Supporting Information

Asymmetric Formal Synthesis of the Long-acting DPP-4 Inhibitor Omarigliptin

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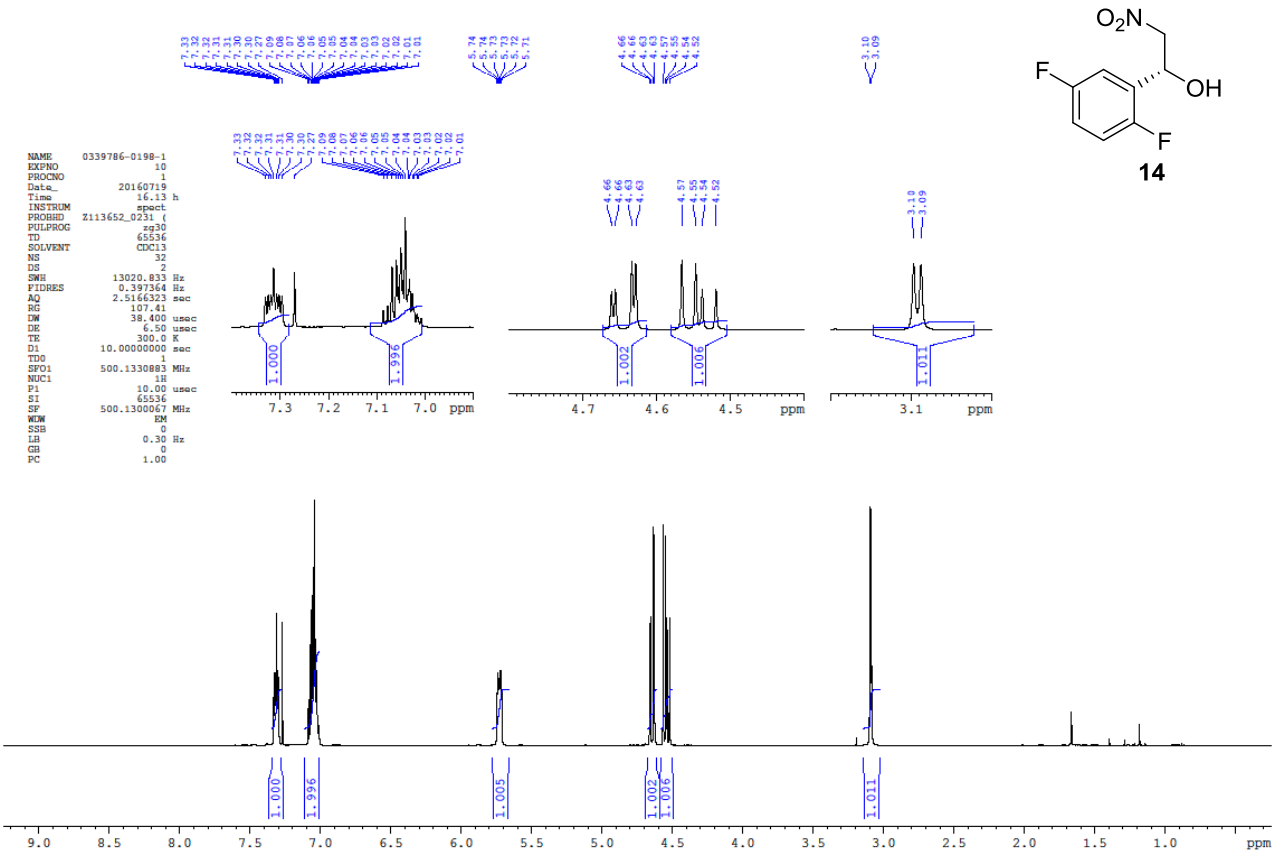
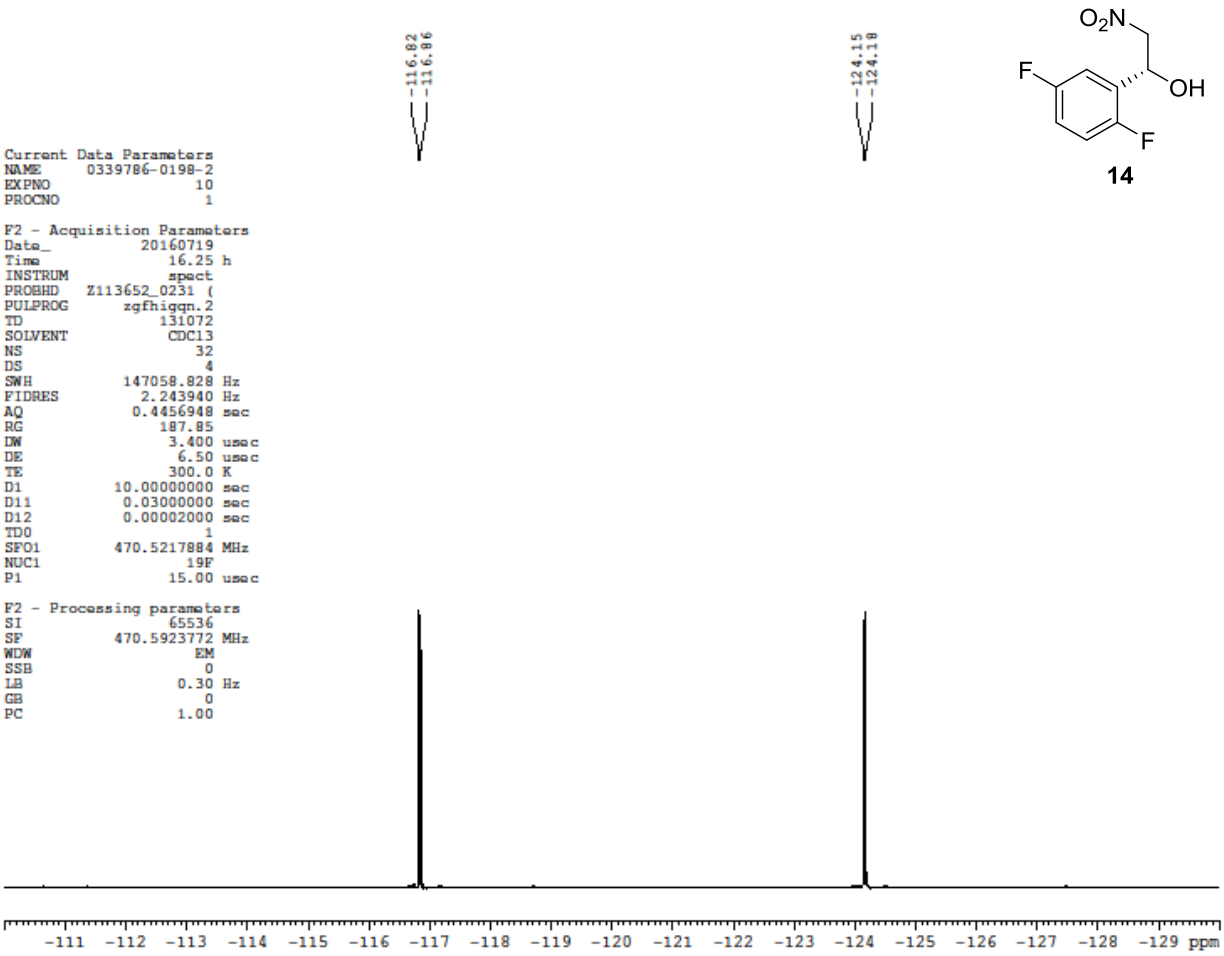
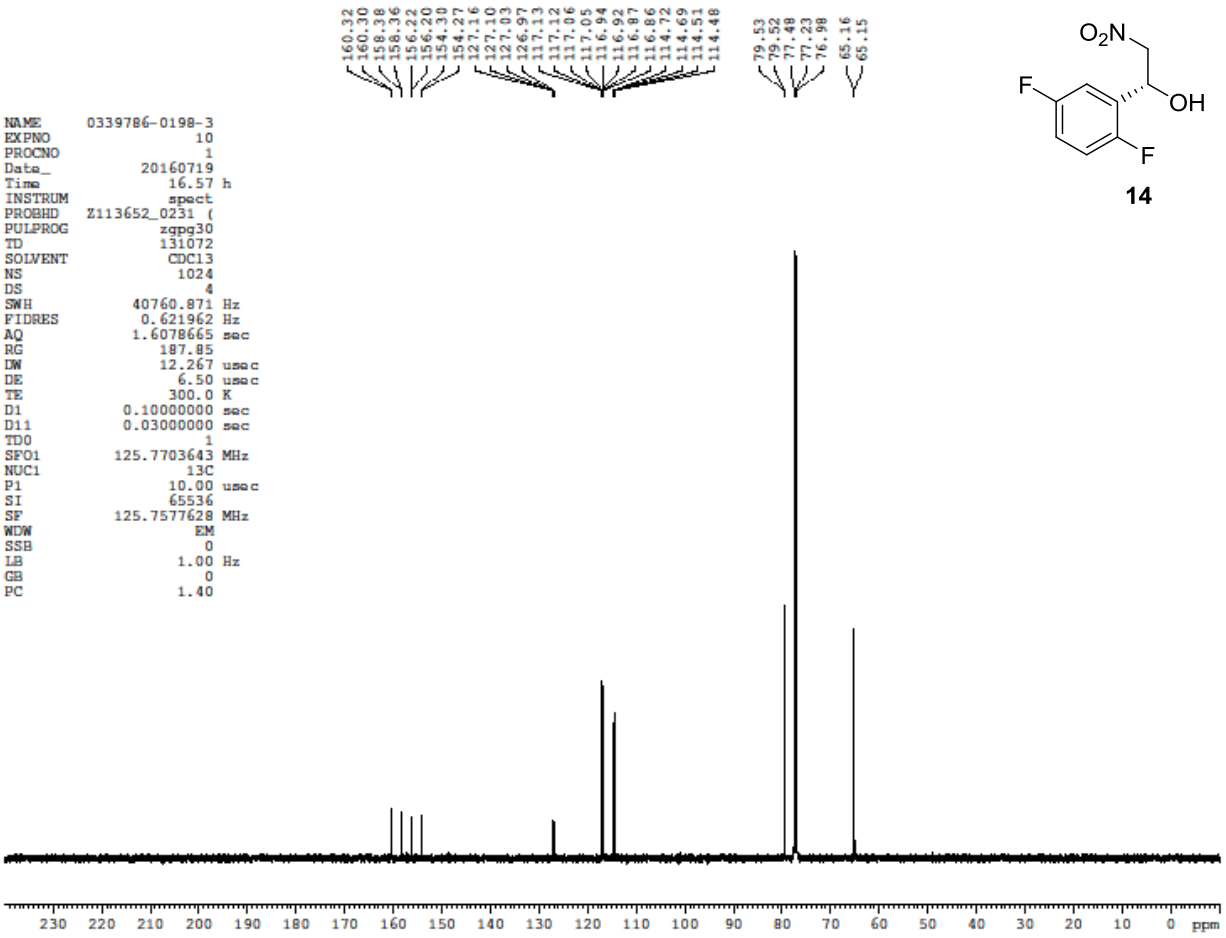

O2N
F
OH
F
14
NAME 0339786-0198-1
EXPNO 10
PROCNO 1
Date_ 20160719
Time 16.13 h
INSTRUM spect
PROBHD Z113652_0231 (
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 2
SWH 13020.833 Hz
FIDRES 0.397364 Hz
AQ 2.5166323 sec
RG 107.41
DW 38.400 usec
DE 6.50 usec
TE 300.0 K
D1 10.00000000 sec
TD0 1
SFO1 500.1330883 MHz
NUC1 1H
P1 10.00 usec
SI 65536
SF 500.1300067 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
1.000
1.996
1.002
1.006
1.011
ppm
1.000
1.996
1.005
1.002
1.006
1.011
ppm


-116.82
-116.96
-124.15
-124.18
O2N
F
OH
F
14
Current Data Parameters
NAME 0339786-0198-2
EXPNO 10
PROCNO 1
F2 - Acquisition Parameters
Date_ 20160719
Time 16.25 h
INSTRUM spect
PROBHD Z113652_0231 (
PULPROG zgfhigqn.2
TD 131072
SOLVENT CDCl3
NS 32
DS 4
SWH 147058.828 Hz
FIDRES 2.243940 Hz
AQ 0.4456948 sec
RG 187.85
DW 3.400 usec
DE 6.50 usec
TE 300.0 K
D1 10.00000000 sec
D11 0.03000000 sec
D12 0.00002000 sec
TD0 1
SFO1 470.5217884 MHz
NUC1 19F
P1 15.00 usec
F2 - Processing parameters
SI 65536
SF 470.5923772 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
-111 -112 -113 -114 -115 -116 -117 -118 -119 -120 -121 -122 -123 -124 -125 -126 -127 -128 -129 ppm


160.32
160.30
158.38
158.36
156.22
156.20
154.30
154.27
127.16
127.10
127.03
126.97
117.13
117.12
117.06
117.05
116.94
116.92
116.87
116.86
114.72
114.69
114.51
114.48
79.53
79.52
77.48
77.23
76.98
65.16
65.15
NAME 0339786-0198-3
EXPNO 10
PROCNO 1
Date_ 20160719
Time 16.57 h
INSTRUM spect
PROBHD Z113652_0231 (
PULPROG zgpg30
TD 131072
SOLVENT CDCl3
NS 1024
DS 4
SWH 40760.871 Hz
FIDRES 0.621962 Hz
AQ 1.6078665 sec
RG 187.85
DW 12.267 usec
DE 6.50 usec
TE 300.0 K
D1 0.10000000 sec
D11 0.03000000 sec
TD0 1
SFO1 125.7703643 MHz
NUC1 13C
P1 10.00 usec
SI 65536
SF 125.7577628 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

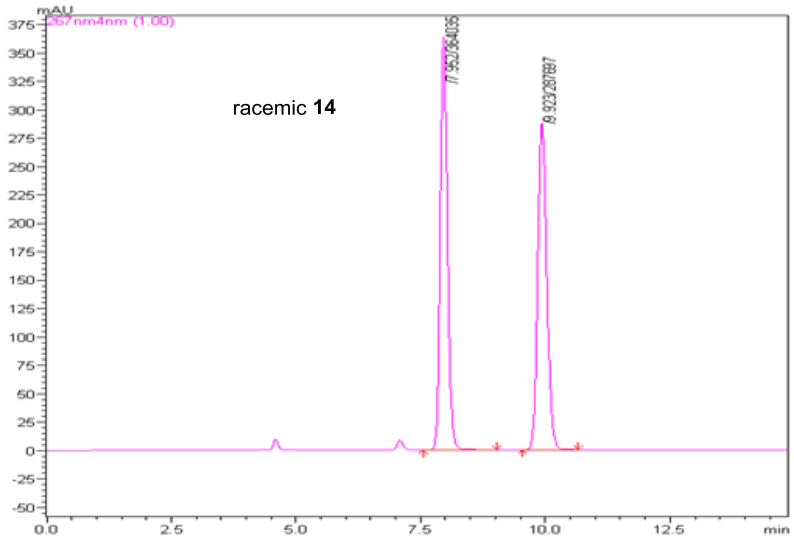
O2N
F
OH
F

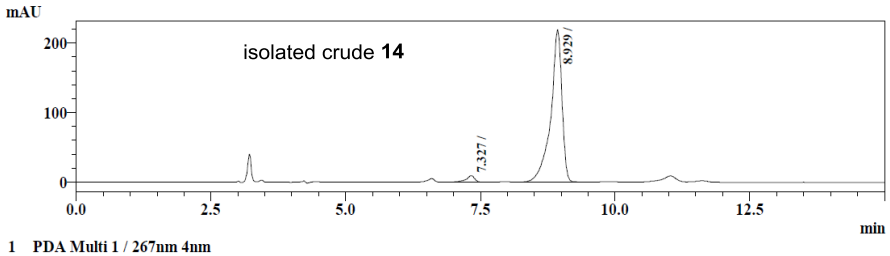
14

Chiral LC Assay of 14

Column	IA（25cm×4.6mm ID×5.0μm）
Mobile phase A	Hexane
Mobile phase B	EtOH
Temperature	40 °C
Gradient	Hold 15min at 10% B
Wavelength	267nm
Flow rate	1.0 mL/min
Injection Volume	3 μL
Solution preparation	5mg/mL
Diluent	Methanol
Chiral marker	**14**+enantiomer

Compound ID	**Retention Time (min)**	**Relative Retention Time (RRT)**
Enantiomer of **14**	8.0	0.81
14	9.9	1.00

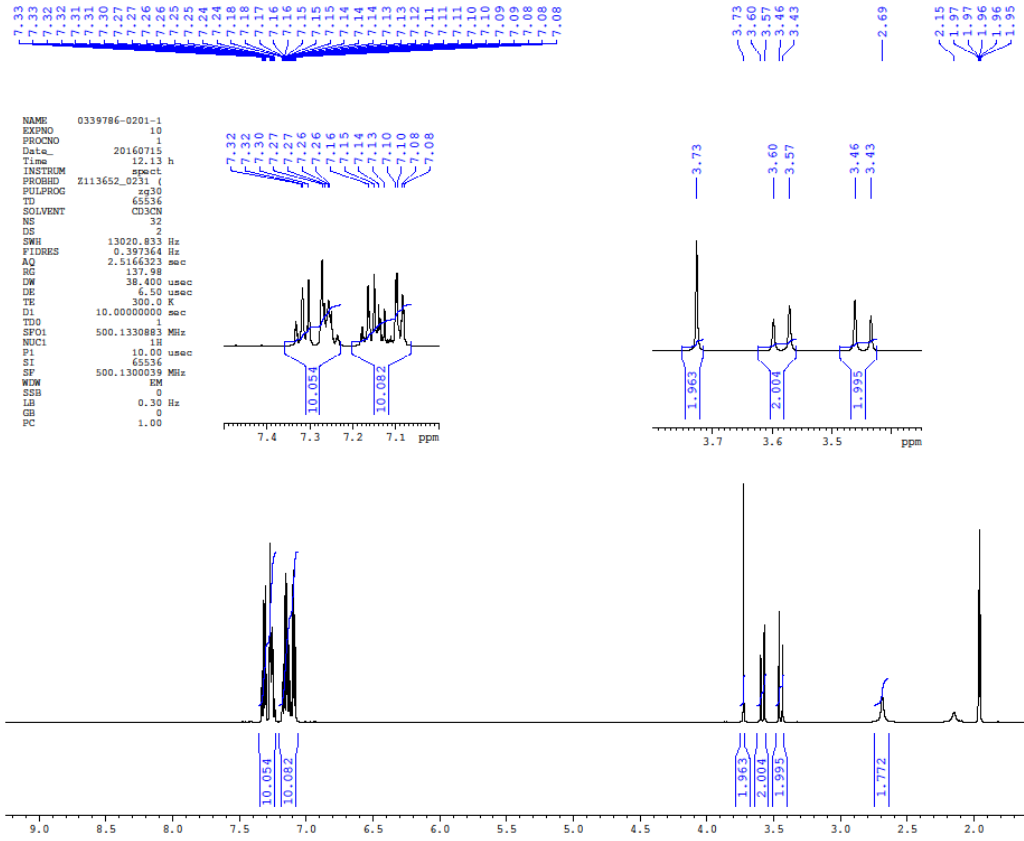


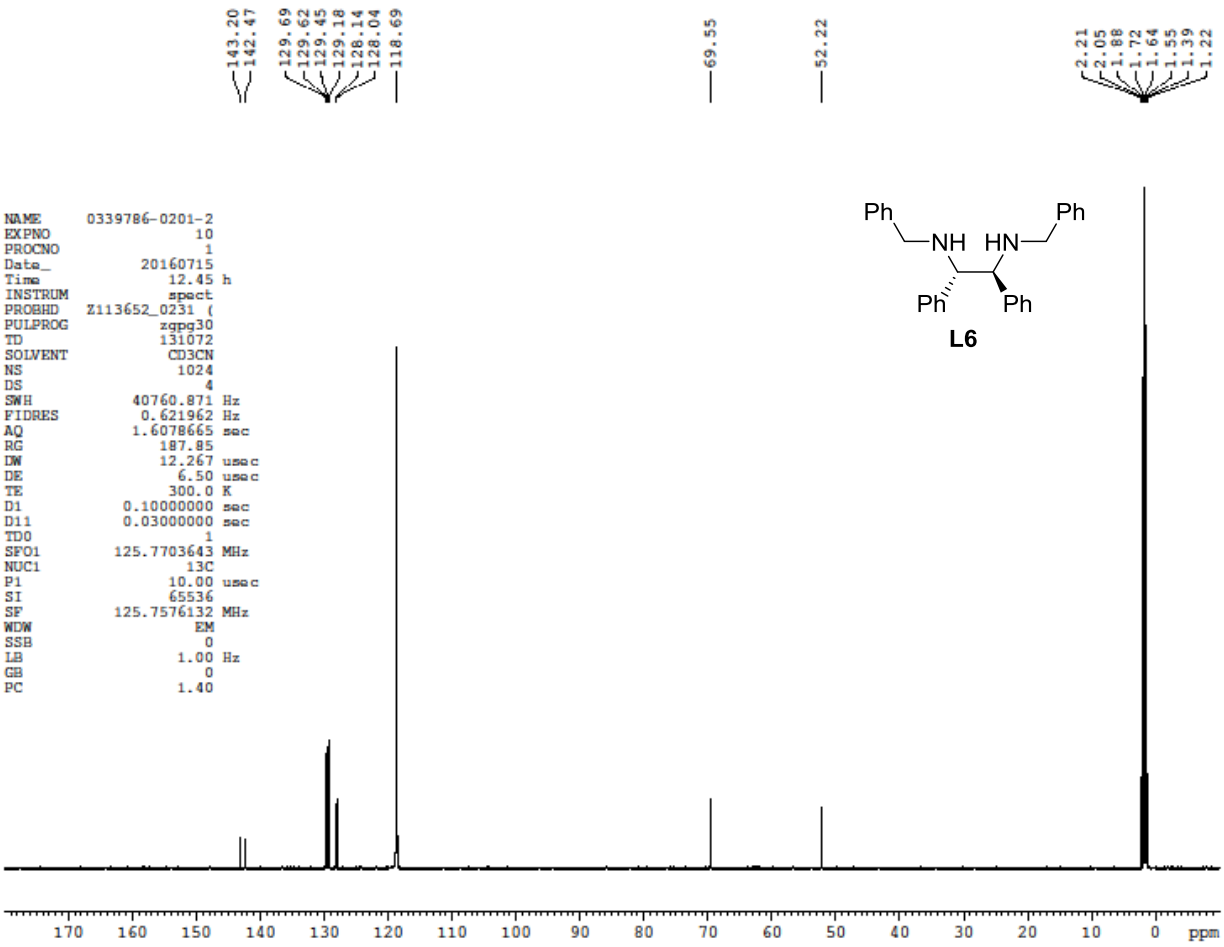


1 PDA Multi 1 / 267nm 4nm

PDA Ch1 267nm 4nm

Peak#	Ret. Time	Name	Area	Height	Area %	Resolution	Tailing Factor
1	7.327		104227	9413	3.193	0.000	0.747
2	8.929		3160038	218498	96.807	5.140	0.753
Total					100.000		


7.33 7.33 7.32 7.32 7.31 7.31 7.30 7.27 7.27 7.26 7.26 7.25 7.25 7.24 7.24 7.18 7.17 7.16 7.16 7.15 7.15 7.15 7.14 7.14 7.14 7.13 7.13 7.12 7.11 7.11 7.10 7.10 7.09 7.09 7.08 7.08 7.08
3.73 3.60 3.57 3.46 3.43
2.69
2.15 1.97 1.97 1.96 1.96 1.95
NAME 0339786-0201-1
EXPNO 10
PROCNO 1
Date_ 20160715
Time 12.13 h
INSTRUM spect
PROBHD Z113652_0231 (
PULPROG zg30
TD 65536
SOLVENT CD3CN
NS 32
DS 2
SWH 13020.833 Hz
FIDRES 0.397364 Hz
AQ 2.5166323 sec
RG 137.98
DW 38.400 usec
DE 6.50 usec
TE 300.0 K
D1 10.00000000 sec
TD0 1
SFO1 500.1330883 MHz
NUC1 1H
P1 10.00 usec
SI 65536
SF 500.1300039 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
7.32 7.32 7.30 7.27 7.27 7.26 7.26 7.16 7.15 7.14 7.14 7.13 7.10 7.10 7.08 7.08
10.054
10.082
7.4 7.3 7.2 7.1 ppm
3.73 3.60 3.57 3.46 3.43
1.963
2.004
1.995
3.7 3.6 3.5 ppm
Ph NH HN Ph Ph Ph
10.054
10.082
1.963
2.004
1.995
1.772
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm


143.20
142.47
129.69
129.62
129.45
129.18
128.14
128.04
118.69
69.55
52.22
2.21
2.05
1.88
1.72
1.64
1.55
1.39
1.22
NAME 0339786-0201-2
EXPNO 10
PROCNO 1
Date_ 20160715
Time 12.45 h
INSTRUM spect
PROBHD Z113652_0231 (
PULPROG zgpg30
TD 131072
SOLVENT CD3CN
NS 1024
DS 4
SWH 40760.871 Hz
FIDRES 0.621962 Hz
AQ 1.6078665 sec
RG 187.85
DW 12.267 usec
DE 6.50 usec
TE 300.0 K
D1 0.10000000 sec
D11 0.03000000 sec
TD0 1
SFO1 125.7703643 MHz
NUC1 13C
P1 10.00 usec
SI 65536
SF 125.7576132 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40
Ph
NH
HN
Ph
Ph
Ph
L6
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

SFC Chiral Assay of L6

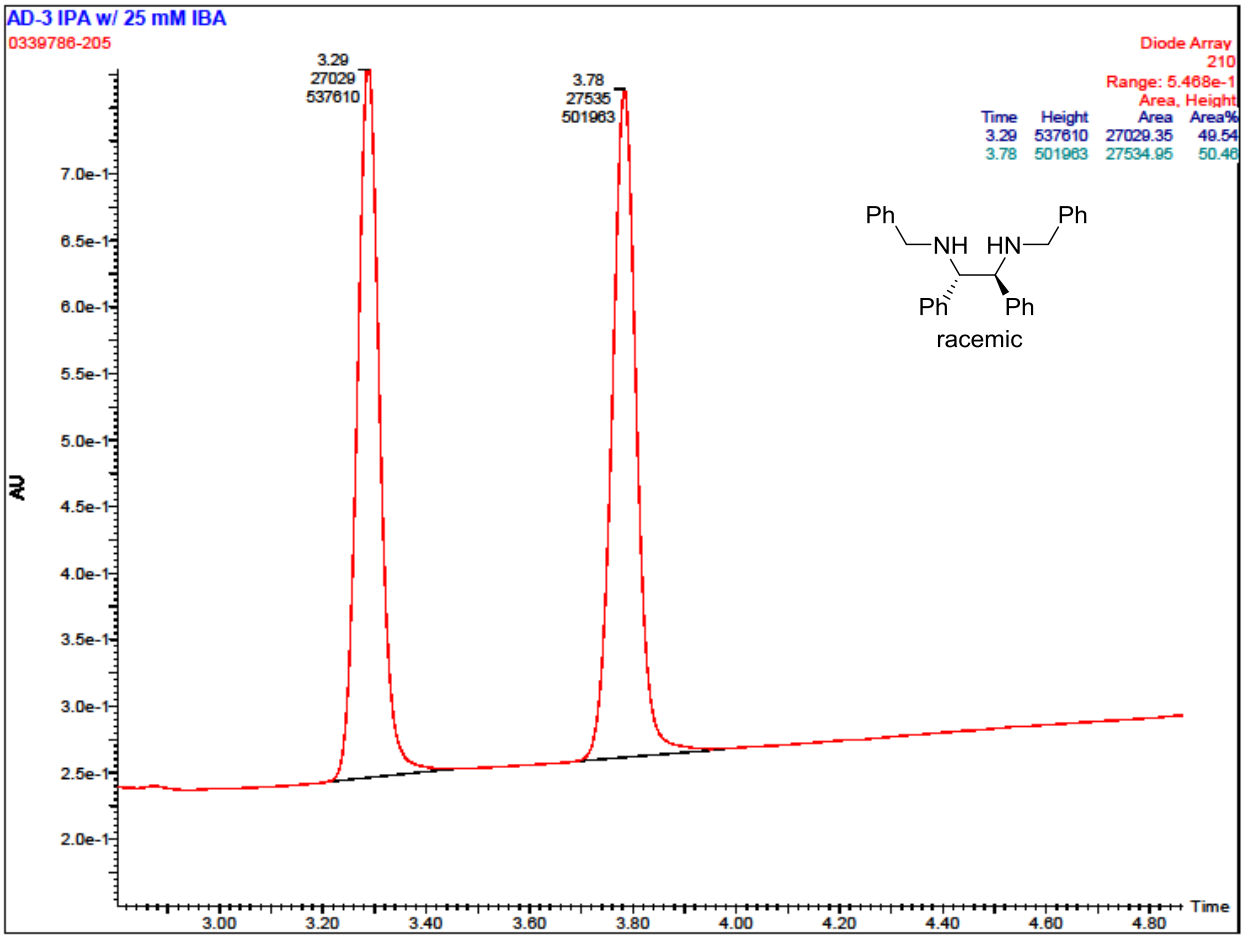
Column:	AD-3, 150 x 4.6 mm, 3 µm particle size
Detector:	210 nm
Temperature:	40°C
Flow rate:	3.0 mL/min
Mobile Phase:	A: CO_2 B: IPA with 25 nM IBA

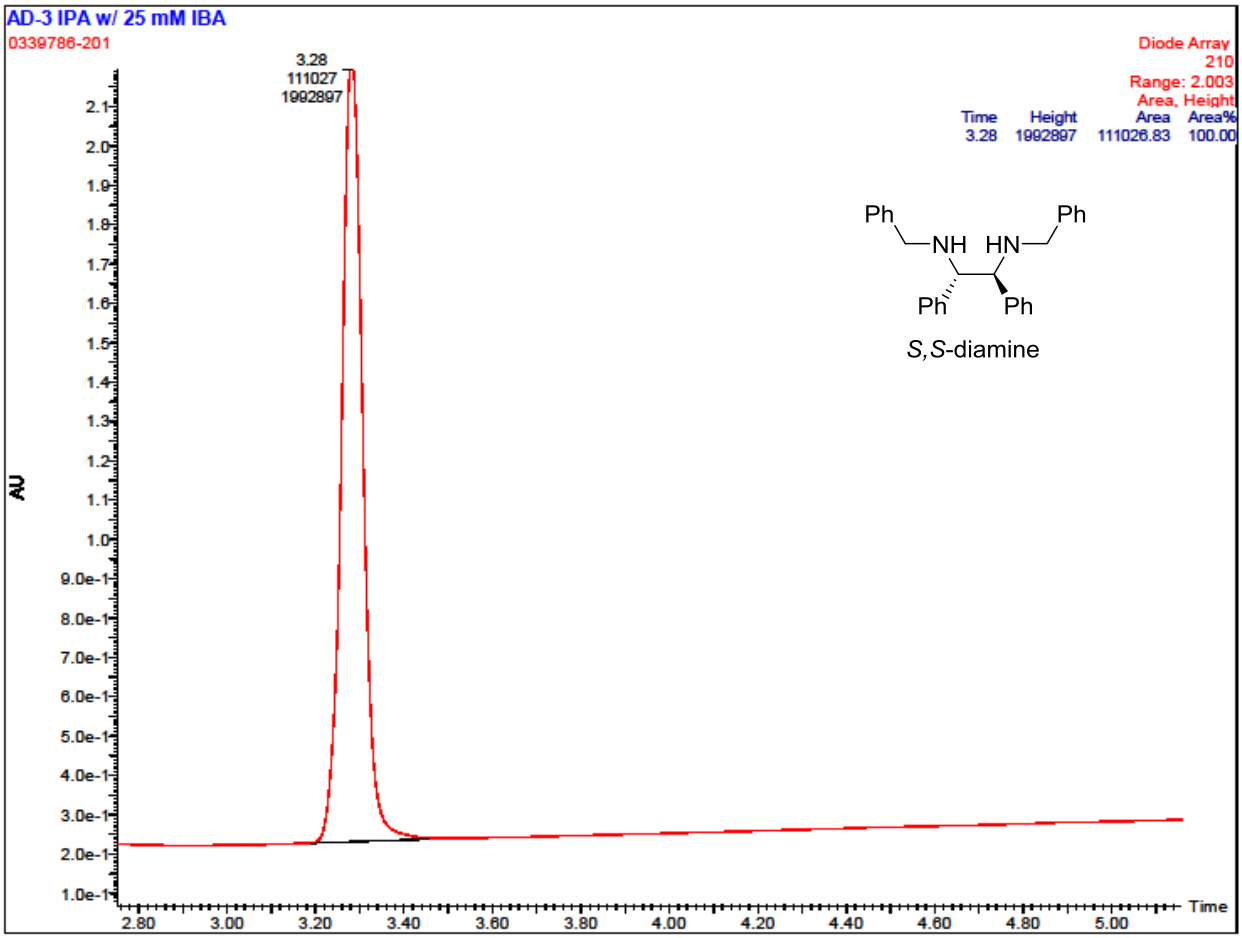
Run Time = 6.6 min, Pressure = 200 (bar), Temperature: 40°C, Column: Chiralpak AD-3

Mobile Phase Program:	Time (min)	%A (CO2)	%B
	0	99	01
	5	60	40
	6	60	40
	6.1	99	01

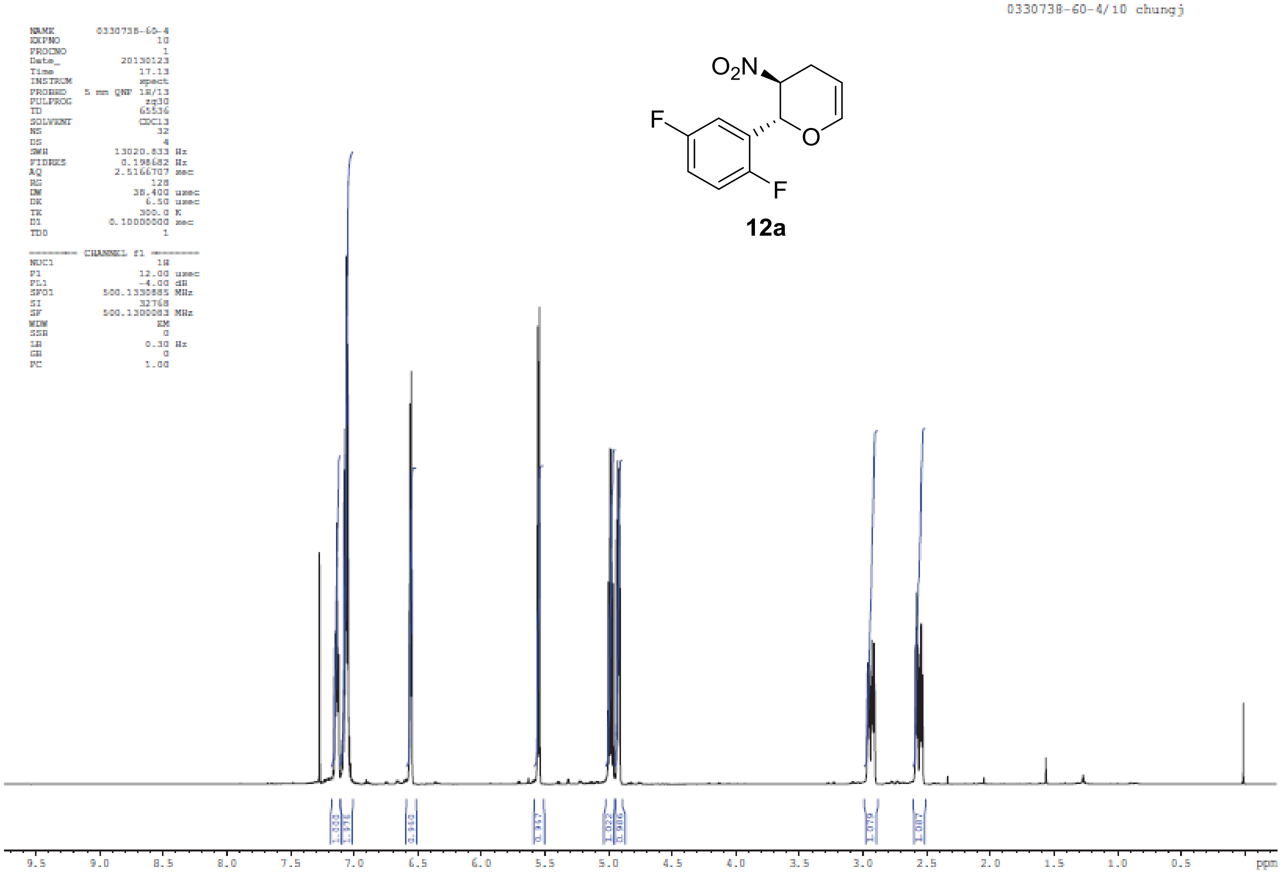
3.29 min = Desired Enantiomer

3.78 min = Undesired Enantiomer




AD-3 IPA w/ 25 mM IBA
0339786-201
3.28
111027
1992897
Diode Array
210
Range: 2.003
Area, Height
Time Height Area Area%
3.28 1992897 111026.83 100.00
Ph
NH HN
Ph
Ph
Ph
S,S-diamine
AU
Time
2.80 3.00 3.20 3.40 3.60 3.80 4.00 4.20 4.40 4.60 4.80 5.00

12a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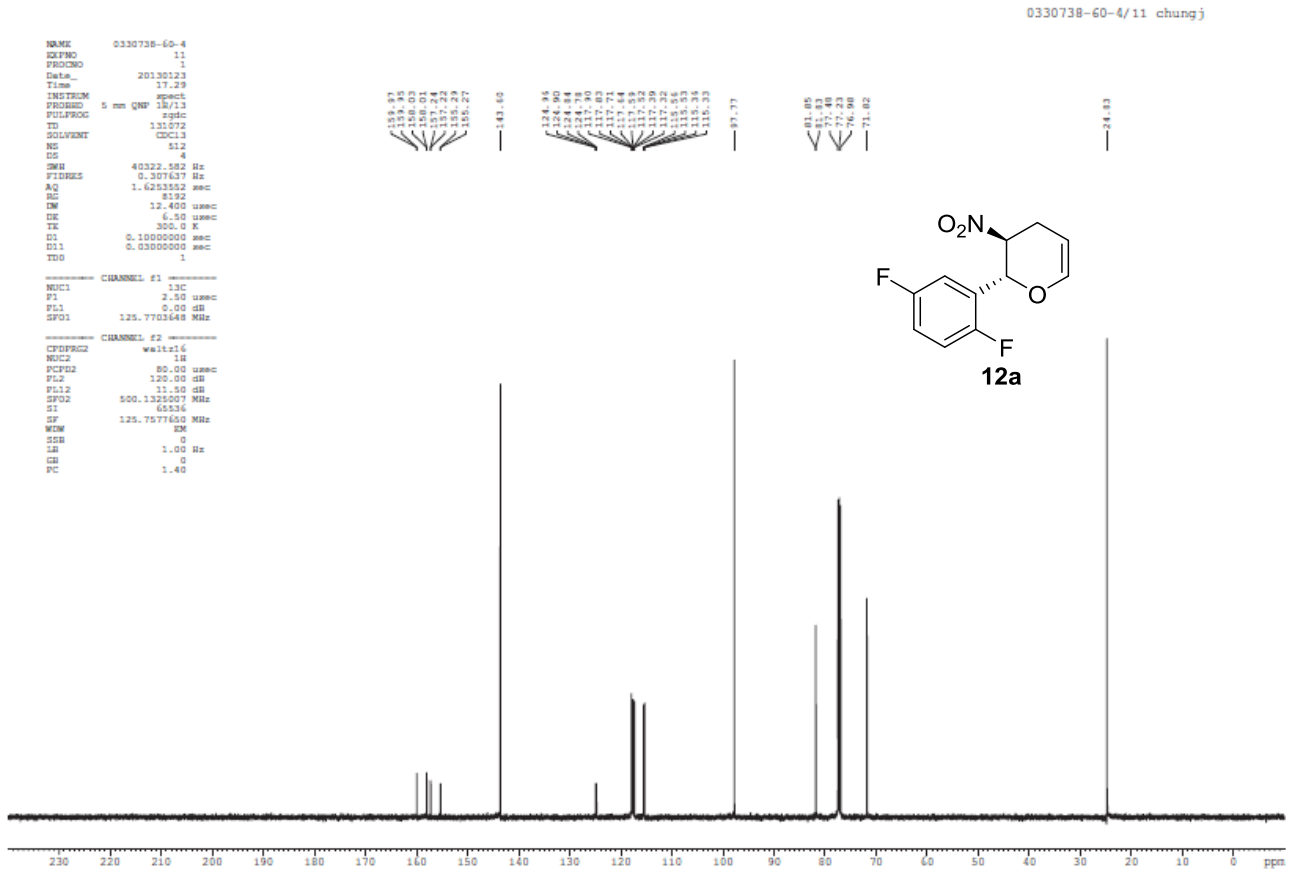
EXPNO 10
PROCNO 1
Date_ 20130123
Time 17.13
INSTRUM spect
PROBHD 5 mm QNP 1H/13
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 13020.833 Hz
FIDRES 0.198682 Hz
AQ 2.5166707 sec
RG 128
DW 38.400 usec
DE 6.50 usec
TE 300.0 K
D1 0.10000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -4.00 dB
SFO1 500.1330885 MHz
SI 32768
SF 500.1300083 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm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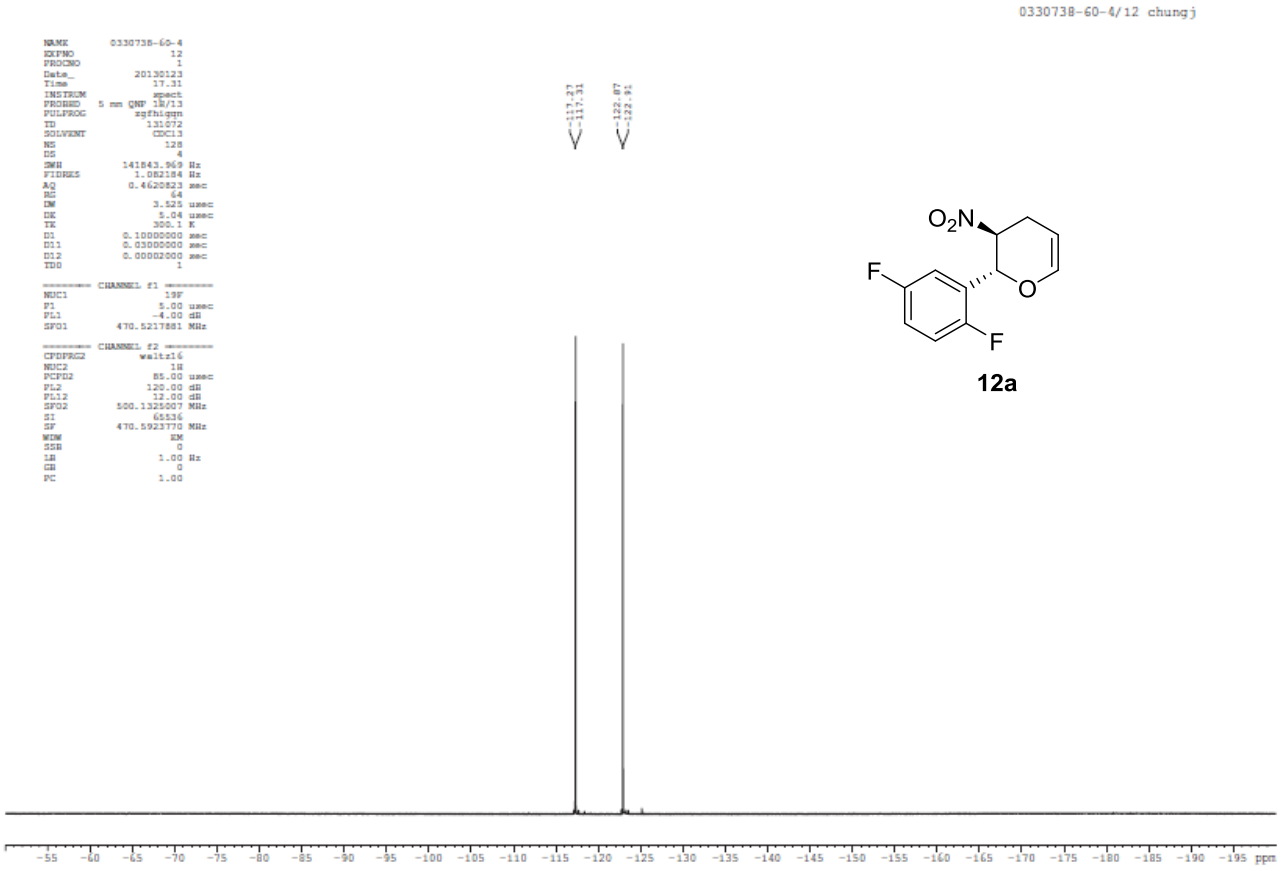
NAME 0330738-60-4
EXPNO 11
PROCNO 1
Date_ 20130123
Time 17.29
INSTRUM spect
PROBHD 5 mm QNP 1H/13
PULPROG zgdc
TD 131072
SOLVENT CDCl3
NS 512
DS 4
SWH 40322.582 Hz
FIDRES 0.307637 Hz
AQ 1.6253552 sec
RG 8192
DW 12.400 usec
DE 6.50 usec
TE 300.0 K
D1 0.10000000 sec
D11 0.03000000 sec
TD0 1
CHANNEL f1
NUC1 13C
P1 2.50 usec
PL1 0.00 dB
SFO1 125.7703648 MHz
CHANNEL f2
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 120.00 dB
PL12 11.50 dB
SFO2 500.1325007 MHz
SI 65536
SF 125.7577650 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40
159.97
158.45
158.03
156.01
157.24
155.22
153.28
151.27
143.60
124.84
124.80
124.64
124.78
117.90
117.83
117.71
117.64
117.59
117.52
117.39
117.32
115.56
115.53
115.34
115.33
97.77
81.85
81.83
77.48
77.23
76.98
71.02
24.83
O2N
F
O
F
12a
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm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EXPNO 12
PROCNO 1
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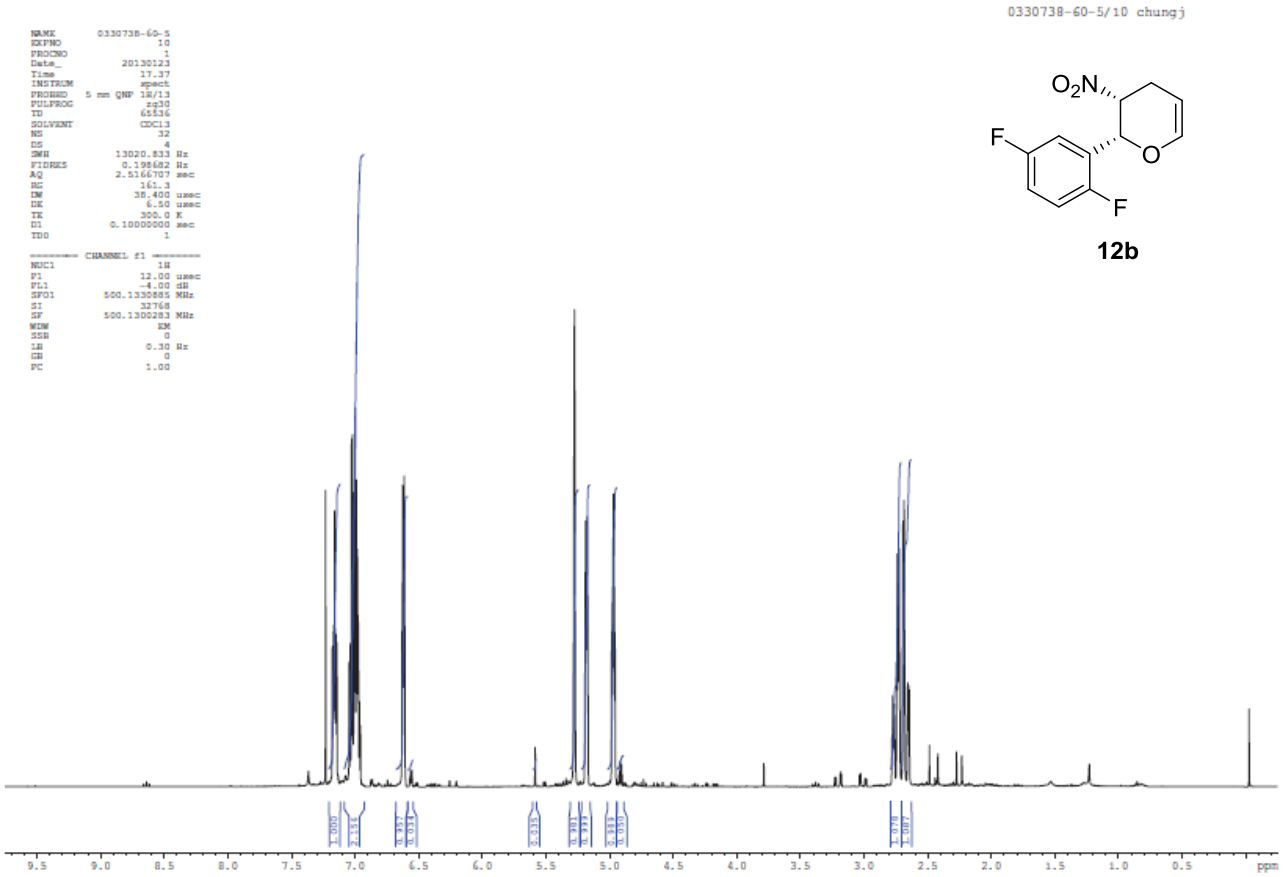
Time 17.31
INSTRUM spect
PROBHD 5 mm QNP 1H/13
PULPROG zgfhiqqn
TD 131072
SOLVENT CDCl3
NS 128
DS 4
SWH 141843.969 Hz
FIDRES 1.082184 Hz
AQ 0.4620823 sec
RG 64
DW 3.525 usec
DE 5.04 usec
TE 300.1 K
D1 0.10000000 sec
D11 0.03000000 sec
D12 0.00002000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 19F
P1 5.00 usec
PL1 -4.00 dB
SFO1 470.5217881 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 85.00 usec
PL2 120.00 dB
PL12 12.00 dB
SFO2 500.1325007 MHz
SI 65536
SF 470.5923770 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.00
-117.27
-117.31
-122.87
-122.91
O2N
F
O
F
12a
-55 -60 -65 -70 -75 -80 -85 -90 -95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150 -155 -160 -165 -170 -175 -180 -185 -190 -195 ppm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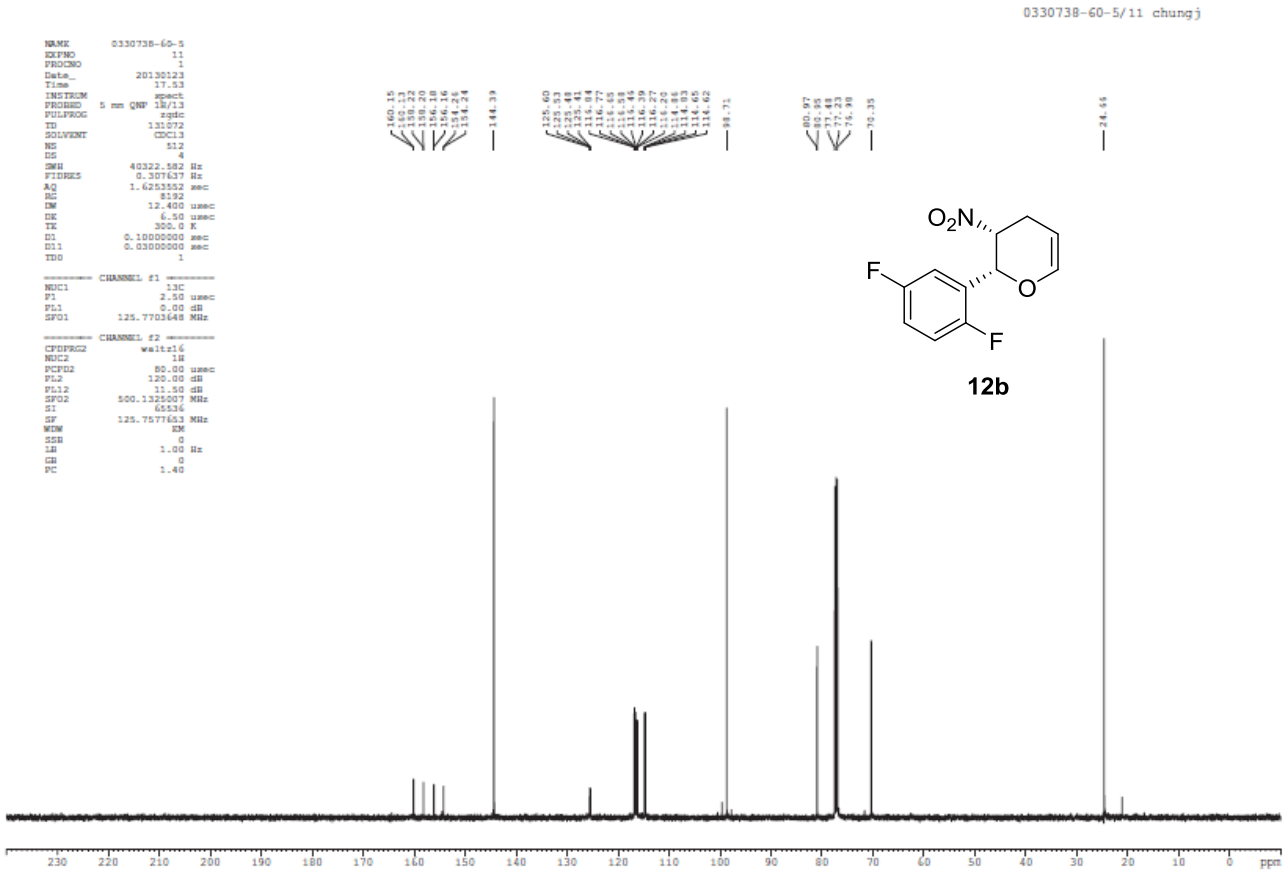
NAME 0330738-60-5
EXPNO 10
PROCNO 1
Date_ 20130123
Time 17.37
INSTRUM spect
PROBHD 5 mm QNP 1H/13
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 13020.833 Hz
FIDRES 0.198682 Hz
AQ 2.5166707 sec
RG 161.3
DW 38.400 usec
DE 6.50 usec
TE 300.0 K
D1 0.10000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -4.00 dB
SFO1 500.1330885 MHz
SI 32768
SF 500.1300283 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
O2N
F
O
F
12b
1.000
2.131
0.971
0.908
2.035
0.791
0.773
0.745
0.800
1.978
1.087
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm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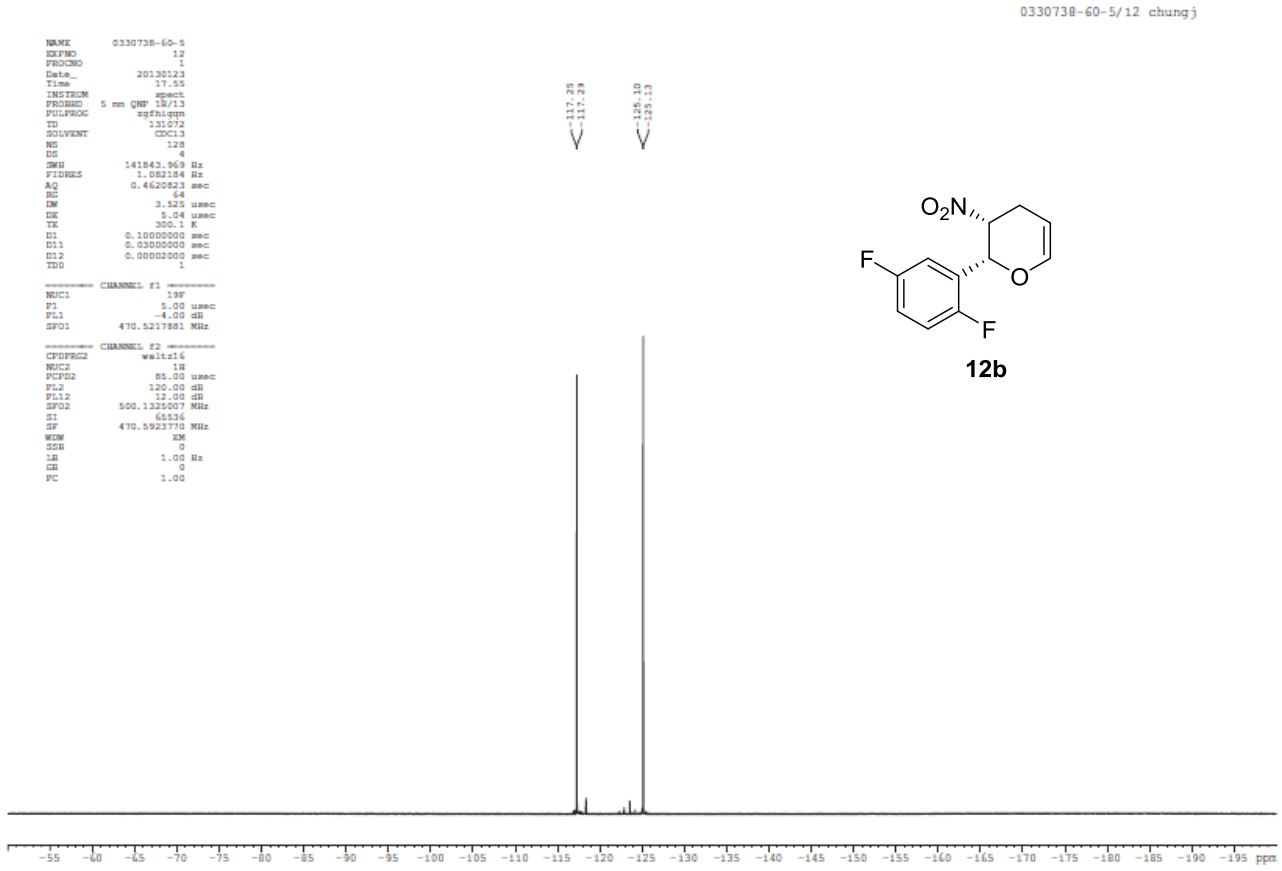
NAME 0330738-60-5
EXPNO 11
PROCNO 1
Date_ 20130123
Time 17.53
INSTRUM spect
PROBHD 5 mm QNP 1H/13
PULPROG zgdc
TD 131072
SOLVENT CDCl3
NS 512
DS 4
SWH 40322.582 Hz
FIDRES 0.307637 Hz
AQ 1.6253552 sec
RG 8192
DW 12.400 usec
DE 6.50 usec
TE 300.0 K
D1 0.10000000 sec
D11 0.03000000 sec
TD0 1
CHANNEL f1
NUC1 13C
P1 2.50 usec
PL1 0.00 dB
SFO1 125.7703648 MHz
CHANNEL f2
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 120.00 dB
PL12 11.50 dB
SFO2 500.1325007 MHz
SI 65536
SF 125.7577653 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40
160.15
159.33
159.22
159.20
156.18
156.16
154.26
154.24
144.39
125.60
125.53
125.48
125.41
116.04
116.77
116.56
116.58
116.46
116.39
116.37
116.20
114.86
114.83
114.65
114.62
98.71
80.97
80.95
77.48
77.23
76.98
70.35
24.66
O2N
F
O
F
12b
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm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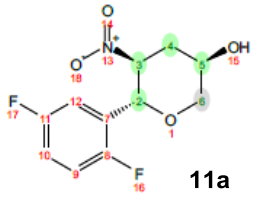
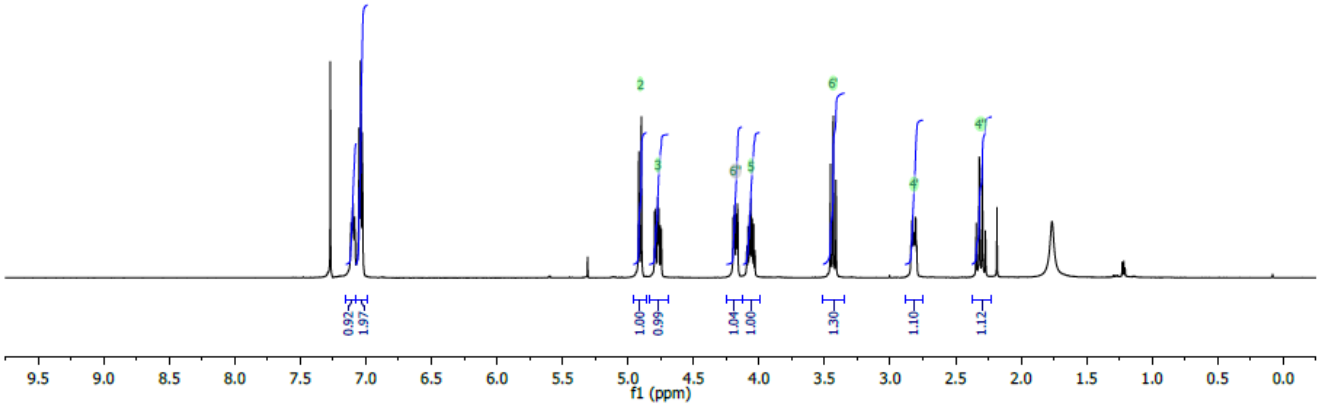
NAME 0330738-60-5
EXPNO 12
PROCNO 1
Date_ 20130123
Time 17.55
INSTRUM spect
PROBHD 5 mm QNP 1H/13
PULPROG zgfhigqn
TD 131072
SOLVENT CDCl3
NS 128
DS 4
SWH 141843.969 Hz
FIDRES 1.082184 Hz
AQ 0.4620823 sec
RG 64
DW 3.525 usec
DE 5.04 usec
TE 300.1 K
D1 0.10000000 sec
D11 0.03000000 sec
D12 0.00002000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 19F
P1 5.00 usec
PL1 -4.00 dB
SFO1 470.5217881 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 85.00 usec
PL2 120.00 dB
PL12 12.00 dB
SFO2 500.1325007 MHz
SI 65536
SF 470.5923770 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.00
117.28
117.29
125.10
125.13
O2N
F
O
F
12b
-55 -60 -65 -70 -75 -80 -85 -90 -95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150 -155 -160 -165 -170 -175 -180 -185 -190 -195 ppm

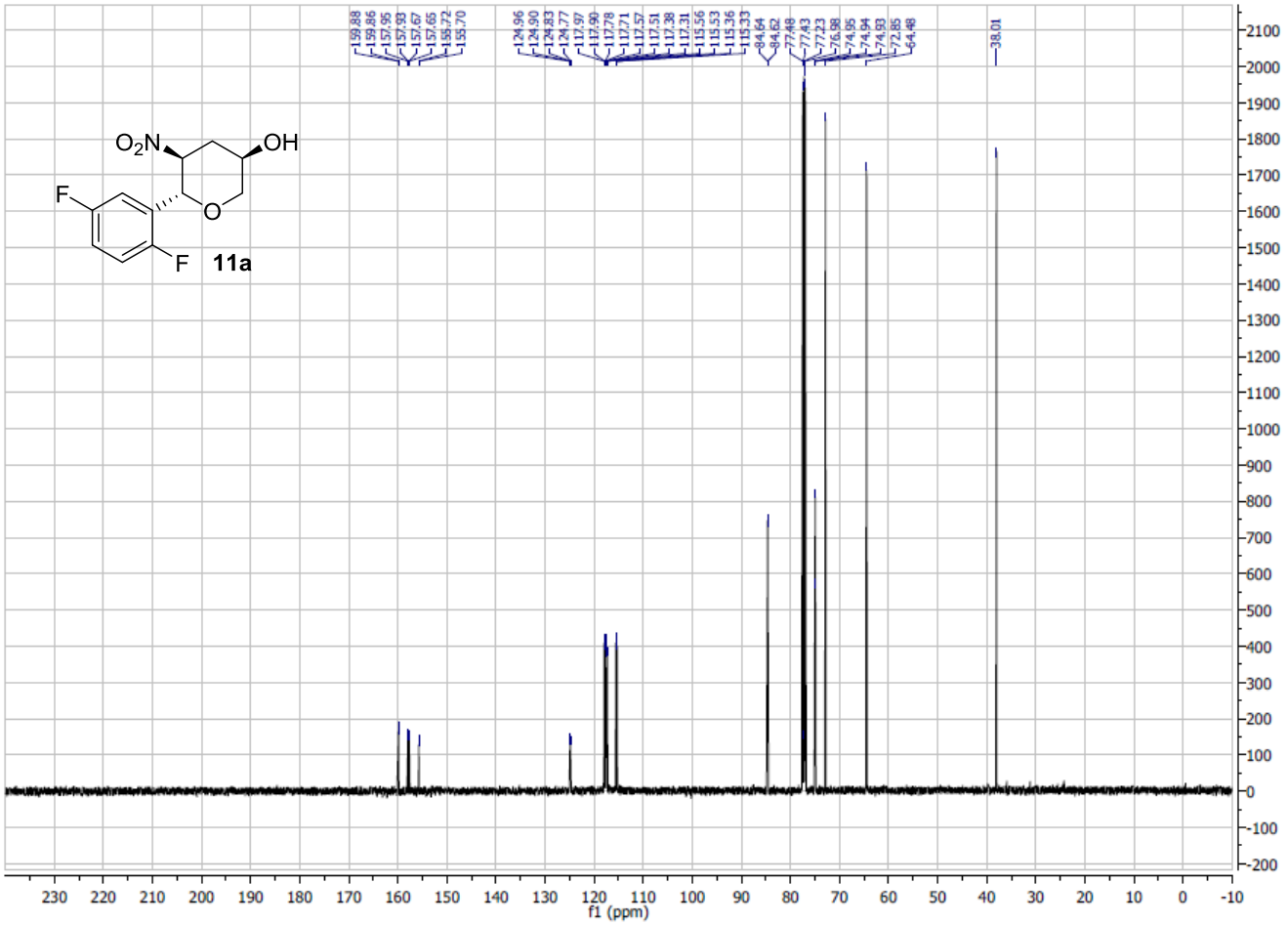
Parameter	Value
Title	0339786-0185-A.10.fid
Spectrometer	spect
Solvent	CDCl3
Temperature	300.0
Pulse Sequence	zg30
Probe	5 mm QNP 1H/ 13C/ 31P/ 19F Z-GRD Z8420/ 0073
Number of Scans	32
Receiver Gain	512
Relaxation Delay	0.1000
Pulse Width	12.0000
Acquisition Time	2.5167
Acquisition Date	2014-05-18T11:15:00
SF01	500.133088507478
TD1	
TD	65536
Spectrometer Frequency	500.13
Spectral Width	13020.8
Lowest Frequency	-3421.9
Nucleus	1H
Acquired Size	32768
Spectral Size	131072

0339786-0185-A/10 kassimam
Pure Diastereomer A (solid)
after SFC Purification



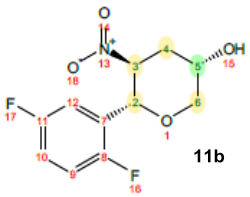
11a

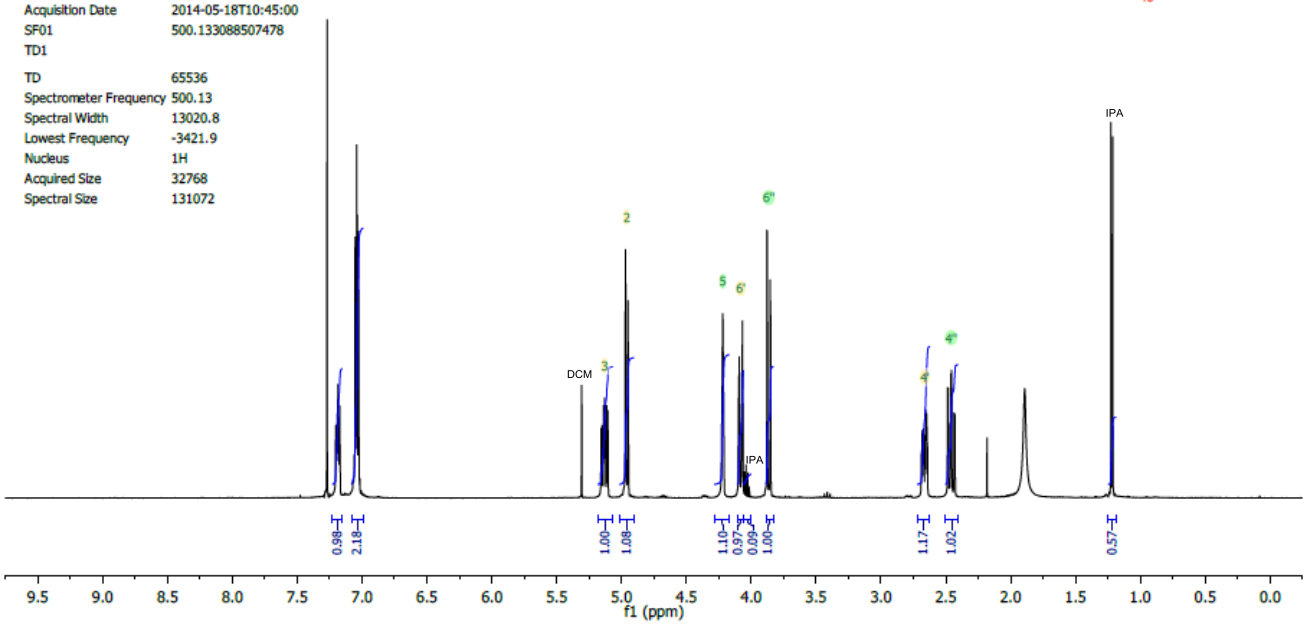


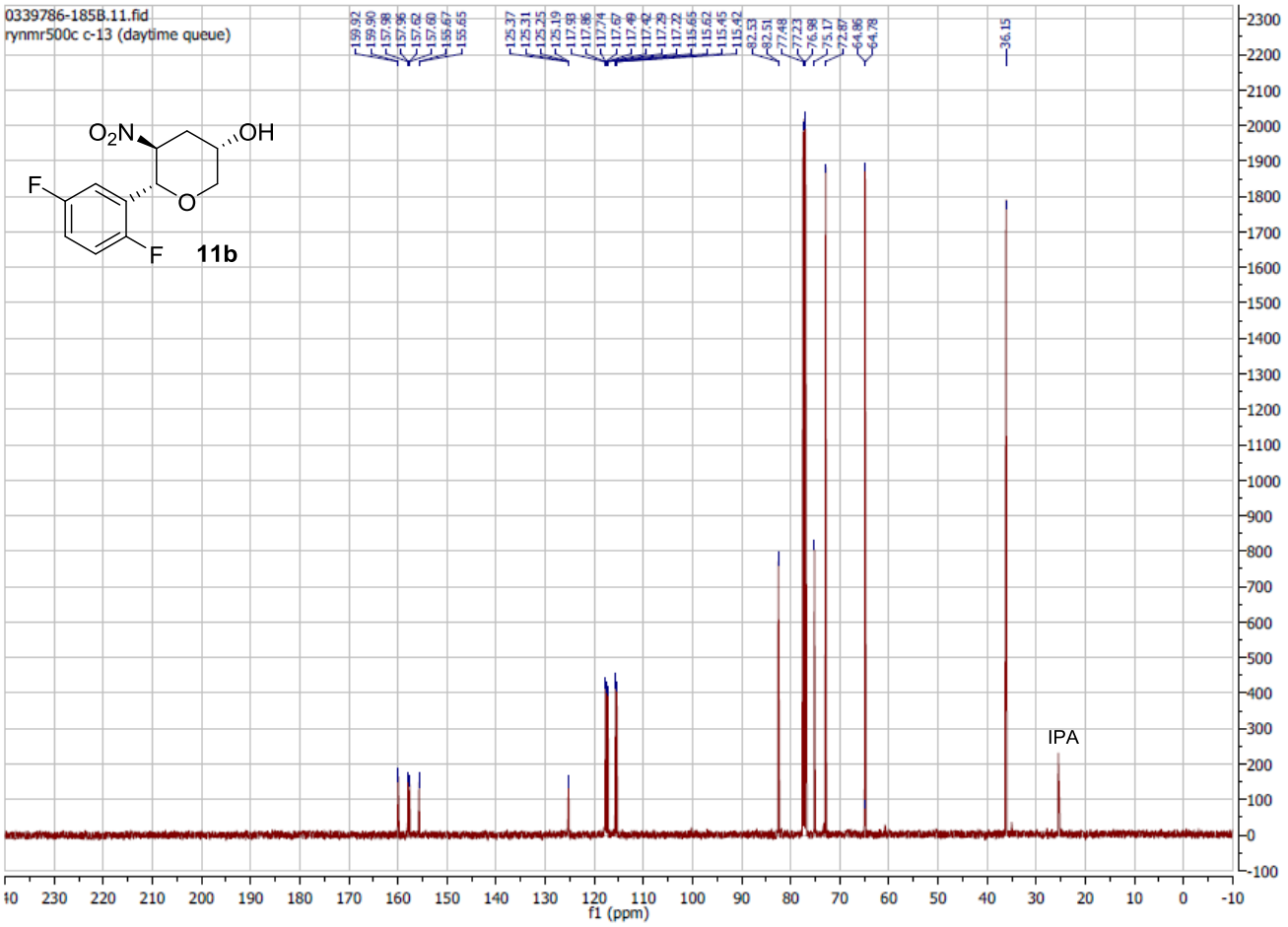

O2N
OH
F
O
F
11a
f1 (ppm)

Parameter	Value
Title	0339786-0185-B.10.fid
Spectrometer	spect
Solvent	CDCl3
Temperature	300.0
Pulse Sequence	zg30
Probe	5 mm QNP 1H/ 13C/ 31P/ 19F Z-GRD Z8420/ 0073
Number of Scans	32
Receiver Gain	456
Relaxation Delay	0.1000
Pulse Width	12.0000
Acquisition Time	2.5167
Acquisition Date	2014-05-18T10:45:00
SF01	500.133088507478
TD1	
TD	65536
Spectrometer Frequency	500.13
Spectral Width	13020.8
Lowest Frequency	-3421.9
Nucleus	1H
Acquired Size	32768
Spectral Size	131072

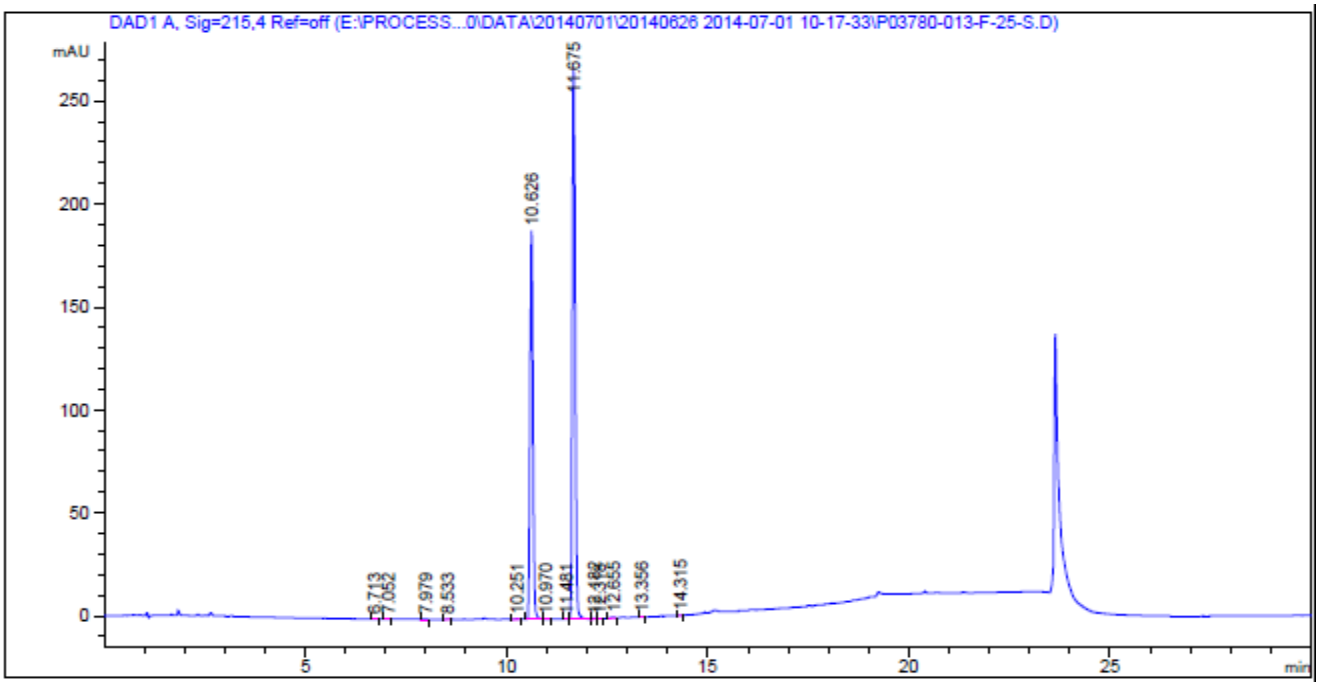
0339786-0185-B/10 kassimam
Pure Diastereomer B (oil)
after SFC Purification






0339786-185B.11.fid
rynmr500c c-13 (daytime queue)
O2N
OH
F
O
F
11b
IPA
f1 (ppm)

HPLC of compound 4




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

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


Signal 1: DAD1 A, Sig=215,4 Ref=off

Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.713 MM    0.0735 7.30334e-1 1.65546e-1   0.0319
   2   7.052 MM    0.0726 3.64797e-1 8.37995e-2   0.0159
   3   7.979 MM    0.0702 5.55305e-1 1.31890e-1   0.0242
   4   8.533 MM    0.0822 8.68835e-1 1.76161e-1   0.0379
   5  10.251 MM    0.1099    1.86373 2.82673e-1   0.0814
   6  10.626 MF    0.0823  933.84955  189.20198  40.7777
   7  10.970 FM    0.1029    1.03617 1.67806e-1   0.0452
   8  11.481 MF    0.0801    1.49801 3.11835e-1   0.0654
   9  11.675 FM    0.0833 1342.21863  268.61728  58.6096
  10  12.182 MF    0.0858    1.52569 2.96277e-1   0.0666
  11  12.318 FM    0.0704 2.84962e-1 6.74206e-2   0.0124
  12  12.655 MM    0.0915    3.19191 5.81224e-1   0.1394
  13  13.356 MM    0.0707    1.52656 3.59626e-1   0.0667
  14  14.315 MM    0.0636 5.86546e-1 1.53605e-1   0.0256

Totals :                  2290.10101  460.59712
```

Cartesian Coordinates for minima

Compound 17			M06/6-31G**	M062X/6-31G**	B3LYP/6-31G** w/ D2	M062X/6-31+G**
	$-NO_2$	-Cl	ΔG	ΔG	ΔG	ΔG
17a	equa	axial	0.0	0.0	0.0	0.0
17b	axial	axial	2.5	2.4	2.5	2.7
17c	equa	equa	3.5	2.6	3.1	2.6
17d	axial	equa	7.7	7.0	7.5	7.3

Compound 17a

M06-2X/6-31+G free energy -1364.893128**

6 2.47949 0.744885 -1.07279
6 0.480544 -0.170602 0.17103
6 2.35101 -1.6096 -0.207005
8 0.972891 -1.47823 -0.095754
6 2.93452 -0.698761 -1.27605
6 0.961173 0.766756 -0.961977
1 2.8032 1.37182 -1.90853
1 2.91004 1.15864 -0.156776
1 0.886626 0.195252 1.12344
1 2.53495 -2.66309 -0.411763
1 2.57737 -1.07843 -2.24142
1 4.02415 -0.770745 -1.26934
1 0.463224 0.483287 -1.89292
17 3.16434 -1.29701 1.39669
6 -1.02221 -0.264796 0.243428
6 -3.82981 -0.323508 0.363838
6 -1.74354 0.657333 0.993035
6 -1.73146 -1.23908 -0.459946
6 -3.11447 -1.24617 -0.384904
6 -3.12626 0.648625 1.06893
1 -1.21295 -1.99219 -1.04215
1 -3.63089 1.39876 1.66665
1 -4.91227 -0.372932 0.388313
7 0.471688 2.16091 -0.668078
8 -0.570176 2.50049 -1.19752
8 1.13231 2.83914 0.094042
9 -1.05809 1.60279 1.66771
9 -3.79224 -2.1905 -1.06708

Compound 17b

M06-2X/6-31+G free energy -1364.888869**

6 -2.52035 0.527899 -1.26627
6 -0.41496 -0.428143 -0.250569
6 -2.46316 -0.738029 0.910162
8 -1.09908 -0.514448 0.988866
6 -3.18715 0.316645 0.09356
6 -1.00278 0.670058 -1.16465

1 -2.94261 1.40402 -1.76482
1 -2.7107 -0.339641 -1.90829
1 -0.584757 -1.36211 -0.805612
1 -2.82255 -0.795111 1.93598
1 -3.14851 1.24313 0.671909
1 -4.23284 0.028236 -0.033433
17 -2.80238 -2.41032 0.215085
6 1.06348 -0.323873 0.025907
6 3.82943 -0.147703 0.521396
6 1.58515 0.566768 0.962408
6 1.95863 -1.13745 -0.668699
6 3.31691 -1.0305 -0.415244
6 2.94193 0.664418 1.22234
1 1.60829 -1.86076 -1.3985
1 3.28779 1.38005 1.95925
1 4.89896 -0.102157 0.691205
9 0.745115 1.37695 1.62781
9 4.16514 -1.82443 -1.09753
1 -0.519489 0.584933 -2.13995
7 -0.599571 2.05018 -0.697153
8 0.496148 2.43891 -1.05635
8 -1.37598 2.67932 -0.004856

Compound 17c
M06-2X/6-31+G free energy -1364.888948**
6 2.29328 1.55494 -0.63751
6 0.43136 0.199722 0.409901
6 2.6329 -0.640286 0.457933
8 1.26923 -0.935803 0.282261
6 3.13238 0.27432 -0.644272
6 0.814579 1.19473 -0.715867
1 2.56645 2.20043 -1.47716
1 2.46776 2.12192 0.28267
1 0.597626 0.694673 1.37966
1 3.03731 -0.256323 -1.59767
1 4.18871 0.505409 -0.486296
1 0.534595 0.759431 -1.67806
6 -0.995453 -0.277888 0.307352
6 -3.6806 -1.07828 0.096077
6 -2.02745 0.463042 0.871178
6 -1.32202 -1.45158 -0.373223
6 -2.65329 -1.82352 -0.463288
6 -3.35803 0.09058 0.779637
1 -0.548204 -2.0744 -0.807631
1 -4.1176 0.7139 1.23705
1 -4.70607 -1.41469 -0.003979
7 -0.034924 2.43075 -0.579836
8 -1.03989 2.48463 -1.26259
8 0.322965 3.27349 0.221033
9 -1.71002 1.59455 1.53483
9 -2.96111 -2.9603 -1.11755
1 2.79379 -0.202762 1.45204
17 3.49682 -2.19907 0.444089

Compound 17d

M06-2X/6-31+G free energy -1364.88144**

6 -2.20888 1.15584 -1.54154
6 -0.247112 -0.234028 -0.764433
6 -2.40558 -1.06698 -0.443868
8 -1.12805 -0.895238 0.119131
6 -3.08927 0.270371 -0.650086
6 -0.747065 1.19261 -1.09825
1 -2.6101 2.17157 -1.58497
1 -2.21021 0.764901 -2.56698
1 -0.255579 -0.753283 -1.7389
1 -3.23491 0.736084 0.326516
1 -4.06556 0.117083 -1.11748
6 1.15787 -0.319107 -0.222745
6 3.79297 -0.474553 0.756095
6 1.46128 -0.040563 1.10877
6 2.20609 -0.680859 -1.06922
6 3.49694 -0.745485 -0.569649
6 2.75145 -0.116419 1.60793
1 2.02847 -0.919398 -2.11339
1 2.92559 0.11626 2.65214
1 4.81661 -0.542621 1.10589
9 0.475159 0.336193 1.93663
9 4.4945 -1.09723 -1.40477
1 -0.095782 1.60787 -1.87011
7 -0.542599 2.1262 0.071035
8 0.568661 2.61143 0.180536
8 -1.47856 2.33557 0.816373
1 -2.31842 -1.63013 -1.38475
17 -3.33044 -2.10362 0.670681