Photoredox-catalyzed sulfonylation of alkyl iodides, sulfur dioxide, and electron-deficient alkenes

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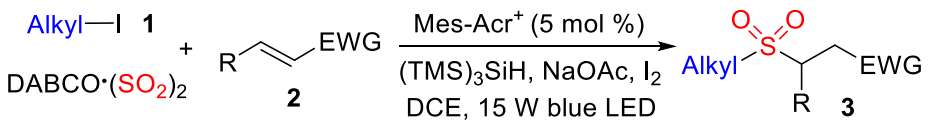
Supporting Information

General experimental methods:

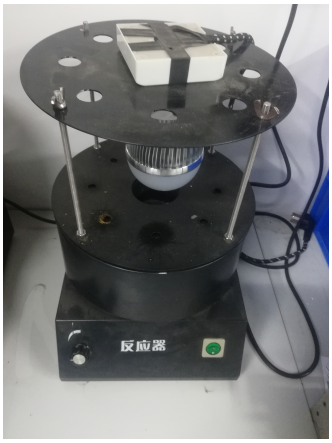
Unless otherwise stated, all commercial reagents were used as received. All solvents were dried and distilled according to standard procedures. Flash column chromatography was performed using silica gel (60-Å pore size, 32–63µm, standard grade). Analytical thin–layer chromatography was performed using glass plates pre-coated with 0.25 mm 230–400 mesh silica gel impregnated with a fluorescent indicator (254 nm). Thin layer chromatography plates were visualized by exposure to ultraviolet light. Organic solutions were concentrated on rotary evaporators at ~20 Torr at 25–35°C. Nuclear magnetic resonance (NMR) spectra are recorded in parts per million from internal tetramethylsilane on the δ scale. ^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$ on a Bruker DRX-400 spectrometer operating at 400 MHz and 100 MHz, respectively. All chemical shift values are quoted in ppm and coupling constants quoted in Hz. High resolution mass spectrometry (HRMS) spectra were obtained on a micrOTOF II Instrument.

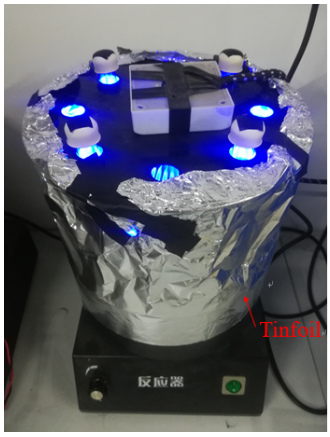
*General experimental procedure for the photoredox-catalyzed sulfonylation of alkyl iodides **1**, sulfur dioxide, and electron-deficient alkenes **2**:*



Alkene **2** (0.2 mmol) and DABCO•$(SO_2)_2$ (0.16 mmol) were combined with NaOAc (0.3 mmol), I_2 (10 mol %) and Mes-Acr$^+$ (5 mol %) in a tube. The tube was evacuated and backfilled with N_2 three times before the addition of DCE (3.0 mL), alkyl iodide **1** (0.4 mmol), and $(TMS)_3SiH$ (0.2 mmol). The mixture was then placed around a blue LED (15 W) with a distance of 10 centimeters, and was stirred under blue light irradiation for 48 hours at room temperature. After completion of reaction as indicated by TLC, the mixture was purified directly by flash column chromatography (EtOAc/*n*-hexane, 1:6) to provide the desired product **3**.

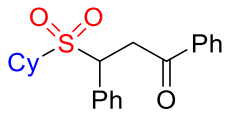
Experimental setup:





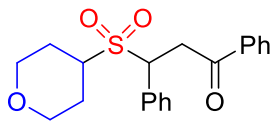
*A typical experimental procedure for the gram-scale reaction of cyclohexyl iodide **1a**, DABCO·$(SO_2)_2$, and (E)-chalcone **2a**:*

*(E)-chalcone **2a*** (1.040 g, 5.0 mmol) and DABCO•$(SO_2)_2$ (4.0 mmol) were combined with NaOAc (0.615 g, 7.5 mmol), I_2 (10 mol %) and Mes-Acr$^+$ (5 mol %) in a flask. The flask was evacuated and backfilled with N_2 three times before the addition of DCE (60.0 mL), cyclohexyl iodide **1a** (2.101 g, 10 mmol), and $(TMS)_3SiH$ (5.0 mmol). The mixture was then placed around a blue LED (15 W) with a distance of 10 centimeters, and was stirred under blue light irradiation for 48 hours at room temperature. After completion of reaction as indicated by TLC, the mixture was purified directly by flash column chromatography (EtOAc/*n*-hexane, 1:6) to provide the desired product **3a** (1.175 g, 66%).

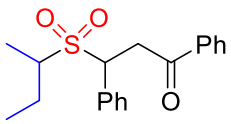


3-(Cyclohexylsulfonyl)-1,3-diphenylpropan-1-one **(3a)**: white solid (50.6 mg, 71%); mp 120−122 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.4 Hz, 2H), 7.55 (t, *J* = 7.0 Hz, 3H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.39 – 7.33 (m, 3H), 5.05 (dd, *J* = 9.7, 3.2 Hz, 1H), 4.05 (dd, *J* = 17.9, 3.2 Hz, 1H), 3.83 (dd, *J* = 17.9, 9.7 Hz, 1H), 2.62 – 2.55 (m, 1H), 2.18 – 1.99 (m, 2H), 1.85 – 1.82 (m, 2H), 1.64 – 1.46 (m, 3H), 1.20 – 1.05 (m, 3H); ^{13}C NMR (100

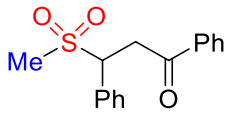
MHz, $CDCl_3$) δ 195.11, 136.07, 133.56, 133.47, 129.40, 128.97, 128.90, 128.64, 128.07, 60.02, 57.90, 37.13, 26.34, 24.94, 24.69, 23.05; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{21}H_{25}O_3S^+$: 357.1519; found: 357.1526.



1,3-Diphenyl-3-((tetrahydro-2H-pyran-4-yl)sulfonyl)propan-1-one **(3b)**: white solid (33.7 mg, 47%); mp 107−109 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.4 Hz, 2H), 7.58 – 7.55 (m, 3H), 7.44 (t, *J* = 7.7 Hz, 2H), 7.41 – 7.33 (m, 3H), 5.02 (dd, *J* = 9.5, 3.2 Hz, 1H), 4.09 – 4.00 (m, 3H), 3.83 (dd, *J* = 18.0, 9.5 Hz, 1H), 3.25 – 3.18 (m, 2H), 2.91 – 2.83 (m, 1H), 1.99 – 1.73 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.90, 135.97, 133.70, 133.15, 129.42, 129.14, 128.70, 128.09, 66.47, 65.90, 60.51, 55.32, 37.18, 26.23, 23.47; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{20}H_{23}O_4S^+$: 359.1312; found: 359.1320.

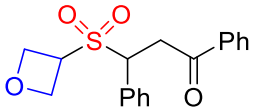


3-(*sec*-Butylsulfonyl)-1,3-diphenylpropan-1-one **(3c)**: white solid (46.2 mg, 70%); mp 126−127 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 7.6 Hz, 2H), 7.59 (t, *J* = 6.6 Hz, 3H), 7.46 (t, *J* = 7.4 Hz, 2H), 7.43 – 7.31 (m, 3H), 5.15 – 5.09 (m, 1H), 4.08 (d, *J* = 17.9 Hz, 1H), 3.91 – 3.81 (m, 1H), 2.67 – 2.63 (m, 1H), 2.09 – 1.97 (m, 1H), 1.61 – 1.50 (m, 1H), 1.37 – 1.26 (m, 3H), 0.94 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.12, 136.06, 133.59, 133.48, 129.46, 129.41, 128.98, 128.65, 128.08, 60.38, 60.34, 56.03, 55.75, 37.31, 37.20, 23.25, 20.47, 13.27, 10.86, 10.68, 10.25; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{19}H_{23}O_3S^+$: 331.1362; found: 331.1364.

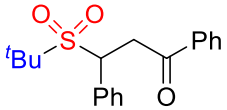


3-(Methylsulfonyl)-1,3-diphenylpropan-1-one[1] **(3d)**: white solid (23.0 mg, 40%); mp 135−137°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 7.2 Hz, 2H), 7.59 – 7.53 (m, 3H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.41 – 7.36 (m, 3H), 4.95 (dd, *J* = 9.5, 3.5 Hz, 1H), 4.08 (dd, *J* = 18.0, 3.5 Hz, 1H), 3.85 (dd, *J* = 18.0, 9.5 Hz, 1H), 2.69 (s, 3H); ^{13}C NMR (100 MHz,

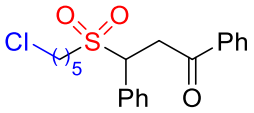
$CDCl_3$) δ 194.75, 135.96, 133.73, 133.27, 129.44, 129.25, 129.13, 128.74, 128.11, 64.90, 38.71, 36.68.



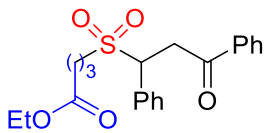
3-(Oxetan-3-ylsulfonyl)-1,3-diphenylpropan-1-one **(3e)**: white solid (39.6 mg, 60%); mp 161−162 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 7.2 Hz, 2H), 7.59 (t, *J* = 7.4 Hz, 1H), 7.48 – 7.45 (m, 4H), 7.41 – 7.35 (m, 3H), 4.98 (t, *J* = 6.9 Hz, 1H), 4.87 – 4.84 (m, 1H), 4.71 (t, *J* = 7.3 Hz, 1H), 4.39 – 4.18 (m, 3H), 4.08 (dd, *J* = 18.0, 3.5 Hz, 1H), 3.88 (dd, *J* = 18.0, 9.5 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.46, 135.84, 133.86, 131.86, 129.57, 129.43, 129.26, 128.79, 128.12, 69.95, 69.44, 63.38, 53.45, 36.23; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{18}H_{19}O_4S^+$: 331.0999; found: 331.0998.



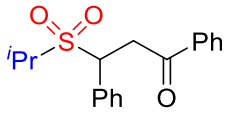
3-(Tert-butylsulfonyl)-1,3-diphenylpropan-1-one **(3f)**: white solid (43.4 mg, 70%); mp 149−150 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 7.4 Hz, 2H), 7.66 – 7.56 (m, 3H), 7.46 (t, *J* = 7.4 Hz, 2H), 7.39– 7.31 (m, 3H), 5.22 (d, *J* = 9.2 Hz, 1H), 4.18 (d, *J* = 17.9 Hz, 1H), 3.76 (dd, *J* = 17.8, 9.2 Hz, 1H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.22, 136.16, 134.79, 133.54, 129.76, 128.81, 128.65, 128.12, 62.19, 59.86, 39.35, 24.19; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{19}H_{23}O_3S^+$:311.1362; found: 311.1389.



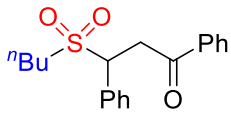
3-((5-Chloropentyl)sulfonyl)-1,3-diphenylpropan-1-one **(3g)**: white solid (49.9 mg, 66%); mp 121−122 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 7.6 Hz, 2H), 7.59 – 7.54 (m, 3H), 7.45 (t, *J* = 7.5 Hz, 2H), 7.41 – 7.34 (m, 3H), 4.95 (d, *J* = 9.4 Hz, 1H), 4.08 (d, *J* = 18.0 Hz, 1H), 3.84 (dd, *J* = 17.9, 9.5 Hz, 1H), 3.49 (t, *J* = 6.3 Hz, 2H), 2.84 – 2.66 (m, 2H), 1.84 – 1.69 (m, 4H), 1.51 – 1.44 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.86, 135.95, 133.70, 133.17, 129.41, 129.20, 129.11, 128.71, 128.10, 63.39, 50.31, 44.28, 36.78, 31.75, 25.60, 20.86; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{20}H_{24}ClO_3S^+$:379.1129; found: 379.1140.



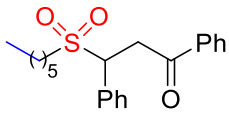
Ethyl 4-((3-oxo-1,3-diphenylpropyl)sulfonyl)butanoate **(3h)**: white solid (45.0 mg, 58%); mp 99–100 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 7.6 Hz, 2H), 7.60 – 7.56 (m, 3H), 7.47 (t, *J* = 7.5 Hz, 2H), 7.43 – 7.33 (m, 3H), 4.98 (d, *J* = 9.4 Hz, 1H), 4.17 – 4.07 (m, 3H), 3.89 – 3.82 (m, 1H), 2.97 – 2.76 (m, 2H), 2.48 – 2.39 (m, 2H), 2.16 – 2.03 (m, 2H), 1.23 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.79, 171.91, 135.94, 133.67, 133.02, 129.45, 129.17, 129.06, 128.68, 128.08, 63.41, 60.61, 49.46, 36.72, 32.32, 17.26, 14.09; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{21}H_{25}O_5S^+$: 389.1417; found: 389.1410.



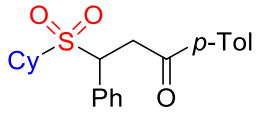
3-(Isopropylsulfonyl)-1,3-diphenylpropan-1-one **(3i)**: white solid (36.7 mg, 58%); mp 117–118 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.2 Hz, 2H), 7.59 – 7.53 (m, 3H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.39 – 7.32 (m, 3H), 5.07 (dd, *J* = 9.7, 3.2 Hz, 1H), 4.06 (dd, *J* = 17.9, 3.2 Hz, 1H), 3.83 (dd, *J* = 18.0, 9.7 Hz, 1H), 2.90 – 2.83 (m, 1H), 1.36 (d, *J* = 6.8 Hz, 3H), 1.26 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.06, 136.04, 133.59, 133.42, 129.42, 128.99, 128.94, 128.65, 128.07, 60.17, 49.99, 37.27, 16.49, 13.57; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{18}H_{21}O_3S^+$: 317.1206; found: 317.1224.



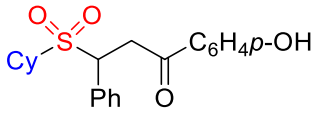
3-(Butylsulfonyl)-1,3-diphenylpropan-1-one **(3j)**: white solid (47.5 mg, 72%); mp 119–121 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 7.4 Hz, 2H), 7.61-7.56 (m, 3H), 7.47 (t, *J* = 7.7 Hz, 2H), 7.44 – 7.35 (m, 3H), 4.97 (dd, *J* = 9.6, 3.3 Hz, 1H), 4.13 - 4.07 (m, 1H), 3.90 – 3.83 (m, 1H), 2.75 (m, 2H), 1.96 – 1.56 (m, 2H), 1.51 – 1.17 (m, 2H), 0.89 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.94, 136.05, 133.63, 133.34, 129.43, 129.09, 129.03, 128.68, 128.09, 63.19, 50.29, 36.82, 23.51, 21.60, 13.40; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{19}H_{23}O_3S^+$: 331.1362; found: 331.1378.



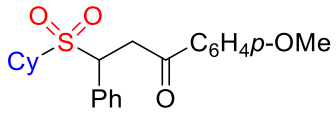
3-(Hexylsulfonyl)-1,3-diphenylpropan-1-one **(3k)**: white solid (50.1 mg, 70%); mp 111−112 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.2 Hz, 2H), 7.57 – 7.53 (m, 3H), 7.44 (t, *J* = 7.7 Hz, 2H), 7.40 – 7.33 (m, 3H), 4.95 (dd, *J* = 9.6, 3.3 Hz, 1H), 4.07 (dd, *J* = 18.0, 3.4 Hz, 1H), 3.84 (dd, *J* = 18.0, 9.6 Hz, 1H), 2.81 – 2.63 (m, 2H), 1.81 – 1.68 (m, 2H), 1.32 – 1.20 (m, 6H), 0.85 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.91, 135.99, 133.62, 133.30, 129.40, 129.06, 129.01, 128.66, 128.07, 63.13, 50.53, 36.77, 31.01, 27.97, 22.15, 21.45, 13.82; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{21}H_{27}O_3S^+$: 359.1675; found: 359.1681.



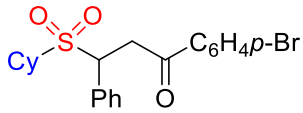
3-(Cyclohexylsulfonyl)-3-phenyl-1-(p-tolyl)propan-1-one **(3l)**: white solid (50.3 mg, 68%); mp 130−131 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (d, *J* = 8.2 Hz, 2H), 7.55 (d, *J* = 6.7 Hz, 2H), 7.38 – 7.32 (m, 3H), 7.23 (d, *J* = 8.1 Hz, 2H), 5.04 (dd, *J* = 9.7, 3.2 Hz, 1H), 4.01 (dd, *J* = 17.8, 3.2 Hz, 1H), 3.81 (dd, *J* = 17.9, 9.7 Hz, 1H), 2.63 – 2.55 (m, 1H), 2.38 (s, 3H), 2.18 – 1.99 (m, 2H), 1.85 – 1.82 (m, 2H), 1.64 – 1.49 (m, 3H), 1.20 – 1.05 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.68, 144.47, 133.64, 133.51, 129.40, 129.30, 128.93, 128.85, 128.18, 60.07, 57.88, 36.94, 26.32, 24.93, 24.69, 23.06, 21.59; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{22}H_{27}O_3S^+$: 371.1675; found: 371.1679.



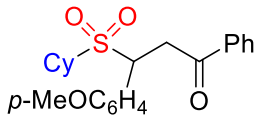
3-(Cyclohexylsulfonyl)-1-(4-hydroxyphenyl)-3-phenylpropan-1-one **(3m)**: colorless oil (49.1 mg, 66%); ^{1}H NMR (400 MHz, DMSO) δ 10.45 (s, 1H), 7.88 (d, *J* = 8.7 Hz, 2H), 7.54 (d, *J* = 6.5 Hz, 2H), 7.45 – 7.20 (m, 3H), 6.84 (d, *J* = 8.7 Hz, 2H), 5.01 – 4.98 (m, 1H), 3.92 – 3.78 (m, 2H), 2.99 – 2.93 (m, 1H), 1.82 – 1.57 (m, 4H), 1.39 – 1.08 (m, 6H); ^{13}C NMR (100 MHz, DMSO) δ 193.42, 162.44, 133.24, 130.79, 129.87, 128.53, 128.42, 127.65, 115.26, 60.15, 57.20, 36.30, 24.95, 24.70, 24.42, 24.36; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{21}H_{25}O_4S^+$: 373.1468; found: 373.1474.



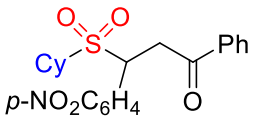
3-(Cyclohexylsulfonyl)-1-(4-methoxyphenyl)-3-phenylpropan-1-one **(3n)**: white solid (52.5 mg, 68%); mp 112–113 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.9 Hz, 2H), 7.56 – 7.53 (m, 2H), 7.38 – 7.26 (m, 3H), 6.89 (d, *J* = 8.9 Hz, 2H), 5.04 (dd, *J* = 9.7, 3.2 Hz, 1H), 3.98 (dd, *J* = 17.7, 3.2 Hz, 1H), 3.83 – 3.74 (m, 4H), 2.62- 2.54 (m, 1H), 2.18 – 1.99 (m, 2H), 1.84 – 1.81 (m, 2H), 1.63 – 1.46 (m, 3H), 1.19 – 1.07 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 193.49, 163.78, 133.54, 130.37, 129.39, 129.16, 128.91, 128.82, 113.75, 60.11, 57.86, 55.42, 36.64, 26.30, 24.92, 24.68, 23.06; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{22}H_{27}O_4S^+$: 387.1625; found: 387.1633.



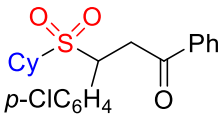
1-(4-Bromophenyl)-3-(cyclohexylsulfonyl)-3-phenylpropan-1-one **(3o)**: white solid (48.6 mg, 56%); mp 167–169 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, *J* = 8.6 Hz, 2H), 7.59 – 7.53 (m, 4H), 7.40 – 7.34 (m, 3H), 5.01 (dd, *J* = 9.6, 3.3 Hz, 1H), 4.02 (dd, *J* = 17.9, 3.4 Hz, 1H), 3.75 (dd, *J* = 17.9, 9.6 Hz, 1H), 2.62 – 2.54 (m, 1H), 2.17 – 1.98 (m, 2H), 1.85 – 1.82 (m, 2H), 1.64 – 1.45 (m, 3H), 1.20 – 1.04 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.25, 134.81, 133.34, 131.99, 129.60, 129.35, 129.05, 128.88, 59.99, 57.92, 37.09, 26.39, 24.94, 24.70, 23.01; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{21}H_{24}BrO_3S^+$: 435.0624; found: 435.0639.



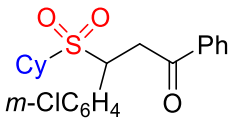
3-(Cyclohexylsulfonyl)-3-(4-methoxyphenyl)-1-phenylpropan-1-one **(3p)**: colorless oil (44.0 mg, 57%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.24 Hz, 2H), 7.59 – 7.40 (m, 5H), 6.88 (d, *J* = 8.8 Hz, 2H), 4.99 (dd, *J* = 9.8, 3.1 Hz, 1H), 4.00 (dd, *J* = 17.9, 3.2 Hz, 1H), 3.84 – 3.72 (m, 4H), 2.64 – 2.57 (m, 1H), 2.16 – 2,00 (m, 2H), 1.94 – 1.77 (m, 2H), 1.64 – 1.46 (m, 3H), 1.20 – 1.05 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.25, 136.12, 133.52, 130.52, 128.62, 128.06, 125.14, 114.37, 113.51, 59.38, 57.59, 55.17, 37.06, 26.34, 24.94, 24.70, 22.99; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{22}H_{27}O_4S^+$: 387.1625; found: 387.1635.



3-(Cyclohexylsulfonyl)-3-(4-nitrophenyl)-1-phenylpropan-1-one **(3q)**: white solid (30.5 mg, 38%); mp 154–156 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (d, *J* = 8.8 Hz, 2H), 7.92 (d, *J* = 7.3 Hz, 2H), 7.77 (d, *J* = 8.8 Hz, 2H), 7.58 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.7 Hz, 2H), 5.13 (dd, *J* = 10.0, 3.1 Hz, 1H), 4.11 (dd, *J* = 18.2, 3.1 Hz, 1H), 3.85 (dd, *J* = 18.2, 10.0 Hz, 1H), 2.63 – 2.55 (m, 1H), 2.16 – 2.03 (m, 2H), 1.98 – 1.86 (m, 2H), 1.67 – 1.51 (m, 2H), 1.25 – 1.08 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.64, 148.06, 140.87, 135.64, 134.00, 130.59, 128.82, 128.09, 124.05, 59.40, 58.83, 37.49, 26.24, 24.86, 24.70, 23.30; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{21}H_{24}NO_5S^+$: 402.1370; found: 402.1373.

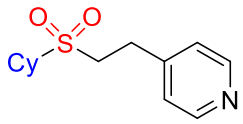


3-(4-Chlorophenyl)-3-(cyclohexylsulfonyl)-1-phenylpropan-1-one **(3r)**: white solid (42.1 mg, 54%); mp 166–168 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.3 Hz, 2H), 7.59 – 7.50 (m, 3H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.35 (d, *J* = 8.5 Hz, 2H), 5.01 (dd, *J* = 9.9, 3.1 Hz, 1H), 4.03 (dd, *J* = 18.0, 3.1 Hz, 1H), 3.78 (dd, *J* = 18.0, 9.9 Hz, 1H), 2.63 – 2.56 (m, 1H), 2.14 – 2.02 (m, 2H), 1.94 – 1.80 (m, 2H), 1.66 – 1.45 (m, 4H), 1.18 – 1.12 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.96, 135.94, 135.01, 133.75, 132.05, 130.77, 129.26, 128.73, 128.09, 59.27, 58.06, 37.20, 26.35, 24.91, 24.70, 23.08; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{21}H_{24}ClO_3S^+$: 391.1129; found: 391.1130.

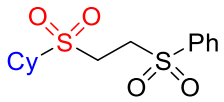


3-(3-Chlorophenyl)-3-(cyclohexylsulfonyl)-1-phenylpropan-1-one (**3s**): white solid (36.7 mg, 47%); mp 165–167 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 7.4 Hz, 2H), 7.69 – 7.54 (m, 2H), 7.450 – 7.46 (m, 3H), 7.38 – 7.30 (m, 2H), 5.04 (dd, *J* = 9.7, 3.2 Hz, 1H), 4.08 (dd, *J* = 18.1, 3.2 Hz, 1H), 3.81 (dd, *J* = 18.1, 9.7 Hz, 1H), 2.68 – 2.61 (m, 1H), 2.19 – 1.88 (m, 4H), 1.69 – 1.52 (m, 3H), 1.28 – 1.14 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.85, 135.91, 135.59, 134.89, 133.77, 130.18, 129.40, 129.23, 128.74,

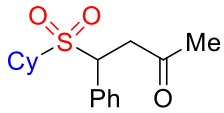
128.12, 127.81, 59.42, 58.24, 37.27, 26.34, 24.93, 24.71 23.17; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{21}H_{24}ClO_3S^+$: 391.1129; found: 391.1131.



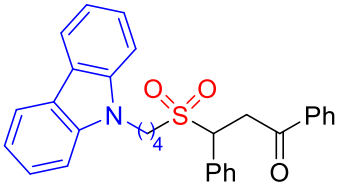
4-(2-(Cyclohexylsulfonyl)ethyl)pyridine[2] **(3t)**: brown solid (36.4 mg, 72%); mp 92–94 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.51 (d, *J* = 5.6 Hz, 2H), 7.15 (d, *J* = 5.9 Hz, 2H), 3.18 – 3.10 (m, 4H), 2.83 – 2.75 (m, 1H), 2.14 – 2.11 (m, 2H), 1.92 – 1.88 (m, 2H), 1.71 – 1.46 (m, 3H), 1.29 – 1.16 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 150.07, 146.96, 123.63, 61.49, 49.22, 26.33, 24.97, 24.91, 24.86.



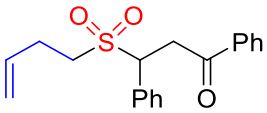
((2-(Cyclohexylsulfonyl)ethyl)sulfonyl)benzene **(3u)**: white solid (29.0 mg, 46%); mp 138–139 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 7.5 Hz, 2H), 7.74 (t, *J* = 7.4 Hz, 1H), 7.64 (t, *J* = 7.7 Hz, 2H), 3.58 – 3.53 (m, 2H), 3.38 – 3.33 (m, 2H), 2.96 – 2.89 (m, 1H), 2.24 – 2.12 (m, 2H), 1.99 – 1.95 (m, 2H), 1.78 – 1.51 (m, 3H), 1.35 – 1.18(m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.30, 134.51, 129.67, 128.00, 62.32, 48.31, 42.33, 25.06, 24.93, 24.88; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{14}H_{21}O_4S_2^+$: 317.0876; found: 317.0875.



4-(Cyclohexylsulfonyl)-4-phenylbutan-2-one **(3v)**: white solid (32.3 mg, 55%); mp 86–87 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 – 7.48 (m, 2H), 7.42 – 7.36 (m, 3H), 4.85 (dd, *J* = 9.1, 3.9 Hz, 1H), 3.56 (dd, *J* = 17.9, 3.9 Hz, 1H), 3.19 (dd, *J* = 17.9, 9.1 Hz, 1H), 2.60 – 2.53 (m, 1H), 2.14 (d, *J* = 19.4 Hz, 4H), 2.01 – 1.83 (m, 3H), 1.66 – 1.45 (m, 3H), 1.20 – 1.08 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 203.52, 133.41, 129.31, 129.02, 128.98, 59.73, 57.93, 41.55, 26.34, 24.95, 24.70, 23.06; HRMS (ESI): m/z [M + H]$^+$ calcd for $C_{16}H_{23}O_3S^+$: 295.1362; found: 295.1367.



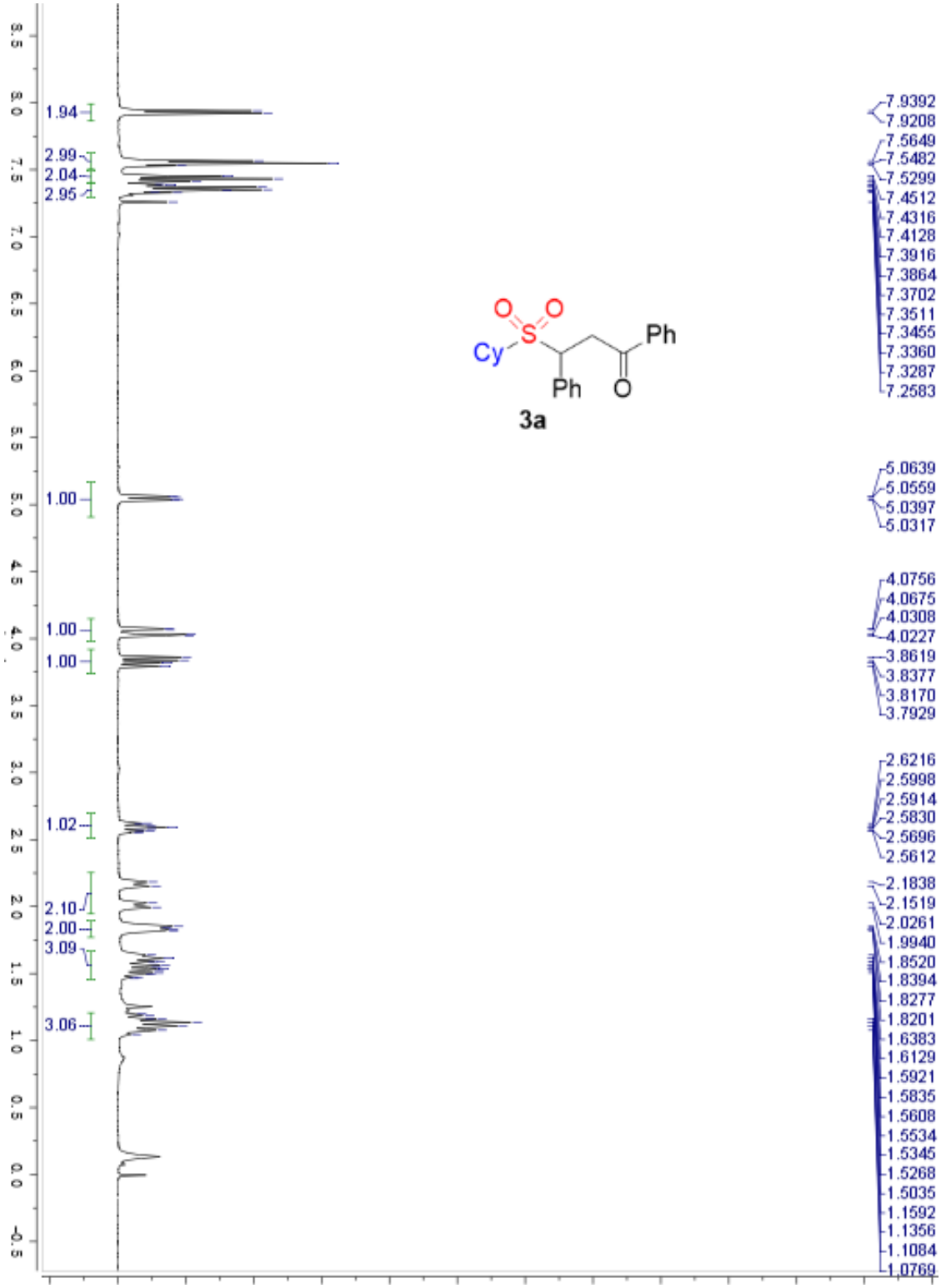
3-((4-(9H-Carbazol-9-yl)butyl)sulfonyl)-1,3-diphenylpropan-1-one (**3w**): white solid (65.3 mg, 66%); mp 83–85 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, *J* = 7.6 Hz, 2H), 7.89 (d, *J* = 7.4 Hz, 2H), 7.53 (t, *J* = 7.3 Hz, 1H), 7.45 – 7.36 (m, 6H), 7.30 – 7.20 (m, 7H), 4.82 (d, *J* = 9.2 Hz, 1H), 4.22 (t, *J* = 6.3 Hz, 2H), 4.00 (d, *J* = 17.9 Hz, 1H), 3.76 (dd, *J* = 17.9, 9.5 Hz, 1H), 2.68 – 2.59 (m, 2H), 1.88 – 1.72 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.72, 140.05, 135.89, 133.64, 132.90, 129.27, 129.10, 128.98, 128.65, 128.04, 125.70, 122.79, 120.36, 118.98, 108.40, 63.65, 50.10, 42.14, 36.66, 27.72, 19.43; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{31}H_{30}NO_3S^+$: 496.1941; found: 496.1950.



3-(But-3-en-1-ylsulfonyl)-1,3-diphenylpropan-1-one (**3x**): white solid (36.7mg, 56%); mp 142–143 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 7.2 Hz, 2H), 7.59 – 7.53 (m, 3H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.41 – 7.35(m, 3H), 5.73 – 5.65 (m, 1H), 5.08 – 4.95 (m, 3H), 4.08 (dd, *J* = 18.0, 3.4 Hz, 1H), 3.84 (dd, *J* = 18.0, 9.6 Hz, 1H), 2.90 – 2.73 (m, 2H), 2.60 – 2.40 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.82, 135.97, 133.76, 133.68, 133.11, 129.45, 129.19, 129.10, 128.70, 128.09, 117.38, 63.57, 49.78, 36.80, 25.75; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{19}H_{21}O_3S^+$: 329.1206; found: 329.1204.

Reference

1. Z. Jin, J. Xu, S. Yang, B.-A. Song, Y. Chi, *Angew. Chem. Int. Ed.*, **2013**, *52*, 12354.
2. T. Liu, Y. Li, L. Lai, J. Cheng, J. Sun, J. Wu, *Org. Lett.,* **2018**, *20*, 3605.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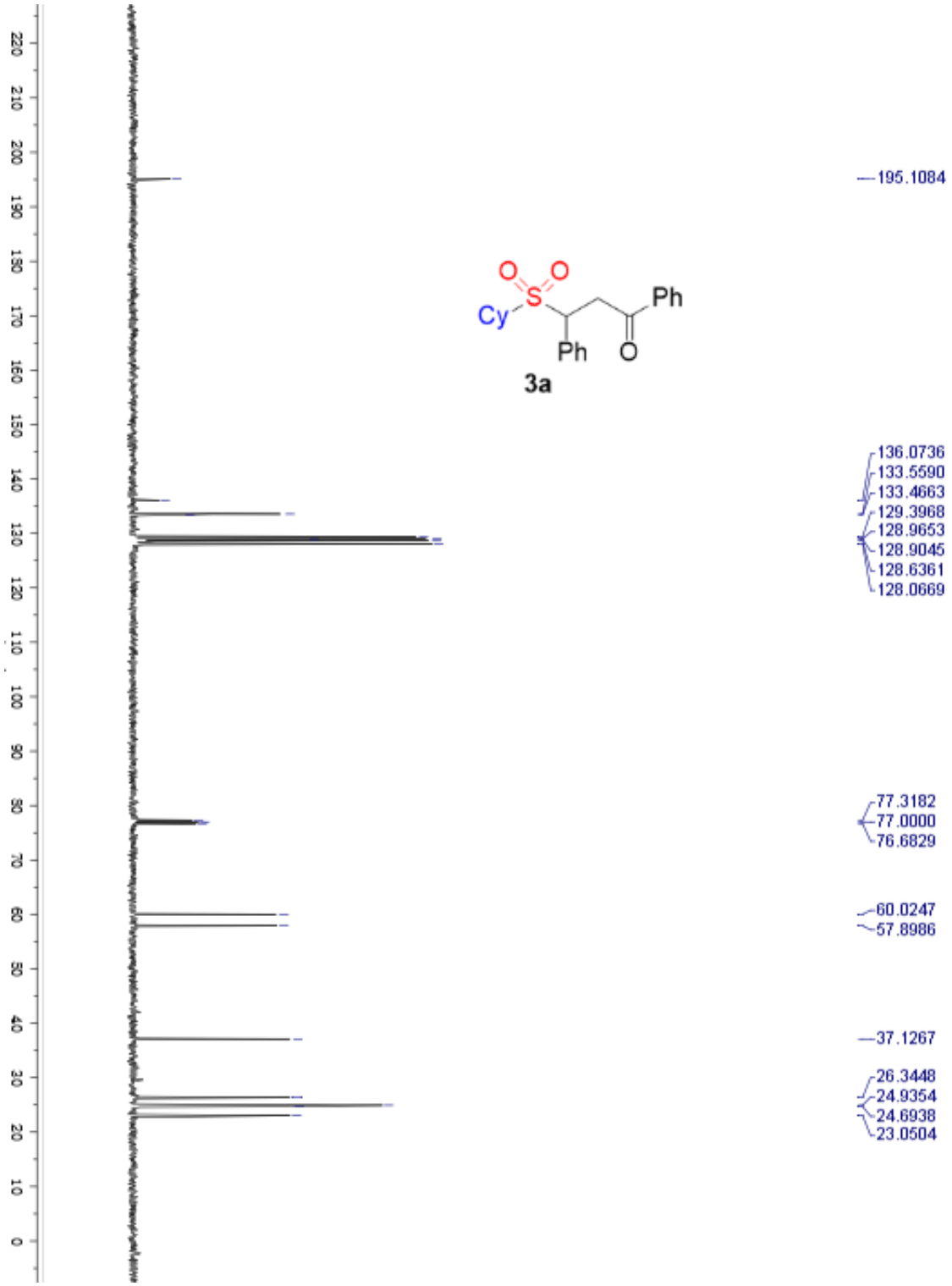
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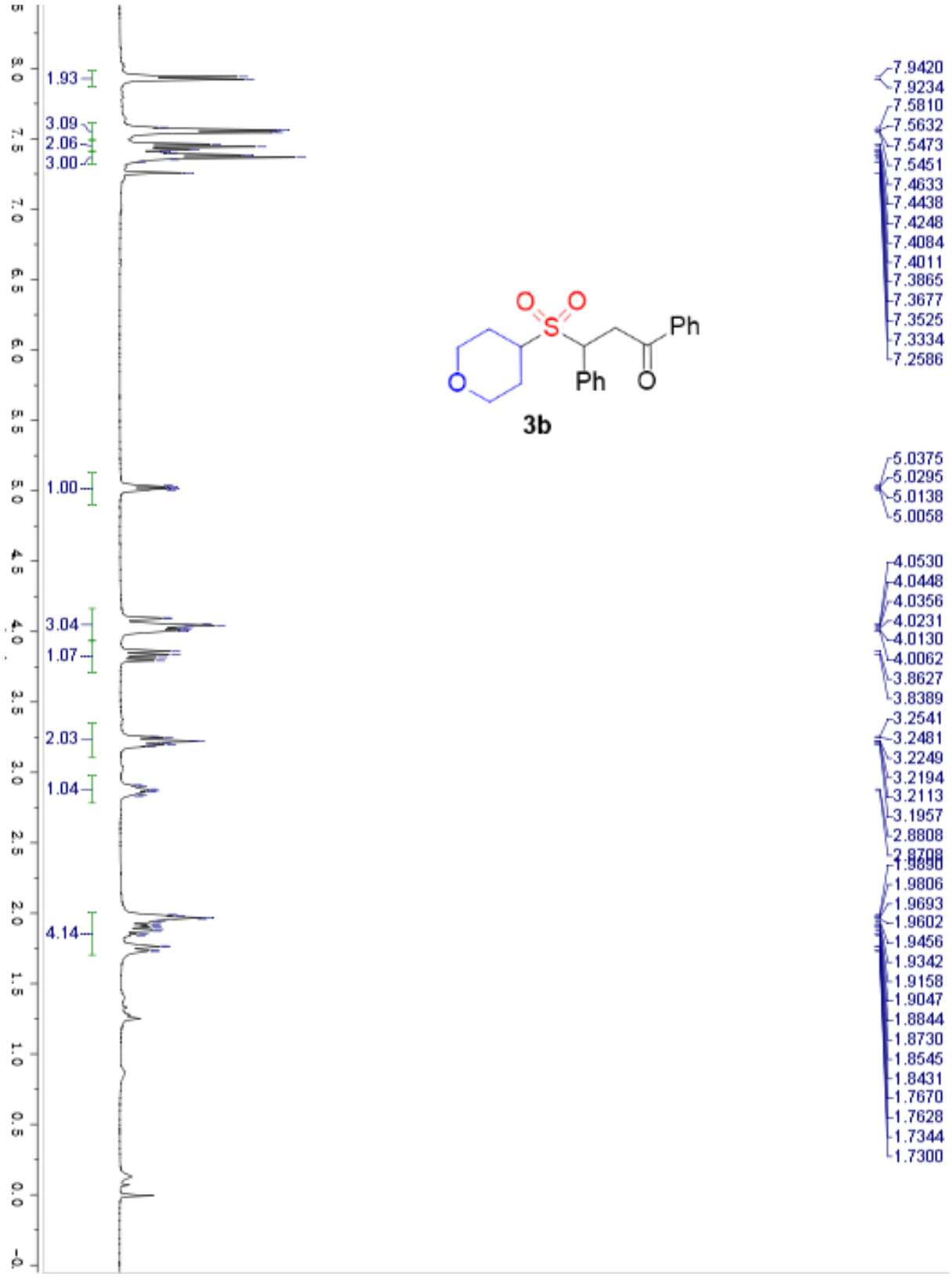
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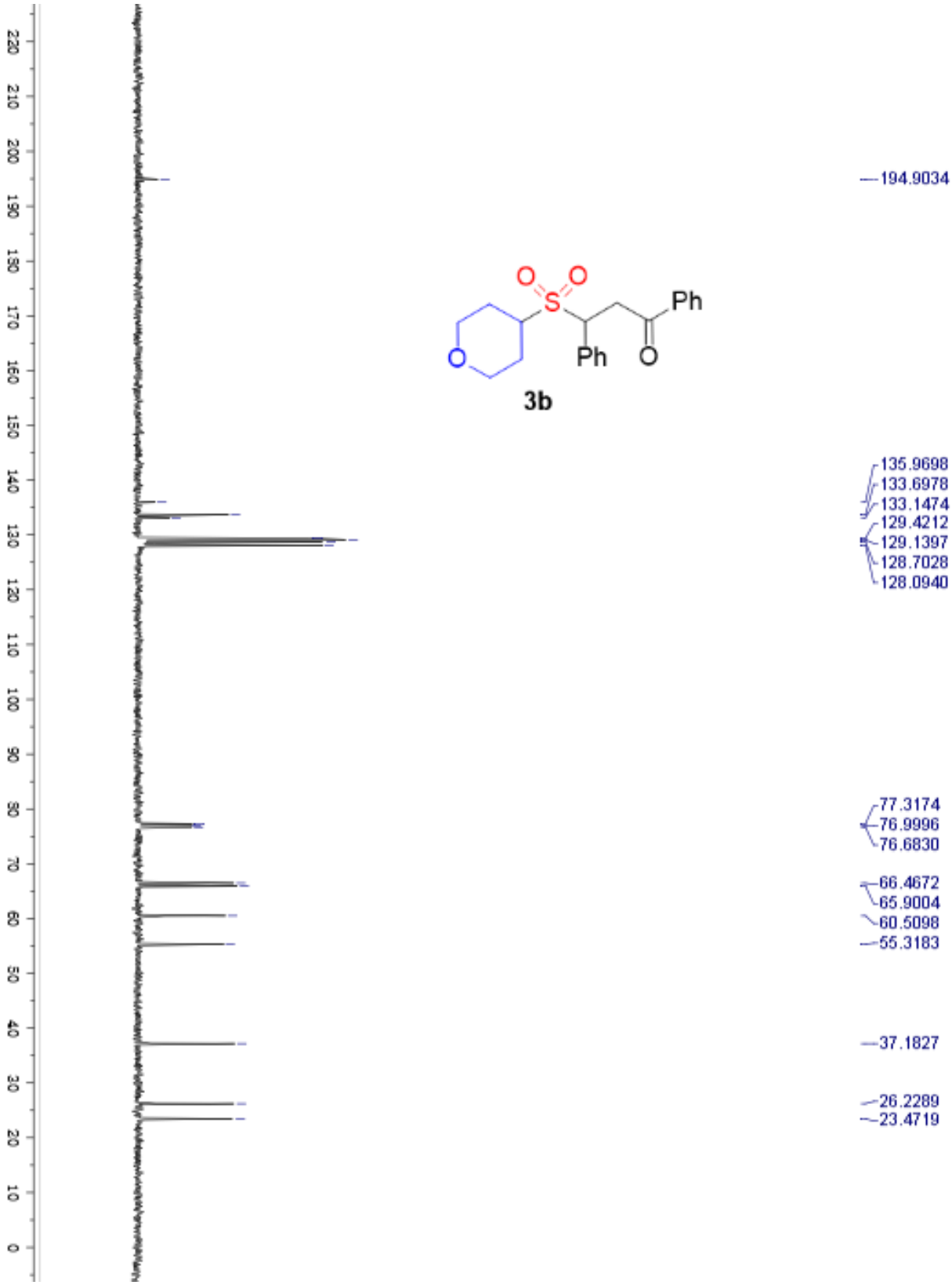
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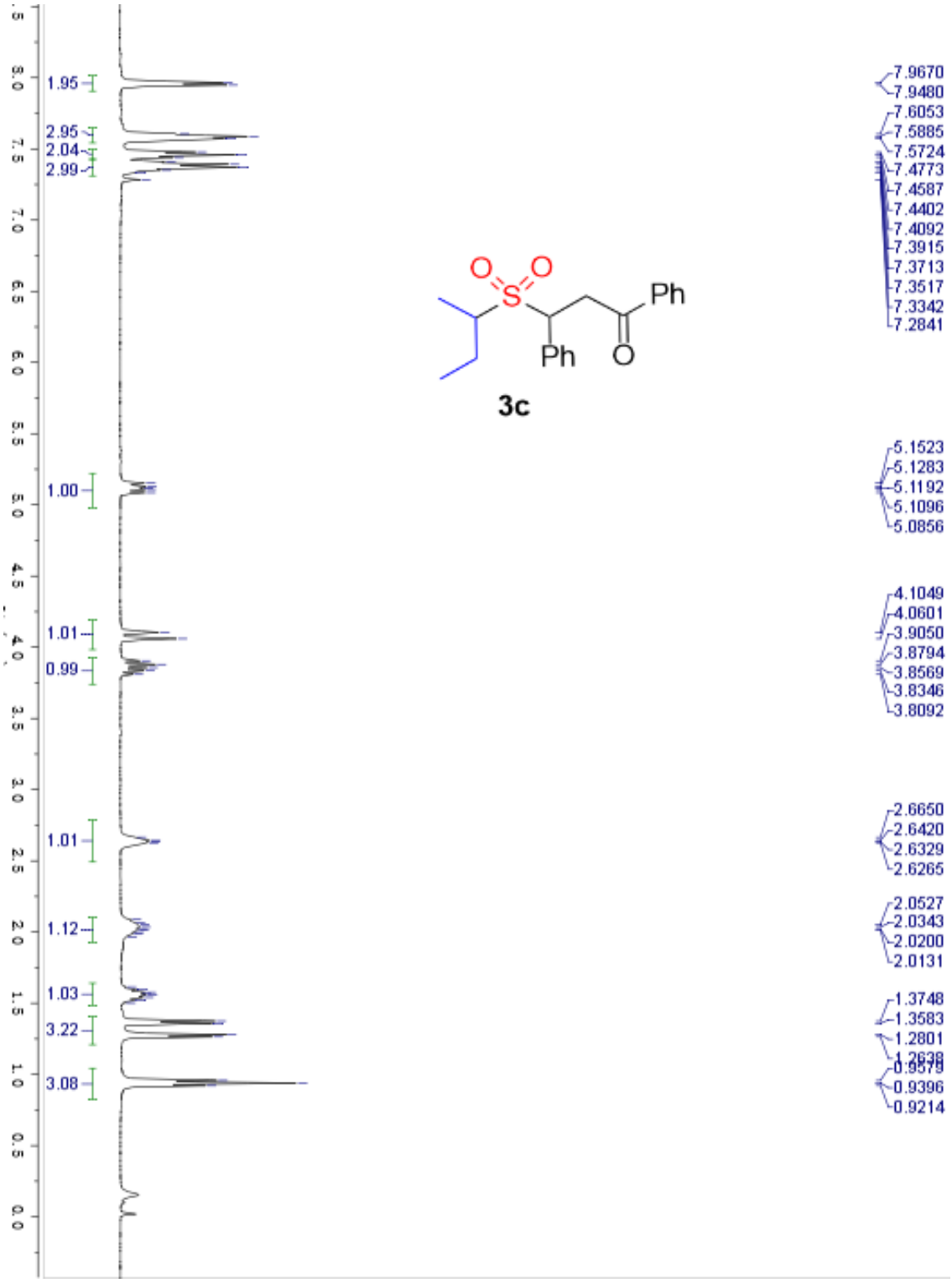
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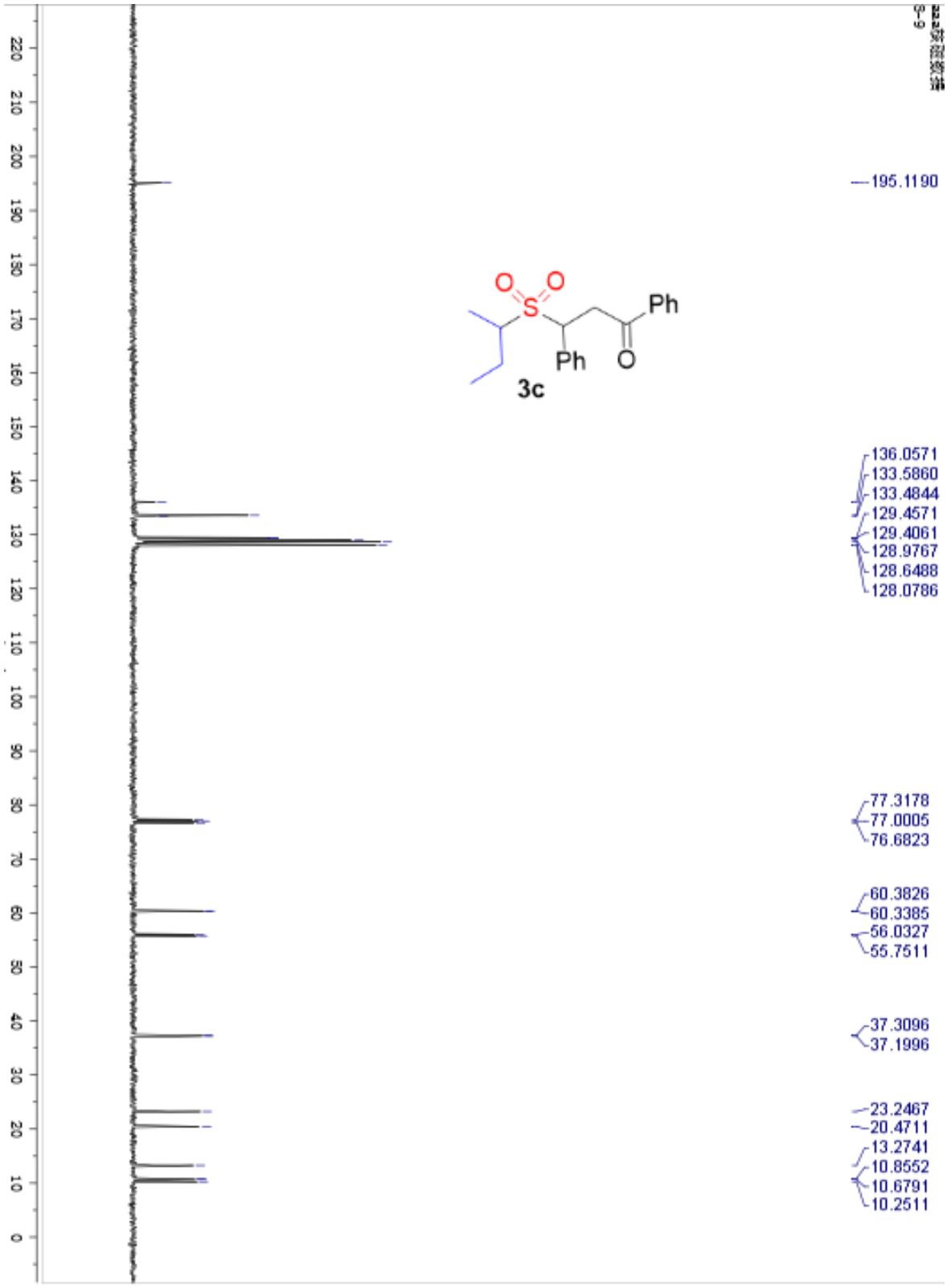
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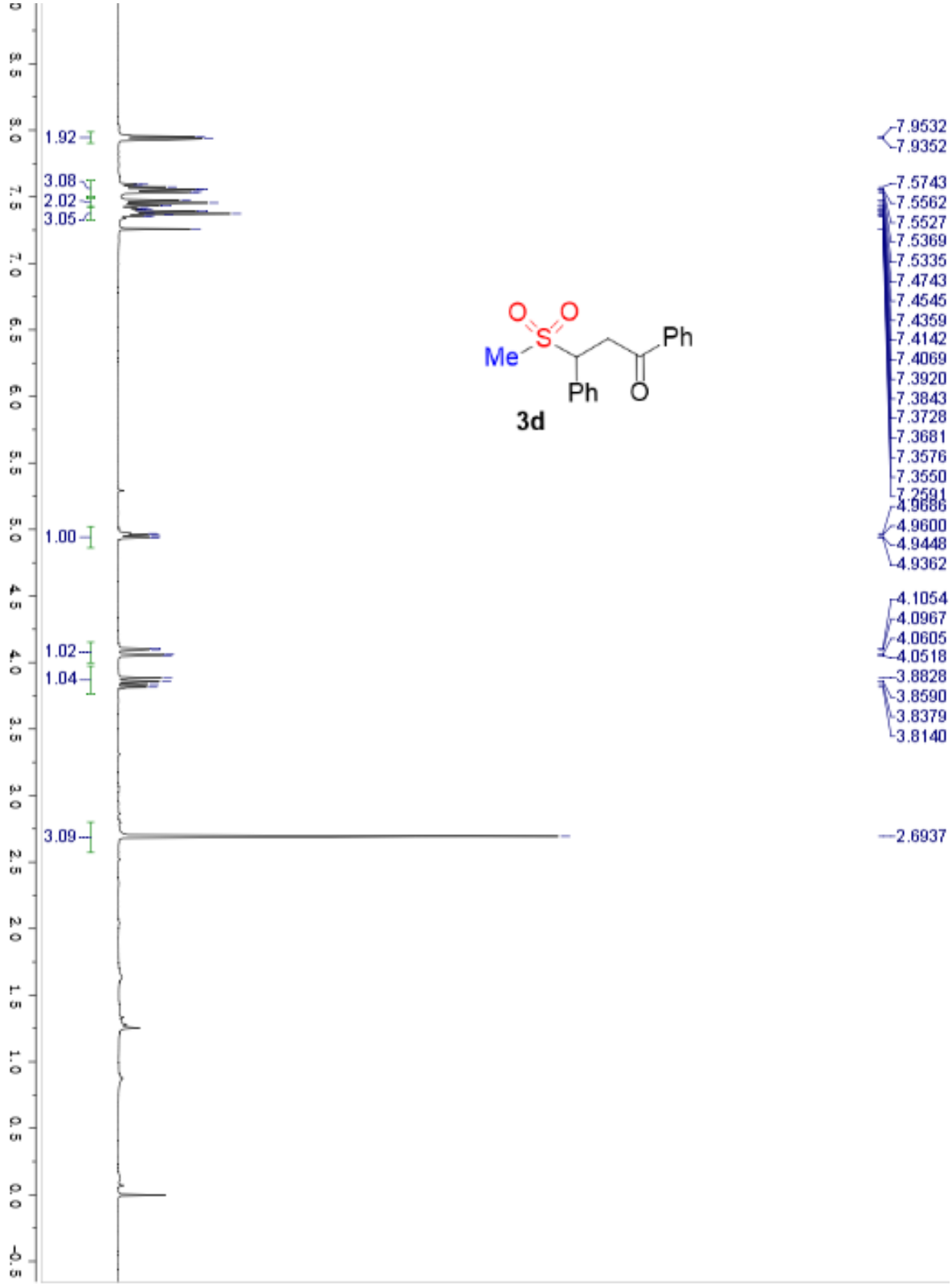
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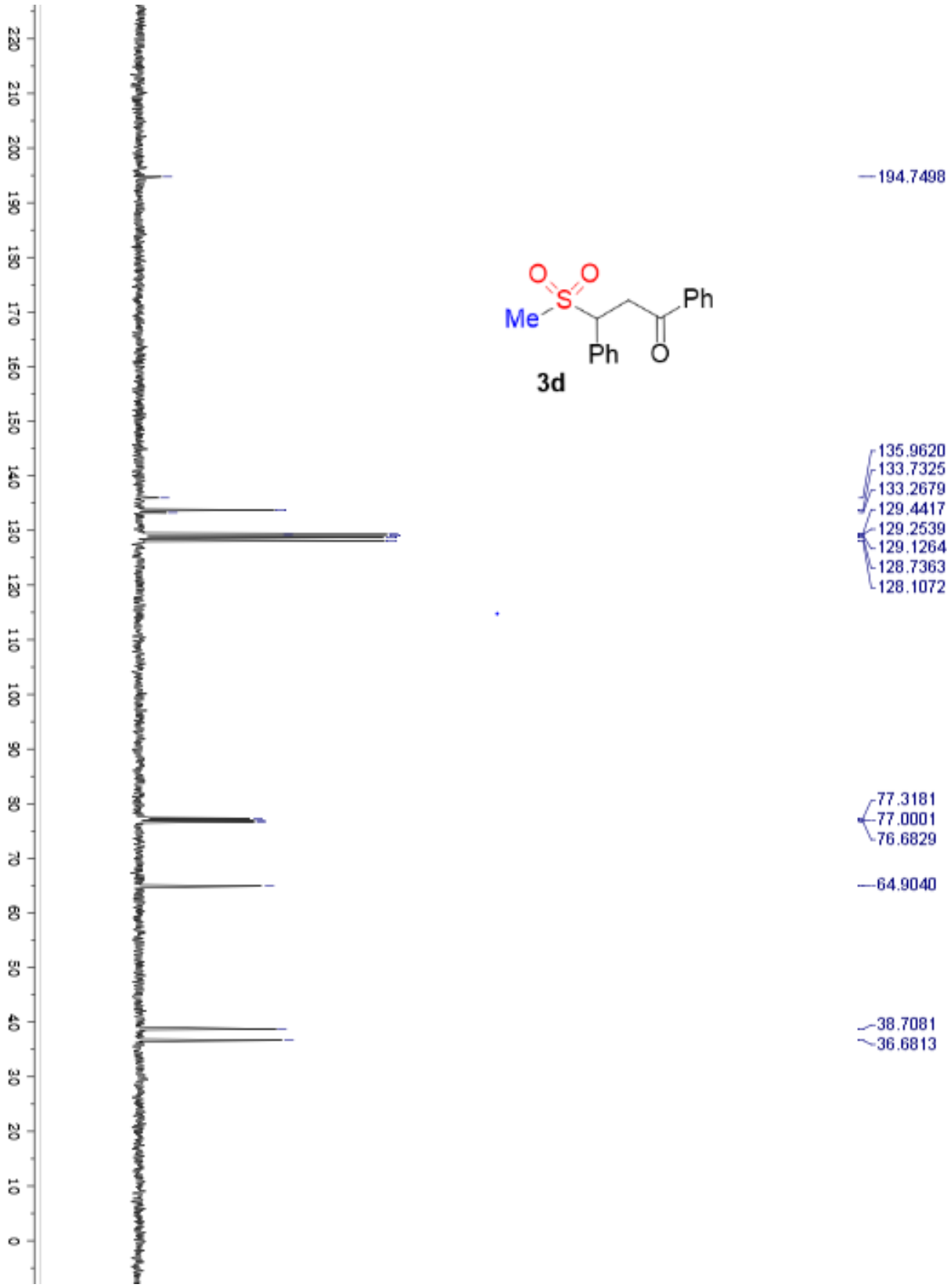
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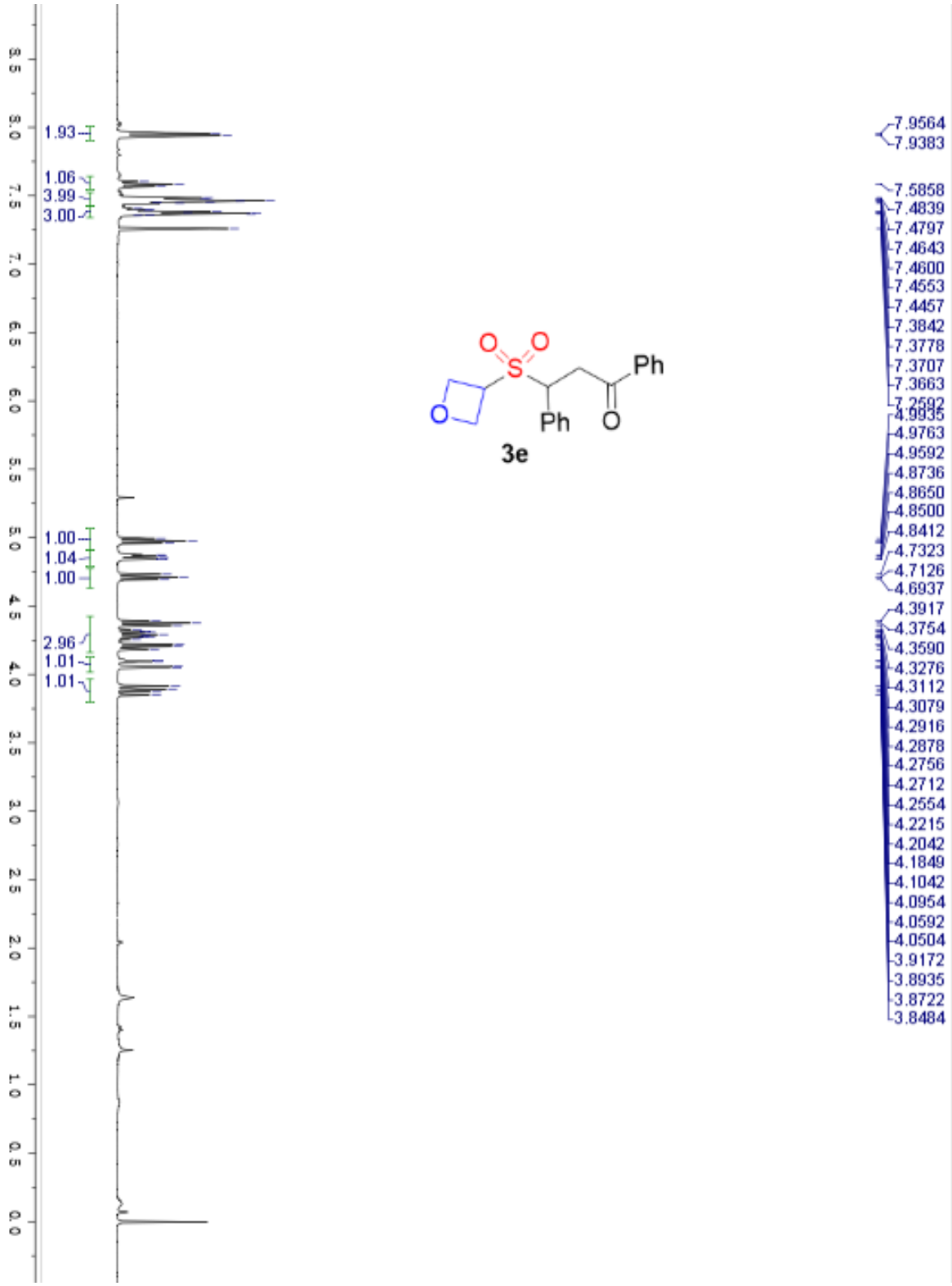
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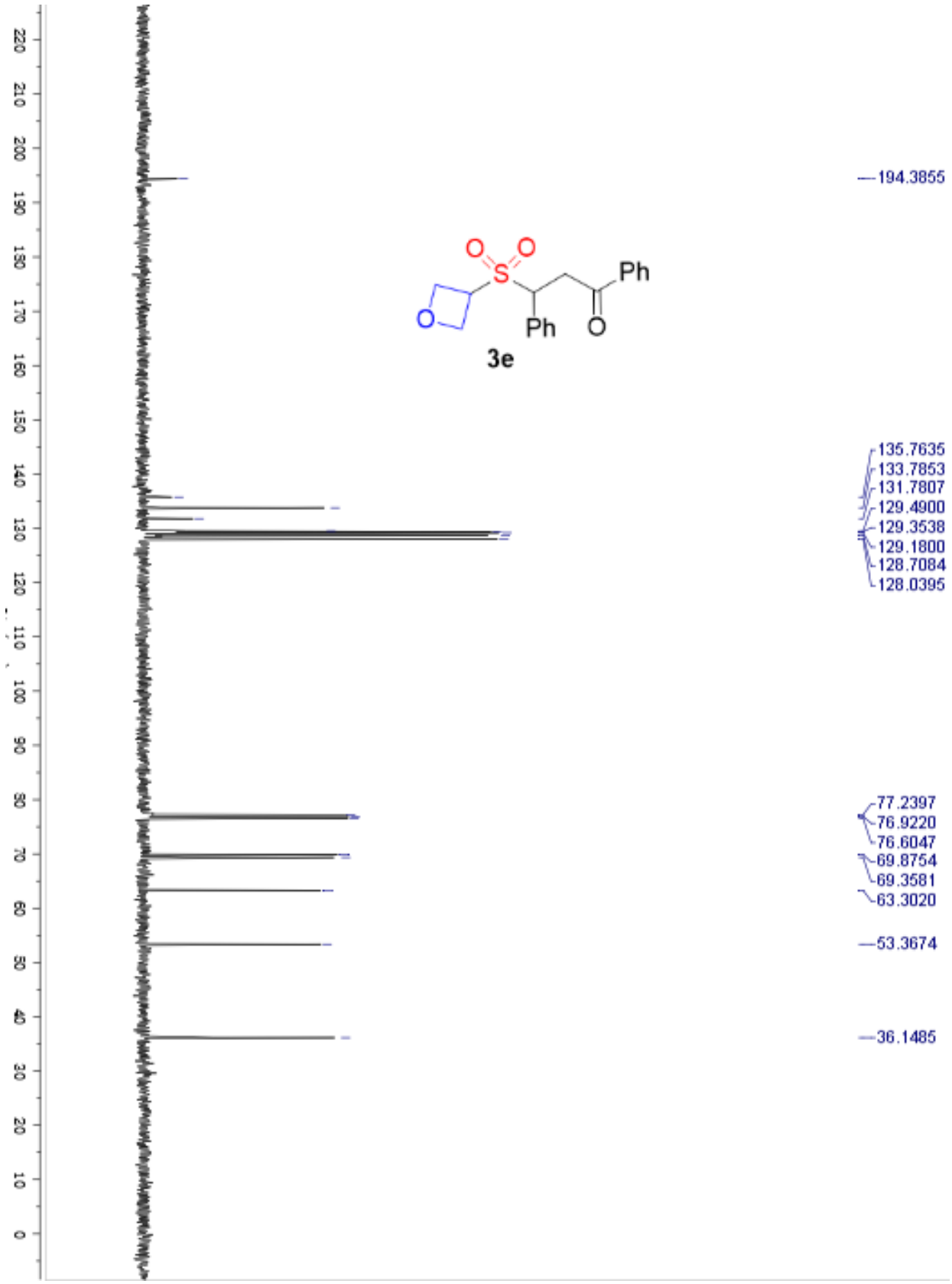
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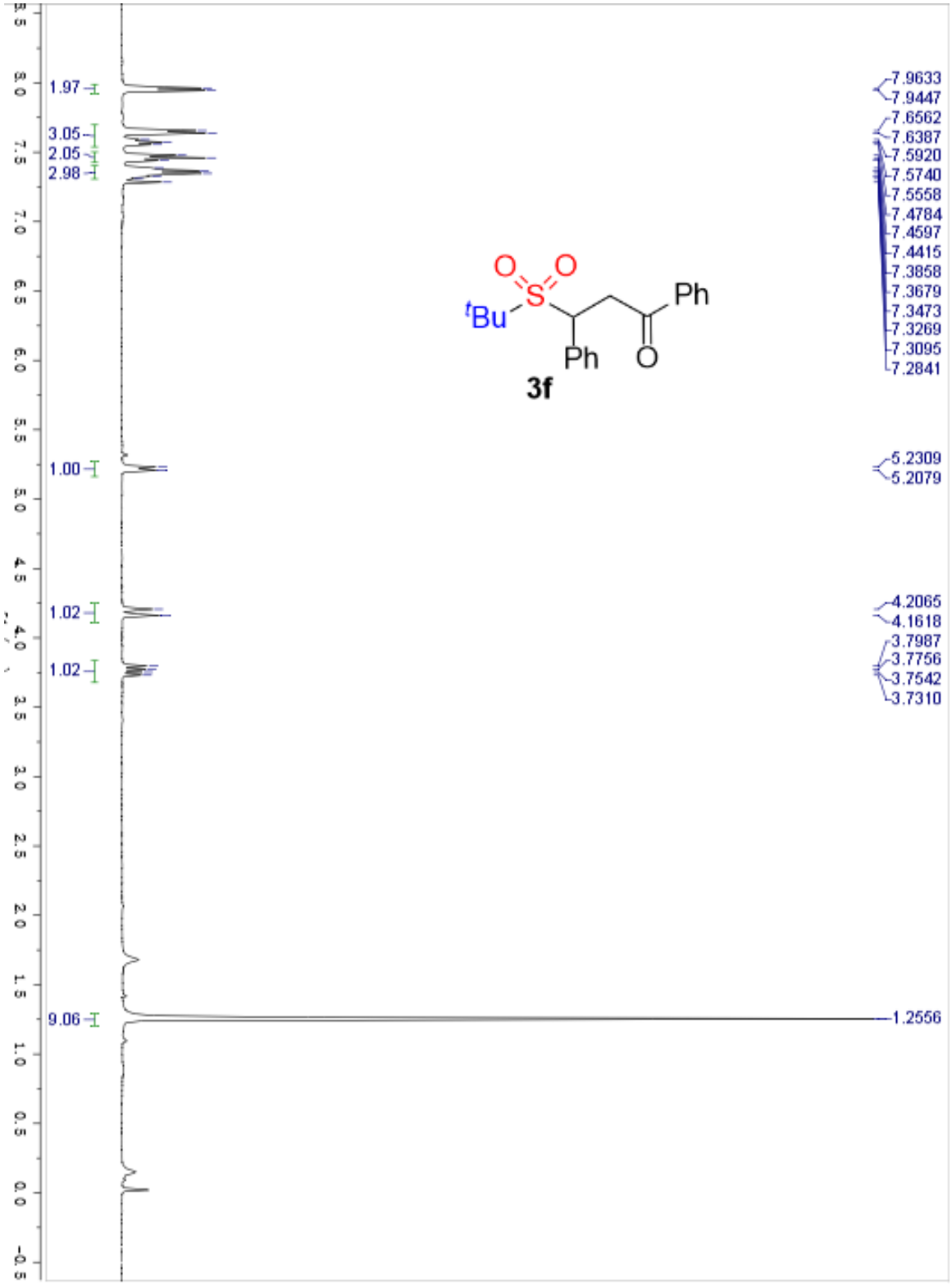
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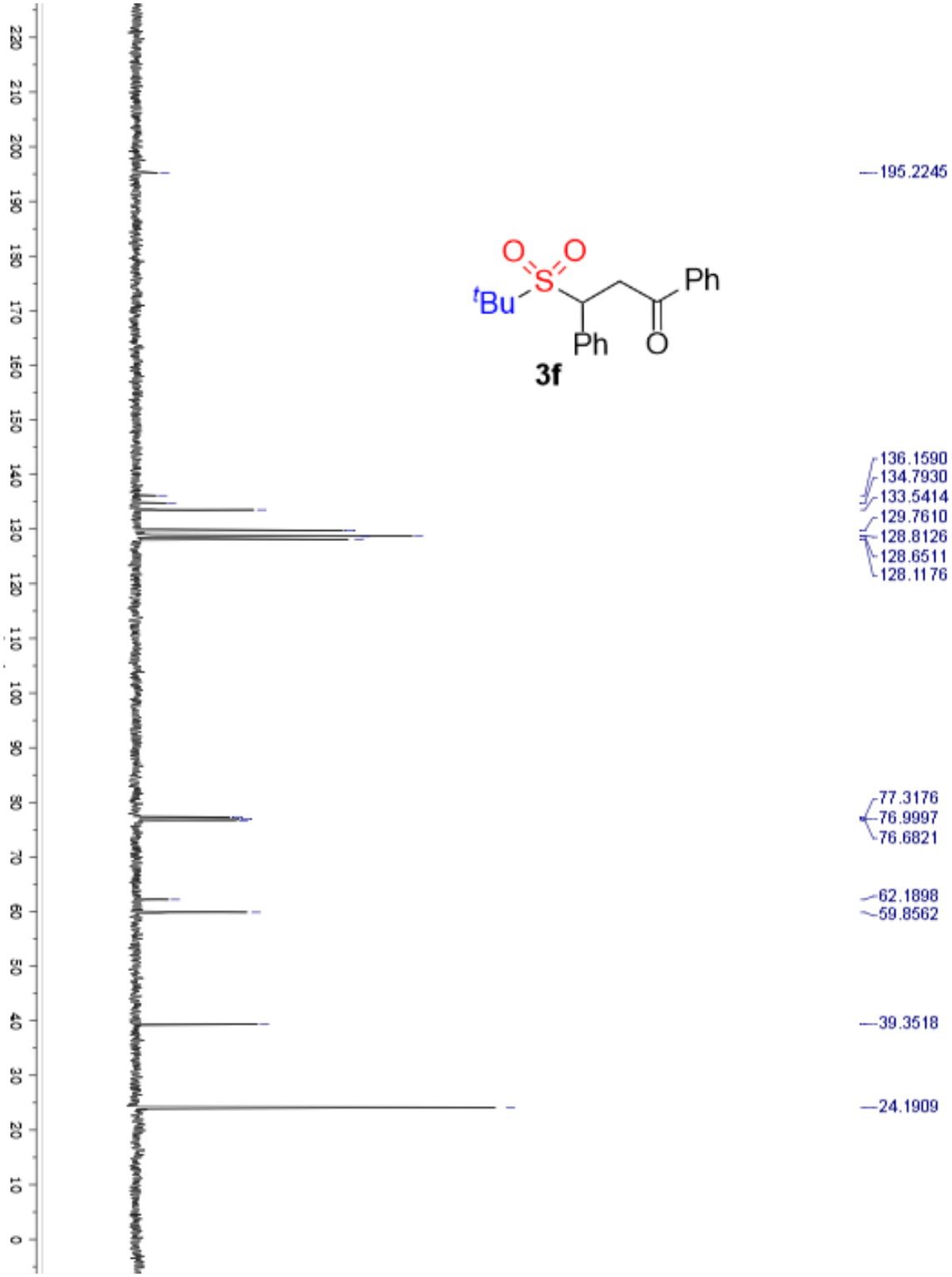
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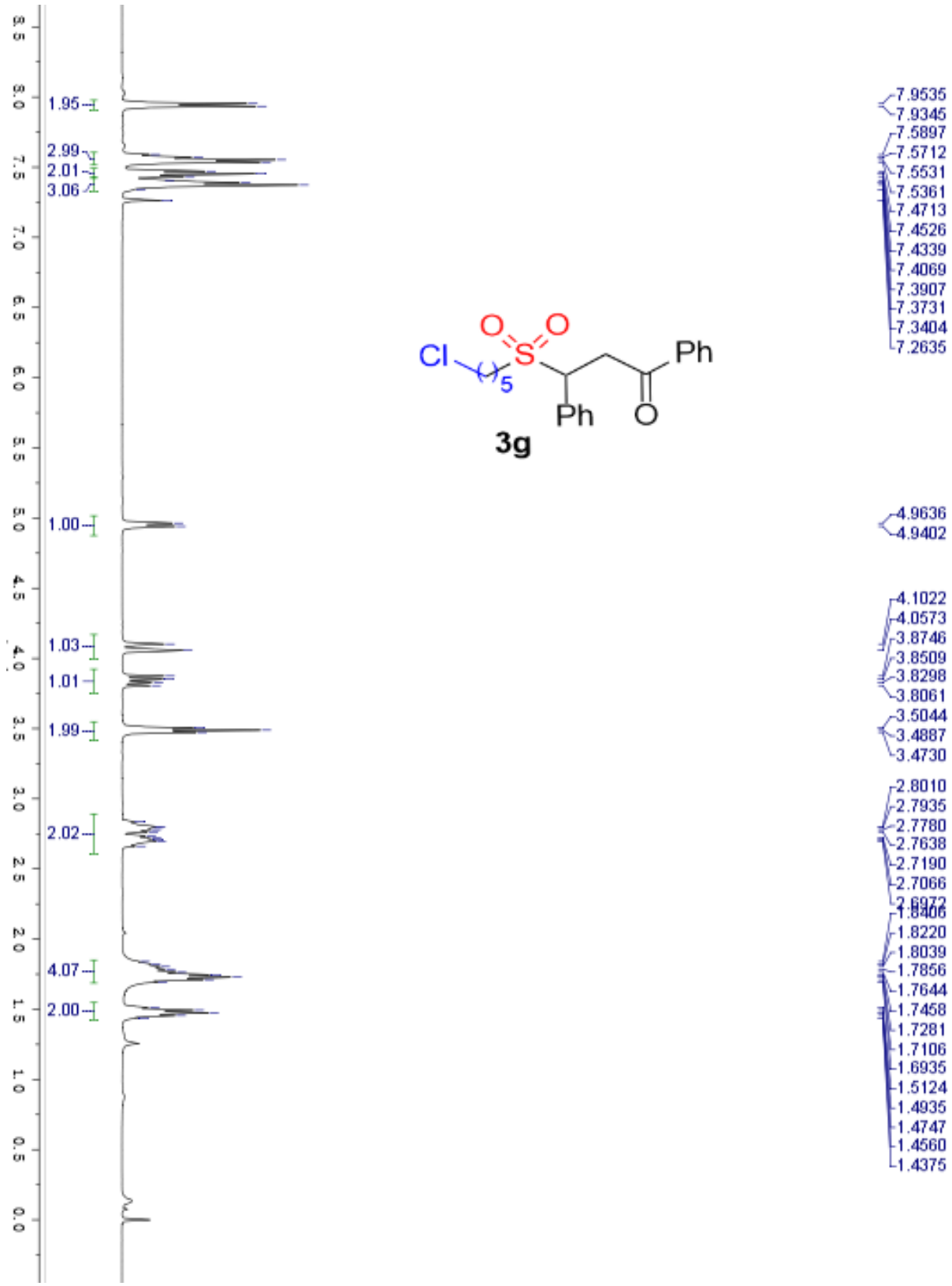
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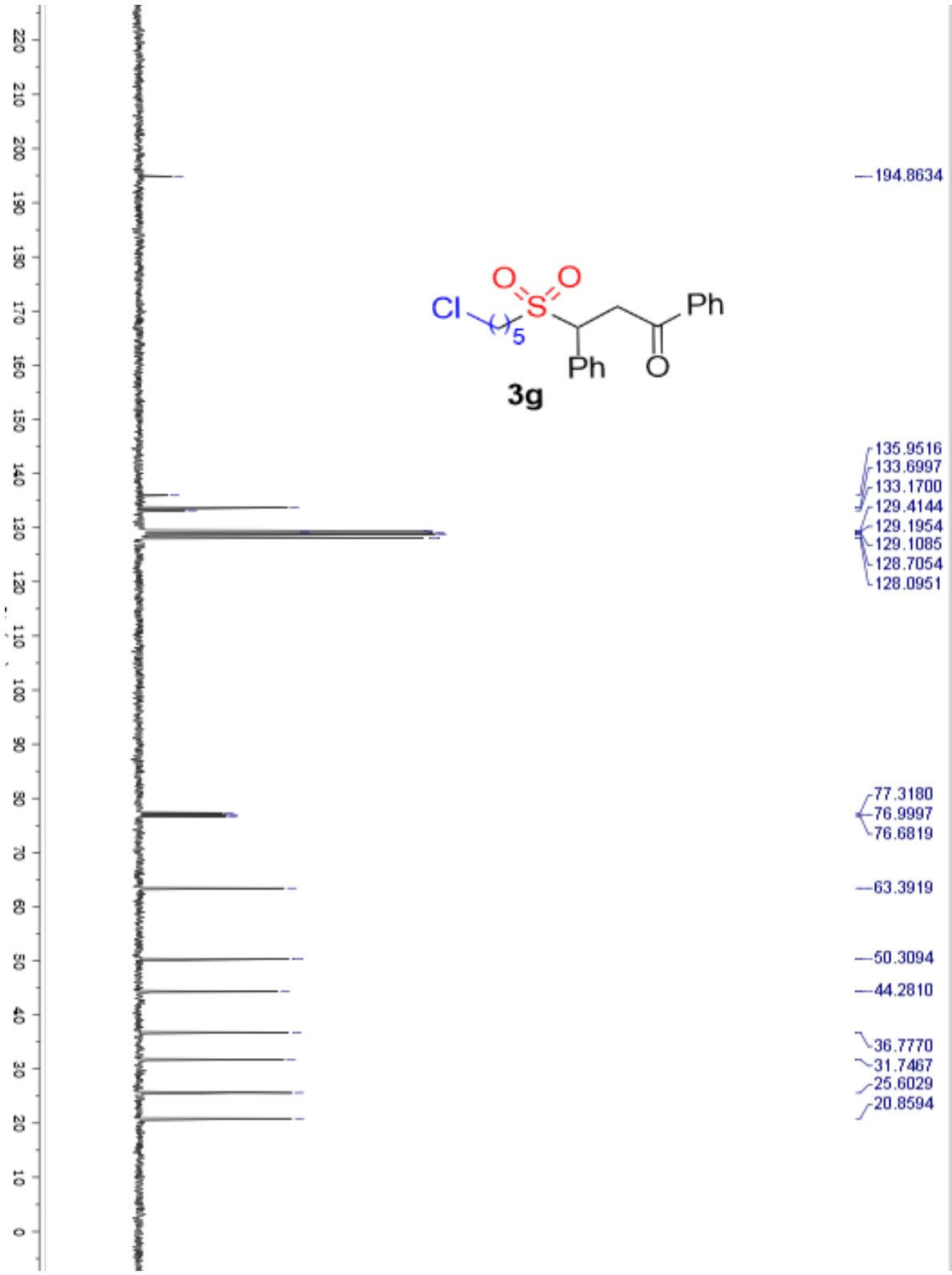
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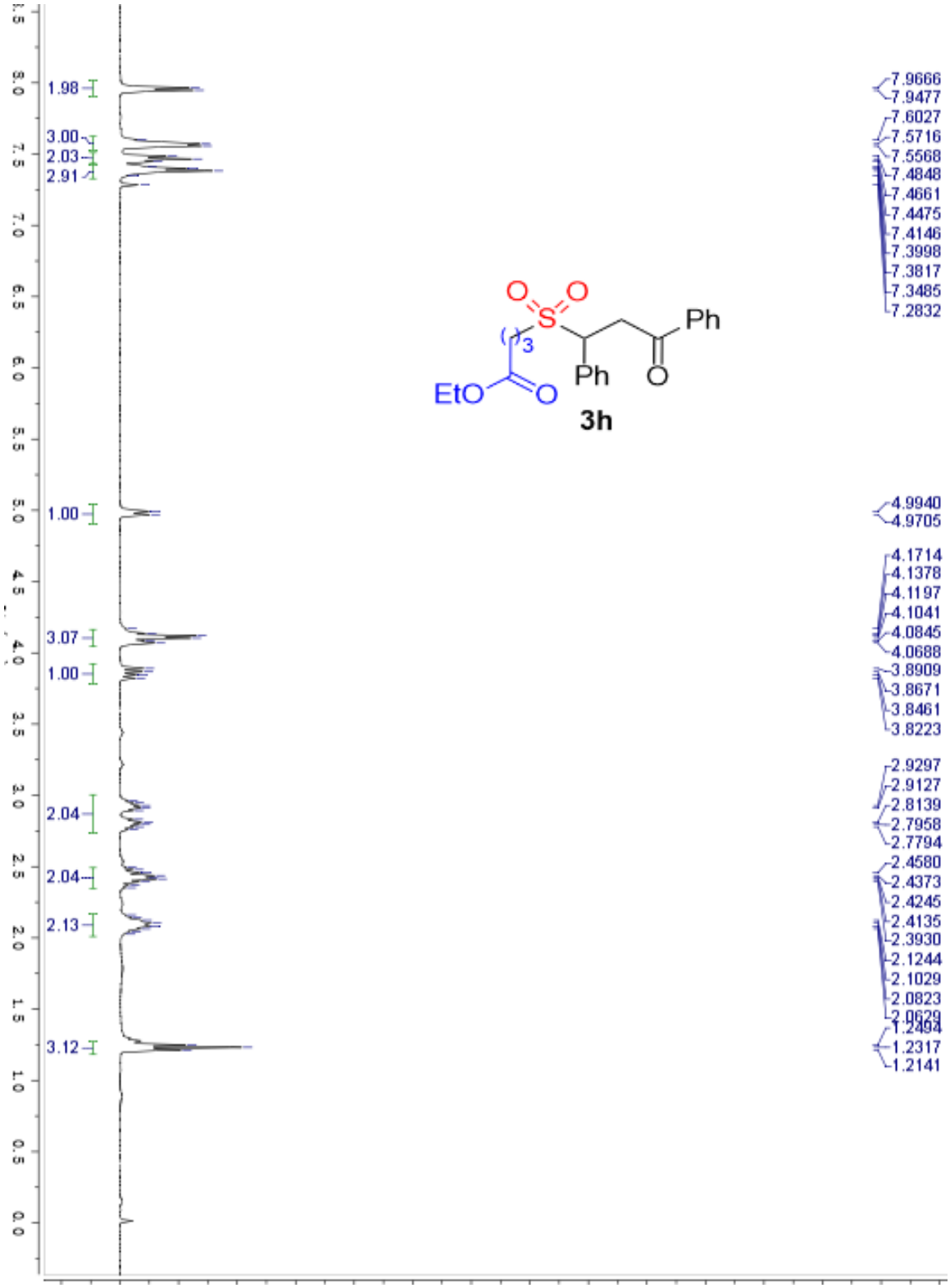
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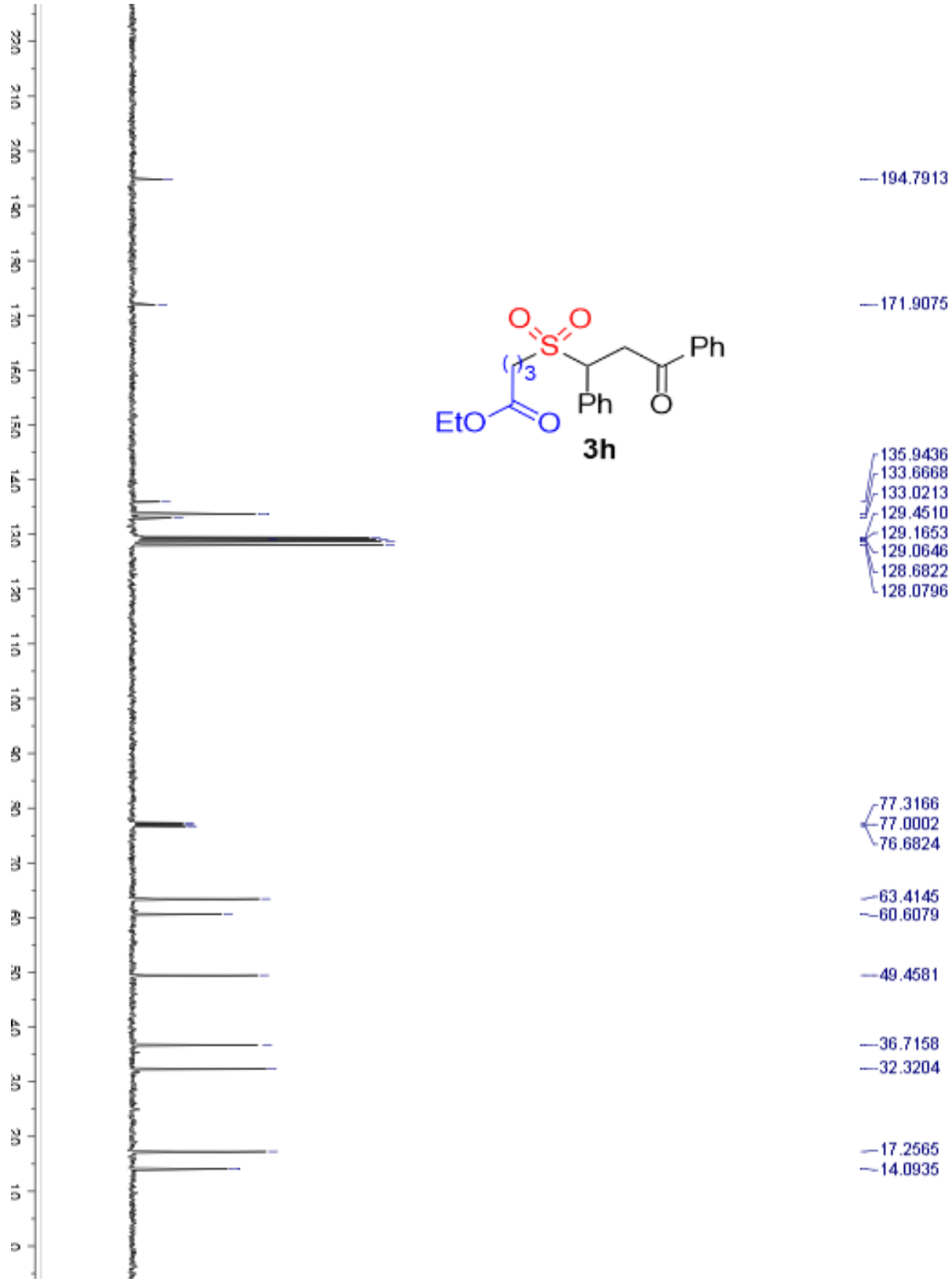
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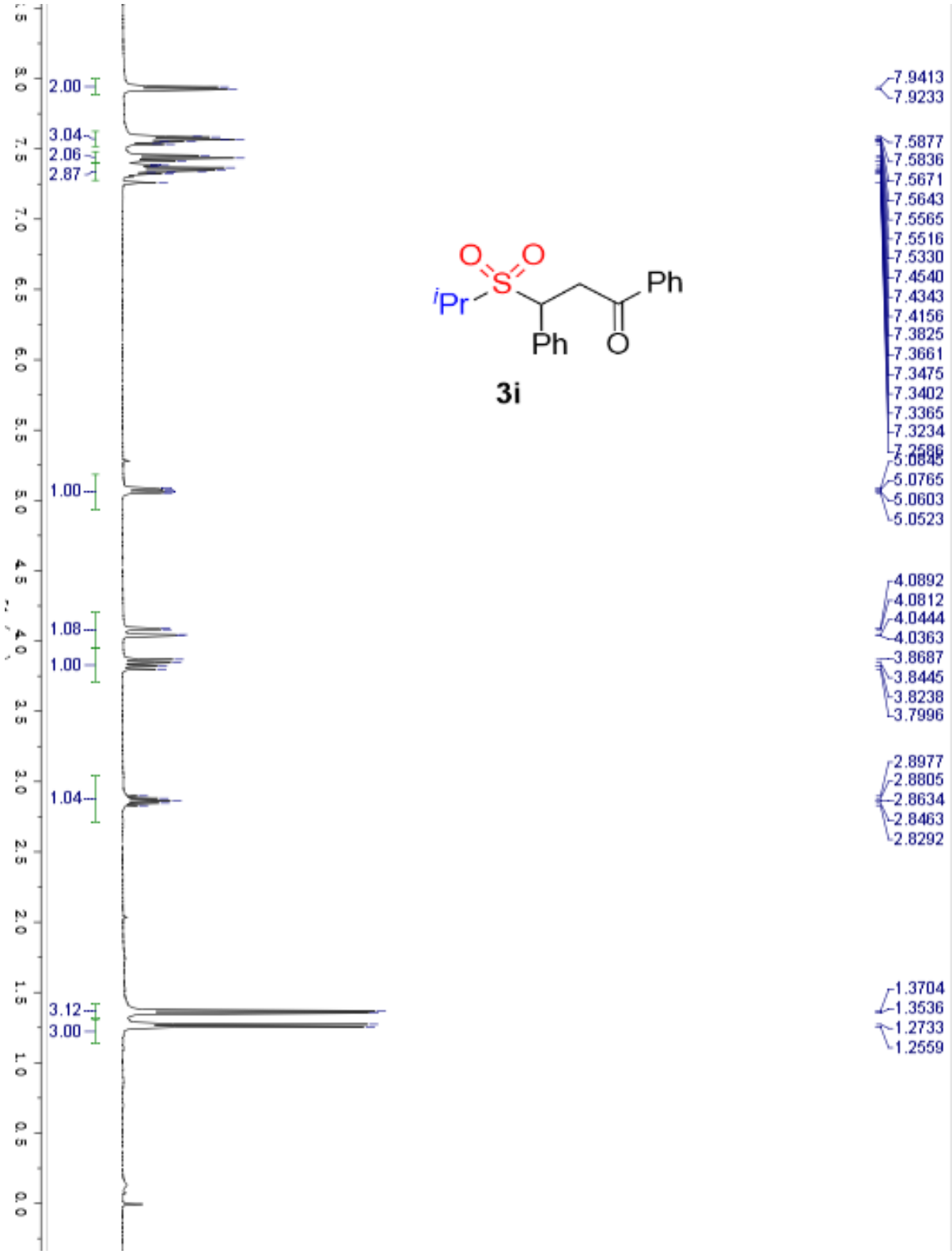
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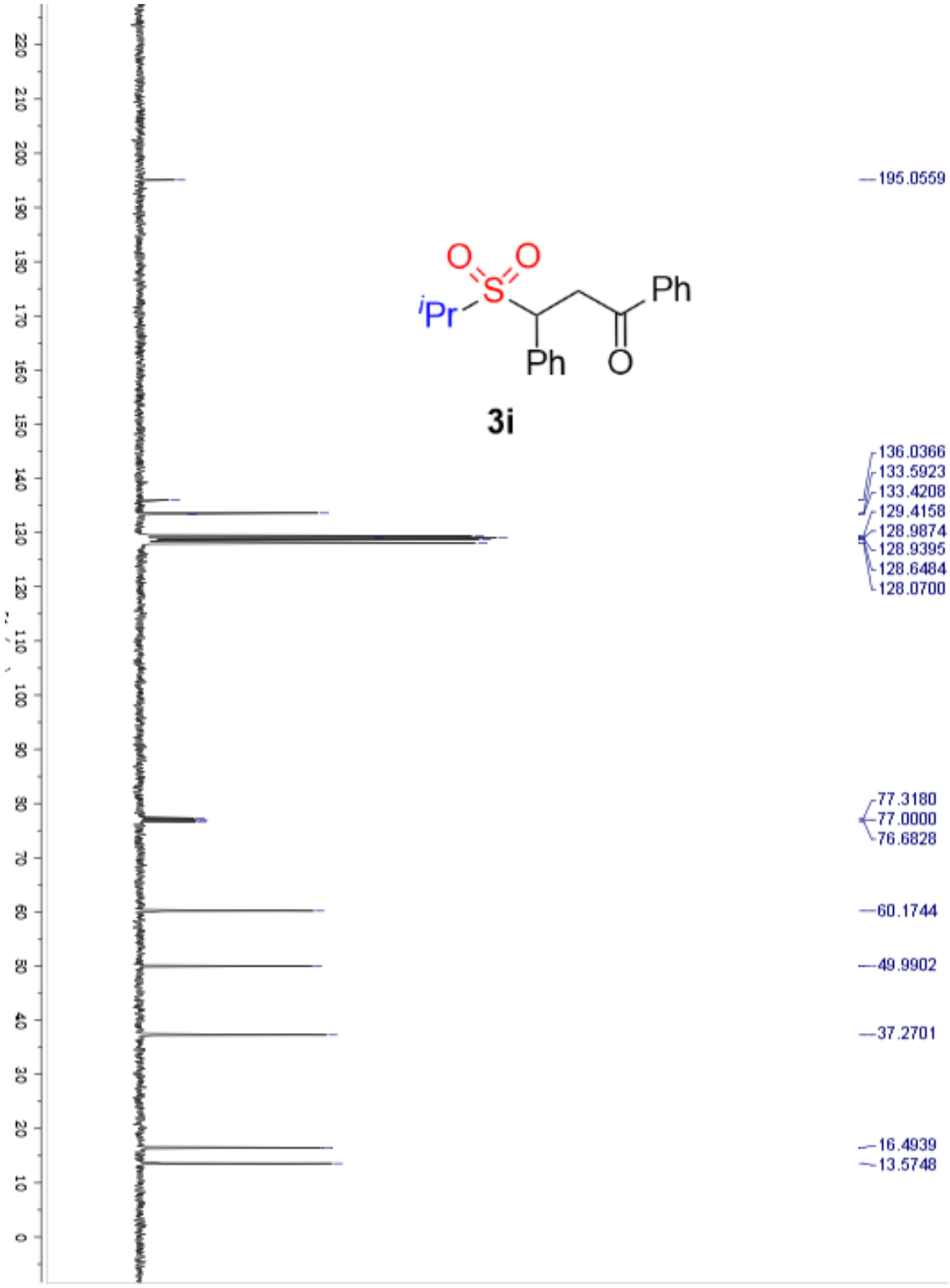
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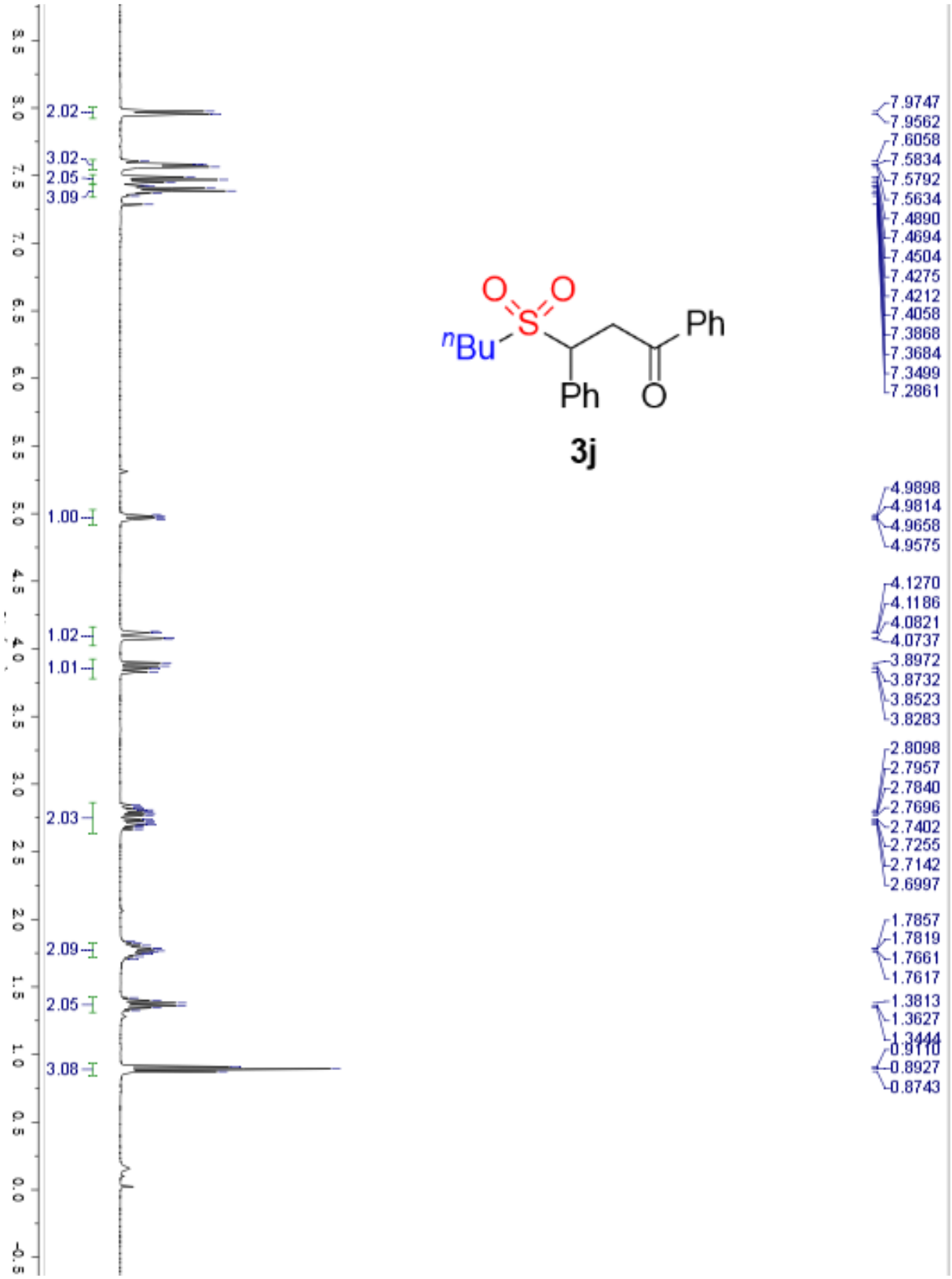
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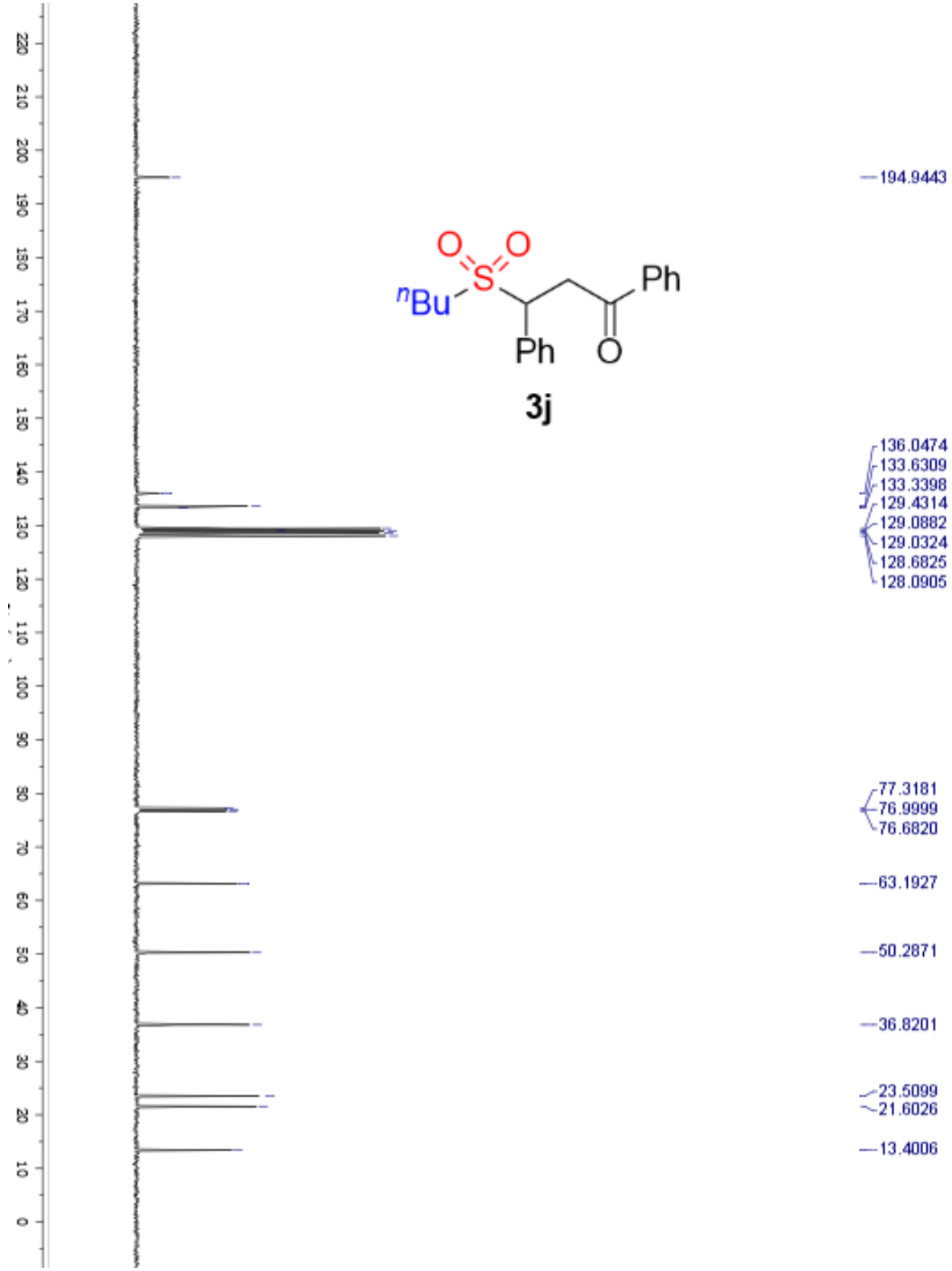
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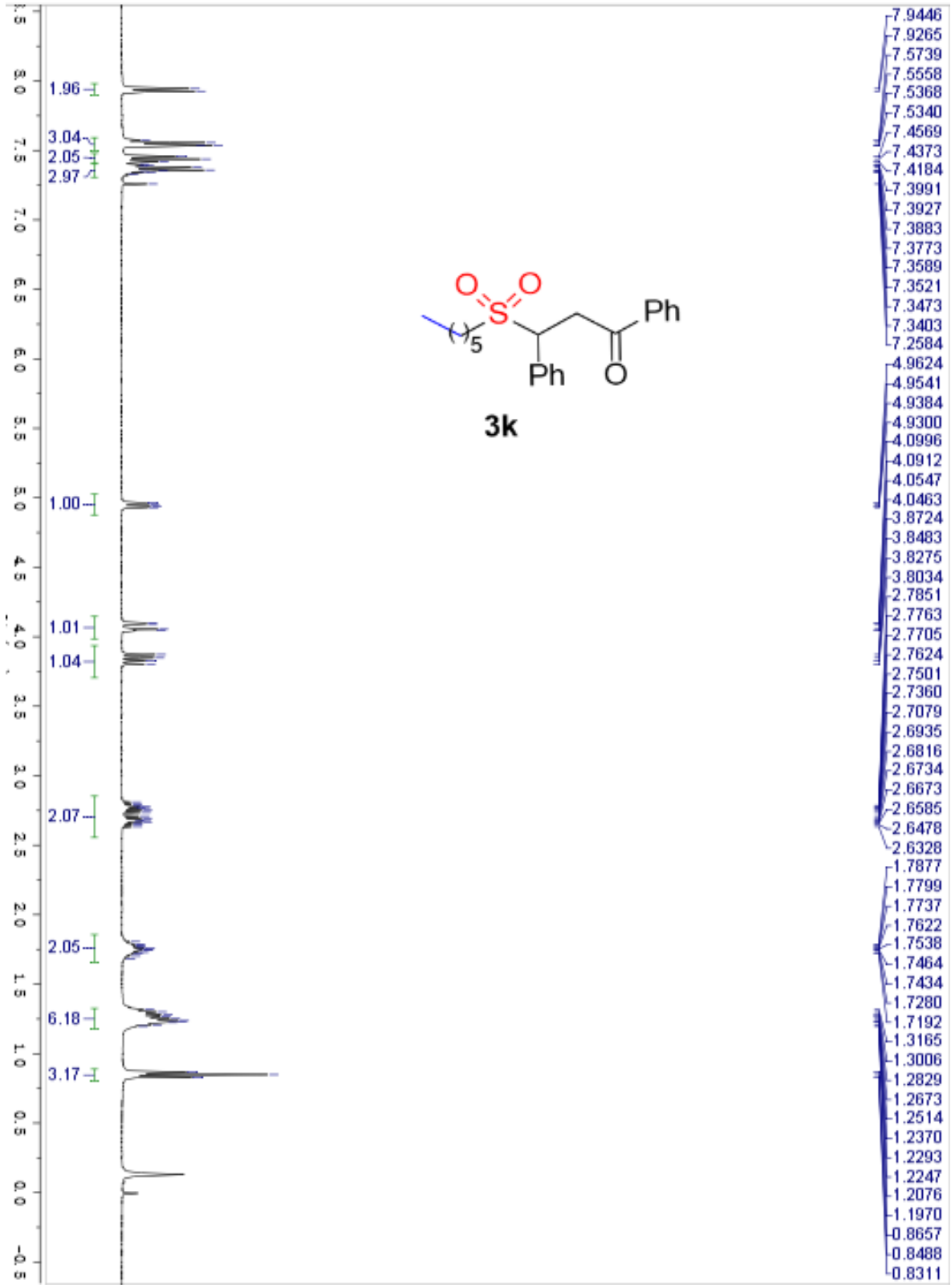
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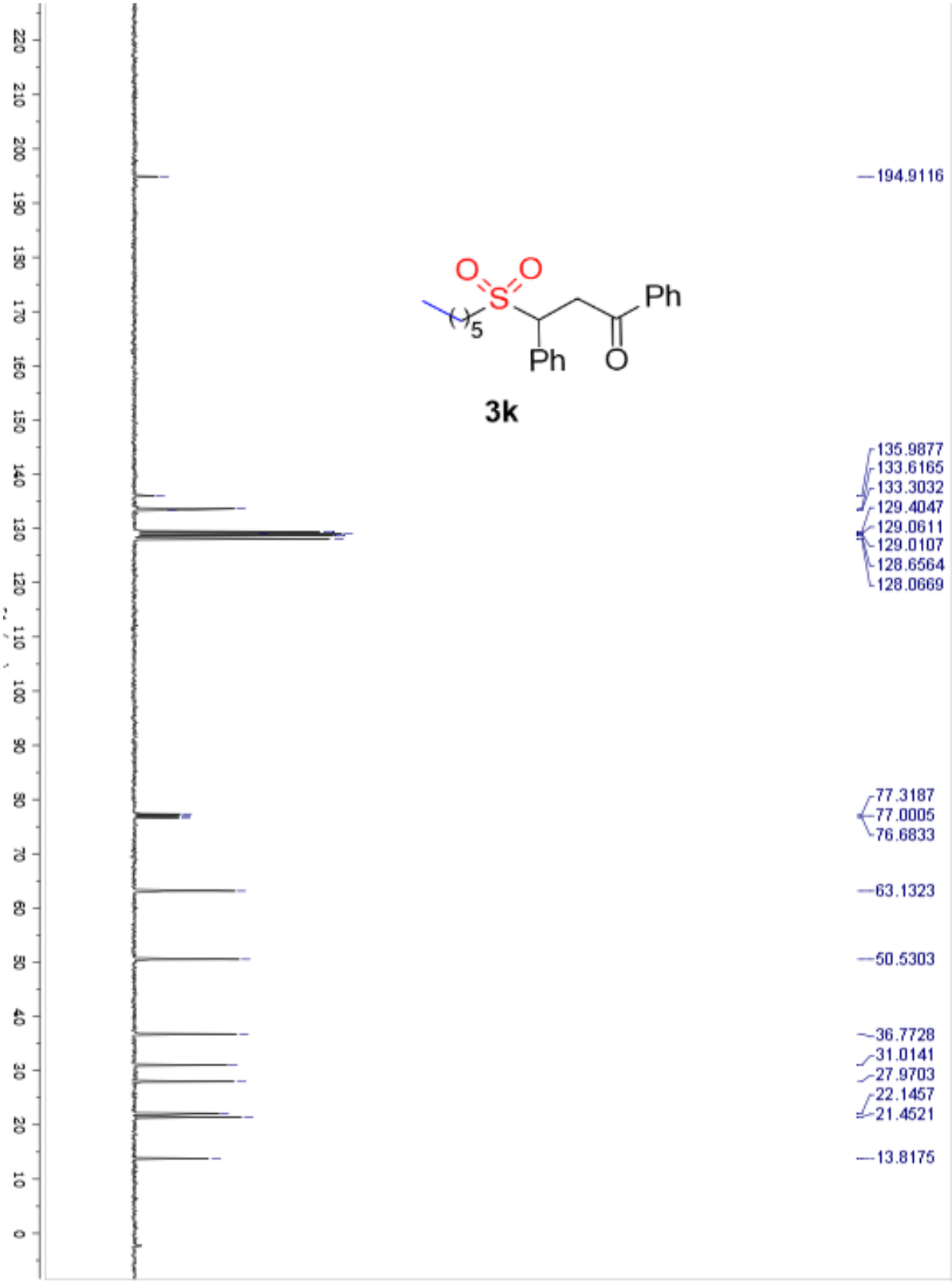
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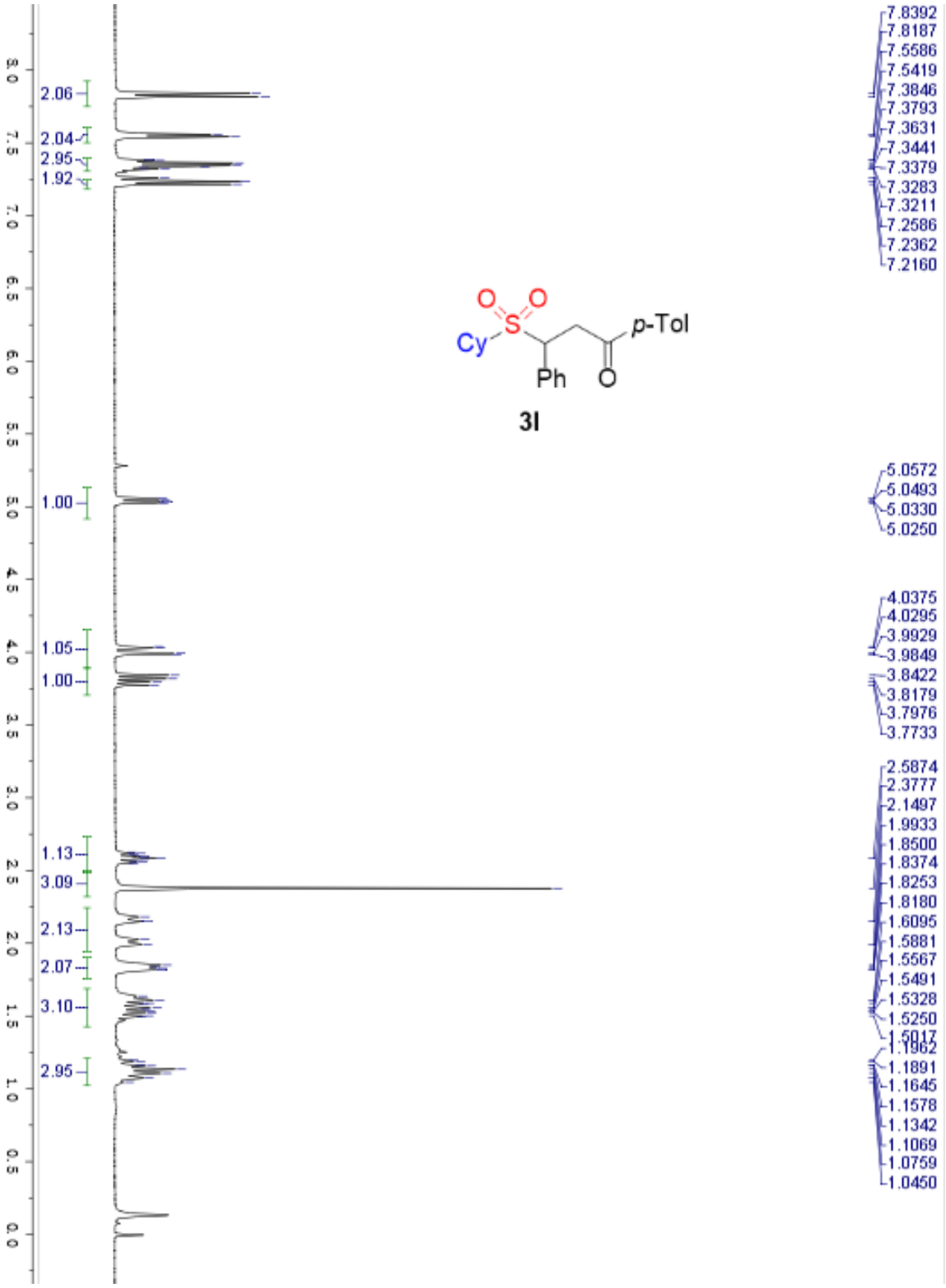
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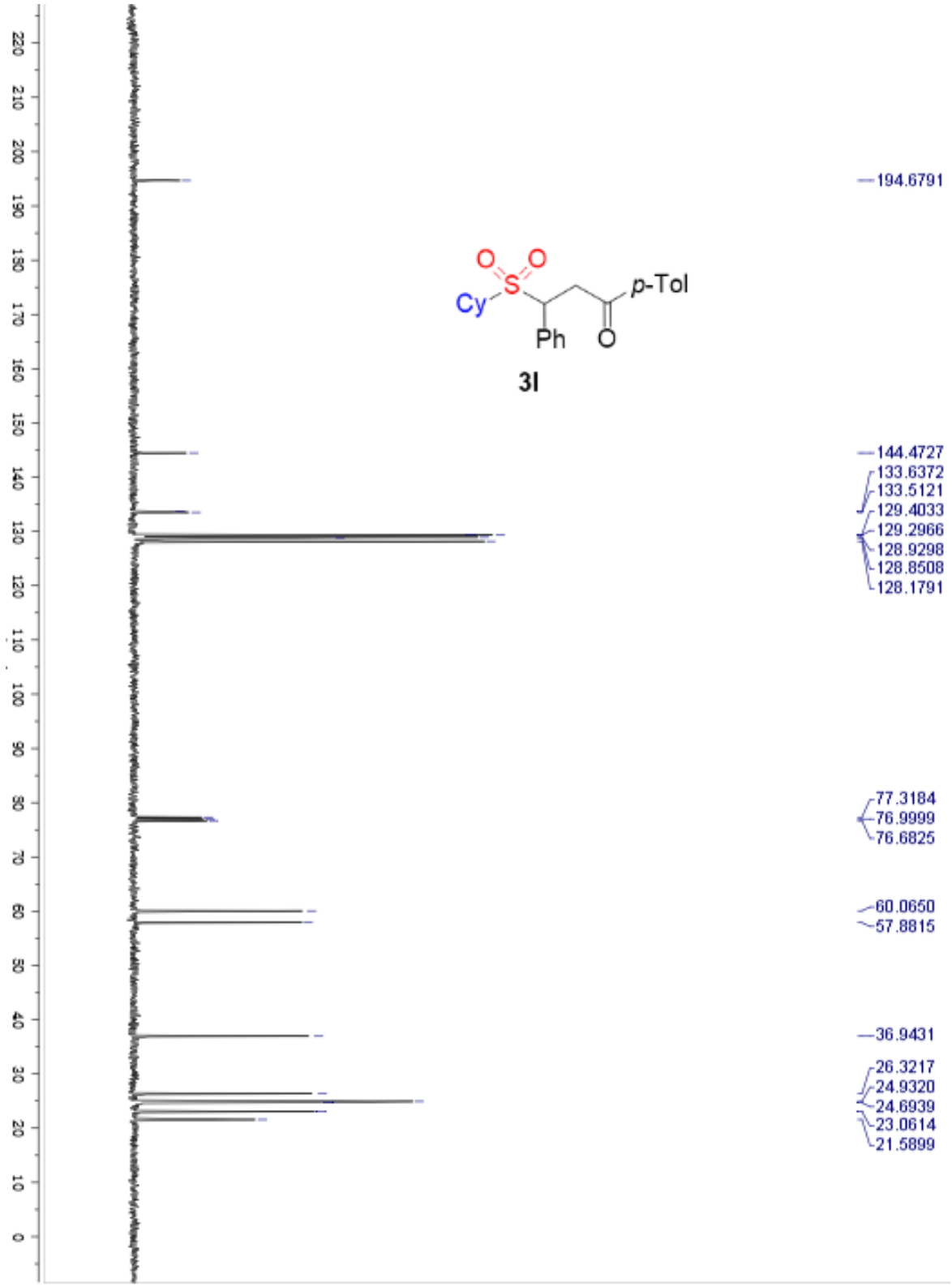
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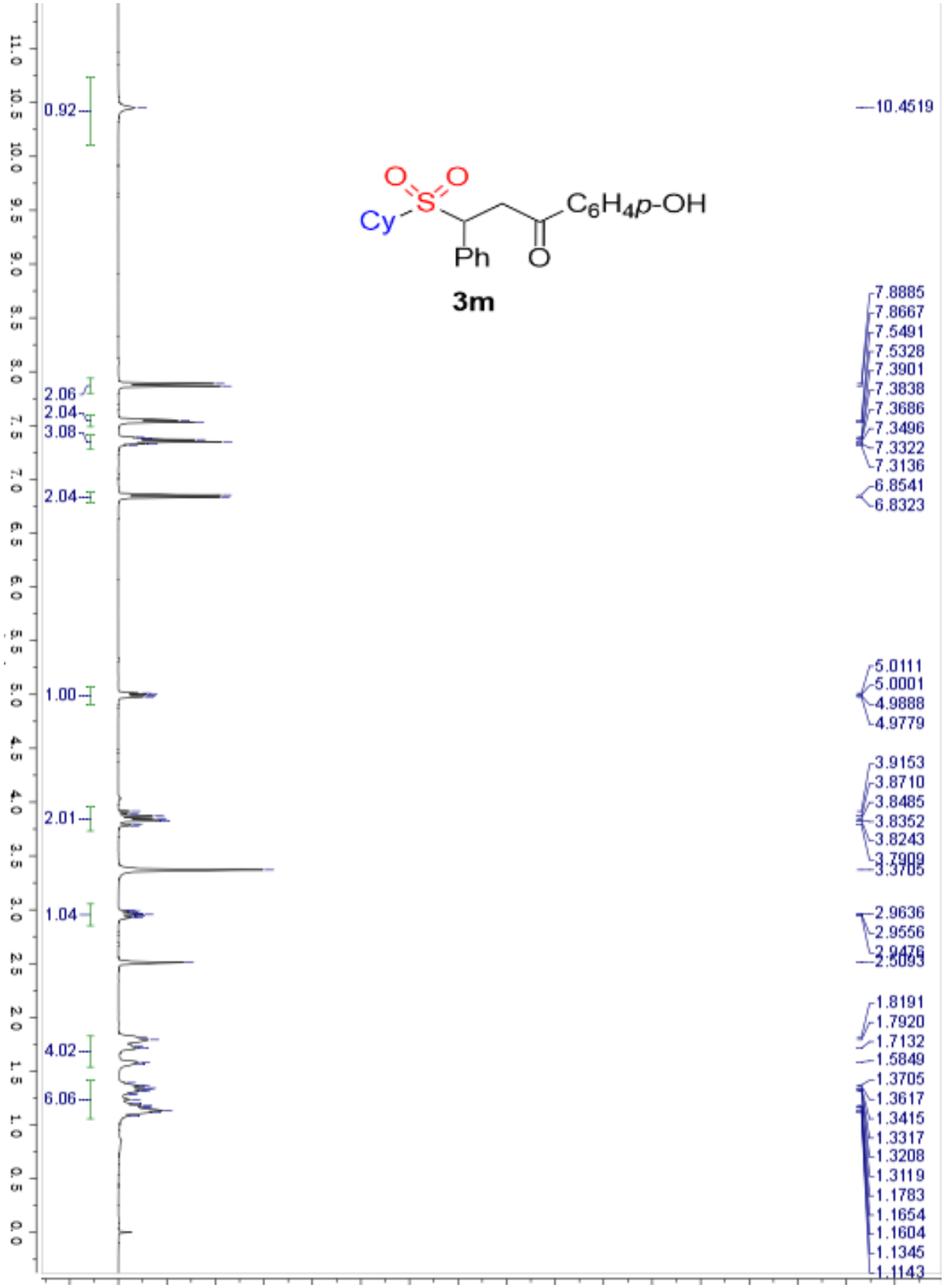
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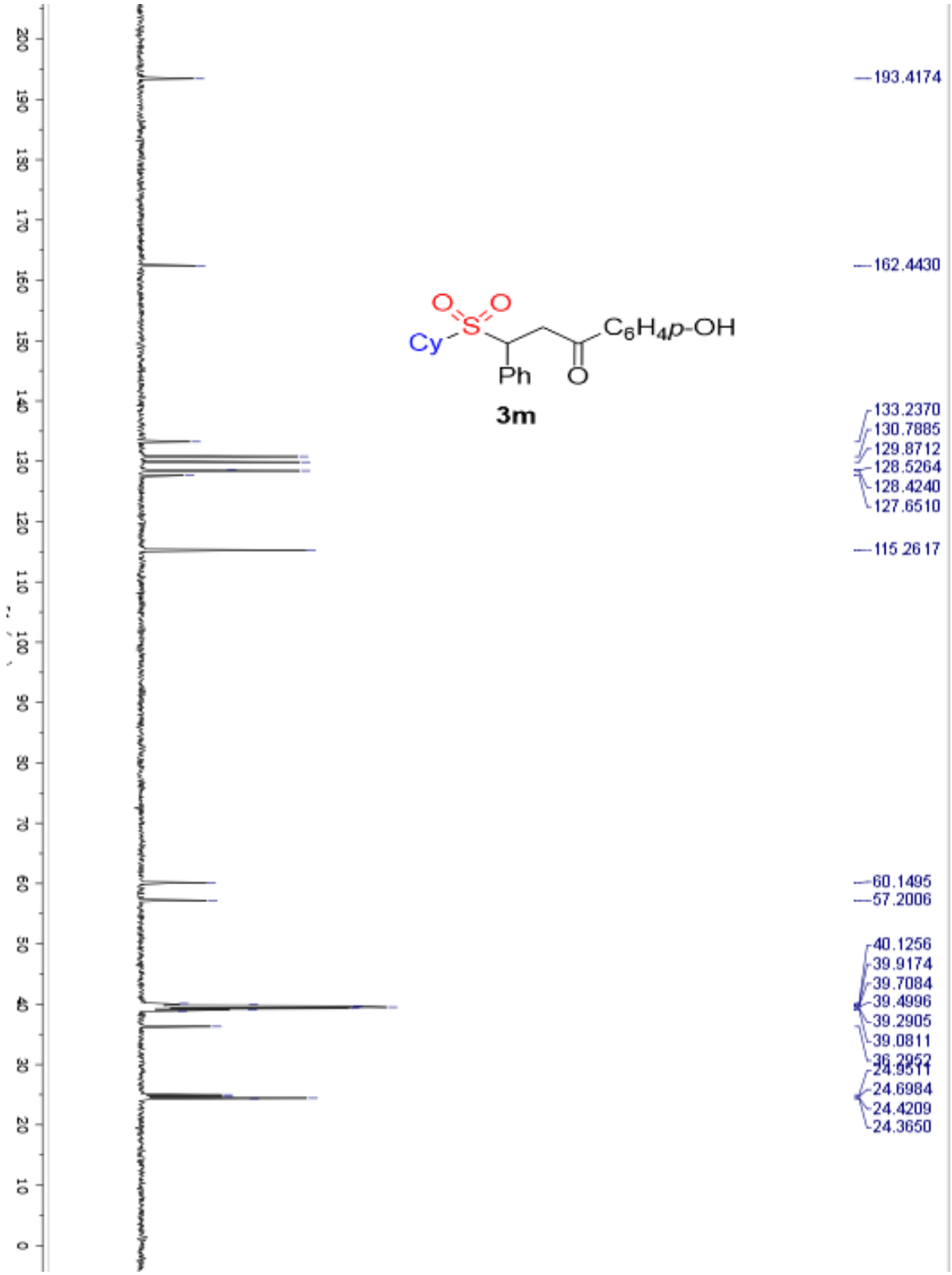
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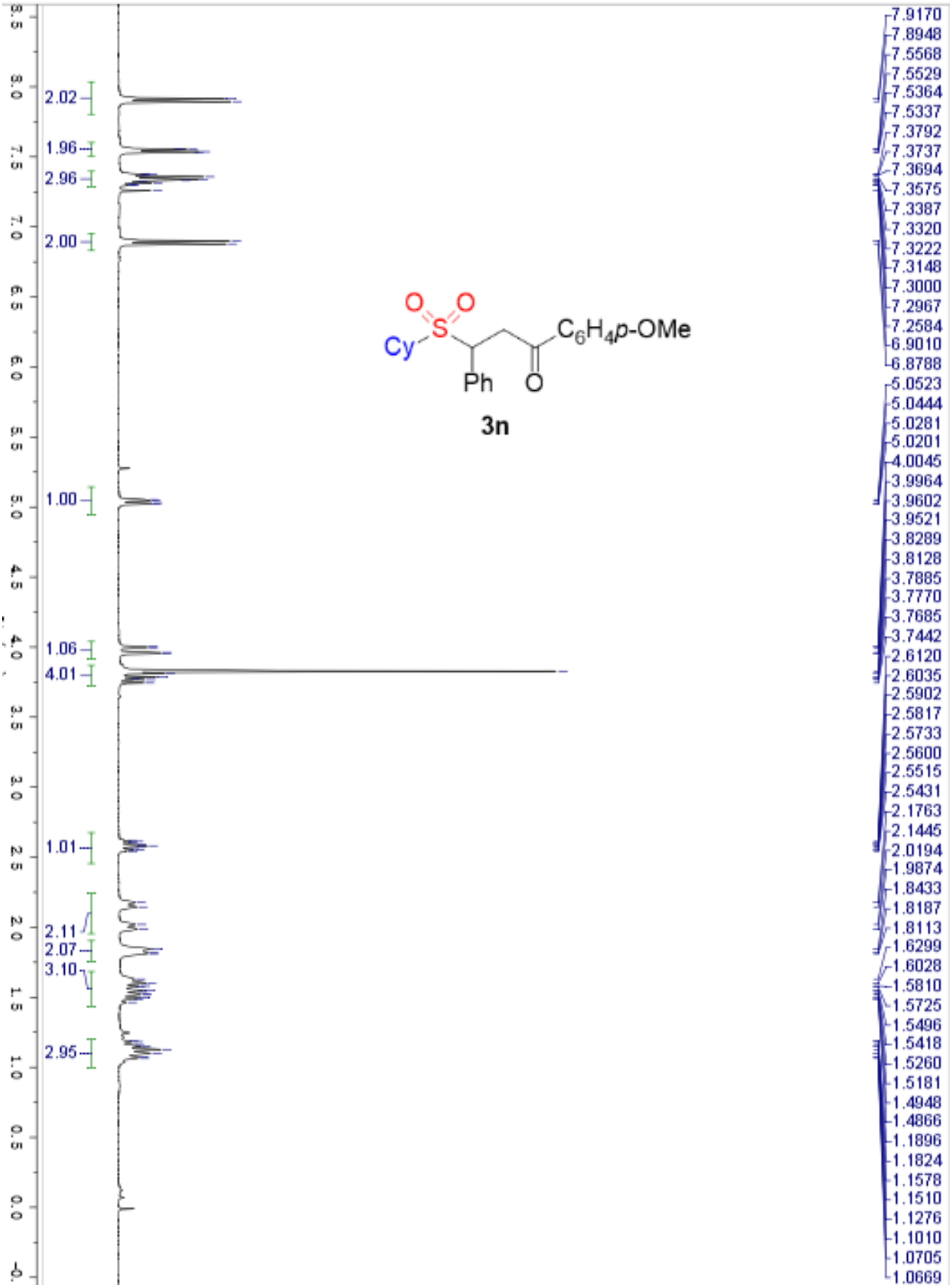
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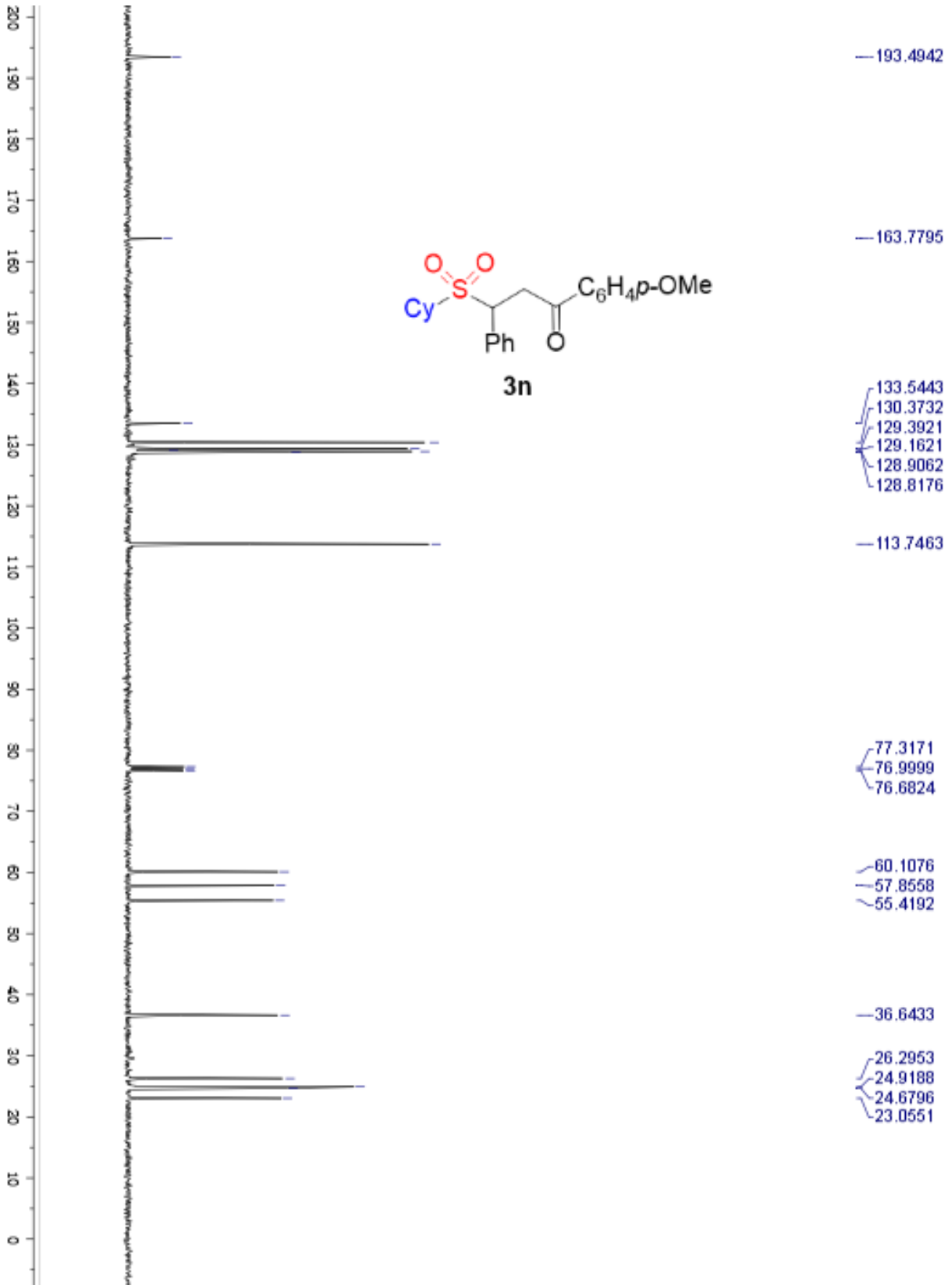
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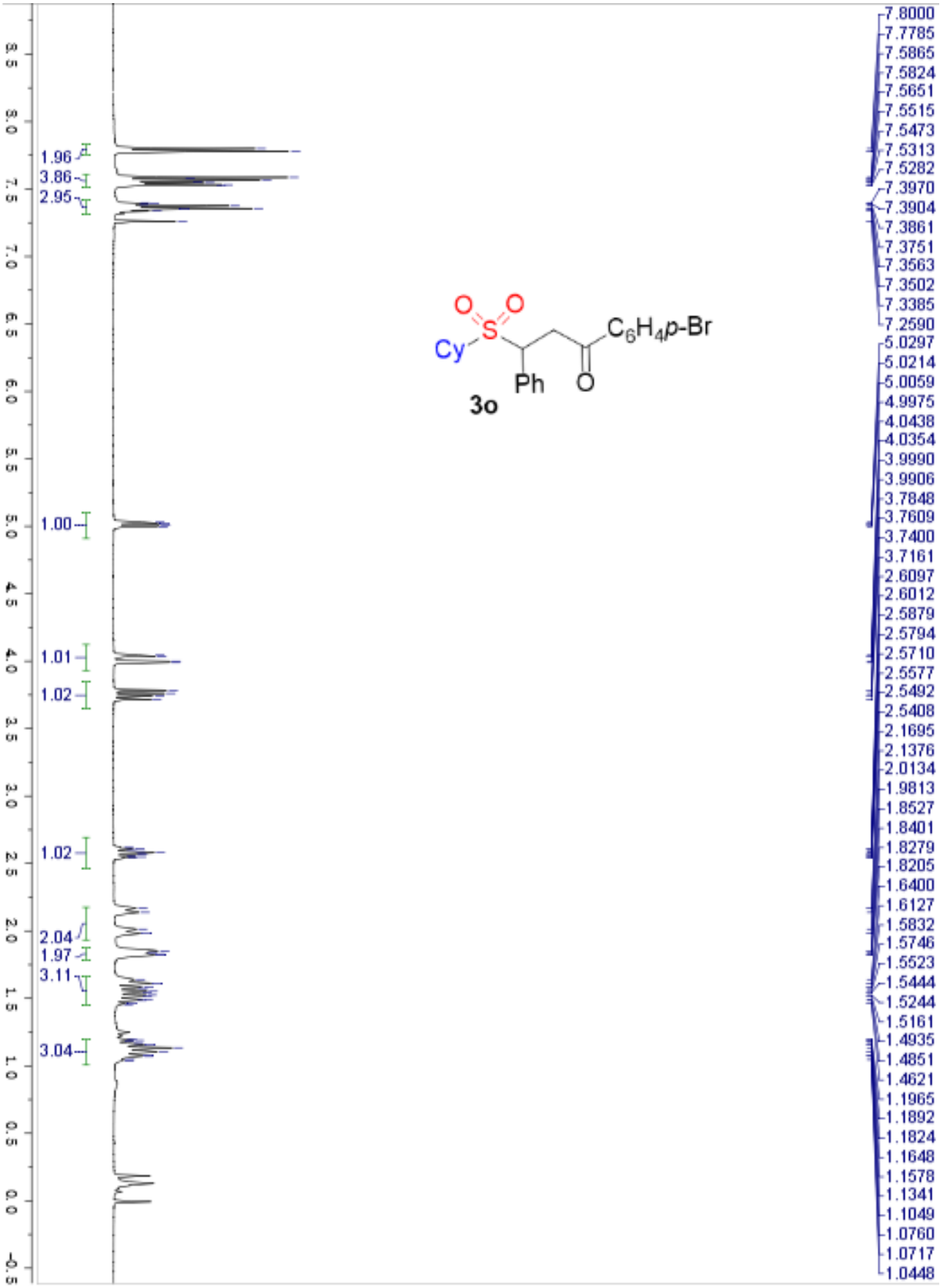
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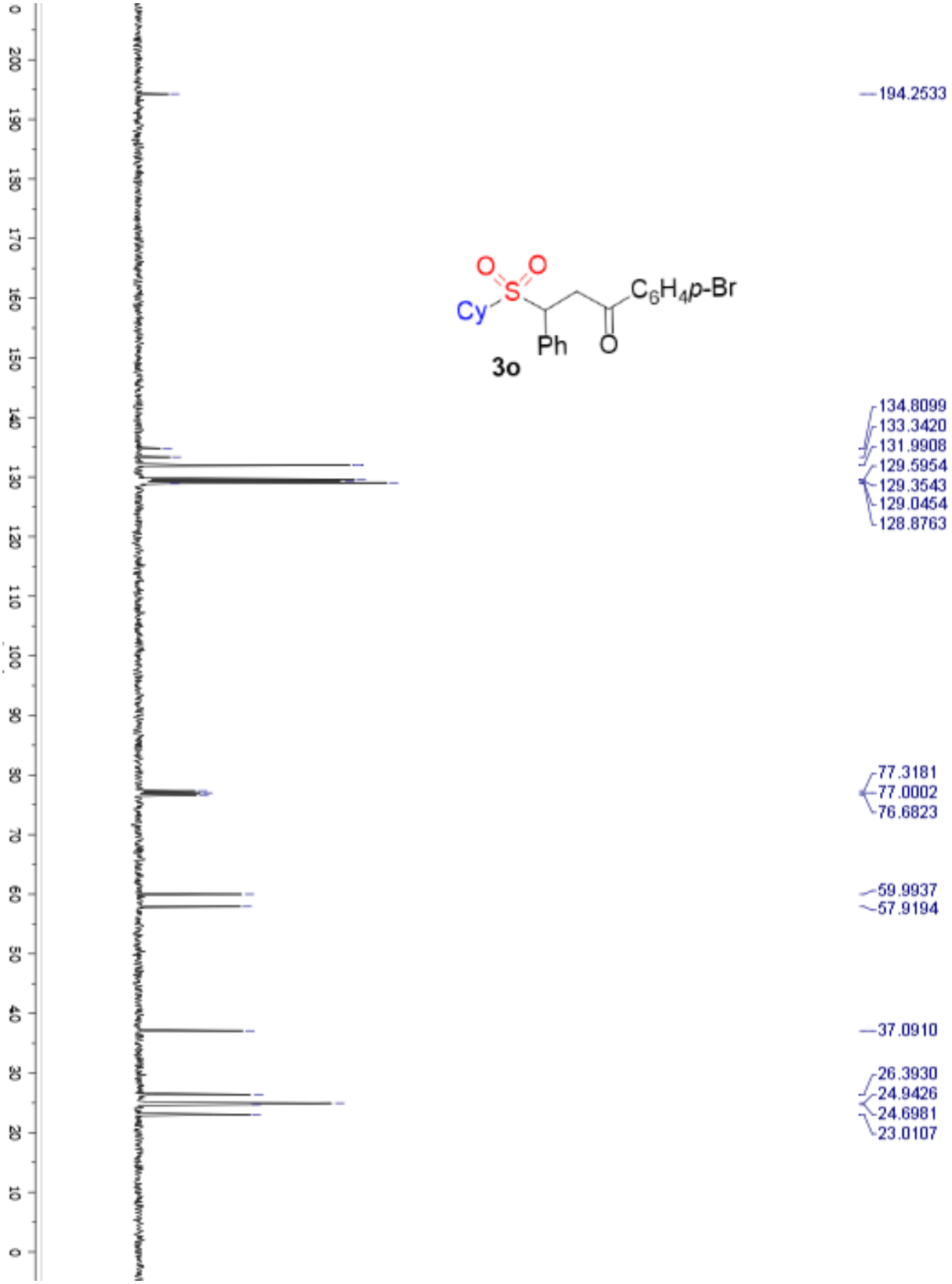
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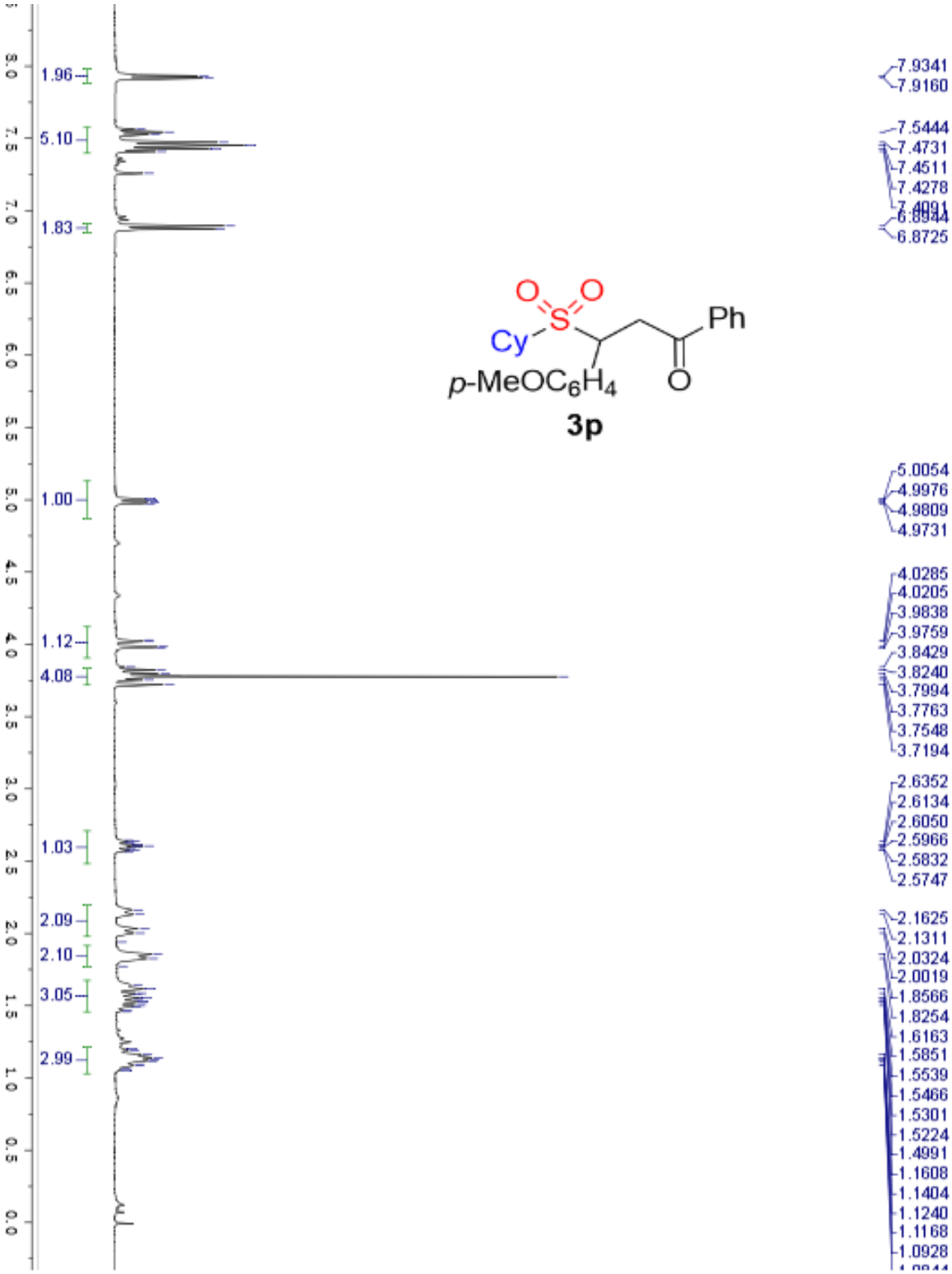
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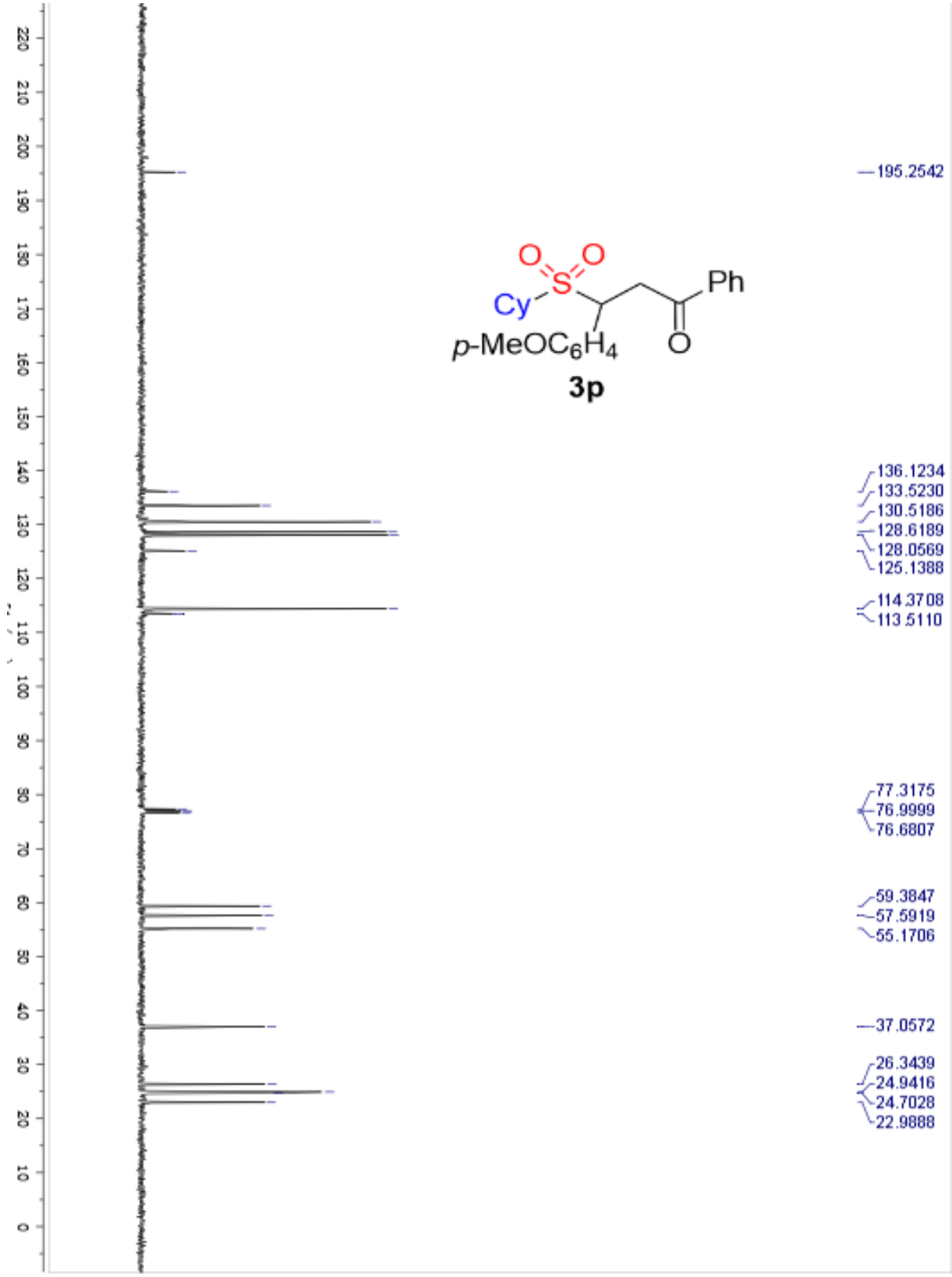
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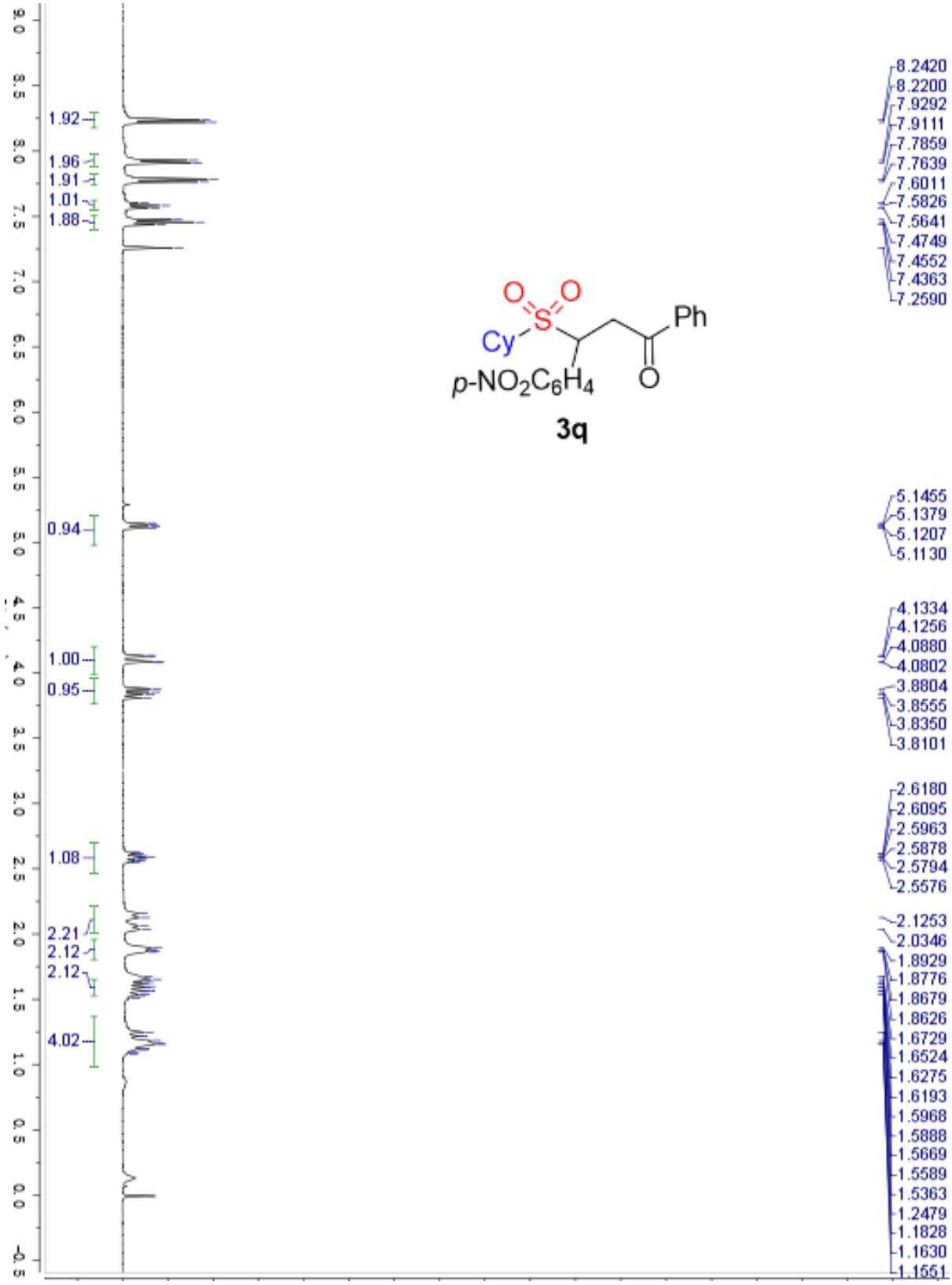
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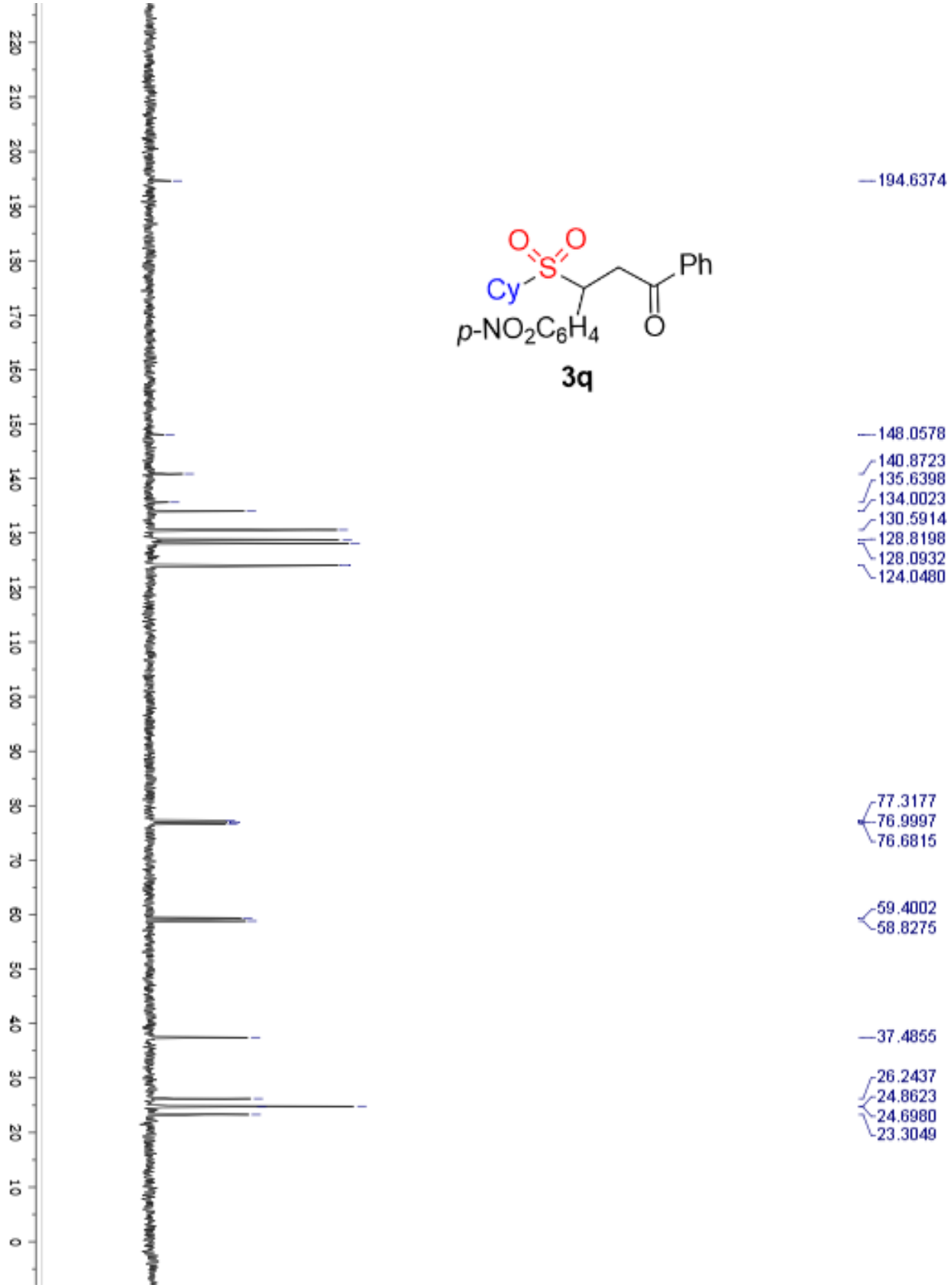
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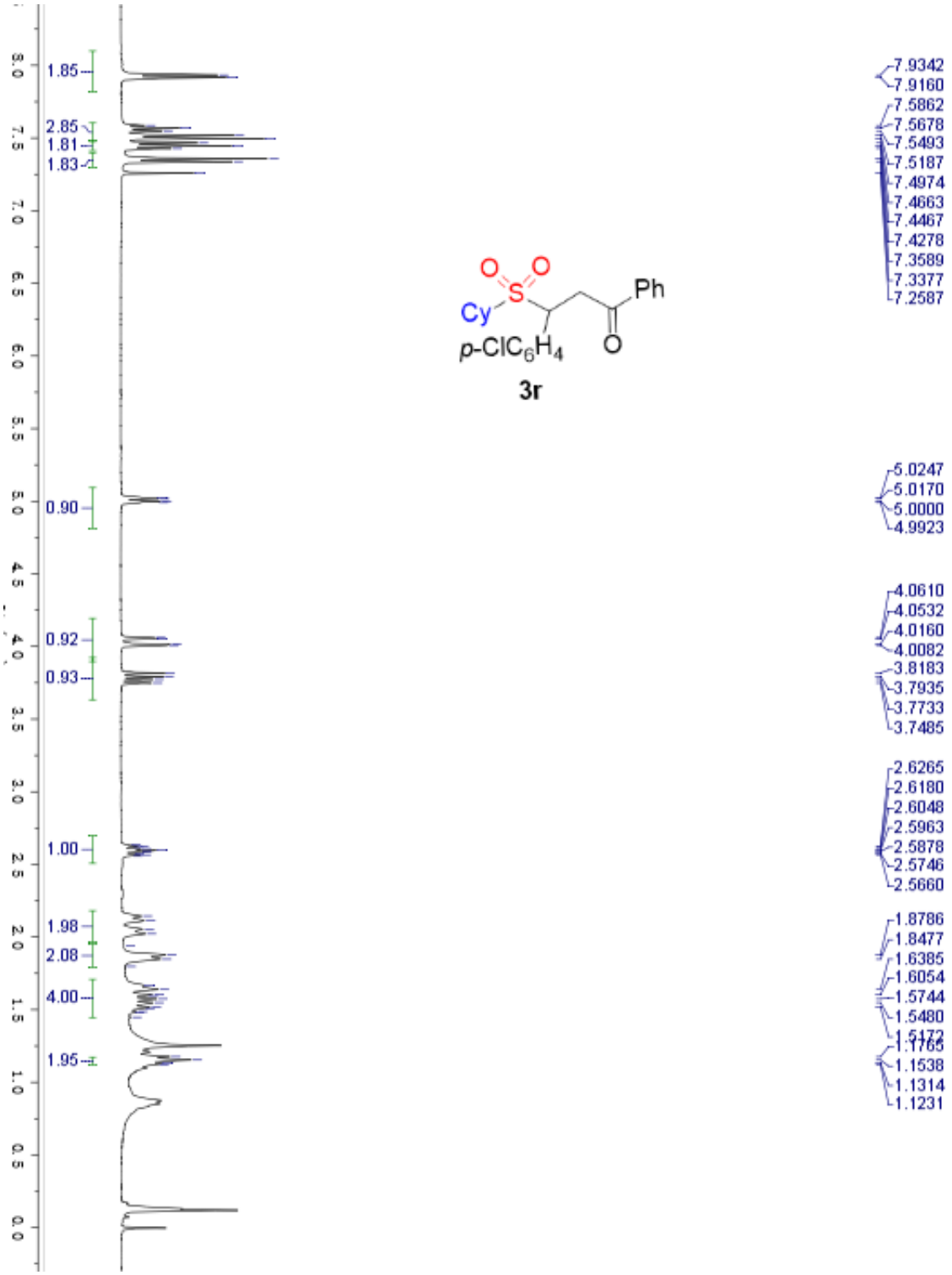
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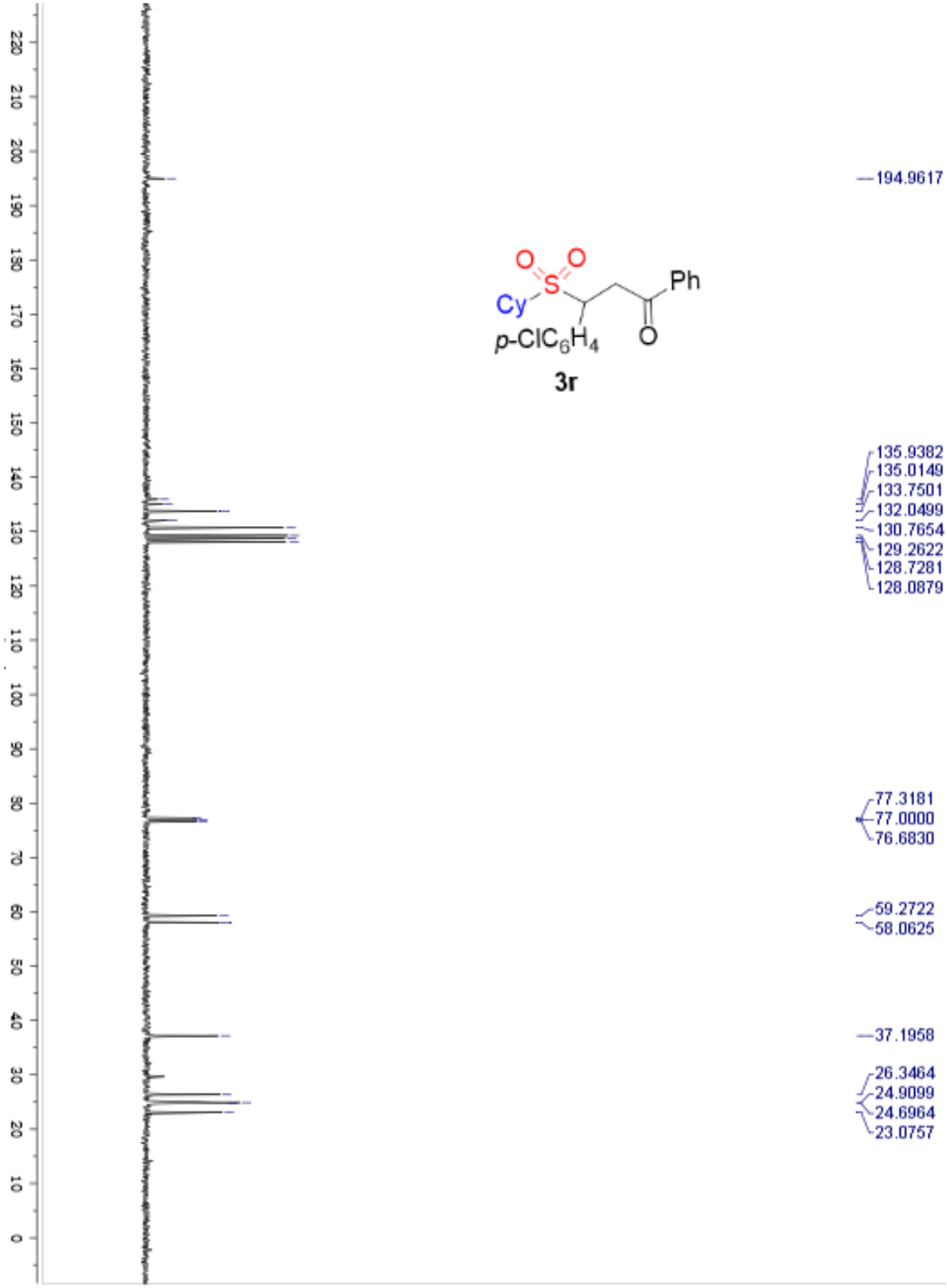
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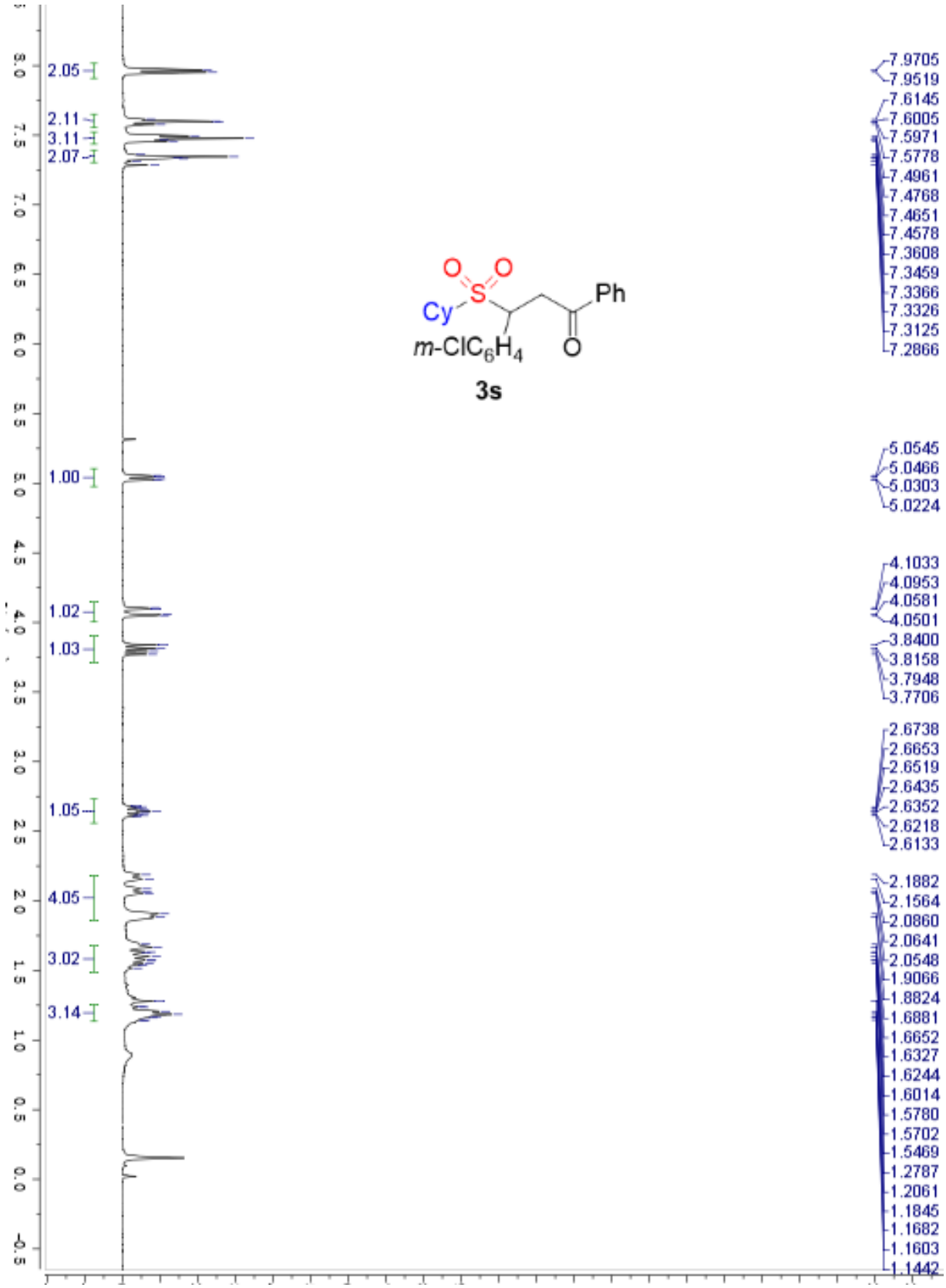
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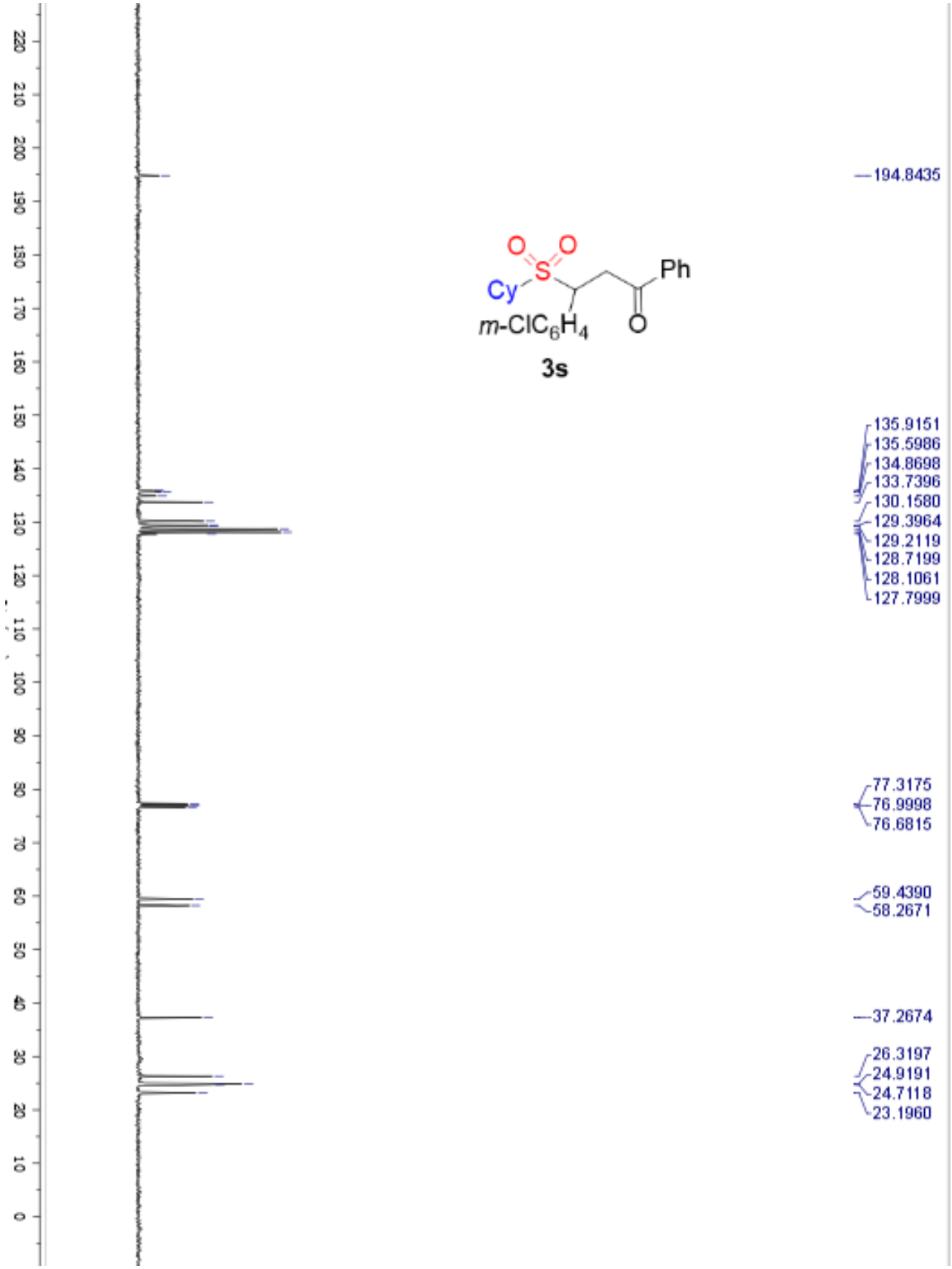
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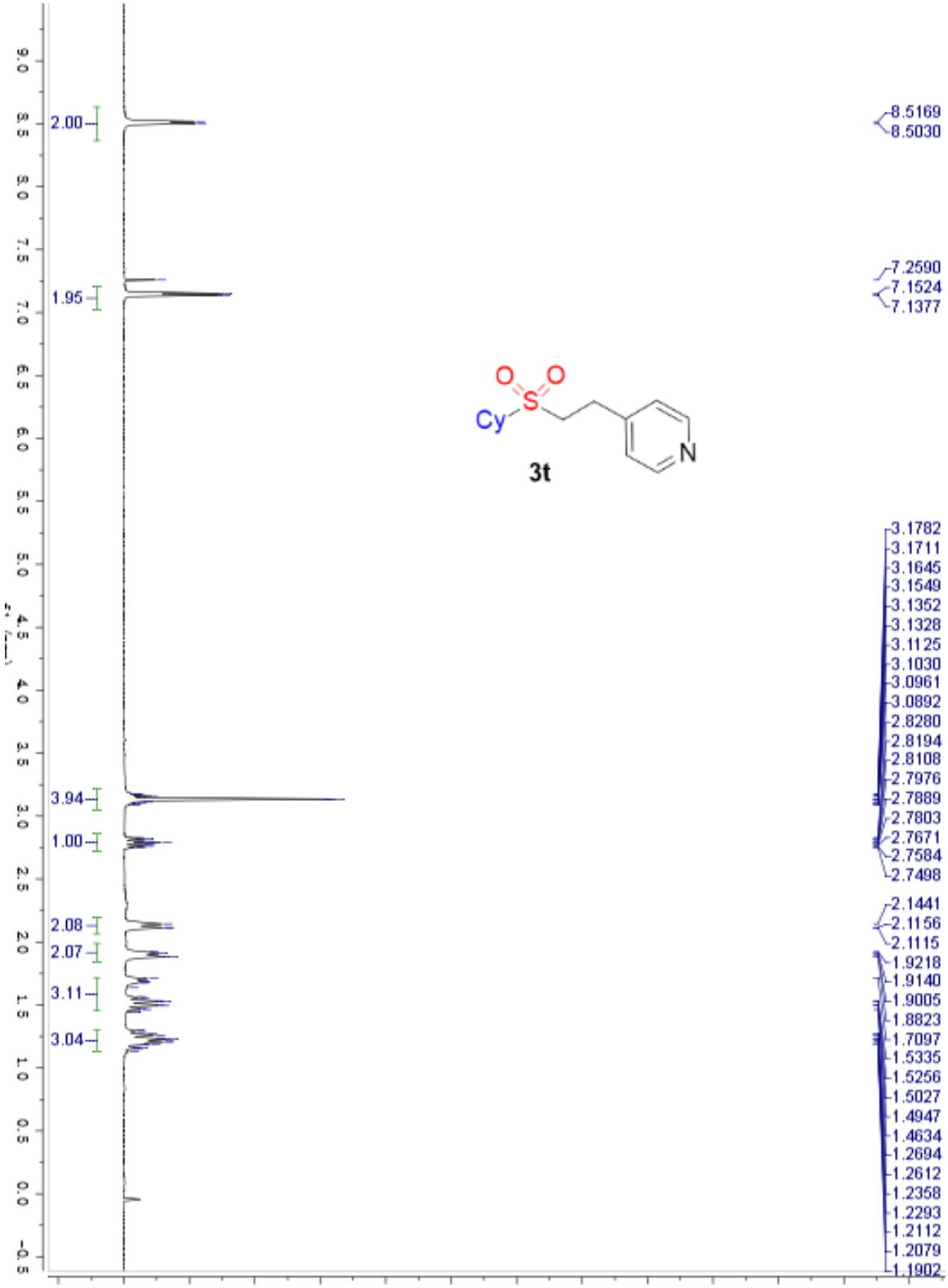
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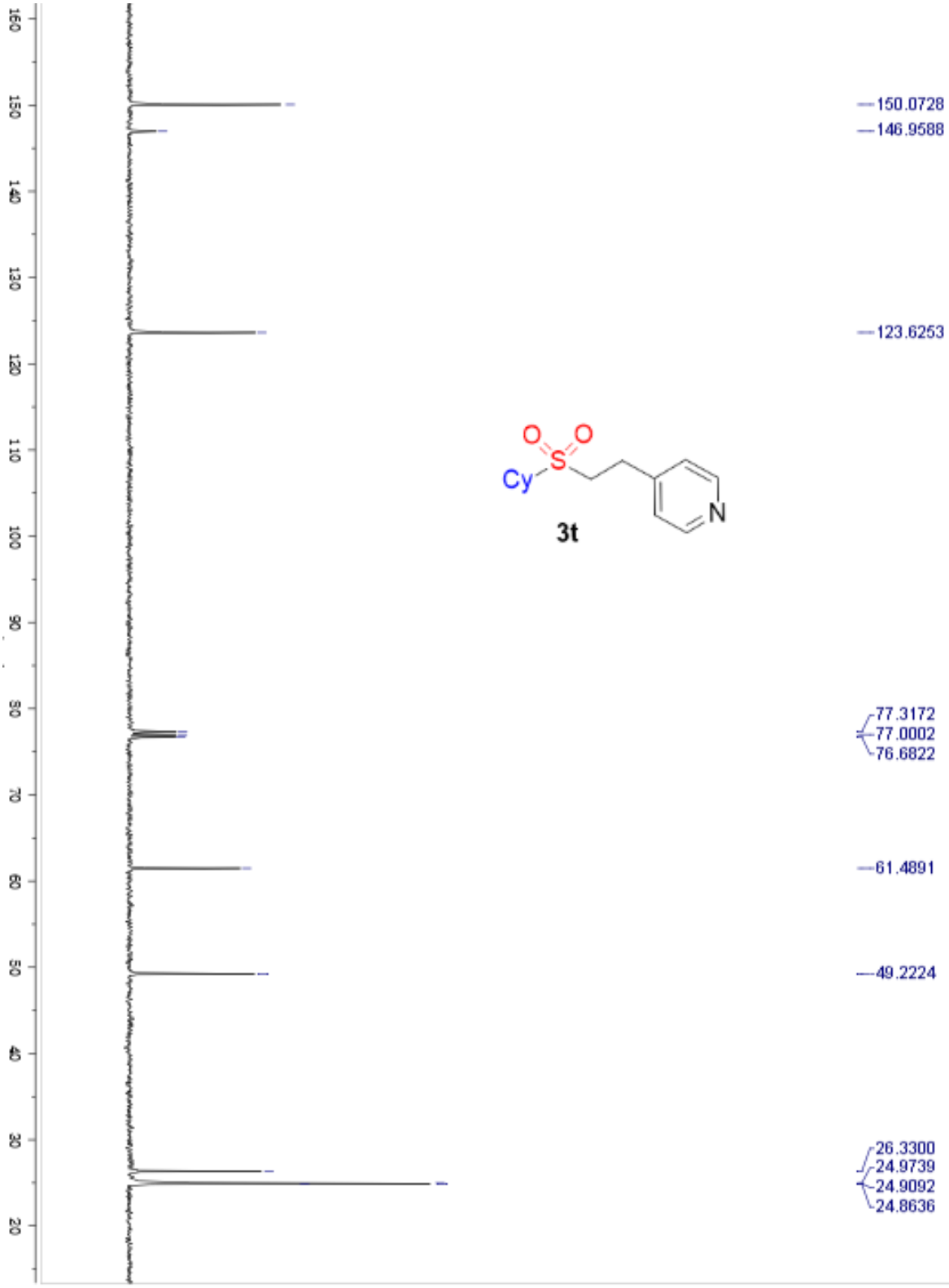
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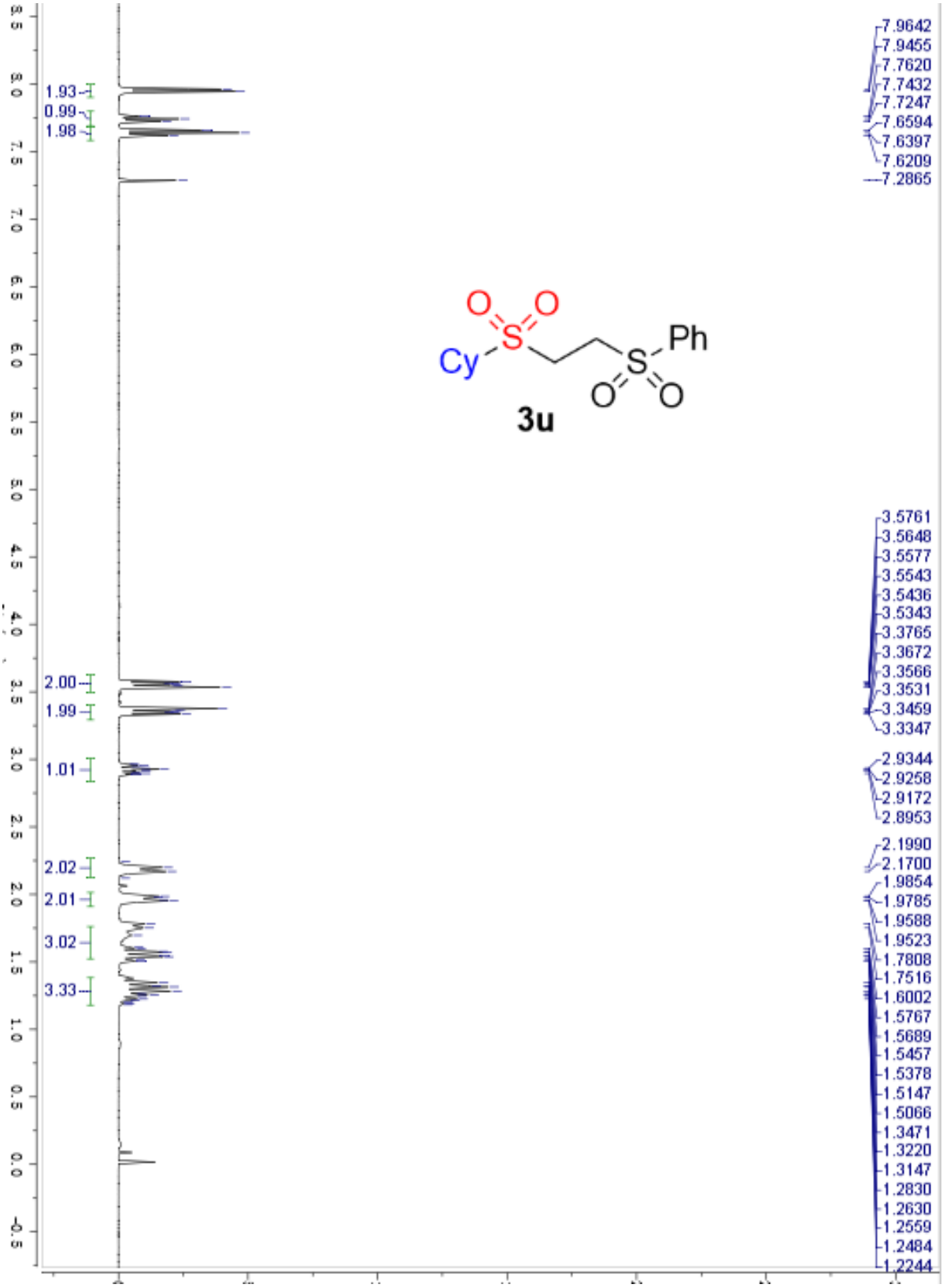
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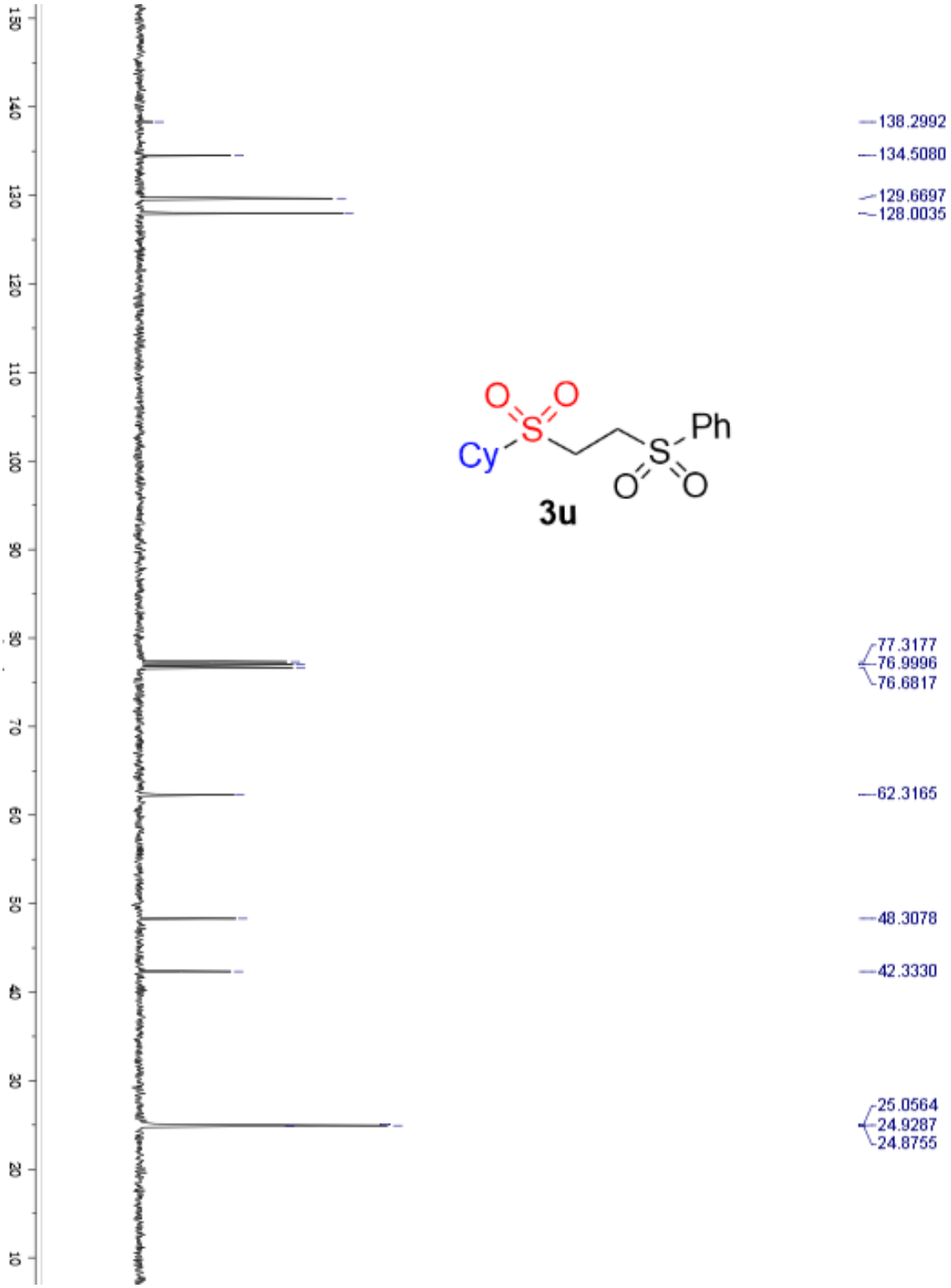
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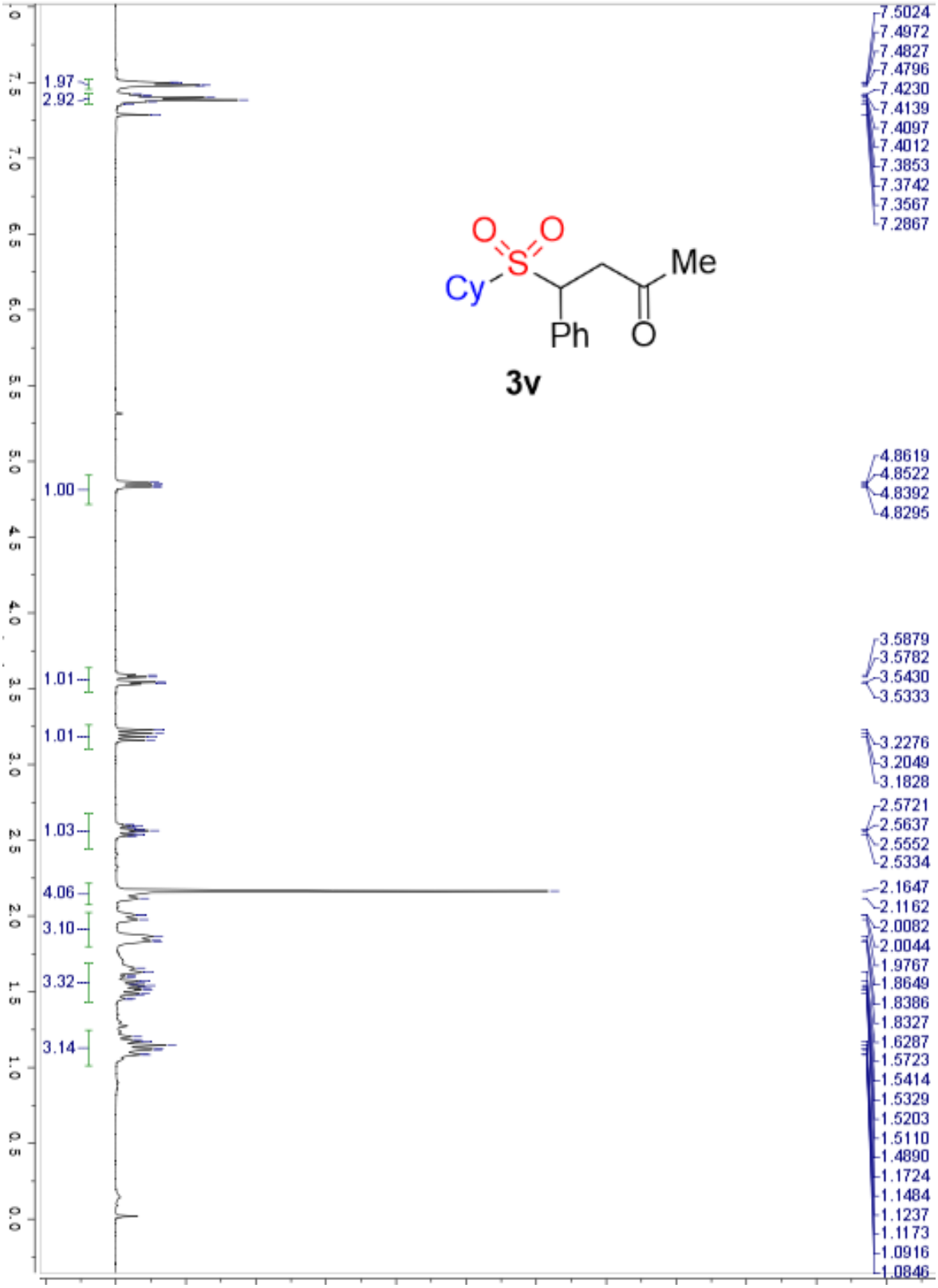
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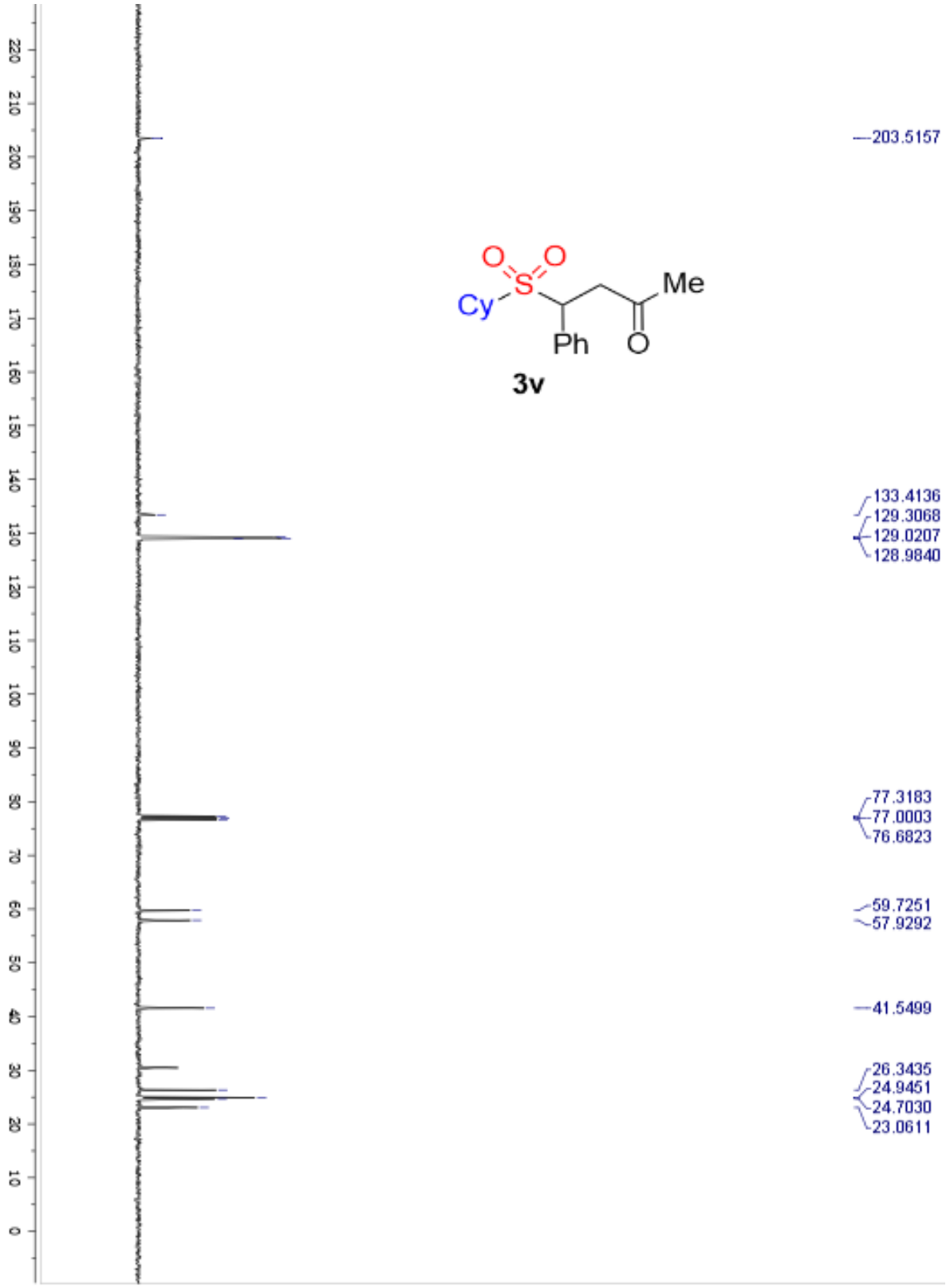
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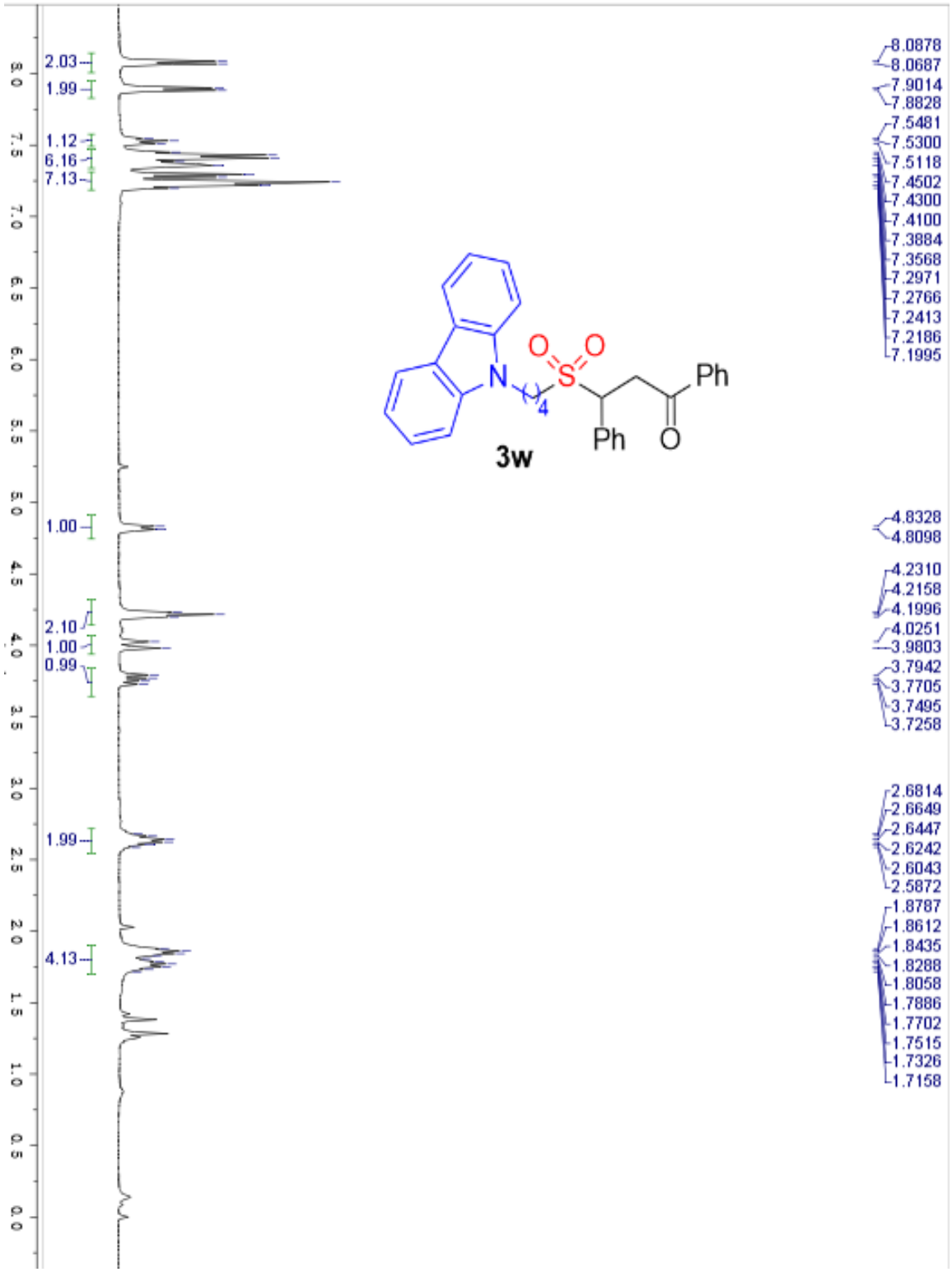
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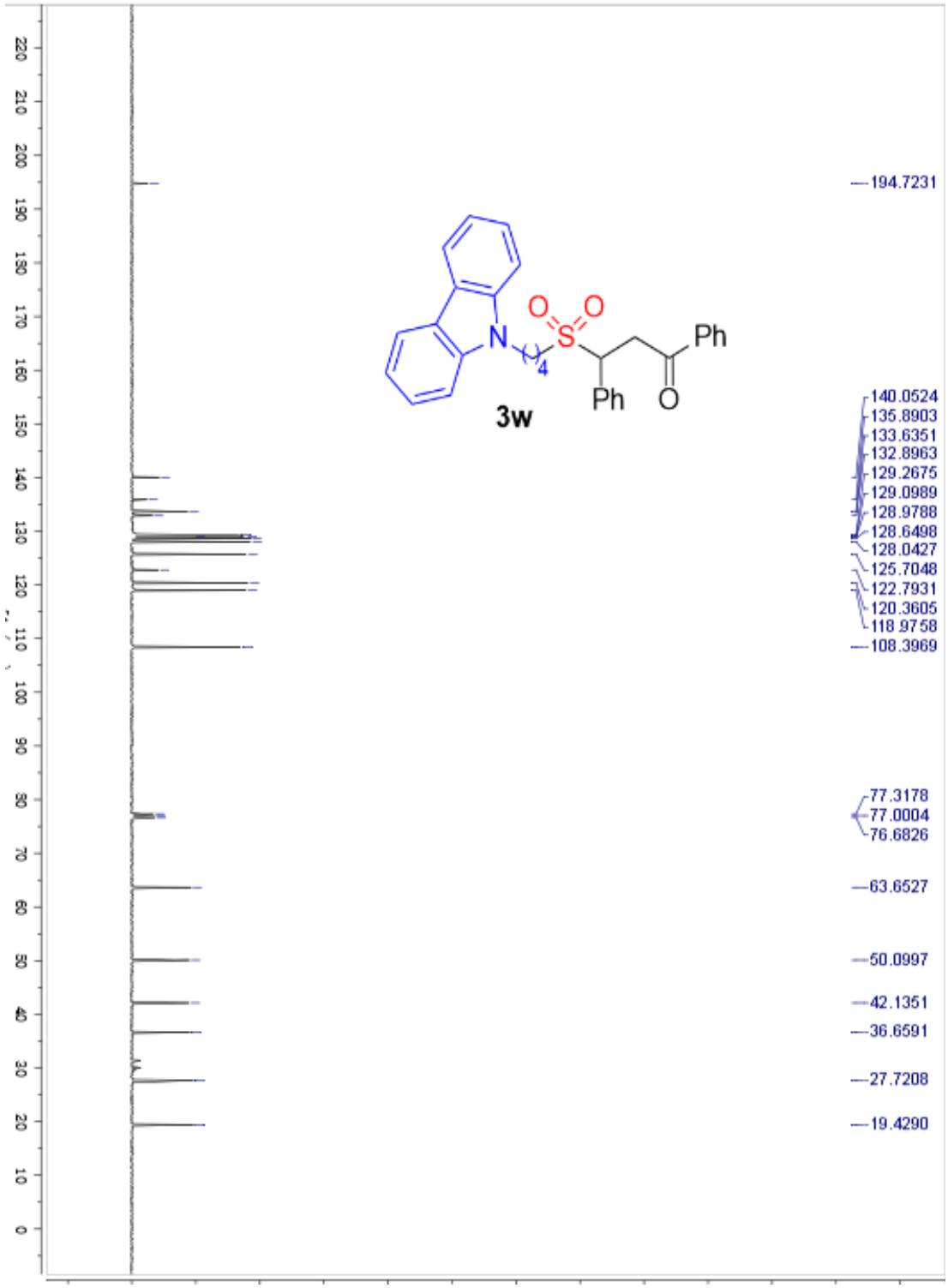
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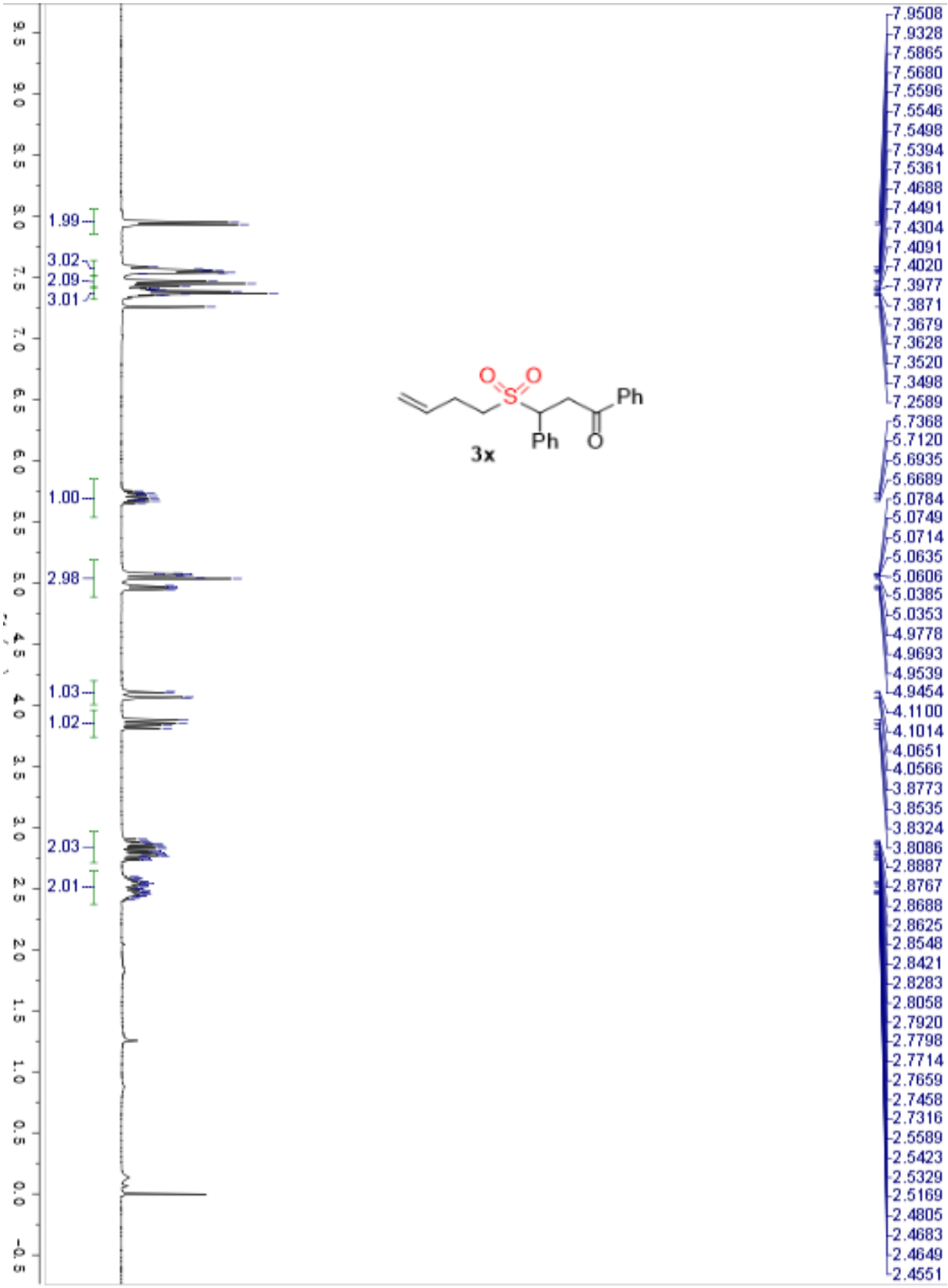
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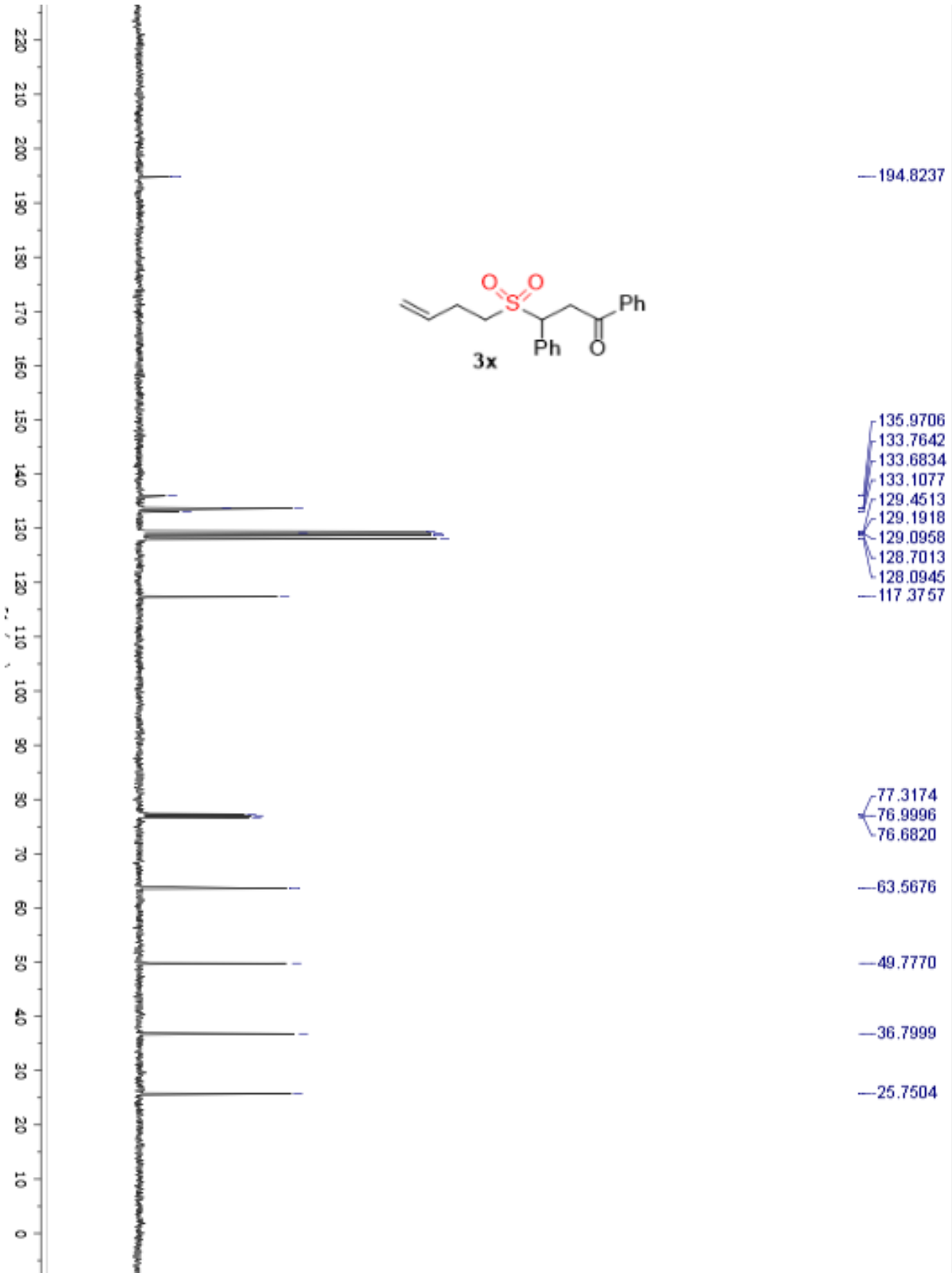
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