

Transition metal free free Asymmetric and Diastereoselective Allylic Alkylation using Grignard reagents: Construction of vicinal stereogenic centers via Kinetic resolution.

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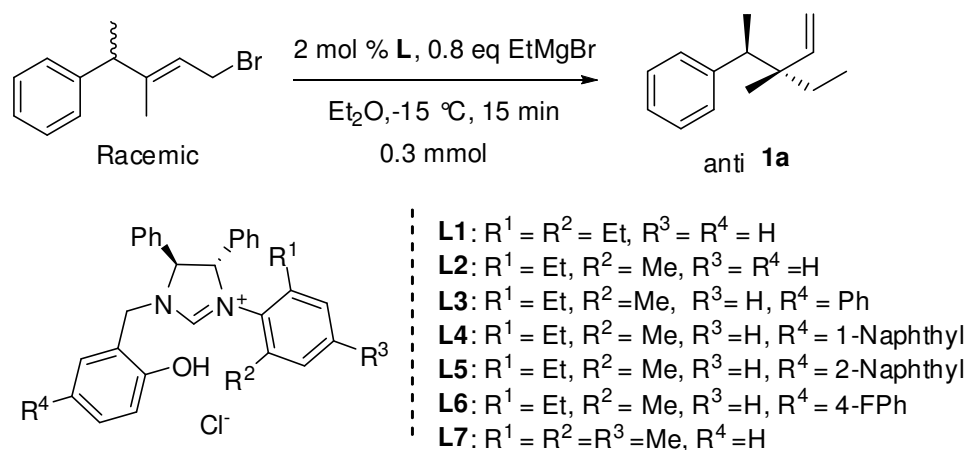
SUPPORTING INFORMATION AVAILABLE

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General Remarks.

All reactions were not carried out under nitrogen or argon atmosphere in flame-dried glassware and with dry solvents. Solvents (THF, Et₂O, Toluene, DCM, MTBE and CH₃CN) were dried over alumina (activated at 350 °C under nitrogen atmosphere for 12 h). Yields refer to chromatographically and spectroscopically ¹H NMR homogeneous materials, unless otherwise stated. Reactions were monitored by GC-MS Hewlet Packard (EI mode) HP6890-5973 on an HP6890 or by TLC carried out on 0.25 mm E. Merck silica gel plates (60F-254) using UV lamp as visualizing agent and KMnO₄ solution as developing agents. Flash chromatographies were performed using silica gel (particle size 32-63 μm, 60 Å). ¹H (300, 400 MHz or 500 MHz) and ¹³C (75 or 100 MHz) NMR spectra were recorded on Bruker AMX-300 or 400 instrument in CDCl₃ and calibrated using residual undeuterated solvent as an internal reference. Chemical shift (δ) are given in ppm relative to tetramethylsilane (0 ppm). Multiplicity is indicated as follows: s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), dd (doublet of doublet), br s (broad singlet). Coupling constants *J* are reported in Hz. Mass spectra (MS) and High resolution mass spectra (HRMS) were obtained by Electrospray Ionisation (ESI) or by electronic impact (EI, 70 eV). Optical rotations were measured at 20°C in a 10 cm cell in the stated solvent; [α]_D values are given in 10⁻¹ deg.cm² g⁻¹ (concentration *c* given as g/100 mL). Enantiomeric excesses were determined either by chiral GC measurement on a HP6890 (H₂ as vector gas) or HP6850 (He or H₂ as vector gas). Temperature programs are described as follows: initial T (°C) – initial times (min) – temperature gradient (°C/min) – final T (°C); retention times (RT) are given in min.). or by SFC with supercritical carbon dioxide as vector and *i*PrOH or MeOH. Programme sequence as followed: Name of the column, percentage of *i*PrOH or MeOH. retention time 1 and retention time 2.

Optimization of the ligand.



Entry	L	Conv% ^[a]	S _N 2'/S _N 2 ^[a]	anti/syn ^[a]	e:r % ^[b]
1	L6	50	100/0	100/0	82:18
2	L1	50 (20) ^[c]	100/0	100/0	91:9
3	L2	52 (25) ^[c]	100/0	100/0	91:9
4	L3	50	100/0	100/0	85:15
5	L4	52 (35) ^[c]	100/0	100/0	91:9
6	L5	52	100/0	100/0	88:12
7	L7	50	100/0	100/0	85:15

Table 1: ^[a] Ratio determined by ¹H-(NMR). ^[b] Determined using chiral GC. ^[c] Isolated yield after silica gel column chromatography on 0.8 mmol scale.

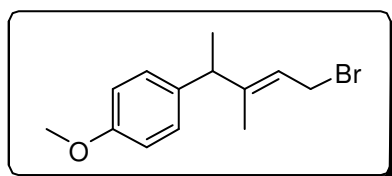
The screening of the ligand library began by examination of the importance of the blocking part of the ligand (left part). The switch from two methyl **L7** to a ethyl/methyl **L2** pattern or a ethyl/ethyl **L1** pattern allowed to improve the enantioselectivity greatly (Tables 1. Entry 1 vs Entries 2,3). However no difference in terms of enantioselectivity can be measured using **L1** or **L2**. Having these results in hand the screen of the moiety in para position of the hydroxyl group on the chelating part of the ligand was then probed (right part). The introduction of a phenyl group **L3** was deleterious on the enantiomeric excess (Table 1. Entry 4). On the opposite the use of more bulky **L4** with a 1-Naphthyl group afforded the same level of enantiomeric excess than **L1** or **L2** (Table 1. Entries 2,3 vs Entry 5). A slight modification of the ligand morphology by using a 2-Naphthyl group **L6** led to a decrease of the ee value to 76 % ee (Table 1. Entry 6). The introduction of a fluorine group led to a decrease of the enantioselectivity to 70 % ee (Table 1. Entry 7). The ligands **L1**, **L2** and **L4** were compared

by isolating the product after silica gel chromatography. To our surprise the ligand **L4** allowed us to isolate the desired adduct in 35 % isolated yield versus 20 and 25 % isolated yield respectively for the ligand **L1** and **L2**. To conclude the enantioselectivity and the isolated yield can be controlled by tuning in an appropriate way the NHC ligand. The diastereoselectivity and the regioselectivity are not affected whatever is the structure of the NHC ligand employed.

The desired methyl ketones were commercially available or prepared according to the following procedure (M. Mc Intosh and al, *J. Org. Chem*, **1983**, 48, 2987.). The other ketone were prepared according to the procedure (G. B. Trimitis and al, *Org. Lett*, **2010**, 9, 1996).

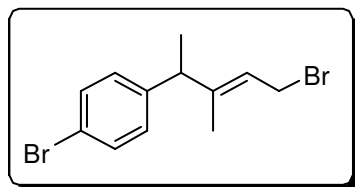
Preparation of substrate.

Into a conditioned two necked round bottomed flask the appropriate ketone (1.5 g, 1 eq) is added and dissolved in 25 mL of dry THF. The round bottomed flask is placed into a bath containing crushed ice. The vinyl magnesium chloride (1.5 eq) is added dropwise and the ice bath is removed and the mixture is stirred at room temperature for 2 h. After completion by TLC the round bottomed flask is placed into an ice bath and 20 mL of saturated aqueous solution of ammonium chloride is added. 30 mL of ether is added and the aqueous phase is extracted two times with 20 mL portion of ether each. The organic phases are combined and dried over anhydrous sodium sulfate. The solvent is removed using a rotavapor and dried over high vacuum using an oil pump. The ¹H NMR analysis of the crude revealed a pure compound which is used in the next step without further purification. The tertiary alcohol (1 eq) is diluted in a mixture of pentane/ether 9/1 and HBr (48 % aq, 5 mL) is added under vigorous stirring. After 30 min (crucial to respect the exact time) the aqueous phase is removed using a separation funnel. The organic phase is washed with saturated solution of sodium bicarbonate. The organic phase is dried over sodium sulfate. The solvent is evaporated and the product is dried under high vacuum. Products are recovered 100 % E isomer and are silica gel, basic alumina and neutral alumina sensitive product in 55-62 % yield over two steps.

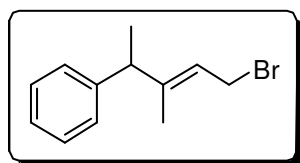


Compound is obtained as brown oil with 70 % purity (55 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C. ¹H (NMR) (400 MHz,

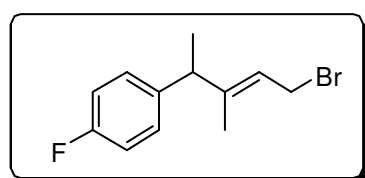
C_6H_6) δ 7.20-6.80 (m, 4H) 5.75 (t, 1H, $J=8$ Hz) 4.10 (d, 2H, $J=8.2$ Hz) 3.62 (s, 3H) 3.50 (q, 1H, $J=6.9$ Hz) 1.66 (s, 3H) 1.46 (d, 3H, $J=7.1$ Hz). ^{13}C NMR (75 MHz, C_6H_6) δ 158.5, 146.5, 136, 128.9 120.1, 113.8, 54.5, 46.5, 28.92, 20.1, 17.1.



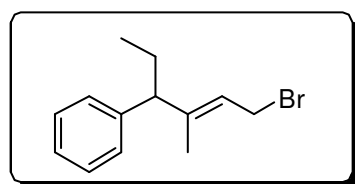
Compound is obtained as brown oil with 75 % purity (58 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at $-30^\circ C$. 1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 2H) 6.90-6.80 (m, 2H) 5.70 (t, 1H, $J=8.2$ Hz) 4.03 (d, 2H, $J=8.4$ Hz) 3.75 (q, 1H, $J=7$ Hz) 1.53 (s, 3H) 1.33 (d, 3H, $J=7.1$ Hz). ^{13}C NMR (75 MHz, C_6H_6) δ 145, 143, 129.9, 129.8, 120.8, 120.2, 46.7, 28.5, 20.4, 18.7. HRMS (EI + mode) m:z expected: 315,9462 observed: 315,9463.



Compound is obtained as brown oil with 75 % purity (56 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at $-30^\circ C$. 1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 5H) 5.81 (t, 1H, $J=8.5$ Hz) 4.11 (d, 2H, $J=8.4$ Hz) 3.50 (q, 1H, $J=7.1$ Hz) 1.61 (s, 3H) 1.41 (d, 3H, $J=6.2$ Hz). ^{13}C NMR (75 MHz, C_6H_6) δ 146, 144.2, 128.5, 128.3, 127.7, 127.5, 126.3, 126.2, 47.4, 28.7, 19, 14.3. HRMS (EI + mode) m:z expected: 238,0357 observed: 238,0358.

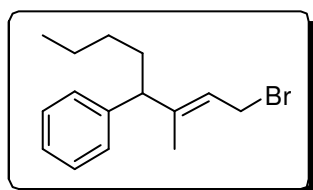


Compound is obtained as brown oil with 80 % purity (62 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at $-30^\circ C$. 1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 5H) 5.78 (t, 1H, $J=8.4$ Hz) 4.09 (d, 2H, $J=8.4$ Hz) 3.85 (q, 1H, $J=7.1$ Hz) 1.59 (s, 3H) 1.38 (d, 3H, $J=6.22$ Hz). ^{13}C NMR (75 MHz, C_6H_6) δ 162 (dd, $J=10.8$ Hz and $J=243.9$ Hz), 146, 140 (d, $J=3.2$ Hz), 139, 129.5 (d, $J=7.6$ Hz), 128.6 (d, $J=7.8$ Hz), 121, 115 (dd, $J=4.7$ Hz and $J=21$ Hz), 46.4, 28.6, 18.9, 14. HRMS (EI + mode) m:z expected: 256,0263 observed: 256,0262.

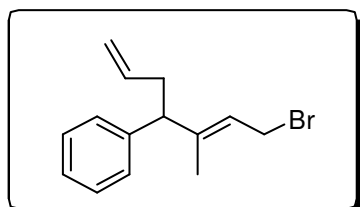


Compound is obtained as brown oil with 70 % purity (52 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at $-30^\circ C$. 1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 5H) 5.67 (t, 1H, $J=8.4$ Hz) 3.94 (dd, 2H, $J=1.3$ Hz and $J=8.4$ Hz) 3.78 (t, 1H, $J=7.6$ Hz) 1.55-1.45 (m, 2H) 1.30 (s, 3H) 0.85-0.7 (m, 3H).

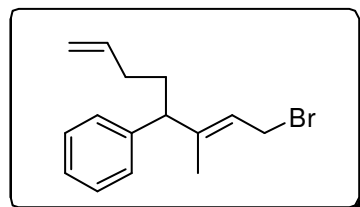
^{13}C NMR (75 MHz, C_6H_6) δ 144.9, 142.7, 129, 128.2, 127.8, 126.3, 120.9, 55.5, 28.7, 25.1, 13.8, 12.1. HRMS (EI + mode) m/z expected: 252,0514 observed: 252,0512.



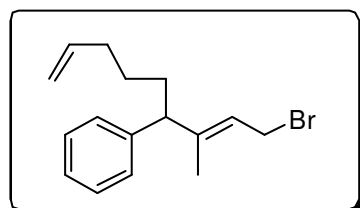
Compound is obtained as brown oil with 70 % purity (55 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C . ^1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 5H) 5.82 (t, 1H, $J=8.3$ Hz) 4.09 (d, 2H, $J=8.5$ Hz) 3.90 (t, 1H, $J=7.5$ Hz) 1.60-1.50 (m, 4H) 1.4-1.30 (m, 2H) 1.30 (s, 3H) 0.8-0.7 (m, 3H). ^{13}C NMR (75 MHz, C_6H_6) δ 145.1, 142.9, 128.9, 127.7, 126.4, 126.2, 120.8, 53.7, 31.9, 29.8, 28.7, 22.8, 13.9, 13.8. HRMS (EI + mode) m/z expected: 280,0827 observed: 280,0829.



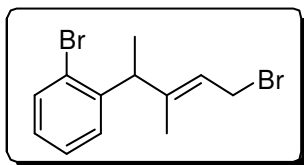
Compound is obtained as brown oil with 70 % purity (52 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C . ^1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 5H) 5.85-5.75 (m, 1H) 5.1-4.9 (m, 3H) 4.12 (t, 2H, $J=8.3$ Hz) 3.9 (t, 1H, $J=7.8$ Hz) 1.60 (s, 3H) 1.25 (t, 2H, $J=6.6$ Hz). ^{13}C NMR (75 MHz, C_6H_6) δ 144.3, 142.2, 136.9, 129, 128.2, 128.1, 126.4, 121.2, 115.9, 53.4, 36.8, 28.6, 20.8. HRMS (EI + mode) m/z expected: 264,0514 observed: 264,0514.



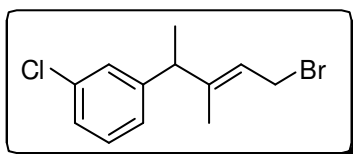
Compound is obtained as brown oil with 75 % purity (58 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C . ^1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 5H) 5.80-5.70 (m, 1H) 5-4.9 (m, 3H) 4.15 (t, 2H, $J=8.3$ Hz) 3.88 (t, 1H, $J=7.8$ Hz) 1.62 (s, 3H) 1.40-1.25 (m, 4H). ^{13}C NMR (75 MHz, C_6H_6) δ 144.3, 142.2, 136.9, 129, 128.2, 128.1, 126.4, 121.2, 115.9, 53.4, 37.2, 36.8, 28.6, 20.8. HRMS (EI + mode) m/z expected: 278,0670 observed: 278,0671.



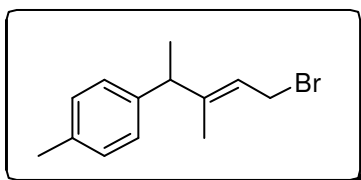
Compound is obtained as brown oil with 75 % purity (58 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C . ^1H (NMR) (400 MHz, C_6H_6) δ 7.50-7.20 (m, 5H) 5.80-5.60 (m, 1H) 5-4.90 (m, 3H) 4.17 (t, 2H, $J=8.3$ Hz) 3.86 (t, 1H, $J=7.8$ Hz) 1.65 (s, 2H) 1.50-1.25 (m, 6H). ^{13}C NMR (75 MHz, C_6H_6) δ 144.3, 142.2, 136.9, 129, 128.2, 128.1, 126.4, 121.2, 115.9, 53.4, 37.2, 36.8, 28.6, 20.8. HRMS (EI + mode) m/z expected: 292,0827 observed: 292,0828.



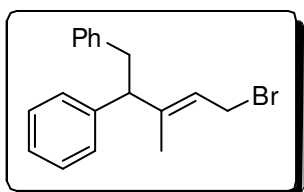
Compound is obtained as brown oil with 70 % purity (61 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C. ¹H (NMR) (400 MHz, C₆H₆) δ 7.30-7.20 (m, 2H) 6.90- 6.80 (m, 2H) 5.71 (t, 1H, J= 8.3 Hz) 4.01 (d, 2H, J=8.3 Hz) 3.80 (q, 1H, J= 7.2 Hz) 1.51 (s, 3H) 1.31 (d, 3H, J= 7.1 Hz). ¹³C NMR (75 MHz, C₆H₆) δ 145.2, 142, 129.6, 129.4, 121.8, 120.4, 47.2, 29.2, 20.1, 18.3. HRMS (EI + mode) m:z expected: 315,9462 observed: 315,9462.



Compound is obtained as brown oil with 70 % purity (55 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C. ¹H (NMR) (400 MHz, C₆H₆) δ 7.40-7.30 (m, 2H) 6.95-6.85 (m, 2H) 5.74 (t, 1H, J= 8.3 Hz) 4.05 (d, 2H, J=8.4 Hz) 3.44 (q, 1H, J= 7.3 Hz) 1.55 (s, 3H) 1.34 (d, 3H, J= 7.15 Hz). ¹³C NMR (75 MHz, C₆H₆) δ 145.2, 142, 134, 129.6, 129.4, 121.8, 120.4, 53.3, 36.8, 28.8, 20.8. HRMS (EI + mode) m:z expected: 271,9967 observed: 271,9965.



Compound is obtained as brown oil with 80 % purity (65 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C. ¹H (NMR) (400 MHz, C₆H₆) δ 7.5-7.20 (m, 2H) 6.95-6.85 (m, 2H) 5.80 (t, 1H, J= 8 Hz) 4.10 (d, 2H, J=8.2 Hz) 3.89 (q, 1H, J=6.9 Hz) 2.36 (s, 3H) 1.61 (s, 3H) 1.40 (d, 3H, J= 7.1 Hz). ¹³C NMR (75 MHz, C₆H₆) δ 146.5, 136, 128.9 120.1, 113.8, 46.5, 28.92, 21.8, 21.3, 20.1, 17.1.



Compound is obtained as brown oil with 70 % purity (62 % yield based on purity) >99/1 % E isomer and is used as crude and stored in the freezer at -30°C. ¹H (NMR) (400 MHz, C₆H₆) δ 7.50-7.20 (m, 5H) 5.70 (t, 1H, J= 8Hz) 4.02 (d, 2H, J=8.2 Hz) 3.78 (q, 1H, J=6.9 Hz) 2.70 (d, 1H, J= 11.7 Hz) 1.76 (s, 3H) 1.33 (d, 3H, J= 7.1 Hz). ¹³C NMR (75 MHz, C₆H₆) δ 146, 141.8, 141.7, 130.2, 128.8, 127.9, 127.8, 127.4, 126 1, 120.1, 113.8, 55.5, 28.92, 21.8, 21.3, 20.1, 17.1.

Preparation of Grignard reagent.

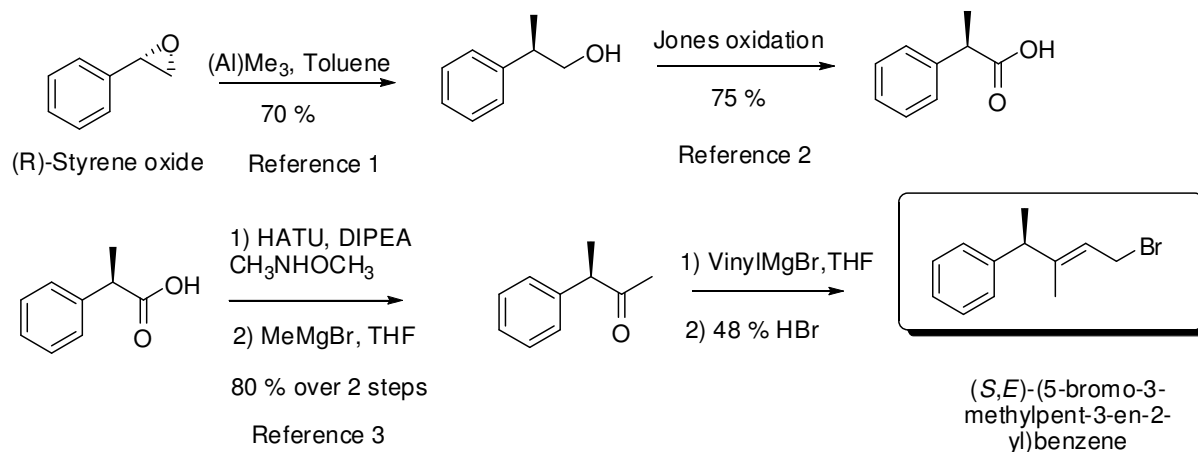
Into a conditioned two necked flask equipped with a reflux condenser and an addition funnel magnesium turnings (2,72 g, 1,3 eq) are introduced. The system is connected to high vacuum of the manifold and heat to 600 °C for 15 minutes using a heating gun. The magnesium turnings are stirred vigorously while cooling down into vacuum. The system is then backfilled with nitrogen and the cycle is repeated two times. The corresponding bromide (1 eq) is dissolved into 30 mL of dry ether and placed into the addition funnel. A few millilitres of the solution are poured and the Grignard formation starts by boiling of the ether. The rest of the solution is added over 45 minutes and stirring is continued for 2 hours. The liquid is cannulated into a conditioned bottle and titrated using phenanthroline/menthol. The typical concentrations obtained are between 1,8 M and 2,3 M.

Catalysis procedure for racemate.

In a flame-dried Schlenk, under N₂ atmosphere, the racemic allylic bromide (0.8 mmol) and racemic NHC ligand **L** (2 mol %) are suspended in 3.2 mL of dry Et₂O (crucial to respect the dilution) and cooled to -15°C. RMgBr x M in Et₂O (0.8 eq) is added dropwise over 4 min. After stirring overnight full conversion is reached, the mixture is quenched by addition of a saturated solution of NH₄Cl (2 ml). The aqueous layer is separated and extracted with Et₂O (3 x 3 ml). The combined organic fractions are dried over Na₂SO₄, filtered and concentrated in vacuo. The residue is purified by flash column chromatography using pentane (100 %) as eluant (0.5 cm diameter and 10 cm high column).

Determination of the absolute configuration.

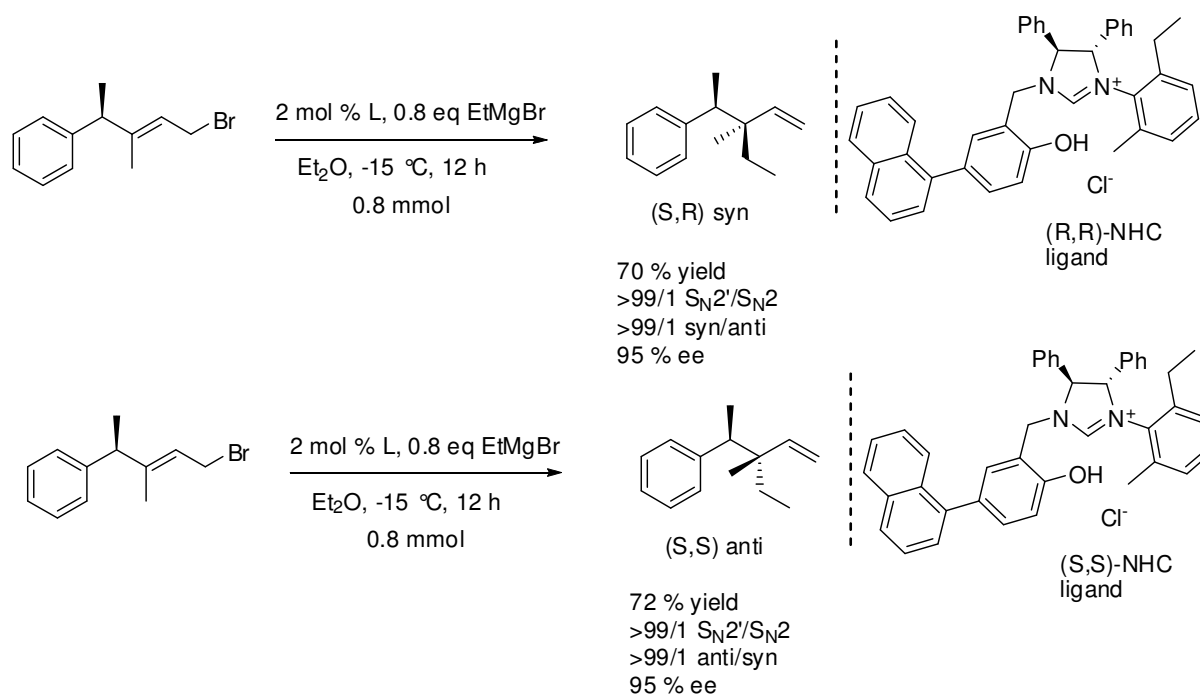
The optically pure (S)-allylic substrate was prepared starting from 2 g of optically pure (R)-Styrene oxide and transformed into the desired allylic bromide by reported procedure. The catalysis was then performed using both (R, R) and (S, S) chiral NHC ligand. The absolute configuration of the product below could be attributed by analogy.



Reference 1: D. Bianchini and al, *JOC*, 53, **1988**, 5531.

Reference 2: C. Jokobsche, *Angew. Chem. Int. Ed*, 47, **2008**, 6707.

Reference 3: R. Aslanian and al, *PCT.Int.Appl*, 2012051036, **2012**.



Catalysis procedure.

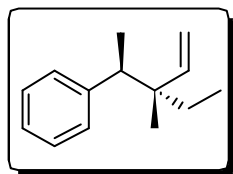
In a flame-dried Schlenk, under N_2 atmosphere, the racemic allylic bromide (0.8 mmol) and chiral NHC ligand (prepared from (S,S) Corey diamine see ref below) **L** (2 mol %) are suspended in 3.2 mL of dry Et_2O (crucial to respect the dilution) and cooled to -40°C . RMgBr x M in Et_2O (0.8 eq) is added dropwise over 4 min. After half conversion, the mixture is quenched by addition of a saturated solution of NH_4Cl (2 ml). The aqueous layer is separated

and extracted with Et₂O (3 × 3 ml). The combined organic fractions are dried over Na₂SO₄, filtered and concentrated in vacuo. The residue is purified by flash column chromatography using pentane (100 %) as eluant (0.5 cm diameter and 6 cm high column).

Reference: O. Jackowski, A. Alexakis, *Angew. Chem. Int. Ed.*, 50, 2010.

Catalysis procedure for scale up.

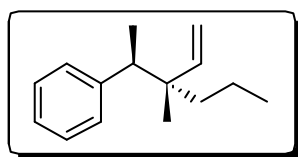
In a flame-dried Schlenk, under N₂ atmosphere, the racemic allylic bromide (5 mmol) and chiral NHC ligand (prepared from (S,S) Corey diamine see ref below) **L** (2 mol %) are suspended in 20 mL of dry Et₂O (crucial to respect the dilution) and cooled to -40°C. RMgBr x M in Et₂O (0.8 eq) is added dropwise over 4 min. After half conversion, the mixture is quenched by addition of a saturated solution of NH₄Cl (2 ml). The aqueous layer is separated and extracted with Et₂O (3 × 3 ml). The combined organic fractions are dried over Na₂SO₄, filtered and concentrated in vacuo. The residue is purified by flash column chromatography using pentane (100 %) as eluant (2 cm diameter and 8 cm high column).



1a. Reaction time: 1 h. Product isolated as colourless oil in 36 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 92 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture.

GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t₁= 55.20 min, t₂=55.80

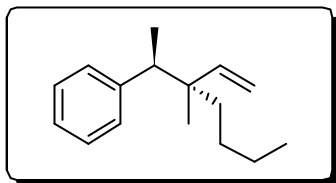
min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.40-7.25 (m, 5H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.93 (d, J=1.59 Hz and J=17.5 Hz) 1.50-1.40 (m, 2H) 1.25 (d, 3H, J= 6.9 Hz) 0.80 (s, 3H) 0.65 (t, 3H, J=7.5 Hz). ¹³C NMR (75 MHz, CDCl₃) δ 145.7, 144.3, 129.4, 127.4, 125.9, 112.4, 48.3, 43.2, 31.6, 17.9, 16.1, 8.5. HRMS (EI + mode) m/z expected: 242,2035 observed: 242,2037. [α]_D = +13.2 (c 1.33, CHCl₃).



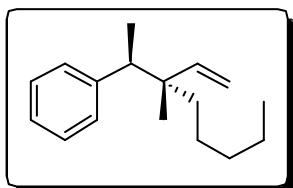
1b. Reaction time: 1h 30. Product isolated as colourless oil in 32 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 86 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture.

GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t₁=52.80 min, t₂= 53.40 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.40-7.25 (m, 5H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.93 (d, J=1.5 Hz and J=17.5 Hz) 1.36-1.25 (m, 7H) 0.80-0.70

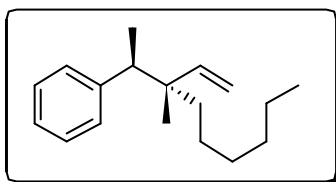
(m, 6H). ^{13}C NMR (75 MHz, CDCl_3) δ 145.7, 144.7, 129.4, 127.4, 125.9, 112.9, 48.6, 43.1, 41.8, 18.6, 17.4, 16.2, 14.9. HRMS (EI + mode) m/z expected: 202,1722 observed: 202,1723. $[\alpha] = +8.1$ (c 1.33, CHCl_3).



1c. Reaction time: 1h 30. Product isolated as colourless oil in 35 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 84 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t1= 68.8 min, t2=69.40 min ^1H (NMR) (400 MHz, CDCl_3) δ 7.40- 7.10 (m,5H) 5.75 (q, 1H, J=10.9 Hz) 5.15 (dd, 1H, J= 1.55 Hz and J= 10.8 Hz) 2.70 (q, 1H, J= 7.2 Hz) 1.45-1.20 (m, 9 H) 0.80-0.70 (m, 6H). ^{13}C NMR (75 MHz, CDCl_3) δ 145.7, 144.3, 129.4, 127.4, 125.9, 112.4, 48.6, 43, 39.2, 26.4, 23.5, 18.7, 16.2, 14.2. HRMS (EI + mode) m/z expected: 216,1878 observed: 216,1877. $[\alpha] = +9.6$ (c 1.33, CHCl_3).

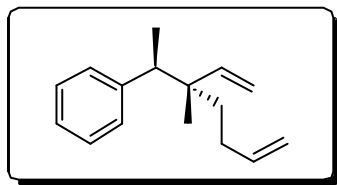


1d. Reaction time: 1h 30. Product isolated as colourless oil in 36 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 91 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t1= 78.90 min, t2=79.30 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.20 (m, 5H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (d, 1H, J=10.90 Hz) 4.92 (d, J=17.5 Hz) 2.70 (q, 1H, J= 7.2 Hz) 1.35-1.25 (m, 12H) 0.80 (t, 3H, J=7.4 Hz) 0.75 (t, 3H, J=7.5 Hz). ^{13}C NMR (75 MHz, CDCl_3) δ 145.7, 144.3, 129.4, 127.4, 125.9, 112.9, 48.6, 43.1, 39.4, 32.8, 23.9, 22.7, 18.7, 16.2, 14.1. HRMS (EI + mode) m/z expected: 230,2035 observed: 230,2037. $[\alpha] = +10.6$ (c 1.33, CHCl_3).

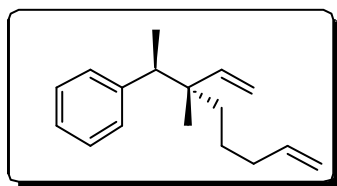


1e. Reaction time: 1h 30. Product isolated as colourless oil in 36 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 90 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t1=88.10 min, t2= 88.50 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.20 (m, 5H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.93 (d, J=1.5 Hz and J=17.5 Hz) 2.70 (q, 1H, J= 7.2 Hz) 1.40-1.32 (m, 15H) 0.80-0.70 (m, 6H). ^{13}C NMR (75 MHz, CDCl_3) δ 145.7, 144.3, 129.4, 127.4, 125.9, 112.9, 48.6, 43, 39.5, 31.9, 30.2, 24.2, 22.7, 18.7, 16.2,

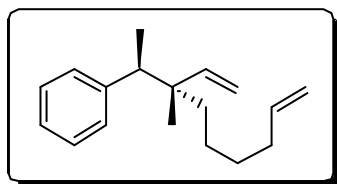
14.1. HRMS (EI + mode) m/z expected: 244,2191 observed: 244,2192. $[\alpha] = +10.1$ (c 1.33, CHCl_3).



1f. Reaction time: 1h 30. Product isolated as colourless oil in 36 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 86 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t1=78.60 min, t2= 79.10 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.84-5.78 (m, 2H) 5.14 (dd, 1H, J= 1.5 Hz and J=10.9 Hz) 5.05-4.95 (m, 3H) 2.70 (q, 1H, J= 7.2 Hz) 2.10-2 (m, 2H) 1.60-1.50 (m, 3H) 1.25 (s, 3H) 1.20 (s, 3H) 0.75 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 145.3, 144, 139.6, 129.4, 127.5, 126, 113.9, 113.8, 48.8, 43, 38.6, 28.8, 18.3, 16.2. HRMS (EI + mode) m/z expected: 214,1722 observed: 214,1724. $[\alpha] = +8.2$ (c 1.33, CHCl_3).

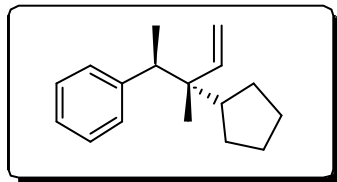


1g. Reaction time: 1h 45. Product isolated as colourless oil in 34 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 84 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t1=75.50 min, t2= 76.10 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.85-5.78 (m, 2H) 5.10 (dd, 1H, J= 1.5 Hz and J=10.9 Hz) 4.97 (q, 2H, J=19.2 Hz) 4.90 (q, 1H, J= 17.6 Hz) 2.70 (q, 1H, J= 7.2 Hz) 2 (d, 2H, J=7 Hz) 1.35-1.25 (m, 7H) 0.75 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 145.3, 139, 129.4, 127.4, 125.9, 114.2, 113.1, 48.7, 38.9, 34.5, 23.7, 18.7, 16.2. HRMS (EI + mode) m/z expected: 228,1878 observed: 228,1880. $[\alpha] = +8.6$ (c 1.33, CHCl_3).

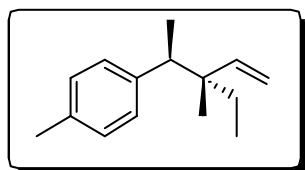


1h. Reaction time: 1h 30. Product isolated as colourless oil in 37 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 86 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t1=88 min, t2= 88.40 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.86-5.78 (m, 2H) 5.10 (dd, 1H, J= 1.5 Hz and J=10.9 Hz) 4.97 (q, 2H, J=19.2 Hz) 4.90 (q, 1H, J= 17.6 Hz) 2.70 (q, 1H, J= 7.20 Hz) 2.10-2 (m, 2H) 1.40-1.25 (m, 9H) 0.75 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 145.6, 144.2, 139.1, 129.4, 128.9, 128, 127.9, 127.4, 125.9, 114.1, 113, 48.6,

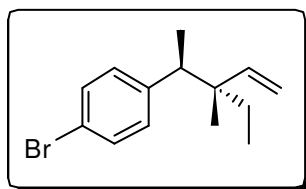
43, 39.2, 33.8, 29.8, 25.6, 23.7, 18.7, 16.2. HRMS (EI + mode) m:z expected: 242,2035 observed: 242,2033. $[\alpha] = +7.7$ (c 1.33, CHCl₃).



1i. Reaction time: 4h 30. Product isolated as colourless oil in 35 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 22 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. ¹H (NMR) (400 MHz, CDCl₃) δ 7.4-7.1 (m, 5H) 6.9 (m, 2H) 5.90 (q, 1H, J= 10,9 Hz) 5.20 (d, 1H, J=1.7 Hz and J=10.9 Hz) 4.90 (d, 1H, J= 1,60Hz and J=17,5 Hz) 2.86 (q, 1H, J= 7.2 Hz) 1.90-1.50 (m, 8H) 1.30 (s, 6H) 1-0.9 (m, 3H). ¹³C NMR (75 MHz, CDCl₃) δ 144.7, 143.6, 129.3, 127.4, 125.9, 114, 46.6, 45.8, 45.3, 27.2, 25.9, 25.8, 16.7, 16.2. HRMS (EI + mode) m:z expected: 228,1878 observed: 228,1881. $[\alpha] = +1.6$ (c 1.33, CHCl₃).

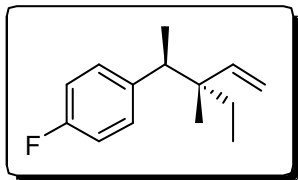


1j. Reaction time: 45 min. Product isolated as colourless oil in 32 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 86 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t₁= 64.8 min, t₂=65.50 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.30-7.20 (s, 4H) 5.70 (q, 1H, J= 10.8 Hz) 5.11 (dd, 1H, J= 1.5 Hz and J=10.9 Hz) 4.90 (dd, 1H, J=1.5 Hz and J=17.5 Hz) 2.70 (q, 1H, J= 7.3 Hz) 2.35 (s, 3H) 1.5-1.4 (m, 3H) 1.25 (d, 3H, J=7.3 Hz) 0.80 (s, 3H) 0.70 (t, 3H, J=7.4 Hz). ¹³C NMR (75 MHz, CDCl₃) δ 145.6, 141.2, 135.3, 129.3, 126.1, 113.1, 48, 43.3, 31.7, 21 17.7, 16.3, 8.5. HRMS (EI + mode) m:z expected: 202,1722 observed: 202,1723. $[\alpha] = +8.6$ (c 1.33, CHCl₃).

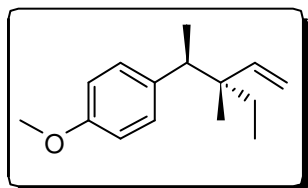


1k. Reaction time: 45 min. Product isolated as colourless oil in 34 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 92 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t₁=86.60 min, t₂= 87.60 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.30 (d, 2H, J=7.7 Hz) 7 (d, 2H, J=7.6 Hz) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.93 (d, J=1.6 Hz and J=17.5 Hz) 2.70 (q, 1H, J= 7.2 Hz) 1.70-1.60 (m, 5H) 0.80 (s, 3H) 0.70 (t, 3H, J=7.5 Hz). ¹³C NMR (75 MHz, CDCl₃) δ 144.8, 143.3, 131, 130.5, 119.7, 113.7, 48, 43.1, 31.6, 18,

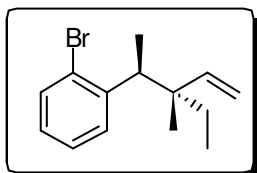
16.1, 8.5. HRMS (EI + mode) m/z expected: 266,0670 observed: 266,0669. $[\alpha] = +11.9$ (c 1.33, CHCl₃).



1l. Reaction time: 40 min. Product isolated as colourless oil in 35 % yield, >99/1 anti/syn ratio, 100/0 S_N2'/S_N2 ratio with 94 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t₁=51.40 min, t₂= 52.70 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.20-7.30 (m, 2H) 7-6.90 (m, 2H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.93 (d, J=1.5 Hz and J=17.5 Hz) 2.70 (q, 1H, J= 7.2 Hz) 1.45-1.35 (m, 2H) 1.25 (d, 3H, J= 6.8 Hz) 0.80 (s, 3H) 0.65 (t, 3H, J=7.5 Hz). ¹³C NMR (75 MHz, CDCl₃) δ 162.5, 160.1, 145, 139.7, 130.6, 114.9, 114.7, 114.2 114, 113.5, 47.2, 43.2, 31.6, 17.9, 16.3, 8.5. HRMS (EI + mode) m/z expected: 206,1471 observed: 206,1472. $[\alpha] = +12.6$ (c 1.33, CHCl₃).

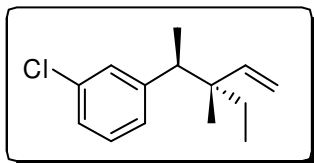


1m. Reaction time: 50 min. Product isolated as colourless oil in 38 % yield, >99/1 anti/syn ratio, 100/0 S_N2'/S_N2 ratio with 78 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t₁=79.20 min, t₂= 79.80 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.20-7.30 (m, 2H) 6.90-6.80 (m, 2H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.93 (d, J=1.6 Hz and J=17.5 Hz) 3.82 (s, 3H) 2.70 (q, 1H, J= 7.2 Hz) 1.70-1.60 (m, 5H) 0.80 (s, 3H) 0.70 (t, 3H, J=7.5 Hz). ¹³C NMR (75 MHz, CDCl₃) δ 157.8, 145.3, 136.4, 130.5, 128.3, 113.4, 113.1, 112.7, 55.2, 47.6, 43.4, 31.6, 17.7, 16.4, 8.6. HRMS (EI + mode) m/z expected: 218,1671 observed: 218,1673. $[\alpha] = +4.5$ (c 1.33, CHCl₃).

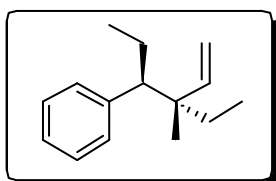


1n. Reaction time: 50 min. Product isolated as colourless oil in 32 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 84 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t₁=70.70 min, t₂= 71.70 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.50 (dd, 1H, J= 1.3 Hz and J= 7.9 Hz) 7.25 (m, 2H) 7-6.90 (m, 1H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.93 (d, J=1.5 Hz and J=17.50 Hz) 3.4 (q, 1H, J= 7.17 Hz) 1.5-1.4 (m, 2H) 1.25 (d, 3H, J= 6.9 Hz)

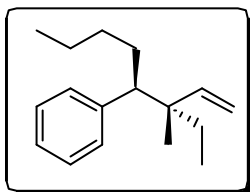
0.80 (s, 3H) 0.65 (t, 3H, J=7.5 Hz). ^{13}C NMR (75 MHz, CDCl_3) δ 144.2, 144, 132.7, 129.8, 127.6, 126.6, 126.3, 114, 45.2, 31.3, 17.8, 16.5, 8.5. HRMS (EI + mode) m/z expected: 266,0670 observed: 266,0672. $[\alpha] = +8.1$ (c 1.33, CHCl_3).



1o. Reaction time: 45 min. Product isolated as colourless oil in 31 % yield, >99/1 anti/syn ratio, >99/1 $\text{S}_{\text{N}}2'/\text{S}_{\text{N}}2$ ratio with 92 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t₁=68.90 min, t₂= 69.40 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.30 (m, 4H) 7.20-7.10 (m, 1H) 5.80 (q, 1H, J= 10.9 Hz) 5.12 (dd, 1H, J= 1.5 Hz and J=10.9 Hz) 4.93 (d, J=1.59 Hz and J=17.5 Hz) 2.70 (q, 1H, J= 7.2 Hz) 1.70-1.60 (m, 5H) 0.80 (s, 3H) 0.70 (t, 3H, J=7.5 Hz). ^{13}C NMR (75 MHz, CDCl_3) δ 146.4, 144.8, 133.2, 129.3, 128.6, 127.5, 126.9, 113.7, 48.3, 43.2, 31.6, 17.9, 16.1, 8.5. HRMS (EI + mode) m/z expected: 222,1175 observed: 222,1175. $[\alpha] = +11.3$ (c 1.33, CHCl_3).

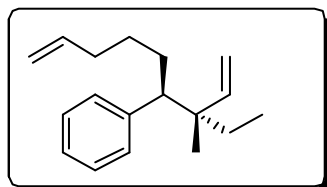


1p. Reaction time: 50 min. Product isolated as colourless oil in 36 % yield, >99/1 anti/syn ratio, >99/1 $\text{S}_{\text{N}}2'/\text{S}_{\text{N}}2$ ratio with 82 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t₁= 57 min, t₂=57.50 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.4-7.1 (m, 5H) 5.66 (q, 1H, J=10.9 Hz) 5 (dd, 1H, J= 1.60 Hz and J=10.9 Hz) 4.80 (dd, 1H, J=1.6 Hz and J=17.6 Hz) 2.24 (dd, 1H, J= 2.8 Hz and J=12 Hz) 1.70-1.50 (m, 2H) 1.25-1.10 (m, 2H) 0.75 (s, 3H) 0.70 (t, 3H, J=7.4 Hz) 0.6 (t, 3H, J=7.4 Hz). ^{13}C NMR (75 MHz, CDCl_3) δ 146.1, 142.1, 129.9, 127.9, 127.8, 127.4, 125.9, 113.2, 57.4, 43.7, 32.2, 22.7, 17.7, 13.1, 8.5. HRMS (EI + mode) m/z expected: 202,1722 observed: 202,1720. $[\alpha] = +7.6$ (c 1.33, CHCl_3).

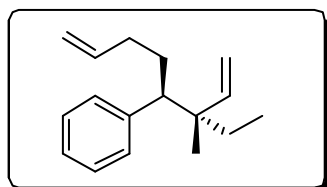


1q. Reaction time: 1h. Product isolated as colourless oil in 35 % yield, >99/1 anti/syn ratio, >99/1 $\text{S}_{\text{N}}2'/\text{S}_{\text{N}}2$ ratio with 82 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t₁=66.20 min, t₂= 66.60 min. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.75 (q, 1H, J= 10.9 Hz) 5.20 (dd, 1H, J= 1.5 Hz and J=10.8 Hz) 4.90 (dd, 1H, J=1.5 Hz and J=17.5 Hz) 2.40 (dd, 1H, J= 2.8 Hz and J=11.9 Hz) 1.80-1.70 (m, 2H) 1.40-1.30 (m, 6H) 1.1-1 (m, 3H) 0.90 (s, 3H) 0.80

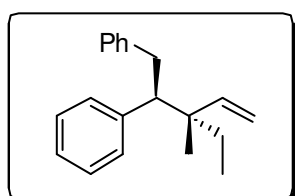
(t, 3H, J=7.3 Hz) 0.70 (t, 3H, J=7.5 Hz). ^{13}C NMR (75 MHz, CDCl_3) δ 146.1, 142.5, 127.4, 125.9, 113.2, 55.2, 43.7, 32.2, 30.6, 29.6, 22.7, 17.8, 14, 8.5. HRMS (EI + mode) m/z expected: 230,2035 observed: 230,2036. $[\alpha] = +6.8$ (c 1.33, CHCl_3).



1s. Reaction time: 45 min. Product isolated as a colourless oil in 37 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 90 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t1=78.1 min, t2=78.4 min. ^1H NMR (400 MHz, CDCl_3) δ 7.40-7.20 (m, 5H) 5.84-5.75 (m, 2H) 5.73 (q, 1H, J= 6.7 Hz) 5.73 (q, 1H, J= 6.7 Hz) 5.82-5.70 (m, 1H) 5.16 (dd, 1H, J= 1.3 Hz and J= 10.8 Hz) 4.94 (dd, 1H, J= 1.5 Hz and J= 11.5 Hz) 4.92-4.80 (m, 2H) 2.49 (dd, 1H, J= 2.1 Hz and J= 11.5 Hz) 2-1.7 (m, 4H) 1.30-1.20 (m, 3H) 1 (dd, 1H, J= 3.3 Hz and J= 6.6 Hz) 0.88 (s, 3H) 0.74 (t, 3H, J= 7.4 Hz). ^{13}C NMR (101 MHz, CDCl_3) δ 146, 142.2, 138.9, 128, 127.7, 127.5, 125.9, 114.1, 113.3, 55.1, 43.6, 33.8, 32.2, 29.3, 27.6, 17.7, 8.4. HRMS (EI + mode) m/z expected: 242,2035 observed: 242,2037. $[\alpha] = +11.1$ (c 1.33, CHCl_3).

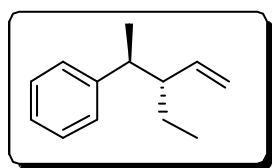


1t. Reaction time: 45 min. Product isolated as colourless oil in 34 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 91 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: HYDRODEX B-6 TBDMS: 60-0-1-170-5: t1=66.5 min, t2=66.8 min. ^1H NMR (400 MHz, CDCl_3) δ 7.40-7.20 (m, 5H) 5.82-5.75 (m, 2H) 5.73 (q, 1H, J= 6.7 Hz) 5.70-5.60 (m, 1H) 5.16 (dd, 1H, J= 1.3 Hz and J= 10.8 Hz) 4.94 (dd, 1H, J= 1.5 Hz and J= 11.5 Hz) 4.92 (m, 2H) 2.49 (dd, 1H, J= 2.1 Hz and J= 11.5 Hz) 1.90-1.82 (m, 4H) 1.34-1.19 (m, 2H) 0.88 (s, 3H) 0.74 (t, 3H, J= 7.4 Hz). ^{13}C NMR (101 MHz, CDCl_3) δ 145.9, 141.9, 138.9, 128, 127.5, 126, 114.3, 113.3, 54.4, 43.5, 32.3, 32.2, 29.1, 17.7, 8.4. HRMS (EI + mode) m/z expected: 228,2878 observed: 228,2880. $[\alpha] = +12.2$ (c 1.33, CHCl_3).

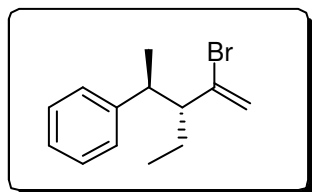


1u. Reaction time: 1h. Product isolated as colourless oil in 35 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 92 % ee after

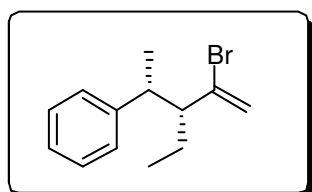
column chromatography on silica gel using 100 % pentane as solvent mixture. SFC: AZ-column with 2 % MeOH and 98 % CO₂: t₁= 4.20 min, t₂= 4.40 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.40-7.10 (m, 8H) 7-6.90 (m, 2H) 5.90 (q, 1H, J= 10,9 Hz) 5.30 (d, 1H, J=10.8 Hz) 5.10 (d, 1H, J= 17,5 Hz) 3.20 (d, 1H, J= 13.3 Hz) 2.90 (t, 1H, J= 11.8 Hz) 2.70 (d, 1H, J= 11.7 Hz) 1.60-1.50 (m, 3H) 1 (s, 3H) 0.80 (t, 3H, J= 7.5 Hz). ¹³C NMR (75 MHz, CDCl₃) δ 146, 141.8, 141.7, 130.2, 128.8, 127.9, 127.8, 127.4, 126 1, 125.3, 114, 57.6, 44.1, 36.8, 32.3, 17.6, 8.6. HRMS (EI + mode) m:z expected: 264,1878 observed: 264,1879. [α] = +11.6 (c 1.33, CHCl₃).



1v. Reaction time: 12 h. Product isolated as colourless oil in 31 % yield, 8.5/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 85 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t₁= 41.90 min, t₂=43.20 min. ¹H NMR (300 MHz, CDCl₃) δ 7.32-7.18 (m, 5H) 5.58 (quin, 1H, J= 9.5 Hz) 5.12 (d, 1H, J=10.3 Hz) 5.09 (d, 1H, J=17.2 Hz) 2.62 (quin, 1H, J=6.2 Hz) 2.09 (m, 1H) 1.20 (d, 3H, J=7.1 Hz) 1.08-0.95 (m, 2H) 0.77 (t, 3H, J=7.5 Hz). ¹³C NMR (101 MHz, CDCl₃) δ 146.6, 141.2, 128.2, 127.7, 125.8, 115.9, 53.10, 44, 25.4, 20.1, 11.8. HRMS (EI + mode) m:z expected: 174,1409 observed: 174,1410. [α] = +7.3 (c 1.33, CHCl₃).



1w. Reaction time: 12 h. Product isolated as colourless oil in 36 % yield, >99/1 anti/syn ratio, >99/1 S_N2'/S_N2 ratio with 85 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. ee determined after lithium/bromide exchange and quench with water. GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t₁= 41.7 min, t₂= 42.9 min. ¹H (NMR) (400 MHz, CDCl₃) δ 7.30-7.10 (m, 5H) 5.75 (s, 1H) 5.60 (s, 1H) 2.85-2.75 (m, 1H) 2 (td, 1H, J= 3.4 Hz and J=10.6 Hz) 1.35-1.25 (m, 4H) 1.20-1.10 (m, 1H) 0.75 (t, 3H, J= 7.4 Hz). ¹³C NMR (75 MHz, CDCl₃) δ 145.5, 138.6, 128.4, 127.8, 126.2, 118.8, 58.4, 43, 24, 21.1, 11.9. HRMS (EI + mode) m:z expected: 252.0514 observed: 252.0512 .

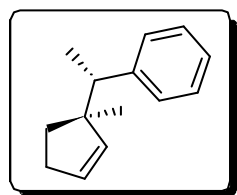


1x. Reaction time: 12 h. Product isolated as colourless oil in 36 % yield, >99/1 syn/anti ratio, >99/1 S_N2'/S_N2 ratio with 77 % ee after column chromatography on silica gel using 100 % pentane as solvent mixture. ee determined after lithium/bromide exchange and quench with water. GC: CP-CHIRASIL DEX CB: 60-0-1-170-5: t₁= 42.6 min, t₂= 43.4 min.

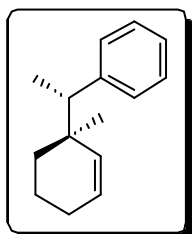
^1H (NMR) (400 MHz, CDCl_3) δ 7.30-7.10 (m, 5H) 5.25 (s, 1H) 5.22 (s, 1H) 3-2.90 (m, 1H) 2.25 (td, 1H, $J=3.4$ Hz and $J=10.6$ Hz) 1.76-1.31 (m, 5H) 0.90 (t, 3H, $J=7.4$ Hz). ^{13}C NMR (75 MHz, CDCl_3) δ 146, 138.1, 128.6, 128, 127.5, 126.8, 118.5, 58.3, 42.7, 22.8, 19, 12. HRMS (EI + mode) m/z expected: 252.0514 observed: 252.0512 .

Application.

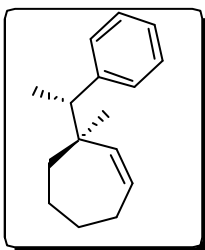
Into a conditioned Young Valve with Grubbs second generation catalyst (5 mol %) the desired catalysis adduct (0.2 mmol) is dissolved into 1 mL of dry and degassed dichloromethane. The flask is sealed and heated at reflux for 24 h. After cooling to room temperature the solvent is evaporated in vacuo and the crude material is purified via flash column chromatography using pentane (100 %) as eluant (0.5 cm diameter and 6 cm high column).



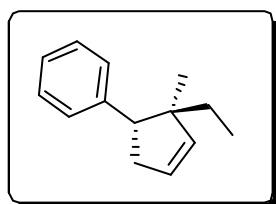
2a. Product isolated as colourless oil in 68 % yield, >99/1 anti/syn ratio with 82 % ee after column chromatography on silica gel using 100 % pentane as solvent. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.75-5.65 (m, 2H) 2.60 (q, 1H, $J=7.10$ Hz) 2.35-2.25 (m, 2H) 1.60-1.50 (m, 1H) 1.25 (d, 3H, $J=7.1$ Hz) 1 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 145.2, 138.3, 129.4, 128.8, 128.7, 127.7, 127.6, 125.8, 52.6, 48.6, 35.9, 32, 25.5, 16.4. HRMS (EI + mode) m/z expected: 186,1409 observed: 186,1410. $[\alpha] = +7.8$ (c 1.33, CHCl_3).



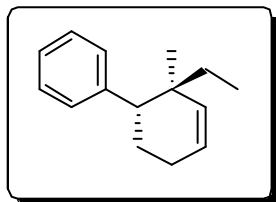
2b. Product isolated as colourless oil in 72 % yield, >99/1 anti/syn ratio with 84 % ee after column chromatography on silica gel using 100 % pentane as solvent. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.20 (m, 5H) 5.80-5.70 (m, 2H) 2.8 (q, 1H, $J=7.1$ Hz) 1.90 (m, 2H) 1.70-1.60 (m, 4H) 1.30 (d, 3H, $J=7.1$ Hz) 0.90 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 144.7, 135.4, 129.2, 127.5, 125.9, 125.8, 48.2, 37.5, 33.7, 25.2, 24.4, 19.1, 15.6. HRMS (EI + mode) m/z expected: 200,1565 observed: 200,1566. $[\alpha] = +8.3$ (c 1.33, CHCl_3).



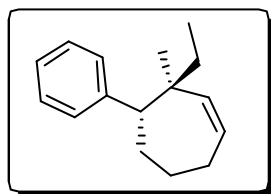
2c. Product isolated as colourless oil in 67 % yield, >99/1 anti/syn ratio with 90 % ee after column chromatography on silica gel using 100 % pentane as solvent. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.20 (m, 5H) 5.80-5.70 (m, 2H) 2.8 (q, 1H, $J=7.10$ Hz) 1.90-1.60 (m, 8H) 1.30 (d, 3H, $J=7.1$ Hz) 0.90 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 144.7, 135.4, 129.2, 127.5, 125.9, 125.8, 48.2, 37.5, 33.7, 28, 25.2, 24.4, 19.1, 15.6. HRMS (EI + mode) m:z expected: 214,1722 observed: 214,1722. $[\alpha] = +11.2$ (c 1.33, CHCl_3).



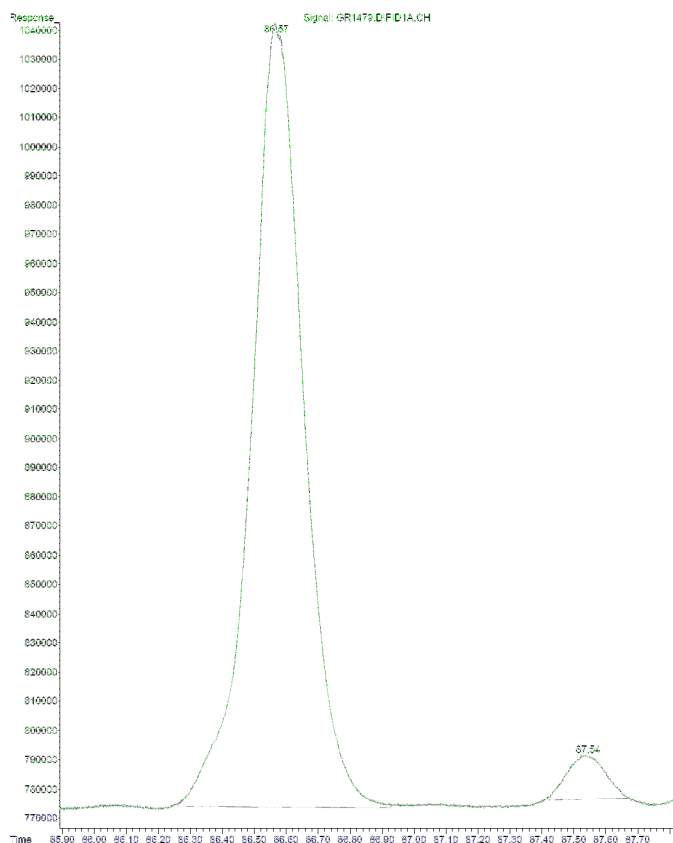
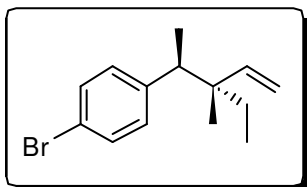
2d. Product isolated as colourless oil in 75 % yield, >99/1 anti/syn ratio with 90 % ee after column chromatography on silica gel using 100 % pentane as solvent. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.80-5.63 (m, 2H) 3.22 (t, 1H, $J=8.3$ Hz) 2.83-2.75 (m, 2H) 1.60-1.50 (m, 2H) 1 (t, 3H, $J=7.4$ Hz) 0.70 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 142.2, 139.4, 130.4, 128.8, 127.9, 127.8, 127.6, 126, 52, 51.7, 37.8, 32.9, 22, 9.5. HRMS (EI + mode) m:z expected: 186,1409 observed: 186,1410. $[\alpha] = +8.7$ (c 1.33, CHCl_3).



2e. Product isolated as colourless oil in 65 % yield, >99/1 anti/syn ratio with 91 % ee after column chromatography on silica gel using 100 % pentane as solvent. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.80-5.63 (m, 2H) 3.22 (t, 1H, $J=8.3$ Hz) 2.80-2.75 (m, 2H) 1.50-1.20 (m, 4H) 1 (t, 3H, $J=7.4$ Hz) 0.70 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 143.8, 136.8, 129.2, 127.5, 125.9, 125.5, 45.6, 39.1, 32.6, 26.2, 25.3, 23.5, 8.6. HRMS (EI + mode) m:z expected: 200,1565 observed: 200,1566. $[\alpha] = +10.6$ (c 1.33, CHCl_3).



2f. Product isolated as colourless oil in 62 % yield, >99/1 anti/syn ratio with 91 % ee after column chromatography on silica gel using 100 % pentane as solvent. ^1H (NMR) (400 MHz, CDCl_3) δ 7.40-7.10 (m, 5H) 5.80-5.63 (m, 2H) 3.22 (t, 1H, $J=8.30$ Hz) 2.85-2.75 (m, 2H) 1.50-1.10 (m, 6H) 1 (t, 3H, $J=7.4$ Hz) 0.70 (s, 3H). ^{13}C NMR (75 MHz, CDCl_3) δ 143.8, 136.8, 129.2, 127.5, 125.9, 125.5, 45.6, 39.1, 32.6, 27.4, 26.2, 25.3, 23.5, 8.6. HRMS (EI + mode) m:z expected: 214,1722 observed: 214,1720. $[\alpha] = +11.1$ (c 1.33, CHCl_3).



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 Misc :
 ALS Vial : 1 Sample Multiplier: 1

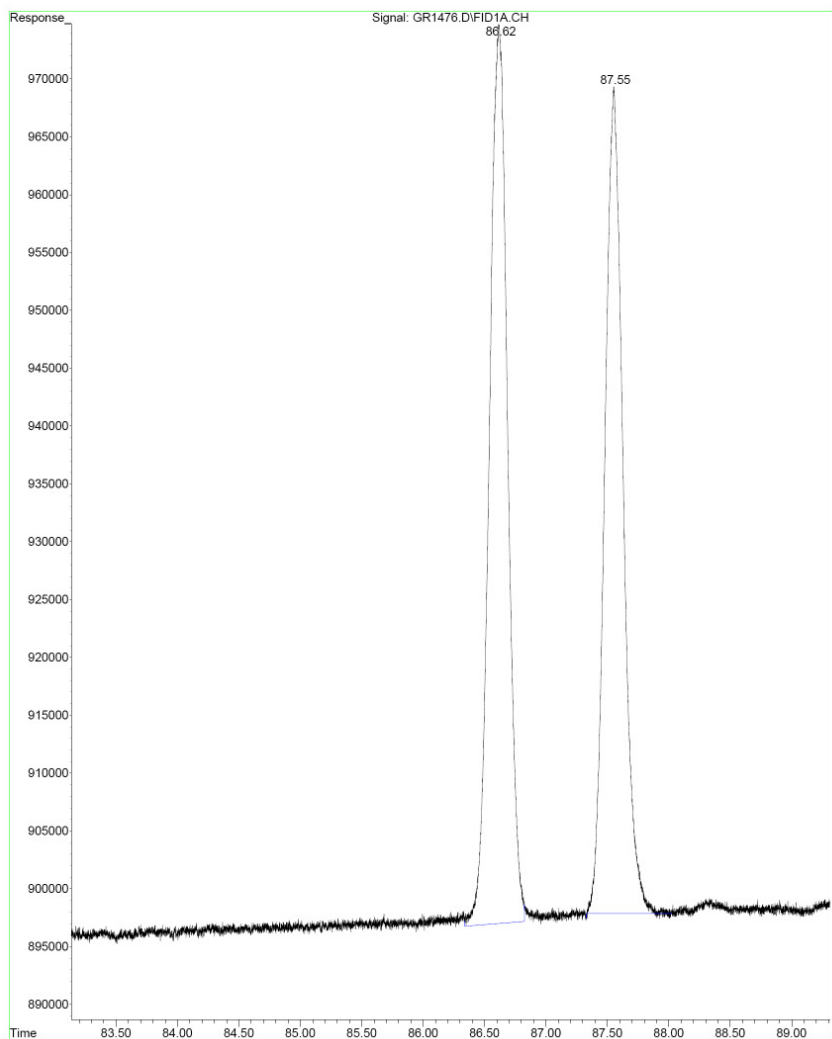
Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
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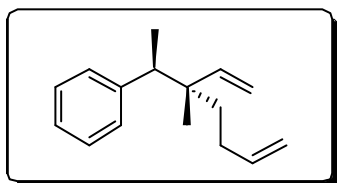
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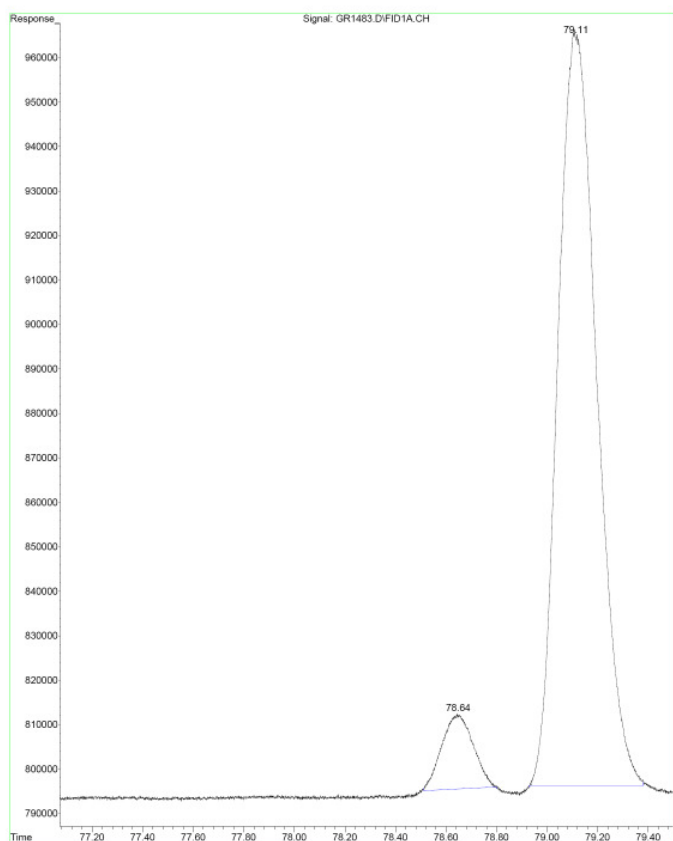
peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	86.565	86.262	86.928	M	269149	30706278	100.00%	96.077%
2	87.541	87.409	87.671	M	14915	1253783	4.08%	3.923%
Sum of corrected areas:						31960061		

60-1.M Sat Nov 16 18:57:10 2013



peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	86.619	86.339	86.824	M	78411	8074753	100.00%	52.199%
2	87.551	87.327	88.020	M	71486	7394491	91.58%	47.801%
Sum of corrected areas:						15469244		





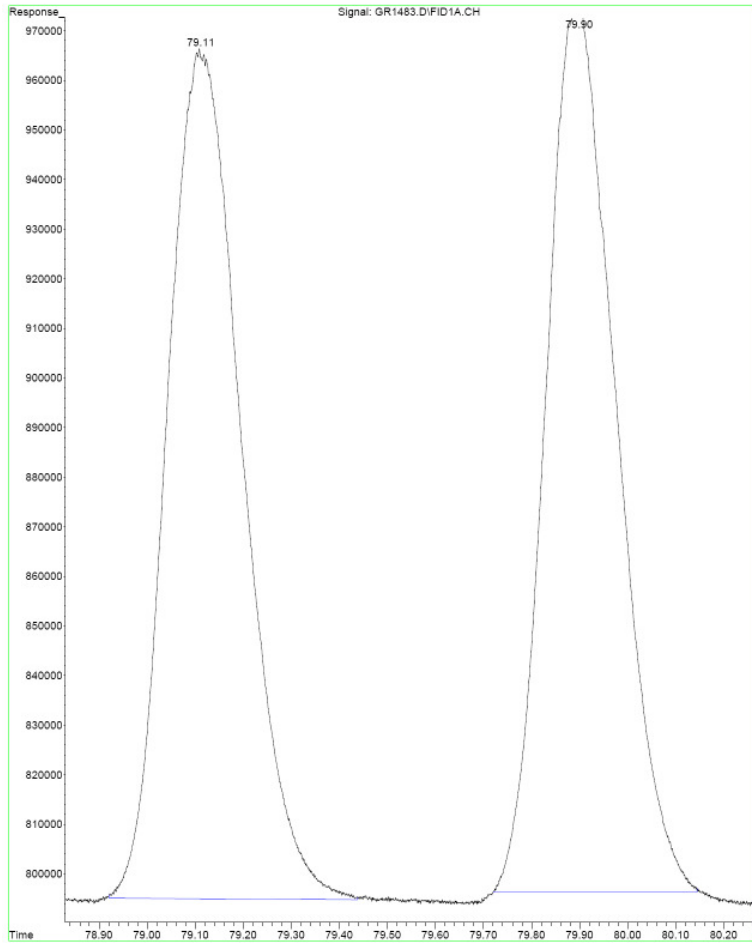
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 Acq On : 14.10.2013 06:46:46 PM
 Sample : GR1483
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	78.642	78.511	78.799	M	17001	1445618	7.95%	7.368%
2	79.109	78.927	79.380	M	170121	18173368	100.00%	92.632%
Sum of corrected areas:						19618986		



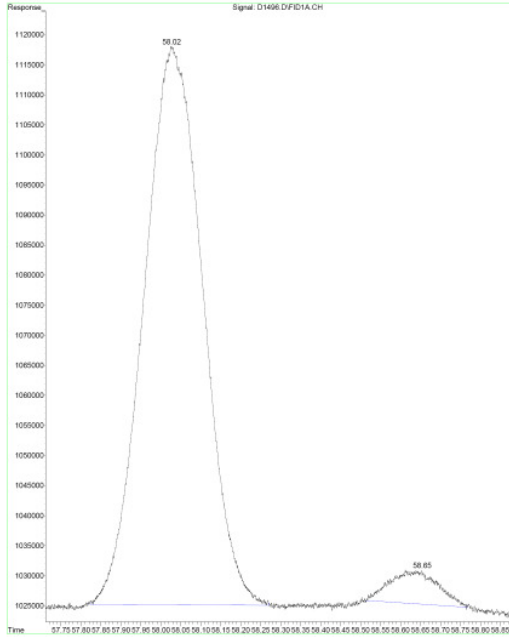
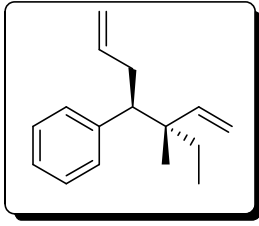
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 Acq On : 14.10.2013 06:46:46 PM
 Sample : GR1483
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	79.109	78.921	79.438	M	171399	18572744	100.00%	50.508%
2	79.896	79.721	80.144	M	177739	18199095	97.99%	49.492%
Sum of corrected areas:						36771839		



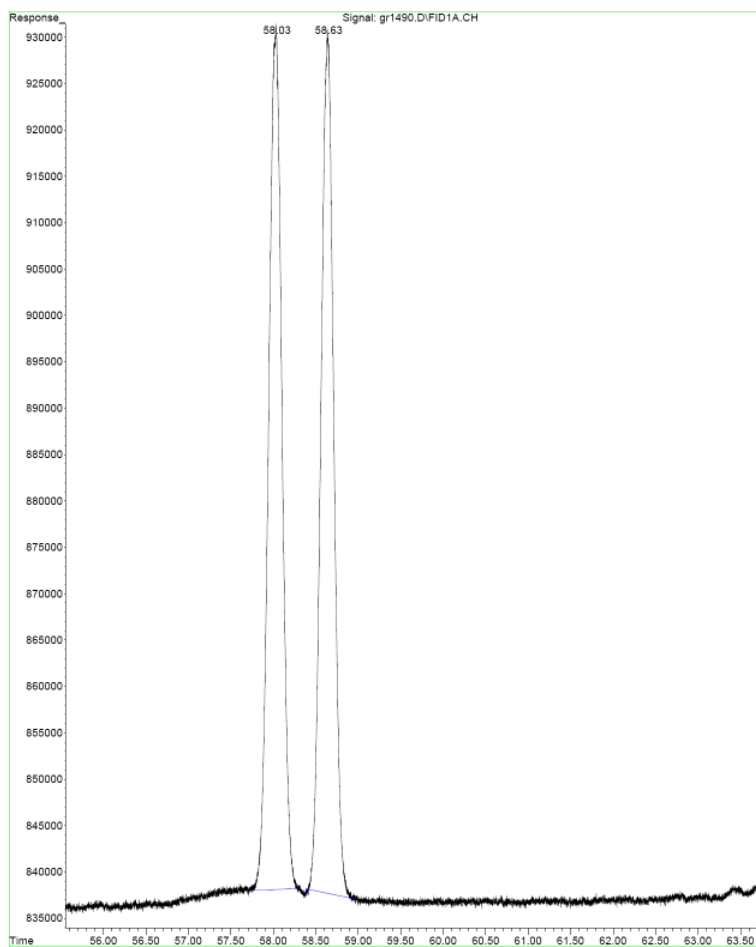
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 Data File : D1496.D
 Signal(s) : FID1A.CH
 Acq On : 22.10.2013 06:59:03 PM
 Sample : D1496
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

Peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	58.024	57.824	58.271	M	92911	9508728	100.00%	95.427%
2	58.652	58.513	58.766	M	5599	455689	4.79%	4.573%
Sum of corrected areas:							9964417	



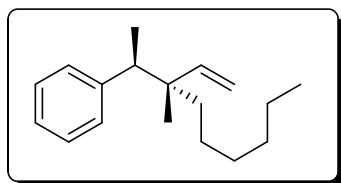
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 Acq On : 18.10.2013 01:24:18 PM
 Sample : gr1490
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

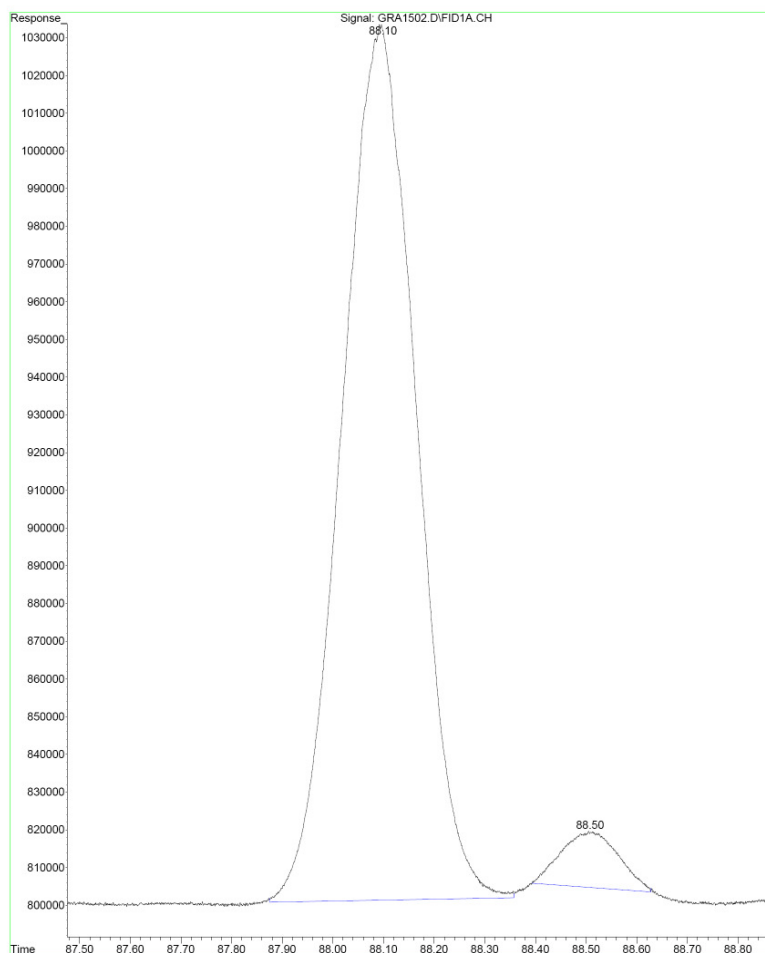
Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	58.027	57.755	58.283	M	93339	10123970	100.00%	50.938%
2	58.634	58.385	58.975	M	93179	9751091	96.32%	49.062%
Sum of corrected areas:							19875061	





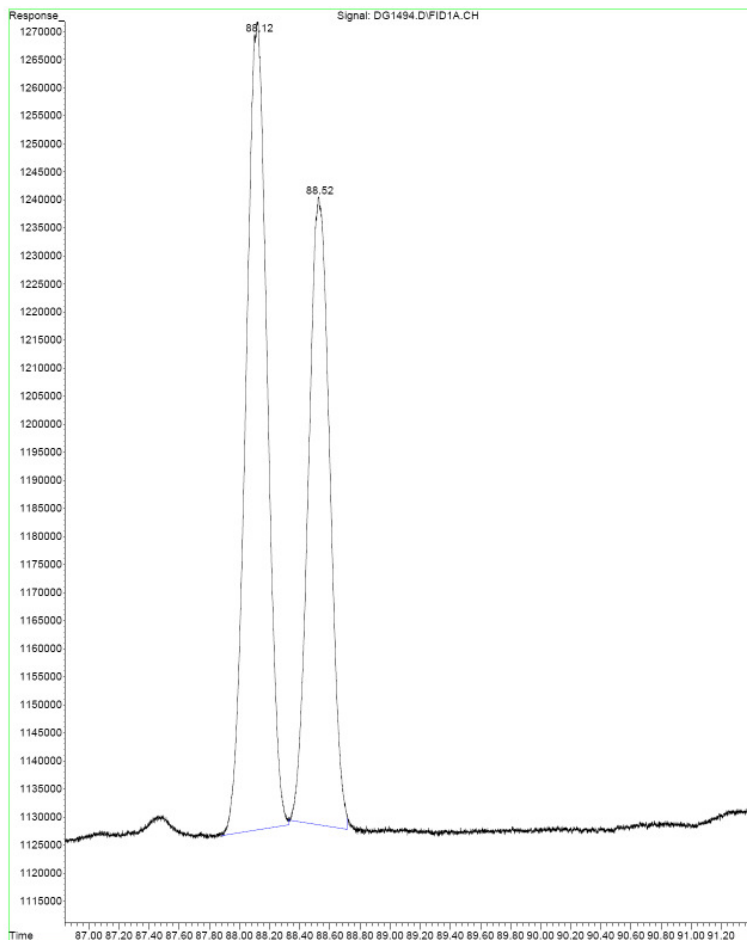
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 Signal(s) : FID1A.CH
 Acq On : 28.10.2013 09:07:38 PM
 Sample : GRA1502
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	88.096	87.875	88.357	M	232947	23565828	100.00%	95.286%
2	88.505	88.393	88.628	M	14880	1165896	4.95%	4.714%
Sum of corrected areas:							24731724	



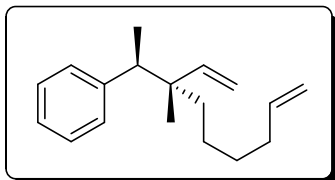
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 Signal(s) : FID1A.CH
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 Sample : DG1494
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

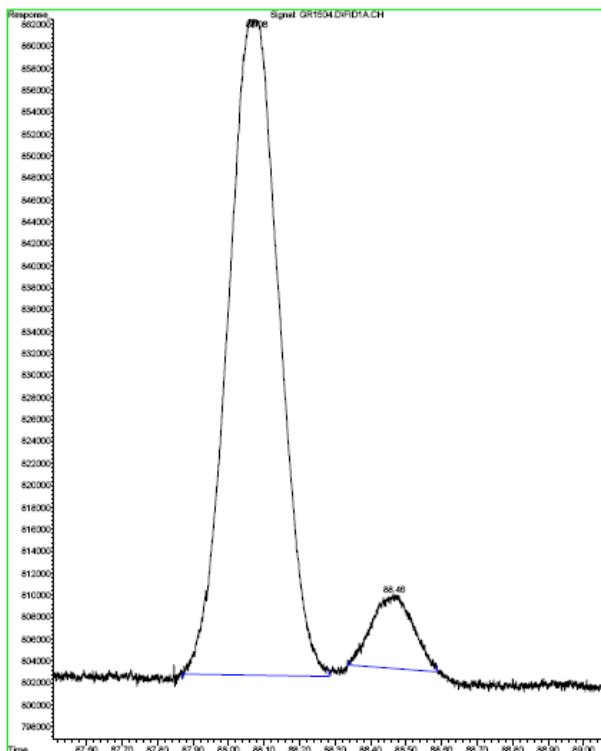
Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	88.123	87.886	88.328	M	144576	14272735	100.00%	56.332%
2	88.524	88.337	88.716	M	111965	11063935	77.52%	43.668%
Sum of corrected areas:						25336670		

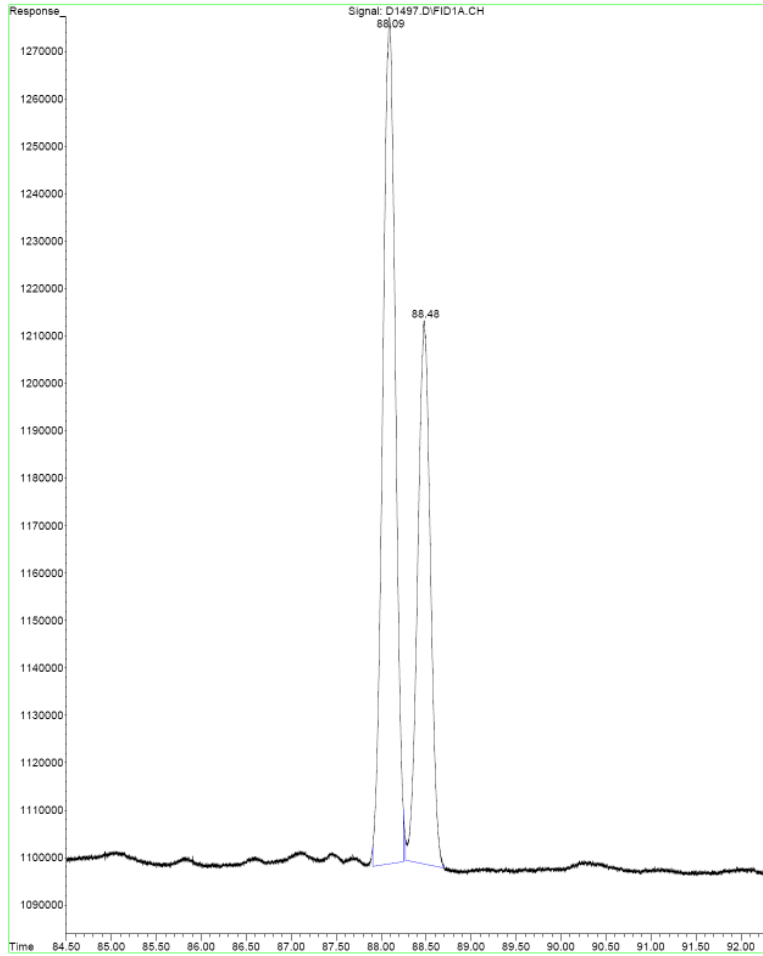


File :E:\GC 546 Janvier 2013 - Octobre 2013\GR1504.D
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 Acquired : 29.10.2013 05:08:39 PM using AcqMethod F60-1.M
 Instrument : GC CHIRAL
 Sample Name: GR1504
 Misc Info :
 Vial Number: 1



Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	88.076	87.869	88.283	M	60272	5993836	100.00%	91.740%
2	88.463	88.336	88.586	M	6786	539670	9.00%	8.260%
Sum of corrected areas:							6533507	



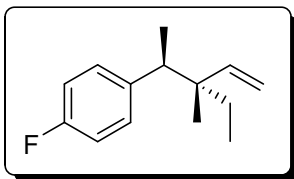
Data Path : E:\GC 5&6 Janvier 2013 - Octobre 2013\
 Data File : D1497.D
 Signal(s) : FID1A.CH
 Acq On : 23.10.2013 01:21:38 PM
 Sample : D1497
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

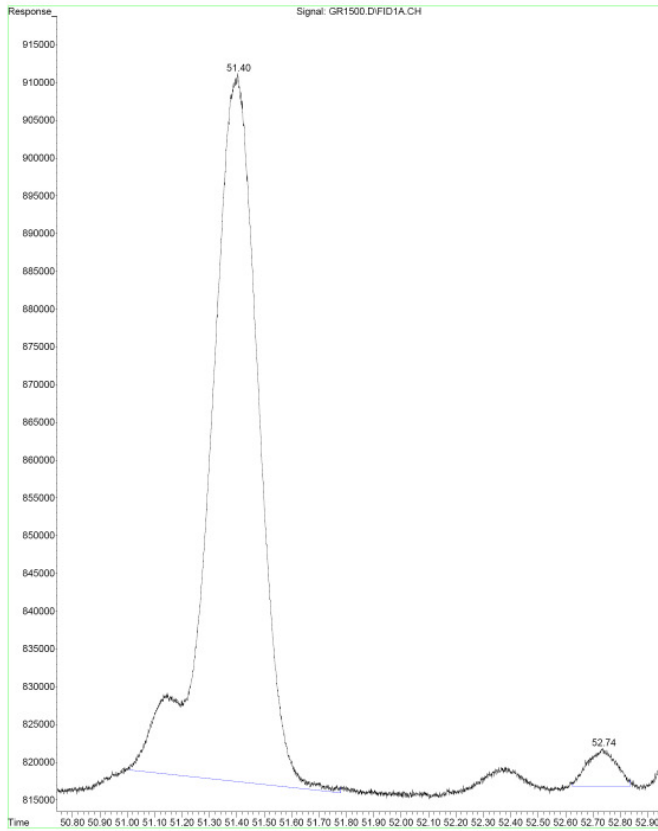
Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

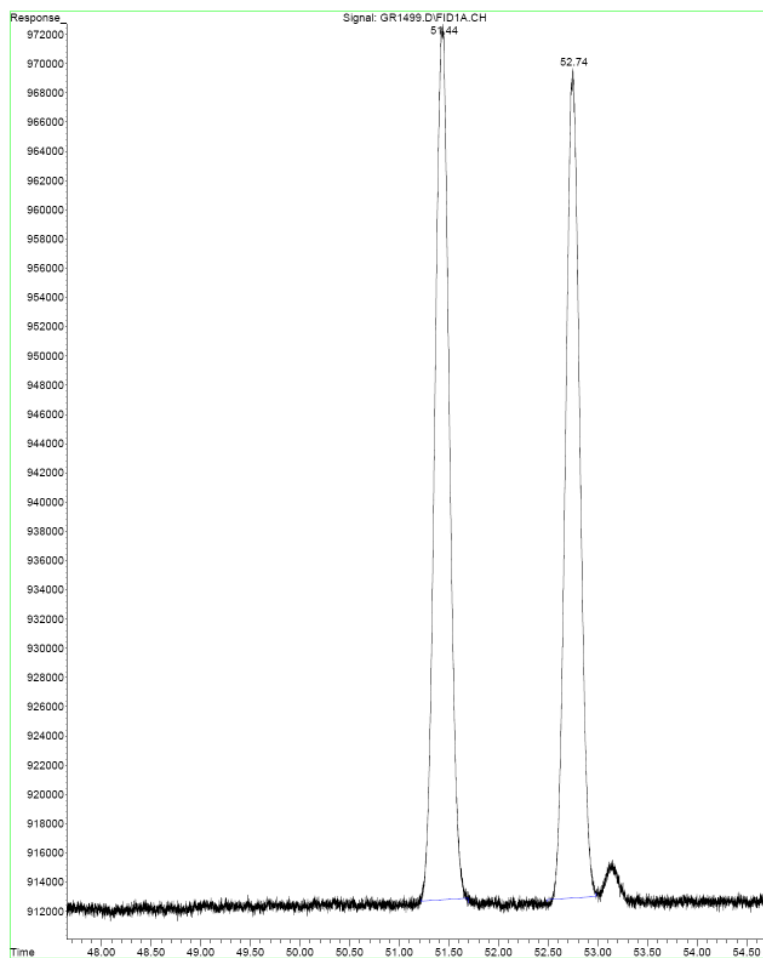
peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	88.088	87.906	88.246	M	179120	17616254	100.00%	60.960%
2	88.477	88.269	88.691	M	114604	11281731	64.04%	39.040%
Sum of corrected areas:						28897984		





Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	51.402	51.008	51.779	M	93823	11567605	100.00%	96.968%
2	52.735	52.625	52.836	M	5060	361699	3.13%	3.032%
Sum of corrected areas:						11929304		



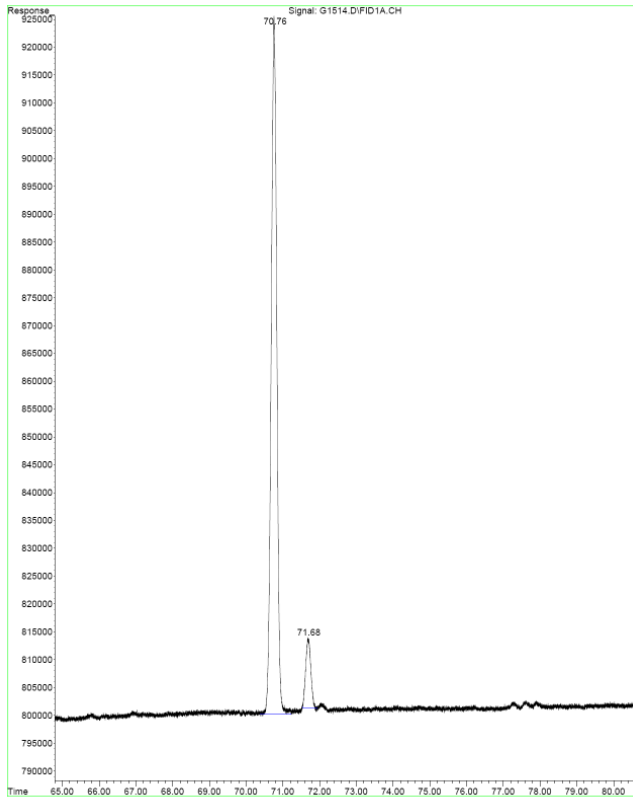
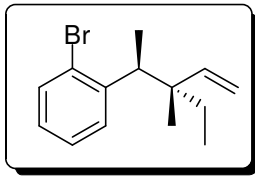
Data Path : E:\GC 5&6 Janvier 2013 - Octobre 2013\
 Data File : GR1499.D
 Signal(s) : FID1A.CH
 Acq On : 27.10.2013 05:33:54 PM
 Sample : GR1499
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	51.437	51.215	51.690	M	59911	6113367	100.00%	51.719%
2	52.744	52.485	52.981	M	56773	5707092	93.35%	48.281%
Sum of corrected areas:							11820459	



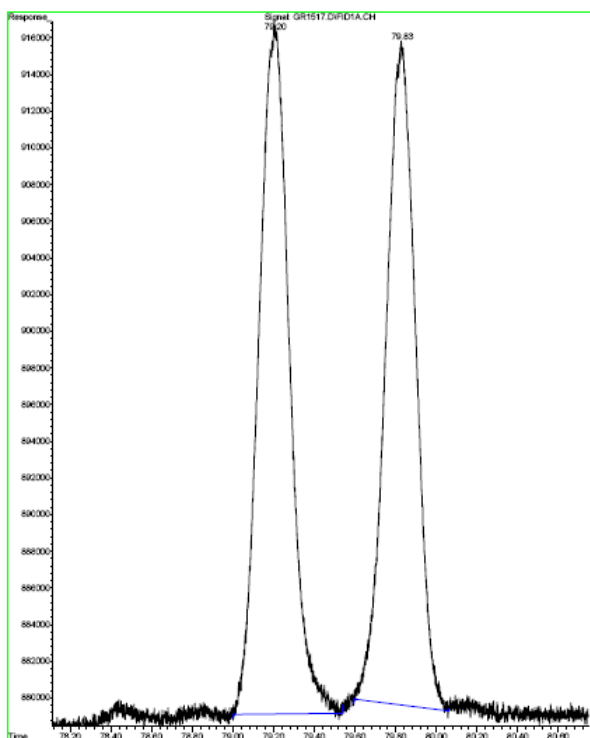
Data Path : E:\GC 5&6 Janvier 2013 - Octobre 2013\
 Data File : G1514.D
 Signal(s) : FID1A.CH
 Acq On : 06.11.2013 10:45:26 PM
 Sample : G1514
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	70.759	70.395	71.221	M	125391	13206137	100.00%	91.671%
2	71.675	71.527	71.925	M	12644	1199826	9.09%	8.329%
Sum of corrected areas:						14405963		



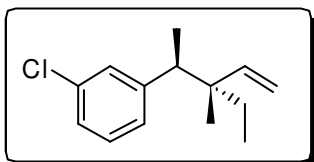
Data Path : C:\MSDCHEM\2\DATA\
 Data File : GR1517.D
 Signal(s) : FID1A.CH
 Acq On : 07.11.2013 01:50:33 PM
 Sample : GR1517
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

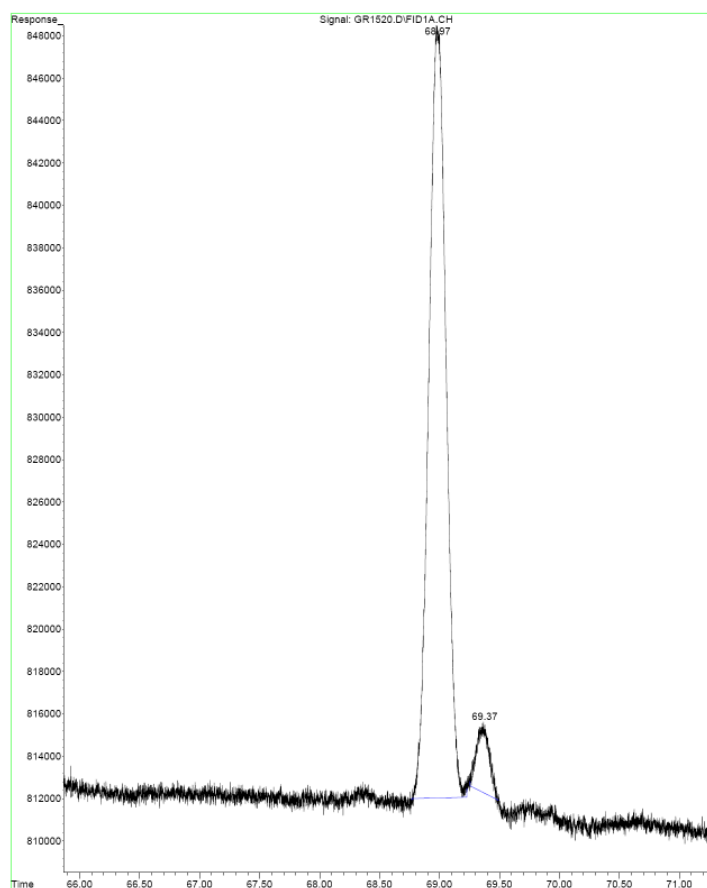
Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	79.203	79.001	79.540	M	37739	3925778	100.00%	51.522%
2	79.827	79.593	80.060	M	36216	3693859	94.09%	48.478%
Sum of corrected areas:							7619637	





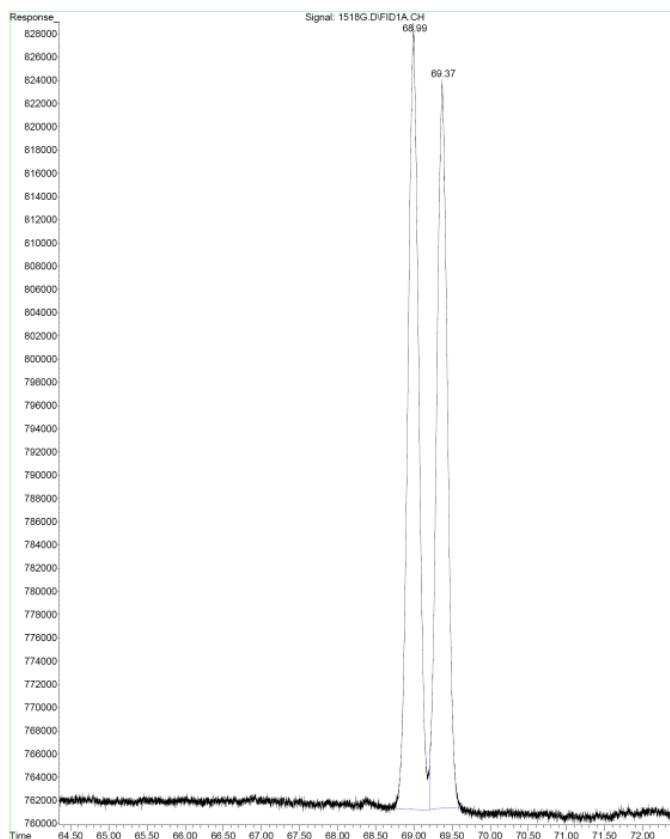
Data Path : C:\MSDCHEM\2\DATA\
 Data File : GR1520.D
 Signal(s) : FID1A.CH
 Acq On : 11.11.2013 06:01:09 PM
 Sample : GR1520
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	68.973	68.768	69.227	M	36475	3663155	100.00%	93.939%
2	69.366	69.253	69.487	M	3344	236331	6.45%	6.061%
Sum of corrected areas:							3899485	



Data Path : C:\MSDCHEM\2\DATA\
 Data File : 1518G.D
 Signal(s) : FID1A.CH
 Acq On : 08.11.2013 06:46:22 PM
 Sample : 1518G
 Misc :
 ALS Vial : 3 Sample Multiplier: 1

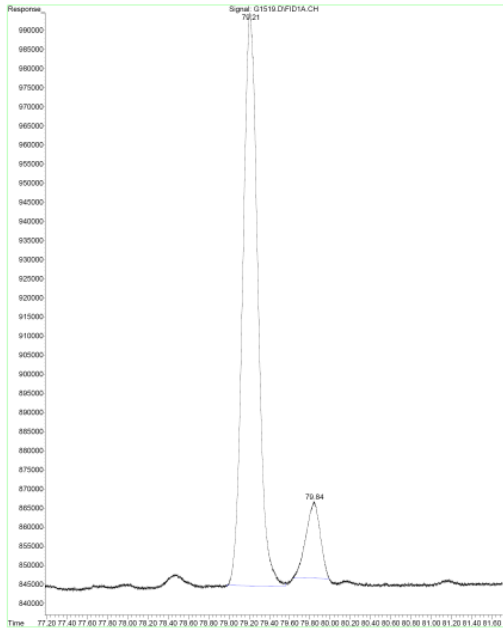
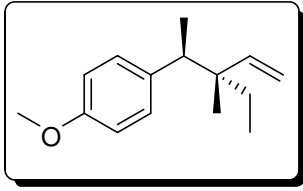
Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

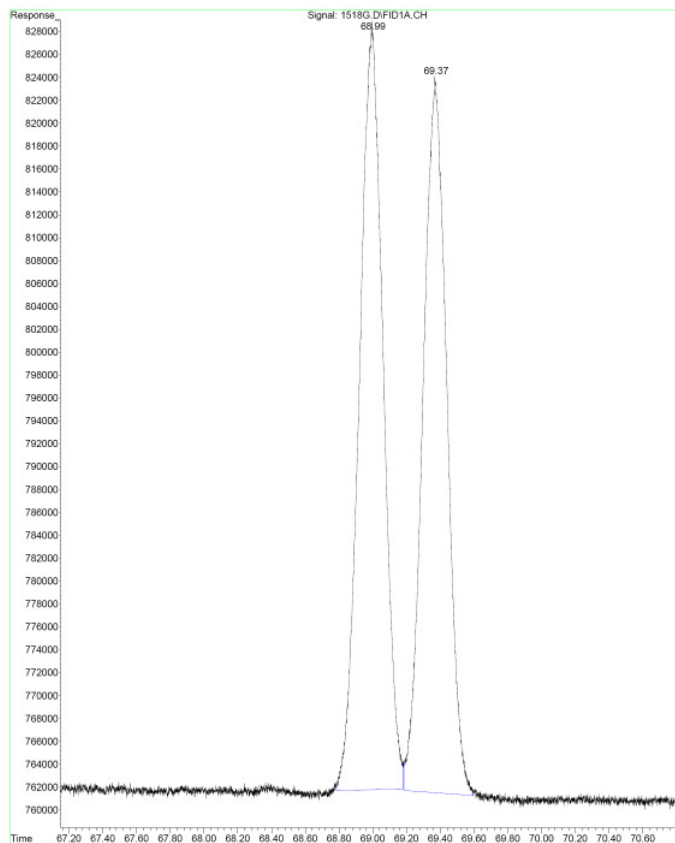
Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	68.993	68.764	69.206	M	67752	6729447	100.00%	52.278%
2	69.367	69.206	69.601	M	62778	6142918	91.28%	47.722%
Sum of corrected areas:							12872365	

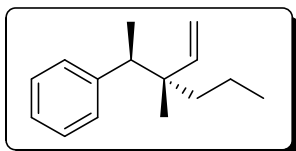
60-1.M Thu Nov 14 17:55:52 2013

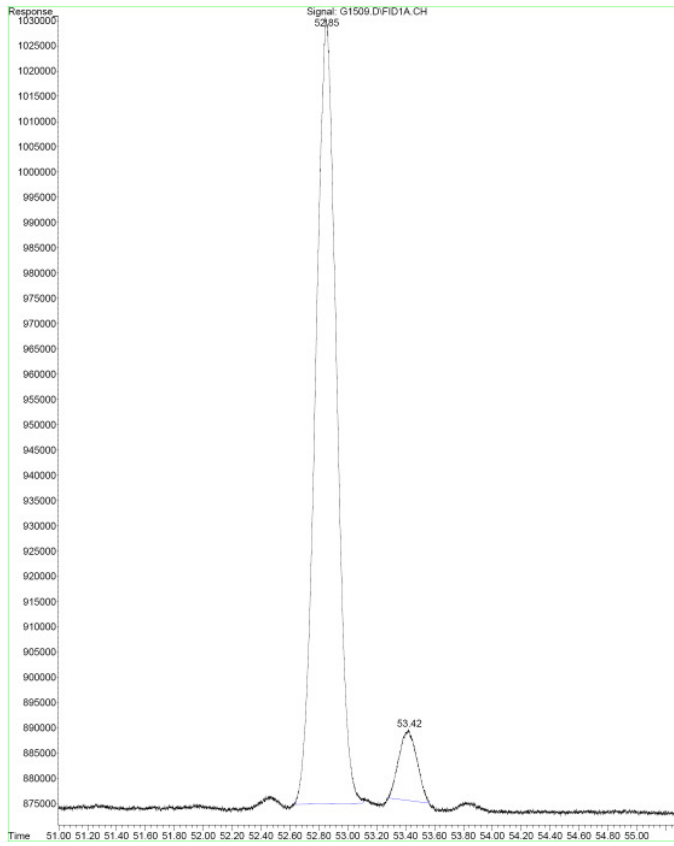


peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	79.208	78.978	79.558	M	150602	15502884	100.00%	88.807%
2	79.836	79.641	79.987	M	20130	1954026	12.60%	11.193%
Sum of corrected areas:						17456909		

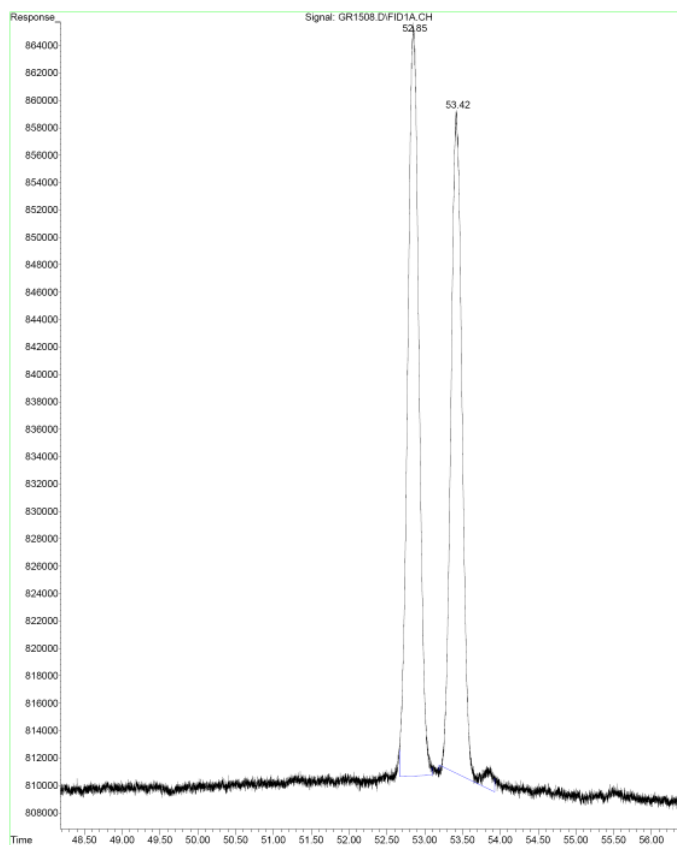


peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	68.993	68.782	69.180	M	67188	6538677	100.00%	51.557%
2	69.367	69.184	69.595	M	62583	6143855	93.96%	48.443%
Sum of corrected areas:						12682532		

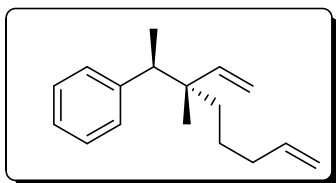


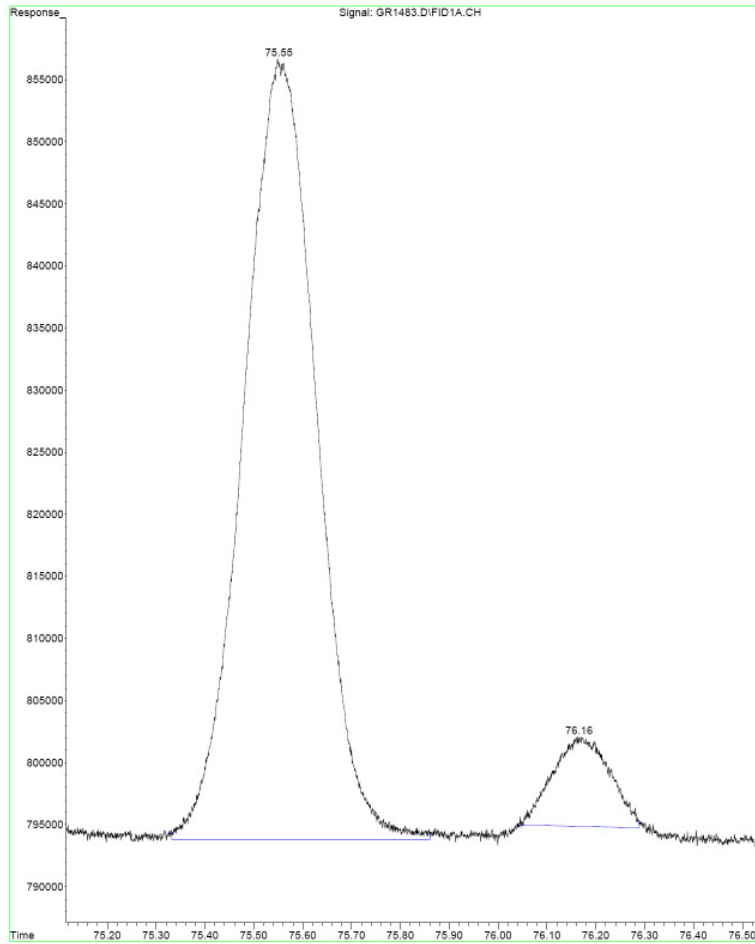


peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	52.845	52.640	53.107	M	155698	15544692	100.00%	92.809%
2	53.417	53.283	53.561	M	14131	1204412	7.75%	7.191%
Sum of corrected areas:						16749105		

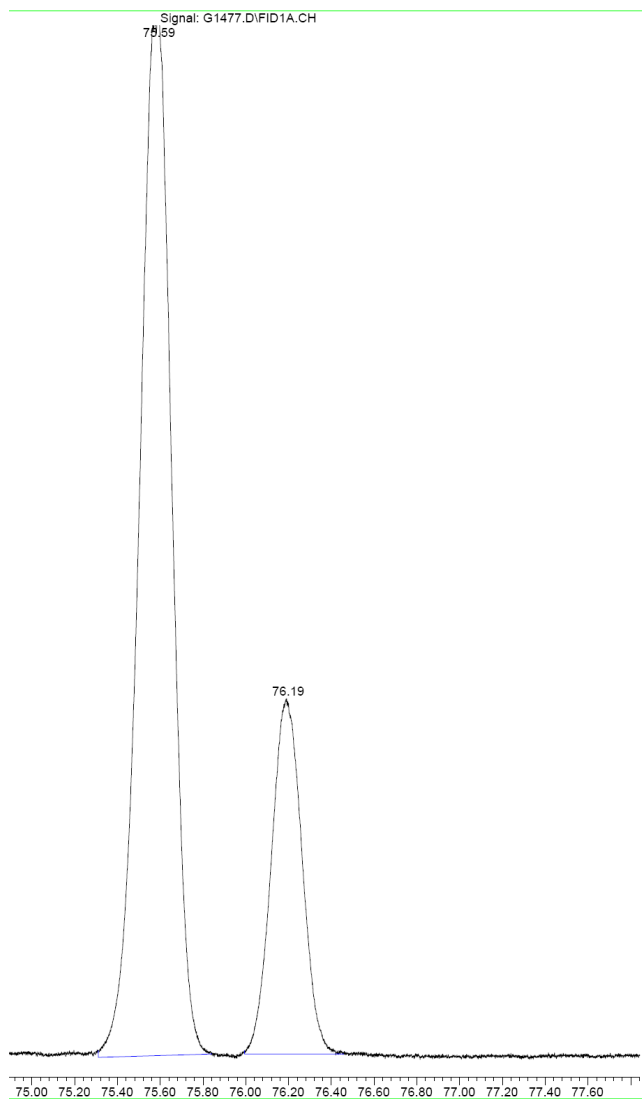


peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	52.850	52.665	53.095	M	54975	5718408	100.00%	53.114%
2	53.421	53.189	53.924	M	48392	5047854	88.27%	46.886%
Sum of corrected areas:						10766262		

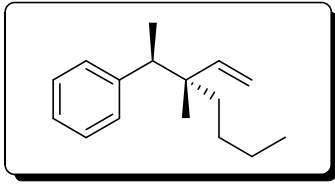




Peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	75.548	75.332	75.860	M	62897	6532851	100.00%	91.791%
2	76.163	76.044	76.289	M	7245	584262	8.94%	8.209%
Sum of corrected areas:							7117112	



peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	75.587	75.310	75.839	M	228687	24144654	100.00%	75.718%
2	76.190	75.993	76.457	M	77990	7743045	32.07%	24.282%
Sum of corrected areas:						31887699		

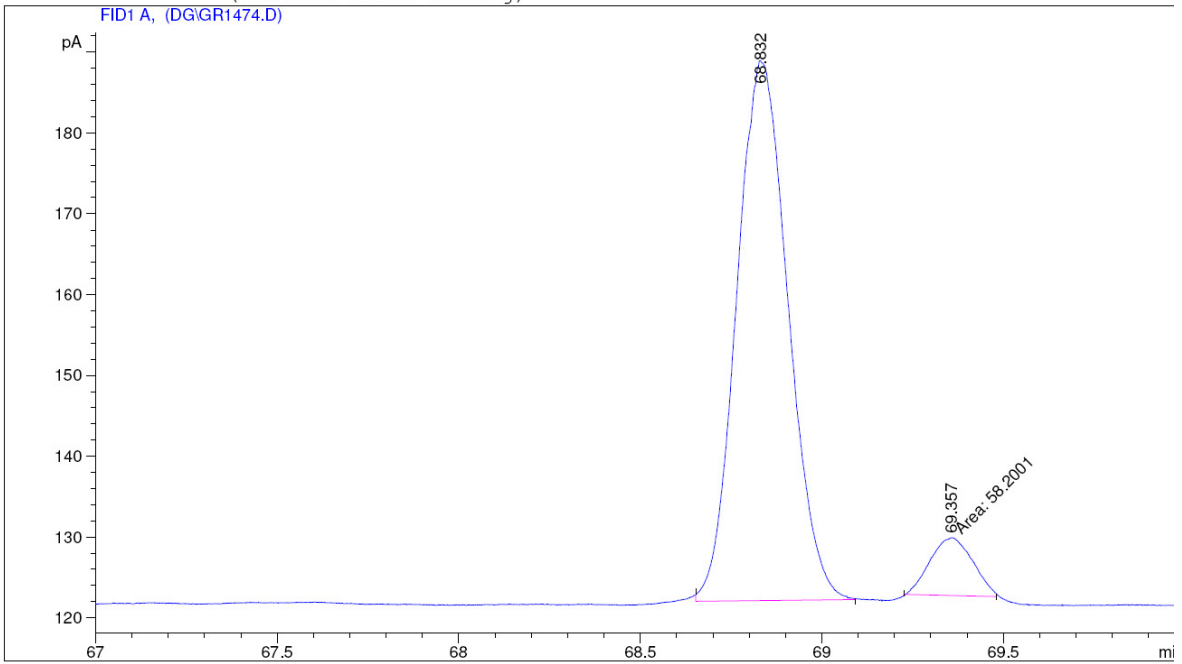


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=====
Injection Date   : 08-Oct-13 5:23:22 PM
Sample Name     : GR1474
Acq. Operator   : dg
Location        : Vial 1
Inj             : 1
Inj Volume      : 1 µl

Acq. Method     : C:\HPCHEM\1\METHODS\60-1-170.M
Last changed    : 17-Jan-13 6:37:28 PM by DG
Analysis Method : C:\HPCHEM\1\METHODS\140-150.M
Last changed    : 18-Nov-13 1:01:48 PM by pg
                  (modified after loading)
=====

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

```

Signal 1: FID1 A,

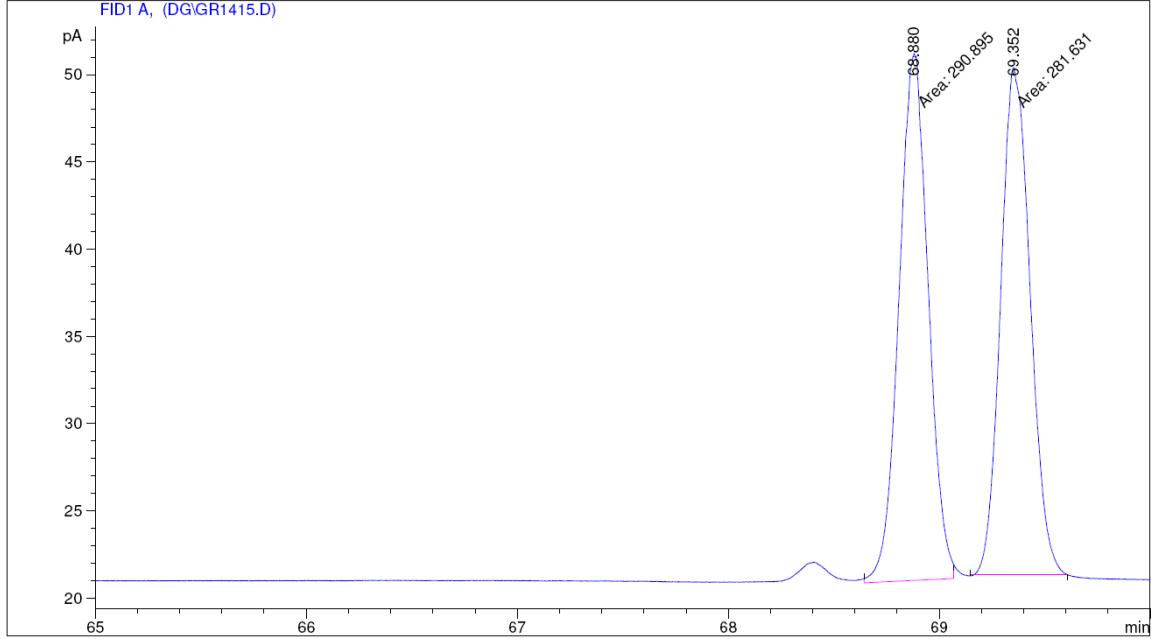
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	68.832	BB	0.1248	656.95709	66.77818	91.86192
2	69.357	MM	0.1362	58.20006	7.12276	8.13808

```

=====
Injection Date   : 20-Sep-13 7:34:39 PM      Seq. Line : 1
Sample Name     : gr1415                    Location  : Vial 1
Acq. Operator   : DG                       Inj      : 1
                                           Inj Volume: 1 µl

Acq. Method    : C:\HPCHEM\1\METHODS\60-1.M
Last changed   : 19-Mar-13 8:33:19 PM by LH
Analysis Method: C:\HPCHEM\1\METHODS\140-150.M
Last changed   : 18-Nov-13 12:58:11 PM by pg
                (modified after loading)
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Area Percent Report
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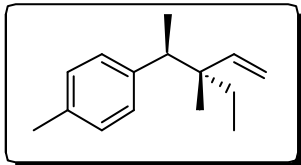
Sorted By      : Signal
Multiplier     : 1.0000
Dilution       : 1.0000
Use Multiplier & Dilution Factor with ISTDs

```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	68.880	MM	0.1604	290.89505	30.21913	50.80902
2	69.352	MM	0.1617	281.63138	29.02872	49.19098

Totals : 572.52643 59.24785

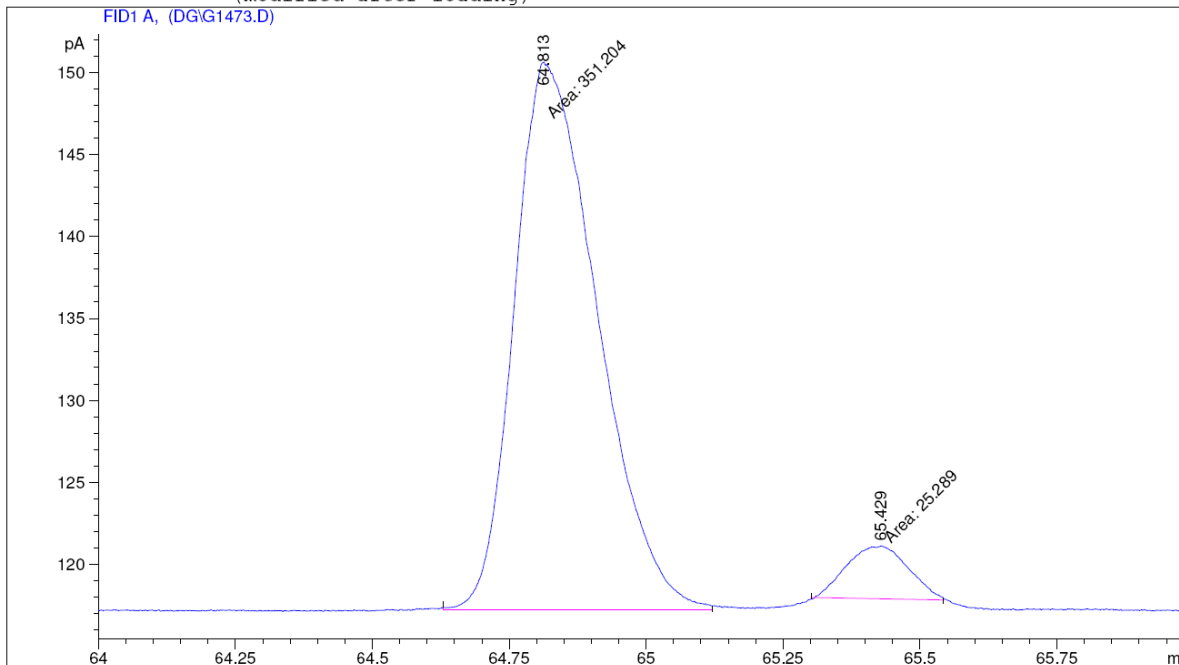


```

=====
Injection Date   : 08-Oct-13 8:15:04 PM
Sample Name     : G1473
Acq. Operator   : dg
Location       : Vial 1
Inj            : 1
Inj Volume     : 1 µl

Acq. Method    : C:\HPCHEM\1\METHODS\60-1-140.M
Last changed   : 18-Apr-12 5:02:59 PM by DM
Analysis Method : C:\HPCHEM\1\METHODS\140-150.M
Last changed   : 18-Nov-13 12:56:45 PM by pg
                (modified after loading)
=====

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

```

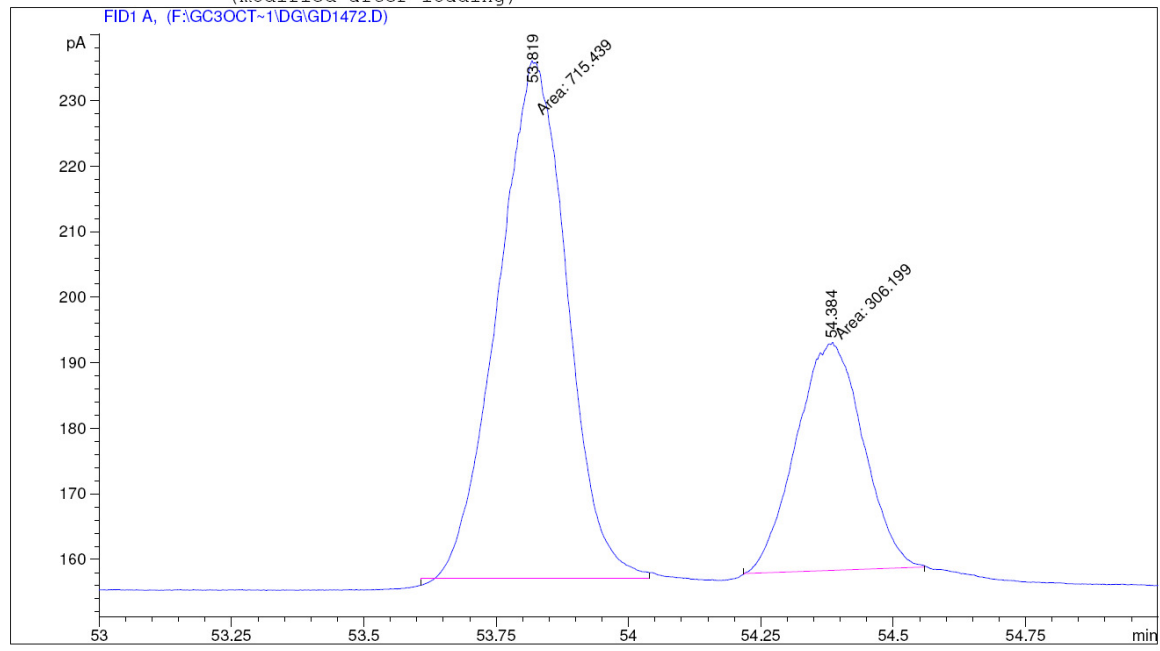
Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	64.813	MM	0.1750	351.20416	33.44104	93.28302
2	65.429	MM	0.1306	25.28898	3.22723	6.71698

```

=====
Injection Date   : 07-Oct-13 10:13:47 PM
Sample Name      : gd1472
Acq. Operator    : dg
Acq. Instrument  : Instrument 3
Acq. Method      : C:\HPCHEM\3\METHODS\60-1.M
Last changed     : 28-Jan-13 3:51:42 PM by NG
Analysis Method  : C:\HPCHEM\1\METHODS\140-150.M
Last changed     : 18-Nov-13 12:32:05 PM by pg
                  (modified after loading)
Location         : Vial 1
Inj              : 1
Inj Volume       : 1 µl
=====

```



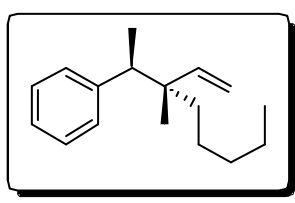
```

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Area Percent Report
=====
Sorted By      : Signal
Multiplier     : 1.0000
Dilution       : 1.0000
Use Multiplier & Dilution Factor with ISTDs

```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	53.819	MM	0.1511	715.43890	78.89700	70.02864
2	54.384	MM	0.1470	306.19861	34.71799	29.97136

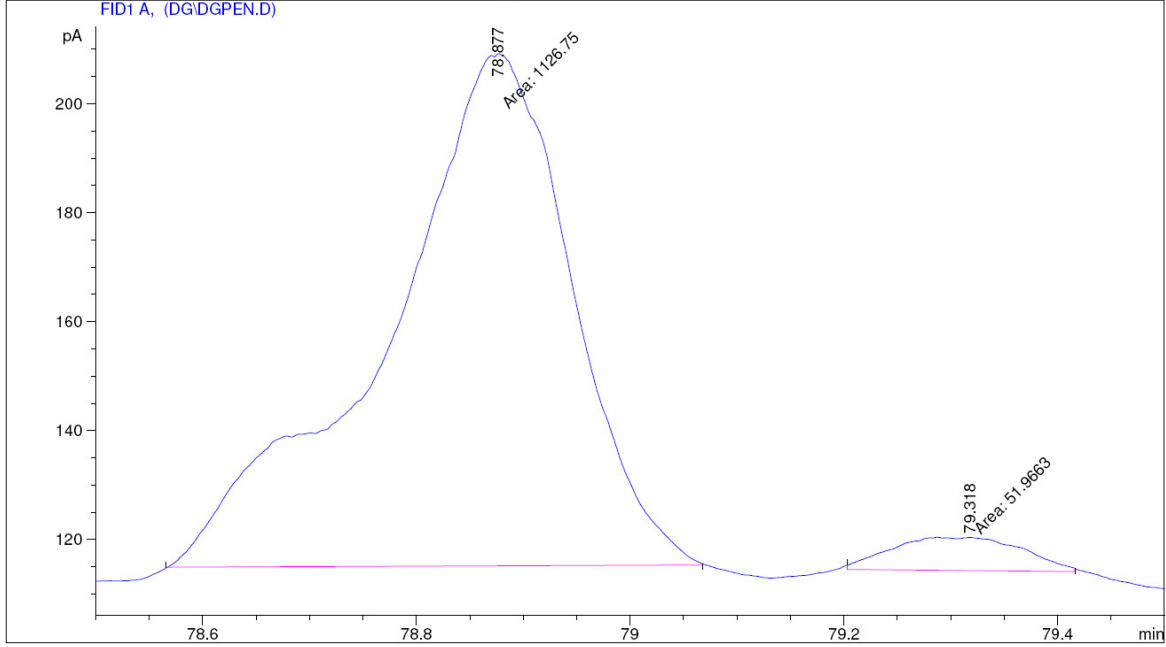


```

=====
Injection Date   : 01-Nov-13 9:08:47 AM
Sample Name     : DGPEN
Acq. Operator   : DG
Location       : Vial 1
Inj            : 1
Inj Volume     : 1 µl

Acq. Method    : C:\HPCHEM\1\METHODS\60-1.M
Last changed   : 19-Mar-13 8:33:19 PM by LH
Analysis Method: C:\HPCHEM\1\METHODS\140-150.M
Last changed   : 18-Nov-13 12:53:56 PM by pg
                (modified after loading)
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                          Area Percent Report
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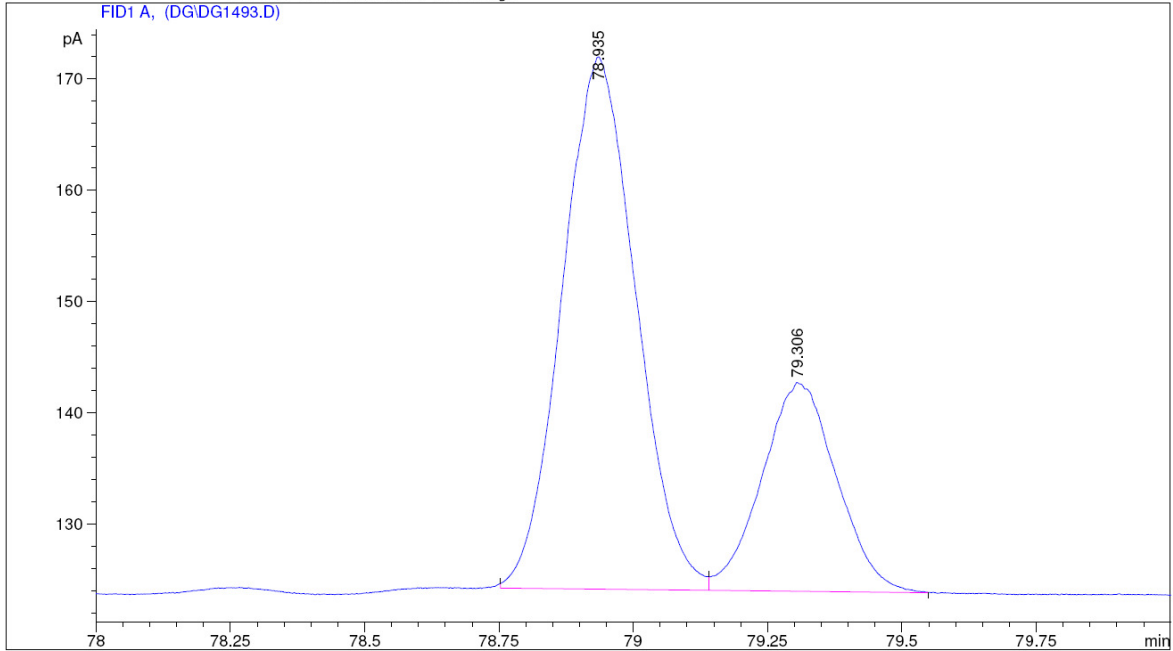
Sorted By      : Signal
Multiplier     : 1.0000
Dilution       : 1.0000
Use Multiplier & Dilution Factor with ISTDs

```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	78.877	MM	0.1997	1126.74939	94.03220	95.59128
2	79.318	MM	0.1425	51.96627	6.07661	4.40872

Injection Date : 21-Oct-13 7:57:51 PM
 Sample Name : dg1493
 Acq. Operator : dg
 Location : Vial 1
 Inj : 1
 Inj Volume : 1 µl
 Acq. Method : C:\HPCHEM\1\METHODS\60-1.M
 Last changed : 19-Mar-13 8:33:19 PM by LH
 Analysis Method : C:\HPCHEM\1\METHODS\140-150.M
 Last changed : 18-Nov-13 1:39:01 PM by pg
 (modified after loading)

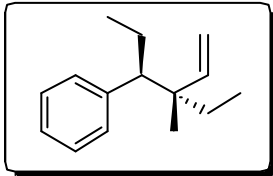


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 Area Percent Report
 =====

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

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	78.935	BV	0.1252	456.17191	47.86106	71.53850
2	79.306	VB	0.1177	181.48737	18.78806	28.46150

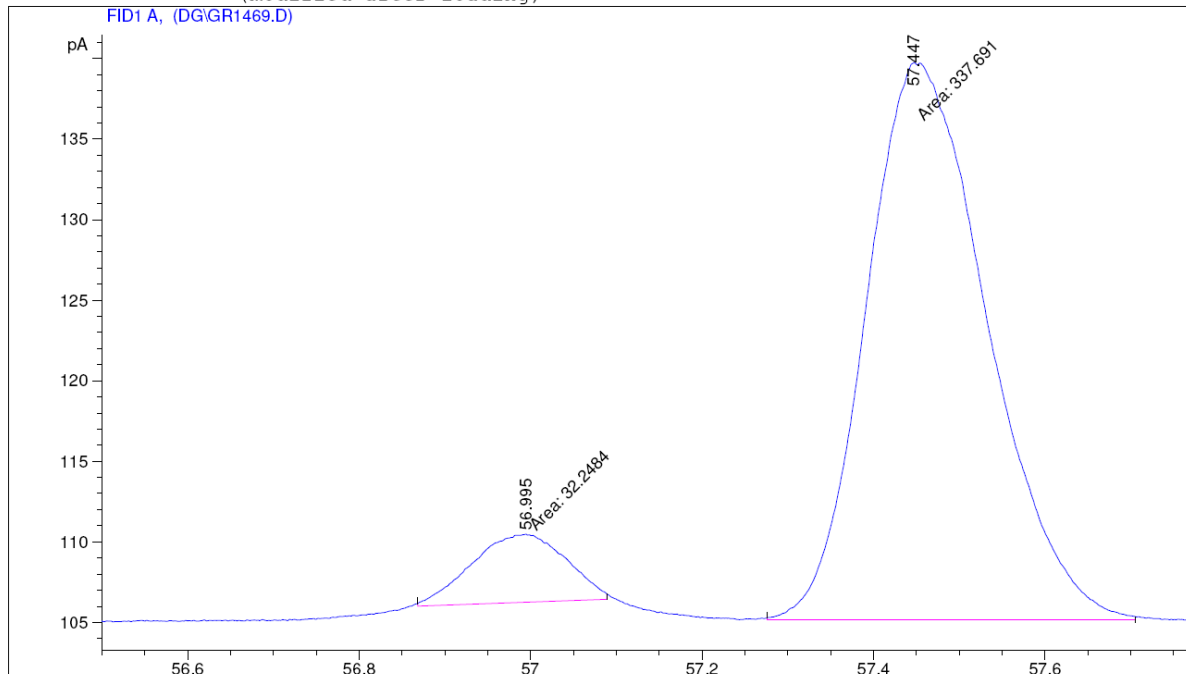


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-----
Injection Date   : 02-Oct-13 4:28:44 PM
Sample Name     : GR1469
Acq. Operator  : DG
Location       : Vial 3
Inj           : 1
Inj Volume    : 1 µl

Acq. Method    : C:\HPCHEM\1\METHODS\60-1-140.M
Last changed   : 02-Oct-13 4:27:02 PM by DG
                (modified after loading)
Analysis Method : C:\HPCHEM\1\METHODS\140-150.M
Last changed   : 18-Nov-13 12:55:44 PM by pg
                (modified after loading)
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                          Area Percent Report
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Sorted By           :      Signal
Multiplier          :      1.0000
Dilution            :      1.0000
Use Multiplier & Dilution Factor with ISTDs

```

Signal 1: FID1 A,

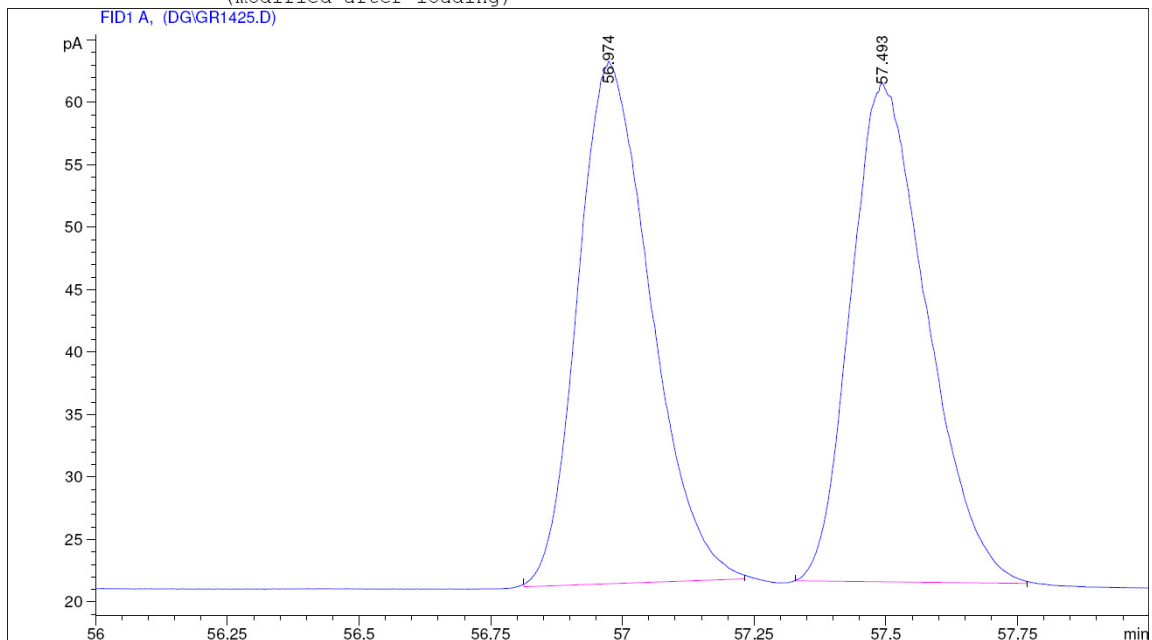
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	56.995	MM	0.1274	32.24837	4.21860	8.71719
2	57.447	MM	0.1627	337.69147	34.60181	91.28281


```

=====
Injection Date   : 20-Sep-13 9:35:26 PM           Seq. Line :    2
Sample Name     : gr1425                         Location  : Vial 2
Acq. Operator  : DG                             Inj      :    1
                                           Inj Volume: 1 µl

Acq. Method    : C:\HPCHEM\1\METHODS\60-1.M
Last changed   : 19-Mar-13 8:33:19 PM by LH
Analysis Method: C:\HPCHEM\1\METHODS\140-150.M
Last changed   : 18-Nov-13 1:39:48 PM by pg
                (modified after loading)
=====

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Area Percent Report
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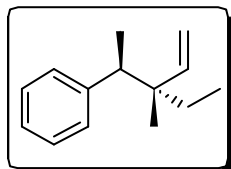
```

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

```

Signal 1: FID1 A,

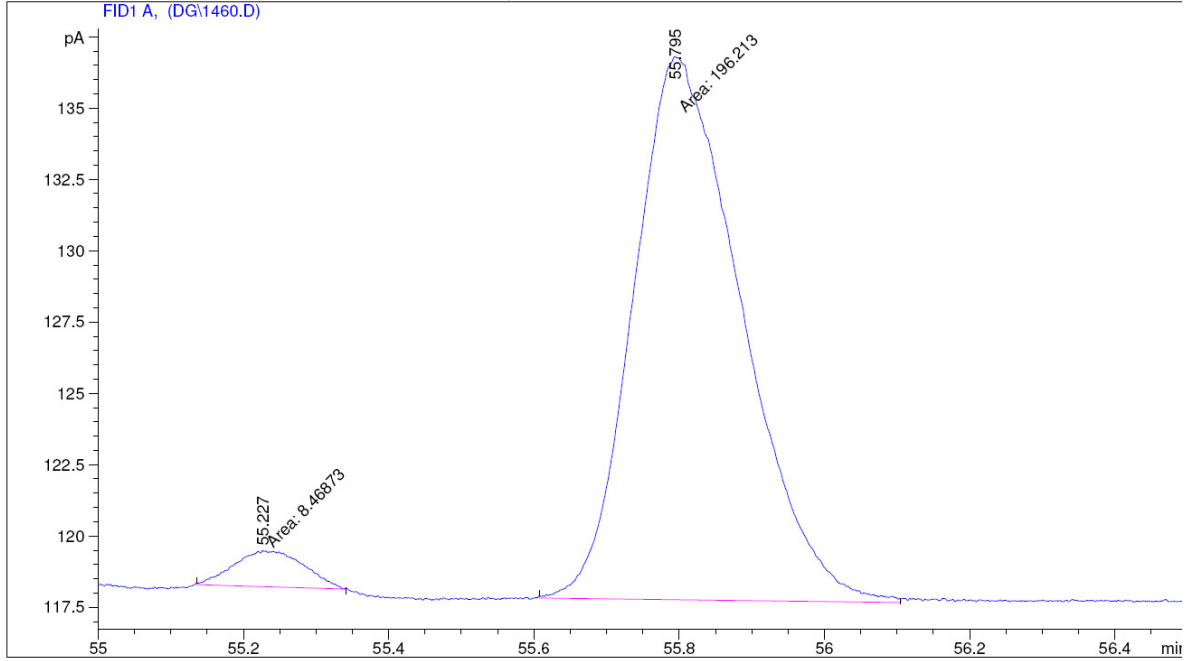
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	56.974	BB	0.1375	402.33231	41.72952	49.98594
2	57.493	BB	0.1216	402.55859	39.92019	50.01406



```

=====
Injection Date   : 27-Sep-13 4:24:29 PM
Sample Name     : 1460
Acq. Operator   : DG
Location        : Vial 1
Inj             : 1
Inj Volume      : 1 µl
Acq. Method     : C:\HPCHEM\1\METHODS\60-1-140.M
Last changed    : 18-Apr-12 5:02:59 PM by DM
Analysis Method : C:\HPCHEM\1\METHODS\140-150.M
Last changed    : 18-Nov-13 12:52:47 PM by pg
                 (modified after loading)
=====

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Area Percent Report
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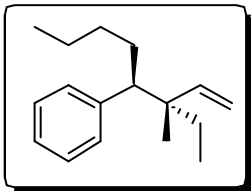
```

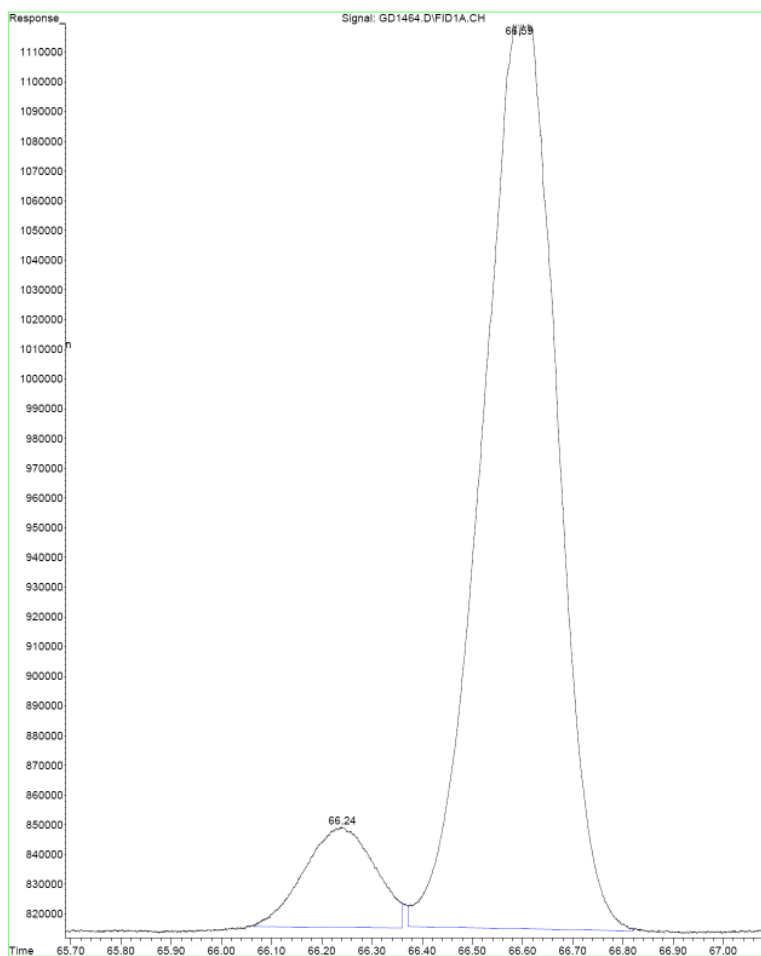
Sorted By      : Signal
Multiplier     : 1.0000
Dilution       : 1.0000
Use Multiplier & Dilution Factor with ISTDs

```

Signal 1: FID1 A,

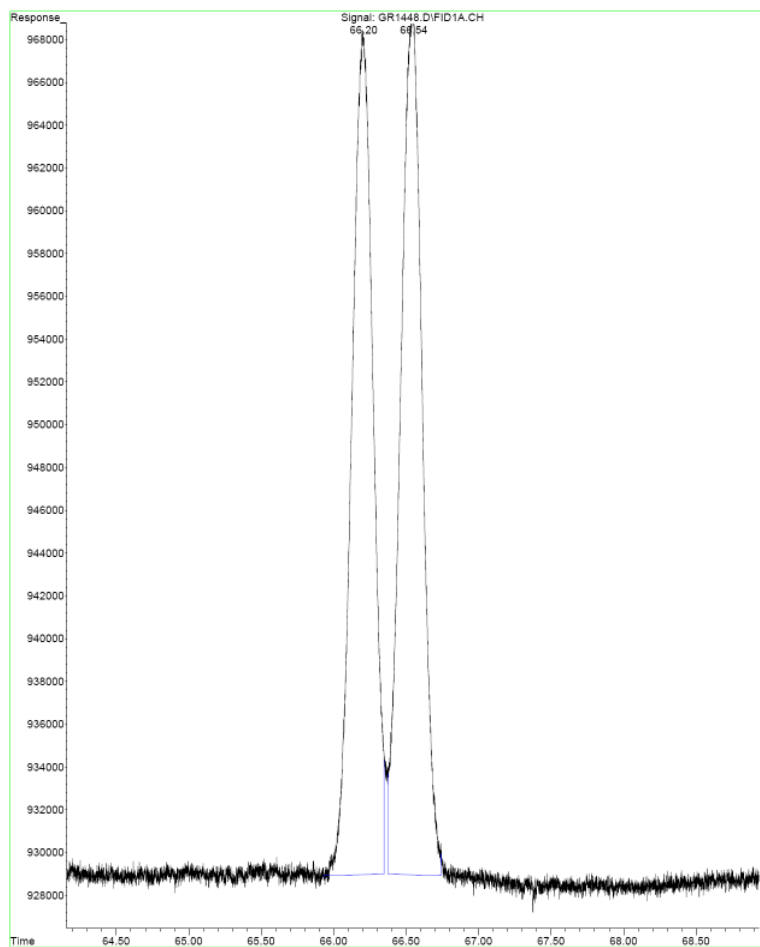
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	55.227	MM	0.1116	8.46873	1.26523	4.13751
2	55.795	MM	0.1716	196.21310	19.05769	95.86249



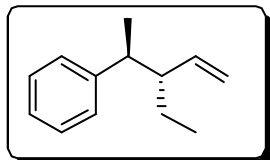


Signal : FID1A.CH

Peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	66.238	66.067	66.360	M	33778	3299134	10.33%	9.366%
2	66.590	66.372	66.820	M	306724	31925474	100.00%	90.634%
Sum of corrected areas:						35224608		



peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	66.197	65.964	66.328	M	39024	3846647	89.95%	47.356%
2	66.542	66.336	66.751	M	40564	4276210	100.00%	52.644%
Sum of corrected areas:							8122856	

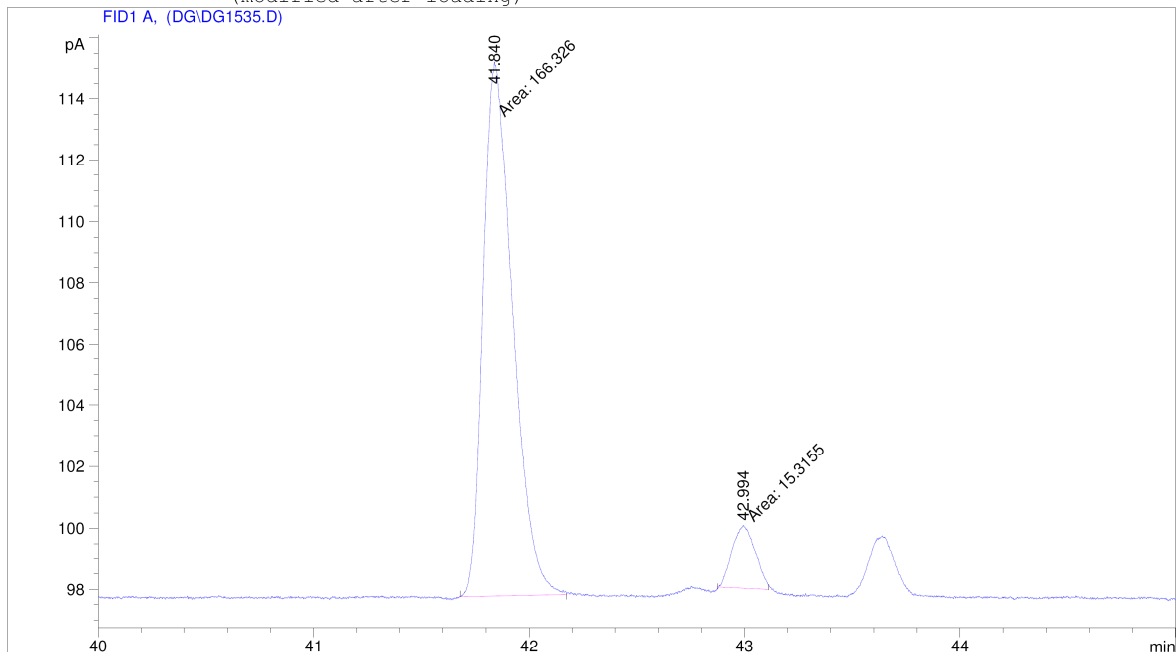


```

=====
Injection Date   : 28-Nov-13 6:39:10 PM
Sample Name     : dg1535
Acq. Operator   : dg
Location        : Vial 1
Inj             : 1
Inj Volume     : 1 µl

Acq. Method     : C:\HPCHEM\1\METHODS\60-1.M
Last changed    : 19-Mar-13 8:33:19 PM by LH
Analysis Method : C:\HPCHEM\1\METHODS\110-1.M
Last changed    : 01-Dec-13 4:32:12 PM by stef
                  (modified after loading)
=====

```



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

```

```

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

```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	41.840	MM	0.1590	166.32570	17.43860	91.56828
2	42.994	MM	0.1239	15.31548	2.06020	8.43172

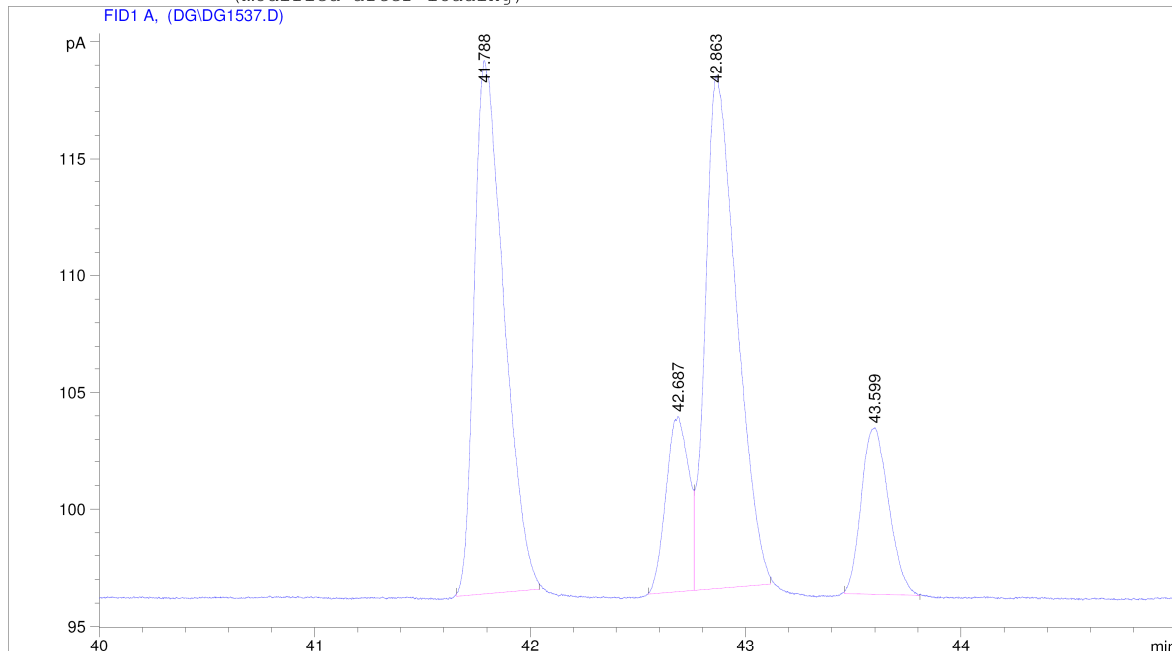
```
Totals :                      181.64118  19.49880
```

```

=====
Injection Date   : 28-Nov-13 9:24:49 PM
Sample Name     : dq1537
Acq. Operator   : dg
Location        : Vial 1
Inj             : 1
Inj Volume      : 1 µl

Acq. Method     : C:\HPCHEM\1\METHODS\60-1.M
Last changed    : 19-Mar-13 8:33:19 PM by LH
Analysis Method : C:\HPCHEM\1\METHODS\110-1.M
Last changed    : 01-Dec-13 4:32:12 PM by stef
                  (modified after loading)
=====

```



```

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

```

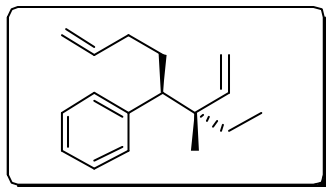
```

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

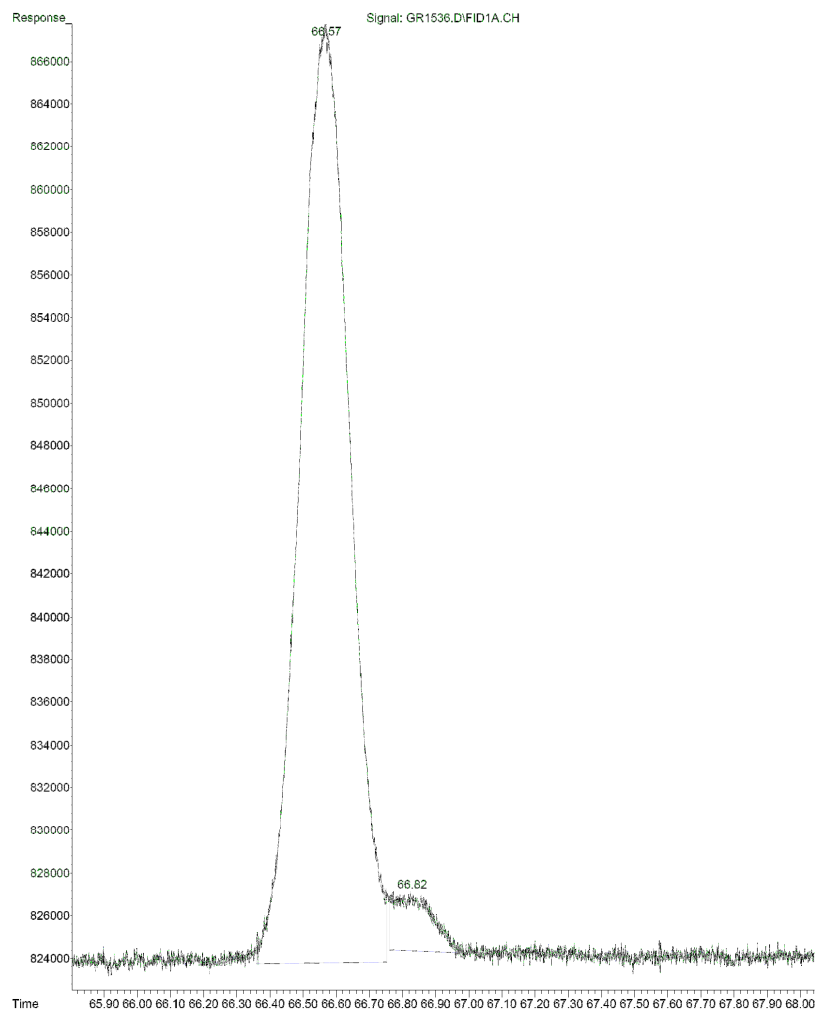
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	41.788	BB	0.1294	217.64574	22.78954	39.08769
2	42.687	BV	0.1047	55.04097	7.49064	9.88498
3	42.863	VB	0.1320	221.32780	21.88451	39.74896
4	43.599	BB	0.1290	62.79955	7.11193	11.27837



File : C:\MSDCHEM\2\DATA\GR1536.D
Operator : DG
Acquired : 28.11.2013 05:40:21 PM using AcqMethod F69-1.M
Instrument : GC CHIRAL
Sample Name: GR1536
Misc Info :
Vial Number: 1



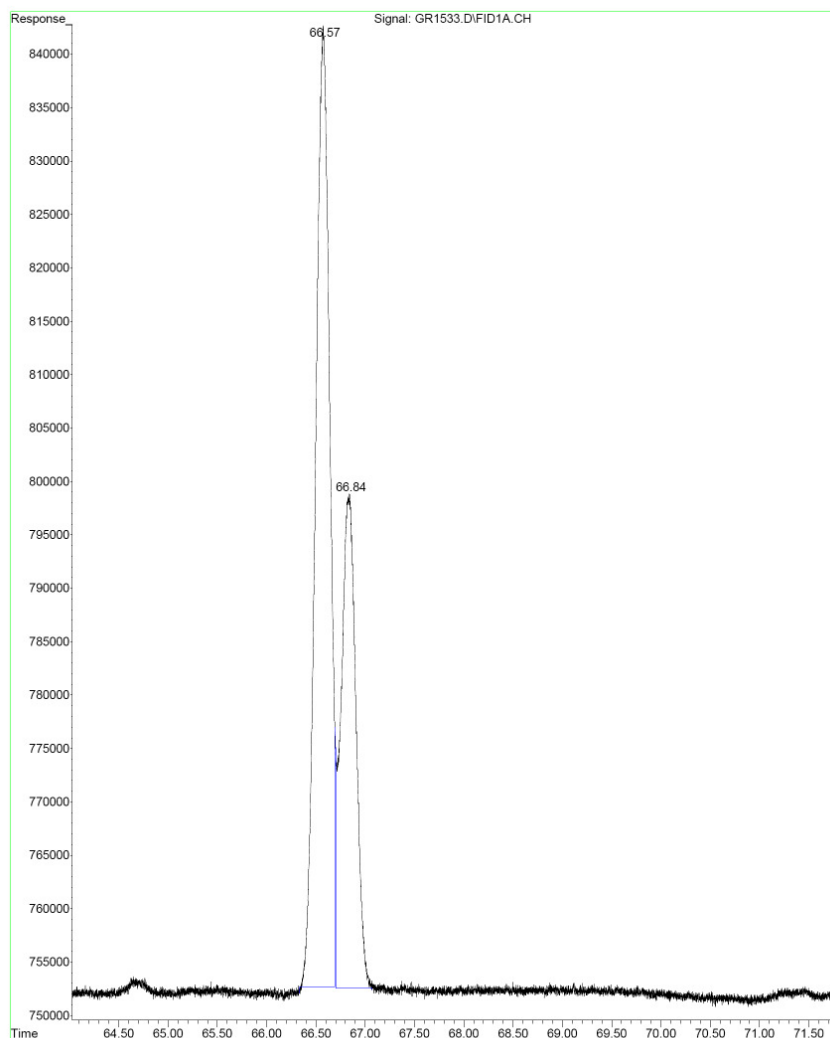
Data Path : C:\MSDCHEM\2\DATA\
 Data File : GR1536.D
 Signal(s) : FID1A.CH
 Acq On : 28.11.2013 05:40:21 PM
 Sample : GR1536
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

Peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	66.565	66.359	66.752	M	43999	4603993	100.00%	95.527%
2	66.824	66.760	66.975	M	2783	215603	4.68%	4.473%
Sum of corrected areas:							4819595	



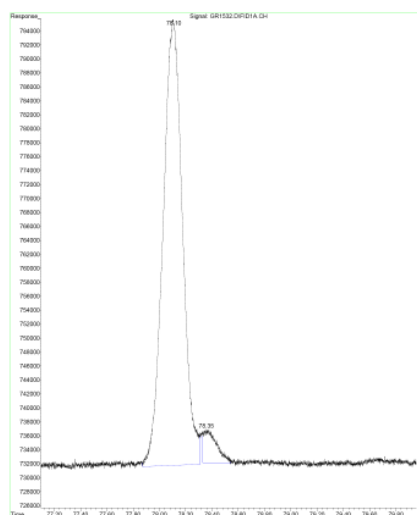
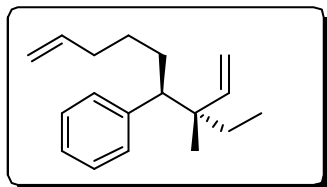
Data Path : C:\MSDCHEM\2\DATA\
 Data File : GR1533.D
 Signal(s) : FID1A.CH
 Acq On : 27.11.2013 03:41:42 PM
 Sample : GR1533
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

Peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	66.572	66.336	66.692	M	90013	8940768	100.00%	64.421%
2	66.839	66.699	67.069	M	46301	4937948	55.23%	35.579%
Sum of corrected areas:							13878716	



Data Path : C:\MSDCHEM\2\DATA\
Data File : GR1532.D
Signal(s) : FID1A.CH
Acq On : 26.11.2013 04:11:16 PM
Sample : GR1532
Misc :
ALS Vial : 1 Sample Multiplier: 1

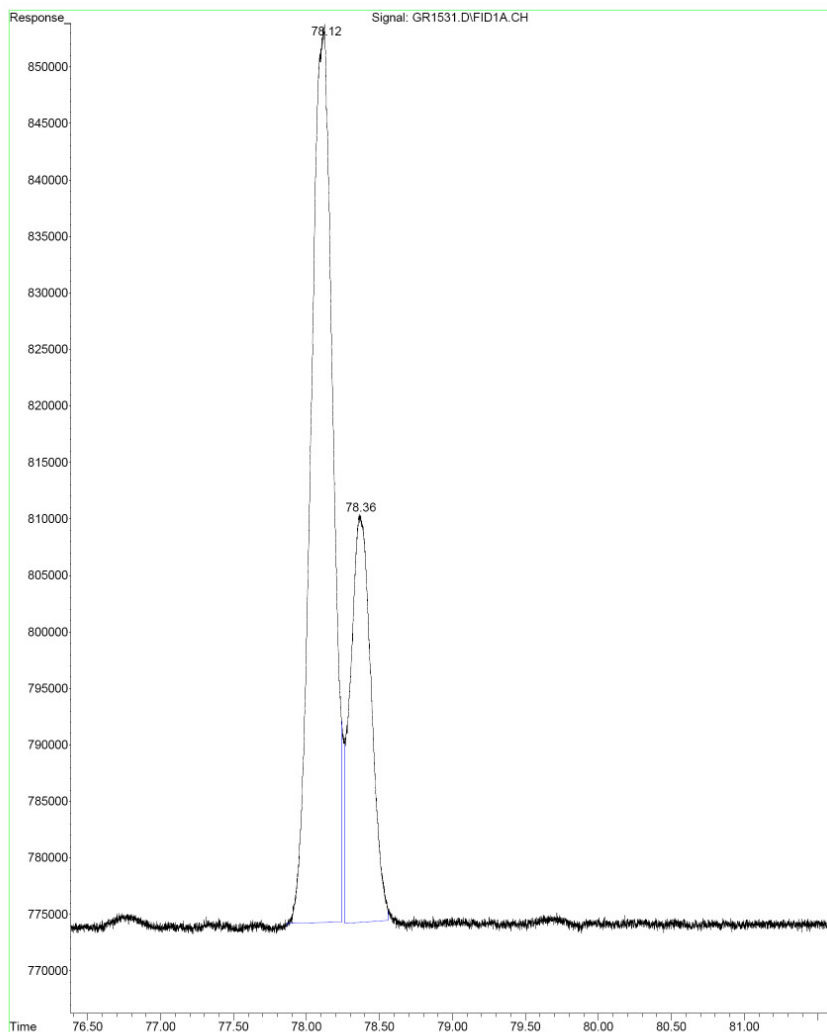
Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	78.103	77.873	78.311	M	63892	6603782	100.00%	95.338%
2	78.350	78.331	78.544	M	4808	322892	4.89%	4.662%

Sum of corrected areas: 6926674



Area Percent Report

Data Path : C:\MSDCHEM\2\DATA\
 Data File : GR1531.D
 Signal(s) : FID1A.CH
 Acq On : 25.11.2013 07:30:11 PM
 Sample : GR1531
 Misc :
 ALS Vial : 1 Sample Multiplier: 1

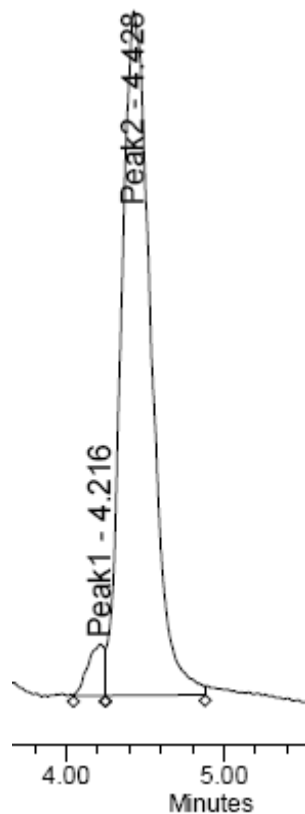
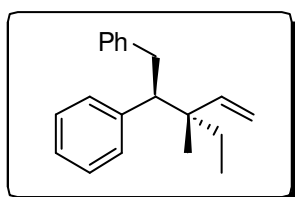
Integration File: autoint1.e

Method : C:\MSDCHEM\2\METHODS\F60-1.M
 Title :

Signal : FID1A.CH

peak #	R.T. min	Start min	End min	PK TY	peak height	peak area	peak % max.	% of total
1	78.124	77.869	78.243	M	79611	8180756	100.00%	69.807%
2	78.361	78.263	78.557	M	36090	3538330	43.25%	30.193%
Sum of corrected areas:							11719085	

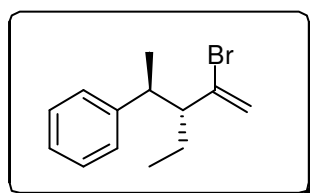
F60-1.M Sun Dec 01 16:41:49 2013



	Peak Name	RT	Area	% Area	Height
1	Peak1	4.216	264367	3.99	36891
2	Peak2	4.428	6364670	96.01	489515



	Peak Name	RT	Area	% Area	Height
1	Peak1	4.185	3602181	44.23	333632
2	Peak2	4.414	4541610	55.77	344396



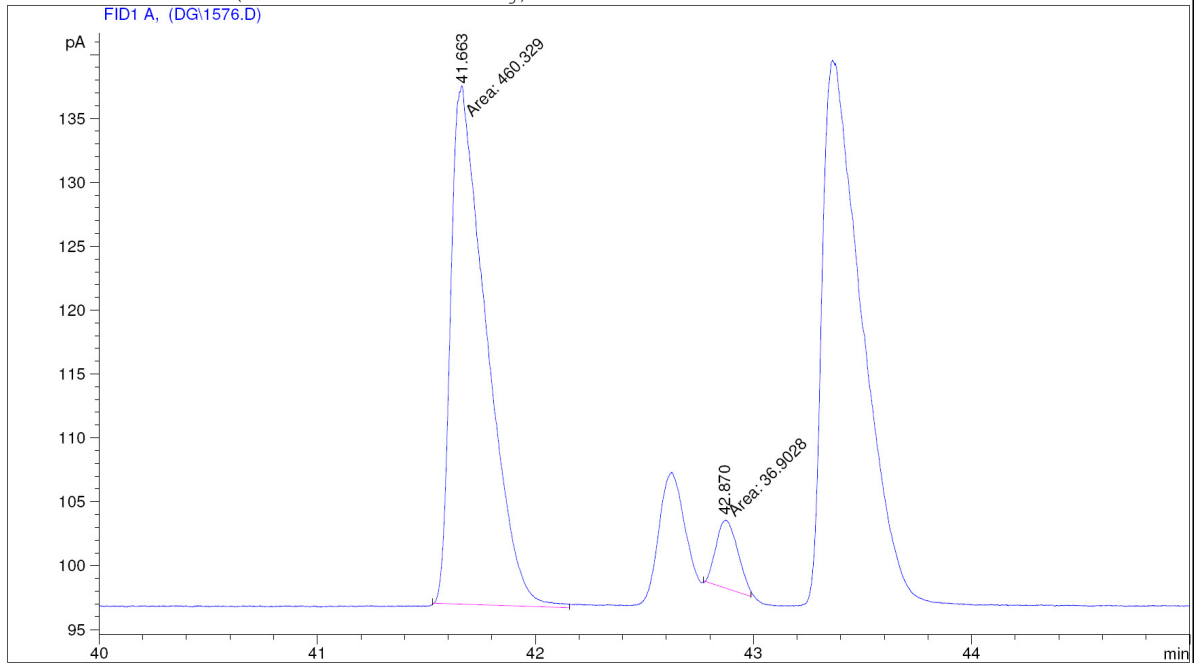
```

=====
Injection Date   : 03-Jan-14 5:26:59 PM
Sample Name     : 1576
Acq. Operator   : dg
Location        : Vial 1
Inj             : 1
Inj Volume     : 1 µl

Acq. Method     : C:\HPCHEM\1\METHODS\60-1-115.M
Last changed    : 03-Jan-14 4:04:33 PM by dg
                  (modified after loading)

Analysis Method : C:\HPCHEM\1\METHODS\60-1.M
Last changed    : 17-Jan-14 4:07:30 PM by pg
                  (modified after loading)
=====

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=====
Area Percent Report
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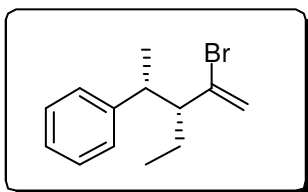
```

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

```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	41.663	MM	0.1890	460.32925	40.58437	92.57835
2	42.870	MM	0.1157	36.90282	5.31766	7.42165



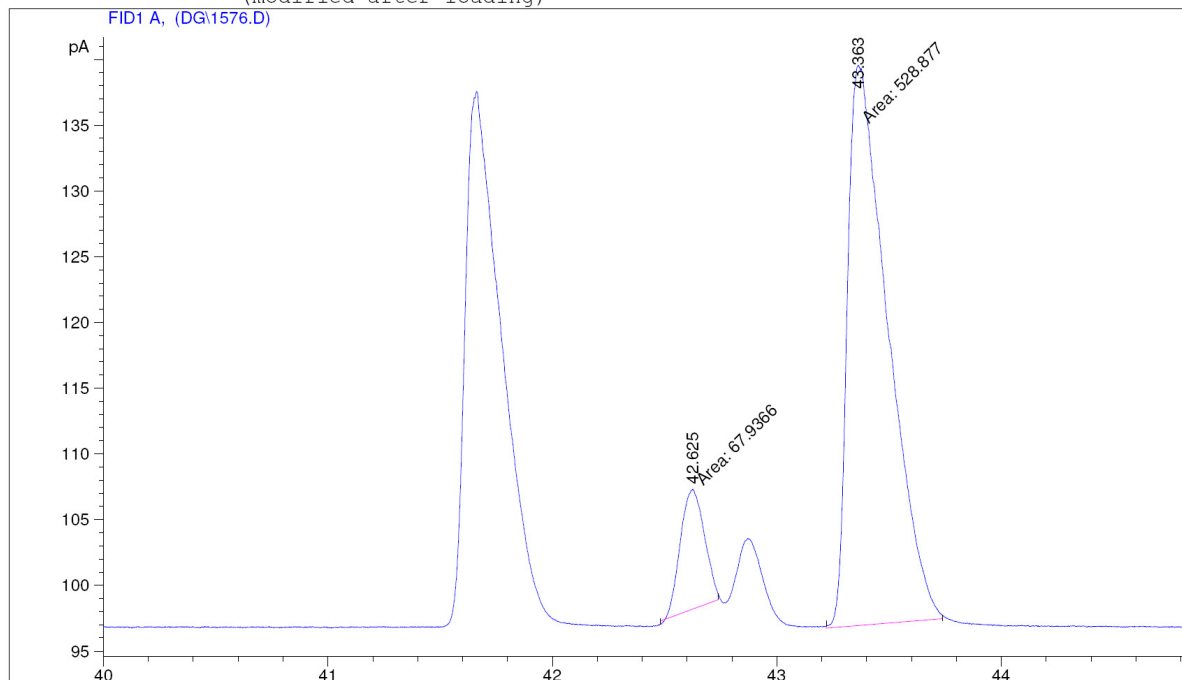
```

=====
Injection Date   : 03-Jan-14 5:26:59 PM
Sample Name     : 1576
Acq. Operator   : dg
Location       : Vial 1
Inj            : 1
Inj Volume     : 1 µl

Acq. Method    : C:\HPCHEM\1\METHODS\60-1-115.M
Last changed   : 03-Jan-14 4:04:33 PM by dg
                (modified after loading)

Analysis Method : C:\HPCHEM\1\METHODS\60-1.M
Last changed   : 17-Jan-14 4:07:30 PM by pg
                (modified after loading)
=====

```



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

```

```

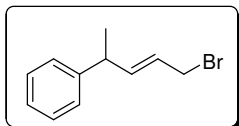
Sorted By      : Signal
Multiplier    : 1.0000
Dilution      : 1.0000
Use Multiplier & Dilution Factor with ISTDs

```

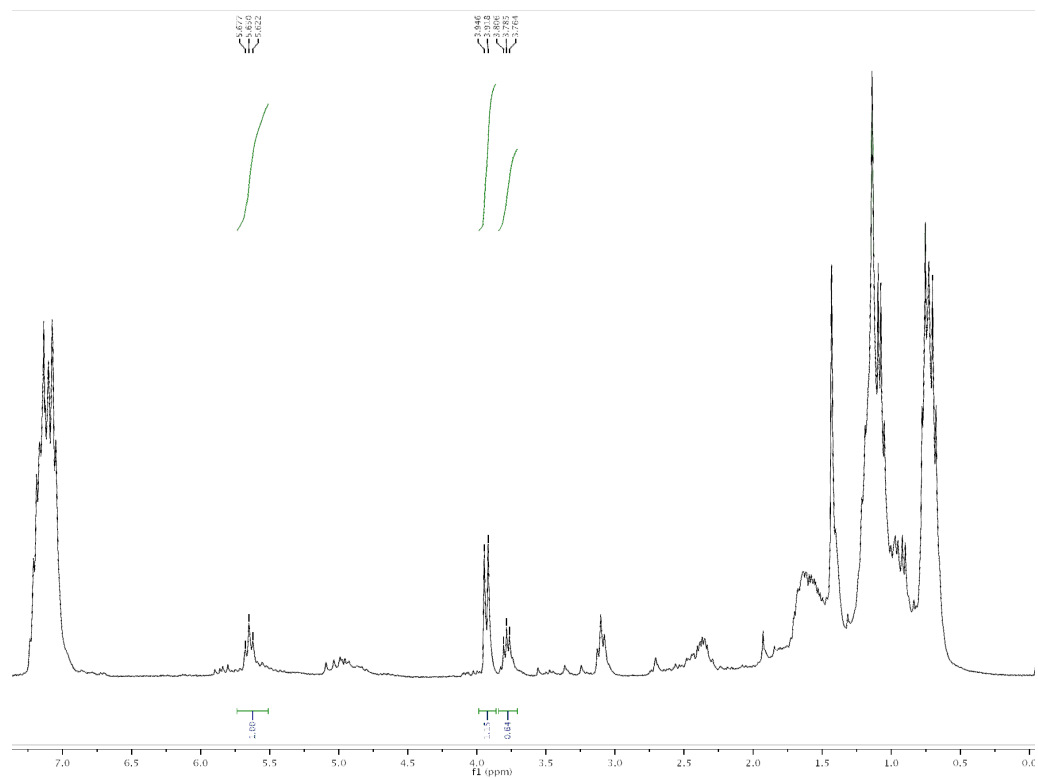
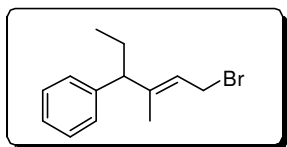
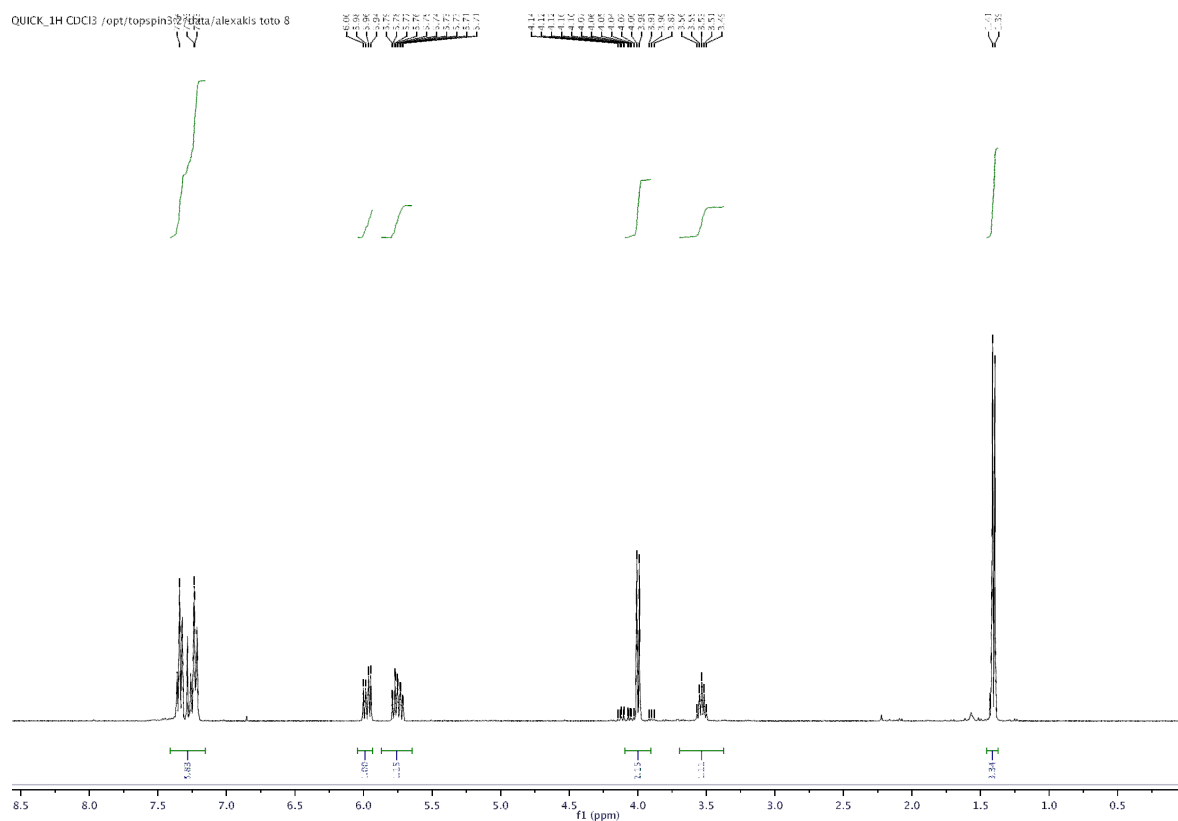
Signal 1: FID1 A,

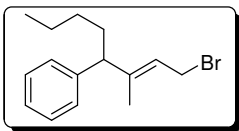
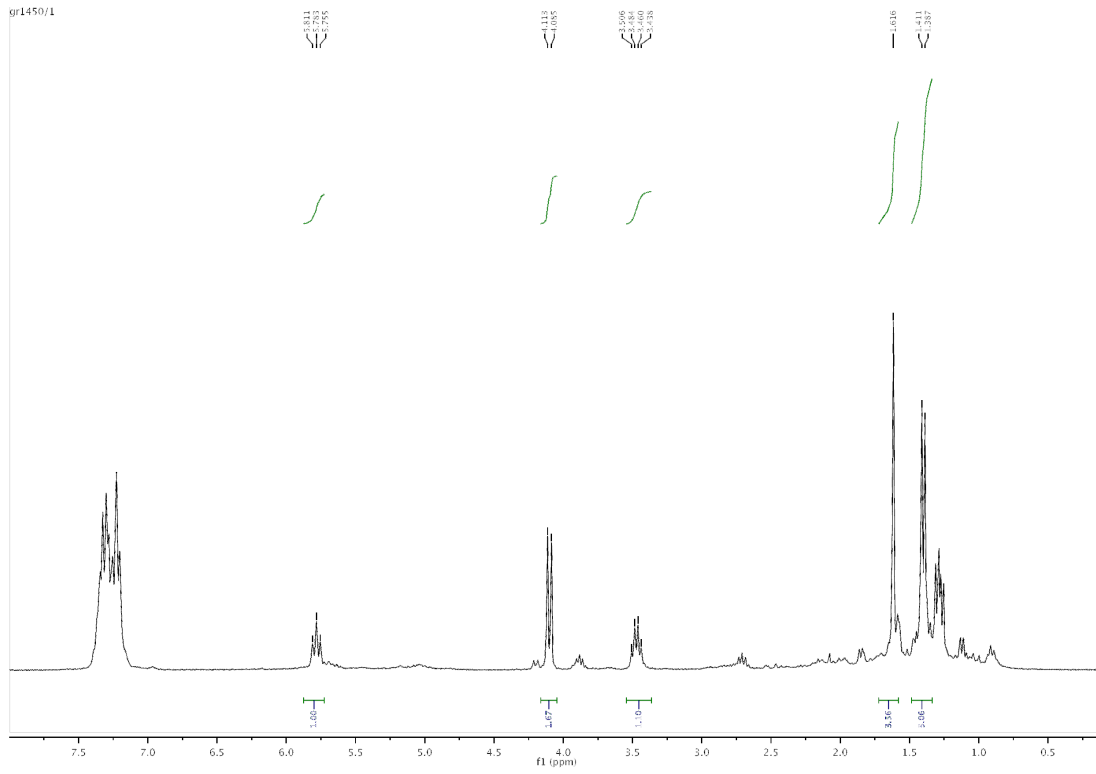
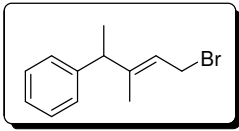
Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Height [pA]	Area %
1	42.625	MM	0.1238	67.93656	9.14555	11.38321
2	43.363	MM	0.2068	528.87720	42.61638	88.61679

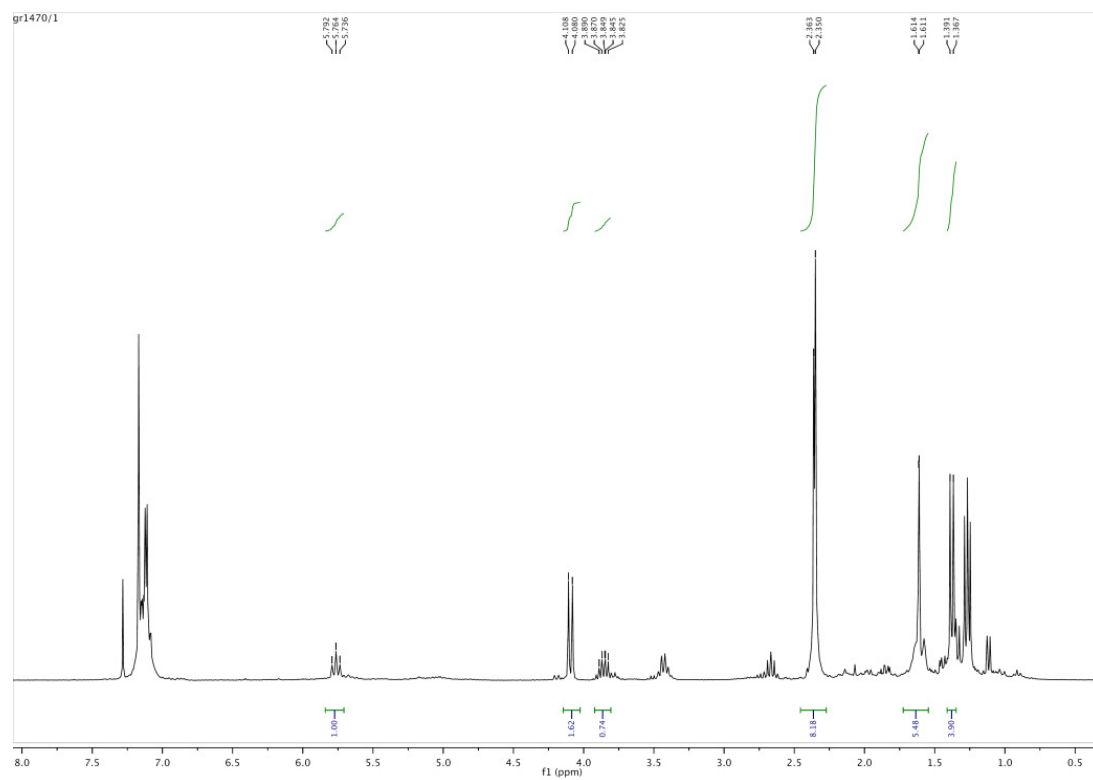
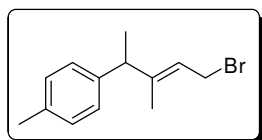
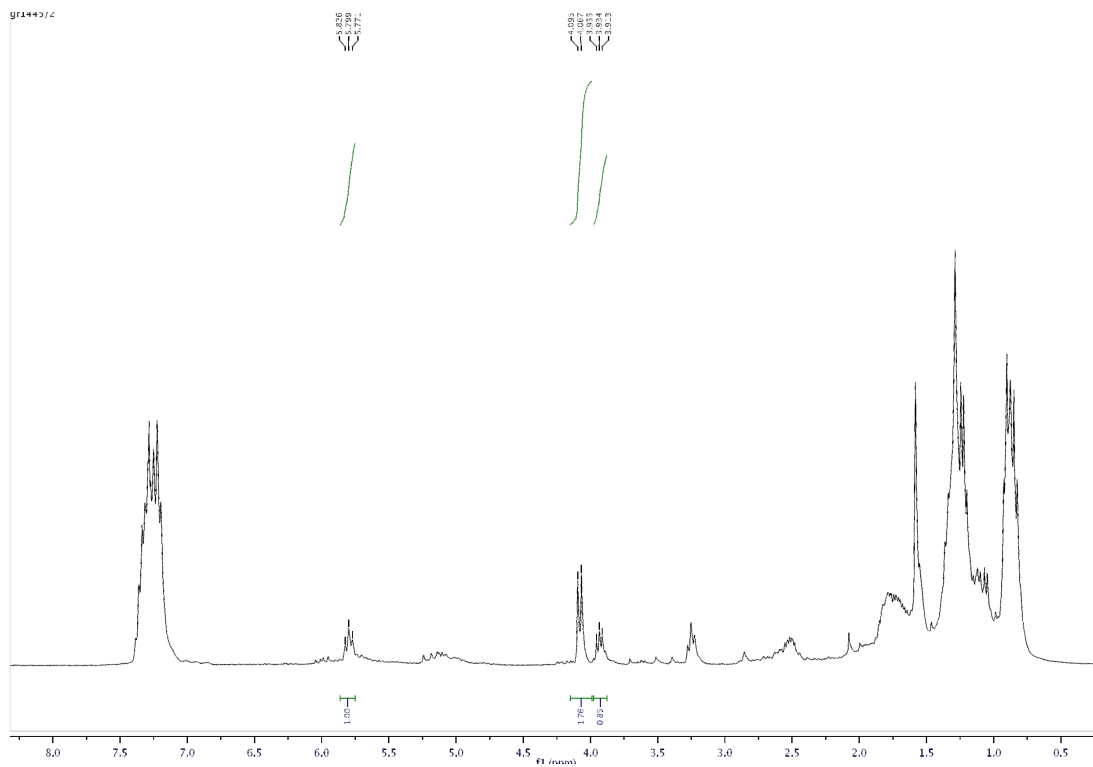
```
Totals :                      596.81376  51.76193
```

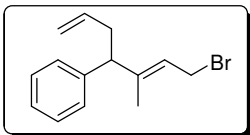
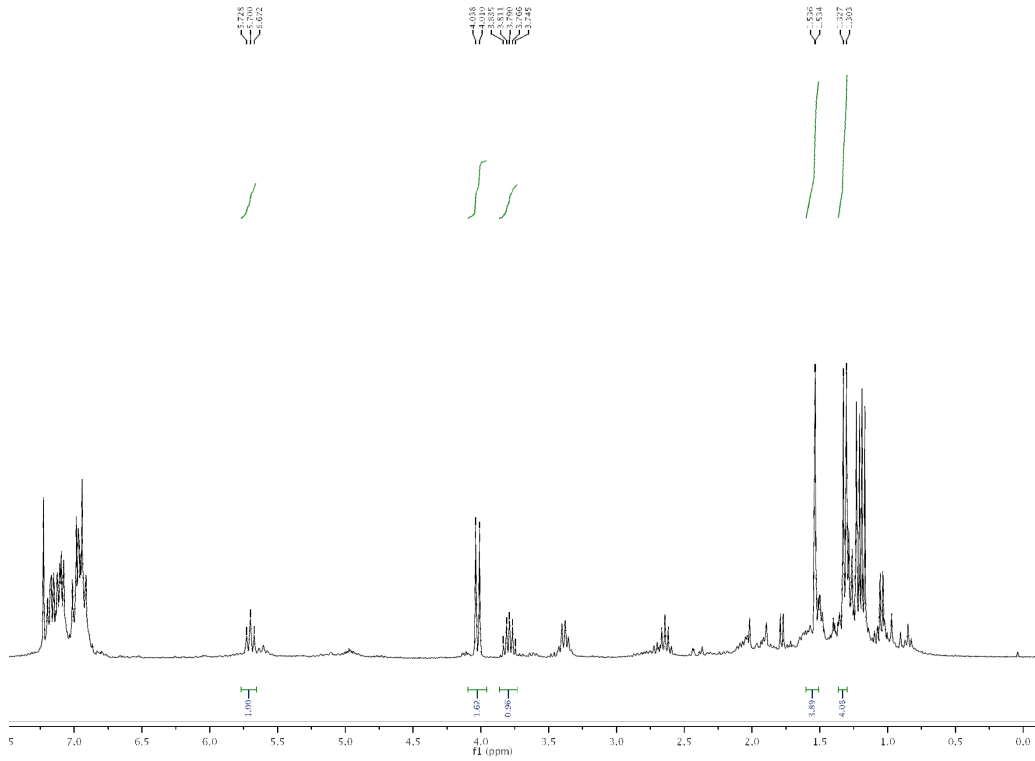
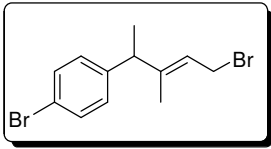


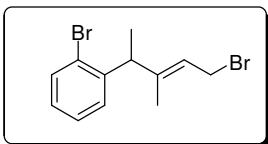
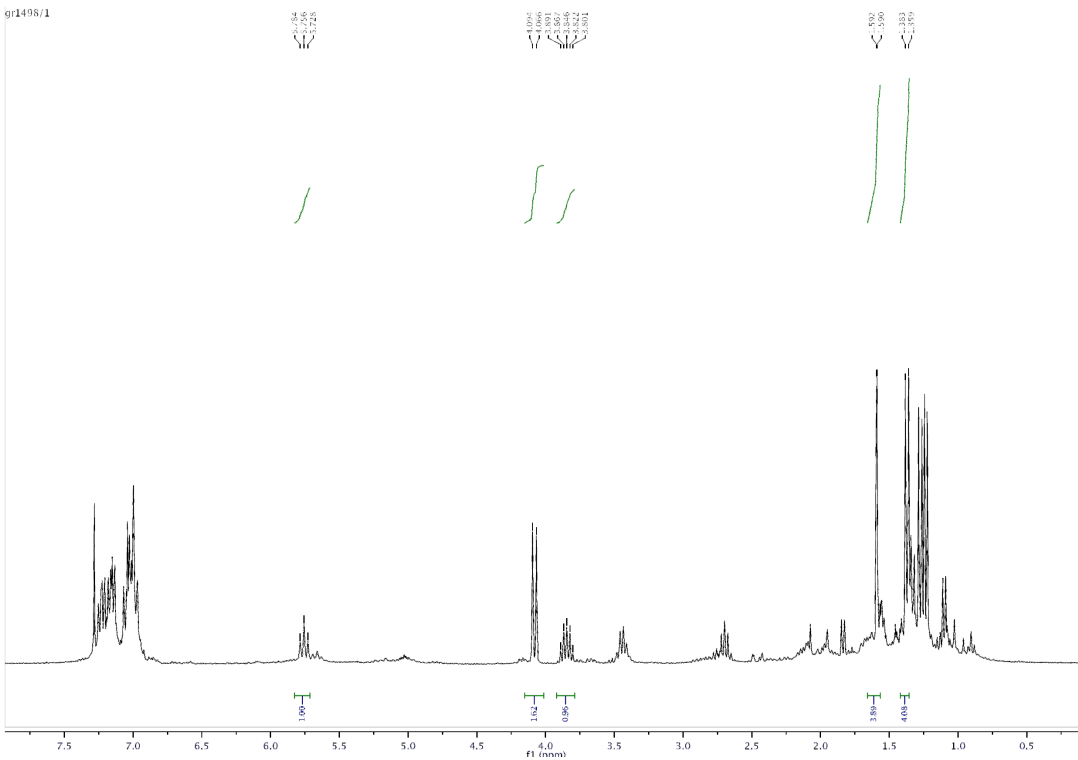
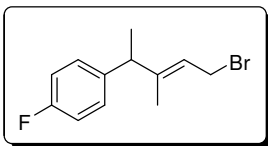
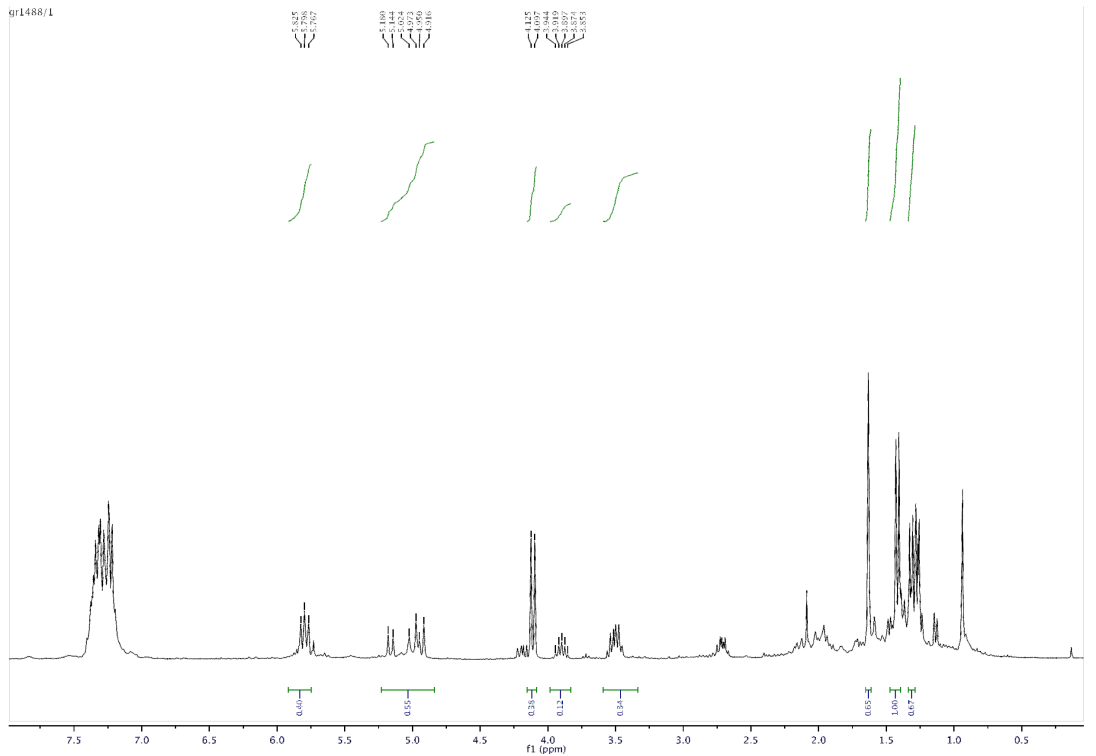
QUICK_1H CDCl3 /opt/topspin3.2\data/alexakis toto 8

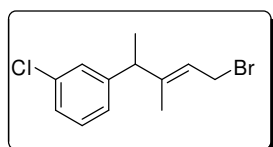
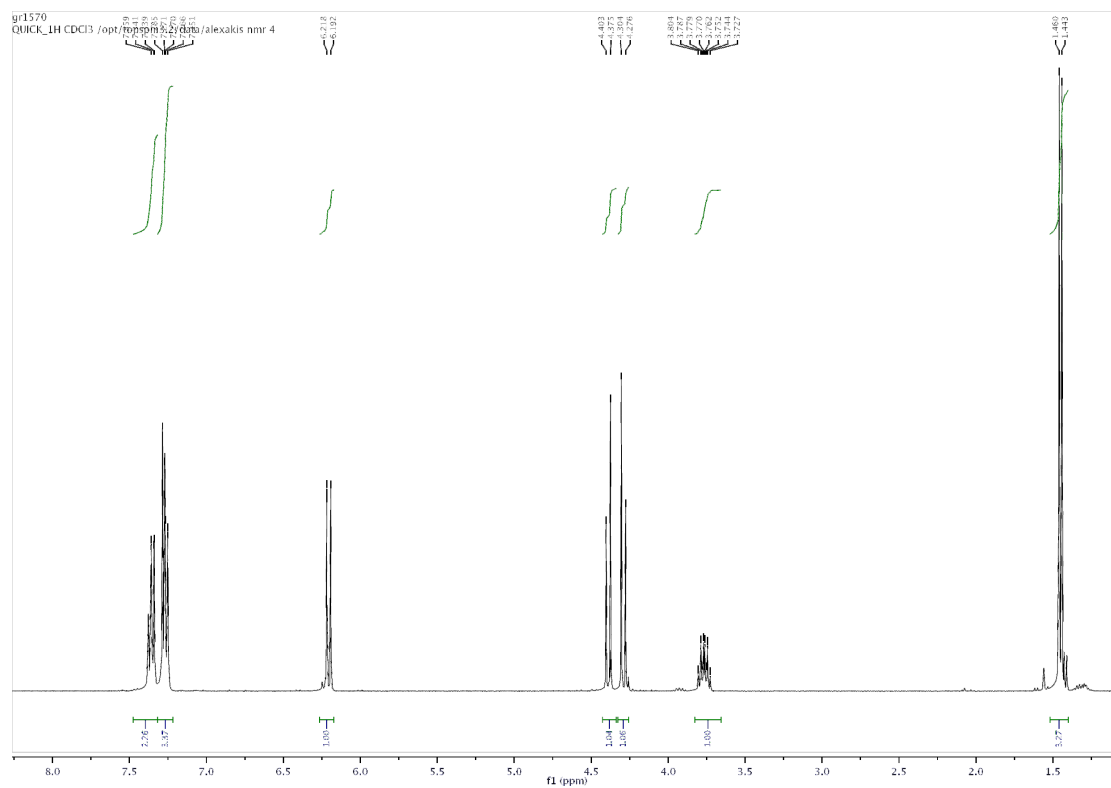
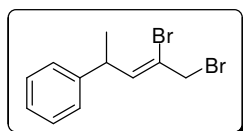
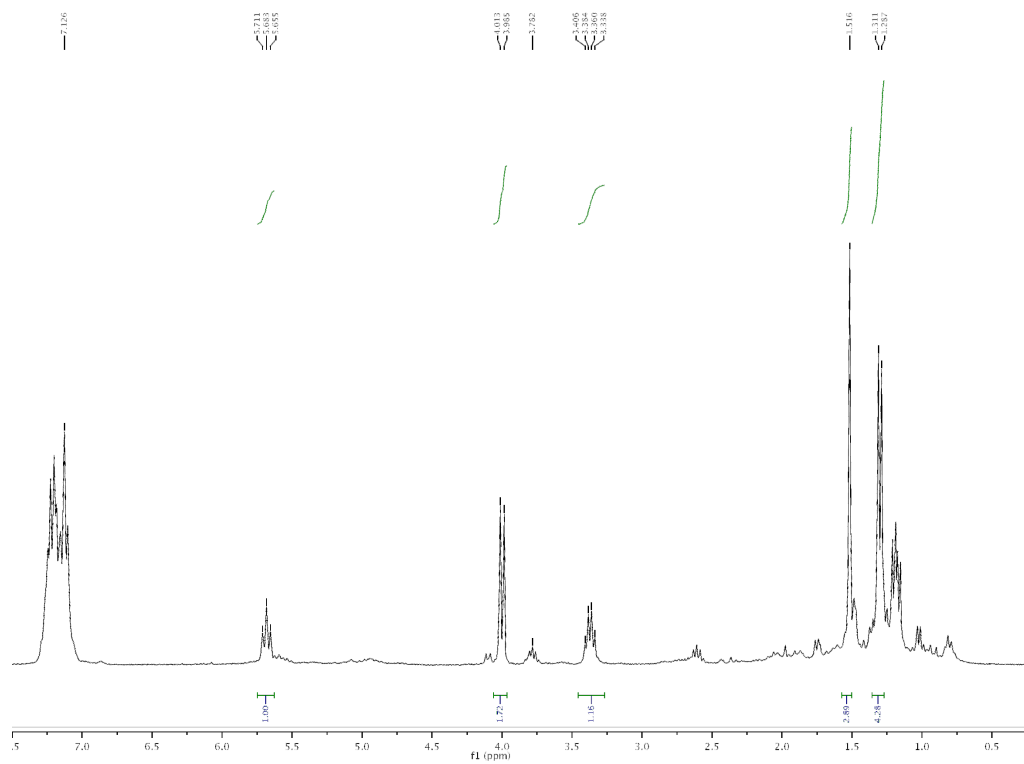


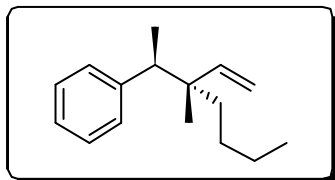
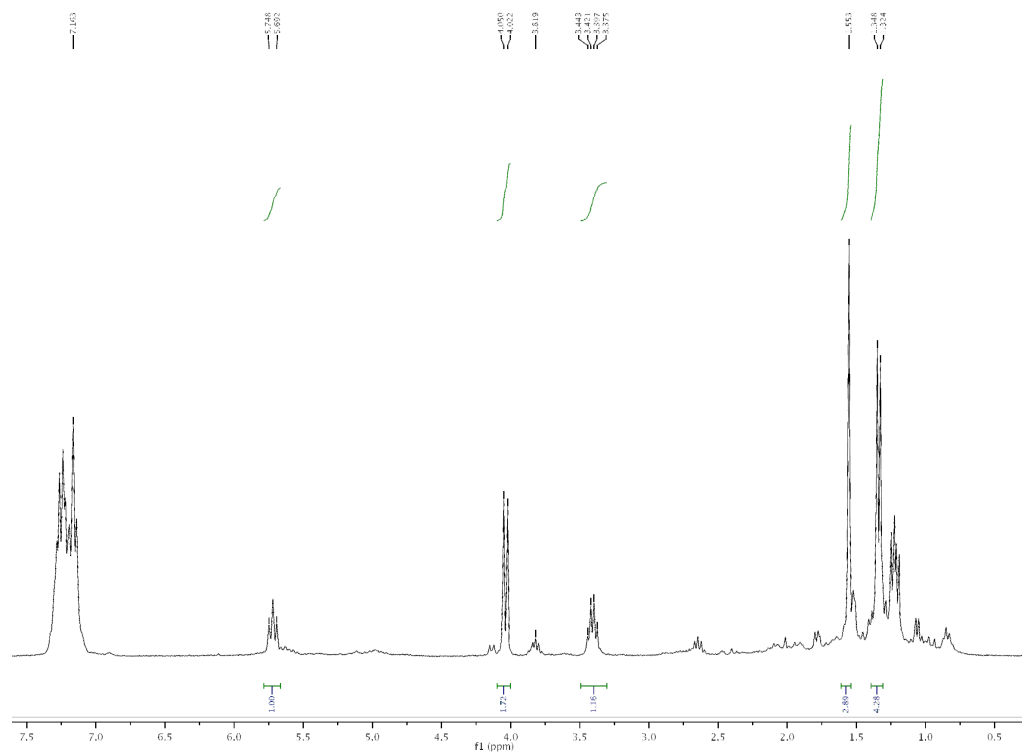




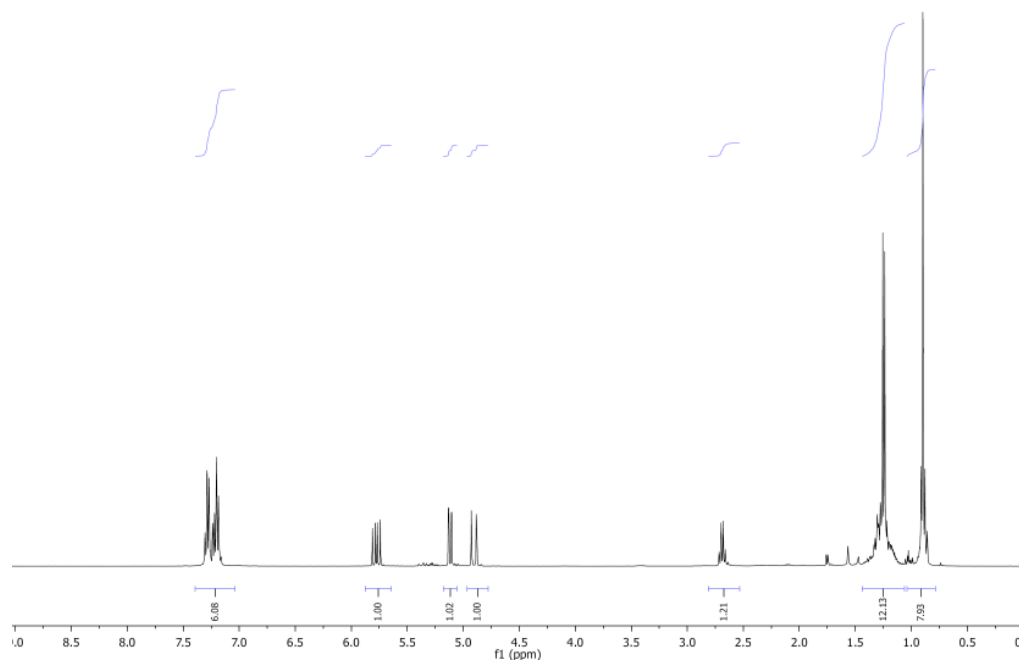




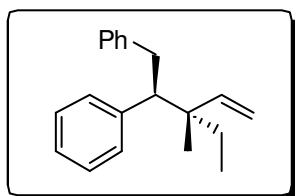
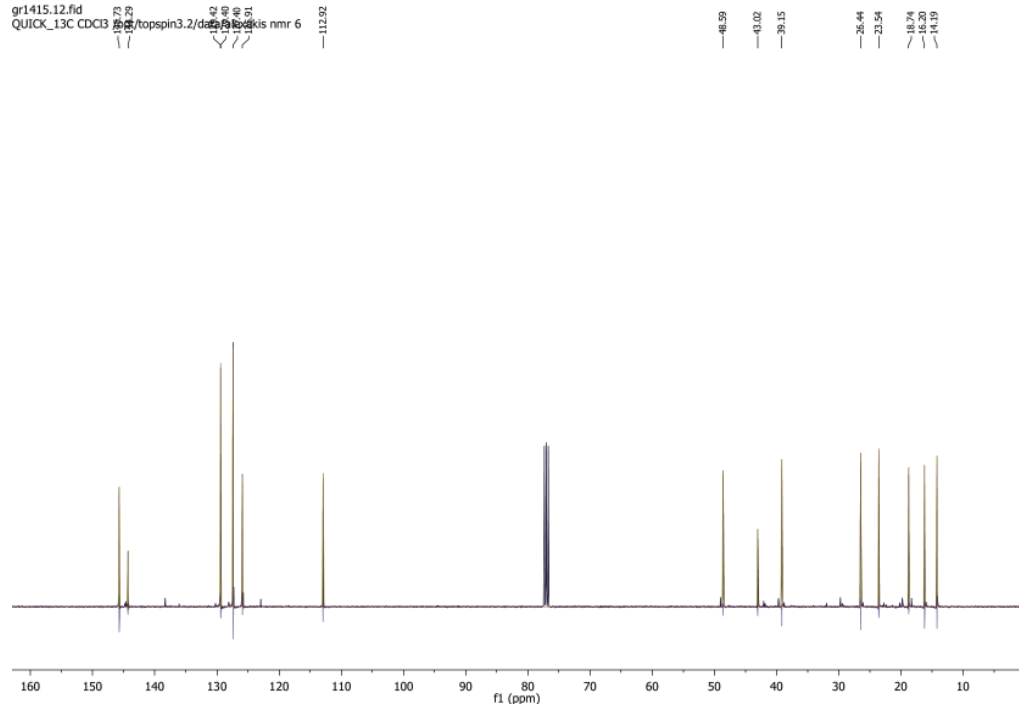




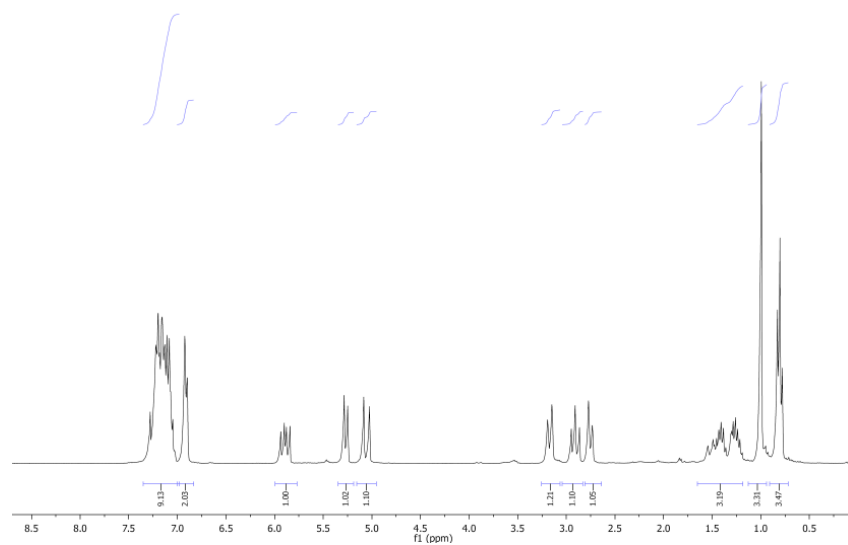
gr1415.11.fid
QUICK_1H CDC13 /opt/topspin3.2/data/alexakis nmr 6



gr1415.12.fid
QUICK_13C CDC13 /opt/topspin3.2/data/alexakis nmr 6



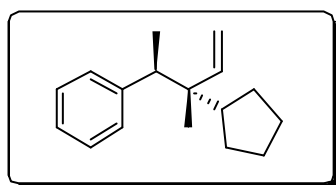
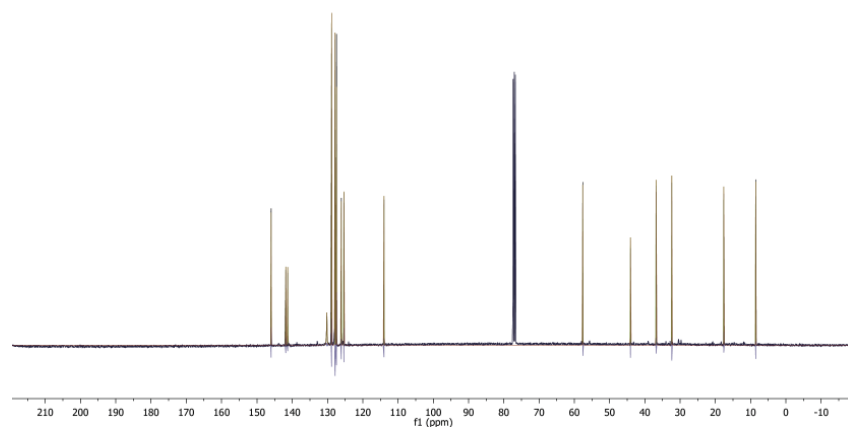
gr1421.2.fid



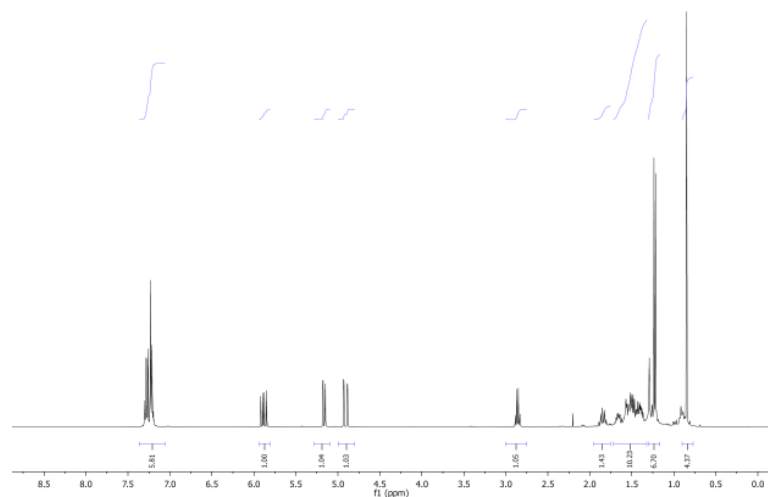
gr1421f2.111.fid
QUICK_13C CDCl3 /opt/topspin3.2/data/alexakis nmr 6

146.07
141.81
141.26
130.77
129.82
127.93
125.34
113.96

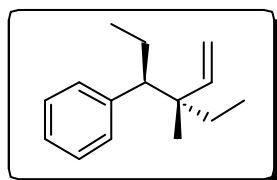
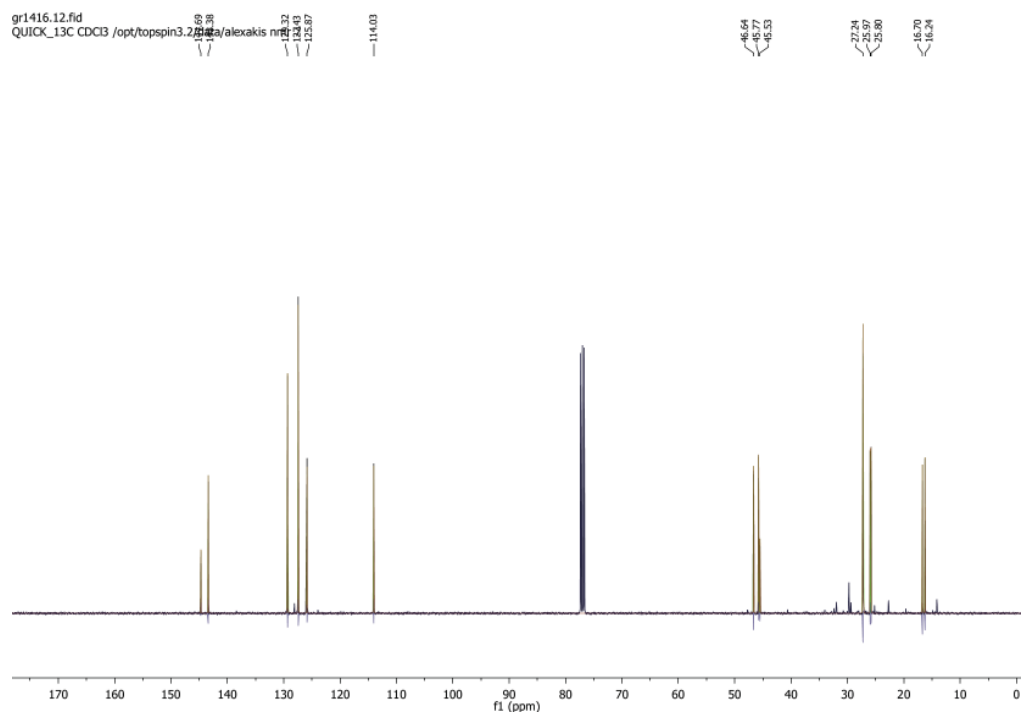
57.61
44.10
36.62
32.38
17.64
8.57



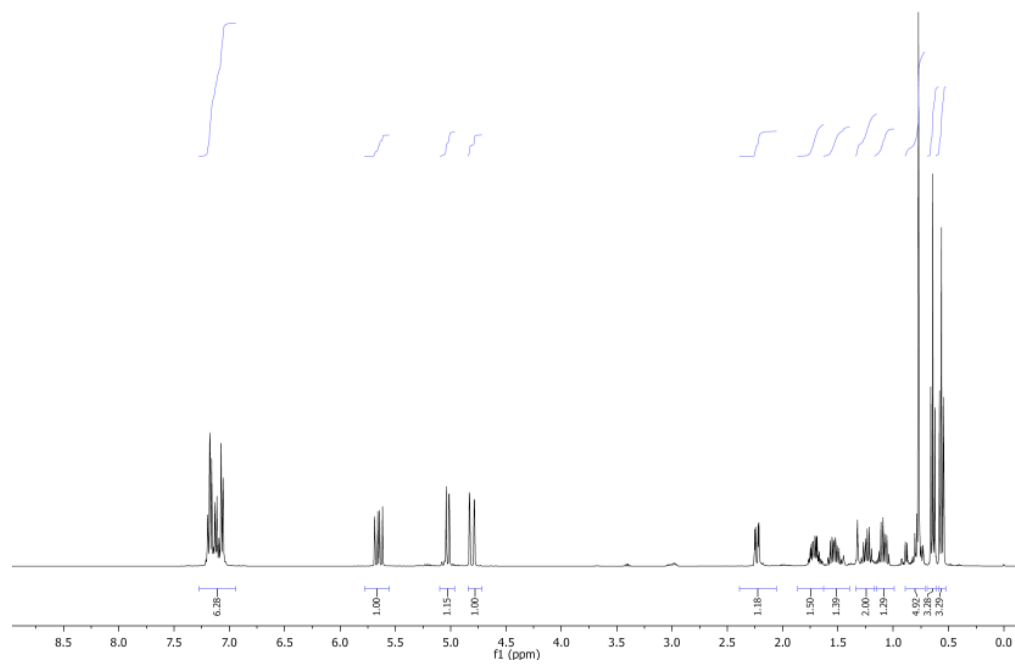
gr1416.13.fid
PROTON CDCl3 /opt/topspin3.2/data/alexakis nmr 7



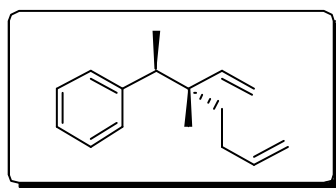
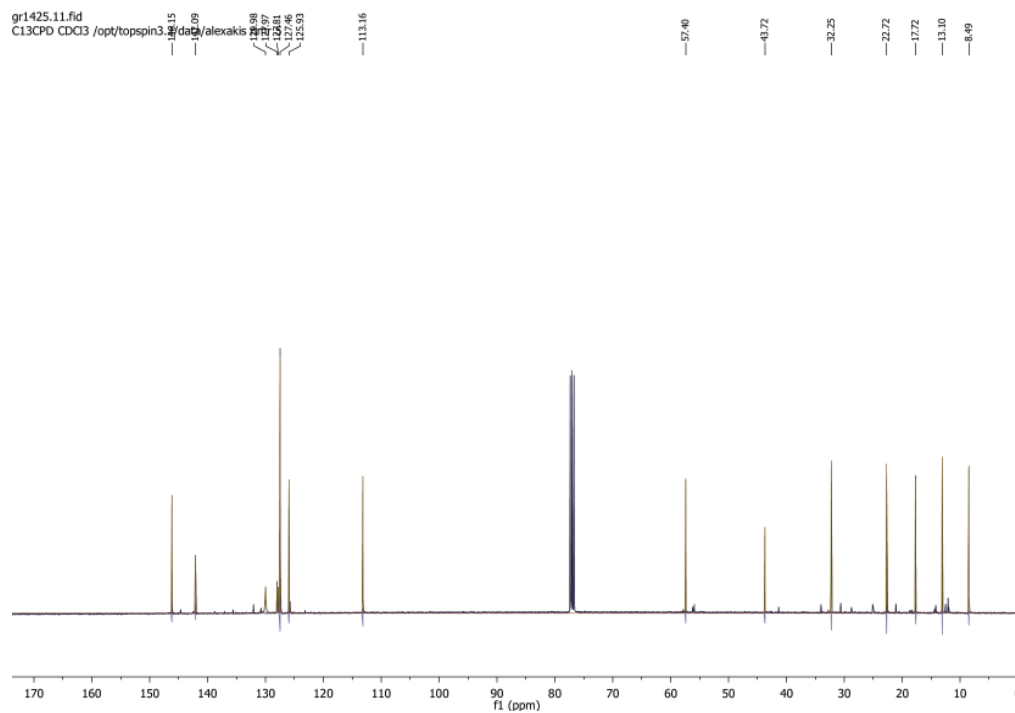
gr1416.12.fid
QUICK_13C CDCl3 /opt/topspin3.2/data/alexakis nmr 7

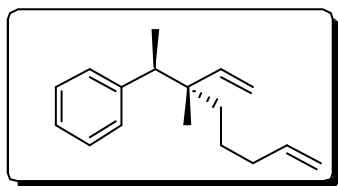
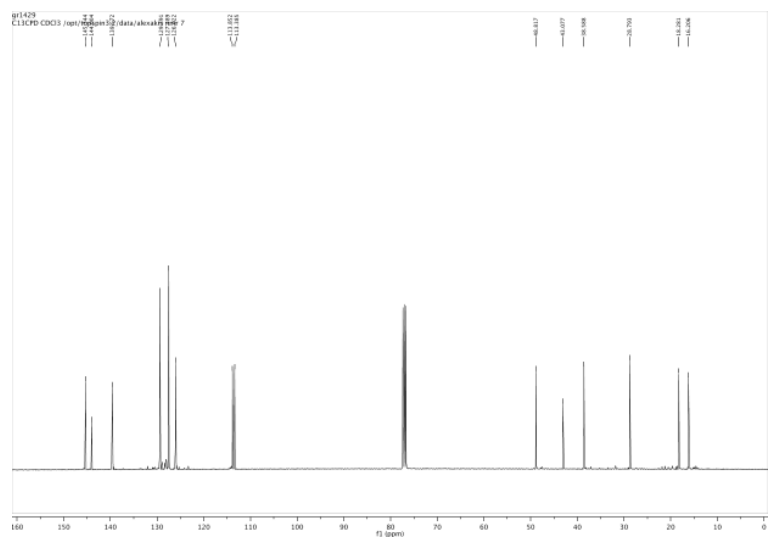
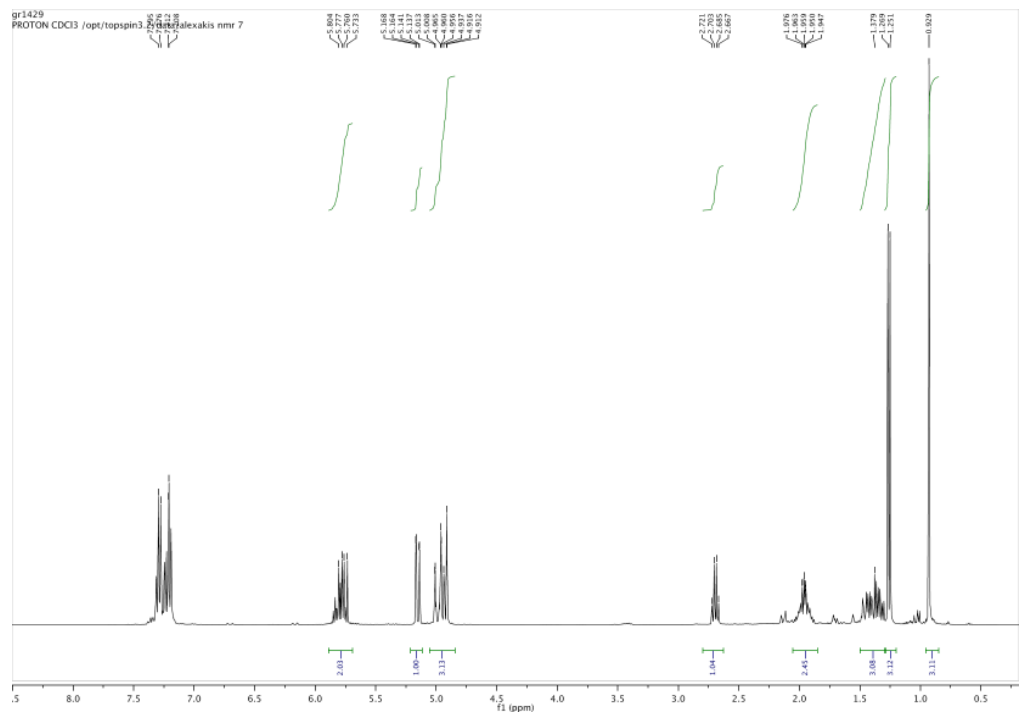


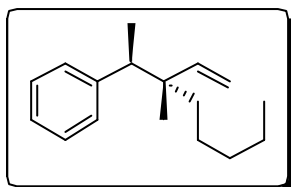
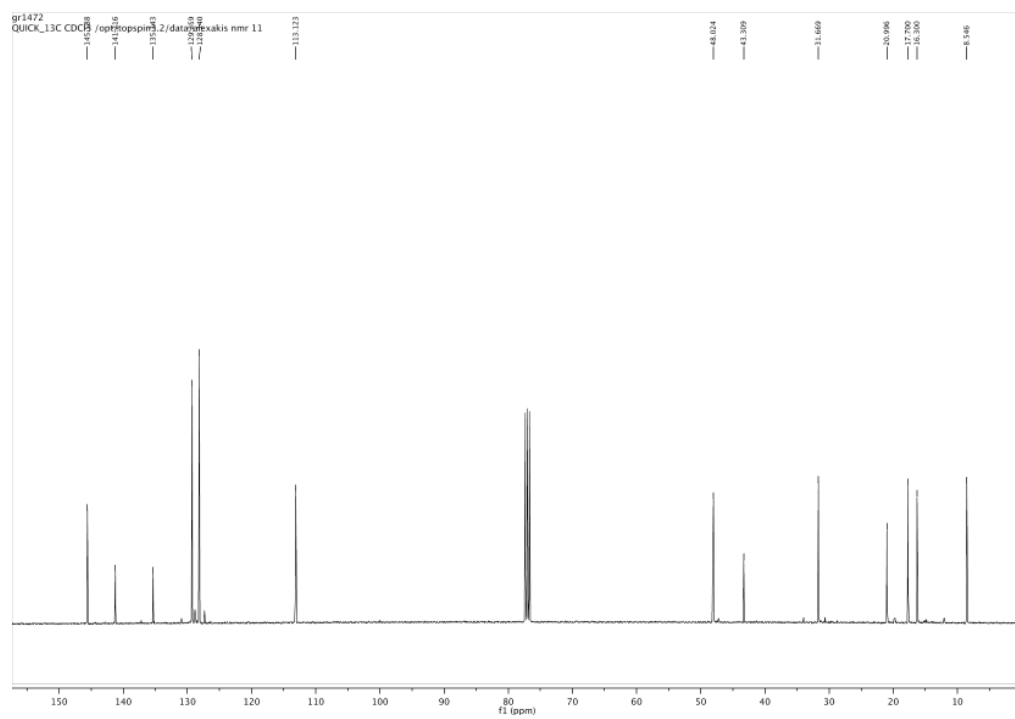
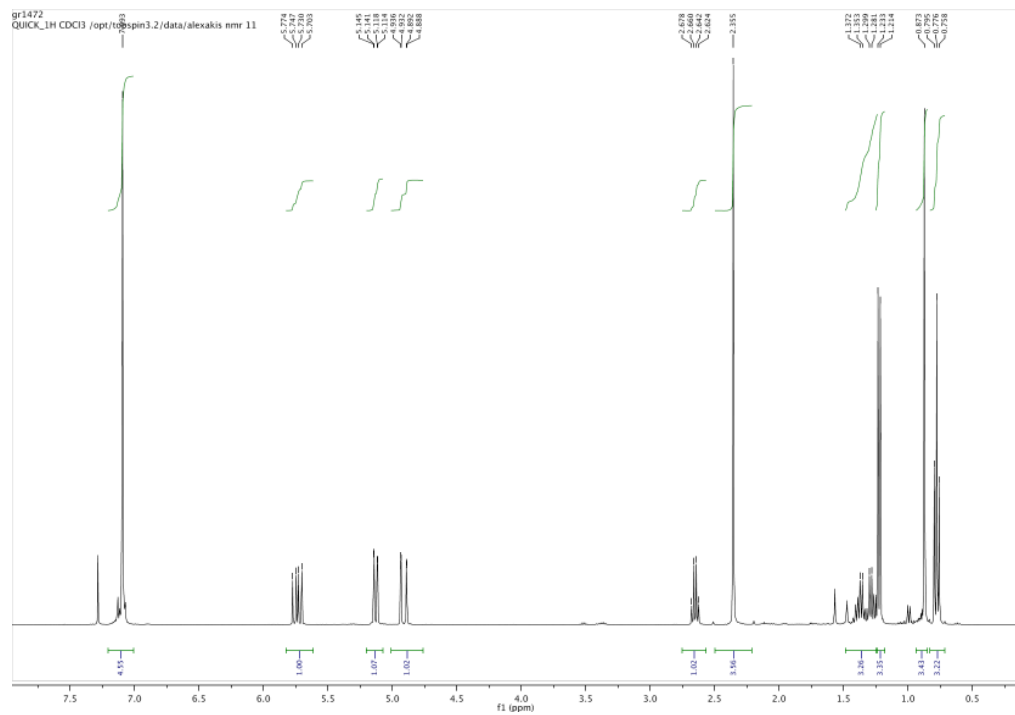
gr1425.10.fid
PROTON CDCl3 /opt/topspin3.2/data/alexakis nmr 5

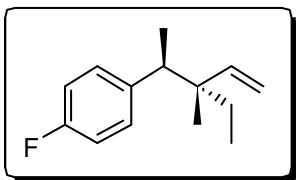
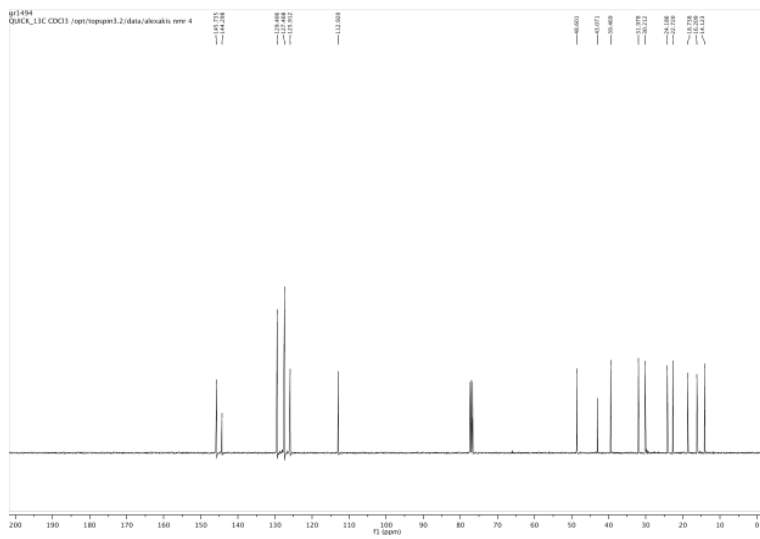
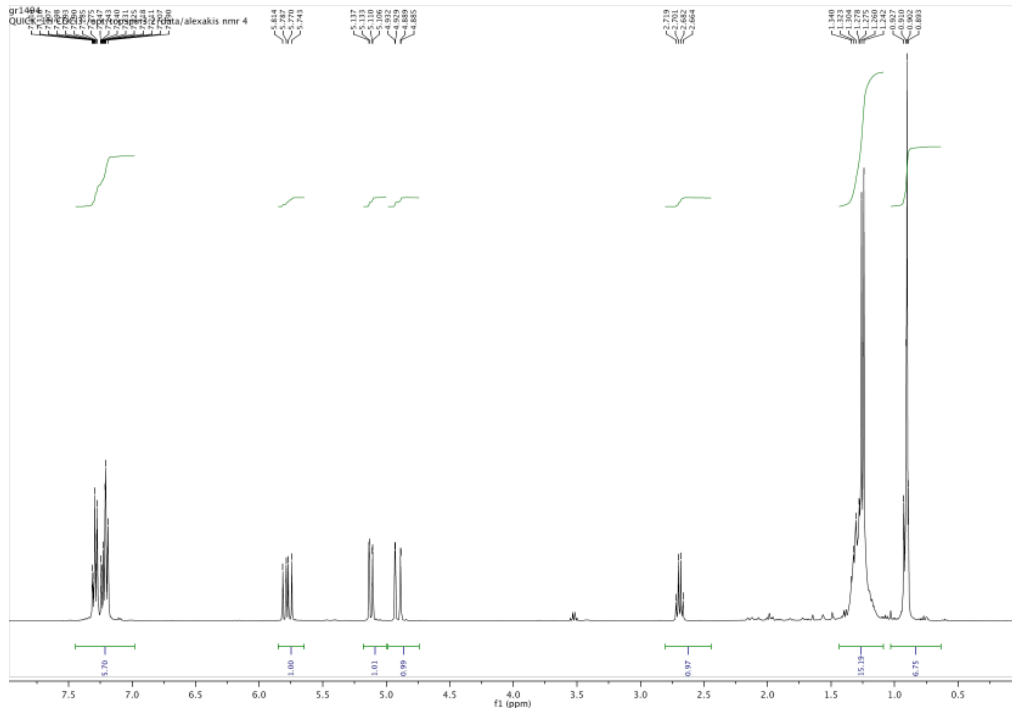


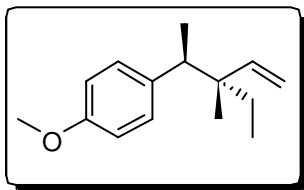
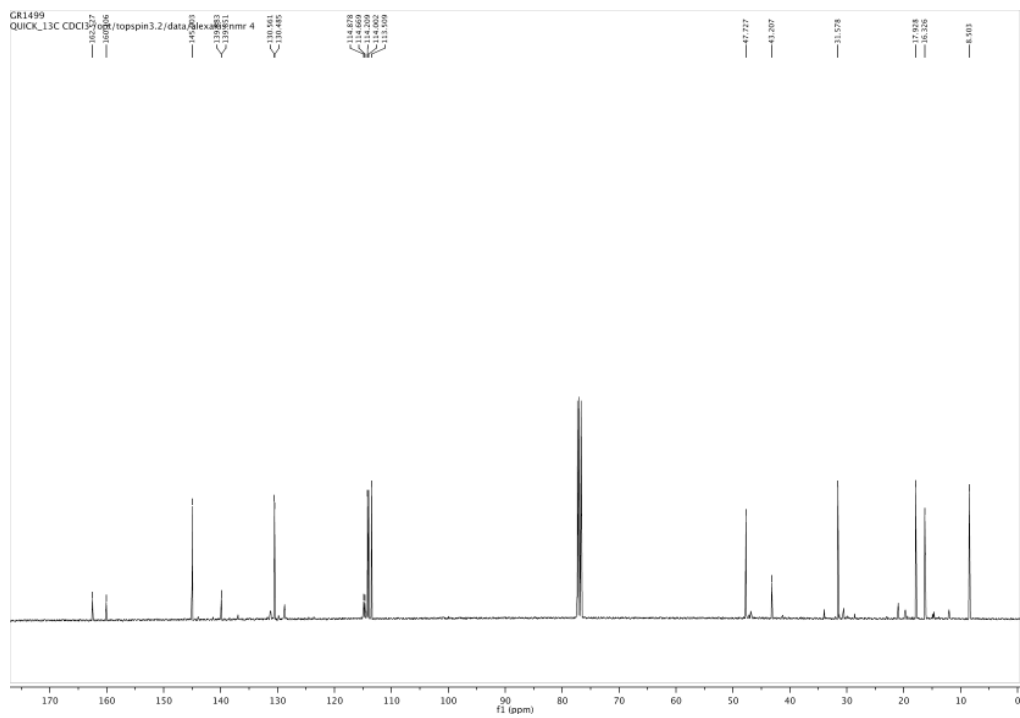
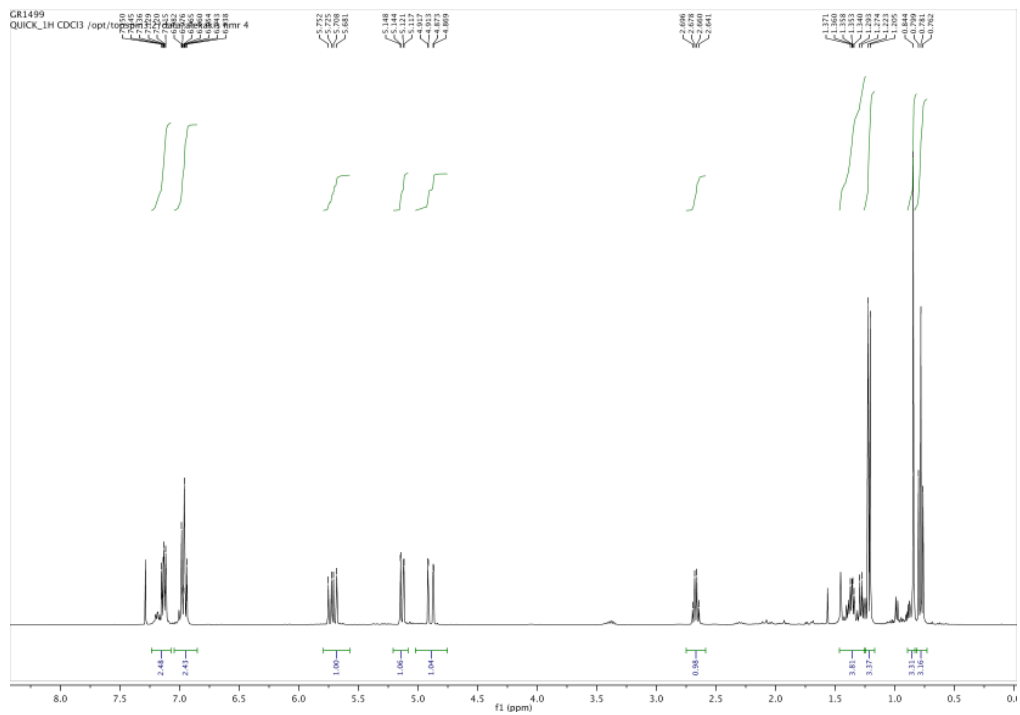
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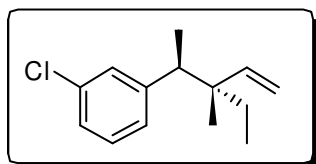
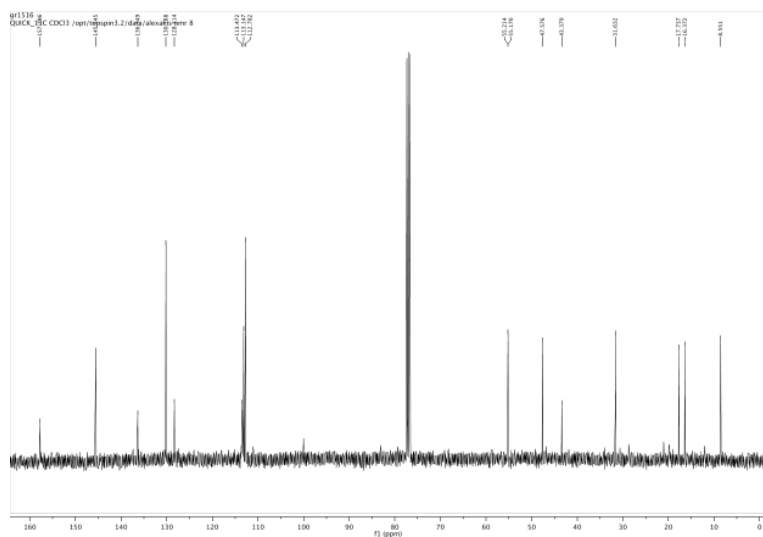
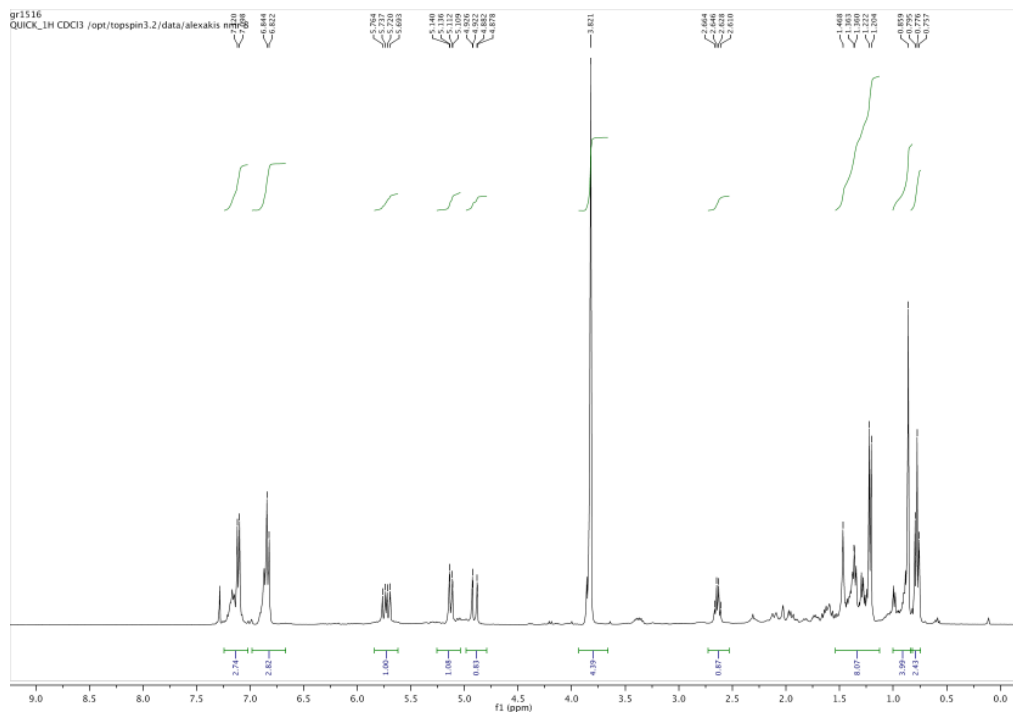


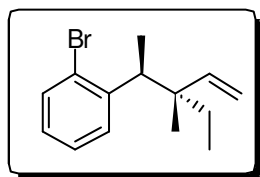
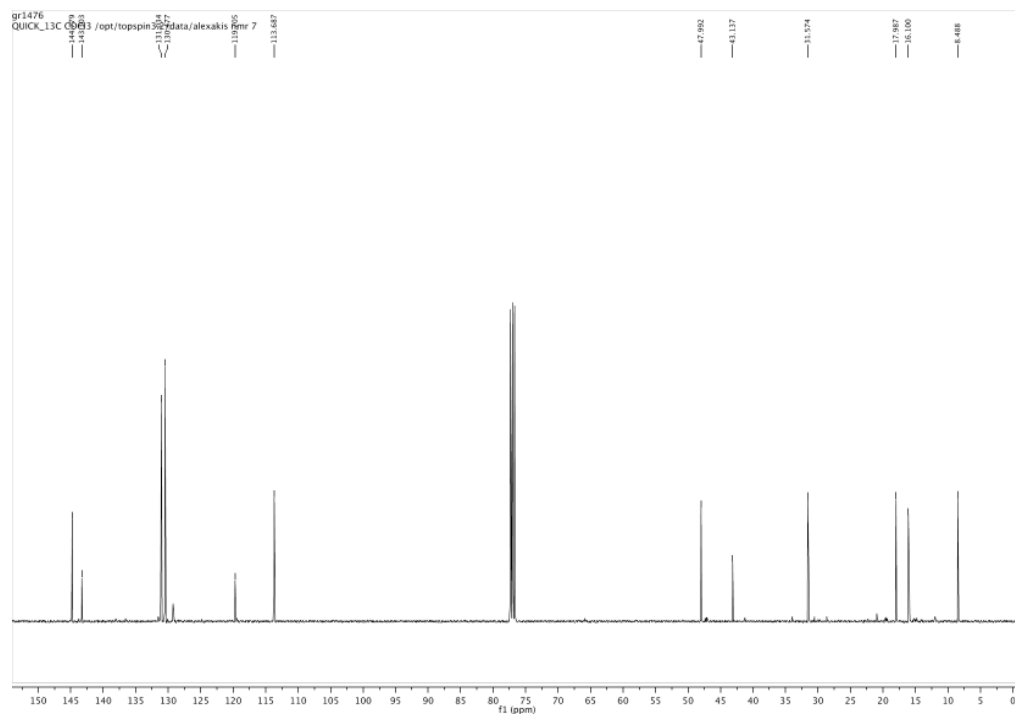
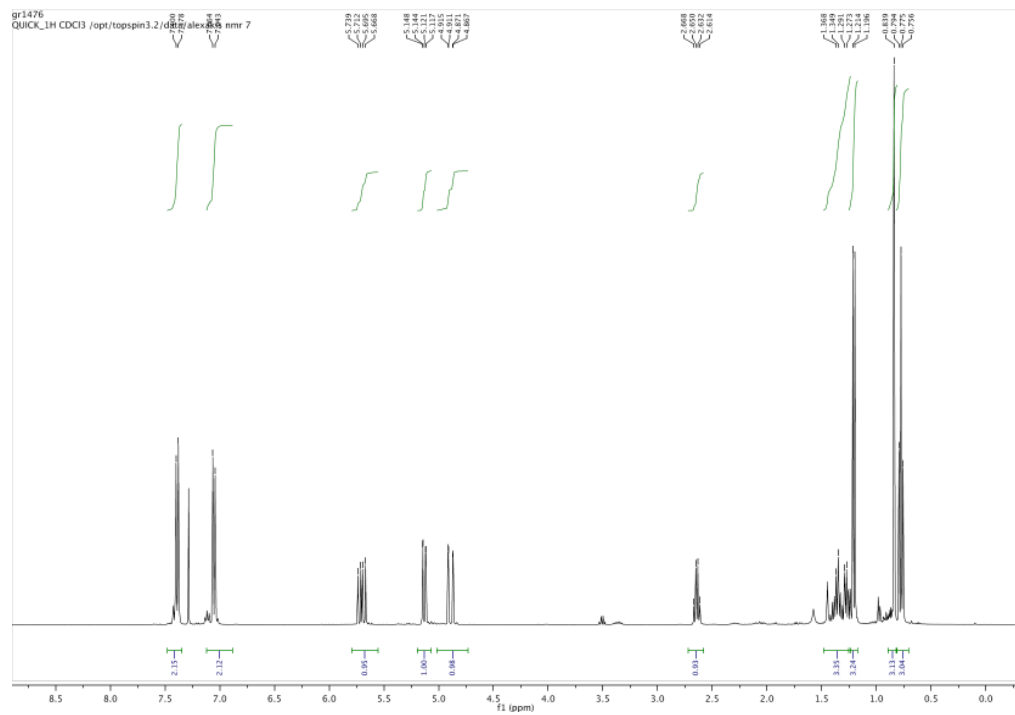


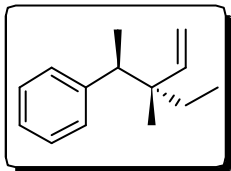
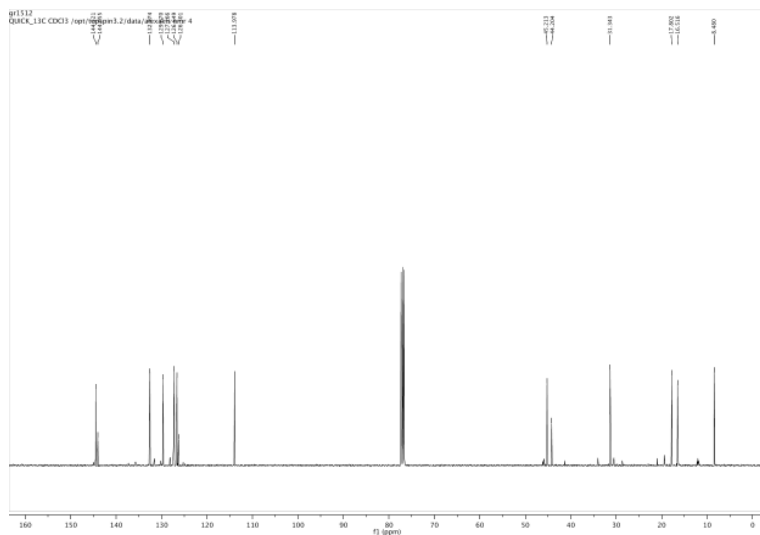
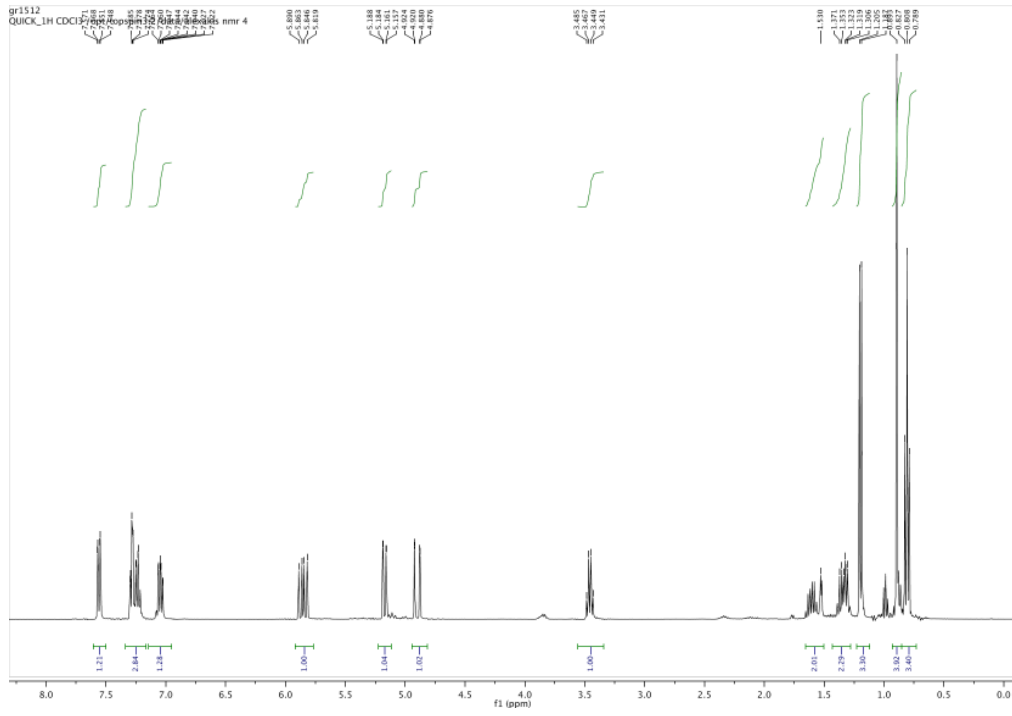


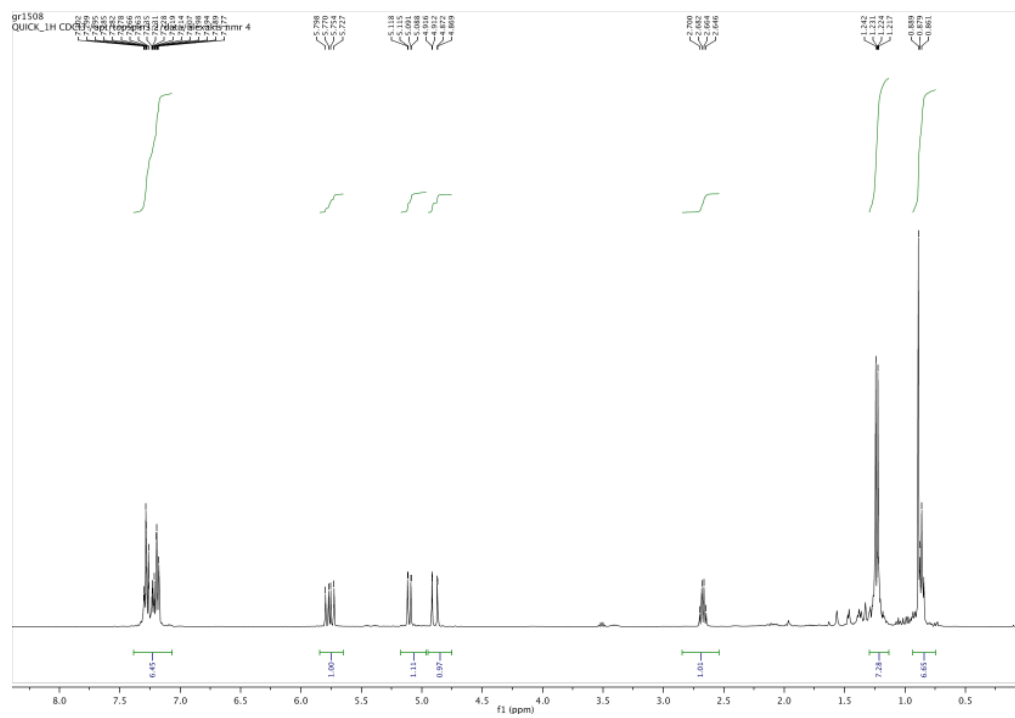
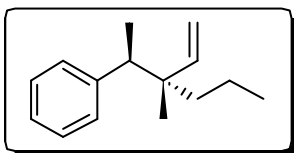
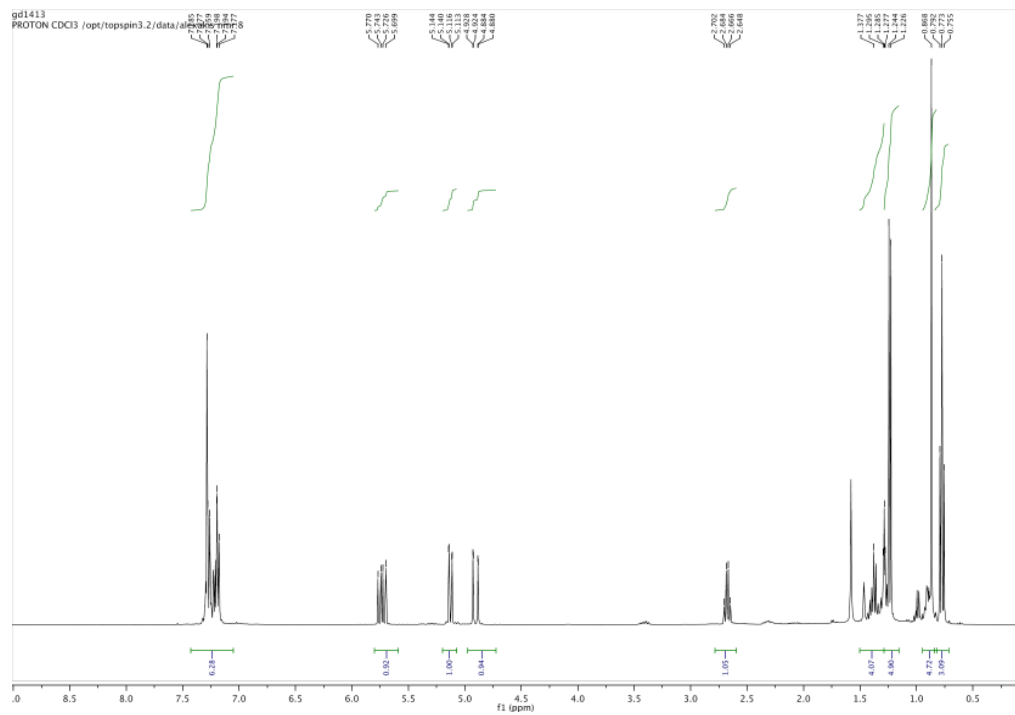


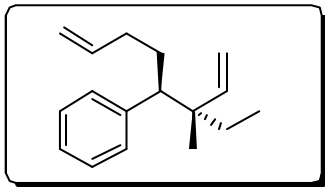
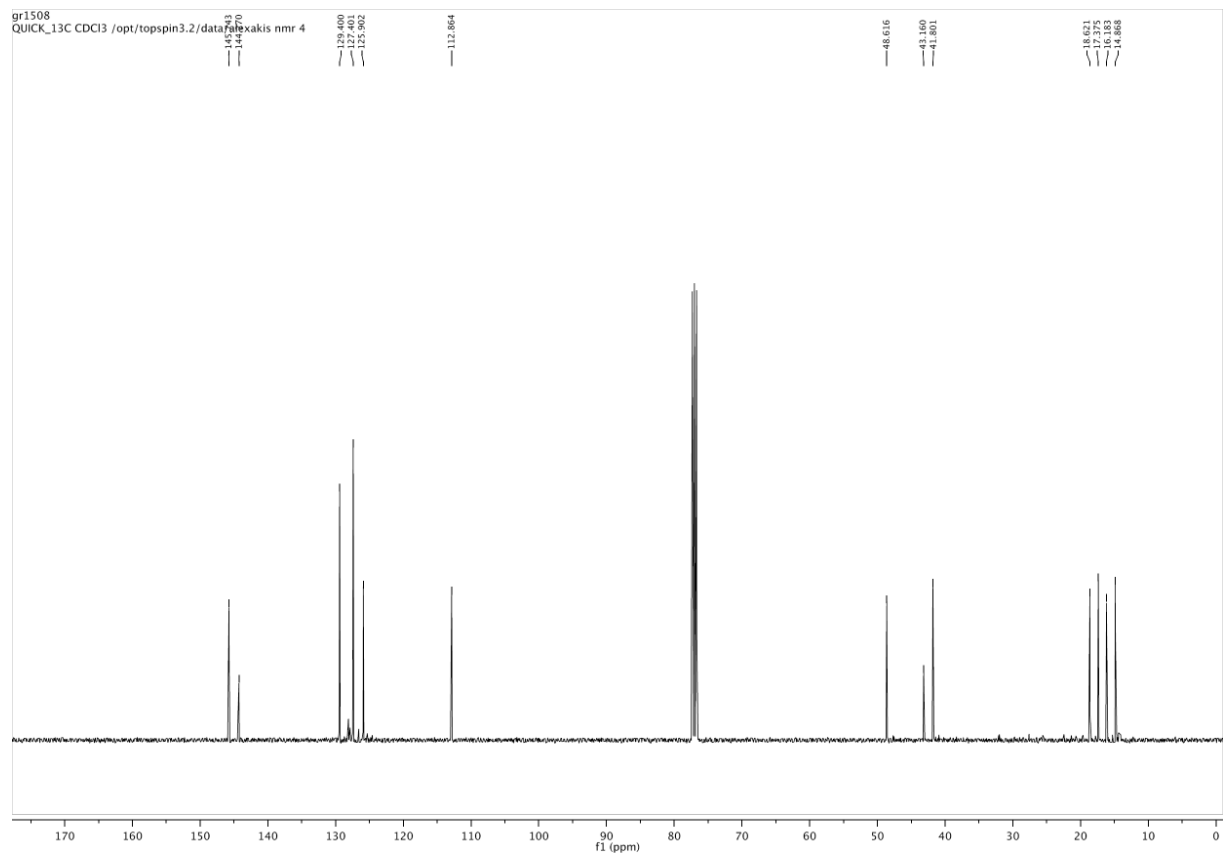


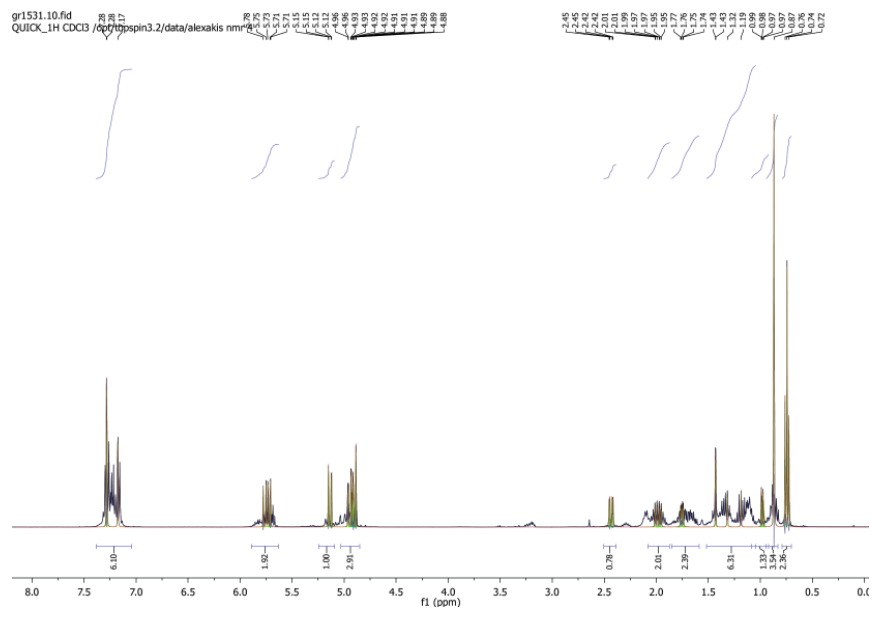






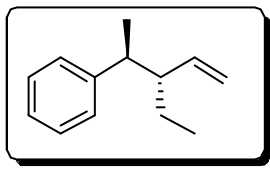
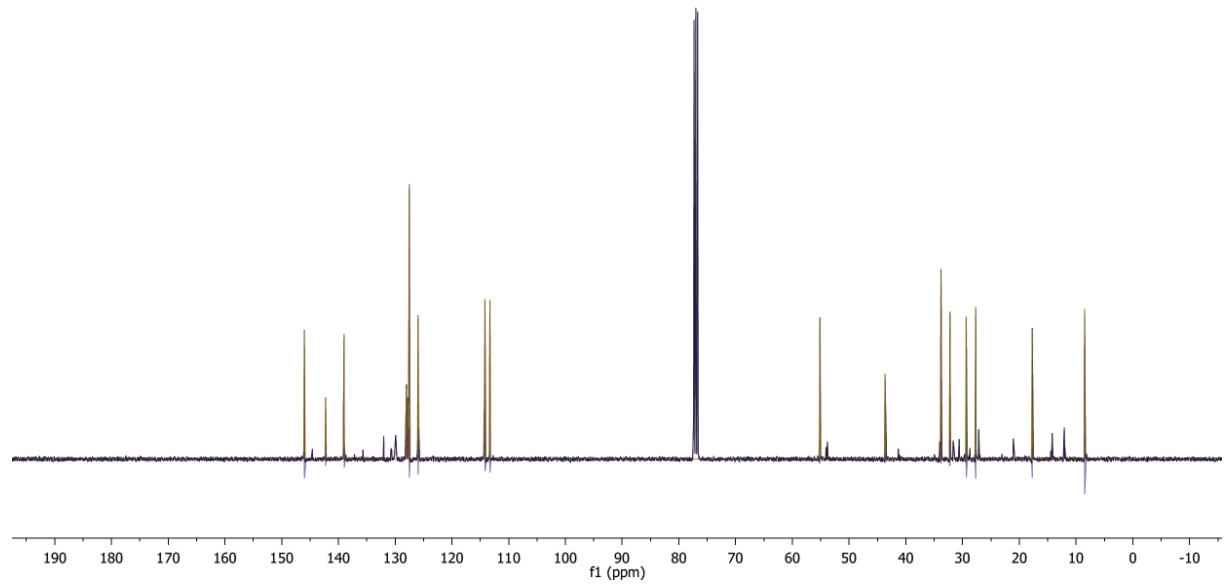




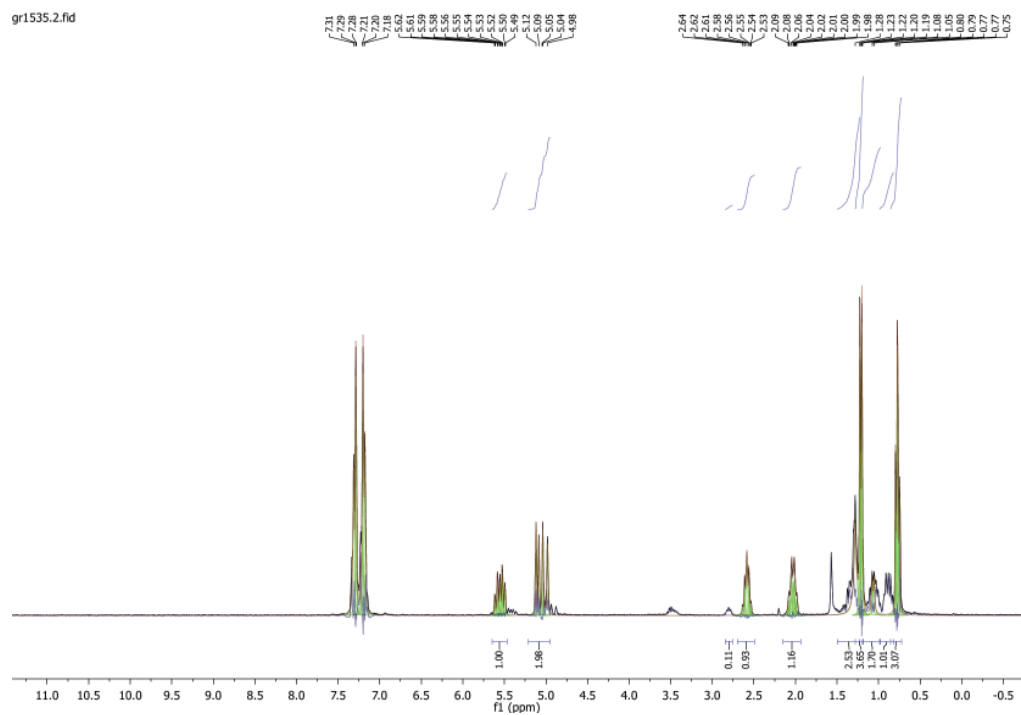


gr1531.11.fid
QUICK_13C CDCl3 /opt/topspin3.2/data/alexakis nmr

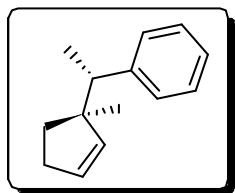
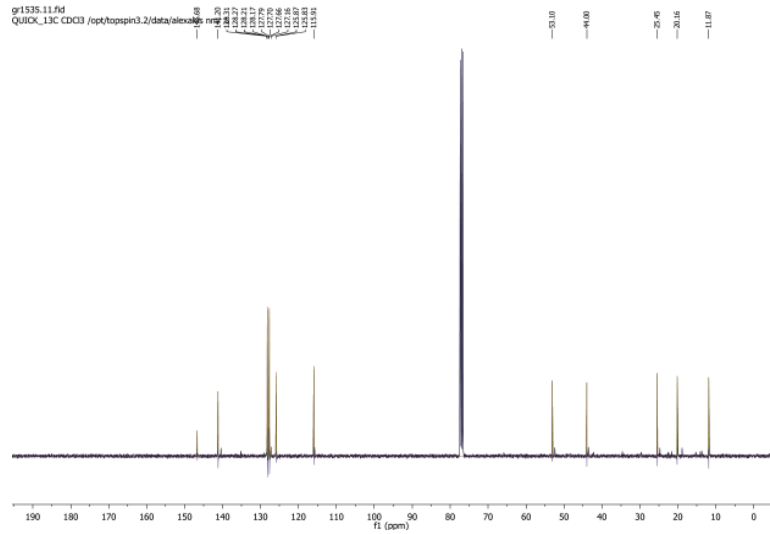
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142.24
138.99
138.4
128.01
127.76
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33.80
32.41
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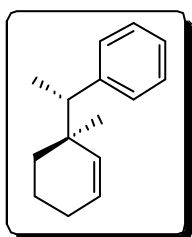
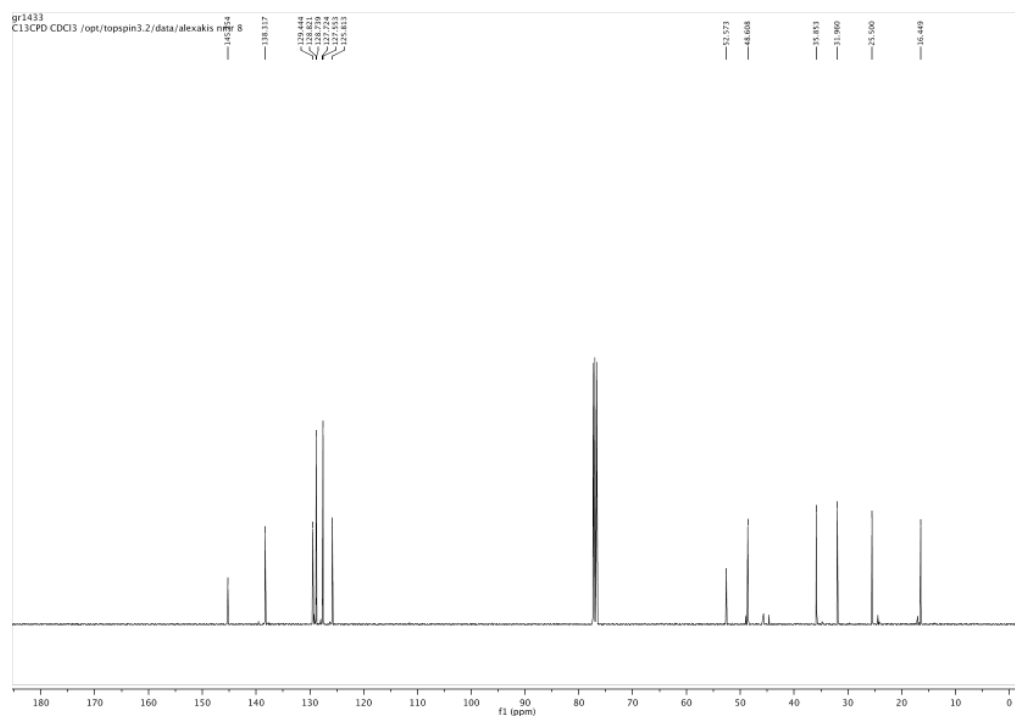
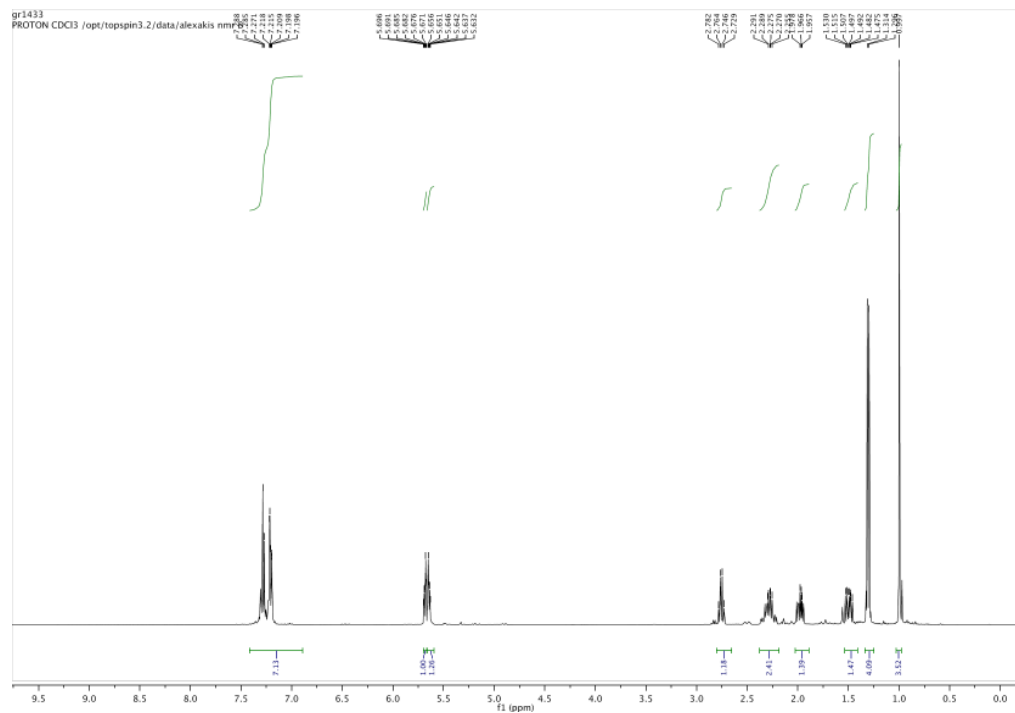


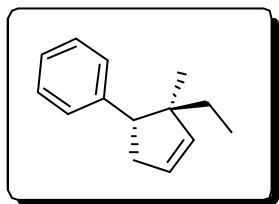
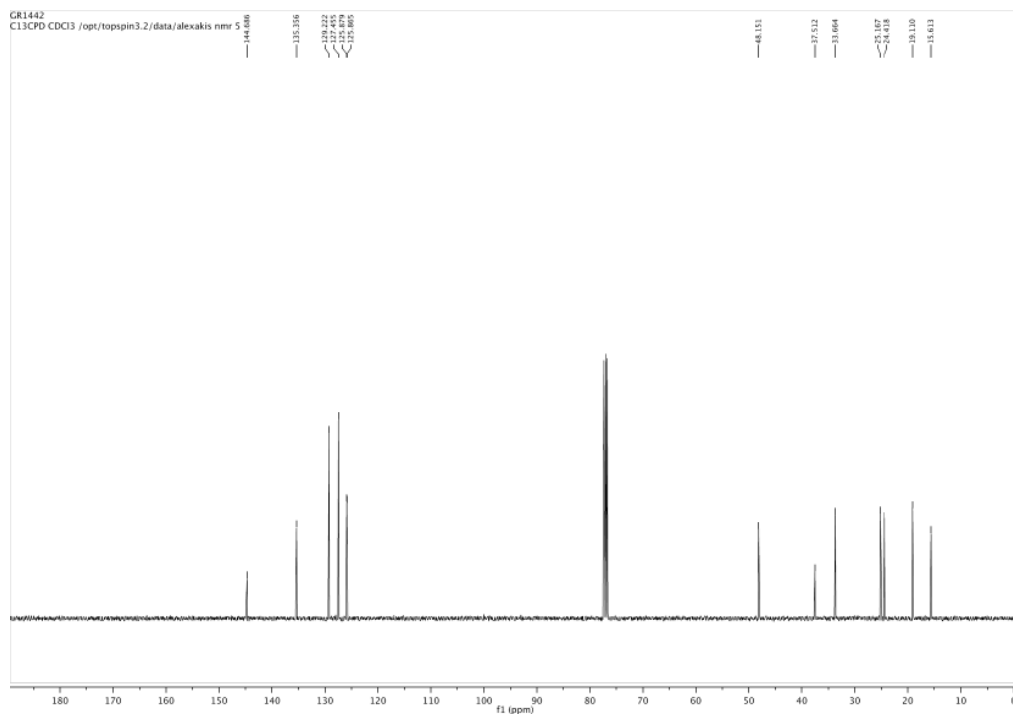
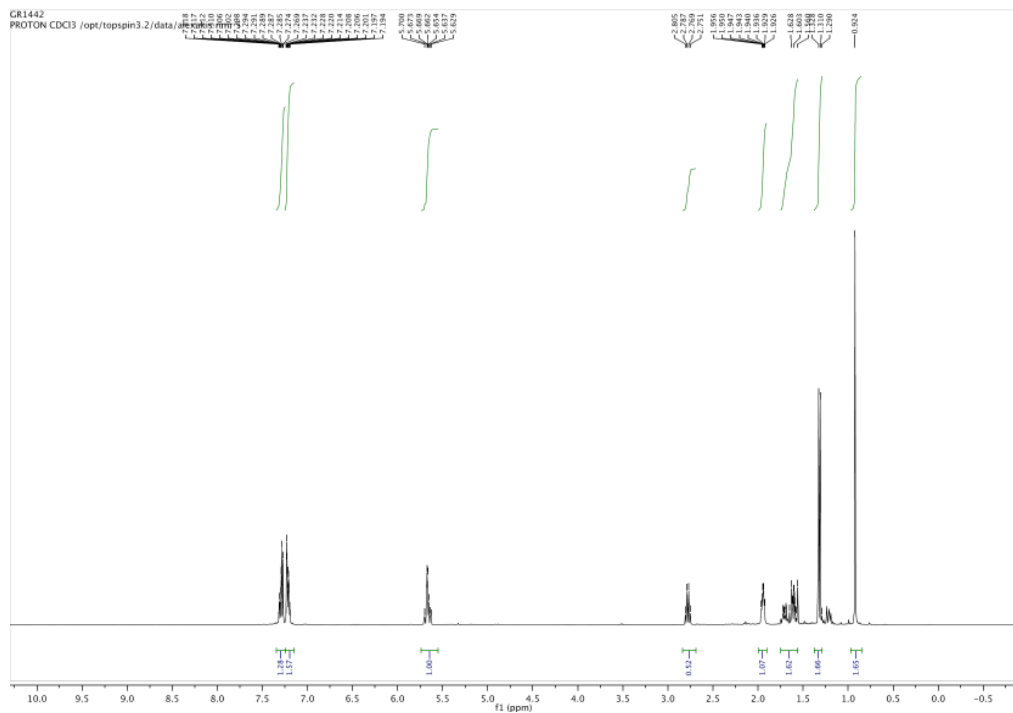
gr1535.2.fid

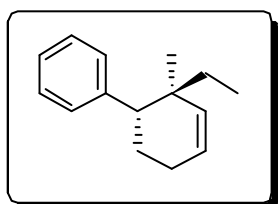
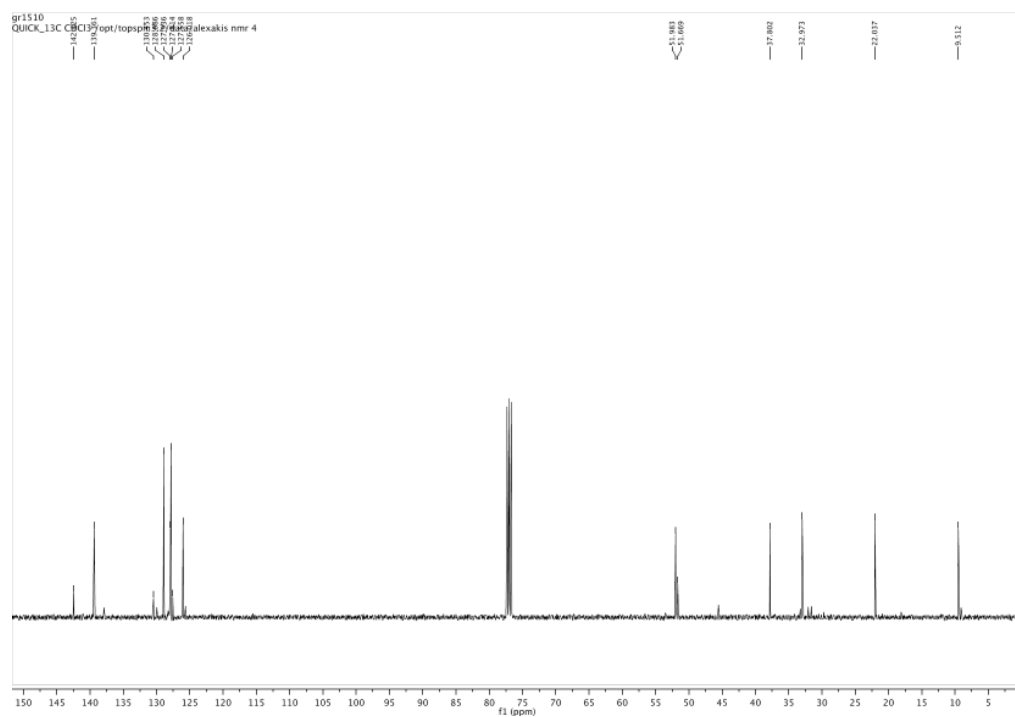
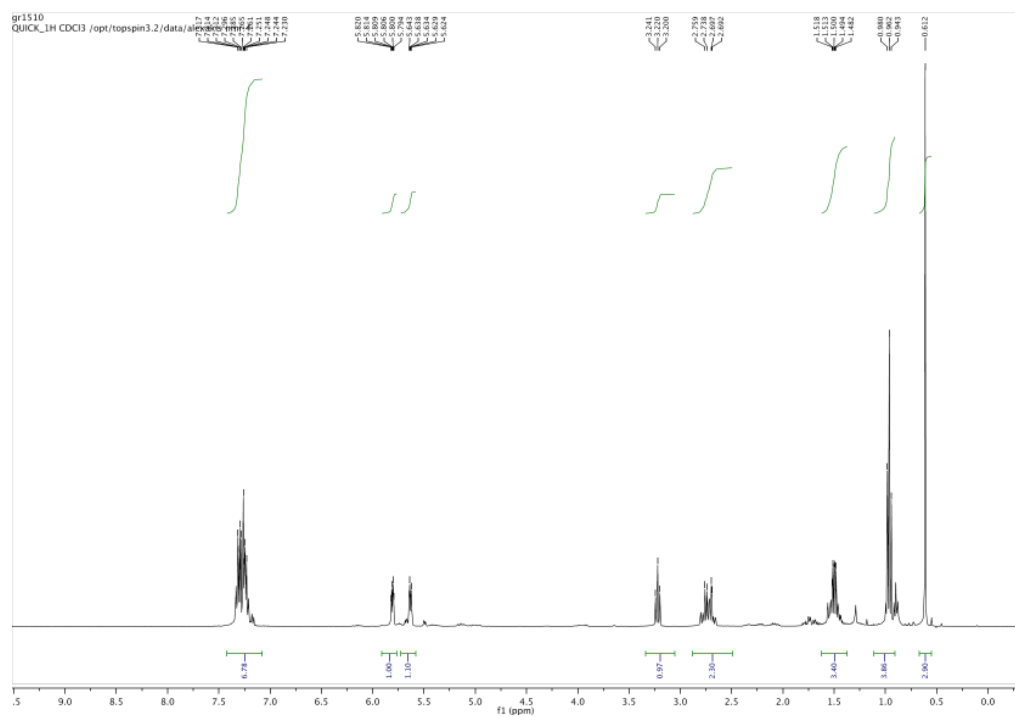


gr1535.11.fid

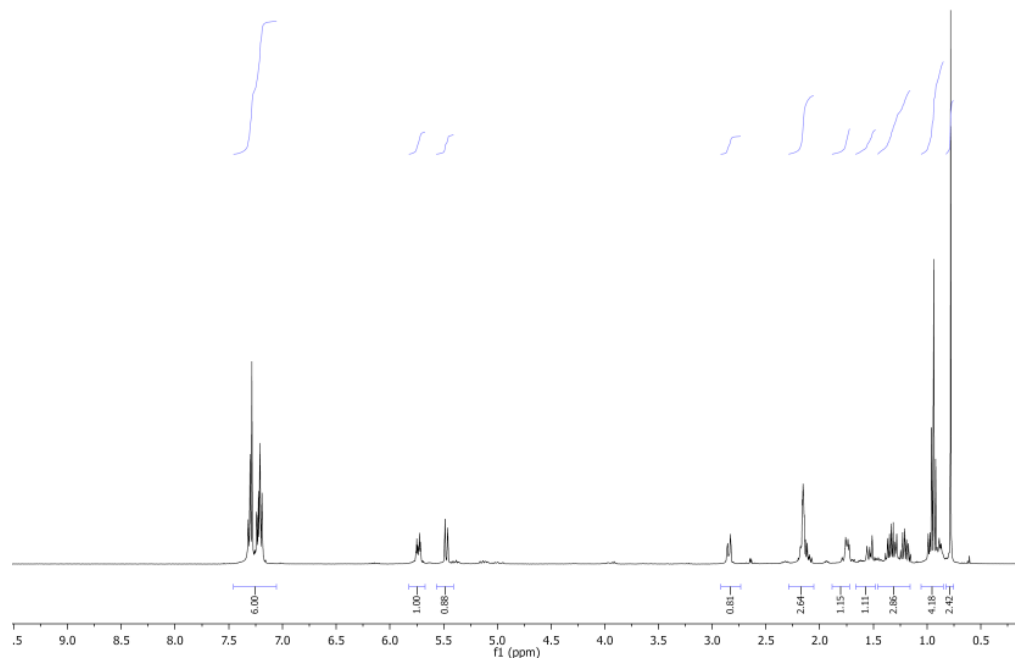








gr1538.10.fid
 QUICK_1H CDCl3 /opt/topspin3.2/data/alexakis nmr 4



gr1538.11.fid
 QUICK_13C CDCl3 /opt/topspin3.2/data/alexakis nmr 4

