Supporting Information

Iron(III)-Catalyzed Radical α,β-Aminophosphinoylation of Styrenes with diphenylphosphine oxides and anilines

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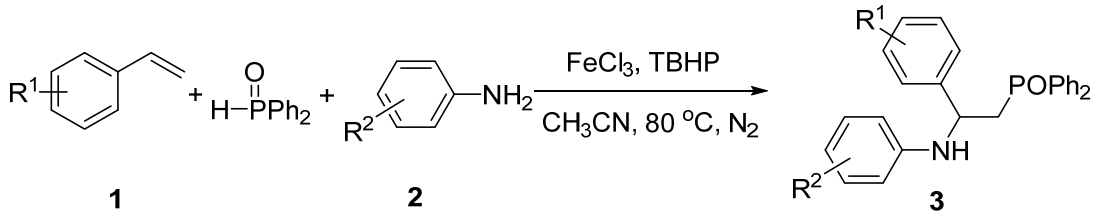
1. General information

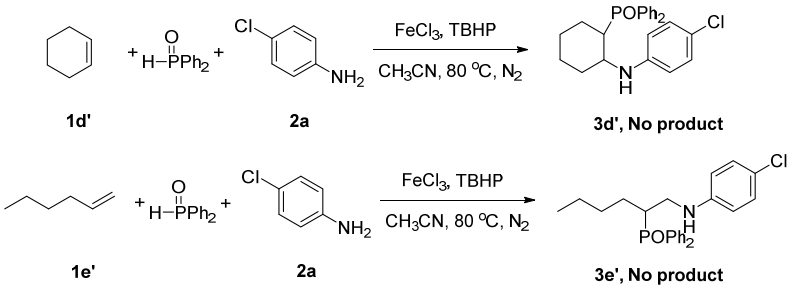
All reagents unless otherwise noted were obtained from commercial sources (purity > 99%) and used without further purification. The products were purified by column chromatography over silica gel. **^{1}H NMR** and **^{13}C NMR** spectra were recorded at 25 ºC on a Varian 400 MHz and 100 MHz, respectively, and TMS was used as internal standard. Mass spectra were recorded on BRUKER AutoflexIII Smartbeam MS-spectrometer. High resolution mass spectra (**HRMS**) were recorded on Bruck microTof by using ESI method.

2. Synthesis of compound 3

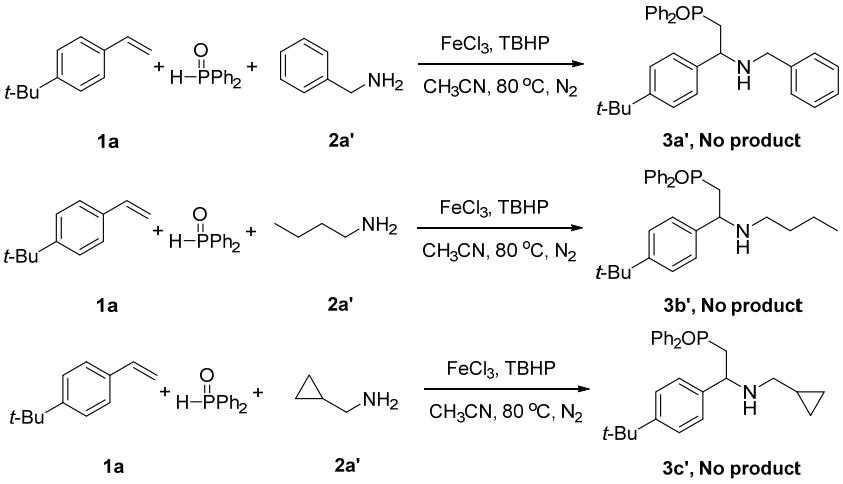
Typical procedure for the preparation of (2-(4-(tert-butyl)phenyl)-2-((4-chlorophenyl) amino)ethyl)diphenylphosphine oxide (3a): To an oven-dried Schlenk tube was added 4-*tert*-butylstyrene (**1a**, 0.092 mL, 0.5 mmol), diphenylphosphine oxide (0.162 g, 0.8 mmol), 4-chloroaniline (**2a**, 0.127 g, 1.0 mmol) and acetonitrile (3 mL). This was followed by the addition of $FeCl_3$ (0.016 g, 0.1 mmol) and TBHP 70% in H_2O (0.137 mL, 1.0 mmol). Then, the Schlenk tube was evacuated and purged thrice with N_2 atmosphere. The reaction mixture was stirred at 80 ºC for 12 hours. The reaction was quenched by addition of H_2O (5 mL) and then extracted with ethyl acetate (4×4mL). The combined organic layer was washed with brine, dried over Mg_2SO_4, and concentrated. The crude product was purified by column chromatography on silica gel (petroleum ether/ethyl acetate = 15/1) to afford the corresponding β-aminophosphonates product **3a**.



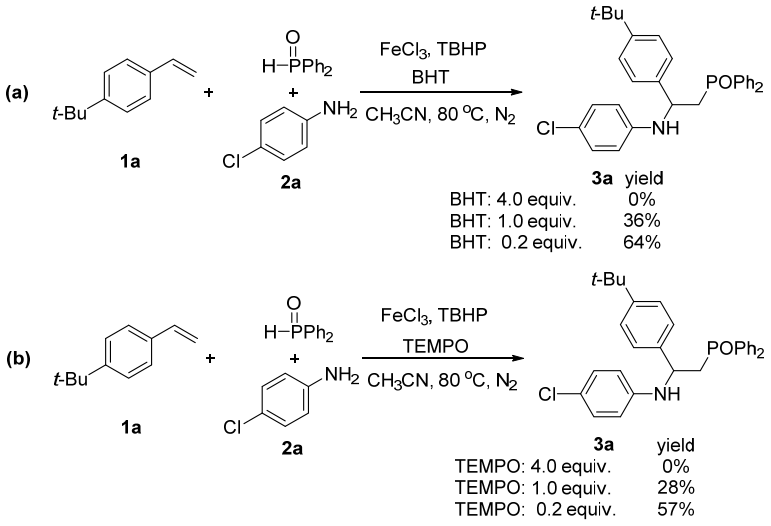
3. Substrate scope and control experiments



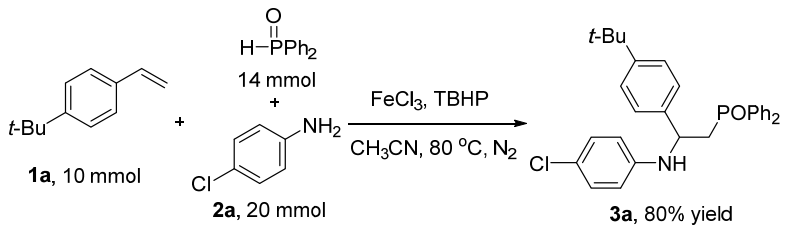
Scheme S1 The substrate scope of aliphatic alkenes



Scheme S2 The substrate scope of alkylamines

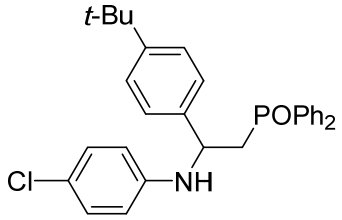


Scheme S3 The control experiments

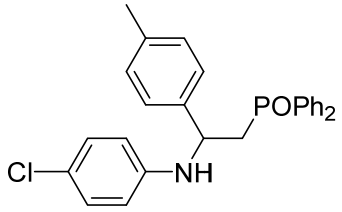


Scheme S4. Gram-scale preparation of **3a**.

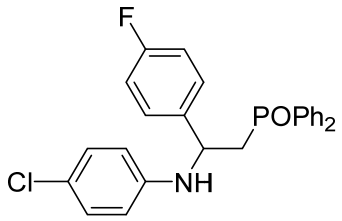
4. Analytical data of compound 3



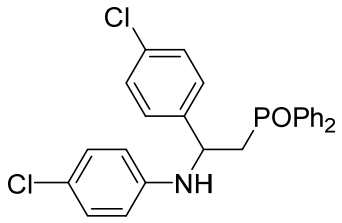
(2-(4-(tert-butyl)phenyl)-2-((4-chlorophenyl)amino)ethyl)diphenylphosphine oxide (**3a**)**:** White solid; m.p. 220.0-225.6 ºC, 81% yield (197 mg); **^{1}H NMR** (400 MHz, $CDCl_3$): δ 7.73-7.63 (m, 4H), 7.55-7.38 (m, 6H), 7.21 (q, *J*= 8.4, 17.6 Hz, 4H), 6.97 (d, *J*= 8.8 Hz, 2H), 6.33 (d, *J*= 8.8 Hz, 2H), 5.72 (s, 1H), 4.50 (t,*J*= 9.6 Hz, 1H), 2.80-2.61 (m, 2H), 1.26 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ150.2, 145.7, 140.2 (d, *J* = 11.1 Hz), 133.4 (d, *J* = 99.0 Hz), 132.0 (d, *J* = 2.8 Hz), 131.9 (d, *J* = 8.1 Hz), 131.0, 130.8 (d, *J* = 9.4 Hz), 130.4 (d, *J* = 9.4 Hz), 128.8, 128.7 (d, *J* = 3.3 Hz), 128.6, 125.7, 125.4, 122.0, 114.9, 54.3 (d, *J* = 3.9 Hz), 38.8 (d, *J* = 65.9), 34.4, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.130; **HRMS** (ESI, m/z): calcd for $C_{30}H_{32}ClNOP$ ($M+H^+$) 488.1910, found: 488.1911.



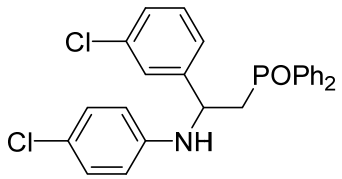
(2-((4-chlorophenyl)amino)-2-(p-tolyl)ethyl)diphenylphosphine oxide (**3b**)**:** White solid; m.p. 214.8-217.2 °C, 83% yield (185 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.73-7.63 (m, 4H), 7.54-7.39 (m, 6H), 7.17 (d, *J* = 8.0 Hz, 2H), 7.05 (d, *J* = 8.0 Hz, 2H), 6.93 (d, *J* = 8.4 Hz, 2H), 6.30 (t, *J* = 3.2 Hz, 2H), 5.75 (s, 1H), 4.44 (q, *J* = 6.4, 9.2Hz, 1H), 2.78-2.60 (m, 2H), 2.27 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 145.7, 140.5 (d, *J* = 11.8 Hz), 137.1, 133.3, 132.3 (d, *J* = 57.5 Hz), 132.0 (d, *J* = 2.8 Hz), 131.9 (d, *J* = 2.6 Hz), 130.8 (d, *J* = 9.4 Hz), 130.4 (d, *J*= 9.4 Hz), 129.5, 128.8, 128.7 (d, *J* = 3.3 Hz), 128.6 (d, *J* = 4.4 Hz), 125.6, 122.0, 114.9, 54.5 (d, *J* = 4.2 Hz), 39.0 (d, *J* = 66.7 Hz), 21.0; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.277; **HRMS** (ESI, m/z): calcd for $C_{27}H_{26}ClNOP$ ($M+H^+$) 446.1441, found: 446.1444.



(2-((4-chlorophenyl)amino)-2-(4-fluorophenyl)ethyl)diphenylphosphine oxide (3c): White solid; m.p. 217.4-220.3 °C, 67% yield (150 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.73-7.62 (m, 4H), 7.55-7.40 (m, 6H), 7.27 (s, 1H), 7.24 (d, *J* = 5.6 Hz,1H), 6.99-6.87 (m, 4H), 6.29 (d, *J* = 8.8 Hz, 2H), 5.83 (s, 1H), 4.49 (t, *J* = 10.0 Hz, 1H), 2.78-2.61 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 163.2, 160.7, 145.4, 139.0, 133.1, 132.1 (d, *J* = 9.1 Hz), 131.8, 130.8 (d, *J* = 9.5 Hz), 130.5 (d, *J* = 9.3 Hz), 128.9 (d, *J* = 8.5 Hz), 128.8 (d, *J* = 9.7 Hz), 127.5 (d, *J* = 8.1 Hz), 122.4, 115.8 (d, *J* = 11.3 Hz), 115.0, 54.2 (d, *J* = 3.9 Hz), 38.8 (d, *J* = 64.8 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.134; **HRMS** (ESI, m/z): calcd for $C_{26}H_{23}ClFNOP$ ($M+H^+$) 450.1190, found: 450.1191.

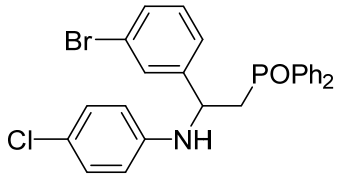


(2-(4-chlorophenyl)-2-((4-chlorophenyl)amino)ethyl)diphenylphosphine oxide (3d): White solid; m.p. 216.6-223.4 °C, 73% yield (170 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.74-7.63 (m, 4H), 7.57-7.41 (m, 7H), 7.22-7.12 (m, 3H), 6.96 (d, *J* = 8.8 Hz, 2H), 6.31 (d, *J* = 8.8 Hz, 2H), 5.86 (s, 1H), 4.44 (q, *J* = 9.6, 13.2 Hz, 2H), 2.77-2.60 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 145.4, 141.8 (d, *J* = 11.4 Hz), 133.1, 132.1, 132.0, 130.8 (d, *J* = 9.4 Hz), 130.5, 130.4 (d, *J* = 9.4 Hz), 129.0, 128.9, 128.8 (d, *J* = 2.2 Hz), 128.7, 128.6, 127.3, 122.4, 115.0, 54.3 (d, *J* = 4.0 Hz), 38.7 (d, *J* = 66.4 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.256; **HRMS** (ESI, m/z): calcd for $C_{26}H_{23}Cl_2NOP$ ($M+H^+$) 466.0894, found: 466.0895.

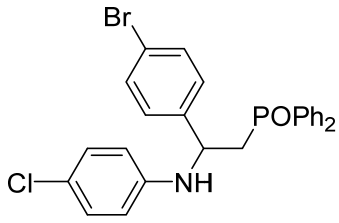


(2-(3-chlorophenyl)-2-((4-chlorophenyl)amino)ethyl)diphenylphosphine oxide (3e): White solid; m.p. 220.7-226.2 °C, 70% yield (163 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.78-7.63 (m, 4H), 7.56-7.39 (m, 6H),

7.27 (s, 1H), 7.22-7.11 (m, 3H), 7.00-6.94 (m, 2H), 6.34-6.26 (m, 2H), 5.85 (d, *J* = 2.4 Hz, 1H), 4.51-4.41 (m, 1H), 2.78-2.61 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 145.6 (d, *J* = 11.4 Hz), 145.3, 134.7, 133.0, 132.2 (d, *J* = 2.9 Hz), 132.1 (d, *J* = 2.7 Hz), 131.6 (d, *J* = 36.7 Hz), 130.8 (d, *J* = 9.5 Hz), 130.6, 130.4 (d, *J* = 9.4 Hz), 130.2, 128.9 (d, *J* = 11.0 Hz), 128.7 (d, *J* = 2.9 Hz), 127.7, 126.0, 124.0, 122.5, 114.9, 54.5 (d, *J* = 4.2 Hz), 38.6 (d, *J* = 66.0 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.254; **HRMS** (ESI, m/z): calcd for $C_{26}H_{23}Cl_2NOP$ ($M+H^+$) 466.0894, found: 466.0897.

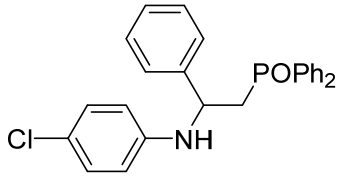


(2-(3-bromophenyl)-2-((4-chlorophenyl)amino)ethyl)diphenylphosphine oxide (**3f**)**:** White solid; m.p. 203.9-213.4 °C, 75% yield (191 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.75-7.63 (m, 4H), 7.55-7.40 (m, 7H), 7.28 (d, *J* = 7.6 Hz, 1H), 7.23 (t, *J* = 9.2 Hz, 1H), 7.10 (t, *J* = 8.0 Hz, 1H), 6.96 (d, *J* = 8.8 Hz, 2H), 6.29 (t, *J* = 3.2 Hz, 2H), 5.86 (s, 1H), 4.44 (q, *J* = 6.4, 9.2 Hz, 1H), 2.78-2.61 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 145.9 (d, *J* = 11.3 Hz), 145.4, 133.0, 132.2 (d, *J* = 2.7 Hz), 132.1 (d, *J* = 2.7 Hz), 131.6 (d, *J* = 35.3 Hz), 130.8, 130.7 (d, *J* = 4.6 Hz), 130.6, 130.4, 130.3, 129.0 (d, *J* = 3.0 Hz), 128.8, 128.7 (d, *J* = 3.3 Hz), 124.5, 123.0, 122.5, 114.9, 54.5 (d, *J* = 4.2 Hz), 38.6 (d, *J* = 65.9 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.108; **HRMS** (ESI, m/z): calcd for $C_{26}H_{23}BrClNOP$ ($M+H^+$) 510.0389, found: 510.0393.

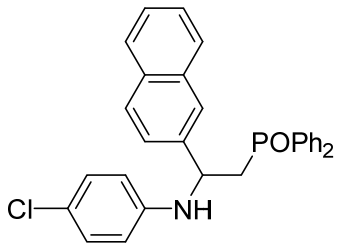


(2-(4-bromophenyl)-2-((4-chlorophenyl)amino)ethyl)diphenylphosphine oxide (**3g**)**:** White solid; m.p. 219.9-221.4 °C, 79% yield (201 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.76-7.60 (m, 4H), 7.55-7.38 (m, 6H), 7.34 (d, *J* = 7.6 Hz, 2H), 7.17 (d, *J* = 7.6 Hz, 2H), 6.97 (d, *J* = 7.6 Hz, 2H), 6.30 (d, *J* = 7.6 Hz, 2H), 5.87 (s, 1H), 4.49 (q, *J* = 4.0, 13.2 Hz, 1H), 2.79-2.58 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 145.4, 142.4 (d, *J* = 11.1 Hz), 133.0, 132.2 (d, *J* = 2.9 Hz), 132.07 (d, *J* = 2.9 Hz), 132.0, 131.8, 130.8 (d, *J* = 9.3 Hz), 130.4 (d, *J* = 9.4 Hz), 128.9, 128.8 (d, *J* = 2.2 Hz), 128.7, 127.6, 122.4, 121.2, 114.9, 54.4 (d, *J* = 4.2 Hz), 38.6 (d, *J* = 66.0 Hz); **^{31}P**

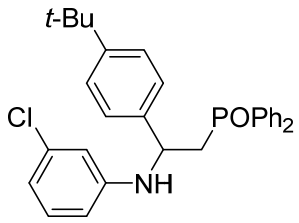
NMR (162 MHz, $CDCl_3$) δ: 31.384; **HRMS** (ESI, m/z): calcd for $C_{26}H_{23}BrClNOP$ ($M+H^+$) 510.0389, found: 510.0390.



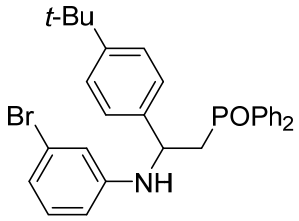
(2-((4-chlorophenyl)amino)-2-phenylethyl)diphenylphosphine oxide (**3h**)**:** White solid; m.p. 218.1-221.8 °C, 80% yield (172 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.76-7.64 (m, 4H), 7.56-7.39 (m, 6H), 7.29 (t, *J* = 7.2 Hz, 4H), 7.24-7.14 (m, 1H), 6.95 (d, *J* = 8.0 Hz, 2H), 6.32 (d, *J* = 8.0 Hz, 2H), 5.77 (s, 1H), 4.47 (t, *J* = 6.8 Hz, 1H), 2.80-2.62 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 145.7, 143.6 (d, *J* = 11.8 Hz), 133.3, 132.3 (d, *J* = 60.5 Hz), 132.1 (d, *J* = 2.8 Hz), 132.0 (d, *J* = 2.6 Hz), 130.9 (d, *J* = 9.4 Hz), 130.5 (d, *J* = 9.4 Hz), 128.99, 128.9, 128.8 (d, *J* = 4.2 Hz), 128.7, 128.6, 127.5, 125.8, 122.2, 115.0, 54.9 (d, *J* = 4.3 Hz), 38.9 (d, *J* = 65.8 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.333; **HRMS** (ESI, m/z): calcd for $C_{26}H_{24}ClNOP$ ($M+H^+$) 432.1284, found: 432.1288.



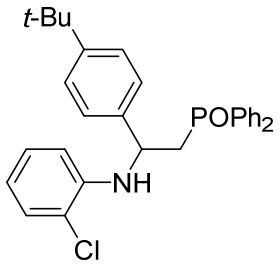
(2-((4-chlorophenyl)amino)-2-(naphthalen-2-yl)ethyl)diphenylphosphine oxide (**3i**)**:** White solid; m.p. 200.6-204.6 °C, 65% yield (156 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.79-7.69 (m, 6H), 7.66 (q, *J* = 7.6, 11.6 Hz, 2H), 7.51 (t, *J* = 6.8, 1H), 7.48-7.39 (m, 6H), 7.39-7.33 (m, 2H), 6.92 (d, *J* = 8.8 Hz, 2H), 6.38 (d, *J* = 8.4 Hz, 2H), 5.93 (s, 1H), 4.65 (t, *J* = 9.6 Hz, 1H), 2.87-2.70 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 145.7, 140.8 (d, *J* = 11.5 Hz), 133.4, 133.1, 132.9, 132.1 (d, *J* = 39.0 Hz), 132.0 (d, *J* = 2.7 Hz), 131.9 (d, *J* = 2.7 Hz), 130.8 (d, *J* = 9.4 Hz), 130.80, 130.4 (d, *J* = 9.4 Hz), 128.9 (d, *J* = 7.5 Hz), 128.7 (d, *J* = 4.5 Hz), 128.6 (d, *J* = 5.6 Hz), 127.8 (d, *J* = 18.3 Hz), 126.2 (d, *J* = 36.0 Hz), 124.6, 123.7, 122.2, 115.0, 55.0 (d, *J* = 4.2 Hz), 38.7 (d, *J* = 65.7 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 30.9; **HRMS** (ESI, m/z): calcd for $C_{30}H_{26}ClNOP$ ($M+H^+$) 482.1441, found: 31.335.



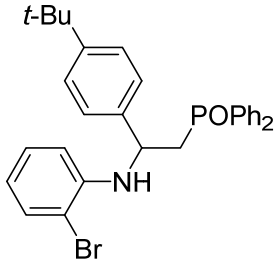
(2-(4-(tert-butyl)phenyl)-2-((3-chlorophenyl)amino)ethyl)diphenylphosphine oxide (**3j**)**:** White solid; m.p. 231.6-234.8 °C, 86% yield (209 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.73-7.62 (m, 4H), 7.53-7.37 (m, 6H), 7.23 (t, *J* = 8.4 Hz, 4H), 6.92 (t, *J* = 8.4 Hz, 1H), 6.57 (d, *J* = 8.0 Hz, 1H), 6.37, (t, *J* = 2.0 Hz, 1H), 6.29 (d, *J* = 8.4 Hz, 1H), 5.80 (s, 1H), 4.58-4.49 (m, 1H), 2.80-2.64 (m, 2H), 1.25 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.2, 148.3, 140.0 (d, *J* = 11.0 Hz), 134.4, 133.3 (d, *J* = 99.0 Hz), 132.0 (d, *J* = 2.5 Hz), 131.9 (d, *J* = 2.7 Hz), 131.0, 130.8 (d, *J*= 9.4 Hz), 130.4 (d, *J* = 9.4 Hz), 129.7, 128.8 (d, *J* = 10.7 Hz), 128.6 (d, *J* = 10.8 Hz), 125.7, 125.4, 117.2, 113.5, 111.9, 54.1 (d, *J* = 4.3 Hz), 38.7 (d, *J* = 65.9 Hz), 34.4, 31.2; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.102; **HRMS** (ESI, m/z): calcd for $C_{30}H_{32}ClNOP$ ($M+H^+$) 488.1910, found: 488.1915.



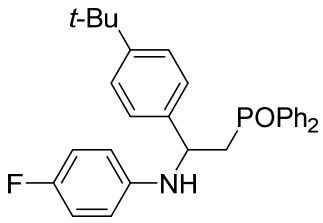
(2-((3-bromophenyl)amino)-2-(4-(tert-butyl)phenyl)ethyl)diphenylphosphine oxide (**3k**)**:** White solid; m.p. 225.9-227.9 °C, 80% yield (212 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.73-7.61 (m, 4H), 7.54-7.38 (m, 6H) 7.21 (t, *J* = 8.4 Hz, 4H), 6.85 (t, *J* = 8.0 Hz, 1H), 6.72 (d, *J* = 8.4 Hz, 1H), 6.54 (s, 1H), 6.33 (q, *J* = 1.2, 8.0 Hz, 1H), 5.78 (s, 1H), 4.58-4.48 (m, 1H), 2.81-2.65 (m, 2H), 1.25 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.3, 148.5, 140.0 (d, *J* = 11.0 Hz), 133.4, 132.4 (d, *J* = 36.0 Hz), 132.0 (d, *J* = 2.6 Hz), 131.9 (d, *J* = 2.7 Hz), 131.1, 130.8 (d, *J* = 9.4 Hz), 130.5 (d, *J* = 9.4 Hz), 130.1, 128.7 (t, *J* = 11.1 Hz), 125.8 (d, *J* = 31.8 Hz), 122.7, 120.2, 116.5, 112.3, 54.1 (d, *J* = 4.2 Hz), 38.8 (d, *J* = 65.9 Hz), 34.4, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.111; **HRMS** (ESI, m/z): calcd for $C_{30}H_{32}BrNOP$ ($M+H^+$) 532.1405, found: 532.1408.



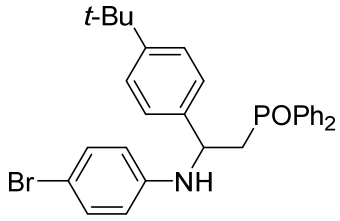
(2-(4-(tert-butyl)phenyl)-2-((2-chlorophenyl)amino)ethyl)diphenylphosphine oxide (**3l**)**:** White solid; m.p. 220.9-222.1 °C, 83% yield (202 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.69 (q, *J* = 11.2, 19.2 Hz, 4H), 7.50-7.33 (m, 6H), 7.20 (d, *J* = 11.6 Hz, 5H), 6.87 (t, *J* = 8.0 Hz, 1H), 6.52 (t, *J* = 7.2 Hz, 1H), 6.32 (d, *J* = 8.0 Hz, 1H), 5.71 (d, *J* = 4.0 Hz, 1H), 4.82 (d, *J* = 4.4Hz, 1H), 2.9-2.74 (m, 2H), 1.24 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.2, 142.6, 139.7 (d, *J* = 9.6 Hz), 133.5, 132.8 (d, *J* = 26.7 Hz), 131.8, 131.7 (d, *J* = 2.7 Hz), 131.72 (d, *J* = 2.7 Hz), 130.7 (d, *J* = 9.3 Hz), 130.5 (d, *J* = 9.3 Hz), 128.9, 128.7 (d, *J* = 7.1 Hz), 128.6 (d, *J* = 7.1 Hz), 127.3, 125.7 (d, *J* = 11.3 Hz), 119.5, 117.3, 112.6, 53.1 (d, *J* = 3.7 Hz), 38.9 (d, *J* = 66.7 Hz), 34.4, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 29.337; **HRMS** (ESI, m/z): calcd for $C_{30}H_{32}ClNOP$ ($M+H^+$) 488.1910, found: 488.1912.



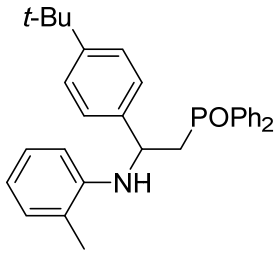
(2-((2-bromophenyl)amino)-2-(4-(tert-butyl)phenyl)ethyl)diphenylphosphine oxide (**3m**)**:** White solid; m.p. 218.4-223.3 °C, 74% yield (197 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.74-7.63 (m, 4H), 7.49-7.34 (m, 7H), 7.22-7.17 (s, 4H), 6.95-6.88 (m, 1H), 6.50-6.43 (m, 1H), 6.32 (t, *J* = 7.2 Hz, 1H), 5.67 (d, *J* = 5.2 Hz, 1H), 4.87-4.78 (m, 1H), 2.94-2.74 (m, 2H), 1.25 (s, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.1, 143.5, 139.5 (d, *J* = 9.4 Hz), 133.5, 132.8 (d, *J* = 20.2 Hz), 132.2, 131.8, 131.7 (d, *J* = 2.7 Hz), 131.6 (d, *J* = 2.7 Hz), 130.7 (d, *J* = 9.3 Hz), 130.5 (d, *J* = 9.4 Hz), 128.7 (d, *J* = 9.3 Hz), 128.4 (d, *J* = 9.3 Hz), 127.9, 125.6 (d, *J* = 6.2 Hz), 117.8, 112.7, 109.9, 53.1 (d, *J* = 3.8 Hz), 38.9 (d, *J* = 66.9 Hz), 34.3, 31.2; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 29.219; **HRMS** (ESI, m/z): calcd for $C_{30}H_{32}BrNOP$ ($M+H^+$) 532.1405, found: 532.1406.



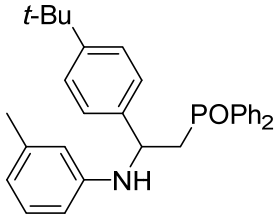
(2-(4-(tert-butyl)phenyl)-2-((4-fluorophenyl)amino)ethyl)diphenylphosphine oxide (**3n**)**:** White solid; m.p. 223.7-224.8 °C, 70% yield (165 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.69 (q, *J*= 8.8, 14.4 Hz, 4H), 7.49 (q, *J*= 6.4, 12.8 Hz, 2H), 7.45-7.38 (m, 4H), 7.23 (q, *J*=6.4, 10.0 Hz, 4H), 6.72 (t, *J*= 8.8 Hz, 2H), 6.35 (q, *J*= 4.8, 9.2 Hz, 2H), 5.57 (s,1H), 4.51-4.44 (m,1H), 2.80-2.62 (m, 2H), 1.26 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 156.9, 154.6, 150.1, 143.6, 140.6 (d, 11.4 Hz), 133.5 (d, *J* = 98.8 Hz), 132.0 (d, *J* = 98.1 Hz), 131.9 (d, *J* = 2.8 Hz), 131.8 (d, *J* = 2.9 Hz), 130.8 (d, *J* = 9.4 Hz), 130.4 (d, *J* = 9.3 Hz), 128.7 (d, *J* = 5.6 Hz), 128.6 (d, *J* = 5.6 Hz), 125.7 (d, *J* = 23.6 Hz), 115.2 (d, *J* = 22.1 Hz), 114.6 (d, *J* = 7.3 Hz), 54.7 (d, *J* = 4.0 Hz), 38.9 (d, *J* = 66.0 Hz), 34.3, 31.2; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.180; **HRMS** (ESI, m/z): calcd for $C_{30}H_{32}FNOP$ ($M+H^+$) 472.2206, found: 472.2208.



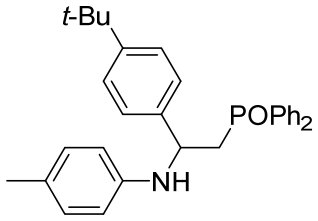
(2-((4-bromophenyl)amino)-2-(4-(tert-butyl)phenyl)ethyl)diphenylphosphine oxide (**3o**)**:** White solid; m.p. 222.8-224.0 °C, 79% yield (210 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.68 (q, *J* = 12.0, 19.6 Hz, 4H), 7.53-7.37 (m, 6H), 7.25-7.17 (m, 4H), 7.09 (d, *J* = 8.0 Hz, 2H), 6.30 (d, *J* = 7.6 Hz, 2H), 5.75 (s, 1H), 4.49 (s, 1H), 2.80-2.63 (m, 2H), 1.25 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.3, 146.2, 140.1 (d, *J* = 11.1 Hz), 133.4 (d, *J* = 98.9 Hz), 132.0 (d, *J* = 2.1 Hz), 131.9 (d, *J* = 2.7 Hz), 131.5, 131.0, 130.8 (d, *J* = 9.3 Hz), 130.5 (d, *J* = 9.4 Hz), 128.8 (d, *J* = 9.3 Hz), 128.7 (d, *J* = 9.4 Hz), 125.8, 125.4, 115.4, 109.1, 54.3 (d, *J* = 4.2 Hz), 38.8 (d, *J* = 65.8 Hz), 34.4, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.205; **HRMS** (ESI, m/z): calcd for $C_{30}H_{32}BrNOP$ ($M+H^+$) 532.1405, found: 532.1406.



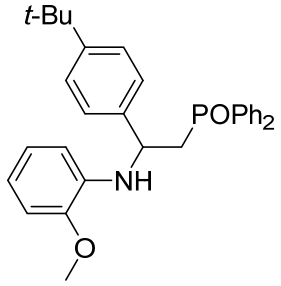
(2-(4-(tert-butyl)phenyl)-2-(o-tolylamino)ethyl)diphenylphosphine oxide (**3p**)**:** White solid; m.p. 189.5-194.7 °C, 71% yield (166 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.69 (t, *J* = 8.4, 17.6 Hz, 4H), 7.52-7.37 (m, 6H), 7.22 (s, 1H), 7.01 (d, *J* = 6.4 Hz, 1H), 6.82 (t, *J* = 8.0 Hz, 1H), 6.55 (t, *J* = 6.4 Hz, 1H), 6.12 (d, *J* = 8.0 Hz, 1H), 5.64 (s, 1H), 4.67-4.58 (m, 1H), 2.89-2.68 (m, 2H), 2.28 (s, 3H), 1.25 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.3, 145.1, 140.8 (d, *J* = 11.3 Hz), 133.6, 132.6 (d, *J* = 36.4 Hz), 131.9 (d, *J* = 2.8 Hz), 131.8 (d, *J* = 2.7 Hz), 131.3, 130.8 (d, *J* = 9.3 Hz), 130.5 (d, *J* = 9.3 Hz), 129.7, 128.7 (t, *J* = 11.6 Hz), 126.4, 125.7, 125.4, 123.2, 116.8, 111.1, 54.0 (d, *J* = 4.4 Hz), 39.0 (d, *J* = 65.9), 34.4, 31.3, 17.8; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.041; **HRMS** (ESI, m/z): calcd for $C_{31}H_{35}NOP$ ($M+H^+$) 468.2456, found: 468.2457.



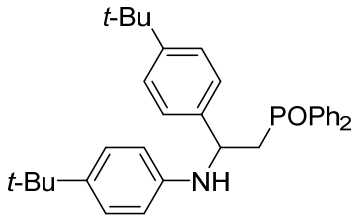
(2-(4-(tert-butyl)phenyl)-2-(m-tolylamino)ethyl)diphenylphosphine oxide (**3q**)**:** White solid; m.p. 211.2-225.1 °C, 76% yield (178 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.66 (q, *J* = 8.4, 18.4 Hz, 4H), 7.54-7.37 (m, 6H), 7.22 (d, *J* = 10.8 Hz, 4H), 6.88 (t, *J* = 7.6 Hz, 1H), 6.45 (d, *J* = 7.2 Hz, 1H), 6.33 (s, 1H), 6.17 (d, *J* = 8.0 Hz, 1H), 5.50 (s, 1H), 4.65-4.57 (m, 1H), 2.83-2.63 (m, 2H), 2.16 (s, 3H), 1.25 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 149.9, 147.1, 140.8 (d, *J* = 10.8 Hz), 138.4, 133.7, 132.7 (d, *J* = 42.7 Hz), 131.8 (d, *J* = 2.8 Hz), 131.7 (d, *J* = 2.7 Hz), 131.3, 130.8 (d, *J* = 9.3 Hz), 130.4 (d, *J* = 9.4 Hz), 128.7 (d, *J* = 6.4 Hz), 128.6 (d, *J* = 2.1 Hz), 128.5, 125.6, 125.5, 118.3, 114.9, 110.5, 54.0 (d, *J* = 4.0 Hz), 38.8 (d, *J* = 66.1 Hz), 34.7, 31.3, 21.4; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 30.775; **HRMS** (ESI, m/z): calcd for $C_{31}H_{35}NOP$ ($M+H^+$) 468.2456, found: 468.2459.



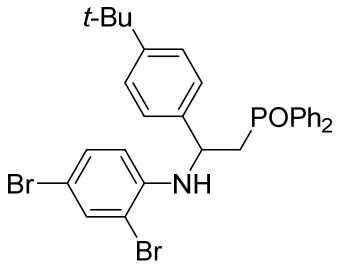
(2-(4-(tert-butyl)phenyl)-2-(p-tolylamino)ethyl)diphenylphosphine oxide (**3r**)**:** White solid; m.p. 197.7-210.2 °C, 79% yield (185 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.69 (q, *J* = 10.4, 18.8 Hz, 4H), 7.51-7.39 (m, 6H), 7.23 (d, *J* =10.8 Hz, 4H), 6.83 (d, *J* = 8.4 Hz, 2H), 6.35 (d, *J* = 8.4 Hz, 2H), 5.47 (q, *J* = 7.2, 14.0 Hz 1H), 4.61-4.53 (m,1H), 2.82-2.63 (m, 2H), 2.15 (s, 3H), 1.26 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 149.9, 144.8, 140.9 (d, *J* = 11.1 Hz), 133.7, 132.7 (d, *J* = 50.3 Hz), 131.8 (d, *J* = 2.7 Hz), 131.7 (d, *J* = 2.7 Hz), 131.2 (d, *J* = 57.2), 130.8 (d, *J* = 9.3 Hz), 130.4 (d, *J* = 9.4 Hz), 129.2, 128.7 (d, *J* = 5.9 Hz), 128.6 (d, *J* = 5.9 Hz), 125.6 (d, *J* = 9.6 Hz), 113.9, 54.2 (d, *J* = 3.9 Hz), 38.9 (d, *J* = 66.1 Hz), 34.3, 31.3, 20.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 30.787; **HRMS** (ESI, m/z): calcd for $C_{31}H_{35}NOP$ ($M+H^+$) 468.2456, found: 468.2460.



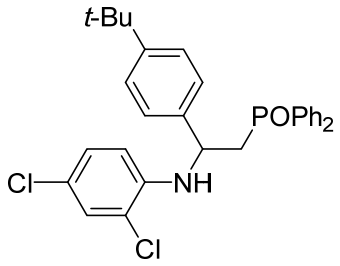
(2-(4-(tert-butyl)phenyl)-2-((2-methoxyphenyl)amino)ethyl)diphenylphosphine oxide (**3s**)**:** White solid; m.p. 176.1-184.4 °C, 69% yield (167 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.75-7.60 (m, 4H), 7.50-7.32 (m, 6H), 7.20 (q, *J* = 8.4, 17.2 Hz, 4H), 6.69 (d, *J* = 7.6 Hz, 1H), 6.66-6.53 (m, 2H), 6.28 (d, *J* = 7.2 Hz, 1H), 5.34 (s, 1H), 4.82-4.72 (m, 1H), 3.79 (s, 3H), 2.99-2.67 (m, 2H), 1.25 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 149.9, 147.0, 140.2 (d, *J* = 10.4 Hz), 133.9, 132.9 (d, *J* = 10.3 Hz), 131.8, 131.6 (d, *J* = 3.0 Hz), 131.5 (d, *J* = 3.0 Hz), 130.8 (d, *J* = 9.3 Hz), 130.6 (d, *J* = 9.3 Hz), 128.5 (d, *J*= 5.6 Hz), 128.4 (d, *J* = 5.6 Hz), 125.7, 125.5, 120.8, 116.5, 111.2, 109.1, 55.4, 52.9 (d, *J* = 1.4 Hz), 39.0 (d, *J* = 67.0 Hz), 34.3, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 31.803; **HRMS** (ESI, m/z): calcd for $C_{31}H_{35}NO_2P$ ($M+H^+$) 484.2405, found: 484.2407.



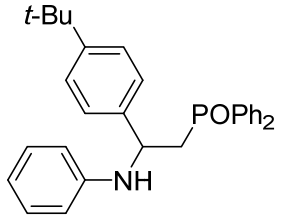
(2-(4-(tert-butyl)phenyl)-2-((4-(tert-butyl)phenyl)amino)ethyl)diphenylphosphine oxide (**3t**)**:** White solid; m.p. 248.5-249.2 °C, 64% yield (163 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.73-7.63 (m, 4H), 7.50-7.37 (m, 6H), 7.24 (s, 1H), 7.04 (d, *J* = 9.6Hz, 2H), 6.38 (d, *J* = 8.4 Hz, 2H), 5.44 (s, 1H), 4.64-4.54 (m, 1H), 2.82-2.63 (m, 2H), 1.27 (d, *J* = 22.8 Hz, 18H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.0, 144.9, 141.1 (d, *J* = 11.0 Hz), 140.0, 133.9, 132.9 (d, *J* = 61.9 Hz), 131.8 (d, *J* = 2.6 Hz), 131.8 (d, *J* = 2.7 Hz), 131.3, 130.9 (d, *J* = 9.3 Hz), 130.5 (d, *J* = 9.4 Hz), 128.7 (d, *J* = 5.4 Hz), 128.6 (d, *J* = 5.4 Hz), 125.6 (d, *J* = 3.7 Hz), 125.5, 113.6, 54.4 (d, *J* = 4.0 Hz), 39.0 (d, *J* = 66.1 Hz), 34.4, 33.7, 31.5, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 30.685; **HRMS** (ESI, m/z): calcd for $C_{34}H_{41}NOP$ ($M+H^+$) 510.2926, found: 510.2928.



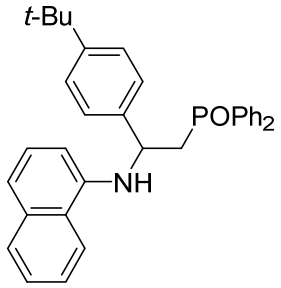
(2-(4-(tert-butyl)phenyl)-2-((2,4-dibromophenyl)amino)ethyl)diphenylphosphine oxide (**3u**)**:** White solid; m.p. 190.4-194.2 °C, 82% yield (250 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.75-7.60 (m, 4H), 7.47 (q, *J* = 2.4, 4.8 Hz, 3H), 7.43-7.37 (m, 4H), 7.20 (q, *J* =8.4, 20.0 Hz, 4H), 7.00 (q, *J* = 2.4, 8.8 Hz, 1H), 6.13 (d, *J* = 8.8 Hz, 1H), 5.87 (d, *J* = 4.8 Hz, 1H), 2.89-2.74 (m, 2H), 1.26 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.4, 142.8, 139.0 (d, *J* = 9.8 Hz), 134.1, 133.2, 132.6 (d, *J* = 30.9 Hz), 131.8, 131.6, 130.6, 130.5 (d, *J* = 5.2 Hz), 130.4, 128.7 (d, *J* = 3.5 Hz), 128.6 (d, *J* = 3.4 Hz), 125.7, 125.4, 113.7, 110.2, 108.3, 53.4 (d, *J* = 4.0 Hz), 38.7 (d, *J* = 66.5 Hz), 34.4, 31.2; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 29.561; **HRMS** (ESI, m/z): calcd for $C_{30}H_{31}Br_2NOP$ ($M+H^+$) 610.0510, found: 610.0511.



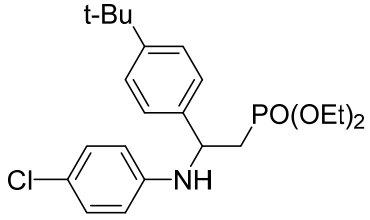
(2-(4-(tert-butyl)phenyl)-2-((2,4-dichlorophenyl)amino)ethyl)diphenylphosphine oxide (**3v**)**:** White solid; m.p. 196.5-198.8 °C, 87% yield (227 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 7.74-7.64 (m, 4H), 7.47 (t, *J* = 6.8 Hz, 2H), 7.43-7.36 (m, 4H), 7.24-7.15 (m, 5H), 6.83 (q, *J* = 2.0, 8.8 Hz, 1H), 6.17 (d, *J* = 8.8 Hz, 1H), 5.88 (d, *J* = 4.8 Hz, 1H), 4.76-4.67 (m, 1H), 2.86-2.72 (m, 2H), 1.26 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.4, 141.5, 139.2 (d, *J* = 9.9 Hz), 133.3, 132.6 (d, *J* = 28.1 Hz), 131.8, 131.6, 130.7 (d, *J* = 9.4 Hz), 130.5 (d, *J* = 9.4 Hz), 128.7 (d, *J* = 2.0 Hz), 128.6 (d, *J* = 2.0 Hz), 128.5, 127.2, 125.8, 125.5, 121.3, 119.9, 113.1, 53.4 (d, *J* = 4.0 Hz), 38.8 (d, *J* = 66.5), 34.4, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 29.546; **HRMS** (ESI, m/z): calcd for $C_{30}H_{31}Cl_2NOP$ ($M+H^+$) 522.1520, found: 522.1524.



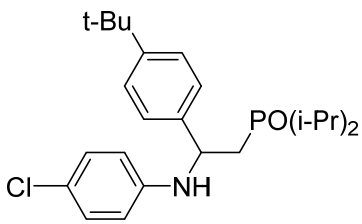
(2-(4-(tert-butyl)phenyl)-2-(phenylamino)ethyl)diphenylphosphine oxide (**3w**)**:** White solid; m.p. 226.5-229.7 °C, 83% yield (188 mg); **^{1}H NMR** (400 MHz, $CDCl_3$):δ 7.74-7.62 (m, 4H), 7.51-7.37 (m, 6H), 7.23 (d, *J* = 12.4 Hz, 4H), 7.02 (t, *J* = 8.0 Hz,2H), 6.61 (t, *J* = 7.2 Hz, 1H) ,6.43 (d, *J* = 7.6 Hz, 2H), 5.56 (s, 1H), 4.60 (q, *J* = 6.0, 9.2 Hz, 1H), 2.83-2.64 (m, 2H), 1.65 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 150.4, 147.1, 140.7 (d, *J* = 11.0 Hz), 133.6, 132.7 (d, *J* = 45.9 Hz), 131.8 (d, *J* = 2.8 Hz), 131.7 (d, *J* = 2.8 Hz), 131.2, 130.8 (d, *J* = 9.4 Hz), 130.4 (d, *J* = 9.4 Hz), 128.7, 128.6 (d, *J* = 5.0 Hz), 128.5 (d, *J* = 5.0 Hz), 125.6 (d, *J* = 11.7 Hz), 117.3, 113.8, 54.1 (d, *J* = 4.1 Hz), 38.9 (d, *J* = 66.1 Hz), 34.3, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 30.859; **HRMS** (ESI, m/z): calcd for $C_{30}H_{33}NOP$ ($M+H^+$) 454.2300, found: 454.2305.



(2-(4-(tert-butyl)phenyl)-2-(naphthalen-1-ylamino)ethyl)diphenylphosphine oxide (**3x**)**:** White solid; m.p. 240.5-243.9 °C, 69% yield (174 mg); **^{1}H NMR** (400 MHz, $CDCl_3$) δ: 8.13 (d, *J* = 8.4 Hz, 1H), 7.77-7.65 (m, 5H), 7.53-7.43 (m, 4H), 7.40 (q, *J* = 7.6, 10.4 Hz, 4H), 7.27 (s, 1H), 7.22 (d, *J* = 8.4 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 1H), 7.04 (t, *J* = 8.0, 1H), 6.83 (s, 1H), 6.09 (d, *J* = 7.6 Hz, 1H), 5.34 (s, 1H), 4.76 (t, *J* = 9.6 Hz, 1H), 3.00-2.76 (m, 2H), 1.25 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.0, 142.3, 140.3 (d, *J* = 10.9 Hz), 134.1, 133.3, 132.3 (d, *J* = 12.2 Hz), 131.9 (d, *J* = 2.7 Hz), 131.8 (d, *J* = 2.8 Hz), 131.2, 130.8 (d, *J* = 9.5 Hz), 130.5 (d, *J* = 9.4 Hz), 128.8 (d, *J* = 7.9 Hz), 128.6 (d, *J* = 7.9 Hz), 128.1, 126.1, 125.6, 125.5, 125.4, 124.9, 123.8, 121.0, 117.0, 105.8, 54.4 (d, *J* = 4.7 Hz), 38.8 (d, *J* = 65.6 Hz), 34.3, 31.3; **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 30.685; **HRMS** (ESI, m/z): calcd for $C_{34}H_{35}NOP$ ($M+H^+$) 504.2456, found: 504.2459.



diethyl (2-(4-(tert-butyl)phenyl)-2-((4-chlorophenyl)amino)ethyl)phosphonate (**3y**)**:** Yellow oil liquid; 65% yield (138 mg); **^{1}H NMR** (400 MHz, $CDCl_3$): *δ* 7.35 (s, 4H), 7.05 (d, *J* = 8.8 Hz, 2H), 6.55 (d, *J* = 8.8 Hz, 2H), 4.91 (t, *J* = 8.8 Hz, 1H), 4.71 (q, *J* = 8.0, 24.0 Hz, 1H), 4.17-4.03 (m, 2H), 3.98-3.87 (m, 1H), 3.70-3.59 (m, 1H), 1.26 (t, *J* = 7.6 Hz, 12H), 1.08 (t, *J* = 7.2Hz, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 151.1 (d, *J* = 3.5 Hz), 145.1 (d, *J* = 14.6), 132.2 (d, *J* = 2.6 Hz), 129.0, 127.4 (d, *J* = 5.5 Hz), 125.6 (d, *J* = 2.7 Hz), 122.8, 114.9; 63.4 (q, *J* = 7.0, 12.8 Hz), 56.4, 54.7, 34.5, 31.3, 16.4 (q, *J* = 5.8, 31.7 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 22.654; **HRMS** (ESI, m/z): calcd for $C_{22}H_{32}ClNO_3P$ ($M+H^+$) 424.1808, found: 424.1813.



(2-(4-(tert-butyl)phenyl)-2-((4-chlorophenyl)amino)ethyl)diisopropylphosphine oxide (**3z**)**:** Yellow solid; m.p. 141.6-237.7°C, 83% yield (174 mg); **^{1}H NMR** (400 MHz, $CDCl_3$): *δ* 7.33 (d, *J* = 2.4 Hz, 4H), 7.05 (d, *J*

= 8.8 Hz, 2H), 6.53 (d, *J* = 8.8 Hz, 2H), 4.84 (t, *J* = 8.8 Hz, 1H), 4.71-4.53 (m, 2H), 4.46-4.35 (m, 1H), 1.36-1.16 (m, 18H), 0.85 (d, *J* = 6.4 Hz, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ: 150.9 (d, *J* = 3.4 Hz), 145.3 (d, *J* = 14.6 Hz), 132.5 (d, *J* = 2.5 Hz), 128.9, 127.6 (d, *J* = 5.6 Hz), 125.4 (d, *J* = 2.5 Hz), 122.7, 114.8, 72.2 (q, *J* = 7.2, 35.5 Hz), 56.9, 55.4, 34.5, 31.6, 24.2 (q, *J* = 2.9, 5.8 Hz), 23.8 (d, *J* = 5.1 Hz), 23.0 (d, *J* = 5.9 Hz); **^{31}P NMR** (162 MHz, $CDCl_3$) δ: 20.897; **HRMS** (ESI, m/z): calcd for $C_{34}H_{35}NOP$ ($M+H^+$) 504.2456, found: 504.2459.

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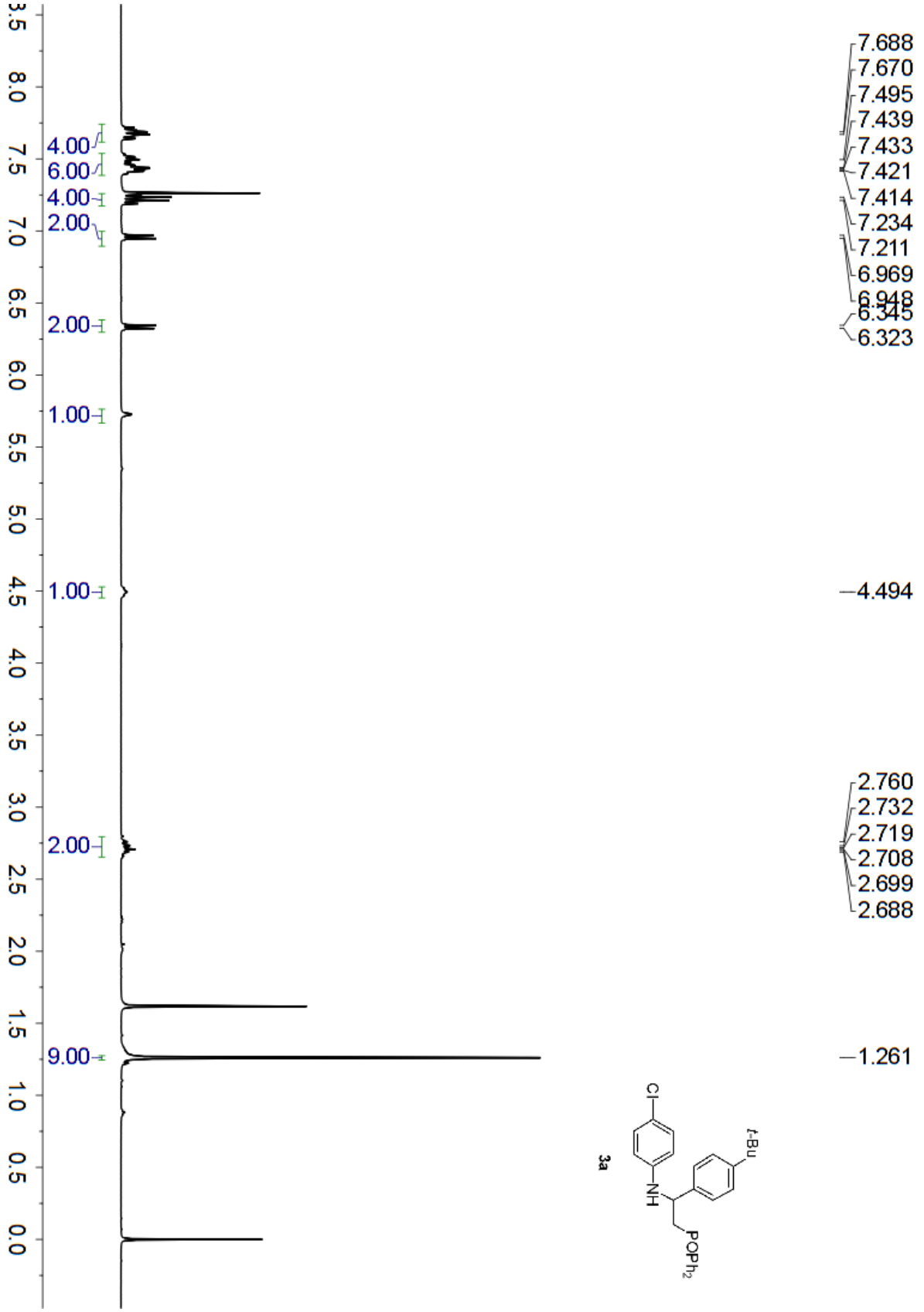
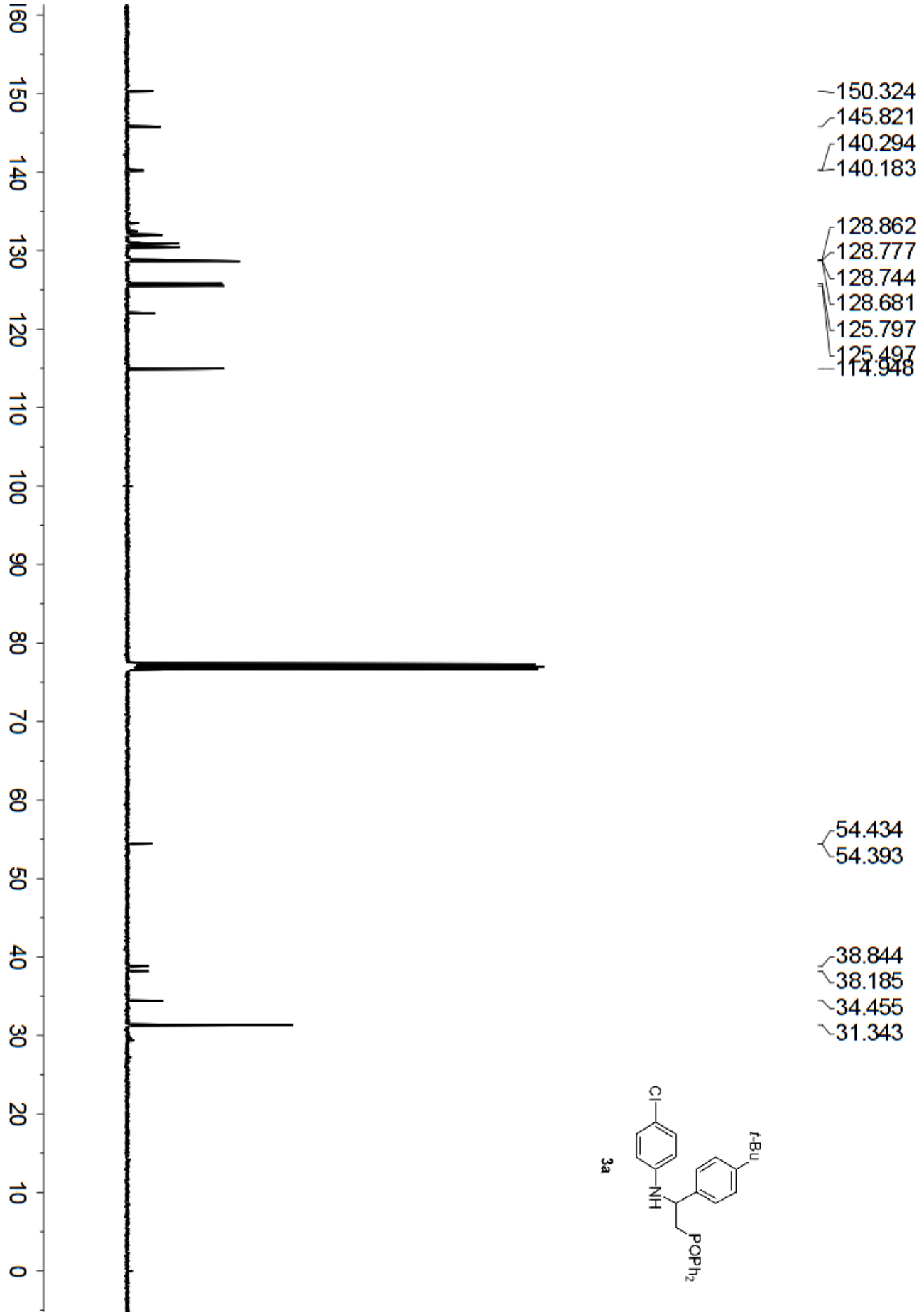
6. Spectra of these compounds

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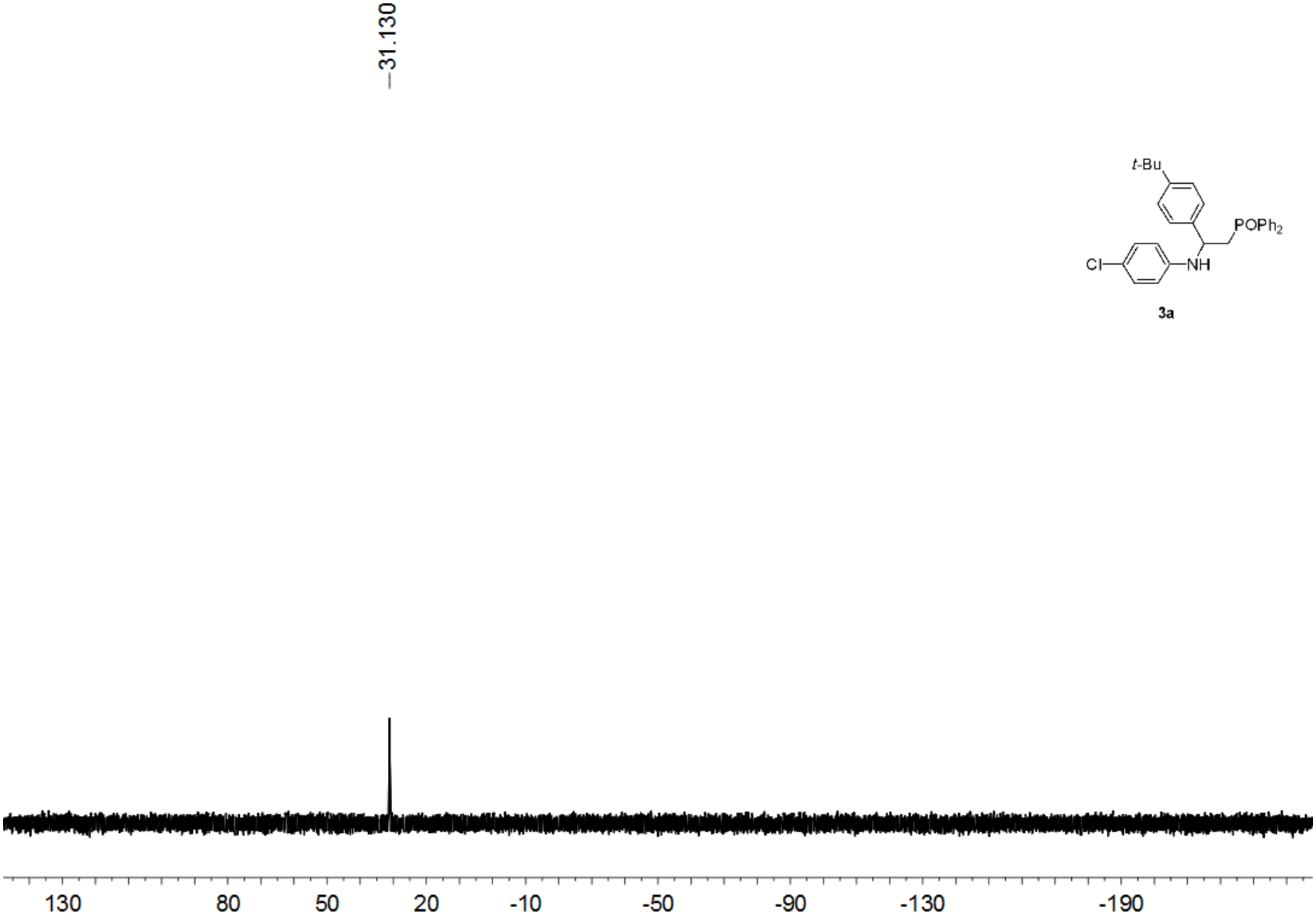
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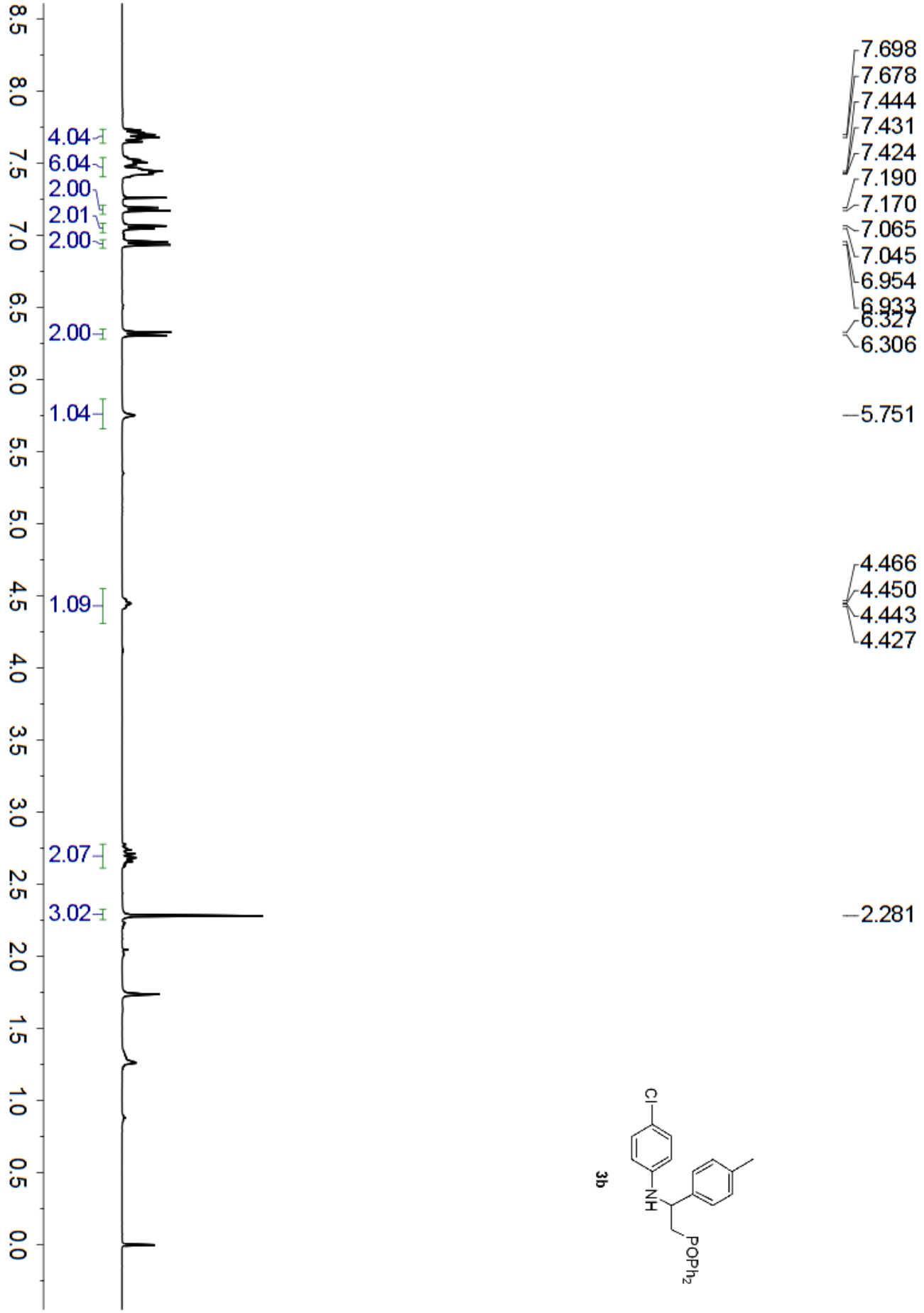
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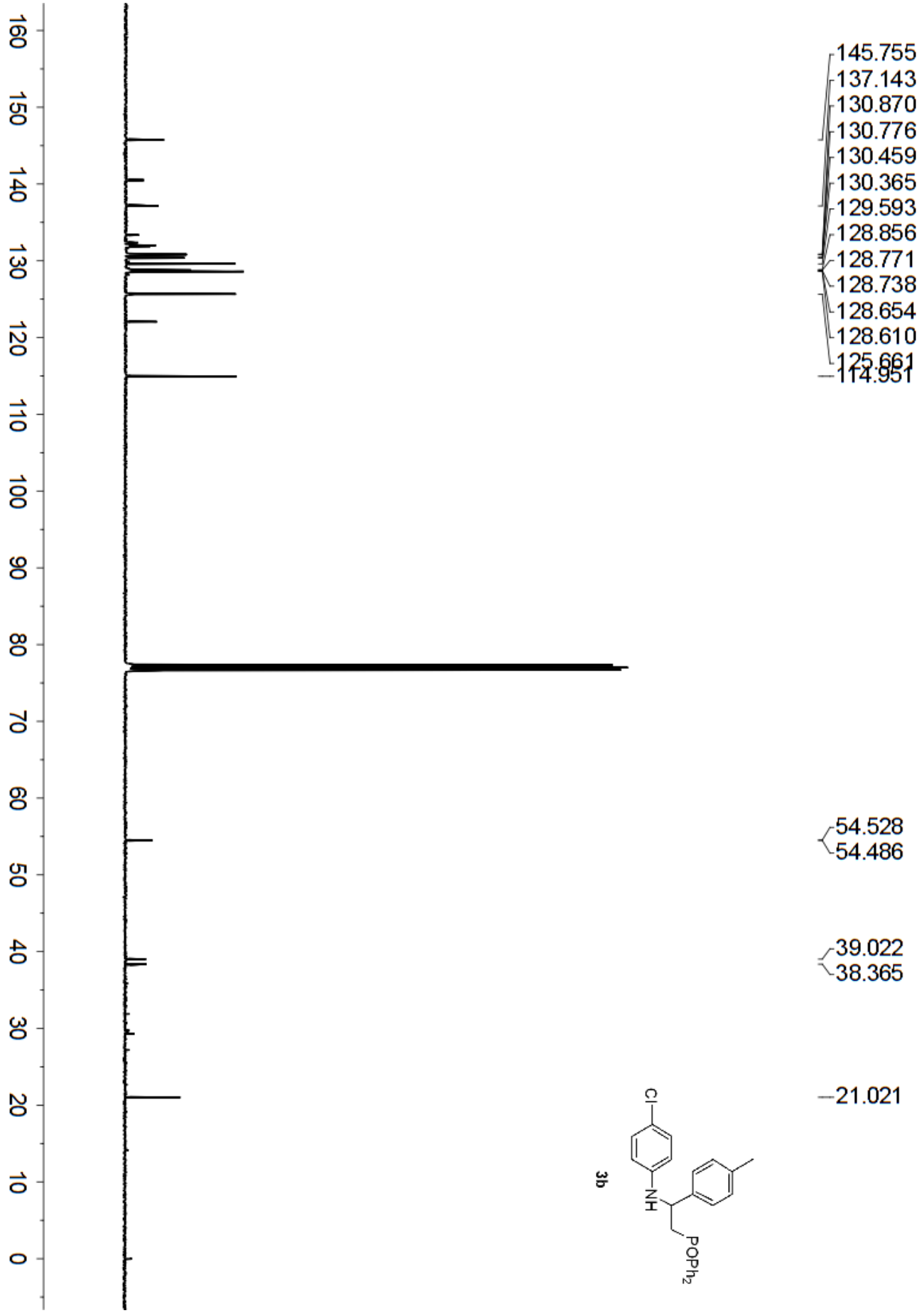
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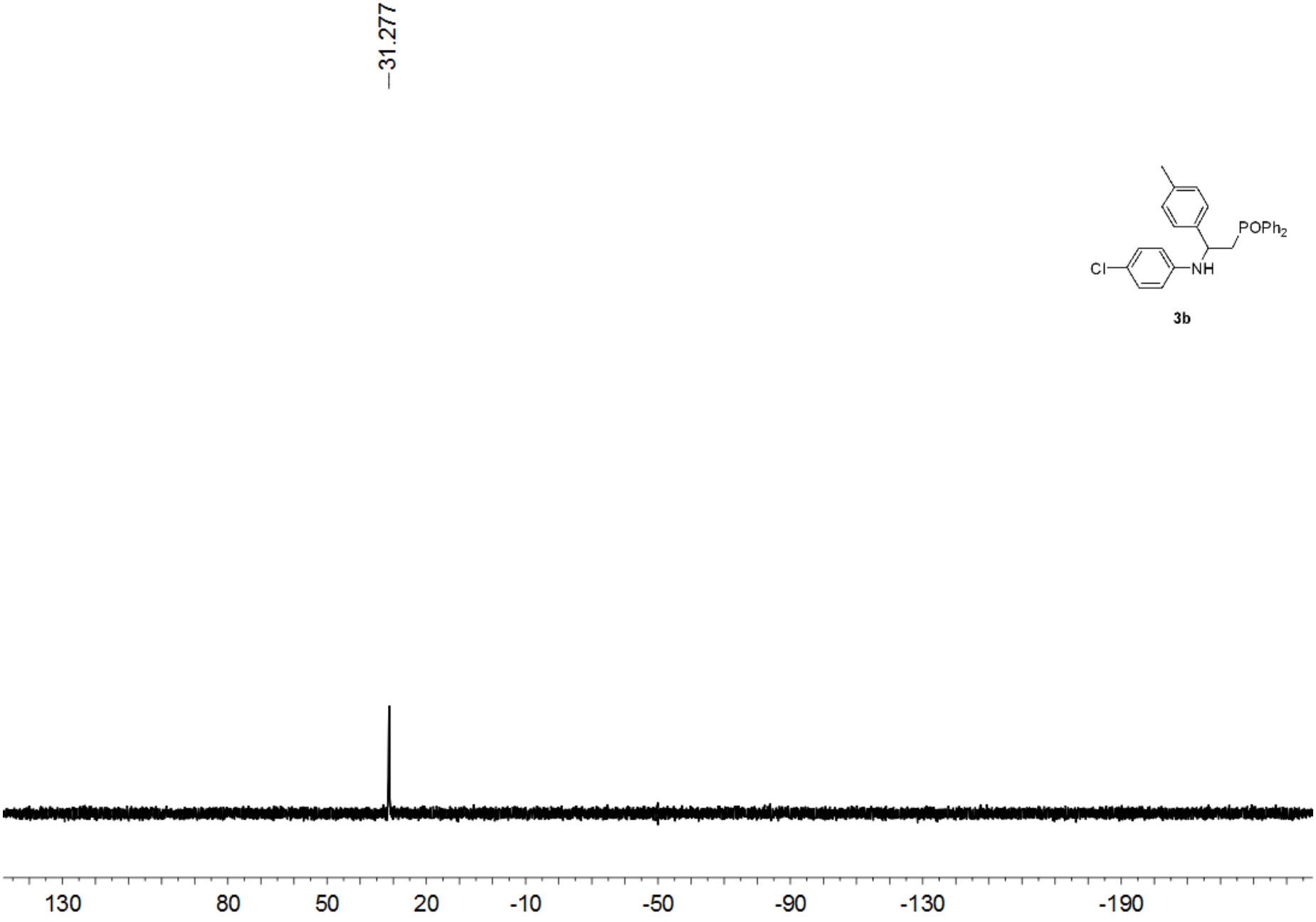
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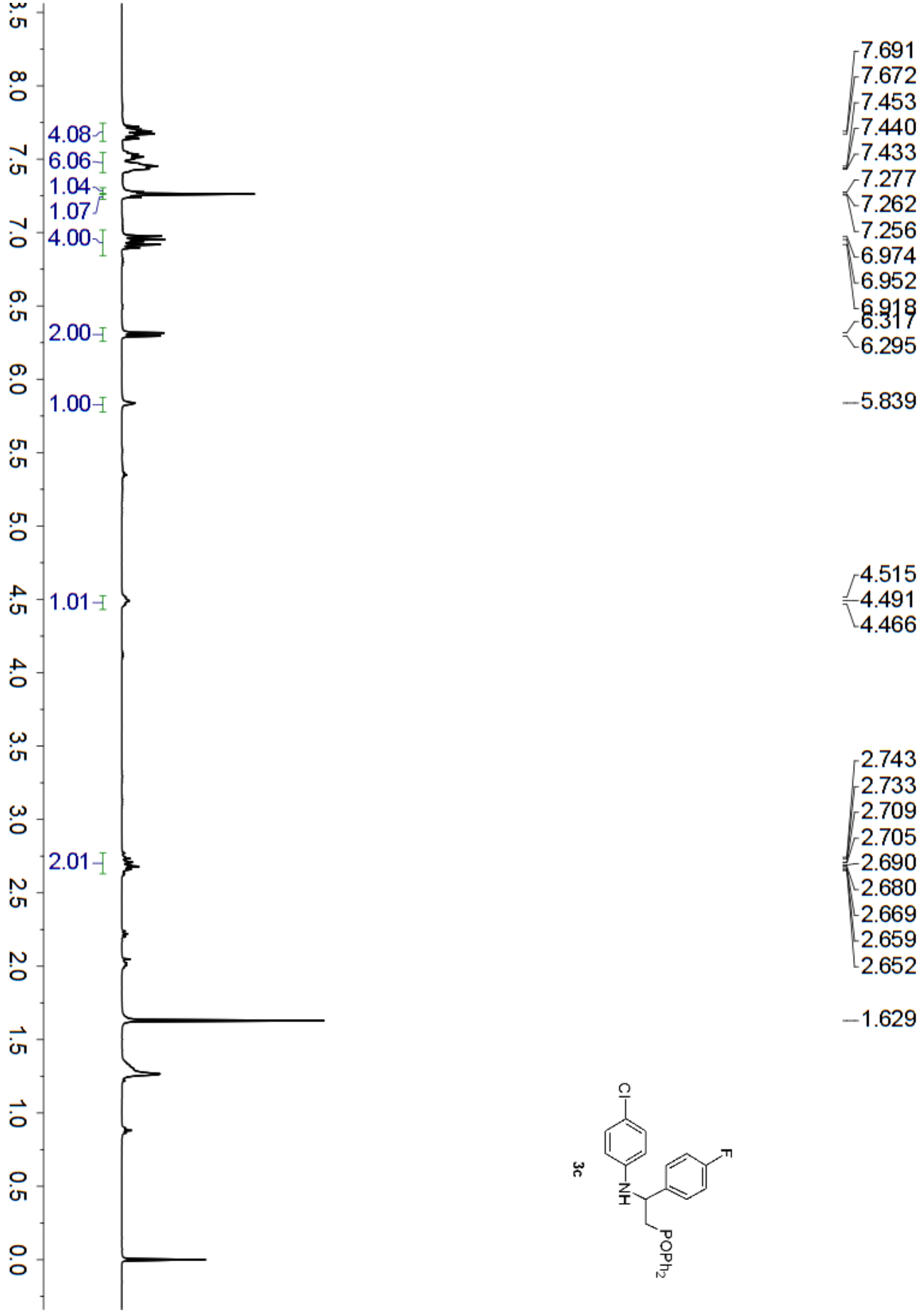
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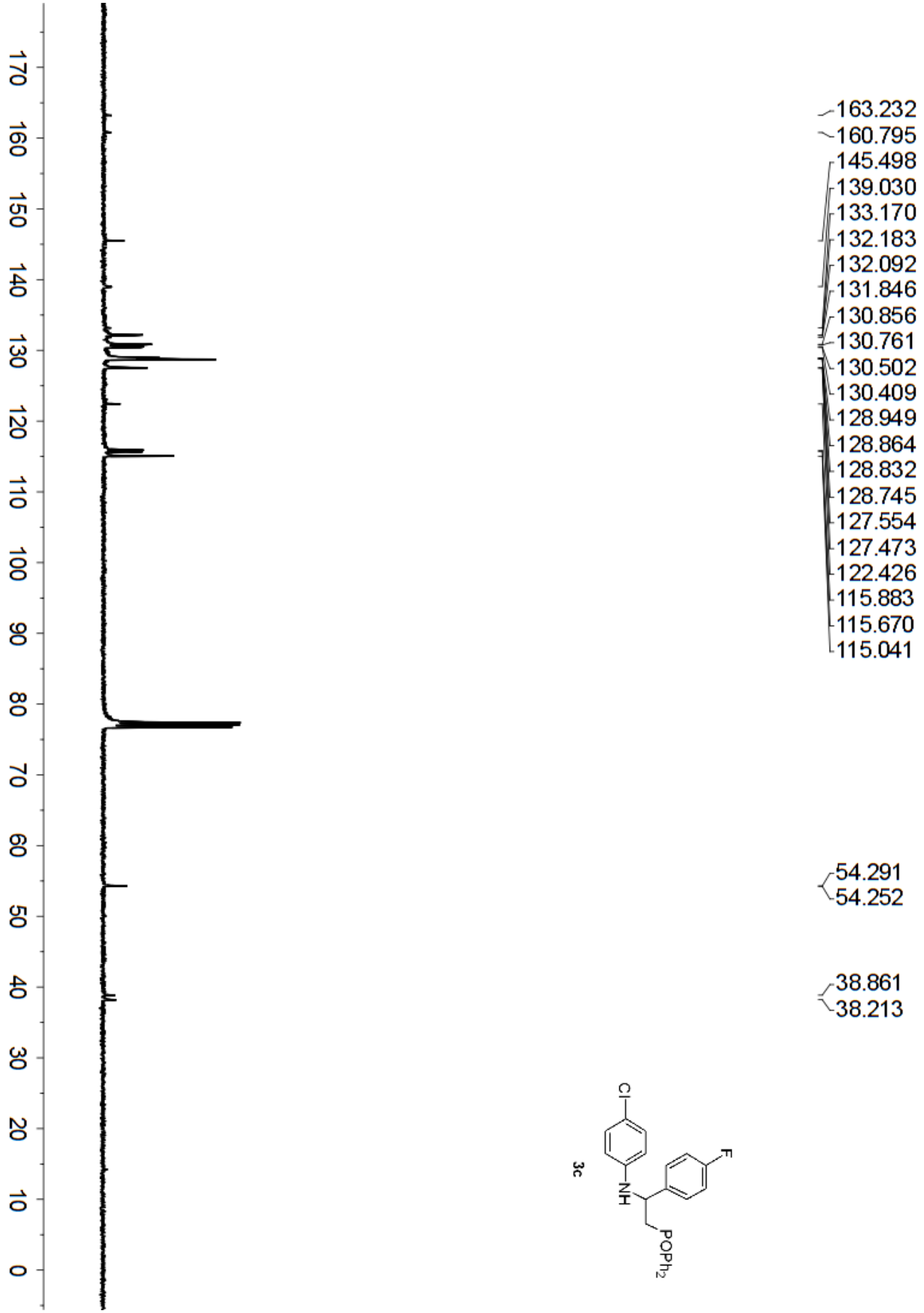
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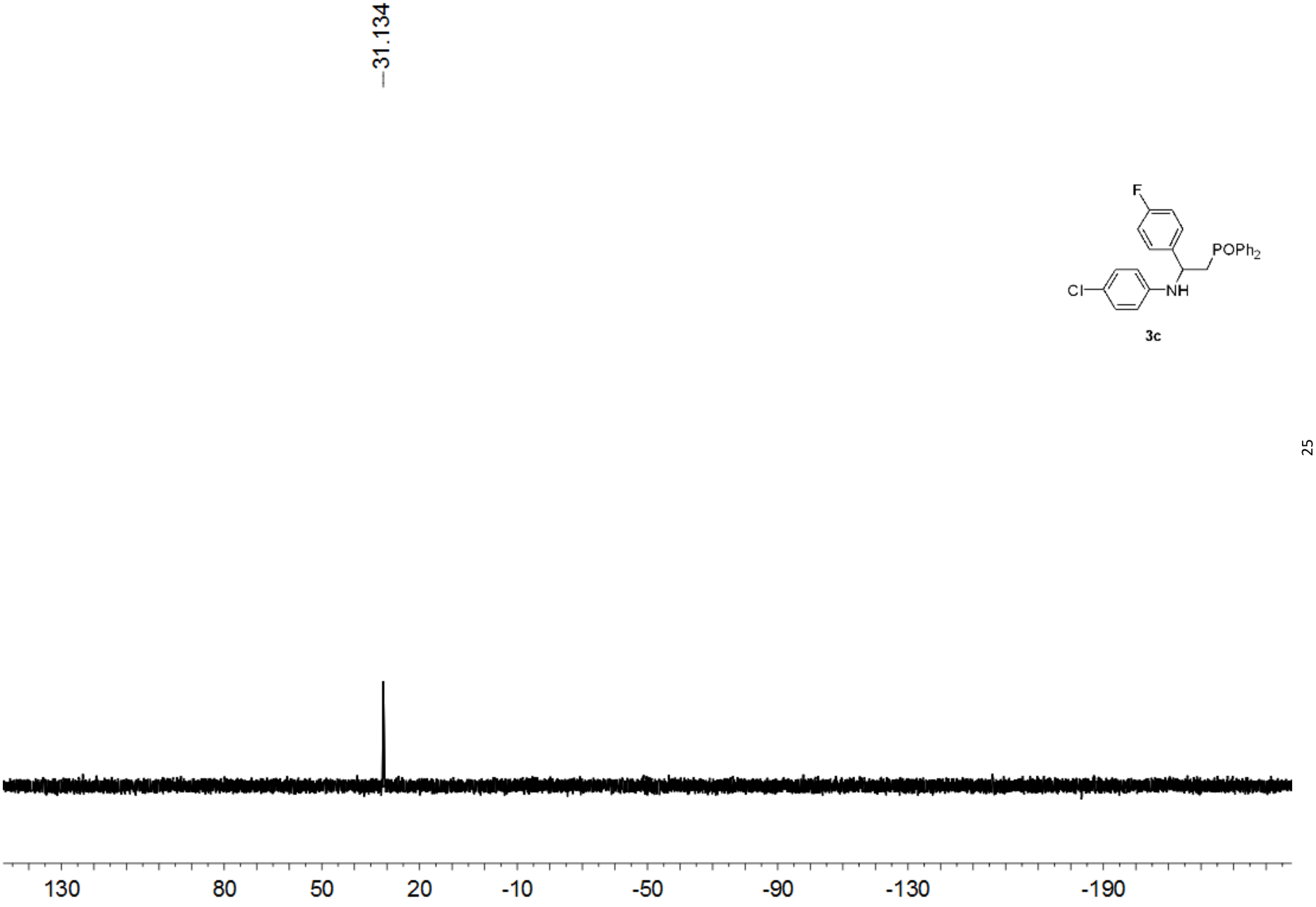
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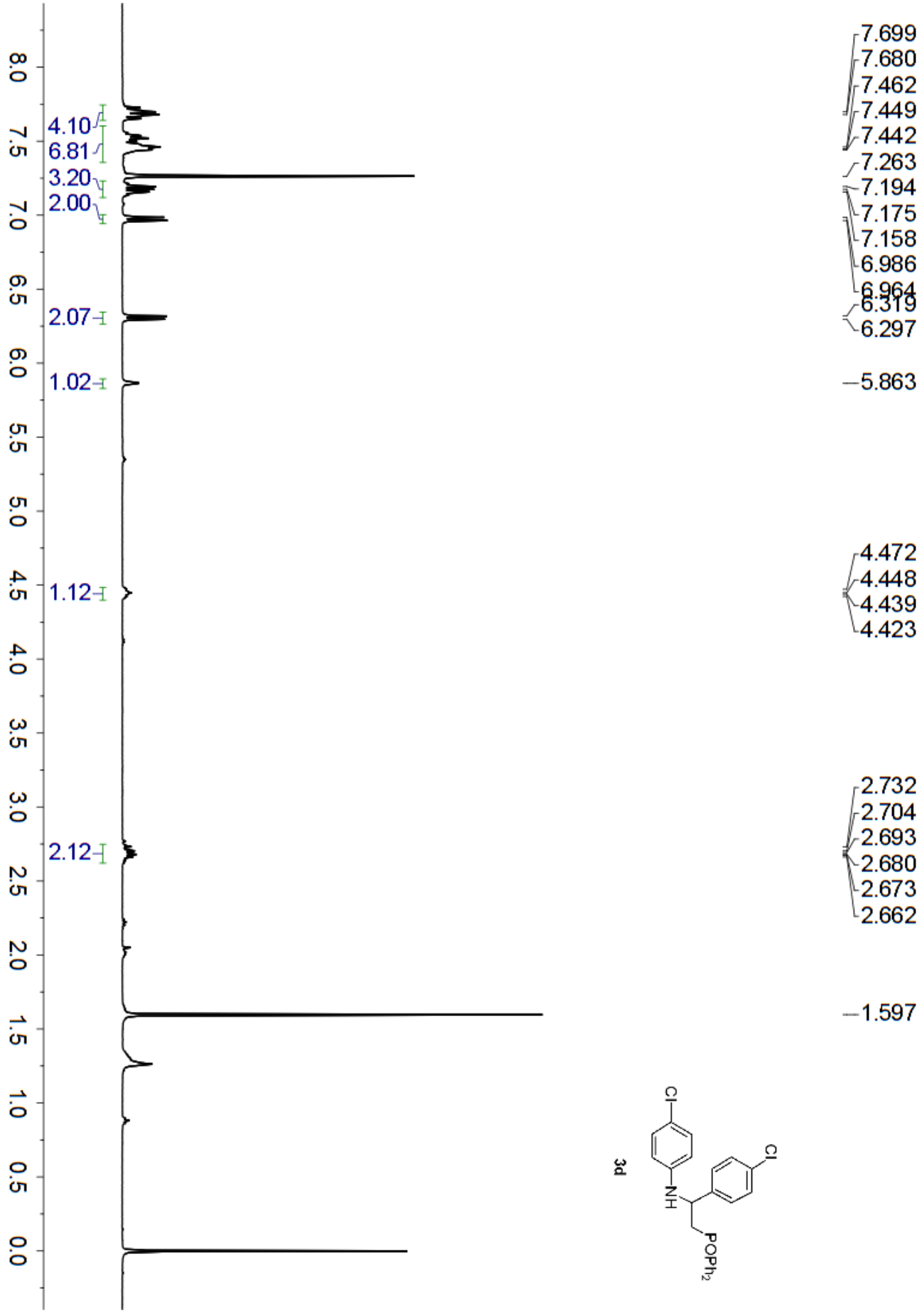
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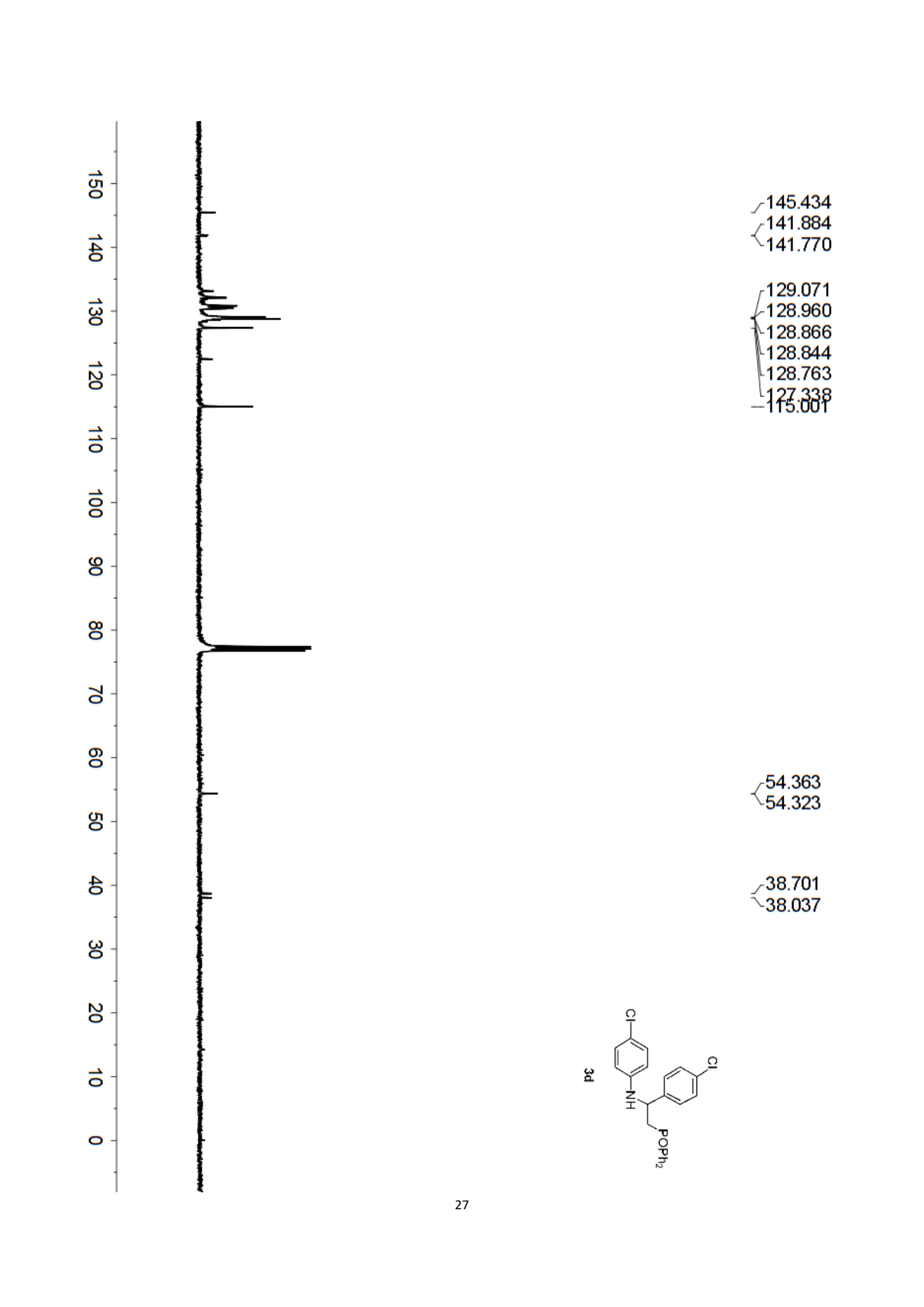
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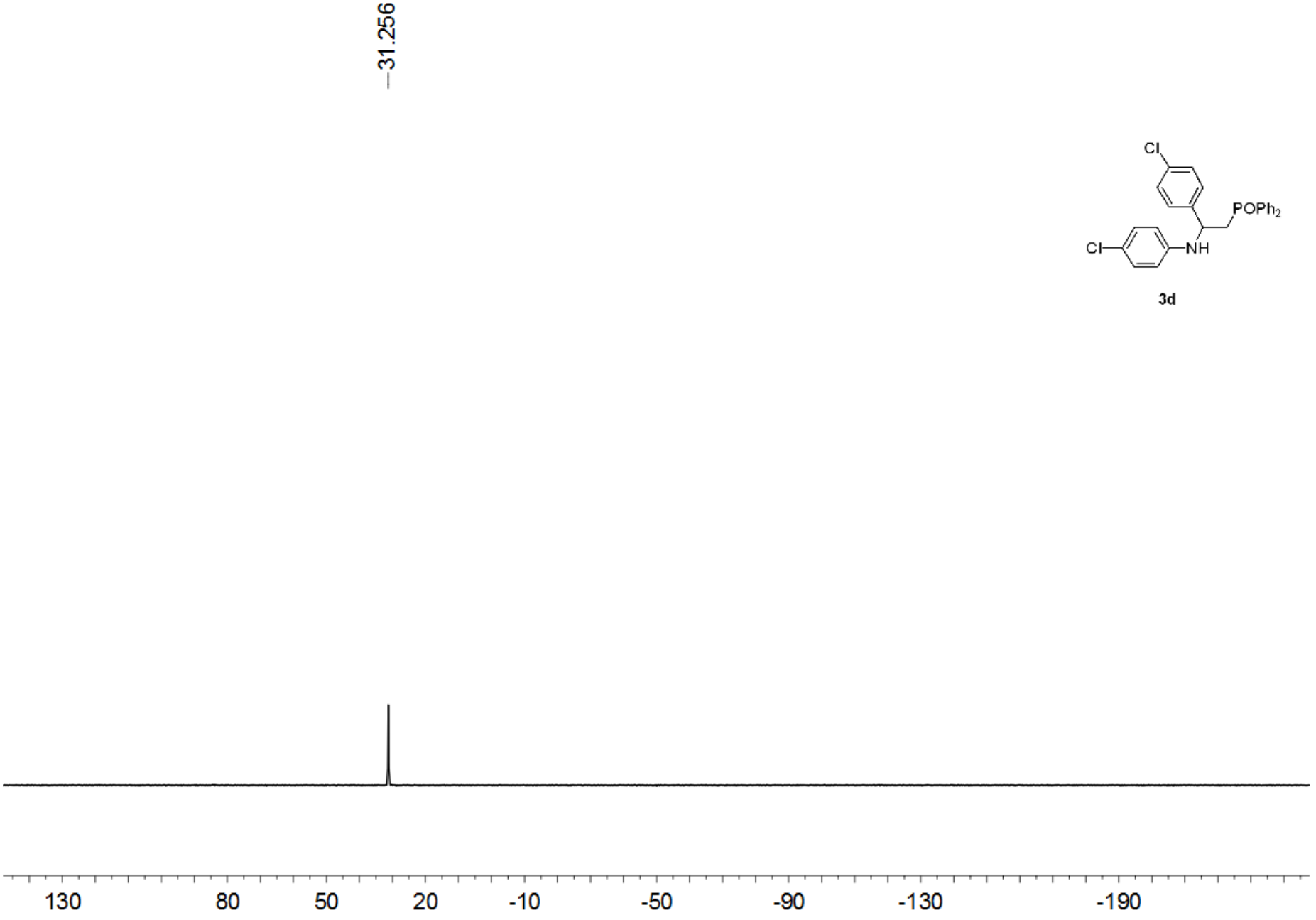
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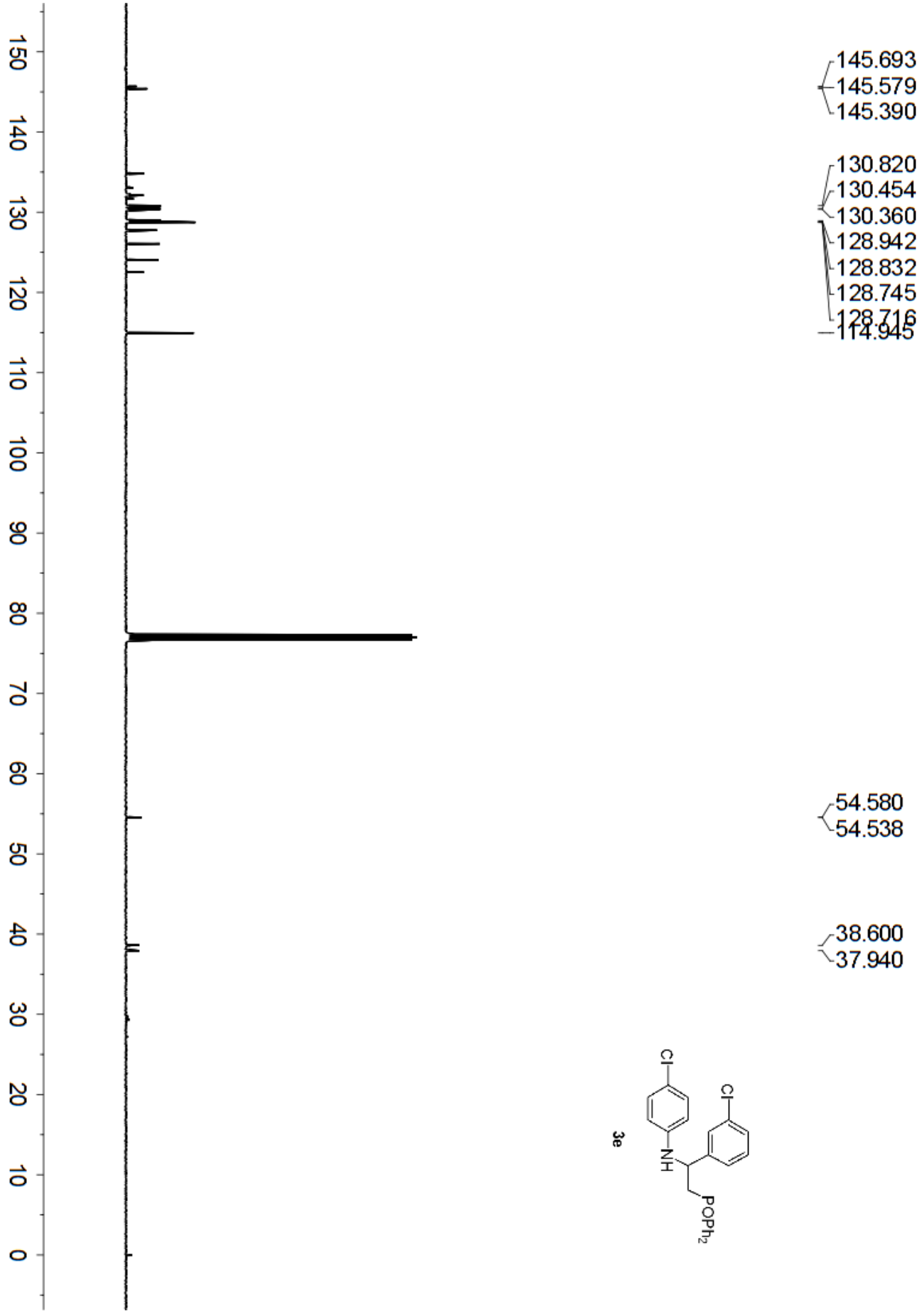
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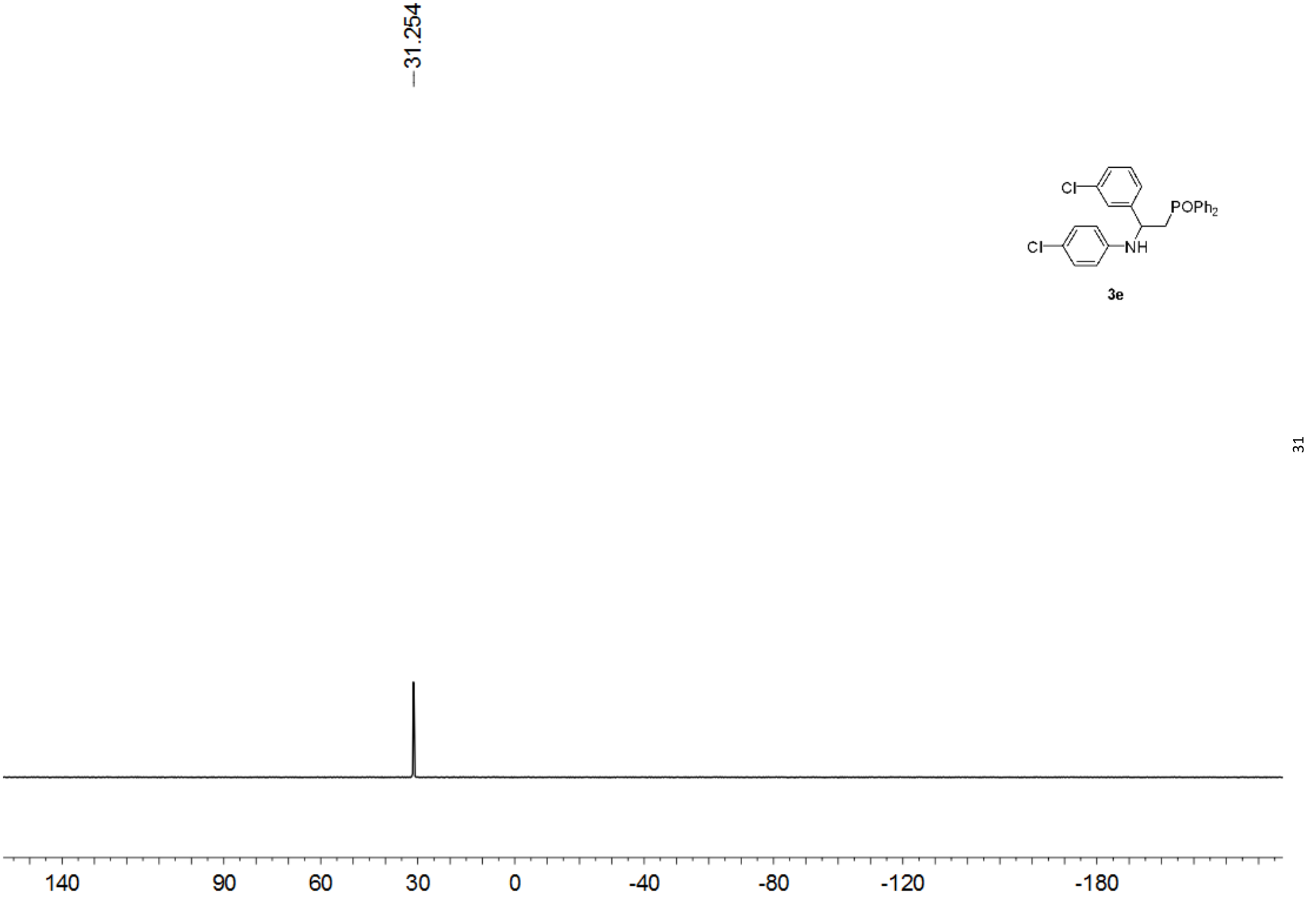
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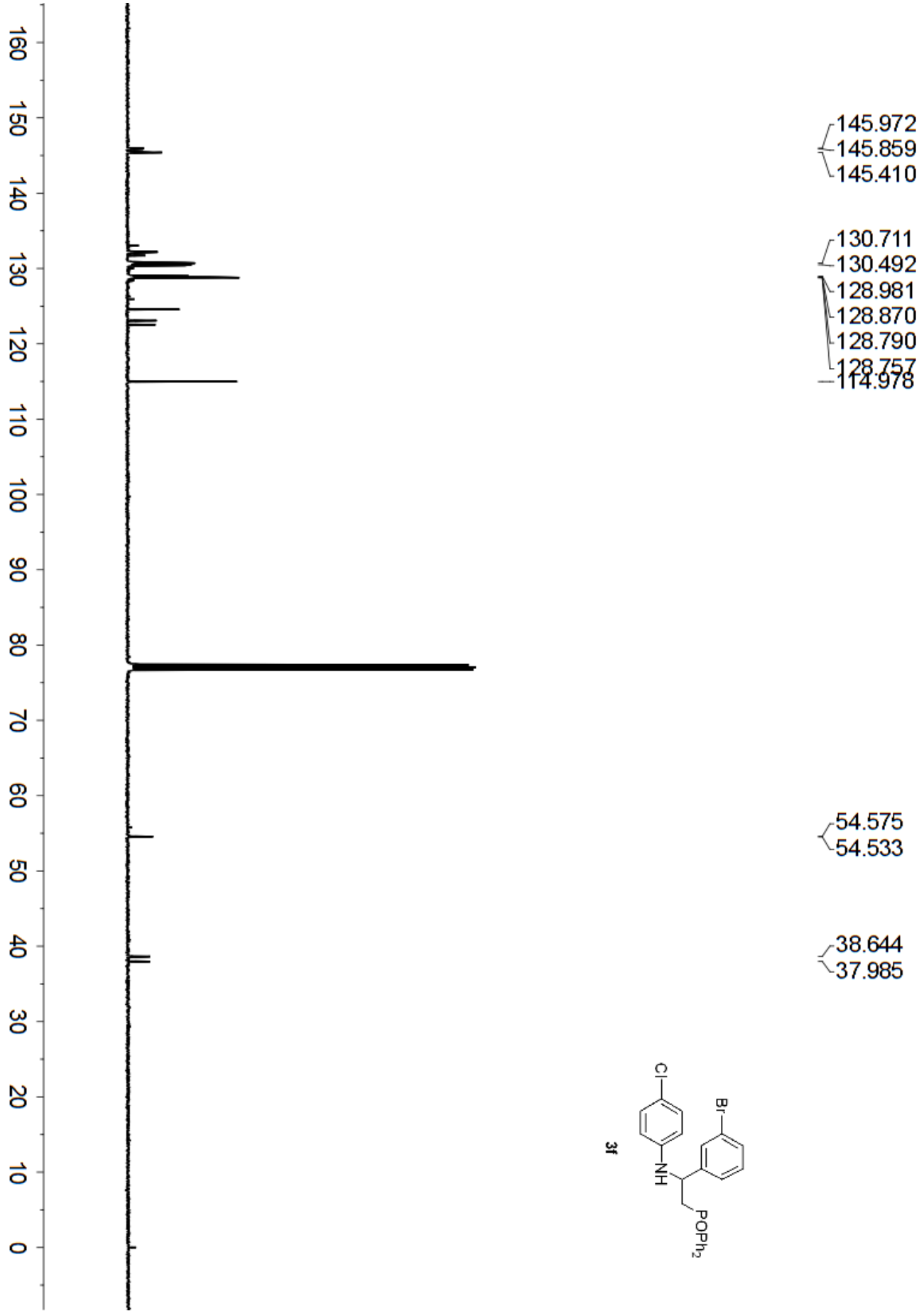
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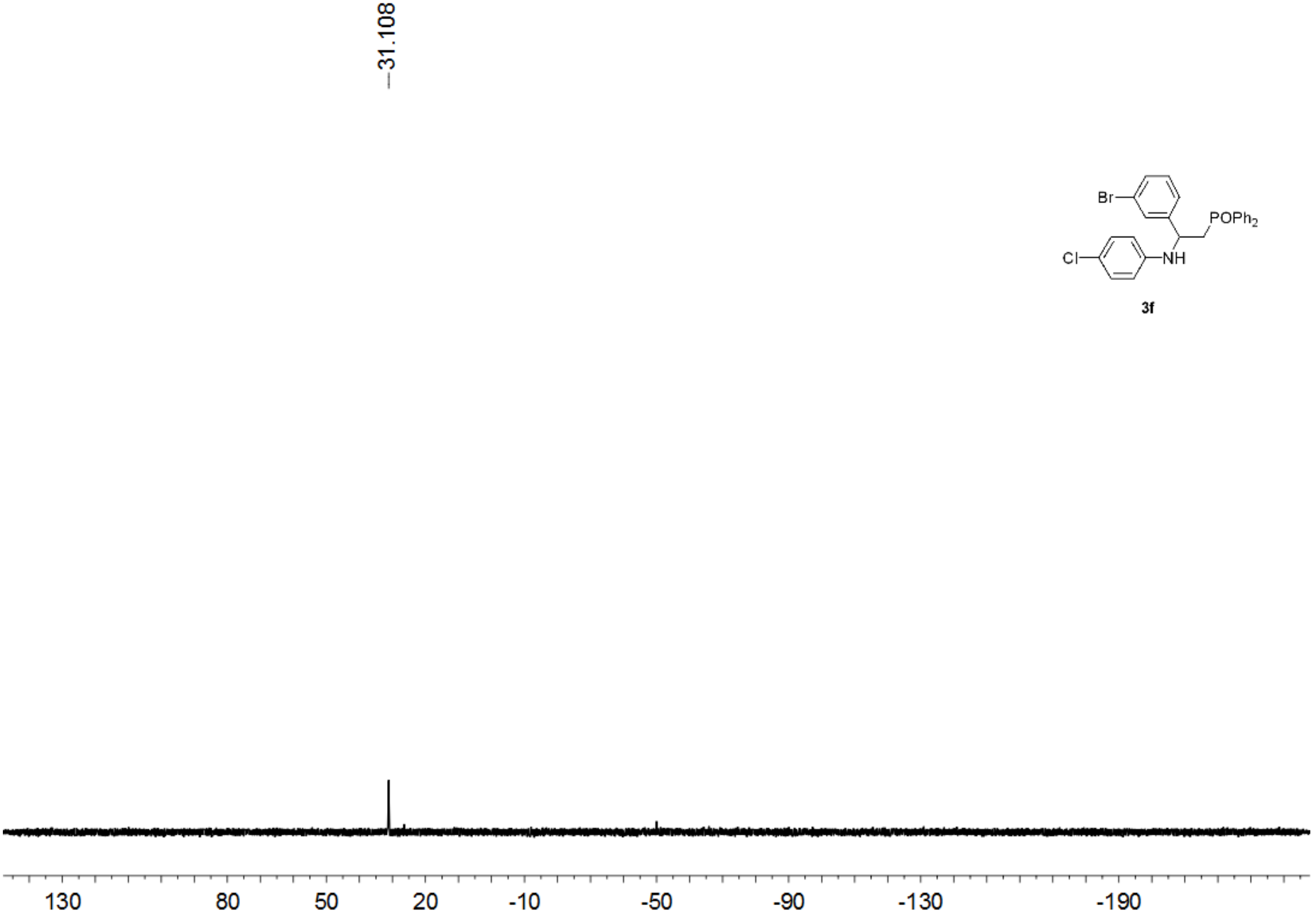
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Cl
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NH
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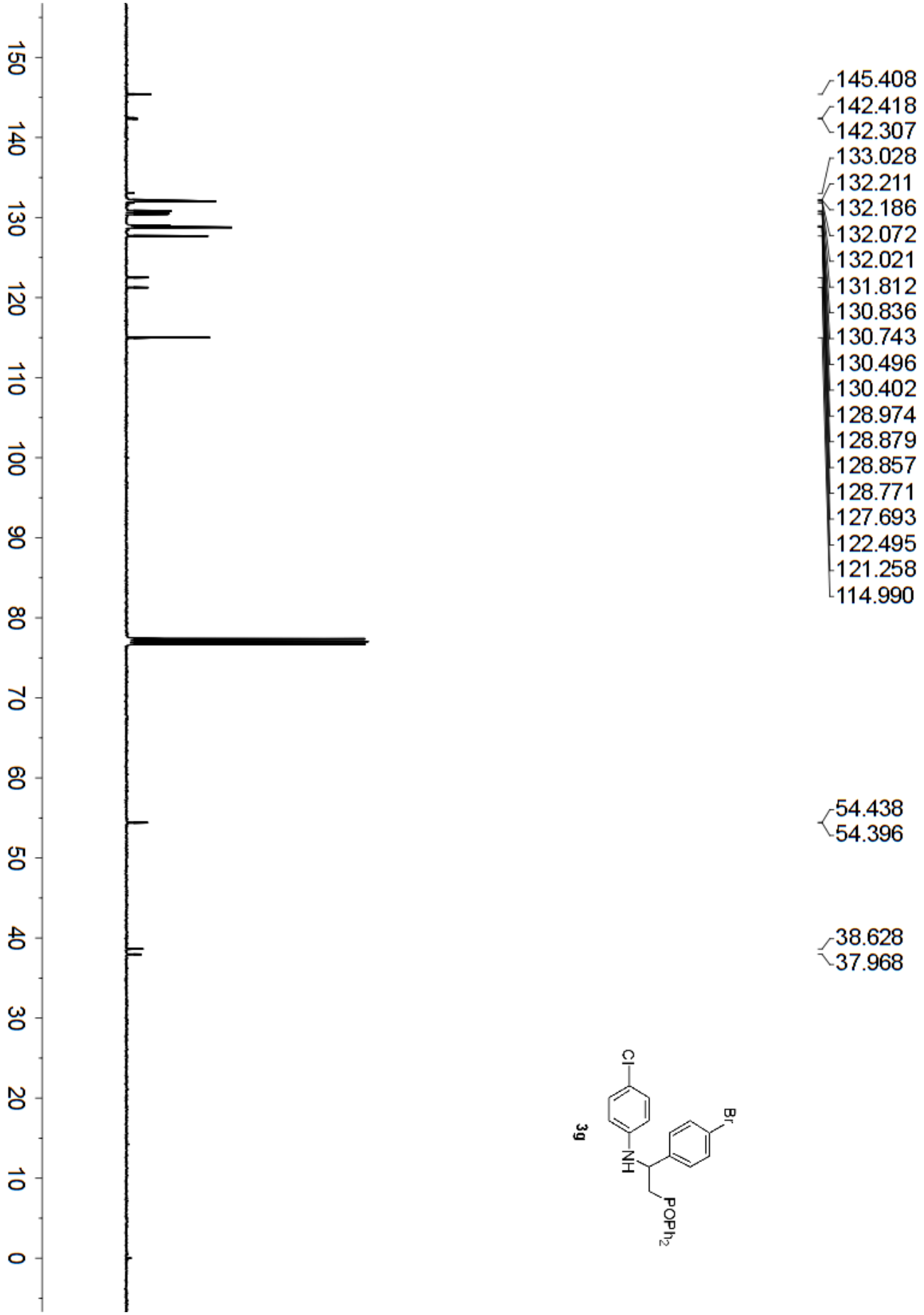
3g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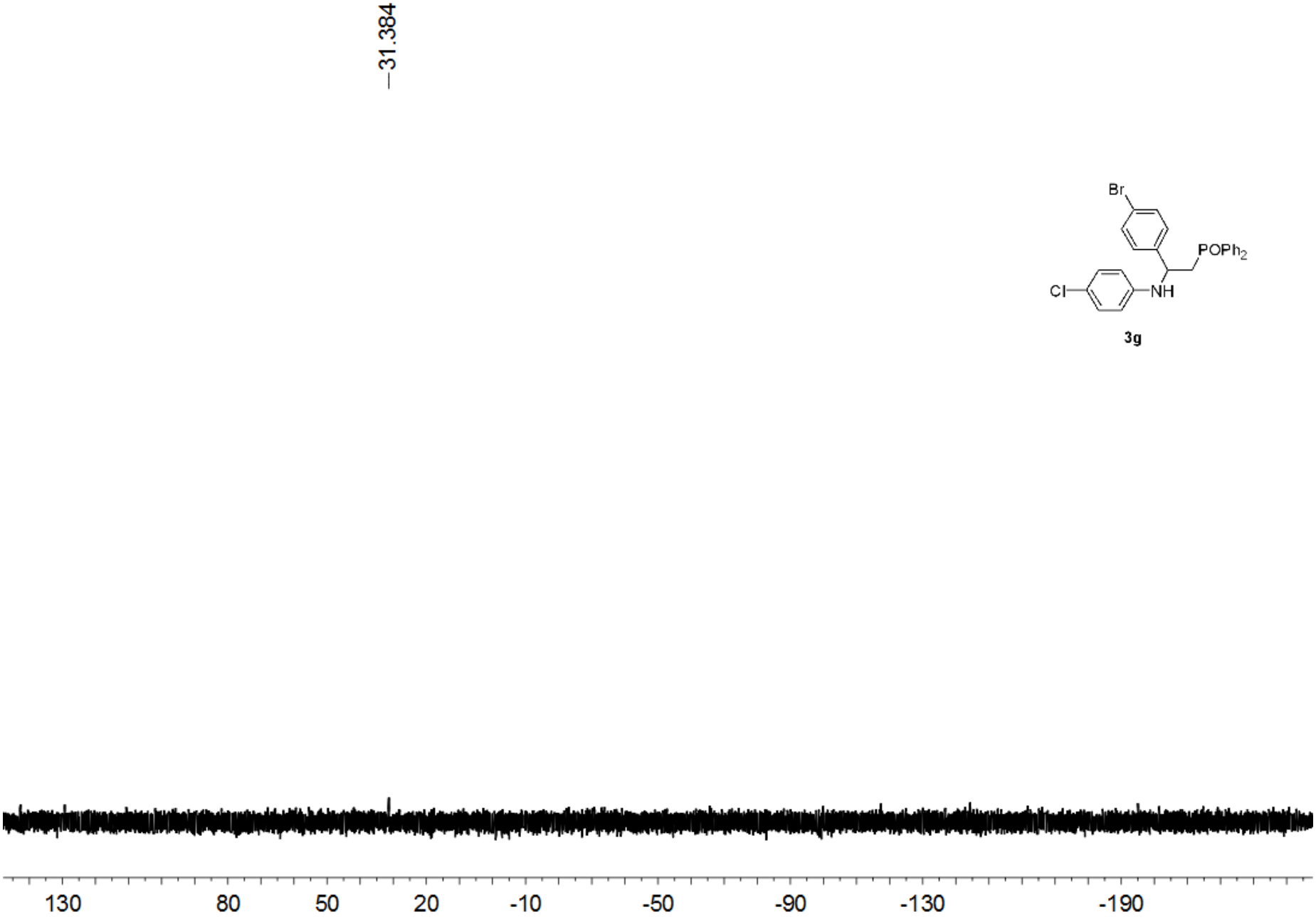
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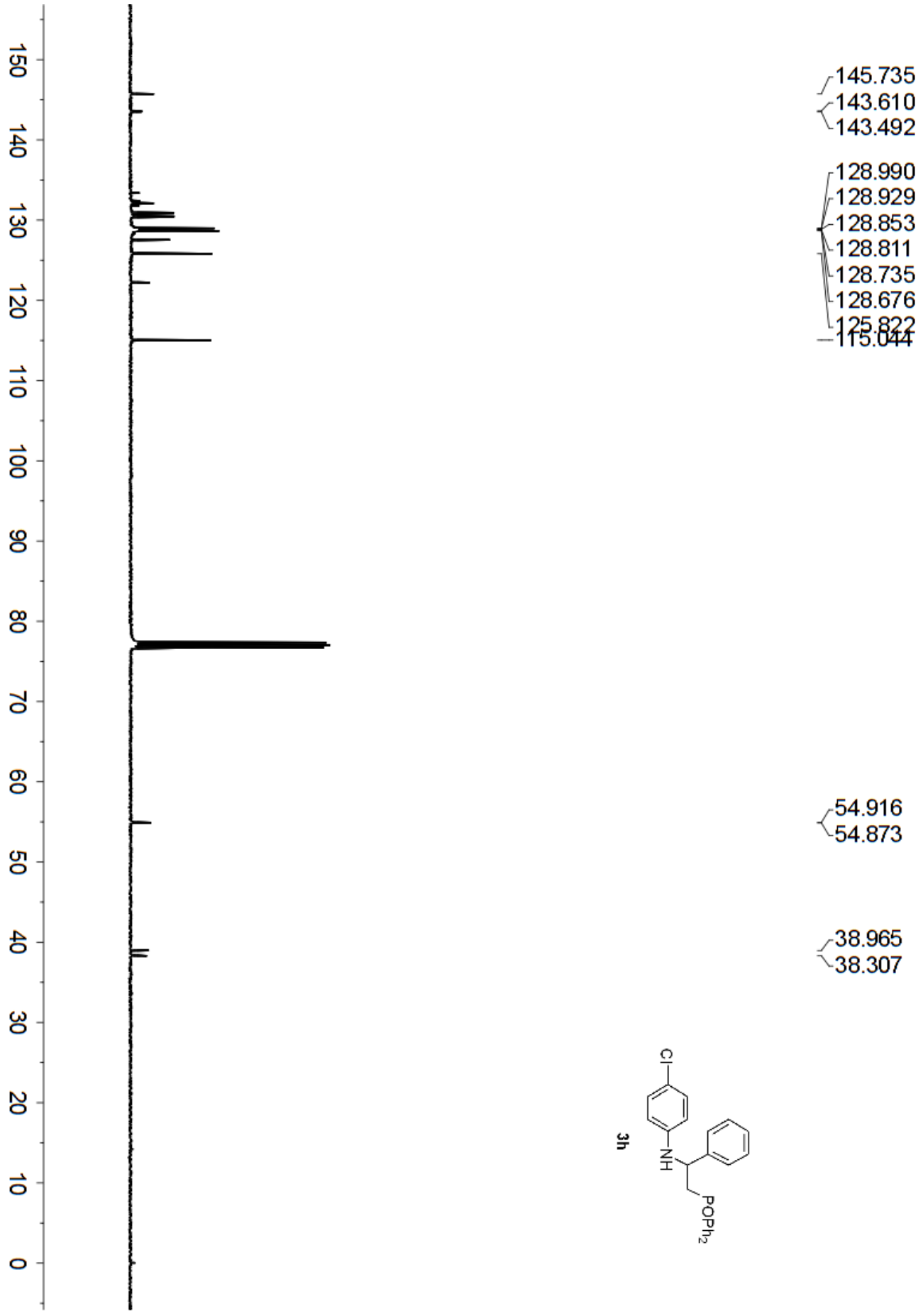
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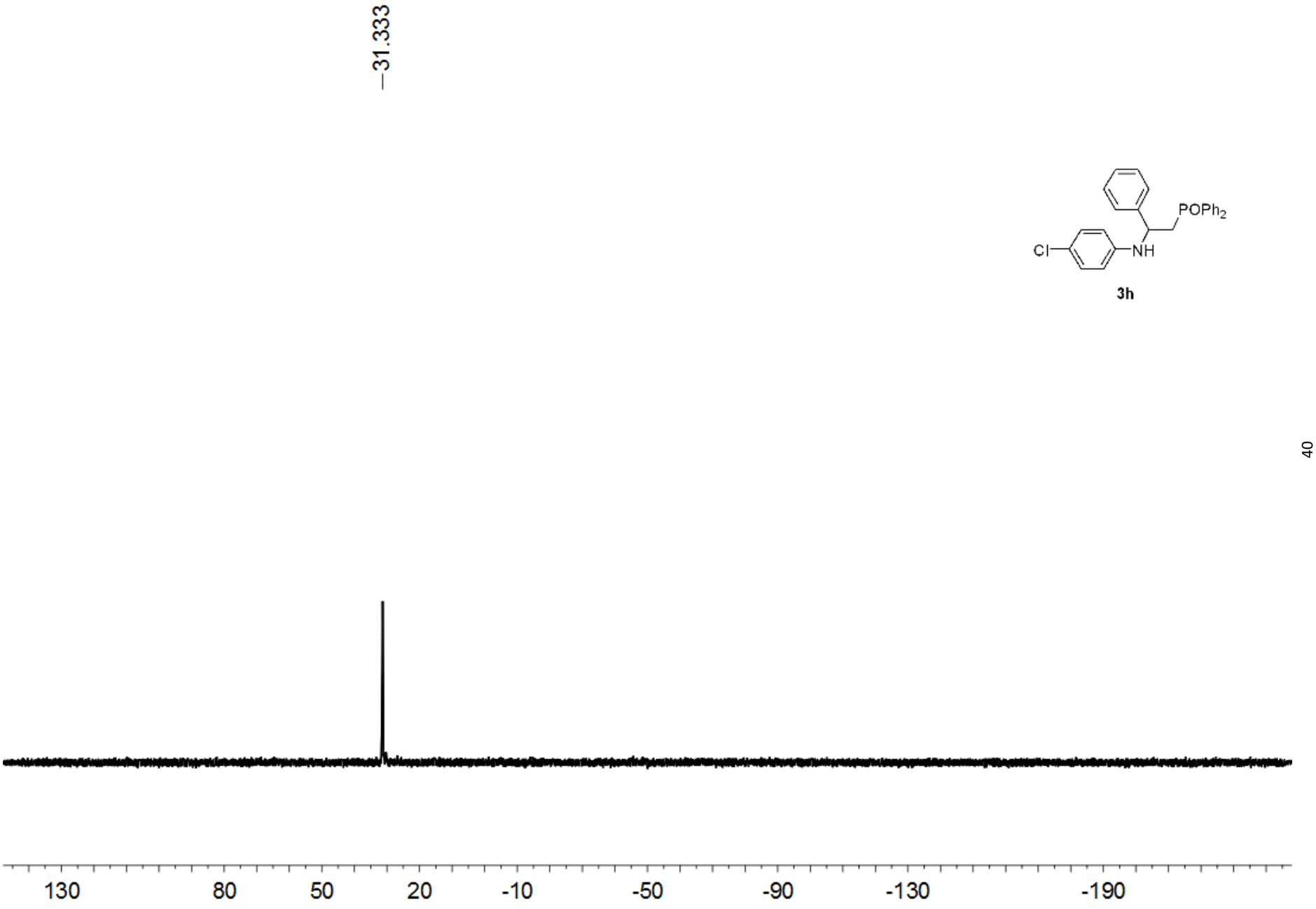
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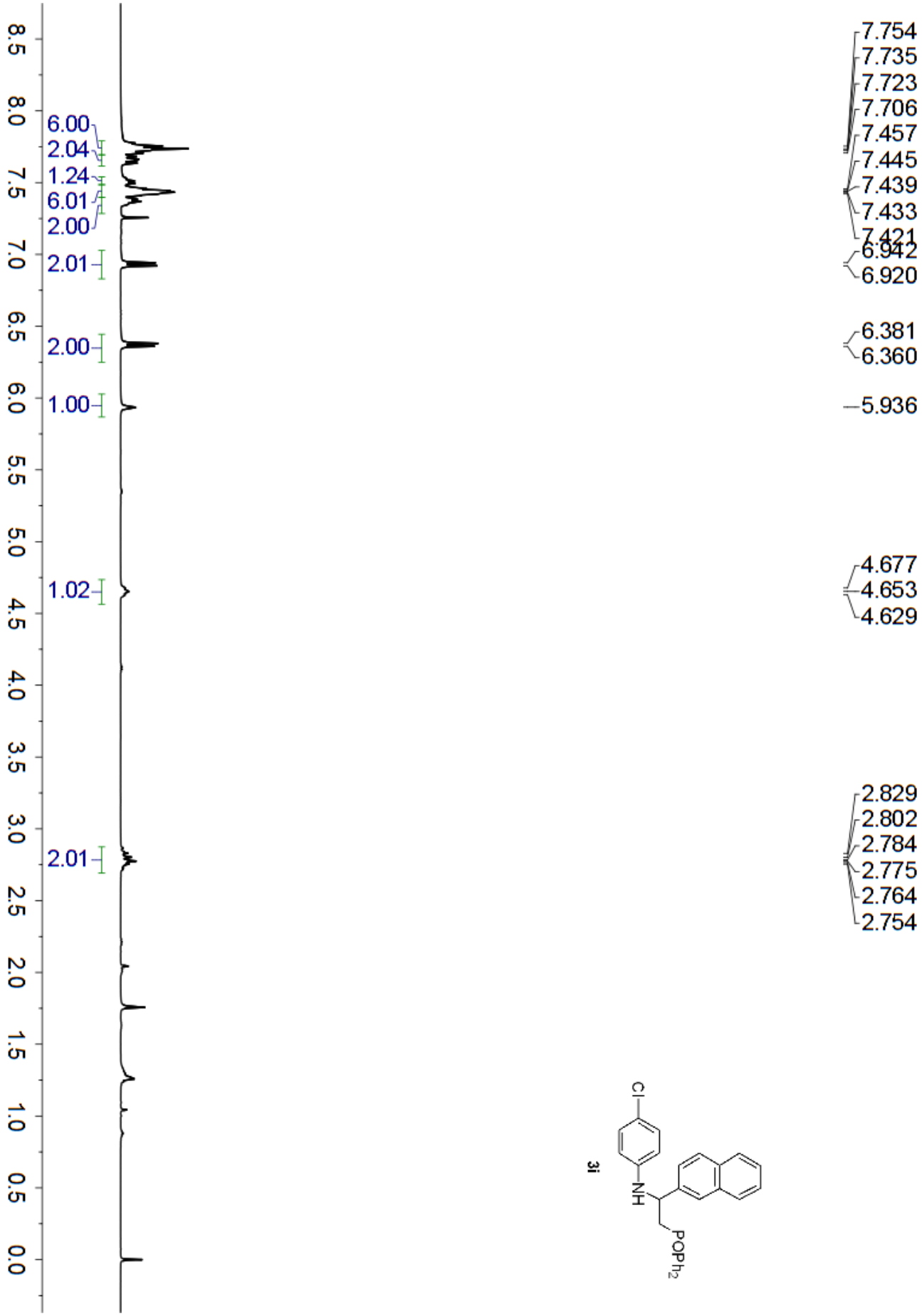
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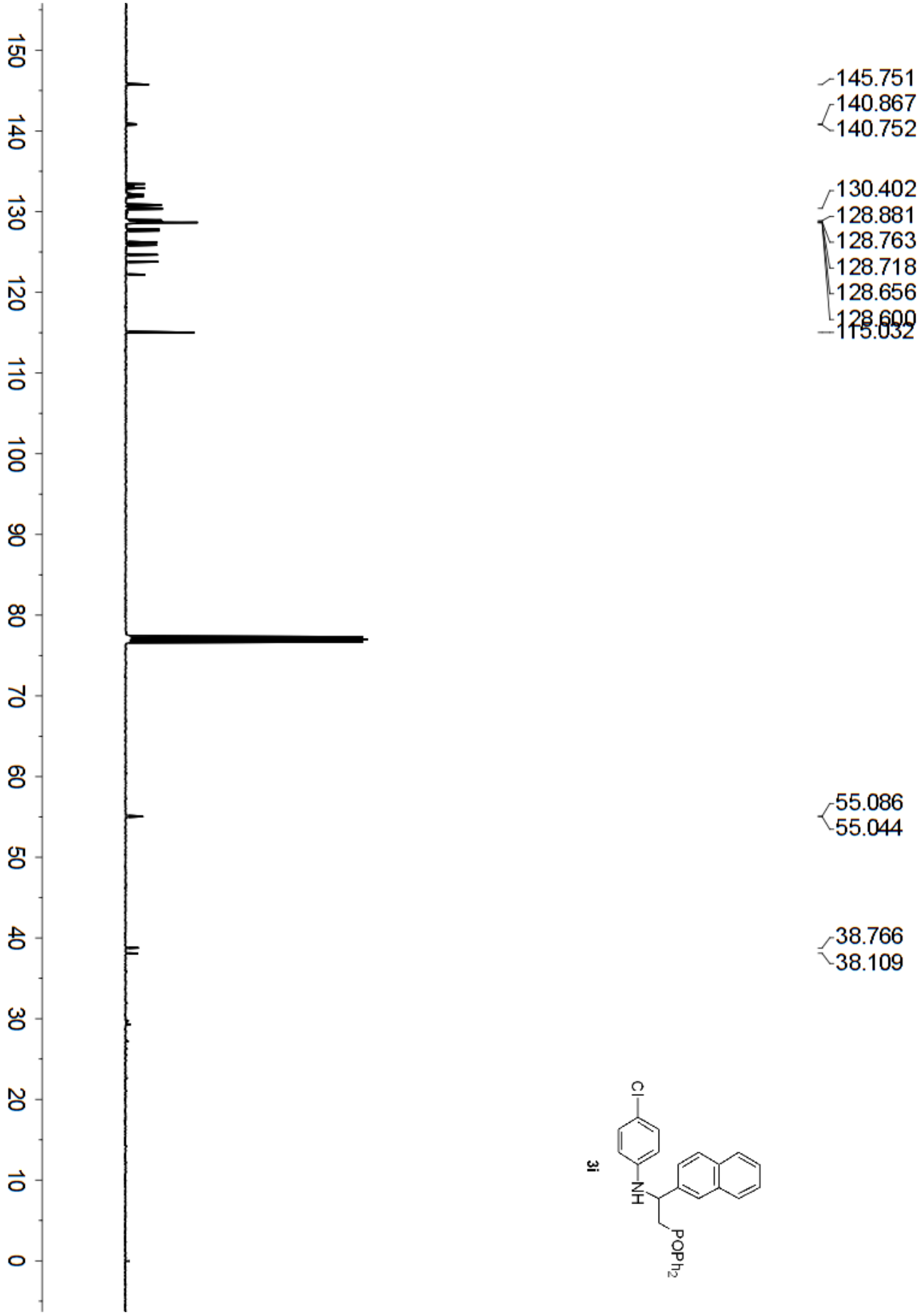
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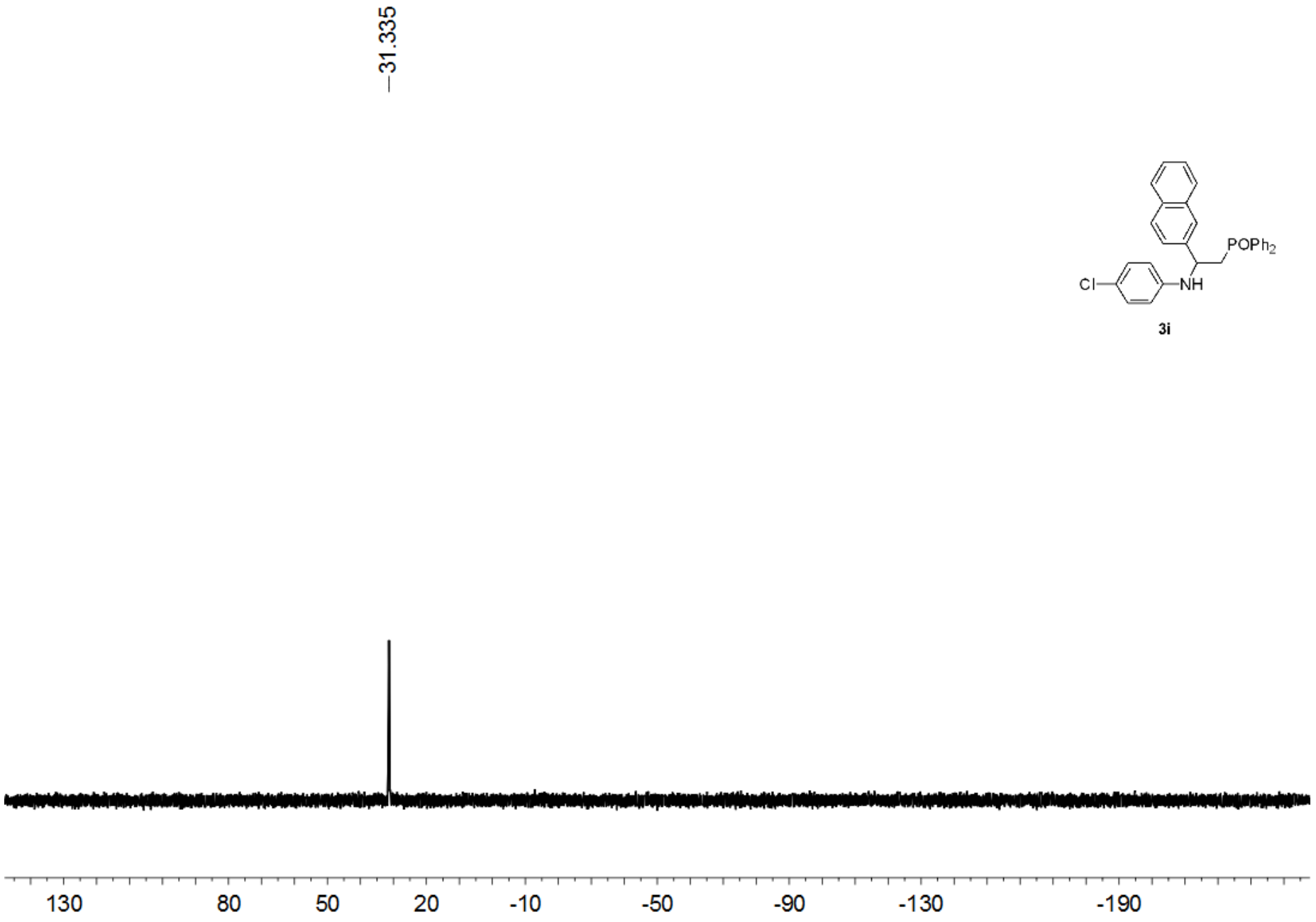
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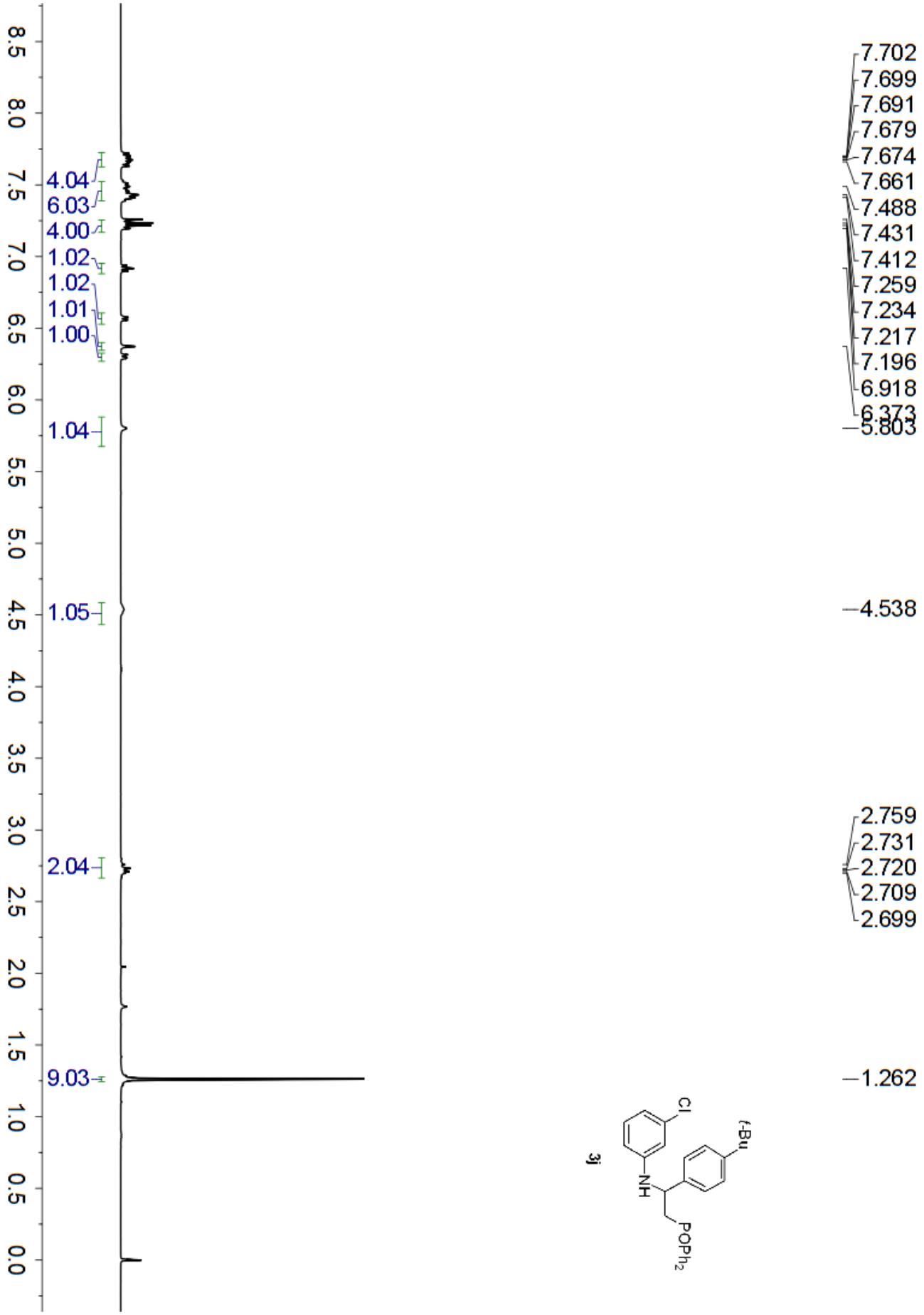
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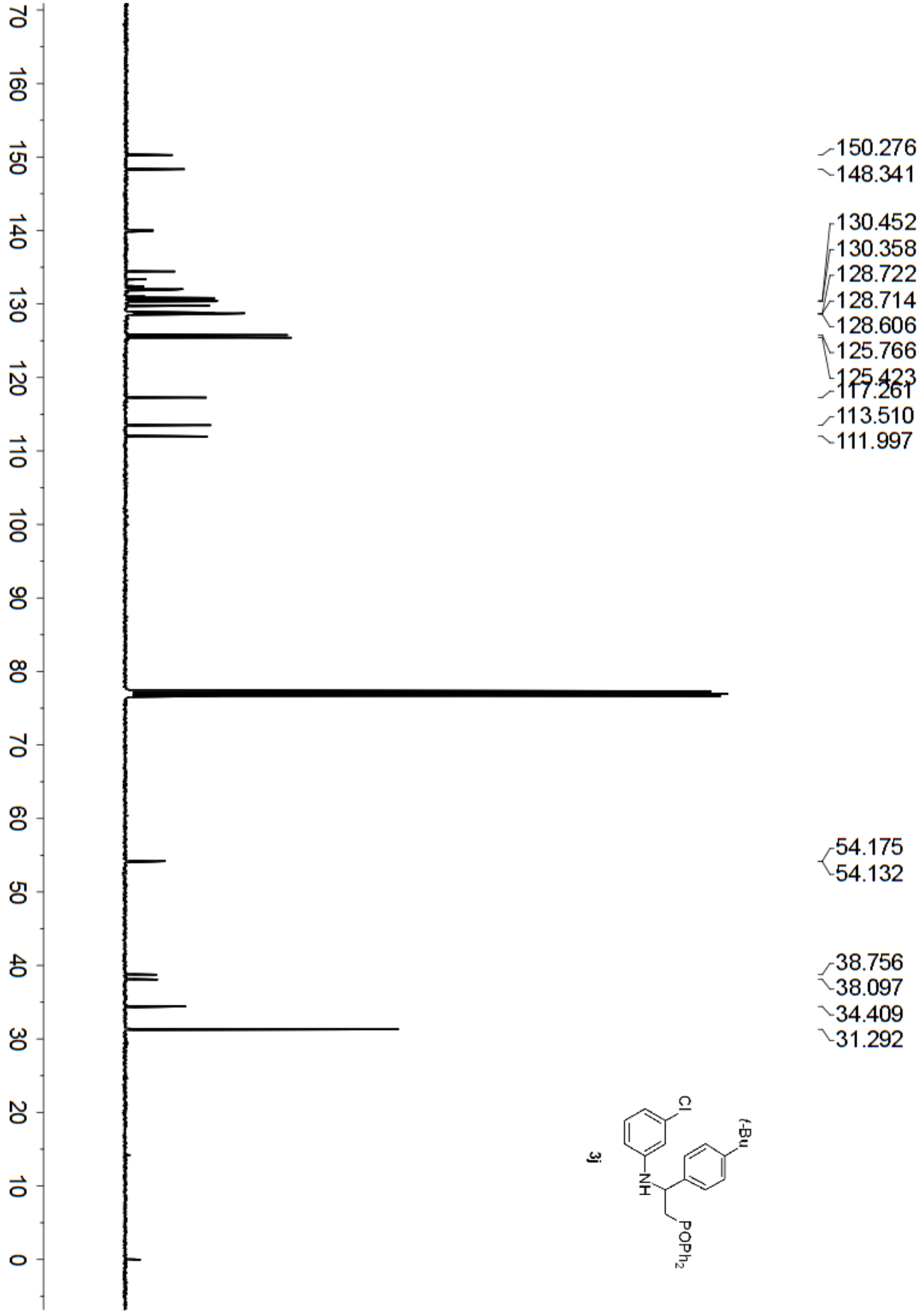
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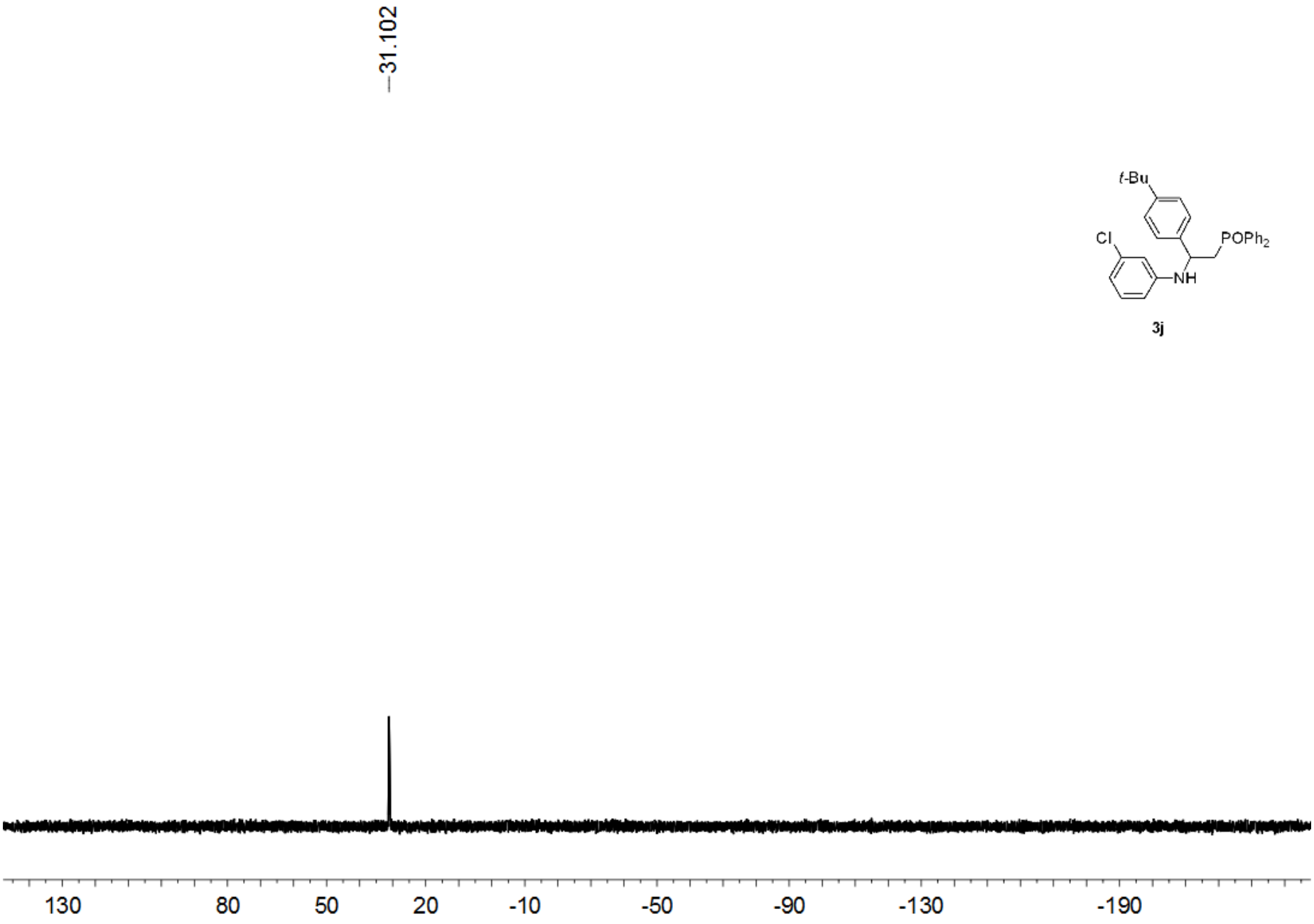
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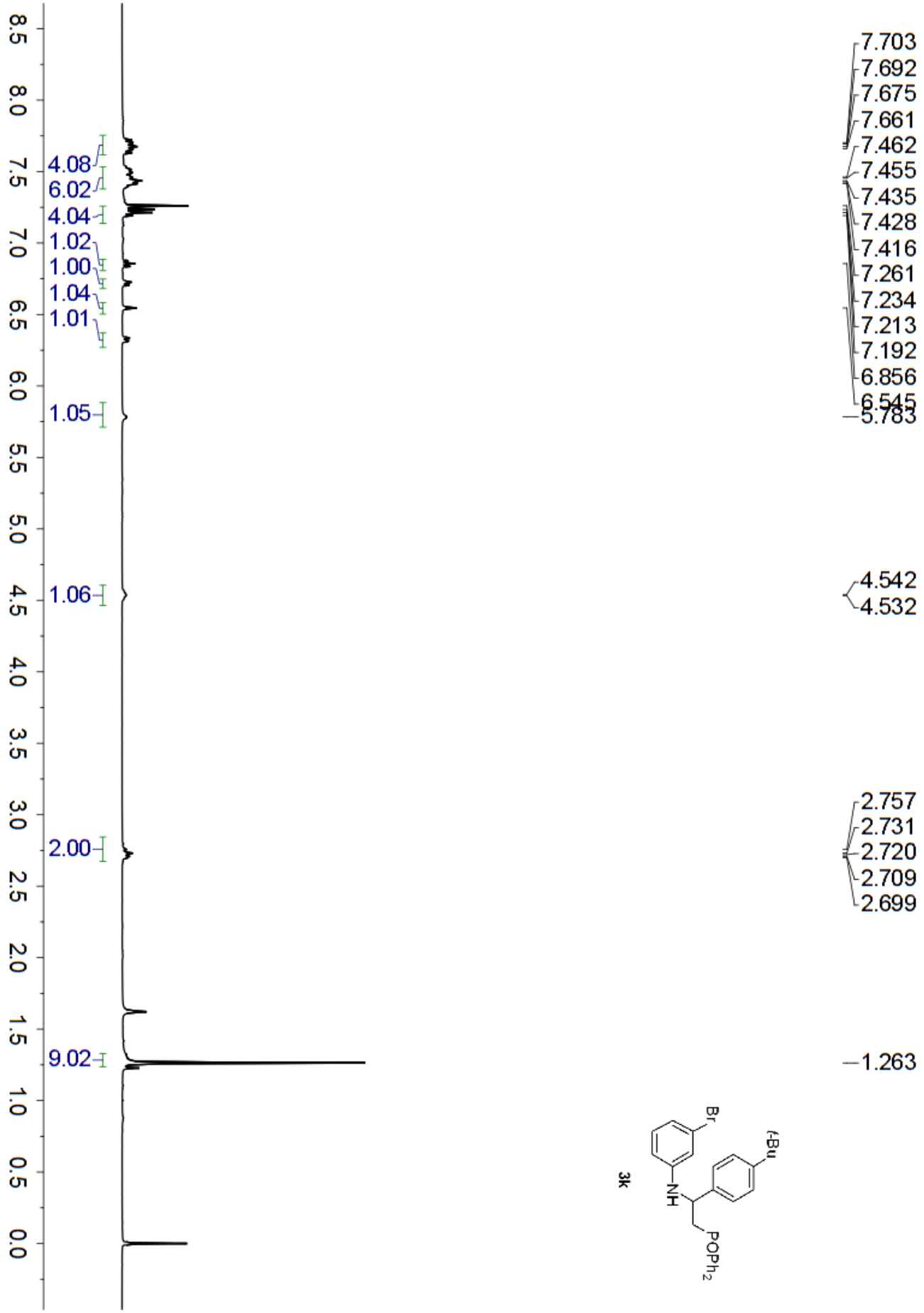
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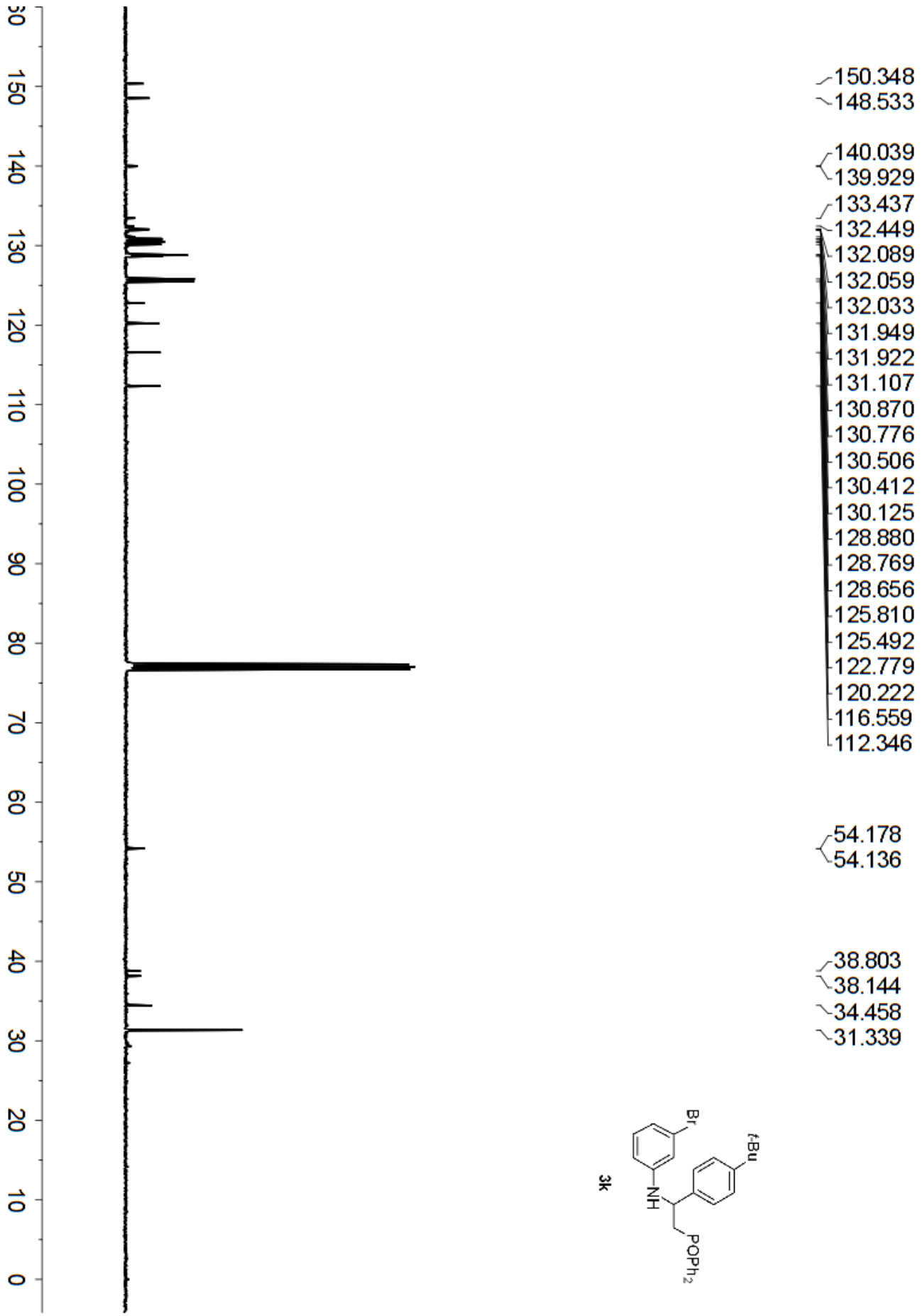
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NH
POPh2
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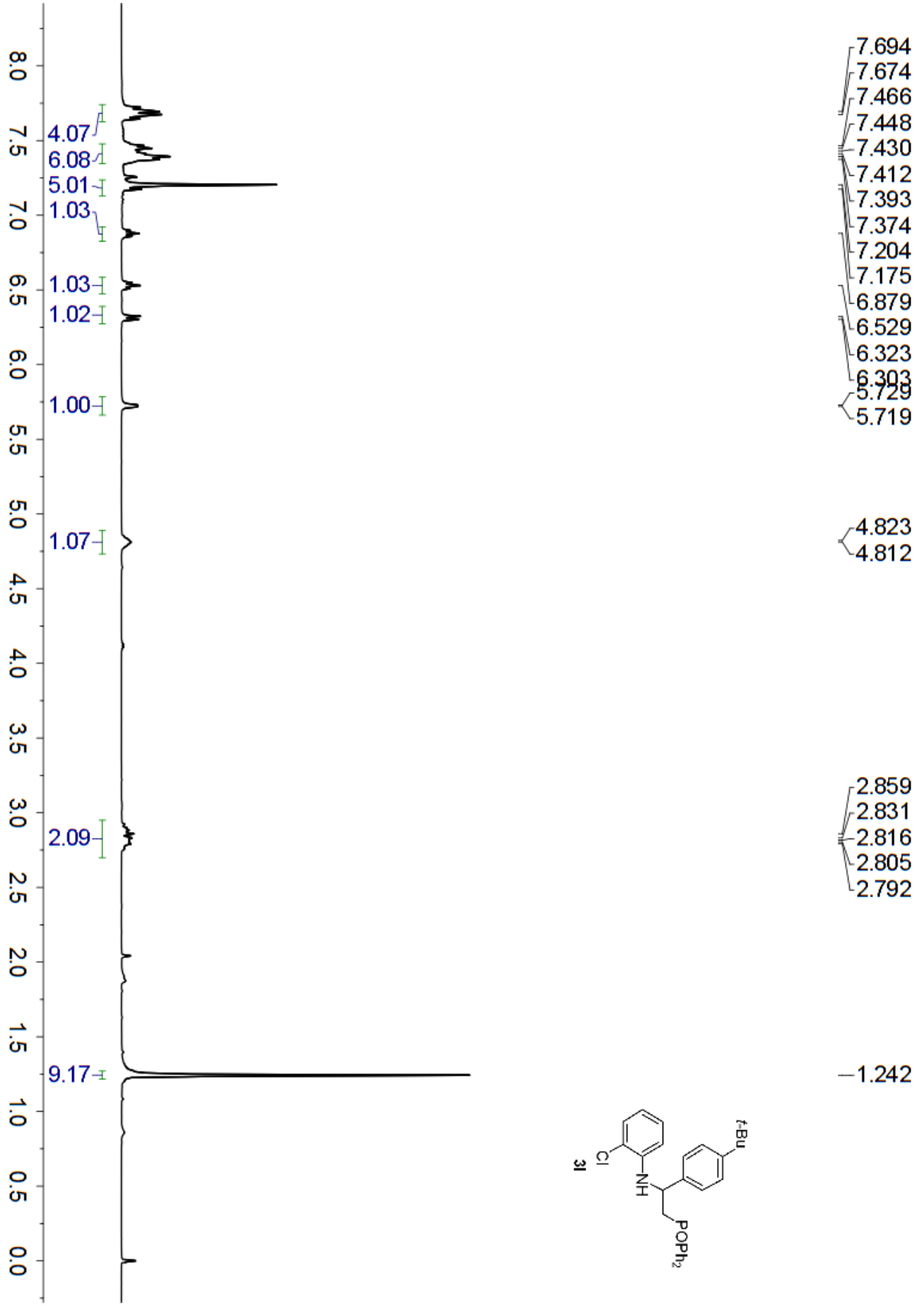
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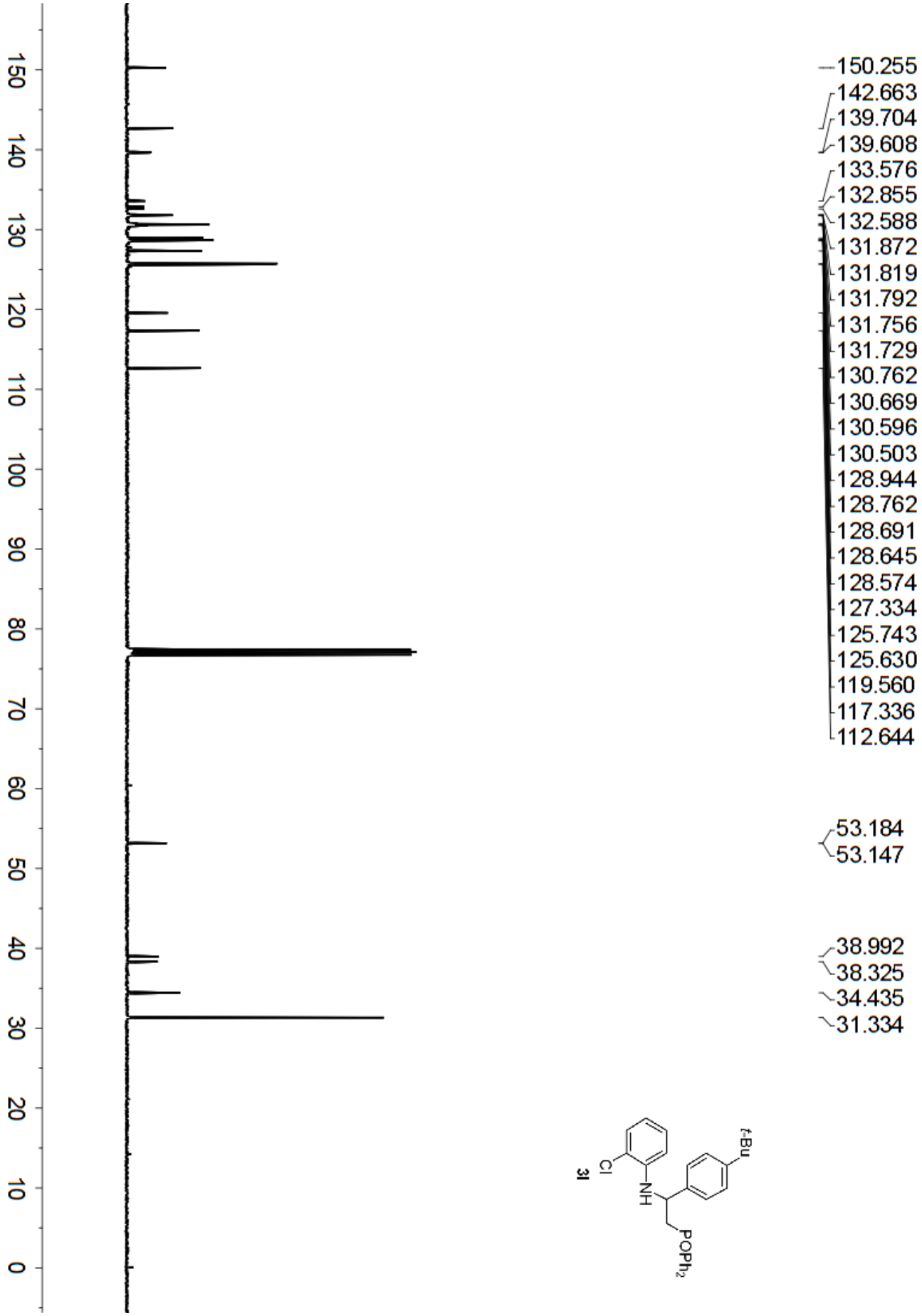
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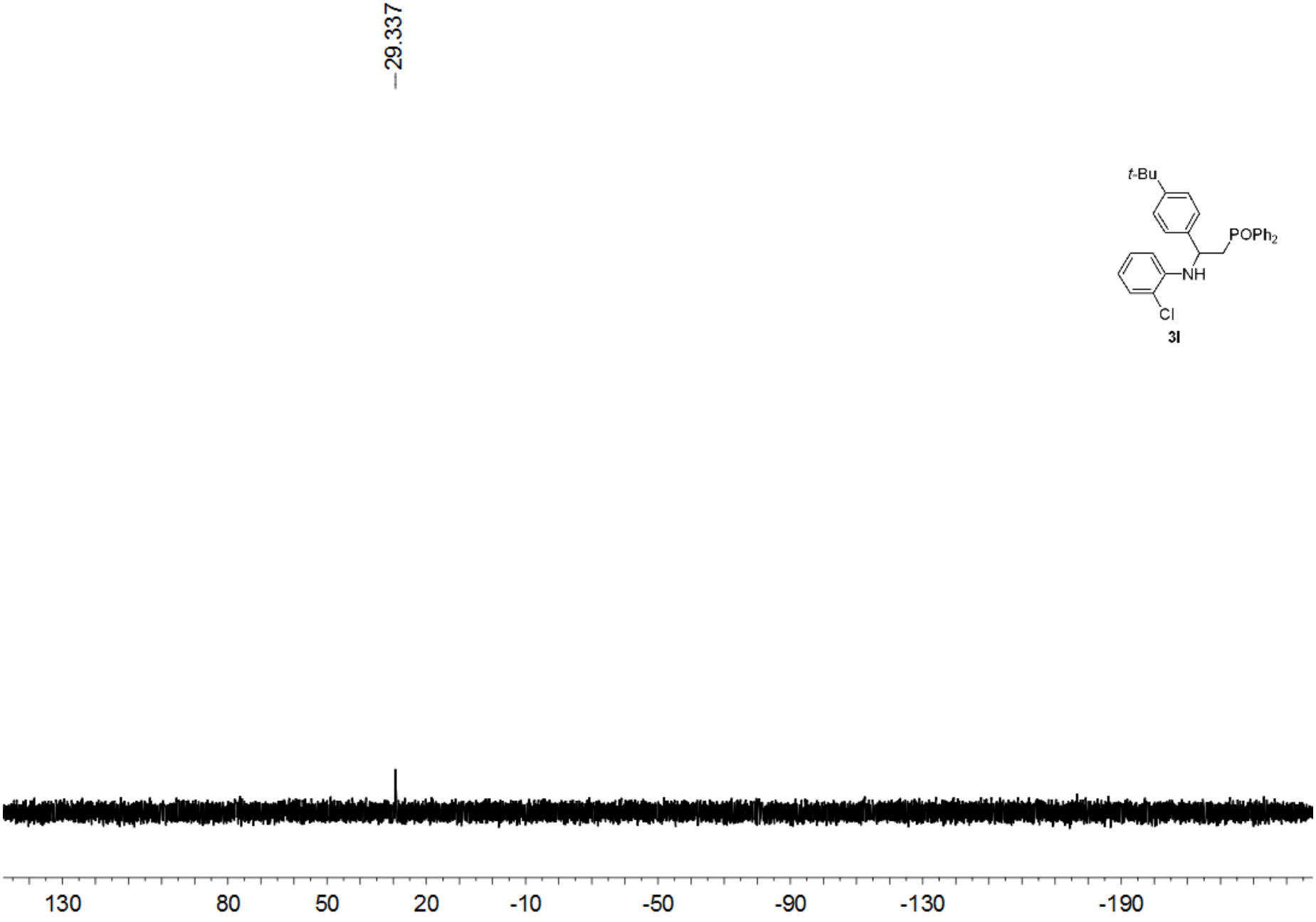
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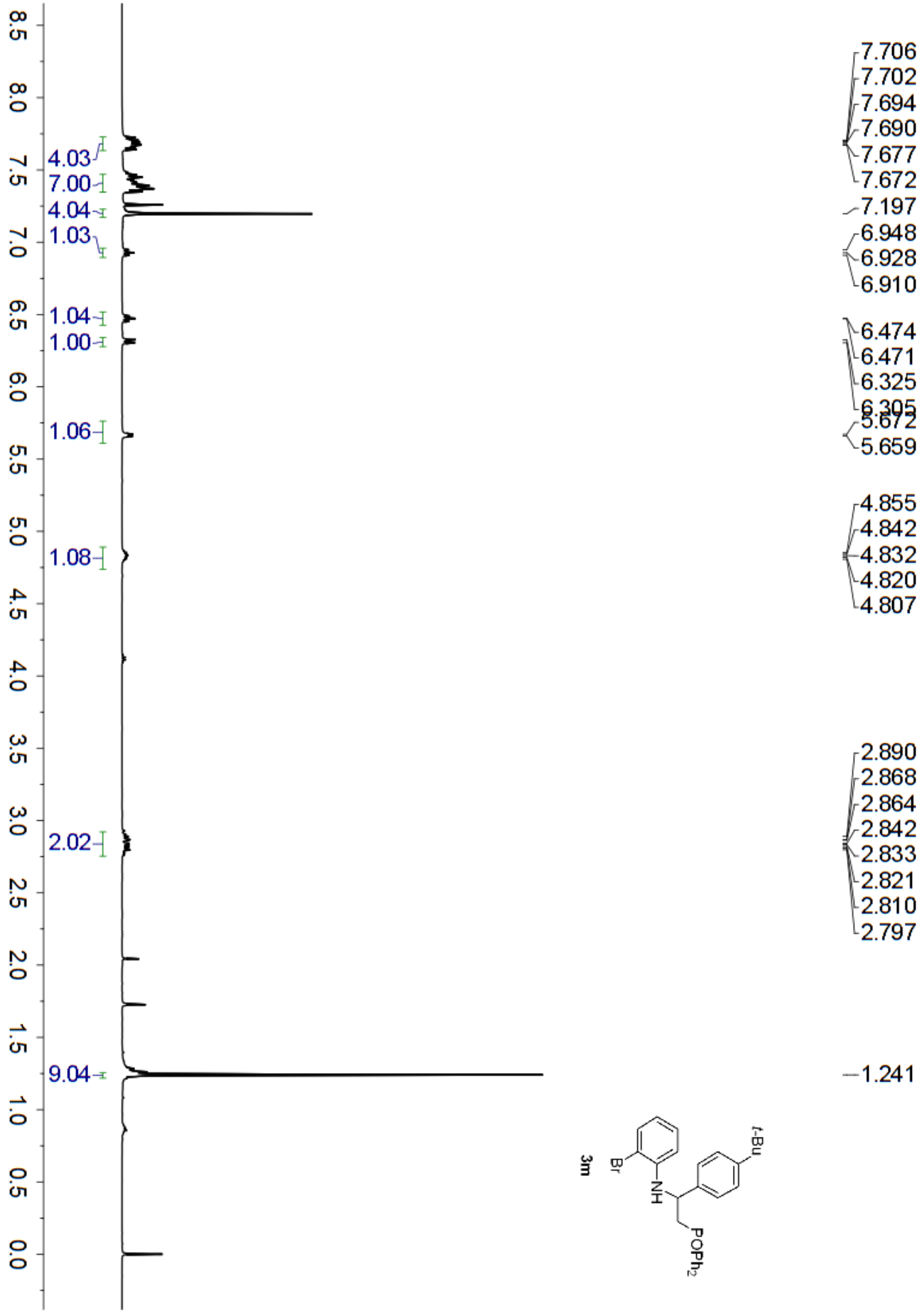
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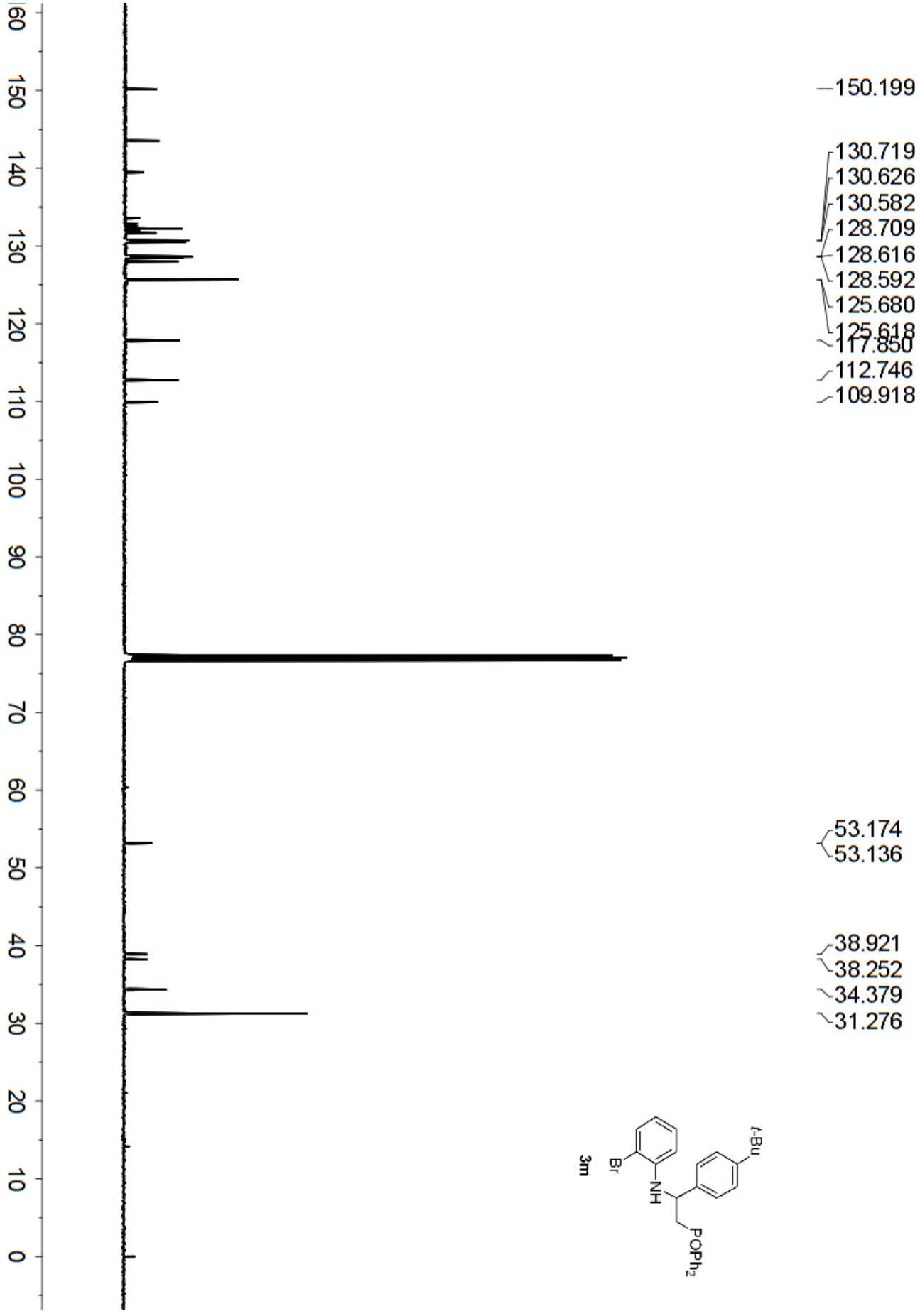
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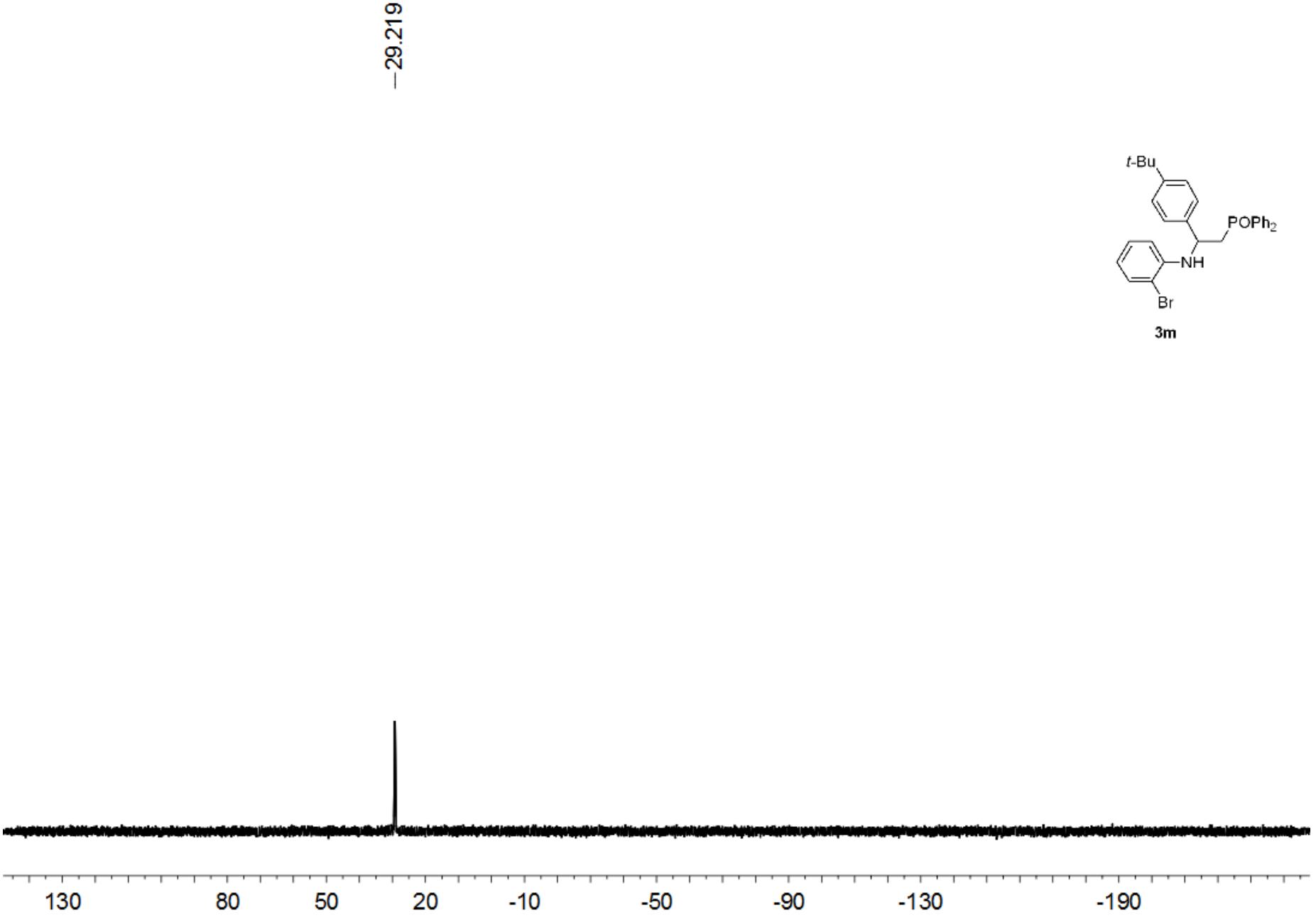
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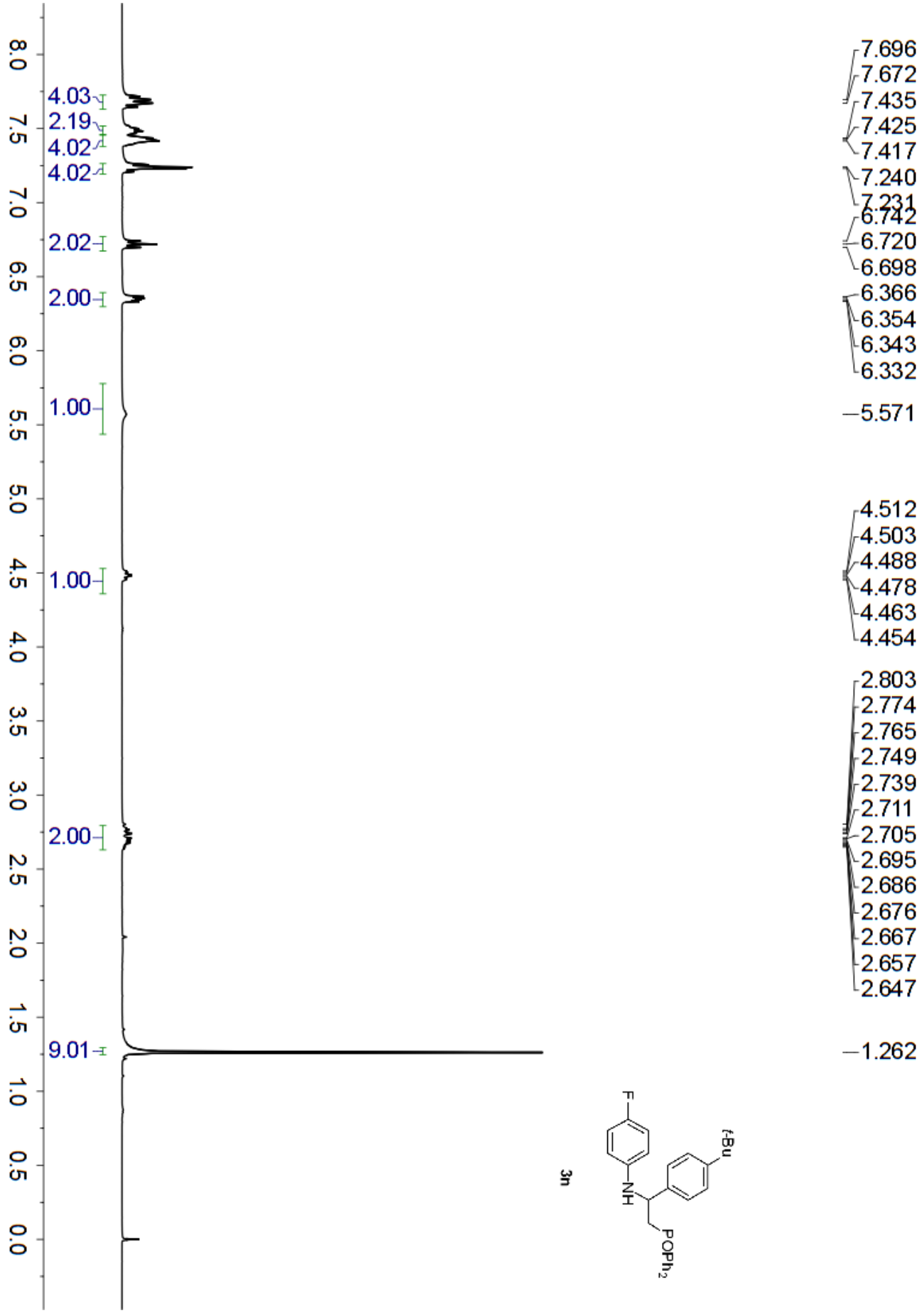
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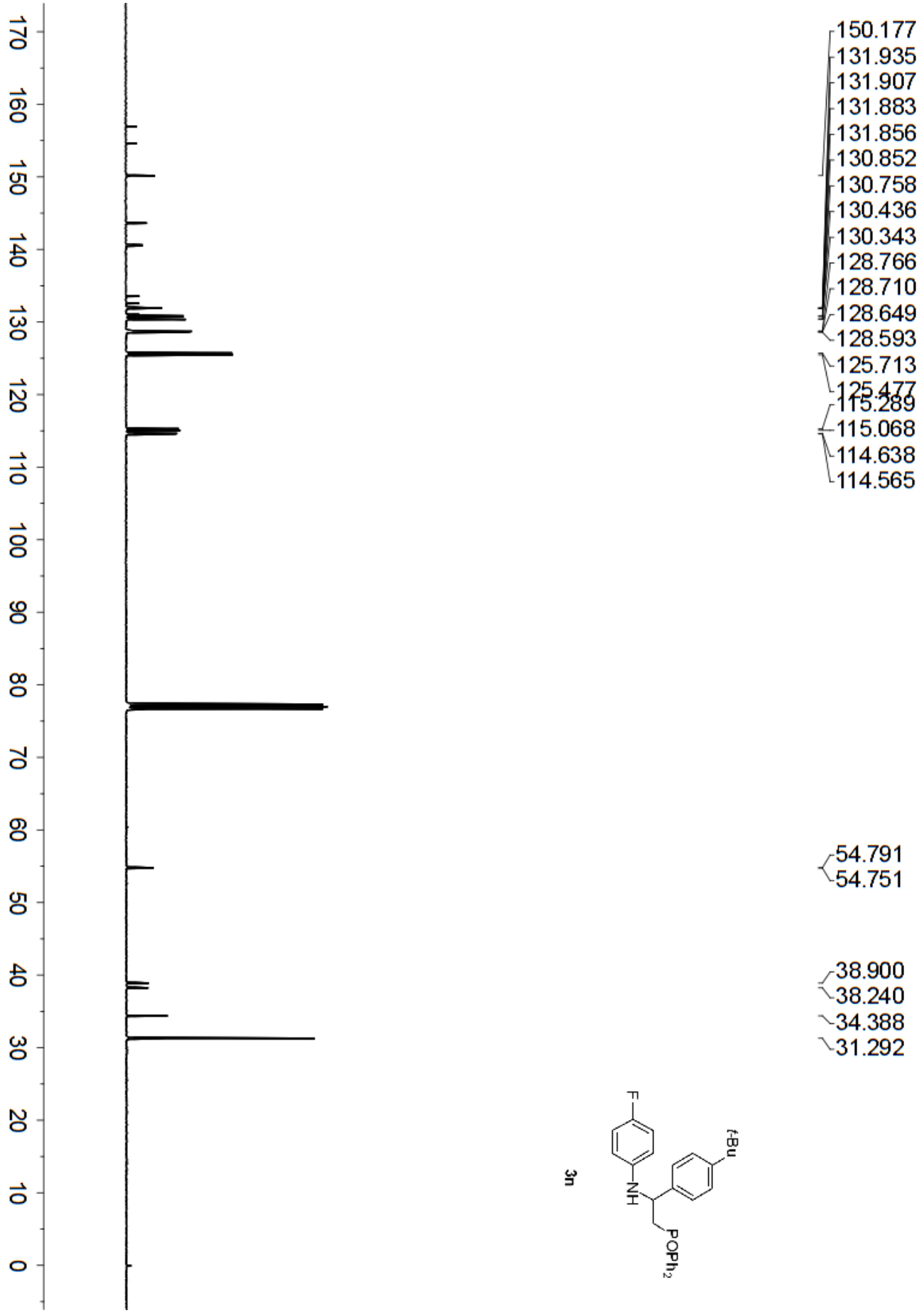
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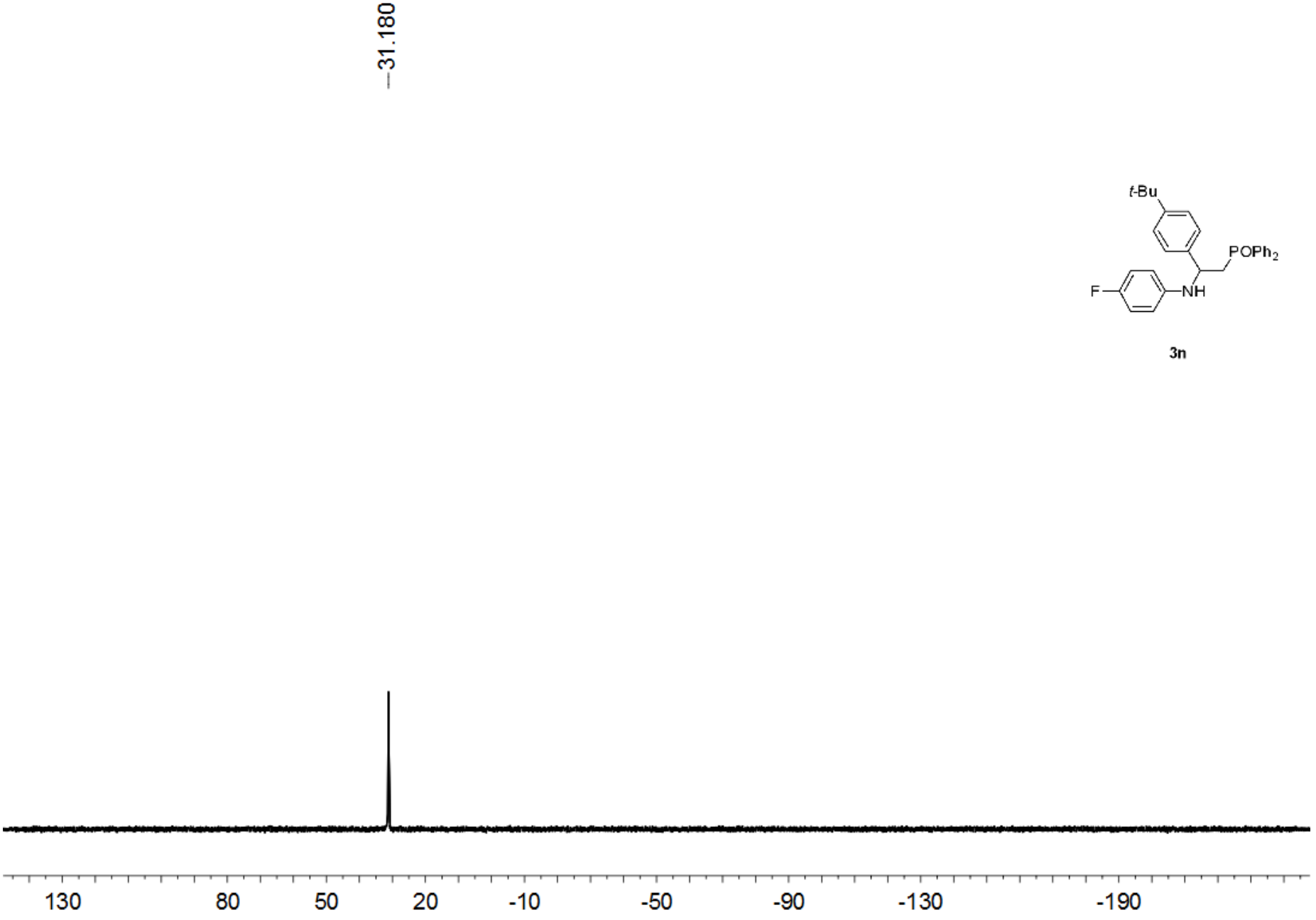
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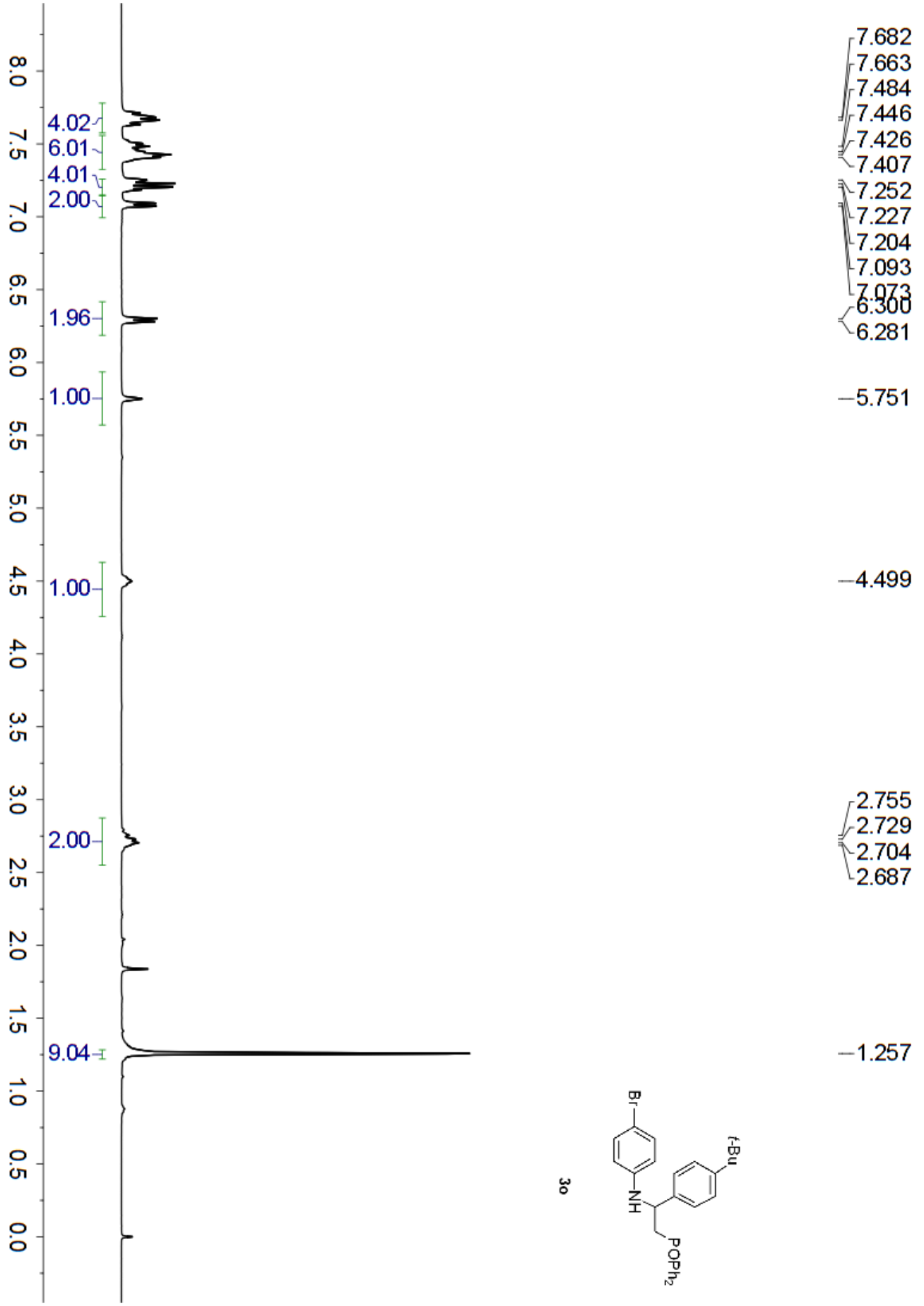
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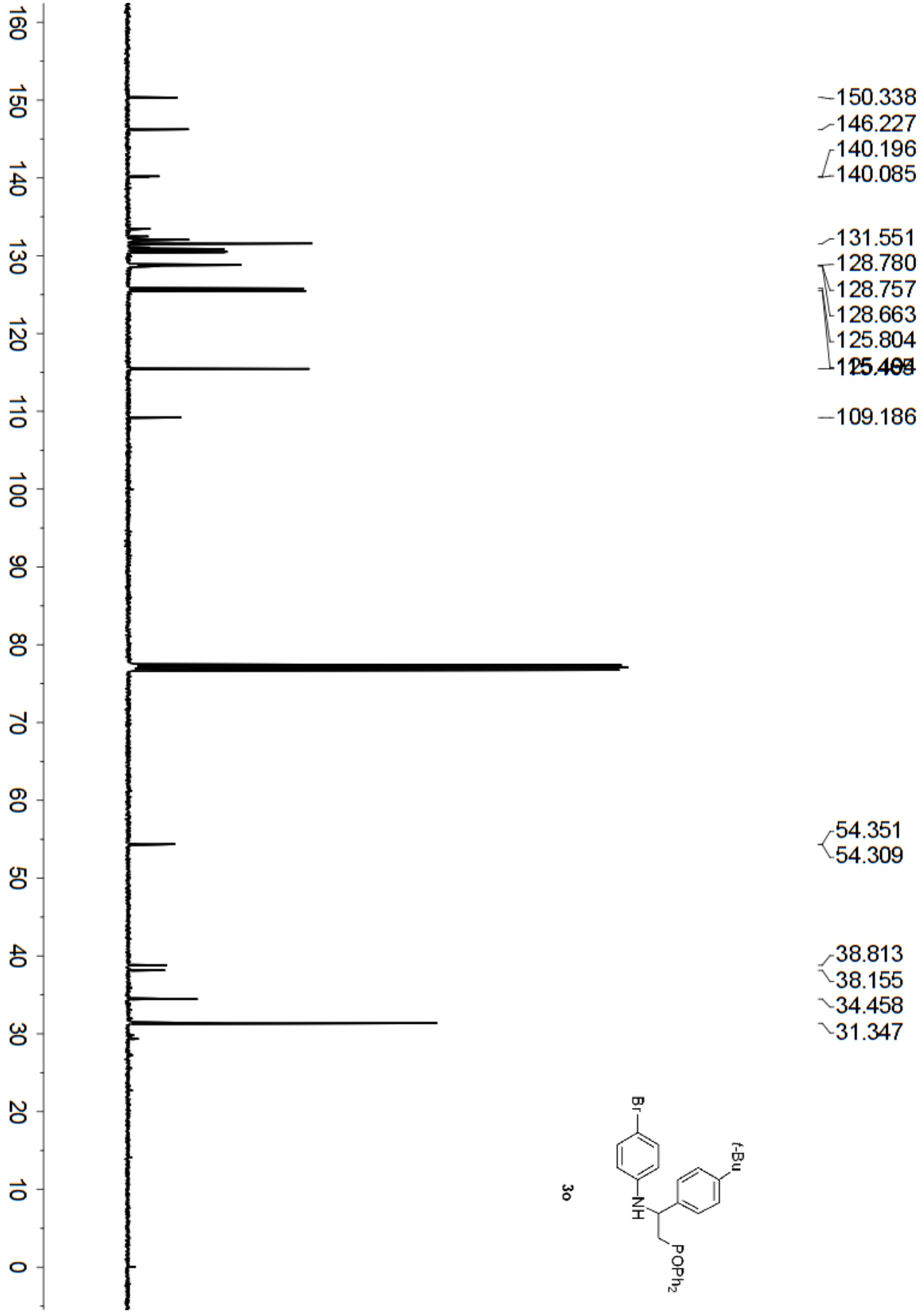
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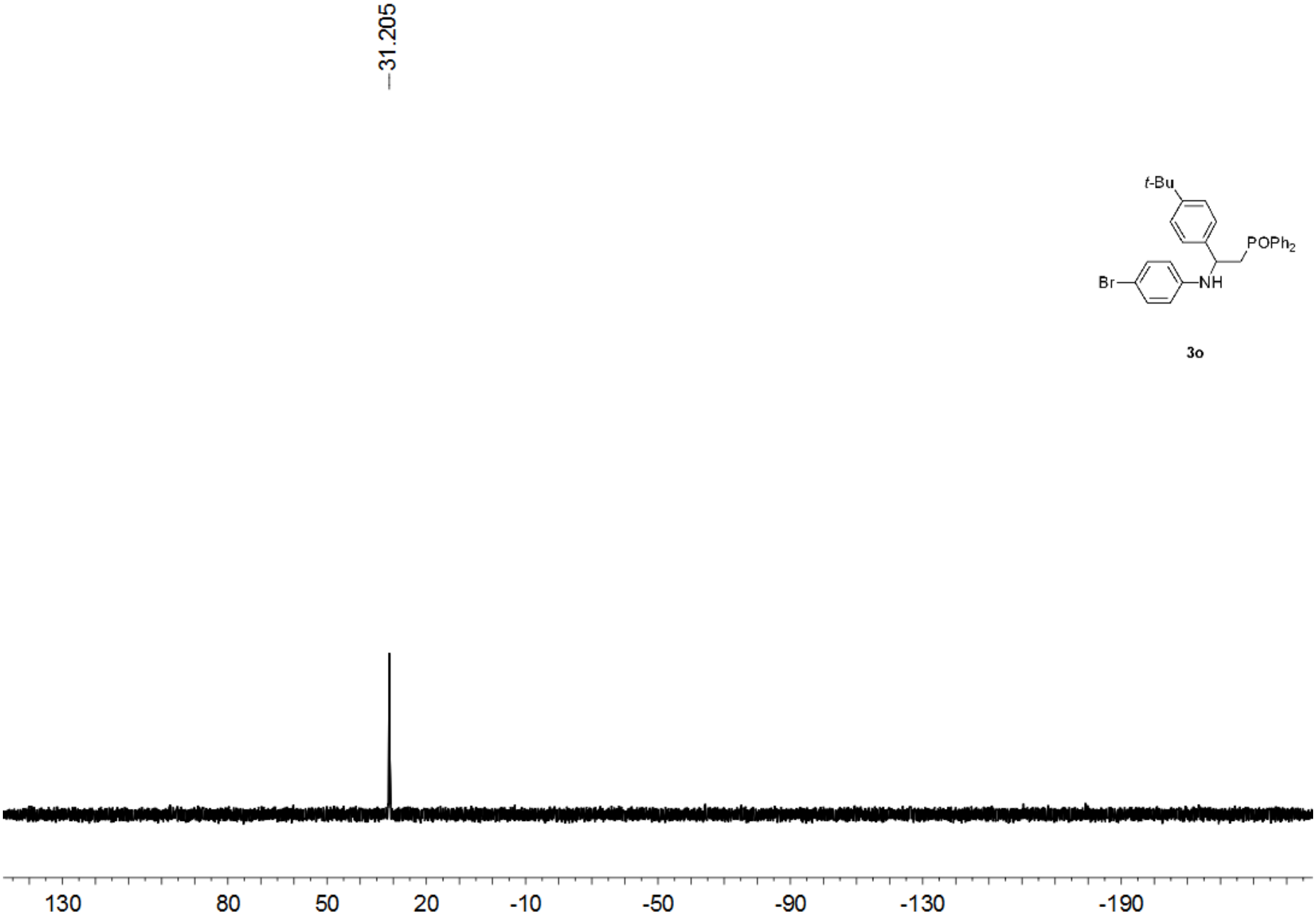
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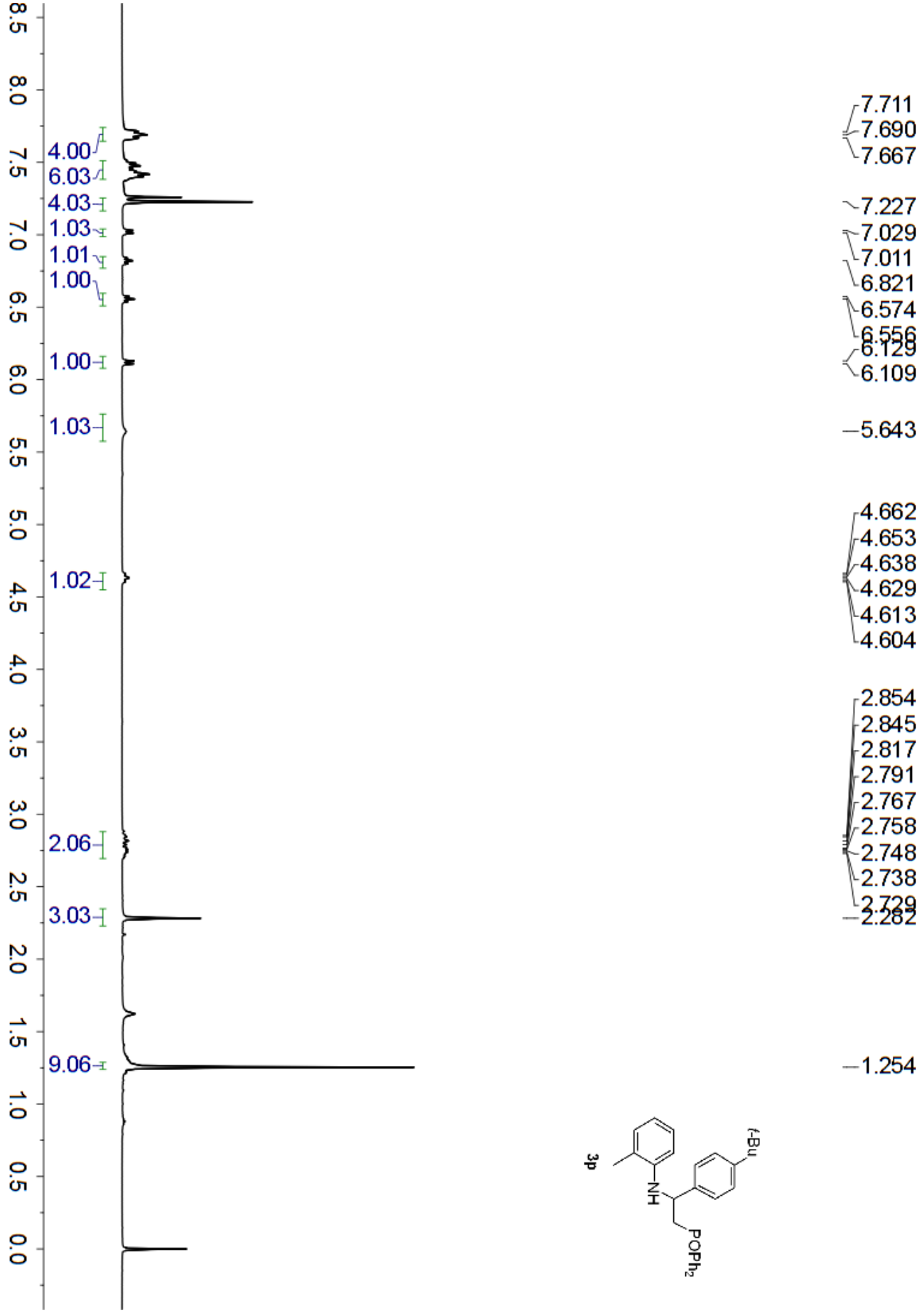
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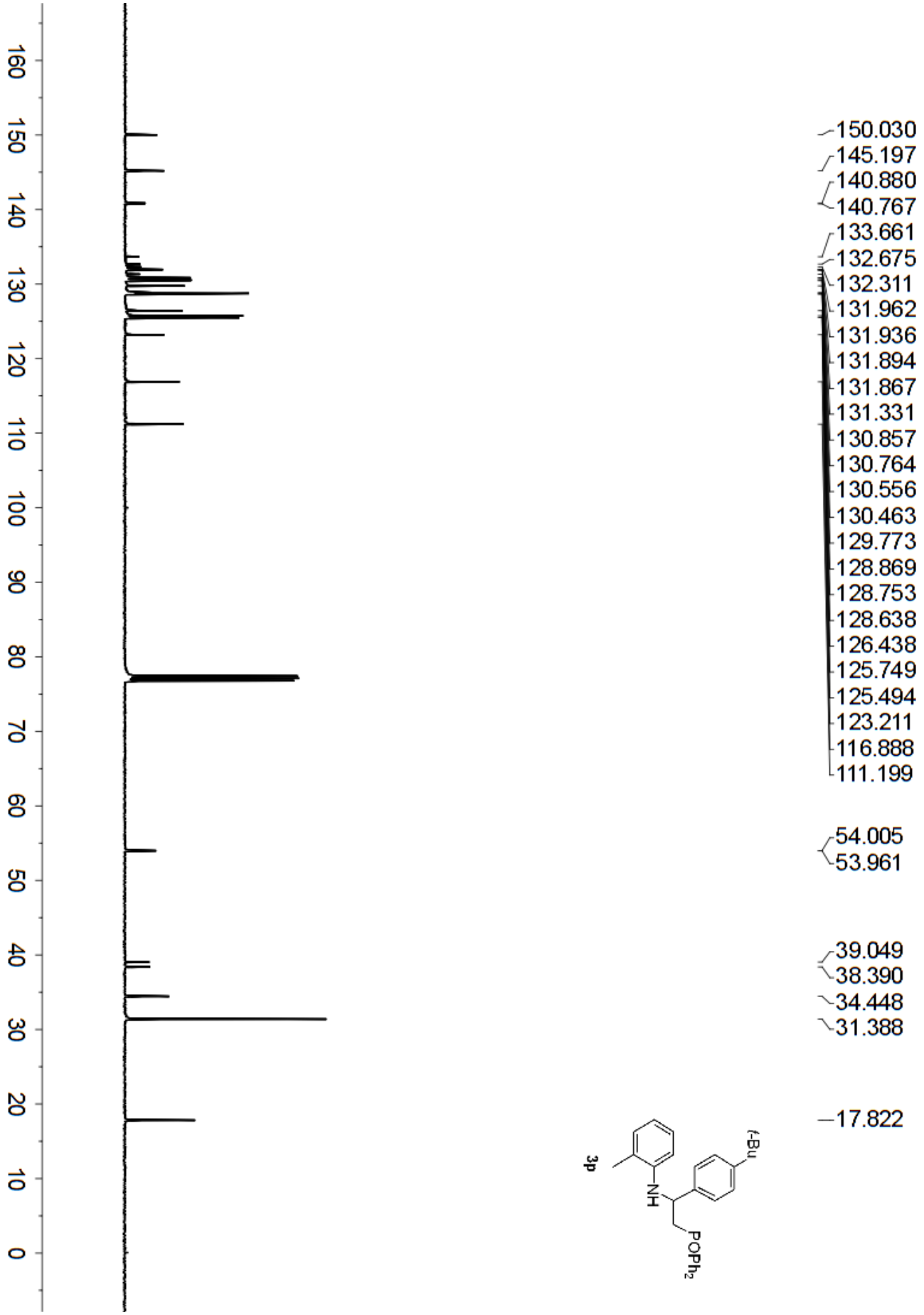
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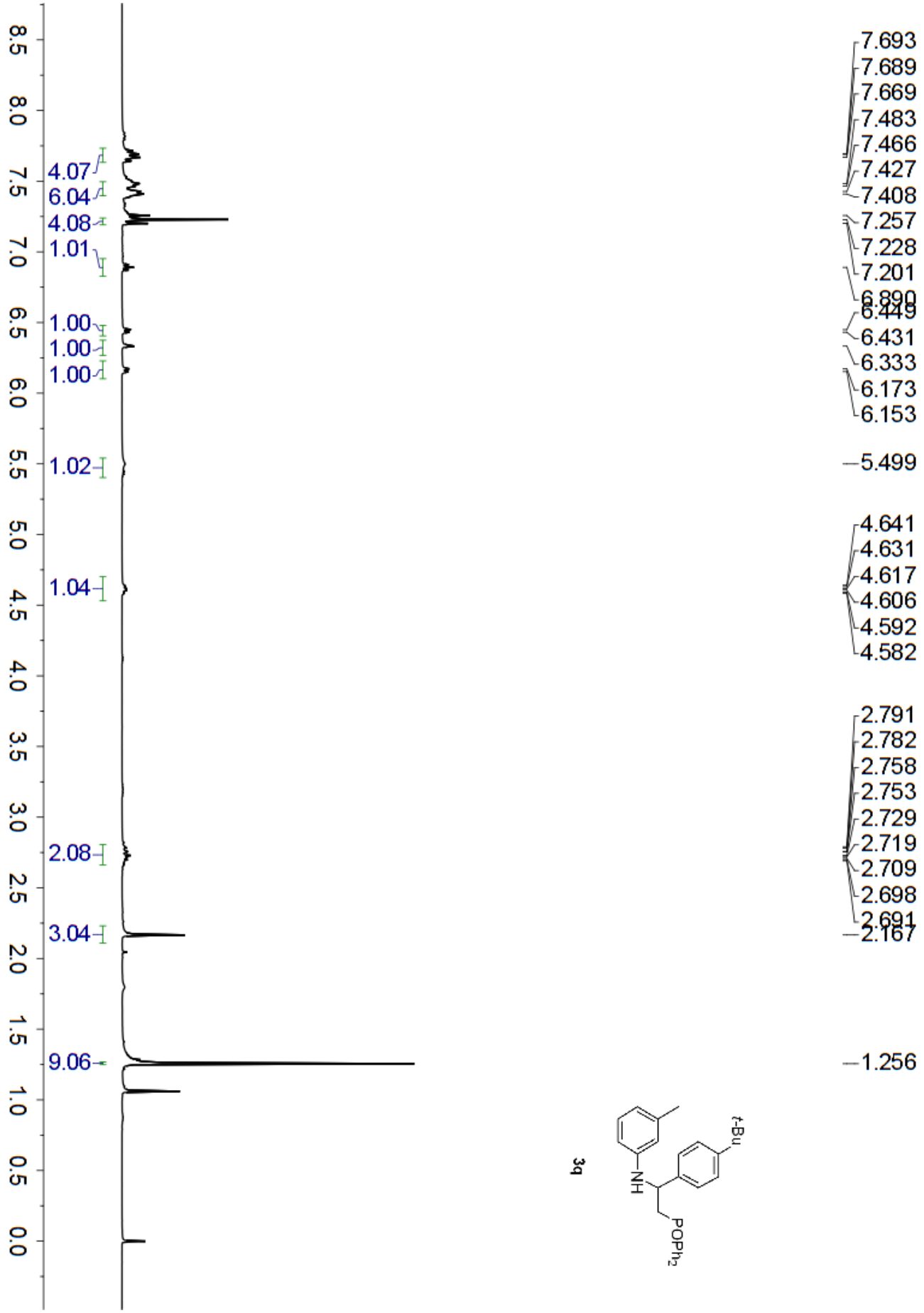
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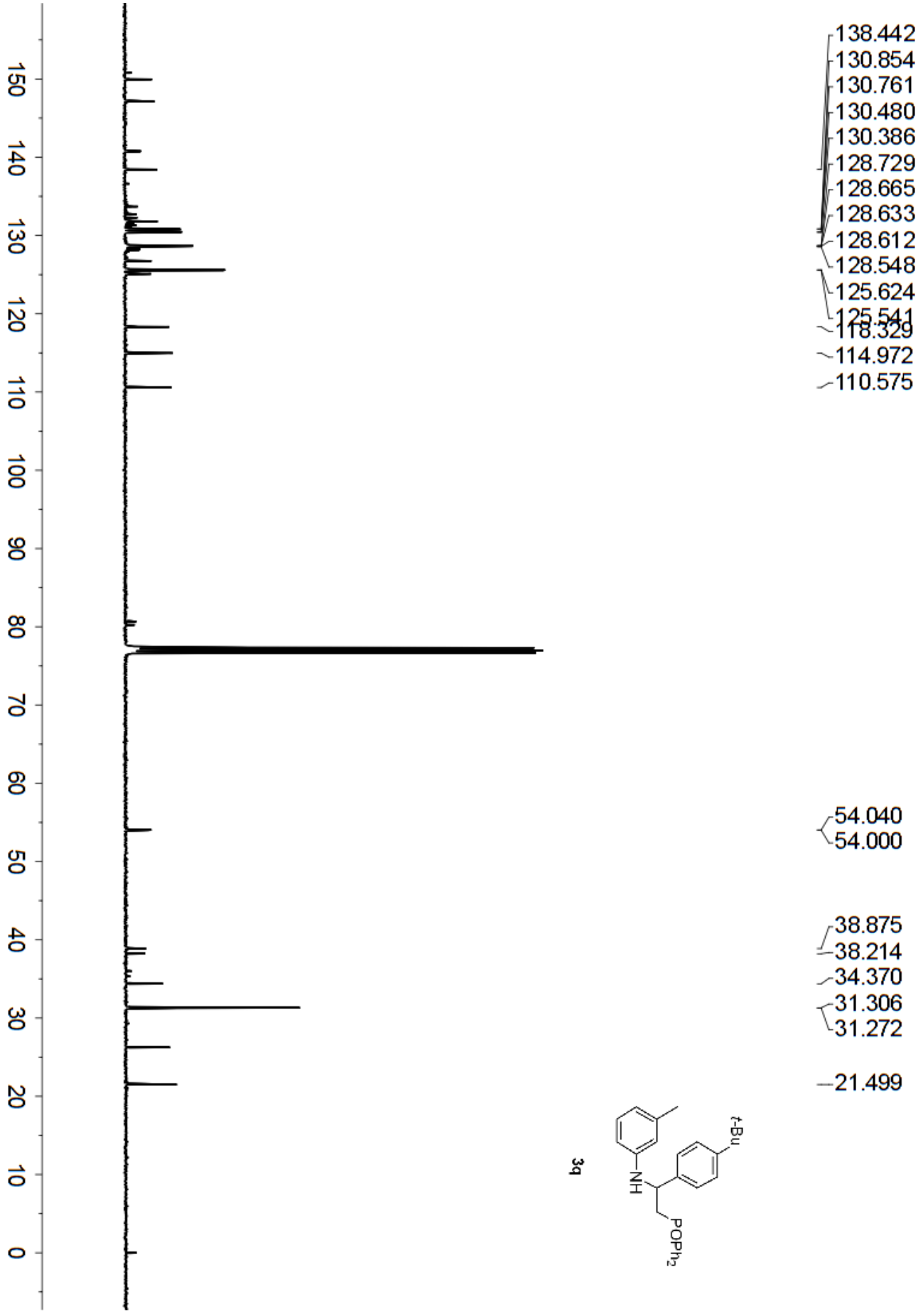
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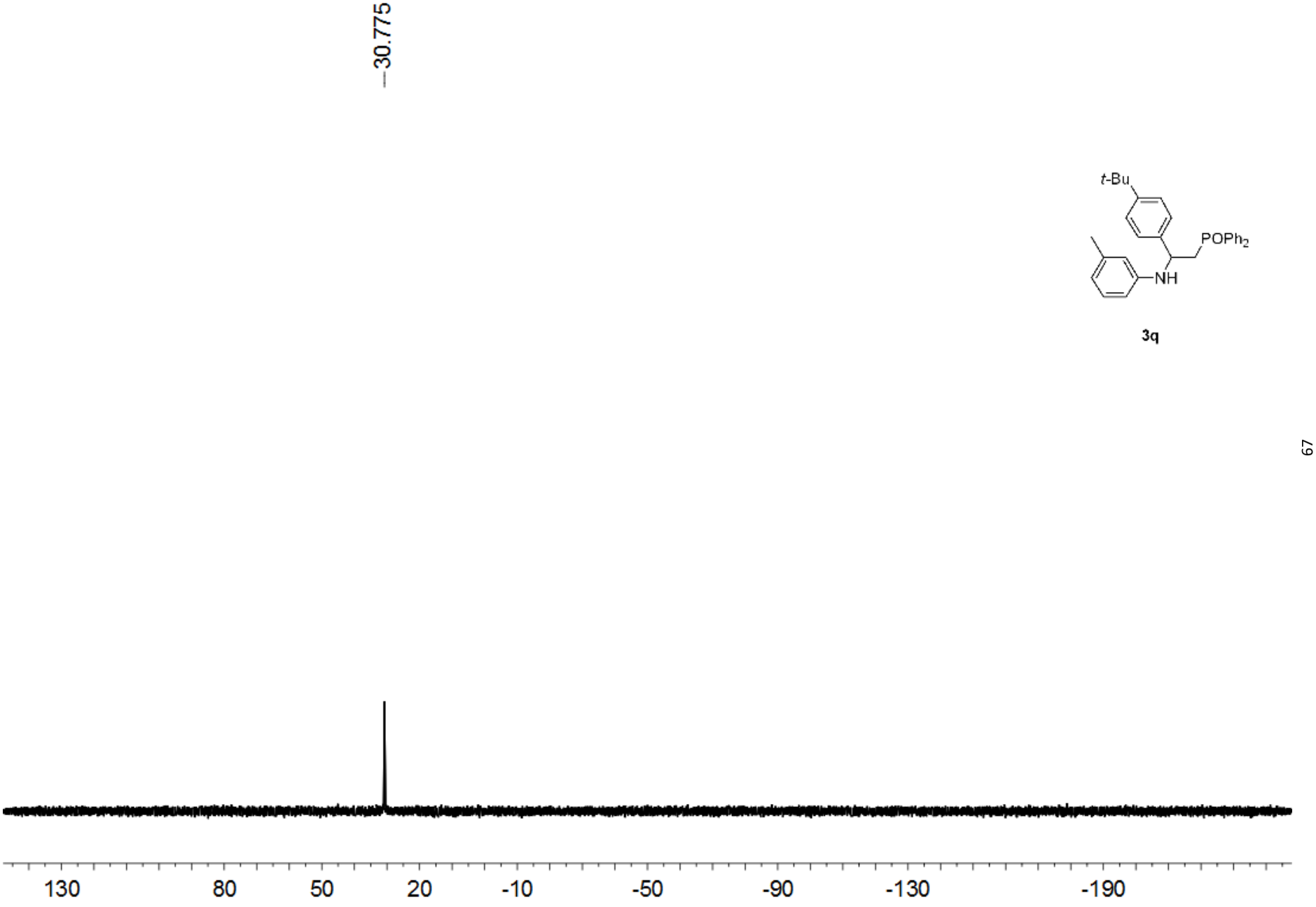
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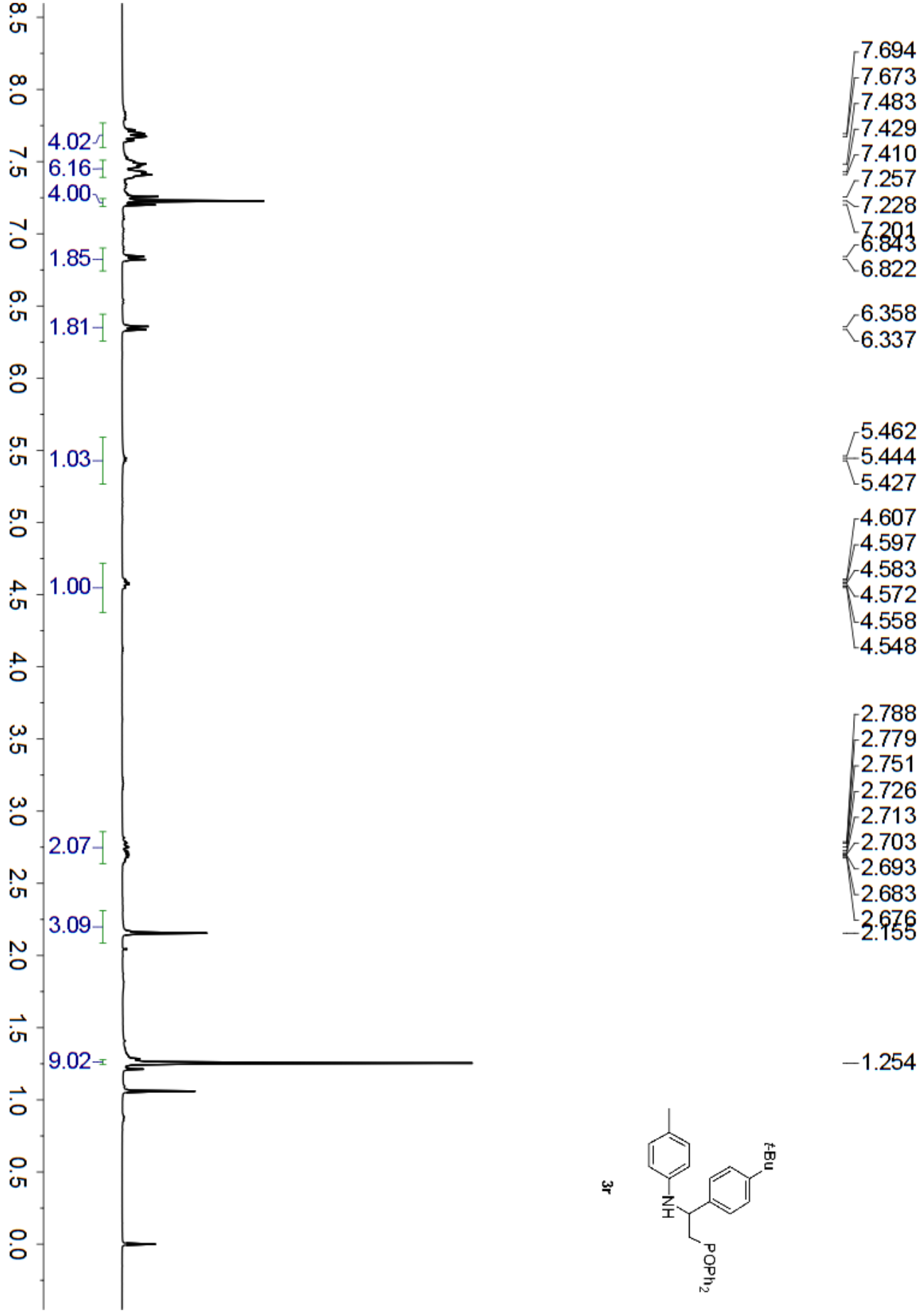
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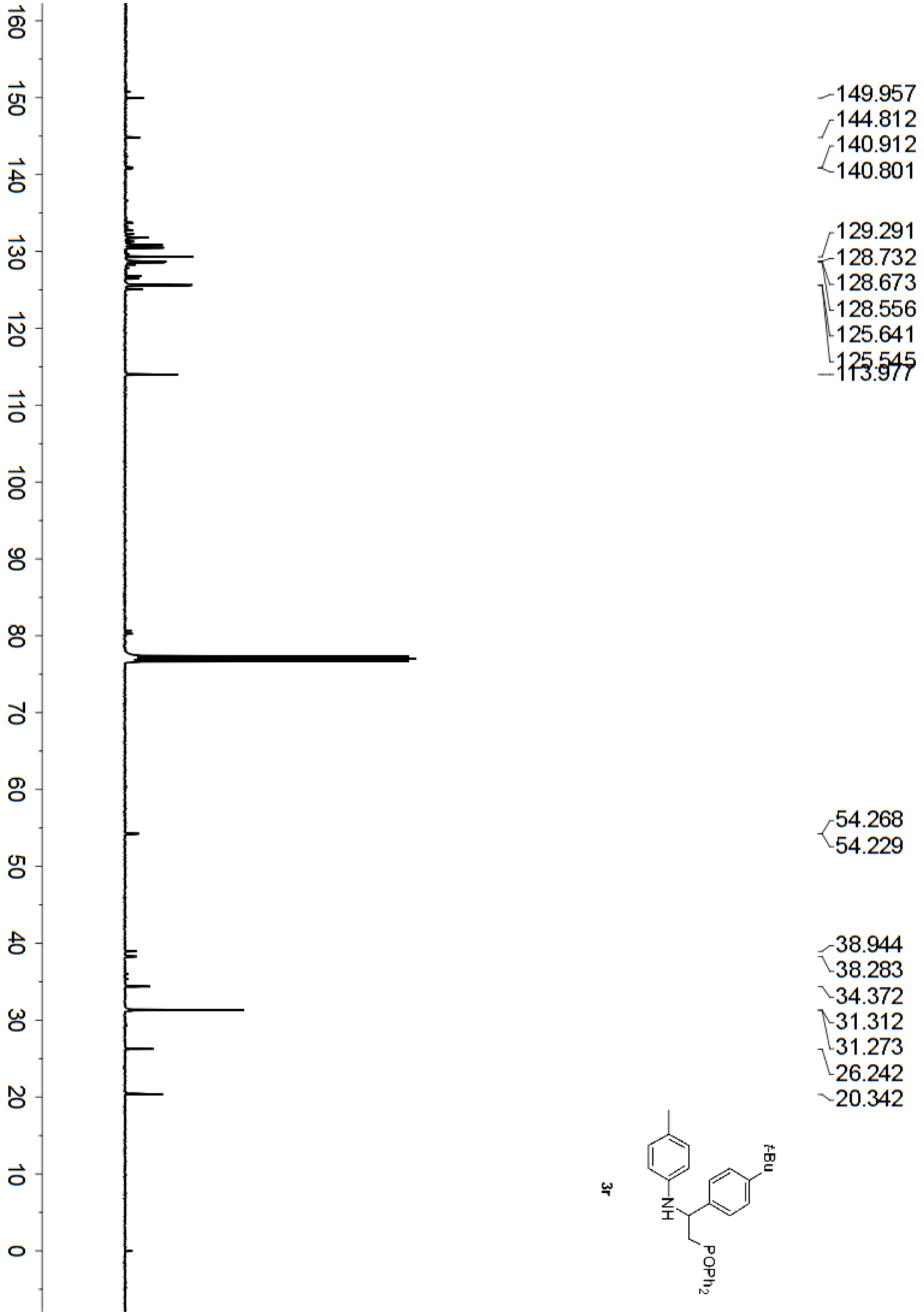
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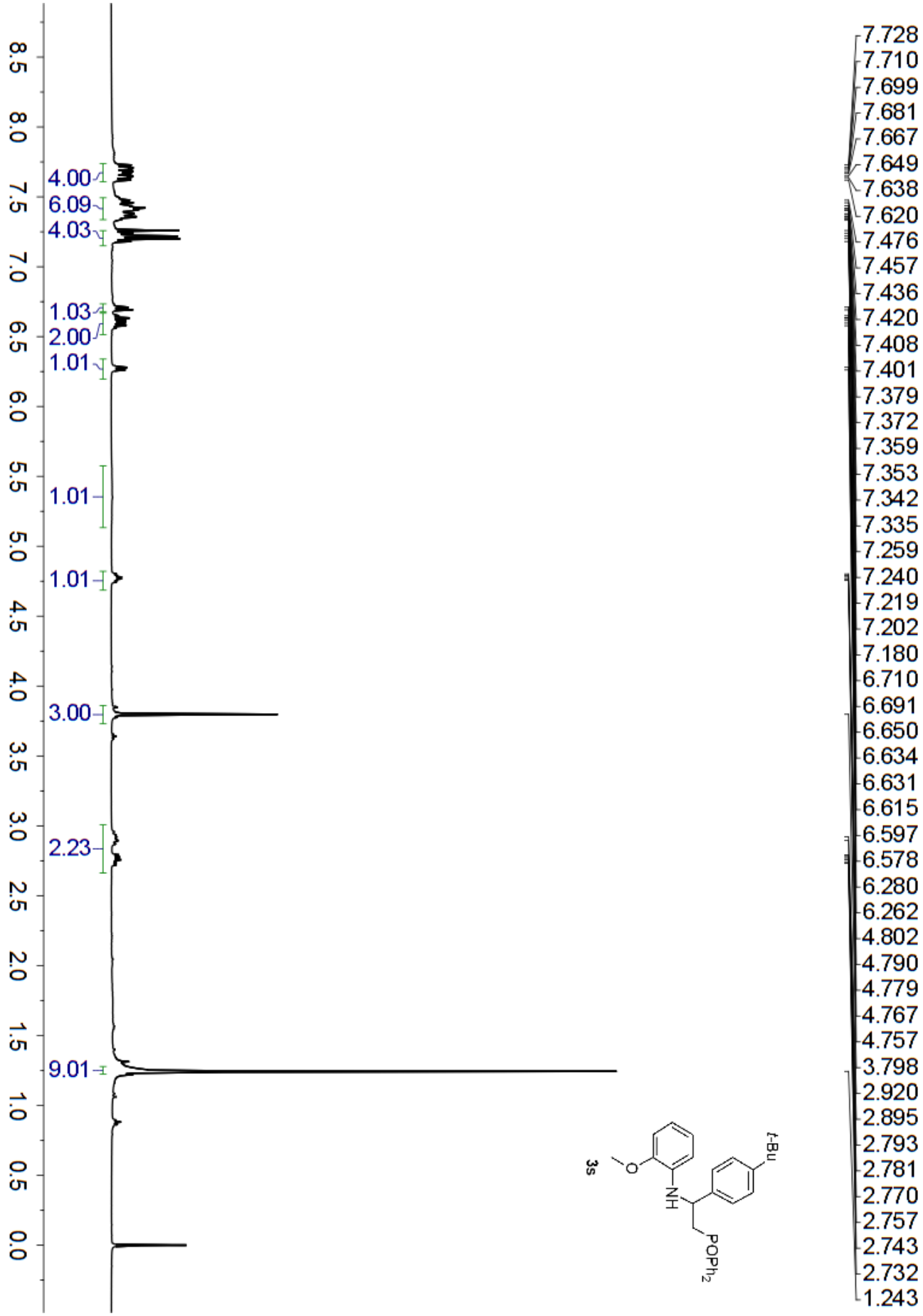
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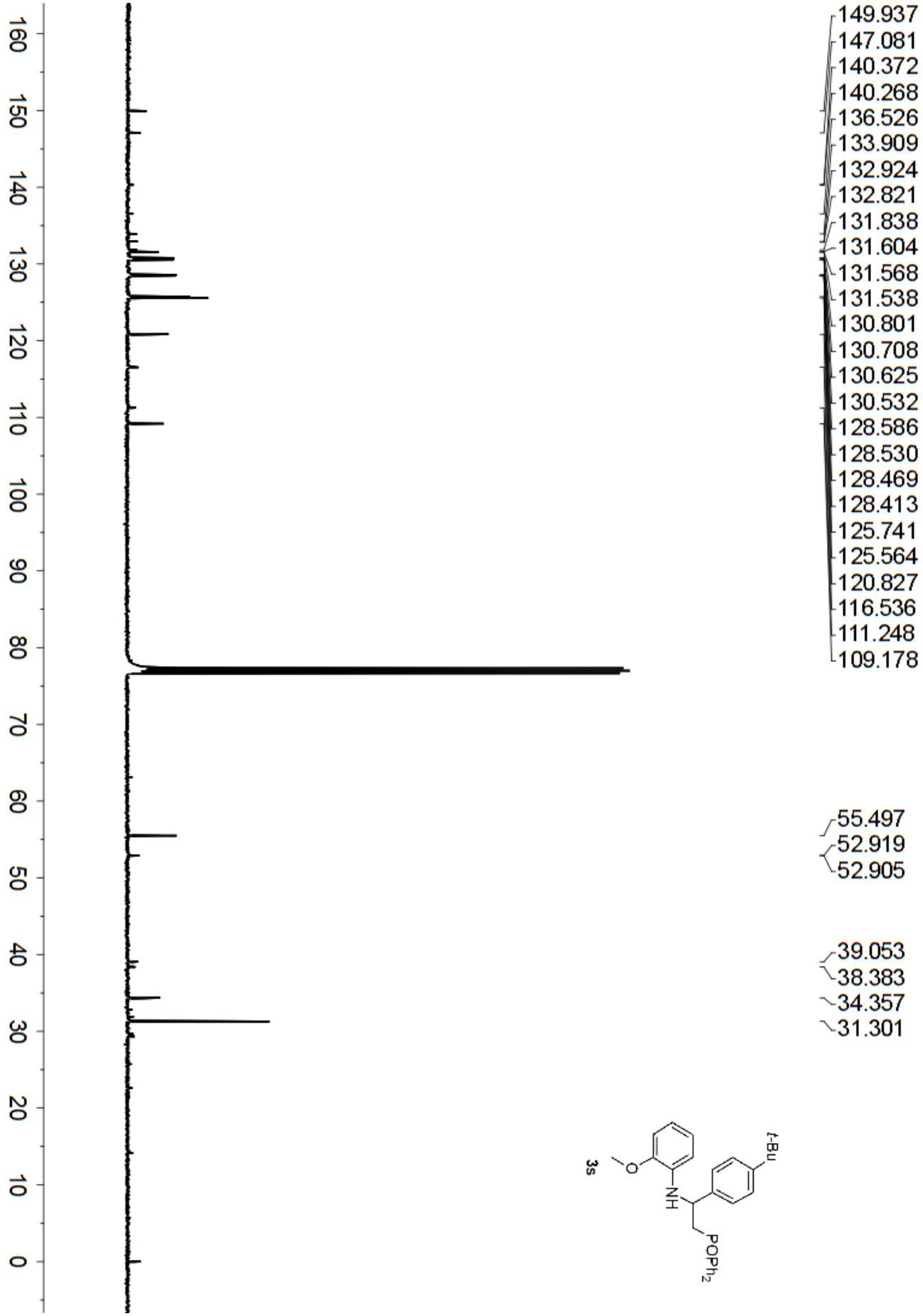
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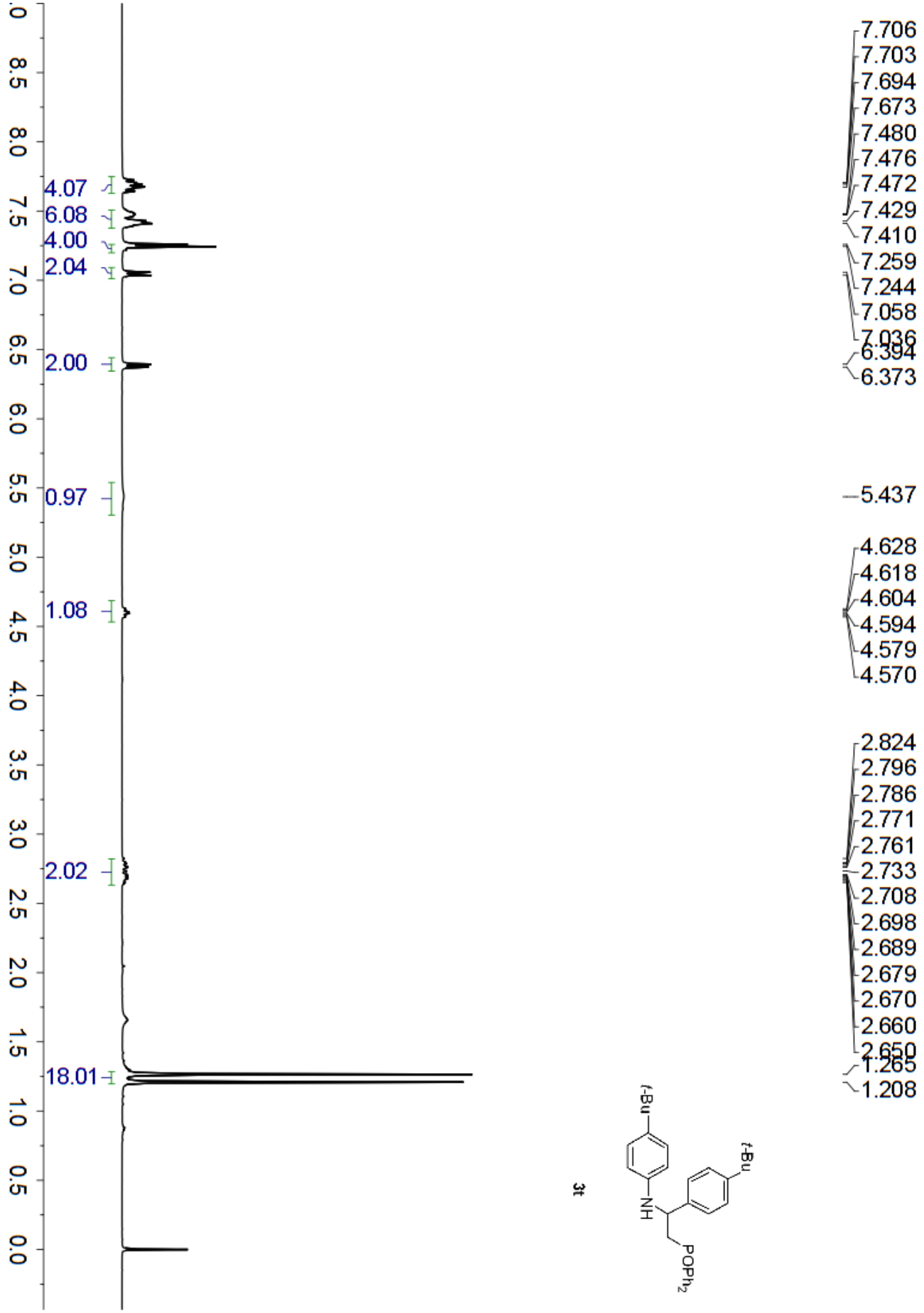
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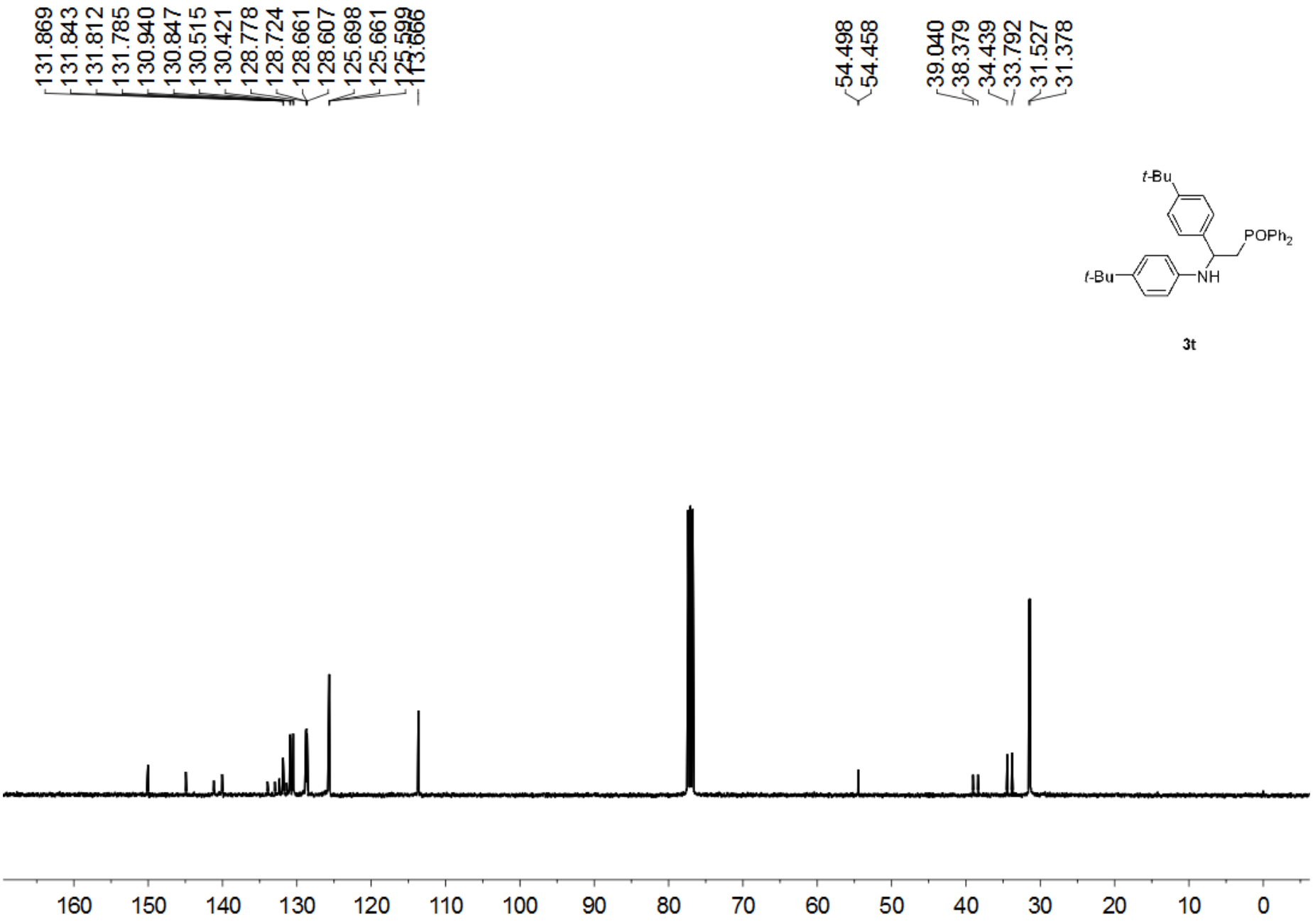
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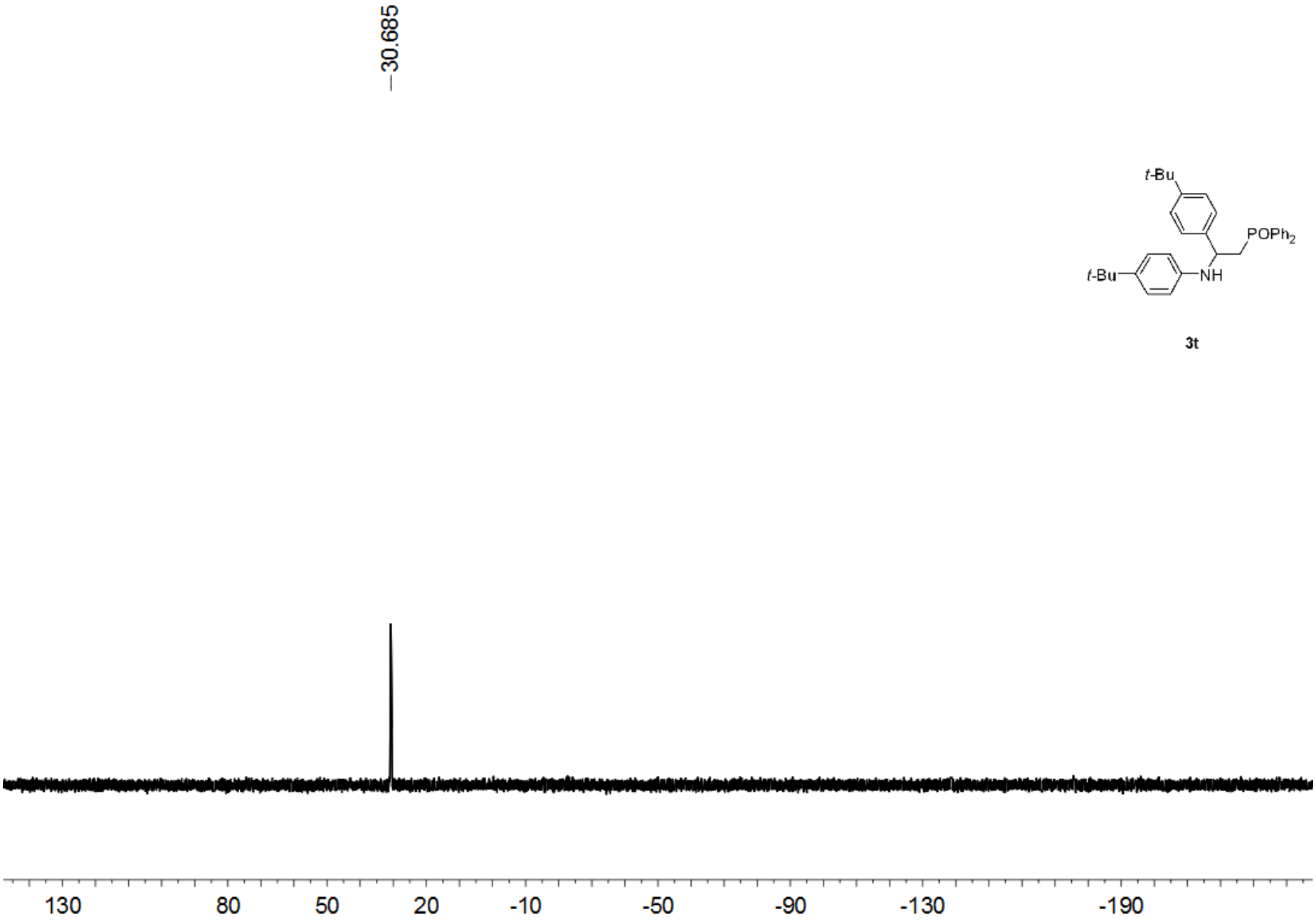
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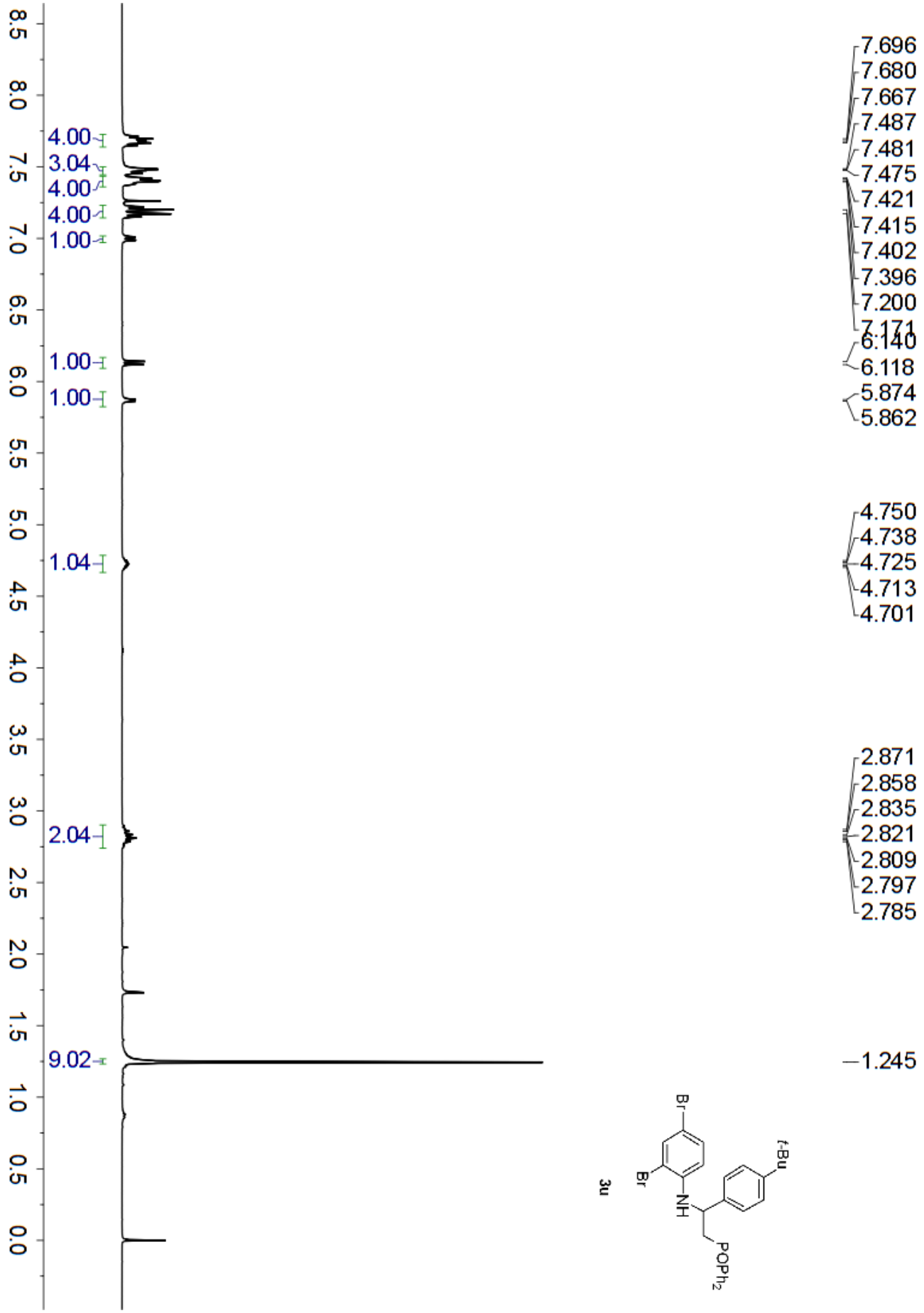
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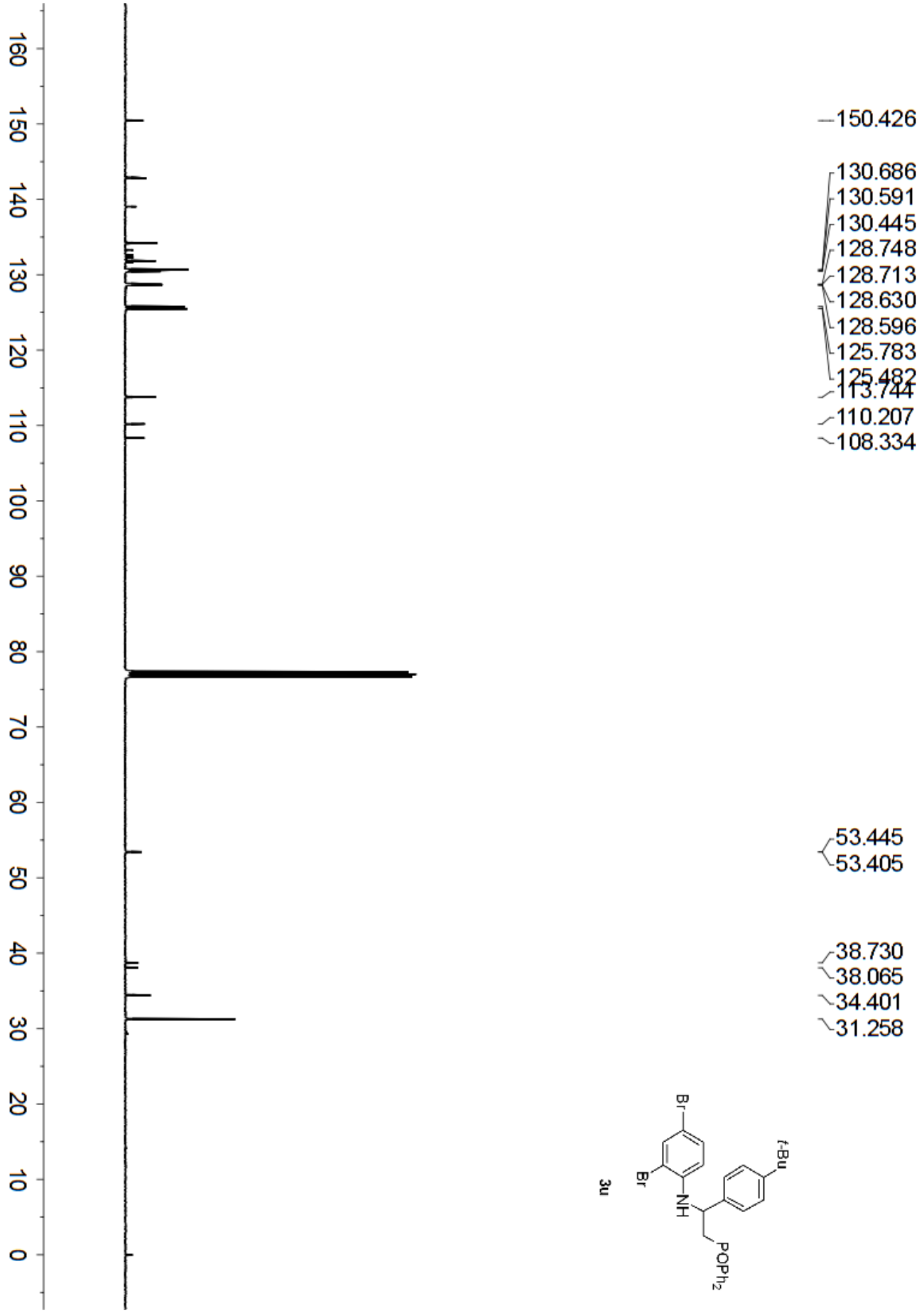
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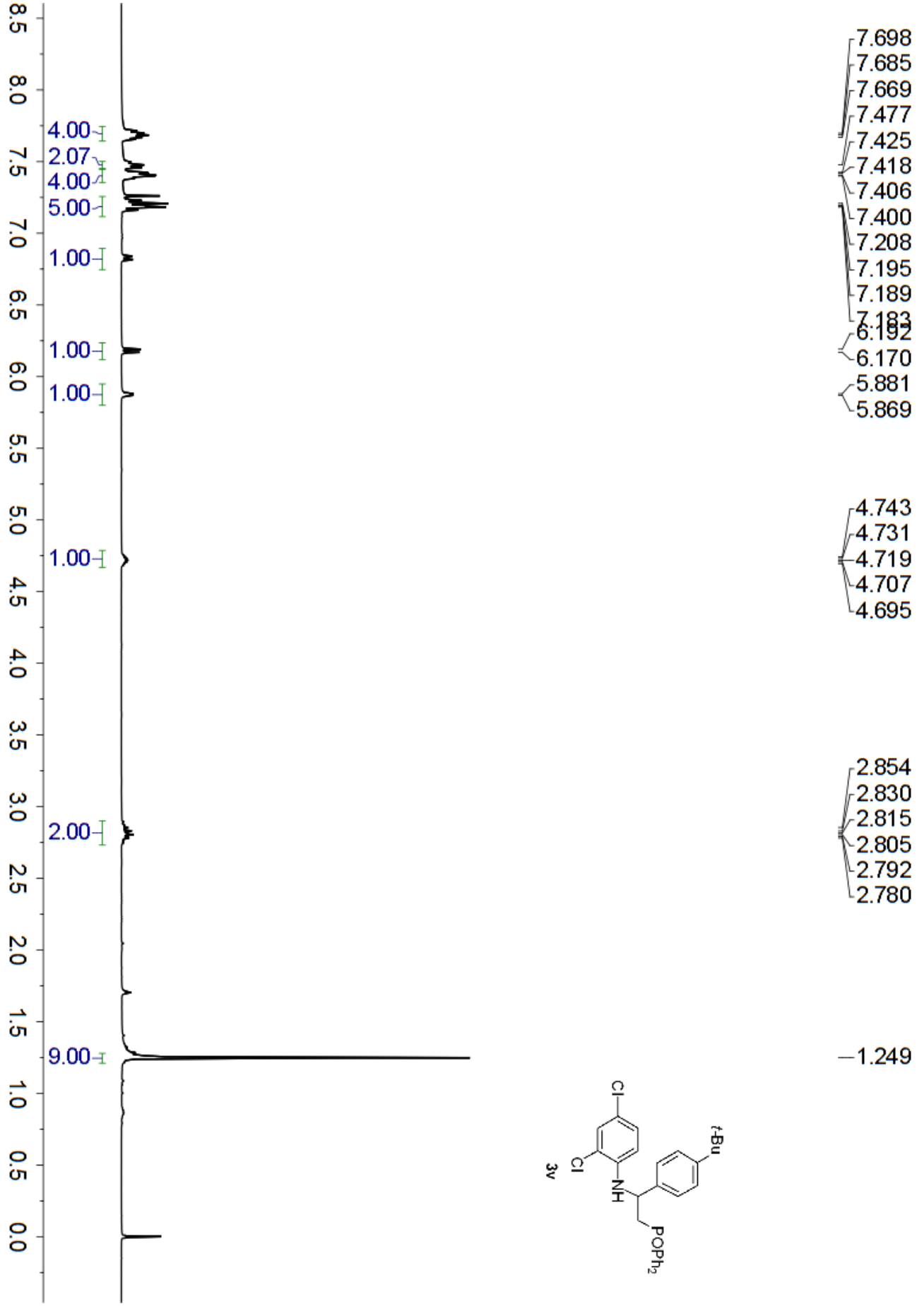
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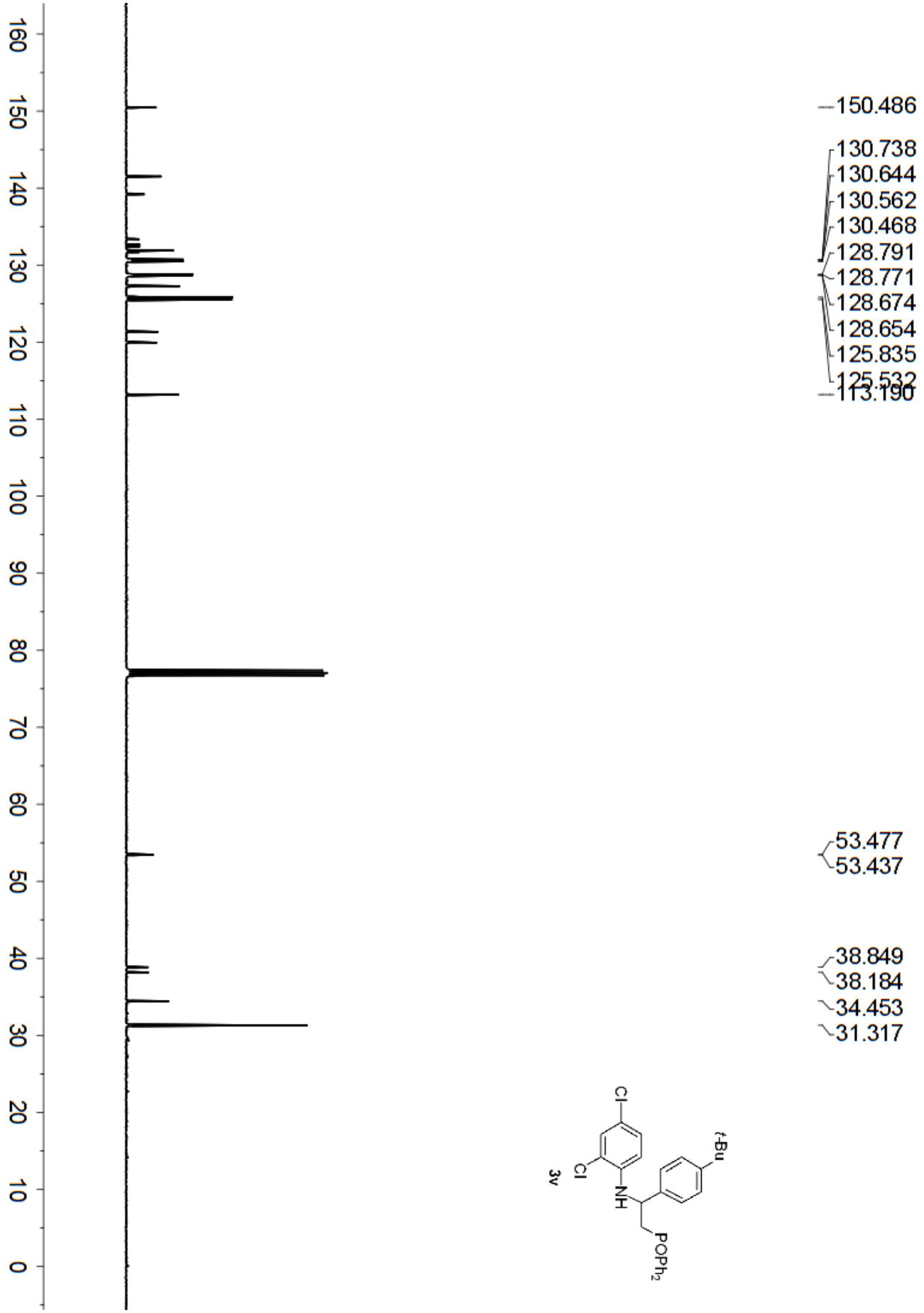
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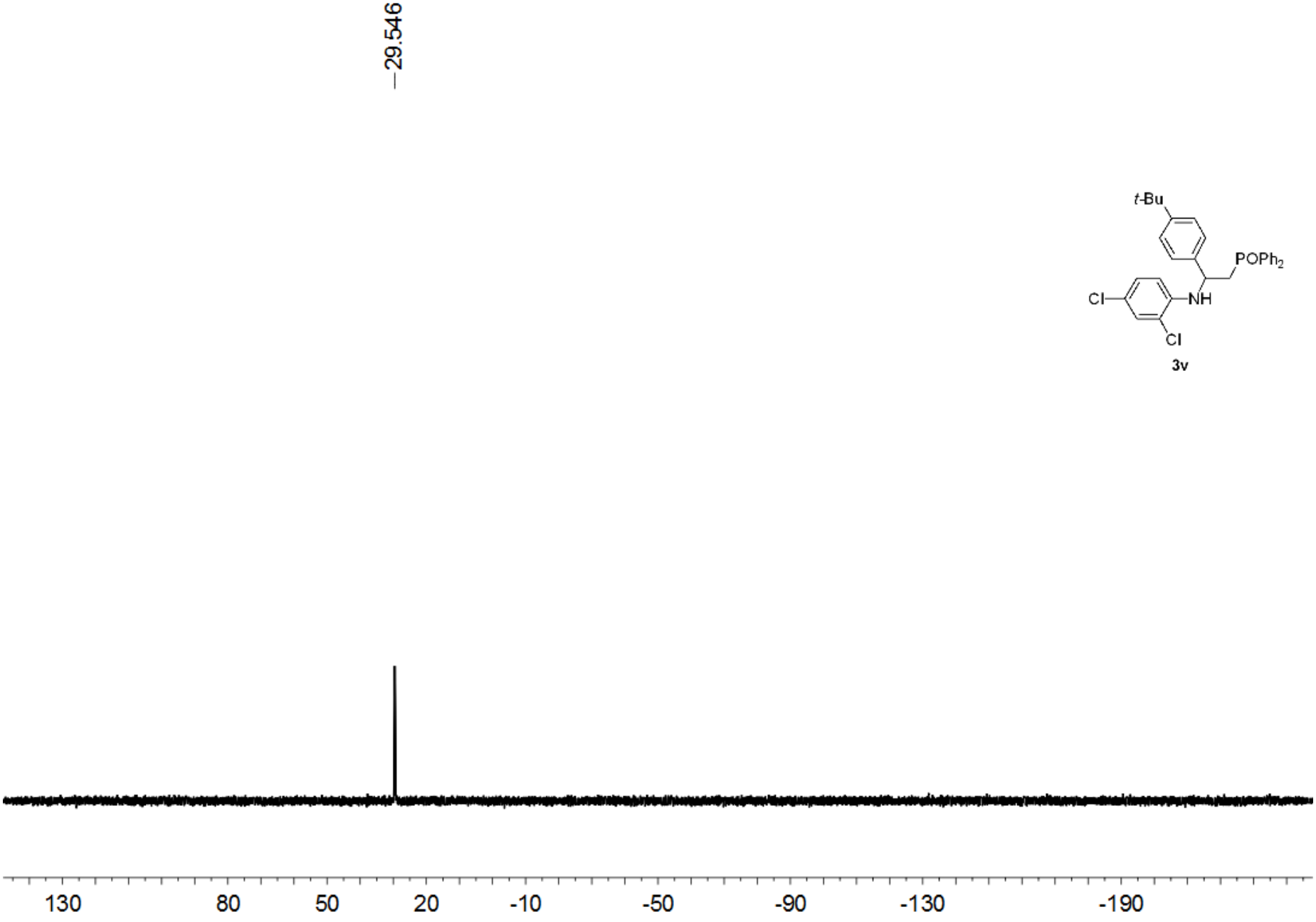
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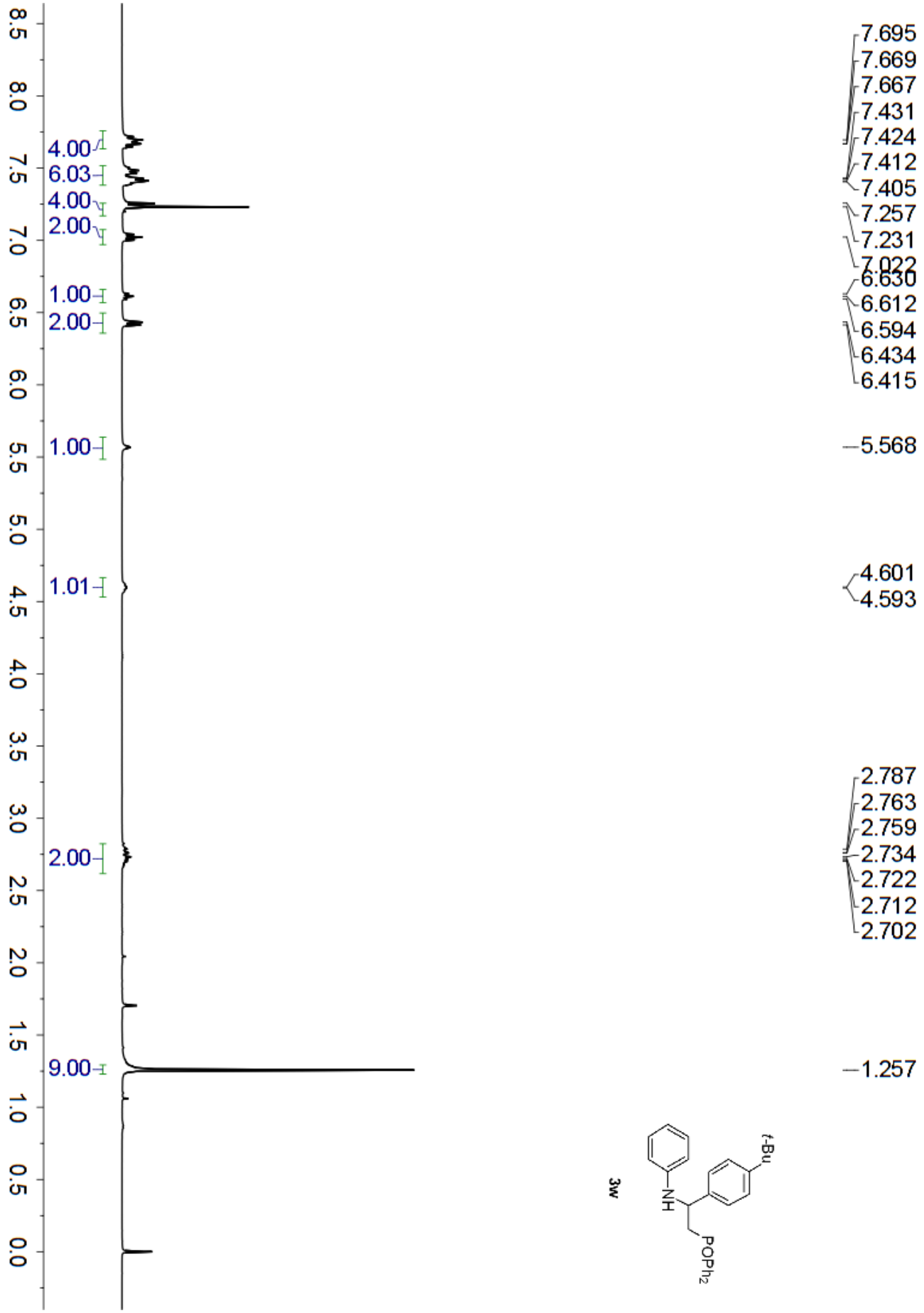
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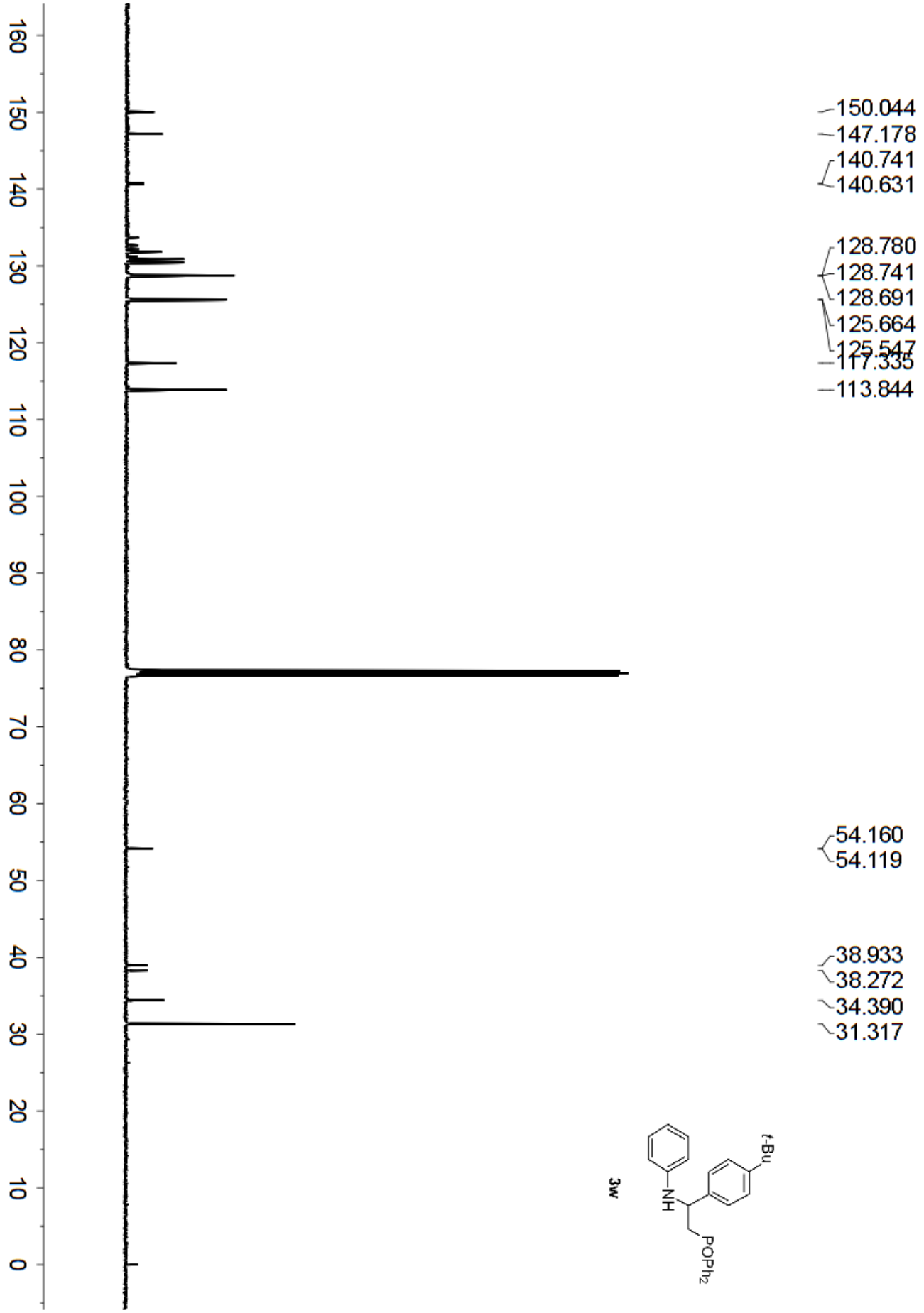
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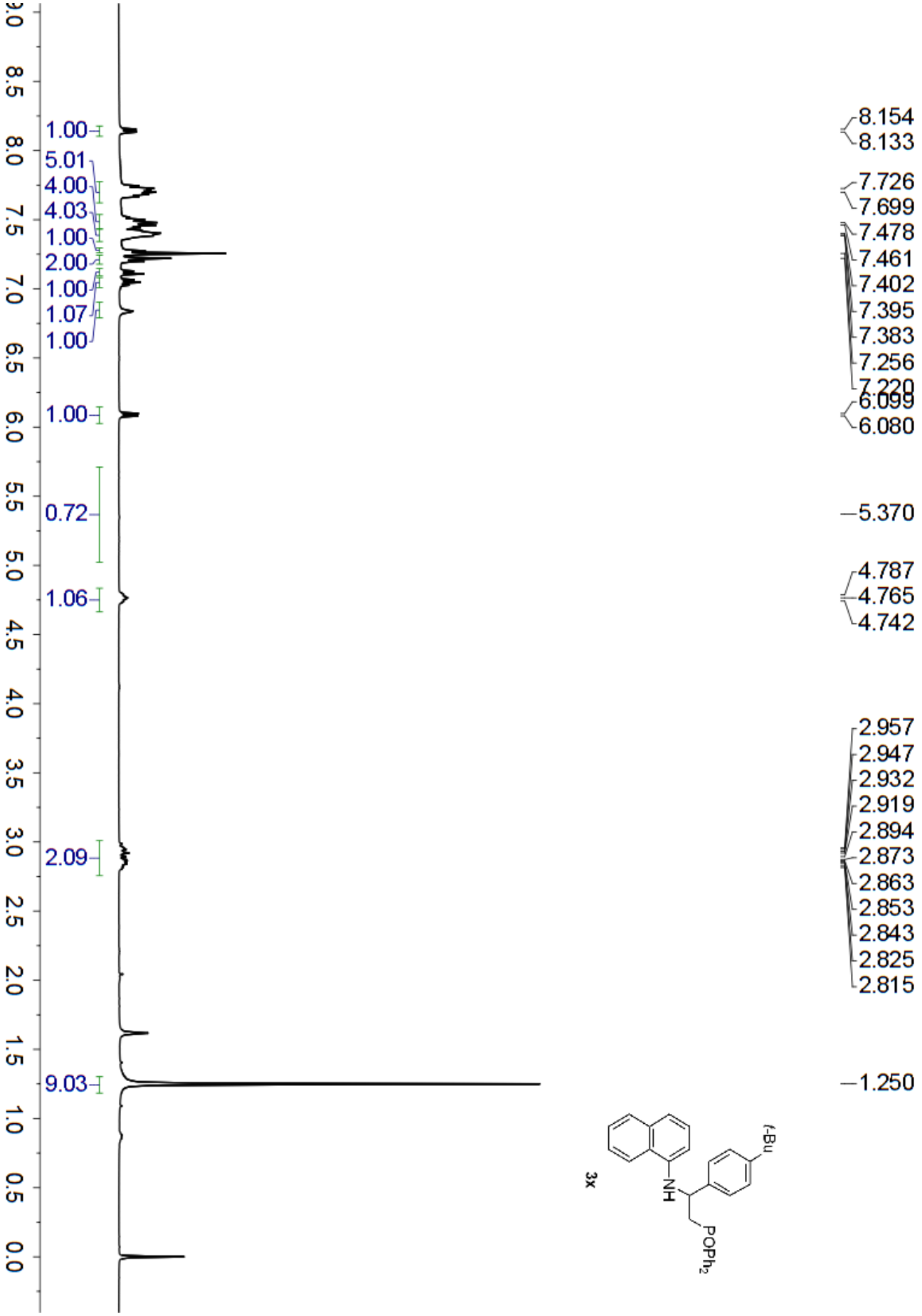
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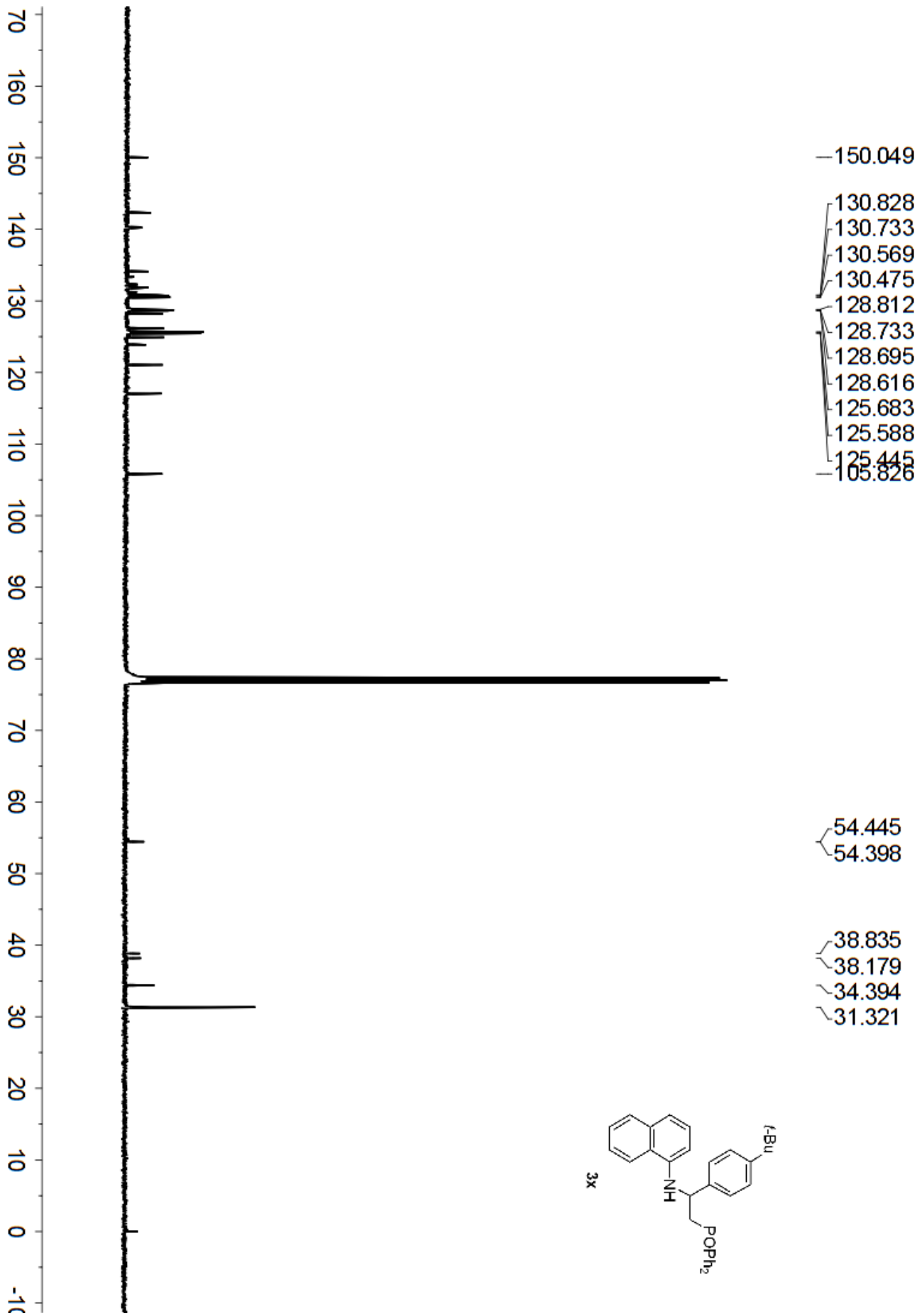
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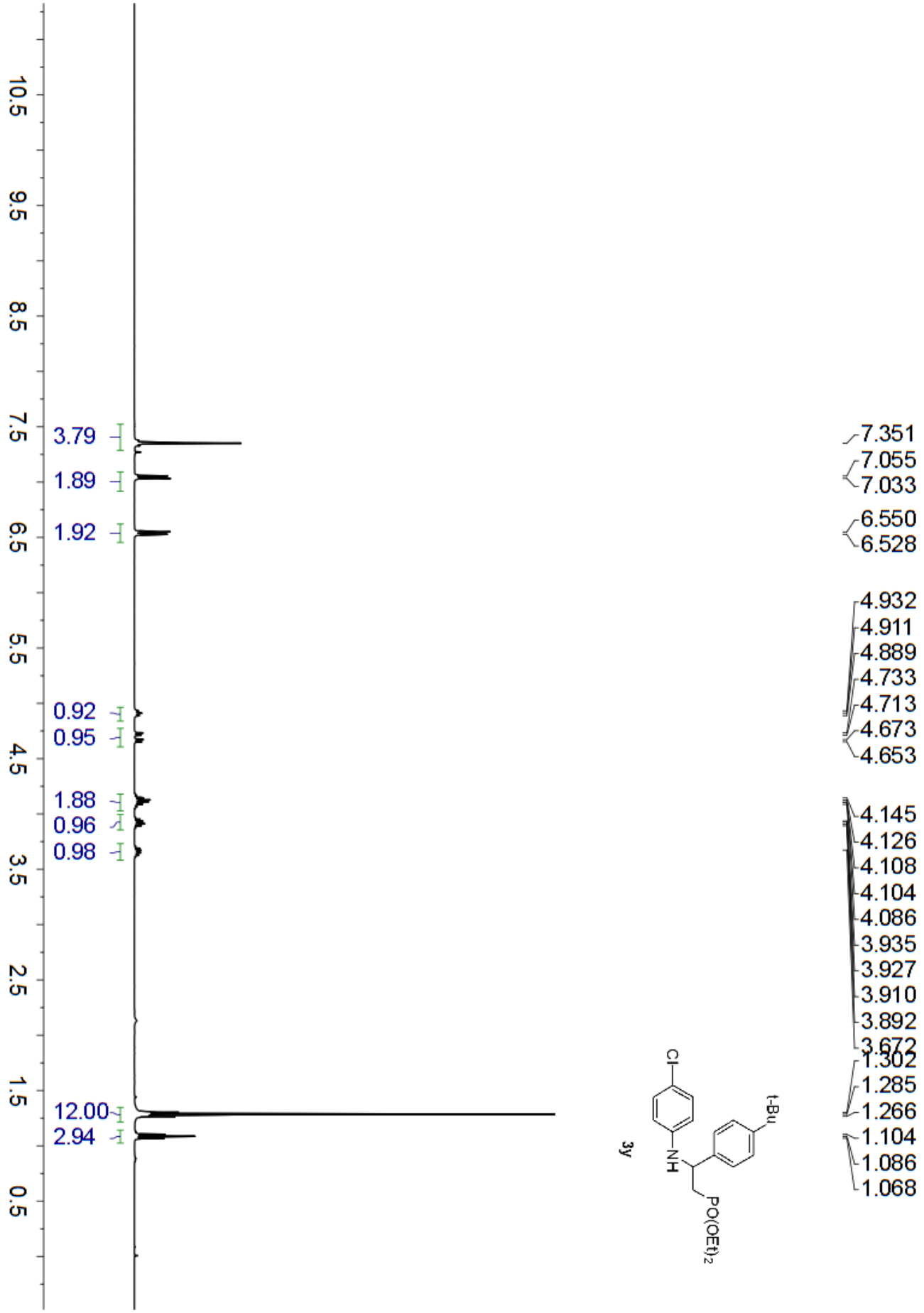
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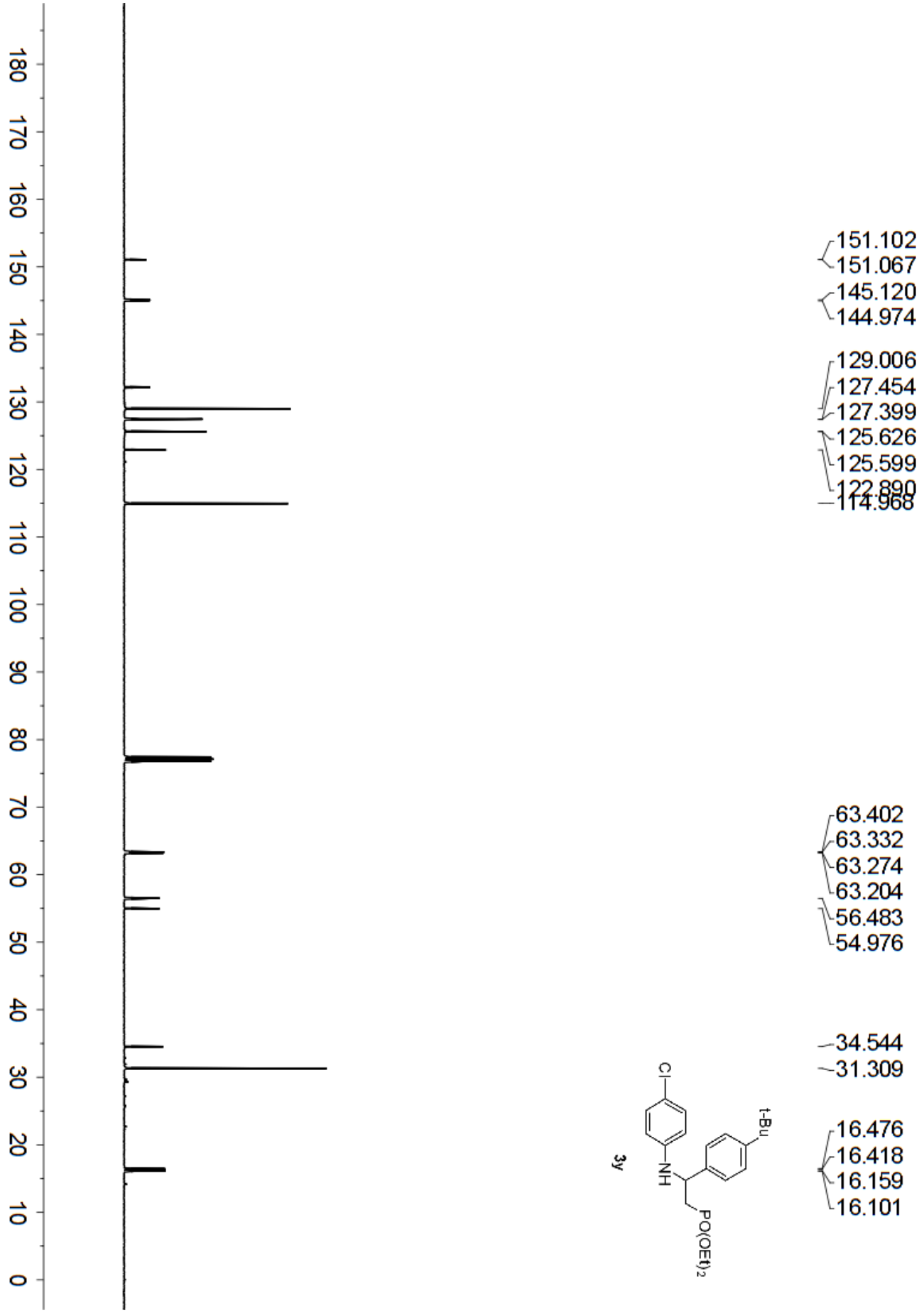
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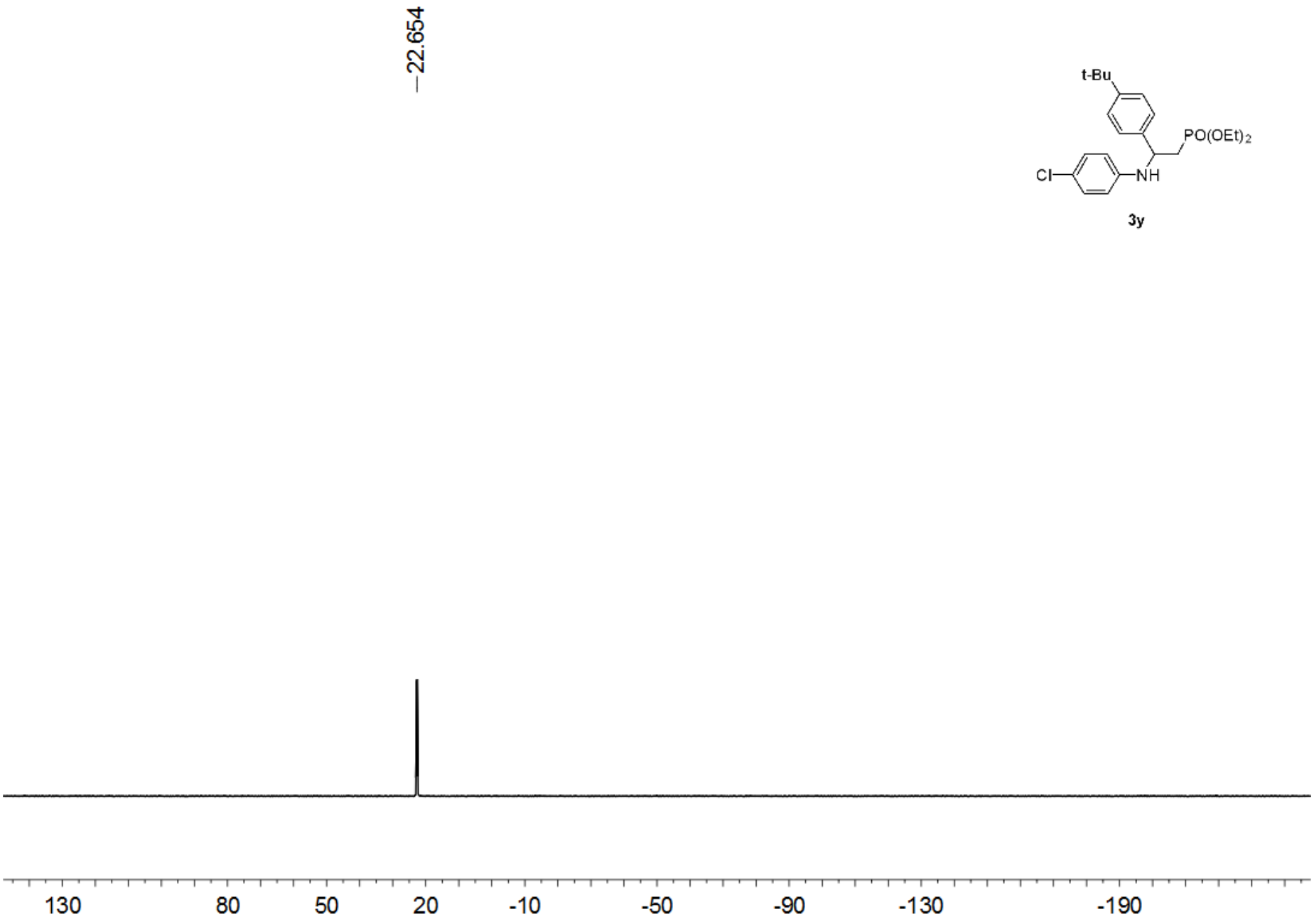
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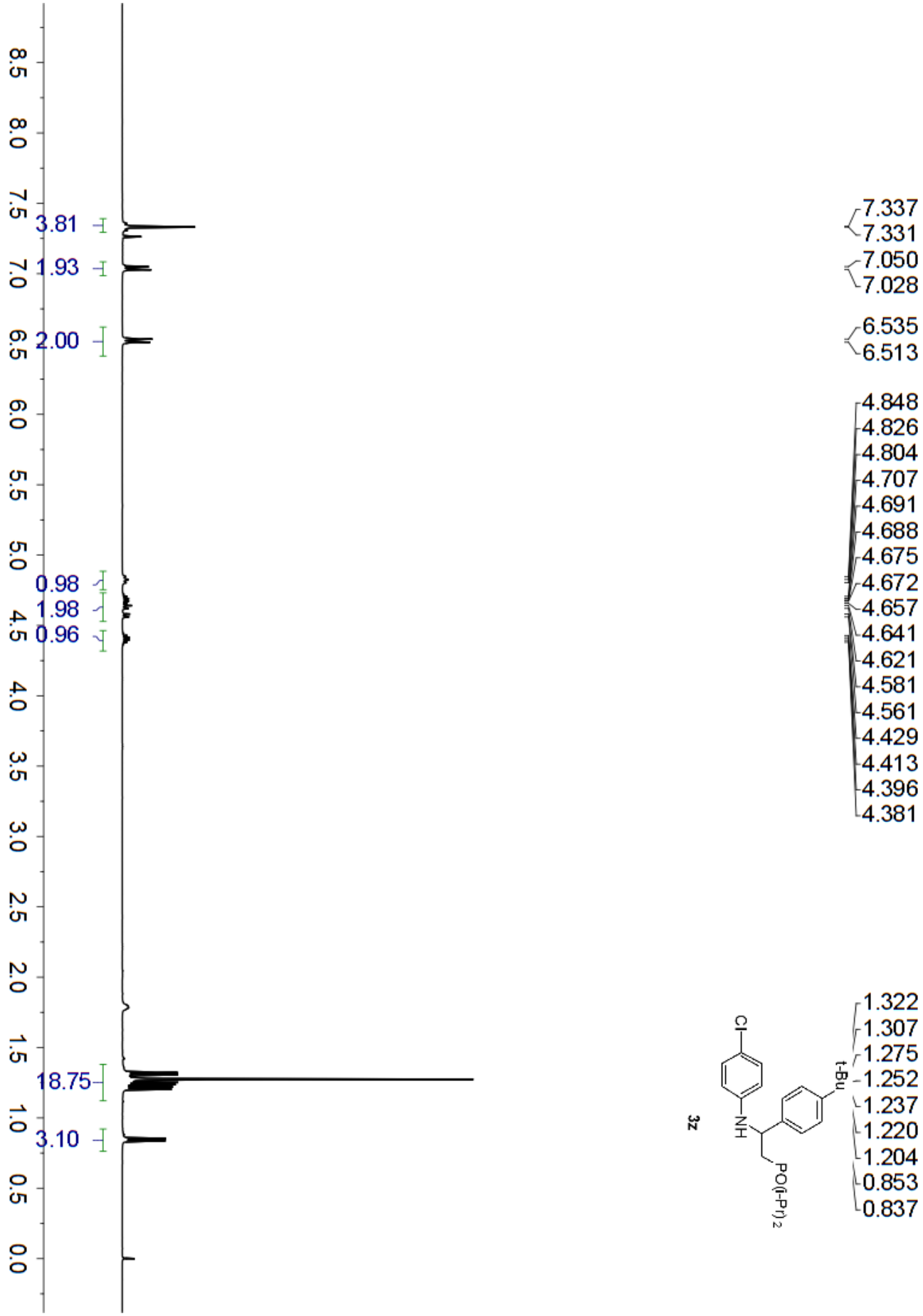
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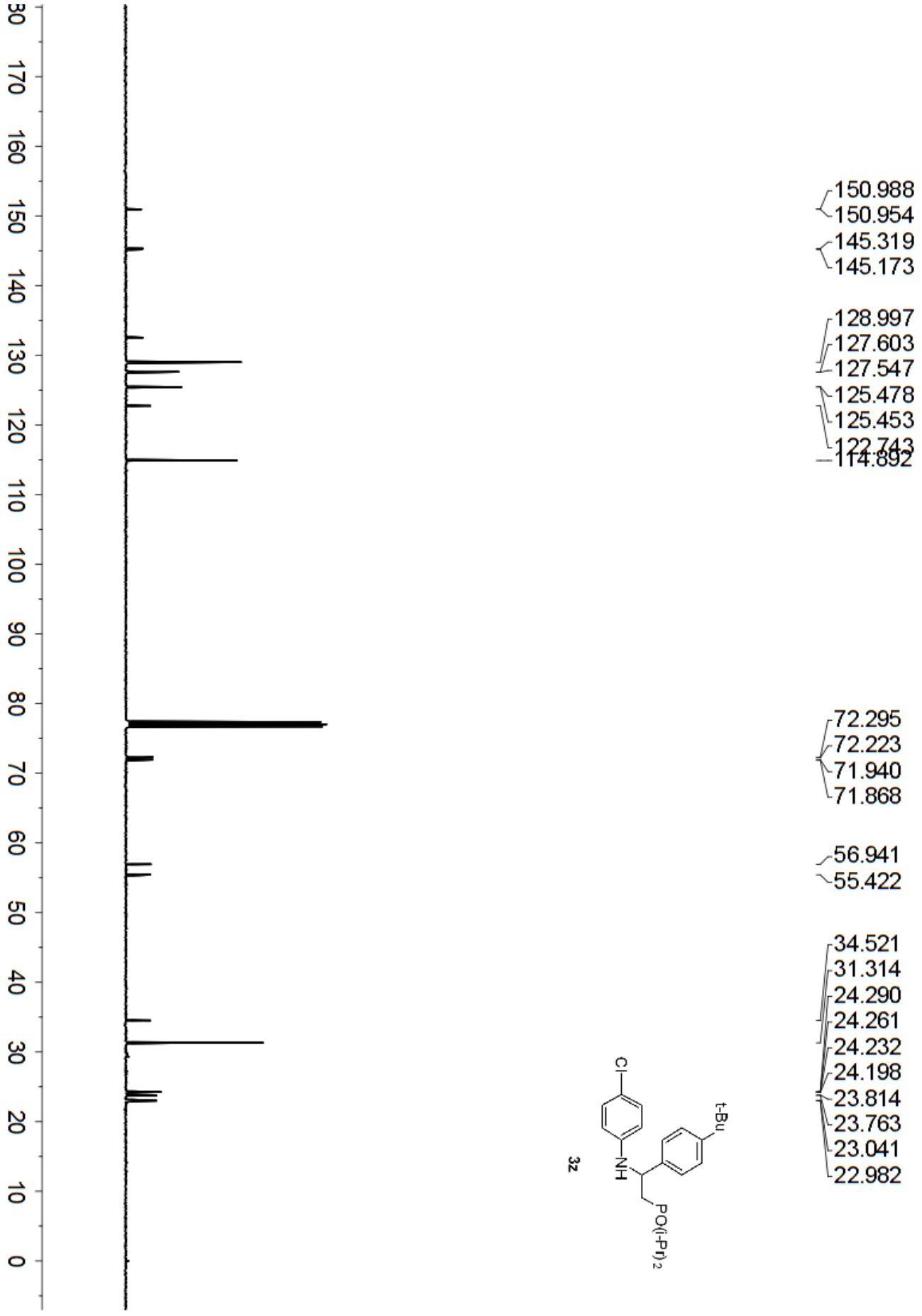
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145.173
128.997
127.603
127.547
125.478
125.453
122.743
114.892
72.295
72.223
71.940
71.868
56.941
55.422
34.521
31.314
24.290
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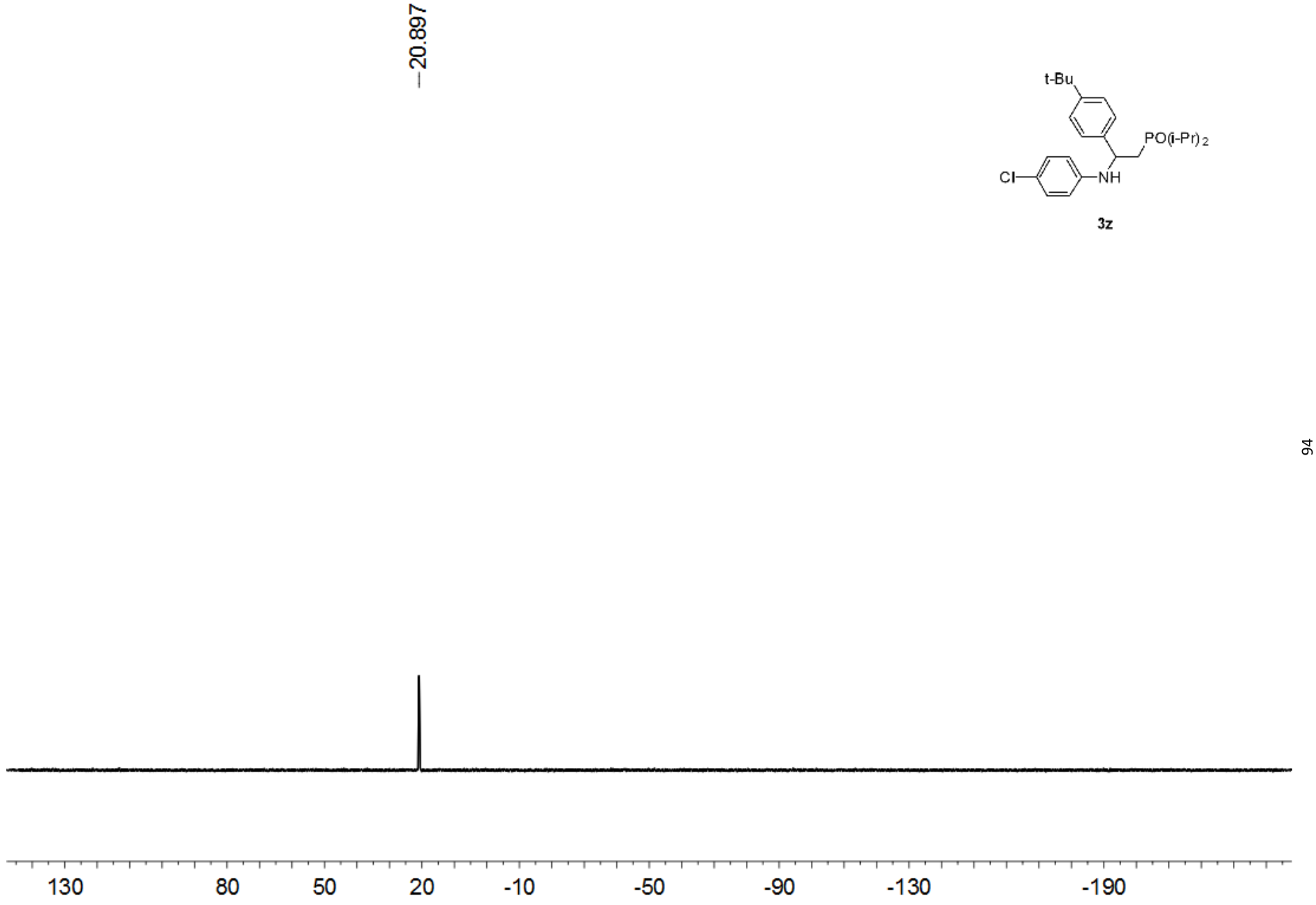
24.232
24.198
23.814
23.763
23.041
22.982
Cl
NH
t-Bu
PO(i-Pr)2
3z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t-Bu
PO(i-Pr)2
Cl
NH
3z
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50
20
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-50
-90
-130
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