

Supporting Information

DBU Mediated Thiocyanate and Selenocyanate Activation Enables Transition-Metal-Free Synthesis of Chalcogen-Linked Heterocycles

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General information

All chemicals were obtained from TCI Chemicals, SRL Chemicals, and BLD Pharma and used without further purification. Molychem silica gel (60-120 mesh and 100-200 mesh) was utilized for column chromatography, while thin-layer chromatography employed Merck pre-coated silica gel 60-F254 plates. Additional chemicals and solvents were sourced commercially and purified using standard procedures. ^1H and ^{13}C NMR spectra were recorded on Bruker Avance spectrometers. Data are reported as follows: chemical shift, integration, multiplicity (br = broad, s = singlet, d = doublet, dd = double doublet, t = triplet, q = quartet, dt = doublet of triplets, td = triplet of doublets, m = multiplet), and coupling constants in hertz (Hz).

General procedure for the synthesis of compounds 1a-1m:

An oven-dried round bottom flask was charged with the corresponding 2-aryl-imidazo[1,2-*a*]pyridines (1 mmol), KSCN (2 equiv.), K₂S₂O₈ (1 equiv.) in 2 mL of H₂O. The reaction mixture was stirred at room temperature for 6 h under irradiation of blue LED light (24 W, 455 nm), at a distance of 10-12 cm away from light source, in open air. After completion of reaction, the reaction mixture was extracted with ethyl acetate (15 mL × 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compounds 4a-4f:

An oven-dried round bottom flask was charged with the corresponding 2-mercaptobenzo[*d*]thiazoles (1 mmol), NH₄SCN (2 equiv.), Rose Bengal (1 mol %) in 2 ml of CH₃CN. The reaction mixture was stirred at room temperature for 6 h under irradiation of blue LED light (24 W, 455 nm), at a distance of 10-12 cm away from light source, in open air. After completion of reaction, the reaction mixture was extracted with ethyl acetate (15 mL × 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compound 6a:

An oven-dried round bottom flask was charged with the corresponding 3-aryl-imidazo[1,5-*a*]pyridine (1 mmol), KSCN (2 equiv.), K₂S₂O₈ (1 equiv.) in 2 mL of H₂O. The reaction mixture was stirred at room temperature for 6 h under irradiation of blue LED light (24 W, 455 nm), at a distance of 10-12 cm away from light source, in open air. After completion of reaction, the reaction mixture was extracted with ethyl acetate (15 mL × 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compounds 6b, 6c:

An oven-dried round bottom flask was charged with indole and aza-indole (1 mmol), KSCN (2 equiv.), K₂S₂O₈ (1 equiv.) in 2 mL of H₂O. The reaction mixture was stirred at room temperature for 6 h under irradiation of blue LED light (24 W, 455 nm), at a distance of 10-12 cm away from light source, in open air. After completion of reaction, the reaction mixture was extracted with ethyl acetate (15 mL × 3). The

combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compounds 3a-3m:

An oven-dried sealed tube was charged with the corresponding 3-thiocyanato-2-aryl-imidazo[1,2-*a*]pyridines, (**1a-1m**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv., 76.12 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, the reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compounds 5a-5f:

An oven-dried sealed tube was charged with the corresponding 2-thiocyanatobenzo[*d*]thiazoles, (**4a-4f**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv., 76.12 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, next reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compounds 7a and 7b:

An oven-dried sealed tube was charged with the corresponding thiocyanato-heterocycles (**6a**, or **6b**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv., 76.12 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, the reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compounds 8a-8i:

An oven-dried sealed tube was charged with the corresponding 3-thiocyanato-2-aryl-imidazo[1,2-*a*]pyridines, (0.5 mmol), the respective bromoalkane derivative (0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv., 76.12 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for appropriate time. On completion of the reaction, the reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

General procedure for the synthesis of compounds 8j:

An oven-dried sealed tube was charged with the 3-thiocyanato-2-phenyl-imidazo[1,2-*a*]pyridines, (0.5 mmol), the benzyl bromide/ pseudohalide substituted derivative (0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv., 76.12 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 45 min. On completion of the reaction, the reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

On using benzyl bromide as reaction substrate, isolated yield of 89 % was noted for compound **8j**.

On using benzyl trifluoromethanesulfonate as reaction substrate, isolated yield of 79 % was noted for compound **8j**.

On using benzyl 1,1,2,2,3,3,4,4,4-nonafluorobutane-1-sulfonate reaction substrate, isolated yield of 82 % was noted for compound **8j**.

On using benzyl 4-methylbenzenesulfonate reaction substrate, isolated yield of 85 % was noted for compound **8j**.

General procedure for the synthesis of compounds 9a-9c:

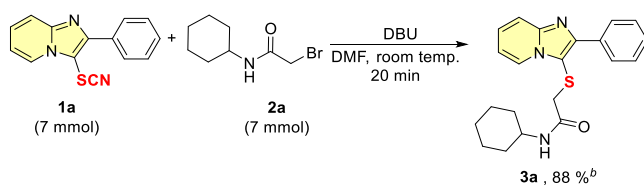
An oven-dried sealed tube was charged with the 3-selenocyanato-2-phenyl-imidazo[1,2-*a*]pyridines, (0.5 mmol), the respective bromoalkene derivative, and benzyl bromide (0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv., 76.12 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, the reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The

residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

Gram Scale Synthesis of **3a**:

An oven-dried sealed tube was charged with the 3-thiocyanato-2-phenylimidazo[1,2-*a*]pyridines, (**1a**, 7 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 7 mmol, 1 equiv.), DBU (1 equiv., 7 mmol, 1.06 gm), in 15 mL of DMF. The reaction mixture was stirred at room temperature for 20 min. On completion of the reaction, next reaction mixture was extracted with ethyl acetate (20 mL × 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

Scheme S1: Gram-scale synthesis of **3a**.^a



^aReaction conditions: **1a** (7 mmol), **2a** (7 mmol), DMF (15 mL), DBU (0.5 mmol, 1 equiv.), room temp. (25-30 °C), 20 min, ^bIsolated yield.

Control Experiments

(a) Reaction in absence of DBU:

An oven-dried sealed tube was charged with the 3-thiocyanato-2-phenylimidazo[1,2-*a*]pyridines (**1a**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 1 h. After 1 h, next the reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the respective product.

(b) Reaction in nitrogen environment:

An oven-dried sealed tube was charged with the 3-thiocyanato-2-phenylimidazo[1,2-*a*]pyridines (**1a**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv.), DBU (1 equiv., 0.5 mmol, 76.12 mg), in 3 mL of DMF under nitrogen atmosphere. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, next reaction mixture was extracted with ethyl acetate (15 mL × 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

(c) Reaction in dark environment:

An oven-dried sealed tube was charged with the 3-thiocyanato-2-phenylimidazo[1,2-*a*]pyridines (**1a**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv.), DBU (1 equiv., 0.5 mmol, 76.12 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min under darkness. On completion of the reaction, next reaction mixture was extracted with ethyl acetate (15 mL × 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by

column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

(d) Reaction with disulfenyl glucal:

An oven-dried sealed tube was charged with the diimidazopyridinyl disulfide (**1a**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 1 mmol, 1 equiv.), tri ethylamine (1 equiv., 0.5 mmol), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, next reaction mixture was extracted with ethyl acetate (15 mL×3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

(e) Reaction with radical scavenger TEMPO:

An oven-dried sealed tube was charged with the 3-thiocyanato-2-phenylimidazo[1,2-*a*]pyridines (**1a**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv.), DBU (1 equiv., 0.5 mmol, 76.12 mg), TEMPO (1.25 mmol, 2.5 equiv., 195.3 mg), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, next reaction mixture was extracted with ethyl acetate (15 mL× 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

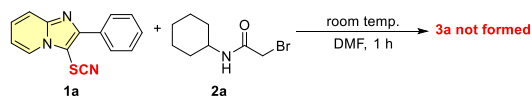
(f) Reaction with radical scavenger BHT:

An oven-dried sealed tube was charged with the 3-thiocyanato-2-phenylimidazo[1,2-*a*]pyridines (**1a**, 0.5 mmol), 2-bromo-*N*-cyclohexylacetamide (**2a**, 0.5 mmol, 1 equiv.), DBU (1 equiv., 0.5 mmol, 76.12 mg), BHT (1.25 mmol, 2.5 equiv.), in 3 mL of DMF. The reaction mixture was stirred at room temperature for 5 min. On completion of the reaction, next reaction mixture was extracted with ethyl acetate (15 mL× 3). The combined organic layers were washed with brine, dried over Na₂SO₄, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a solvent system of ethyl acetate/*n*-hexane to afford the desired product.

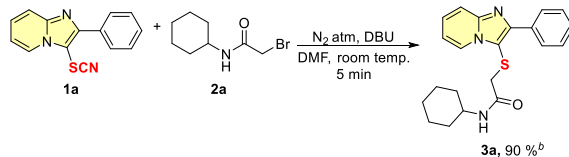
Scheme S2. Control Experiments.^a

CONTROL EXPERIMENTS

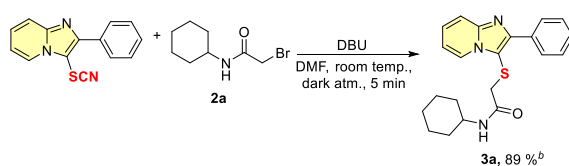
(a) Reaction in absence of DBU:



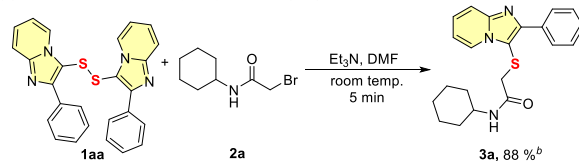
(b) Reaction in nitrogen environment:



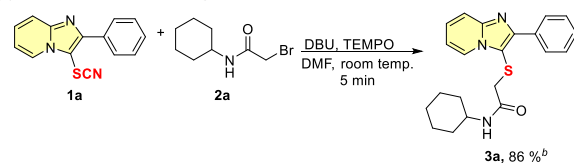
(c) Reaction in darkness:



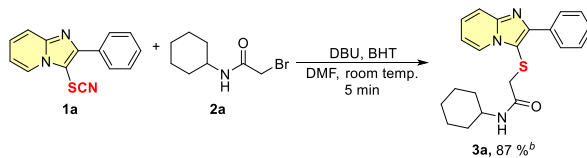
(d) Reaction with diimidazopyridinyl disulfide (1aa):



(e) Reaction with radical scavenger TEMPO:

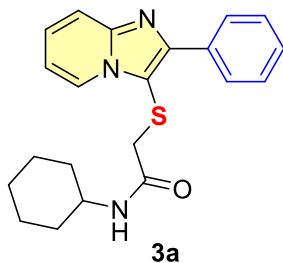


(f) Reaction with radical scavenger BHT:

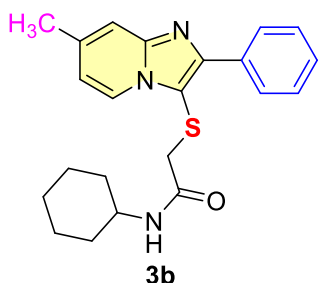


^aReaction conditions: (a) **1a** (0.5 mmol), **2a** (0.5 mmol, 1 equiv.), DMF (3 mL), room temp. (25-30 °C), 1 h; (b) **1a** (0.5 mmol), **2a** (0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv.), DMF (3 mL), N₂ atmosphere, room temp. (25-30 °C), 5 min; (c) **1a** (0.5 mmol), **2a** (0.5 mmol, 1 equiv.), DBU (0.5 mmol, 1 equiv.), DMF (3 mL), dark atmosphere, room temp. (25-30 °C), 5 min; (d) **1aa** (0.5 mmol), **2a** (1 mmol, 2 equiv.), Et₃N (0.5 mmol, 1 equiv.), DMF (3 mL), room temp. (25-30 °C), 5 min; (e) **1a** (0.5 mmol), **2a** (0.5 mmol, 1 equiv.), TEMPO (1.5 mmol, 3 equiv.), DBU (0.5 mmol, 1 equiv.), DMF (3 mL), room temp. (25-30 °C), 5 min; (f) **1a** (0.5 mmol), **2a** (0.5 mmol, 1 equiv.), DBU (1 equiv., 0.5 mmol), BHT (1.5 mmol, 3 equiv.), DMF (3 mL), room temp. (25-30 °C), 5 min. ^bIsolated yield.

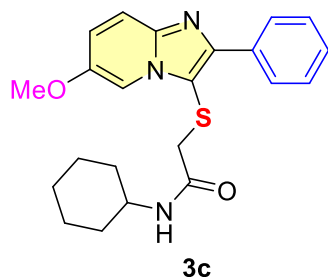
Spectral Data



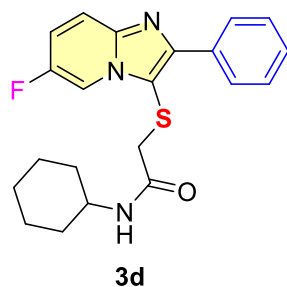
***N*-cyclohexyl-2-((2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (3a):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (35 %) as a mixed eluent to give **3a** as white solid, in 93 % yield. ^1H NMR (CDCl_3 , 600 MHz) δ (ppm) 8.5 (d, $J = 7.2$ Hz, 1H), 8.23 (d, $J = 7.8$ Hz, 2H), 7.67 (d, $J = 7.8$ Hz, 1H), 7.51 (t, $J = 7.2$ Hz, 2H), 7.42 (t, $J = 7.2$, 1H), 7.43-7.32 (m, 1H), 6.97 (t, $J = 7.2$ Hz, 1H), 5.76 (d, $J = 6.6$ Hz, 1H), 3.39-3.36 (m, 1H), 3.27 (s, 2H), 1.51-1.49 (m, 3H), 1.42 (d, $J = 10.2$ Hz, 2H), 1.14-1.12 (m, 2H), 0.96-0.9 (m, 1H), 0.52-0.46 (m, 2H); $^{13}\text{C}\{^1\text{H}\}$ NMR (CDCl_3 , 150 MHz,) δ (ppm) 166.3, 149.9, 146.8, 133.5, 128.8, 128.7, 128.6, 126.6, 124.5, 117.7, 113.2, 108.1, 48.6, 38.5, 32, 25.1, 24.7. HRMS (ESI-TOF) m/z : $[\text{M}+\text{H}]^+$ Calcd. for $\text{C}_{21}\text{H}_{24}\text{N}_3\text{OS}$: 366.1635; found 366.1632.



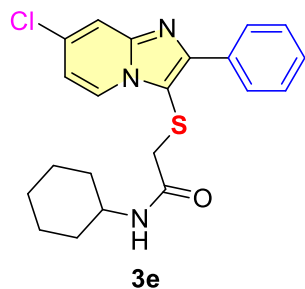
***N*-cyclohexyl-2-((7-methyl-2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (3b):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (45 %) as a mixed eluent to give **3b** as pale white solid, in 93 % yield. ^1H NMR (CDCl_3 , 600 MHz) δ (ppm) 8.34 (d, $J = 6.6$ Hz, 1H), 8.20 (d, $J = 7.2$ Hz, 1H), 7.49 (t, $J = 7.8$ Hz, 2H), 7.41-7.40 (m, 2H), 6.78 (d, $J = 6.6$ Hz, 1H), 5.84 (d, $J = 7.2$ Hz, 1H), 3.40-3.34 (m, 1H), 3.23 (s, 2H), 2.43 (s, 3H), 1.51-1.49 (m, 3H), 1.43 (d, $J = 10.8$ Hz, 2H), 1.16-1.11 (m, 2H), 0.96-0.90 (m, 1H), 0.53-0.47 (m, 2H); $^{13}\text{C}\{^1\text{H}\}$ NMR (CDCl_3 , 150 MHz) δ (ppm) 166.5, 149.8, 147.2, 137.8, 133.7, 128.7, 128.6, 128.5, 123.7, 116.2, 115.7, 107.4, 48.7, 38.7, 32.1, 25.2, 24.7, 21.4. HRMS (ESI-TOF) m/z : $[\text{M}+\text{H}]^+$ Calcd. for $\text{C}_{22}\text{H}_{26}\text{N}_3\text{OS}$: 380.1792; found 380.1796.



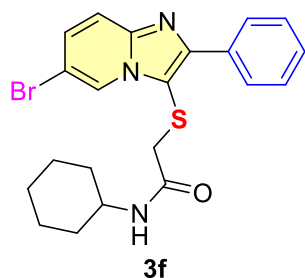
***N*-cyclohexyl-2-((6-methoxy-2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (3c):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (55 %) as a mixed eluent to give **3c** as pale white solid, in 92 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.20 (d, *J* = 7.2 Hz, 2H), 8.03 (d, *J* = 2.4 Hz, 1H), 7.53 (d, *J* = 9.6 Hz, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 7.40 (t, *J* = 7.8 Hz, 1H), 7.10 (dd, *J* = 9.6 Hz, 3.6 Hz, 1H), 5.79 (d, *J* = 7.8 Hz, 1H), 3.91 (s, 3H), 3.41-3.36 (m, 1H), 3.25 (s, 2H), 1.98 (s, 1H), 1.51-1.49 (m, 3H), 1.42 (d, *J* = 10.2 Hz, 2H), 1.16-1.10 (m, 2H), 0.96-0.89 (m, 1H), 0.54-0.47 (m, 2H); ¹³C{¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.5, 150.0, 149.7, 143.7, 133.7, 128.7, 128.5, 128.4, 121.6, 117.9, 108.8, 106.4, 56.4, 48.7, 38.5, 32.1, 25.2, 24.7. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₂H₂₆N₃O₂S: 396.1741; found 396.1753.



***N*-cyclohexyl-2-((6-fluoro-2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (3d):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (40 %) as a mixed eluent to give **3d** as pale white solid, in 85 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.35 (s, 1H), 8.11 (d, *J* = 7.2 Hz, 2H), 7.55-7.53 (m, 1H), 7.42 (t, *J* = 7.2 Hz, 2H), 7.34 (t, *J* = 6.6 Hz, 1H), 7.15 (t, *J* = 8.4 Hz, 1H), 5.78 (d, *J* = 6 Hz, 1H), 3.33 (d, *J* = 7.8 Hz, 1H), 3.17 (s, 2H), 1.44-1.39 (m, 5H), 1.11-1.07 (m, 2H), 0.88-0.84 (m, 1H), 0.51-0.45 (m, 2H); ¹³C{¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.3, 153.8 (d, *J*_{F-C} = 237.3 Hz), 151.0, 144.3, 133.3, 128.8, 128.5, 118.5 (d, *J*_{F-C} = 25.5 Hz), 118.2 (d, *J*_{F-C} = 8.5 Hz), 111.61 (d, *J*_{F-C} = 41.5 Hz), 109.9, 48.7, 38.5, 32.1, 25.2, 24.7. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₁H₂₃FN₃OS: 384.1541; found 384.1545.

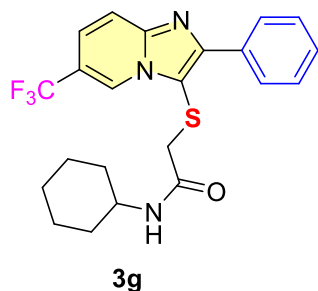


2-((7-Chloro-2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)-*N*-cyclohexylacetamide (3e): The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (45 %) as a mixed eluent to give **3e** as pale white solid, in 87 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.47 (d, *J* = 7.2 Hz, 1H), 8.22 (d, *J* = 7.8 Hz, 1H); ¹³C{¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.2, 150.7, 146.5, 133.3, 133.2, 128.9, 128.8, 128.6, 125.1, 116.5, 114.7, 108.8, 48.7, 38.9, 32.2, 25.2, 24.7. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₁H₂₃ClN₃OS: 400.1245; found 400.1242.



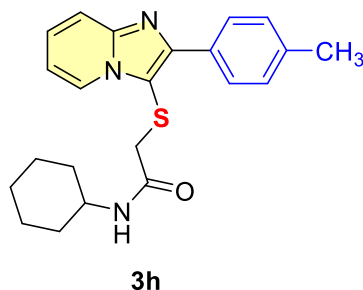
2-((6-Bromo-2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)-*N*-cyclohexylacetamide (3f):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (45 %) as a mixed eluent to give **3f** as pale white solid, in 88 % yield. ¹H NMR (DMSO-*d*₆, 600 MHz) δ (ppm) 8.72 (d, *J* = 1.2 Hz, 1H), 8.25 (d, *J* = 7.2 Hz, 2H), 7.84 (d, *J* = 7.2 Hz, 1H), 7.65 (d, *J* = 9 Hz, 1H), 7.54 (dd, *J* = 9.6 Hz, 1.8 Hz, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 7.42 (t, *J* = 7.2 Hz, 1H), 3.33 (s, 2H), 3.30 (s, 1H), 1.58-1.52 (m, 2H), 1.48-1.43 (m, 3H), 1.18-1.12 (m, 2H), 1.05-0.99 (m, 1H), 0.90-0.80 (m, 2H); ¹³C{¹H} NMR (DMSO-*d*₆, 150 MHz) δ (ppm) 167.7, 144.9, 133.7, 130.2, 128.9, 128.8, 128.4, 125.9, 118.5, 110.4, 107.5, 48.4, 39.2, 32.3, 25.5, 24.8. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₁H₂₃BrN₃OS: 444.0740; found 444.0736.



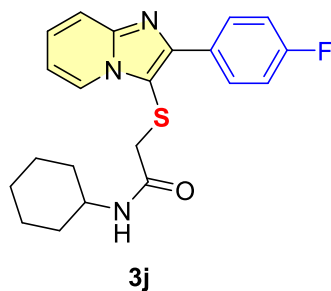
***N*-cyclohexyl-2-((2-phenyl-6-(trifluoromethyl)imidazo[1,2-*a*]pyridin-3-yl)thio)acetamide**

(3g): The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (35 %) as a mixed eluent to give **3g** as pale white solid, in 85 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.62 (d, *J* = 7.2 Hz, 1H), 8.21 (d, *J* = 7.8 Hz, 2H), 7.90 (s, 1H), 7.48 (t, *J* = 7.2 Hz, 2H), 7.41 (d, *J* = 6.6 Hz, 1H), 7.10 (d, *J* = 7.2 Hz, 1H), 5.86 (d, *J* = 7.8 Hz, 1H), 3.39-3.40 (m, 1H), 3.18 (s, 2H), 1.51-1.50 (m, 2H), 1.41 (d, *J* = 11.4 Hz, 2H), 1.17-1.11 (m, 2H), 0.97-0.91 (m, 1H), 0.60-0.54 (m, 2H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.34, 151.30, 144.82, 132.87, 129.1, 128.8, 128.4, 125.8, 123.1 (d, *J*_{F-C} = 271.5 Hz), 115.3 (q, *J*_{F-C} = 10.5 Hz), 110.6, 108.7, 108.7, 48.7, 38.8, 32.2, 25.2, 24.6. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₂H₂₃F₃N₃OS: 434.1509; found 434.1511.

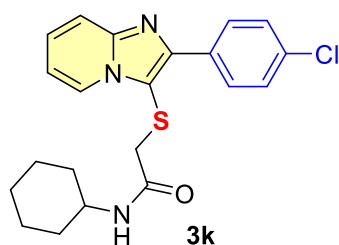


***N*-cyclohexyl-2-((2-(*p*-tolyl)imidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (3h):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (50 %) as a mixed eluent to give **3h** as pale white solid, in 90 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.47 (d, *J* = 6.6 Hz, 1H), 8.11 (d, *J* = 7.8 Hz, 1H), 7.64 (d, *J* = 8.4 Hz, 1H), 7.31 (d, *J* = 7.8 Hz, 3H), 6.95 (t, *J* = 7.2 Hz, 2H), 5.80 (d, *J* = 7.2 Hz, 1H), 3.41-3.34 (m, 1H), 3.24 (s, 2H), 2.43 (s, 3H), 1.50 (d, *J* = 10.2 Hz, 3H), 1.43 (d, *J* = 10.2 Hz, 1H), 1.17-1.10 (m, 2H), 0.96-0.89 (m, 1H), 0.52-0.46 (m, 2H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.4, 150.1, 146.8, 138.7, 130.7, 129.5, 128.56 126.5, 124.5, 117.7, 113.0, 107.8, 48.6, 38.6, 32.0, 25.2, 24.7, 21.3. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₂H₂₆N₃OS: 380.1792; found 380.1793.

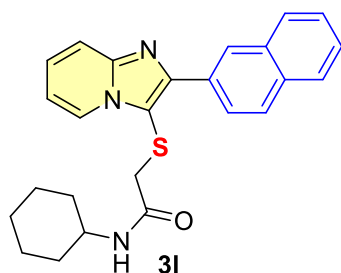


***N*-cyclohexyl-2-((2-(4-fluorophenyl)imidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (3j):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (45 %) as a mixed eluent to give **3j** as pale white solid, in 90 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.50 (d, *J* = 6.6 Hz, 1H), 8.25-8.23 (m, 2H), 7.64 (d, *J* = 9 Hz, 1H), 7.33 (t, *J* = 8.4 Hz, 2H), 6.97 (t, *J* = 6.6 Hz, 1H), 5.67 (d, *J* = 7.2 Hz, 1H), 3.44-3.37 (m, 1H), 3.25 (s, 1H), 1.82 (s, 1H), 1.54-1.46 (m, 5H), 1.19-1.13 (m, 2H), 1.00-0.94 (m, 1H), 0.60-0.54 (m, 2H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.4, 163.1 (d, *J*_{F-C} = 247.9 Hz), 149.0, 146.8, 130.4 (d, *J*_{F-C} = 9 Hz), 129.8 (d, *J*_{F-C} = 3 Hz), 126.7, 124.6, 117.7, 115.7 (d, *J*_{F-C} = 22.5 Hz), 113.2, 108.0, 48.7, 38.8, 32.2, 25.2, 24.7. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₁H₂₃FN₃OS: 384.1541; found 384.154.



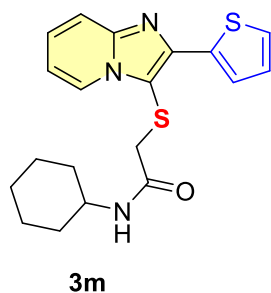
2-((2-(4-Chlorophenyl)imidazo[1,2-*a*]pyridin-3-yl)thio)-*N*-cyclohexylacetamide (3k):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (35%) as a mixed eluent to give **3k** as pale white solid, in 86 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.50 (d, *J* = 6.6 Hz, 1H), 8.20 (d, *J* = 7.8 Hz, 2H), 7.65 (d, *J* = 9 Hz, 1H), 7.48 (d, *J* = 8.4 Hz, 2H), 7.34 (t, *J* = 7.8 Hz, 1 H), 6.98 (t, *J* = 6.6 Hz, 1 H), 5.67 (d, *J* = 6.6 Hz, 1 H), 3.42-3.37 (m, 2H), 3.25 (s, 2H), 1.82 (s, 1H), 1.55-1.53 (m, 3H), 1.46 (d, *J* = 10.8 Hz, 2 H), 1.20-1.13 (m, 2H), 1.02-0.96 (m, 1H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.3, 163.5, 148.8, 146.8, 134.8, 132.1, 129.9, 128.9, 126.8, 124.6, 117.8, 113.3, 108.4, 48.7, 38.8, 32.2, 25.2, 24.7. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₁H₂₃ClN₃OS: 400.1245; found 400.1240.



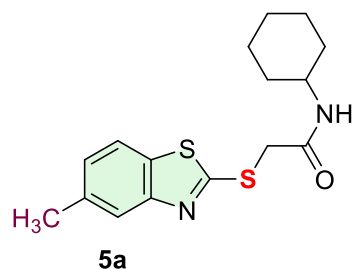
***N*-cyclohexyl-2-((2-(naphthalen-2-yl)imidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (**3l**):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (50 %) as a mixed eluent to give **3l** as pale white solid, in 84 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.66 (s, 1H), 8.43 (d, *J* = 6.6 Hz, 1H), 8.31 (d, *J* = 8.4 Hz, 1H), 7.92-7.91 (m, 2H), 7.85-7.84 (m, 1H), 7.61 (d, *J* = 9 Hz, 1H), 7.50-7.48 (m, 2H), 7.27 (t, *J* = 7.8 Hz, 1H), 6.07 (t, *J* = 6.6 Hz, 1H), 6.07 (d, *J* = 7.8 Hz, 1H), 3.30-3.25 (m, 1H), 3.16 (s, 2H), 1.33-1.28 (m, 5H), 1.00-0.94 (m, 2H), 0.61-0.55 (m, 1H), 0.28-0.22 (m, 2H); ¹³C{¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.5, 149.7, 146.8, 133.5, 133.3, 130.9, 128.5, 128.2, 127.9, 127.6, 126.6, 126.6, 126.4, 126.1, 124.6, 117.6, 113.1, 108.7, 48.5, 38.7, 32.0, 25.0, 24.6. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₅H₂₆N₃OS: 416.1792; found 416.1766.

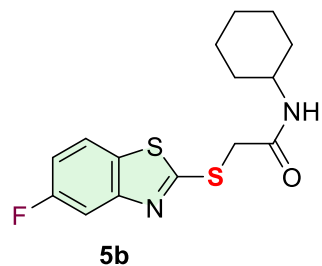


***N*-cyclohexyl-2-((2-(thiophen-2-yl)imidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (**3m**):**

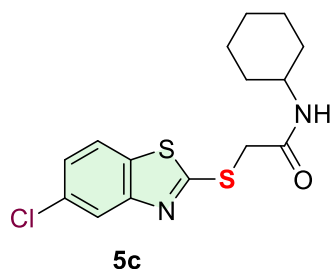
The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (50 %) as a mixed eluent to give **3m** as pale white solid, in 86 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.49 (dd, *J* = 7.8 Hz, 1.2 Hz, 1H), 8.05 (dd, *J* = 4.2 Hz, 1.2 Hz, 1H), 7.62 (d, *J* = 10.8 Hz, 1H), 7.44 (dd, *J* = 6 Hz, 1.2 Hz, 1H), 7.34-7.30 (m, 1H), 7.20-7.18 (m, 1H), 6.95 (td, *J* = 7.8 Hz, 1.2 Hz, 1H), 5.76 (d, *J* = 9 Hz, 1H), 3.49-3.41 (m, 1H), 3.33 (m, 2H), 1.55-1.47 (m, 5H), 1.22-1.13 (m, 2H), 1.02-0.93 (m, 1H), 0.70-0.62 (m, 2H); ¹³C{¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 166.7, 146.9, 145.3, 136.4, 128.0, 126.9, 126.6, 124.76, 117.3, 113.2, 107.2, 48.8, 38.7, 32.2, 25.2, 24.7. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₁₉H₂₂N₃OS₂: 372.1199; found 372.1200.



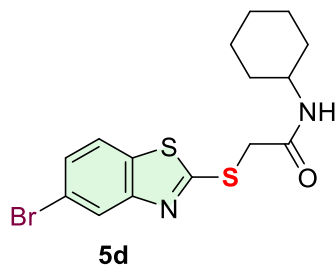
***N*-cyclohexyl-2-((6-methylbenzo[*d*]thiazol-2-yl)thio)acetamide (5a):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (45 %) as a mixed eluent to give **5a** as white solid, in 89 % yield. ¹H NMR (DMSO-*d*₆, 500 MHz) δ 8.21 (d, *J* = 7.5 Hz, 1H), 7.81 (s, 1H), 7.70 (d, *J* = 8.5 Hz, 1H), 7.29 (d, *J* = 8.5 Hz, 1H), 4.09 (s, 2H), 3.54 (m, 1H), 2.41 (s, 1H), 1.74-1.72 (m, 2H), 1.69-1.65 (m, 2H), 1.55-1.52 (m, 1H), 1.30-1.13 (m, 5H); ¹³C {¹H} NMR (DMSO-*d*₆, 125 MHz) δ 165.7, 165.4, 151.2, 135.3, 134.6, 128.2, 121.9, 121.0, 48.4, 37.3, 32.6, 25.6, 24.8, 21.4. HRMS (ESI-TOF) *m/z*: [M + H]⁺ Calcd. for C₁₆H₂₁N₂OS₂: 321.1095; found: 321.1089.



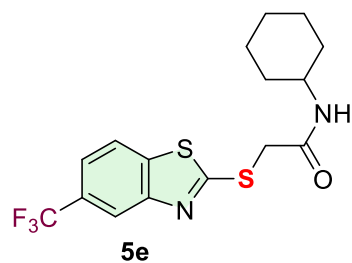
***N*-cyclohexyl-2-((6-fluorobenzo[*d*]thiazol-2-yl)thio)acetamide (5b):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (40 %) as a mixed eluent to give **5b** as white solid, in 83 % yield. White solid, yield 83%. ¹H NMR (DMSO-*d*₆, 500 MHz) δ 8.21 (d, *J* = 8 Hz, 1H), 7.97 (dd, *J* = 9 Hz, 3 Hz, 1H), 7.83 (q, *J* = 5 Hz, 1H), 7.34 (td, *J* = 9 Hz, 2.5 Hz, 1H), 4.11 (s, 2H), 3.57-3.51 (m, 1H), 1.75-1.72 (m, 2H), 1.69-1.65 (m, 2H), 1.55-1.53 (m, 1H), 1.27-1.13 (m, 5H); ¹³C {¹H} NMR (DMSO-*d*₆, 125 MHz) δ 166.6, 149.9, 136.5 (d, *J*_{F-C} = 3.12 Hz), 122.5 (d, *J*_{F-C} = 9.6 Hz), 115.0 (d, *J*_{F-C} = 24.25 Hz), 109.1, 108.9, 48.5, 37.4, 32.7, 25.6, 24.8; ¹⁹F NMR (DMSO-*d*₆, 471 MHz) δ -117.18 to -117.23 (m, 1F). HRMS (ESI TOF) *m/z*: [M + H]⁺ Calcd. for C₁₅H₁₈FN₂OS₂: 325.0840; found: 325.0845.



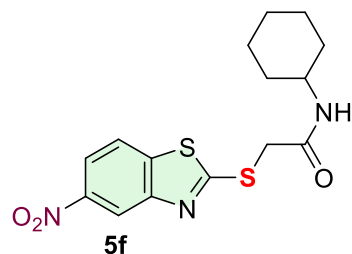
2-((6-Chlorobenzod[thiazol-2-yl)thio)-N-cyclohexylacetamide (5c): The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (35 %) as a mixed eluent to give **5c** as white solid, in 84 % yield. ¹H NMR (DMSO-*d*₆, 500 MHz) δ 8.22 (d, *J* = 8 Hz, 1H), 8.19 (d, *J* = 2.5 Hz, 1H), 7.80 (d, *J* = 9 Hz, 1H), 7.50 (dd, *J* = 8.75 Hz, 2.5 Hz, 1H), 4.12, (s, 2H), 3.93-3.52 (m, 1H), 1.75-1.72 (m, 2H), 1.69-1.66 (m, 2H), 1.55-1.53 (m, 1H), 1.28-1.14 (m, 5H); ¹³C {¹H} NMR (DMSO-*d*₆, 125 MHz) δ 168.2, 165.5, 151.9, 136.8, 129.3, 127.3, 122.5, 122.0, 48.3, 37.4, 32.6, 25.6, 24.8. HRMS (ESI-TOF) *m/z*: [M + H]⁺ Calcd. for C₁₅H₁₈ClN₂OS₂: 341.0544; found: 341.0545.



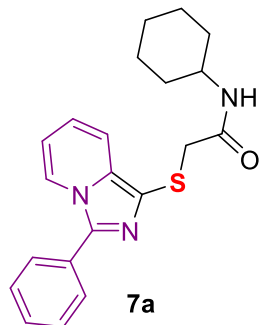
2-((6-Bromobenzod[thiazol-2-yl)thio)-N-cyclohexylacetamide (5d): The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (35 %) as a mixed eluent to give **5d** as white solid, in 86 % yield. ¹H NMR (DMSO-*d*₆, 500 MHz) δ 8.32 (d, *J* = 2 Hz, 1H), 8.23 (d, *J* = 8 Hz, 1H), 7.75 (d, *J* = 8.5 Hz, 1H), 7.62 (dd, *J* = 6.5 Hz, 2 Hz, 1H), 4.11 (s, 2H), 3.57-3.51 (m, 1H), 1.75-1.72 (m, 2H), 1.69- 1.65 (m, 2H), 1.55-1.53 (m, 1H), 1.27-1.14 (m, 5H); ¹³C {¹H} NMR (DMSO-*d*₆, 125 MHz) δ = 168.3, 165.5, 152.1, 137.2, 130.0, 124.9, 122.9, 117.3, 48.5, 37.3, 32.6, 25.6, 24.8. HRMS (ESI-TOF) *m/z*: [M + H]⁺ Calcd. for C₁₅H₁₇BrN₂OS₂: 385.0039; found: 385.0041.



***N*-cyclohexyl-2-((6-(trifluoromethyl)benzo[*d*]thiazol-2-yl)thio)acetamide (5e)** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (30 %) as a mixed eluent to give **5e** as white solid, in 82 % yield. ¹H NMR (DMSO-*d*₆, 500 MHz) δ 8.56 (s, 1H), 8.25 (d, *J* = 7.5 Hz, 1H), 7.97 (d, *J* = 8.5 Hz, 1H), 7.78 (dd, *J* = 1.5 Hz, 8.5 Hz, 1H), 4.16 (s, 2H), 3.56-3.54 (m, 1H), 1.76-1.73 (m, 2H), 1.69-1.66 (m, 2H), 1.55-1.52 (m, 1H), 1.29-1.12 (m, 5H); ¹³C {¹H} NMR (DMSO-*d*₆, 125 MHz) δ = 171.8, 165.4, 155.3, 135.8, 125.9, 125.1, 124.9, 123.8 (q, *J*_{F-C} = 15 Hz), 121.9, 120.4 (q, *J*_{F-C} = 14.5 Hz), 48.5, 37.4, 32.6, 25.6, 24.8; ¹⁹F NMR (DMSO-*d*₆, 471 MHz) δ = -79.71 (s, 3F). HRMS (ESI TOF) *m/z*: [M + H]⁺ Calcd. for C₁₆H₁₈F₃N₂OS₂: 375.0813; found: 375.0810.

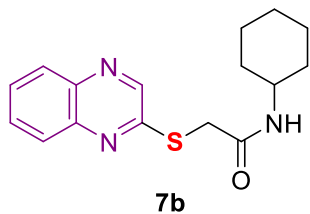


***N*-cyclohexyl-2-((6-nitrobenzo[*d*]thiazol-2-yl)thio)acetamide (5f):** The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (50 %) as a mixed eluent to give **5f** as white solid, in 81 % yield. ¹H NMR (DMSO-*d*₆, 500 MHz) δ 9.23 (d, *J* = 2 Hz, 1H), 8.32-8.27 (m, 2H), 7.97 (d, *J* = 8.5 Hz, 1H), 4.20 (s, 2H), 3.58-3.53 (m, 1H), 1.76-1.74 (m, 2H), 1.70-1.67 (m, 2H), 1.60-1.54 (m, 1H), 1.28-1.4 (m, 5); ¹³C {¹H} NMR (DMSO-*d*₆, 125 MHz) δ 175.0, 165.3, 156.9, 144.0, 136.0, 122.5, 121.5, 119.4, 48.6, 37.6, 32.7, 25.6, 24.9. HRMS (ESI-TOF) *m/z*: [M + H]⁺ Calcd. for C₁₅H₁₇N₃O₃S₂: 352.0790; found: 352.0783



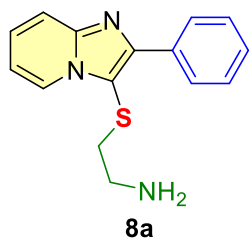
***N*-cyclohexyl-2-((3-phenylimidazo[1,5-*a*]pyridin-1-yl)thio)acetamide (**7a**):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (40 %) as a mixed eluent to give **7a** as buff coloured solid, in 83 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.23 (d, *J* = 7 Hz, 1H), 7.93-7.92 (m, 1H), 7.77-7.75 (m, 2H), 7.61 (d, *J* = 9.5 Hz, 1H), 7.54-7.51 (m, 2H), 7.45 (dt, *J* = 6.5 Hz, 1 Hz, 1H), 6.87-6.84 (m, 2H), 6.65-6.62 (m, 1H), 3.76-3.69 (m, 1H), 3.48 (m, 2H), 1.81-1.77 (m, 2H), 1.69-1.61 (m, 2H), 1.54-1.51 (m, 1H), 1.29-1.25 (m, 3H), 1.22-1.18 (m, 2H); ¹³C {¹H} NMR (CDCl₃, 125 MHz) δ (ppm) 168.7, 138.5, 133.2, 129.4, 129.2, 129.0, 128.0, 122.0, 121.9, 120.7, 118.3, 114.0, 65.8, 48.4, 40.2, 32.6, 25.6, 24.6, 15.3. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₁H₂₄N₃OS: 366.1635; found 366.1633.



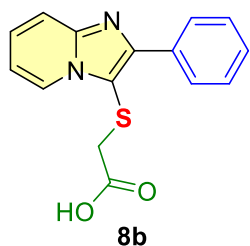
***N*-cyclohexyl-2-(quinoxalin-2-ylthio)acetamide (**7b**):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (50 %) as a mixed eluent to give **7b** as buff coloured solid, in 83 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.86 (s, 1H), 8.07 (dd, *J* = 8.8 Hz, 1.2 Hz, 1H), 7.91 (dd, *J* = 8.4 Hz, 1.2 Hz, 1H), 7.77-7.74 (m, 1H), 7.70-7.68 (m, 1H), 7.17 (d, *J* = 6.6 Hz, 1H), 3.93 (s, 2H), 3.76-3.73 (m, 1H), 1.84-1.82 (m, 2H), 1.59-1.56 (m, 2H), 1.54-1.51 (m, 1H), 1.33-1.26 (m, 2H), 1.11-1.02 (m, 3H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 167.6, 154.8, 144.4, 142.0, 140.2, 130.8, 129.5, 128.8, 127.2, 48.4, 33.3, 32.7, 25.4, 24.5. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₁₆H₂₀N₃OS: 302.1322; found 302.1318.



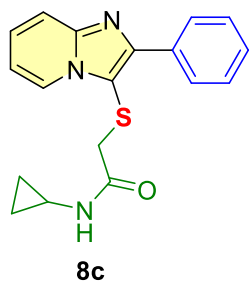
2-((2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)ethan-1-amine (8a):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (75 %) as a mixed eluent to give **8a** as a solid in 80 % yield; melting point: 211-214°C. $^{13}\text{C}\{^1\text{H}\}$ NMR (CDCl_3 , 600 MHz) δ (ppm) 8.38 (d, $J=6.6$ Hz, 1H), 8.2-8.19 (m, 2H), 7.77 (d, $J=9$ Hz, 1H), 7.54-7.51 (m, 2H), 7.49-7.46 (m, 2H), 7.1 (td, $J=7.2$ Hz, 1.2 Hz, 1H), 2.17 (s, 1H), 1.25 (s, 4H); ^{13}C NMR (CDCl_3 , 150 MHz) δ (ppm) 153.4, 146.8, 131.2, 130.1, 129.0, 128.7, 127.3, 125.6, 118.2, 114.7, 112.8, 30.9, 29.7. HRMS (ESI-TOF) m/z : $[\text{M}+\text{H}]^+$ Calcd. for $\text{C}_{15}\text{H}_{16}\text{N}_3\text{S}$: 270.1060; found 270.1045.



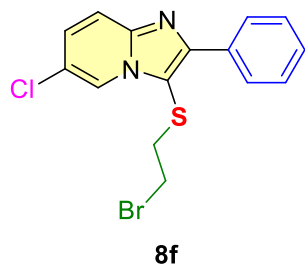
2-((2-Phenylimidazo[1,2-*a*]pyridin-3-yl)thio)acetic acid (8b):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (75 %) as a mixed eluent to give **8b** as a yellow solid in 75 % yield; melting point: 195-96°C. ^1H NMR ($\text{DMSO-}d_6$, 600 MHz) δ (ppm) 12.71 (s, 1H), 8.68 (d, $J=7.2$ Hz, 1H), 8.27 (d, $J=8.4$ Hz, 2H), 7.68 (d, $J=9$ Hz, 1H), 7.49 (t, $J=7.8$ Hz, 2H), 7.46-7.39 (m, 2H), 7.11 (td, $J=6.6$ Hz, 0.6 Hz, 1H), 3.53 (s, 2H); $^{13}\text{C}\{^1\text{H}\}$ NMR ($\text{DMSO-}d_6$, 150 MHz) δ (ppm) 170.8, 149.0, 146.4, 134.0, 128.8, 128.7, 128.3, 127.4, 125.7, 117.4, 113.5, 108.6, 37.3. HRMS (ESI-TOF) m/z : $[\text{M}+\text{H}]^+$ Calcd. for $\text{C}_{15}\text{H}_{13}\text{N}_2\text{O}_2\text{S}$: 285.2010; found 285.2813.



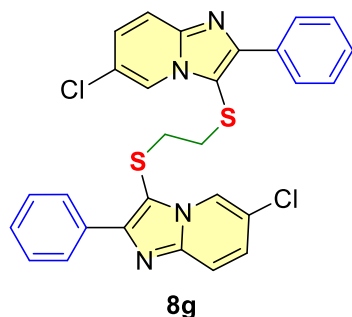
***N*-cyclopropyl-2-((2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)acetamide (**8c**):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (35 %) as a mixed eluent to give **8c** as white solid, in 86 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 9.15 (d, *J* = 7.2 Hz, 1H), 8.83-8.82 (m, 2H), 8.32 (d, *J* = 9 Hz, 1H), 8.18 (t, *J* = 7.2 Hz, 2H), 8.11 (d, *J* = 7.8 Hz, 1H), 8.02-7.99 (m, 1H), 6.78 (s, 1H), 3.89 (s, 2H), 2.97-2.93 (m, 1H), 1.13-1.10 (m, 2H), 0.57-0.55 (m, 2H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 167.8, 149.2, 145.8, 132.4, 127.8, 127.6, 125.7, 123.4, 116.8, 112.2, 107.0, 37.25, 21.6, 4.9. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₁₈H₁₈N₃OS: 324.1166; found 324.1175.



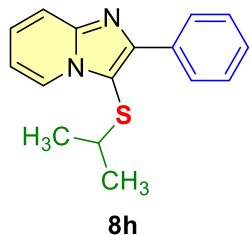
3-((2-Bromoethyl)thio)-6-chloro-2-phenylimidazo[1,2-*a*]pyridine (8f**):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (30 %) as a mixed eluent to give **8f** as white solid, in 50 % yield. ¹H NMR (CDCl₃, 500 MHz) δ (ppm) 7.83 (dd, *J* = 2 Hz, 0.5 Hz, 1H), 8.30-8.28 (m, 2H), 7.65 (dd, *J* = 2 Hz, 9.5 Hz, 0.5 Hz, 1H), 7.52-7.49 (m, 2H), 7.44 (tt, *J* = 7 Hz, 1.5 Hz, 1H), 7.32 (dd, *J* = 9.5 Hz, 2 Hz, 1H), 3.28-3.25 (m, 2H), 3.08-3.05 (m, 2H); ¹³C {¹H} NMR (CDCl₃, 125 MHz) δ (ppm) 151.1, 145.1, 133.0, 128.9, 128.6, 128.4, 127.8, 122.3, 121.7, 118.2, 37.7, 29.8. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₁₅H₁₃BrClN₂S: 366.9666; found 366.9670.

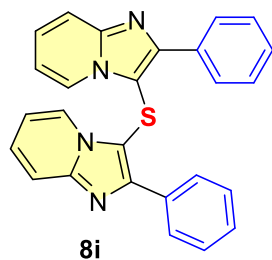


1,2-Bis((6-chloro-2-phenylimidazo[1,2-*a*]pyridin-3-yl)thio)ethane (8g):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (30 %) as a mixed eluent to give **8g** as white solid, in 20 % yield. ^1H NMR (CDCl_3 , 500 MHz) δ (ppm) 8.33 (dd, $J = 2$ Hz, 1 Hz, 2H), 8.13-8.11 (m, 4H), 7.59 (dd, $J = 9$ Hz, 0.5 Hz, 2H), 7.47-7.44 (m, 4H), 7.43-7.39 (m, 2H), 7.30 (d, $J = 2$ Hz, 1H), 7.28 (s, 1H), 2.53 (s, 4H); $^{13}\text{C}\{^1\text{H}\}$ NMR (CDCl_3 , 125 MHz) δ (ppm) 144.9, 132.9, 128.7, 128.5, 128.3, 127.7, 122.1, 121.5, 118.1, 109.2, 34.9. HRMS (ESI-TOF) m/z : $[\text{M}+\text{H}]^+$ Calcd. for $\text{C}_{28}\text{H}_{21}\text{Cl}_2\text{N}_4\text{S}_2$: 547.0580; found 547.0582.

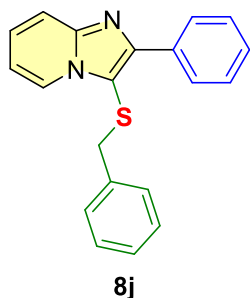


3-(Isopropylthio)-2-phenylimidazo[1,2-*a*]pyridine (8h): The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (10 %) as a mixed eluent to give **8h** as white semi-solid, in 67 % yield. ^1H NMR (CDCl_3 , 600 MHz) δ (ppm) 7.54 (d, $J = 7.54$ Hz, 2H), 7.46 (d, $J = 8.4$ Hz, 2H), 7.15 (s, 1H), 6.92 (d, $J = 8.4$ Hz, 4H), 5.74 (d, $J = 13.2$ Hz, 2H), 3.84 (s, 6H); $^{13}\text{C}\{^1\text{H}\}$ NMR (CDCl_3 , 125 MHz) δ (ppm) 160.9, 159.1, 142.6, 134.4, 128.6, 128.0, 127.4, 126.8, 122.9, 117.3, 114.3, 114.2, 110.1, 55.4, 55.4. HRMS (ESI-TOF) m/z : $[\text{M}+\text{H}]^+$ Calcd. for $\text{C}_{16}\text{H}_{17}\text{N}_2\text{S}$: 269.1107; found 269.1108.



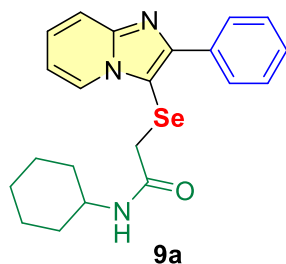
Bis(2-phenylimidazo[1,2-*a*]pyridin-3-yl)sulfane (8i):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (30%) as a mixed eluent to give **8i** as a pale-yellow solid in 20 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.10 (d, *J*= 7.8 Hz, 4H), 7.51 (t, *J*= 7.8 Hz, 4H), 7.56-7.55 (m, 4H), 7.49 (d, *J*= 9 Hz, 2H), 7.09 (t, *J*= 7.8 Hz, 2H), 6.34 (t, *J*= 6.6 Hz, 2H); ¹³C{¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 150.9, 146.6, 133.8, 129.6, 128.9, 128.6, 126.3, 125.3, 117.4, 112.6, 107.5. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₆H₁₉N₄S: 419.1325; found 419.1321.



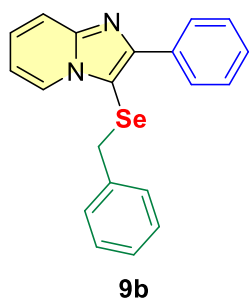
3-(Benzylthio)-2-phenylimidazo[1,2-*a*]pyridine (8j):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (12 %) as a mixed eluent to give **8j** as white solid, in 89 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.14 (d, *J*= 7.8 Hz, 2H), 7.94 (d, *J*= 2 Hz, 2H), 7.47 (d, *J*=9 Hz, 1H), 7.34 (t, *J*= 7.8 Hz, 2H), 7.26 (t, *J*= 7.2 Hz, 1H), 7.04 (t, *J*= 7.2 Hz, 1H), 6.97-6.91 (m, 3H), 6.79 (d, *J*= 7.2 Hz, 2H), 6.52 (t, *J*= 6.6 Hz, 1H), 3.68 (s, 2H); ¹³C{¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 150.1, 146.4, 137.1, 133.8, 128.7, 128.5, 128.3, 128.3, 127.3, 126.0, 124.2, 117.2, 112.3, 109.4, 40.6. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₀H₁₇N₂S: 317.1107; found 317.1133.



***N*-cyclohexyl-2-((2-phenylimidazo[1,2-*a*]pyridin-3-yl)selanyl)acetamide (**9a**):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (30 %) as a mixed eluent to give **9a** as white solid, in 89 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.55 (d, *J* = 6.6 Hz, 1H), 8.17 (d, *J* = 7.8 Hz, 2H), 7.66 (d, *J* = 9 Hz, 1H), 7.54 (t, *J* = 7.2 Hz, 2H), 7.40 (t, *J* = 7.2 Hz, 1H), 7.32-7.28 (m, 1H), 6.93 (t, *J* = 6.6 Hz, 1H), 3.40-3.34 (m, 1H), 3.18 (s, 2H), 1.52-1.50 (m, 3H), 1.45-1.43 (m, 2H), 1.19-1.11 (m, 2H), 1.00-0.93 (m, 1H), 0.64-0.58 (m, 2H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 167.6, 150.4, 147.5, 133.6, 128.8, 128.6, 128.5, 126.6, 125.9, 117.3, 113.1, 103.2, 77.3, 77.1, 76.9, 48.8, 32.2, 31.1, 25.2, 24.6. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₁H₂₄N₃OS: 414.1080; found 414.1084.

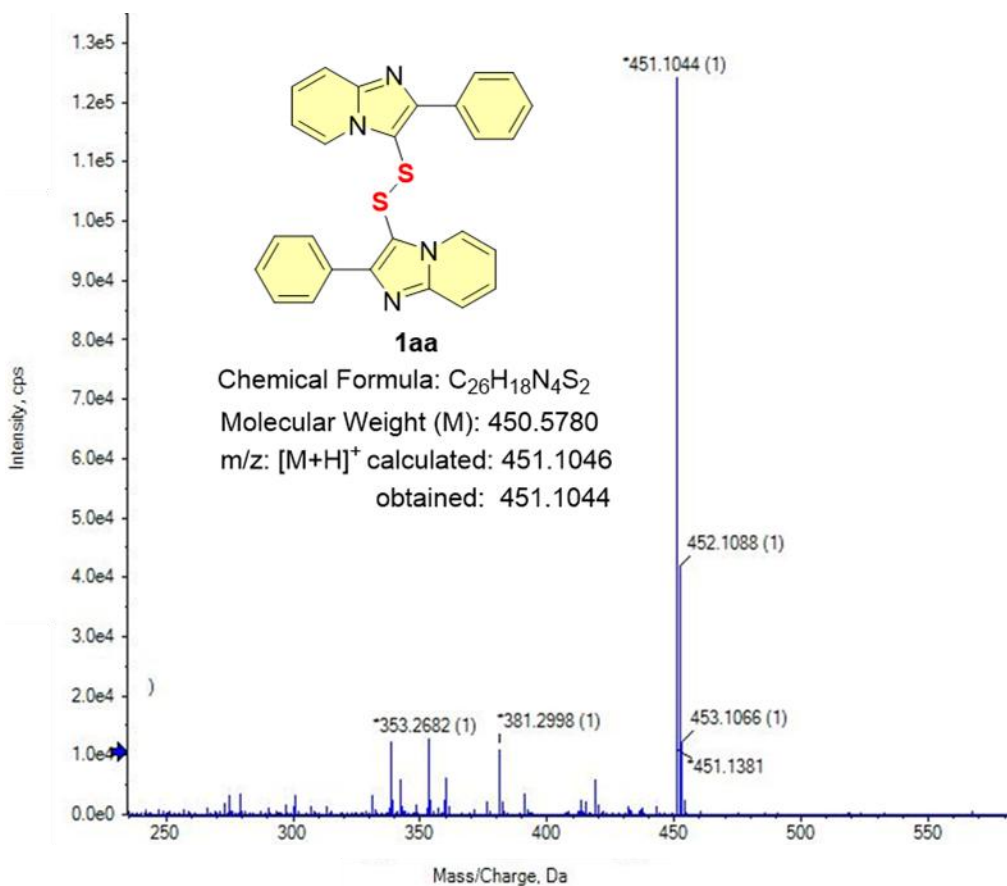


3-(Benzylselanyl)-2-phenylimidazo[1,2-*a*]pyridine (9b**):**

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (12 %) as a mixed eluent to give **9b** as white solid, in 86 % yield. ¹H NMR (CDCl₃, 600 MHz) δ (ppm) 8.15 (t, *J* = 8.4 Hz, 3H), 7.63 (d, *J* = 8.4 Hz, 1H), 7.45 (t, *J* = 7.2 Hz, 2H), 7.41-7.38 (m, 2H), 7.23-7.20 (m, 1H), 7.07-7.04 (m, 2H), 6.90 (d, *J* = 7.2 Hz, 2H), 6.70 (t, *J* = 6.6 Hz, 1H), 3.88 (s, 2H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ (ppm) 150.9, 147.2, 137.9, 134.0, 128.7, 128.5, 128.4, 128.2, 128.9, 127.1, 127.0, 126.0, 125.3, 117.1, 112.3, 33.1. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₀H₁₇N₂Se: 365.0552; found 365.0550.

2-Phenyl-3-((2-phenyl-1,8a-dihydroimidazo[1,2-a]pyridin-3-yl)disulfanyl)imidazo[1,2-a]pyridine (1aa):

The compound was purified by silica gel column chromatography using ethyl acetate/*n*-hexane (50 %) as a mixed eluent to give **1aa** as a yellow solid. ¹H NMR (CDCl₃, 600 MHz) δ= 8.12 (d, *J* = 5.4 Hz, 2H), 7.65 (s, 4H), 7.38 (d, *J* = 5.4 Hz, 2H), 7.22 (t, *J* = 7.8 Hz, 2H), 7.16-7.11 (m, 6H), 6.77 (t, *J* = 6.6 Hz, 2H); ¹³C {¹H} NMR (CDCl₃, 150 MHz) δ = 147.3, 132.0, 128.2, 127.9, 127.7, 127.0, 124.4, 117.6, 113.0. HRMS (ESI-TOF) *m/z*: [M+H]⁺ Calcd. for C₂₇H₁₈N₄S₂: 451.1046; found 451.1040.

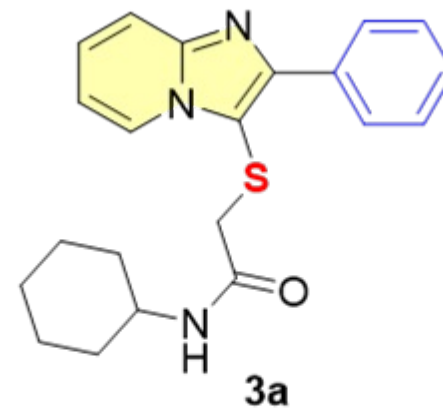


8.507
8.495
8.241
8.228
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7.665
7.531
7.519
7.506
7.429
7.335
7.265
6.987
6.975
6.964

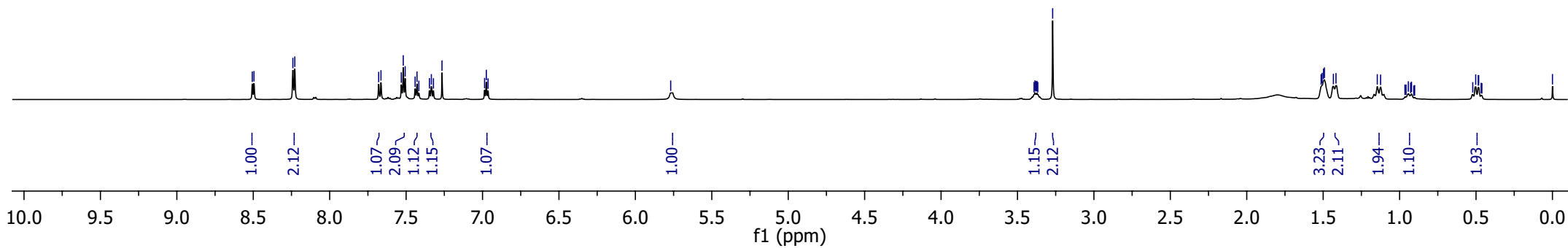
5.769

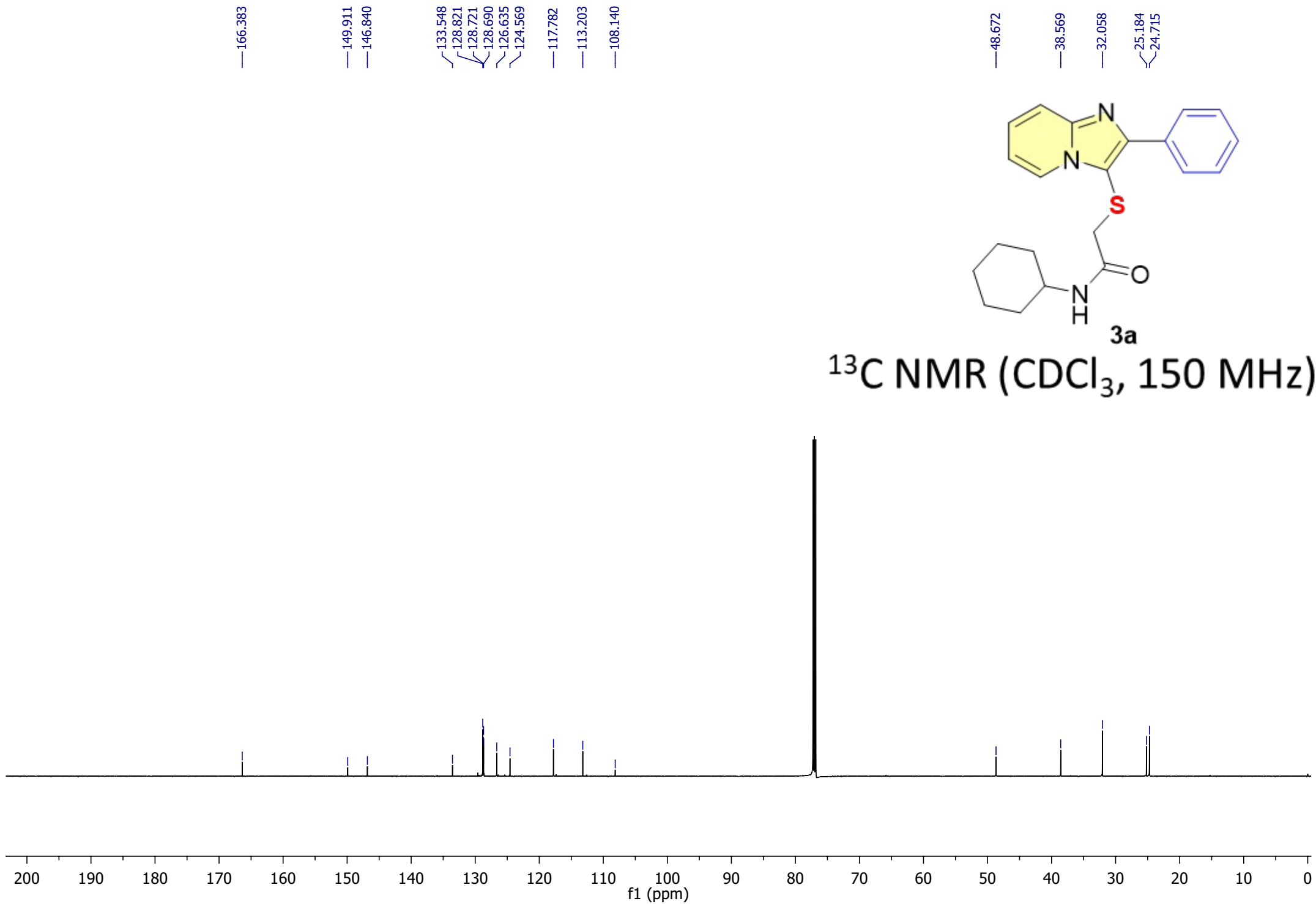
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3.379
3.373
3.367
3.270

1.513
1.507
1.498
1.492
1.433
1.416
1.146
1.124
0.943
0.922
0.521
0.502
0.485
0.482
0.000



¹H NMR (CDCl₃, 600 MHz)





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8.339
8.211
8.199

7.506
7.493
7.480
7.415
7.400

6.788
6.777

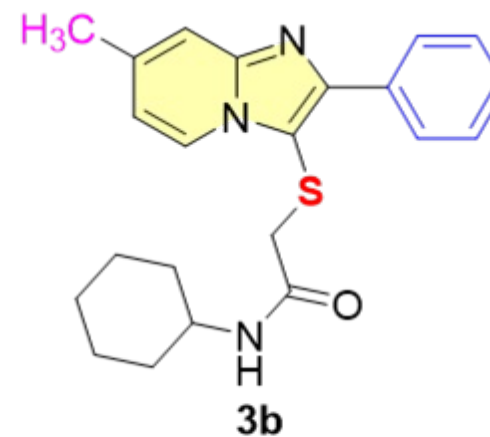
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5.837

3.402
3.389
3.383
3.377
3.370
3.365
3.359
3.352
3.345
3.229

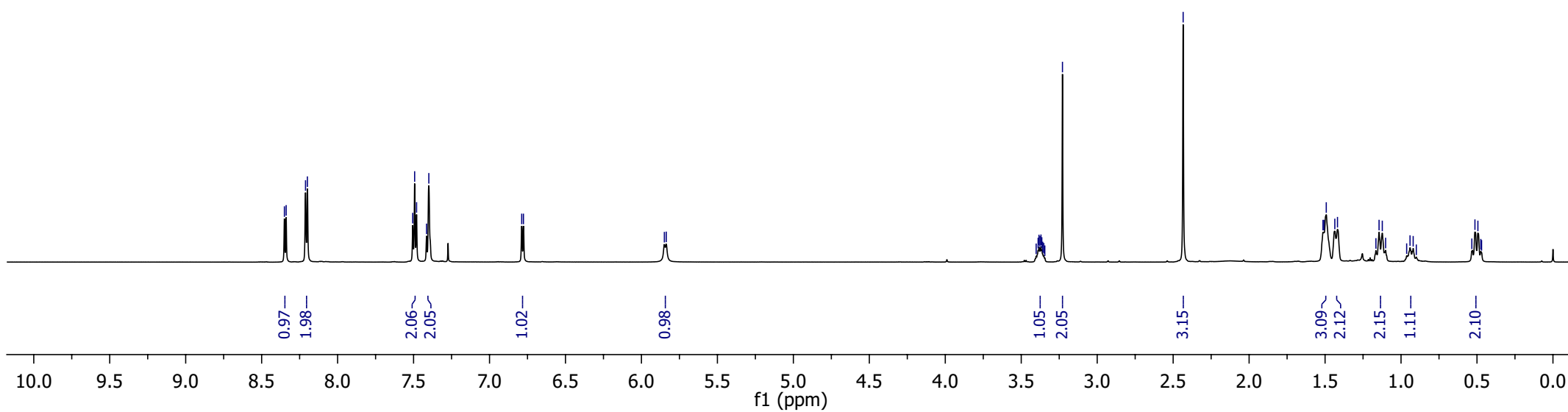
2.434

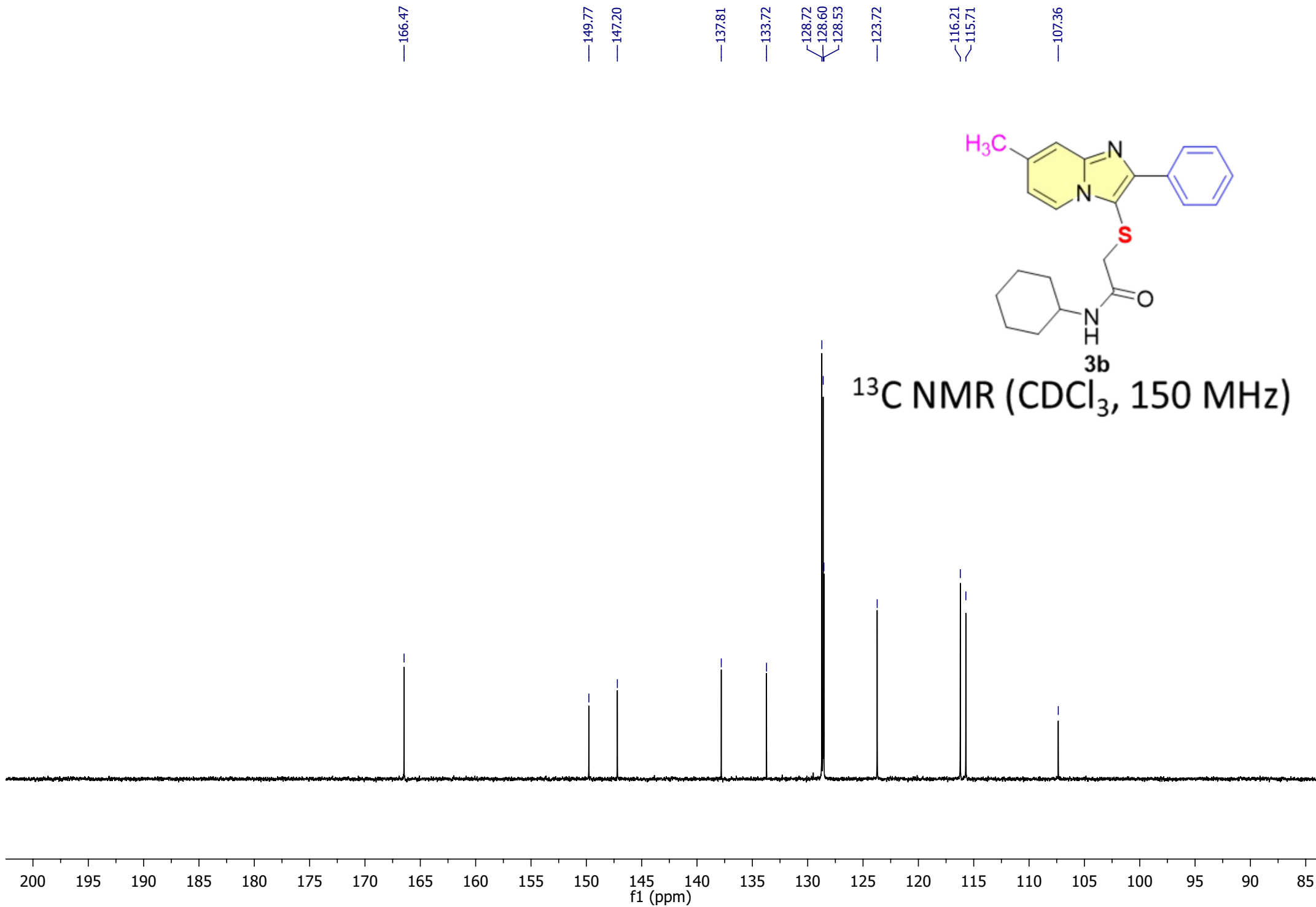
1.514
1.508
1.492
1.436
1.418

1.145
1.123
0.941
0.920
0.513
0.494
0.475
0.470



^1H NMR (CDCl_3 , 600 MHz)





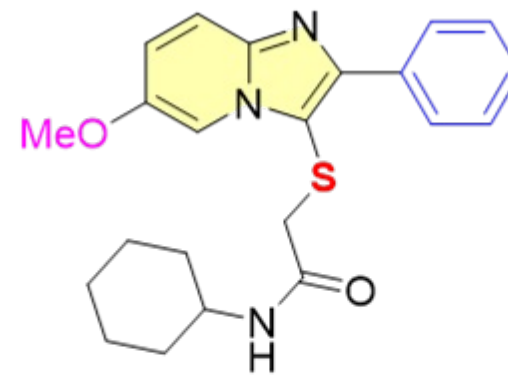
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8.037
8.033

7.542
7.526
7.493
7.489
7.106
7.093
7.090

5.795
5.782

3.915
3.409
3.402
3.396
3.390
3.384
3.377
3.372
3.366
3.359
3.251

1.981
1.514
1.507
1.498
1.492
1.429
1.412
1.148
1.127
0.946
0.535
0.519
0.499
0.496
0.480
0.475



3c

$^1\text{H NMR}$ (CDCl_3 , 600 MHz)

2.01
0.98

0.92
1.93
0.98

0.91

0.96

3.08

1.05
2.06

1.02

3.16
2.08

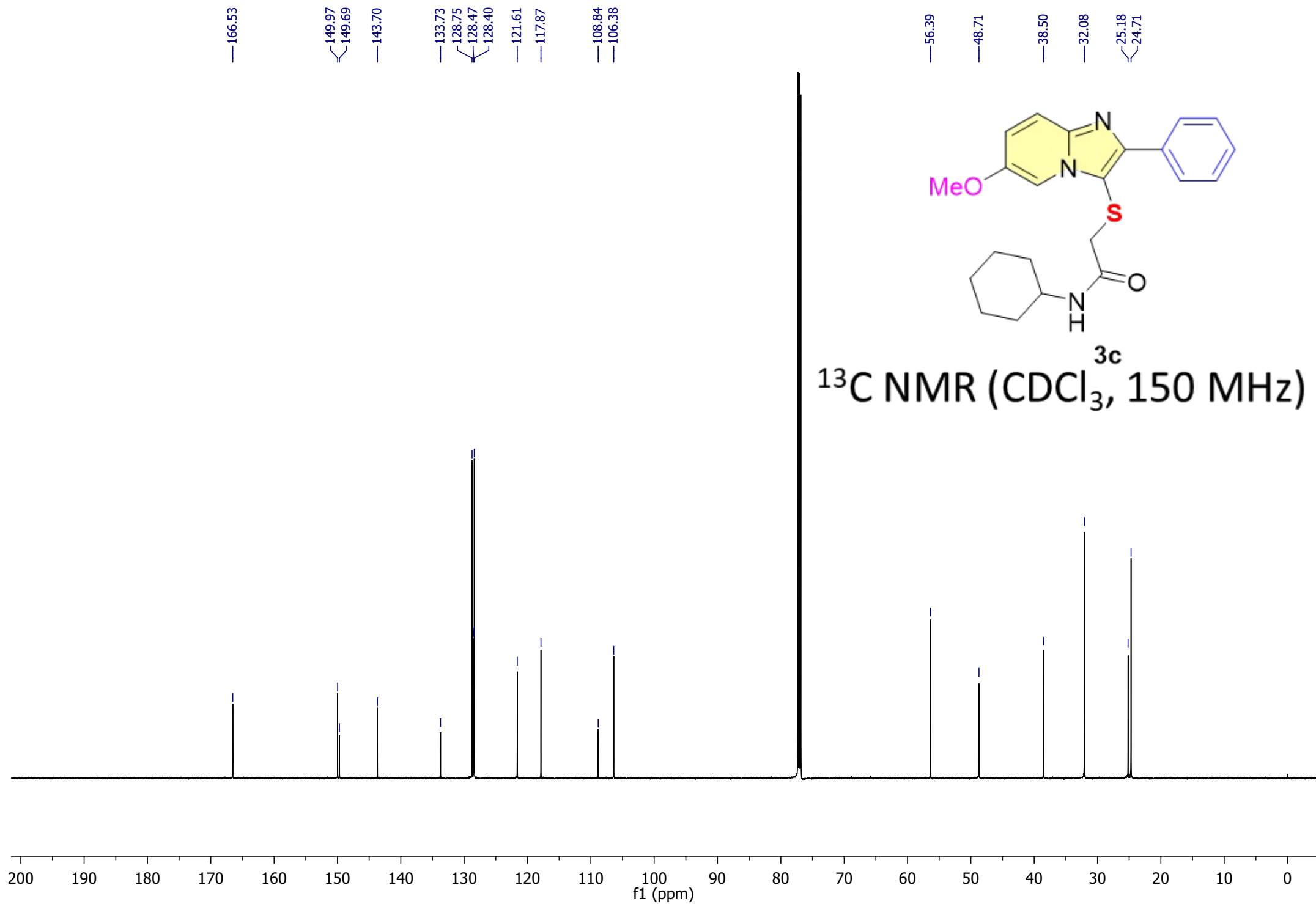
2.11

1.08

2.06

10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

f1 (ppm)

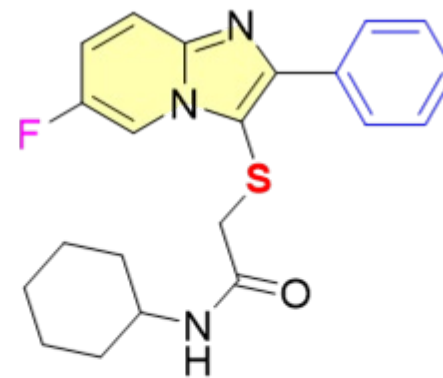


8.353
8.121
8.109
7.548
7.541
7.533
7.526
7.436
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7.412
7.356
7.345
7.333
7.168
7.155
7.141

5.786
5.776

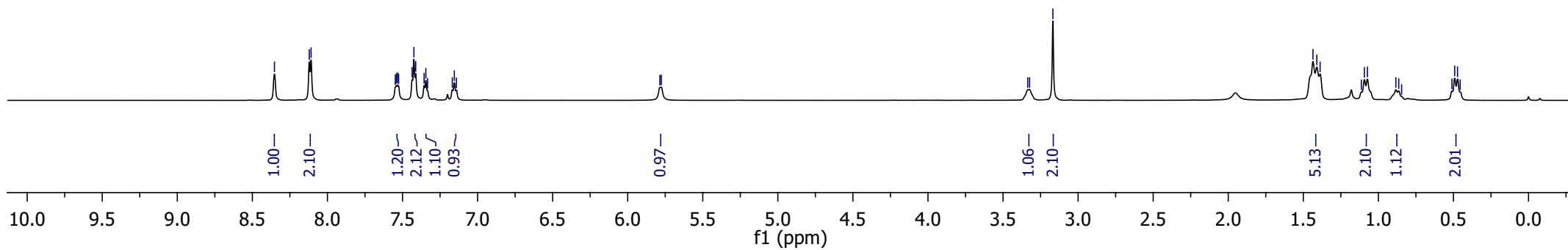
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1.410
1.388
1.093
1.073
0.884
0.864
0.856
0.492
0.473
0.455



3d

$^1\text{H NMR}$ (CDCl_3 , 600 MHz)



—166.287

—154.608

—153.026

—150.992

—144.294

—133.308

—128.801

—128.496

—118.564

—118.394

—118.242

—118.185

—111.752

—111.475

—109.788

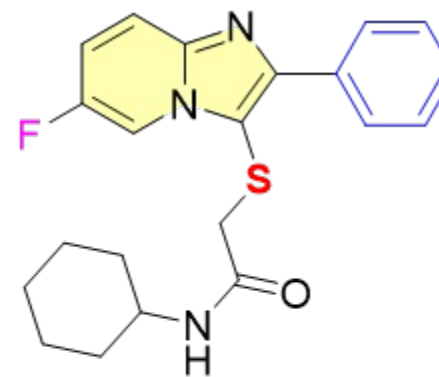
—48.722

—38.480

—32.132

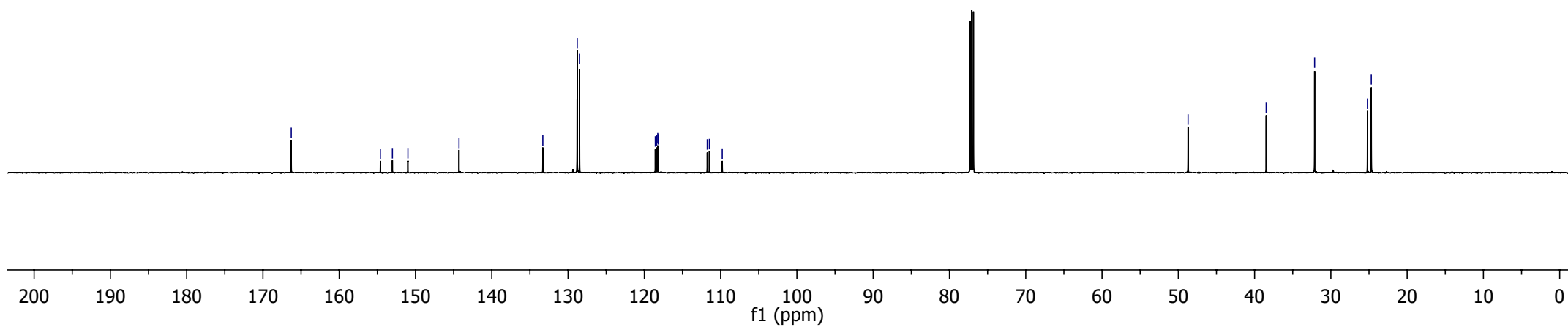
—25.205

—24.700



3d

^{13}C NMR (CDCl_3 , 150 MHz)



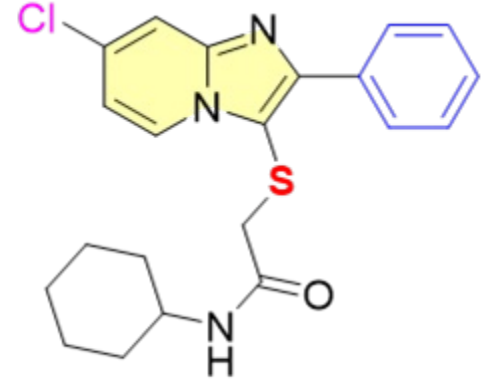
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8.227
8.215
7.651
7.650
7.528
7.515
7.502
7.447
7.435
6.957
6.954
6.945
6.942

5.630
5.618

3.418
3.411
3.405
3.400
3.393
3.387
3.368
3.251

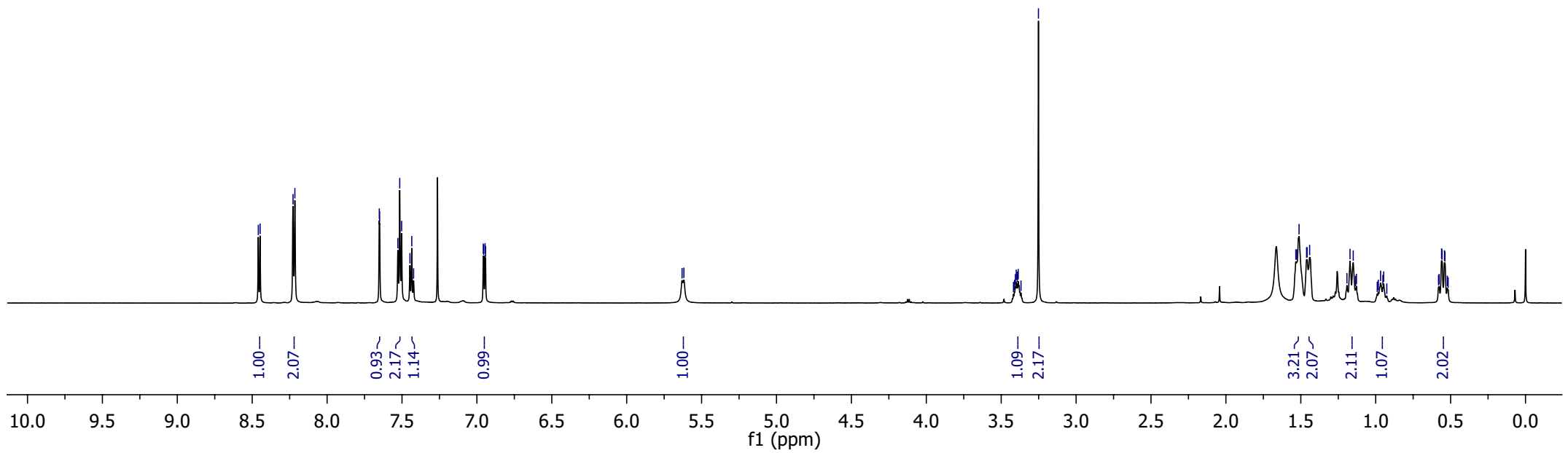
1.533
1.527
1.512
1.461
1.458
1.441

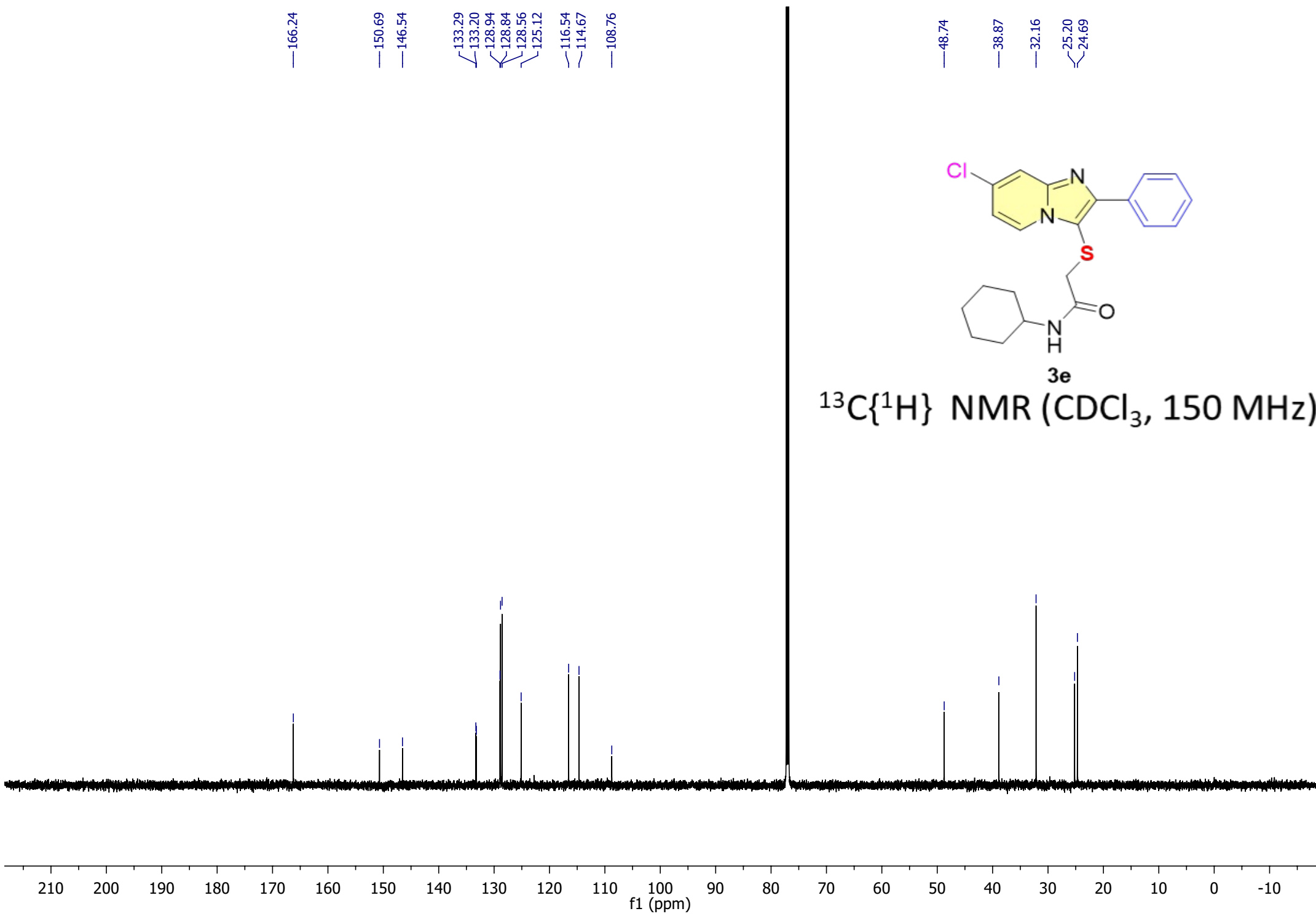
1.171
1.150
0.967
0.947
0.581
0.576
0.560
0.557
0.541
0.538
0.522
0.516

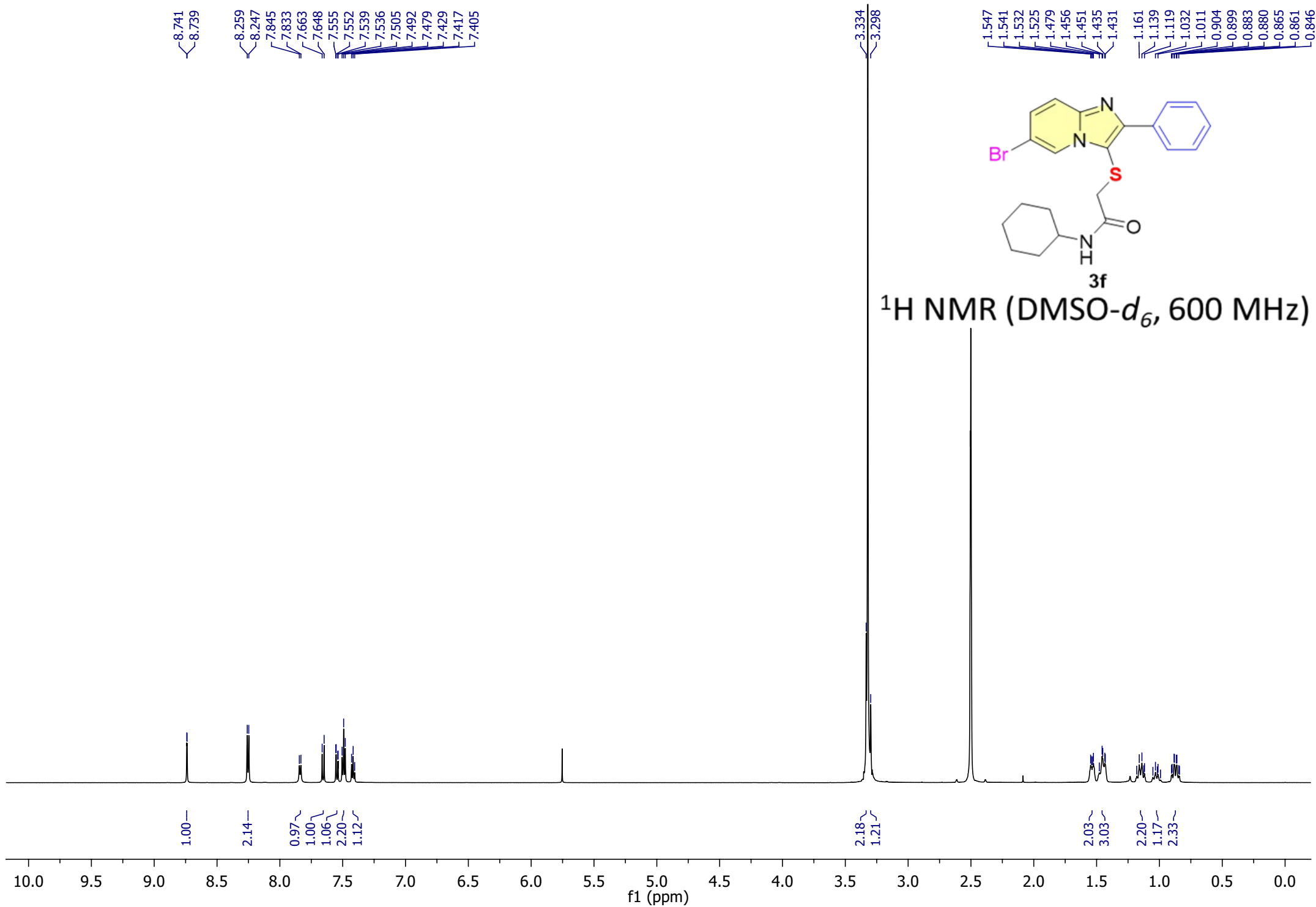


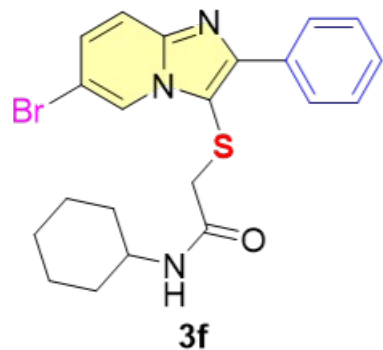
3e

¹H NMR (CDCl₃, 600 MHz)

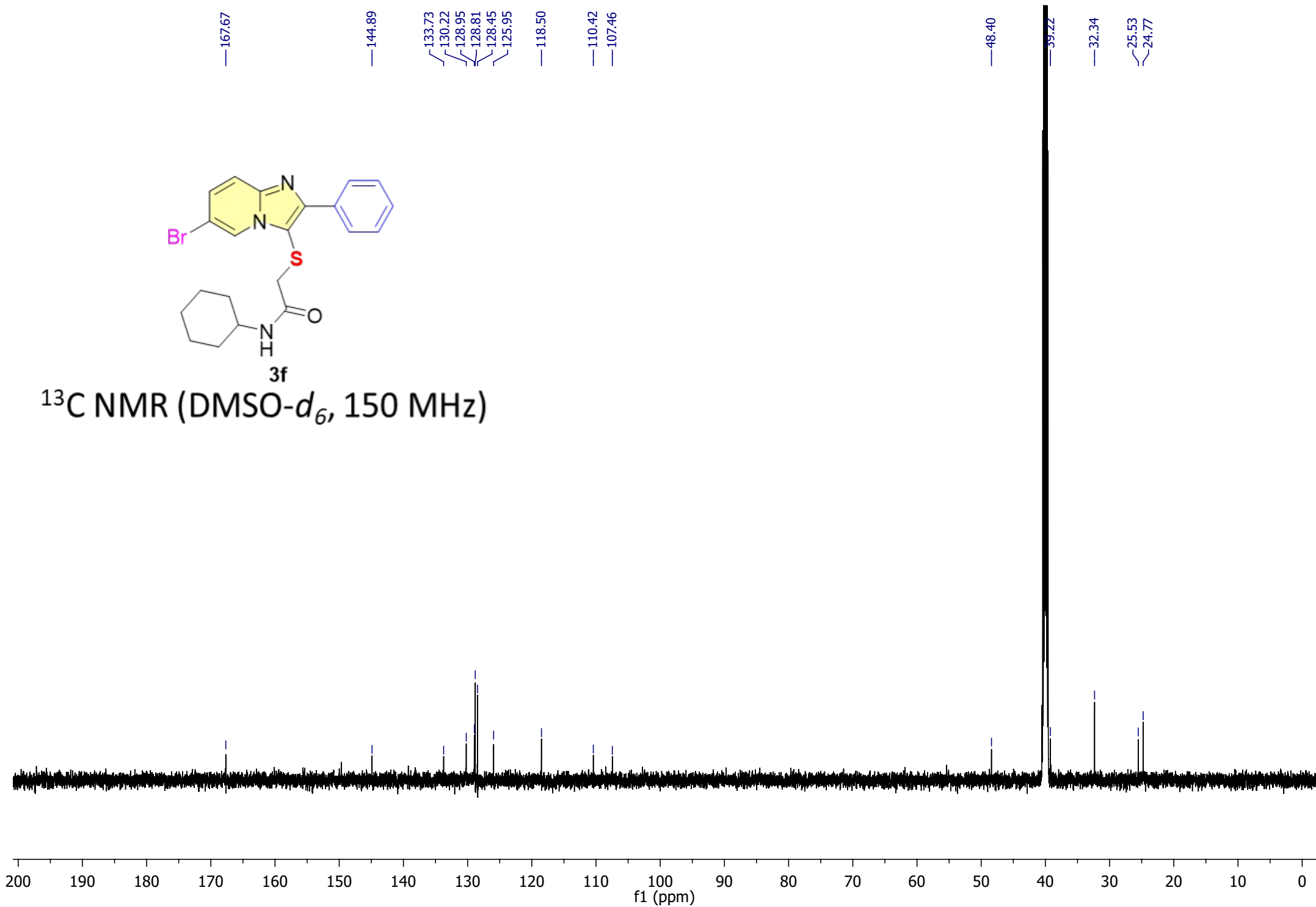








^{13}C NMR (DMSO- d_6 , 150 MHz)

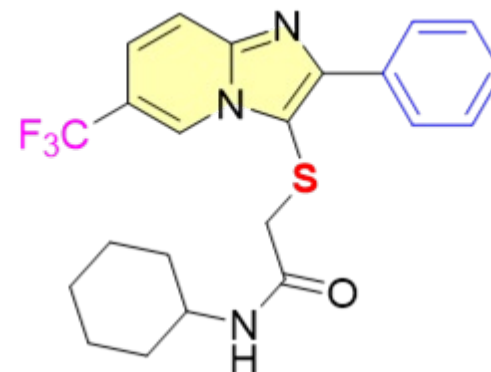


8.626
8.614
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8.201
7.896
7.494
7.482
7.469
7.417
7.102
7.090

5.873
5.860

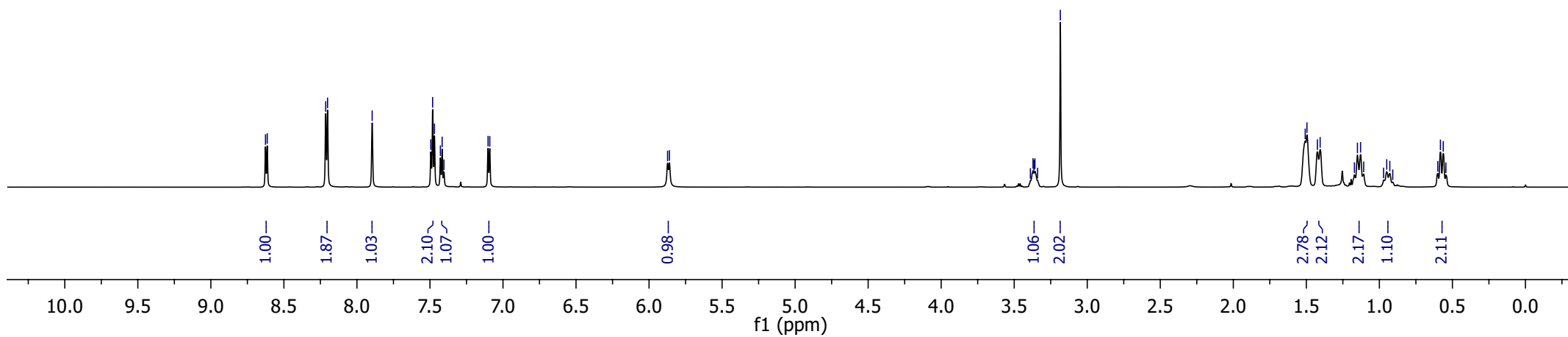
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3.340
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1.496
1.424
1.405
1.171
1.150
1.129
1.107
0.971
0.950
0.929
0.908
0.600
0.582
0.563
0.545



3g

¹H NMR (CDCl₃, 600 MHz)



—166.34

—151.30

—144.82

132.87

129.06

128.76

128.45

125.84

124.03

122.22

115.36

115.33

115.30

115.27

110.57

108.73

108.71

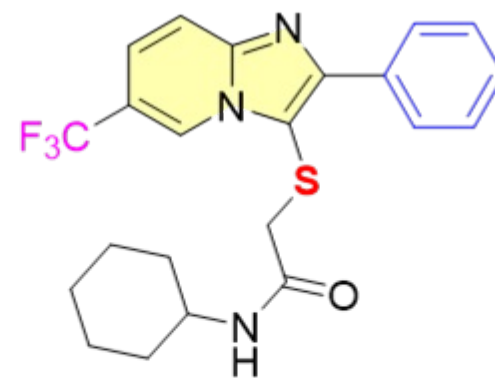
—48.75

—38.82

—32.17

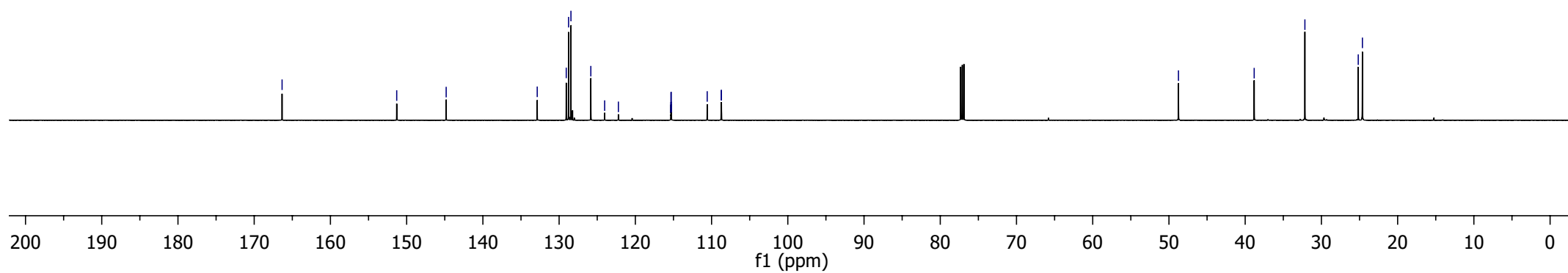
25.17

24.62



3g

^{13}C NMR (CDCl₃, 150 MHz)

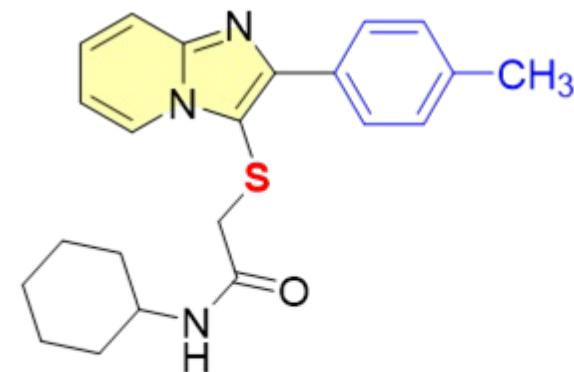


8.479
8.468
8.122
8.109
7.650
7.636
7.326
7.313
6.949
6.938

5.842
5.829

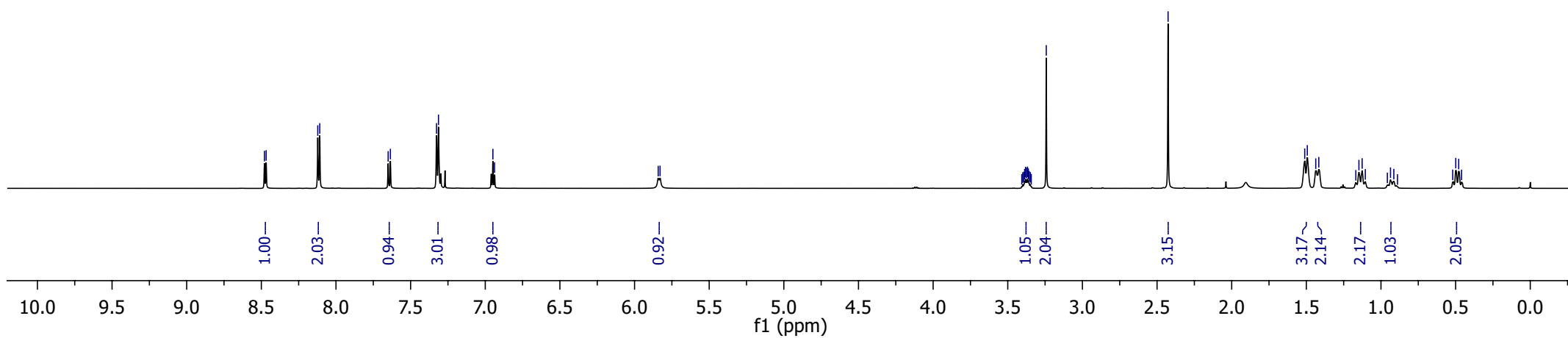
3.406
3.400
3.393
3.387
3.381
3.374
3.368
3.362
3.356
3.349
3.343
3.242
2.426

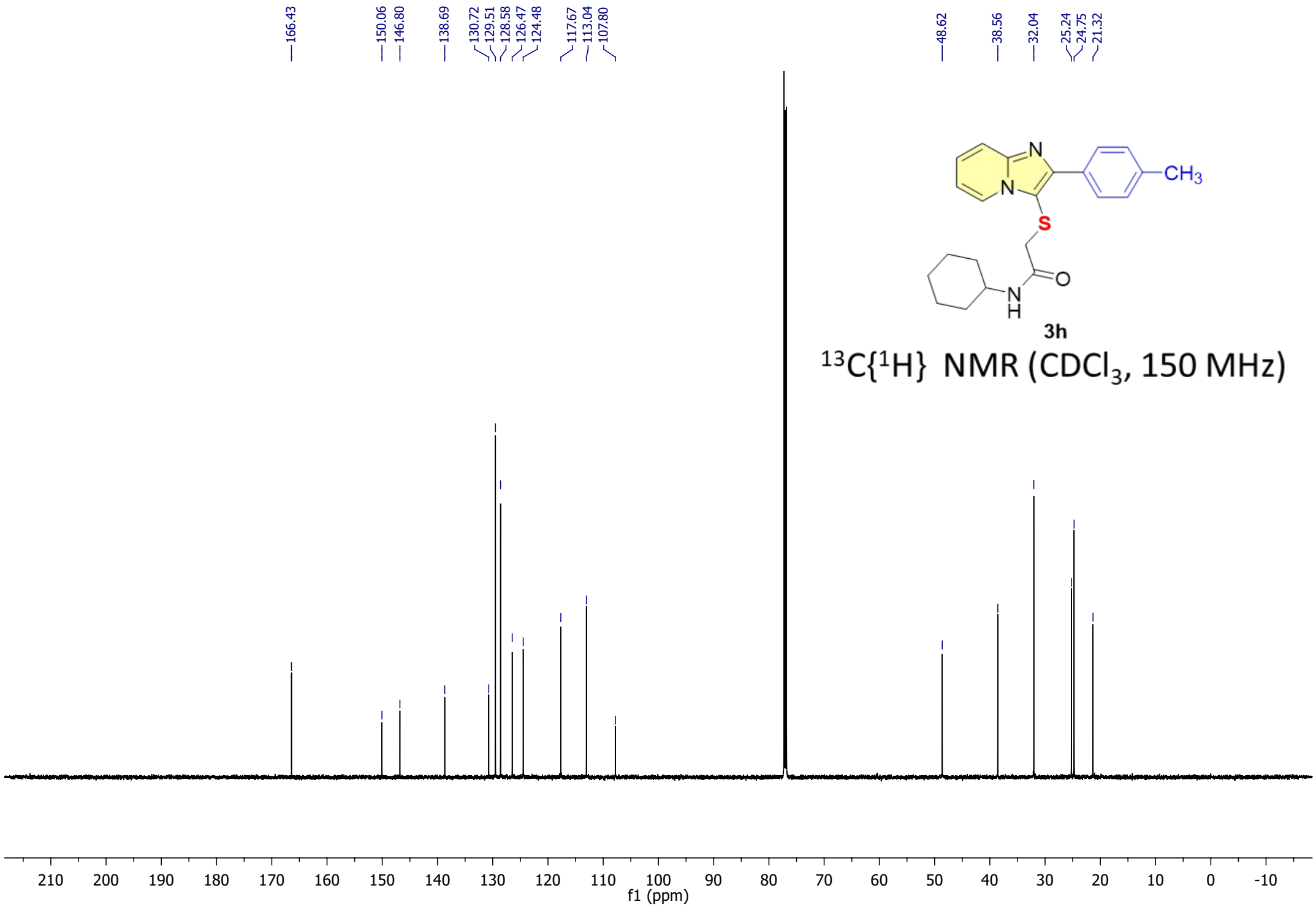
1.511
1.494
1.437
1.417
1.168
1.148
1.126
1.105
0.957
0.936
0.914
0.889
0.520
0.499
0.479
0.460



3h

$^1\text{H NMR (CDCl}_3\text{, 600 MHz)}$





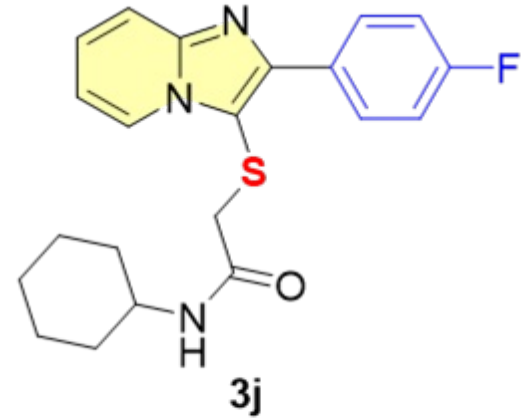
8.507
8.496
8.254
8.244
8.240
8.231

7.652
7.637
7.347
7.335
7.321
7.215
7.201
7.186
6.984
6.973
6.961

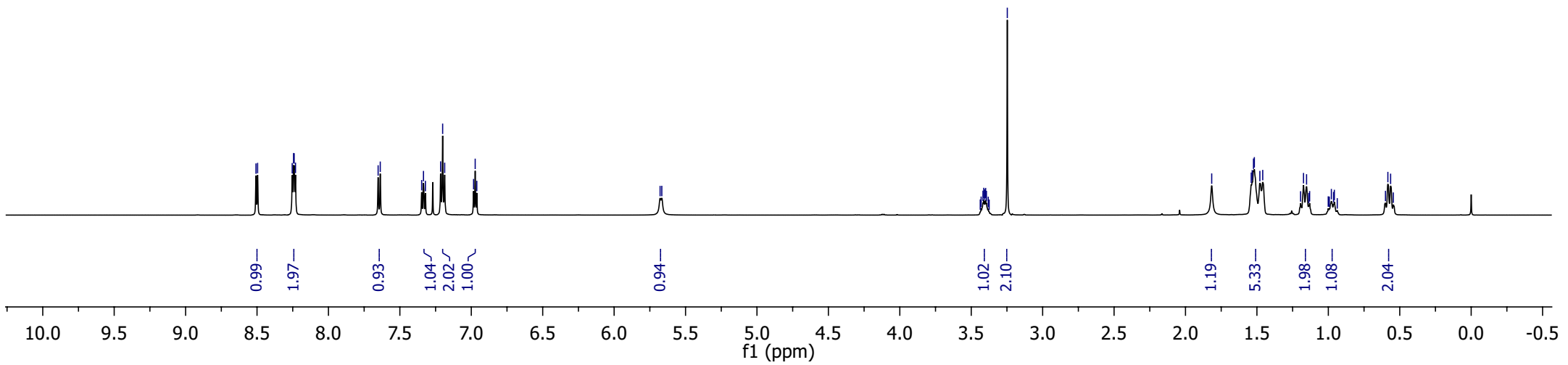
5.678
5.666

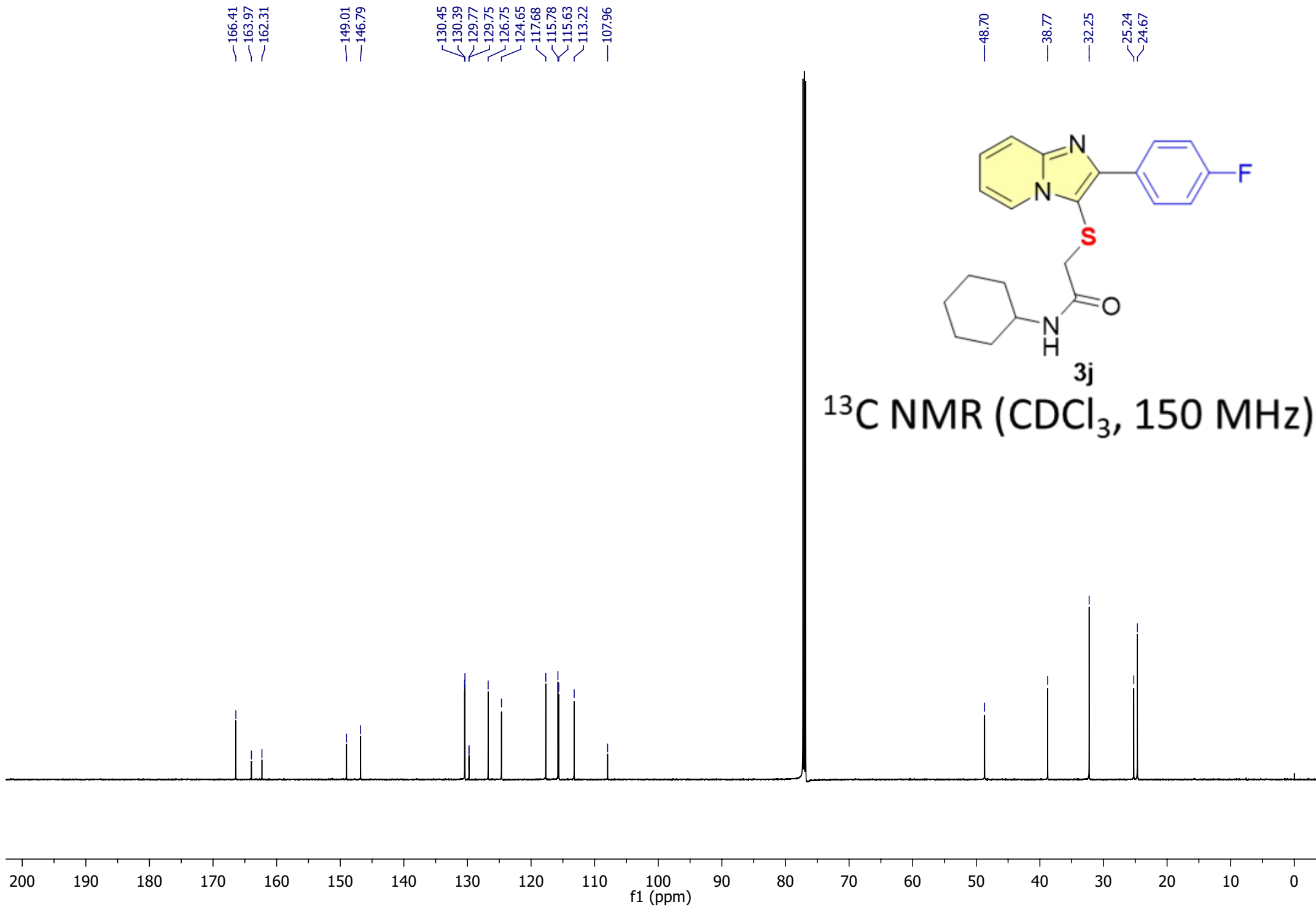
3.437
3.431
3.418
3.412
3.406
3.399
3.394
3.381
3.375
3.248

1.816
1.524
1.518
1.459
1.174
1.152
0.979
0.868
0.868
0.583
0.564
0.545



¹H NMR (CDCl₃, 600 MHz)



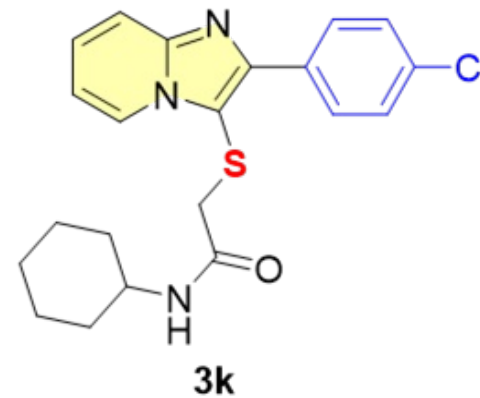


8.509
8.498
8.210
8.197
7.659
7.644
7.489
7.475
7.354
7.341
7.328
6.990
6.979
6.968

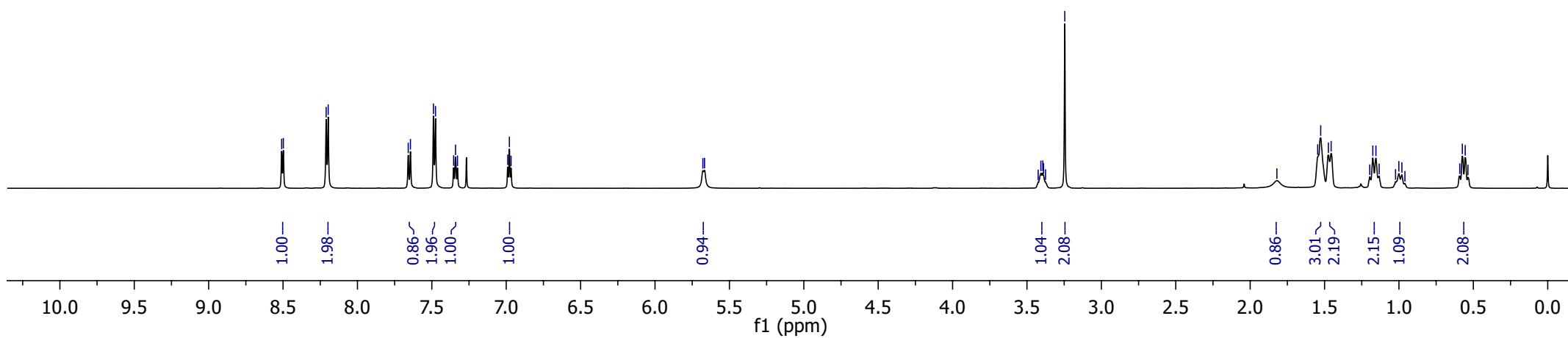
5.678
5.667

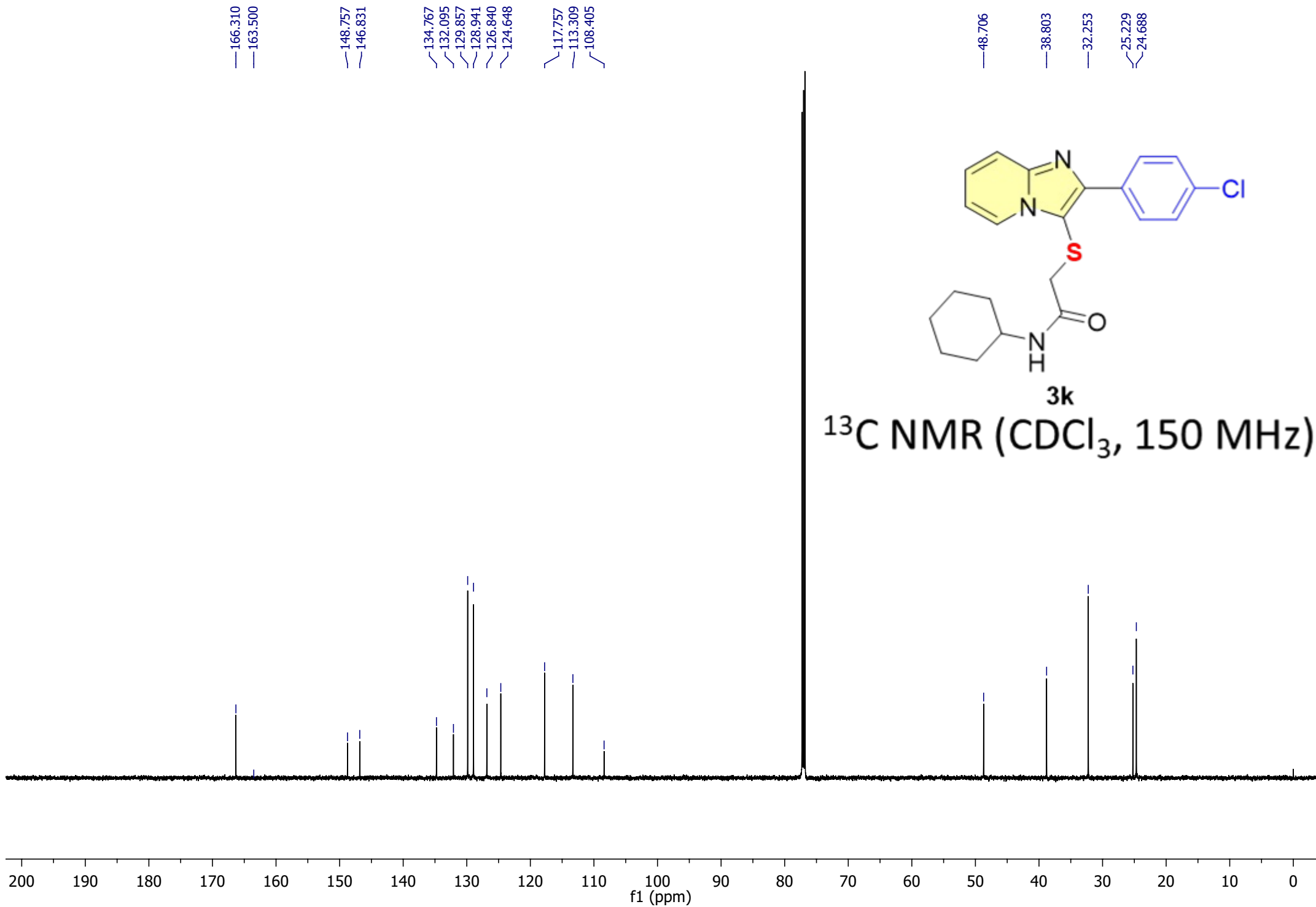
3.425
3.407
3.394
3.389
3.375
3.246

1.820
1.526
1.474
1.456
1.176
1.155
1.001
0.989
0.574
0.555
0.536



¹H NMR (CDCl₃, 600 MHz)





8.664
8.438
8.427
8.319
8.305
7.920
7.906
7.622
7.607
7.498
7.492
7.484
7.269
6.882
6.871

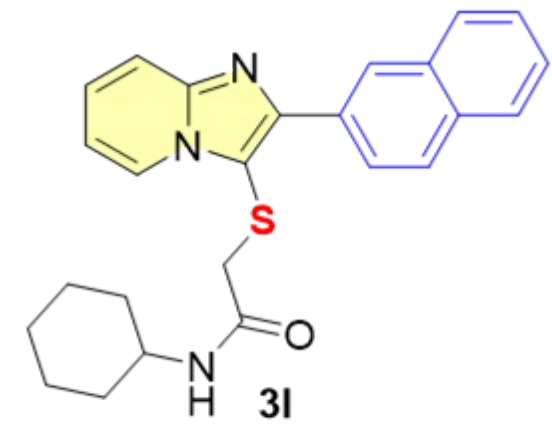
6.076
6.063

3.297
3.279
3.272
3.266
3.248
3.157

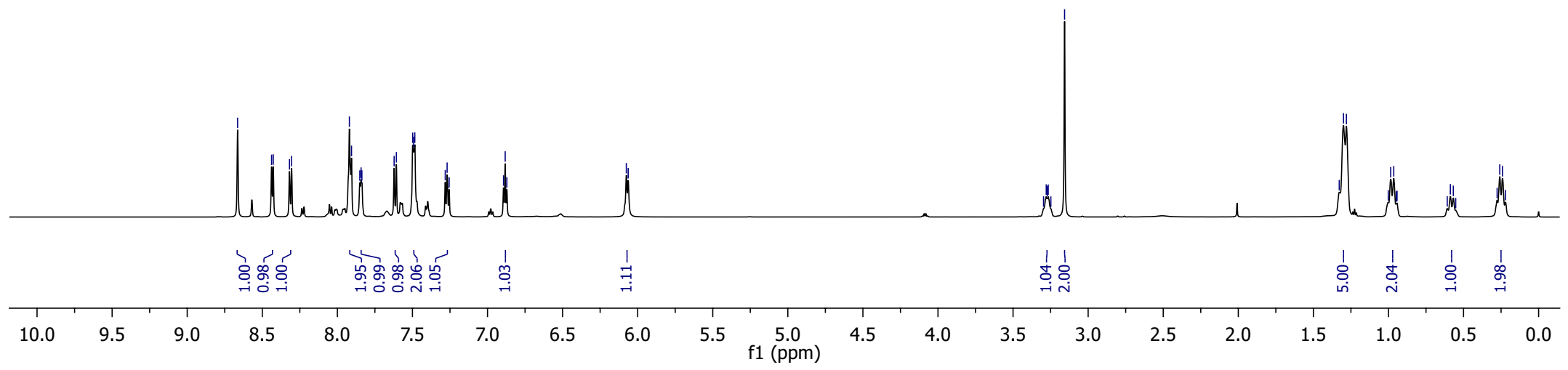
1.328
1.300
1.280

0.985
0.965

0.588
0.598
0.259
0.241
0.221



¹H NMR (CDCl₃, 600 MHz)



—166.49

—149.68

—146.79

133.33

130.95

128.54

128.25

127.91

127.62

126.62

126.59

126.38

126.11

117.56

—113.07

—108.73

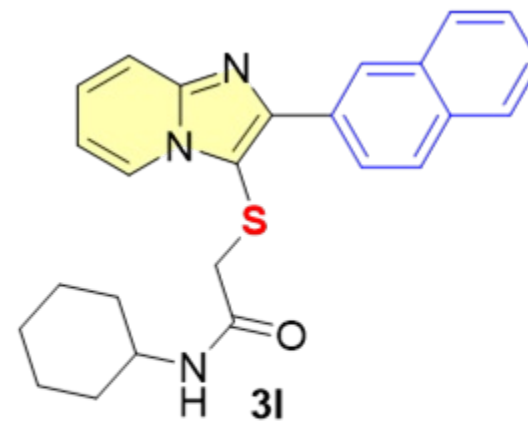
—48.53

—38.69

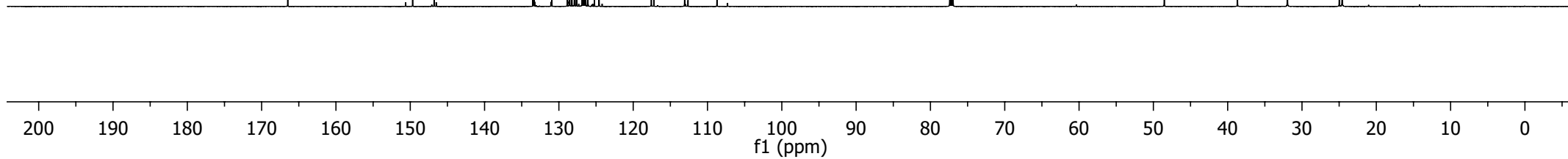
—31.96

24.98

24.59



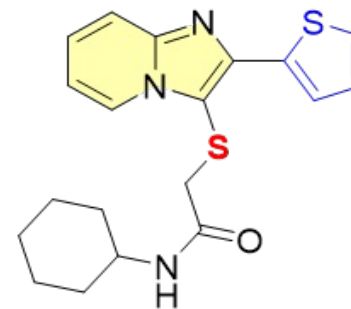
^{13}C NMR (CDCl_3 , 150 MHz)



8.497
8.495
8.493
8.484
8.482
8.480
8.049
8.044
7.634
7.616
7.444
7.442
7.434
7.431
7.338
7.336
7.325
7.322
7.320
7.318
7.307
7.304
7.201
7.194
7.191
7.184
6.969
6.967
6.956
6.954
6.942
6.940

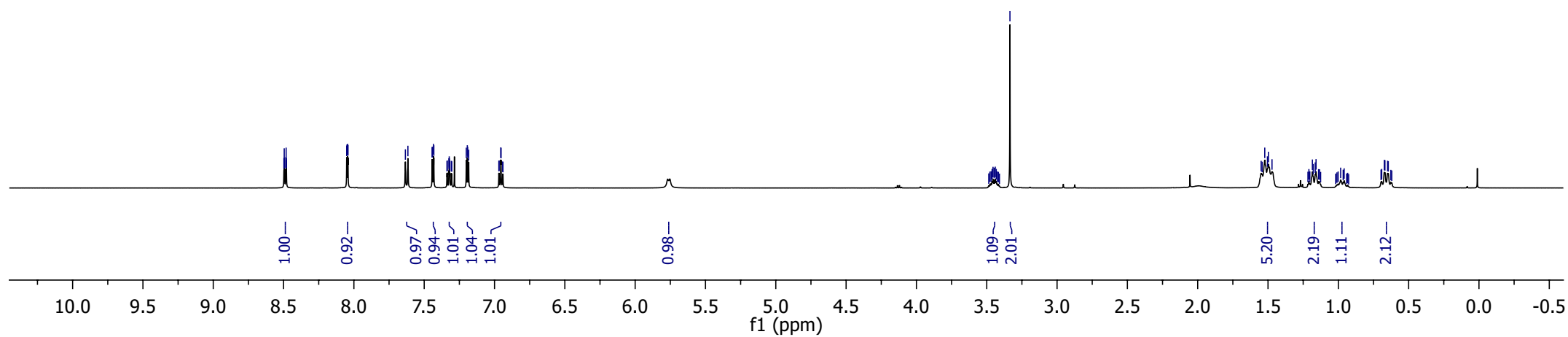
3.486
3.477
3.469
3.462
3.455
3.447
3.439
3.432
3.425
3.417
3.410
3.335

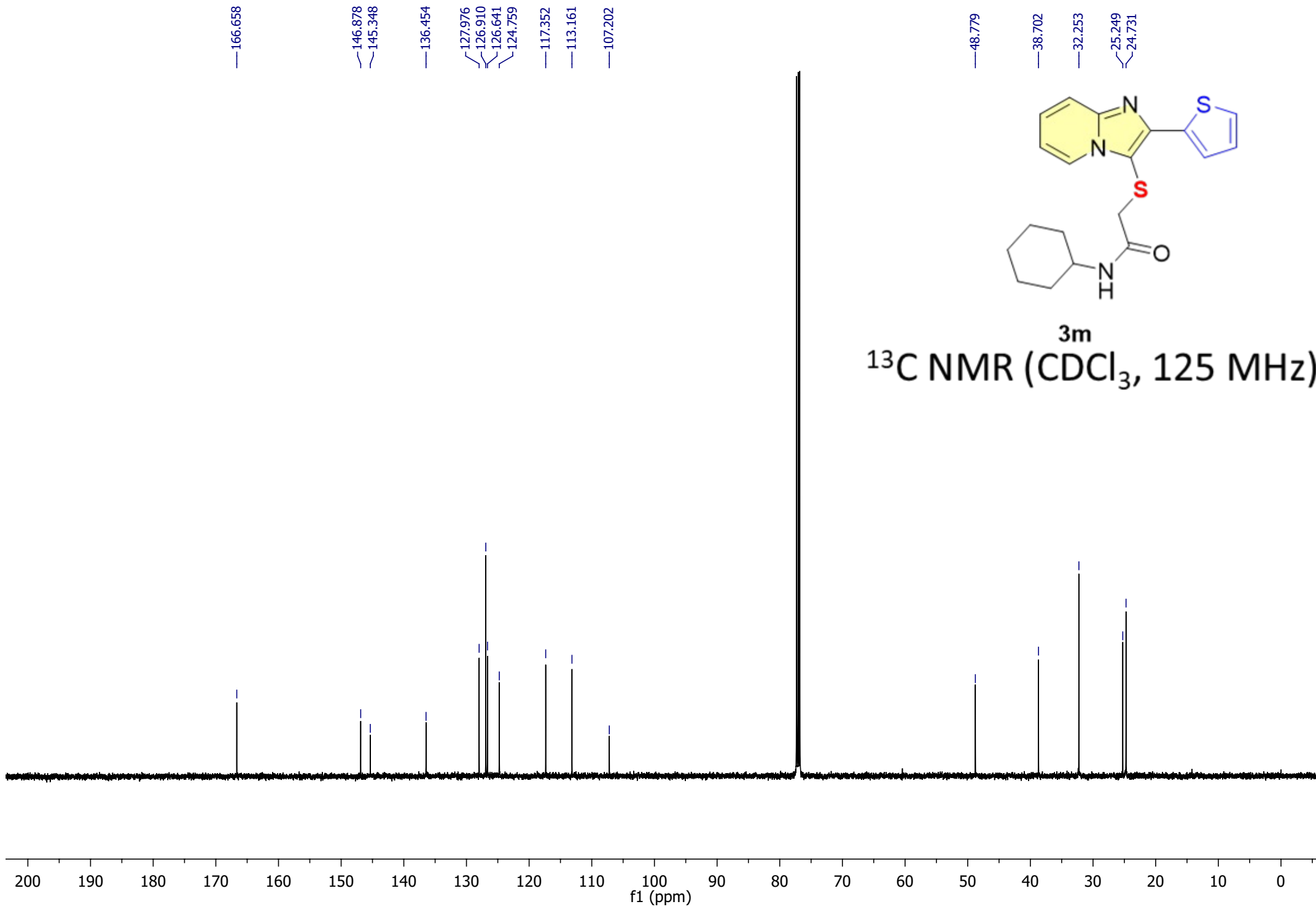
1.549
1.542
1.523
1.504
1.497
1.472
1.209
1.184
1.178
1.164
1.158
1.140
1.133
0.983
0.965
0.959
0.696
0.692
0.673
0.669
0.650
0.645
0.627
0.620

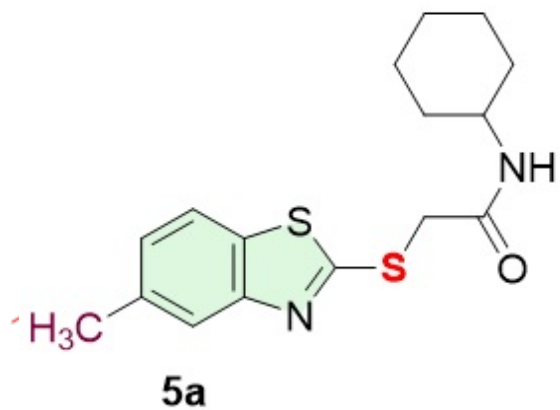


3m

¹H NMR (CDCl₃, 500 MHz)





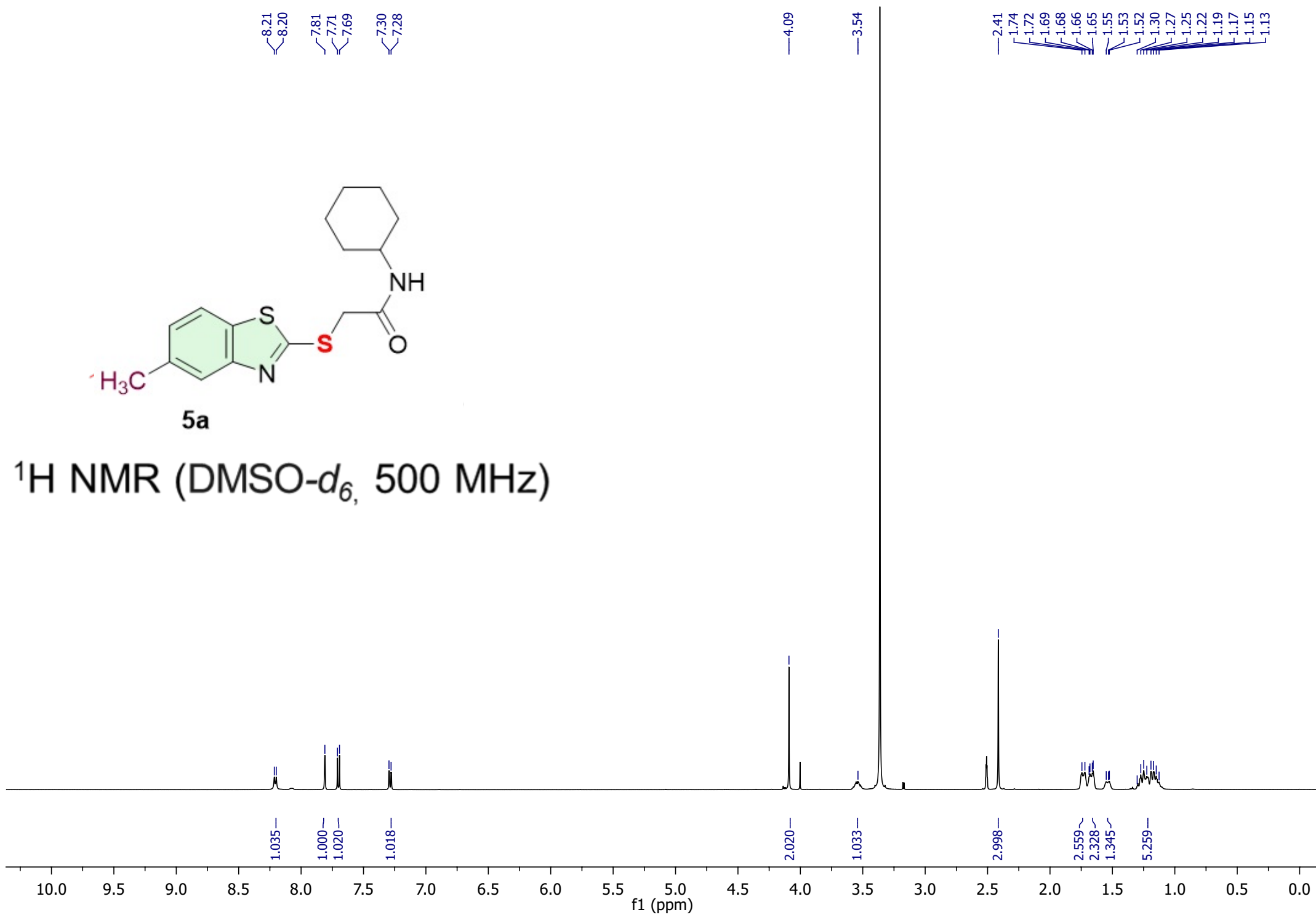


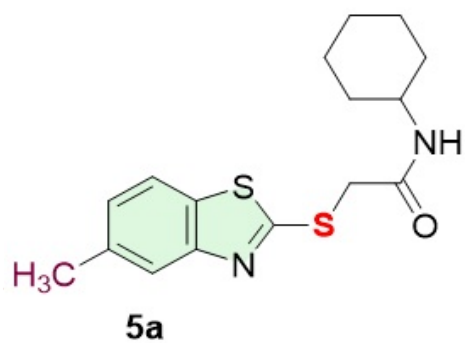
8.21
8.20
7.81
7.71
7.69
7.30
7.28

4.09
3.54

2.41
1.74
1.72
1.69
1.68
1.66
1.65
1.55
1.53
1.52
1.30
1.27
1.25
1.22
1.19
1.17
1.15
1.13

¹H NMR (DMSO-*d*₆, 500 MHz)





165.68
165.36

151.19

135.33
134.61

128.18

121.90
121.05

48.45

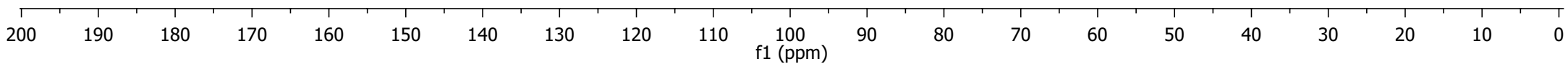
37.30

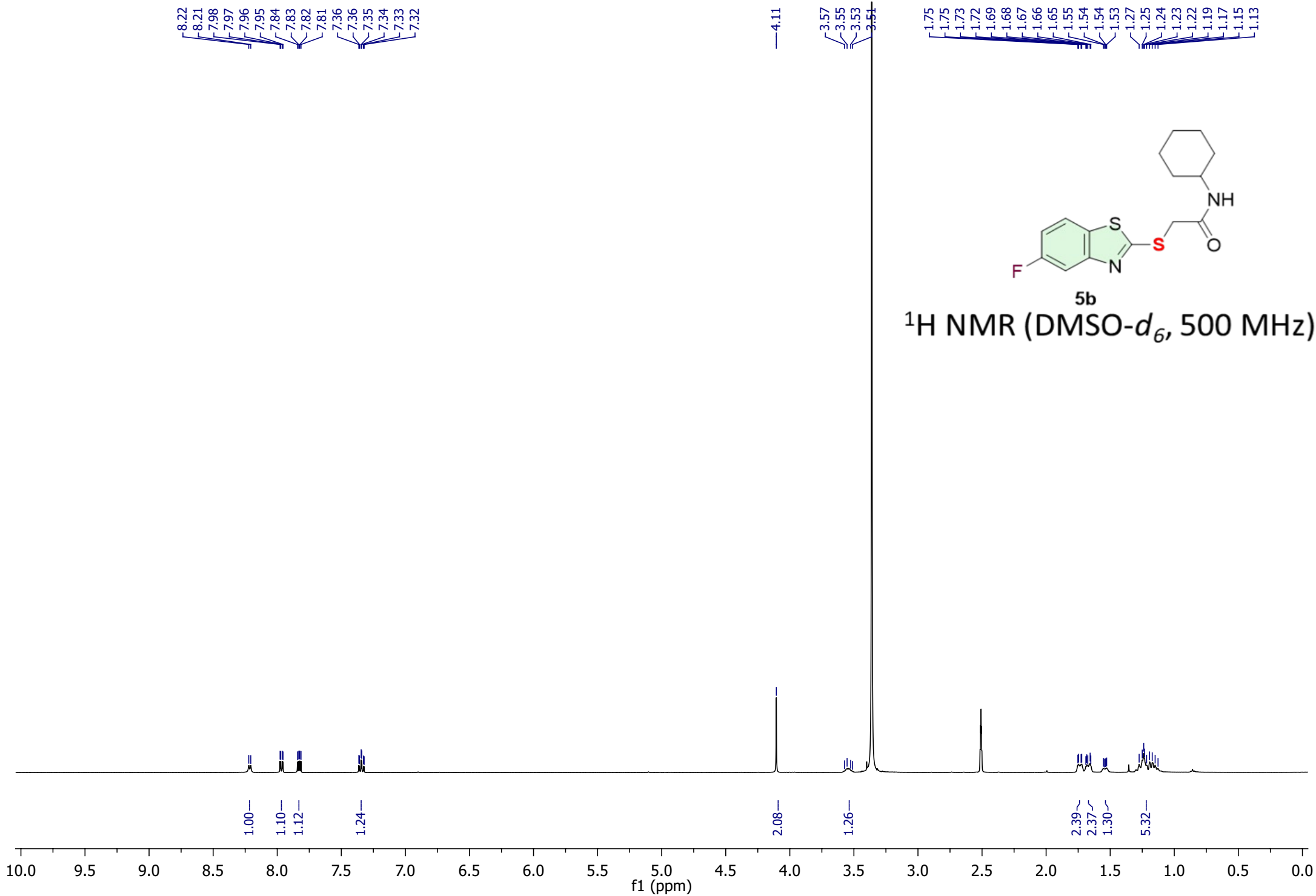
32.66

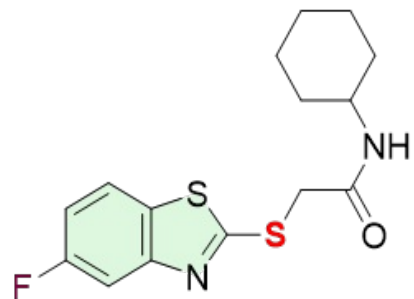
25.62
24.82

21.40

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

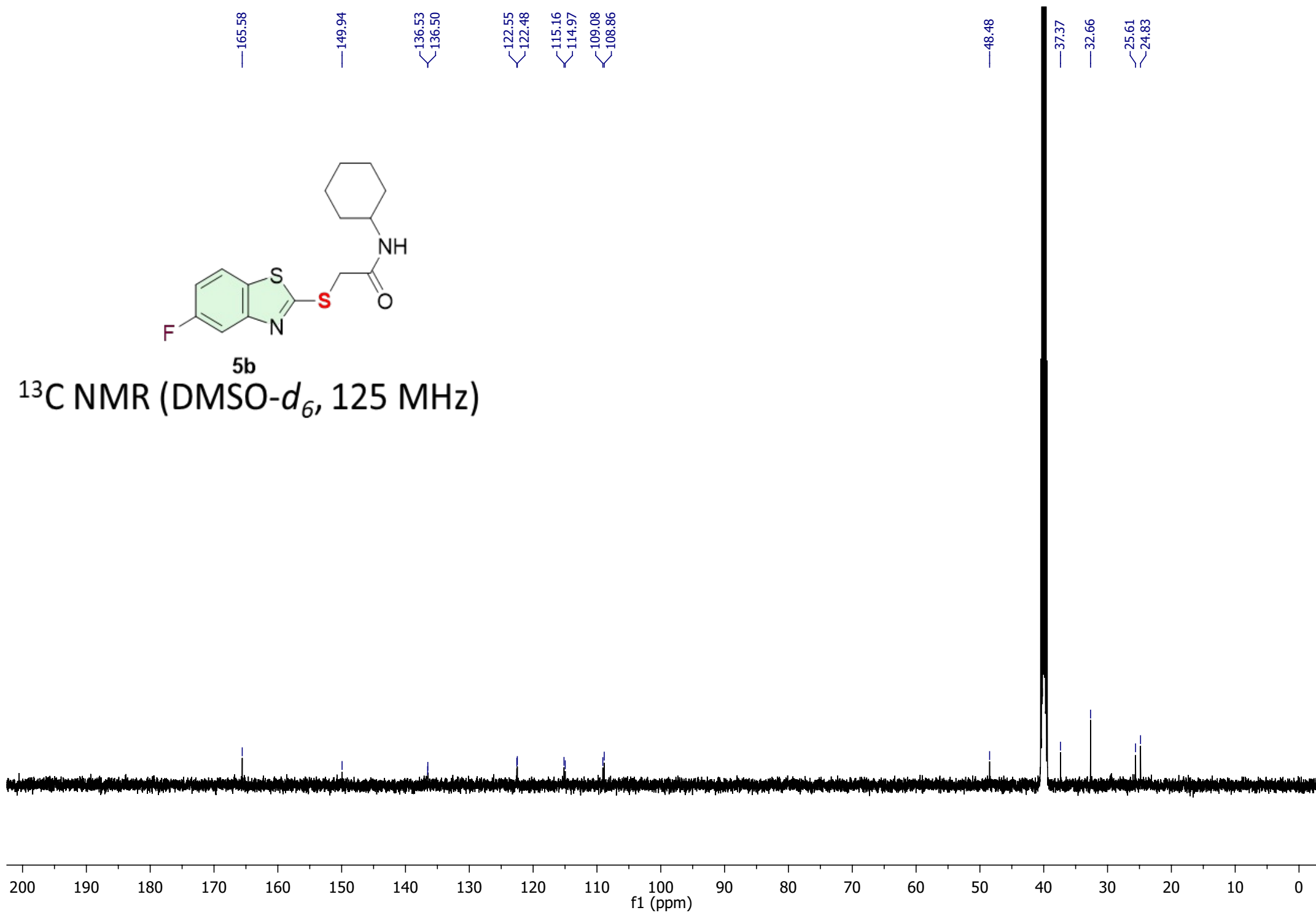


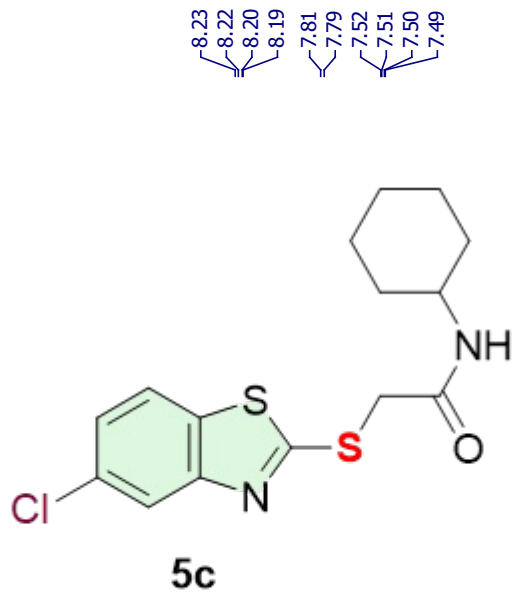




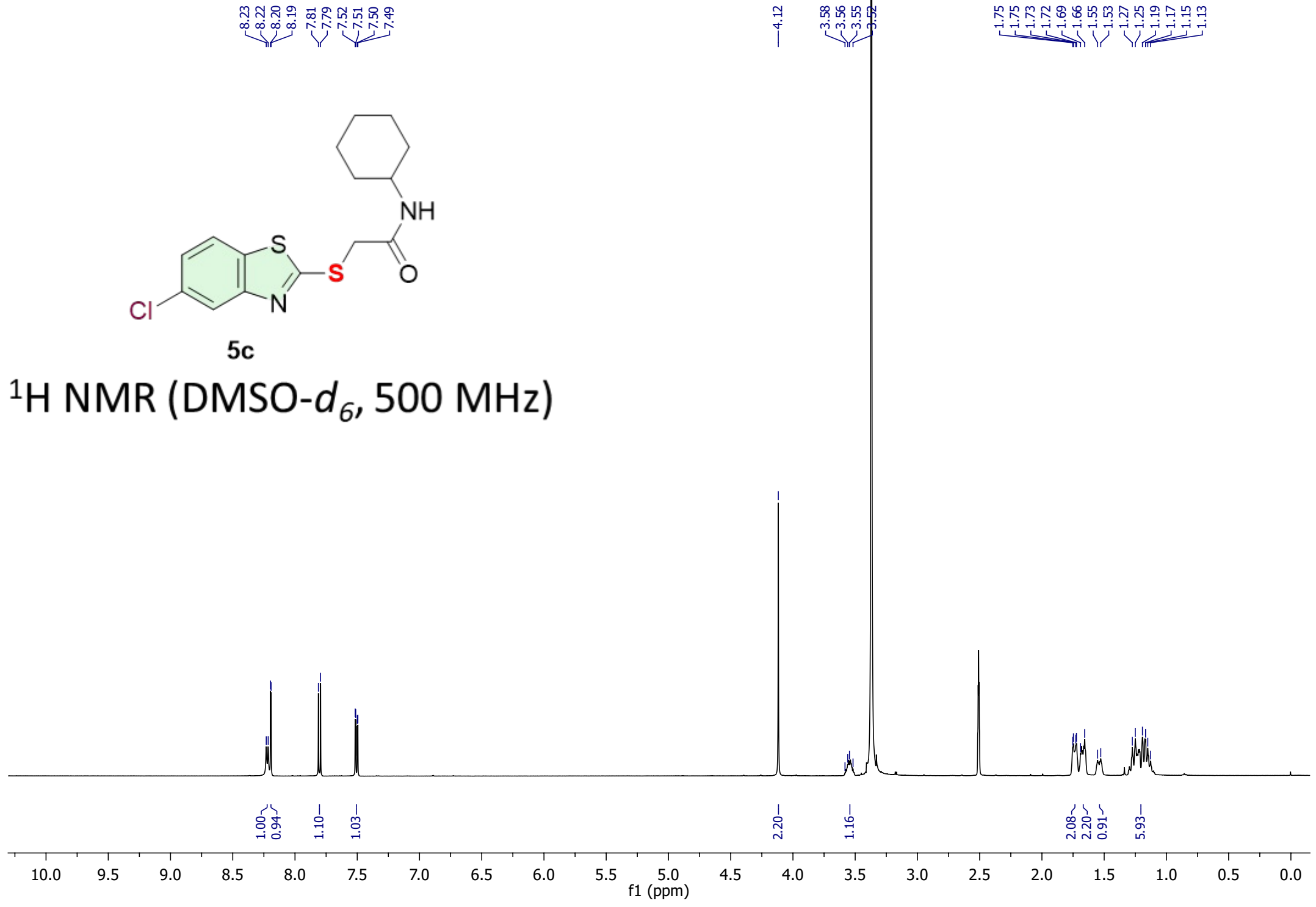
5b

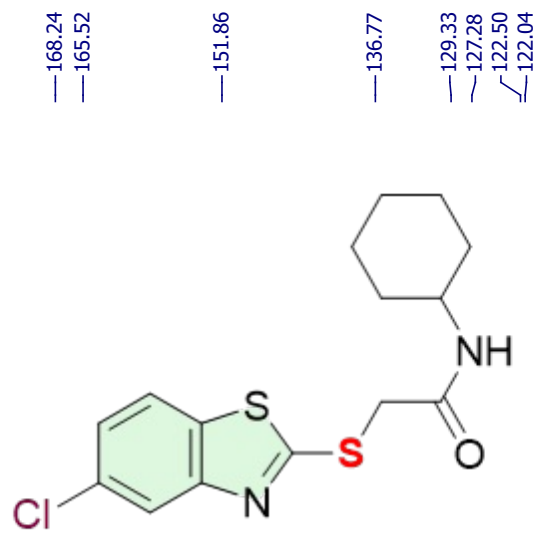
^{13}C NMR (DMSO- d_6 , 125 MHz)





¹H NMR (DMSO-*d*₆, 500 MHz)

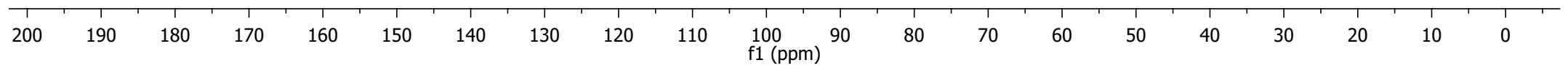




5c

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

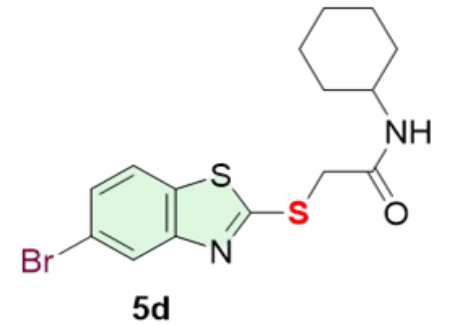
- 168.24
- 165.52
- 151.86
- 136.77
- 129.33
- 127.28
- 122.50
- 122.04
- 48.50
- 37.38
- 32.66
- 25.61
- 24.83



8.323
8.319
8.235
8.219
7.751
7.734
7.632
7.628
7.615
7.611

4.112
3.571
3.562
3.556
3.550
3.542
3.534
3.529
3.522
3.514
3.508

1.749
1.743
1.733
1.724
1.719
1.687
1.680
1.672
1.662
1.654
1.647
1.247
1.222
1.215
1.190
1.170
1.165
1.147
1.124



¹H NMR (DMSO-*d*₆, 500 MHz)

0.99

1.07

1.00

1.05

1.69

0.90

1.67

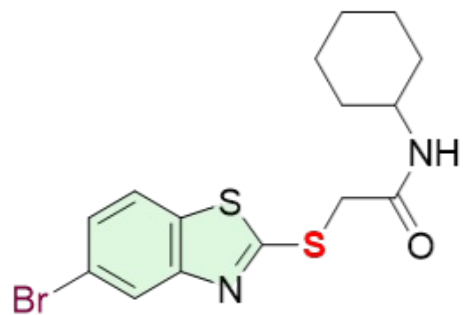
1.53

0.93

4.64

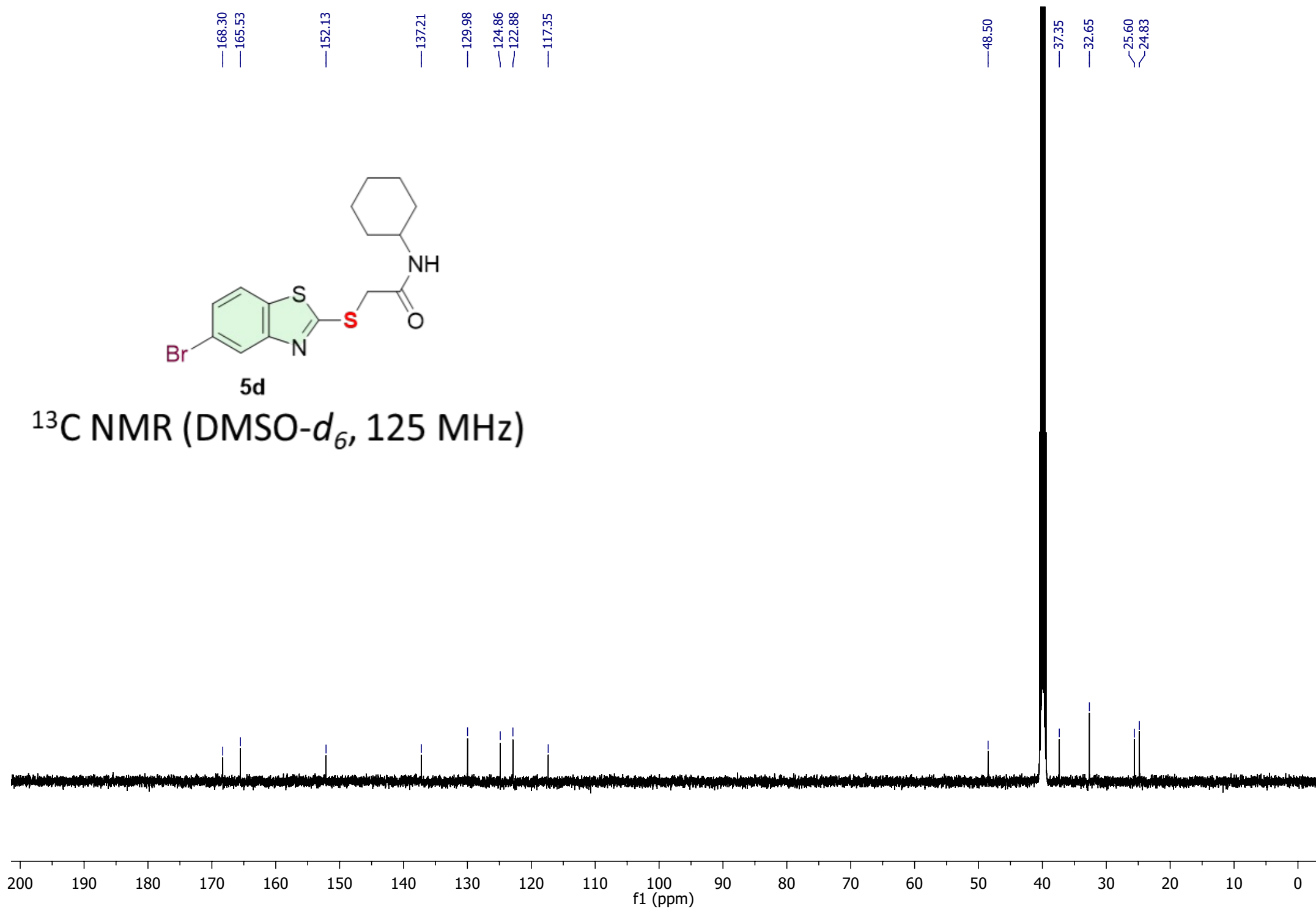
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

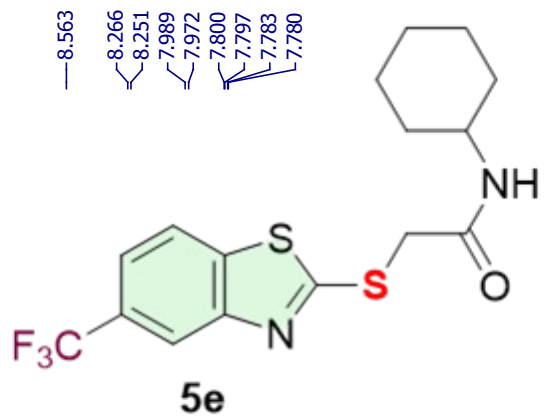
f1 (ppm)



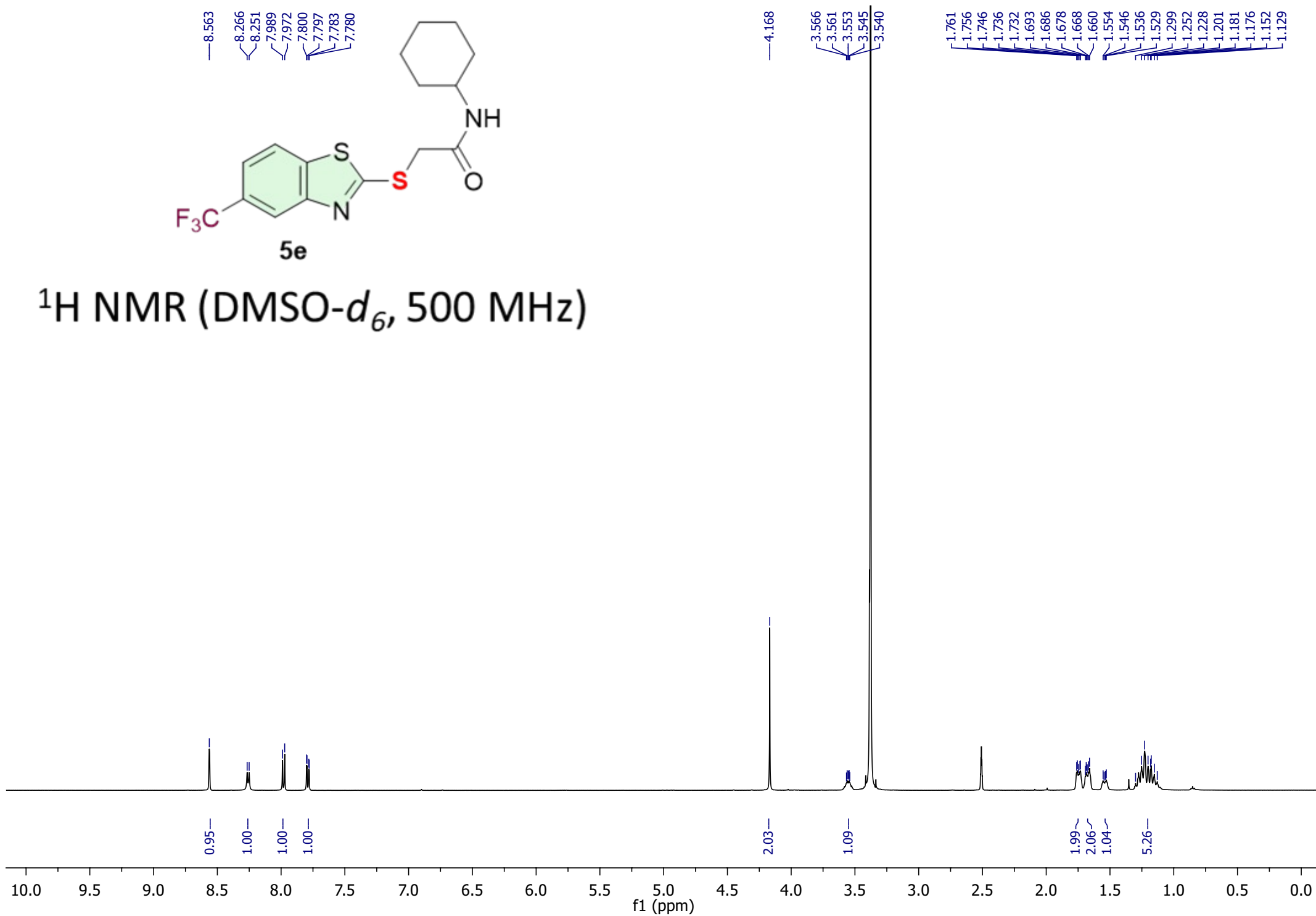
5d

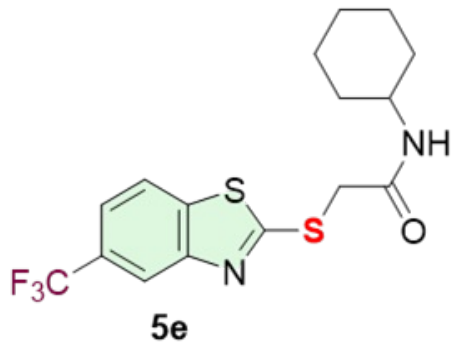
^{13}C NMR (DMSO- d_6 , 125 MHz)



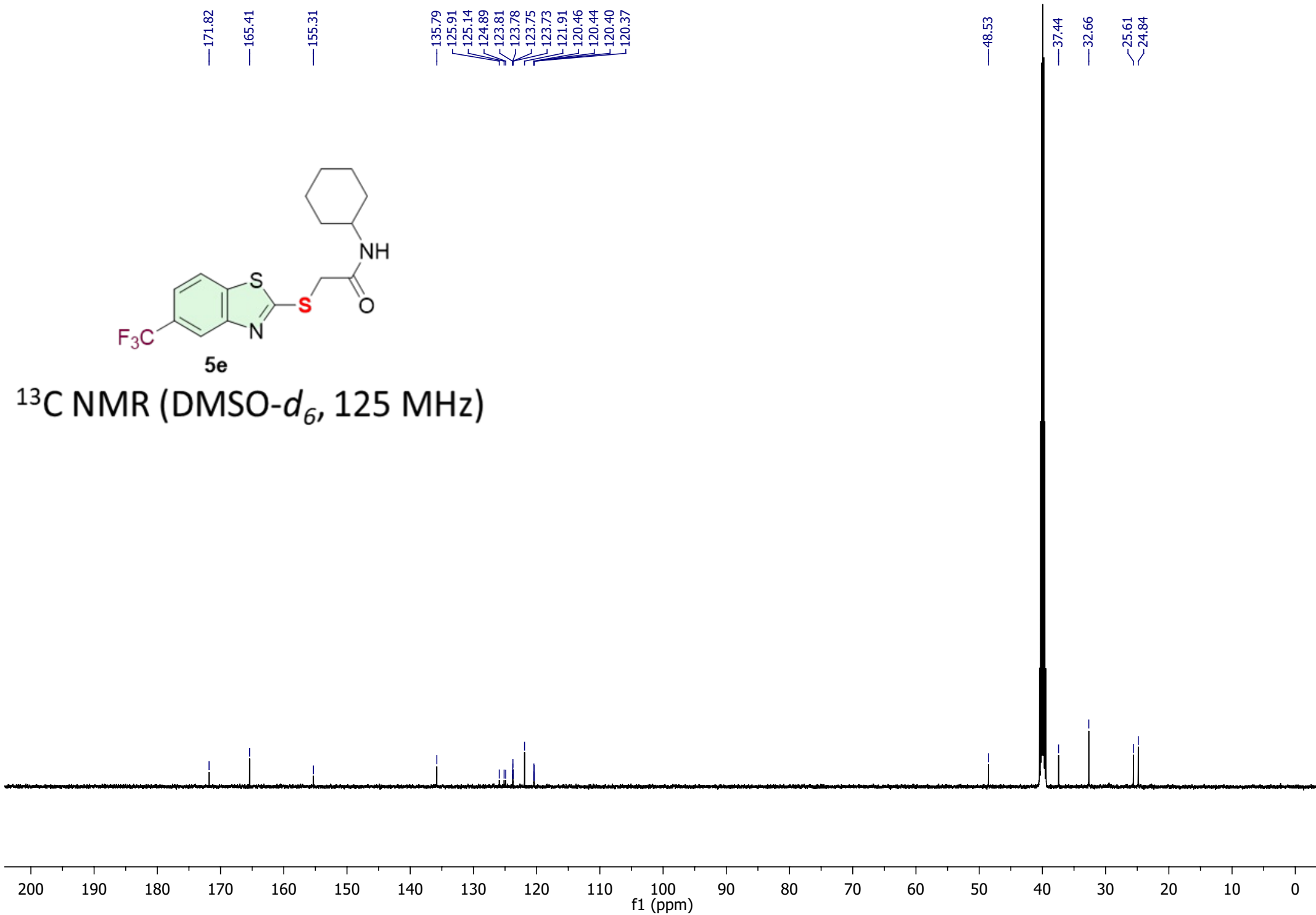


^1H NMR (DMSO- d_6 , 500 MHz)





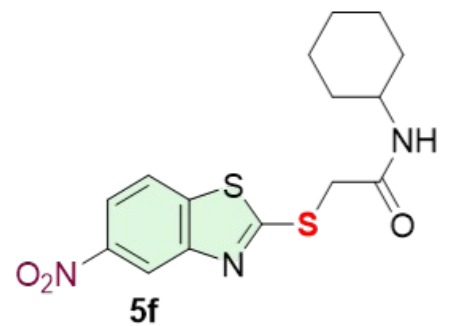
^{13}C NMR (DMSO- d_6 , 125 MHz)



9.110
9.106
8.321
8.316
8.303
8.298
8.289
8.274
7.976
7.959

4.196
3.584
3.569
3.563
3.556
3.548
3.543
3.536
3.527

1.761
1.751
1.737
1.698
1.691
1.684
1.673
1.665
1.559
1.551
1.534
1.279
1.256
1.231
1.206
1.180
1.157
1.134



¹H NMR (DMSO-d₆, 500 MHz)

0.67

1.64

1.00

2.00

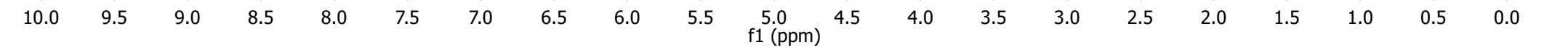
1.09

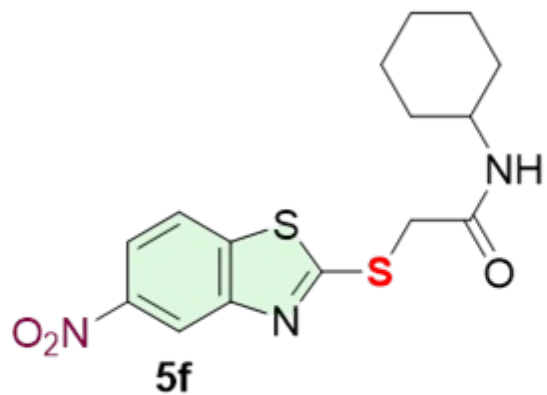
2.00

2.05

1.07

5.55





—175.04

—165.27

—156.93

—144.04

—135.97

—122.51

—121.51

—119.37

—48.56

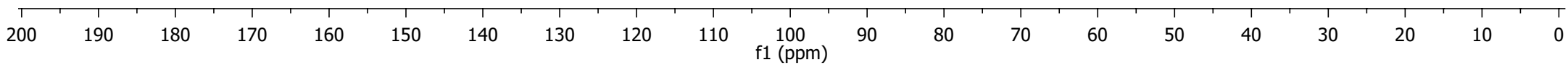
—37.56

—32.67

—25.61

—24.84

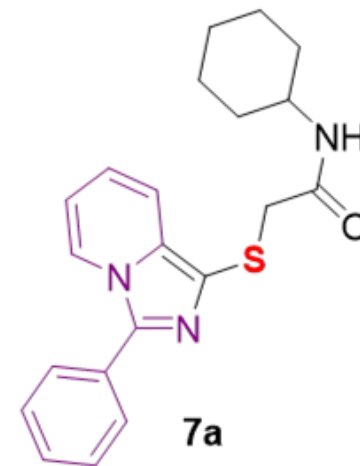
^{13}C NMR (DMSO- d_6 , 125 MHz)



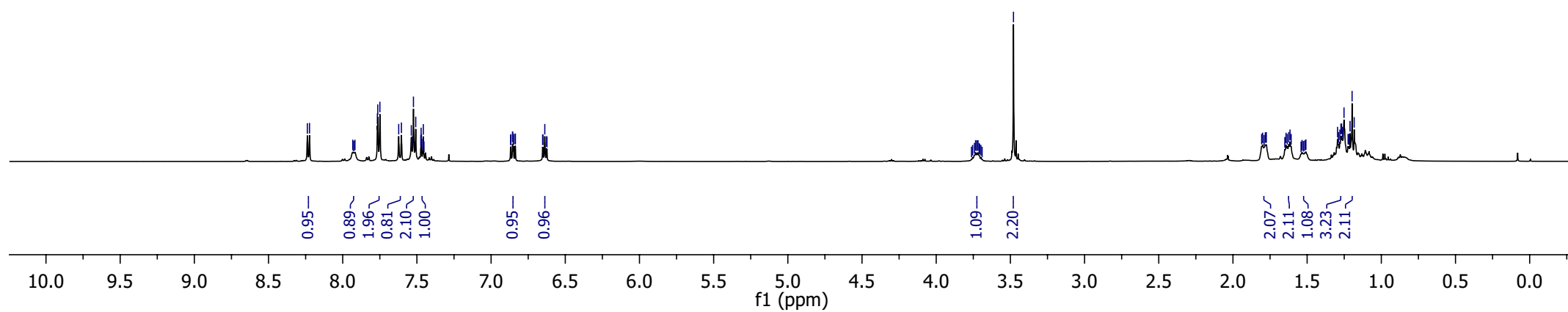
8.238
8.224
7.767
7.764
7.750
7.623
7.604
7.523
7.508
6.867
6.856
6.855
6.850
6.849
6.837
6.836
6.653
6.651
6.638
6.626
6.623

3.762
3.754
3.742
3.734
3.726
3.718
3.711
3.707
3.698
3.691
3.479

1.806
1.800
1.790
1.782
1.775
1.650
1.642
1.634
1.624
1.615
1.608
1.534
1.508
1.295
1.289
1.280
1.272
1.268
1.261
1.251
1.224
1.218
1.211
1.197
1.183



¹H NMR (CDCl₃, 500 MHz)



—168.695

—138.548
—133.210
—129.568
—129.204
—129.029
—127.976
—122.007
—121.869
—120.687
—118.333
—113.984

—65.831

—48.413

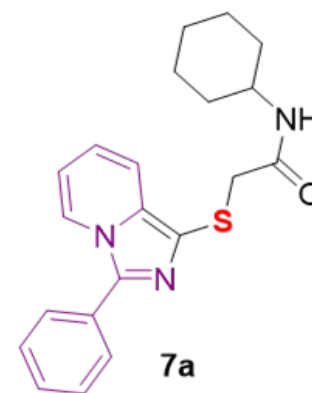
—40.206

—32.637

—25.616

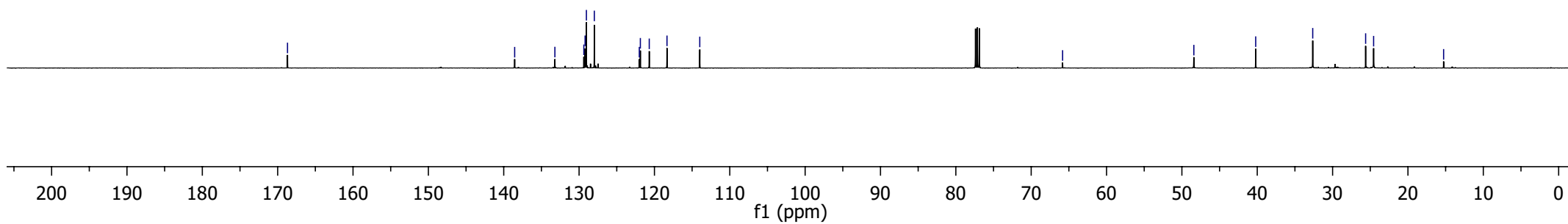
—24.556

—15.267

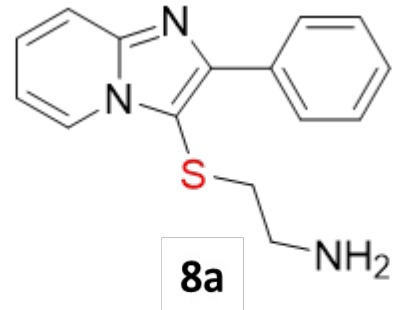


7a

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



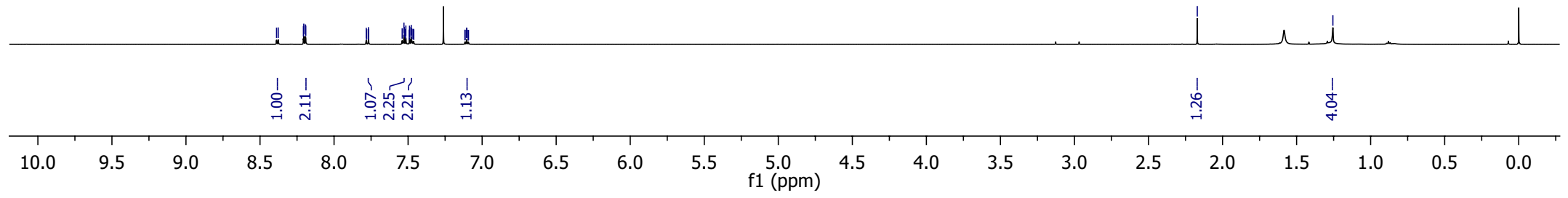
8.388
8.377
8.207
8.204
8.193
8.191
7.528
7.526
7.515
7.490
7.479
7.477
7.115
7.105
7.104
7.094
7.092

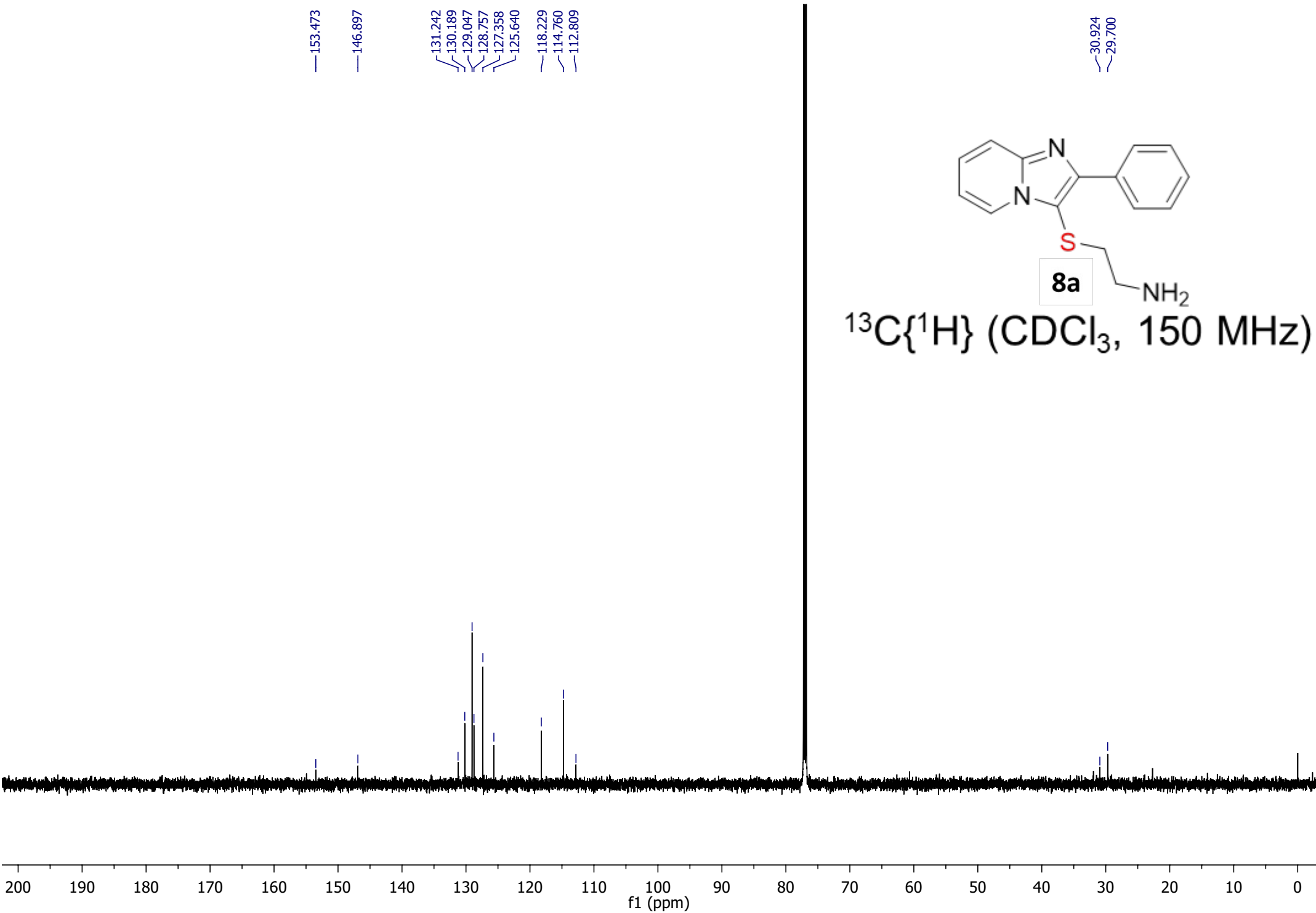


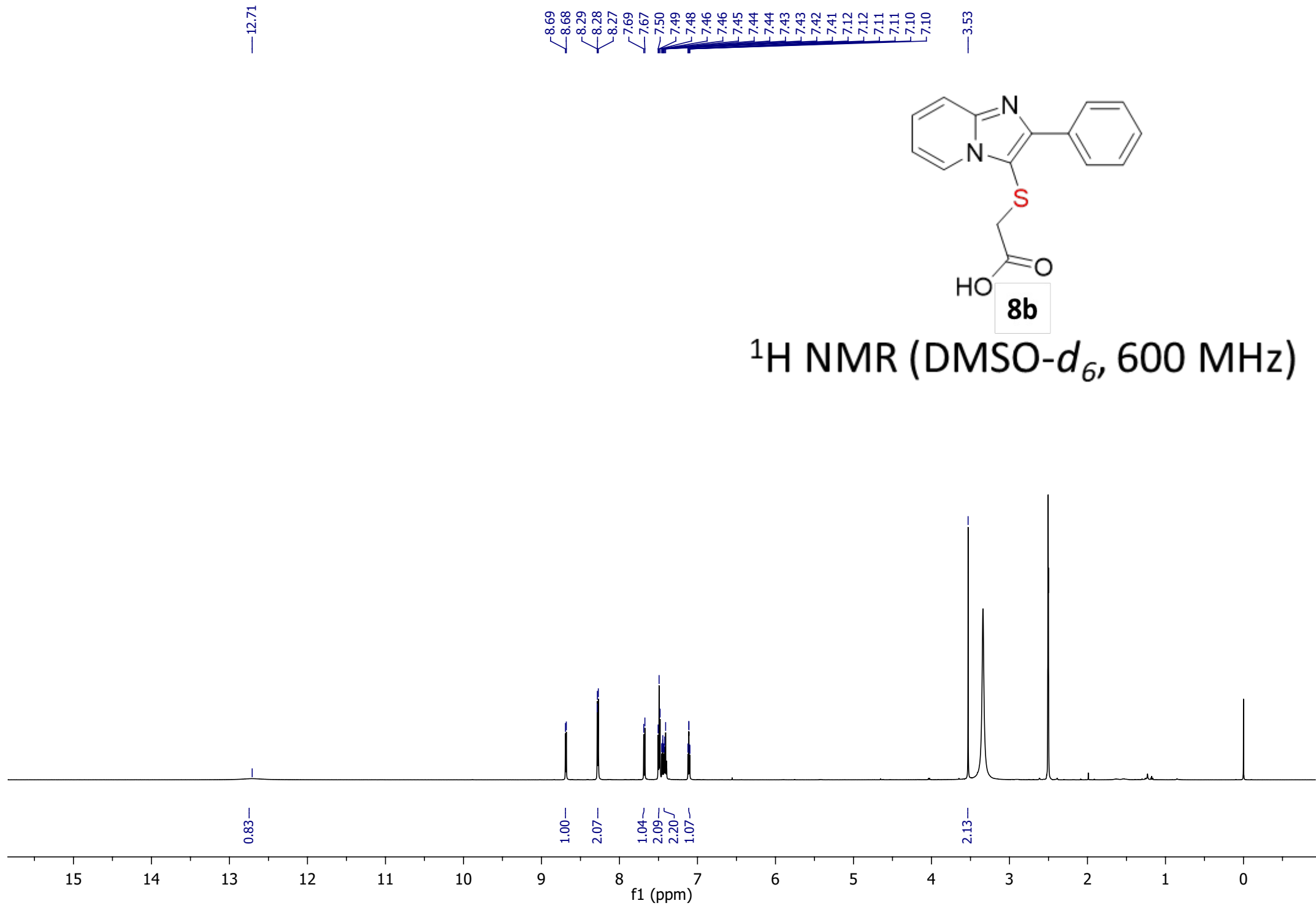
2.171

1.255

¹H NMR (CDCl₃, 600 MHz)







—170.88

—149.10

—146.43

—134.02

—128.82

—128.76

—128.35

—127.41

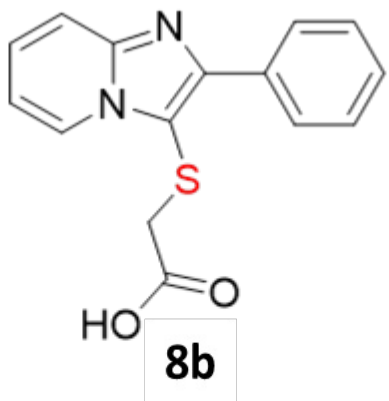
—125.79

—117.43

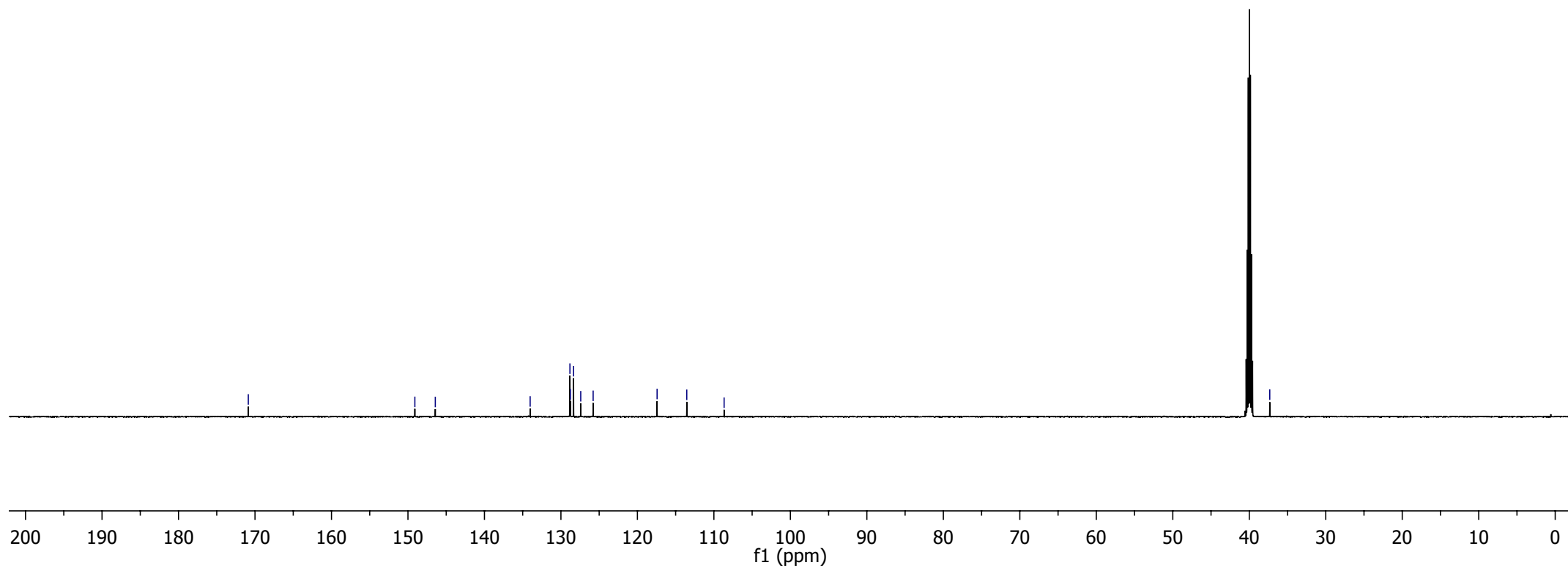
—113.55

—108.66

—37.32



$^{13}\text{C}\{^1\text{H}\}$ (DMSO- d_6 , 150 MHz)

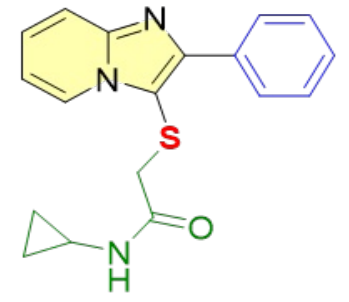


9.153
9.141
8.831
8.828
8.817
8.329
8.314
8.189
8.177
8.164
8.119
8.106
8.021
8.019
8.010
8.007
8.004
7.995
7.993
6.788

3.890

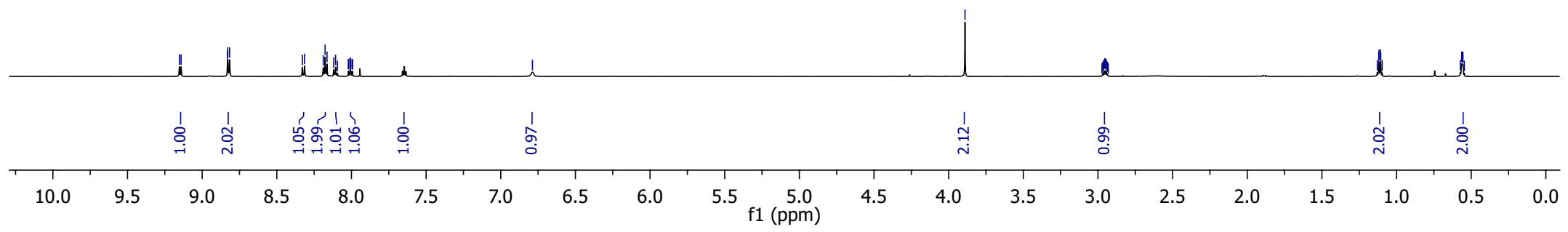
2.973
2.967
2.961
2.955
2.949
2.943
2.937
2.931

1.129
1.120
1.117
1.108
1.106
1.096
0.573
0.564
0.562
0.558
0.555
0.546

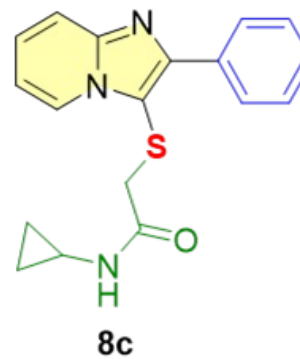


8c

¹H NMR (CDCl₃, 600 MHz)

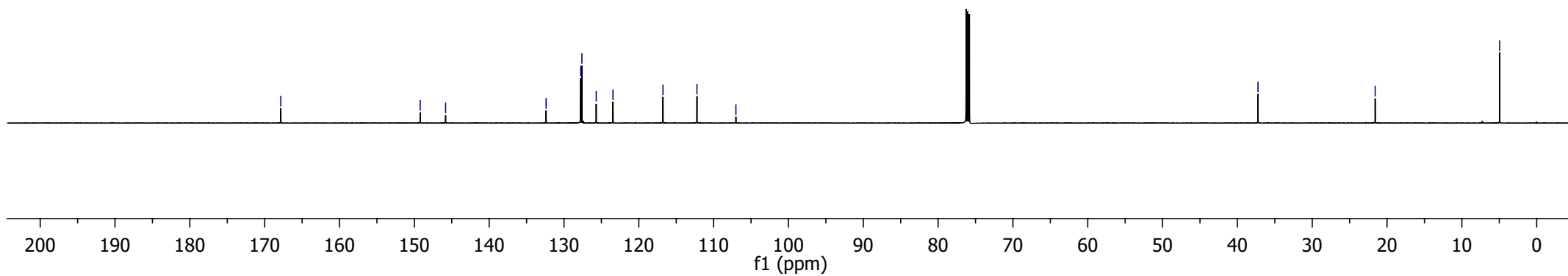


—167.84
—149.22
—145.82
—132.39
—127.76
—127.61
—125.69
—123.45
—116.77
—112.23
—107.02



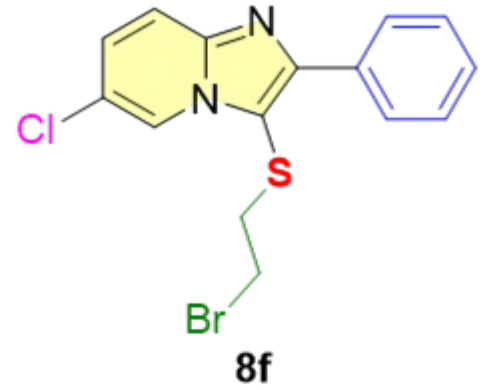
—37.25
—21.59
—4.95

^{13}C NMR (CDCl_3 , 150 MHz)

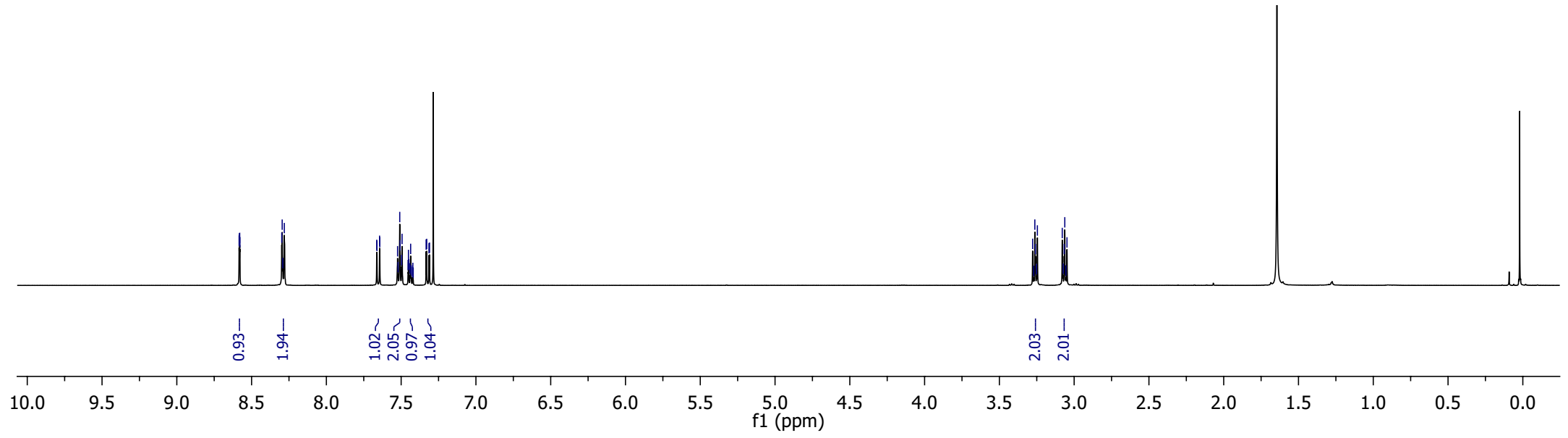


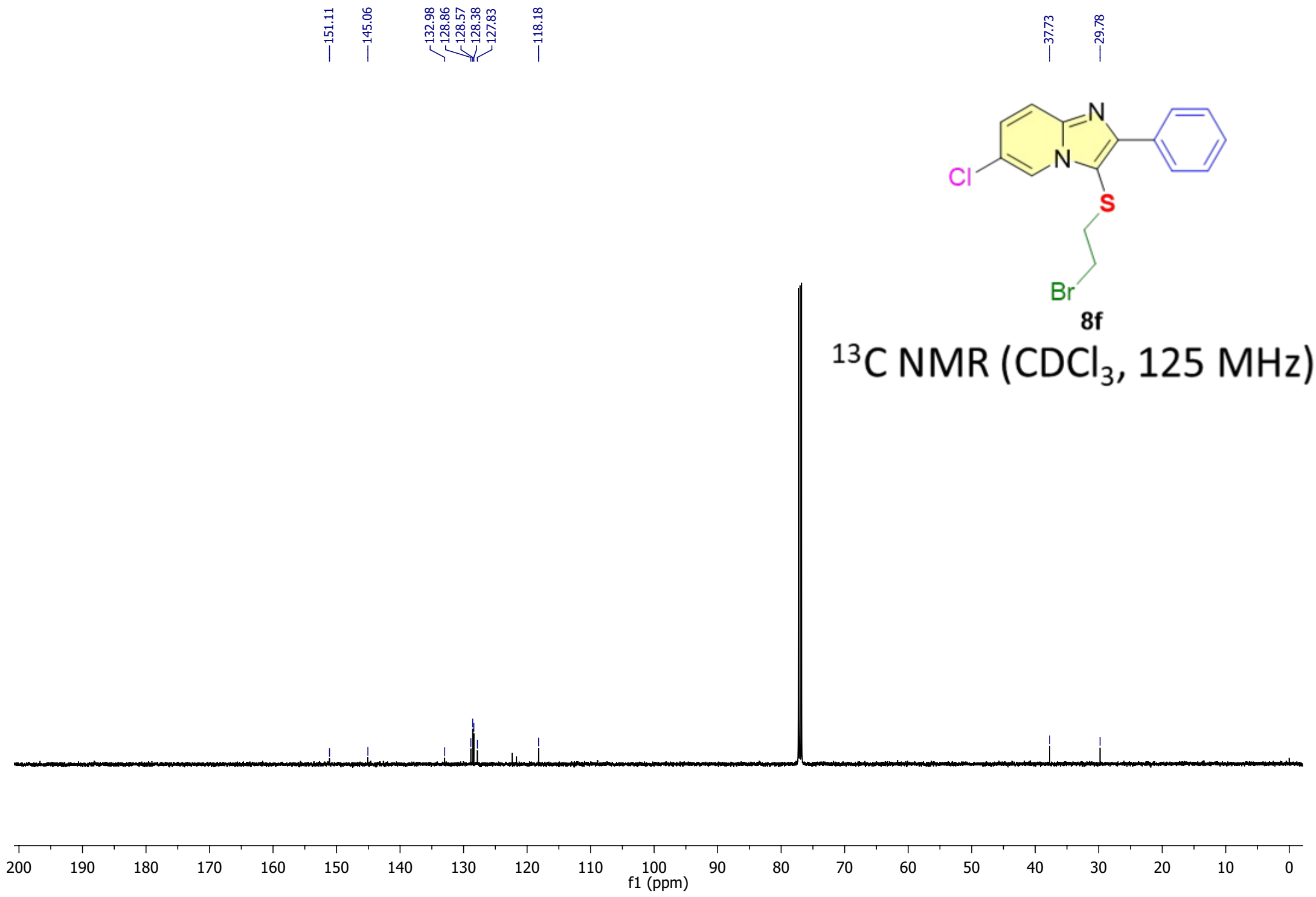
8.58
8.58
8.58
8.58
8.30
8.30
7.68
7.66
7.64
7.64
7.52
7.52
7.51
7.51
7.50
7.49
7.45
7.45
7.45
7.44
7.44
7.43
7.42
7.42
7.42
7.33
7.33
7.31
7.31

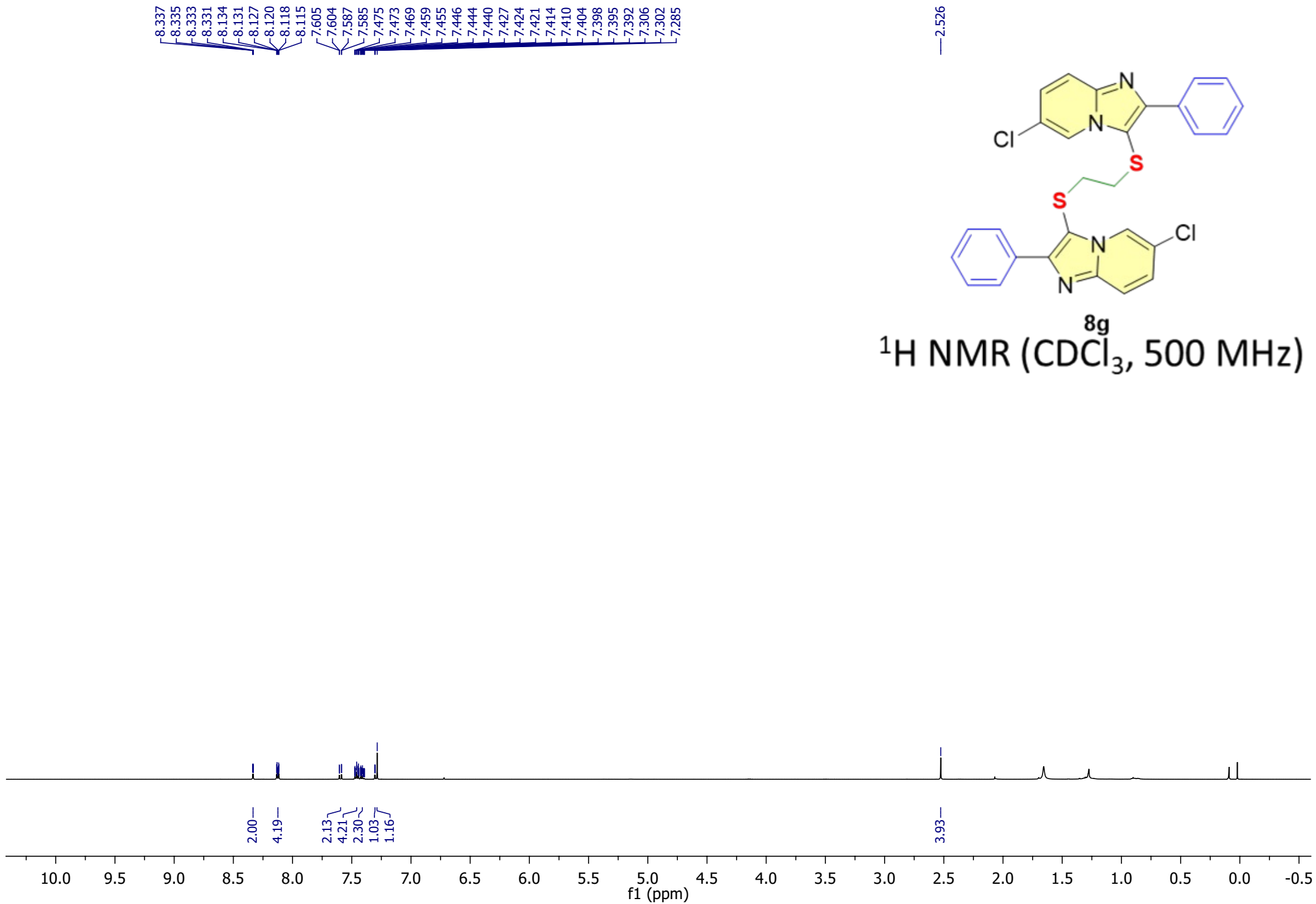
3.28
3.27
3.26
3.26
3.25
3.25
3.08
3.07
3.07
3.06
3.05
3.05

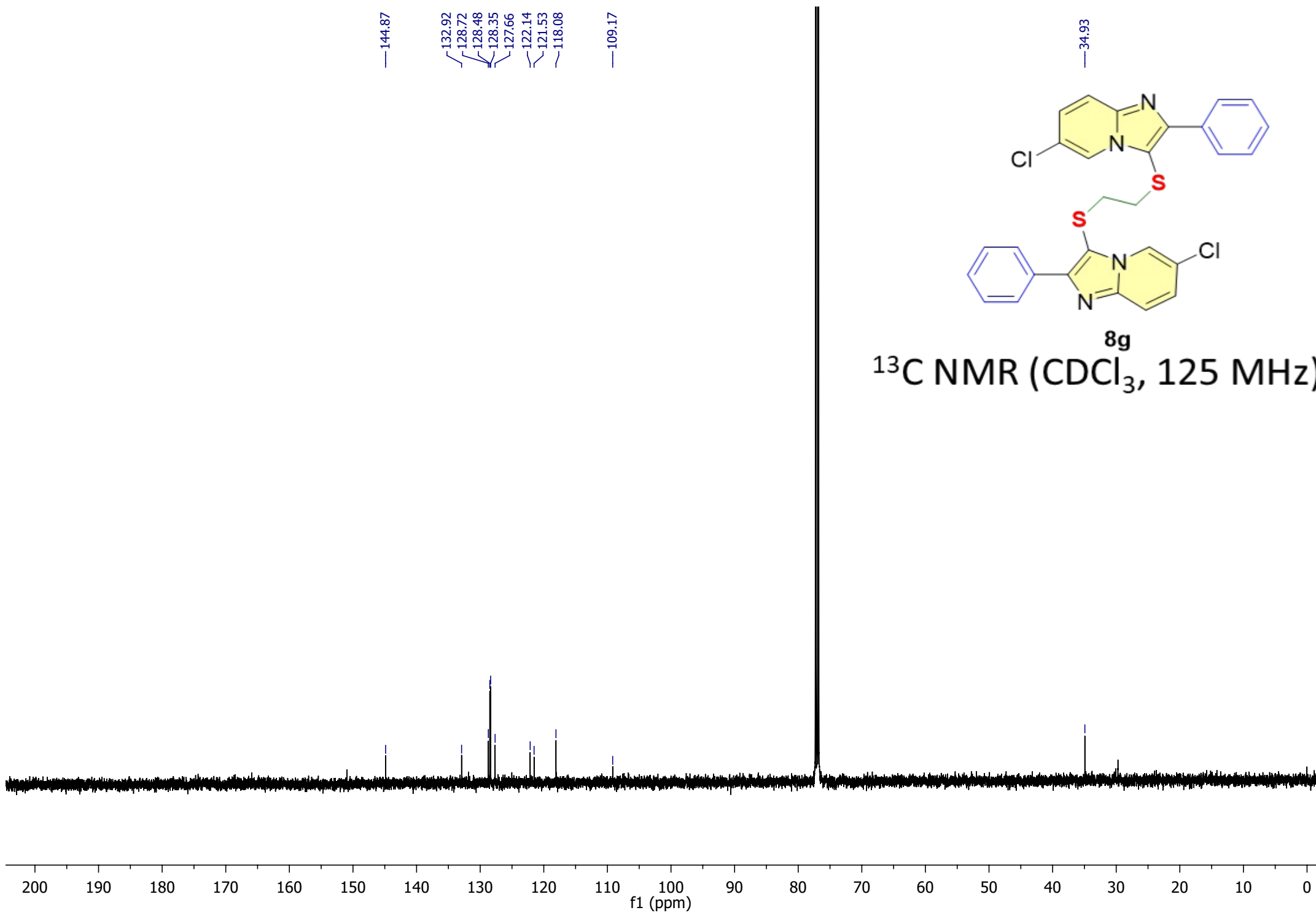


¹H NMR (CDCl₃, 500 MHz)





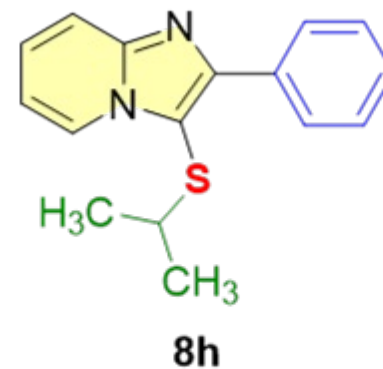




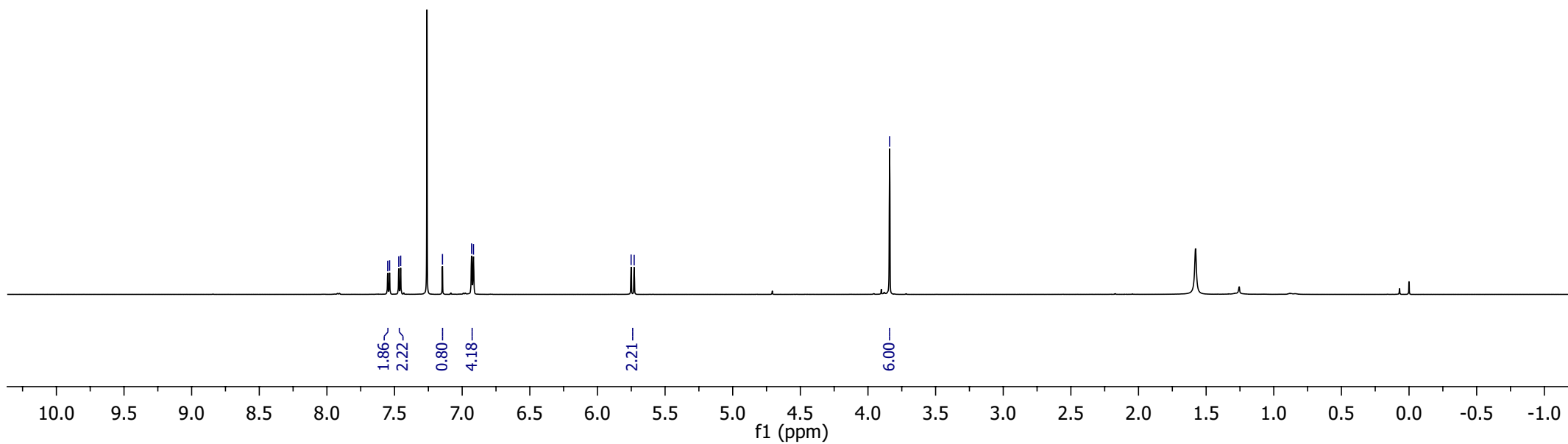
7.551
7.537
7.469
7.455
7.146
6.931
6.917

5.751
5.729

3.840



^1H NMR (CDCl_3 , 600 MHz)



—160.93
—159.12

—142.60

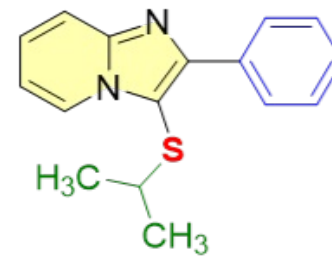
—134.40

—128.61
—127.96
—127.36
—126.84

—122.90

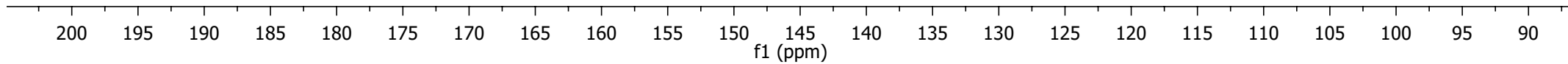
—117.31
—114.31
—114.25

—110.07

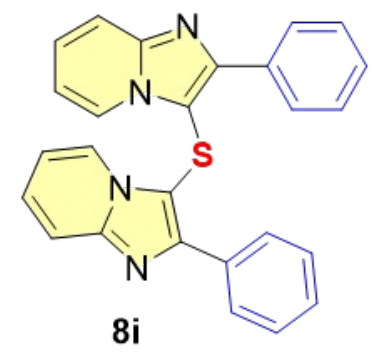


8h

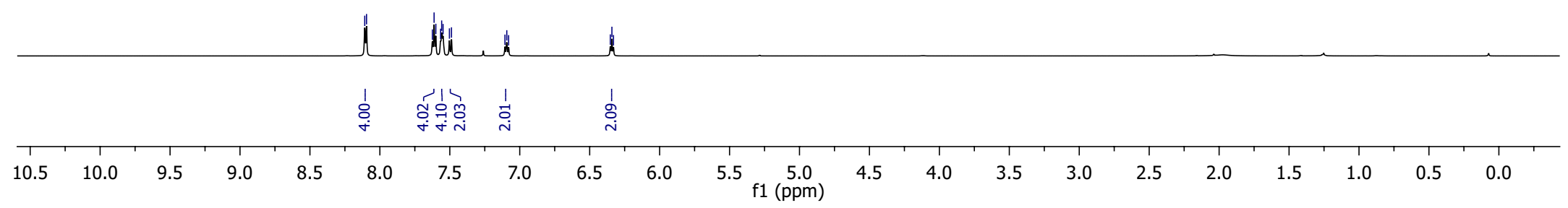
$^{13}\text{C}\{^1\text{H}\}$ (CDCl_3 , 150 MHz)



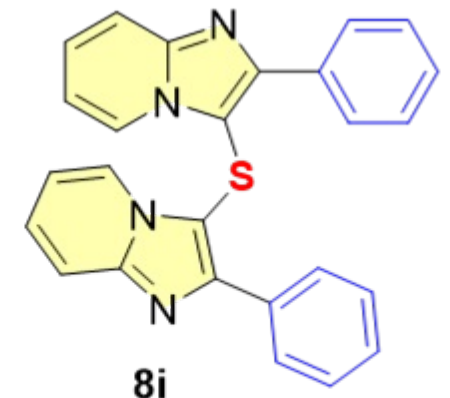
8.108
8.095
7.612
7.600
7.558
7.548
7.488
7.106
7.093
7.080
6.352
6.341
6.330



¹H NMR (CDCl₃, 600 MHz)

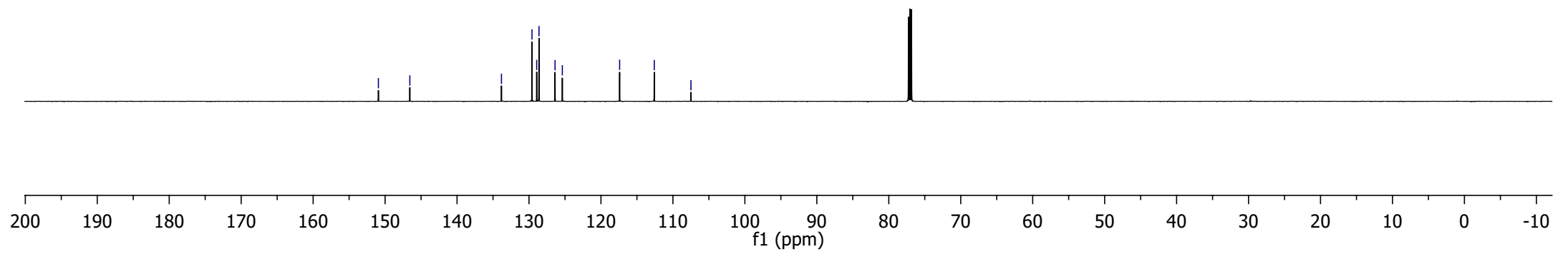


—150.93
—146.56
133.83
129.59
128.93
128.61
126.38
125.37
—117.40
—112.59
—107.49



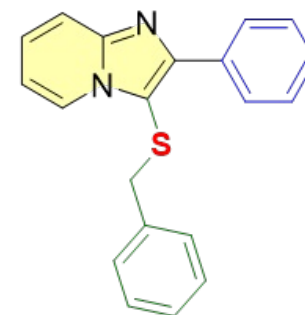
8i

$^{13}\text{C}\{^1\text{H}\}$ (CDCl₃, 150 MHz)



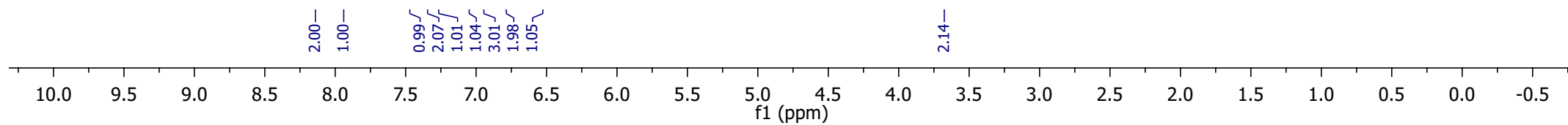
8.146
8.133
7.944
7.932
7.477
7.462
7.356
7.343
7.330
7.275
7.263
7.251
7.060
7.048
7.034
6.972
6.960
6.948
6.938
6.926
6.914
6.793
6.781
6.535
6.523
6.512

3.677



8j

$^1\text{H NMR}$ (CDCl_3 , 600 MHz)

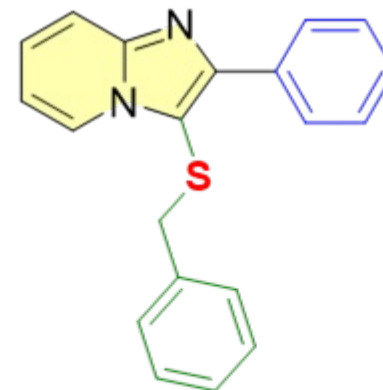


—150.11
—146.41

—137.13
—133.78
—128.69
—128.46
—128.32
—128.27
—127.35
—117.22

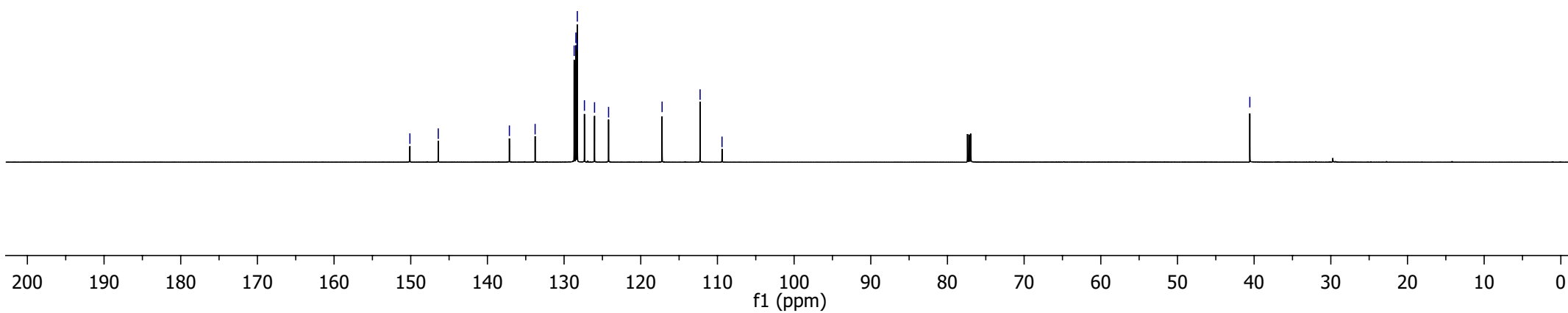
—112.26
—109.40

—40.56



8j

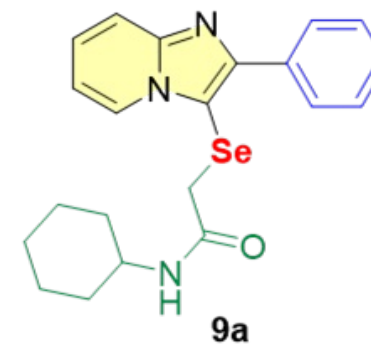
$^{13}\text{C}\{^1\text{H}\}$ (CDCl_3 , 150 MHz)



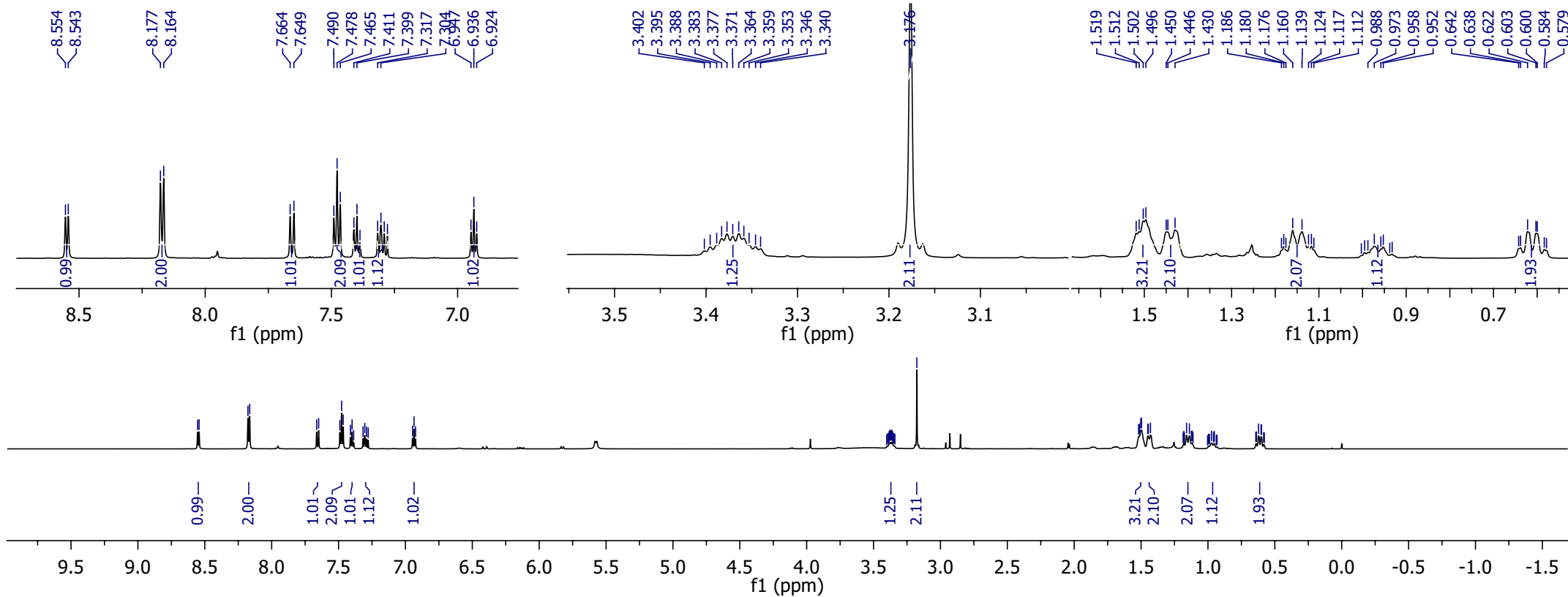
8.554
8.543
8.177
8.164
7.664
7.649
7.490
7.478
7.465
7.399
6.936
6.924

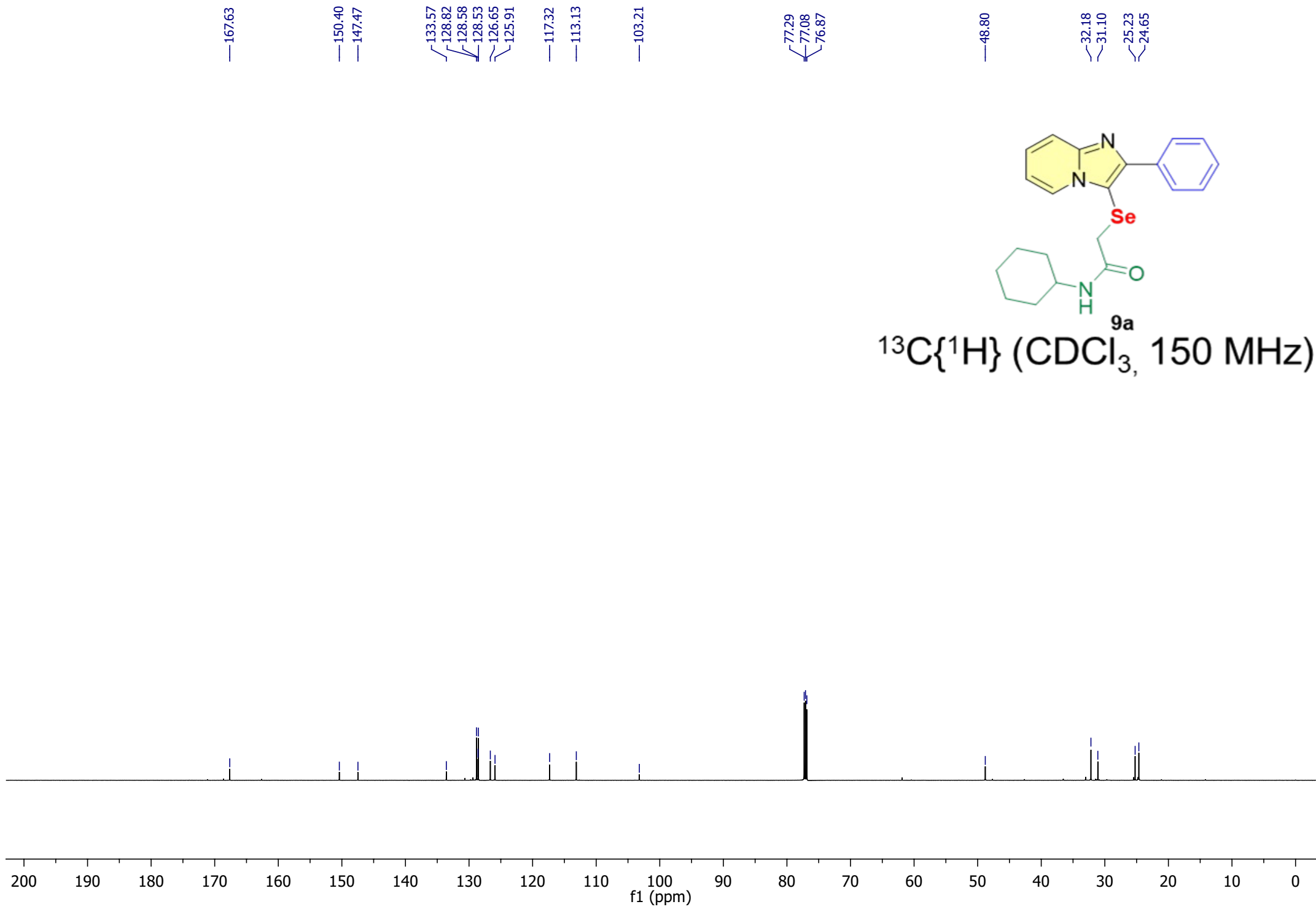
3.402
3.395
3.388
3.383
3.377
3.371
3.364
3.359
3.353
3.346
3.340
3.176

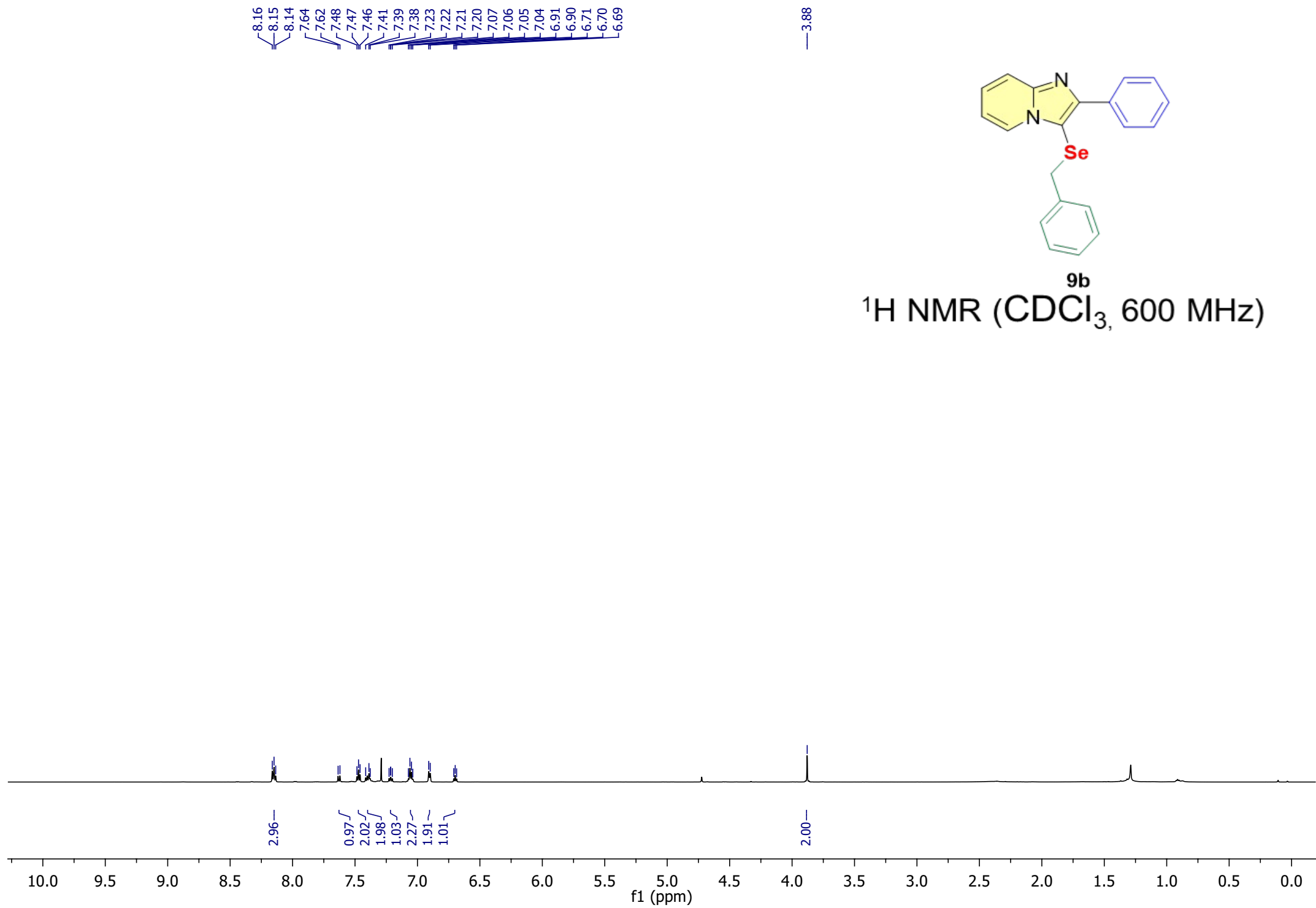
1.519
1.512
1.502
1.496
1.450
1.446
1.430
1.160
1.139
1.117
0.973
0.972
0.638
0.622
0.603
0.600
0.584
0.579

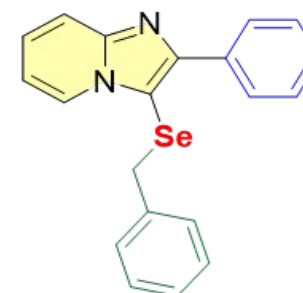


$^1\text{H NMR}$ (CDCl_3 , 600 MHz)

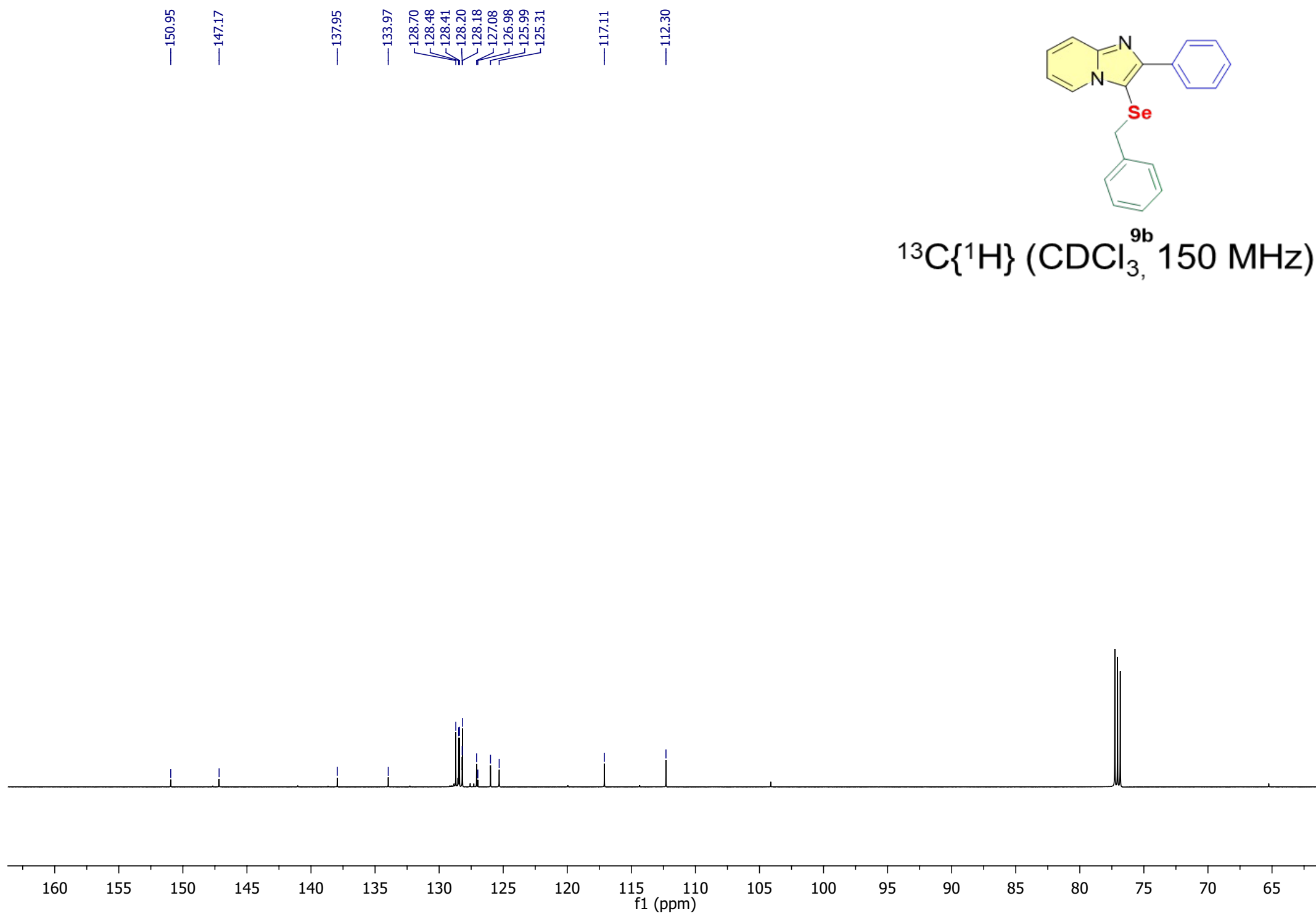




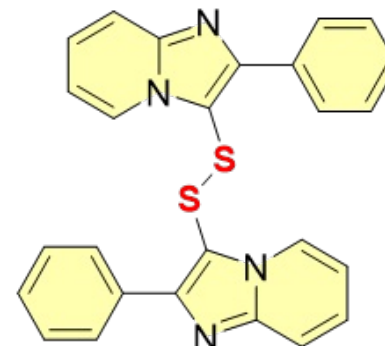




$^{13}\text{C}\{^1\text{H}\}$ (CDCl_3 , 150 MHz)

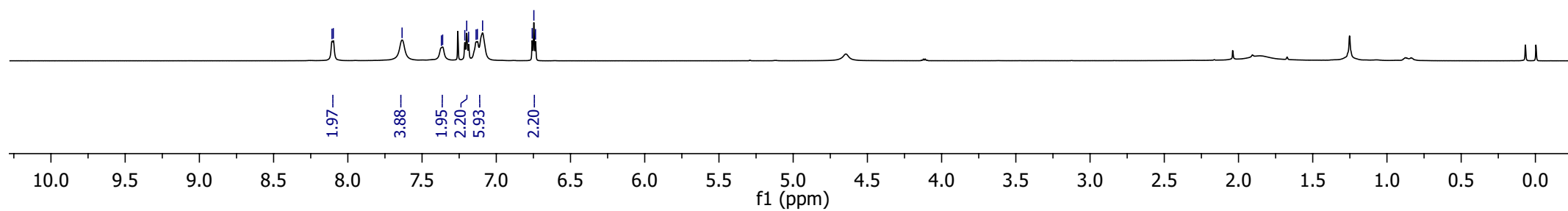
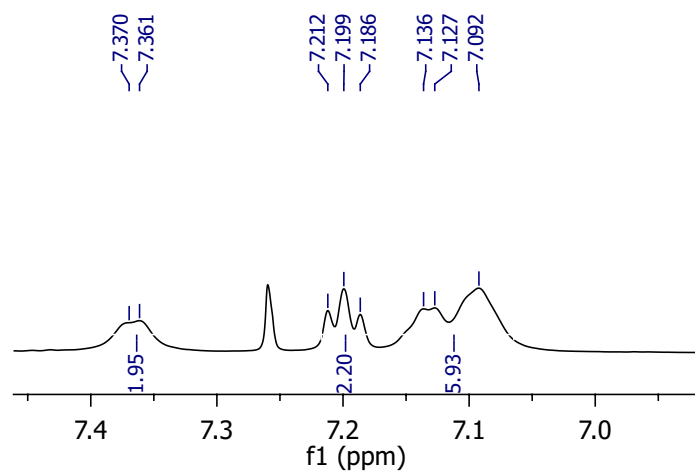


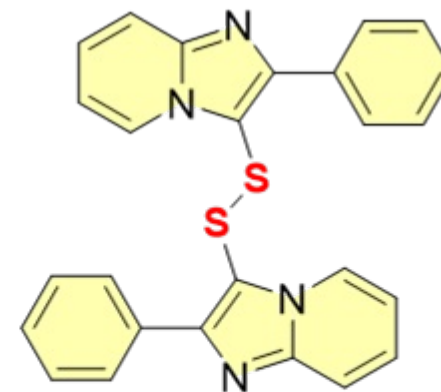
8.107
8.098
7.635
7.212
7.199
7.136
7.127
7.092
6.758
6.747
6.736



1aa

^1H NMR (CDCl_3 , 600 MHz)





1aa

$^{13}\text{C}\{^1\text{H}\}$ (CDCl_3 , 150 MHz)

