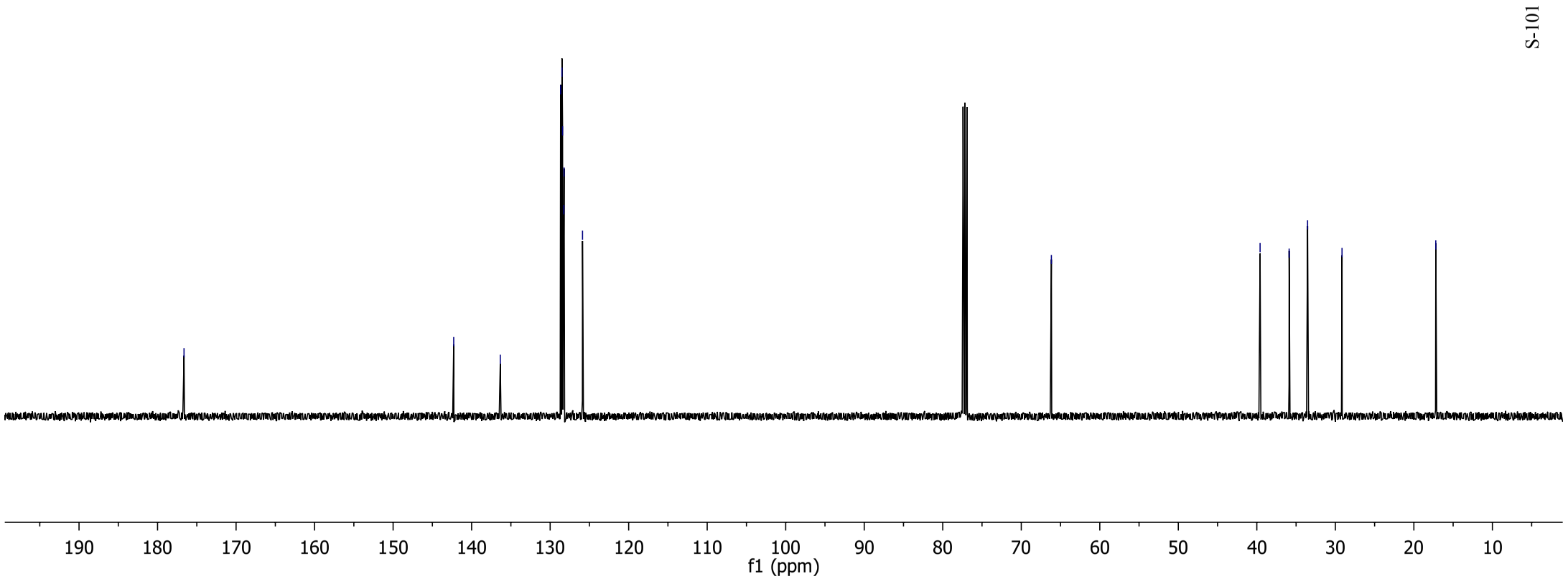
41

^{1}H NMR (500 MHz, $CDCl_3$)

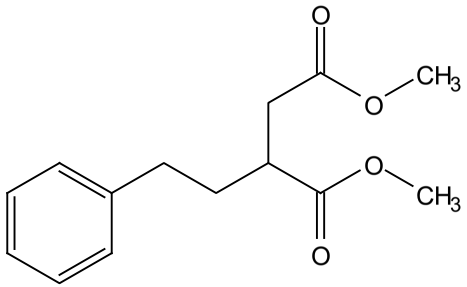


41

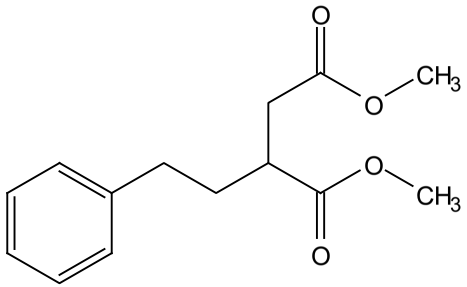
^{13}C NMR (125 MHz, $CDCl_3$)



^{1}H NMR (500 MHz, $CDCl_3$)

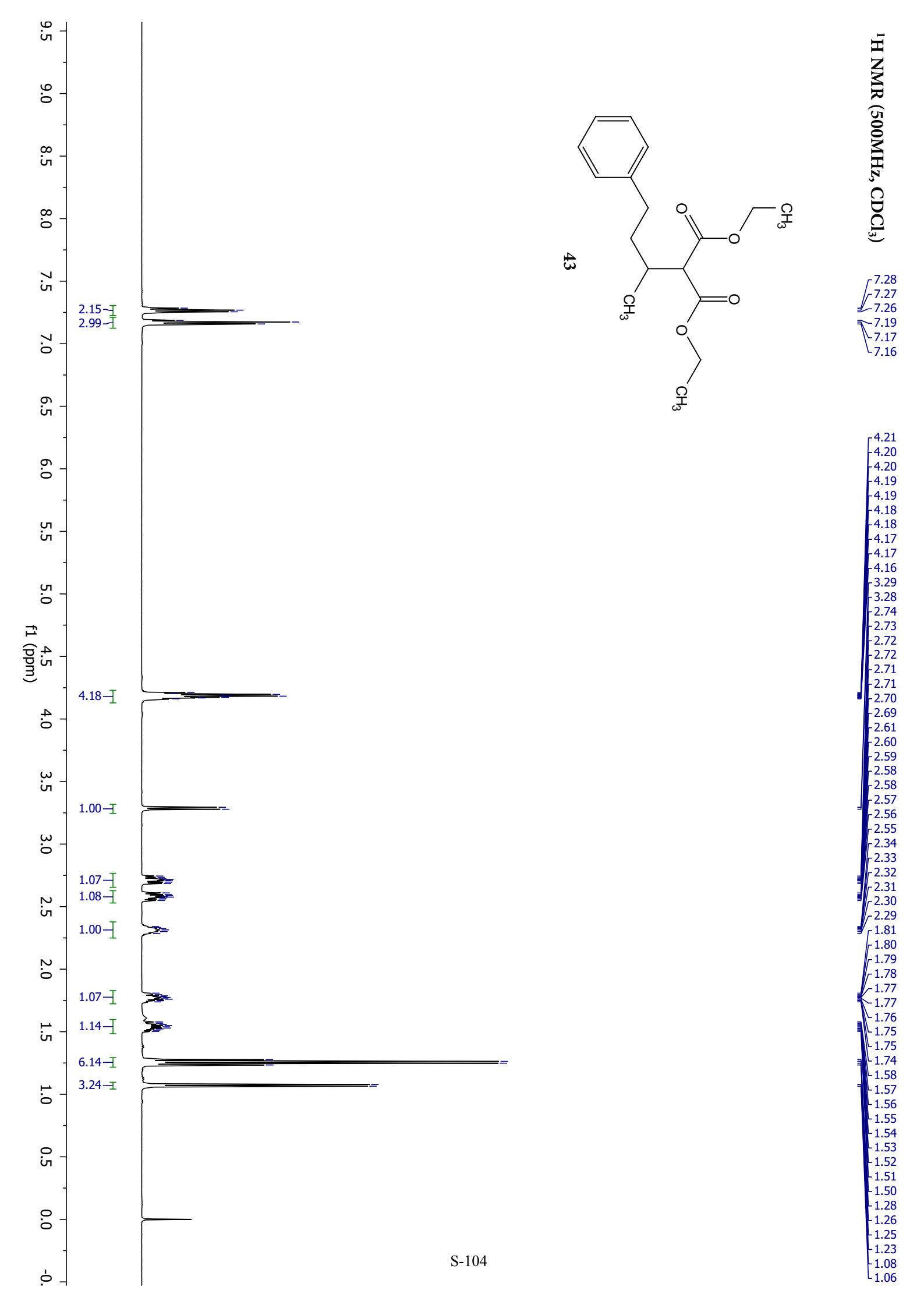


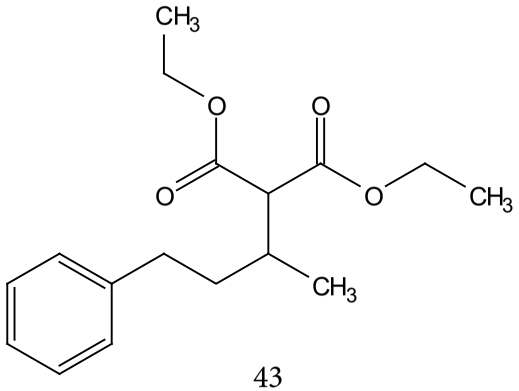
42



42

^{13}C NMR (125 MHz, $CDCl_3$)

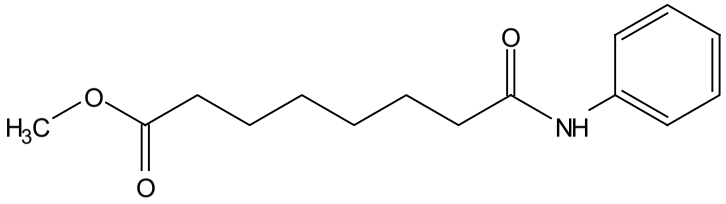

¹H NMR (500MHz, CDCl₃)
43
f1 (ppm)
2.15
2.99
4.18
1.00
1.07
1.08
1.00
1.07
1.14
6.14
3.24
7.28
7.27
7.26
7.19
7.17
7.16
4.21
4.20
4.20
4.19
4.19
4.18
4.18
4.17
4.17
4.16
3.29
3.28
2.74
2.73
2.72
2.72
2.71
2.71
2.70
2.69
2.61
2.60
2.59
2.58
2.58
2.57
2.56
2.55
2.34
2.33
2.32
2.31
2.30
2.29
1.81
1.80
1.79
1.78
1.77
1.77
1.76
1.75
1.75
1.74
1.58
1.57
1.56
1.55
1.54
1.53
1.52
1.51
1.50
1.28
1.26
1.25
1.23
1.08
1.06



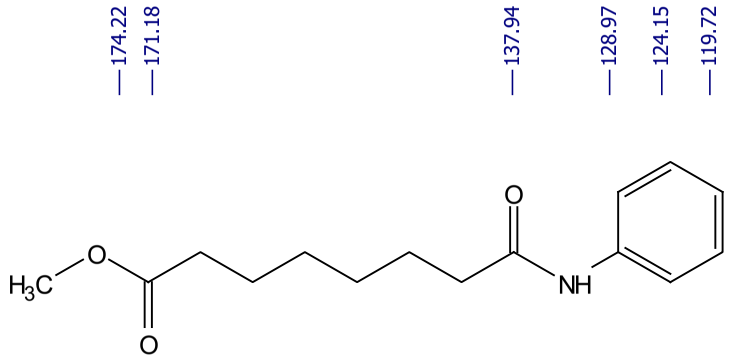
43

^{13}C NMR (125 MHz, $CDCl_3$)

^{1}H NMR (500 MHz, $CDCl_3$)

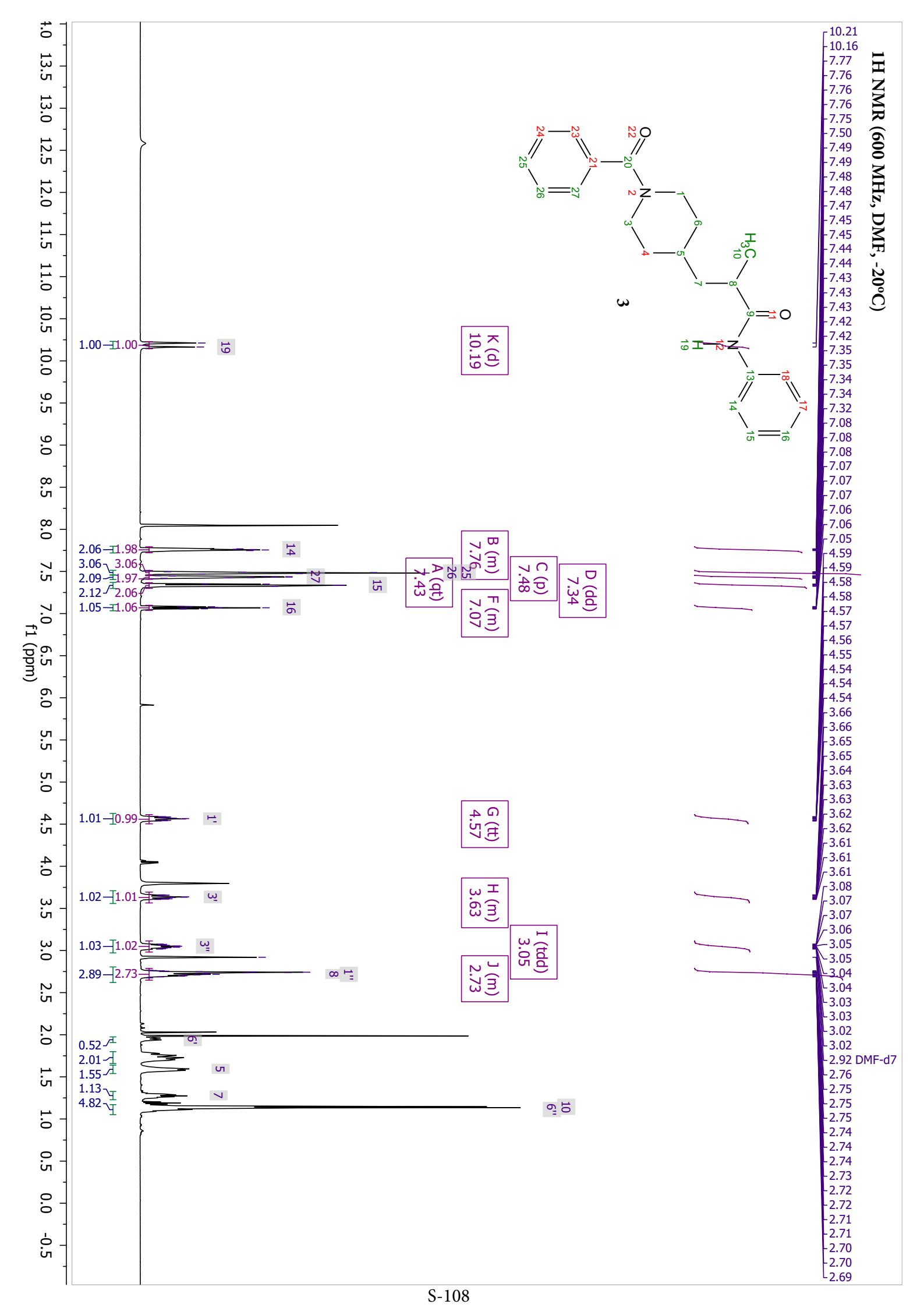


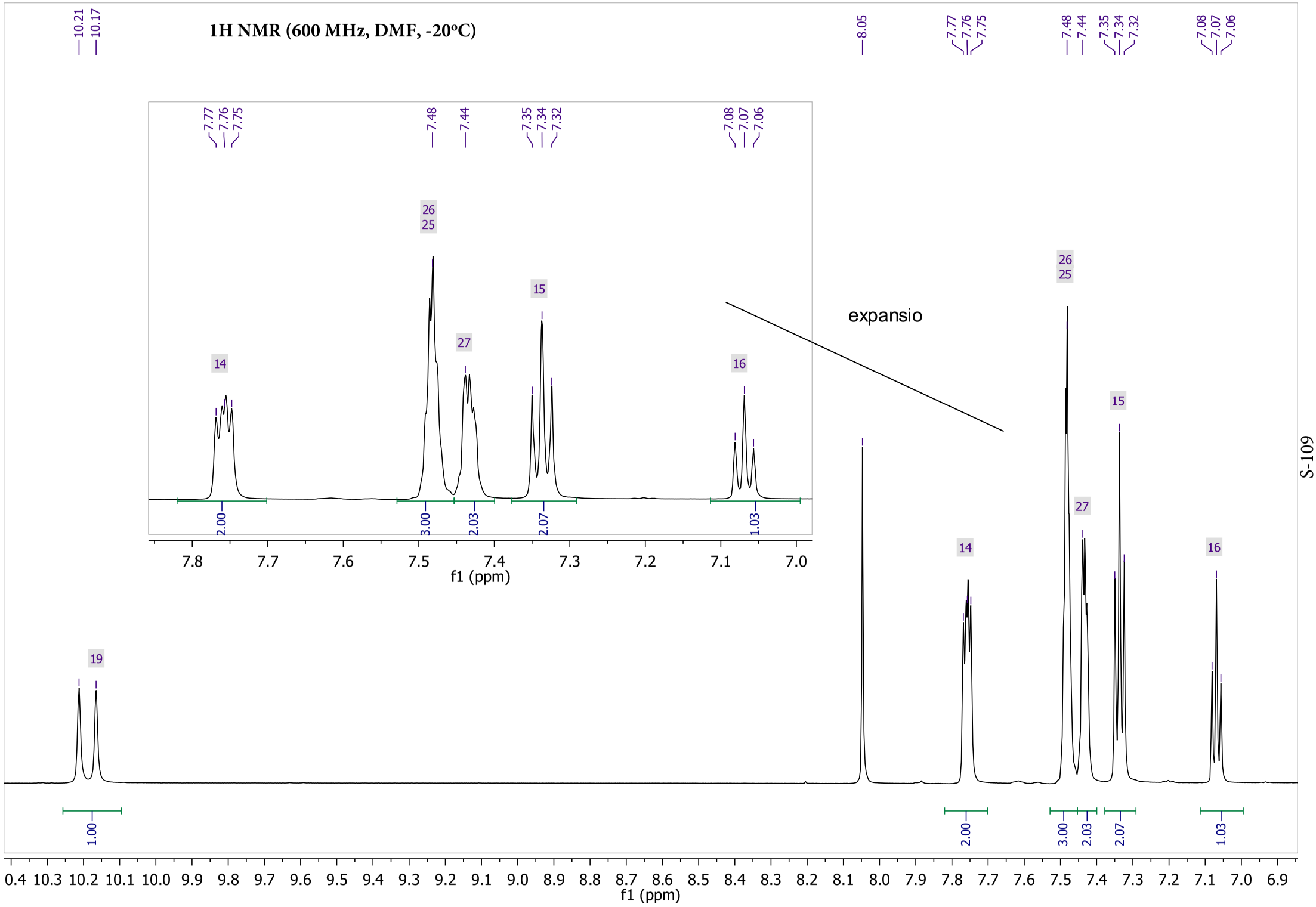
46

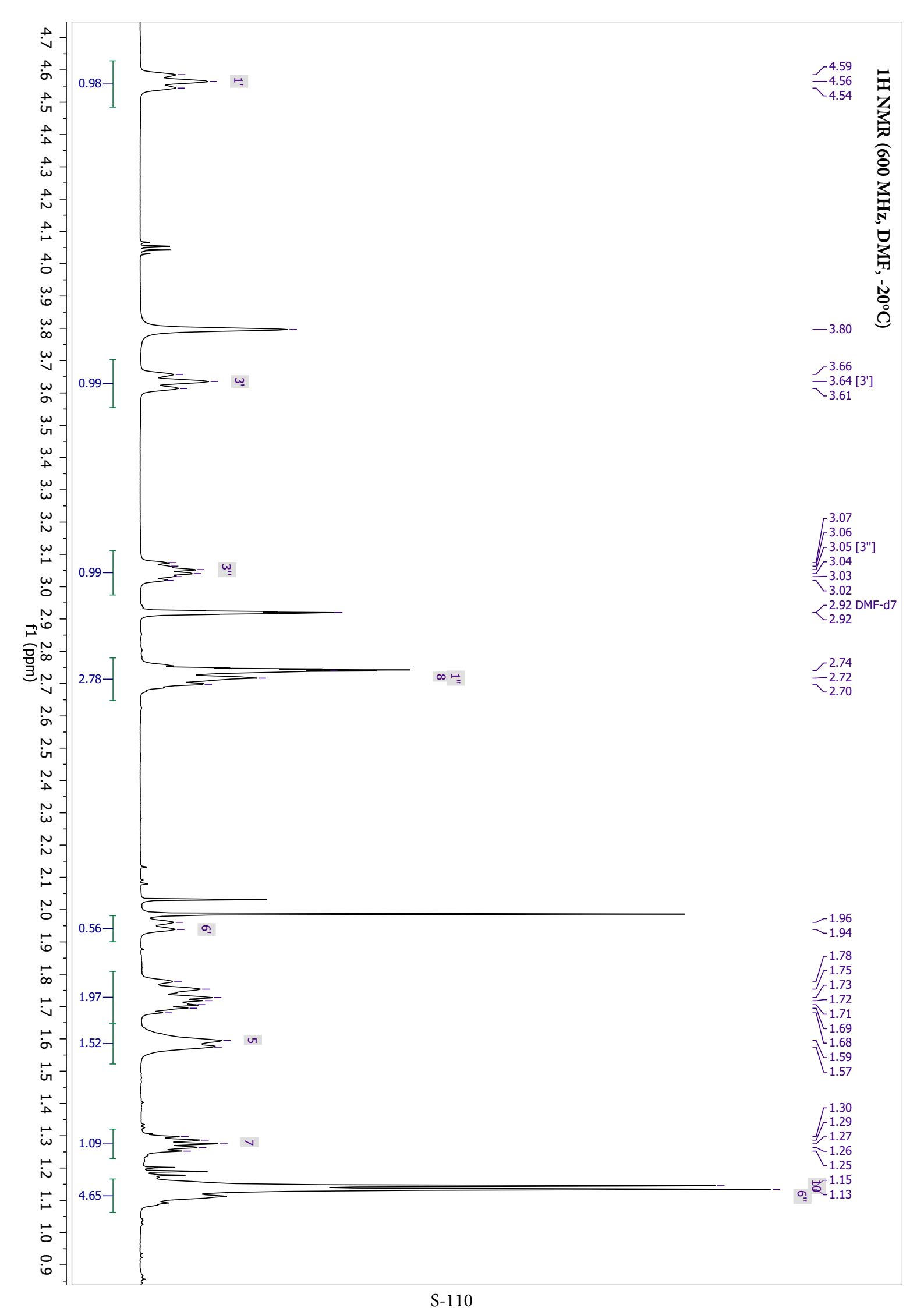


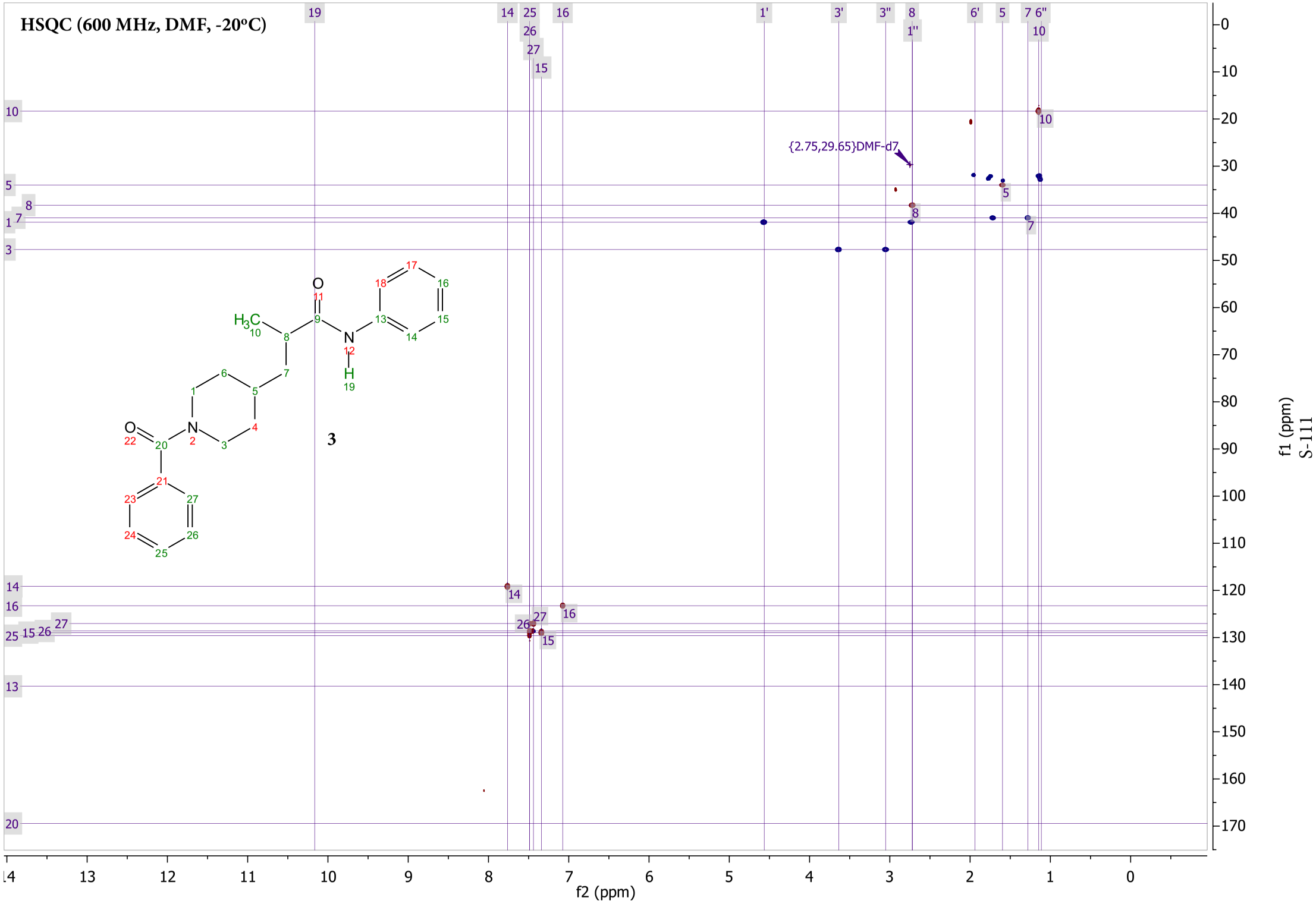
46

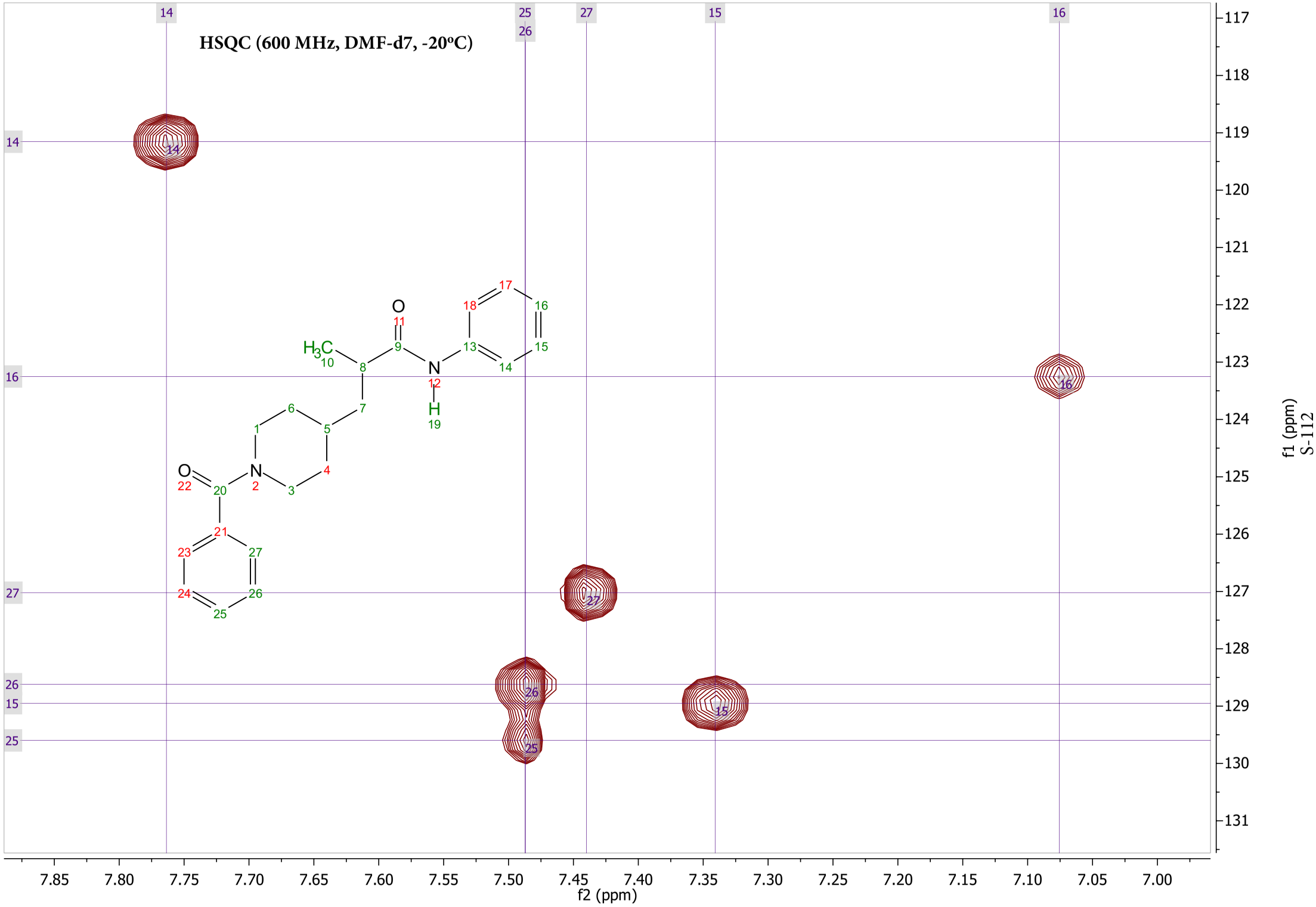
^{13}C NMR (125 MHz, $CDCl_3$)

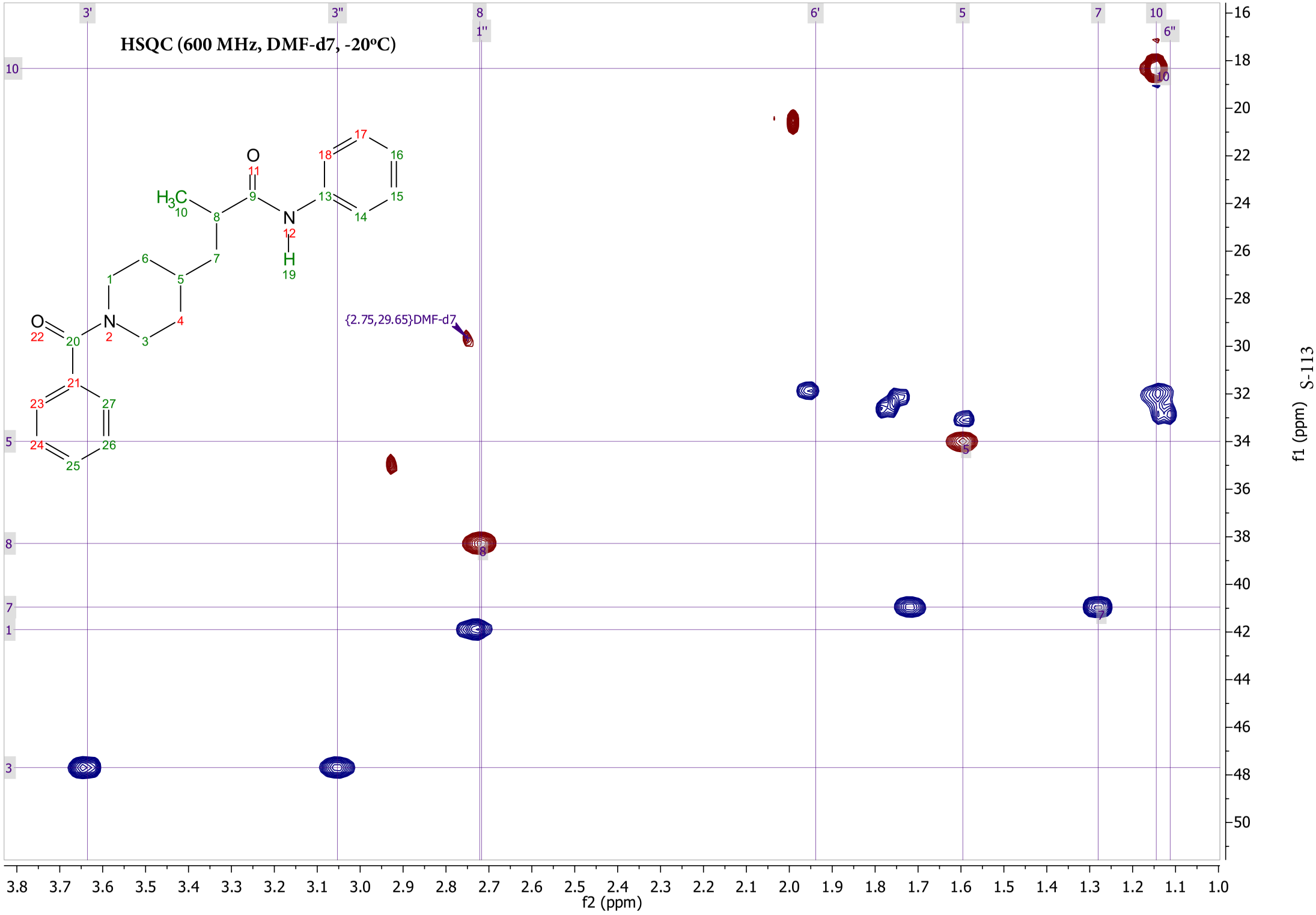

1H NMR (600 MHz, DMF, -20°C)
f1 (ppm)
3
A (qt) 7.43
B (m) 7.76
C (p) 7.48
D (dd) 7.34
F (m) 7.07
G (tt) 4.57
H (m) 3.63
I (tdd) 3.05
J (m) 2.73
K (d) 10.19
DMF-d7

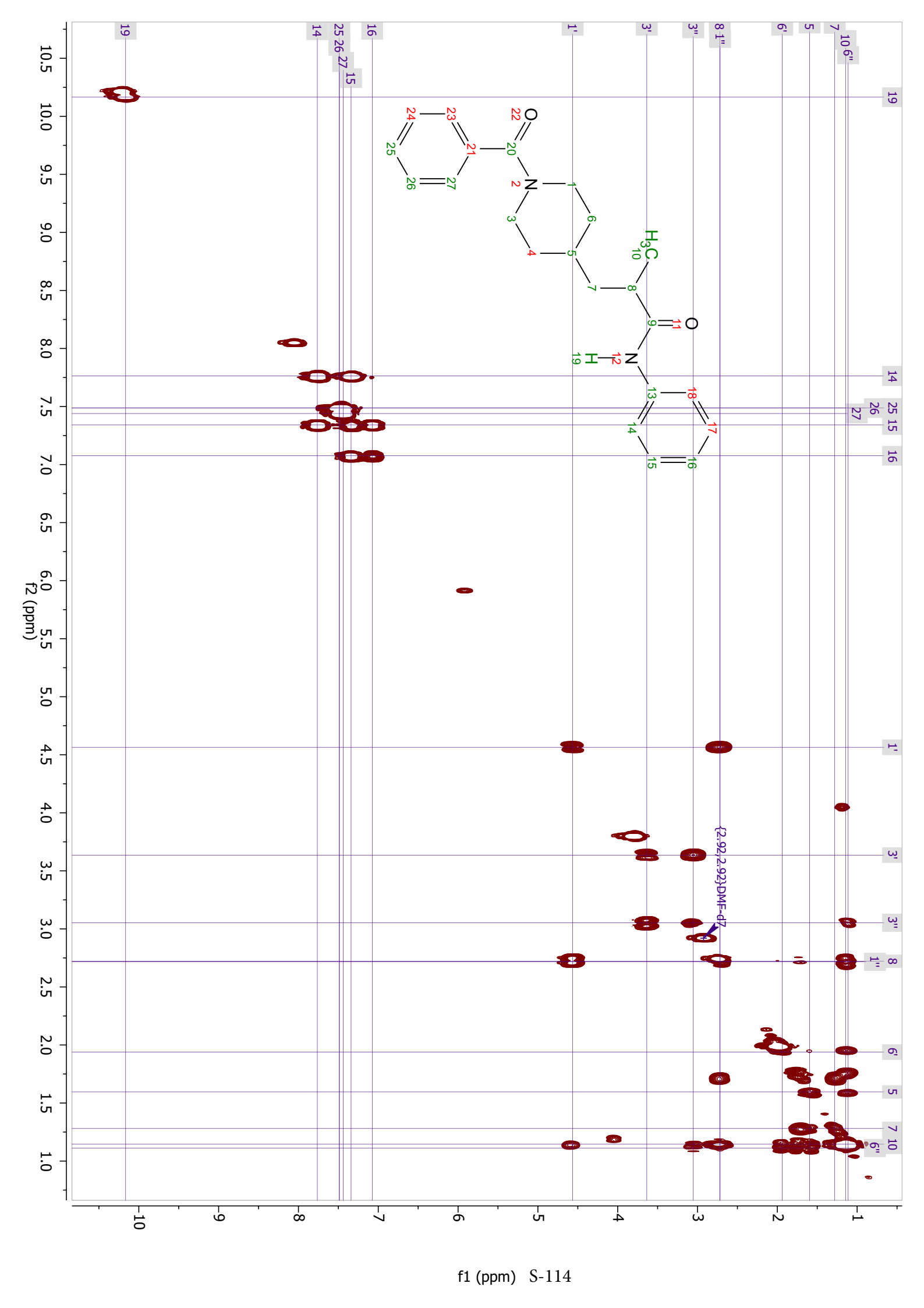

1H NMR (600 MHz, DMF, -20°C)
10.21
10.17
8.05
7.77
7.76
7.75
7.48
7.44
7.35
7.34
7.32
7.08
7.07
7.06
expansio
19
14
26
25
27
15
16
1.00
2.00
3.00
2.03
2.07
1.03
f1 (ppm)

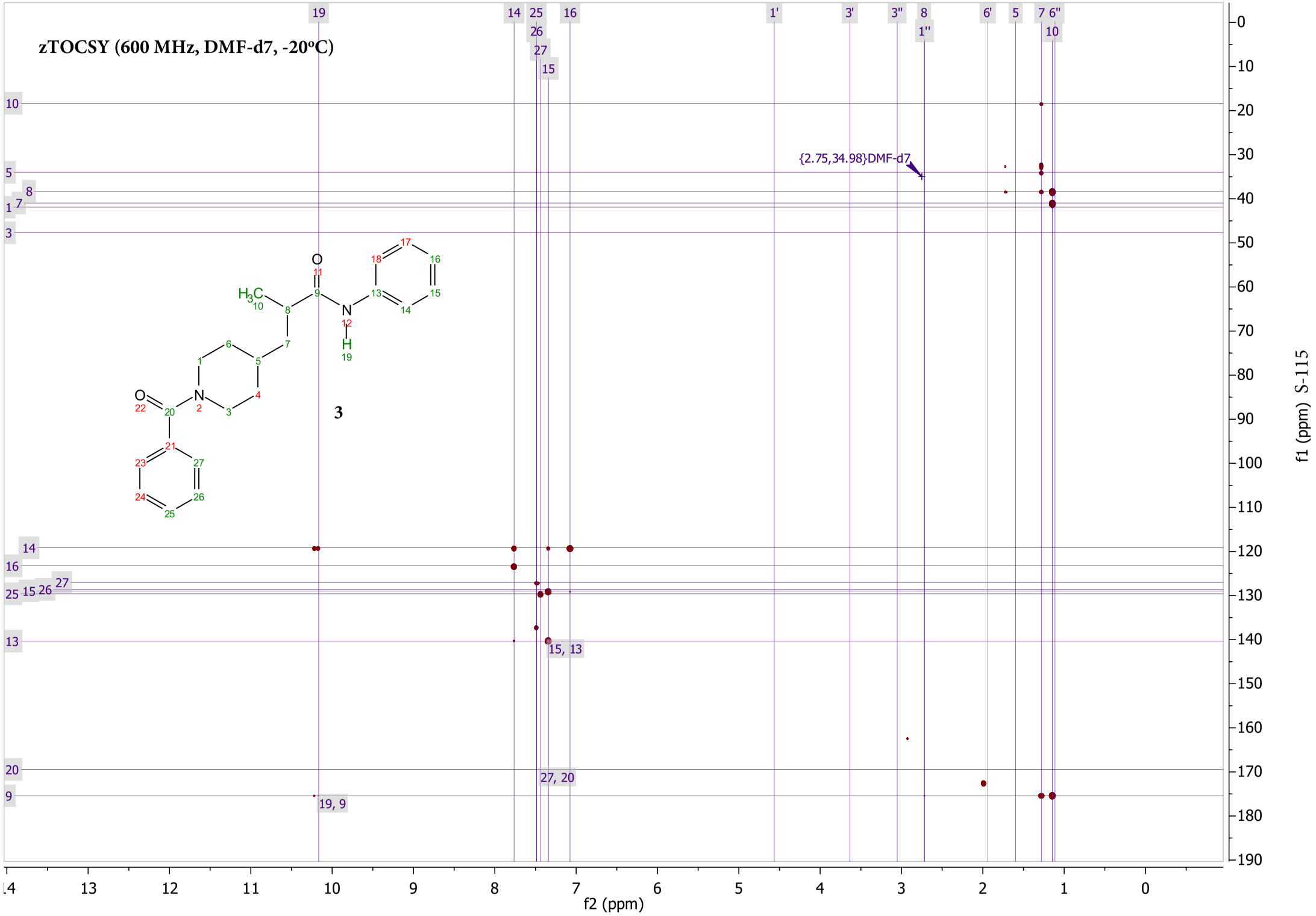

1H NMR (600 MHz, DMF, -20°C)
f1 (ppm)
0.98
0.99
0.99
2.78
0.56
1.97
1.52
1.09
4.65
1'
3'
3''
1''
8
6'
5
7
10
6''
4.59
4.56
4.54
3.80
3.66
3.64 [3']
3.61
3.07
3.06
3.05 [3'']
3.04
3.03
3.02
2.92 DMF-d7
2.92
2.74
2.72
2.70
1.96
1.94
1.78
1.75
1.73
1.72
1.71
1.69
1.68
1.59
1.57
1.30
1.29
1.27
1.26
1.25
1.15
1.13


HSQC (600 MHz, DMF, -20°C)
{2.75,29.65}DMF-d7
3
f2 (ppm)
f1 (ppm)
S-111


HSQC (600 MHz, DMF-d7, -20°C)
f2 (ppm)
f1 (ppm)
S-112


HSQC (600 MHz, DMF-d7, -20°C)
{2.75,29.65}DMF-d7
f2 (ppm)
f1 (ppm)
S-113


f2 (ppm)
f1 (ppm)
{2.92,2.92}DMF-d7


zTOCSY (600 MHz, DMF-d7, -20°C)
{2.75,34.98}DMF-d7
15, 13
27, 20
19, 9
3
f2 (ppm)
f1 (ppm)
S-115