Supporting Information:

Chiral Bicyclic NHC/Cu Complexes for Catalytic Asymmetric Borylation of α,β-Unsaturated Esters

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^{1}H and ^{13}C NMR Spectra of New Compounds

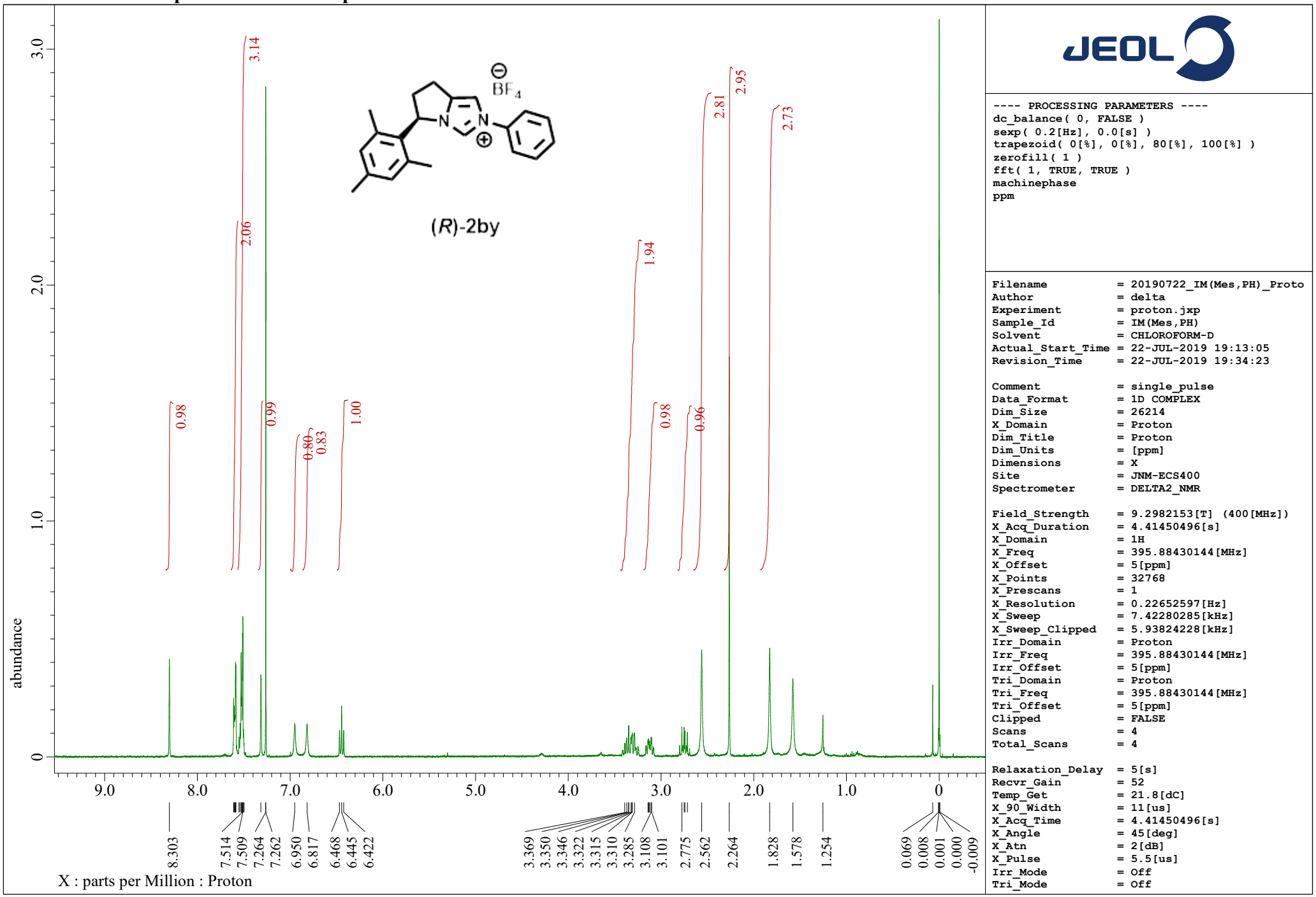
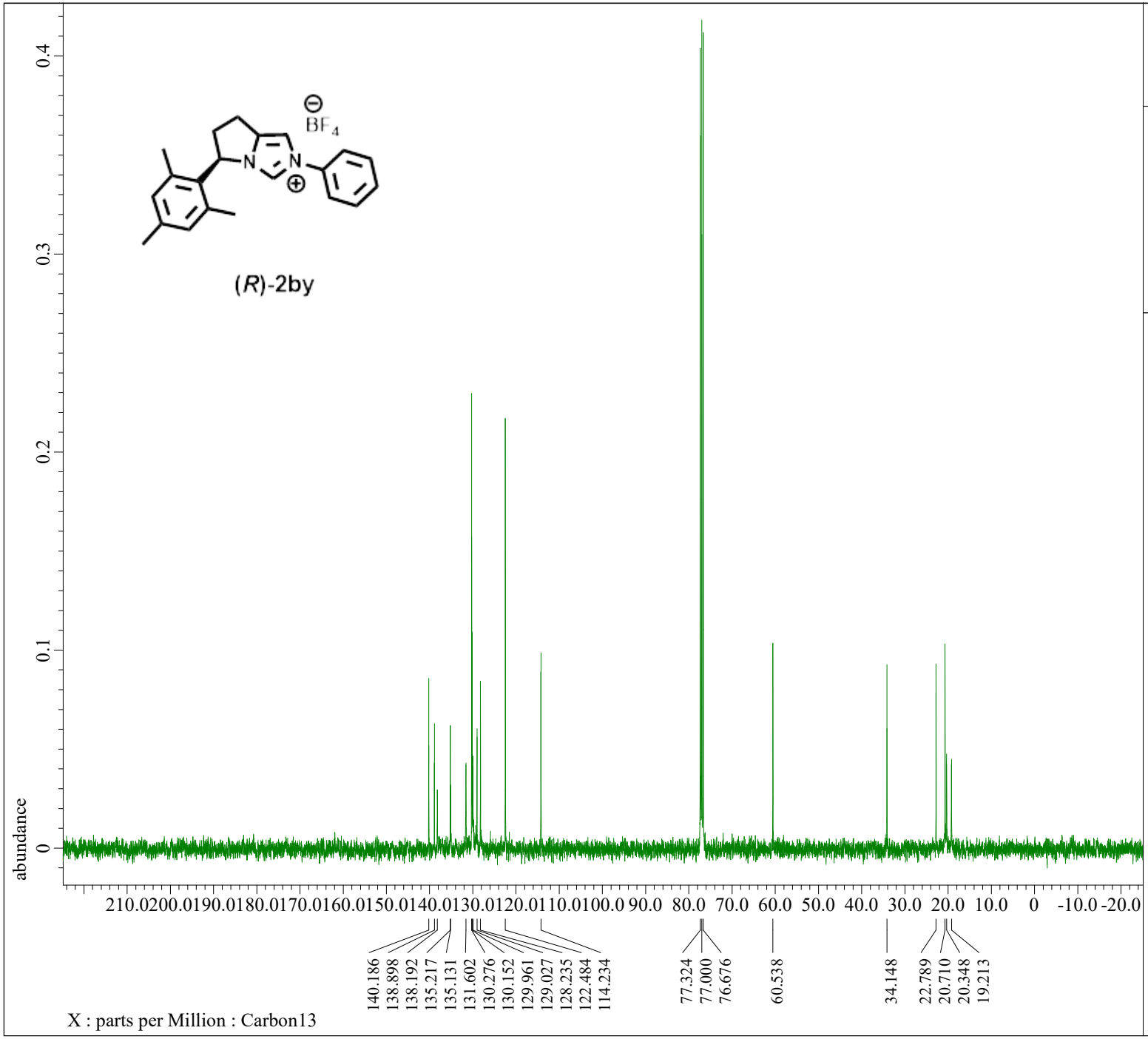


Figure S1. ^{1}H NMR spectrum of (*R*)-**2by** (400 MHz, $CDCl_3$).

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sexp( 2.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm
```

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Filename           = 20190529_im(Mes, Ph)_Carb
Author             = delta
Experiment         = carbon.jxp
Sample_Id          = IM( Mes, Ph)
Solvent            = CHLOROFORM-D
Actual_Start_Time  = 29-MAY-2019 10:30:51
Revision_Time      =  9-JUL-2019 11:08:04

Comment            = single pulse decoupled ga
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X_Domain           = Carbon
Dim_Title          = Carbon13
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400SSL
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.20197068[T] (390[MHz])
X_Acq_Duration     = 1.06430464[s]
X_Domain           = 13C
X_Freq             = 98.51479726[MHz]
X_Offset           = 100[ppm]
X_Points           = 32768
X_Prescans         = 4
X_Resolution       = 0.93958061[Hz]
X_Sweep            = 30.78817734[kHz]
X_Sweep_Clipped    = 24.63054187[kHz]
Irr_Domain         = Proton
Irr_Freq           = 391.78655441[MHz]
Irr_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 105
Total_Scans        = 105

Relaxation_Delay   = 2[s]
Recvr_Gain         = 50
Temp_Get           = 21.3[dC]
X_90_Width         = 8.75[us]
X_Acq_Time         = 1.06430464[s]
X_Angle            = 30[deg]
X_Atn              = 3.8[dB]
X_Pulse            = 2.91666667[us]
Irr_Atn_Dec        = 18.024[dB]
Irr_Atn_Noe        = 18.024[dB]
Irr_Noise          = WALTZ
Irr_Pwidth         = 0.115[ms]
Decoupling         = TRUE
```
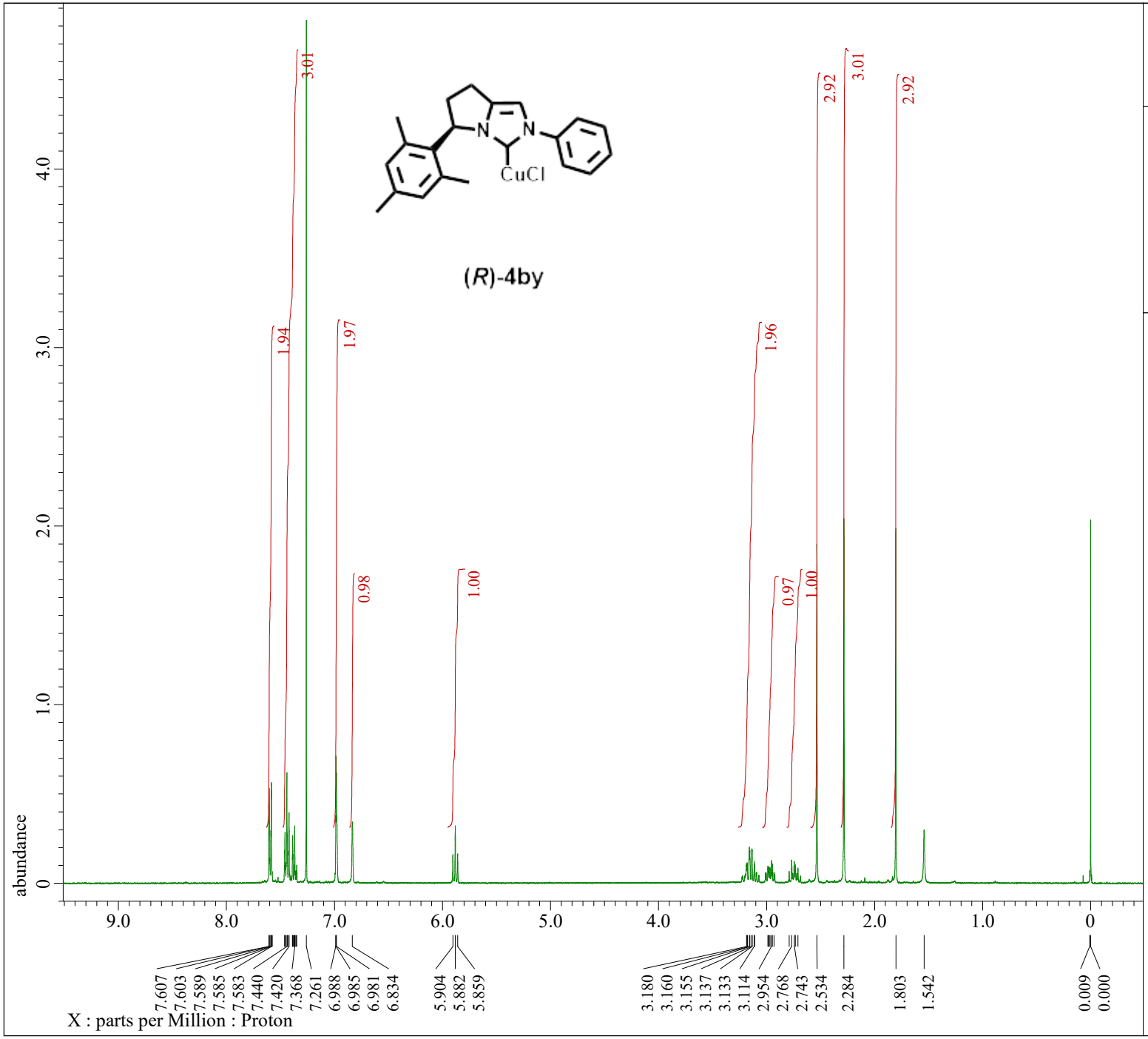

Figure S2. ^{13}C NMR spectrum of (*R*)-**2by** (100 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

以下に由来:: 20190919_Cu cat_Proton-1-1 (2).jdf

Filename          = 20190919_Cu cat_Proton-1-
Author            = delta
Experiment        = proton.jxp
Sample_Id         = Cu cat
Solvent           = CHLOROFORM-D
Actual_Start_Time = 19-SEP-2019 09:56:38
Revision_Time     = 19-SEP-2019 11:50:50

Comment           = single_pulse
Data_Format       = 1D COMPLEX
Dim_Size          = 26214
X_Domain          = Proton
Dim_Title         = Proton
Dim_Units         = [ppm]
Dimensions        = X
Site              = JNM-ECS400
Spectrometer      = DELTA2_NMR

Field_Strength    = 9.2982153[T] (400[MHz])
X_Acq_Duration    = 4.41450496[s]
X_Domain          = 1H
X_Freq            = 395.88430144[MHz]
X_Offset          = 5[ppm]
X_Points          = 32768
X_Prescans        = 1
X_Resolution      = 0.22652597[Hz]
X_Sweep           = 7.42280285[kHz]
X_Sweep_Clipped   = 5.93824228[kHz]
Irr_Domain        = Proton
Irr_Freq          = 395.88430144[MHz]
Irr_Offset        = 5[ppm]
Tri_Domain        = Proton
Tri_Freq          = 395.88430144[MHz]
Tri_Offset        = 5[ppm]
Clipped           = FALSE
Scans             = 4
Total_Scans       = 4

Relaxation_Delay  = 5[s]
Recvr_Gain        = 50
Temp_Get          = 24.3[dC]
X_90_Width        = 11[us]
X_Acq_Time        = 4.41450496[s]
X_Angle           = 45[deg]
X_Atn             = 2[dB]
X_Pulse           = 5.5[us]
Irr_Mode          = Off
Tri_Mode          = Off
```

Figure S3. ^{1}H NMR spectrum of (*R*)-**4by** (400 MHz, $CDCl_3$).

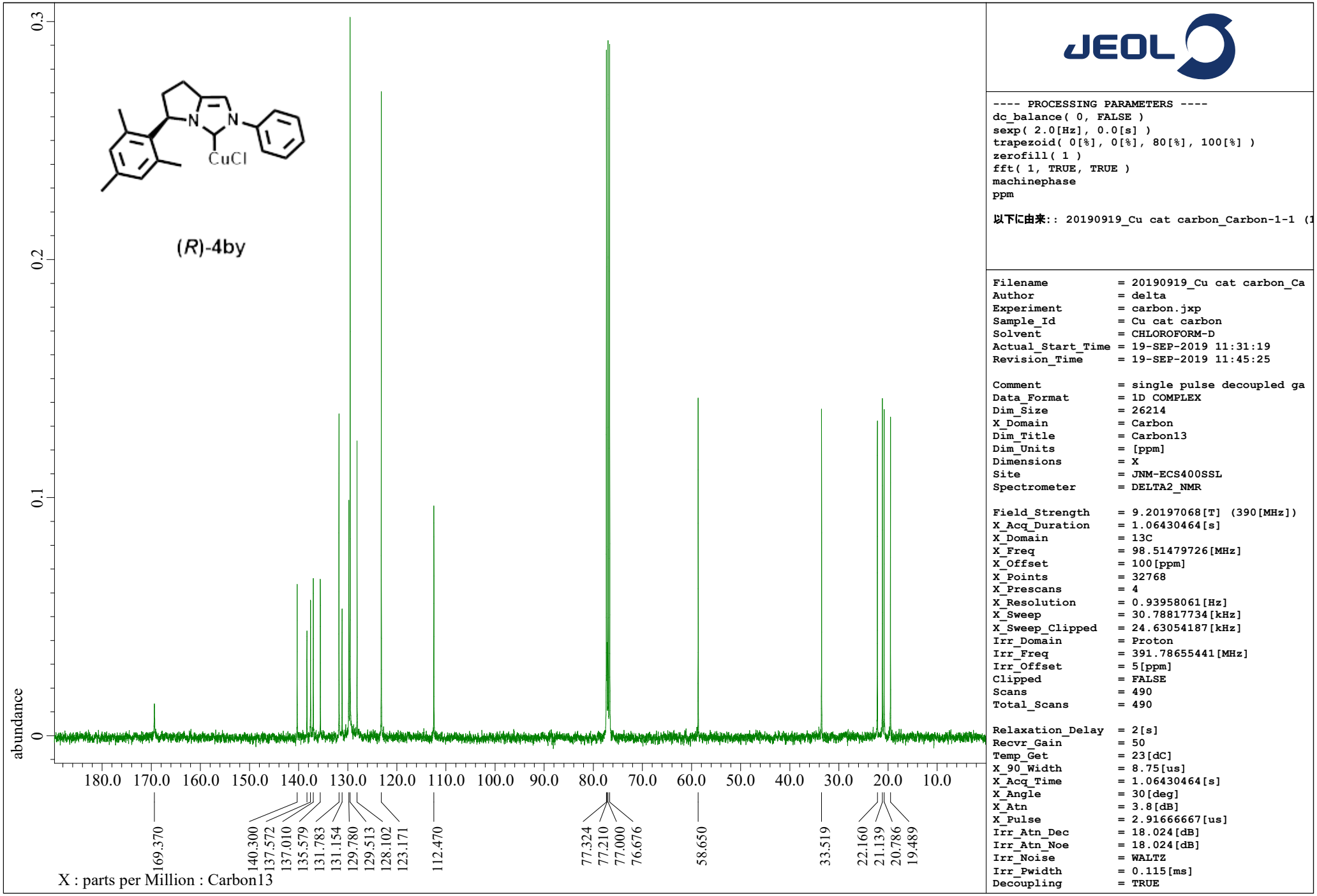


Figure S4. ^{13}C NMR spectrum of (*R*)-**4by** (100 MHz, $CDCl_3$).

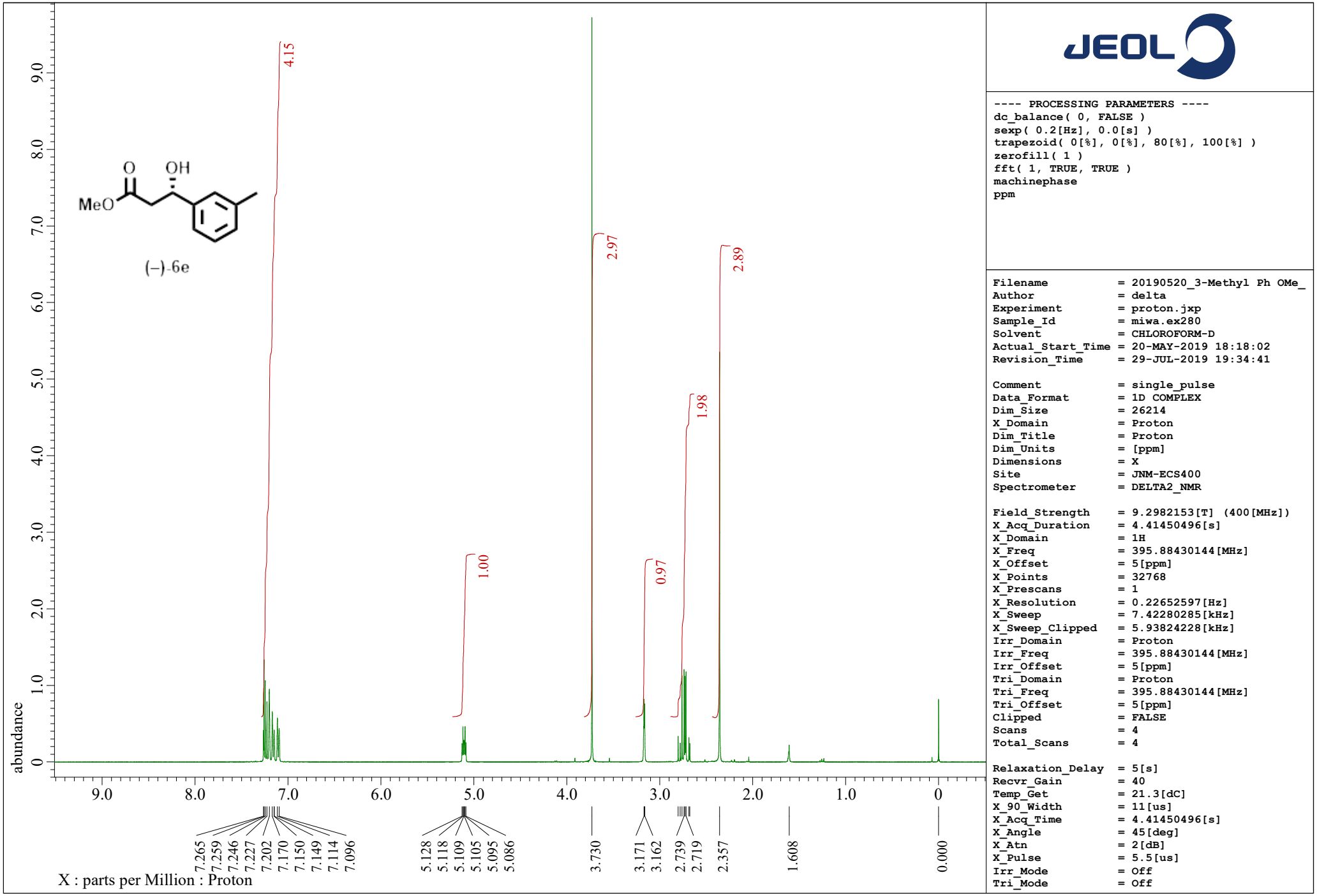
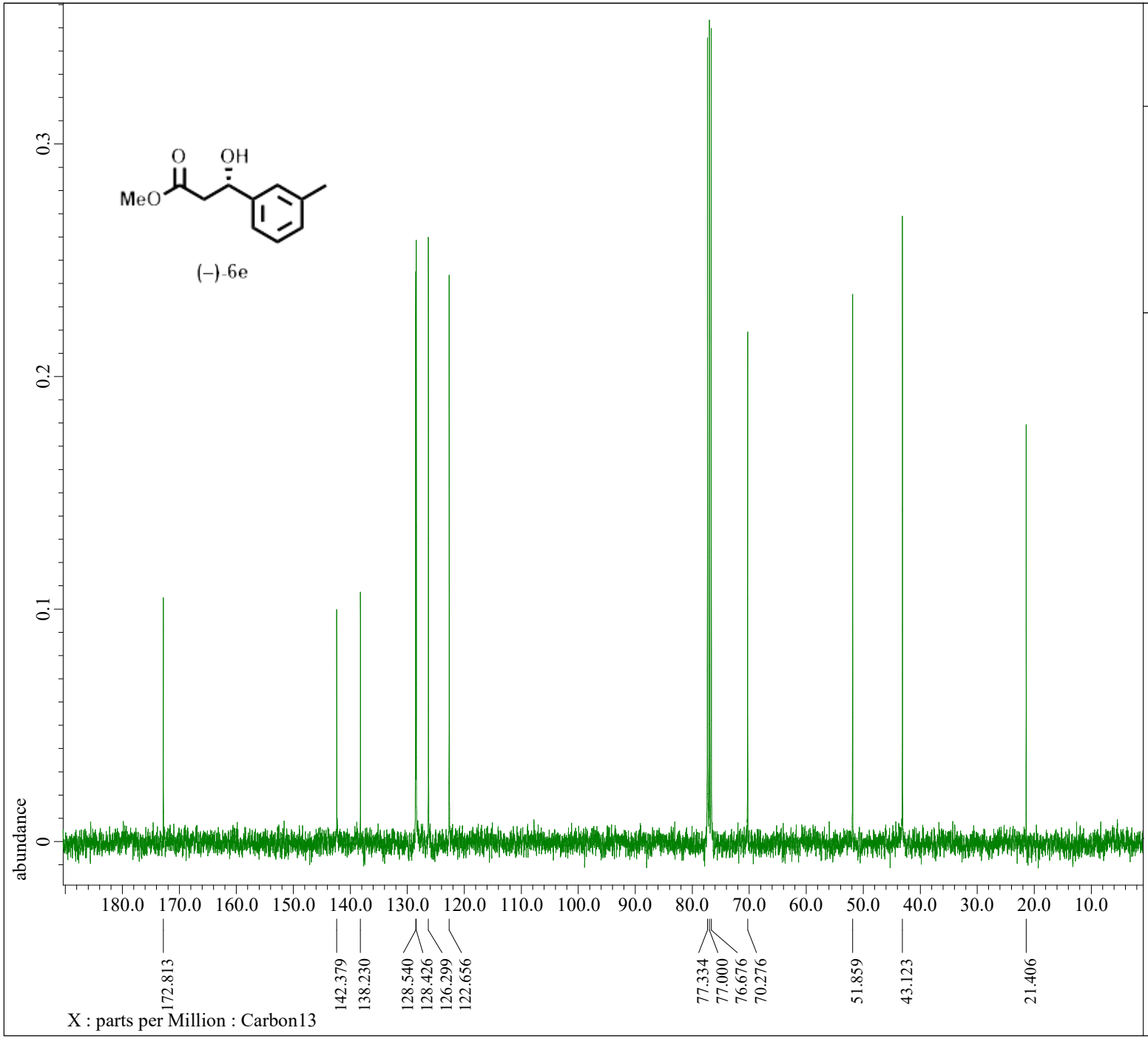


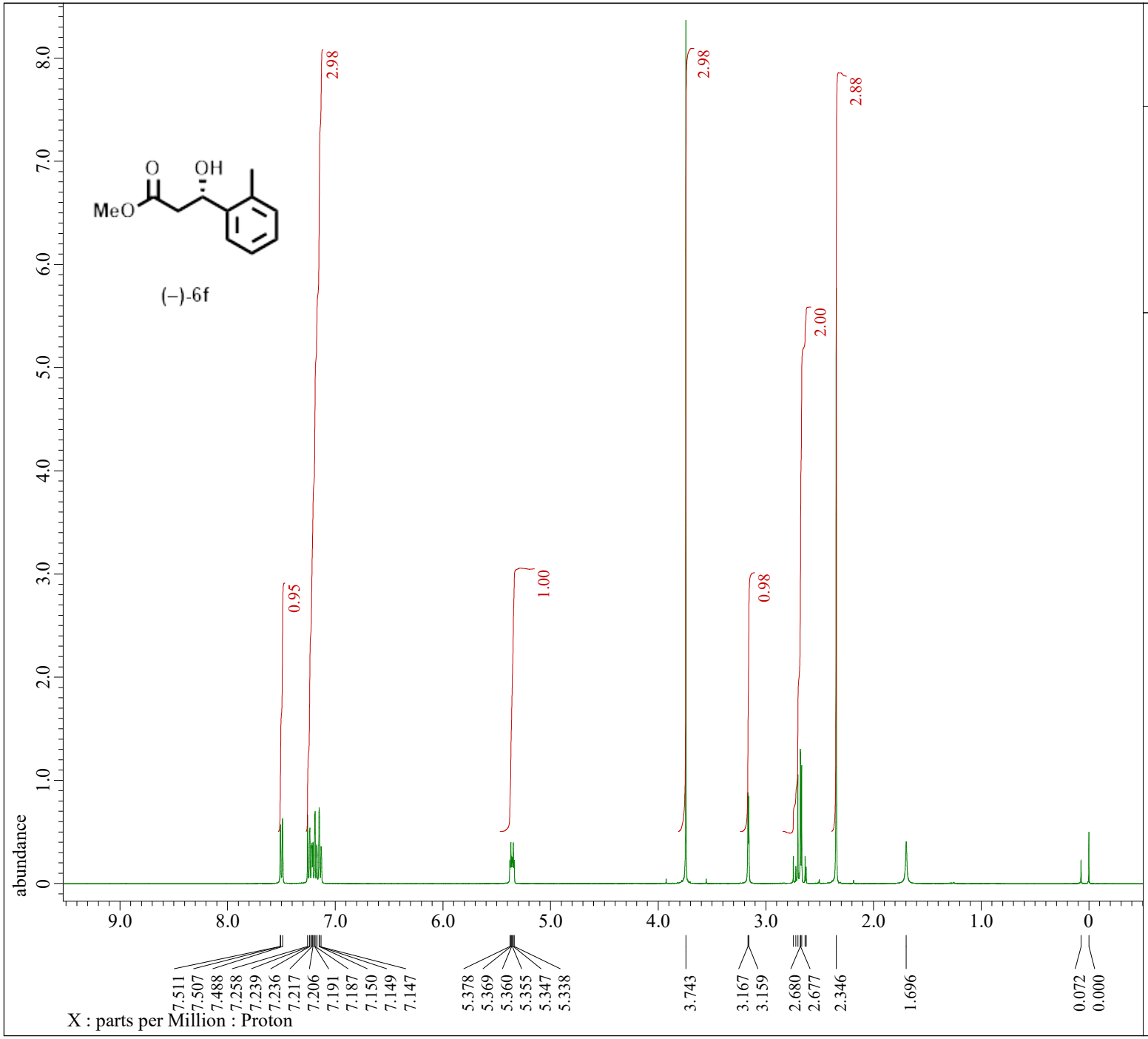
Figure S5. ^{1}H NMR spectrum of (–)-**6e** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 2.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

以下に由来:: 20190528_3-MePh OMe carbon_Carbon-1-
```

```
Filename           = 20190528_3-MePh OMe carbo
Author             = delta
Experiment         = carbon.jxp
Sample_Id          = 3-MePh OMe carbon
Solvent            = CHLOROFORM-D
Actual_Start_Time  = 28-MAY-2019 14:43:33
Revision_Time      = 29-JUL-2019 19:40:23

Comment            = single pulse decoupled ga
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Carbon
Dim_Title          = Carbon13
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400SSL
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.20197068[T] (390[MHz])
X_Acq_Duration     = 1.06430464[s]
X_Domain           = 13C
X_Freq             = 98.51479726[MHz]
X_Offset           = 100[ppm]
X_Points           = 32768
X_Prescans         = 4
X_Resolution       = 0.93958061[Hz]
X_Sweep            = 30.78817734[kHz]
X_Sweep_Clipped    = 24.63054187[kHz]
Irr_Domain         = Proton
Irr_Freq           = 391.78655441[MHz]
Irr_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 67
Total_Scans        = 67

Relaxation_Delay   = 2[s]
Recvr_Gain         = 50
Temp_Get           = 21.1[dC]
X_90_Width         = 8.75[us]
X_Acq_Time         = 1.06430464[s]
X_Angle            = 30[deg]
X_Atn              = 3.8[dB]
X_Pulse            = 2.91666667[us]
Irr_Atn_Dec        = 18.024[dB]
Irr_Atn_Noe        = 18.024[dB]
Irr_Noise          = WALTZ
Irr_Pwidth         = 0.115[ms]
Decoupling         = TRUE
```

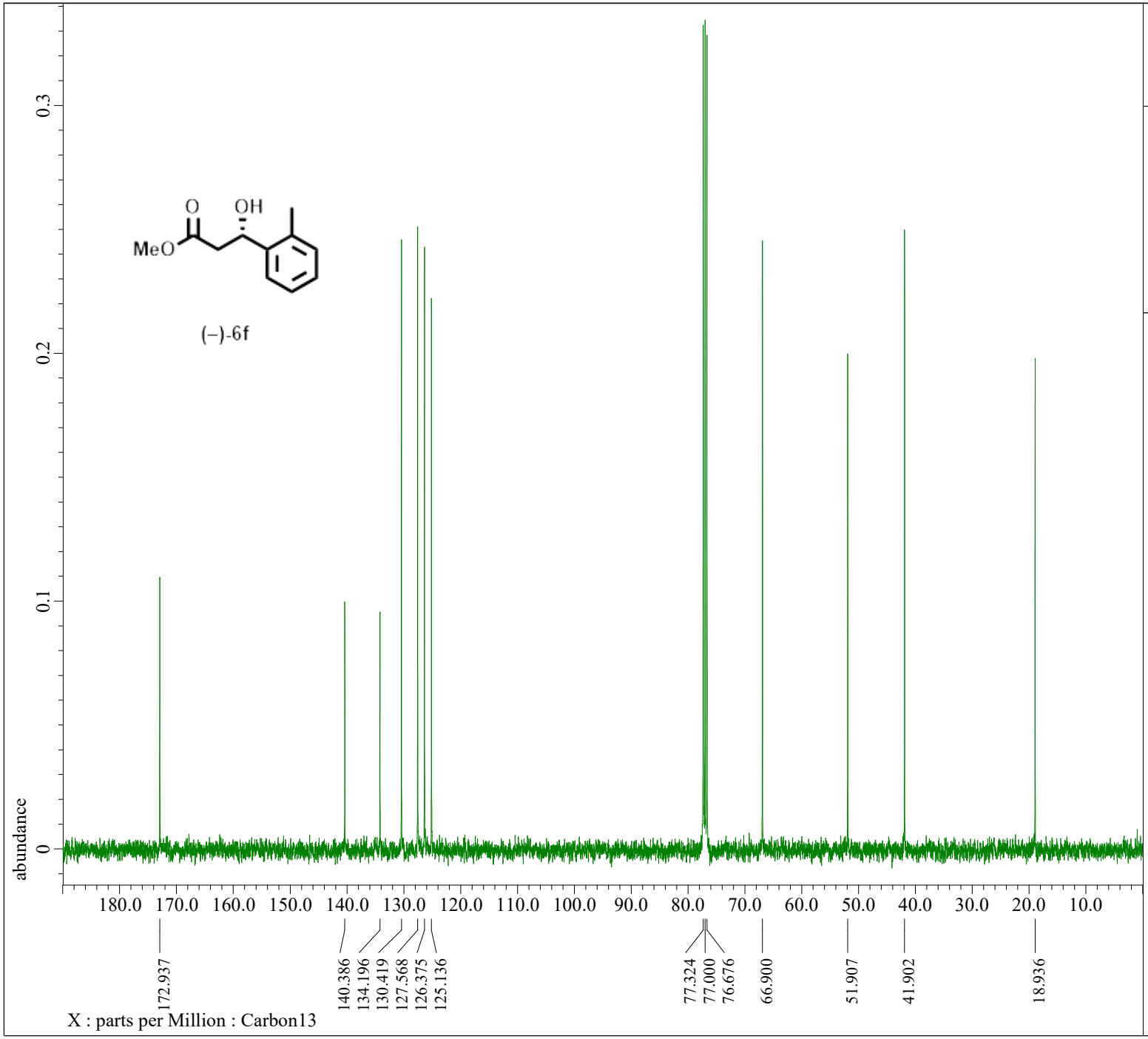
Figure S6. ^{13}C NMR spectrum of (–)-**6e** (100 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm
```

```
Filename            = 20190708_2-MePhOMe_Proton
Author              = delta
Experiment          = proton.jxp
Sample_Id           = miw.ex259
Solvent             = CHLOROFORM-D
Actual_Start_Time   =  8-JUL-2019 14:58:31
Revision_Time       =  8-JUL-2019 15:16:12

Comment             = single_pulse
Data_Format         = 1D COMPLEX
Dim_Size            = 26214
X_Domain            = Proton
Dim_Title           = Proton
Dim_Units           = [ppm]
Dimensions          = X
Site                = JNM-ECS400
Spectrometer        = DELTA2_NMR

Field_Strength      = 9.2982153[T] (400[MHz])
X_Acq_Duration      = 4.41450496[s]
X_Domain            = 1H
X_Freq              = 395.88430144[MHz]
X_Offset            = 5[ppm]
X_Points            = 32768
X_Prescans          = 1
X_Resolution        = 0.22652597[Hz]
X_Sweep             = 7.42280285[kHz]
X_Sweep_Clipped     = 5.93824228[kHz]
Irr_Domain          = Proton
Irr_Freq            = 395.88430144[MHz]
Irr_Offset          = 5[ppm]
Tri_Domain          = Proton
Tri_Freq            = 395.88430144[MHz]
Tri_Offset          = 5[ppm]
Clipped             = FALSE
Scans               = 4
Total_Scans         = 4

Relaxation_Delay    = 5[s]
Recvr_Gain          = 36
Temp_Get            = 21.1[dC]
X_90_Width          = 11[us]
X_Acq_Time          = 4.41450496[s]
X_Angle             = 45[deg]
X_Atn               = 2[dB]
X_Pulse             = 5.5[us]
Irr_Mode            = Off
Tri_Mode            = Off
```

Figure S7. ^{1}H NMR spectrum of (–)-**6f** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 2.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

以下に由来:: 20190528_2-MePh OMe carbon_Carbon-1-
```

```
Filename           = 20190528_2-MePh OMe carbo
Author             = delta
Experiment         = carbon.jxp
Sample_Id          = 2-MePh OMe carbon
Solvent            = CHLOROFORM-D
Actual_Start_Time  = 28-MAY-2019 14:30:32
Revision_Time      = 29-JUL-2019 19:41:23

Comment            = single pulse decoupled ga
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Carbon
Dim_Title          = Carbon13
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400SSL
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.20197068[T] (390[MHz])
X_Acq_Duration     = 1.06430464[s]
X_Domain           = 13C
X_Freq             = 98.51479726[MHz]
X_Offset           = 100[ppm]
X_Points           = 32768
X_Prescans         = 4
X_Resolution       = 0.93958061[Hz]
X_Sweep            = 30.78817734[kHz]
X_Sweep_Clipped    = 24.63054187[kHz]
Irr_Domain         = Proton
Irr_Freq           = 391.78655441[MHz]
Irr_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 142
Total_Scans        = 142

Relaxation_Delay   = 2[s]
Recvr_Gain         = 50
Temp_Get           = 21.1[dC]
X_90_Width         = 8.75[us]
X_Acq_Time         = 1.06430464[s]
X_Angle            = 30[deg]
X_Atn              = 3.8[dB]
X_Pulse            = 2.91666667[us]
Irr_Atn_Dec        = 18.024[dB]
Irr_Atn_Noe        = 18.024[dB]
Irr_Noise          = WALTZ
Irr_Pwidth         = 0.115[ms]
Decoupling         = TRUE
```

Figure S8. ^{13}C NMR spectrum of (–)-**6f** (100 MHz, $CDCl_3$).

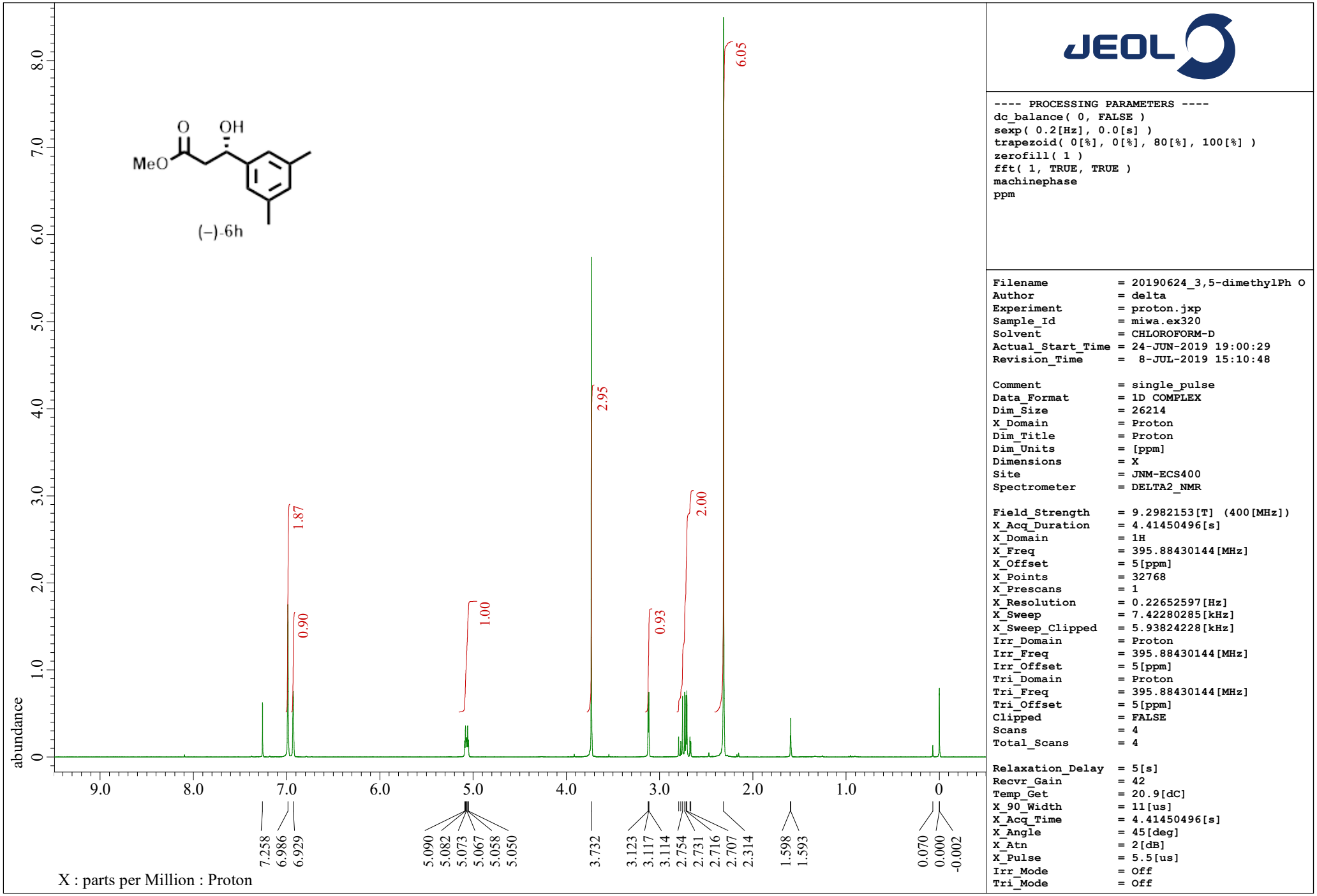
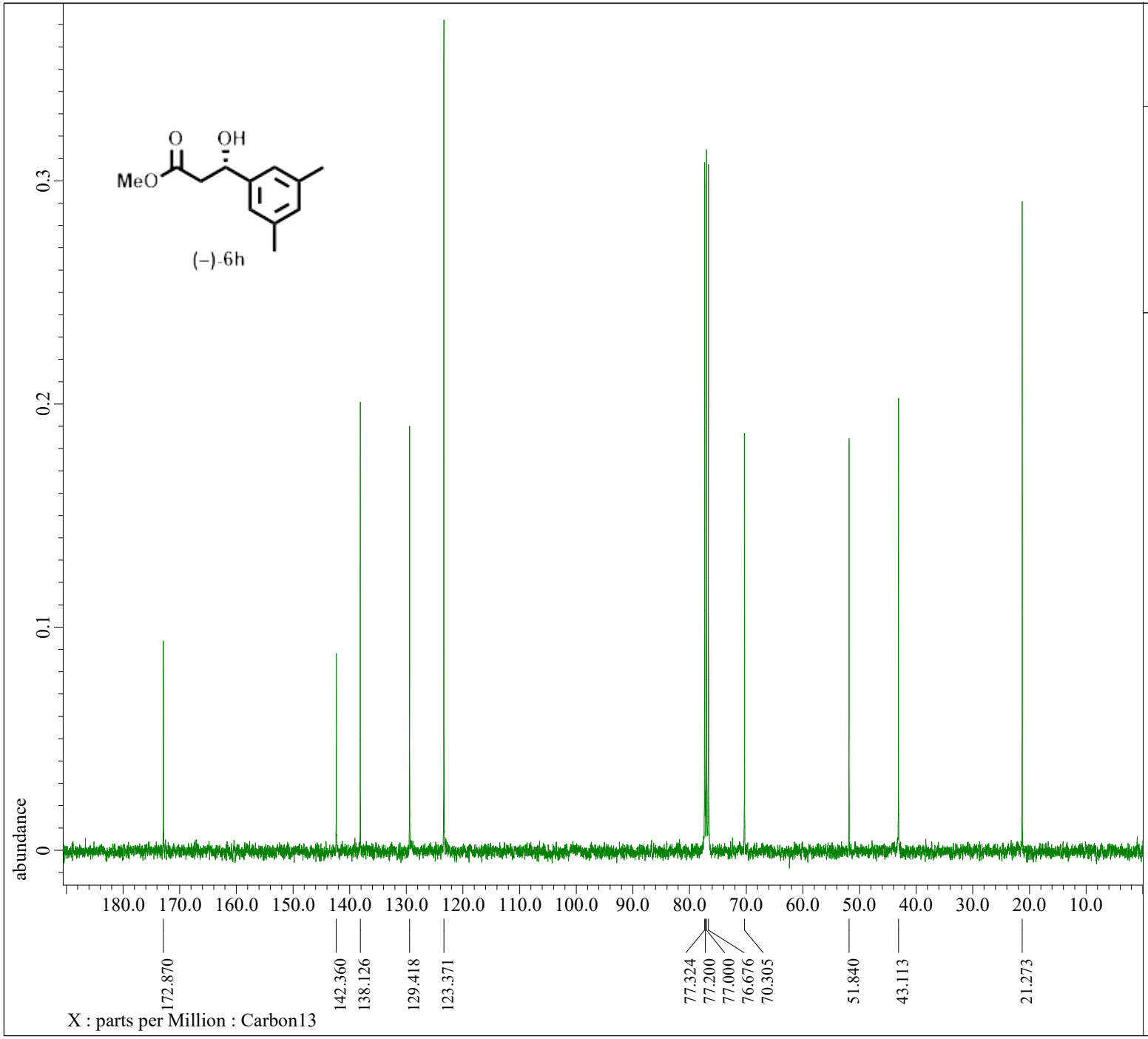


Figure S9. ^{1}H NMR spectrum of (–)-**6h** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 2.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm
```

```
Filename           = 20190720_3,5-dimethyl_Car
Author             = delta
Experiment         = carbon.jxp
Sample_Id          = 3,5-dimethyl
Solvent            = CHLOROFORM-D
Actual_Start_Time  = 20-JUL-2019 10:46:37
Revision_Time      = 20-JUL-2019 10:57:21

Comment            = single pulse decoupled ga
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Carbon
Dim_Title          = Carbon13
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400SSL
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.20197068[T] (390[MHz])
X_Acq_Duration     = 1.06430464[s]
X_Domain           = 13C
X_Freq             = 98.51479726[MHz]
X_Offset           = 100[ppm]
X_Points           = 32768
X_Prescans         = 4
X_Resolution       = 0.93958061[Hz]
X_Sweep            = 30.78817734[kHz]
X_Sweep_Clipped    = 24.63054187[kHz]
Irr_Domain         = Proton
Irr_Freq           = 391.78655441[MHz]
Irr_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 217
Total_Scans        = 217

Relaxation_Delay   = 2[s]
Recvr_Gain         = 50
Temp_Get           = 21.2[dC]
X_90_Width         = 8.75[us]
X_Acq_Time         = 1.06430464[s]
X_Angle            = 30[deg]
X_Atn              = 3.8[dB]
X_Pulse            = 2.91666667[us]
Irr_Atn_Dec        = 18.024[dB]
Irr_Atn_Noe        = 18.024[dB]
Irr_Noise          = WALTZ
Irr_Pwidth         = 0.115[ms]
Decoupling         = TRUE
```

Figure S10. ^{13}C NMR spectrum of (–)-**6h** (100 MHz, $CDCl_3$).

^{1}H NMR Spectra of Known Compounds

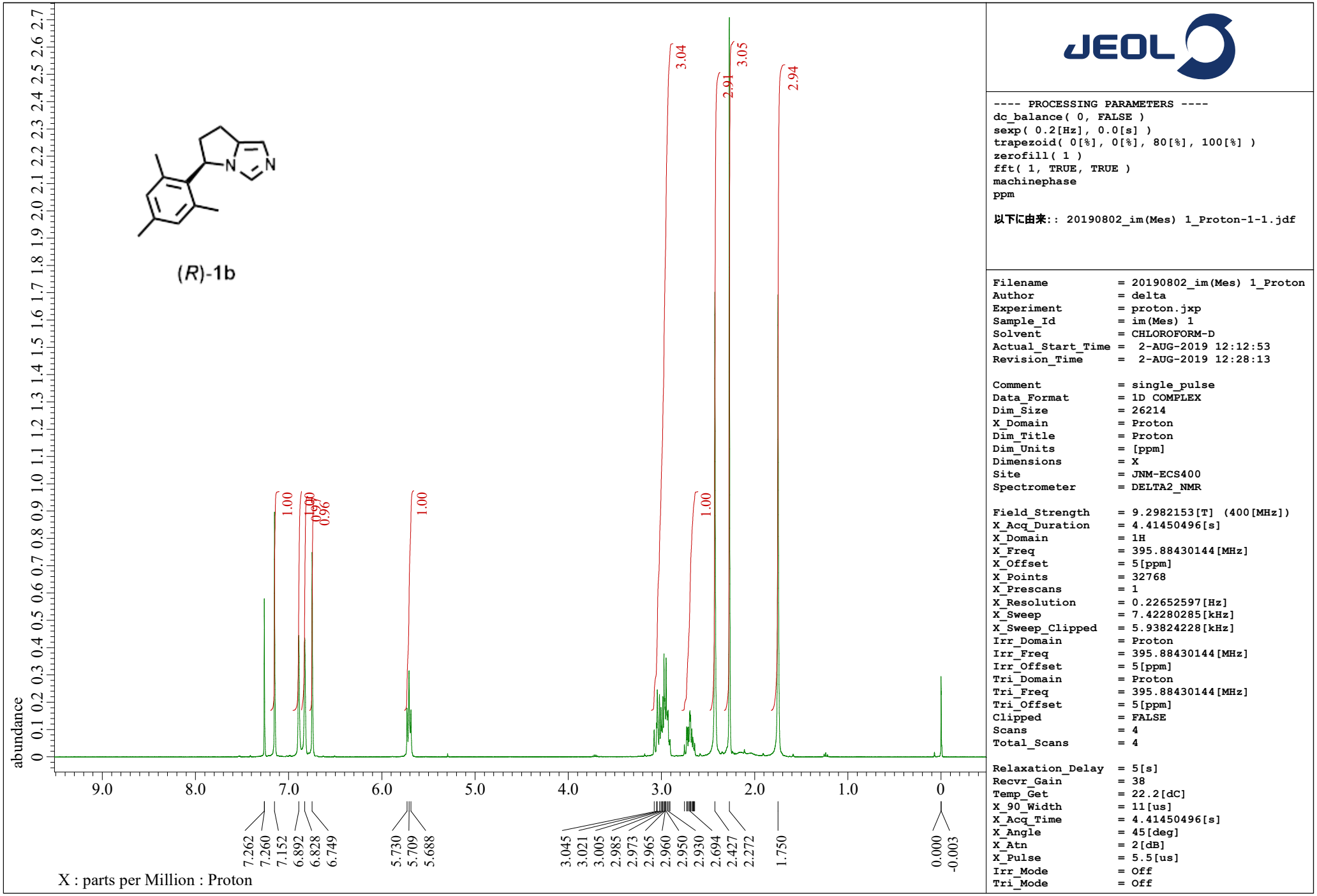
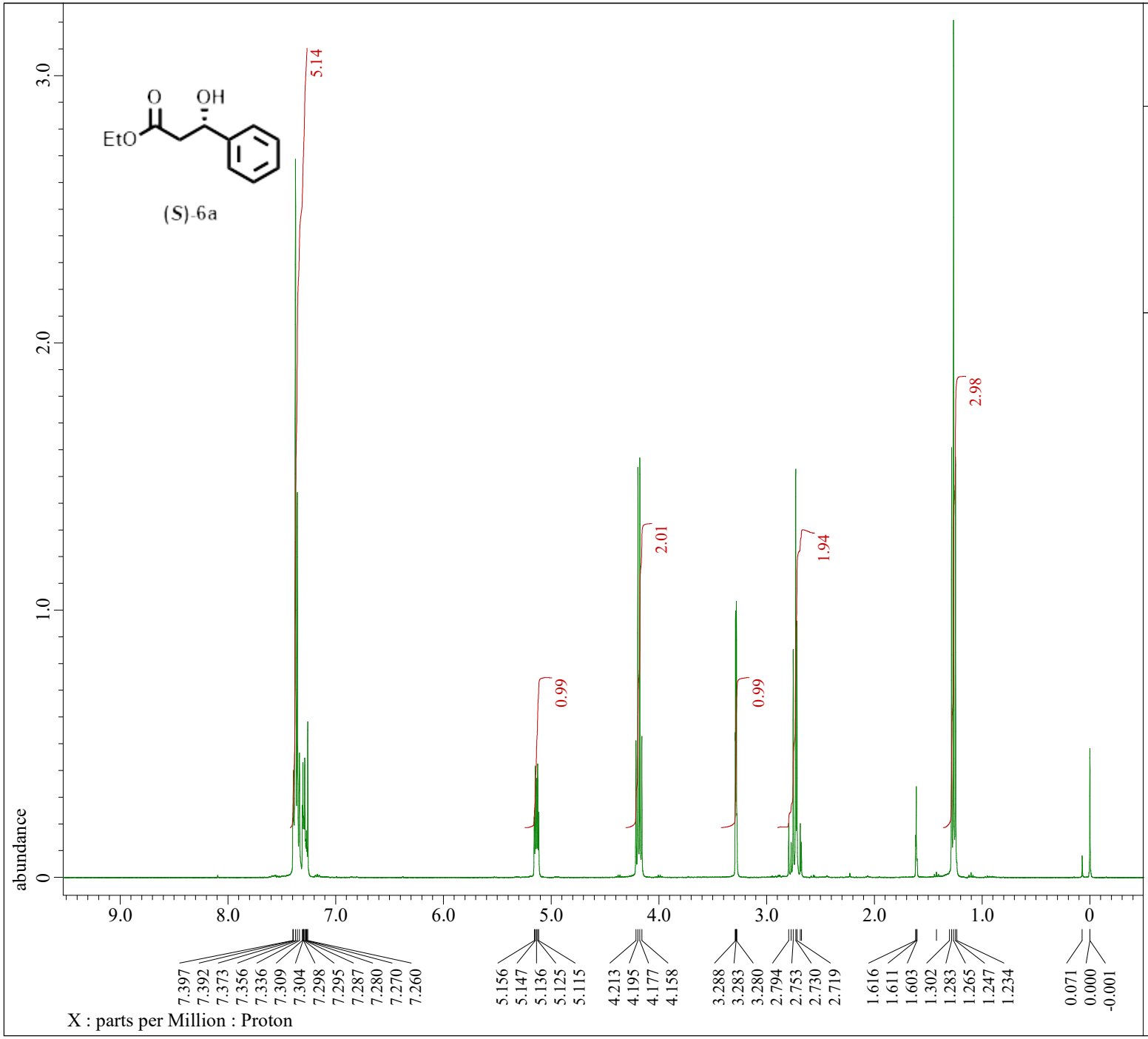


Figure S11. ^{1}H NMR spectrum of (*R*)-**1b** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

Filename           = 20190405_miwa.ex245 Ph-OE
Author             = delta
Experiment         = proton.jxp
Sample_Id          = miwa.ex245 pure
Solvent            = CHLOROFORM-D
Actual_Start_Time  =  5-APR-2019 19:27:13
Revision_Time      = 29-JUL-2019 19:27:40

Comment            = single_pulse
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Proton
Dim_Title          = Proton
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.2982153[T] (400[MHz])
X_Acq_Duration     = 4.41450496[s]
X_Domain           = 1H
X_Freq             = 395.88430144[MHz]
X_Offset           = 5[ppm]
X_Points           = 32768
X_Prescans         = 1
X_Resolution       = 0.22652597[Hz]
X_Sweep            = 7.42280285[kHz]
X_Sweep_Clipped    = 5.93824228[kHz]
Irr_Domain         = Proton
Irr_Freq           = 395.88430144[MHz]
Irr_Offset         = 5[ppm]
Tri_Domain         = Proton
Tri_Freq           = 395.88430144[MHz]
Tri_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 4
Total_Scans        = 4

Relaxation_Delay   = 5[s]
Recvr_Gain         = 40
Temp_Get           = 21.2[dC]
X_90_Width         = 11[us]
X_Acq_Time         = 4.41450496[s]
X_Angle            = 45[deg]
X_Atn              = 2[dB]
X_Pulse            = 5.5[us]
Irr_Mode           = Off
Tri_Mode           = Off
```

Figure S12. ^{1}H NMR spectrum of (*S*)-**6a** (400 MHz, $CDCl_3$).

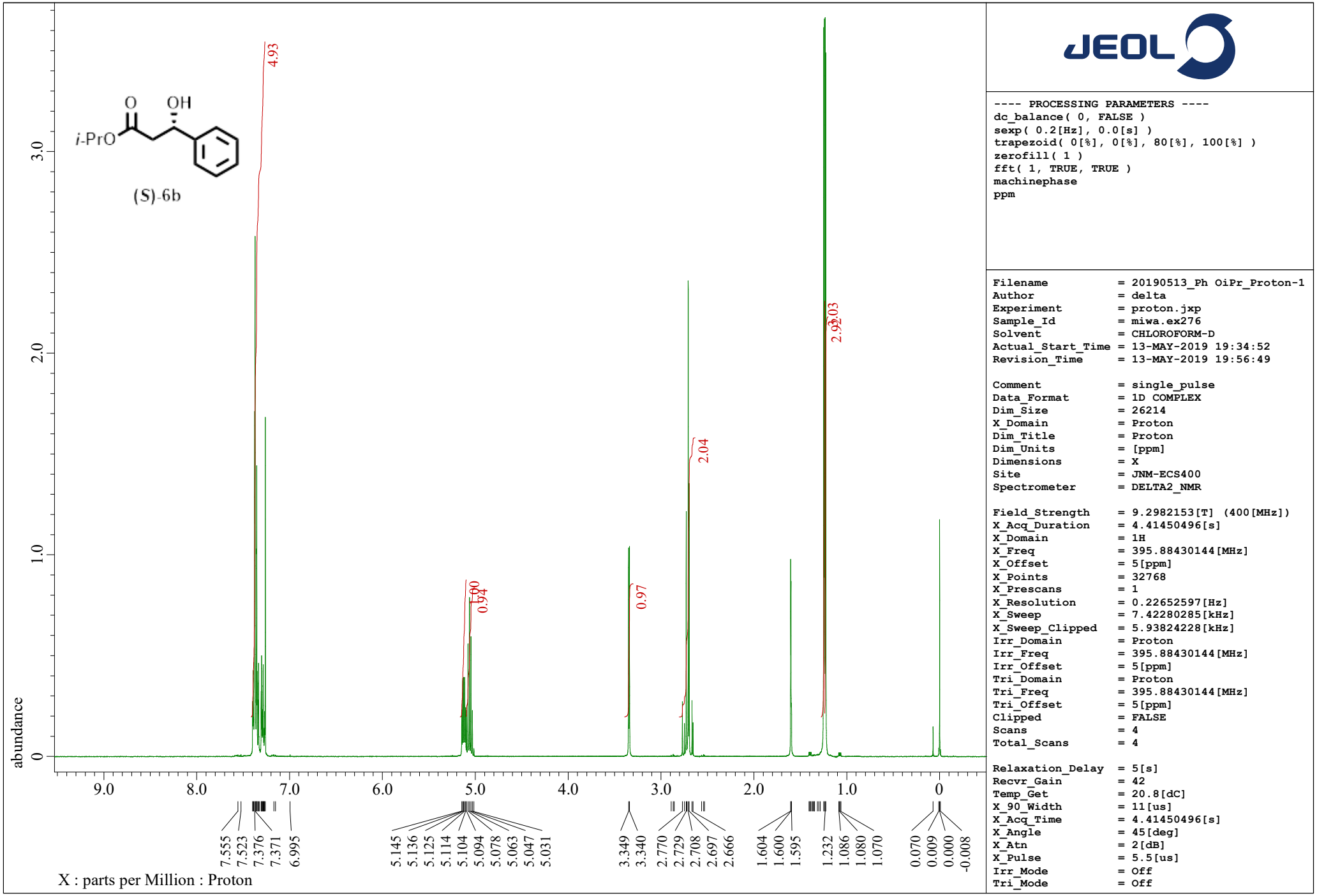
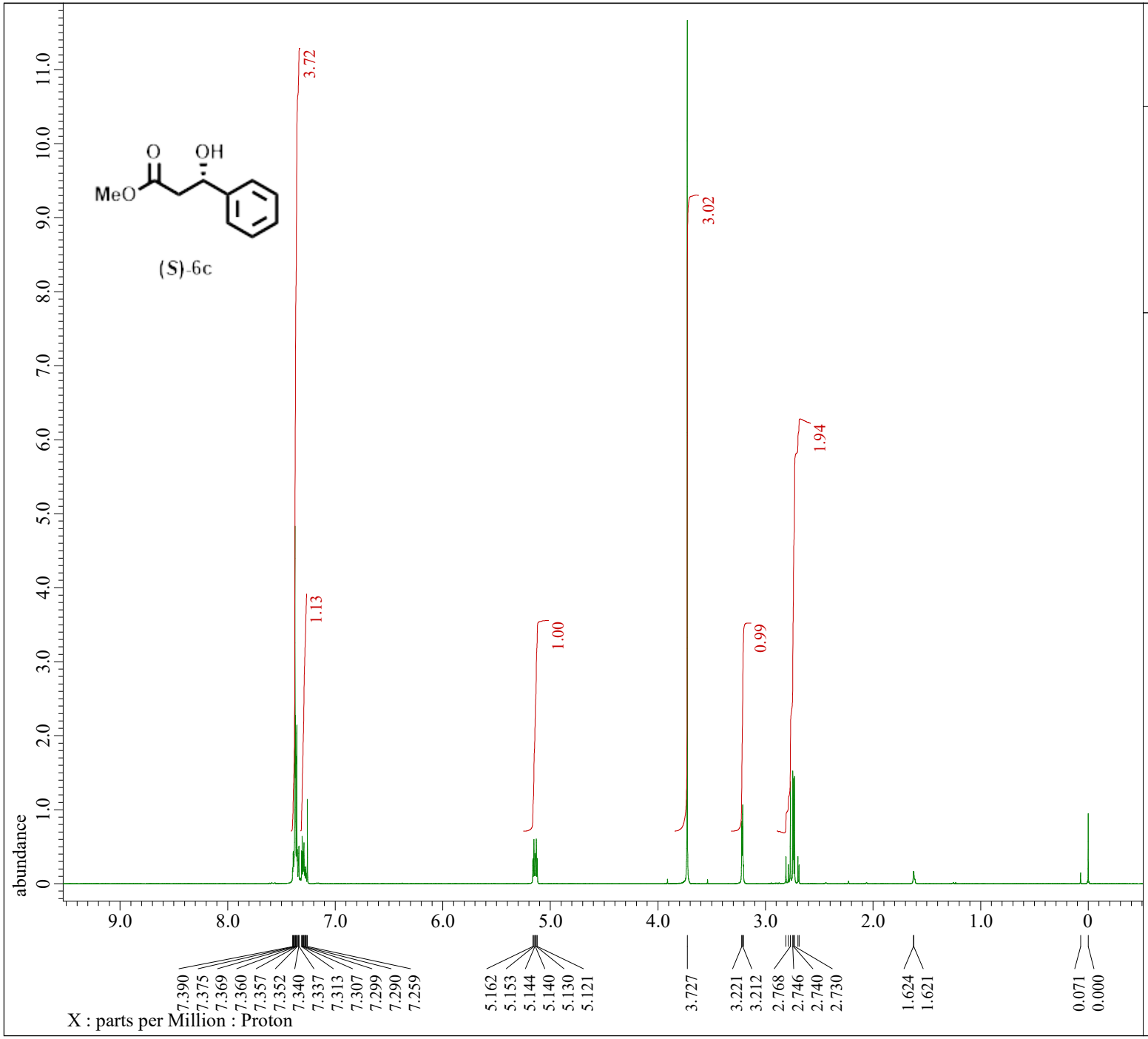


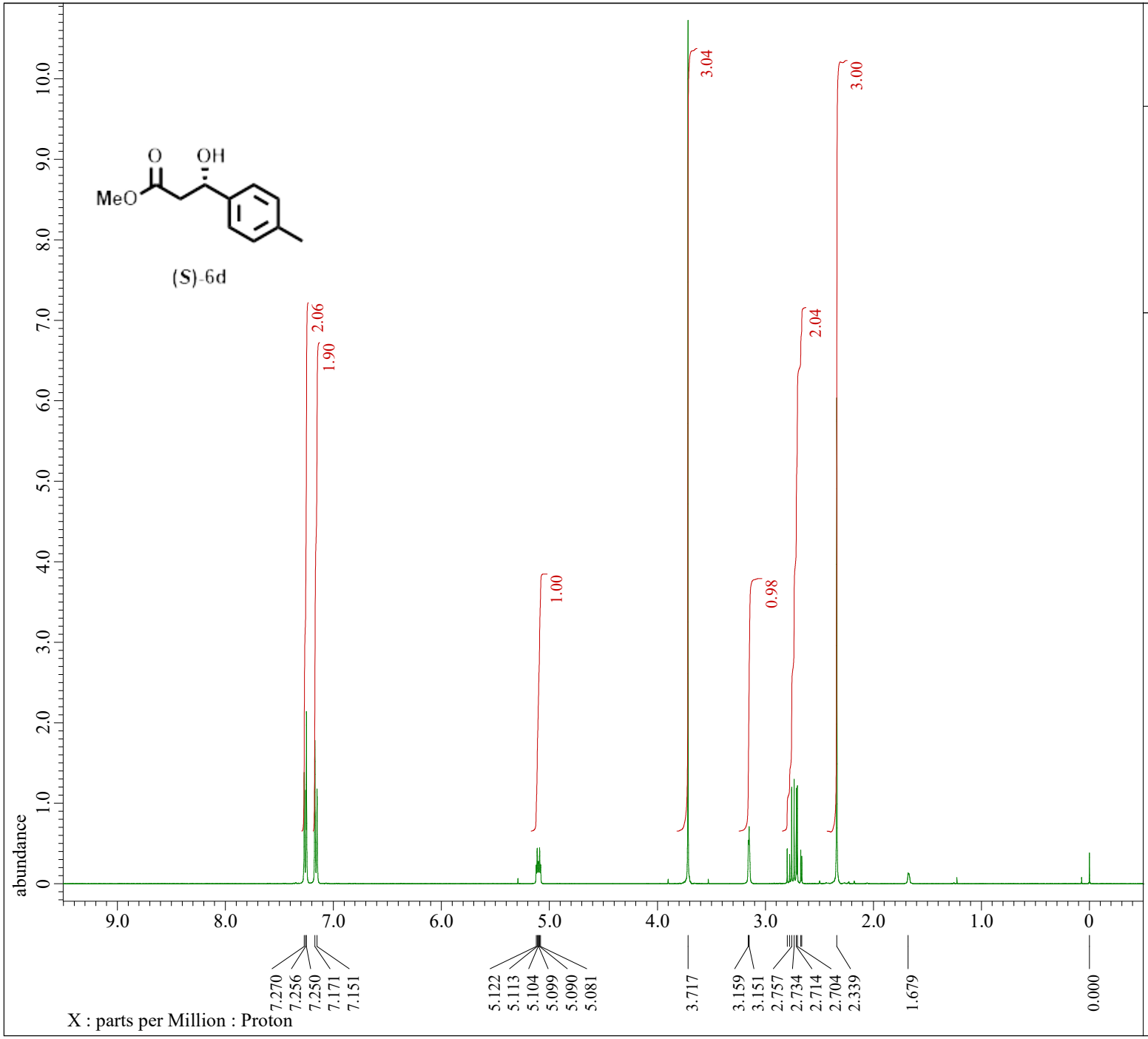
Figure S13. ^{1}H NMR spectrum of (*S*)-**6b** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm
```

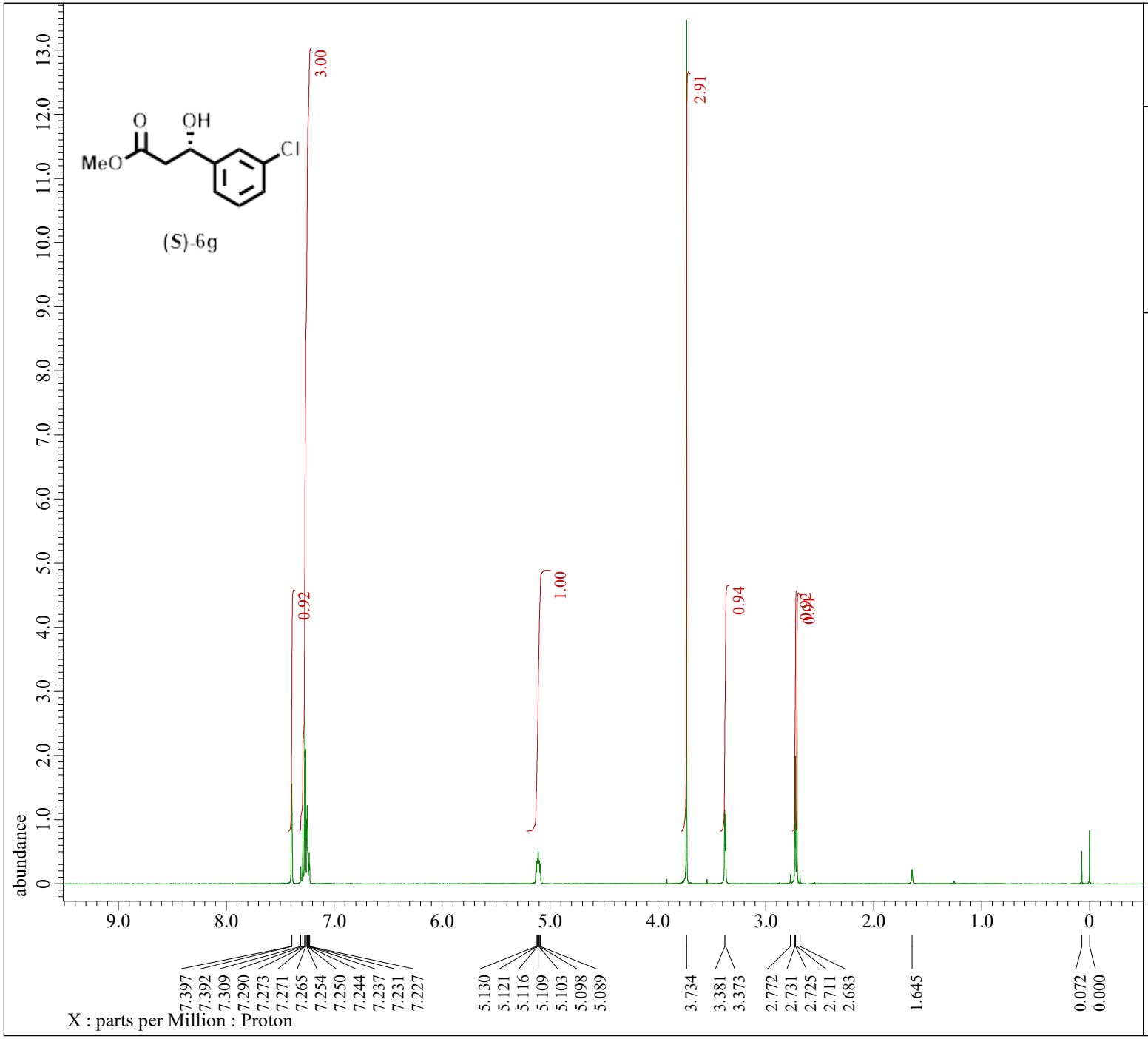
```
Filename           = 20190410_miwa.ex249 Ph-OM
Author             = delta
Experiment         = proton.jxp
Sample_Id          = miwa.ex249 pure
Solvent            = CHLOROFORM-D
Actual_Start_Time  = 10-APR-2019 12:41:27
Revision_Time      = 29-JUL-2019 19:32:46

Comment            = single_pulse
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Proton
Dim_Title          = Proton
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.2982153[T] (400[MHz])
X_Acq_Duration     = 4.41450496[s]
X_Domain           = 1H
X_Freq             = 395.88430144[MHz]
X_Offset           = 5[ppm]
X_Points           = 32768
X_Prescans         = 1
X_Resolution       = 0.22652597[Hz]
X_Sweep            = 7.42280285[kHz]
X_Sweep_Clipped    = 5.93824228[kHz]
Irr_Domain         = Proton
Irr_Freq           = 395.88430144[MHz]
Irr_Offset         = 5[ppm]
Tri_Domain         = Proton
Tri_Freq           = 395.88430144[MHz]
Tri_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 4
Total_Scans        = 4

Relaxation_Delay   = 5[s]
Recvr_Gain         = 40
Temp_Get           = 21[dC]
X_90_Width         = 11[us]
X_Acq_Time         = 4.41450496[s]
X_Angle            = 45[deg]
X_Atn              = 2[dB]
X_Pulse            = 5.5[us]
Irr_Mode           = Off
Tri_Mode           = Off
```

Figure S14. ^{1}H NMR spectrum of (*S*)-**6c** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

Filename           = 20190424_miwa.ex266 4-MeP
Author             = delta
Experiment         = proton.jxp
Sample_Id          = miwa.ex266 pure
Solvent            = CHLOROFORM-D
Actual_Start_Time  = 24-APR-2019 14:20:59
Revision_Time      = 29-JUL-2019 19:33:44

Comment            = single_pulse
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Proton
Dim_Title          = Proton
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.2982153[T] (400[MHz])
X_Acq_Duration     = 4.41450496[s]
X_Domain           = 1H
X_Freq             = 395.88430144[MHz]
X_Offset           = 5[ppm]
X_Points           = 32768
X_Prescans         = 1
X_Resolution       = 0.22652597[Hz]
X_Sweep            = 7.42280285[kHz]
X_Sweep_Clipped    = 5.93824228[kHz]
Irr_Domain         = Proton
Irr_Freq           = 395.88430144[MHz]
Irr_Offset         = 5[ppm]
Tri_Domain         = Proton
Tri_Freq           = 395.88430144[MHz]
Tri_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 4
Total_Scans        = 4

Relaxation_Delay   = 5[s]
Recvr_Gain         = 36
Temp_Get           = 21.3[dC]
X_90_Width         = 11[us]
X_Acq_Time         = 4.41450496[s]
X_Angle            = 45[deg]
X_Atn              = 2[dB]
X_Pulse            = 5.5[us]
Irr_Mode           = Off
Tri_Mode           = Off
```

Figure S15. ^{1}H NMR spectrum of (*S*)-**6d** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

Filename           = 20190625_3-ClPh OMe_Proto
Author             = delta
Experiment         = proton.jxp
Sample_Id          = miwa.ex319
Solvent            = CHLOROFORM-D
Actual_Start_Time  = 25-JUN-2019 13:27:50
Revision_Time      =  8-JUL-2019 15:12:57

Comment            = single_pulse
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Proton
Dim_Title          = Proton
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.2982153[T] (400[MHz])
X_Acq_Duration     = 4.41450496[s]
X_Domain           = 1H
X_Freq             = 395.88430144[MHz]
X_Offset           = 5[ppm]
X_Points           = 32768
X_Prescans         = 1
X_Resolution       = 0.22652597[Hz]
X_Sweep            = 7.42280285[kHz]
X_Sweep_Clipped    = 5.93824228[kHz]
Irr_Domain         = Proton
Irr_Freq           = 395.88430144[MHz]
Irr_Offset         = 5[ppm]
Tri_Domain         = Proton
Tri_Freq           = 395.88430144[MHz]
Tri_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 4
Total_Scans        = 4

Relaxation_Delay   = 5[s]
Recvr_Gain         = 40
Temp_Get           = 20.6[dC]
X_90_Width         = 11[us]
X_Acq_Time         = 4.41450496[s]
X_Angle            = 45[deg]
X_Atn              = 2[dB]
X_Pulse            = 5.5[us]
Irr_Mode           = Off
Tri_Mode           = Off
```

Figure S16. ^{1}H NMR spectrum of (*S*)-**6g** (400 MHz, $CDCl_3$).

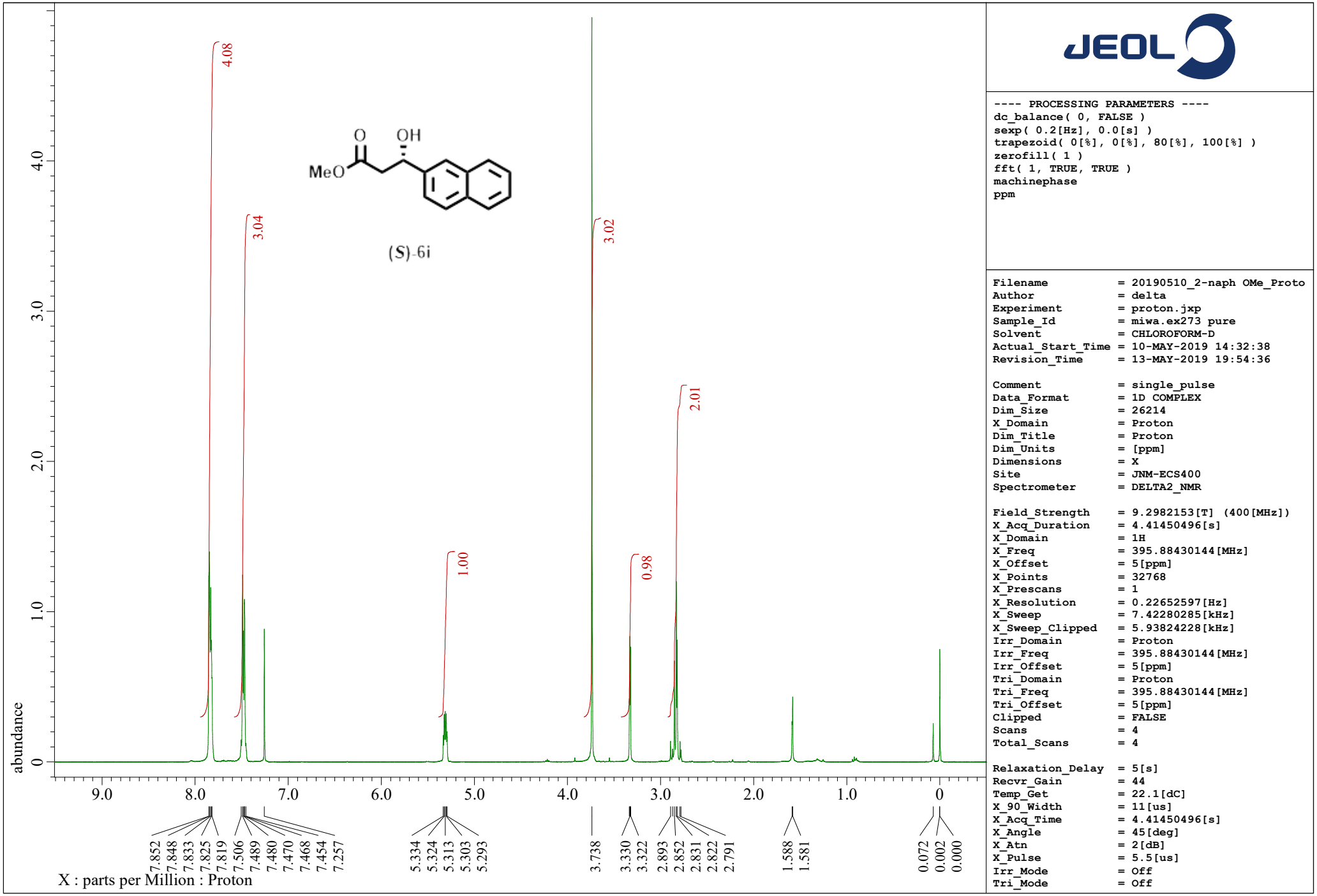


Figure S17. ^{1}H NMR spectrum of (*S*)-**6i** (400 MHz, $CDCl_3$).

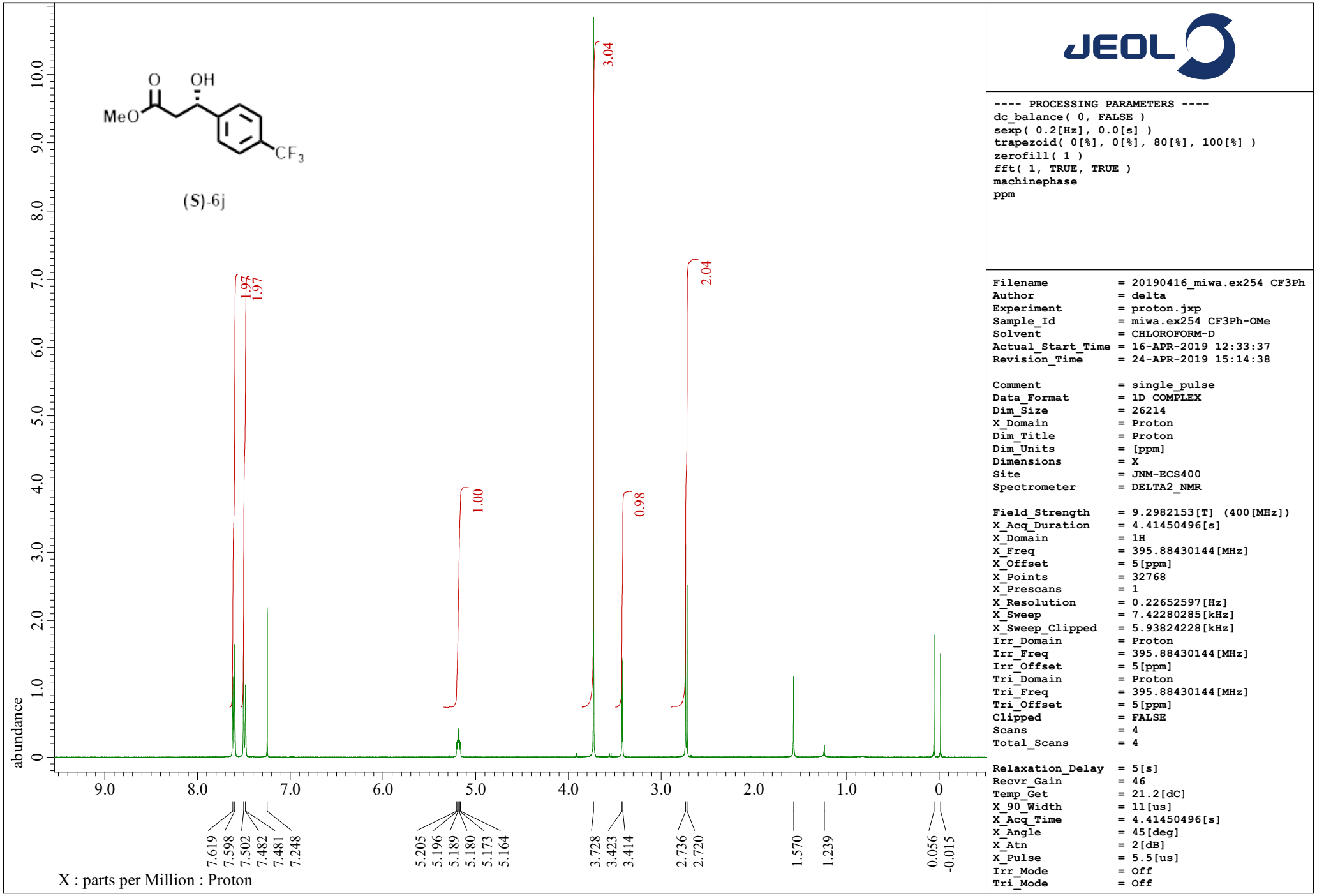
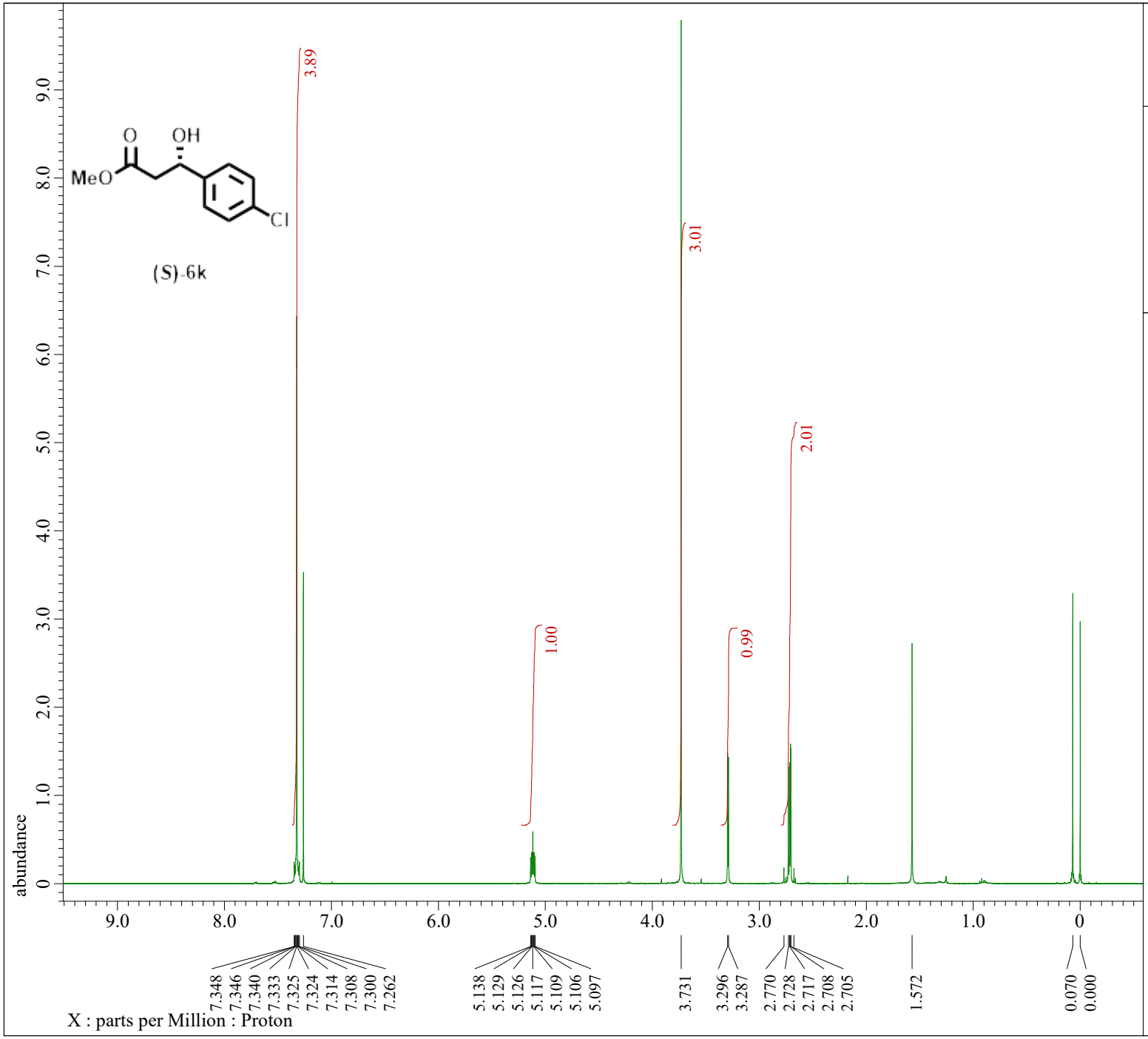


Figure S18. ^{1}H NMR spectrum of (*S*)-**6j** (400 MHz, $CDCl_3$).




```
---- PROCESSING PARAMETERS ----
dc_balance( 0, FALSE )
sexp( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm
```

```
Filename           = 20190507_miwa.ex257 4-ClP
Author             = delta
Experiment         = proton.jxp
Sample_Id          = Cl OMe
Solvent            = CHLOROFORM-D
Actual_Start_Time  =  7-MAY-2019 14:11:09
Revision_Time      =  7-MAY-2019 14:46:21

Comment            = single_pulse
Data_Format        = 1D COMPLEX
Dim_Size           = 26214
X_Domain           = Proton
Dim_Title          = Proton
Dim_Units          = [ppm]
Dimensions         = X
Site               = JNM-ECS400
Spectrometer       = DELTA2_NMR

Field_Strength     = 9.2982153[T] (400[MHz])
X_Acq_Duration     = 4.41450496[s]
X_Domain           = 1H
X_Freq             = 395.88430144[MHz]
X_Offset           = 5[ppm]
X_Points           = 32768
X_Prescans         = 1
X_Resolution       = 0.22652597[Hz]
X_Sweep            = 7.42280285[kHz]
X_Sweep_Clipped    = 5.93824228[kHz]
Irr_Domain         = Proton
Irr_Freq           = 395.88430144[MHz]
Irr_Offset         = 5[ppm]
Tri_Domain         = Proton
Tri_Freq           = 395.88430144[MHz]
Tri_Offset         = 5[ppm]
Clipped            = FALSE
Scans              = 4
Total_Scans        = 4

Relaxation_Delay   = 5[s]
Recvr_Gain         = 50
Temp_Get           = 22.3[dC]
X_90_Width         = 11[us]
X_Acq_Time         = 4.41450496[s]
X_Angle            = 45[deg]
X_Atn              = 2[dB]
X_Pulse            = 5.5[us]
Irr_Mode           = Off
Tri_Mode           = Off
```

Figure S19. ^{1}H NMR spectrum of (*S*)-**6k** (400 MHz, $CDCl_3$).

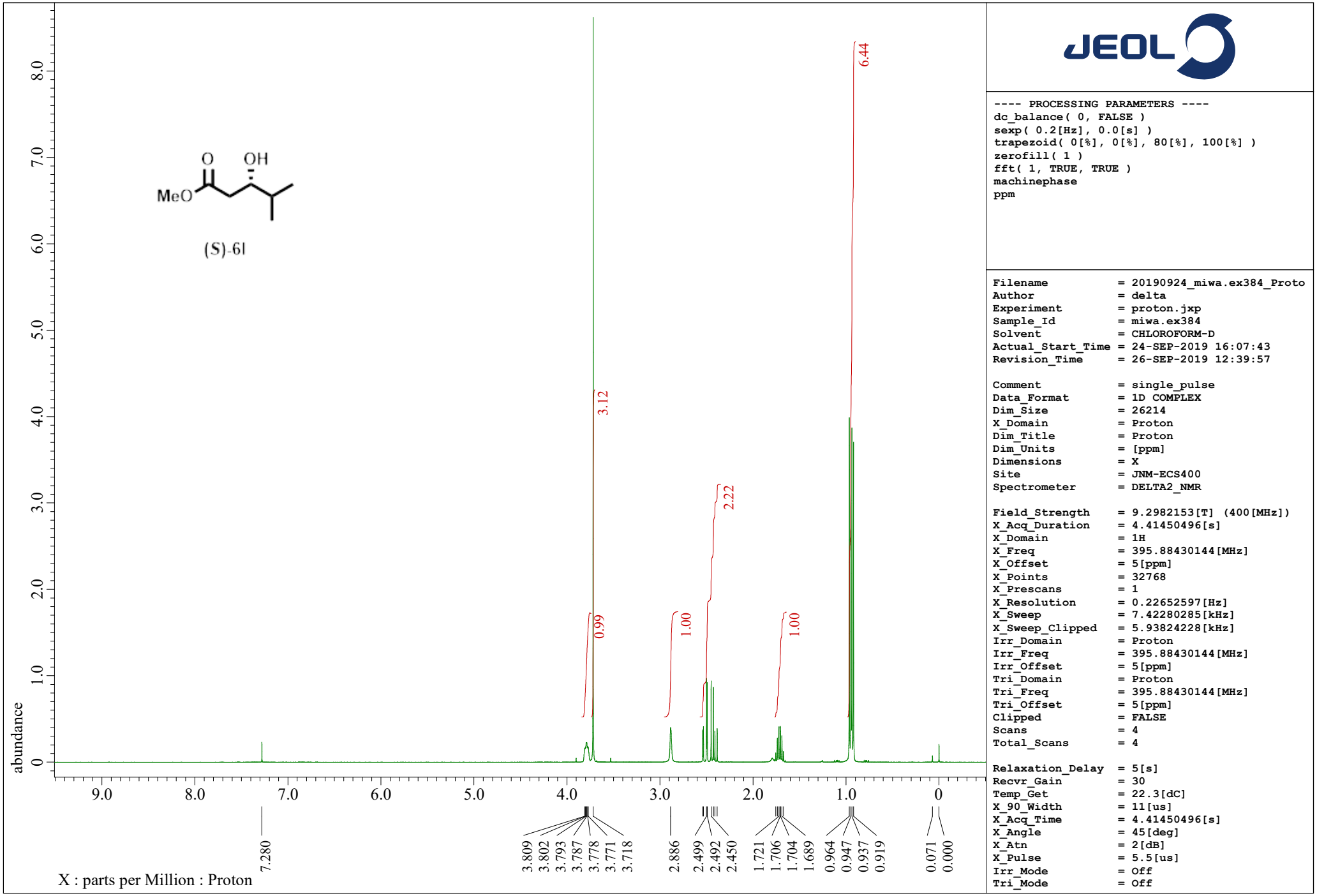
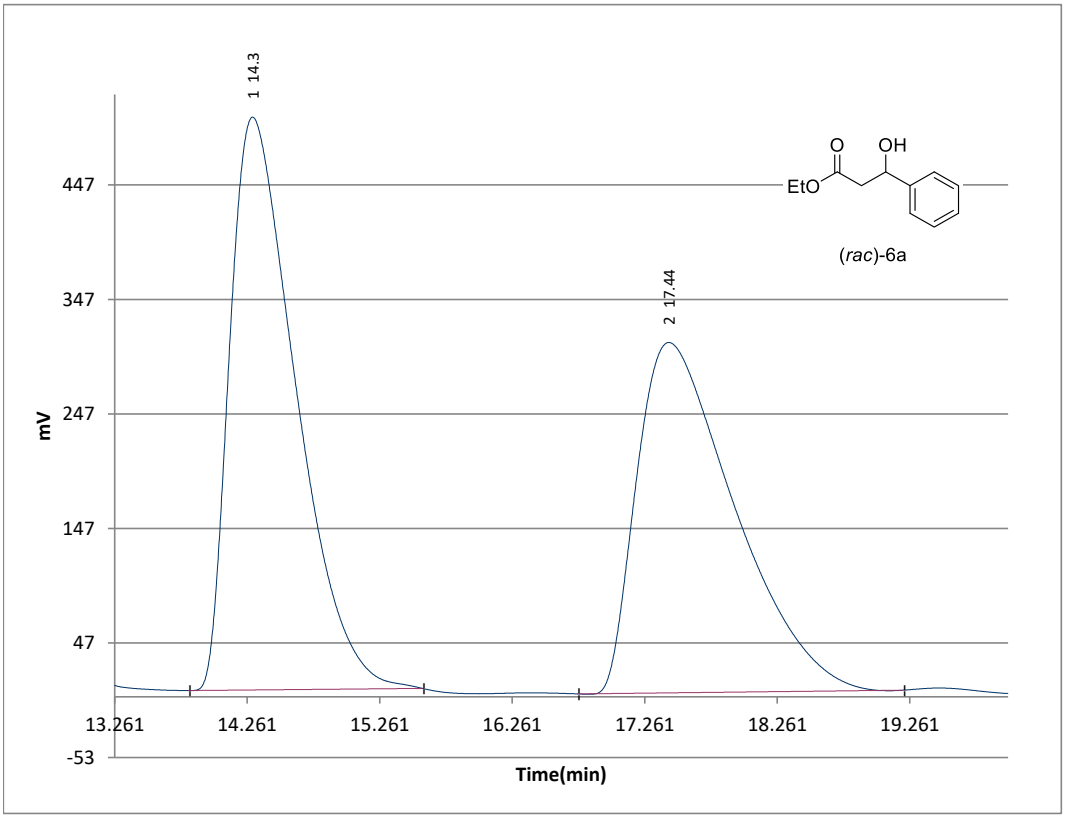


Figure S20. ^{1}H NMR spectrum of (*S*)-**6l** (400 MHz, $CDCl_3$).

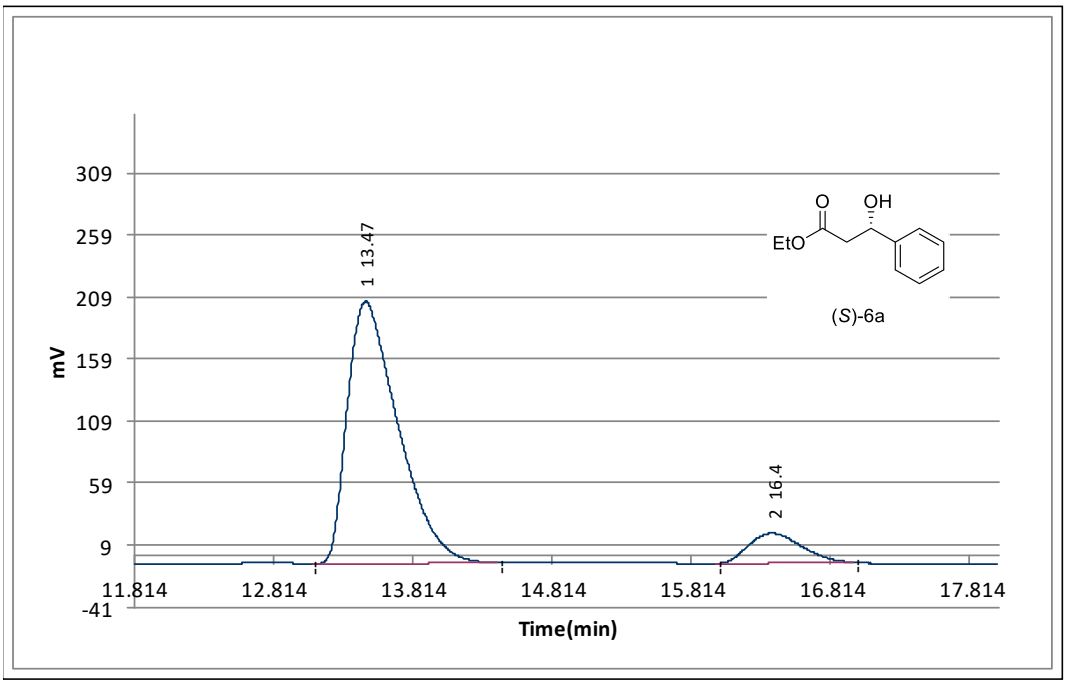
HPLC Analysis Data of 6

Figure S21. HPLC Analysis Data of (*S*)-**6a**.

Chiral column: Daicel Chiralcel OD-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



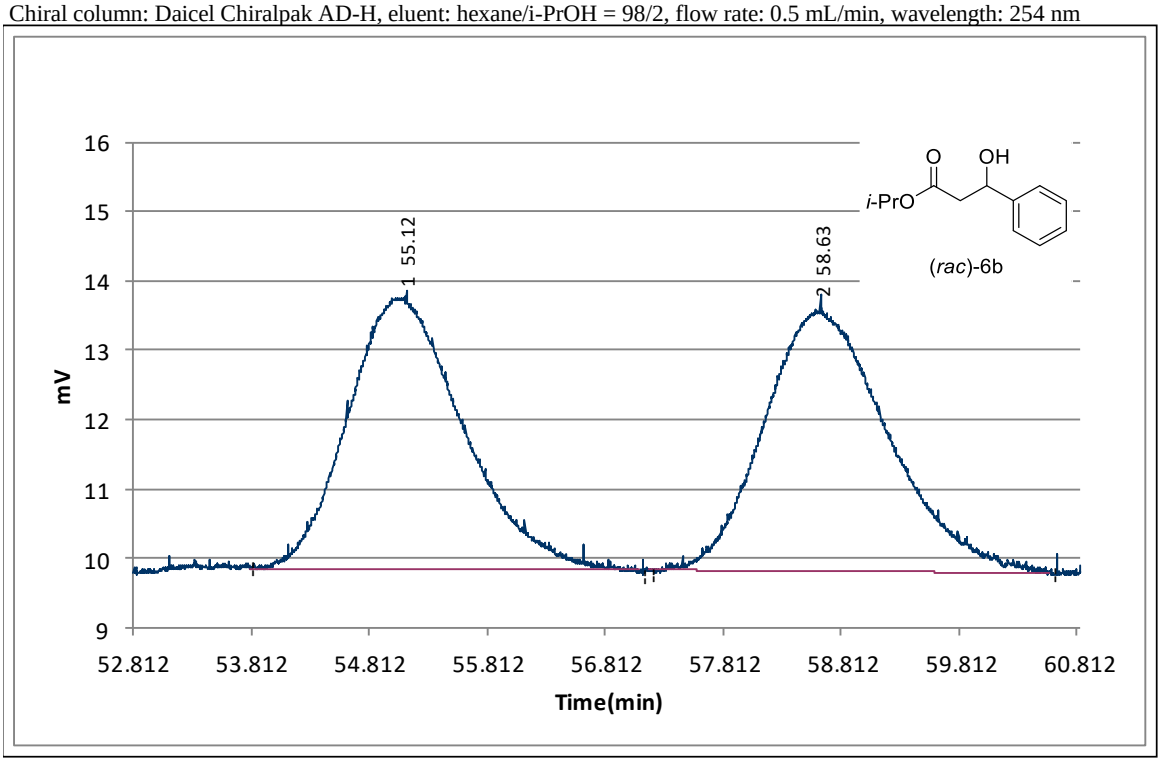
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	14.3		17317112	52.5368	500206	----	3740.7	1.734	2.692
2	17.44		15644781	47.4632	305967	----	2491.4	1.841	----
			32961894	100	806173				



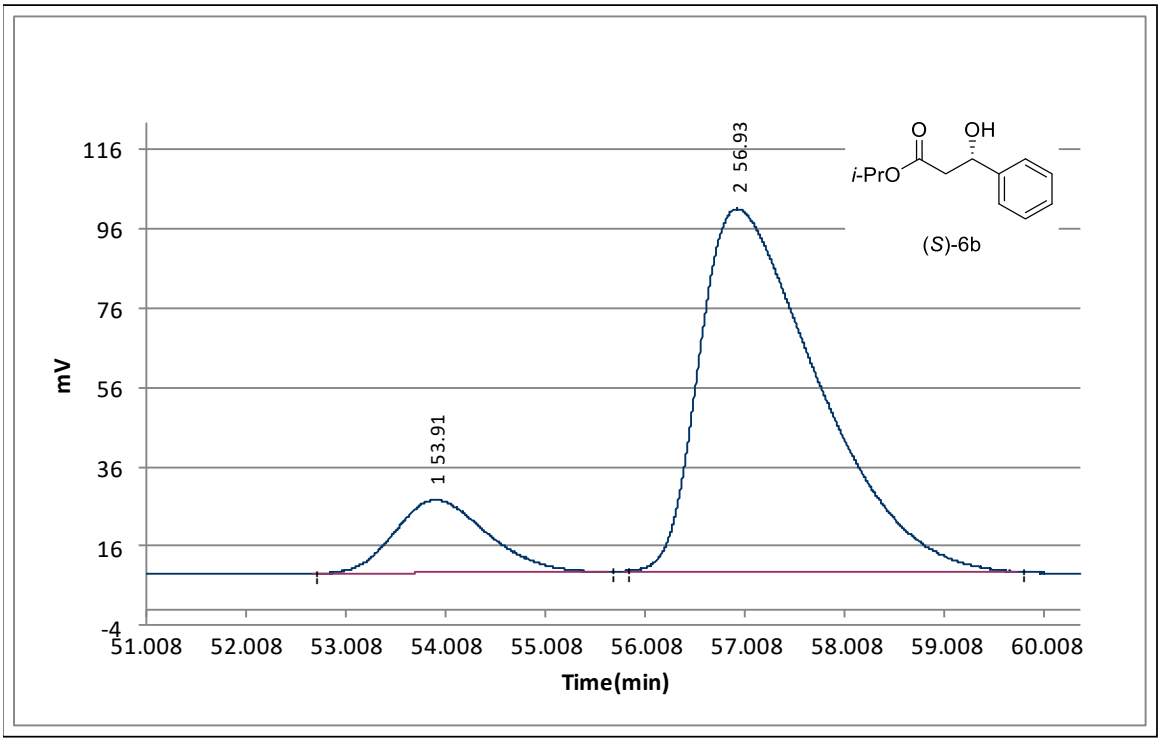
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	13.47		5361544	89.3571	211345	----	6070.9	1.68	4.194
2	16.4		638587.4	10.6429	24182	----	8723.5	1.234	----
			6000131	100	235527				

Figure S22. HPLC Analysis Data of (*S*)-**6b**.

Chiral column: Daicel Chiralpak AD-H, eluent: hexane/i-PrOH = 98/2, flow rate: 0.5 mL/min, wavelength: 254 nm



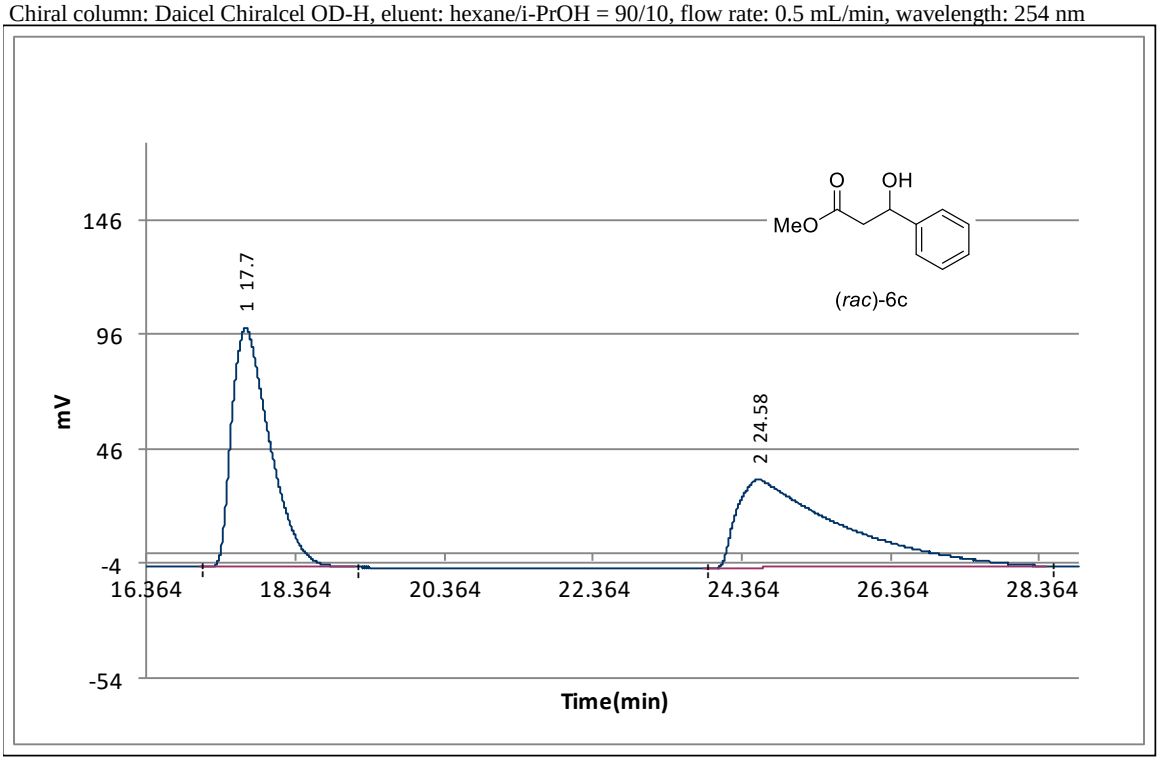
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	55.12		264418.6	49.1044	4025	----	14737	1.146	1.864
2	58.63		274063.8	50.8956	3981	----	14478.8	1.216	----
			538482.4	100	8006				



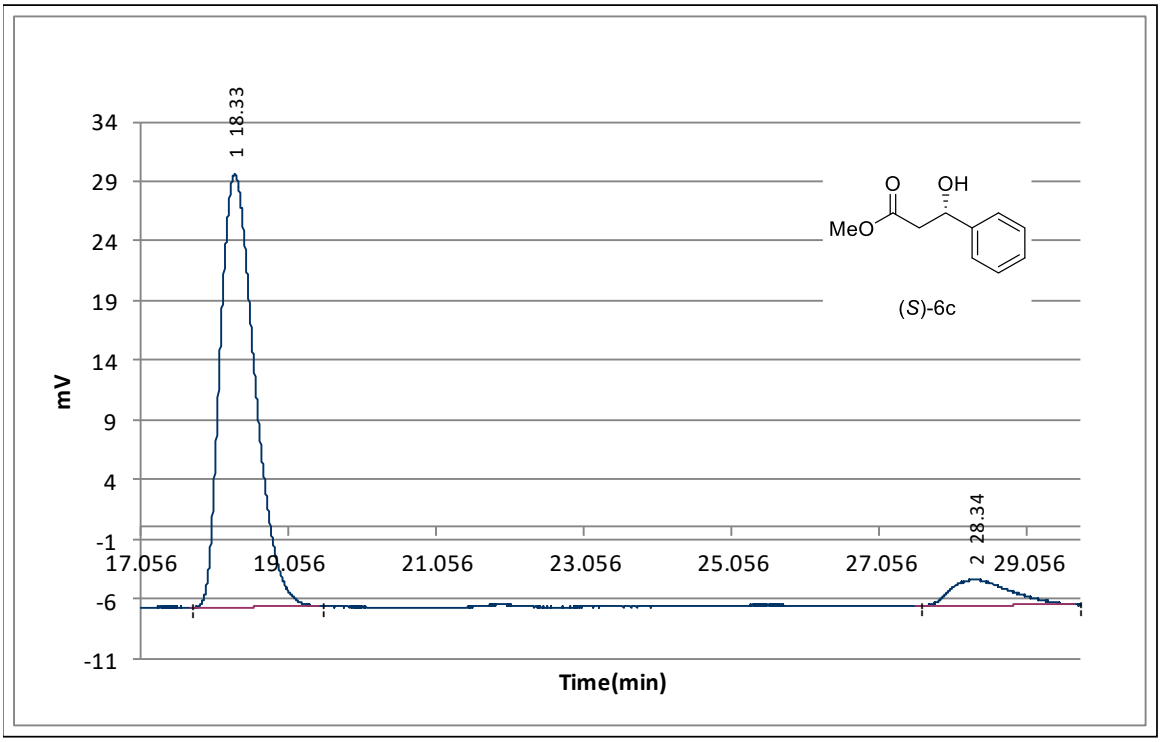
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	53.91		1168325	13.4248	18340	----	15497.1	1.206	1.517
2	56.93		7534418	86.5752	91388	----	10197.7	1.831	----
			8702743	100	109728				

Figure S23. HPLC Analysis Data of (*S*)-**6c**.

Chiral column: Daicel Chiralcel OD-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



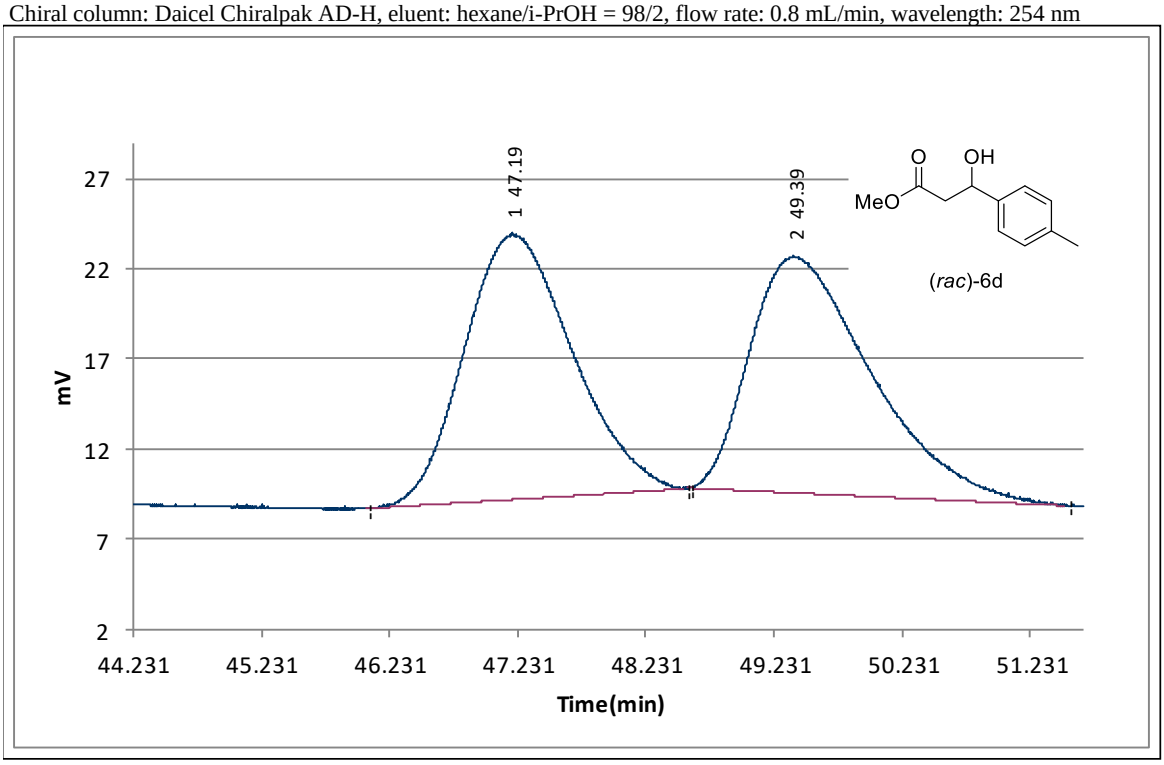
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	17.7		3693806	49.8812	104162	----	5409.5	1.695	3.52
2	24.58		3711395	50.1188	38599	----	1113.2	3.919	----
			7405200	100	142761				



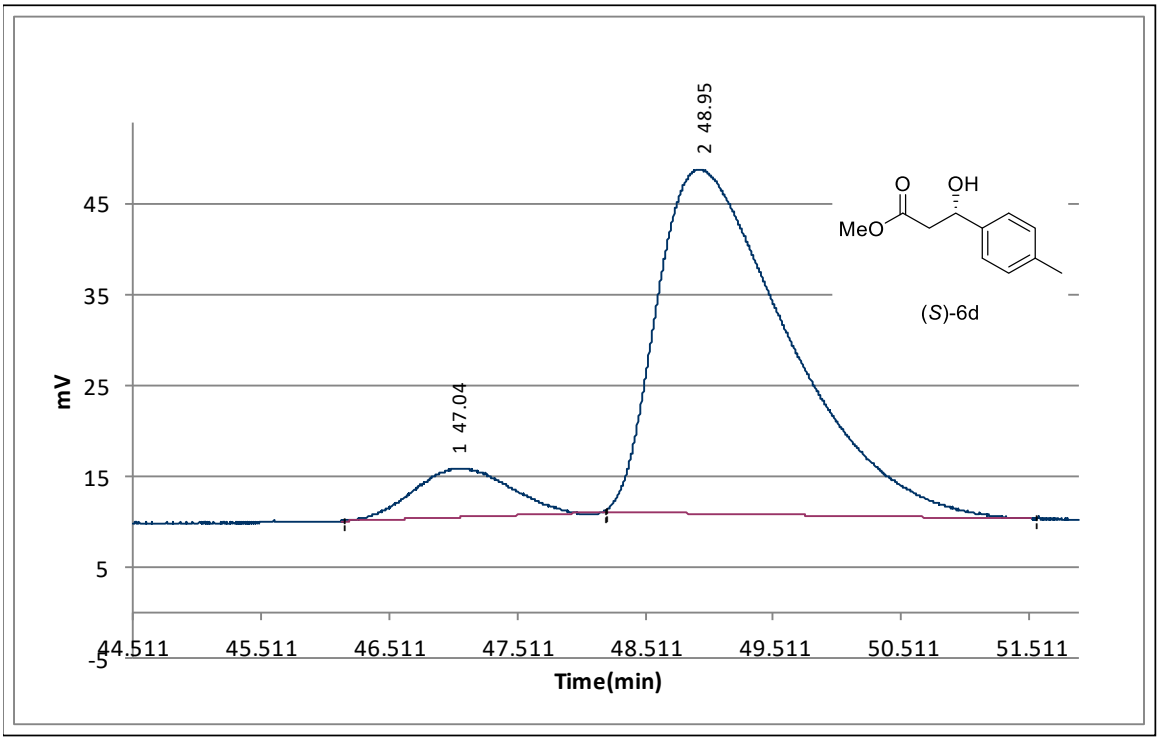
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	18.33		1180432	90.3409	36264	----	7131.2	1.367	8.339
2	28.34		126209.8	9.6591	2185	----	5468.1	1.616	----
			1306642	100	38449				

Figure S24. HPLC Analysis Data of (*S*)-**6d**.

Chiral column: Daicel Chiralpak AD-H, eluent: hexane/i-PrOH = 98/2, flow rate: 0.8 mL/min, wavelength: 254 nm



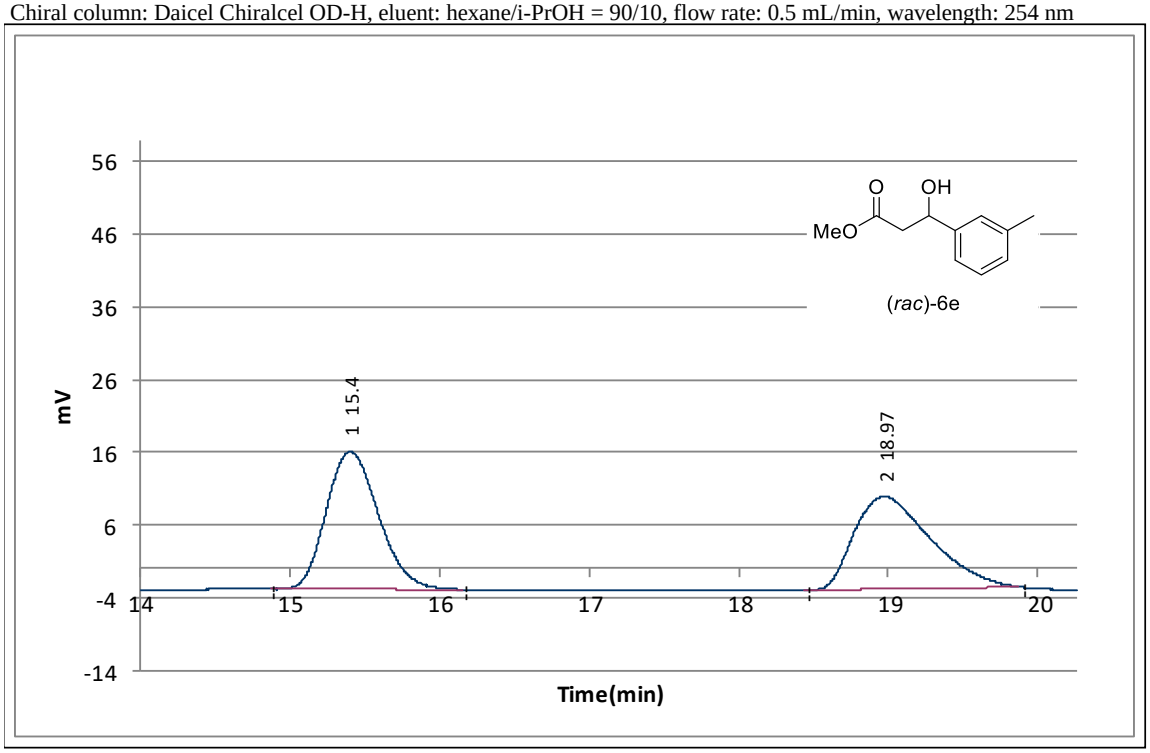
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	47.19		857054.8	50.6465	14728	----	14285.3	1.185	1.318
2	49.39		835175.4	49.3535	12997	----	12700.4	1.543	----
			1692230	100	27725				



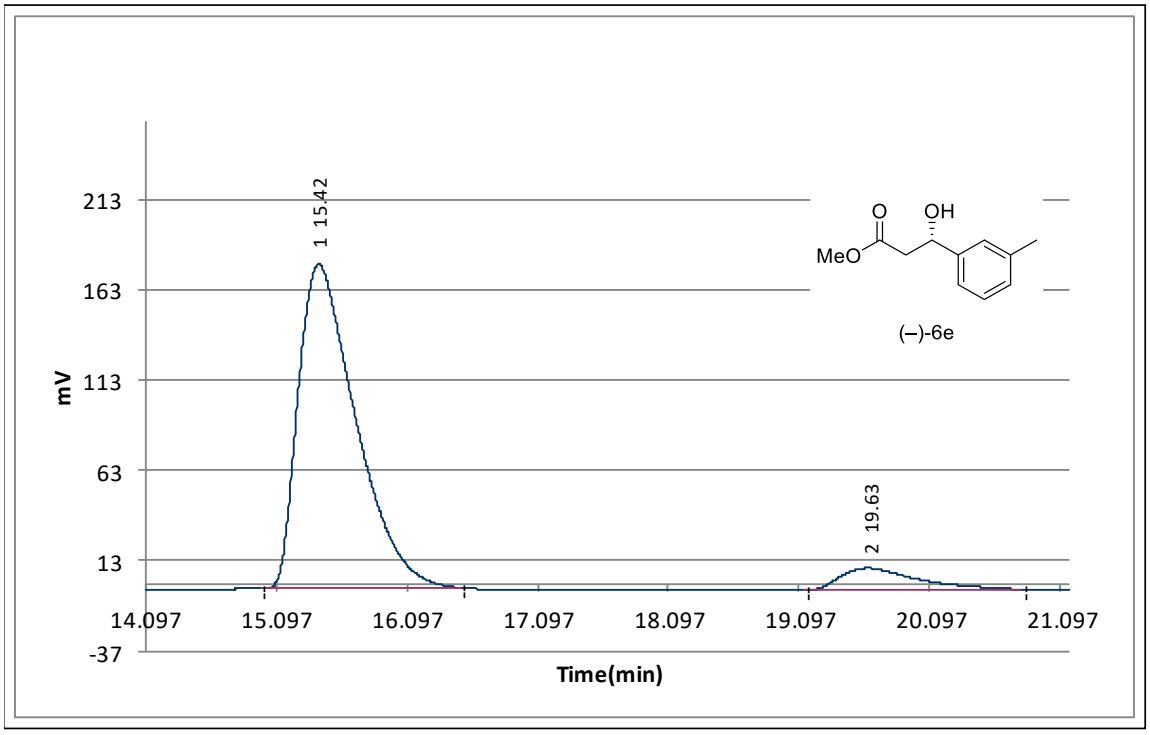
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	47.04		291477.3	9.6995	5533	----	17898.5	1.099	1.13
2	48.95		2713603	90.3005	38045	----	9911.4	1.831	----
			3005080	100	43578				

Figure S25. HPLC Analysis Data of (–)-**6e**.

Chiral column: Daicel Chiralcel OD-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



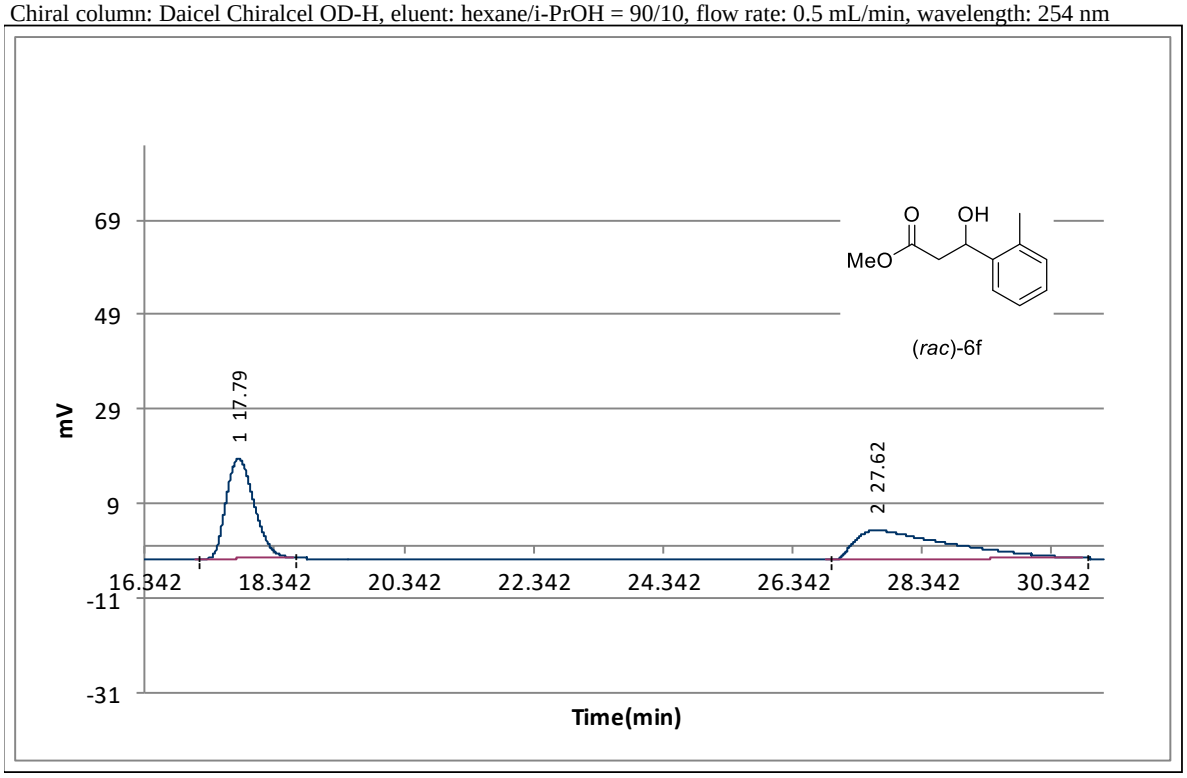
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	15.4		461250.3	49.3907	18962	----	9133.3	1.194	4.354
2	18.97		472630.6	50.6093	12905	----	5827.8	1.62	----
			933880.9	100	31867				



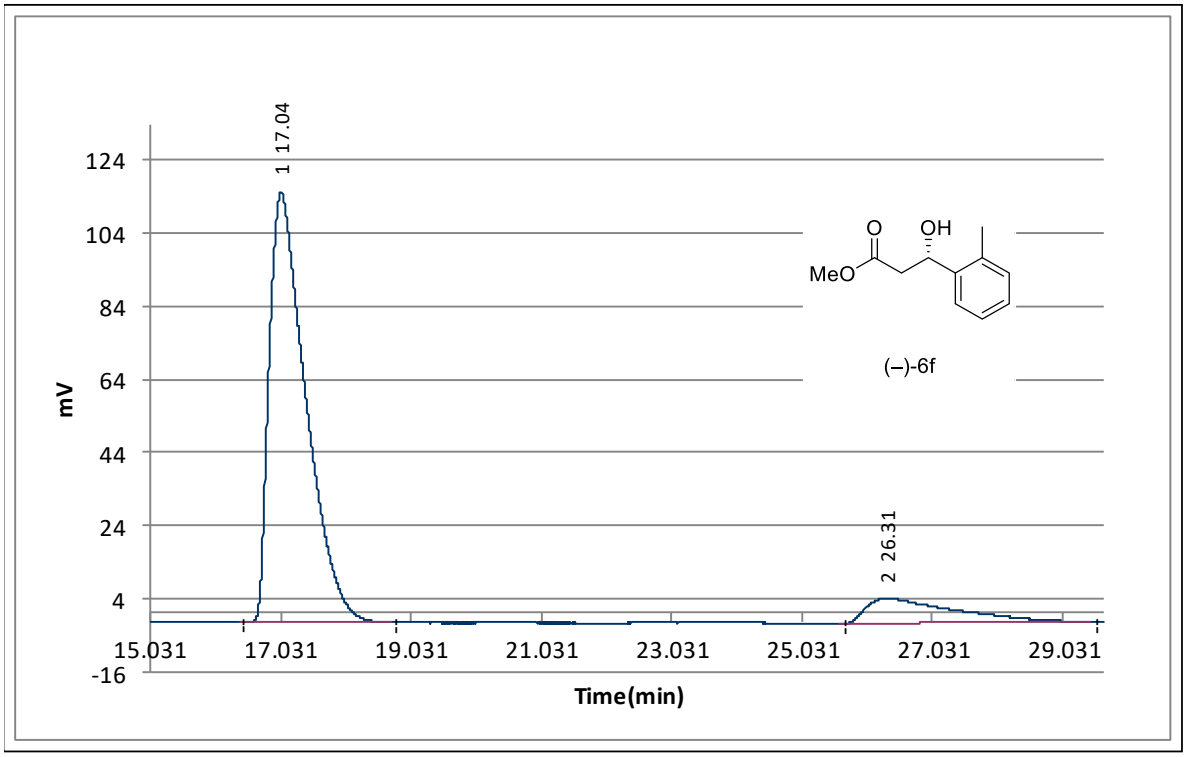
No.	Rt	Peak Name							
1	15.42		Area	Area(%)	Height	Amount	NTP		
2	19.63		5549879	91.9572	180087	----	5383.4	Tf	Resolution
			485406.5	8.0428	11986	----	4528.5	1.742	4.195
			6035285	100	192073			1.797	----

Figure S26. HPLC Analysis Data of (–)-**6f**.

Chiral column: Daicel Chiralcel OD-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



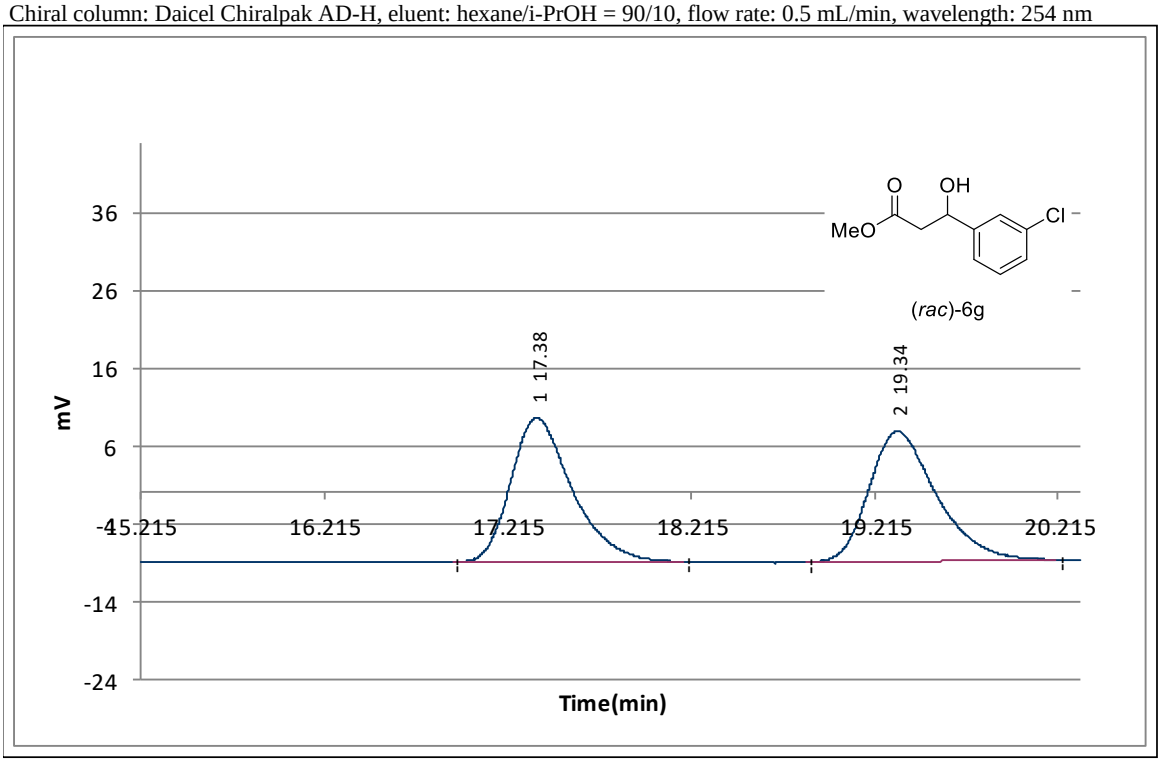
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	17.79		645080.5	50.9429	21300	----	7868.8	1.297	5.259
2	27.62		621200	49.0571	6214	----	1415.6	3.281	----
			1266281	100	27514				



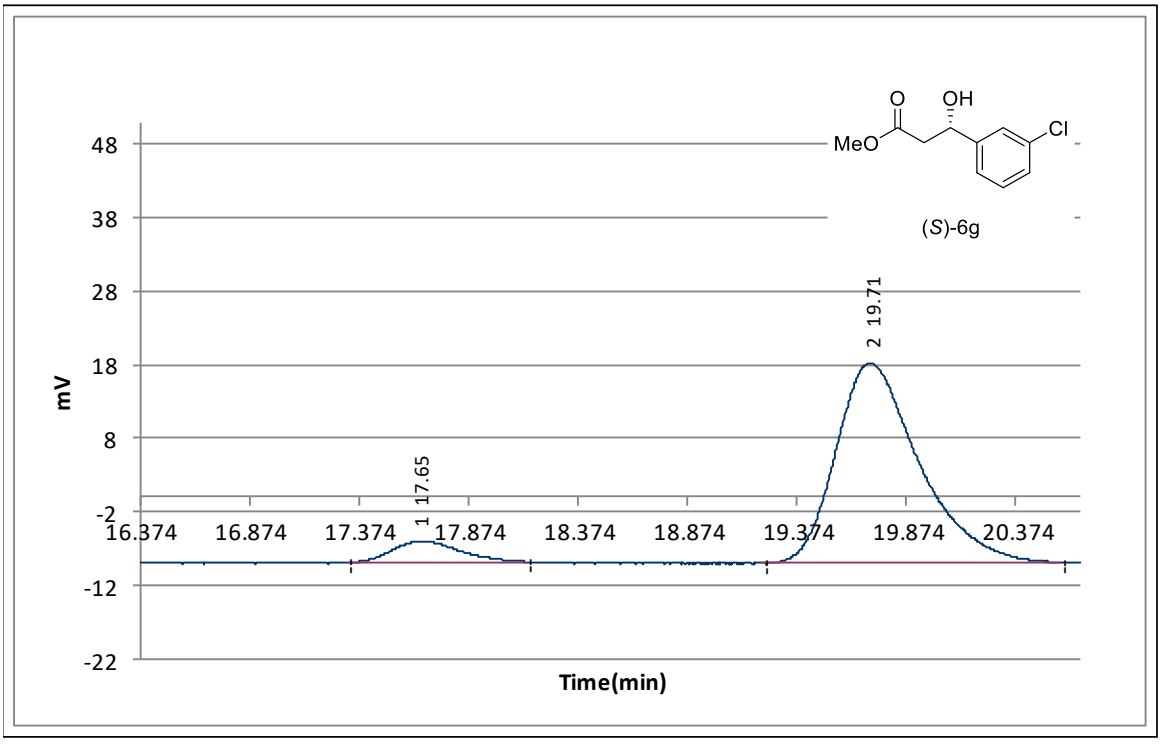
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	17.04		4580423	87.5813	117852	----	4033	1.932	4.831
2	26.31		649484.6	12.4187	6907	----	1448	3.328	----
			5229908	100	124759				

Figure S27. HPLC Analysis Data of (*S*)-**6g**.

Chiral column: Daicel Chiralpak AD-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



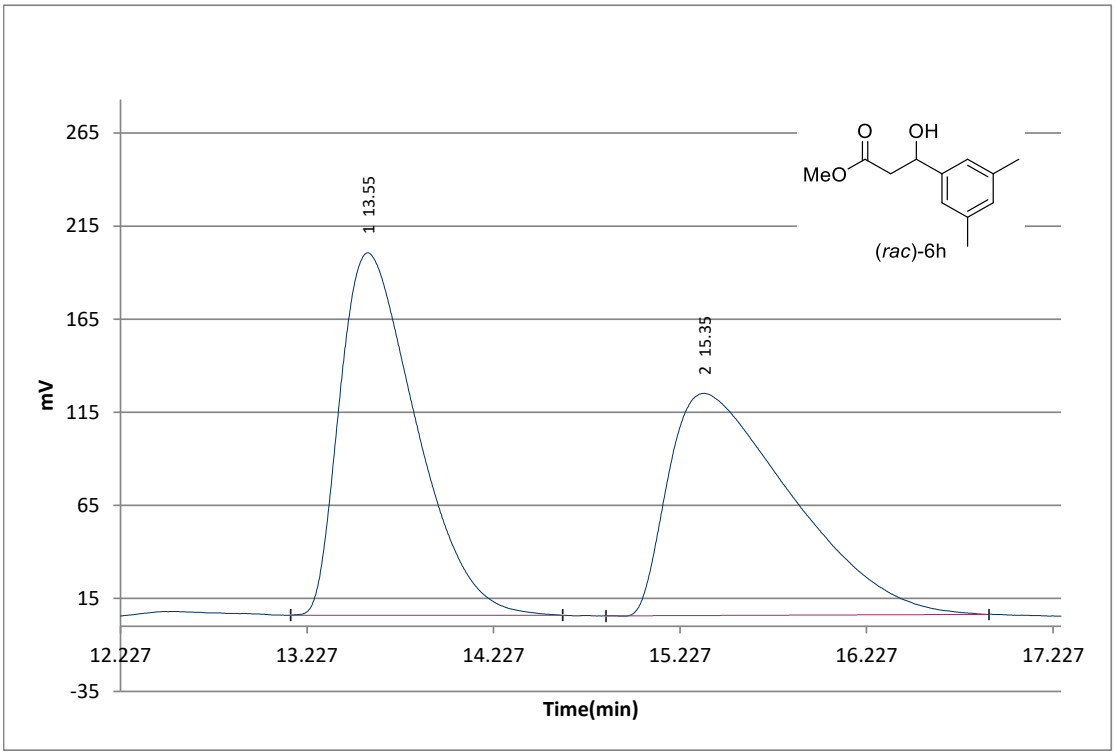
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	17.38		430322.6	50.0881	18556	----	11510.1	1.317	2.891
2	19.34		428808.4	49.9119	16746	----	11925.9	1.367	----
			859131	100	35302				



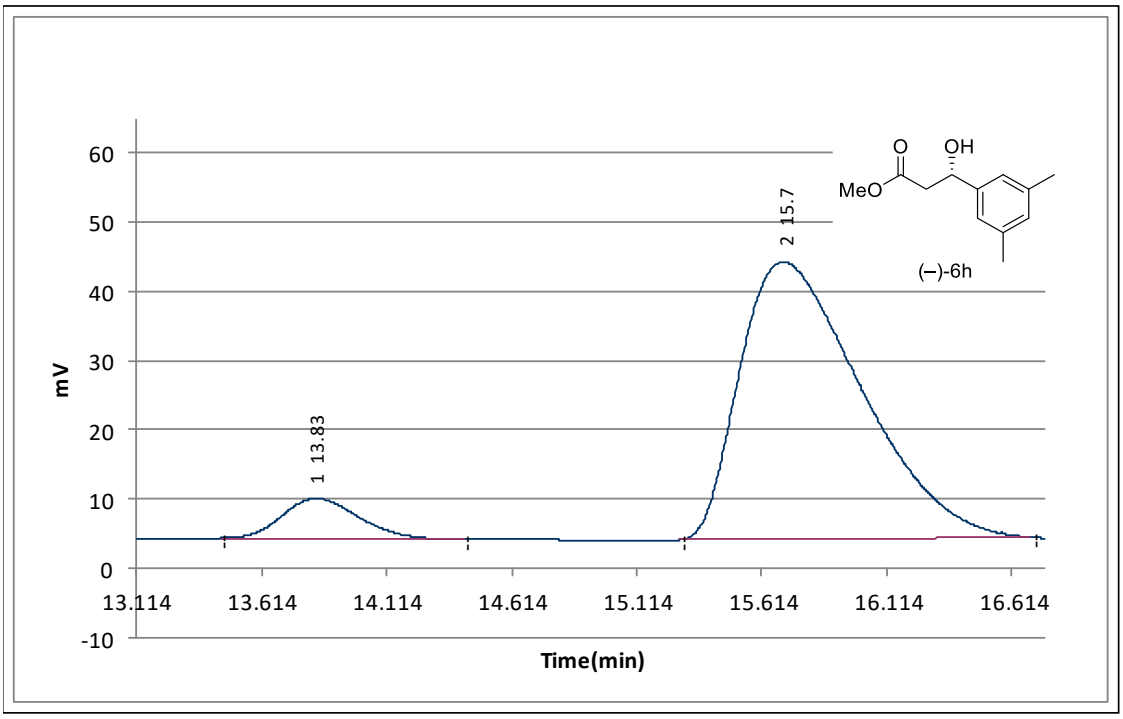
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	17.65		62944.4	8.0846	2923	----	13985.9	1.268	3.089
2	19.71		715630.9	91.9154	27189	----	11448.4	1.387	----
			778575.3	100	30112				

Figure S28. HPLC Analysis Data of (–)-**6h**.

Chiral column: Daicel Chiralpak AS-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



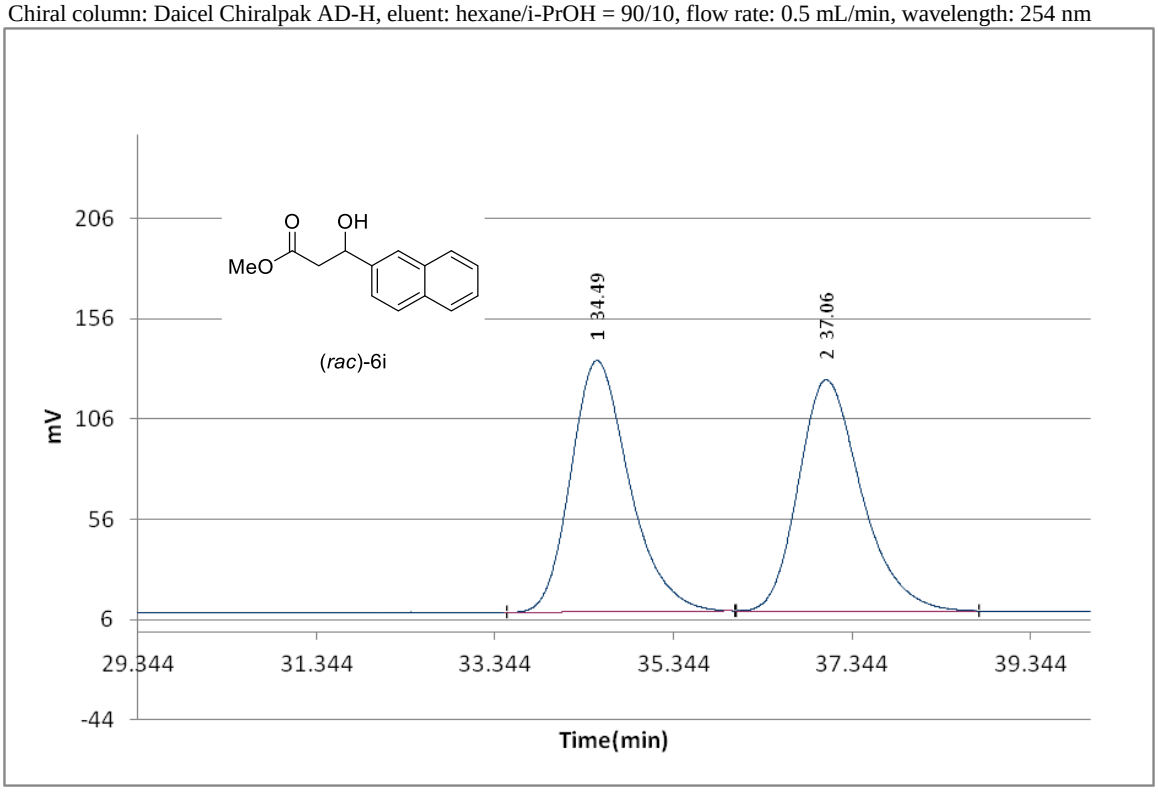
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	13.55		5517035	50.2649	194723	----	5107	1.621	1.809
2	15.35		5458895	49.7351	119367	----	2470.7	2.132	----
			10975929	100	314090				



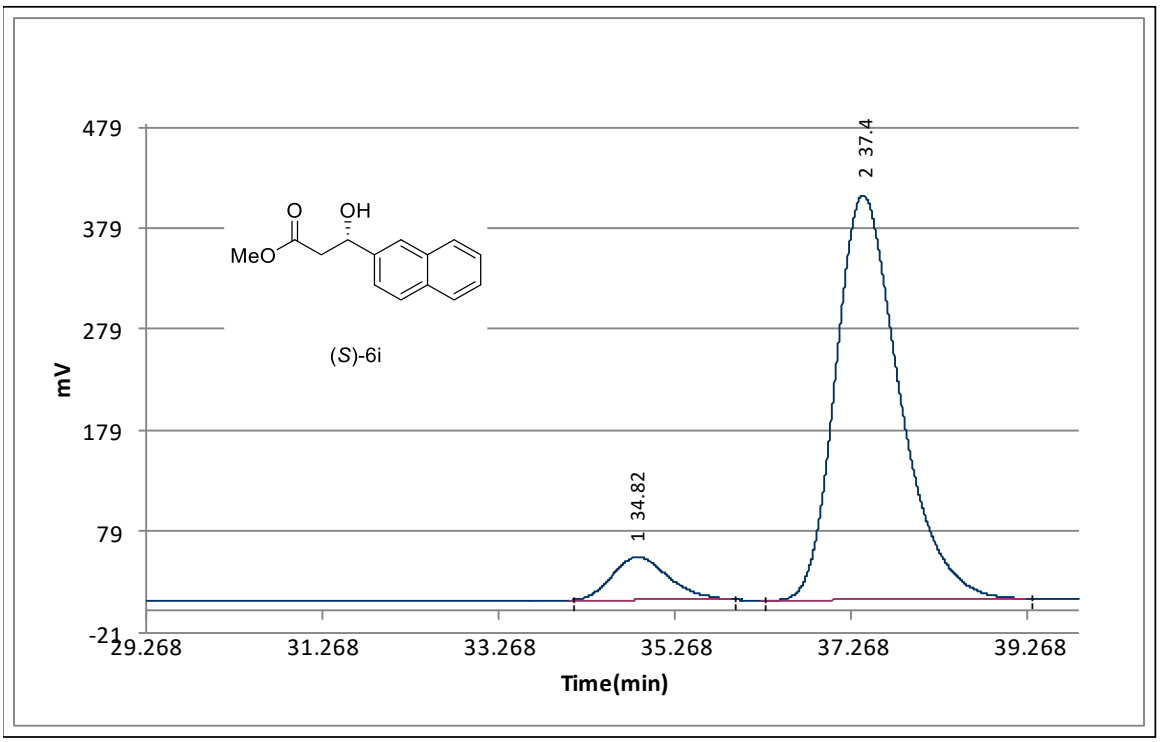
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	13.83		122907.2	8.3209	5802	----	9498.9	1.221	2.545
2	15.7		1354175	91.6791	40106	----	4818.3	1.63	----
			1477082	100	45908				

Figure S29. HPLC Analysis Data of (*S*)-**6i**.

Chiral column: Daicel Chiralpak AD-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



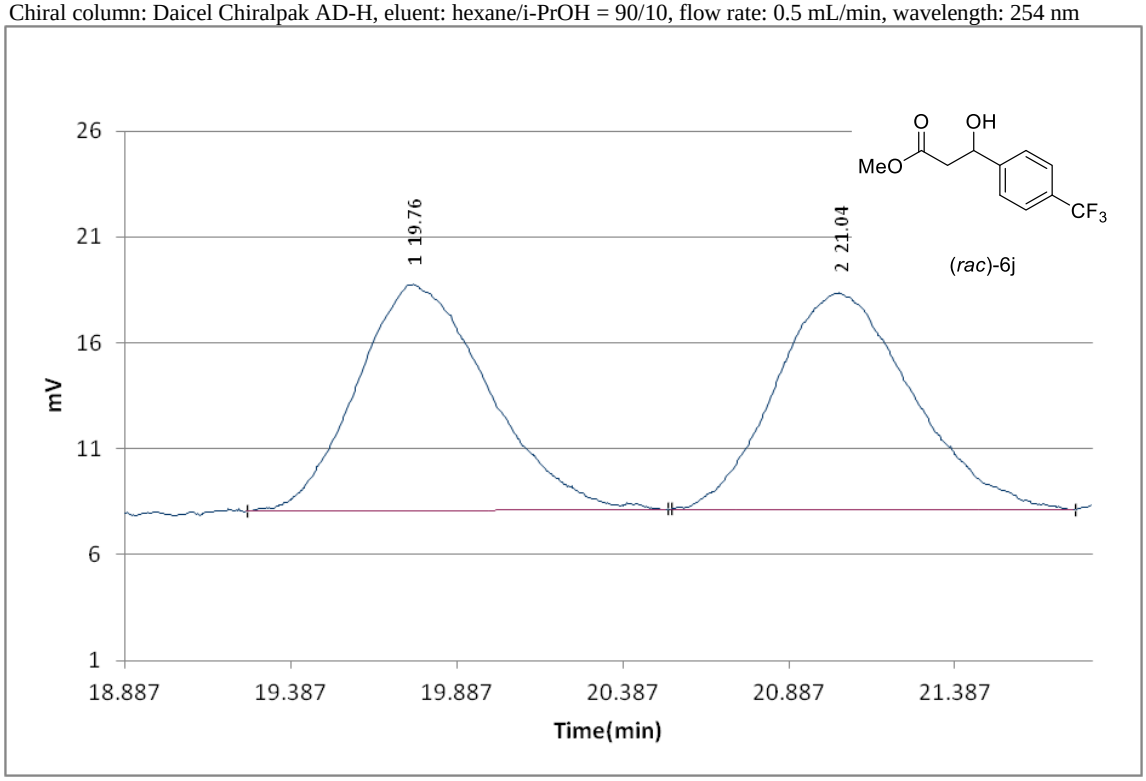
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	34.49		5702394	50.1989	125388	----	12186.9	1.253	1.981
2	37.06		5657205	49.8011	115354	----	12136.3	1.272	----
			11359598	100	240742				



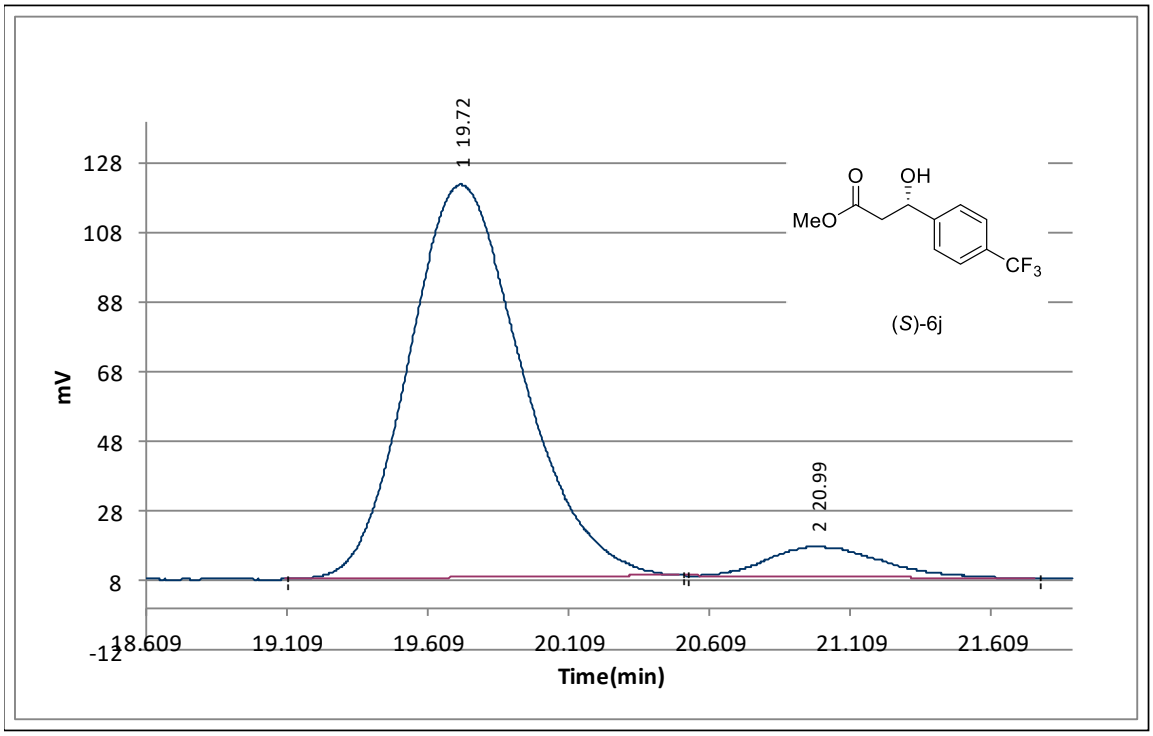
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	34.82		1926275	8.7079	43031	----	12818.8	1.284	1.977
2	37.4		20194706	91.2921	400814	----	11747.7	1.336	----
			22120981	100	443845				

Figure S30. HPLC Analysis Data of (*S*)-**6j**.

Chiral column: Daicel Chiralpak AD-H, eluent: hexane/i-PrOH = 90/10, flow rate: 0.5 mL/min, wavelength: 254 nm



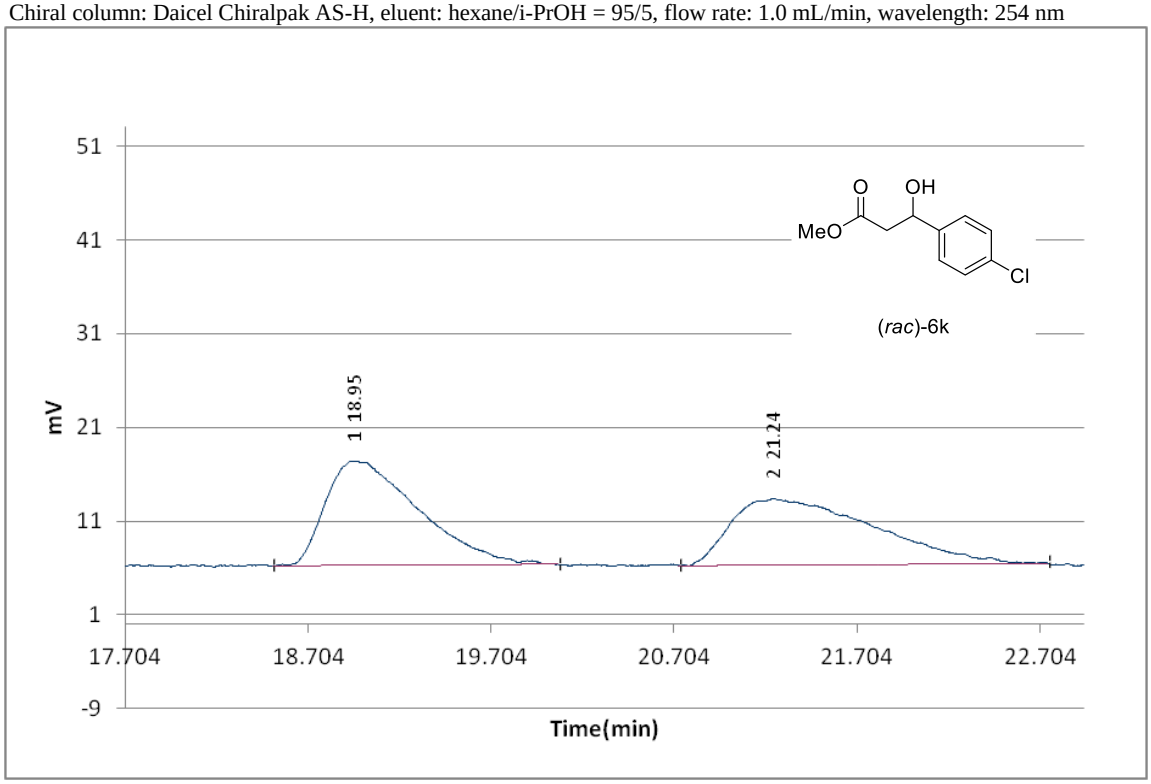
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	19.76		293982.7	50.0682	10682	----	10936.7	1.223	1.677
2	21.04		293181.4	49.9318	10223	----	11794.6	1.152	----
			587164.1	100	20905				



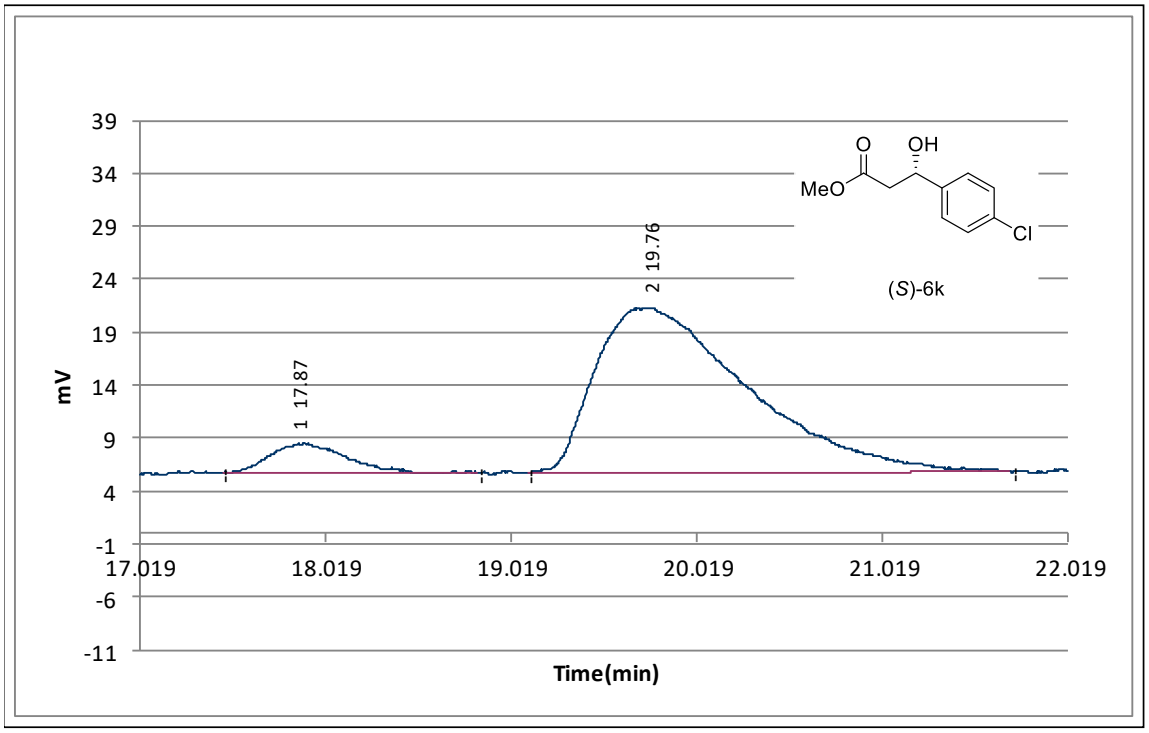
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	19.72		3146088	92.9337	112926	----	10821.9	1.181	1.682
2	20.99		239215.9	7.0663	8742	----	12731	1.265	----
			3385304	100	121668				

Figure S31. HPLC Analysis Data of (*S*)-**6k**.

Chiral column: Daicel Chiralpak AS-H, eluent: hexane/i-PrOH = 95/5, flow rate: 1.0 mL/min, wavelength: 254 nm



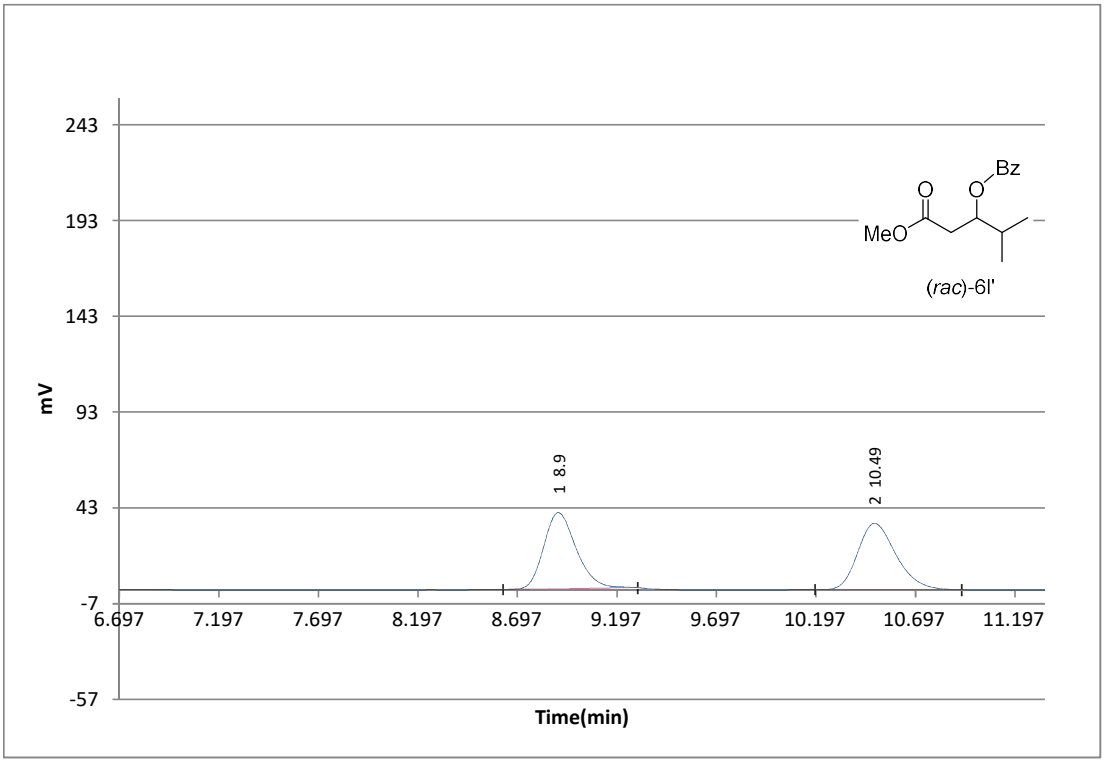
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	18.95		390555.3	50.5166	11133	----	6313.1	1.937	1.916
2	21.24		382567.6	49.4834	7094	----	3518.2	1.989	----
			773122.9	100	18227				



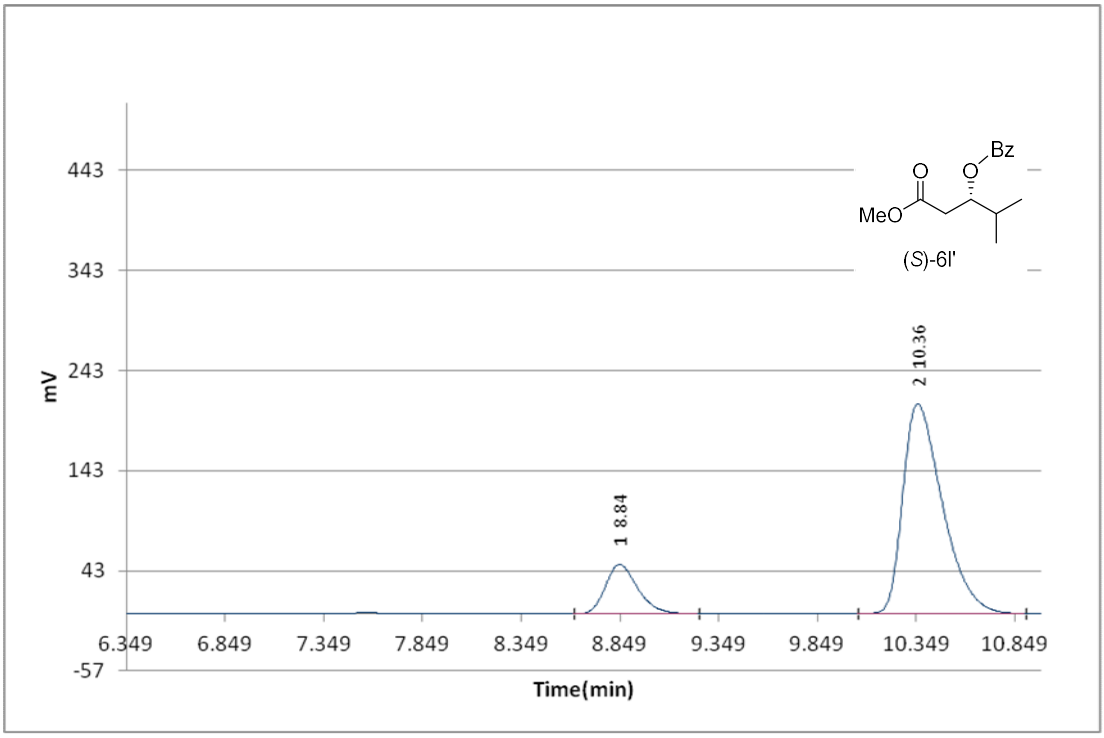
No.	Rt	Peak Nam	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	17.87		74261	7.6999	2721	----	9742.5	1.428	1.663
2	19.76		890184.8	92.3001	15585	----	2589.9	1.909	----
			964445.8	100	18306				

Figure S32. HPLC Analysis Data of (*S*)-**6l'**.

Chiral column: Daicel Chiralpak AD-H, eluent: hexane/i-PrOH = 95/5, flow rate: 0.8 mL/min, wavelength: 254 nm



No.	Rt	Peak Name	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	8.9		449233.6	49.3054	39689	----	13554	1.213	4.748
2	10.49		461890.5	50.6946	34602	----	13407.1	1.268	----
			911124.1	100	74291				



No.	Rt	Peak Name	Area	Area(%)	Height	Amount	NTP	Tf	Resolution
1	8.84		560326	16.1772	49235	----	12968.9	1.275	4.388
2	10.36		2903346	83.8228	209156	----	11935	1.527	----
			3463672	100	258391				