Supporting Information

Palladium-Catalyzed Cross-Coupling of *H*-Phosphinate Esters with Chloroarenes

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List of contents : Page

General Chemistry	1
Reagents and solvents	1
^{31}P NMR Yield Measurements	2
Representative procedure	2
Spectral data	3
Spectra	8

General Chemistry.

^{1}H NMR spectra were recorded on a 300-MHz spectrometer. Chemical shift for ^{1}H NMR spectra (in parts per million) relative to internal tetramethylsilane (Me_4Si, δ = 0.00 ppm) with $CDCl_3$. ^{13}C NMR spectra were recorded at 75 MHz. Chemical shifts for ^{13}C NMR spectra are reported (in parts per million) relative to $CDCl_3$ (δ = 77.0 ppm) ^{31}P NMR spectra were recorded at 121 MHz, and chemical shifts reported (in parts per million) relative to external 85% phosphoric acid (δ = 0.0 ppm). TLC plates were visualized by UV or immersion in anisaldehyde stain (by volume: 93% ethanol, 3.5% sulfuric acid, 1% acetic acid, and 2.5% anisaldehyde) followed by heating.

Reagent and solvents.

H-Phosphinates were prepared using our previously reported Et_3B method (ref). Aryl chlorides were purchased by Alfa Aesar and Aldrich and used as received. $Pd(OAc)_2$ was purchased from Strem and Xantphos from Alfa Aesar. Toluene was freshly distilled

from CaH_2. . Ethylene glycol was dried and stored over activated 4A molecular sieves. *i*-Pr_2NEt was distilled over CaH_2 and stored under N_2 and 4A molecular sieves.

^{31}P NMR Yield Measurements.

The NMR yields are determined by integration of all the resonances in the ^{31}P spectra, an approach which is valid if no phosphorus-containing gas (i.e. PH_3) evolves, or if the precipitate in a heterogeneous mixture does not contain phosphorus. The yields determined by NMR are generally accurate within ~10% of the value indicated, and are reproductible.

Representative procedure for cross coupling :

To a tube was added *H*-Phosphinate (1 mmol, 1 eq), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol, 2 mol %), Xantphos (12.7 mg, 0.022 mmol, 2.2 mol %), Toluene and Ethylene Glycol (4.5 ml : 0.5 ml), *i*-Pr_2NEt (0.23 ml, 1.3 mmol, 1.3 eq) and aryl chloride (1 mmol, 1 eq). The heterogeneous mixture was stirred under a flow of N_2 for 10 minutes and then heated at 110°C for 24 hrs. After cooling to rt, the reaction mixture was diluted with ca. 2.5 ml EtOH until homogenous for ^{31}P NMR of the crude.

Procedure A
The solvent was then evaporated and the resulting residue partitioned between EtOAc (10 ml) and H_2O (5 ml). The aqeuous layer was extracted with EtOAc (3 x 5 ml). The organic layers were combined, dried over $MgSO_4$ and concentrated under reduced pressure. The resulting oil was then purified by chromatography (silica gel) using mixtures of hexanes and EtOAc.

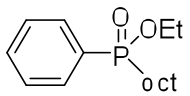
Procedure B
The solvent was then evaporated and the resulting residue partitioned between toluene (10 ml) and H_2O (5 ml). The aqeuous layer was extracted with toluene (3 x 5 ml). The organic layers were combined, dried over $MgSO_4$ and concentrated under reduced pressure. The resulting oil was then purified by chromatography (silica gel) using mixtures of hexanes and EtOAc.

Representative procedure for cross coupling with nixantphos:

Run 1:To a tube was added *H*-Phosphinate (1 mmol, 1 eq), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol, 2 mol %), nixantphos polymer (0.26mmol/g, 85 mg, 0.022 mmol, 2.2 mol %), Toluene and Ethylene Glycol (4.5 ml : 0.5 ml), *i*-Pr_2NEt (0.23 ml, 1.3 mmol, 1.3 eq) and aryl chloride (1 mmol, 1 eq). The heterogeneous mixture was stirred under a flow of N_2 for 10 minutes and then heated at 110°C for 24 hrs. After cooling to rt, the reaction mixture was diluted with ca. 2.5 ml EtOH until homogenous for ^{31}P NMR of the crude.

Run 2:The catalytic system is filtered via frit, then washed with 10 mL of Toluene. Then the second run is started with this catalytic system, *H*-Phosphinate (1 mmol, 1 eq), Toluene and Ethylene Glycol (4.5 ml : 0.5 ml), *i*-Pr_2NEt (0.23 ml, 1.3 mmol, 1.3 eq) and aryl chloride (1 mmol, 1 eq). The heterogeneous mixture was stirred under a flow of N_2 for 10 minutes and then heated at 110°C for 24 hrs.

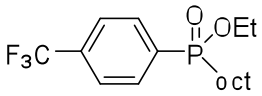
Ethyl octylphenylphosphinate[i] (Table 2, entries 1-4)



Chemical Formula: $C_{16}H_{27}O_2P$
Molecular Weight: 282.36

^{1}H NMR ($CDCl_3$, 300 MHz) δ 7.82-7.75 (m, 2H), 7.56-7.45 (m, 3H), 4.10-3.78 (dm, 2H), 2.05-1.75 (m, 2H), 1.75-1.52 (m, 2H), 1.50-1.12 (m, 13H), 0.90-0.74 (m, 3H) ppm, ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 46.0 ppm

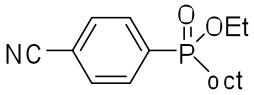
Ethyl octyl(4-trifluorophenyl)phosphinate (Table 2, entry 5)



Chemical Formula: $C_{17}H_{26}F_3O_2P$
Molecular Weight: 350.36

Yield = 65%; ^{1}H NMR ($CDCl_3$, 300 MHz) δ 7.95-7.83 (m, 2H), 7.76-7.27 (m, 2H), 4.15-3.81 (dm, 2H), 1.97-1.82 (m, 2H), 1.79-1.46 (m, 2H), 1.40-1.06 (m, 13H), 0.98-0.83 (m, 3H) ppm ; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 135.8 (d, J_{PC} = 118.6 Hz, C), 134.1 (d, J_{FCC} = 35.4 Hz, C), 132.3 (d, J_{PCC} = 10.1, 2*CH), 125.7-125.5 (m, 2*CH), 123.8 (q, J_{FC}= 273.1 Hz, CF_3), 61.0 (d, J_{POC} = 6.3 Hz, CH_2), 31.9 (CH_2), 30.9 (d, J_{PCC} = 16.1, CH_2), 29.8 (d, J_{PC} = 101.1 Hz, CH_2), 29.2 (2*CH_2), 22.8 (CH_2), 21.7 (d, J_{PCCC} = 3.7 Hz, CH_2), 16.4 (d, J_{POCC} = 6.0 Hz, CH_3), 14.2 (CH_3); ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 44.2 (s) ppm; ^{19}F NMR ($CDCl_3$, 282.28 MHz) δ -63.6 ppm ; HRMS (EI^+) m/z calcd for $C_{17}H_{26}F_3O_2P$ ($[M]^+$) 350.1623 found 350.1625

Ethyl octyl(4-cyanophenyl)phosphinate (Table 2, entry 6)

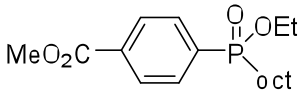


Chemical Formula: $C_{17}H_{26}NO_2P$
Molecular Weight: 307.37

Yield = 58%; ^{1}H NMR ($CDCl_3$, 300 MHz) δ 7.96-7.90 (m, 2H), 7.82-7.79 (m, 2H), 4.15-3.87 (dm, 2H), 1.94-1.83 (m, 2H), 1.56-1.48 (m, 2H), 1.36-1.23 (m, 13H), 0.91-0.87 (m, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 136.7 (d, J_{PC} = 117.5 Hz, C), 132.2 (d, J_{PCC} = 16.4 Hz, 2*CH), 132.2 (d, J_{PCCC} = 5.5 Hz, 2*CH), 117.9 (CN), 115.9 (d, J_{PCCCC} = 2.9 Hz, CH), 61.0 (d, J_{POC} = 6.3 Hz, CH_2), 31.7 (CH_2), 30.6 (d, J_{PCC} = 15.8 Hz, CH_2), 29.6 (d, J_{PC} = 95.0 Hz, CH_2), 29.0 (2*CH_2), 22.6 (CH_2), 21.5 (d, J_{PCCC} = 3.7 Hz, CH_2), 16.5 (d, J_{POCC}

= 6.3 Hz, CH_3), 14.1 (CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 43.9 (s) ppm ; HRMS (EI^+) m/z calcd for $C_{17}H_{26}NO_2P$ ($[M]^+$) 307.1701 found 307.1708

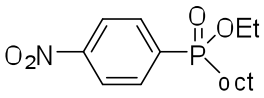
Ethyl octyl(4-methylbenzoate)phosphinate (Table 2, entry 7)



Chemical Formula: $C_{18}H_{29}O_4P$
Molecular Weight: 340.39

Yield = 67%; ^1H NMR ($CDCl_3$, 300 MHz) δ 8.16-8.13 (m, 2H), 7.90-7.83 (m, 2H), 4.16-3.81 (dm, 2H), 3.96 (s, 3H), 2.00-1.83 (m, 2H), 1.79-1.46 (m, 2H), 1.42-1.15 (m, 13H), 0.96-0.84 (m, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 166.5 (C), 136.2 (d, J_{PC} = 118.0 Hz, C), 133.6 (C), 131.9 (d, J_{PCCC} = 9.8 Hz, 2*CH), 129.8 (d, J_{PCC} = 12.4 Hz, 2*CH), 61.0 (d, J_{POC} = 6.3 Hz, CH_2), 52.7 (CH_3), 30.9 (d, J_{PCC} = 16.1 Hz, CH_2), 29.9 (d, J_{PC} = 98.8 Hz, CH_2), 29.2 (2 *CH_2), 22.8 (CH_2), 21.8 (d, J_{PCCC} = 3.5 Hz, CH_2), 16.7 (d, J_{POCC} = 6.3 Hz, CH_3), 14.3 (CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 45.0 (s) ppm ; HRMS (EI^+) m/z calcd for $C_{18}H_{29}O_4P$ ($[M]^+$) 340.1803 found 340.1807

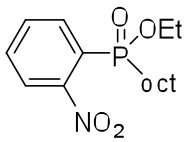
Ethyl octyl(4-nitrophenyl)phosphinate (Table 2, entry 8)



Chemical Formula: $C_{16}H_{26}NO_4P$
Molecular Weight: 327.36

Yield = 64%; ^1H NMR ($CDCl_3$, 300 MHz) δ 8.36 (m, 2H), 8.02-7.91(m, 2H), 4.17-3.81 (dm, 2H), 2.04-1.78 (m, 2H), 1.63-1.45 (m, 2H), 1.335-1.20 (m, 13H), 0.87-0.82 (m, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 150.4 (C), 138.6 (d, J_{PC} = 116.6 Hz, C), 133.1 (d, J_{PCCC} = 10.4 Hz, 2*CH), 123.7 (d, J_{PCC} = 12.4 Hz, CH), 61.4 (d, J_{POC} = 6.6 Hz, CH_2), 31.9 (CH_2), 30.8 (d, J_{PCC} = 16.1 Hz, CH_2), 29.8 (d, J_{PC} = 101.1 Hz, CH_2), 29.2 (2*CH_2), 22.8 (CH_2), 21.7 (d, J_{PCCC} = 3.7 Hz, CH_2), 16.7 (d, J_{POCC} = 6.3 Hz, CH_3), 14.3 (CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 43.2 (s) ppm; HRMS (EI^+) m/z calcd for $C_{16}H_{26}NO_4P$ ($[M]^+$) 327.1599 found 327.1599

Ethyl octyl(2-nitrophenyl)phosphinate (Table 2, entry 9)

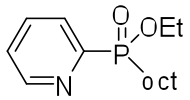


Chemical Formula: $C_{16}H_{26}NO_4P$
Molecular Weight: 327.36

Yield = 57%; ^1H NMR ($CDCl_3$, 300 MHz) δ 8.19-8.12 (m, 1H), 7.88-7.76 (m, 1H), 4.15-3.80 (dm, 2H), 2.28-2.18 (m, 2H), 1.74–1.48 (m, 2H), 1.38-1.07 (m, 13H), 0.88-0.83 (m, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 152.4 (C), 136.1 (d, J_{PCCC} = 6.0 Hz, CH), 133.3 (CH), 132.7 (d, J_{PCC} = 10.1 Hz, CH), 126.4 (d, J_{PC} = 111.4 Hz, C), 124.4 (d, J_{PCCC} = 6.0 Hz, CH), 61.6 (d, J_{POC} = 6.9 Hz, CH_2), 31.0 (CH_2), 30.8 (d, J_{PCC} = 17.0, CH_2), 30.5

(d, J_{PC} = 104.2 Hz, CH_2), 29.2 (2 x CH_2), 22.8 (CH_2), 22.1 (d, J_{PCCC} = 4.0 Hz, CH_2), 16.4 (d, J_{POCC} = 6.3 Hz, CH_3), 14.3 (CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 43.3 (s) ppm; HRMS (EI^+) m/z calcd for $C_{16}H_{26}NO_4P$ ($[M]^+$) 327.1599 found 327.1590

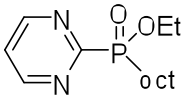
Ethyl octyl(2-pyridine)phosphinate (Table 2, entry 10)



Chemical Formula: $C_{15}H_{26}NO_2P$
Molecular Weight: 283.35

Yield = 80%; ^{1}H NMR ($CDCl_3$, 300 MHz) δ 8.81 (d, J =2.62 Hz, 1H), 8.09 (t, J = 6.60 Hz, 1H), 7.87-7.81 (m, 1H), 7.33-7.46 (m, 1H), 4.16-3.83 (dm, 2H), 2.14-2.01 (m, 2H), 1.72-1.44 (m, 2H), 1.43-1.05 (m, 13H), 0.86 (t, J = 6.60 Hz, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 154.4 (d, J_{PC} = 151.4 Hz, CH), 150.6 (d, J_{PCNC} = 19.6 Hz, CH), 136.3 (d, J_{PCCC} = 6.2 Hz, CH), 128.5 (d, J_{PCC} = 20.7 Hz, CH), 126.0 (d, J_{PCCCC} = 3.2 Hz, CH), 61.1 (d, J_{POC} = 6.3 Hz, CH_2), 31.9 (CH_2), 30.8 (d, J_{PCC} = 15.8 Hz, CH_2), 29.1 (2*CH_2), 27.4 (d, J_{PC} = 100.8 Hz, CH_2), 22.8 (CH_2), 21.4 (d, J_{PCCC} = 3.7 Hz, CH_2), 16.6 (d, J_{POCC} = 6.0 Hz, CH_3), 14.2 (CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 42.8 (s) ppm; HRMS (EI^+) m/z calcd for $C_{15}H_{26}NO_2P$ ($[M]^+$) 284.1779 found 284.1780

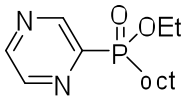
Ethyl octyl(2-pyrimidine)phosphinate (Table 2, entry 11)



Chemical Formula: $C_{14}H_{25}N_2O_2P$
Molecular Weight: 284.33

Yield = 51%; ^{1}H NMR ($CDCl_3$, 300 MHz) δ 8.93-8.89 (m, 2H), 7.46-7.41 (m, 1H), 4.45-3.76 (dm, 2H), 2.25-2.11 (m, 2H), 1.75-1.51 (m, 2H), 1.42-1.10 (m, 13H), 0.96-0.87 (m, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 166.5 (d, J_{PC} = 182.5 Hz, C), 156.9 (d, J_{PCNC} = 14.4 Hz, 2*CH), 122.2 (d, J_{PCNCC} = 2.9 Hz, CH), 61.9 (d, J_{POC} = 6.9 Hz, CH_2), 31.8 (CH_2), 30.8 (d, J_{PCC} = 15.8 Hz, CH_2), 29.0 (2*CH_2), 27.1 (d, J_{PC} = 101.0 Hz, CH_2), 22.6 (CH_2), 21.2 (d, J_{PCCC} = 4.3 Hz, CH_2), 16.6 (d, J_{POCC} = 6.0 Hz, CH_3), 14.1 (CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 38.8 (s) ppm; HRMS (EI^+) m/z calcd for $C_{14}H_{25}N_2O_2P$($[M]^+$) 284.1654 found 284.1652

Ethyl octyl(pyrazine)phosphinate (Table 2, entry 12)

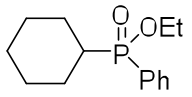


Chemical Formula: $C_{14}H_{25}N_2O_2P$
Molecular Weight: 284.33

Yield = 79%;
^{1}H NMR ($CDCl_3$, 300 MHz) δ 9.21(s, 1H), 8.75 (d, J= 9.96 Hz, 2H); 4.28-3.80 (dm, 2H), 2.20-1.95 (m, 2H), 1.77-0.99 (m, 18H), 0.97-0.72 (m, 3H); ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 150.0 (d, J_{PC} = 145.6 Hz, C), 148.4 (d, J_{PCC} = 21.6 Hz, CH), 146.8 (d, J_{PCNCC} = 2.9 Hz, CH), 145.3 (d, J_{PCNC} = 15.3 Hz, CH), 61.4 (d, J_{POC} = 6.6 Hz, CH_2), 31.7 (CH_2), 30.6 (d, J_{PCC} = 16.1 Hz, CH_2), 29.0 (2*CH_2), 27.4 (d, J_{PC} = 101.6 Hz, CH_2), 22.6 (CH_2),

21.2 (d, J_{PCCC} = 3.7 Hz, CH_2), 16.4 (d, J_{POCC} = 6.3 Hz, CH_3), 14.1 (CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 41.8 (s) ppm ; HRMS (EI^+) m/z calcd for $C_{14}H_{25}N_2O_2P$ ($[M]^+$) 284.1654 found 284.1653

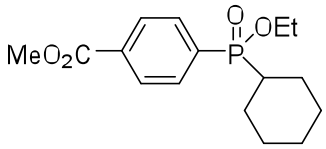
Ethyl cyclohexyl(phenyl)phosphinate[ii] (Table 2, entry 13)



Chemical Formula: $C_{14}H_{21}O_2P$
Molecular Weight: 252.29

Yield = 67 %; ^1H NMR ($CDCl_3$, 300 MHz) δ 7.83-7.69 (m, 2H), 7.61-7.43 (m, 3H), 4.21-3.55 (m, 2H), 2.1°-1.92(m, 1H), 1.91-1.52 (m, 5H), 1.48-1.05 (m, 8H) ppm ; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 47.3 (s) ppm

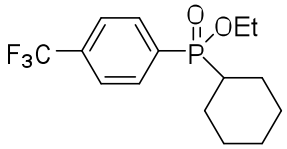
Ethyl cyclohexyl(4-methylbenzoate)phosphinate (Table 2, entry 14)



Chemical Formula: $C_{16}H_{23}O_4P$
Molecular Weight: 310.33

Yield = 86 %; ^1H NMR ($CDCl_3$, 300 MHz) δ 8.17-8.14 (m, 2H), 7.85 (t, J= 8.9 Hz, 2H), 4.17-3.85 (dm, 2H), 3.97 (s, 3H), 2.07-1.4 (m, 7H), 1.33 (t, J= 7.03 Hz, 3H), 1.29-1.21 (m, 4H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 166.4 (C), 135.0 (d, J_{PC} = 114.9 Hz, C), 133.3 (C), 132.3 (d, J_{PCCC} = 9.5 Hz, 2*CH), 129.4(d, J_{PCC} = 11.8 Hz, 2*CH), 60.8 (d, J_{POC} = 6.9 Hz, CH_2), 52.5 (CH_3), 38.4 (d, J_{PC} = 102.2 Hz, CH), 26.1 (d, J_{PCCC} = 15.0 Hz, 2*CH_2), 25.5 (d, J_{PCC} = 38.3 Hz, 2*CH_2), 24.9 (d, J_{PCCCC} = 3.7 Hz, CH_2), 16.5 (d, J_{POCC} = 6.3 Hz, CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 46.2 (s) ppm; HRMS (EI^+) m/z calcd for $C_{16}H_{23}O_4P$ ($[M]^+$) 310.1334 found 310.1327

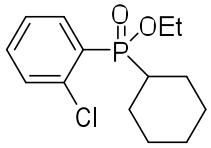
Ethyl cyclohexyl(4-trifluorophenyl)phosphinate (Table 2, entry 15)



Chemical Formula: $C_{15}H_{20}F_3O_2P$
Molecular Weight: 320.29

Yield = 69 %; ^1H NMR ($CDCl_3$, 300 MHz) δ 7.92-7.83 (m, 2H), 7.77-7.73 (m, 2H), 4.17-3.83 (dm, 2H), 2.06-1.91(m, 1H), 1.89-1.59 (m, 5H), 1.41-1.10 (m, 8H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 134.4 (d, J_{PC} = 115.2 Hz, C), 134.0 (d, J_{FCC} = 32.2 Hz, C), 132.8 (d, J_{PCC} = 9.5 Hz, 2*CH), 125.5-125.2 (m, 2*CH), 123.7 (q, J_{FC} = 272.8 Hz, CF_3), 61.0 (d, J_{POC} = 6.9 Hz, CH_2), 38.4 (d, J_{PC} = 102.5 Hz, CH), 26.0 (d, J_{PCCC} = 15.0 Hz, 2*CH_2) , 25.5 (d, J_{PCC} = 38.3 Hz, CH_2), 25.5 (d, J_{PCC} = 29.7 Hz, CH_2), 24.8 (d, J_{PCCCC} = 3.7 Hz, CH_2), 33.0 (d, J_{POCC} = 6.3 Hz, CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 45.7 (s) ppm; ^{19}F NMR ($CDCl_3$, 282.28 MHz) δ -63.7 ppm; HRMS (EI^+) m/z calcd for $C_{15}H_{20}F_3O_2P$ ($[M]^+$) 320.1153 found 320.1151

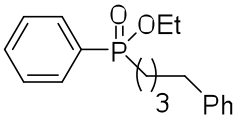
Ethyl cyclohexyl(2-chlorophenyl)phosphinate (Table 2, entry 16)



Chemical Formula: $C_{14}H_{20}ClO_2P$
Molecular Weight: 286.73

Yield = 47%; ^{1}H NMR ($CDCl_3$, 300 MHz) δ 8.07 (dd, J = 11.14 Hz, J = 7.62 Hz), 7.53-7.31 (m, 3H), 4.16-3.72 (dm, 2H), 2.37-2.15 (m, 1H), 2.12-1.96 (m, 1H), 1.95-1.45 (m, 12H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 137.3 (d, J_{PCCC} = 6.3 Hz, CH), 136.0 (d, J_{PCC} = 5.5 Hz, C), 133.4 (d, J_{PCCCC} = 2.3 Hz, CH), 130.6 (d, J_{PCCC} = 7.8 Hz, CH), 128.6 (d, J_{PC} = 113.7 Hz, C), 126.7 (d, J_{PCC} = 10.1 Hz, CH), 60.3 (d, J_{POC} = 7.5 Hz, CH_2), 36.7 (d, J_{PC} = 105.1, CH), 26.2 (d, J_{PCC} = 5.8 Hz, CH_2), 26.0 (d, J_{PCCC} = 2.9 Hz, CH_2), 25.8 (CH_2), 25.0 (CH_2), 24.3 (d, J_{PCC} = 5.5 Hz, CH_2), 16.3 (d, J_{POCC} = 6.6 Hz, CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 44.8 (s) ppm; HRMS (EI^+) m/z calcd for $C_{14}H_{20}ClO_2P$ ($[M]^+$) 286.0889 found 286.0890

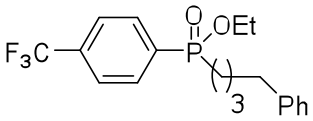
Ethyl phenylbutyl(phenyl)phosphinate (Table 2, entry 17)



Chemical Formula: $C_{18}H_{23}O_2P$
Molecular Weight.: 302.3478

Yield = 53%; ^{1}H NMR ($CDCl_3$, 300 MHz) δ 7.81-7.77 (m, 2H), 7.76-7.44 (m, 3H), 7.32-7.09 (m, 5H), 4.65-3.76 (dm, 2H), 2.64-2.48 (m, 2H), 2.09-1.79 (m, 2H), 1.77-1.45 (m, 4H), 1.33-1.é" (m, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 142.2 (C), 132.4 (d, J_{PCCCC} = 2.9 Hz, CH), 131.9 (d, J_{PCCC} = 9.8 Hz, CH), 131.2 (d, J_{PC} = 131.8 Hz, C), 128.8 (d, J_{PCC} = 12.4 Hz, CH), 128.6 (2*CH), 128.5 (2*CH), 126.0 (CH), 60.7 (d, J_{POC} = 6.6 Hz, CH_2), 35.6 (CH_2), 32.7 (d, J_{PCC} = 15.8 Hz, CH_2), 29.9 (d, J_{PC} = 100.5 Hz, CH_2), 21.6 (d, J_{PCCC} = 3.5 Hz, CH_2), 16.7 (d, J_{POCC} = 6.6 Hz, CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 45.7 (s) ppm; HRMS (EI^+) m/z calcd for $C_{18}H_{23}O_2P$ ($[M]^+$) 302.1436 found 302.1430

Ethyl phenylbutyl(4-trifluorophenyl)phosphinate (Table 2, entry 18)



Chemical Formula: $C_{19}H_{22}F_3O_2P$
Molecular Weight.: 370.3458

Yield = 82%; ^{1}H NMR ($CDCl_3$, 300 MHz) δ 7.95-7.89 (m, 2H), 7.81-7.72 (m, 2H), 7.33-7.08 (m, 5H), 4.21-3.78 (dm, 2H), 2.66-2.50 (m, 2H), 2.11-1.82 (m, 2H), 1.80-1.46 (m, 4H), 1.32 (t, J = 7.04 Hz, 3H) ppm; ^{13}C NMR ($CDCl_3$, 75.45 MHz) δ 141.9 (C), 135.5 (d, J_{PC} = 119.2 Hz, C), 134.1 (d, J_{FCC} = 32.5 Hz, C), 132.3 (d, J_{PCC} = 10.1 Hz, 2*CH), 128.5

(4*CH), 126.0 (CH), 125.8-125.5 (m, 2*CH), 123.5 (q, J_{FC} = 235.6 Hz, CF_3), 61.1 (d, J_{POC} = 6.6 Hz, CH_2), 35.4 (CH_2), 32.5 (d, J_{PCC} = 15.8 Hz, CH_2), 29.6 (d, J_{PC} = 101.1 Hz, CH_2), 21.3 (d, J_{PCCC} = 3.5 Hz, CH_2), 16.6 (d, J_{POCC} = 6.3 Hz, CH_3) ppm; ^{31}P NMR ($CDCl_3$, 121.47 MHz) δ 44.0 (s) ppm; ^{19}F NMR ($CDCl_3$, 282.28 MHz) δ – 63.6 ppm; HRMS (EI^+) m/z calcd for $C_{19}H_{22}F_3O_2P$ ($[M]^+$) 370.1310 found 370.1315

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[i] Abrunhosa-Thomas, I. ; Sellers, C.E ; Montchamp, J.-L. ; *J. Org. Chem.*, **2007**, *72*, 2851.

[ii] a) Pudovik, A.N.; Konovalona, I.V.; Zhurnal Obshchei Khimii, **1960**, *30*, 2348. b) Muller, E; Padeken, H.G.; Chem. Berichte, **1967**, *100*(2), 521.

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sw           4803.1 pw90         17.200
at            1.994 alfa         20.000
np            19158        FLAGS
fb         not used  il                n
bs               16  in                n
ss                4  dp                y
d1            1.000  hs               nn
nt               16      PROCESSING
ct               16  fn        not used
   TRANSMITTER            DISPLAY
tn               H1  sp          -170.6
sfrq        300.053  wp          3288.9
tof           300.9  rfl          593.6
tpwr             55  rfp              0
pw            8.600  rp            -99.0
    DECOUPLER        lp           -75.6
dn              C13          PLOT
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dm              nnn  sc               0
dmm               c  vs             254
dpwr             45  th               2
dmf           13100  ai  cdc  ph
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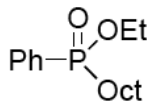
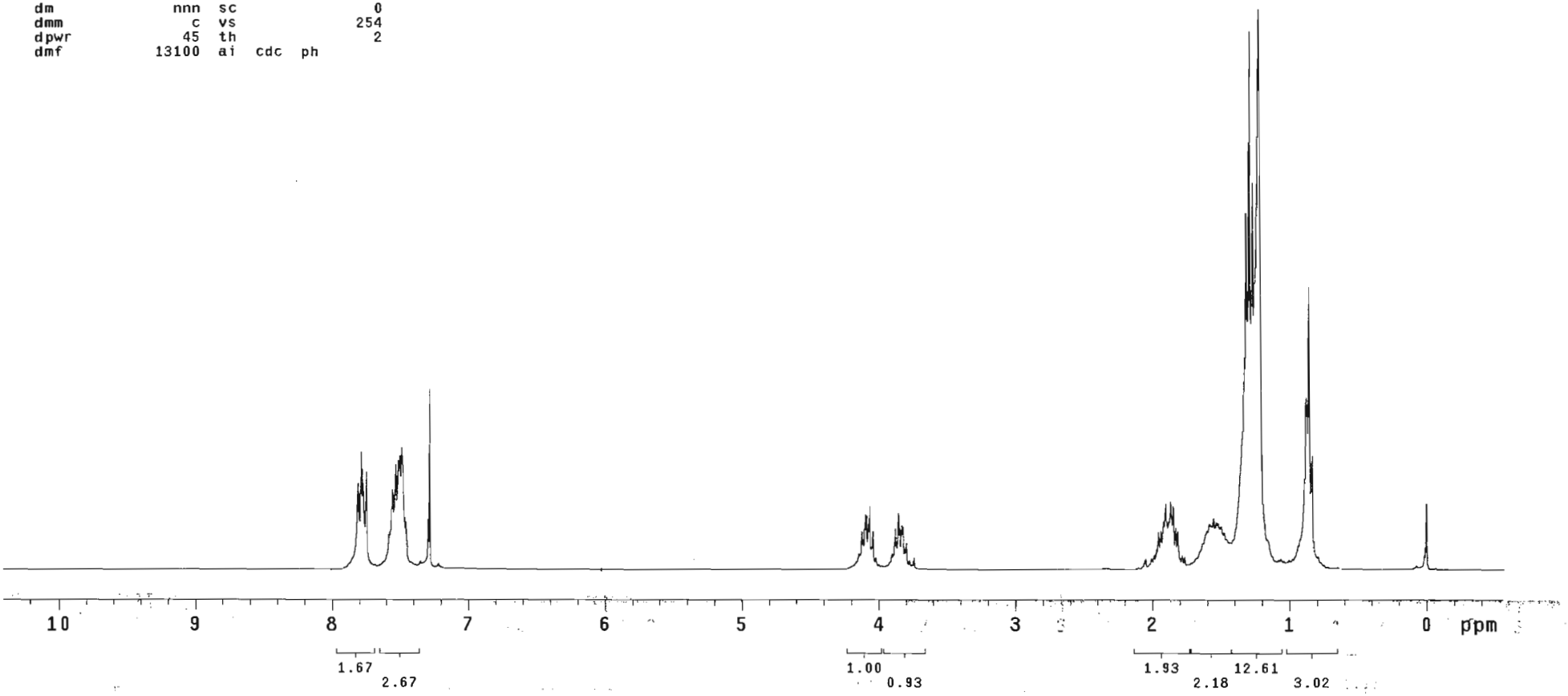


Table 2 Entries 1-4

^{1}H NMR



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file            exp  spin             20
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sw          26738.0  pw90         18.300
at            1.598  alfa         20.000
np            85476        FLAGS
fb            14800  il                n
bs               64  in                n
ss                4  dp                y
d1            1.000  hs               nn
nt               64     PROCESSING
ct               64  lb             1.00
   TRANSMITTER       fn         not used
tn              P31       DISPLAY
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tof         10608.2  wp          10010.0
tpwr             55  rfl          2437.3
pw            7.117  rfp               0
    DECOUPLER        rp           -100.8
dn                H1  lp           -437.0
dof                0        PLOT
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dmm                w  sc                0
dpwr              35  vs                4
dmf             6700  th               57
                      ai  no  ph
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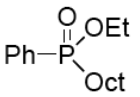
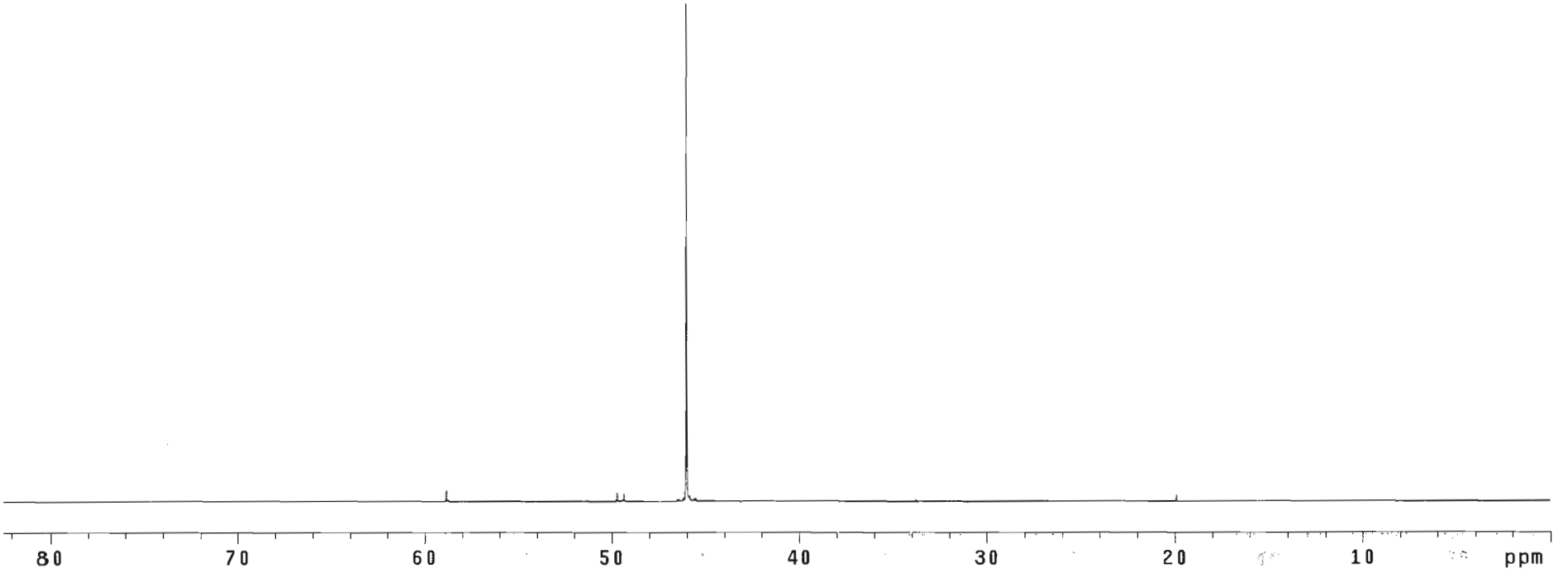


Table 2 Entries 1-4

^{31}P decoupled NMR



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exp1  s2pul

      SAMPLE                SPECIAL
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solvent      CDCl3  gain       not used
file           exp  spin             20
   ACQUISITION      hst           0.008
sw         26738.0  pw90         18.300
at           1.598  alfa         20.000
np           85476        FLAGS
fb           14800  il                n
bs              64  in                n
ss               4  dp                y
d1           1.000  hs               nn
nt              64     PROCESSING
ct              64  lb             1.00
   TRANSMITTER      fn         not used
tn             P31       DISPLAY
sfrq       121.474  sp             33.4
tof        10608.2  wp           9976.1
tpwr            55  rf1          2437.3
pw           7.117  rfp               0
    DECOUPLER       rp           -151.3
dn               H1  lp           -288.8
dof               0         PLOT
dm              ynn  wc              250
dmm               w  sc                0
dpwr             35  vs               41
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                     ai   no   ph
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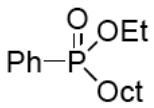
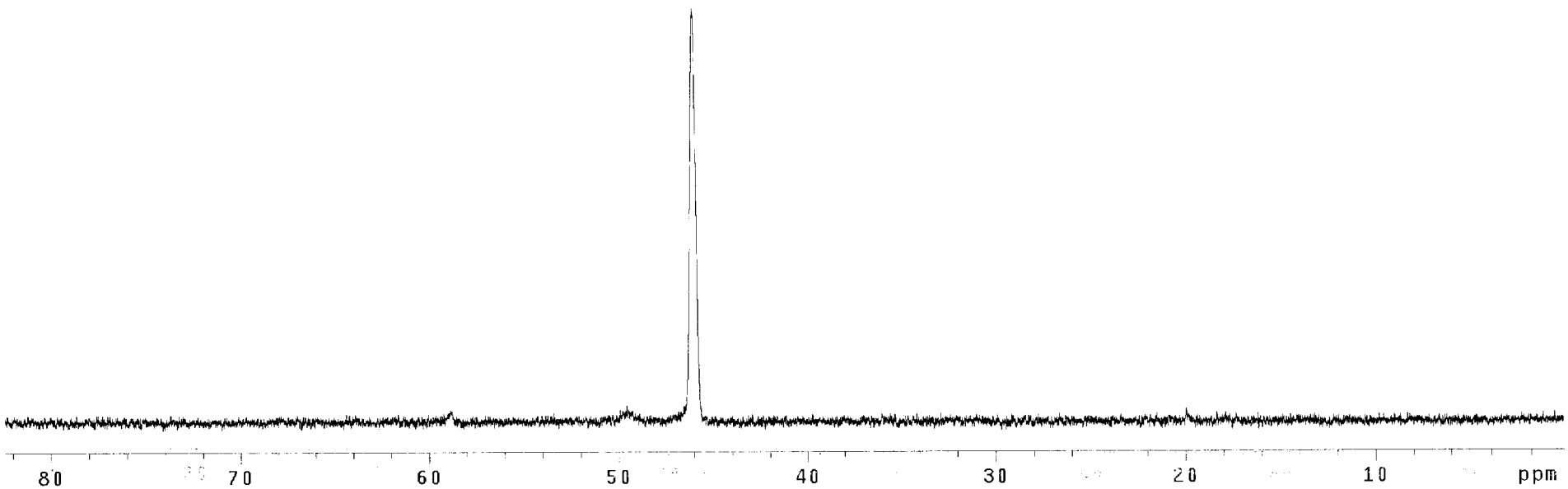


Table 2 Entries 1-4

^{31}P coupled NMR



3.85

exp1 s2pul

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solvent	CDCl3	gain	not used
file	exp	spin	20
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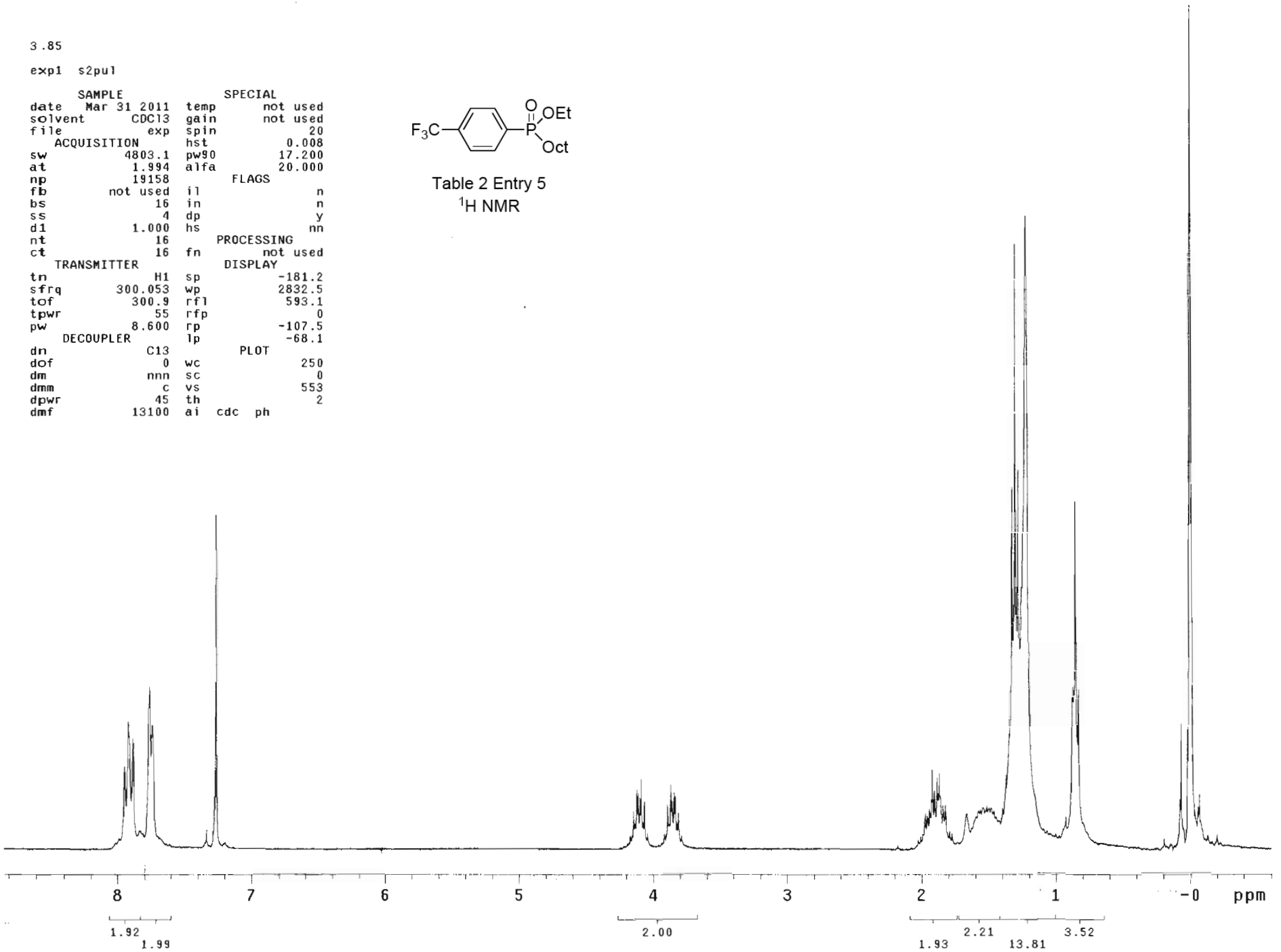
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-181.2
sfrq	300.053	wp	2832.5
tof	300.9	rfl	593.1
tpwr	55	rfp	0
pw	8.600	rp	-107.5
DECOUPLER		lp	-68.1
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	553
dpwr	45	th	2
dmf	13100	ai cdc ph	

Table 2 Entry 5
^{1}H NMR

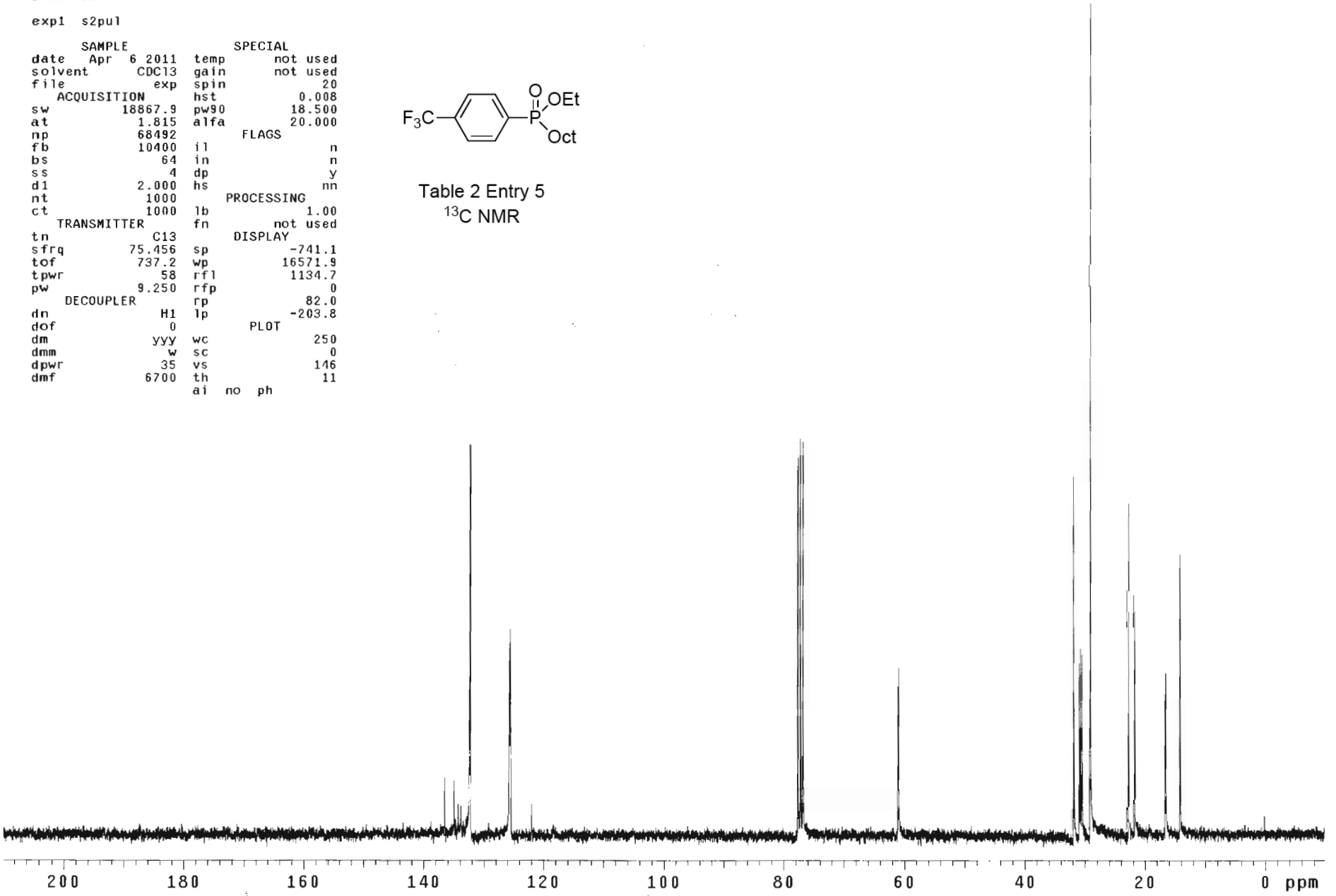


3.85.13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 6 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	2.000	hs	nn
nt	1000	PROCESSING	
ct	1000	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-741.1
tof	737.2	wp	16571.9
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	82.0
dn	H1	lp	-203.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	146
dmf	6700	th	11
		ai no ph	

Table 2 Entry 5
^{13}C NMR



3.85

exp1 s2pul

SAMPLE		SPECIAL	
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solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	-51.4
tof	10608.2	wp	11215.2
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
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dn	H1	lp	-288.8
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dmf	6700	th	3
		ai no ph	

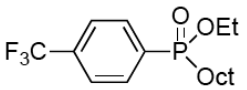
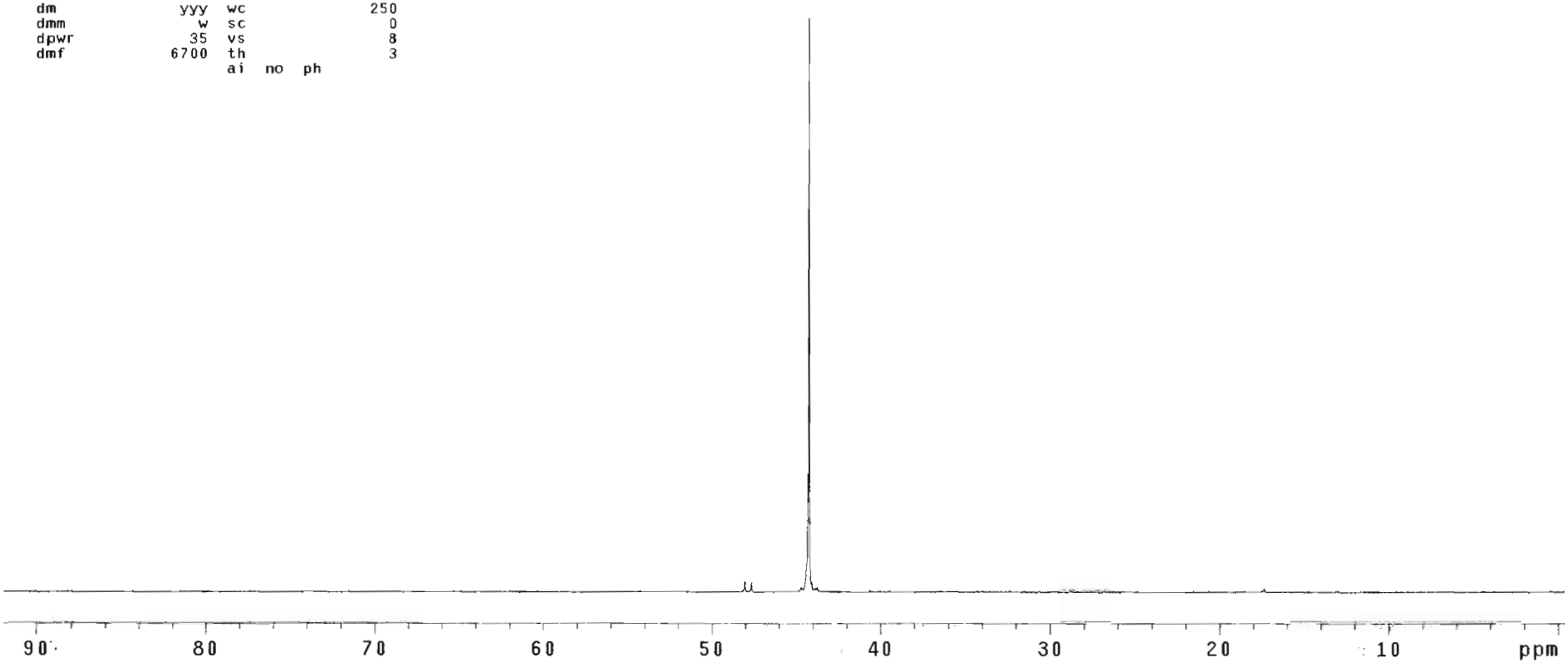


Table 2 Entry 5

^{31}P decoupled NMR



3.85

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 31 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	-51.4
tof	10608.2	wp	11215.2
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-155.2
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	37
dmf	6700	th	5
		ai no ph	

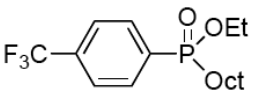
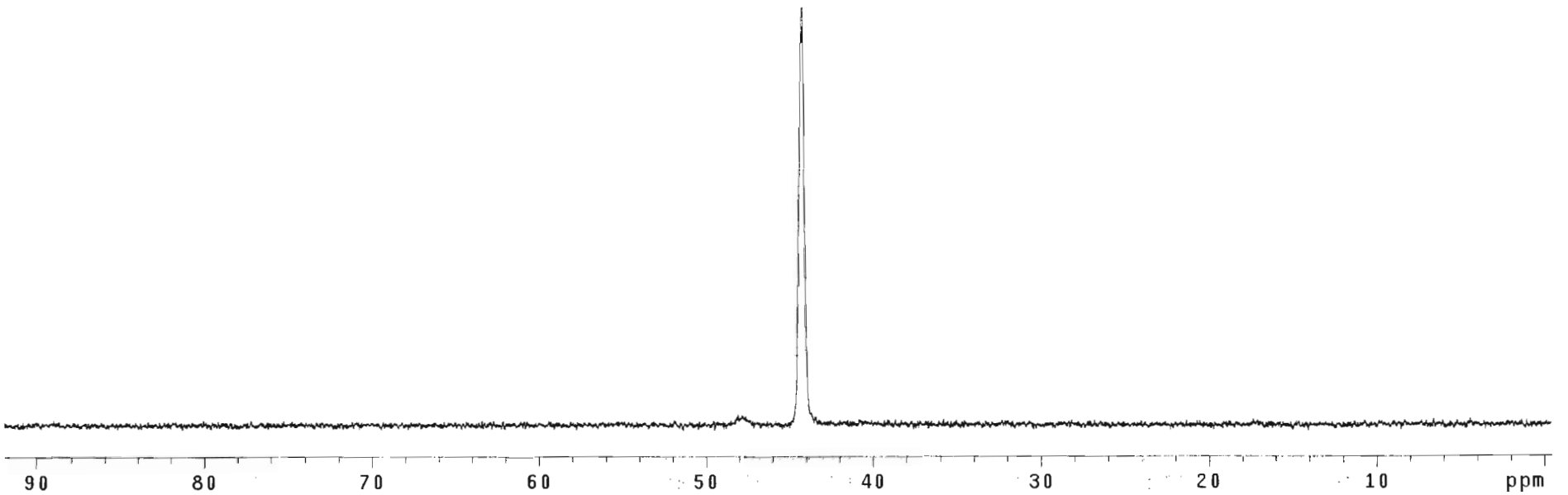


Table 2 Entry 5
^{31}P coupled NMR



3.85.19F

exp1 s2pul

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at	0.300	alfa	82.400
np	38898	FLAGS	
fb	35800	il	n
bs	16	in	n
ss	4	dp	y
d1	1.500	hs	nn
nt	64	PROCESSING	
ct	64	lb	0.30
TRANSMITTER		lsfid	-6
tn	F19	fn	not used
sfrq	282.306	DISPLAY	
tof	5380.7	sp	-34869.5
tpwr	57	wp	35212.1
pw	8.000	rfl	56465.6
DECOUPLER		rfp	0
dn	H1	rp	-153.9
dof	0	lp	0.0
dm	nnn	PLOT	
dmm	c	wc	250
dpwr	35	sc	0
dmf	6700	vs	5
		th	0
		ai no ph	

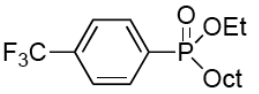
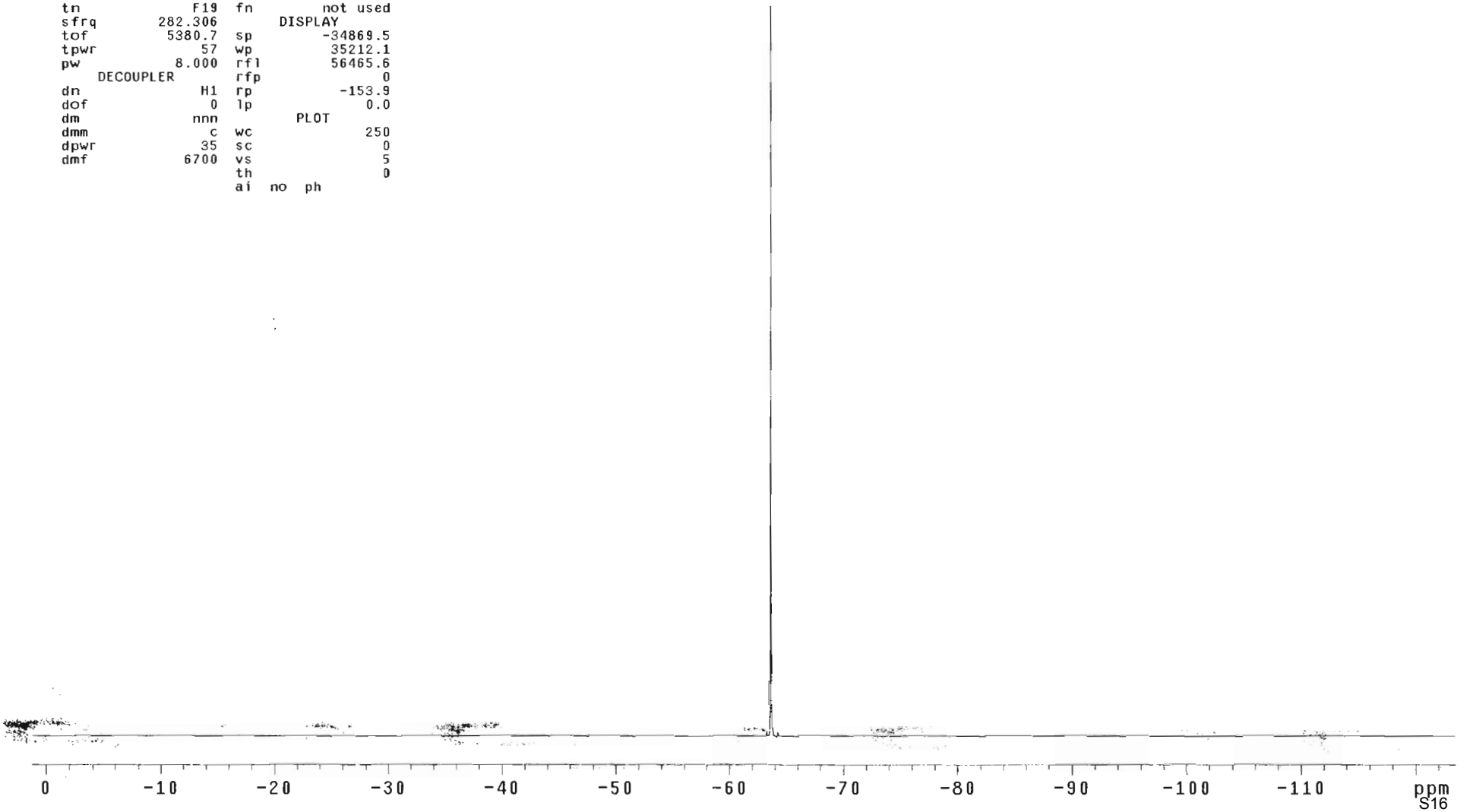


Table 2 Entry 5
^{19}F NMR



3.87.1H

exp1 s2pul

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solvent	CDCl3	gain	not used
file	exp	spin	20
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sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	8	PROCESSING	
ct	8	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-90.0
sfrq	300.053	wp	2587.7
tof	300.9	rfl	591.0
tpwr	55	rfp	0
pw	8.600	rp	-99.6
DECOUPLER		lp	-47.8
dn	C13	PLOT	
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dmm	c	vs	244
dpwr	45	th	2
dmf	13100	ai cdc ph	

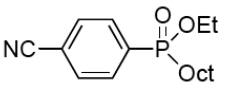
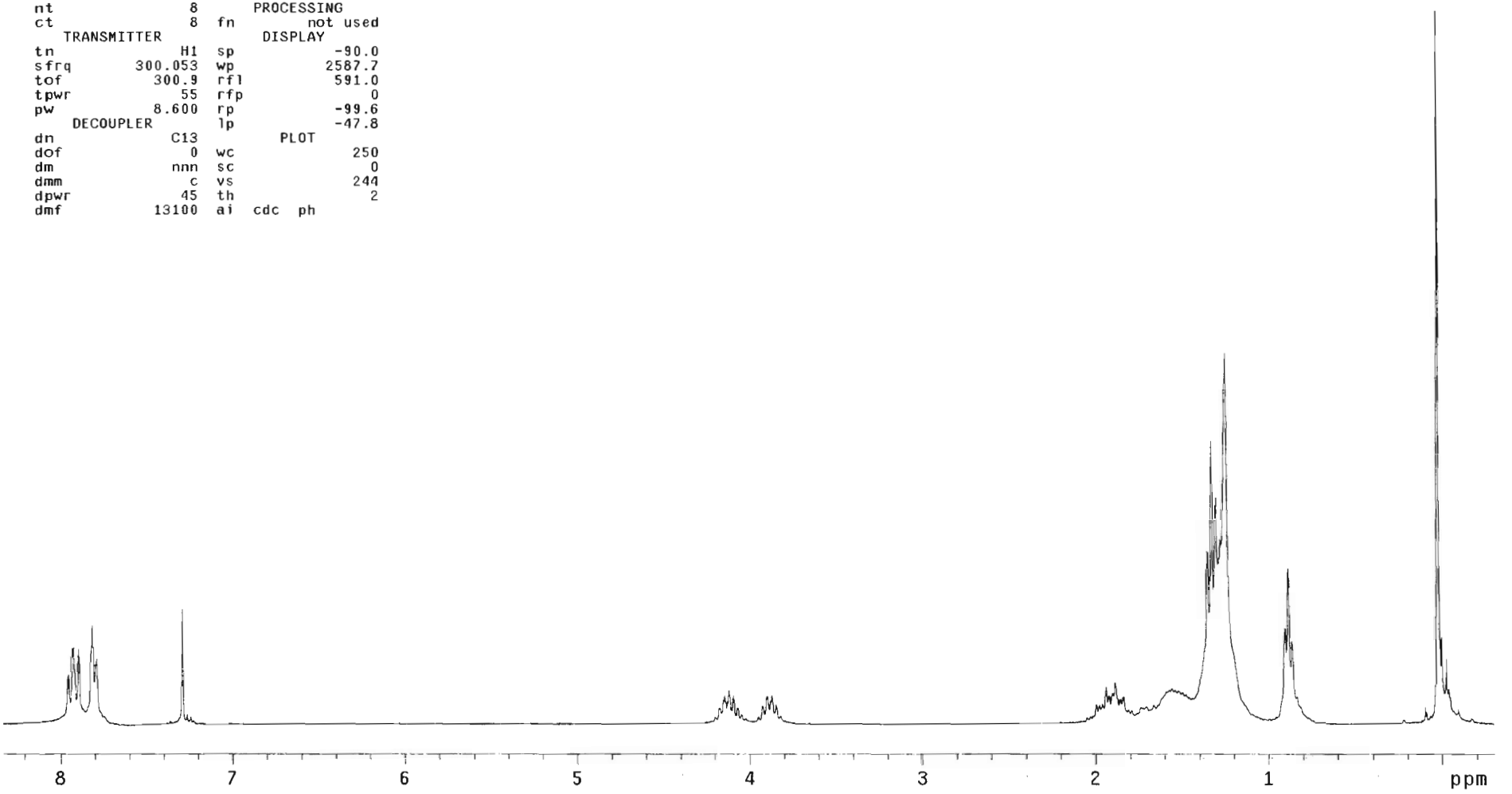


Table 2 Entry 6

^{1}H NMR



3.187.13C

exp1 s2pul

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at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	2.000	hs	nn
nt	512	PROCESSING	
ct	512	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-784.8
tof	737.2	wp	16593.8
tpwr	58	rfl	1148.7
pw	9.250	rfp	0
DECOUPLER		rp	108.9
dn	H1	lp	-265.6
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	77
dmf	6700	th	4
		ai no ph	

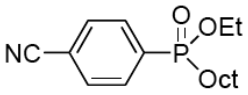
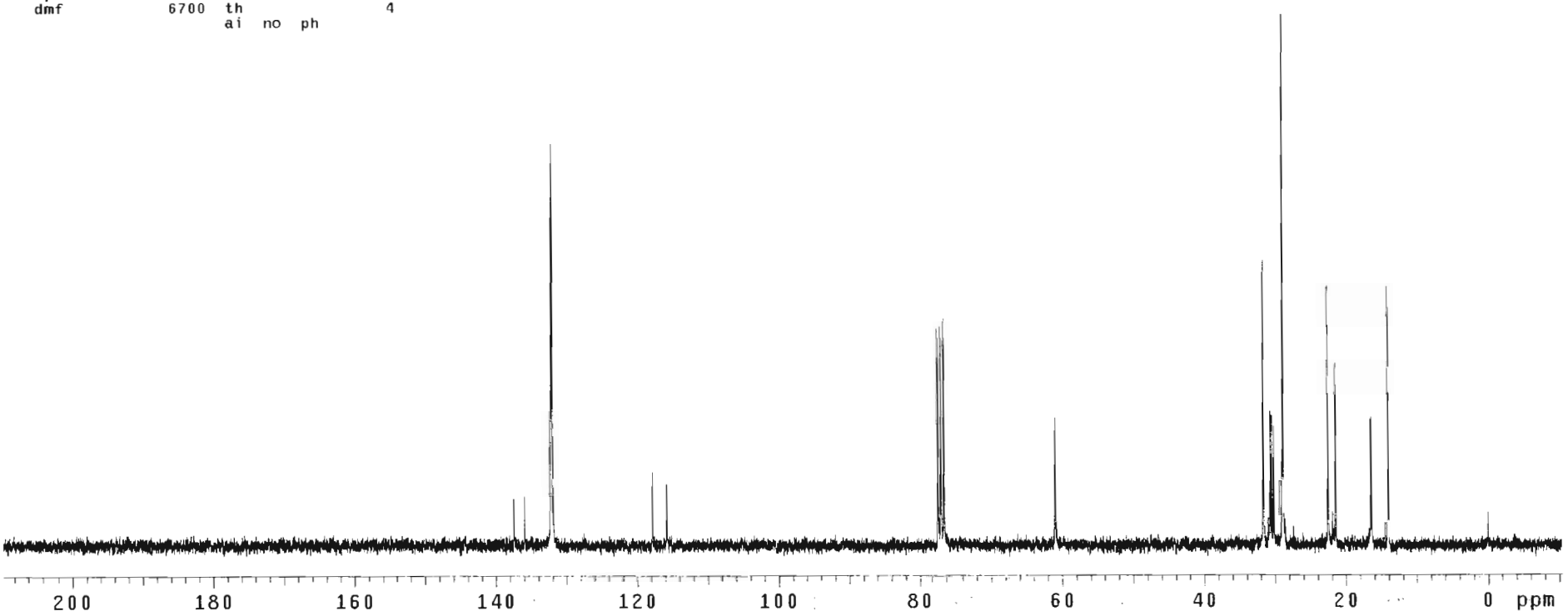


Table 2 Entry 6

^{13}C NMR



3.$87.31P dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 30 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	2117.0
tof	10608.2	wp	6382.2
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-175.1
dn	H1	lp	-193.1
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	13
dmf	6700	th	2
		ai no ph	

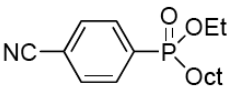
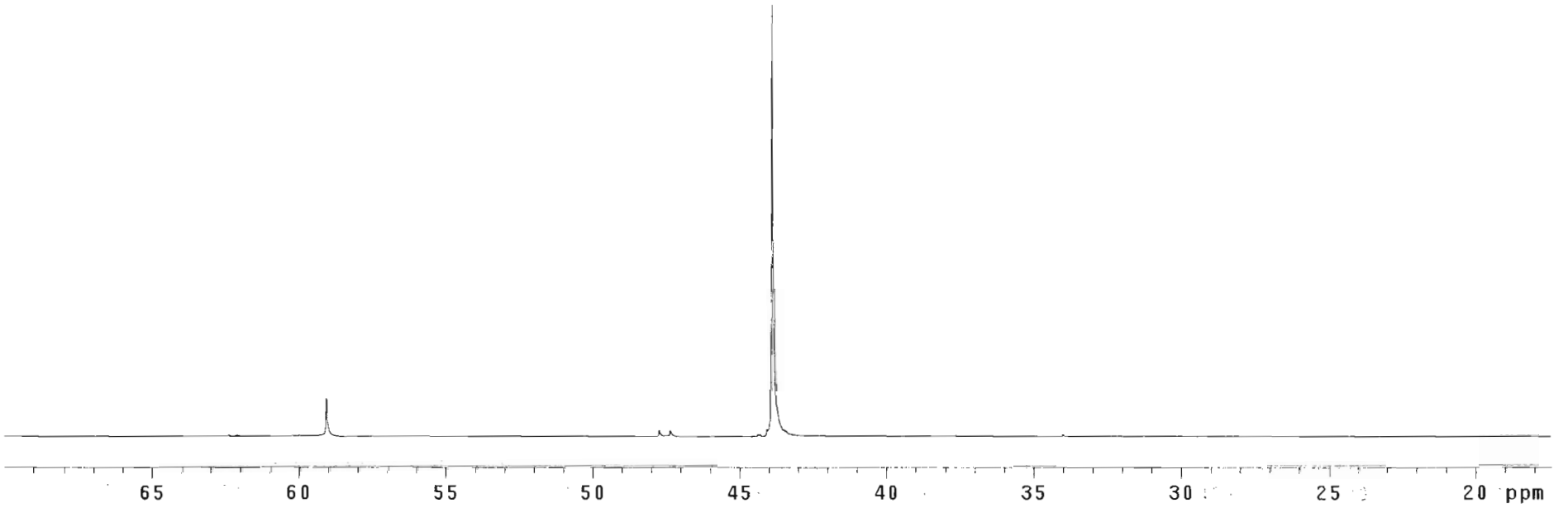


Table 2 Entry 6

^{31}P decoupled NMR



3.187.31P cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 30 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	32	PROCESSING	
ct	32	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	2674.8
tof	10608.2	wp	5638.4
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-144.8
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	32
dmf	6700	th	4
		ai no ph	

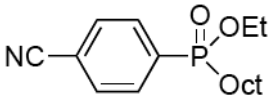
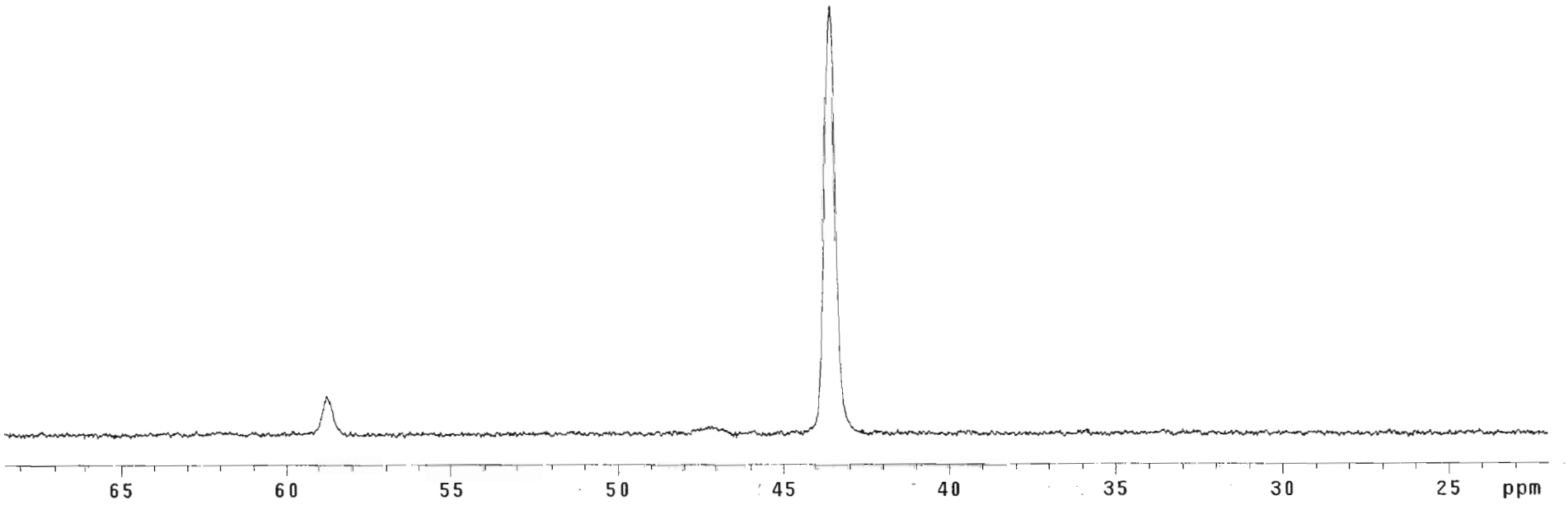


Table 2 Entry 6

^{31}P coupled NMR



3.109

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 31 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-204.6
sfrq	300.053	wp	3116.3
tof	300.9	rfl	594.2
tpwr	55	rfp	0
pw	8.600	rp	-99.8
DECOUPLER		lp	-55.4
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	194
dpwr	45	th	2
dmf	13100	ai cdc ph	

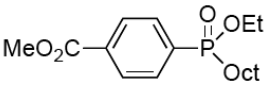
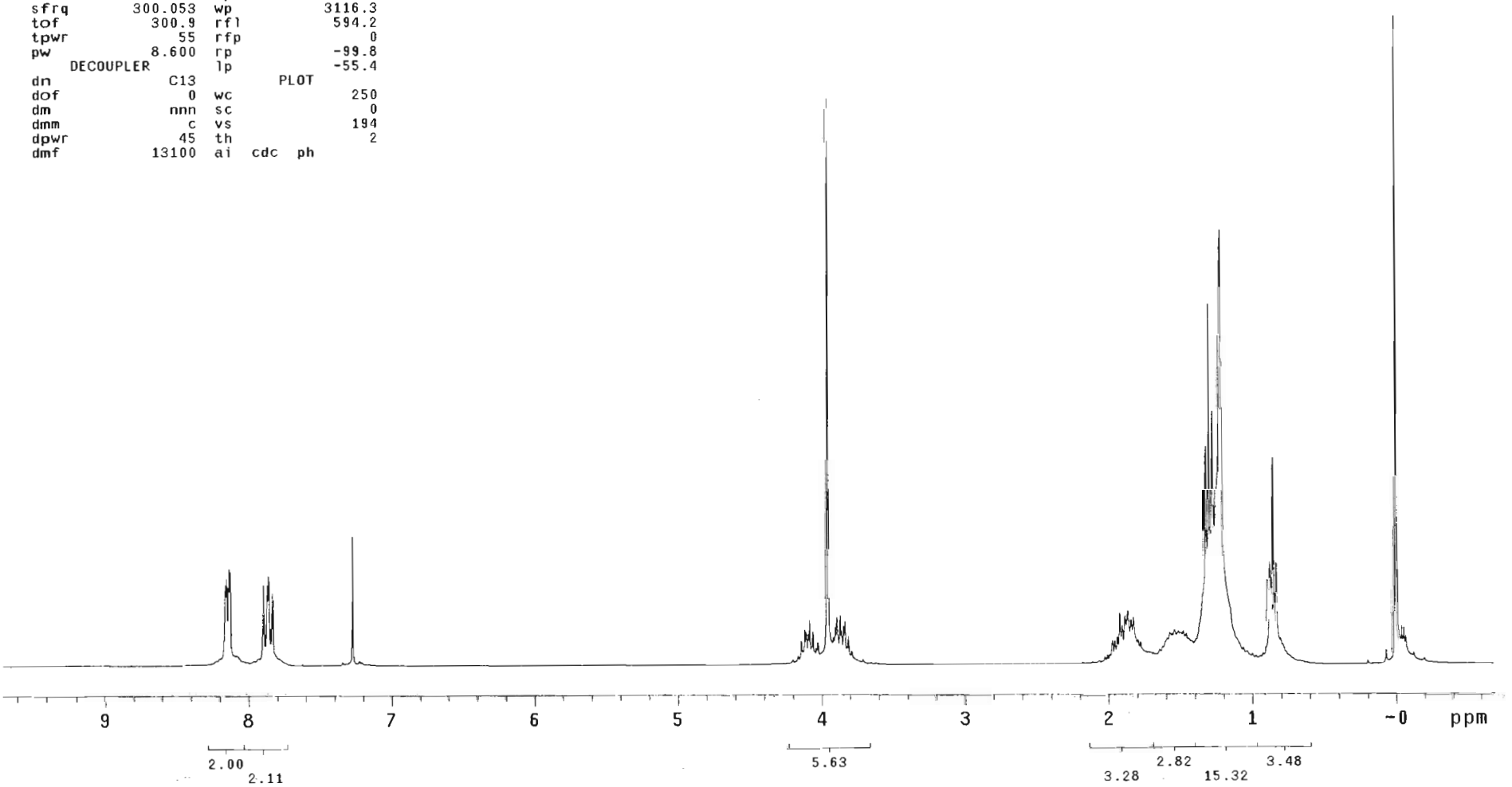


Table 2 Entry 7

^{1}H NMR



3.109.13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	2.000	hs	nn
nt	256	PROCESSING	
ct	256	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-741.1
tof	737.2	wp	16571.9
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	124.7
dn	H1	lp	-291.4
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	94
dmf	6700	th	6
		ai no ph	

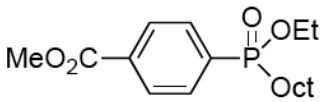
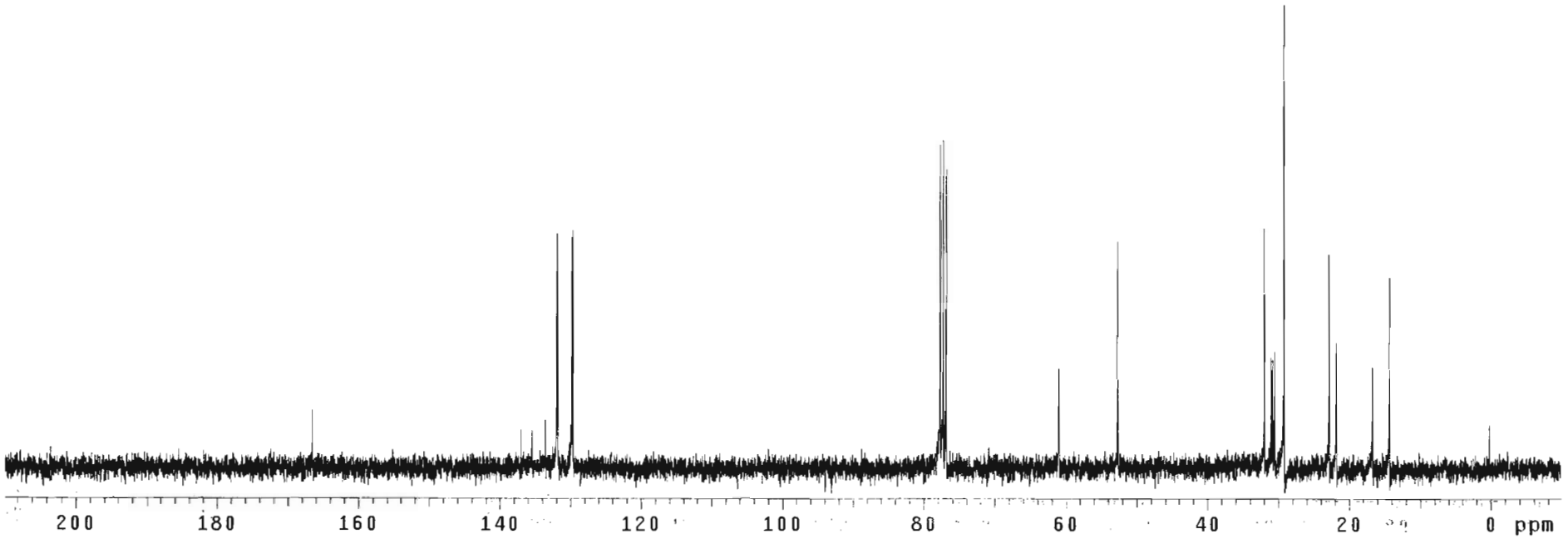


Table 2 Entry 7

^{13}C NMR



3.109.31P.dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	466.7
tof	10608.2	wp	9542.5
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-151.9
dn	H1	lp	-557.4
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	8
dmf	6700	th	3
		ai no ph	

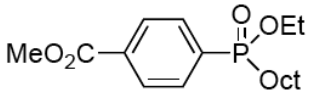
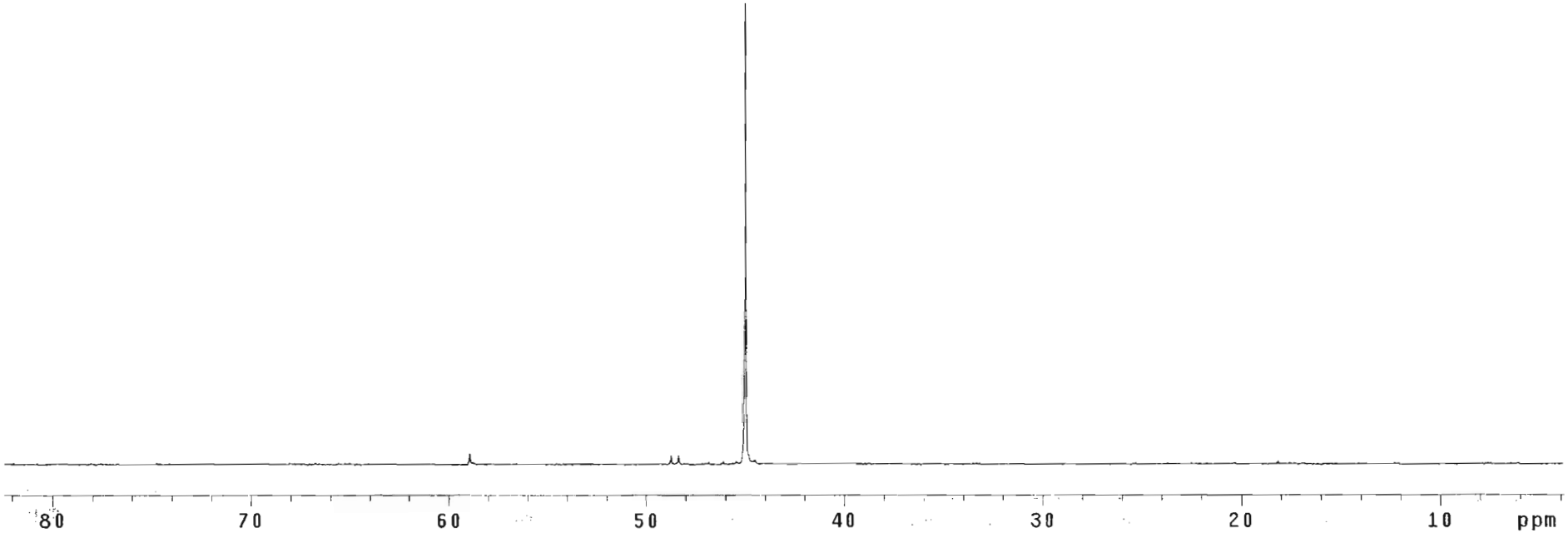


Table 2 Entry 7

^{31}P decoupled NMR



3.109.31P.cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	95.5
tof	10608.2	wp	9914.1
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	122.0
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	48
dmf	6700	th	6
		ai no ph	

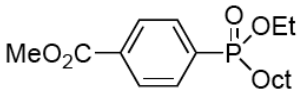
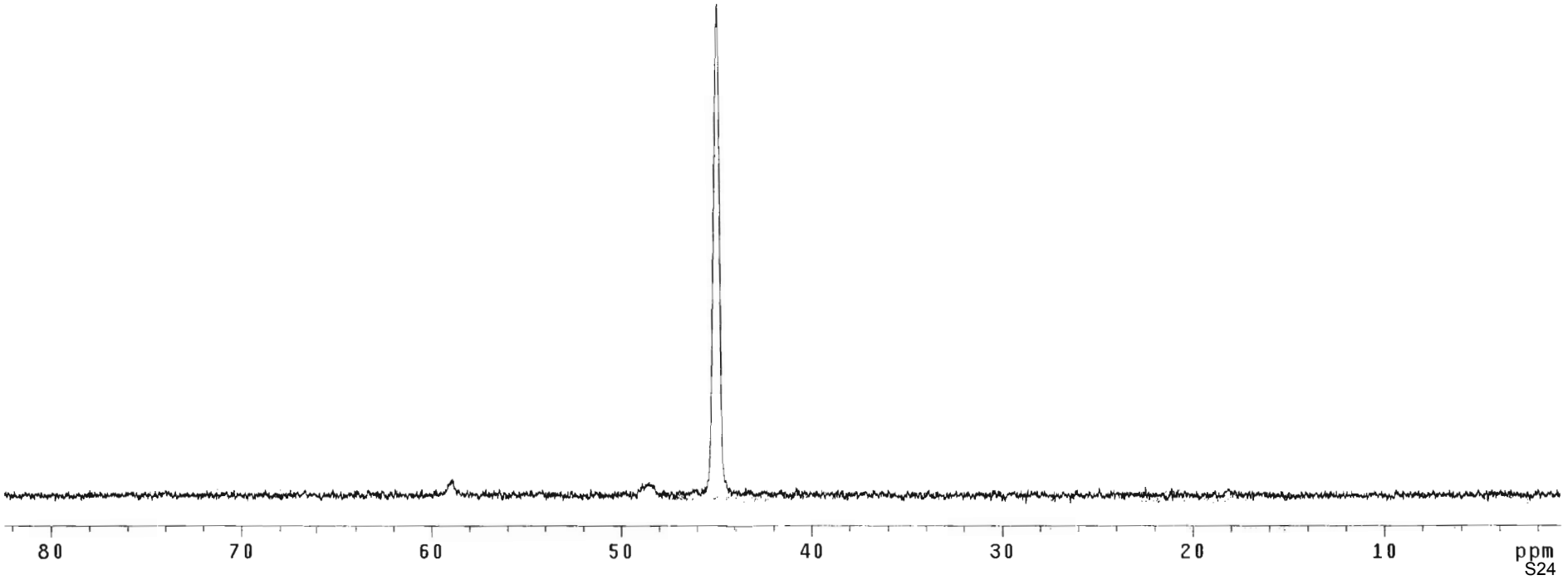


Table 2 Entry 7

^{31}P coupled NMR



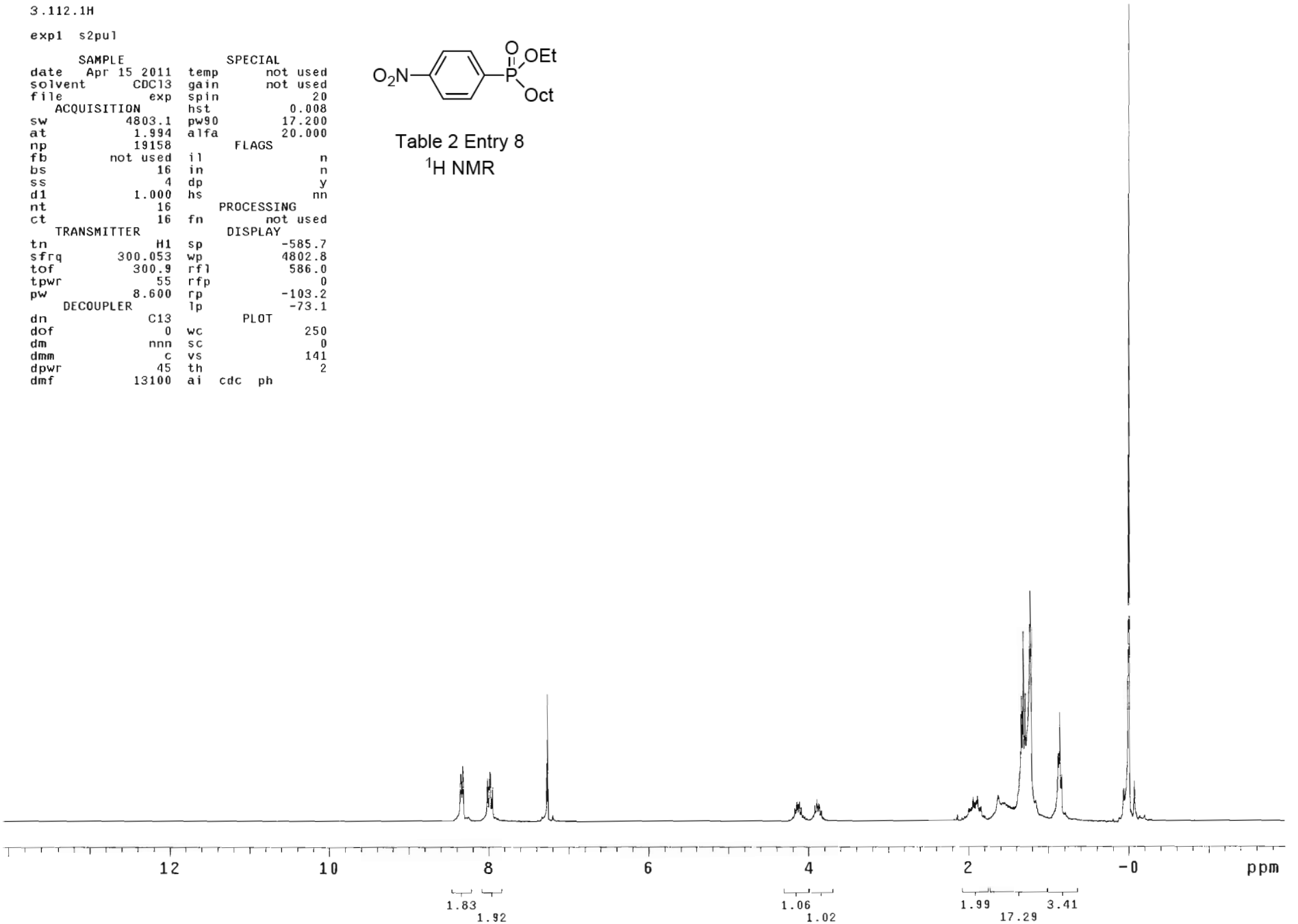
3.112.1H

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 15 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-585.7
sfrq	300.053	wp	4802.8
tof	300.9	rfl	586.0
tpwr	55	rfp	0
pw	8.600	rp	-103.2
DECOUPLER		lp	-73.1
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	141
dpwr	45	th	2
dmf	13100	ai cdc ph	

Table 2 Entry 8

^{1}H NMR



3.112.13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 15 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	1000	PROCESSING	
ct	1000	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-763.0
tof	737.2	wp	16615.7
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	100.4
dn	H1	lp	-249.5
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	141
dmf	6700	th	7
		ai no ph	

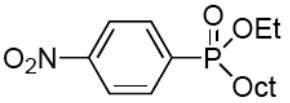
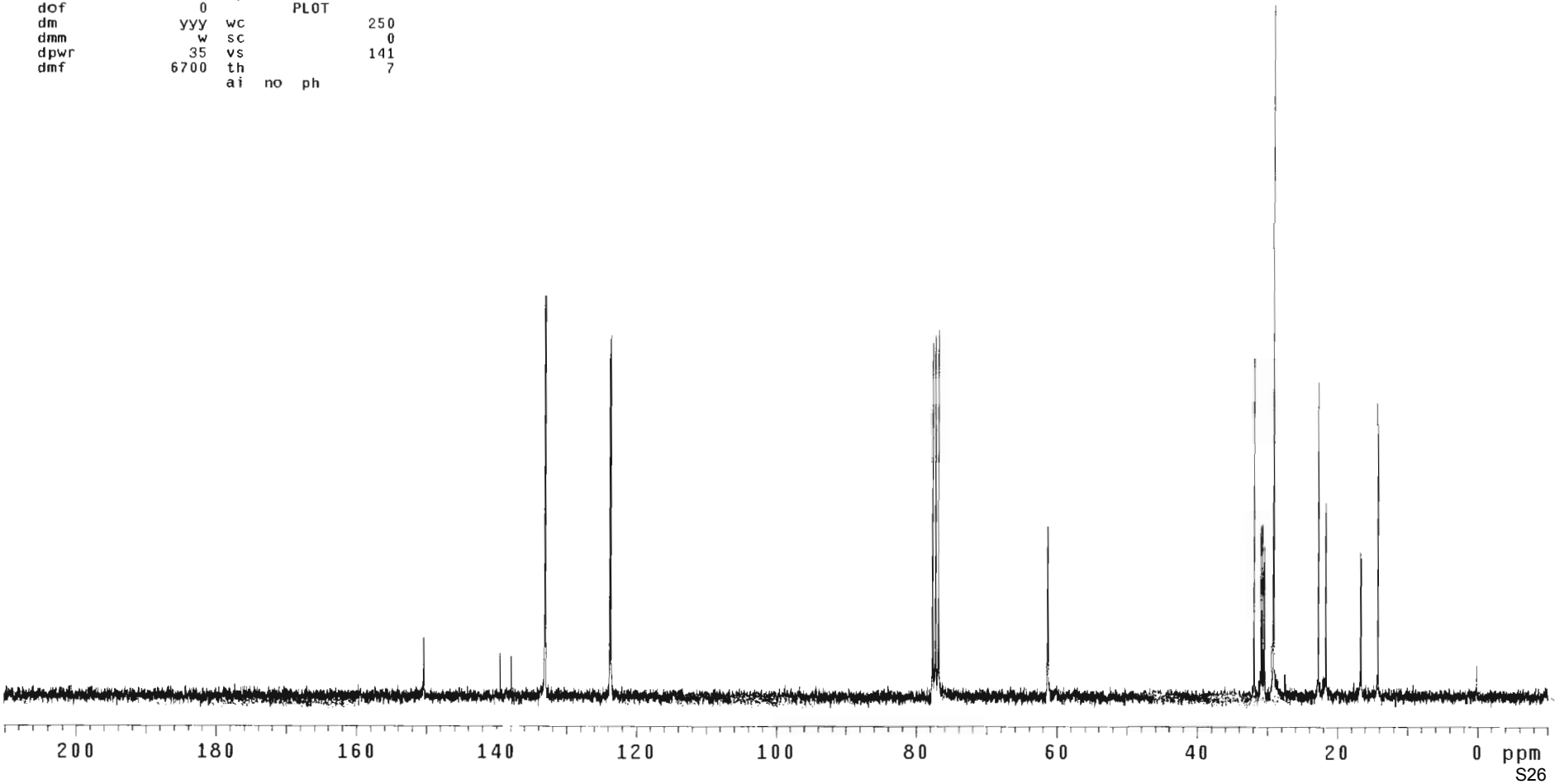


Table 2 Entry 8

^{13}C NMR



3.112.dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 23 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	-1228.9
tof	10608.2	wp	12206.6
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	140.4
dn	H1	lp	-366.1
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	19
dmf	6700	th	5
		ai no ph	

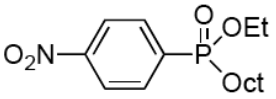
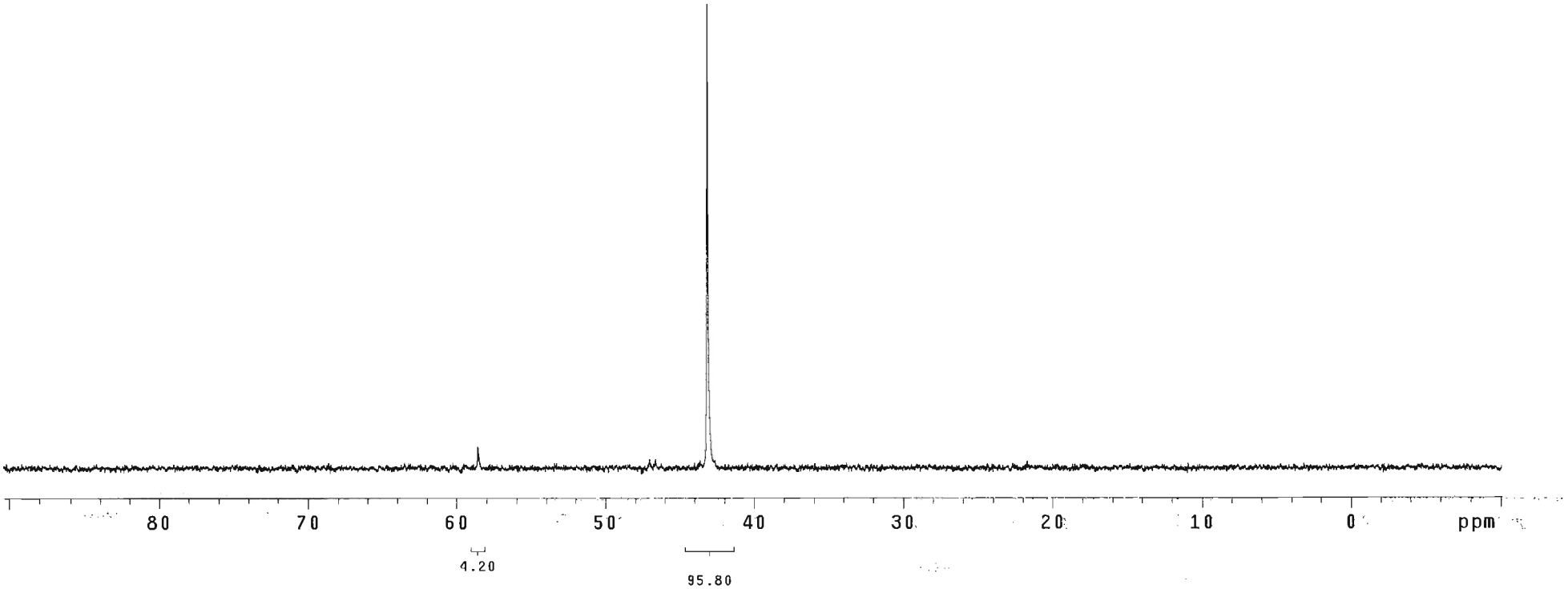


Table 2 Entry 8
^{31}P decoupled NMR



3.112.cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 23 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	-0.0
tof	10608.2	wp	10010.0
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	149.5
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	85
dmf	6700	th	12
		ai no ph	

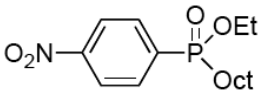
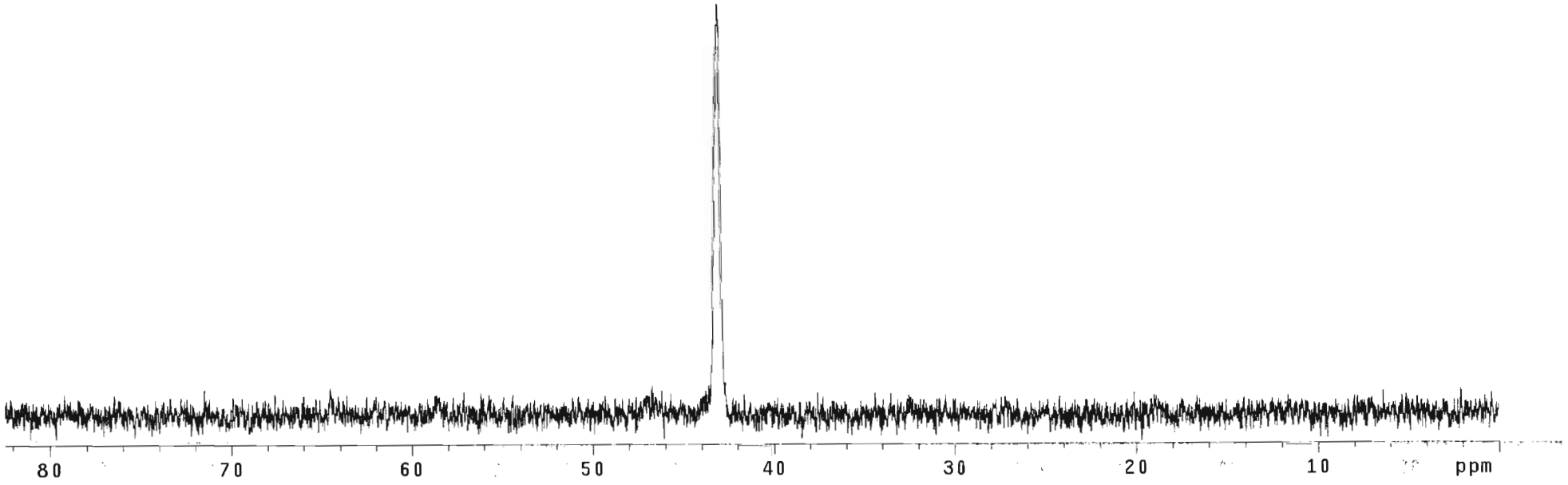


Table 2 Entry 8

^{31}P coupled NMR



3.113.1H

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 1 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	8	PROCESSING	
ct	8	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-164.2
sfrq	300.053	wp	2748.9
tof	300.9	rfl	592.8
tpwr	55	rfp	0
pw	8.600	rp	-102.5
DECOUPLER		lp	-65.1
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	201
dpwr	45	th	3
dmf	13100	ai cdc ph	

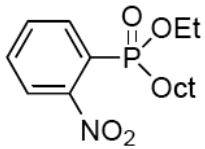
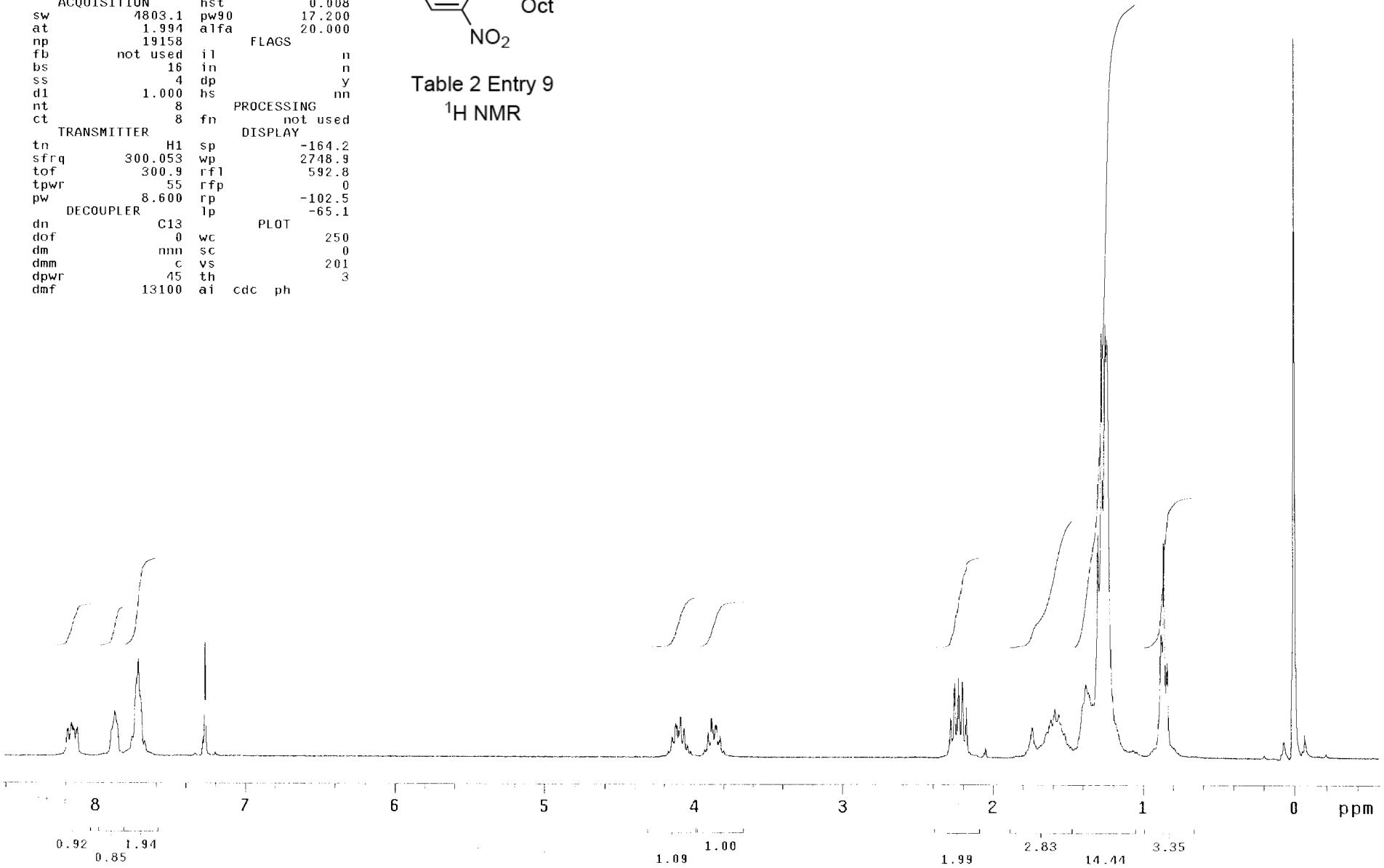


Table 2 Entry 9
^{1}H NMR



3.113.13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	5.000	hs	nn
nt	256	PROCESSING	
ct	256	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-697.4
tof	737.2	wp	16528.1
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	76.8
dn	H1	lp	-203.6
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	95
dmf	6700	th	11
		ai no ph	

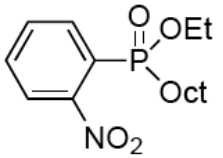
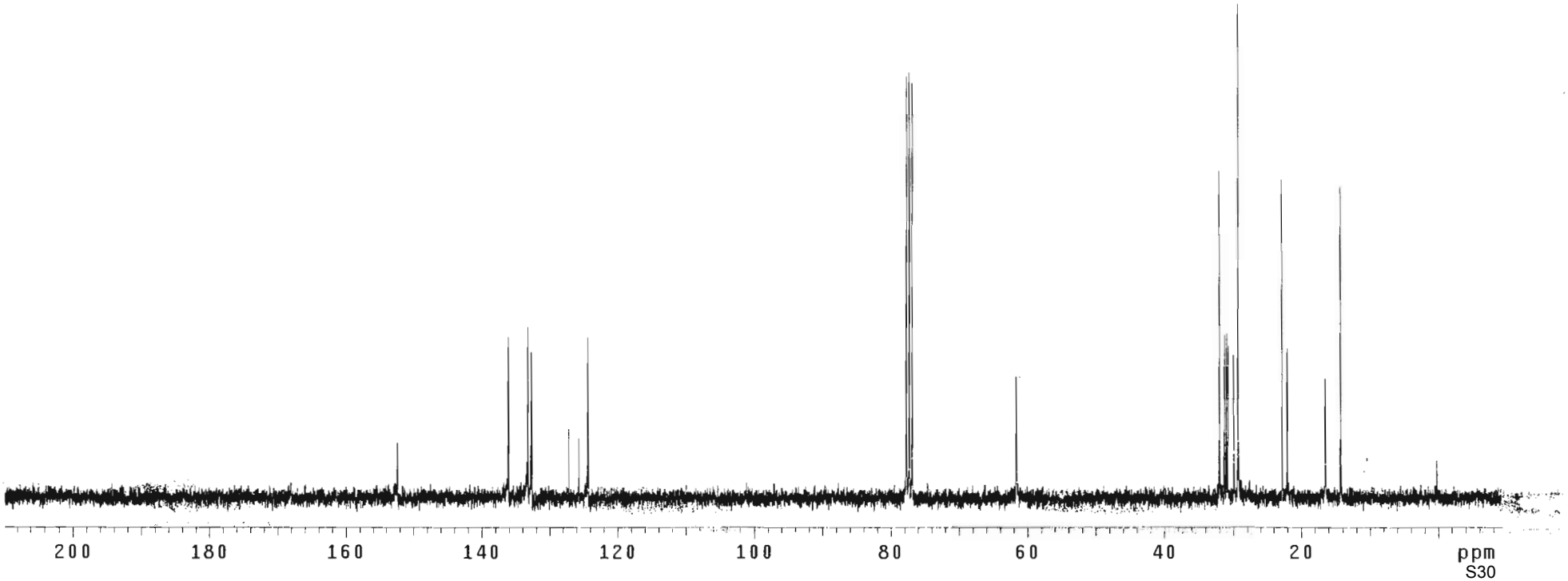


Table 2 Entry 9

^{13}C NMR



3.113.31P dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	497.7
tof	10608.2	wp	9511.4
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	149.8
dn	H1	lp	-361.4
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	11
dmf	6700	th	2
		ai no ph	

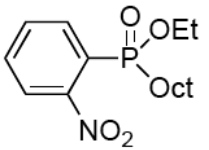
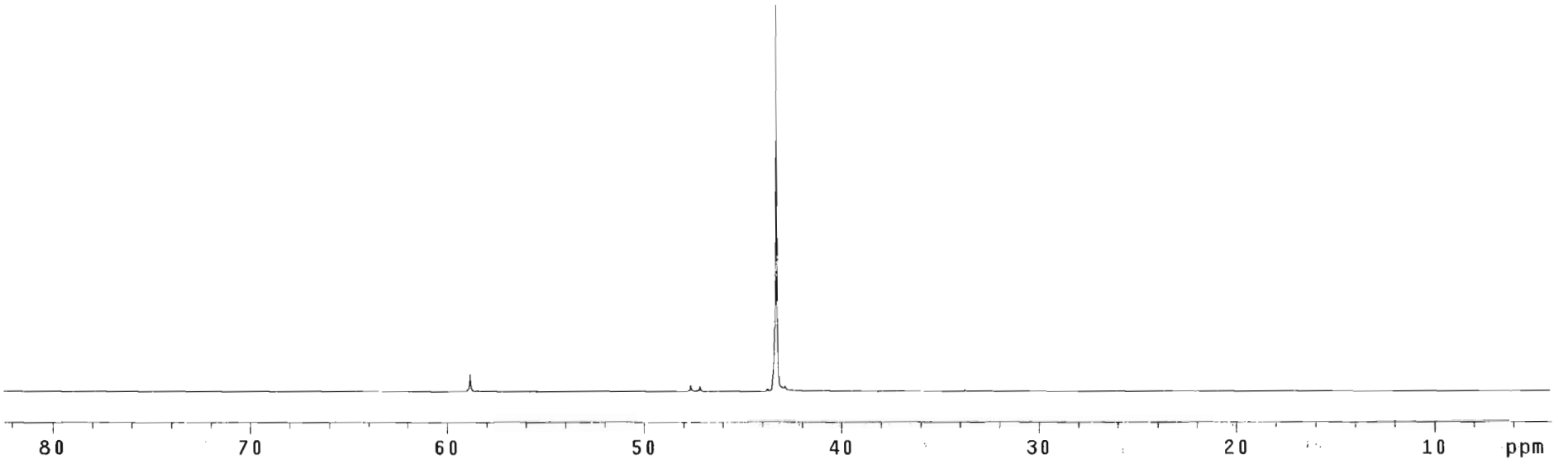


Table 2 Entry 9

^{31}P decoupled NMR



3.113.31P cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	993.9
tof	10608.2	wp	9015.7
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	168.7
dn	H1	lp	-396.5
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	42
dmf	6700	th	3
		ai no ph	

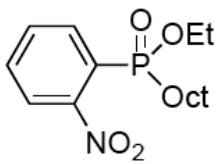
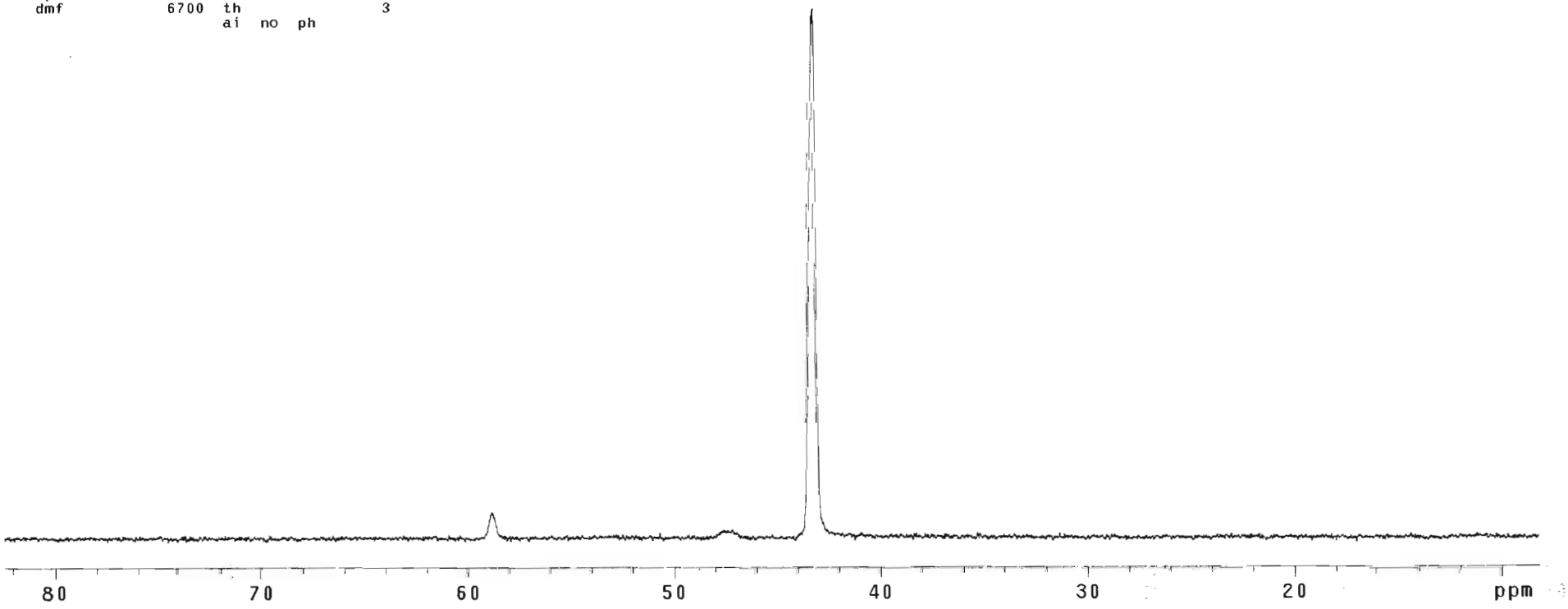


Table 2 Entry 9

^{31}P coupled NMR



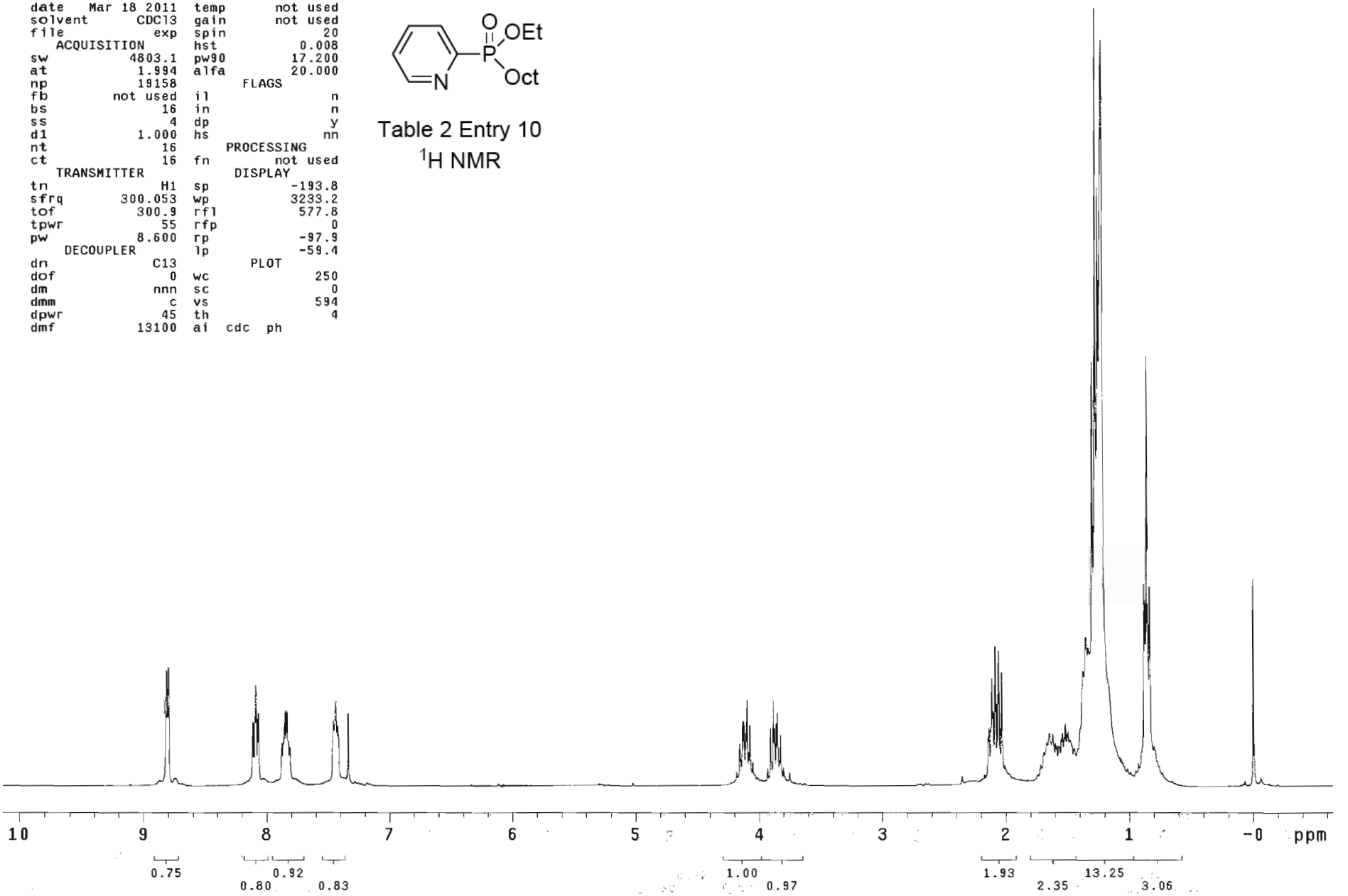
CP3-418

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 18 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-193.8
sfrq	300.053	wp	3233.2
tof	300.9	rfl	577.8
tpwr	55	rfp	0
pw	8.600	rp	-97.9
DECOUPLER		lp	-59.4
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	594
dpwr	45	th	4
dmf	13100	ai cdc ph	

Table 2 Entry 10

^{1}H NMR



418 13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	5.000	hs	nn
nt	256	PROCESSING	
ct	192	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-741.1
tof	737.2	wp	16593.8
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	93.3
dn	H1	lp	-254.2
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	96
dmf	6700	th	9
		nm no ph	

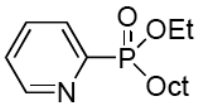
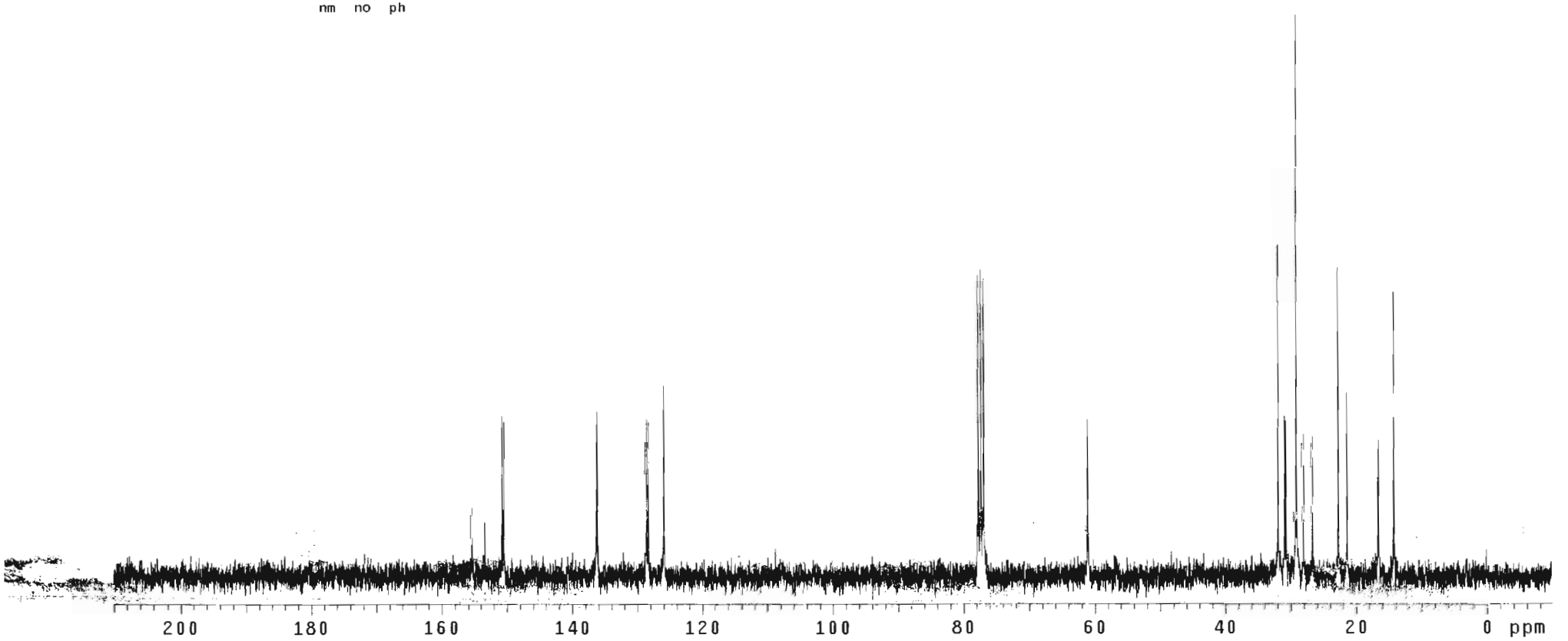


Table 2 Entry 10
^{13}C NMR



CP3-418

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 31 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	-0.0
tof	10608.2	wp	10010.0
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-62.2
dn	H1	lp	-576.9
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	14
dmf	6700	th	3
		ai no ph	

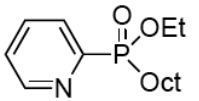
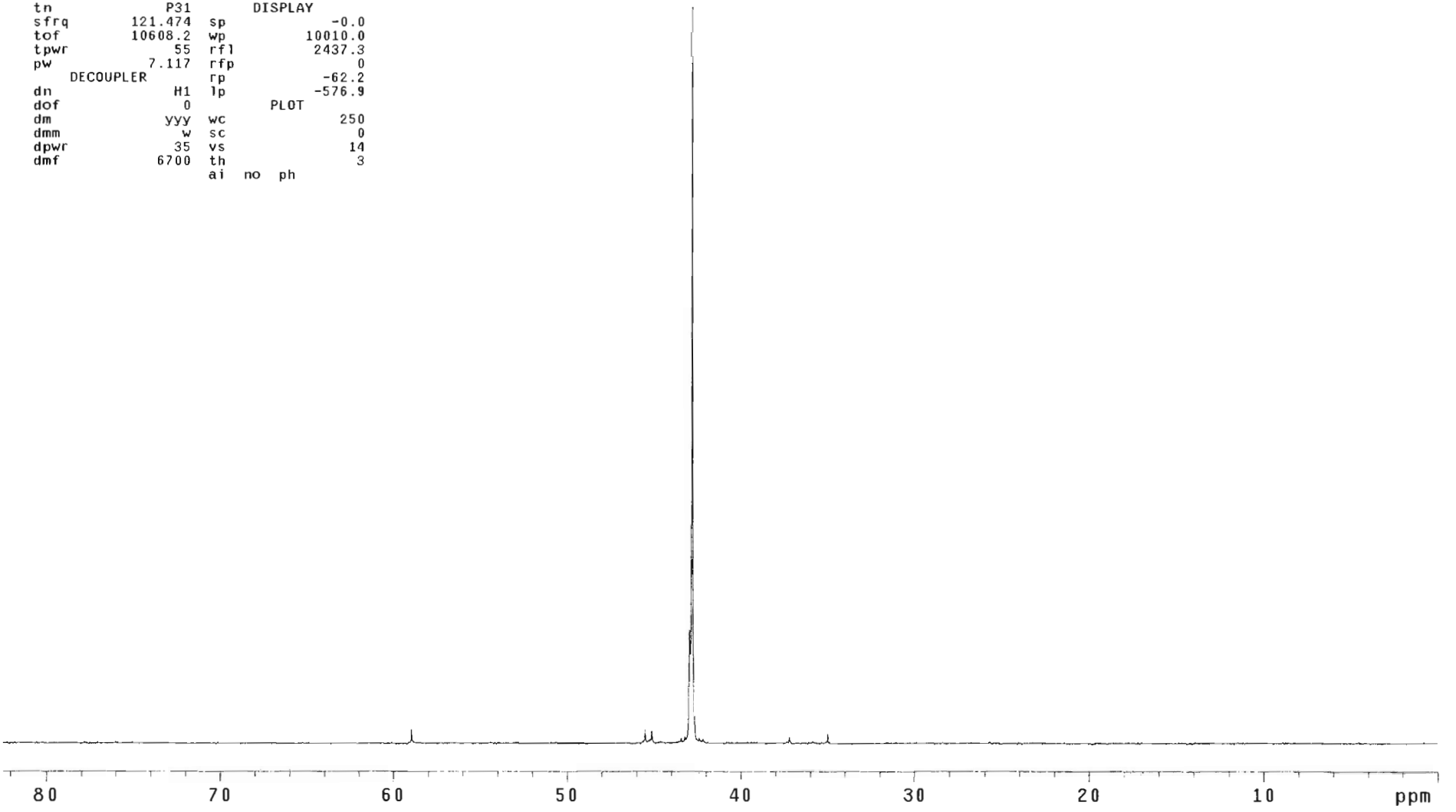


Table 2 Entry 10

^{31}P decoupled NMR



CP3-418

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 31 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	-0.0
tof	10608.2	wp	10010.0
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-142.2
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	40
dmf	6700	th	3
		ai no ph	

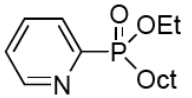
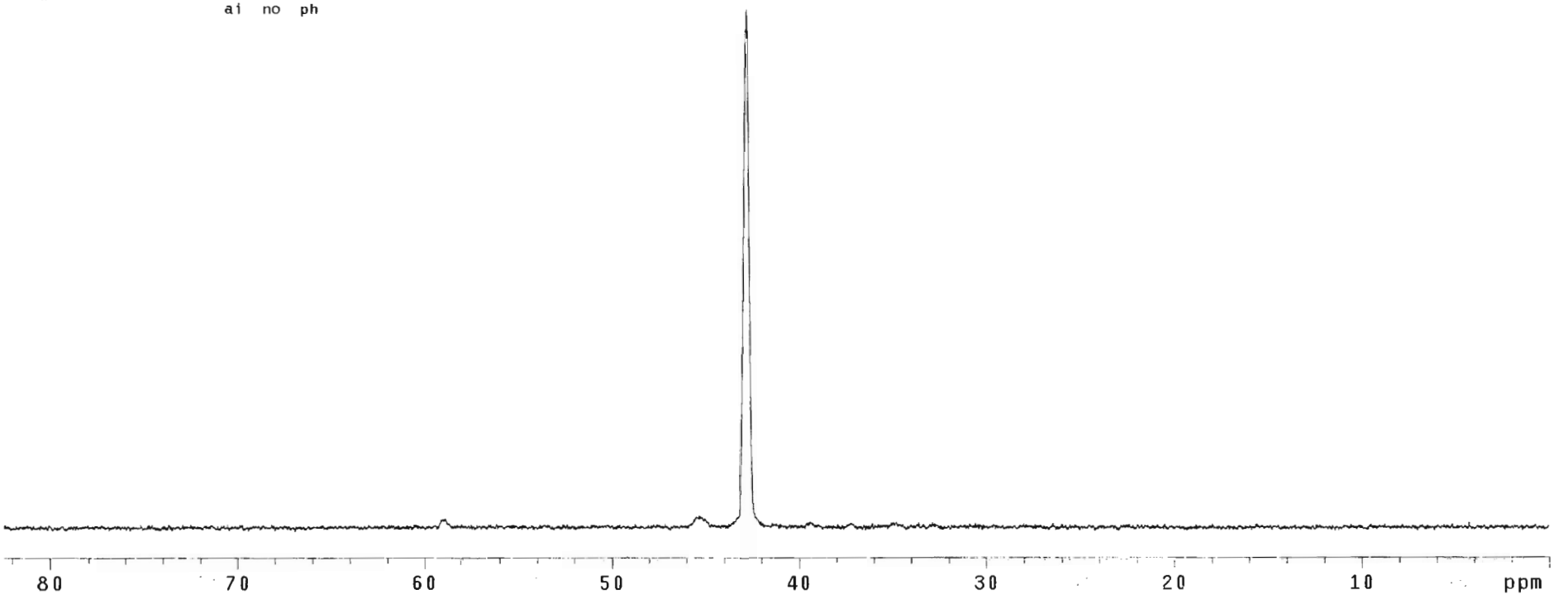


Table 2 Entry 10
^{31}P coupled NMR



3.110

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 31 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-255.0
sfrq	300.053	wp	3350.2
tof	300.9	rfl	583.7
tpwr	55	rfp	0
pw	8.600	rp	-103.2
DECOUPLER		lp	-71.0
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	417
dpwr	45	th	6
dmf	13100	ai cdc ph	

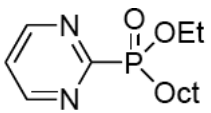
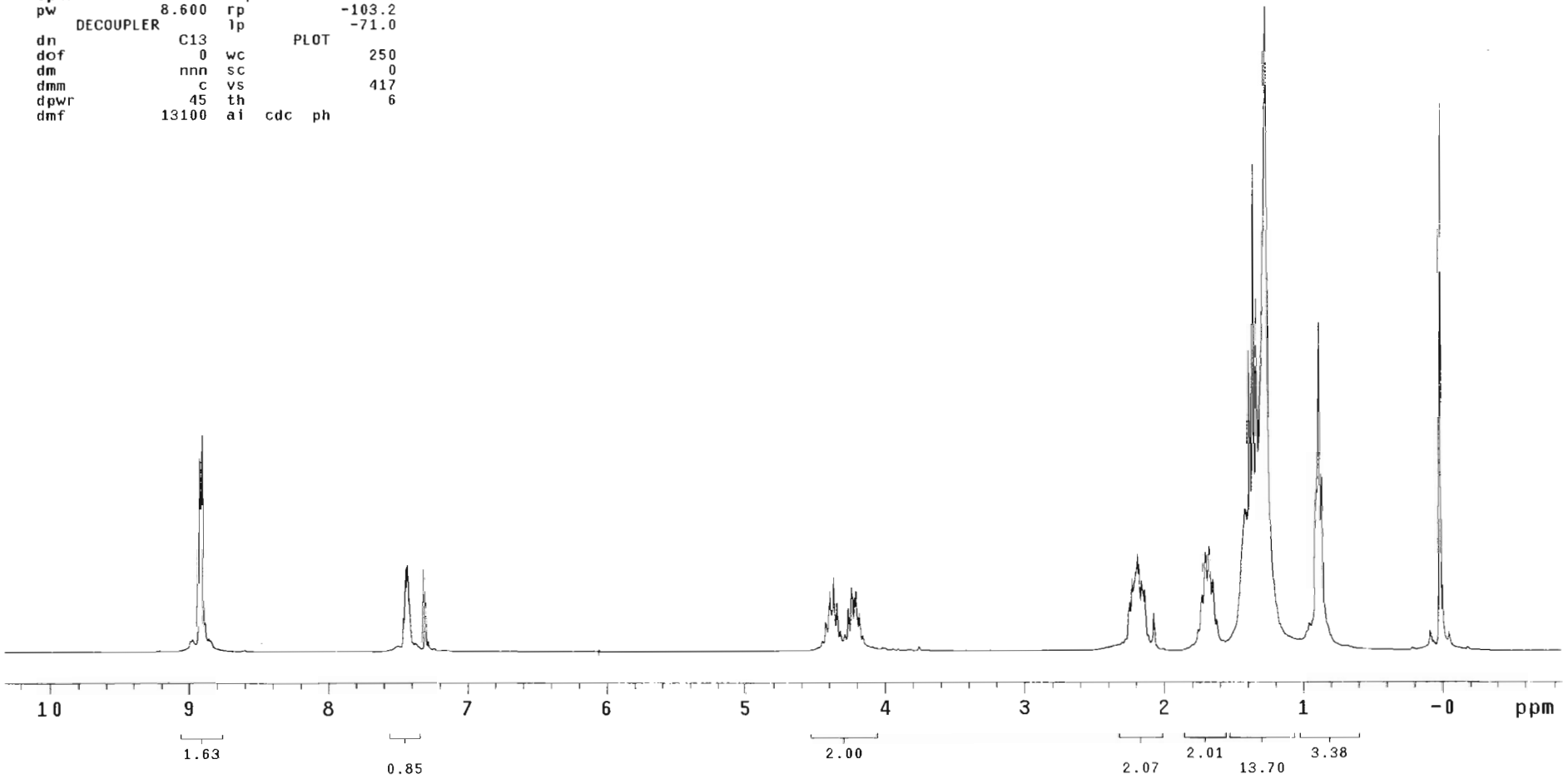


Table 2 Entry 11

^{1}H NMR



3.110.13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 24 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	5.000	hs	nn
nt	256	PROCESSING	
ct	192	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-981.5
tof	737.2	wp	16768.5
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	100.9
dn	H1	lp	-229.3
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	64
dmf	6700	th	20
		nm no ph	

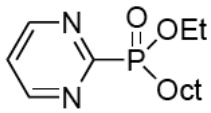
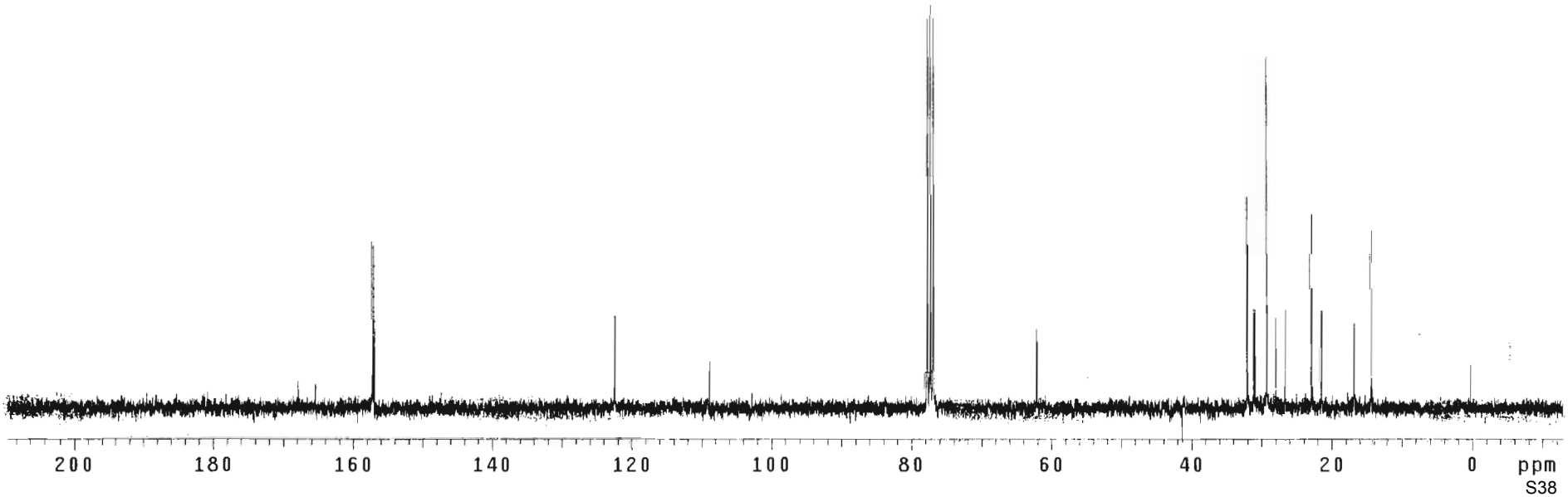


Table 2 Entry 11
^{13}C NMR



```
110

exp1  s2pul

      SAMPLE                SPECIAL
date   Mar 23 2011  temp        not used
solvent      CDCl3  gain        not used
file           exp  spin              20
   ACQUISITION      hst            0.008
sw          26738.0 pw90          18.300
at            1.598 alfa          20.000
np            85476         FLAGS
fb            14800  il                n
bs               64  in                n
ss                4  dp                y
d1            1.000  hs               nn
nt               64      PROCESSING
ct               64  lb             1.00
   TRANSMITTER       fn        not used
tn              P31       DISPLAY
sfrq        121.474  sp          -764.2
tof         10608.2  wp         12640.3
tpwr             55  rfl         2437.3
pw            7.117  rfp               0
    DECOUPLER        rp           120.4
dn               H1  lp          -288.8
dof               0         PLOT
dm              yyy  wc              250
dmm               w  sc                0
dpwr             35  vs               21
dmf            6700  th                5
                     ai  no  ph
```

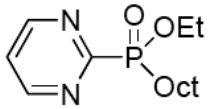
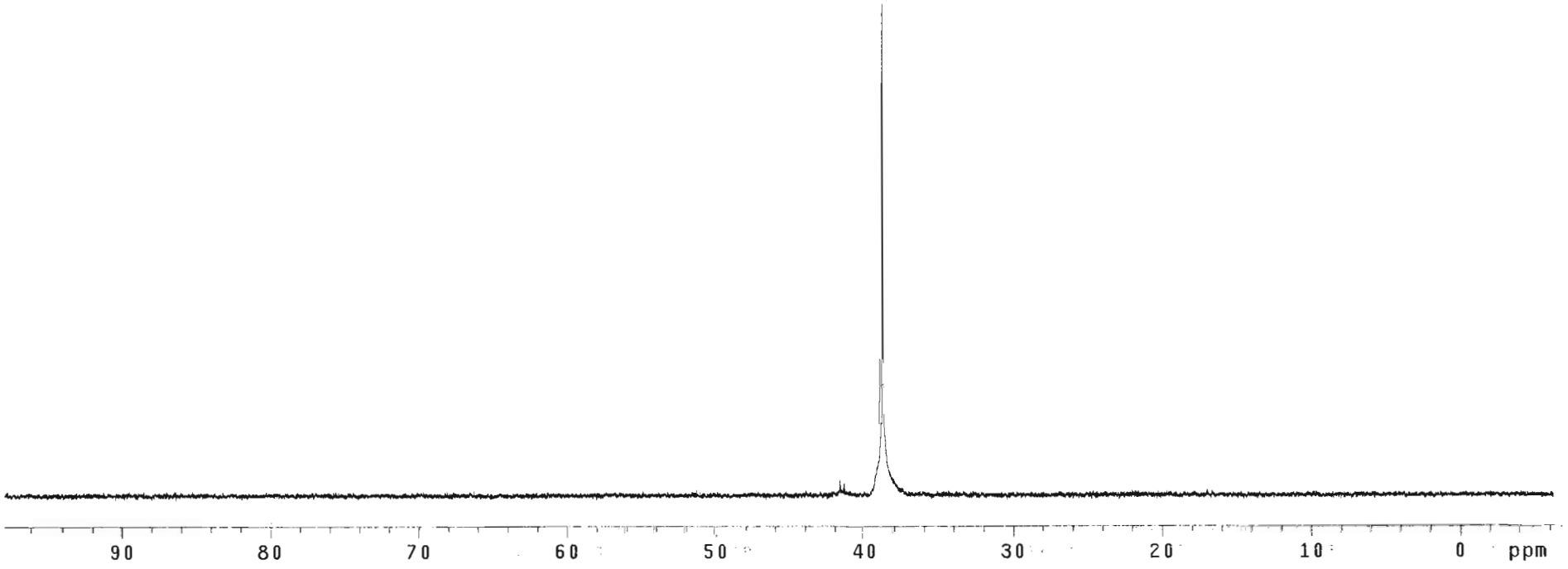


Table 2 Entry 11

^{31}P decoupled NMR



```
110

exp1  s2pul

      SAMPLE                SPECIAL
date   Mar 23 2011  temp       not used
solvent       CDCl3  gain       not used
file            exp  spin             20
   ACQUISITION       hst           0.008
sw          26738.0  pw90         18.300
at            1.598  alfa         20.000
np            85476        FLAGS
fb            14800  il                n
bs               64  in                n
ss                4  dp                y
d1            1.000  hs               nn
nt               64      PROCESSING
ct               64  lb             1.00
   TRANSMITTER       fn        not used
tn              P31       DISPLAY
sfrq        121.474  sp          -764.2
tof         10608.2  wp         12640.3
tpwr             55  rfl         2437.3
pw            7.117  rfp               0
    DECOUPLER        rp            139.8
dn               H1  lp          -288.8
dof               0         PLOT
dm              ynn  wc              250
dmm               w  sc                0
dpwr             35  vs               83
dmf            6700  th               11
                     ai  no  ph
```

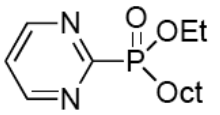
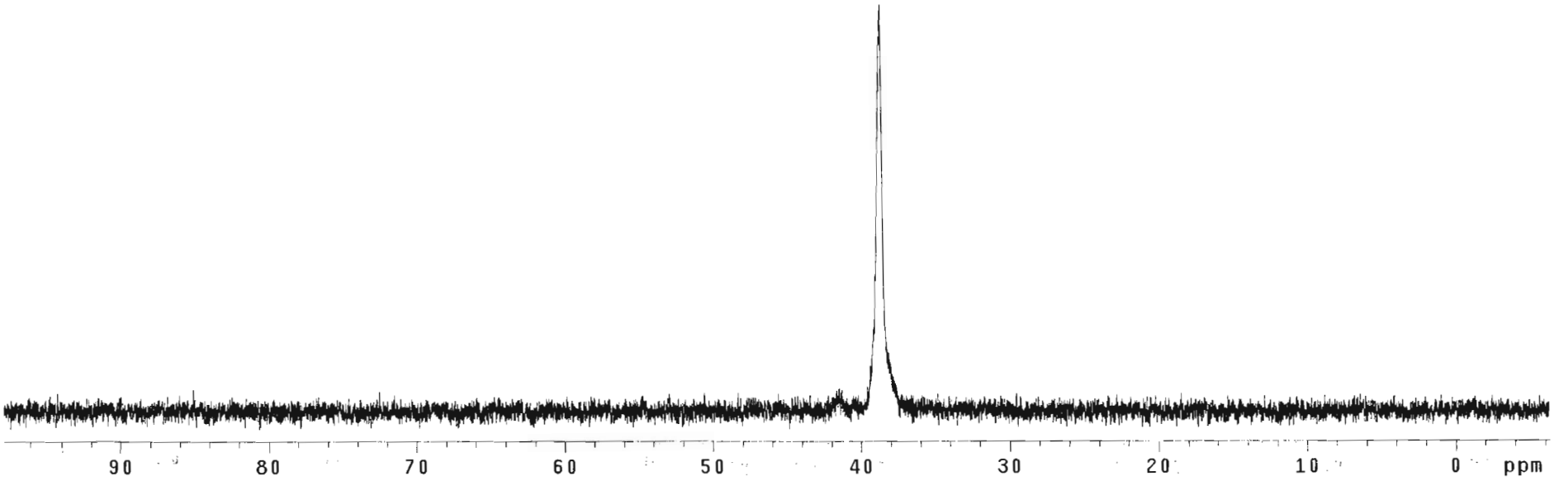


Table 2 Entry 11

^{31}P coupled NMR



411

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 15 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-219.9
sfrq	300.053	wp	3503.5
tof	300.9	rfl	581.0
tpwr	55	rfp	0
pw	8.600	rp	-111.3
DECOUPLER		lp	-63.4
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	342
dpwr	45	th	2
dmf	13100	ai cdc ph	

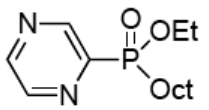
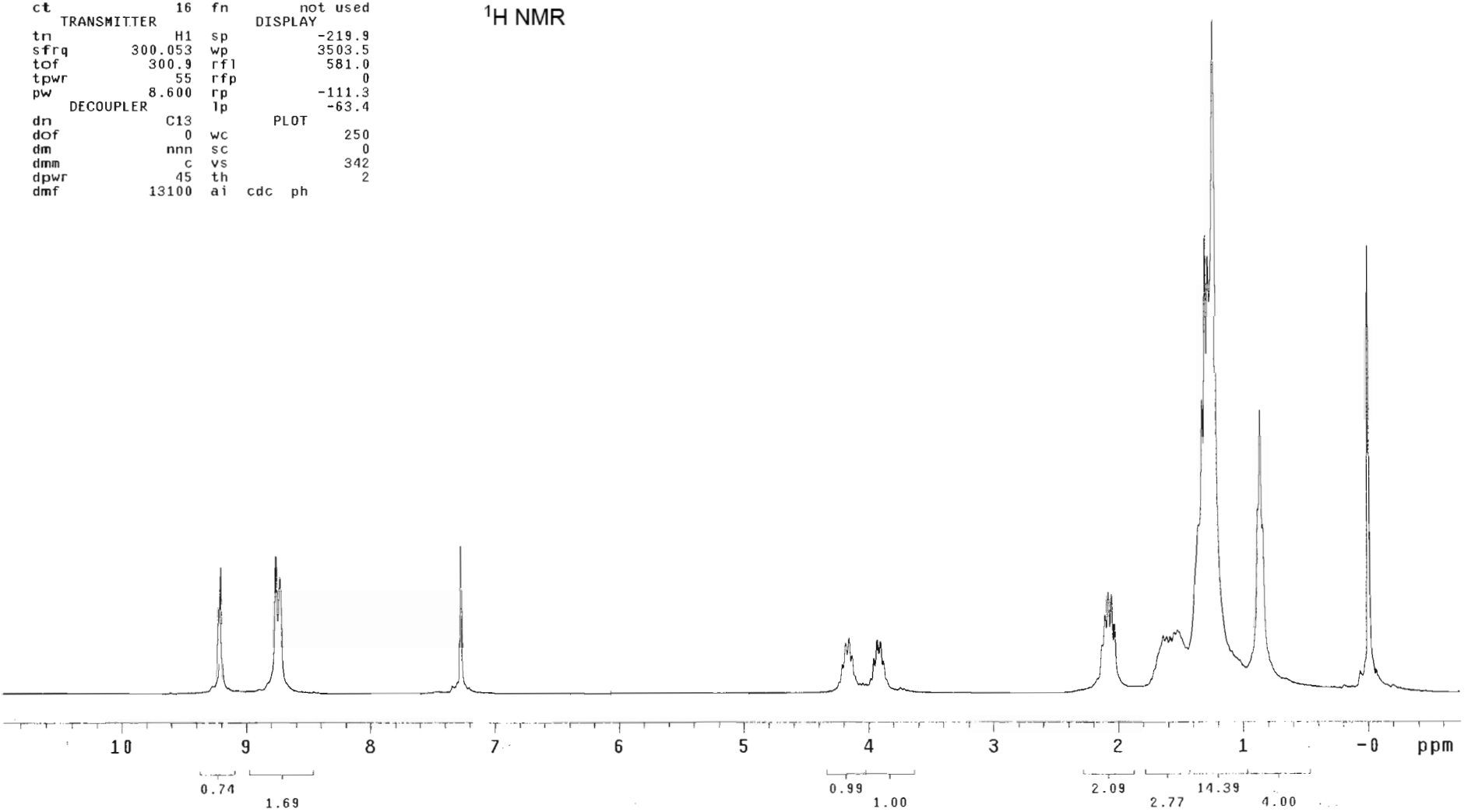


Table 2 Entry 12
^{1}H NMR



411 13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 25 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	5.000	hs	nn
nt	256	PROCESSING	
ct	256	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-755.7
tof	737.2	wp	16593.8
tpwr	58	rfl	1149.3
pw	9.250	rfp	0
DECOUPLER		rp	85.0
dn	H1	lp	-203.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	115
dmf	6700	th	5
		ai no ph	

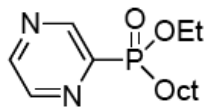
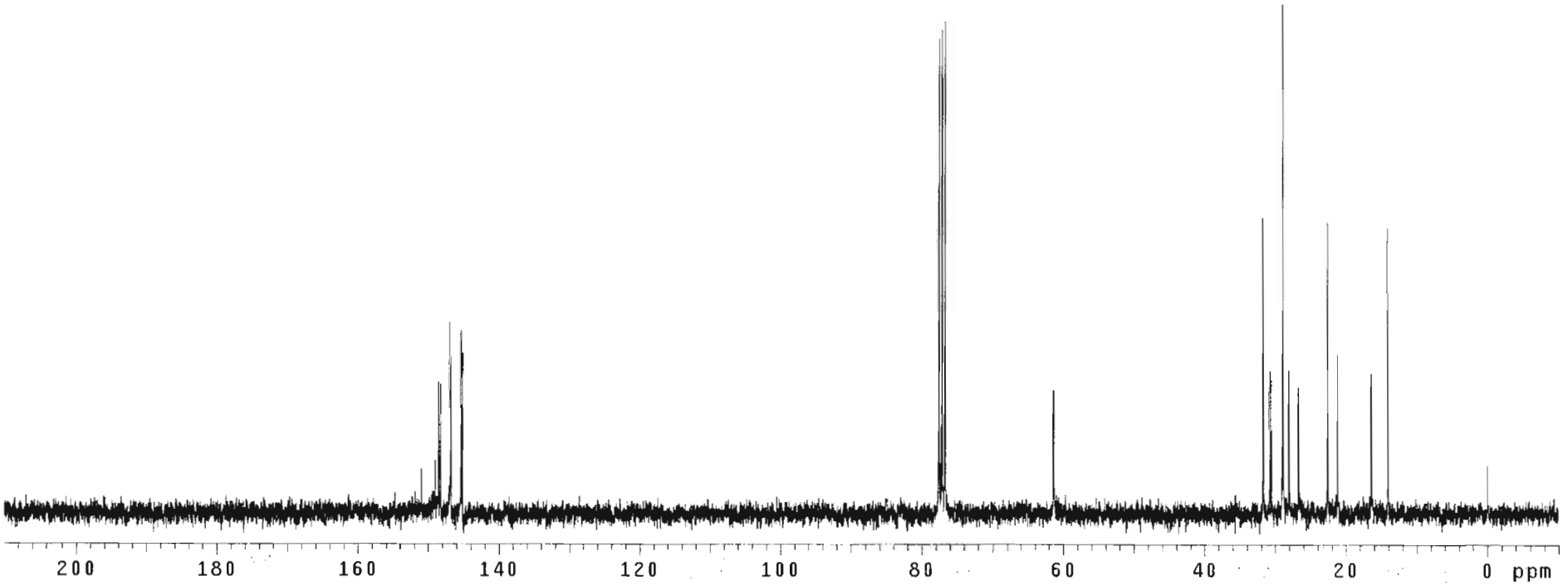


Table 2 Entry 12
^{13}C NMR



CP3-411

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 11 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	1.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	10.6
tof	10608.2	wp	9790.1
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-77.9
dn	H1	lp	-493.7
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	6
dmf	6700	th	65
		ai no ph	

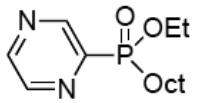
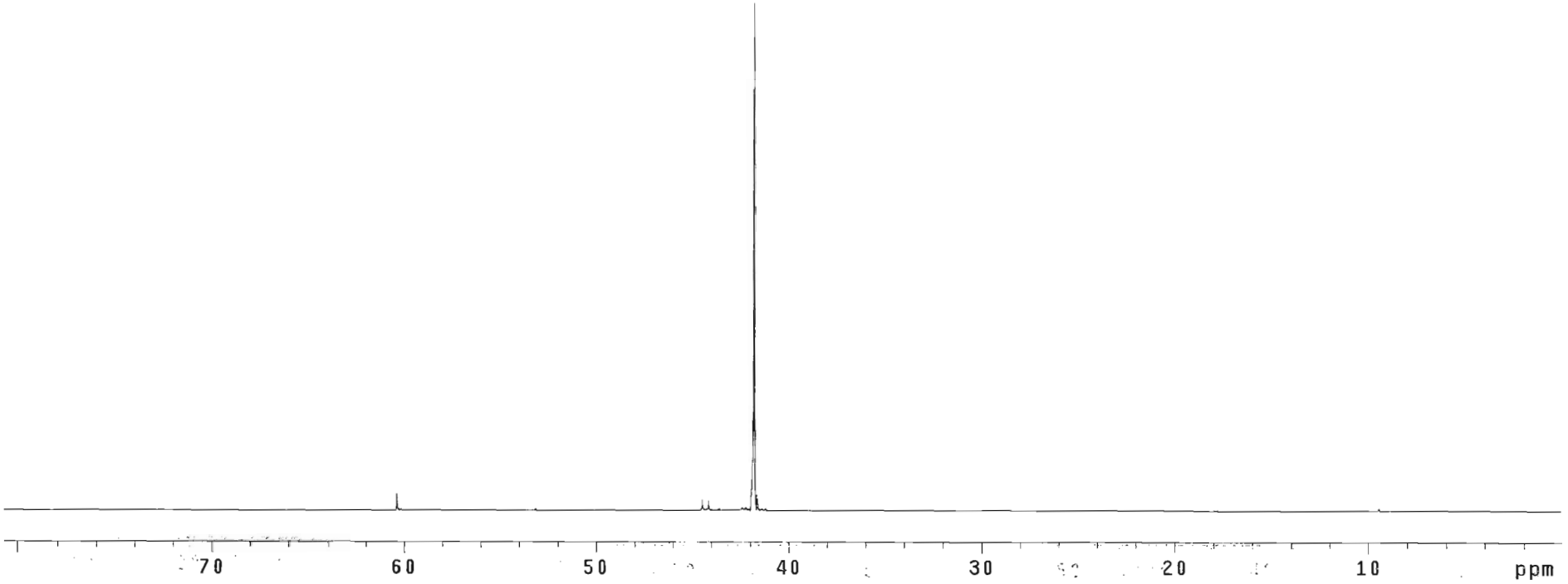


Table 2 Entry 12

^{31}P decoupled NMR



CP3-411

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 11 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	1.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	10.6
tof	10608.2	wp	9790.1
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-143.1
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	32
dmf	6700	th	46
		ai no ph	

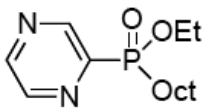
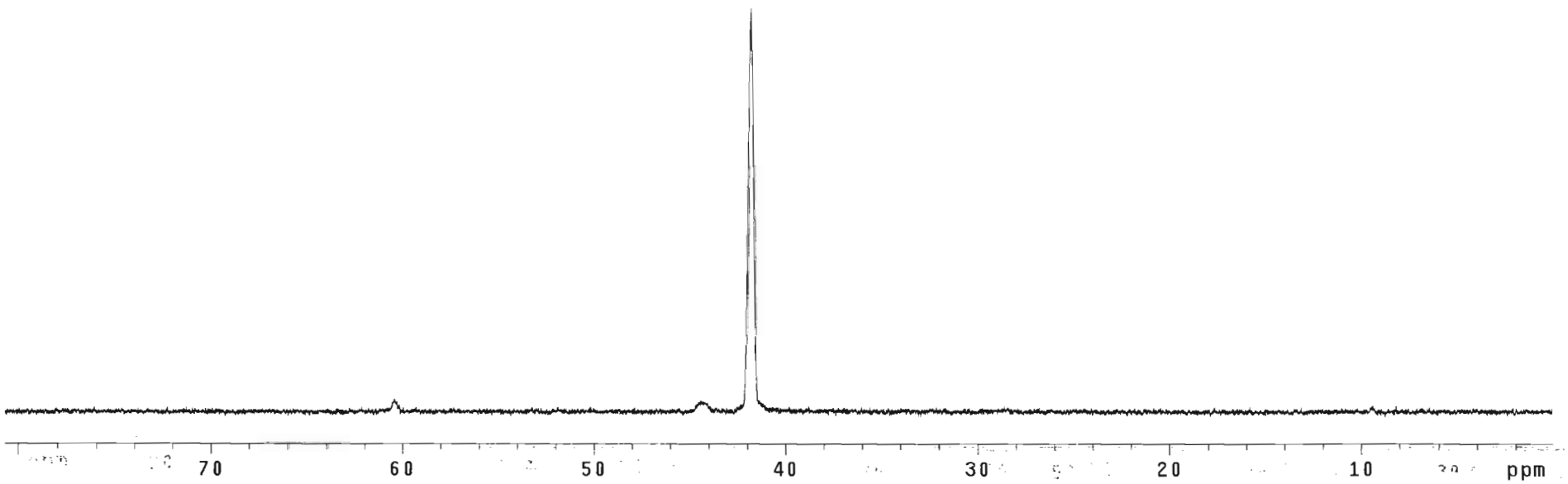


Table 2 Entry 12

^{31}P coupled NMR



3.125.1H

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 13 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-114.6
sfrq	300.053	wp	2548.7
tof	300.9	rfl	582.2
tpwr	55	rfp	0
pw	8.600	rp	-93.8
DECOUPLER		lp	-68.7
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	273
dpwr	45	th	14
dmf	13100	ai cdc ph	

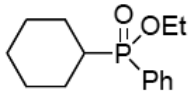
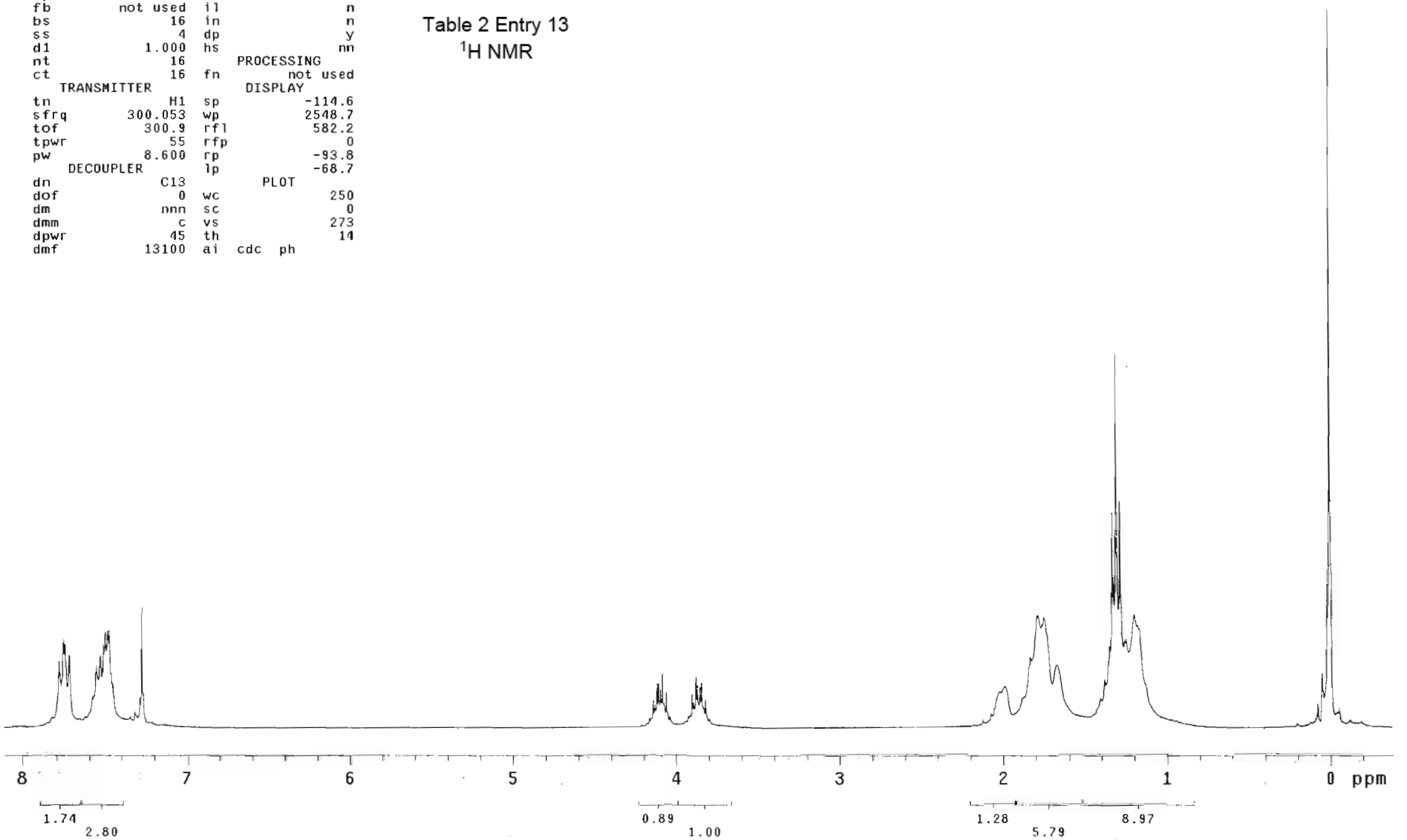


Table 2 Entry 13
^{1}H NMR



3.125.31P dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 13 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	45	PROCESSING	
ct	45	lb	1.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	1241.9
tof	10608.2	wp	8767.7
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	136.1
dn	H1	lp	-288.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	8
dmf	6700	th	2
		ai no ph	

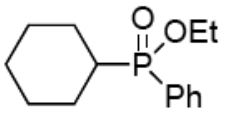
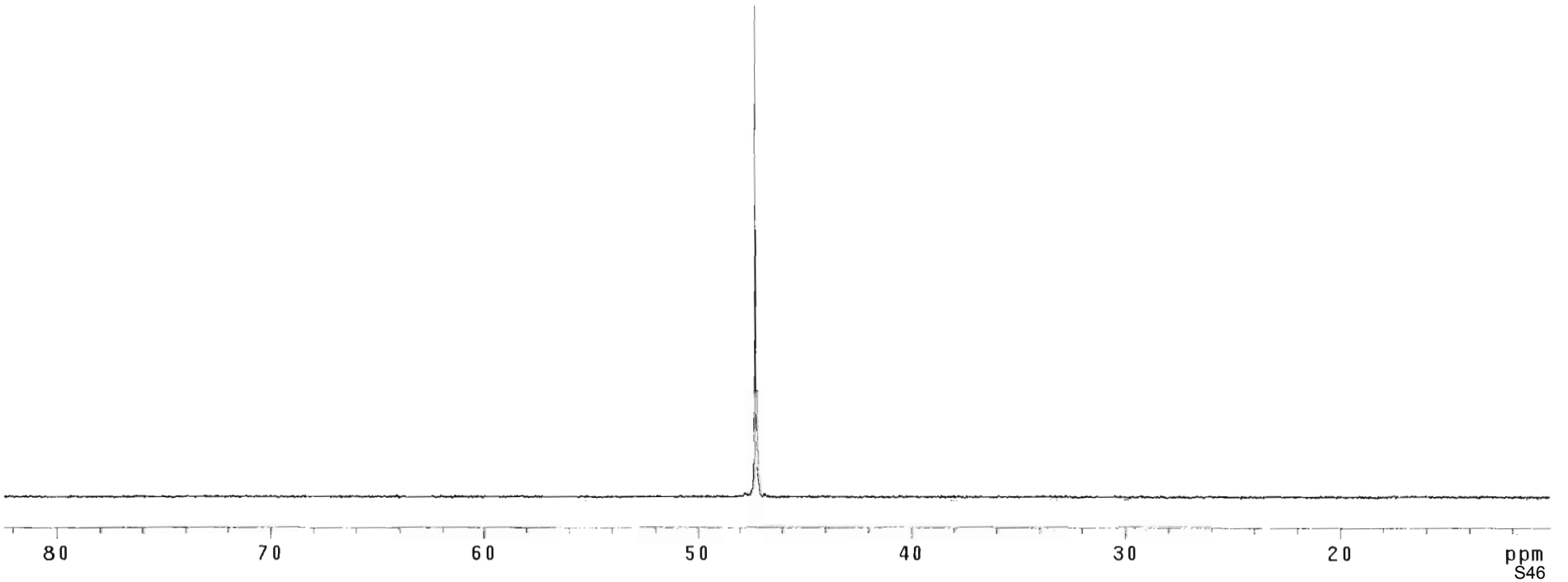


Table 2 Entry 13
^{31}P decoupled NMR



3.125.31P cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 13 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	24	PROCESSING	
ct	24	lb	1.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	1613.6
tof	10608.2	wp	8396.0
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	130.0
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	28
dmf	6700	th	15
		ai no ph	

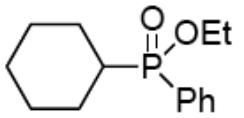
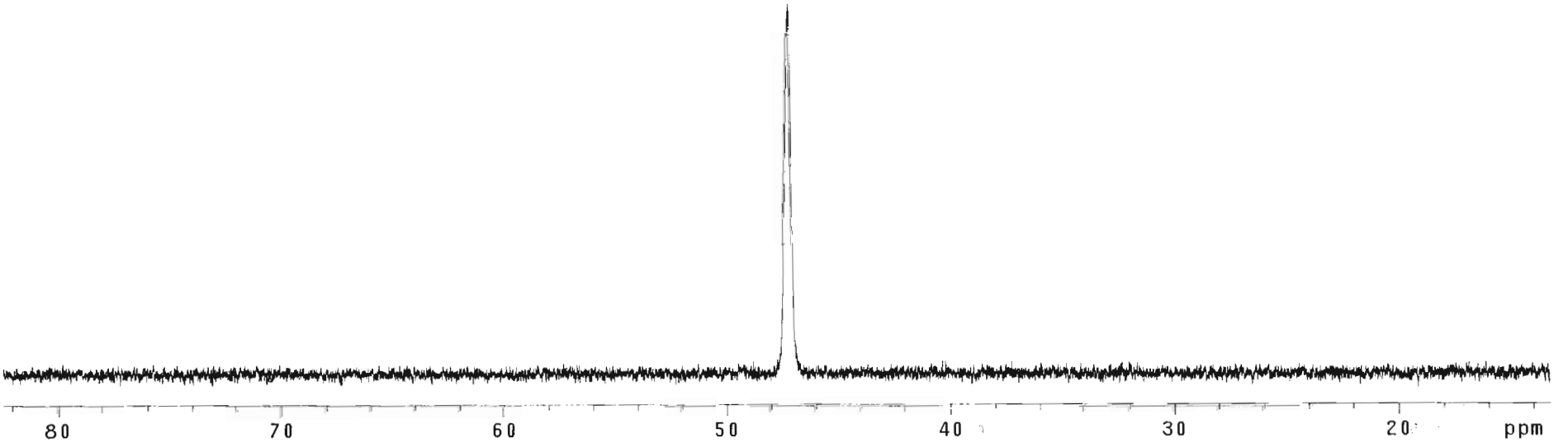


Table 2 Entry 13
^{31}P coupled NMR



3.126.1H

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 23 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-53.1
sfrq	300.053	wp	2560.1
tof	300.9	rfl	593.1
tpwr	55	rfp	0
pw	8.600	rp	-97.4
DECOUPLER		lp	-71.2
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	143
dpwr	45	th	5
dmf	13100	ai cdc ph	

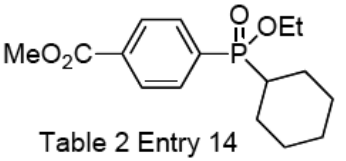
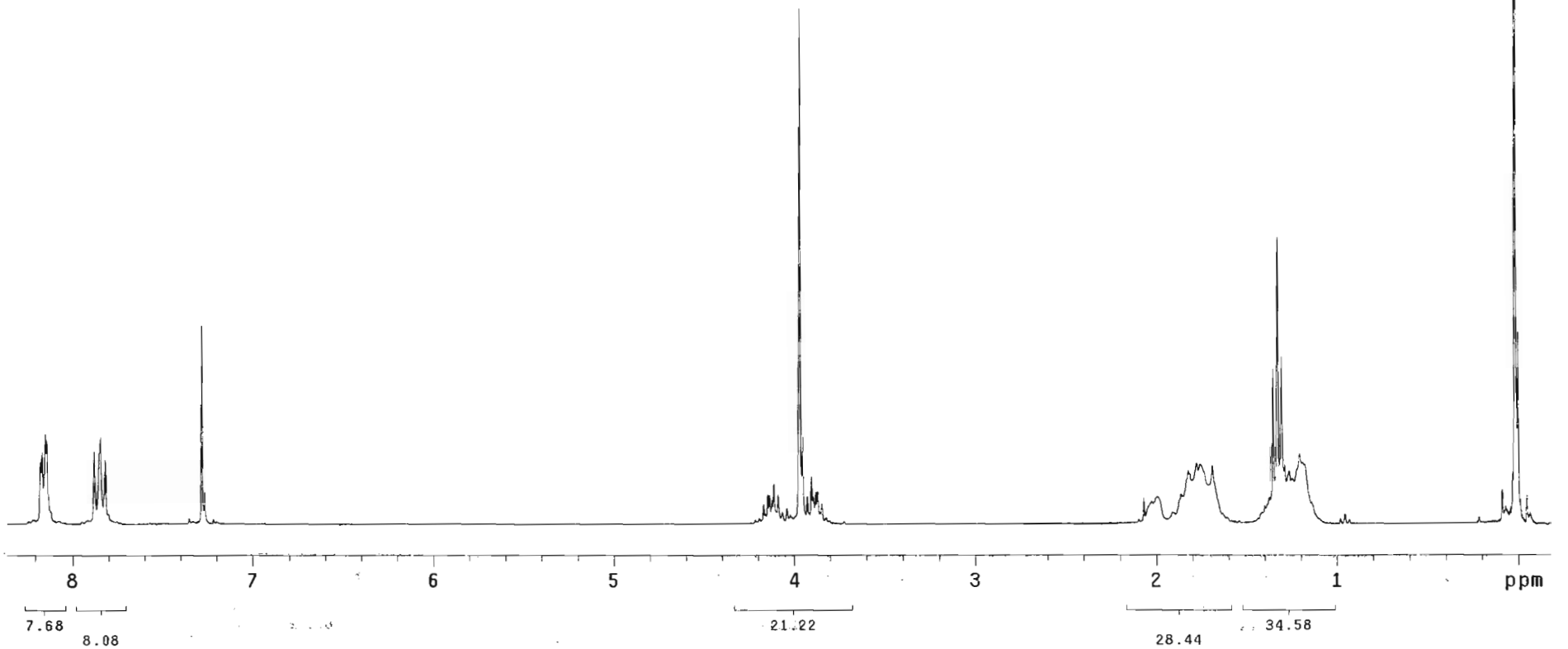


Table 2 Entry 14

^{1}H NMR



3.126.13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 24 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	2.000	hs	nn
nt	512	PROCESSING	
ct	512	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-1107.0
tof	737.2	wp	16768.5
tpwr	58	rfl	1150.7
pw	9.250	rfp	0
DECOUPLER		rp	108.1
dn	H1	lp	-259.2
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	111
dmf	6700	th	4
		ai no ph	

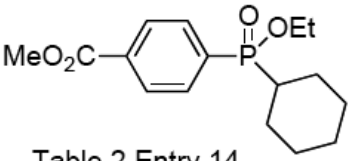
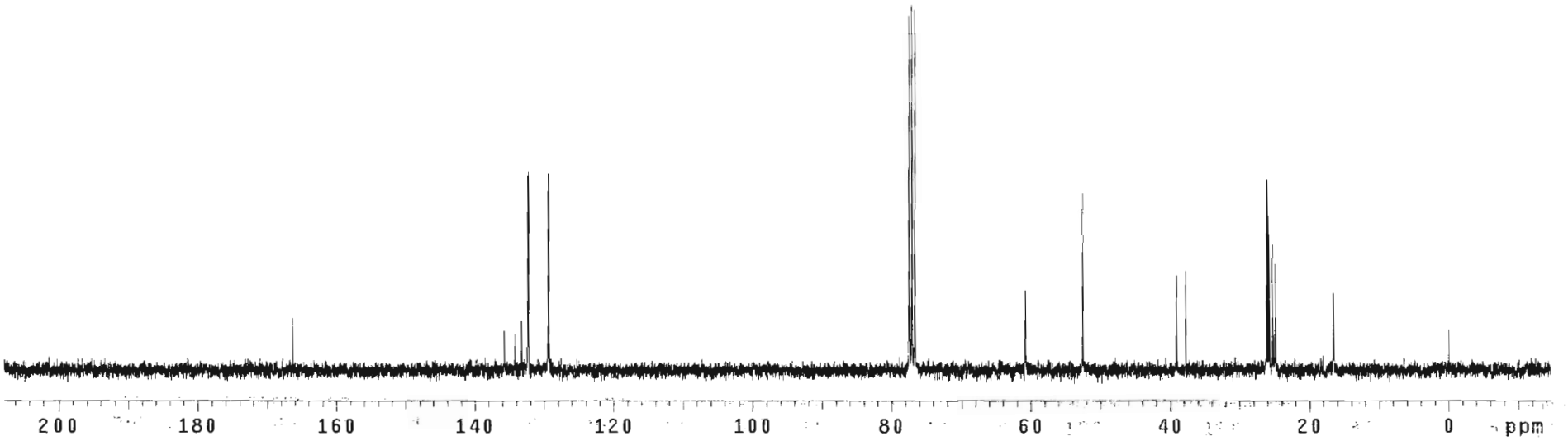


Table 2 Entry 14

^{13}C NMR



3.126.dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 23 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	50	PROCESSING	
ct	50	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	0
tof	10608.2	wp	10010.0
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	112.9
dn	H1	lp	-288.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	14
dmf	6700	th	2
		ai no ph	

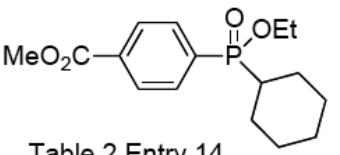
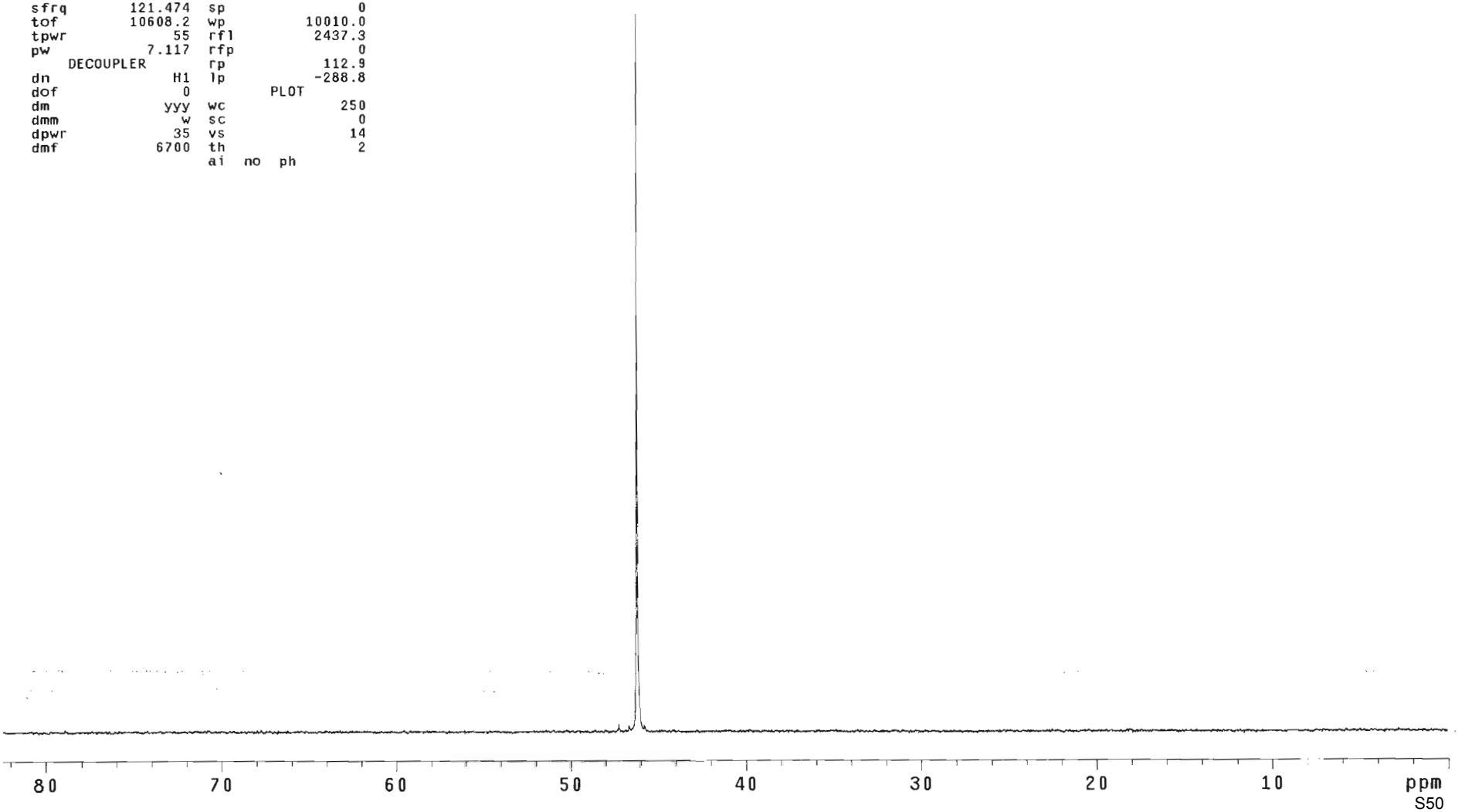


Table 2 Entry 14

^{31}P decoupled NMR



3.126.cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 23 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	1993.4
tof	10608.2	wp	7311.6
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	124.2
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	51
dmf	6700	th	6
		ai no ph	

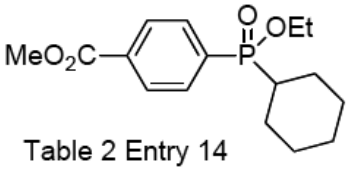
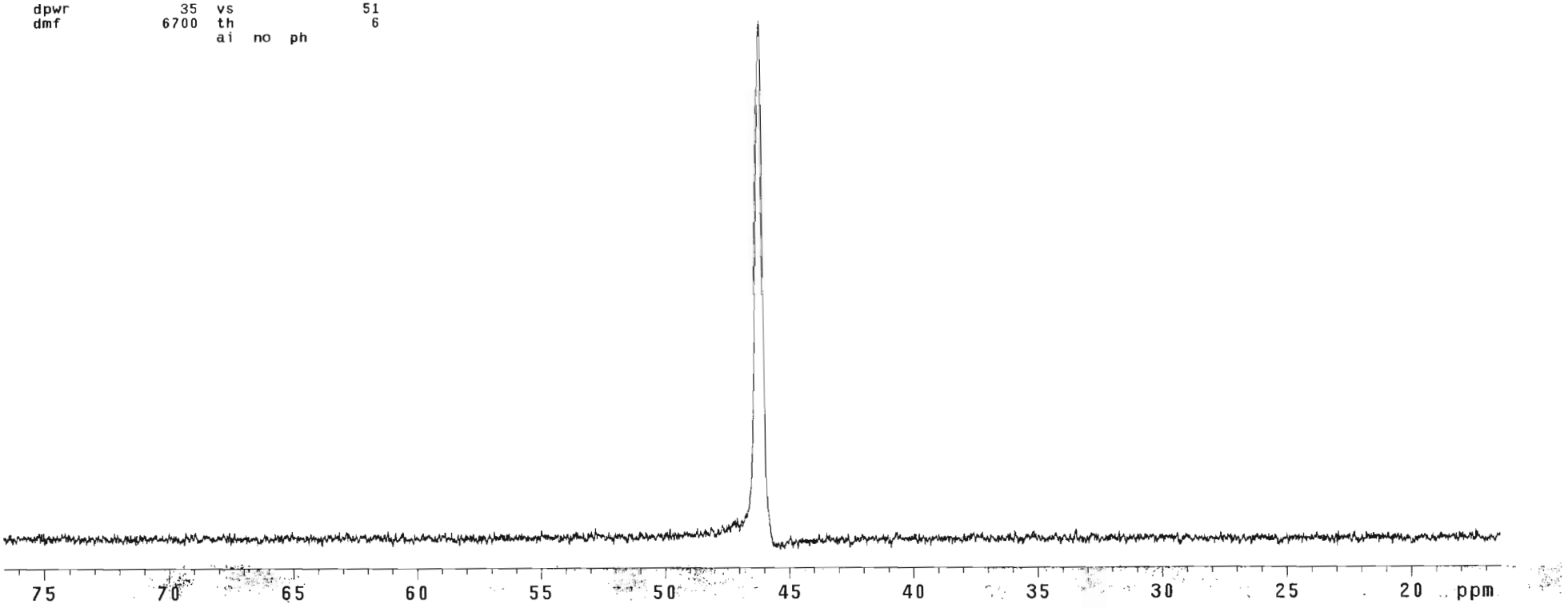


Table 2 Entry 14

^{31}P coupled NMR



124

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 5 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-289.6
sfrq	300.053	wp	3155.2
tof	300.9	rfl	590.4
tpwr	55	rfp	0
pw	8.600	rp	-103.4
DECOUPLER		lp	-66.6
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	331
dpwr	45	th	3
dmf	13100	ai cdc ph	

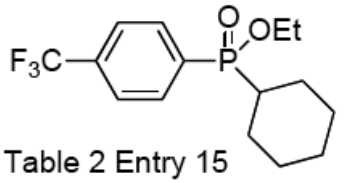
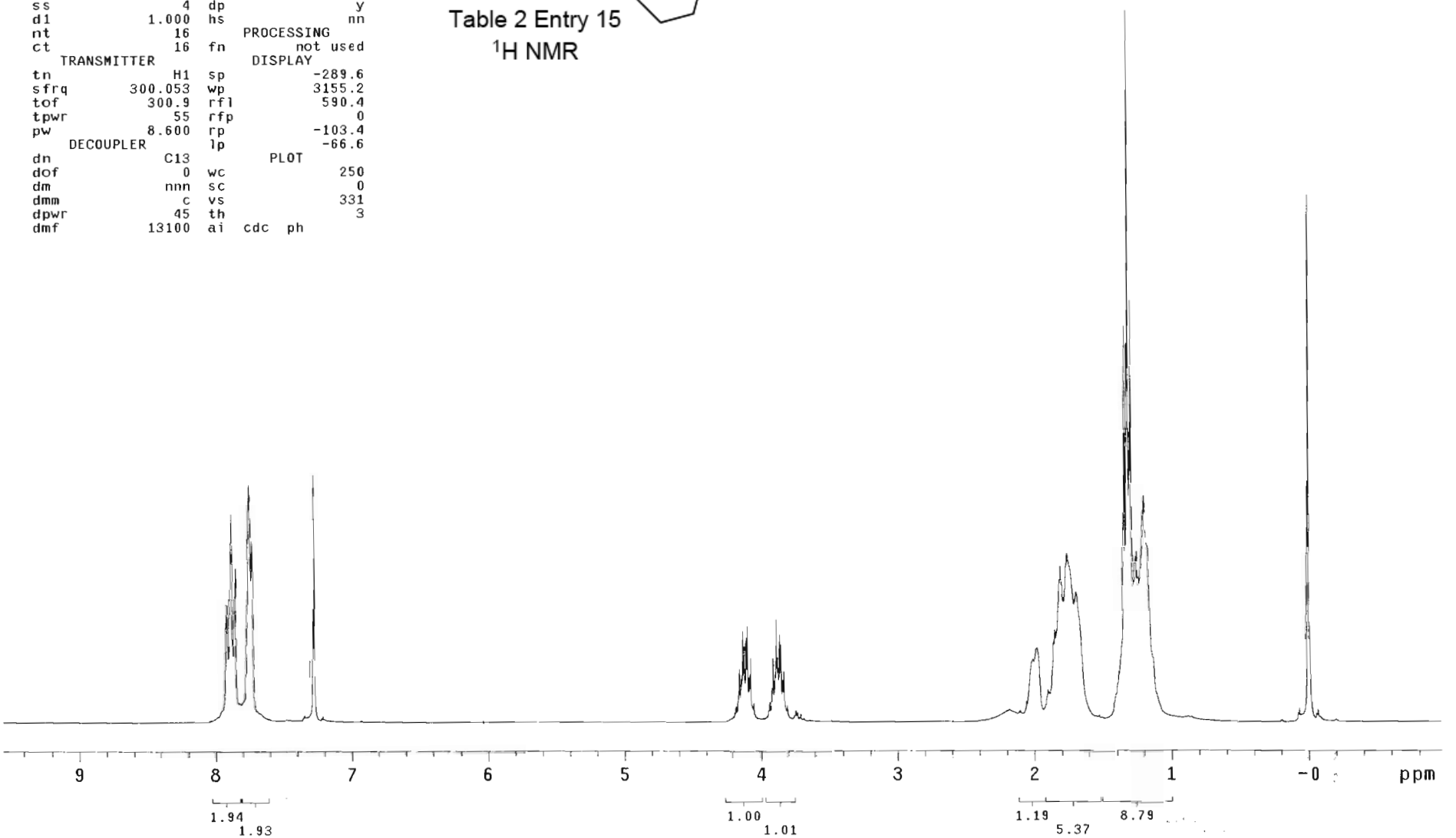


Table 2 Entry 15

^{1}H NMR



124

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 2 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	2.000	hs	nn
nt	1000	PROCESSING	
ct	1000	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-597.1
tof	737.2	wp	13183.0
tpwr	58	rfl	1143.8
pw	9.250	rfp	0
DECOUPLER		rp	102.7
dn	H1	lp	-265.2
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	96
dmf	6700	th	3
		ai no ph	

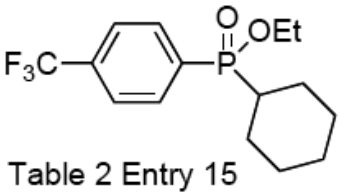
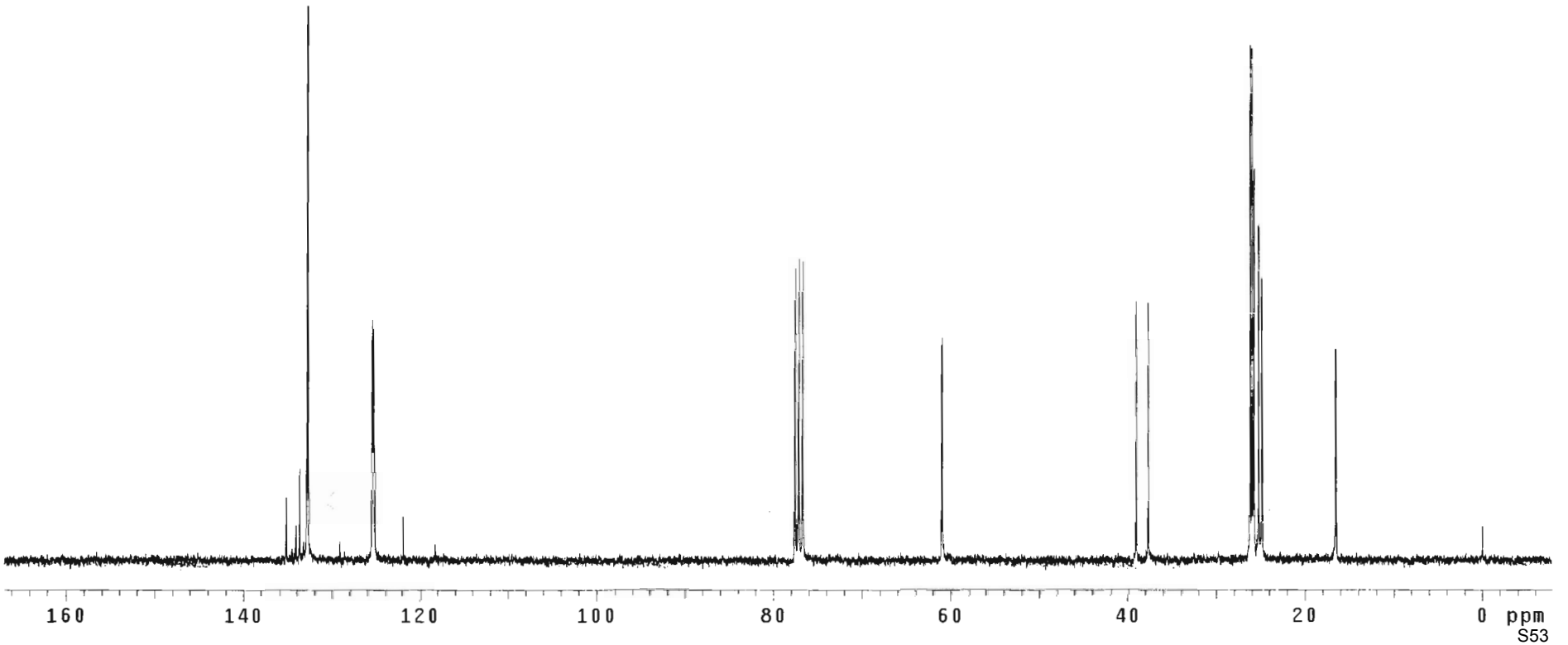


Table 2 Entry 15

^{13}C NMR



3.124.31P dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 28 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	281.5
tof	10608.2	wp	9728.1
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-148.3
dn	H1	lp	-288.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	7
dmf	6700	th	2
		ai no ph	

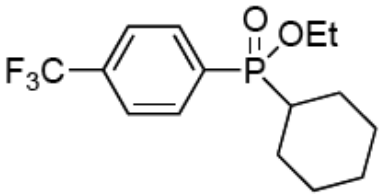
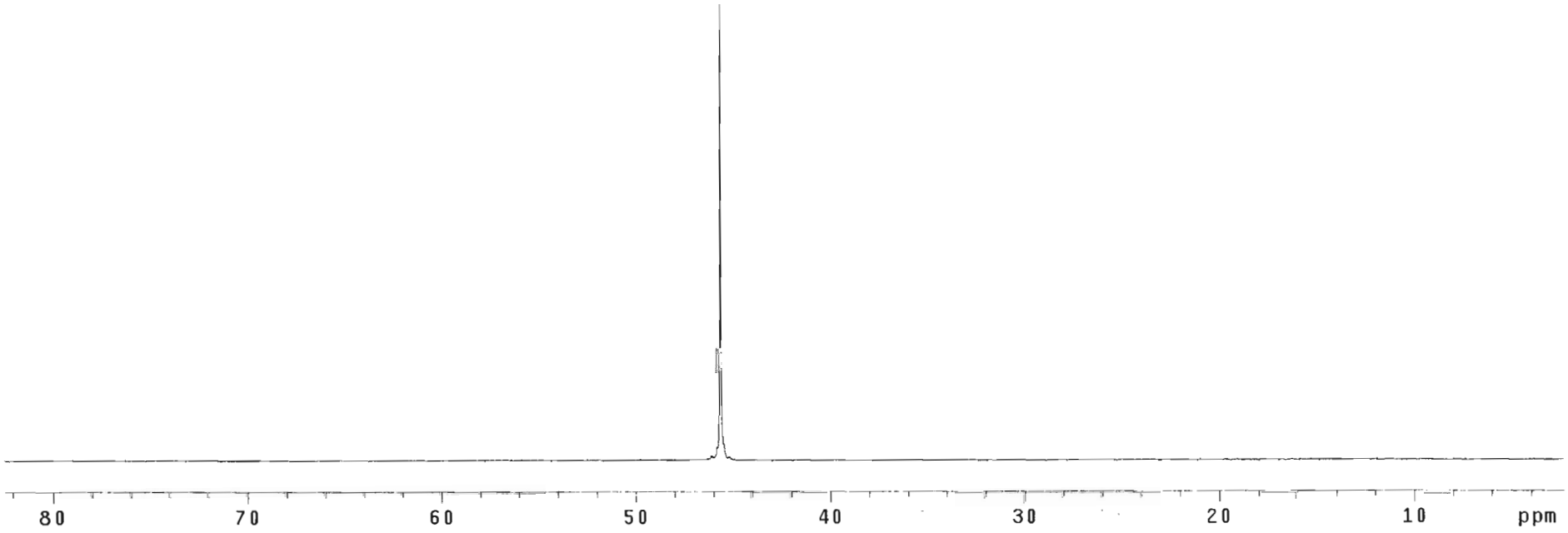


Table 2 Entry 15

^{31}P decoupled NMR



3.124.31P cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 28 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	591.2
tof	10608.2	wp	9418.4
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-152.2
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	37
dmf	6700	th	4
		ai no ph	

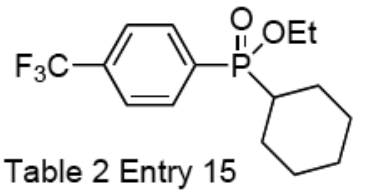
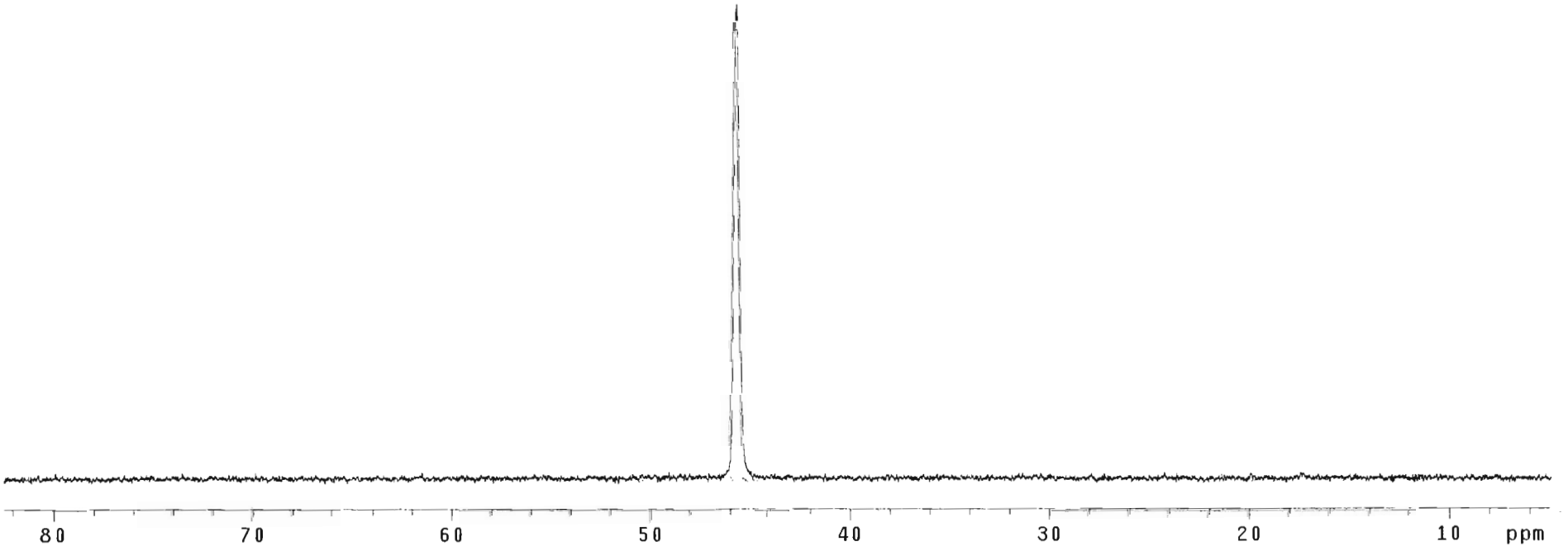


Table 2 Entry 15

^{31}P coupled NMR



124

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 2 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	64935.1	pw90	24.000
at	0.300	alfa	82.400
np	38898	FLAGS	
fb	35800	il	n
bs	16	in	n
ss	4	dp	y
d1	1.500	hs	nn
nt	16	PROCESSING	
ct	16	lb	1.00
TRANSMITTER		lsfid	-6
tn	F19	fn	not used
sfrq	282.306	DISPLAY	
tof	5380.7	sp	-36375.5
tpwr	57	wp	36490.3
pw	8.000	rfl	56465.6
DECOUPLER		rfp	0
dn	H1	rp	-153.0
dof	0	lp	0.0
dm	nnn	PLOT	
dmm	c	wc	250
dpwr	35	sc	0
dmf	6700	vs	3
		th	0
		ai no ph	

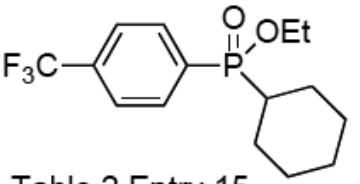
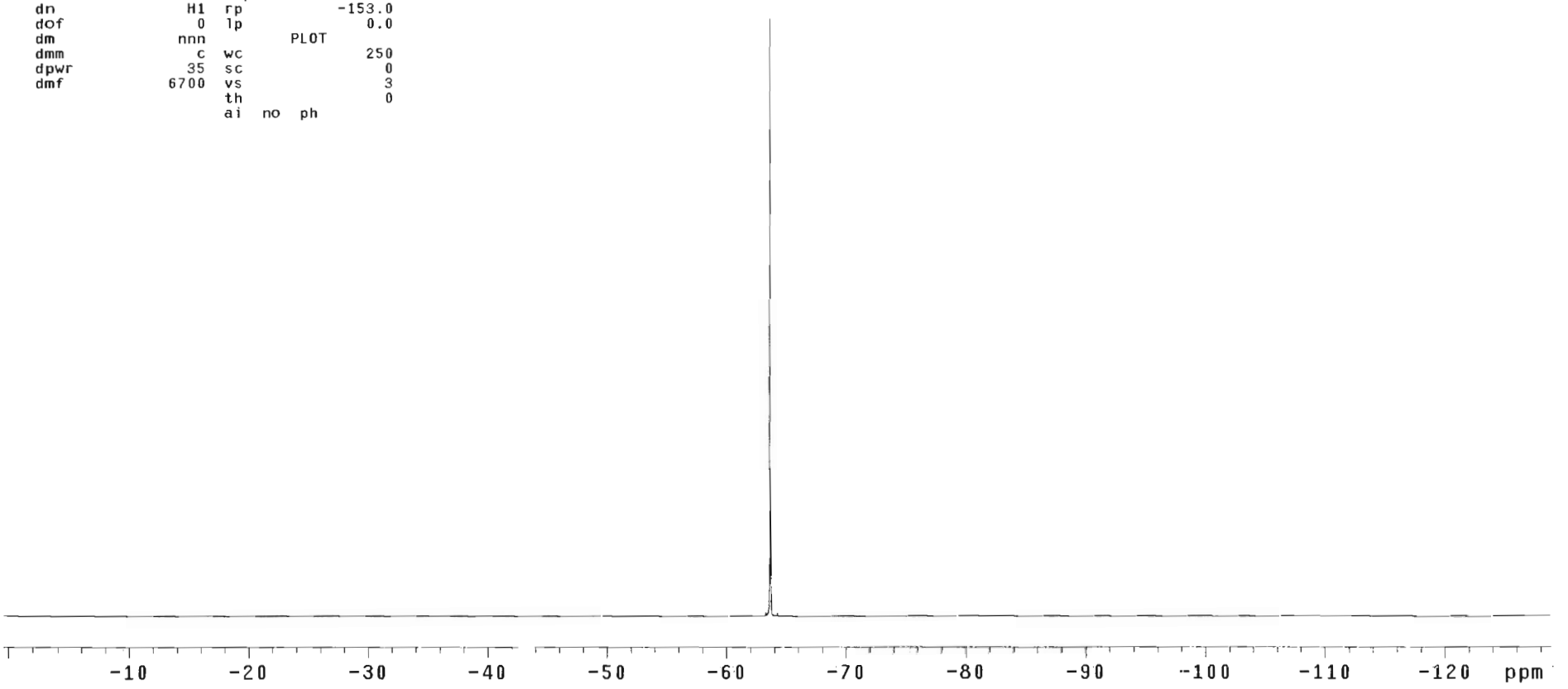


Table 2 Entry 15

^{19}F NMR



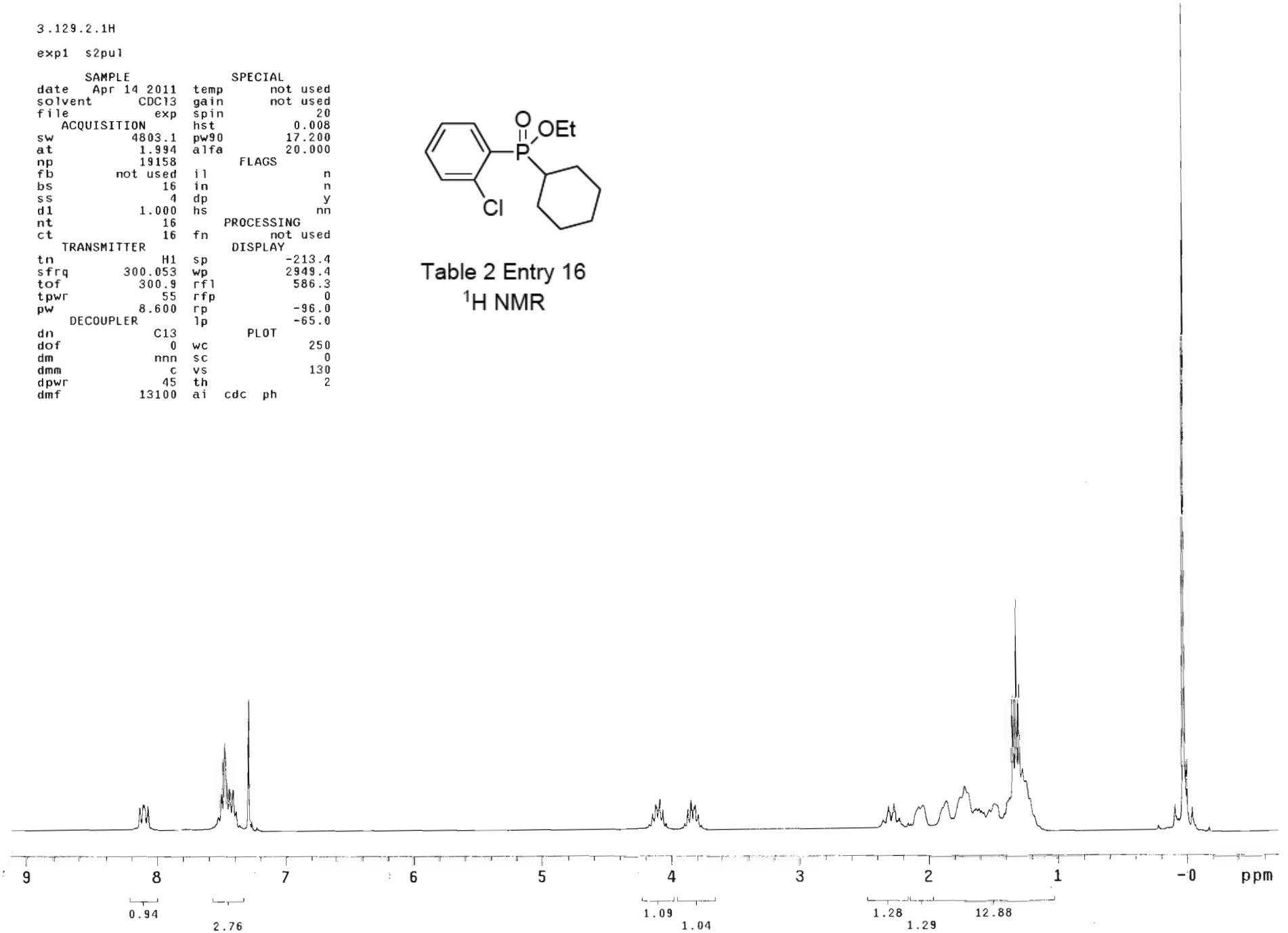
3.129.2.1H

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 14 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-213.4
sfrq	300.053	wp	2949.4
tof	300.9	rfl	586.3
tpwr	55	rfp	0
pw	8.600	rp	-96.0
DECOUPLER		lp	-65.0
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	130
dpwr	45	th	2
dmf	13100	ai cdc ph	

Table 2 Entry 16

^{1}H NMR



3.129.13C.1000

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 14 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	1000	PROCESSING	
ct	1000	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-778.5
tof	737.2	wp	16637.6
tpwr	58	rfl	1150.2
pw	9.250	rfp	0
DECOUPLER		rp	110.4
dn	H1	lp	-272.9
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	178
dmf	6700	th	8
		ai no ph	

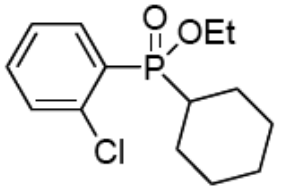
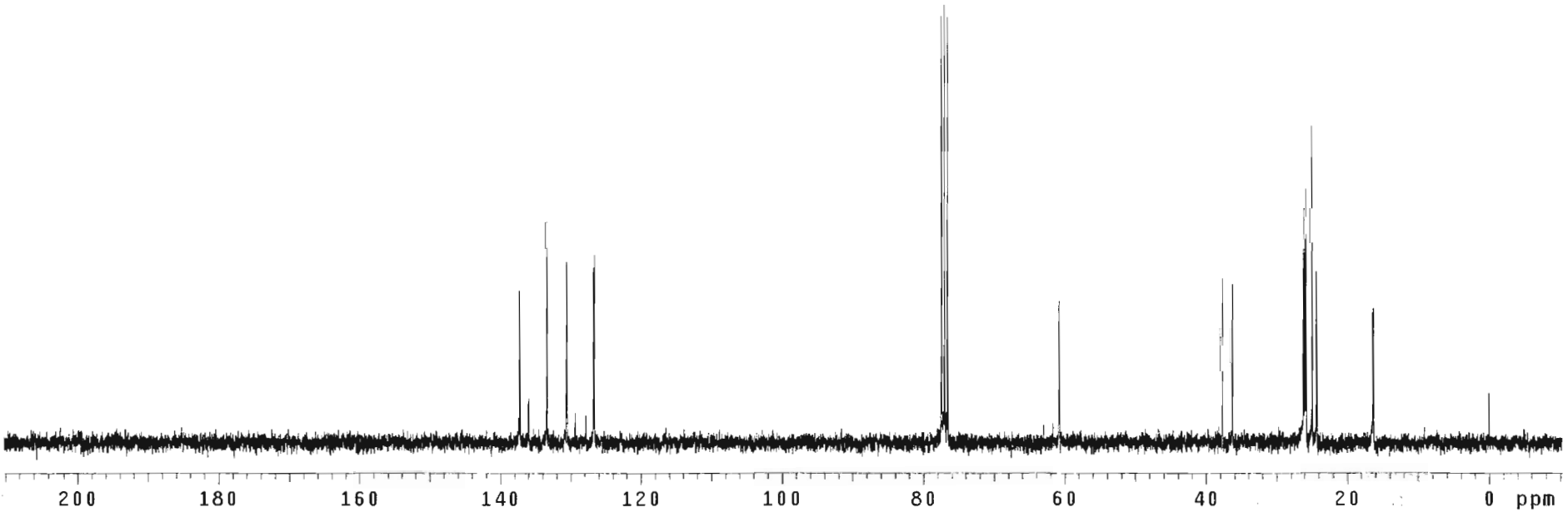


Table 2 Entry 16
^{13}C NMR



3.129.31P dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 13 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	45	PROCESSING	
ct	45	lb	1.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	2302.7
tof	10608.2	wp	6227.1
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	111.7
dn	H1	lp	-288.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	11
dmf	6700	th	2
		ai no ph	

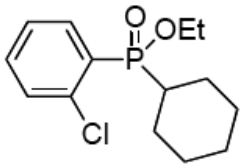
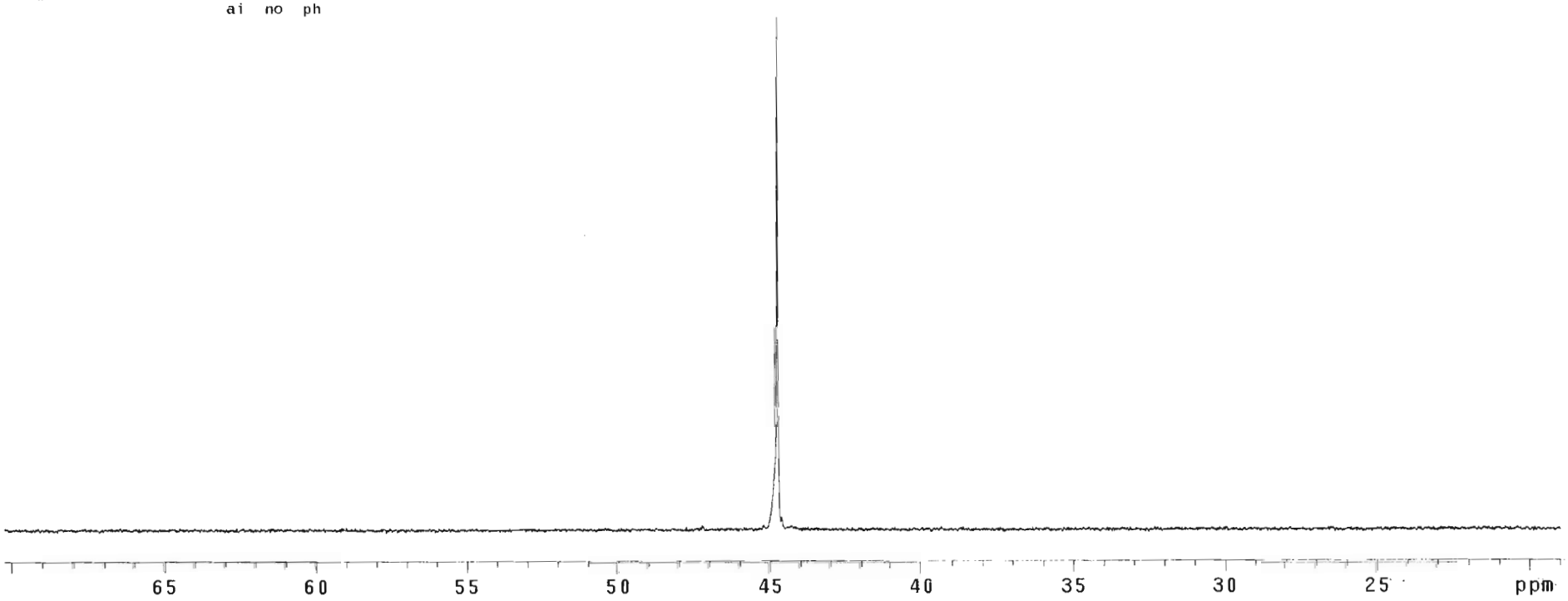


Table 2 Entry 16
^{31}P decoupled NMR



3.129.31P cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 13 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	36	PROCESSING	
ct	36	lb	1.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	1590.7
tof	10608.2	wp	7838.3
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	113.4
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	41
dmf	6700	th	12
		ai no ph	

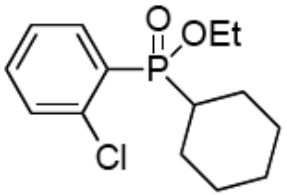
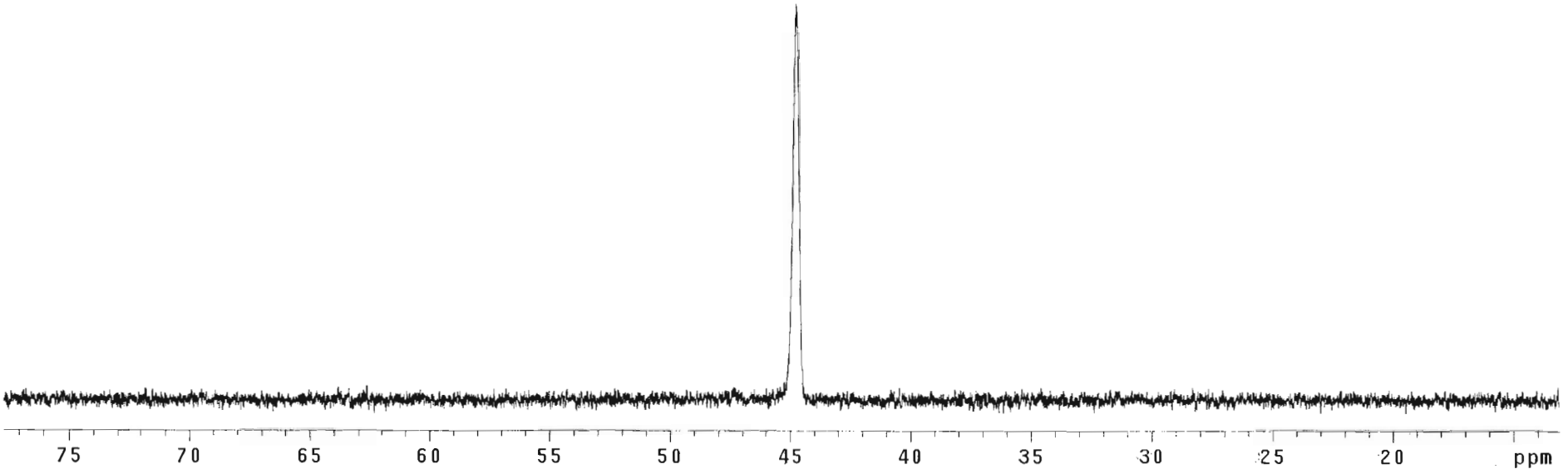


Table 2 Entry 16
^{31}P coupled NMR



3.118.1H

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 13 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-96.4
sfrq	300.053	wp	2804.6
tof	300.9	rfl	591.9
tpwr	55	rfp	0
pw	8.600	rp	-94.7
DECOUPLER		lp	-73.9
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	105
dpwr	45	th	2
dmf	13100	ai cdc ph	

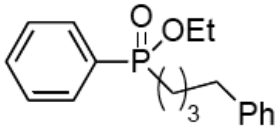
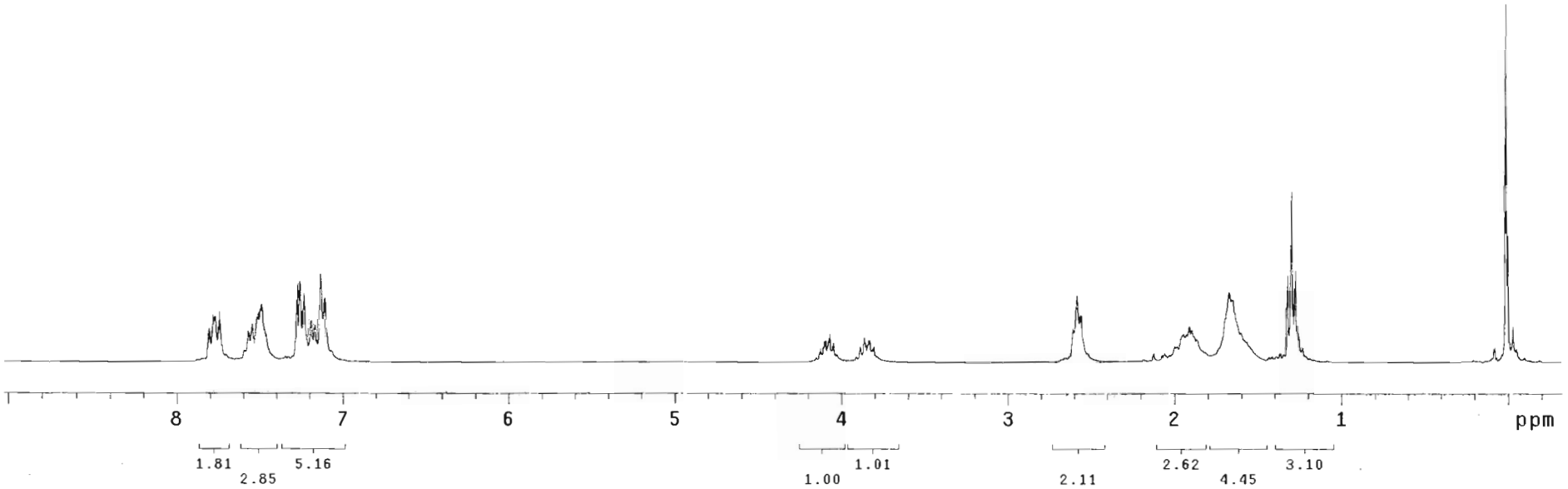


Table 2 Entry 17

^{1}H NMR



3.11a.13C

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 28 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	2.000	hs	nn
nt	512	PROCESSING	
ct	320	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-741.1
tof	737.2	wp	16550.0
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	89.9
dn	H1	lp	-220.3
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	99
dmf	6700	th	8
		nm	no ph

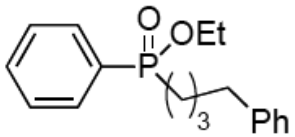
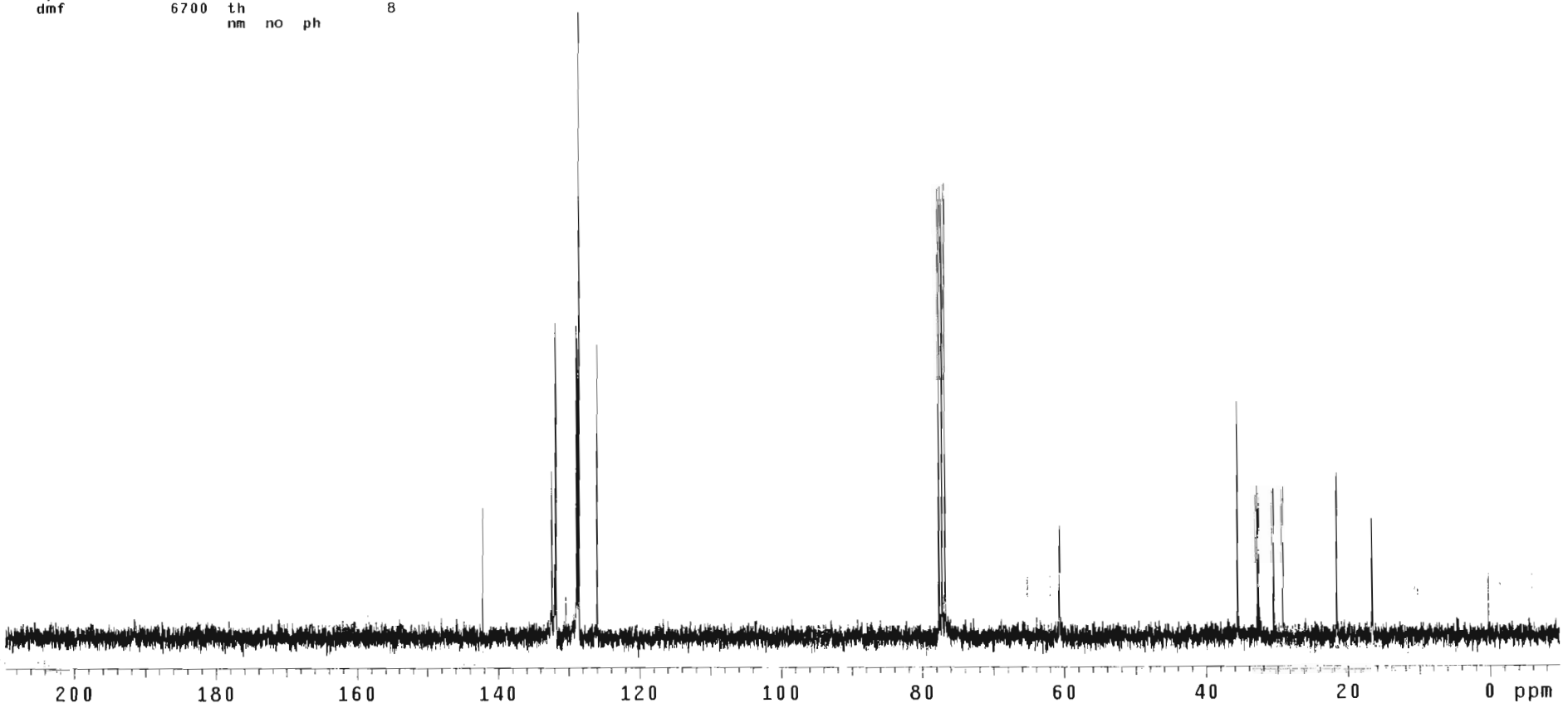


Table 2 Entry 17

^{13}C NMR



3.118.31P dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 30 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	1311.7
tof	10608.2	wp	8612.6
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-149.3
dn	H1	lp	-288.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	8
dmf	6700	th	2
		ai no ph	

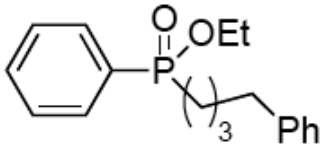
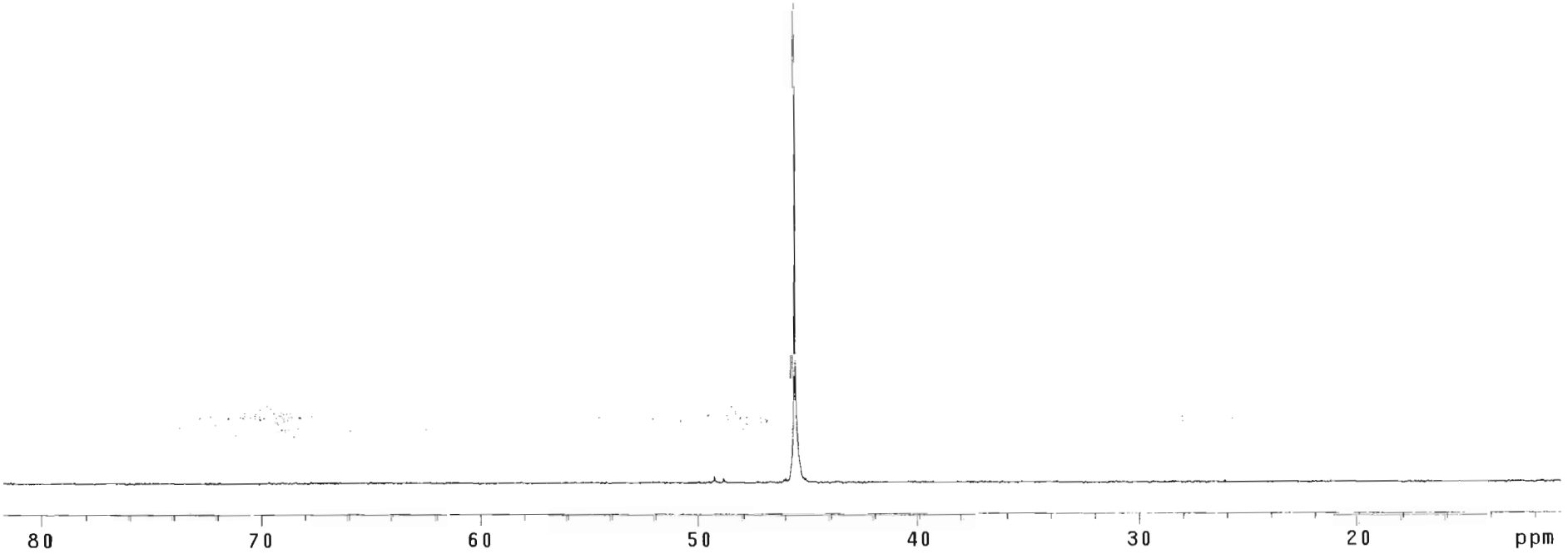


Table 2 Entry 17

^{31}P decoupled NMR



3.118.31P cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 30 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	1.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	808.2
tof	10608.2	wp	9201.4
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-147.8
dn	H1	lp	-288.8
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	36
dmf	6700	th	10
		ai no ph	

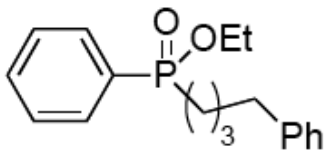
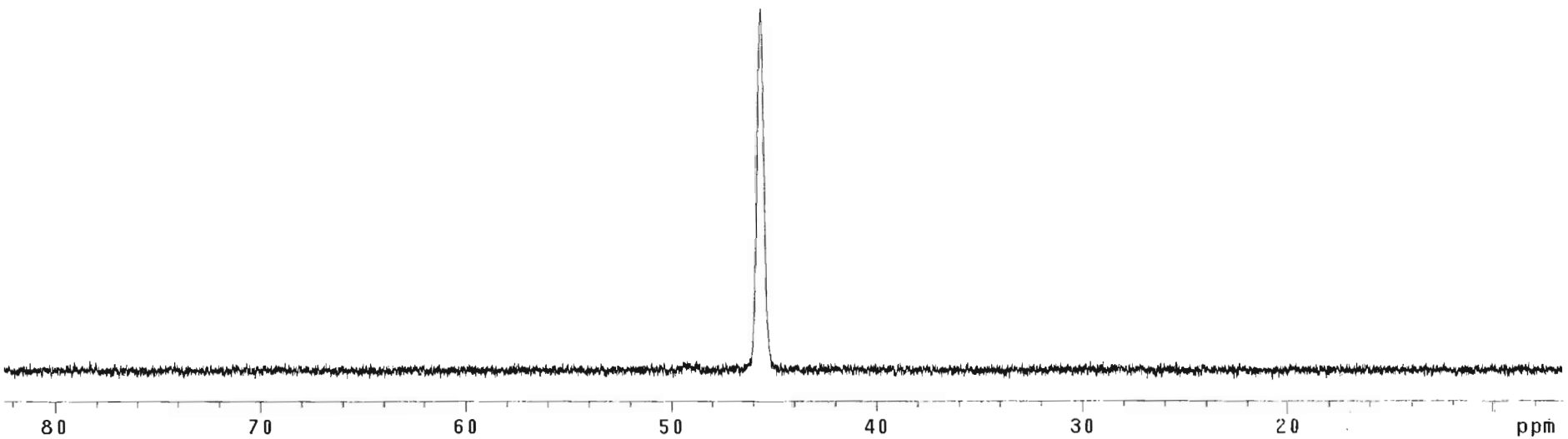


Table 2 Entry 17

^{31}P coupled NMR



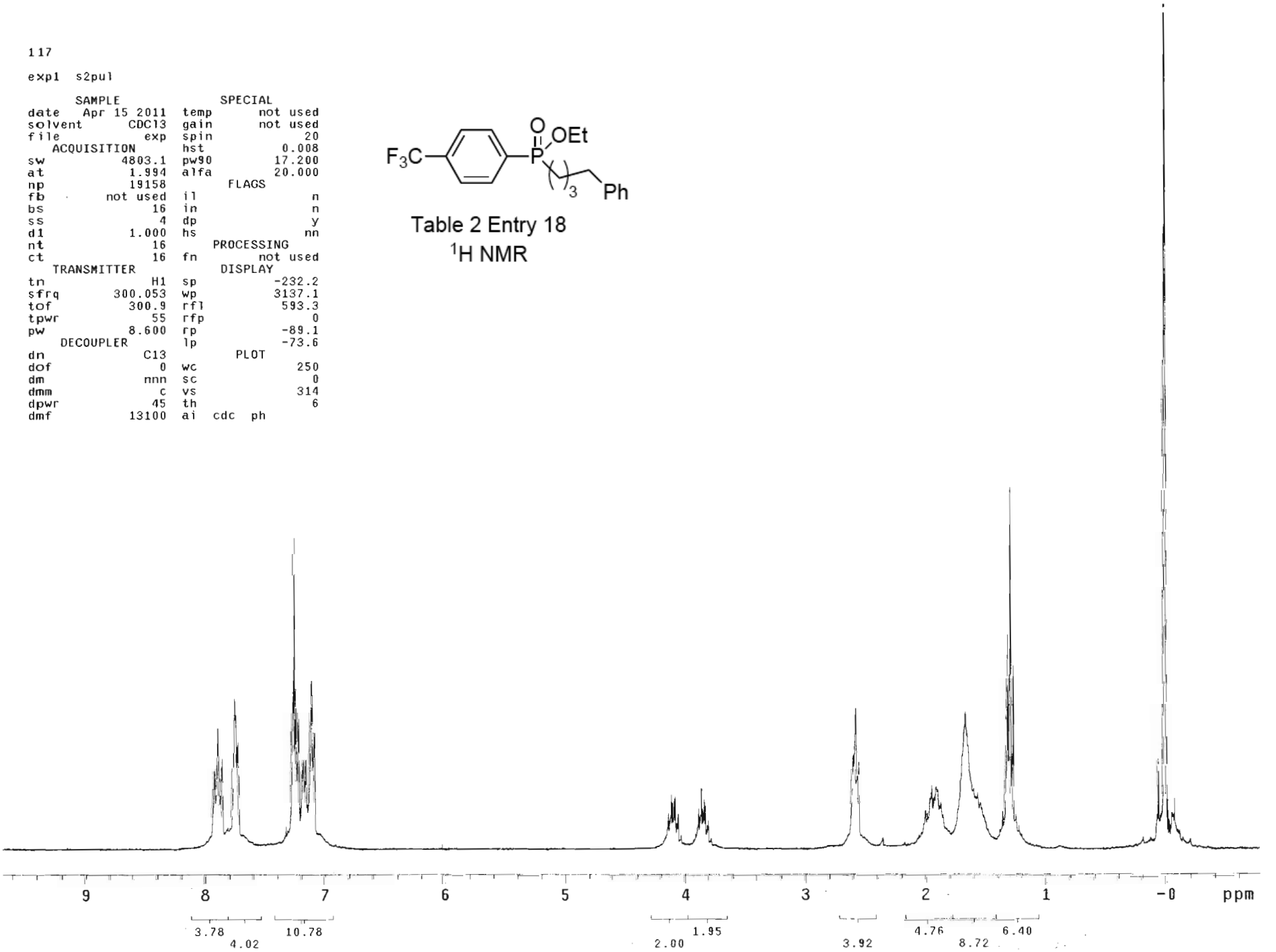
117

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 15 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	4803.1	pw90	17.200
at	1.994	alfa	20.000
np	19158	FLAGS	
fb	not used	il	n
bs	16	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	16	PROCESSING	
ct	16	fn	not used
TRANSMITTER		DISPLAY	
tn	H1	sp	-232.2
sfrq	300.053	wp	3137.1
tof	300.9	rf1	593.3
tpwr	55	rfp	0
pw	8.600	rp	-89.1
DECOUPLER		lp	-73.6
dn	C13	PLOT	
dof	0	wc	250
dm	nnn	sc	0
dmm	c	vs	314
dpwr	45	th	6
dmf	13100	ai cdc ph	

Table 2 Entry 18

^{1}H NMR



117

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 2 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	18867.9	pw90	18.500
at	1.815	alfa	20.000
np	68492	FLAGS	
fb	10400	il	n
bs	64	in	n
ss	4	dp	y
d1	2.000	hs	nn
nt	1000	PROCESSING	
ct	1000	lb	1.00
TRANSMITTER		fn	not used
tn	C13	DISPLAY	
sfrq	75.456	sp	-128.8
tof	737.2	wp	13904.5
tpwr	58	rfl	1134.7
pw	9.250	rfp	0
DECOUPLER		rp	100.5
dn	H1	lp	-261.0
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	25
dmf	6700	th	2
		ai no ph	

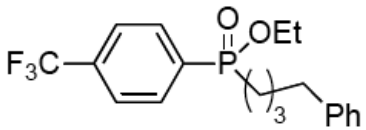
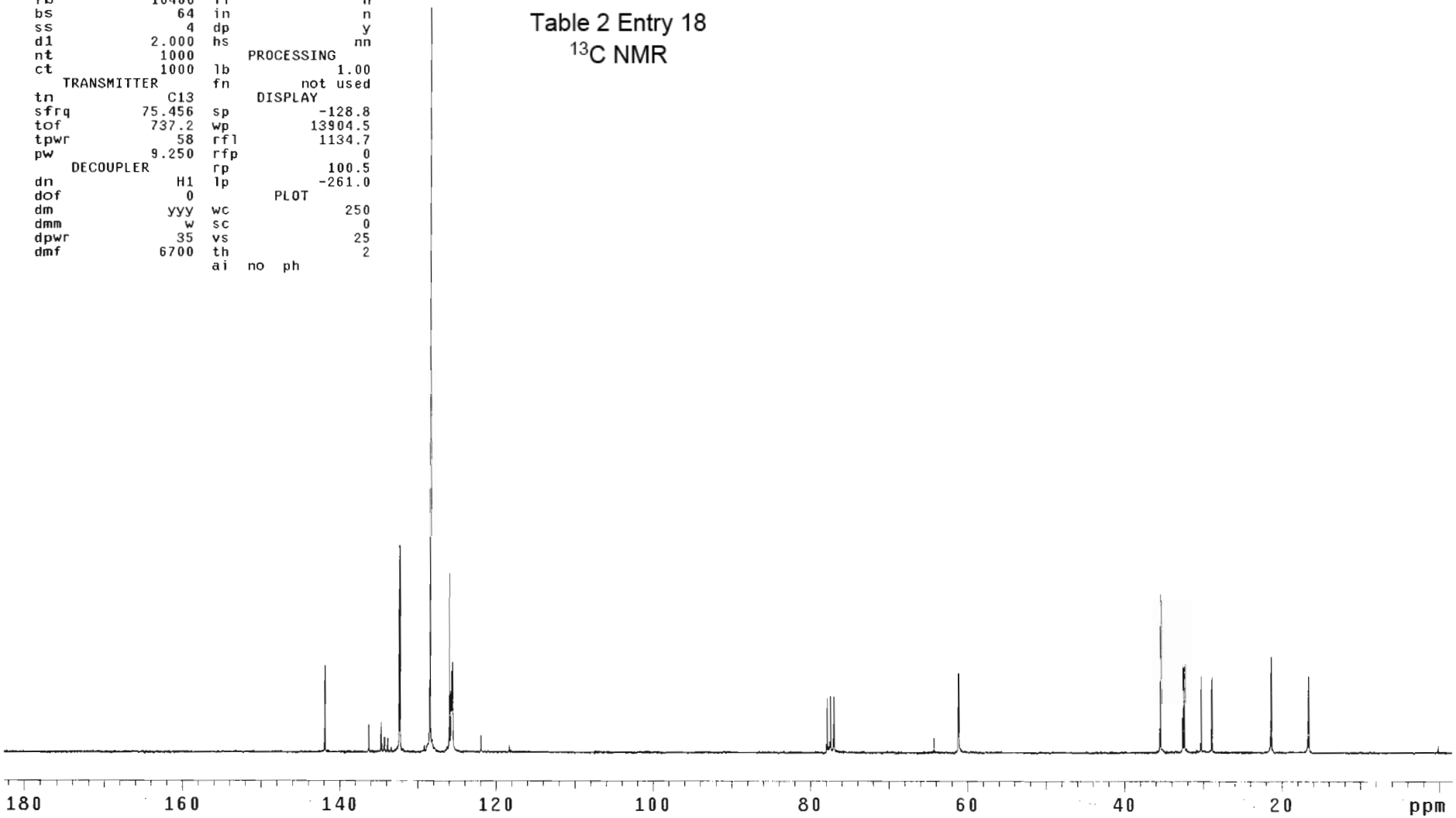


Table 2 Entry 18

^{13}C NMR



3.117.dc

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 28 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	64	PROCESSING	
ct	64	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	188.5
tof	10608.2	wp	9821.1
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	-145.0
dn	H1	lp	-288.8
dof	0	PLOT	
dm	yyy	wc	250
dmm	w	sc	0
dpwr	35	vs	10
dmf	6700	th	2
		ai no ph	

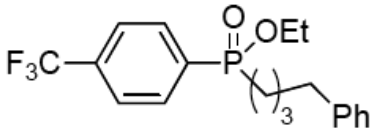
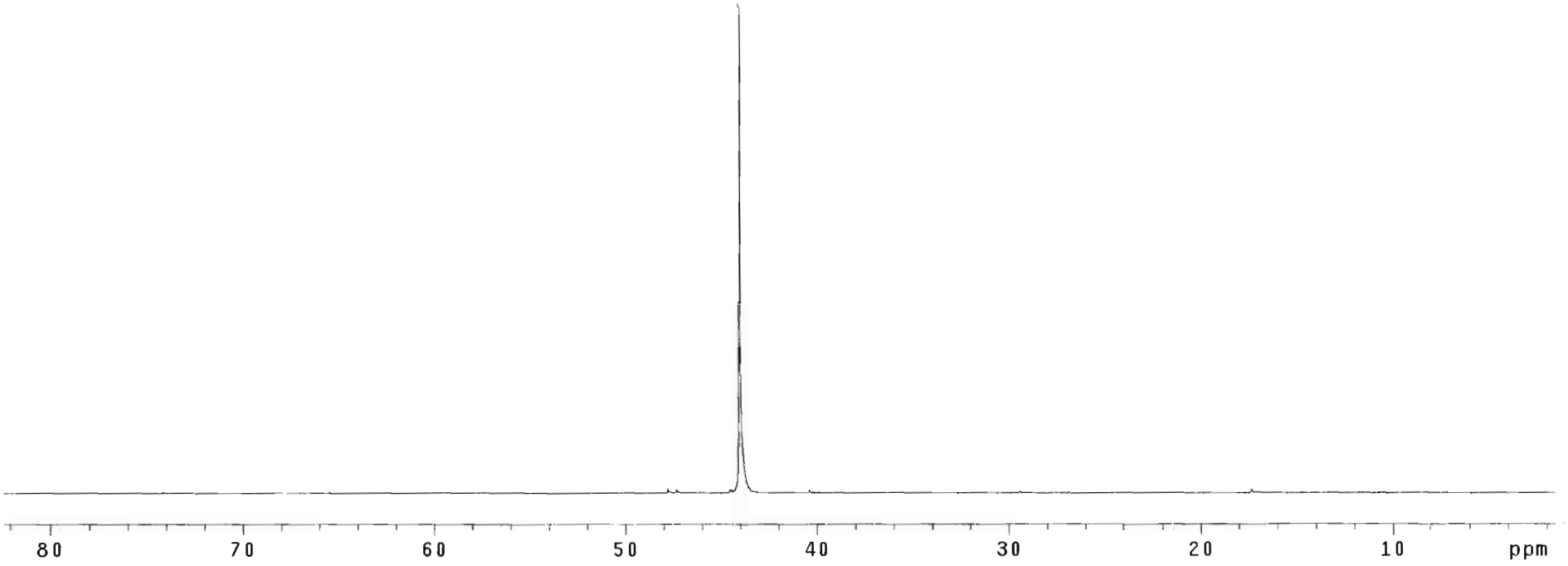


Table 2 Entry 18

^{31}P decoupled NMR



3.117.cpl

exp1 s2pul

SAMPLE		SPECIAL	
date	Mar 28 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	26738.0	pw90	18.300
at	1.598	alfa	20.000
np	85476	FLAGS	
fb	14800	il	n
bs	64	in	n
ss	4	dp	y
d1	1.000	hs	nn
nt	45	PROCESSING	
ct	45	lb	2.00
TRANSMITTER		fn	not used
tn	P31	DISPLAY	
sfrq	121.474	sp	-0.0
tof	10608.2	wp	10010.0
tpwr	55	rfl	2437.3
pw	7.117	rfp	0
DECOUPLER		rp	133.8
dn	H1	lp	-0
dof	0	PLOT	
dm	ynn	wc	250
dmm	w	sc	0
dpwr	35	vs	30
dmf	6700	th	4
		ai no ph	

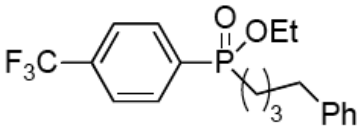
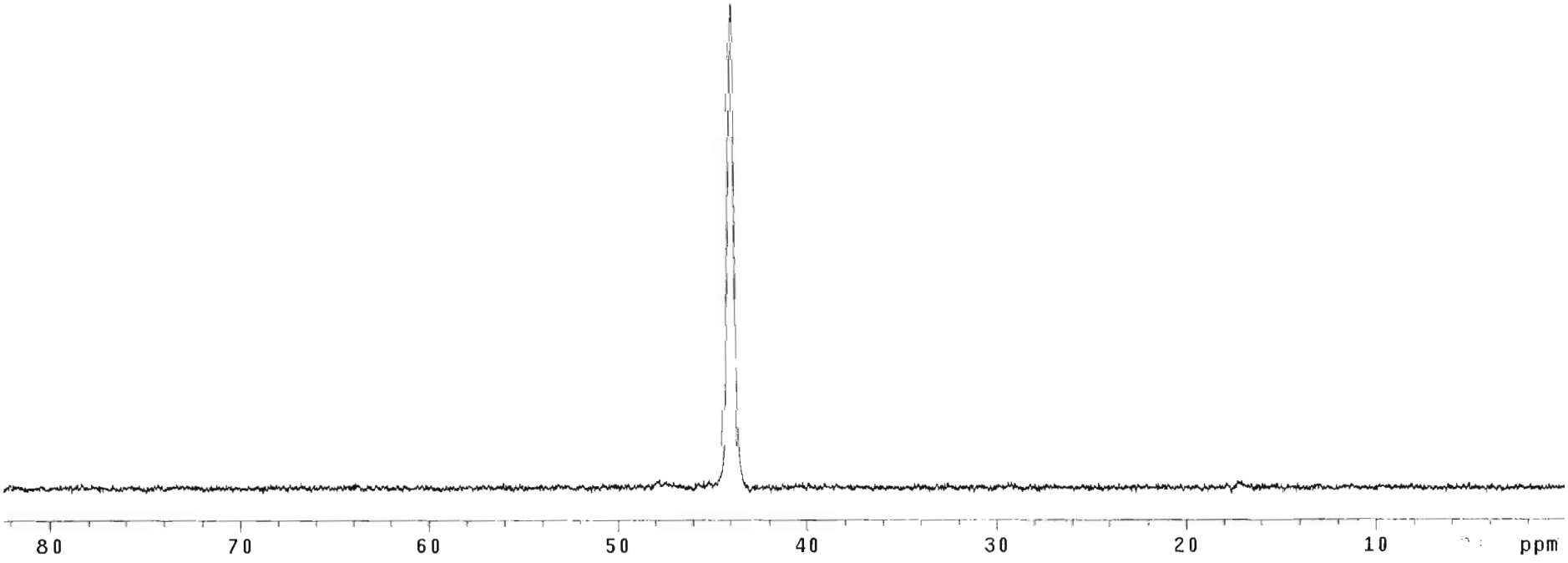


Table 2 Entry 18
^{31}P coupled NMR



117

exp1 s2pul

SAMPLE		SPECIAL	
date	Apr 2 2011	temp	not used
solvent	CDCl3	gain	not used
file	exp	spin	20
ACQUISITION		hst	0.008
sw	64935.1	pw90	24.000
at	0.300	alfa	82.400
np	38898	FLAGS	
fb	35800	il	n
bs	16	in	n
ss	4	dp	y
d1	1.500	hs	nn
nt	16	PROCESSING	
ct	16	lb	1.00
TRANSMITTER		lsfid	-6
tn	F19	fn	not used
sfrq	282.306	DISPLAY	
tof	5380.7	sp	-34269.0
tpwr	57	wp	34910.9
pw	8.000	rfl	56465.6
DECOUPLER		rfp	0
dn	H1	rp	-153.0
dof	0	lp	0.0
dm	nnn	PLOT	
dmm	c	wc	250
dpwr	35	sc	0
dmf	6700	vs	4
		th	0
		ai no ph	

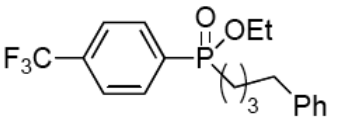
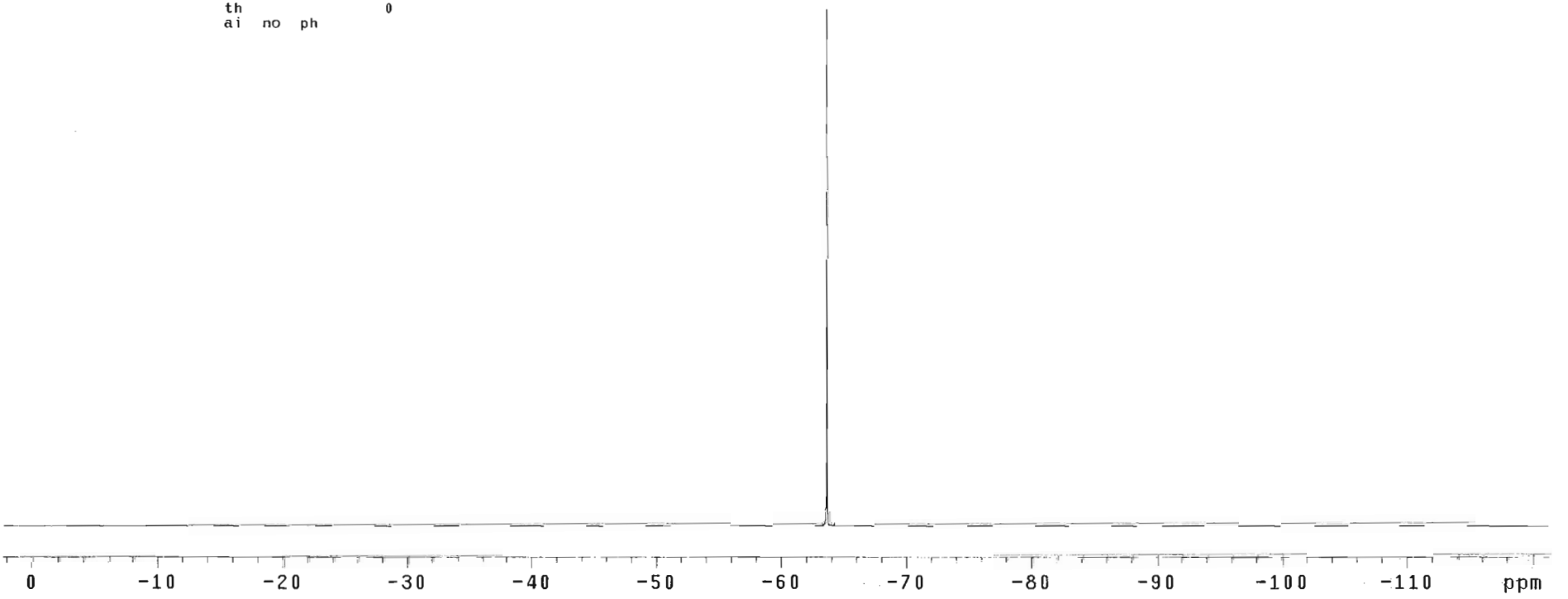


Table 2 Entry 18

^{19}F NMR