Nickel-Catalyzed Asymmetric Reductive Cross-Coupling Between Vinyl and Benzyl Electrophiles

Alan H. Cherney and Sarah E. Reisman*

The Warren and Katharine Schlinger Laboratory of Chemistry and Chemical Engineering
Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, California 91125
reisman@caltech.edu

Supporting Information 1 (Experimental Procedures):

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1. Materials and Methods

Unless otherwise stated, reactions were performed under a nitrogen atmosphere using freshly dried solvents. Tetrahydrofuran (THF), methylene chloride (CH_2Cl_2), and diethyl ether (Et_2O), were dried by passing through activated alumina columns. Anhydrous dimethylacetamide (DMA) was purchased from Aldrich and stored under inert atmosphere. Manganese powder (– 325 mesh, 99.3%) was purchased from Alfa Aesar. $NiCl_2$(dme) was purchased from Strem and stored in a glovebox under N_2 when not in use. Unless otherwise stated, chemicals and reagents were used as received. Triethylamine (Et_3N) was distilled over calcium hydride prior to use. All reactions were monitored by thin-layer chromatography using EMD/Merck silica gel 60 F254 pre-coated plates (0.25 mm) and were visualized by UV, CAM, or $KMnO_4$ staining. Flash column chromatography was performed as described by Still et al.[1] using silica gel (partical size 0.032-0.063) purchased from Silicycle. Optical rotations were measured on a Jasco P-2000 polarimeter using a 100 mm path-length cell at 589 nm. ^1H and ^{13}C NMR spectra were recorded on a Varian Inova 500 (at 500 MHz and 126 MHz, respectively), and are reported relative to internal $CHCl_3$ (^1H, δ = 7.26) and $CDCl_3$ (^{13}C, δ = 77.0). Data for ^1H NMR spectra are reported as follows: chemical shift (δ ppm) (multiplicity, coupling constant (Hz), integration). Multiplicity and qualifier abbreviations are as follows: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad, app = apparent. IR spectra were recorded on a Perkin Elmer Paragon 1000 spectrometer and are reported in frequency of absorption (cm^{-1}). HRMS were acquired using an Agilent 6200 Series TOF with an Agilent G1978A Multimode source in electrospray ionization (ESI), atmospheric pressure chemical ionization (APCI), or mixed (MM) ionization mode. Analytical SFC was performed with a Mettler SFC supercritical CO_2 analytical chromatography system with Chiralcel AD-H, OD-H, AS-H, OB-H, and OJ-H columns (4.6 mm x 25 cm) with visualization at 254 nm. Analytical achiral GC-MS was performed with an Agilent 7890A GC and an Agilent 5975C VL MSD with triple axis detector utilizing an Agilent HP-5MS (30.0 m x 0.25 mm) column (0.4 mL/min He carrier gas flow). Analytical chiral HPLC was performed with an Agilent 1100 Series HPLC utilizing Chiralpak AD or Chiralcel OD-H columns (4.6 mm x 25 cm) obtained from Daicel Chemical Industries, Ltd with visualization at 254 nm.

Abbreviations used: DMA – dimethylacetamide; dme – dimethoxyethane; IPA – isopropanol; ee – enantiomeric excess; dr – diastereomeric ratio; SFC – supercritical fluid chromatography; TDAE – tetrakis(dimethylamino)ethylene

[1] Still, W. C.; Kahn, M.; Mitra, A. *J. Org. Chem*. **1978**, *43*, 2923.

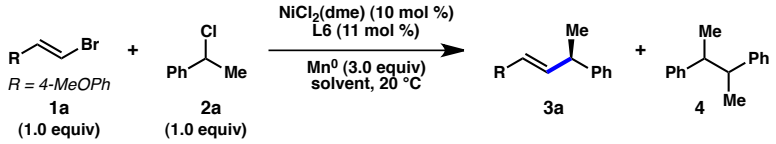
2. Optimization of Reaction Parameters

A. General Procedure 1 (Table 1)

On a bench-top, to a 1/2 dram vial was added the appropriate ligand (0.022 mmol, 11 mol %), reductant (0.6 mmol, 3 equiv), $NiCl_2$(dme) (0.02 mmol, 10 mol %), vinyl bromide (**1a**, 0.2 mmol, 1.0 equiv), and NaI (0.1 mmol, 0.5 equiv) if necessary. The vial was transferred into an N_2-filled glovebox and charged with the appropriate solvent (0.2 mL, 1.0 M) followed by benzyl chloride and dodecane (internal standard). The vial was sealed and removed from the glovebox. The mixture was stirred vigorously, ensuring that the reductant was uniformly suspended, at 20 °C for 6 h. The dark mixture was diluted with 10% ethyl acetate/hexane and passed through a plug of silica, using 10% ethyl acetate/hexane eluent. The solution was concentrated to afford a clear oil. The crude residue was analyzed by GC-MS.

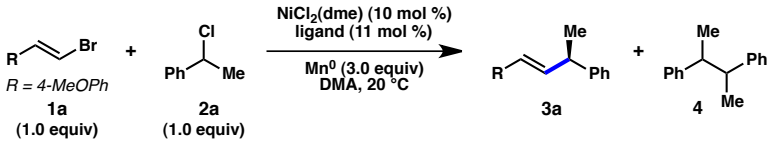
Dodecane was used as an internal standard. GC samples were analyzed by flame ionization detection and yields calculated based on a calibrated response factor.

B. Solvent Screen

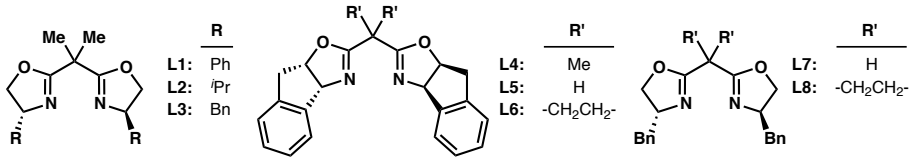


entry	solvent	yield **4** (%)	yield **3a** (%)	ee **3a** (%)
1	**DMA**	**20**	**56**	**87**
2	NMP	20	40	85
3	DMPU	19	40	89
4	THF	27	18	74

C. Expanded Ligand Screen

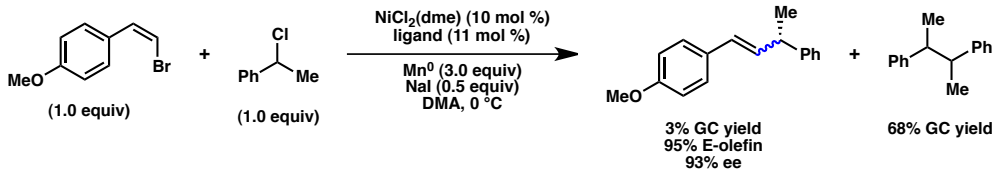


entry	solvent	yield **4** (%)	yield **3a** (%)	ee **3a** (%)
1	L1	48	50	40
2	L2	33	21	57
3	L3	38	25	68
4	L4	35	26	70
5	L5	21	33	49
6	**L6**	**20**	**56**	**87**
7	L7	26	20	27
8	L8	21	56	78

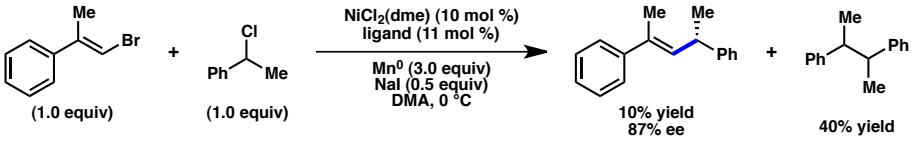


3. Additional Substrate Scope

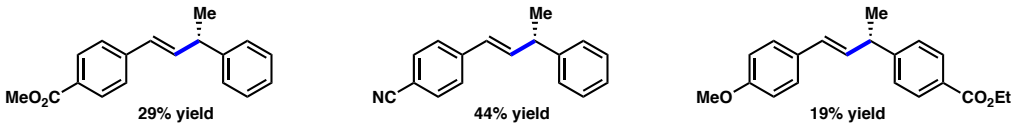
a) *Z*-Vinyl Bromide



b) Trisubstituted Olefin

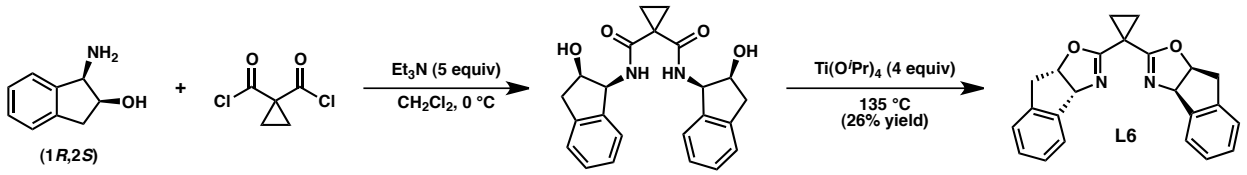


c) Challenging Functional Groups



Reactions were run according to General Procedure 5 (see page 14).

4. Ligand Preparation



To a flame-dried flask was added (1*R*,2*S*)-(+)-*cis*-1-amino-2-indanol (38 mmol, 2.1 equiv) and CH_2Cl_2 (70 mL). The reaction was cooled to 0 °C and freshly-distilled Et_3N (90 mmol, 5 equiv) was added dropwise. Cyclopropane-1,1-dicarbonyl dichloride[2] (18 mmol) was added dropwise and the solution was warmed to room temperature and stirred at 23 °C under N_2 for 6 h. A white precipitate slowly formed over the course of the reaction. The mixture was quenched with 1 M HCl and a white precipitate formed. The mixture was filtered and the white solid was collected and washed several times with an excess of water. The bis-amide product was dried under vacuum and used in the next step without any further purification.

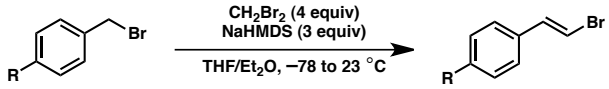
According to procedure by Kurosu and coworkers,[3] to a flame-dried flask was added crude bis-amide (3.6 mmol, 1 equiv) and anhydrous $Ti(O^iPr)_4$ (14.4 mmol, 4 equiv). The mixture was equipped with a distillation head and stirred at 135 °C under N_2 for 10 h. The reaction became a brown solution at high temperatures and isopropanol was observed to have been distilled from the solution. The reaction was cooled to 23 °C and 3-(dimethylamino)-1,2-propanediol (4.8 equiv) was added. The reaction was heated with a heat gun until the solution became homogeneous and was then stirred for 30 min. EtOAc (8 mL) and water (8 mL) were added and the reaction was stirred for 1 h. The organic layer was separated and the aqueous layer was extracted with EtOAc. The combined organic layers were dried (Na_2SO_4), filtered, and concentrated. The crude residue was purified by flash chromatography (2% methanol/dichloromethane) to isolate a light brown solid. The material was recrystallized from isopropanol to provide a white solid (1.15 g, 26% yield). $[\alpha]_D^{25} = +274.5°$ (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.49 – 7.42 (m, 2H), 7.30 – 7.20 (m, 6H), 5.53 (dd, *J* = 7.9, 0.8 Hz, 2H), 5.34 (ddd, *J* = 7.9, 7.0, 1.9 Hz, 2H), 3.44 – 3.35 (m, 2H), 3.20 (dd, *J* = 17.9, 1.8 Hz, 2H), 1.41 – 1.23 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 165.8, 141.8, 139.7, 128.3, 127.3, 125.6, 125.1, 83.3, 76.4, 39.6, 18.3, 15.7; FTIR (NaCl, thin film): 3246, 3023, 2917, 1654, 1534, 1479, 1459, 1426, 1364, 1302, 1247, 1159, 1115, 1001, 754, 733 cm^{-1}; HRMS (MM) calc'd for $C_{23}H_{20}N_2O_2$ $[M+Na]^+$ 379.1417, found 379.1438.

[2] Ginotra, S. K.; Singh, V. K.; *Org. Biomol. Chem.* **2007**, *5*, 3932.
[3] Kurosu, M.; Porter, J. R.; Foley, M. A. *Tetrahedron Lett.* **2004**, *45*, 145.

5. Substrate Preparation

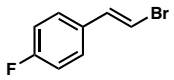
Vinyl bromides **1a**[4] and **1g**[5] and benzyl chloride **2m**[6] and **2n**[7] were prepared according to literature precedent.

A. General Procedure 2: Vinyl Bromide Synthesis from Benzyl Bromides



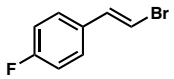
According to a protocol by Charette and coworkers,[8] to a flame-dried flask under N_2 was added NaHMDS (9 mmol, 3 equiv, 1 M in THF) and Et_2O (6 mL). The flask was cooled to –78 °C and wrapped in aluminum foil. To the solution was added freshly-distilled dibromomethane (12 mmol, 4 equiv) dropwise. The solution was stirred at –78 °C for 20 min and then benzyl bromide in 2 mL THF was added dropwise. The solution was stirred at –78 °C for an additional 3 h and then slowly warmed to room temperature and stirred in the dark at 23 °C for 21 h. The mixture was filtered through a pad of celite and silica and concentrated. The crude material was purified by flash chromatography.

(*E*)-1-(2-bromovinyl)-4-fluorobenzene (1b)



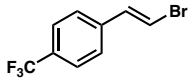
Prepared from 1-(bromomethyl)-4-(fluoromethyl)benzene (3.0 mmol) according to General Procedure 2. The crude residue was purified by silica gel chromatography (hexanes) to yield **1b** (419.2 mg, 70% yield) as a white solid. Spectral data matched those reported in the literature.

(*E*)-1-(2-bromovinyl)-4-chlorobenzene (1c)



Prepared from 1-(bromomethyl)-4-(chloromethyl)benzene (3.0 mmol) according to General Procedure 2. The crude residue was purified by silica gel chromatography (hexanes) to yield **1c** (496.2 mg, 76% yield) as a white solid. Spectral data matched those reported in the literature.

(*E*)-1-(2-bromovinyl)-4-(trifluoromethyl)benzene (1d)

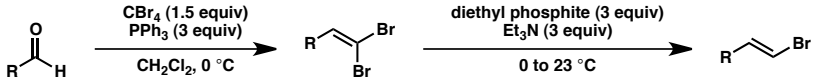


Prepared from 1-(bromomethyl)-4-(trifluoromethyl)benzene (3.0 mmol) according to General Procedure 2. The crude residue was purified by silica gel chromatography (1 to 2% ethyl

[4] Robiette, R.; Pospíšil, J. *Eur. J. Org. Chem.* **2013**, 836.
[5] Akiyama, S.; Nakatsuji, S.; Yoshida, K.; Nakashima, K.; Hagiwara, T.; Tsuruta, H.; Yoshida, T. *Bull. Chem. Soc. Jpn.* **1983**, *56*, 361.
[6] Yoshida, K.; Horikoshi, Y.; Eta, M.; Chikazawa, J.; Ogishima, M.; Fukuda, Y.; Sato, H. *Bioorg. Med. Chem. Lett.* **1998**, *8*, 2967.
[7] Ayala, C. E.; Villalpando, A.; Nguyen, A. L.; McCandless, G. T.; Kartika, R. *Org. Lett.* **2012**, *14*, 3676.
[8] Bull, J. A.; Mousseau, J. J.; Charette, A. B. *Org. Lett.* **2008**, *10*, 5485.

acetate/hexanes) to yield **1d** (138.4 mg, 18% yield) as a clear oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.60 (d, J = 7.7 Hz, 2H), 7.41 (d, J = 8.1 Hz, 2H), 7.15 (d, J = 14.1 Hz, 1H), 6.92 (d, J = 14.0 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 139.2, 135.9, 130.1 (q, J = 33 Hz), 126.3, 125.8 (q, J = 4 Hz), 124.0 (q, J = 276 Hz), 109.4; FTIR (NaCl, thin film): 3074, 1617, 1604, 1574, 1411, 1326, 1166, 1127, 1068, 1017, 935, 848, 785, 739, 724 cm^{-1}; HRMS (MM) calc'd for $C_9H_6BrF_3$ $[M]^+$ 249.9605, found 249.9569.

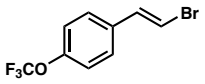
B. General Procedure 3: Vinyl Bromide Synthesis from Aldehydes



According to a modified synthetic sequence by Alexakis and coworkers,[9] to a flame-dried flask under N_2 was added aldehyde (10 mmol, 1 equiv), CBr_4 (15 mmol, 3 equiv), and CH_2Cl_2 (80 mL). The flask was cooled to 0 °C. A solution of PPh_3 in CH_2Cl_2 (70 mL) was added to the reaction dropwise via addition funnel over 30 min. The solution was stirred at 0 °C under N_2 for 1 h. The solution was concentrated to remove CH_2Cl_2 and $CHCl_3$ was added. The resulting mixture was filtered and washed with $CHCl_3$ (2 x 20 mL). The filtrate was concentrated to give a thick orange oil. The crude material was purified by flash chromatography to isolate the dibromoalkene.

To a vial containing dibromoalkene was added diethyl phosphite (3 equiv). Additional DMF was added to dissolve solid substrates. The solution was cooled to 0 °C and Et_3N (3 equiv) was added dropwise. The reaction was warmed to 23 °C and stirred overnight. The mixture was diluted with water. The aqueous layer was extracted with CH_2Cl_2 and the combined organic layers were washed with brine and dried (Na_2SO_4), filtered, and concentrated. The crude material was purified by flash chromatography.

(*E*)-1-(2-bromovinyl)-4-(trifluoromethoxy)benzene (1e)



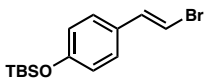
Prepared from 4-(trifluoromethoxy)benzaldehyde (10.0 mmol) according to General Procedure 3. The crude residue was purified by silica gel chromatography (hexanes) to yield **1e** (2.07 g, 72% yield, 94% E olefin) as a pale yellow oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38 – 7.24 (m, 2H), 7.24 – 7.16 (m, 2H), 7.10 (d, J = 14.0 Hz, 1H), 6.79 (d, J = 14.0 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 148.9 (q, J = 2 Hz), 135.7, 134.6, 127.4, 121.2, 120.40 (q, J = 257 Hz), 107.5; FTIR (NaCl, thin film): 3073, 2430, 1895, 1607, 1507, 1411, 1261, 1215, 1162, 1104, 1017, 948, 931, 841, 778, 745, 713 cm^{-1}; HRMS (MM) calc'd for $C_9H_6BrF_3O$ $[M+H_3O]^+$ 284.9733, found 284.9819.

According to Alexakis and coworkers,[9] to a vial containing vinyl bromide **1e** (6 mmol) was added NaOH (0.85 equiv) and IPA (0.5 M). The mixture was stirred at 75 °C for 2 h. The reaction was cooled to room

[9] Müller, D.; Alexakis, A. *Chem. Eur. J.* **2013**, *19*, 15226.

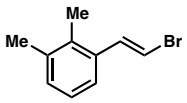
temperature and diluted with pentane and water. The organic layer was washed with water and 1 M HCl. The organic layer was then dried (Na_2SO_4), filtered, and concentrated to isolate geometrically pure product (1.44 g, 82% yield).

(*E*)-(4-(2-bromovinyl)phenoxy)(*tert*-butyl)dimethylsilane (1f)



Prepared from 4-((*tert*-butyldimethylsilyl)oxy)benzaldehyde (18.0 mmol) according to General Procedure 3. The crude residue was purified by silica gel chromatography (hexanes) to yield **1f** (3.66 g, 66% yield, 88% E olefin) as a pale yellow oil. Spectral data matched those reported in the literature.

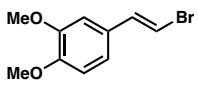
(*E*)-1-(2-bromovinyl)-2,3-dimethylbenzene (1h)



Prepared from 2,3-dimethylbenzaldehyde (10.0 mmol) according to General Procedure 3. The crude residue was purified by silica gel chromatography (hexanes) to yield **1h** (1.73 g, 82% yield, 88% E olefin) as a clear oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.47 – 7.37 (m, 1H), 7.23 – 7.05 (m, 3H), 6.64 – 6.57 (m, 1H), 2.35 (s, 3H), 2.28 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 137.1, 136.5, 135.5, 133.8, 130.0, 125.8, 124.3, 107.2, 20.6, 15.6; FTIR (NaCl, thin film): 3068, 2942, 2864, 1725, 1607, 1587, 1456, 1383, 1248, 1203, 1181, 1168, 1092, 938, 784, 757, 707, 668 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{18}O$ $[M]^+$ 210.0044, found 209.9930.

According to Alexakis and coworkers,[9] to a vial containing vinyl bromide **1h** (6 mmol) was added NaOH (0.85 equiv) and IPA (0.5 M). The mixture was stirred at 75 °C for 2 h. The reaction was cooled to room temperature and diluted with pentane and water. The organic layer was washed with water and 1 M HCl. The organic layer was then dried (Na_2SO_4), filtered, and concentrated to isolate geometrically pure product (1.03 g, 81% yield).

(*E*)-4-(2-bromovinyl)-1,2-dimethoxybenzene (1i)

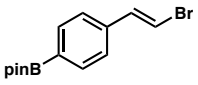


Prepared from 3,4-dimethoxybenzaldehyde (10.0 mmol) according to General Procedure 3. The crude residue was purified by silica gel chromatography (0 to 5% ethyl acetate/hexanes) to yield **1i** (2.02 g, 83% yield, 93% E olefin) as a white solid. Spectral data matched those reported in the literature.

According to Alexakis and coworkers,[9] to a vial containing vinyl bromide **1i** (6 mmol) was added NaOH (0.85 equiv) and IPA (0.5 M). The mixture was stirred at 75 °C for 2 h. The reaction was cooled to room temperature and diluted with Et_2O and water. The organic layer was washed with water and 1 M HCl. The organic

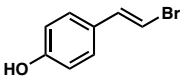
layer was then dried (Na_2SO_4), filtered, and concentrated to isolate geometrically pure product (1.35 g, 92% yield).

(*E*)-2-(4-(2-bromovinyl)phenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (1j)



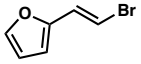
Prepared from 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzaldehyde (12.5 mmol) according to General Procedure 3. The crude residue was purified by silica gel chromatography (10 to 20% ethyl acetate/hexanes) to yield **1j** (2.55 g, 68% yield) as a low melting solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.78 (d, *J* = 7.7 Hz, 2H), 7.31 (d, *J* = 8.1 Hz, 2H), 7.12 (d, *J* = 14.5 Hz, 1H), 6.86 (d, *J* = 14.4 Hz, 1H), 1.36 (s, 12H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 138.4, 137.2, 135.2, 125.4, 107.7, 83.9, 24.9; FTIR (NaCl, thin film): 3073, 2978, 2931, 1729, 1607, 1516, 1468, 1401, 1361, 1324, 1269, 1214, 1144, 1090, 1019, 962, 937, 860, 782, 745, 727, 653 cm^{-1}; HRMS (MM) calc'd for $C_{14}H_{18}BBrO_2$ $[M+H]^+$ 334.2213, found 334.2030.

(*E*)-4-(2-bromovinyl)phenol (1k)



To a vial containing vinyl bromide **1f** (6 mmol, obtained from General Procedure 3) was added NaOH (0.85 equiv) and ^{i}PrOH. The mixture was stirred at 75 °C for 2 h. The reaction was cooled to room temperature and diluted with Et_2O and water. The organic layer was washed with water (2x) and 1 M HCl (2x). The organic layer was then dried ($MgSO_4$), filtered, and concentrated. The crude residue was purified by flash chromatography (10 to 20% ethyl acetate/hexanes) to yield **1k** (750.0 mg, 63% yield, 92% E olefin) as a white solid. Spectral data for **1k** matched that reported in the literature.

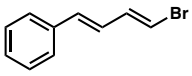
(*E*)-2-(2-bromovinyl)furan (1l)



Prepared from furfural (10.0 mmol) according to General Procedure 3. The crude residue was purified by silica gel chromatography (hexanes) to yield **1l** (745 mg, 49% yield, 71% E olefin) as a yellow oil. Spectral data matched those reported in the literature.

According to Alexakis and coworkers,[9] to a vial containing vinyl bromide **1l** (6 mmol) was added NaOH (0.85 equiv) and IPA (0.5 M). The mixture was stirred at 75 °C for 1 h. The reaction was cooled to room temperature and diluted with pentane and water. The organic layer was washed with water and 1 M HCl. The organic layer was then dried (Na_2SO_4), filtered, and concentrated to isolate geometrically pure product (54 mg, 8% yield).

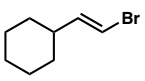
((1*E*,3*E*)-4-bromobuta-1,3-dien-1-yl)benzene (1m)



Prepared from cinnamaldehyde (10.0 mmol) according to General Procedure 3. The crude residue was purified by silica gel chromatography (hexanes) to yield **1m** (910 mg, 44% yield, 73% E olefin) as a white solid. Spectral data matched those reported in the literature.

According to Alexakis and coworkers,[9] to a vial containing vinyl bromide **1m** (4.3 mmol) was added NaOH (0.85 equiv) and IPA (0.5 M). The mixture was stirred at 75 °C for 1 h. The reaction was cooled to room temperature and diluted with pentane and water. The organic layer was washed with water and 1 M HCl. The organic layer was then dried (Na_2SO_4), filtered, and concentrated to isolate geometrically pure product (584 mg, 66% yield).

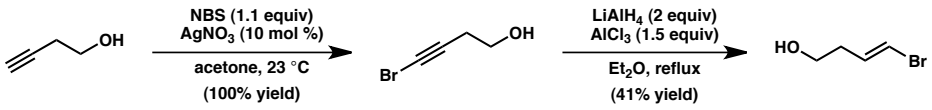
(*E*)-(2-bromovinyl)cyclohexane (1n)



Prepared from cycloexanecarboxaldehyde (10.0 mmol) according to General Procedure 3, except the debromination was performed at 80 °C for 12 h. The crude residue was purified by silica gel chromatography (hexanes) to yield **1n** (800 mg, 43% yield, 72% E olefin) as a clear oil. Spectral data matched those reported in the literature.

According to Alexakis and coworkers,[9] to a vial containing vinyl bromide **1n** (3.7 mmol) was added NaOH (0.85 equiv) and IPA (0.5 M). The mixture was stirred at 75 °C for 1 h. The reaction was cooled to room temperature and diluted with pentane and water. The organic layer was washed with water and 1 M HCl. The organic layer was then dried (Na_2SO_4), filtered, and concentrated to isolate geometrically pure product (480 mg, 61% yield).

(*E*)-4-bromobut-3-en-1-ol (1p)

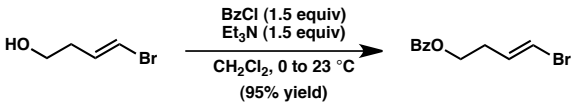


According to a procedure by Hofmeister and coworkers,[10] 3-butyn-1-ol (1 equiv, 15 mmol) was dissolved in acetone (50 mL). To the solution was added NBS (16.5 mmol, 1.1 equiv) and $AgNO_3$ (1.5 mmol, 10 mol %). The reaction was stirred at 23 °C for 2 h. The reaction was concentrated and diluted with Et_2O and water. The aqueous layer was extracted with Et_2O and the combined organic layers were dried ($MgSO_4$), filtered, and concentrated to give a clear oil (2.22 g, 100% yield).

[10] Hofmeister, H.; Annen, K.; Laurent, H.; Wiechert, R. *Angew. Chem., Int. Ed.* **1984**, *23*, 727.

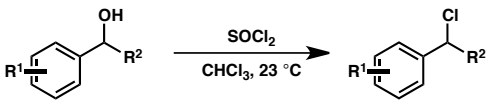
To a flame-dried flask was added $LiAlH_4$ (30 mmol, 2 equiv) and Et_2O (90 mL). The flask was equipped with a reflux condenser and cooled to –5 °C. $AlCl_3$ (22.5 mmol, 1.5 equiv) was carefully added to the reaction. The reaction was stirred for 10 min at –5 °C under N_2. Bromoalkyne (15 mmol, 1 equiv) was added dropwise and the reaction was stirred at reflux under N_2 for 2.5 h. The reaction was cooled to 0 °C and Et_2O (60 mL) was added, followed by 2 M HCl (60 mL) dropwise to quench the reaction. The aqueous layer was extracted with Et_2O (3 x 40 mL) and the combined organic layers were washed with brine, dried ($MgSO_4$), filtered, and concentrated. The crude material was purified by flash chromatography (15 to 30% ethyl acetate/hexanes) to isolate a clear oil (917.6 mg, 41% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.28 – 6.04 (m, 2H), 3.75 – 3.52 (m, 2H), 2.44 (s, 1H), 2.36 – 2.18 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 134.3, 106.6, 61.1, 36.1; FTIR (NaCl, thin film): 3338, 3065, 2935, 2880, 1622, 1427, 1227, 1168, 1046, 1002, 937, 710 cm^{-1}; HRMS (MM) calc'd for C_4H_7BrO $[M+OH]^+$ 166.9702, found 166.9662.

(*E*)-4-bromobut-3-en-1-yl benzoate (1o)



To a flame-dried flask was added alcohol **1p** (1.5 mmol, 1 equiv,) and CH_2Cl_2 (5 mL). The solution was cooled to 0 °C and Et_3N (2.25 mmol, 1.5 equiv) and BzCl (2.25 mmol, 1.5 equiv) were added. The solution was stirred at 23 °C under N_2 for 3 h. The reaction was quenched with sat. aqueous NH_4Cl and the aqueous layer was extracted with Et_2O. The combined organic layers were washed with brine, dried ($MgSO_4$), filtered, and concentrated. The crude oil was purified by flash chromatography (1% ethyl acetate/hexanes) to isolate a clear oil (363.8 mg, 95% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.09 – 8.01 (m, 2H), 7.61 – 7.53 (m, 1H), 7.45 (td, J = 7.7, 1.6 Hz, 2H), 6.32 – 6.18 (m, 2H), 4.36 (td, J = 6.6, 1.8 Hz, 2H), 2.52 (qd, J = 6.6, 2.2 Hz, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 166.3, 133.4, 133.1, 130.0, 129.6, 128.4, 107.1, 63.1, 32.4; FTIR (NaCl, thin film): 3064, 2957, 2898, 1717, 1622, 1602, 1492, 1451, 1382, 1314, 1273, 1176, 1116, 1070, 1026, 937, 710 cm^{-1}; HRMS (ESI) calc'd for $C_{11}H_{11}BrO_2$ $[M+H]^+$ 255.0015, found 254.9994.

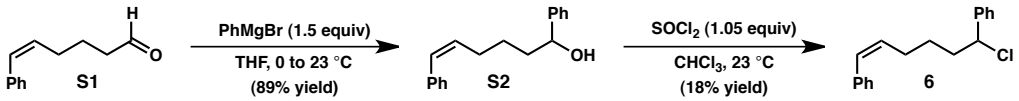
C. General Procedure 4: Benzyl Chloride Synthesis



A flask was charged with the appropriate benzyl alcohol (1.0 equiv) and $CHCl_3$ (1.5 M). Thionyl chloride (1.05 equiv) was added dropwise. Evolved gas was quenched via cannula by aqueous $NaHCO_3$. The solution was stirred at 23 °C for 12 h and then concentrated to afford a yellow oil. The crude residue was purified by Kugelrohr

distillation to isolate **2a**–**l**, **2o**, and **2p** as clear oils. Spectral data for all compounds matched those reported in the literature.

D. Preparation of Radical Clock Substrate 6



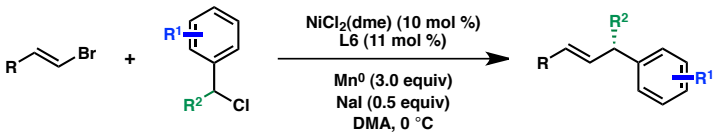
Aldehyde **S1** was prepared according to a known procedure from 5-hexyn-1-ol.[11] To a flame-dried flask was added PhMgBr (16 mmol, 1.5 equiv, 3 M in Et_2O) and THF (33 mL). The solution was cooled to 0 °C and aldehyde **S1** was added dropwise. The solution was slowly warmed to 23 °C and stirred under N_2 overnight. The reaction was quenched with sat. aqueous NH_4Cl and H_2O. The aqueous layer was extracted with Et_2O. The combined organic layers were washed with brine and dried ($MgSO_4$), filtered, and concentrated. The crude residue was purified by flash chromatography (10% ethyl acetate/hexanes) to isolate **S2** as a pale yellow oil (2.37 g, 89% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.49 – 7.11 (m, 10H), 6.46 (d, J = 11.4 Hz, 1H), 5.67 (dt, J = 11.7, 7.2 Hz, 1H), 4.66 (dd, J = 7.5, 5.8 Hz, 1H), 2.52 – 2.28 (m, 2H), 2.12 – 1.93 (m, 1H), 1.93 – 1.68 (m, 2H), 1.68 – 1.36 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 144.7, 137.7, 132.6, 129.2, 128.8, 128.5, 128.2, 127.6, 126.5, 125.9, 74.5, 38.6, 28.4, 26.1; FTIR (NaCl, thin film): 3546, 3350, 3058, 3024, 2935, 2856, 1948, 1880, 1807, 1757, 1599, 1574, 1493, 1453, 1406, 1319, 1269, 1200, 1156, 1069, 1028, 1001, 914, 764, 699; HRMS (MM) calc'd for $C_{18}H_{20}O$ $[M]^+$ 252.1514, found 252.1520.

A flask was charged with the **S2** (5.2 mmol, 1.0 equiv) and $CHCl_3$ (1.5 M). Thionyl chloride (5.5 mmol, 1.05 equiv) was added dropwise. Evolved gas was quenched via cannula by aqueous $NaHCO_3$. The solution was stirred at 23 °C for 12 h and then concentrated to afford a yellow oil. The crude residue was purified by flash chromatography (hexanes) to isolate **7** as a clear oil (250.9 mg, 18% yield). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.48 – 7.09 (m, 10H), 6.46 (d, J = 11.8 Hz, 1H), 5.63 (dt, J = 11.6, 7.2 Hz, 1H), 4.83 (dd, J = 8.2, 6.4 Hz, 1H), 2.39 (qd, J = 7.4, 1.9 Hz, 2H), 2.25 – 1.97 (m, 2H), 1.80 – 1.34 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 141.7, 137.5, 132.0, 129.5, 128.7, 128.6, 128.24, 128.17, 126.9, 126.6, 63.5, 39.4, 27.8, 27.3; FTIR (NaCl, thin film): 3057, 3024, 2943, 2860, 1599, 1493, 1454, 1235, 1075, 1028, 914, 766, 752, 697 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{19}Cl$ $[M+H_3O]^+$ 289.1354, found 289.1340.

[11] Petrignet, J.; Boudhar, A.; Blond, G.; Suffert, J. *Angew. Chem., Int. Ed.* **2011**, *50*, 3285.

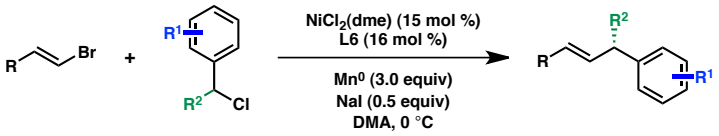
6. Enantioselective Reductive Cross-Coupling

General Procedure 5: Enantioselective Reductive Coupling of Benzyl Chlorides and Vinyl Bromides



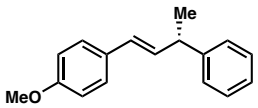
On a bench-top, to a 10 mL round-bottom flask was added **L6** (0.022 mmol, 11 mol), Mn^0 (0.6 mmol, 3 equiv), $NiCl_2$(dme) (0.02 mmol, 10 mol %), vinyl bromide **1** (if a solid, 0.2 mmol, 1 equiv), and NaI (0.1 mmol, 0.5 equiv). The flask was covered with a rubber septum, purged with N_2, and cooled to 0 °C. To the mixture was added DMA (0.2 mL), vinyl bromide **1** (if an oil, 0.2 mmol, 1 equiv), and benzyl chloride **2** (0.2 mmol, 1 equiv). The mixture was stirred vigorously, ensuring that the manganese powder was uniformly suspended. After 6 h, the mixture was allowed to warm to room temperature and was quenched with 1 M HCl (0.5 mL). The mixture was transferred to a separatory funnel using water (5 mL) and Et_2O (10 mL), and the aqueous and organic layers were separated. The aqueous layer was extracted with Et_2O (2 x 10 mL) and the combined organic layers were washed with brine (1 x 5 mL) and dried ($MgSO_4$), filtered, and concentrated. The crude residue was purified by flash chromatography.

General Procedure 6: Enantioselective Reductive Coupling of Benzyl Chlorides and Vinyl Bromides – 15% Catalyst Loading



On a bench-top, to a 10 mL round-bottom flask was added **L6** (0.032 mmol, 16 mol %), Mn^0 (0.6 mmol, 3 equiv), $NiCl_2$(dme) (0.03 mmol, 15 mol %), vinyl bromide **1** (if a solid, 0.2 mmol, 1 equiv), and NaI (0.1 mmol, 0.5 equiv). The flask was covered with a rubber septum, purged with N_2, and cooled to 0 °C. To the mixture was added DMA (0.2 mL), vinyl bromide **1** (if an oil, 0.2 mmol, 1 equiv), and benzyl chloride **2** (0.2 mmol, 1 equiv). The mixture was stirred vigorously, ensuring that the manganese powder was uniformly suspended. After 6 h, the mixture was allowed to warm to room temperature and was quenched with 1 M HCl (0.5 mL). The mixture was transferred to a separatory funnel using water (5 mL) and Et_2O (10 mL), and the aqueous and organic layers were separated. The aqueous layer was extracted with Et_2O (2 x 10 mL) and the combined organic layers were washed with brine (1 x 5 mL) and dried ($MgSO_4$), filtered, and concentrated. The crude residue was purified by flash chromatography.

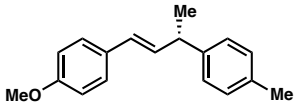
(*S*,*E*)-1-methoxy-4-(3-phenylbut-1-en-1-yl)benzene (3a)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3a** (43.4 mg, 91% yield) in 93% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 20% IPA in CO_2, λ = 254 nm): t_R (major) = 7.6 min, t_R (minor) = 9.2 min. $[\alpha]_D^{25} = -41.9°$ (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.39 – 7.20 (m, 7H), 6.90 – 6.83 (m, 2H), 6.40 (d, J = 16.2 Hz, 1H), 6.28 (dd, J = 15.9, 6.7 Hz, 1H), 3.82 (s, 3H), 3.70 – 3.60 (m, 1H), 1.49 (d, J = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.9, 145.9, 133.2, 130.5, 128.4, 128.0, 127.3, 127.2, 126.1, 114.0, 55.3, 42.5, 21.3; FTIR (NaCl, thin film): 3026, 2962, 2834, 1607, 1577, 1511, 1492, 1452, 1298, 1251, 1174, 1034, 967, 818, 760 cm^{-1}; HRMS (MM) calc'd for $C_{17}H_{20}O$ $[M]^+$ 238.1358, found 238.1346.

The optical rotation of the product generated in the presence of (*R*,*R*,*S*,*S*)-**L6** was measured as $[\alpha]_D^{25} = -41.9°$ (c = 1.0, $CHCl_3$). Lit: $[\alpha]_D^{20} = -16°$ (c = 1.28, $CHCl_3$, *S* enantiomer, 94% ee).[12] Based on the literature precedent, we assign our product as the *S* enantiomer.

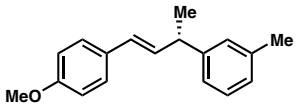
(*S*,*E*)-1-methoxy-4-(3-(*p*-tolyl)but-1-en-1-yl)benzene (3b)



Prepared from 1-(1-chloroethyl)-4-methylbenzene (**2b**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3b** (41.4 mg, 82% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 15% IPA in CO_2, λ = 254 nm): t_R (major) = 11.4 min, t_R (minor) = 13.0 min. $[\alpha]_D^{25} = -41.1°$ (c = 1.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 – 7.28 (m, 2H), 7.23 – 7.13 (m, 4H), 6.90 – 6.83 (m, 2H), 6.39 (d, J = 16.2 Hz, 1H), 6.27 (dd, J = 15.9, 6.7 Hz, 1H), 3.82 (s, 3H), 3.66 – 3.58 (m, 1H), 2.37 (s, 3H), 1.47 (d, J = 7.0 Hz, 3H).; ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.8, 142.9, 135.6, 133.4, 130.5, 129.2, 127.7, 127.23, 127.18, 113.9, 55.3, 42.1, 21.4, 21.0.; FTIR (NaCl, thin film): 3019, 2961, 2929, 2834, 1607, 1577, 1511, 1454, 1298, 1273, 1250, 1174, 1036, 967, 814 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}O$ $[M]^+$ 252.1514, found 252.1477.

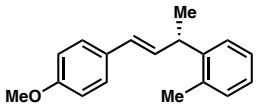
[12] Wu, H.-B.; Ma, X.-T.; Tian, S.-K. *Chem. Commun.* **2014**, *50*, 219.

(*S*,*E*)-1-(4-(4-methoxyphenyl)but-3-en-2-yl)-3-methylbenzene (3c)



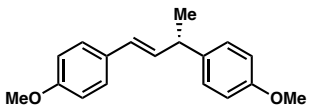
Prepared from 1-(1-chloroethyl)-3-methylbenzene (**2c**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (0 to 2% Et_2O/hexanes) to yield **3c** (44.6 mg, 88% yield) in 93% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 15% IPA in CO_2, λ = 254 nm): t_R (major) = 7.1 min, t_R (minor) = 8.9 min. $[\alpha]_D^{25} = -40.5°$ (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36 – 7.28 (m, 2H), 7.29 – 7.19 (m, 1H), 7.15 – 7.01 (m, 3H), 6.88 – 6.83 (m, 2H), 6.40 (d, *J* = 16.0 Hz, 1H), 6.28 (dd, *J* = 15.9, 6.8 Hz, 1H), 3.83 (s, 3H), 3.66 – 3.57 (m, 1H), 2.38 (s, 3H), 1.48 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.8, 145.9, 138.0, 133.3, 130.5, 128.3, 128.1, 127.8, 127.2, 126.9, 124.3, 113.9, 55.3, 42.5, 21.5, 21.4; FTIR (NaCl, thin film): 3029, 2962, 2834, 1607, 1577, 1511, 1488, 1463, 1371, 1299, 1251, 1175, 1107, 1036, 967, 848, 817, 785, 767 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}O$ $[M]^+$ 252.1514, found 252.1443.

(*S*,*E*)-1-(4-(4-methoxyphenyl)but-3-en-2-yl)-2-methylbenzene (3d)



Prepared from 1-(1-chloroethyl)-2-methylbenzene (**2d**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3d** (22.3 mg, 44% yield) in 85% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 15% IPA in CO_2, λ = 254 nm): t_R (major) = 8.7 min, t_R (minor) = 10.4 min. $[\alpha]_D^{25} = -40.3°$ (c = 0.9, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.33 – 7.09 (m, 6H), 6.87 – 6.80 (m, 2H), 6.32 (d, *J* = 15.7 Hz, 1H), 6.23 (dd, *J* = 16.0, 6.2 Hz, 1H), 3.89 – 3.82 (m, 1H), 3.81 (s, 3H), 2.39 (s, 3H), 1.45 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.8, 143.8, 135.6, 132.7, 130.42, 130.36, 127.8, 127.2, 126.3, 126.2, 126.0, 113.9, 55.3, 38.0, 20.6, 19.5; FTIR (NaCl, thin film): 3017, 2962, 2929, 2834, 1607, 1576, 1511, 1488, 1462, 1297, 1250, 1174, 1106, 1035, 968, 818, 758, 729 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}O$ $[M]^+$ 252.1514, found 252.1673.

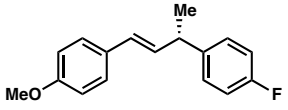
(*S*,*E*)-4,4'-(but-1-ene-1,3-diyl)bis(methoxybenzene) (3e)



Prepared from 1-(1-chloroethyl)-4-methoxybenzene (**2e**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (0 to 2% Et_2O/hexanes) to yield **3e** (34.5 mg, 64% yield) in 93% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (AD-H, 2.5 mL/min, 20% IPA in CO_2, λ = 254 nm): t_R (major) = 7.3 min, t_R (minor) = 8.9 min. $[\alpha]_D^{25} = -32.1°$ (c = 0.9, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 – 7.28 (m, 2H), 7.27 – 7.15 (m, 2H), 6.91 – 6.82 (m, 4H), 6.36 (d, *J* = 16.2 Hz, 1H), 6.25 (dd, *J* = 15.9, 6.7 Hz, 1H), 3.83 – 3.80 (m, 6H), 3.65 – 3.55 (m, 1H),

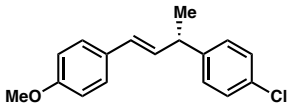
1.45 (d, J = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.8, 158.0, 138.0, 133.6, 130.5, 128.2, 127.7, 127.2, 113.94, 113.88, 55.3 (2C), 41.7, 21.4.; FTIR (NaCl, thin film): 2999, 2960, 2834, 1608, 1582, 1511, 1463, 1441, 1419, 1300, 1248, 1175, 1107, 1036, 968, 830, 818, 767 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}O_2$ $[M]^+$ 268.1463, found 268.1394.

(*S*,*E*)-1-fluoro-4-(4-(4-methoxyphenyl)but-3-en-2-yl)benzene (3f)



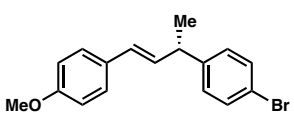
Prepared from 1-(1-chloroethyl)-4-fluorobenzene (**2f**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (0 to 2% Et_2O/hexanes) to yield **3f** (41.4 mg, 81% yield) in 89% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 15% IPA in CO_2, λ = 254 nm): t_R (major) = 5.6 min, t_R (minor) = 8.0 min. $[\alpha]_D^{25}$ = –35.1° (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.34 – 7.28 (m, 2H), 7.28 – 7.20 (m, 2H), 7.07 – 6.96 (m, 2H), 6.91 – 6.83 (m, 2H), 6.36 (d, J = 16.1 Hz, 1H), 6.23 (dd, J = 15.9, 6.7 Hz, 1H), 3.82 (s, 3H), 3.68 – 3.58 (m, 1H), 1.46 (d, J = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 161.4 (d, J = 244 Hz), 159.0, 141.5, 132.9, 130.3, 128.6 (d, J = 8 Hz), 128.1, 127.2, 115.1 (d, J = 21 Hz), 114.0, 55.3, 41.8, 21.4; FTIR (NaCl, thin film): 3032, 2963, 2835, 1607, 1577, 1510, 1464, 1419, 1298, 1251, 1223, 1175, 1159, 1107, 1035, 968, 835, 821, 769 cm^{-1}; HRMS (MM) calc'd for $C_{17}H_{17}FO$ $[M]^+$ 265.1263, found 265.1223.

(*S*,*E*)-1-chloro-4-(4-(4-methoxyphenyl)but-3-en-2-yl)benzene (3g)



Prepared from 1-(1-chloroethyl)-4-chlorobenzene (**2g**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (0 to 2% Et_2O/hexanes) to yield **3g** (40.9 mg, 75% yield) in 88% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 25% IPA in CO_2, λ = 254 nm): t_R (major) = 6.6 min, t_R (minor) = 9.4 min. $[\alpha]_D^{25}$ = –27.9° (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 – 7.26 (m, 4H), 7.25 – 7.18 (m, 2H), 6.91 – 6.82 (m, 2H), 6.36 (d, J = 16.0 Hz, 1H), 6.21 (dd, J = 15.9, 6.8 Hz, 1H), 3.82 (s, 3H), 3.66 – 3.56 (m, 1H), 1.45 (d, J = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 159.0, 144.4, 132.5, 131.8, 130.2, 128.6, 128.5, 128.4, 127.3, 114.0, 55.3, 41.9, 21.3; FTIR (NaCl, thin film): 3030, 2963, 2834, 1607, 1576, 1511, 1491, 1463, 1408, 1297, 1251, 1174, 1091, 1035, 1012, 967, 828, 817 cm^{-1}; HRMS (MM) calc'd for $C_{17}H_{17}ClO$ $[M]^+$ 272.0968, found 272.0904.

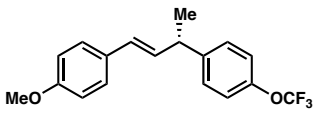
(*S*,*E*)-1-bromo-4-(4-(4-methoxyphenyl)but-3-en-2-yl)benzene (3h)



Prepared from 1-(1-chloroethyl)-4-bromobenzene (**2h**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3h** (37.6 mg, 59% yield) in 90% ee as a white solid. The enantiomeric excess was determined by chiral SFC

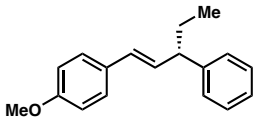
analysis (OB-H, 2.5 mL/min, 35% IPA in CO_2, λ = 254 nm): t_R (major) = 5.4 min, t_R (minor) = 9.0 min. $[\alpha]_D^{25} = -30.1°$ (c = 0.9, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.51 – 7.38 (m, 2H), 7.38 – 7.22 (m, 2H), 7.22 – 7.08 (m, 2H), 6.91 – 6.78 (m, 2H), 6.36 (d, *J* = 15.8 Hz, 1H), 6.20 (dd, *J* = 15.9, 6.8 Hz, 1H), 3.82 (s, 3H), 3.71 – 3.47 (m, 1H), 1.45 (d, *J* = 6.9 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 159.0, 144.9, 132.4, 131.5, 130.2, 129.1, 128.4, 127.3, 119.8, 114.0, 55.3, 42.0, 21.2; FTIR (NaCl, thin film): 2962, 2930, 2834, 1607, 1577, 1511, 1487, 1297, 1250, 1174, 1073, 1035, 1008, 967, 816 cm^{-1}; HRMS (MM) calc'd for $C_{17}H_{17}BrO$ $[M+H]^+$ 317.0536, found 317.0449.

(*S*,*E*)-1-methoxy-4-(3-(4-(trifluoromethoxy)phenyl)but-1-en-1-yl)benzene (3i)



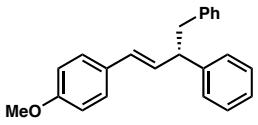
Prepared from 1-(1-chloroethyl)-4-(trifluoromethoxy)benzene (**2i**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3i** (54.2 mg, 84% yield) in 88% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (AD-H, 2.5 mL/min, 7% IPA in CO_2, λ = 254 nm): t_R (major) = 7.7 min, t_R (minor) = 8.8 min. $[\alpha]_D^{25} = -27.2°$ (c = 1.1, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.37 – 7.23 (m, 4H), 7.23 – 7.13 (m, 2H), 6.90 – 6.83 (m, 2H), 6.38 (d, *J* = 16.0 Hz, 1H), 6.22 (dd, *J* = 15.9, 6.8 Hz, 1H), 3.82 (s, 3H), 3.70 – 3.61 (m, 1H), 1.47 (d, *J* = 7.1 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 159.0, 147.6, 144.6, 132.4, 130.2, 128.5, 128.4, 127.3, 120.9, 114.0, 55.3, 41.9, 21.3; FTIR (NaCl, thin film): 3033, 2965, 2836, 1607, 1577, 1511, 1465, 1420, 1374, 1255, 1223, 1174, 1106, 1036, 1015, 968, 849, 819 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{17}F_3O_2$ $[M]^+$ 322.1181, found 322.1105.

(*S*,*E*)-1-methoxy-4-(3-phenylpent-1-en-1-yl)benzene (3j)



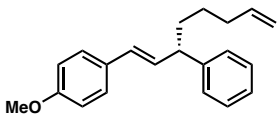
Prepared from (1-chloropropyl)benzene (**2j**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3j** (40.3 mg, 80% yield) in 97% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 15% IPA in CO_2, λ = 254 nm): t_R (minor) = 7.7 min, t_R (major) = 9.3 min. $[\alpha]_D^{25} = -47.8°$ (c = 0.9, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.39 – 7.19 (m, 5H), 6.90 – 6.83 (m, 2H), 6.38 (d, *J* = 14.8 Hz, 1H), 6.23 (dd, *J* = 15.8, 7.9 Hz, 1H), 3.82 (s, 3H), 3.32 (q, *J* = 7.3 Hz, 1H), 1.86 (pd, *J* = 7.4, 2.4 Hz, 2H), 0.95 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.9, 144.8, 132.2, 130.6, 128.9, 128.4, 127.7, 127.2, 126.1, 113.9, 55.3, 51.0, 28.9, 12.2; FTIR (NaCl, thin film): 3025, 2958, 2929, 2834, 1607, 1510, 1451, 1300, 1247, 1174, 1107, 1034, 964, 830, 757 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}O$ $[M]^+$ 252.1514, found 252.1466.

(*S*,*E*)-(4-(4-methoxyphenyl)but-3-ene-1,2-diyl)dibenzene (3k)



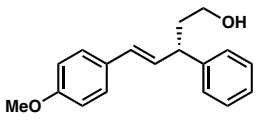
Prepared from (1-chloroethane-1,2-diyl)dibenzene (**2k**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (0 to 2% Et_2O/hexanes) to yield **3k** (51.3 mg, 82% yield) in 94% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (AS-H, 2.5 mL/min, 10% IPA in CO_2, λ = 254 nm): t_R (minor) = 5.8 min, t_R (major) = 6.4 min. $[\alpha]_D^{25}$ = +18.9° (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.45 – 7.02 (m, 10H), 6.94 – 6.78 (m, 2H), 6.40 – 6.24 (m, 2H), 3.82 (s, 3H), 3.76 (q, *J* = 7.2 Hz, 1H), 3.22 – 3.09 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.9, 144.1, 140.1, 131.3, 130.4, 129.4, 129.3, 128.4, 128.1, 127.9, 127.3, 126.3, 125.9, 113.9, 55.3, 50.9, 42.8; FTIR (NaCl, thin film): 3060, 3026, 2932, 2834, 1607, 1577, 1511, 1494, 1452, 1299, 1249, 1174, 1109, 1033, 965, 820, 756 cm^{-1}; HRMS (MM) calc'd for $C_{23}H_{22}O$ $[M+H]^+$ 315.1743, found 315.1699.

(*S*,*E*)-1-methoxy-4-(3-phenylocta-1,7-dien-1-yl)benzene (3l)



Prepared from (1-chlorohex-5-en-1-yl)benzene (**2l**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3l** (39.6 mg, 68% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (AS-H, 2.5 mL/min, 10% IPA in CO_2, λ = 254 nm): t_R (minor) = 3.1 min, t_R (major) = 3.7 min. $[\alpha]_D^{25}$ = –22.7° (c = 1.2, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.39 – 7.19 (m, 7H), 6.89 – 6.81 (m, 2H), 6.36 (d, *J* = 15.8 Hz, 1H), 6.21 (dd, *J* = 15.8, 7.9 Hz, 1H), 5.81 (ddt, *J* = 17.0, 10.2, 6.7 Hz, 1H), 5.06 – 4.93 (m, 2H), 3.81 (s, 3H), 3.41 (q, *J* = 7.6 Hz, 1H), 2.15 – 2.04 (m, 2H), 1.87 – 1.77 (m, 2H), 1.53 – 1.32 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.9, 144.8, 138.7, 132.2, 130.4, 128.8, 128.5, 127.6, 127.2, 126.1, 114.5, 113.9, 55.3, 49.1, 35.5, 33.7, 27.0; FTIR (NaCl, thin film): 3060, 3026, 2931, 2856, 2834, 1639, 1607, 1577, 1511, 1493, 1464, 1452, 1441, 1418, 1299, 1250, 1174, 1108, 1036, 965, 910, 828, 759 cm^{-1}; HRMS (MM) calc'd for $C_{21}H_{24}O$ $[M+H]^+$ 293.1900, found 293.1867.

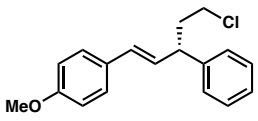
(*S*,*E*)-5-(4-methoxyphenyl)-3-phenylpent-4-en-1-ol (3m)



Prepared from 3-chloro-3-phenylpropan-1-ol (**2m**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (10 to 20% ethyl acetate/hexanes) to yield **3m** (43.3 mg, 81% yield) in 96% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 30% IPA in CO_2, λ = 254 nm): t_R (minor) = 5.5 min, t_R (major) = 6.9 min. $[\alpha]_D^{25}$ = –27.5° (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38 – 7.20 (m, 7H), 6.90 – 6.81 (m, 2H), 6.41 (d, *J* = 15.5 Hz, 1H), 6.22 (dd, *J* = 15.8, 8.0 Hz, 1H), 3.81 (s, 3H), 3.74 – 3.60 (m, 3H), 2.18 – 2.01 (m, 2H); ^{13}C NMR (126 MHz,

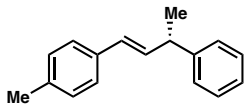
$CDCl_3$) δ 158.9, 144.1, 131.4, 130.1, 129.1, 128.6, 127.6, 127.3, 126.4, 113.9, 61.0, 55.3, 45.5, 38.5; FTIR (NaCl, thin film): 3350, 3026, 2933, 2835, 1607, 1577, 1511, 1492, 1452, 1300, 1249, 1175, 1033, 967, 809, 760 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}O_2$ $[M+H]^+$ 269.1536, found 269.1470.

(*S*,*E*)- 1-(5-chloro-3-phenylpent-1-en-1-yl)-4-methoxybenzene (3n)



Prepared from (1,3-dichloropropyl)benzene (**2n**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (5 to 20% toluene/hexanes) to yield **3n** (34.3 mg, 60% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (AS-H, 2.5 mL/min, 3% ACN in CO_2, λ = 254 nm): t_R (major) = 15.5 min, t_R (minor) = 22.0 min. $[\alpha]_D^{25} = -10.9°$ (c = 1.0, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.41 – 7.15 (m, 7H), 6.91 – 6.82 (m, 2H), 6.44 (d, *J* = 16.1 Hz, 3H), 6.18 (dd, *J* = 15.8, 8.0 Hz, 1H), 3.81 (s, 3H), 3.76 – 3.68 (m, 1H), 3.61 – 3.45 (m, 2H), 2.34 – 2.19 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 159.0, 143.1, 130.1, 129.9, 129.8, 128.7, 127.6, 127.3, 126.6, 113.9, 55.3, 45.9, 43.1, 38.4; FTIR (NaCl, thin film): 3027, 2956, 2835, 1607, 1576, 1511, 1492, 1452, 1291, 1250, 1175, 1034, 967, 760, 701 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{19}ClO$ $[M]^+$ 286.1119, found 286.1119.

(*S*,*E*)-1-methyl-4-(3-phenylbut-1-en-1-yl)benzene (5a)

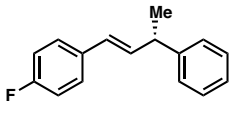


Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methylbenzene (0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (hexanes, 6% $AgNO_3$-adsorbed silica gel) to yield **5a** (36.9 mg, 83% yield) in 96% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 7% IPA in CO_2, λ = 254 nm): t_R (minor) = 7.5 min, t_R (major) = 9.3 min. $[\alpha]_D^{25} = -47.3°$ (c = 1.1, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.49 – 7.18 (m, 7H), 7.17 – 7.08 (m, 2H), 6.53 – 6.23 (m, 2H), 3.73 – 3.59 (m, 1H), 2.35 (s, 3H), 1.54 – 1.42 (m, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 145.8, 136.8, 134.8, 134.2, 129.2, 128.5, 128.4, 127.3, 126.2, 126.0, 42.6, 21.3, 21.2; FTIR (NaCl, thin film): 3083, 3024, 2964, 2924, 2870, 1602, 1512, 1492, 1451, 1371, 1154, 1017, 967, 803, 759 cm^{-1}; HRMS (MM) calc'd for $C_{17}H_{18}$ $[M+H_2O]^+$ 240.1509, found 240.1517.

The optical rotation of the product generated in the presence of (*R*,*R*,*S*,*S*)-**L6** was measured as $[\alpha]_D^{25} = -47.3°$ (c = 1.1, $CHCl_3$). Lit: $[\alpha]_D^{20} = +38.4°$ (c = 0.98, $CHCl_3$, *R* enantiomer, 91% ee). Based on the literature precedent, we assign our product as the *S* enantiomer.[13]

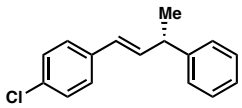
[13] Ye, J.; Zhao, J.; Xu, J.; Mao, Y.; Zhang, Y. J. *Chem. Commun.* **2013**, *49*, 9761.

(*S*,*E*)-1-fluoro-4-(3-phenylbut-1-en-1-yl)benzene (5b)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-fluorobenzene (**1b**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (hexanes, 6% $AgNO_3$-adsorbed silica gel) to yield **5b** (33.7 mg, 74% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 7% IPA in CO_2, λ = 254 nm): t_R (minor) = 5.9 min, t_R (major) = 7.1 min. $[\alpha]_D^{25} = -34.6°$ (c = 1.1, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.48 – 7.12 (m, 7H), 7.10 – 6.88 (m, 2H), 6.47 – 6.21 (m, 2H), 3.81 – 3.53 (m, 1H), 1.49 (d, *J* = 7.2 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 162.0 (d, *J* = 246 Hz), 145.5, 135.0, 133.7, 128.5, 127.6 (d, *J* = 8 Hz), 127.35, 127.28, 126.3, 115.3 (d, *J* = 22 Hz), 42.6, 21.2; FTIR (NaCl, thin film): 3025, 2965, 2927, 2871, 1602, 1508, 1492, 1451, 1226, 1157, 1094, 1011, 965, 855, 818, 761 cm^{-1}; HRMS (MM) calc'd for $C_{16}H_{15}F$ $[M+Li]^+$ 232.1304, found 232.1321.

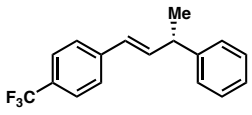
(*S*,*E*)-1-chloro-4-(3-phenylbut-1-en-1-yl)benzene (5c)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-chlorobenzene (**1c**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (hexanes, 6% $AgNO_3$-adsorbed silica gel) to yield **5c** (32.1 mg, 66% yield) in 95% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 10% IPA in CO_2, λ = 254 nm): t_R (minor) = 6.4 min, t_R (major) = 7.9 min. $[\alpha]_D^{25} = -42.2°$ (c = 1.0, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.53 – 7.09 (m, 9H), 6.45 – 6.32 (m, 2H), 3.70 – 3.60 (m, 1H), 1.49 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 145.3, 136.1, 136.0, 132.6, 128.6, 127.6, 127.4, 127.3, 126.3, 42.6, 21.1; FTIR (NaCl, thin film): 3082, 3060, 3026, 2965, 2927, 2871, 1646, 1602, 1491, 1451, 1404, 1372, 1062, 1012, 966, 858, 810, 761 cm^{-1}; HRMS (ESI) calc'd for $C_{16}H_{15}Cl$ $[M+H]^+$ 243.0935, found 243.0985.

The optical rotation of the product generated in the presence of (*R*,*R*,*S*,*S*)-**L6** was measured as $[\alpha]_D^{25} = -42.2°$ (c = 1.0, $CHCl_3$). Lit: $[\alpha]_D^{20} = +33°$ (c = 1.0, $CHCl_3$, *R* enantiomer, 91% ee).[14] Based on the literature precedent, we assign our product as the *S* enantiomer.

(*S*,*E*)-1-(3-phenylbut-1-en-1-yl)-4-(trifluoromethyl)benzene (5d)

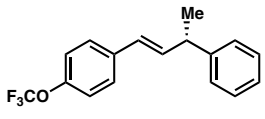


Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-(trifluoromethyl)benzene (**1d**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (hexanes) to yield **5d** (27.0 mg, 49% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5

[14] Li, M.-B.; Wang, Y.; Tian, S.-K. *Angew. Chem., Int. Ed.* **2012**, *51*, 2968.

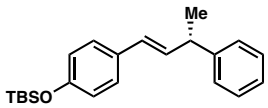
mL/min, 3% IPA in CO_2, λ = 254 nm): t_R (minor) = 5.4 min, t_R (major) = 6.3 min. $[\alpha]_D^{25}$ = –33.1° (c = 0.9, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.59 – 7.52 (m, 2H), 7.49 – 7.41 (m, 2H), 7.40 – 7.21 (m, 4H), 6.52 (dd, *J* = 15.9, 6.3 Hz, 1H), 6.45 (d, *J* = 16.0 Hz, 1H), 3.73 – 3.63 (m, 1H), 1.50 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 145.0, 138.0, 128.6, 127.6, 127.33, 127.29, 126.4, 126.3, 125.4 (q, *J* = 4 Hz), 124.3 (q, *J* = 272 Hz) 42.6, 21.0; FTIR (NaCl, thin film): 3027, 2967, 1614, 1493, 1452, 1413, 1326, 1164, 1122, 1067, 1016, 967, 864, 820, 760 cm^{-1}; HRMS (MM) calc'd for $C_{17}H_{15}F_3$ $[M+H]^+$ 227.1199, found 227.1490.

(*S*,*E*)-1-(3-phenylbut-1-en-1-yl)-4-(trifluoromethoxy)benzene (5e)



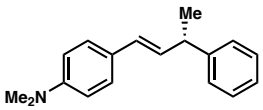
Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-(trifluoromethoxy)benzene (**1e**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (hexanes, 6% $AgNO_3$-adsorbed silica gel) to yield **5e** (47.1 mg, 81% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 10% IPA in CO_2, λ = 254 nm): t_R (minor) = 2.3 min, t_R (major) = 2.5 min. $[\alpha]_D^{25}$ = –27.9° (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.50 – 7.20 (m, 5H), 7.20 – 7.08 (m, 2H), 6.57 – 6.24 (m, 2H), 3.83 – 3.53 (m, 1H), 1.49 (d, *J* = 7.2 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 148.1, 145.3, 136.4, 128.6, 128.3, 127.31, 127.28, 127.1, 126.4, 121.1, 42.6, 21.1; FTIR (NaCl, thin film): 3083, 3061, 3027, 2967, 2930, 2873, 1602, 1587, 1507, 1493, 1452, 1260, 1220, 1164, 1017, 965, 864, 762 cm^{-1}; HRMS (MM) calc'd for $C_{17}H_{15}F_3O$ $[M+H]^+$ 293.1148, found 293.1237.

(*S*,*E*)-*tert*-butyldimethyl(4-(3-phenylbut-1-en-1-yl)phenoxy)silane (5f)



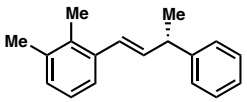
Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-(4-(2-bromovinyl)phenoxy)(*tert*-butyl)dimethylsilane (**1f**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (hexanes, 6% $AgNO_3$-adsorbed silica gel) to yield **5f** (55.4 mg, 82% yield) in 96% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 5% IPA in CO_2, λ = 254 nm): t_R (major) = 8.6 min, t_R (minor) = 13.2 min. $[\alpha]_D^{25}$ = –31.1° (c = 1.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.45 – 7.10 (m, 7H), 6.87 – 6.68 (m, 2H), 6.38 (d, *J* = 17.3 Hz, 1H), 6.27 (dd, *J* = 15.9, 6.8 Hz, 1H), 3.69 – 3.58 (m, 1H), 1.48 (d, *J* = 7.0 Hz, 3H), 1.00 (s, 9H), 0.21 (s, 6H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 154.9, 145.9, 133.2, 130.9, 128.5, 128.0, 127.3, 127.2, 126.1, 120.2, 42.6, 25.7, 21.3, 18.3, –4.4; FTIR (NaCl, thin film): 3060, 3027, 2958, 2929, 2884, 2857, 1604, 1508, 1472, 1462 1451, 1362, 1264, 1168, 1099, 1009, 967, 914, 839, 822, 802, 781 cm^{-1}; HRMS (MM) calc'd for $C_{22}H_{30}OSi$ $[M+H]^+$ 339.2139, found 339.2118.

(*S*,*E*)-*N*,*N*-dimethyl-4-(3-phenylbut-1-en-1-yl)aniline (5g)



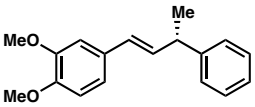
Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-4-(2-bromovinyl)-*N*,*N*-dimethylaniline (**1g**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (20 to 40% toluene/hexanes) to yield **5g** (27.5 mg, 55% yield) in 95% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 35% IPA in CO_2, λ = 254 nm): t_R (major) = 5.7 min, t_R (major) = 9.0 min. $[\alpha]_D^{25} = -67.3°$ (c = 1.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38 – 7.17 (m, 7H), 6.70 (d, *J* = 8.3 Hz, 2H), 6.37 (d, *J* = 15.9 Hz, 1H), 6.21 (dd, *J* = 15.9, 6.8 Hz, 1H), 3.69 – 3.59 (m, 1H), 2.96 (s, 6H), 1.48 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 149.8, 146.3, 131.2, 128.4, 128.2, 127.3, 127.0, 126.0, 112.6, 42.5, 40.7, 21.5; FTIR (NaCl, thin film): 3009, 2955, 2870, 2808, 1611, 1525, 1490, 1446, 1359, 1231, 1186, 1168, 1063, 1020, 958, 802, 754 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{21}N$ $[M+H]^+$ 252.1747, found 252.1789.

(*S*,*E*)-1,2-dimethyl-3-(3-phenylbut-1-en-1-yl)benzene (5h)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-2,3-dimethylbenzene (**1h**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (hexanes, 6% $AgNO_3$-adsorbed silica gel) to yield **5h** (35.9 mg, 76% yield) in 96% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 4% EtOH in CO_2, λ = 254 nm): t_R (minor) = 4.4 min, t_R (major) = 5.6 min. $[\alpha]_D^{25} = -19.4°$ (c = 1.2, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.46 – 7.16 (m, 7H), 7.08 (d, *J* = 4.7 Hz, 2H), 6.73 (dd, *J* = 15.6, 1.4 Hz, 1H), 6.23 (dd, *J* = 15.7, 6.9 Hz, 1H), 3.75 – 3.66 (m, 1H), 2.33 (s, 3H), 2.28 (s, 3H), 1.52 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 145.8, 137.2, 137.0, 136.6, 133.8, 128.7, 128.5, 127.4, 127.3, 126.2, 125.5, 124.1, 42.8, 21.5, 20.7, 15.4; FTIR (NaCl, thin film): 3060, 3025, 2963, 2927, 2869, 1600, 1582, 1491, 1451, 1371, 1015, 971, 781, 759 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}$ $[M]^+$ 236.1565, found 236.1477.

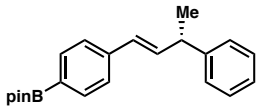
(*S*,*E*)-1,2-dimethoxy-4-(3-phenylbut-1-en-1-yl)benzene (5i)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-4-(2-bromovinyl)-1,2-dimethoxybenzene (**1i**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (20 to 40% toluene/hexanes) to yield **5i** (39.3 mg, 73% yield) in 95% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 25% IPA in CO_2, λ = 254 nm): t_R (minor) = 5.6 min, t_R (major) = 7.8 min. $[\alpha]_D^{25} = -36.4°$ (c = 1.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.39 – 7.19 (m, 5H), 6.96 – 6.88 (m, 2H), 6.82 (d, *J* = 8.2 Hz, 1H), 6.38 (d, *J* = 15.9 Hz, 1H), 6.28 (dd, *J* = 15.8, 6.6 Hz, 1H), 3.90 (s, 3H), 3.89 (s, 3H), 3.70 – 3.61 (m, 1H), 1.49 (d, *J* = 7.1 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 149.0, 148.4, 145.8, 133.4, 130.7, 128.5, 128.1, 127.3, 126.2, 119.1, 111.1, 108.5, 55.9, 55.8, 42.5, 21.3; FTIR (NaCl, thin film): 3058, 3024, 2961, 2931, 2833, 1601, 1583, 1513,

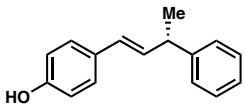
1492, 1463 1451, 1417, 1264, 1158, 1139, 1027, 966, 803, 763 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{20}O_2$ $[M+H]^+$ 269.1536, found 269.1534.

(*S*,*E*)-4,4,5,5-tetramethyl-2-(4-(3-phenylbut-1-en-1-yl)phenyl)-1,3,2-dioxaborolane (5j)



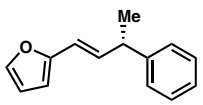
Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-2-(4-(2-bromovinyl)phenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (**1j**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (20 to 40% hexanes) to yield **5j** (39.4 mg, 59% yield) in 94% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 15% IPA in CO_2, λ = 254 nm): t_R (major) = 3.9 min, t_R (minor) = 7.5 min. $[\alpha]_D^{25} = -33.5°$ (c = 0.9, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.80 – 7.72 (m, 2H), 7.40 – 7.19 (m, 7H), 6.53 – 6.39 (m, 2H), 3.71 – 3.62 (m, 1H), 1.49 (d, *J* = 7.2 Hz, 3H), 1.36 (s, 12H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 145.5, 140.3, 136.4, 135.0, 128.6, 128.5, 127.3, 126.3, 125.5, 83.7, 42.7, 24.9, 21.2; FTIR (NaCl, thin film): 3025, 2975, 2929, 1607, 1602, 1492, 1452, 1397, 1360, 1321, 1270, 1144, 1090, 1017, 962, 860 cm^{-1}; HRMS (MM) calc'd for $C_{22}H_{27}BO_2$ $[M]^+$ 333.2140, found 333.1960.

(*S*,*E*)-4-(3-phenylbut-1-en-1-yl)phenol (5k)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-4-(2-bromovinyl)phenol (**1k**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (10 to 20% ethyl acetate/hexanes) to yield **5k** (38.6 mg, 86% yield) in 93% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 30% IPA in CO_2, λ = 254 nm): t_R (major) = 3.0 min, t_R (minor) = 3.4 min. $[\alpha]_D^{25} = -39.1°$ (c = 0.8, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.38 – 7.16 (m, 7H), 6.84 – 6.74 (m, 2H), 6.37 (d, *J* = 16.0 Hz, 1H), 6.26 (dd, *J* = 15.9, 6.7 Hz, 1H), 4.89 (s, 1H), 3.69 – 3.60 (m, 1H), 1.48 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 154.6, 145.9, 133.2, 130.6, 128.5, 127.8, 127.5, 127.3, 126.2, 115.4, 42.5, 21.3; FTIR (NaCl, thin film): 3368, 3025, 2963, 2927, 2871, 1633, 1608, 1512, 1492, 1451, 1371, 1227, 1170, 1010, 966, 819, 762 cm^{-1}; HRMS (MM) calc'd for $C_{16}H_{16}O$ $[M]^+$ 224.1201, found 224.1164.

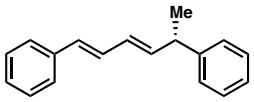
(*S*,*E*)-2-(3-phenylbut-1-en-1-yl)furan (5l)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-2-(2-bromovinyl)furan (**1l**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (hexanes) to yield **5l** (31.7 mg, 80% yield) in 91% ee as a yellow oil. The enantiomeric excess was determined by chiral SFC analysis (AD-H, 2.5 mL/min, 3% IPA in CO_2, λ = 254 nm): t_R (miajor) = 3.2 min, t_R (minor) = 3.5 min. $[\alpha]_D^{25} = -48.3°$ (c = 0.9, $CHCl_3$), lit:[12] $[\alpha]_D^{20} = -48°$ (c = 1.0, $CHCl_3$, *S* enantiomer, 95% ee); ^1H NMR (500 MHz, $CDCl_3$) δ 7.41 – 7.18 (m, 6H), 6.43 – 6.35 (m, 2H), 6.26 – 6.16 (m,

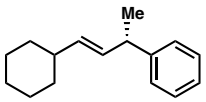
2H), 3.69 – 3.58 (m, 1H), 1.48 (d, J = 7.1 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 153.1, 145.3, 141.4, 134.2, 128.5, 127.3, 126.3, 117.4, 111.2, 106.7, 42.3, 21.1; FTIR (NaCl, thin film): 3060, 3026, 2965, 2928, 2871, 1602, 1491, 1452, 1371, 1255, 1151, 1012, 961, 928, 884, 760, 732 cm^{-1}; HRMS (MM) calc'd for $C_{14}H_{14}O$ $[M+H]^+$ 199.1117, found 199.1067.

(*S*,1*E*,3*E*)-hexa-1,3-diene-1,5-diyldibenzene (5m)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and ((1*E*,3*E*)-4-bromobuta-1,3-dien-1-yl)benzene (**1m**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by flash chromatography (hexanes, florisil) to yield **5m** (38.5 mg, 82% yield) in 92% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 15% IPA in CO_2, λ = 254 nm): t_R (major) = 6.9 min, t_R (minor) = 9.4 min. $[\alpha]_D^{25}$ = –34.1° (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.43 – 7.16 (m, 9H), 6.80 (dd, J = 15.7, 10.4 Hz, 1H), 6.52 (d, J = 15.7 Hz, 1H), 6.26 (dd, J = 15.2, 10.4 Hz, 1H), 6.03 (dd, J = 15.3, 6.8 Hz, 1H), 3.66 – 3.56 (m, 1H), 1.46 (d, J = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 145.6, 139.9, 137.5, 131.0, 129.20, 129.18, 128.6, 128.5, 127.3, 127.2, 126.23, 126.19, 42.5, 21.2; FTIR (NaCl, thin film): 3059, 3023, 2964, 2927, 2870, 1638, 1596, 1492, 1448, 1371, 1259, 1154, 1117, 1072, 988, 909, 760, 745 cm^{-1}; HRMS (MM) calc'd for $C_{18}H_{18}$ $[M]^+$ 234.1409, found 234.1342.

(*S*,*E*)-(4-cyclohexylbut-3-en-2-yl)benzene (5n)

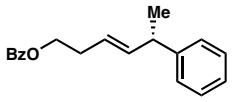


Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-(2-bromovinyl)cyclohexane (**1n**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by flash chromatography (hexanes) to yield **5n** (23.6 mg, 55% yield) in 96% ee as a clear oil. The enantiomeric excess was determined by chiral HPLC analysis (OJ-H, 1 mL/min, 1% IPA in hexanes, λ = 220 nm): t_R (minor) = 5.1 min, t_R (major) = 5.8 min. $[\alpha]_D^{25}$ = –5.5° (c = 0.8, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 – 7.26 (m, 2H), 7.26 – 7.16 (m, 3H), 5.57 (ddd, J = 15.5, 6.7, 1.2 Hz, 1H), 5.44 (ddd, J = 15.4, 6.7, 1.2 Hz, 1H), 3.47 – 3.37 (m, 1H), 2.01 – 1.89 (m, 1H), 1.78 – 1.61 (m, 4H), 1.35 (d, J = 7.0 Hz, 3H), 1.32 – 1.01 (m, 6H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 146.7, 135.2, 132.3, 128.3, 127.2, 125.8, 42.2, 40.6, 33.20, 33.18, 26.2, 26.1, 21.7; FTIR (NaCl, thin film): 3024, 2962, 2922, 2850, 1601, 1492, 1448, 1371, 1009, 965, 759, 698 cm^{-1}; HRMS (MM) calc'd for $C_{16}H_{22}$ $[M]^+$ 214.1722, found 214.1689.

The optical rotation of the product generated in the presence of (*R*,*R*,*S*,*S*)-**L6** was measured as $[\alpha]_D^{25}$ = –5.5° (c = 0.8, $CHCl_3$). Lit: $[\alpha]_D^{20}$ = +10.1° (c = 0.45, $CHCl_3$, *R* enantiomer, 95% ee).[15] Based on the literature precedent, we assign our product as the *S* enantiomer.

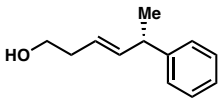
[15] Zhao, J.; Ye, J.; Zhang, Y. J. *Adv. Synth. Catal.* **2013**, 355, 491.

(*S*,*E*)-5-phenylhex-3-en-1-yl benzoate (5o)



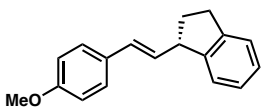
Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-4-bromobut-3-en-1-yl benzoate (**1o**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (2% Et_2O/hexanes) to yield **5o** (40.5 mg, 72% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 10% IPA in CO_2, λ = 210 nm): t_R (major) = 5.0 min, t_R (minor) = 5.8 min. $[\alpha]_D^{25}$ = 2.8° (c = 1.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.09 – 7.99 (m, 2H), 7.63 – 7.54 (m, 1H), 7.51 – 7.40 (m, 2H), 7.31 – 7.14 (m, 5H), 5.78 (ddt, *J* = 15.4, 6.8, 1.4 Hz, 1H), 5.54 (dtd, *J* = 15.2, 6.8, 1.3 Hz, 1H), 4.37 (td, *J* = 6.7, 2.2 Hz, 2H), 3.52 – 3.43 (m, 1H), 2.51 (qt, *J* = 6.7, 1.1 Hz, 2H), 1.36 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 166.6, 145.9, 138.2, 132.8, 130.4, 129.6, 128.4, 128.3, 127.1, 126.0, 124.1, 64.3, 42.3, 32.1, 21.3; FTIR (NaCl, thin film): 3061, 3027, 2963, 2929, 2898, 2872, 1720, 1602, 1584, 1492, 1451, 1380, 1314, 1274, 1176, 1116, 1070, 1026, 968, 760, 712 cm^{-1}; HRMS (MM) calc'd for $C_{19}H_{20}O_2$ $[M+H]^+$ 281.1536, found 281.1522.

(*S*,*E*)-5-phenylhex-3-en-1-ol (5p)



Prepared from (1-chloroethyl)benzene (**2a**, 0.2 mmol) and (*E*)-4-bromobut-3-en-1-ol (**1p**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (10 to 20% ethyl acetate/hexanes) to yield **5p** (19.7 mg, 56% yield) in 94% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 2% MeOH in CO_2, λ = 210 nm): t_R (major) = 9.6 min, t_R (minor) = 10.5 min. $[\alpha]_D^{25}$ = +13.1° (c = 0.6, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 – 7.27 (m, 2H), 7.25 – 7.15 (m, 3H), 5.77 (ddt, *J* = 15.4, 6.8, 1.4 Hz, 1H), 5.46 (dtd, *J* = 15.4, 7.0, 1.4 Hz, 1H), 3.66 (t, *J* = 6.2 Hz, 2H), 3.52 – 3.43 (m, 1H), 2.37 – 2.27 (m, 2H), 1.37 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 145.9, 138.7, 128.4, 127.1, 126.1, 124.7, 62.1, 42.4, 35.9, 21.4; FTIR (NaCl, thin film): 3337, 3025, 2963, 2928, 1653, 1636, 1491, 1451, 1371, 1258, 1150, 1048, 968, 759 cm^{-1}; HRMS (MM) calc'd for $C_{12}H_{16}O$ $[M+H]^+$ 177.1274, found 177.1248.

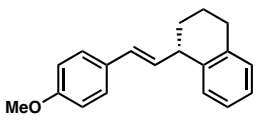
(*S*,*E*)-1-(4-methoxystyryl)-2,3-dihydro-1*H*-indene (3o)



Prepared from 1-chloro-2,3-dihydro-1*H*-indene (**2o**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 6. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3o** (38.8 mg, 77% yield) in 94% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 20% IPA in CO_2, λ = 254 nm): t_R (major) = 5.1 min, t_R (minor) = 8.7 min. $[\alpha]_D^{25}$ = –6.5° (c = 1.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.39 – 7.32 (m, 2H), 7.32 – 7.16 (m, 4H), 6.91 – 6.85 (m, 2H), 6.51 (d, *J* = 15.7 Hz, 1H), 6.14 (dd, *J* = 15.9, 8.6 Hz, 1H), 3.97 – 3.88 (m, 1H), 3.83 (s, 3H), 3.06 – 2.89 (m, 2H), 2.49 – 2.38 (m, 1H), 2.01 – 1.89 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.9, 146.1, 144.0, 130.9, 130.3,

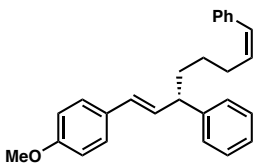
129.7, 127.3, 126.6, 126.2, 124.53, 124.50, 114.0, 55.3, 49.2, 33.7, 31.7; FTIR (NaCl, thin film): 3065, 3018, 2952, 2835, 1606, 1576, 1511, 1476, 1457, 1440, 1292, 1250, 1174, 1036, 965, 844, 811, 754, 740 cm^{-1}; HRMS (MM) calc'd for $C_{16}H_{18}O$ $[M+H]^+$ 251.1430, found 251.1371.

(*S*,*E*)-1-(4-methoxystyryl)-1,2,3,4-tetrahydronaphthalene (3p)



Prepared from 1-chloro-1,2,3,4-tetrahydronaphthalene (**2p**, 0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (5 to 15% toluene/hexanes) to yield **3p** (21.2 mg, 40% yield) in 90% ee as a white solid. The enantiomeric excess was determined by chiral SFC analysis (OB-H, 2.5 mL/min, 20% IPA in CO_2, λ = 254 nm): t_R (major) = 5.4 min, t_R (minor) = 8.3 min. $[\alpha]_D^{25}$ = +9.1° (c = 0.9, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36 – 7.28 (m, 2H), 7.25 – 7.19 (m, 1H), 7.20 – 7.09 (m, 3H), 6.91 – 6.81 (m, 2H), 6.38 (d, *J* = 15.7 Hz, 1H), 6.16 (dd, *J* = 15.7, 8.5 Hz, 1H), 3.82 (s, 3H), 3.66 – 3.58 (m, 1H), 2.91 – 2.77 (m, 2H), 2.10 – 1.91 (m, 2H), 1.86 – 1.72 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.8, 138.6, 137.0, 132.9, 130.4, 129.7, 129.6, 129.2, 127.2, 126.0, 125.6, 113.9, 55.3, 42.9, 30.5, 29.7, 21.0; FTIR (NaCl, thin film): 3014, 2930, 2856, 2834, 1607, 1577, 1511, 1489, 1463, 1450, 1297, 1249, 1174, 1035, 965, 843, 814, 755, 735 cm^{-1}; HRMS (MM) calc'd for $C_{19}H_{20}O$ $[M+H]^+$ 265.1587, found 265.1483.

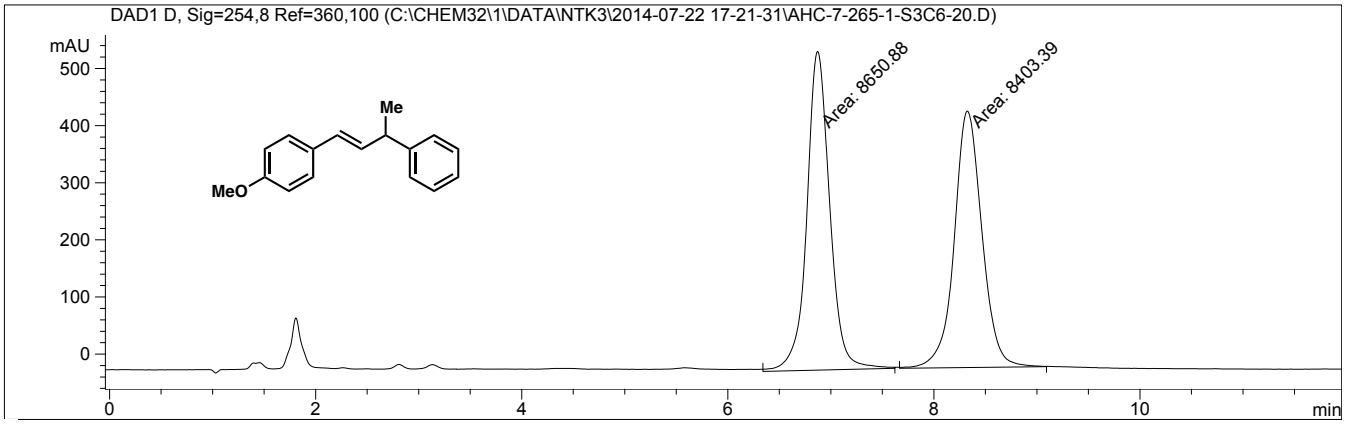
((*S*,1*Z*,7*E*)-8-(4-methoxyphenyl)octa-1,7-diene-1,6-diyl)dibenzene (7)



Prepared from **6** (0.2 mmol) and (*E*)-1-(2-bromovinyl)-4-methoxybenzene (**1a**, 0.2 mmol) according to General Procedure 5. The crude residue was purified by silica gel chromatography (hexanes) to yield **7** (45.8 mg, 62% yield) in 96% ee as a clear oil. The enantiomeric excess was determined by chiral SFC analysis (OJ-H, 2.5 mL/min, 10% IPA in CO_2, λ = 254 nm): t_R (minor) = 7.2 min, t_R (major) = 7.9 min. $[\alpha]_D^{25}$ = –2.0° (c = 1.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.43 – 7.13 (m, 12H), 6.94 – 6.75 (m, 2H), 6.43 (dt, *J* = 11.7, 1.9 Hz, 1H), 6.34 (d, *J* = 16.4 Hz, 1H), 6.20 (dd, *J* = 15.8, 7.9 Hz, 1H), 5.65 (dt, *J* = 11.7, 7.2 Hz, 1H), 3.81 (s, 3H), 3.50 – 3.30 (m, 1H), 2.39 (qd, *J* = 7.4, 1.8 Hz, 2H), 1.94 – 1.74 (m, 2H), 1.64 – 1.35 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 158.8, 144.7, 137.7, 132.8, 132.1, 130.4, 129.0, 128.8, 128.7, 128.5, 128.1, 127.6, 127.2, 126.5, 126.2, 113.9, 55.3, 49.0, 35.5, 28.5, 27.9; FTIR (NaCl, thin film): 3057, 3024, 2931, 2856, 2834, 1607, 1576, 1511, 1492, 1452, 1300, 1249, 1174, 1035, 965, 914, 829, 804, 760, 699 cm^{-1}; HRMS (MM) calc'd for $C_{27}H_{28}O$ $[M+H]^+$ 369.2213, found 369.2219.

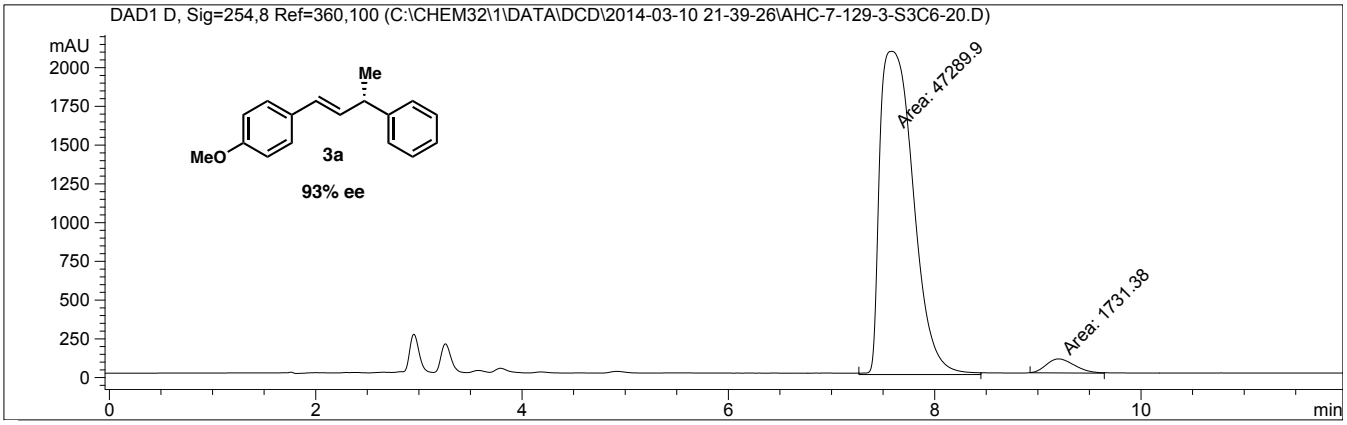
7. SFC Traces of Racemic and Enantioenriched Products

3a (Table 2, entry 1): racemic



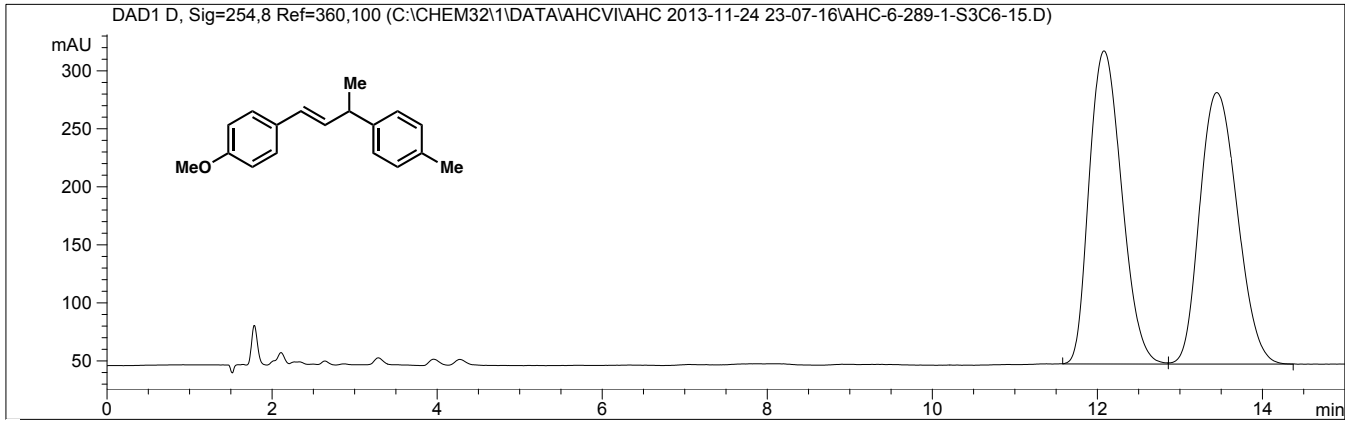
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.871	MM	0.2583	8650.88281	558.20911	50.7256
2	8.325	MM	0.3119	8403.38672	449.10953	49.2744

3a (Table 2, entry 1): enantioenriched, 93% ee



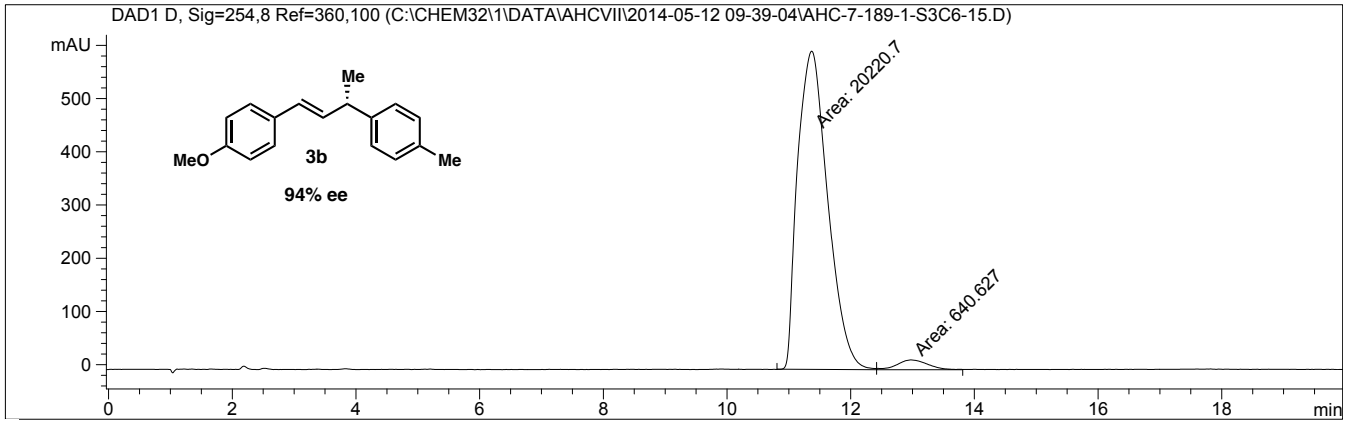
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.587	MM	0.3780	4.72899e4	2085.26416	96.4681
2	9.201	MM	0.3190	1731.38208	90.45088	3.5319

3b (Table 2, entry 2): racemic



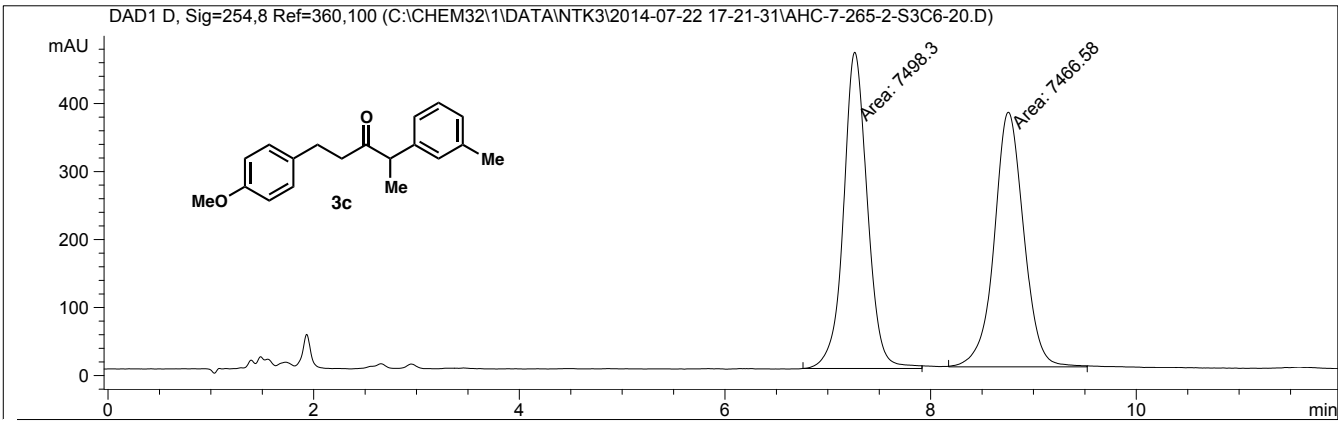
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.081	BB	0.4356	7393.43018	269.87115	49.9809
2	13.448	BB	0.5069	7399.08838	233.99118	50.0191

3b (Table 2, entry 2): enantioenriched, 94% ee



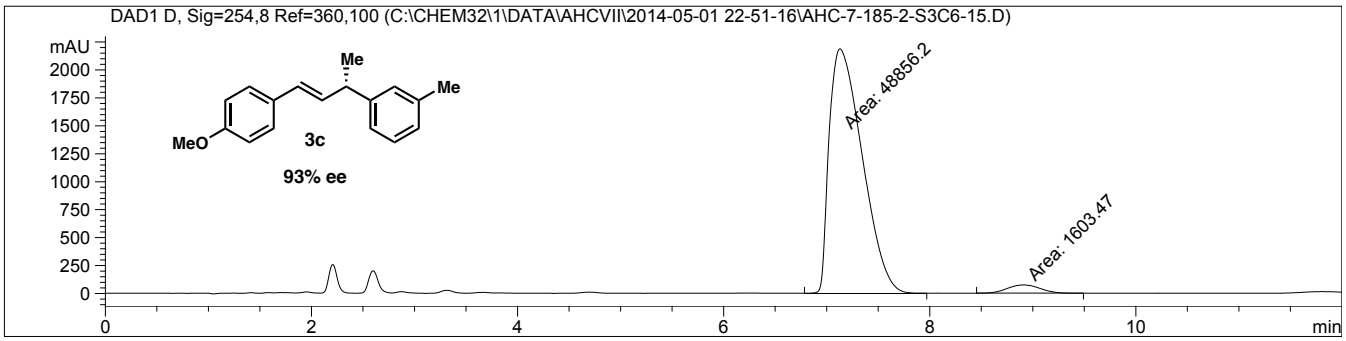
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.369	MM	0.5638	2.02207e4	597.78845	96.9291
2	12.970	MM	0.5781	640.62689	18.46935	3.0709

3c (Table 2, entry 3): racemic



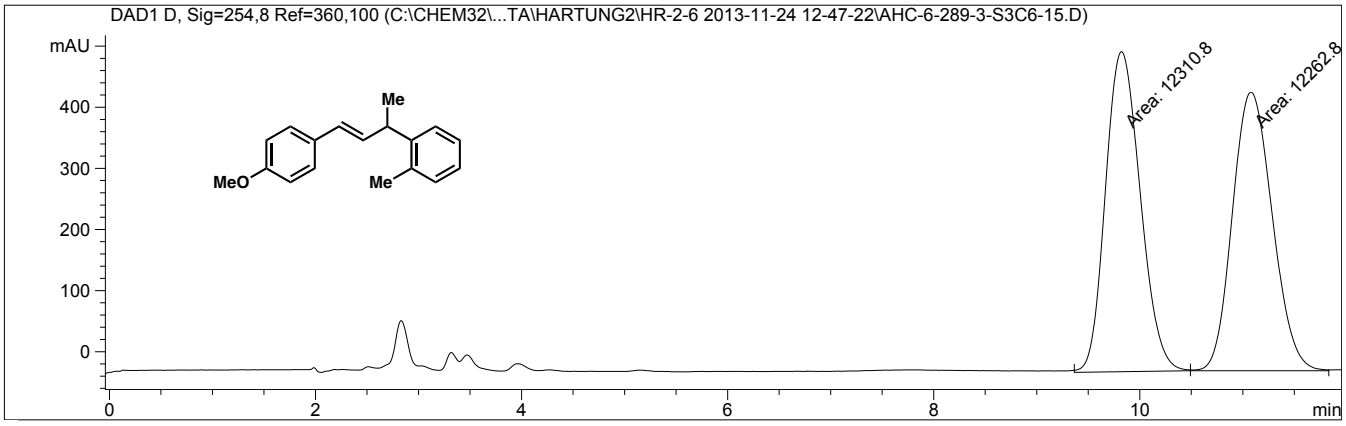
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.261	MM	0.2686	7498.30225	465.33981	50.1060
2	8.755	MM	0.3322	7466.58496	374.60574	49.8940

3c (Table 2, entry 3): enantioenriched, 93% ee



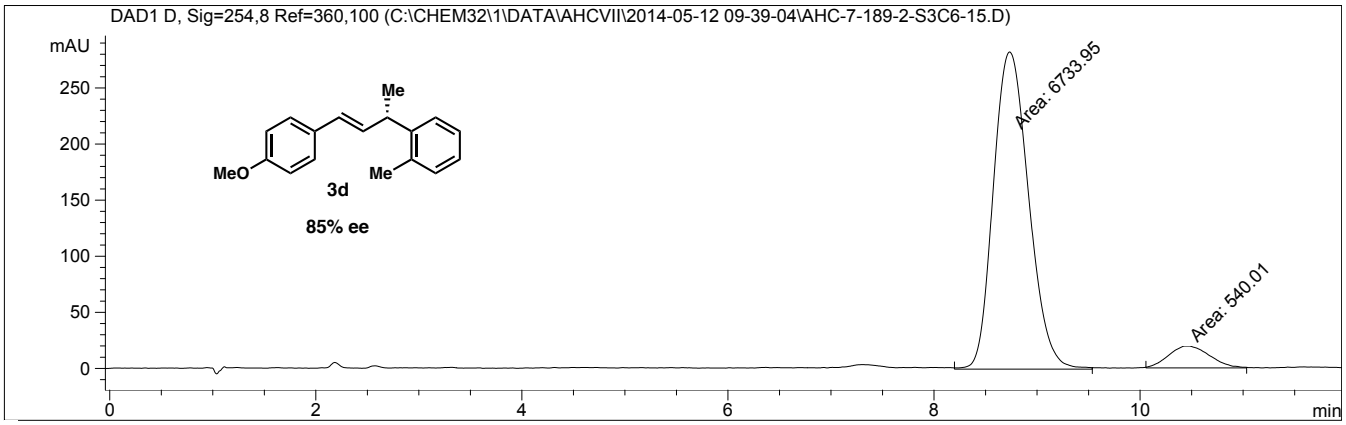
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.129	MM	0.3720	4.88562e4	2189.11938	96.8223
2	8.913	MM	0.3645	1603.46533	73.32549	3.1777

3d (Table 2, entry 4): racemic



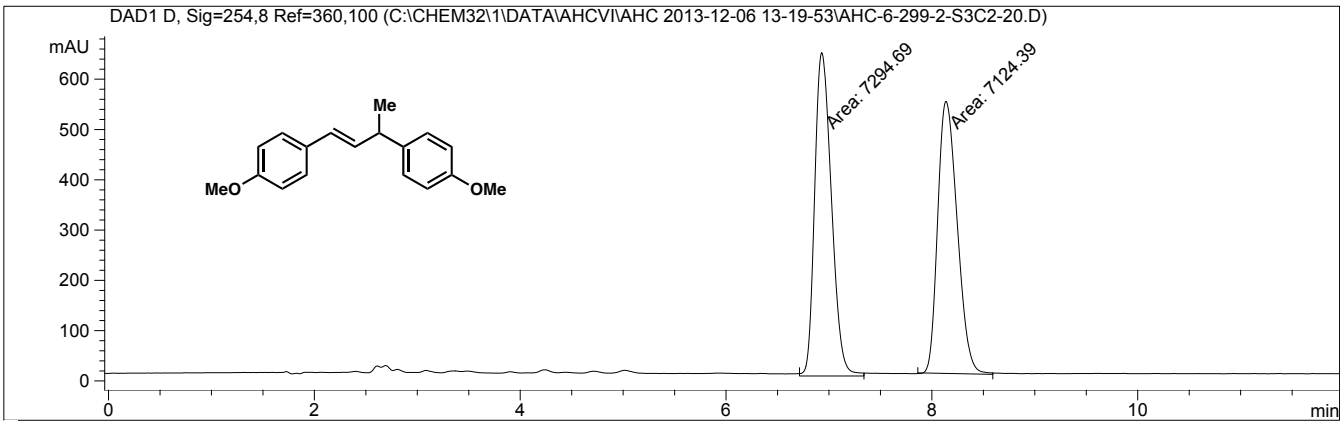
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.822	MM	0.3917	1.23108e4	523.83447	50.0978
2	11.079	MM	0.4482	1.22628e4	456.04102	49.9022

3d (Table 2, entry 4): enantioenriched, 85% ee



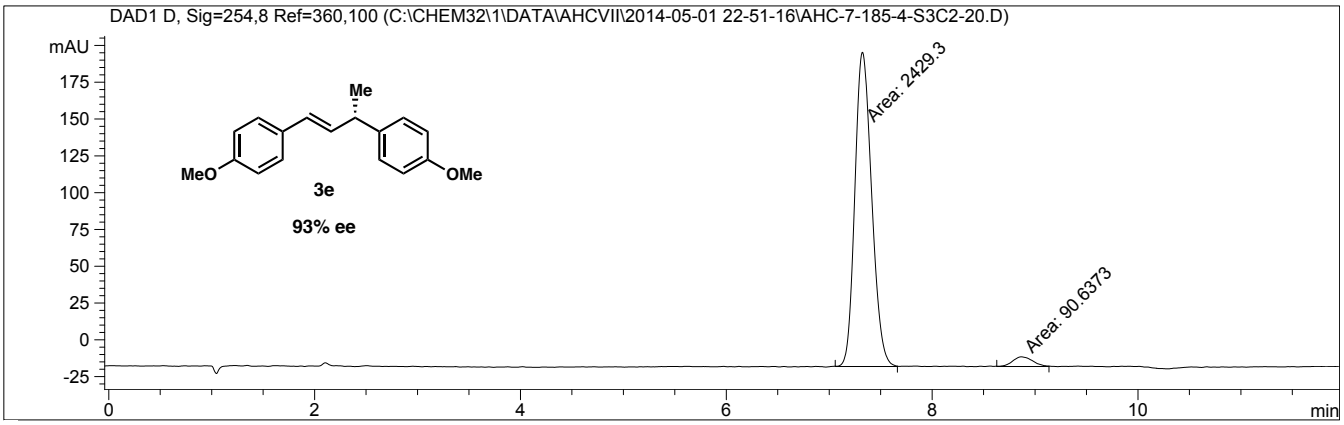
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.734	MM	0.3969	6733.94727	282.75232	92.5761
2	10.444	MM	0.4602	540.01031	19.55776	7.4239

3e (Table 2, entry 5): racemic



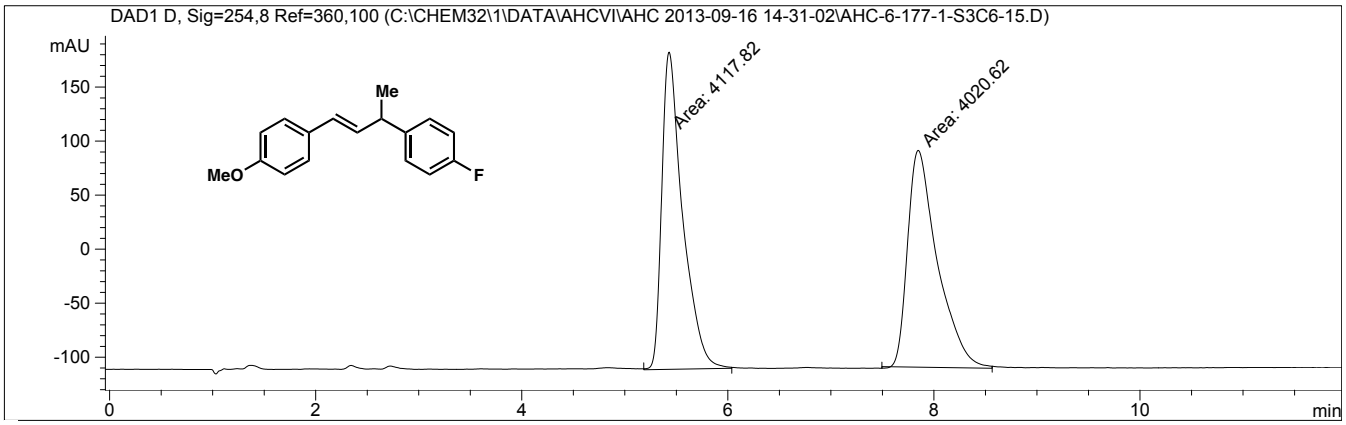
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.930	MM	0.1890	7294.69238	643.23810	50.5906
2	8.137	MM	0.2193	7124.38721	541.33319	49.4094

3e (Table 2, entry 5): enantioenriched, 93% ee



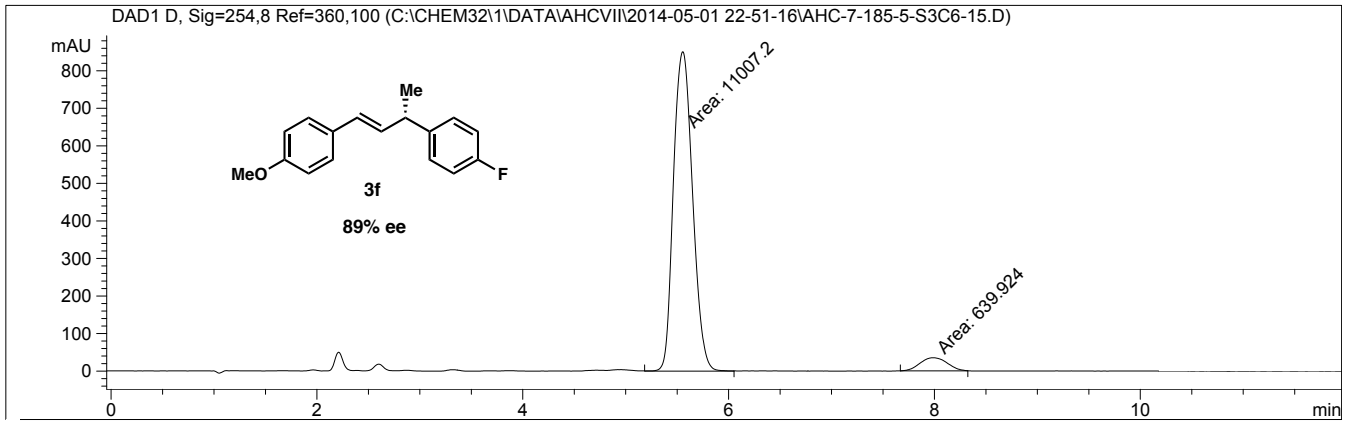
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.323	MM	0.1893	2429.29541	213.84731	96.4032
2	8.864	MM	0.2287	90.63728	6.60611	3.5968

3f (Table 2, entry 6): racemic



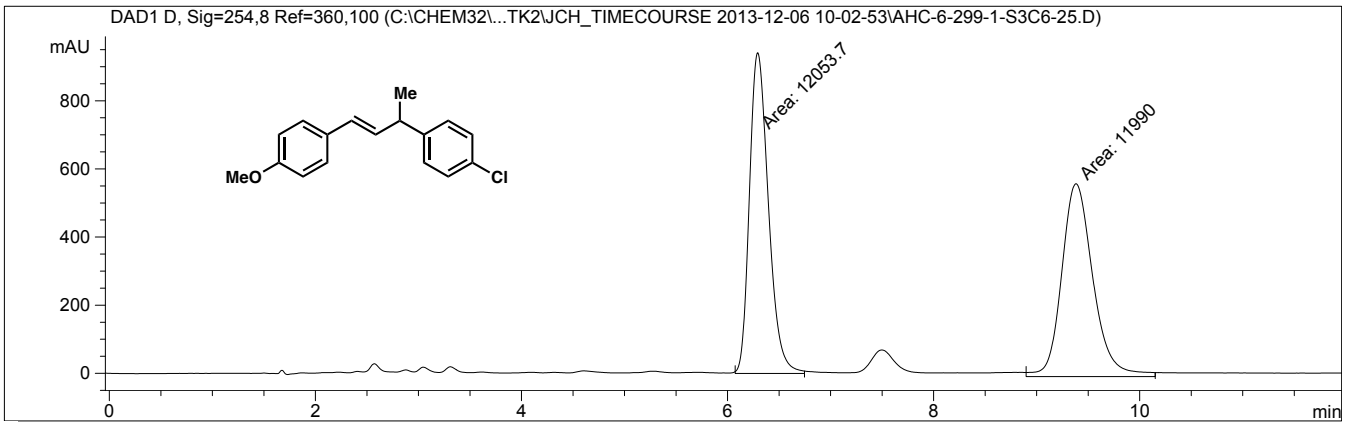
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.429	MM	0.2337	4117.82129	293.71591	50.5972
2	7.848	MM	0.3339	4020.61816	200.69434	49.4028

3f (Table 2, entry 6): enantioenriched, 89% ee



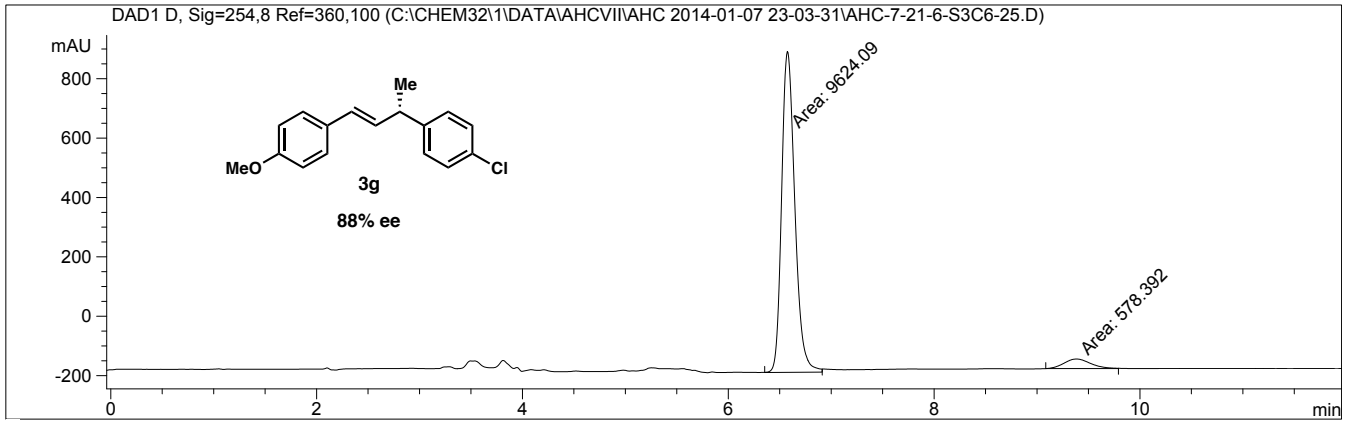
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.554	MM	0.2155	1.10072e4	851.35431	94.5057
2	7.988	MM	0.3047	639.92358	34.99786	5.4943

3g (Table 2, entry 7): racemic



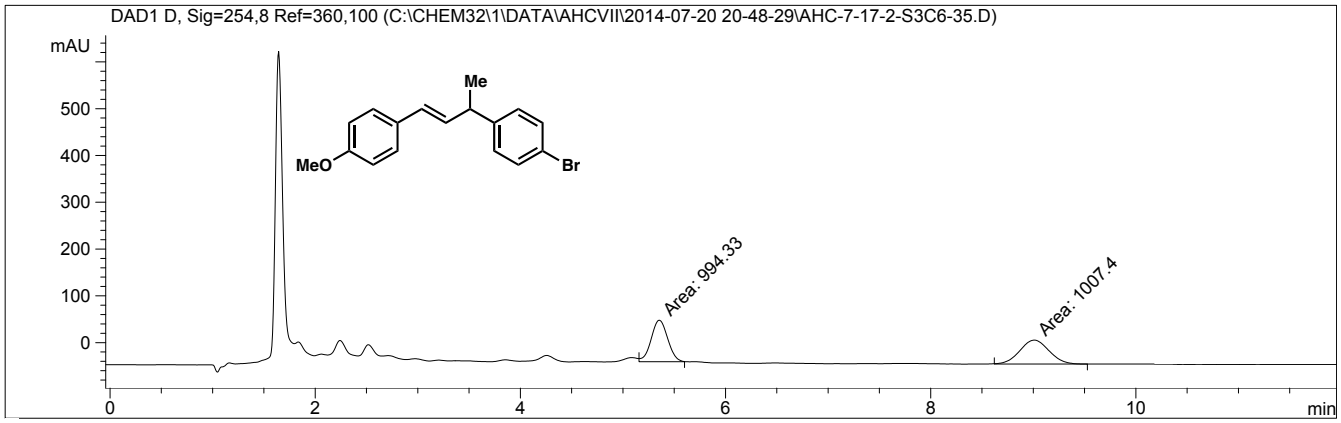
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.292	MM	0.2133	1.20537e4	941.72620	50.1325
2	9.381	MM	0.3530	1.19900e4	566.09015	49.8675

3g (Table 2, entry 7): enantioenriched, 88% ee



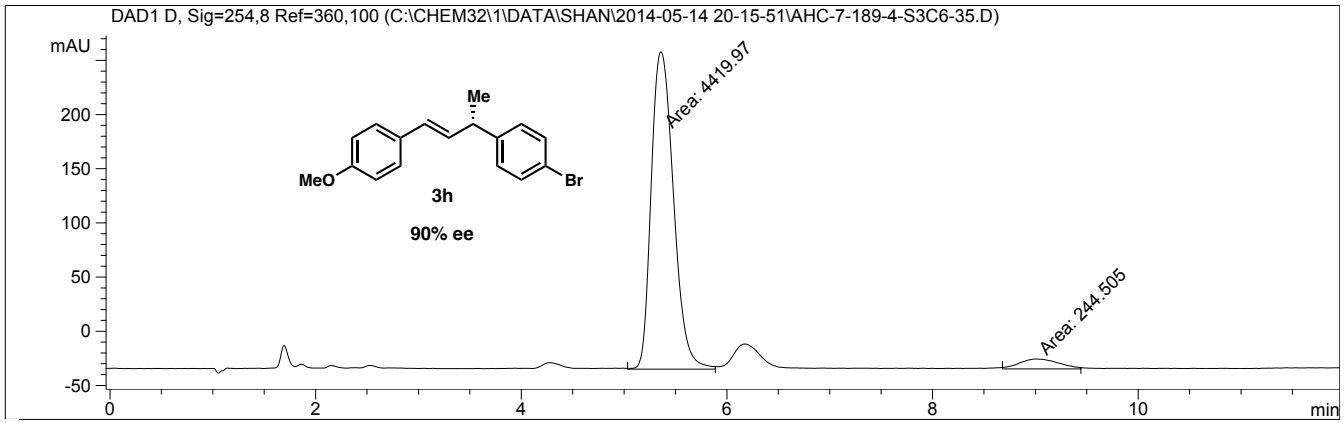
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.575	MM	0.1483	9624.08691	1081.90076	94.3309
2	9.384	MM	0.2997	578.39185	32.16311	5.6691

3h (Table 2, entry 8): racemic



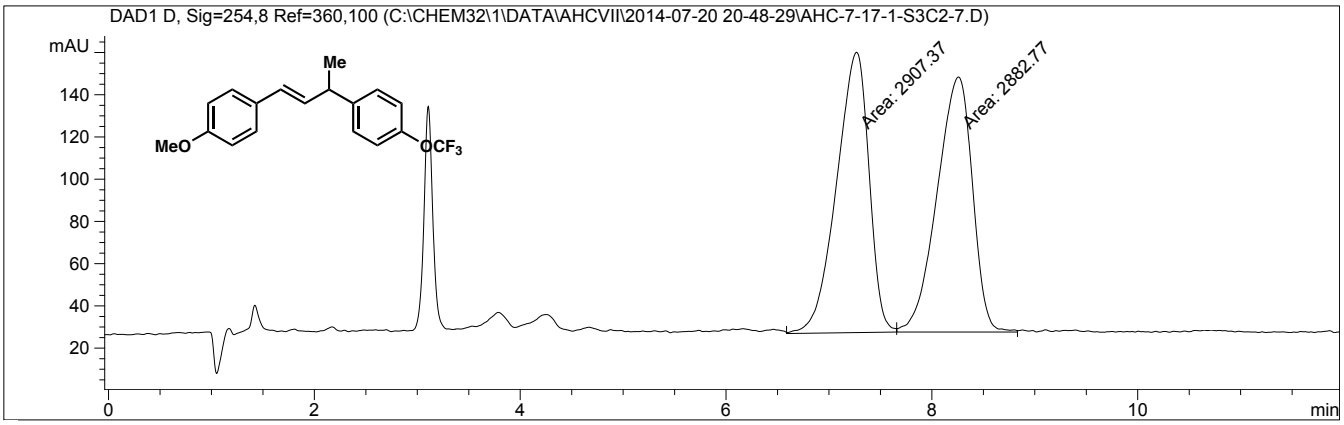
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.354	MM	0.1867	994.32965	88.77684	49.6736
2	9.010	MM	0.3286	1007.39520	51.08786	50.3264

3h (Table 2, entry 8): enantioenriched, 90% ee



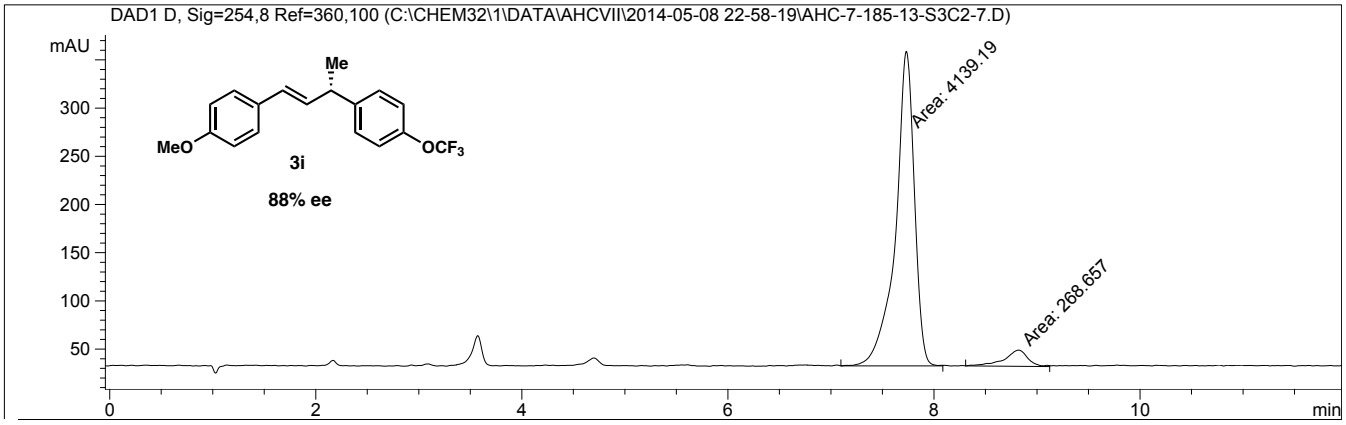
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.359	MM	0.2515	4419.97461	292.93845	94.7581
2	9.000	MM	0.4463	244.50519	9.13001	5.2419

3i (Table 2, entry 9): racemic



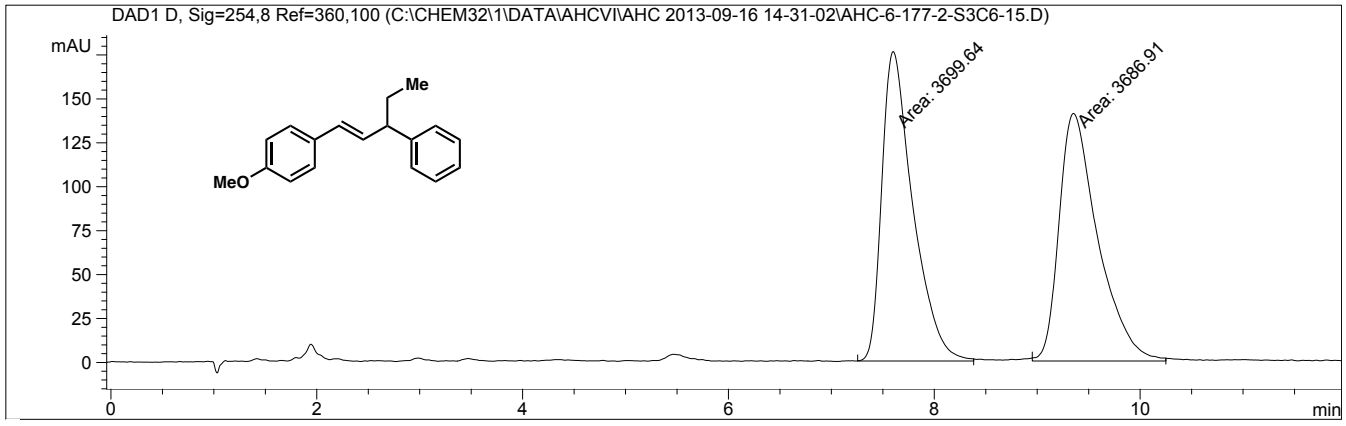
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.268	MM	0.3649	2907.36719	132.79340	50.2124
2	8.258	MM	0.3976	2882.76611	120.83252	49.7876

3i (Table 2, entry 9): enantioenriched, 88% ee



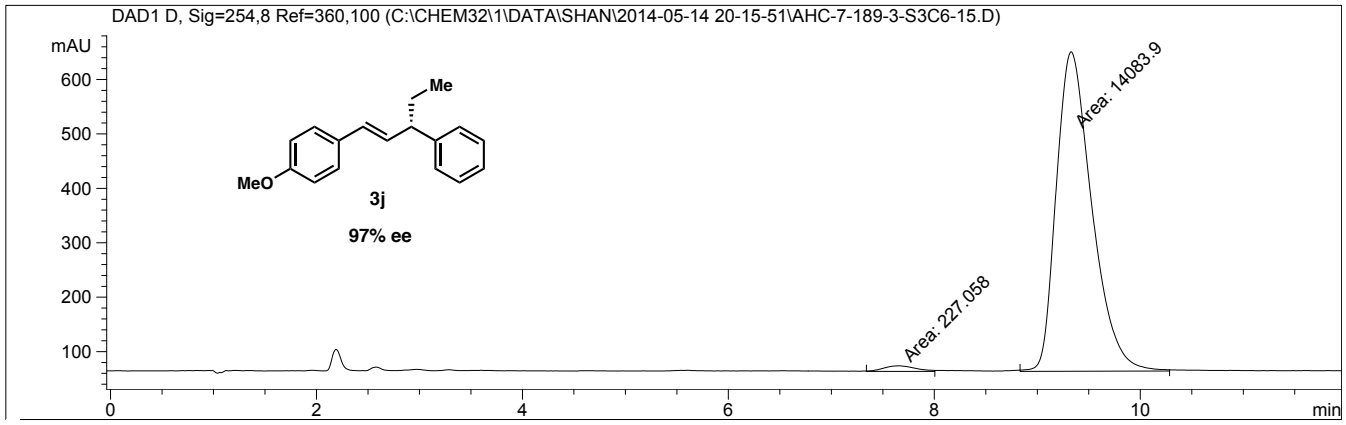
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.733	MM	0.2112	4139.18750	326.62589	93.9050
2	8.821	MM	0.2665	268.65671	16.80058	6.0950

3j (Table 2, entry 10): racemic



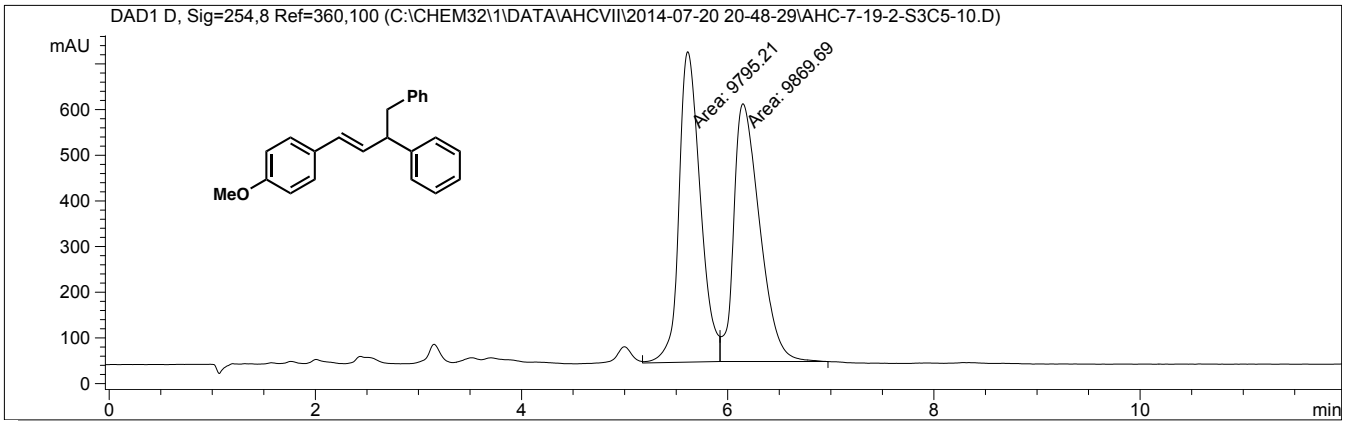
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.600	MM	0.3500	3699.64233	176.16603	50.0862
2	9.352	MM	0.4361	3686.90503	140.91353	49.9138

3j (Table 2, entry 10): enantioenriched, 97% ee



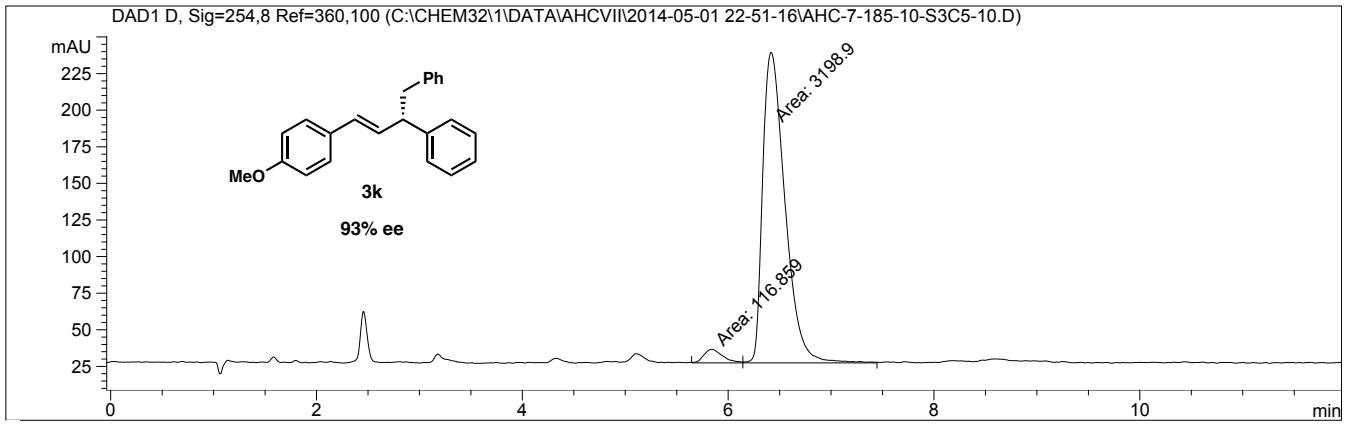
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.659	MM	0.3658	227.05769	10.34652	1.5866
2	9.329	MM	0.3998	1.40839e4	587.16370	98.4134

3k (Table 2, entry 11): racemic



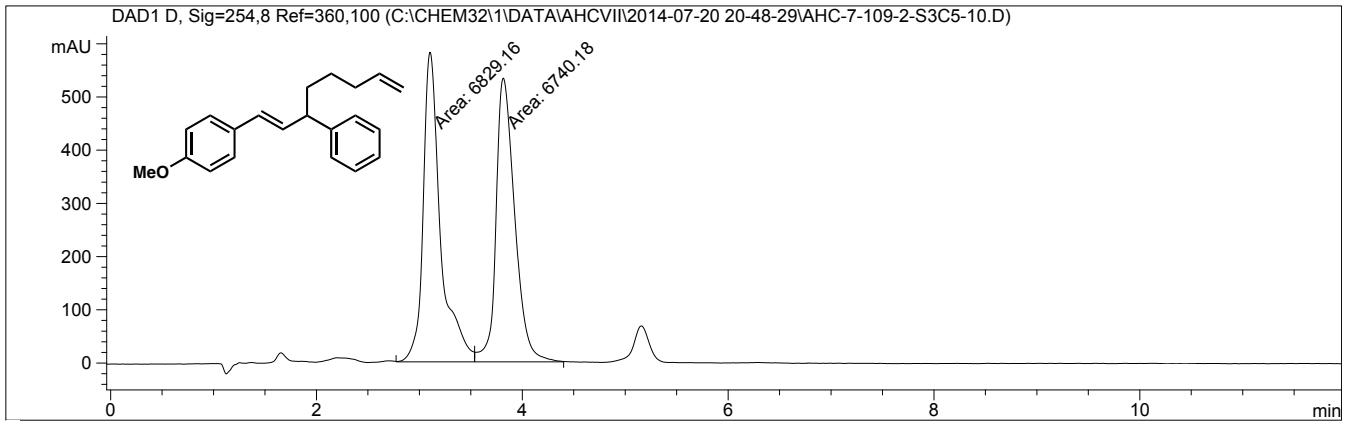
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.612	MM	0.2400	9795.21289	680.30035	49.8106
2	6.148	MM	0.2913	9869.69043	564.75275	50.1894

3k (Table 2, entry 11): enantioenriched, 93% ee



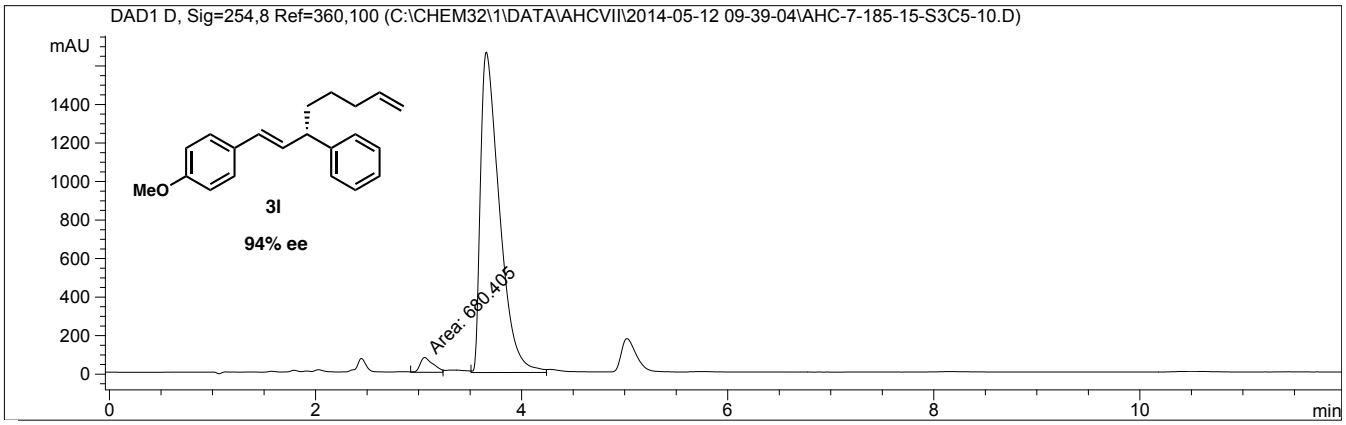
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.843	MM	0.2131	116.85924	9.14146	3.5244
2	6.416	MM	0.2513	3198.90405	212.16275	96.4756

3l (Table 2, entry 12): racemic



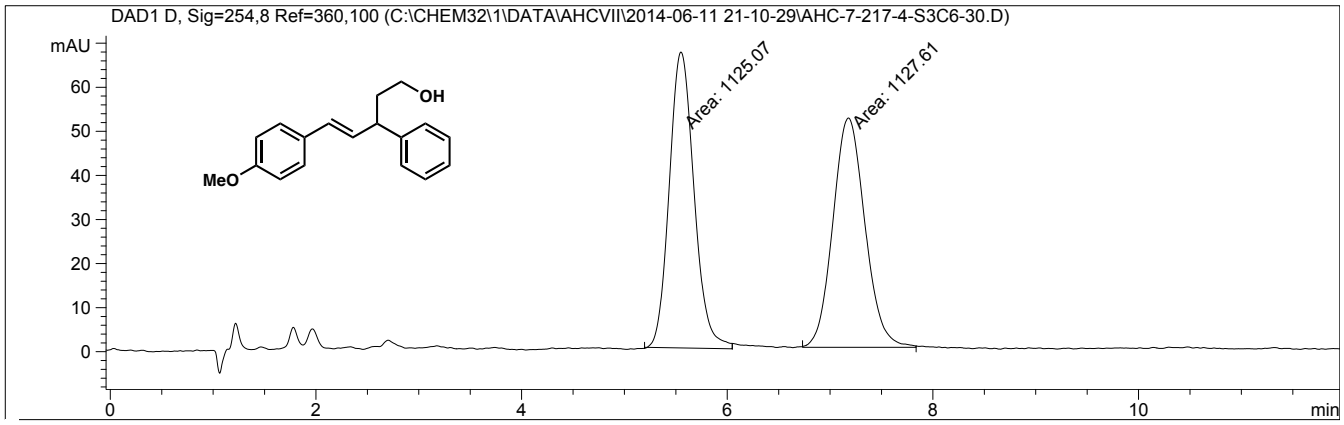
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.104	MM	0.1953	6829.15918	582.89142	50.3279
2	3.815	MM	0.2105	6740.18213	533.69666	49.6721

3l (Table 2, entry 12): enantioenriched, 94% ee



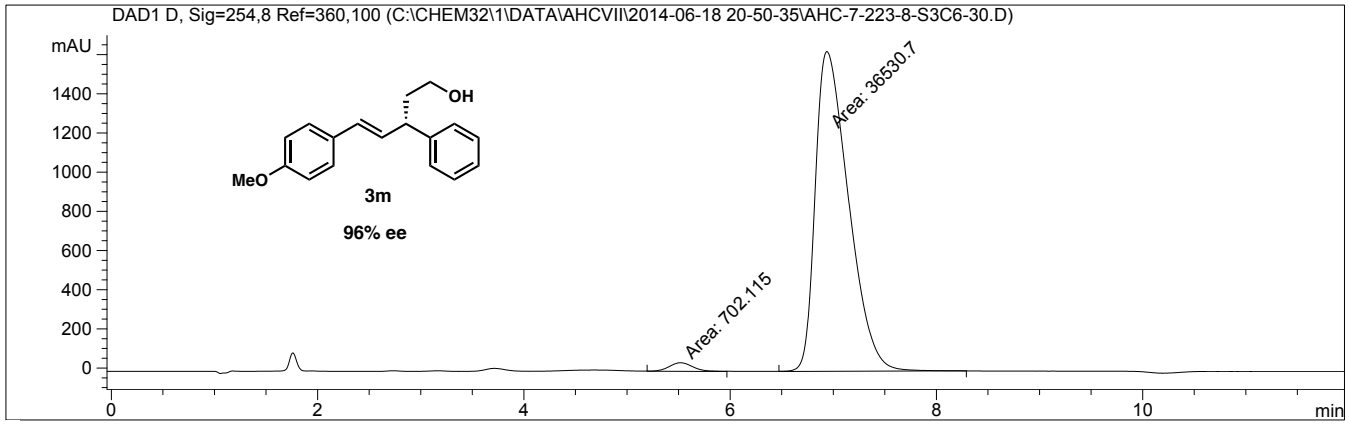
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.058	MM	0.1470	680.40527	77.13821	3.0921
2	3.659	VV	0.1956	2.13239e4	1663.29028	96.9079

3m (Table 2, entry 13): racemic



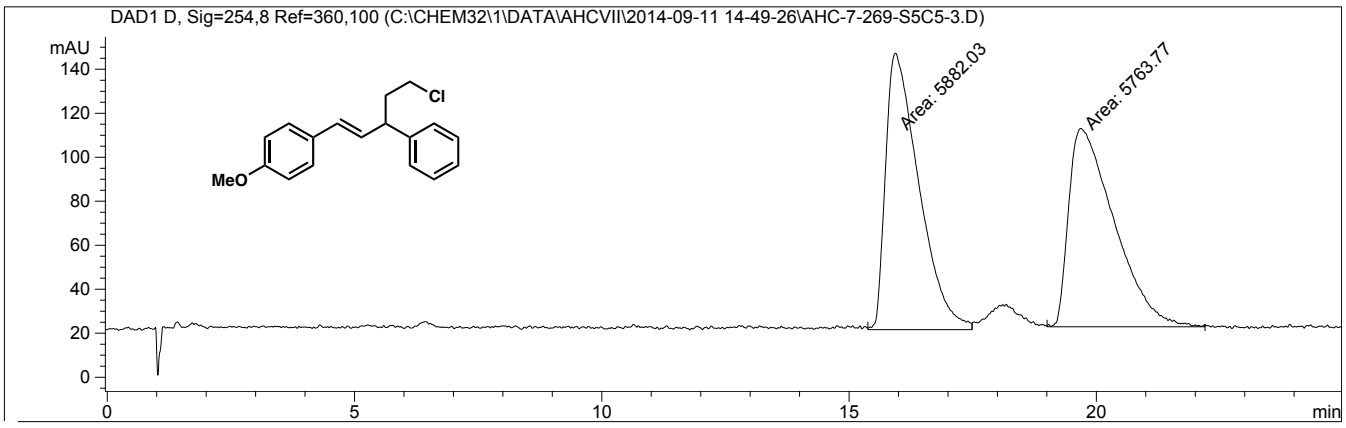
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.549	MM	0.2793	1125.06787	67.14302	49.9435
2	7.178	MM	0.3612	1127.61450	52.03247	50.0565

3m (Table 2, entry 13): enantioenriched, 96% ee



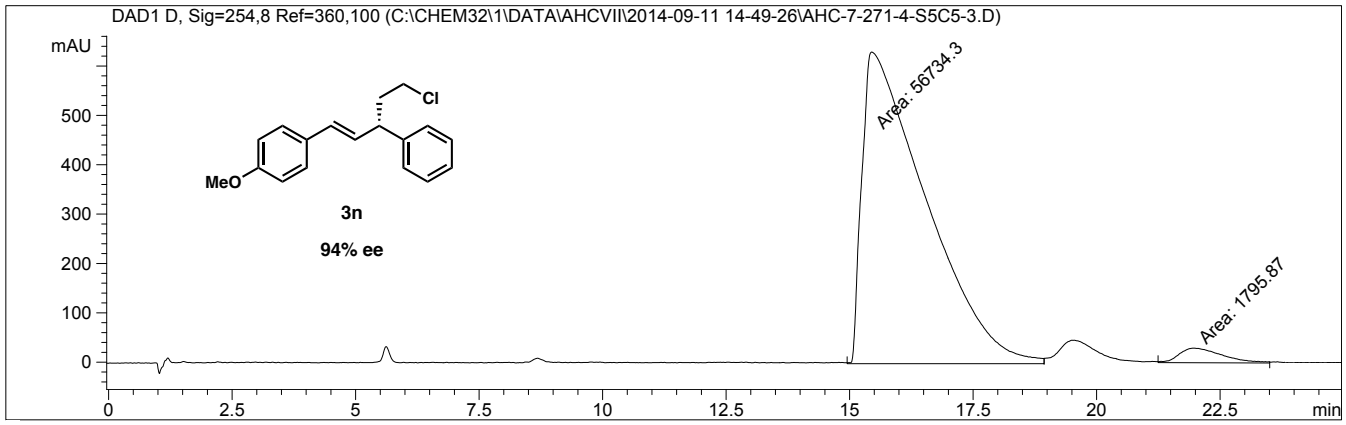
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.519	MM	0.2665	702.11481	43.90331	1.8857
2	6.938	MM	0.3729	3.65307e4	1632.66406	98.1143

3n (Table 2, entry 14): racemic



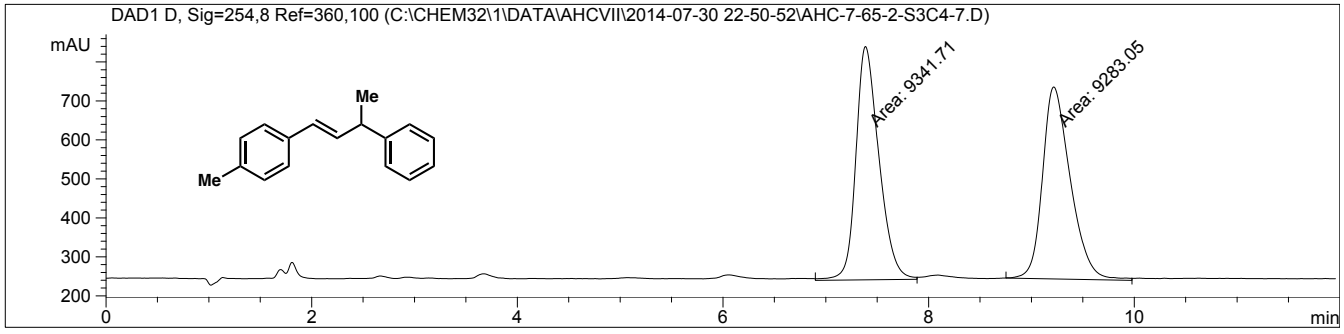
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.941	MM	0.7802	5882.02979	125.65482	50.5077
2	19.687	MM	1.0651	5763.77490	90.19390	49.4923

3n (Table 2, entry 14): enantioenriched, 94% ee



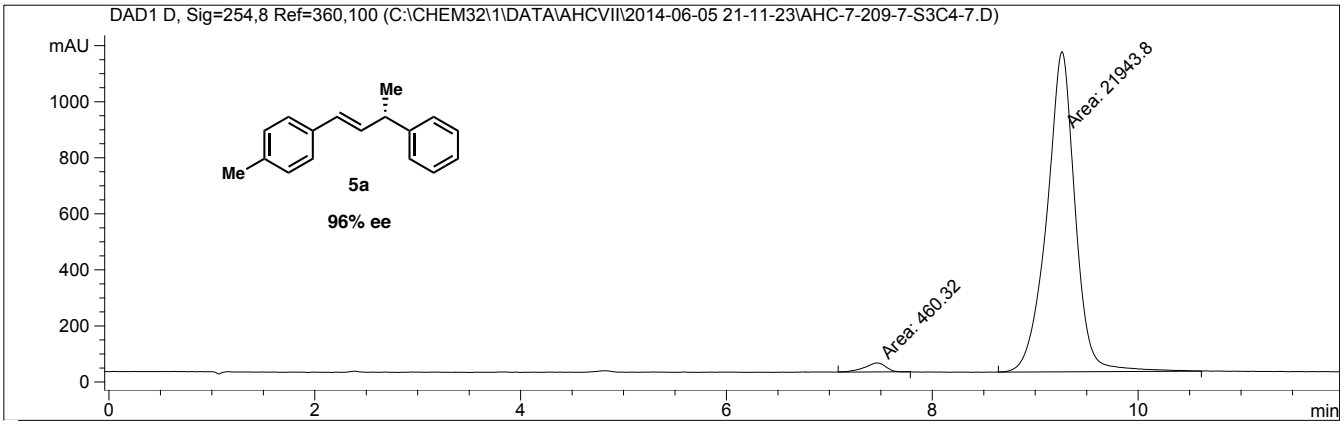
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.449	MM	1.4976	5.67343e4	631.38782	96.9317
2	21.994	MM	1.0162	1795.87158	29.45459	3.0683

5a (Table 3, entry 1): racemic



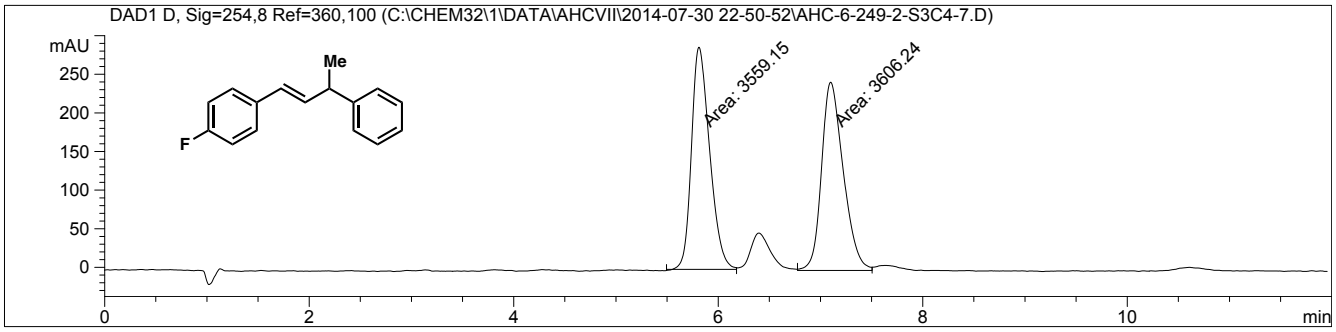
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.386	MM	0.2600	9341.71094	598.85675	50.1575
2	9.217	MM	0.3140	9283.04590	492.80606	49.8425

5a (Table 3, entry 1): enantioenriched, 96% ee



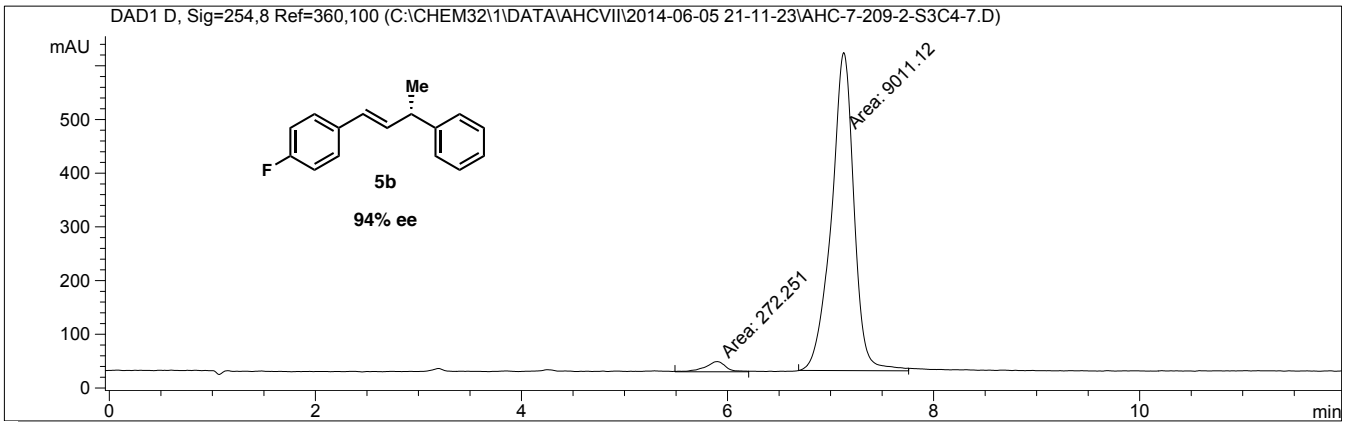
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.461	MM	0.2411	460.31961	31.82347	2.0546
2	9.260	MM	0.3201	2.19438e4	1142.71289	97.9454

5b (Table 3, entry 2): racemic



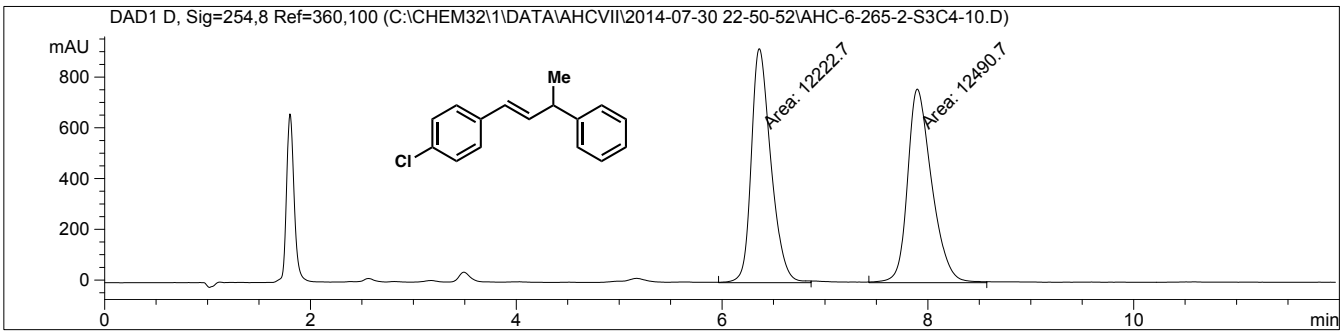
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.812	MM	0.2061	3559.15161	287.79590	49.6714
2	7.099	MM	0.2464	3606.24365	243.90446	50.3286

5b (Table 3, entry 2): enantioenriched, 94% ee



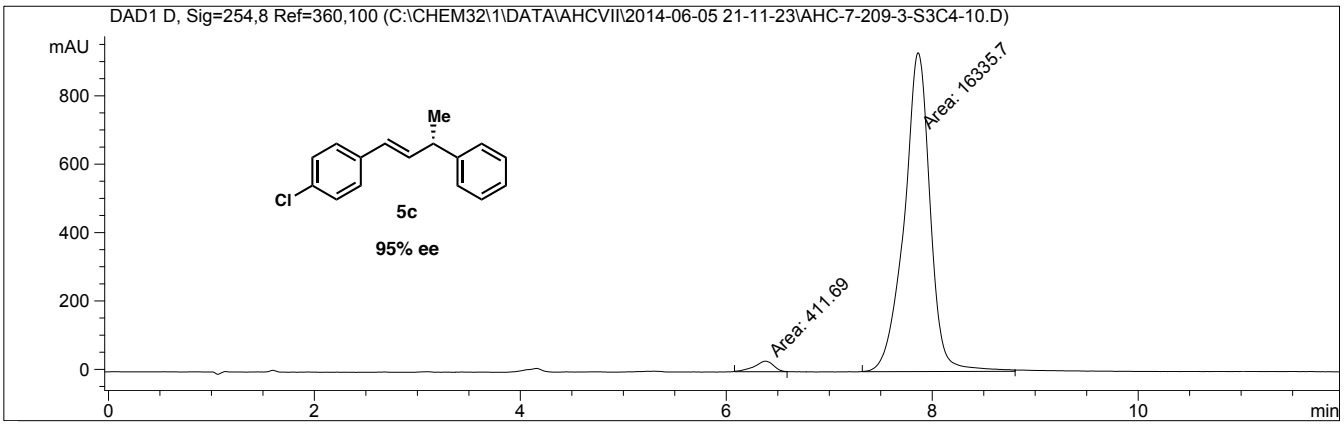
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.899	MM	0.2386	272.25067	19.01509	2.9327
2	7.128	MM	0.2536	9011.11523	592.32813	97.0673

5c (Table 3, entry 3): racemic



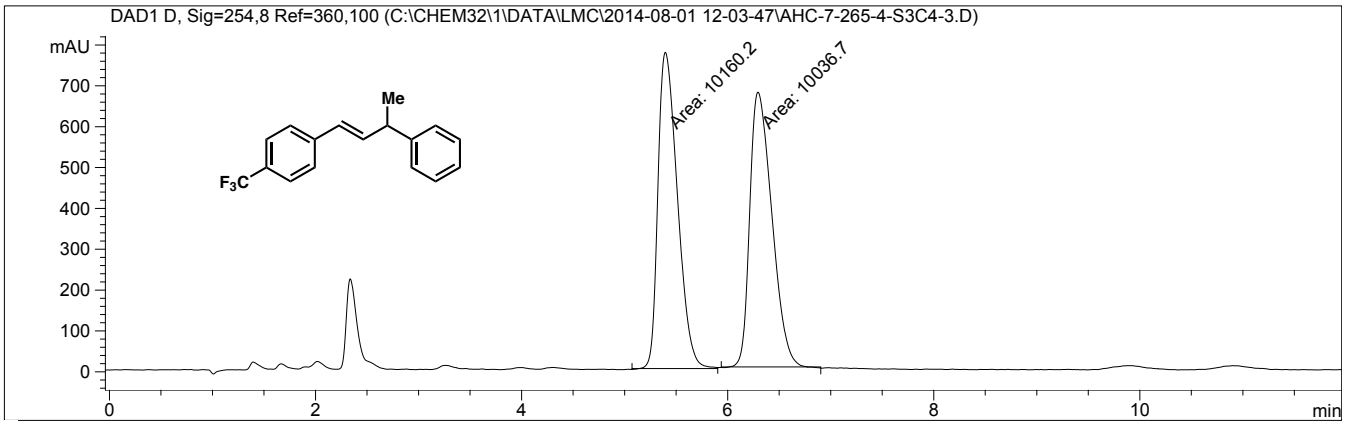
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.362	MM	0.2207	1.22227e4	922.92114	49.4580
2	7.898	MM	0.2727	1.24907e4	763.51147	50.5420

5c (Table 3, entry 3): enantioenriched, 95% ee



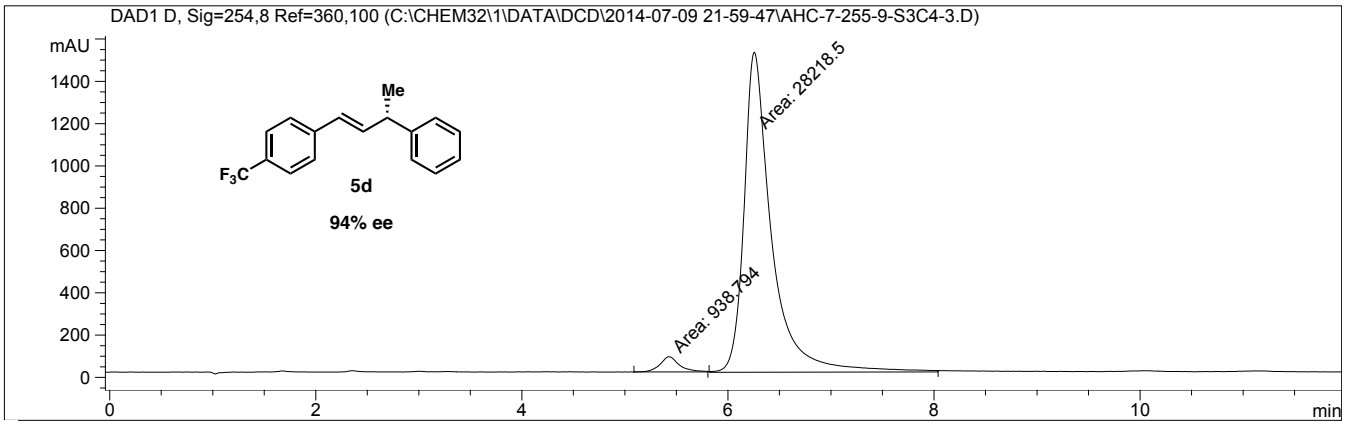
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.381	MM	0.2204	411.68973	31.13871	2.4582
2	7.864	MM	0.2918	1.63357e4	932.91962	97.5418

5d (Table 3, entry 4): racemic



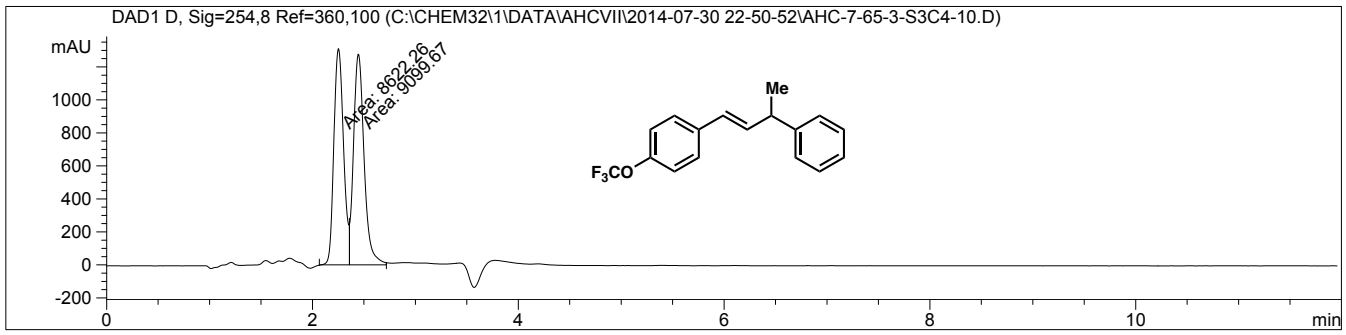
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.395	MM	0.2185	1.01602e4	774.91656	50.3057
2	6.295	MM	0.2484	1.00367e4	673.30627	49.6943

5d (Table 3, entry 4): enantioenriched, 94% ee



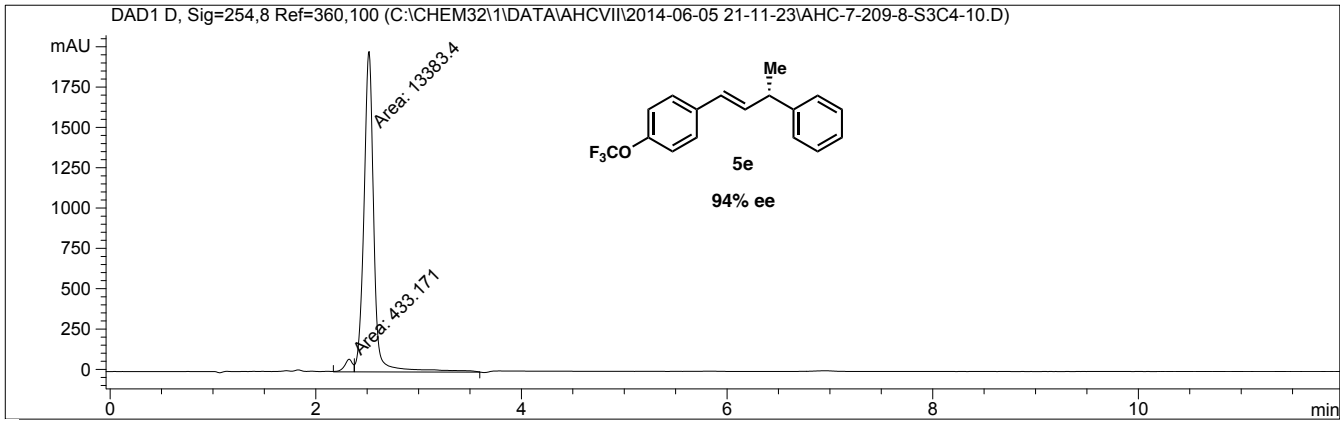
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.428	MM	0.2175	938.79395	71.92260	3.2198
2	6.256	MM	0.3107	2.82185e4	1513.67834	96.7802

5e (Table 3, entry 5): racemic



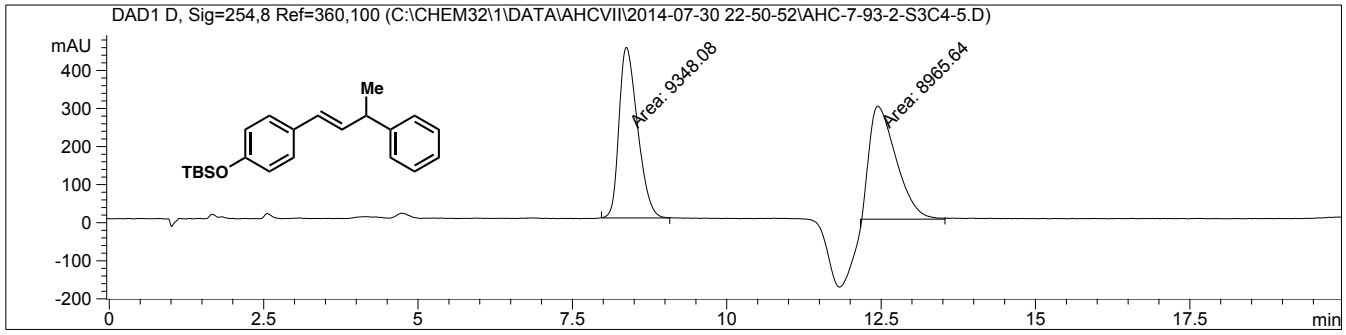
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.252	MM	0.1095	8622.25586	1312.58875	48.6531
2	2.446	MM	0.1185	9099.66504	1279.80774	51.3469

5e (Table 3, entry 5): enantioenriched, 94% ee



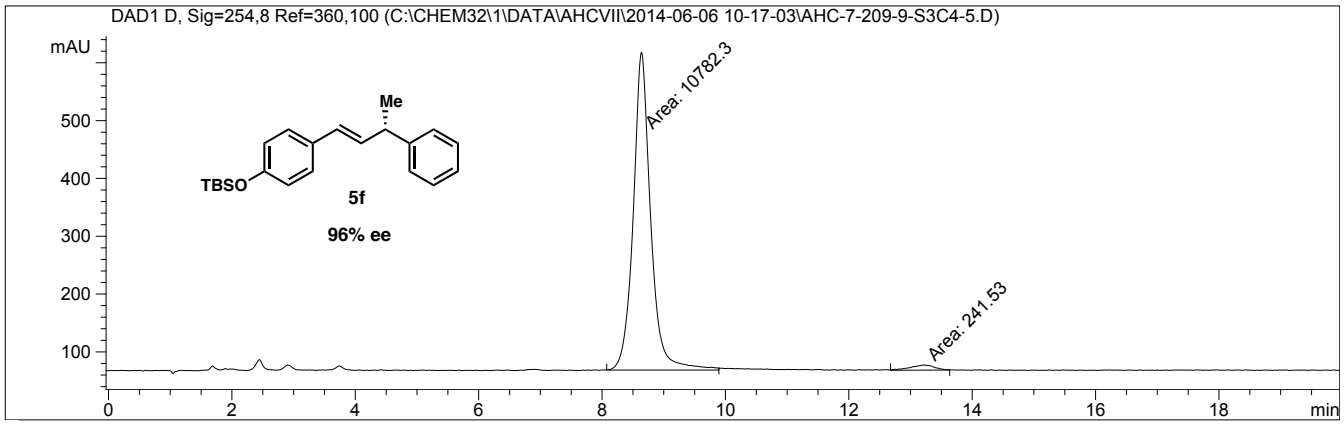
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.324	MM	0.0917	433.17111	78.69621	3.1352
2	2.517	MM	0.1119	1.33834e4	1993.22083	96.8648

5f (Table 3, entry 6): racemic



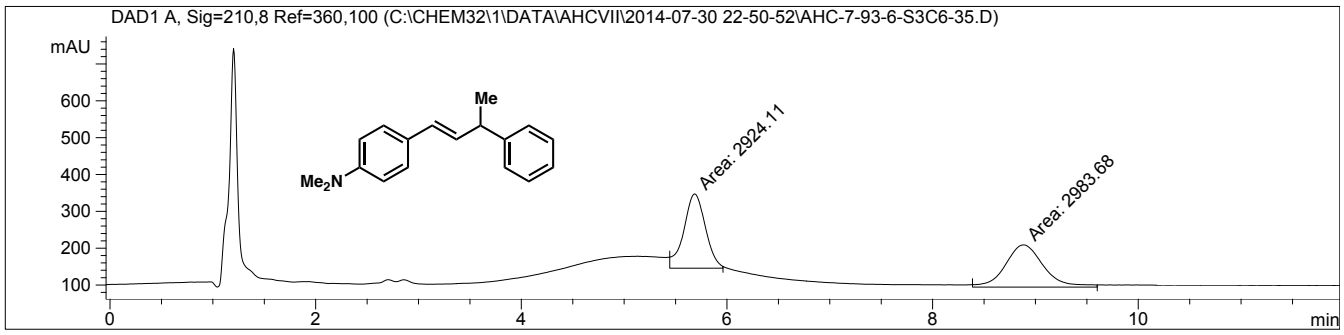
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.373	MM	0.3477	9348.08398	448.07748	51.0442
2	12.445	MM	0.5034	8965.63672	296.82007	48.9558

5f (Table 3, entry 6): enantioenriched, 96% ee



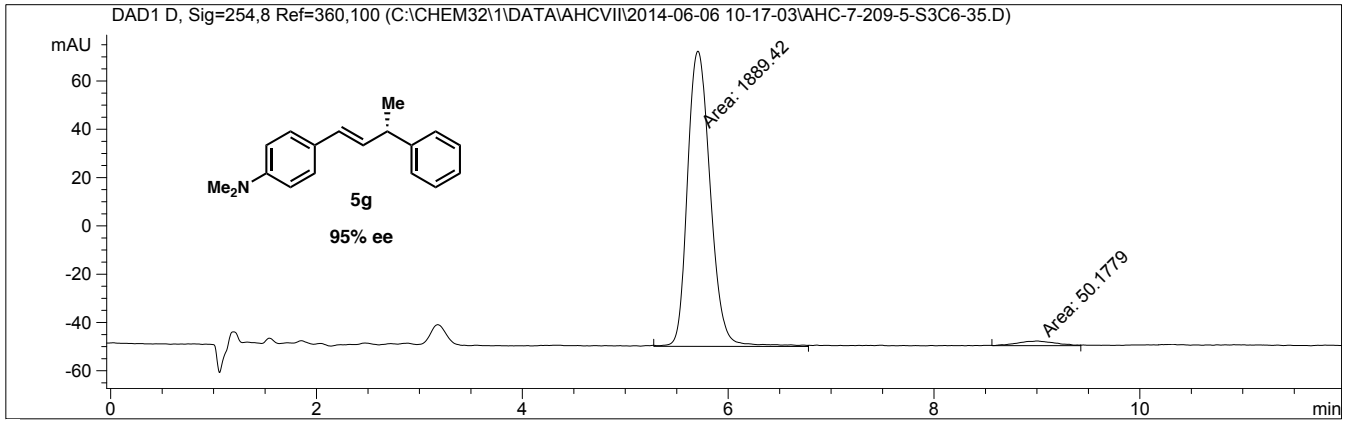
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.638	MM	0.3270	1.07823e4	549.47449	97.8090
2	13.210	MM	0.4557	241.52989	8.83361	2.1910

5g (Table 3, entry 7): racemic



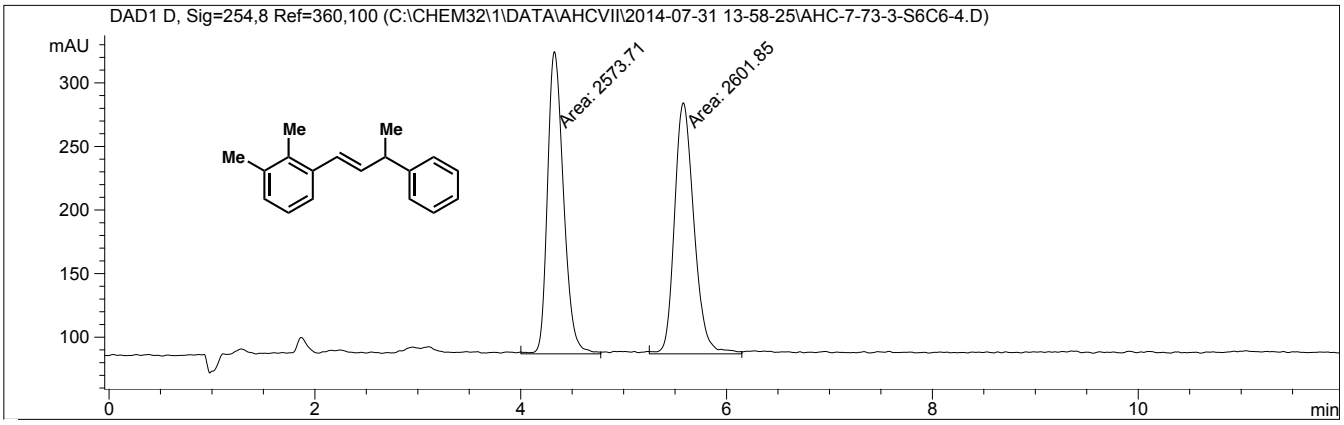
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.686	MM	0.2419	2924.10986	201.49109	49.4958
2	8.884	MM	0.4337	2983.68335	114.67265	50.5042

5g (Table 3, entry 7): enantioenriched, 95% ee



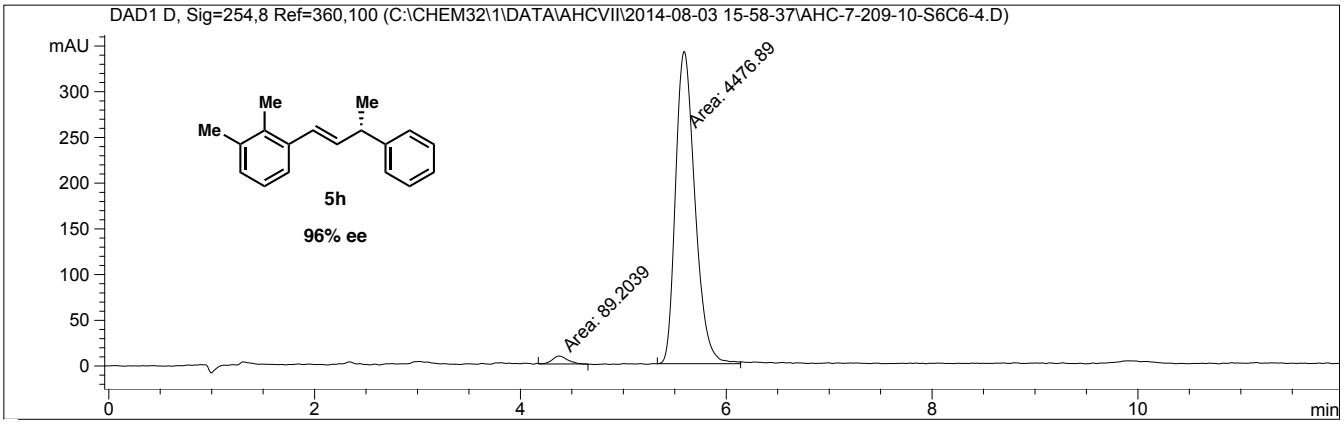
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.706	MM	0.2574	1889.41882	122.31673	97.4130
2	9.005	MM	0.4300	50.17793	1.94500	2.5870

5h (Table 3, entry 8): racemic



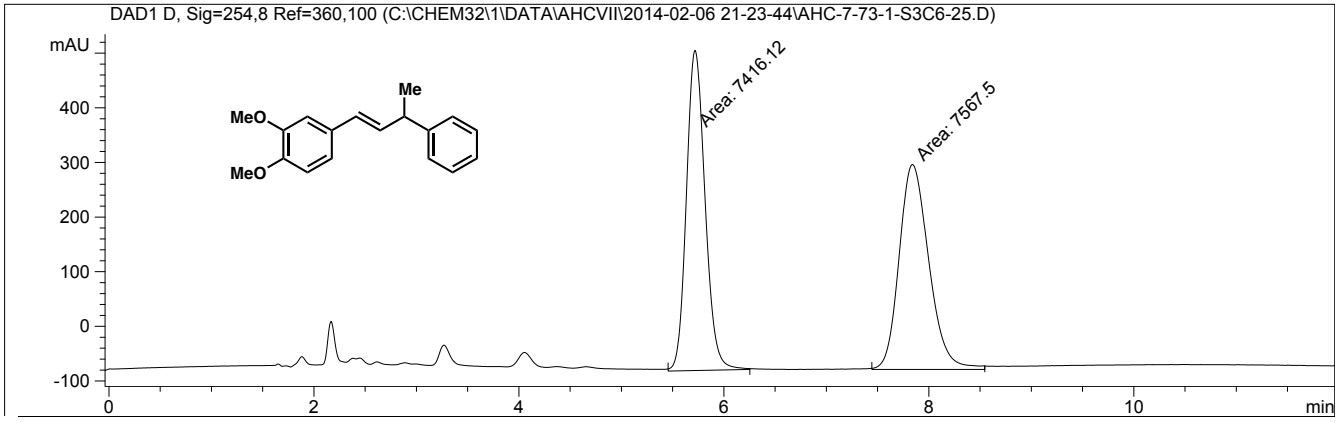
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.327	MM	0.1803	2573.70605	237.87602	49.7281
2	5.579	MM	0.2195	2601.85254	197.58577	50.2719

5h (Table 3, entry 8): enantioenriched, 96% ee



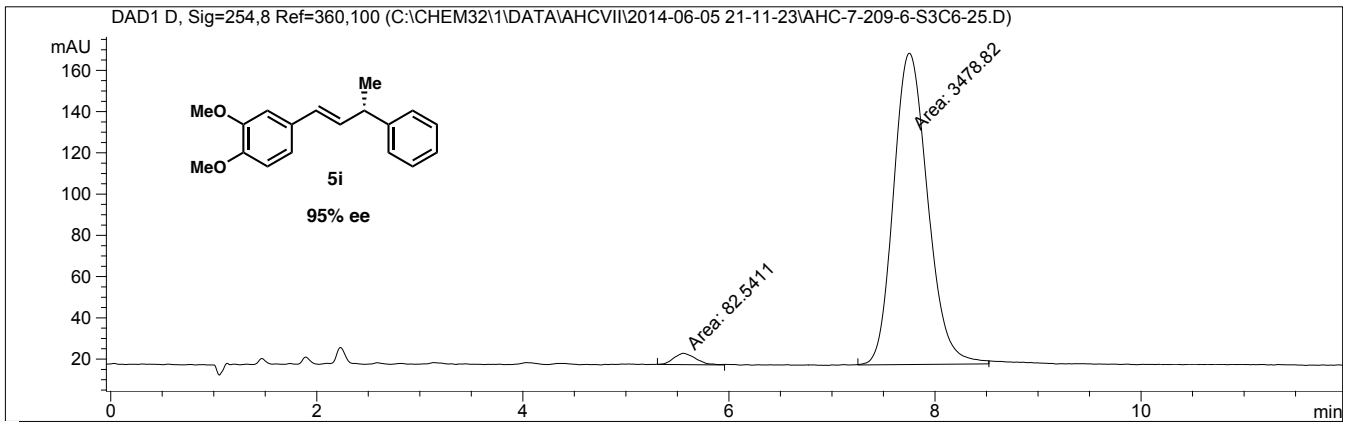
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.374	MM	0.1704	89.20393	8.72473	1.9536
2	5.590	MM	0.2184	4476.88916	341.59937	98.0464

5i (Table 3, entry 9): racemic



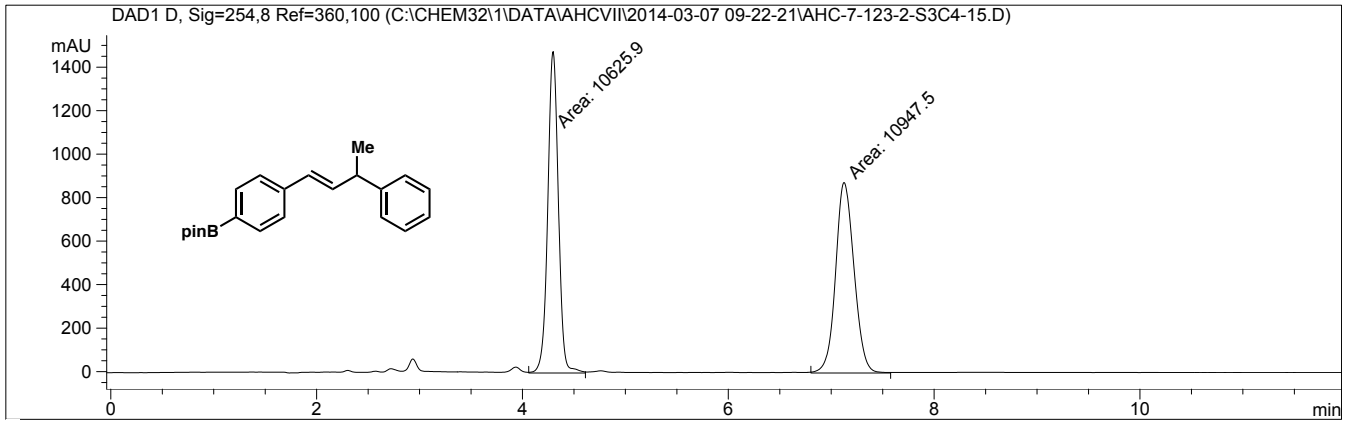
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.719	MM	0.2109	7416.11523	586.16187	49.4948
2	7.839	MM	0.3362	7567.49658	375.18320	50.5052

5i (Table 3, entry 9): enantioenriched, 95% ee



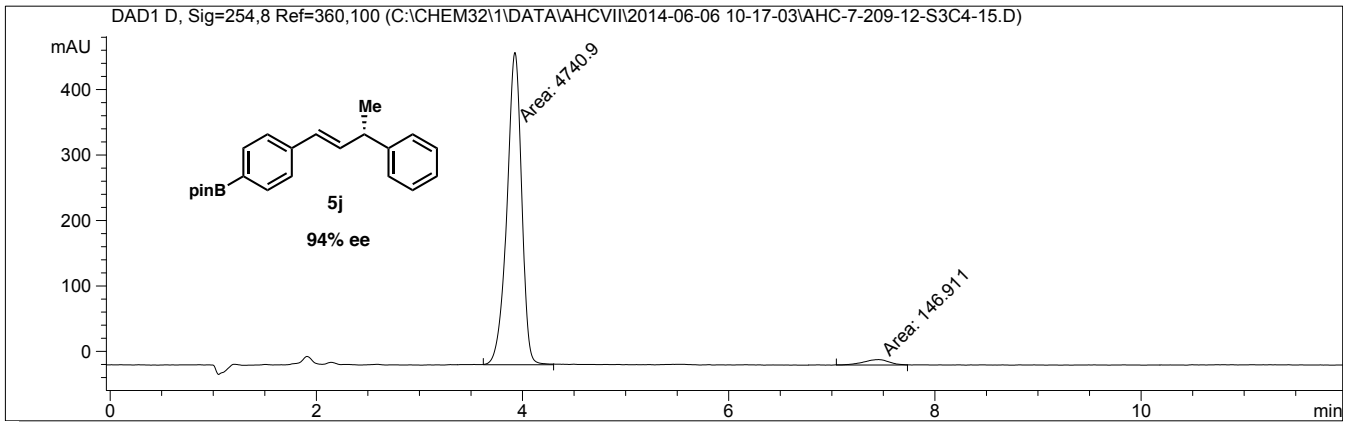
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.558	MM	0.2489	82.54113	5.52799	2.3177
2	7.751	MM	0.3840	3478.81641	150.97183	97.6823

5j (Table 3, entry 10): racemic



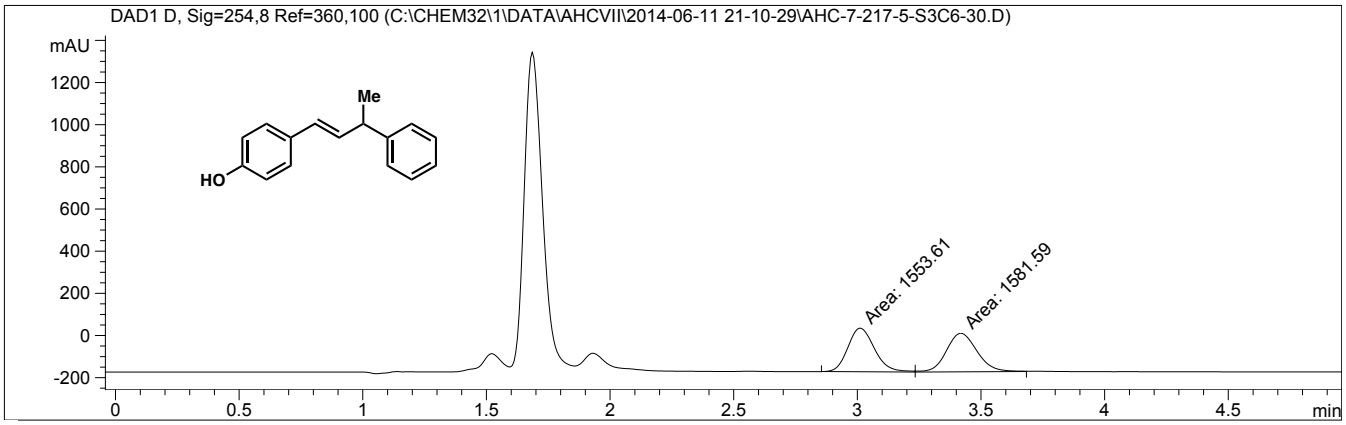
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.297	MM	0.1195	1.06259e4	1481.47107	49.2547
2	7.125	MM	0.2081	1.09475e4	876.78436	50.7453

5j (Table 3, entry 10): enantioenriched, 94% ee



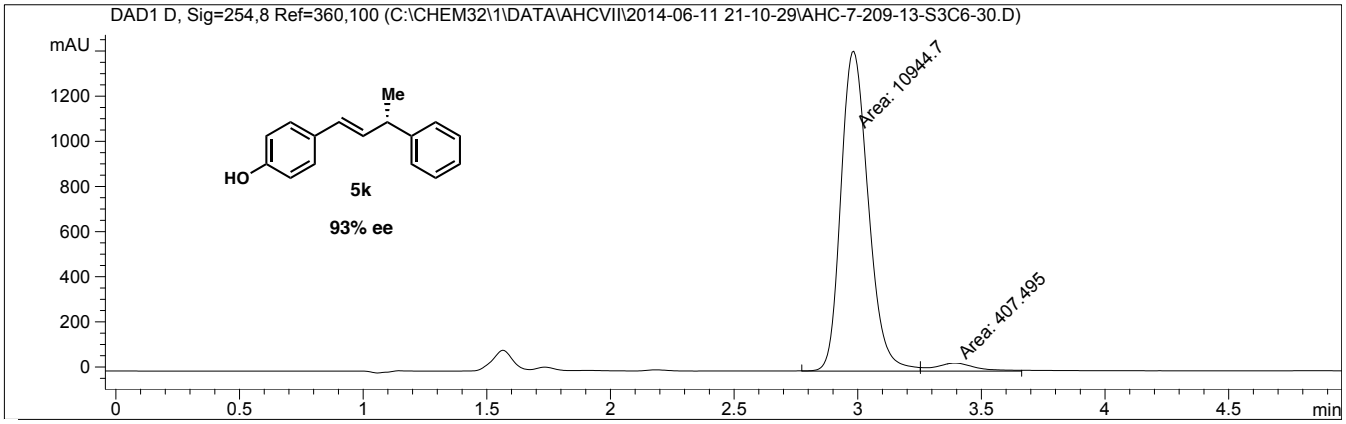
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.926	MM	0.1654	4740.90332	477.81689	96.9943
2	7.451	MM	0.2946	146.91095	8.30996	3.0057

5k (Table 3, entry 11): racemic



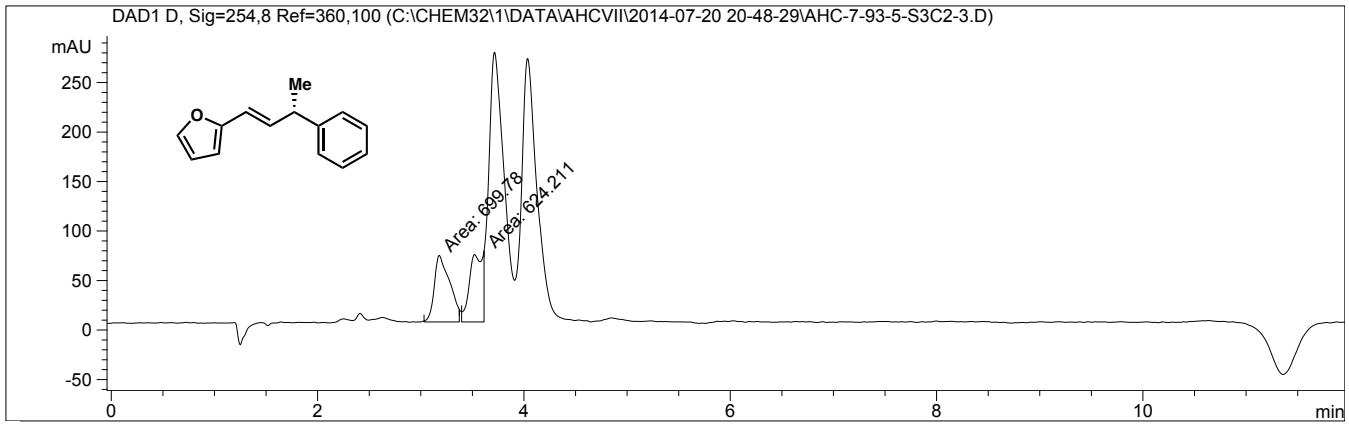
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.011	MM	0.1249	1553.60925	207.25208	49.5538
2	3.418	MM	0.1438	1581.58533	183.37068	50.4462

5k (Table 3, entry 11): enantioenriched, 93% ee



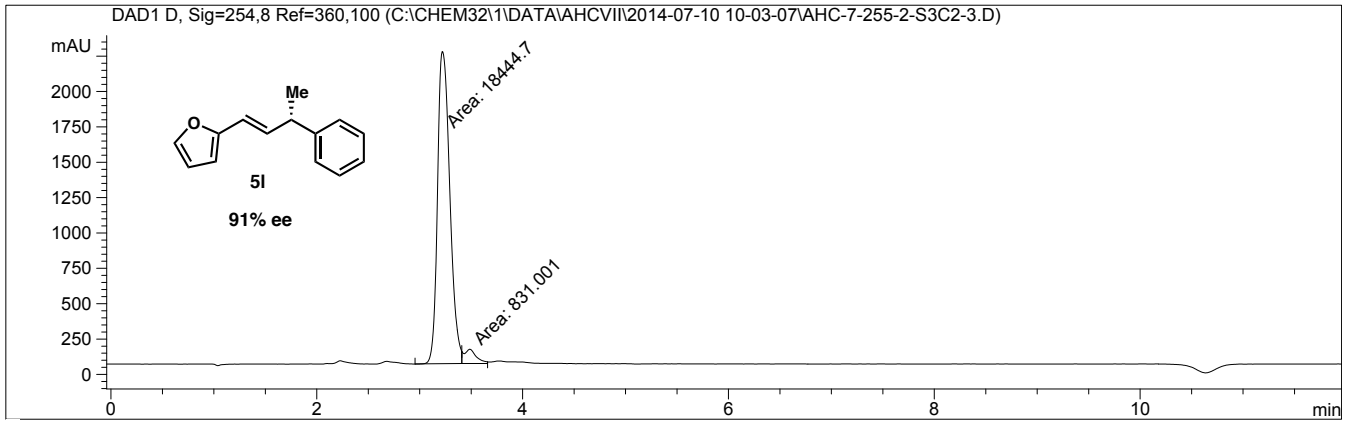
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	2.982	MM	0.1285	1.09447e4	1419.67334	96.4104
2	3.392	MM	0.1893	407.49545	35.88238	3.5896

5l (Scheme 1): racemic



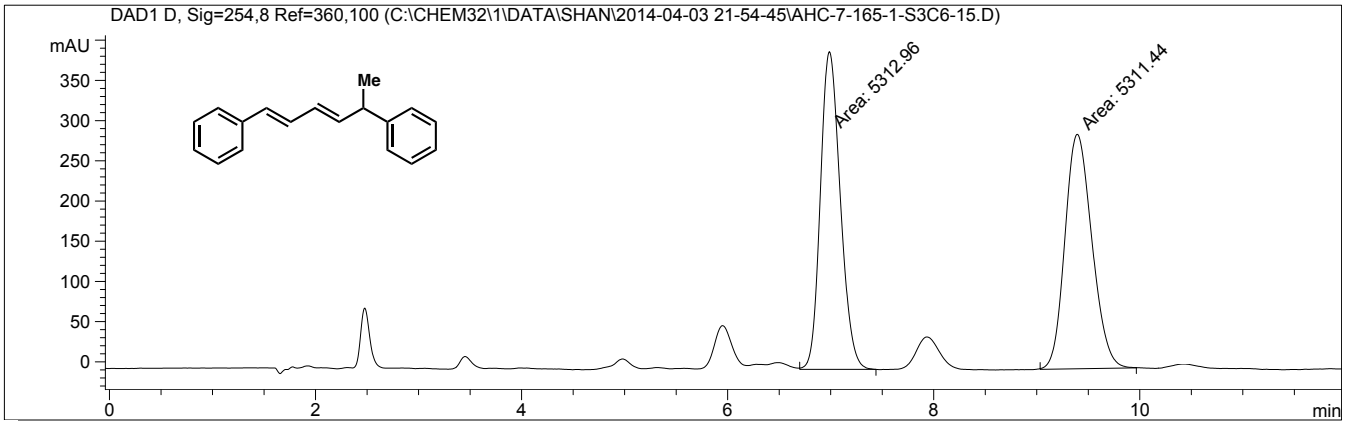
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.178	MM	0.1734	699.77979	67.27696	52.8538
2	3.611	MM	0.1474	624.21143	70.55936	47.1462

51 (Scheme 1): enantioenriched, 91% ee



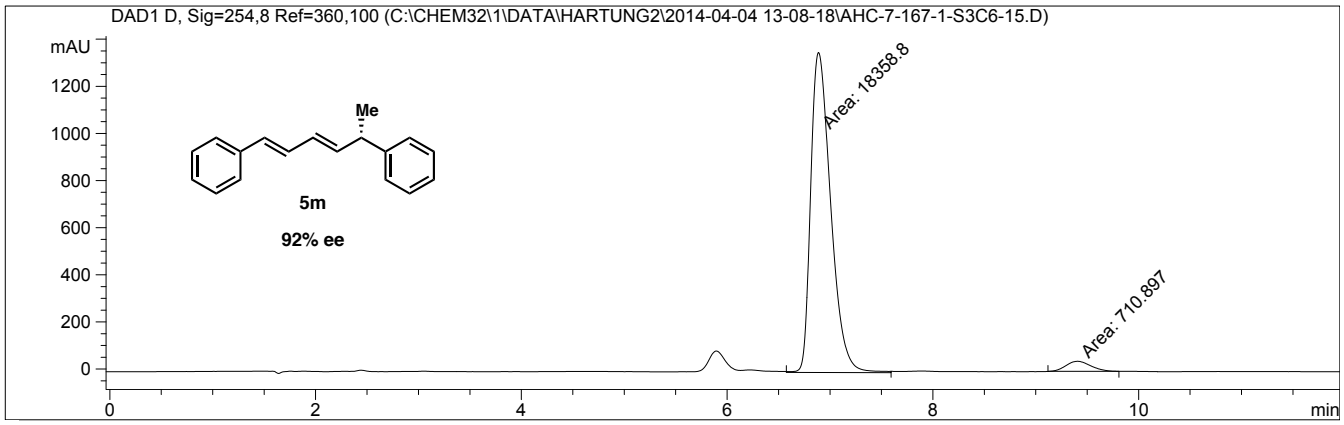
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	3.220	MM	0.1391	1.84447e4	2209.27100	95.6889
2	3.487	MM	0.1366	831.00092	101.37794	4.3111

5m (Scheme 1): racemic



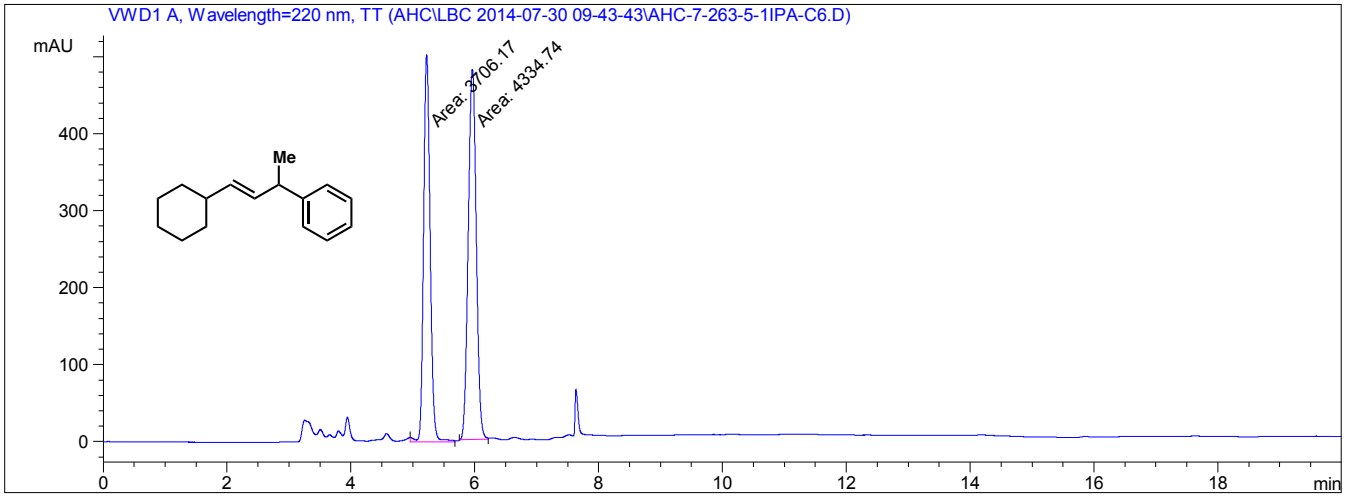
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.987	MM	0.2241	5312.95996	395.21527	50.0072
2	9.393	MM	0.3035	5311.43506	291.66327	49.9928

5m (Scheme 1): enantioenriched, 92% ee



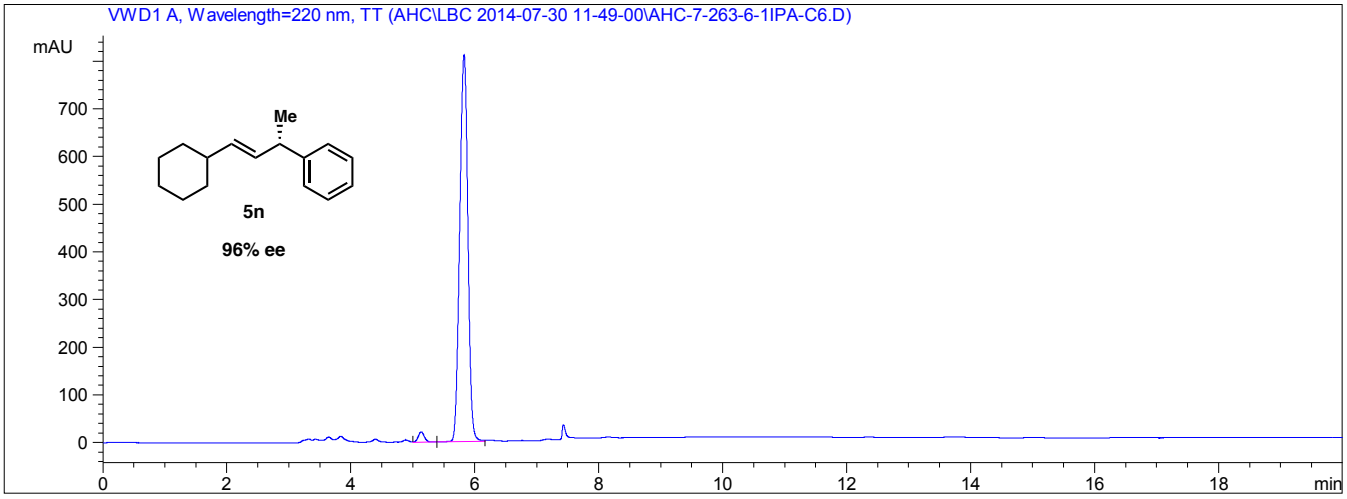
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.889	MM	0.2251	1.83588e4	1359.02136	96.2721
2	9.404	MM	0.2780	710.89673	42.61983	3.7279

5n (Scheme 1): racemic



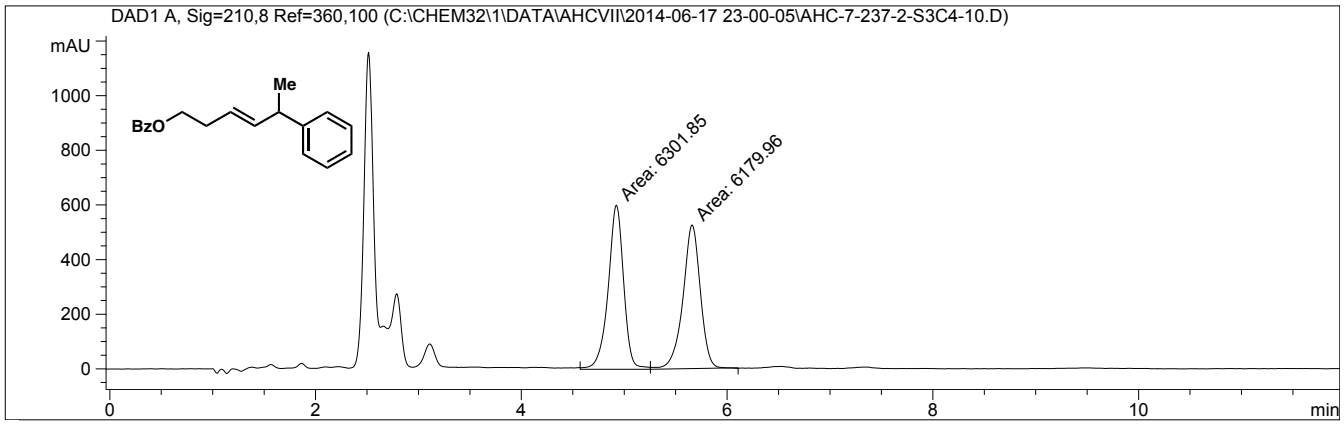
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	5.224	MM	0.1228	3706.16968	503.21298	46.0914
2	5.962	MM	0.1500	4334.74365	481.51410	53.9086

5n (Scheme 1): enantioenriched, 96% ee



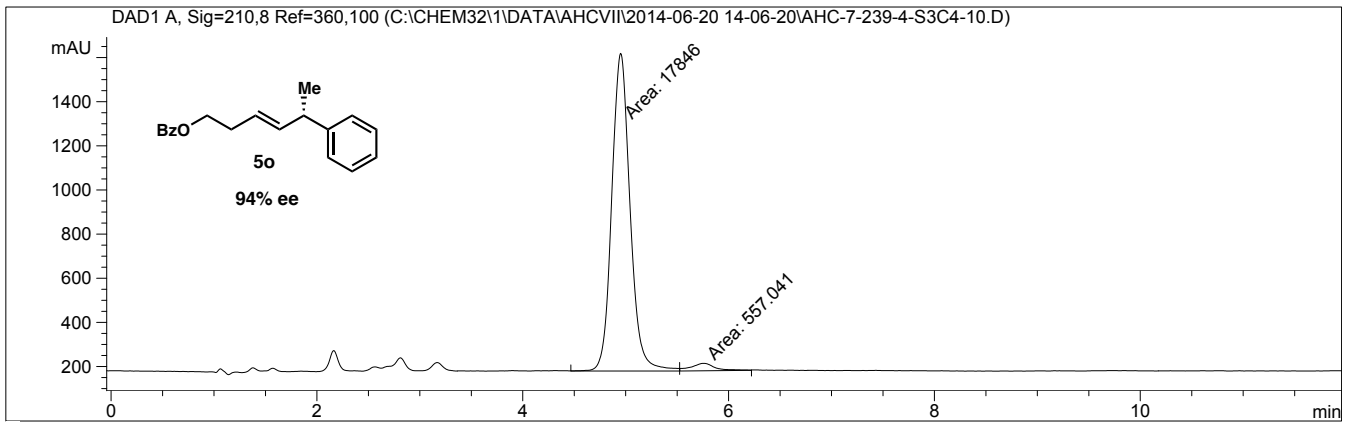
Peak #	RetTime [min]	Type	Width [min]	Area mAU *s	Height [mAU]	Area %
1	5.135	VV	0.1050	148.14879	21.73537	1.9461
2	5.828	VV	0.1459	7464.48193	811.72534	98.0539

5o (Scheme 1): racemic



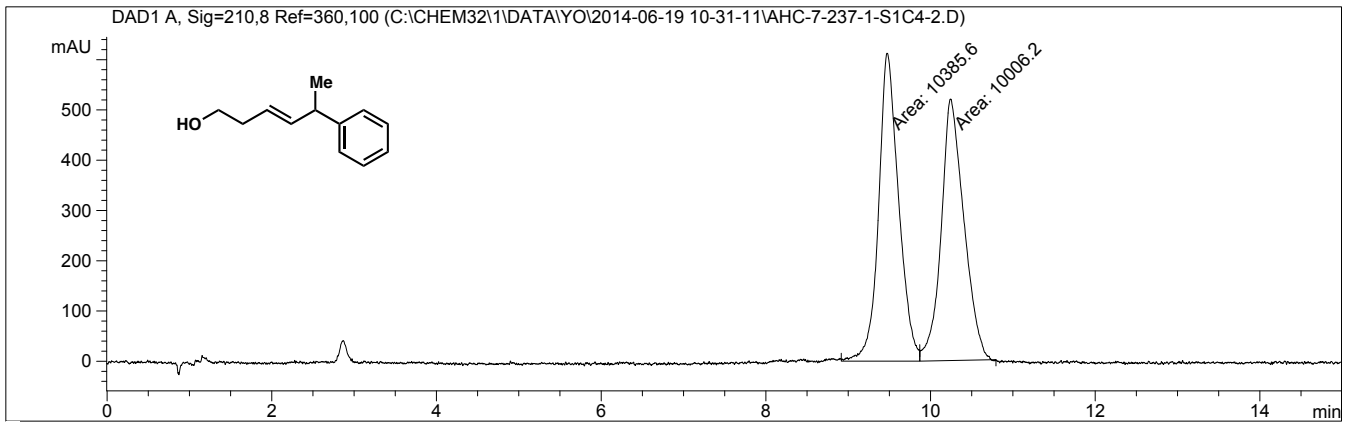
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.924	MM	0.1744	6301.85156	602.20233	50.4883
2	5.660	MM	0.1955	6179.95850	526.80280	49.5117

5o (Scheme 1): enantioenriched, 94% ee



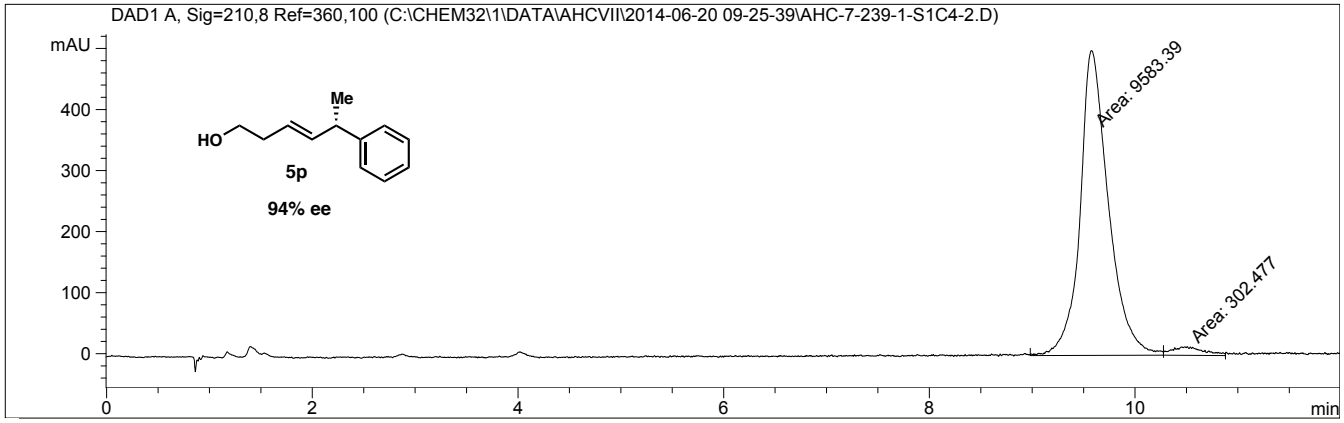
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	4.951	MM	0.2063	1.78460e4	1441.90649	96.9731
2	5.755	MM	0.2719	557.04138	34.14230	3.0269

5p (Scheme 1): racemic



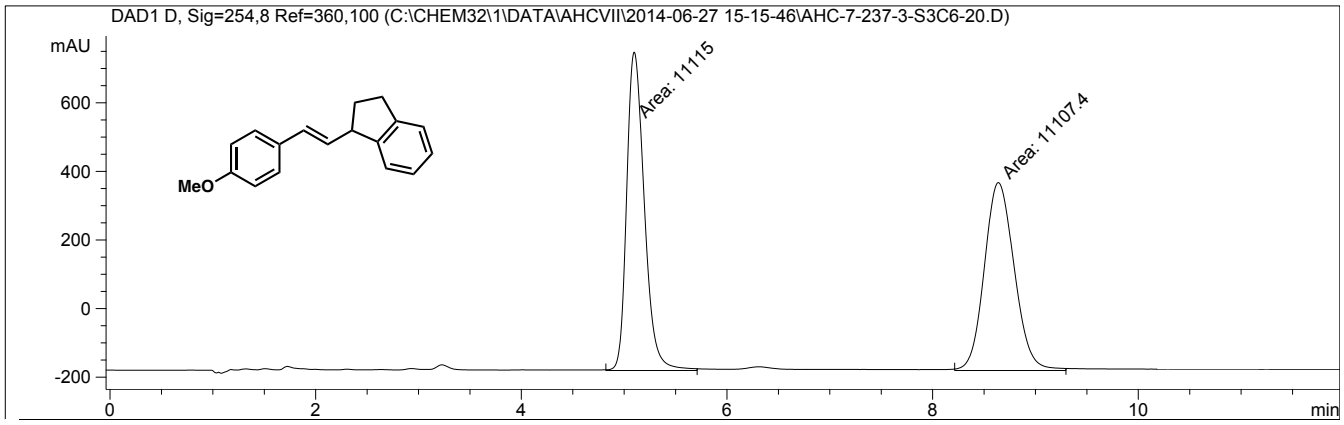
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.474	MM	0.2823	1.03856e4	613.19647	50.9302
2	10.244	MM	0.3204	1.00062e4	520.49475	49.0698

5p (Scheme 1): enantioenriched, 94% ee



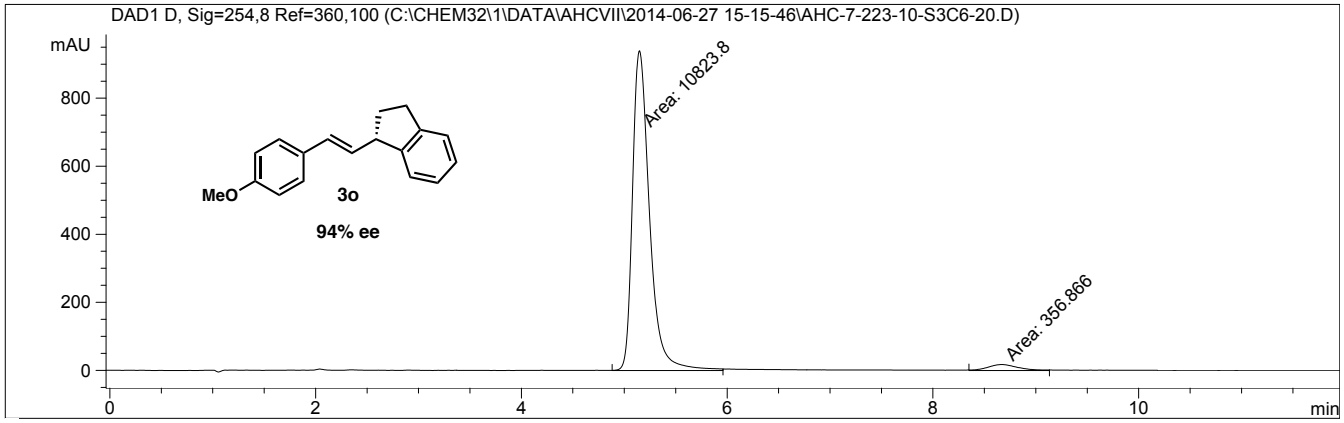
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.577	MM	0.3197	9583.38965	499.54858	96.9403
2	10.504	MM	0.3286	302.47656	13.89878	3.0597

3o (Scheme 1): racemic



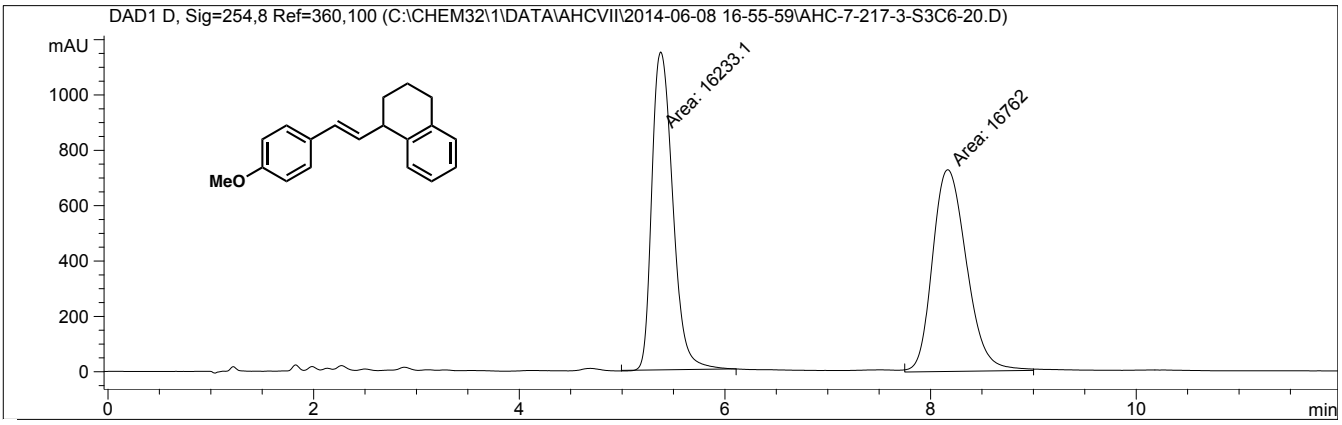
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.098	MM	0.1994	1.11150e4	929.12982	50.0170
2	8.639	MM	0.3377	1.11074e4	548.26196	49.9830

3o (Scheme 1): enantioenriched, 94% ee



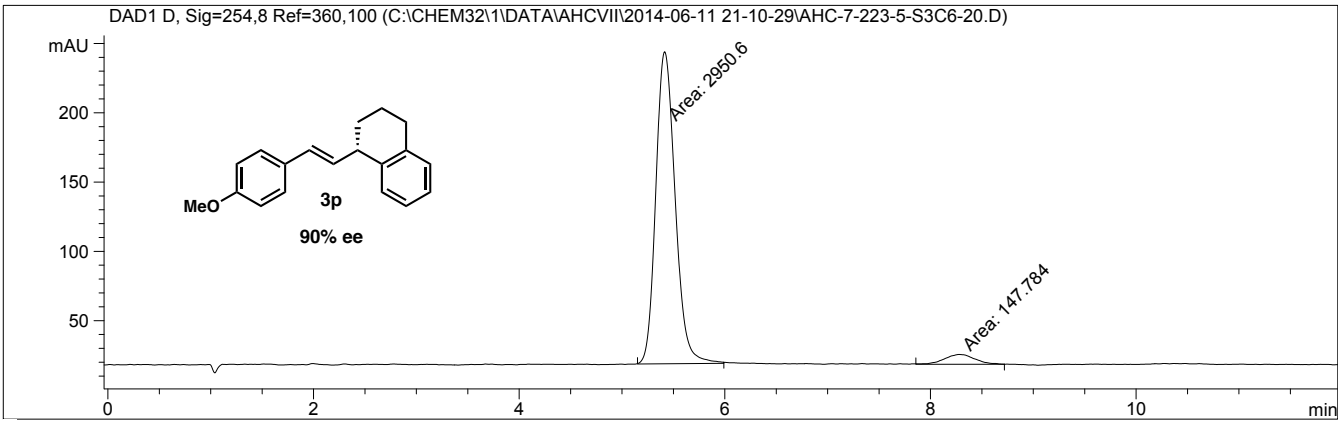
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.147	MM	0.1918	1.08238e4	940.38129	96.8082
2	8.669	MM	0.3406	356.86603	17.46182	3.1918

3p (Scheme 1): racemic



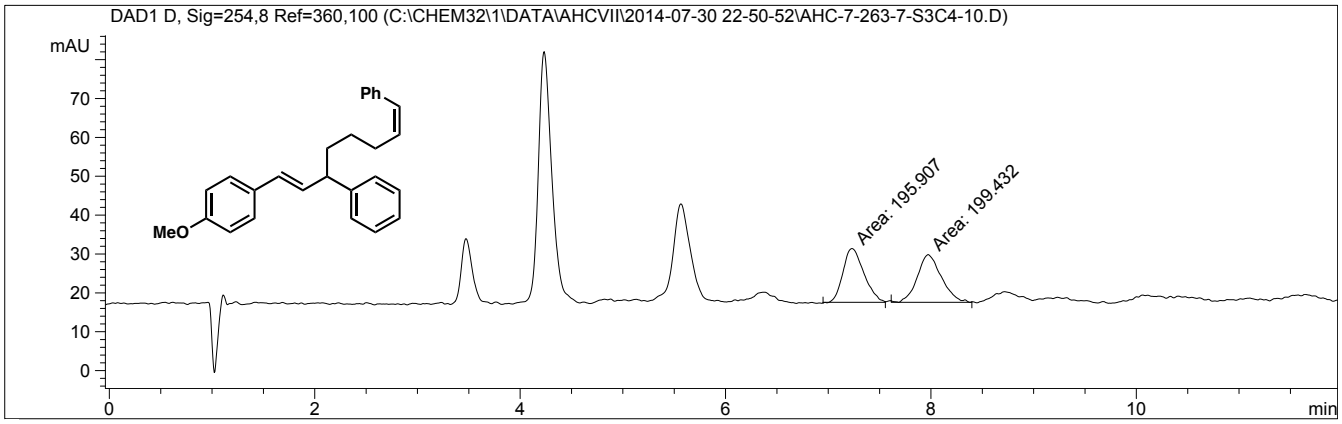
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.375	MM	0.2355	1.62331e4	1148.88831	49.1985
2	8.167	MM	0.3832	1.67620e4	728.97369	50.8015

3p (Scheme 1): enantioenriched, 90% ee



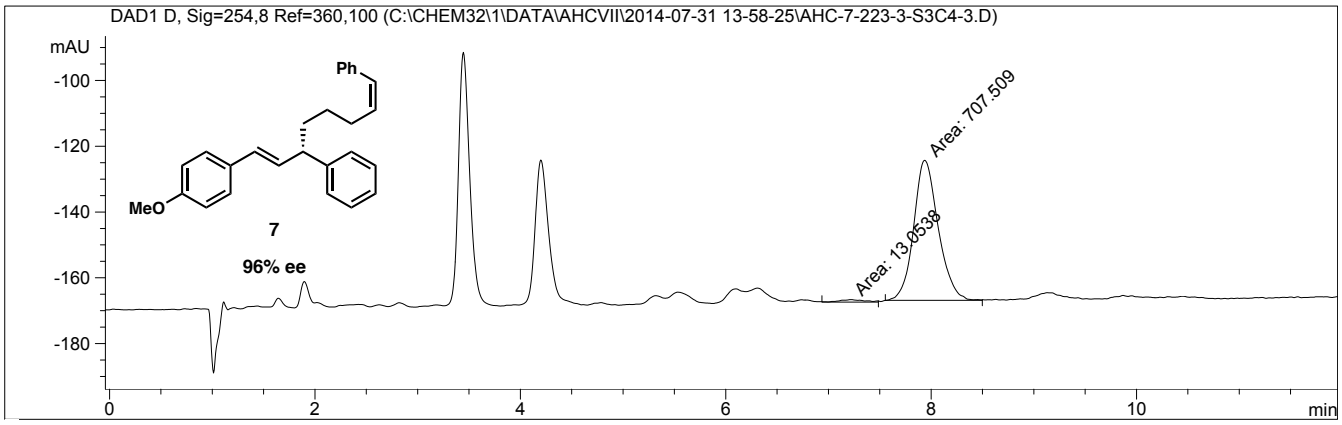
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	5.414	MM	0.2183	2950.59619	225.29623	95.2303
2	8.276	MM	0.3454	147.78352	7.13138	4.7697

7 (Scheme 2): racemic



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.230	MM	0.2362	195.90703	13.82199	49.5542
2	7.972	MM	0.2706	199.43159	12.28512	50.4458

7 (Scheme 2): enantioenriched, 96% ee

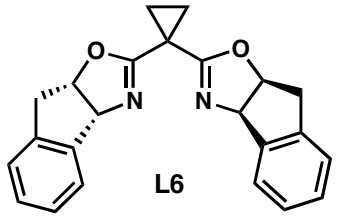


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.215	MM	0.2808	13.05381	7.74711e-1	1.8116
2	7.938	MM	0.2768	707.50922	42.60372	98.1884

Agilent Technologies

ahc-7-181

Sample Name **ahc-7-181**	Pulse sequence **PROTON**	Temperature **25**	Study owner **acherney**
Date collected **2014-04-29**	Solvent **cdcl3**	Spectrometer **-vnmrs400**	Operator **autouser**



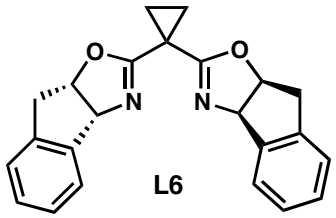
L6

Data file /indy/acherney/vnmrsys/data/ahc-7-181/PROTON01.fid

Plot date 2014-08-01

Agilent Technologies

Sample Name	**ahc-7-181**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-04-29**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



L6

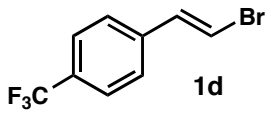
Data file /indy/acherney/vnmrsys/data/ahc-7-181/CARBON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-259-2

Sample Name	**ahc-7-259-2**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-16**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



1d

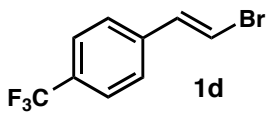
Data file /indy/acherney/vnmrsys/data/ahc-7-259-2/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-259-2

Sample Name	**ahc-7-259-2**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-16**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



1d

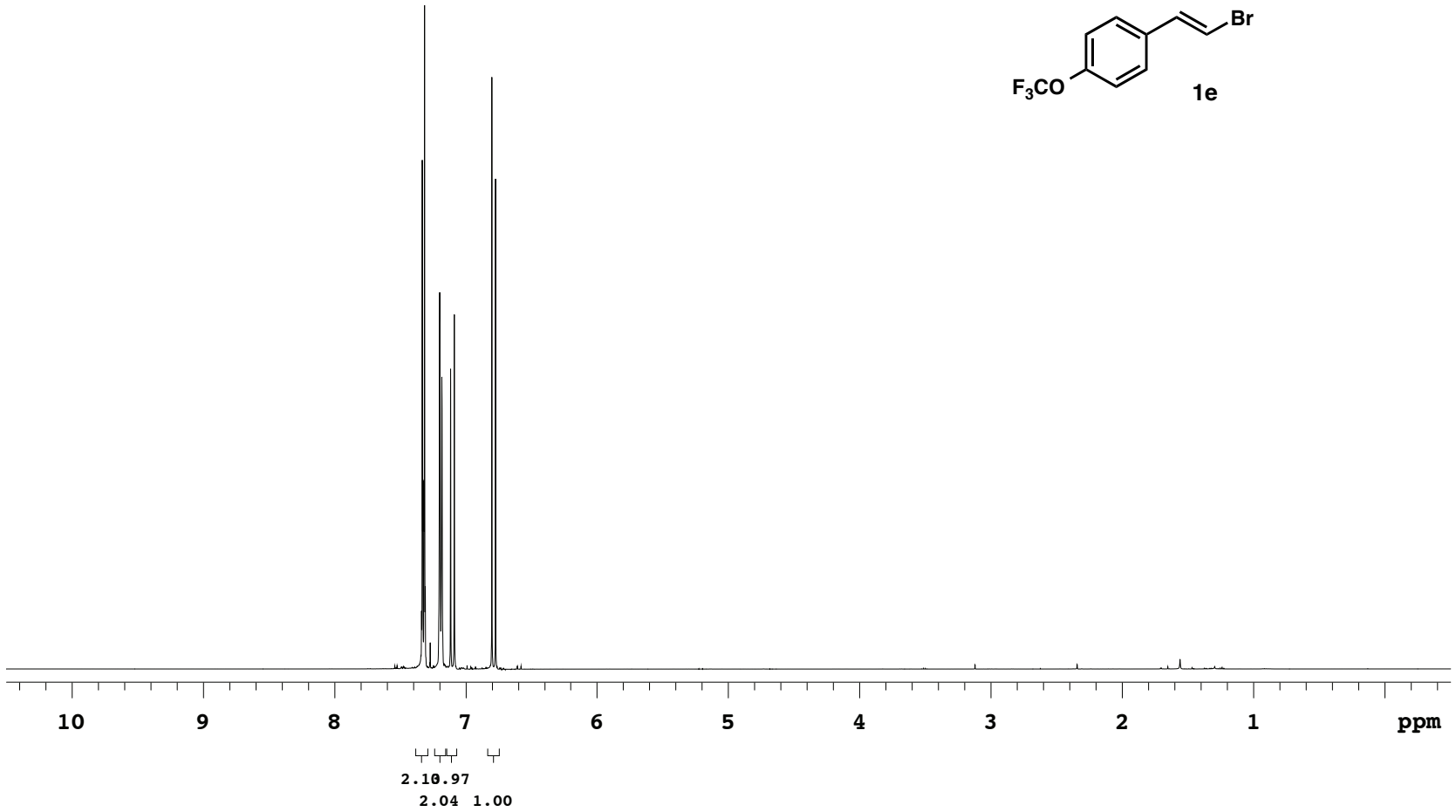
Data file /indy/acherney/vnmrsys/data/ahc-7-259-2/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-213-2

Sample Name	**ahc-7-213-2**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-31**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



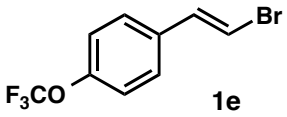
Data file /indy/acherney/vnmrsys/data/ahc-7-213-2/PROTON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-213-2

Sample Name	**ahc-7-213-2**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-31**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



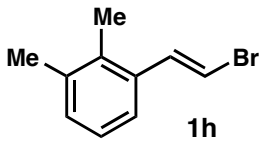
1e

Data file /indy/acherney/vnmrsys/data/ahc-7-213-2/CARBON01.fid

Plot date 2014-08-01

Agilent Technologies

Sample Name **ahc-7-213-3**	Pulse sequence **PROTON**	Temperature **25**	Study owner **acherney**
Date collected **2014-07-17**	Solvent **cdcl3**	Spectrometer **-vnmrs400**	Operator **autouser**



1h

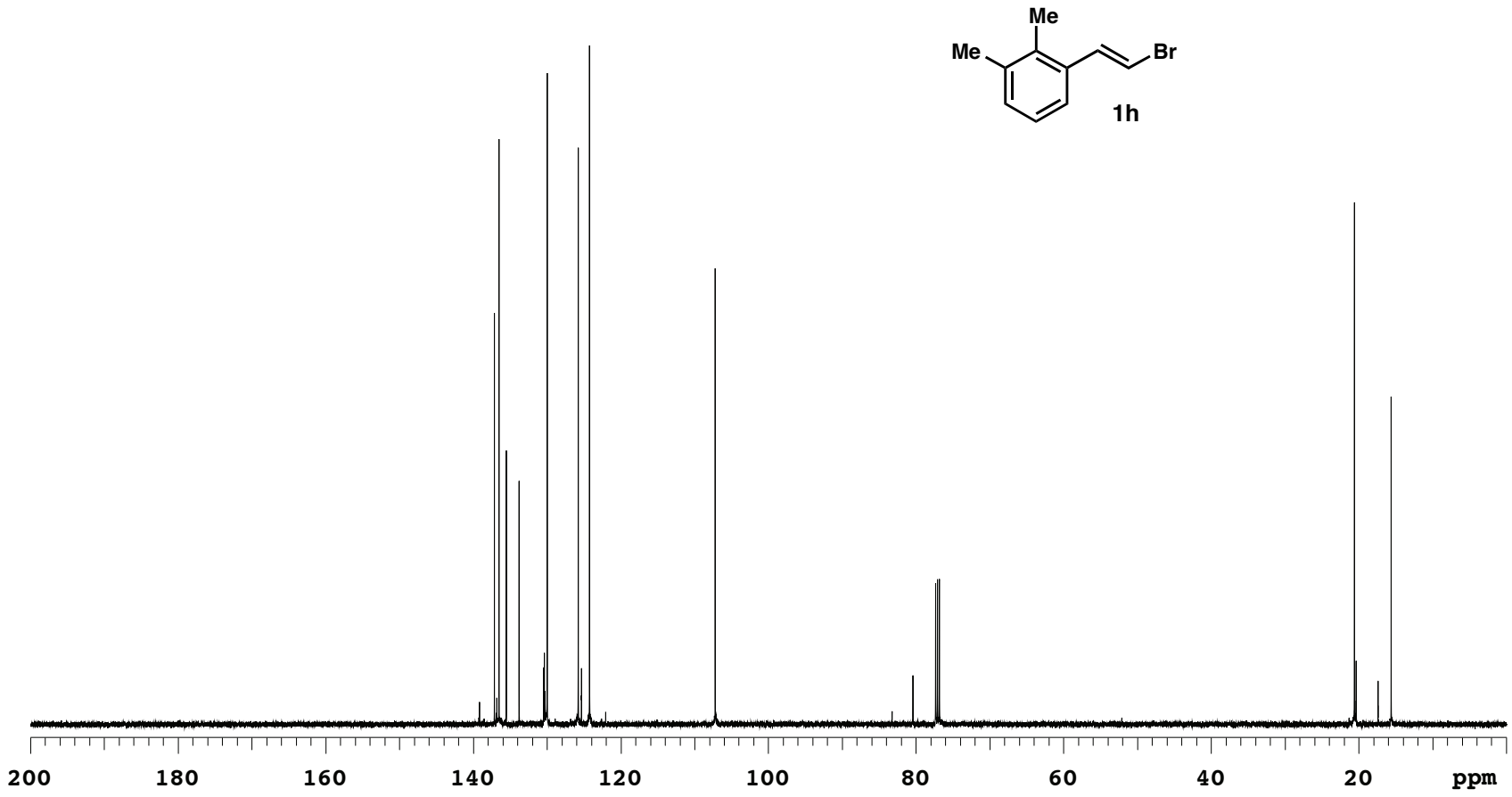
Data file /indy/acherney/vnmrsys/data/ahc-7-213-3/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-213-3

Sample Name	**ahc-7-213-3**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-17**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



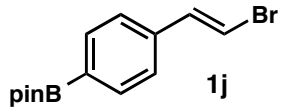
Data file /indy/acherney/vnmrsys/data/ahc-7-213-3/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-213-7

Sample Name	ahc-7-213-7	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-07-15	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



1j

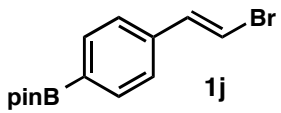
Data file /indy/acherney/vnmrsys/data/ahc-7-213-7/PROTON01.fid

Plot date 2014-07-30

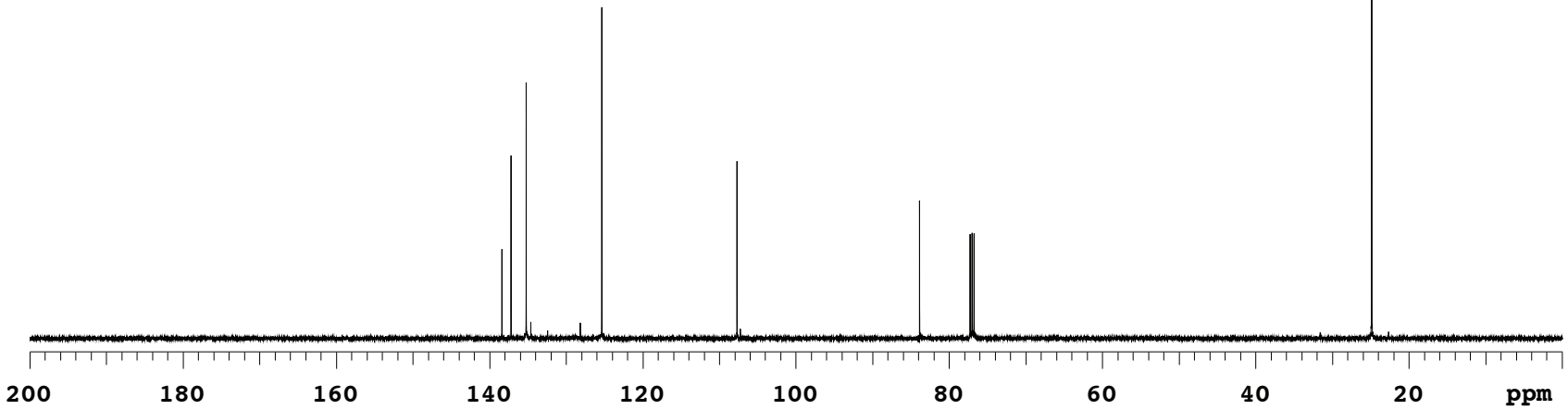
Agilent Technologies

ahc-7-213-7

Sample Name	**ahc-7-213-7**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-15**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



1j



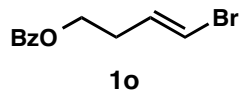
Data file /indy/acherney/vnmrsys/data/ahc-7-213-7/CARBON01.fid

Plot date 2014-07-30

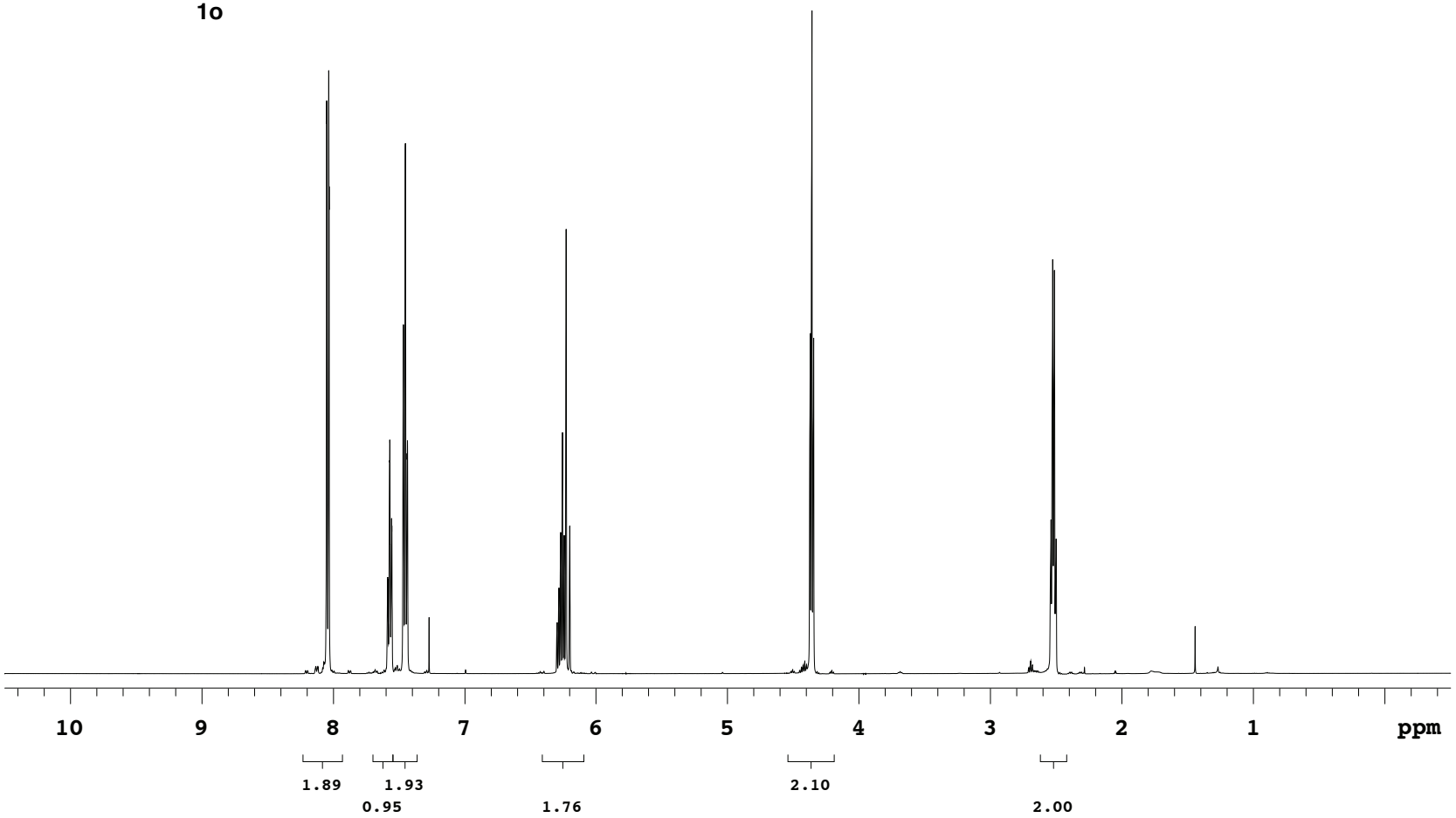
Agilent Technologies

ahc-7-231

Sample Name	**ahc-7-231**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-18**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



1o



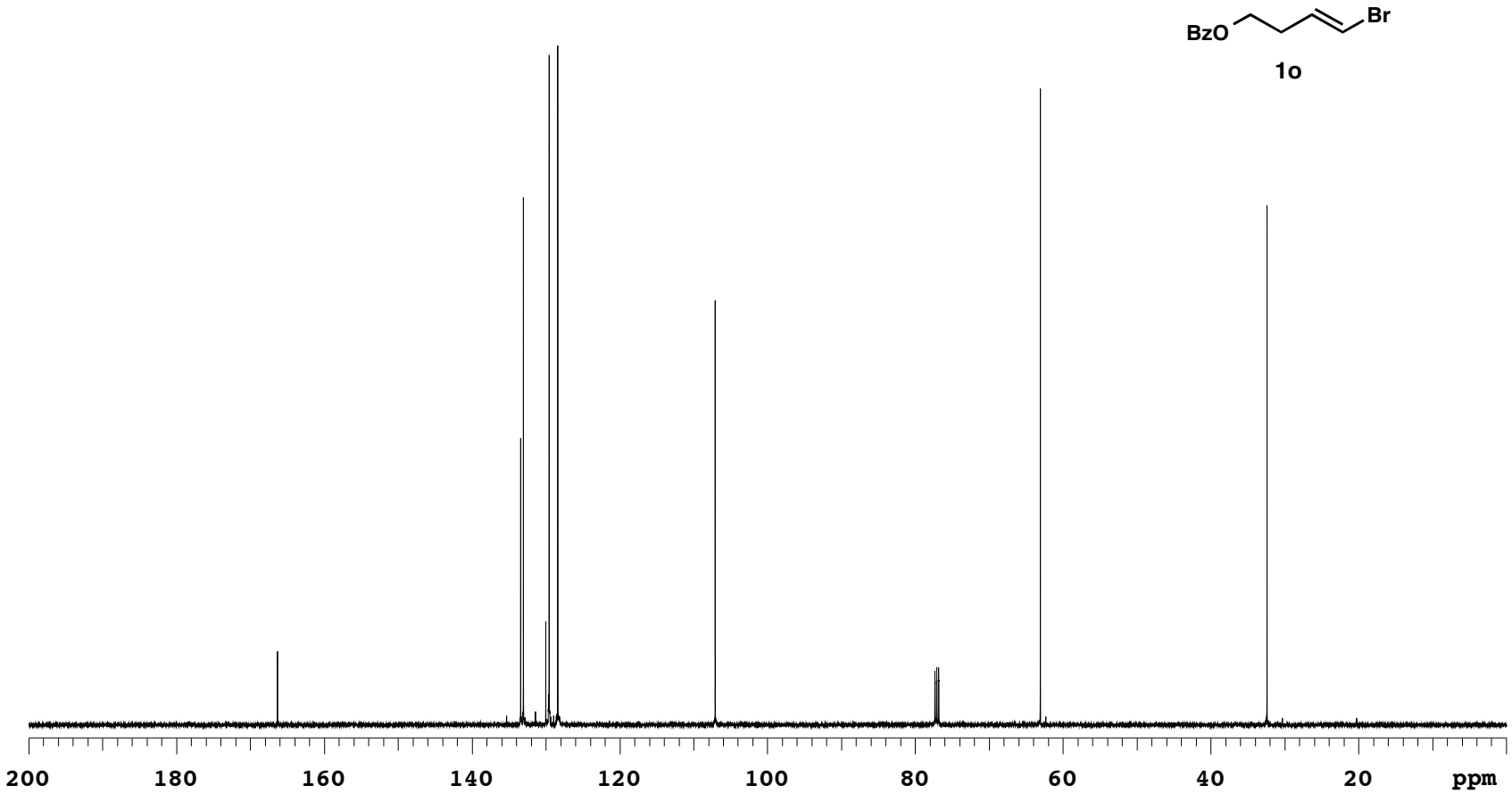
Data file /indy/acherney/vnmrsys/data/ahc-7-231/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-231

Sample Name	**ahc-7-231**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-18**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



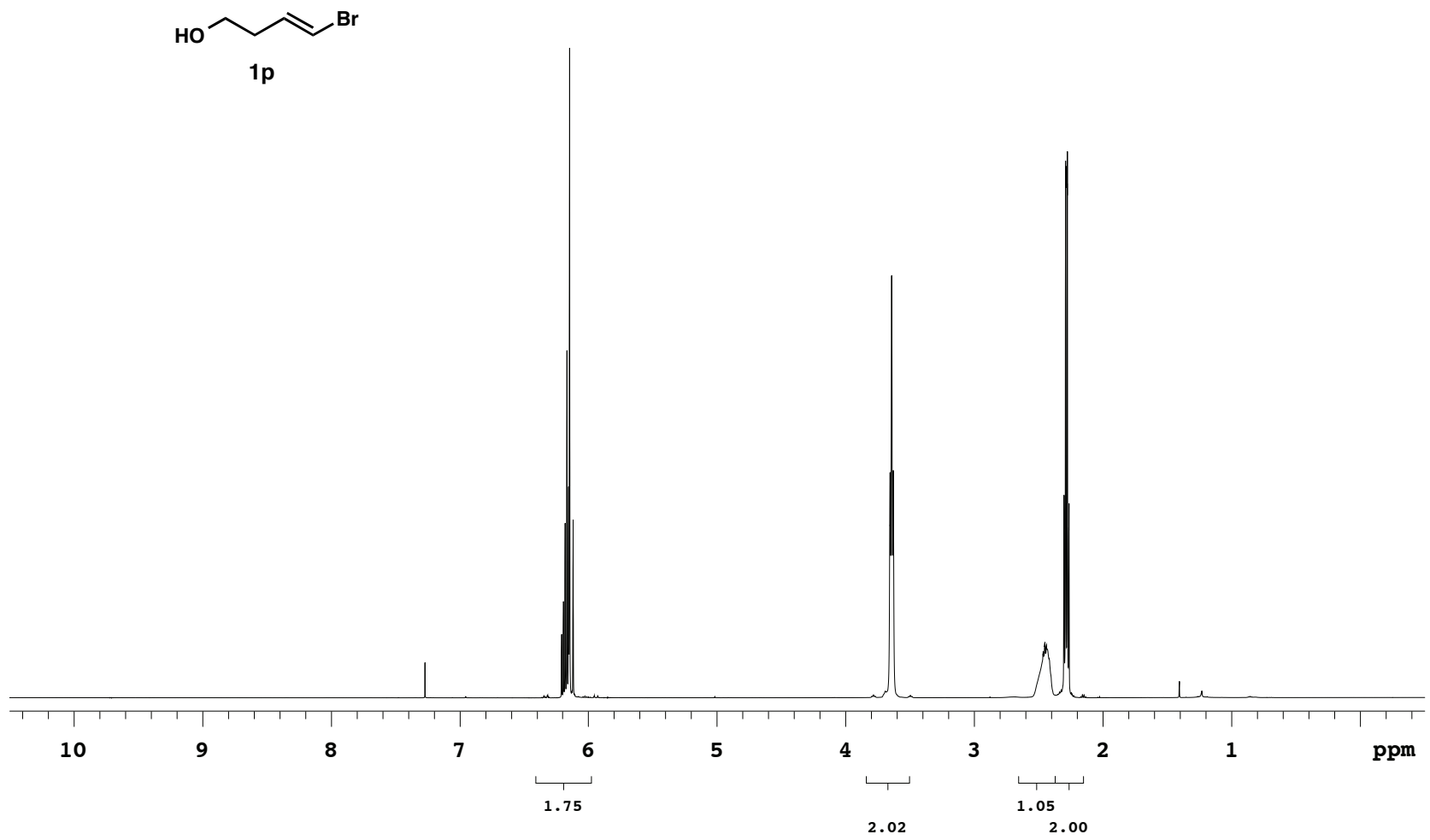
Data file /indy/acherney/vnmrsys/data/ahc-7-231/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-229

Sample Name	**ahc-7-229**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-18**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**

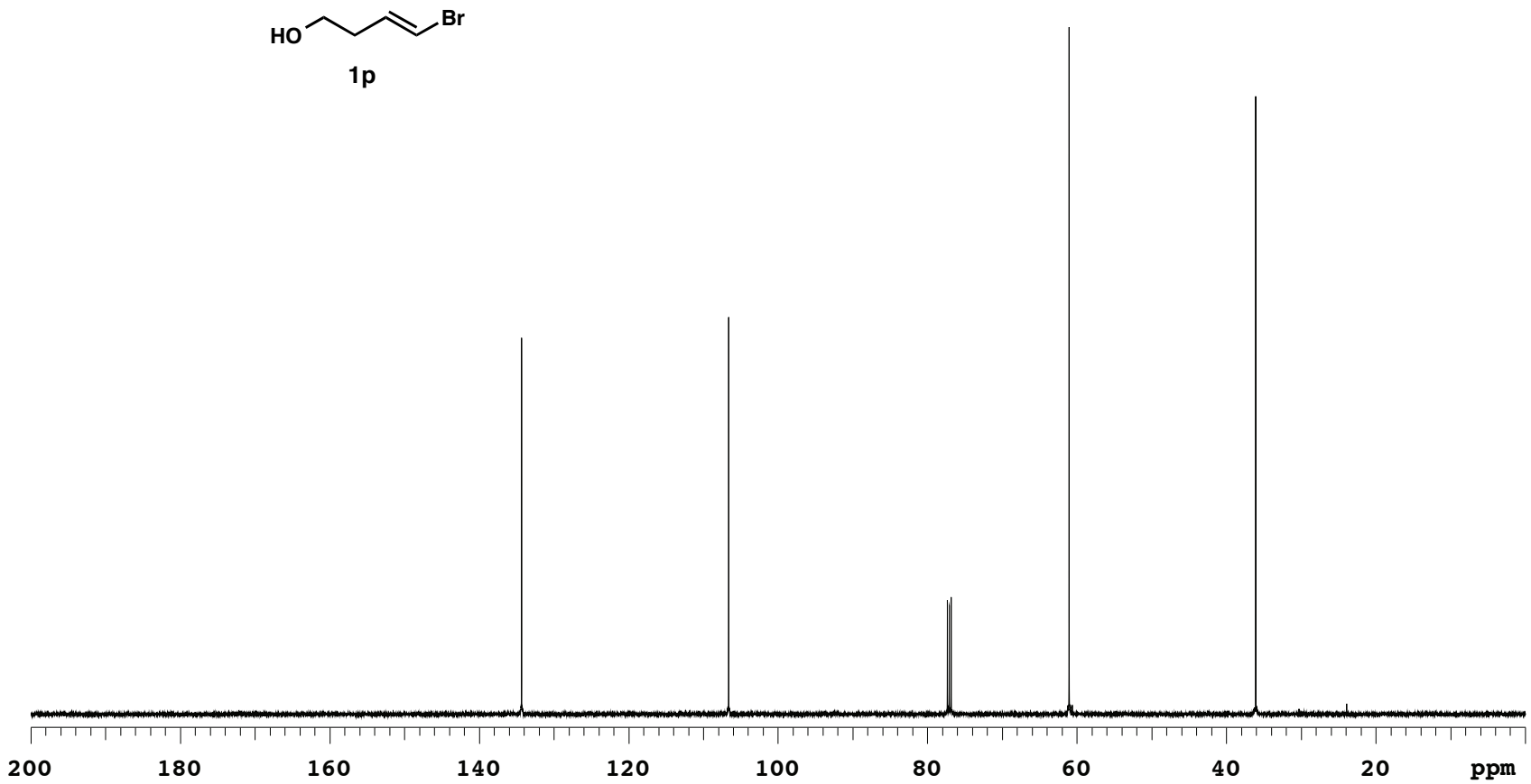


Data file /indy/acherney/vnmrsys/data/ahc-7-229/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

Sample Name	**ahc-7-229**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-18**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



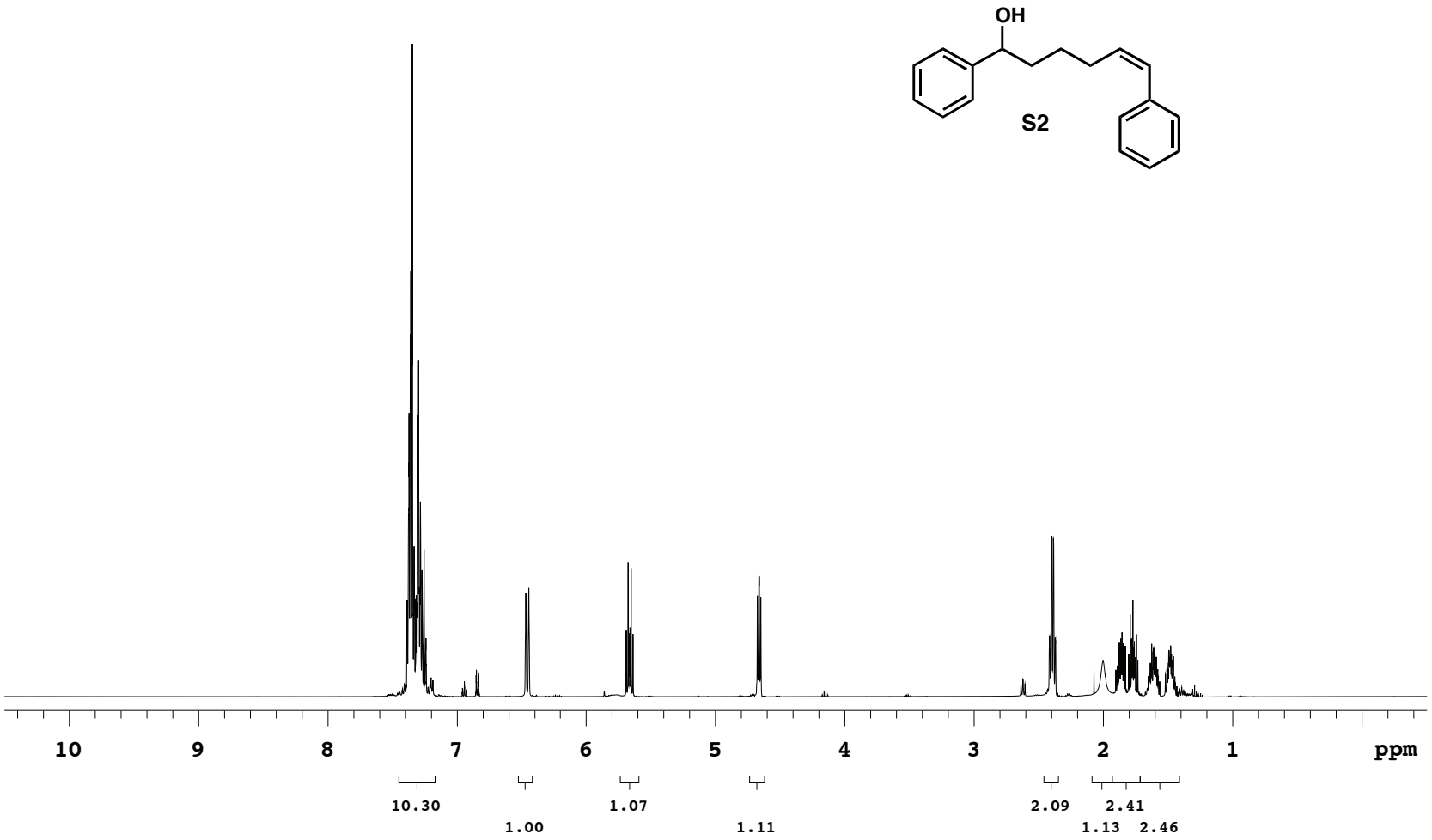
Data file /indy/acherney/vnmrsys/data/ahc-7-229/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-207

Sample Name	**ahc-7-207**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-31**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



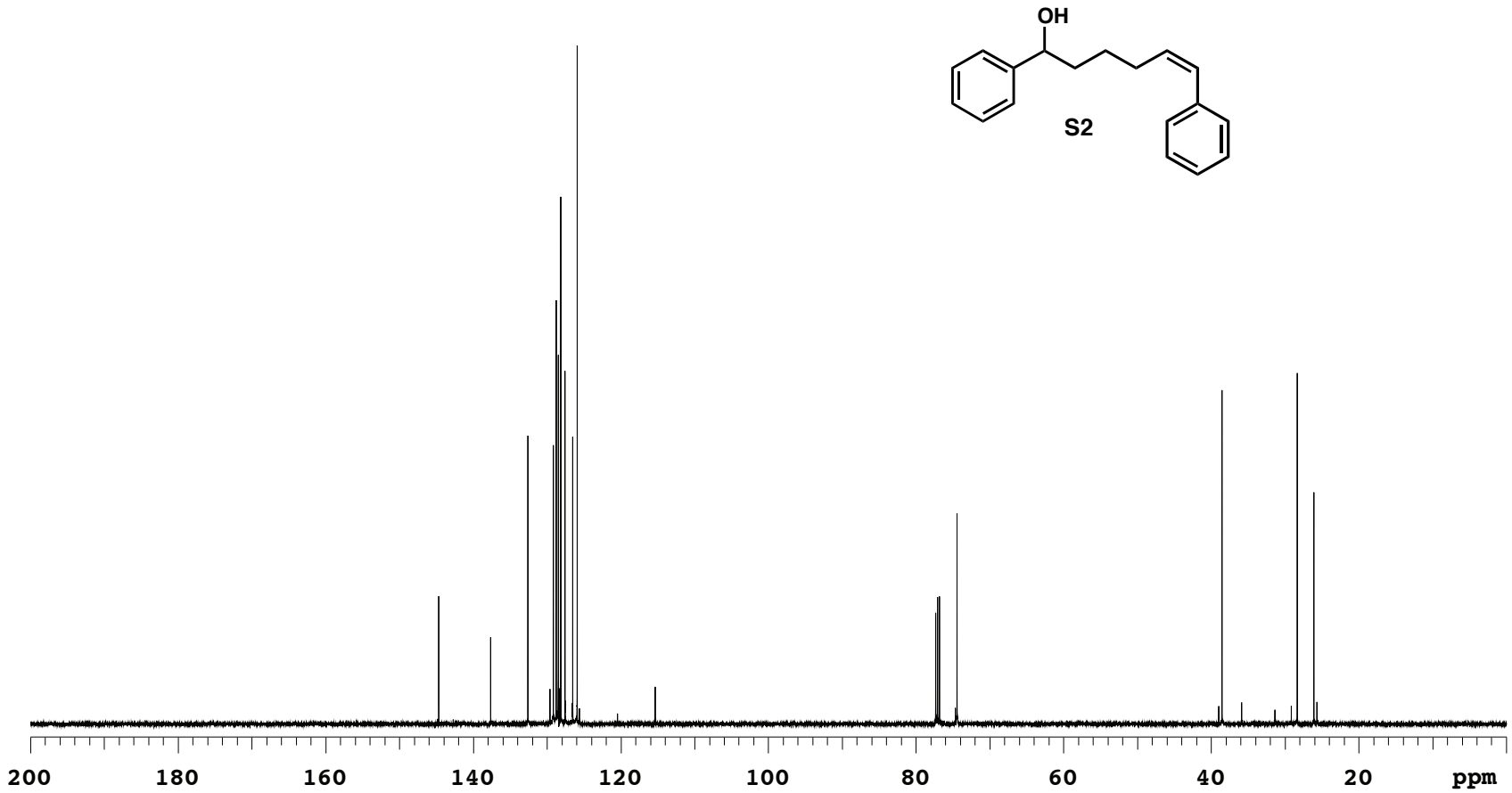
Data file /indy/acherney/vnmrsys/data/ahc-7-207/PROTON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-207

Sample Name	**ahc-7-207**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-31**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



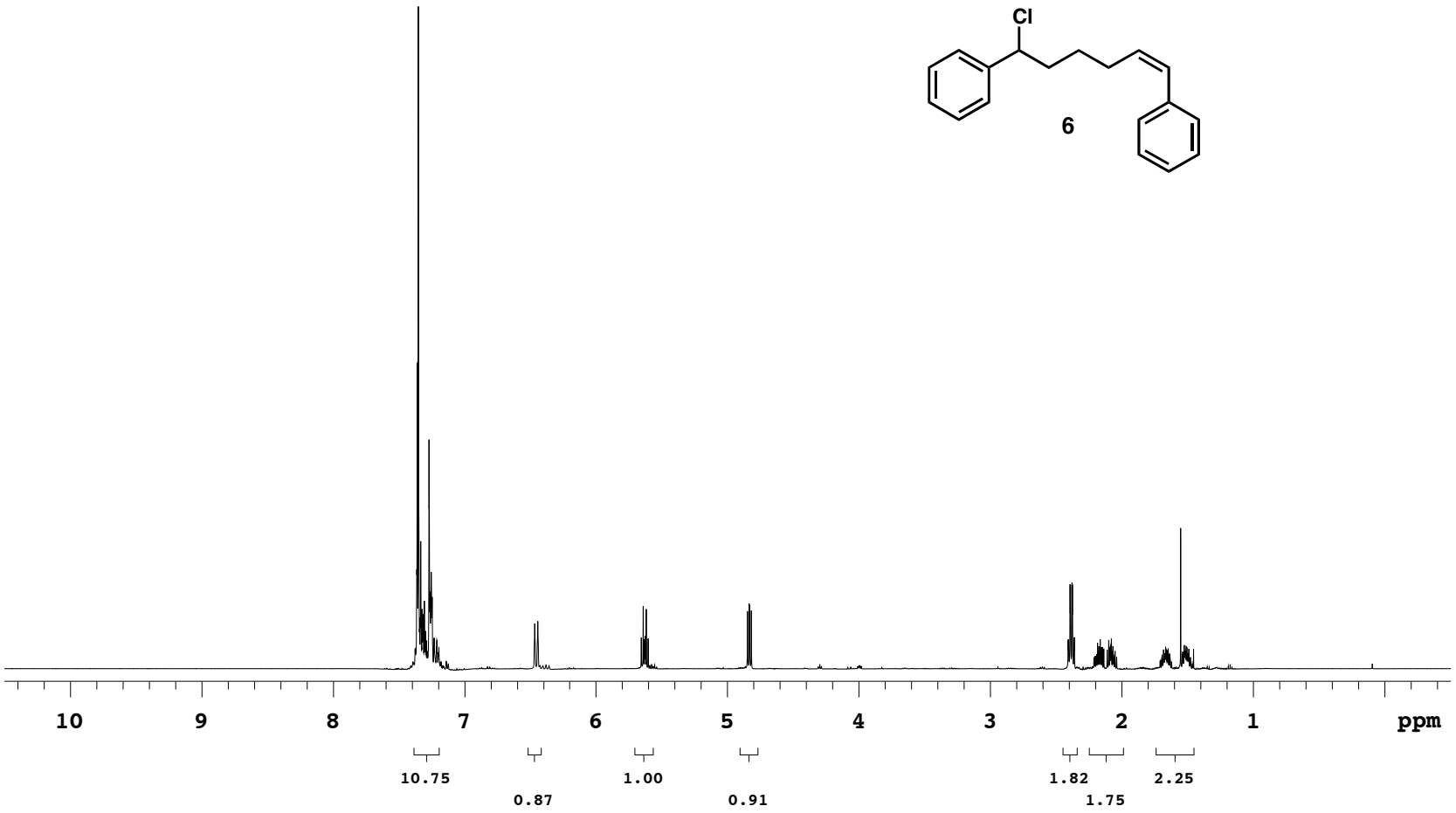
Data file /indy/acherney/vnmrsys/data/ahc-7-207/CARBON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-211

Sample Name	**ahc-7-211**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-31**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



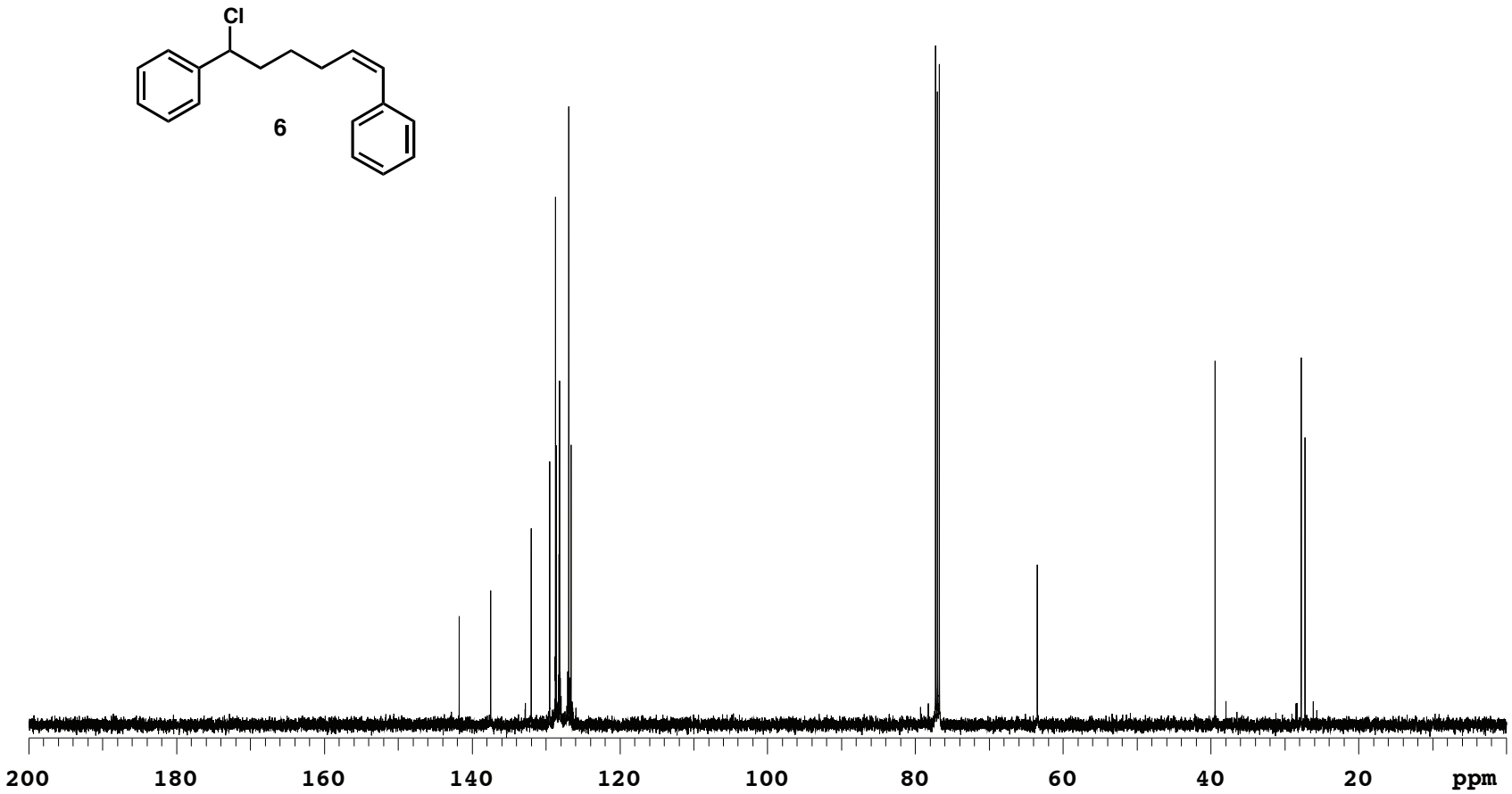
Data file /indy/acherney/vnmrsys/data/ahc-7-211/PROTON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-211

Sample Name	**ahc-7-211**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-31**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



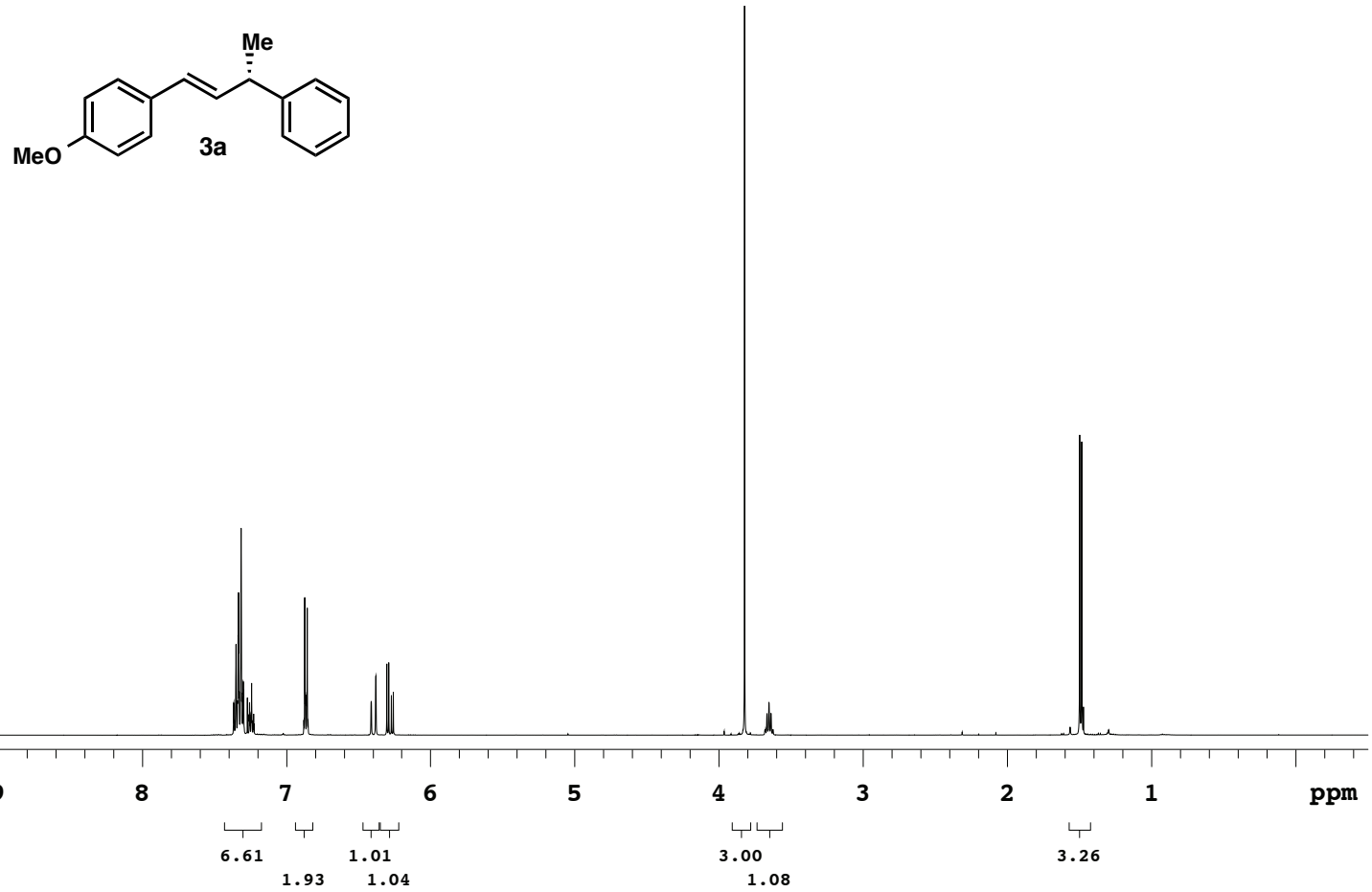
Data file /indy/acherney/vnmrsys/data/ahc-7-211/CARBON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-131-8

Sample Name	ahc-7-131-8	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-05-12	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



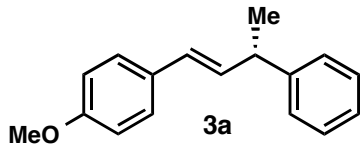
Data file /indy/acherney/vnmrsys/data/ahc-7-131-8/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-131-8

Sample Name	**ahc-7-131-8**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-12**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



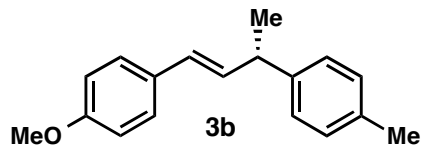
Data file /indy/acherney/vnmrsys/data/ahc-7-131-8/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-189-1

Sample Name	**ahc-7-189-1**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-15**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



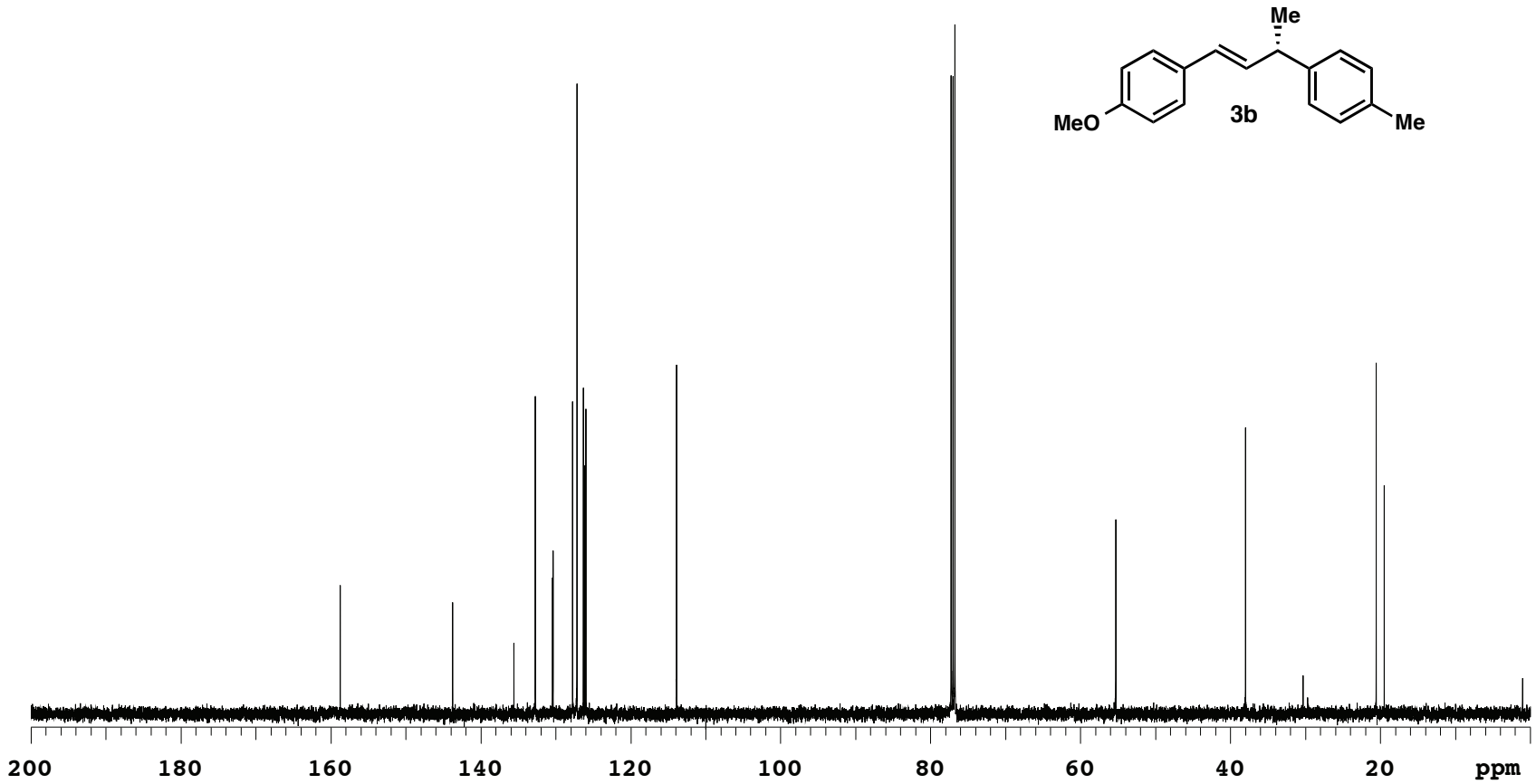
Data file /indy/acherney/vnmrsys/data/ahc-7-189-1/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-189-2

Sample Name	**ahc-7-189-2**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-16**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



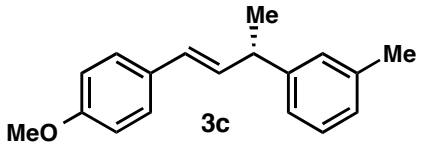
Data file /indy/acherney/vnmrsys/data/ahc-7-189-2/CARBON03.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-2

Sample Name	**ahc-7-185-2**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-01**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



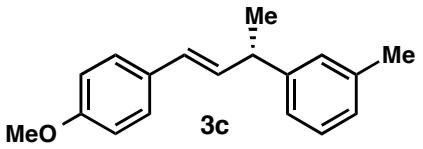
Data file /indy/acherney/vnmrsys/data/ahc-7-185-2/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-2

Sample Name	**ahc-7-185-2**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-01**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



3c

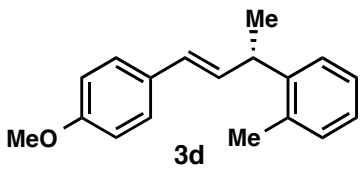
Data file /indy/acherney/vnmrsys/data/ahc-7-185-2/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-189-2-column

Sample Name	ahc-7-189-2-column	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-05-08	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



3d

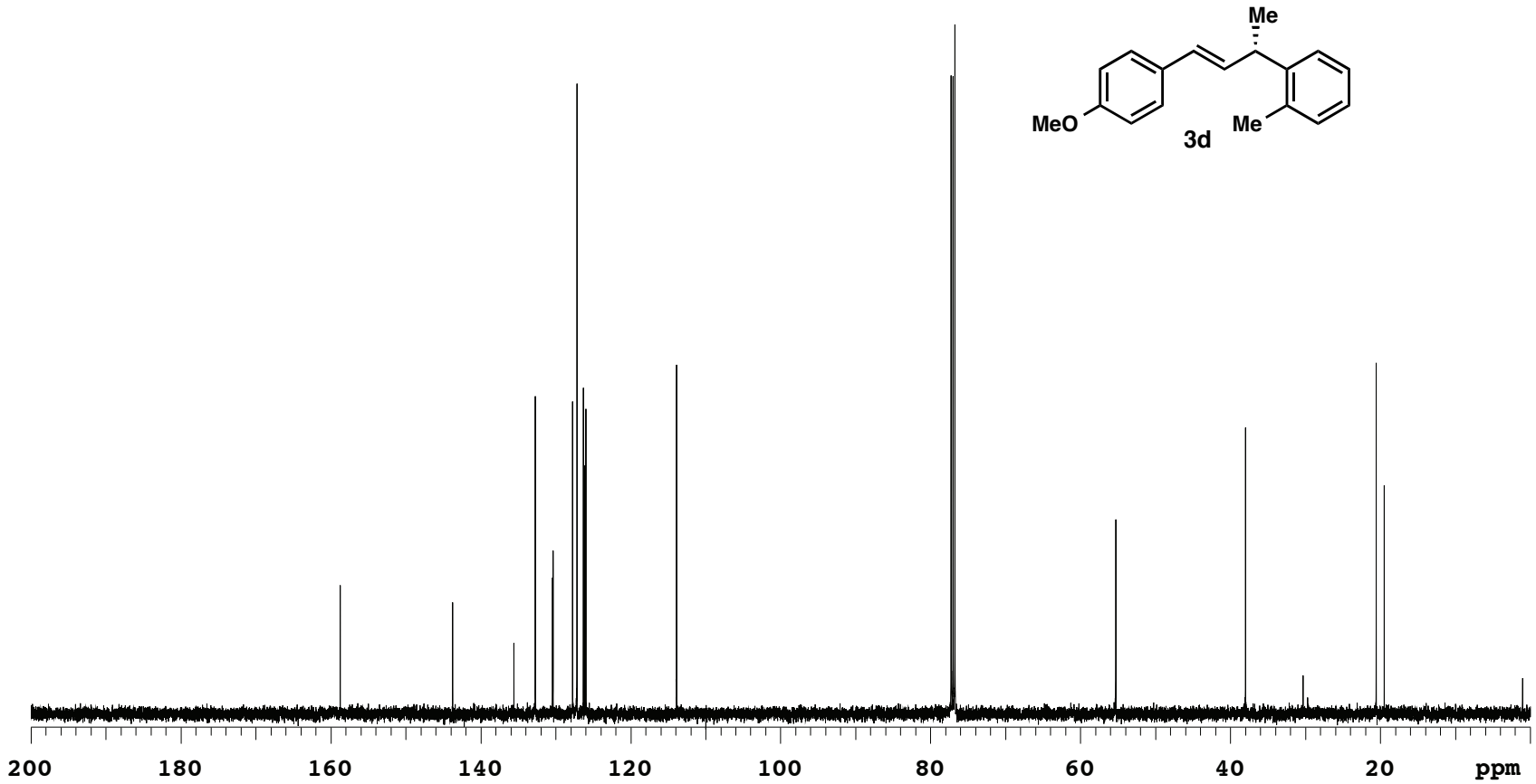
Data file /indy/acherney/vnmrsys/data/ahc-7-189-2-column/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-189-2

Sample Name	**ahc-7-189-2**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-16**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



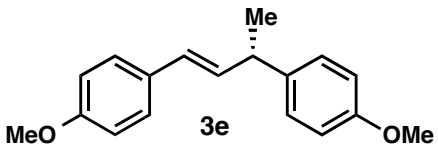
Data file /indy/acherney/vnmrsys/data/ahc-7-189-2/CARBON03.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-4

Sample Name	**ahc-7-185-4**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-02**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



3e

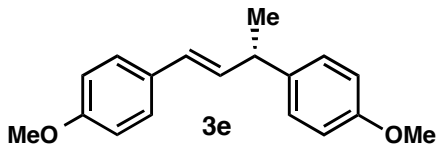
Data file /indy/acherney/vnmrsys/data/ahc-7-185-4/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-4

Sample Name	**ahc-7-185-4**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-02**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



3e

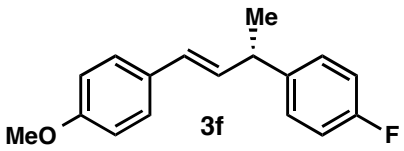
Data file /indy/acherney/vnmrsys/data/ahc-7-185-4/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-5

Sample Name	**ahc-7-185-5**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-01**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**

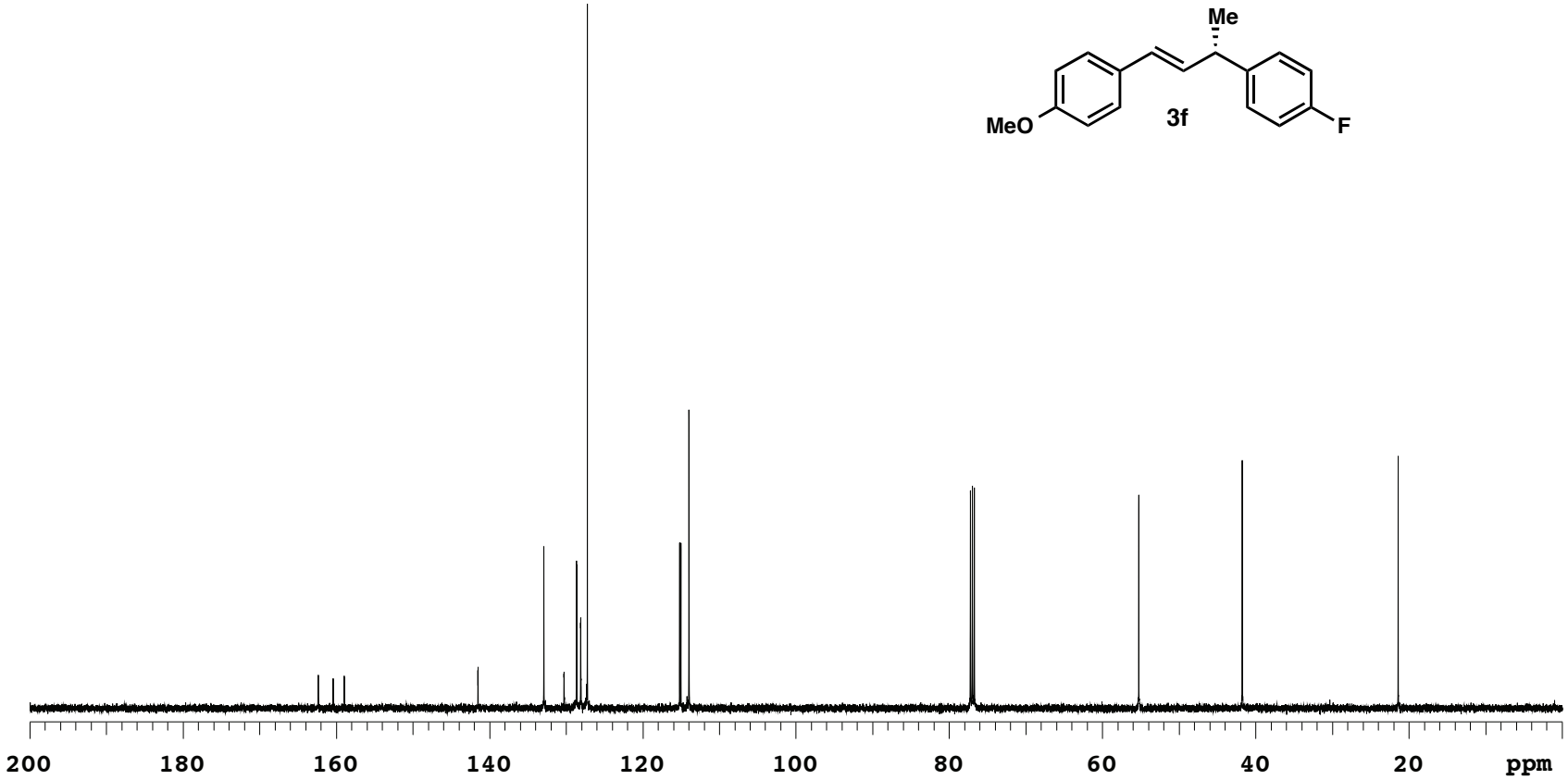


Data file /indy/acherney/vnmrsys/data/ahc-7-185-5/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

Sample Name	**ahc-7-185-5**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-01**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



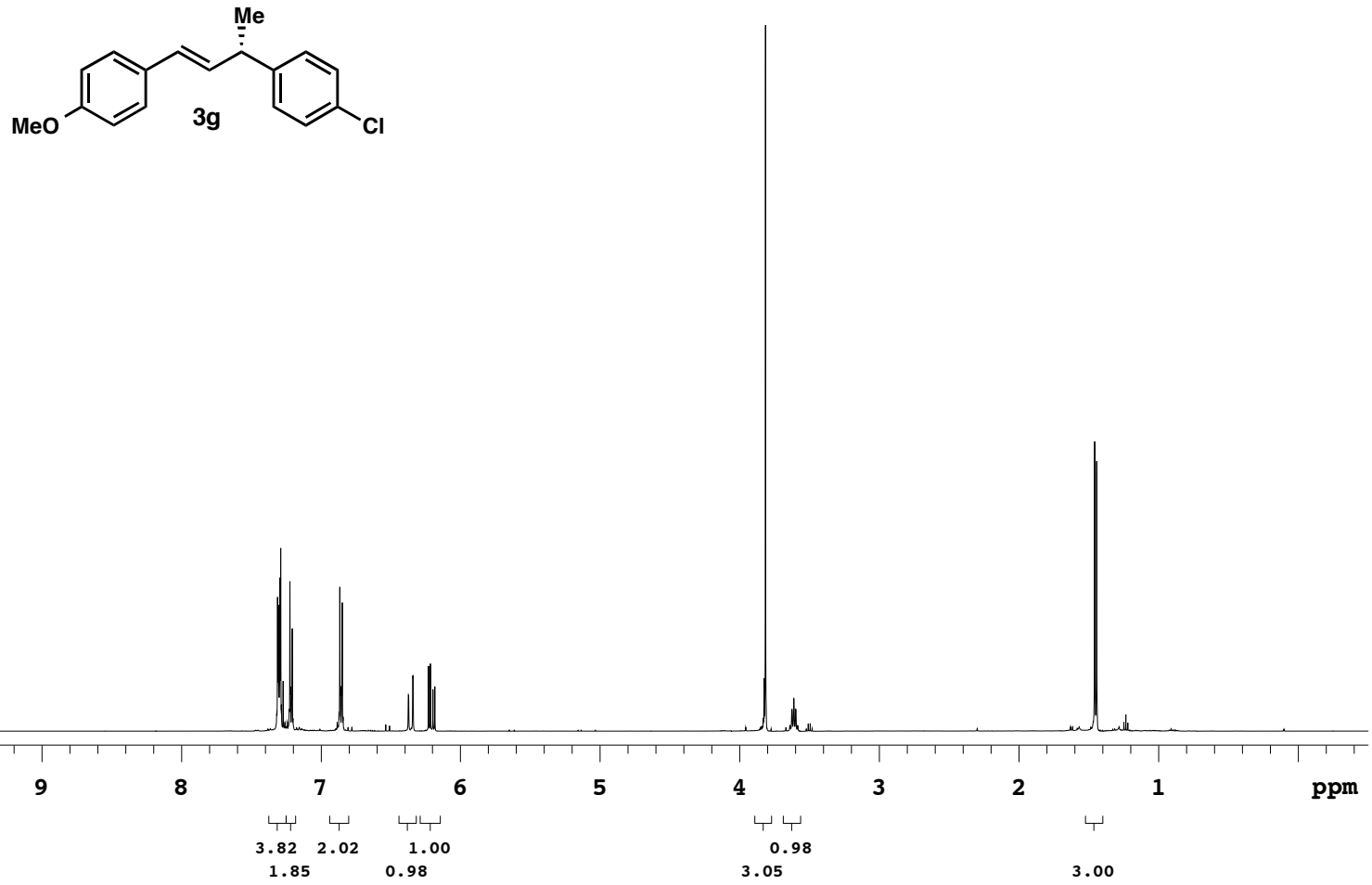
Data file /indy/acherney/vnmrsys/data/ahc-7-185-5/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-7

Sample Name	ahc-7-185-7	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-05-05	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



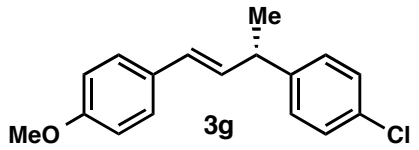
Data file /indy/acherney/vnmrsys/data/ahc-7-185-7/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-7

Sample Name	**ahc-7-185-7**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-05**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



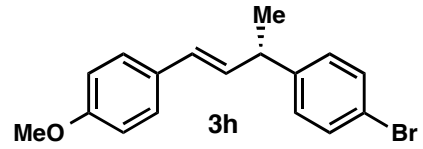
Data file /indy/acherney/vnmrsys/data/ahc-7-185-7/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-189-4

Sample Name	ahc-7-189-4	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-05-14	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



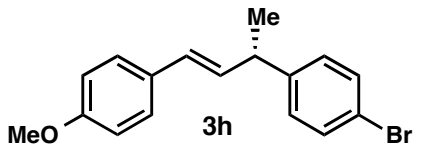
Data file /indy/acherney/vnmrsys/data/ahc-7-189-4/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-189-4

Sample Name	**ahc-7-189-4**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**

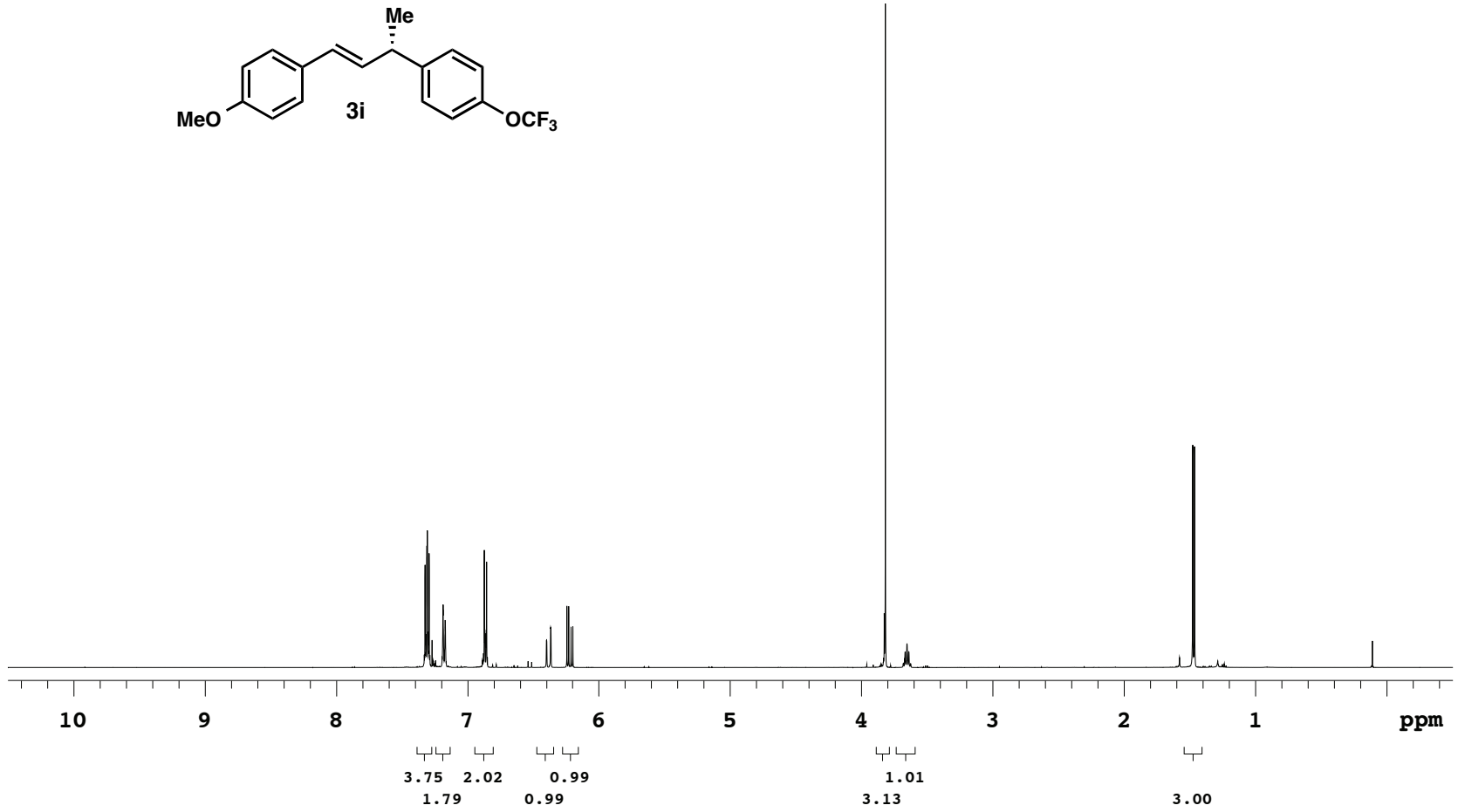


Data file /indy/acherney/vnmrsys/data/ahc-7-189-4/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

Sample Name	ahc-7-185-13	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-05-08	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser

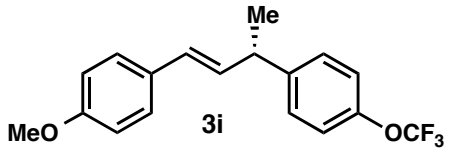


Data file /indy/acherney/vnmrsys/data/ahc-7-185-13/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

Sample Name	**ahc-7-185-13**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-08**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



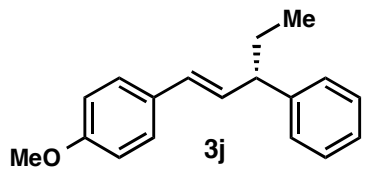
Data file /indy/acherney/vnmrsys/data/ahc-7-185-13/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-189-3

Sample Name	**ahc-7-189-3**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



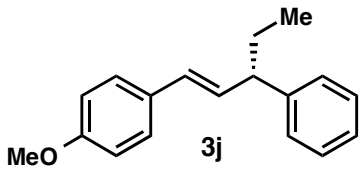
3j

Data file /indy/acherney/vnmrsys/data/ahc-7-189-3/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

Sample Name	**ahc-7-189-3**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



3j

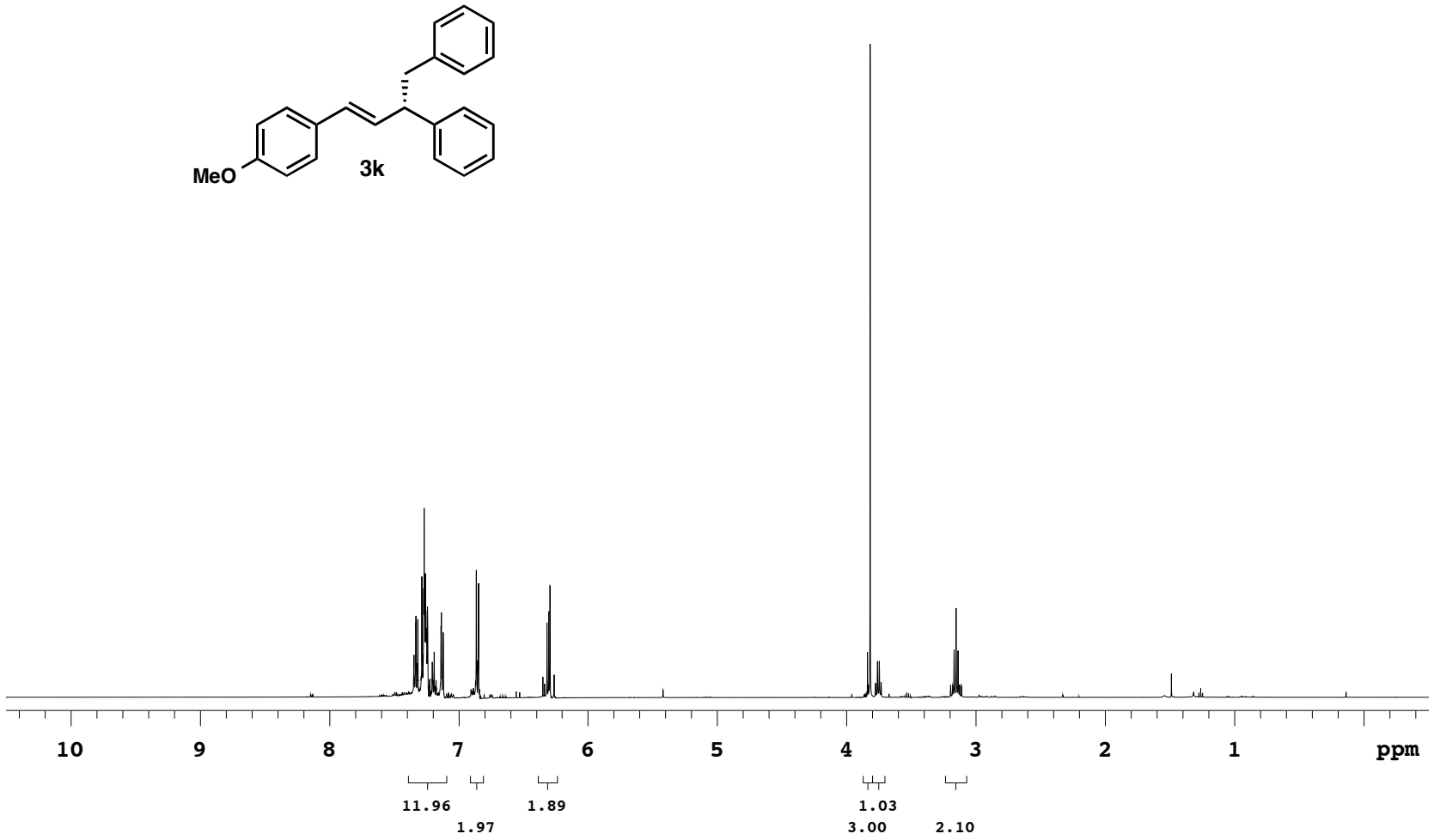
Data file /indy/acherney/vnmrsys/data/ahc-7-189-3/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-10

Sample Name	ahc-7-185-10	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-05-05	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



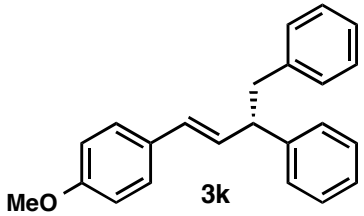
Data file /indy/acherney/vnmrsys/data/ahc-7-185-10/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-10

Sample Name	**ahc-7-185-10**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-05**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



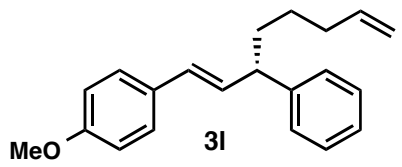
Data file /indy/acherney/vnmrsys/data/ahc-7-185-10/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-185-15

Sample Name	ahc-7-185-15	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-05-08	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



3l

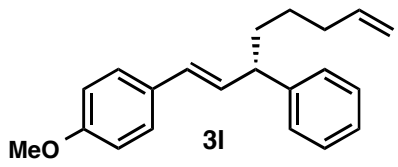
Data file /indy/acherney/vnmrsys/data/ahc-7-185-15/PROTON01.fid

Plot date 2014-07-29

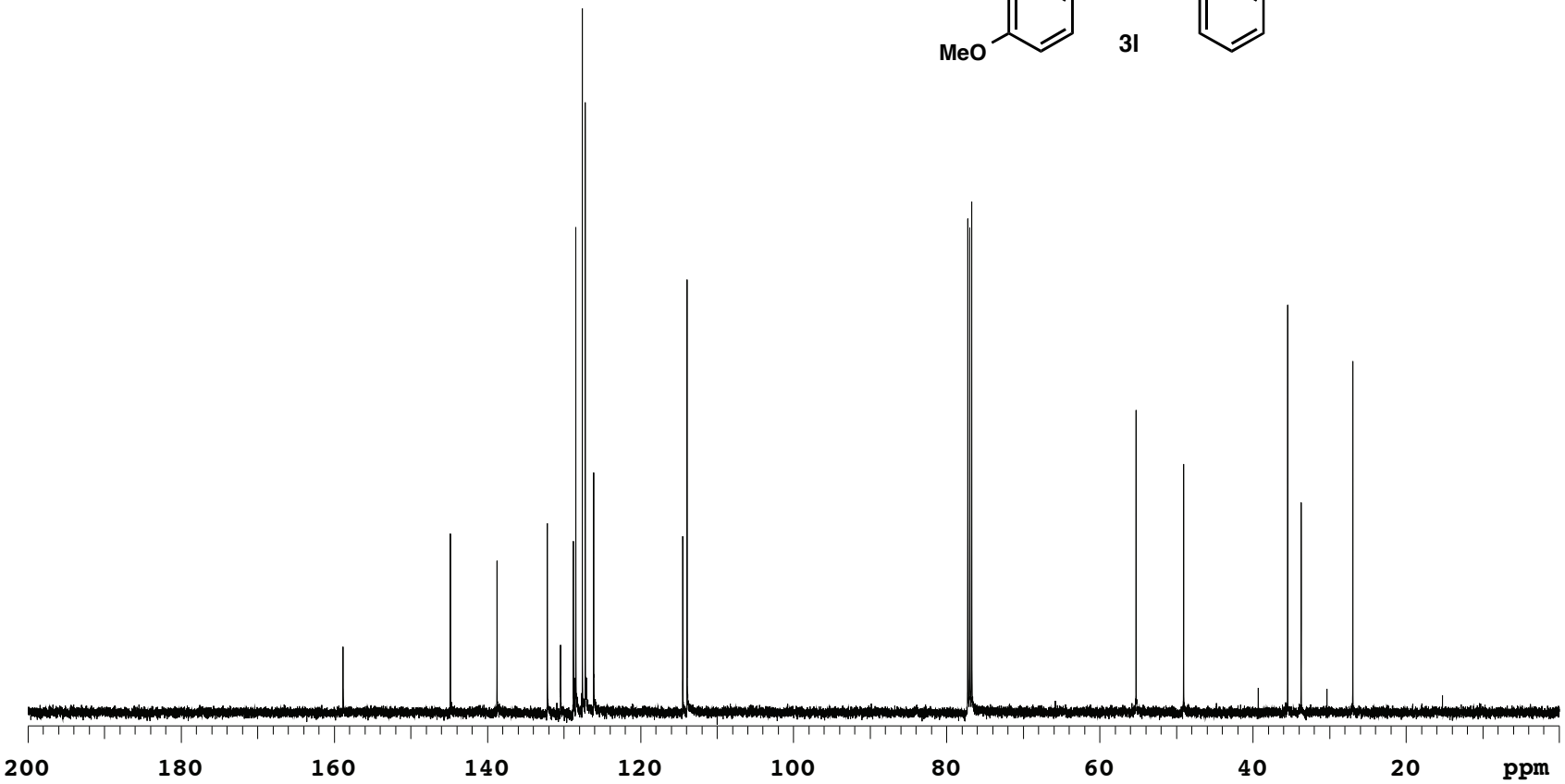
Agilent Technologies

ahc-7-185-15

Sample Name	**ahc-7-185-15**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-05-08**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



3l



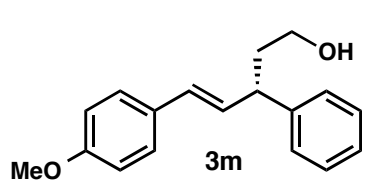
Data file /indy/acherney/vnmrsys/data/ahc-7-185-15/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-223-8

Sample Name	ahc-7-223-8	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-07-13	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



3m

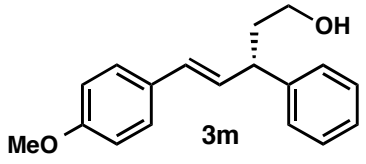
Data file /indy/acherney/vnmrsys/data/ahc-7-223-8/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-223-8

Sample Name	**ahc-7-223-8**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



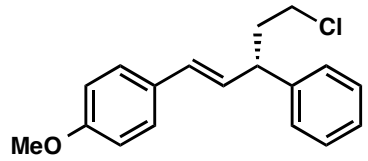
3m

Data file /indy/acherney/vnmrsys/data/ahc-7-223-8/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

Sample Name	ahc-7-271-4	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-09-10	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



3n

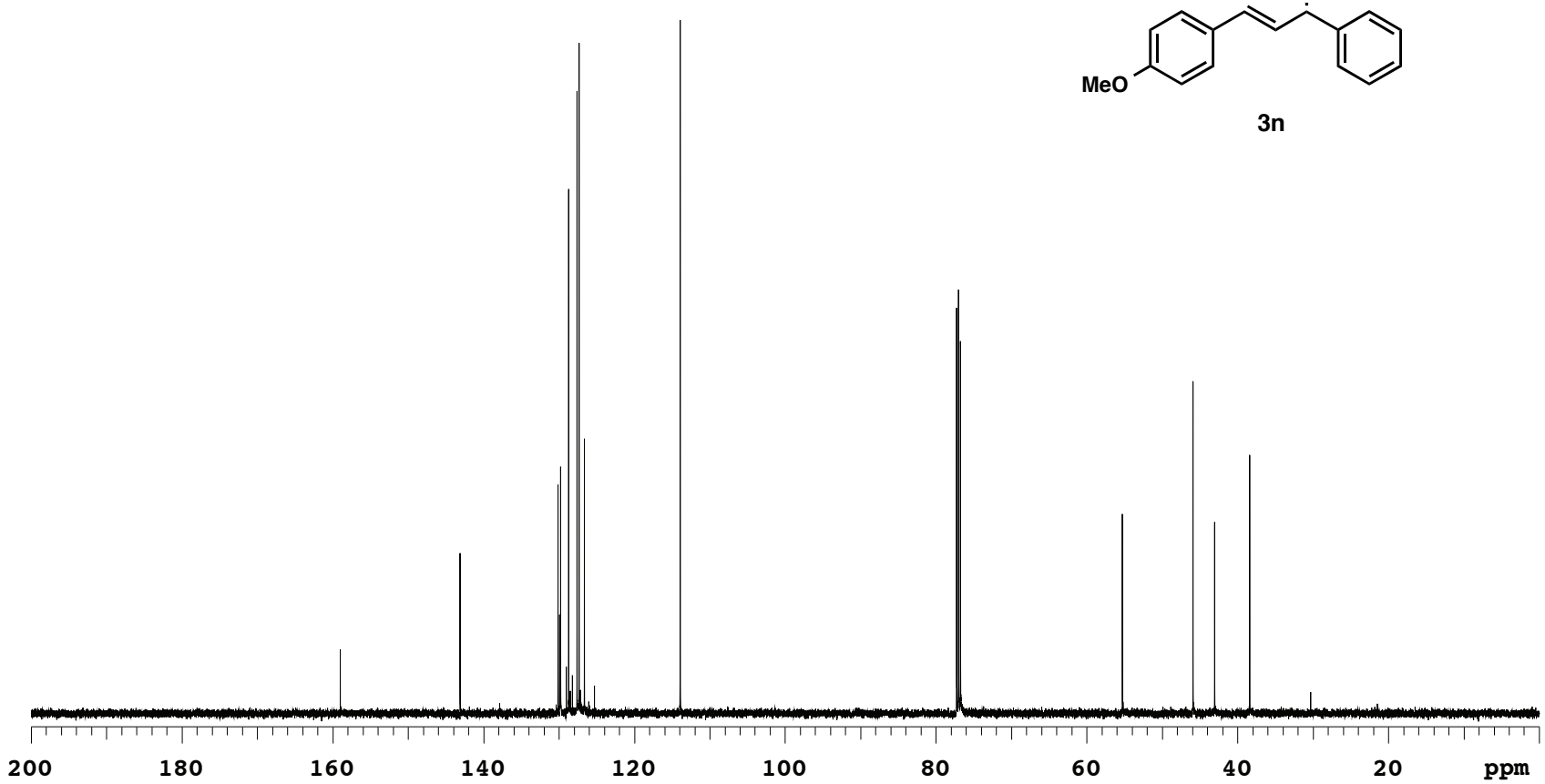
Data file /data/indy/acherney/vnmrsys/data/ahc-7-271-4/PROTON01.fid

Plot date 2014-09-11

Agilent Technologies

ahc-7-271-4

Sample Name	**ahc-7-271-4**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-09-10**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



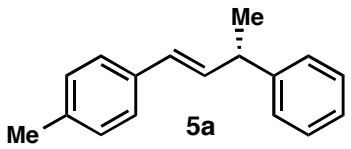
Data file /data/indy/acherney/vnmrsys/data/ahc-7-271-4/CARBON01.fid

Plot date 2014-09-11

Agilent Technologies

ahc-7-209-7

Sample Name	**ahc-7-209-7**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



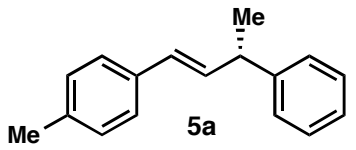
Data file /indy/acherney/vnmrsys/data/ahc-7-209-7/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-209-7

Sample Name	**ahc-7-209-7**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



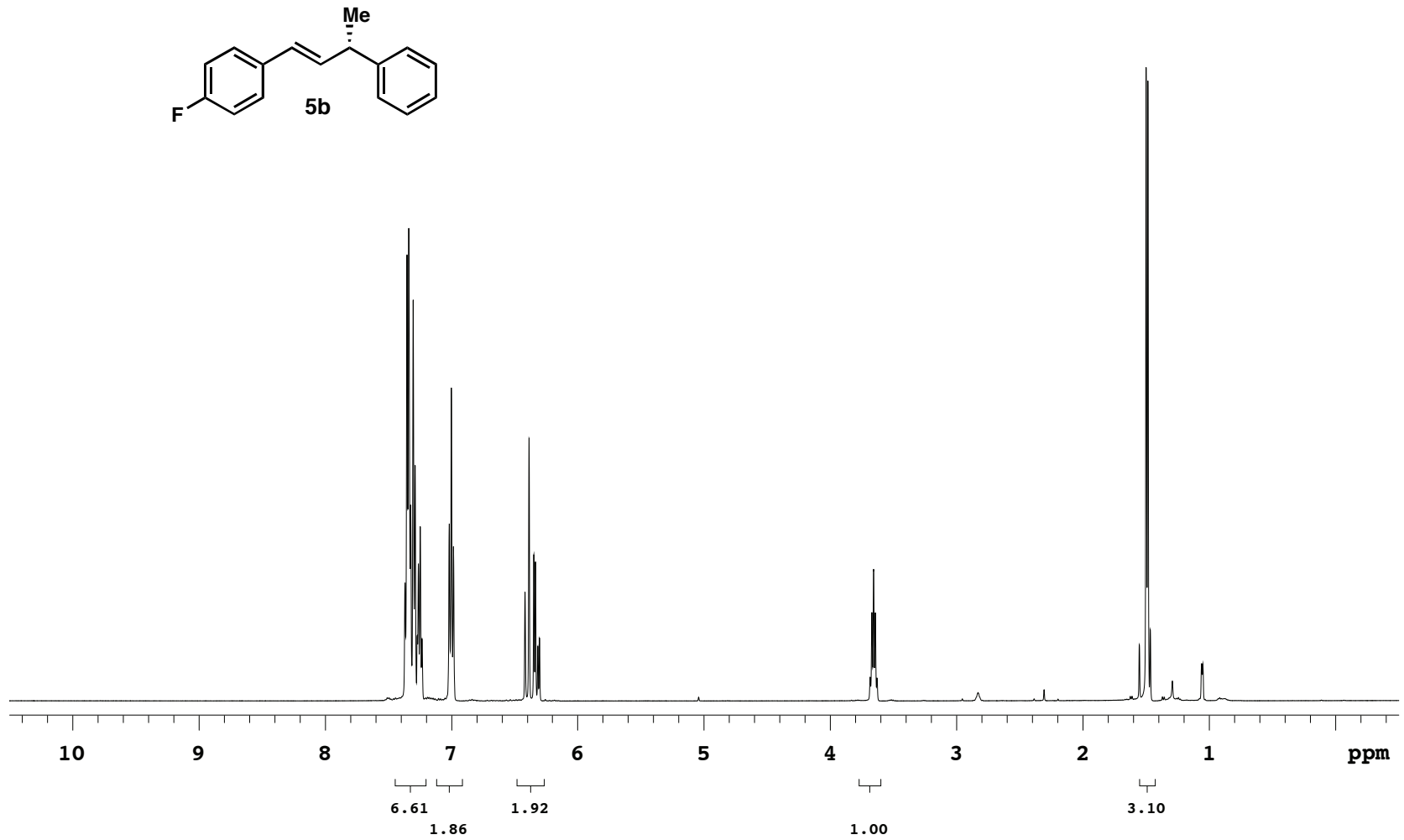
Data file /indy/acherney/vnmrsys/data/ahc-7-209-7/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-209-2

Sample Name	ahc-7-209-2	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-07-14	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



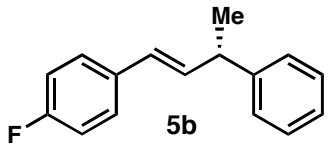
Data file /indy/acherney/vnmrsys/data/ahc-7-209-2/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-209-2

Sample Name	**ahc-7-209-2**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



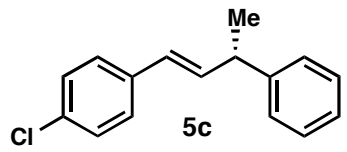
Data file /indy/acherney/vnmrsys/data/ahc-7-209-2/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-209-3

Sample Name	**ahc-7-209-3**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5c

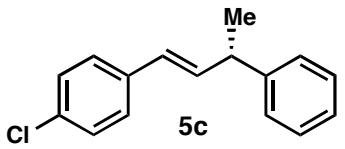
Data file /indy/acherney/vnmrsys/data/ahc-7-209-3/PROTON01.fid

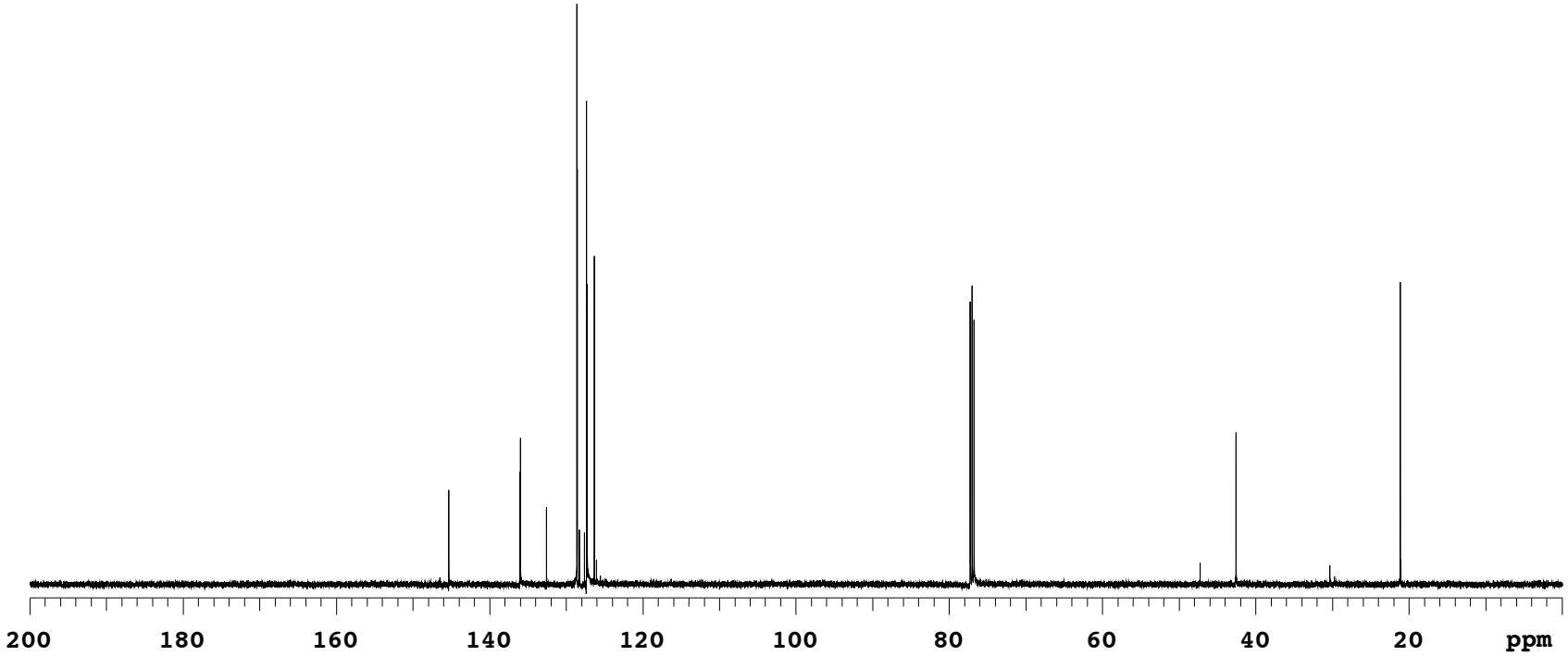
Plot date 2014-07-29

Agilent Technologies

ahc-7-209-3

Sample Name	**ahc-7-209-3**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**





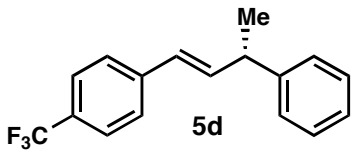
Data file /indy/acherney/vnmrsys/data/ahc-7-209-3/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-255-9

Sample Name	**ahc-7-255-9**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5d

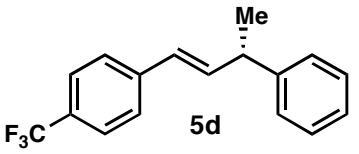
Data file /indy/acherney/vnmrsys/data/ahc-7-255-9/PROTON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-255-9

Sample Name	**ahc-7-255-9**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



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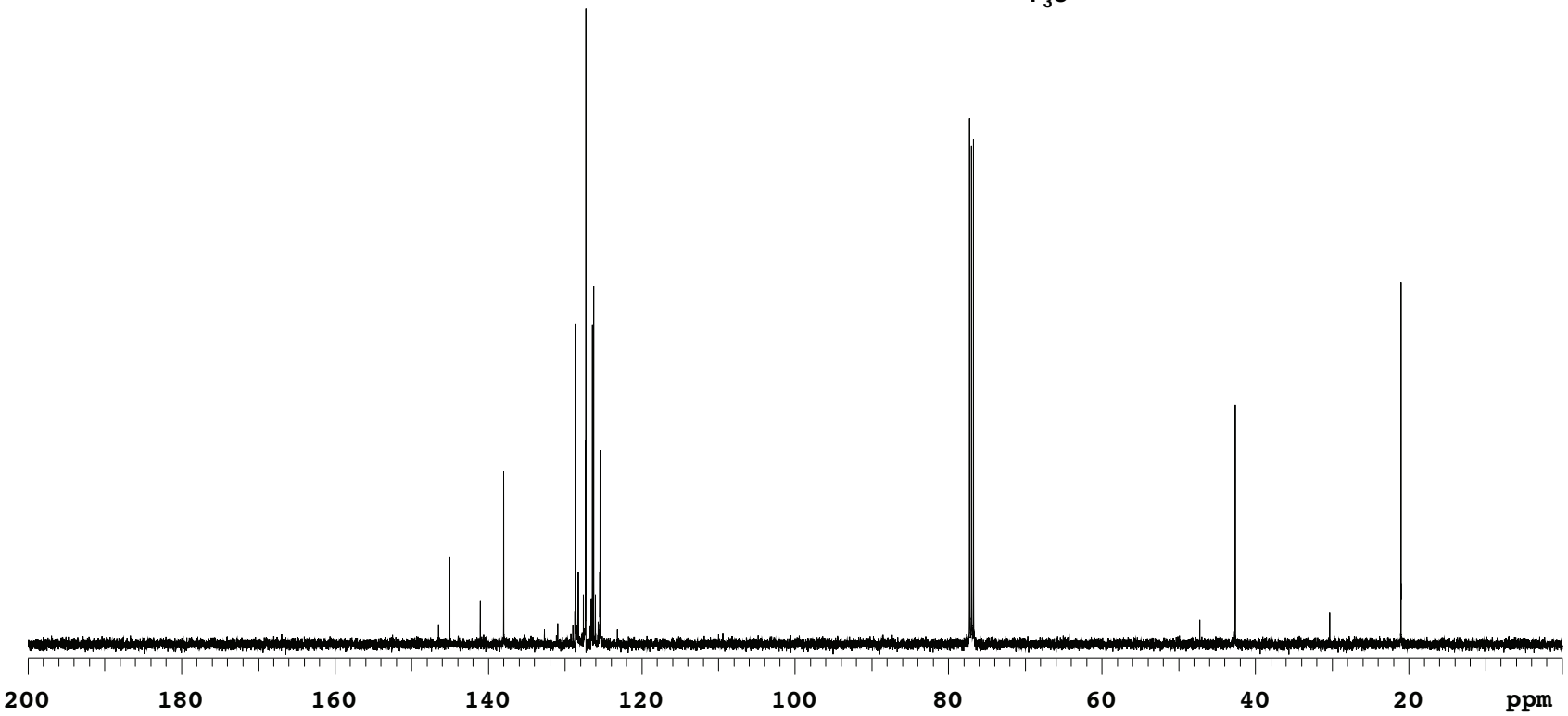


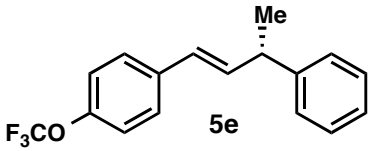
Data file /indy/acherney/vnmrsys/data/ahc-7-255-9/CARBON01.fid

Plot date 2014-07-29

Agilent Technologies

ahc-7-209-8

Sample Name	**ahc-7-209-8**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5e

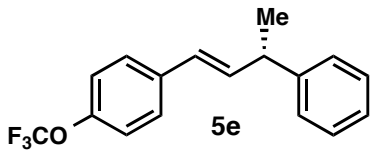
Data file /indy/acherney/vnmrsys/data/ahc-7-209-8/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-209-8

Sample Name	**ahc-7-209-8**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**

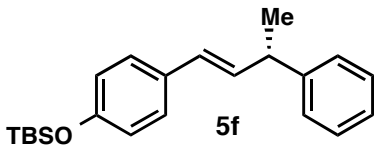


Data file /indy/acherney/vnmrsys/data/ahc-7-209-8/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

Sample Name	**ahc-7-97-2-column**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-02-21**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**

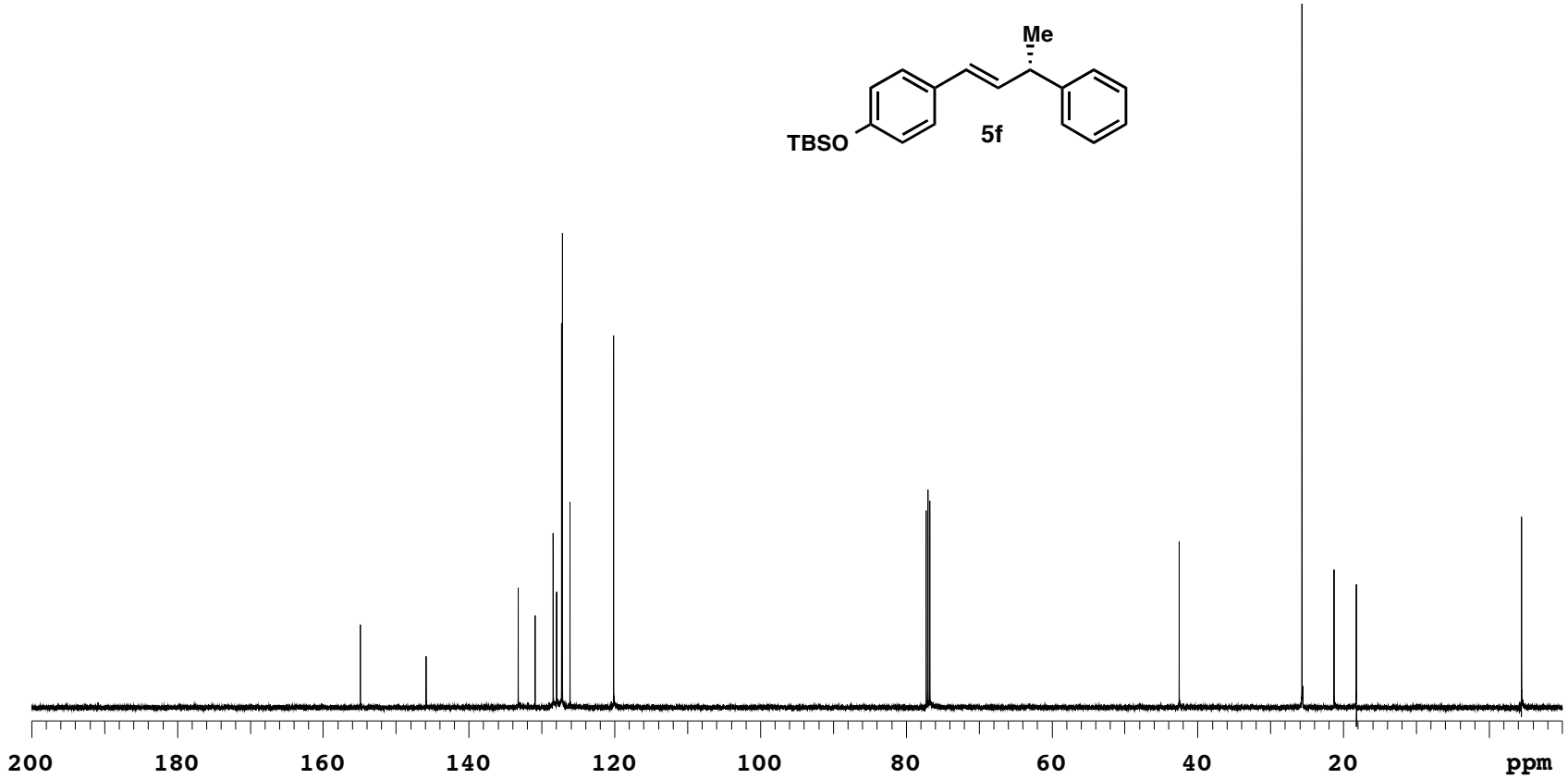


Data file /indy/acherney/vnmrsys/data/ahc-7-97-2-column/PROTON02.fid

Plot date 2014-07-30

Agilent Technologies

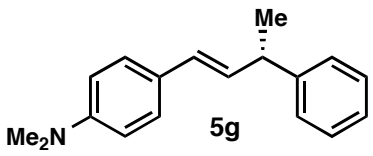
Sample Name	**ahc-7-97-2-column**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-02-21**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



Agilent Technologies

ahc-7-97-6-column

Sample Name	ahc-7-97-6-column	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-02-21	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser

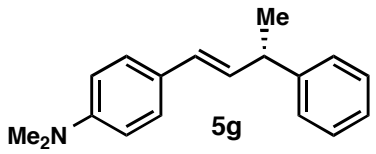


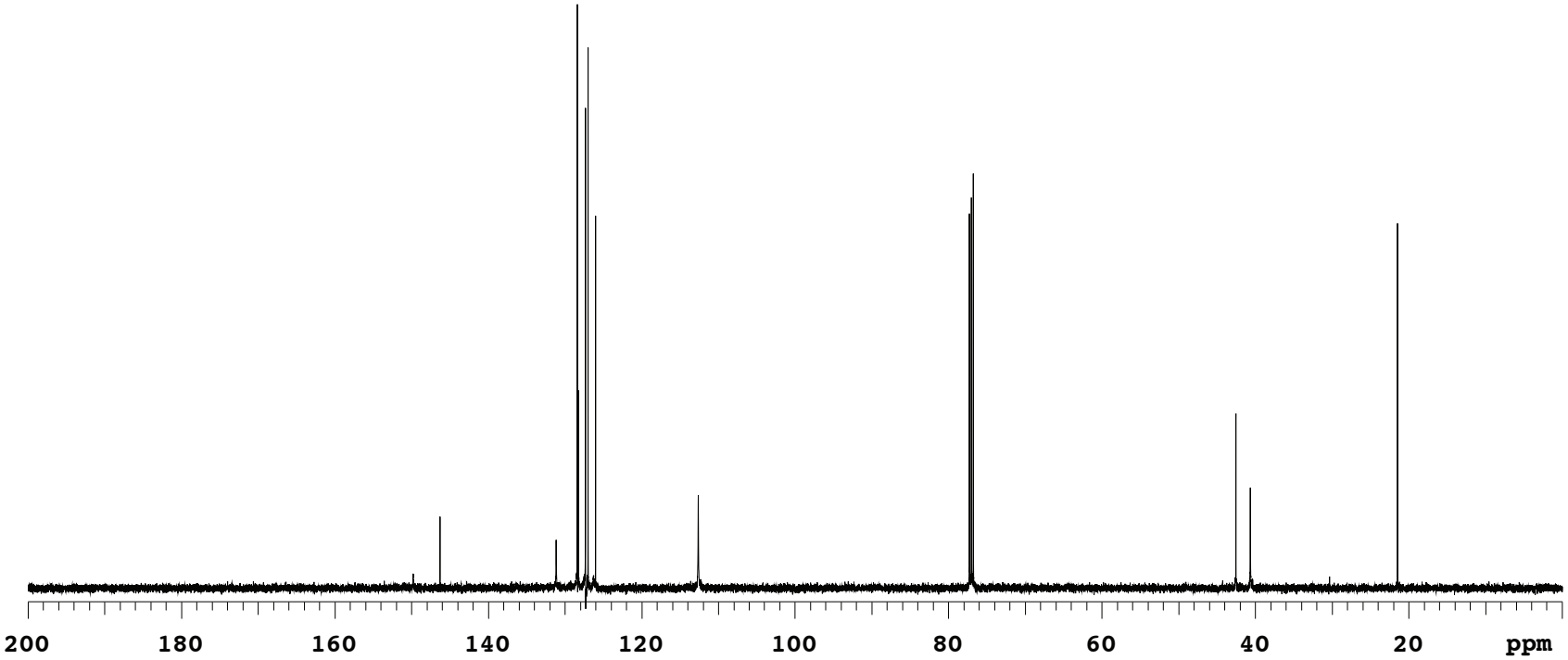
Data file /indy/acherney/vnmrsys/data/ahc-7-97-6-column/PROTON02.fid

Plot date 2014-07-30

Agilent Technologies

Sample Name	**ahc-7-97-6-column**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-02-21**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



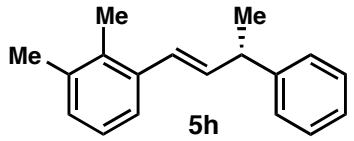


Data file /indy/acherney/vnmrsys/data/ahc-7-97-6-column/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

Sample Name	**ahc-7-209-10**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-15**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5h

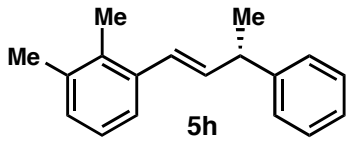
Data file /indy/acherney/vnmrsys/data/ahc-7-209-10/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-209-10

Sample Name	**ahc-7-209-10**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-15**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5h

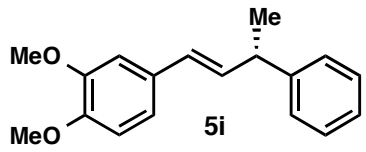
Data file /indy/acherney/vnmrsys/data/ahc-7-209-10/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-209-6

Sample Name	ahc-7-209-6	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-07-14	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



5i

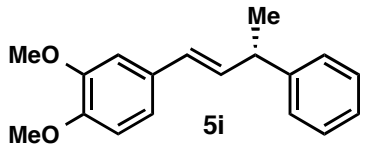
Data file /indy/acherney/vnmrsys/data/ahc-7-209-6/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-209-6

Sample Name	**ahc-7-209-6**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



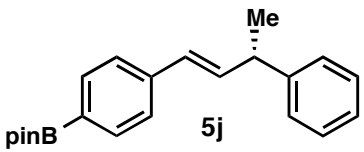
Data file /indy/acherney/vnmrsys/data/ahc-7-209-6/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-209-12

Sample Name	ahc-7-209-12	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-07-14	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



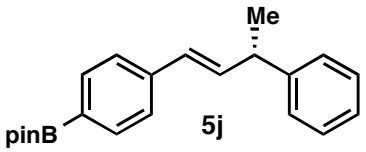
5j

Data file /indy/acherney/vnmrsys/data/ahc-7-209-12/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

Sample Name	**ahc-7-209-12**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



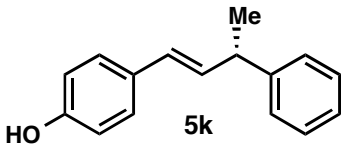
Data file /indy/acherney/vnmrsys/data/ahc-7-209-12/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-209-13

Sample Name	**ahc-7-209-13**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5k

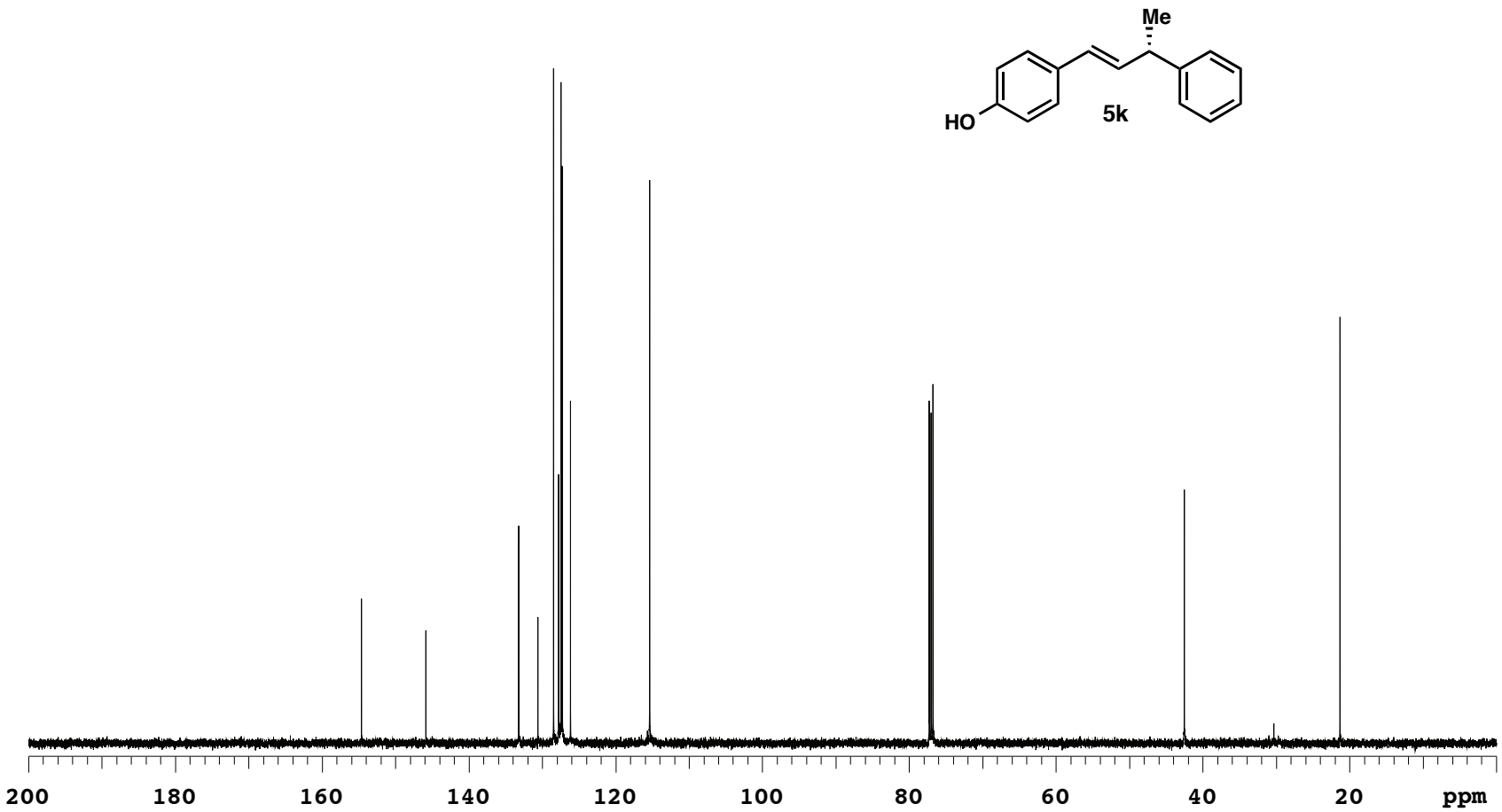
Data file /indy/acherney/vnmrsys/data/ahc-7-209-13/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-209-13

Sample Name	**ahc-7-209-13**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-14**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



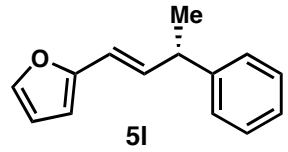
Data file /indy/acherney/vnmrsys/data/ahc-7-209-13/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-255-2

Sample Name	**ahc-7-255-2**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5l

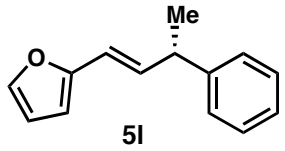
Data file /indy/acherney/vnmrsys/data/ahc-7-255-2/PROTON01.fid

Plot date 2014-07-30

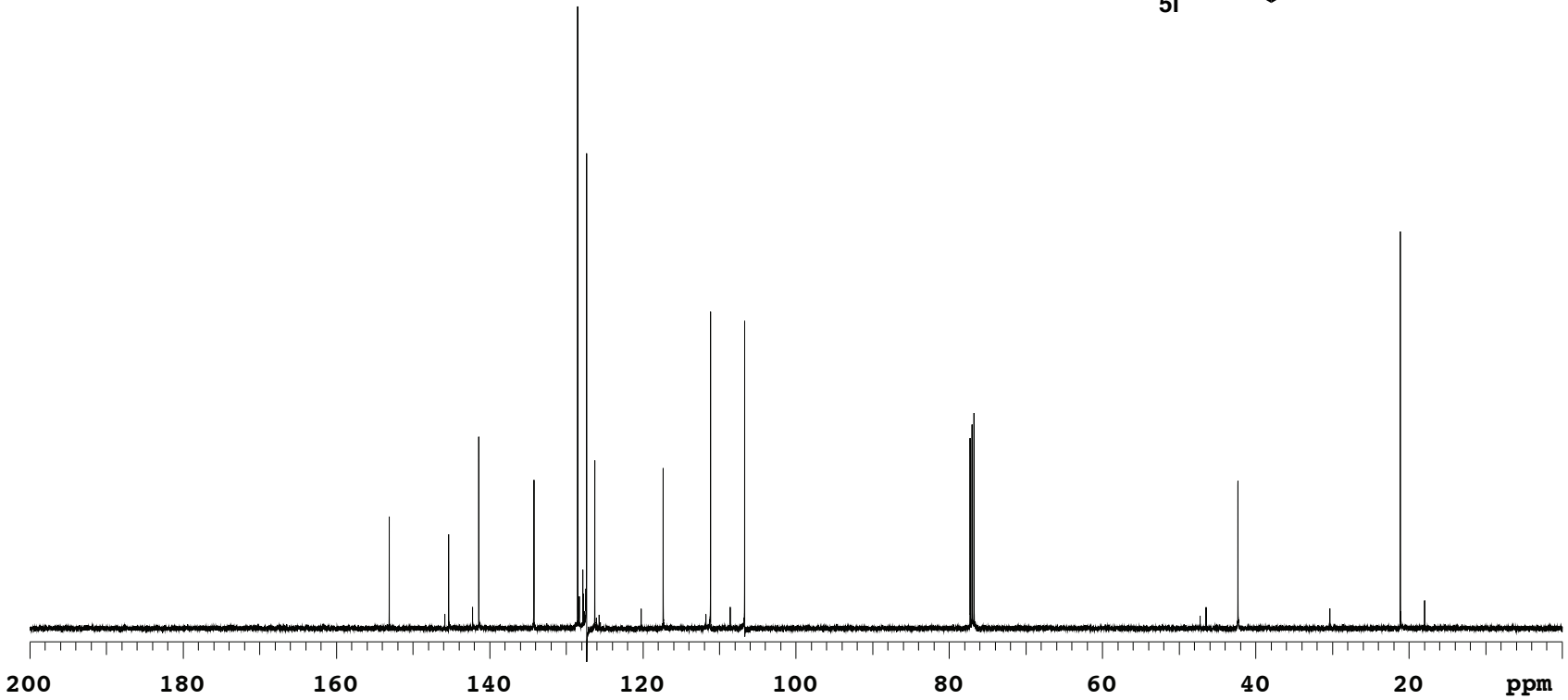
Agilent Technologies

ahc-7-255-2

Sample Name	**ahc-7-255-2**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5l



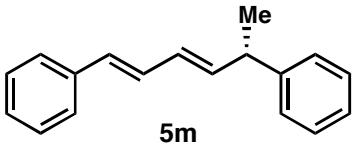
Data file /indy/acherney/vnmrsys/data/ahc-7-255-2/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-255-5

Sample Name	**ahc-7-255-5**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5m

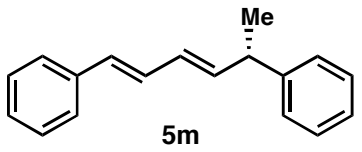
Data file /indy/acherney/vnmrsys/data/ahc-7-255-5/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-255-5

Sample Name	**ahc-7-255-5**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5m

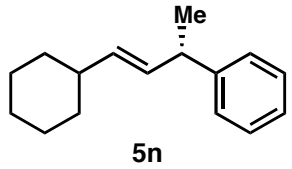
Data file /indy/acherney/vnmrsys/data/ahc-7-255-5/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-263-6

Sample Name **ahc-7-263-6**	Pulse sequence **PROTON**	Temperature **25**	Study owner **acherney**
Date collected **2014-08-01**	Solvent **cdcl3**	Spectrometer **-vnmrs400**	Operator **autouser**



5n

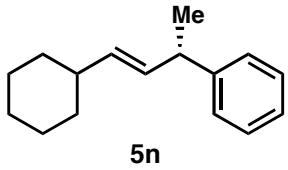
Data file /indy/acherney/vnmrsys/data/ahc-7-263-6/PROTON01.fid

Plot date 2014-08-01

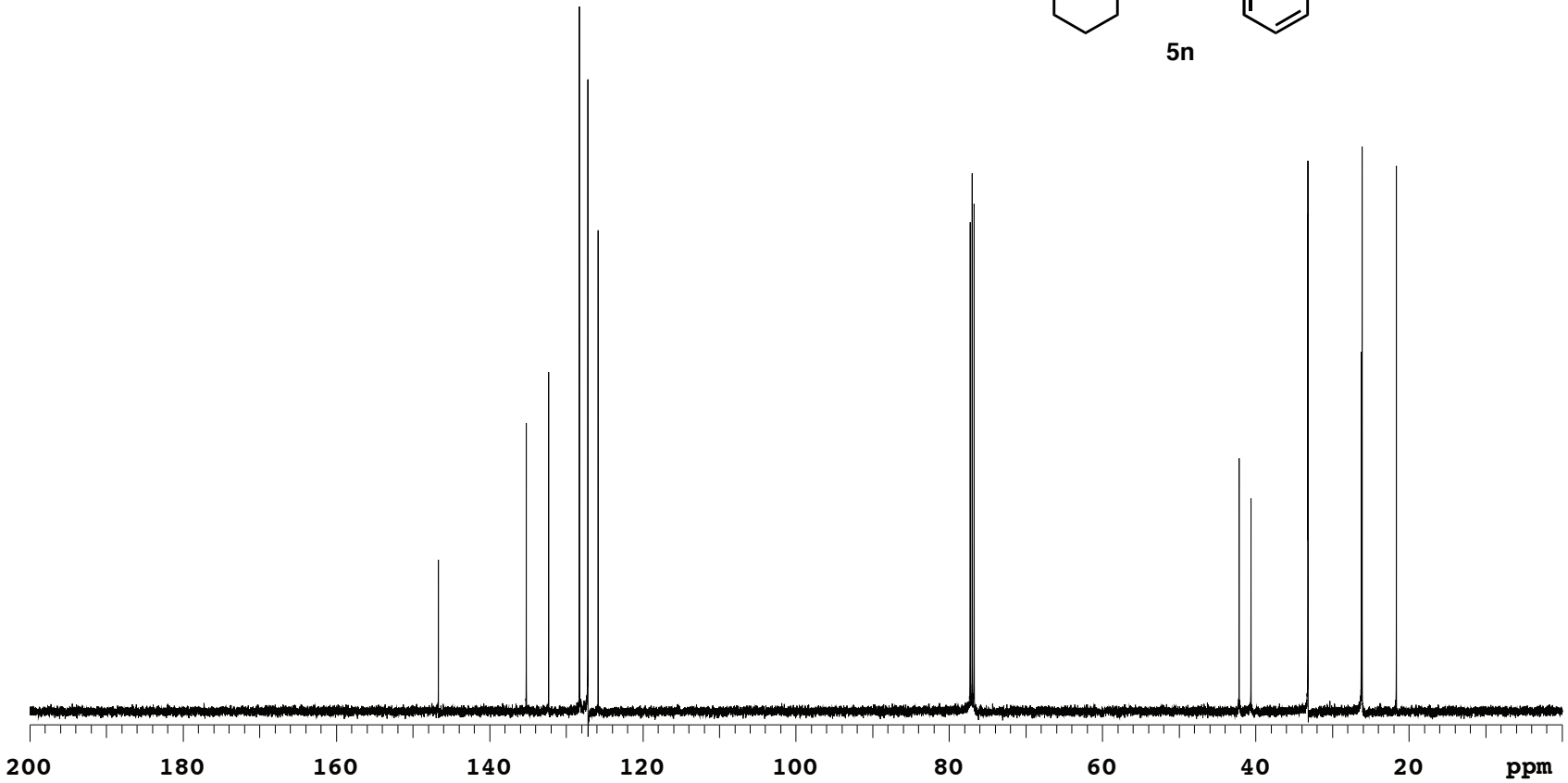
Agilent Technologies

ahc-7-263-6

Sample Name	**ahc-7-263-6**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-08-01**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5n



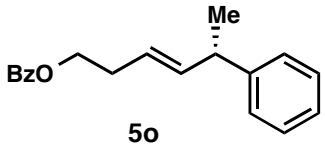
Data file /indy/acherney/vnmrsys/data/ahc-7-263-6/CARBON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-239-4

Sample Name	**ahc-7-239-4**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



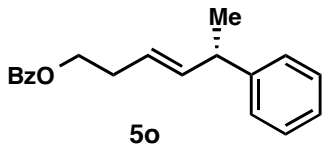
5o

Data file /indy/acherney/vnmrsys/data/ahc-7-239-4/PROTON01.fid

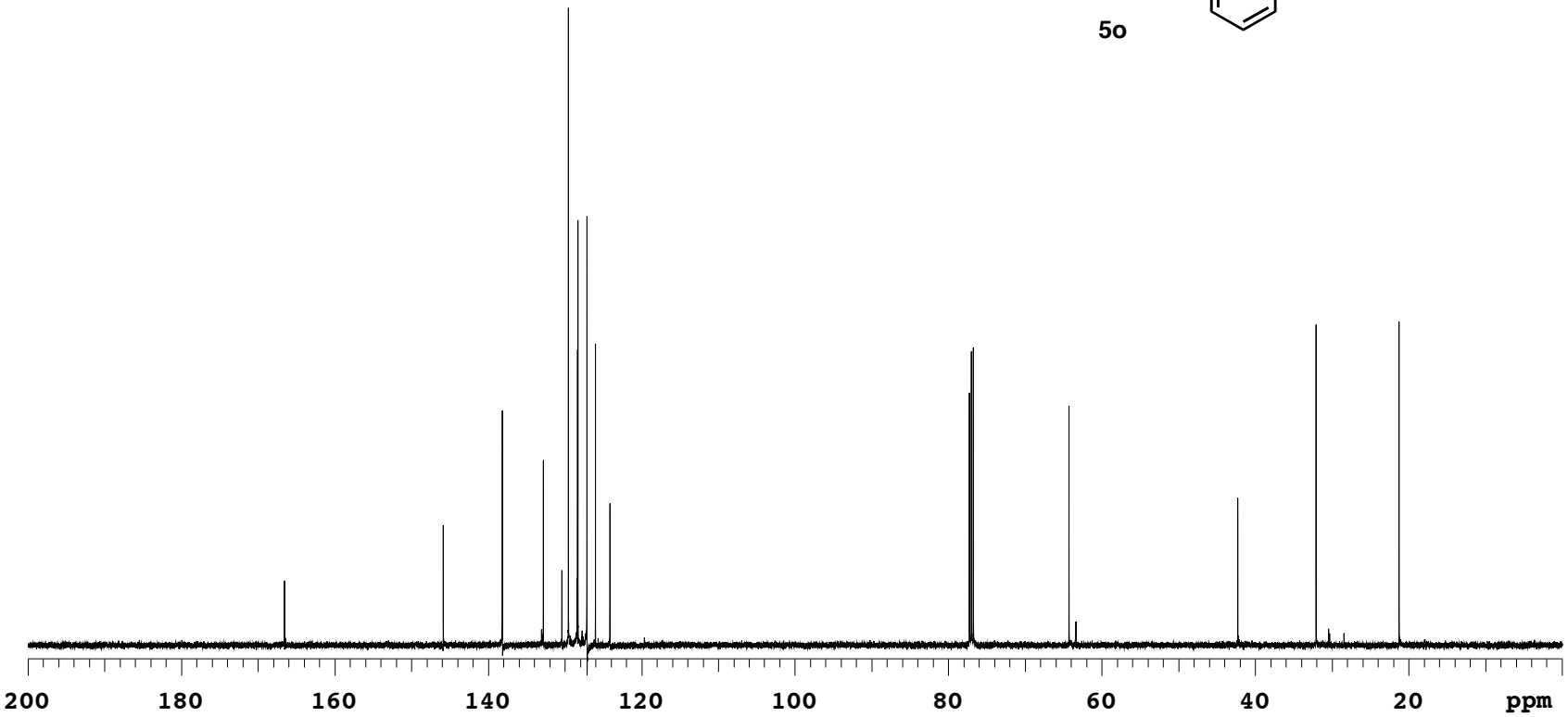
Plot date 2014-07-30

Agilent Technologies

Sample Name	**ahc-7-239-4**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



5o



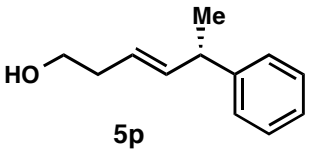
Data file /indy/acherney/vnmrsys/data/ahc-7-239-4/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-239-1

Sample Name	**ahc-7-239-1**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



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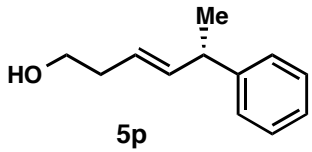
Data file /indy/acherney/vnmrsys/data/ahc-7-239-1/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-239-1

Sample Name	**ahc-7-239-1**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



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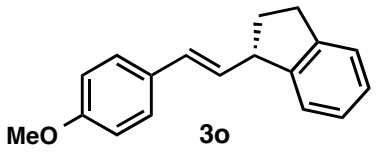
Data file /indy/acherney/vnmrsys/data/ahc-7-239-1/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-223-10

Sample Name	ahc-7-223-10	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-07-13	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



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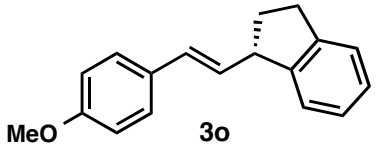
Data file /indy/acherney/vnmrsys/data/ahc-7-223-10/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-223-10

Sample Name	**ahc-7-223-10**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



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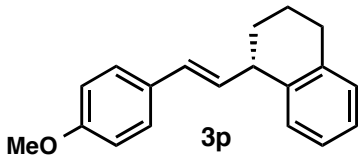
Data file /indy/acherney/vnmrsys/data/ahc-7-223-10/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

Sample Name	**ahc-7-223-7**	Pulse sequence	**PROTON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



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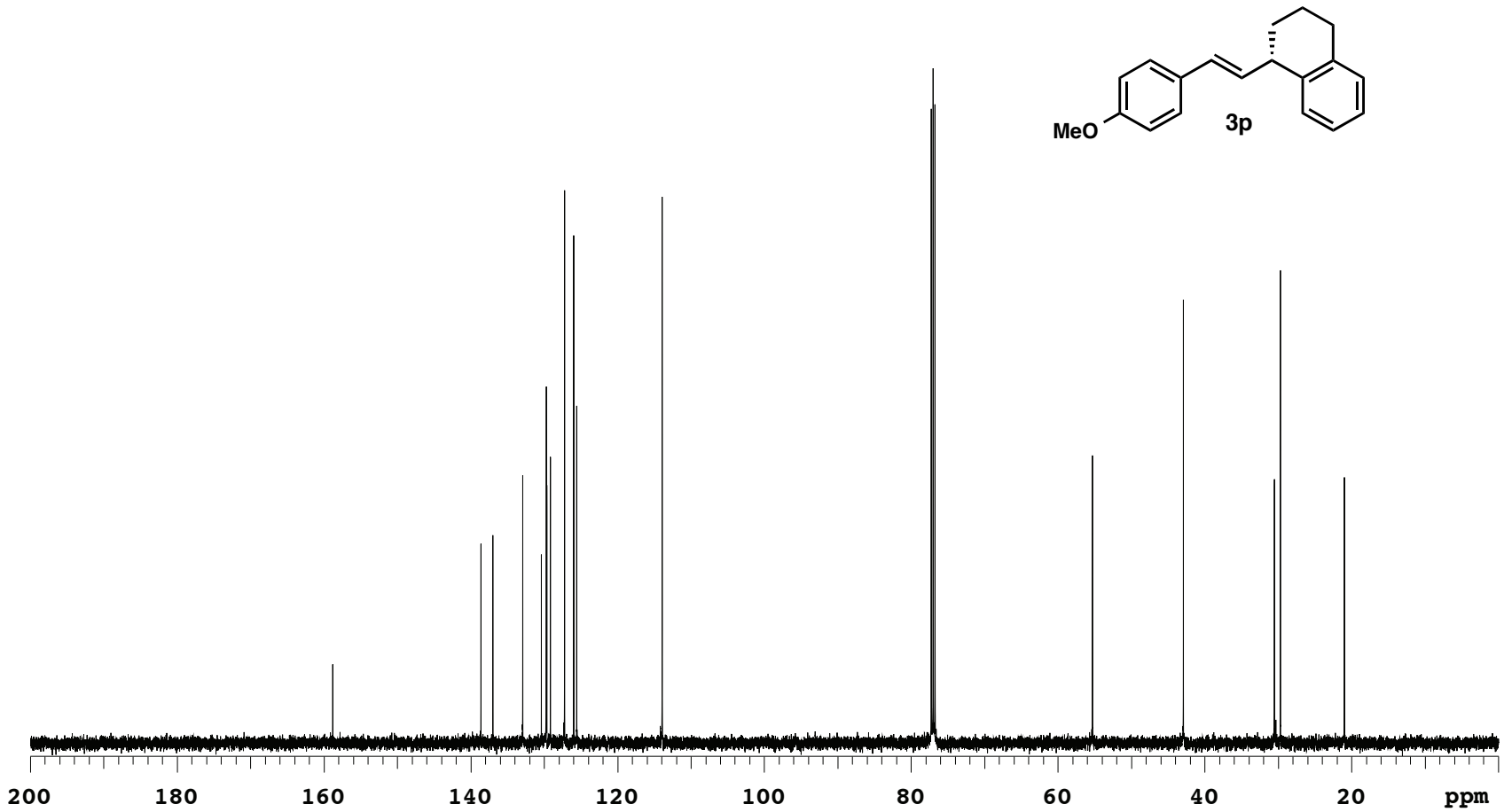
Data file /indy/acherney/vnmrsys/data/ahc-7-223-7/PROTON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-223-7

Sample Name	**ahc-7-223-7**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-13**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



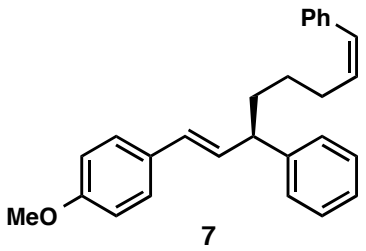
Data file /indy/acherney/vnmrsys/data/ahc-7-223-7/CARBON01.fid

Plot date 2014-07-30

Agilent Technologies

ahc-7-223-3

Sample Name	ahc-7-223-3	Pulse sequence	PROTON	Temperature	25	Study owner	acherney
Date collected	2014-07-31	Solvent	cdcl3	Spectrometer	-vnmrs400	Operator	autouser



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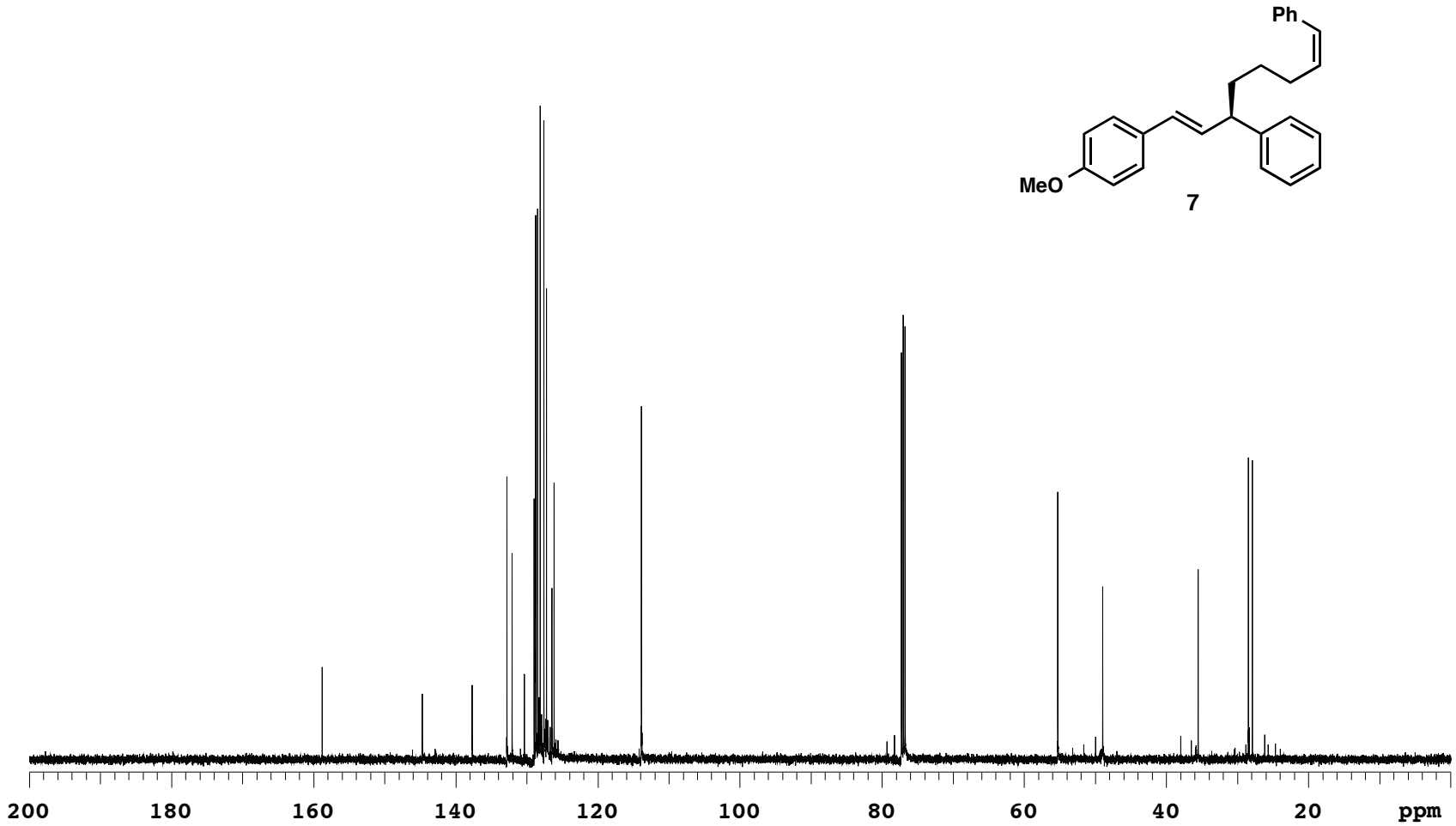
Data file /indy/acherney/vnmrsys/data/ahc-7-223-3/PROTON01.fid

Plot date 2014-08-01

Agilent Technologies

ahc-7-223-3

Sample Name	**ahc-7-223-3**	Pulse sequence	**CARBON**	Temperature	**25**	Study owner	**acherney**
Date collected	**2014-07-31**	Solvent	**cdcl3**	Spectrometer	**-vnmrs400**	Operator	**autouser**



Data file /indy/acherney/vnmrsys/data/ahc-7-223-3/CARBON01.fid

Plot date 2014-08-01