Electronic Supplementary Material (ESI) for ChemComm.


# Supporting Information

## Enantioselective Synthesis of Quaternary α-Aminophosphonates by Palladium-catalyzed Arylation of Cyclic α-Ketiminophosphonates with Arylboronic Acids

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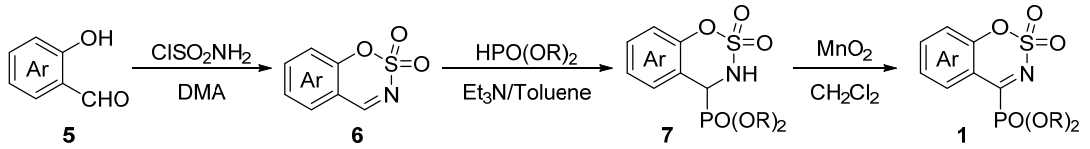
### Table of Contents

## 1. General

All reactions were carried out under an atmosphere of nitrogen using the standard Schlenk techniques, unless otherwise noted. Commercially available reagents were used without further purification. Solvents were treated prior to use according to the standard methods. $^{1}$H NMR, $^{13}$C NMR $^{31}$P NMR and $^{19}$F NMR spectra were recorded at room temperature in $CDCl_3$ on 400 MHz instrument with tetramethylsilane (TMS) as internal standard. Optical rotations were measured with JASCO P-1010 polarimeter. Flash column chromatography was performed on silica gel (200-300 mesh). All reactions were monitored by TLC analysis. Cyclic α-ketiminophosphonates **1a-1r** and **3a-3e** could be conveniently synthesized according to the known literature procedure.[1]

## 2. General Procedure for Synthesis of α-Ketiminophosphonates

α-Ketiminophosphonates were synthesized according to the known literature procedure,[1] among them, **1a-f**, **1j-r** and **3a-e** are the known compounds.

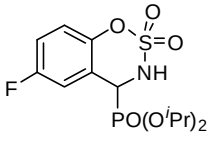



To a solution of salicylaldehyde (15 mmol) in dimethylacetamide (100 mL) at 0 $^{o}$C was carefully added freshly prepared chlorosulfonamide (40 mmol) in small portions and the resulting solution was stirred for 12 h. The reaction was quenched carefully with ice-cold water (100 mL) and the mixture was transferred to a separating funnel containing dichloromethane (200 mL). The aqueous layer was separated and extracted with dichloromethane (3×50 mL), and the combined organic layers were washed with saturated sodium bicarbonate solution (100 mL), dried over sodium sulfate, filtered through a short pad of silica using dichloromethane as eluent and concentrated in vacuo. The residue was heated to 180 °C under vacuum to remove volatile impurities to get benzoxathiazine-2,2-dioxide **6**.

To a suspension of the corresponding benzoxathiazine-2,2-dioxide (25 mmol) and the corresponding dialkyllphosphite (30 mmol) in toluene (50 mL) was added triethylamine (2.5 mmol). The solution was stirred and refluxed in toluene for 24 h until disappearance of benzo-xathiazine-2,2-dioxide. The solution was allowed to cool to room temperature and purification was performed by a silica gel column eluted with dichloromethane to give pure product **7**.

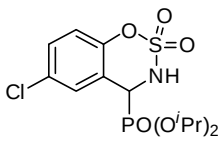
To a solution of the above product (1.0 mmol) in dichloromethane was added freshly prepared manganese dioxide (10 mmol) (the manganese dioxide must be freshly prepared, or the reaction yield will be low). The solution was stirred and refluxed at 50 $^{o}$C for 4-8 h. The solution was allowed to cool to room temperature and purification was performed by a silica gel column eluted with dichloromethane to give pure product **1**.

**Diisopropyl (6-fluoro-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (7g) :** The reaction was conducted by using 6-fluorobenzo[*e*][1,2,3]oxathiazine 2,2-dioxide (0.604 g, 3.0 mmol), affording 1.023 g (93% yield) of **7g** as a white solid, m.p. = 151-152 $^{o}$C, $R_f$ = 0.70 (petroleum ether/ethyl acetate 1/1). $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, $J$ = 9.1 Hz, 1H), 7.15-6.87 (m, 2H), 6.47 (s, 1H), 5.01 (d, $J$ = 21.1 Hz, 1H), 4.91-4.79 (m, 1H), 4.78-4.66 (m, 1H), 1.42-1.32 (m, 9H), 1.21 (d, $J$ = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 159.2 (dd, $J_{FC}$ = 245.1 Hz , $J_{PC}$

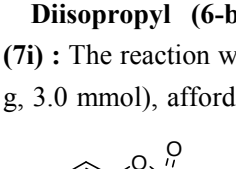


= 2.5 Hz), 147.8 (dd, $J_{PC}$ = 8.9 Hz, $J_{FC}$ = 2.7 Hz), 120.6 (d, $J_{FC}$ = 8.4 Hz), 118.3 (dd, $J_{FC}$ = 8.2 Hz, $J_{PC}$ = 3.7 Hz), 116.9 (dd, $J_{FC}$ = 23.9 Hz, $J_{PC}$ = 1.8 Hz), 114.6 (dd, $J_{FC}$ = 26.5 Hz, $J_{PC}$ = 3.0 Hz), 74.1 (d, $J_{PC}$ = 7.1 Hz), 73.9 (d, $J_{PC}$ = 7.0 Hz), 54.3 (d, $J_{PC}$ = 155.7 Hz), 24.2 (d, $J_{PC}$ = 3.4 Hz), 24.1 (d, $J_{PC}$ = 4.0 Hz), 23.9 (d, $J_{PC}$ = 4.9 Hz), 23.7 (d, $J_{PC}$ = 5.3 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ -115.2; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 13.9. HRMS Calculated for $C_{13}H_{20}FNO_6PS$ $[M+H]^+$ 368.0727, found 368.0727.

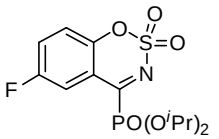
**Diisopropyl (6-chloro-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (7h) :** The reaction was conducted by using 6-chlorobenzo[*e*][1,2,3]oxathiazine 2,2-dioxide (0.653 g, 3.0 mmol), affording 0.995 g (86% yield) of **7h** as a white solid, m.p. = 147-148 °C, $R_f$ = 0.70 (petroleum ether/ethyl acetate 1/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.78 (s, 1H), 7.34-7.22 (m, 1H), 6.95 (d, *J* = 8.8 Hz, 1H), 6.60 (brs, 1H), 5.00 (d, *J* = 21.1 Hz, 1H), 4.91-4,79 (m, 1H), 4.78-4.65 (m, 1H), 1.42-1.36 (m, 6H), 1.34 (d, *J* = 6.2 Hz, 3H), 1.23 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 150.4 (d, $J_{PC}$ = 8.9 Hz), 130.6 (d, $J_{PC}$ = 2.6 Hz), 130.0 (d, $J_{PC}$ = 1.8 Hz), 127.7 (d, $J_{PC}$ = 3.0 Hz), 120.5, 118.3 (d, $J_{PC}$ = 3.6 Hz), 74.2 (d, $J_{PC}$ = 7.1 Hz), 74.0 (d, $J_{PC}$ = 7.0 Hz), 54.1 (d, $J_{PC}$ = 156.3 Hz), 24.2 (d, $J_{PC}$ = 3.4 Hz), 24.1 (d, $J_{PC}$ = 3.9 Hz), 23.9 (d, $J_{PC}$ = 5.0 Hz), 23.7 (d, $J_{PC}$ = 5.4 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 13.9. HRMS Calculated for $C_{13}H_{20}ClNO_6PS$ $[M+H]^+$ 384.0432, found 384.0437.



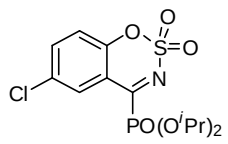

**Diisopropyl (6-bromo-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (7i) :** The reaction was conducted by using 6-bromobenzo[*e*][1,2,3]oxathiazine 2,2-dioxide (0.786 g, 3.0 mmol), affording 1.093 g (85% yield) of **7i** as a white solid, m.p. = 133-134 °C, $R_f$ = 0.70 (petroleum ether/ethyl acetate 1/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.91 (s, 1H), 7.43 (d, *J* = 8.7 Hz, 1H), 6.89 (d, *J* = 8.7 Hz, 1H), 6.76 (brs, 1H), 4.99 (d, *J* = 21.2 Hz, 1H), 4.91-4,79 (m, 1H), 4.78-4.64 (m, 1H), 1.44-1.36 (m, 6H), 1.34 (d, *J* = 6.2 Hz, 3H), 1.25 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 150.9 (d, $J_{PC}$ = 8.9 Hz), 132.9 (d, $J_{PC}$ = 1.7 Hz), 130.6 (d, $J_{PC}$ = 3.0 Hz), 120.8, 118.7 (d, $J_{PC}$ = 3.4 Hz), 118.0 (d, $J_{PC}$ = 2.6 Hz), 74.2 (d, $J_{PC}$ = 7.1 Hz), 74.0 (d, $J_{PC}$ = 7.1 Hz), 54.0 (d, $J_{PC}$ = 156.9 Hz), 24.3 (d, $J_{PC}$ = 3.4 Hz), 24.1 (d, $J_{PC}$ = 3.9 Hz), 23.9 (d, $J_{PC}$ = 5.1 Hz), 23.7 (d, $J_{PC}$ = 5.3 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 13.9. HRMS Calculated for $C_{13}H_{20}BrNO_6PS$ $[M+H]^+$ 427.9927, found 427.9924.




**Diisopropyl (6-fluoro-2,2-dioxidobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (1g):** The reaction was conducted by using **7g** (0.868 g, 2.4 mmol), affording 0.084 g (10% yield) of **1g** as a white solid, m.p. = 71-72 °C, $R_f$ = 0.40 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 8.32-8.20 (m, 1H), 7.53-7.42 (m, 1H), 7.37-7.29 (m, 1H), 5.03-4.85 (m, 2H), 1.49-1.38 (m, 12H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.8 (dd, $J_{PC}$ = 200.8 Hz, $J_{FC}$ = 2.5 Hz), 159.1 (d, $J_{FC}$ = 248.4 Hz), 150.4 (dd, $J_{PC}$ = 8.3 Hz, $J_{FC}$ = 2.5 Hz), 125.1 (d, $J_{FC}$ = 24.4 Hz), 120.9 (dd, $J_{FC}$ = 8.0 Hz, $J_{PC}$ = 3.1 Hz), 117.4 (d, $J_{PC}$ = 26.3 Hz), 116.4 (dd, $J_{FC}$ = 24.0 Hz, $J_{PC}$ = 8.8 Hz), 75.5 (d, $J_{PC}$ = 7.2 Hz), 24.1 (d, $J_{PC}$ = 3.9 Hz), 23.9 (d, $J_{PC}$ = 5.3 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ -112.2; $^{31}$P NMR (162 MHz, $CDCl_3$) δ -1.3. HRMS Calculated for $C_{13}H_{21}FN_2O_6PS$ $[M+NH_4]^+$ 383.0436, found 383.0841.

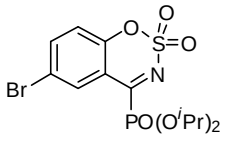



**Diisopropyl (6-chloro-2,2-dioxidobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (1h):** The reaction was conducted by using **7h** (0.840 g, 2.2 mmol), affording 0.164 g (20% yield) of **1h** as a white solid, m.p. = 62-63 °C, $R_f$ = 0.40 (dichloromethane). $^1$H NMR (400 MHz, $CDCl_3$) δ 8.50 (s,



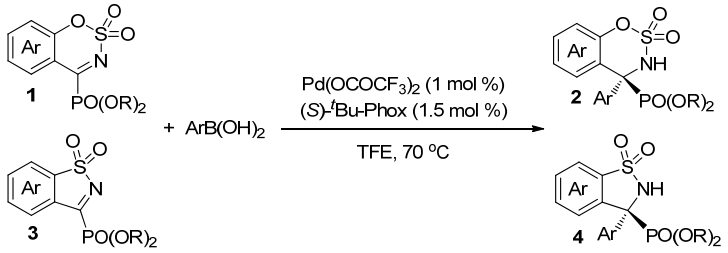
1H), 7.68 (d, $J$ = 8.6 Hz, 1H), 7.26 (d, $J$ = 8.6 Hz, 1H), 4.99-4.84 (m, 2H), 1.48-1.37 (m, 12H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.7 (d, $J_{PC}$ = 200.9 Hz), 152.7 (d, $J_{PC}$ = 8.4 Hz), 137.6, 131.9, 130.7, 120.6 (d, $J_{PC}$ = 3.1 Hz), 116.5 (d, $J_{PC}$ = 24.1 Hz), 75.4 (d, $J_{PC}$ = 7.1 Hz), 24.1 (d, $J_{PC}$ = 3.8 Hz), 23.8 (d, $J_{PC}$ = 5.3 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ -1.4 (t, $J$ = 7.0 Hz). HRMS Calculated for $C_{13}H_{21}ClN_2O_6PS$ $[M+NH_4]^+$ 399.0541, found 399.0545.

**Diisopropyl (6-bromo-2,2-dioxidobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (1i):** The reaction was conducted by using **7i** (0.922 g, 2.2 mmol), affording 0.300 g (32% yield) of **1i** as a white solid, m.p. = 48-49 °C, $R_f$ = 0.40 (dichloromethane). $^1$H NMR (400 MHz, $CDCl_3$) δ



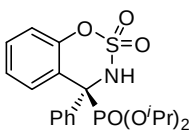
8.71-8.61 (m, 1H), 7.91-7.77 (m, 1H), 7.20 (d, $J$ = 8.8 Hz, 1H), 5.10-4.85 (m, 2H), 1.51-1.39 (m, 12H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.7 (d, $J$ = 201.2 Hz), 153.3 (d, $J$ = 8.4 Hz), 140.4, 133.8, 120.9 (d, $J$ = 3.1 Hz), 119.2, 117.1 (d, $J$ = 24.1 Hz), 75.5 (d, $J$ = 7.2 Hz), 24.2 (d, $J$ = 3.8 Hz), 23.9 (d, $J$ = 5.4 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ -1.3. HRMS Calculated for $C_{13}H_{21}BrN_2O_6PS$ $[M+NH_4]^+$ 443.0036, found 443.0035.

## 3. Pd-Catalyzed Asymmetric Arylation of Cyclic α-Ketiminophosphonates




$Pd(OCOCF_3)_2$ (0.7 mg, 0.002 mmol) and (*S*)-$^t$Bu-Phox (1.2 mg, 0.003 mmol) were placed in a dried Schlenk tube, and degassed anhydrous acetone (1 mL) was added. The mixture was stirred at room temperature for 0.5 h, then, the solvent was removed under vacuum to give the catalyst. In air, to the mixture of iminophosphonates (**1** or **3**, 0.20 mmol) and arylboronic acids (0.40 mmol) was added the above catalyst with 2,2,2-trifluoroethanol (4.0 mL). The solution was stirred at 70 °C for 12-48 h. The reaction mixture was cooled to room temperature, and the solvent was removed by rotary evaporation. Flash chromatography on silica gel using dichloromethane as the eluent gave the quaternary α-aminophosphonates products.

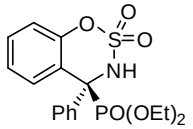
**(*S*)-(+)-Diisopropyl(2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2a):** 81 mg, 95% yield, 99.9% ee, $[\alpha]^{20}_D$ = +70.84 (*c* 1.66, $CHCl_3$), unknown compound, white solid, m.p. = 184-185 °C, $R_f$ = 0.30 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz,



$CDCl_3$) δ 7.87-7.66 (m, 3H), 7.48-7.18 (m, 6H), 7.12 (d, $J$ = 8.0 Hz, 1H), 4.80-4.60 (m, 1H), 4.60-4.40 (m, 1H), 1.27 (d, $J$ = 5.9 Hz, 3H), 1.22 (d, $J$ = 5.9 Hz, 3H), 1.15 (d, $J$ = 5.9 Hz, 3H), 0.86 (d, $J$ = 5.8 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.2 (d, $J_{PC}$ = 8.3 Hz), 137.4 (d, $J_{PC}$ = 0.9 Hz), 130.7 (d, $J_{PC}$ = 3.4 Hz), 130.3 (d, $J_{PC}$ = 1.8 Hz), 128.7 (d, $J_{PC}$ = 2.1 Hz), 128.5 (d, $J_{PC}$ = 5.5 Hz), 128.3 (d, $J_{PC}$ = 1.5 Hz), 124.8 (d, $J_{PC}$ = 2.2 Hz), 120.6 (d, $J_{PC}$ = 6.0 Hz), 119.9, 74.8 (d, $J_{PC}$ = 7.7 Hz), 74.1 (d, $J_{PC}$ = 7.8 Hz), 67.5 (d, $J_{PC}$ = 155.5 Hz), 24.5 (d, $J_{PC}$ = 2.3 Hz), 24.2 (d, $J_{PC}$ = 3.1 Hz), 23.5 (d, $J_{PC}$ = 5.8 Hz), 22.9 (d, $J_{PC}$ = 6.5 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.1. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 80/20, flow = 0.7 mL/min, retention time 18.7 min

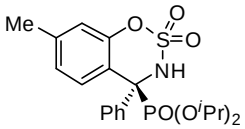
and 22.5 min (maj). HRMS Calculated for $C_{19}H_{25}NO_6PS$ $[M+H]^+$ 426.1135, found 426.1137.

**(*S*)-(+)-Diethyl(2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2b):** 77 mg, 97% yield, 99.8% ee, $[\alpha]^{20}_D$ = +62.09 (*c* 1.72, $CHCl_3$), unknown compound, white solid, m.p. = 168-169 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$)



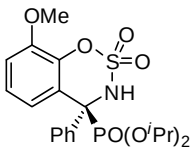
δ 7.81 (d, *J* = 8.0 Hz, 1H), 7.75-7.65 (m, 2H), 7.43 (t, *J* = 7.8 Hz, 1H), 7.40-7.32 (m, 3H), 7.32-7.27 (m, 1H), 7.15 (d, *J* = 8.2 Hz, 1H), 6.53 (s, 1H), 4.13-3.96 (m, 3H), 3.87-3.75 (m, 1H), 1.22 (t, *J* = 7.1 Hz, 3H), 1.13 (t, *J* = 7.1 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.2 (d, $J_{PC}$ = 8.3 Hz), 136.7 (d, $J_{PC}$ = 1.8 Hz), 130.6 (d, $J_{PC}$ = 3.5 Hz), 130.5 (d, $J_{PC}$ = 2.1 Hz), 128.9 (d, $J_{PC}$ = 2.1 Hz), 128.6 (d, $J_{PC}$ = 5.7 Hz), 128.5 (d, $J_{PC}$ = 2.1 Hz), 125.2 (d, $J_{PC}$ = 2.3 Hz), 121.2 (d, $J_{PC}$ = 4.9 Hz), 120.0 (d, $J_{PC}$ = 0.8 Hz), 67.5 (d, $J_{PC}$ = 154.2 Hz), 65.2 (d, $J_{PC}$ = 6.8 Hz), 65.1 (d, $J_{PC}$ = 6.8 Hz), 16.4 (d, $J_{PC}$ = 5.7 Hz), 16.3 (d, $J_{PC}$ = 5.4 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 16.7. HPLC: Chiralcel AS-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 9.8 min (maj) and 18.1 min. HRMS Calculated for $C_{17}H_{21}NO_6PS$ $[M+H]^+$ 398.0822, found 398.0824.

**(*S*)-(+)-Diisopropyl(7-methyl-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2c):** 78 mg, 89% yield, 99.9% ee, $[\alpha]^{20}_D$ = +57.59 (*c* 1.62, $CHCl_3$), unknown compound, white solid, m.p. = 173-174 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR



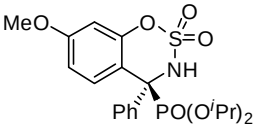
(400 MHz, $CDCl_3$) δ 7.74 (d, *J* = 7.0 Hz, 2H), 7.67 (d, *J* = 7.5 Hz, 1H), 7.40-7.28 (m, 3H), 7.08 (d, *J* = 8.0 Hz, 1H), 6.94 (s, 1H), 6.72 (s, 1H), 4.70-4.57 (m, 1H), 4.56-4.44 (m, 1H), 2.39 (s, 3H), 1.27 (d, *J* = 6.1 Hz, 3H), 1.23 (d, *J* = 6.1 Hz, 3H), 1.15 (d, *J* = 6.1 Hz, 3H), 0.89 (d, *J* = 6.1 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.1 (d, $J_{PC}$ = 8.3 Hz), 141.0 (d, $J_{PC}$ = 2.3 Hz), 137.4 (d, $J_{PC}$ = 1.2 Hz), 130.4 (d, $J_{PC}$ = 3.5 Hz), 128.7 (d, $J_{PC}$ = 2.1 Hz), 128.6 (d, $J_{PC}$ = 5.5 Hz), 128.3 (d, $J_{PC}$ = 1.7 Hz), 125.9 (d, $J_{PC}$ = 2.3 Hz), 120.1 (d, $J_{PC}$ = 0.8 Hz), 117.6 (d, $J_{PC}$ = 5.7 Hz), 74.5 (d, $J_{PC}$ = 7.8 Hz), 74.1 (d, $J_{PC}$ = 7.8 Hz), 67.3 (d, $J_{PC}$ = 155.3 Hz), 24.5 (d, $J_{PC}$ = 2.4 Hz), 24.3 (d, $J_{PC}$ = 3.0 Hz), 23.5 (d, $J_{PC}$ = 6.0 Hz), 23.1 (d, $J_{PC}$ = 6.3 Hz), 21.2; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 80/20, flow = 0.7 mL/min, retention time 14.1 min and 25.1 min (maj). HRMS Calculated for $C_{20}H_{27}NO_6PS$ $[M+H]^+$ 440.1291, found 440.1295.

**(*S*)-(+)-Diisopropyl(8-methoxy-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2d):** 81 mg, 89% yield, 99.9% ee, $[\alpha]^{20}_D$ = +77.53 (*c* 1.50, $CHCl_3$), unknown compound, white solid, m.p. = 206-207 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR



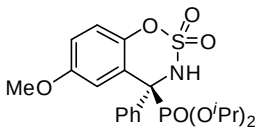
(400 MHz, $CDCl_3$) δ 7.76-7.70 (m, 2H), 7.45-7.39 (m, 1H), 7.39-7.30 (m, 3H), 7.20 (t, *J* = 8.2 Hz, 1H), 7.00 (d, *J* = 8.3 Hz, 1H), 6.58 (brs, 1H), 4.71-4.58 (m, 1H), 4.57-4.45 (m, 1H), 3.90 (s, 3H), 1.28 (d, *J* = 6.2 Hz, 3H), 1.24 (d, *J* = 6.2 Hz, 3H), 1.17 (d, *J* = 6.2 Hz, 3H), 0.88 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 149.80, 141.1 (d, $J_{PC}$ = 8.9 Hz), 137.2 (d, $J_{PC}$ = 1.9 Hz), 128.7 (d, $J_{PC}$ = 2.3 Hz), 128.6 (d, $J_{PC}$ = 5.5 Hz), 128.3 (d, $J_{PC}$ = 1.8 Hz), 124.5 (d, $J_{PC}$ = 2.2 Hz), 122.2 (d, $J_{PC}$ = 5.2 Hz), 121.7 (d, $J_{PC}$ = 3.4 Hz), 112.8 (d, $J_{PC}$ = 2.1 Hz), 74.7 (d, $J_{PC}$ = 7.7 Hz), 74.1 (d, $J_{PC}$ = 7.9 Hz), 67.8 (d, $J_{PC}$ = 155.2 Hz), 56.6, 24.5 (d, $J_{PC}$ = 2.4 Hz), 24.2 (d, $J_{PC}$ = 3.3 Hz), 23.6 (d, $J_{PC}$ = 5.8 Hz), 23.0 (d, $J_{PC}$ = 6.4 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.1. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 20.0 min and 36.6 min (maj). HRMS Calculated for $C_{20}H_{27}NO_7PS$ $[M+H]^+$ 456.1240, found 456.1239.

**(*S*)-(+)-Diisopropyl(7-methoxy-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2e):** 83 mg, 91% yield, 99.9% ee, $[\alpha]^{20}_{D}$ = +46.89 (*c* 1.74, $CHCl_3$), unknown compound, white solid, m.p. = 162-163 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR



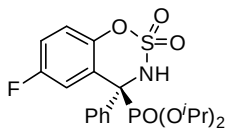

(400 MHz, $CDCl_3$) δ 7.74 (d, *J* = 6.6 Hz, 2H), 7.69 (d, *J* = 8.8 Hz, 1H), 7.39-7.28 (m, 3H), 6.88-6.79 (m, 1H), 6.77 (s, 1H), 6.65 (s, 1H), 4.71-4.57 (m, 1H), 4.57-4.42 (m, 1H), 3.84 (s, 3H), 1.27 (d, *J* = 6.1 Hz, 3H), 1.24 (d, *J* = 6.1 Hz, 3H), 1.17 (d, *J* = 6.1 Hz, 3H), 0.90 (d, *J* = 6.1 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 160.9 (d, $J_{PC}$ = 1.8 Hz), 152.1 (d, $J_{PC}$ = 8.2 Hz), 137.6, 131.4 (d, $J_{PC}$ = 3.3 Hz), 128.7 (d, $J_{PC}$ = 2.1 Hz), 128.5 (d, $J_{PC}$ = 5.5 Hz), 128.3 (d, $J_{PC}$ = 1.7 Hz), 112.1 (d, $J_{PC}$ = 6.0 Hz), 111.7 (d, $J_{PC}$ = 2.2 Hz), 104.5, 74.6 (d, $J_{PC}$ = 7.8 Hz), 74.1 (d, $J_{PC}$ = 7.8 Hz), 67.0 (d, $J_{PC}$ = 155.7 Hz), 55.9, 24.5 (d, $J_{PC}$ = 2.4 Hz), 24.3 (d, $J_{PC}$ = 3.1 Hz), 23.6 (d, $J_{PC}$ = 5.9 Hz), 23.1 (d, $J_{PC}$ = 6.3 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 12.7 min and 25.5 min (maj). HRMS Calculated for $C_{20}H_{27}NO_7PS$ $[M+H]^+$ 456.1240, found 456.1244.

**(*S*)-(+)-Diisopropyl(6-methoxy-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2f):** 78 mg, 86% yield, 99.5% ee, $[\alpha]^{20}_{D}$ = +81.46 (*c* 1.50, $CHCl_3$), unknown compound, white solid, m.p. = 164-165 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR




(400 MHz, $CDCl_3$) δ 7.80-7.72 (m, 2H), 7.40-7.31 (m, 4H), 7.06 (d, *J* = 9.0 Hz, 1H), 6.98-6.91 (m, 1H), 6.63 (s, 1H), 4.66-4.51 (m, 2H), 3.80 (s, 3H), 1.29 (d, *J* = 6.2 Hz, 3H), 1.23 (d, *J* = 6.1 Hz, 3H), 1.16 (d, *J* = 6.2 Hz, 3H), 0.95 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 156.3 (d, $J_{PC}$ = 2.5 Hz), 145.0 (d, $J_{PC}$ = 8.5 Hz), 137.0 (d, $J_{PC}$ = 1.6 Hz), 128.8 (d, $J_{PC}$ = 2.2 Hz), 128.6 (d, $J_{PC}$ = 5.5 Hz), 128.4 (d, $J_{PC}$ = 1.7 Hz), 122.0 (d, $J_{PC}$ = 5.6 Hz), 120.6 (d, $J_{PC}$ = 0.8 Hz), 116.1 (d, $J_{PC}$ = 2.1 Hz), 115.2 (d, $J_{PC}$ = 3.4 Hz), 74.5 (d, $J_{PC}$ = 7.9 Hz), 74.3 (d, $J_{PC}$ = 7.7 Hz), 67.6 (d, $J_{PC}$ = 155.0 Hz), 56.0, 24.5 (d, $J_{PC}$ = 2.6 Hz), 24.3 (d, $J_{PC}$ = 3.1 Hz), 23.5 (d, $J_{PC}$ = 6.0 Hz), 23.1 (d, $J_{PC}$ = 6.2 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.1. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 12.9 min and 16.3 min (maj). HRMS Calculated for $C_{20}H_{27}NO_7PS$ $[M+H]^+$ 456.1240, found 456.1242.

**(*S*)-(+)-Diisopropyl(6-fluoro-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2g):** 82 mg, 92% yield, 99.9% ee, $[\alpha]^{20}_{D}$ = +71.56 (*c* 1.60, $CHCl_3$), unknown compound, white solid, m.p. = 142-143 °C, $R_f$ = 0.60 (dichloromethane/methanol 80/1). $^1$H NMR



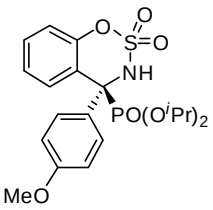

(400 MHz, $CDCl_3$) δ 7.75 (d, *J* = 3.3 Hz, 2H), 7.47 (d, *J* = 9.4 Hz, 1H), 7.42-7.32 (m, 3H), 7.20-7.05 (m, 2H), 4.82-4.65 (m, 1H), 4.64-4.46 (m, 1H), 1.28 (d, *J* = 6.2 Hz, 3H), 1.22 (d, *J* = 6.1 Hz, 3H), 1.17 (d, *J* = 6.2 Hz, 3H), 0.91 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 158.7 (dd, $J_{FC}$ = 244.6 Hz, $J_{PC}$ = 2.8 Hz), 147.2 (dd, $J_{PC}$ = 8.0 Hz, $J_{FC}$ = 2.6 Hz), 137.2, 128.9 (d, $J_{PC}$ = 1.9 Hz), 128.5 (d, $J_{PC}$ = 1.5 Hz), 128.4 (d, $J_{PC}$ = 5.7 Hz), 122.6, 121.1 (d, $J_{FC}$ = 8.8 Hz), 117.3 (d, $J_{FC}$ = 29.5 Hz), 117.3 (d, $J_{FC}$ = 22.8 Hz), 75.1 (d, $J_{PC}$ = 7.8 Hz), 74.4 (d, $J_{PC}$ = 7.8 Hz), 67.5 (d, $J_{PC}$ = 156.6 Hz), 24.3 (d, $J_{PC}$ = 2.5 Hz), 24.2 (d, $J_{PC}$ = 3.2 Hz), 23.5 (d, $J_{PC}$ = 5.8 Hz), 23.0 (d, $J_{PC}$ = 6.3 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ -115.8; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 80/20, flow = 0.7 mL/min, retention time 19.4 min and 24.2 min (maj). HRMS Calculated for $C_{19}H_{24}FNO_6PS$ $[M+H]^+$ 444.1040, found 444.1045.

**(*S*)-(+)-Diisopropyl(6-chloro-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2h):** 82 mg, 89% yield, 99.9% ee, $[\alpha]^{20}_{D}$ = +65.79 (*c* 1.64, $CHCl_3$), unknown compound, white solid, m.p. = 190-191 °C, $R_f$ = 0.40 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.84-7.64 (m, 3H), 7.45-7.29 (m, 5H), 7.08 (d, *J* = 8.7 Hz, 1H), 4.78-4.64 (m, 1H), 4.62-4.47 (m, 1H), 1.29 (d, *J* = 6.1 Hz, 3H), 1.22 (d, *J* = 6.1 Hz, 3H), 1.18 (d, *J* = 6.2 Hz, 3H), 0.94 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 149.8 (d, $J_{PC}$ = 8.2 Hz), 136.9, 130.4 (d, $J_{PC}$ = 3.4 Hz), 130.3 (d, $J_{PC}$ = 2.1 Hz), 130.2 (d, $J_{PC}$ = 2.7 Hz), 129.0 (d, $J_{PC}$ = 2.0 Hz), 128.5 (d, $J_{PC}$ = 1.5 Hz), 128.4 (d, $J_{PC}$ = 5.5 Hz), 122.6 (d, $J_{PC}$ = 6.2 Hz), 121.1, 75.0 (d, $J_{PC}$ = 7.8 Hz), 74.4 (d, $J_{PC}$ = 7.8 Hz), 67.4 (d, $J_{PC}$ = 155.8 Hz), 24.3 (d, $J_{PC}$ = 2.7 Hz), 24.2 (d, $J_{PC}$ = 3.2 Hz), 23.5 (d, $J_{PC}$ = 5.8 Hz), 23.1 (d, $J_{PC}$ = 6.1 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.4. HPLC: Chiralcel AS-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 95/5, flow = 0.7 mL/min, retention time 17.2 min (maj) and 22.6 min. HRMS Calculated for $C_{19}H_{24}ClNO_6PS$ $[M+H]^+$ 460.0745, found 460.0748.

**(*S*)-(+)-Diisopropyl(6-bromo-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2i):** 74 mg, 73% yield, 99.9% ee, $[\alpha]^{20}_{D}$ = +65.00 (*c* 1.48, $CHCl_3$), unknown compound, white solid, m.p. = 192-193 °C, $R_f$ = 0.30 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.91 (s, 1H), 7.71 (d, *J* = 5.0 Hz, 2H), 7.53 (d, *J* = 8.6 Hz, 1H), 7.45-7.32 (m, 3H), 7.02 (d, *J* = 8.7 Hz, 1H), 4.78-4.63 (m, 1H), 4.62-4.46 (m, 1H), 1.29 (d, *J* = 6.1 Hz, 3H), 1.22 (d, *J* = 6.1 Hz, 3H), 1.18 (d, *J* = 6.1 Hz, 3H), 0.95 (d, *J* = 6.1 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 150.4 (d, $J_{PC}$ = 7.9 Hz), 136.8 (d, $J_{PC}$ = 1.4 Hz), 133.3 (d, $J_{PC}$ = 3.3 Hz), 133.2 (d, $J_{PC}$ = 2.0 Hz), 129.0 (d, $J_{PC}$ = 1.9 Hz), 128.6 (d, $J_{PC}$ = 1.4 Hz), 128.5 (d, $J_{PC}$ = 5.5 Hz), 123.0 (d, $J_{PC}$ = 6.2 Hz), 121.5, 117.6 (d, $J_{PC}$ = 2.9 Hz), 75.0 (d, $J_{PC}$ = 8.0 Hz), 74.5 (d, $J_{PC}$ = 7.8 Hz), 67.3 (d, $J_{PC}$ = 155.6 Hz), 24.3 (d, $J_{PC}$ = 2.8 Hz), 24.2 (d, $J_{PC}$ = 3.2 Hz), 23.6 (d, $J_{PC}$ = 5.8 Hz), 23.1 (d, $J_{PC}$ = 6.1 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 80/20, flow = 0.7 mL/min, retention time 21.1 min (maj) and 25.3 min. HRMS Calculated for $C_{19}H_{24}BrNO_6PS$ $[M+H]^+$ 504.0240, found 504.0244.

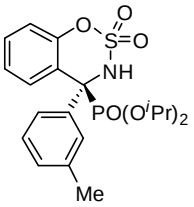
**(*S*)-(+)-Diisopropyl(2,2-dioxido-4-(*p*-tolyl)-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2j):** 78 mg, 89% yield, 99.0% ee, $[\alpha]^{20}_{D}$ = +59.77 (*c* 1.74, $CHCl_3$), unknown compound, white solid, m.p. = 150-151 °C, $R_f$ = 0.60 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, *J* = 8.0 Hz, 1H), 7.60 (d, *J* = 6.8 Hz, 2H), 7.41 (t, *J* = 7.8 Hz, 1H), 7.30-7.22 (m, 1H), 7.18-7.09 (m, 3H), 6.57 (brs, 1H), 4.68-4.58 (m, 1H), 4.56-4.46 (m, 1H), 2.33 (s, 3H), 1.27 (d, *J* = 6.2 Hz, 3H), 1.23 (d, *J* = 6.1 Hz, 3H), 1.17 (d, *J* = 6.2 Hz, 3H), 0.89 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.3 (d, $J_{PC}$ = 8.3 Hz), 138.6 (d, $J_{PC}$ = 2.4 Hz), 134.2 (d, $J_{PC}$ = 1.6 Hz), 130.7 (d, $J_{PC}$ = 3.5 Hz), 130.3 (d, $J_{PC}$ = 2.0 Hz), 129.1 (d, $J_{PC}$ = 1.7 Hz), 128.5 (d, $J_{PC}$ = 5.6 Hz), 125.0 (d, $J_{PC}$ = 2.3 Hz), 121.0 (d, $J_{PC}$ = 5.6 Hz), 119.9 (d, $J_{PC}$ = 0.8 Hz), 74.5 (d, $J_{PC}$ = 7.7 Hz), 74.1 (d, $J_{PC}$ = 7.8 Hz), 67.4 (d, $J_{PC}$ = 155.2 Hz), 24.5 (d, $J_{PC}$ = 2.5 Hz), 24.3 (d, $J_{PC}$ = 3.0 Hz), 23.6 (d, $J_{PC}$ = 6.0 Hz), 23.0 (d, $J_{PC}$ = 6.3 Hz), 21.3; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 60/40, flow = 0.6 mL/min, retention time 14.2 min and 44.4 min (maj). HRMS Calculated for $C_{20}H_{27}NO_6PS$ $[M+H]^+$ 440.1291, found 440.1291.

**(*S*)-(+)-Diisopropyl(4-(4-methoxyphenyl)-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2k):** 82 mg, 90% yield, 99.7% ee, $[\alpha]^{20}_{D}$ = +63.08 (*c* 1.62, $CHCl_3$), unknown compound, white solid, m.p. = 172-173 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR



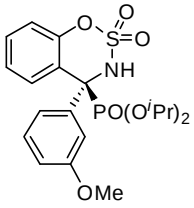

(400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 7.5 Hz, 1H), 7.64 (d, *J* = 7.9 Hz, 2H), 7.41 (t, *J* = 7.3 Hz, 1H), 7.30-7.22 (m, 1H), 7.12 (d, *J* = 7.9 Hz, 1H), 6.86 (d, *J* = 8.4 Hz, 2H), 6.74 (brs, 1H), 4.75-4.60 (m, 1H), 4.60-4.40 (m, 1H), 3.80 (s, 3H), 1.27 (d, *J* = 5.9 Hz, 3H), 1.24 (d, *J* = 5.9 Hz, 3H), 1.18 (d, *J* = 5.9 Hz, 3H), 0.89 (d, *J* = 5.9 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 159.8 (d, $J_{PC}$ = 1.9 Hz), 151.3 (d, $J_{PC}$ = 8.3 Hz), 130.6 (d, $J_{PC}$ = 3.4 Hz), 130.3 (d, $J_{PC}$ = 1.9 Hz), 129.9 (d, $J_{PC}$ = 5.6 Hz), 129.2 (d, $J_{PC}$ = 1.6 Hz), 124.9 (d, $J_{PC}$ = 2.2 Hz), 121.0 (d, $J_{PC}$ = 5.5 Hz), 119.9, 113.7 (d, $J_{PC}$ = 1.4 Hz), 74.6 (d, $J_{PC}$ = 7.8 Hz), 74.0 (d, $J_{PC}$ = 7.9 Hz), 67.2 (d, $J_{PC}$ = 156.4 Hz), 55.4, 24.5 (d, $J_{PC}$ = 2.3 Hz), 24.3 (d, $J_{PC}$ = 3.2 Hz), 23.6 (d, $J_{PC}$ = 5.8 Hz), 23.1 (d, $J_{PC}$ = 6.3 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.2. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 60/40, flow = 0.6 mL/min, retention time 17.1 min and 53.3 min (maj). HRMS Calculated for $C_{20}H_{27}NO_7PS$ $[M+H]^+$ 456.1240, found 456.1242.

**(*S*)-(+)-Diisopropyl(2,2-dioxido-4-(*m*-tolyl)-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2l):** 71 mg, 81% yield, 99.9% ee, $[\alpha]^{20}_{D}$ = +70.56 (*c* 1.42, $CHCl_3$), unknown compound, white solid, m.p. = 180-181 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz,




$CDCl_3$) δ 7.86-7.80 (m, 1H), 7.56-7.49 (m, 2H), 7.46-7.37 (m, 1H), 7.31-7.19 (m, 2H), 7.13 (t, *J* = 7.2 Hz, 2H), 6.82 (brs, 1H), 4.74-4.59 (m, 1H), 4.57-4.42 (m, 1H), 2.33 (s, 3H), 1.28 (d, *J* = 6.2 Hz, 3H), 1.23 (d, *J* = 6.2 Hz, 3H), 1.16 (d, *J* = 6.2 Hz, 3H), 0.86 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.3 (d, $J_{PC}$ = 8.4 Hz), 137.9 (d, $J_{PC}$ = 1.8 Hz), 137.0 (d, $J_{PC}$ = 1.8 Hz), 130.7 (d, $J_{PC}$ = 3.5 Hz), 130.2 (d, $J_{PC}$ = 2.0 Hz), 129.5 (d, $J_{PC}$ = 2.2 Hz), 129.1 (d, $J_{PC}$ = 5.5 Hz), 128.2 (d, $J_{PC}$ = 1.7 Hz), 125.7 (d, $J_{PC}$ = 5.4 Hz), 124.8 (d, $J_{PC}$ = 2.2 Hz), 120.8 (d, $J_{PC}$ = 5.8 Hz), 119.9, 74.7 (d, $J_{PC}$ = 7.8 Hz), 74.0 (d, $J_{PC}$ = 7.9 Hz), 67.5 (d, $J_{PC}$ = 154.7 Hz), 24.5 (d, $J_{PC}$ = 2.2 Hz), 24.2 (d, $J_{PC}$ = 3.2 Hz), 23.6 (d, $J_{PC}$ = 5.9 Hz), 22.9 (d, $J_{PC}$ = 6.5 Hz), 21.8; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.2. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 60/40, flow = 0.6 mL/min, retention time 10.5 min (maj) and 13.9 min. HRMS Calculated for $C_{20}H_{27}NO_6PS$ $[M+H]^+$ 440.1291, found 440.1295.

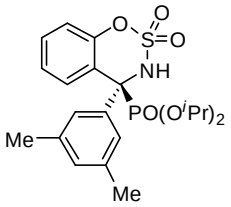
**(*S*)-(+)-Diisopropyl(4-(3-methoxyphenyl)-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2m):** 84 mg, 92% yield, 99.9% ee, $[\alpha]^{20}_{D}$ = +61.01 (*c* 1.68, $CHCl_3$), unknown compound, white solid, m.p. = 129-130 °C, $R_f$ = 0.40 (dichloromethane/methanol 80/1). $^1$H NMR




(400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.0 Hz, 1H), 7.34-7.29 (m, 1H), 7.29-7.23 (m, 2H), 7.27 (d, *J* = 6.6 Hz, 2H), 7.13 (d, *J* = 8.2 Hz, 1H), 6.87 (d, *J* = 7.9 Hz, 1H), 6.26 (brs, 1H), 4.70-4.58 (m, 1H), 4.56-4.43 (m, 1H), 3.77 (s, 3H), 1.28 (d, *J* = 6.2 Hz, 3H), 1.25 (d, *J* = 6.2 Hz, 3H), 1.17 (d, *J* = 6.2 Hz, 3H), 0.88 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 159.5 (d, $J_{PC}$ = 1.3 Hz), 151.2 (d, $J_{PC}$ = 8.2 Hz), 138.9 (d, $J_{PC}$ = 0.8 Hz), 130.6 (d, $J_{PC}$ = 3.5 Hz), 130.3 (d, $J_{PC}$ = 1.9 Hz), 129.3 (d, $J_{PC}$ = 1.7 Hz), 124.9 (d, $J_{PC}$ = 2.1 Hz), 120.9 (d, $J_{PC}$ = 5.2 Hz), 120.6 (d, $J_{PC}$ = 5.9 Hz), 119.8, 114.8 (d, $J_{PC}$ = 5.8 Hz), 113.9 (d, $J_{PC}$ = 1.9 Hz), 74.8 (d, $J_{PC}$ = 7.7 Hz), 74.1 (d, $J_{PC}$ = 7.9 Hz), 67.5 (d, $J_{PC}$ = 155.0 Hz), 55.40, 24.5 (d, $J_{PC}$ = 2.3 Hz), 24.2 (d, $J_{PC}$ = 3.2 Hz), 23.6 (d, $J_{PC}$ = 5.7 Hz), 23.0 (d, $J_{PC}$ = 6.5 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.1. HPLC: Chiralcel AD-H column, 220 nm, 30 °C,

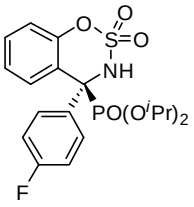
*n*-hexane/*i*-propanol = 60/40, flow = 0.6 mL/min, retention time 13.7 min (maj) and 20.7 min. HRMS Calculated for $C_{20}H_{27}NO_7PS$ $[M+H]^+$ 456.1240, found 456.1244.

**(*S*)-(+)-Diisopropyl(4-(3,5-dimethylphenyl)-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2n):** 82 mg, 90% yield, 99.6% ee, $[\alpha]^{20}_D$ = +70.42 (*c* 1.64, $CHCl_3$), unknown compound, white solid, m.p. = 200-201 °C, $R_f$ = 0.60 (dichloromethane/methanol 80/1).



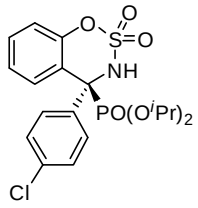

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.0 Hz, 1H), 7.41 (t, *J* = 7.8 Hz, 1H), 7.32-7.23 (m, 3H), 7.11 (d, *J* = 8.2 Hz, 1H), 6.94 (s, 1H), 4.70-4.56 (m, 1H), 4.55-4.41 (m, 1H), 2.27 (s, 6H), 1.27 (d, *J* = 6.2 Hz, 3H), 1.23 (d, *J* = 6.2 Hz, 3H), 1.17 (d, *J* = 6.2 Hz, 3H), 0.85 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.2 (d, $J_{PC}$ = 8.4 Hz), 137.7 (d, $J_{PC}$ = 1.8 Hz), 136.7 (d, $J_{PC}$ = 2.0 Hz), 130.7 (d, $J_{PC}$ = 3.5 Hz), 130.5 (d, $J_{PC}$ = 2.2 Hz), 130.2 (d, $J_{PC}$ = 2.0 Hz), 126.3 (d, $J_{PC}$ = 5.5 Hz), 124.8 (d, $J_{PC}$ = 2.2 Hz), 120.9 (d, $J_{PC}$ = 5.2 Hz), 119.8, 74.6 (d, $J_{PC}$ = 7.7 Hz), 73.9 (d, $J_{PC}$ = 7.9 Hz), 67.5 (d, $J_{PC}$ = 154.3 Hz), 24.5 (d, $J_{PC}$ = 2.1 Hz), 24.2 (d, $J_{PC}$ = 3.1 Hz), 23.5 (d, $J_{PC}$ = 6.0 Hz), 22.9 (d, $J_{PC}$ = 6.5 Hz), 21.7; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 60/40, flow = 0.6 mL/min, retention time 7.2 min (maj) and 12.9 min. HRMS Calculated for $C_{21}H_{29}NO_6PS$ $[M+H]^+$ 454.1448, found 454.1450.

**(*S*)-(+)-Diisopropyl(4-(4-fluorophenyl)-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2o):** 85 mg, 96% yield, 99.9% ee, $[\alpha]^{20}_D$ = +63.48 (*c* 1.78, $CHCl_3$), unknown compound, white solid, m.p. = 186-187 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR




(400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 7.8 Hz, 1H), 7.77-7.66 (m, 2H), 7.44 (t, *J* = 7.6 Hz, 1H), 7.30 (d, *J* = 7.7 Hz, 1H), 7.15 (d, *J* = 8.2 Hz, 1H), 7.03 (t, *J* = 8.4 Hz, 2H), 6.14 (brs, 1H), 4.71-4.57 (m, 1H), 4.55-4.42 (m, 1H), 1.36-1.22 (m, 6H), 1.19 (d, *J* = 6.1 Hz, 3H), 0.89 (d, *J* = 6.1 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 162.9 (dd, $J_{FC}$ = 248.7, $J_{PC}$ = 2.2 Hz), 151.3 (d, $J_{PC}$ = 8.2 Hz), 133.3, 130.7, 130.6 (d, $J_{PC}$ = 2.7 Hz), 130.5 (d, $J_{PC}$ = 3.6 Hz), 125.0, 120.5 (d, $J_{PC}$ = 5.9 Hz), 120.0, 115.2 (d, $J_{PC}$ = 22.8 Hz), 74.9 (d, $J_{PC}$ = 7.8 Hz), 74.2 (d, $J_{PC}$ = 7.9 Hz), 67.0 (d, $J_{PC}$ = 156.0 Hz), 24.4 (d, $J_{PC}$ = 2.4 Hz), 24.2 (d, $J_{PC}$ = 3.3 Hz), 23.6 (d, $J_{PC}$ = 5.7 Hz), 23.1 (d, $J_{PC}$ = 6.3 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ -113.3 (d, $J_{PF}$ = 3.4 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.8. HPLC: Chiralcel OJ-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 95/5, flow = 0.6 mL/min, retention time 13.1 min and 17.5 min (maj). HRMS Calculated for $C_{19}H_{24}FNO_6PS$ $[M+H]^+$ 444.1040, found 444.1040.

**(*S*)-(+)-Diisopropyl(4-(4-chlorophenyl)-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (2p):** 79 mg, 86% yield, 99.9% ee, $[\alpha]^{20}_D$ = +50.63 (*c* 1.58, $CHCl_3$), unknown compound, white solid, m.p. = 186-187 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR




(400 MHz, $CDCl_3$) δ 7.81-7.73 (m, 1H), 7.71-7.63 (m, 2H), 7.47-7.38 (m, 1H), 7.35-7.27 (m, 3H), 7.13 (d, *J* = 8.2 Hz, 1H), 4.79-4.60 (m, 1H), 4.60-4.40 (m, 1H), 1.28 (d, *J* = 6.2 Hz, 3H), 1.23 (d, *J* = 6.2 Hz, 3H), 1.18 (d, *J* = 6.2 Hz, 3H), 0.91 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.3 (d, $J_{PC}$ = 8.2 Hz), 136.1 (d, $J_{PC}$ = 1.6 Hz), 134.9 (d, $J_{PC}$ = 2.6 Hz), 130.6 (d, $J_{PC}$ = 2.0 Hz), 130.5 (d, $J_{PC}$ = 3.5 Hz), 130.0 (d, $J_{PC}$ = 5.5 Hz), 128.5 (d, $J_{PC}$ = 1.7 Hz), 125.0 (d, $J_{PC}$ = 2.2 Hz), 120.2 (d, $J_{PC}$ = 5.9 Hz), 120.0, 75.0 (d, $J_{PC}$ = 7.9 Hz), 74.3 (d, $J_{PC}$ = 7.9 Hz), 67.0 (d, $J_{PC}$ = 155.3 Hz), 24.4 (d, $J_{PC}$ = 2.5 Hz), 24.2 (d, $J_{PC}$ = 3.3 Hz), 23.6 (d, $J_{PC}$ = 5.7 Hz), 23.1 (d, $J_{PC}$ = 6.3 Hz);

$^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.6. HPLC: Chiralcel IC-H column, 220 nm, 30 °C, *n*-hexane/ *i*-propanol = 90/10, flow = 0.7 mL/min, retention time 16.6 min and 22.2 min (maj). HRMS Calculated for $C_{19}H_{24}ClNO_6PS$ $[M+H]^+$ 460.0745, found 460.0742.

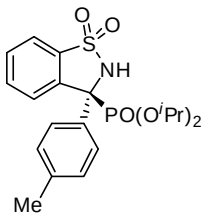
**(*S*)-(+)-Diisopropyl(4-(4-bromophenyl)-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4 -yl)phosphonate (2q):** 92 mg, 91% yield, 99.9% ee, $[\alpha]^{20}_D$ = +46.03 (*c* 1.84, $CHCl_3$), unknown compound, white solid, m.p. = 192-193 °C, $R_f$ = 0.70 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.84-7.62 (m, 3H), 7.42 (t, *J* = 7.7 Hz, 1H), 7.31-7.24 (m, 2H), 7.13 (d, *J* = 8.2 Hz, 1H), 7.03 (t, *J* = 8.5 Hz, 2H), 4.78-4.64 (m, 1H), 4.58-4.44 (m, 1H), 1.28 (d, *J* = 6.1 Hz, 3H), 1.22 (d, *J* = 6.1 Hz, 3H), 1.17 (d, *J* = 6.1 Hz, 3H), 0.90 (d, *J* = 6.1 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.2 (d, $J_{PC}$ = 8.2 Hz), 136.8 (d, $J_{PC}$ = 1.1 Hz), 131.5 (d, $J_{PC}$ = 1.6 Hz), 130.5 (d, $J_{PC}$ = 2.0 Hz), 130.5 (d, $J_{PC}$ = 3.4 Hz), 130.3 (d, $J_{PC}$ = 5.5 Hz), 125.0 (d, $J_{PC}$ = 2.2 Hz), 123.1 (d, $J_{PC}$ = 2.7 Hz), 120.1 (d, $J_{PC}$ = 6.0 Hz), 120.0, 75.0 (d, $J_{PC}$ = 7.8 Hz), 74.3 (d, $J_{PC}$ = 7.9 Hz), 67.1 (d, $J_{PC}$ = 155.8 Hz), 24.4 (d, $J_{PC}$ = 2.5 Hz), 24.2 (d, $J_{PC}$ = 3.3 Hz), 23.6 (d, $J_{PC}$ = 5.8 Hz), 23.1 (d, $J_{PC}$ = 6.3 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.5. HPLC: Chiralcel IA-H column, 230 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 12.0 min and 19.2 min (maj). HRMS Calculated for $C_{19}H_{24}BrNO_6PS$ $[M+H]^+$ 504.0240, found 504.0246.

**(*S*)-(+)-Diisopropyl(4-([1,1'-biphenyl]-4-yl)-2,2-dioxido-3,4-dihydrobenzo[*e*][1,2,3]oxathiaz in-4-yl)phosphonate (2r):** 95 mg, 95% yield, 99.2% ee, $[\alpha]^{20}_D$ = +51.00 (*c* 2.00, $CHCl_3$), unknown compound, white solid, m.p. = 172-173 °C, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.81 (t, *J* = 7.9 Hz, 3H), 7.57 (t, *J* = 7.7 Hz, 5H), 7.45-7.36 (m, 3H), 7.36-7.23 (m, 2H), 7.13 (d, *J* = 8.2 Hz, 1H), 4.81-4.68 (m, 1H), 4.61-4.47 (m, 1H), 1.27 (d, *J* = 6.1 Hz, 3H), 1.24 (d, *J* = 6.1 Hz, 3H), 1.18 (d, *J* = 6.1 Hz, 3H), 0.89 (d, *J* = 6.1 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 151.2 (d, $J_{PC}$ = 8.1 Hz), 141.3 (d, $J_{PC}$ = 2.0 Hz), 140.4, 136.6, 130.7 (d, $J_{PC}$ = 3.3 Hz), 130.3 (d, $J_{PC}$ = 1.3 Hz), 129.0, 129.0, 127.7, 127.2, 126.9 (d, $J_{PC}$ = 1.3 Hz), 124.9 (d, $J_{PC}$ = 1.7 Hz), 120.6 (d, $J_{PC}$ = 6.0 Hz), 119.9, 74.9 (d, $J_{PC}$ = 7.8 Hz), 74.2 (d, $J_{PC}$ = 7.8 Hz), 67.4 (d, $J_{PC}$ = 156.2 Hz), 24.4, 24.3 (d, $J_{PC}$ = 3.1 Hz), 23.6 (d, $J_{PC}$ = 5.9 Hz), 23.0 (d, $J_{PC}$ = 6.5 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.9. HPLC: Chiralcel AD-H column, 254 nm, 30 °C, *n*-hexane/ *i*-propanol = 60/40, flow = 0.6 mL/min, retention time 16.5 min and 36.7 min (maj). HRMS Calculated for $C_{25}H_{29}NO_6PS$ $[M+H]^+$ 502.1448, found 502.1450.

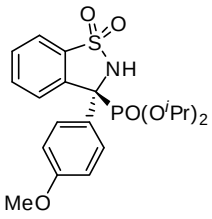
**(*S*)-(-)-Diisopropyl(1,1-dioxido-3-phenyl-2,3-dihydrobenzo[*d*]isothiazol-3-yl)phosphonate (4a):** 80 mg, 98% yield, 99.0% ee, $[\alpha]^{20}_D$ = -12.62 (*c* 1.60, $CHCl_3$), unknown compound, white solid, m.p. = 181-182 °C, $R_f$ = 0.30 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.98-7.88 (m, 3H), 7.77 (d, *J* = 7.7 Hz, 1H), 7.64 (t, *J* = 7.6 Hz, 1H), 7.56 (t, *J* = 7.5 Hz, 1H), 7.38-7.27 (m, 3H), 6.19 (brs, 1H), 4.74-4.60 (m, 1H), 4.56-4.37 (m, 1H), 1.27 (d, *J* = 6.2 Hz, 6H), 0.99 (d, *J* = 6.2 Hz, 3H), 0.82 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 137.4 (d, $J_{PC}$ = 1.9 Hz), 137.3 (d, $J_{PC}$ = 4.3 Hz), 134.9 (d, $J_{PC}$ = 5.8 Hz), 133.1 (d, $J_{PC}$ = 2.2 Hz), 130.0 (d, $J_{PC}$ = 1.9 Hz), 128.8 (d, $J_{PC}$ = 1.0 Hz), 128.6 (d, $J_{PC}$ = 1.6 Hz), 127.3 (d, $J_{PC}$ = 5.3 Hz), 127.0 (d, $J_{PC}$ = 2.9 Hz), 121.5 (d, $J_{PC}$ = 0.9 Hz), 74.1 (d, $J_{PC}$ = 7.6 Hz), 73.8 (d, $J_{PC}$ = 7.5 Hz), 67.0 (d, $J_{PC}$ = 159.5 Hz), 24.5 (d, $J_{PC}$ = 2.6 Hz), 24.3 (d, $J_{PC}$ = 2.9 Hz), 23.3 (d, $J_{PC}$ = 6.2 Hz), 23.0 (d, $J_{PC}$ = 5.8 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.2. HPLC: Chiralcel AD-H column, 220 nm, 30 °C,

*n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 14.6 min (maj) and 19.6 min. HRMS Calculated for $C_{19}H_{25}NO_5PS$ $[M+H]^+$ 410.1186, found 410.1186.

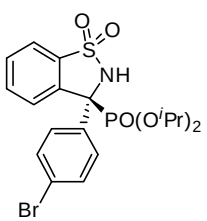
**(*S*)-(-)-Diisopropyl(1,1-dioxido-3-(*p*-tolyl)-2,3-dihydrobenzo[*d*]isothiazol-3-yl)phosphonate (4b):** 83 mg, 98% yield, 99.4% ee, $[\alpha]^{20}_D$ = -13.19 (*c* 1.66, $CHCl_3$), unknown compound, colorless oil, $R_f$ = 0.40 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.0 Hz, 1H), 7.84-7.71 (m, 3H), 7.68-7.59 (m, 1H), 7.55 (t, *J* = 7.5 Hz, 1H), 7.12 (d, *J* = 8.2 Hz, 2H), 6.10 (brs, 1H), 4.78-4.59 (m, 1H), 4.54-4.39 (m, 1H), 2.30 (s, 3H), 1.27 (d, *J* = 6.2 Hz, 6H), 1.01 (d, *J* = 6.2 Hz, 3H), 0.83 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 138.4 (d, $J_{PC}$ = 1.7 Hz), 137.6 (d, $J_{PC}$ = 5.1 Hz), 134.8 (d, $J_{PC}$ = 5.7 Hz), 134.4 (d, $J_{PC}$ = 3.0 Hz), 133.1 (d, $J_{PC}$ = 2.1 Hz), 129.9 (d, $J_{PC}$ = 1.9 Hz), 129.5 (d, $J_{PC}$ = 0.9 Hz), 127.1 (d, $J_{PC}$ = 5.4 Hz), 127.0 (d, $J_{PC}$ = 2.9 Hz), 121.5 (d, $J_{PC}$ = 0.9 Hz), 74.0 (d, $J_{PC}$ = 7.6 Hz), 73.7 (d, $J_{PC}$ = 7.5 Hz), 66.9 (d, $J_{PC}$ = 159.9 Hz), 24.5 (d, $J_{PC}$ = 2.7 Hz), 24.4 (d, $J_{PC}$ = 2.8 Hz), 23.4 (d, $J_{PC}$ = 6.2 Hz), 23.0 (d, $J_{PC}$ = 5.8 Hz), 21.2; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 19.7 min (maj) and 25.3 min. HRMS Calculated for $C_{20}H_{27}NO_5PS$ $[M+H]^+$ 424.1342, found 424.1335.




**(*S*)-(-)-Diisopropyl(3-(4-methoxyphenyl)-1,1-dioxido-2,3-dihydrobenzo[*d*]isothiazol-3-yl)phosphonate (4c):** 85 mg, 97% yield, 98.5% ee, $[\alpha]^{20}_D$ = -4.82 (*c* 1.70, $CHCl_3$), unknown compound, colorless oil, $R_f$ = 0.50 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.9 Hz, 1H), 7.84-7.72 (m, 3H), 7.69-7.60 (m, 1H), 7.55 (t, *J* = 7.5 Hz, 1H), 6.83 (d, *J* = 8.9 Hz, 2H), 6.18 (brs, 1H), 4.78-4.59 (m, 1H), 4.56-4.37 (m, 1H), 3.75 (s, 3H), 1.27 (d, *J* = 6.1 Hz, 3H), 1.26 (d, *J* = 6.2 Hz, 3H), 1.02 (d, *J* = 6.2 Hz, 3H), 0.84 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 159.7 (d, $J_{PC}$ = 1.4 Hz), 137.6 (d, $J_{PC}$ = 5.0 Hz), 134.9 (d, $J_{PC}$ = 5.7 Hz), 133.1 (d, $J_{PC}$ = 2.1 Hz), 129.9 (d, $J_{PC}$ = 1.9 Hz), 129.4 (d, $J_{PC}$ = 3.0 Hz), 128.7 (d, $J_{PC}$ = 5.4 Hz), 126.9 (d, $J_{PC}$ = 2.8 Hz), 121.5 (d, $J_{PC}$ = 0.6 Hz), 114.1 (d, $J_{PC}$ = 0.5 Hz), 74.1 (d, $J_{PC}$ = 7.6 Hz), 73.7 (d, $J_{PC}$ = 7.6 Hz), 66.7 (d, $J_{PC}$ = 160.9 Hz), 55.4, 24.5 (d, $J_{PC}$ = 2.6 Hz), 24.3 (d, $J_{PC}$ = 2.9 Hz), 23.4 (d, $J_{PC}$ = 6.2 Hz), 23.1 (d, $J_{PC}$ = 5.8 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.4. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 23.5 min (maj) and 31.2 min. HRMS Calculated for $C_{20}H_{27}NO_6PS$ $[M+H]^+$ 440.1291, found 440.1291.

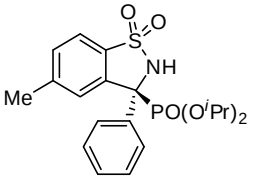



**(*S*)-(-)-Diisopropyl(3-(4-bromophenyl)-1,1-dioxido-2,3-dihydrobenzo[*d*]isothiazol-3-yl)phosphonate (4d):** 93 mg, 95% yield, 99.5% ee, $[\alpha]^{20}_D$ = -14.03 (*c* 1.86, $CHCl_3$), unknown compound, white solid, m.p. = 169-170 °C, $R_f$ = 0.80 (dichloromethane/methanol 40/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.9 Hz, 1H), 7.83-7.73 (m, 3H), 7.69-7.62 (m, 1H), 7.58 (t, *J* = 7.5 Hz, 1H), 7.44 (d, *J* = 8.6 Hz, 2H), 6.49 (brs, 1H), 4.76-4.63 (m, 1H), 4.56-4.42 (m, 1H), 1.28 (d, *J* = 6.2 Hz, 6H), 1.03 (d, *J* = 6.2 Hz, 3H), 0.86 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 136.9 (d, $J_{PC}$ = 5.4 Hz), 136.6 (d, $J_{PC}$ = 3.1 Hz), 134.9 (d, $J_{PC}$ = 5.7 Hz), 133.3 (d, $J_{PC}$ = 2.0 Hz), 131.9 (d, $J_{PC}$ = 0.9 Hz), 130.2 (d, $J_{PC}$ = 1.8 Hz), 129.1 (d, $J_{PC}$ = 5.2 Hz), 126.8 (d, $J_{PC}$ = 2.8 Hz), 123.0 (d, $J_{PC}$ = 2.2 Hz), 121.6, 74.4 (d, $J_{PC}$ = 7.6 Hz), 74.1 (d, $J_{PC}$ = 7.6 Hz), 66.4 (d, $J_{PC}$ = 159.6 Hz), 24.5 (d, $J_{PC}$ = 2.7 Hz), 24.3 (d, $J_{PC}$ = 3.0 Hz), 23.4 (d, $J_{PC}$ = 6.2 Hz), 23.1 (d, $J_{PC}$ = 5.7 Hz); $^{31}$P NMR (162 MHz, $CDCl_3$) δ 14.7. HPLC: Chiralcel AD-H column, 220 nm, 30 °C,



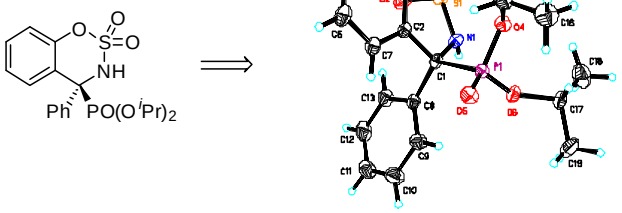
*n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 18.3 min (maj) and 30.2 min. HRMS Calculated for $C_{19}H_{24}BrNO_5PS$ $[M+H]^+$ 488.0291, found 488.0293.

**(*S*)-(-)-Diisopropyl(6-methyl-2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3]oxathiazin-4-yl)phosphonate (4e):** 81 mg, 95% yield, 99.4% ee, $[\alpha]^{20}_D$ = -7.34 (*c* 1.54, $CHCl_3$), unknown compound, white solid, m.p. = 173-174 °C, $R_f$ = 0.20 (dichloromethane/methanol 80/1). $^1$H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 7.6 Hz, 2H), 7.73 (s, 1H), 7.66 (d, *J* = 8.0 Hz, 1H), 7.41-7.27 (m, 4H), 5.77 (brs, 1H), 4.83-4.56 (m, 1H), 4.55-4.34 (m, 1H), 2.47 (s, 3H), 1.28 (d, *J* = 6.1 Hz, 3H), 1.28 (d, *J* = 6.1 Hz, 3H), 1.00 (d, *J* = 6.2 Hz, 3H), 0.83 (d, *J* = 6.2 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.3 (d, $J_{PC}$ = 1.9 Hz), 137.8 (d, $J_{PC}$ = 4.8 Hz), 137.7 (d, $J_{PC}$ = 3.2 Hz), 132.2 (d, $J_{PC}$ = 5.6 Hz), 131.1 (d, $J_{PC}$ = 2.0 Hz), 128.8, 128.6 (d, $J_{PC}$ = 1.4 Hz), 127.2 (d, $J_{PC}$ = 5.4 Hz), 127.1 (d, $J_{PC}$ = 3.0 Hz), 121.2, 73.9 (d, $J_{PC}$ = 7.0 Hz), 73.8 (d, $J_{PC}$ = 7.3 Hz), 66.8 (d, $J_{PC}$ = 158.4 Hz), 24.4 (d, $J_{PC}$ = 2.7 Hz), 24.4 (d, $J_{PC}$ = 3.0 Hz), 23.4 (d, $J_{PC}$ = 6.0 Hz), 23.0 (d, $J_{PC}$ = 5.8 Hz), 22.1; $^{31}$P NMR (162 MHz, $CDCl_3$) δ 15.3. HPLC: Chiralcel AD-H column, 220 nm, 30 °C, *n*-hexane/*i*-propanol = 70/30, flow = 0.7 mL/min, retention time 14.1 min (maj) and 15.7 min. HRMS Calculated for $C_{20}H_{27}NO_5PS$ $[M+H]^+$ 424.1342, found 424.1345.




## 4. Determination of the Absolute Configuration of (+)-2a

Based on the single crystal X-ray diffraction analysis, the absolute configuration of product (+)-**2a** was determined to be (*S*)-(+)-diisopropyl(2,2-dioxido-4-phenyl-3,4-dihydrobenzo[*e*][1,2,3] oxathiazin-4-yl)phosphonate **2a**. The CCDC number is 1469544. These details can be obtained free of charge *via* www.ccdc.com. ac.uk/data_request/cif from the Cambridge Crystallographic Data Centre.

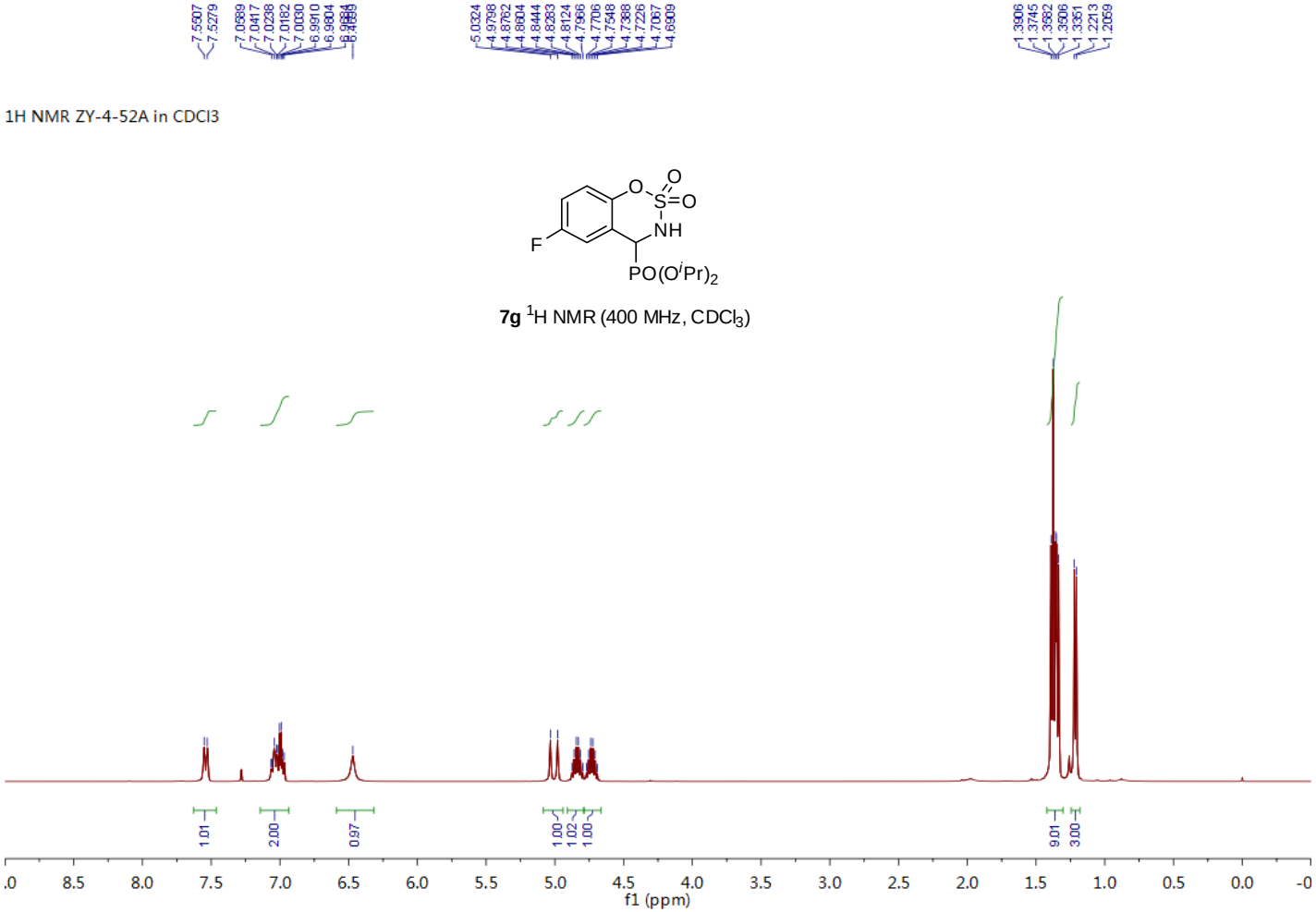



X-ray Single Crystal Structure of (*S*)-(+)-**2a**

## 4. References

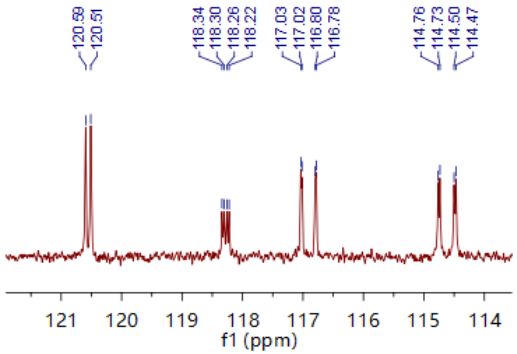
[1]. Yan, Z.; Wu, B.; Gao, X.; Chen, M.-W.; Zhou, Y.-G. *Org. Lett*. **2016**, *18*, 692.

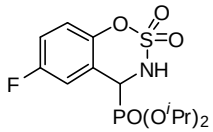
## 5. Copy of NMR and HPLC for the Compounds



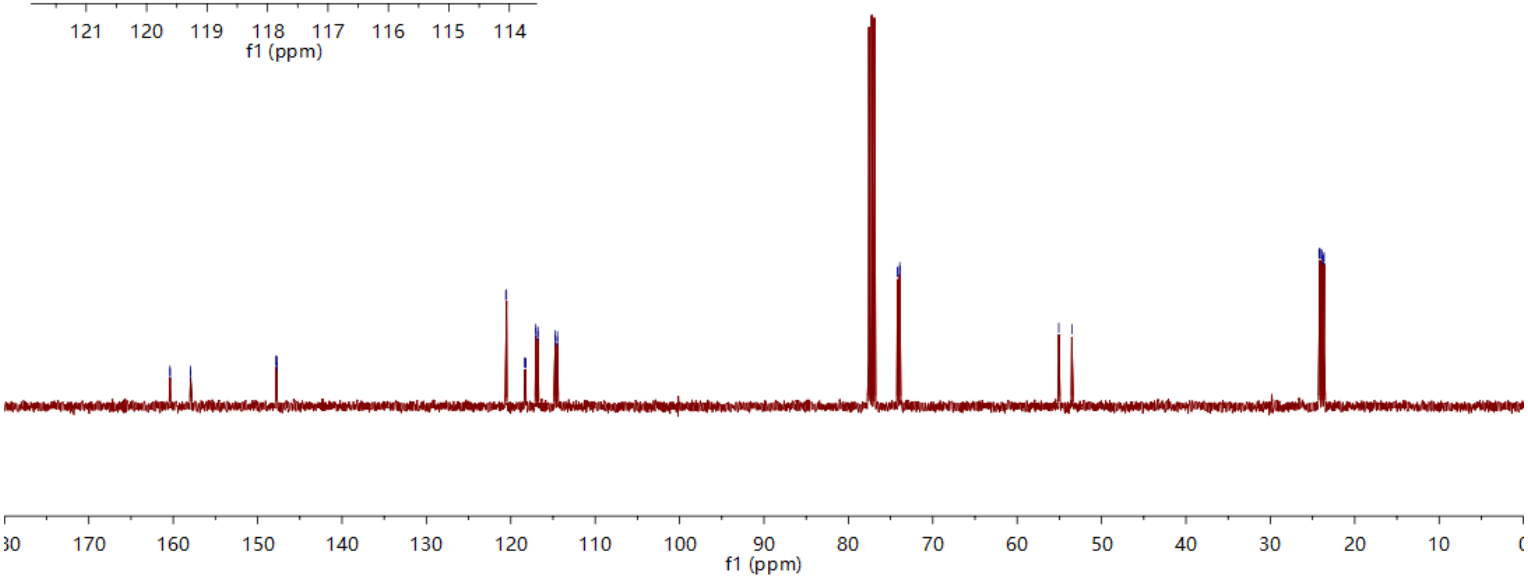

**7g** $^1$H NMR (400 MHz, $CDCl_3$)


13C NMR ZY-4-52A in CDCl3

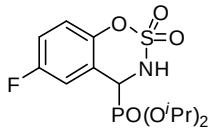


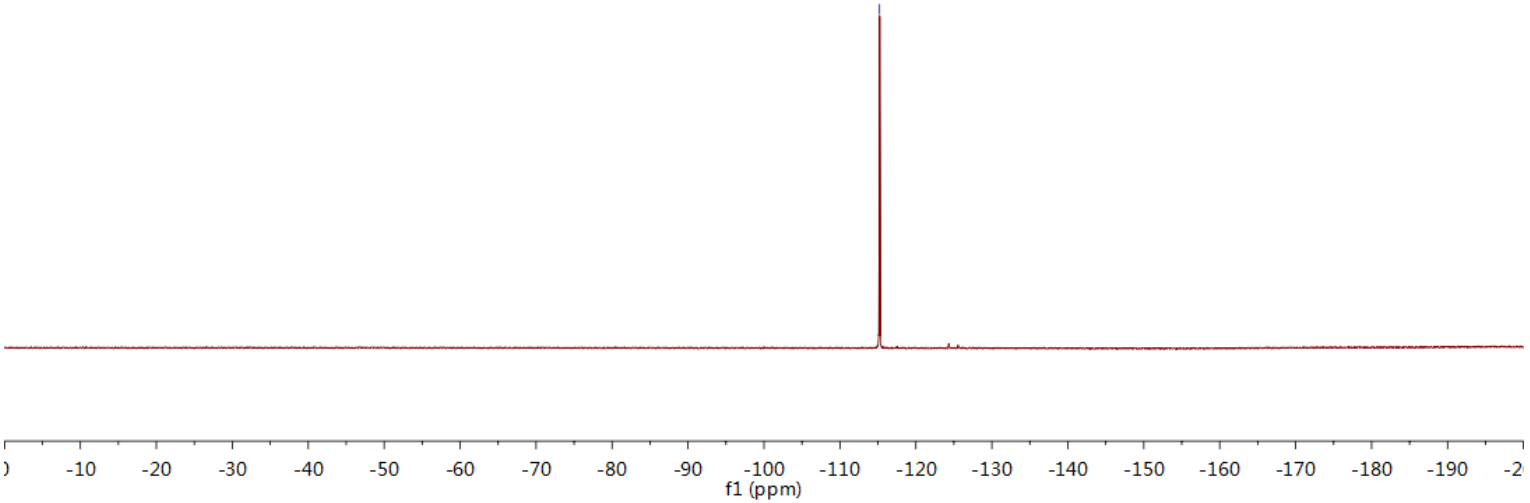

**7g** $^{13}$C NMR (100 MHz, $CDCl_3$)



19F NMR ZY-4-52A in CDCl3

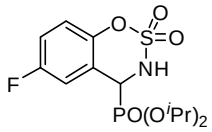



**7g** $^{19}$F NMR (376 MHz, $CDCl_3$)

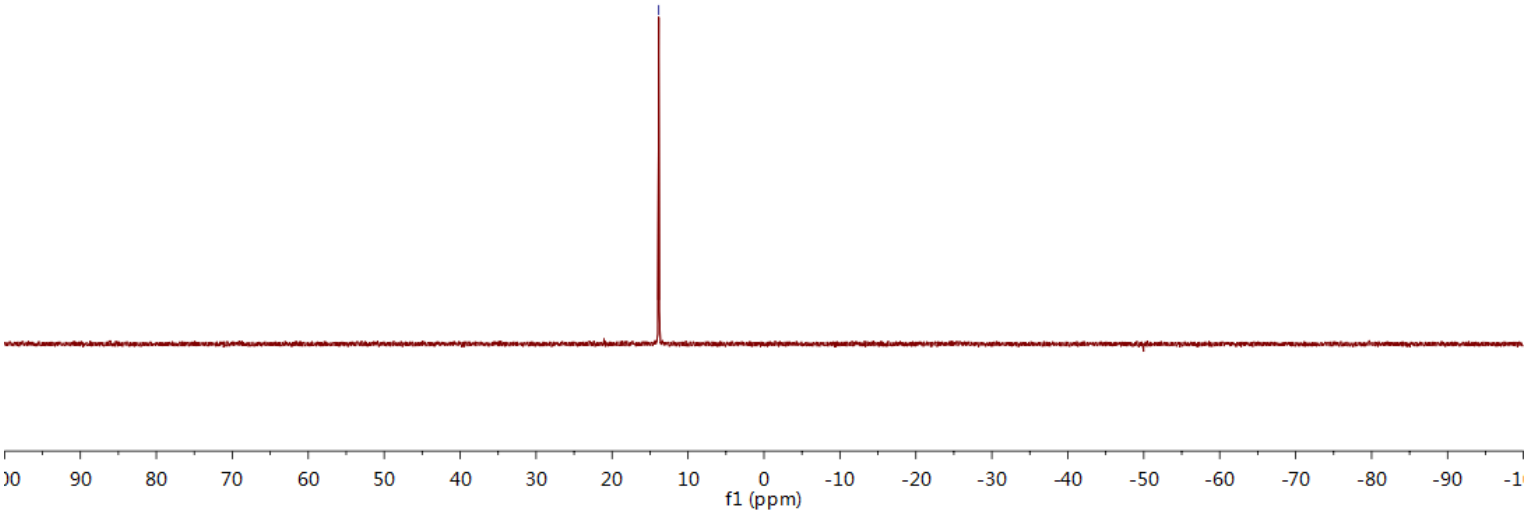


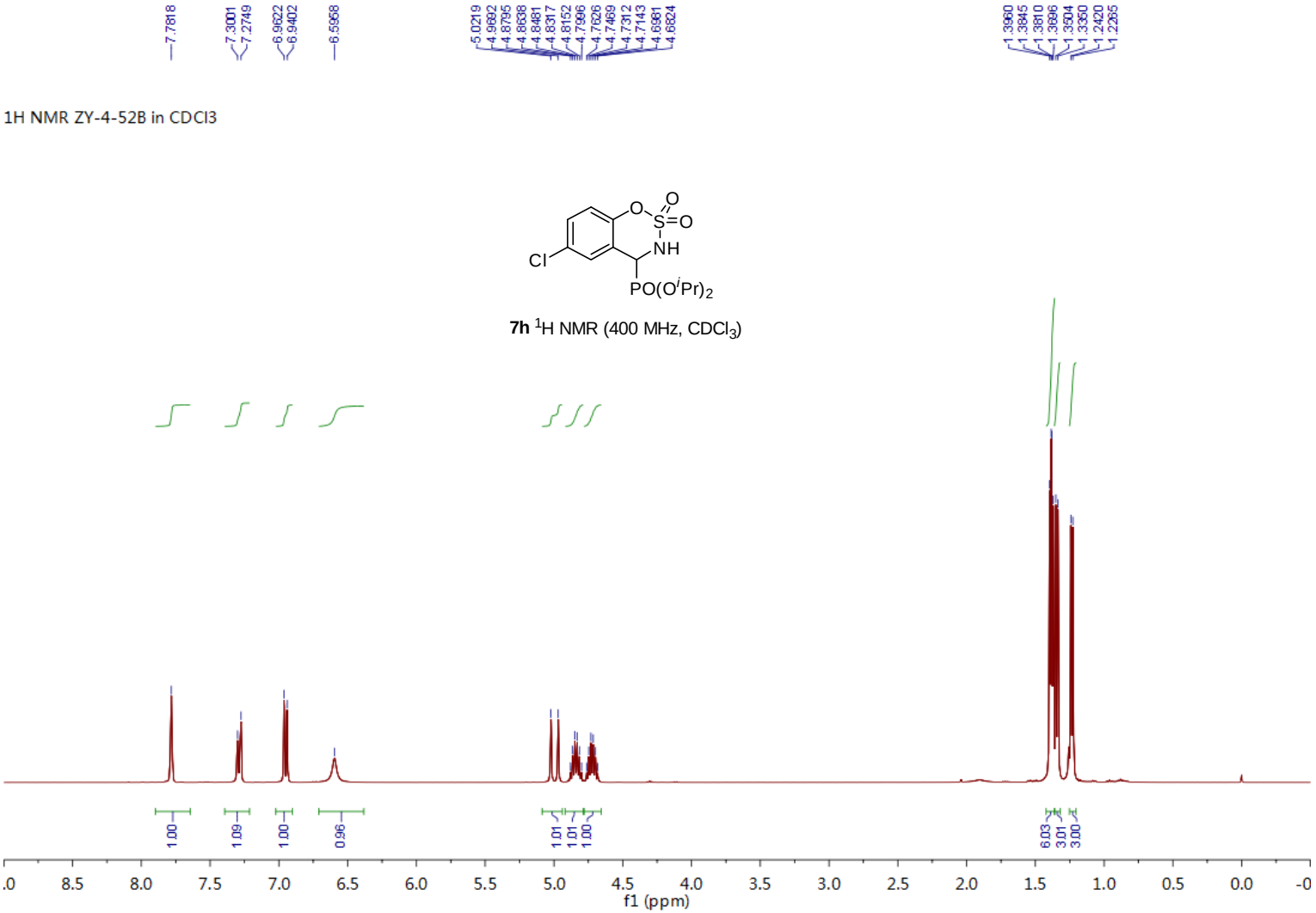
13.85

31P NMR ZY-4-52A in CDCl3



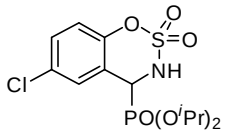

**7g** $^{31}$P NMR (162 MHz, $CDCl_3$)



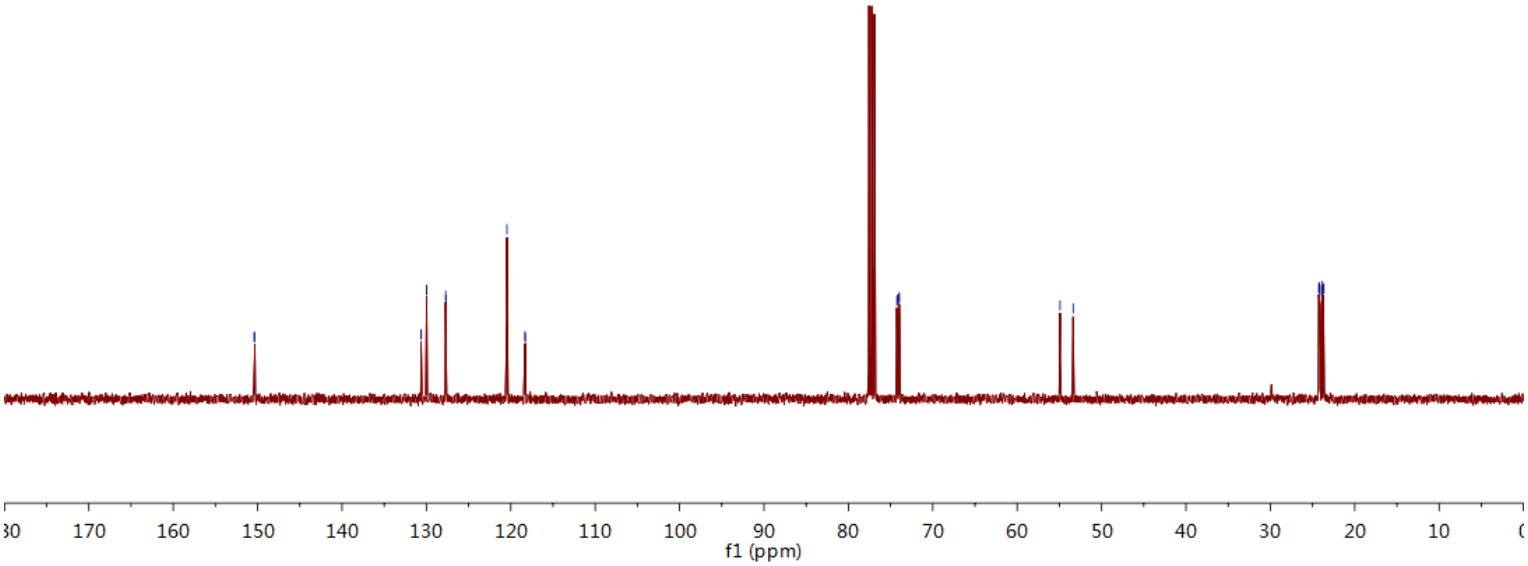



**7h** $^1$H NMR (400 MHz, $CDCl_3$)


13C NMR ZY-4-52B in CDCl3

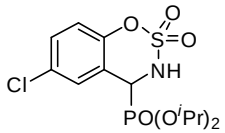



**7h** $^{13}C$ NMR (100 MHz, $CDCl_3$)

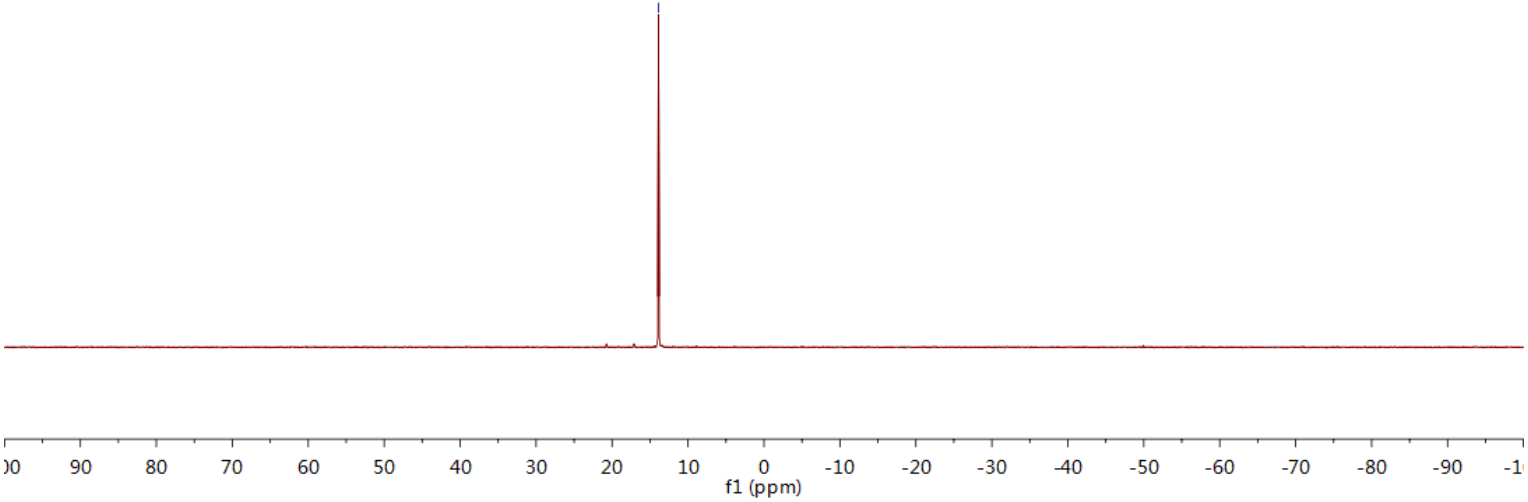


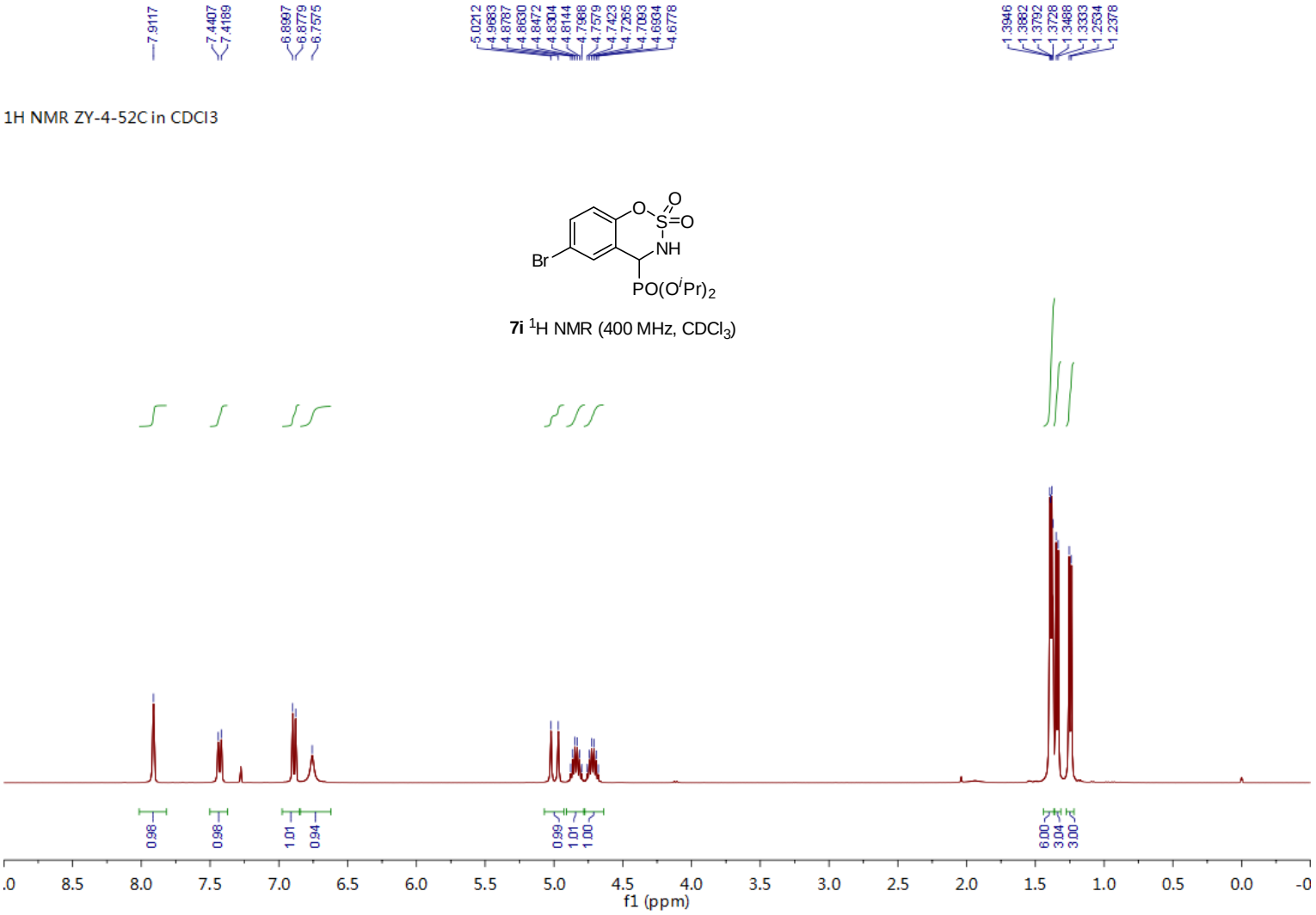
13.88

31P NMR ZY-4-52B in CDCl3




**7h** $^{31}$P NMR (162 MHz, $CDCl_3$)

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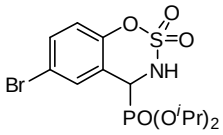
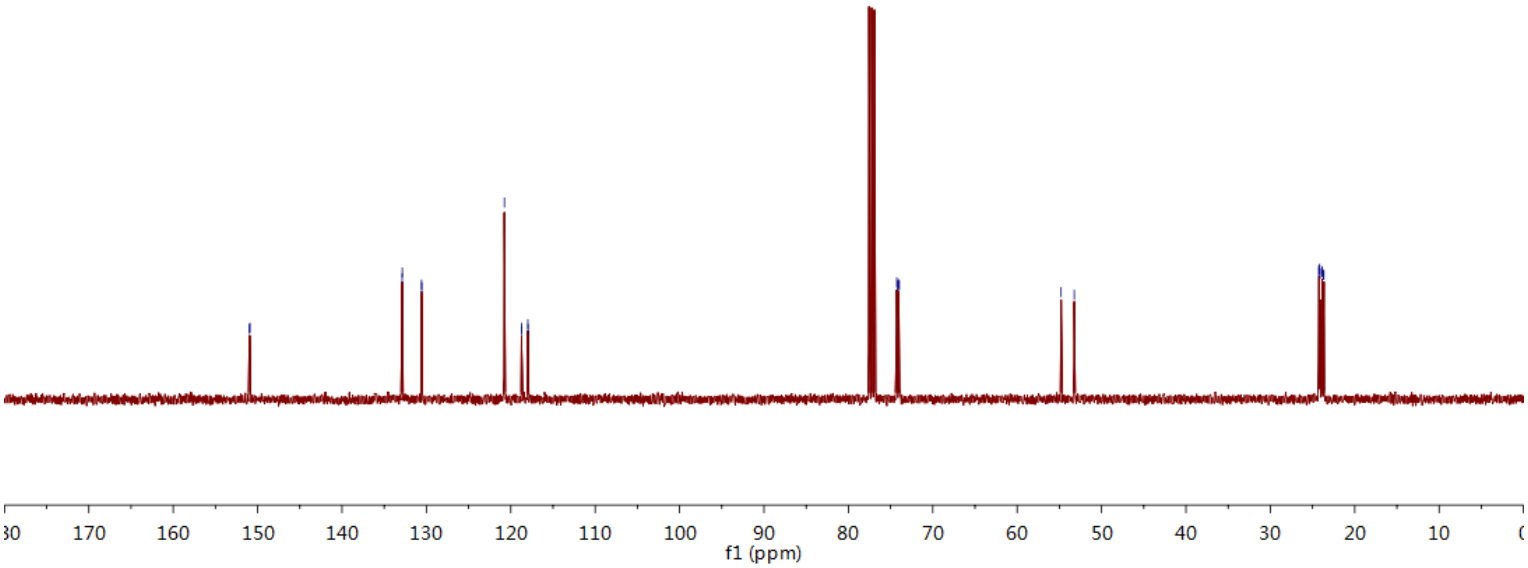
7.4407
7.4189
6.8997
6.8779
6.7575
5.0212
4.9683
4.8787
4.8630
4.8472
4.8304
4.8144
4.7988
4.7579
4.7423
4.7265
4.7093
4.6934
4.6778
1.3946
1.3882
1.3792
1.3728
1.3488
1.3333
1.2534
1.2378
1H NMR ZY-4-52C in CDCl3
O
O
S=O
NH
Br
PO(O^iPr)2
7i 1H NMR (400 MHz, CDCl3)
0.98
0.98
1.01
0.94
0.99
1.01
1.00
6.00
3.04
3.00
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

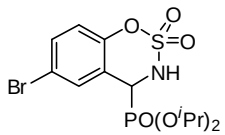

13C NMR ZY-4-52C in CDCl3



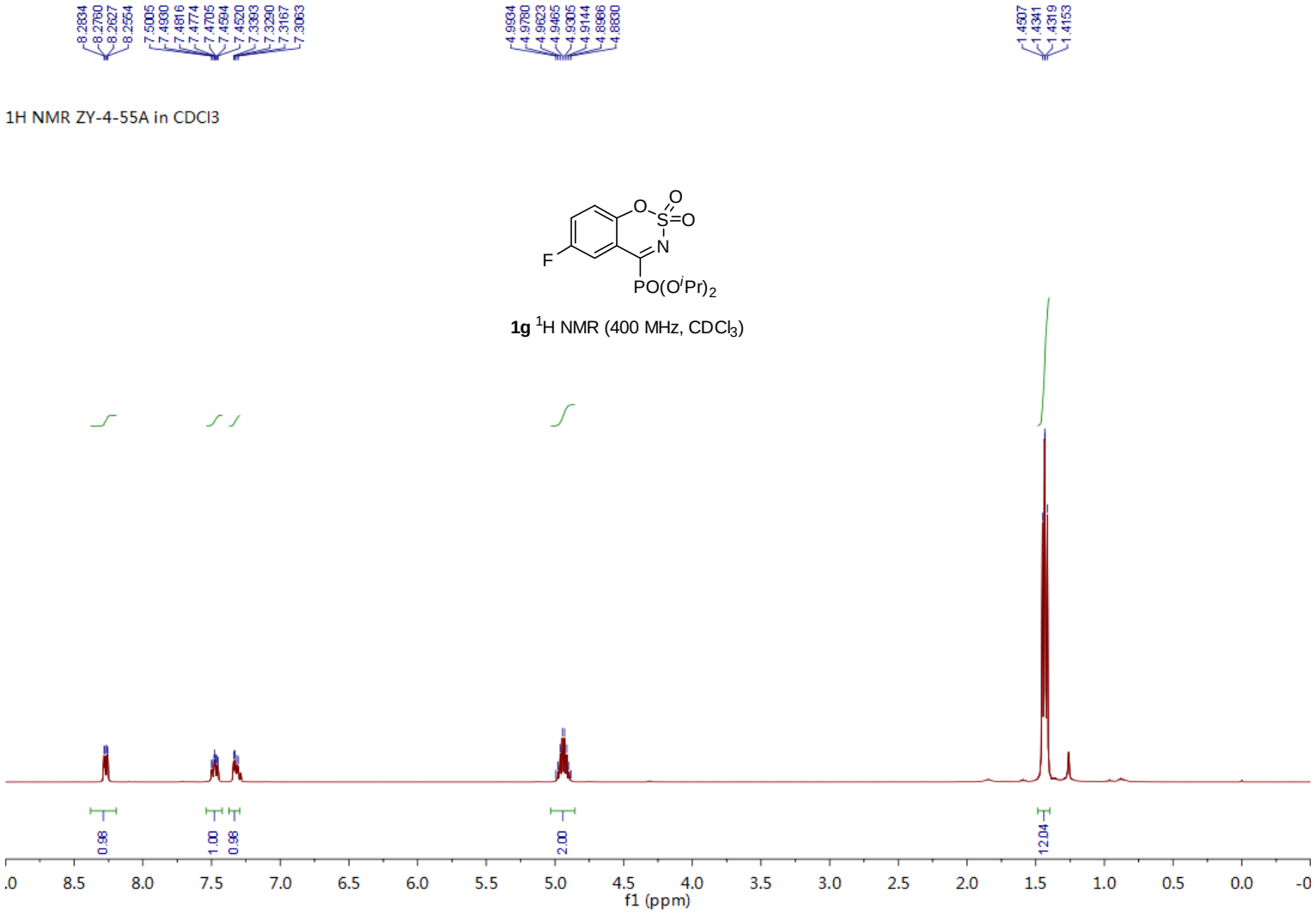

**7i** $^{13}$C NMR (100 MHz, $CDCl_3$)



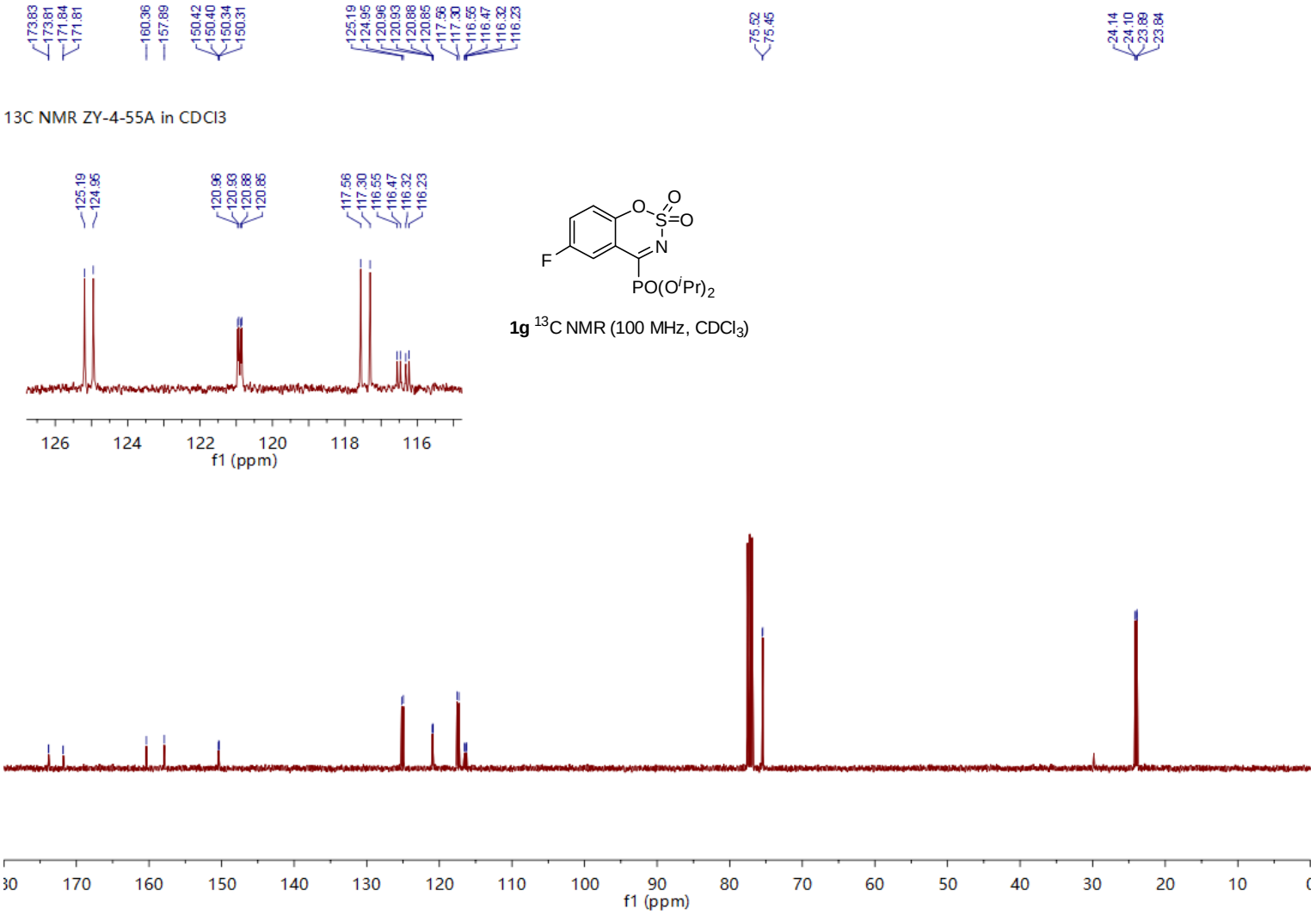
31P NMR ZY-4-52C in CDCl3




**7i** $^{31}$P NMR (162 MHz, $CDCl_3$)

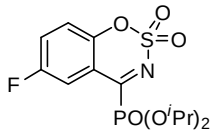



**1g** $^{1}$H NMR (400 MHz, $CDCl_3$)

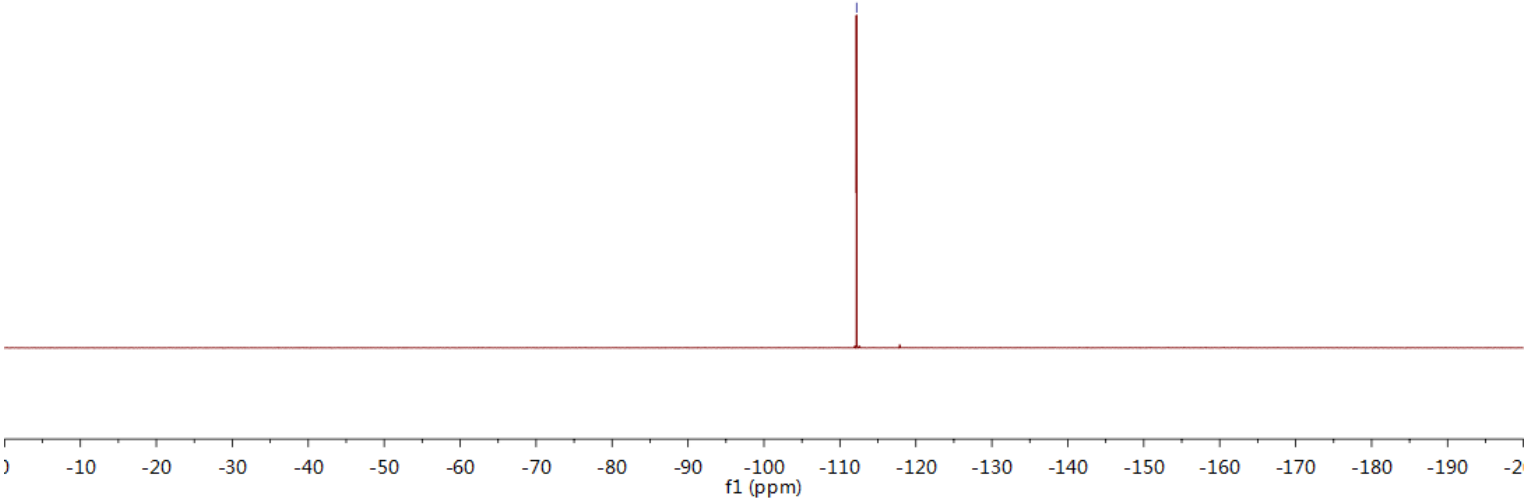



**1g** $^{13}$C NMR (100 MHz, $CDCl_3$)

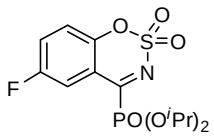
19F NMR ZY-4-55A in CDCl3



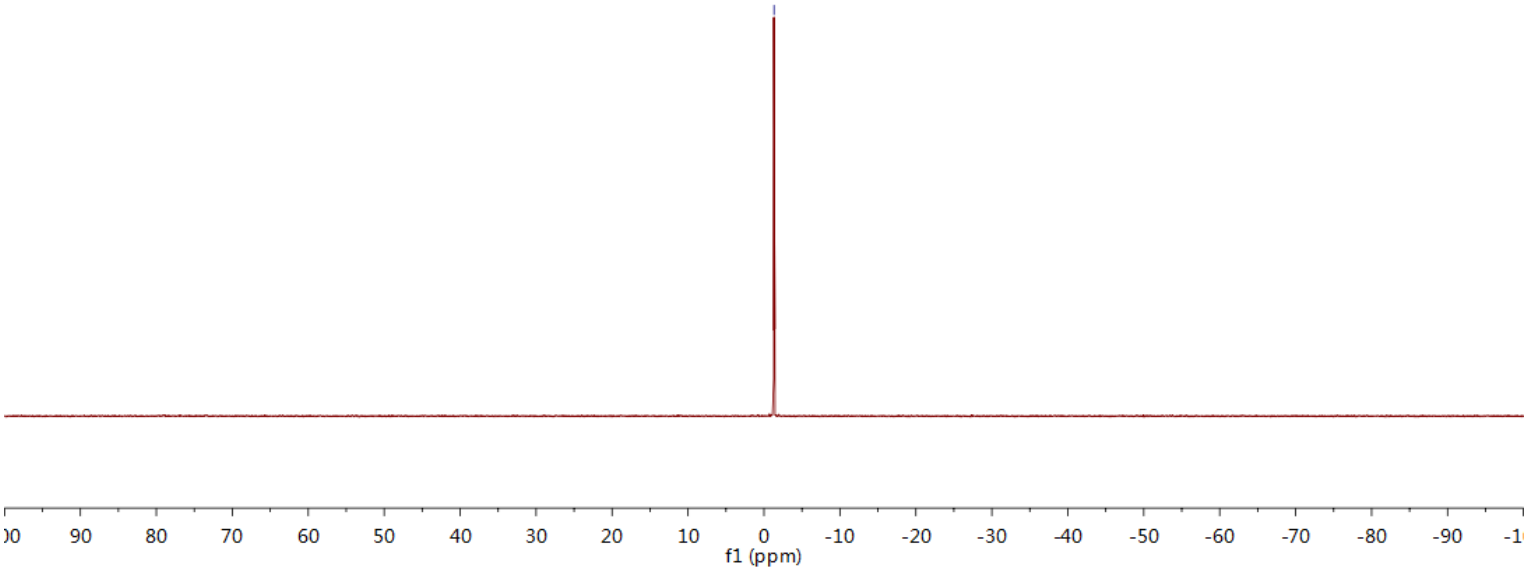

**1g** $^{19}$F NMR (376 MHz, $CDCl_3$)

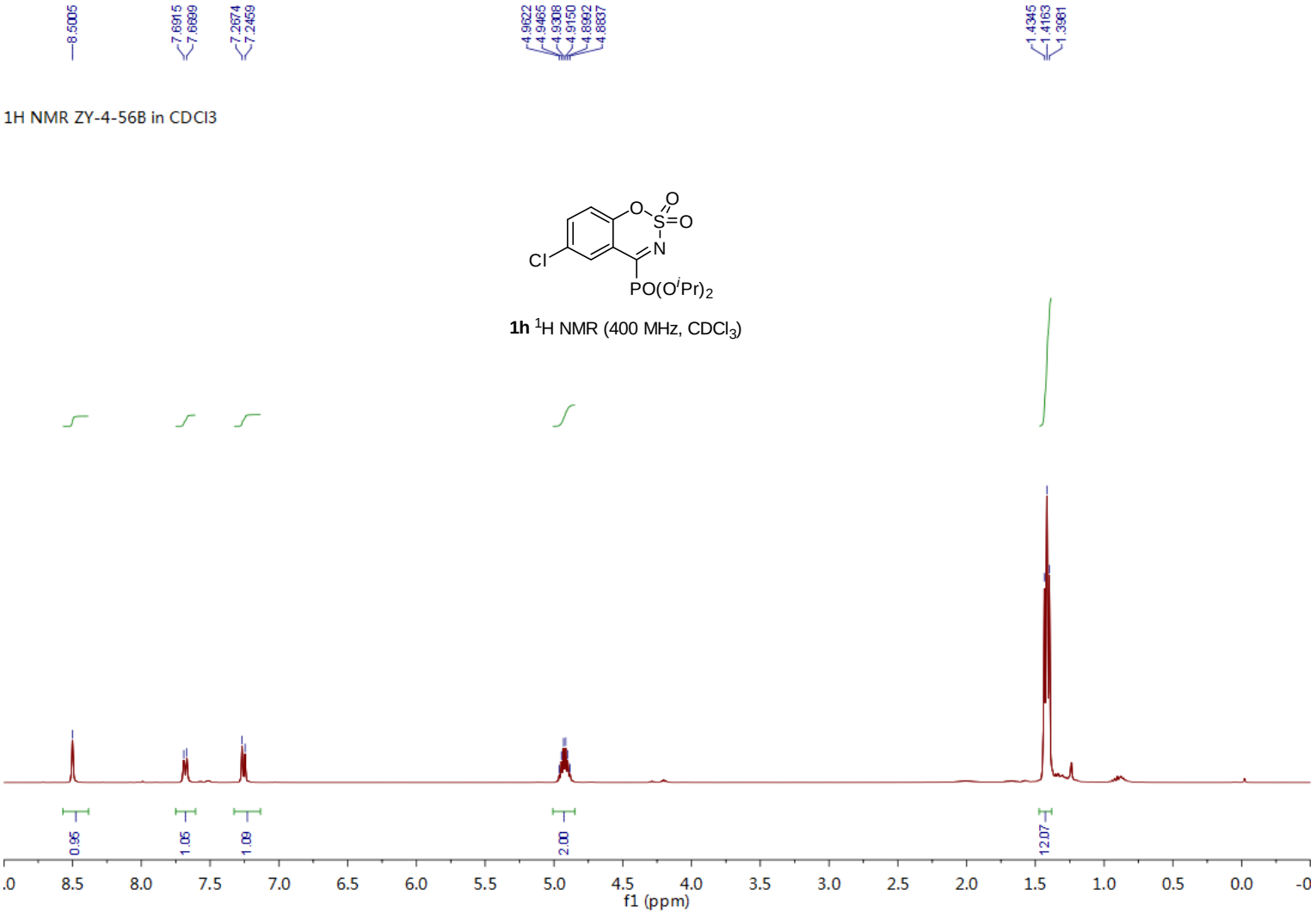


31P NMR ZY-4-55A in CDCl3

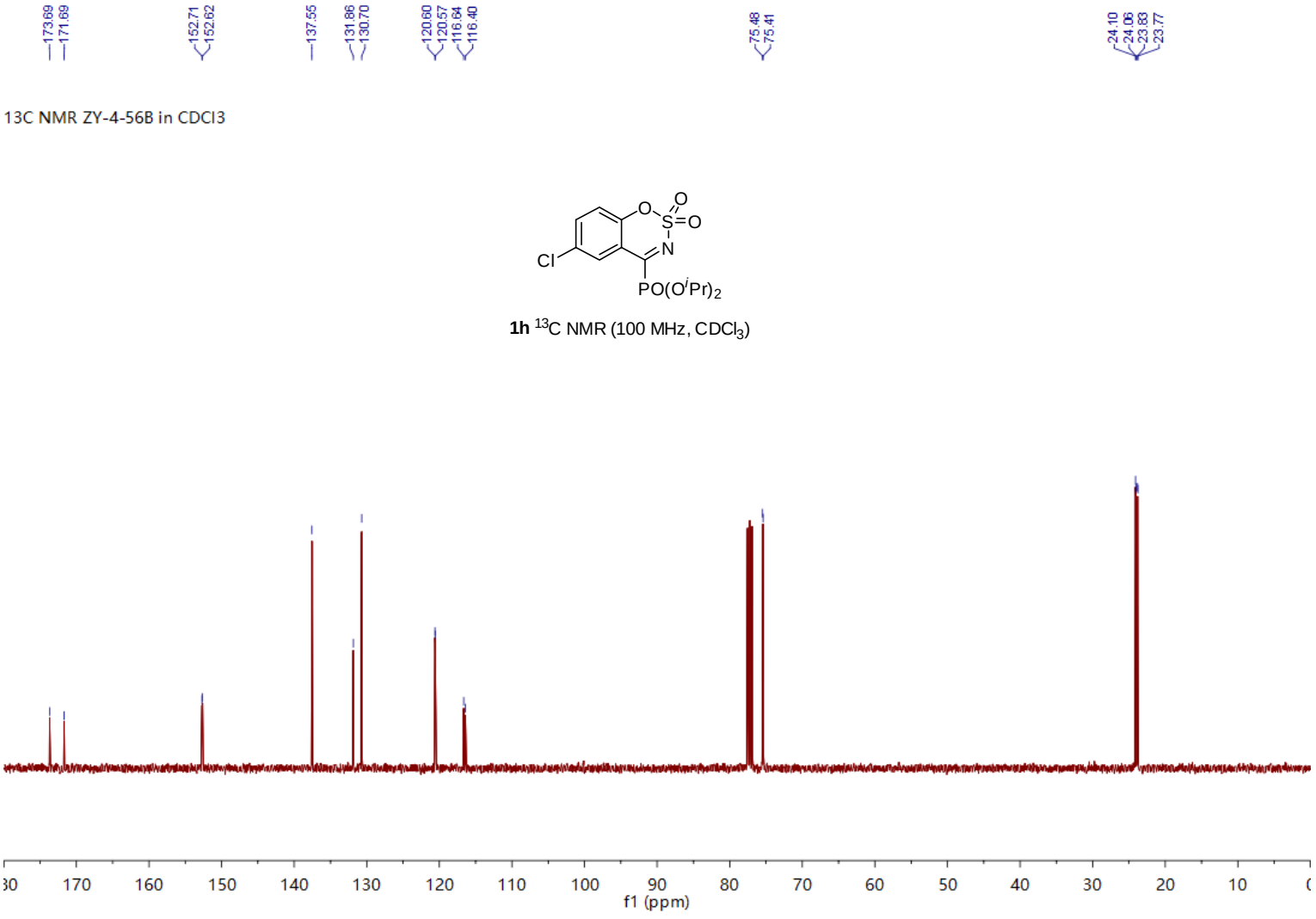



**1g** $^{31}$P NMR (162 MHz, $CDCl_3$)



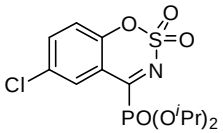



**1h** $^1$H NMR (400 MHz, $CDCl_3$)

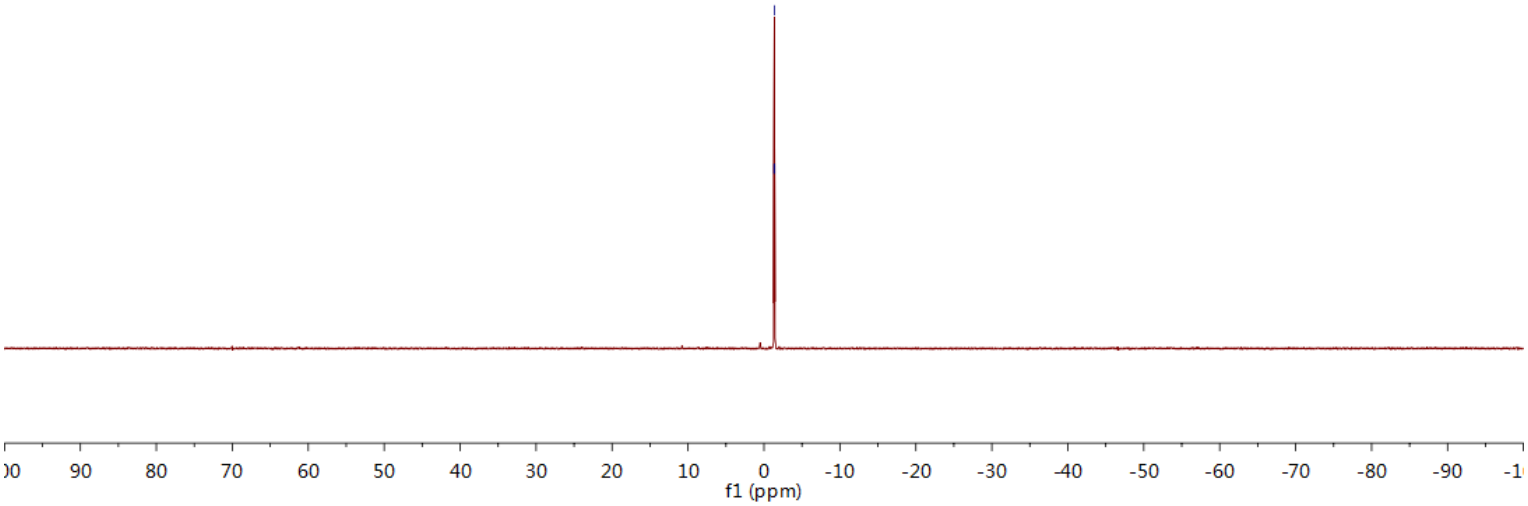


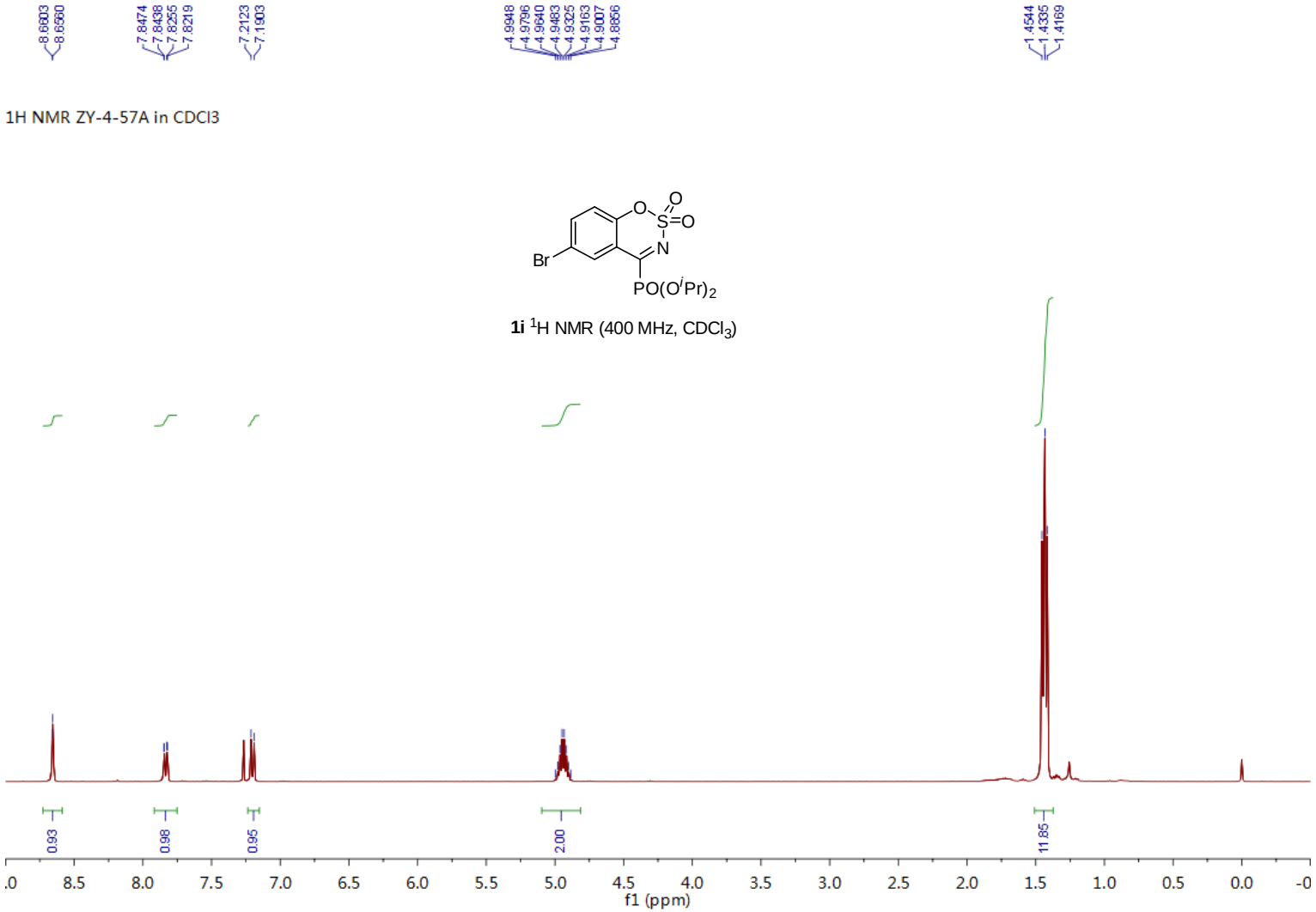

**1h** $^{13}$C NMR (100 MHz, $CDCl_3$)


31P NMR ZY-4-56B in CDCl3

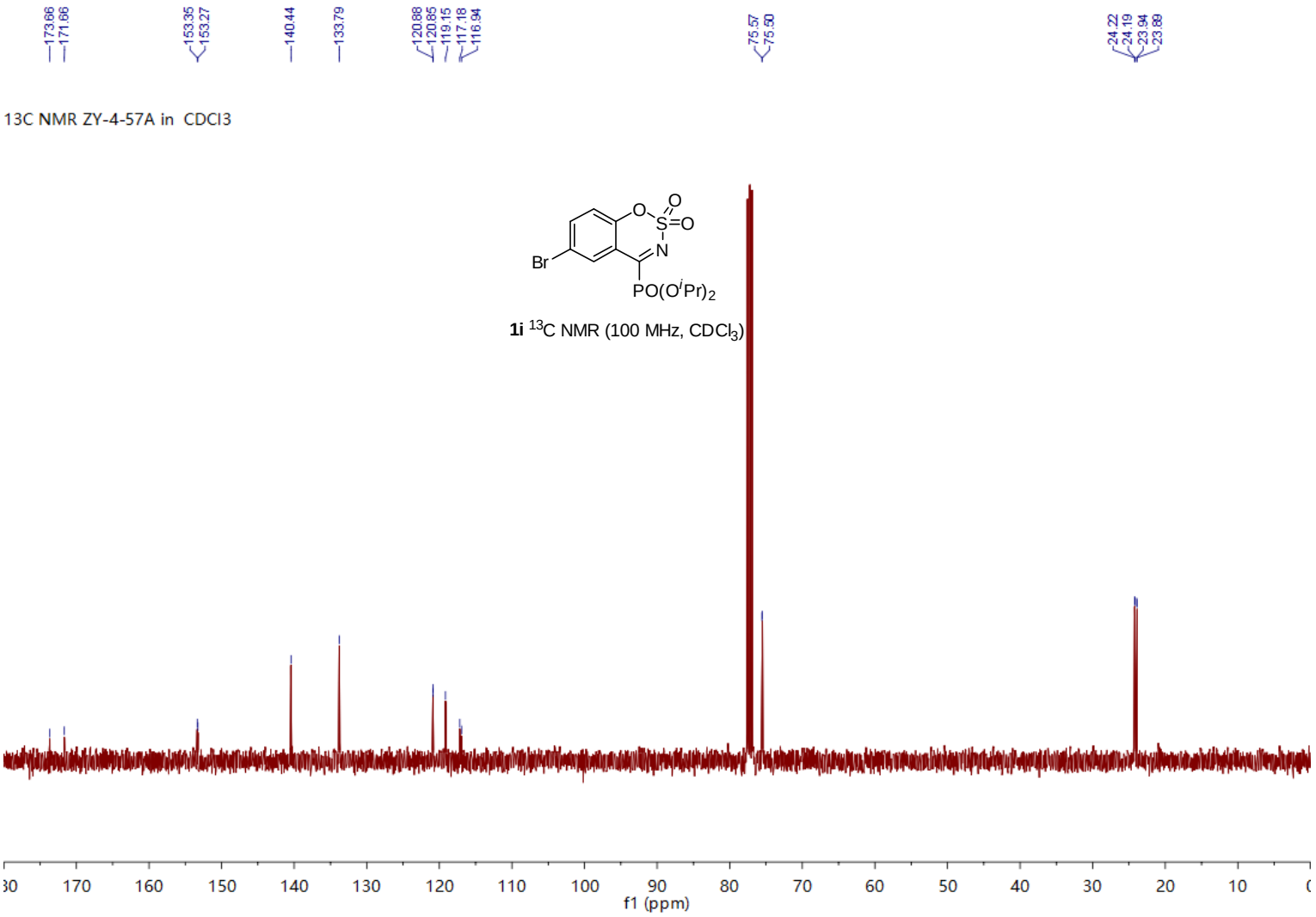



**1h** $^{31}$P NMR (162 MHz, $CDCl_3$)



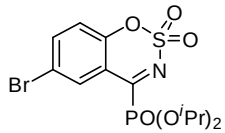



**1i** $^1$H NMR (400 MHz, $CDCl_3$)

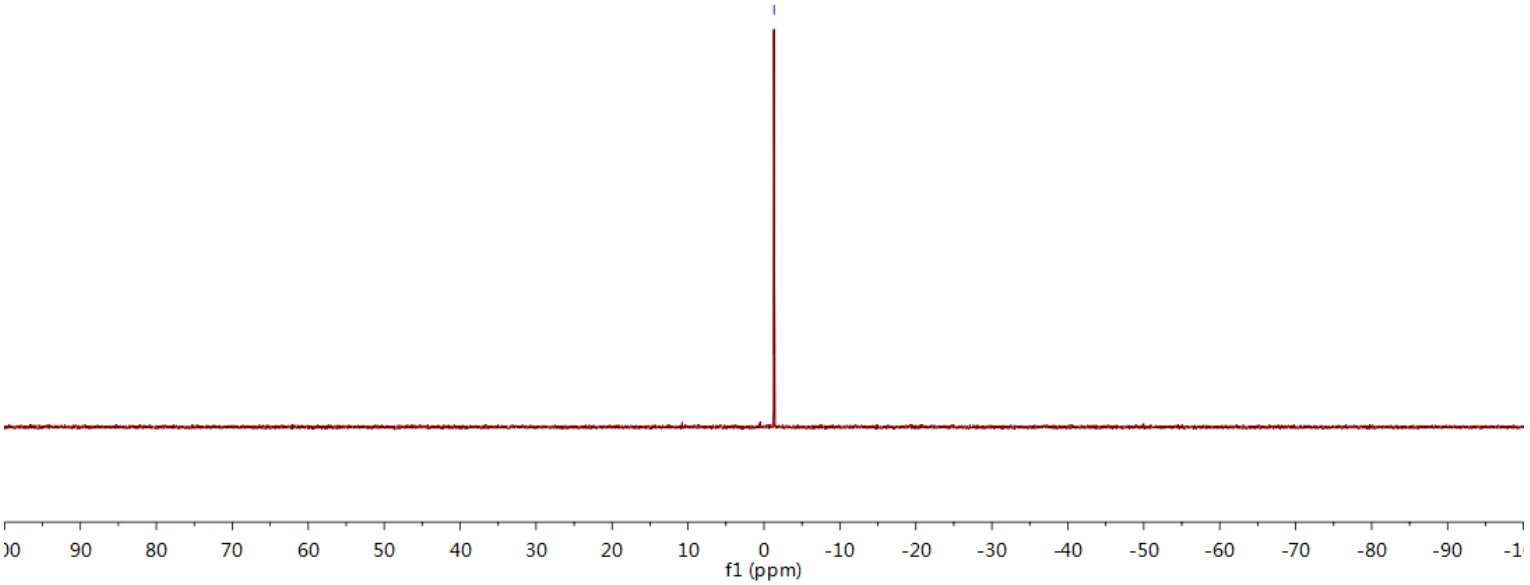



**1i** $^{13}$C NMR (100 MHz, $CDCl_3$)

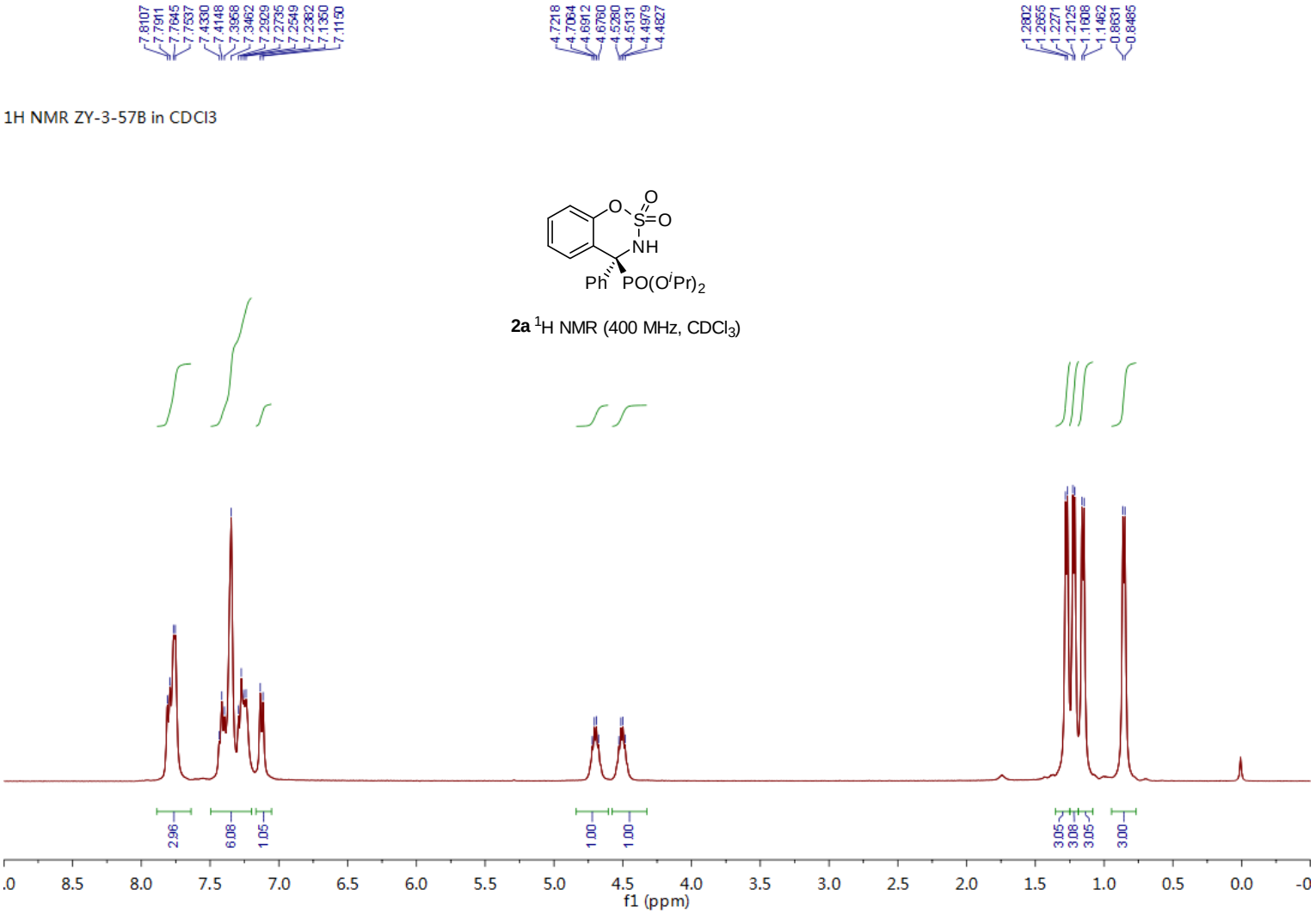
31P NMR ZY-4-57A in CDCl3



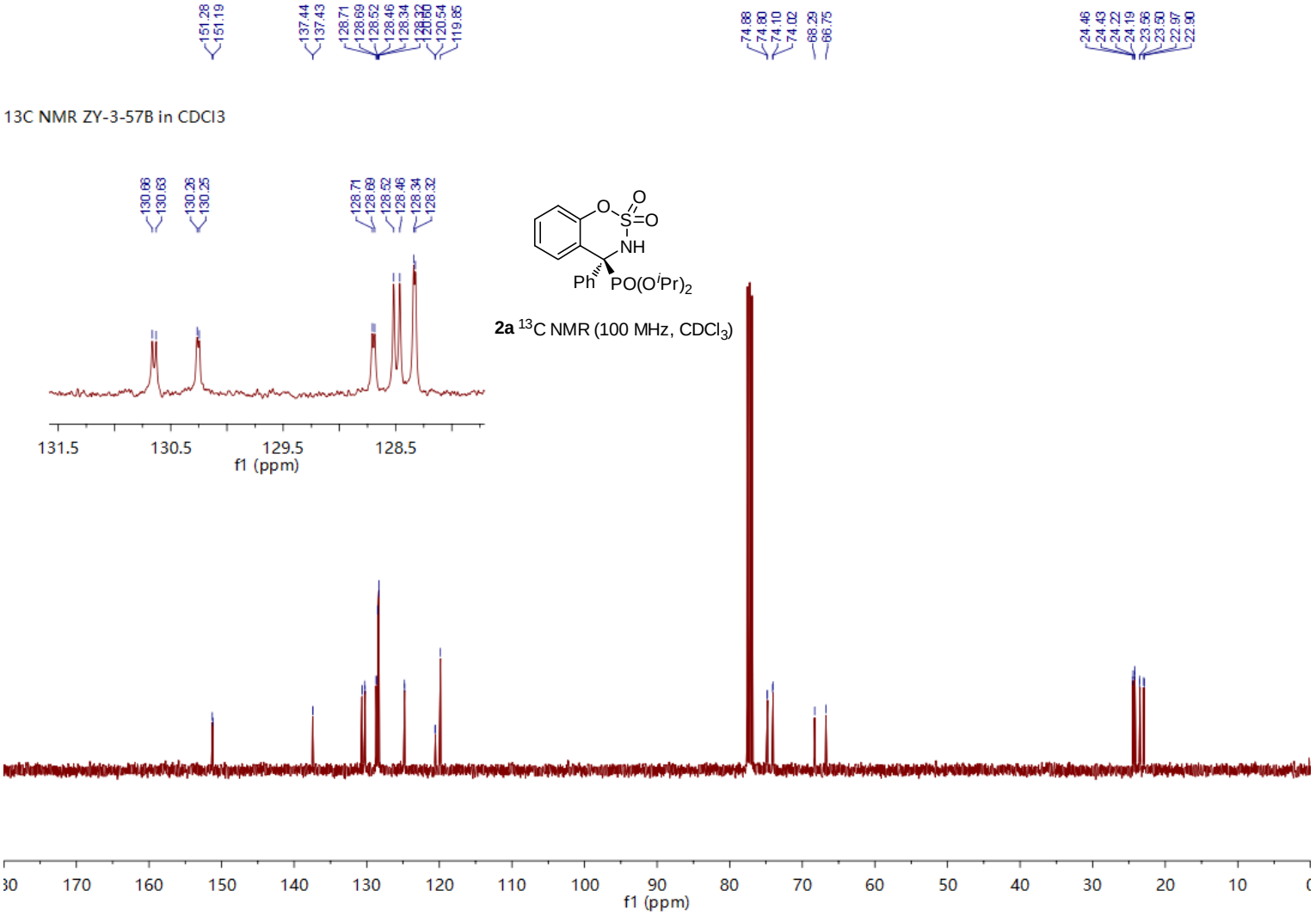

**1i** $^{31}$P NMR (162 MHz, $CDCl_3$)



1H NMR ZY-3-57B in CDCl3

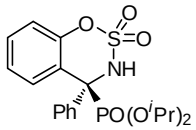



**2a** $^1$H NMR (400 MHz, $CDCl_3$)

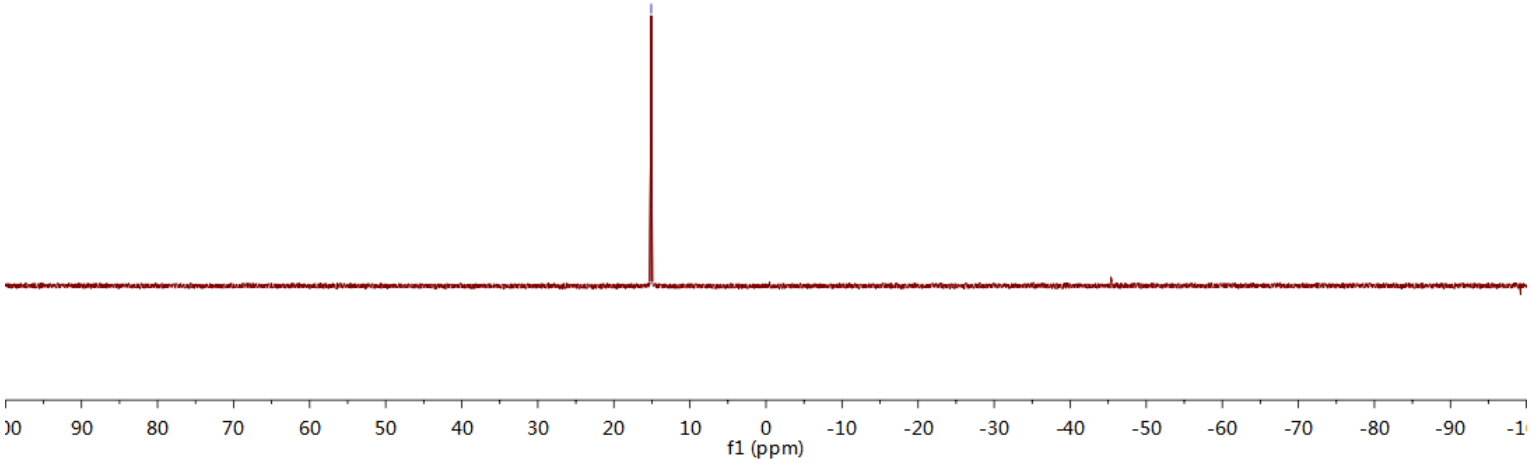

151.28
151.19
137.44
137.43
128.71
128.69
128.52
128.46
128.34
120.54
119.85
74.88
74.80
74.10
74.02
68.29
66.75
24.46
24.43
24.22
24.19
23.66
23.60
22.97
22.90
13C NMR ZY-3-57B in CDCl3
130.66
130.63
130.26
130.25
128.71
128.69
128.52
128.46
128.34
128.32
131.5
130.5
129.5
128.5
f1 (ppm)
O
O
S
O
NH
Ph
PO(O$^i$Pr)$_2$
**2a** $^{13}$C NMR (100 MHz, CDCl$_3$)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

15.08

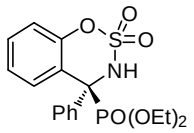
31P NMR ZY-3-57B in CDCl3



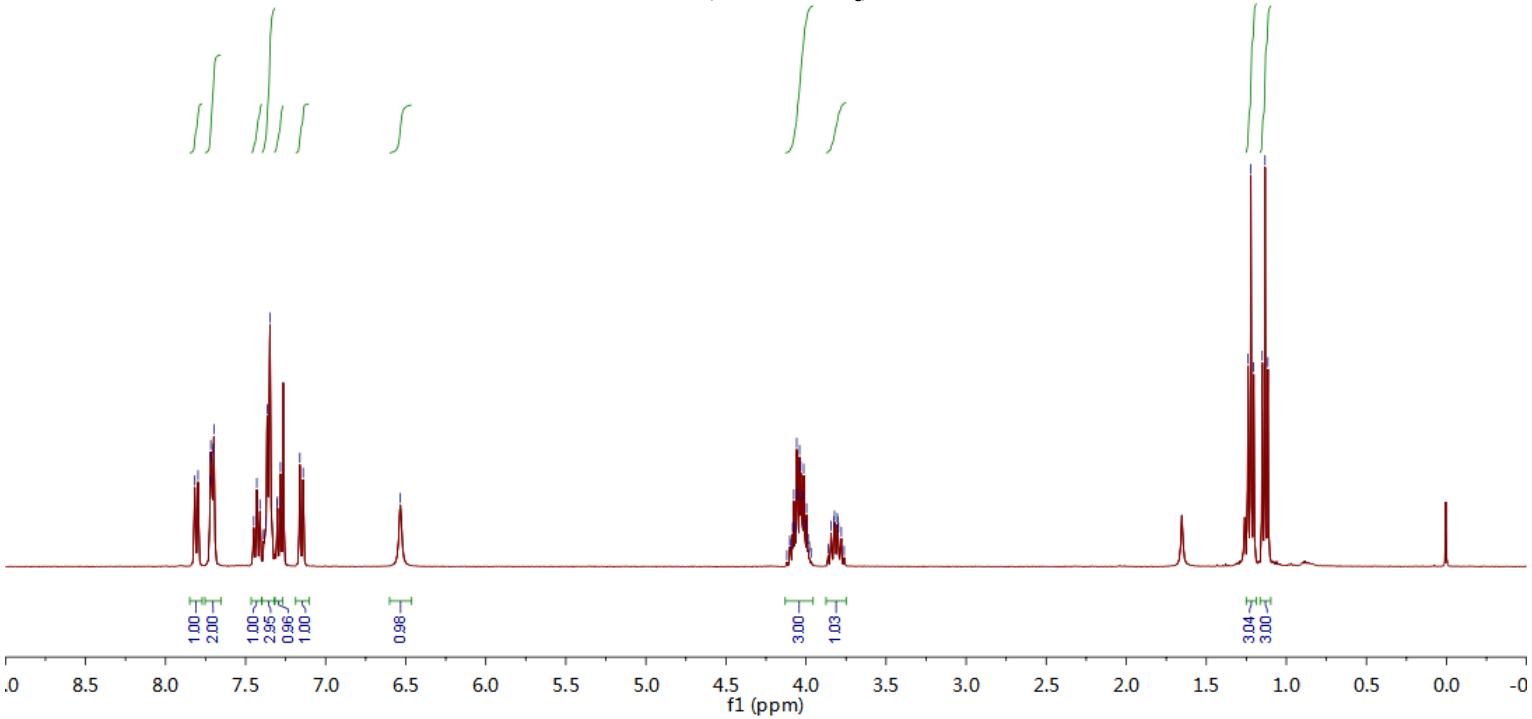

**2a** $^{31}$P NMR (162 MHz, $CDCl_3$)

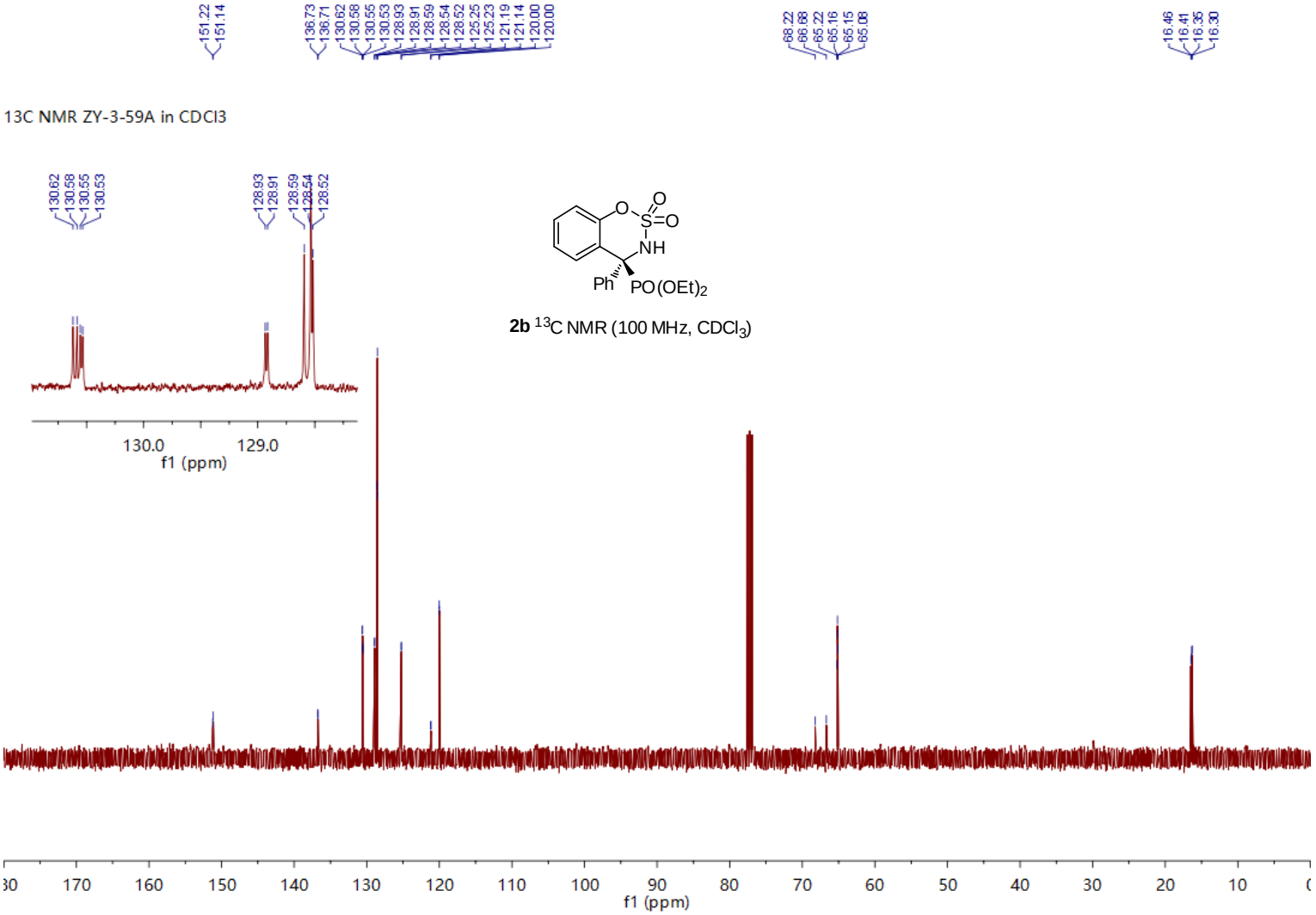


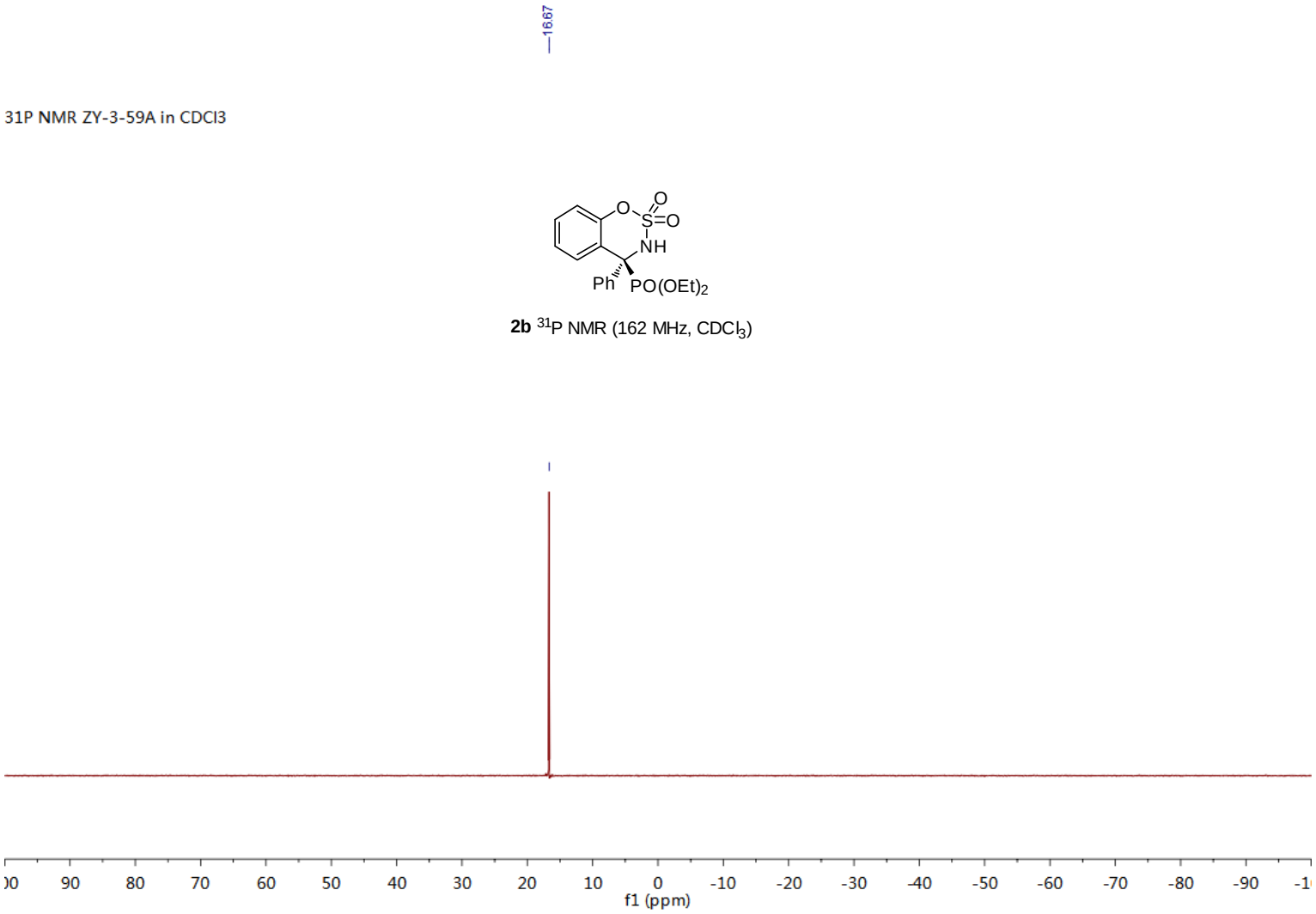

1H NMR ZY-3-59A in CDCl3



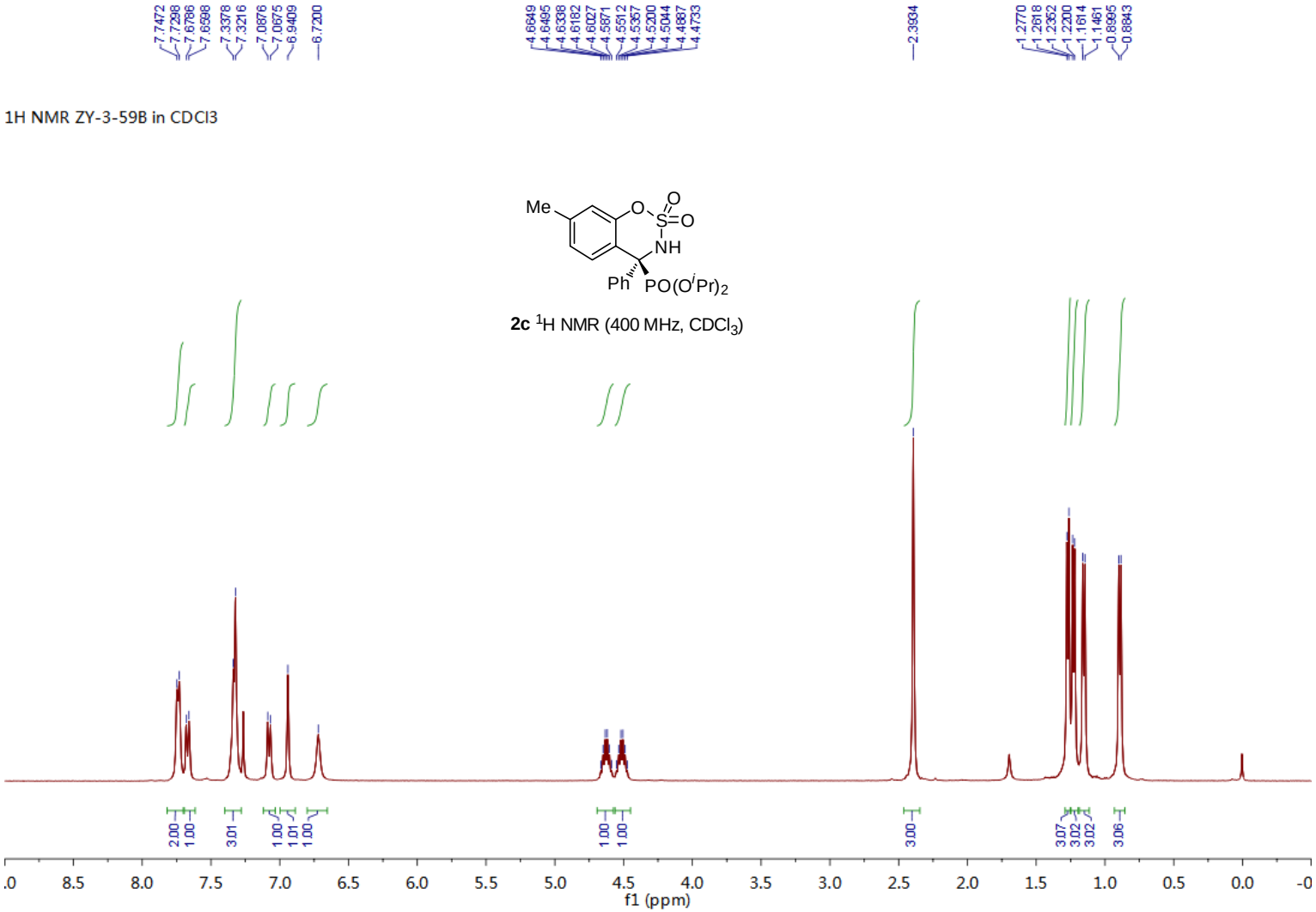

**2b** $^{1}$H NMR (400 MHz, $CDCl_3$)

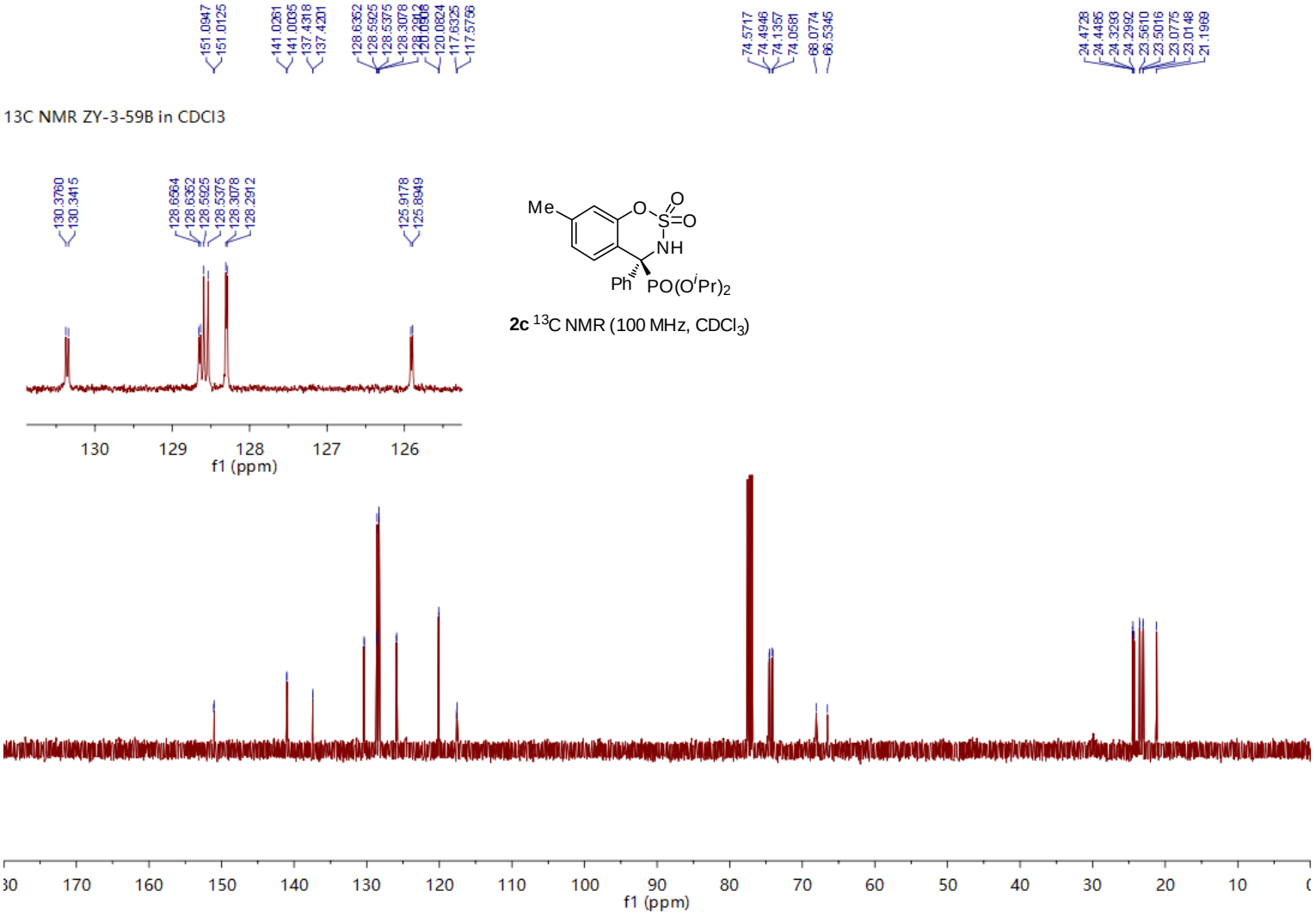


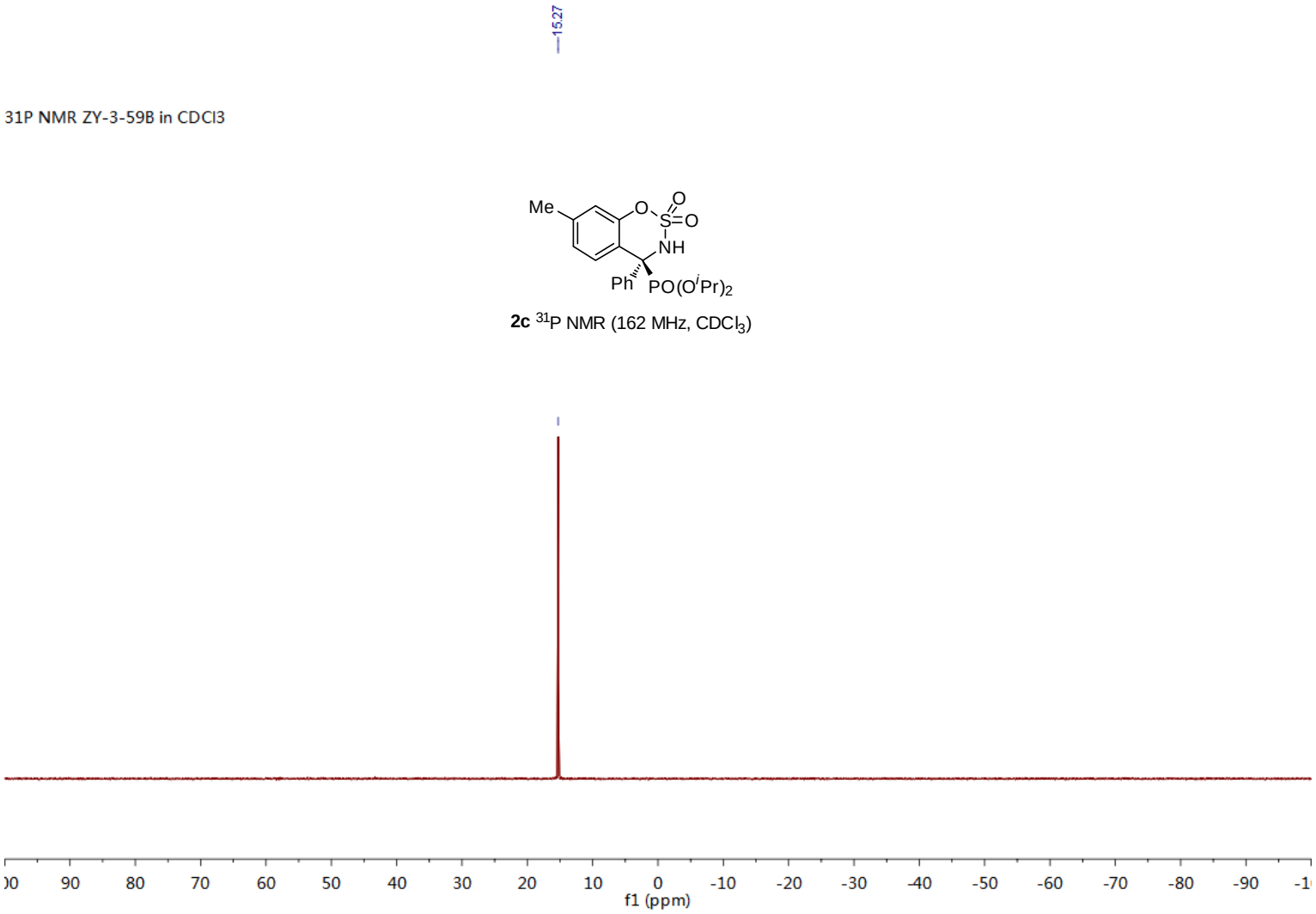

151.22
151.14
136.73
136.71
130.62
130.58
130.55
130.53
128.93
128.91
128.59
128.54
128.52
125.25
125.23
121.19
121.14
120.00
120.00
68.22
66.68
65.22
65.16
65.15
65.08
16.46
16.41
16.35
16.30
13C NMR ZY-3-59A in CDCl3
130.62
130.58
130.55
130.53
128.93
128.91
128.59
128.54
128.52
130.0
129.0
f1 (ppm)
O
O
S=O
NH
Ph
PO(OEt)2
2b 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)




**2b** $^{31}$P NMR (162 MHz, $CDCl_3$)

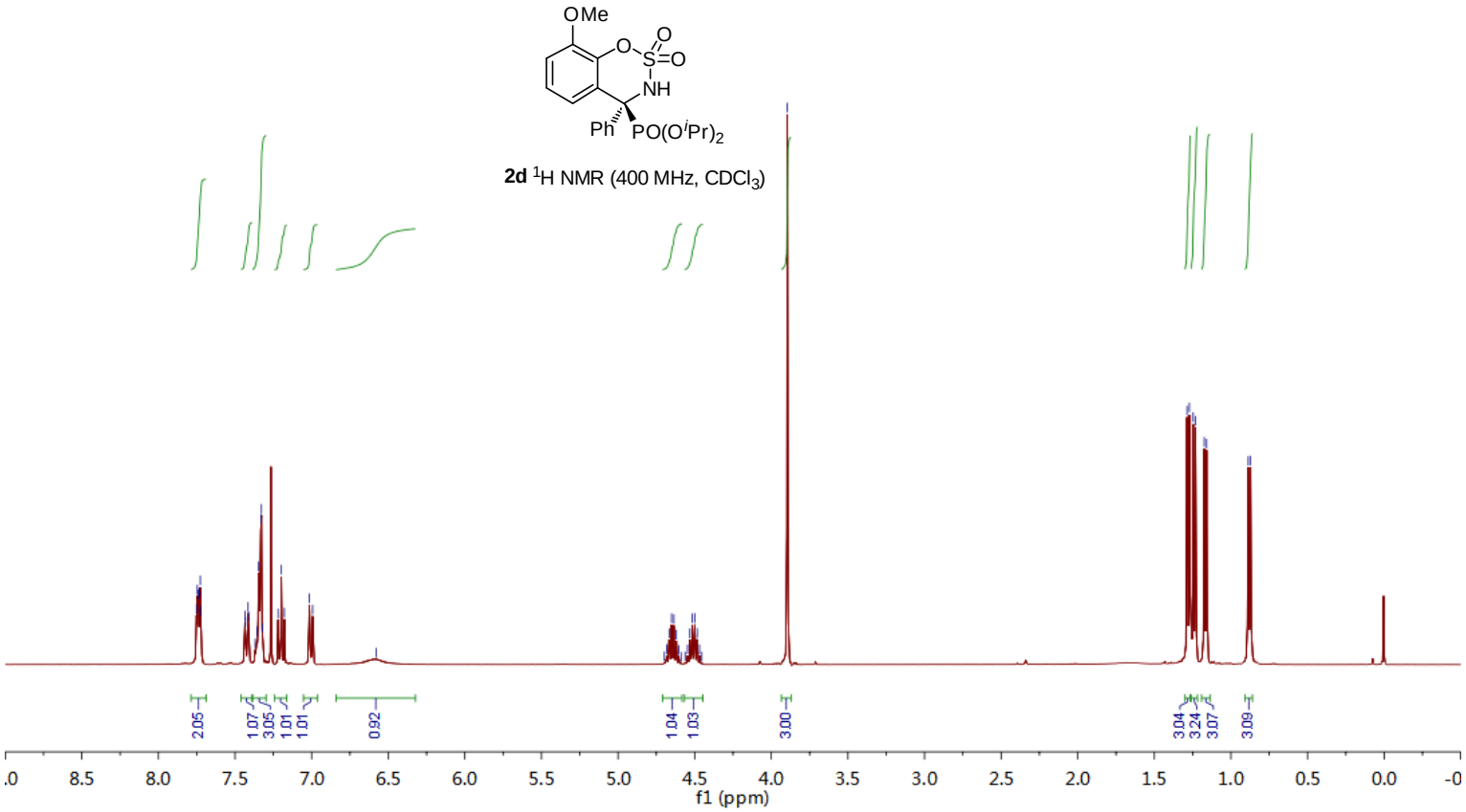

7.7472
7.7298
7.6786
7.6598
7.3378
7.3216
7.0676
7.0675
6.9409
6.7200
4.6649
4.6495
4.6338
4.6182
4.6027
4.5871
4.5512
4.5357
4.5200
4.5044
4.4887
4.4733
2.3934
1.2770
1.2618
1.2362
1.2200
1.1614
1.1461
0.8995
0.8843
1H NMR ZY-3-59B in CDCl3
Me
O
S
O
O
NH
Ph
PO(OiPr)2
2c 1H NMR (400 MHz, CDCl3)
2.00
1.00
3.01
1.00
1.01
1.00
1.00
1.00
3.00
3.07
3.02
3.02
3.06
f1 (ppm)


13C NMR ZY-3-59B in CDCl3
151.0947
151.0125
141.0261
141.0095
137.4318
137.4201
128.6352
128.5925
128.5375
128.3078
120.0824
117.6325
117.5756
74.5717
74.4946
74.1357
74.0581
68.0774
68.5345
24.4728
24.4485
24.3293
24.2992
23.5610
23.5016
23.0775
23.0148
21.1969
130.3760
130.3415
128.6564
128.6352
128.5925
128.5375
128.3078
128.2912
125.9178
125.8949
130
129
128
127
126
f1 (ppm)
Me
O
S
O
O
NH
Ph
PO(OiPr)2
2c 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

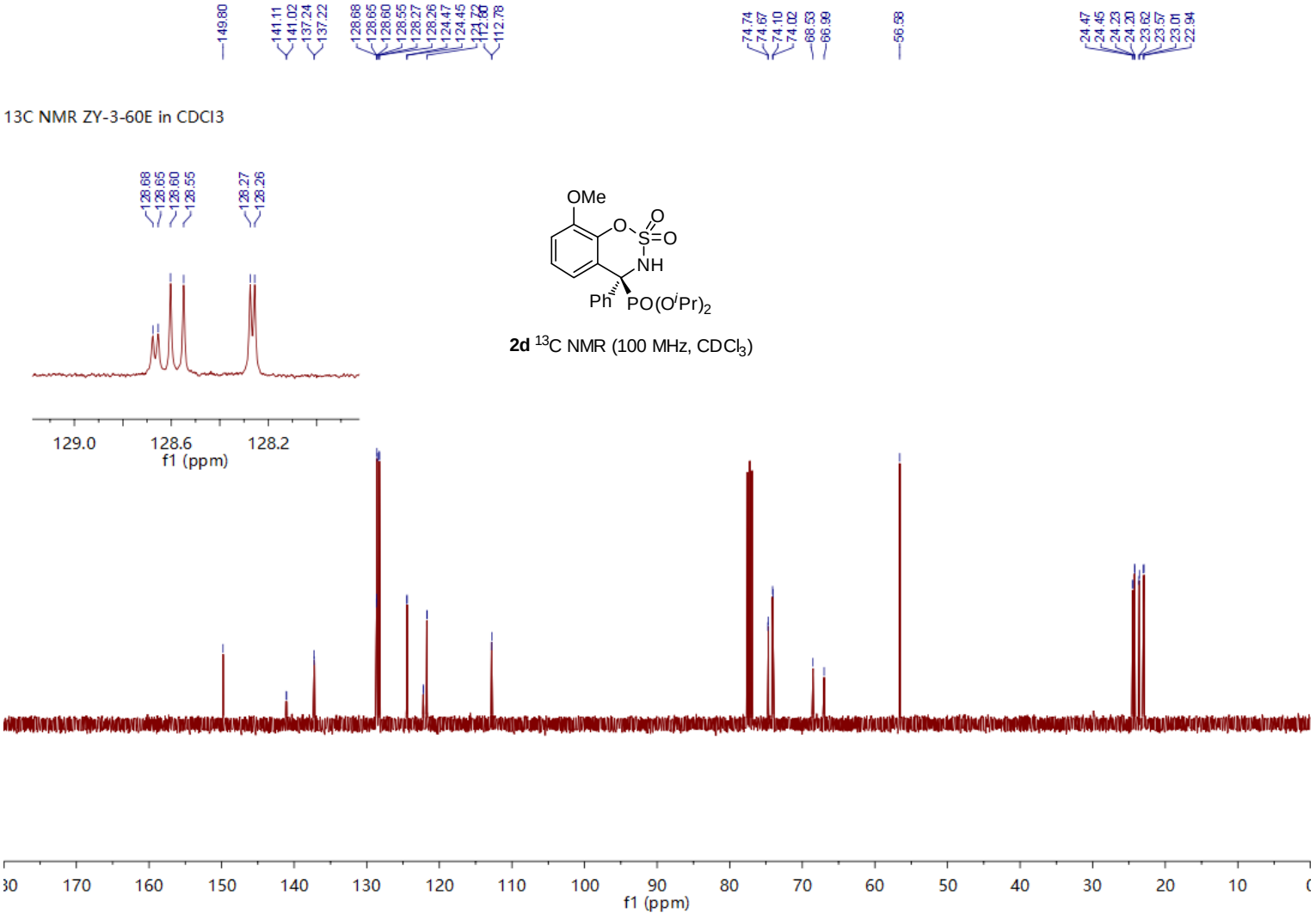



**2c** $^{31}$P NMR (162 MHz, $CDCl_3$)

1H NMR ZY-3-60E in CDCl3

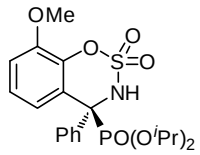



**2d** $^1$H NMR (400 MHz, $CDCl_3$)

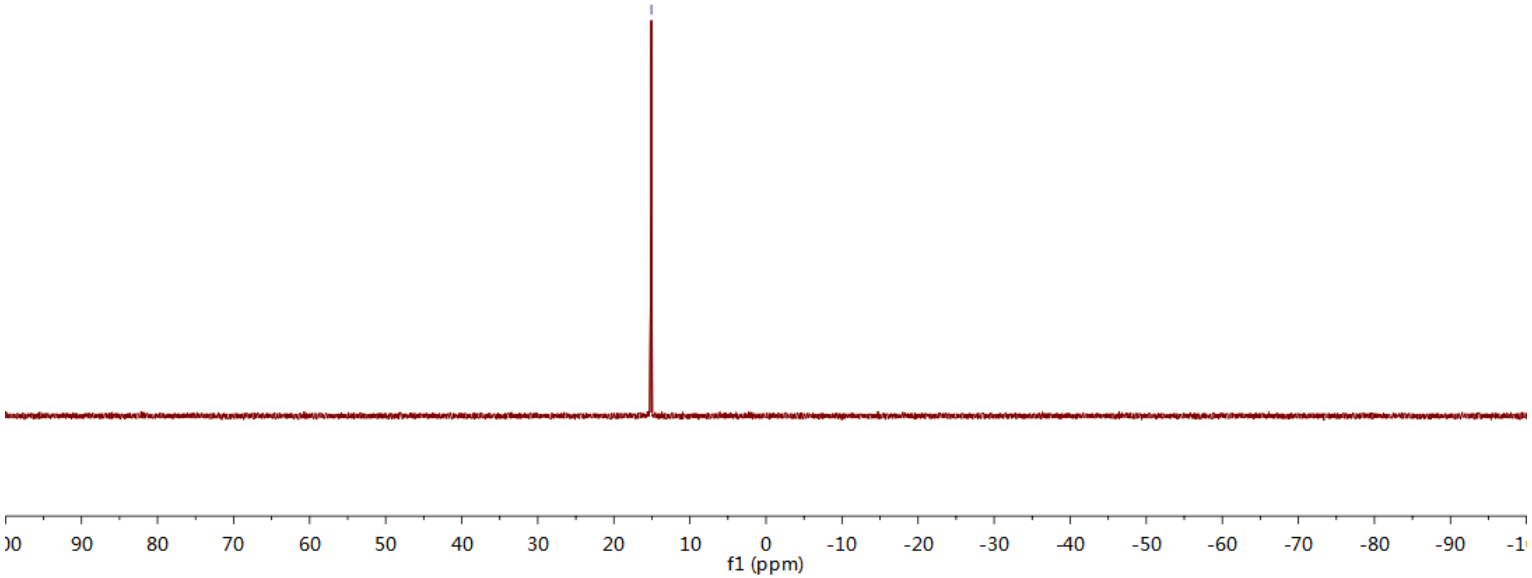

149.80
141.11
141.02
137.24
137.22
128.68
128.65
128.60
128.55
128.27
128.26
124.47
124.45
112.78
74.74
74.67
74.10
74.02
68.53
66.99
56.68
24.47
24.45
24.23
24.20
23.62
23.57
23.01
22.94
13C NMR ZY-3-60E in CDCl3
OMe
O
S
O
O
NH
Ph
PO(OiPr)2
2d 13C NMR (100 MHz, CDCl3)
f1 (ppm)

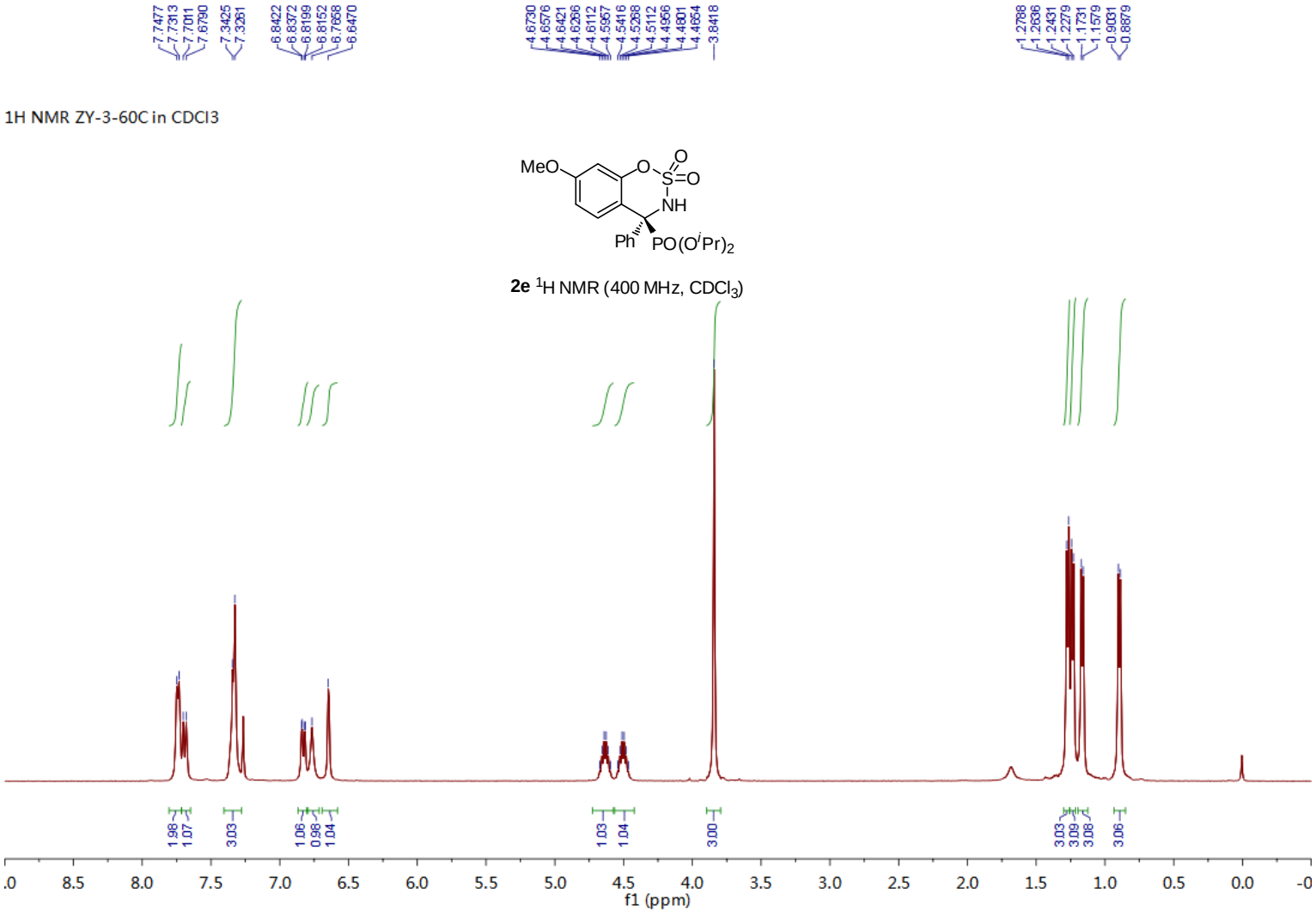
15.06

31P NMR ZY-3-60E in CDCl3

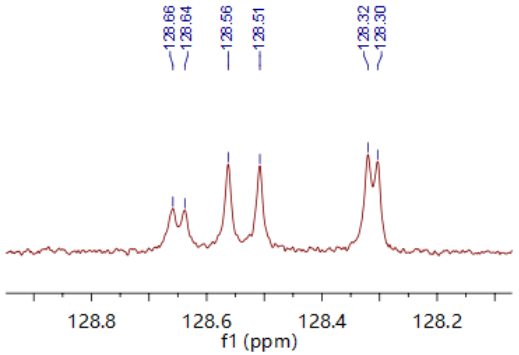


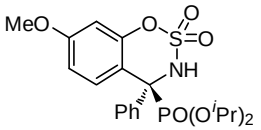

**2d** $^{31}$P NMR (162 MHz, $CDCl_3$)



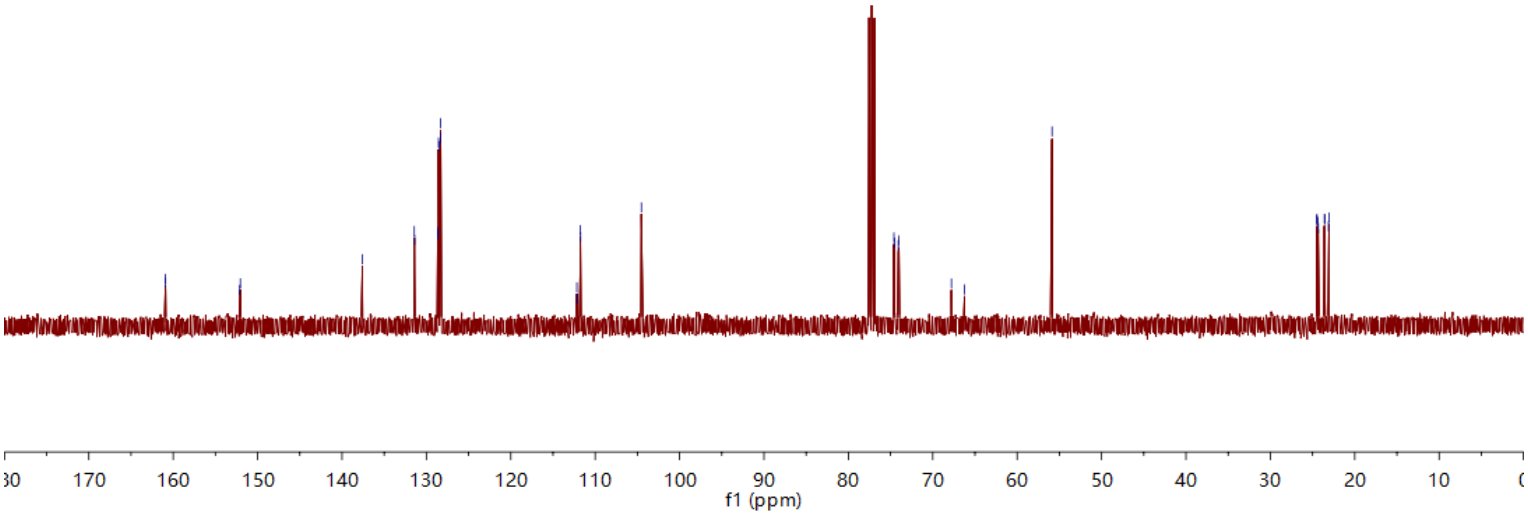

7.7477
7.7313
7.7011
7.6790
7.3425
7.3261
6.8422
6.8372
6.8199
6.8152
6.7868
6.6470
4.6730
4.6576
4.6421
4.6266
4.6112
4.5967
4.5416
4.5268
4.5112
4.4956
4.4801
4.4654
3.8418
1.2788
1.2636
1.2431
1.2279
1.1731
1.1579
0.9031
0.8879
1H NMR ZY-3-60C in CDCl3
MeO
O
S
O
O
NH
Ph
PO(OiPr)2
2e 1H NMR (400 MHz, CDCl3)
1.98
1.07
3.03
1.06
0.98
1.04
1.03
1.04
3.00
3.03
3.09
3.08
3.06
f1 (ppm)

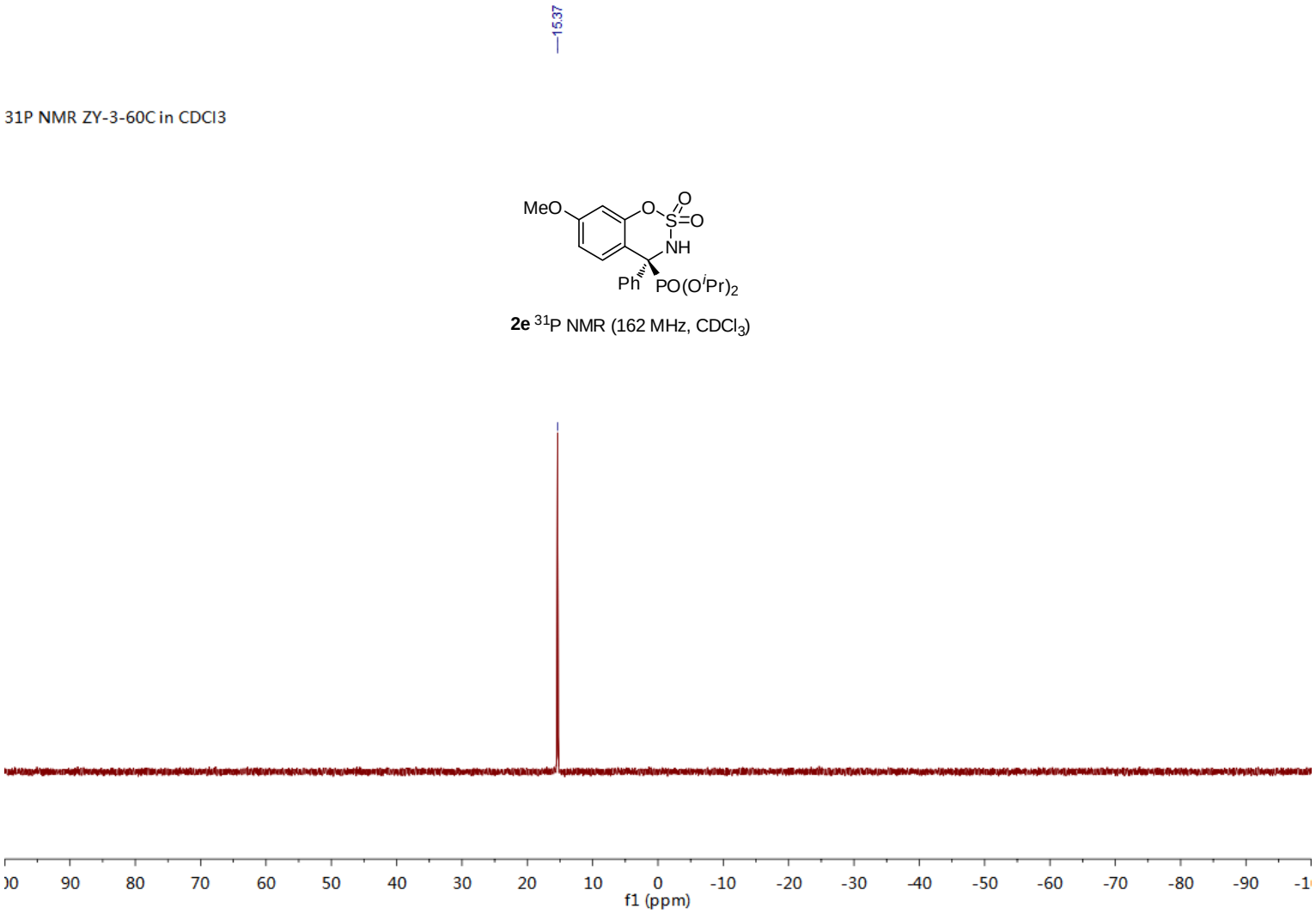

13C NMR ZY-3-60C in CDCl3



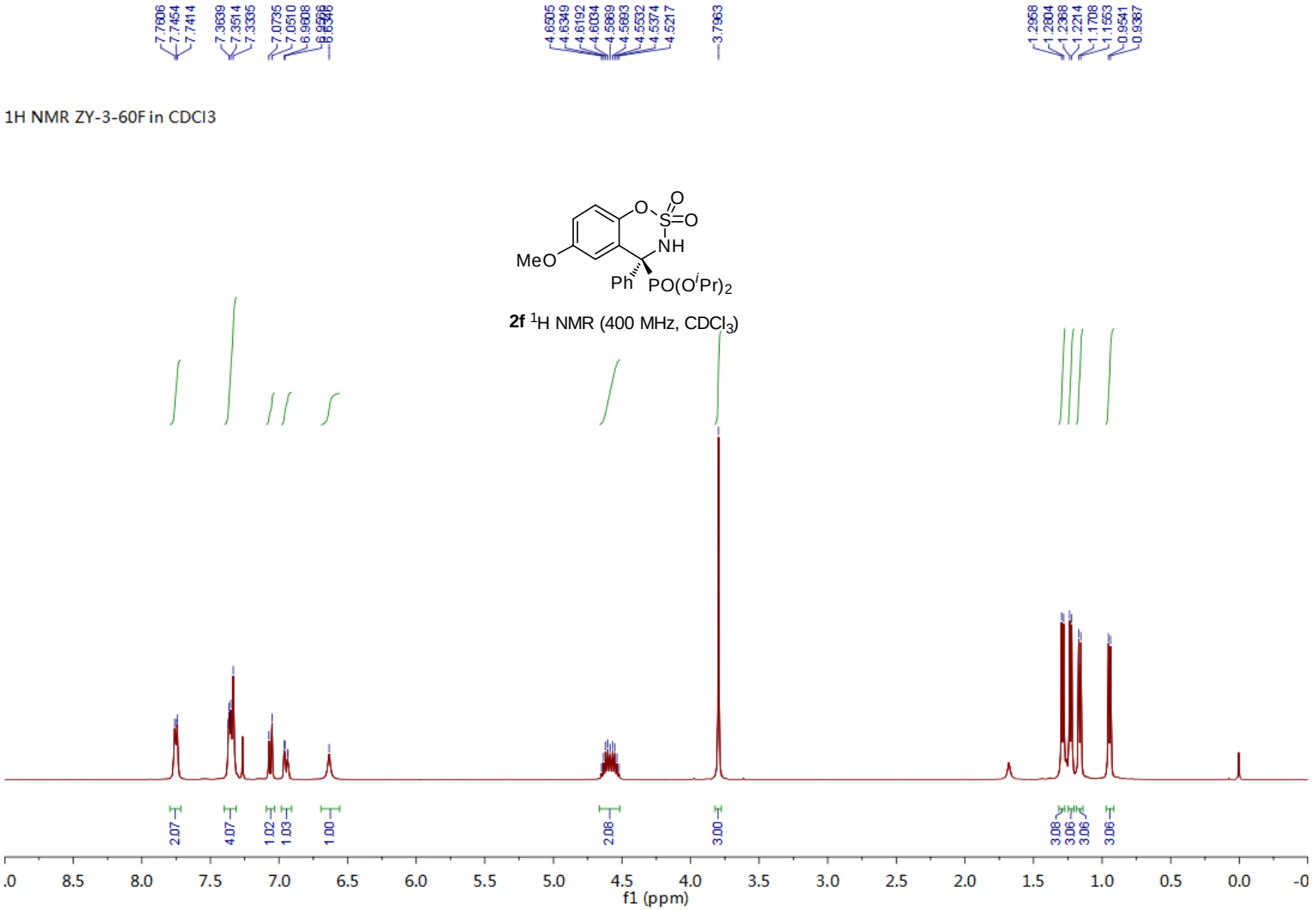

**2e** $^{13}$C NMR (100 MHz, $CDCl_3$)



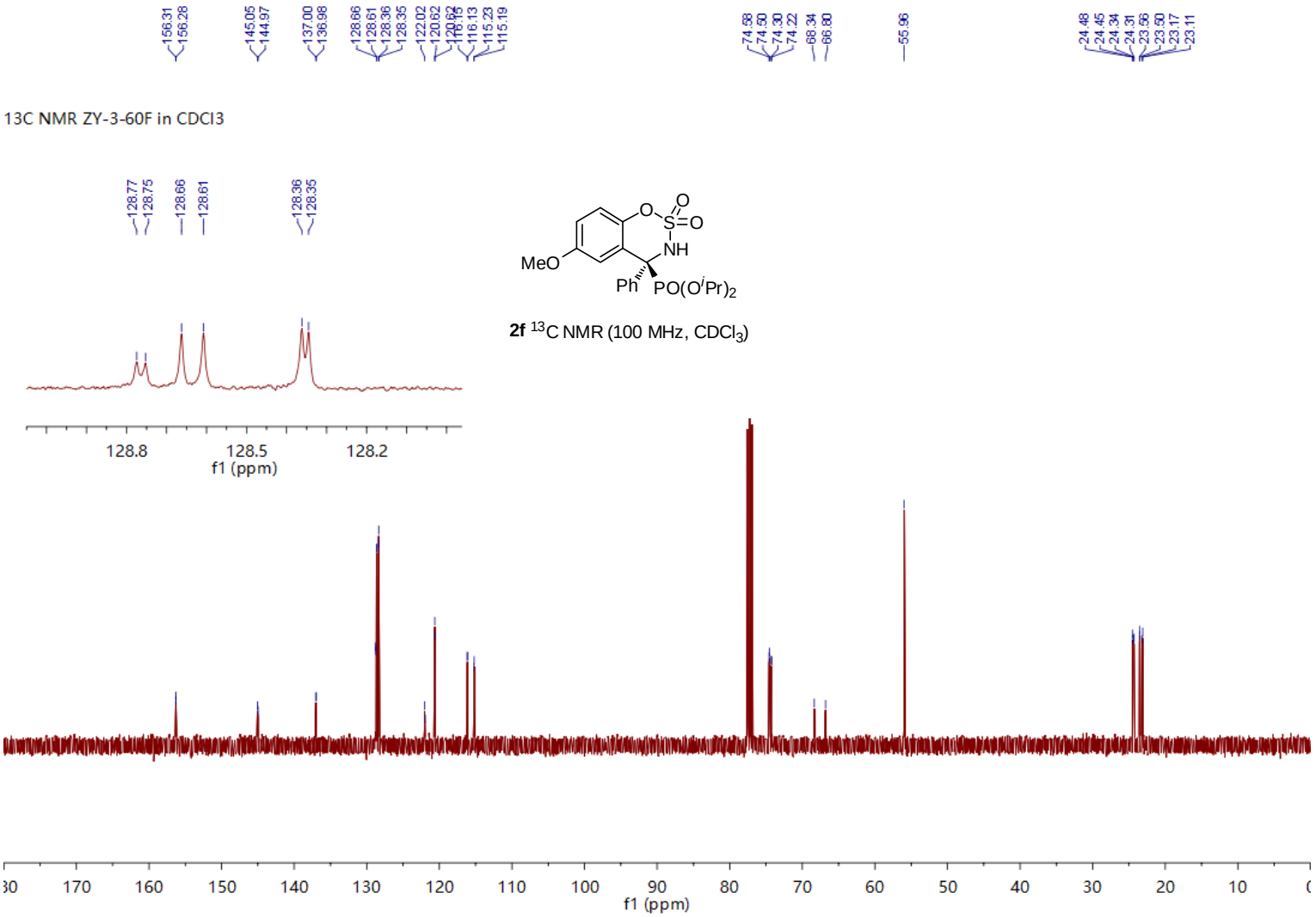



**2e** $^{31}$P NMR (162 MHz, $CDCl_3$)

1H NMR ZY-3-60F in CDCl3



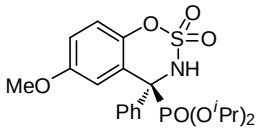

**2f** $^1$H NMR (400 MHz, $CDCl_3$)



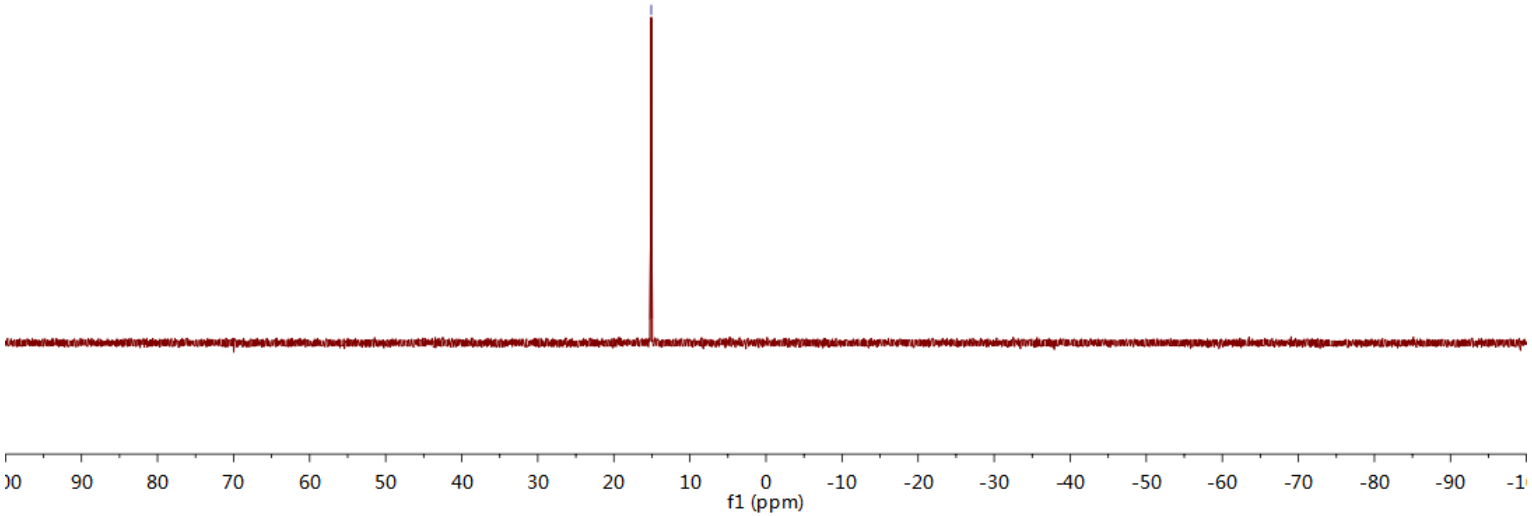

**2f** $^{13}$C NMR (100 MHz, $CDCl_3$)

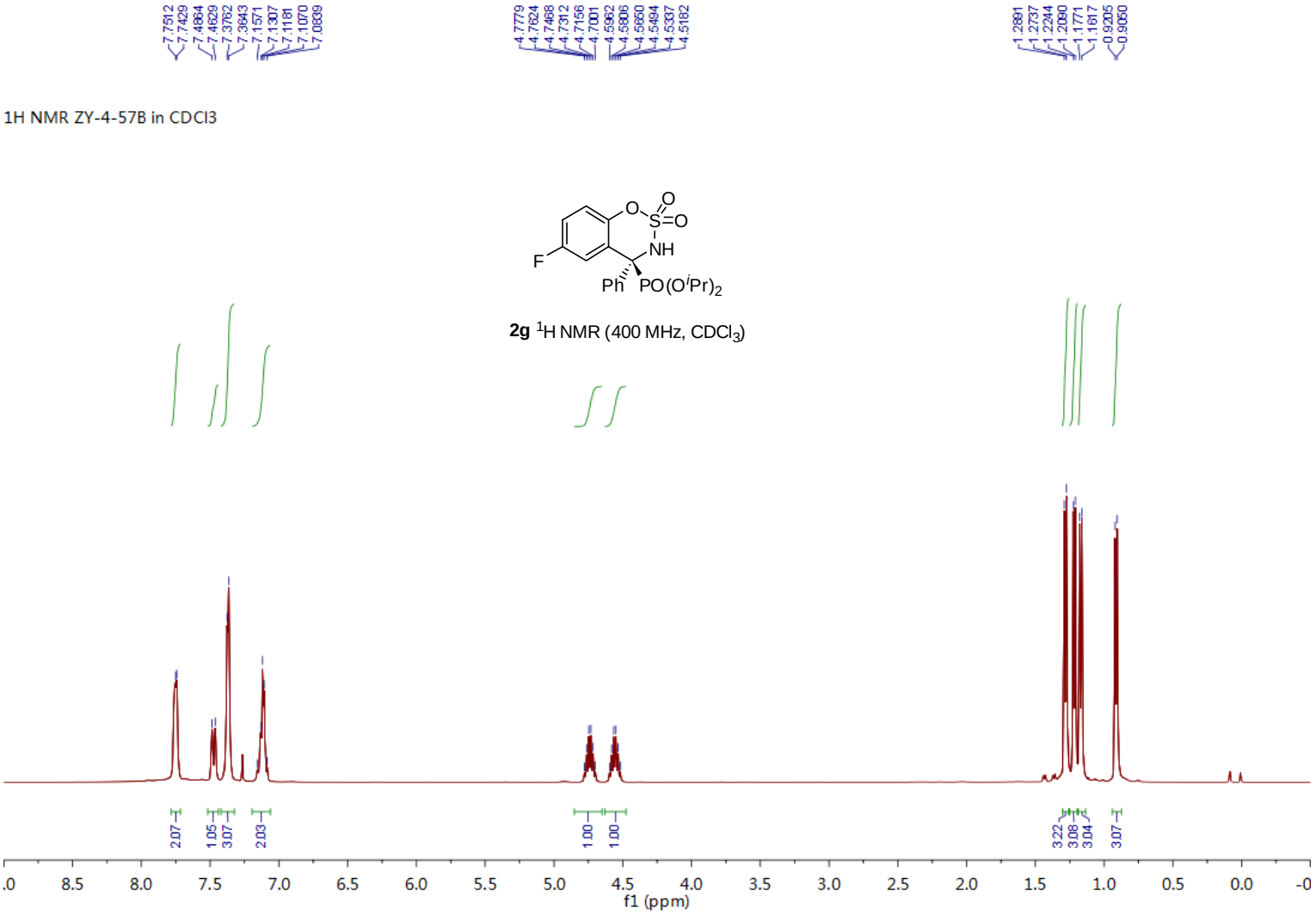
15.08

31P NMR ZY-3-60F in CDCl3

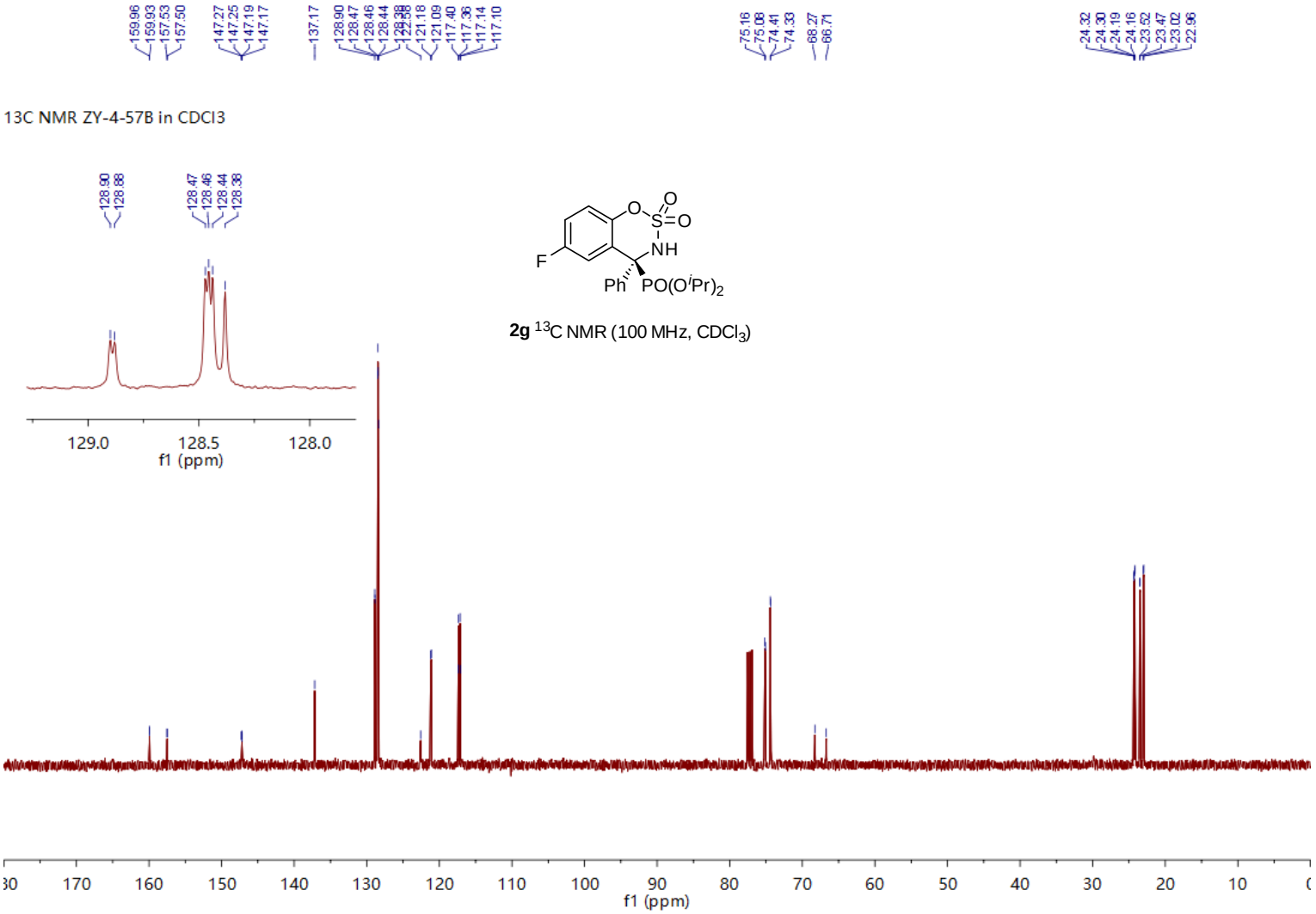



**2f** $^{31}$P NMR (162 MHz, $CDCl_3$)

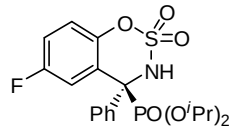





**2g** $^1$H NMR (400 MHz, $CDCl_3$)


159.96
159.93
157.53
157.50
147.27
147.25
147.19
147.17
137.17
128.90
128.47
128.46
128.44
128.38
121.18
121.09
117.40
117.36
117.14
117.10
75.16
75.08
74.41
74.33
68.27
66.71
24.32
24.30
24.19
24.16
23.52
23.47
23.02
22.96
13C NMR ZY-4-57B in CDCl3
128.90
128.88
128.47
128.46
128.44
128.38
129.0
128.5
128.0
f1 (ppm)
F
O
S
O
O
NH
Ph
PO(OiPr)2
2g 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

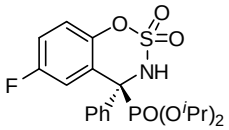
19F NMR ZY-4-57B in CDCl3



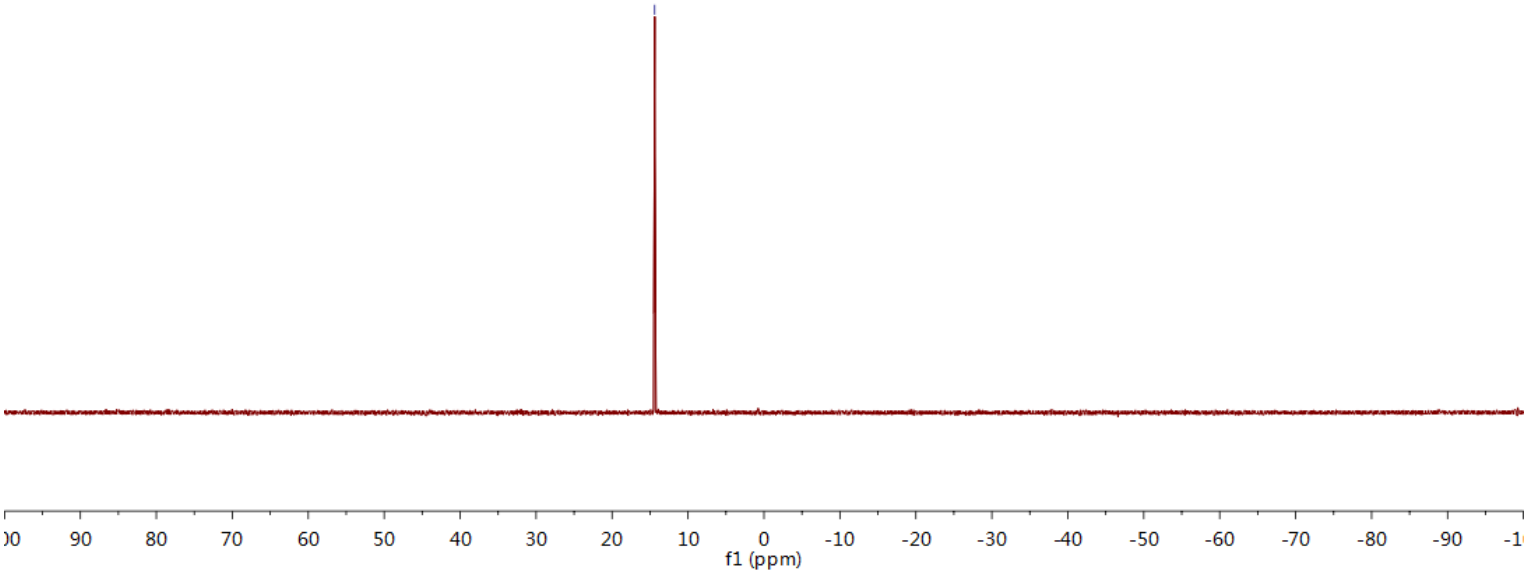

**2g** $^{19}F$ NMR (367 MHz, $CDCl_3$)

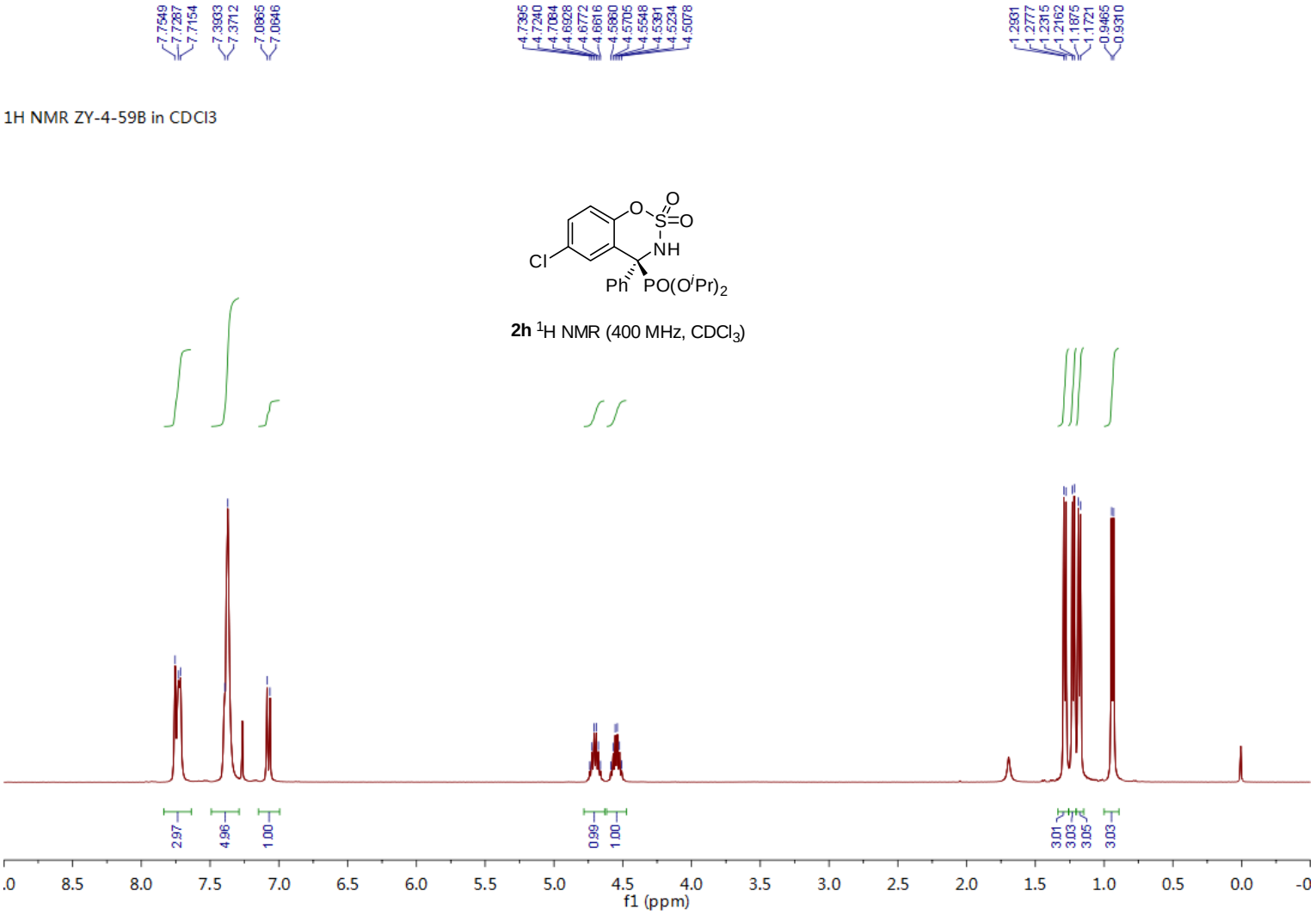
14.39

31P NMR ZY-4-57B in CDCl3

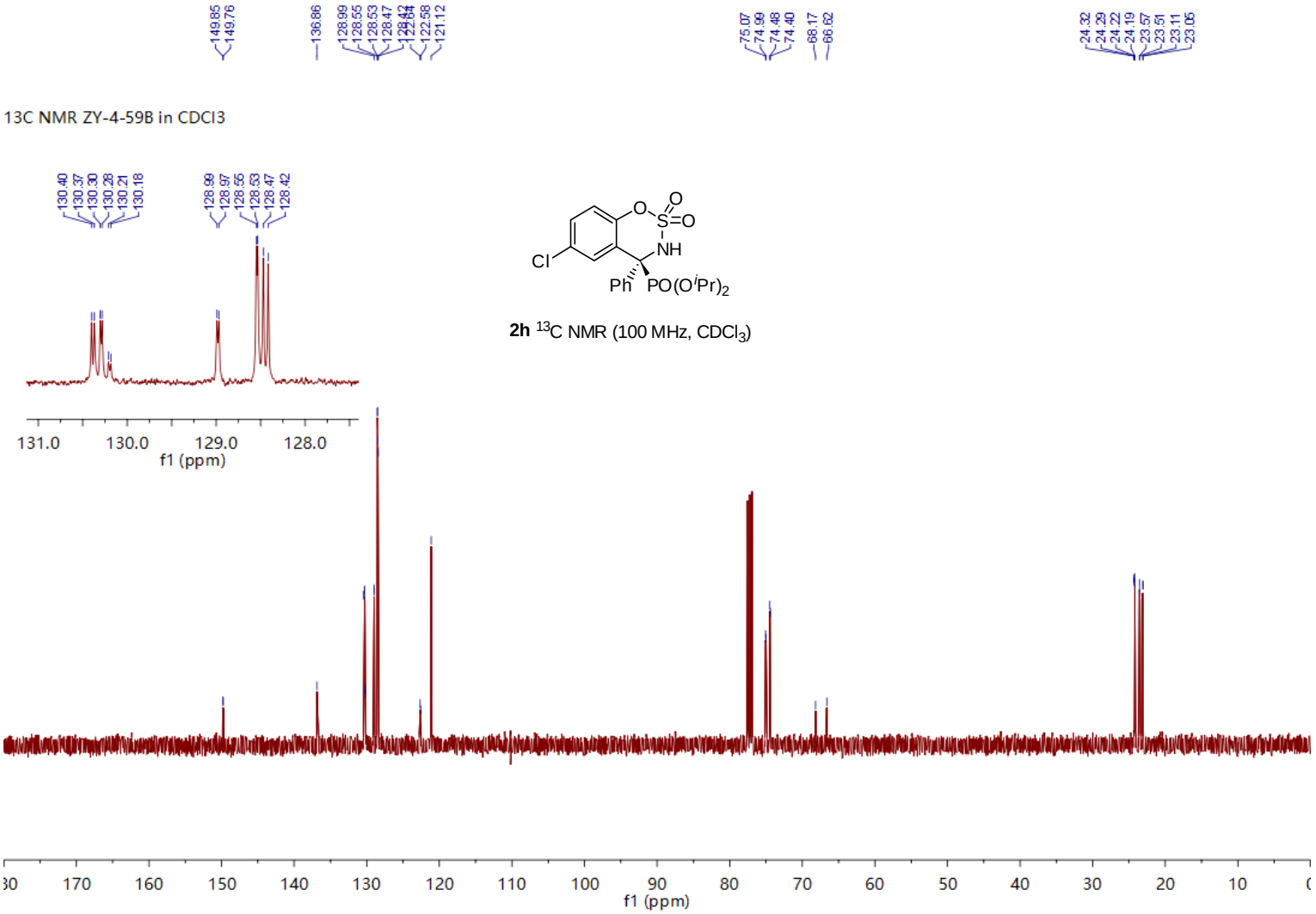



**2g** $^{31}$P NMR (162 MHz, $CDCl_3$)



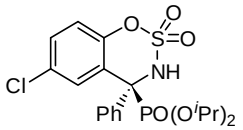



**2h** $^{1}$H NMR (400 MHz, $CDCl_3$)

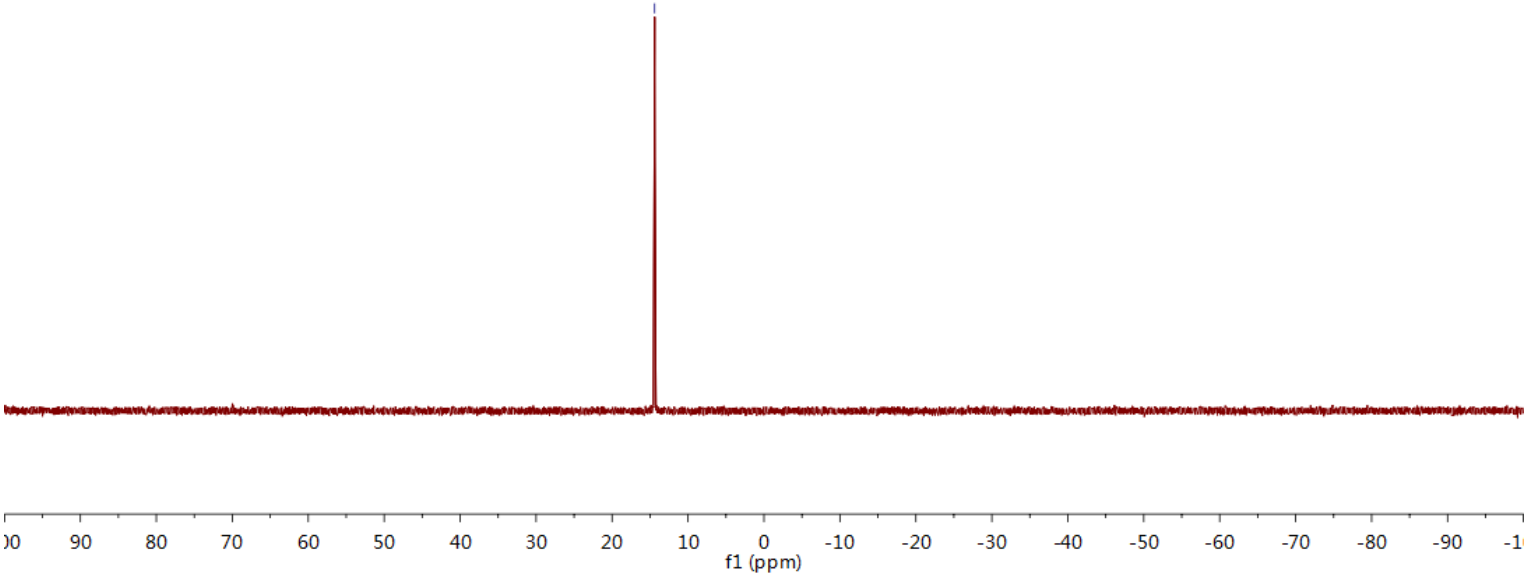

149.85
149.76
136.86
128.99
128.55
128.53
128.47
122.58
121.12
75.07
74.99
74.48
74.40
68.17
66.62
24.32
24.29
24.22
24.19
23.57
23.51
23.11
23.05
13C NMR ZY-4-59B in CDCl3
130.40
130.37
130.30
130.28
130.21
130.18
128.99
128.97
128.55
128.53
128.47
128.42
131.0
130.0
129.0
128.0
f1 (ppm)
O
O
S=O
NH
Cl
Ph
PO(OiPr)2
2h 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

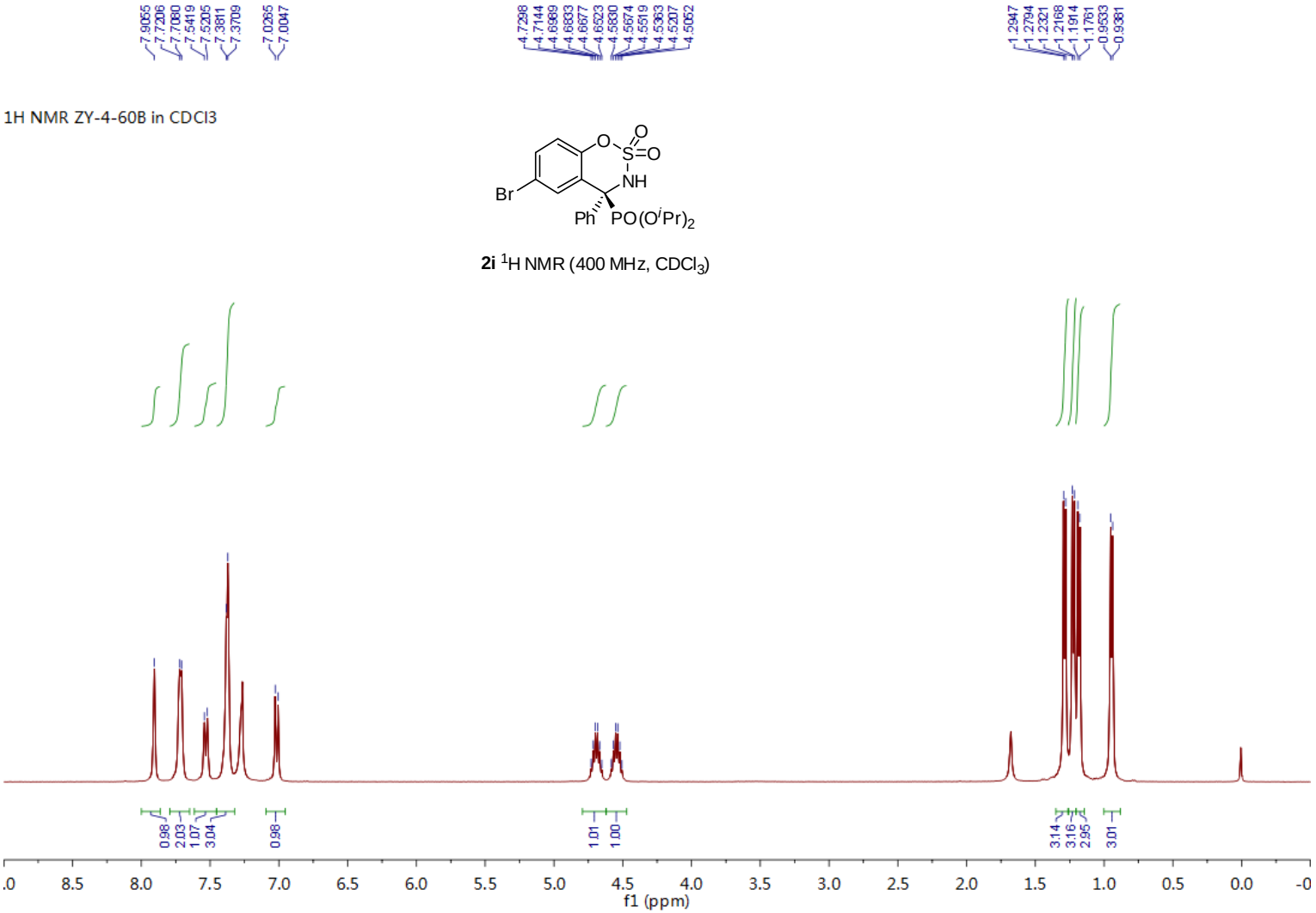
14.39

31P NMR ZY-4-59B in CDCl3

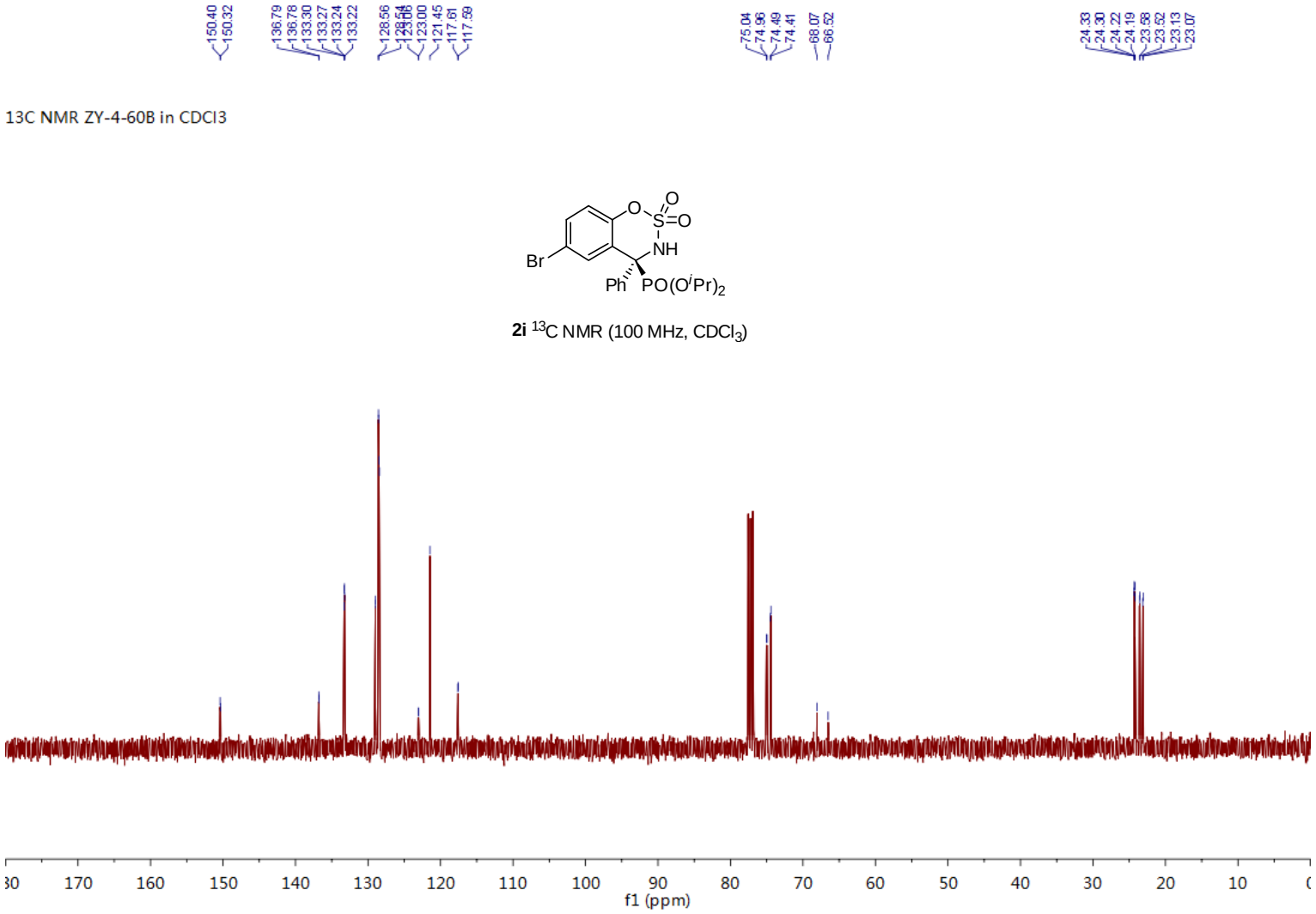



**2h** $^{31}$P NMR (162 MHz, $CDCl_3$)





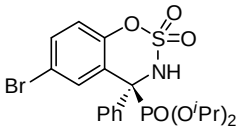

**2i** $^1$H NMR (400 MHz, $CDCl_3$)



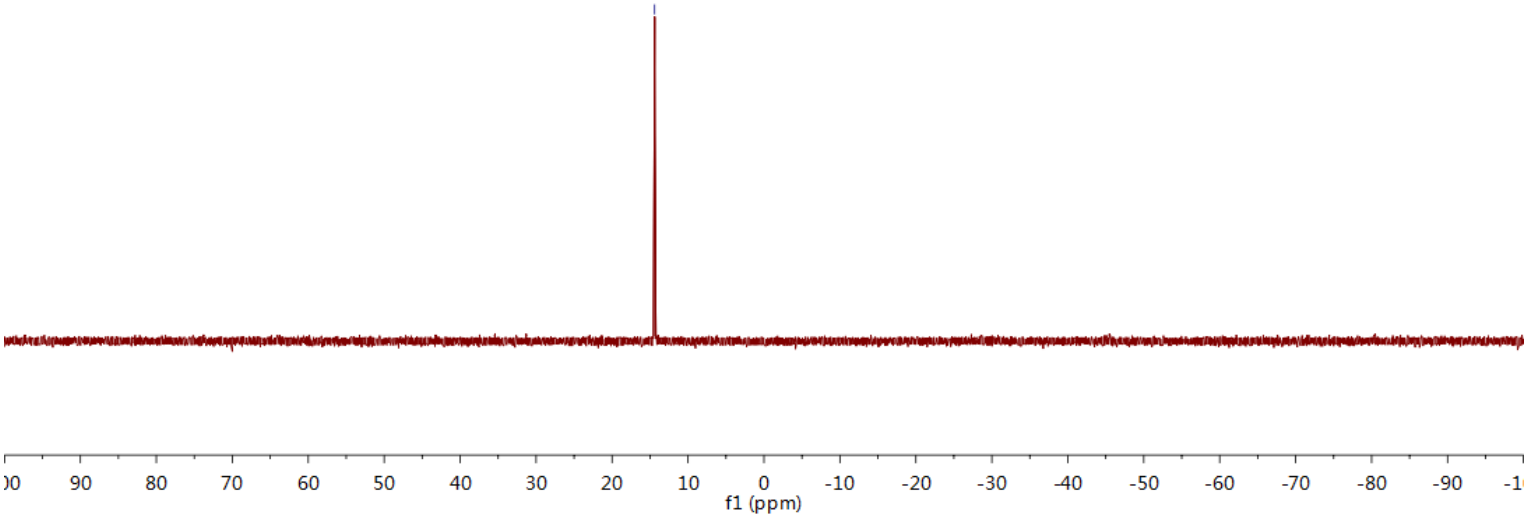

**2i** $^{13}$C NMR (100 MHz, $CDCl_3$)

14.40

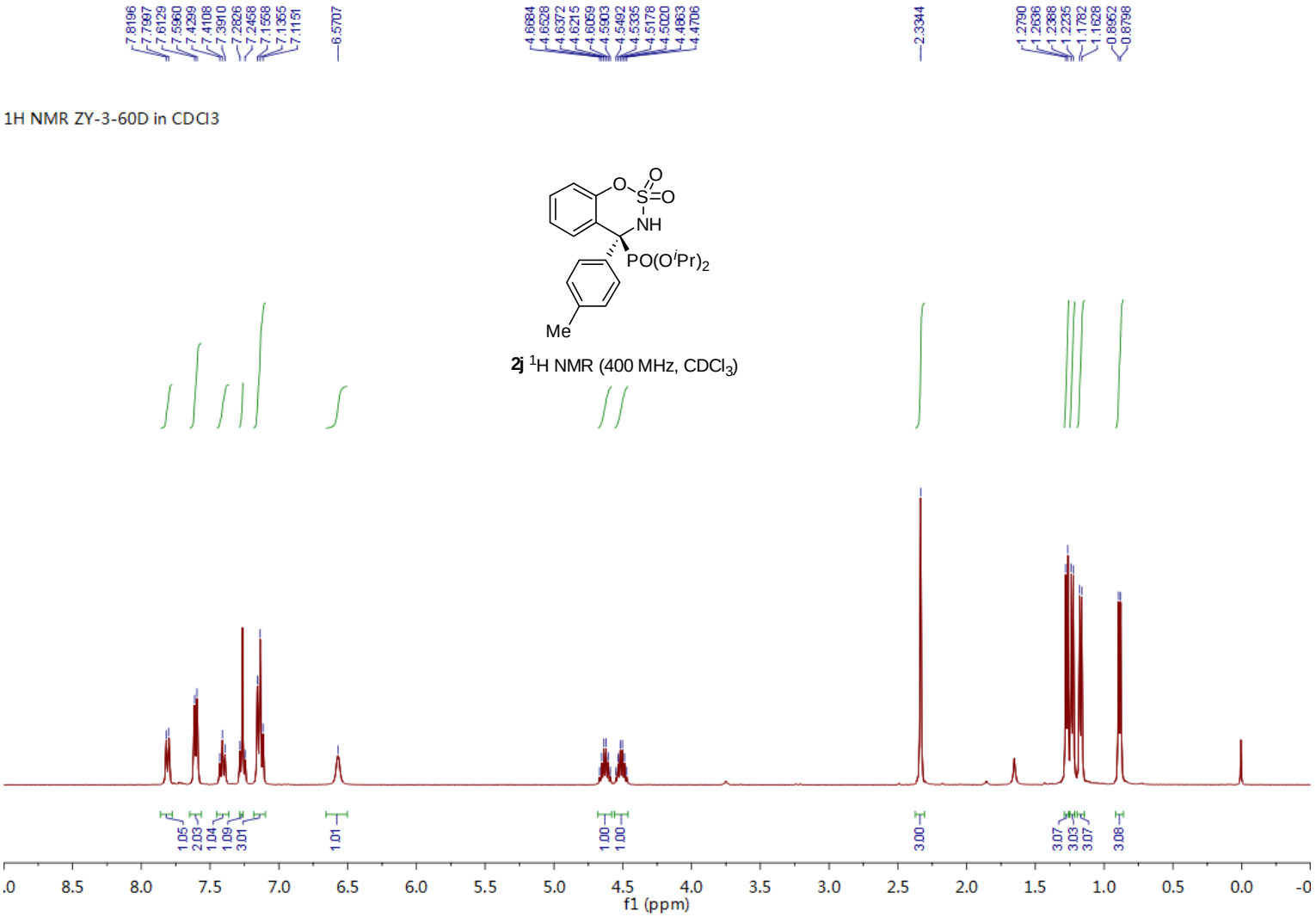
31P NMR ZY-4-60B in CDCl3



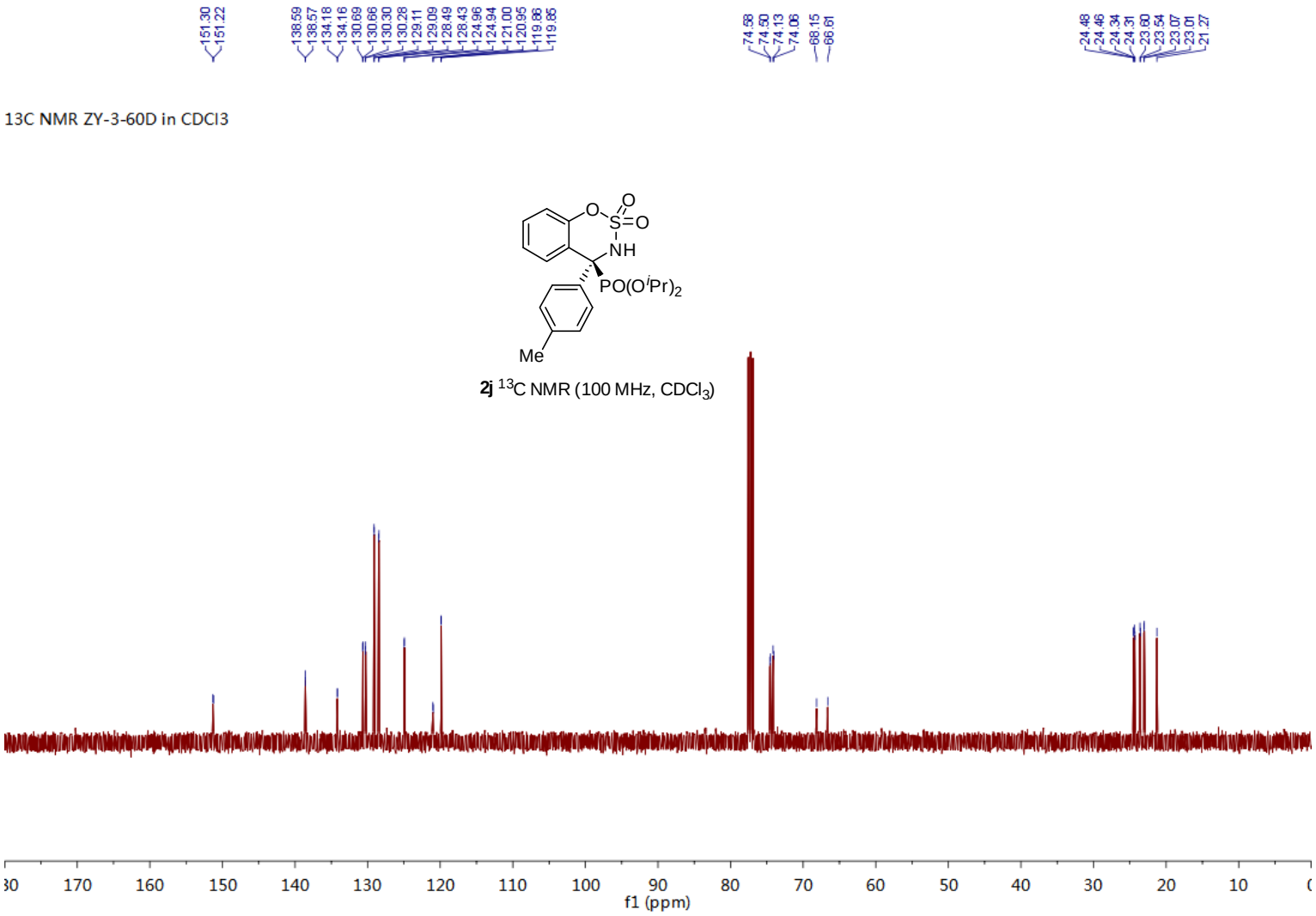

**2i** $^{31}$P NMR (162 MHz, $CDCl_3$)



1H NMR ZY-3-60D in CDCl3



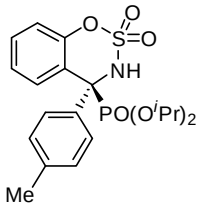

**2j** $^1$H NMR (400 MHz, $CDCl_3$)



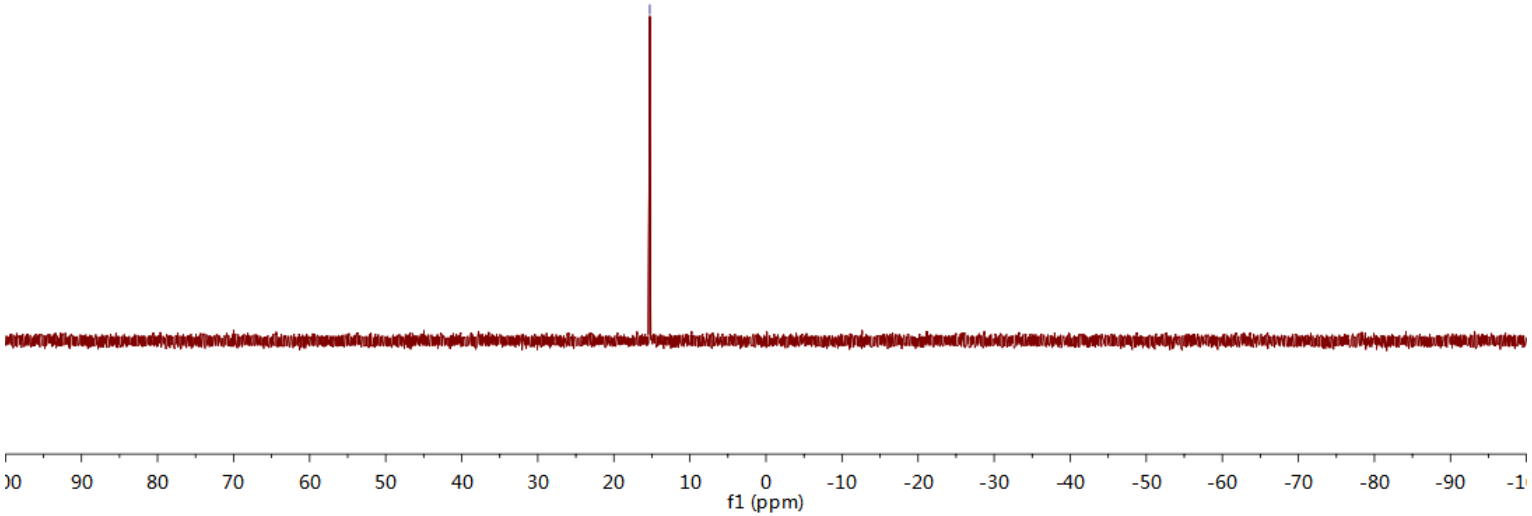

**2j** $^{13}$C NMR (100 MHz, $CDCl_3$)

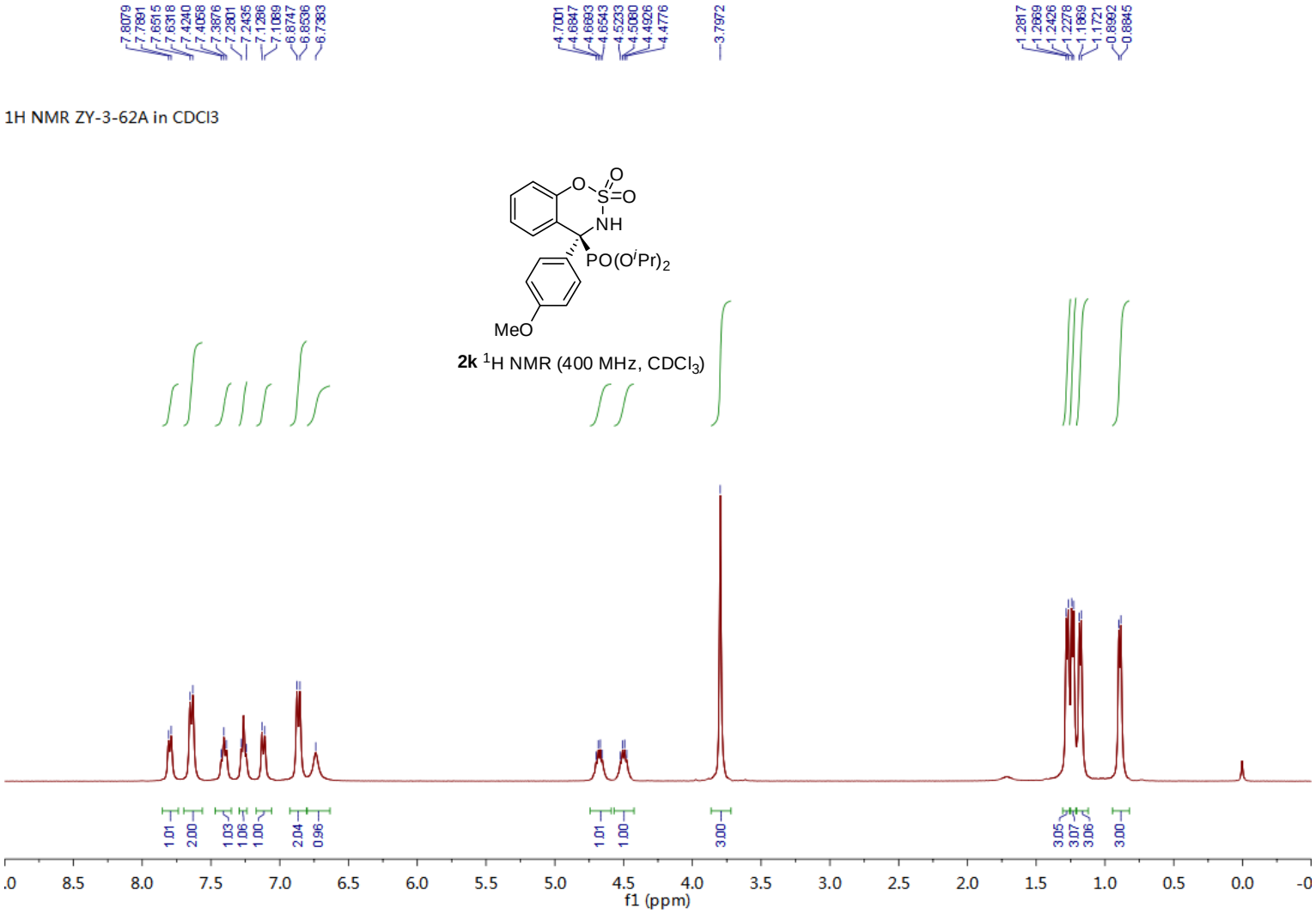
15.28

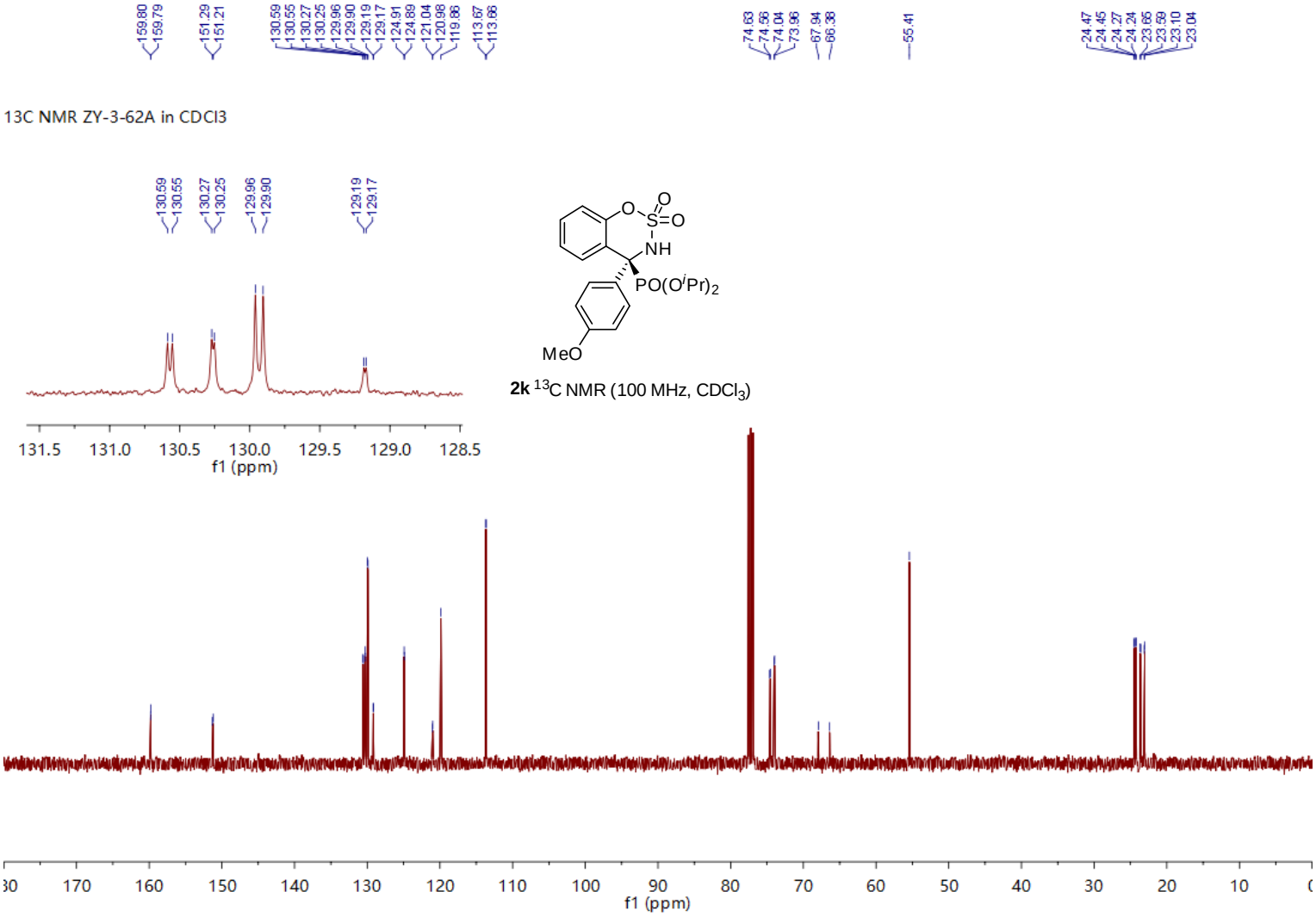
31P NMR ZY-3-60D in CDCl3



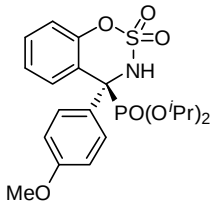

**2j** $^{31}$P NMR (162 MHz, $CDCl_3$)



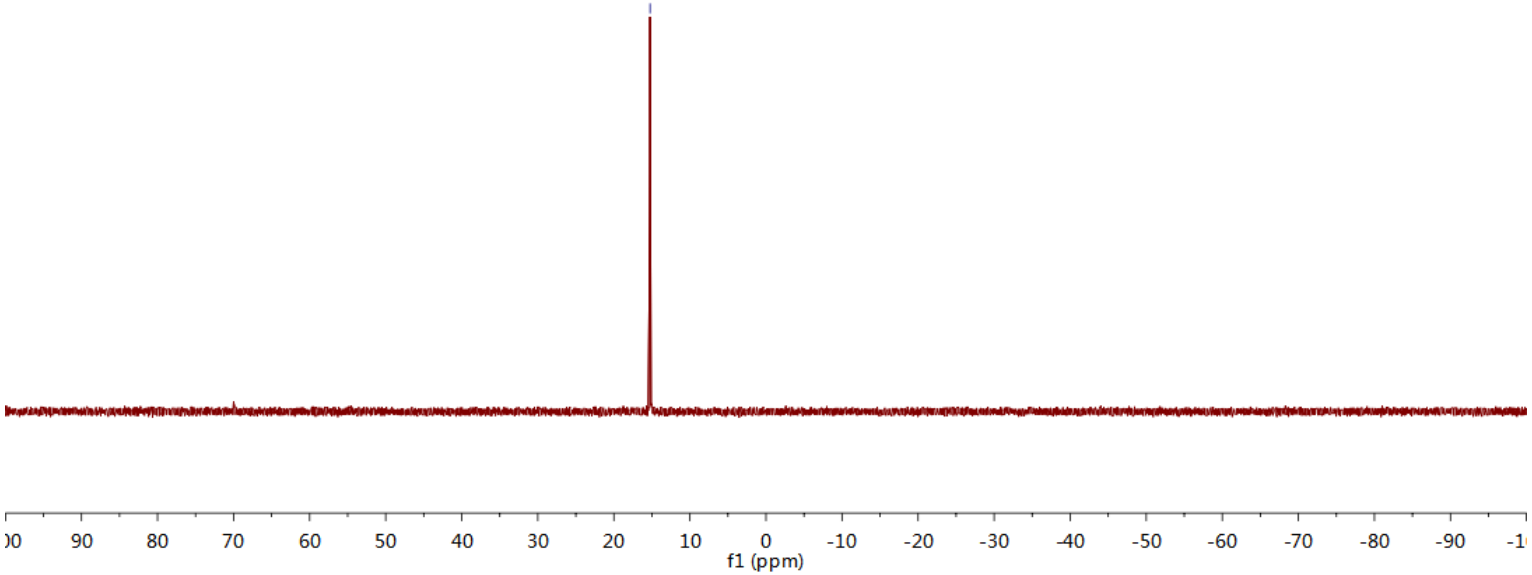

7.8079
7.7891
7.6515
7.6318
7.4240
7.4058
7.3876
7.2801
7.2435
7.1286
7.1089
6.8747
6.8536
6.7383
4.7001
4.6847
4.6693
4.6543
4.5233
4.5080
4.4926
4.4776
3.7972
1.2817
1.2669
1.2426
1.2278
1.1869
1.1721
0.8992
0.8845
1H NMR ZY-3-62A in CDCl3
O
O
S=O
NH
PO(O$^i$Pr)$_2$
MeO
**2k** $^1$H NMR (400 MHz, $CDCl_3$)
1.01
2.00
1.03
1.06
1.00
2.04
0.96
1.01
1.00
3.00
3.05
3.07
3.06
3.00
f1 (ppm)

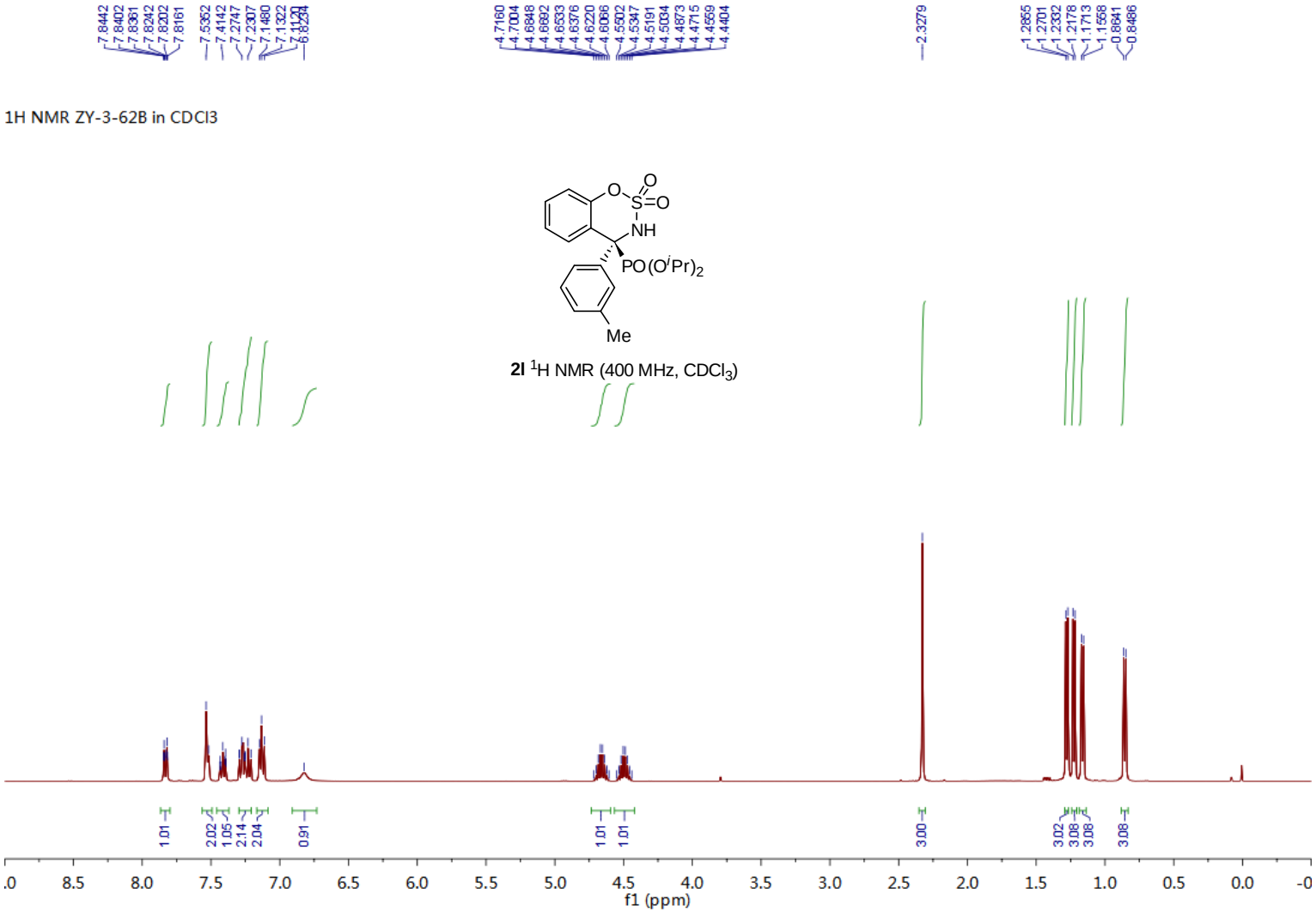

159.80
159.79
151.29
151.21
130.59
130.55
130.27
130.25
129.96
129.90
129.19
129.17
124.91
124.89
121.04
120.98
119.86
113.67
113.66
74.63
74.66
74.04
73.96
67.94
66.38
55.41
24.47
24.45
24.27
24.24
23.86
23.69
23.10
23.04
13C NMR ZY-3-62A in CDCl3
130.59
130.55
130.27
130.25
129.96
129.90
129.19
129.17
131.5
131.0
130.5
130.0
129.5
129.0
128.5
f1 (ppm)
O
S
O
O
NH
PO(OiPr)2
MeO
2k 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

31P NMR ZY-3-62A in CDCl3

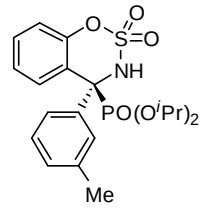



**2k** $^{31}$P NMR (162 MHz, $CDCl_3$)

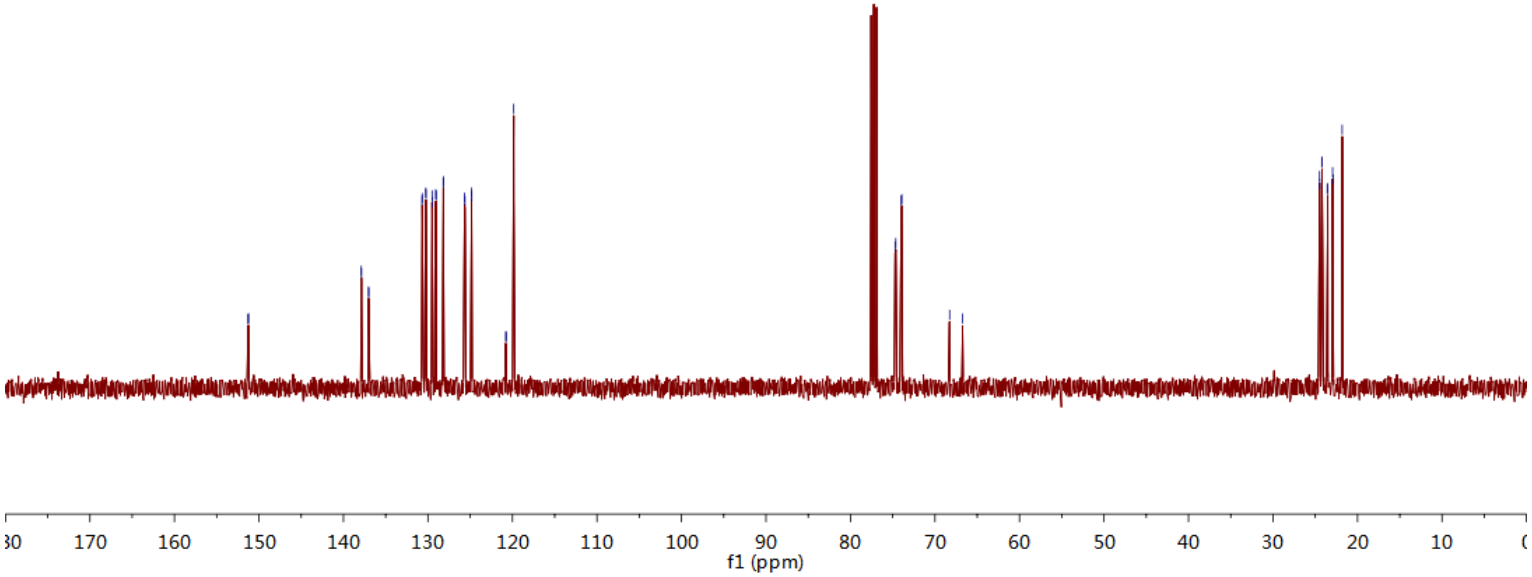


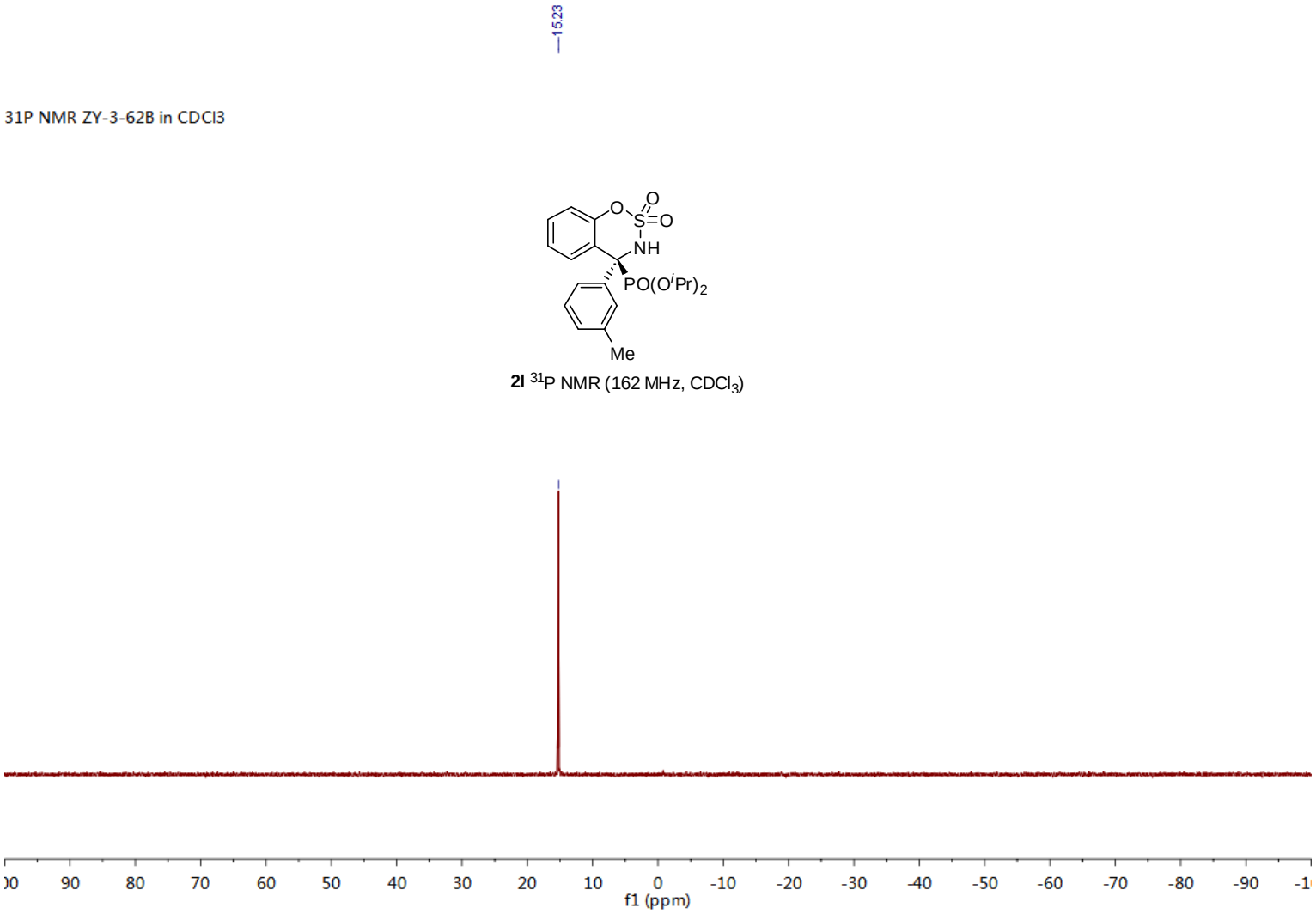

7.8442
7.8402
7.8361
7.8242
7.8202
7.8161
7.5362
7.4142
7.2747
7.2307
7.1480
7.1322
7.1124
6.8234
4.7160
4.7004
4.6848
4.6692
4.6533
4.6376
4.6220
4.6066
4.5802
4.5347
4.5191
4.5034
4.4873
4.4715
4.4559
4.4404
2.3279
1.2865
1.2701
1.2332
1.2178
1.1713
1.1558
0.8641
0.8486
1H NMR ZY-3-62B in CDCl3
O
O
S=O
NH
PO(O$^i$Pr)$_2$
Me
**2l** $^1$H NMR (400 MHz, CDCl$_3$)
1.01
2.02
1.05
2.14
2.04
0.91
1.01
1.01
3.00
3.02
3.08
3.08
3.08
f1 (ppm)


13C NMR ZY-3-62B in CDCl3



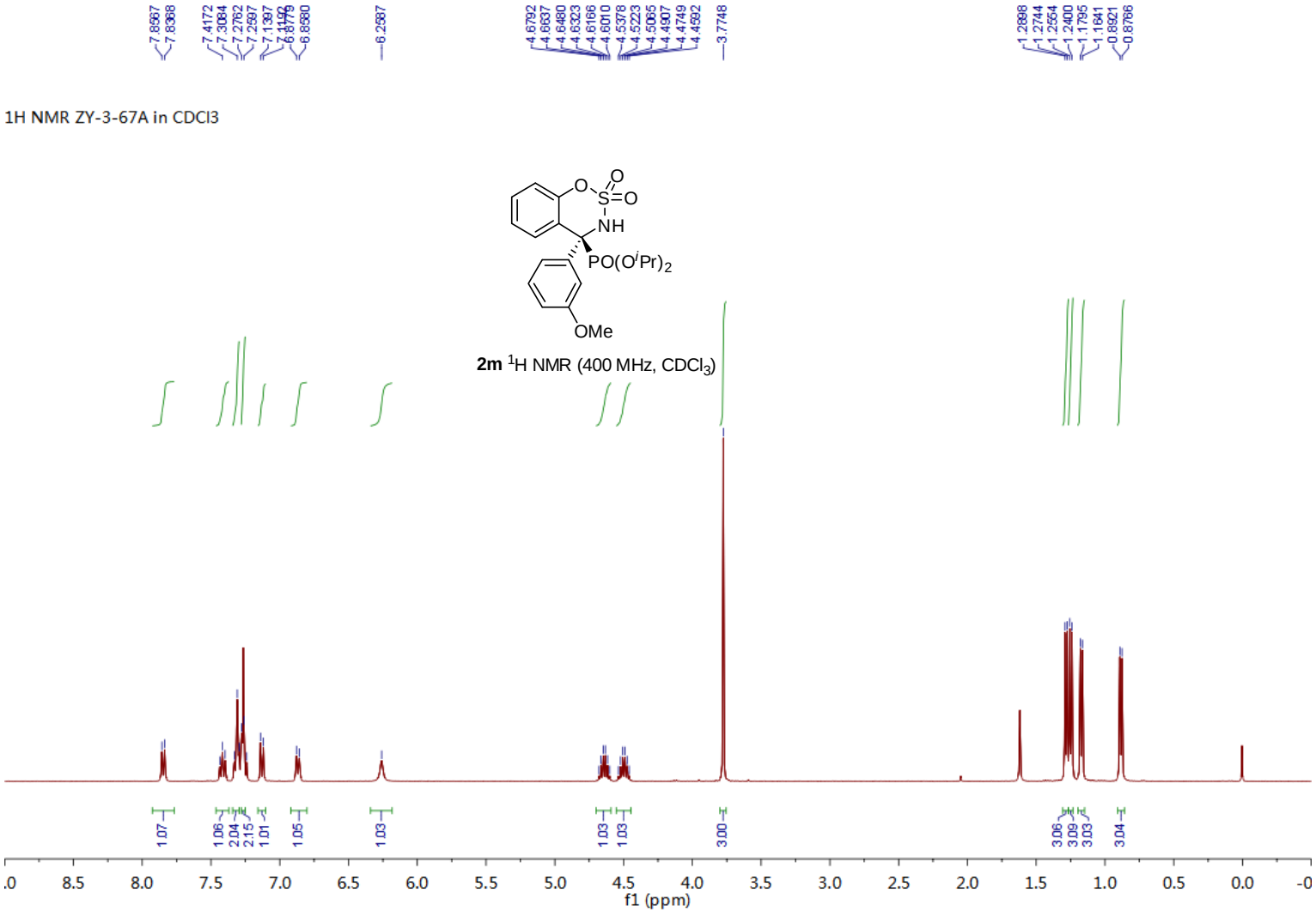

**2l** $^{13}$C NMR (100 MHz, $CDCl_3$)



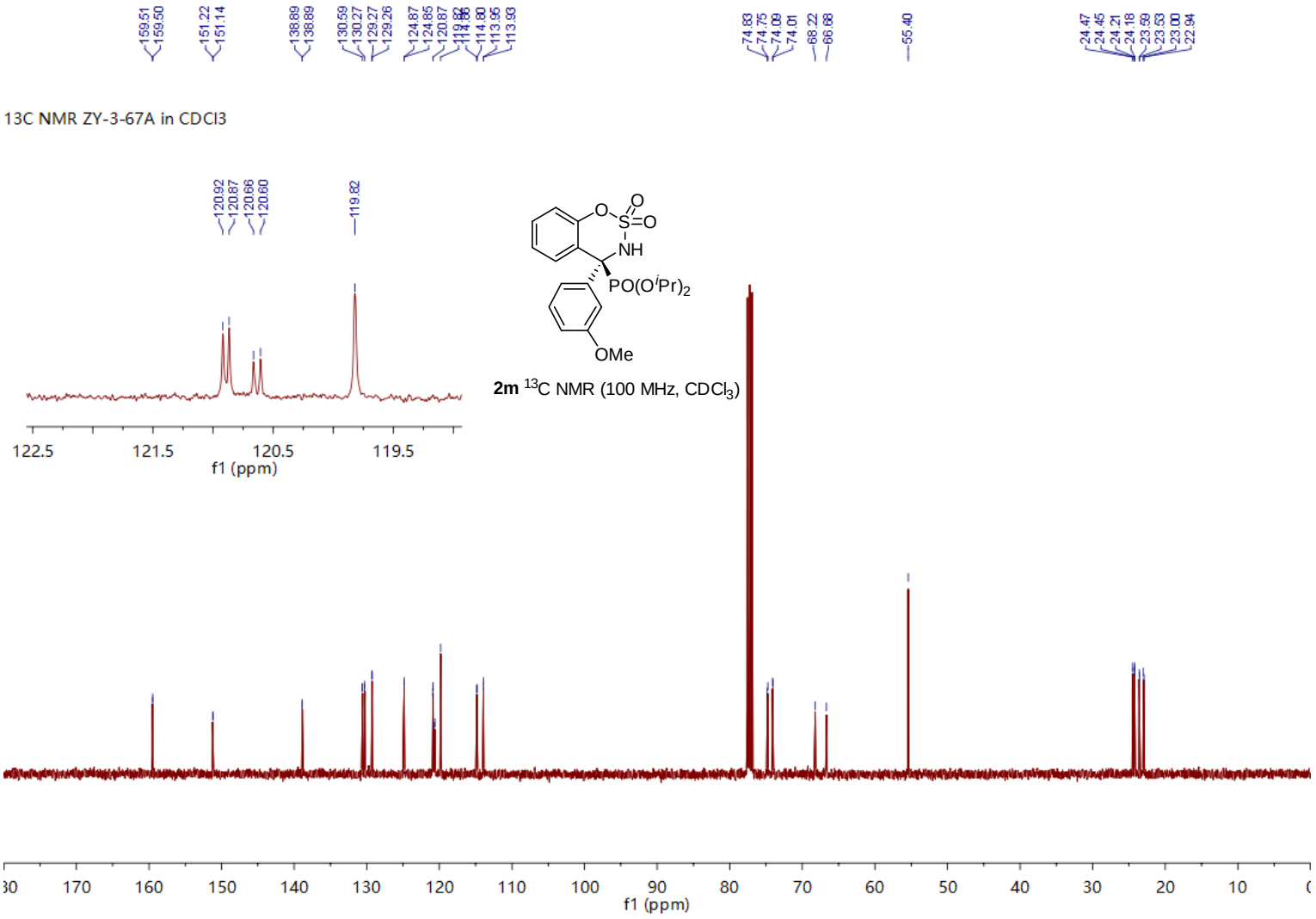



**2l** $^{31}$P NMR (162 MHz, $CDCl_3$)

1H NMR ZY-3-67A in CDCl3

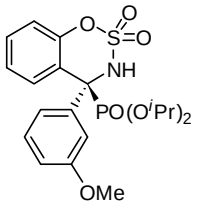



**2m** $^1$H NMR (400 MHz, $CDCl_3$)

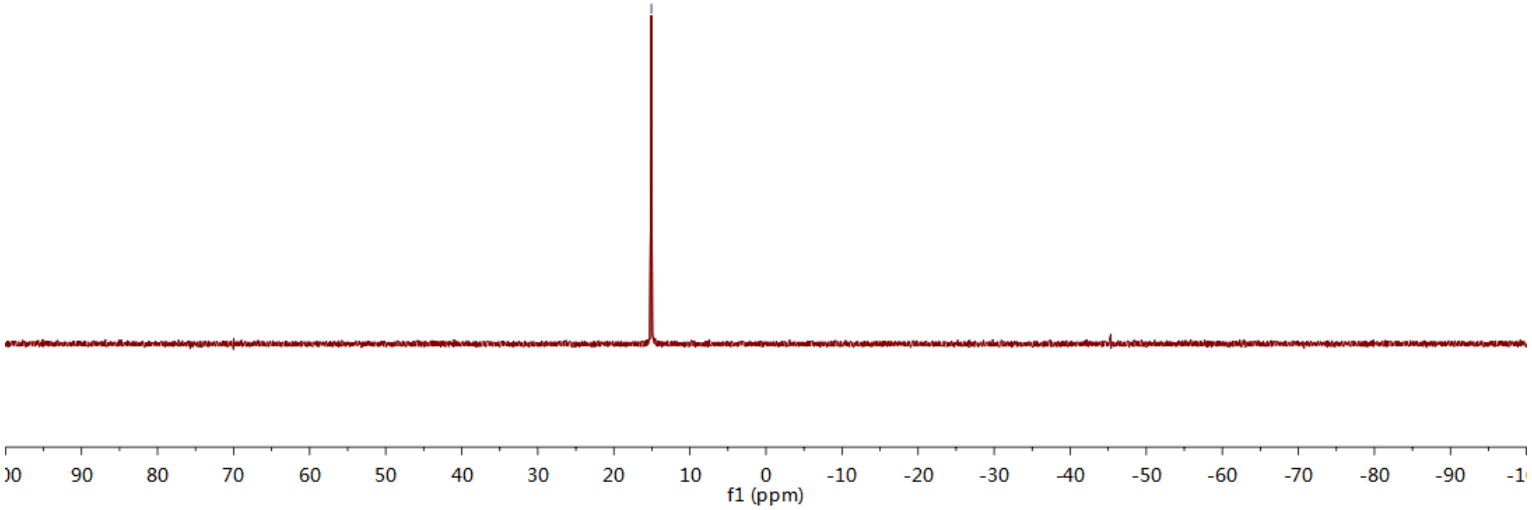

159.51
159.50
151.22
151.14
138.89
138.89
130.59
130.27
129.27
129.26
124.87
124.85
120.87
114.80
113.95
113.93
74.83
74.75
74.09
74.01
68.22
66.68
55.40
24.47
24.45
24.21
24.18
23.59
23.53
23.00
22.94
13C NMR ZY-3-67A in CDCl3
120.92
120.87
120.66
120.60
119.82
122.5
121.5
120.5
119.5
f1 (ppm)
O
O
S=O
NH
PO(O$^i$Pr)$_2$
OMe
**2m** $^{13}$C NMR (100 MHz, $CDCl_3$)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

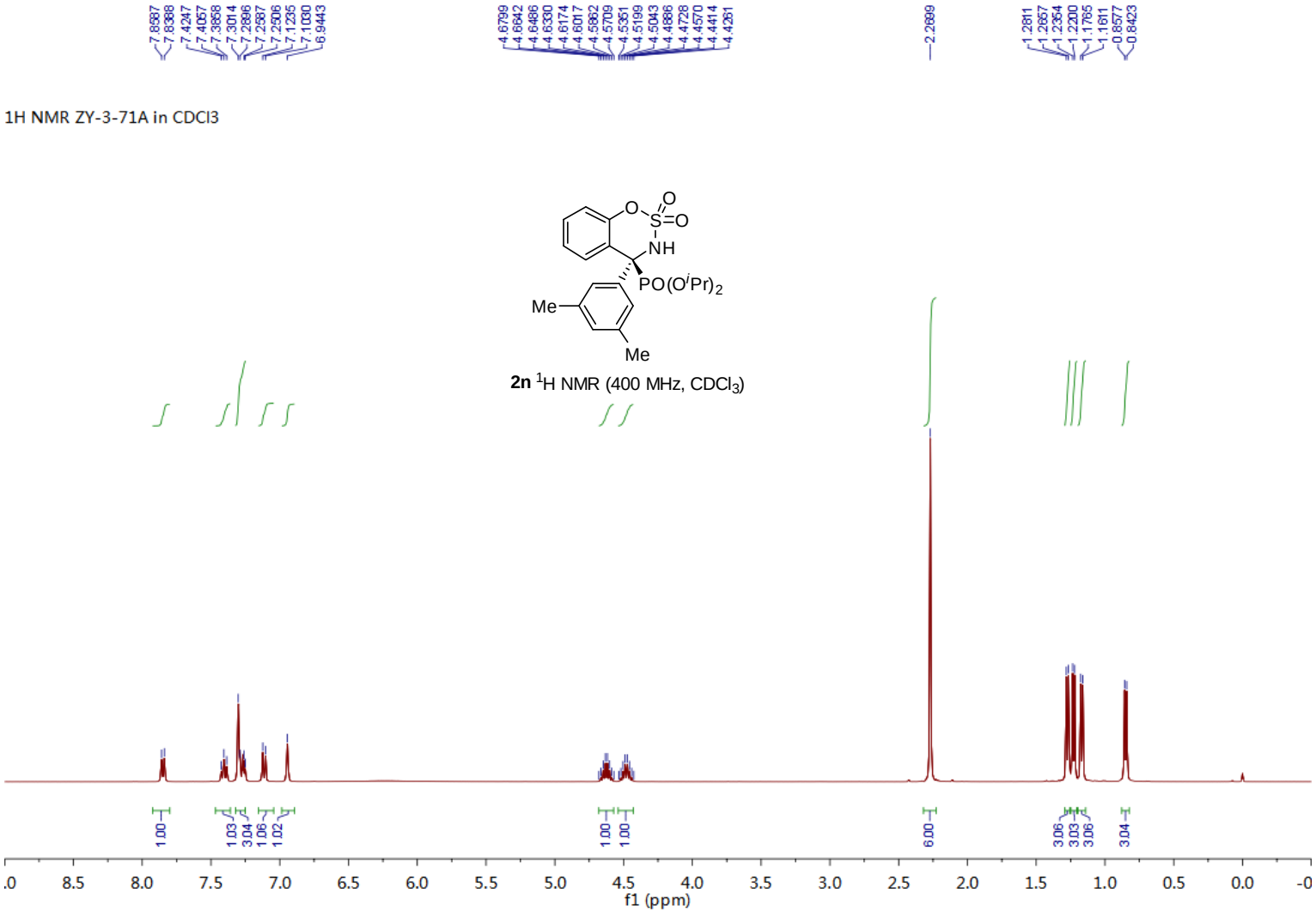
15.07

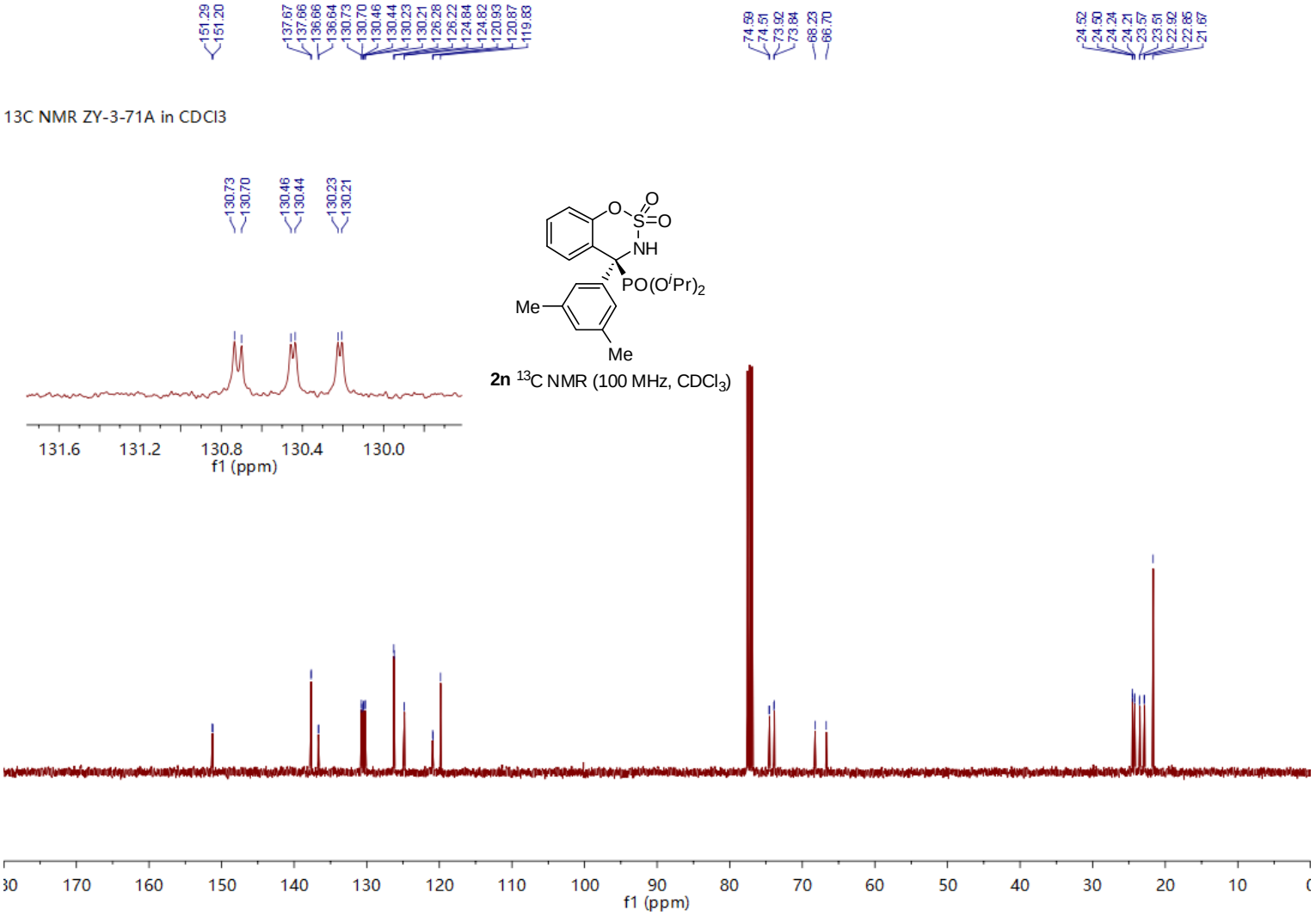
31P NMR ZY-3-67A in CDCl3

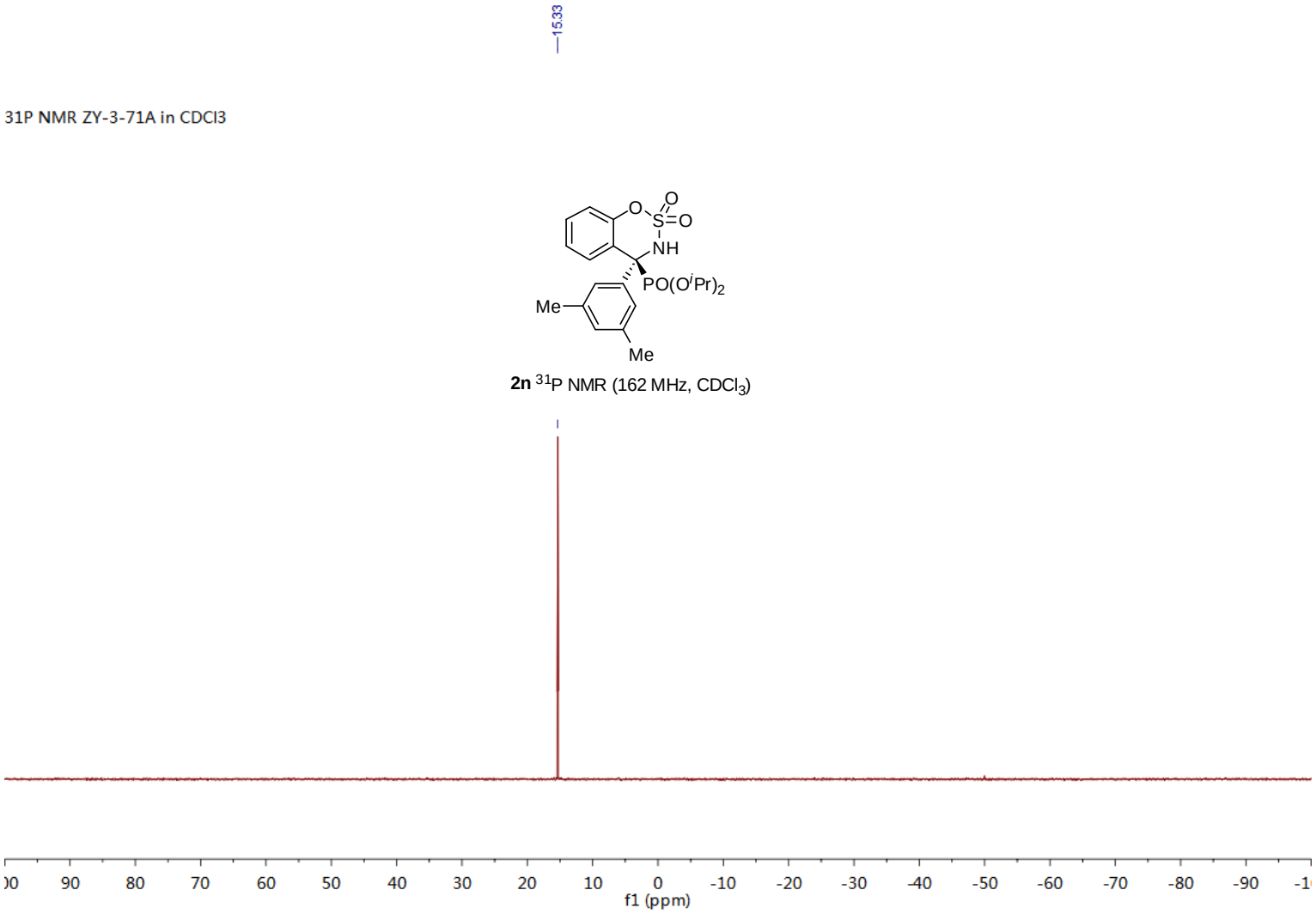



**2m** $^{31}$P NMR (162 MHz, $CDCl_3$)

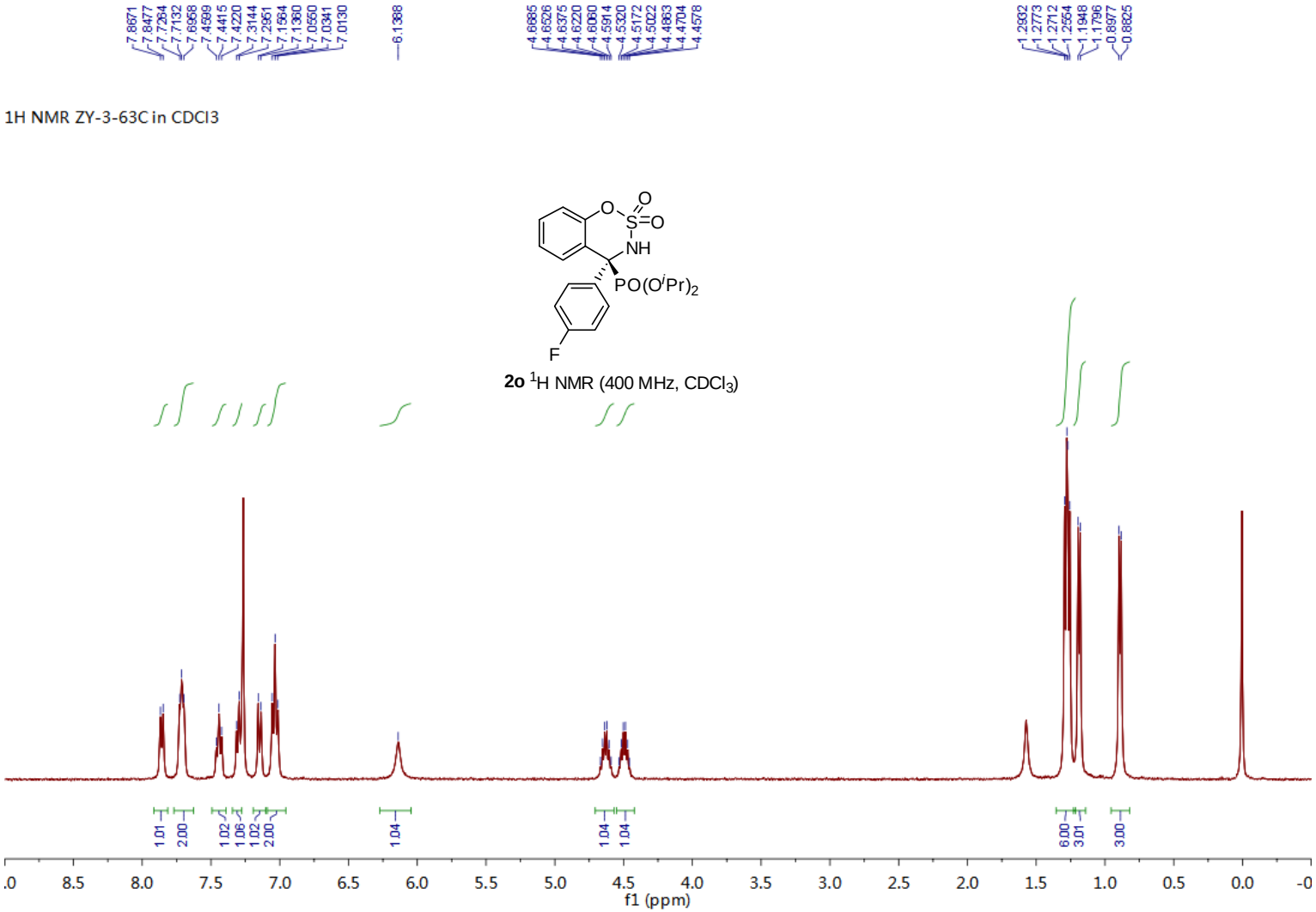



7.8687
7.8388
7.4247
7.4057
7.3858
7.3014
7.2896
7.2687
7.2506
7.1235
7.1030
6.9443
4.6799
4.6642
4.6486
4.6330
4.6174
4.6017
4.5862
4.5709
4.5361
4.5199
4.5043
4.4886
4.4728
4.4570
4.4414
4.4261
2.2699
1.2811
1.2657
1.2354
1.2200
1.1765
1.1611
0.8577
0.8423
1H NMR ZY-3-71A in CDCl3
O
O
S=O
NH
PO(O$^i$Pr)$_2$
Me
Me
**2n** $^1$H NMR (400 MHz, CDCl$_3$)
1.00
1.03
3.04
1.06
1.02
1.00
1.00
6.00
3.06
3.03
3.06
3.04
f1 (ppm)

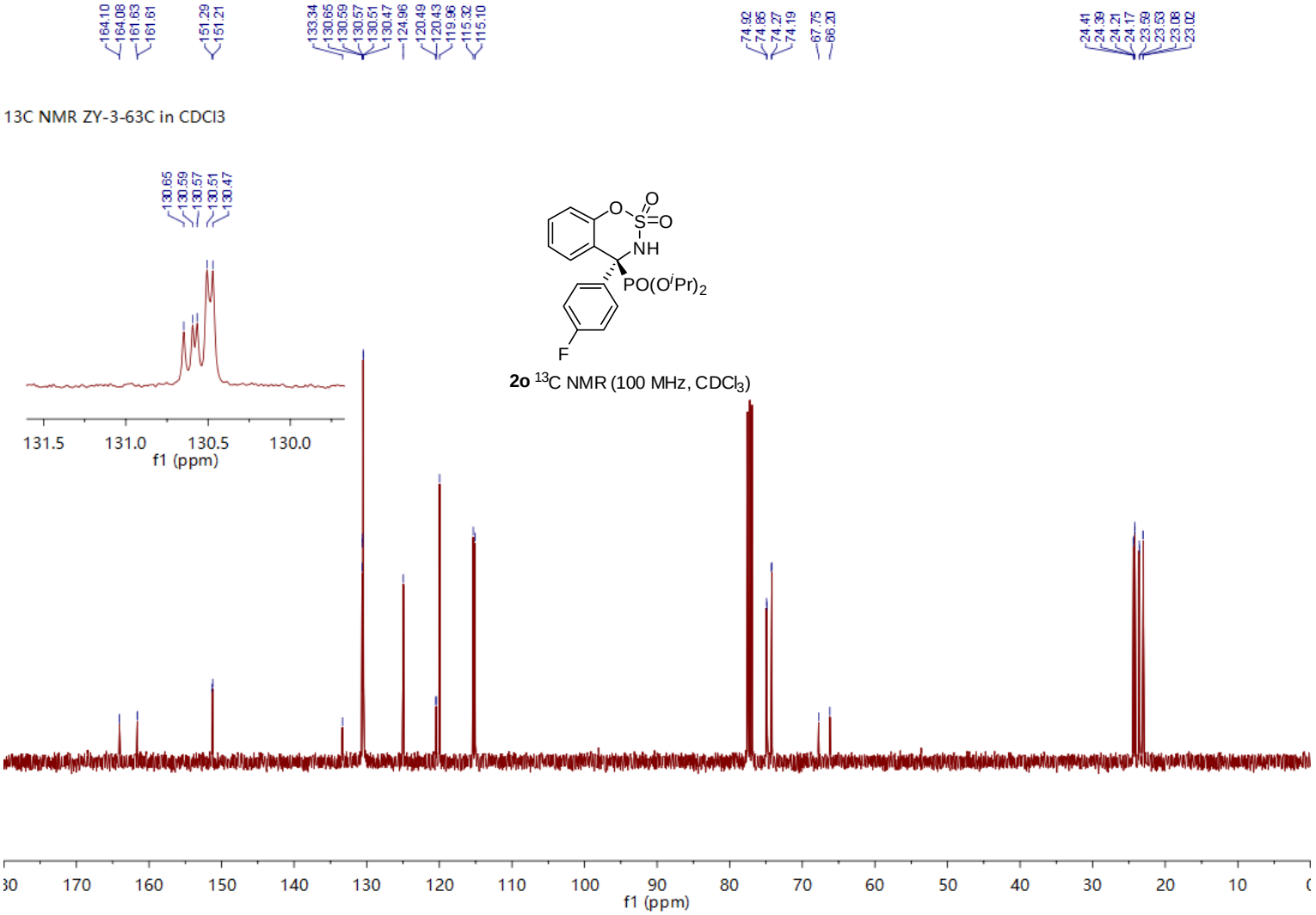

151.29
151.20
137.67
137.66
136.66
136.64
130.73
130.70
130.46
130.44
130.23
130.21
126.28
126.22
124.84
124.82
120.93
120.87
119.83
74.59
74.51
73.92
73.84
68.23
66.70
24.52
24.50
24.24
24.21
23.57
23.51
22.92
22.85
21.67
13C NMR ZY-3-71A in CDCl3
130.73
130.70
130.46
130.44
130.23
130.21
131.6
131.2
130.8
130.4
130.0
f1 (ppm)
O
O
S
O
NH
PO(OiPr)2
Me
Me
2n 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

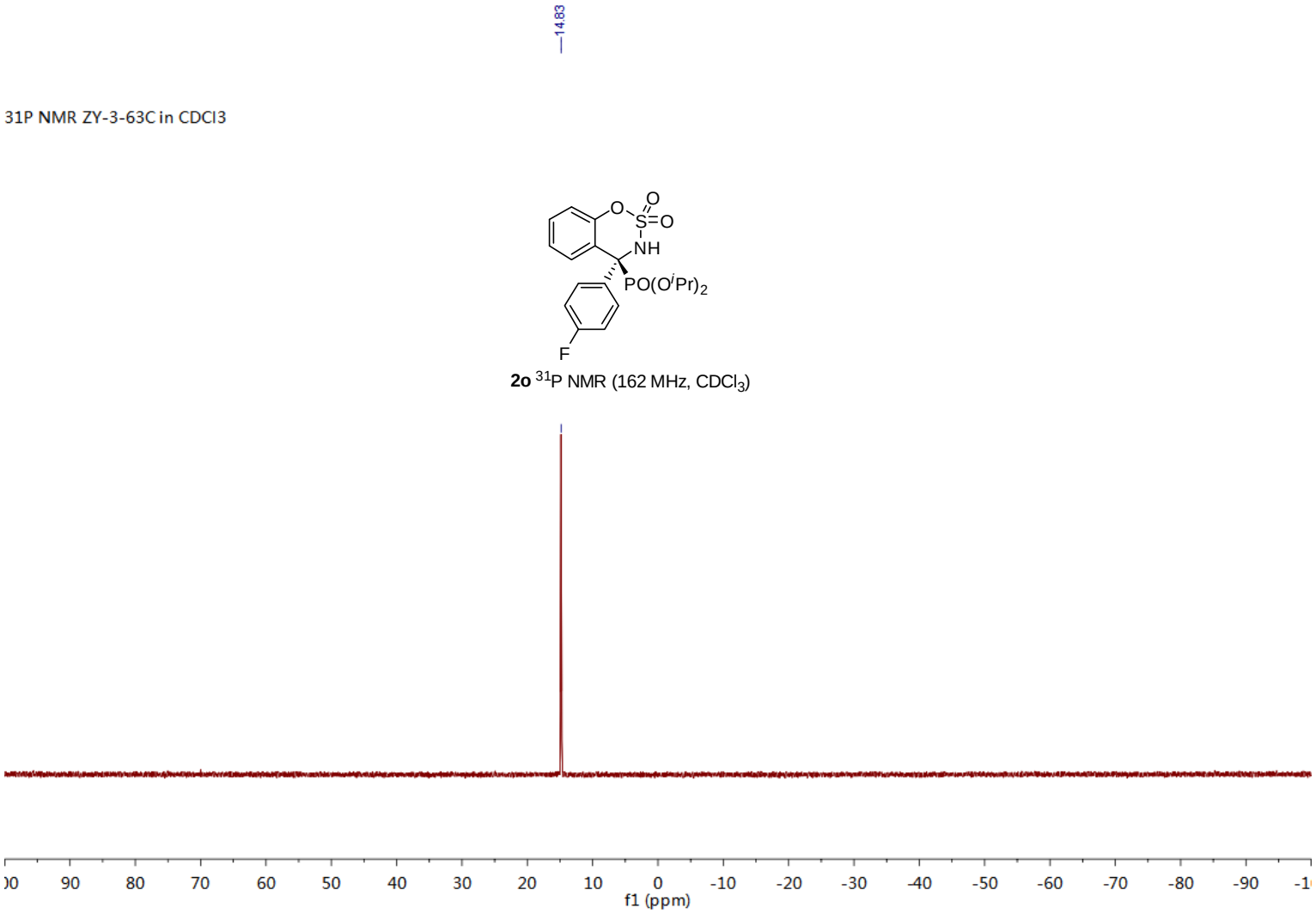



**2n** $^{31}$P NMR (162 MHz, $CDCl_3$)




**2o** $^1$H NMR (400 MHz, $CDCl_3$)

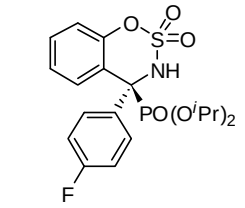

164.10
164.08
161.63
161.61
151.29
151.21
133.34
130.65
130.59
130.57
130.51
130.47
124.96
120.49
120.43
119.96
115.32
115.10
74.92
74.86
74.27
74.19
67.75
66.20
24.41
24.39
24.21
24.17
23.59
23.53
23.08
23.02
13C NMR ZY-3-63C in CDCl3
130.65
130.59
130.57
130.51
130.47
131.5
131.0
130.5
130.0
f1 (ppm)
O
S=O
NH
PO(OiPr)2
F
2o 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)



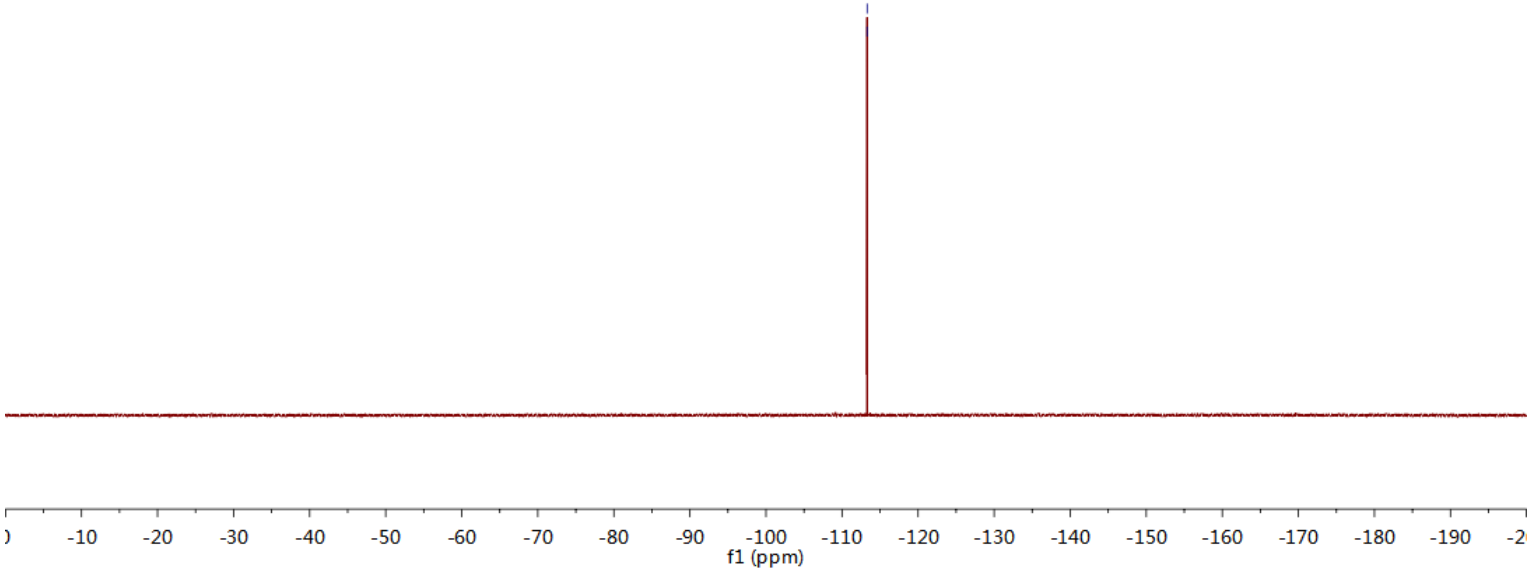

**2o** $^{31}$P NMR (162 MHz, $CDCl_3$)

-113.29
-113.30

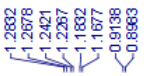
19F NMR ZY-3-63C in CDCl3



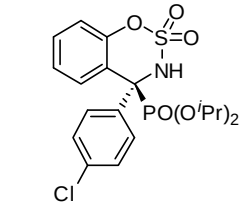

**2o** $^{19}$F NMR (376 MHz, $CDCl_3$)



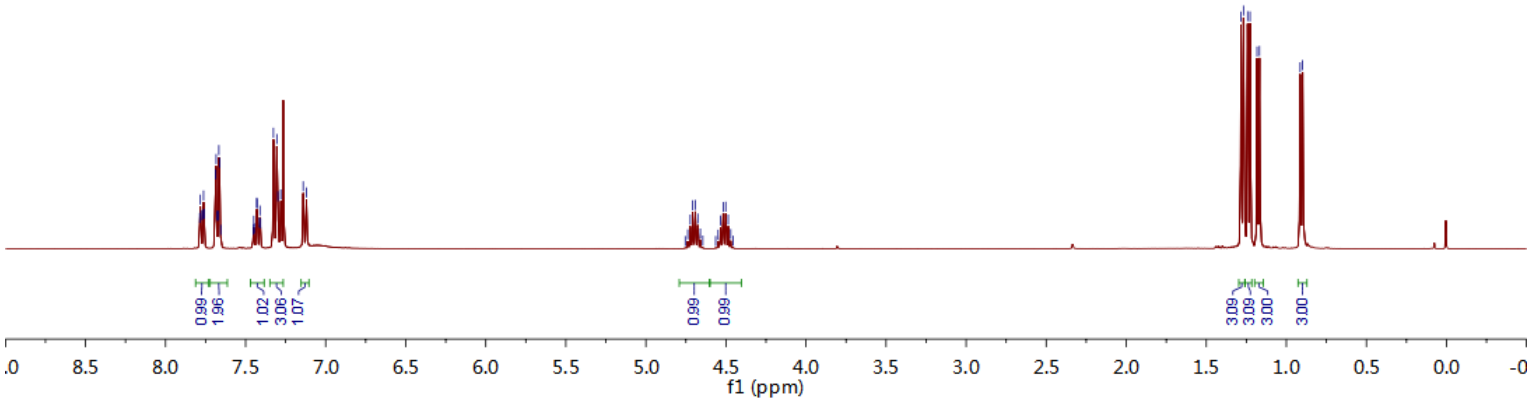


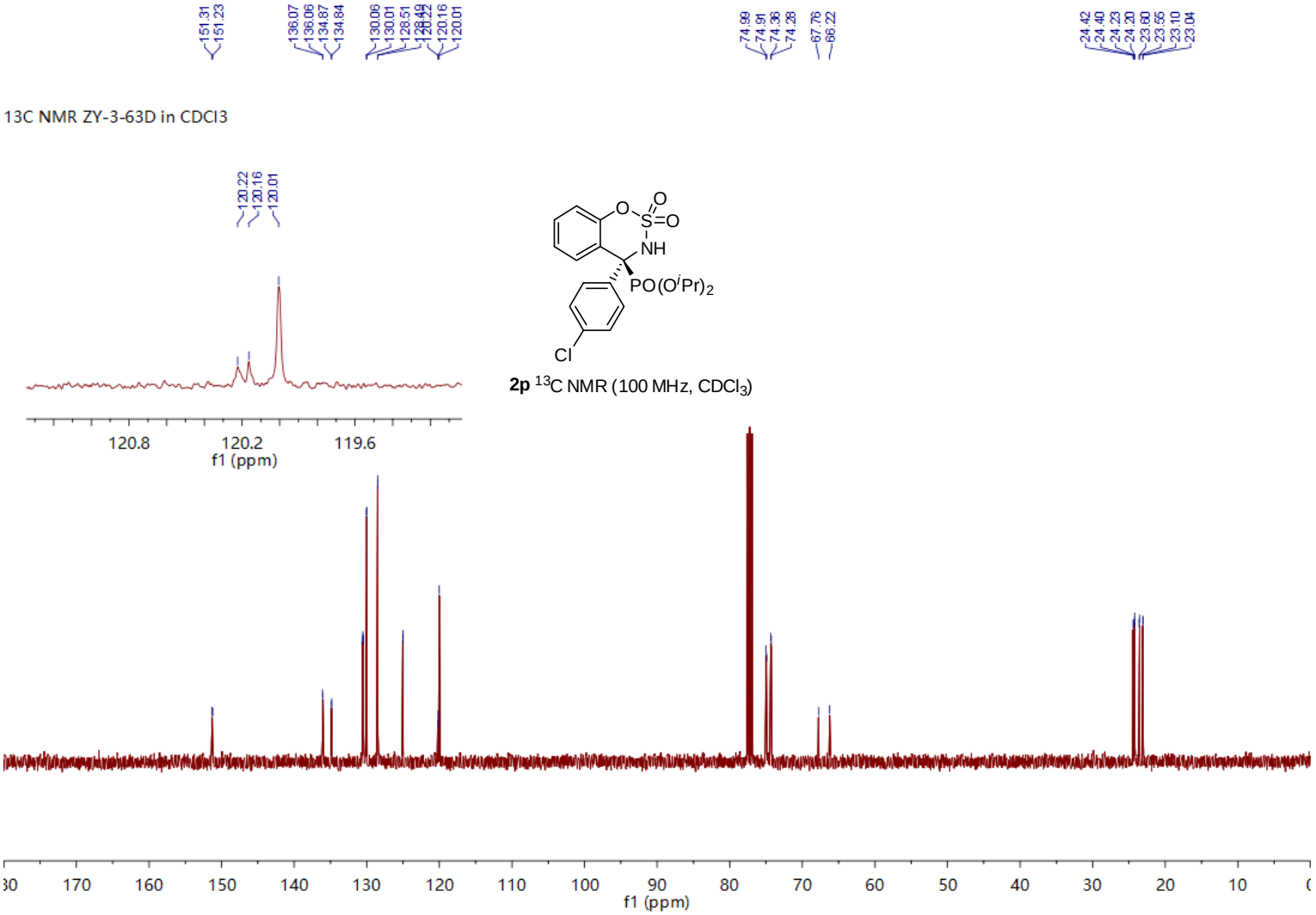



1H NMR ZY-3-63D in CDCl3

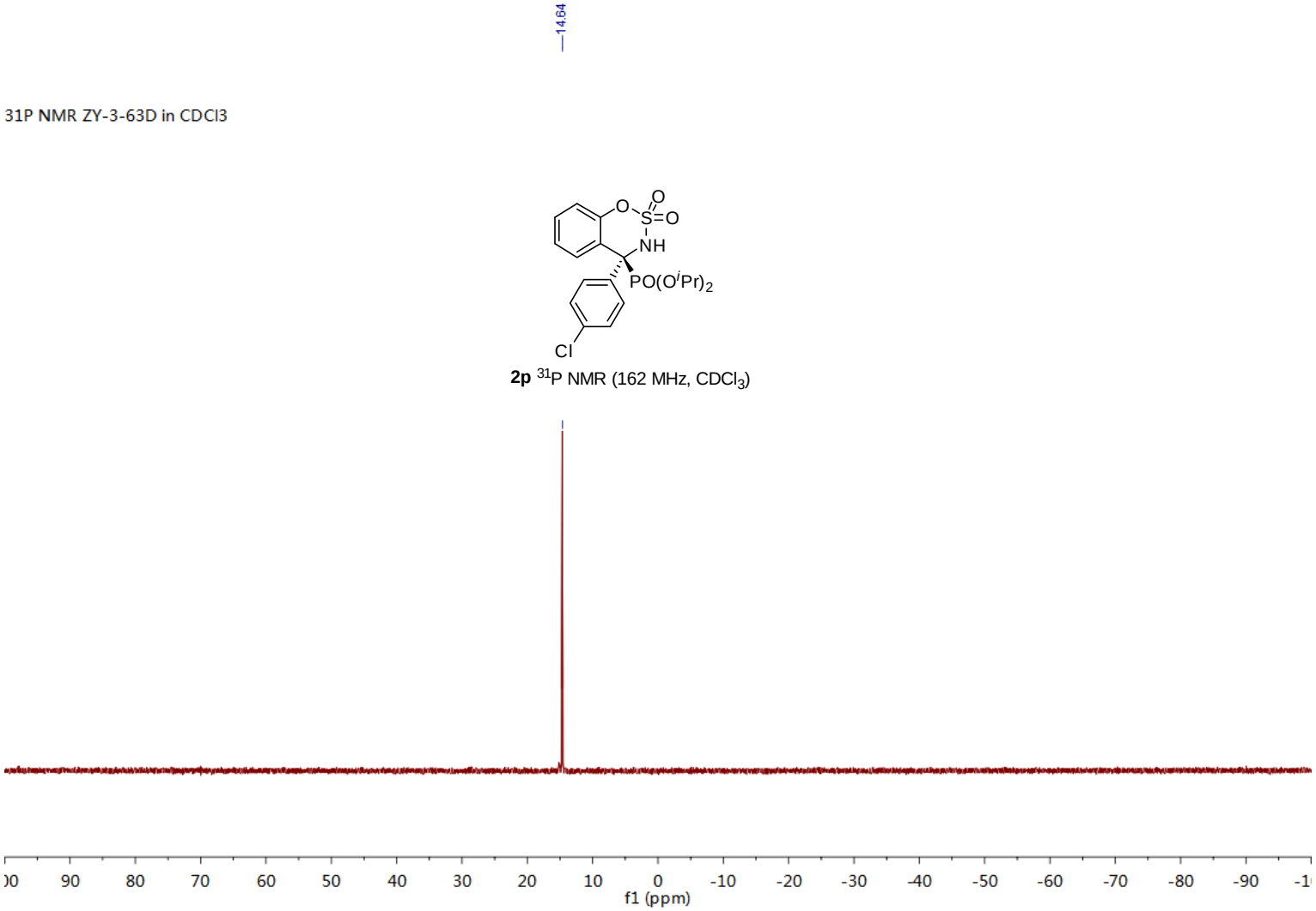



**2p** $^1$H NMR (400 MHz, $CDCl_3$)

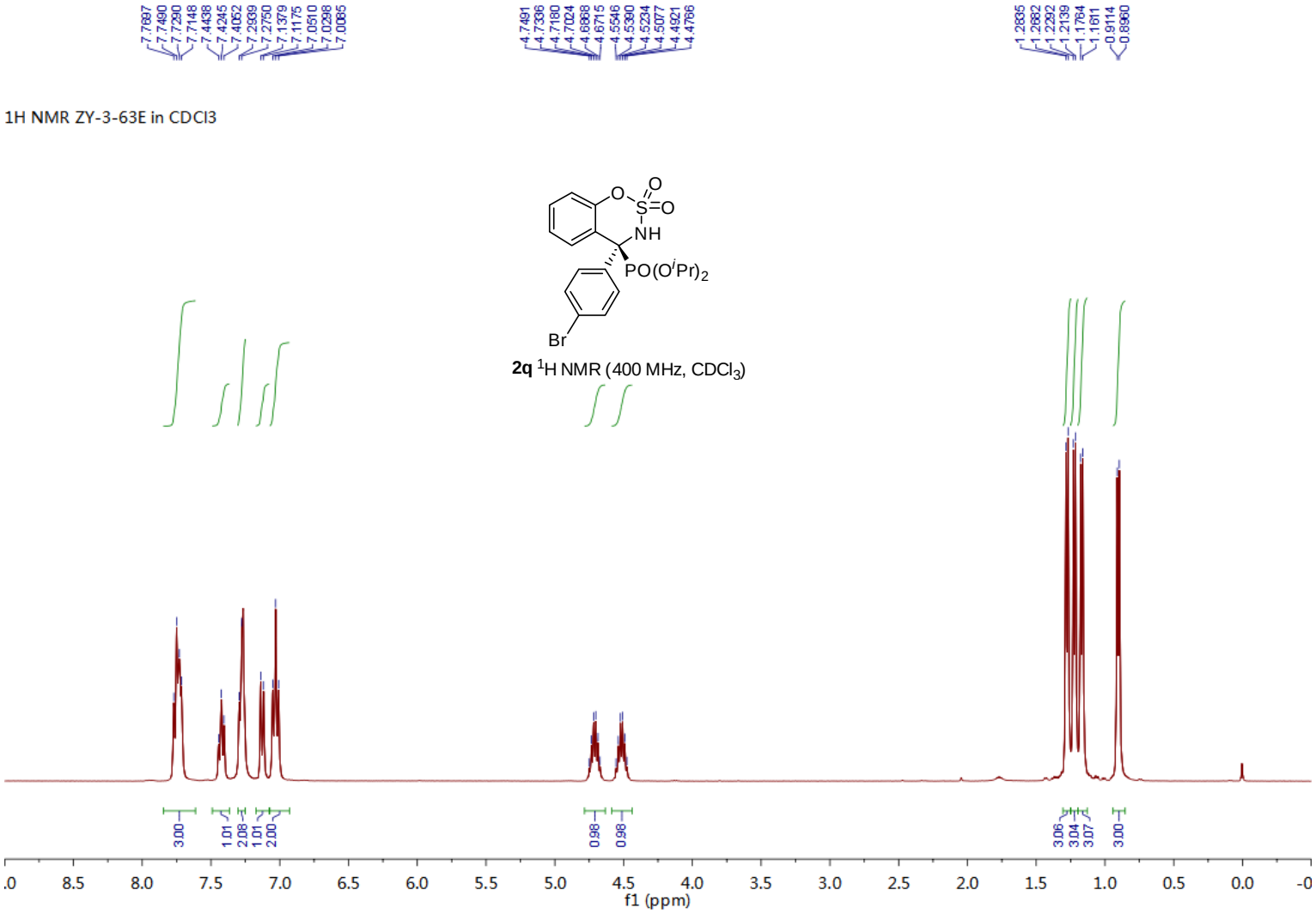


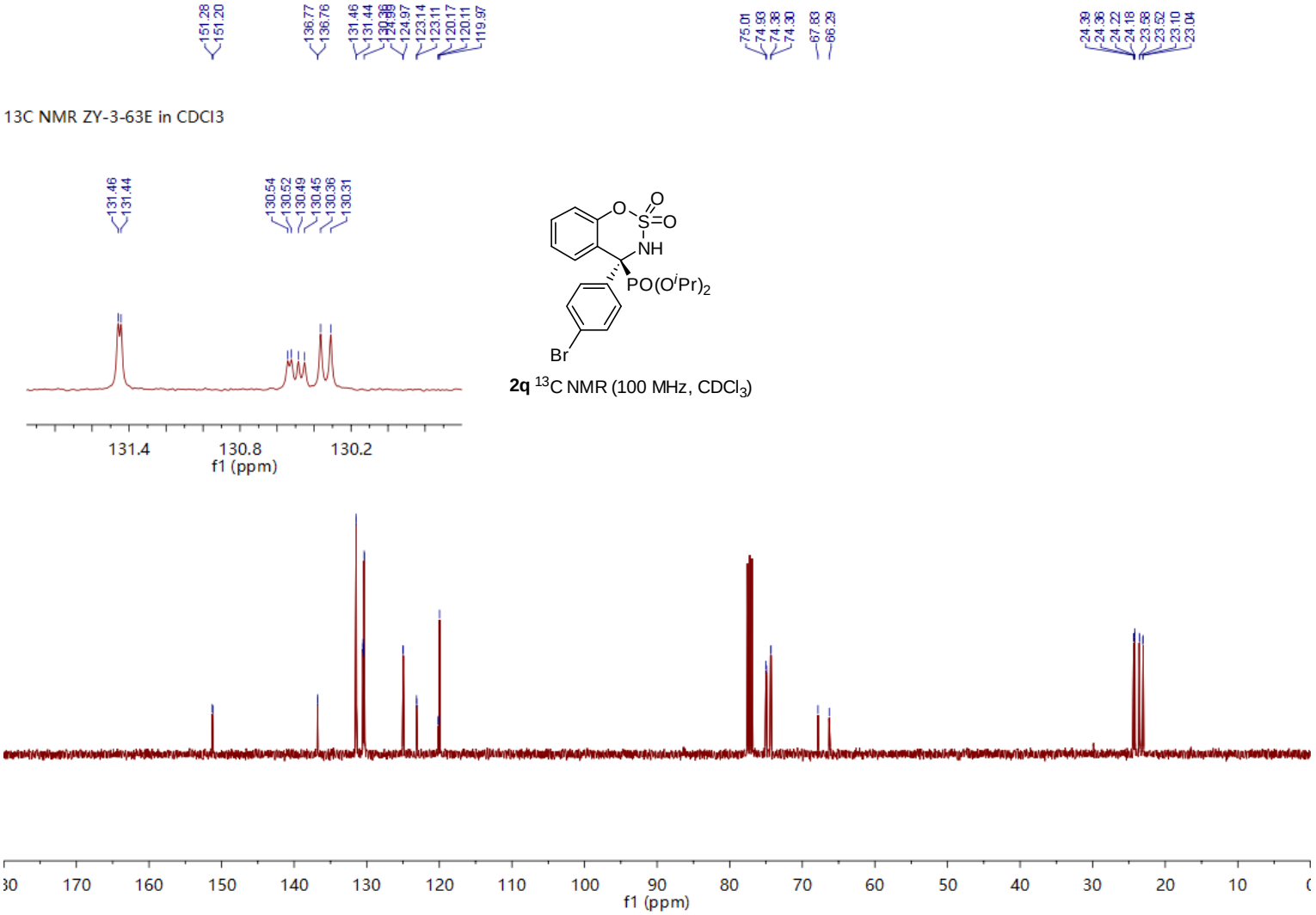



**2p** $^{13}$C NMR (100 MHz, $CDCl_3$)

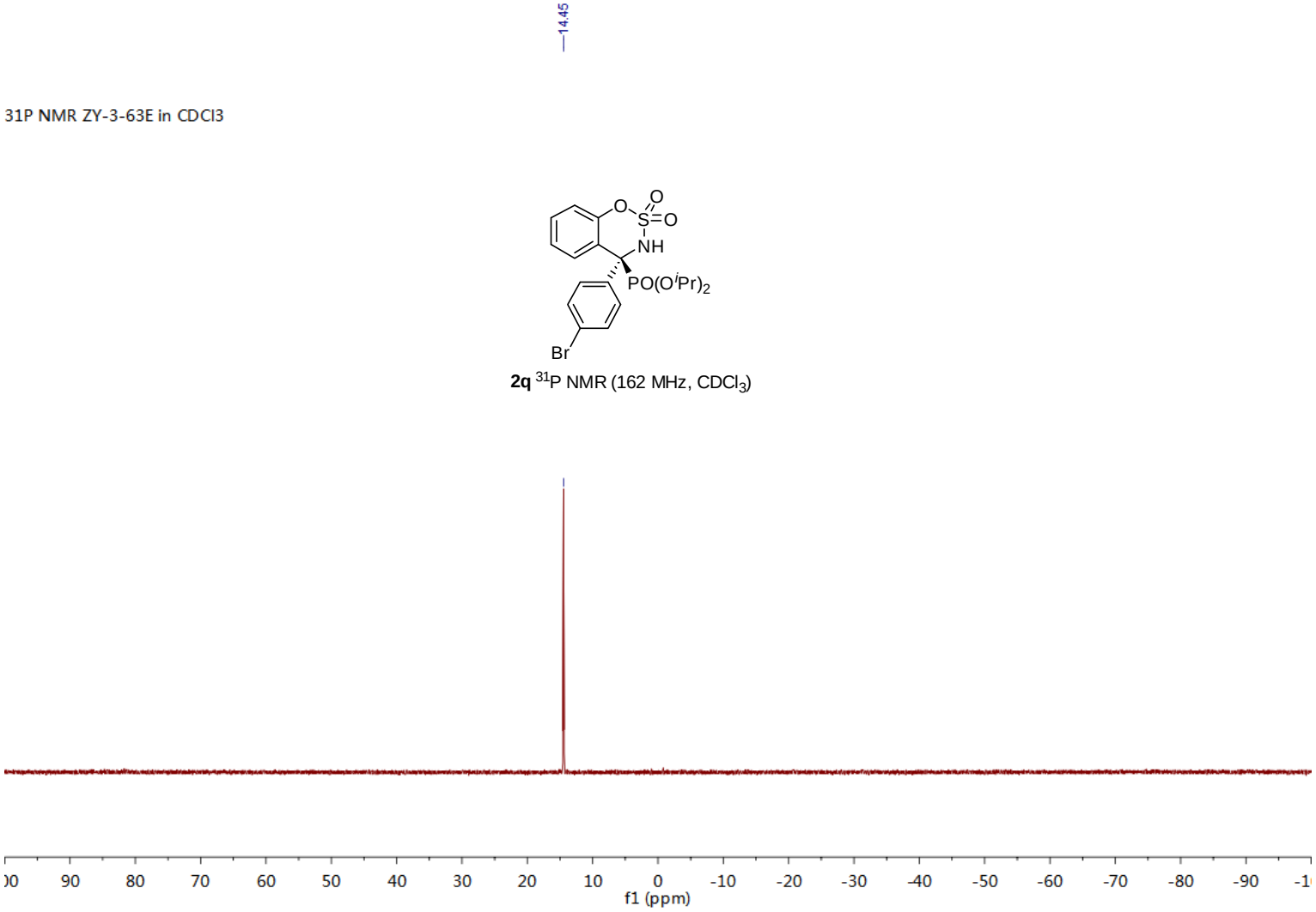



**2p** $^{31}$P NMR (162 MHz, $CDCl_3$)

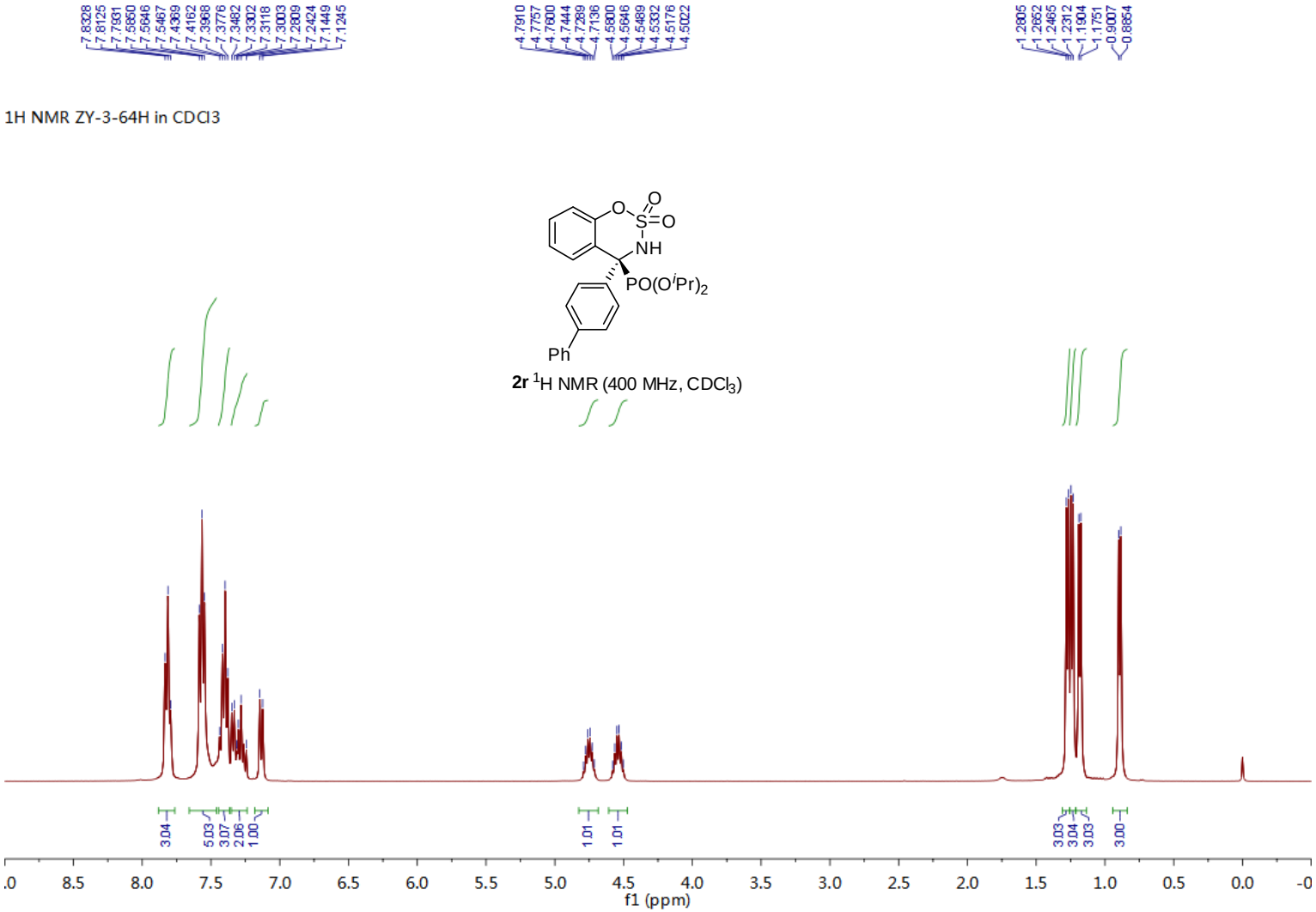

7.7697
7.7490
7.7290
7.7148
7.4438
7.4245
7.4052
7.2939
7.2750
7.1379
7.1175
7.0510
7.0298
7.0085
4.7491
4.7336
4.7180
4.7024
4.6868
4.6715
4.5546
4.5390
4.5234
4.5077
4.4921
4.4766
1.2835
1.2682
1.2292
1.2139
1.1764
1.1611
0.9114
0.8960
1H NMR ZY-3-63E in CDCl3
O
O
S
O
NH
PO(O$^i$Pr)$_2$
Br
**2q** $^1$H NMR (400 MHz, CDCl$_3$)
3.00
1.01
2.08
1.01
2.00
0.98
0.98
3.06
3.04
3.07
3.00
f1 (ppm)

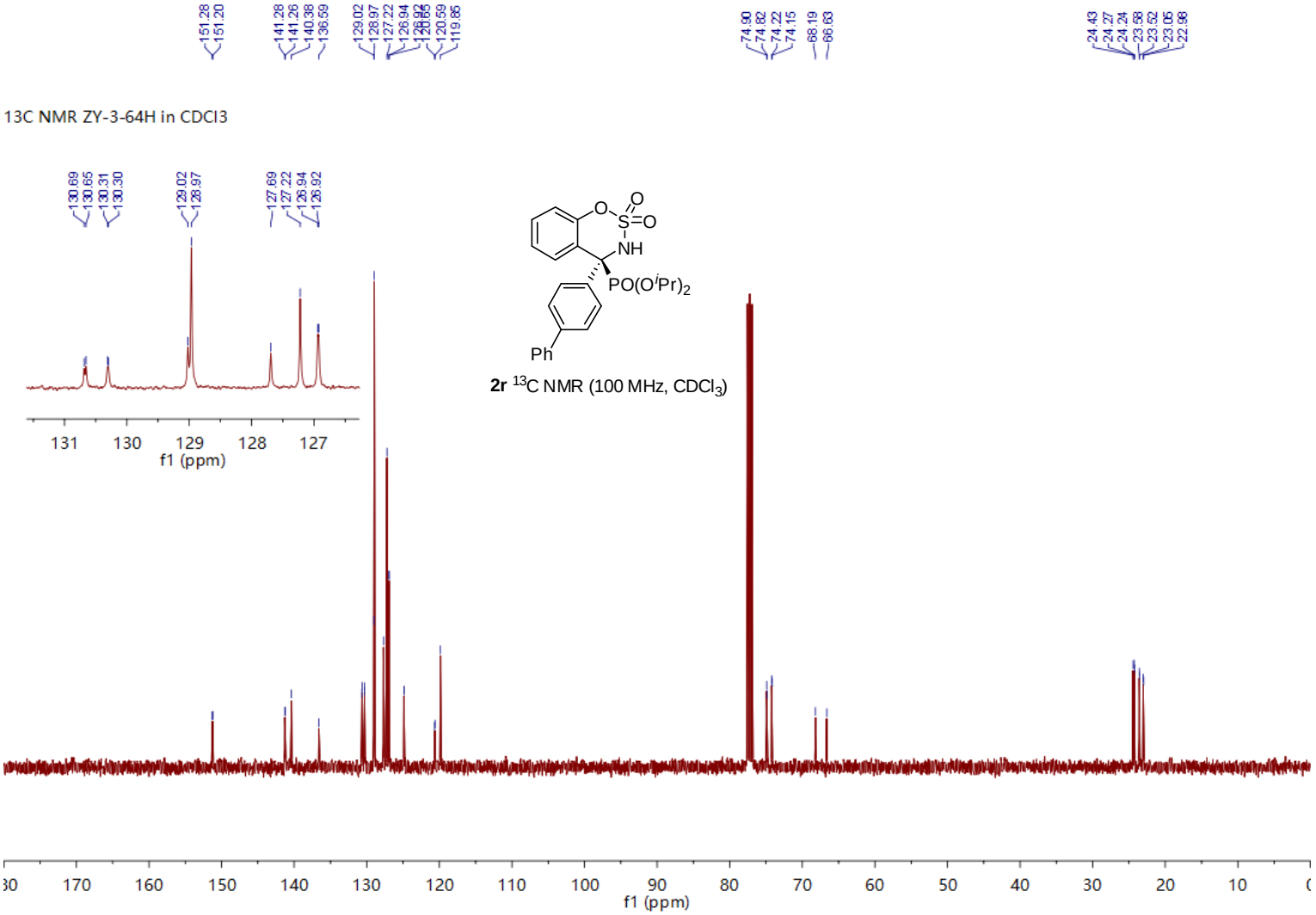



**2q** $^{13}$C NMR (100 MHz, $CDCl_3$)

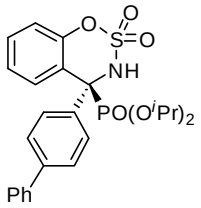



**2q** $^{31}$P NMR (162 MHz, $CDCl_3$)

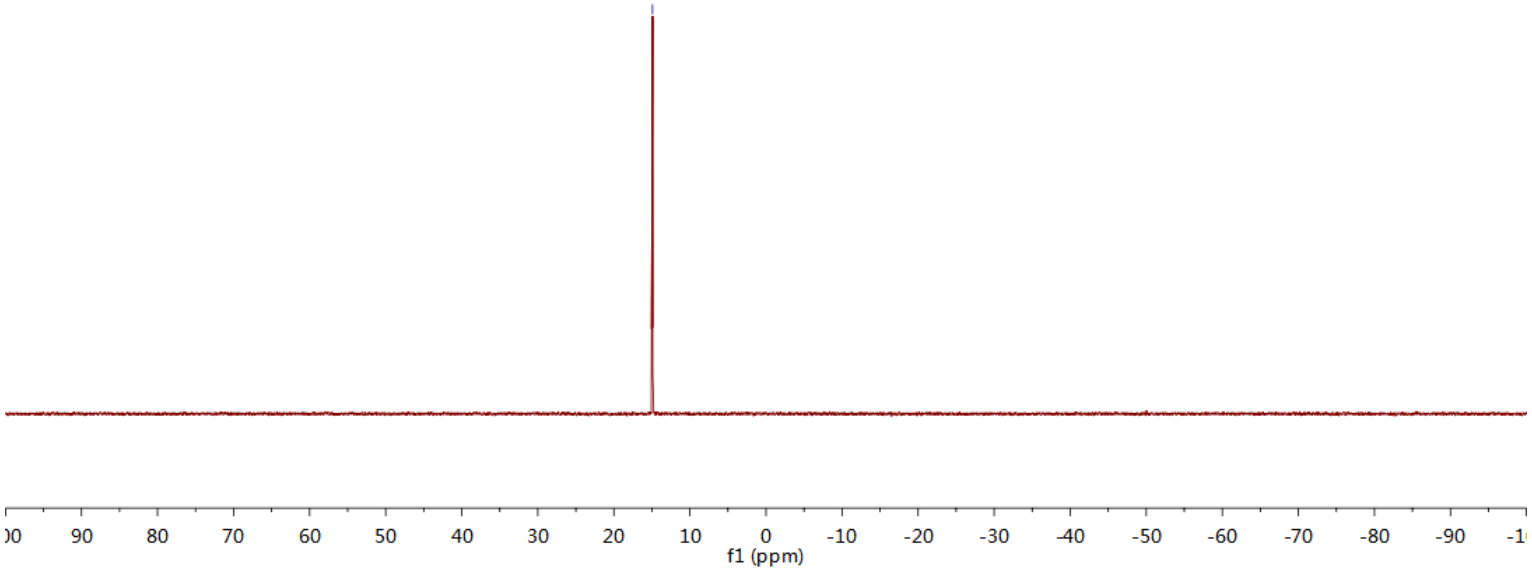

7.8328
7.8125
7.7931
7.5850
7.5646
7.5467
7.4369
7.4162
7.3968
7.3776
7.3482
7.3302
7.3118
7.3003
7.2809
7.2424
7.1449
7.1245
4.7910
4.7757
4.7600
4.7444
4.7289
4.7136
4.5800
4.5646
4.5489
4.5332
4.5176
4.5022
1.2805
1.2662
1.2465
1.2312
1.1904
1.1751
0.9007
0.8854
1H NMR ZY-3-64H in CDCl3
O
O
S
O
NH
PO(O$^i$Pr)$_2$
Ph
**2r** $^1$H NMR (400 MHz, $CDCl_3$)
3.04
5.03
3.07
2.06
1.00
1.01
1.01
3.03
3.04
3.03
3.00
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)


13C NMR ZY-3-64H in CDCl3
151.28
151.20
141.28
141.26
140.38
136.59
129.02
128.97
127.22
126.94
120.59
119.85
74.90
74.82
74.22
74.15
68.19
66.63
24.43
24.27
24.24
23.88
23.52
23.05
22.98
130.69
130.65
130.31
130.30
129.02
128.97
127.69
127.22
126.94
126.92
131
130
129
128
127
f1 (ppm)
O
O
S=O
NH
PO(OiPr)2
Ph
2r 13C NMR (100 MHz, CDCl3)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

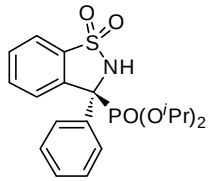
31P NMR ZY-3-64H in CDCl3



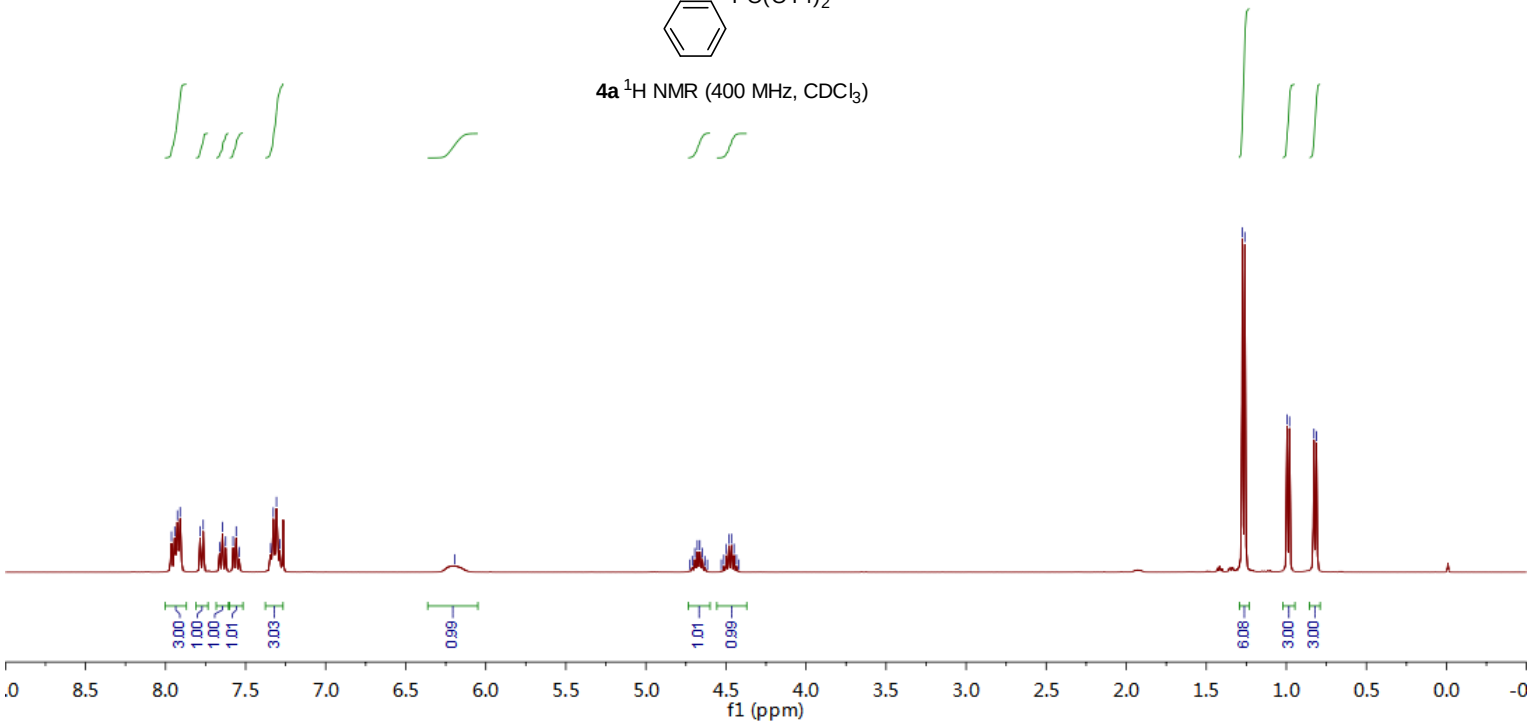

**2r** $^{31}$P NMR (162 MHz, $CDCl_3$)

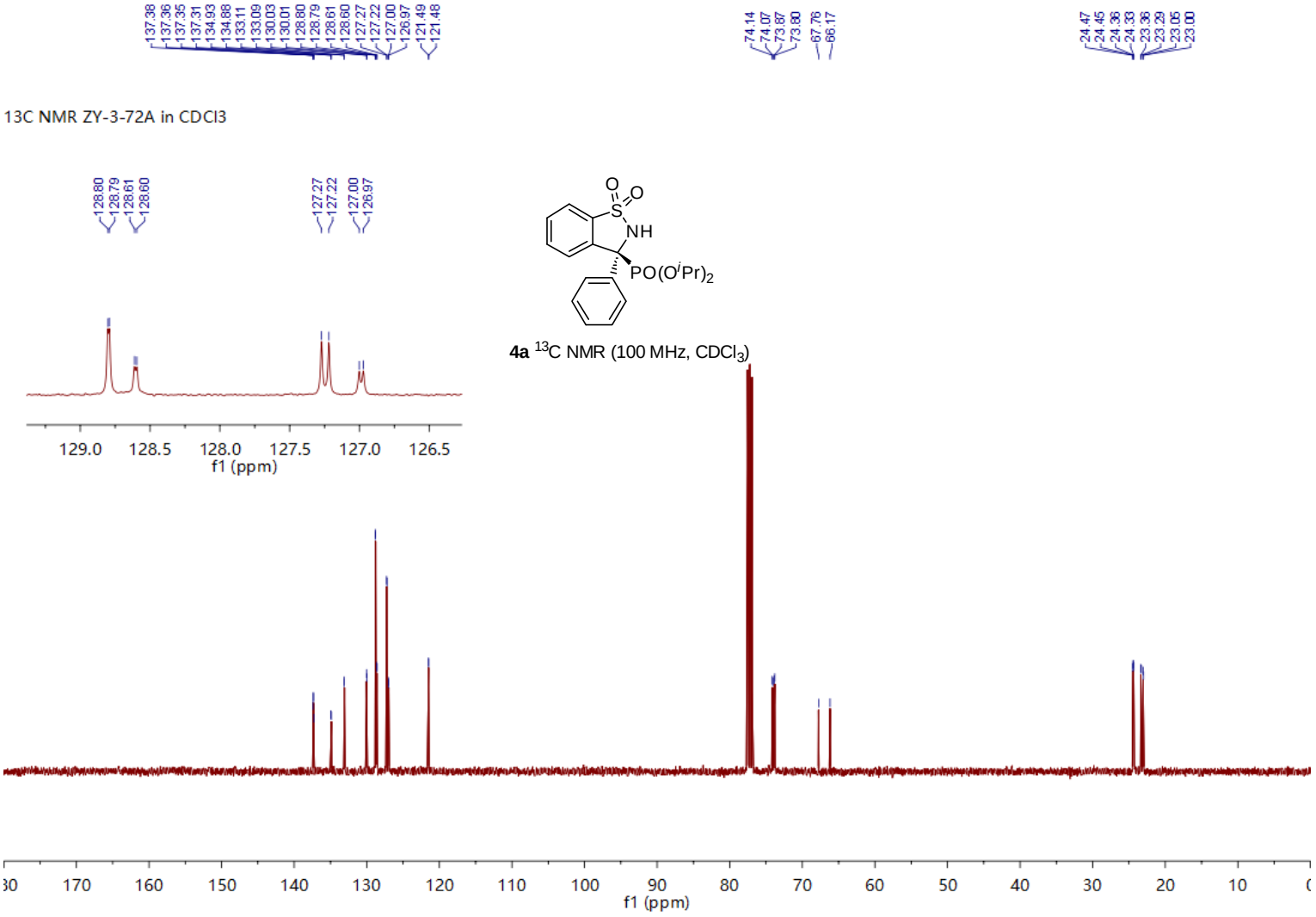



1H NMR ZY-3-72A in CDCl3



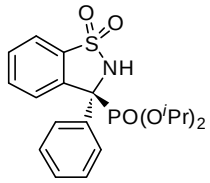

**4a** $^1$H NMR (400 MHz, $CDCl_3$)



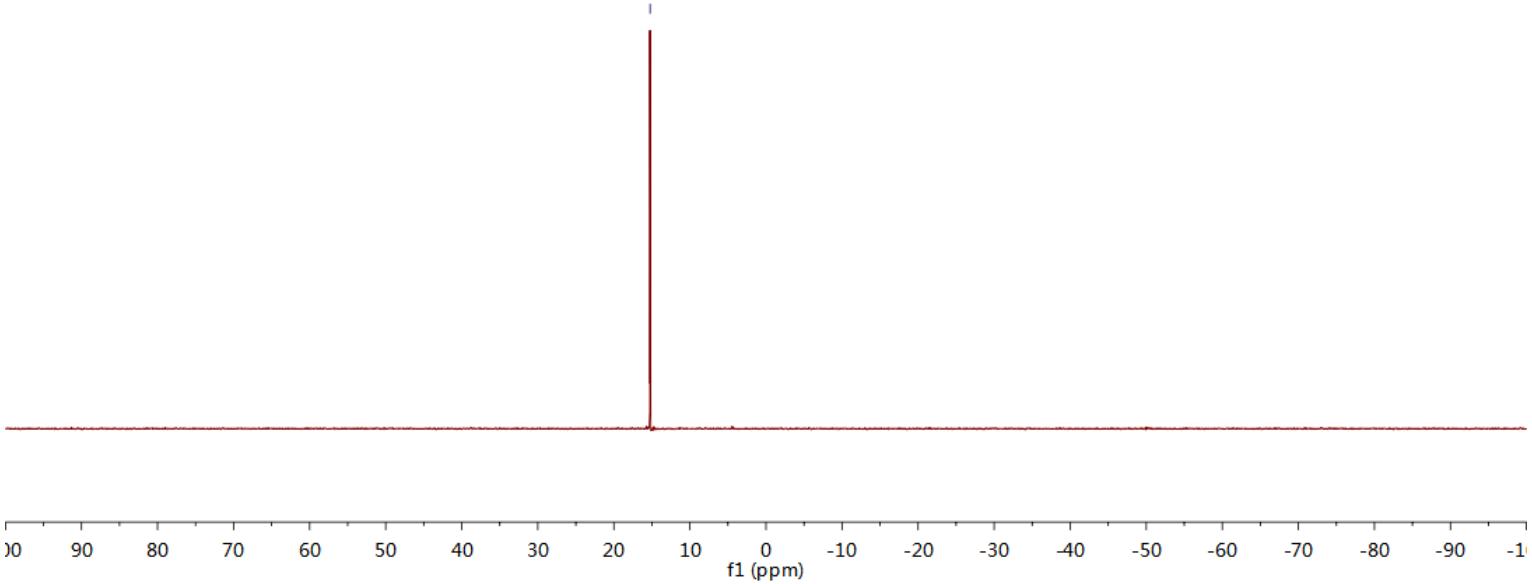

137.38
137.36
137.35
137.31
134.93
134.88
133.11
133.09
130.03
130.01
128.80
128.79
128.61
128.60
127.27
127.22
127.00
126.97
121.49
121.48
74.14
74.07
73.87
73.80
67.76
66.17
24.47
24.45
24.36
24.33
23.36
23.29
23.05
23.00
13C NMR ZY-3-72A in CDCl3
O
O
S
NH
PO(OiPr)2
4a 13C NMR (100 MHz, CDCl3)
f1 (ppm)
f1 (ppm)

15.23

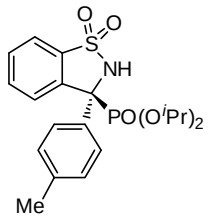
31P NMR ZY-3-72A in CDCl3



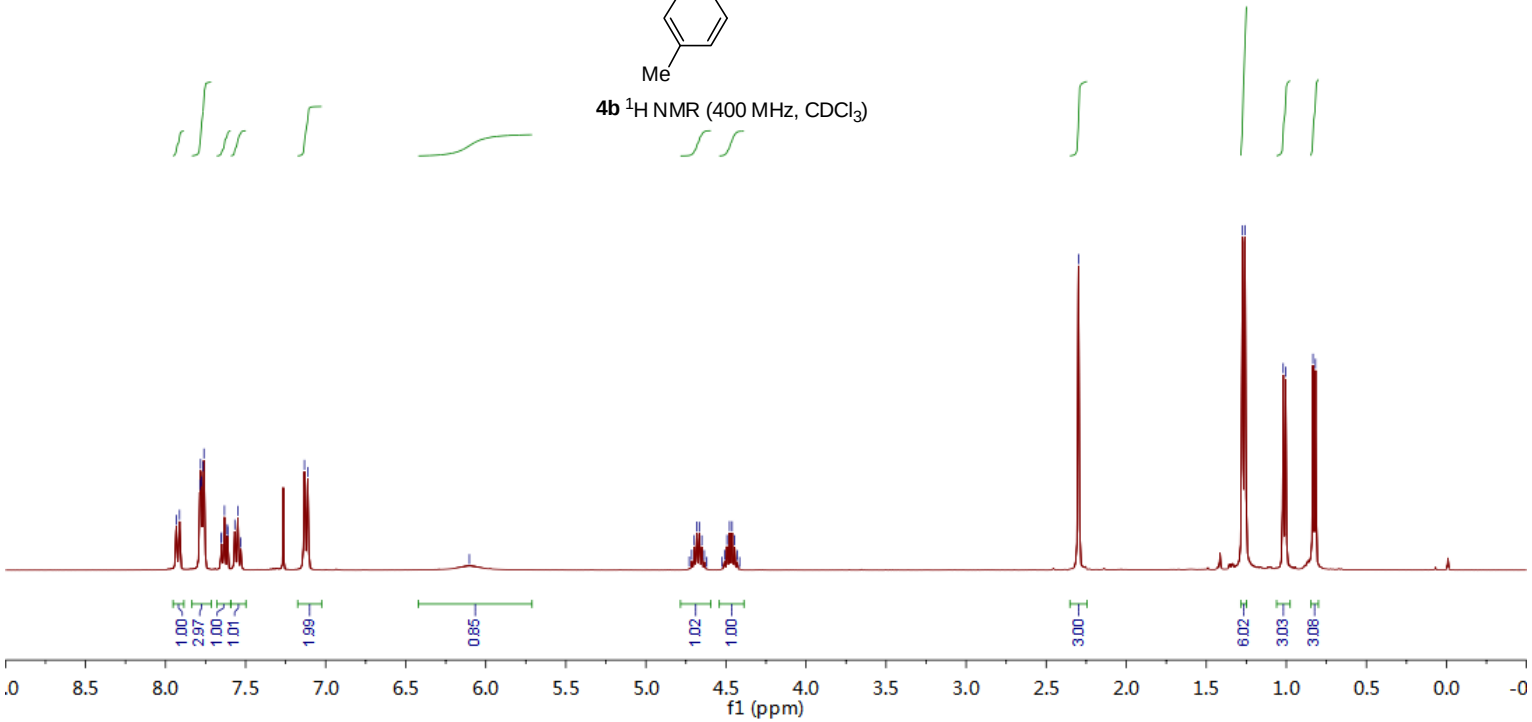

**4a** $^{31}$P NMR (162 MHz, $CDCl_3$)

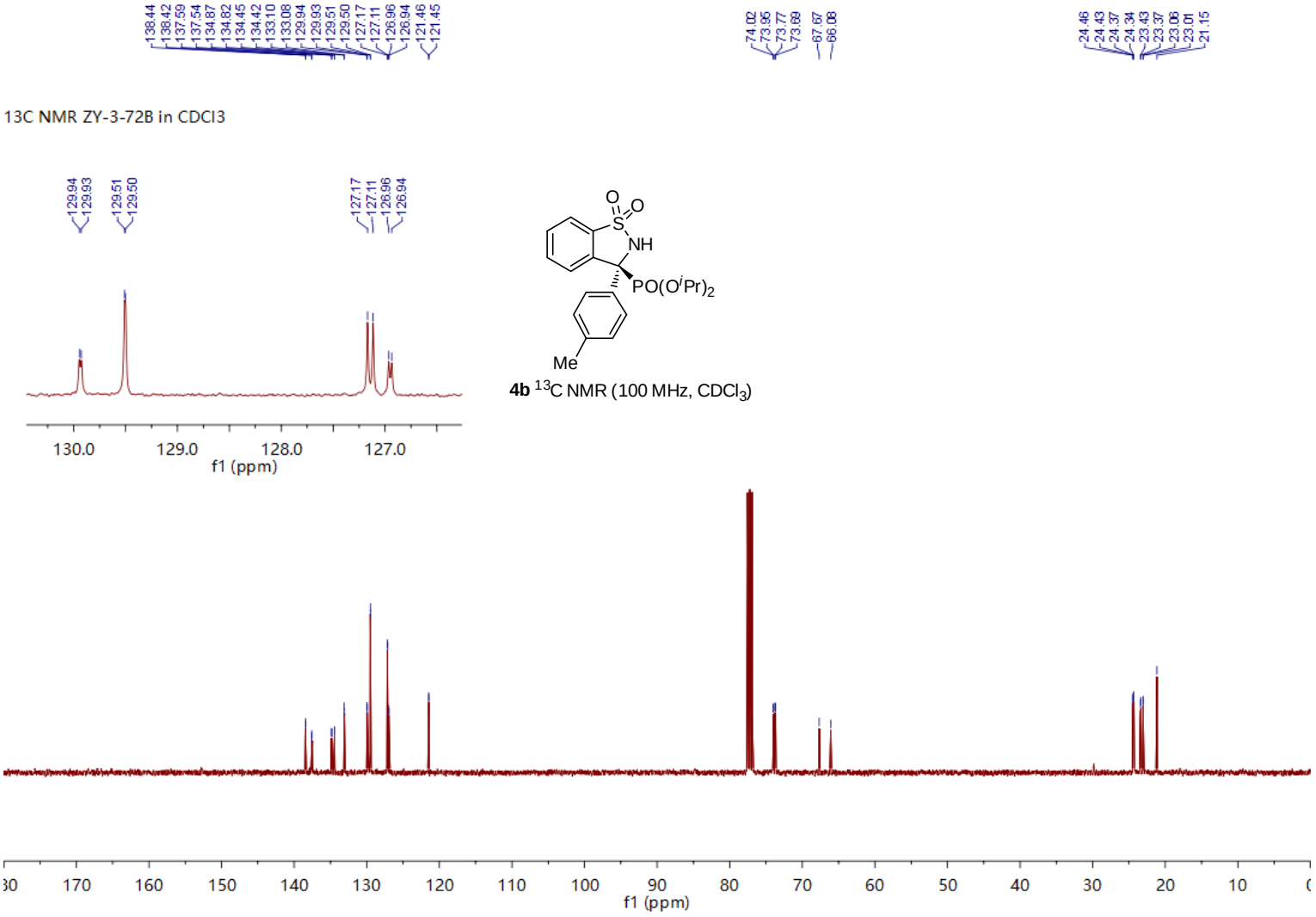


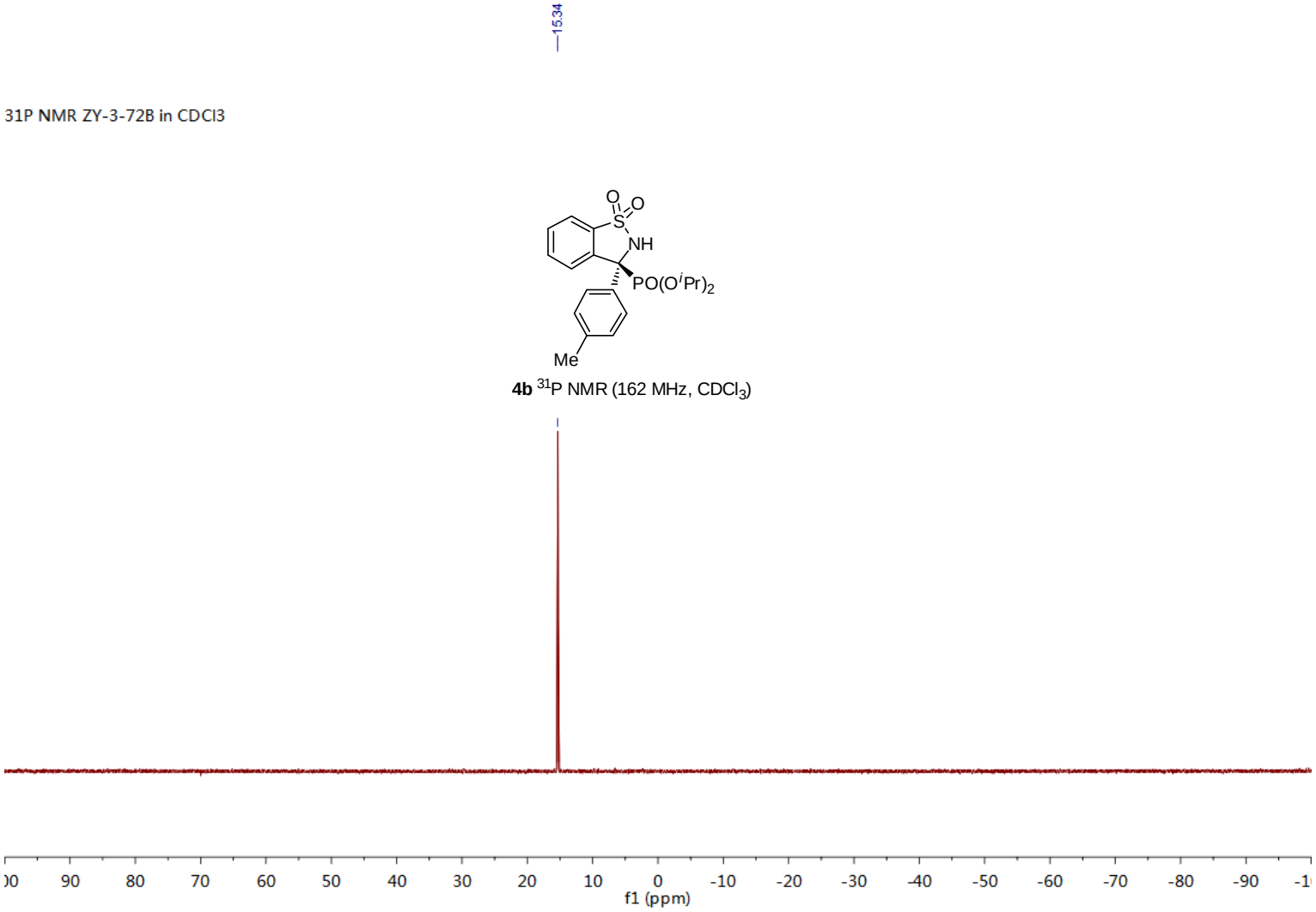

1H NMR ZY-3-72B in CDCl3

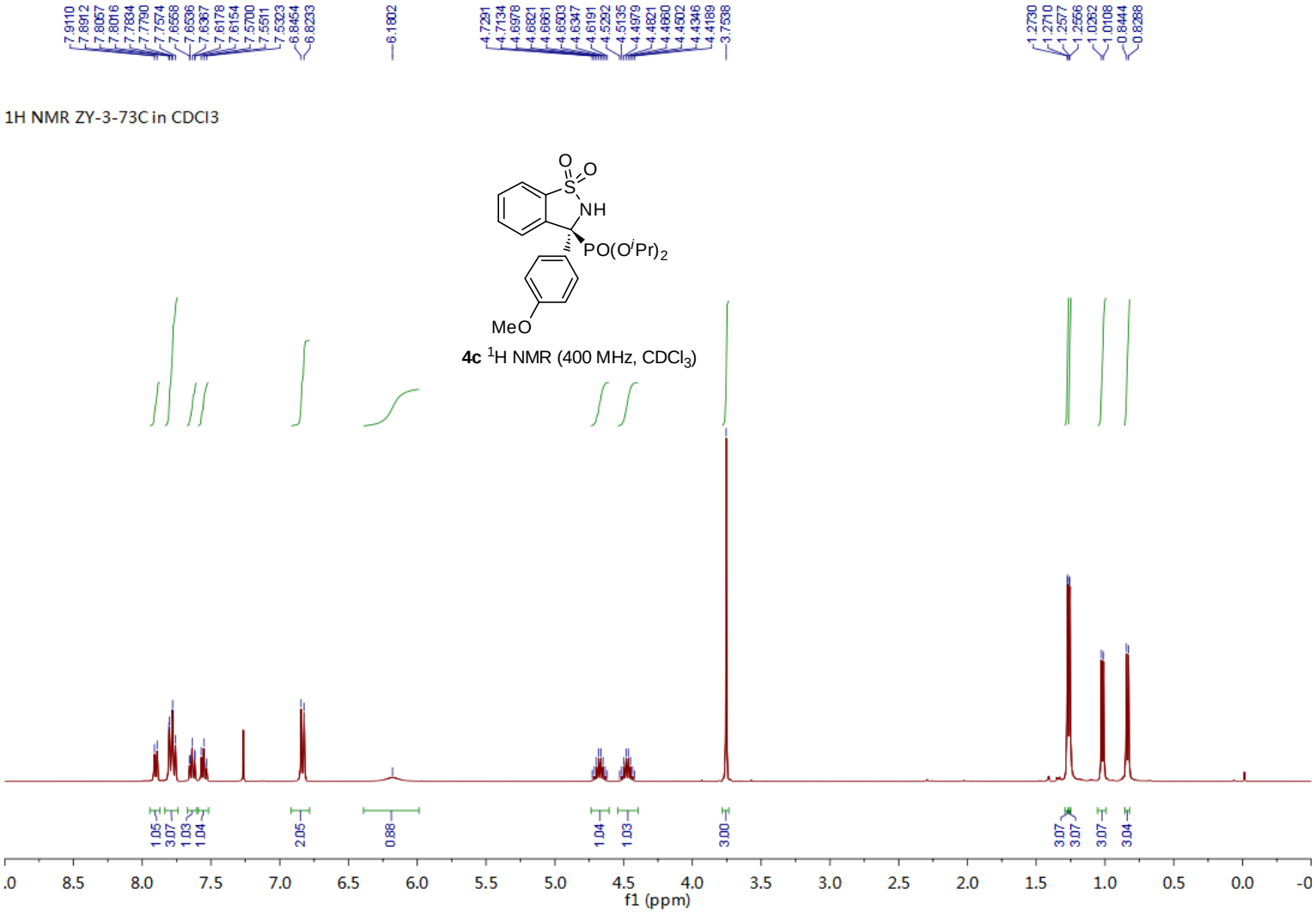



**4b** $^1$H NMR (400 MHz, $CDCl_3$)

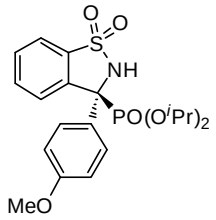



138.44
138.42
137.59
137.54
134.87
134.82
134.45
134.42
133.10
133.08
129.94
129.93
129.51
129.50
127.17
127.11
126.96
126.94
121.46
121.45
74.02
73.95
73.77
73.69
67.67
66.08
24.46
24.43
24.37
24.34
23.43
23.37
23.06
23.01
21.15
13C NMR ZY-3-72B in CDCl3
129.94
129.93
129.51
129.50
127.17
127.11
126.96
126.94
130.0
129.0
128.0
127.0
f1 (ppm)
O
O
S
NH
PO(O$^i$Pr)$_2$
Me
**4b** $^{13}$C NMR (100 MHz, CDCl$_3$)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

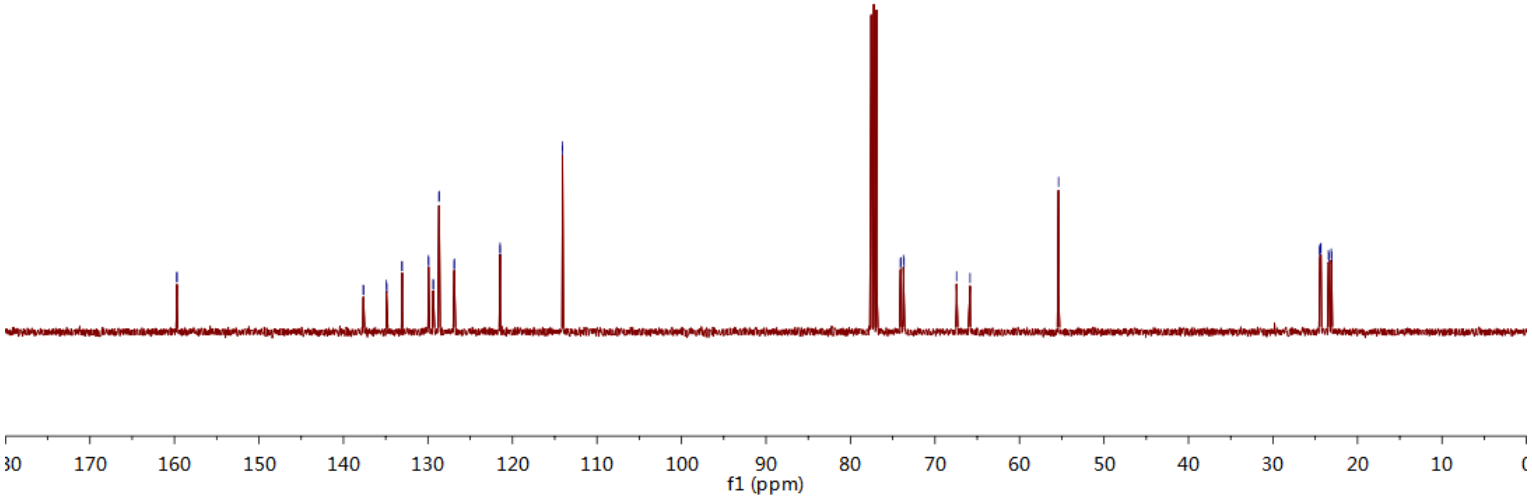

15.34
31P NMR ZY-3-72B in CDCl3
O
O
S
NH
PO(O$^i$Pr)$_2$
Me
**4b** $^{31}$P NMR (162 MHz, CDCl$_3$)
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
f1 (ppm)


7.9110
7.8912
7.8057
7.8016
7.7834
7.7790
7.7574
7.6658
7.6536
7.6367
7.6178
7.6154
7.5700
7.5511
7.5323
6.8454
6.8233
6.1802
4.7291
4.7134
4.6978
4.6821
4.6661
4.6503
4.6347
4.6191
4.5292
4.5135
4.4979
4.4821
4.4660
4.4502
4.4346
4.4189
3.7538
1.2730
1.2710
1.2577
1.2556
1.0262
1.0108
0.8444
0.8288
1H NMR ZY-3-73C in CDCl3
O
O
S
NH
PO(OiPr)2
MeO
4c 1H NMR (400 MHz, CDCl3)
1.05
3.07
1.03
1.04
2.05
0.88
1.04
1.03
3.00
3.07
3.07
3.04
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

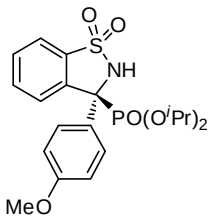

13C NMR ZY-3-73C in CDCl3



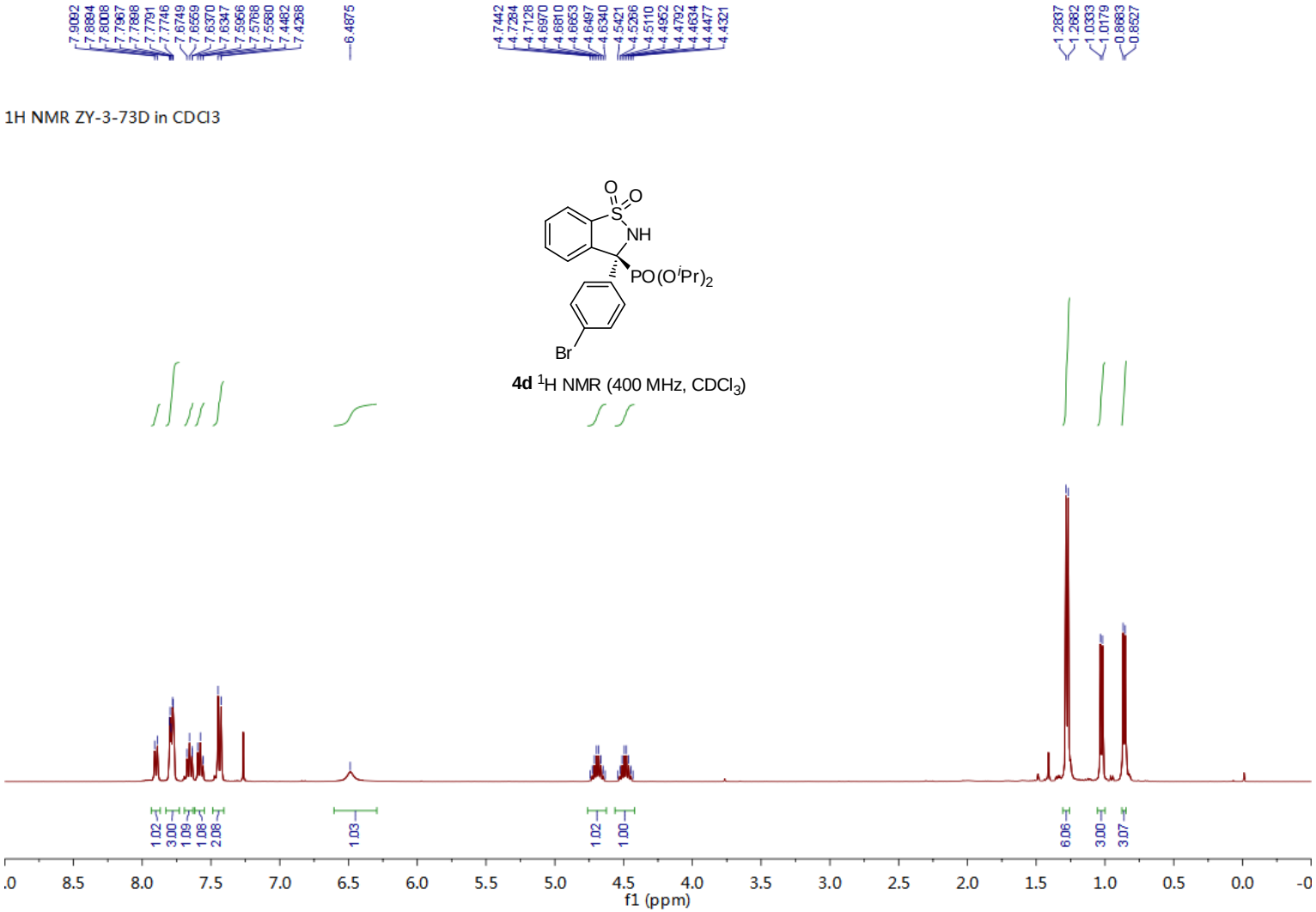

**4c** $^{13}$C NMR (100 MHz, $CDCl_3$)

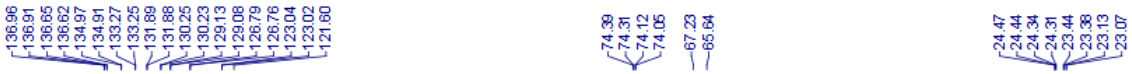


31P NMR ZY-3-73C in CDCl3

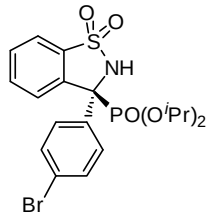



**4c** $^{31}$P NMR (162 MHz, $CDCl_3$)

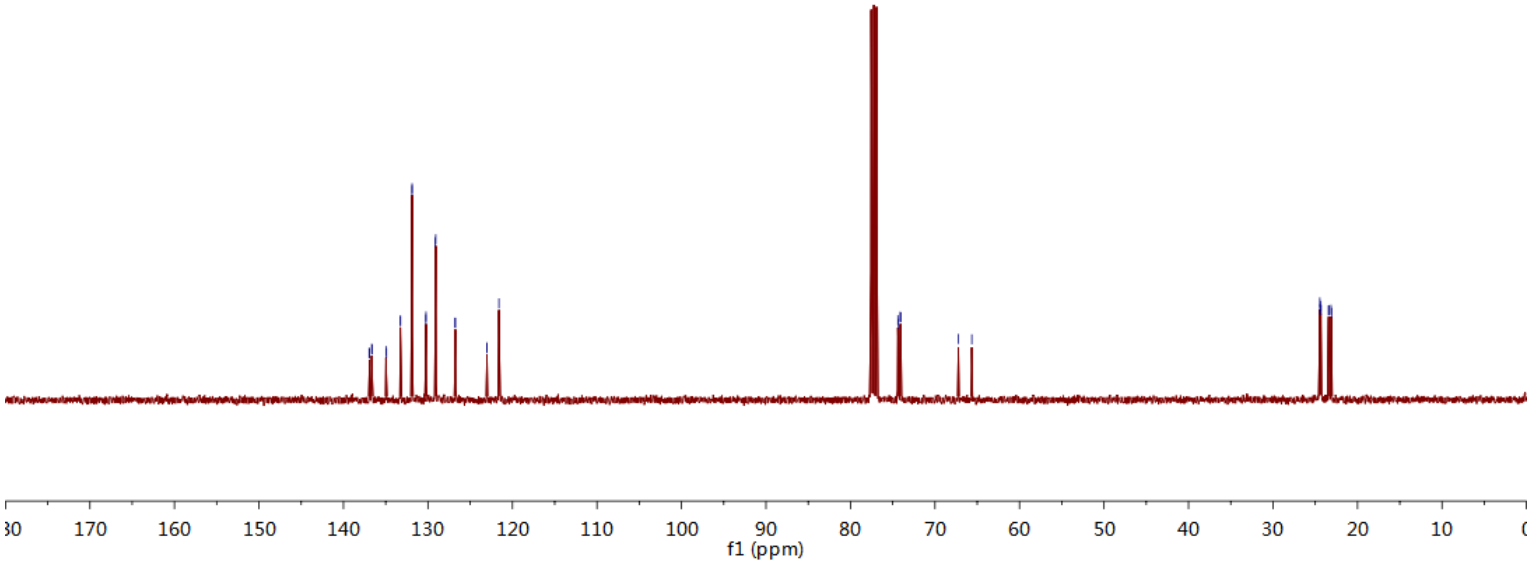

7.9092
7.8894
7.8008
7.7967
7.7898
7.7791
7.7746
7.6749
7.6559
7.6370
7.6347
7.5956
7.5768
7.5580
7.4482
7.4268
6.4875
4.7442
4.7284
4.7128
4.6970
4.6810
4.6653
4.6497
4.6340
4.5421
4.5266
4.5110
4.4952
4.4792
4.4634
4.4477
4.4321
1.2837
1.2682
1.0333
1.0179
0.8683
0.8527
1H NMR ZY-3-73D in CDCl3
O
O
S
NH
PO(O$^i$Pr)$_2$
Br
**4d** $^1$H NMR (400 MHz, CDCl$_3$)
1.02
3.00
1.09
1.08
2.08
1.03
1.02
1.00
6.06
3.00
3.07
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)



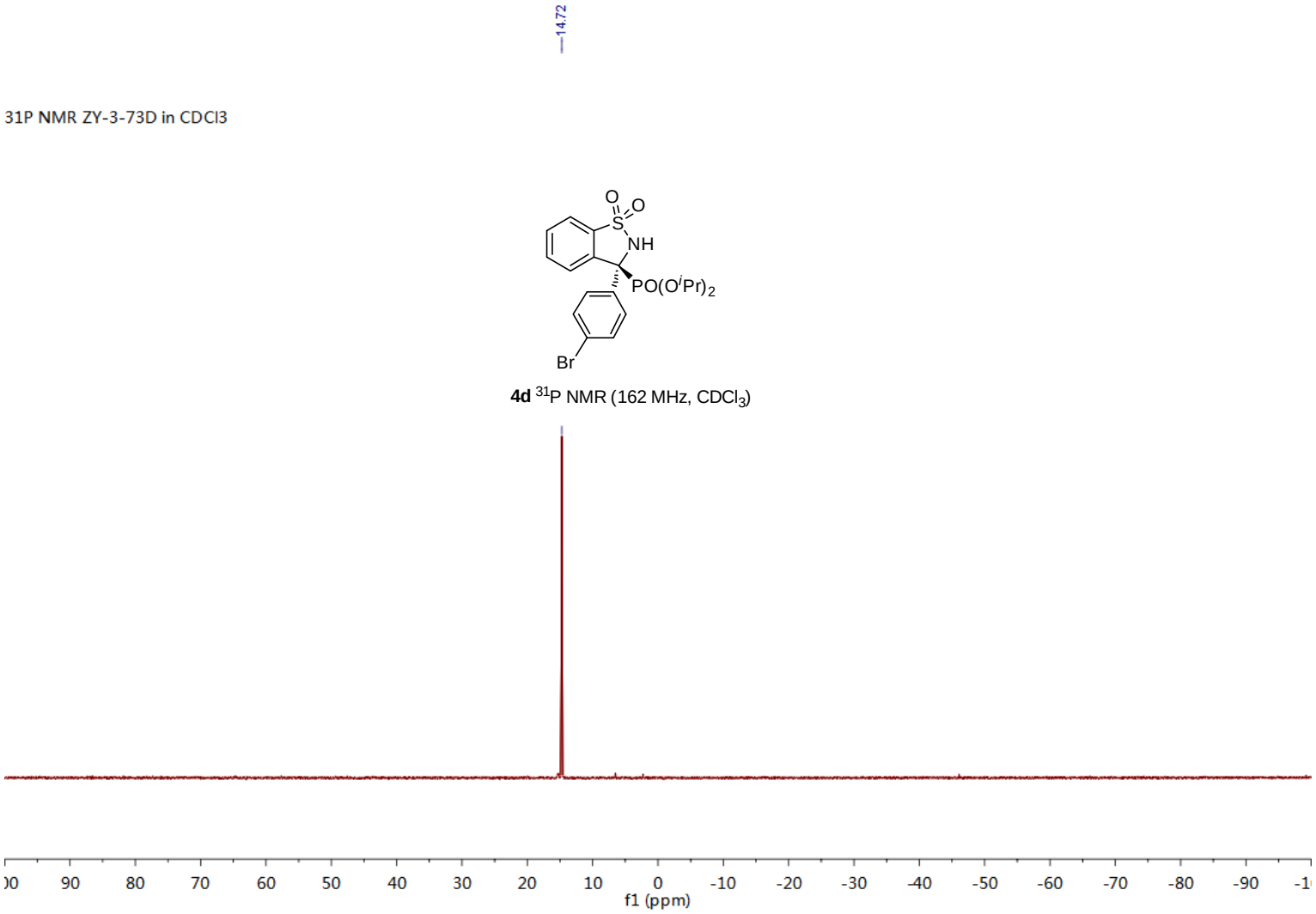

13C NMR ZY-3-73D in CDCl3



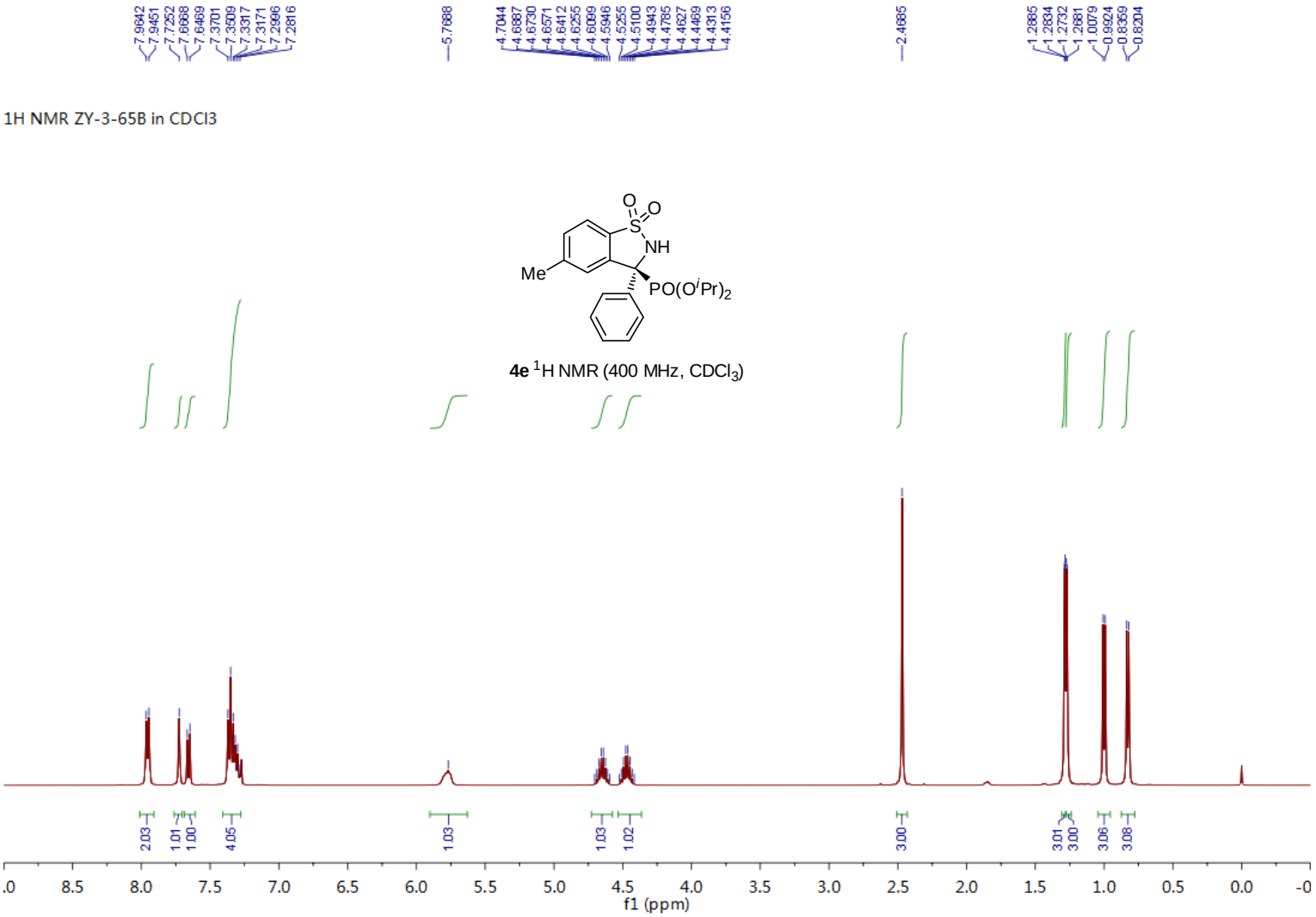

**4d** $^{13}$C NMR (100 MHz, $CDCl_3$)

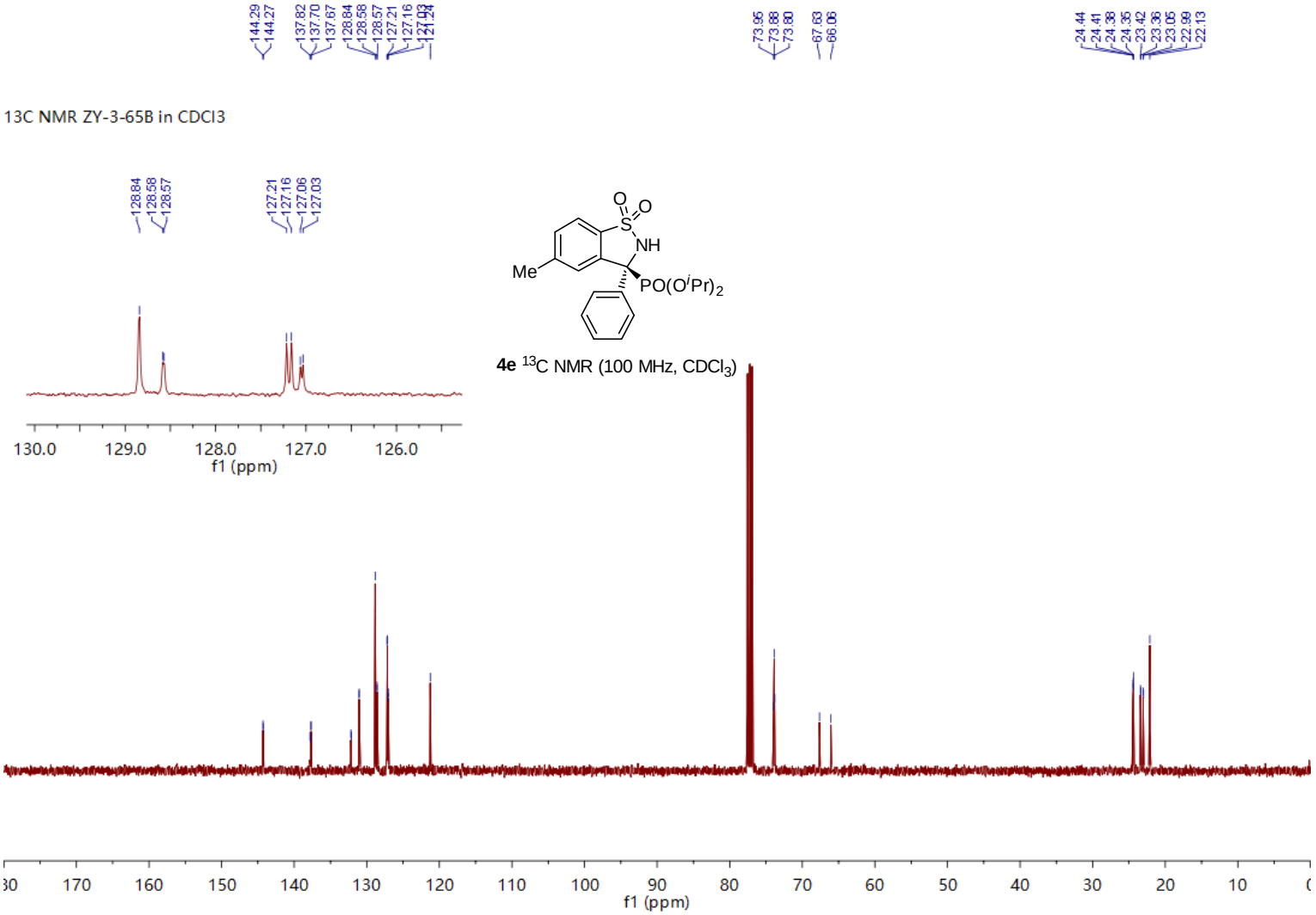


31P NMR ZY-3-73D in CDCl3



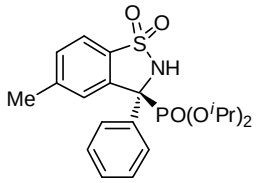

**4d** $^{31}$P NMR (162 MHz, $CDCl_3$)


7.9642
7.9451
7.7252
7.6868
7.6469
7.3701
7.3509
7.3317
7.3171
7.2996
7.2816
5.7888
4.7044
4.6887
4.6730
4.6571
4.6412
4.6255
4.6099
4.5946
4.5255
4.5100
4.4943
4.4785
4.4627
4.4469
4.4313
4.4156
2.4685
1.2885
1.2834
1.2732
1.2681
1.0079
0.9924
0.8359
0.8204
1H NMR ZY-3-65B in CDCl3
O
O
S
NH
Me
PO(O$^i$Pr)$_2$
**4e** $^1$H NMR (400 MHz, CDCl$_3$)
2.03
1.01
1.00
4.05
1.03
1.03
1.02
3.00
3.01
3.00
3.06
3.08
.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

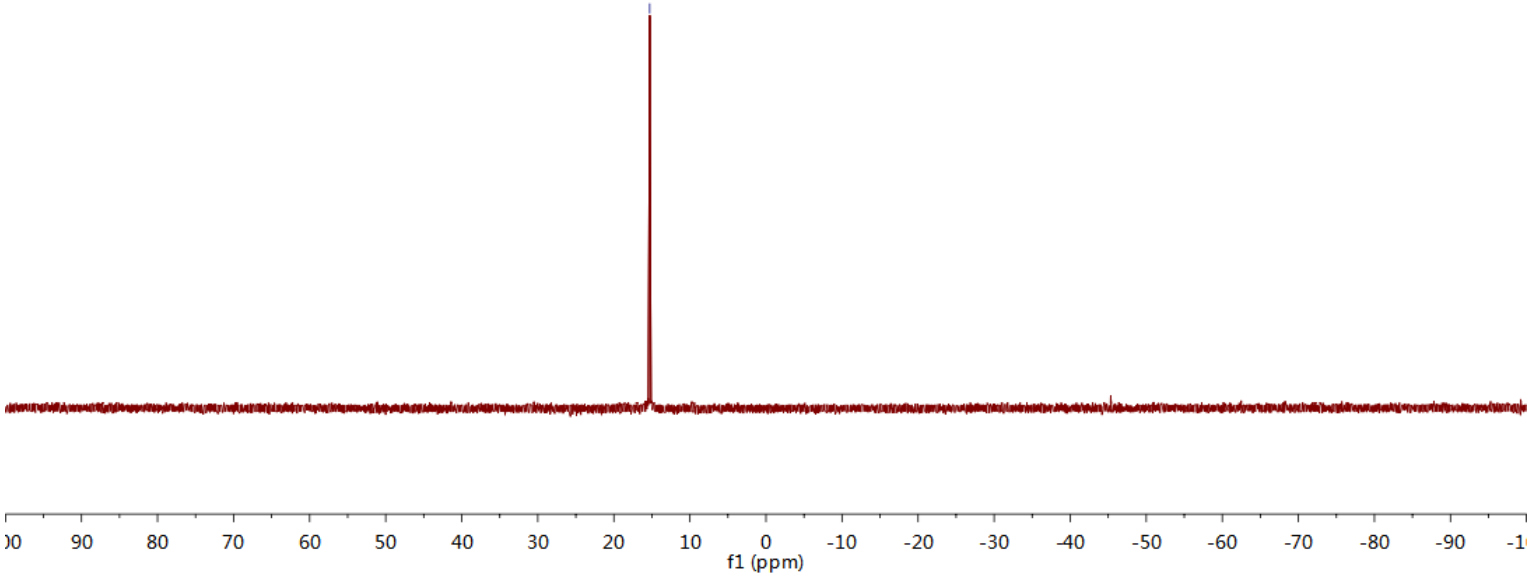

144.29
144.27
137.82
137.70
137.67
128.84
128.58
128.57
127.21
127.16
127.06
127.03
121.24
73.95
73.88
73.80
67.63
66.06
24.44
24.41
24.38
24.35
23.42
23.36
23.05
22.99
22.13
13C NMR ZY-3-65B in CDCl3
128.84
128.58
128.57
127.21
127.16
127.06
127.03
130.0
129.0
128.0
127.0
126.0
f1 (ppm)
O
O
S
NH
Me
PO(O$^i$Pr)$_2$
**4e** $^{13}$C NMR (100 MHz, CDCl$_3$)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

15.29

31P NMR ZY-3-65B in CDCl3




**4e** $^{31}$P NMR (162 MHz, $CDCl_3$)



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009546.D
Sample Name: ZY-3-57B(+-)

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Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/26/2015 4:01:38 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/26/2015 3:48:39 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:48:48 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 80/20, 0.7mL/min, 30 oC, 220nm
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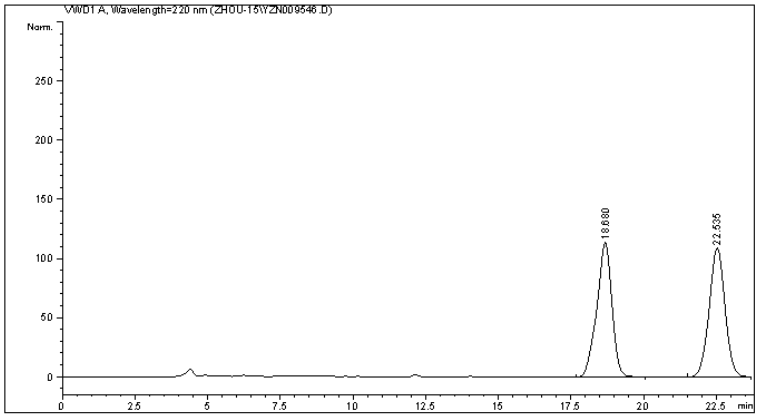


```
                          Area Percent Report

Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]      [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  18.680 BB    0.5353 4107.44141  113.63403  49.9213
   2  22.535 BBA   0.5809 4120.38916  108.97152  50.0787

Totals :                  8227.83057  222.60555

                          *** End of Report ***
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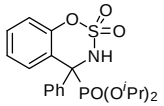

(+/-)-**2a**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009547.D
Sample Name: ZY-3-57B

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Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/26/2015 4:28:07 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/26/2015 4:25:21 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:47:41 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 80/20, 0.7mL/min, 30 oC, 220nm
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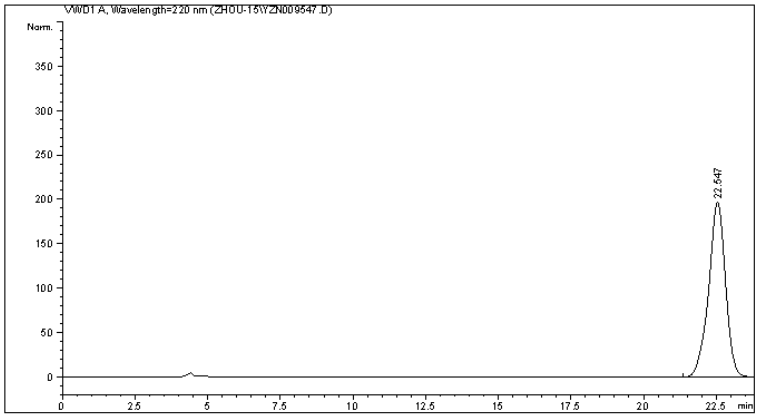


```
                          Area Percent Report

Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]      [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  22.547 BB    0.6060 7934.42236  197.29561 100.0000

Totals :                  7934.42236  197.29561

                          *** End of Report ***
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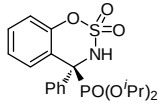

(+)-**2a**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009538.D
Sample Name: ZY-3-59A(+-)

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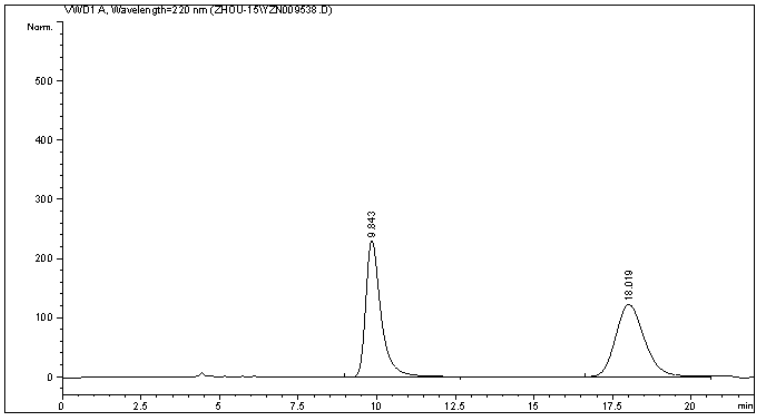
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/25/2015 7:11:57 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/25/2015 6:49:20 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:26:23 PM
                  (modified after loading)
Sample Info     : AS-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220nm
```




```
                          Area Percent Report

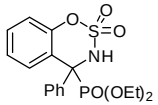
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|--------|
   1   9.843 BB    0.5010 7719.98975  230.75404  49.9459
   2  18.019 BB    0.9816 7736.71924  121.99339  50.0541

Totals :                  1.54567e4   352.74743

                          *** End of Report ***
```

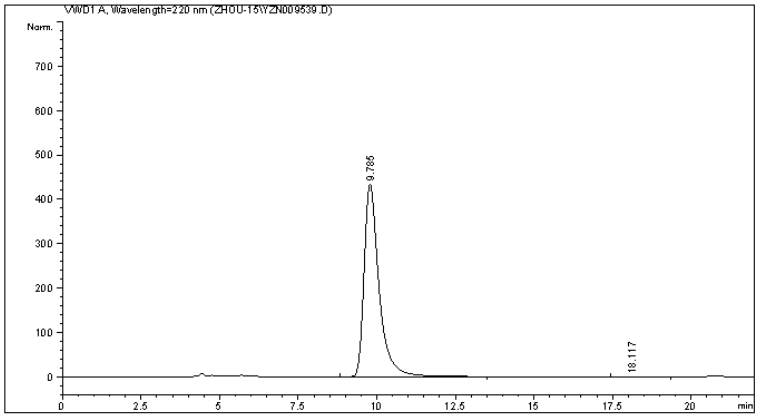



(+/-)-**2b**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009539.D
Sample Name: ZY-3-59A

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/25/2015 7:46:06 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/25/2015 7:44:43 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:24:05 PM
                  (modified after loading)
Sample Info     : AS-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220nm
```




```
                          Area Percent Report

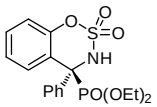
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|--------|
   1   9.785 VB    0.4966 1.43535e4   433.90518  99.8773
   2  18.117 BB    0.6853   17.63156 3.13486e-1   0.1227

Totals :                  1.43711e4   434.21867

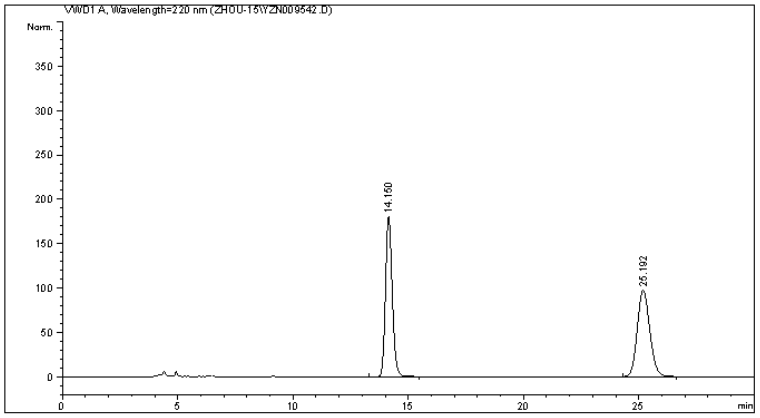
                          *** End of Report ***
```




(+)-**2b**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009542.D
Sample Name: ZY-3-59B(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/26/2015 9:14:27 AM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/26/2015 8:32:04 AM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:30:12 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 80/20, 0.7mL/min, 30 oC, 220nm
```




```
                          Area Percent Report

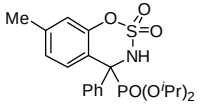
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  14.150 BB    0.3133 3674.01855  180.40199  50.0841
   2  25.192 BB    0.5837 3661.68286   97.50363  49.9159

Totals :                  7335.70142  277.90562

                          *** End of Report ***
```

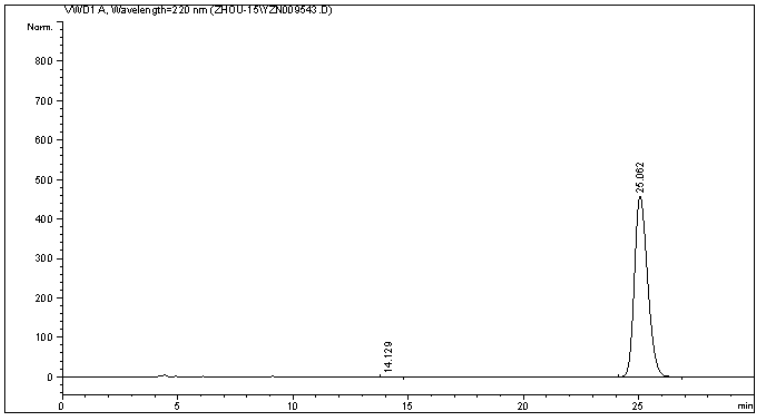



(+/-)-**2c**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009543.D
Sample Name: ZY-3-59B

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/26/2015 10:01:17 AM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/26/2015 9:57:24 AM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:28:55 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 80/20, 0.7mL/min, 30 oC, 220nm
```




```
                          Area Percent Report

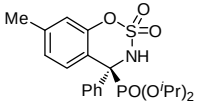
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  14.129 VB    0.3180    8.79107 4.18331e-1   0.0484
   2  25.062 BB    0.6177 1.81607e4   457.30035  99.9516

Totals :                  1.81695e4   457.71868

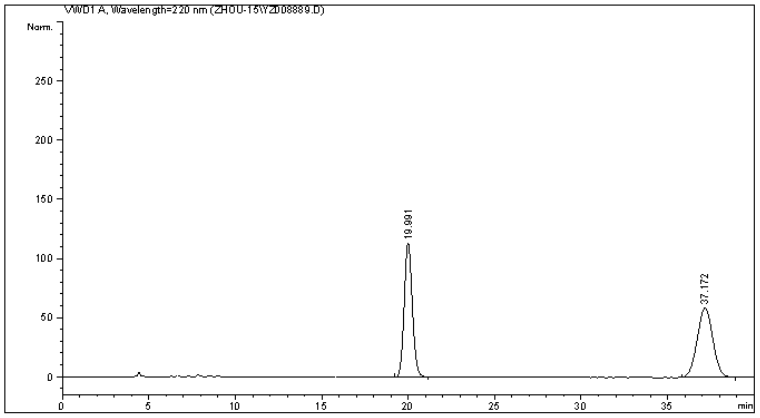
                          *** End of Report ***
```




(+)-**2c**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008889.D
Sample Name: ZY-3-60E(+-)

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/13/2015 6:26:16 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 10/13/2015 5:57:22 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:35:54 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

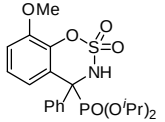
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  19.991 BB    0.5085 3693.26538  113.27541  49.9493
   2  37.172 BB    0.9726 3700.76392   58.83889  50.0507

Totals :                  7394.02930  172.11430


                          *** End of Report ***
```

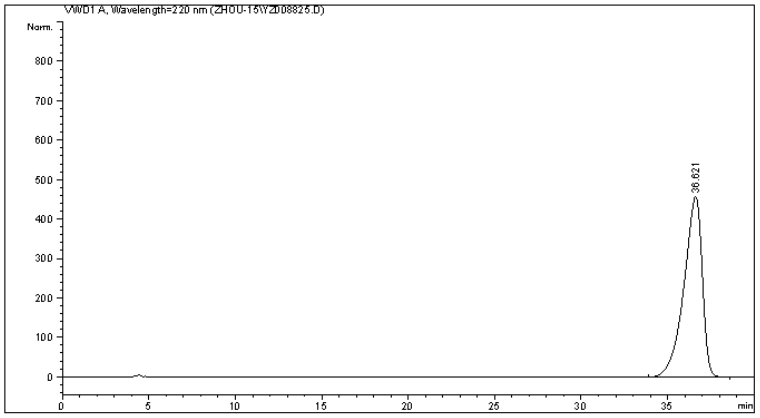



(+/-)-**2d**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008825.D
Sample Name: ZY-3-60E

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/30/2015 12:33:37 PM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 9/30/2015 11:29:45 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:33:25 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

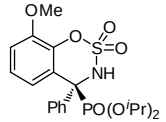
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  36.621 BB    1.1113 3.35395e4   457.60403 100.0000

Totals :                  3.35395e4   457.60403

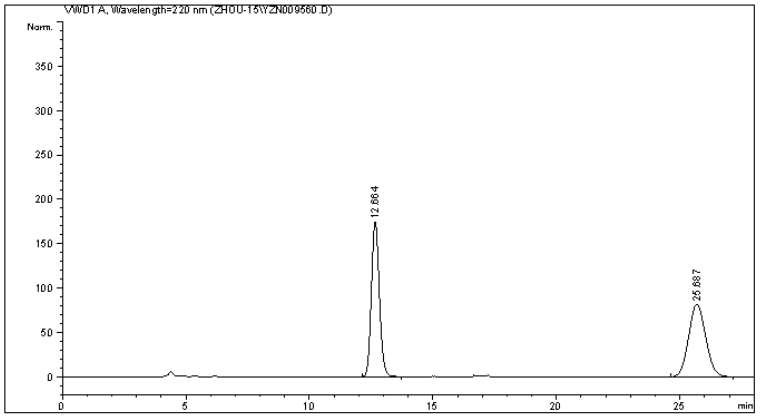

                          *** End of Report ***
```




(+)-**2d**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009560.D
Sample Name: ZY-3-60C(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/28/2015 3:41:50 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/28/2015 3:38:57 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:41:40 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

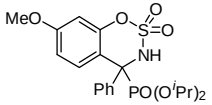
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  12.664 BB    0.3489 3916.77856  174.72066  49.9683
   2  25.687 BB    0.7386 3921.75269   81.98679  50.0317

Totals :                  7838.53125  256.70745

                          *** End of Report ***
```

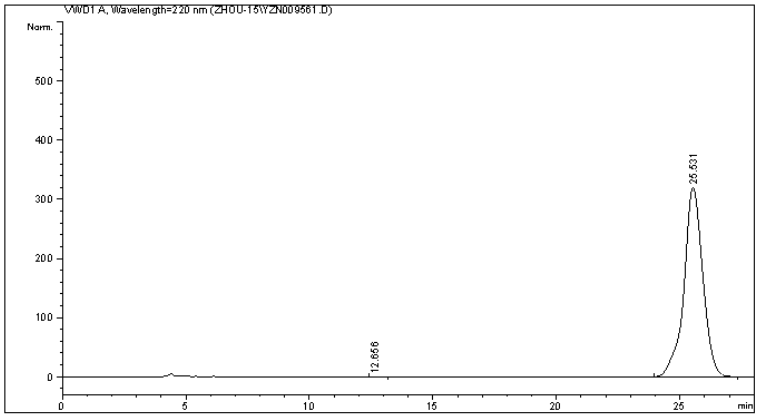



(+/-)-**2e**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009561.D
Sample Name: ZY-3-60C

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/28/2015 4:12:48 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 9/28/2015 4:11:05 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/26/2015 4:42:55 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

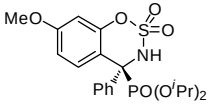
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  12.656 BB    0.3155    6.26127 3.04634e-1   0.0368
   2  25.531 BB    0.8004 1.69944e4   319.88434  99.9632

Totals :                  1.70007e4   320.18897

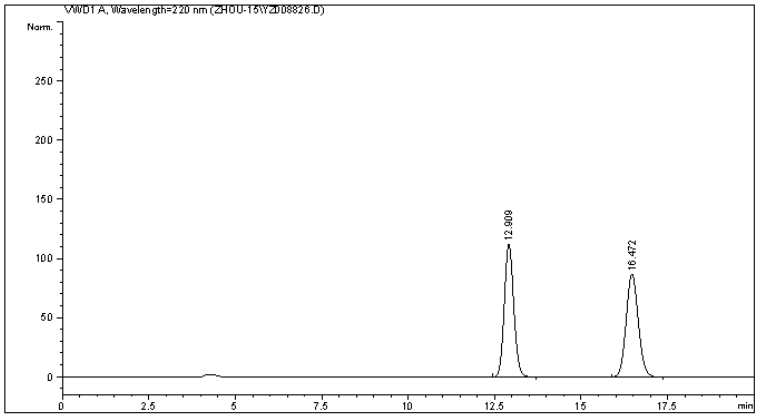
                          *** End of Report ***
```




(+)-**2e**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008826.D
Sample Name: ZY-3-60F(+-)

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/30/2015 11:46:49 PM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 9/30/2015 11:27:58 PM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:07:05 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

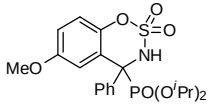
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  12.909 BB    0.2977 2132.28027  112.07968  49.9541
   2  16.472 BB    0.3800 2136.19995   86.89104  50.0459

Totals :                  4268.48022  198.97073

                          *** End of Report ***
```

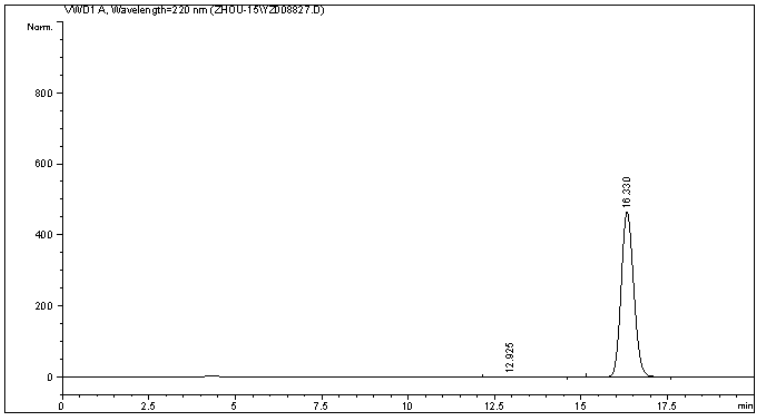



(+/-)-**2f**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008827.D
Sample Name: ZY-3-60F

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/1/2015 12:29:26 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 9/30/2015 11:27:58 PM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:05:03 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

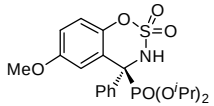
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs

Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  12.925 VV    0.9021   27.60604 3.71405e-1   0.2353
   2  16.330 VB    0.3923 1.17032e4   465.50668  99.7647

Totals :                  1.17308e4   465.87809

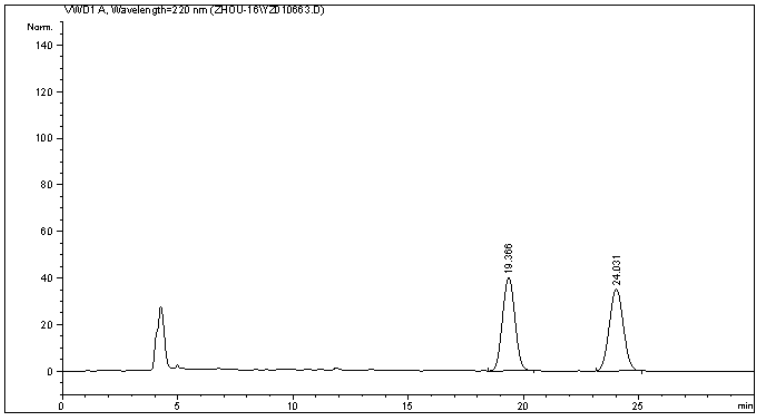
                          *** End of Report ***
```




(+)-**2f**

Data File C:\CHEM32\1\DATA\ZHOU-16\YZ010663.D
Sample Name: ZY-4-57B(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 6/18/2016 10:39:51 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 6/18/2016 10:18:09 AM by
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/30/2016 9:42:43 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 80/20, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

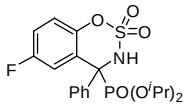
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]      [min] mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  19.366 VB    0.5971 1498.80945   39.88867  50.3105
   2  24.031 BB    0.6515 1480.31140   35.15281  49.6895

Totals :                  2979.12085   75.04147

                          *** End of Report ***
```

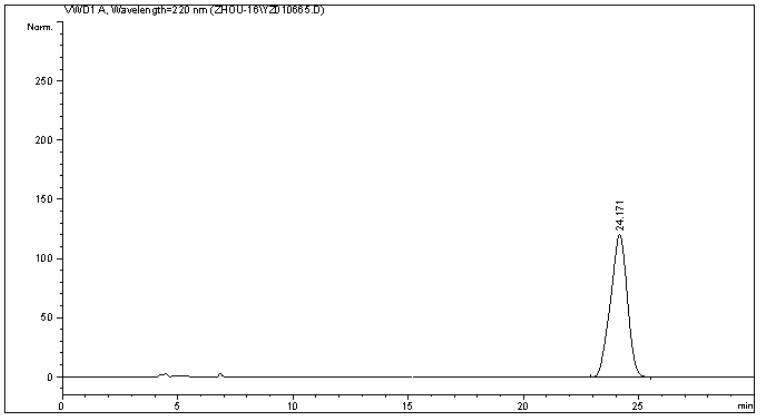


(+/-)-**2g**

Instrument 1 6/30/2016 9:43:08 PM Page 1 of 1

Data File C:\CHEM32\1\DATA\ZHOU-16\YZ010665.D
Sample Name: ZY-4-57B

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 6/18/2016 11:43:09 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 6/18/2016 10:18:09 AM by
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/30/2016 9:44:45 PM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 80/20, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

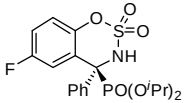
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]      [min] mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  24.171 VB    0.7646 6101.17139  120.66354 100.0000

Totals :                  6101.17139  120.66354

                          *** End of Report ***
```

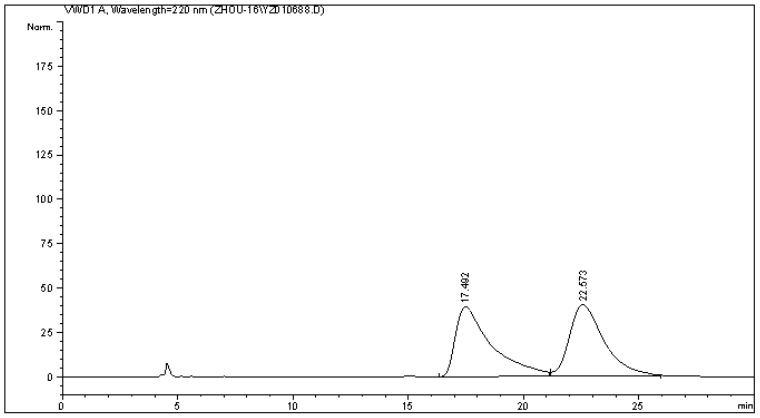


(+)-**2g**

Instrument 1 6/30/2016 9:44:56 PM Page 1 of 1

Data File C:\CHEM32\1\DATA\ZHOU-16\YZ010688.D
Sample Name: ZY-4-59B(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 6/24/2016 1:09:13 PM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 6/24/2016 1:01:50 PM by
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/30/2016 9:46:16 PM
                  (modified after loading)
Sample Info     : AS-H, H/i-PrOH = 95/5, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

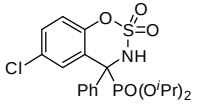
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  17.492 BB    1.5178 4273.96875   39.29910  50.6365
   2  22.573 BB    1.5023 4166.51709   40.13602  49.3635

Totals :                  8440.48584   79.43512

                          *** End of Report ***
```

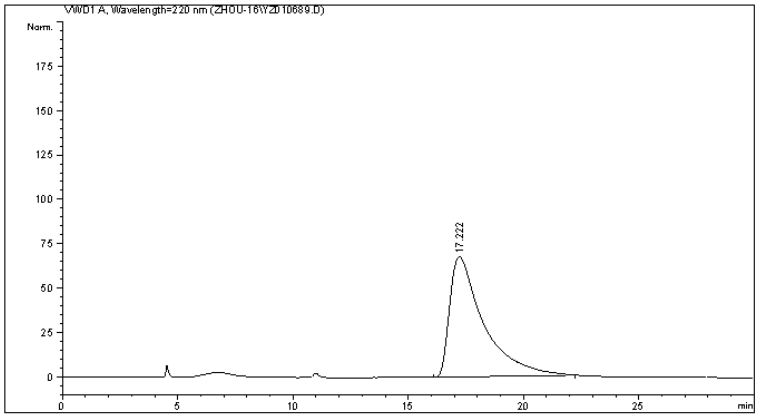


(+/-)-**2h**



Data File C:\CHEM32\1\DATA\ZHOU-16\YZ010689.D
Sample Name: ZY-4-59B

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 6/24/2016 1:41:09 PM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 6/24/2016 1:01:50 PM by
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/30/2016 9:46:16 PM
                  (modified after loading)
Sample Info     : AS-H, H/i-PrOH = 95/5, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

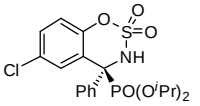
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  17.222 BB    1.4384 6917.11035   67.67933 100.0000

Totals :                  6917.11035   67.67933

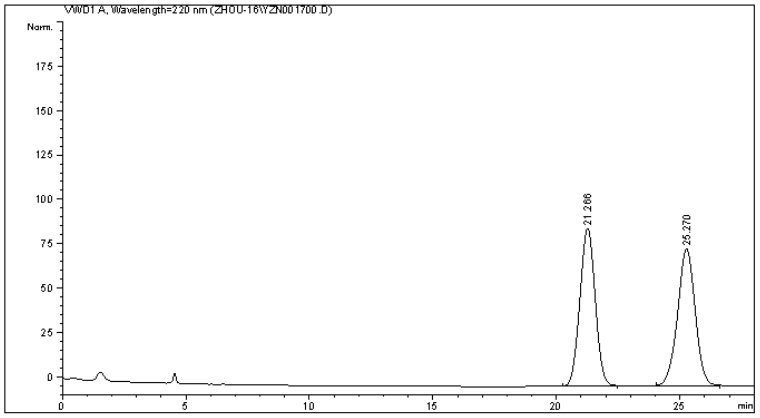
                          *** End of Report ***
```



(+)-**2h**

Data File C:\CHEM32\1\DATA\ZHOU-16\YZN001700.D
Sample Name: ZY-4-60B(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 6/25/2016 8:24:04 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/25/2016 8:11:00 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/30/2016 9:49:28 PM
                  (modified after loading)
Sample Info     : AD-H, Hex/i-PrOH = 80/20, 0.7 mL/min, 30oC, 220 nm
```




```
                          Area Percent Report

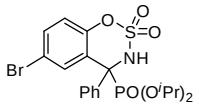
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  21.266 BB    0.6711 3825.06299   88.85781  50.1306
   2  25.270 BB    0.7517 3805.12964   77.13310  49.8694

Totals :                  7630.19263  165.99091

                          *** End of Report ***
```

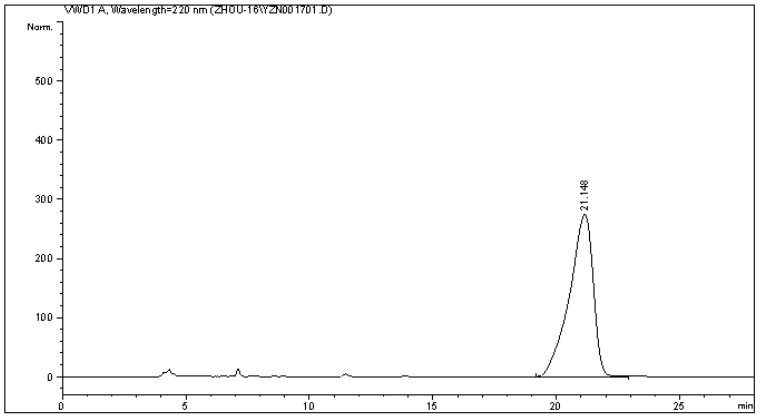



(+/-)-**2i**



Data File C:\CHEM32\1\DATA\ZHOU-16\YZN001701.D
Sample Name: ZY-4-60B

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 6/25/2016 8:54:05 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/25/2016 8:52:54 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 6/30/2016 9:50:37 PM
                  (modified after loading)
Sample Info     : AD-H, Hex/i-PrOH = 80/20, 0.7 mL/min, 30oC, 220 nm
```




```
                          Area Percent Report

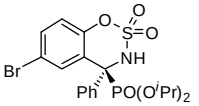
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  21.148 BB    0.9963 1.82910e4   274.30804 100.0000

Totals :                  1.82910e4   274.30804

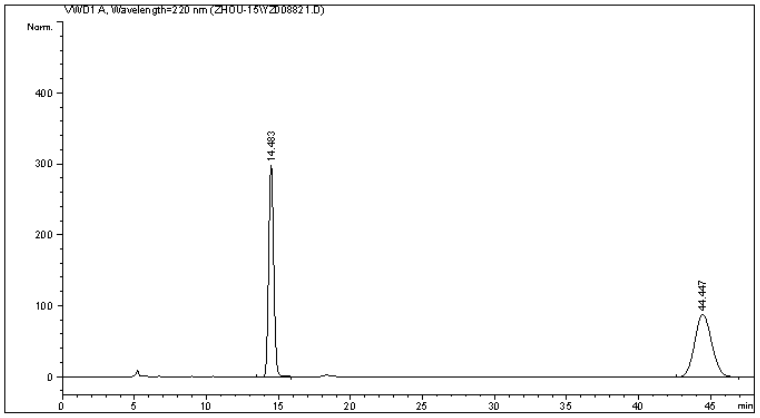
                          *** End of Report ***
```




(+)-**2i**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008821.D
Sample Name: ZY-3-60D(+-)

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/30/2015 7:08:31 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 9/30/2015 6:52:09 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:10:10 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

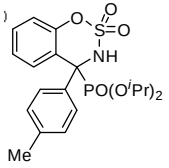
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  14.483 VB    0.3752 7211.51709  298.37463  49.8745
   2  44.447 BB    1.2885 7247.81934   88.40045  50.1255

Totals :                  1.44593e4   386.77509

                          *** End of Report ***
```

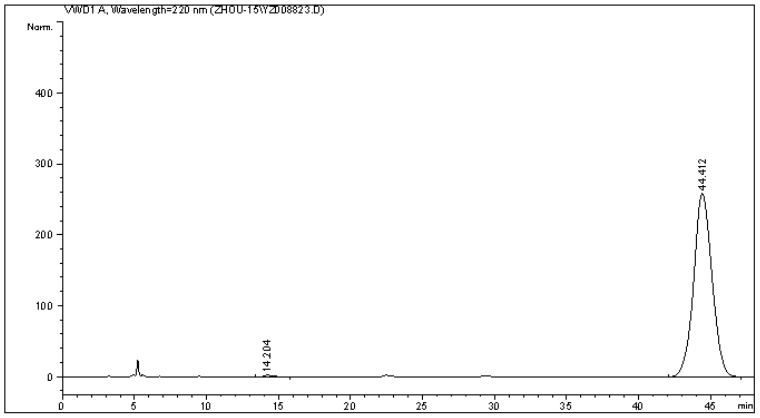



(+/-)-**2j**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008823.D
Sample Name: ZY-3-60D

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 9/30/2015 8:59:47 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 9/30/2015 8:57:09 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:10:10 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

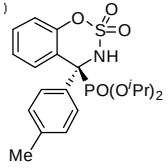
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  14.204 BB    0.6387  117.06583    2.57232   0.5083
   2  44.412 BB    1.3543 2.29154e4   258.56592  99.4917

Totals :                  2.30325e4   261.13823

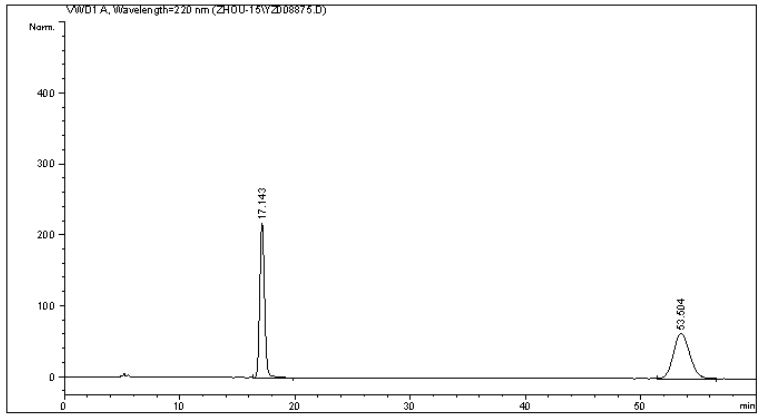
                          *** End of Report ***
```




(+)-**2j**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008875.D
Sample Name: ZY-3-62A(+-)

```
==========================================================================
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/11/2015 12:20:00 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 10/10/2015 11:49:45 PM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:14:59 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

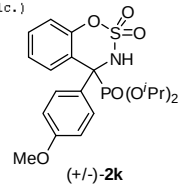
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|-------|
   1  17.143 VB    0.4490 6325.97852  218.10677  50.2315
   2  53.504 BB    1.5109 6267.66504   63.91665  49.7685

Totals :                  1.25936e4   282.02342

==========================================================================
                        *** End of Report ***
```

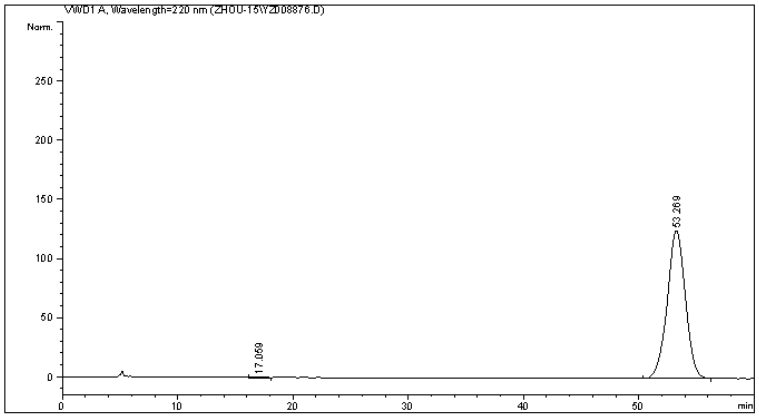



(+/-)-**2k**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008876.D
Sample Name: ZY-3-62A

```
==========================================================================
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/11/2015 1:28:07 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 10/10/2015 11:49:45 PM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:16:21 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

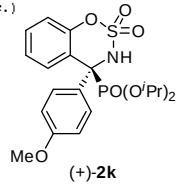
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|-------|
   1  17.059 VV    0.7171   22.66384 3.94335e-1   0.1654
   2  53.269 BB    1.6607 1.36774e4   125.02090  99.8346

Totals :                  1.37000e4   125.41523

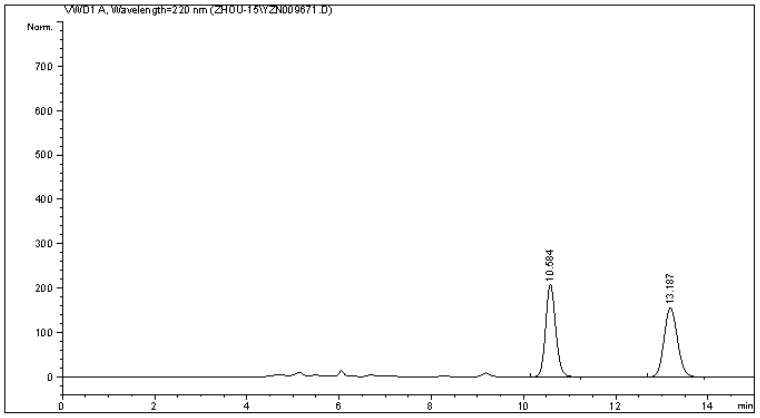
==========================================================================
                        *** End of Report ***
```




(+)-**2k**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009671.D
Sample Name: ZY-3-62B(+-)

```
==========================================================================
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/12/2015 8:15:42 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 10/12/2015 7:46:55 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:22:44 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

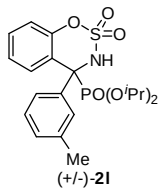
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|--------|
   1  10.584 BV    0.2326 3160.62378  208.04991  50.1699
   2  13.187 BV    0.3100 3139.21924  156.32187  49.8301

Totals :                  6299.84302  364.37178

==========================================================================
                        *** End of Report ***
```

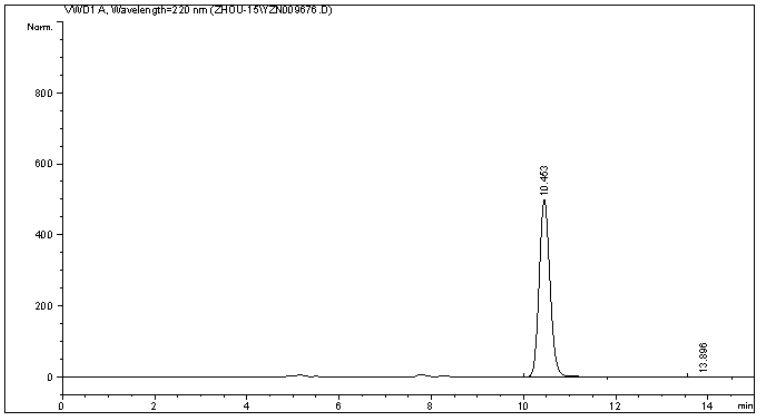



(+/-)-**2l**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009676.D
Sample Name: ZY-3-62B

```
==========================================================================
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/13/2015 11:14:24 AM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 10/13/2015 11:13:22 AM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:18:14 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

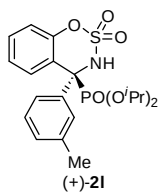
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|--------|
   1  10.453 VB    0.2533 8076.81152  498.01129  99.9576
   2  13.896 BB    0.3343    3.42285 1.59838e-1   0.0424

Totals :                  8080.23437  498.17113

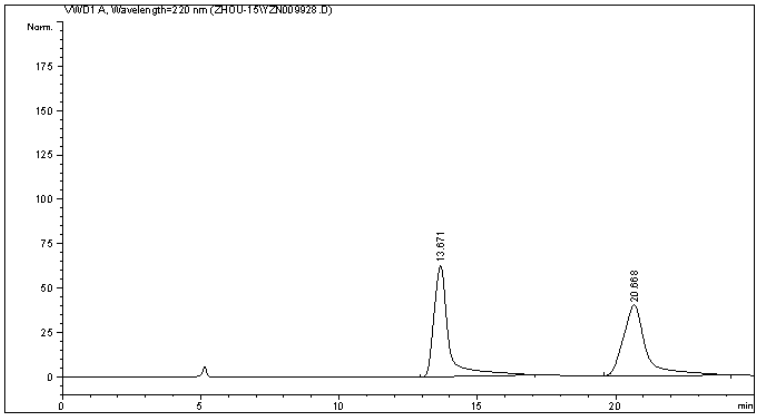
==========================================================================
                        *** End of Report ***
```




(+)-**2l**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009928.D
Sample Name: ZY-3-67A(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/6/2015 3:36:20 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 11/6/2015 3:34:50 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:14:06 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

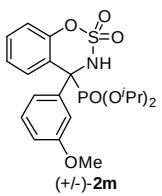
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  13.671 BB    0.5685 2330.20630   62.56181  50.6564
   2  20.668 BB    0.8211 2269.81812   39.71776  49.3436

Totals :                  4600.02441  102.27956

                          *** End of Report ***
```

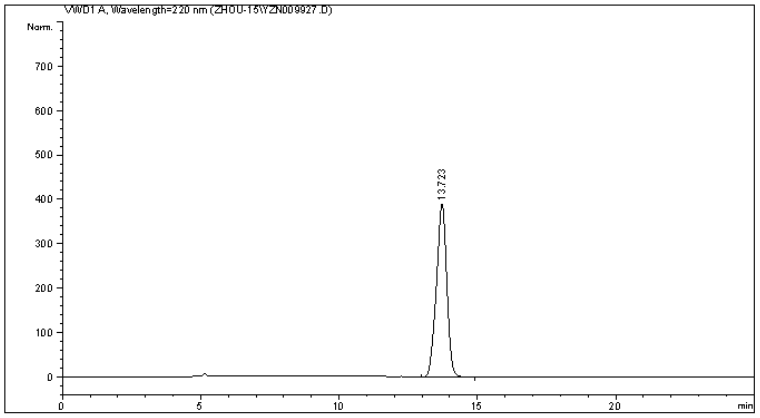



(+/-)-**2m**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009927.D
Sample Name: ZY-3-67A

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/6/2015 2:55:08 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 11/6/2015 2:53:47 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:11:54 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

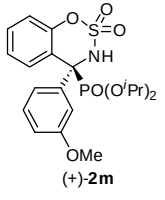
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  13.723 BB    0.3940 1.02905e4   391.47638 100.0000

Totals :                  1.02905e4   391.47638

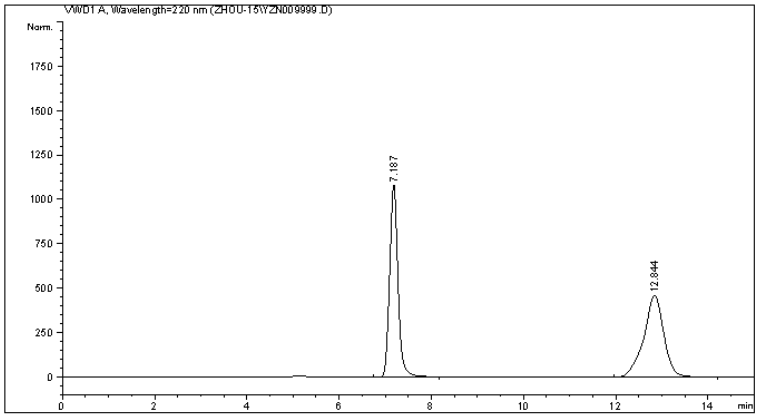
                          *** End of Report ***
```




(+)-**2m**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009999.D
Sample Name: ZY-3-71A(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/12/2015 2:43:03 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 11/12/2015 2:25:12 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:18:24 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
Area Percent Report

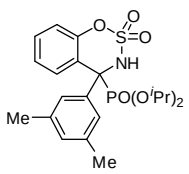
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1   7.187 VV    0.1899 1.35661e4  1082.45422  49.6519
   2  12.844 BB    0.4431 1.37563e4   458.66183  50.3481

Totals :                  2.73224e4  1541.11606

*** End of Report ***
```

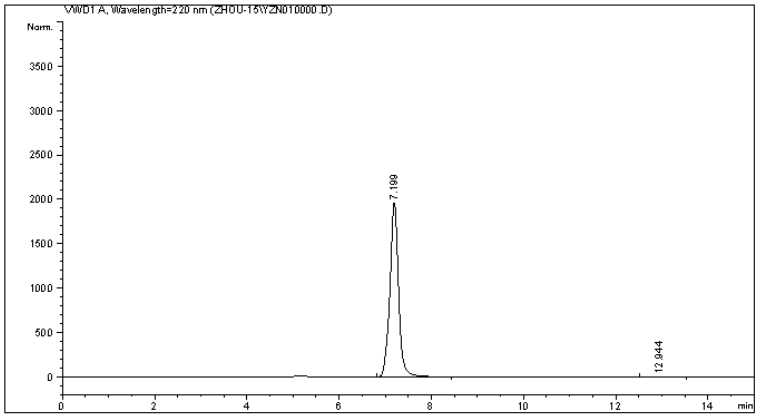



(+/-)-**2n**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN010000.D
Sample Name: ZY-3-71A

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/12/2015 3:06:05 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 11/12/2015 3:04:45 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:17:12 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 220 nm
```




```
Area Percent Report

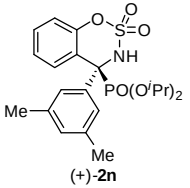
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1   7.199 VV    0.1934 2.56601e4  1961.77734  99.8181
   2  12.944 BB    0.3333   46.74881    2.07088   0.1819

Totals :                  2.57068e4  1963.84822

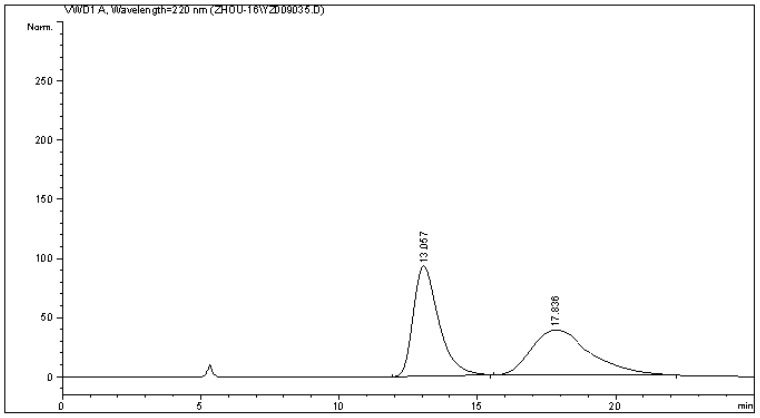
*** End of Report ***
```




(+)-**2n**

Data File C:\CHEM32\1\DATA\ZHOU-16\YZ009035.D
Sample Name: ZY-3-63C(+-)

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/4/2015 7:21:42 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/4/2015 6:33:08 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 3/18/2016 10:09:35 PM
                  (modified after loading)
Sample Info     : OJ, H/i-PrOH = 95/5, 0.6mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

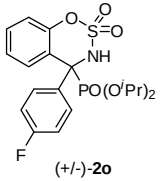
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  13.057 BB    0.9655 5939.86670   92.93832  51.3222
   2  17.836 BB    2.0406 5633.82178   38.04663  48.6778

Totals :                  1.15737e4   130.98495

                          *** End of Report ***
```

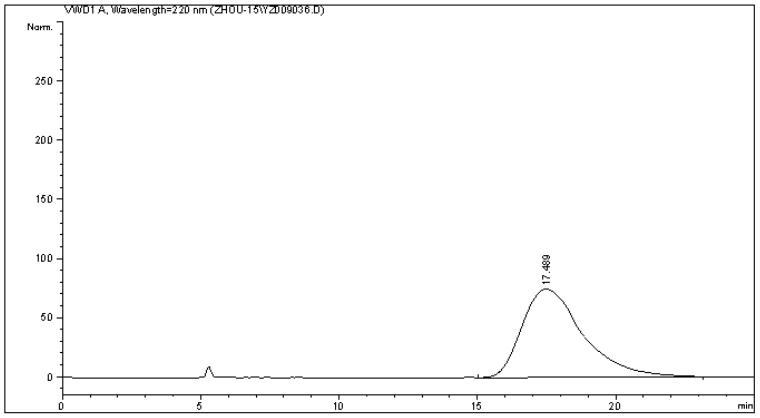



(+/-)-**2o**

Instrument 1 3/18/2016 10:09:42 PM Page 1 of 1

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ009036.D
Sample Name: ZY-3-63C

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/4/2015 8:20:19 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/4/2015 6:33:08 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:29:05 AM
                  (modified after loading)
Sample Info     : OJ, H/i-PrOH = 95/5, 0.6mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

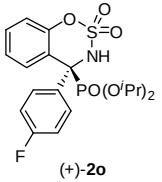
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  17.489 VB    2.3315 1.14597e4   74.81992 100.0000

Totals :                  1.14597e4   74.81992

                          *** End of Report ***
```

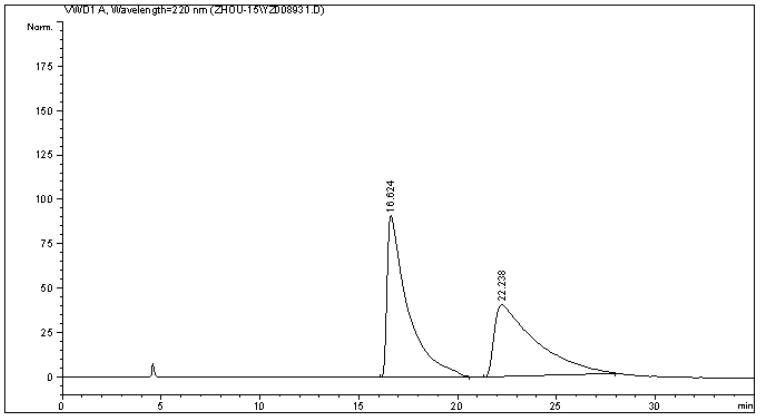



(+)-**2o**

Instrument 1 12/28/2015 10:29:19 AM Page 1 of 1

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008931.D
Sample Name: ZY-3-63D(+-)

```
==========================================================================
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/17/2015 11:44:38 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 10/17/2015 10:41:43 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:39:36 AM
                  (modified after loading)
Sample Info     : IC-H, H/i-PrOH = 90/10, 0.7 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

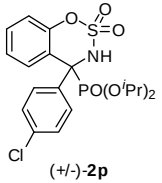
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  16.624 BB    0.9536 6575.19727   91.16359  52.8017
   2  22.238 BB    1.8641 5877.43701   40.65810  47.1983

Totals :                  1.24526e4   131.82169

==========================================================================
                        *** End of Report ***
```

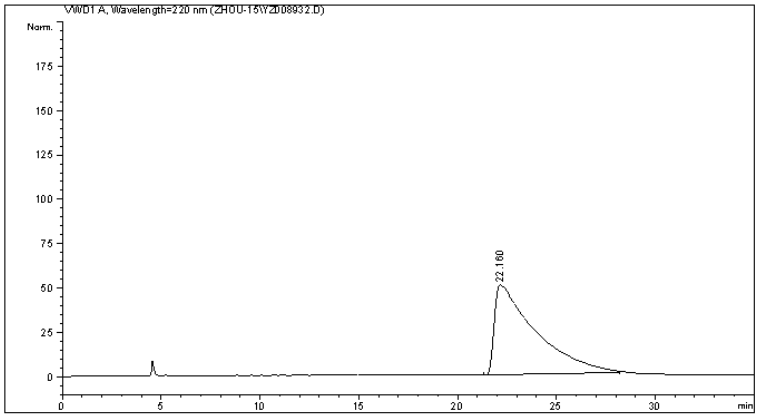



(+/-)-**2p**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008932.D
Sample Name: ZY-3-63D

```
==========================================================================
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/18/2015 5:55:56 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 10/18/2015 5:29:38 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:40:55 AM
                  (modified after loading)
Sample Info     : IC-H, H/i-PrOH = 90/10, 0.7 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

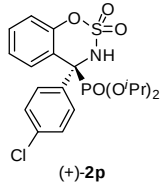
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  22.160 BB    1.8070 7288.64697   50.47561 100.0000

Totals :                  7288.64697   50.47561

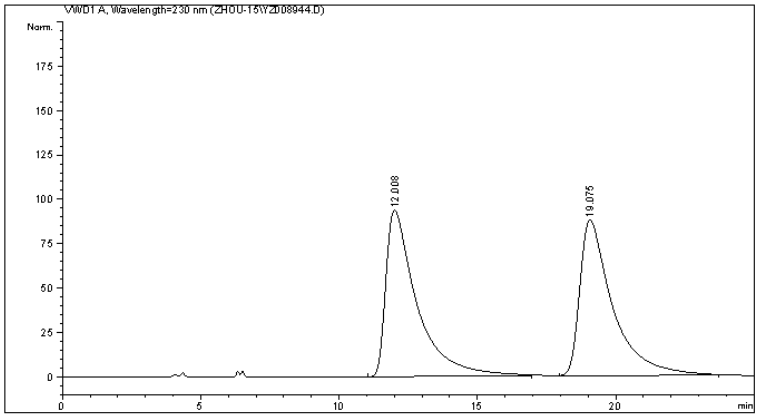
==========================================================================
                        *** End of Report ***
```




(+)-**2p**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008944.D
Sample Name: ZY-3-63E(+-)

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/20/2015 5:05:03 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 10/20/2015 4:52:10 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:44:31 AM
                  (modified after loading)
Sample Info     : IA-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 230 nm
```




```
                          Area Percent Report

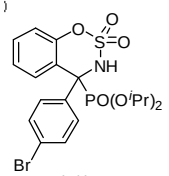
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=230 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  12.008 BB    1.1157 7299.03906   93.68808  50.2288
   2  19.075 BB    1.1820 7232.54541   87.56483  49.7712

Totals :                  1.45316e4   181.25291

                          *** End of Report ***
```

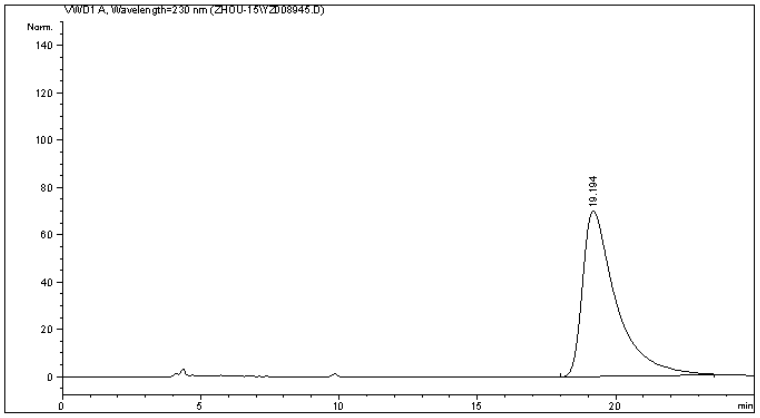


(+/-)-**2q**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ008945.D
Sample Name: ZY-3-63E

```
Acq. Operator   : ZHOU
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/20/2015 5:45:08 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 10/20/2015 4:52:10 AM by ZHOU
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:43:22 AM
                  (modified after loading)
Sample Info     : IA-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 230 nm
```




```
                          Area Percent Report

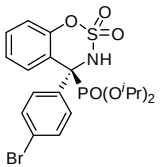
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=230 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  19.194 BB    1.2388 5899.48779   70.05099 100.0000

Totals :                  5899.48779   70.05099

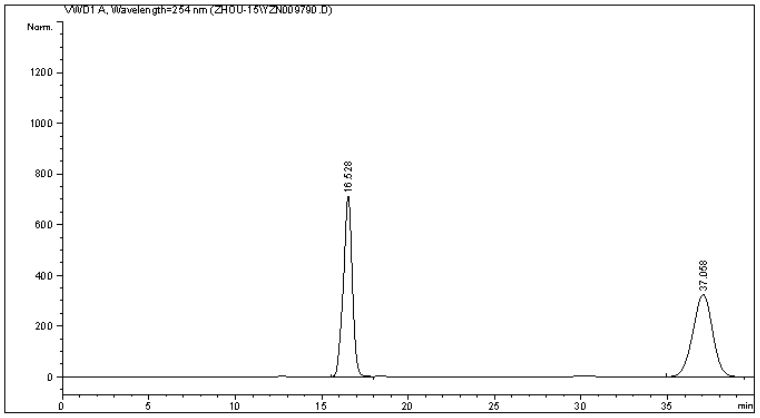
                          *** End of Report ***
```



(+)-**2q**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009790.D
Sample Name: ZY-3-64H(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/23/2015 10:37:58 AM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 10/23/2015 10:36:42 AM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:47:46 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 254 nm
```




```
                          Area Percent Report

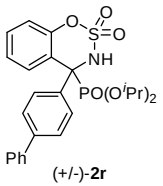
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=254 nm

Peak RetTime Type  Width     Area      Height     Area
  #  [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  16.528 BV    0.5364 2.56655e4   713.02032  49.9914
   2  37.058 BB    1.2265 2.56743e4   324.27612  50.0086

Totals :                  5.13398e4  1037.29645

                          *** End of Report ***
```

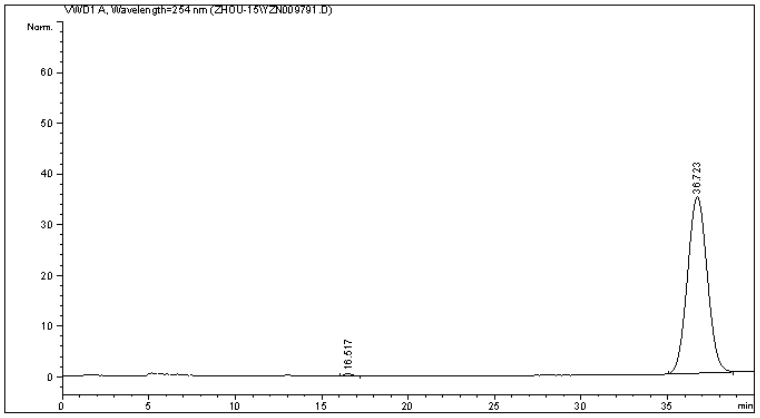



(+/-)-**2r**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009791.D
Sample Name: ZY-3-64H

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/23/2015 2:08:13 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 10/23/2015 1:41:16 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:46:19 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 60/40, 0.6 mL/min, 30 oC, 254 nm
```




```
                          Area Percent Report

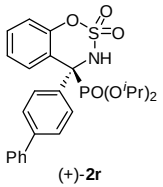
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=254 nm

Peak RetTime Type  Width     Area      Height     Area
  #  [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|---------|---------|-------|
   1  16.517 BB    0.4410   11.59417 3.98872e-1   0.4176
   2  36.723 BB    1.2361 2764.75342   34.78008  99.5824

Totals :                  2776.34759   35.17895

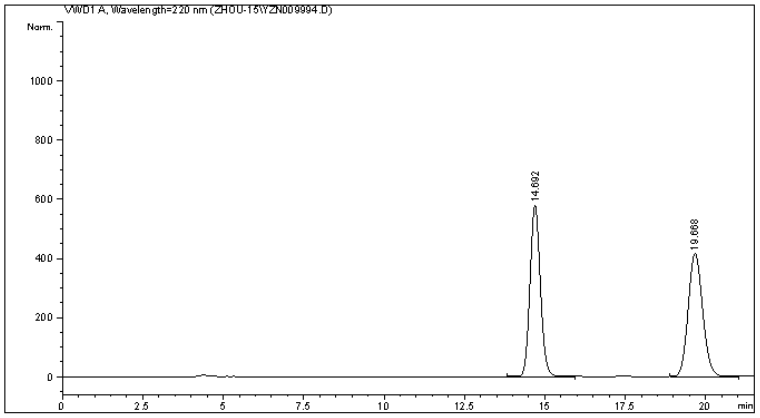
                          *** End of Report ***
```




(+)-**2r**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009994.D
Sample Name: ZY-3-72A(+-)

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/11/2015 9:30:57 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 11/11/2015 9:06:46 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:58:21 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

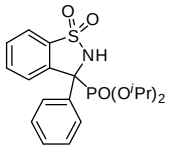
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  14.692 BB    0.3457 1.29592e4   578.70093  49.9083
   2  19.668 BB    0.4844 1.30068e4   415.72769  50.0917

Totals :                  2.59660e4   994.42862

                          *** End of Report ***
```

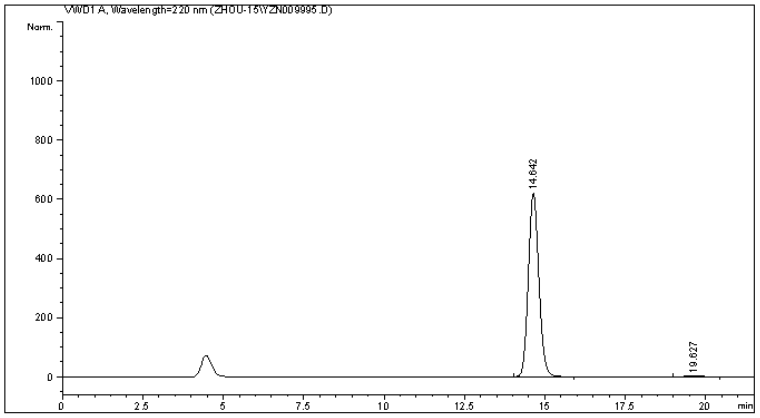



(+/-)-**4a**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009995.D
Sample Name: ZY-3-72A

```
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/11/2015 9:57:44 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 11/11/2015 9:52:54 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:58:21 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
                          Area Percent Report

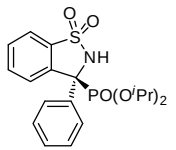
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  14.642 BB    0.3532 1.41325e4   620.11041  99.5107
   2  19.627 BB    0.4827   69.49609    2.21367   0.4893

Totals :                  1.42020e4   622.32408

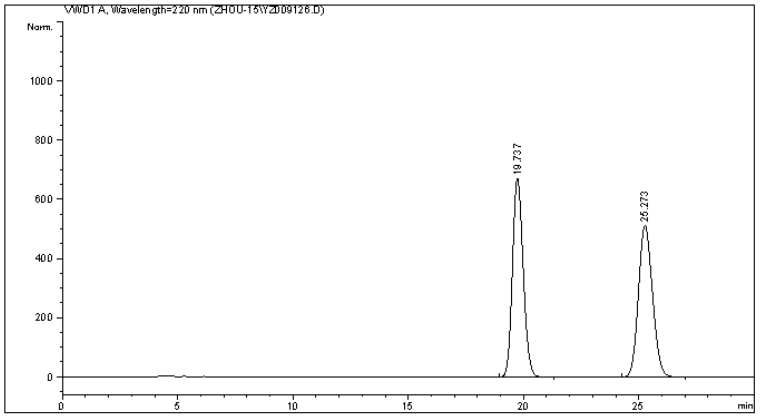
                          *** End of Report ***
```




(-)-**4a**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ009126.D
Sample Name: ZY-3-72B(+-)

```
==========================================================================
Acq. Operator   : j
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/15/2015 7:03:09 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/15/2015 6:36:02 AM by j
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:02:56 AM
                  (modified after loading)
Sample Info     : AD, H/i-PrOH = 70/30, 0.70 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

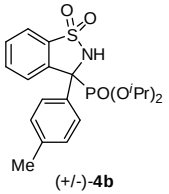
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  19.737 BB    0.5058 2.17435e4   671.73767  49.9558
   2  25.273 BB    0.6622 2.17820e4   512.07880  50.0442

Totals :                  4.35255e4  1183.81647

==========================================================================
                        *** End of Report ***
```

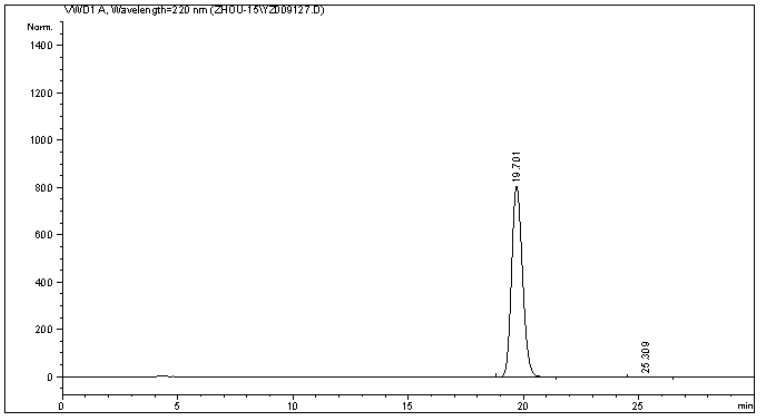



(+/-)-**4b**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ009127.D
Sample Name: ZY-3-72B

```
==========================================================================
Acq. Operator   : j
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/15/2015 7:40:43 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/15/2015 6:36:02 AM by j
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:01:36 AM
                  (modified after loading)
Sample Info     : AD, H/i-PrOH = 70/30, 0.70 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

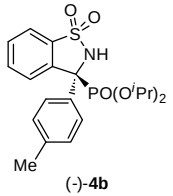
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  19.701 BB    0.5108 2.64735e4   807.17657  99.6786
   2  25.309 BB    0.6539   85.35922    1.95938   0.3214

Totals :                  2.65588e4   809.13595

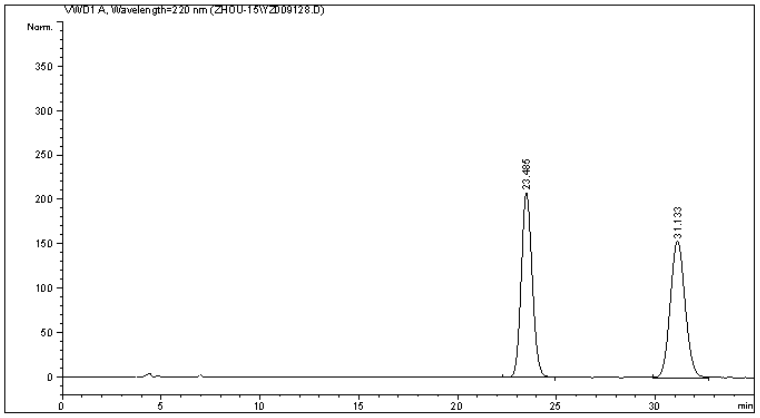
==========================================================================
                        *** End of Report ***
```




(-)-**4b**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ009128.D
Sample Name: ZY-3-73C(+-)

```
==========================================================================
Acq. Operator   : j
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/15/2015 8:14:31 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/15/2015 6:36:02 AM by j
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:06:09 AM
                  (modified after loading)
Sample Info     : AD, H/i-PrOH = 70/30, 0.70 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

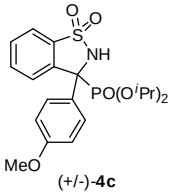
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|-------|
   1  23.485 VB    0.5988 8022.50732  207.86746  50.0107
   2  31.133 BV    0.8045 8019.05859  153.51097  49.9893

Totals :                  1.60416e4   361.37843

==========================================================================
                        *** End of Report ***
```

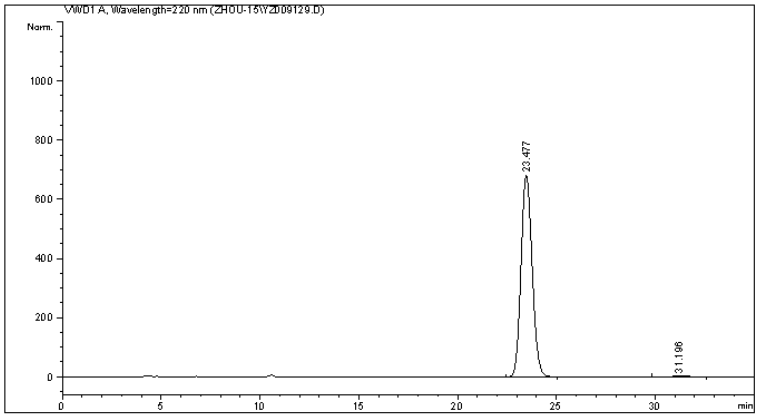



(+/-)-**4c**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ009129.D
Sample Name: ZY-3-73C

```
==========================================================================
Acq. Operator   : j
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/15/2015 8:53:45 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/15/2015 6:36:02 AM by j
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:04:31 AM
                  (modified after loading)
Sample Info     : AD, H/i-PrOH = 70/30, 0.70 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

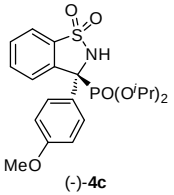
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|-------|
   1  23.477 VB    0.6141 2.67050e4  681.97137  99.2472
   2  31.196 VV    1.0200  202.56876    2.71189   0.7528

Totals :                  2.69076e4   684.68327

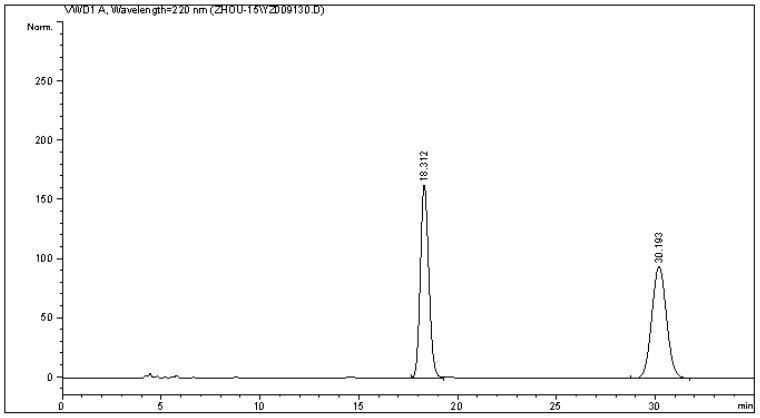
==========================================================================
                        *** End of Report ***
```




(-)-**4c**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZ009130.D
Sample Name: ZY-3-73D(+-)

```
==========================================================================
Acq. Operator   : j
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/15/2015 9:48:09 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/15/2015 6:36:02 AM by j
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:09:50 AM
                  (modified after loading)
Sample Info     : AD, H/i-PrOH = 70/30, 0.70 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

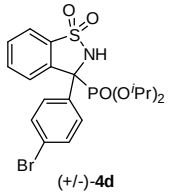
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  18.312 BV    0.4642 4863.51563  163.19772  49.9653
   2  30.193 BB    0.8029 4870.27148   94.38426  50.0347

Totals :                  9733.78711  257.58199

==========================================================================
                        *** End of Report ***
```

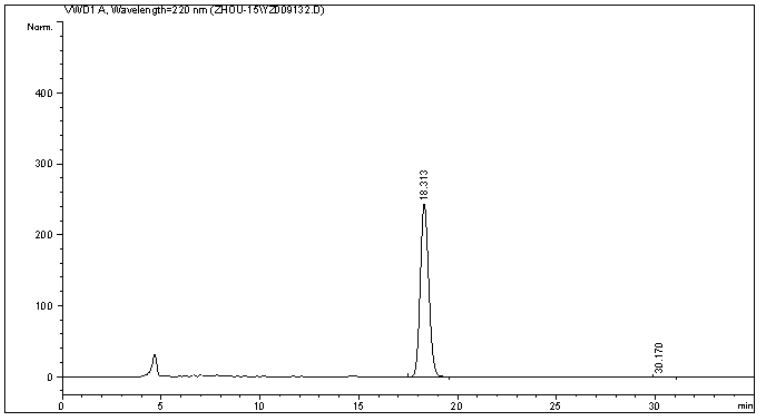



(+/-)-**4d**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZ009132.D
Sample Name: ZY-3-73D

```
==========================================================================
Acq. Operator   : j
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 11/15/2015 11:32:44 AM
Acq. Method     : C:\HPCHEM\1\METHODS\DEF LC.M
Last changed    : 11/15/2015 6:36:02 AM by j
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 11:08:05 AM
                  (modified after loading)
Sample Info     : AD, H/i-PrOH = 70/30, 0.70 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

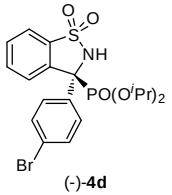
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Sample Amount:                :      1.00000  [ng/ul]   (not used in calc.)
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]  mAU   *s   [mAU   ]      %
----|------|----|-------|---------|---------|-------|
   1  18.313 VB    0.4658 7290.01807  243.46350  99.7391
   2  30.170 VB    0.6440   19.07194 3.79880e-1   0.2609

Totals :                  7309.09000  243.84338

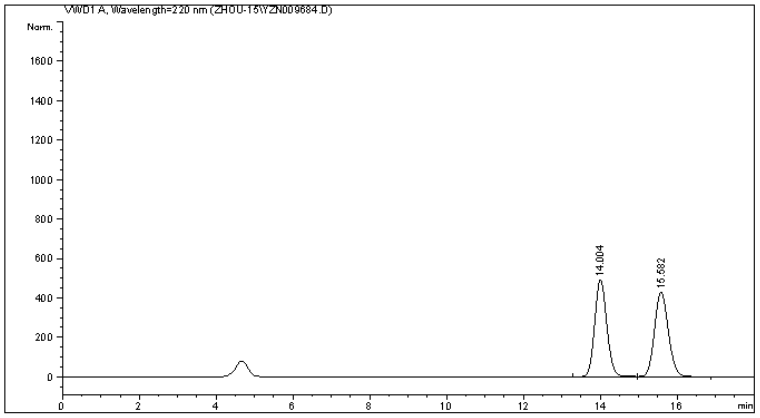
==========================================================================
                        *** End of Report ***
```




(-)-**4d**

Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009684.D
Sample Name: ZY-3-65

```
==========================================================================
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/13/2015 9:11:13 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 10/13/2015 8:42:55 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:51:11 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

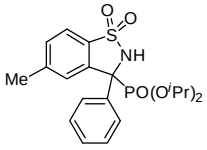
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]      [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  14.004 VV    0.3396 1.07398e4   490.98856  49.9772
   2  15.582 VB    0.3915 1.07496e4   428.69989  50.0228

Totals :                  2.14894e4   919.68845

==========================================================================
                        *** End of Report ***
```

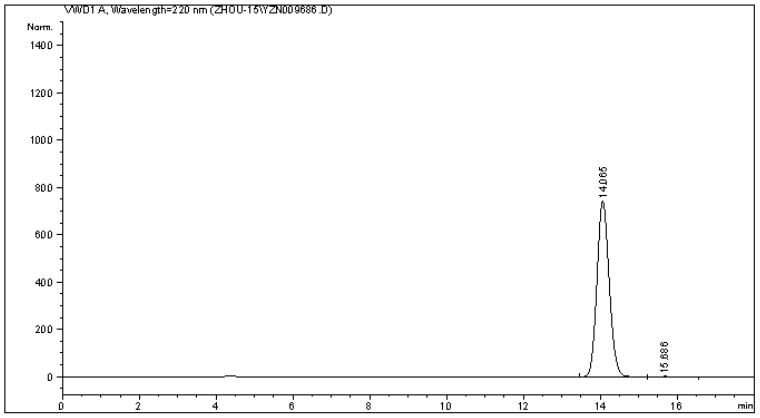



(+/-)-**4e**



Data File C:\CHEM32\1\DATA\ZHOU-15\YZN009686.D
Sample Name: ZY-3-65

```
==========================================================================
Acq. Operator   :
Acq. Instrument : Instrument 1                    Location : Vial 1
Injection Date  : 10/13/2015 10:20:45 PM
Acq. Method     : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 10/13/2015 10:03:54 PM
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
Last changed    : 12/28/2015 10:49:19 AM
                  (modified after loading)
Sample Info     : AD-H, H/i-PrOH = 70/30, 0.7 mL/min, 30 oC, 220 nm
```




```
==========================================================================
                        Area Percent Report
==========================================================================

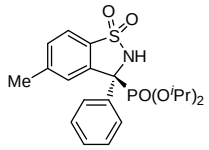
Sorted By             :      Signal
Multiplier:                   :      1.0000
Dilution:                     :      1.0000
Use Multiplier & Dilution Factor with ISTDs


Signal 1: VWD1 A, Wavelength=220 nm

Peak RetTime Type  Width     Area      Height     Area
  #   [min]      [min]  mAU   *s   [mAU   ]      %
----|-------|----|-------|----------|----------|--------|
   1  14.065 BV    0.3462 1.64629e4   742.17401  99.6923
   2  15.686 VB    0.3999   50.80680    1.93231   0.3077

Totals :                  1.65137e4   744.10632

==========================================================================
                        *** End of Report ***
```




(-)-**4e**