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Supporting Information

Chiral Phosphorus–Olefin Ligands for the Rh^{I}-Catalyzed Asymmetric Addition of Aryl Boronic Acids to Electron-Deficient Olefins

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Contents

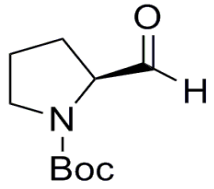
1. General information

^{1}H, ^{13}C and ^{31}P NMR data was acquired on a Bruker AV-400 MHz spectrometer. Commercial reagents were purchased and used without further purification. THF was distilled over benzophenone ketyl under nitrogen. CH_2Cl_2 was distilled over CaH_2 under nitrogen. CH_3OH was distilled over CaH_2 under nitrogen. THF was distilled over CaH_2 under nitrogen. Dioxane was distilled over $LiAlH_4$ under nitrogen.

2. Preparation of Ligands

Synthesis of *L*-prolinal from (*S*)-(-)-1-Boc-2-pyrrolidinemethanol [1]:

To a solution of *L*-Prolinol (1 mmol) in dry CH_3CN (1 mL) in a 50 mL flask were added the following solutions: (1)$[Cu(MeCN)_4]PF_6$ (0.05 mmol in 1 mL CH_3CN) (2) bpy (0.05 mmol in 1 mL CH_3CN) (3) TEMPO (0.05 mmol in 1 mL CH_3CN) (4) N-methyl imidazole (0.1 mmol in 1 mL CH_3CN). The dark red/brown reaction mixture was stirred rapidly open to air and monitored by TLC until no starting material remained (often accompanied by a change in reaction color to green/blue). The crude reaction mixture was concentrated and purified by silica column chromatography (gradient elution of EtOAC in Hex).

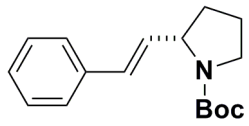


^{1}H NMR (400 MHz, $CDCl_3$): δ 9.64 – 9.41 (m, 1H), 4.20-4.01 (m, 1H), 3.71 – 3.38 (m, 2H), 2.17 – 1.79 (m, 4H), 1.49 – 1.39 (m, 9H). ^{13}C NMR (101 MHz, $CDCl_3$): δ

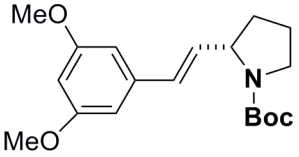
200.64, 153.66, 80.62, 79.78, 65.01, 46.71, 28.26, 23.95. HRMS-ESI(*m/z*): Calcd for $C_{10}H_{17}NO_3$ $[M+H]^+$ 200.1287, Found: 200.1292.

General procedure for the synthesis of olefin from *L*-prolinal:

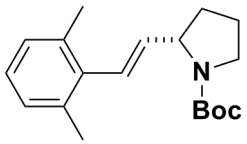
To a solution of diethyl benzylphosphonate (1.5 mmol) in THF (5 mL) was added *n*-BuLi (2.4M in hexane, 0.625 ml, 1.5mmol) at -78 °C over 5 min, and then the whole was stirred at the same temperature for 1 h. A solution of *L*-prolinal (1mmol) in THF was added to the above solution. At this temperature, it was stirred for 1 h and then allowed to warm to rt. After being stirred for overnight, 20 mL of water was added to quench the reaction. The aqueous phase was extracted by AcOEt (3×20 mL) and the combined organic phases were washed with brine and dried over anhydrous Na_2SO_4 and evaporated in vacuum. The desired products were isolated by silica gel column chromatography.



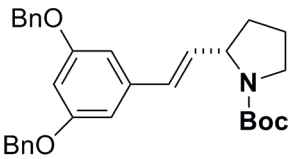
A pale yellow oil, yield 62%, $[\alpha]_D^{20}$ -62(*c* 0.05 $CHCl_3$). ^{1}H NMR(400 MHz, $CDCl_3$): δ 7.37-7.22 (m, 5H), 6.42 (d, *J* =16 Hz, 1H), 6.13-6.08 (m, 1H), 4.44-4.40 (m, 1H), 3.48 (br, 2H), 2.14-1.83 (m, 4H), 1.45 (s, 9H). ^{13}C NMR(100 MHz, $CDCl_3$): δ 154.8, 137.1, 130.8, 129.4, 128.6, 1227.3, 126.3, 79.2, 59.0, 46.3, 32.6 28.5, 23.0. HRMS(ESI)(*m/z*): Calcd for $C_{17}H_{23}NO_2$ $[M+Na]^+$ 296.1665, Found: 296.1606.



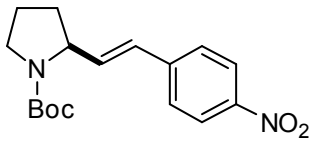
A colorless oil, yield 75%, $[\alpha]_D^{20}$ -41(*c* 0.05 $CHCl_3$). ^1H NMR(400 MHz, $CDCl_3$): δ 6.53 (s, 2H), 6.37-6.33 (m, 2H), 6.10-6.06 (m, 1H), 4.43-4.39 (m, 1H), 3.81 (s, 6H), 3.48-3.40 (m, 2H), 2.07-1.79 (m, 4H), 1.62-1.44 (m, 9H): δ 160.9, 156.1, 139.1, 131.3, 129.6, 104.4, 99.5, 79.2, 58.9, 55.3, 46.3, 32.6, 28.5, 23.1. HRMS(ESI)(*m/z*): Calcd for $C_{19}H_{27}NO_4$ $[M+H]^+$ 334.1931, Found: 334.1963.



A pale oil, yield 55%, $[\alpha]_D^{20}$ -20 (*c* 0.08 $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$): δ 7.02 (br, 3H), 6.30 (d, *J* =15.6 Hz, 1H), 5.57 (dd, *J* = 15.6 and 5.2 Hz, 1H), 4.49 (br, 1H), 3.37 (br, 2H), 2.28 (s, 6H), 2.15-1.78 (m, 4H), 1.47 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.8, 137.0, 135.9, 135.8, 135.7, 127.6, 126.4, 79.3 , 58.8, 46.2, 32.4, 28.6, 22.7, 20.9. HRMS-ESI(*m/z*): Calcd for $C_{19}H_{27}NO_2$ $[M+Na]^+$ 324.1934, Found: 324.1930.



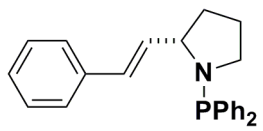
A pale oil, 83% yield, $[\alpha]_D^{20}$ -44 (*c* 0.04, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$): δ 7.45 – 7.28 (m, 10H), 6.61 (s, 2H), 6.51 (s, 1H), 6.31 (d, *J* = 14.4 Hz, 1H), 6.06 (br，1H), 5.05 (s, 4H), 4.60–4.11 (m, 1H), 3.43 (m, 2H), 2.05–1.57 (m,4H), 1.53–1.20 (m, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.0, 139.2, 136.9, 131.5, 128.6, 128.0, 127.6, 127.19, 108.3, 105.6, 101.1, 79.3, 70.1, 59.0, 46.3, 32.8, 28.5, 22.9. HRMS-ESI(*m/z*): Calcd for $C_{31}H_{35}NO_4$ $[M+Na]^+$ 508.2458, Found: 508.2446.



A pale oil, 78% yield, $[\alpha]_D^{20}$ -40 (*c* 0.50, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$): δ 8.16 (d, *J* = 7.6 Hz, 2H), 7.47 (d, *J* = 8.4 Hz, 2H), 6.47 (d, *J* = 13.2 Hz 1H), 6.32 (br, 1H), 4.55–4.49 (m, 1H), 3.58-3.48 (m, 2H), 2.14–1.81 (m,4H), 1.48–1.41 (br, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 200.5, 154.6, 146.7, 143.6, 136.0, 127.6, 127.0, 124.0, 78.5, 65.0, 59.0, 46.7, 32.4, 28.5. HRMS-ESI(*m/z*): Calcd for $C_{31}H_{35}NO_4$ $[M+Na]^+$ 508.2458, Found: 508.2446.

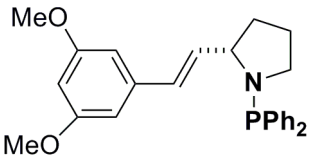
General procedure for the synthesis of the chiral olefin, P-ligands:

AcCl (10 mmol) was added slowly to an oven-dried 25 mL flask charged with dried methanol (10 ml) at 0ºC. The resulting mixture was stirring for 1 hour at room temperature. A solution of olefin (1 mmol) in dried 1,4-dioxane was added to the reaction mixture. The resulting mixture was stirring for 3 hours at rt. The solvent was removed and then an aqueous solution of 10%NaOH (10 mL) was added. The reaction mixture was extracted by CH_2Cl_2 and the organic phases was dried over Na_2SO_4 and evaporated under vacuum to give a colourless amorphous. To this amorphous in CH_2Cl_2 was added Et_3N (5mmol) and PPh_2Cl (2mmol) in CH_2Cl_2 at 0 ºC. The mixture was stirred at room temperature for 6-10 h. The residue was purified by silica gel chromatography to give the desired ligand.

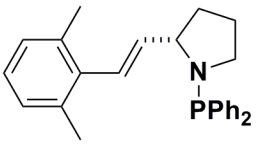


pale yellow oil, yield 65%. $[\alpha]_D^{20}$ +39 (*c* 0.08 $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$): δ 7.47-7.16 (m, 15H),

6.47 (d, J =10.8 Hz, 1H), 6.15 (dd, J =10.6 and 4.8 Hz, 1H), 4.20-4.18 (m, 1H), 2.99--2.96 (m, 1H), 2.88-2.87 (m, 1H), 2.12-2.09(m,1H), 1.86-1.85 (m, 1H), 1.76-1.72 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.4 (d, J_{CP} =6.6Hz), 139.1(d, J_{CP} =10.1Hz), 137.3, 133.7 (d, J_{CP} =1.8Hz), 132.5, 132.32, 132.25, 132.12, 129.8, 128.5, 128.2 (d, J_{CP} =4.3Hz), 128.1(d, J_{CP} =3.8Hz), 127.1, 126.4, 65.7(d, J_{CP} =20.3Hz), 46.7(d, J_{CP} =5.7Hz), 33.9(d, J_{CP} =4.3Hz), 25.5. HRMS-ESI(*m/z*): Calcd for $C_{12}H_{24}FN$ $[M+H]^+$ 358.1646, Found: 358.1672. ^{31}P NMR (162 MHz, $CDCl_3$): δ 43.46.

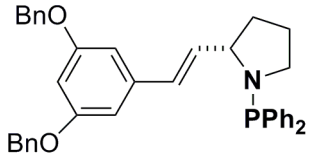


A pale yellow oil, yield 52%, $[\alpha]_D^{20}$ +47 (*c* 0.20 $CHCl_3$). ^{1}H NMR(400 MHz, $CDCl_3$): 7.40–7.21 (m, 10H), 6.40 (s, 2H), 6.31 (d, J = 10.4 Hz, 1H), 6.26 (s, 1H), 6.04 (dd, J =10.4 and 3.6 Hz, 1H), 4.11-4.09 (m, 1H), 3.70 (s, 6H), 2.90–2.88 (m, 1H), 2.82 –2.81 (m, 1H), 2.04-2.01 (m, 1H), 1.79-1.75(m, 1H), 1.68-1.63(m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.8, 139.4 (d, J_{CP} = 7.8 Hz), 134.2 (d, J_{CP} = 2.9 Hz), 132.6, 132.4, 132.2, 132.0, 129.8, 128.2 (d, J_{CP} = 10.0 Hz), 128.1 (d, J_{CP} = 6.0 Hz), 104.5, 99.6, 65.6 (d, J_{CP} = 30.0 Hz), 55.3, 46.7 (d, J_{CP} = 8.2 Hz), 33.8 (d, J_{CP} = 5.6 Hz), 25.5. HRMS-ESI (*m/z*): Calcd for $C_{26}H_{28}NO_2P$ $[M+H]^+$ 417.1858, Found: 417.1858. ^{31}P NMR (162 MHz, $CDCl_3$): δ 43.65.

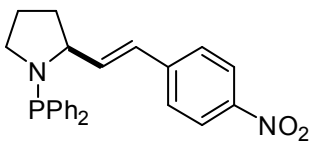


A pale yellow oil, yield 62%. $[\alpha]_D^{20}$ -90 (*c* 0.12 $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.45 – 7.22 (m, 10H), 7.00 (br, 3H), 6.46 (d, J = 16.0 Hz, 1H), 5.65 (dd, J = 16.0 and

7.2 Hz, 1H), 4.21 (br, 1H), 3.03 (br, 1H), 2.83 (br, 1H), 2.26 (s, 6H), 2.10 (br, 1H), 1.86–1.73 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.7 (d, J_{CP} = 24Hz), 139.5, 139.4, 138.5, 137.3, 136.1, 132.5, 132.4, 132.1, 132.0, 128.3, 128.2, 128.1, 127.7, 127.6, 126.3, 66.2 (d, J_{CP} = 21Hz), 47.0(d, J_{CP} = 5.9Hz), 34.6 (d, J_{CP} = 4.4Hz), 25.7, 21.1. HRMS-ESI(*m/z*): Calcd for $C_{26}H_{28}P$ $[M+H]^+$ 386.2032, Found: 386.2034.



A pale yellow oil, yield 80%. $[\alpha]_D^{20}$ -28 (*c* 0.13 $CHCl_3$). ^{1}H NMR (400 MHz, CDCl3): δ 7.49 – 7.30 (m, 20H), 6.56 (s, 2H), 6.49 (s, 1H), 6.38 (d, *J* = 15.6 Hz, 1H), 6.11 (dd, *J* = 16.0 and 7.6 Hz, 1H), 5.01 (s, 4H), 4.18 – 4.13 (m, 1H), 2.99-2.96 (m, 1H), 2.90-2.87 (m, 1H), 2.12-2.04 (m, 1H), 1.85 – 1.83 (m, 1H), 1.77 – 1.68 (m, 2H). ^{13}C NMR (100MHz,$CDCl_3$) :δ 160.1, 139.5, 137.0, 134.4 (d, J_{CP}= 8.0 Hz), 132.5, 132.4, 132.3, 132.2, 129.8, 128.7, 128.6, 128.3, 128.2, 128.1 (d, J_{CP}= 6.8Hz), 128.0, 127.6, 105.7, 101.2, 70.1, 65.6 (d, J_{CP} = 20.0Hz), 46.8 (d, J_{CP} = 5.4Hz), 33.9 (d, J_{CP} =4.4 Hz), 25.6. HRMS-ESI(*m/z*): Calcd for $C_{38}H_{36}NO_2P$ $[M+H]^+$ 570.2556, Found: 570.2542. ^{31}P NMR (162 MHz, $CDCl_3$): δ 43.58.



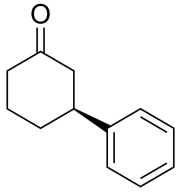
A pale yellow oil, yield 52%, $[\alpha]_D^{20}$ -64 (*c* 1.0 $CHCl_3$). ^{1}H NMR(400 MHz, $CDCl_3$): 8.12 (d, *J* = 8.4 Hz, 2H), 7.46-7.29 (m, 12H), 6.50 (d, *J* = 16.0 Hz, 1H), 6.33 (dd, *J* =16.0 and 7.6 Hz, 1H), 4.25-4.22 (m, 1H), 3.03–2.99 (m, 1H), 2.92 –2.91 (m, 1H), 2.16-2.11 (m, 1H), 1.87-1.82(m, 1H), 1.79-1.72(m, 2H). ^{13}C

NMR (100 MHz, $CDCl_3$): δ 146.6, 143.9, 139.2 (d, J_{CP} = 6.1 Hz), 139.0 (d, J_{CP} = 1.5 Hz), 138.7 (d, J_{CP} = 9.7 Hz),132.6, 132.4, 132.2, 132.0, 129.8, 128.3, 128.2, 128.1 (d, J_{CP} = 6.0 Hz), 104.5, 99.6, 65.6 (d, J_{CP} = 20.0 Hz), 55.3, 46.7 (d, J_{CP} = 5.2 Hz), 33.8 (d, J_{CP} = 4.3 Hz), 25.5. HRMS-ESI (*m/z*): Calcd for $C_{26}H_{28}NO_2P$ $[M+H]^+$ 417.1858, Found: 417.1858. ^{31}P NMR (162 MHz, $CDCl_3$): δ 44.49.

3. Asymmetric Catalytic Reactions

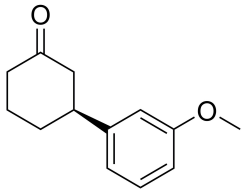
General procedure for Rhodium(I)-catalyzed asymmetric 1,4-addition of phenylboronic Acid to cycloalkenones:

Under N_2 atmosphere, a reaction flask was charged with $RhCl(C_2H_4)_2$ (2.9 mg, 0.0075 mmol) and $PhB(OH)_2$ (2.5 mmol). To the flask were added successively 1, 4-dioxane (2.0 mL), ligand (0.018 mmol), cyclohexenone (0.5 mmol), and 4M aq potassium hydroxide (0.5 mmol). The mixture was stirred at room temperature. After dilution with AcOEt, the mixture was washed with 10% aq NaOH and brine, and then dried over Na_2SO_4. Concentration and purification by silica gel column chromatography.

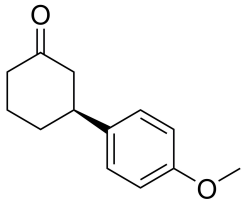


97% yield, $[\alpha]_D^{20}$ -21 (*c* 0.10 $CHCl_3$), 93% ee, (AD, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 16.0 and 18.9 min for major and minor). ^1H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.29 (m, 2H), 7.27 – 7.20 (m, 3H), 3.01 (tt, *J* = 11.7, 4.0 Hz, 1H), 2.65 – 2.33 (m, 4H), 2.20 – 2.04 (m, 2H), 1.91 – 1.74 (m, 2H). ^{13}C NMR

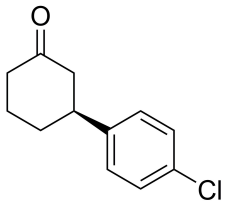
(100 MHz, $CDCl_3$): δ 211.1, 144.4, 128.7, 126.7, 48.9, 44.8, 41.2, 32.8, 25.6.



93% yield, $[\alpha]_D^{20}$ -10 (*c* 0.24 $CHCl_3$), 90% ee (OD-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 40.4 and 45.1 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 (td, *J* = 7.7, 1.3 Hz, 1H), 6.84 – 6.75 (m, 3H), 3.80 (s, 3H), 2.98 (tt, *J* = 11.8, 3.9 Hz, 1H), 2.62 – 2.32 (m, 4H), 2.18 – 2.04 (m, 2H), 1.91 – 1.73 (m, 2H). ^{13}C NMR (100MHz, $CDCl_3$): δ 211.0, 159.8, 146.1, 129.7, 118.9, 112.7, 111.7, 55.2 48.9, 44.8, 41.2, 32.7, 25.5.

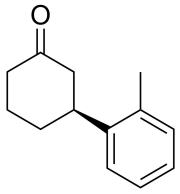


99%yield, $[\alpha]_D^{20}$ -18 (*c* 0.50 $CHCl_3$), 90% ee (OJ-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 39.8 and 42.3 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.14 (d, *J* = 8.7 Hz, 2H), 6.87 (d, *J* = 8.7 Hz, 2H), 3.80 (s, 3H), 2.97 (tt, *J* = 11.7, 3.9 Hz, 1H), 2.60 – 2.34 (m, 4H), 2.18 – 2.02 (m, 2H), 1.85 – 1.72 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 211.5, 158.5, 136.6, 127.5, 114.0, 55.3, 49.3, 44.0, 41.2, 33.0, 25.0.

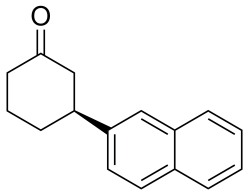


70% yield, $[\alpha]_D^{20}$ -8.0 (*c* 0.24 $CHCl_3$), 93% ee (AD-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 18.6 and 20.9 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30 (d, J = 8.4 Hz, 2H), 7.15 (d, *J* = 8.4 Hz, 2H), 2.99 (tt, *J* = 11.8, 3.9 Hz, 1H), 2.60 – 2.33 (m, 4H), 2.19 – 2.03 (m, 2H), 1.88 – 1.74

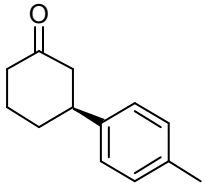
(m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 210.6, 142.8, 132.4, 128.8, 128.0, 48.8, 44.1, 32.7, 25.4.



98% yield, $[\alpha]_D^{20}$ -22 (*c* 0.30 $CHCl_3$), 87% ee (AD-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 14.2 and 17.5 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.27 – 7.11 (m, 4H), 3.27 – 3.14 (m, 1H), 2.56 – 2.35 (m, 4H), 2.32 (s, 3H), 2.17 (ddd, *J* = 12.5, 6.3, 3.4 Hz, 1H), 2.00 (d, *J* = 10.2 Hz, 1H), 1.90 – 1.72 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 211.3, 142.3, 135.1, 130.7, 126.5, 125.1, 48.4, 41.3, 40.3, 32.0, 25.8, 19.3.

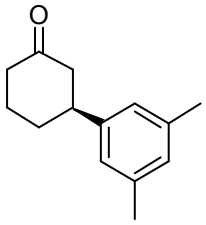


95% yield, $[\alpha]_D^{20}$ -8.0 (*c* 0.08 $CHCl_3$), 88% ee (AD-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 21.3 and 23.6 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.80 (dd, *J* = 8.7, 4.2 Hz, 3H), 7.63 (s, 1H), 7.50 – 7.41 (m, 2H), 7.35 (dd, *J* = 8.5, 1.7 Hz, 1H), 3.22 – 3.10 (m, 1H), 2.72 – 2.57 (m, 2H), 2.45 (dddd, *J* = 26.8, 19.6, 8.5, 3.8 Hz, 2H), 2.17 (tdd, *J* = 9.8, 6.9, 3.3 Hz, 2H), 2.01 – 1.73 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 211.0, 141.8, 133.6, 132.4, 128.4, 127.7, 126.2, 125.7, 125.4, 124.8, 48.9, 44.8, 41.3, 32.7, 25.6.

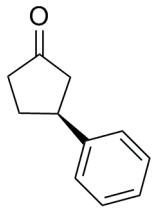


90% yield, a colorless oil, $[\alpha]_D^{20}$ -16 (c 0.03, $CHCl_3$), 84% ee (AD, hexane/2-propanol = 99.2/0.8, 0.4 mL/min, 254 nm, 14.4 and 17.7 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.20 – 7.15 (m, 4H), 3.04 – 2.98 (m, 1H), 2.63 –

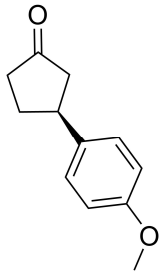
2.39 (m, 4H), 2.38 (s, 3H), 2.19 – 2.08 (m, 2H), 1.92 – 1.78 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 211.0, 141.5, 136.2, 129.4, 126.5, 49.1, 44.4, 41.2, 32.9, 25.6, 21.1.



90% yield, a colorless oil, $[\alpha]_D^{20}$ -57 (c 0.04, $CHCl_3$), 88% ee (OD-H, hexane/2-propanol= 99.2/0.8, 0.4 mL/min, 254 nm, 21.9 and 17.3 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.92 (s, 1H), 6.89 (s, 2H), 3.00 – 2.94 (m, 1H), 2.63 – 2.39 (m, 4H), 2.36 (s, 6H), 2.21– 2.08 (m, 2H), 1.91 – 1.80 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 211.2, 144.5, 138.2, 128.4, 124.5, 49.1, 44.8, 41.3, 32.9, 25.7, 21.4.

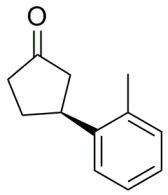


95% yield, $[\alpha]_D^{20}$ -82 (*c* 0.10 $CHCl_3$), 86% ee (AS-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 41.9 and 45.2 min for major and minor).^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 (dd, *J* = 9.8, 5.3 Hz, 2H), 7.34 – 7.23 (m, 3H), 3.45 (tt, *J* = 11.1, 7.0 Hz, 1H), 2.70 (dd, *J* = 18.2, 7.6 Hz, 1H), 2.57 – 2.43 (m, 2H), 2.43 – 2.26 (m, 2H), 2.11 – 1.92 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 218.39, 143.08, 128.70, 126.75, 45.81, 42.23, 38.89, 31.21.

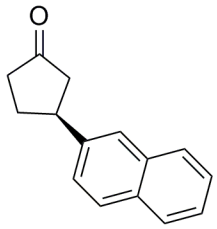


99% yield, $[\alpha]_D^{20}$ -86 (*c* 0.21 $CHCl_3$), 91% ee (OD-H, hexane/2-propanol = 99/1, 0.5 mL/min, 254 nm, 32.4 and 34.0 min for minor and major). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.18 (d, *J* = 8.5 Hz, 2H), 6.88 (d, *J* = 8.7 Hz, 2H), 3.80 (s, 3H), 3.43 – 3.31 (m, 1H), 2.65 (dd, *J* = 18.1, 7.5 Hz, 1H), 2.42 (dddd, *J* =

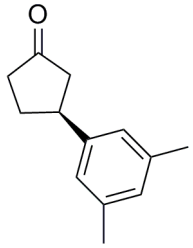
10.0, 8.0, 6.0, 5.0 Hz, 2H), 2.35 – 2.23 (m, 2H), 2.01 – 1.89 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 218.7, 158.4, 135.1, 127.7, 114.1, 55.3, 46.1, 41.5, 38.9, 31.4.



96% yield, $[\alpha]_D^{20}$ -46 (*c* 0.24 $CHCl_3$), 93% ee (AS-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 62.6 and 78.8 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 – 7.15 (m, 4H), 3.82 – 3.45 (m, 1H), 2.72 – 2.44 (m, 2H), 2.41 (s, 3H), 2.40 – 1.92 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) : δ 218.66, 140.97, 135.97, 130.64, 126.48, 124.75, 45.33, 38.56, 38.33, 30.08, 19.66. HRMS-ESI(*m/z*): Calcd for $C_{12}H_{14}O$ $[M+Na]^+$ 197.0937, Found: 197.0922.

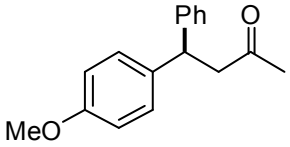


95% yield, $[\alpha]_D$ -38 (*c* 0.14 $CHCl_3$), 84% ee (AS-H, hexane/2-propanol = 99/1, 0.5 mL/min, 254 nm, 112.0 and121.5 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 – 7.76 (m, 3H), 7.67 (s, 1H), 7.53 – 7.37 (m, 3H), 3.60 (ddd, *J* = 13.6, 10.7, 6.9 Hz, 1H), 2.75 (dd, *J* = 18.3, 7.6 Hz, 1H), 2.61 – 2.30 (m, 4H), 2.22 – 1.99 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 218.32, 140.44, 133.48, 132.40, 128.43, 127.63, 126.29, 125.70, 125.35, 124.87, 45.73, 42.34, 38.82, 31.11.

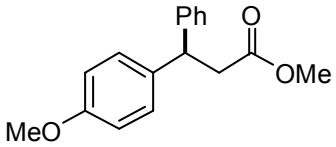


98% yield, $[\alpha]_D^{20}$ -62 (*c* 0.46 $CHCl_3$), 90% ee (AS-H, hexane/2-propanol = 99/1, 0.5 mL/min, 254 nm, 32.9 and 38.0 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$)

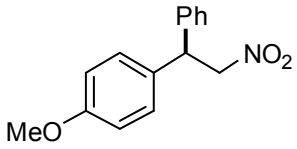
δ 6.89 (s, 1H), 6.87 (s, 2H), 3.43 – 3.22 (m, 1H), 2.64 (dd, *J* = 18.3, 7.3 Hz, 2H), 2.43 (ddd, *J* = 12.3, 8.2, 5.3 Hz,2H), 2.31 (s, 6H), 2.30 – 2.10 (m, 2H), 2.06 – 1.88 (m, 1H). ^{13}C NMR: (100 MHz, $CDCl_3$) δ 219.01, 143.05, 138.24, 128.40, 124.59, 113.11, 45.93, 42.16, 38.95, 31.37，31.26, 21.38. HRMS-ESI(*m/z*): Calcd for $C_{13}H_{16}O$ $[M+Na]^+$ 211.1093, Found: 211.1073.



73% yield, $[\alpha]_D^{20}$ -1.2 (*c* 0.43 $CHCl_3$), 87% ee (OD-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 22.4 and 25.9 min for major and minor). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 – 7.10 (m, 7H), 6.81 (d, *J* = 8.7 Hz, 2H), 4.53 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.14 (d, *J* = 7.6 Hz, 2H), 2.06 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) :δ 207.06, 158.13, 144.25, 135.99, 128.63, 127.62, 126.39, 113.98, 55.23, 49.91, 45.31, 30.68. HRMS-ESI(*m/z*): Calcd for $C_{17}H_{18}O_2$ $[M+Na]^+$ 277.1199, Found: 277.1194.

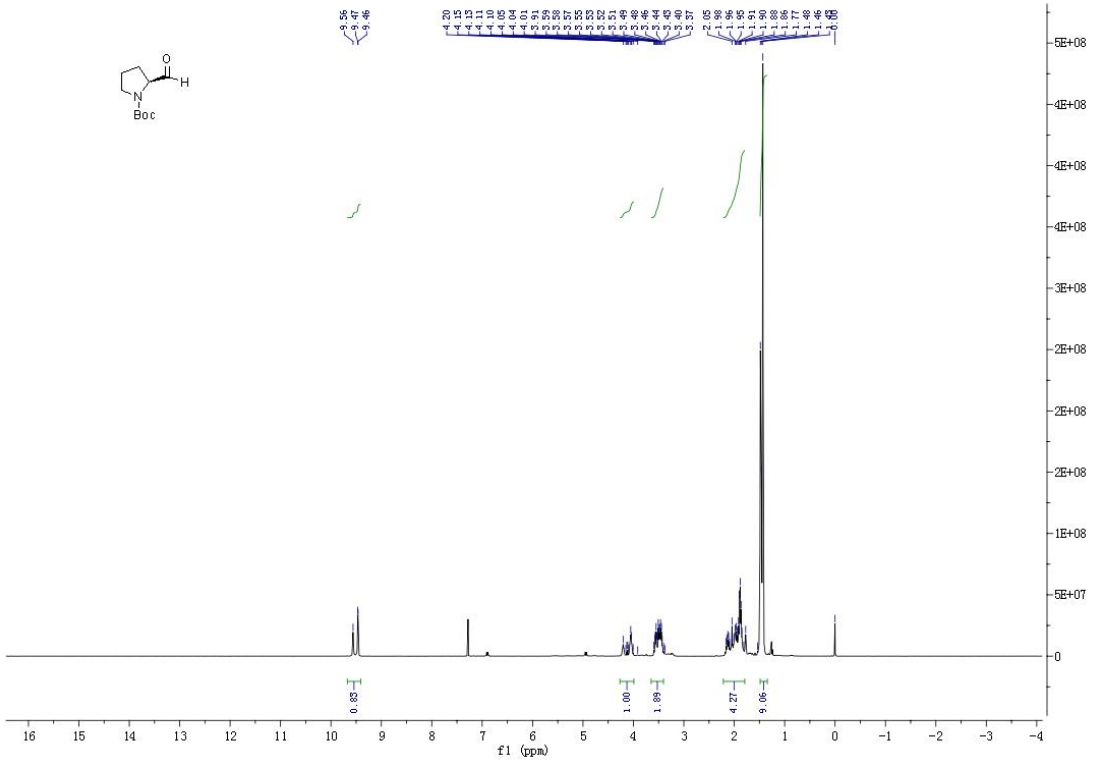


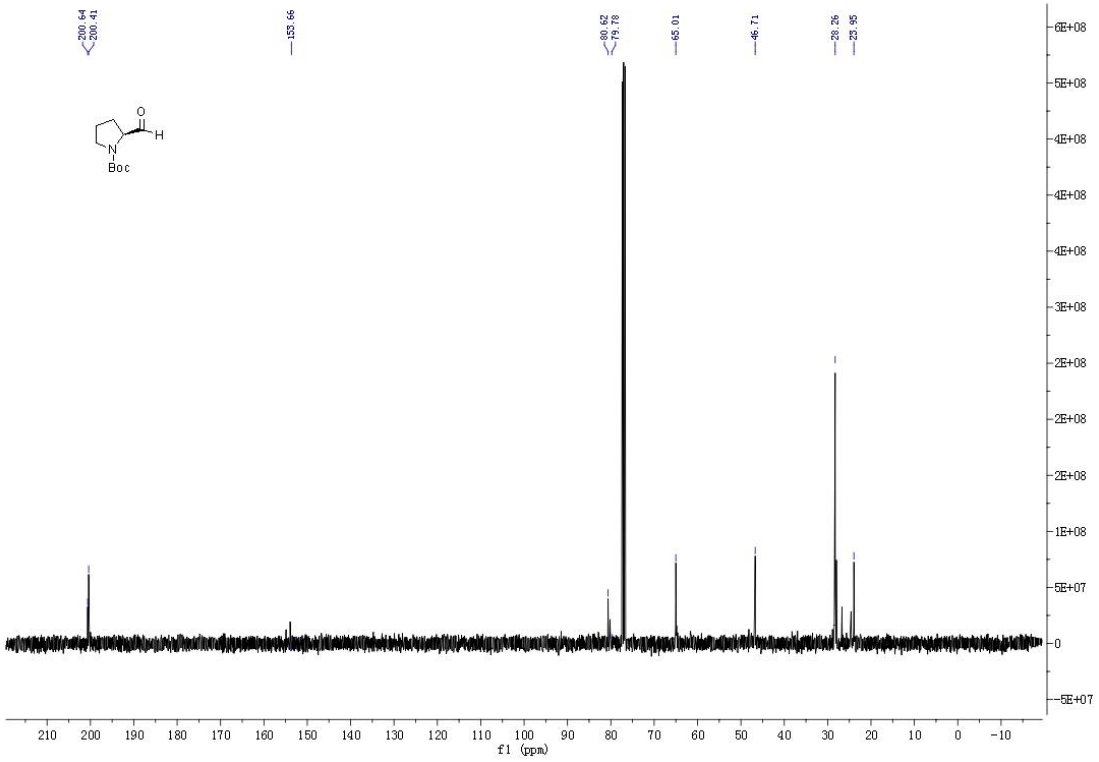
95% yield, $[\alpha]_D^{20}$ +17 (*c* 0.02 $CHCl_3$), 92% ee (OD-H, hexane/2-propanol = 98/2, 0.5 mL/min, 254 nm, 6.5 and 9.0 min for minor and major).^{1}H NMR (400 MHz, $CDCl_3$) δ 7.27–7.13(m, 7H), 6.81(d, *J* = 8.8 Hz, 2H), 4.51(t, *J* = 8 Hz, 1H), 3.76(s, 3H), 3.57(s, 3H), 3.02 (d, *J* = 8.0 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) :δ 172.4, 158.2, 143.3, 135.6, 128.63, 128.58, 127.6, 113.9, 55.2, 51.7, 46.2,40.8.

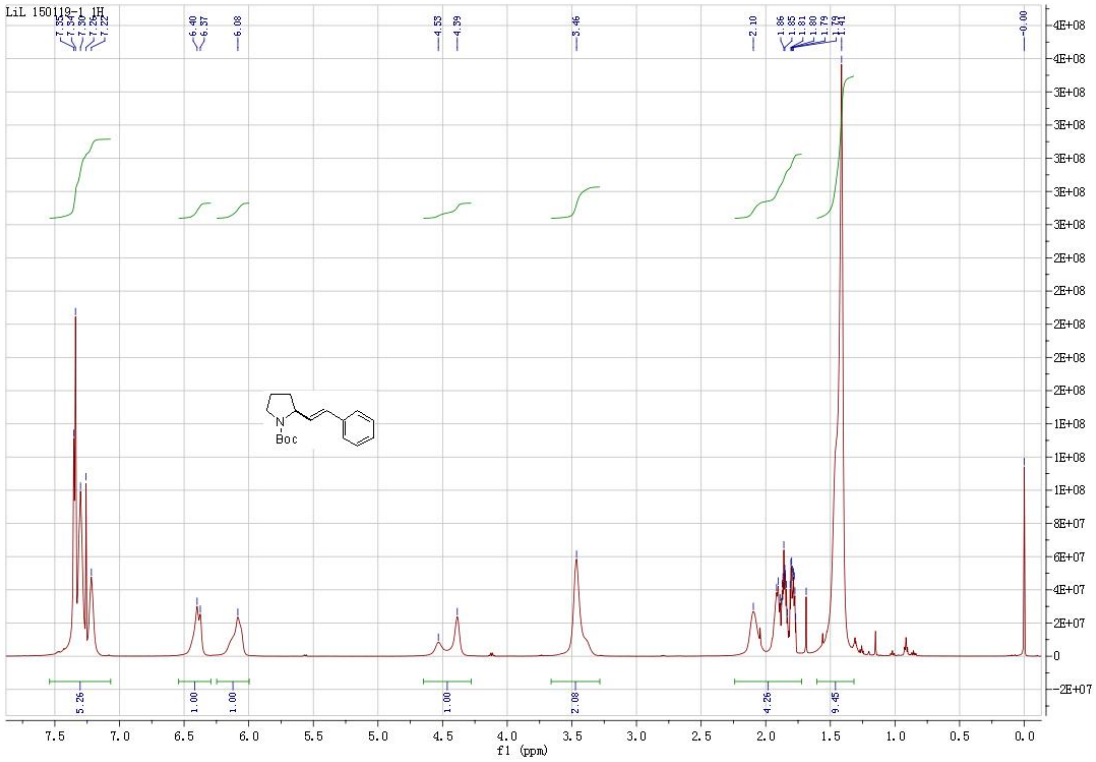


79% yield, $[\alpha]_D^{20}$ -6.8 (*c* 0.10 $CHCl_3$), 70% ee (OD-H, hexane/2-propanol = 95/5, 0.5 mL/min, 254 nm, 45.7 and 49.2 min for major and minor) [2]. ^1H NMR (400 MHz, $CDCl_3$) δ7.33 –7.20(m, 5H), 7.14(d, *J* = 8.0 Hz, 2H), 6.84(d, *J* = 8.0 Hz, 2H), 4.94-4.92 (m, 2H), 4.84-4.86 (m, 1H), 3.76 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) :δ 203.3, 157.3, 143.5, 135.0, 127.6, 126.6,125.4, 113.0, 56.3, 48.7, 44.3.

4. ^{1}H NMR and ^{13}C NMR spectra



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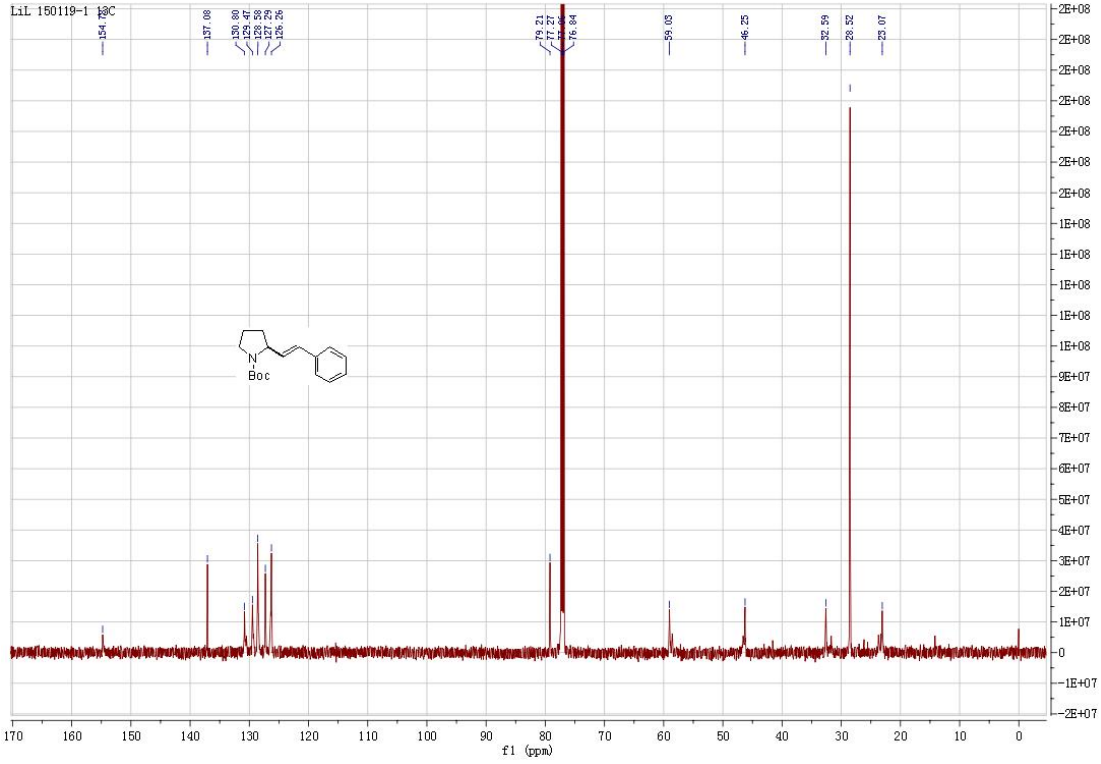
7.34
7.30
7.25
7.22
6.40
6.37
6.08
4.53
4.39
3.46
2.10
1.86
1.85
1.83
1.80
1.79
1.77
1.47
0.00
N
Boc
5.26
1.00
1.00
1.00
2.08
4.26
9.45
f1 (ppm)


LiL 150119-1 13C
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137.08
130.80
129.47
128.58
127.29
126.26
79.21
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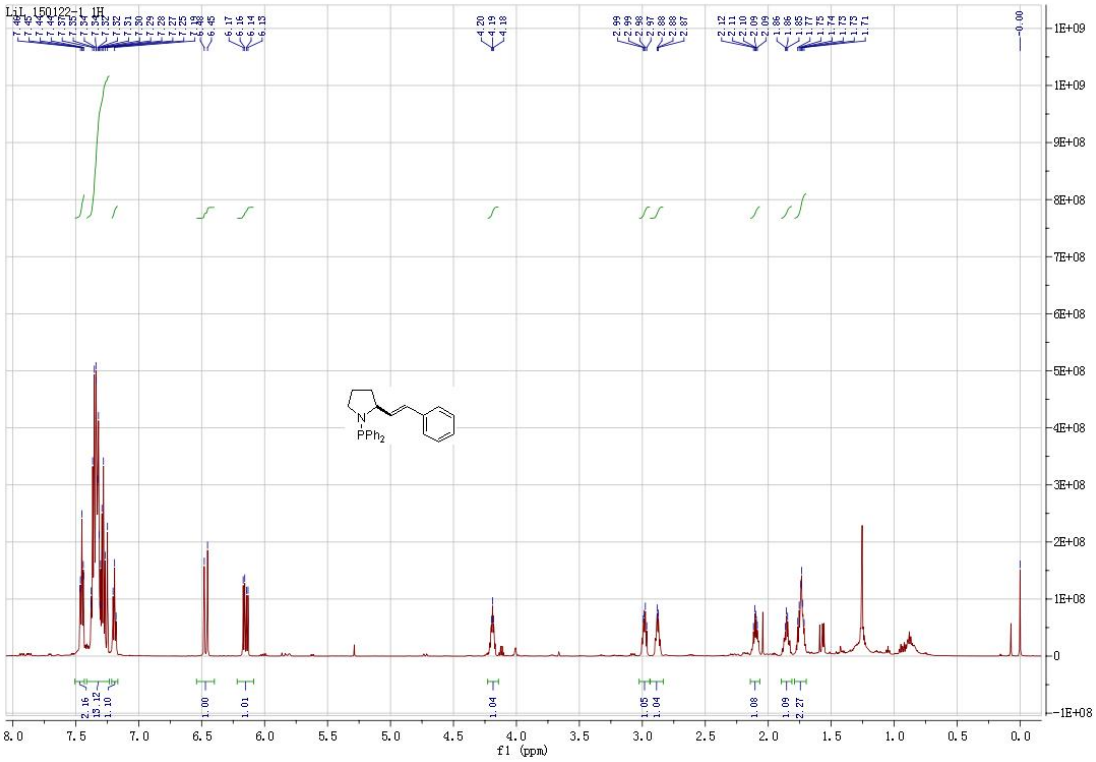
77.04
76.84
59.05
46.25
32.59
28.52
23.07
N
Boc
f1 (ppm)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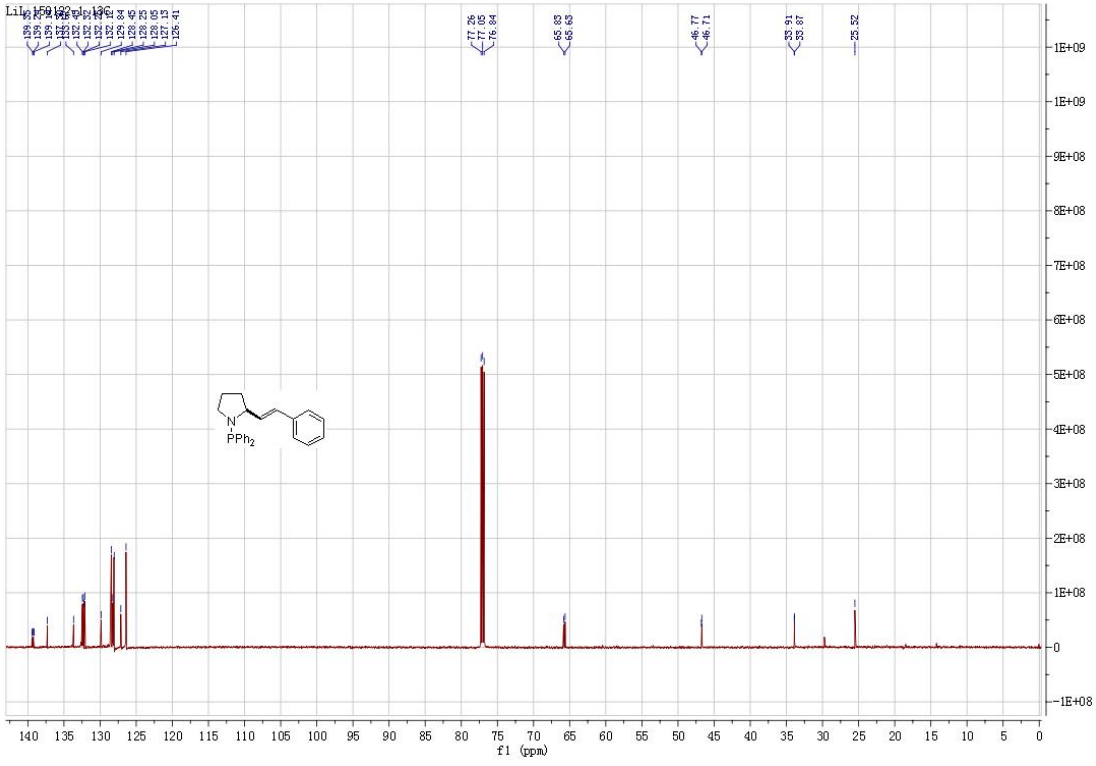
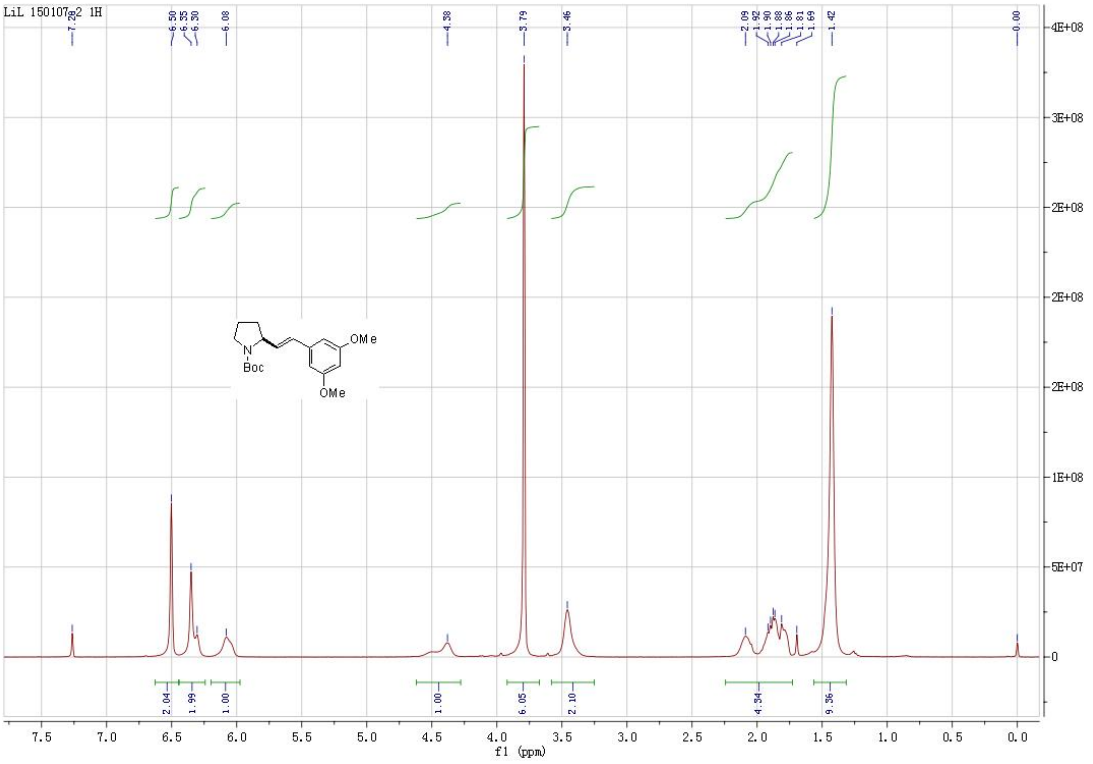
PPh2
f1 (ppm)


LiL-150122-pl-13C
PPh2
f1 (ppm)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6.50
6.35
6.30
6.08
4.38
3.79
3.46
2.09
1.92
1.90
1.88
1.86
1.81
1.69
1.42
0.00
OMe
OMe
Boc
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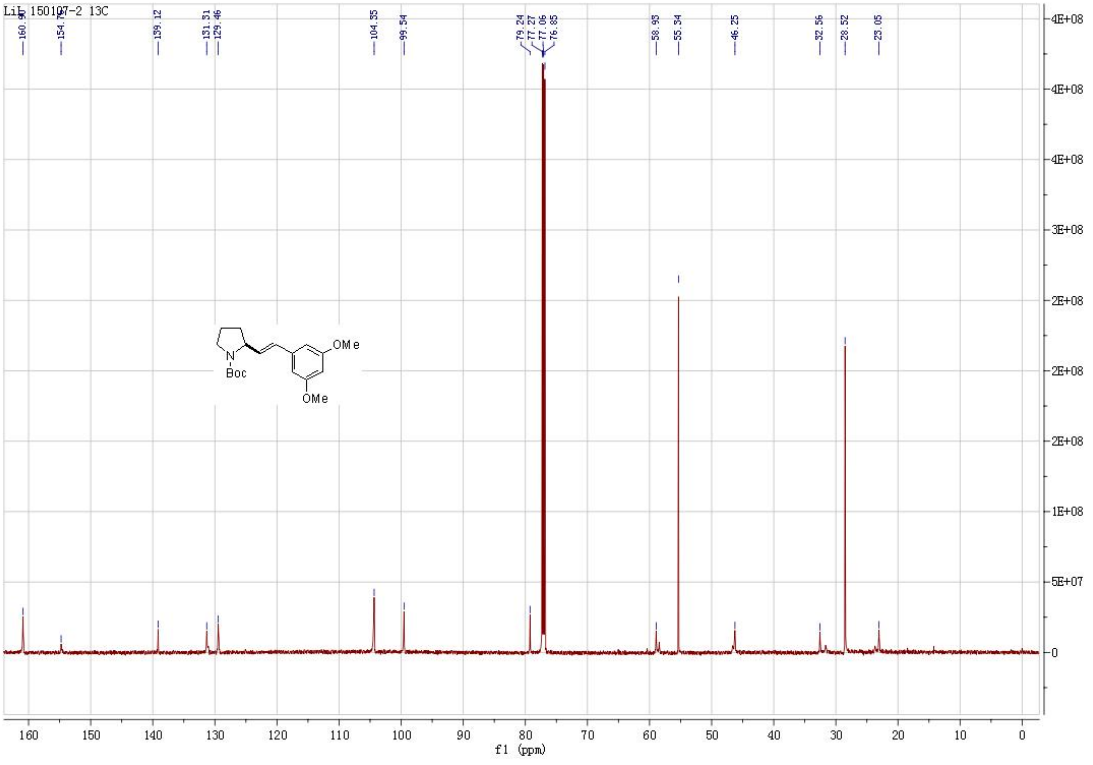
1.00
1.00
6.05
2.10
4.34
9.36
f1 (ppm)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104.55
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77.27
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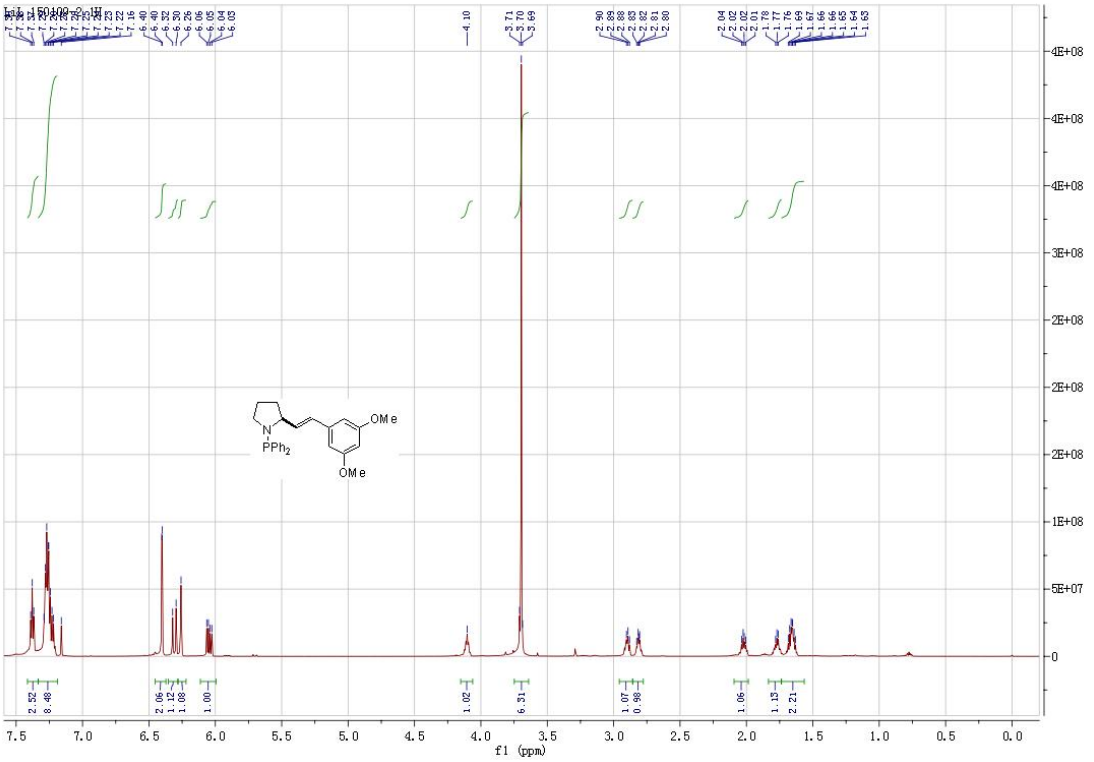
58.93
55.54
46.25
32.56
28.52
23.05
OMe
OMe
Boc
f1 (ppm)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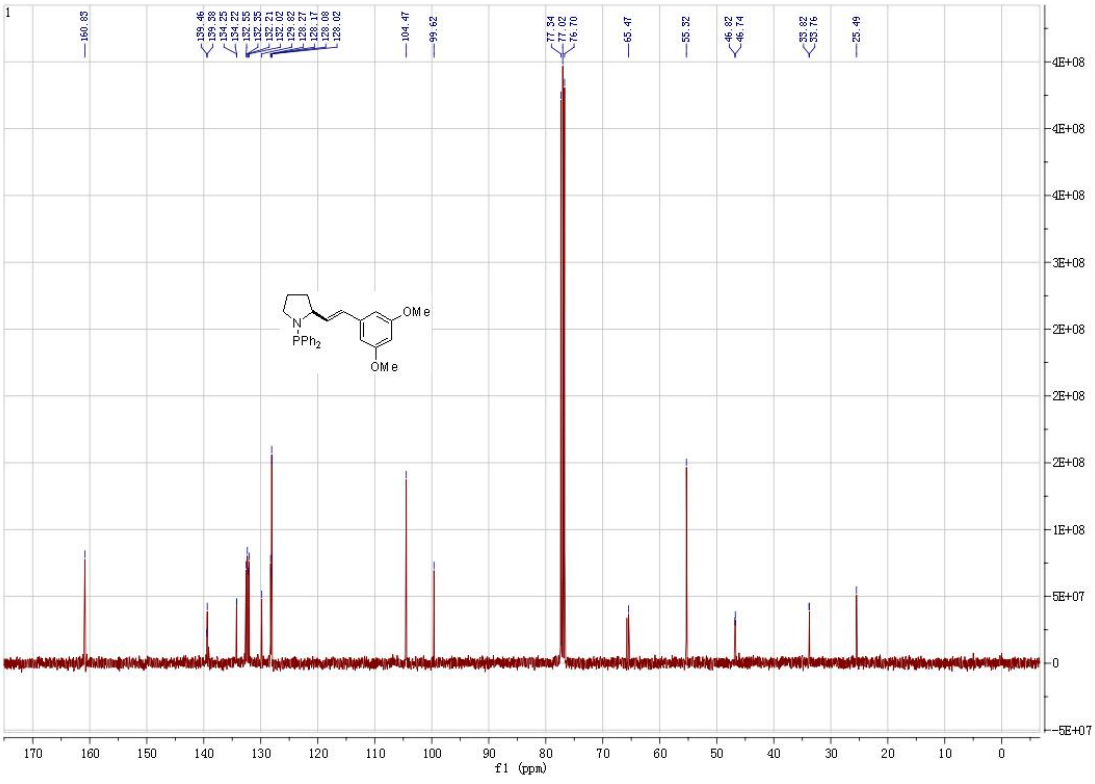
OMe
f1 (ppm)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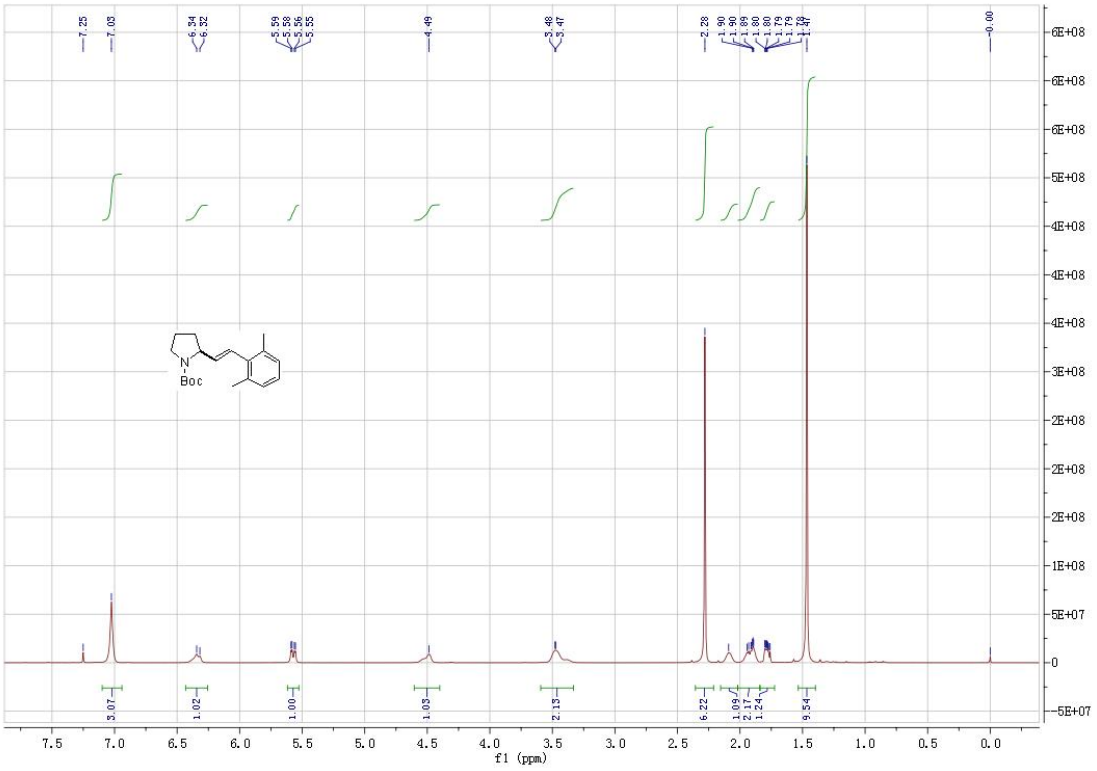
PPh2
OMe
f1 (ppm)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7.03
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6.52
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5.55
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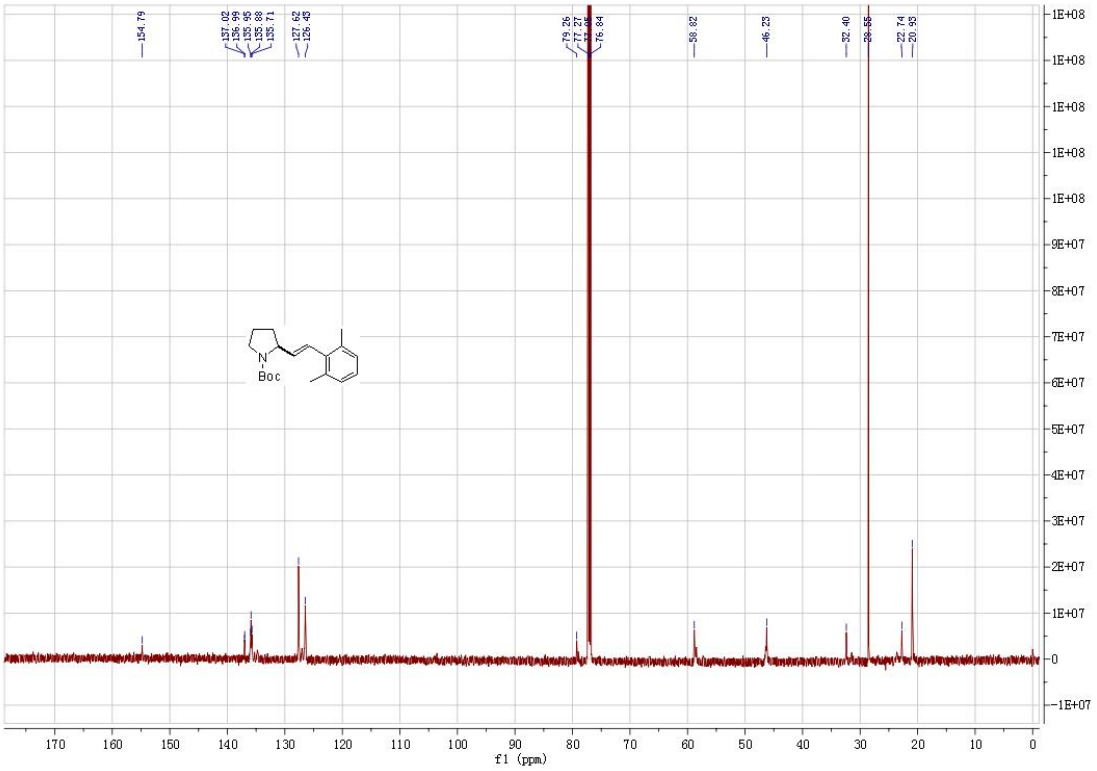
1.90
1.89
1.80
1.79
1.78
1.47
0.00
N
Boc
3.07
1.02
1.00
1.03
2.13
6.22
1.09
1.07
1.24
9.54
f1 (ppm)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135.98
135.88
135.71
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126.43
79.26
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76.84
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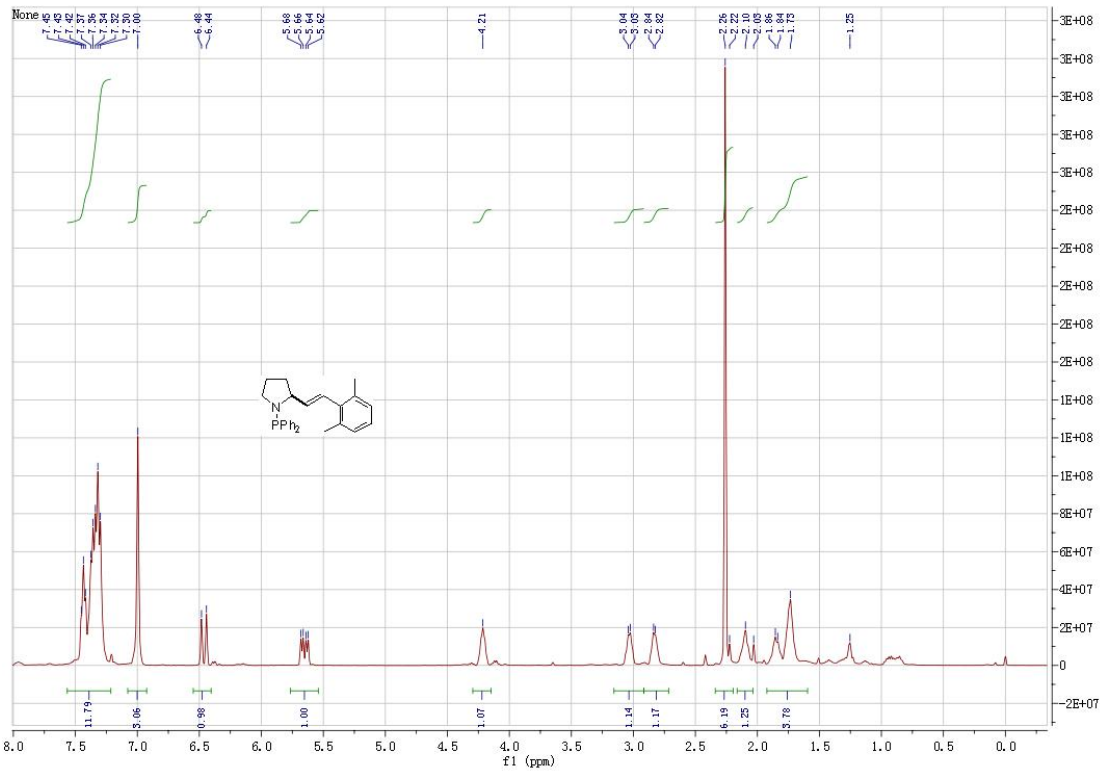
28.56
22.74
20.93
N
Boc
f1 (ppm)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7.36
7.34
7.32
7.30
7.00
6.48
6.44
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3.03
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2.82
2.26
2.22
2.10
2.05
1.86
1.84
1.73
1.25
PPh2
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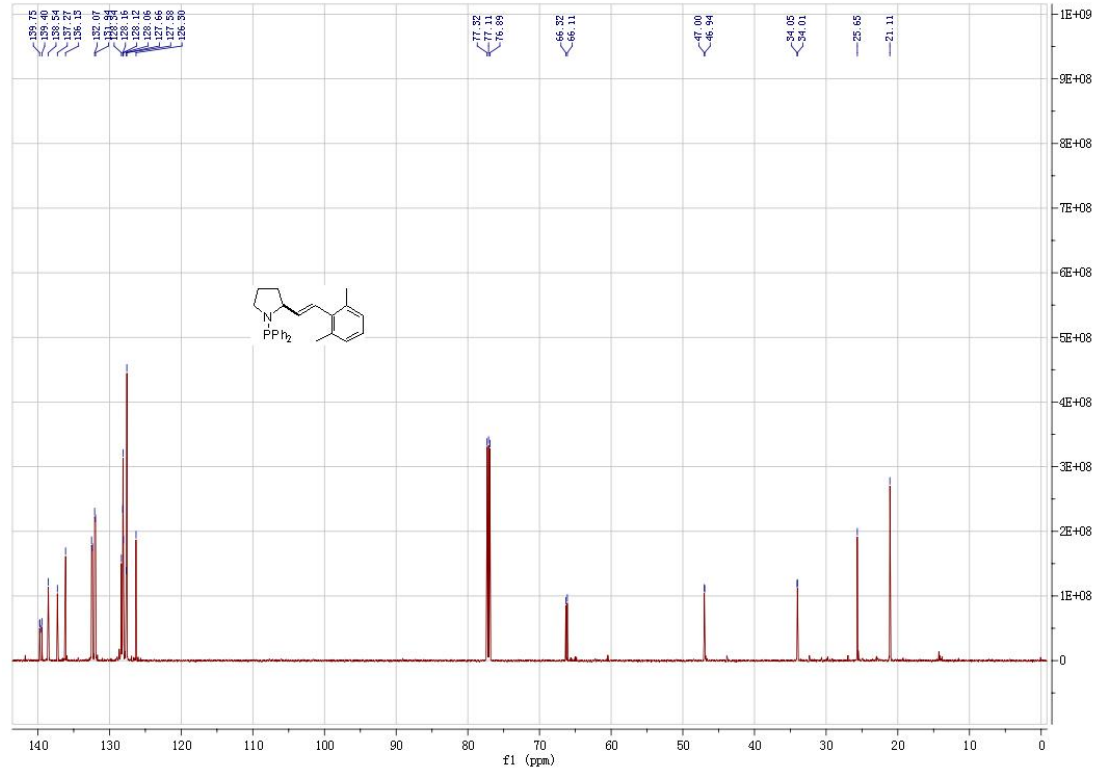
1.00
1.07
1.14
1.17
6.19
1.25
3.78
f1 (ppm)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157.27
156.13
132.07
131.84
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128.06
127.66
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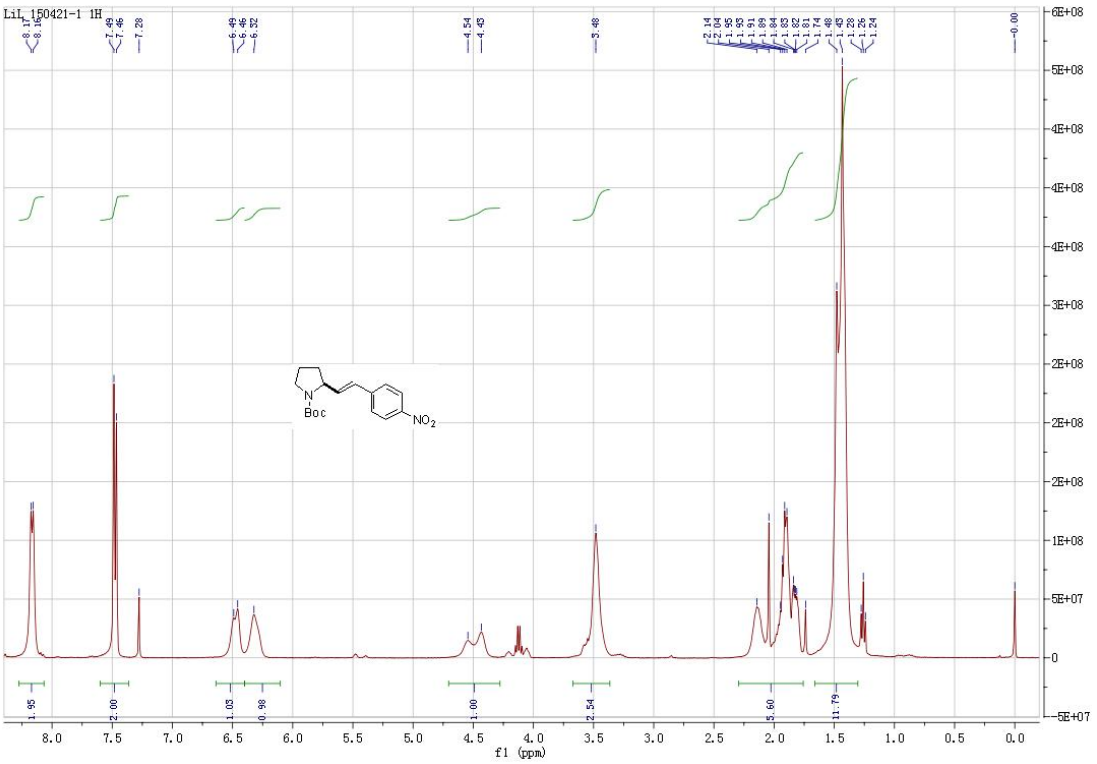
34.01
25.65
21.11
PPh2
f1 (ppm)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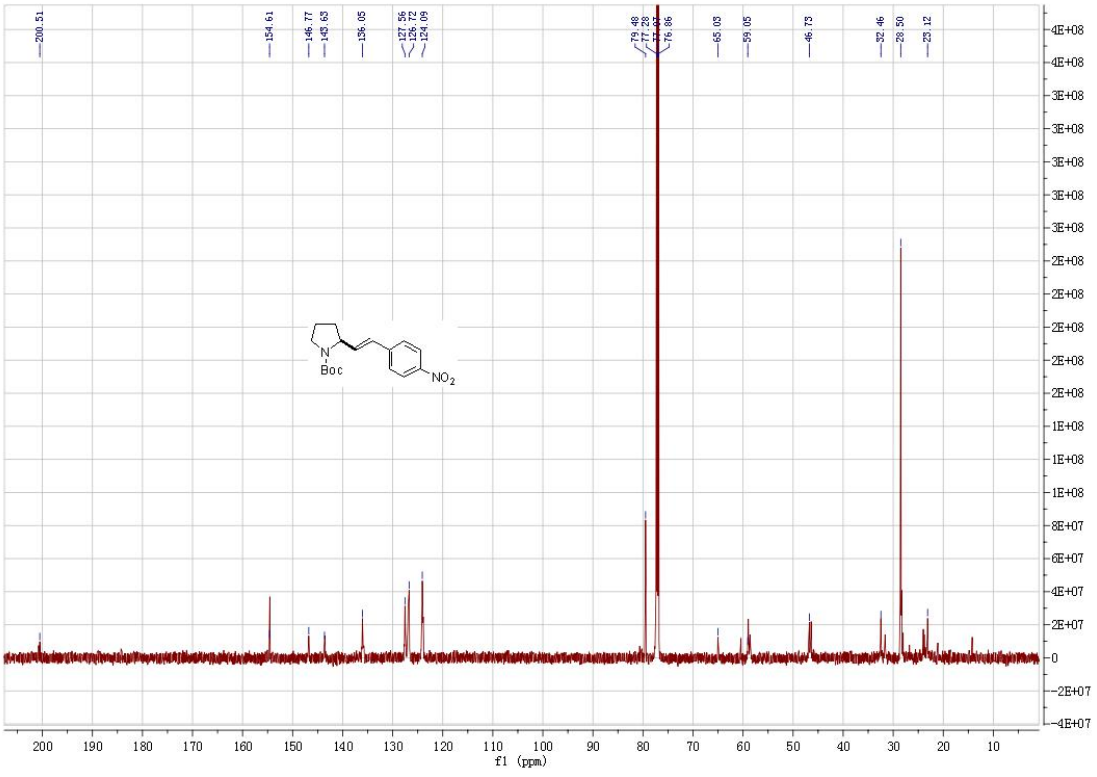
f1 (ppm)
Boc
NO2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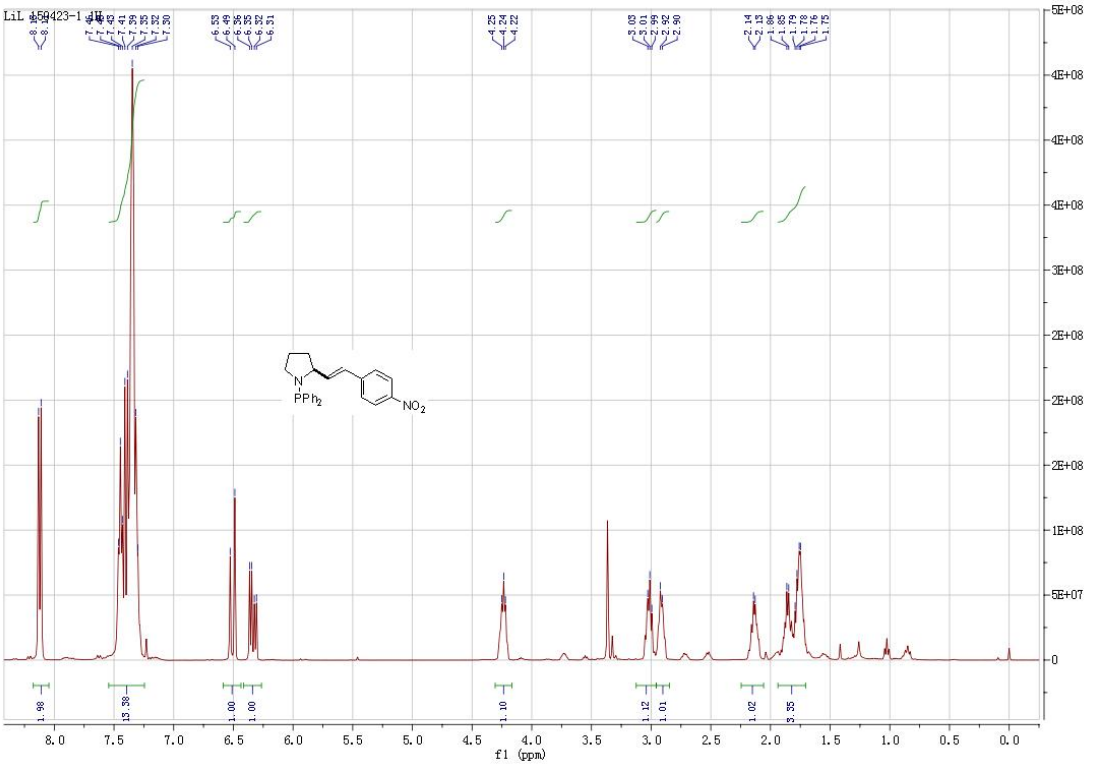
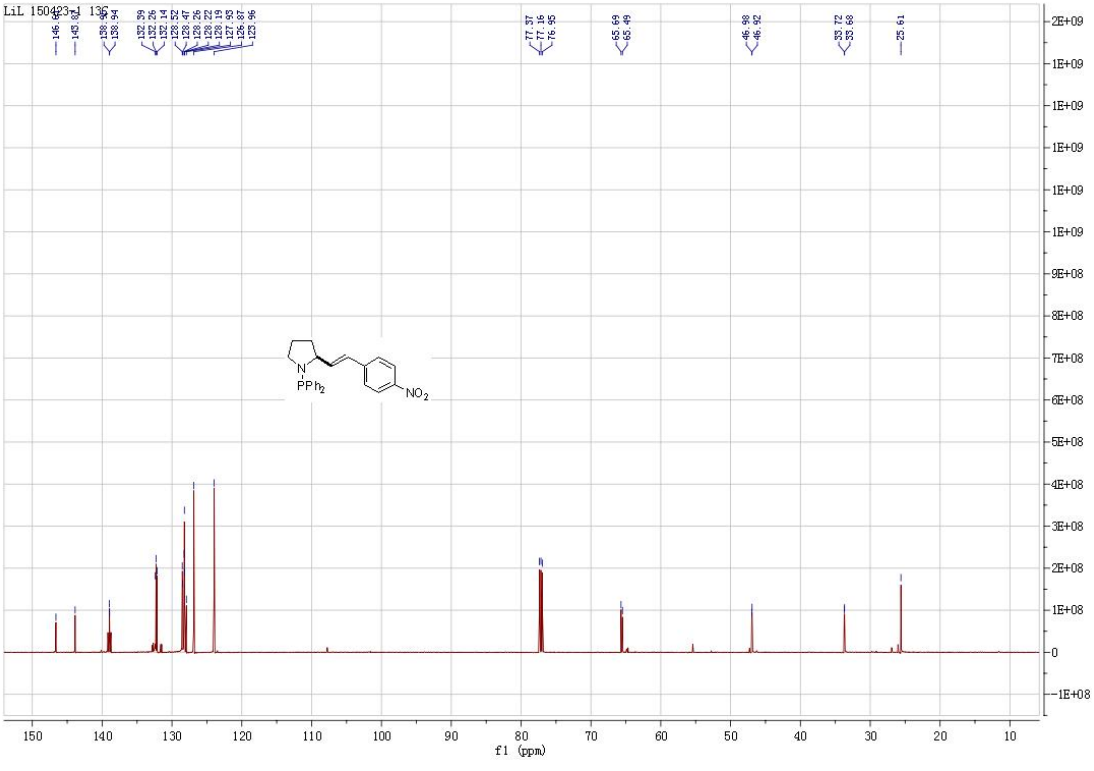

f1 (ppm)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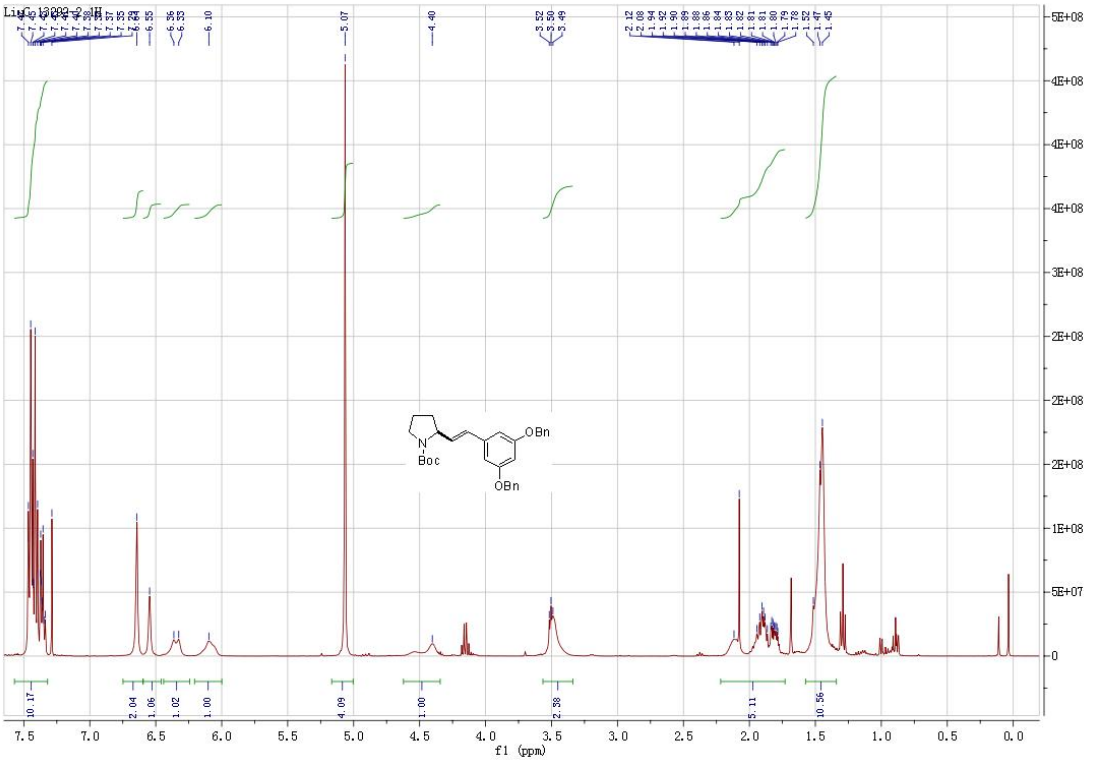
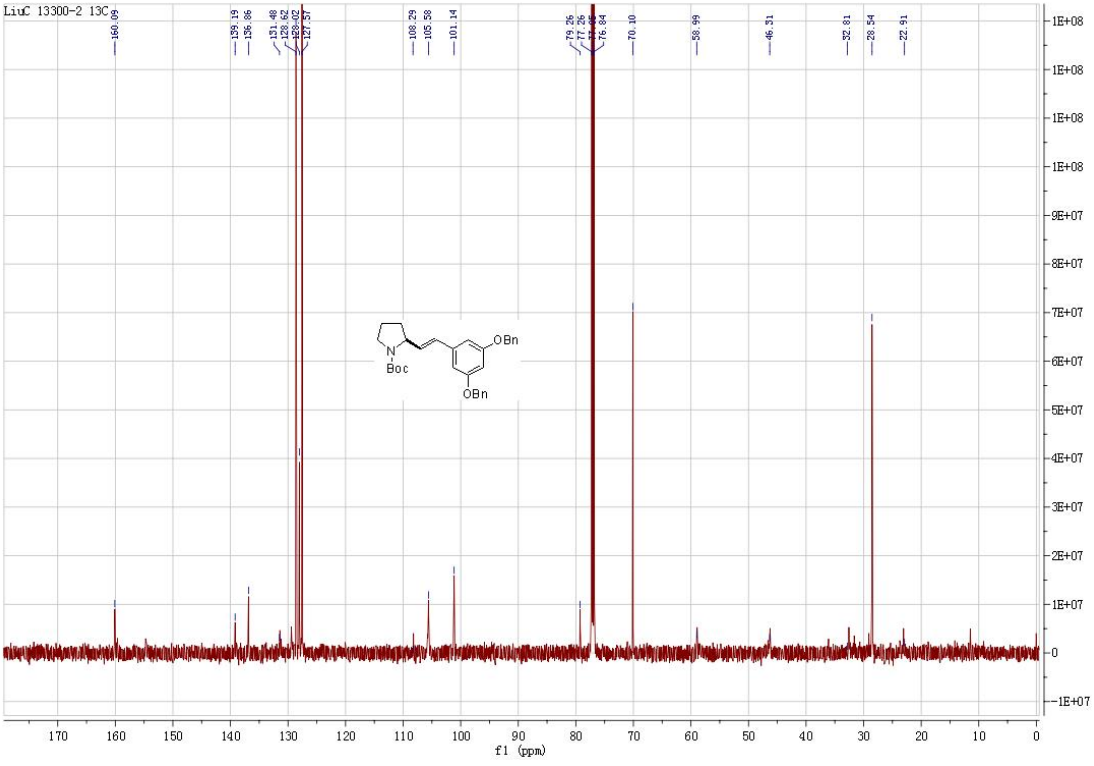

OBn
N
Boc
OBn
f1 (ppm)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N
Boc
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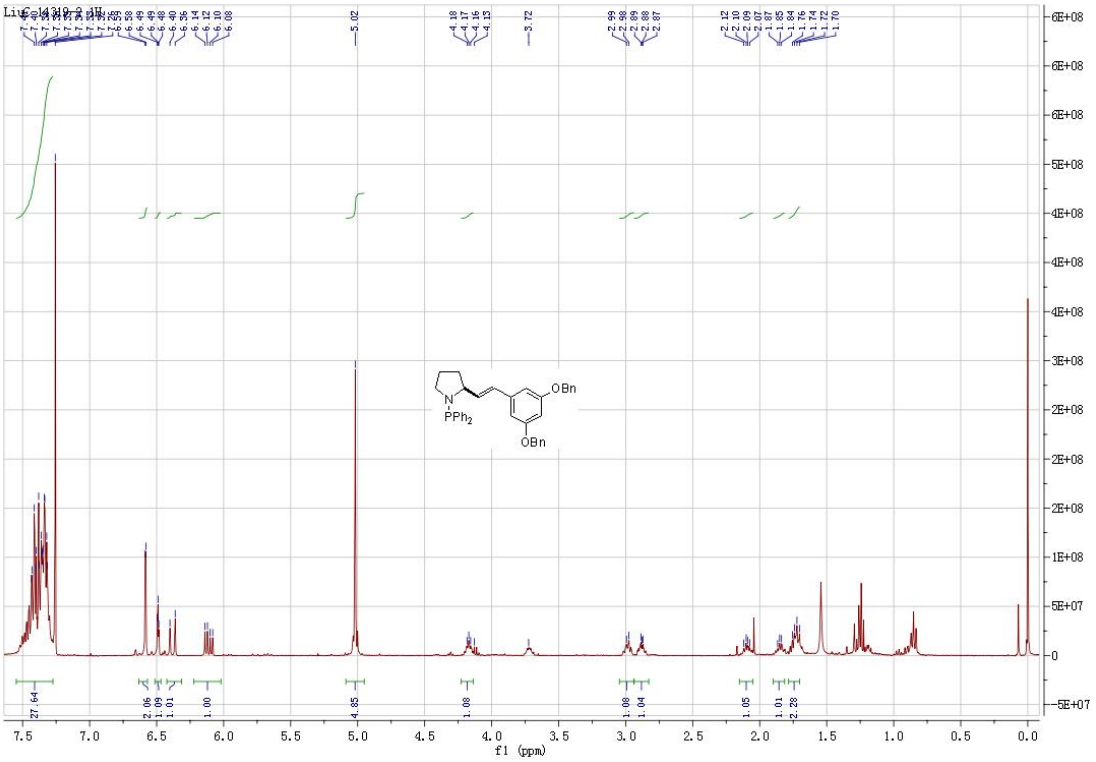
f1 (ppm)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OBn
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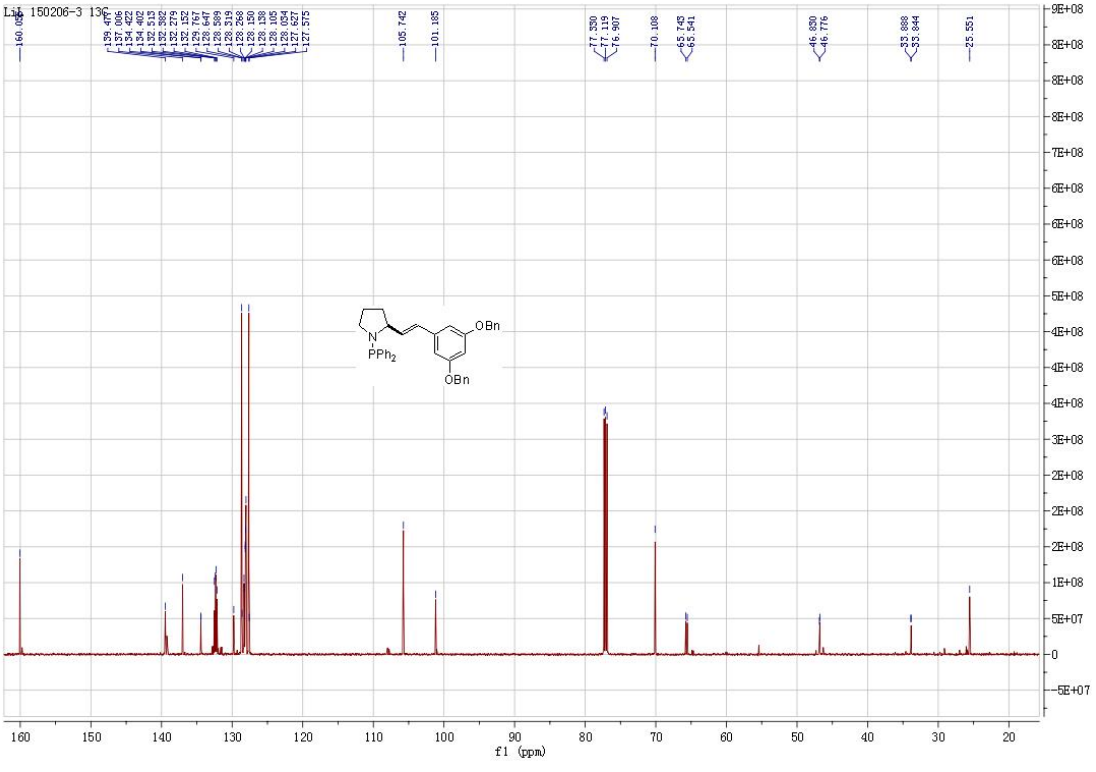
f1 (ppm)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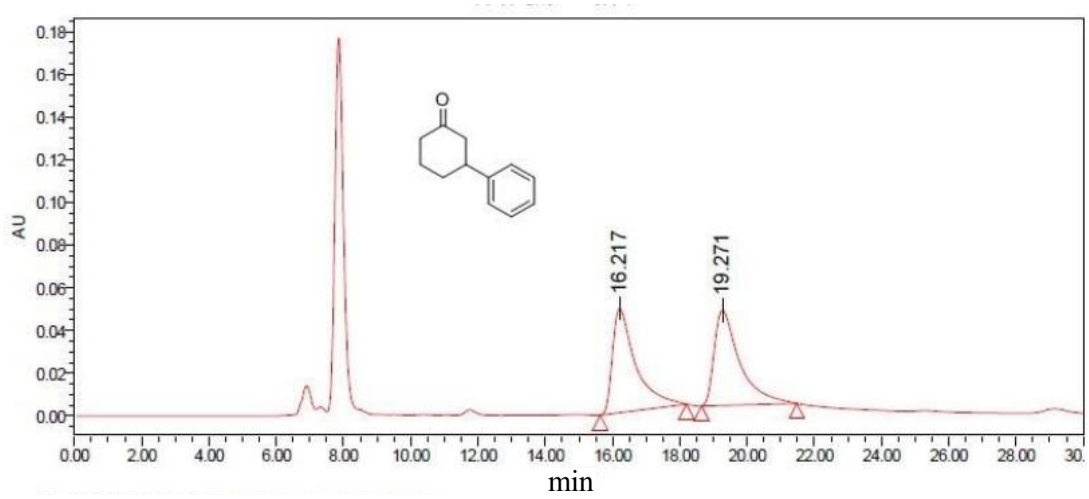
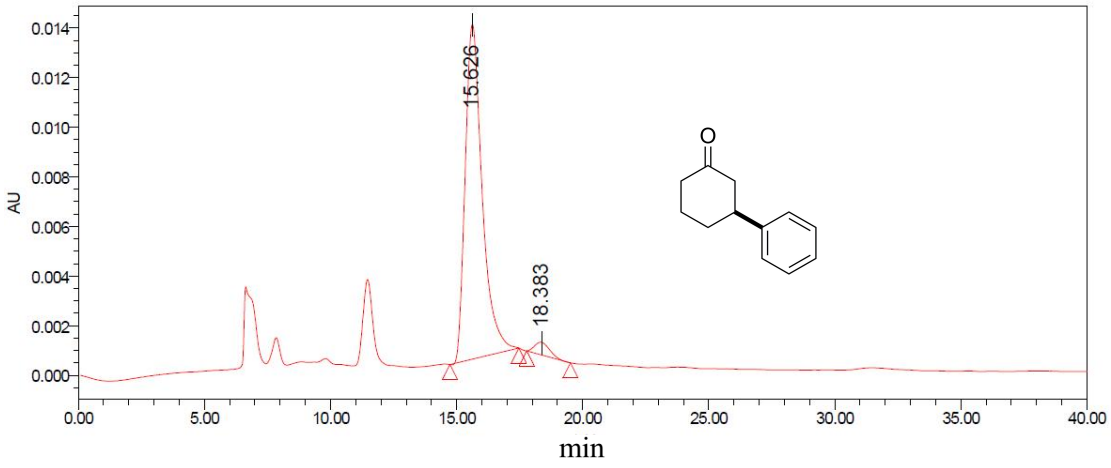
OBn
PPh2
f1 (ppm)

5. HPLC Chromatograms



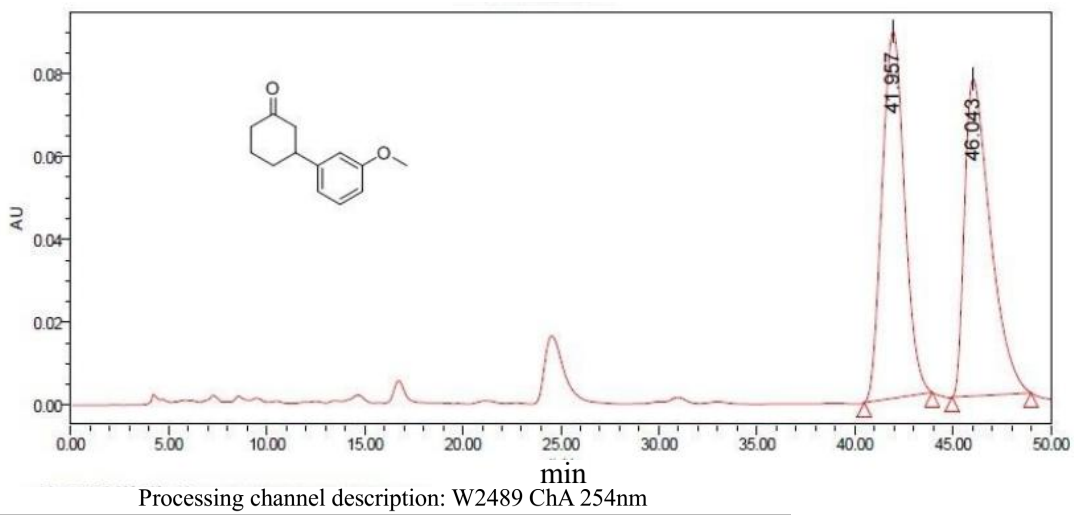
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	16.217	2343250	49.93	48706
2	W2489 ChA 254nm	19.271	2349419	50.07	44601



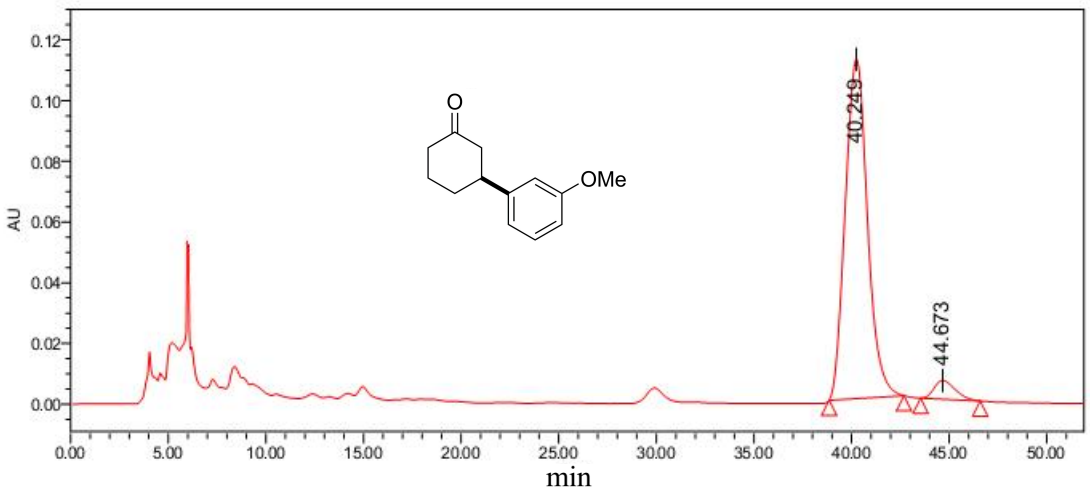
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	15.626	632356	96.77	13499
2	W2489 ChA 254nm	18.383	21078	3.23	510



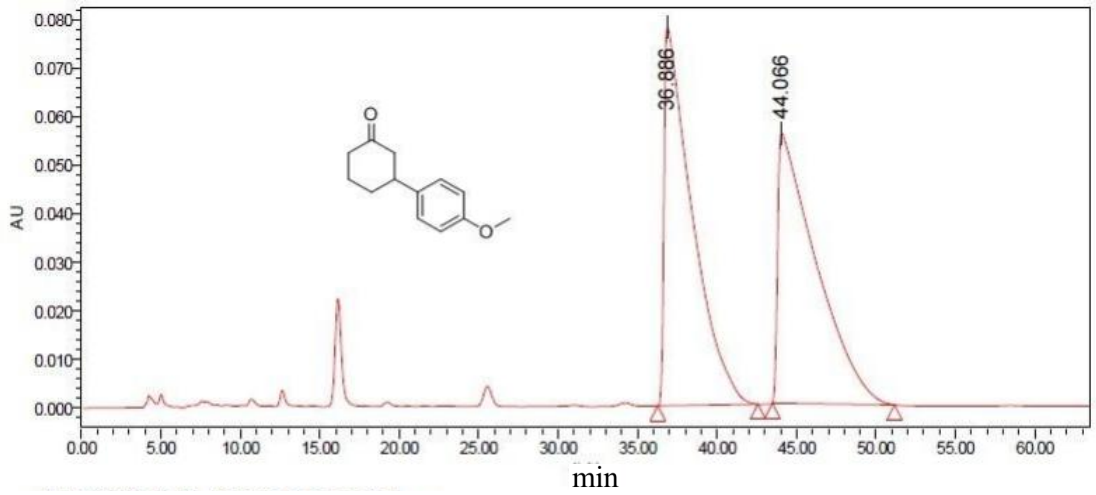
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	41.957	7049581	50.15	88438
2	W2489 ChA 254nm	46.043	7007276	49.85	76473



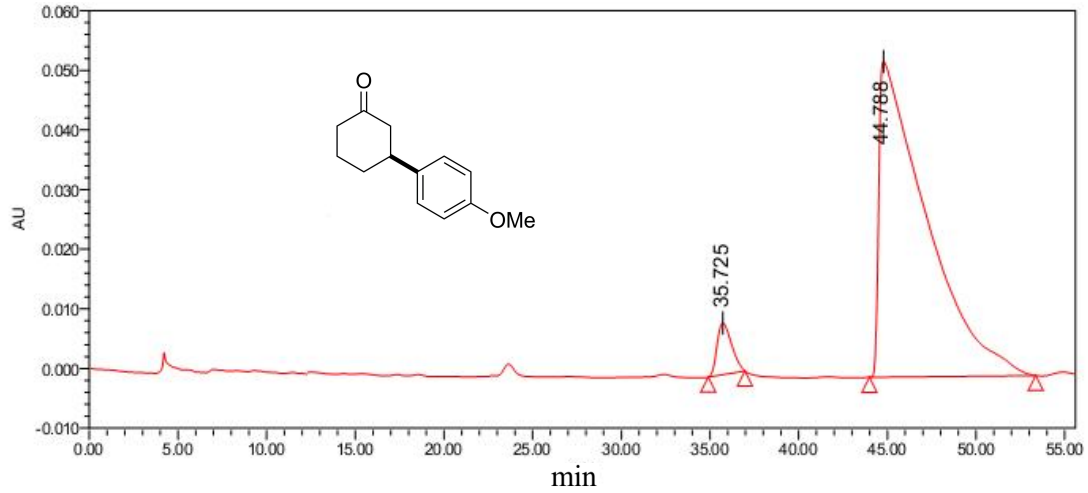
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	40.249	8829162	94.99	111724
2	W2489 ChA 254nm	44.673	465582	5.01	6187



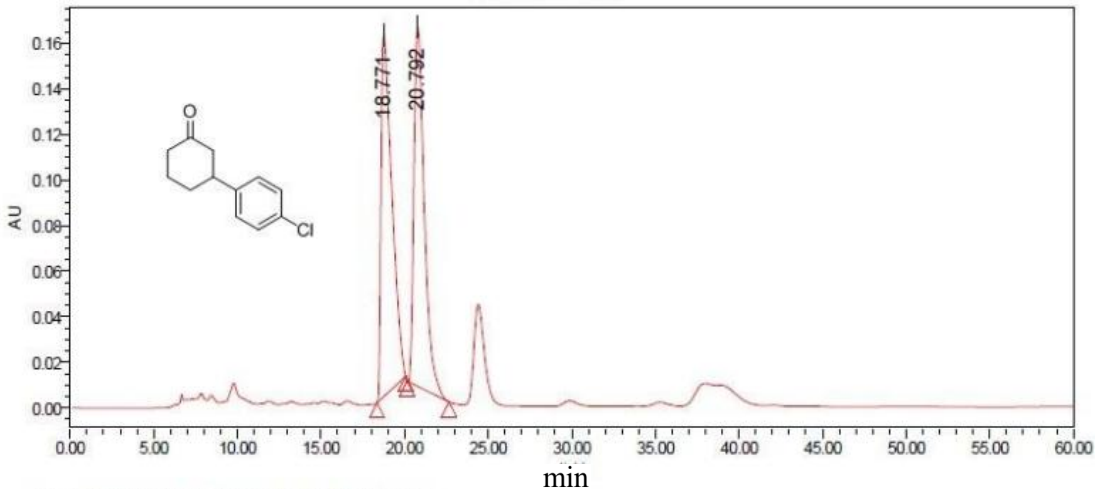
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	36.886	9517607	50.49	77935
2	W2489 ChA 254nm	44.066	9333339	49.51	55563



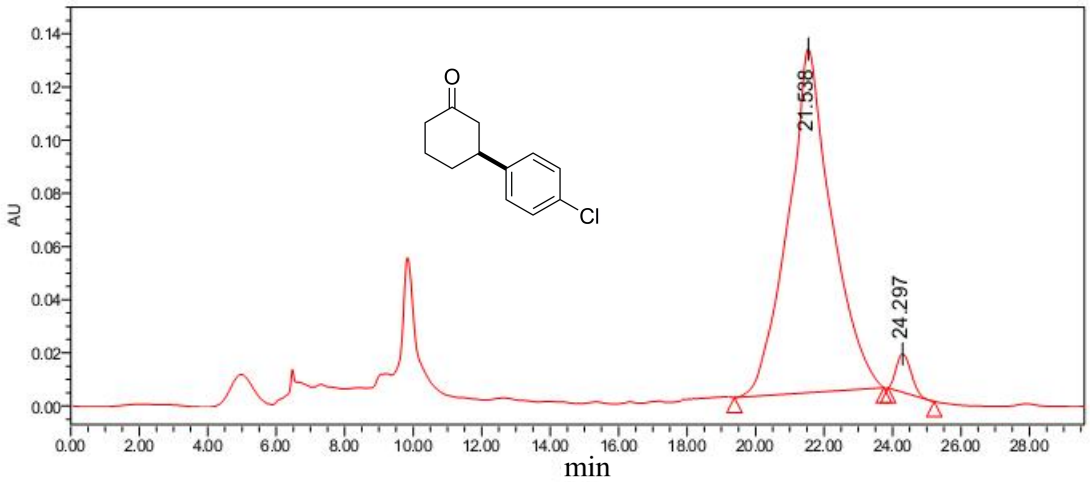
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	35.725	493372	4.77	8668
2	W2489 ChA 254nm	44.788	9845801	95.23	52949



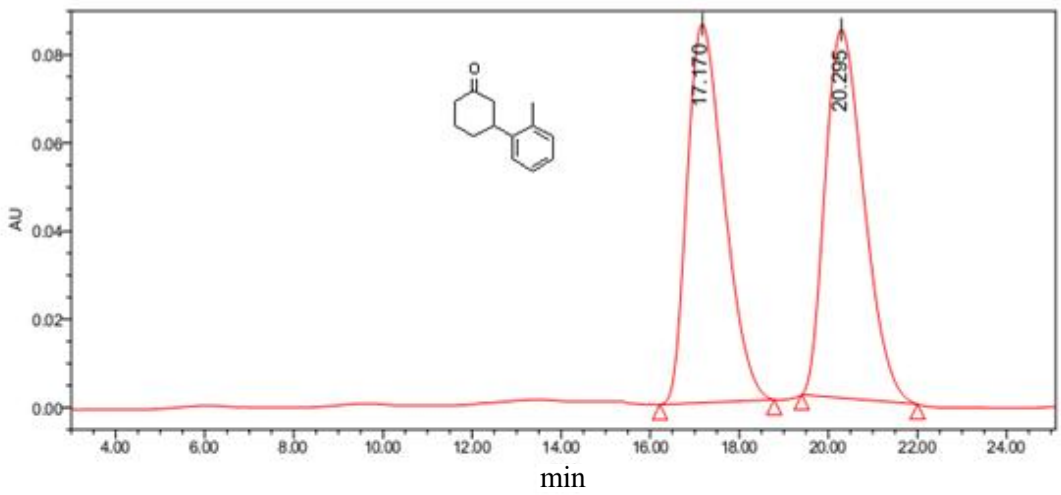
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	18.771	7109362	51.12	158953
2	W2489 ChA 254nm	20.792	6797895	48.88	157808



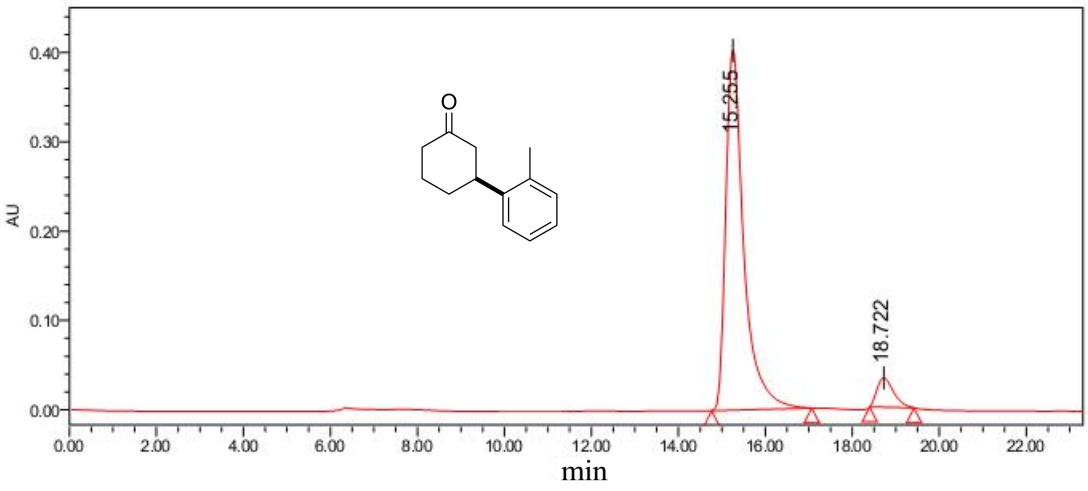
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	21.538	11435440	96.30	129257
2	W2489 ChA 254nm	24.297	438908	3.70	14454



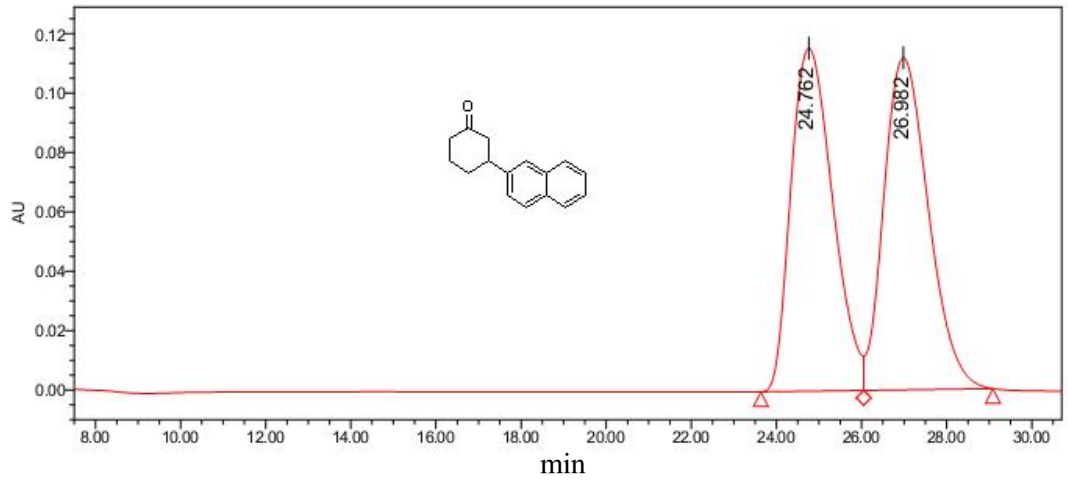
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	17.170	4956070	49.39	85938
2	W2489 ChA 254nm	20.295	5077628	50.61	83622



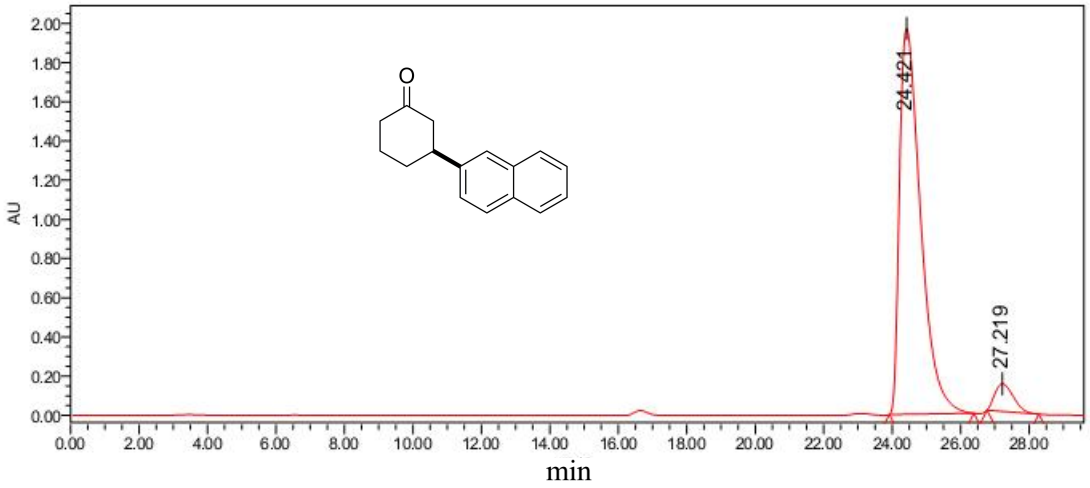
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	15.255	11628261	93.07	402990
2	W2489 ChA 254nm	18.722	866004	6.93	32767



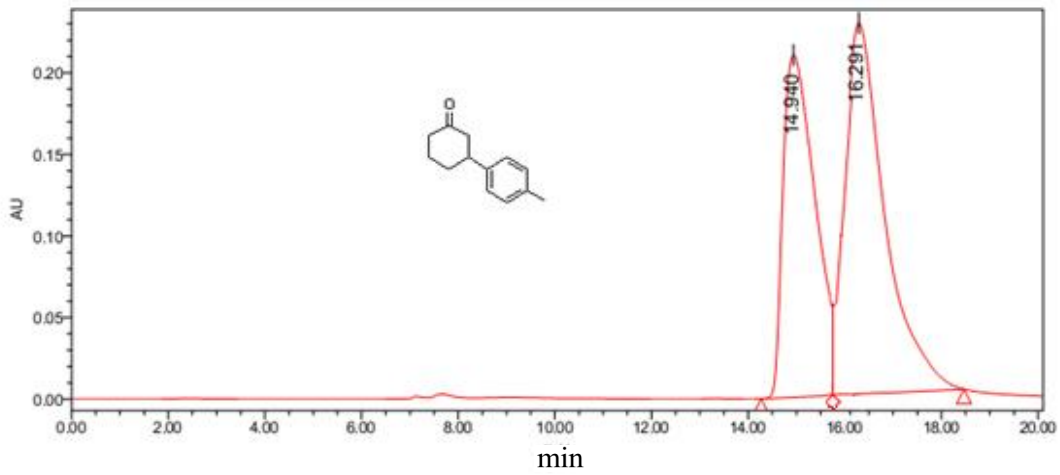
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	24.762	7871785	49.17	115491
2	W2489 ChA 254nm	26.982	8137551	50.83	111860



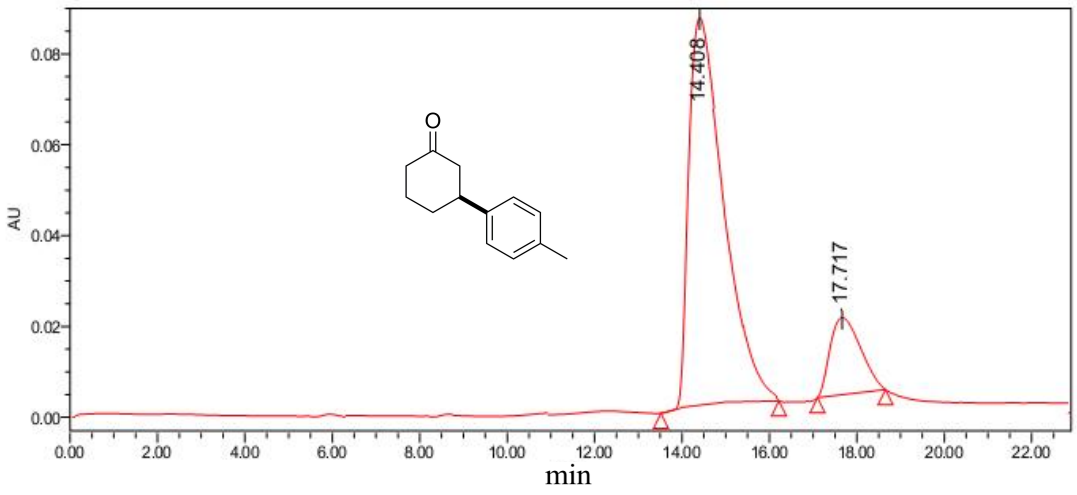
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	24.421	84172432	94.05	1968660
2	W2489 ChA 254nm	27.219	5328647	5.95	140772



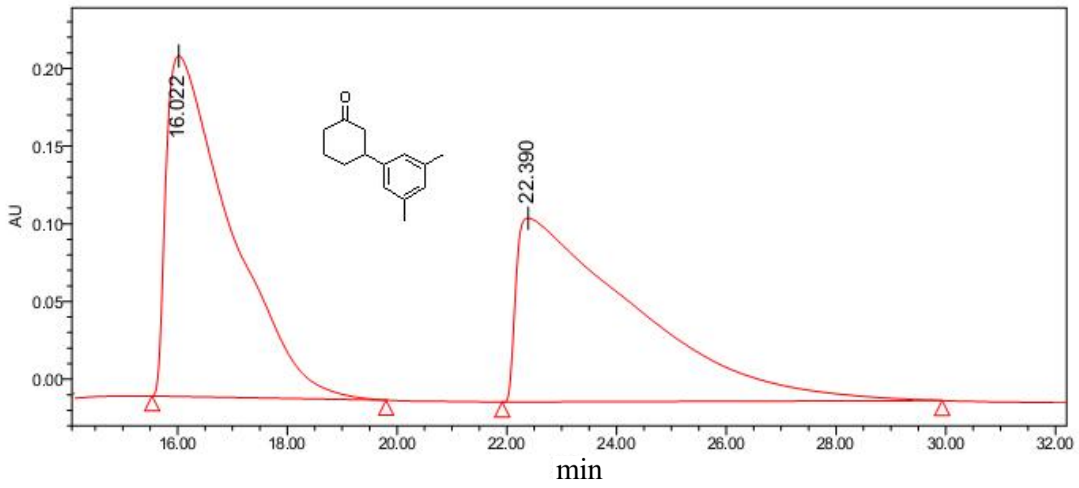
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	14.940	11411482	50.06	209896
2	W2489 ChA 254nm	16.291	11382017	49.94	227611



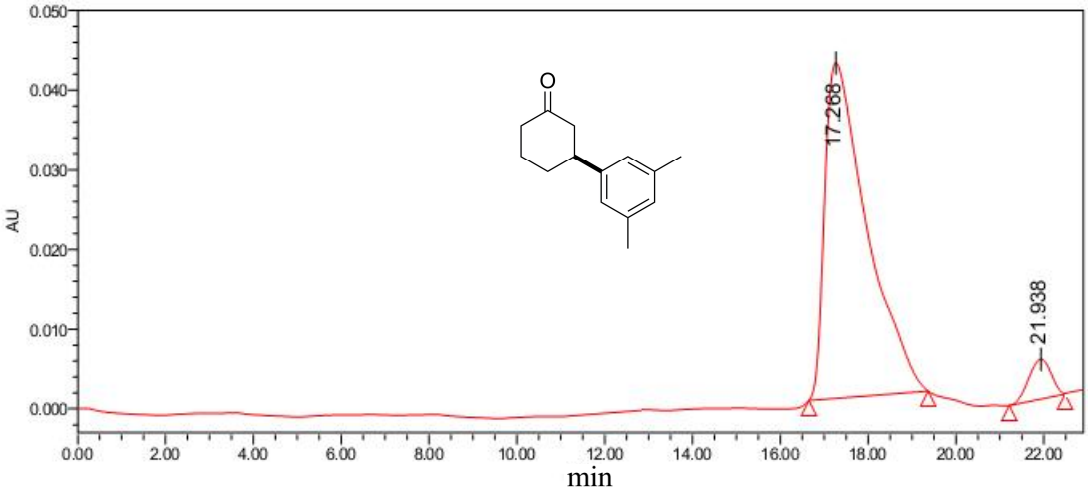
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	14.408	5341659	91.82	84797
2	W2489 ChA 254nm	17.717	475619	8.18	9305



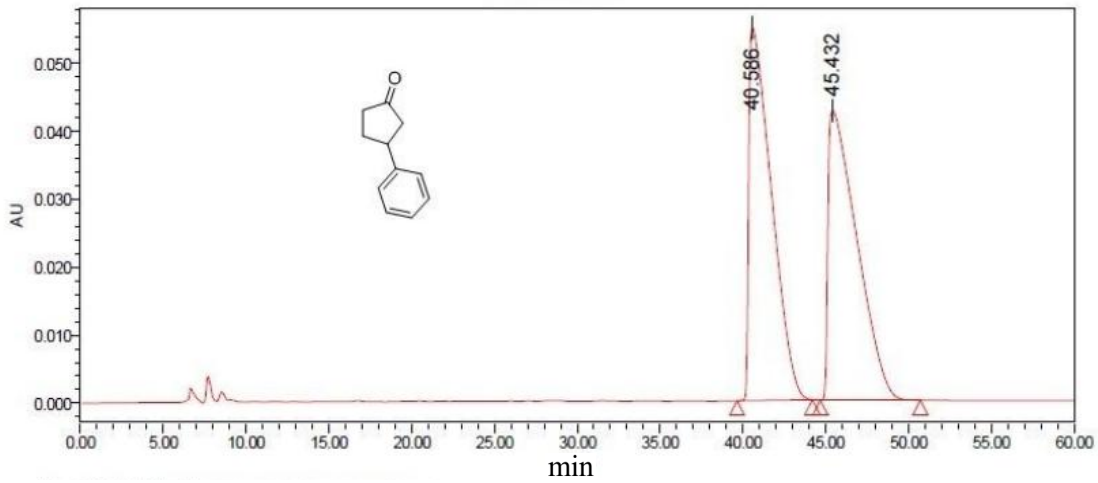
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	16.022	26852997	50.21	327910
2	W2489 ChA 254nm	22.390	26630957	49.79	176983



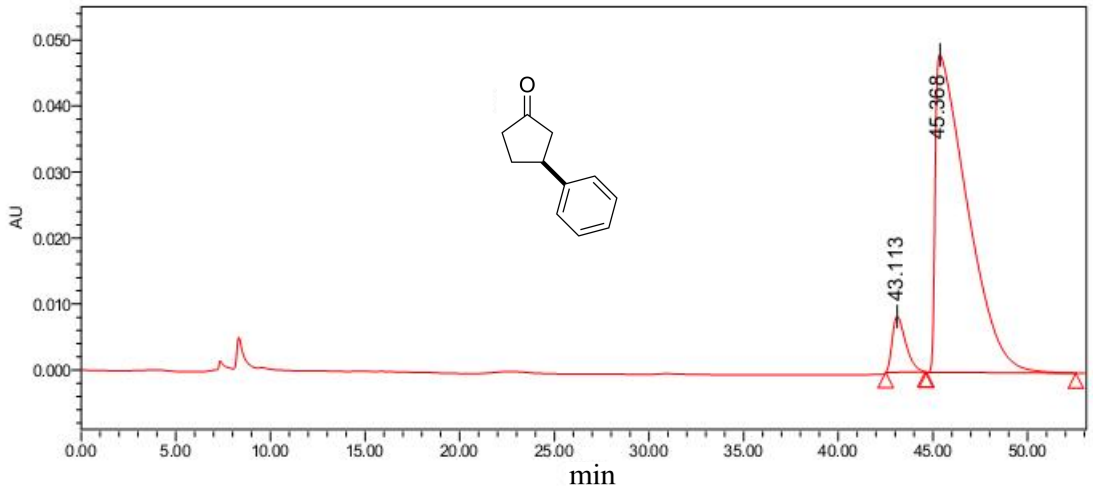
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	17.268	2802313	94.08	42107
2	W2489 ChA 254nm	21.938	176464	5.92	4991



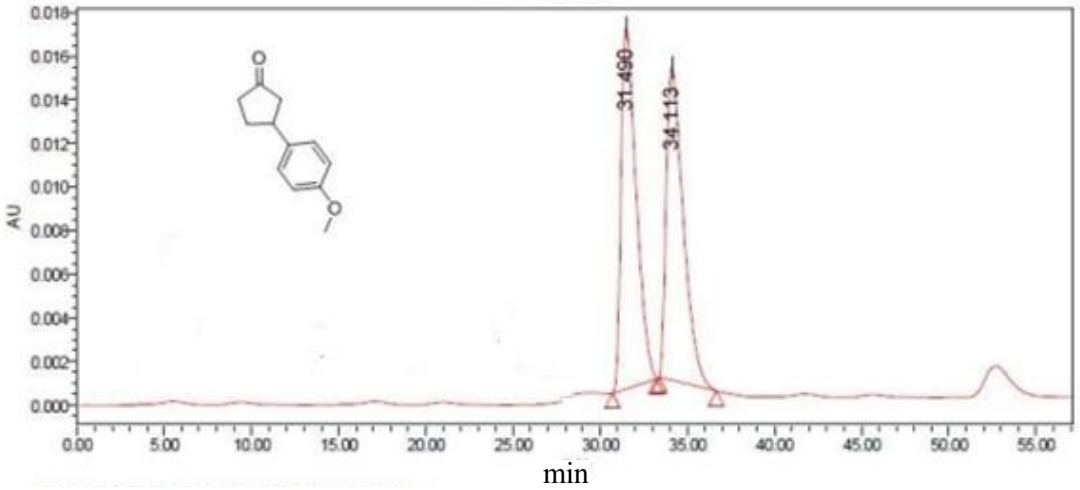
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	40.586	5203829	50.26	54896
2	W2489 ChA 254nm	45.432	5149785	49.74	42624



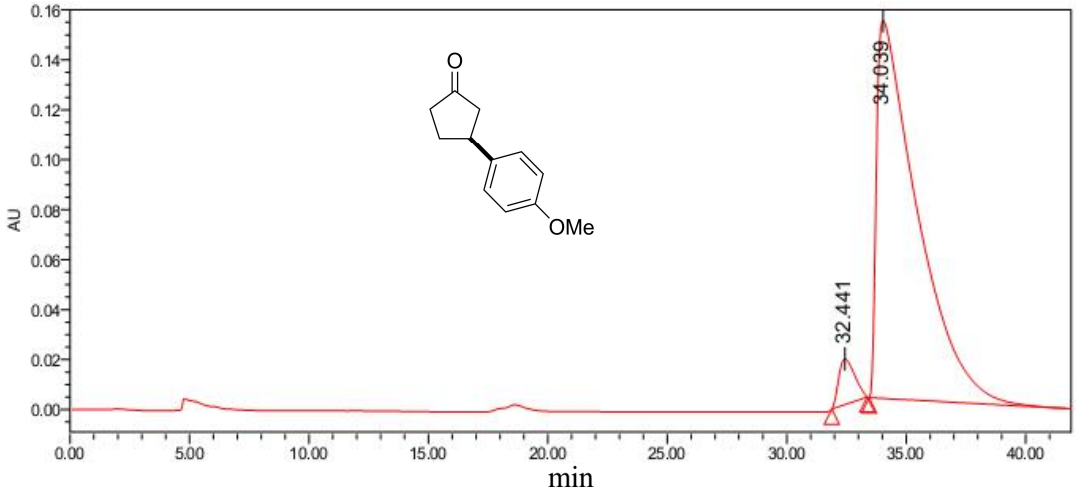
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	43.113	419931	6.92	8457
2	W2489 ChA 254nm	45.368	5644163	93.08	48060



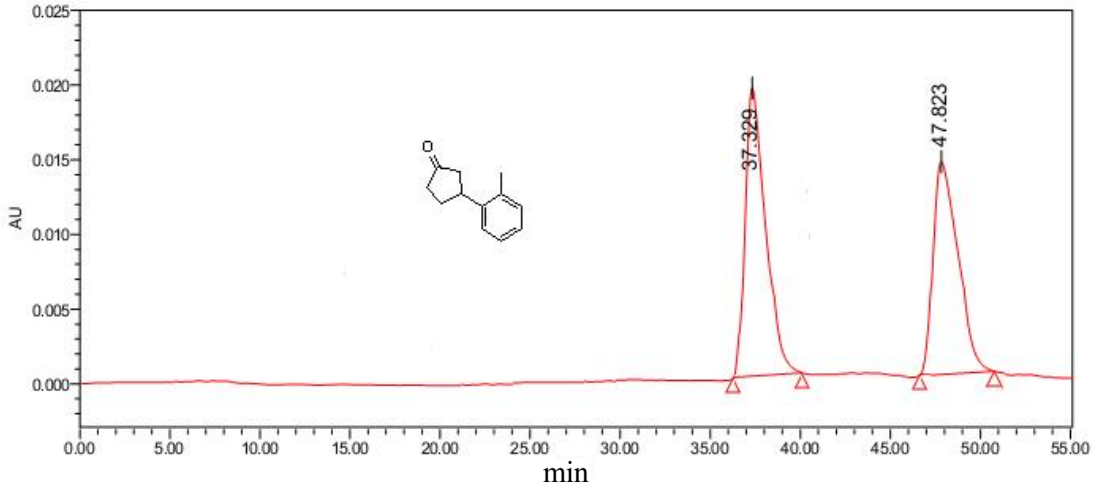
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	31.490	994322	50.35	16543
2	W2489 ChA 254nm	34.112	960623	49.65	14344



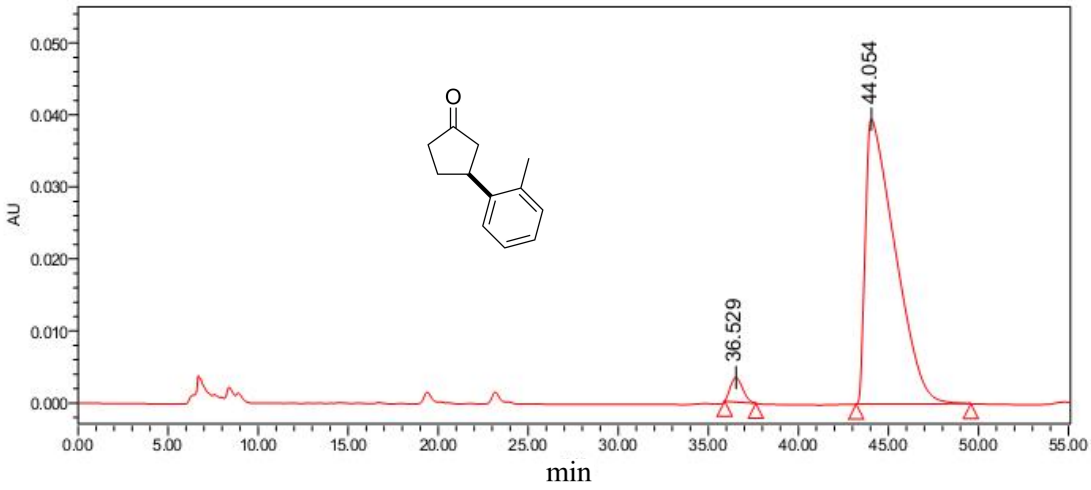
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	32.441	844277	4.49	18270
2	W2489 ChA 254nm	34.039	17972653	95.51	151221



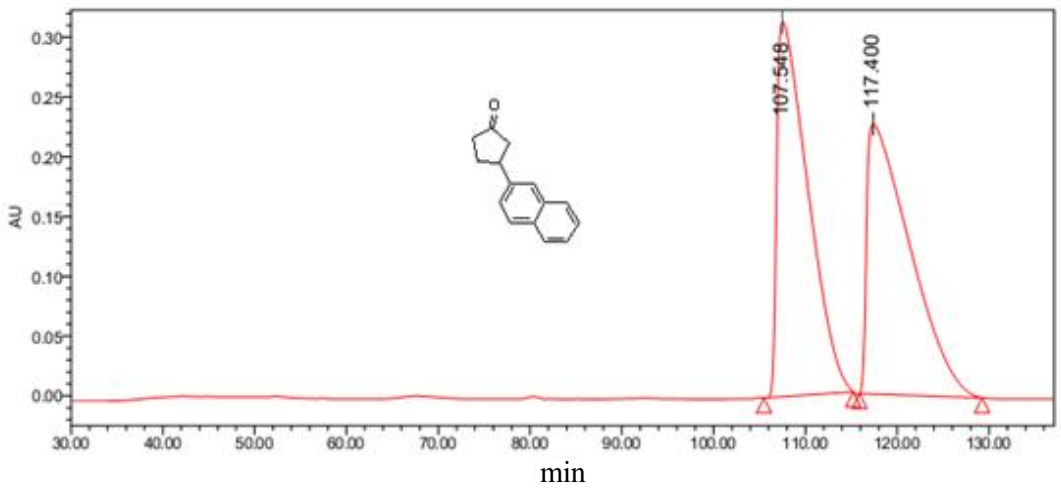
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	37.329	1236446	50.27	18043
2	W2489 ChA 254nm	47.823	1223120	49.73	13342



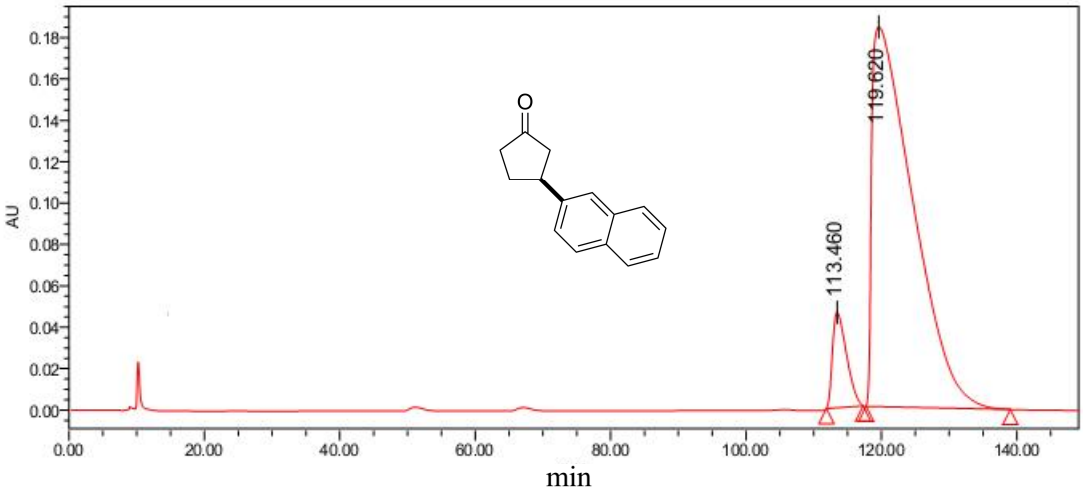
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	36.529	162179	3.45	3394
2	W2489 ChA 254nm	44.054	4538878	96.55	39579



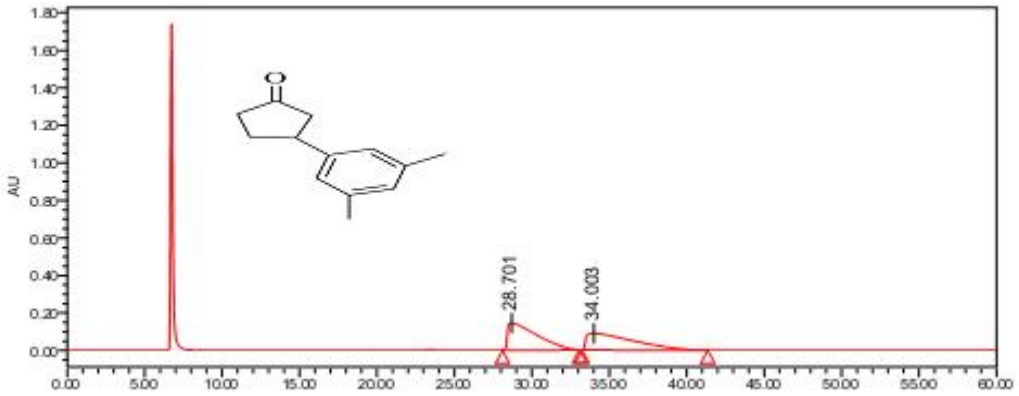
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	107.548	73618514	49.90	313379
2	W2489 ChA 254nm	117.400	73908719	50.10	225990



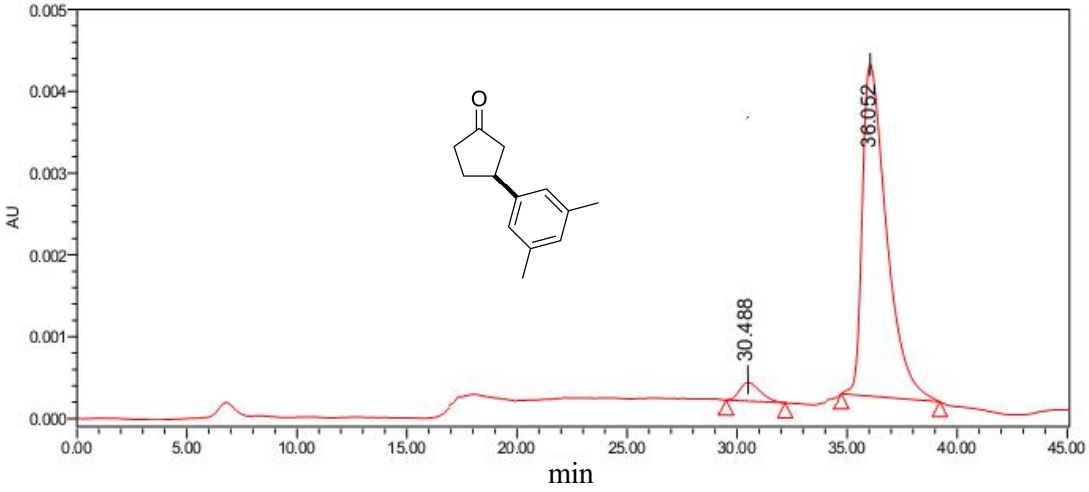
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	113.460	6645904	7.93	46085
2	W2489 ChA 254nm	119.620	77112165	92.07	183440



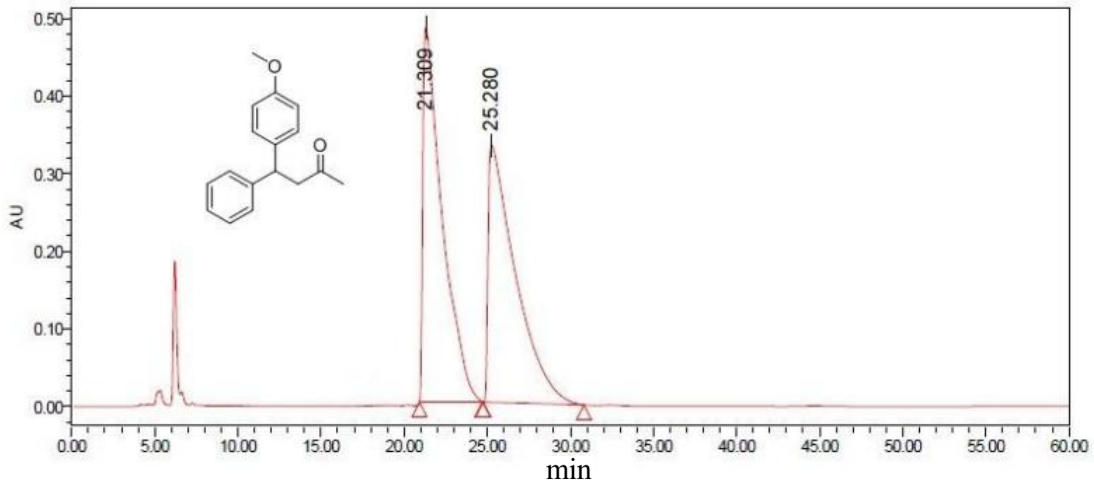
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	28.701	19301306	50.37	145569
2	W2489 ChA 254nm	34.003	19017006	49.63	88236



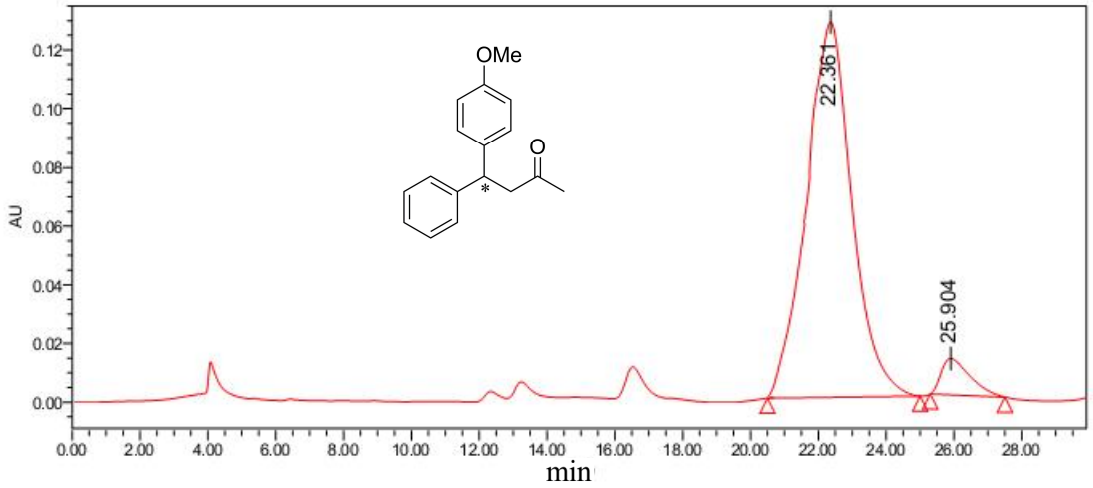
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	30.488	15617	4.79	677
2	W2489 ChA 254nm	36.052	310650	95.21	4055



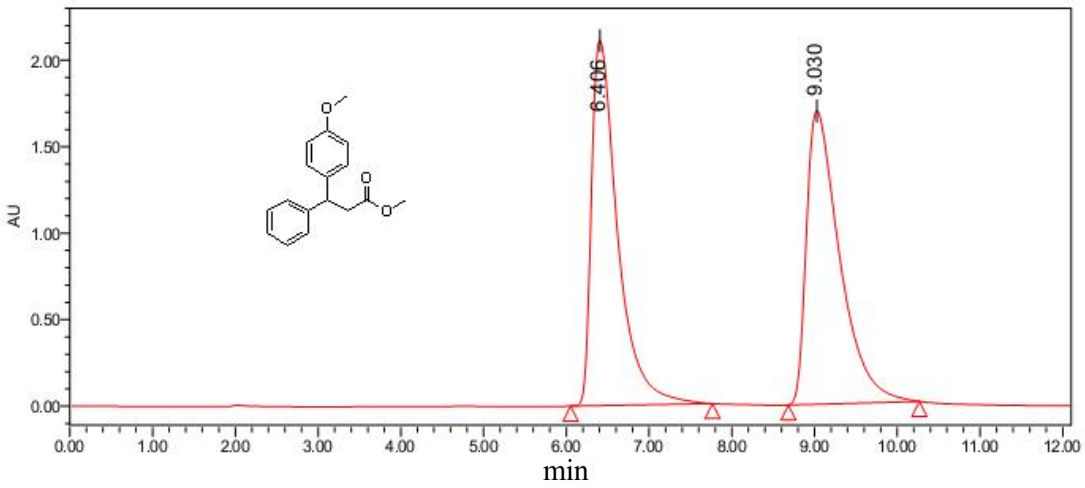
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	21.309	39040087	50.73	482751
2	W2489 ChA 254nm	25.280	37922434	49.27	330750



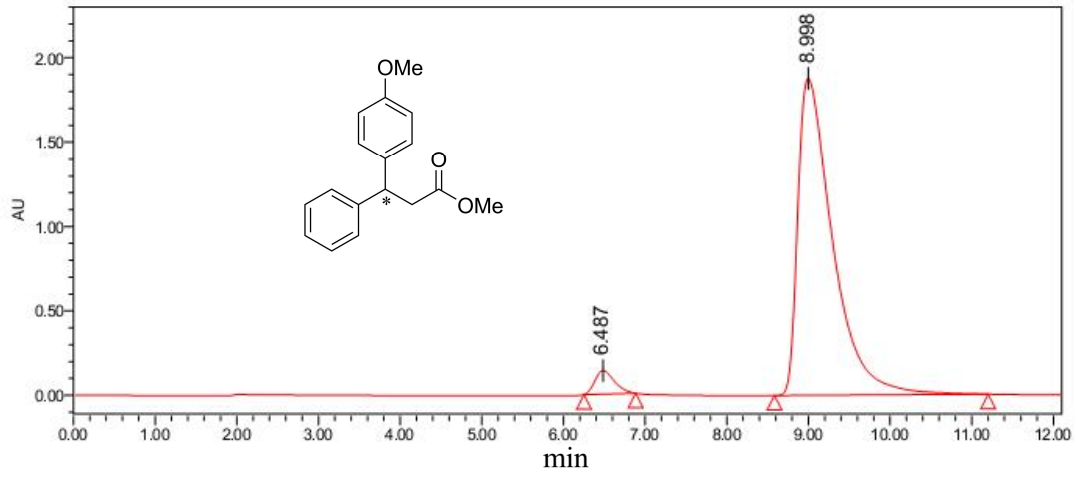
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	22.361	10837909	93.66	127959
2	W2489 ChA 254nm	25.904	733146	6.34	12362



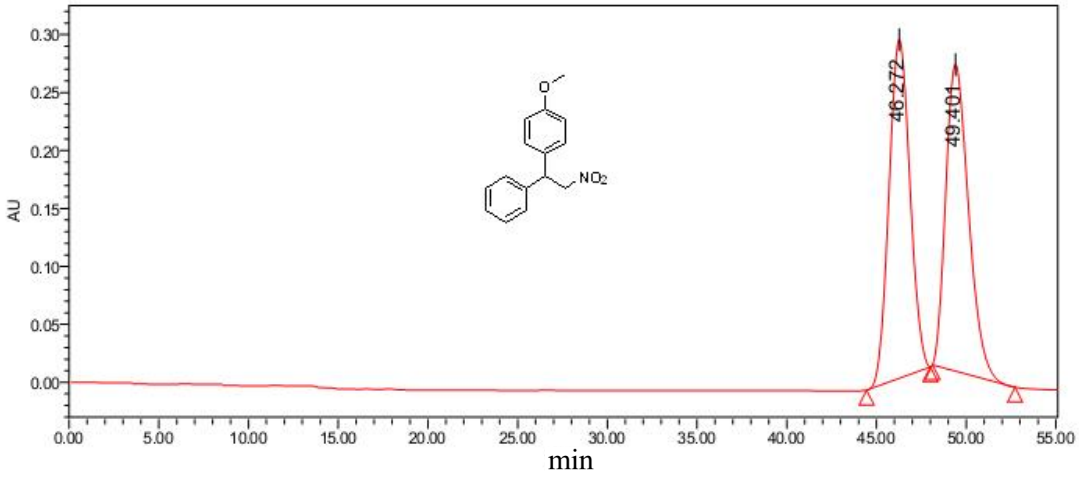
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	6.406	46376414	49.43	2115166
2	W2489 ChA 254nm	9.030	47447740	50.57	1696895



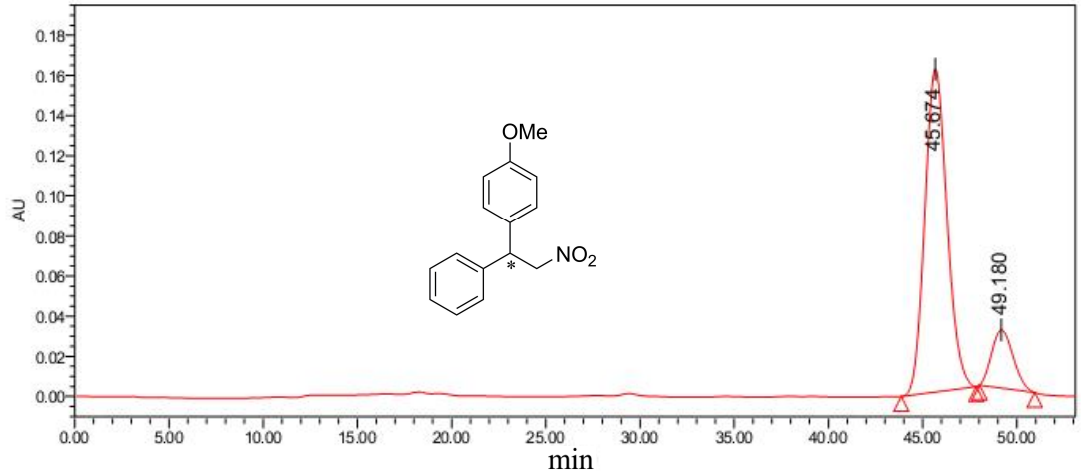
Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	6.487	2308872	3.98	139452
2	W2489 ChA 254nm	8.998	55746656	96.02	1878035



Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	46.272	23671274	50.29	292156
2	W2489 ChA 254nm	49.401	23402266	49.71	264516



Processing channel description: W2489 ChA 254nm

	Processing channel description	Retention time (min)	Peak area (uAU*s)	Peak area (%)	Peak height (uAU)
1	W2489 ChA 254nm	45.674	13194880	85.08	160900
2	W2489 ChA 254nm	49.180	2313883	14.92	29039

6. Computational Details

The B3PW91 functional [3] planted in Gaussian 09 software package [4] was used for geometrical optimization and subsequent frequency calculations without any symmetry or geometrical constraints. In these calculations, the 6-31G(d) basis set was used for C, H, N, O, and P atoms, and LanL2DZ basis set together with associated effective core potential (ECP) was applied for Rh atom. To obtain more accurate energies, single-point energy calculations were performed with larger basis sets, viz., 6-311+G(d, p) for C, H, N, O, and P atoms, and the Stuttgart/Dresden ECP and associated basis set (8s7p6d)/[6s5p3d] for Rh atom. The energy profiles were described by these single-point energies including zero-point energy corrections. The stationary points reported are their lowest conformations in energy along the reaction pathway.

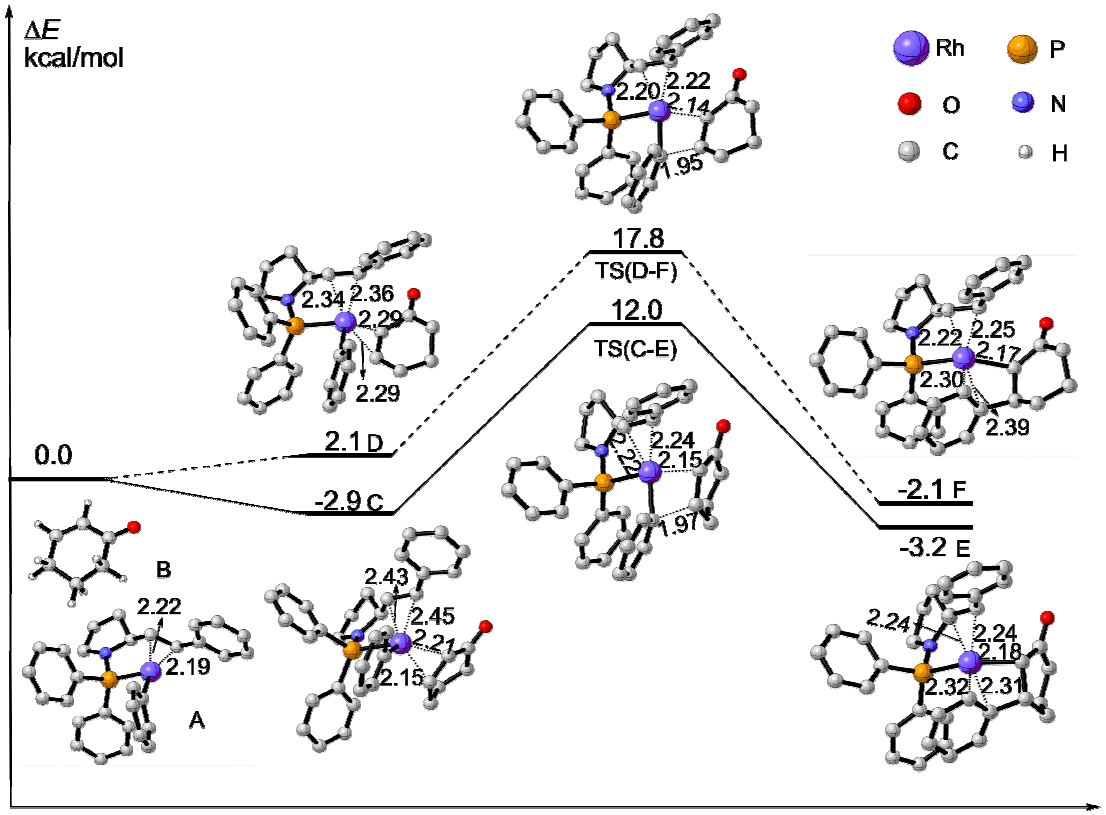


Figure S1. Computed energy profiles (energies in kcal/mol) for the different stereochemical pathway and optimized geometric structures (Distances are shown in Å, H atom is omitted for clarity) in the arylation of cyclohexenone and the arylrhodium species. Solid line denotes the *si*-face insertion to give (*S*)-configuration, whereas dashed line denotes the *re*-face insertion to get (*R*)-configuration.

7. Table S1. Optimized Cartesian Coordinates (Å) and Electronic Energy (a.u., including zero-point energy correction) of Cationic Species **A**, **B**, **C**, **TS(C-E)**, **E**, **D**,**TS(D-F)** and **F**.

Atom	X	Y	Z
A, -1666.696524			
C	1.204188000	-2.077088000	-0.743583000
C	-0.059647000	-2.846866000	-0.451639000
C	2.164594000	-1.894029000	0.250514000
P	-1.107646000	-0.395318000	-0.062628000
C	-2.116957000	0.564167000	-1.252820000
Rh	1.040933000	-0.025486000	0.082295000
C	-2.091275000	-0.335390000	1.493773000
C	-1.399530000	-0.410912000	2.709713000
C	-2.090829000	-0.463306000	3.918662000
C	-3.485194000	-0.441518000	3.925265000
C	-4.184970000	-0.367938000	2.720817000
C	-3.493723000	-0.315692000	1.511267000
C	-2.249607000	0.119801000	-2.574424000
C	-2.952012000	0.879147000	-3.508406000
C	-3.519934000	2.096742000	-3.135646000
C	-3.374314000	2.555848000	-1.826542000
C	-2.674128000	1.798171000	-0.890513000
N	-1.234276000	-1.990167000	-0.661170000
C	-0.402270000	-4.032651000	-1.357632000
C	-1.908432000	-4.221994000	-1.114062000
C	-2.443003000	-2.805605000	-0.777554000
C	3.470748000	-1.247351000	0.067732000
C	0.548463000	2.594814000	1.473879000
C	0.615024000	3.985307000	1.600362000
C	0.818752000	4.783094000	0.475589000
C	0.955360000	4.180096000	-0.775801000
C	0.897196000	2.791133000	-0.896901000
C	0.715806000	1.964814000	0.227610000
C	4.344121000	-1.138811000	1.169002000
C	5.562775000	-0.480731000	1.058113000
C	5.941335000	0.098127000	-0.154798000
C	5.088036000	0.008801000	-1.253724000
C	3.868405000	-0.655475000	-1.150092000
H	1.443670000	-1.944689000	-1.798486000
H	-0.015280000	-3.201986000	0.594814000
H	2.000132000	-2.358330000	1.223037000
H	-0.310767000	-0.419545000	2.687909000
H	-1.541256000	-0.513732000	4.855413000
H	-4.026585000	-0.477559000	4.867448000

H	-5.272102000	-0.347905000	2.722590000
H	-4.047709000	-0.243258000	0.578822000
H	-1.791703000	-0.821976000	-2.864625000
H	-3.053241000	0.519397000	-4.529569000
H	-4.066944000	2.690000000	-3.864184000
H	-3.800925000	3.511452000	-1.532547000
H	-2.551658000	2.173409000	0.121683000
H	0.185433000	-4.926115000	-1.124014000
H	-0.207524000	-3.756566000	-2.401391000
H	-2.421882000	-4.664088000	-1.973663000
H	-2.069444000	-4.891808000	-0.261979000
H	-3.026625000	-2.818630000	0.154923000
H	-3.092452000	-2.403871000	-1.564618000
H	0.367201000	1.996830000	2.365176000
H	0.496719000	4.445282000	2.580117000
H	0.861027000	5.865934000	0.570704000
H	1.104119000	4.794767000	-1.662017000
H	0.994636000	2.343976000	-1.884835000
H	4.052592000	-1.585144000	2.117422000
H	6.220028000	-0.415326000	1.921629000
H	6.892656000	0.616334000	-0.240958000
H	5.372943000	0.457439000	-2.202003000
H	3.223684000	-0.724724000	-2.021430000
B, -308.5050468			
C	-1.814503000	0.089813000	0.132657000
C	-0.962219000	1.320405000	0.026578000
C	0.378584000	1.286493000	-0.054130000
C	1.140809000	0.022544000	0.017537000
C	0.327251000	-1.237605000	0.271835000
C	-1.070338000	-1.159075000	-0.344397000
H	-2.740827000	0.231110000	-0.439229000
H	-2.132290000	-0.031528000	1.181639000
H	-1.473694000	2.283030000	0.018004000
H	0.969370000	2.194285000	-0.150523000
O	2.357317000	0.002310000	-0.079034000
H	0.898680000	-2.094958000	-0.097490000
H	0.247516000	-1.354673000	1.364170000
H	-1.645553000	-2.061548000	-0.106611000
H	-0.979243000	-1.119659000	-1.438167000
C, -1975.206249			
C	0.996027000	0.048308000	-1.903299000
C	-0.028783000	-0.817850000	-2.581287000
C	2.212408000	-0.383521000	-1.427635000
P	-1.402685000	0.164780000	-0.467434000

C	-1.668147000	1.981948000	-0.689887000
Rh	0.606013000	-0.585940000	0.404880000
C	-3.010631000	-0.445126000	0.184594000
C	-3.278024000	-1.819696000	0.082326000
C	-4.459350000	-2.354807000	0.588099000
C	-5.391193000	-1.526481000	1.215255000
C	-5.135883000	-0.161405000	1.321482000
C	-3.956748000	0.378239000	0.806705000
C	-1.713306000	2.536915000	-1.976387000
C	-1.840038000	3.913262000	-2.160390000
C	-1.918588000	4.761696000	-1.058144000
C	-1.854998000	4.224554000	0.226928000
C	-1.723048000	2.849526000	0.413444000
N	-1.361586000	-0.534399000	-2.012495000
C	-0.257800000	-0.572617000	-4.079516000
C	-1.686113000	-1.091118000	-4.287548000
C	-2.432607000	-0.683692000	-3.001378000
C	3.332423000	0.498457000	-1.036878000
C	-0.707085000	0.590602000	2.911495000
C	-0.767377000	1.529612000	3.945933000
C	0.206617000	2.520643000	4.058351000
C	1.246283000	2.559883000	3.128711000
C	1.308692000	1.625885000	2.091659000
C	0.326065000	0.633636000	1.963202000
C	4.487173000	-0.074098000	-0.475873000
C	5.573136000	0.720548000	-0.119545000
C	5.535661000	2.100395000	-0.318484000
C	4.397565000	2.680039000	-0.880524000
C	3.309657000	1.889453000	-1.238419000
H	0.805528000	1.117905000	-1.985392000
H	0.238211000	-1.878558000	-2.436203000
H	2.467031000	-1.439048000	-1.514309000
H	-2.557271000	-2.469061000	-0.407486000
H	-4.652548000	-3.420483000	0.493138000
H	-6.312232000	-1.943748000	1.614105000
H	-5.859471000	0.493514000	1.800430000
H	-3.785755000	1.447511000	0.878618000
H	-1.638593000	1.889619000	-2.844184000
H	-1.875925000	4.320464000	-3.168015000
H	-2.017276000	5.835033000	-1.199158000
H	-1.893777000	4.877924000	1.094801000
H	-1.641392000	2.457855000	1.422707000
H	0.484482000	-1.081575000	-4.702000000
H	-0.197277000	0.502698000	-4.291516000

H	-2.164507000	-0.690662000	-5.186855000
H	-1.673091000	-2.183595000	-4.381747000
H	-3.160308000	-1.445424000	-2.694741000
H	-2.988427000	0.253874000	-3.133772000
H	-1.479382000	-0.172260000	2.845819000
H	-1.581369000	1.479326000	4.666932000
H	0.162475000	3.248216000	4.865114000
H	2.020241000	3.320850000	3.206638000
H	2.128794000	1.676217000	1.378505000
H	4.508902000	-1.147474000	-0.298747000
H	6.454368000	0.256142000	0.316393000
H	6.386127000	2.719237000	-0.043367000
H	4.358265000	3.753599000	-1.048912000
H	2.441768000	2.364304000	-1.687491000
C	-0.290578000	-3.277472000	1.666118000
C	0.614580000	-2.098554000	1.937482000
C	1.930002000	-2.052653000	1.393294000
C	2.424456000	-3.108277000	0.500878000
C	1.475201000	-4.259205000	0.176642000
C	-0.006676000	-3.915190000	0.308727000
H	-1.340828000	-2.972488000	1.745834000
H	-0.128615000	-4.027760000	2.459313000
H	0.466719000	-1.635867000	2.910458000
H	2.702323000	-1.453153000	1.873504000
O	3.572848000	-3.137970000	0.058359000
H	1.730617000	-4.638353000	-0.819123000
H	1.727390000	-5.064486000	0.884341000
H	-0.619080000	-4.814832000	0.164932000
H	-0.291926000	-3.206360000	-0.482877000

TS(C-E), -1975.182372, Imaginary frequency = 286.62*i*

C	1.135127000	1.051891000	-1.488841000
C	0.247593000	0.769944000	-2.670411000
C	2.344655000	0.403178000	-1.235727000
P	-1.315287000	0.479841000	-0.524912000
C	-1.712878000	2.092231000	0.280525000
Rh	0.739277000	-0.502100000	0.040929000
C	-2.907371000	-0.445255000	-0.478512000
C	-3.018911000	-1.561105000	-1.322917000
C	-4.177463000	-2.333167000	-1.334869000
C	-5.245587000	-2.003974000	-0.499326000
C	-5.147609000	-0.894469000	0.337770000
C	-3.988175000	-0.118365000	0.348062000
C	-1.703079000	3.291685000	-0.442683000
C	-1.904901000	4.513731000	0.198817000

C	-2.115692000	4.555321000	1.575516000
C	-2.107738000	3.368551000	2.308853000
C	-1.898411000	2.147656000	1.671007000
N	-1.139292000	0.748809000	-2.185296000
C	0.181658000	1.827798000	-3.779579000
C	-1.201372000	1.573866000	-4.397056000
C	-2.096600000	1.190187000	-3.197783000
C	3.442834000	0.970275000	-0.424871000
C	-1.242490000	-1.567417000	2.261155000
C	-1.890147000	-1.226432000	3.451698000
C	-1.256608000	-0.420203000	4.395459000
C	0.036693000	0.048350000	4.135820000
C	0.684235000	-0.297216000	2.955394000
C	0.052397000	-1.101389000	1.979599000
C	4.707163000	0.360363000	-0.496088000
C	5.788532000	0.867477000	0.220607000
C	5.631624000	1.993344000	1.027685000
C	4.379653000	2.605801000	1.111774000
C	3.298067000	2.102335000	0.395666000
H	0.973615000	2.038828000	-1.050467000
H	0.524305000	-0.202263000	-3.109403000
H	2.648729000	-0.401256000	-1.902328000
H	-2.192770000	-1.812256000	-1.983607000
H	-4.247391000	-3.191405000	-1.998711000
H	-6.150671000	-2.606060000	-0.506344000
H	-5.979334000	-0.623617000	0.983590000
H	-3.935017000	0.752205000	0.994140000
H	-1.523969000	3.273203000	-1.513152000
H	-1.895554000	5.434129000	-0.380231000
H	-2.273241000	5.507212000	2.076371000
H	-2.250959000	3.391250000	3.386382000
H	-1.861973000	1.237720000	2.264043000
H	0.999964000	1.734559000	-4.500347000
H	0.231715000	2.831055000	-3.336262000
H	-1.594013000	2.435468000	-4.946503000
H	-1.143890000	0.735997000	-5.102099000
H	-2.805230000	0.393292000	-3.459540000
H	-2.691234000	2.042311000	-2.843627000
H	-1.766867000	-2.183753000	1.536435000
H	-2.898707000	-1.591618000	3.633177000
H	-1.755654000	-0.167239000	5.327593000
H	0.546597000	0.673675000	4.865445000
H	1.702562000	0.045518000	2.780615000
H	4.822364000	-0.528923000	-1.111363000

H	6.757612000	0.379564000	0.146751000
H	6.474796000	2.391083000	1.586972000
H	4.244491000	3.483359000	1.739873000
H	2.331084000	2.590063000	0.485230000
C	0.499158000	-3.745170000	1.026014000
C	1.284354000	-2.480096000	1.311223000
C	2.220039000	-2.034711000	0.296445000
C	2.318774000	-2.735967000	-0.995380000
C	1.267931000	-3.783929000	-1.349393000
C	0.052178000	-3.815402000	-0.427197000
H	-0.342592000	-3.846408000	1.717537000
H	1.178908000	-4.585512000	1.240462000
H	1.714357000	-2.479464000	2.309771000
H	3.157049000	-1.591609000	0.630764000
O	3.255866000	-2.545034000	-1.771243000
H	0.988217000	-3.638726000	-2.399251000
H	1.791525000	-4.751212000	-1.309773000
H	-0.541294000	-4.720461000	-0.608342000
H	-0.593386000	-2.951518000	-0.635660000

E, -1975.206664

C	-0.955650000	1.223631000	1.381680000
C	-0.094232000	0.782905000	2.532490000
C	-2.235376000	0.755161000	1.096572000
P	1.395476000	0.460775000	0.316254000
C	1.954610000	2.102913000	-0.330547000
Rh	-0.766602000	-0.411204000	-0.133942000
C	2.895086000	-0.601346000	0.178801000
C	2.837779000	-1.844493000	0.828156000
C	3.916753000	-2.721665000	0.784151000
C	5.072898000	-2.373717000	0.082729000
C	5.142692000	-1.139651000	-0.558902000
C	4.063000000	-0.255845000	-0.508382000
C	1.955717000	3.238685000	0.489650000
C	2.285226000	4.493915000	-0.022260000
C	2.619235000	4.636934000	-1.366874000
C	2.609908000	3.516930000	-2.198653000
C	2.273221000	2.265375000	-1.687825000
N	1.269964000	0.607823000	2.003046000
C	0.127939000	1.769163000	3.686977000
C	1.485622000	1.319770000	4.245600000
C	2.298397000	0.906749000	2.999482000
C	-3.209718000	1.462776000	0.242273000
C	0.687849000	-2.526035000	-2.012061000
C	1.607864000	-1.898542000	-2.830905000

C	1.270712000	-0.698285000	-3.483051000
C	0.033922000	-0.116965000	-3.272383000
C	-0.913060000	-0.741032000	-2.427601000
C	-0.610810000	-1.990825000	-1.813210000
C	-4.557945000	1.072713000	0.312269000
C	-5.529964000	1.718559000	-0.448333000
C	-5.176064000	2.765025000	-1.298804000
C	-3.838366000	3.157473000	-1.383118000
C	-2.865802000	2.515154000	-0.623748000
H	-0.648598000	2.177443000	0.949204000
H	-0.480605000	-0.164604000	2.939980000
H	-2.674520000	0.007539000	1.753007000
H	1.940258000	-2.114113000	1.379229000
H	3.856330000	-3.678559000	1.296966000
H	5.916002000	-3.058964000	0.044472000
H	6.044162000	-0.854223000	-1.095755000
H	4.144037000	0.710721000	-0.995540000
H	1.689798000	3.144219000	1.537590000
H	2.280091000	5.360674000	0.634260000
H	2.877722000	5.614084000	-1.766671000
H	2.857800000	3.618915000	-3.252556000
H	2.241149000	1.407343000	-2.351867000
H	-0.676950000	1.733753000	4.427622000
H	0.183551000	2.794230000	3.297669000
H	1.991276000	2.094347000	4.831179000
H	1.344804000	0.452890000	4.902193000
H	2.931830000	0.032577000	3.198123000
H	2.961415000	1.714776000	2.661818000
H	0.957519000	-3.466359000	-1.541612000
H	2.590471000	-2.338577000	-2.976330000
H	1.983705000	-0.235318000	-4.162264000
H	-0.238266000	0.803052000	-3.783344000
H	-1.943623000	-0.394401000	-2.467198000
H	-4.826359000	0.246875000	0.967034000
H	-6.567772000	1.402005000	-0.375092000
H	-5.933299000	3.270671000	-1.892896000
H	-3.551268000	3.970347000	-2.046344000
H	-1.828219000	2.825128000	-0.716829000
C	-1.432894000	-4.154008000	-0.671376000
C	-1.793352000	-2.773074000	-1.226818000
C	-2.413928000	-1.833870000	-0.181564000
C	-2.626137000	-2.345456000	1.181282000
C	-1.768891000	-3.497916000	1.700911000
C	-0.764038000	-4.053988000	0.697028000

H	-0.809918000	-4.700949000	-1.390518000
H	-2.360129000	-4.735480000	-0.568185000
H	-2.507300000	-2.929423000	-2.050115000
H	-3.303690000	-1.305928000	-0.530095000
O	-3.478750000	-1.877788000	1.943816000
H	-1.284831000	-3.161051000	2.626287000
H	-2.475518000	-4.282969000	2.004202000
H	-0.396098000	-5.033754000	1.028039000
H	0.107000000	-3.389484000	0.634252000

D, -1975.198152

C	0.705968000	1.963495000	-0.859300000
C	-0.262290000	2.084576000	-2.001493000
C	1.994597000	1.474312000	-0.975475000
P	-1.538734000	0.412163000	-0.319846000
C	-2.258962000	1.225659000	1.166802000
Rh	0.604109000	-0.307493000	-0.295826000
C	-2.840029000	-0.762162000	-0.879308000
C	-2.530231000	-1.566669000	-1.986892000
C	-3.471232000	-2.448458000	-2.510524000
C	-4.737626000	-2.542845000	-1.930404000
C	-5.056786000	-1.744120000	-0.834768000
C	-4.115659000	-0.855274000	-0.312683000
C	-2.372095000	2.622199000	1.208584000
C	-2.825060000	3.268700000	2.357919000
C	-3.170378000	2.527725000	3.486308000
C	-3.051573000	1.138067000	3.460115000
C	-2.595366000	0.489156000	2.314669000
N	-1.560011000	1.572839000	-1.551334000
C	-0.630940000	3.496026000	-2.476797000
C	-2.007663000	3.274686000	-3.120401000
C	-2.685785000	2.211407000	-2.228577000
C	3.026739000	1.663090000	0.064574000
C	-0.956653000	-2.531567000	1.273688000
C	-1.227543000	-3.234186000	2.452377000
C	-0.588839000	-2.891348000	3.642640000
C	0.327525000	-1.838728000	3.639367000
C	0.590882000	-1.133020000	2.463590000
C	-0.044514000	-1.467669000	1.254907000
C	4.384274000	1.544362000	-0.279949000
C	5.382944000	1.759144000	0.667742000
C	5.051232000	2.096998000	1.978536000
C	3.706768000	2.215739000	2.335854000
C	2.707093000	2.002738000	1.392541000
H	0.436015000	2.543111000	0.023486000

H	0.118050000	1.505299000	-2.860047000
H	2.363216000	1.169197000	-1.953107000
H	-1.541788000	-1.492966000	-2.435178000
H	-3.216096000	-3.065431000	-3.368593000
H	-5.471974000	-3.235543000	-2.333736000
H	-6.043369000	-1.807971000	-0.382412000
H	-4.379830000	-0.232369000	0.536486000
H	-2.099080000	3.206353000	0.334500000
H	-2.909116000	4.352792000	2.368613000
H	-3.524958000	3.029680000	4.383034000
H	-3.306948000	0.551847000	4.339281000
H	-2.489513000	-0.591576000	2.319746000
H	0.107989000	3.912941000	-3.168015000
H	-0.707643000	4.168936000	-1.612872000
H	-2.601185000	4.191357000	-3.195055000
H	-1.881641000	2.882632000	-4.136602000
H	-3.266058000	1.492852000	-2.822178000
H	-3.373806000	2.667274000	-1.503454000
H	-1.469522000	-2.825034000	0.361067000
H	-1.940561000	-4.056600000	2.433328000
H	-0.796764000	-3.438309000	4.559098000
H	0.838805000	-1.557577000	4.558180000
H	1.307109000	-0.314091000	2.491114000
H	4.648988000	1.269853000	-1.297069000
H	6.426158000	1.663878000	0.376366000
H	5.831121000	2.266981000	2.716534000
H	3.435032000	2.476028000	3.356082000
H	1.666387000	2.087594000	1.694057000
C	2.042431000	-3.270920000	-0.081248000
C	1.206595000	-2.396701000	-1.003068000
C	1.822257000	-1.470628000	-1.850694000
C	3.277375000	-1.273931000	-1.885030000
C	4.107188000	-2.085716000	-0.905312000
C	3.466813000	-3.444200000	-0.615953000
H	1.554303000	-4.246031000	0.028895000
H	2.085852000	-2.845809000	0.928431000
H	0.234005000	-2.786567000	-1.292255000
H	1.300861000	-1.092808000	-2.729914000
O	3.802580000	-0.509931000	-2.693740000
H	5.115596000	-2.178506000	-1.322378000
H	4.198655000	-1.504933000	0.025255000
H	4.073380000	-4.005075000	0.106042000
H	3.445132000	-4.036722000	-1.541600000

TS(D-F), -1975.173234, Imaginary frequency = 292.49*i*

C	0.609471000	2.011742000	-0.635328000
C	-0.380962000	2.333844000	-1.719606000
C	1.920111000	1.565131000	-0.841330000
P	-1.624673000	0.473849000	-0.248994000
C	-2.381219000	1.003034000	1.341258000
Rh	0.611378000	-0.171296000	-0.379473000
C	-2.880872000	-0.650824000	-0.991973000
C	-2.519097000	-1.295037000	-2.185659000
C	-3.424191000	-2.114264000	-2.854704000
C	-4.706122000	-2.307585000	-2.336144000
C	-5.075766000	-1.670956000	-1.153453000
C	-4.170757000	-0.844087000	-0.485797000
C	-2.563796000	2.360771000	1.633601000
C	-3.027495000	2.762709000	2.885896000
C	-3.309201000	1.812876000	3.865958000
C	-3.112429000	0.458927000	3.590568000
C	-2.645836000	0.055256000	2.341977000
N	-1.678111000	1.818301000	-1.273739000
C	-0.715481000	3.805947000	-1.988777000
C	-2.121210000	3.713820000	-2.604133000
C	-2.801873000	2.543910000	-1.855362000
C	2.973366000	1.723994000	0.187383000
C	-0.848710000	-2.871998000	0.608512000
C	-1.406500000	-3.483219000	1.732475000
C	-0.877875000	-3.241639000	2.999814000
C	0.217067000	-2.381750000	3.129666000
C	0.781782000	-1.787305000	2.005881000
C	0.247125000	-1.998677000	0.716883000
C	4.319519000	1.817939000	-0.204232000
C	5.328730000	2.004846000	0.739323000
C	5.019826000	2.102380000	2.094743000
C	3.686663000	2.007923000	2.499199000
C	2.677447000	1.822045000	1.560170000
H	0.381399000	2.496480000	0.316127000
H	-0.060087000	1.855004000	-2.660224000
H	2.280296000	1.409259000	-1.856728000
H	-1.516214000	-1.146330000	-2.582977000
H	-3.129063000	-2.605849000	-3.778585000
H	-5.412978000	-2.950882000	-2.854258000
H	-6.074546000	-1.812466000	-0.747518000
H	-4.473989000	-0.347642000	0.431390000
H	-2.331104000	3.105323000	0.877649000
H	-3.167929000	3.820693000	3.094531000
H	-3.670989000	2.125361000	4.842341000

H	-3.313804000	-0.288016000	4.354604000
H	-2.472932000	-1.000629000	2.149931000
H	0.011185000	4.291847000	-2.647397000
H	-0.739637000	4.356725000	-1.039508000
H	-2.689202000	4.645824000	-2.520358000
H	-2.041240000	3.475251000	-3.671263000
H	-3.389237000	1.913629000	-2.537219000
H	-3.485262000	2.900111000	-1.072893000
H	-1.275219000	-3.080431000	-0.369907000
H	-2.254223000	-4.154237000	1.611834000
H	-1.302489000	-3.726293000	3.875459000
H	0.639452000	-2.182040000	4.111980000
H	1.644192000	-1.133596000	2.125691000
H	4.570832000	1.730832000	-1.257085000
H	6.362367000	2.077046000	0.409000000
H	5.807350000	2.249979000	2.829557000
H	3.431107000	2.078262000	3.554074000
H	1.647588000	1.728786000	1.895593000
C	2.547320000	-3.174962000	0.033582000
C	1.490023000	-2.379056000	-0.742337000
C	1.973433000	-1.300900000	-1.585542000
C	3.406811000	-1.025377000	-1.777804000
C	4.400795000	-1.849229000	-0.977460000
C	3.864069000	-3.261369000	-0.738157000
H	2.144270000	-4.166617000	0.268491000
H	2.762474000	-2.696635000	0.992737000
H	0.767277000	-3.012886000	-1.253522000
H	1.417825000	-1.109995000	-2.508165000
O	3.792438000	-0.220702000	-2.623356000
H	5.349457000	-1.842714000	-1.523774000
H	4.577157000	-1.347090000	-0.014324000
H	4.586082000	-3.857328000	-0.165904000
H	3.720206000	-3.773763000	-1.699710000

F, -1975.204948

C	-0.532165000	-1.777549000	-0.997025000
C	0.459076000	-1.772792000	-2.125988000
C	-1.854497000	-1.343348000	-1.071277000
P	1.701810000	-0.314548000	-0.235262000
C	2.650120000	-1.196229000	1.076861000
Rh	-0.582736000	0.277363000	-0.169430000
C	2.840780000	1.040870000	-0.761525000
C	2.284365000	2.111855000	-1.475065000
C	3.095181000	3.107000000	-2.015218000
C	4.479172000	3.047293000	-1.849756000

C	5.045837000	1.981816000	-1.152740000
C	4.233638000	0.981794000	-0.617159000
C	2.584528000	-2.595536000	1.139619000
C	3.188329000	-3.294465000	2.182998000
C	3.869433000	-2.605597000	3.185778000
C	3.941514000	-1.213893000	3.136146000
C	3.335538000	-0.514730000	2.093628000
N	1.747976000	-1.375190000	-1.556197000
C	0.809093000	-3.121651000	-2.768836000
C	2.222043000	-2.868735000	-3.315134000
C	2.884819000	-1.959573000	-2.257643000
C	-2.898200000	-1.844451000	-0.149206000
C	0.330336000	3.196372000	1.127160000
C	1.278471000	2.997994000	2.111864000
C	1.144590000	1.919025000	3.007516000
C	0.079850000	1.046929000	2.892698000
C	-0.902204000	1.239237000	1.890753000
C	-0.794358000	2.344990000	1.001591000
C	-4.223926000	-1.948193000	-0.602197000
C	-5.221568000	-2.472907000	0.218518000
C	-4.919919000	-2.903963000	1.508684000
C	-3.607259000	-2.800426000	1.974614000
C	-2.610296000	-2.277142000	1.158099000
H	-0.272497000	-2.479237000	-0.202092000
H	0.125814000	-1.072802000	-2.910435000
H	-2.219822000	-0.908781000	-1.999932000
H	1.205205000	2.154338000	-1.603941000
H	2.646374000	3.930996000	-2.564686000
H	5.113385000	3.825340000	-2.267462000
H	6.124457000	1.922989000	-1.028241000
H	4.690627000	0.152501000	-0.084471000
H	2.059034000	-3.138122000	0.358141000
H	3.129745000	-4.379917000	2.209601000
H	4.343355000	-3.149560000	3.998888000
H	4.474586000	-0.668216000	3.911224000
H	3.400980000	0.568534000	2.067467000
H	0.092985000	-3.418653000	-3.541203000
H	0.825117000	-3.903879000	-1.998417000
H	2.790066000	-3.788848000	-3.486000000
H	2.158658000	-2.339555000	-4.273386000
H	3.521228000	-1.192961000	-2.720290000
H	3.514922000	-2.534711000	-1.563916000
H	0.416347000	4.048745000	0.456140000
H	2.118257000	3.681750000	2.204209000

H	1.875852000	1.779302000	3.799735000
H	-0.032684000	0.223422000	3.592887000
H	-1.841901000	0.697117000	1.981452000
H	-4.466913000	-1.602006000	-1.602607000
H	-6.239704000	-2.545555000	-0.156683000
H	-5.697895000	-3.314049000	2.147835000
H	-3.360430000	-3.126223000	2.982600000
H	-1.597628000	-2.178159000	1.541522000
C	-3.236436000	3.021482000	0.968303000
C	-1.985021000	2.725087000	0.121983000
C	-2.143936000	1.602088000	-0.898810000
C	-3.491137000	1.233377000	-1.362227000
C	-4.683992000	1.619677000	-0.501439000
C	-4.507117000	3.004430000	0.125217000
H	-3.103243000	3.985205000	1.476666000
H	-3.341348000	2.266927000	1.758702000
H	-1.722158000	3.653922000	-0.408869000
H	-1.518790000	1.764645000	-1.789383000
O	-3.677948000	0.655240000	-2.435692000
H	-5.578344000	1.554113000	-1.129306000
H	-4.789885000	0.867183000	0.294495000
H	-5.378205000	3.257936000	0.742549000
H	-4.449917000	3.766735000	-0.665295000

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