Supporting Information

Synthesis and Application of P,Olefin Type Axially Chiral Ligands with *sec*-Alkyl Groups

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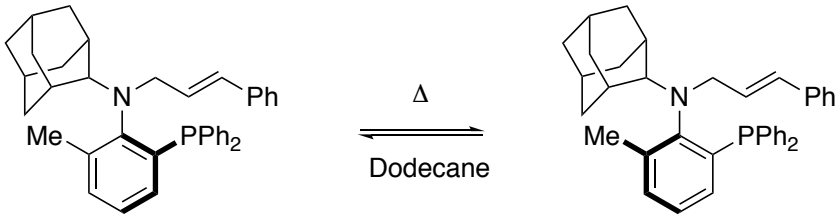
Table S1. Time Dependence of Ee Value of (a*R*)-(+)-**3b** at Various Temperatures



(a*R*)-(+)-**3b** (a*S*)-(–)-**3b**

Time (sec)	Ee (%)[a] at 30 °C	Ee (%)[a] at 40 °C	Ee (%)[a] at 50 °C	Ee (%)[a] at 60 °C
0	96.4	96.4	95.6	97.2
1800	94.7	93.7	84.2	65.6
3600	94.4	90.7	73.1	48.5
7200	92.7	84.7	55.9	28.0
14400	90.0	75.2	38.6	7.8
28800	84.5	56.9	14.5	-
86400	67.5	18.0	-	-

[a] Ee was determined by chiral HPLC analysis.

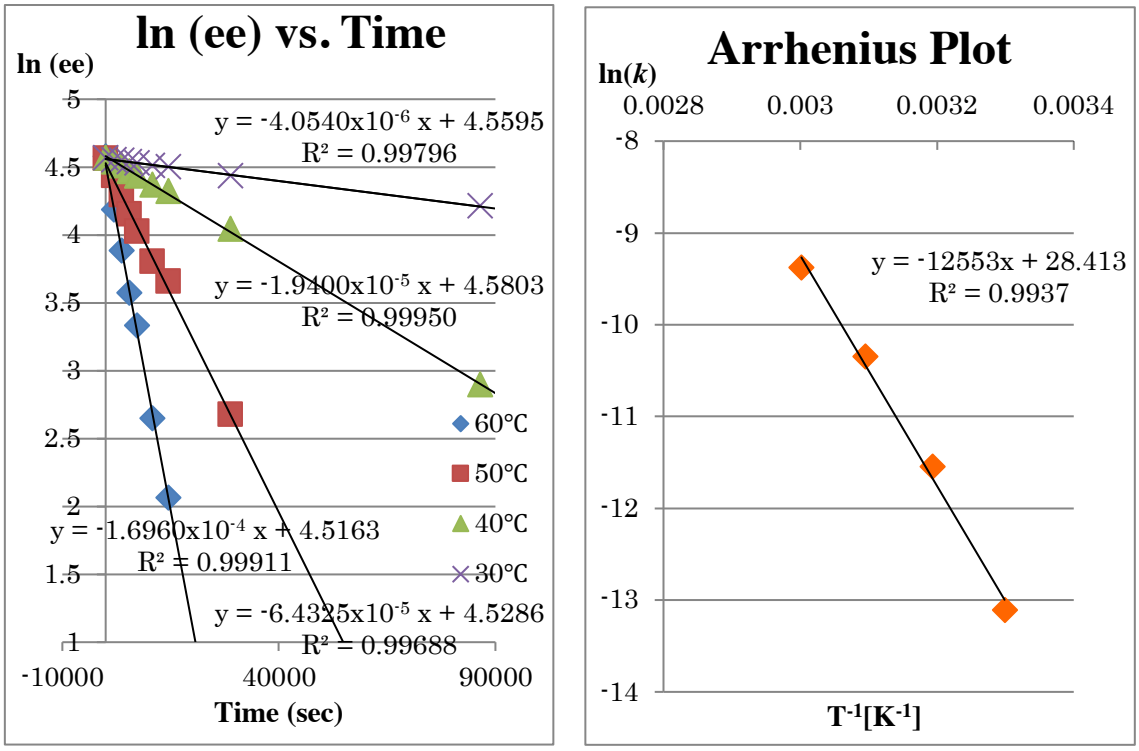
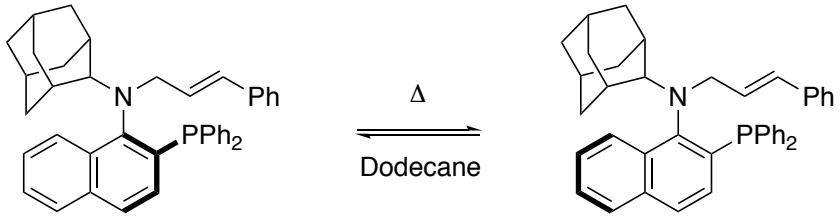


Figure S1. Data for the Racemization and Arrhenius Plot of (a*R*)-(+)-**3b**

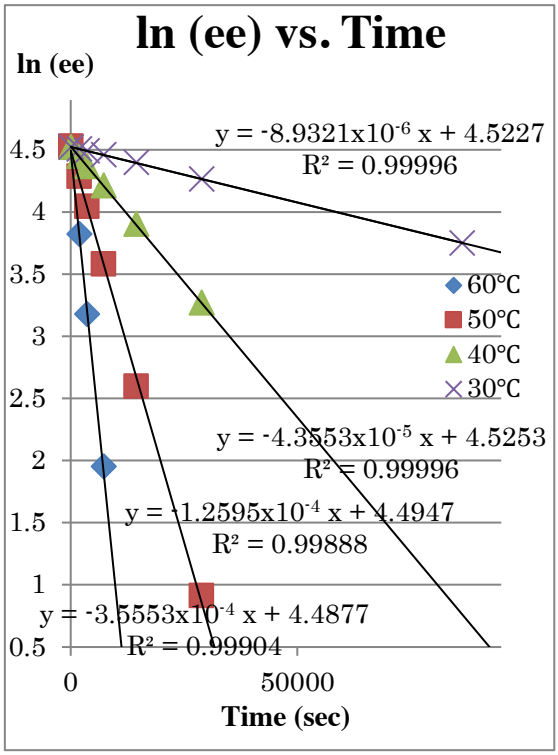
Table S2. Time Dependence of Ee Value of (a*R*)-(–)-**3c** at Various Temperatures



(a*R*)-(–)-**3c** (a*S*)-(+)-**3c**

Time (sec)	Ee (%)[a] at 30 °C	Ee (%)[a] at 40 °C	Ee (%)[a] at 50 °C	Ee (%)[a] at 60 °C
0	91.9	91.9	92.3	92.1
1800	90.6	85.5	72.6	45.6
3600	89.1	78.8	57.0	23.9
7200	86.2	67.5	35.8	7.0
14400	81.2	49.5	13.4	-
28800	71.2	26.2	2.4	-
86400	42.5	-	-	-

[a] Ee was determined by chiral HPLC analysis.



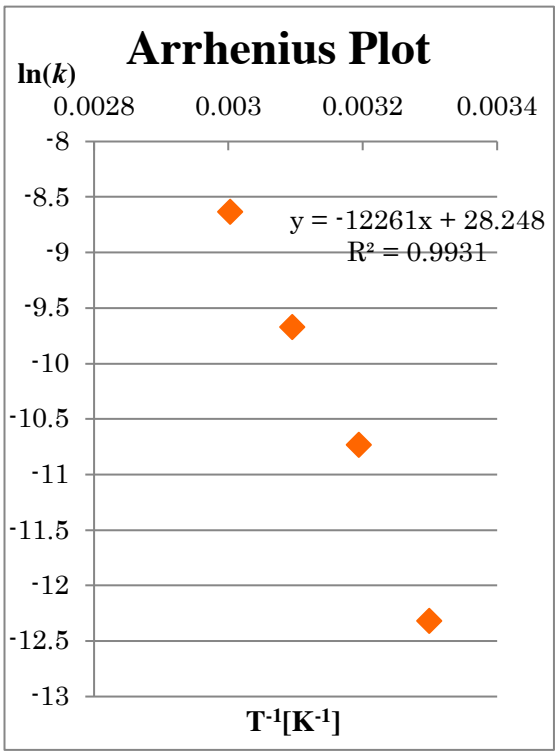
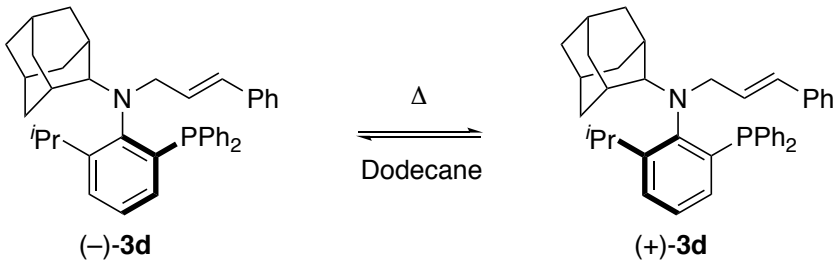


Figure S2. Data for the Racemization and Arrhenius Plot of (a*R*)-(–)-**3c**

Table S3. Time Dependence of Ee Value of (–)-**3d** at Various Temperatures



(–)-**3d** (+)-**3d**

Time (sec)	Ee (%)[a] at 40 °C	Ee (%)[a] at 50 °C	Ee (%)[a] at 60 °C	Ee (%)[a] at 70 °C
0	99.6	98.8	98.7	98.7
1800	-	96.8	92.6	77.3
3600	-	94.7	85.9	59.3
7200	-	90.9	75.1	37.0
14400	94.2	83.7	58.5	12.7
28800	91.0	71.5	33.6	2.1
86400	75.9	-	-	-

[a] Ee was determined by chiral HPLC analysis.

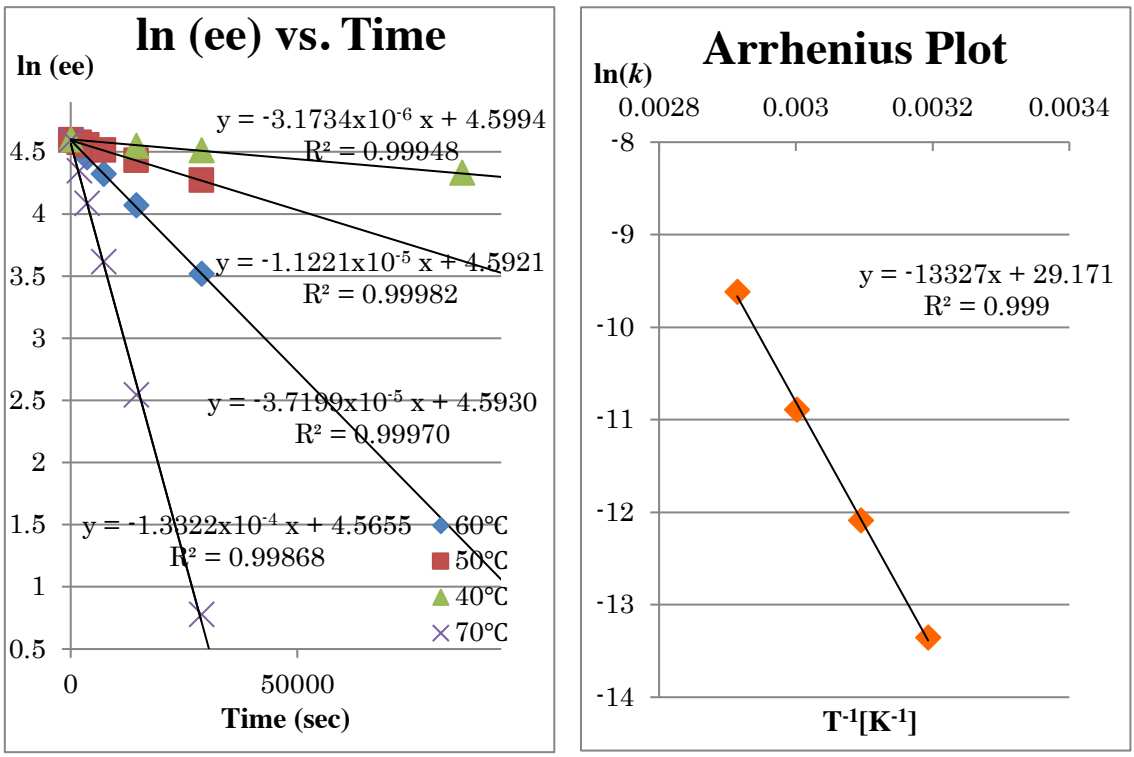
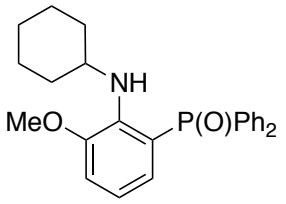
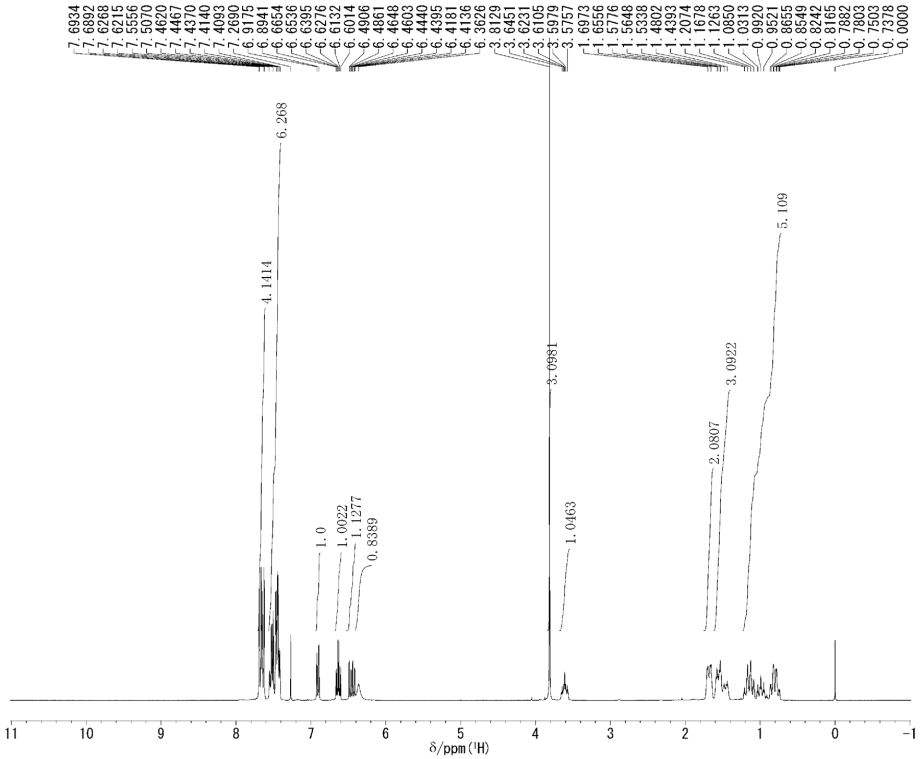


Figure S3. Data for the Racemization and Arrhenius Plot of (–)-**3d**

^{1}H, ^{13}C and ^{31}P NMR of **5**





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FREQU	3612.717 Hz
SCANS	8
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
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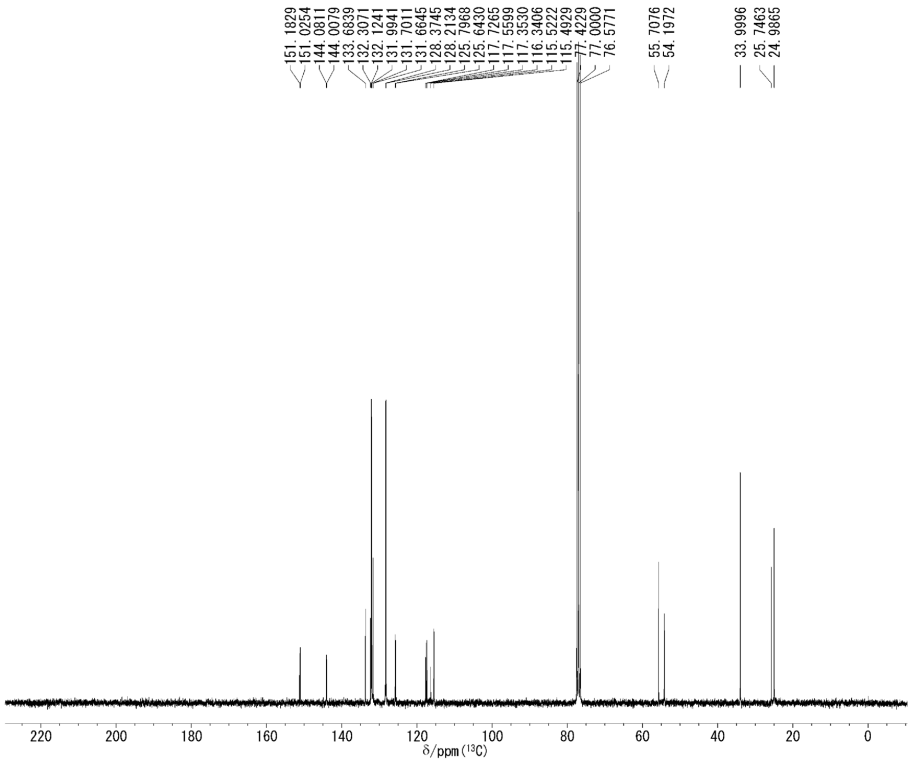
WINDOW	Exponential
RGAIN	228

Operator_____



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PD	2.0 s
PW1	0.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
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SLVNT	$CDCl_3$
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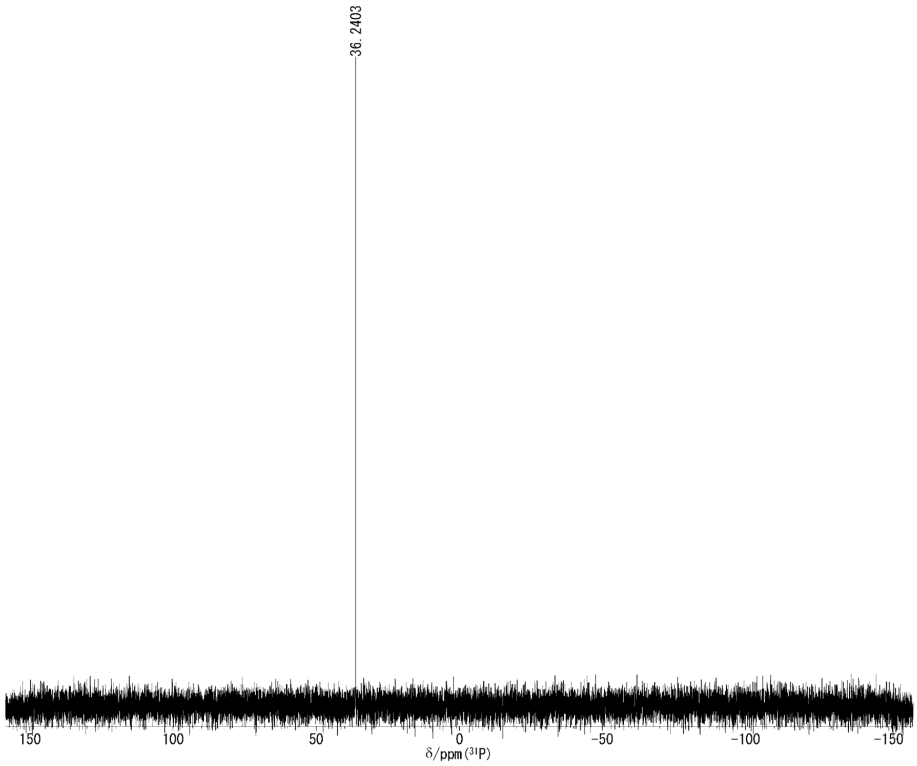
WINDOW	Exponential
RGAIN	2299

Operator_____

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OBFIN              10005.0 Hz
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PD                       8.0 s
PW1                      0.0 µs
IRNUC                  OFF
PROBHD   5 MM BBO BB-1H-D Z-GRD
    Z8284/01
INSTRUM              SPECT
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GRDPROG
CTEMP                 26.85 °C
SLVNT                 CDCL3
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    m
BF                       0.25 Hz
WINDOW         Exponential
RGAIN                13004

Operator_____________________
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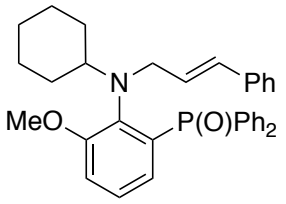
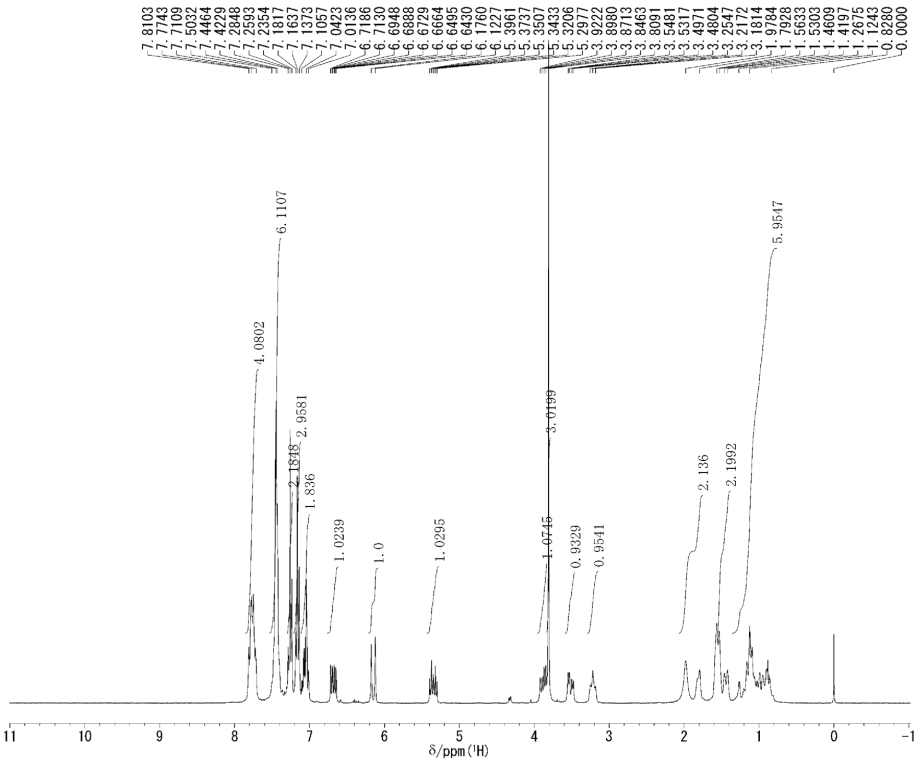
^{1}H, ^{13}C and ^{31}P NMR of **6**





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FREQU	3612.717 Hz
SCANS	8
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	20.01 °C
SLVNT	CDCl₃
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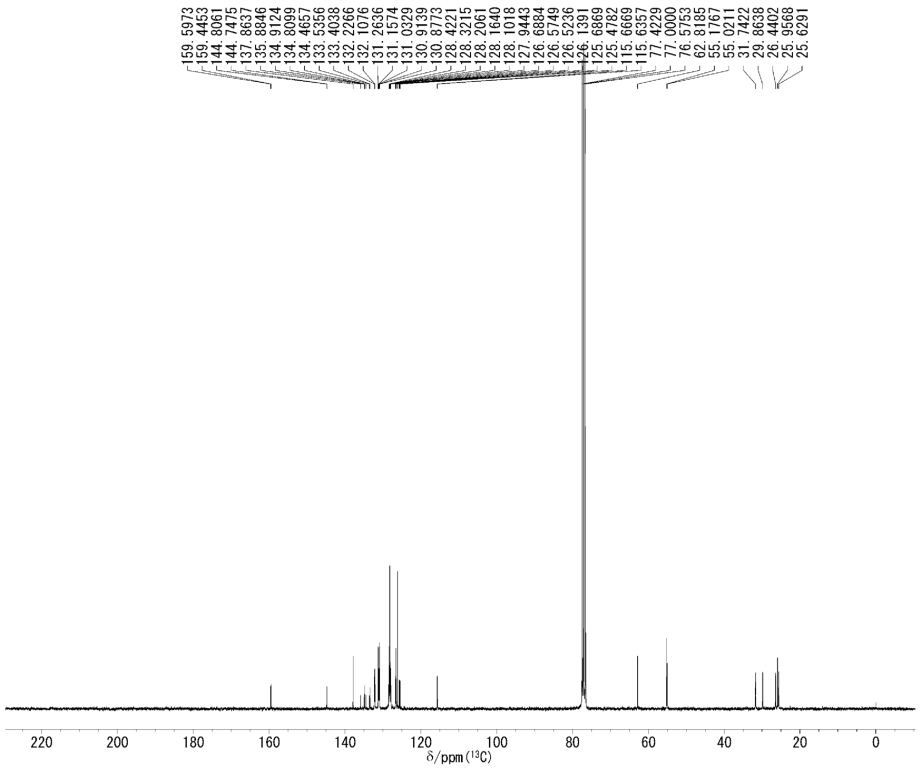
BF	0.25 Hz
WINDOW	Exponential
RGAIN	256

Operator_____



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PD	2.0 s
PW1	0.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
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SLVNT	CDCl₃
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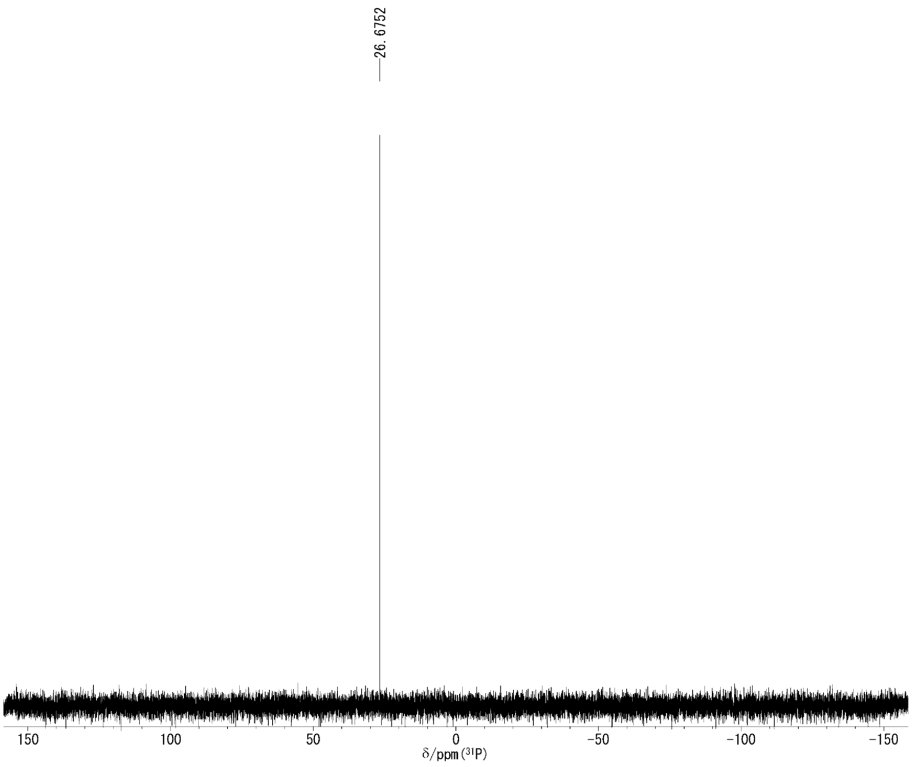
RGAIN	1626

Operator_____

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COMNT


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OBFIN                10005.0 Hz
POINT                32768
FREQU                38535.64 Hz
SCANS                    8
ACQTM                    0.8503 s
PD                       8.0 s
PW1                      0.0 µs
IRNUC                  OFF
PROBUD    5 MM BBO BB-1H-D Z-GRD
    Z8284/01
INSTRUM                SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                   26.85 °C
SLVNT                 CDCL3
EXREF                  158.537 pp
    m
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WINDOW         Exponential
RGAIN                13004

Operator_____________________
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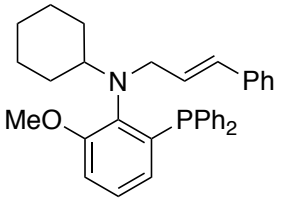
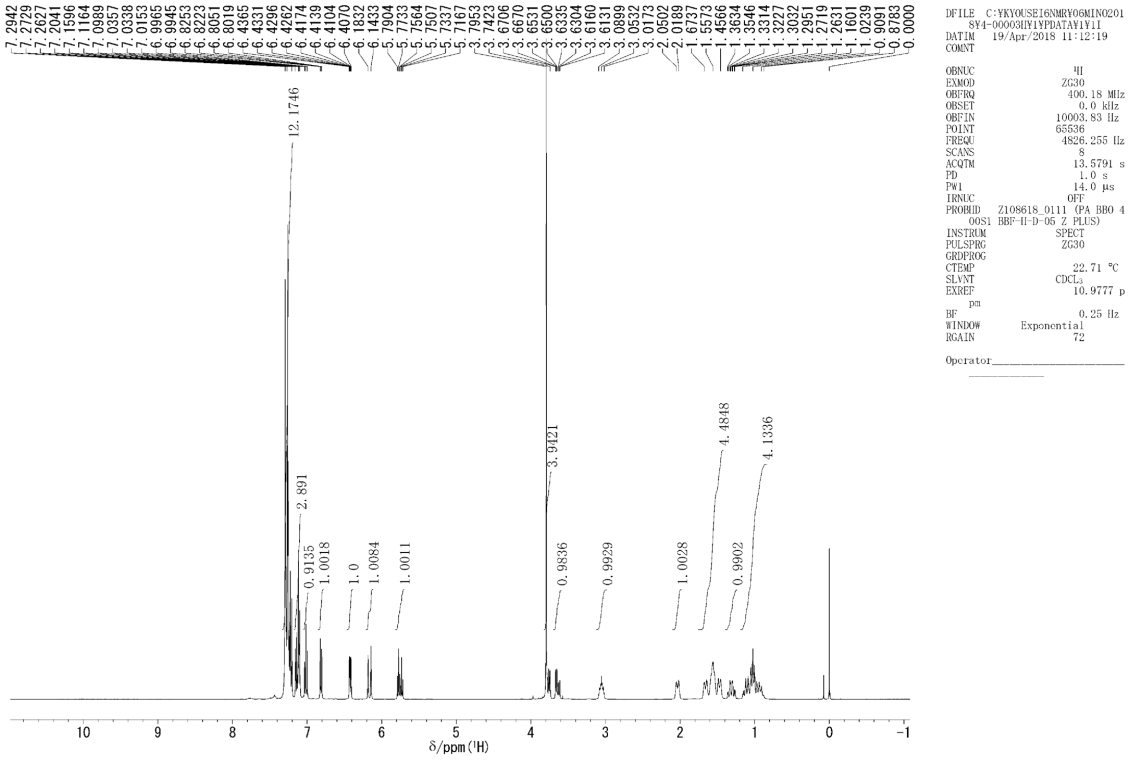
```

^{1}H, ^{13}C and ^{31}P NMR of **2**





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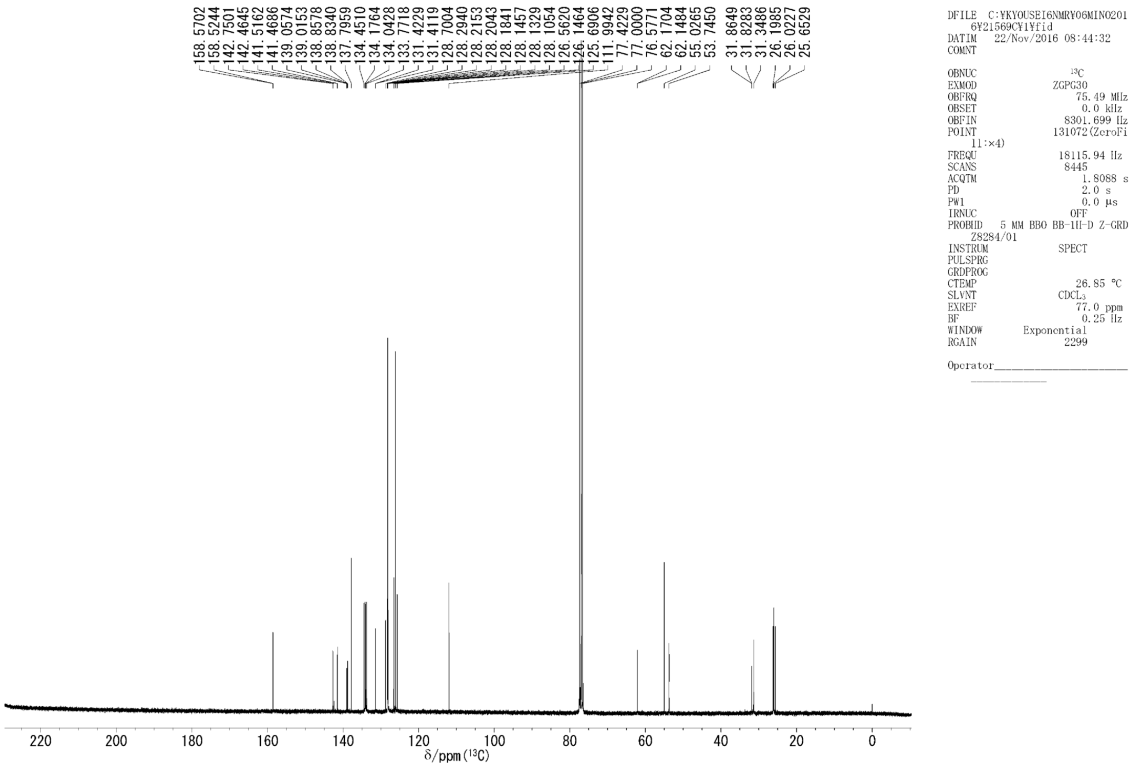
PD	1.0 s
PW1	14.0 μs
IRNUC	OFF
PROBHD	Z108618_0111 (PA BBO 400S1 BBF-H-D-05 Z PLUS)
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	22.71 ℃
SLVNT	CDCL₃
EXREF	10.9777 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	72

Operator_____



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INSTRUM	SPECT
PULSPRG	
GRDPROG	
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SLVNT	CDCL₃
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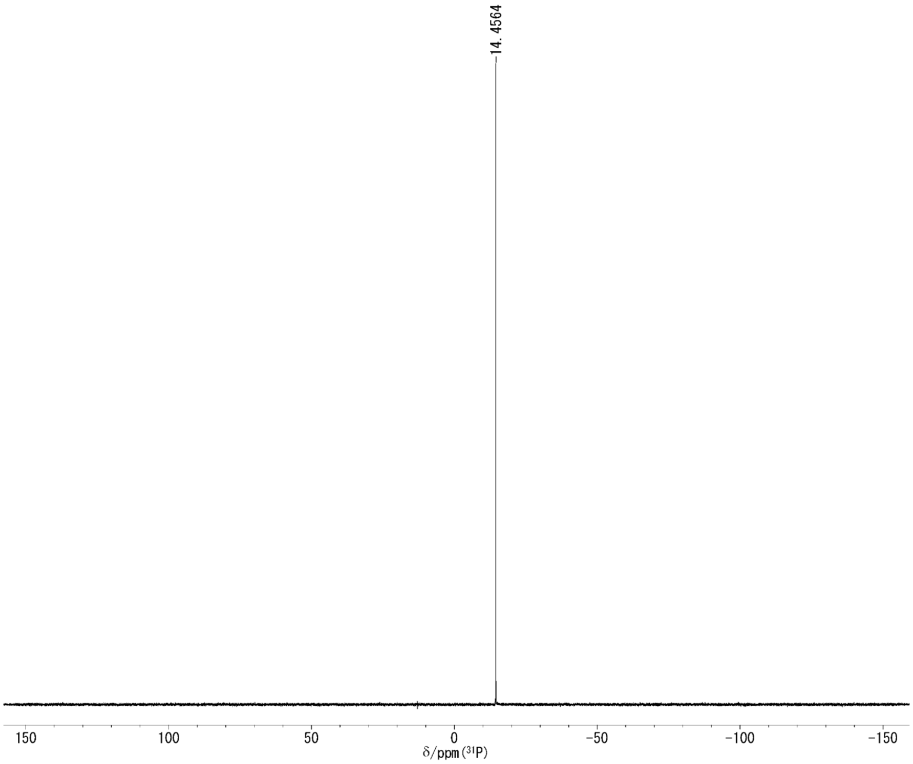
WINDOW	Exponential
RGAIN	2299

Operator_____

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POINT                32768
FREQU              38535.64 Hz
SCANS                    8
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PW1                    0.0 µs
IRNUC                  OFF
PROBHD   5 MM BBO BB-1H-D Z-GRD
    Z8284/01
INSTRUM              SPECT
PULSPRG             ZGPG30
GRDPROG
CTEMP                 26.85 °C
SLVNT                CDCl3
EXREF                157.7821 p
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WINDOW          Exponential
RGAIN                11885

Operator_____________________
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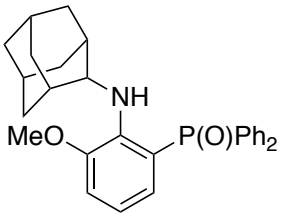
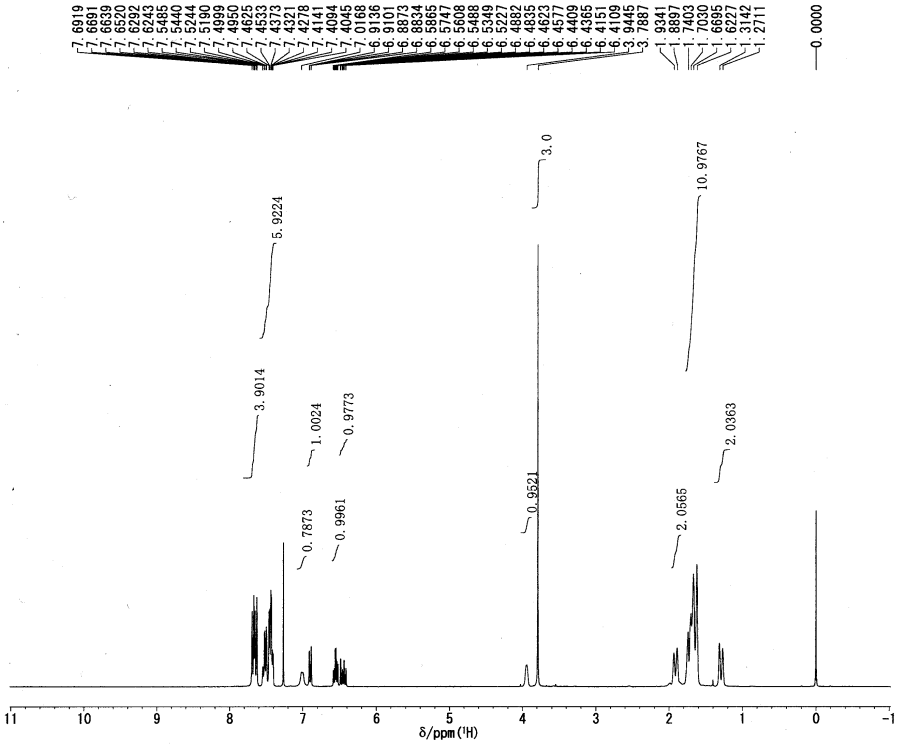
^{1}H, ^{13}C and ^{31}P NMR of **7a**





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POINT 16384
FREQU 3612.717 Hz
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ACQTM 4.5351 s
PD 1.0 s
PW1 9.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM SPECT
PULSPRG ZG30
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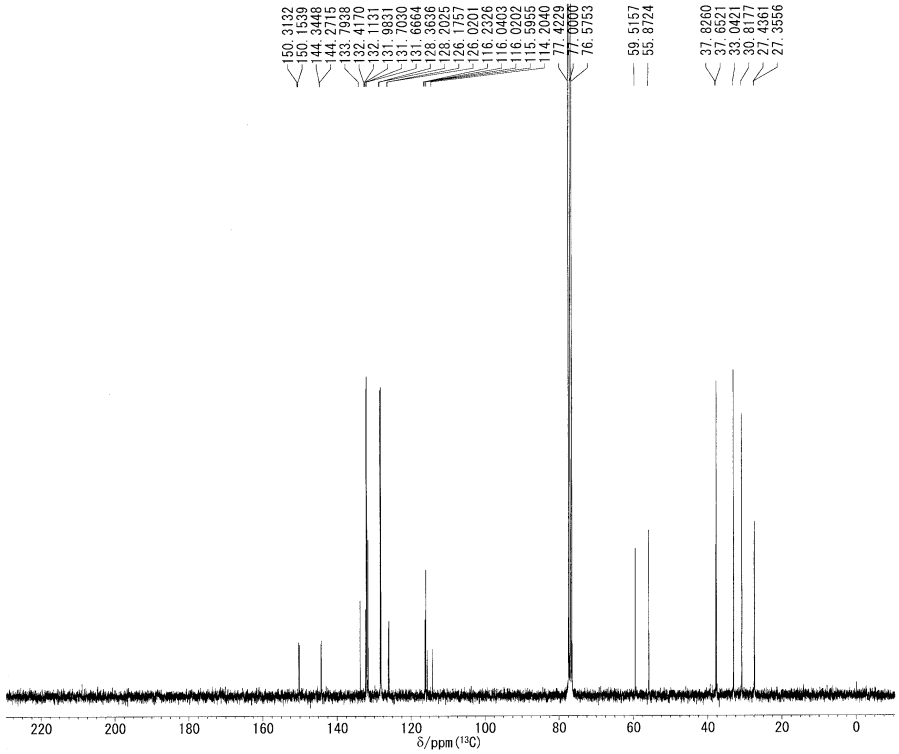
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 362

Operator_____



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POINT 32768
FREQU 18115.94 Hz
SCANS 1024
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PD 2.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM SPECT
PULSPRG ZGPG30
GRDPROG
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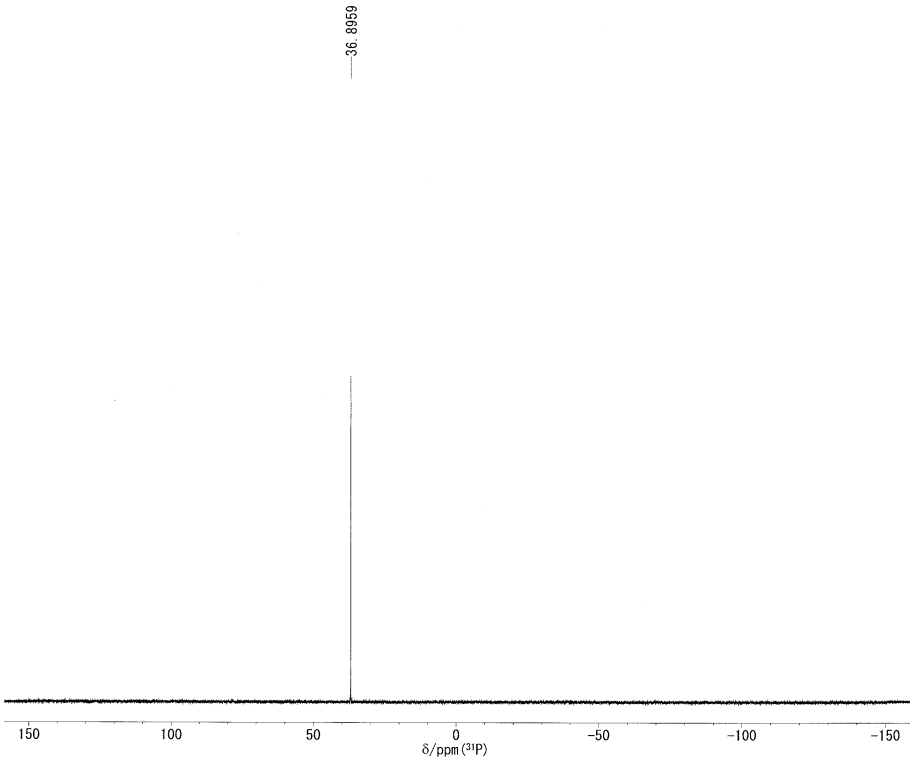
SLVNT CDCl₃
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 2048

Operator_____

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    z
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POINT                 32768
FREQU              38535.64 Hz
SCANS                     8
ACQTM                 0.8503
    s
PD                        8.0 s
PW1                       0.0 µs
IRNUC                   OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCl3
EXREF                158.537 p
    pm
BF                     0.25 Hz
WINDOW          Exponential
RGAIN                  11585

Operator_____________________
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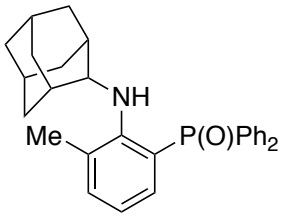
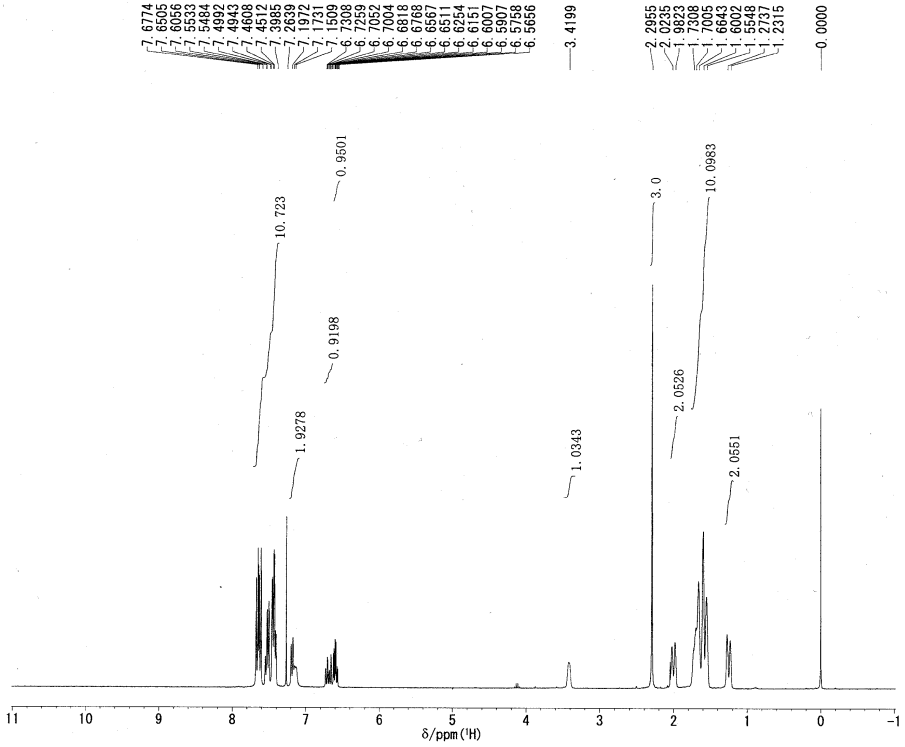
^{1}H, ^{13}C and ^{31}P NMR of **7b**





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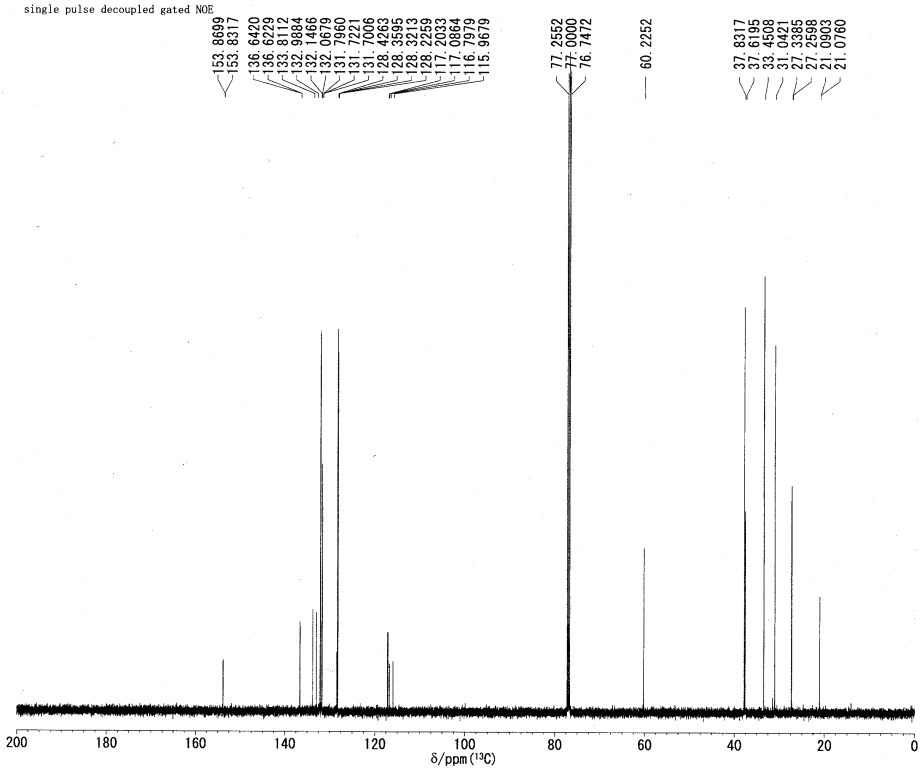
POINT 16384
FREQU 3612.717 Hz
SCANS 8
ACQTM 4.5351 s
PD 1.0 s
PW1 9.0 μs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM SPECT
PULSPRG ZG30
GRDPROG
CTEMP 26.85 °C
SLVNT CDCl3
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 512
Operator_____

single pulse decoupled gated NOE



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COMNT single pulse decoupled gated NOE
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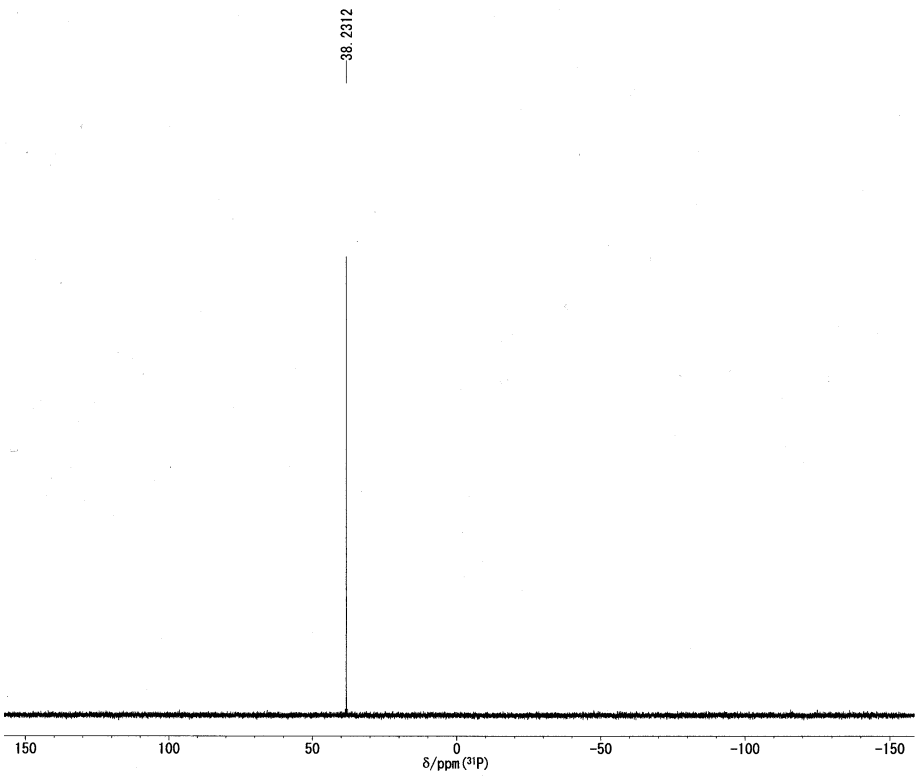
EXMOD carbon.jxp
OBFRQ 125.77 MHz
OBSET -5.0 kHz
OBFIN 301.0403 Hz
POINT 131072(ZeroFill:×4)
FREQU 39308.18 Hz
SCANS 321
ACQTM 0.8336 s
PD 2.0 s
PW1 3.5333 ms
IRNUC 1H
PROBHD
INSTRUM JNM-ECA500
PULSPRG
GRDPROG
CTEMP 25.0 °C
SLVNT CHLOROFORM-D
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 50
Operator_____

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DFILE  C:¥KYOUSEI6NMR¥06MINO20
    14¥19893P¥1¥PDATA¥1¥1I
DATIM    12/Dec/2014 15:09:28
COMNT

OBNUC                    31P
EXMOD                ZGPG30
OBFRQ                  121.54 MH
    z
OBSET                    0.0 kHz
OBFIN                10005.0 Hz
POINT                32768
FREQU                38535.64 Hz
SCANS                    8
ACQTM                    0.8503
    s
PD                       8.0 s
PW1                      0.0 µs
IRNUC                  OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                   26.85 °C
SLVNT                CDCl3
EXREF                  158.537 p
    pm
BF                       0.25 Hz
WINDOW         Exponential
RGAIN                10321

Operator_____________________
```
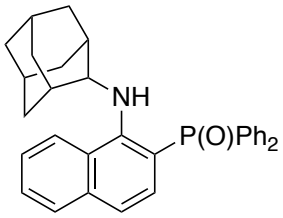
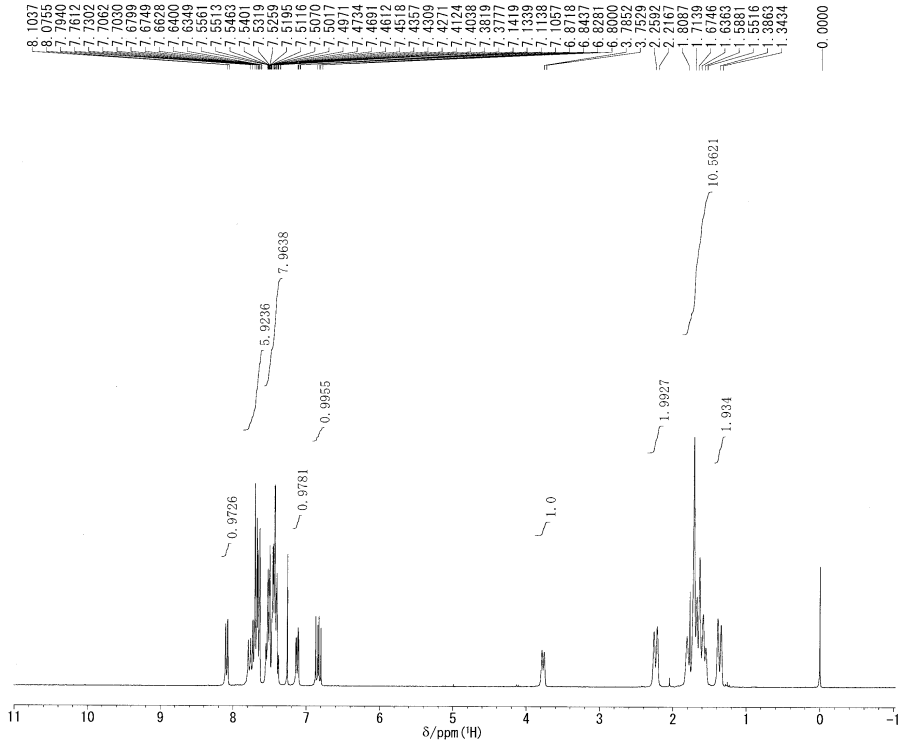

^{1}H, ^{13}C and ^{31}P NMR of **7c**

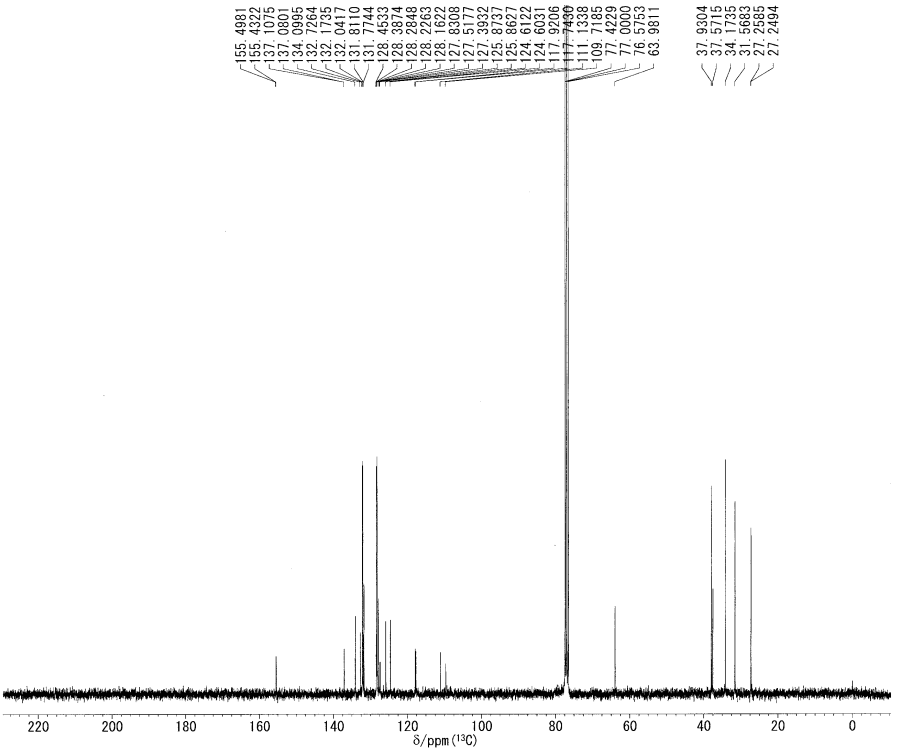




DFILE C:¥KYOUSEI6NMR¥06MIN020
16Y21244H¥1¥PDATA¥1¥1i
DATIM 19/Aug/2016 19:59:46
COMNT

OBNUC ¹H
EXMOD ZG30
OBFRQ 300.23 MH
z
OBSET 0.0 kHz
OBFIN 10004.57 Hz
POINT 16384
FREQU 3612.717 H
z
SCANS 8
ACQTM 4.5351
s
PD 1.0 s
PW1 9.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR
D Z8284/01
INSTRUM SPECT
PULSPRG ZG30
GRDPROG
CTEMP 21.01 ℃
SLVNT $CDCl_3$
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 287

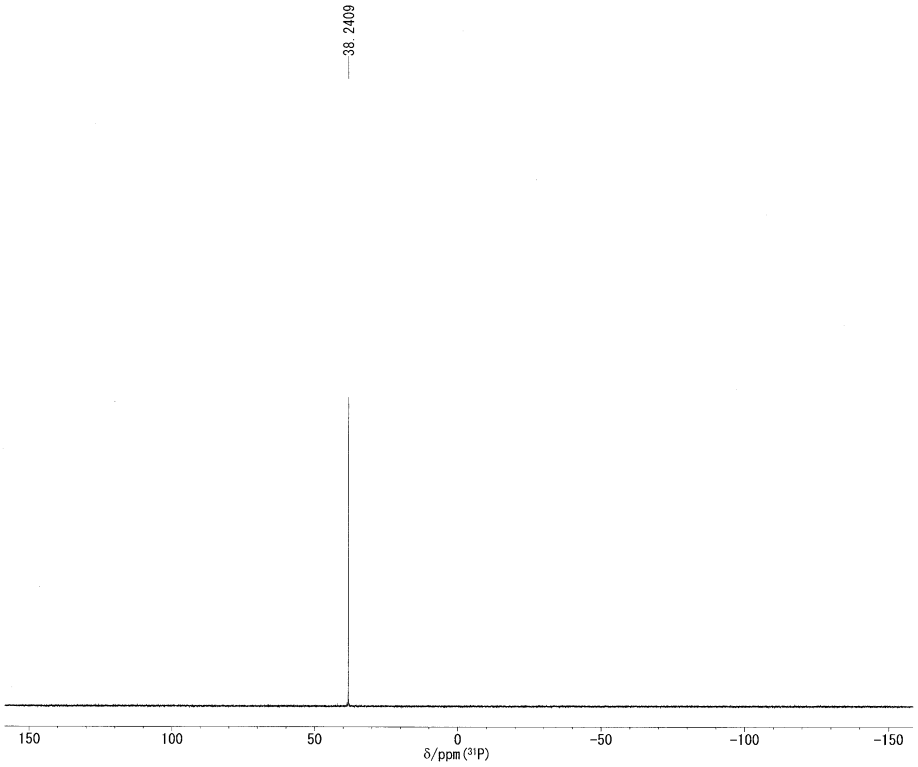
Operator_____



DFILE C:¥KYOUSEI6NMR¥06MIN020
16Y21244CY1¥PDATA¥1¥1i
DATIM 19/Aug/2016 21:07:01
COMNT

OBNUC ¹³C
EXMOD ZGPG30
OBFRQ 75.49 MH
z
OBSET 0.0 kHz
OBFIN 10003.06 Hz
POINT 32768
FREQU 18115.94 Hz
SCANS 1024
ACQTM 1.8088
s
PD 2.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR
D Z8284/01
INSTRUM SPECT
PULSPRG ZGPG30
GRDPROG
CTEMP 21.01 ℃
SLVNT ACETON
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 2299

Operator_____

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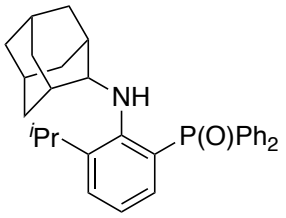
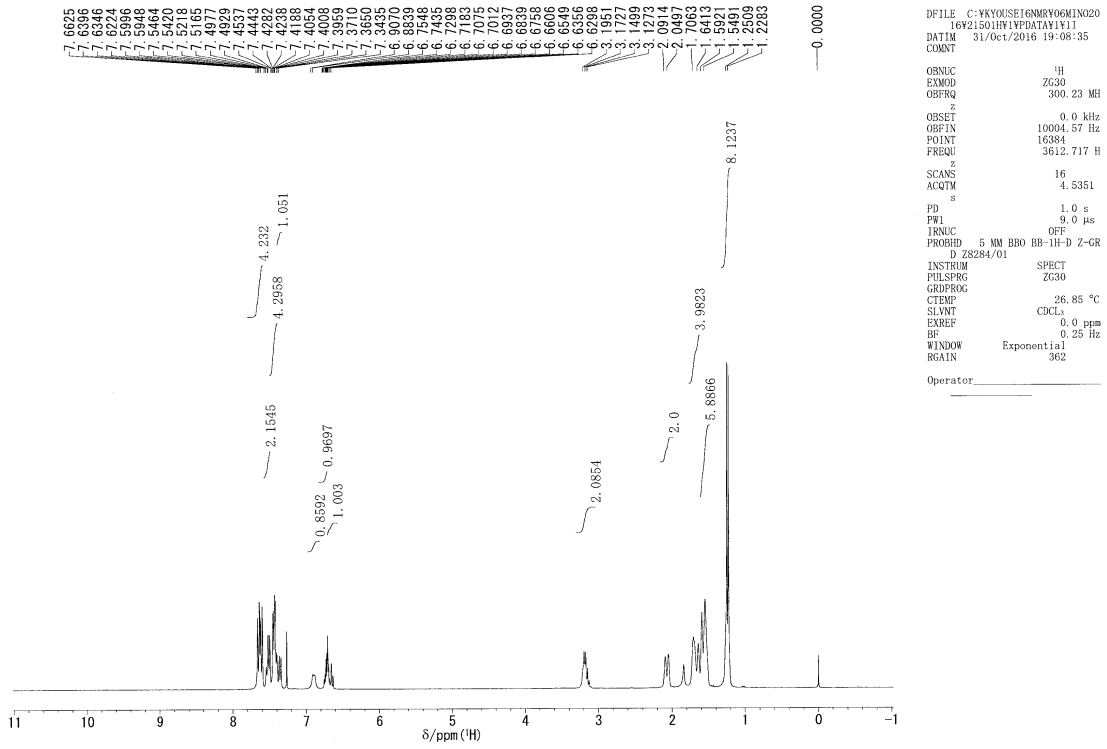
DFILE  C:¥KYOUSEIGNMR¥06MIN020
    15¥20221PY¥1¥PDATA¥1¥1I
DATIM   29/May/2015 17:36:39
COMNT

OBNUC                   31P
EXMOD                ZGPG30
OBFRQ                 121.54 MH
    z
OBSET                   0.0 kHz
OBFIN                10005.0 Hz
POINT                  32768
FREQU                38535.64 Hz
SCANS                      8
ACQTM                   0.8503
    s
PD                        8.0 s
PW1                       0.0 µs
IRNUC                    OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                   CDCl3
EXREF                 158.537 p
    pm
BF                        0.25 Hz
WINDOW          Exponential
RGAIN                  11585

Operator_____________________
    _____________
```

^{1}H, ^{13}C and ^{31}P NMR of **7d**

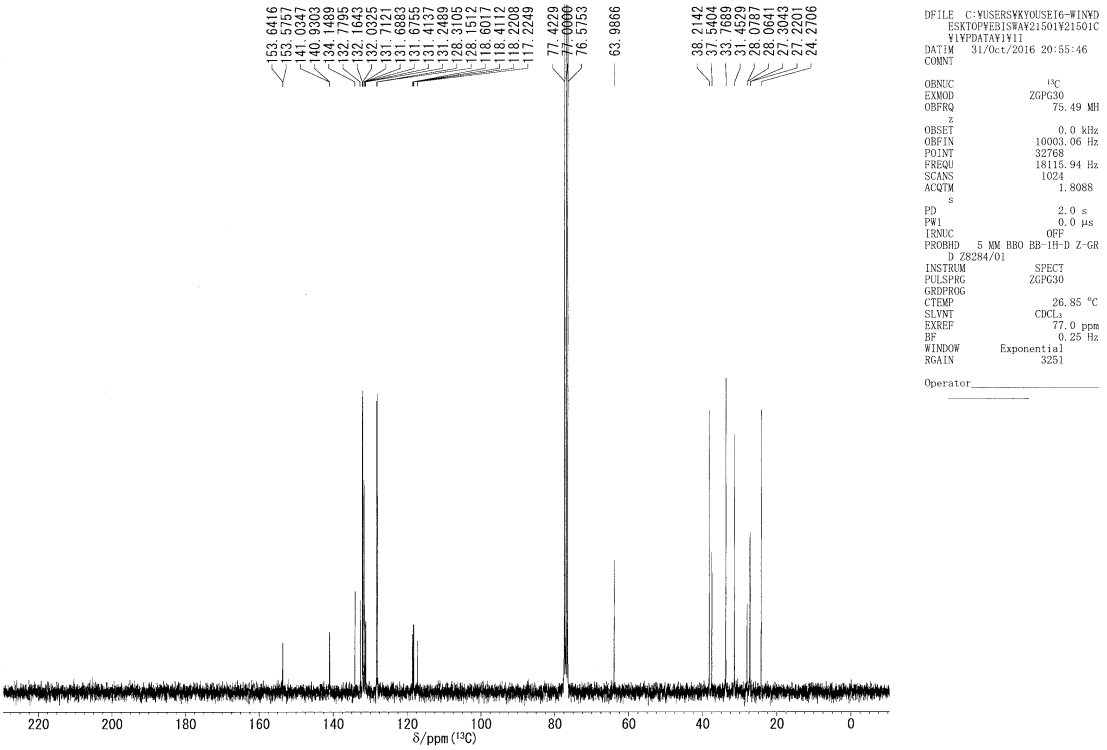




DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21501H¥1¥PDATA¥1¥1I
DATIM 31/Oct/2016 19:08:35
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	16
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	362

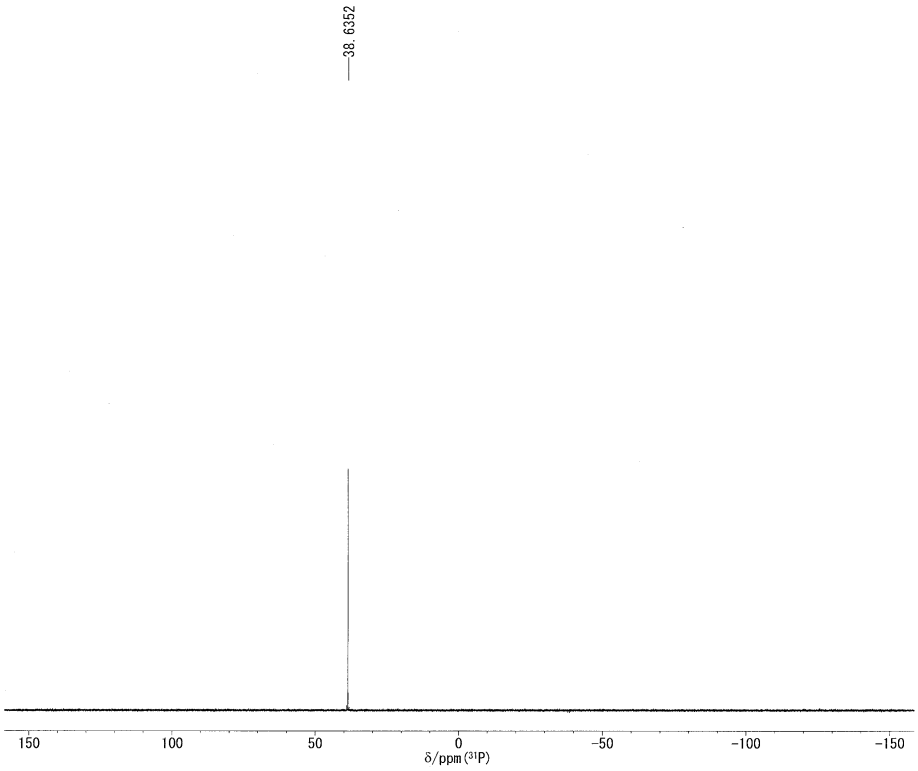
Operator_____



DFILE C:¥USERS¥KYOUSEI6-WIN¥DESKTOP¥EBISWA¥21501¥21501C¥1¥PDATA¥1¥1I
DATIM 31/Oct/2016 20:55:46
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	1024
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	3251

Operator_____

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DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21490P¥1¥PDATA¥1¥1I
DATIM   27/Oct/2016 19:00:51
COMNT

OBNUC                   31P
EXMOD                ZGPG30
OBFRQ                121.54 MH
    z
OBSET                 0.0 kHz
OBF1N               10005.0 Hz
POINT                 32768
FREQU               38535.64 Hz
SCANS                     8
ACQTM                 0.8503
    s
PD                        8.0 s
PW1                       0.0 µs
IRNUC                    OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCl3
EXREF                158.537 p
    pm
BF                        0.25 Hz
WINDOW          Exponential
RGAIN                    5793

Operator_____________________
```
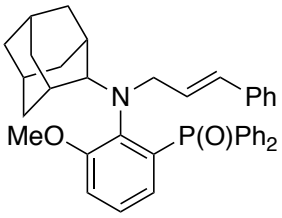
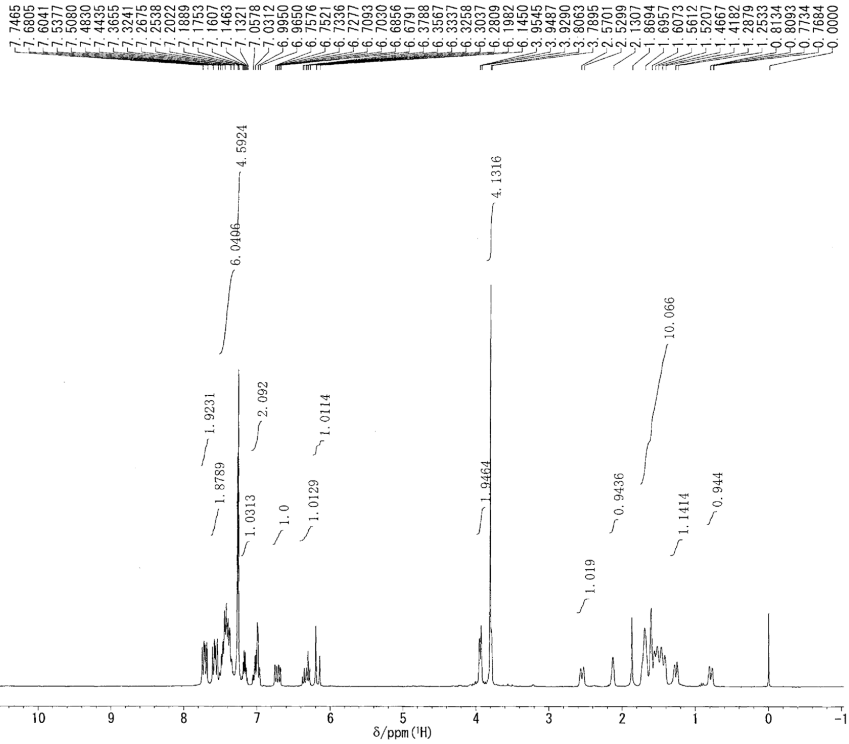

^{1}H, ^{13}C and ^{31}P NMR of **8a**

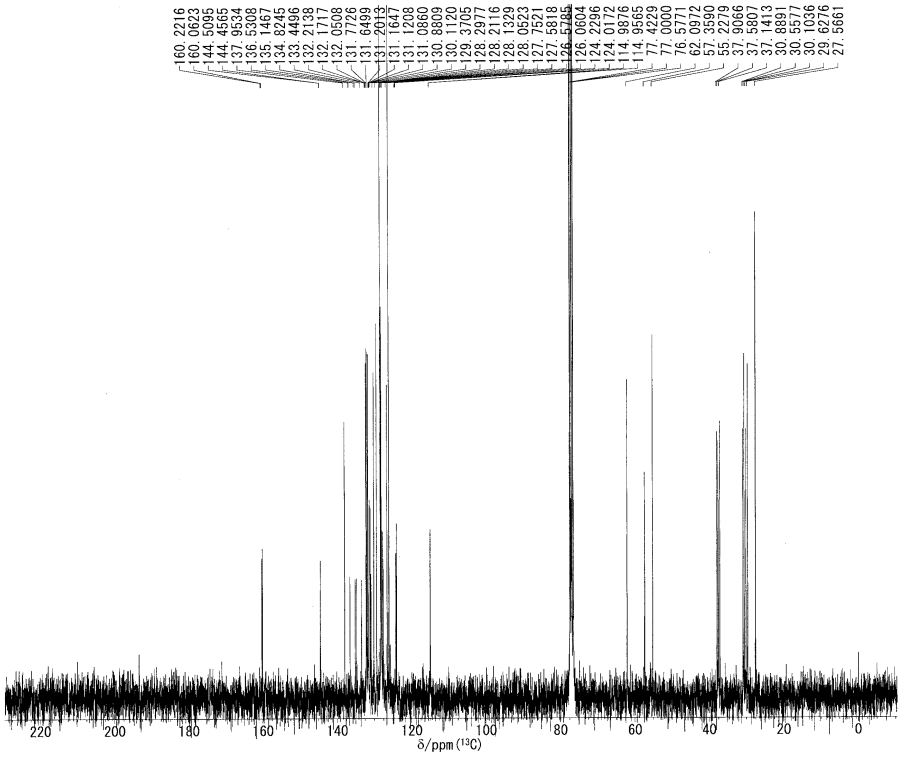




DFILE C:¥KYOUSEI6NMR¥06MIN020
16¥21161HY1¥PDATA¥1¥1I
DATIM 16/Jul/2016 13:35:29
COMNT

OBNUC ¹H
EXMOD ZG30
OBFRQ 300.23 MH
z
OBSET 0.0 kHz
OBFIN 10004.57 Hz
POINT 16384
FREQU 3612.717 H
z
SCANS 8
ACQTM 4.5351
s
PD 1.0 s
PW1 9.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR
D Z8284/01
INSTRUM SPECT
PULSPRG ZG30
GRDPROG
CTEMP 20.01 °C
SLVNT CDCL₃
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 181

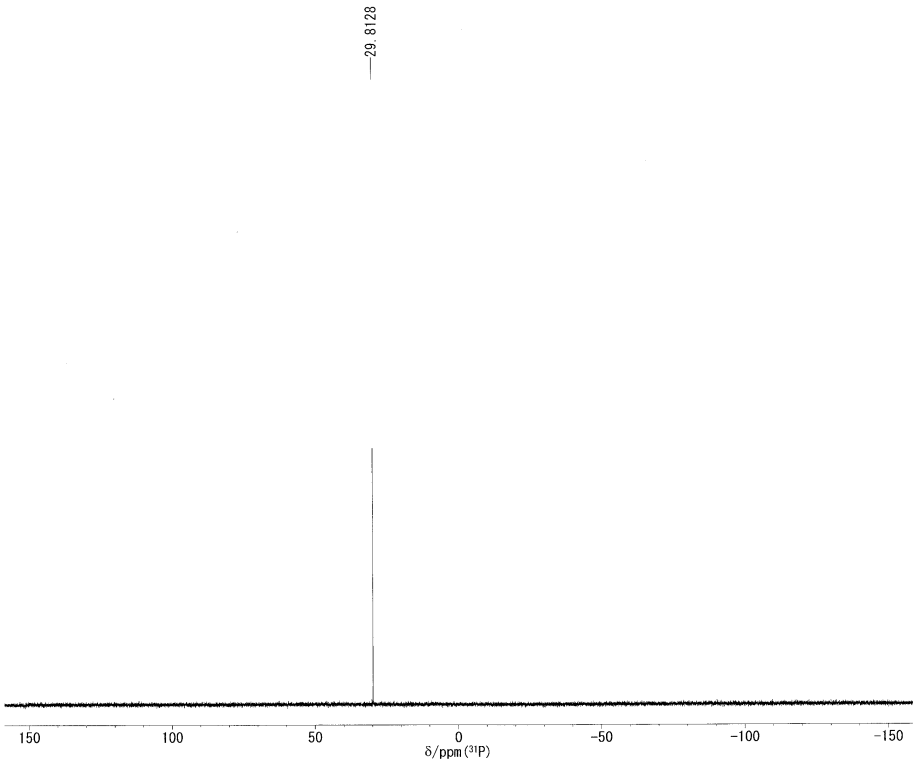
Operator



DFILE C:¥KYOUSEI6NMR¥06MIN020
16¥21161CY1¥PDATA¥1¥1I
DATIM 16/Jul/2016 14:42:29
COMNT

OBNUC ¹³C
EXMOD ZGPG30
OBFRQ 75.49 MH
z
OBSET 0.0 kHz
OBFIN 10003.06 Hz
POINT 32768
FREQU 18115.94 Hz
SCANS 1024
ACQTM 1.8088
s
PD 2.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR
D Z8284/01
INSTRUM SPECT
PULSPRG ZGPG30
GRDPROG
CTEMP 20.01 °C
SLVNT CDCL₃
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 2048

Operator

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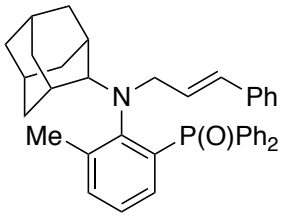
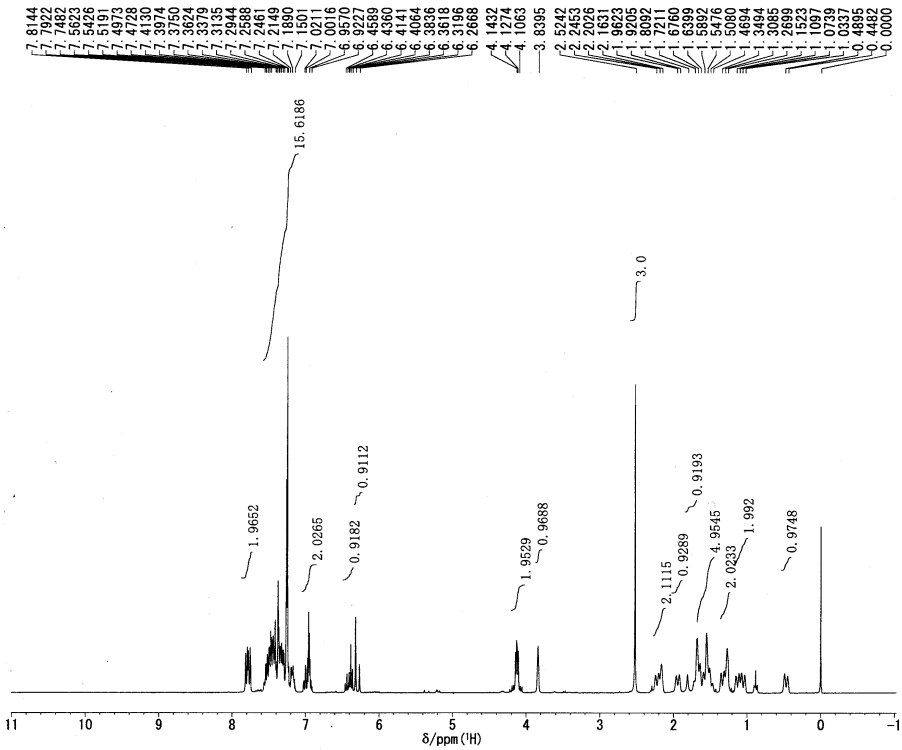
DFILE  C:¥KYOUSEI6NMR¥06MIN020
    15¥20458P¥2¥PDATA¥1¥1I
DATIM   02/Oct/2015 18:03:17
COMNT

OBNUC                   31P
EXMOD                ZGPG30
OBFRQ                121.54 MH
    z
OBSET                 0.0 kHz
OBFIN              10005.0 Hz
POINT                 32768
FREQU              38535.64 Hz
SCANS                     8
ACQTM                 0.8503
    s
PD                        8.0 s
PW1                       0.0 µs
IRNUC                   OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                 SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCL3
EXREF                158.537 p
    pm
BF                        0.25 Hz
WINDOW          Exponential
RGAIN                  13004

Operator_____________________
```

^{1}H, ^{13}C and ^{31}P NMR of **8b**

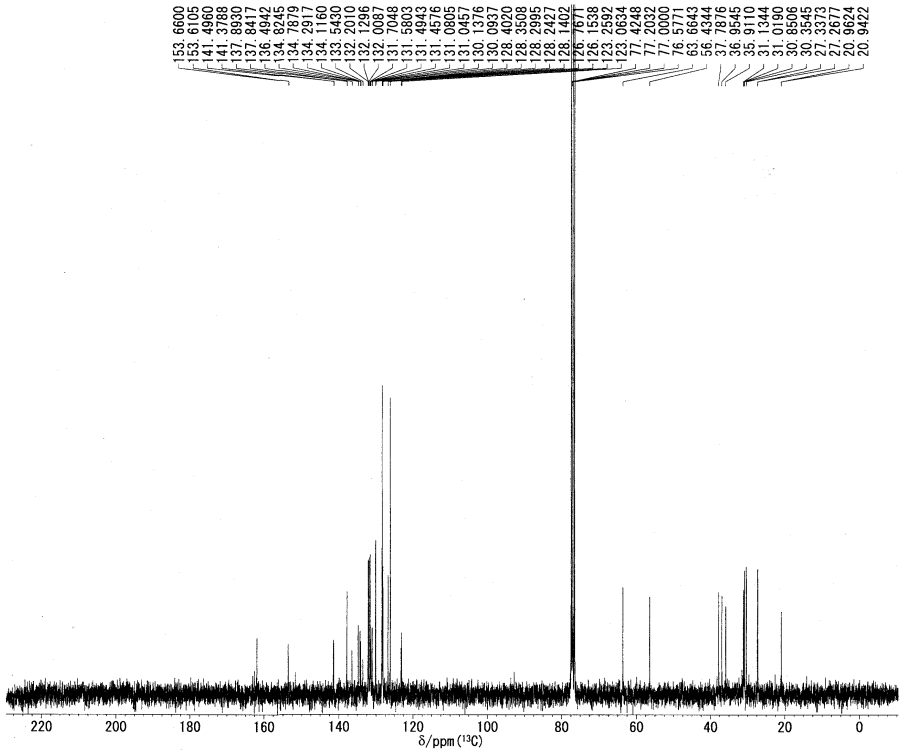




DFILE C:¥KYOUSEI6NMR¥06MIN020
14¥20030HY1¥PDATA¥1¥1I
DATIM 17/Feb/2015 17:58:33
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MH z
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 H z
SCANS	8
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GR D Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	256

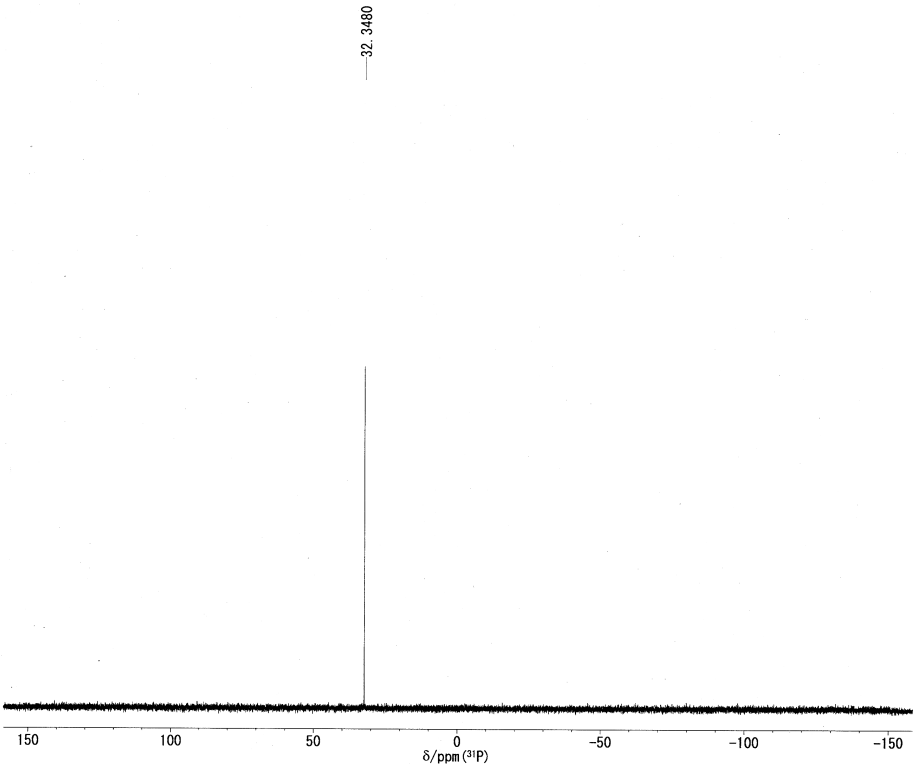
Operator



DFILE C:¥KYOUSEI6NMR¥06MIN020
14¥20059CY1¥PDATA¥1¥1I
DATIM 04/Mar/2015 16:38:33
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MH z
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	512
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GR D Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	2048

Operator

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DFILE   C:¥KYOUSEI6NMR¥OGMINO20
    14¥19885P¥1¥PDATA¥1¥1I
DATIM   10/Dec/2014 21:30:35
COMNT

OBNUC                   31P
EXMOD                ZGPG30
OBFRQ                 121.54 MH
    z
OBSET                   0.0 kHz
OBFIN                10005.0 Hz
PO1NT                32768
FREQU                38535.64 Hz
SCANS                    8
ACQTM                   0.8503
    s
PD                      8.0 s
PW1                     0.0 µs
IRNUC                   OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM               SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                 CDCl3
EXREF                 158.537 p
    pm
BF                      0.25 Hz
WINDOW         Exponential
RGAIN                11585

Operator_____________________
    ____________
```
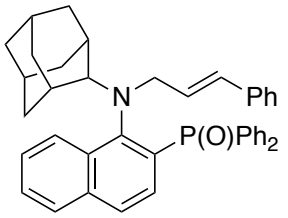
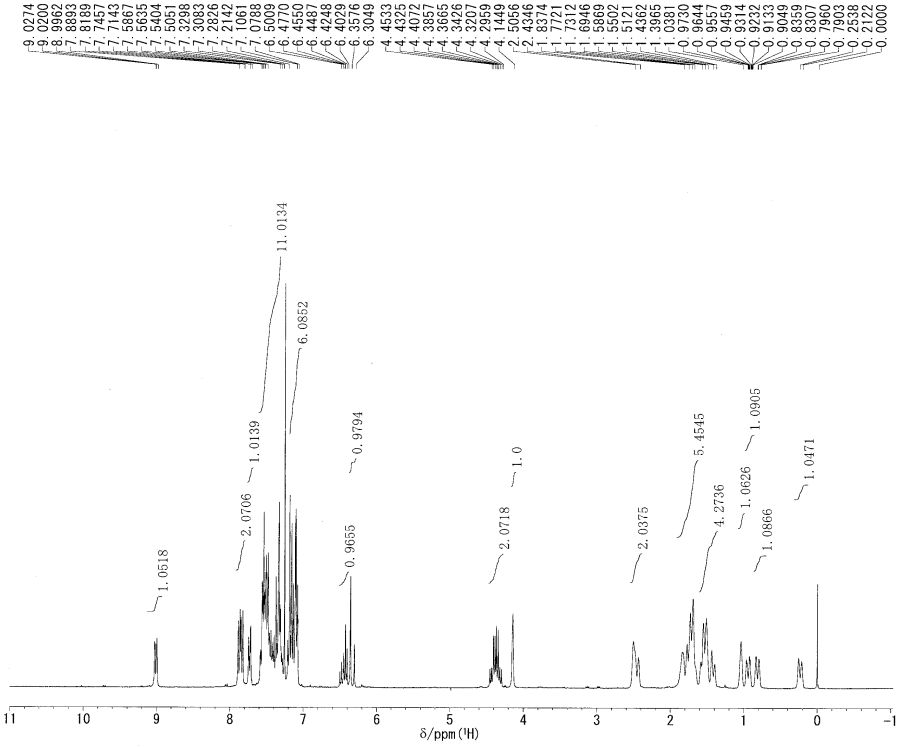

^{1}H, ^{13}C and ^{31}P NMR of **8c**



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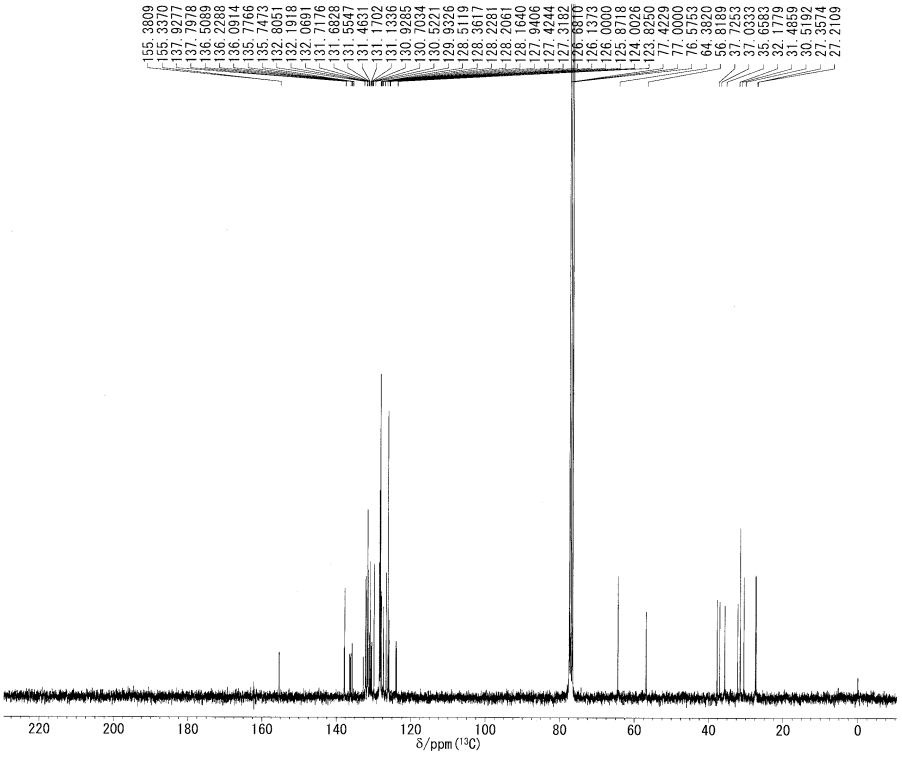
DFILE  C:¥KYOUSEI6NMR¥06MIN020
    15¥20284H¥1¥PDATA¥1¥1I
DATIM   19/Jun/2015 18:10:51
COMNT

OBNUC                    ¹H
EXMOD                  ZG30
OBFRQ                300.23 MH
     z
OBSET                  0.0 kHz
OBFIN              10004.57 Hz
POINT                  16384
FREQU               3612.717 H
     z
SCANS                     8
ACQTM                4.5351
     s
PD                       1.0 s
PW1                      9.0 µs
IRNUC                   OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
     D Z8284/01
INSTRUM                SPECT
PULSPRG                ZG30
GRDPROG
CTEMP                 26.85 °C
SLVNT                 CDCL3
EXREF                  0.0 ppm
BF                     0.25 Hz
WINDOW         Exponential
RGAIN                    228

Operator_____________________
```

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DFILE  C:¥KYOUSEI6NMR¥06MIN020
    16¥21347CY1¥PDATA¥1¥1I
DATIM   22/Sep/2016 18:40:48
COMNT

OBNUC                   ¹³C
EXMOD                ZGPG30
OBFRQ                75.49 MH
     z
OBSET                  0.0 kHz
OBFIN              10003.06 Hz
POINT                  32768
FREQU              18115.94 Hz
SCANS                  2048
ACQTM                1.8088
     s
PD                       2.0 s
PW1                      0.0 µs
IRNUC                   OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
     D Z8284/01
INSTRUM                SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                 19.01 °C
SLVNT                 CDCL3
EXREF                 77.0 ppm
BF                     0.25 Hz
WINDOW         Exponential
RGAIN                    813

Operator_____________________
```
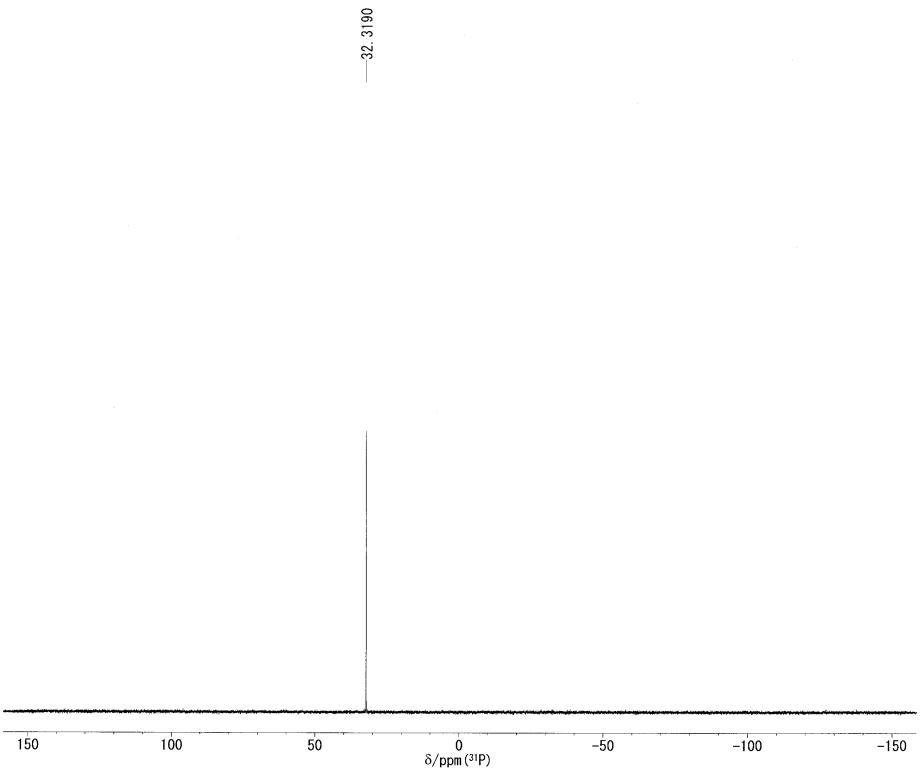
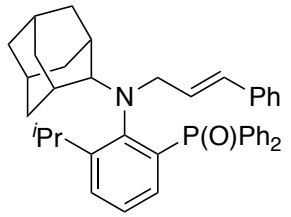
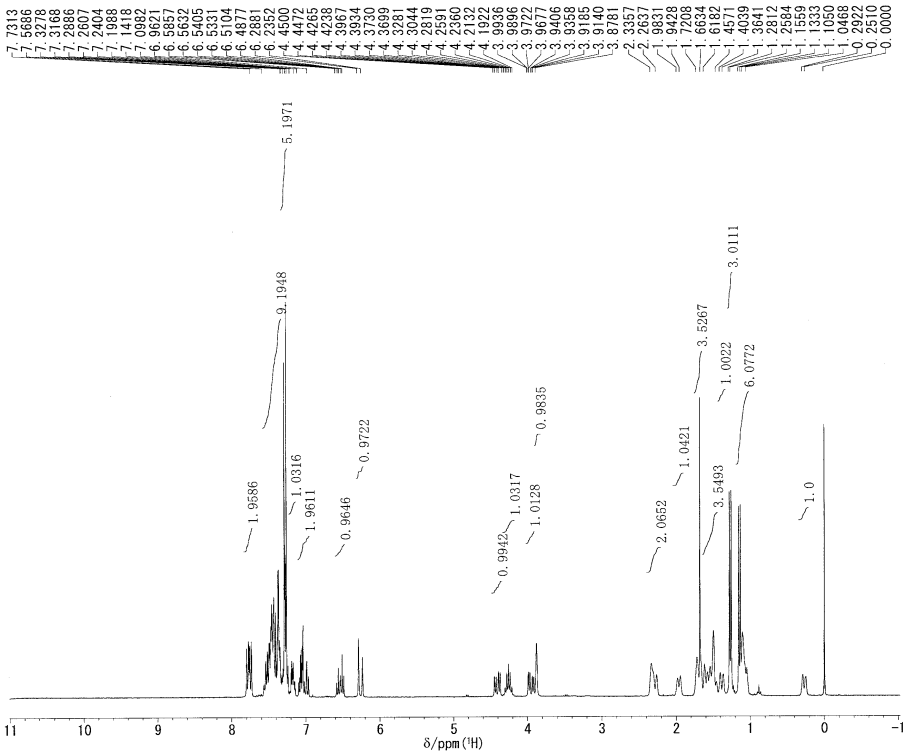



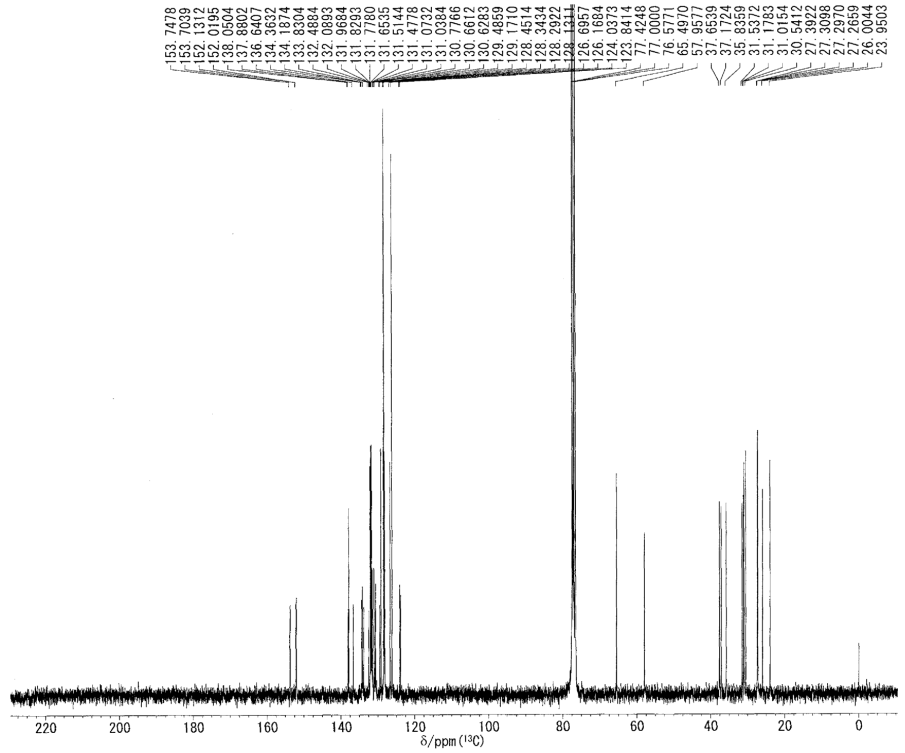

```
DFILE   C:¥KYOUSEI6NMR¥06MIN020
    15¥20266PY3¥PDATA¥1¥1I
DATIM   12/Jun/2015 20:32:19
COMNT


OBNUC                   31P
EXMOD                ZGPG30
OBFRQ                 121.54 MH
    z
OBSET                   0.0 kHz
OBFIN                10005.0 Hz
POINT                32768
FREQU                38535.64 Hz
SCANS                    8
ACQTM                   0.8503
    s
PD                      8.0 s
PW1                     0.0 µs
IRNUC                  OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM               SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCl3
EXREF                 158.537 p
    pm
BF                      0.25 Hz
WINDOW         Exponential
RGAIN                  4096

Operator_____
```

^{1}H, ^{13}C and ^{31}P NMR of **8d**

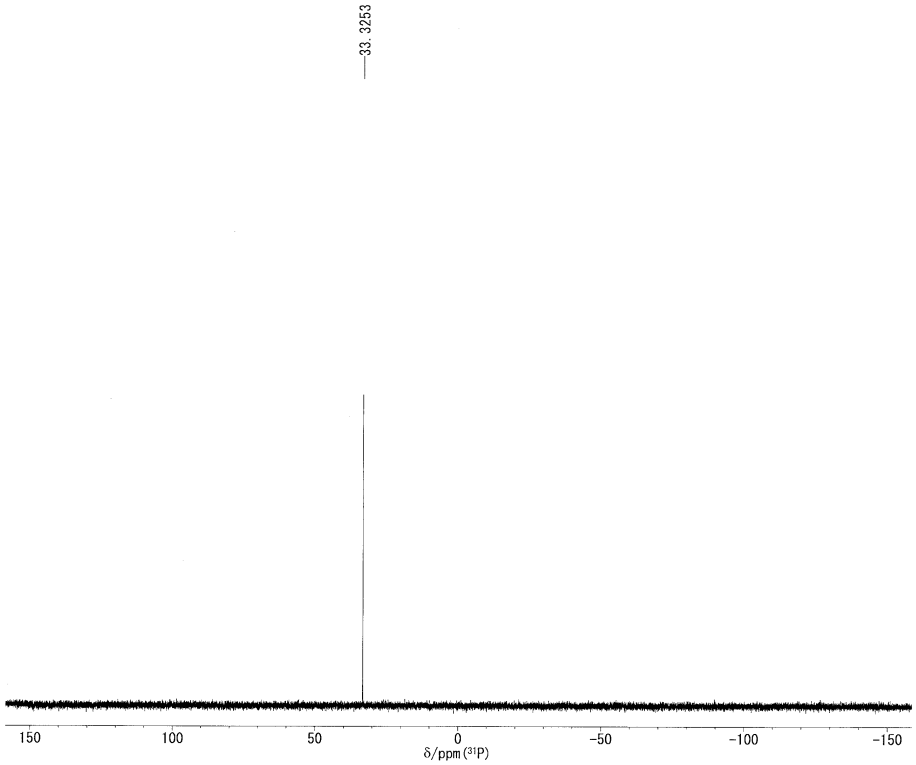





```
DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21490H¥2¥PDATA¥1¥1I
DATIM   27/Oct/2016 19:13:28
COMNT

OBNUC                      1H
EXMOD                    ZG30
OBFRQ                  300.23 MH
    z
OBSET                   0.0 kHz
OBFIN                10004.57 Hz
POINT                   16384
FREQU                3612.717 H
    z
SCANS                      16
ACQTM                   4.5351
    s
PD                        1.0 s
PW1                       9.0 µs
IRNUC                     OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                 SPECT
PULSPRG                  ZG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCL3
EXREF                   0.0 ppm
BF                      0.25 Hz
WINDOW          Exponential
RGAIN                      362

Operator_____________________
```




```
DFILE  C:¥USERS¥KYOUSEI6-WIN¥D
    ESKTOP¥EB1SWA¥21516-2AD,1S
    OP80,CINNAMYL OXIDE¥21516C
    ¥2¥PDATA¥1¥1I
DATIM   09/Nov/2016 09:44:00
COMNT

OBNUC                     13C
EXMOD                 ZGPG30
OBFRQ                  75.49 MH
    z
OBSET                   0.0 kHz
OBFIN                10003.06 Hz
POINT                   32768
FREQU                18115.94 Hz
SCANS                      9539
ACQTM                   1.8088
    s
PD                        2.0 s
PW1                       0.0 µs
IRNUC                     OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                 SPECT
PULSPRG                ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCL3
EXREF                  77.0 ppm
BF                      0.25 Hz
WINDOW          Exponential
RGAIN                     2580

Operator_____________________
```

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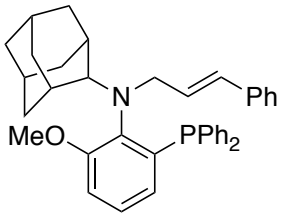
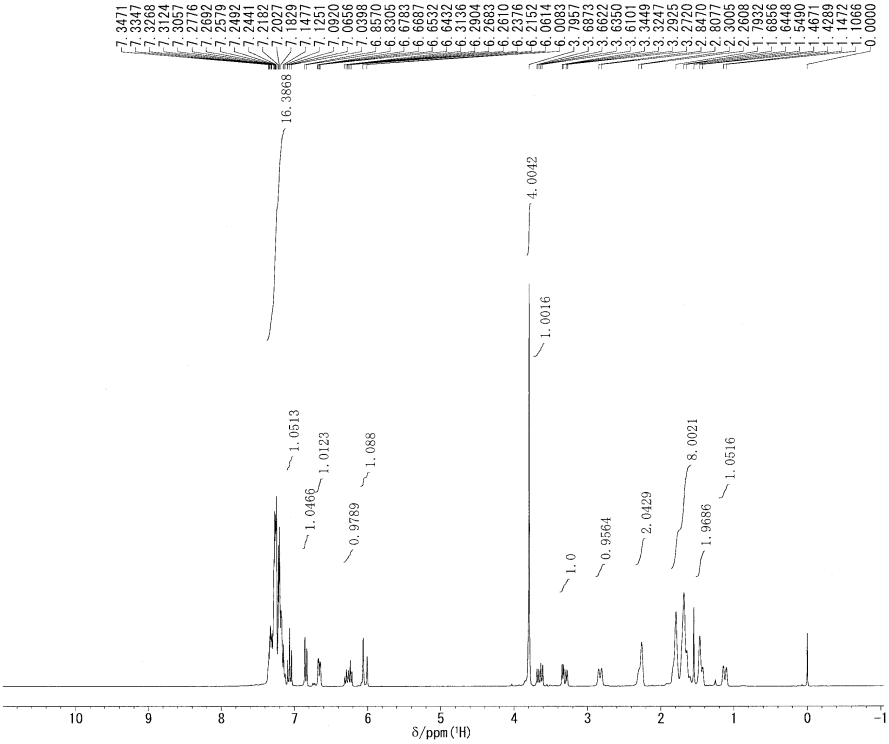
DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21490¥2¥PDATA¥1¥1i
DATIM   27/Oct/2016 19:16:15
COMNT

OBNUC                   31P
EXMOD                ZGPG30
OBFRQ                121.54 MH
    z
OBSET                 0.0 kHz
OBFIN               10005.0 Hz
POINT                 32768
FREQU               38535.64 Hz
SCANS                     8
ACQTM                 0.8503
    s
PD                        8.0 s
PW1                     0.0 µs
IRNUC                   OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                 SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                   CDCLs
EXREF                158.537 p
    pm
BF                     0.25 Hz
WINDOW          Exponential
RGAIN                  13004

Operator_____________________
```

^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (±)-**3a**

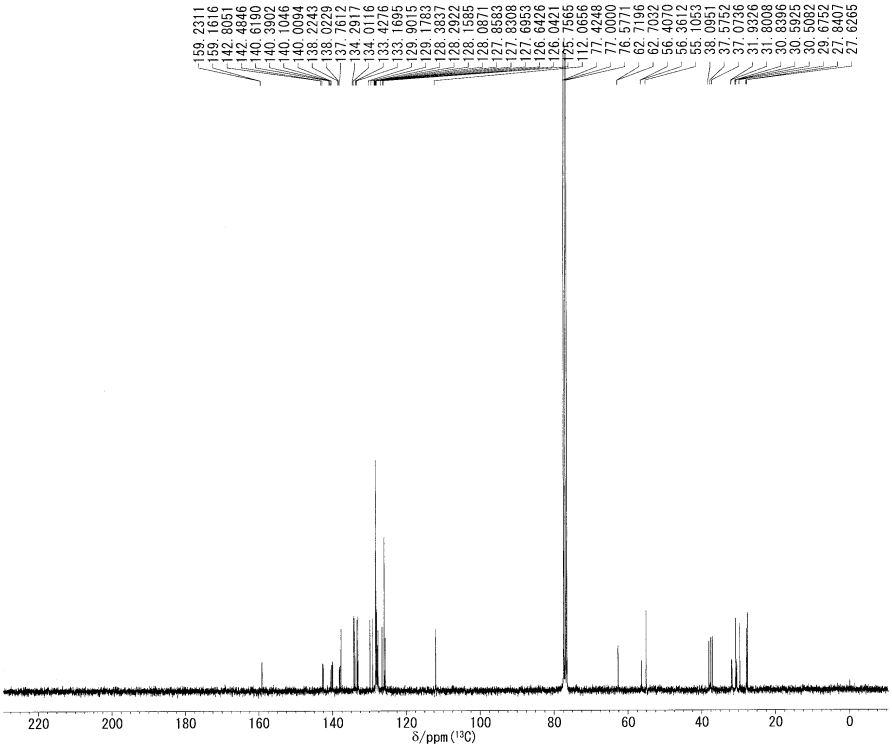




DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21162HY1¥PDATA¥1¥1I
DATIM 18/Jul/2016 10:13:16
COMNT

OBNUC ¹H
EXMOD ZG30
OBFRQ 300.23 MH z
OBSET 0.0 kHz
OBFIN 10004.57 Hz
POINT 16384
FREQU 3612.717 H z
SCANS 8
ACQTM 4.5351 s
PD 1.0 s
PW1 9.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR D Z8284/01
INSTRUM SPECT
PULSPRG ZG30
GRDPROG
CTEMP 21.01 °C
SLVNT CDCL₃
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 181

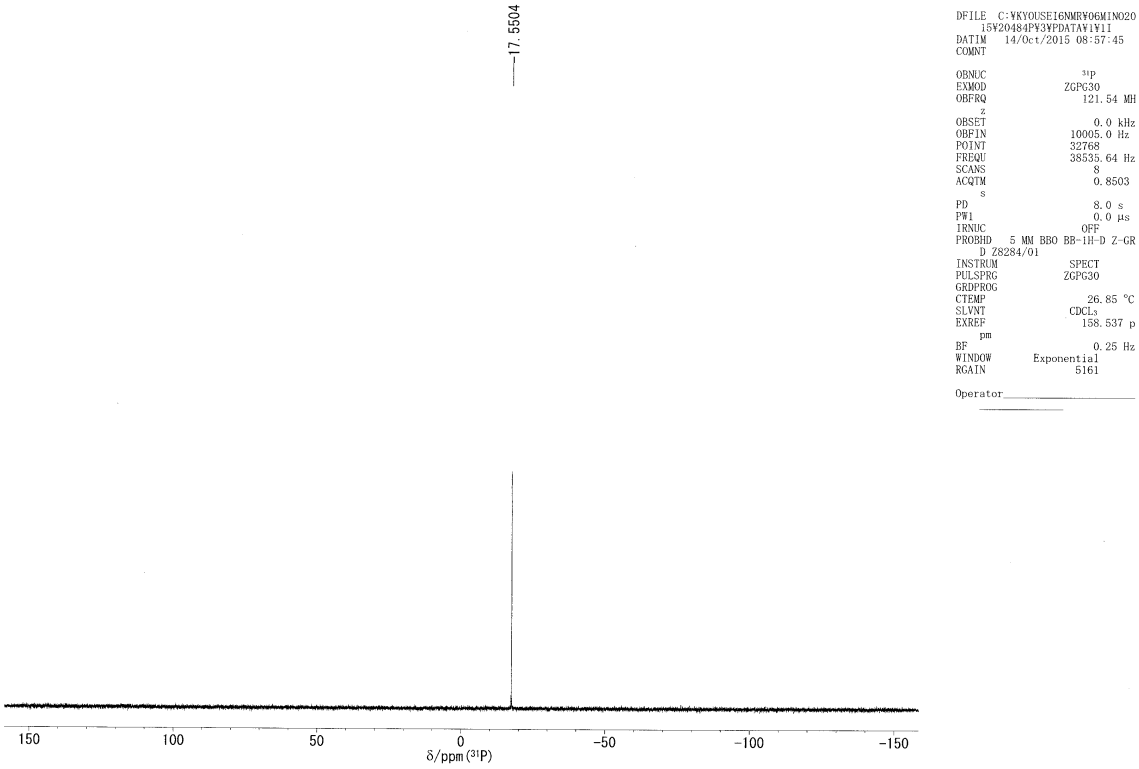
Operator_____

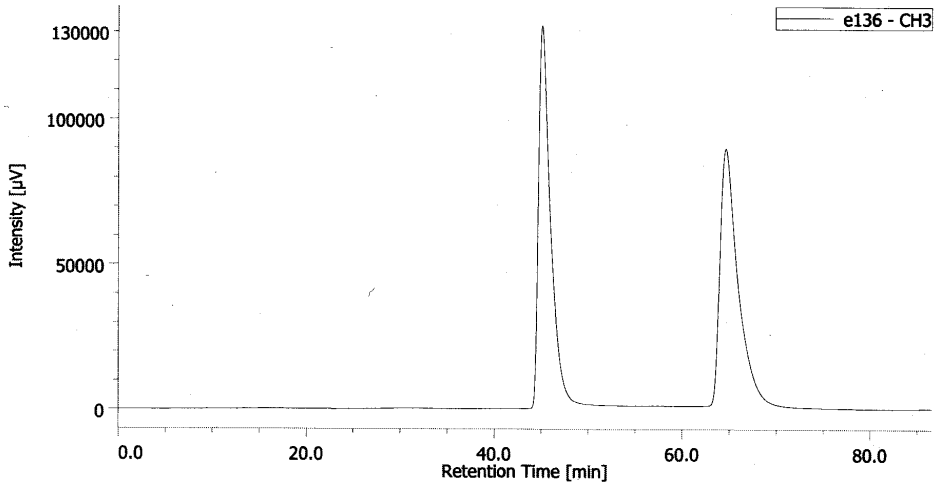


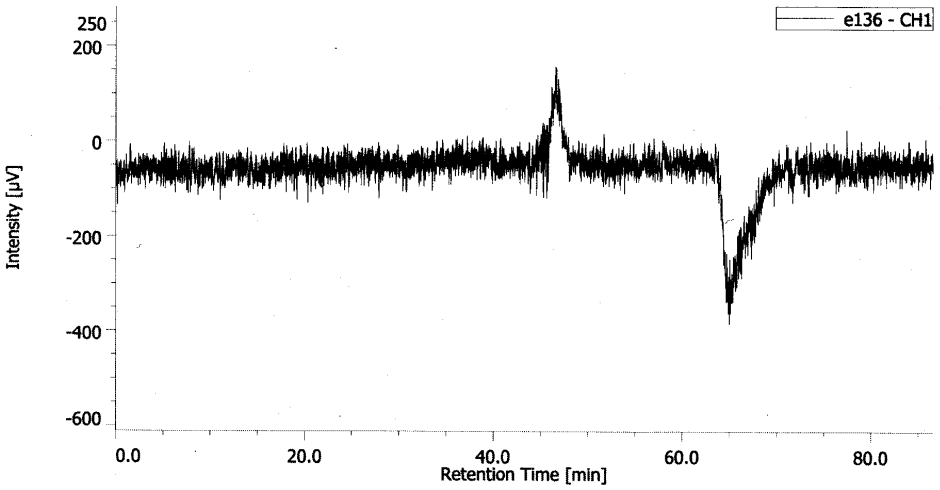
DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21162CY1¥PDATA¥1¥1I
DATIM 18/Jul/2016 11:20:13
COMNT

OBNUC ¹³C
EXMOD ZGPG30
OBFRQ 75.49 MH z
OBSET 0.0 kHz
OBFIN 10003.06 Hz
POINT 32768
FREQU 18115.94 Hz
SCANS 1024
ACQTM 1.8088 s
PD 2.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR D Z8284/01
INSTRUM SPECT
PULSPRG ZGPG30
GRDPROG
CTEMP 21.01 °C
SLVNT CDCL₃
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 2048

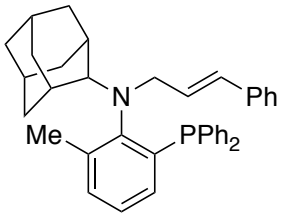
Operator_____

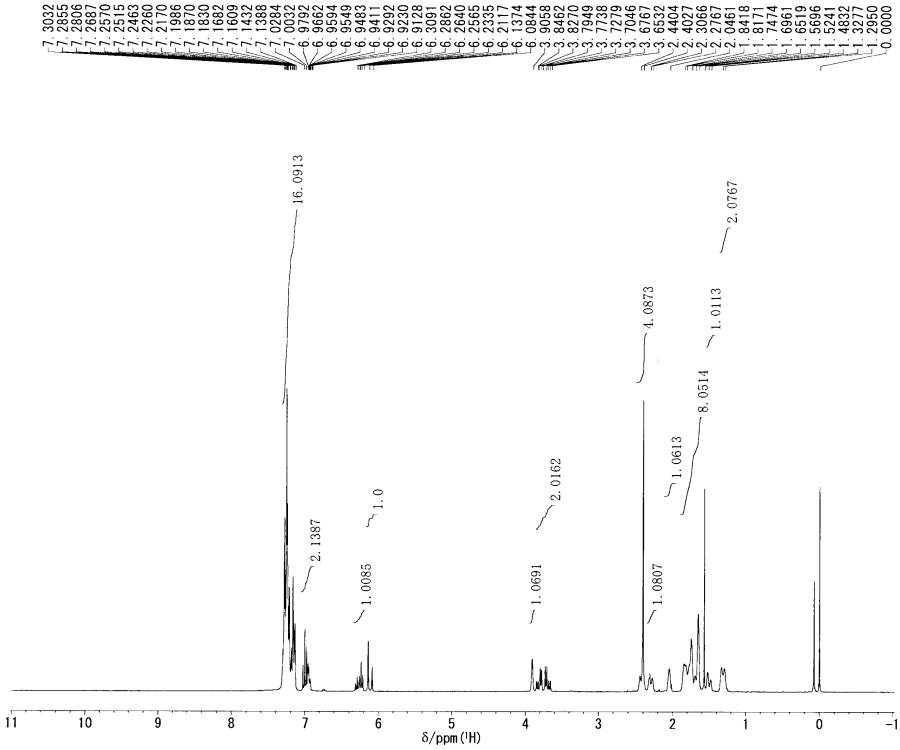

17.5504
DFILE C:¥KYOUSEI6NMR¥06MINO20 15¥20484PY3¥PDATA¥1¥1I
DATIM 14/Oct/2015 08:57:45
COMNT
OBNUC 31P
EXMOD ZGPG30
OBFRQ 121.54 MH z
OBSET 0.0 kHz
OBFIN 10005.0 Hz
POINT 32768
FREQU 38535.64 Hz
SCANS 8
ACQTM 0.8503 s
PD 8.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR D Z8284/01
INSTRUM SPECT
PULSPRG ZGPG30
GRDPROG
CTEMP 26.85 °C
SLVNT CDCl3
EXREF 158.537 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 5161
Operator
150
100
50
0
-50
-100
-150
δ/ppm(31P)


e136 - CH3
130000
100000
50000
0
Intensity [µV]
0.0
20.0
40.0
60.0
80.0
Retention Time [min]


e136 - CH1
250
200
0
-200
-400
-600
Intensity [µV]
0.0
20.0
40.0
60.0
80.0
Retention Time [min]

^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (±)-**3b**

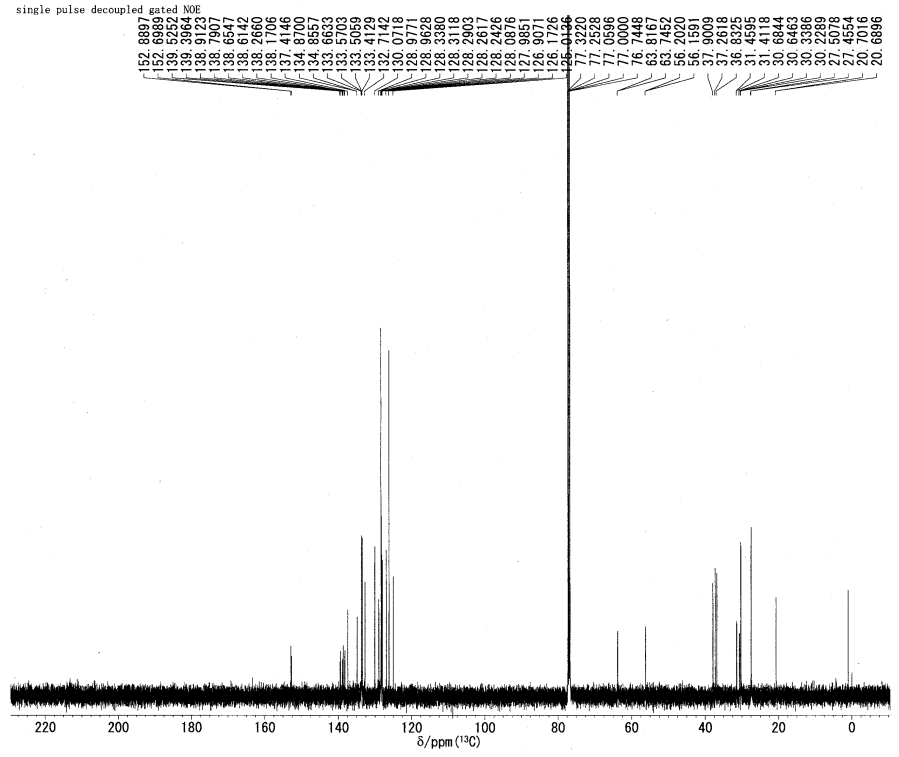




DFILE C:¥KYOUSEI6NMRY06MIN0201 4Y19920HY1¥PDATA¥1¥1I
DATIM 05/Jan/2015 14:09:13
COMNT

OBNUC	¹H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	8
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	CDCL3
EXREF	11.0049 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	362

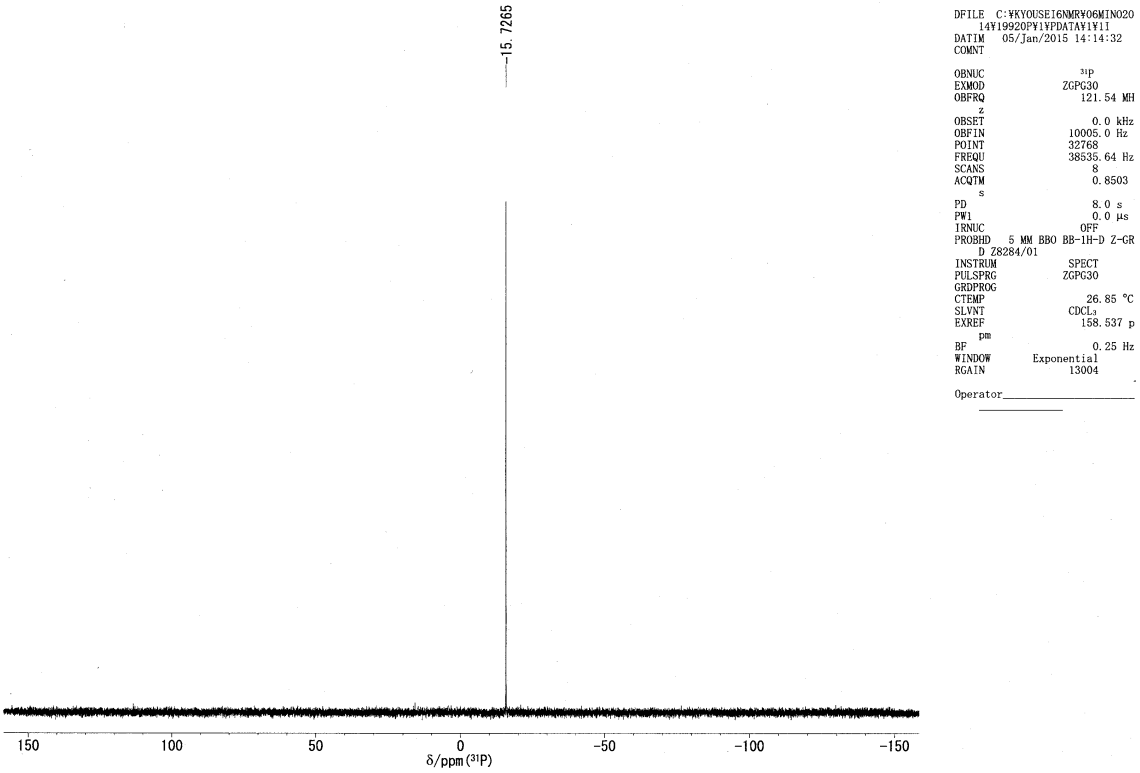
Operator_____



DFILE C:¥Users¥kyousei6-win¥Desktop¥20150226_ebi exp62_Carbon-1-1.jdf
DATIM 26/Feb/2015 04:50:37
COMNT single pulse decoupled gated NOE

OBNUC	¹³C
EXMOD	carbon.jxp
OBFRQ	125.77 MHz
OBSET	-5.0 kHz
OBFIN	301.0403 Hz
POINT	131072(ZeroFill:×4)
FREQU	39308.18 Hz
SCANS	256
ACQTM	0.8336 s
PD	2.0 s
PW1	3.5333 ms
IRNUC	¹H
PROBHD	
INSTRUM	JNM-ECA500
PULSPRG	
GRDPROG	
CTEMP	20.4 °C
SLVNT	CHLOROFORM-D
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	50

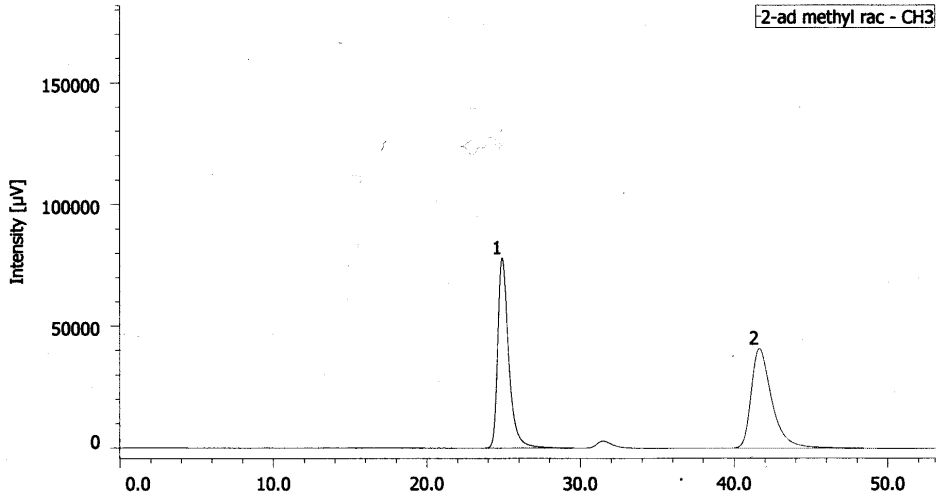
Operator_____

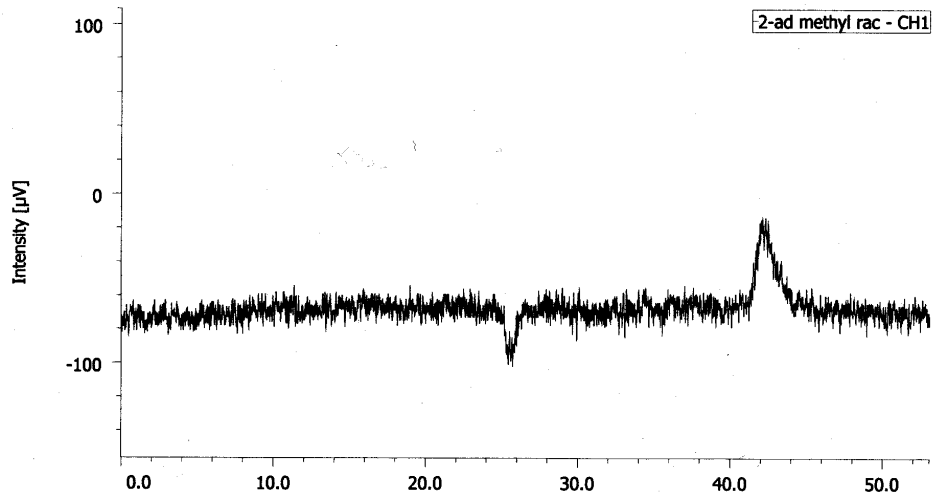



```
DFILE  C:¥KYOUSEI6NMR¥06MINO20
    14¥19920P¥1¥PDATA¥1¥1I
DATIM   05/Jan/2015 14:14:32
COMNT

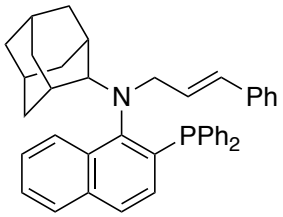
OBNUC                  31P
EXMOD               ZGPG30
OBFRQ                121.54 MH
    z
OBSET                 0.0 kHz
OBFIN              10005.0 Hz
POINT                 32768
FREQU              38535.64 Hz
SCANS                     8
ACQTM                 0.8503
    s
PD                        8.0 s
PW1                       0.0 µs
IRNUC                   OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM               SPECT
PULSPRG             ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                 CDCL3
EXREF                158.537 p
    pm
BF                     0.25 Hz
WINDOW        Exponential
RGAIN                 13004

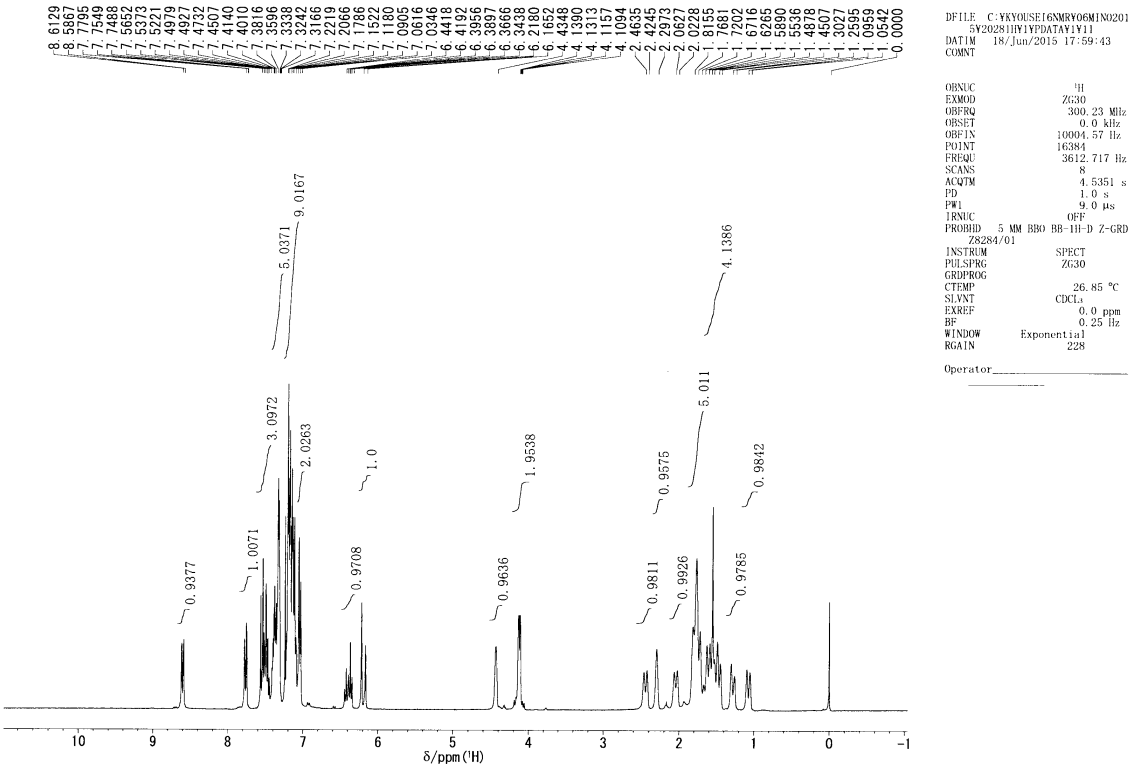
Operator_____________________
    _____
```





^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (±)-**3c**

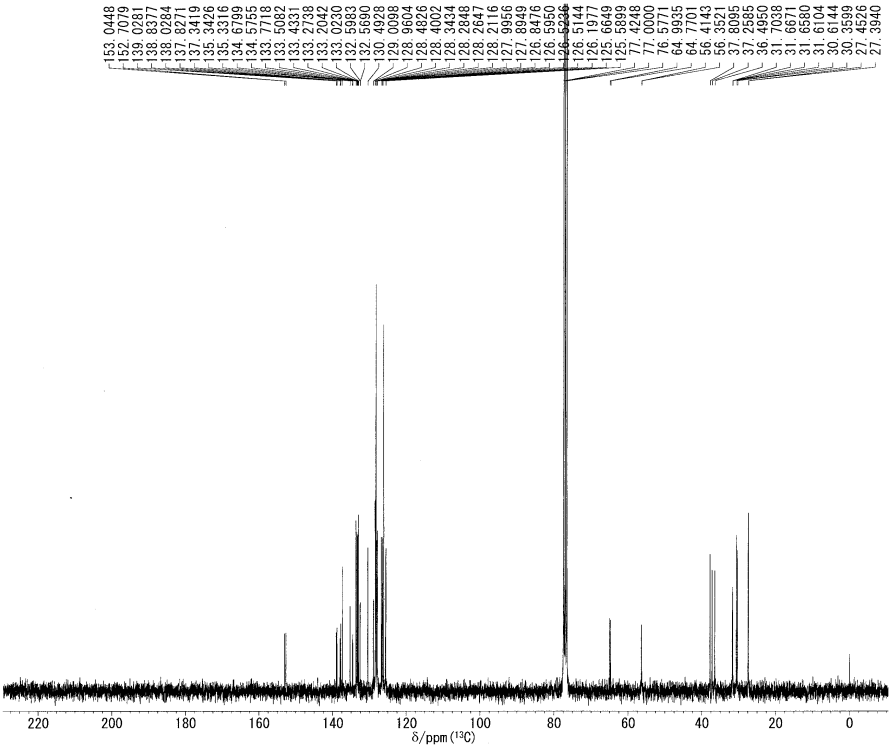




DFILE C:¥KYOUSEI6NMR¥06MIN0201
5¥2028¹H¥1¥PDATA¥1¥1I
DATIM 18/Jun/2015 17:59:43
COMNT

OBNUC	¹H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	8
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	CDCL₃
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	228

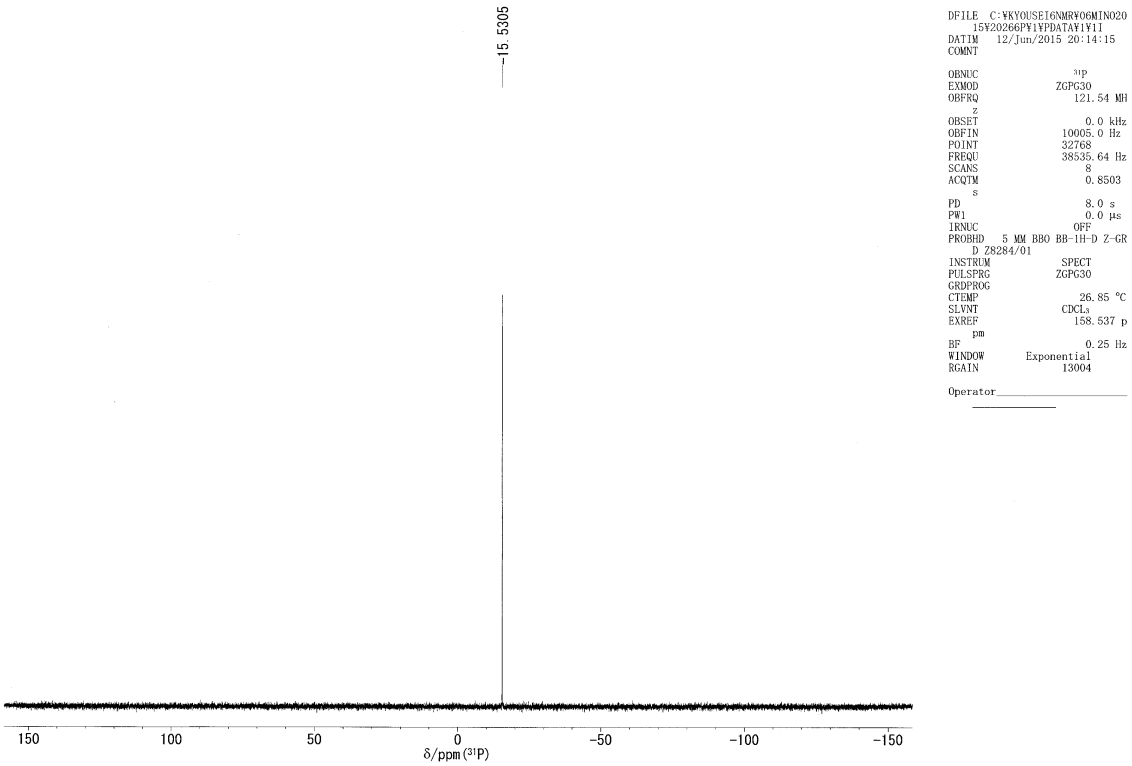
Operator_____



DFILE C:¥KYOUSEI6NMR¥06MIN020
16¥21347CY2¥PDATA¥1¥1I
DATIM 22/Sep/2016 20:58:43
COMNT

OBNUC	¹³C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	2048
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	20.01 °C
SLVNT	CDCL₃
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	1626

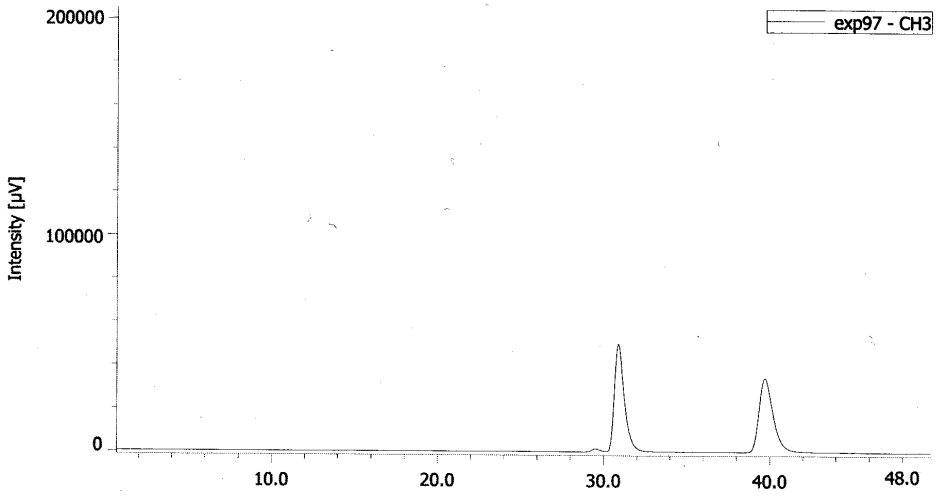
Operator_____

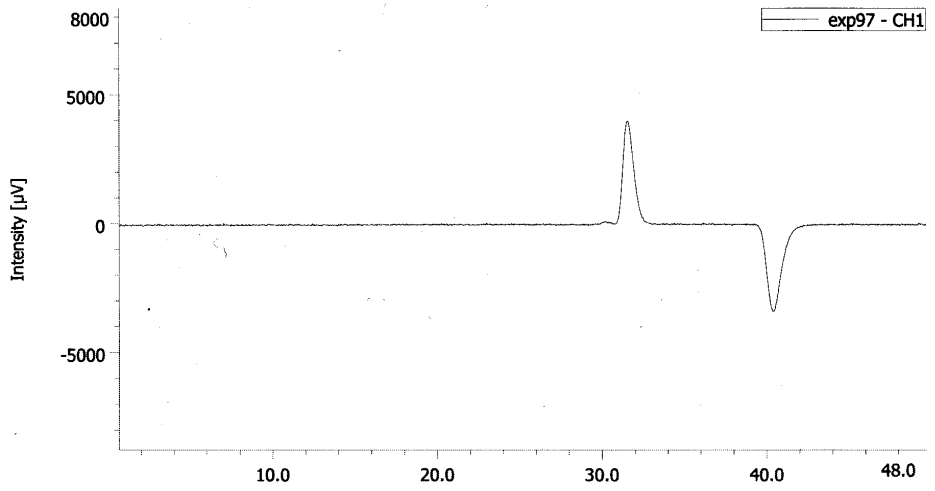



```
DFILE  C:¥KYOUSEI6NMR¥06MINO20
    15¥20266PY1¥PDATA¥1¥1I
DATIM   12/Jun/2015 20:14:15
COMNT

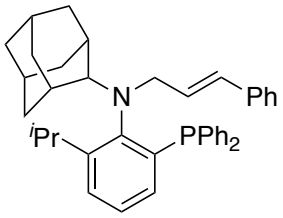
OBNUC                  31P
EXMOD              ZGPG30
OBFRQ                121.54 MH
    z
OBSET                  0.0 kHz
OBFIN              10005.0 Hz
POINT              32768
FREQU              38535.64 Hz
SCANS                  8
ACQTM                  0.8503
    s
PD                     8.0 s
PW1                    0.0 µs
IRNUC                OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM              SPECT
PULSPRG            ZGPG30
GRDPROG
CTEMP                 26.85 °C
SLVNT              CDCl3
EXREF                158.537 p
    pm
BF                     0.25 Hz
WINDOW         Exponential
RGAIN              13004

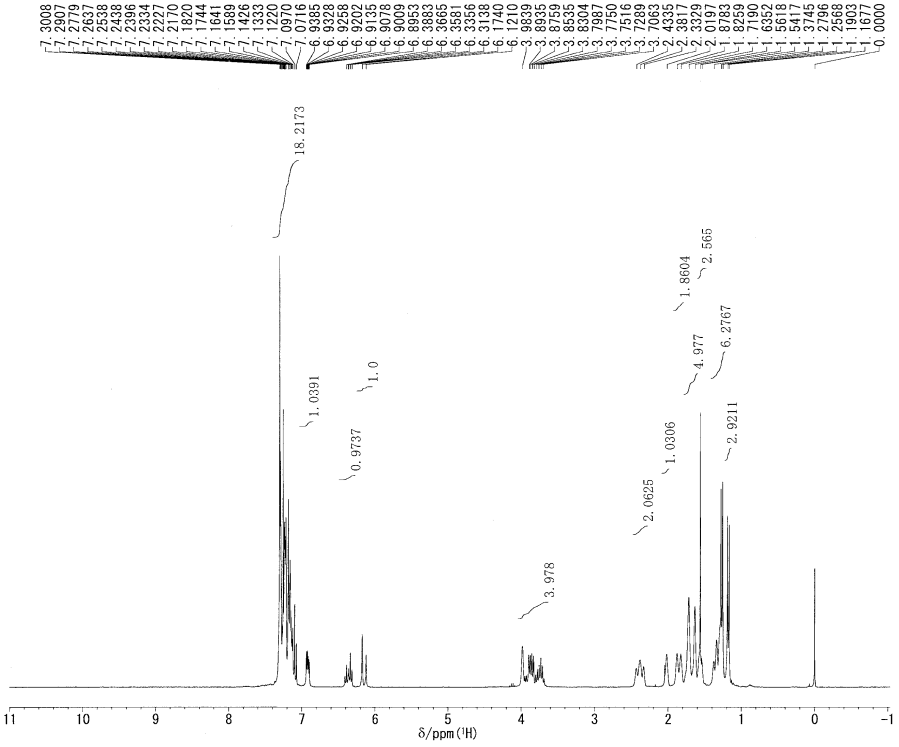
Operator_____
```





^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (±)-**3d**

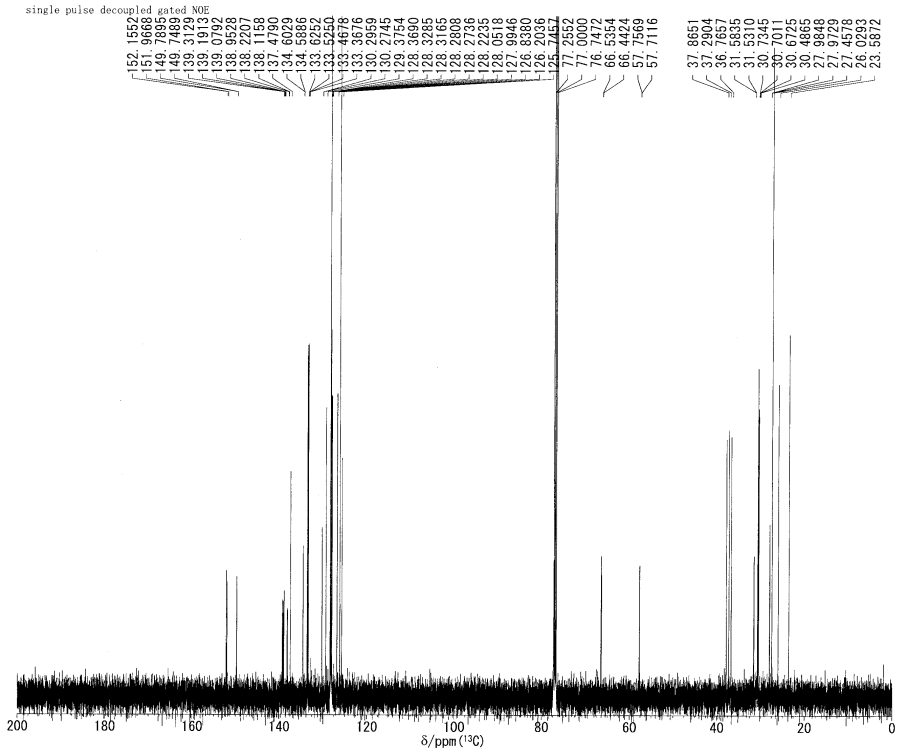




DFILE C:¥KYOUSEI6NMR¥O6MINO20 16¥21500HY2¥PDATA¥1¥1I
DATIM 31/Oct/2016 18:59:40
COMNT

OBNUC ¹H
EXMOD ZG30
OBFRQ 300.23 MHz
OBSET 0.0 kHz
OBFIN 10004.57 Hz
POINT 16384
FREQU 3612.717 Hz
SCANS 16
ACQTM 4.5351 s
PD 1.0 s
PW1 9.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM SPECT
PULSPRG ZG30
GRDPROG
CTEMP 26.85 °C
SLVNT CDCl₃
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 362

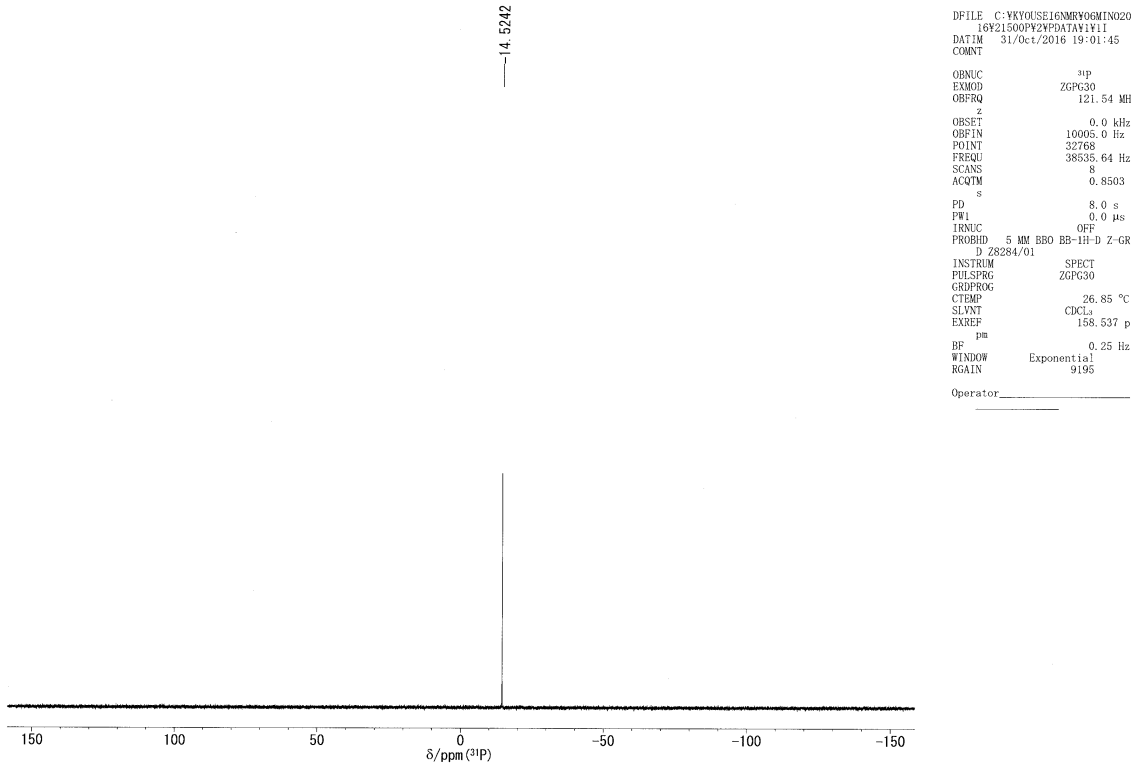
Operator_____

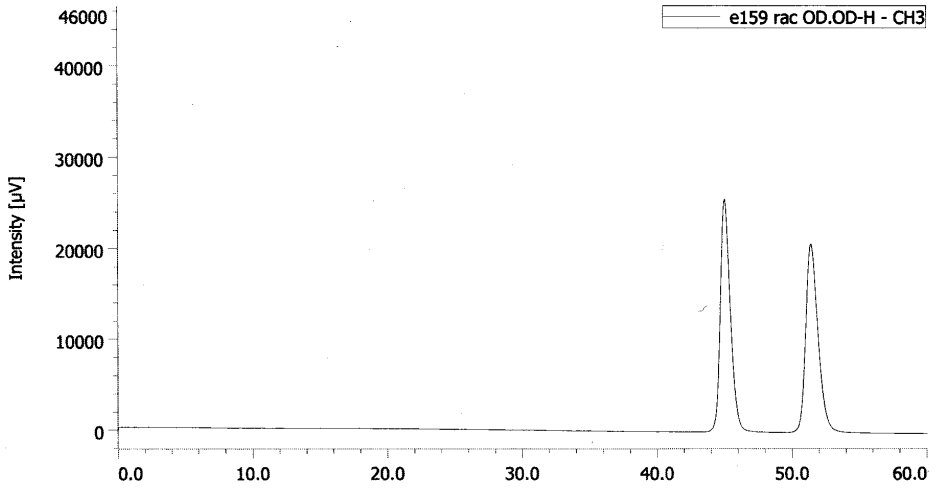


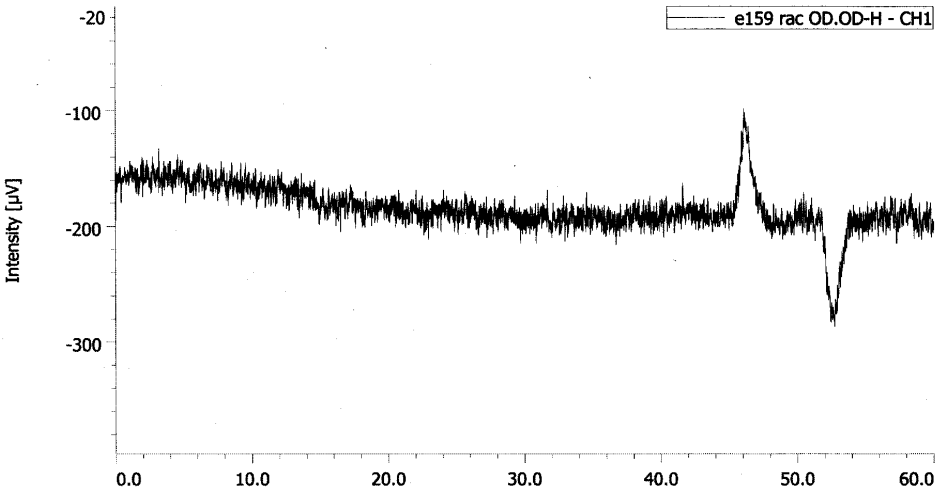
DFILE C:¥Users¥kyousei6-win¥Desktop¥20161111_ebisawa el68_Carbon-1-1.jdf
DATIM 11/Nov/2016 08:53:39
COMNT single pulse decoupled gated NOE

OBNUC ¹³C
EXMOD carbon.jxp
OBFRQ 125.77 MHz
OBSET -5.0 kHz
OBFIN 301.0403 Hz
POINT 131072(ZeroFill:×4)
FREQU 39308.18 Hz
SCANS 1024
ACQTM 0.8336 s
PD 2.0 s
PW1 3.7833 ms
IRNUC ¹H
PROBHD
INSTRUM JNM-ECA500
PULSPRG
GRDPROG
CTEMP 20.6 °C
SLVNT CHLOROFORM-D
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 50

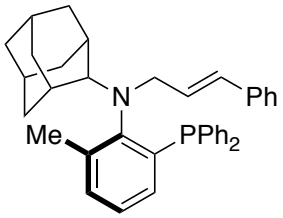
Operator_____

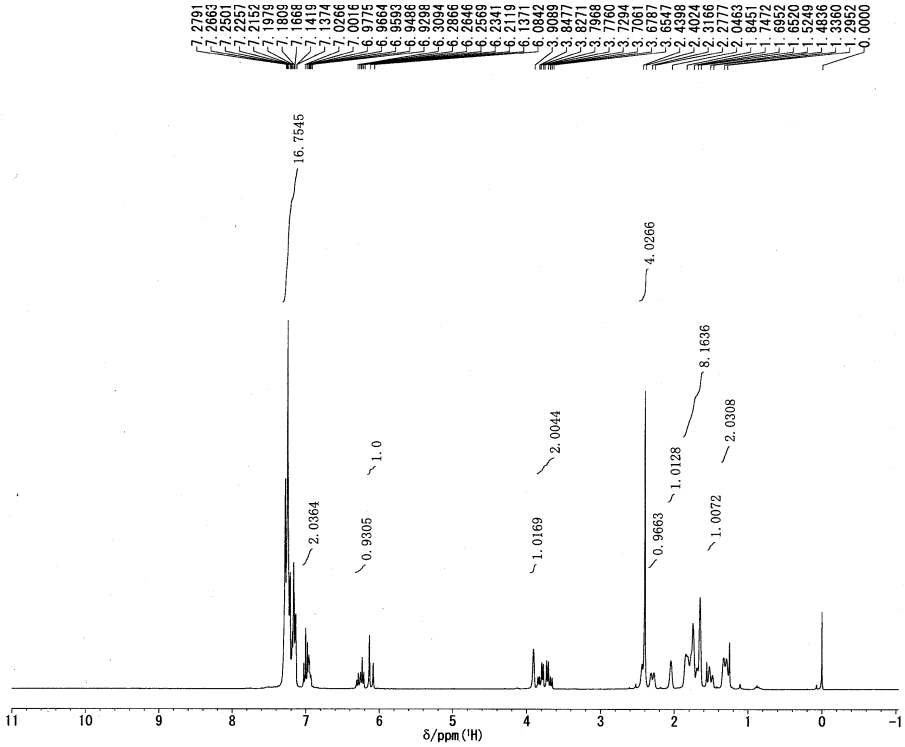

14.5242
DFILE C:¥KYOUSEI6NMR¥OGMINO20
16¥21500P¥2¥PDATA¥1¥1I
DATIM 31/Oct/2016 19:01:45
COMNT
OBNUC 31P
EXMOD ZGPG30
OBFRQ 121.54 MH
z
OBSET 0.0 kHz
OBFIN 10005.0 Hz
POINT 32768
FREQU 38535.64 Hz
SCANS 8
ACQTM 0.8503
s
PD 8.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR
D Z8284/01
INSTRUM SPECT
PULSPRG ZGPG30
GRDPROG
CTEMP 26.85 °C
SLVNT CDCl3
EXREF 158.537 p
pm
BF 0.25 Hz
WINDOW Exponential
RGAIN 9195
Operator
150
100
50
0
−50
−100
−150
δ/ppm(31P)


e159 rac OD.OD-H - CH3
Intensity [µV]
46000
40000
30000
20000
10000
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0


e159 rac OD.OD-H - CH1
Intensity [µV]
-20
-100
-200
-300
0.0
10.0
20.0
30.0
40.0
50.0
60.0

^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (*S*)-(−)-**3b**

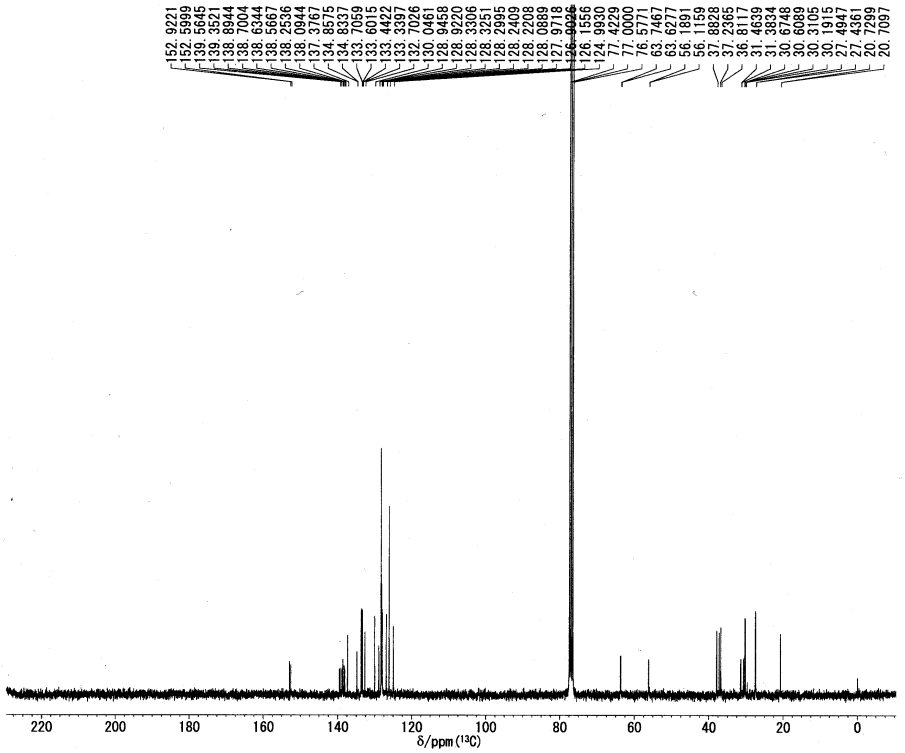




DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21718UN3¥PDATA¥1¥1I
DATIM 17/Jan/2017 22:58:07
COMNT

OBNUC ¹H
EXMOD ZG30
OBFRQ 300.23 MH z
OBSET 0.0 kHz
OBFIN 10004.57 Hz
POINT 16384
FREQU 3612.717 H z
SCANS 16
ACQTM 4.5351 s
PD 1.0 s
PW1 9.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR D Z8284/01
INSTRUM SPECT
PULSPRG ZG30
GRDPROG
CTEMP 26.85 °C
SLVNT CDCL₃
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 256

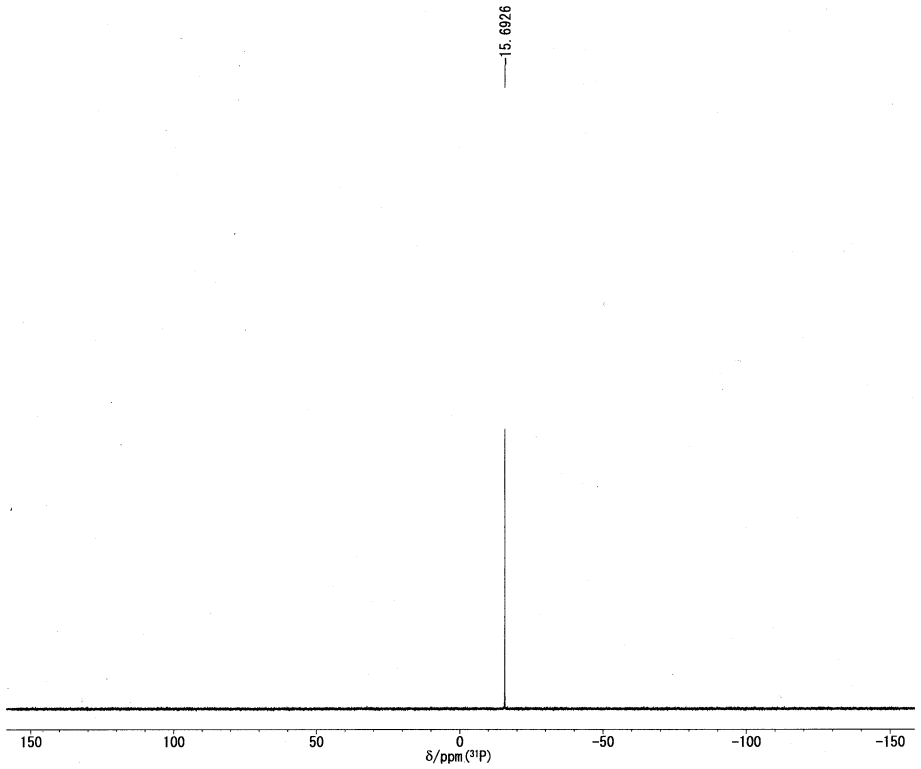
Operator



DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21718CN3¥PDATA¥1¥1I
DATIM 18/Jan/2017 01:11:40
COMNT

OBNUC ¹³C
EXMOD ZGPG30
OBFRQ 75.49 MH z
OBSET 0.0 kHz
OBFIN 10003.06 Hz
POINT 32768
FREQU 18115.94 Hz
SCANS 2048
ACQTM 1.8088 s
PD 2.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GR D Z8284/01
INSTRUM SPECT
PULSPRG ZGPG30
GRDPROG
CTEMP 26.85 °C
SLVNT CDCL₃
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 4598

Operator

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DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21718P¥1¥PDATA¥1¥1I
DATIM   16/Jan/2017 22:13:36
COMNT

OBNUC                  31P
EXMOD              ZGPG30
OBFRQ               121.54 MH
    z
OBSET                 0.0 kHz
OBFIN              10005.0 Hz
POINT                 32768
FREQU              38535.64 Hz
SCANS                     8
ACQTM                 0.8503
    s
PD                        8.0 s
PW1                       0.0 µs
IRNUC                   OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                SPECT
PULSPRG            ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCl3
EXREF               158.537 p
    pm
BF                    0.25 Hz
WINDOW         Exponential
RGAIN                  9195

Operator_____________________
```
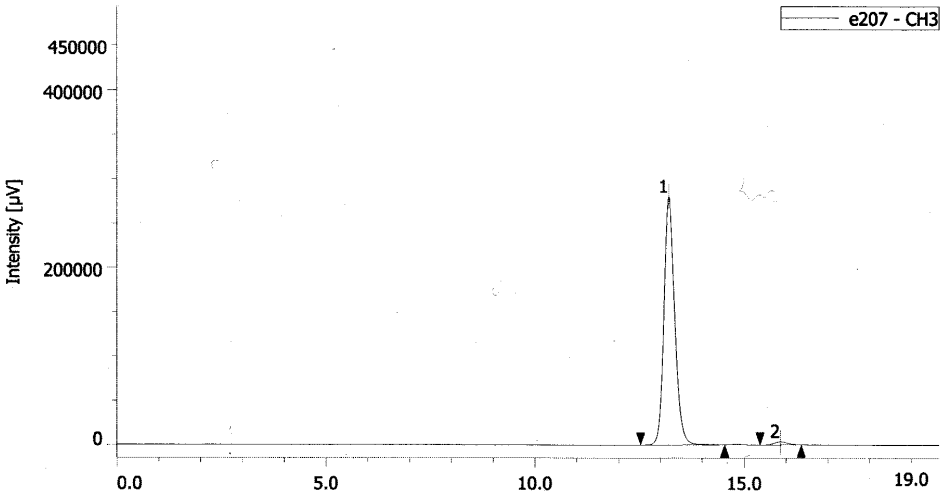
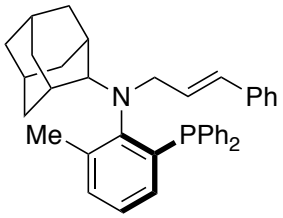
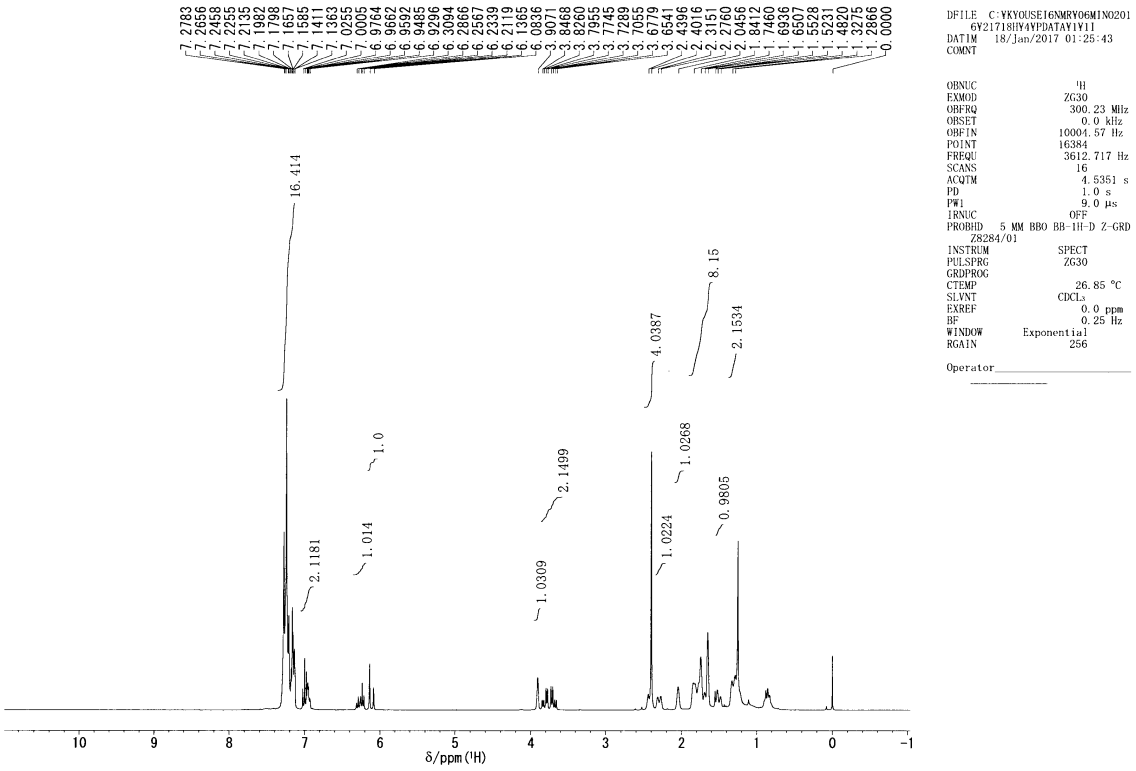



peak name area area%

1	Unknown	3	13.200	5084478	98.514
2	Unknown	3	15.867	76710	1.486

^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (*R*)-(+)-**3b**

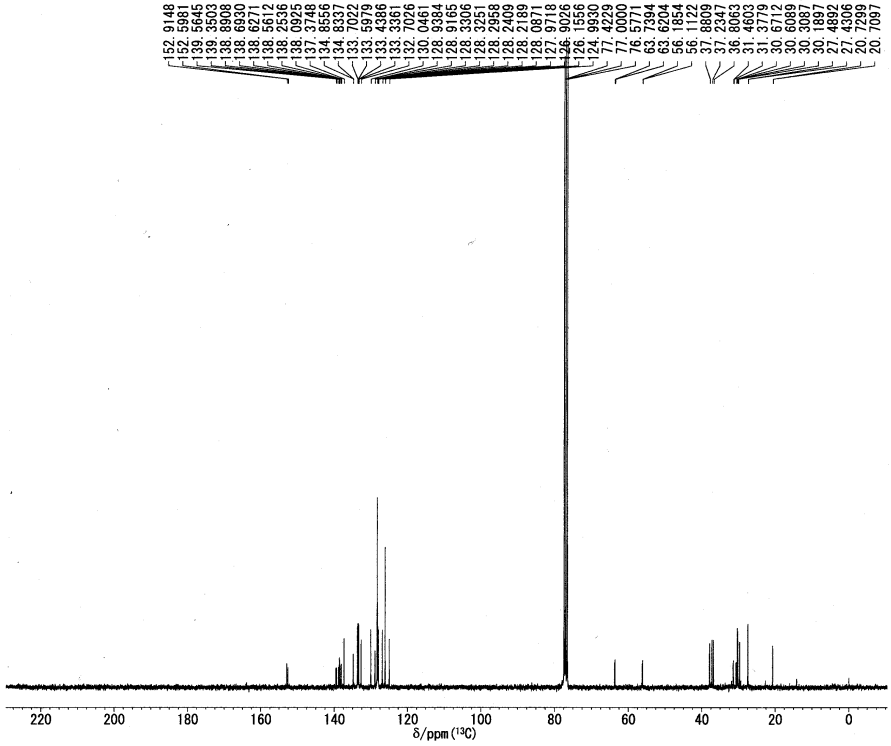




DFILE C:¥KYOUSEI6NMR¥O6MINO201
6¥21718H¥4¥PDATA¥1¥1I
DATIM 18/Jan/2017 01:25:43
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	16
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	CDCL3
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	256

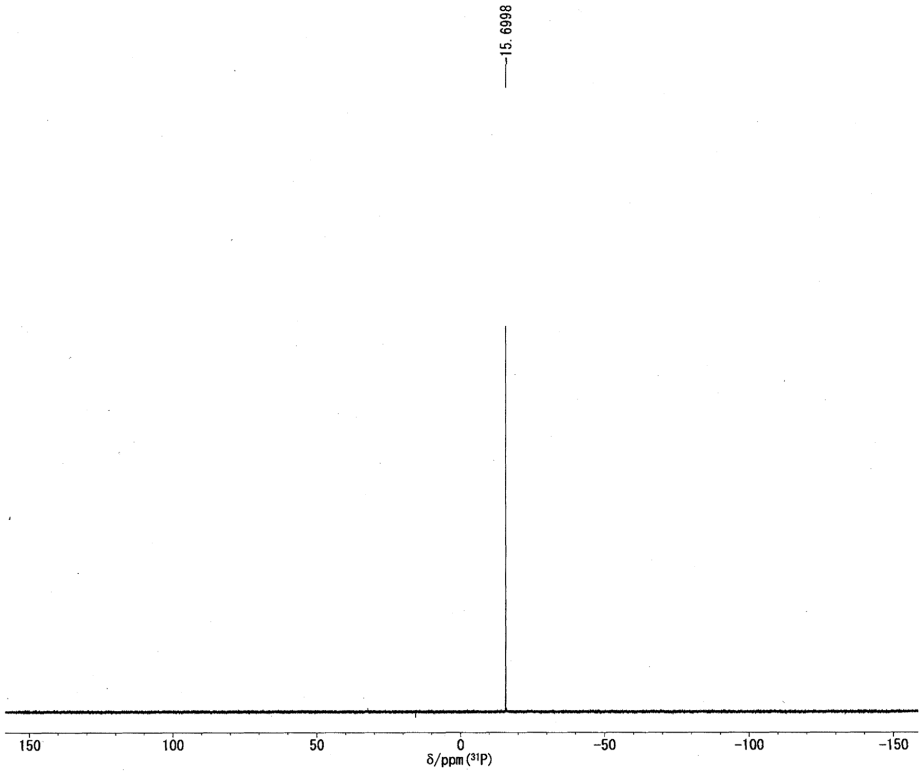
Operator



DFILE C:¥KYOUSEI6NMR¥O6MINO20
16¥21718C¥4¥PDATA¥1¥1I
DATIM 18/Jan/2017 03:38:44
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	2048
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	CDCL3
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	4598

Operator

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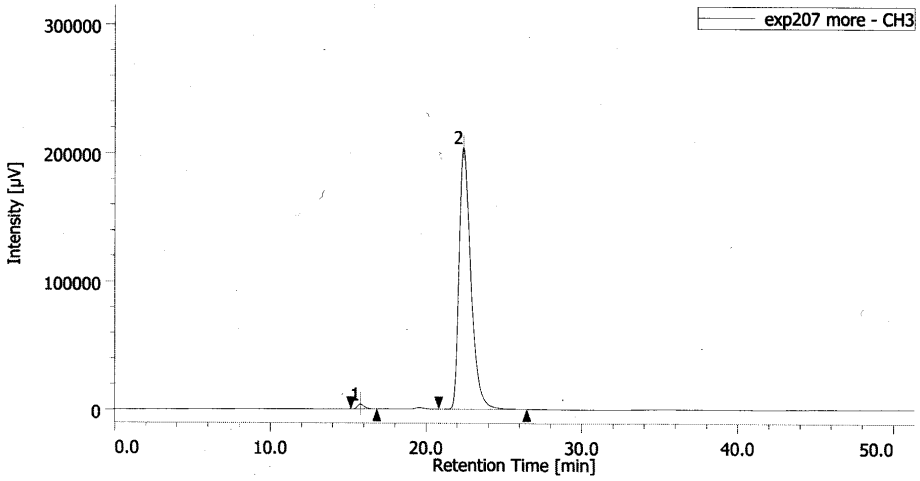
DFILE  C:¥KYOUSEI6NMR¥06MIN020
    16¥21718P¥2¥PDATA¥1¥1I
DATIM   16/Jan/2017 22:21:17
COMNT

OBNUC                  31P
EXMOD               ZGPG30
OBFRQ              121.54 MH
    z
OBSET                0.0 kHz
OBFIN             10005.0 Hz
POINT                32768
FREQU             38535.64 Hz
SCANS                    8
ACQTM                0.8503
    s
PD                     8.0 s
PW1                    0.0 µs
IRNUC                  OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM              SPECT
PULSPRG             ZGPG30
GRDPROG
CTEMP                 26.85 ℃
SLVNT                CDCL3
EXREF              158.537 p
    pm
BF                   0.25 Hz
WINDOW         Exponential
RGAIN                9195

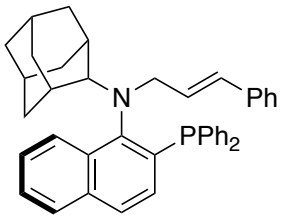
Operator_____________________
```

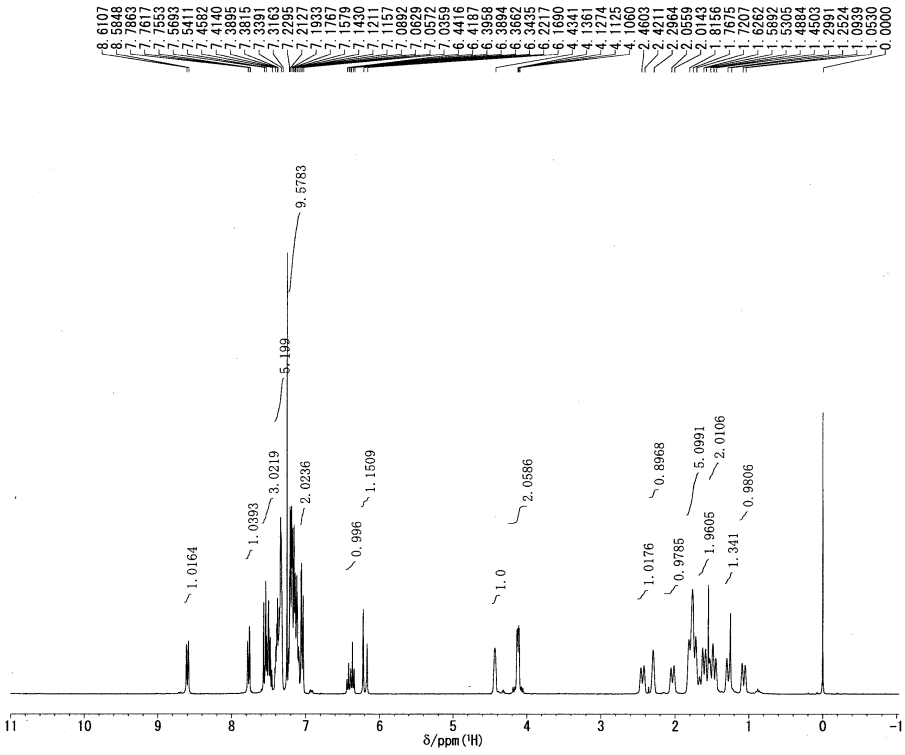


peak name area area%

	C~ 名	CH	R [min]	[µV*min]	[mass]
1	Unknown	3	15.775	111654	1.043
2	Unknown	3	22.392	10589311	98.957

^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (*S*)-(+)-**3c**

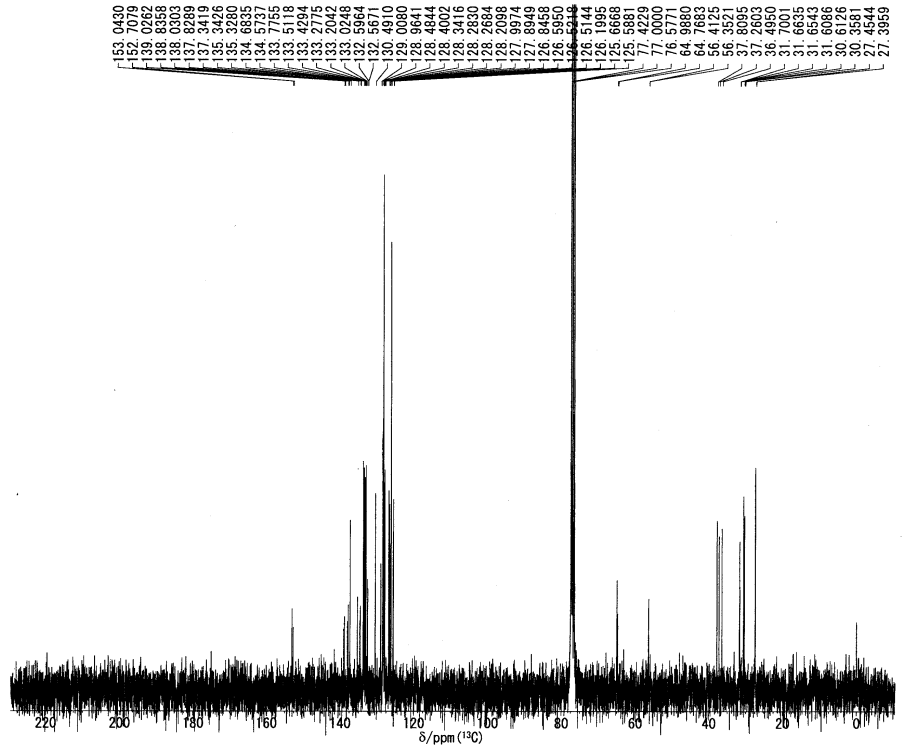





```
DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21640H¥1¥PDATA¥1¥1I
DATIM    11/Dec/2016 21:32:38
COMNT

OBNUC                      ¹H
EXMOD                    ZG30
OBFRQ                  300.23 MH
     z
OBSET                   0.0 kHz
OBFIN                10004.57 Hz
POINT                   16384
FREQU                3612.717 H
     z
SCANS                      16
ACQTM                   4.5351
     s
PD                        1.0 s
PW1                       9.0 µs
IRNUC                     OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                 SPECT
PULSPRG                 ZG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCL₃
EXREF                   0.0 ppm
BF                      0.25 Hz
WINDOW          Exponential
RGAIN                     456

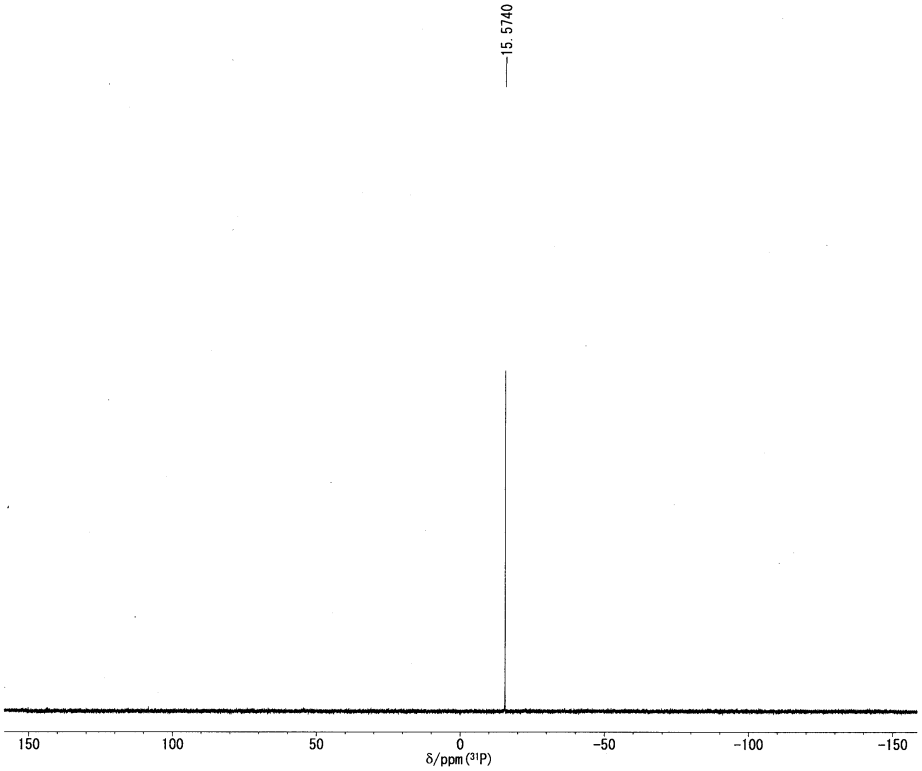
Operator_____________________
```




```
DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21640C¥1¥PDATA¥1¥1I
DATIM    11/Dec/2016 22:39:38
COMNT

OBNUC                     ¹³C
EXMOD                 ZGPG30
OBFRQ                  75.49 MH
     z
OBSET                   0.0 kHz
OBFIN                10003.06 Hz
POINT                   32768
FREQU                18115.94 Hz
SCANS                     1024
ACQTM                   1.8088
     s
PD                        2.0 s
PW1                       0.0 µs
IRNUC                     OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                 SPECT
PULSPRG                 ZGPG30
GRDPROG
CTEMP                  26.85 °C
SLVNT                  CDCL₃
EXREF                  77.0 ppm
BF                      0.25 Hz
WINDOW          Exponential
RGAIN                    2299

Operator_____________________
```

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DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21640P¥1¥PDATA¥1¥1I
DATIM   11/Dec/2016 22:46:47
COMNT

OBNUC                    31P
EXMOD                ZGPG30
OBFRQ                 121.54 MH
    z
OBSET                   0.0 kHz
OBFIN                10005.0 Hz
POINT                  32768
FREQU                38535.64 Hz
SCANS                     16
ACQTM                  0.8503
    s
PD                       8.0 s
PW1                      0.0 µs
IRNUC                    OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM                SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                 26.85 °C
SLVNT                 CDCL3
EXREF                 158.537 p
    pm
BF                       0.25 Hz
WINDOW         Exponential
RGAIN                    9195

Operator_____________________
```
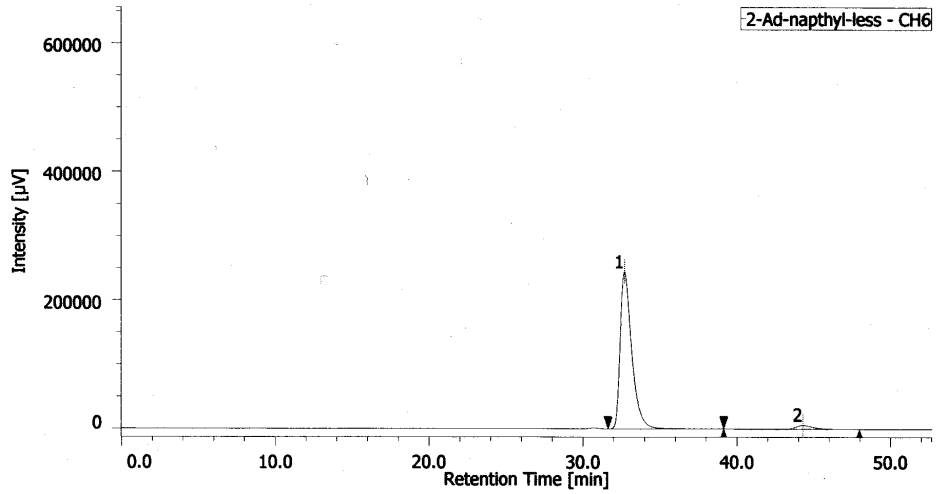
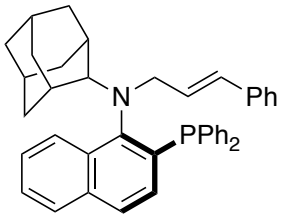
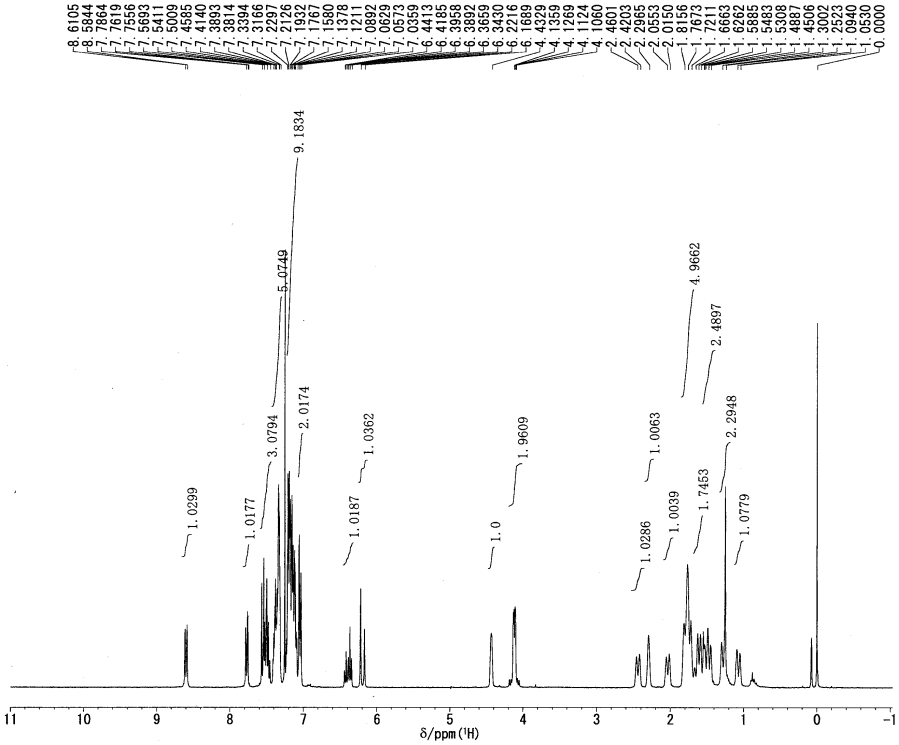



peak name area height area%

1	Unknown	6	32.693	12848301	244544	96.359
2	Unknown	6	44.267	485470	6014	3.641

^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (*R*)-(–)-**3c**

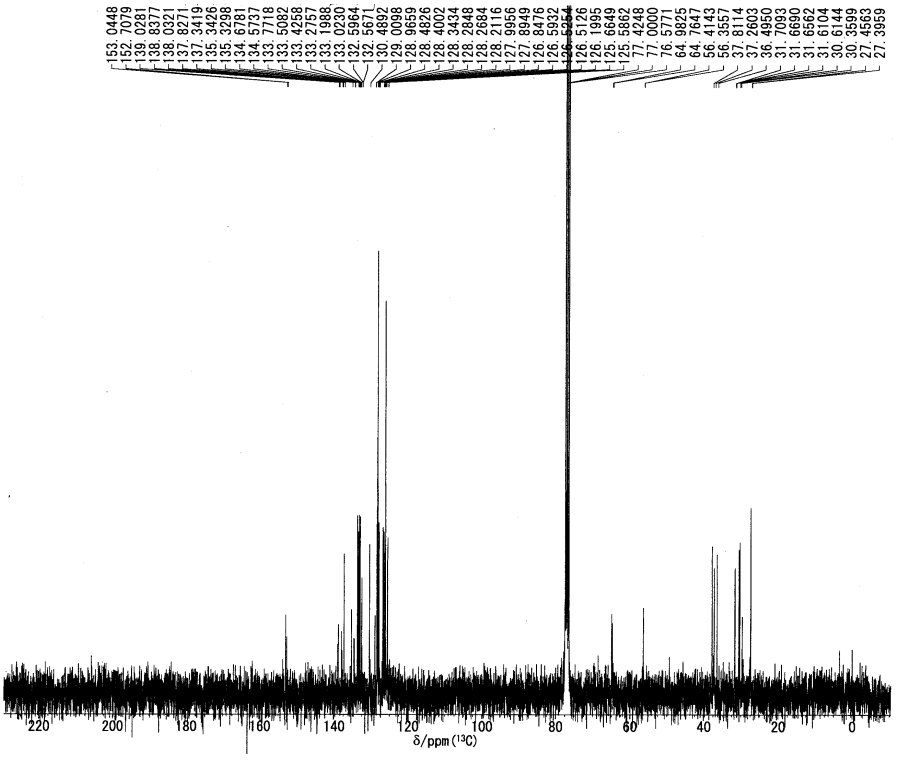




DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21640HY2¥PDATA¥1¥1I
DATIM 11/Dec/2016 23:46:41
COMNT

OBNUC	¹H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	16
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	575

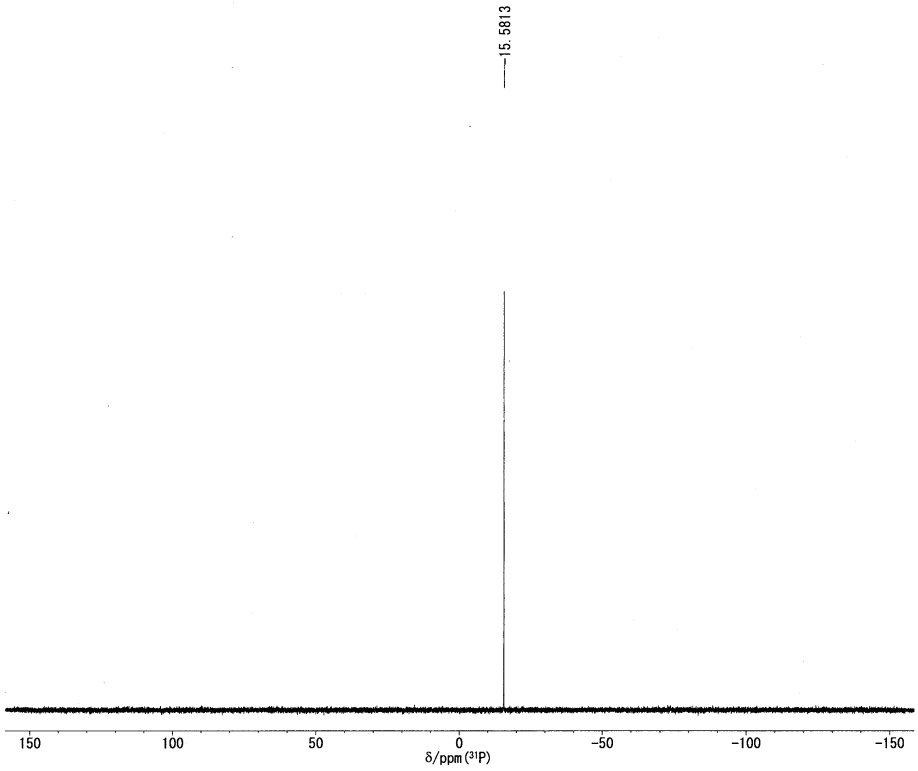
Operator_____



DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21640CY2¥PDATA¥1¥1I
DATIM 12/Dec/2016 00:59:31
COMNT

OBNUC	¹³C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	1024
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	5793

Operator_____

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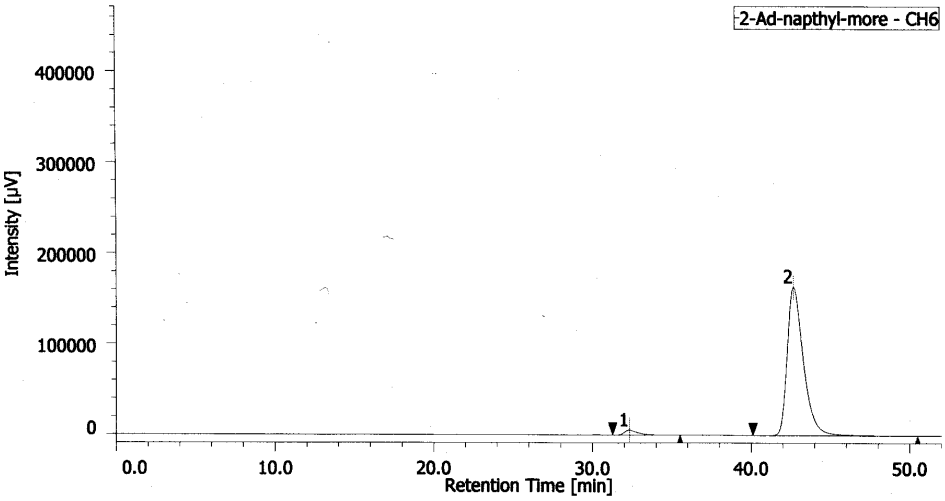
DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21640P¥2¥PDATA¥1¥1I
DATIM   11/Dec/2016 23:50:50
COMNT

OBNUC                  31P
EXMOD              ZGPG30
OBFRQ               121.54 MH
    z
OBSET                0.0 kHz
OBFIN              10005.0 Hz
POINT                32768
FREQU              38535.64 Hz
SCANS                   16
ACQTM                0.8503
    s
PD                       8.0 s
PW1                      0.0 µs
IRNUC                   OFF
PROBHD   5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM               SPECT
PULSPRG            ZGPG30
GRDPROG
CTEMP                26.85 °C
SLVNT                CDCl3
EXREF                158.537 p
    pm
BF                   0.25 Hz
WINDOW         Exponential
RGAIN                11585

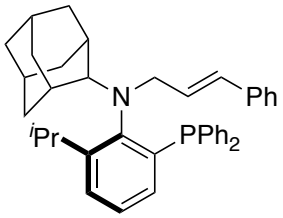
Operator_____________________
```

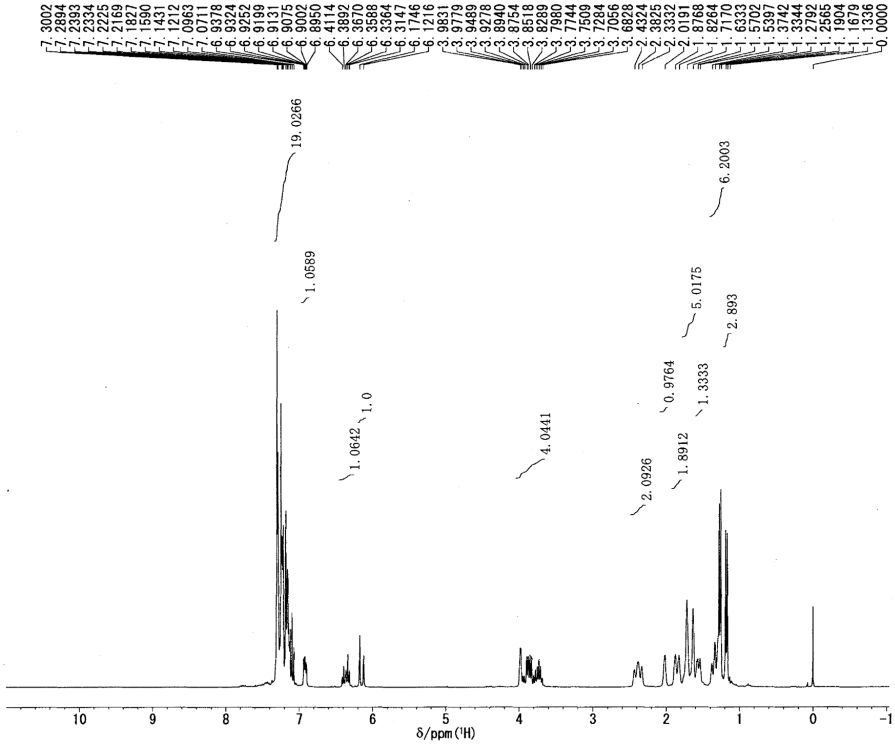


peak name area height area%

#	ピーク名	CH	時間 [min]	面積 [µV*sec]	高さ [µV]	面積%
1	Unknown	6	32.307	329660	5611	2.750
2	Unknown	6	42.653	11656865	163694	97.250

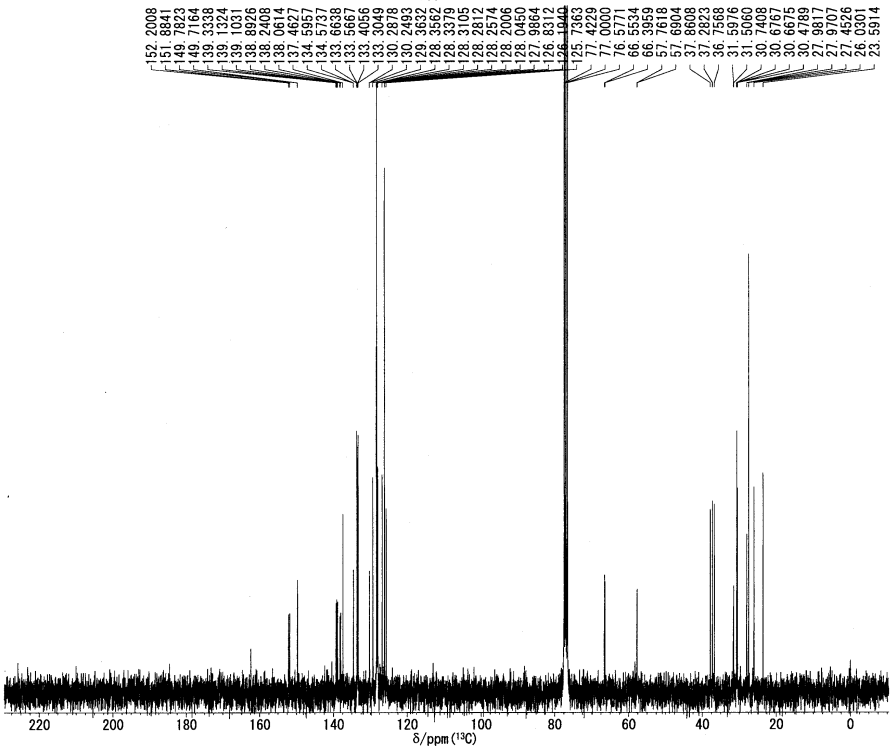
^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (+)-**3d**





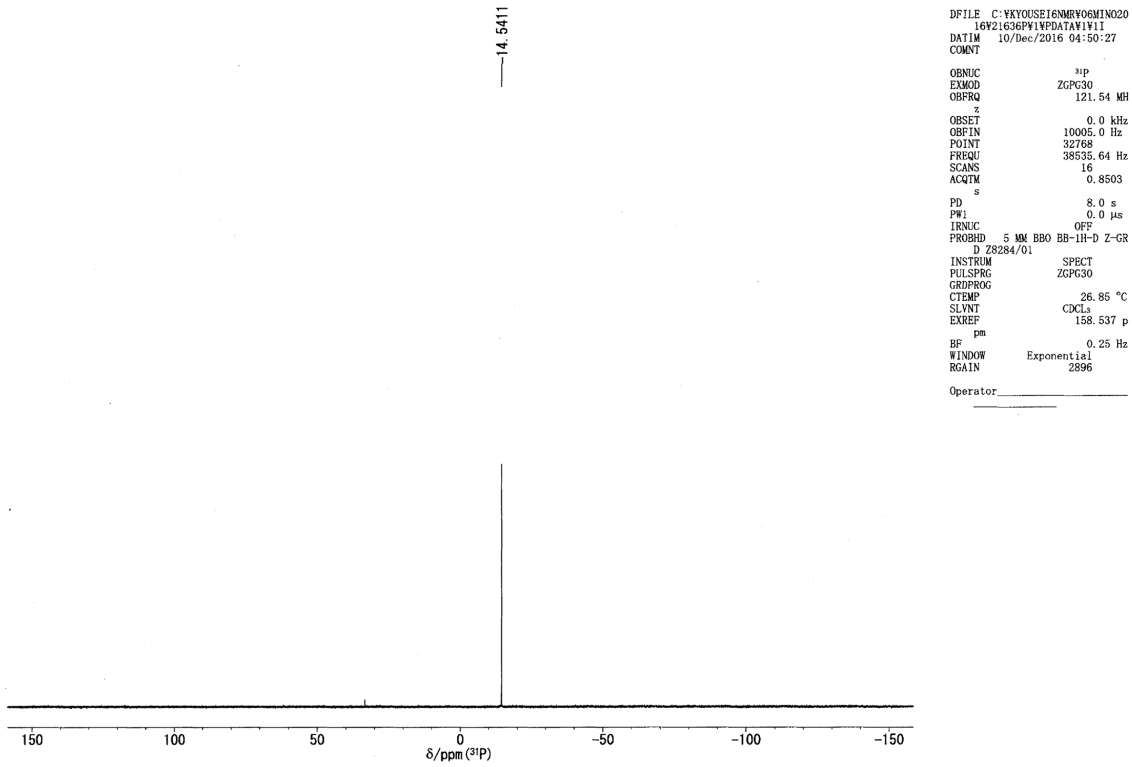
DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21636H¥1¥PDATA¥1¥1I
DATIM 10/Dec/2016 03:03:41
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	16
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	256
Operator	



DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21636C¥1¥PDATA¥1¥1I
DATIM 10/Dec/2016 04:10:42
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	1024
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	2299
Operator	

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DFILE  C:¥KYOUSEI6NMR¥06MINO20
    16¥21636P¥1¥PDATA¥1¥1I
DATIM    10/Dec/2016 04:50:27
COMNT

OBNUC                   31P
EXMOD                ZGPG30
OBFRQ                121.54 MH
     z
OBSET                 0.0 kHz
OBFIN              10005.0 Hz
POINT                 32768
FREQU              38535.64 Hz
SCANS                    16
ACQTM                 0.8503
     s
PD                      8.0 s
PW1                     0.0 µs
IRNUC                   OFF
PROBHD    5 MM BBO BB-1H-D Z-GR
    D Z8284/01
INSTRUM               SPECT
PULSPRG              ZGPG30
GRDPROG
CTEMP                26.85 °C
SLVNT                 CDCLs
EXREF                158.537 p
     pm
BF                    0.25 Hz
WINDOW          Exponential
RGAIN                 2896

Operator_____________________
```
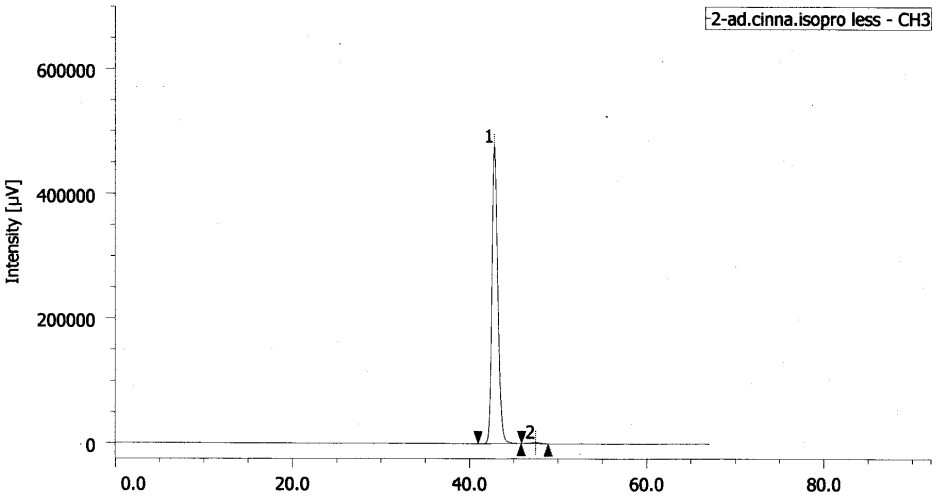
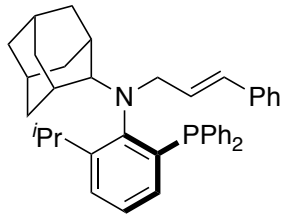
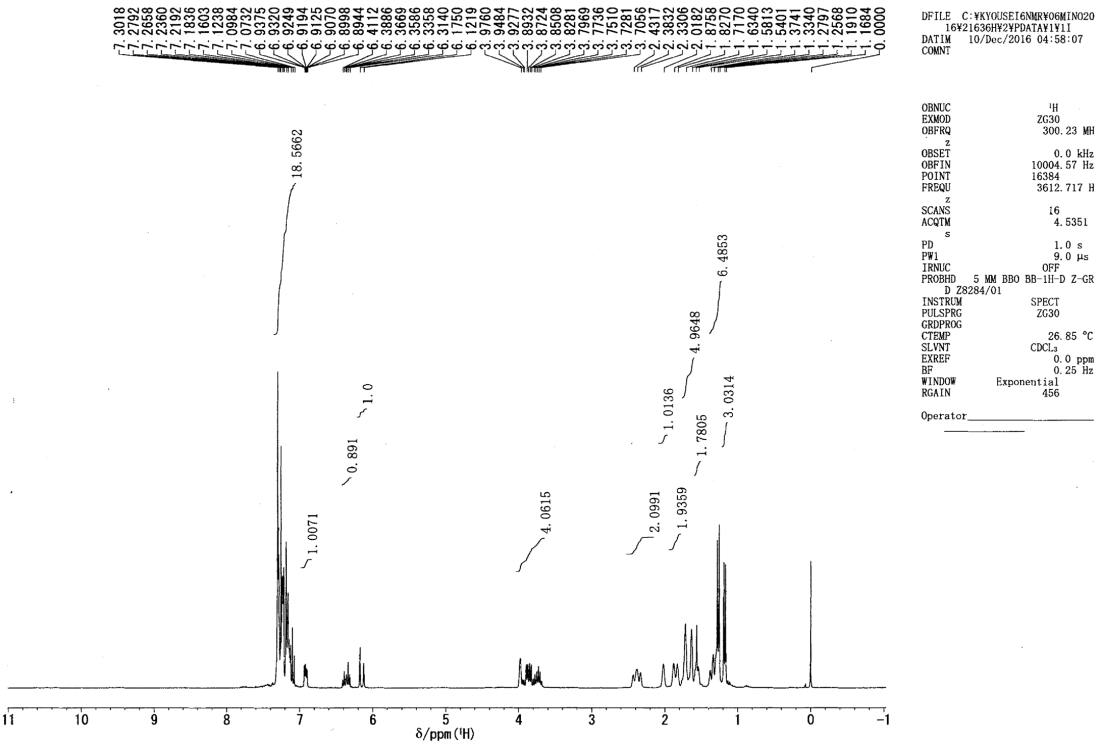



peak name area height area%

#	ピーク名	CH	tR [min]	面積 [uV*sec]	高さ [uV]	面積%
1	Unknown	3	42.792	21993084	476599	99.475
2	Unknown	3	47.442	116044	1883	0.525

^{1}H, ^{13}C and ^{31}P NMR, and chiral phase HPLC chart of (–)-**3d**

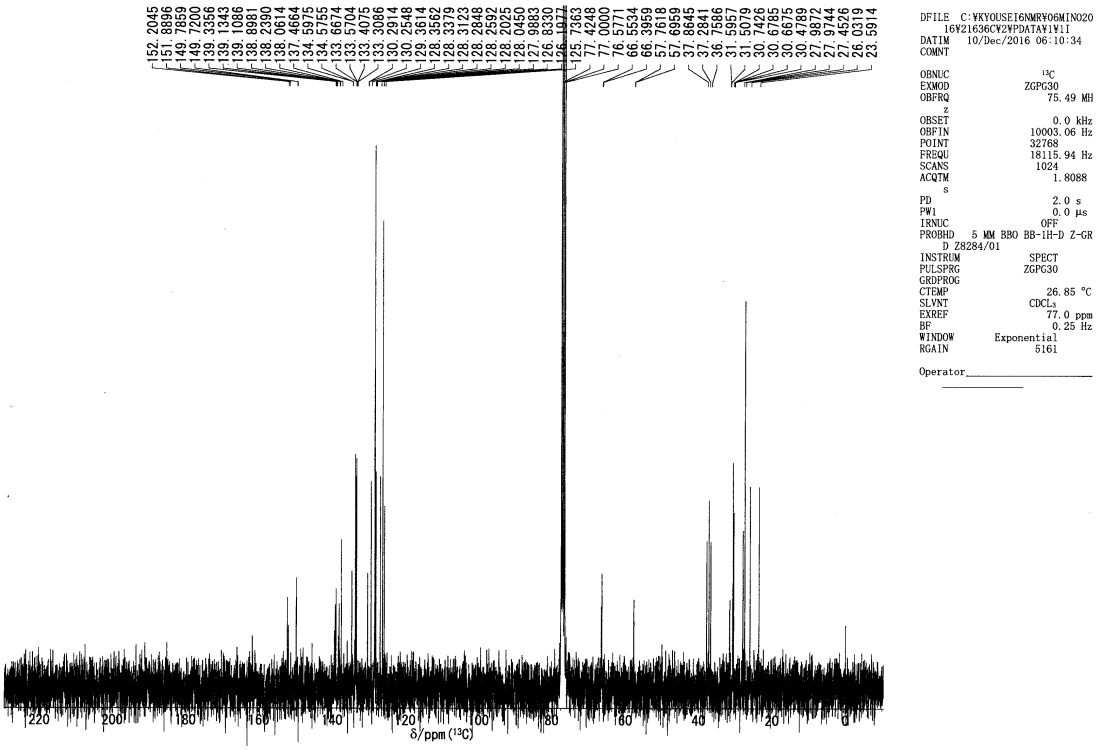




DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21636HY2¥PDATA¥1¥1I
DATIM 10/Dec/2016 04:58:07
COMNT

OBNUC ¹H
EXMOD ZG30
OBFRQ 300.23 MHz
OBSET 0.0 kHz
OBFIN 10004.57 Hz
POINT 16384
FREQU 3612.717 Hz
SCANS 16
ACQTM 4.5351 s
PD 1.0 s
PW1 9.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRM SPECT
PULSPRG ZG30
GRDPROG
CTEMP 26.85 °C
SLVNT $CDCl_3$
EXREF 0.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 456

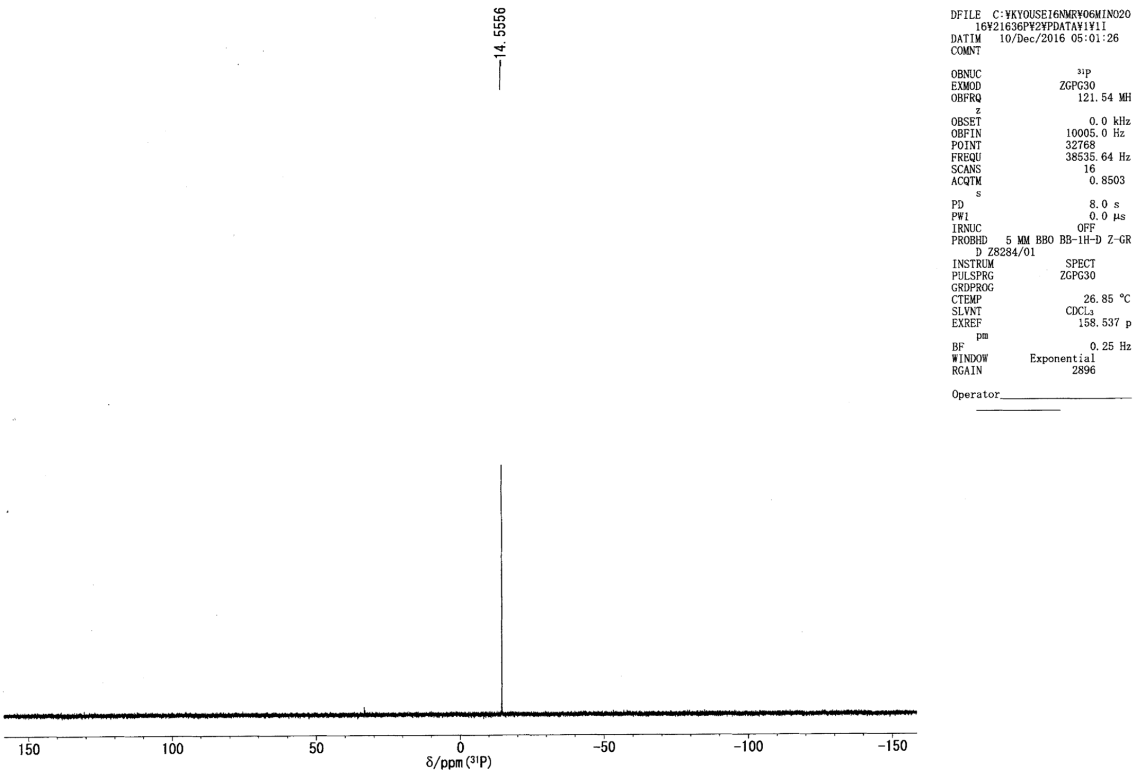
Operator_____

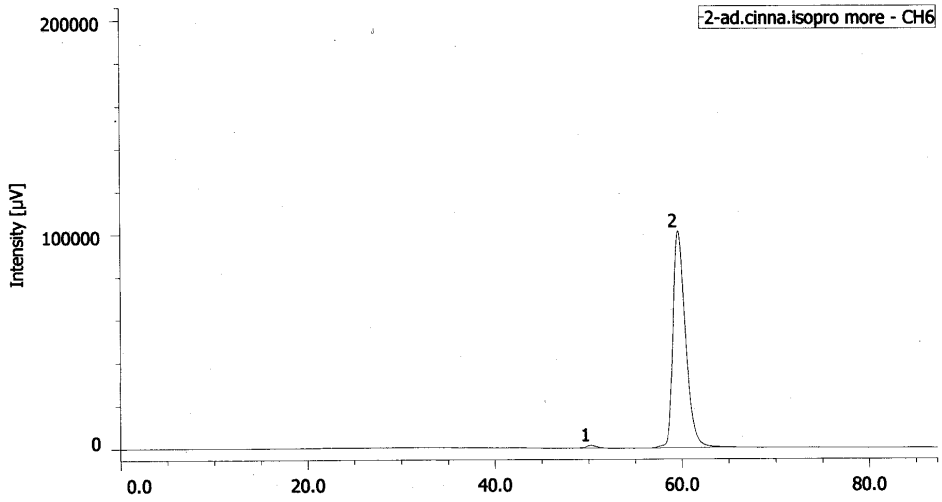


DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21636CY2¥PDATA¥1¥1I
DATIM 10/Dec/2016 06:10:34
COMNT

OBNUC ¹³C
EXMOD ZGPG30
OBFRQ 75.49 MHz
OBSET 0.0 kHz
OBFIN 10003.06 Hz
POINT 32768
FREQU 18115.94 Hz
SCANS 1024
ACQTM 1.8088 s
PD 2.0 s
PW1 0.0 µs
IRNUC OFF
PROBHD 5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRM SPECT
PULSPRG ZGPG30
GRDPROG
CTEMP 26.85 °C
SLVNT $CDCl_3$
EXREF 77.0 ppm
BF 0.25 Hz
WINDOW Exponential
RGAIN 5161

Operator_____

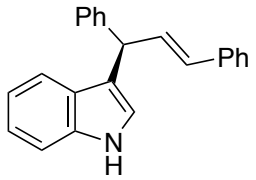


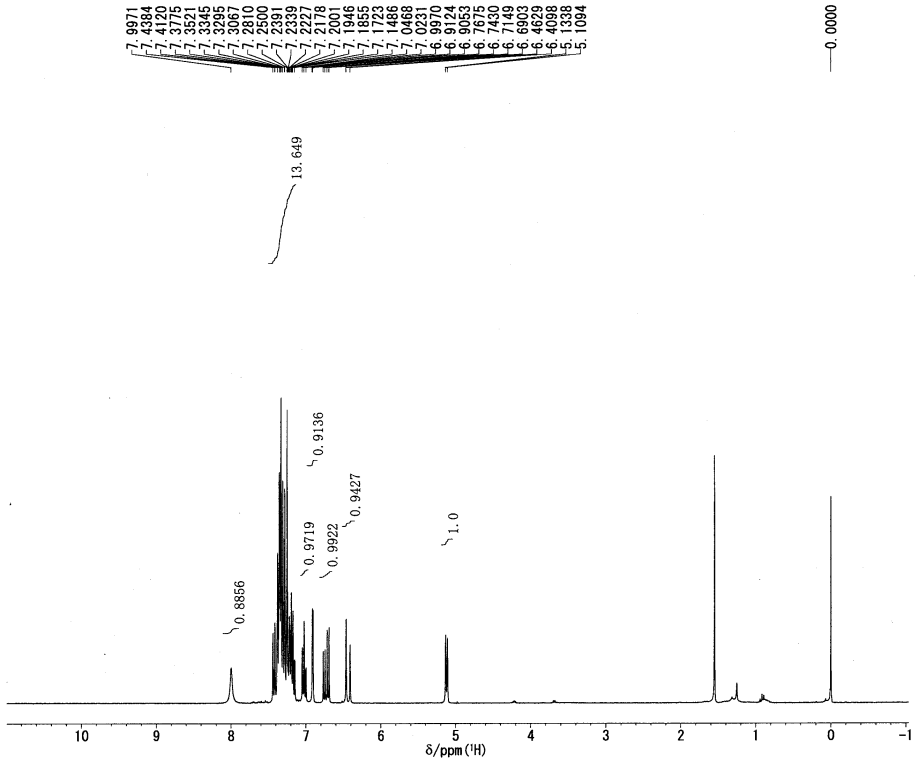


peak name area height area%

#	ピーク名	CH	tR [min]	面積 [µV*sec]	高さ [µV]	面積%
1	Unknown	6	50.253	105070	1329	1.102
2	Unknown	6	59.587	9429093	101038	98.898

^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9a** (Table 3, entry 1)

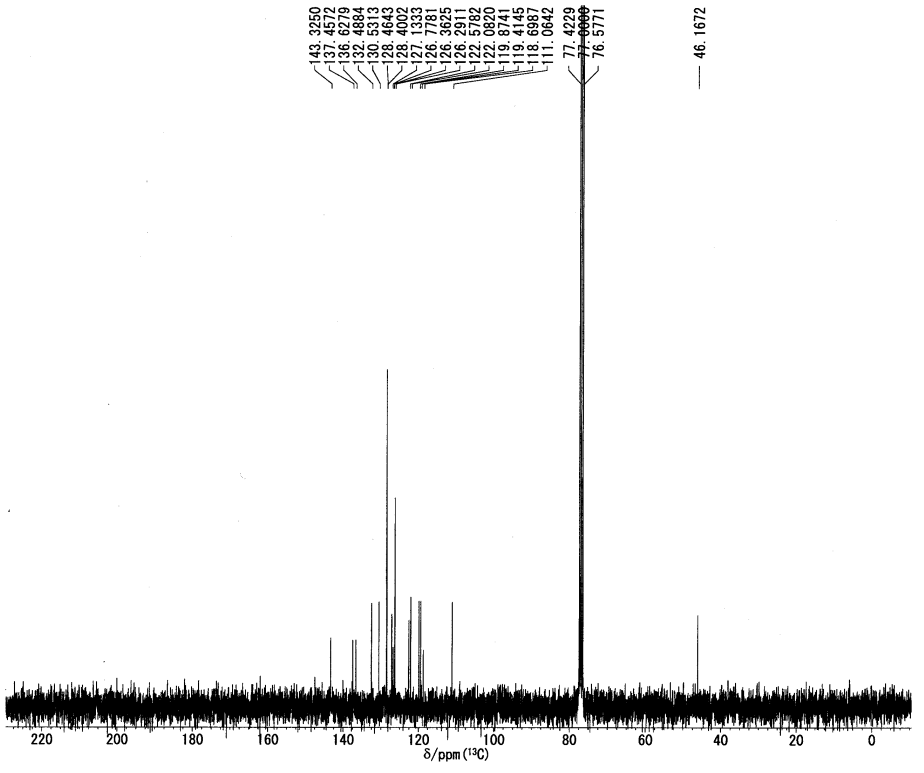




DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21493HY2¥PDATA¥1¥1I
DATIM 28/Oct/2016 10:59:13
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	16
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	575

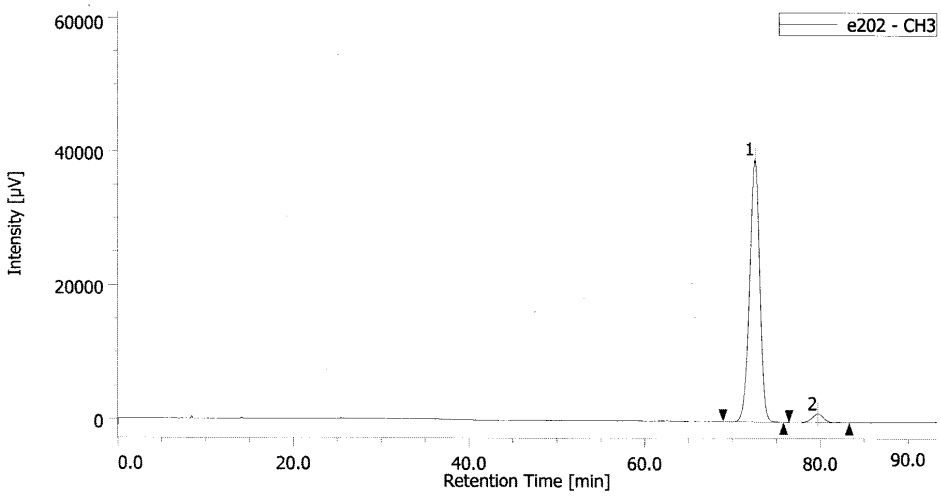
Operator



DFILE C:¥KYOUSEI6NMR¥06MINO20 16¥21493CY2¥PDATA¥1¥1I
DATIM 28/Oct/2016 18:43:37
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	512
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	2580

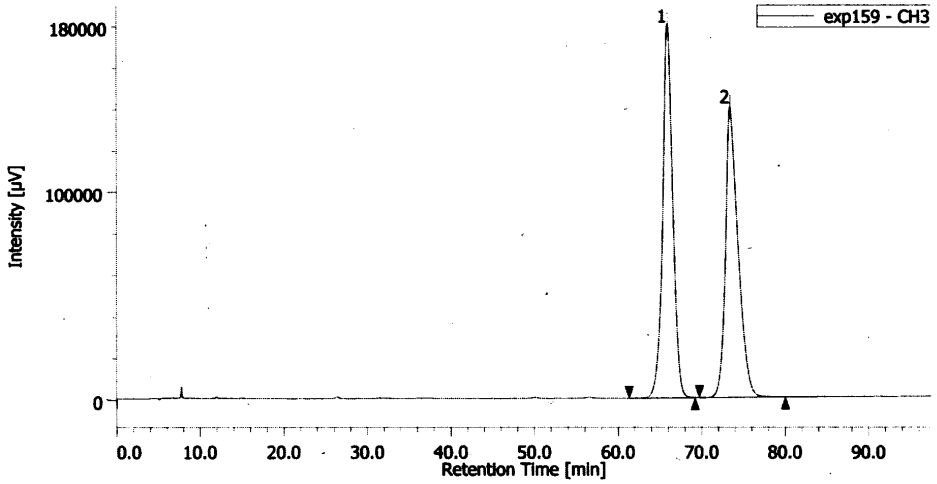
Operator



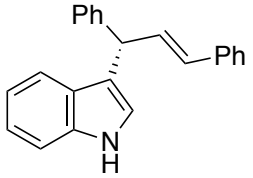
peak name

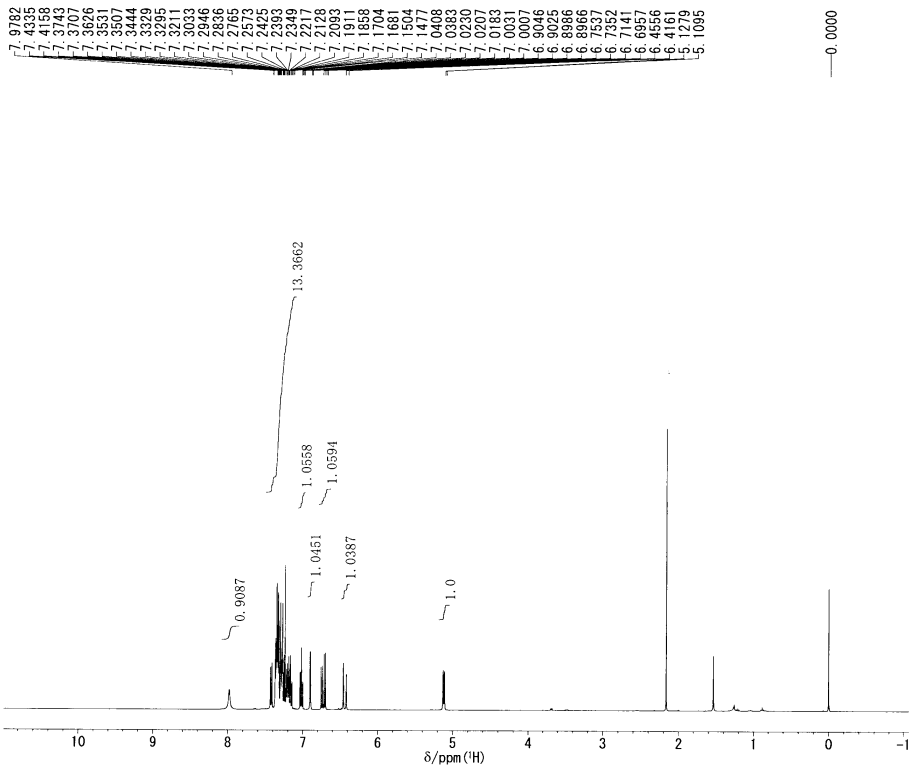
#	ピーク名	CH	tR [min]	area [μV*sec]	area%
1	Unknown	3	72.500	3127948	96.604
2	Unknown	3	79.683	109944	3.396

(±)-9a



^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*S*)-**9a** (Table 2, entry 11)

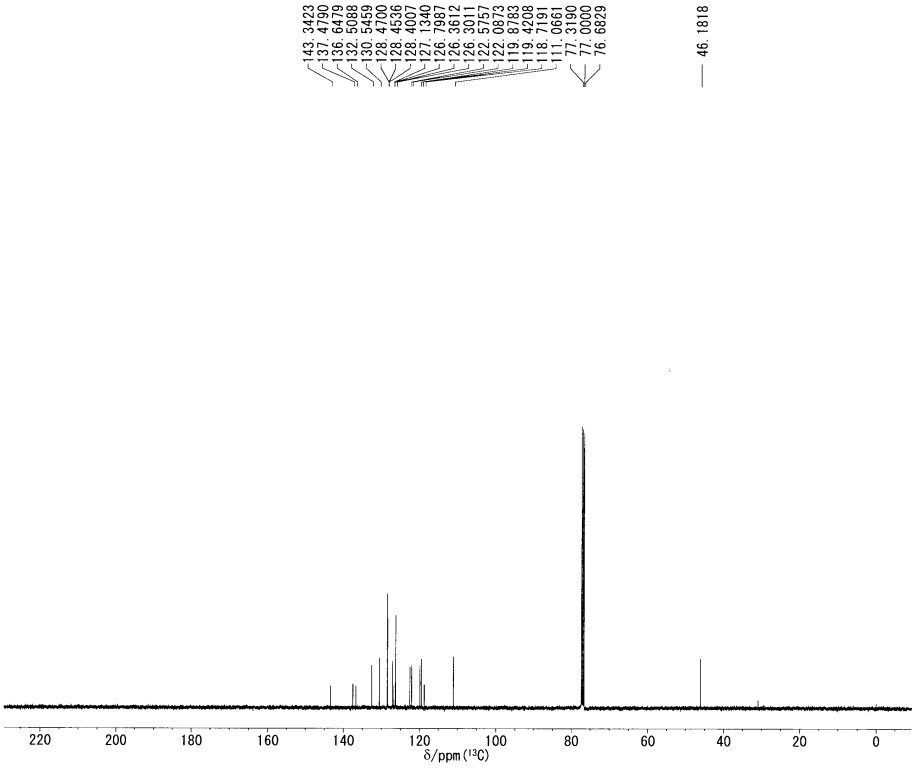




DFILE C:¥KYOUSEI6NMR¥06MIN0201
8¥4-00315H¥1¥PDATA¥1¥1
DATIM 19/Dec/2018 16:21:15
COMNT

OBNUC	¹H
EXMOD	ZG30
OBFRQ	400.18 MHz
OBSET	0.0 kHz
OBFIN	10003.83 Hz
POINT	65536
FREQU	4826.255 Hz
SCANS	19
ACQTM	13.5791 s
PD	1.0 s
PW1	14.0 μs
IRNUC	OFF
PROBHD	Z108618_0111 (PA BBO 4 00S1 BBF-H-D-05 Z PLUS)
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	24.21 °C
SLVNT	$CDCl_3$
EXREF	10.989 pp m
BF	0.25 Hz
WINDOW	Exponential
RGAIN	203

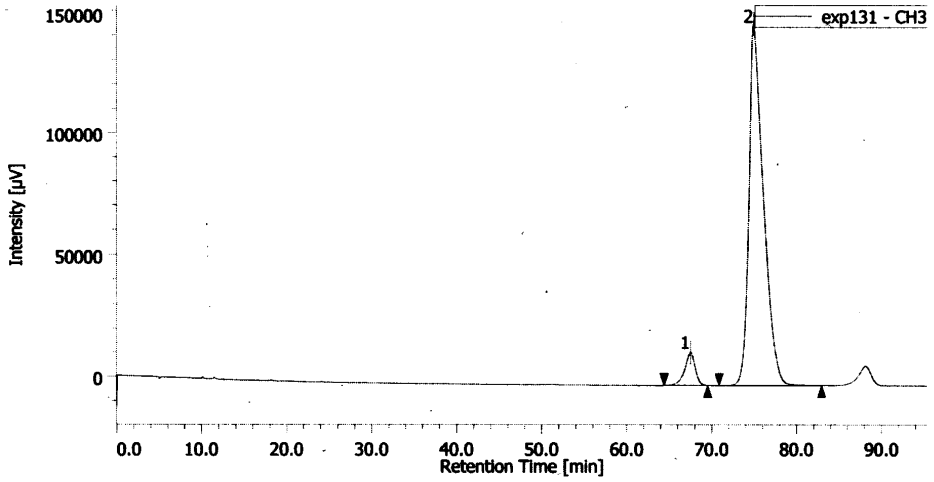
Operator



DFILE C:¥KYOUSEI6NMR¥06MIN0201
8¥4-00315C¥1¥PDATA¥1¥11
DATIM 19/Dec/2018 16:37:53
COMNT

OBNUC	¹³C
EXMOD	ZGPG30
OBFRQ	100.63 MHz
OBSET	0.0 kHz
OBFIN	9998.39 Hz
POINT	32768
FREQU	24038.46 Hz
SCANS	273
ACQTM	1.3631 s
PD	2.0 s
PW1	10.0 μs
IRNUC	OFF
PROBHD	Z108618_0111 (PA BBO 4 00S1 BBF-H-D-05 Z PLUS)
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	25.01 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	203

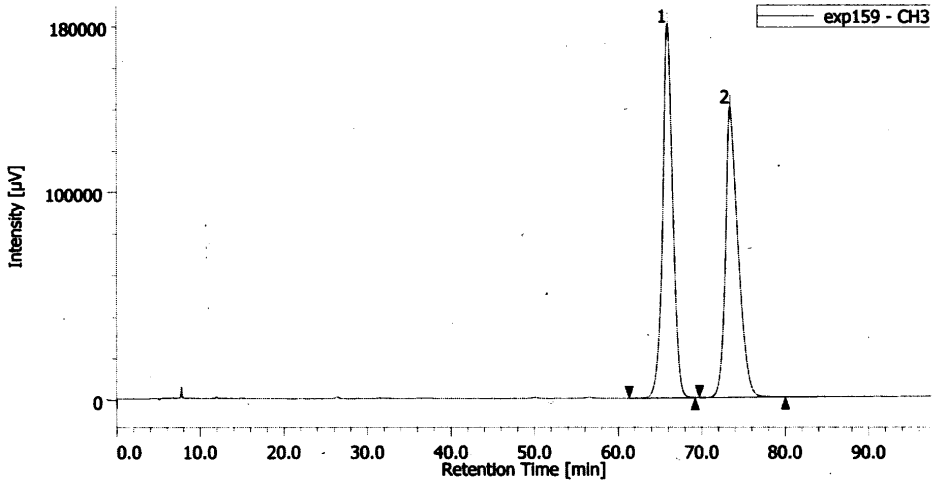
Operator



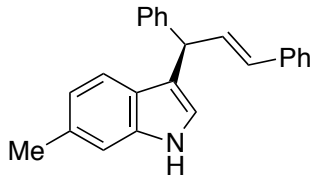
peak name area height area%

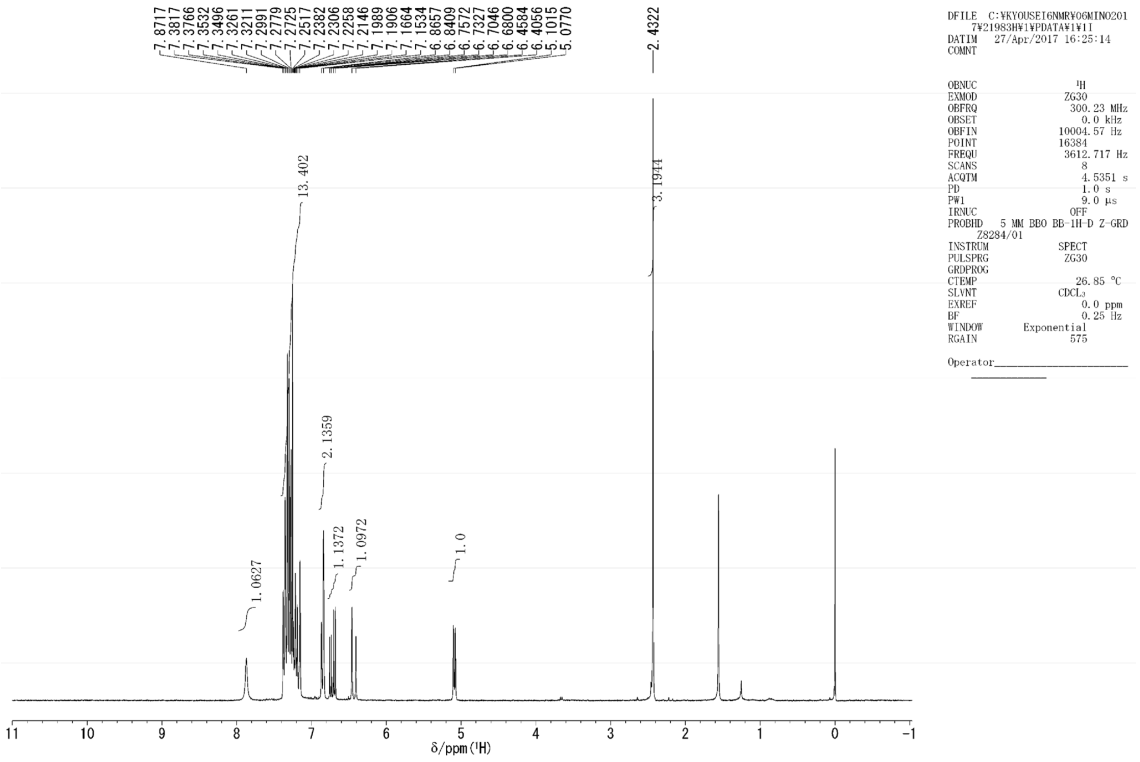
#	ピーク名	CH	tR [min]	面積 [μV·sec]	高さ [μV]	面積%
1	Unknown	3	67.492	1163406	13523	6.217
2	Unknown	3	74.967	17549119	147977	93.783

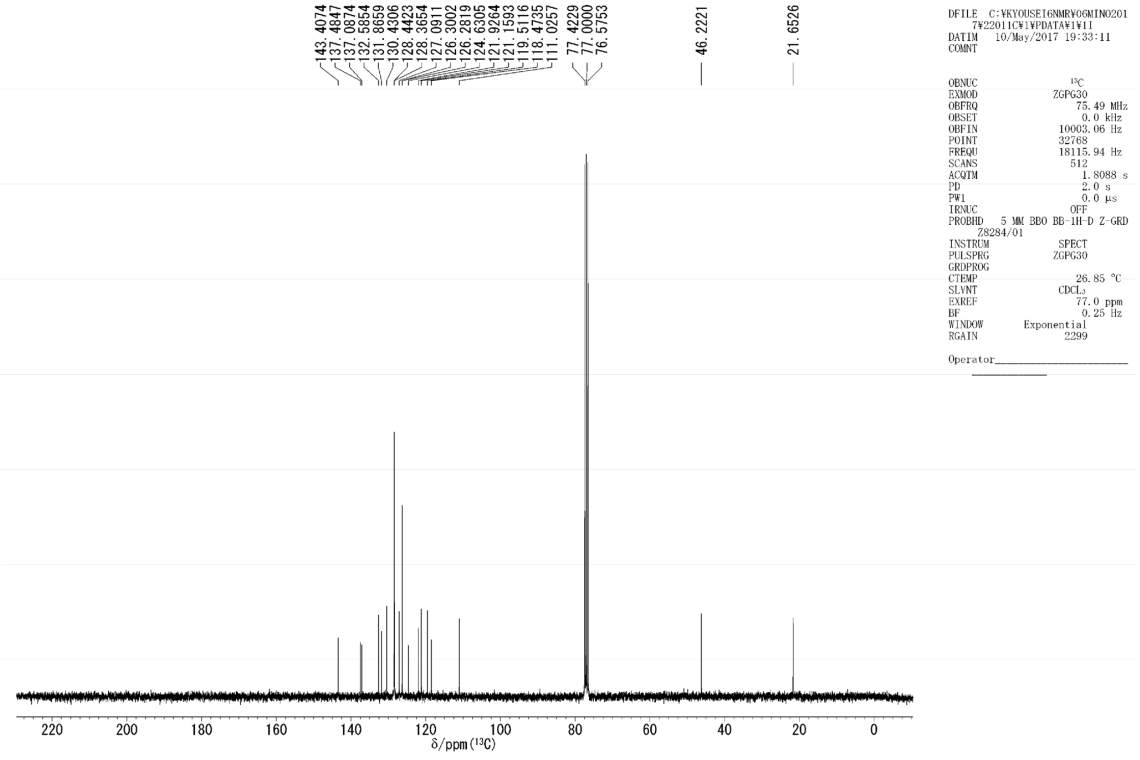
(±)-**9a**

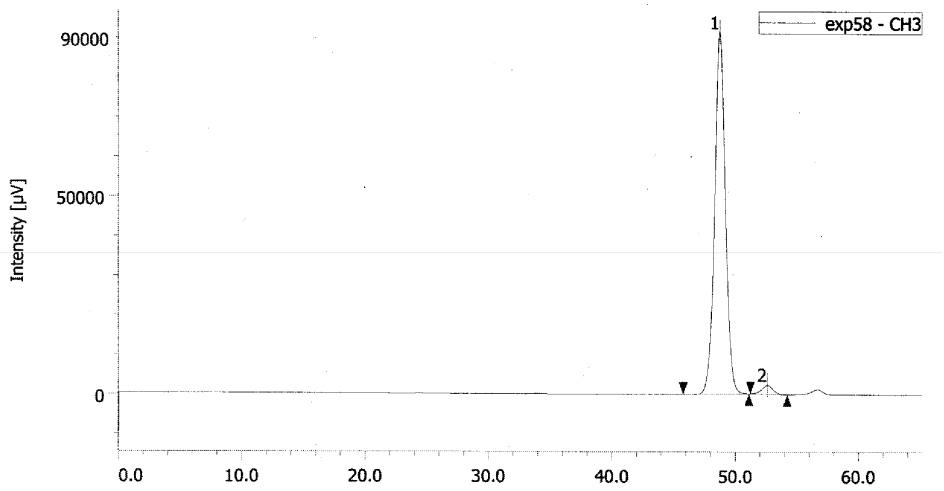


^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9b** (Table 3, entry 2)





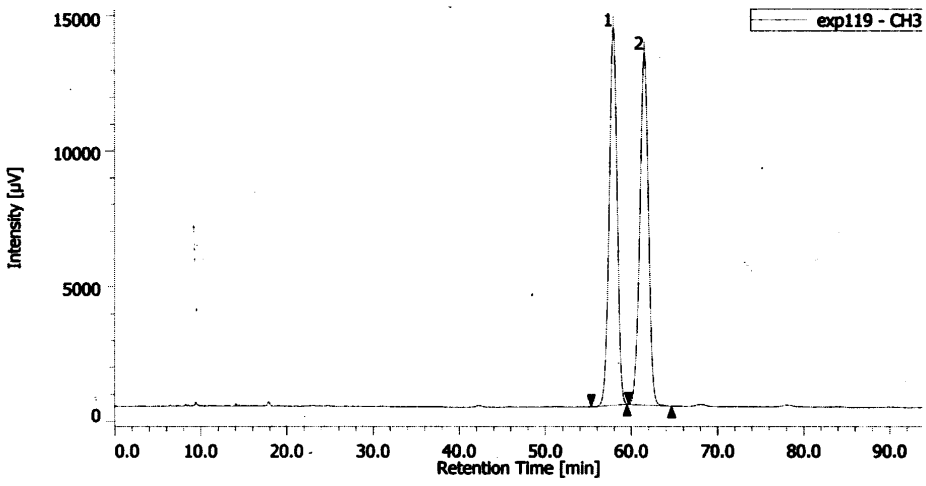




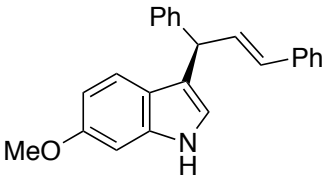
peak name

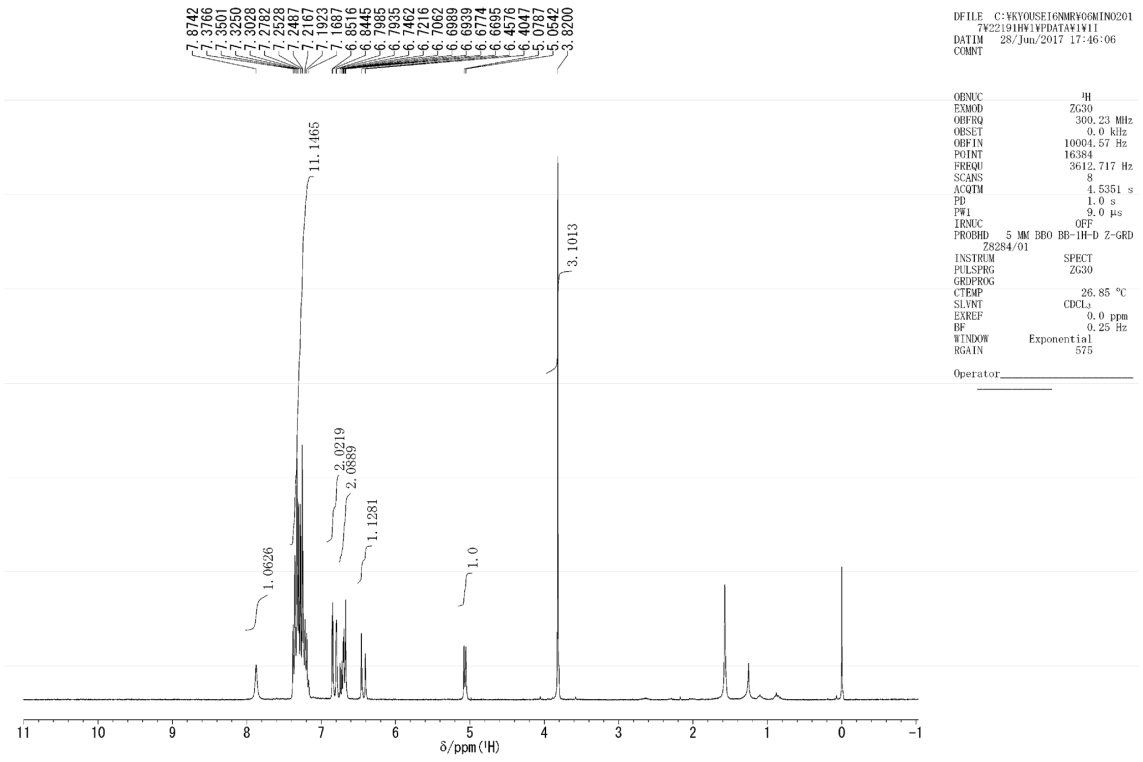
#	ピーク名	CH	tR [min]	area [μV·sec]	area%
1	Unknown	3	48.7	5491026	97.547
2	Unknown	3	52.6	138061	2.453

(±)-**9b**



^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9c** (Table 3, entry 3)

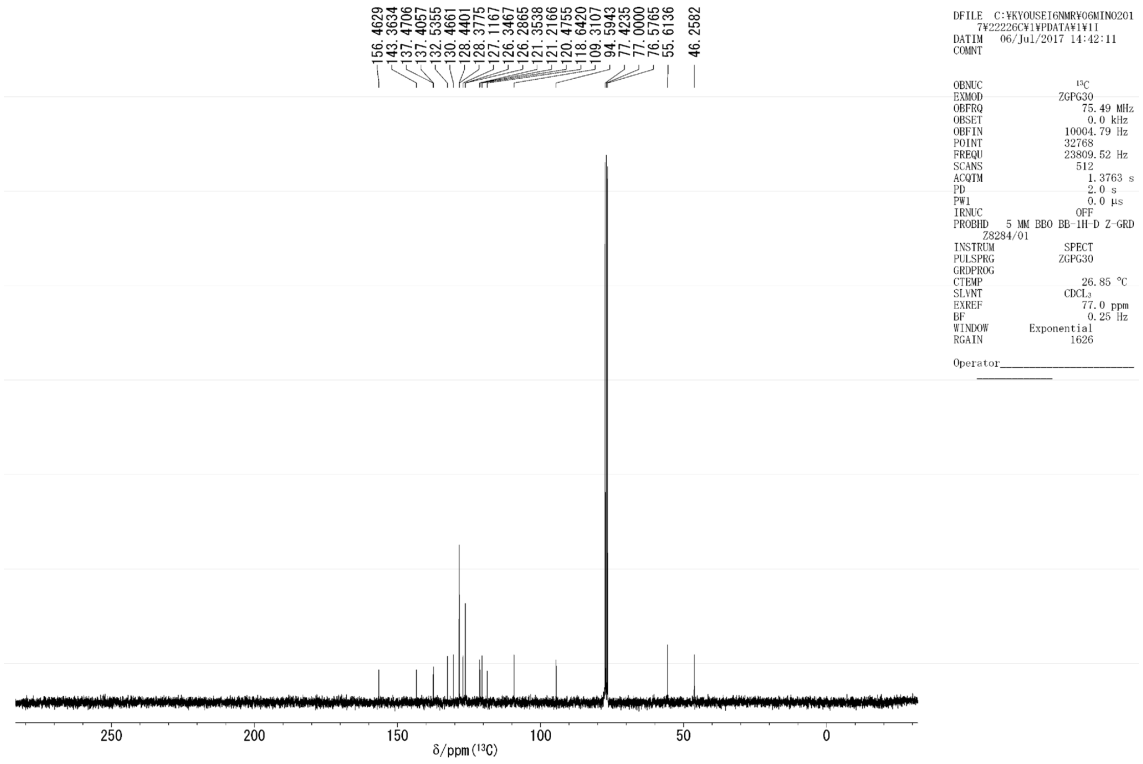




DFILE C:¥KYOUSEI6NMR¥O6MINO201
7¥22191H¥1¥PDATA¥1¥1I
DATIM 28/Jun/2017 17:46:06
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	8
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	575

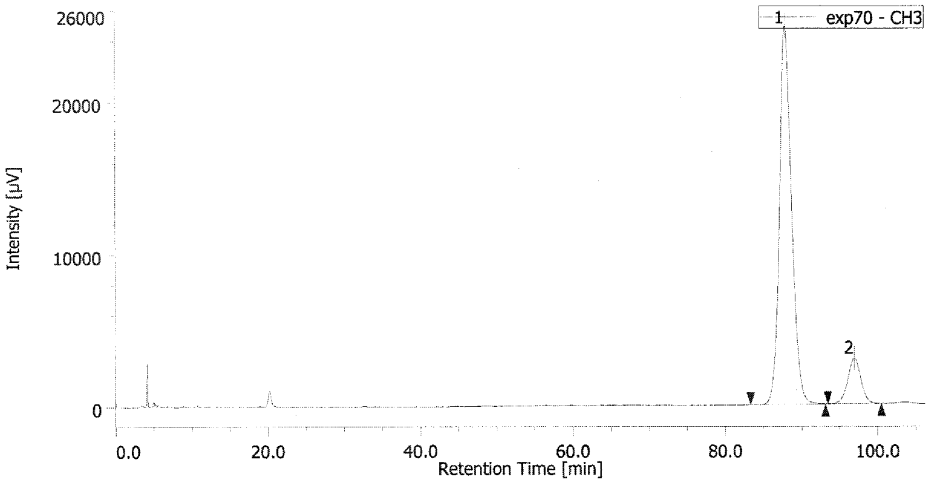
Operator:



DFILE C:¥KYOUSEI6NMR¥O6MINO201
7¥22226C¥1¥PDATA¥1¥1I
DATIM 06/Jul/2017 14:42:11
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10004.79 Hz
POINT	32768
FREQU	23809.52 Hz
SCANS	512
ACQTM	1.3763 s
PD	2.0 s
PW1	0.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	1626

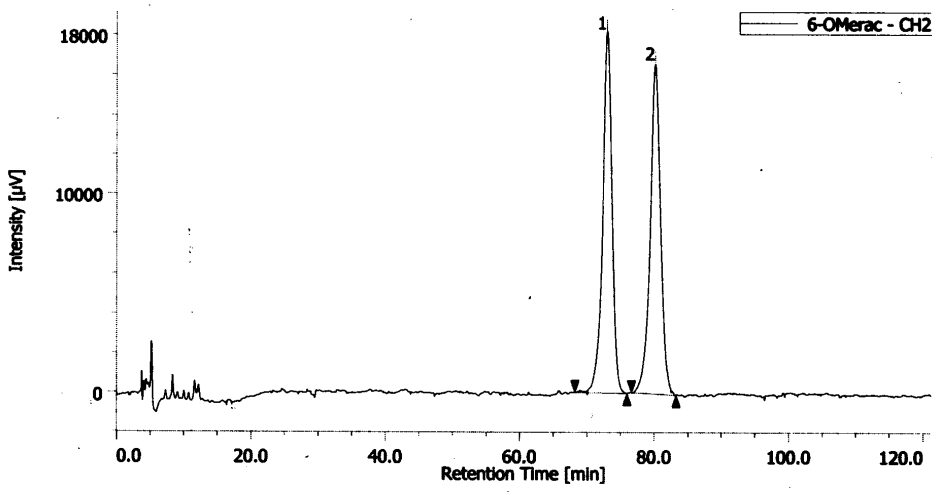
Operator:



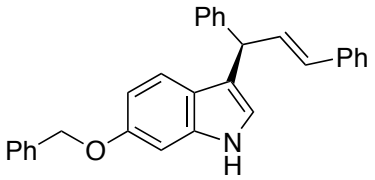
peak name

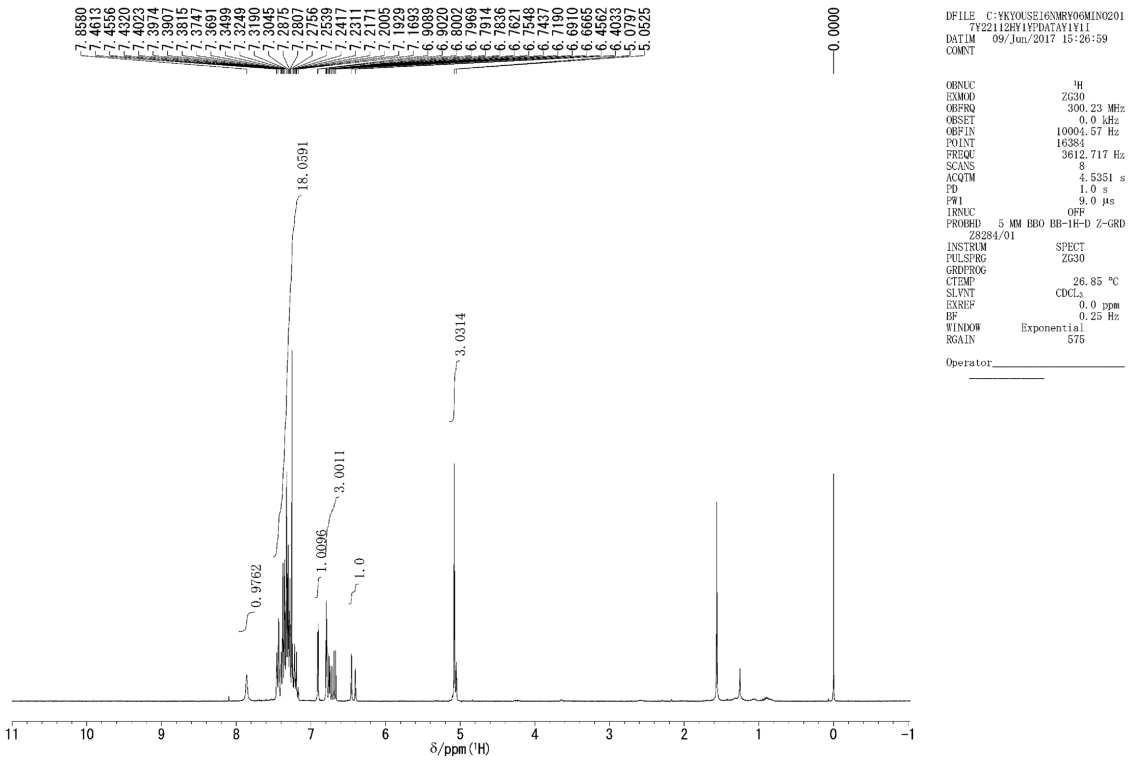
#	ピーク名	CH	tR [min]	area [μV·sec]	area%
1	Unknown	3	87.867	2733858	88.415
2	Unknown	3	96.950	358203	11.585

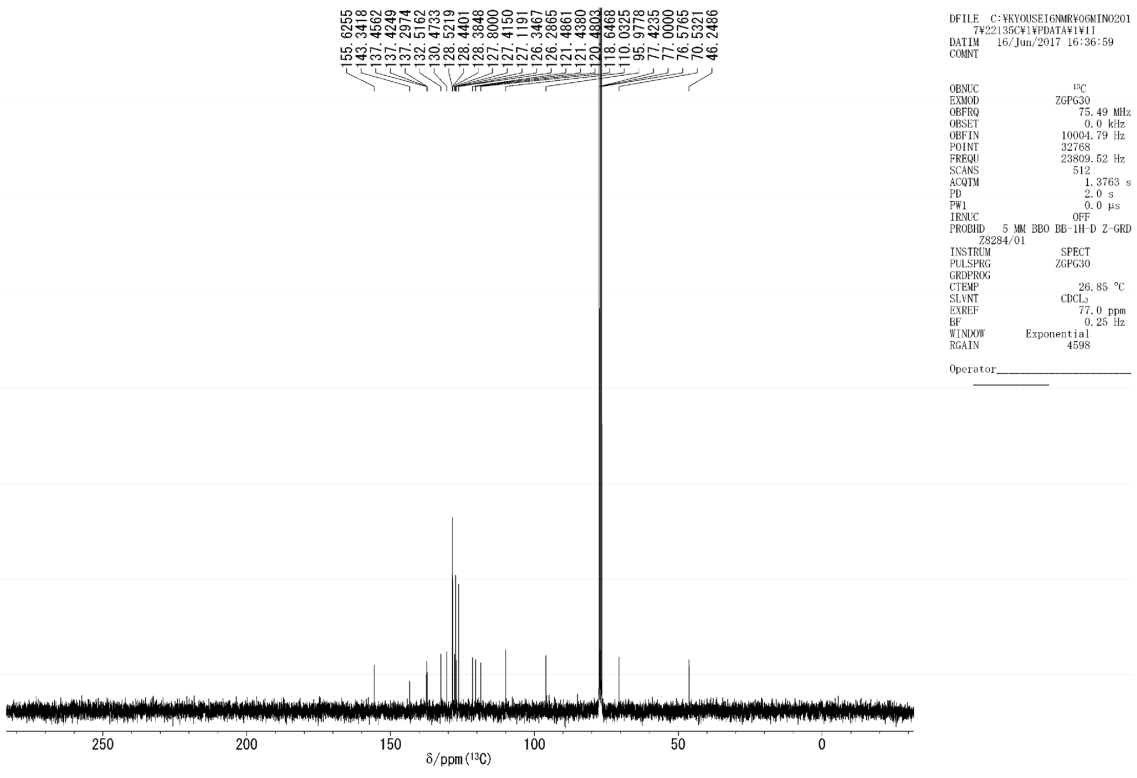
(±)-**9c**

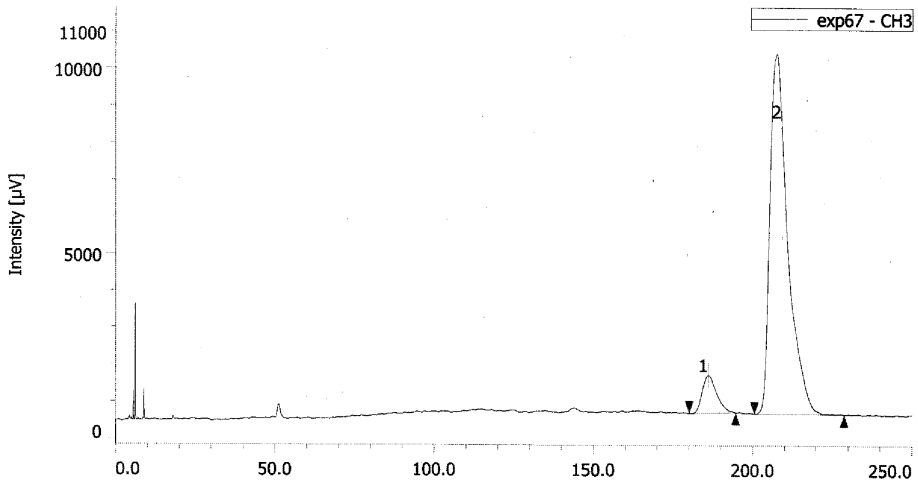


^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9d** (Table 3, entry 4)





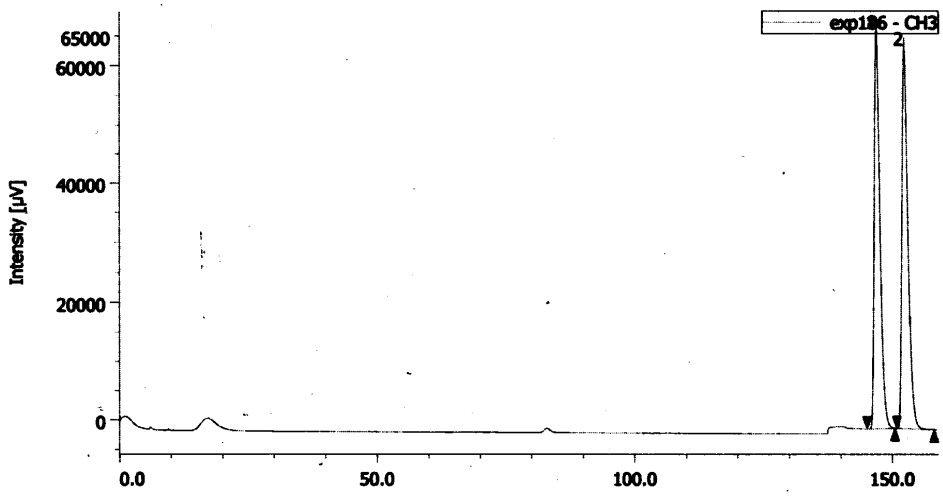




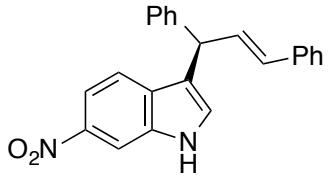
peak name

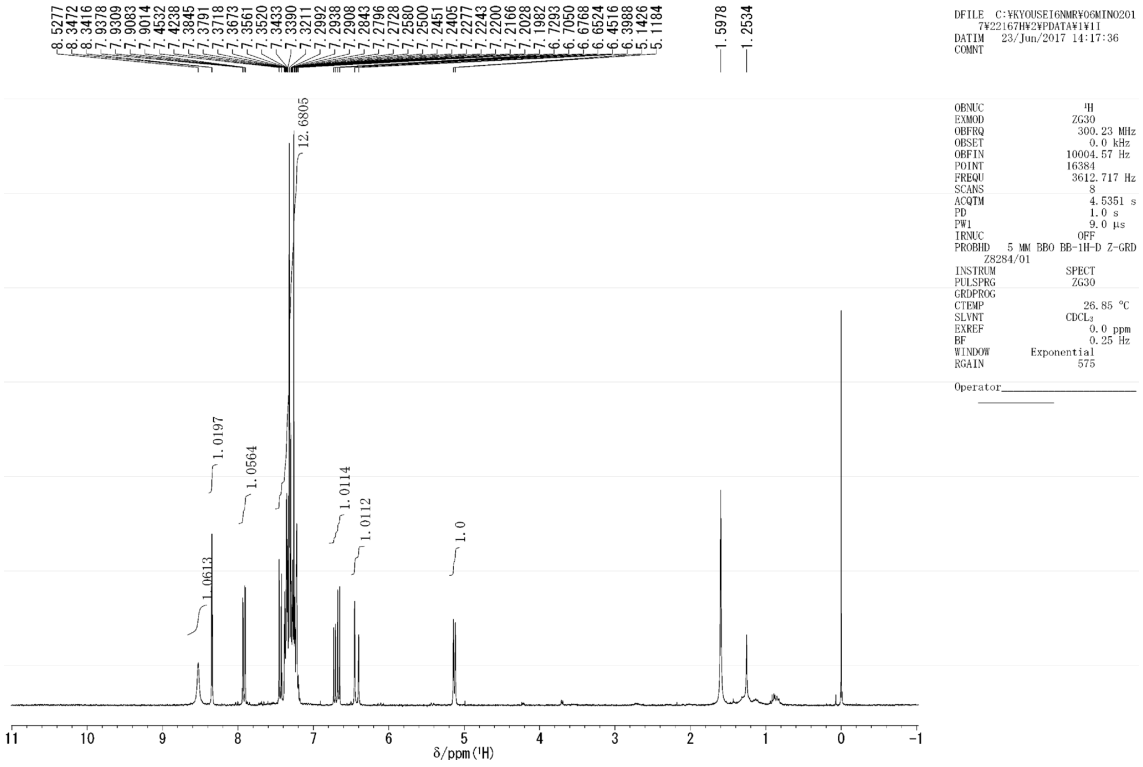
#	ピーク名	CH	tR [min]	area [μV sec]	area%
1	Unknown	3	186	315738	7.711
2	Unknown	3	209	3778805	92.289

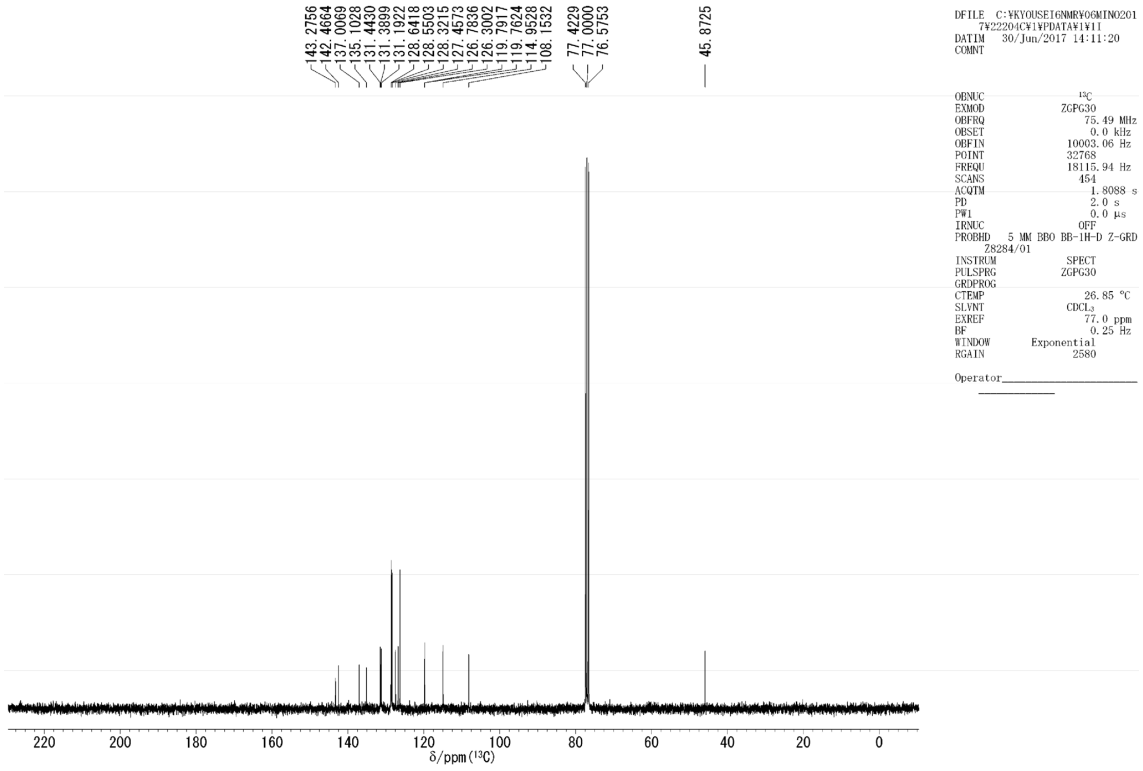
(±)-**9d**

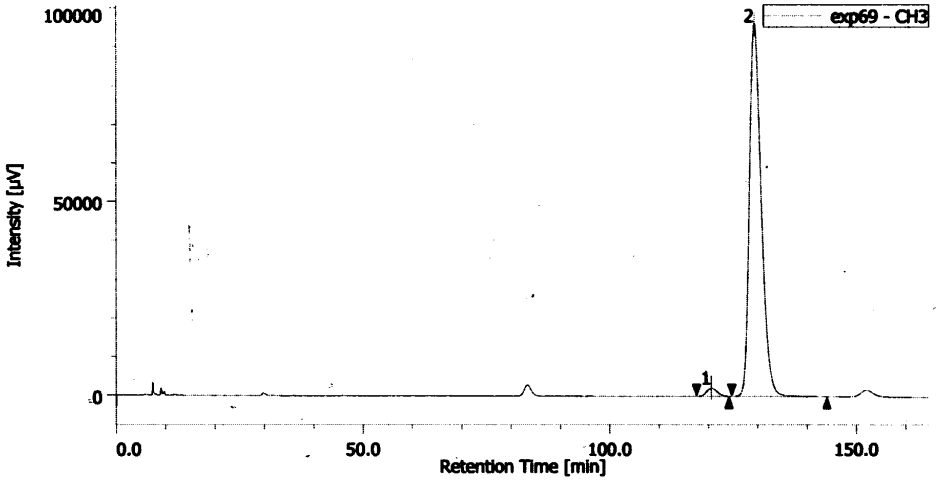


^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9e** (Table 3, entry 5)





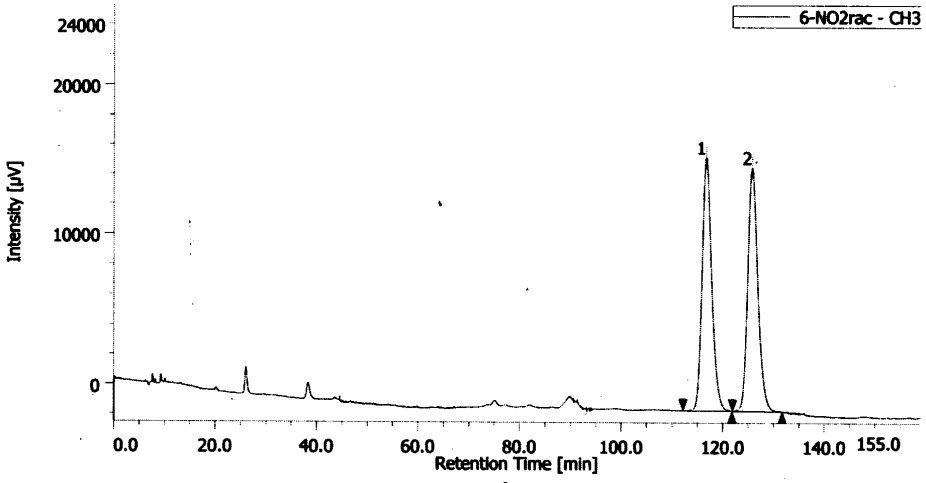




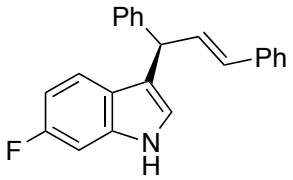
peak name

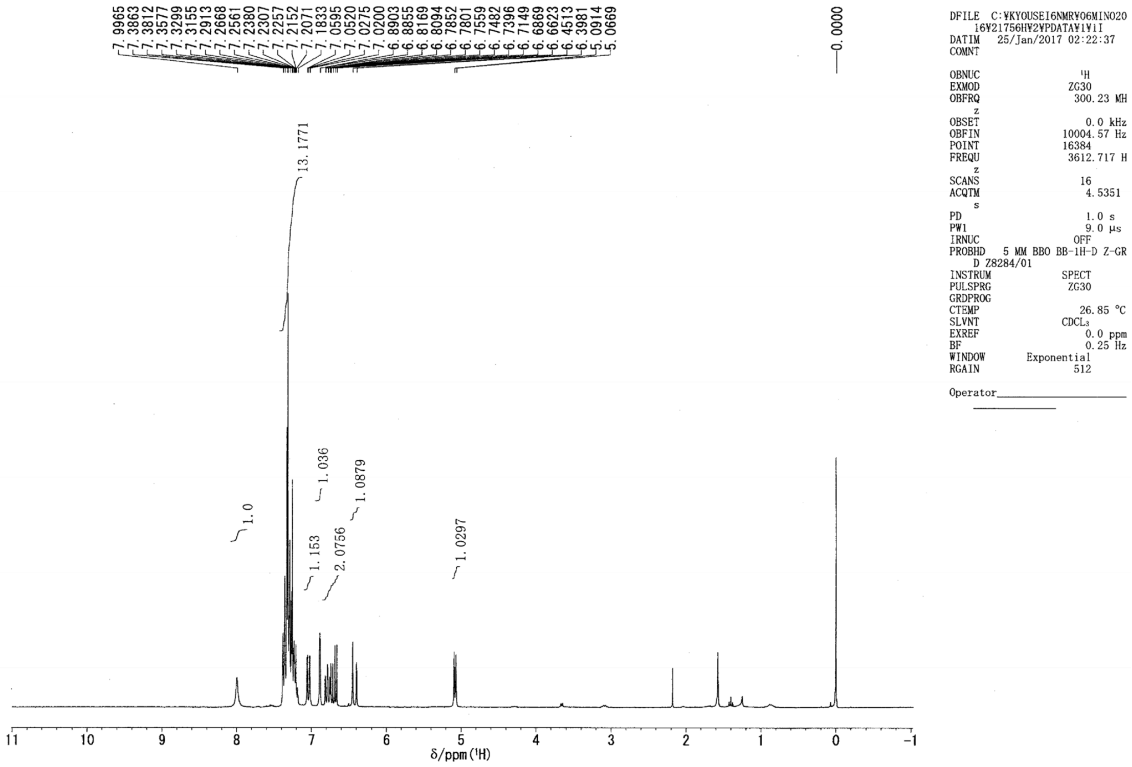
#	ピーク名	CH	tR [min]	area [μV·sec]	area%
1	Unknown	3	120.533	316346	1.934
2	Unknown	3	129.375	16037220	98.066

(±)-**9e**



^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9f** (Table 3, entry 6)

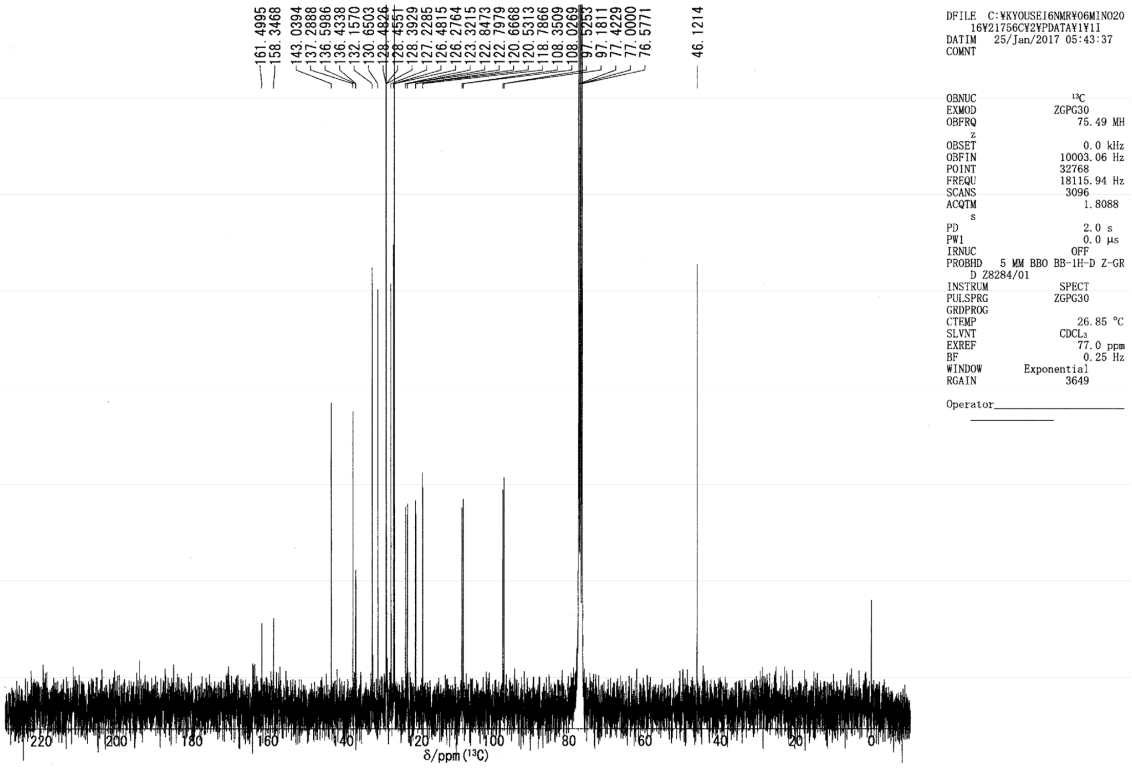




DFILE C:¥KYOUSEI6NMR¥06M1NO20 16¥21756H¥2¥PDATA¥1¥1I
DATIM 25/Jan/2017 02:22:37
COMNT

OBNUC	¹H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	16
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	CDCl₃
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	512

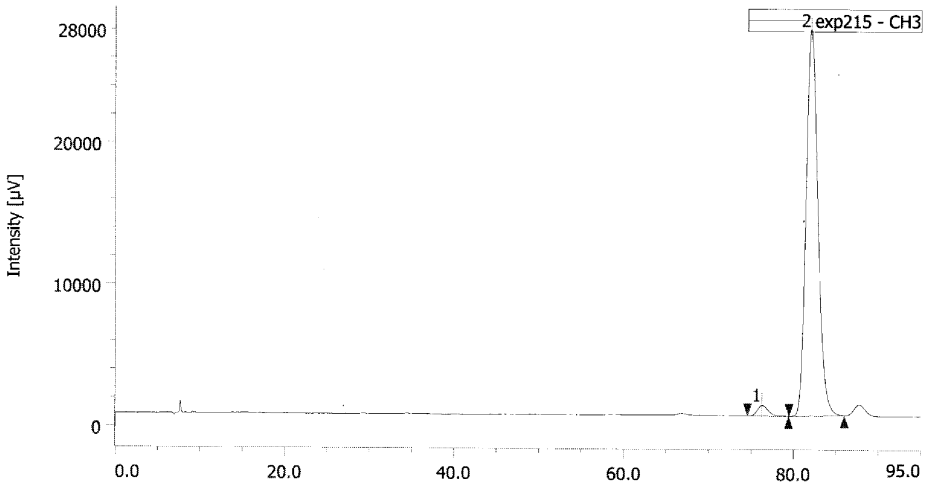
Operator



DFILE C:¥KYOUSEI6NMR¥06M1NO20 16¥21756C¥2¥PDATA¥1¥1I
DATIM 25/Jan/2017 05:43:37
COMNT

OBNUC	¹³C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	3096
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	CDCl₃
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	3649

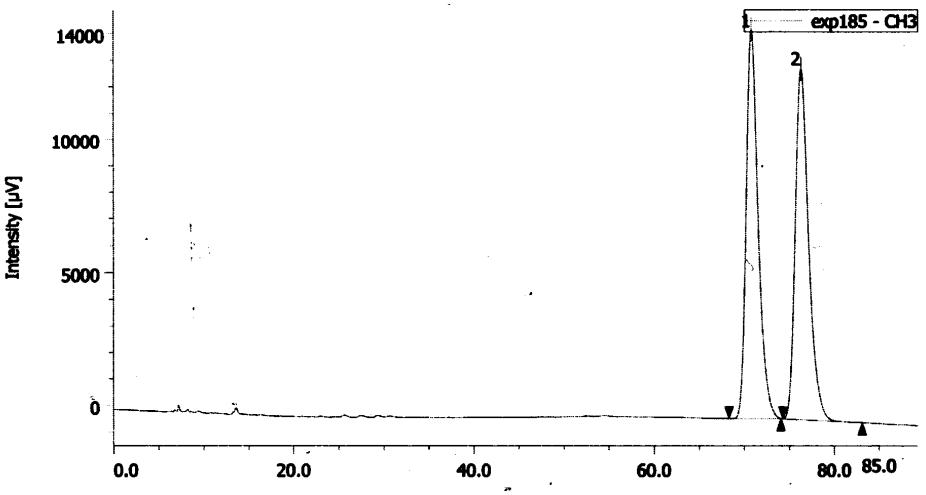
Operator



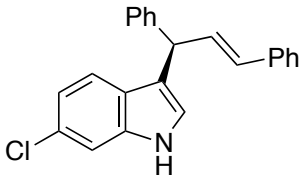
peak name

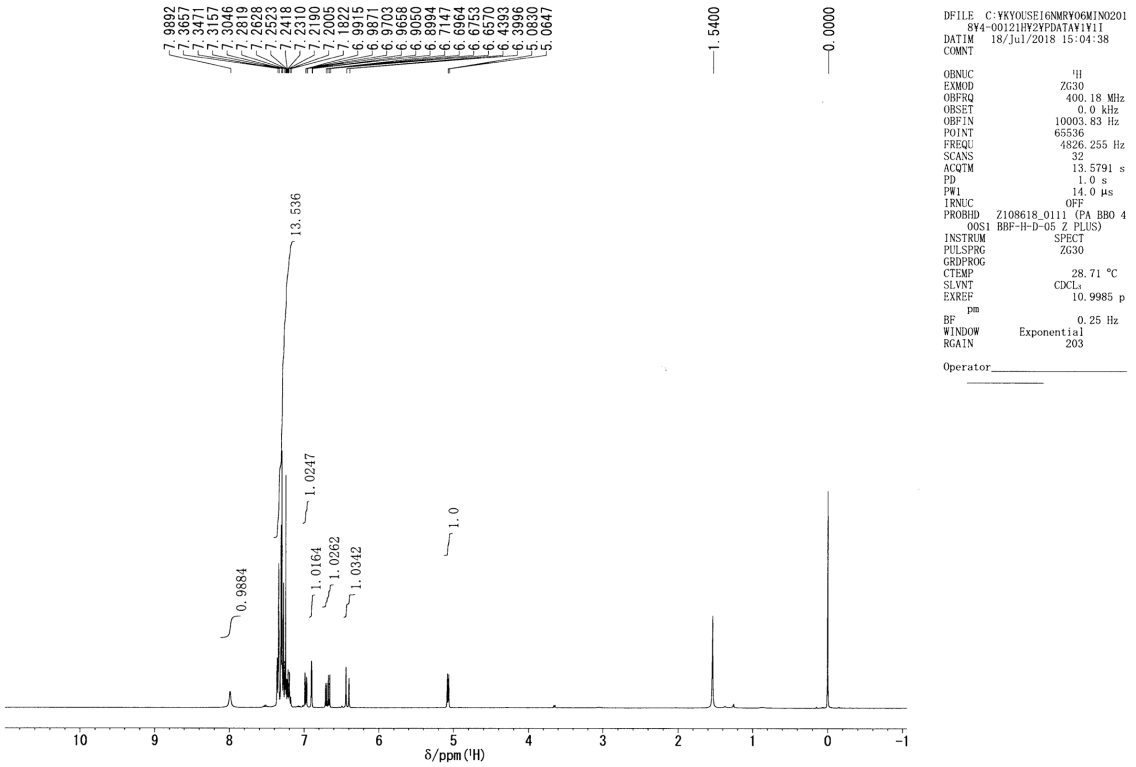
#	ピーク名	CH	tR [min]	area [μV*sec]	area%
1	Unknown	3	76.3	66210	2.405
2	Unknown	3	82.0	2687301	97.595

(±)-**9f**



^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9g** (Table 3, entry 7)

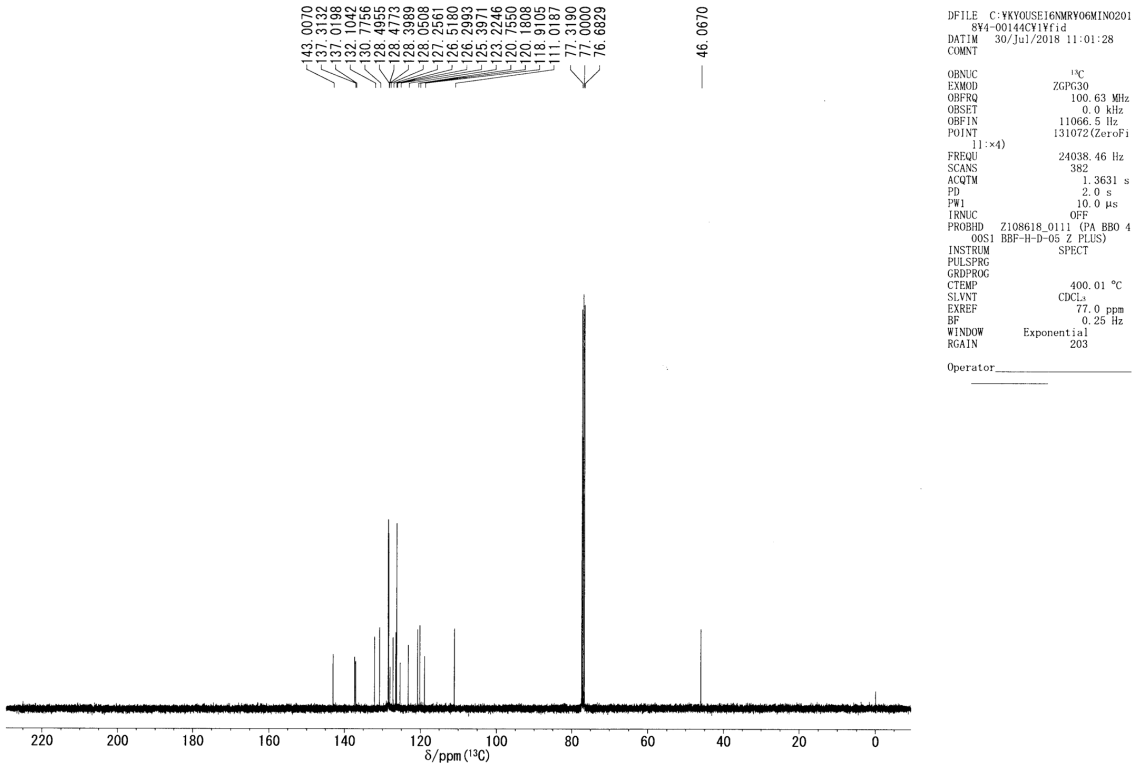




DFILE C:¥KYOUSEI6NMR¥O6MINO201
8¥4-00121HY2YPDATA¥1¥1I
DATIM 18/Jul/2018 15:04:38
COMNT

OBNUC	¹H
EXMOD	ZG30
OBFRQ	400.18 MHz
OBSET	0.0 kHz
OBFIN	10003.83 Hz
POINT	65536
FREQU	4826.255 Hz
SCANS	32
ACQTM	13.5791 s
PD	1.0 s
PW1	14.0 µs
IRNUC	OFF
PROBHD	Z108618_0111 (PA BBO 4 00S1 BBF-H-D-05 Z PLUS)
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	28.71 °C
SLVNT	CDCL₃
EXREF	10.9985 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	203

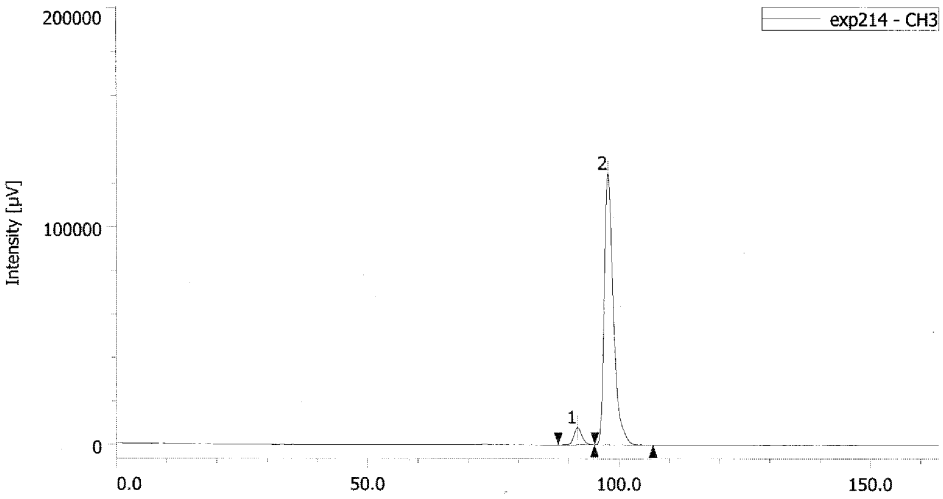
Operator_____



DFILE C:¥KYOUSEI6NMR¥O6MINO201
8¥4-00144CY1¥fid
DATIM 30/Jul/2018 11:01:28
COMNT

OBNUC	¹³C
EXMOD	ZGPG30
OBFRQ	100.63 MHz
OBSET	0.0 kHz
OBFIN	11066.5 Hz
POINT	131072(ZeroFill:×4)
FREQU	24038.46 Hz
SCANS	382
ACQTM	1.3631 s
PD	2.0 s
PW1	10.0 µs
IRNUC	OFF
PROBHD	Z108618_0111 (PA BBO 4 00S1 BBF-H-D-05 Z PLUS)
INSTRUM	SPECT
PULSPRG	
GRDPROG	
CTEMP	400.01 °C
SLVNT	CDCL₃
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	203

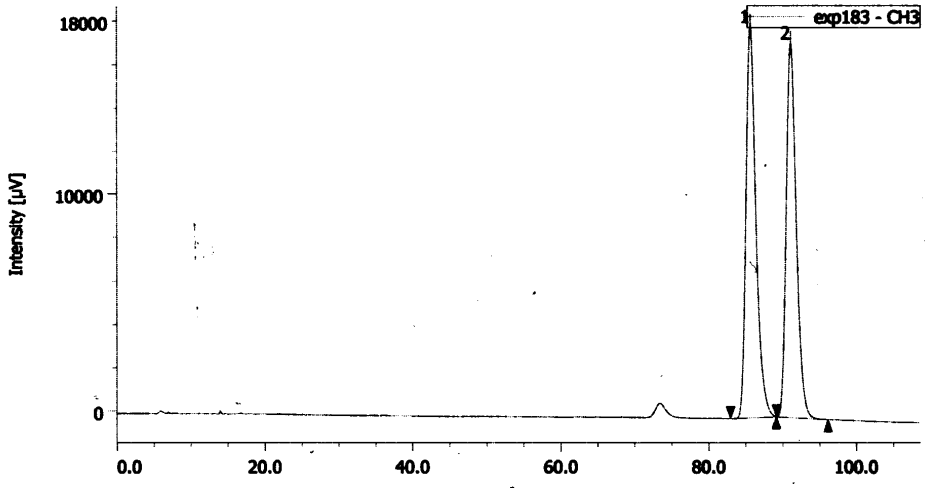
Operator_____



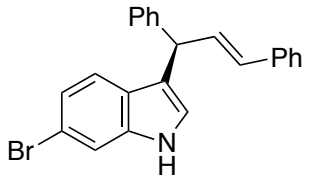
peak name

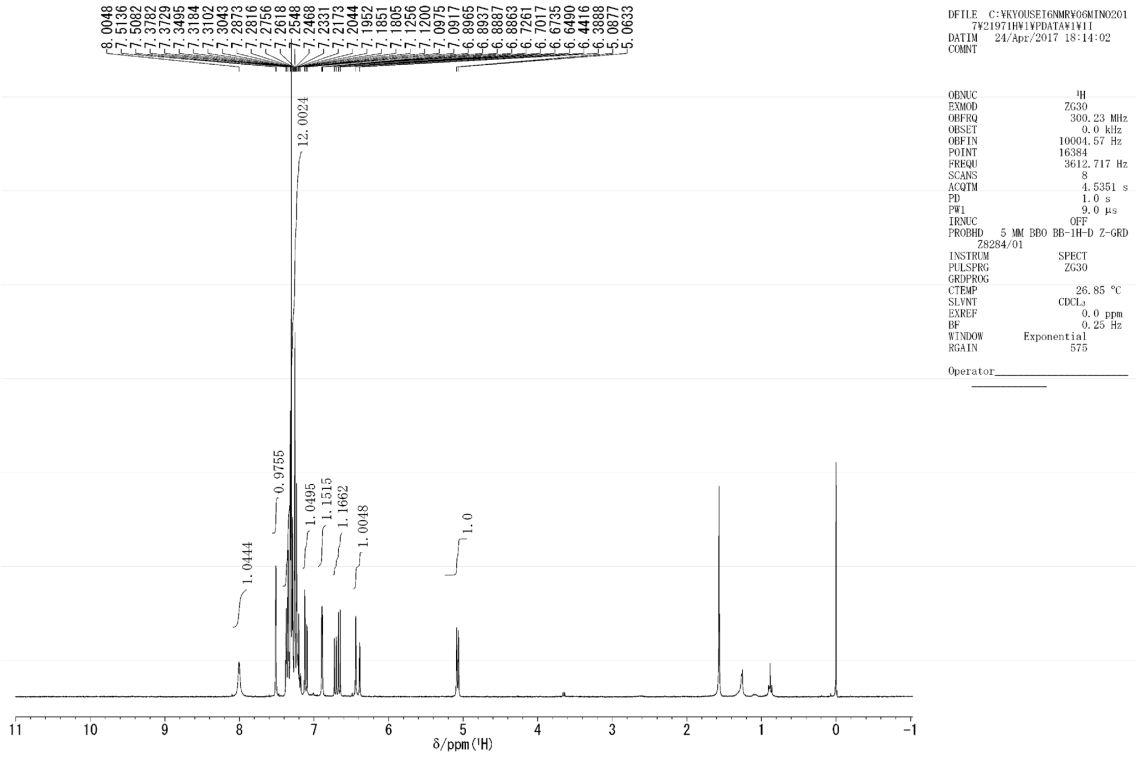
#	ピーク名	CH	tR [min]	area [μV sec]	area%
1	Unknown	3	91.7	898727	5.406
2	Unknown	3	97.8	15726310	94.594

(±)-9g



^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9h** (Table 3, entry 8)

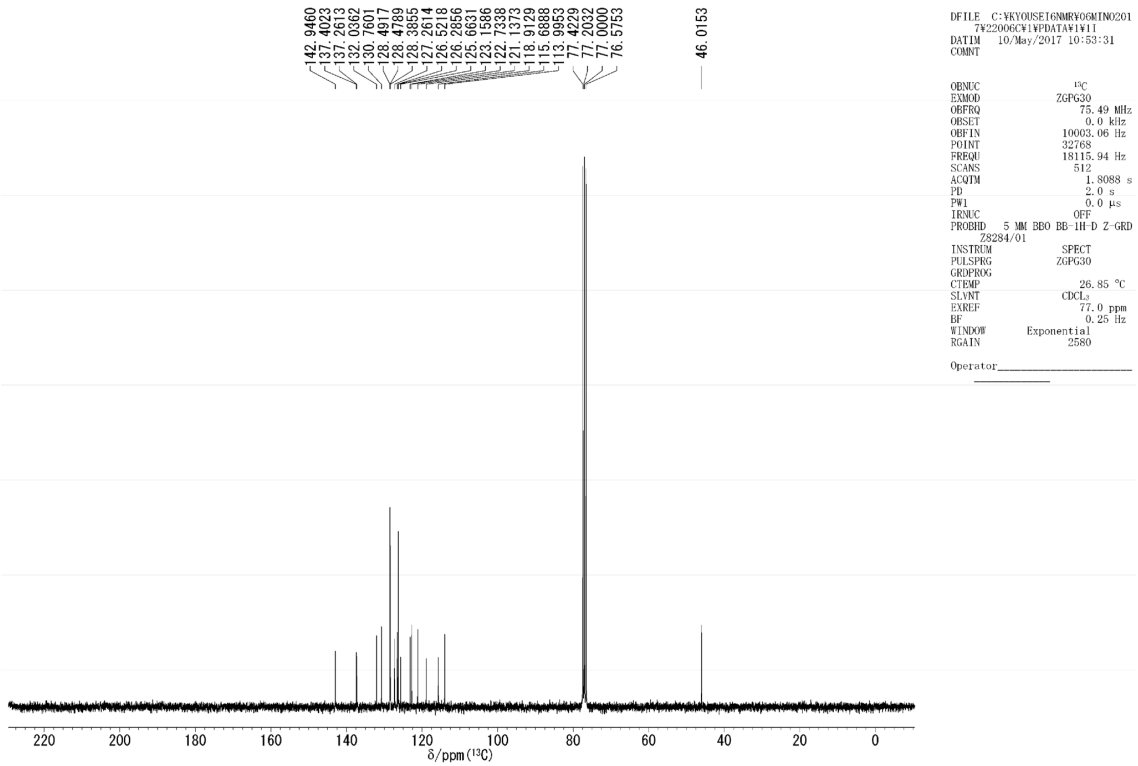




DFILE C:¥KYOUSEIGNMR¥06MINO201
7¥21971HW1¥PDATA¥1¥1I
DATIM 24/Apr/2017 18:14:02
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	8
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	575

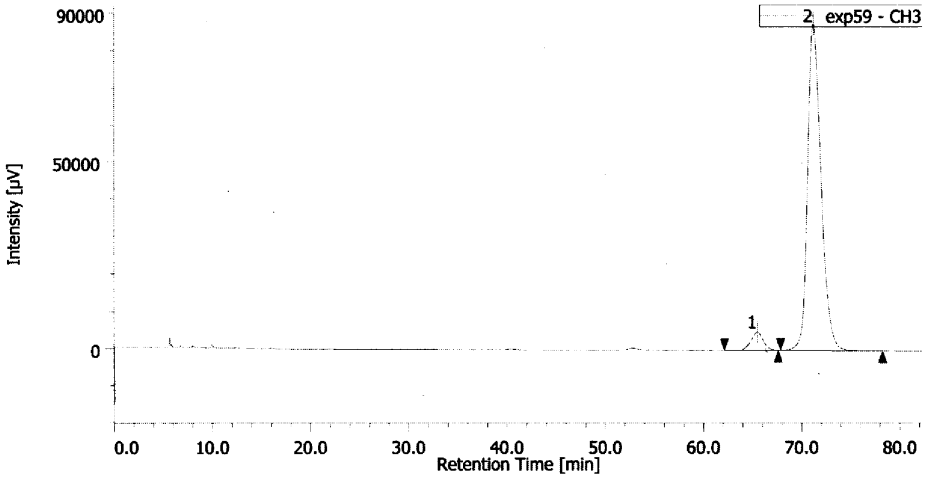
Operator_____



DFILE C:¥KYOUSEIGNMR¥06MINO201
7¥22006C¥1¥PDATA¥1¥1I
DATIM 10/May/2017 10:53:31
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	512
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 µs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	2580

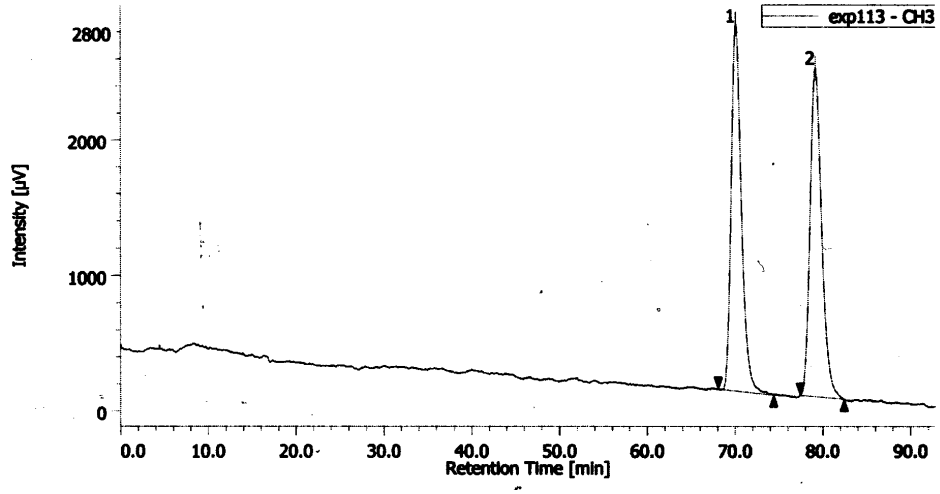
Operator_____



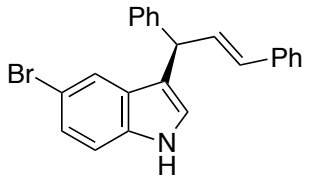
peak name area height area%

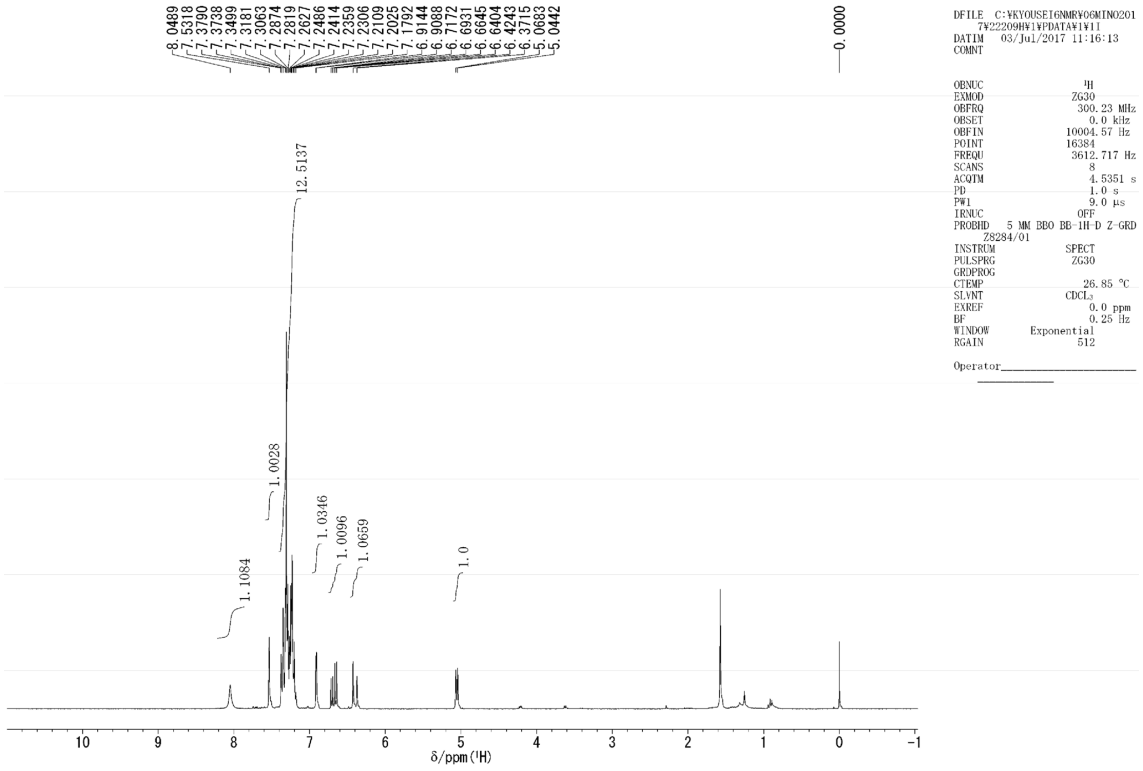
		CH	tR (min)	[μV*sec]	[μV]	[%]
1	Unknown	3	65.500	437396	5042	4.937
2	Unknown	3	71.208	8421365	87567	95.063

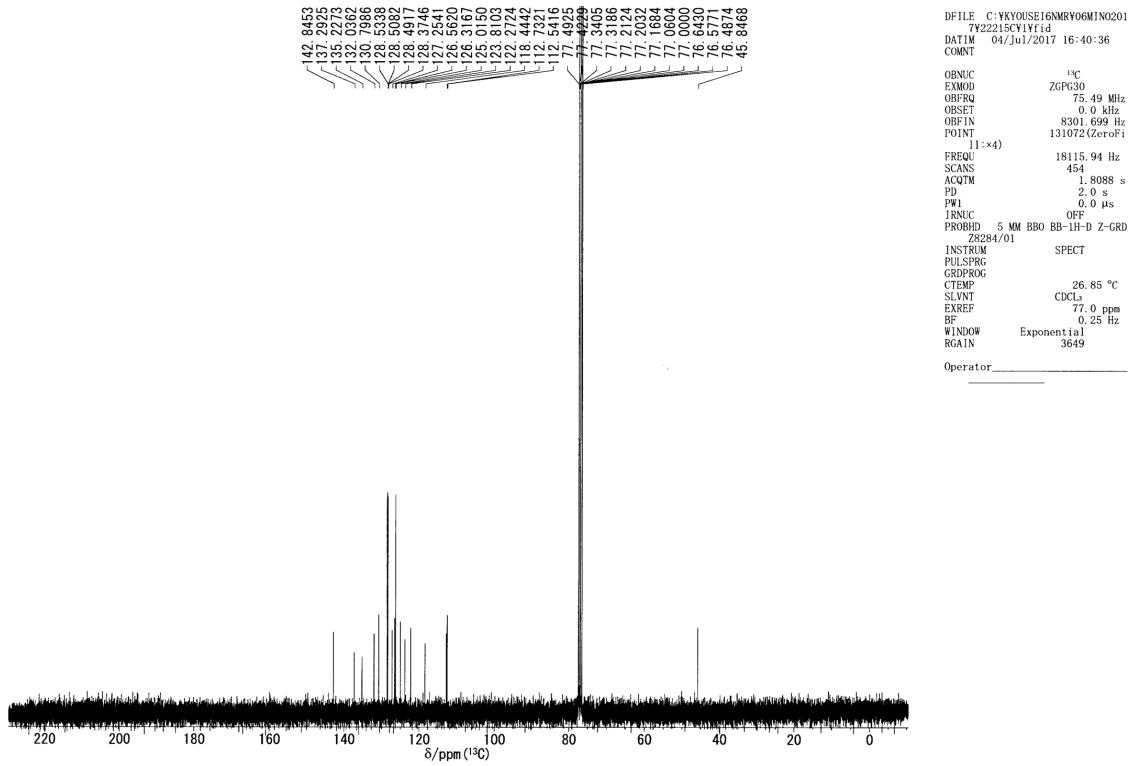
(±)-**9h**

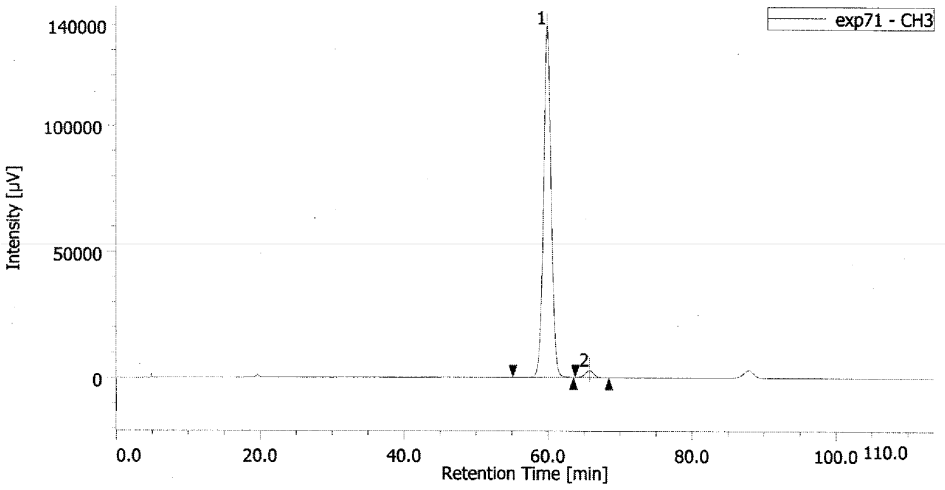


^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9i** (Table 3, entry 9)





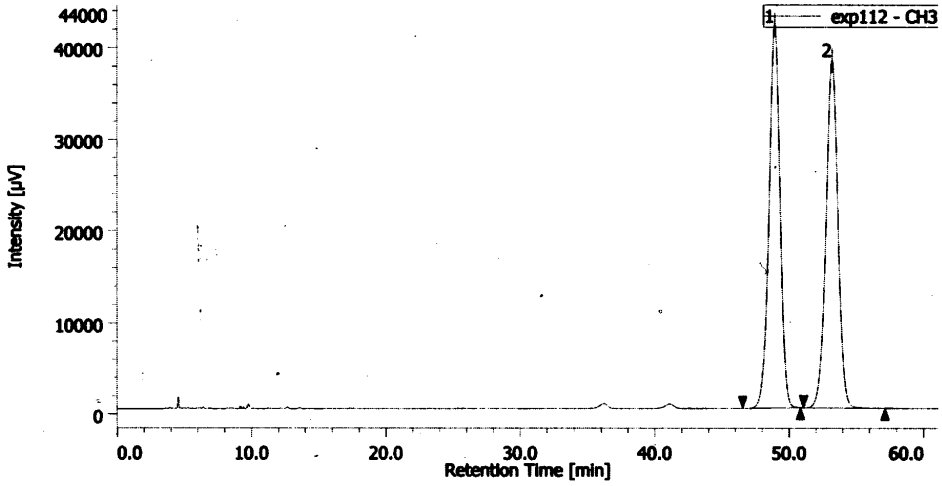




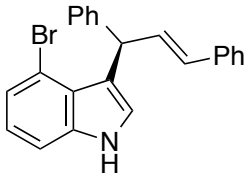
peak name

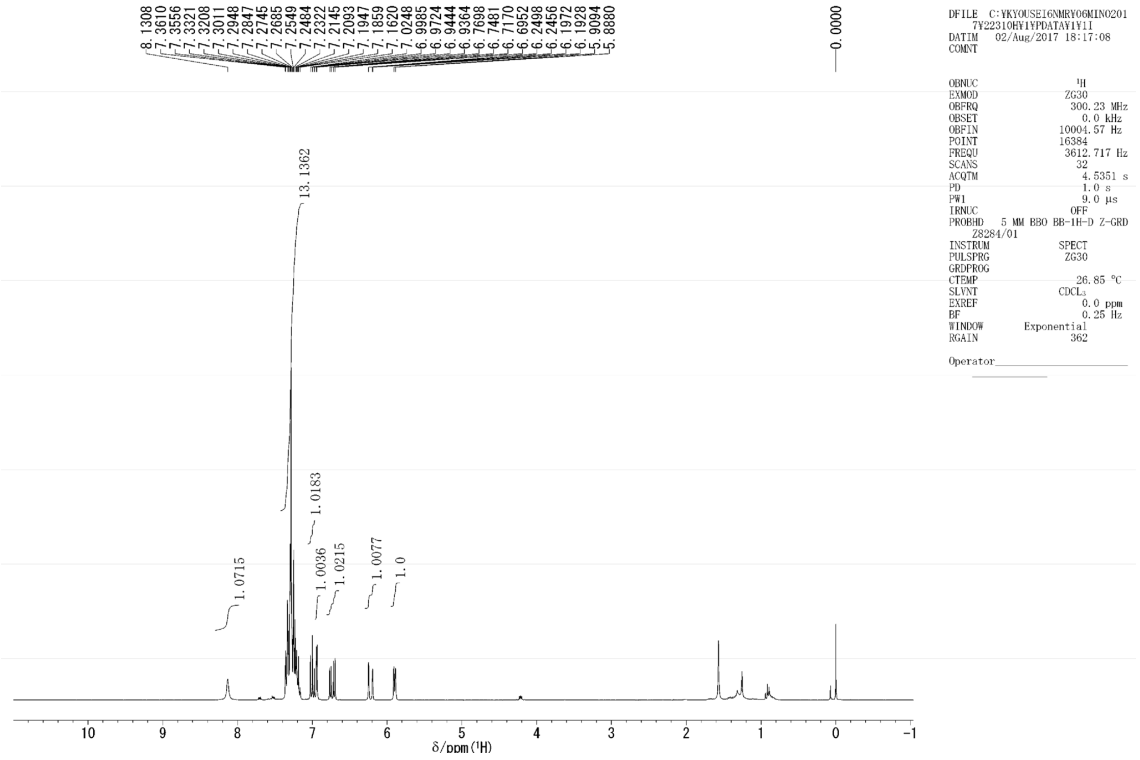
#	ピーク名	CH	tR [min]	area [μV·sec]	area%
1	Unknown	3	59.850	10094480	97.833
2	Unknown	3	65.742	223582	2.167

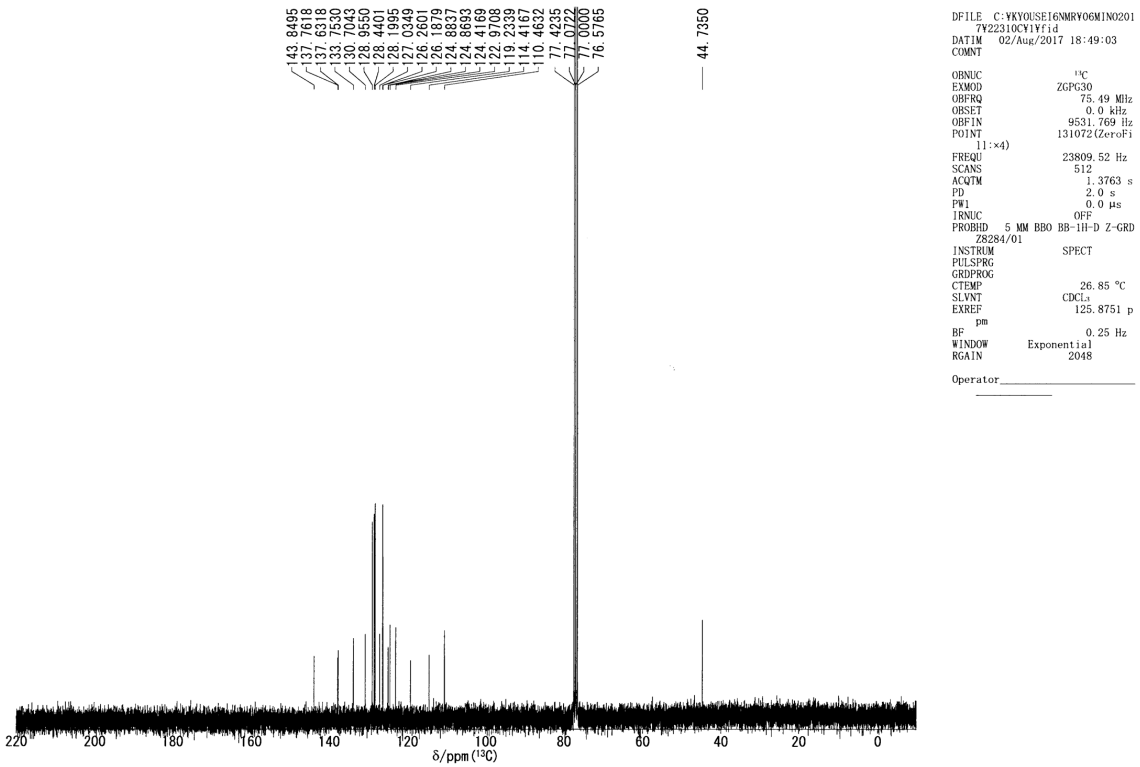
(±)-**9i**

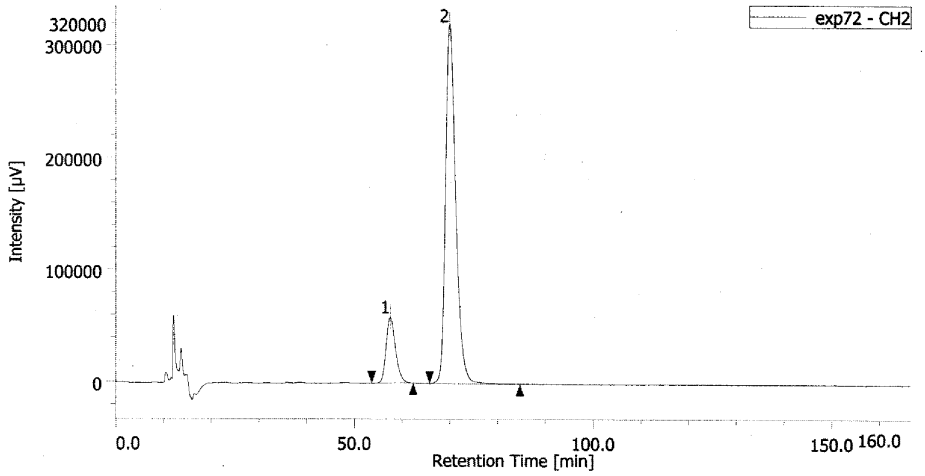


^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9j** (Table 3, entry 10)





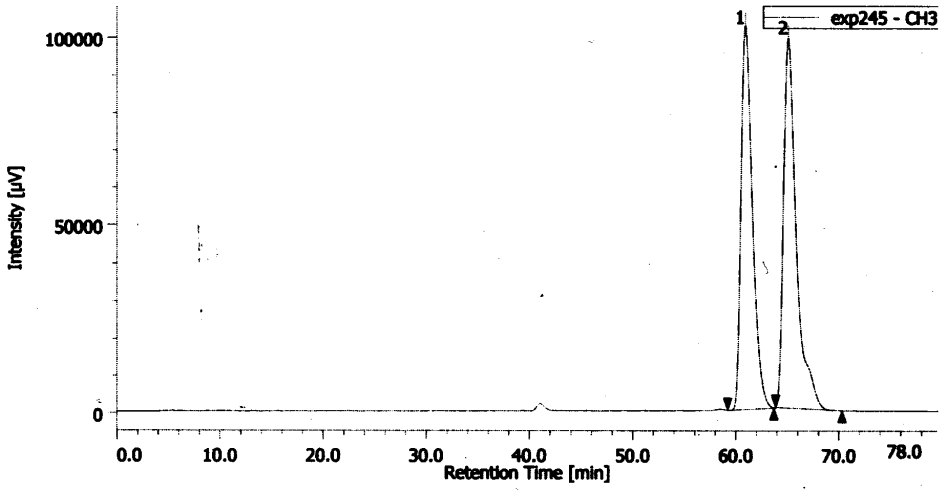




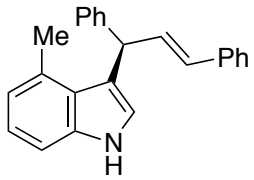
peak name

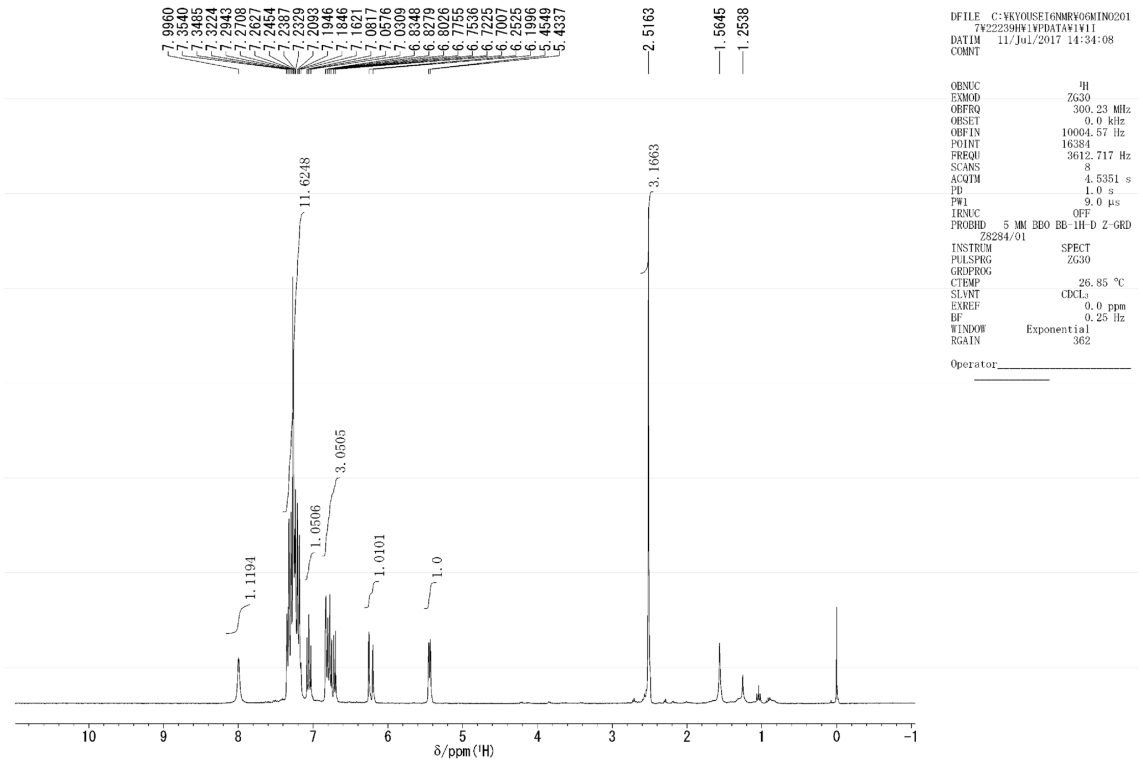
#	ピーク名	CH	tR [min]	area [μV·sec]	area%
1	Unknown	2	57.525	8016504	14.436
2	Unknown	2	69.950	47514564	85.564

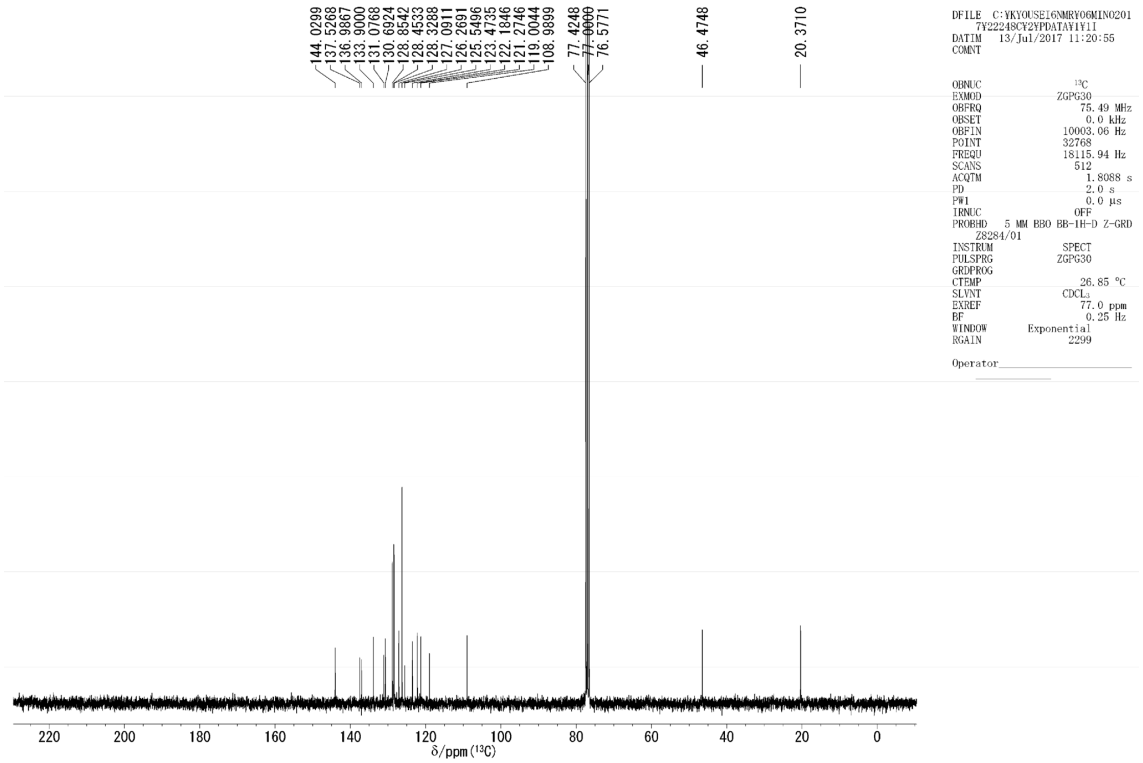
(±)-**9j**

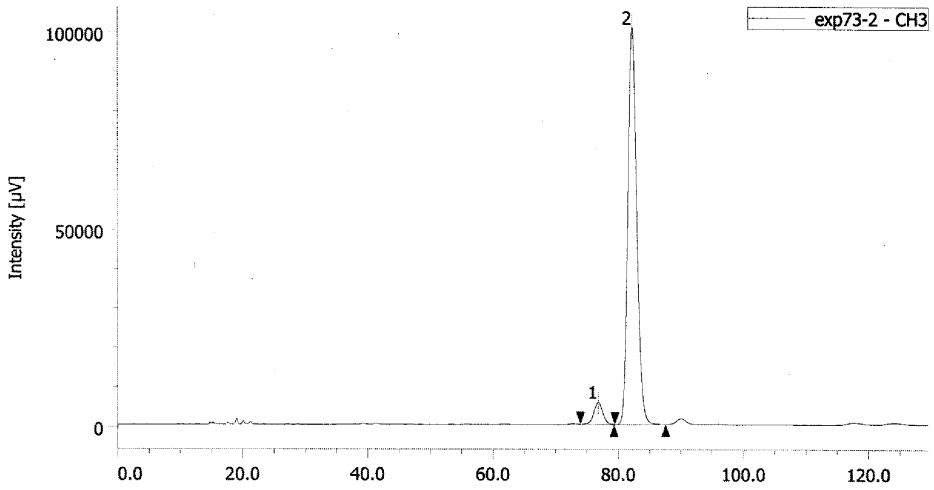


^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9k** (Table 3, entry 11)





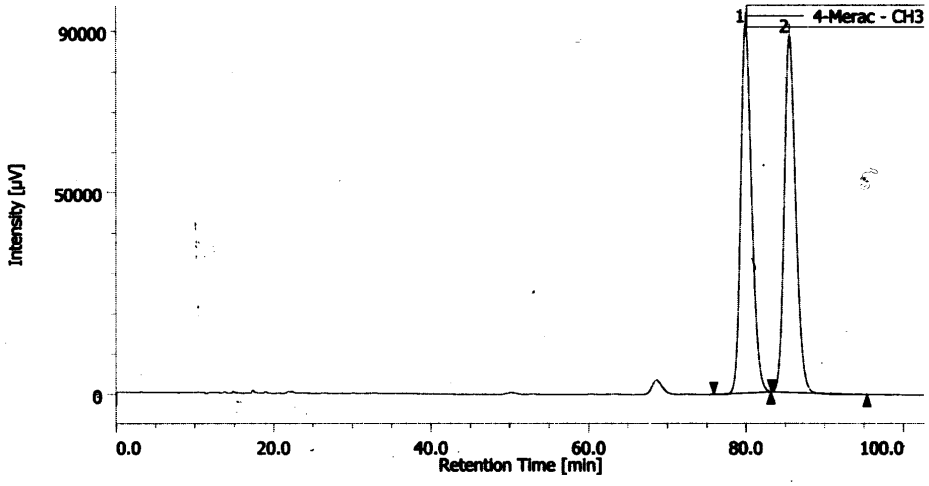




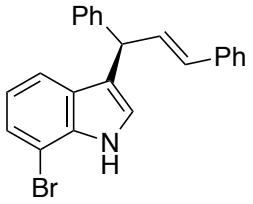
peak name

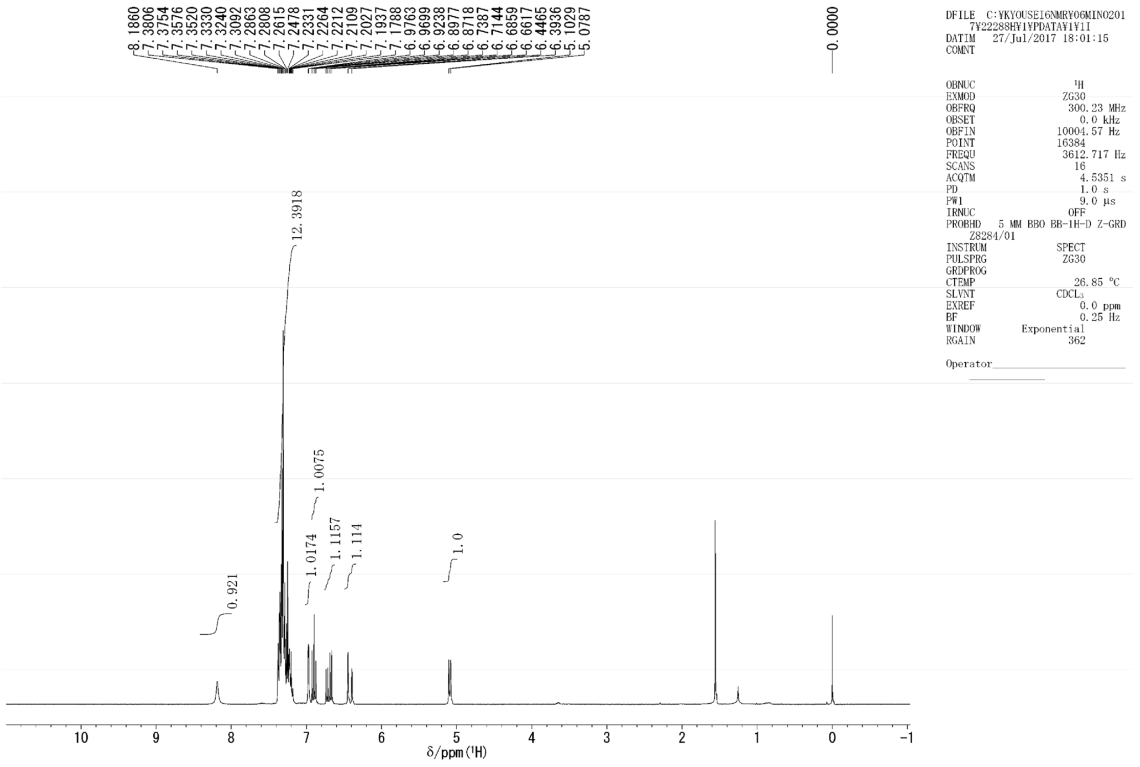
#	ピーク名	CH	tR [min]	area [μV sec]	area%
1	Unknown	3	76.8	539268	5.155
2	Unknown	3	82.1	9922279	94.845

(±)-9k



^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9l** (Table 3, entry 12)

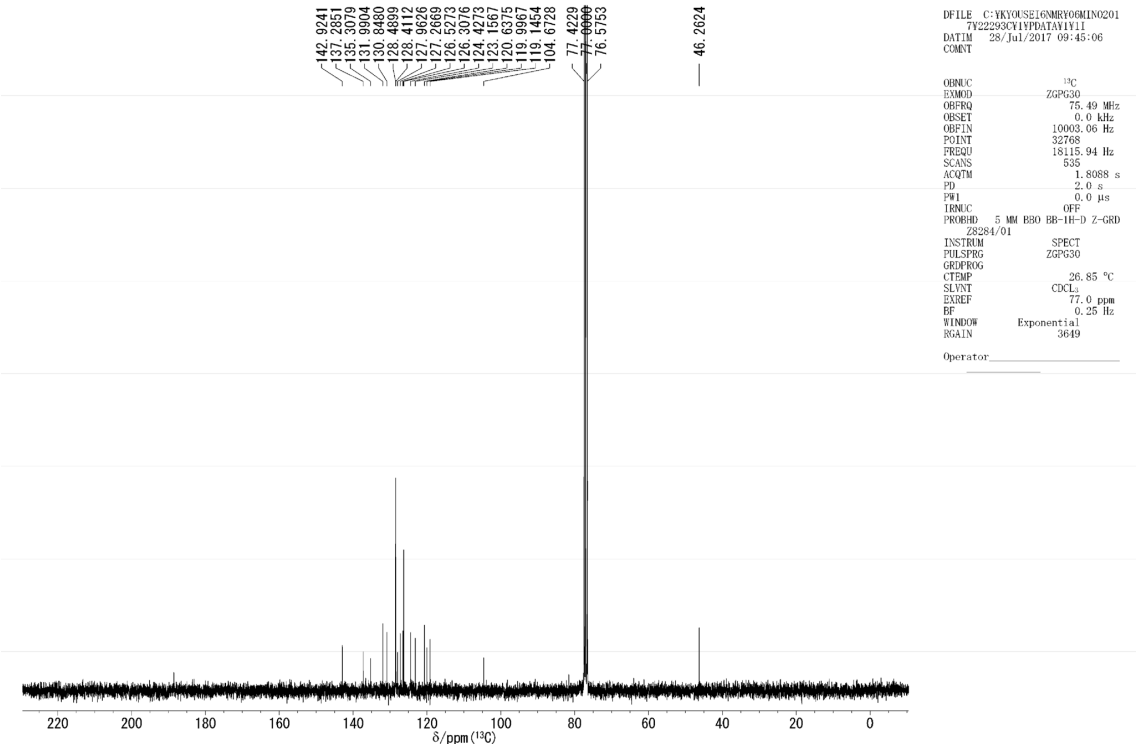




DFILE C:¥KYOUSEI6NMRY06MIN0201
7¥22288HY1¥PDATAY1¥1I
DATIM 27/Jul/2017 18:01:15
COMNT

OBNUC	^{1}H
EXMOD	ZG30
OBFRQ	300.23 MHz
OBSET	0.0 kHz
OBFIN	10004.57 Hz
POINT	16384
FREQU	3612.717 Hz
SCANS	16
ACQTM	4.5351 s
PD	1.0 s
PW1	9.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	0.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	362

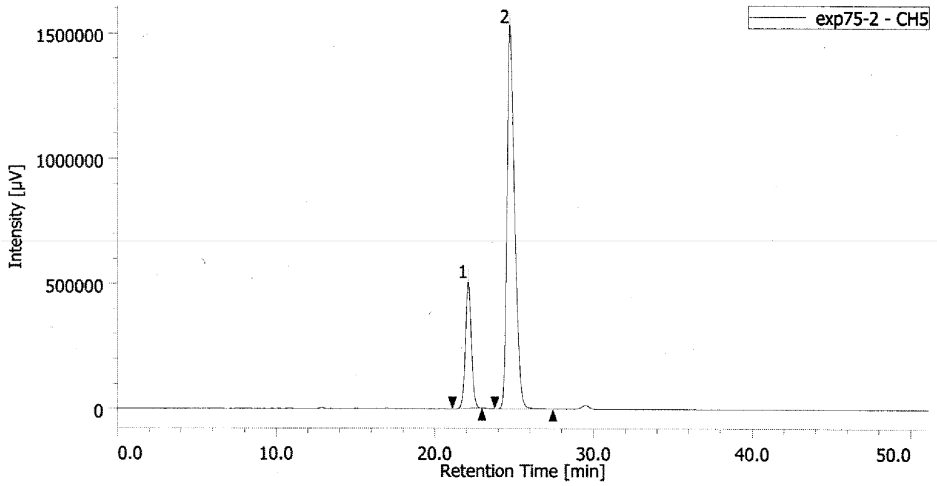
Operator



DFILE C:¥KYOUSEI6NMRY06MIN0201
7¥22293CY1¥PDATAY1¥1I
DATIM 28/Jul/2017 09:45:06
COMNT

OBNUC	^{13}C
EXMOD	ZGPG30
OBFRQ	75.49 MHz
OBSET	0.0 kHz
OBFIN	10003.06 Hz
POINT	32768
FREQU	18115.94 Hz
SCANS	535
ACQTM	1.8088 s
PD	2.0 s
PW1	0.0 μs
IRNUC	OFF
PROBHD	5 MM BBO BB-1H-D Z-GRD Z8284/01
INSTRUM	SPECT
PULSPRG	ZGPG30
GRDPROG	
CTEMP	26.85 °C
SLVNT	$CDCl_3$
EXREF	77.0 ppm
BF	0.25 Hz
WINDOW	Exponential
RGAIN	3649

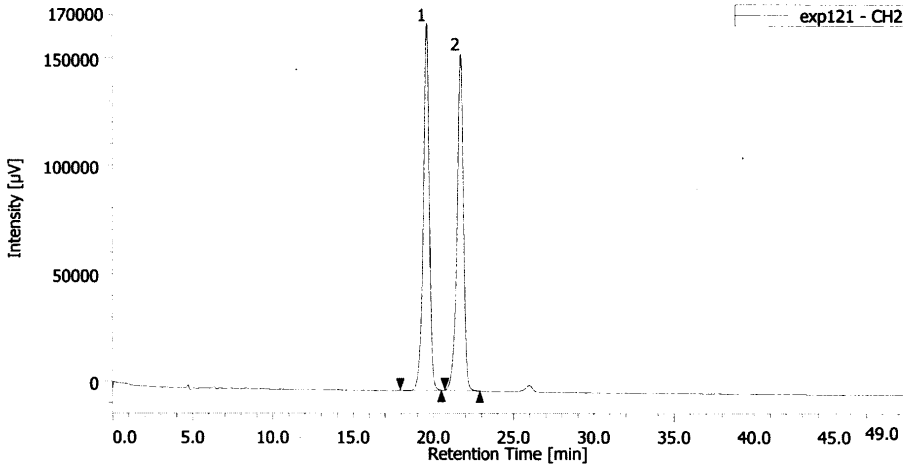
Operator



peak name

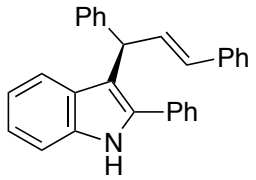
#	ピーク名	CH	tR [min]	area [μV·sec]	area%
1	Unknown	5	22.100	13035572	20.386
2	Unknown	5	24.710	50907963	79.614

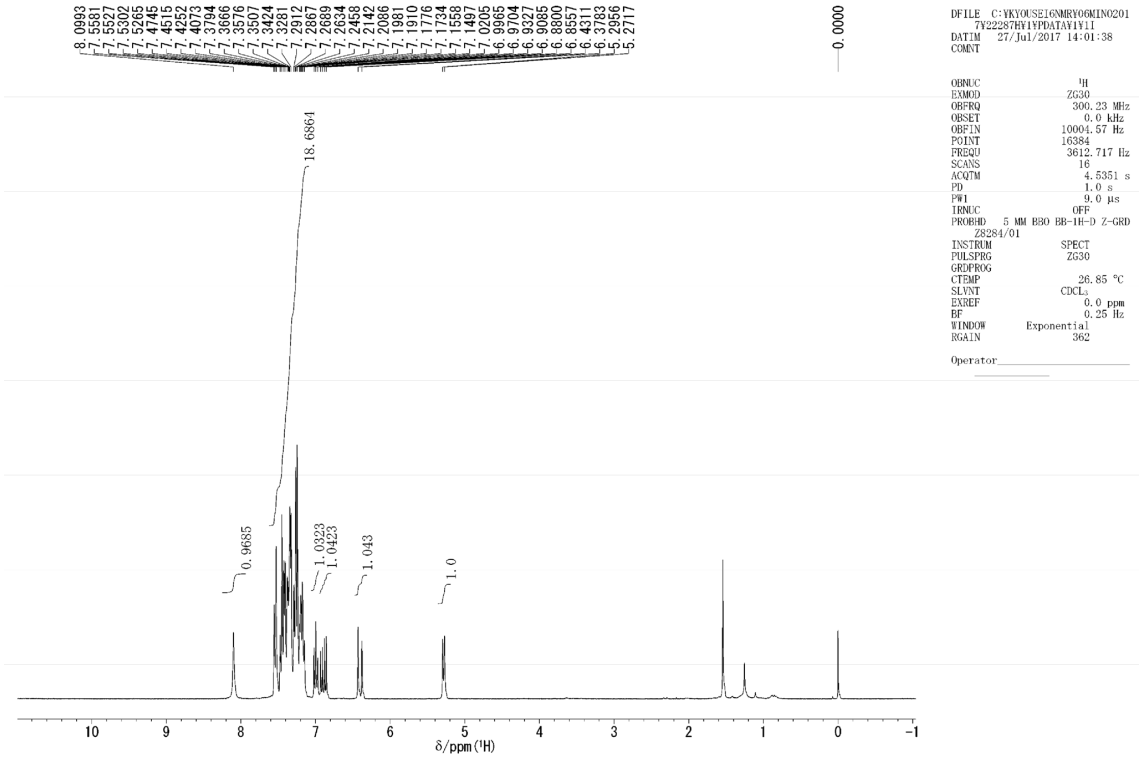
(±)-**9l**

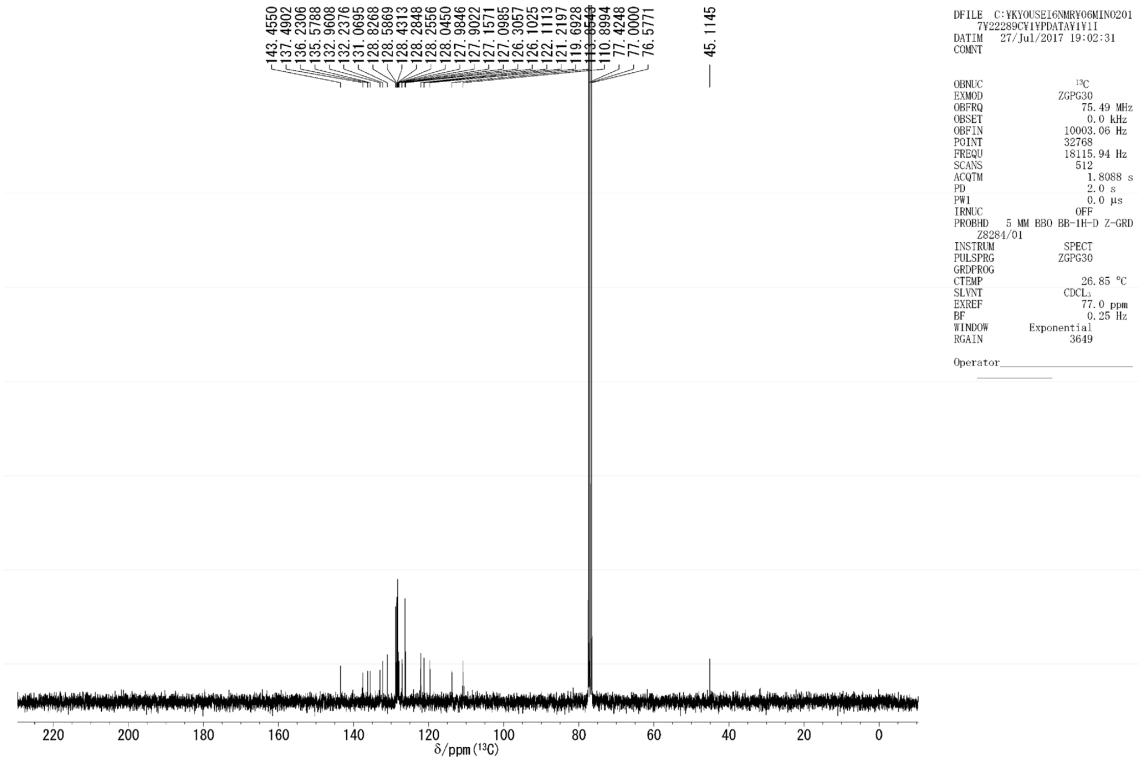


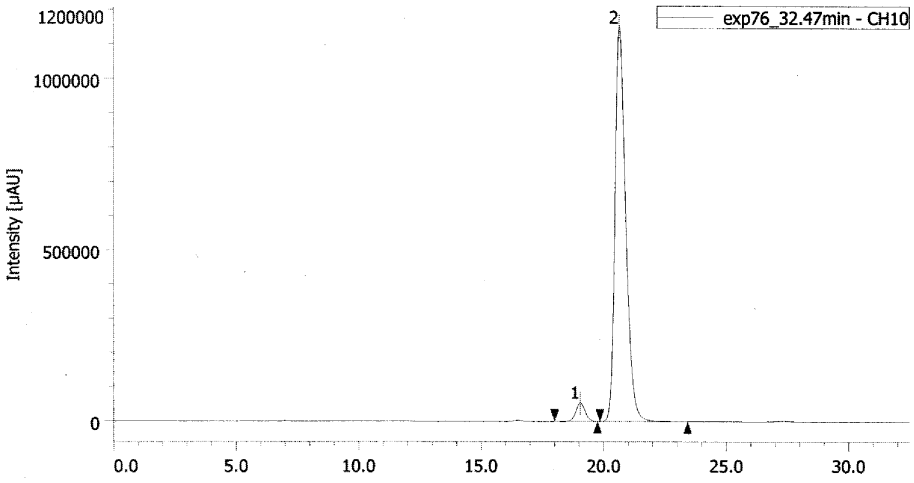
peak name

^{1}H and ^{13}C NMR, and chiral phase HPLC chart of (*R*)-**9m** (Table 2, entry 13)









peak name

#	ピーク名	CH	tR [min]	area [μV·sec]	area%
1	Unknown	10	19.0	1394440	3.830
2	Unknown	10	20.6	35014510	96.170

(±)-9m