Electronic Supporting Information (ESI)

Independent Generation of Intermediates in the Asymmetric Appel Process leads to a One Pot Stereoselective Synthesis of P-Stereogenic Phosphines and Phosphine Boranes from Racemic Phosphine Oxides

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Contents

General Experimental

NMR spectra were recorded at 25 °C on Varian VNMRS 300, 400, and 500 MHz spectrometers. ^{13}C NMR spectra (^{31}P decoupled) were recorded on a VNMRS 600 MHz spectrometer. All NMR samples of potentially air-sensitive compounds were made up under nitrogen in dry $CDCl_3$. $CDCl_3$ was purchased from Aldrich, and dried by adding to a Young's flask containing activated molecular sieves (4 Å) under an atmosphere of nitrogen. It was then stored under nitrogen in the Young's flask over the molecular sieves.

High-performance liquid chromatography was performed on an Agilent Technologies 1200 series equipped with a 6 column switching device. HPLC grade solvents were purchased from Aldrich and Lennox Supplies Ireland and used as supplied. All samples were filtered through an Acrodisc CR 13 mm syringe filter with 0.2 μm PTFE prior to injection.

Unless otherwise stated all reactions were carried out under N_2 atmosphere in dry glassware using Schlenk-line techniques and all glassware was flame dried prior to use. Air and moisture sensitive liquids and solutions were transferred *via* syringe. All commercially available solvents were used as supplied unless otherwise stated. All "dry" solvents were dried and distilled by standard procedures[1] or were processed through a Grubbs type still, supplied by Innovative Technology Inc. Pure Solv-400-3-MD solvent purification system. Oxygen free nitrogen was obtained from BOC gases and was used without further drying. Thin layer chromatography (TLC) was performed on Merck pre-coated Kieselgel $60F_{254}$ aluminium plates with realization by UV irradiation. Flash column chromatography was performed on Merck silica 9385, particle size 0.040-0.063 mm. 4Å Molecular sieves were kept stored in an oven at 180 °C at all times. Prior to use sieves were heated to ~300 °C, using a heat gun, for 2 minutes while under vacuum. They were allowed to cool to room temperature and this procedure was then repeated. Oxalyl chloride, $LiAlH_4$, $NaBH_4$, menthol and other chiral alcohols were purchased from Sigma-Aldrich, Fluka or Merck & Co., Inc.

A number of the required phosphines, and phosphine oxides were synthesised previously by us as follows. Details of these syntheses are given in the file "SI for Reviewer Only"

Compound	Reference
Methyl(phenyl)-*o*-tolylphosphine oxide	[2]
o-Anisyl(methyl)phenylphosphine oxide	[2]
Methyl(phenyl)-2-trifluoromethylphenylphosphine oxide	[3]
2-Biphenyl(methyl)phenylphosphine oxide	[3]
Methyl(phenyl)-2-*iso*-propylphenylphosphine oxide	[2]
4-Fluoro-2-methylphenyl(methyl)phenylphosphine oxide	[3]

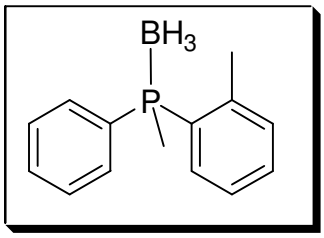
Experimental Procedure- Phosphine Boranes

Determination of absolute configurations

The phosphine boranes obtained from the reaction of methyl(phenyl)-*o*-tolylphosphine oxide, methyl(phenyl)-2-*iso*-propylphenylphosphine oxide and *o*-anisyl(methyl)phenylphosphine oxide with oxalyl chloride and (-)-menthol were confirmed to be (*R*)-enantiomer in excess by comparison with reported HPLC data[4,5]

Scalemic Phosphine boranes

Optimised Procedure for $NaBH_4$ Reduction to give methyl(phenyl)-*o*-tolylphosphine borane using (-)-menthol as chiral auxiliary



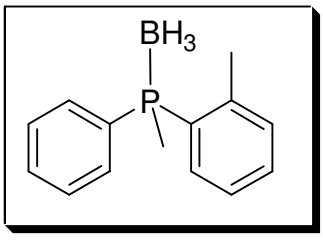
Methyl(phenyl)-*o*-tolylphosphine borane : The water contents of the solvent and stock solutions were determined by Karl Fischer titration to be less than 5 ppm. A standard solution of methylphenyl(*o*-tolyl)phosphine oxide (0.110 M) was prepared in anhydrous THF in a sealed vessel under nitrogen. Standard solutions of (-)-menthol (0.132 M) and oxalyl chloride (0.110 M) were prepared in a similar manner. Oxalyl chloride solution (10.0 mL, 1.1 mmol) was added dropwise at room temperature to the phosphine oxide solution

(10.0 mL, 1.1 mmol) in a flame-dried degassed Schlenk tube. Analysis by ^{31}P NMR showed the formation of the chlorophosphonium salt at 71.0 ppm. Following addition of alcohol solution (10.0 mL, 1.32 mmol) at -78 °C, the formation of the diastereomeric alkoxyphosphonium salts was confirmed by ^{31}P NMR (δ = 67.8 and 67.3 ppm).

Sampling DAPS (diasteromeric alkoxyphosphonium salts) for ^{31}P-NMR

When all the menthol had been added, the reaction was stirred at -78 °C for 5 minutes. After this time a 3 mL sample of reaction mixture was syringed from the reaction mixture into a separate flame dried degassed Schlenk tube. Solvent was completely removed under vacuum at room temperature and the residue was dissolved in dry $CDCl_3$ (0.7 mL), this was then syringed into a NMR tube contained in a long Schlenk tube that was charged with an atmosphere of nitrogen. The % de was measured by ^{31}P NMR with 128 scans and 3 second relaxation delay.

$NaBH_4$ solution (11.0 mL, 0.5 M in diglyme, 5.5 mmol) was added dropwise at -78 °C, the vessel removed from the cooling bath and allowed to warm to room temperature. The reaction was stirred for a further 60 min, at which point the diastereomeric salts were shown by ^{31}P NMR to have been consumed and the phosphine borane formed (peak at δ 10.2 ppm). The reaction mixture was concentrated under reduced pressure and the residue diluted with ethyl acetate (100 mL) and water added (100 mL). The organic layer was separated and the aqueous layer extracted with ethyl acetate (50 mL). The combined extracts were dried over $MgSO_4$ and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (ethyl acetate: cyclohexane 1:1) yielding the phosphine borane as a colourless oil (0.22 g, 87%). CSP-HPLC analysis revealed it to have 76% ee.

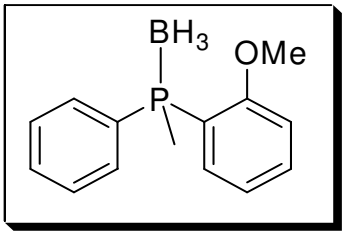


^{1}H NMR ($CDCl_3$, 300 MHz): δ = 7.72–7.14 (m, 9H, Ar), 2.17 (s, 3H, $ArCH_3$), 1.82 (d, $^2J_{PH}$ = 9.8 Hz, 3H, PCH_3) 1.61–0.72 (brm, 3H, BH_3) ppm. ^{31}P NMR ($CDCl_3$, 121 MHz): δ = 10.2 (lit[4] 10.9) ppm. HPLC (CHIRALPAK® AS-H column, 98:2 heptane:EtOH, 1 mL/min) R_t: 9.3 min(*R*), 11.2 min(*S*).

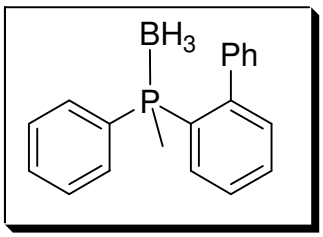
Optimised Procedure for $LiAlH_4$ Reduction to give methyl(phenyl)-*o*-tolylphosphine using (-)-menthol as chiral auxiliary

DAPS was generated as described in the above procedure and their presence was confirmed by ^{31}P NMR. To the mixture was added $LiAlH_4$ solution (10.0 mL, 0.11M in toluene, 1.1 mmol.) was added dropwise at -78 °C, the vessel removed from the cooling bath and allowed to warm to room temperature. The reaction was stirred for a further 60 min., at which point the diastereomeric salts were shown by ^{31}P NMR to have undergone full conversion to phosphine (δ -36.2 ppm). BH_3-THF complex (0.65 mL, 2.0 M solution in THF, 1.2 equiv) was added and ^{31}P NMR of the clear solution revealed one peak at δ 10.2 ppm (phosphine borane). The reaction mixture was concentrated under reduced pressure, the residue diluted with ethyl acetate (100 mL) and water added (100 mL). The organic layer was separated and the aqueous layer extracted with ethyl acetate (50 mL). The combined extracts were dried over $MgSO_4$ and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (ethyl acetate:hexane 1:1) yielding the phosphine borane as a colourless oil (0.23 g, 91%). CSP HPLC analysis revealed it to have 78% ee.

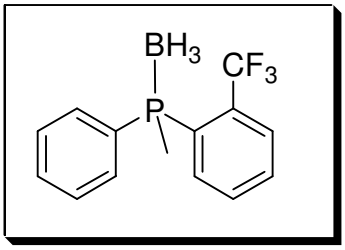
Similar procedures were followed to generate other scalemic phosphine boranes by both methods



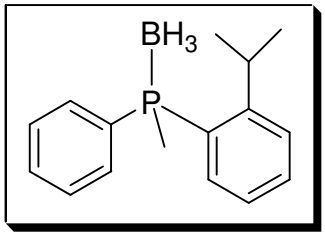
***o*-Anisyl(methyl)phenylphosphine borane :** (0.22 g, 91%, 40% ee) ^1H NMR ($CDCl_3$, 300 MHz): δ = 7.90–6.77 (m, 9H, Ar), 3.68 (s, 3H, Ar-OCH_3), 1.94 (d, $^2J_{PH}$ = 10.2 Hz, 3H, PCH_3) 1.43–0.50 (brm, 3H, BH_3) ppm. ^{31}P NMR ($CDCl_3$, 121 MHz): δ = 8.4 (lit[5] 9.2) ppm. HPLC (CHIRALPAK® AS-H column, 98:2 heptane:EtOH, 1 mL/min) R_t: 12.3 min(*R*), 13.1 min(*S*).



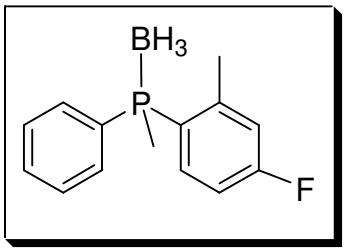
2-Biphenyl(methyl)phenylphosphine borane : (0.26 g, 89%, 51% ee) ^1H NMR ($CDCl_3$, 300 MHz): δ = 7.89-7.82 (m, 5H, Ar), 7.70–7.19 (m, 9H, Ar), 1.41 (d, $^2J_{PH}$ = 10.1 Hz, 3H, PCH_3), 1.56–0.73 (brm, 3H, BH_3) ppm. ^{31}P NMR ($CDCl_3$, 121 MHz): δ = 13.3 (lit.[6] 14.4) ppm. HPLC (CHIRALPAK® AS-H column, 98:2 heptane:EtOH, 1 mL/min) R_t: 8.7 min(*R*), 10.0 min(*S*).



Methyl(phenyl)-2-trifluoromethylphenylphosphine borane (0.26 g, 92%, 71 % ee) ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 7.70-7.02 (m, 9H, Ar), 1.91 (d, $^{2}J_{PH}$ = 9.9 Hz, 3H, PCH_3), 0.65-1.53 (brm, 3H, BH_3) ppm. ^{31}P NMR ($CDCl_3$, 121 MHz): δ = 18.3 (lit.[7] 18.7) ppm. HPLC (CHIRALPAK® AS-H column, 98:2 heptane:EtOH, 1 mL/min) R_t: 8.0 min(*R*), 9.0 min(*S*).



Methyl(phenyl)-2-*iso*-propylphenylphosphine borane: (0.24 g, 92%, 41% ee) ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 7.67-7.26 (m, 9H, Ar) 3.18 (m 1H, CH), 1.86 (d, $^{2}J_{PH}$ = 10.0 Hz, 3H, PCH_3), 1.08 (d, $^{3}J_{HH}$ = 6.8 Hz, 3H, $CHC\underline{H}_3$), 0.73 (d, $^{3}J_{HH}$ = 7.4 Hz, 3H, $CHC\underline{H}_3$); 1.62–0.51 (brm, 3H, BH_3) ppm. ^{31}P NMR ($CDCl_3$, 300 MHz) : δ = 9.0 (lit.[4] 9.7) ppm. HPLC (CHIRALPAK® AS-H column, 98:2 heptane:EtOH, 1 mL/min) R_t: 6.7 min(*R*), 8.2 min(*S*).



4-Fluoro-2-methylphenyl(methyl)phenylphosphine borane: (0.22 g, 84%, 58% ee) ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 7.74-6.89 (m, 8H, Ar), 2.18 (s, 3H, $ArCH_3$), 1.84 (d, $^{2}J_{PH}$ = 9.9 Hz, 3H, CH_3), 0.90-1.57 (brm, 3H, BH_3) ppm. ^{31}P NMR ($CDCl_3$, 121 MHz): δ = 10.2 ppm. HPLC (CHIRALPAK® AS-H column, 98:2 heptane:EtOH, 1 mL/min) R_t: 9.0 min(*R*), 11.0 min(*S*).

Overview of Mechanistic Hypotheses

Plausible mechanisms for the three stages of the reaction are shown in Figure 1. In the first instance it is postulated that the phosphine oxide **a** reacts with oxalyl chloride to form a transient species **b** which collapses to give **CPS** with the release of CO and CO_2. In the second stage of the reaction, species reacts with menthol to give *unequal* amounts of a pair of diastereomeric alkoxyphosphonium salts (**DAPS**). This could be by direct reaction (route B) or could go *via* the pentaco-ordinate species diastereomeric chloroalkoxy phosphoranes **d** (route A). The latter would also presumably exist as an unequal pair of diastereomers, rapidly interconverting by Berry pseudorotation. In the third stage of the reaction, borohydride attack on **DAPS** releases the alcohol, forming a H-phosphonium salt. Hydride attack on this salt by another molecule of

borohydride gives phosphine with release of hydrogen gas. Boranation of the phosphine occurs *in situ* utilizing BH_3 resulting from hydrogen transfer from borohydride.

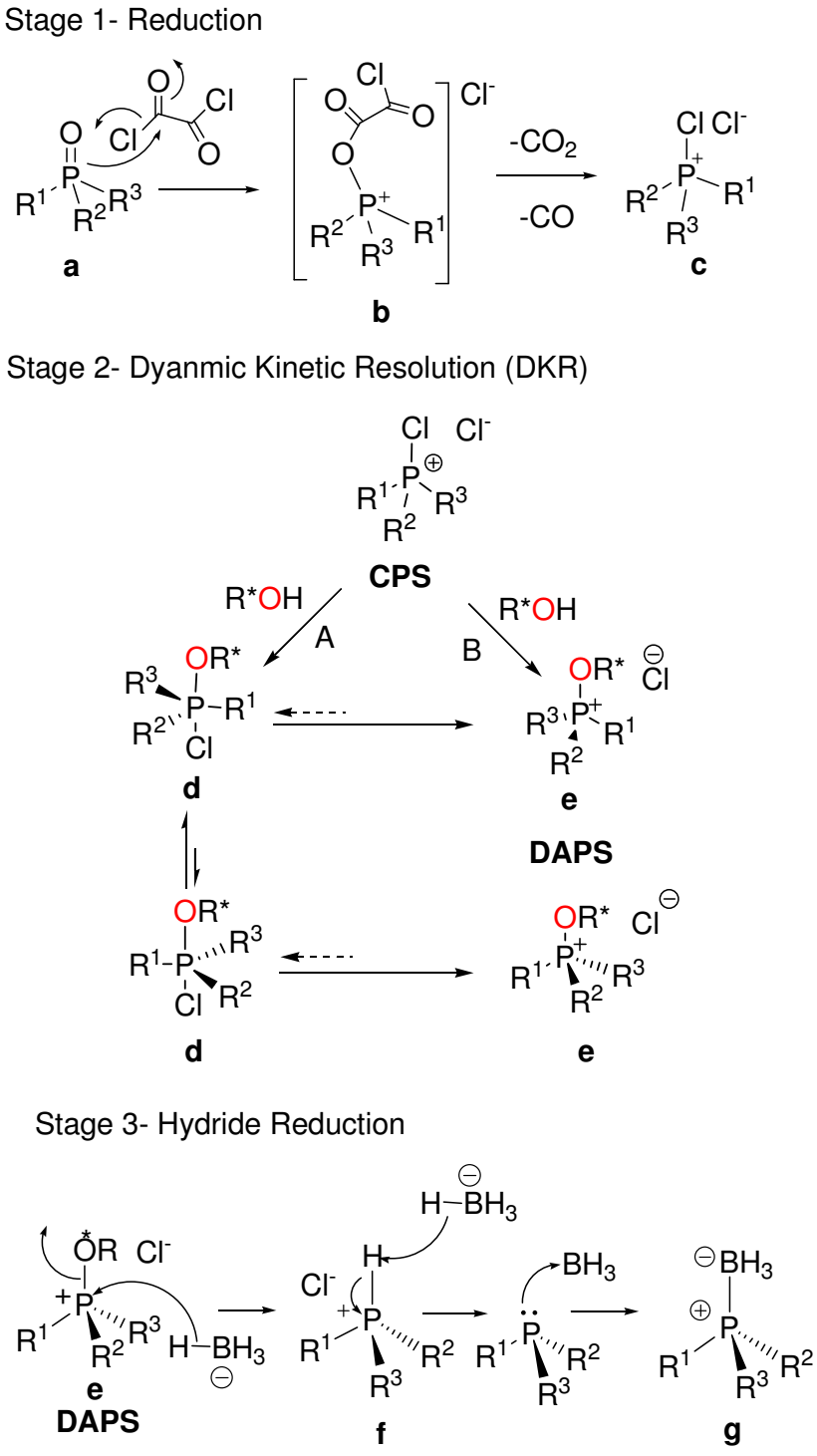
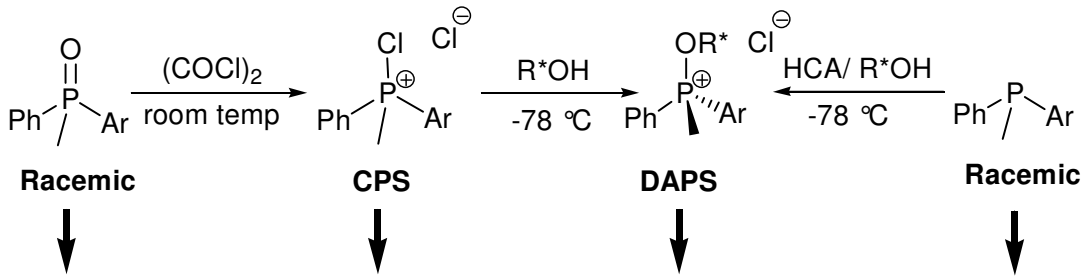
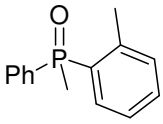
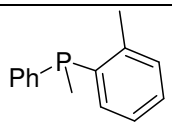
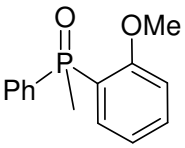
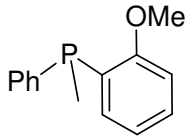
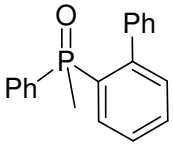
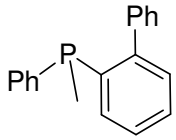
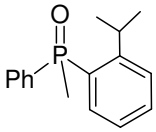
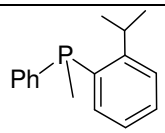
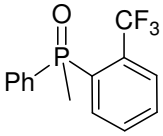
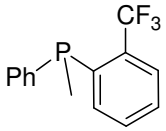
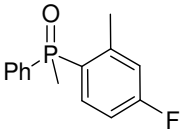
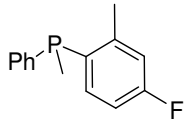


Figure 1. Proposed working reaction mechanism.

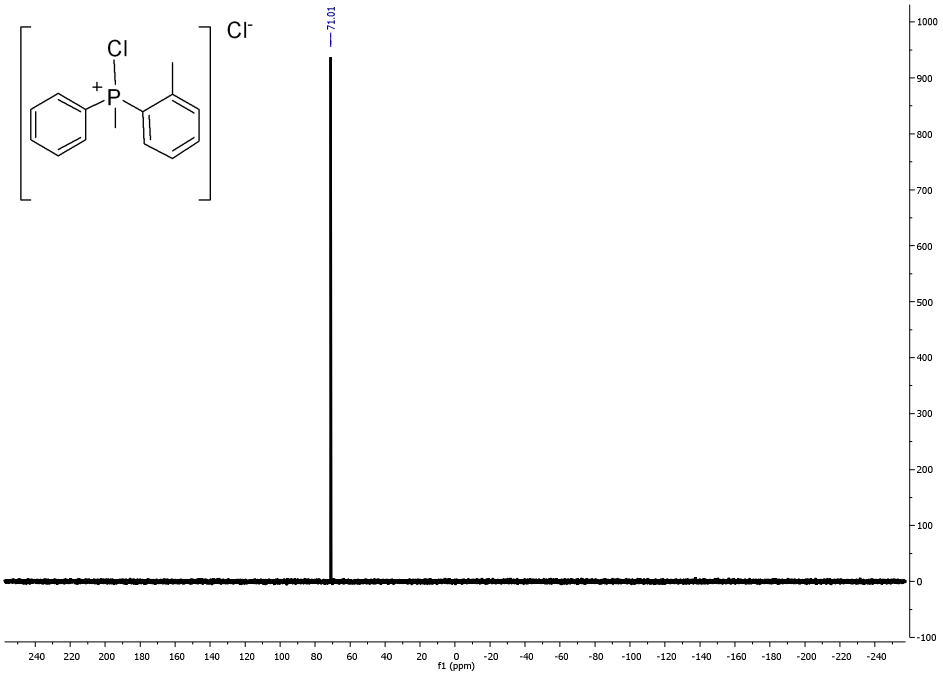
List of ^{31}P-NMR Shifts of CPS and DAPS



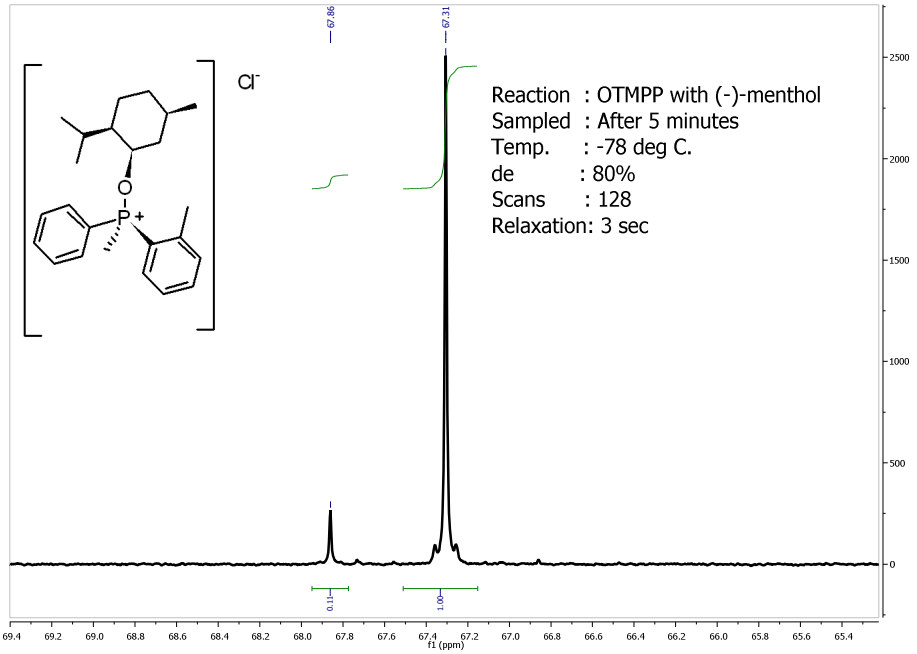
Entry	Starting material	CPS[a] (ppm)	DAPS[b] (ppm) R*OH = (-)-menthol	Starting material
1		71.0	Major: 67.3 Minor: 67.8	
2		70.5	Major: 66.8 Minor: 66.6	
2		67.1	Major: 66.7 Minor: 66.3	
3		70.8	Major: 67.2 Minor: 67.6	
4		66.8	Major: 69.6 Minor: 69.2	
5		70.4	Major: 67.2 Minor: 67.8	

[a]: CPS: ^{31}P NMR shift assigned as chlorophosphonium salt;
[b]: DAPS: ^{31}P NMR shift assigned as diastereomeric alkoxyphosphonium salts prepared by both the routes

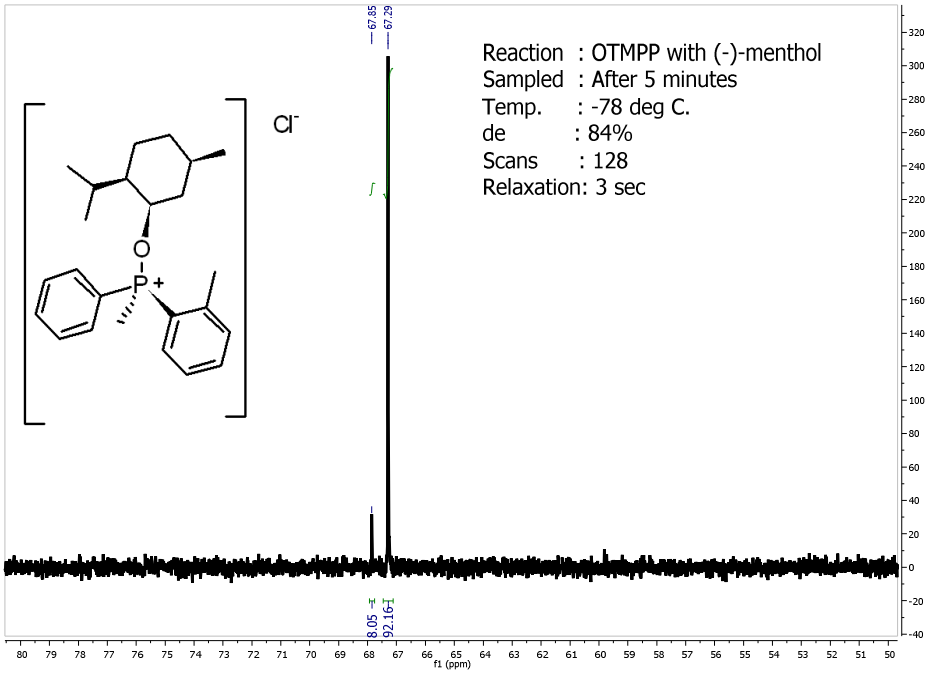
Exemplar NMR spectra of chlorophosphonium salt (CPS), diastereomeric alkoxyphosphonium salts (DAPS-A), (DAPS-B) and phosphine borane (from reaction of methyl(phenyl)-*o*-tolylphosphine oxide)



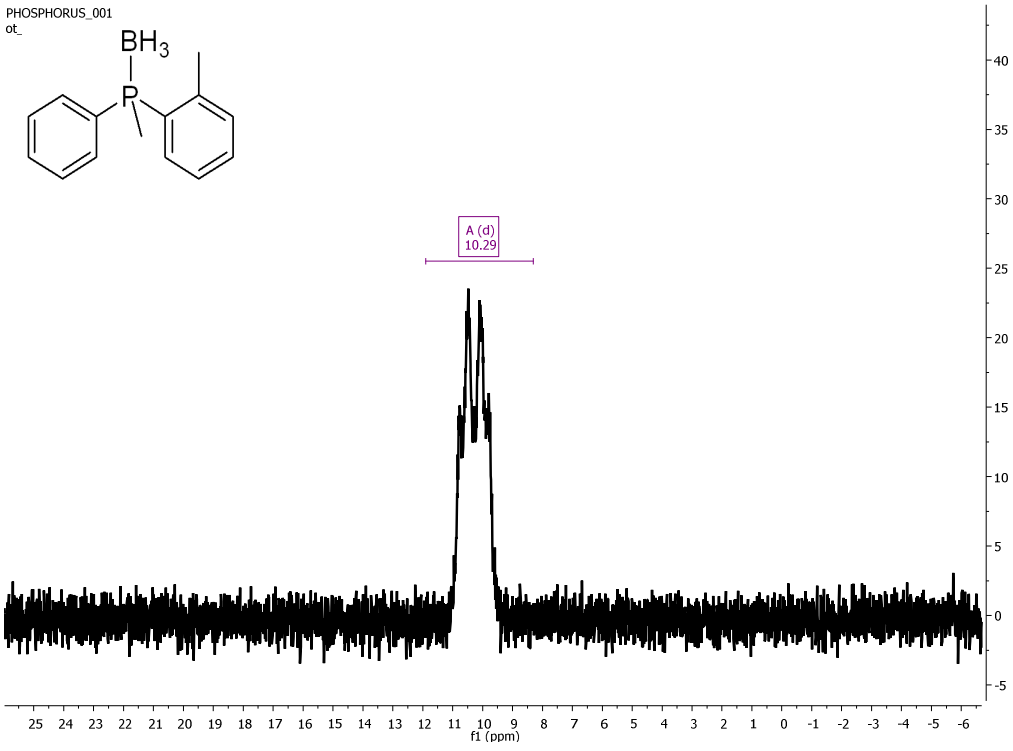
^{31}P-NMR of chlorophosphonium salt (CPS)



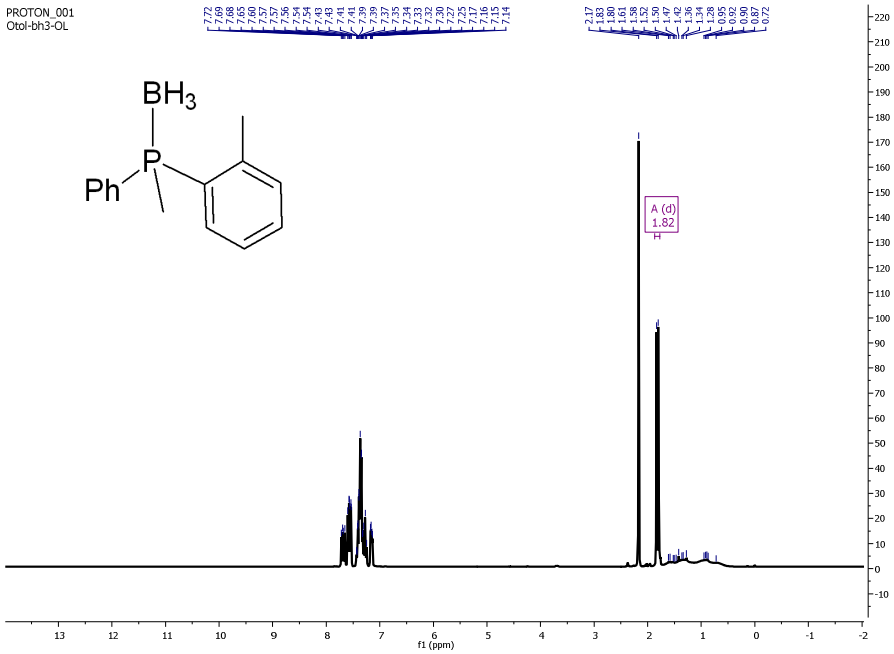
^{31}P-NMR diastereomeric alkoxyphosphonium salts (DAPS-A)



^{31}P-NMR diastereomeric alkoxyphosphonium salts (DAPS-B)



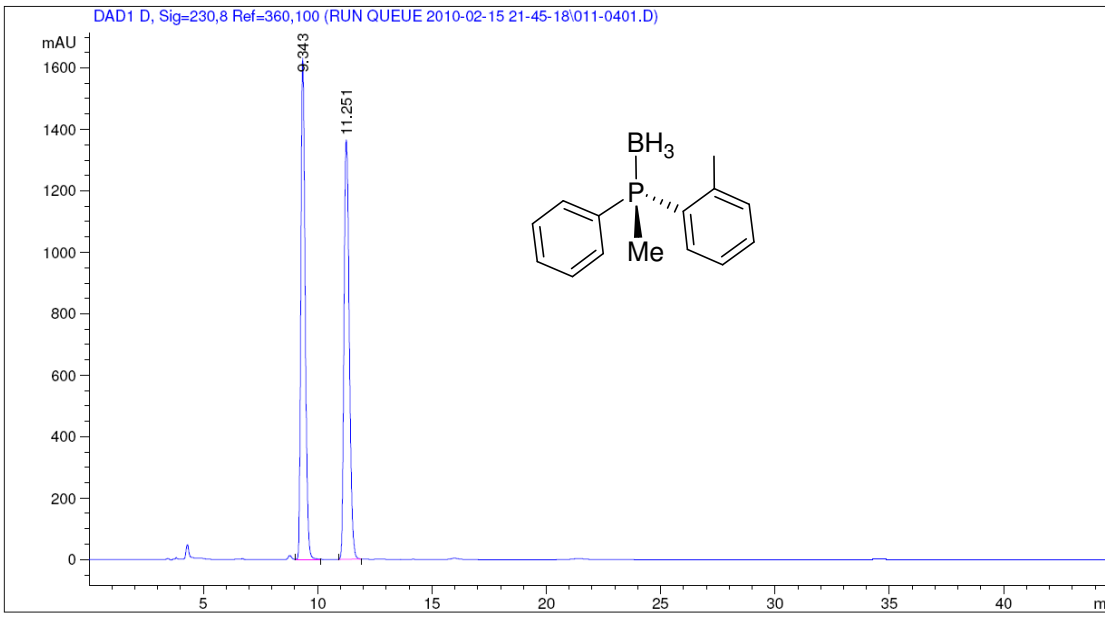
^{31}P-NMR of phosphine borane



^{1}H-NMR of phosphine borane

Supporting HPLC Traces Corresponding to Results in Table 1 Scalemic **C**

Racemic

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Dilution              :      1.0000
Use Multiplier & Dilution Factor with ISTDs


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Entry 1

Enantioenriched using (-)-menthol

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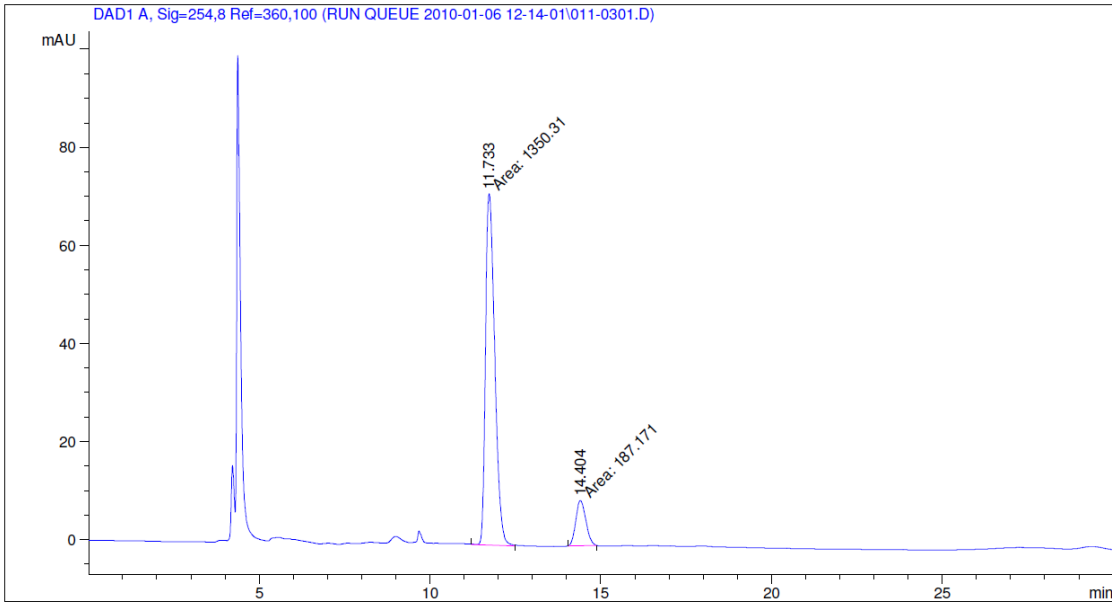


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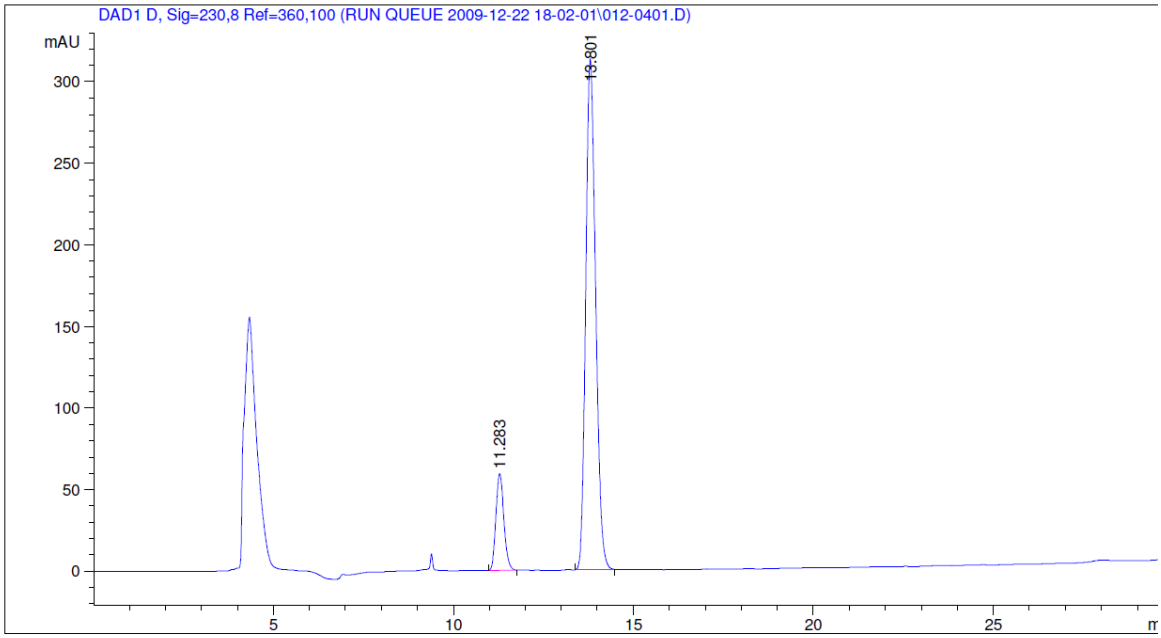
Entry 2

Enantioenriched using (+)-menthol

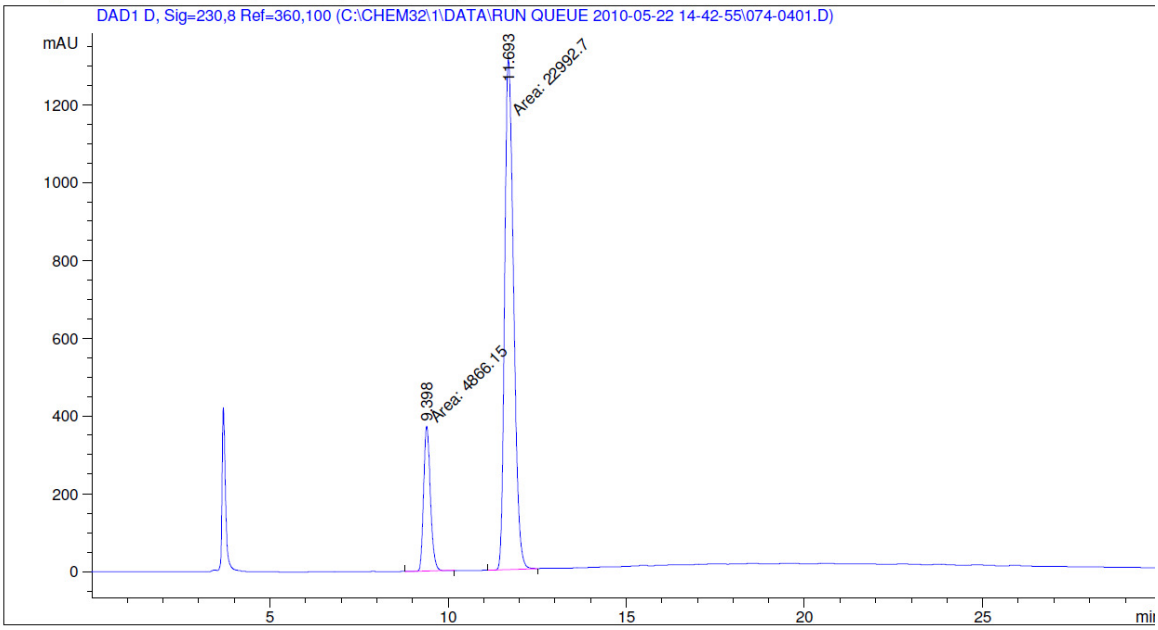



```
=====================================================================
                        Area Percent Report
=====================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.283 BB    0.2371  911.22461   59.36821  13.2247
   2  13.801 BB    0.2966 5979.10449  313.36383  86.7753
```

Entry 3

Enantioenriched using (+)-isomenthol

```
======================================================================
Acq. Operator    : General sequence              Seq. Line :   4
Acq. Instrument  : Kev HPLC 1                     Location : Vial 74
Injection Date   : 5/22/2010 3:57:37 PM                Inj :   1
                                                 Inj Volume : 5 µl
Acq. Method      : C:\Chem32\1\DATA\RUN QUEUE 2010-05-22 14-42-55\ISO_98_02_30MIN_1MLMIN.M
Last changed     : 5/22/2010 3:57:26 PM by General sequence
                   (modified after loading)
Analysis Method  : C:\CHEM32\1\METHODS\DEF_LC.M
```

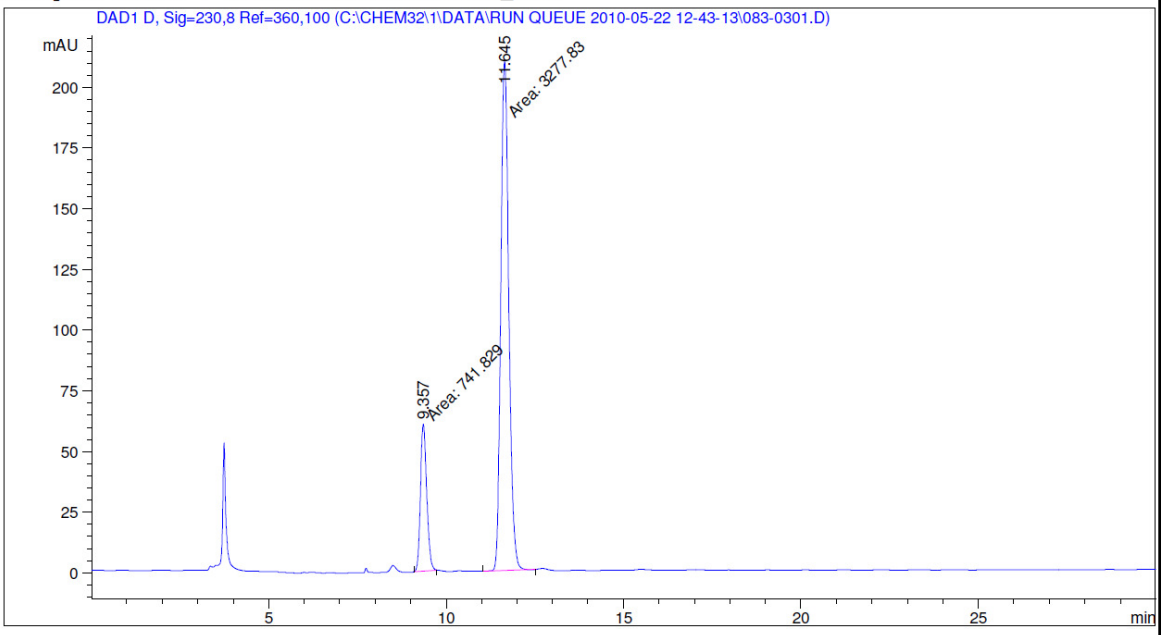



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.398 MM    0.2178 4866.14990  372.31458  17.4672
   2  11.693 MM    0.2921 2.29927e4  1312.09778  82.5328
```

Entry 4

Enantioenriched using (+)-neomenthol

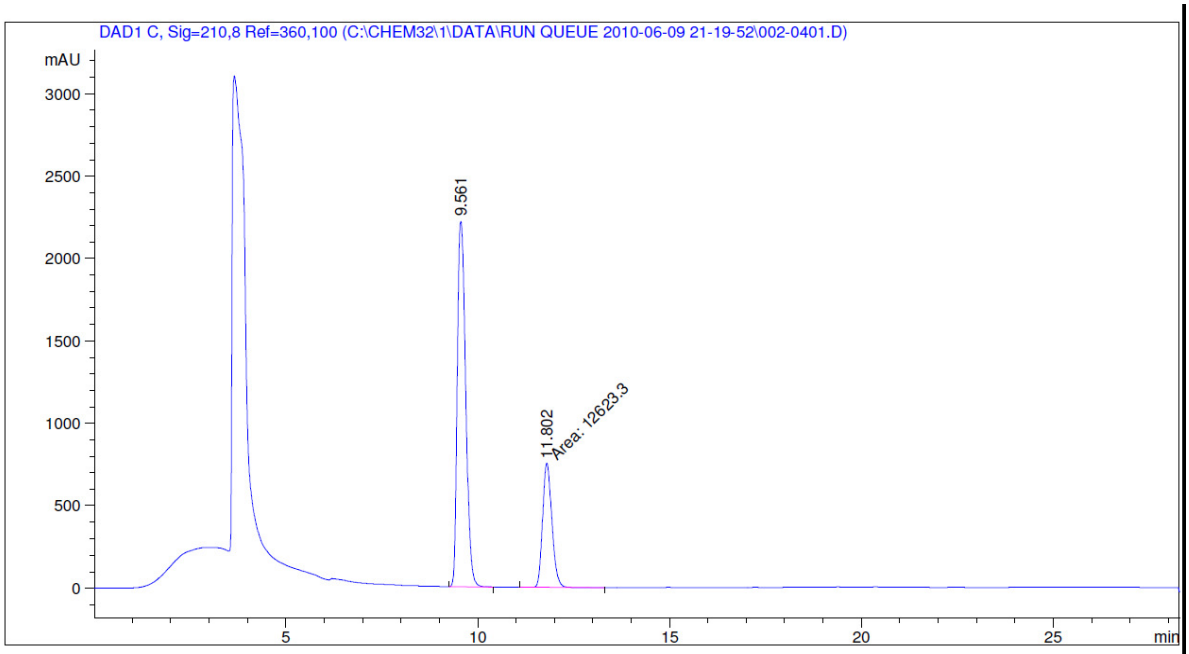
```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   3
Acq. Instrument : Kev HPLC 1                    Location : Vial 83
Injection Date  : 5/22/2010 1:16:07 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-05-22 12-43-13\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/22/2010 1:15:56 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\DEF_LC.M
```




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

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.357 MM    0.2042  741.82941   60.55114  18.4550
   2  11.645 MM    0.2605 3277.83325  209.70517  81.5450
```

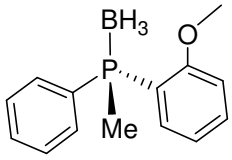
Entry 5

Enantioenriched using (*R*)-BINOL



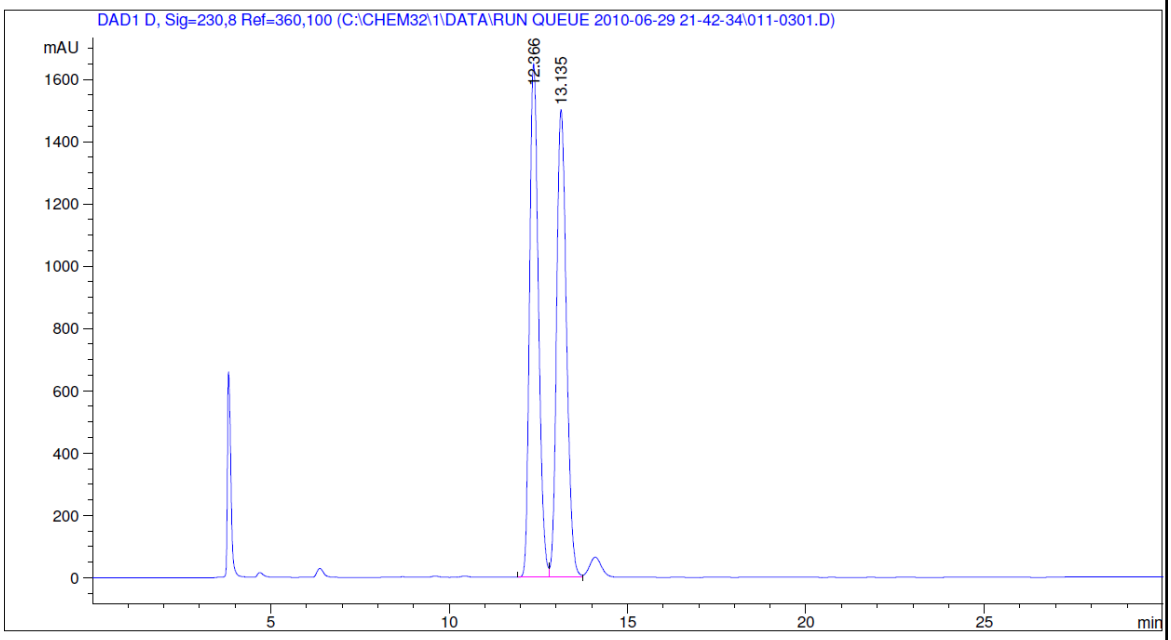

```
=====================================================================
                      Area Percent Report
=====================================================================

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


Signal 1: DAD1 C, Sig=210,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.561 BB    0.2409 3.36242e4  2217.39478  72.7049
   2  11.802 MM    0.2792 1.26233e4   753.55151  27.2951
```

Ar = *o*-anisyl



Racemic

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   3
Acq. Instrument : Kev HPLC 1                    Location : Vial 11
Injection Date  : 6/29/2010 10:17:16 PM              Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-29 21-42-34\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 6/29/2010 10:17:05 PM by General sequence
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed    : 6/29/2010 9:32:43 PM by General sequence
Method Info     : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```

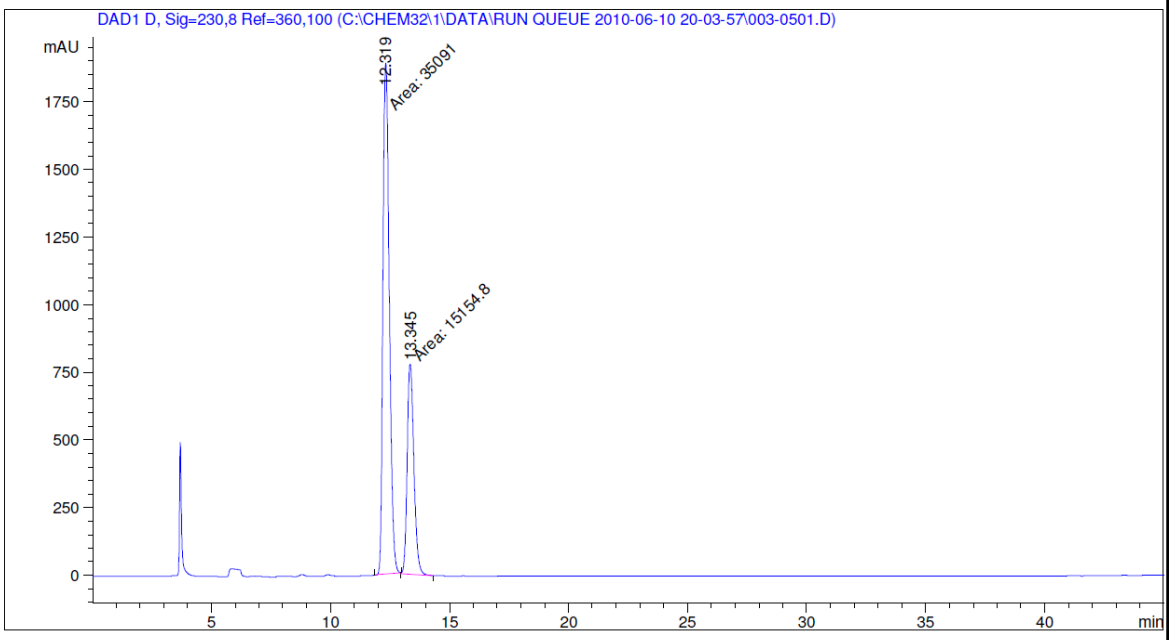



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  12.366 BV    0.2707 2.86744e4  1650.24219  49.7663
   2  13.135 VV    0.3028 2.89437e4  1502.02356  50.2337
```

Entry 6

Enantioenriched using (-)-menthol ($NaBH_4$ as reductant)

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   5
Acq. Instrument : Kev HPLC 1                    Location : Vial 3
Injection Date  : 6/10/2010 9:59:23 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-10 20-03-57\ISO_98_02_45MIN_1MLMIN.M
Last changed    : 6/10/2010 9:59:13 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\03_QUICKSTART 1 MLMIN METHODS\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/20/2010 11:50:38 AM by General sequence
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

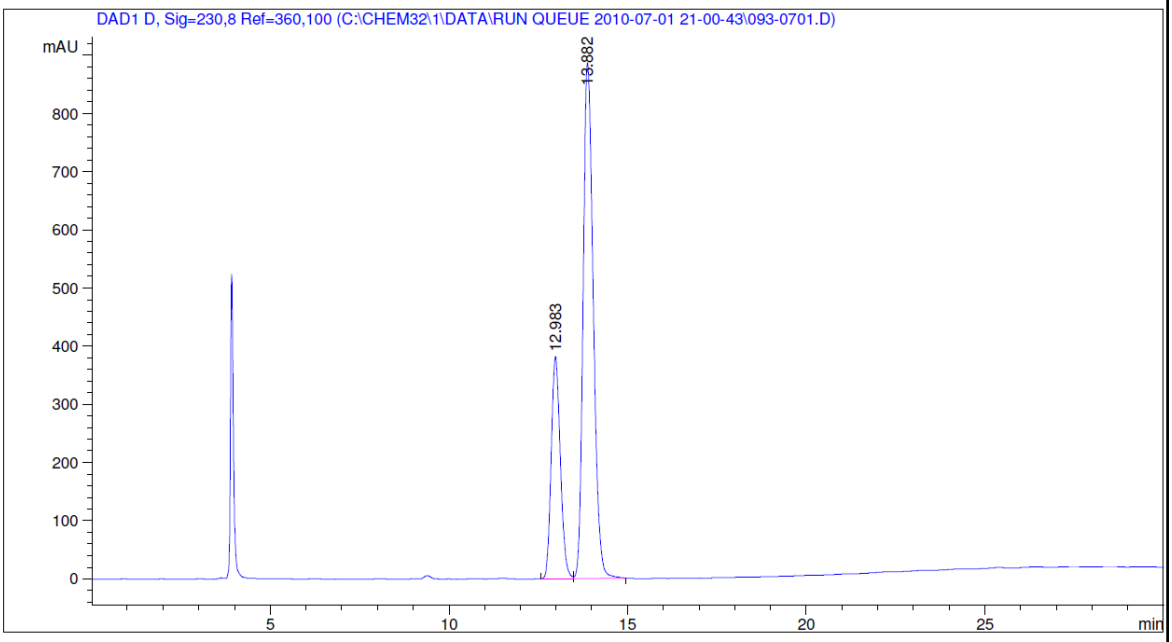



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  12.319 MM    0.3099 3.50910e4  1887.43652  69.8386
   2  13.345 MM    0.3255 1.51548e4   776.07684  30.1614
```

Entry 7

Enantioenriched using (+)-menthol ($NaBH_4$ as reductant)

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   7
Acq. Instrument : Kev HPLC 1                    Location : Vial 93
Injection Date  : 7/1/2010 11:28:03 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-07-01 21-00-43\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 7/1/2010 11:27:51 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed    : 6/29/2010 9:32:43 PM by General sequence
Method Info     : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```

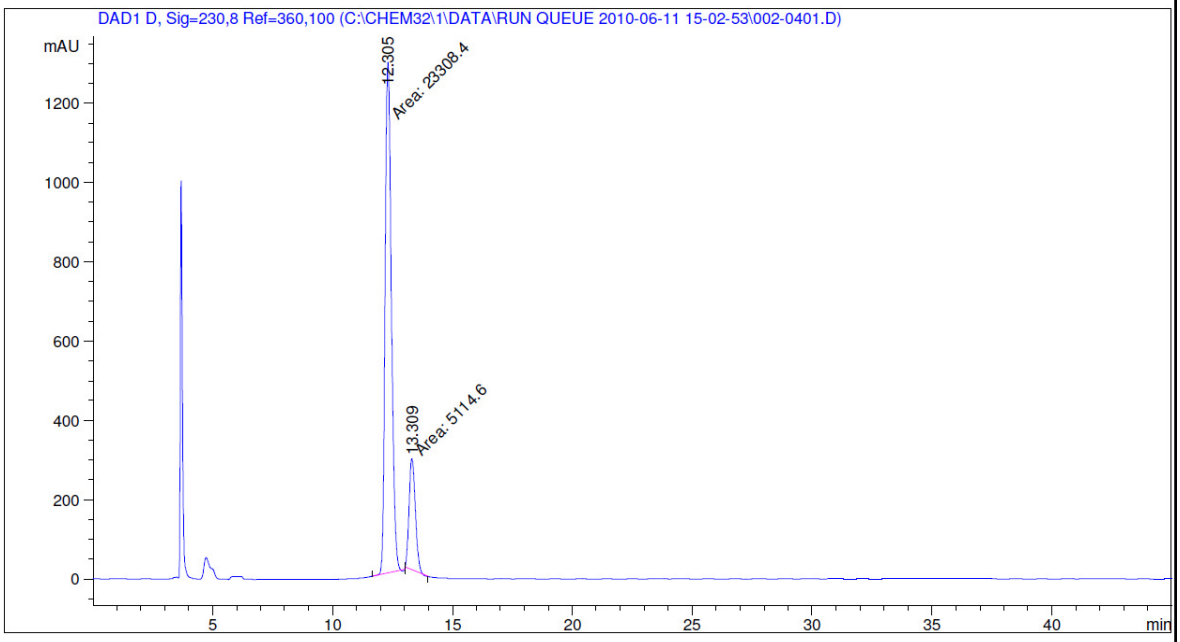



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  12.983 BV    0.2755 6796.08691  382.17450  27.9796
   2  13.882 VB    0.3083 1.74933e4   886.18372  72.0204
```

Entry 8

Enantioenriched using (-)-8-phenylmenthol ($NaBH_4$ as reductant)

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   4
Acq. Instrument : Kev HPLC 1                    Location : Vial 2
Injection Date  : 6/11/2010 4:17:25 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-11 15-02-53\ISO_98_02_45MIN_1MLMIN.M
Last changed    : 6/11/2010 4:17:15 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\03_QUICKSTART 1 MLMIN METHODS\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/20/2010 11:50:38 AM by General sequence
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

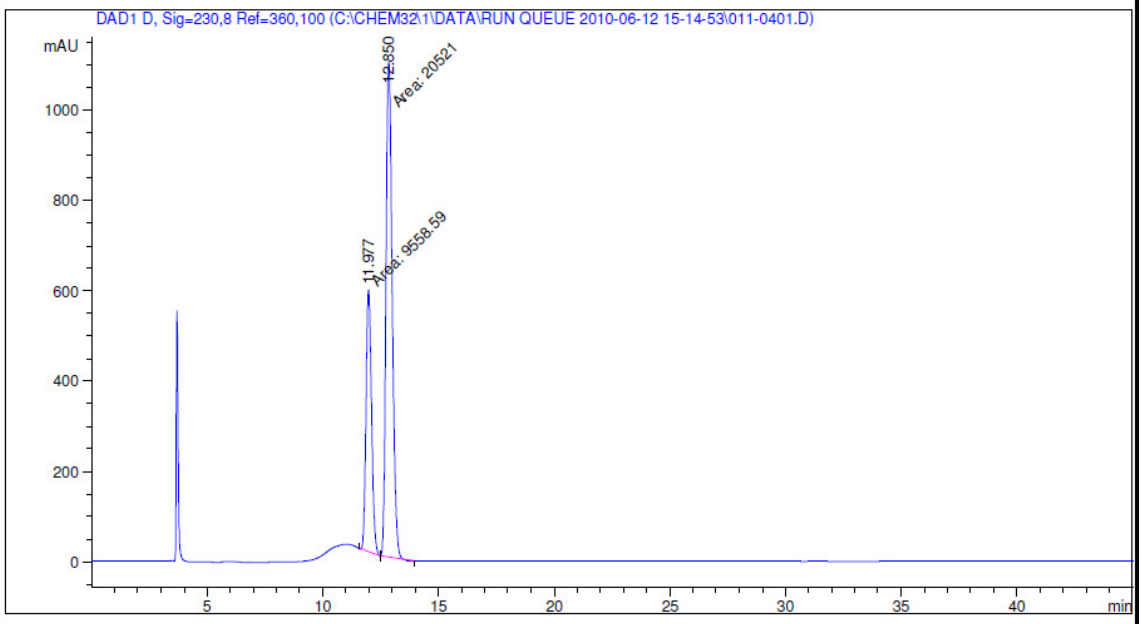



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  12.305 MM    0.3017 2.33084e4  1287.76392  82.0054
   2  13.309 MM    0.3041 5114.60107  280.33661  17.9946
```

Entry 9

Enantioenriched using (+)-isomenthol

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   4
Acq. Instrument : Kev HPLC 1                    Location : Vial 11
Injection Date  : 6/12/2010 4:29:22 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-12 15-14-53\ISO_98_02_45MIN_1MLMIN.M
Last changed    : 6/12/2010 4:29:12 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\03_QUICKSTART 1 MLMIN METHODS\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/20/2010 11:50:38 AM by General sequence
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

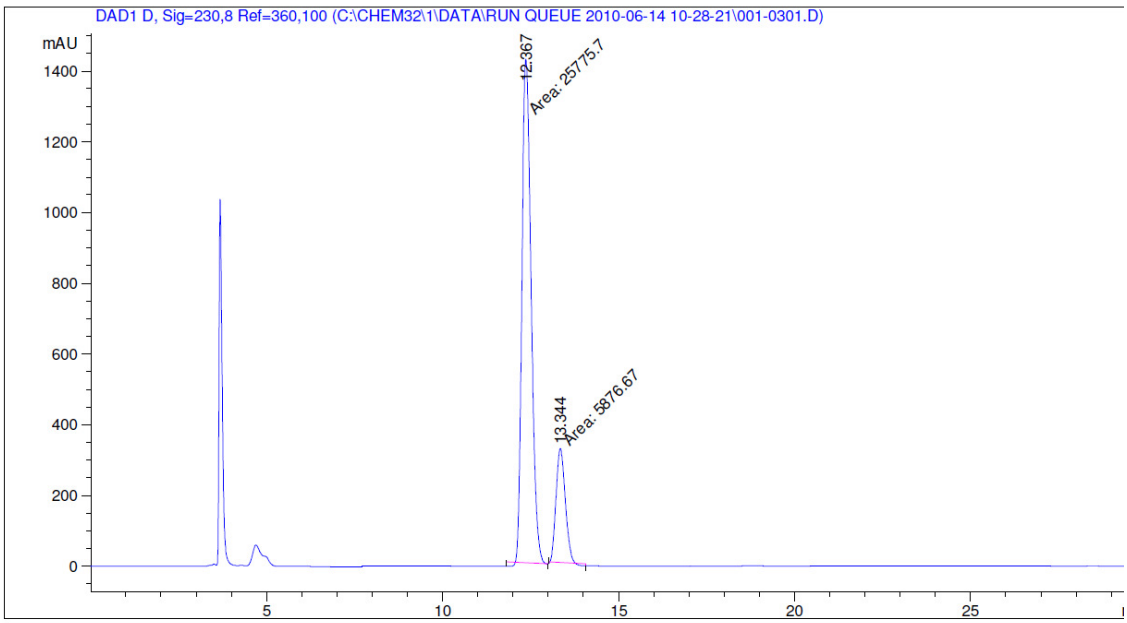



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.977 MM    0.2749 9558.58984  579.56219  31.7776
   2  12.850 MM    0.3118 2.05210e4  1096.96289  68.2224
```

Entry 10

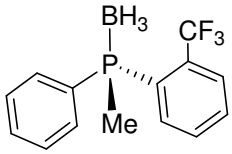
Enantioenriched using (+)-neomenthol ($NaBH_4$ as reductant)

```
=====================================================================
Acq. Operator   : General sequence              Seq. Line :   3
Acq. Instrument : Kev HPLC 1                    Location : Vial 1
Injection Date  : 6/14/2010 11:01:52 AM             Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-14 10-28-21\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 6/14/2010 11:01:42 AM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\03_QUICKSTART 1 MLMIN METHODS\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/20/2010 11:50:38 AM by General sequence
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```



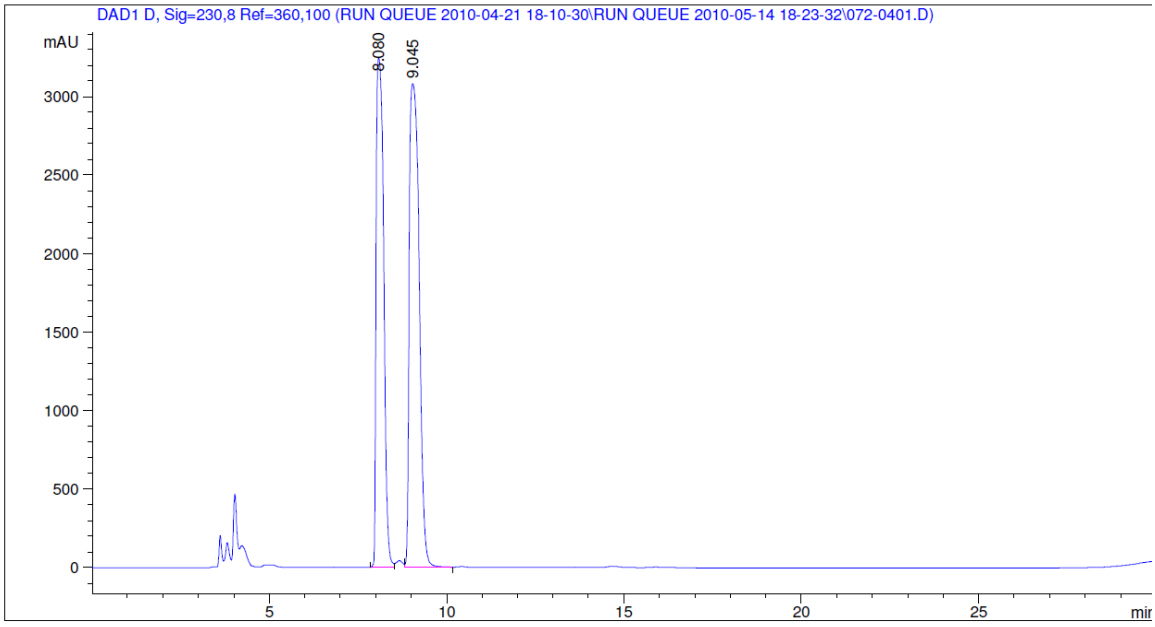

```
=====================================================================
                        Area Percent Report
=====================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  12.367 MM    0.3019 2.57757e4  1422.85376  81.4337
   2  13.344 MM    0.3043 5876.67285  321.89029  18.5663
```

Ar = 2-trifluoromethylphenyl



Racemic

```
======================================================================
Acq. Operator    : General sequence              Seq. Line :   4
Acq. Instrument  : Kev HPLC 1                    Location : Vial 72
Injection Date   : 5/14/2010 7:38:52 PM               Inj :   1
                                                 Inj Volume : 5 µl
Acq. Method      : C:\Chem32\1\DATA\RUN QUEUE 2010-04-21 18-10-30\RUN QUEUE 2010-05-14 18-23-
                   32\ISO_98_02_30MIN_1MLMIN.M
Last changed     : 5/14/2010 7:38:41 PM by General sequence
                   (modified after loading)
Analysis Method  : C:\CHEM32\1\DATA\RUN QUEUE 2010-04-21 18-10-30\RUN QUEUE 2010-05-14 18-23-
                   32\072-0401.D\DA.M (ISO_98_02_30MIN_1MLMIN.M)
Last changed     : 5/15/2010 9:22:41 PM by General sequence
Method Info      : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

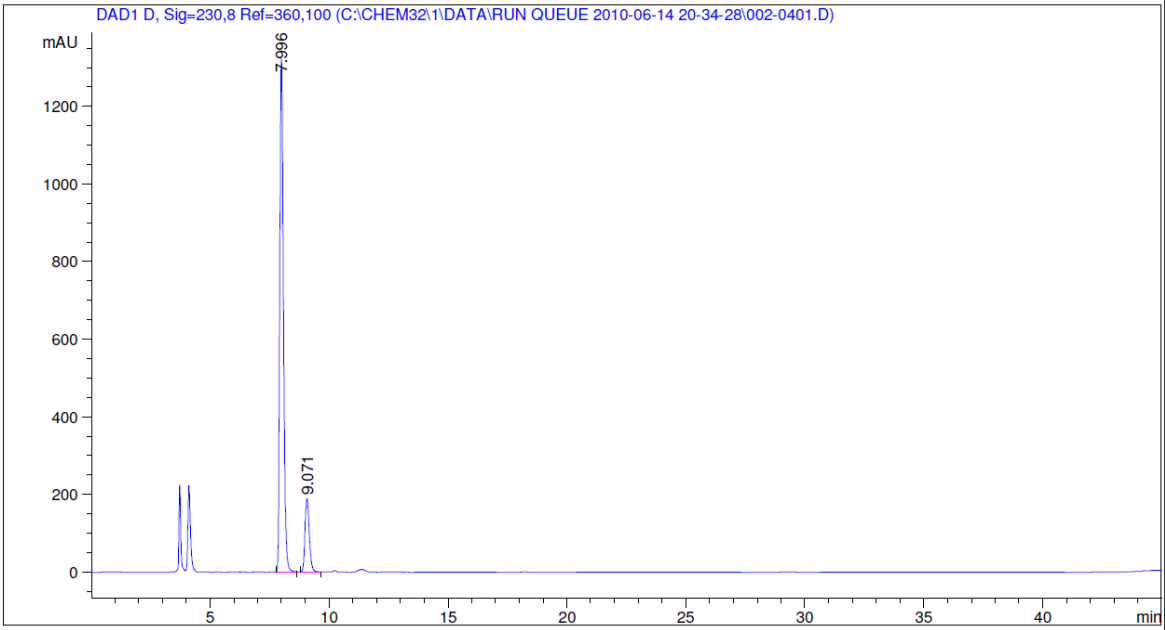



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.080 BV    0.2440 4.78741e4  3248.14136  44.3462
   2   9.045 VB    0.3193 6.00813e4  3084.19385  55.6538
```

Entry 11

Enantioenriched using (-)-menthol

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   4
Acq. Instrument : Kev HPLC 1                     Location : Vial 2
Injection Date  : 6/14/2010 9:48:42 PM                Inj :   1
                                                Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-14 20-34-28\ISO_98_02_45MIN_1MLMIN.M
Last changed    : 6/14/2010 9:48:31 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\03_QUICKSTART 1 MLMIN METHODS\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/20/2010 11:50:38 AM by General sequence
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

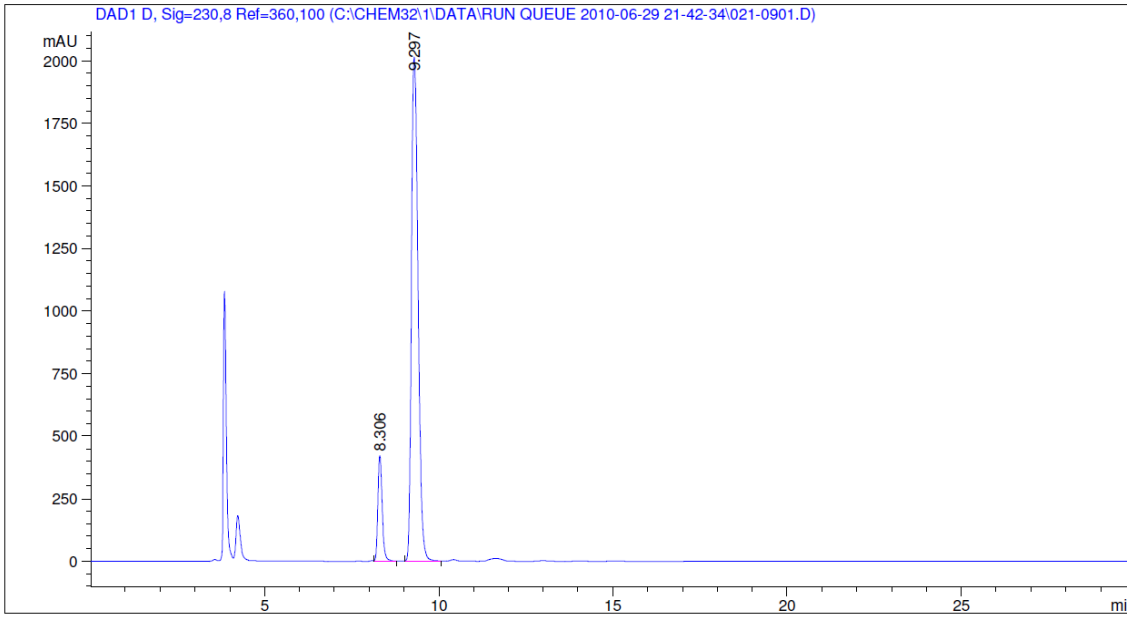



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   7.996 BB    0.1637 1.40517e4  1325.03333  85.6526
   2   9.071 BB    0.1916 2353.75732  188.58267  14.3474
```

Entry 12

Enantioenriched using (+)-menthol

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   9
Acq. Instrument : Kev HPLC 1                     Location : Vial 21
Injection Date  : 6/30/2010 12:43:40 AM               Inj :   1
                                                Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-29 21-42-34\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 6/30/2010 12:43:30 AM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed    : 6/29/2010 9:32:43 PM by General sequence
Method Info     : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```

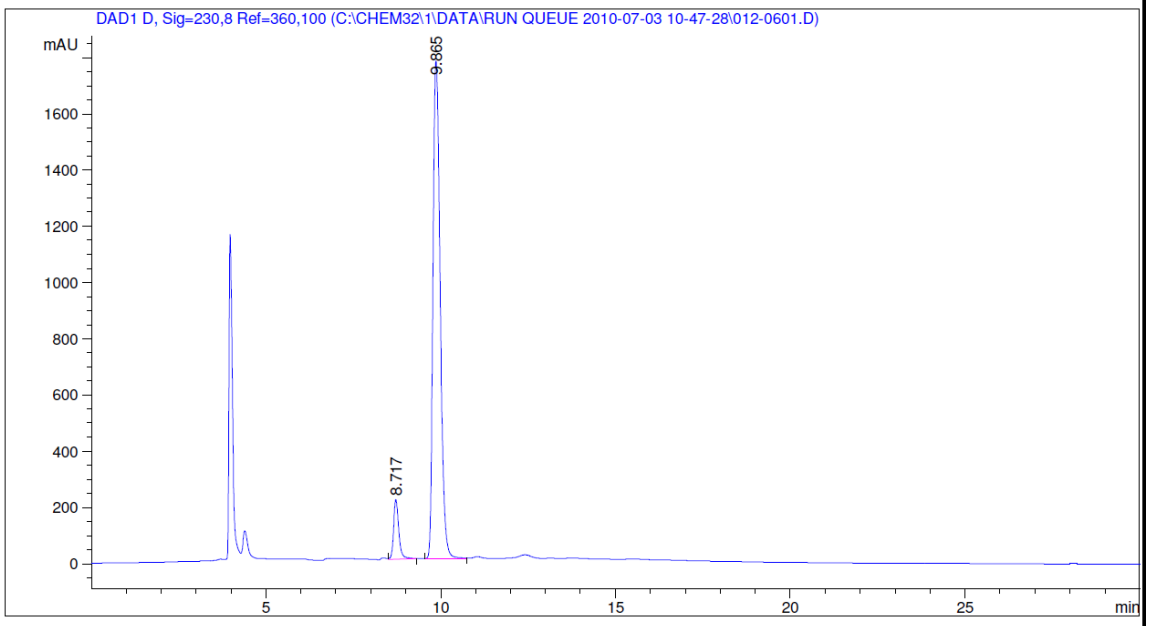



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.306 VB    0.1316 3604.08301  422.18564  11.9773
   2   9.297 VB    0.2055 2.64870e4  2013.10217  88.0227
```

Entry 13

Enantioenriched using (+)-isomenthol

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   6
Acq. Instrument : Kev HPLC 1                    Location : Vial 12
Injection Date  : 7/3/2010 12:33:38 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-07-03 10-47-28\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 7/3/2010 12:33:27 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed    : 7/3/2010 2:11:48 AM by General sequence
                  (modified after loading)
Method Info     : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```

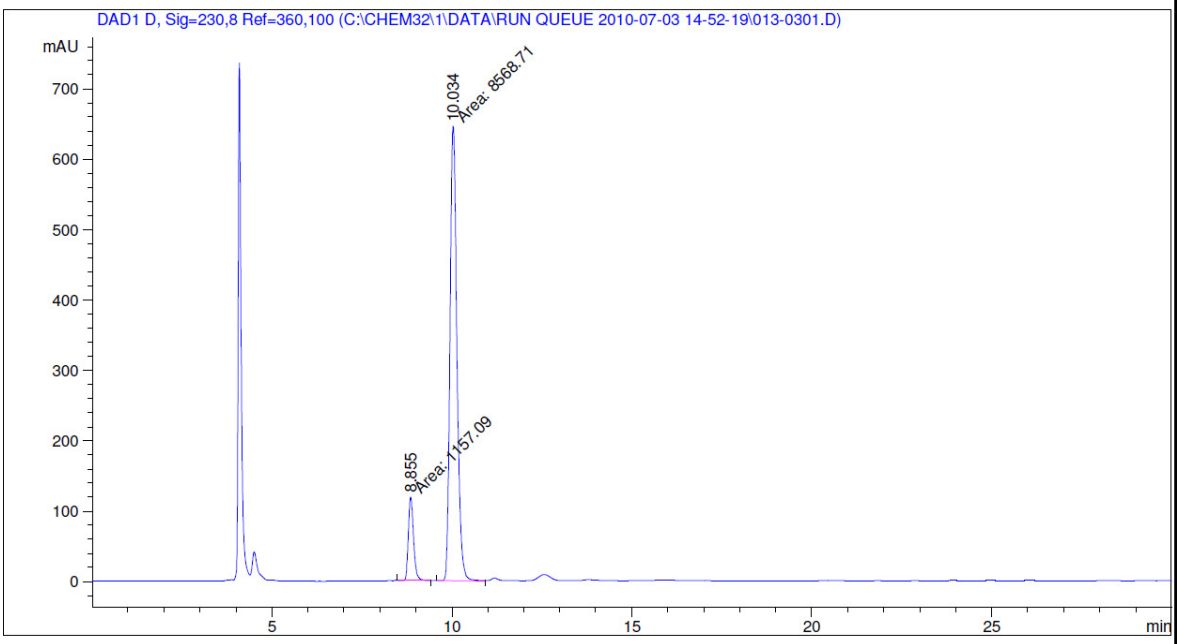



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.717 VB    0.1570 2204.11548  212.46716   8.0375
   2   9.865 BB    0.2221 2.52188e4  1771.23987  91.9625
```

Entry 14

Enantioenriched using (+)-neomenthol

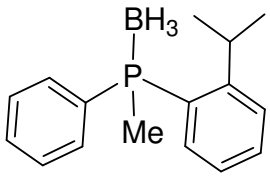
```
======================================================================
Acq. Operator    : General sequence              Seq. Line :   3
Acq. Instrument  : Kev HPLC 1                     Location : Vial 13
Injection Date   : 7/3/2010 3:25:14 PM                 Inj :   1
                                                Inj Volume : 5 µl
Acq. Method      : C:\Chem32\1\DATA\RUN QUEUE 2010-07-03 14-52-19\ISO_98_02_30MIN_1MLMIN.M
Last changed     : 7/3/2010 3:25:02 PM by General sequence
                   (modified after loading)
Analysis Method  : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed     : 7/3/2010 2:11:48 AM by General sequence
                   (modified after loading)
Method Info      : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```

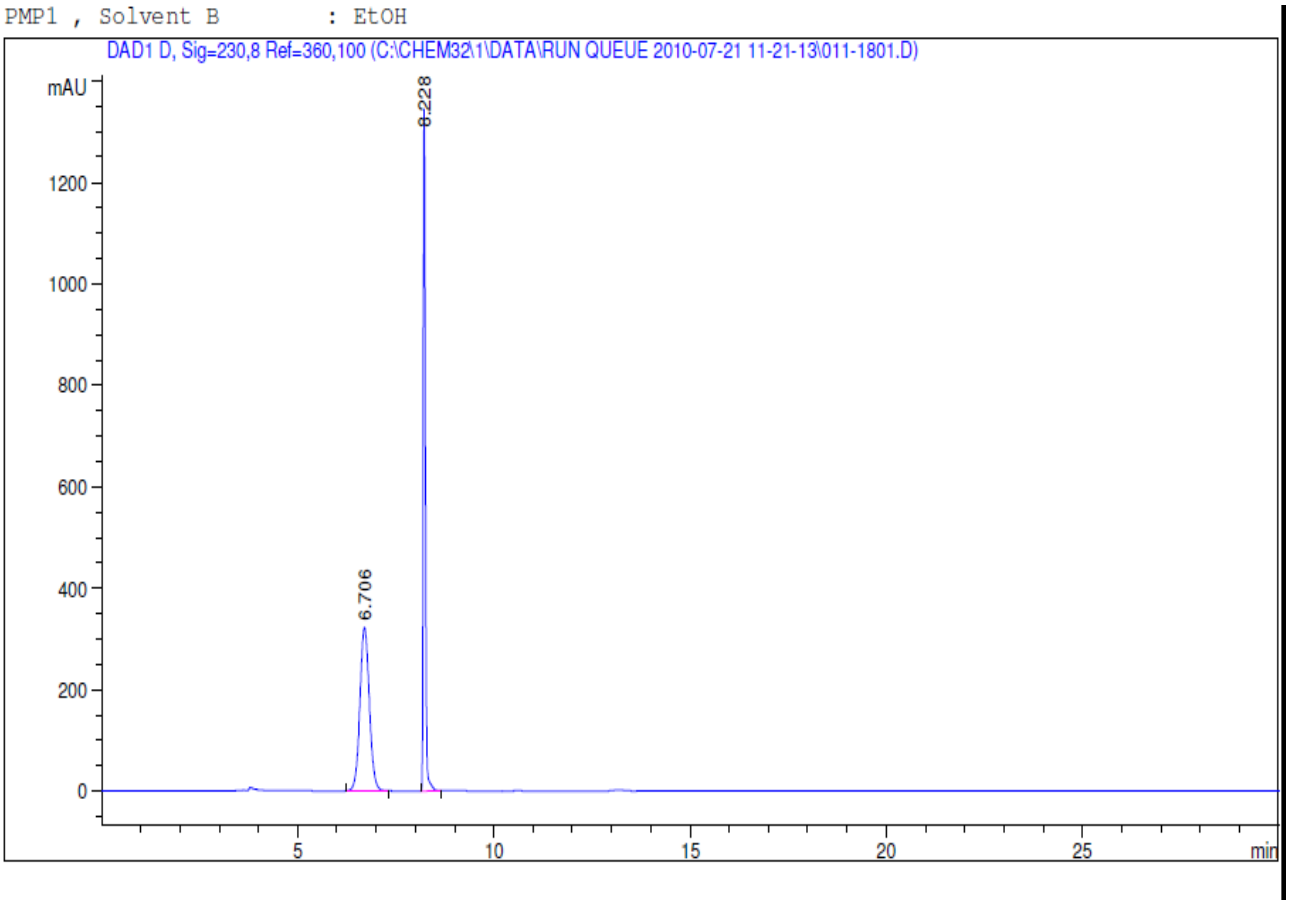



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]    [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.855 MM    0.1625 1157.08789  118.63963  11.8971
   2  10.034 MM    0.2212 8568.71484  645.69299  88.1029
```

Ar = 2-isopropylphenyl

Racemic





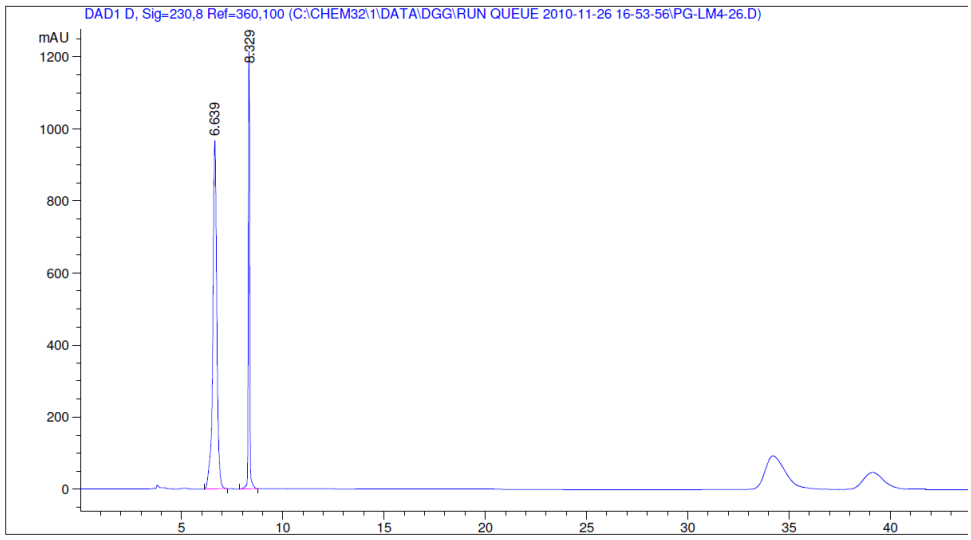
Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.706	BB	0.2578	5412.32080	322.45352	50.4836
2	8.228	BB	0.0619	5308.62305	1348.78296	49.5164
Totals :				1.07209e4	1671.23648	

Entry 15

Enantioenriched using (-)-menthol (NaBH4 as reductant)

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   6
Acq. Instrument : Kev HPLC 1                    Location : Vial 63
Injection Date  : 11/26/2010 6:54:29 PM              Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-11-26 16-53-56\ISO_98_02_45MIN_1MLMIN.M
Last changed    : 11/26/2010 6:54:18 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\SELECT IA COLUMN.M
Last changed    : 11/26/2010 7:56:29 PM by General sequence
Method Info     : Select IA column
```

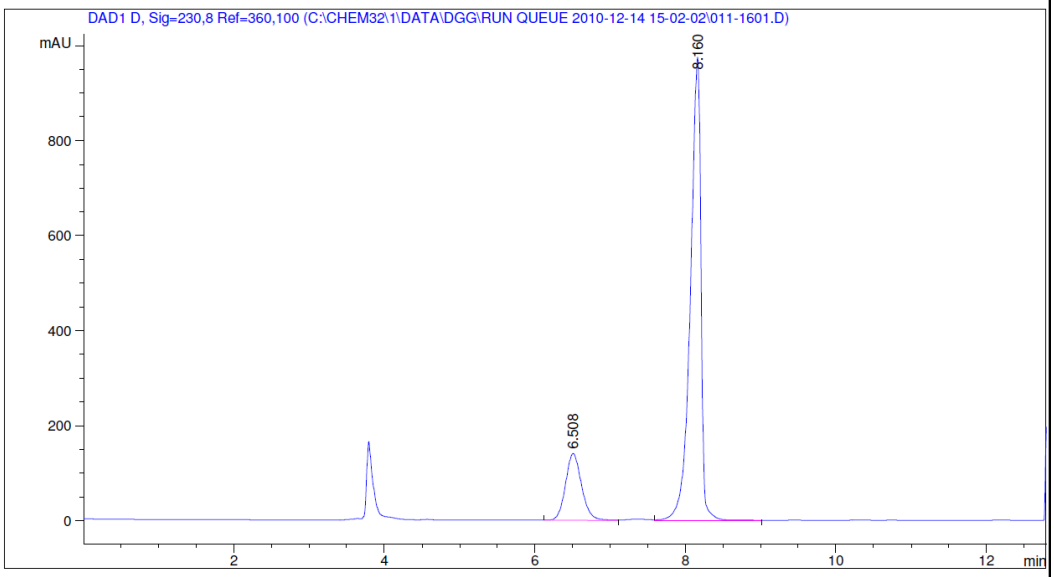



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.639 BB    0.2005 1.31445e4   967.59772  70.2318
   2   8.329 BB    0.0694 5571.37842 1218.07849  29.7682
```

Entry 16

Enantioenriched using (+)-menthol

```
=====================================================================
Acq. Operator   : General sequence              Seq. Line :  16
Acq. Instrument : Kev HPLC 1                    Location : Vial 11
Injection Date  : 12/14/2010 11:21:16 PM            Inj :   1
                                                Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-04-21 18-10-30\RUN QUEUE 2010-12-14 15-02-
                  02\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 12/14/2010 11:21:04 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\SELECT IA COLUMN.M
Last changed    : 11/30/2010 9:11:53 AM by General sequence
                  (modified after loading)
Method Info     : Select IA column
```

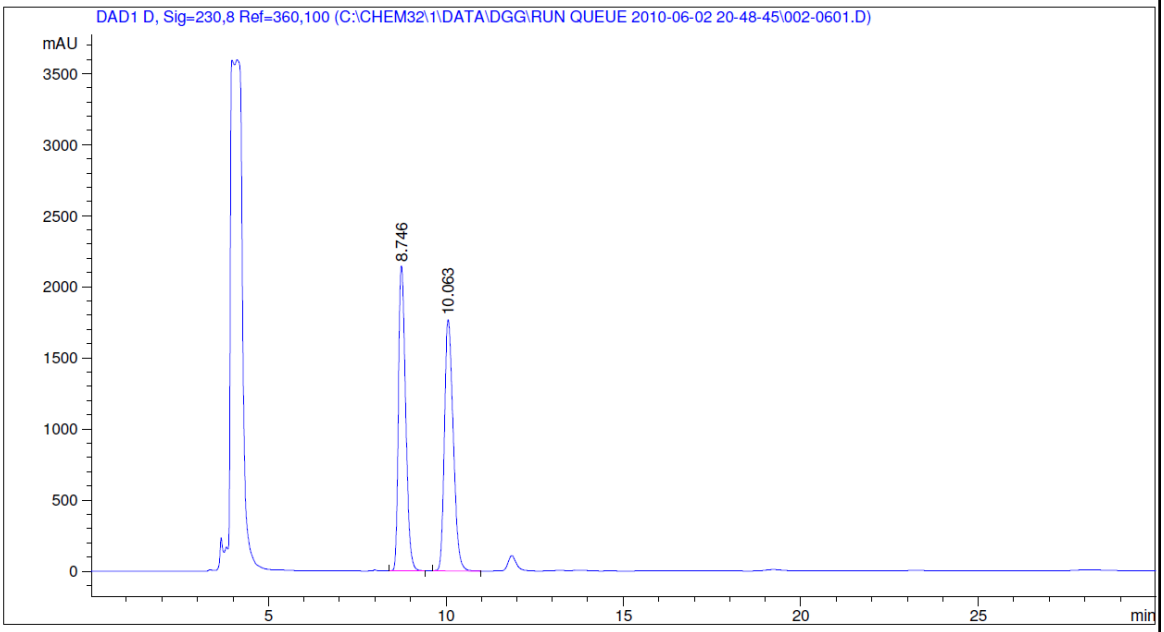



```
=====================================================================
                        Area Percent Report
=====================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.508 VV    0.2269 2081.57104  140.47777  18.0134
   2   8.160 VB    0.1474 9474.08301  975.08246  81.9866
```

Ar = 2-biphenyl

Racemic

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   6
Acq. Instrument : Kev HPLC 1                    Location : Vial 2
Injection Date  : 6/2/2010 10:34:56 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-04-21 18-10-30\RUN QUEUE 2010-06-02 20-48-
                  45\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 6/2/2010 10:34:46 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\03_QUICKSTART 1 MLMIN METHODS\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/20/2010 11:50:38 AM by General sequence
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

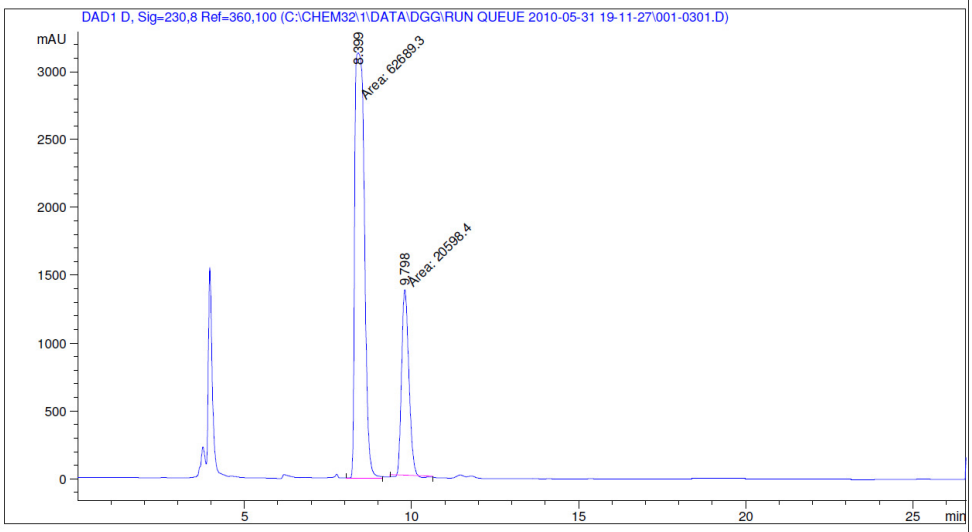



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.746 VB    0.2174 3.00823e4  2148.21655  49.6276
   2  10.063 BB    0.2695 3.05337e4  1767.96008  50.3724
```

Entry 17

Enantioenriched using (-)-menthol ($NaBH_4$ as reductant)

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   3
Acq. Instrument : Kev HPLC 1                    Location : Vial 1
Injection Date  : 5/31/2010 7:44:23 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-04-21 18-10-30\RUN QUEUE 2010-05-31 19-11-
                  27\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 5/31/2010 7:44:12 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed    : 6/29/2010 9:32:43 PM by General sequence
Method Info     : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```

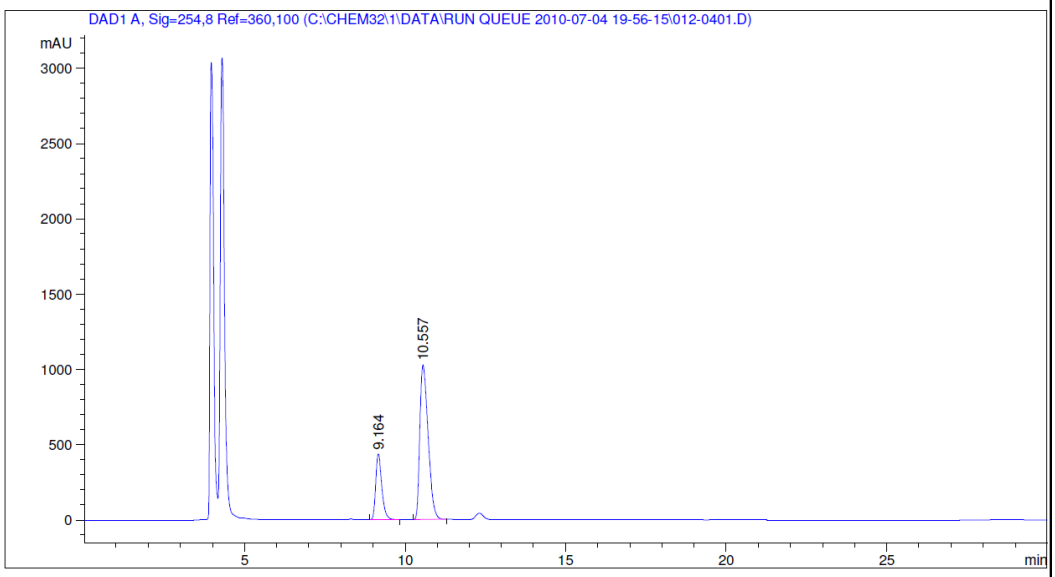



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.399 MM    0.3334 6.26893e4  3133.59351  75.2684
   2   9.798 MM    0.2514 2.05984e4  1365.67688  24.7316
```

Entry 18

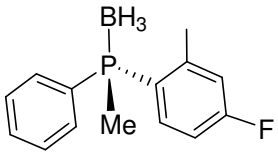
Enantioenriched using (+)-menthol ($NaBH_4$ as reductant)

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   4
Acq. Instrument : Kev HPLC 1                    Location : Vial 12
Injection Date  : 7/4/2010 9:10:25 PM                Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-07-04 19-56-15\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 7/4/2010 9:10:12 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed    : 7/3/2010 2:11:48 AM by General sequence
                  (modified after loading)
Method Info     : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```



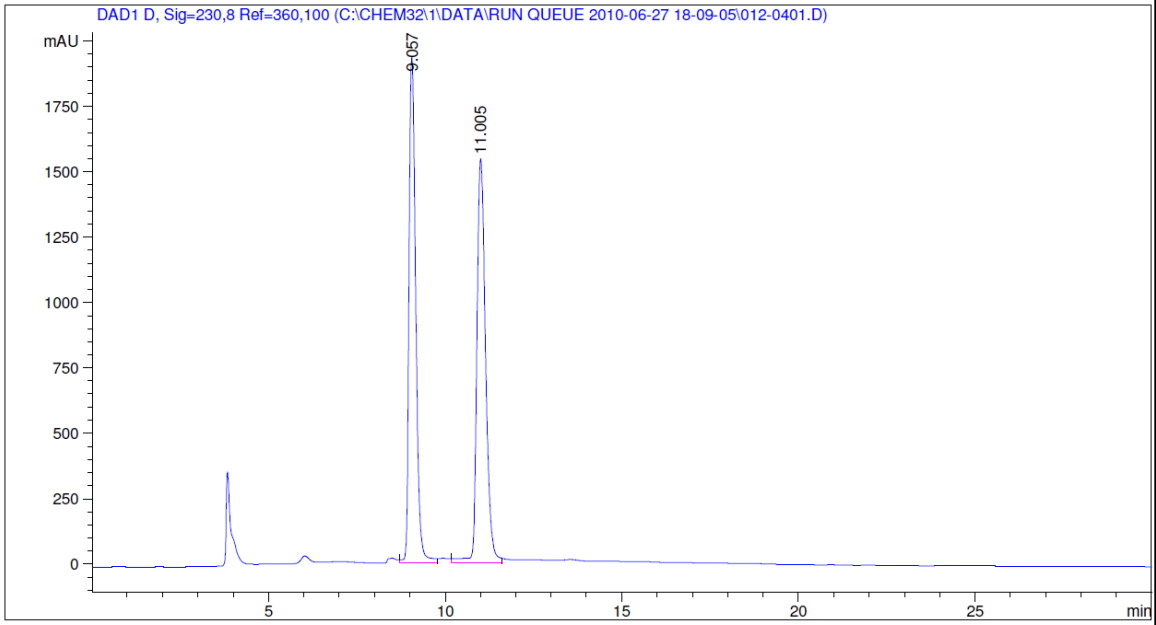

```
======================================================================
                      Area Percent Report
======================================================================

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


Signal 1: DAD1 A, Sig=254,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.164 BB    0.2043 5782.34521  437.32153  23.8184
   2  10.557 BB    0.2817 1.84945e4  1029.13379  76.1816
```

Ar = 4-fluoro-2-methylphenyl



Racemic

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   4
Acq. Instrument : Kev HPLC 1                    Location : Vial 12
Injection Date  : 6/27/2010 7:23:21 PM               Inj :   1
                                               Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-06-27 18-09-05\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 6/27/2010 7:23:09 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\03_QUICKSTART 1 MLMIN METHODS\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 6/23/2010 10:22:59 AM by General sequence
                  (modified after loading)
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

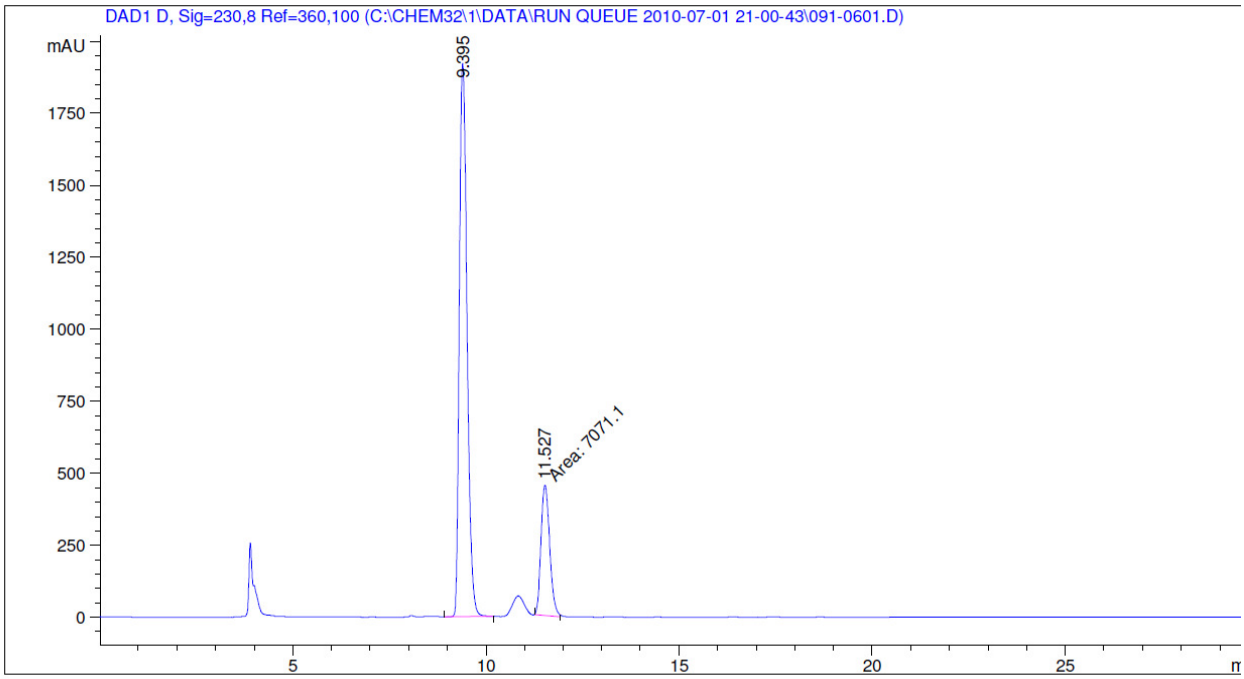



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.057 VB    0.2060 2.55190e4  1933.06165  49.0175
   2  11.005 VBA   0.2663 2.65420e4  1545.97217  50.9825
```

Entry 19

Enantioenriched using (-)-menthol

```
======================================================================
Acq. Operator    : General sequence              Seq. Line :   6
Acq. Instrument  : Kev HPLC 1                     Location : Vial 91
Injection Date   : 7/1/2010 10:46:49 PM                Inj :   1
                                                Inj Volume : 5 µl
Acq. Method      : C:\Chem32\1\DATA\RUN QUEUE 2010-07-01 21-00-43\ISO_98_02_30MIN_1MLMIN.M
Last changed     : 7/1/2010 10:46:38 PM by General sequence
                   (modified after loading)
Analysis Method  : C:\CHEM32\1\METHODS\01_COLUMN METHODS\STABILISE_98_02_10MIN_1MLMIN.M
Last changed     : 6/29/2010 9:32:43 PM by General sequence
Method Info      : Stabilise column at 99/1 heptane/EtOH for 10min at 1ml/min
```



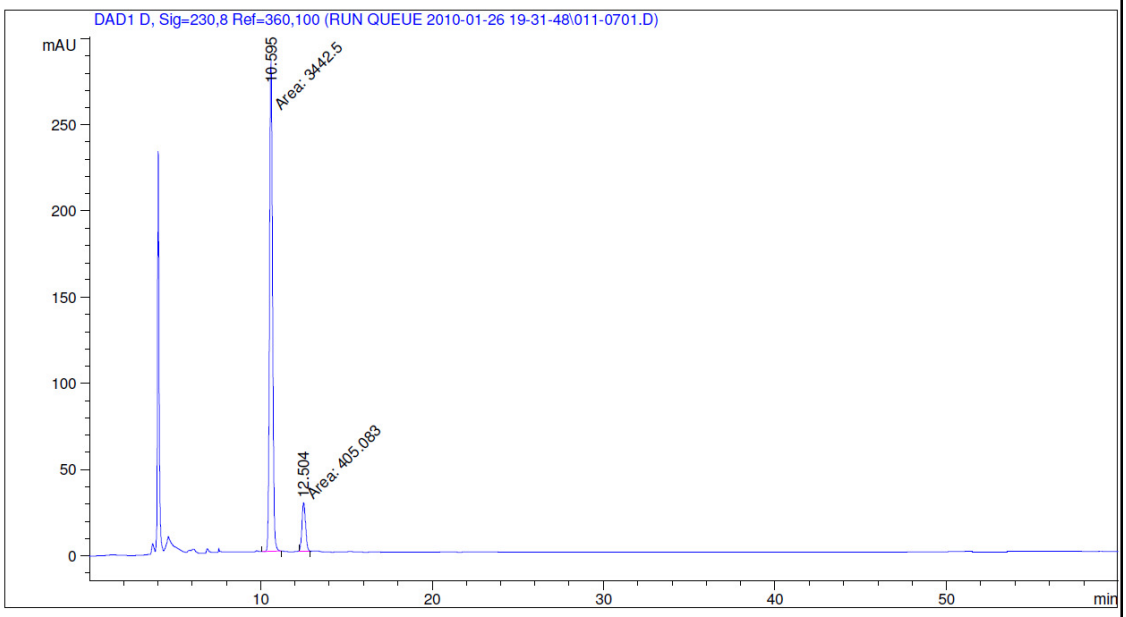

```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.395 VB    0.2172 2.65441e4  1921.01575  78.9646
   2  11.527 MM    0.2599 7071.10059  453.36371  21.0354
```

Supporting HPLC Traces Corresponding to Results in Table 1 Scalmeic **D**

Entry 1

Enantioenriched using (-)-menthol

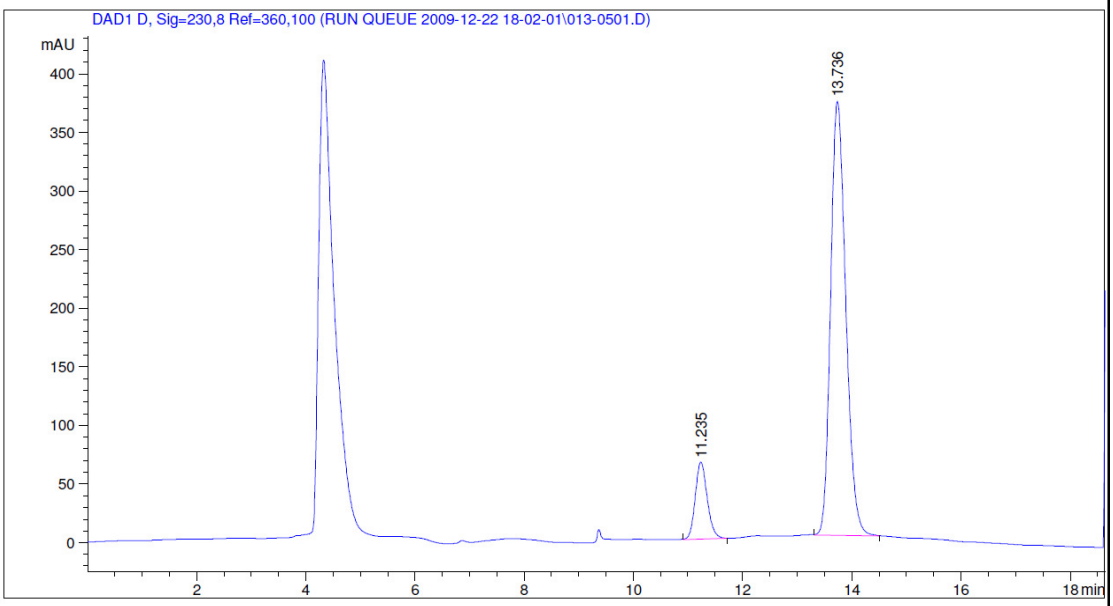
```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   7
Acq. Instrument : Kev HPLC 1                    Location : Vial 11
Injection Date  : 1/26/2010 8:39:39 PM               Inj :   1
                                                Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-01-26 19-31-48\ISO_98_02_60MIN_1MLMIN.M
Last changed    : 1/26/2010 8:39:28 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\DATA\RUN QUEUE 2010-01-26 19-31-48\011-0701.D\DA.M (ISO_98_02_
                  60MIN_1MLMIN.M)
Last changed    : 1/27/2010 9:53:55 AM by General sequence
Method Info     : Isocratic at 98/02 heptane/EtOH for 60min at 1ml/min
```




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

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.595 MM    0.2017 3442.50464  284.45837  89.4718
   2  12.504 MM    0.2409  405.08322   28.02859  10.5282
```

Entry 2

Enantioenriched using (+)-menthol

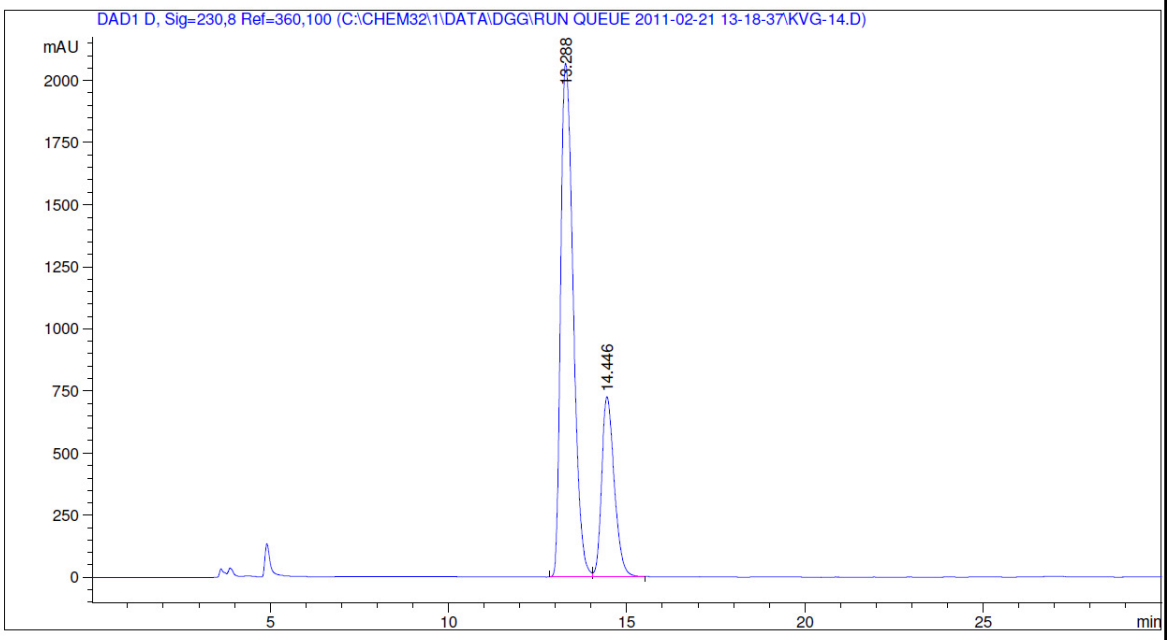



```
=====================================================================
                        Area Percent Report
=====================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.235 BB    0.2358  999.67938   65.57795  12.2461
   2  13.736 BB    0.3017 7163.58252  370.36810  87.7539
```

Entry 6

Enantioenriched using (-)-menthol

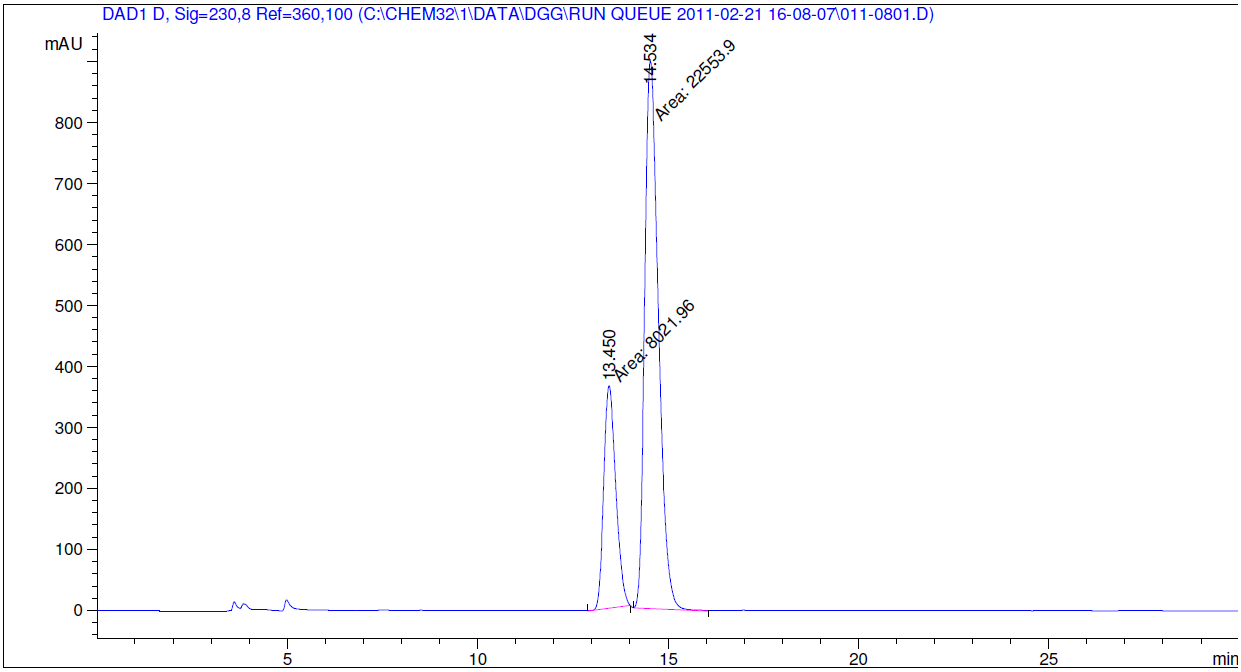
```
======================================================================
Acq. Operator   : KV                          Seq. Line :   3
Acq. Instrument : Kev HPLC 1                   Location : Vial 11
Injection Date  : 2/21/2011 1:51:35 PM              Inj :   1
                                              Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\DGG\RUN QUEUE 2011-02-21 13-18-37\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 2/21/2011 1:51:24 PM by KV
                  (modified after loading)
Analysis Method : C:\CHEM32\1\DATA\DGG\RUN QUEUE 2011-02-21 13-18-37\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 2/21/2011 3:18:13 PM by KV
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```




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

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]    [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  13.288 BV    0.3843 5.04041e4  2068.42871  73.9150
   2  14.446 VB    0.3803 1.77879e4   724.90161  26.0850
```

Entry 7

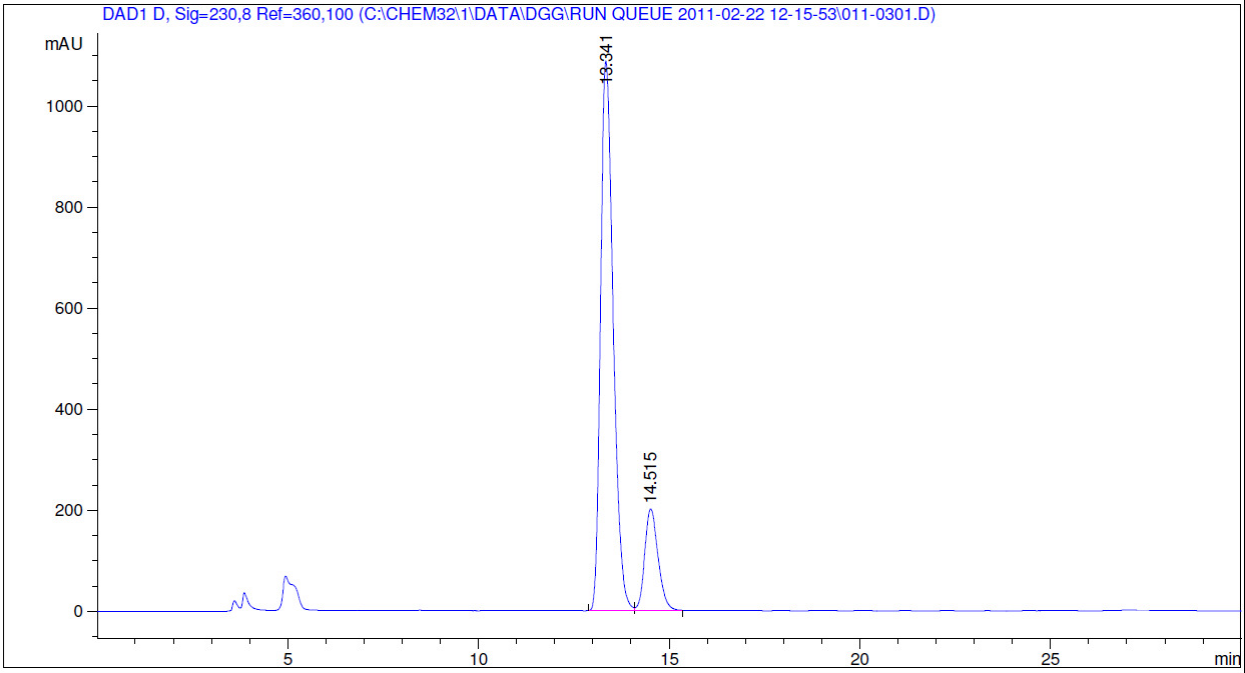
Enantioenriched using (+)-menthol




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

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  13.450 MM    0.3663 8021.96191  364.98315  26.2363
   2  14.534 MM    0.4183 2.25539e4   898.59552  73.7637
```

Entry 8

Enantioenriched using (-)-8-phenylmenthol

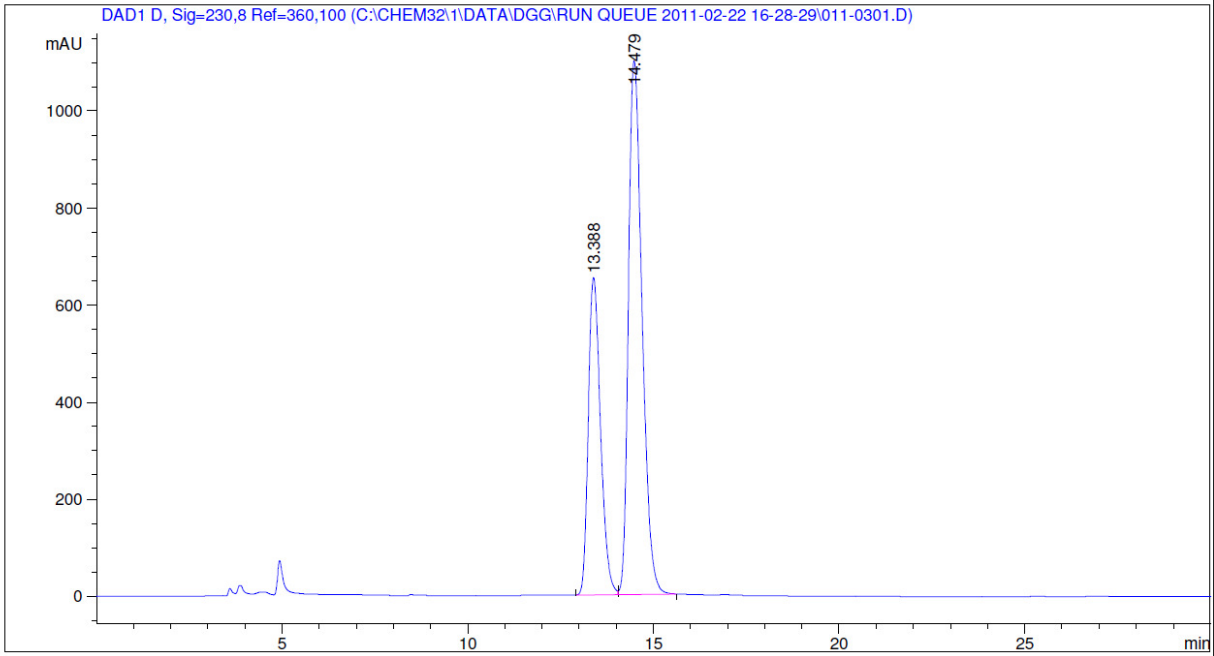



```
=====================================================================
                      Area Percent Report
=====================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  13.341 BV    0.3565 2.50451e4  1088.05994  83.5931
   2  14.515 VB    0.3751 4915.63623  201.12798  16.4069
```

Entry 9

Enantioenriched using (+)-isomenthol

Method Info : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min



==========

Area Percent Report

==========

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

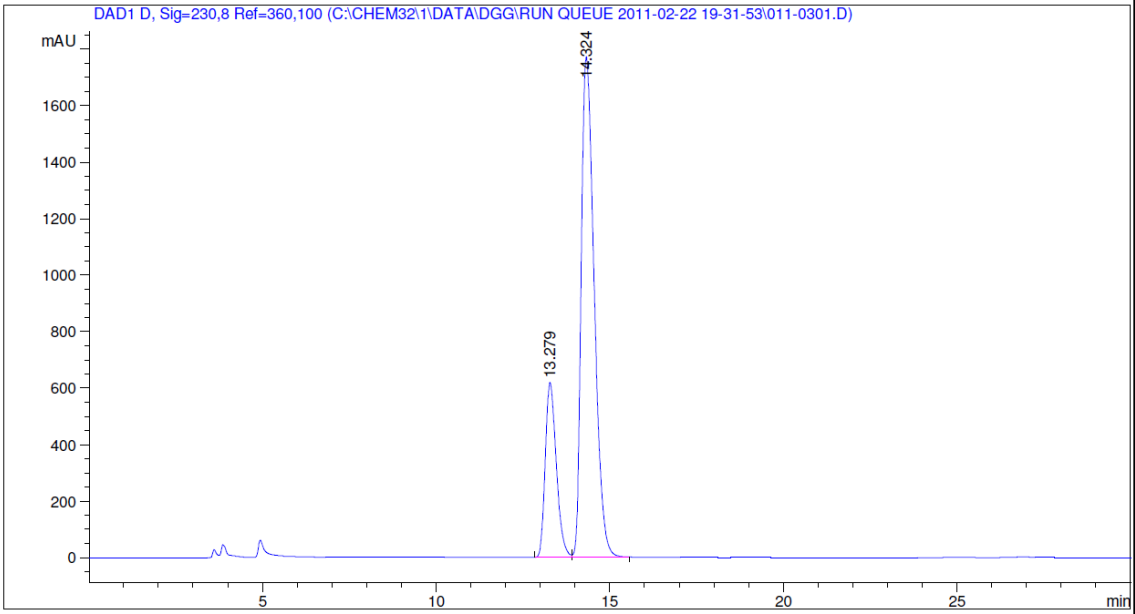
Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.388	BV	0.3547	1.49509e4	654.08862	34.8429
2	14.479	VB	0.3945	2.79586e4	1099.92725	65.1571

Entry 10

Enantioenriched using (+)-neomenthol

```
======================================================================
Acq. Operator   : KV                          Seq. Line :   3
Acq. Instrument : Kev HPLC 1                   Location : Vial 11
Injection Date  : 2/22/2011 8:07:22 PM              Inj :   1
                                              Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\DGG\RUN QUEUE 2011-02-22 19-31-53\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 2/22/2011 8:07:12 PM by KV
                  (modified after loading)
Analysis Method : C:\CHEM32\1\DATA\DGG\RUN QUEUE 2011-02-22 19-31-53\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 2/23/2011 9:08:30 AM by KV
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

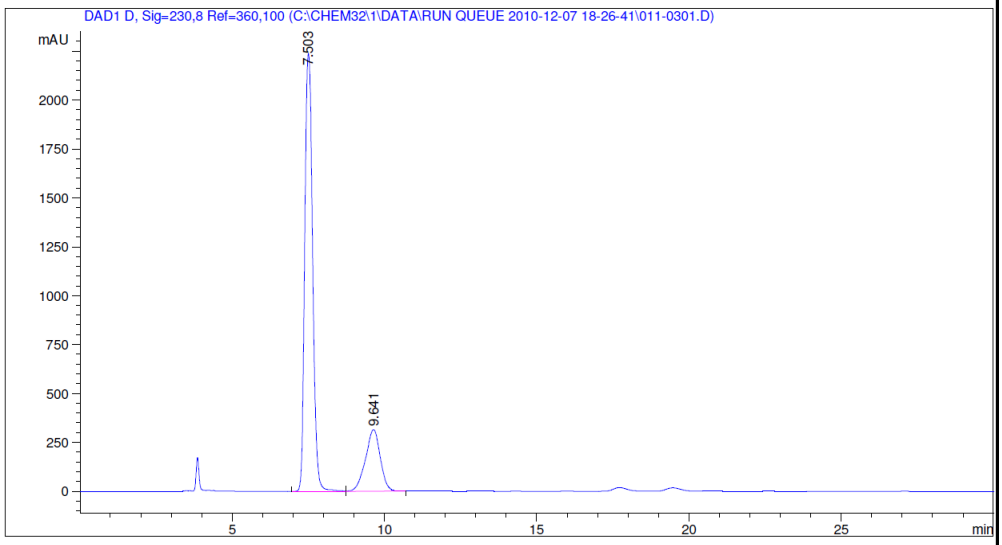



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  13.279 BV    0.3400 1.37033e4   619.59167  22.9996
   2  14.324 VB    0.4041 4.58775e4  1771.54102  77.0004
```

Entry 11

Enantioenriched using (-)-menthol

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :   3
Acq. Instrument : Kev HPLC 1                    Location : Vial 11
Injection Date  : 12/7/2010 7:19:45 PM               Inj :   1
                                                Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-12-07 18-26-41\ISO_99_01_30MIN_1MLMIN.M
Last changed    : 12/7/2010 6:38:59 PM by General sequence
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\SELECT IA COLUMN.M
Last changed    : 11/30/2010 9:11:53 AM by General sequence
                  (modified after loading)
Method Info     : Select IA column
```

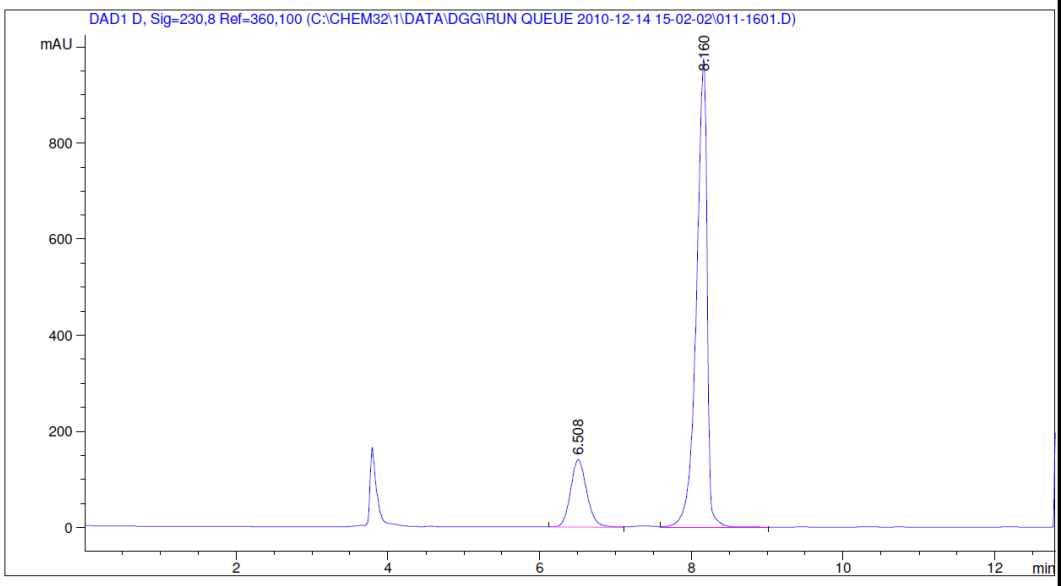



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   7.503 VV    0.2845 3.99992e4  2237.73389  78.9461
   2   9.641 VB    0.5063 1.06673e4   315.64572  21.0539
```

Entry 12

Enantioenriched using (+)-menthol

```
======================================================================
Acq. Operator   : General sequence              Seq. Line :  16
Acq. Instrument : Kev HPLC 1                    Location : Vial 11
Injection Date  : 12/14/2010 11:21:16 PM             Inj :   1
                                                Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2010-04-21 18-10-30\RUN QUEUE 2010-12-14 15-02-
                  02\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 12/14/2010 11:21:04 PM by General sequence
                  (modified after loading)
Analysis Method : C:\CHEM32\1\METHODS\01_COLUMN METHODS\SELECT IA COLUMN.M
Last changed    : 11/30/2010 9:11:53 AM by General sequence
                  (modified after loading)
Method Info     : Select IA column
```

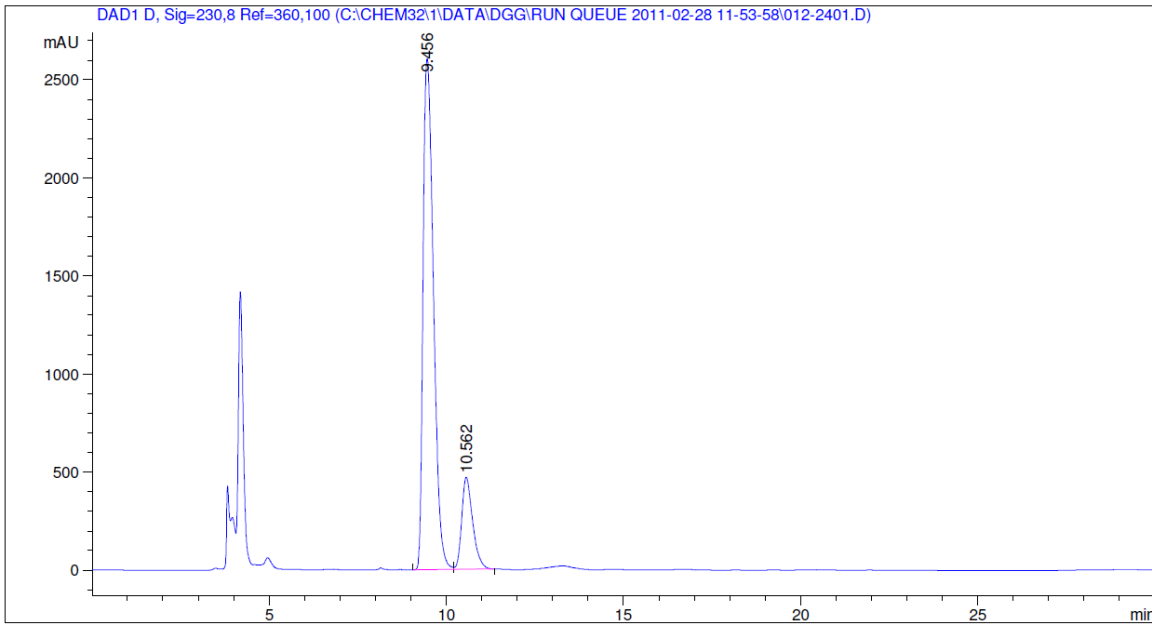



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.508 VV    0.2269 2081.57104  140.47777  18.0134
   2   8.160 VB    0.1474 9474.08301  975.08246  81.9866

Totals :                  1.15557e4  1115.56023
```

Entry 15

Enantioenriched using (-)-menthol ($LiAlH_4$ as reductant)

```
======================================================================
Acq. Operator   : KV                          Seq. Line :  24
Acq. Instrument : Kev HPLC 1                   Location : Vial 12
Injection Date  : 2/28/2011 9:29:41 PM              Inj :   1
                                              Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\DGG\RUN QUEUE 2011-02-28 11-53-58\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 2/28/2011 9:29:30 PM by KV
                  (modified after loading)
Analysis Method : C:\CHEM32\1\DATA\DGG\RUN QUEUE 2011-02-28 11-53-58\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 3/1/2011 9:03:17 AM by KV
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

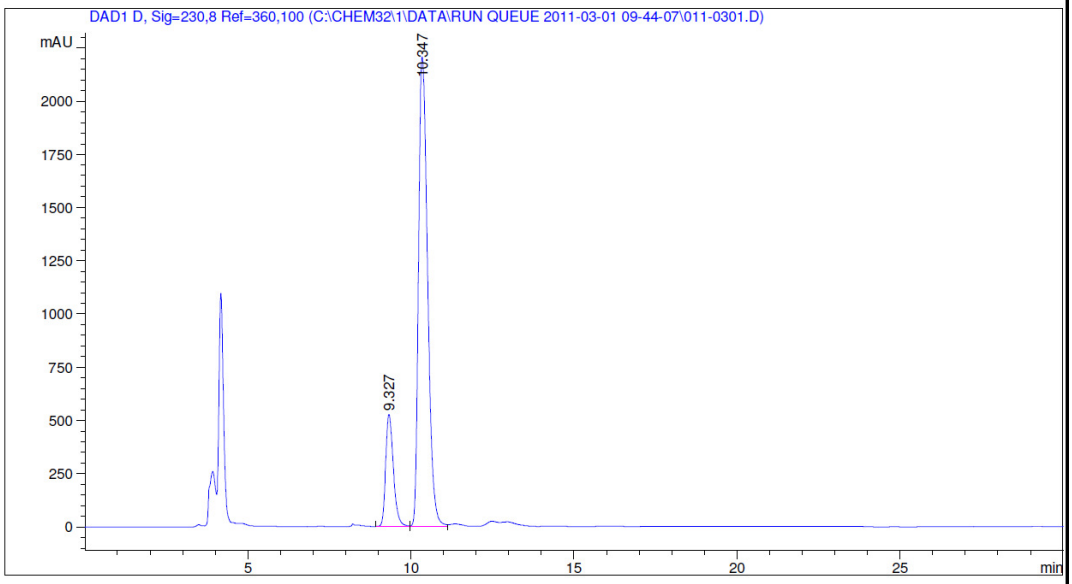



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.456 BV    0.3188 5.28854e4  2605.26904  83.9893
   2  10.562 VB    0.3264 1.00815e4   469.67587  16.0107
```

Entry 16

Enantioenriched using (+)-menthol

```
======================================================================
Acq. Operator    : K                              Seq. Line :   3
Acq. Instrument : Kev HPLC 1                       Location : Vial 11
Injection Date  : 3/1/2011 10:16:59 AM                 Inj :   1
                                                  Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\RUN QUEUE 2011-03-01 09-44-07\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 3/1/2011 10:16:49 AM by K
                  (modified after loading)
Analysis Method : C:\CHEM32\1\DATA\RUN QUEUE 2011-03-01 09-44-07\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 3/1/2011 11:02:40 AM by KV
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```

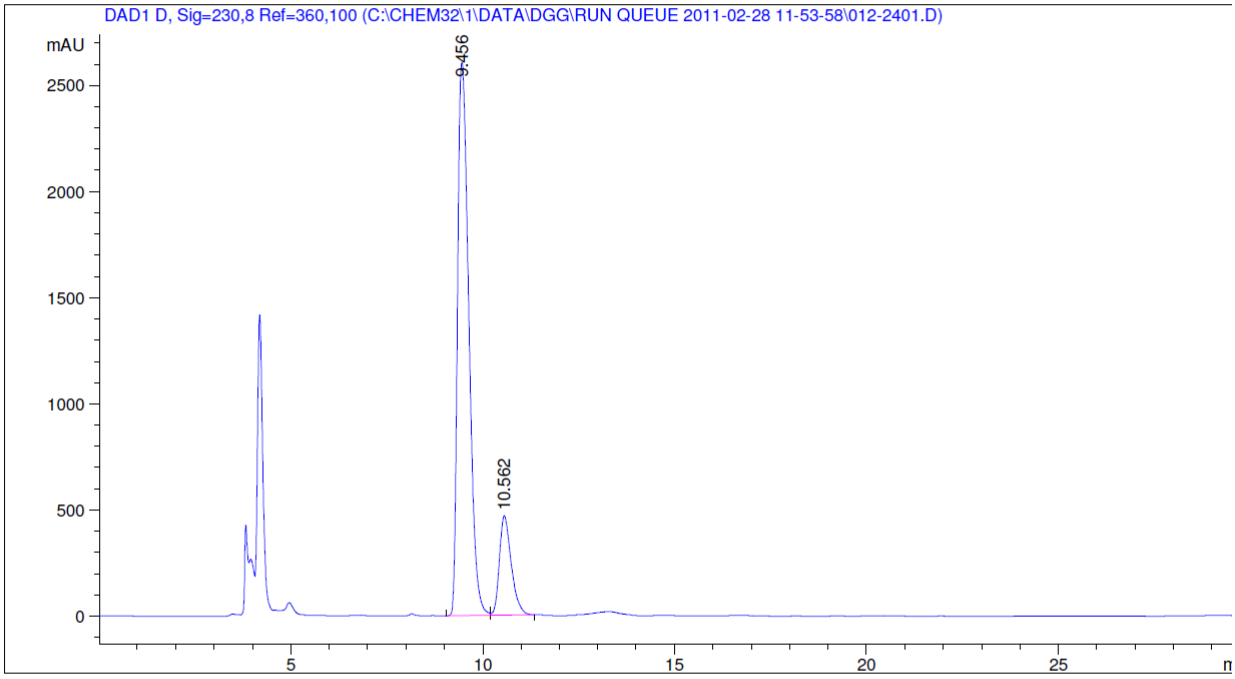



```
======================================================================
                        Area Percent Report
======================================================================

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.327 BV    0.2510 8633.30664  527.36957  16.8216
   2  10.347 VV    0.3037 4.26894e4  2206.27295  83.1784
```

Entry 17

Enantioenriched using (-)-menthol

```
======================================================================
Acq. Operator   : KV                              Seq. Line :  24
Acq. Instrument : Kev HPLC 1                       Location : Vial 12
Injection Date  : 2/28/2011 9:29:41 PM                  Inj :   1
                                                  Inj Volume : 5 µl
Acq. Method     : C:\Chem32\1\DATA\DGG\RUN QUEUE 2011-02-28 11-53-58\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 2/28/2011 9:29:30 PM by KV
                  (modified after loading)
Analysis Method : C:\CHEM32\1\DATA\DGG\RUN QUEUE 2011-02-28 11-53-58\ISO_98_02_30MIN_1MLMIN.M
Last changed    : 3/1/2011 9:03:17 AM by KV
Method Info     : Isocratic at 98/02 heptane/EtOH for 30min at 1ml/min
```




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

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


Signal 1: DAD1 D, Sig=230,8 Ref=360,100

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.456 BV    0.3188 5.28854e4  2605.26904  83.9893
   2  10.562 VB    0.3264 1.00815e4   469.67587  16.0107
```

References

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