

Copper-Catalyzed Three-Component Phosphorylation-Peroxidation of Alkenes

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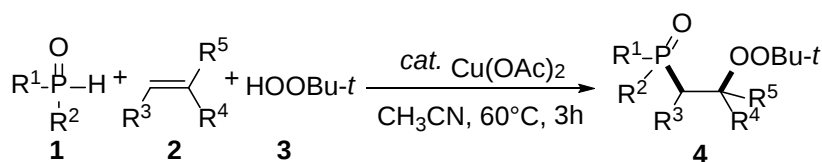
Contents

1. General information	S2
2. General procedure for synthesis of 4	S2
3. Characterization of 4	S3
4. Synthesis and characterization of 5	S11
5. Synthesis and characterization of 6, 7	S17
6. BHT-trapping experiment	S18
7. References	S19
8. Copies of ¹ H and ¹³ C, ³¹ P NMR spectra for all compounds	S19

1. General information

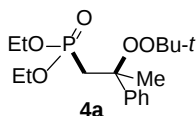
^1H NMR spectra were recorded on Bruker 400 MHz and 600 MHz spectrometer and the chemical shifts were reported in parts per million (δ) relative to internal standard TMS (0 ppm) for CDCl_3 . The peak patterns are indicated as follows: s, singlet; d, doublet; dd, doublet of doublet; t, triplet; m, multiplet; q, quartet. The coupling constants, J , are reported in Hertz (Hz). ^{13}C NMR spectra were obtained at Bruker 100 MHz, 150 MHz and referenced to the internal solvent signals (central peak is 77.0 ppm in CDCl_3). ^{31}P NMR spectra were proton decoupled and recorded in CDCl_3 on 243 MHz NMR spectrometer. CDCl_3 was used as the NMR solvent. APEX II (Bruker Inc.) was used for ESI-MS and EI-MS. IR spectra were recorded by a Bruker Tensor 27 infrared spectrometer. Flash column chromatography was performed over silica gel 200-300. All reagents were weighed and handled in air at room temperature. All chemical reagents were purchased from Alfa, Acros, Aldrich, TCI, and J&K and used without further purification. The substrates **1b**^[1], **2e**, **2i**^[2], **2k**, **2o**^[3] were prepared according to the reported literatures.

2. General procedure for synthesis of **4**

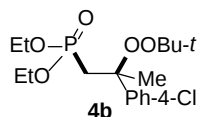


To a dry Schlenk tube were added phosphoryl compound **1** (2.5 mmol), alkene **2** (0.5 mmol), Cu(OAc)_2 (0.05 mmol), and anhydrous MeCN (5.0 mL) under N_2 atmosphere at room temperature. Subsequently, *tert*-butyl hydroperoxide **3** (5-6 M solution in decane, 2.5 mmol) was added to the mixture, and the resulting solution was stirred at 60°C for 3 h. The resulting mixture was cooled to room temperature and the solvent was evaporated under vacuum. The residue was purified by flash column chromatography on silica gel (eluent: ethylacetate/ petroleum ether) to give the peroxide **4**.

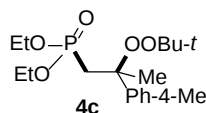
3. Characterization of 4



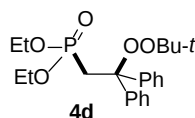
Diethyl (2-(*tert*-butylperoxy)-2-phenylpropyl)phosphonate (4a): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0. 4) in 73% yield (126 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2982, 1645, 1366, 1249, 1197, 1057, 1029, 963, 877, 762, 689 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.52-7.49 (m, 2H), 7.35-7.31 (m, 2H), 7.29-7.25 (m, 1H), 4.00-3.59 (m, 4H), 2.62 (dd, J = 18.8 Hz, 15.2 Hz, 1H), 2.42 (dd, J = 15.2 Hz, 19.6 Hz, 1H), 1.91 (s, 3H), 1.23 (s, 9H), 1.20 (t, J = 7.2 Hz, 3H), 1.07 (t, J = 4.0 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 143.2 (d, J = 4.4 Hz), 127.8, 127.4, 126.3, 81.3, 79.2, 61.2, 61.1, 37.5 (d, J = 138.2 Hz), 26.6, 23.2, 16.2 (d, J = 6.5 Hz), 16.1 (d, J = 6.4 Hz); ^{31}P NMR (243 MHz, CDCl_3): δ 26.2; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{29}\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 367.1645; found: 367.1640.



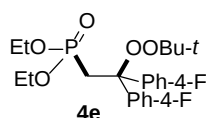
Diethyl (2-(*tert*-butylperoxy)-2-(4-chlorophenyl)propyl)phosphonate (4b): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0. 4) in 53% yield (100.9 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2982, 1646, 1491, 1395, 1249, 1197, 1029, 964, 877, 826, 747 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.37-7.35 (m, 2H), 7.23-7.21 (m, 2H), 3.95-3.60 (m, 4H), 2.46 (dd, J = 15.2 Hz, 18.8 Hz, 1H), 2.29 (dd, J = 15.4 Hz, J = 19.6 Hz, 1H), 1.81 (s, 3H), 1.15 (t, J = 7.2 Hz, 3H), 1.14 (s, 9H), 1.02 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 141.8 (d, J = 4.4 Hz), 133.1, 127.9, 127.8, 80.8, 79.3, 61.3 (d, J = 5.8 Hz), 61.2 (d, J = 6.0 Hz), 37.4 (d, J = 138.8 Hz), 26.5, 23.3, 16.2 (d, J = 6.9 Hz), 16.0 (d, J = 6.35 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 25.6; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{28}\text{ClO}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 401.1255; found: 401.1251.



Diethyl (2-(*tert*-butylperoxy)-2-(*p*-tolyl)propyl)phosphonate (4c): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.4) in 40% yield (70.8 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2982, 1649, 1514, 1455, 1366, 1249, 1197, 1029, 963, 878, 816, 747 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.39-7.37 (m, 2H), 7.15-7.13 (m, 2H), 4.00-3.62 (m, 4H), 2.63 (dd, J = 15.2 Hz, J = 18.8 Hz, 1H), 2.41 (dd, J = 15.2 Hz, J = 19.6 Hz, 1H), 2.33 (s, 3H), 1.89 (s, 3H), 1.22 (s, 9H), 1.21 (t, J = 7.2 Hz, 3H), 1.08 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 140.1 (d, J = 4.4 Hz), 137.1, 128.4, 126.2, 81.1, 79.1, 61.2 (d, J = 6.0 Hz), 61.1 (d, J = 5.9 Hz), 37.4 (d, J = 138.0 Hz), 26.6, 23.2, 21.0, 16.2 (d, J = 6.4 Hz), 16.0 (d, J = 6.4 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 26.3; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{31}\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 381.1801; found: 381.1795.

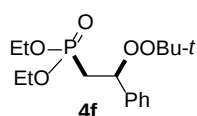


Diethyl (2-(*tert*-butylperoxy)-2,2-diphenylethyl)phosphonate (4d): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.4) in 73% yield (149 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 3062, 2981, 1646, 1493, 1449, 1391, 1364, 1245, 1197, 1029, 963, 882, 757, 699 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.38-7.36 (m, 4H), 7.29-7.21 (m, 6H), 3.89-3.79 (m, 2H), 3.76-3.66 (m, 2H), 3.14 (d, J = 19.6 Hz, 2H), 1.11 (s, 9H), 1.10 (t, J = 7.2 Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 143.3 (d, J = 7.2 Hz), 127.6, 127.2, 127.1, 84.4, 79.5, 60.9, 60.9, 34.9 (d, J = 142.6 Hz), 26.5, 16.1, 16.0; ^{31}P NMR (243 MHz, CDCl_3) δ 26.1; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{31}\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 429.1801; found: 429.1783.

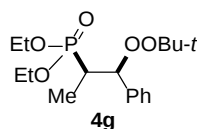


Diethyl (2-(*tert*-butylperoxy)-2,2-bis(4-fluorophenyl)ethyl)phosphonate (4e):

Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.3) in 64% yield (141 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2982, 1605, 1500, 1392, 1232, 1196, 1029, 965, 836, 747 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.36-7.33 (m, 4H), 7.00-6.96 (m, 4H), 3.92-3.72 (m, 4H), 3.10 (d, J = 19.6 Hz, 2H), 1.13 (t, J = 7.2 Hz, 6H), 1.10 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 163.2, 160.7, 138.7, 129.7, 129.6, 114.2, 114.0, 84.0, 79.7, 61.2, 61.1, 35.4 (d, J = 142.5 Hz), 26.4, 16.1, 16.0; ^{31}P NMR (243 MHz, CDCl_3) δ 25.5; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{29}\text{F}_2\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 465.1613; found: 465.1608.

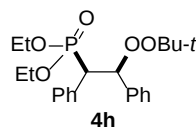


Diethyl (2-(*tert*-butylperoxy)-2-phenylethyl)phosphonate (4f): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.3) in 69% yield (114 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2981, 1645, 1454, 1391, 1364, 1255, 1197, 1026, 965, 877, 798, 960 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.39-7.31 (m, 5H), 5.23-5.17 (m, 1H), 4.05-3.78 (m, 4H), 2.71-2.61 (m, 1H), 2.29-2.18 (m, 1H), 1.21 (s, 9H), 1.20 (t, J = 6.8 Hz, 3H), 1.16 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 139.4 (d, J = 6.1 Hz), 128.2, 128.1, 127.3, 80.9, 80.5, 61.4 (d, J = 5.9 Hz), 61.3 (d, J = 5.8 Hz), 31.3 (d, J = 138.3 Hz), 26.2, 16.1, 16.0; ^{31}P NMR (243 MHz, CDCl_3) δ 26.5; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{27}\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 353.1488; found: 353.1485.



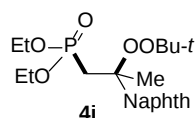
Diethyl (1-(*tert*-butylperoxy)-1-phenylpropan-2-yl)phosphonate (4g and 4g'): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.3) in 58% yield (99 mg); d.r. = 8:1; Colorless oil; IR (KBr): $\nu_{\max}$ 2981, 1646, 1456, 1390, 1254, 1197, 1057, 962, 911, 751, 701 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.37-7.24 (m, 10H), 5.28-5.24 (m, 1H), 5.18-5.14 (m, 1H), 4.21-3.78 (m, 8H), 2.63-2.51 (m, 1H), 2.30-2.18 (m, 1H), 1.31-1.19 (m, 36H); ^{13}C NMR (100 MHz, CDCl_3) δ 140.3 (d, J = 9.3 Hz), 127.8, 127.4, 127.1, 83.2, 80.5, 61.6 (d, J = 6.1), 61.5

(d, $J=4.9$), 60.3, 38.0 (d, $J = 139.6$ Hz), 26.5, 16.3 (d, $J = 3.8$ Hz), 16.3 (d, $J = 2.5$ Hz), 8.9 (d, $J = 4.3$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 30.0 ; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{29}\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 367.1645; found: 367.1636.



Diethyl (2-(*tert*-butylperoxy)-1,2-diphenylethyl)phosphonate (4h and 4h'):

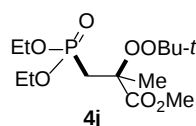
Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.5) in 62% yield (126 mg); d.r. = 3:1; IR (KBr): ν_{max} 3032, 2979, 2235, 1718, 1602, 1496, 1389, 1249, 1026, 879, 816, 757, 700, 647 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.42-7.33 (m, 6H), 7.29-7.23 (m, 10H), 7.12-7.06 (m, 4H), 5.54-5.47 (m, 2H), 4.21-3.47 (m, 9H), 3.41-3.33 (m, 1H), 1.35 (t, $J = 7.2$ Hz, 3H), 1.24 (s, 9H), 1.01 (s, 9H), 1.01 (t, $J = 8.4$ Hz, 3H), 0.99 (t, $J = 4.4$ Hz, 3H), 0.94 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 139.9, 139.8, 139.0, 138.8, 133.5, 133.4, 133.3, 130.3, 130.2, 130.1, 130.0, 128.0, 127.9, 127.6, 127.5, 127.4, 127.3, 127.1, 127.0, 85.6, 84.3, 80.7, 80.5, 62.6 (d, $J = 6.9$ Hz), 61.6 (d, $J=7.3$), 61.3 (d, $J=7.1$), 51.4 (d, $J = 138.4$ Hz), 49.5 (d, $J = 137.0$ Hz), 26.4, 26.2, 16.3, 16.2, 16.0, 15.9, 15.9, 15.8; ^{31}P NMR (243 MHz, CDCl_3) δ 23.6, 25.3; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{31}\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 429.1801; found: 429.1787.



Diethyl (2-(*tert*-butylperoxy)-2-(naphthalen-1-yl)propyl)phosphonate (4i):

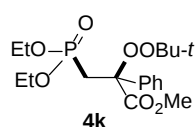
Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:2, R_f = 0.25) in 26% yield (52 mg); yellow oil; IR (KBr): ν_{max} 3051, 2981, 1602, 1509, 1448, 1366, 1249, 1197, 1020, 964, 878, 805, 779, 603 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 8.83-8.80 (m, 1H), 7.84-7.77 (m, 2H), 7.63-7.61 (m, 1H), 7.49-7.39 (m, 3H), 3.92-3.72 (m, 2H), 3.58-3.48 (m, 1H), 3.42-3.32 (m, 1H), 2.91 (dd, $J = 15.2$ Hz, $J = 20.8$ Hz, 1H), 2.81 (dd, $J = 15.2$ Hz, 19.2 Hz, 1H), 2.17 (s, 3H), 1.22 (s, 9H), 1.13 (t, J

= 7.2 Hz, 3H), 0.84 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 138.0 (d, J = 4.5 Hz), 134.5, 131.5, 129.2, 128.8, 126.9, 125.6, 125.3, 125.0, 124.7, 83.2, 79.1, 61.1 (d, J = 3.2 Hz), 61.1 (d, J = 3.2 Hz), 35.9 (d, J = 138.0 Hz), 26.7, 25.1, 16.1 (d, J = 6.5 Hz), 15.8 (d, J = 6.6 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 25.9; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{31}\text{O}_5\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 417.1801; found: 417.1794.



Methyl 2-(*tert*-butylperoxy)-3-(diethoxyphosphoryl)-2-methylpropanoate (4j):

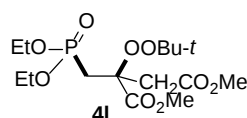
Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:2, R_f = 0.25) in 55% yield (89.5 mg); Colorless oil; IR (KBr): ν_{max} 2983, 1748, 1644, 1455, 1367, 1248, 1197, 1108, 1020, 965, 879, 840, 747 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 4.14-4.06 (m, 4H), 3.75 (s, 3H), 2.56 (dd, J = 15.2 Hz, 19.2 Hz, 1H), 2.30 (dd, J = 15.2 Hz, 19.2 Hz, 1H), 1.64 (s, 3H), 1.32 (t, J = 7.04 Hz, 3H), 1.32 (t, J = 7.2 Hz, 3H), 1.20 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 171.7, 81.5, 80.1, 61.7 (d, J = 3.4 Hz), 61.7 (d, J = 3.9 Hz), 52.2, 32.4 (d, J = 140.8 Hz), 26.4, 20.7, 16.4, 16.3; ^{31}P NMR (243 MHz, CDCl_3) δ 25.4; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{27}\text{O}_7\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 349.1387; found: 349.1372.



Methyl 2-(*tert*-butylperoxy)-3-(diethoxyphosphoryl)-2-phenylpropanoate (4k):

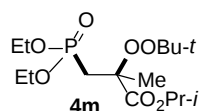
Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.4) in 75% yield (145 mg); Colorless oil; IR (KBr): ν_{max} 2982, 2375, 1742, 1646, 1541, 1455, 1392, 1297, 1029, 961, 746 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.41-7.39 (m, 2H), 7.36-7.28 (m, 3H), 3.95-3.74 (m, 4H), 3.71 (s, 3H), 3.07 (dd, J = 16.0 Hz, J = 18 Hz, 1H), 2.96 (dd, J = 16.0 Hz, J = 18.8 Hz, 1H), 1.30 (s, 9H), 1.14 (t, J = 7.2 Hz, 3H), 1.11 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 171.5 (d, J = 15.7 Hz), 137.5 (d, J = 4.4 Hz), 128.1, 128.0, 125.6, 84.8, 80.9, 61.2, 61.1, 52.5, 32.2 (d, J =

144.6 Hz), 26.6, 16.2 (d, $J = 6.3$ Hz), 16.1 (d, $J = 6.3$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 25.2; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{29}\text{O}_7\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 411.1543; found: 411.1535.



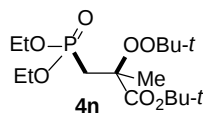
Dimethyl 2-(tert-butylperoxy)-2-((diethoxyphosphoryl)methyl)succinate (4af):

Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:2, R_f = 0.25) in 68% yield (130 mg); Colorless oil; IR (KBr): ν_{max} 2985, 1746, 1646, 1541, 1392, 1260, 1026, 913, 749 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 4.13-4.05 (m, 4H), 3.76 (s, 3H), 3.68 (s, 3H), 3.32 (dd, $J = 16.8$ Hz, 15.6 Hz, 2H), 2.88 (dd, $J = 15.6$ Hz, $J = 18.4$ Hz, 1H), 2.67 (dd, $J = 15.6$ Hz, 19.6 Hz, 1H), 1.31 (t, $J = 6.0$ Hz, 3H), 1.31 (t, $J = 7.2$ Hz, 3H), 1.19 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.5, 170.3 (d, $J = 12.1$ Hz), 81.6, 80.5, 61.8, 61.7, 52.4, 51.5, 36.4, 28.8 (d, $J = 140.3$ Hz), 26.3, 16.3, 16.2; ^{31}P NMR (243 MHz, CDCl_3) δ 25.0; HRMS (ESI) calcd for $\text{C}_{15}\text{H}_{29}\text{O}_9\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 407.1441; found: 407.1424.



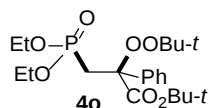
Isopropyl 2-(tert-butylperoxy)-3-(diethoxyphosphoryl)-2-methylpropanoate (4m):

Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.4) in 72% yield (127 mg); Colorless oil; IR (KBr): ν_{max} 2982, 1740, 1459, 1369, 1252, 1193, 1104, 1020, 961, 882, 850, 755 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 5.09-5.00 (m, 1H), 4.14-4.07 (m, 4H), 2.56 (dd, $J = 15.2$ Hz, 19.2 Hz, 1H), 2.32 (dd, $J = 15.2$ Hz, 19.2 Hz, 3H), 1.62 (s, 3H), 1.32 (t, $J = 7.2$ Hz, 3H), 1.32 (t, $J = 7.2$ Hz, 3H), 1.28 (d, $J = 3.2$ Hz, 3H), 1.27 (d, $J = 2.0$ Hz, 3H), 1.21 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.8 (d, $J = 9.0$ Hz), 81.3, 79.8, 68.8, 61.6 (d, $J = 5.4$ Hz), 61.5 (d, $J = 4.6$ Hz), 32.0 (d, $J = 141.0$ Hz), 26.4, 21.6, 20.6, 16.3, 16.3; ^{31}P NMR (243 MHz, CDCl_3) δ 25.9; HRMS (ESI) calcd for $\text{C}_{15}\text{H}_{31}\text{O}_7\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 377.1700; found: 377.1695.



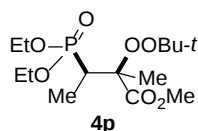
***Tert*-butyl 2-(*tert*-butylperoxy)-3-(diethoxyphosphoryl)-2-methylpropanoate**

(4n): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.3) in 75% yield (138 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2981, 1738, 1643, 1368, 1257, 1162, 1029, 961, 749 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 4.15-4.07 (m, 4H), 2.52 (dd, J = 15.4 Hz, 19.2 Hz, 1H), 2.33 (dd, J = 15.4 Hz, J = 19.0 Hz, 1H), 1.58 (s, 3H), 1.48 (s, 9H), 1.32 (t, J = 7.2 Hz, 6H), 1.22 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.4 (d, J = 9.6 Hz), 81.7, 81.2, 79.7, 61.6, 61.5, 31.9 (d, J = 141.3 Hz), 27.8, 28.5, 20.7, 16.4, 16.3; ^{31}P NMR (243 MHz, CDCl_3) δ 26.5; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{33}\text{O}_7\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 391.1856; found: 391.1847.



***Tert*-butyl 2-(*tert*-butylperoxy)-3-(diethoxyphosphoryl)-2-phenylpropanoate**

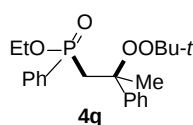
(4o): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.5) in 63% yield (136 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2980, 1730, 1451, 1392, 1253, 1161, 1030, 886, 847, 698 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.40-7.38 (m, 2H), 7.34-7.25 (m, 3H), 3.93-3.70 (m, 4H), 3.06 (dd, J = 16.0 Hz, J = 17.6 Hz, 1H), 2.92 (dd, J = 16.0 Hz, 18.8 Hz, 1H), 1.38 (s, 9H), 1.33 (s, 9H), 1.14-1.09 (m, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 169.7 (d, J = 16.5 Hz), 138.1, 138.0, 127.7, 125.5, 84.9, 81.7, 80.5, 61.0 (d, J = 6.4 Hz), 60.9 (d, J = 6.4 Hz), 31.8 (d, J = 144.5 Hz), 27.6, 26.7, 16.1 (d, J = 5.6 Hz), 16.0 (d, J = 4.4 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 26.0; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{35}\text{O}_7\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 453.2013; found: 453.2004.



Methyl 2-(*tert*-butylperoxy)-3-(diethoxyphosphoryl)-2-methylbutanoate (4p and 4p')

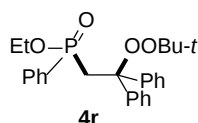
and 4p') Isolated by flash column chromatography (ethyl acetate/petroleum ether =

1:2, $R_f = 0.25$) in 52% yield (88.4 mg); d.r. = 8:1; Colorless oil; IR (KBr): $\nu_{\max}$ 2984, 1748, 1646, 1456, 1390, 1265, 1138, 1024, 963, 791, 748 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 4.16-4.04 (m, 8H), 3.75 (s, 6H), 2.99-2.88 (m, 1H), 2.60-2.48 (m, 1H), 1.64 (s, 3H), 1.52 (s, 3H), 1.32-1.21 (m, 27H), 1.18 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 171.6, 83.1 (d, $J = 6.5$ Hz), 79.9, 61.9 (d, $J = 6.6$ Hz), 61.7 (d, $J = 6.9$ Hz), 51.9, 35.9 (d, $J = 138.6$ Hz), 26.3, 16.3, 16.3, 15.8, 8.5 (d, $J = 5.8$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 28.5 ; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{29}\text{O}_7\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 363.1543; found: 363.1539.



Ethyl (2-(*tert*-butylperoxy)-2-phenylpropyl)(phenyl)phosphinate (4q and 4q'):

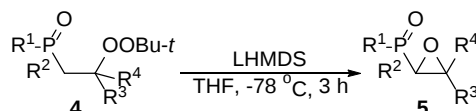
Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, $R_f = 0.5$) in 50% yield (95 mg); d.r. = 1:1; Colorless oil; IR (KBr): $\nu_{\max}$ 3059, 2981, 1721, 1443, 1366, 1285, 1121, 1095, 1035, 950, 876, 756, 698 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.76-7.71 (m, 2H), 7.52-7.18 (m, 15H) , 7.04-7.02 (m, 3H), 3.98-3.89 (m, 1H), 3.80-3.63 (m, 2H), 3.61-3.51 (m, 1H), 2.85 (dd, $J = 19.2$ Hz, 15.2 Hz, 1H), 2.70 (dd, $J = 11.6$ Hz, 15.2 Hz, 1H), 2.61-2.51 (m, 2H), 1.97 (s, 3H), 1.96 (s, 3H), 1.21 (t, $J = 7.2$ Hz, 3H), 1.20 (s, 9H), 1.02 (t, $J=7.2,3\text{H}$) ,1.01 (s,9H); ^{13}C NMR (100 MHz, CDCl_3) δ 144.4 (d, $J = 6.6$ Hz), 142.1, 131.8, 131.5, 131.3 (d, $J = 10.8$ Hz), 128.3 (d, $J = 12.5$ Hz), 127.9 (d, $J = 12.5$ Hz), 127.6 (d, $J = 22.9$ Hz), 127.2 (d, $J = 18.2$ Hz), 126.1 (d, $J = 23.5$ Hz), 81.9, 81.4 (d, $J = 2.5$ Hz), 79.0 (d, $J = 4.1$ Hz), 59.9 (d, $J = 6.1$), 59.8 (d, $J = 6.2$), 41.9 (d, $J = 99.7$ Hz), 40.9 (d, $J = 98.8$ Hz), 26.6, 26.3, 23.4, 23.3, 16.3 (d, $J = 6.8$ Hz), 16.0 (d, $J = 6.7$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 38.7, 39.1; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{29}\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 399.1696; found: 399.1680.



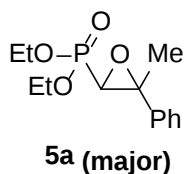
Ethyl (2-(*tert*-butylperoxy)-2,2-diphenylethyl)(phenyl)phosphinate (4r): Isolated

by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.5) in 51% yield (112 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 3059, 2980, 1595, 1445, 1390, 1231, 1197, 1037, 949, 880, 791, 754, 697 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.53-7.15 (m, 15H), 3.87-3.73 (m, 1H), 3.66-3.56 (m, 1H), 3.35 (d, J = 16.4 Hz, 2H), 1.10 (t, J = 7.2 Hz, 3H), 0.93 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 143.4 (d, J = 6.4 Hz), 142.8 (d, J = 5.8 Hz), 132.8, 131.7, 131.6, 131.3, 128.0, 127.8, 127.7, 127.2, 84.8, 79.4, 59.8 (d, J = 5.9 Hz), 38.9 (d, J = 101.0 Hz), 26.3, 16.1 (d, J = 6.8 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 39.0; HRMS (ESI) calcd for $\text{C}_{26}\text{H}_{31}\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 461.1852; found: 461.1837.

4. Synthesis and characterization of 5

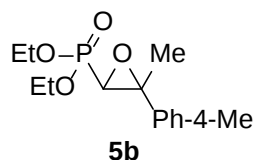


To a solution of the peroxide **4** (0.2 mmol) in THF (2.0 mL) under N_2 atmosphere, LHMDs (1.0 M in THF, 0.4 mL, 2 equiv) was added dropwise to the mixture at -78°C and stirred for 3 h. Then NH_4Cl aq (5.0 mL) was added and the organic layer was separated. The aqueous layer was extracted with EtOAc (3 x 15 mL). The collected organic layers were dried over MgSO_4 and concentrated under reduced pressure to give the crude product. The residue was purified by flash column chromatography on silica gel using ethyl acetate/petroleum ether as eluent to give the epoxide **5**.

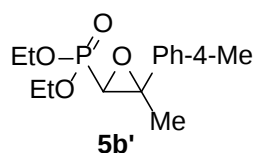


Diethyl ((2R,3R)-3-methyl-3-phenyloxiran-2-yl)phosphonate (5a major): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:2, R_f = 0.3) in 82% yield (44.5 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2983, 1448, 1389, 1260, 1163, 1024, 968, 854, 789, 700 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.38-7.29 (m, 5H), 4.30-4.17 (m, 4H), 2.93 (d, J = 28.0 Hz, 1H), 1.97 (s, 3H), 1.40 (t, J = 7.2, 3H), 1.37 (t, J = 8.4

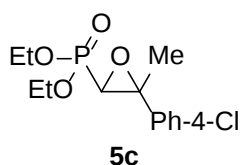
Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 141.0, 128.4, 127.8, 124.9, 62.8 (d, J = 6.2 Hz), 62.3 (d, J = 6.2 Hz), 61.9, 59.1 (d, J = 196.0 Hz), 18.4, 16.4, 16.3; ^{31}P NMR (243 MHz, CDCl_3) δ 17.3; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{19}\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 293.0913; found: 293.0908.



Diethyl ((2R,3R)-3-methyl-3-(p-tolyl)oxiran-2-yl)phosphonate (5b): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0. 5) in 79% yield (45.2mg); Colorless oil; IR (KBr): ν_{max} 2983, 1515, 1448, 1372, 1260, 1164, 1022, 968, 798 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.27-7.24 (m, 2H), 7.16-7.14 (m, 2H), 4.31-4.14 (m, 4H), 2.92 (d, J = 28.0 Hz, 1H), 2.34 (s, 3H), 1.95 (s, 3H), 1.39 (t, J = 7.2 Hz, 3H), 1.37 (t, J = 7.08, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 138.1, 137.6, 129.1, 124.9, 62.8 (d, J = 6.2 Hz), 62.3 (d, J = 6.1 Hz), 61.9, 59.2 (d, J = 195.5 Hz), 21.0, 18.5, 16.4, 16.3; ^{31}P NMR (243 MHz, CDCl_3) δ 17.5; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{21}\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 307.1070; found: 307.1058.

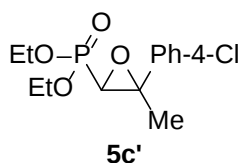


Diethyl ((2R,3S)-3-methyl-3-(p-tolyl)oxiran-2-yl)phosphonate (5b'): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0. 25) in 3% yield (1.6 mg); Colorless oil; ^1H NMR (400 MHz, CDCl_3) δ 7.35-7.33 (m, 2H), 7.16-7.14 (m, 2H), 4.04-3.89 (m, 2H), 3.80-3.70 (m, 1H), 3.47-3.37 (m, 1H), 3.19 (d, J = 28.0 Hz, 1H), 2.33 (s, 3H), 1.68 (d, J = 2.4 Hz, 3H), 1.23 (t, J = 7.2 Hz, 3H), 1.03 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 137.4, 135.0, 128.5, 126.3, 63.5, 62.1 (d, J = 5.8 Hz), 62.0 (d, J = 5.7 Hz), 58.4 (d, J = 210.4 Hz), 26.3, 21.1, 16.2 (d, J = 6.1 Hz), 16.1 (d, J = 5.6 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 16.7; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{21}\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 307.1070; found: 307.1060.



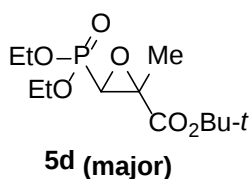
Diethyl ((2R,3R)-3-(4-chlorophenyl)-3-methyloxiran-2-yl)phosphonate (5c):

Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.4) in 67% yield (41mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2983, 1599, 1492, 1448, 1389, 1260, 1197, 1019, 969, 842, 620 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.33-7.28 (m, 4H), 4.29-4.18(m, 4H), 2.88 (d, J = 27.2 Hz, 1H), 1.95 (s, 3H), 1.40 (t, J = 7.2 Hz, 3H), 1.37 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 139.5, 133.7, 128.5, 126.4, 62.8 (d, J = 5.9 Hz), 62.3 (d, J = 5.9 Hz), 61.4, 59.1 (d, J = 196.1 Hz), 18.2, 16.3, 16.2; ^{31}P NMR (243 MHz, CDCl_3) δ 16.9; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{18}\text{ClO}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 327.0523; found: 327.0518.

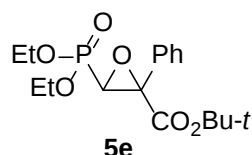


Diethyl ((2R,3S)-3-(4-chlorophenyl)-3-methyloxiran-2-yl)phosphonate (5c'):

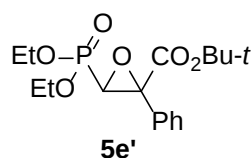
Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.25) in 7% yield (4.3 mg); Colorless oil; ^1H NMR (400 MHz, CDCl_3) δ 7.41-7.38 (m, 2H), 7.33-7.30 (m, 2H), 4.05-3.90 (m, 2H), 3.85-3.75 (m, 1H), 3.62-3.52 (m, 1H), 3.19 (d, J = 28.0 Hz, 1H), 1.68 (d, J = 2.4 Hz, 3H), 1.23 (t, J = 7.2 Hz, 3H), 1.07 (t, J = 7.2 Hz, 3H); ^{13}C NMR (150 MHz, CDCl_3) δ 136.6, 133.6, 128.1, 128.0, 63.0, 62.3 (d, J = 8.4Hz), 62.2 (d, J = 7.2 Hz), 58.3 (d, J = 201.3 Hz), 25.9, 16.2 (d, J = 5.9 Hz), 16.1 (d, J = 5.4 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 16.2; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{18}\text{ClO}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 327.0523; found: 327.0521.



Tert-butyl (2R,3R)-3-(diethoxyphosphoryl)-2-methyloxirane-2-carboxylate (5d major): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0. 4) in 70% yield (40.6 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2982, 1733, 1453, 1393, 1261, 1154, 1023, 971, 847, 792, 750 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 4.24-4.16 (m, 4H), 3.25 (d, J = 28.0 Hz, 1H), 1.76 (s, 3H), 1.48 (s, 9H), 1.37 (t, J = 7.08 Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 168.1, 82.8, 63.0 (d, J = 6.4 Hz), 62.6 (d, J = 6.16 Hz), 58.5, 54.4 (d, J = 200.3 Hz), 27.6, 16.3, 16.2, 13.9; ^{31}P NMR (243 MHz, CDCl_3) δ 16.0; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{23}\text{O}_6\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 317.1124; found: 317.1121.

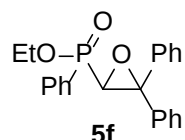


Tert-butyl (2R,3R)-3-(diethoxyphosphoryl)-2-phenyloxirane-2-carboxylate (5e): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0. 4) in 50% yield (35.4 mg); Colorless oil; IR (KBr): $\nu_{\max}$ 2981, 1753, 1451, 1371, 1329, 1205, 1152, 1097, 839, 790, 698, 637 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.56-7.52 (m, 2H), 7.40-7.35 (m, 3H), 4.32-4.21 (m, 4H), 3.11 (d, J = 28.0 Hz, 1H), 1.53 (s, 9H), 1.39 (t, J = 7.2 Hz, 3H), 1.38 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 164.6, 134.4, 128.9, 128.5, 125.9, 83.3, 63.7, 63.4 (d, J = 5.8 Hz), 63.1 (d, J = 6.2 Hz), 58.1 (d, J = 197.7 Hz), 27.8, 16.4 (d, J = 4.6 Hz), 16.3 (d, J = 5.1 Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 14.4; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{25}\text{O}_6\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 379.1281; found: 379.1273.

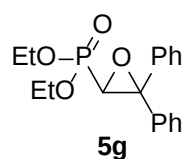


Tert-butyl (2S,3R)-3-(diethoxyphosphoryl)-2-phenyloxirane-2-carboxylate (5e'): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0. 5) in 32% yield (22.8mg); Colorless oil; ^1H NMR (400 MHz, CDCl_3) δ 7.56-7.54 (m,

2H), 7.38-7.31 (m, 3H), 4.07-3.97 (m, 2H), 3.76-3.67 (m, 1H), 3.61 (d, $J = 29.2$ Hz, 1H), 3.42-3.32 (m, 1H), 1.43 (s, 9H), 1.25 (t, $J = 7.2$ Hz, 3H), 1.00 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 166.7, 131.5, 128.4, 128.1, 127.4, 83.4, 62.5, 62.4, 60.9, 56.1 (d, $J = 201.6$ Hz), 27.6, 16.1 (d, $J = 6.1$ Hz), 15.9 (d, $J = 5.7$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 13.7; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{25}\text{O}_6\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 379.1281; found: 379.1275.

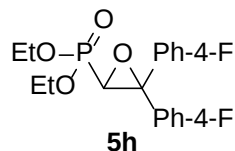


Ethyl (3,3-diphenyloxiran-2-yl)(phenyl)phosphinate (5f and 5f'): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, $R_f = 0.4$) in 80% yield (58mg); d.r. = 1.7:1; IR (KBr): ν_{max} 3060, 2988, 2234, 1964, 1813, 1592, 1494, 1390, 1217, 1160, 1020, 959, 695, 637 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.70-7.02 (m, 30H), 4.13-3.61 (m, 5H), 2.75 (d, $J = 31.2$ Hz, 1H), 1.29 (t, $J = 7.2$ Hz, 3H), 0.96 (t, $J = 8.0$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 139.8, 139.6, 135.8, 134.4, 132.6, 132.5, 131.9, 131.5 (d, $J = 9.87$ Hz), 128.5, 128.4, 128.2, 128.20, 127.9, 127.88, 127.72, 127.57, 126.53, 126.22, 62.4 (d, $J = 137.5$ Hz), 62.3 (d, $J = 142.6$ Hz), 61.0, 60.9, 60.3, 16.4 (d, $J = 6.3$ Hz), 15.9 (d, $J = 6.1$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 34.4, 29.4; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{21}\text{O}_3\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 387.1121; found: 387.1109.

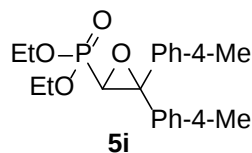


Diethyl (3,3-diphenyloxiran-2-yl)phosphonate (5g): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, $R_f = 0.4$) in 68% yield (45mg); IR (KBr): ν_{max} 2983, 1448, 1389, 1264, 1162, 1026, 970, 757, 701, 638 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.59-7.56 (m, 2H), 7.40-7.25 (m, 8H), 4.12-3.97 (m, 2H), 3.85-3.75 (m, 1H), 3.55-3.45 (m, 1H), 3.48 (d, $J = 28.0$ Hz, 1H), 1.24 (t, $J = 7.2$ Hz, 3H), 1.03 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 139.6, 136.0, 128.4, 128.2,

128.1, 127.9, 126.5, 66.3, 62.5 (d, $J = 7.2$ Hz), 62.4 (d, $J = 7.0$ Hz), 60.1 (d, $J = 198.4$ Hz), 16.2 (d, $J = 6.1$ Hz), 16.1 (d, $J = 5.7$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 15.1; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 355.1070; found: 355.1059.



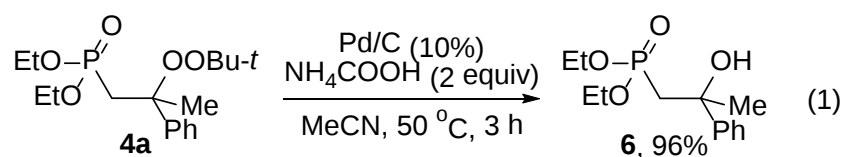
Diethyl (3,3-bis(4-fluorophenyl)oxiran-2-yl)phosphonate (5h): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, $R_f = 0.3$) in 70% yield (51.4 mg); IR (KBr): ν_{max} 3074, 2986, 1729, 1611, 1507, 1444, 1409, 1157, 1051, 836, 678 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.55-7.51 (m, 2H), 7.28-7.23 (m, 2H), 7.11-7.06 (m, 2H), 7.02-6.96 (m, 2H), 4.13-3.98 (m, 2H), 3.91-3.81 (m, 1H), 3.71-3.61 (m, 1H), 3.44 (d, $J = 28.0$ Hz, 1H), 1.26 (t, $J = 7.2$ Hz, 3H), 1.09 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 162.6 (d, $J = 245.8$ Hz), 135.3, 131.8, 130.1, 130.0, 128.4, 128.3, 115.4 (d, $J = 21.7$ Hz), 115.0 (d, $J = 21.5$ Hz), 65.3, 62.6 (d, $J = 6.9$ Hz), 62.6 (d, $J = 6.8$ Hz), 60.2 (d, $J = 198.3$ Hz), 16.3 (d, $J = 5.9$ Hz), 16.1 (d, $J = 5.6$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 14.7; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{19}\text{F}_2\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 391.0881; found: 391.0874.



Diethyl (3,3-di-*p*-tolylloxiran-2-yl)phosphonate (5i): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, $R_f = 0.3$) in 60% yield (43 mg); IR (KBr): ν_{max} 2984, 2361, 1655, 1609, 1511, 1213, 1025, 750 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.46-7.44 (m, 2H), 7.38-7.35 (m, 2H), 7.13-7.07 (m, 4H), 4.84 (d, $J = 8.8$ Hz, 1H), 4.19-4.04 (m, 2H), 3.75-3.65 (m, 1H), 3.42-3.31 (m, 1H), 2.28 (s, 3H), 2.27 (s, 3H), 1.27 (t, $J = 7.2$ Hz, 3H), 0.92 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 140.6, 140.5, 136.7, 128.9, 128.6, 125.9, 125.8, 79.1, 72.3 (d, $J = 159.2$ Hz), 63.9 (d, $J = 6.9$), 61.8 (d, $J = 7.3$ Hz), 20.9, 20.8, 16.4 (d, $J = 5.7$ Hz), 15.7 (d, $J = 6.1$ Hz); ^{31}P NMR (243 MHz, CDCl_3) δ 23.2; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{26}\text{O}_4\text{P}$ ($\text{M}+\text{H}$) $^+$:

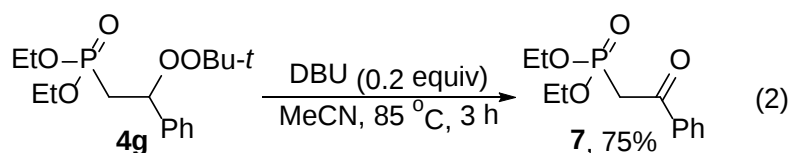
361.1563; found: 361.1558.

5. Synthesis and characterization of 6 and 7



To a solution of **4a** (0.2 mmol) and NH₄COOH (2 equiv) in CH₃CN (2 mL) under nitrogen at room temperature, then Pd/C (10%, 10 mol%) was added to the mixture under nitrogen at room temperature. The reaction mixture was stirred at 50°C for 3 h, then passed through celite. The celite was washed with diethyl ether, the eluent was chromatography concentrated in vacuo, and the residue was subjected to silica gel flash. **6** was obtained as a colorless oil in 96% yield.

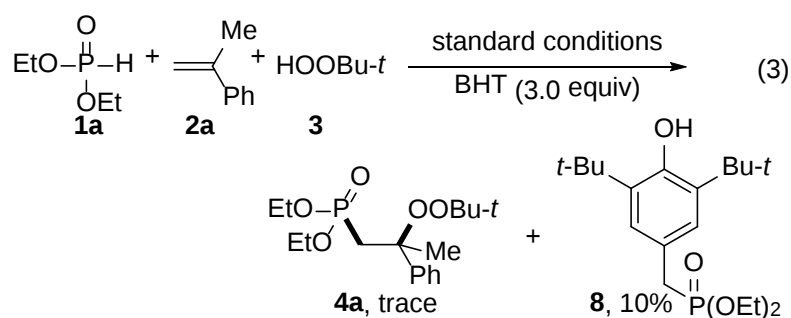
Diethyl (2-hydroxy-2-phenylpropyl)phosphonate (6) ^[4] Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:3, R_f = 0.3) in 96% yield (52 mg); ¹H NMR (400 MHz, CDCl₃) δ 7.49-7.47 (m, 2H), 7.36-7.32 (m, 2H), 7.25-7.21 (m, 1H), 5.02 (s, 1H), 4.12-3.98 (m, 2H), 3.74-3.64 (m, 1H), 3.42-3.32 (m, 1H), 2.47 (dd, *J* = 15.6 Hz, *J* = 17.6 Hz, 1H), 2.34 (dd, *J* = 15.6 Hz, *J* = 16.8 Hz, 1H), 1.62 (d, *J* = 2.4 Hz, 3H), 1.31 (t, *J* = 7.2 Hz, 3H), 1.00 (t, *J* = 7.2 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 147.1 (d, *J* = 7.0 Hz), 128.0, 126.7, 124.7, 71.9 (d, *J* = 4.7 Hz), 61.7 (d, *J* = 6.4 Hz), 61.4 (d, *J* = 6.5 Hz), 39.6 (d, *J* = 134.8 Hz), 32.4 (d, *J* = 14.3 Hz), 16.3 (d, *J* = 6.2 Hz), 16.0 (d, *J* = 6.1 Hz).



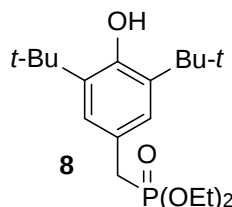
To a solution of **4g** (0.2 mmol) in MeCN (2 mL) under nitrogen at room temperature. Then DBU (0.04 mmol, 0.2 equiv) was added to the mixture under nitrogen at room temperature. The reaction stirred at 85 °C for 3 h. Subsequently, the reaction solution was evaporated in vacuo at 25 °C, and the resulting residue was purified by flash column chromatography on silica gel using ethyl acetate/petroleum ether (1:1) as an eluent to give the desired product **7** in 75% combined yield.

Diethyl (2-oxo-2-phenylethyl)phosphonate 7^[5] Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.25) in 75% yield (38.3 mg); ^1H NMR (400 MHz, CDCl_3) δ 8.03-8.01 (m, 2H), 7.61-7.57 (m, 1H), 7.61-7.57 (m, 1H), 7.50-7.46 (m, 2H), 4.18-4.10 (m, 4H), 3.64 (d, J = 22.8 Hz, 2H), 1.28 (t, J = 7.2 Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 191.9 (d, J = 6.2 Hz), 136.4, 133.6, 128.9, 128.5, 62.6, 62.5, 38.4 (d, J = 129.2 Hz), 16.2, 16.1.

6.BHT-trapping experiment



To a dry Schlenk tube were added alpha-Methylstyrene **2a** (0.5 mmol), diethyl phosphite **1a** (2.5 mmol), and $\text{Cu}(\text{OAc})_2$ (0.05 mmol), BHT (1.5 mmol, 3 equiv), anhydrous CH_3CN (5.0 mL) at room temperature. Subsequently, *tert*-butyl hydroperoxide **3** (5-6M solution in decane, 2.5 mmol) was added to the mixture, and the resulting solution was stirred at 60 °C for 3 h. The resulting reaction solution was filtered through a pad of silica with ethyl acetate as eluent. The solvent was evaporated *in vacuo*. The formation of **8** in 0.08 mmol amount was determined by ^1H NMR using dibromomethane as an internal standard; 0.05 mmol amount of **8** was isolated by flash column chromatography on silica gel.



Diethyl (3,5-di-*tert*-butyl-4-hydroxybenzyl)phosphonate 8: Isolated by flash column chromatography (ethyl acetate/petroleum ether = 1:1, R_f = 0.4) in 10% yield (17 mg); IR (KBr): ν_{max} 3360, 2957, 2873, 1658, 1436, 1393, 1222, 1162, 1056, 966,

888, 808, 768, 704, 634 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.08 (m, 2H), 5.13 (br, 1H), 4.04-3.97 (m, 4H), 3.07 (d, $J = 21.0$ Hz, 2H) 1.43 (s, 18H), 1.24 (t, $J = 7.2$ Hz, 6H); ^{13}C NMR (150 MHz, CDCl_3) δ 152.7 (d, $J = 3.5$ Hz), 136.0, 126.4, 126.3, 61.9, 61.8, 34.3, 33.4 (d, $J = 137.85$ Hz), 30.3, 16.4, 16.3; ^{31}P NMR (243 MHz, CDCl_3) δ 27.4; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{33}\text{O}_4\text{PNa}$ ($\text{M}+\text{Na}$) $^+$: 379.2009; found: 379.1998.

7. References:

[1] L. Y. Kuo, D. C. Baker, A.K. Dortignacq, K. M. Dill, *Organometallics.*, 2013, **32**, 4759

For the spectroscopic properties, see:

K. E. Debruin, C. W. Tang, D. M. Johnson, R. L. Wilde, *J. Am. Chem. Soc.*, 1989, **111**, 5871.

[2] C. Chatalova-Sazepin, Q. Wang, G. M. Sammis, J. Zhu, *Angew. Chem. Int. Ed.*, 2015, **54**, 5443.

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For spectroscopic data, see:

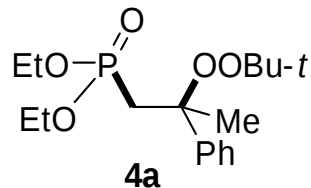
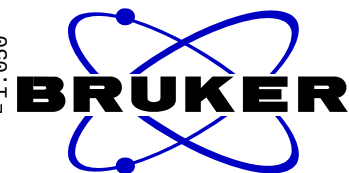
A. T. Biju, M. Padmanaban, N. E. Wurz, F. Glorius, *Angew. Chem. Int. Ed.*, 2011, **50**, 8412.

[4] T. Taniguchi, A. Idota, S. Yokoyama, H. Ishibashi, *Tetrahedron Lett.*, 2011, **52**, 4768.

[5] W. Wei, J. Ji, *Angew. Chem., Int. Ed.*, 2011, **50**, 9097.

8. Copies of ^1H and ^{13}C , ^{31}P NMR spectra for all compounds

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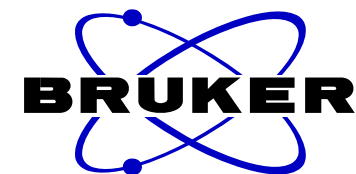
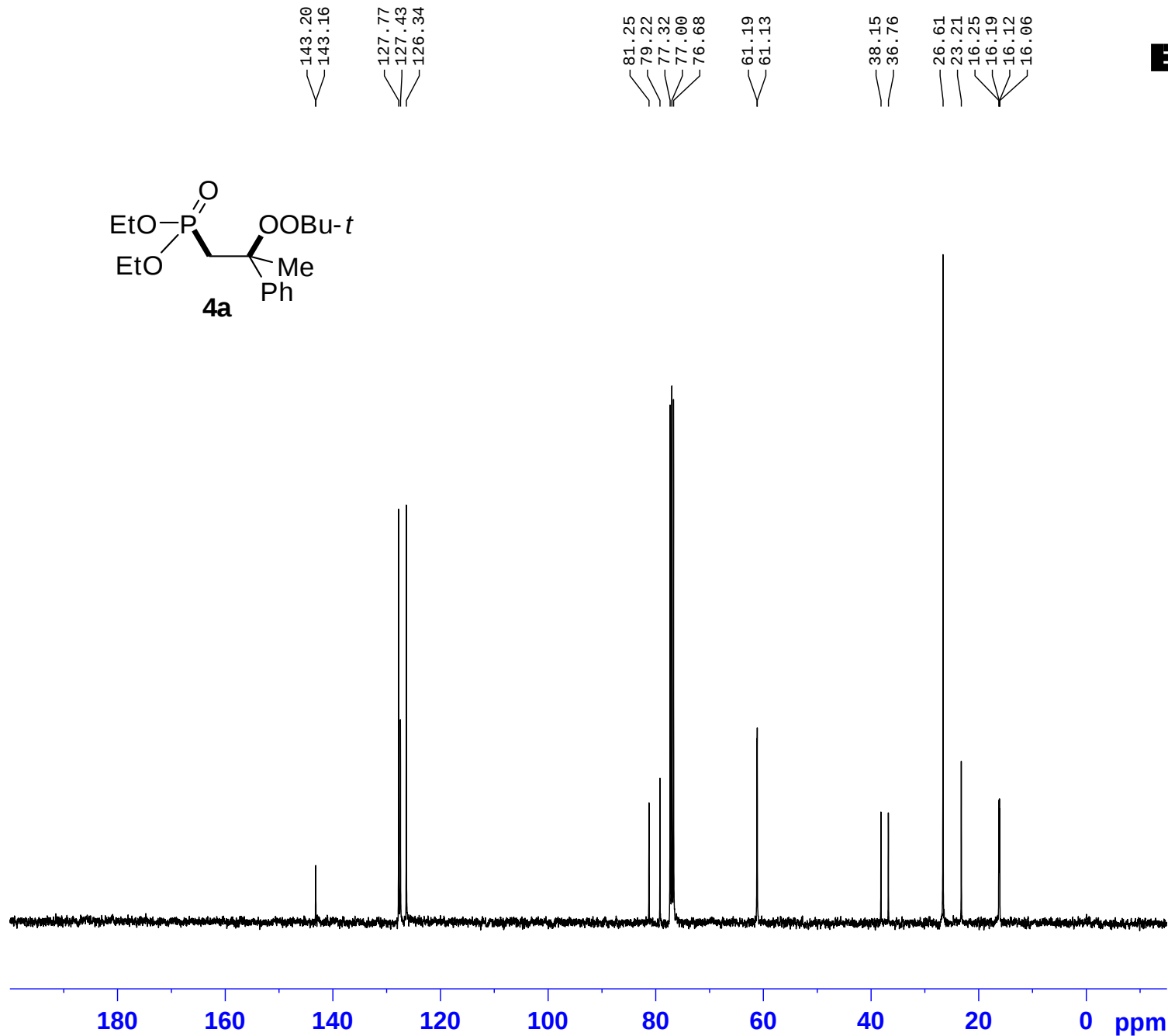
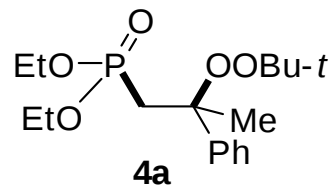
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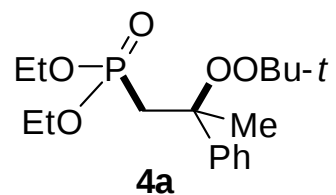
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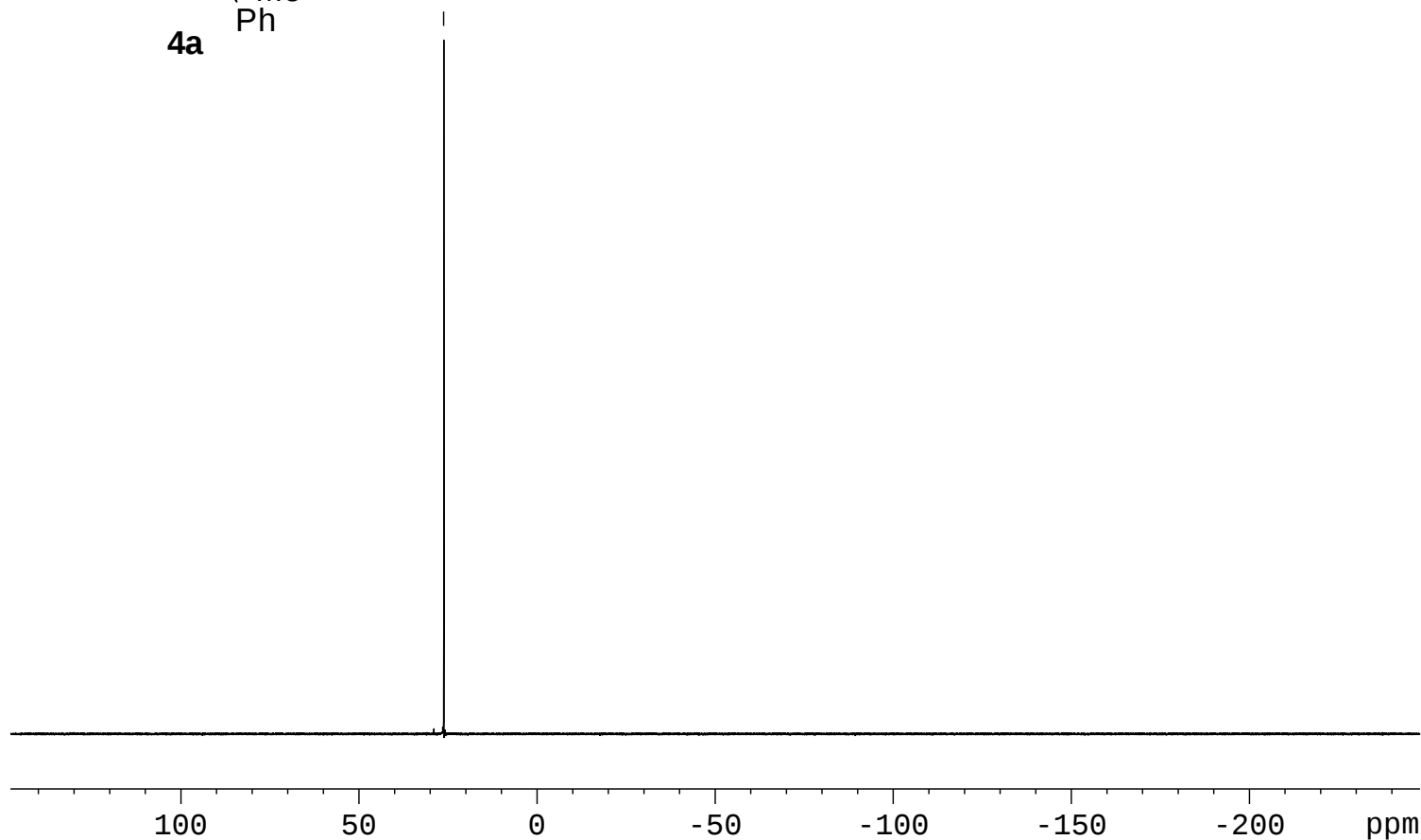


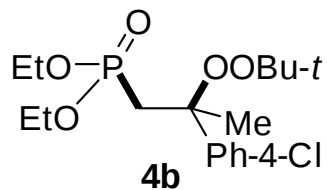
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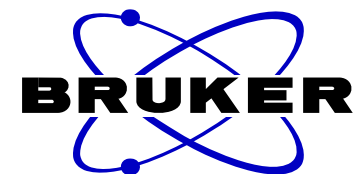
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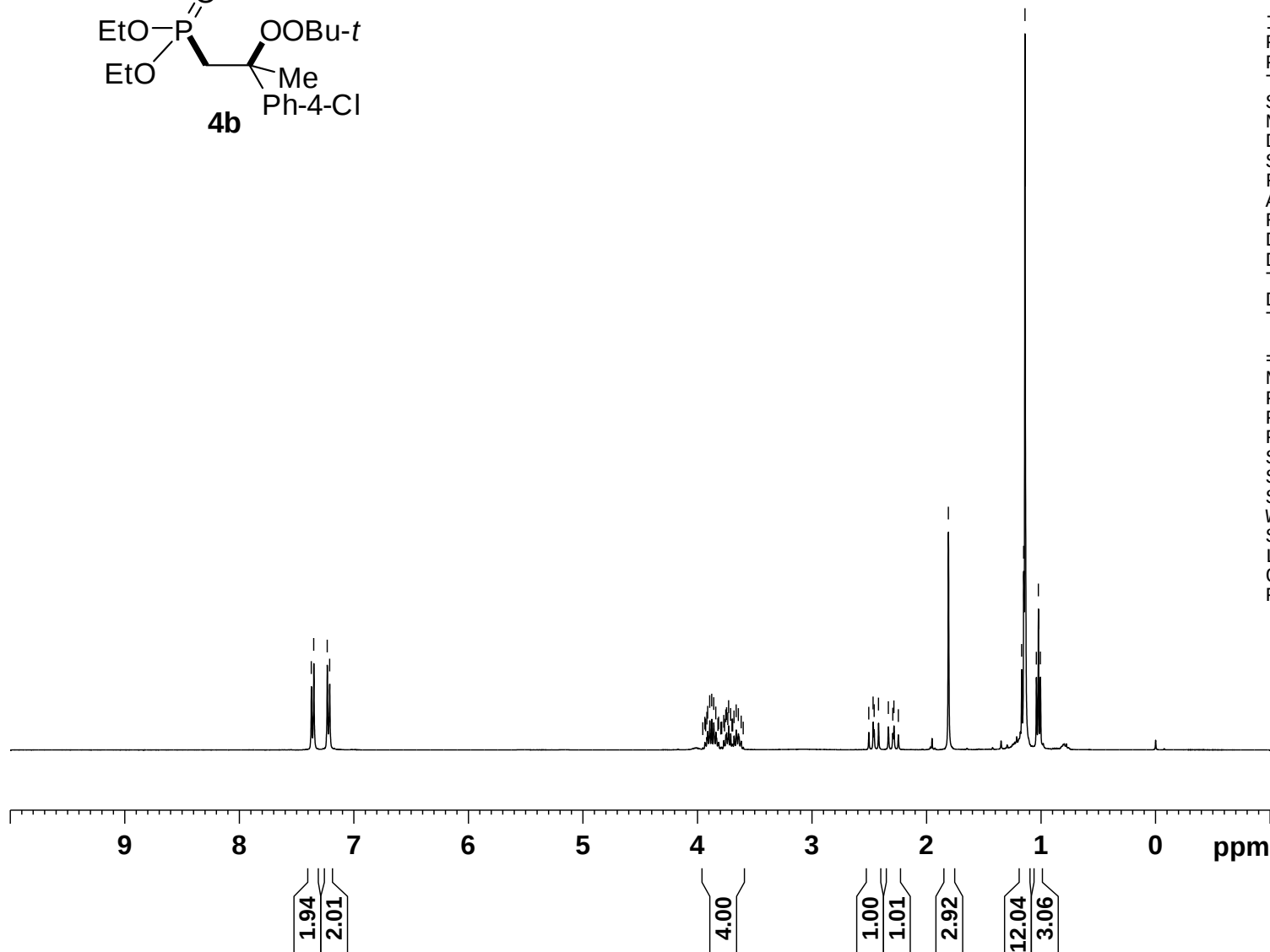
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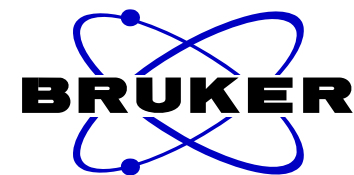
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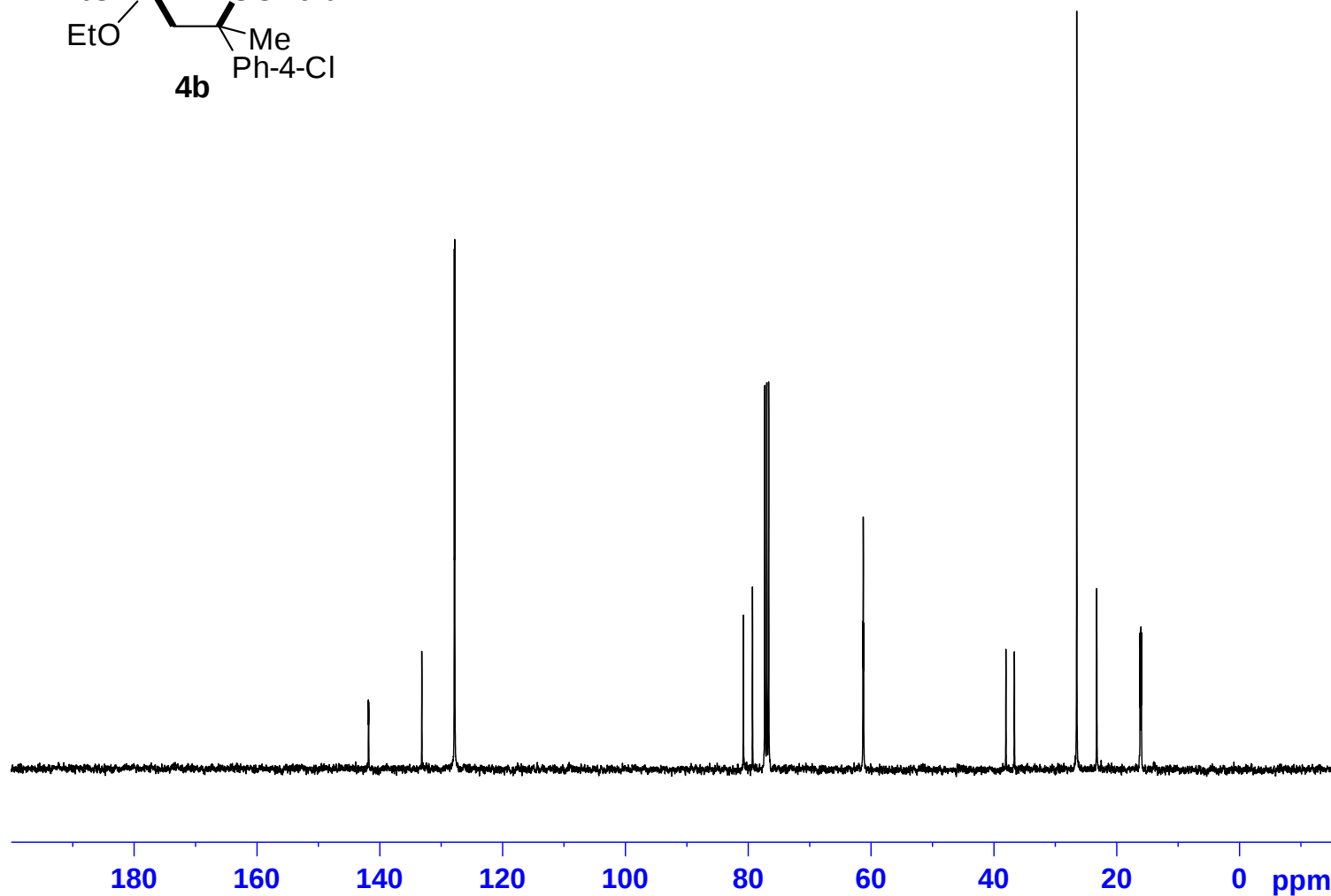
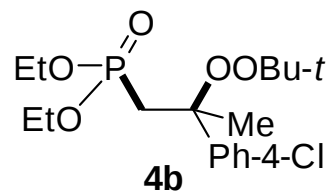
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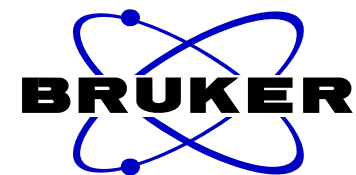
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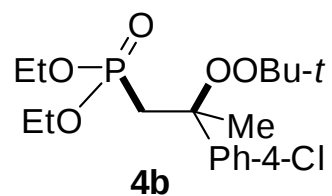
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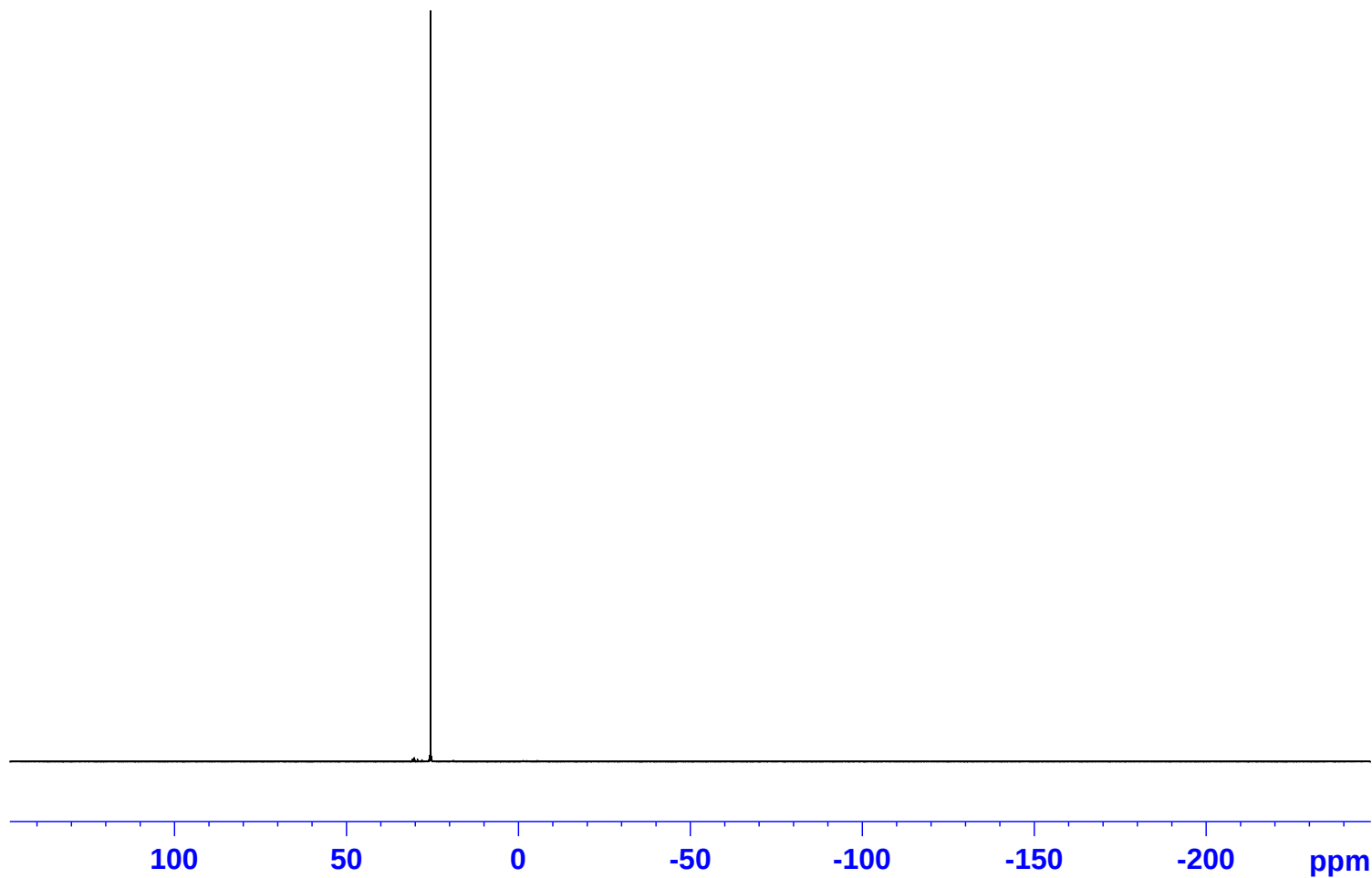


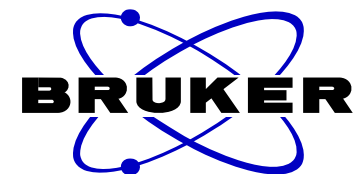
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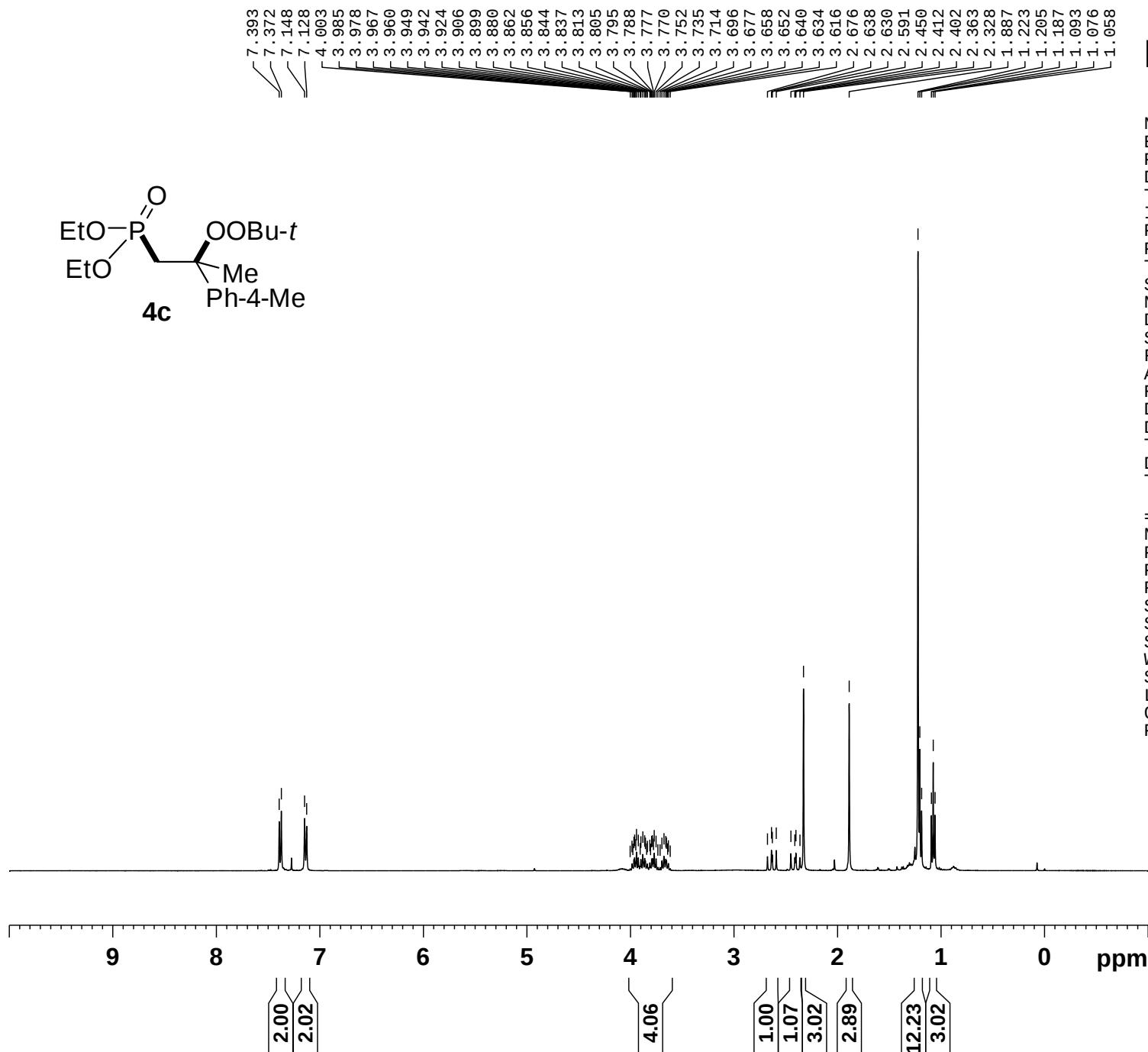
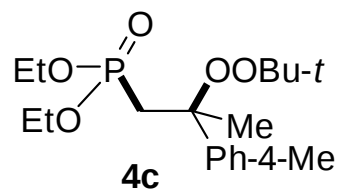
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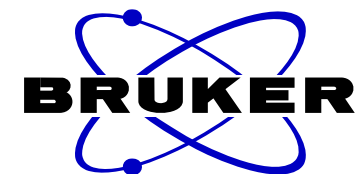




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 DW 78.200 usec
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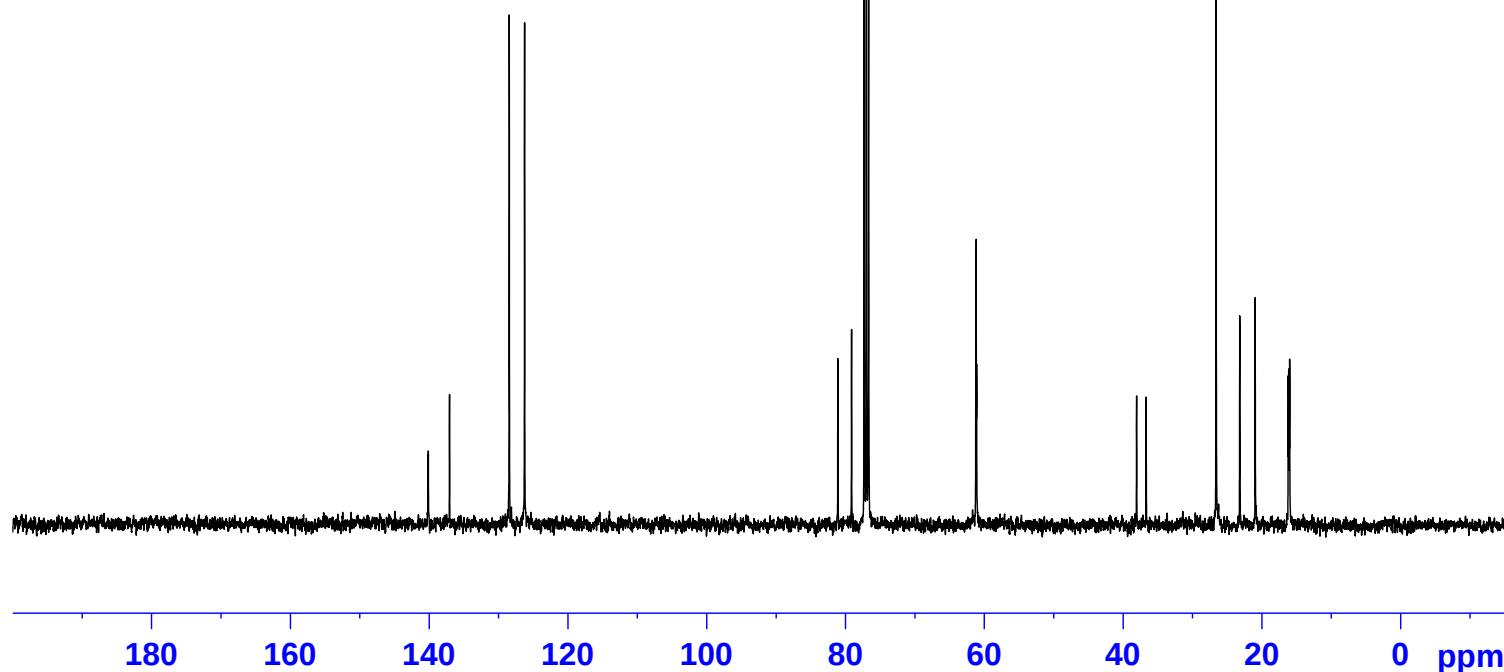
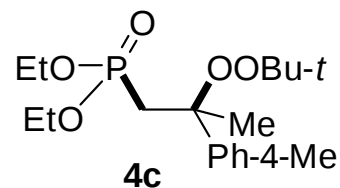
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 PL1W 43.93649673 W
 SF01 100.6238364 MHz

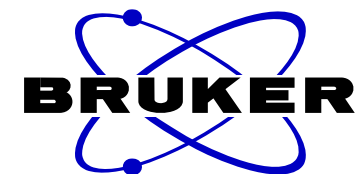
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127773 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

140.15
 140.10
 137.05
 128.44
 126.23

81.11
 79.14
 77.32
 77.00
 76.68
 61.23
 61.18
 61.12

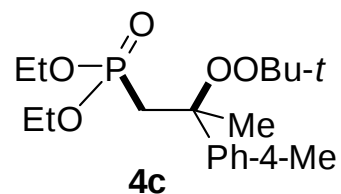
38.06
 36.68
 26.60
 23.19
 20.96
 16.21
 16.14
 16.06
 16.00



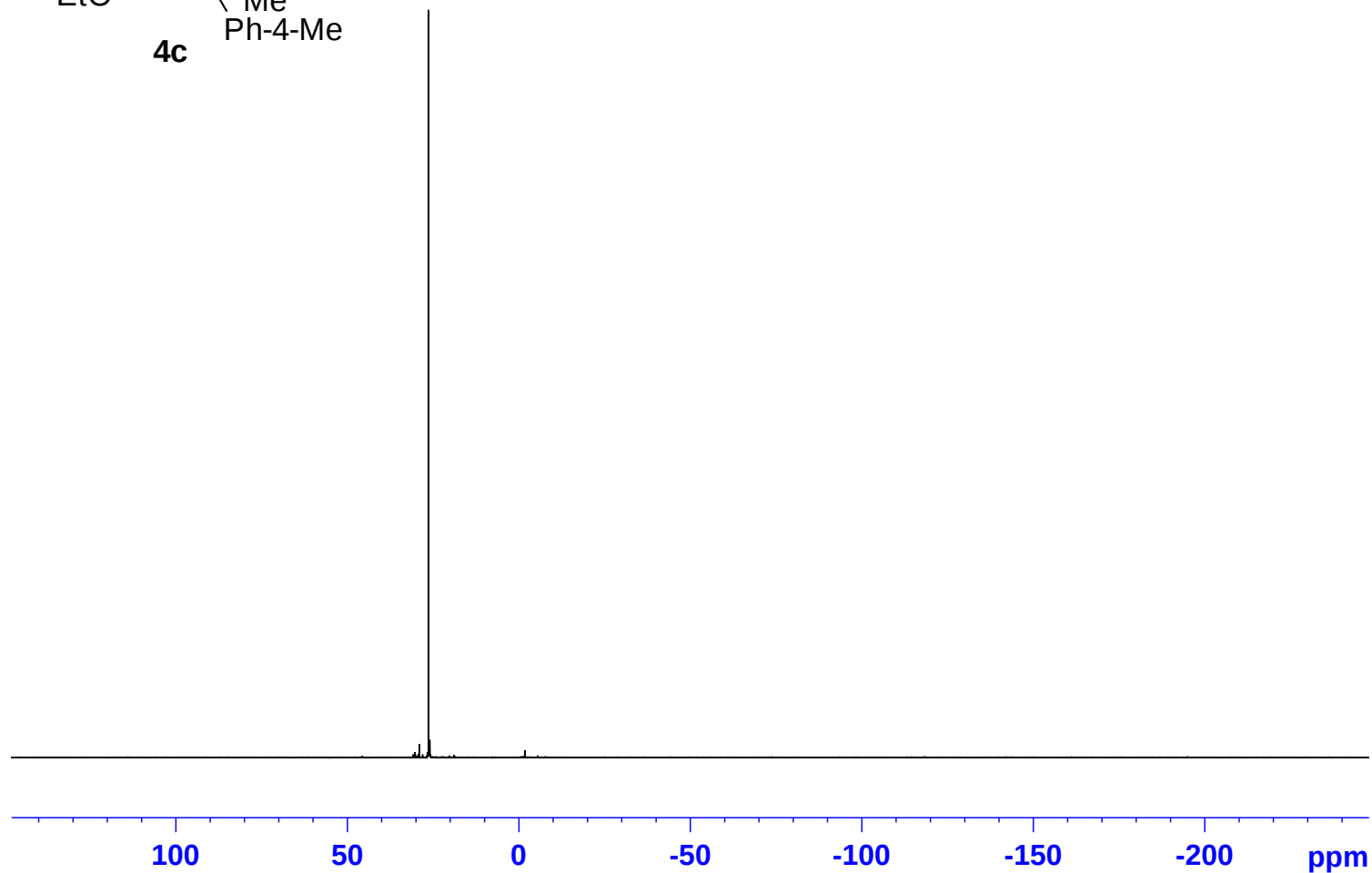


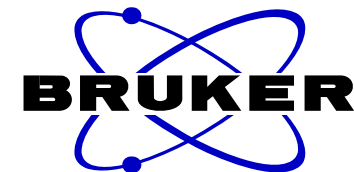
NAME cy-177bp
EXPNO 3
PROCNO 1
Date_ 20170913
Time 10.41
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



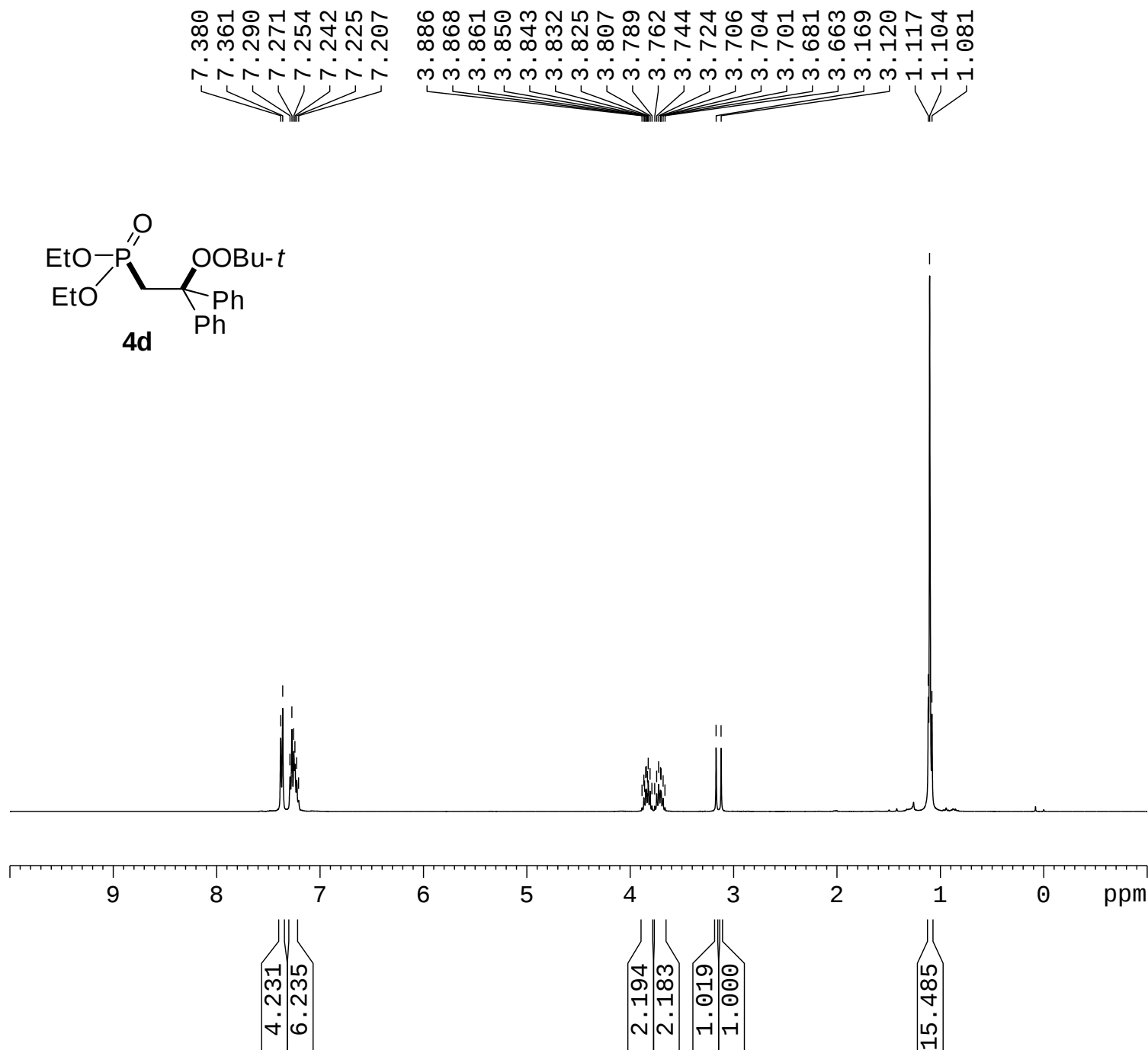
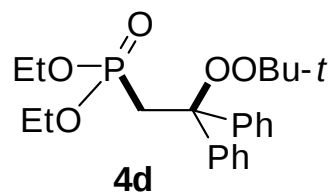
— 26.34

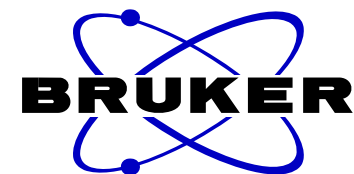




NAME cy-99a1-20170330
 EXPNO 1
 PROCNO 1
 Date_ 20170330
 Time 17.27
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 40.3
 DW 78.200 usec
 DE 6.50 usec
 TE 292.8 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1300052 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

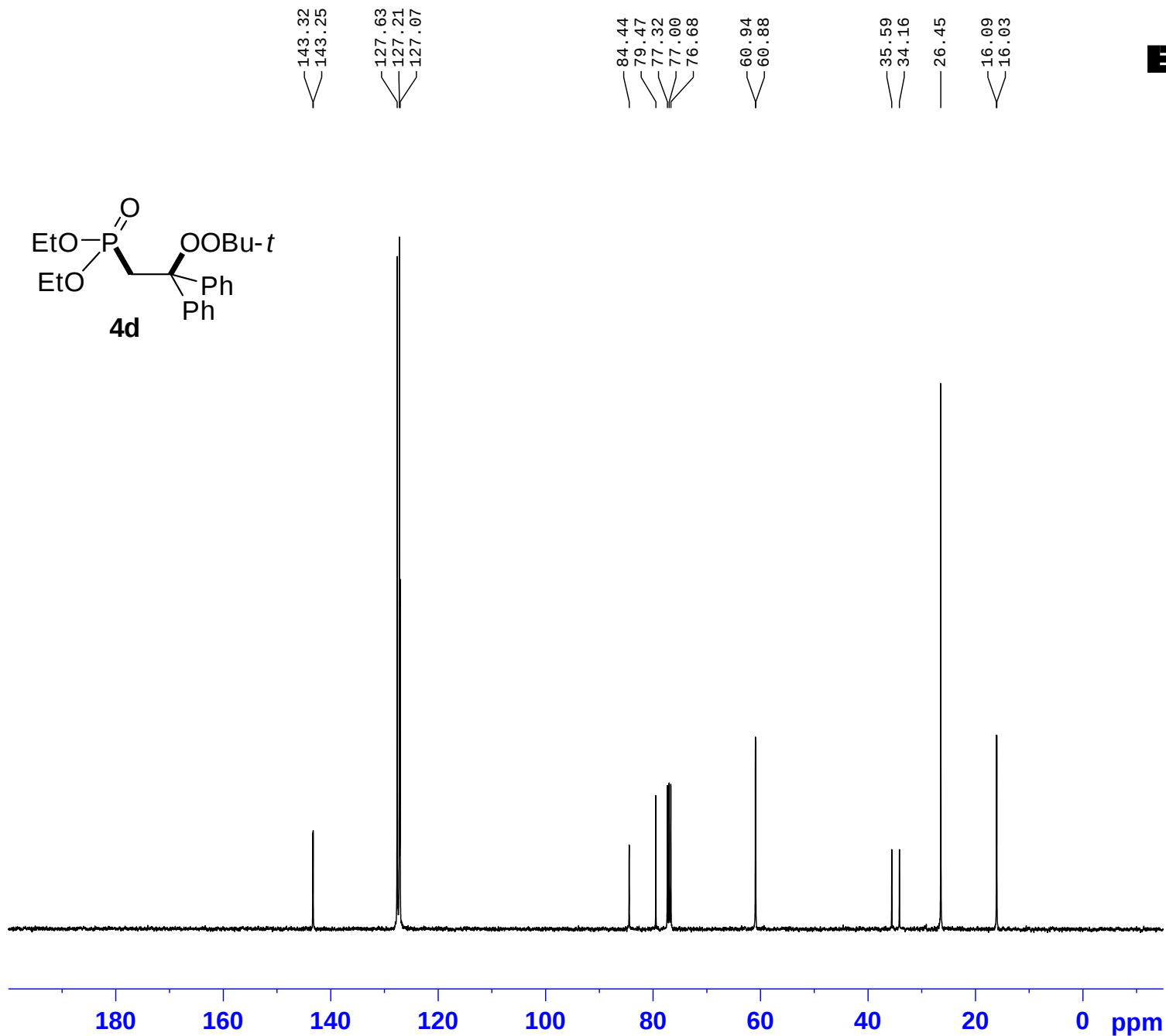


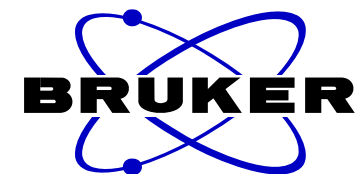


NAME cy-99a1-20170330
 EXPNO 2
 PROCNO 1
 Date_ 20170330
 Time 17.33
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 120
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 293.8 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127860 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

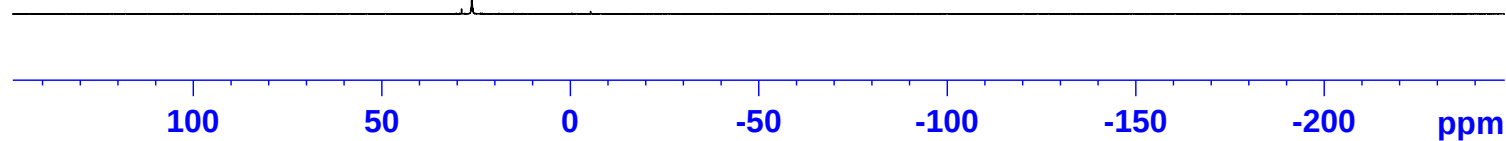
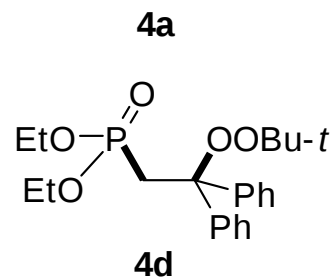


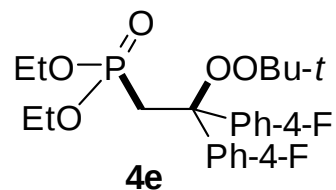
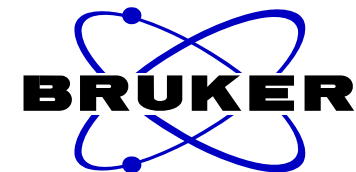


NAME cy-99a1
EXPNO 3
PROCNO 1
Date_ 20170426
Time 9.54
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 64
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 295.1 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40

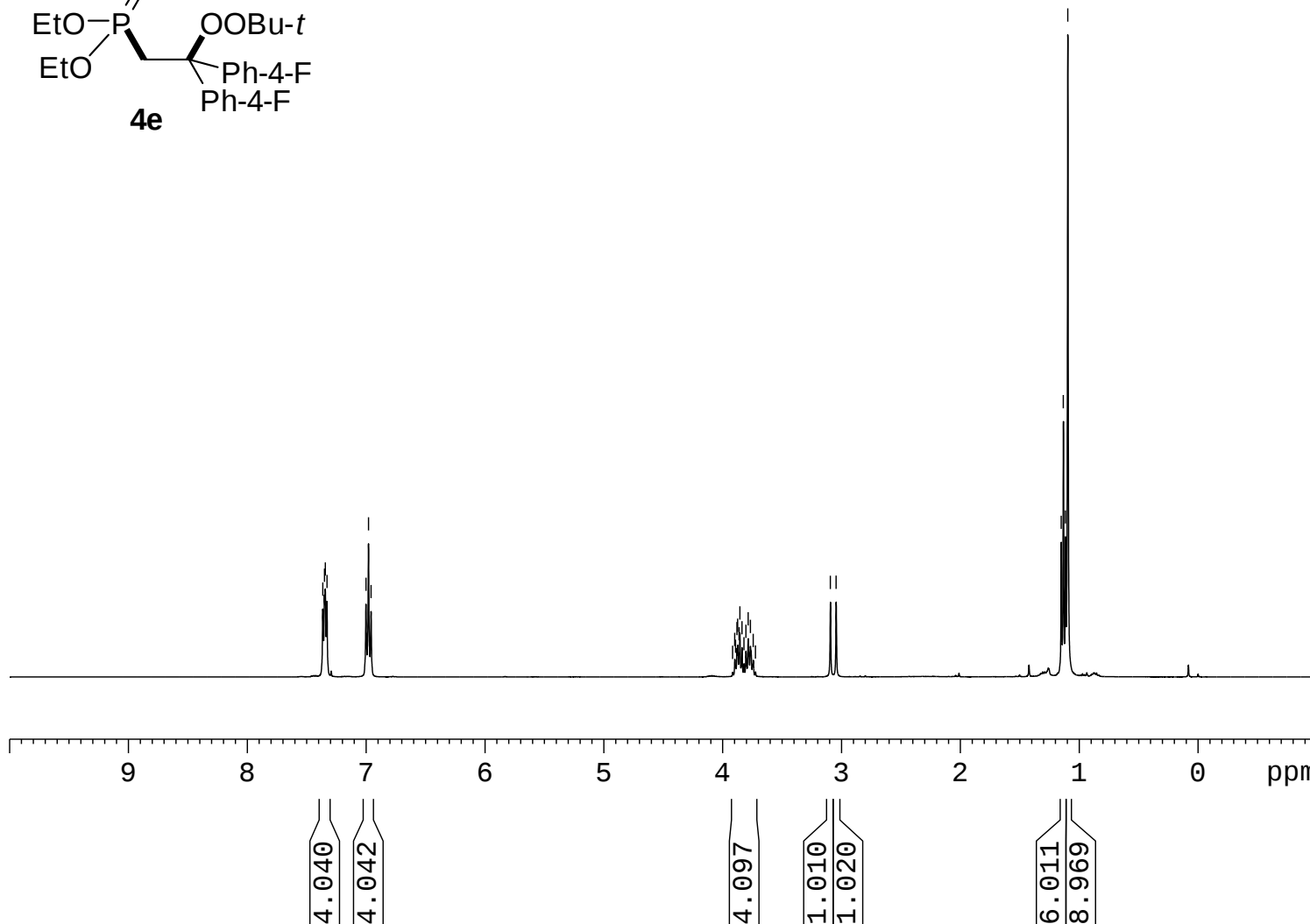
— 26.11





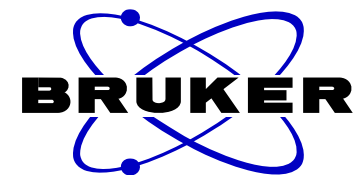
7.364
7.350
7.342
7.329
7.000
6.979
6.957

3.916
3.898
3.891
3.880
3.873
3.862
3.855
3.837
3.821
3.804
3.785
3.766
3.742
3.724
3.093
3.045
1.150
1.133
1.115
1.096



NAME cy-179bp-20170908
EXPNO 1
PROCNO 1
Date_ 20170908
Time 17.03
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 45.2
DW 78.200 usec
DE 6.50 usec
TE 294.3 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1299972 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

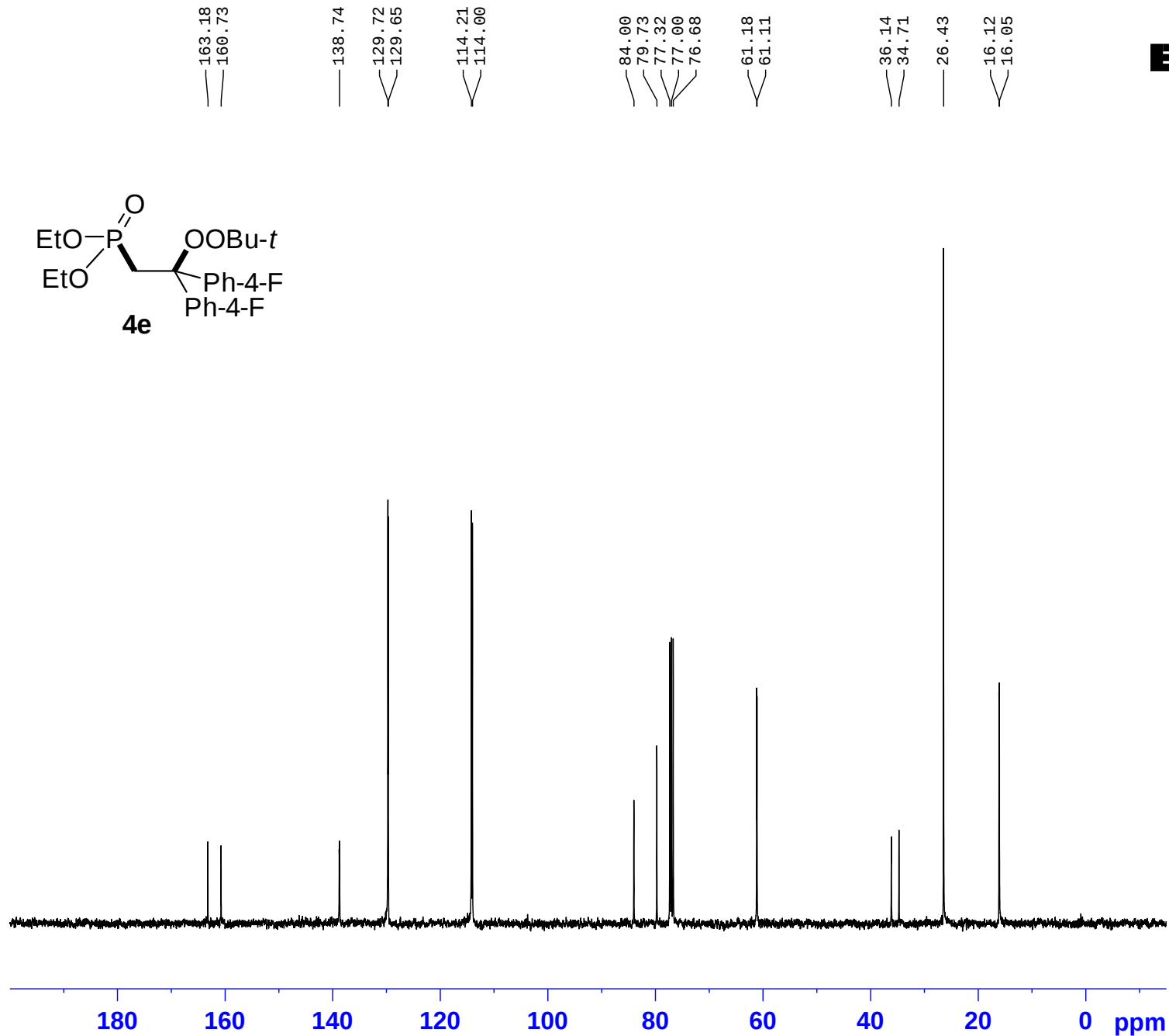
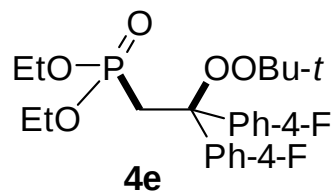


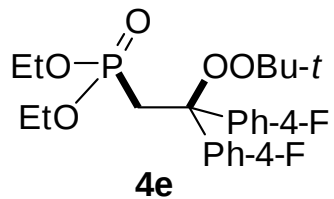
NAME cy-179bp-20170908

EXPNO 2
 PROCNO 1
 Date_ 20170908
 Time 17.07
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 56
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 294.9 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

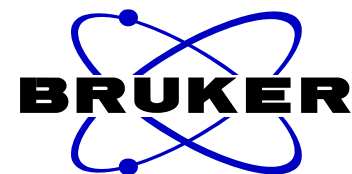
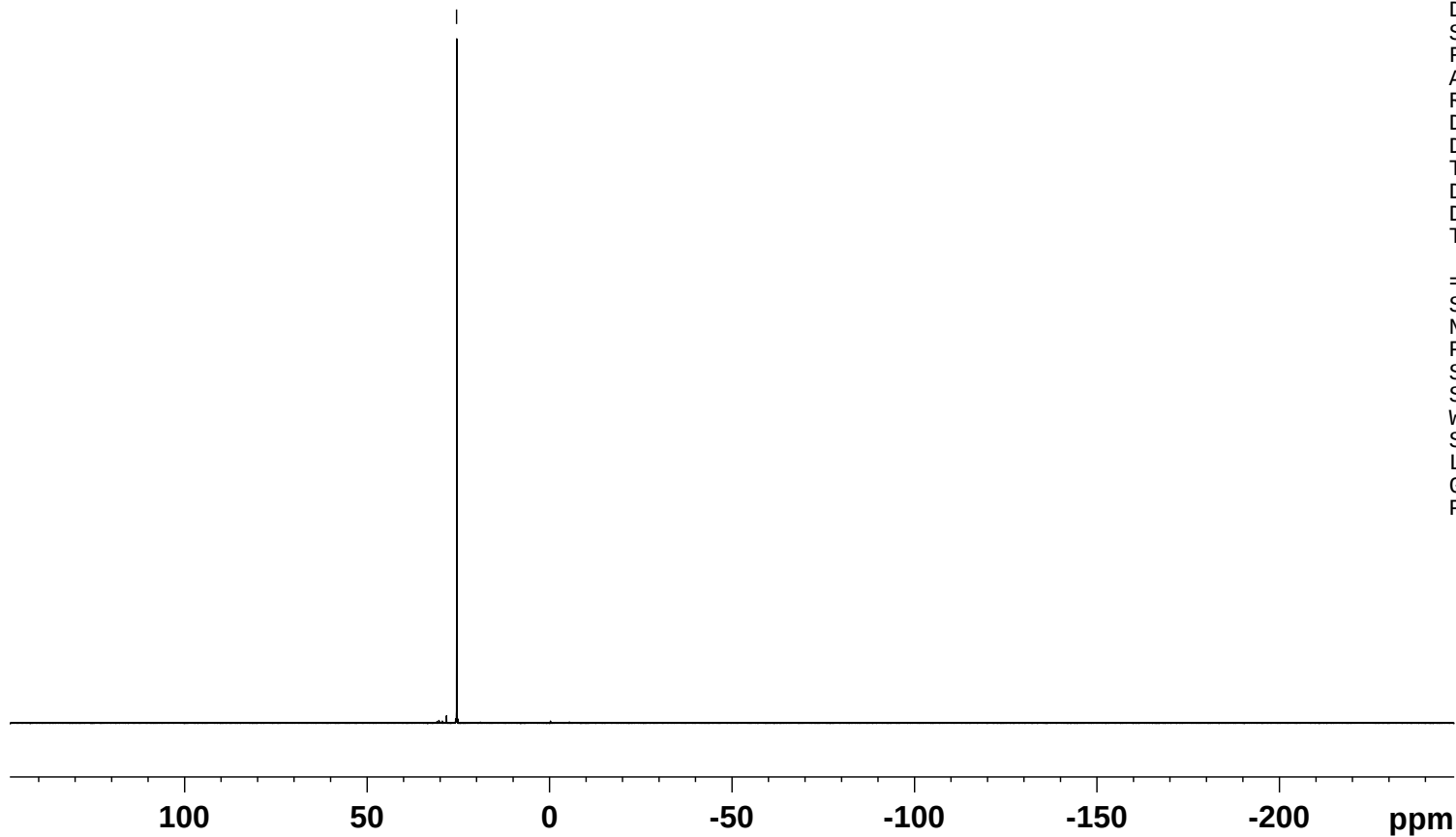
===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127787 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40





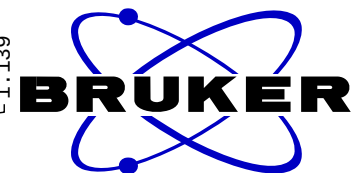
— 25.462



NAME cy-179bp
 EXPNO 3
 PROCNO 1
 Date_ 20170913
 Time 10.26
 INSTRUM spect
 PROBHD 5 mm PABBO BB/
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl₃
 NS 32
 DS 4
 SWH 96153.844 Hz
 FIDRES 1.467191 Hz
 AQ 0.3408372 sec
 RG 190.02
 DW 5.200 usec
 DE 6.50 usec
 TE 0.0 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 1

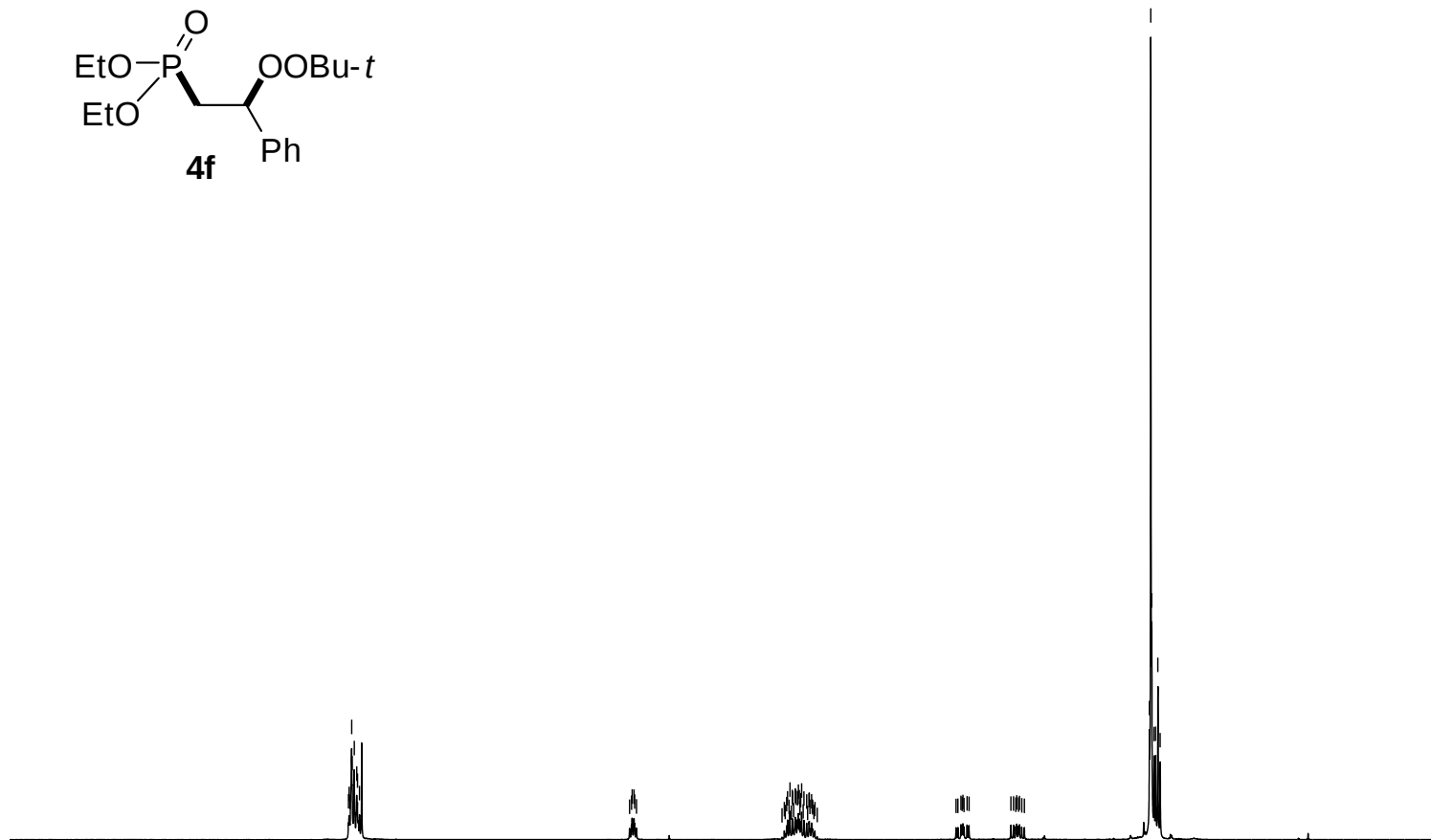
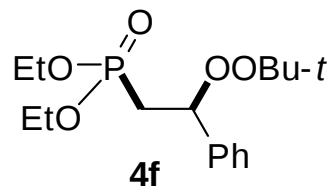
===== CHANNEL f1 =====
 SF01 242.9411216 MHz
 NUC1 31P
 P1 11.90 usec
 SI 32768
 SF 242.9532693 MHz
 WDW EM
 SSB 0
 LB 1.00 Hz
 GB 0
 PC 1.40

7.391
7.386
7.381
7.366
7.362
7.346
7.327
7.322
7.305
5.225
5.211
5.206
5.191
5.187
5.172
4.034
4.016
4.008
3.998
3.990
3.973
3.968
3.961
3.950
3.949
3.943
3.931
3.926
3.918
3.914
3.907
3.900
3.889
3.882
3.862
3.844
3.841
3.836
3.823
3.819
3.816
3.806
3.798
2.711
2.696
2.673
2.664
2.658
2.649
2.626
2.611
2.288
2.288
2.250
2.243
2.230
2.223
2.205
2.184
1.222
1.212
1.204
1.187
1.174
1.157
1.139



NAME cy-114a1-20170422
EXPNO 1
PROCNO 1
Date_ 20170422
Time 19.58
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 64
DW 78.200 usec
DE 6.50 usec
TE 293.6 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1299981 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



9 8 7 6 5 4 3 2 1 0 ppm

4.98

1.00

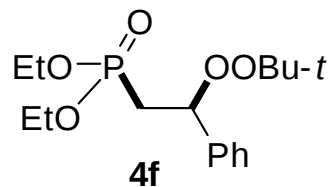
4.11

1.03

1.06

12.02

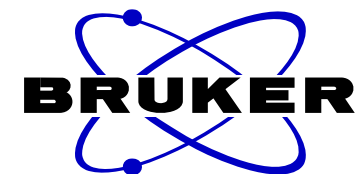
3.20



139.39
139.33
128.21
128.13
127.35

80.90
80.48
77.32
77.00
76.68
61.39
61.33
61.27

32.00
30.62
26.24
16.11
16.05

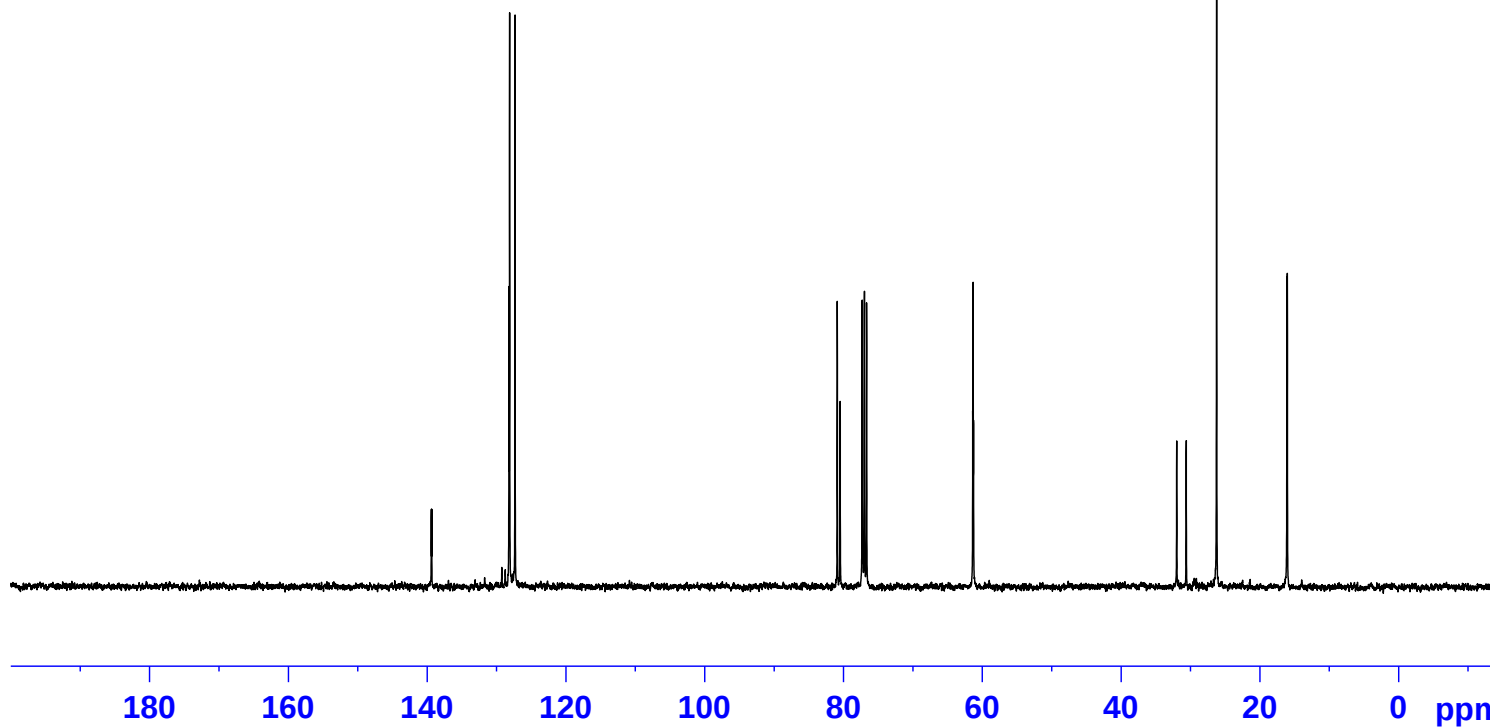


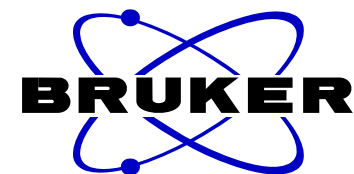
NAME cy-96a-20170426

EXPNO 2
PROCNO 1
Date_ 20170426
Time 18.43
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 128
DS 4
SWH 25252.525 Hz
FIDRES 0.385323 Hz
AQ 1.2976629 sec
RG 2050
DW 19.800 usec
DE 8.00 usec
TE 294.3 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 10

===== CHANNEL f1 =====
NUC1 13C
P1 13.50 usec
PL1 3.00 dB
PL1W 43.93649673 W
SF01 100.6238364 MHz

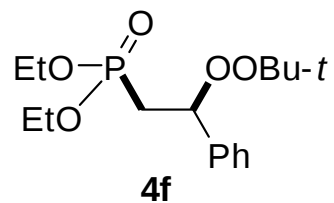
===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 1.80 dB
PL12 17.19 dB
PL13 18.46 dB
PL2W 8.92857742 W
PL12W 0.25809658 W
PL13W 0.19265592 W
SF02 400.1316005 MHz
SI 32768
SF 100.6127820 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40



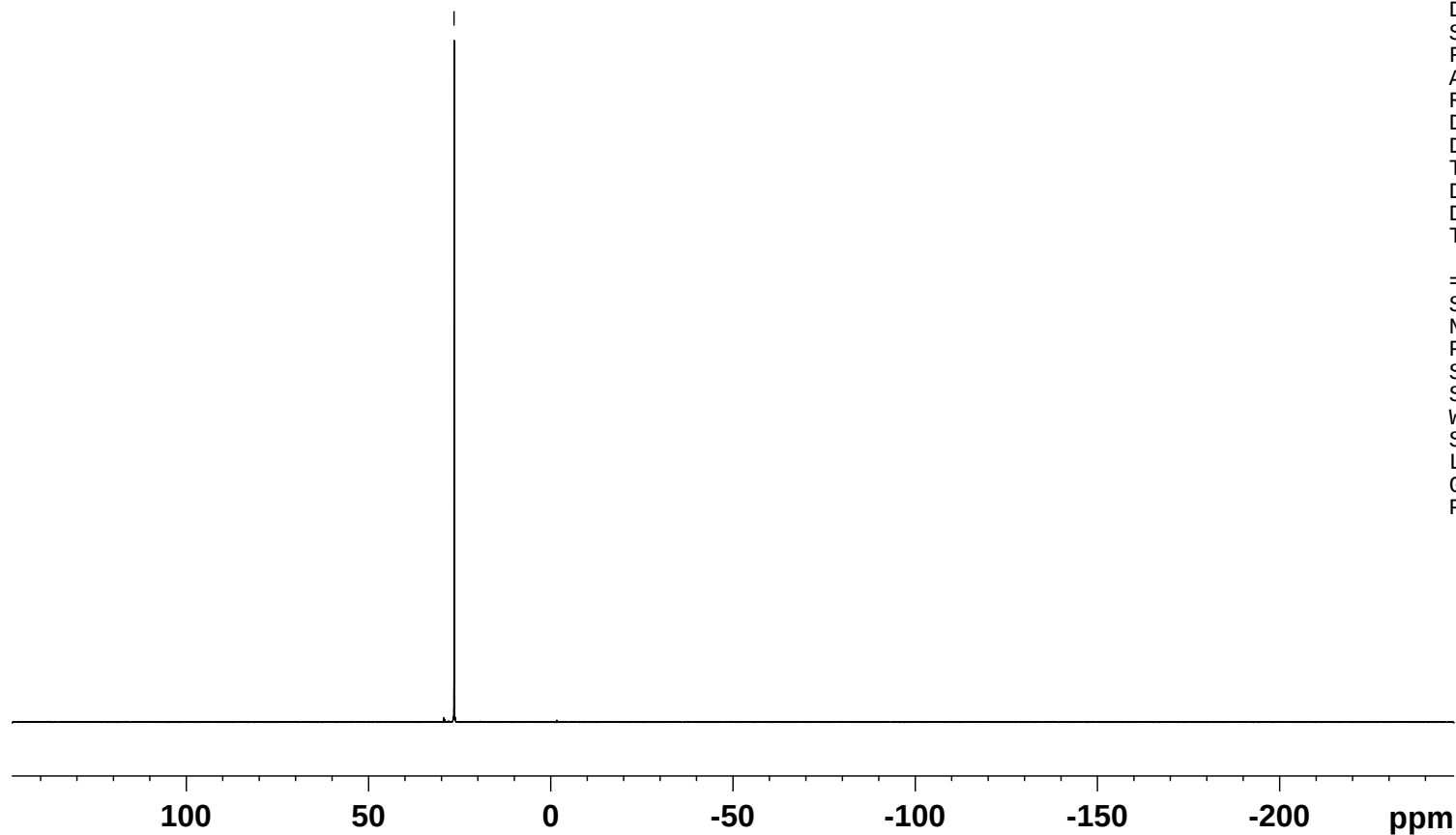


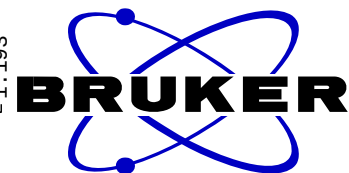
NAME cy-114a1
EXPNO 3
PROCNO 1
Date_ 20170428
Time 10.05
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 294.4 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532692 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40



— 26.524





NAME cy-142c-2-20170609

EXPNO 1

PROCNO 1

Date_ 20170609

Time 17.31

INSTRUM spect

PROBHD 5 mm PADUL 13C

PULPROG zg30

TD 32768

SOLVENT CDCl3

NS 8

DS 0

SWH 6393.862 Hz

FIDRES 0.195125 Hz

AQ 2.5625076 sec

RG 50.8

DW 78.200 usec

DE 6.50 usec

TE 294.9 K

D1 1.00000000 sec

TD0 1

===== CHANNEL f1 =====

NUC1 1H

P1 13.10 usec

PL1 1.80 dB

PL1W 8.92857742 W

SF01 400.1326008 MHz

SI 32768

SF 400.1299984 MHz

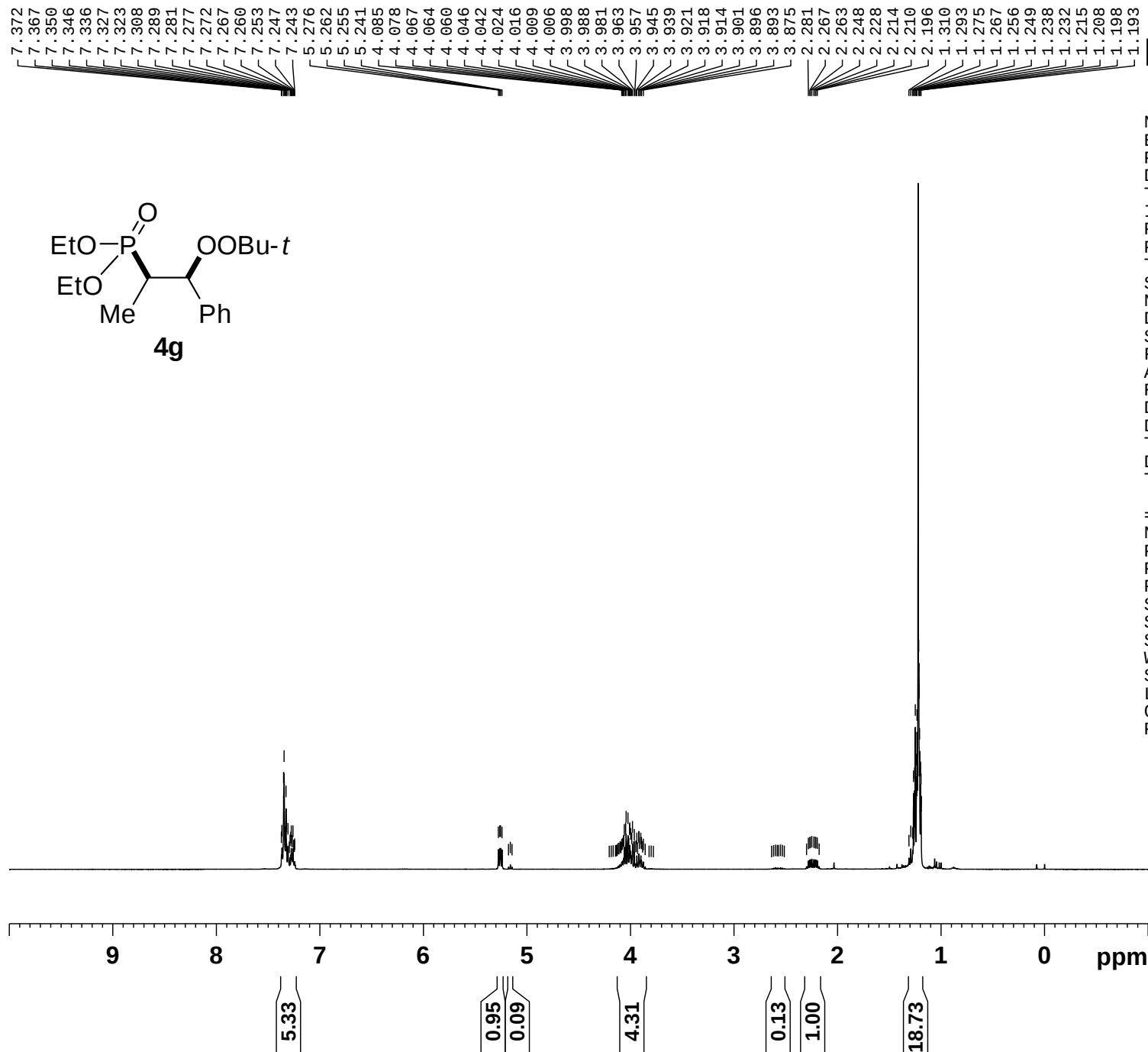
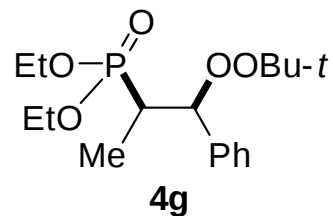
WDW EM

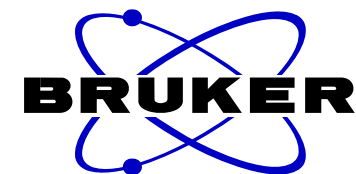
SSB 0

LB 0.30 Hz

GB 0

PC 1.00





NAME cy-63-2p-20161123
 EXPNO 2
 PROCNO 1
 Date_ 20161123
 Time 10.14
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 88
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 297.4 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127734 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

140.37
140.27

127.78
127.38
127.12

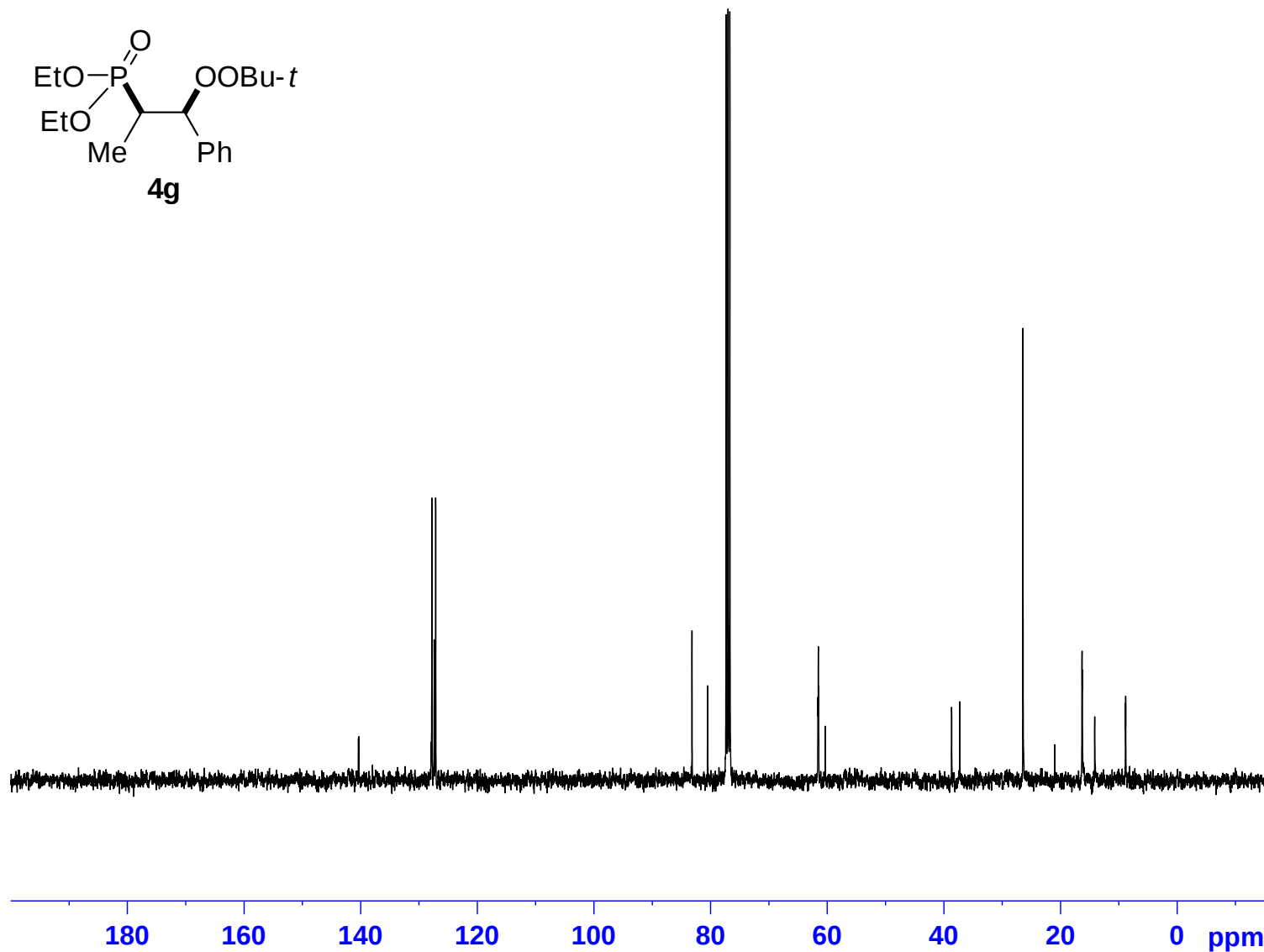
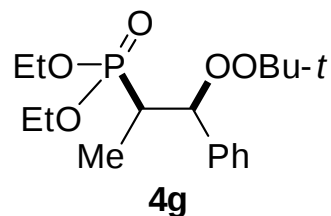
83.17
80.51
77.32
77.00
76.68

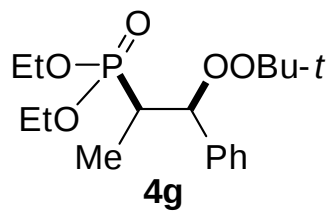
61.53
60.33

38.67
37.28

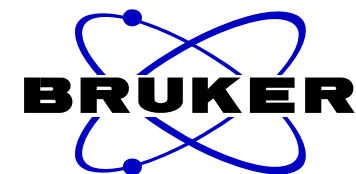
26.45

16.32
16.28
16.25
8.87
8.83





— 30.035

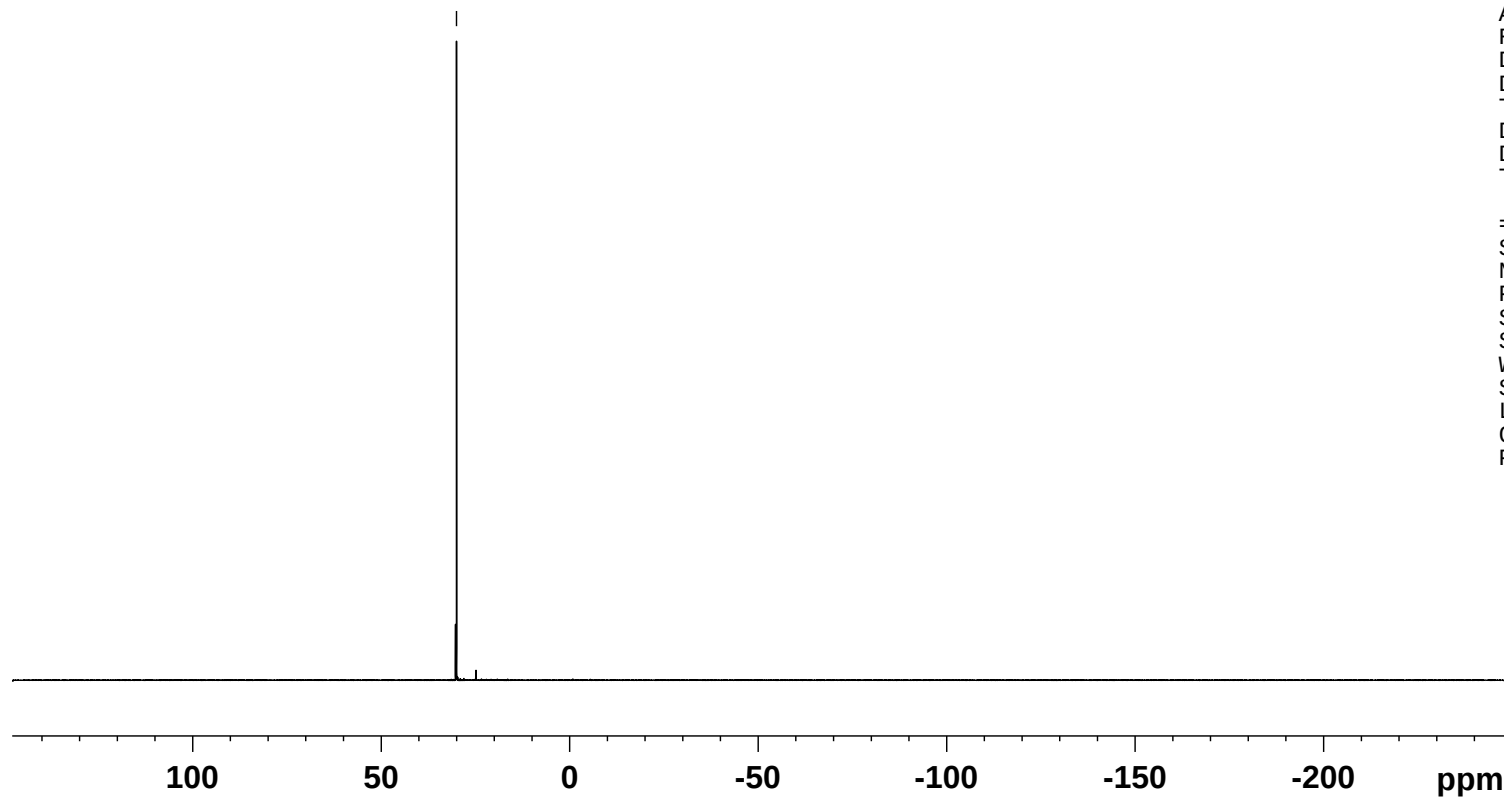


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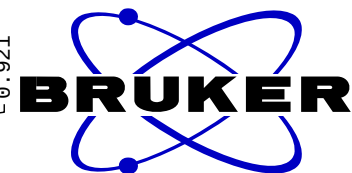
NAME          cy-142c-2
EXPNO          3
PROCNO         1
Date_          20170913
Time           10.31
INSTRUM        spect
PROBHD         5 mm PABBO BB/
PULPROG        zgpg30
TD             65536
SOLVENT        CDCl3
NS             32
DS             4
SWH            96153.844 Hz
FIDRES         1.467191 Hz
AQ            0.3408372 sec
RG            190.02
DW            5.200 usec
DE            6.50 usec
TE            0.0 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0           1
  
```

```

===== CHANNEL f1 =====
SF01          242.9411216 MHz
NUC1           31P
P1            11.90 usec
SI            32768
SF            242.9532693 MHz
WDW            EM
SSB            0
LB            1.00 Hz
GB            0
PC            1.40
  
```

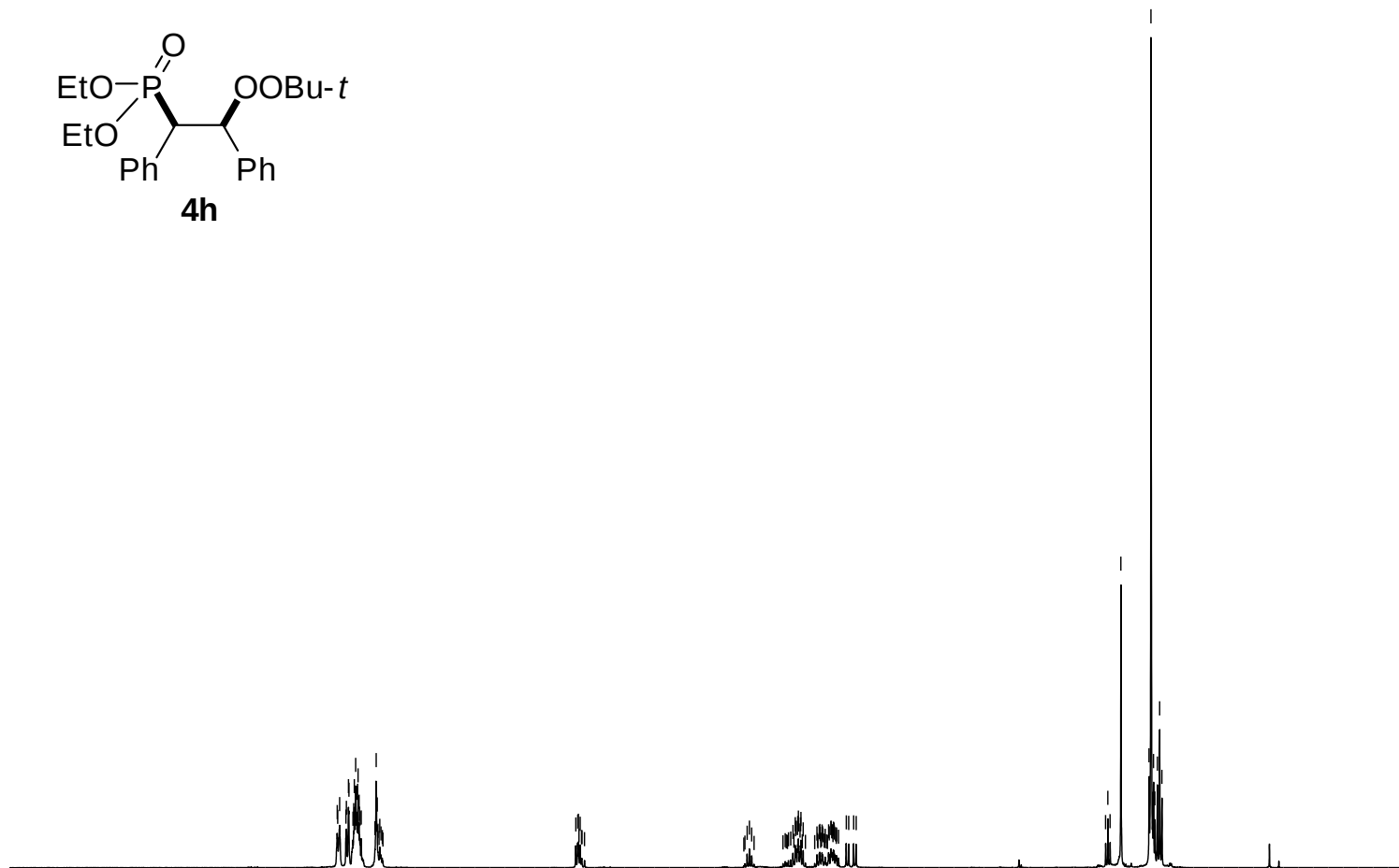
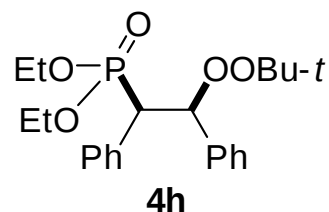


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7.326
7.294
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7.257
7.254
7.246
7.242
7.237
7.229
7.121
7.112
7.103
7.097
7.082
5.539
5.523
5.519
5.504
4.170
3.828
3.810
3.807
3.802
3.792
3.789
3.785
3.782
3.772
3.767
3.764
3.747
3.620
3.616
3.598
3.547
3.529
3.526
3.522
3.518
3.508
3.504
3.408
3.388
3.350
3.330
1.364
1.347
1.329
1.244
1.022
1.007
0.994
0.987
0.976
0.957
0.939
0.921



NAME cy-194p-20171012
EXPNO 1
PROCNO 1
Date_ 20171012
Time 17.23
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 50.8
DW 78.200 usec
DE 6.50 usec
TE 293.9 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300049 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



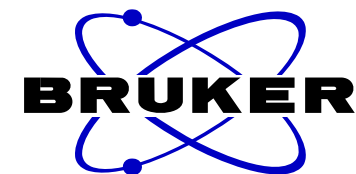
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1.28
0.87

0.77
2.13
9.80
2.62

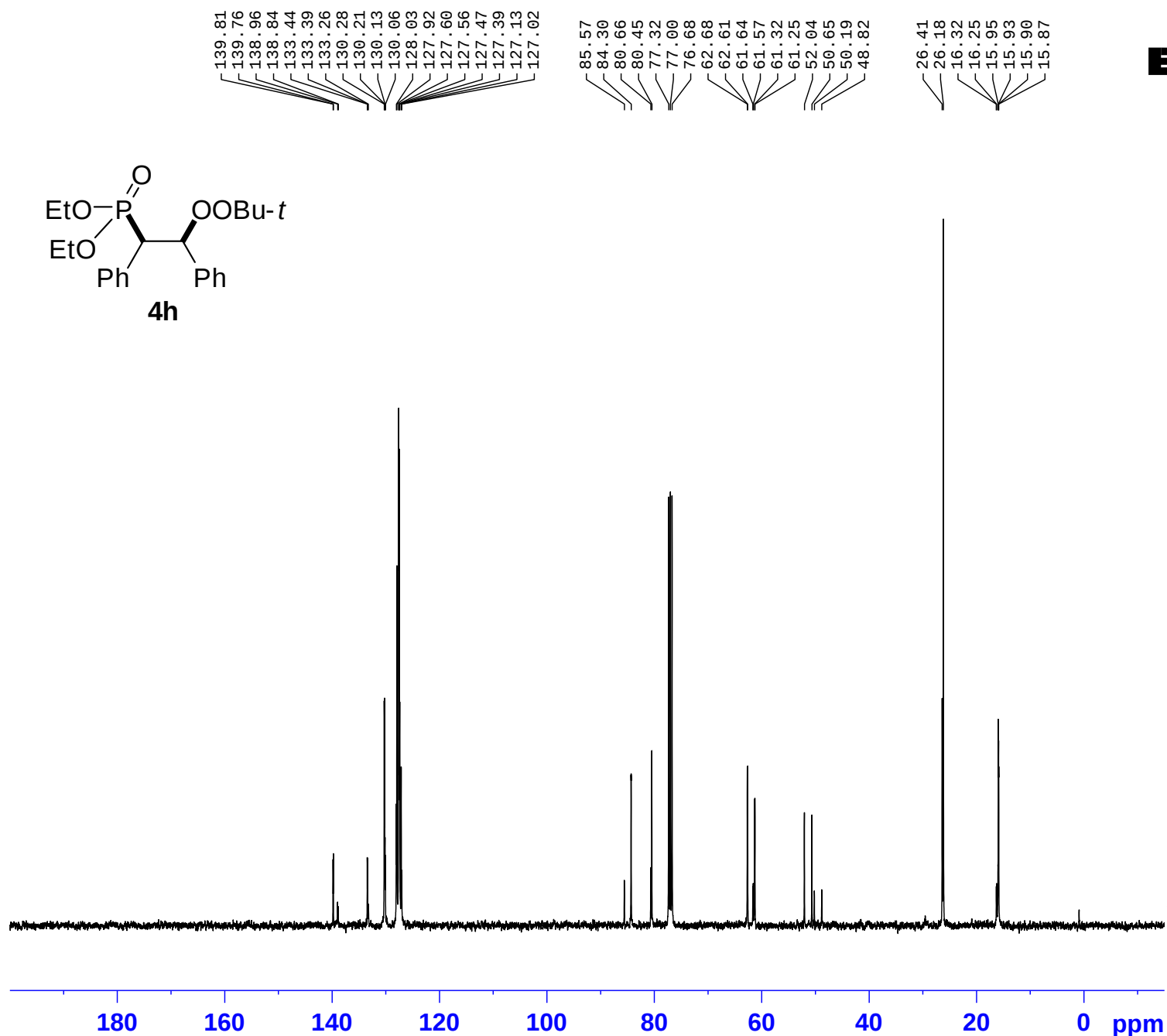
ppm

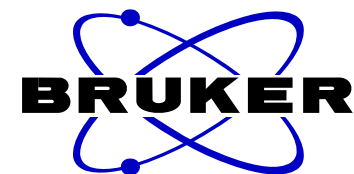


NAME cy-194p-20171012
 EXPNO 2
 PROCNO 1
 Date_ 20171012
 Time 17.28
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 152
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 294.7 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

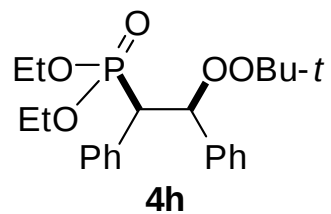
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127811 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40



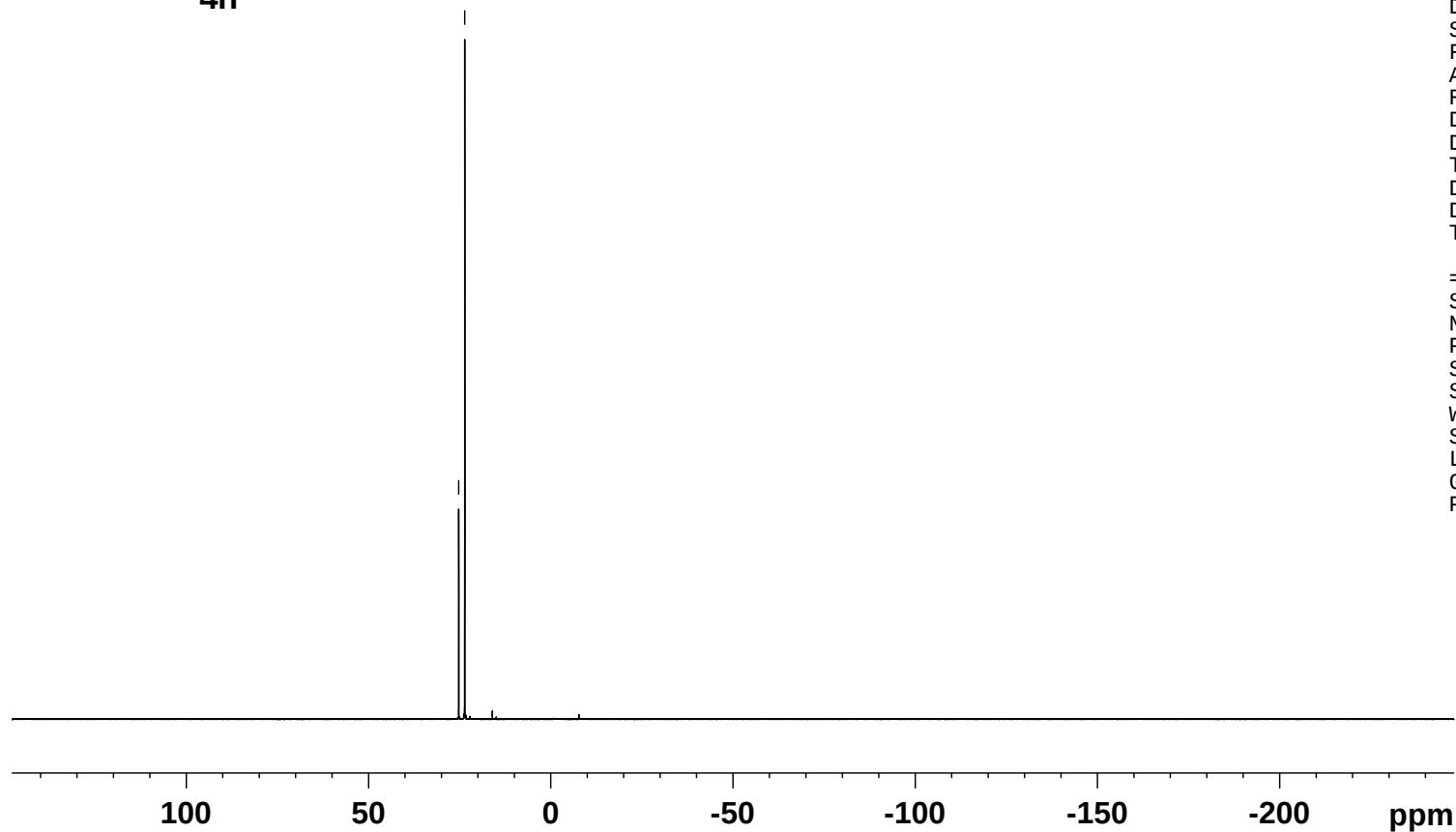


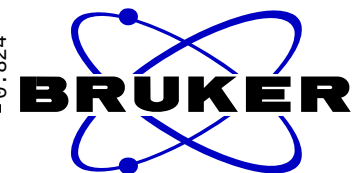
NAME cy-194p
EXPNO 3
PROCNO 1
Date_ 20171013
Time 10.18
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



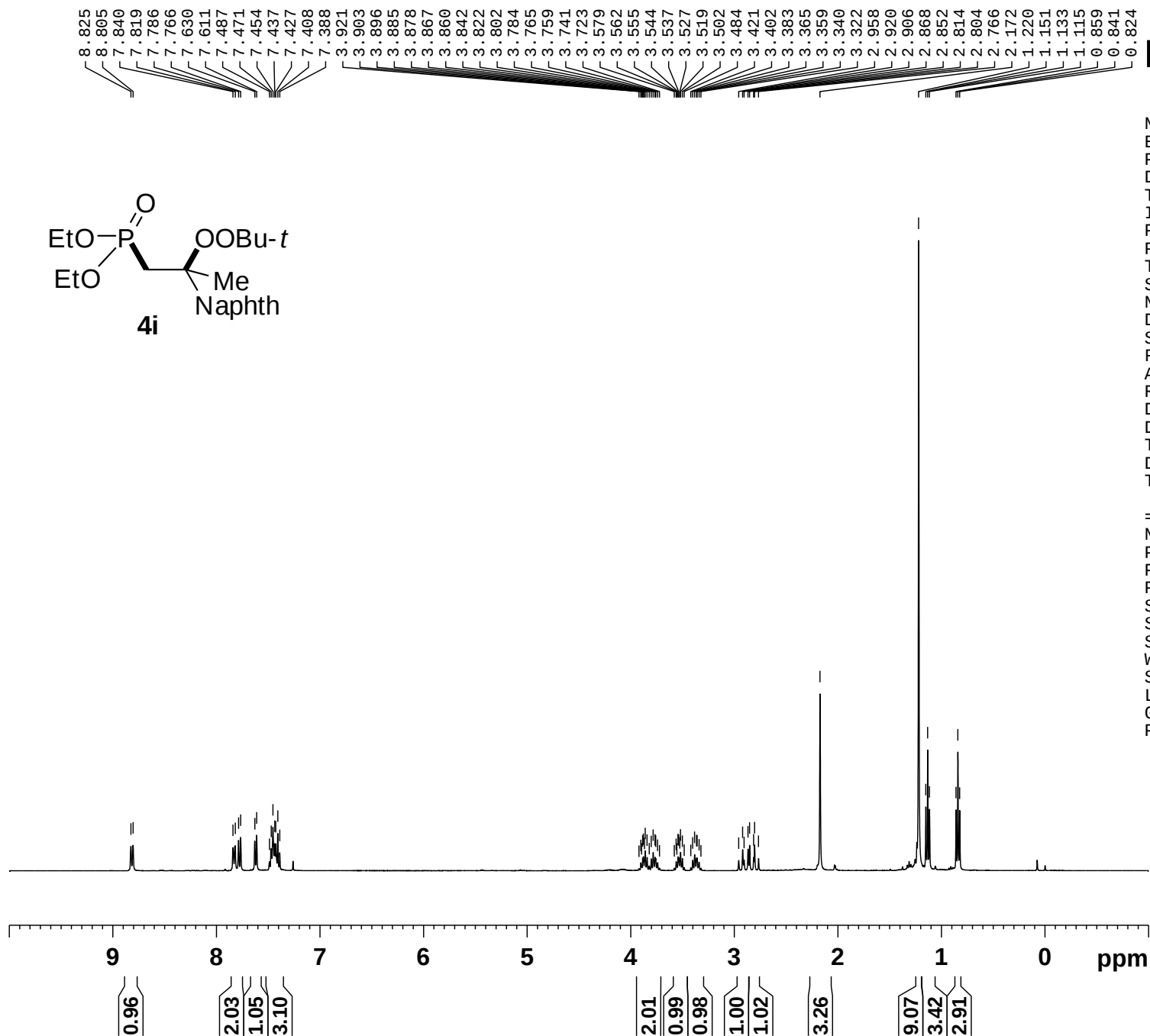
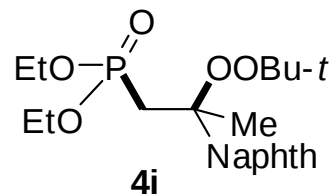
25.274
23.631

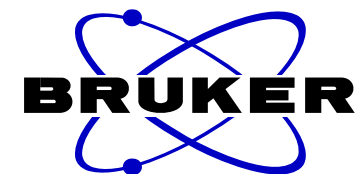




NAME cy-181ap-20170911
EXPNO 1
PROCNO 1
Date_ 20170911
Time 9.02
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 57
DW 78.200 usec
DE 6.50 usec
TE 294.0 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300095 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00





NAME cy-181ap-20170911
 EXPNO 2
 PROCNO 1
 Date_ 20170911
 Time 9.06
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 80
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 294.6 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

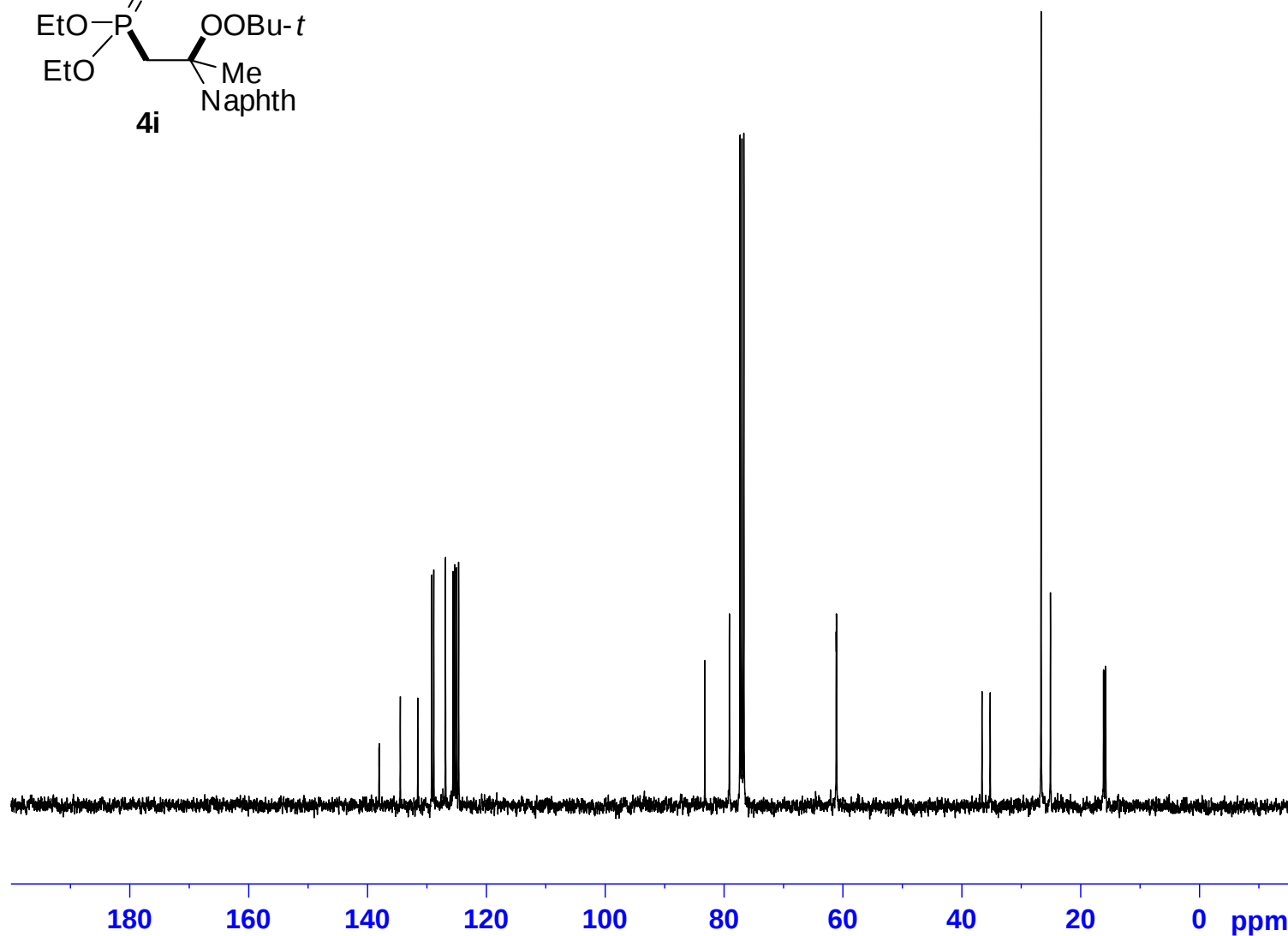
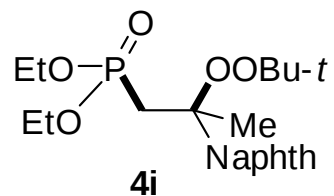
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127778 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

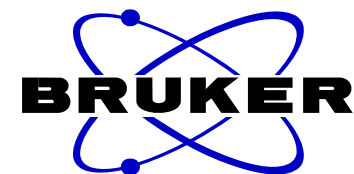
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 138.01
 134.47
 131.54
 129.16
 128.84
 126.86
 125.61
 125.32
 124.98
 124.65

83.24
 79.12
 77.32
 77.00
 76.68

61.14
 61.11
 61.08

36.61
 35.23
 26.66
 25.09
 16.15
 16.09
 15.84
 15.78

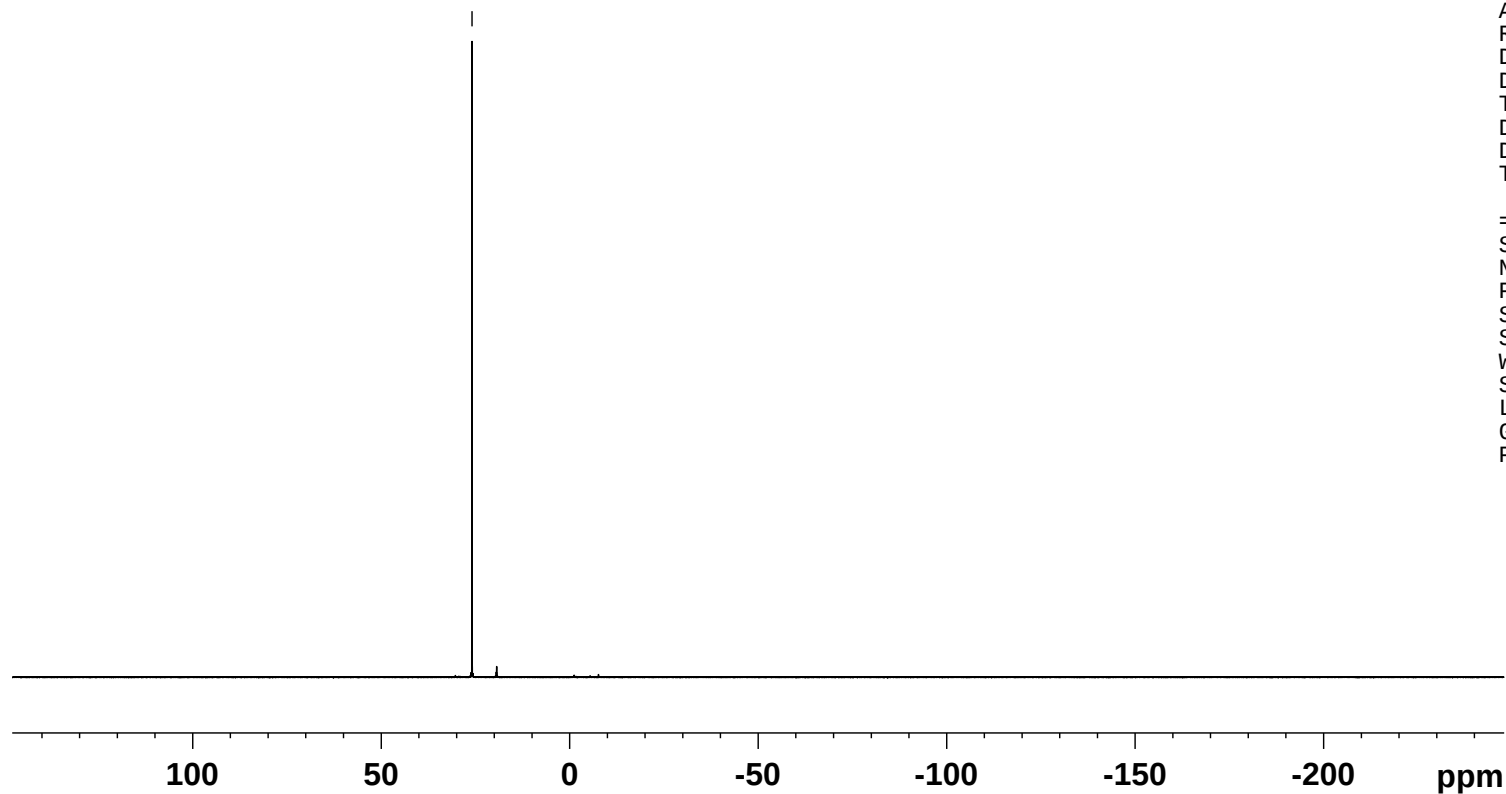
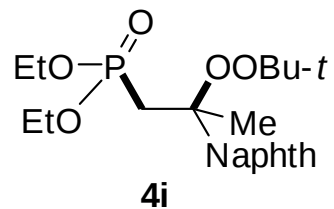


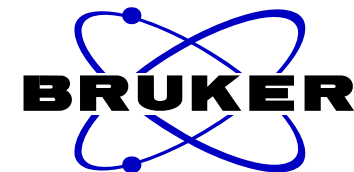


NAME cy-181ap
EXPNO 3
PROCNO 1
Date_ 20170913
Time 10.55
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

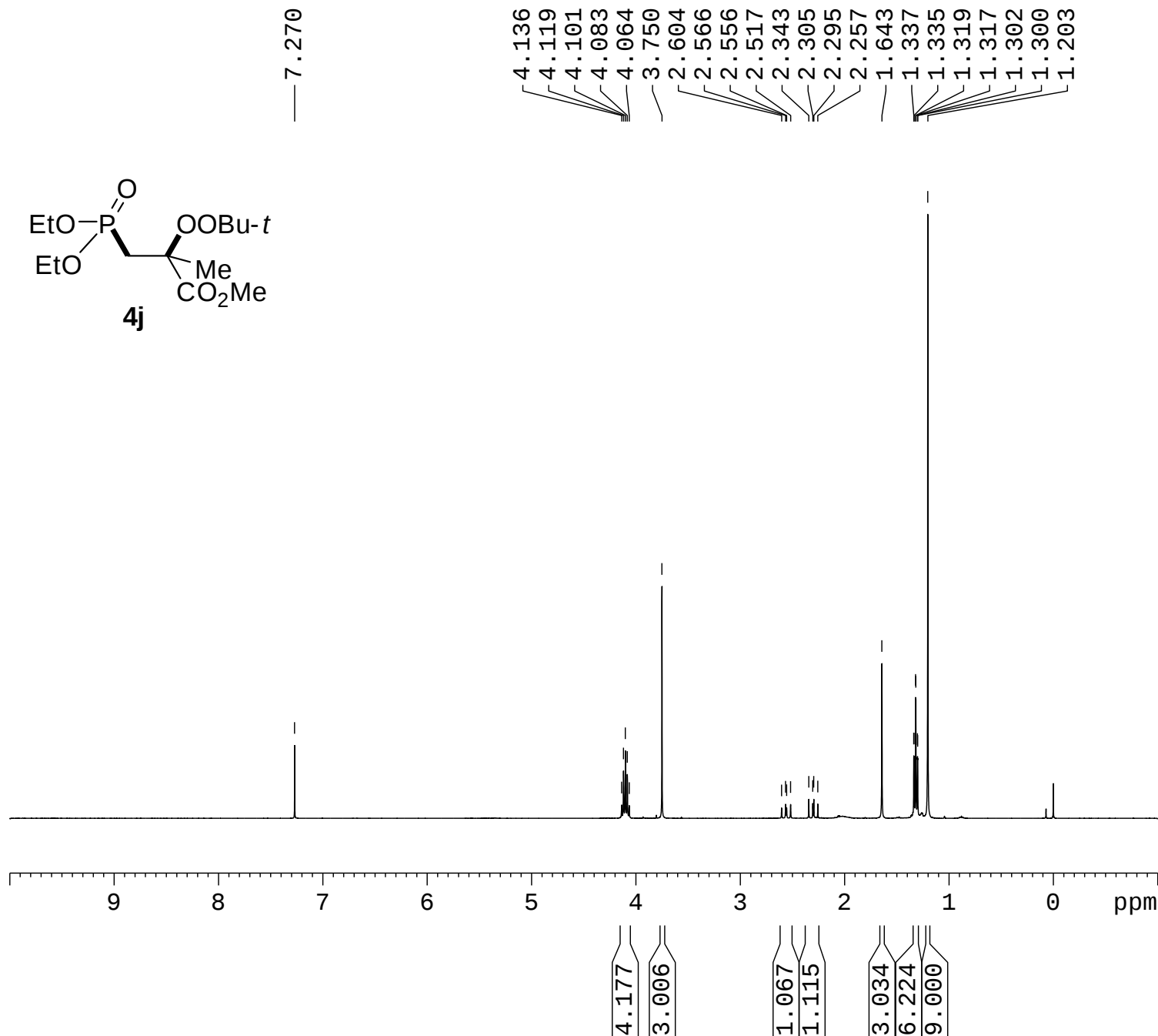
— 25.912

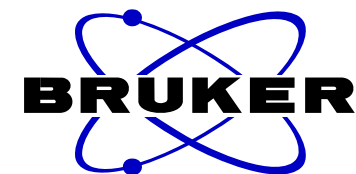
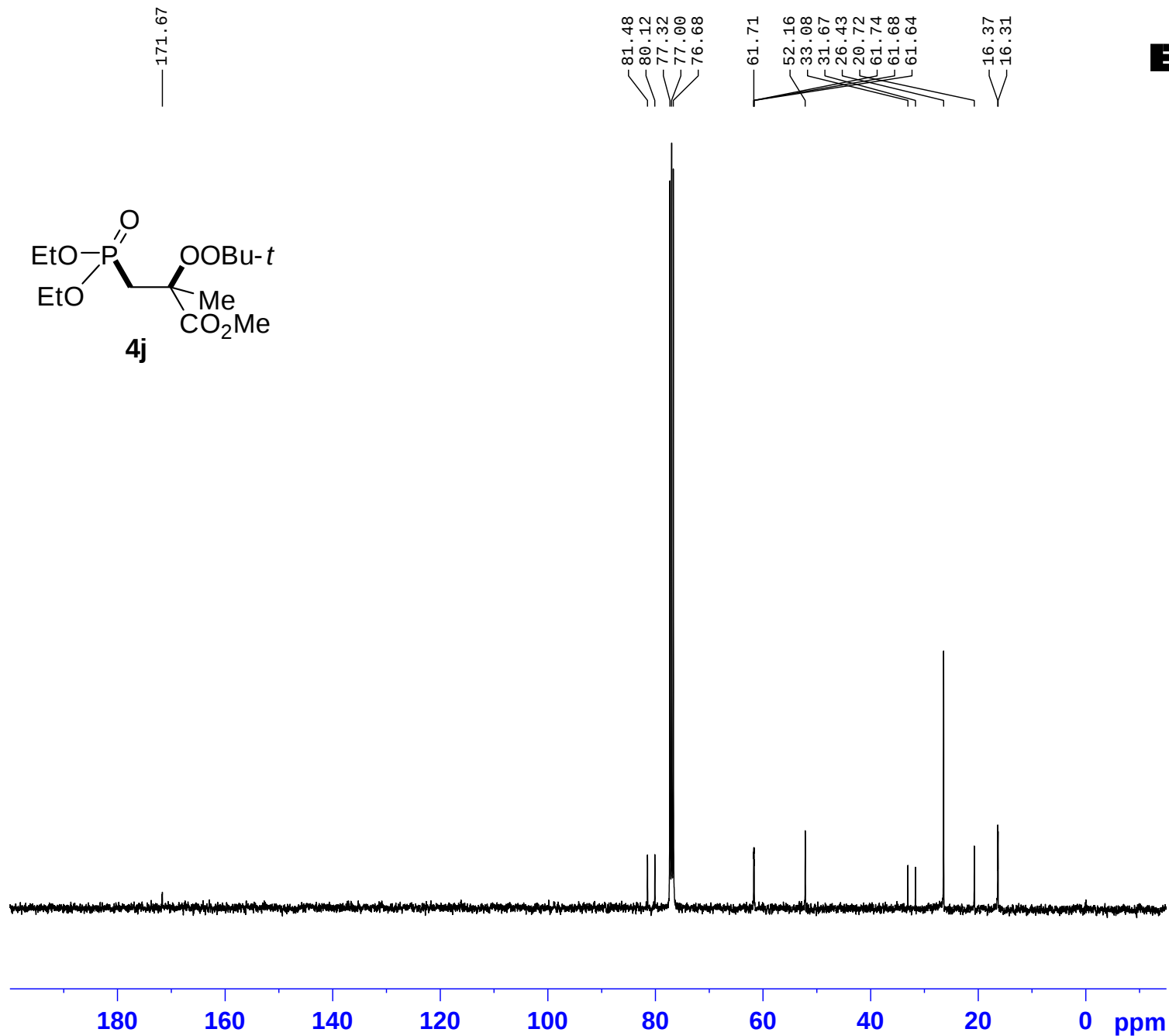
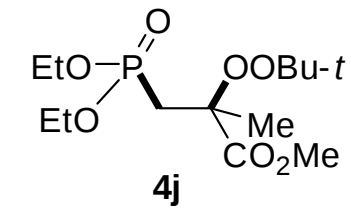




NAME cy-25-20170426
 EXPNO 1
 PROCNO 1
 Date_ 20170426
 Time 17.31
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 287
 DW 78.200 usec
 DE 6.50 usec
 TE 293.3 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1300058 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

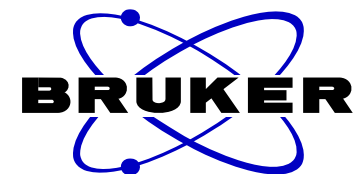




NAME cy-25-20170426
 EXPNO 2
 PROCNO 1
 Date_ 20170426
 Time 17.35
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 456
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 294.2 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

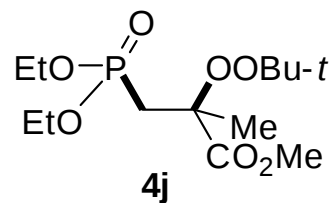
===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127720 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

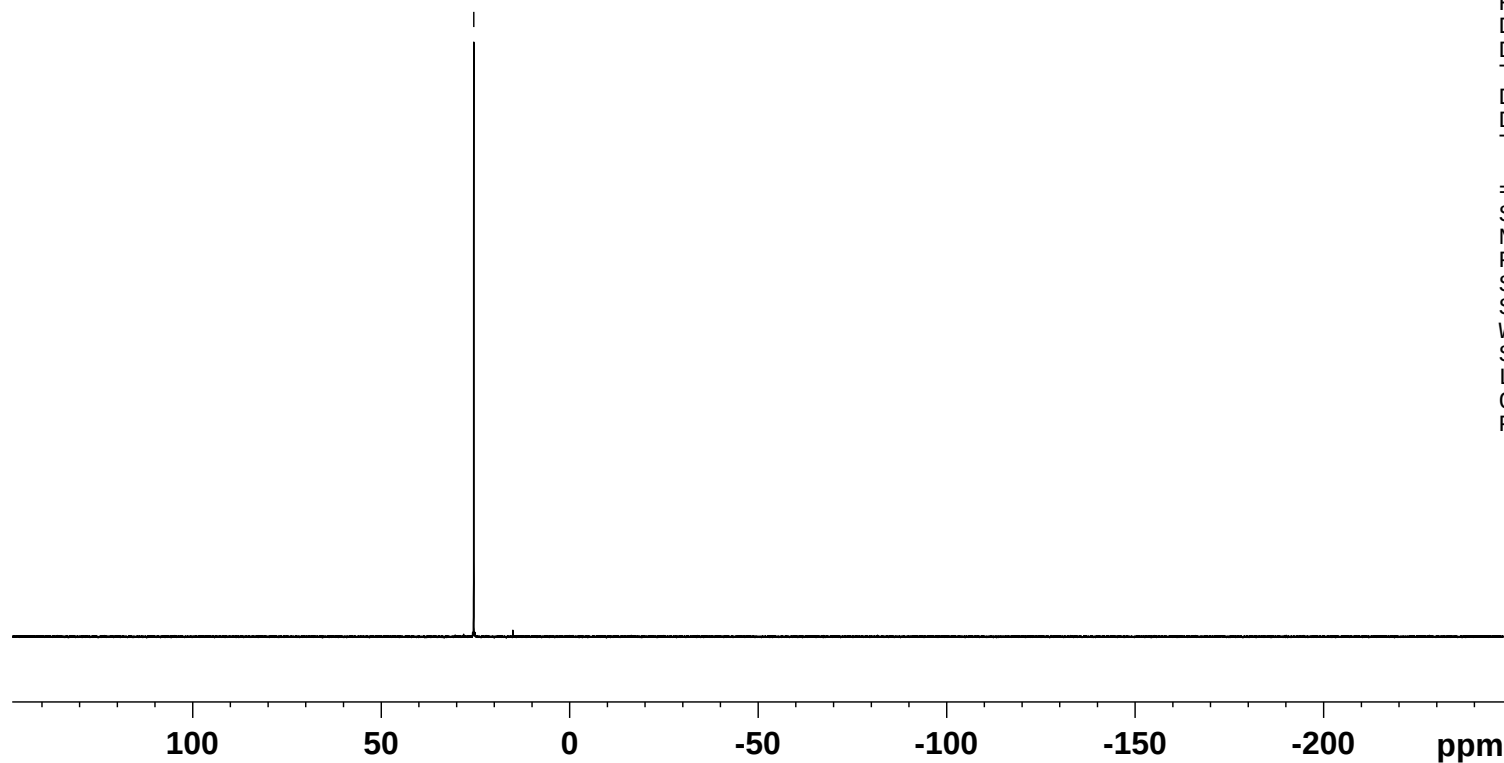


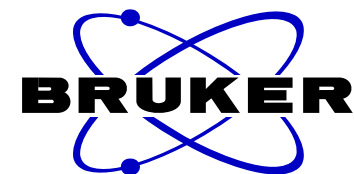
NAME cy-25
EXPNO 3
PROCNO 1
Date_ 20170426
Time 9.37
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 40
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 294.6 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40



— 25.435

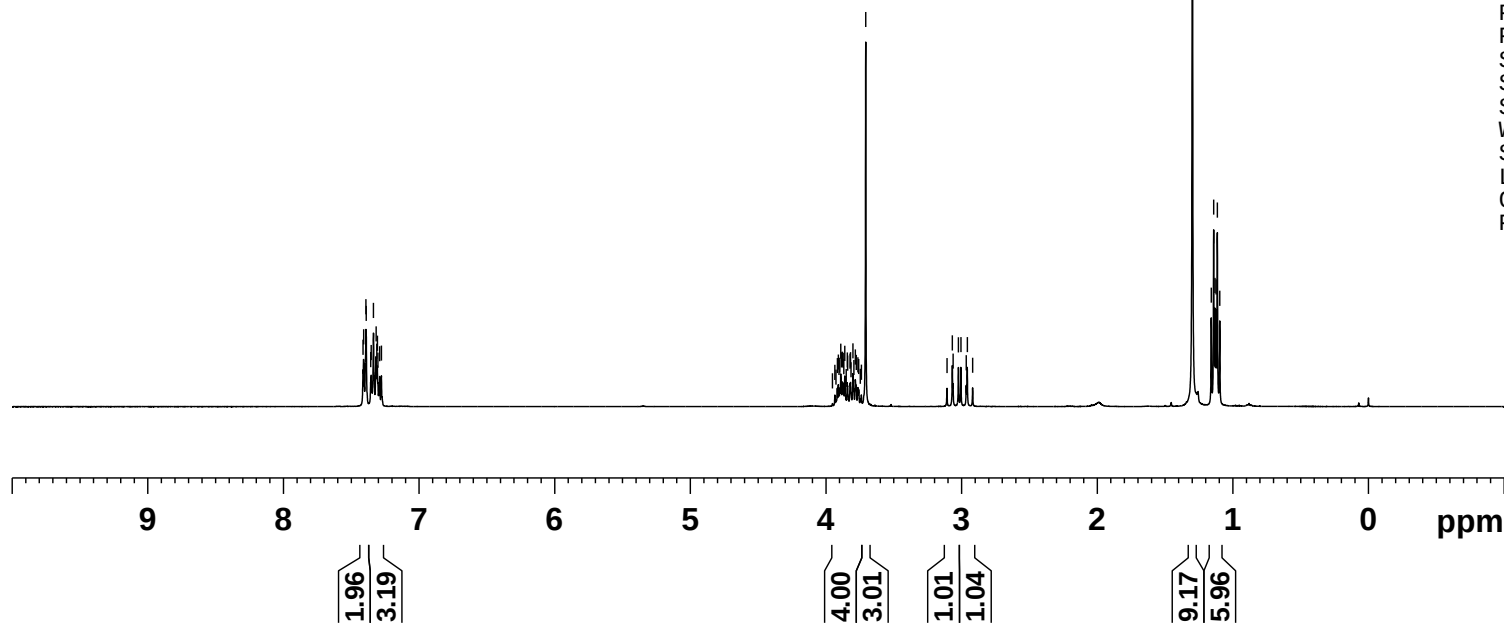
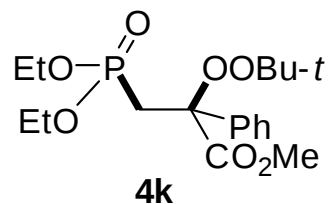


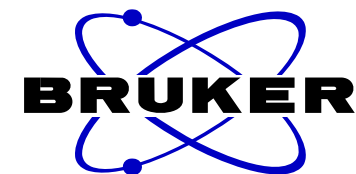


NAME cy-120a1-20170511
 EXPNO 1
 PROCNO 1
 Date_ 20170511
 Time 9.46
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 80.6
 DW 78.200 usec
 DE 6.50 usec
 TE 297.1 K
 D1 1.000000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1300027 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

7.413
7.409
7.392
7.389
7.357
7.353
7.336
7.317
7.311
7.307
7.304
7.290
7.278
3.952
3.934
3.927
3.916
3.909
3.904
3.898
3.891
3.887
3.879
3.873
3.869
3.861
3.851
3.843
3.840
3.822
3.819
3.815
3.802
3.794
3.784
3.777
3.764
3.759
3.746
3.739
3.707
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3.068
3.063
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1.114
1.097

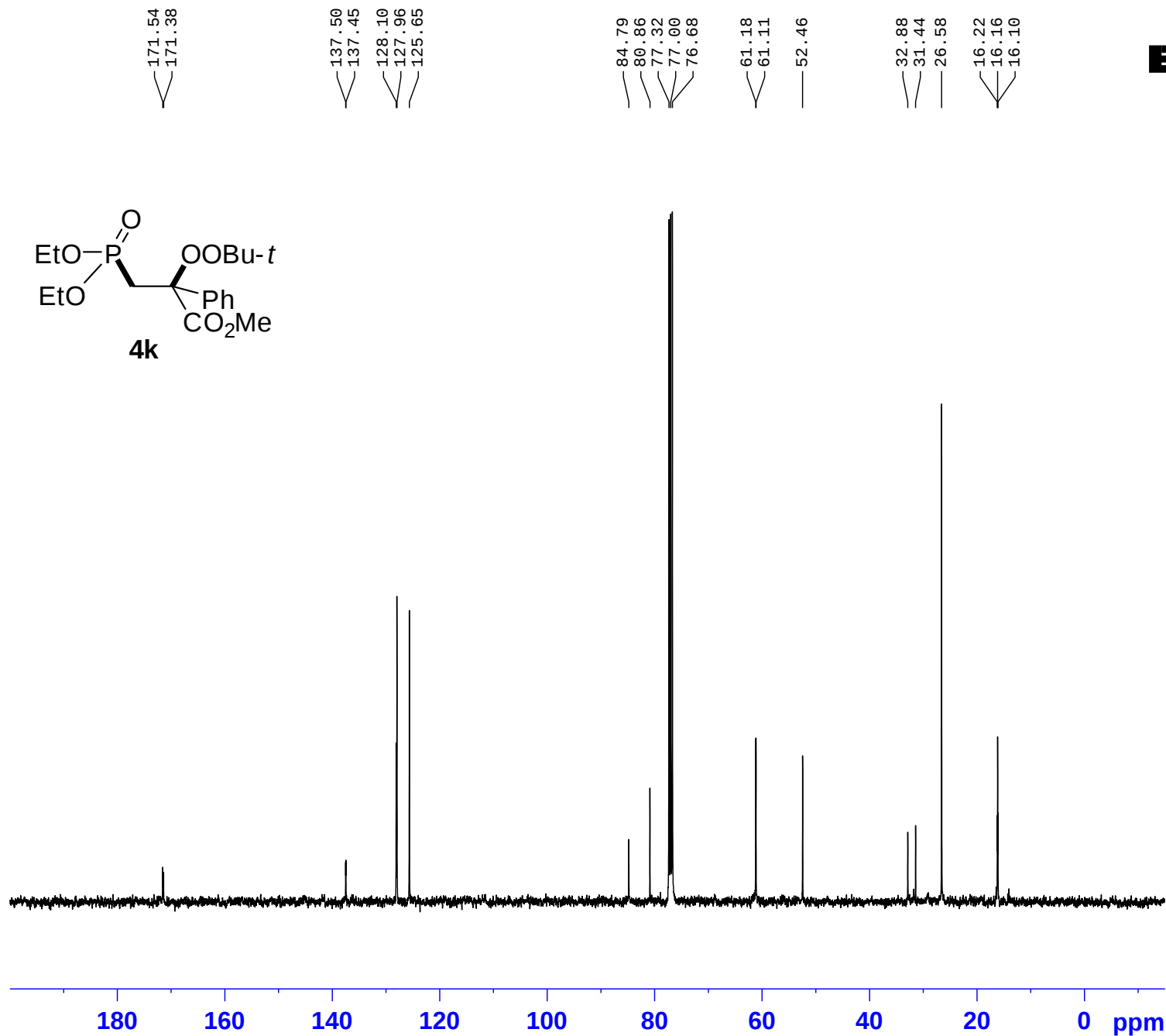




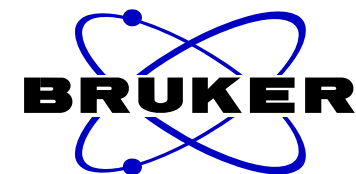
NAME cy-182ap-20170912
 EXPNO 2
 PROCNO 1
 Date_ 20170912
 Time 16.41
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 280
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.3 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127737 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

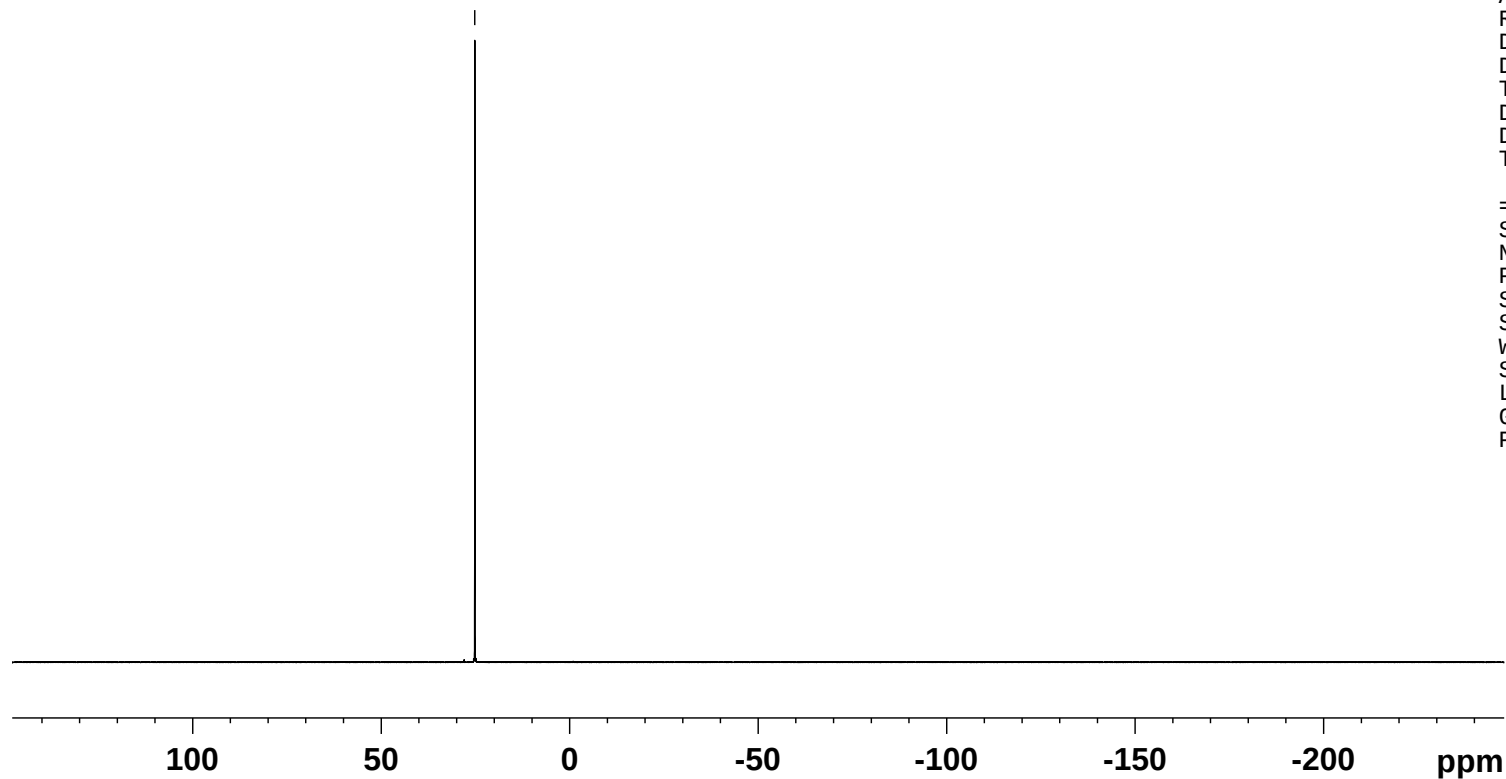
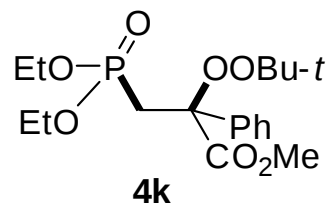


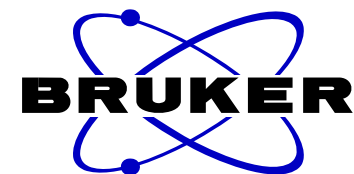
— 25.192



NAME cy-120a1
EXPNO 3
PROCNO 1
Date_ 20170511
Time 10.09
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 48
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 299.3 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

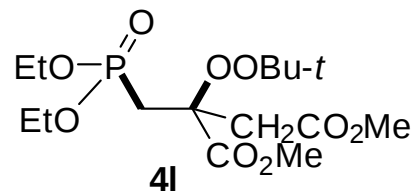
===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40





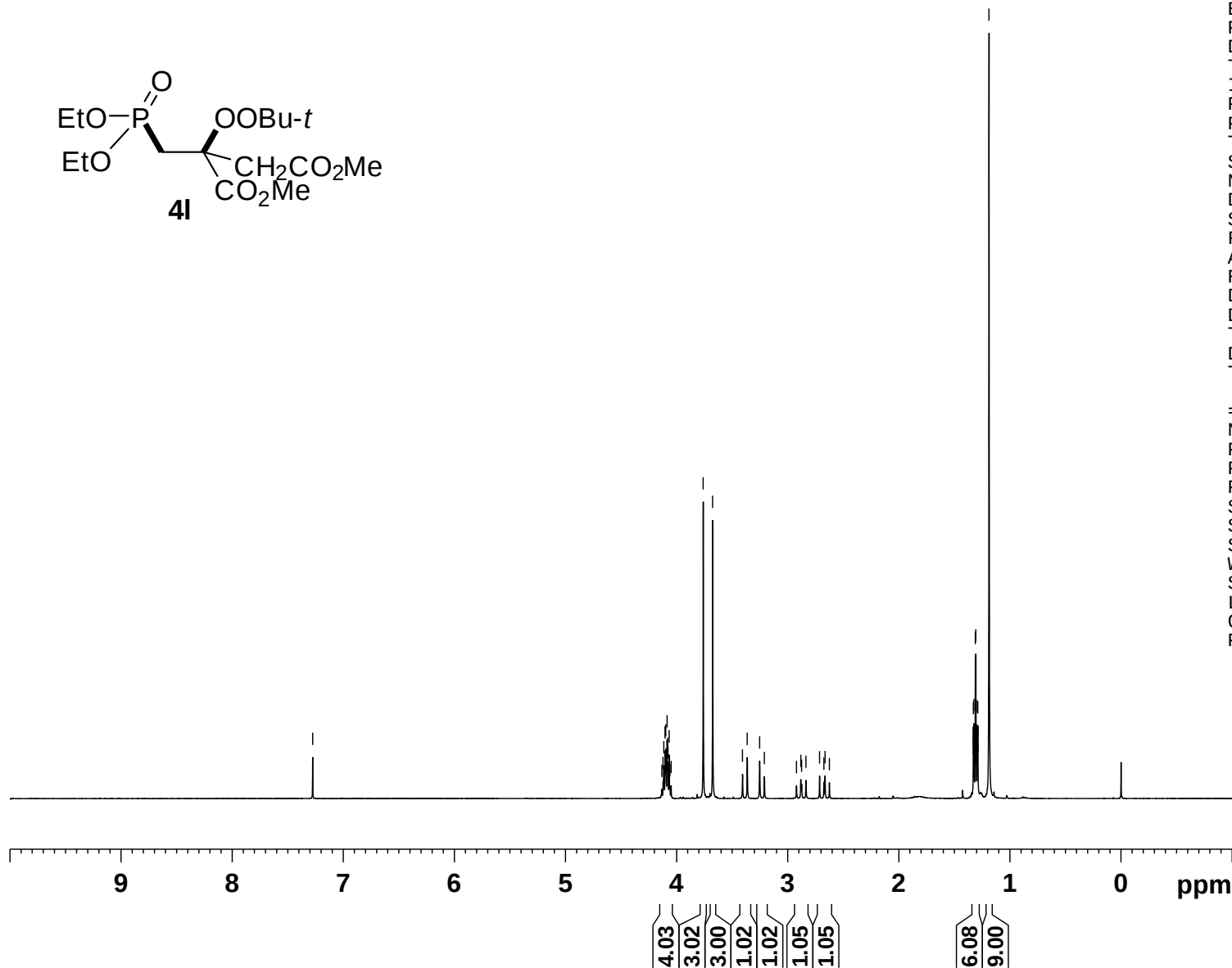
NAME cy-148a-20170613
EXPNO 1
PROCNO 1
Date_ 20170613
Time 8.51
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 144
DW 78.200 usec
DE 6.50 usec
TE 293.4 K
D1 1.00000000 sec
TD0 1

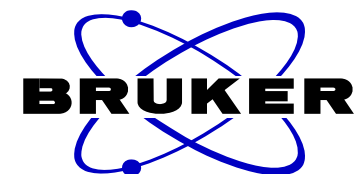
===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300038 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



7.275

4.133
4.122
4.116
4.104
4.098
4.086
4.080
4.078
4.067
4.060
4.050
3.761
3.676
3.407
3.365
3.253
3.211
2.921
2.882
2.876
2.836
2.713
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2.664
2.625
1.329
1.325
1.312
1.307
1.294
1.289
1.188

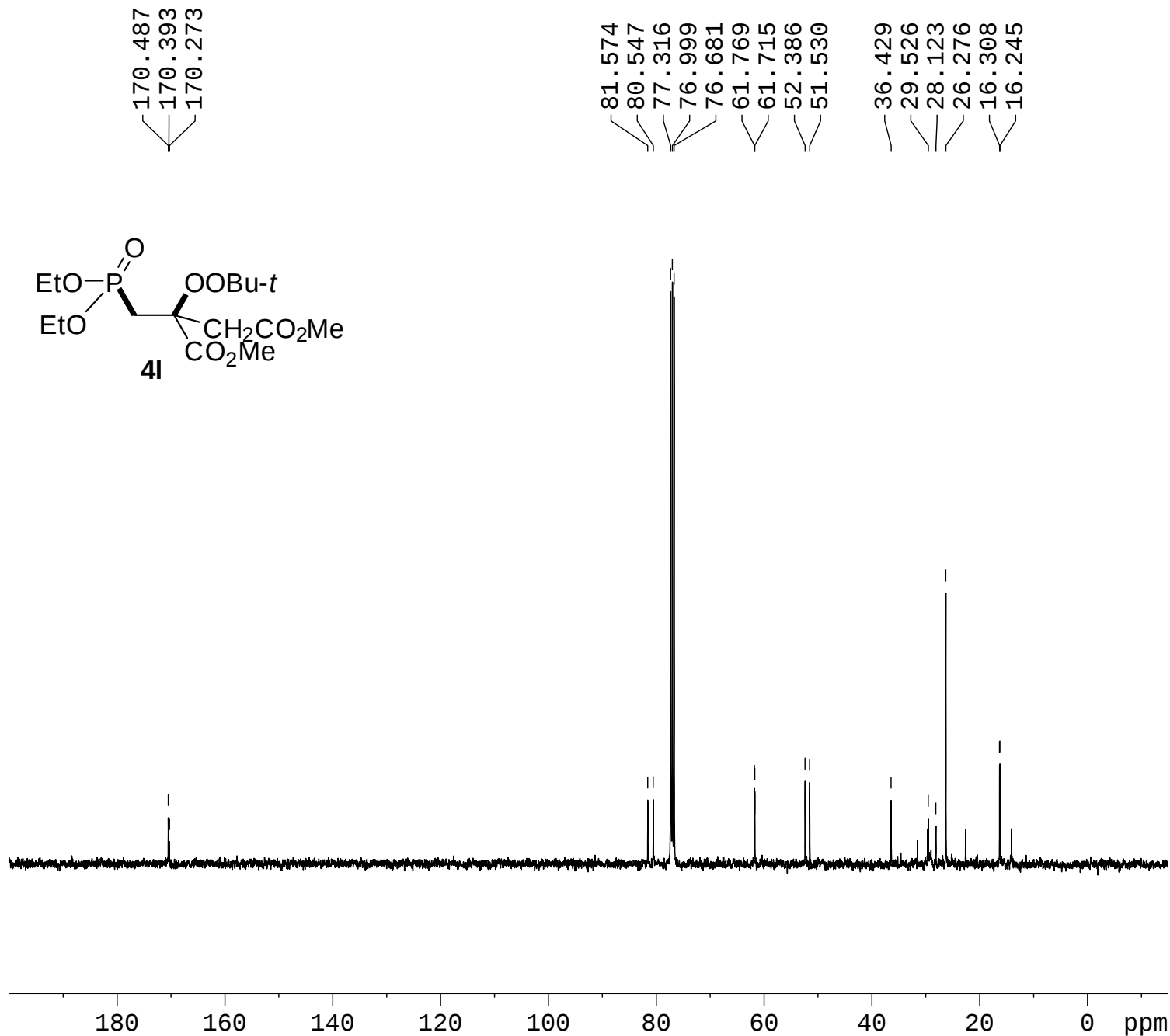


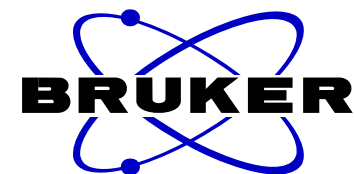


NAME cy-109a-20170426
 EXPNO 2
 PROCNO 1
 Date_ 20170426
 Time 18.23
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 232
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 294.2 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127727 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

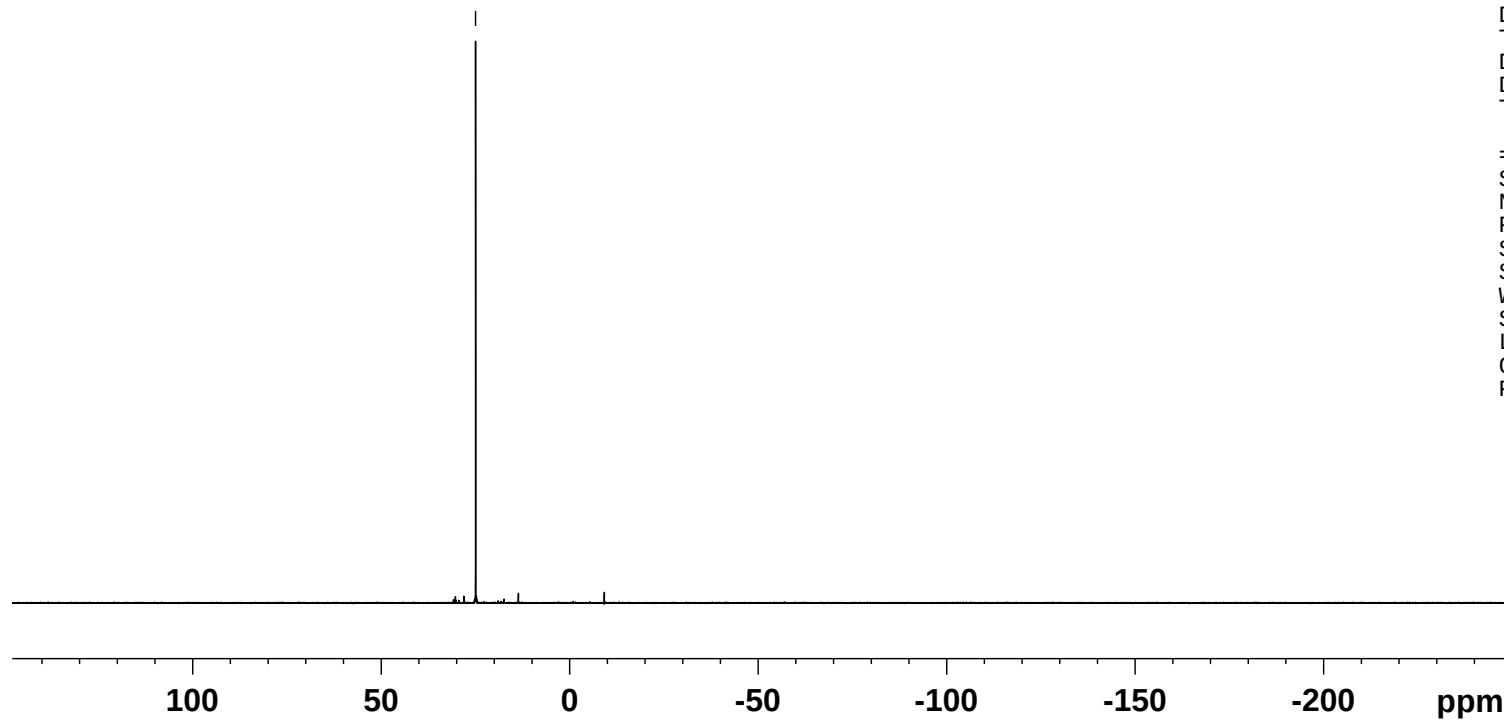
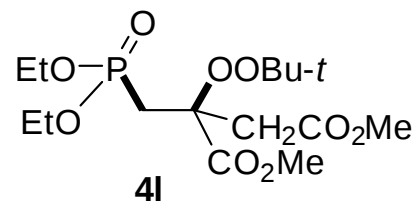


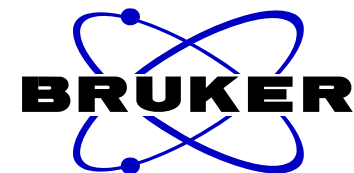


NAME cy-109a
EXPNO 3
PROCNO 1
Date_ 20170426
Time 9.47
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 294.7 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40

— 24.974

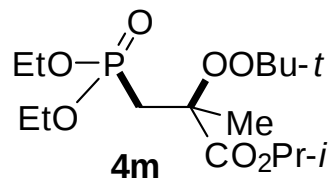




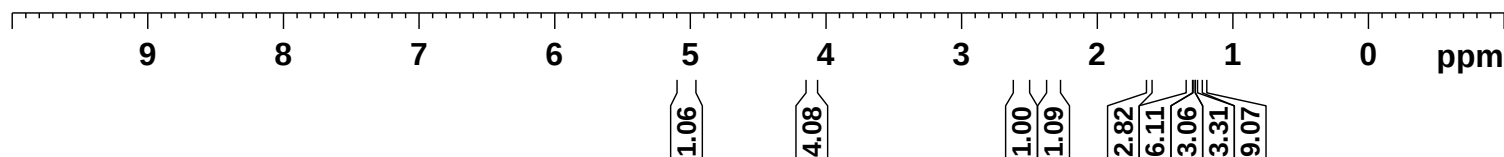
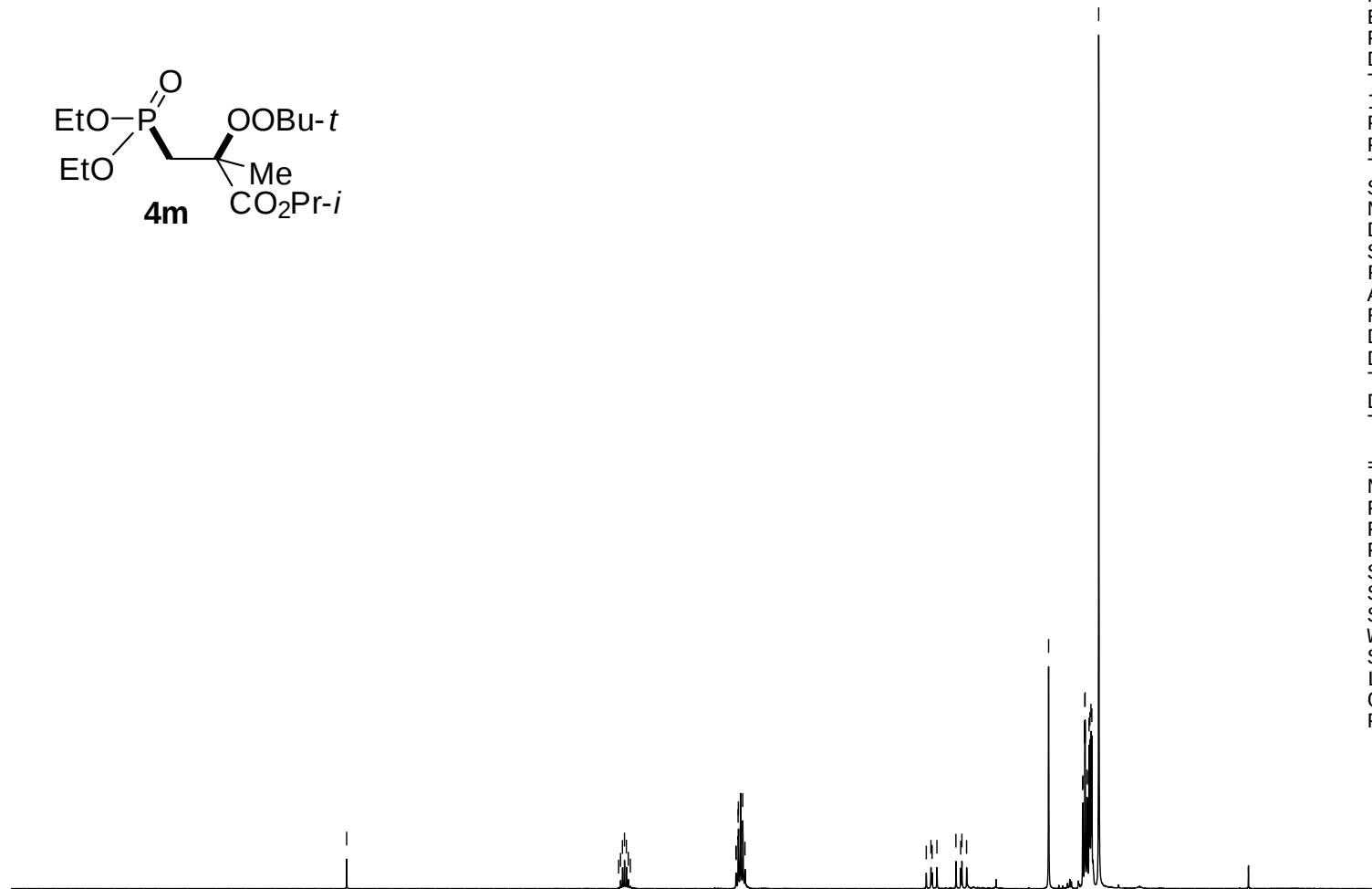
NAME cy-191p-20170923
 EXPNO 1
 PROCNO 1
 Date_ 20170923
 Time 22.46
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 101
 DW 78.200 usec
 DE 6.50 usec
 TE 293.8 K
 D1 1.00000000 sec
 TD0 1

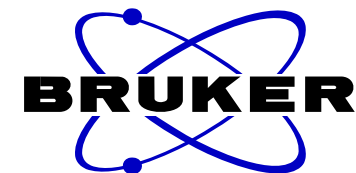
===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1299986 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

— 7.288



5.090
5.074
5.059
5.043
5.027
5.012
4.995
4.142
4.140
4.124
4.122
4.087
4.069
2.604
2.566
2.556
2.518
2.364
2.325
2.316
2.277
1.615
1.340
1.337
1.322
1.320
1.305
1.302
1.288
1.281
1.272
1.265
1.210

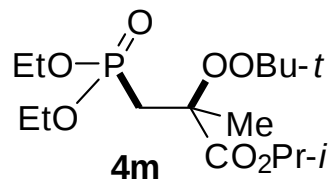
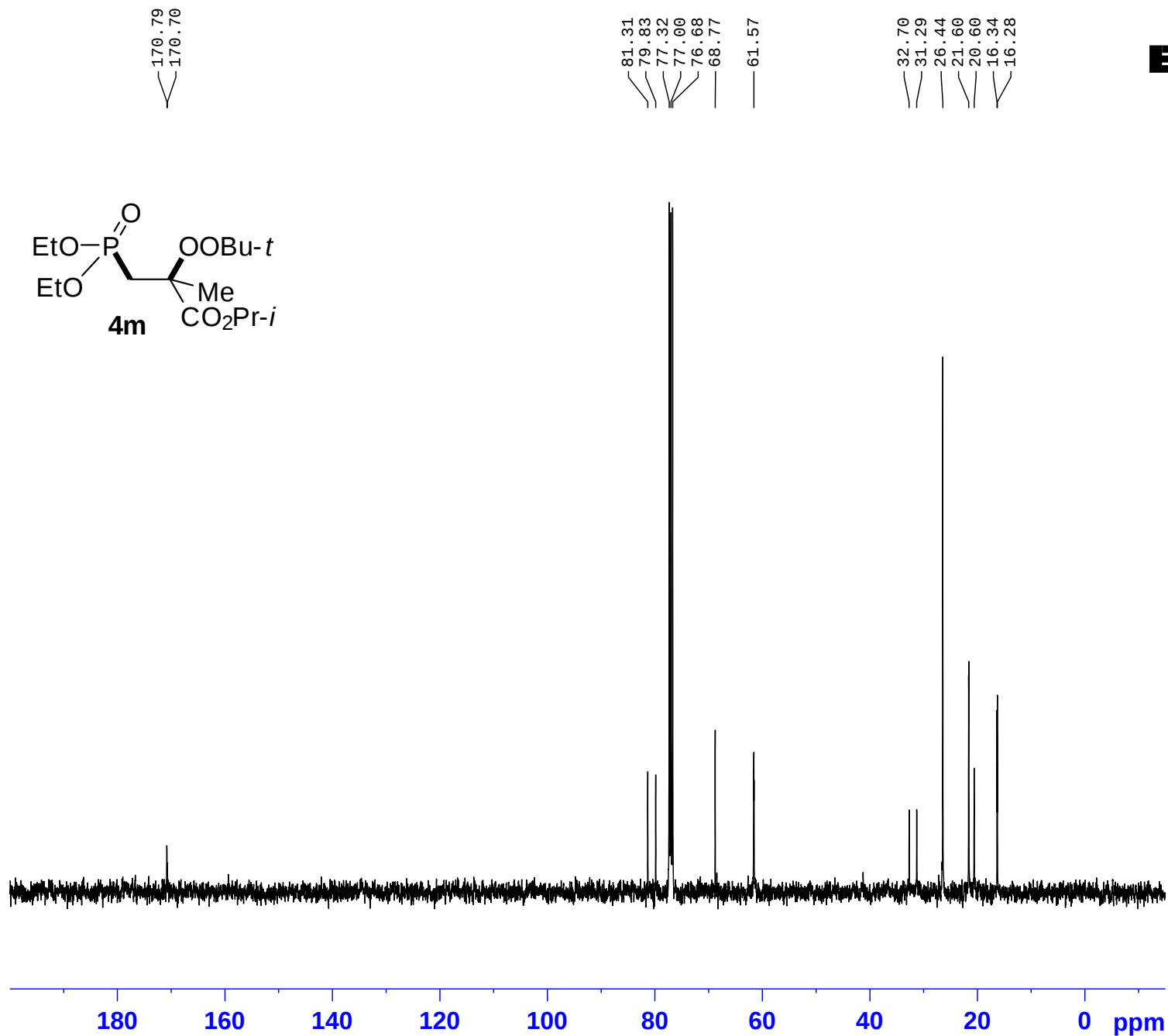


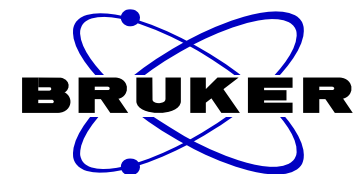


NAME cy-191p-20170923
 EXPNO 2
 PROCNO 1
 Date_ 20170923
 Time 22.49
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 40
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 294.5 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127736 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

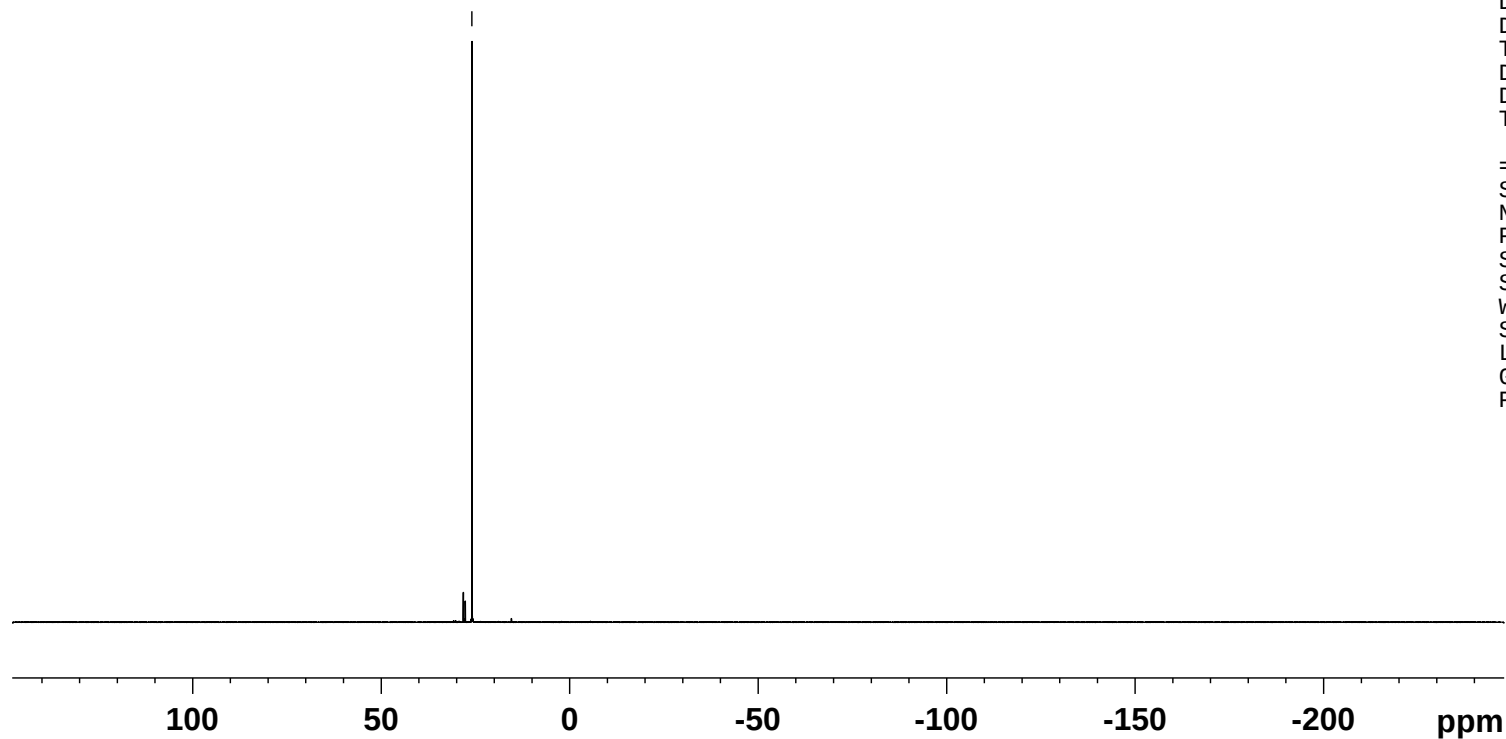
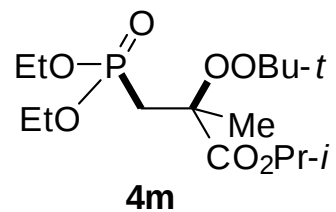


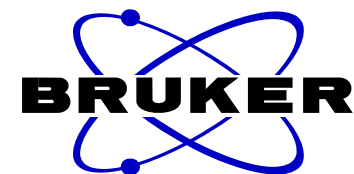


NAME cy-191p-p
EXPNO 3
PROCNO 1
Date_ 20171017
Time 9.59
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 296.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

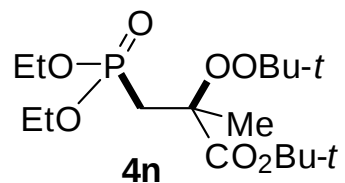
— 25.928





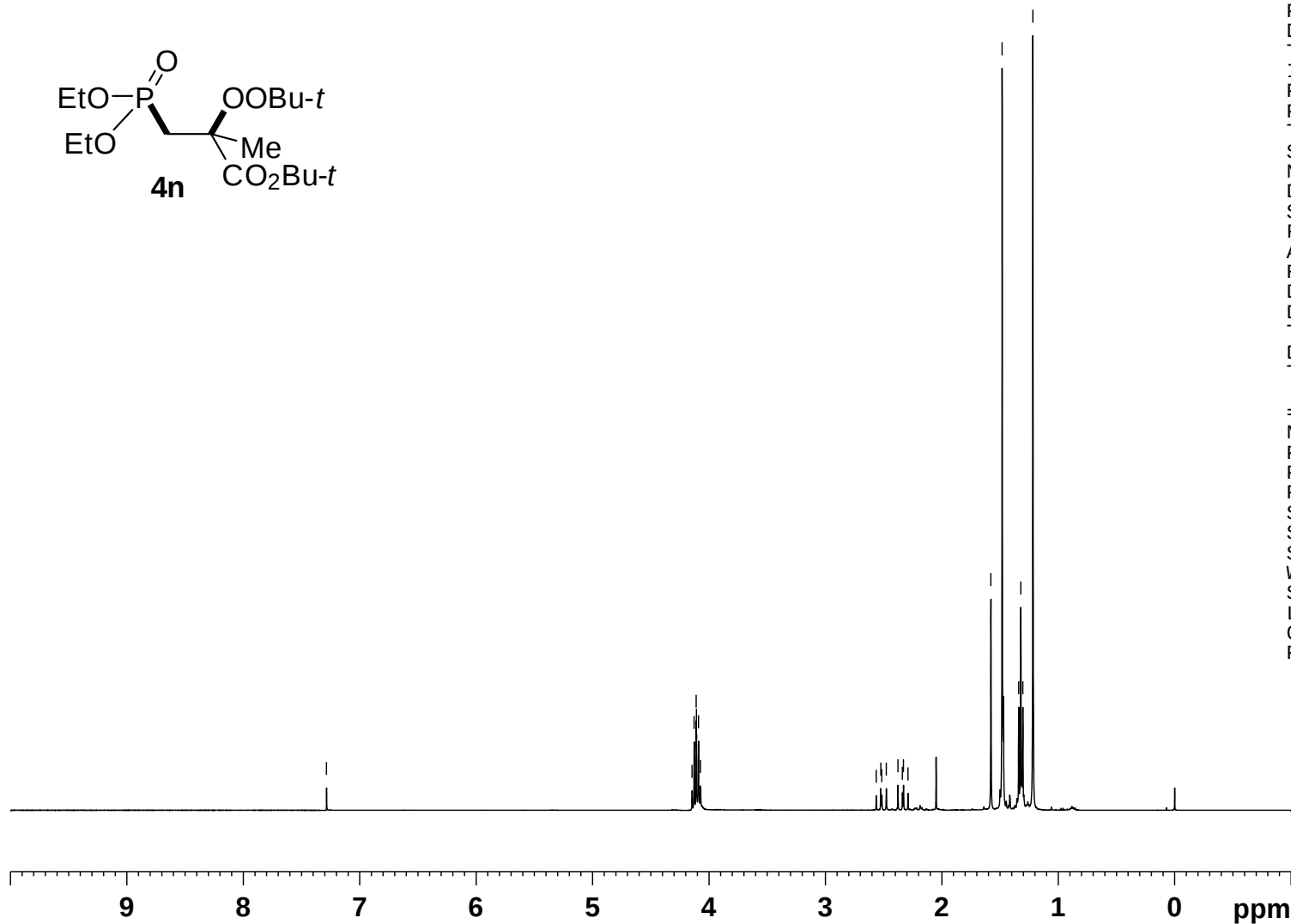
NAME cy-186ap-20170916
 EXPNO 1
 PROCNO 1
 Date_ 20170916
 Time 20.37
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 128
 DW 78.200 usec
 DE 6.50 usec
 TE 294.3 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1299997 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

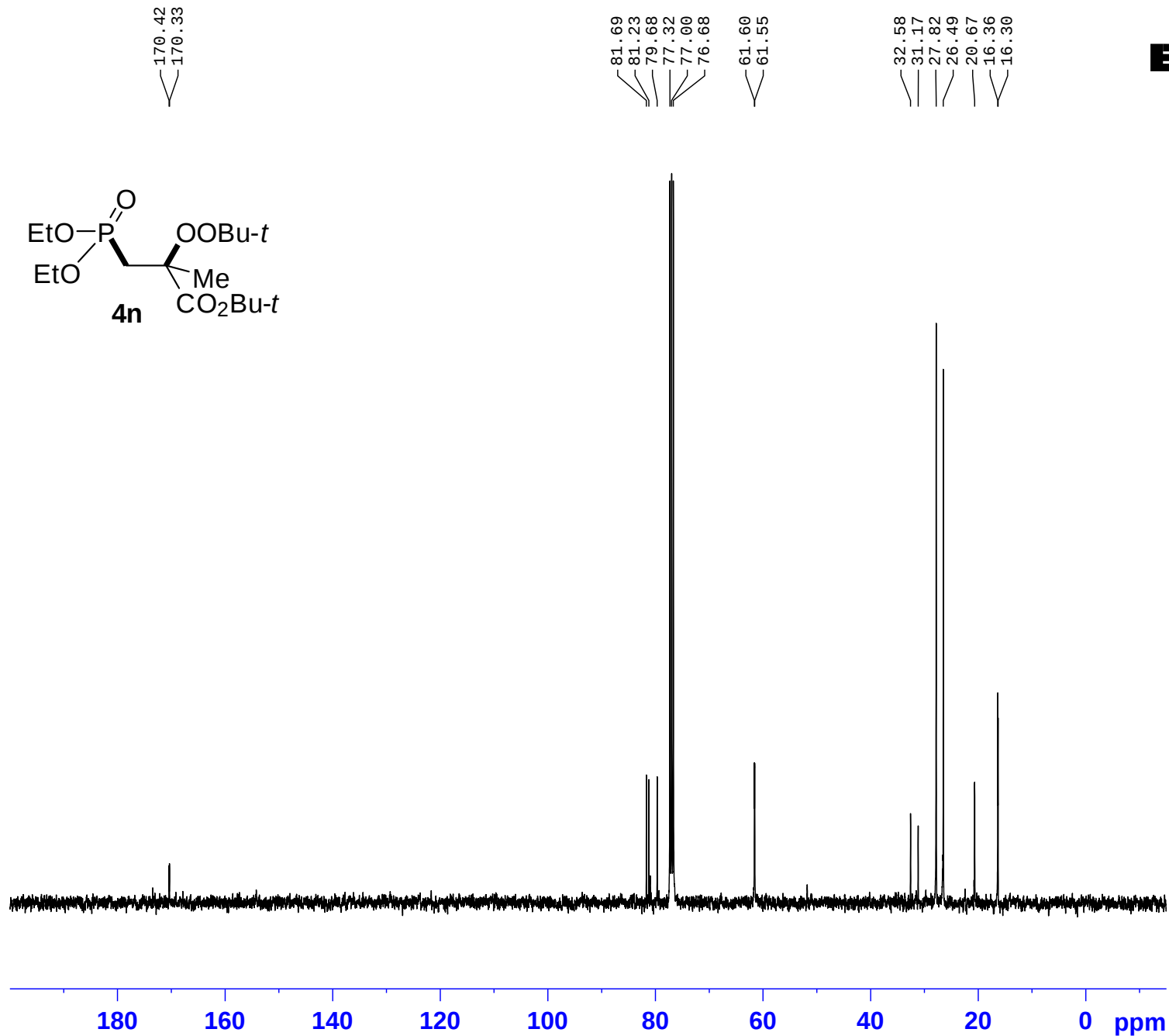
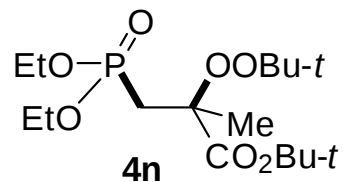
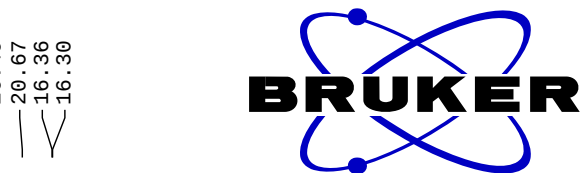


— 7.285

4.146
4.128
4.110
4.108
4.090
4.072
 2.563
2.525
2.516
2.477
2.377
2.339
2.330
2.291
1.579
1.482
1.340
1.322
1.305
1.218



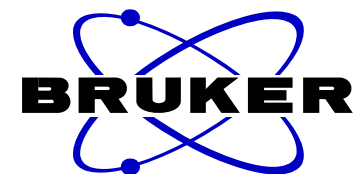
4.37
1.00
1.01
2.84
8.98
6.37
9.16



NAME cy-186ap-20170916
EXPNO 2
PROCNO 1
Date_ 20170916
Time 20.40
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 120
DS 4
SWH 25252.525 Hz
FIDRES 0.385323 Hz
AQ 1.2976629 sec
RG 2050
DW 19.800 usec
DE 8.00 usec
TE 295.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 10

===== CHANNEL f1 =====
NUC1 13C
P1 13.50 usec
PL1 3.00 dB
PL1W 43.93649673 W
SF01 100.6238364 MHz

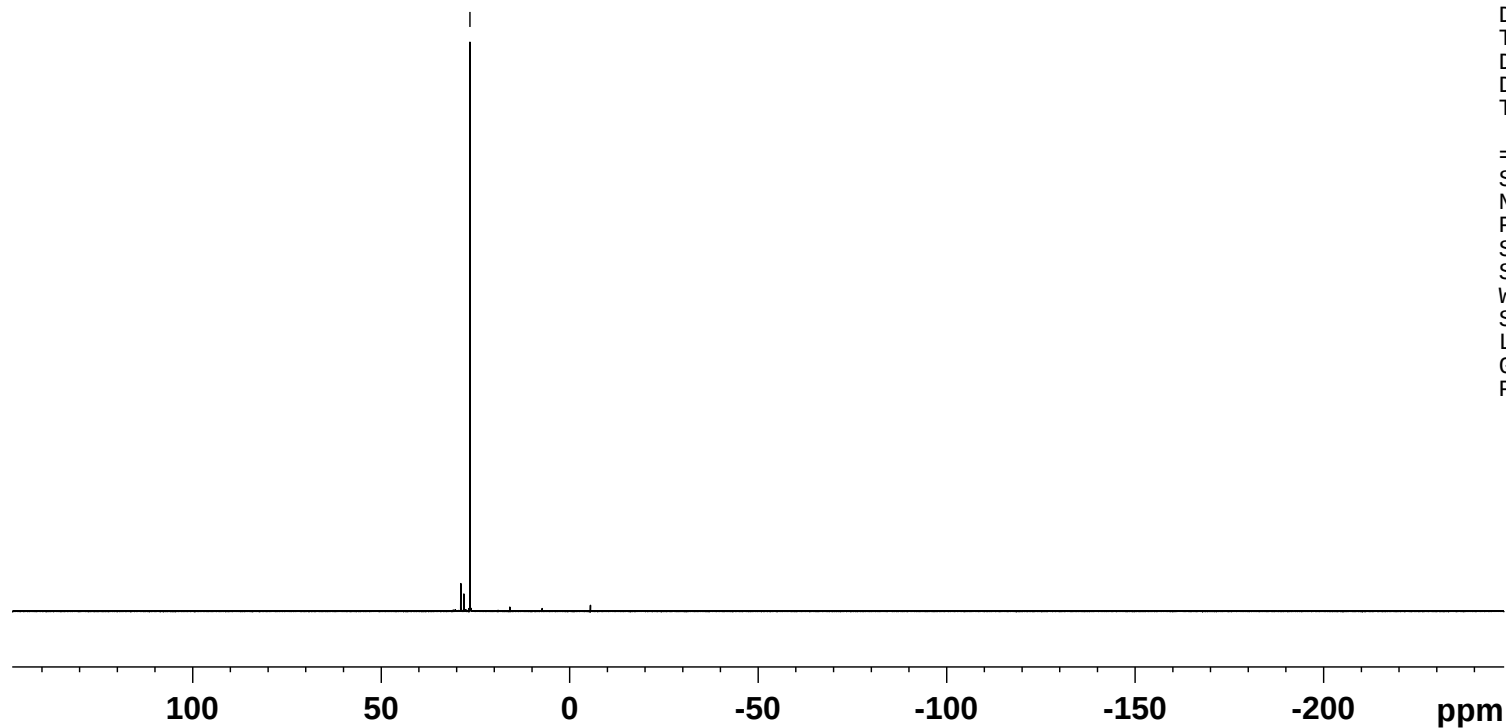
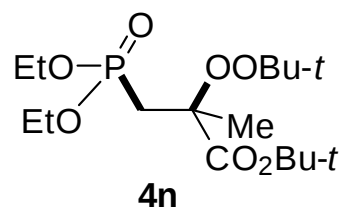
===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 1.80 dB
PL12 17.19 dB
PL13 18.46 dB
PL2W 8.92857742 W
PL12W 0.25809658 W
PL13W 0.19265592 W
SF02 400.1316005 MHz
SI 32768
SF 100.6127732 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40

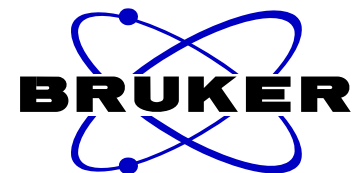


NAME cy-186ap
EXPNO 3
PROCNO 1
Date_ 20170920
Time 10.00
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

— 26.459

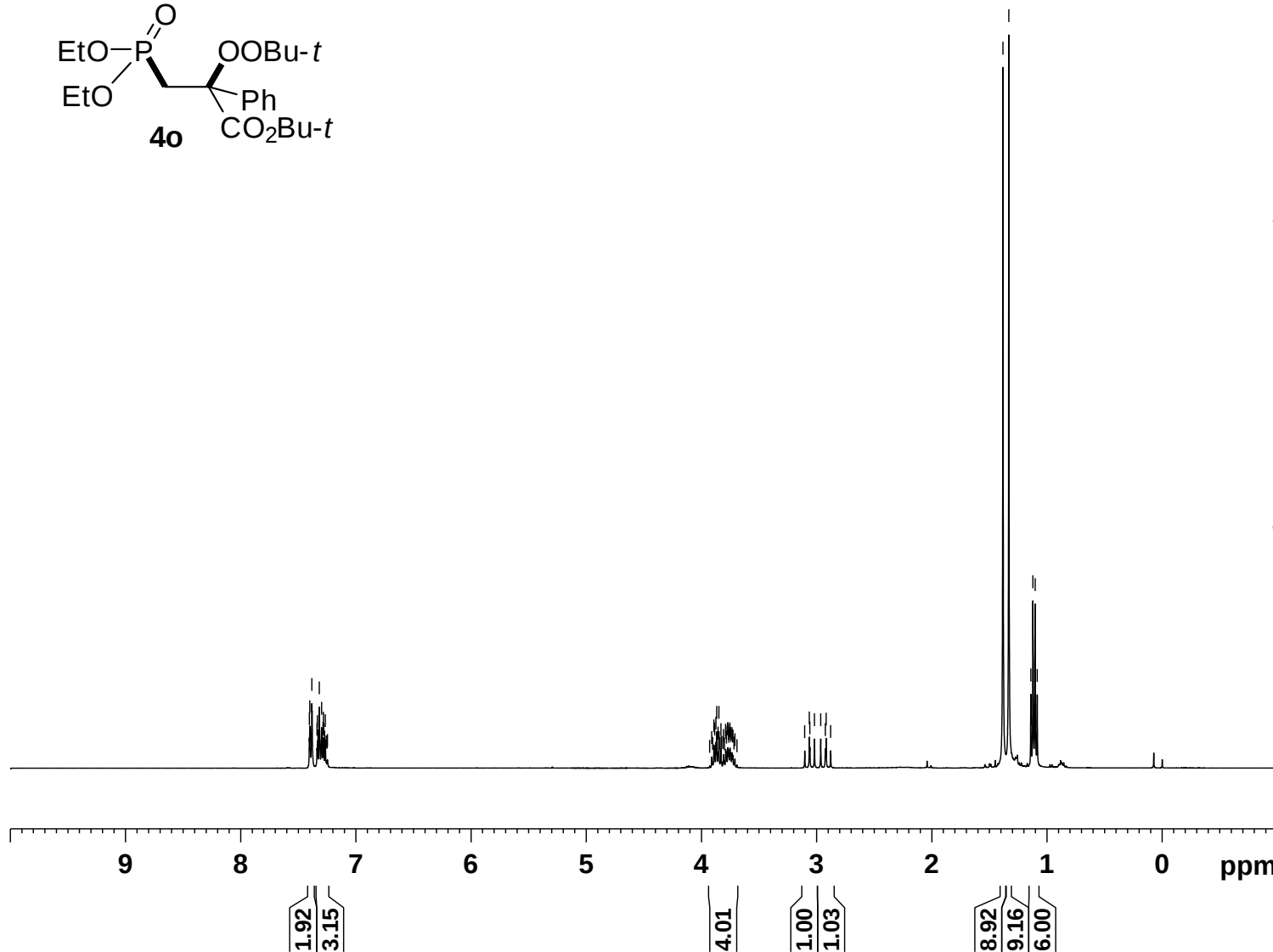
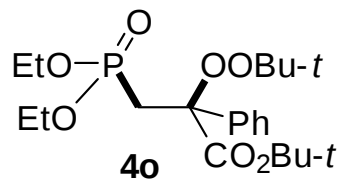


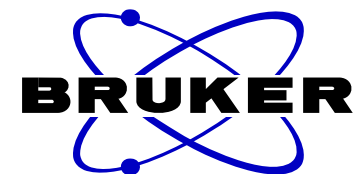


NAME cy-208p-20171019
 EXPNO 1
 PROCNO 1
 Date_ 20171019
 Time 21.26
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 57
 DW 78.200 usec
 DE 6.50 usec
 TE 294.6 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1299958 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

7.404
7.401
7.383
7.338
7.335
7.330
7.317
7.298
7.286
7.283
7.279
7.272
7.265
7.258
7.250
7.247
3.929
3.911
3.903
3.892
3.885
3.874
3.867
3.856
3.849
3.838
3.831
3.826
3.813
3.808
3.800
3.790
3.787
3.783
3.773
3.769
3.765
3.762
3.755
3.752
3.748
3.744
3.735
3.730
3.728
3.717
3.710
3.692
3.103
3.064
3.059
3.019
2.965
2.925
2.918
2.878
1.383
1.332
1.141
1.123
1.103
1.085

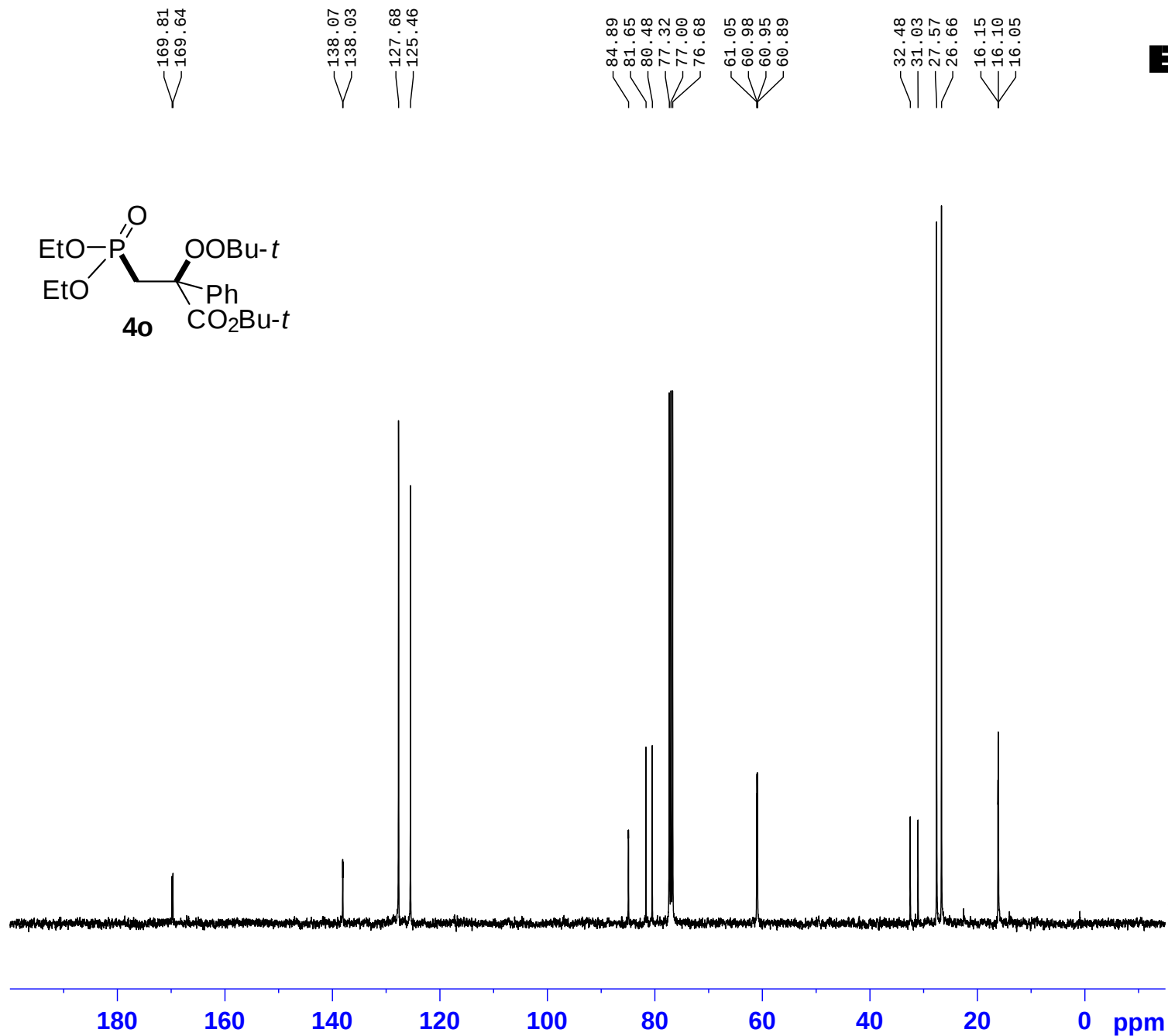


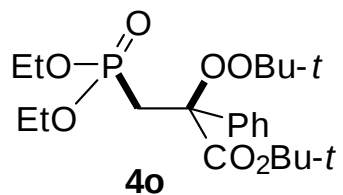


NAME cy-208p-20171019
 EXPNO 2
 PROCNO 1
 Date_ 20171019
 Time 21.29
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 96
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.2 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

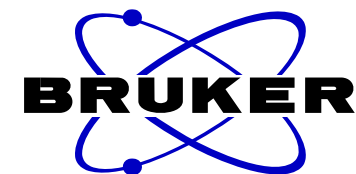
===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127772 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40



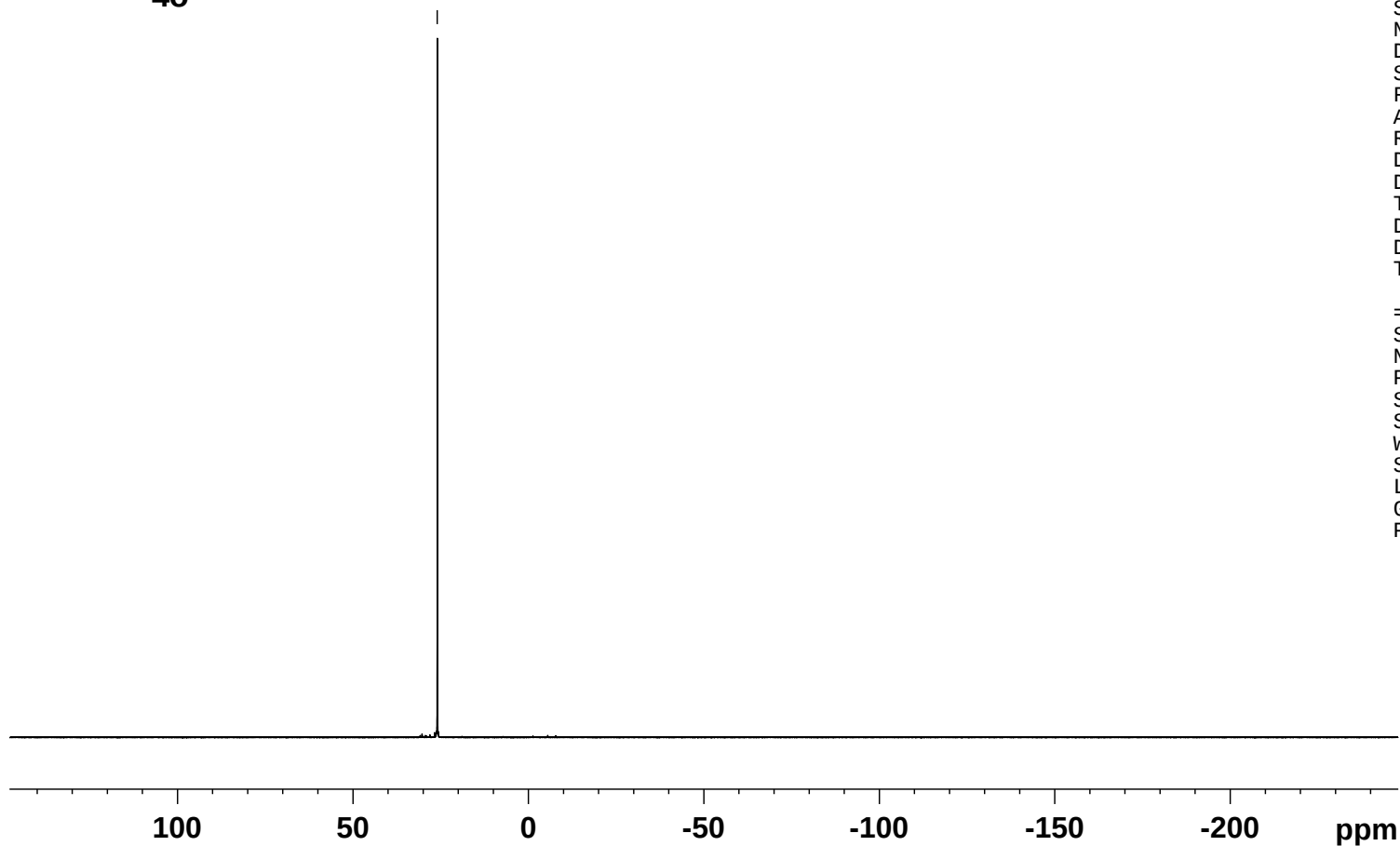


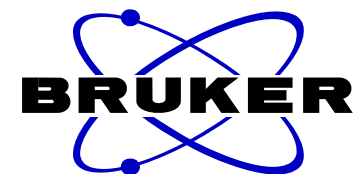
— 25.984



NAME cy-208p
 EXPNO 4
 PROCNO 1
 Date_ 20171024
 Time 14.44
 INSTRUM spect
 PROBHD 5 mm PABBO BB/
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 32
 DS 4
 SWH 96153.844 Hz
 FIDRES 1.467191 Hz
 AQ 0.3408372 sec
 RG 190.02
 DW 5.200 usec
 DE 6.50 usec
 TE 296.5 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 1

===== CHANNEL f1 =====
 SF01 242.9411216 MHz
 NUC1 31P
 P1 11.90 usec
 SI 32768
 SF 242.9532693 MHz
 WDW EM
 SSB 0
 LB 1.00 Hz
 GB 0
 PC 1.40

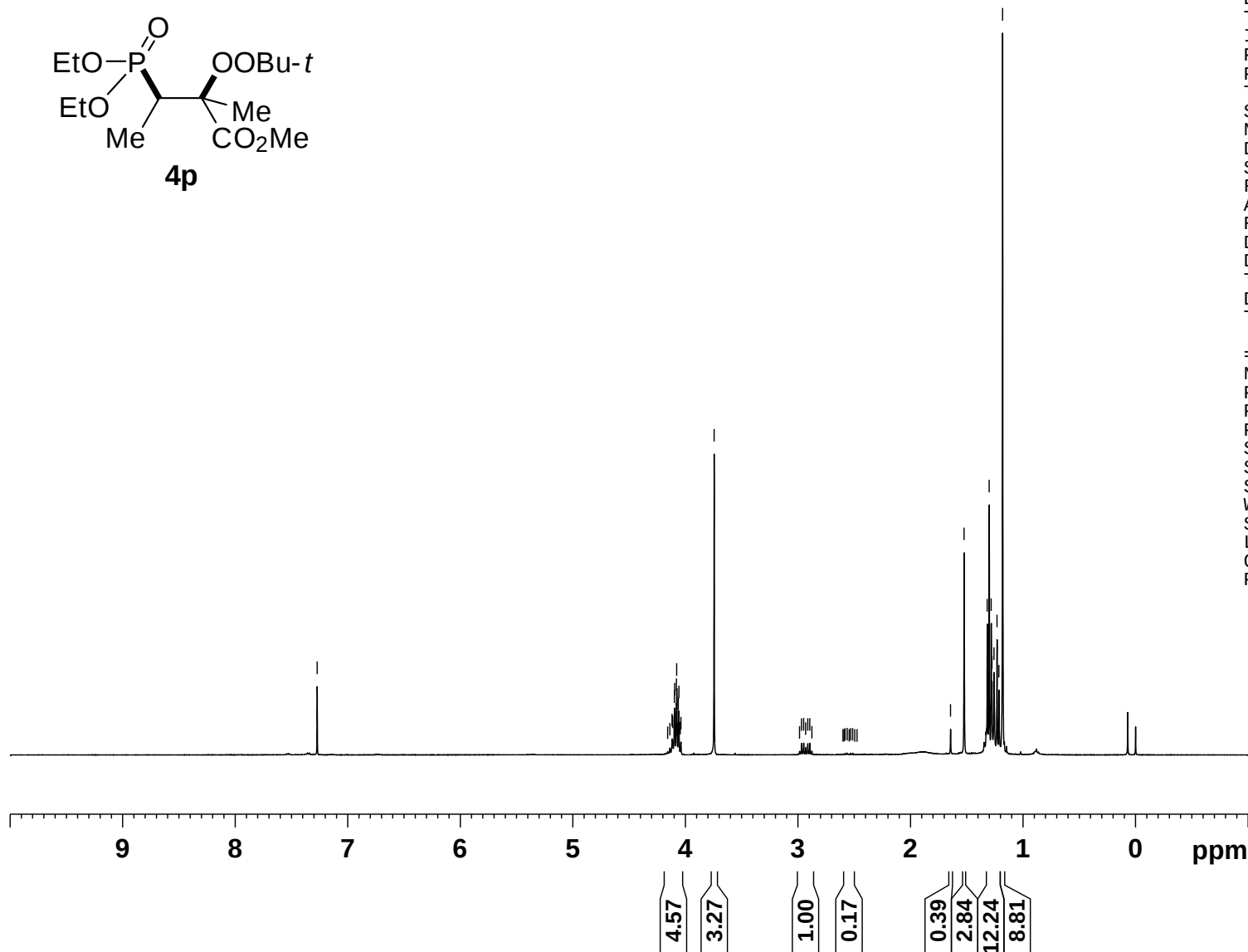
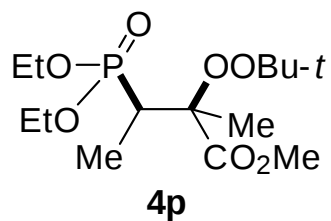


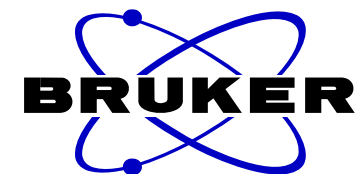


NAME cy-1-24-1-1-20160918
 EXPNO 1
 PROCNO 1
 Date_ 20160918
 Time 16.29
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDC13
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 203
 DW 78.200 usec
 DE 6.50 usec
 TE 294.6 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1300050 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

4.158
4.138
4.118
4.113
4.098
4.095
4.080
4.077
4.063
4.058
4.045
4.040
3.745
2.986
2.968
2.949
2.931
2.913
2.895
2.877
2.600
2.591
2.582
2.563
2.544
2.532
2.513
2.495
2.475
1.644
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1.300
1.283
1.276
1.258
1.231
1.214
1.181

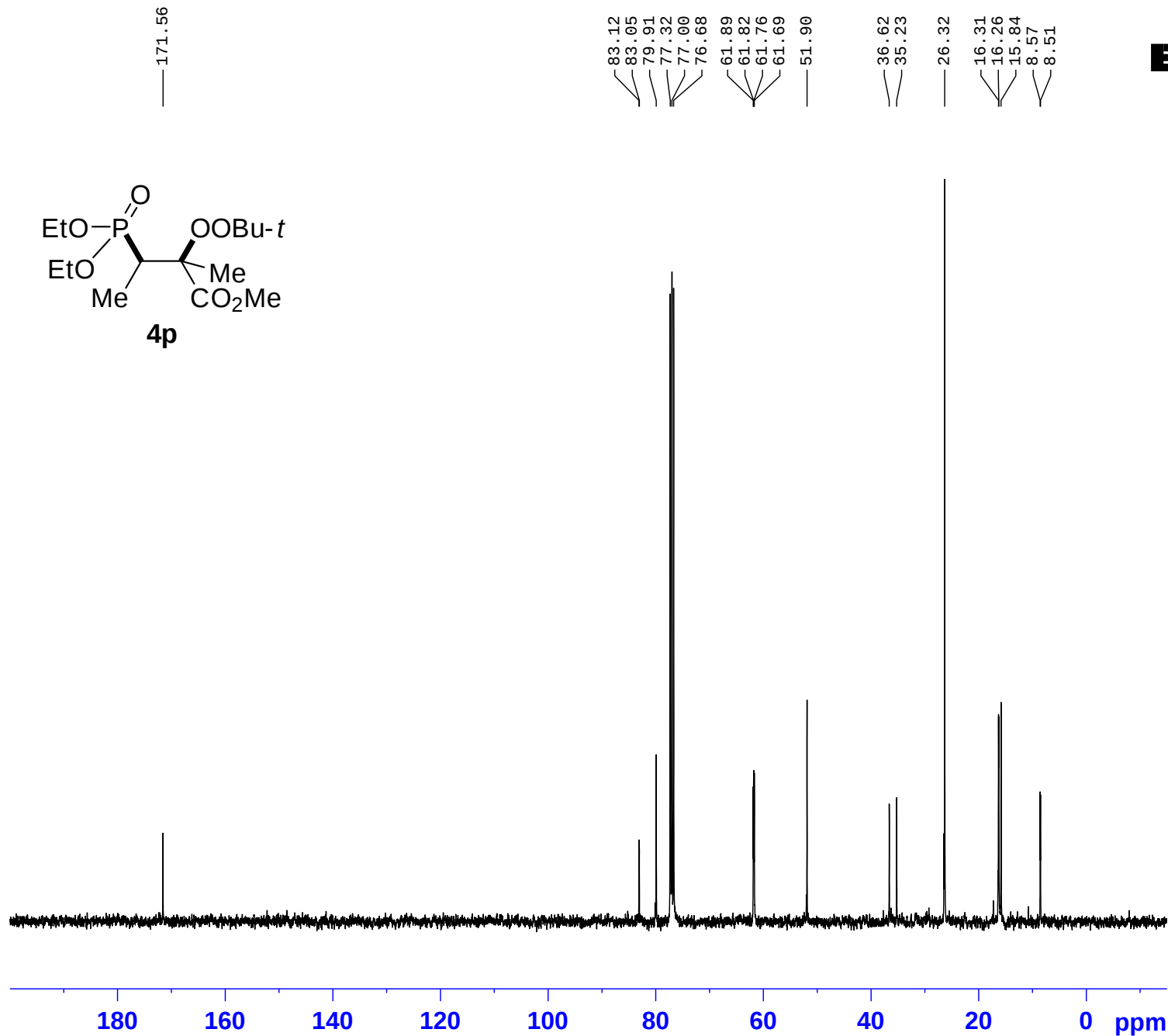


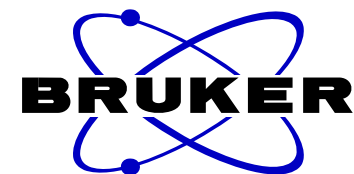


NAME cy-108b1-20170428
 EXPNO 2
 PROCNO 1
 Date_ 20170428
 Time 17.02
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 192
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 294.0 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127742 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

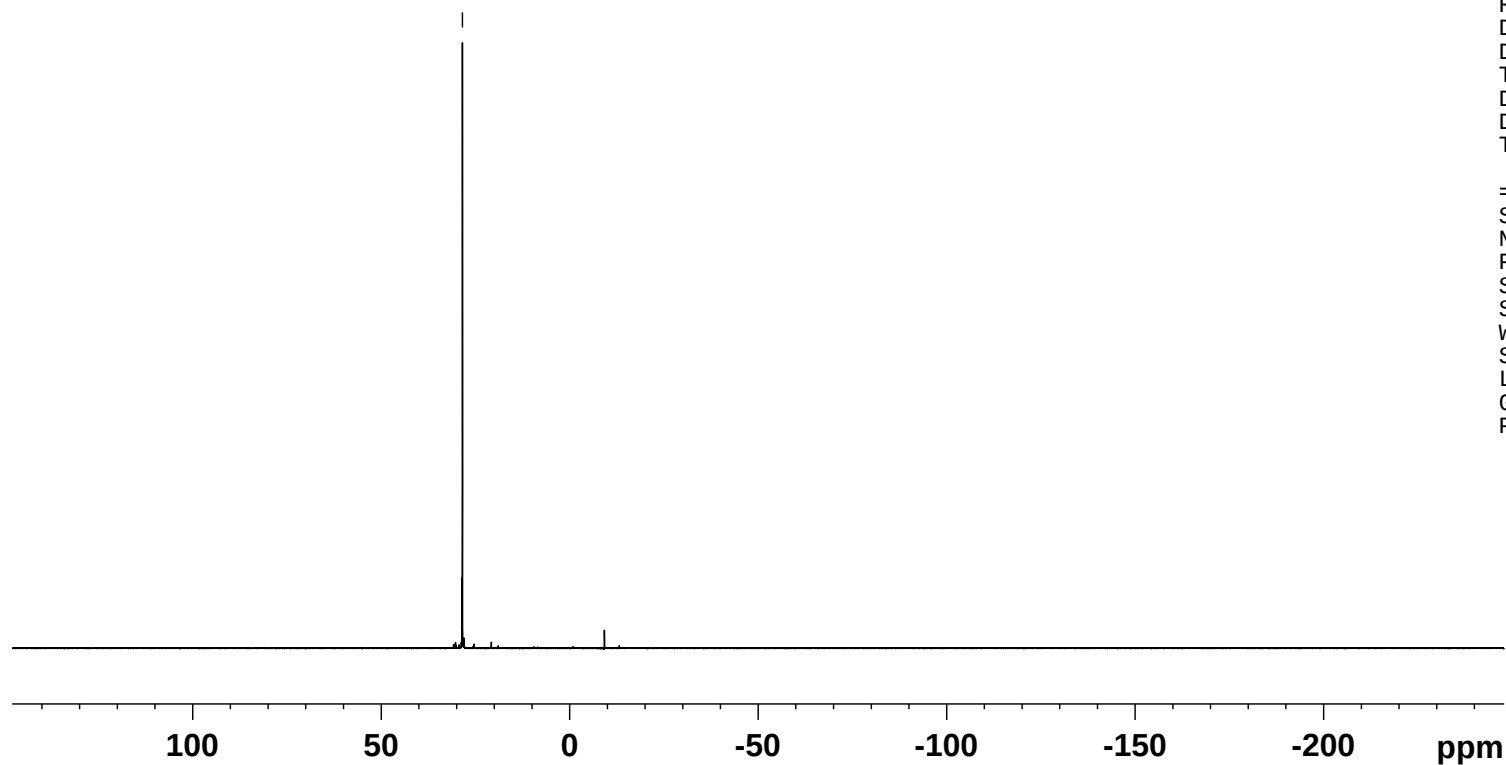
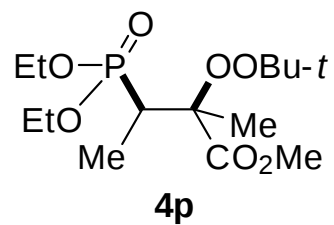




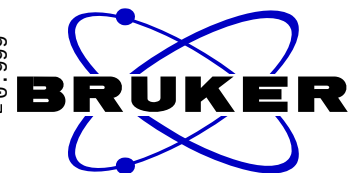
NAME cy-108b1
EXPNO 3
PROCNO 1
Date_ 20170428
Time 10.00
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 294.4 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532692 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40

— 28.469

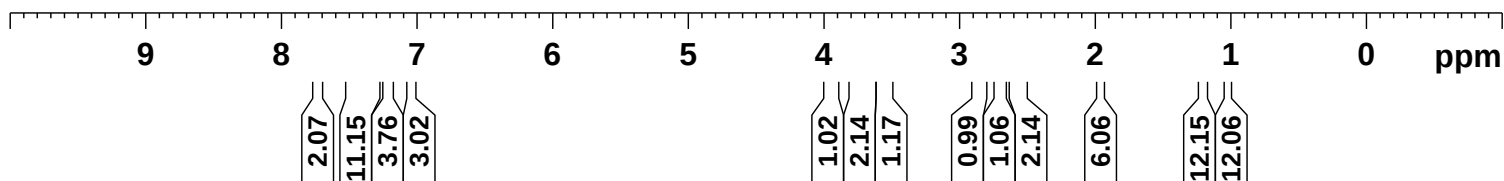
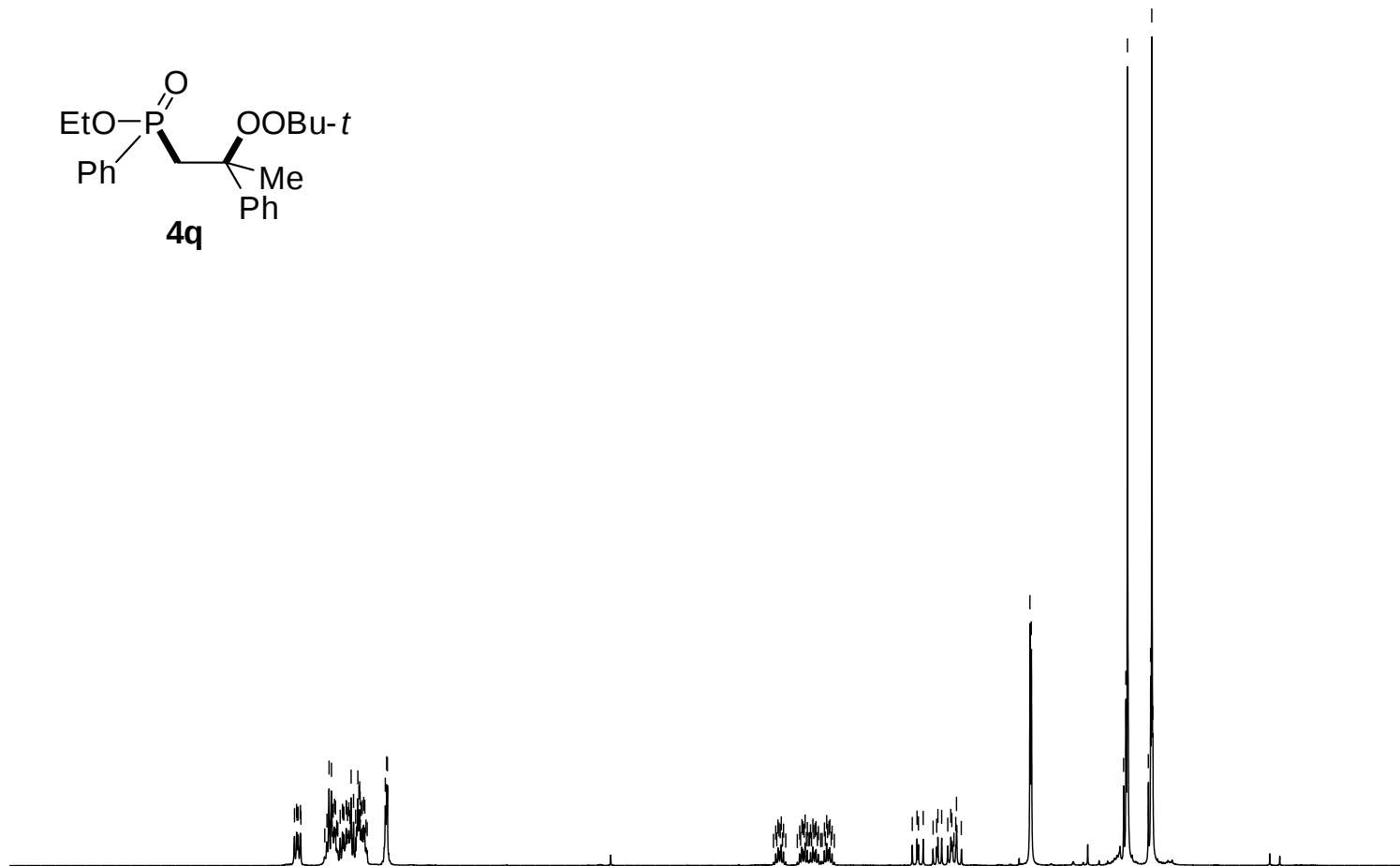
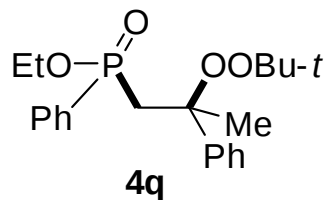


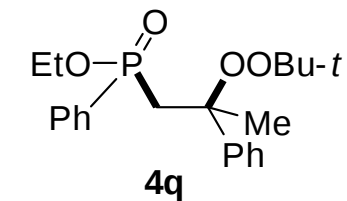
7.757
7.740
7.736
7.727
7.710
7.706
7.500
7.484
7.465
7.452
7.441
7.433
7.424
7.396
7.379
7.376
7.367
7.350
7.346
7.339
7.329
7.320
7.311
7.291
7.276
7.257
7.249
7.244
7.240
7.232
7.222
7.212
7.204
7.193
7.041
7.031
7.025
3.950
3.924
3.762
3.737
3.675
3.567
3.542
2.892
2.854
2.844
2.806
2.729
2.700
2.691
2.662
2.613
2.589
2.581
2.551
2.544
1.966
1.956
1.228
1.211
1.198
1.034
1.016
1.007
0.999



NAME cy-102p-20170328
EXPNO 1
PROCNO 1
Date_ 20170328
Time 17.50
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 57
DW 78.200 usec
DE 6.50 usec
TE 292.5 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300033 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

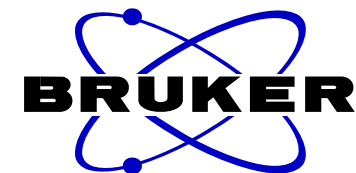




144.39
144.33
142.08
131.76
131.47
131.37
131.26
128.33
128.21
127.99
127.87
127.69
127.47
127.25
127.07
126.21
125.97

81.86
81.44
81.41
79.05
79.00
77.32
77.00
76.68
59.94
59.88
59.84
59.77

42.11
41.67
41.13
40.69
26.55
26.34
23.41
23.34
16.28
16.22
16.04
15.97

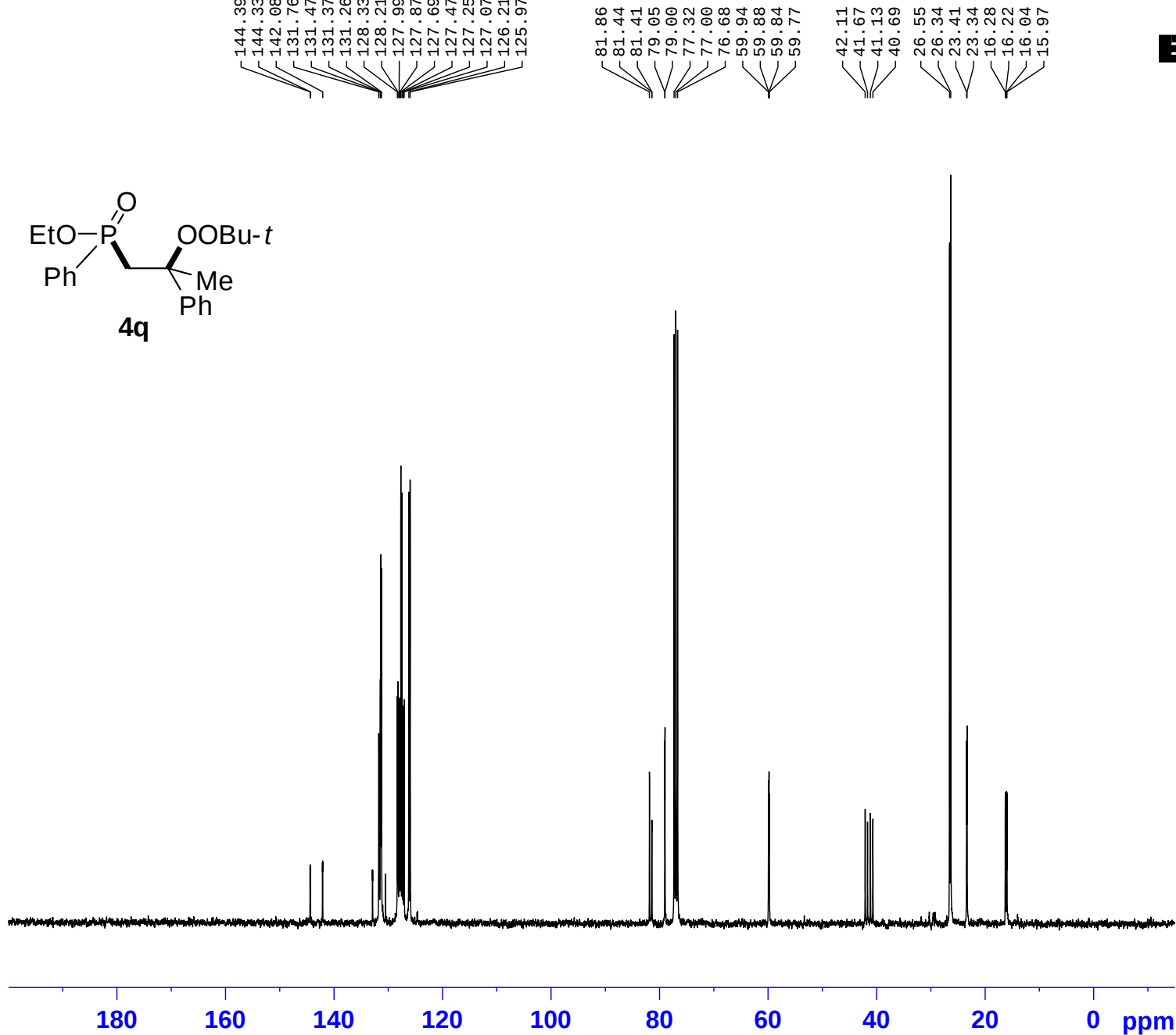


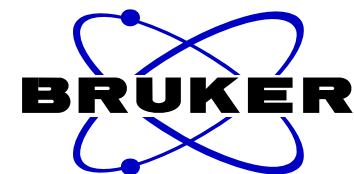
NAME cy-102p-20170328

EXPNO 2
PROCNO 1
Date_ 20170328
Time 17.53
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 424
DS 4
SWH 25252.525 Hz
FIDRES 0.385323 Hz
AQ 1.2976629 sec
RG 2050
DW 19.800 usec
DE 8.00 usec
TE 293.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 10

===== CHANNEL f1 =====
NUC1 13C
P1 13.50 usec
PL1 3.00 dB
PL1W 43.93649673 W
SF01 100.6238364 MHz

===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 1.80 dB
PL12 17.19 dB
PL13 18.46 dB
PL2W 8.92857742 W
PL12W 0.25809658 W
PL13W 0.19265592 W
SF02 400.1316005 MHz
SI 32768
SF 100.6127809 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40

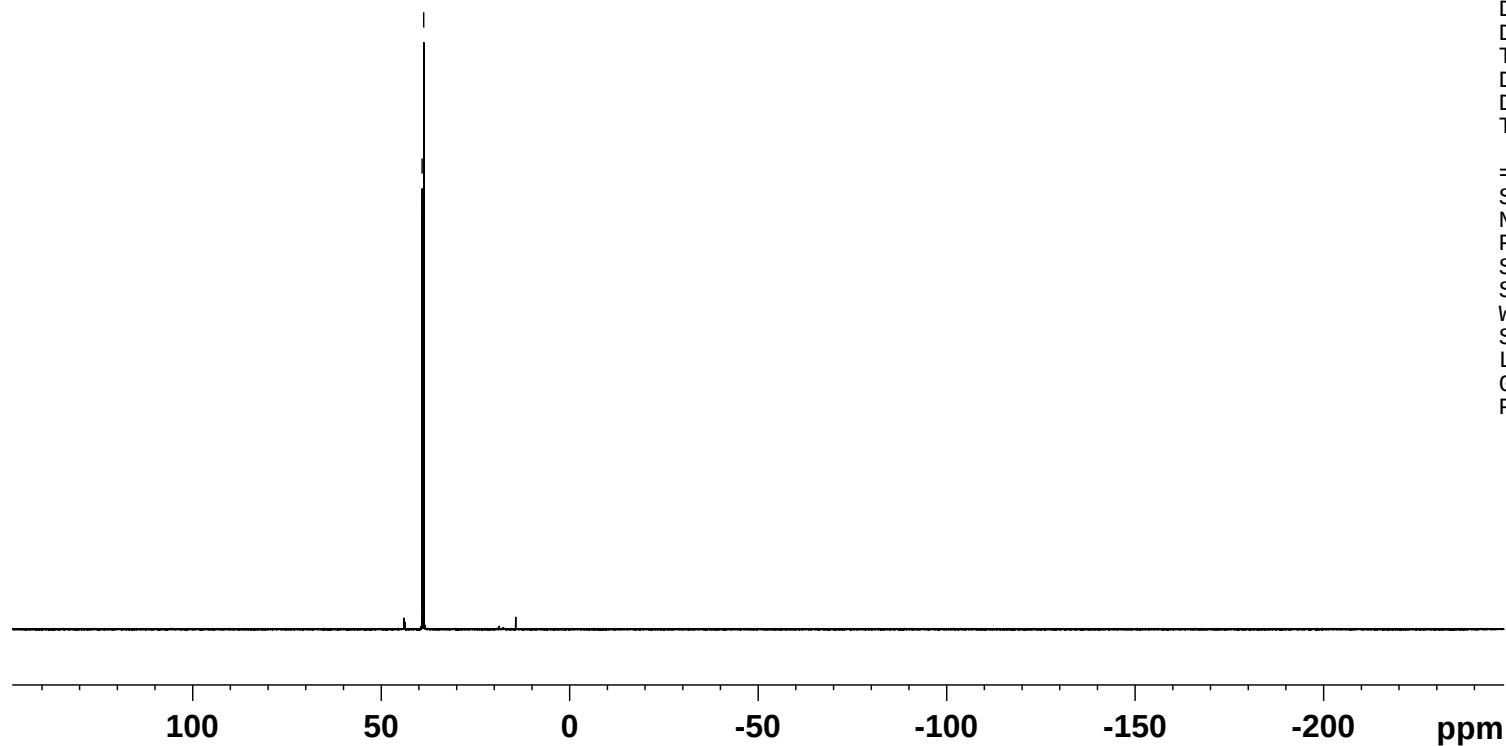
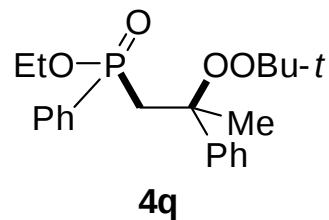




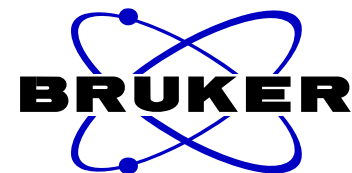
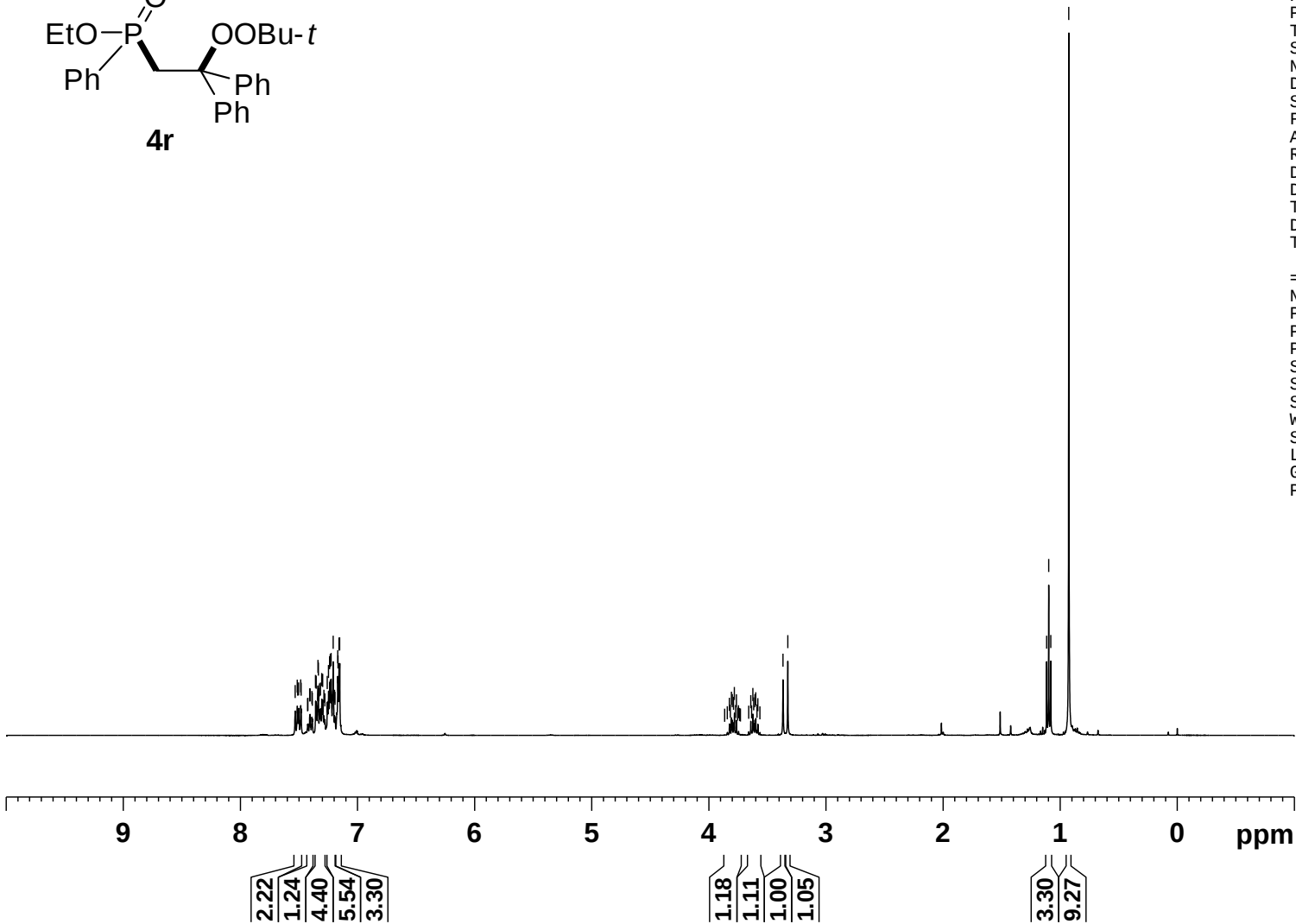
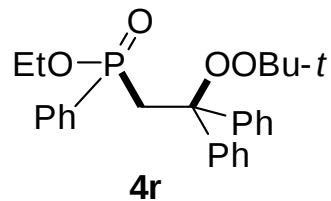
NAME cy-102p
EXPNO 3
PROCNO 1
Date_ 20170329
Time 9.51
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

39.144
38.706

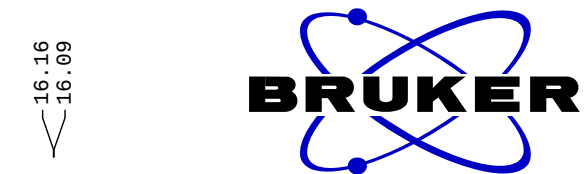


7.482
7.427
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7.338
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7.316
7.306
7.297
7.287
7.279
7.259
7.248
7.238
7.232
7.226
7.208
7.196
7.193
7.170
7.167
7.159
7.152
3.865
3.842
3.825
3.817
3.807
3.800
3.789
3.782
3.772
3.764
3.756
3.747
3.738
3.730
3.660
3.642
3.635
3.625
3.617
3.607
3.599
3.589
3.582
3.564
3.367
3.326
1.116
1.098
1.081
0.926



NAME cy-104b1-again-20170330
EXPNO 1
PROCNO 1
Date_ 20170330
Time 17.05
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 71.8
DW 78.200 usec
DE 6.50 usec
TE 292.6 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300101 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



cy-104b1-again-20170330

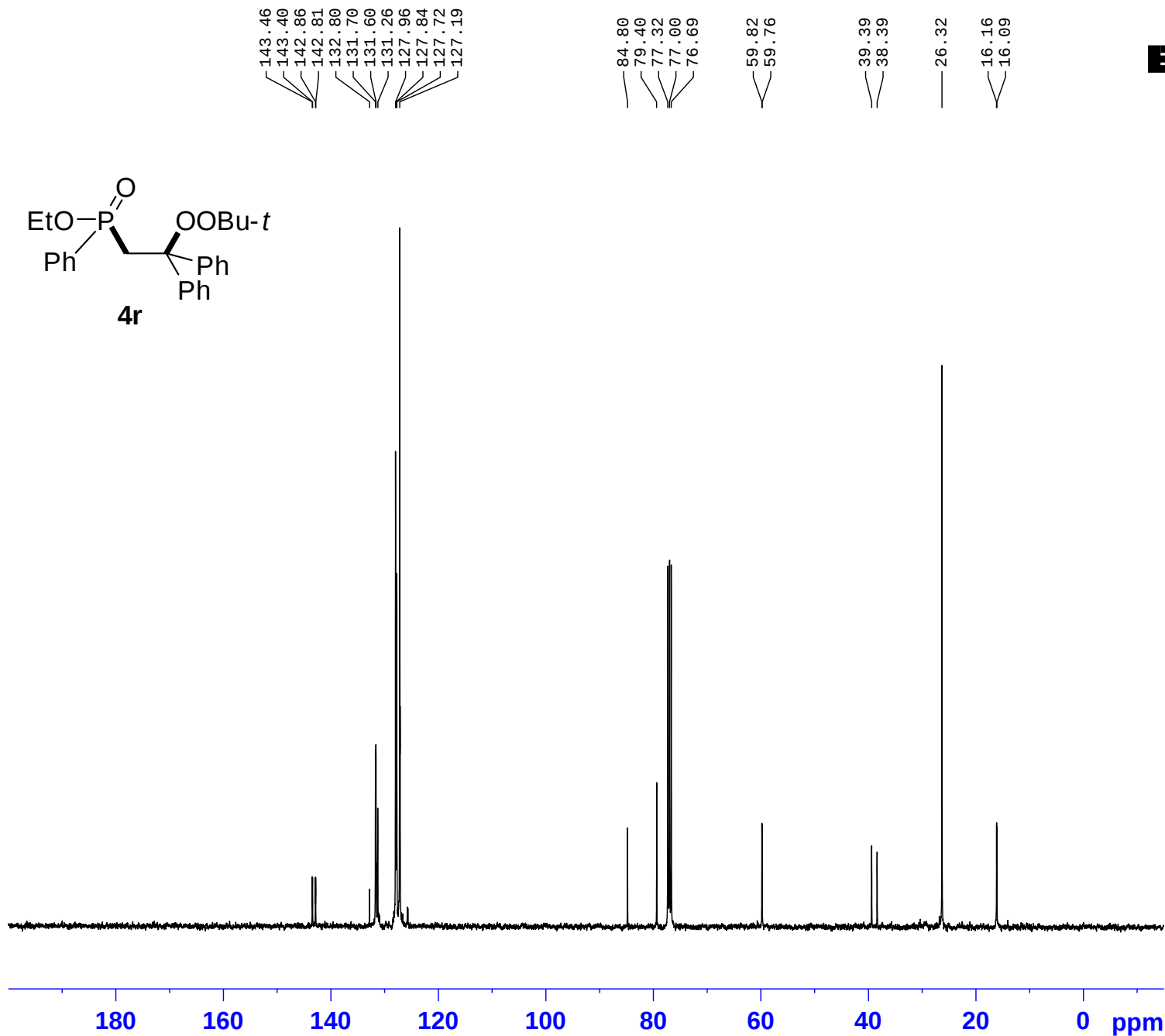
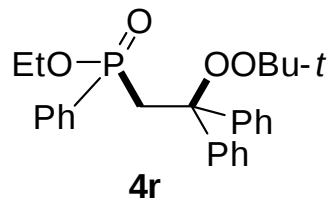
NAME	cy-104b1-again-20170330
EXPNO	2
PROCNO	1
Date_	20170330
Time	17.09
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zgpg30
TD	65536
SOLVENT	CDC13
NS	256
DS	4
SWH	25252.525 Hz
FIDRES	0.385323 Hz
AQ	1.2976629 sec
RG	2050
DW	19.800 usec
DE	8.00 usec
TE	293.5 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	10

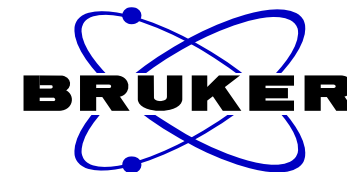
===== CHANNEL f1 =====

NUC1	13C
P1	13.50 usec
PL1	3.00 dB
PL1W	43.93649673 W
SF01	100.6238364 MHz

===== CHANNEL f2 =====

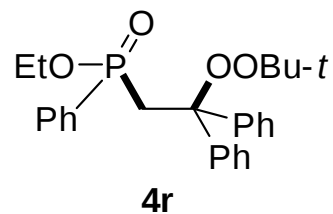
CPDPRG2	waltz16
NUC2	1H
PCPD2	80.00 usec
PL2	1.80 dB
PL12	17.19 dB
PL13	18.46 dB
PL2W	8.92857742 W
PL12W	0.25809658 W
PL13W	0.19265592 W
SF02	400.1316005 MHz
SI	32768
SF	100.6127796 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40



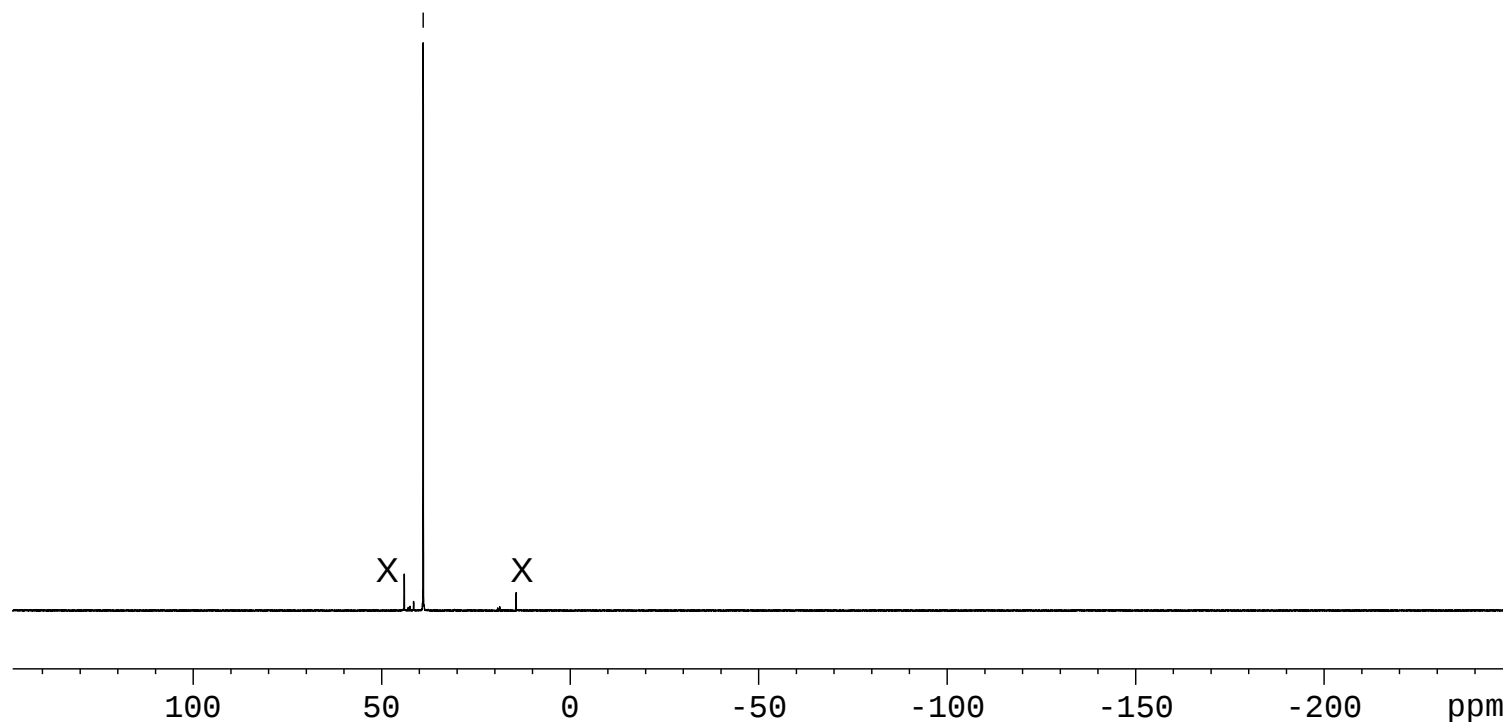


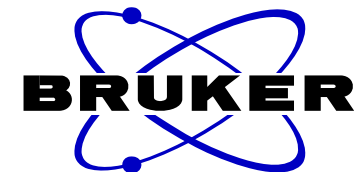
NAME cy-104b1
EXPNO 3
PROCNO 1
Date_ 20170426
Time 9.42
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 40
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 294.6 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40



— 38.987

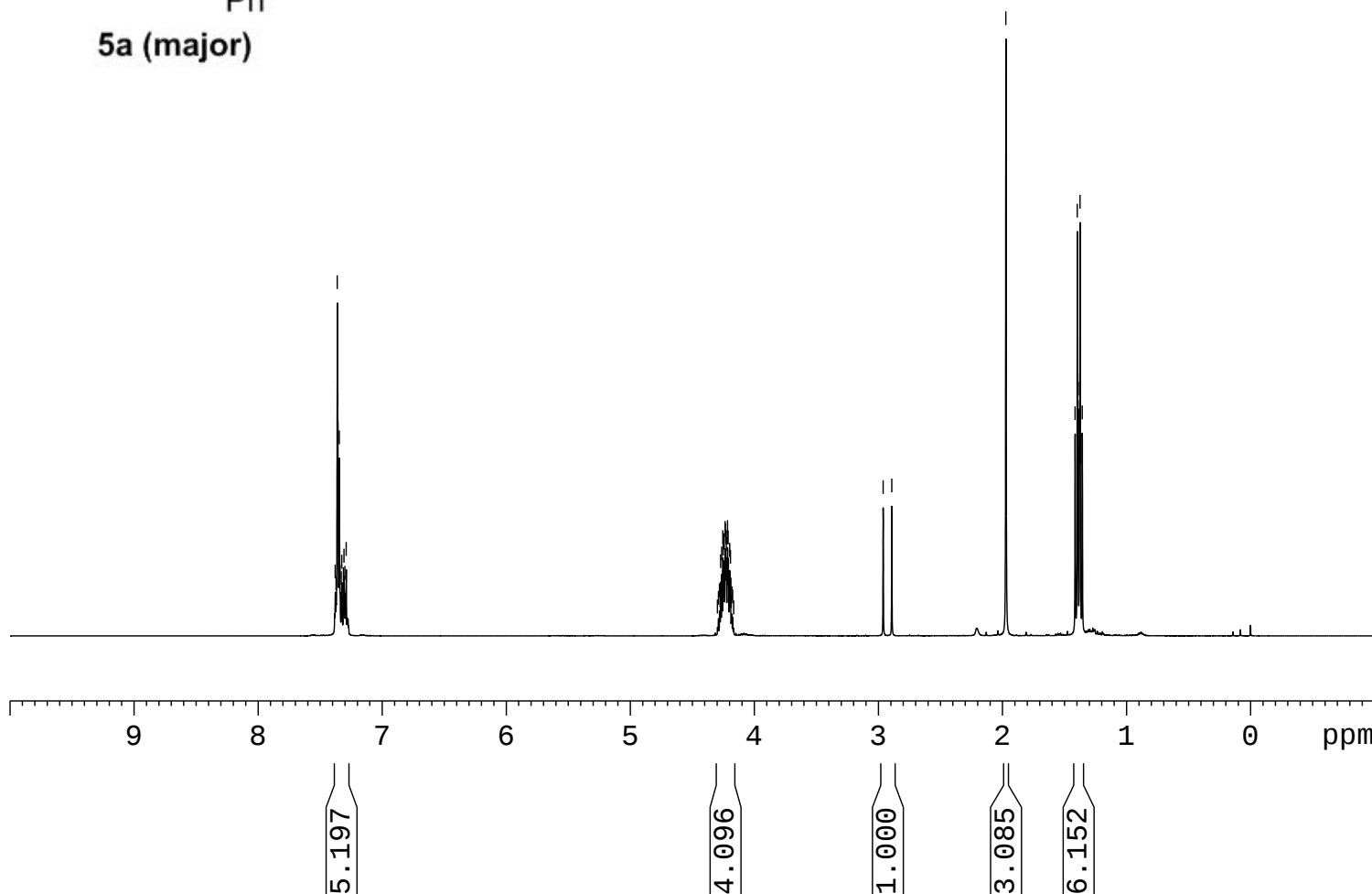


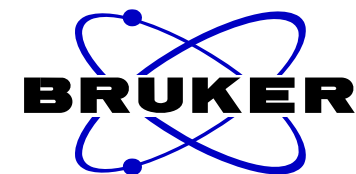
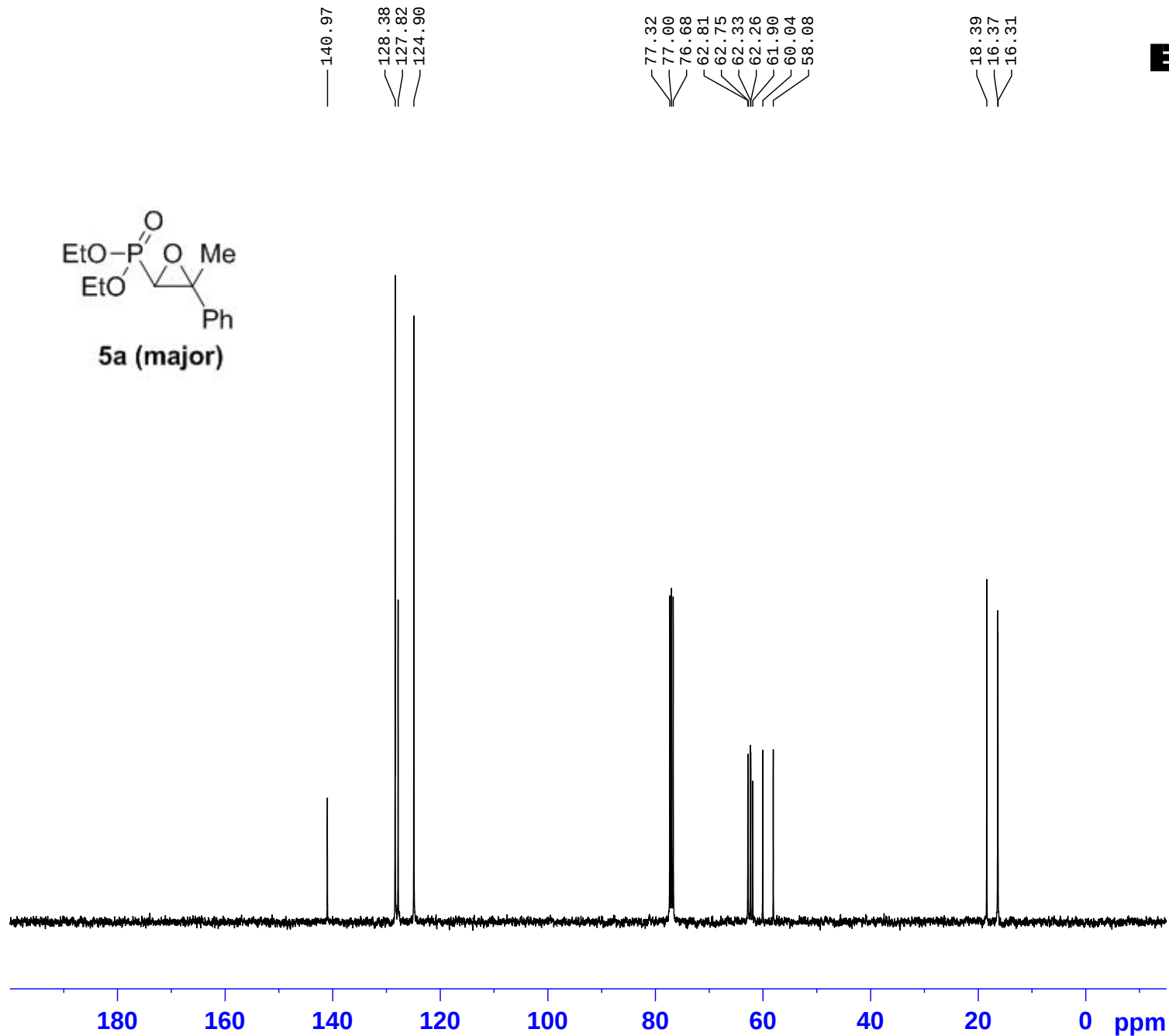
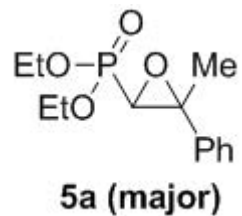


NAME cy-213-1p-20171028
 EXPNO 1
 PROCNO 1
 Date_ 20171028
 Time 20.34
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 64
 DW 78.200 usec
 DE 6.50 usec
 TE 294.6 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1299982 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

7.371
 7.361
 7.357
 7.345
 7.339
 7.329
 7.324
 7.312
 7.307
 7.300
 7.289
 4.296
 4.289
 4.280
 4.276
 4.271
 4.262
 4.253
 4.250
 4.245
 4.242
 4.236
 4.233
 4.229
 4.224
 4.218
 4.216
 4.211
 4.198
 4.192
 4.186
 4.180
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 1.374
 1.356

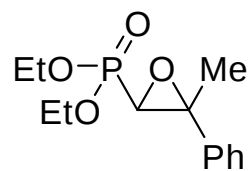




NAME cy-213-1p-20171028
 EXPNO 2
 PROCNO 1
 Date_ 20171028
 Time 20.41
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 80
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.8 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

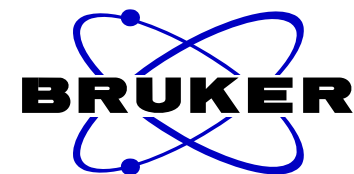
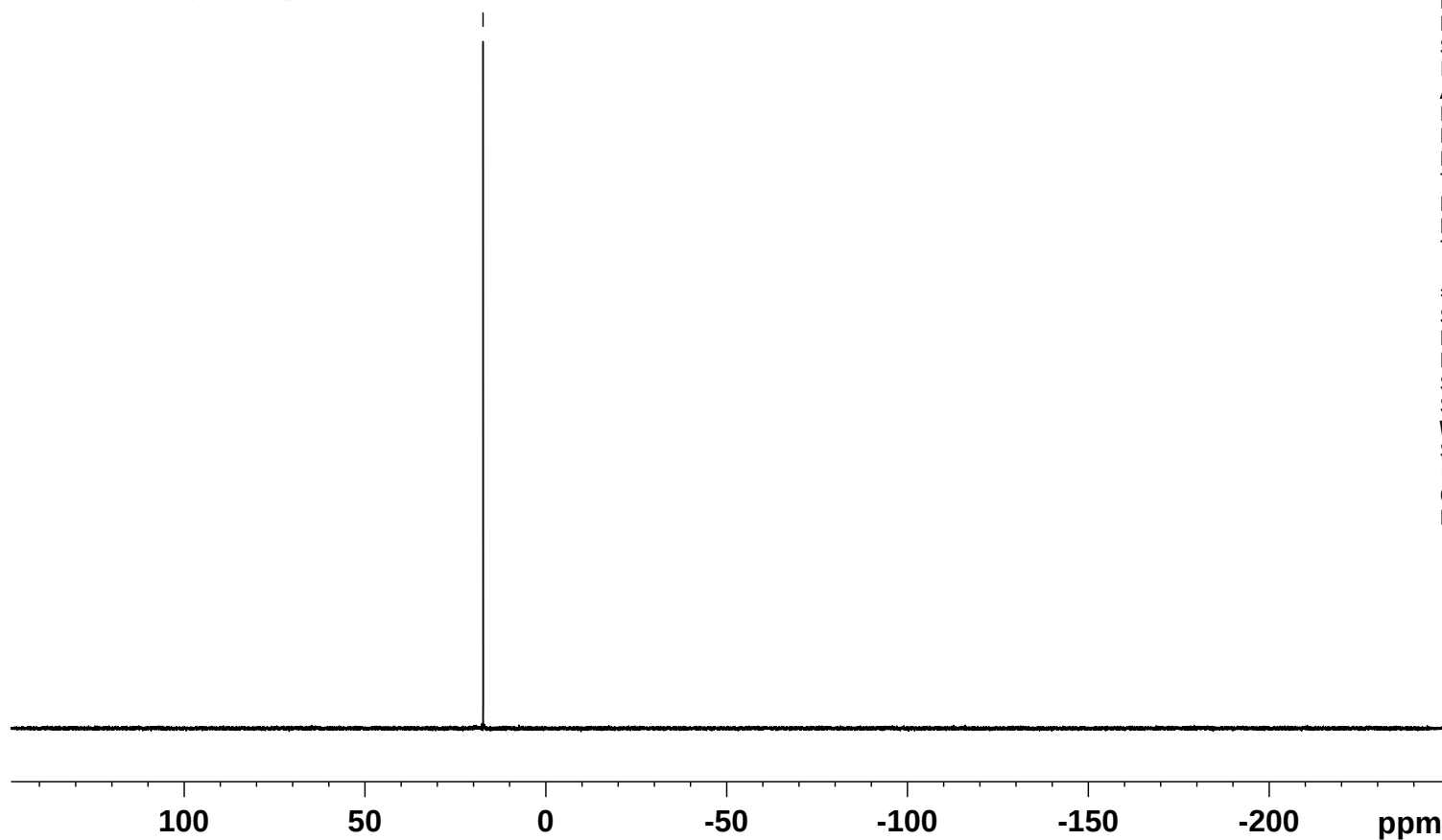
===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127818 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40



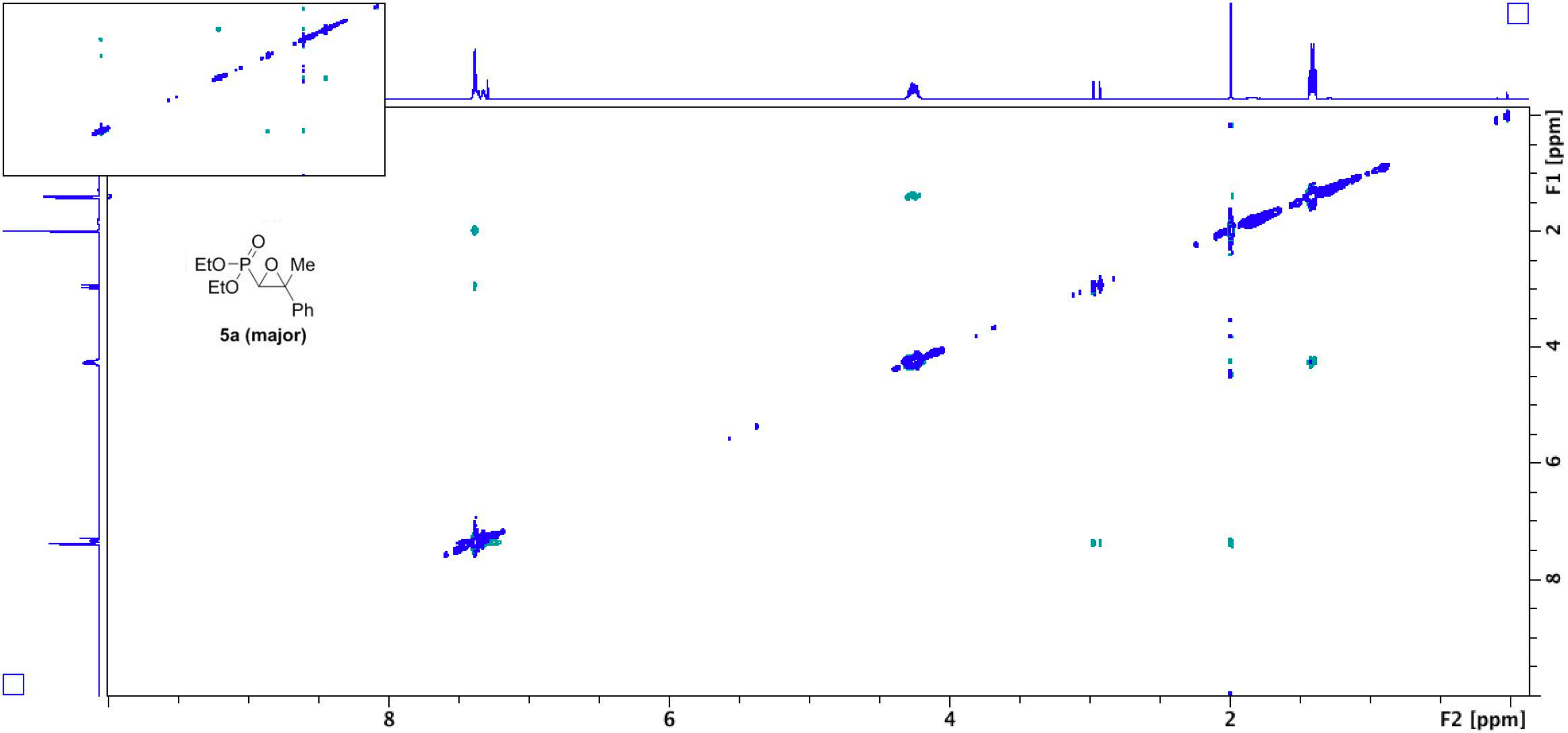
5a (major)

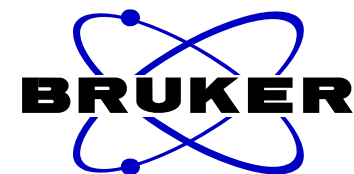
17.341



NAME cy-68a-p1-p
 EXPNO 3
 PROCNO 1
 Date_ 20170109
 Time 14.00
 INSTRUM spect
 PROBHD 5 mm PABBO BB/
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 16
 DS 4
 SWH 96153.844 Hz
 FIDRES 1.467191 Hz
 AQ 0.3408372 sec
 RG 190.02
 DW 5.200 usec
 DE 6.50 usec
 TE 306.3 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 1

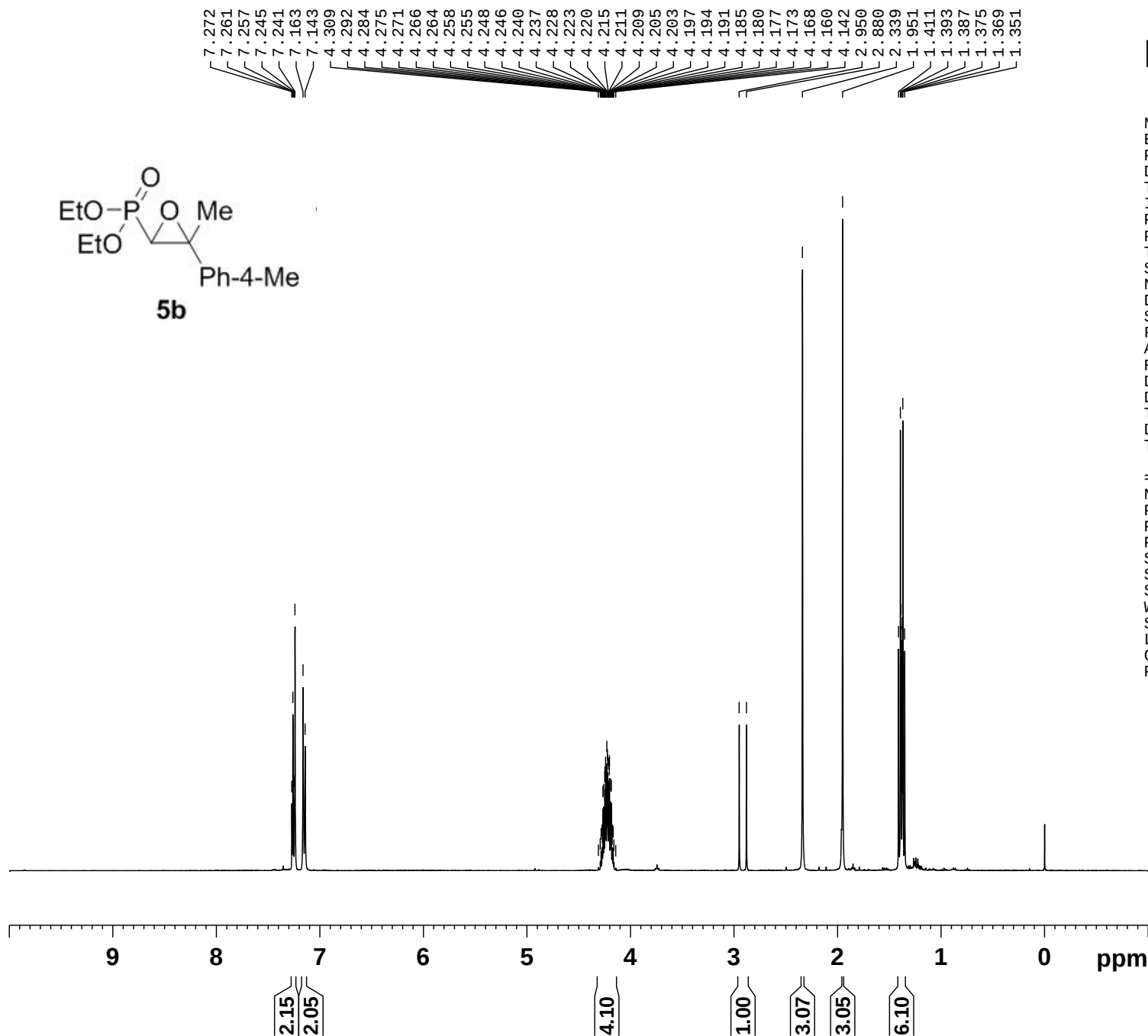
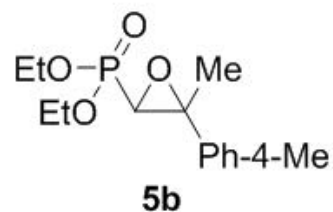
===== CHANNEL f1 =====
 SF01 242.9411216 MHz
 NUC1 31P
 P1 11.90 usec
 SI 32768
 SF 242.9532693 MHz
 WDW EM
 SSB 0
 LB 1.00 Hz
 GB 0
 PC 1.40

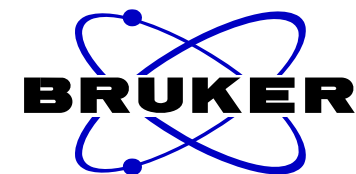




NAME cyj-89ap-pure-20171030
 EXPNO 1
 PROCNO 1
 Date_ 20171030
 Time 16.56
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 114
 DW 78.200 usec
 DE 6.50 usec
 TE 294.4 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1300052 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

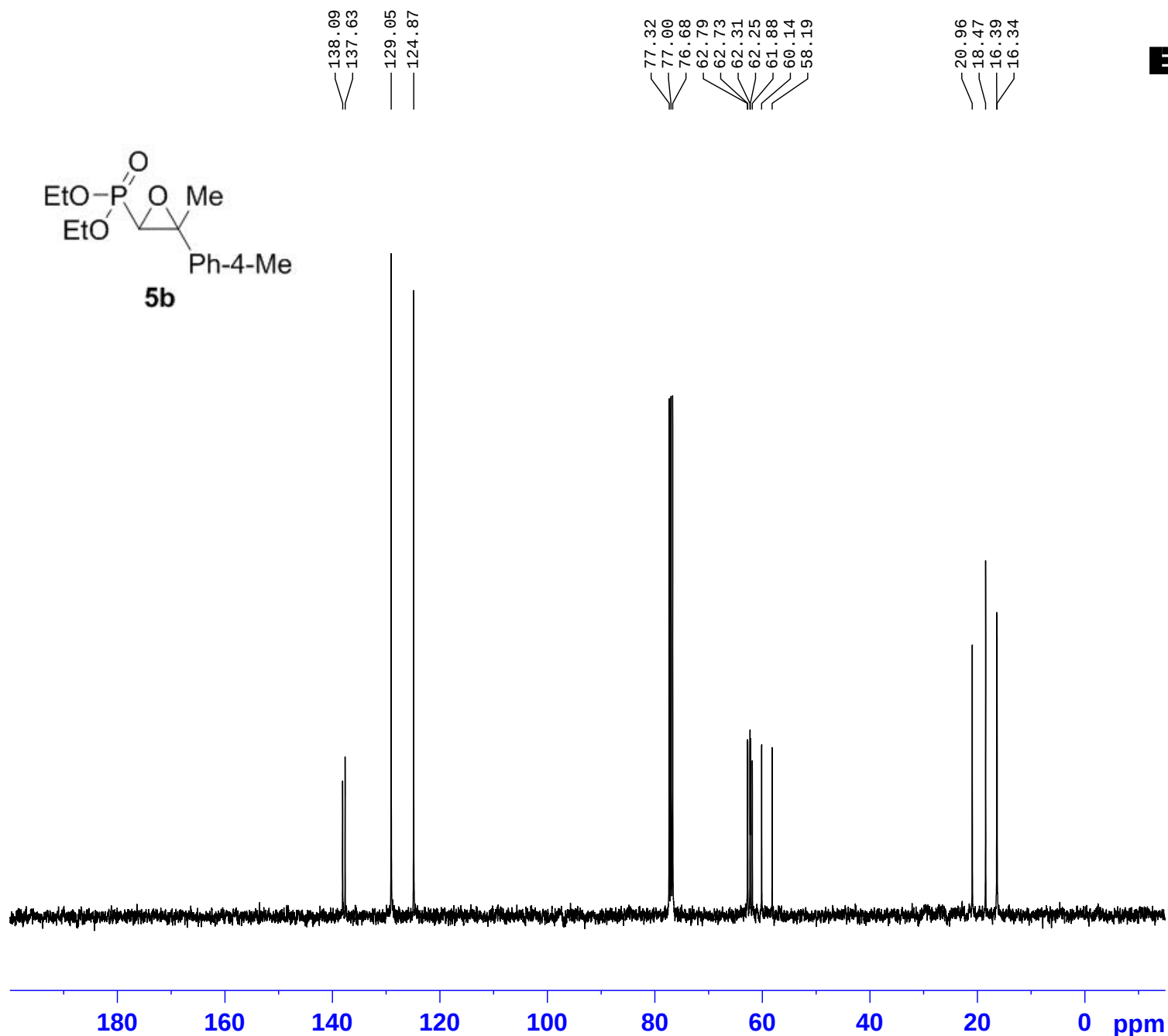


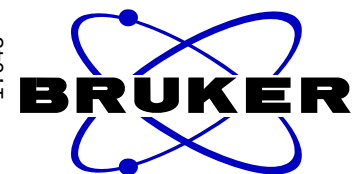


NAME cy-25-ir-20171119
 EXPNO 2
 PROCNO 1
 Date_ 20171119
 Time 11.12
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 56
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 298.2 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

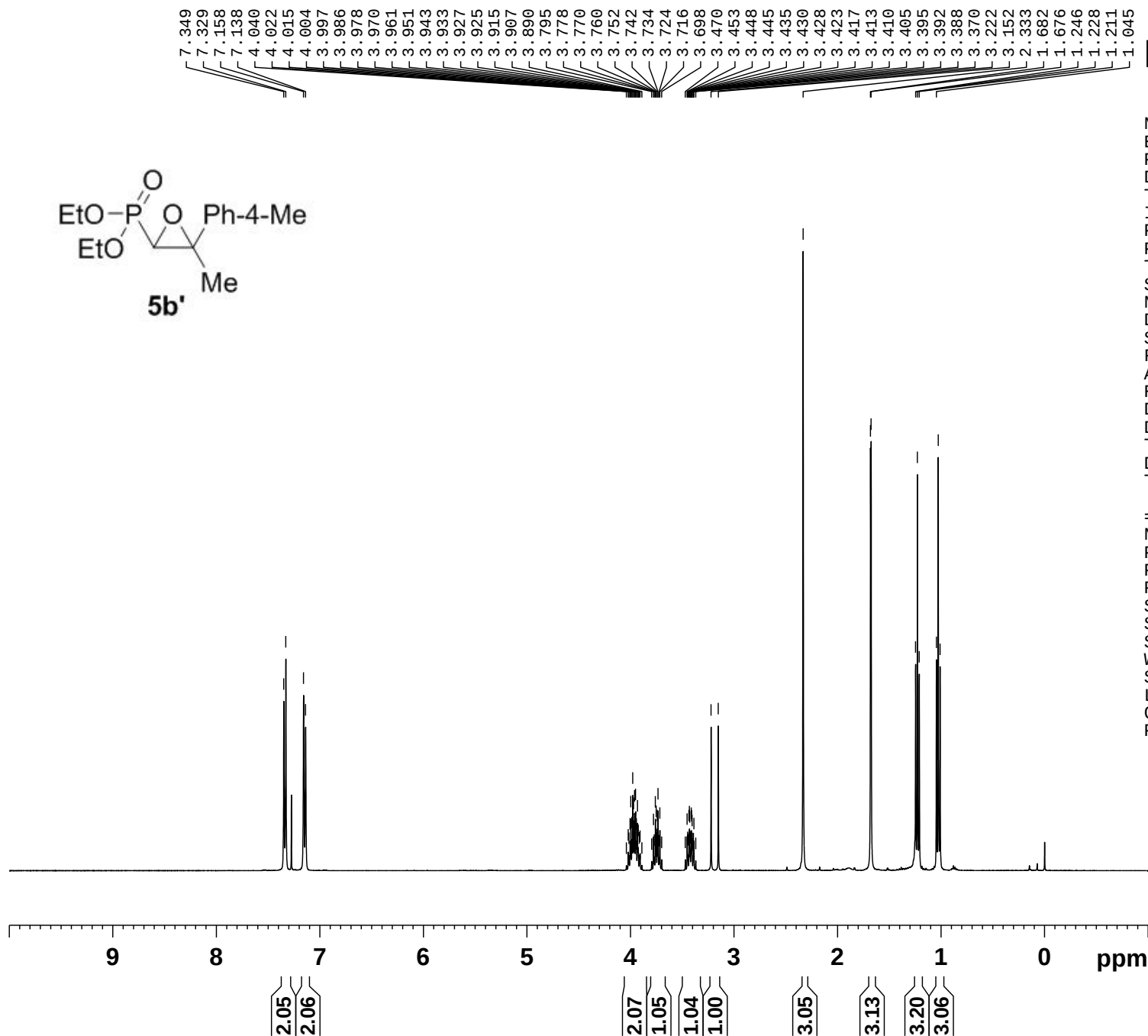
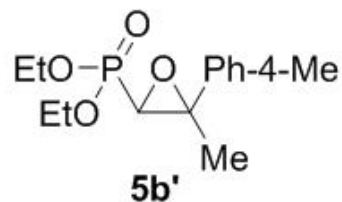
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127791 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

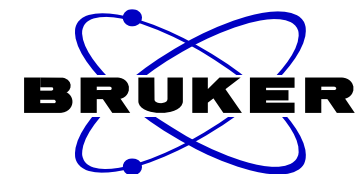




NAME cyj94-2p-20171101
 EXPNO 1
 PROCNO 1
 Date_ 20171101
 Time 18.15
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 128
 DW 78.200 usec
 DE 6.50 usec
 TE 294.4 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1300034 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

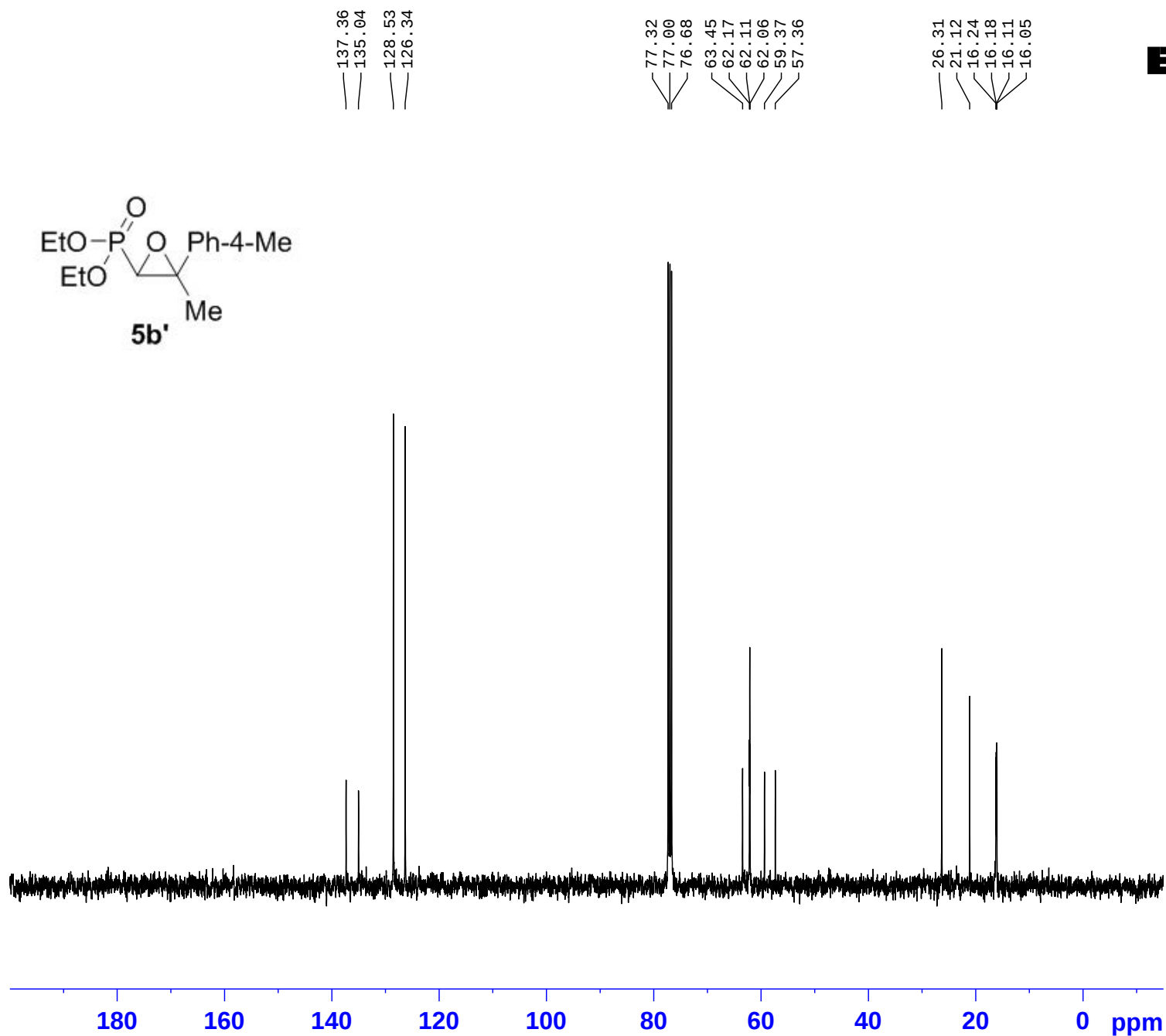


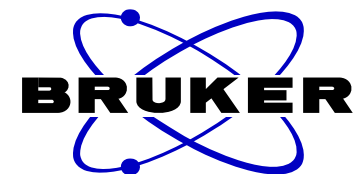


NAME cyj94-2p-20171101
 EXPNO 2
 PROCNO 1
 Date_ 20171101
 Time 18.19
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 40
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.4 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

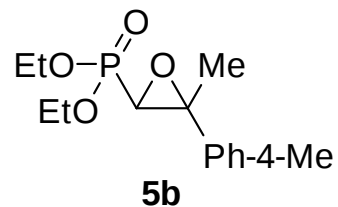
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127758 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40



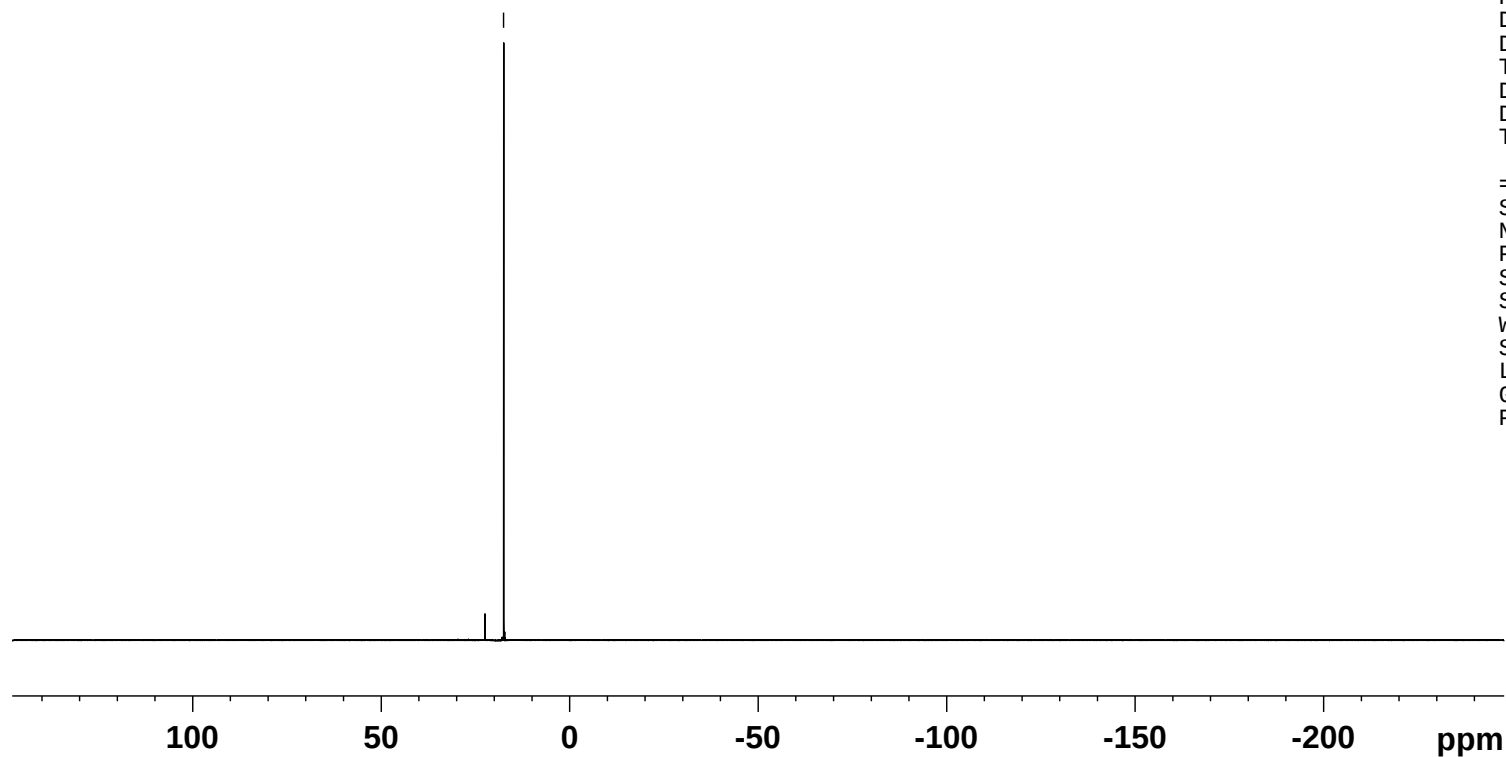


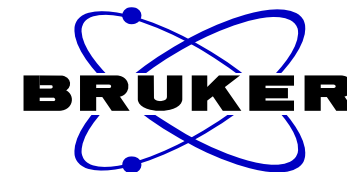
NAME cy-187a-1p
EXPNO 3
PROCNO 1
Date_ 20170920
Time 9.41
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



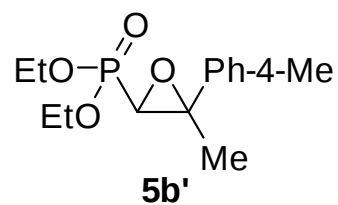
— 17.534



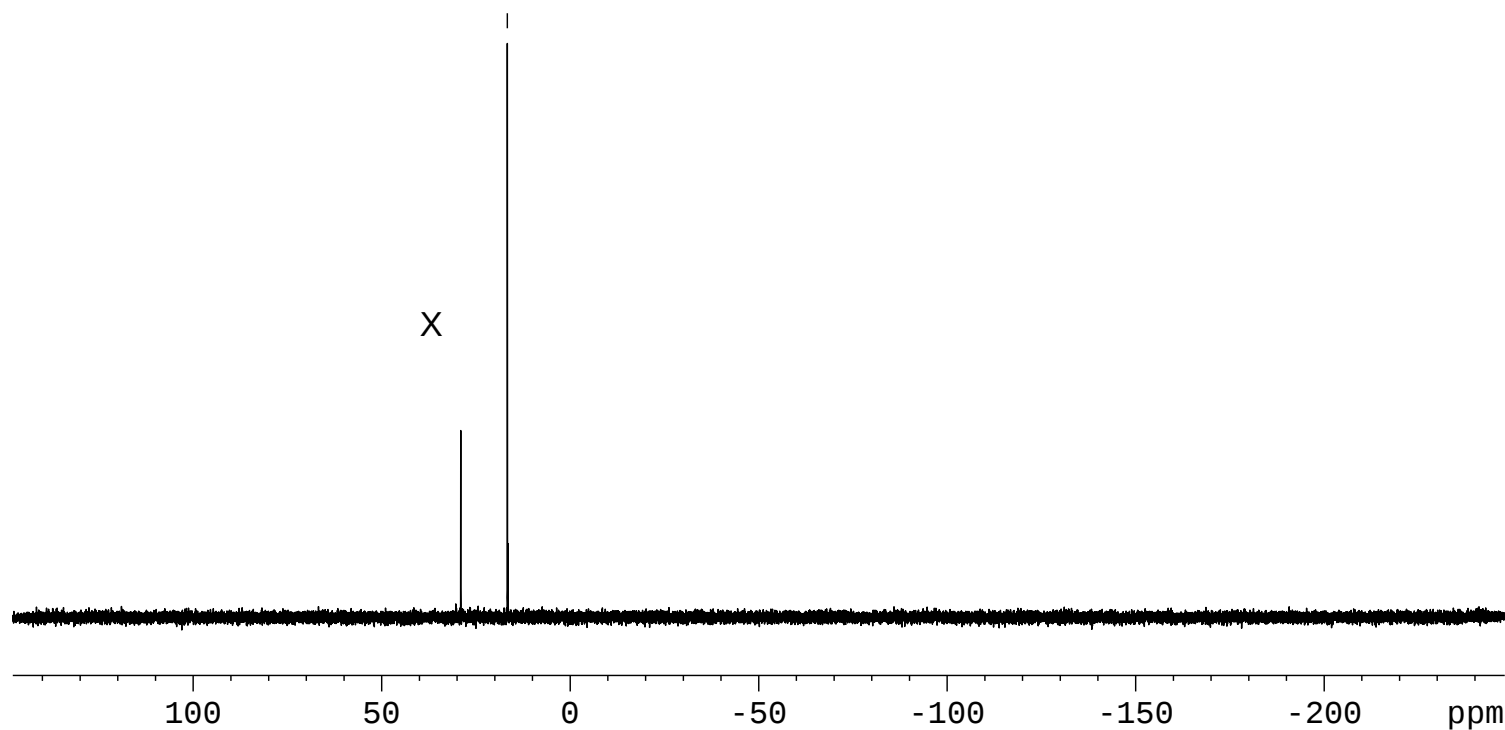


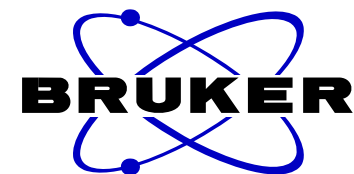
NAME cy-187a-2p
EXPNO 3
PROCNO 1
Date_ 20171031
Time 9.47
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 64
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



— 16.653



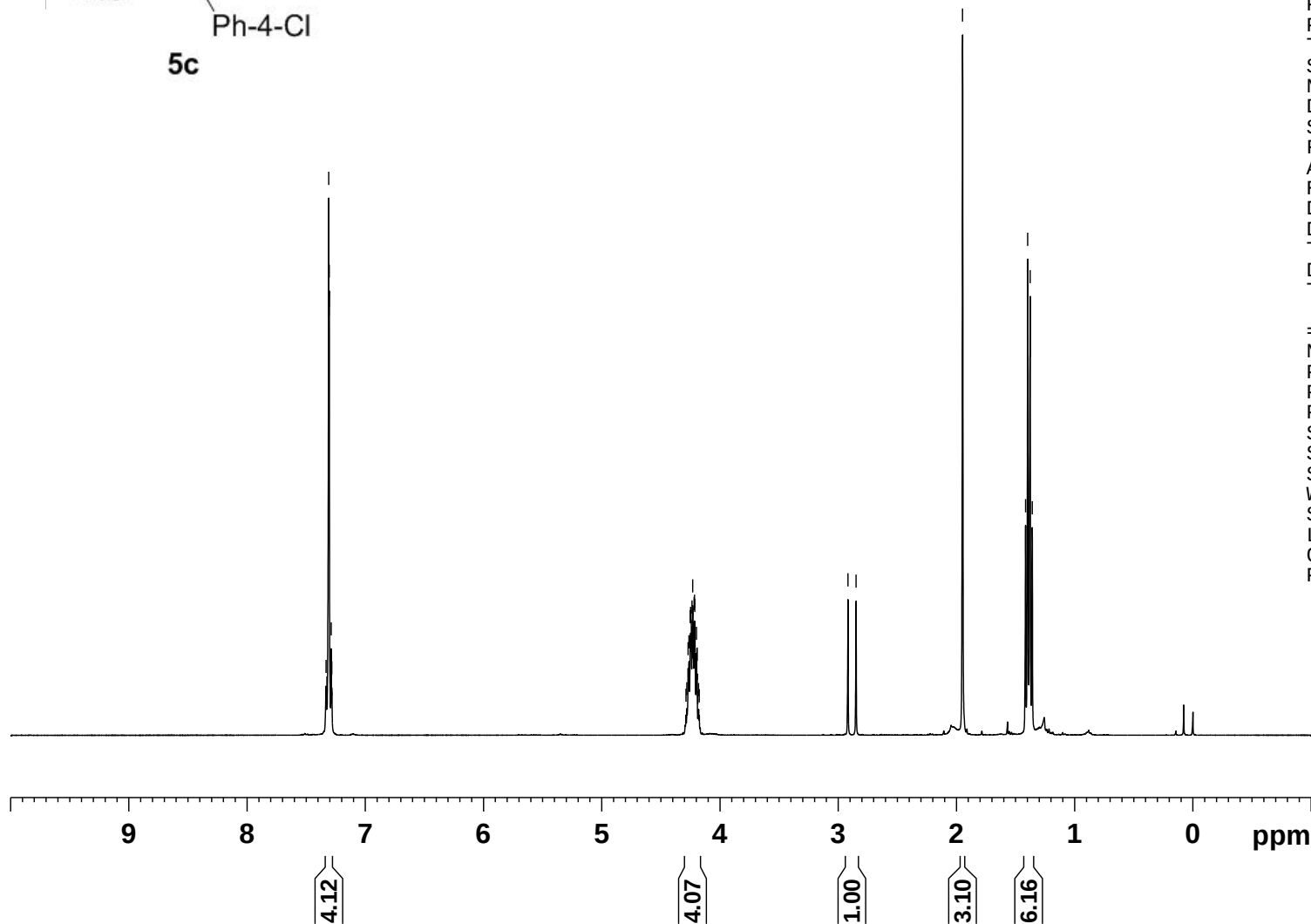
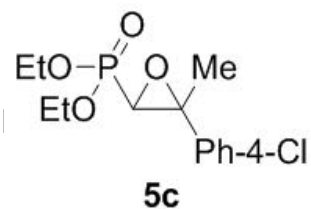


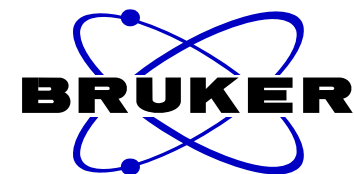
NAME cy-187b-1p-20171012
 EXPNO 1
 PROCNO 1
 Date_ 20171012
 Time 22.05
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 101
 DW 78.200 usec
 DE 6.50 usec
 TE 293.6 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1299983 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

7.332
7.325
7.309
7.305
7.289
7.283

4.288
4.280
4.270
4.263
4.252
4.249
4.245
4.242
4.237
4.231
4.224
4.219
4.216
4.213
4.207
4.199
4.195
4.193
4.187
4.181
4.176
2.918
2.849
1.948
1.416
1.398
1.377
1.359

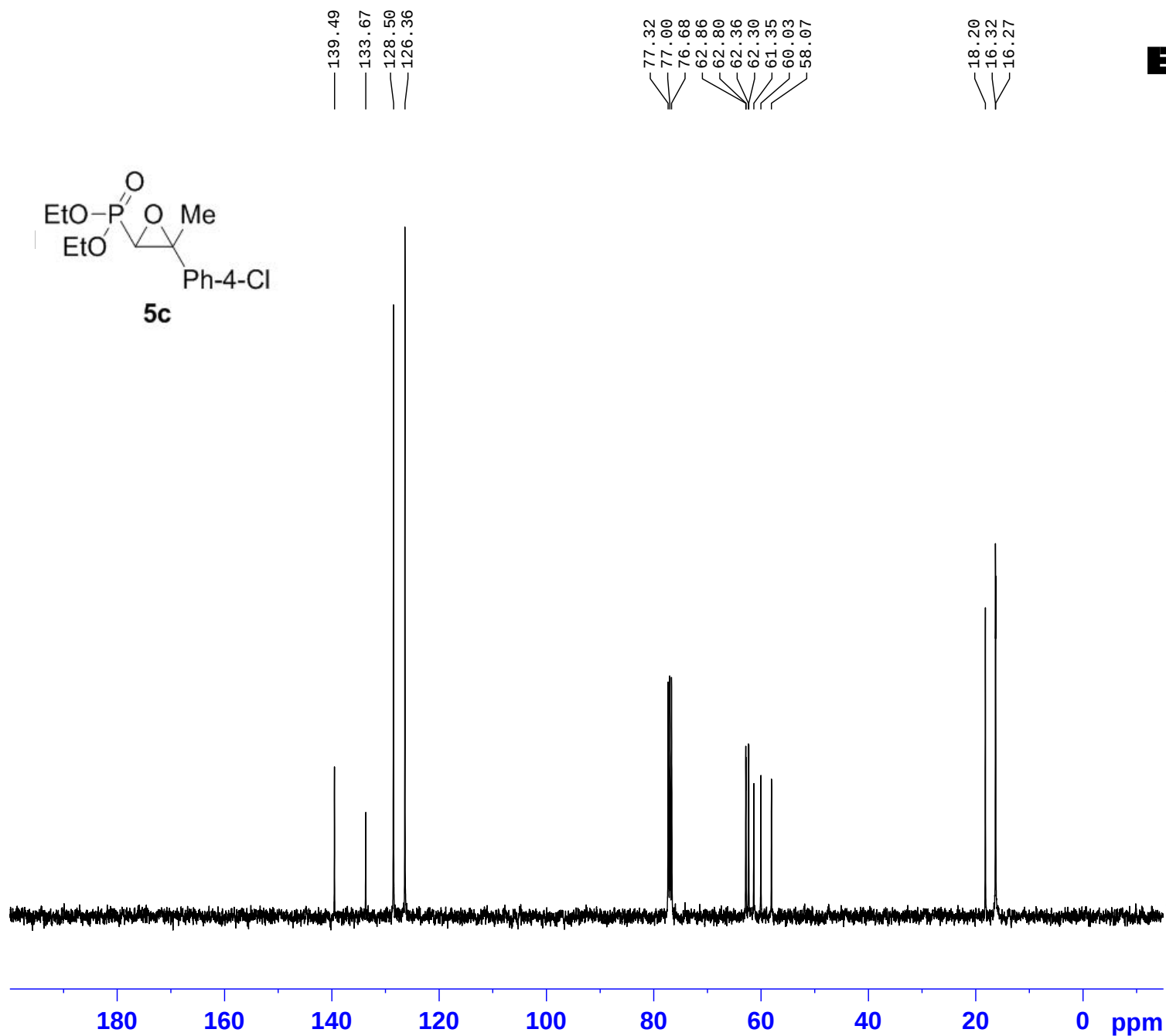


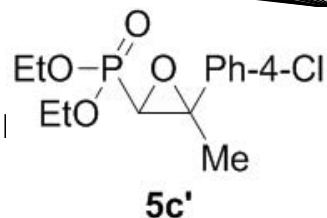
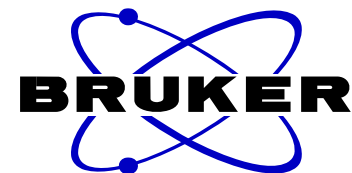


NAME cyj91ap-c-20171031
EXPNO 2
PROCNO 1
Date_ 20171031
Time 16.55
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 40
DS 4
SWH 25252.525 Hz
FIDRES 0.385323 Hz
AQ 1.2976629 sec
RG 2050
DW 19.800 usec
DE 8.00 usec
TE 295.4 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 10

===== CHANNEL f1 =====
NUC1 13C
P1 13.50 usec
PL1 3.00 dB
PL1W 43.93649673 W
SF01 100.6238364 MHz

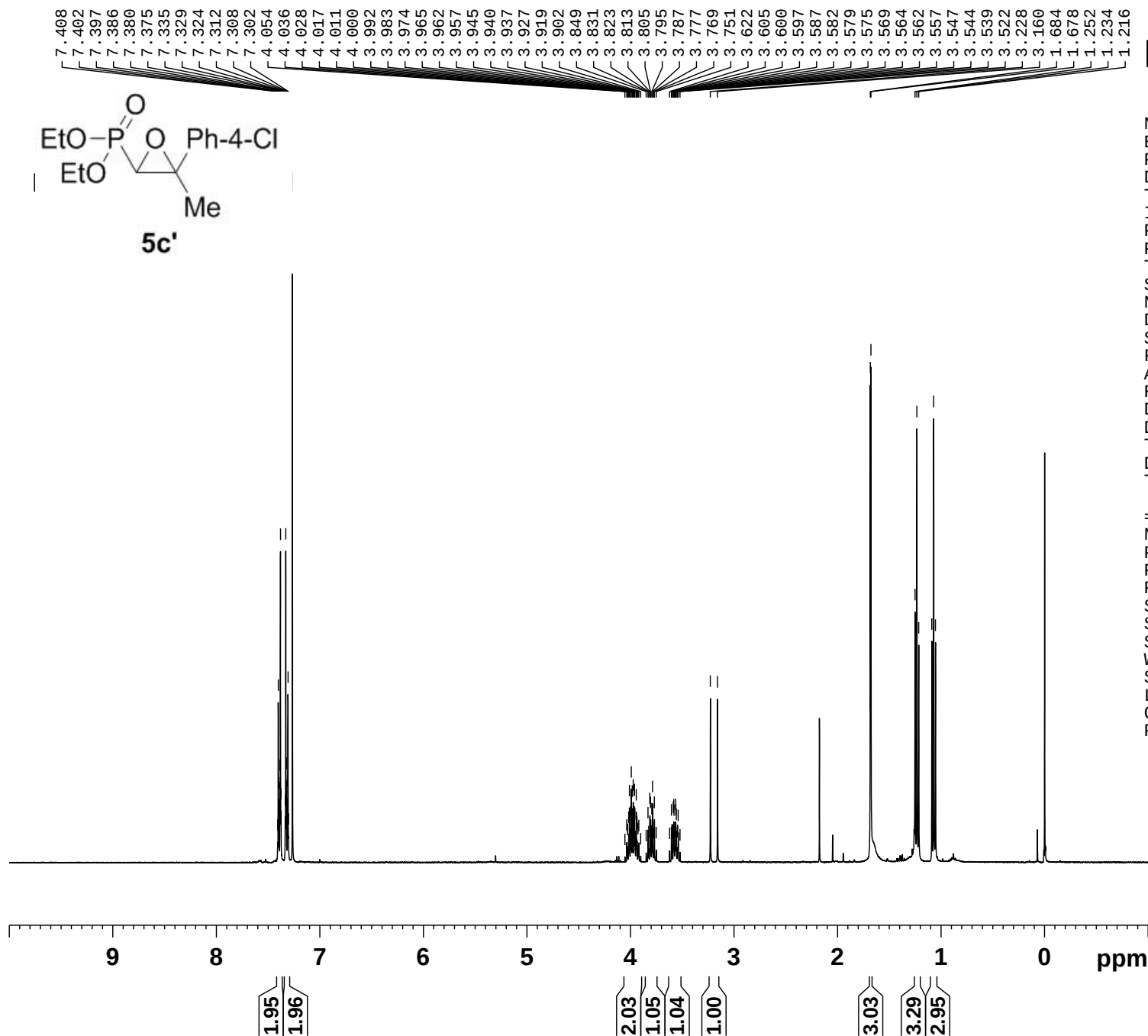
===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 1.80 dB
PL12 17.19 dB
PL13 18.46 dB
PL2W 8.92857742 W
PL12W 0.25809658 W
PL13W 0.19265592 W
SF02 400.1316005 MHz
SI 32768
SF 100.6127838 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40

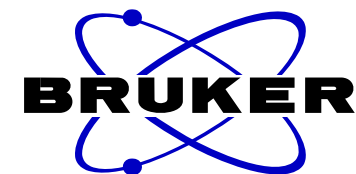




NAME cyj91bp-20171031
EXPNO 1
PROCNO 1
Date_ 20171031
Time 9.24
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 406
DW 78.200 usec
DE 6.50 usec
TE 293.9 K
D1 1.00000000 sec
TD0 1

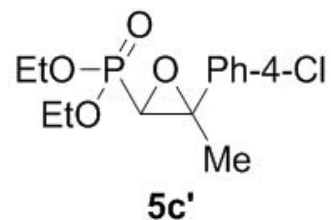
===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300081 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00





NAME cyj91bp
 EXPNO 2
 PROCNO 1
 Date_ 20171031
 Time 14.59
 INSTRUM spect
 PROBHD 5 mm PABBO BB/
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 184
 DS 4
 SWH 37878.789 Hz
 FIDRES 0.577984 Hz
 AQ 0.8651252 sec
 RG 190.02
 DW 13.200 usec
 DE 6.50 usec
 TE 297.2 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 3

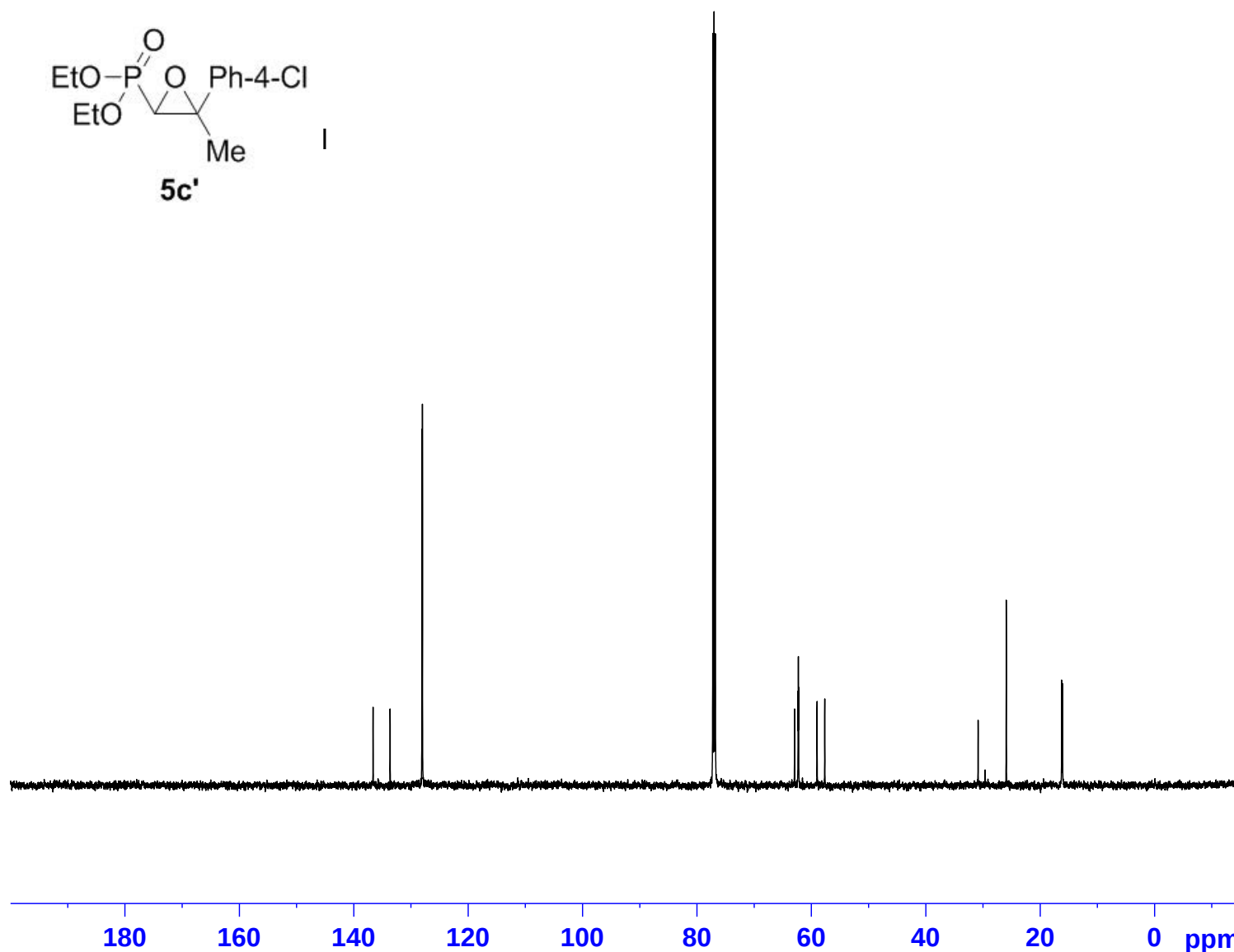
===== CHANNEL f1 =====
 SF01 150.9294669 MHz
 NUC1 13C
 P1 11.90 usec
 SI 32768
 SF 150.9128729 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

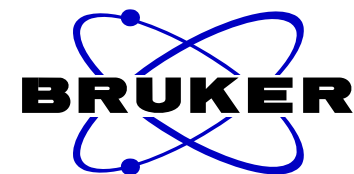


136.61
 133.63
 128.07
 127.98

77.21
 77.00
 76.79
 62.95
 62.33
 62.27
 62.23
 59.01
 57.67

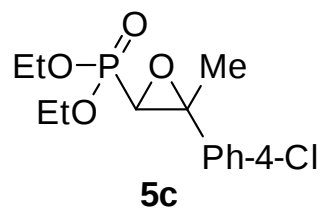
25.94
 16.26
 16.22
 16.12
 16.09



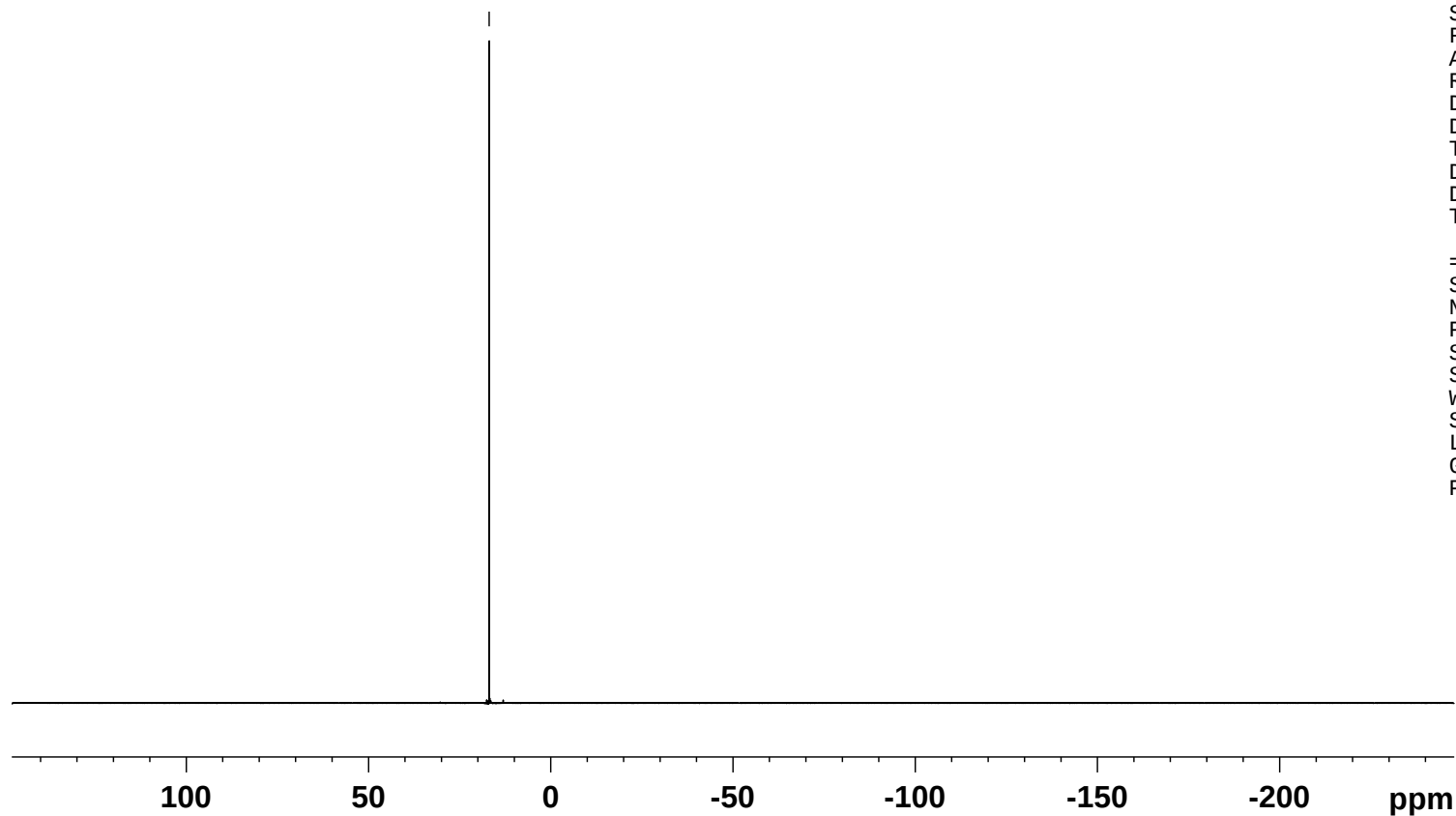


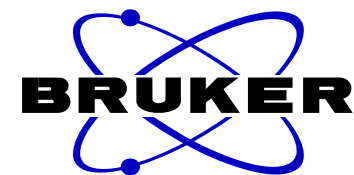
NAME cy-187b-1p
EXPNO 3
PROCNO 1
Date_ 20170920
Time 10.10
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



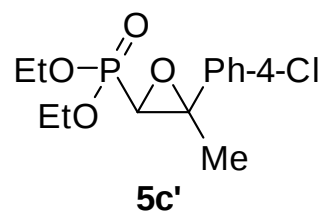
— 16.894



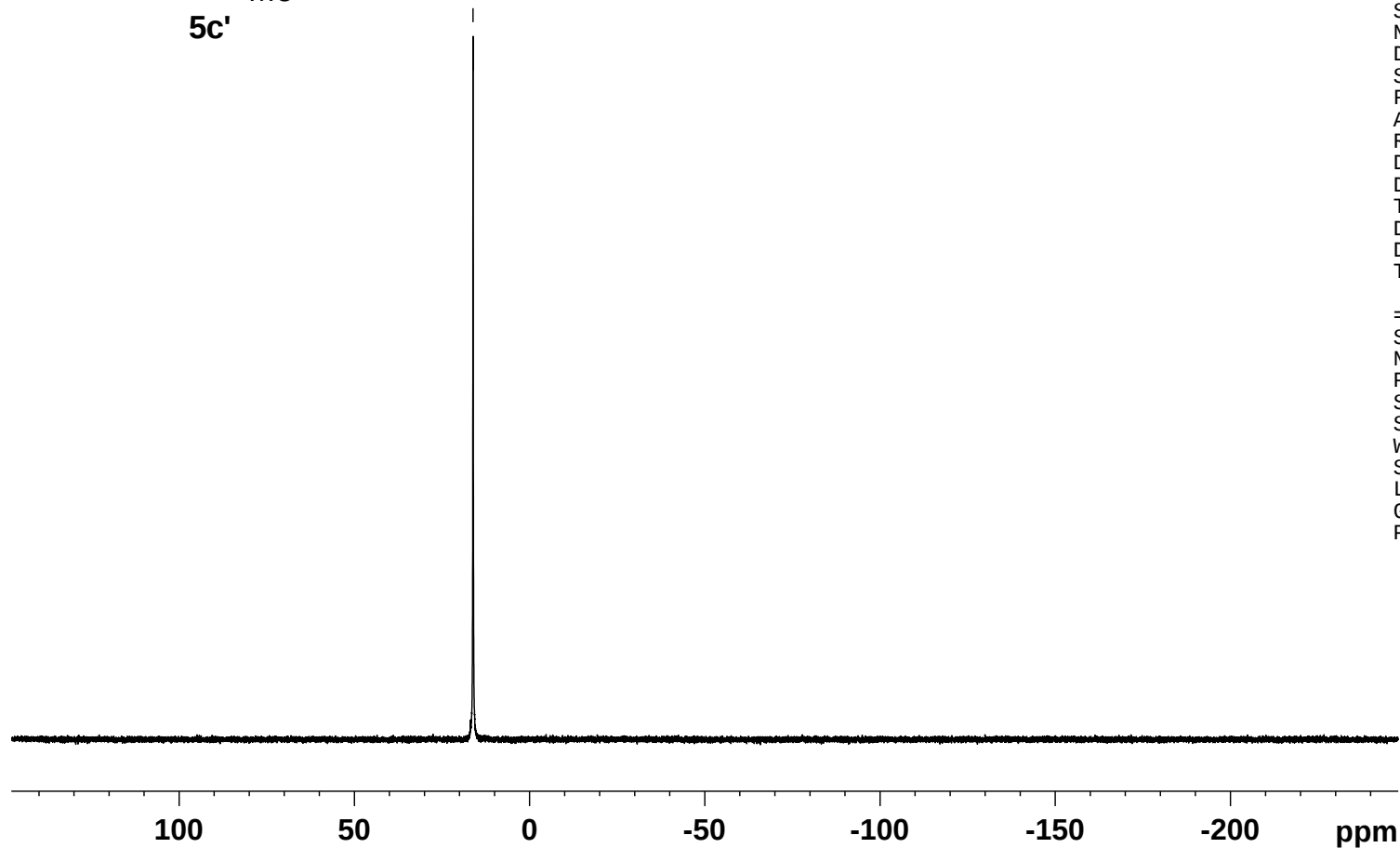


NAME cyj91bp
EXPNO 3
PROCNO 1
Date_ 20171031
Time 14.53
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 64
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 297.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



— 16.149

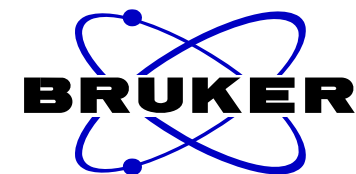




4.236
4.230
4.219
4.201
4.192
4.183
4.165

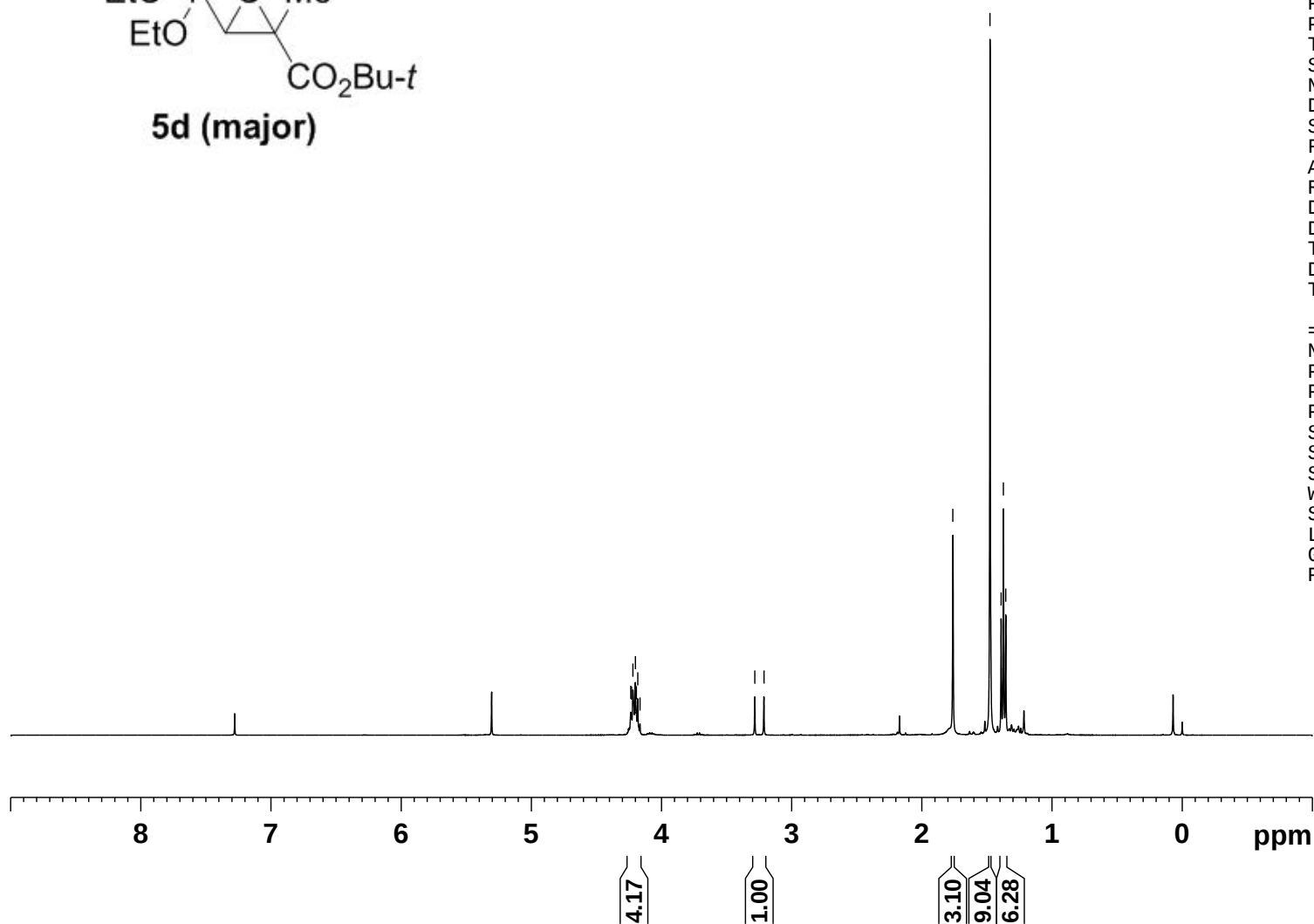
3.283
3.213

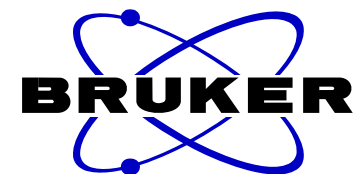
1.762
1.477
1.391
1.374
1.356



NAME cy-189ap-20171016
EXPNO 1
PROCNO 1
Date_ 20171016
Time 9.09
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 181
DW 78.200 usec
DE 6.50 usec
TE 298.4 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300025 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

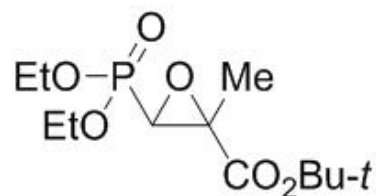




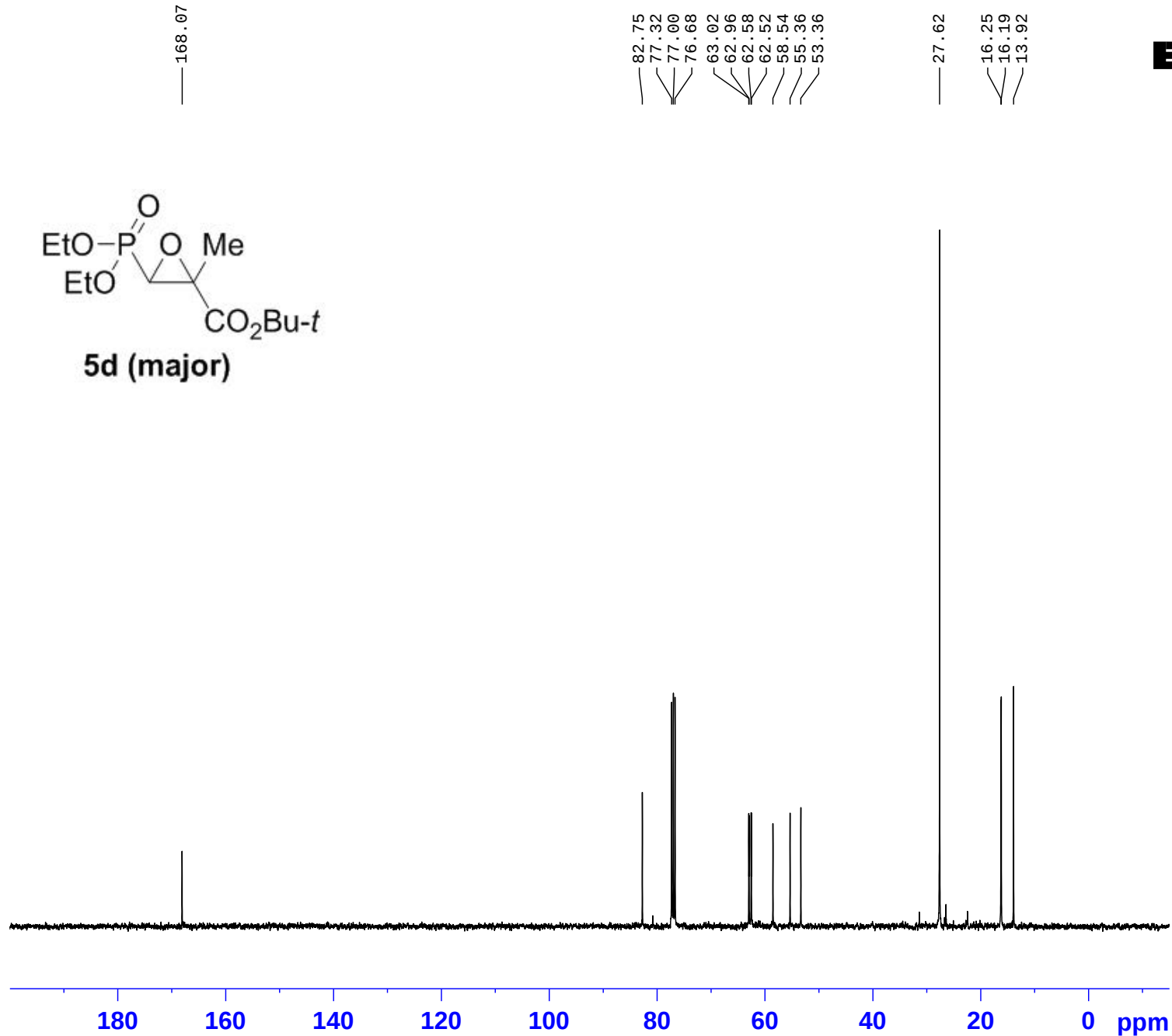
NAME cy-214-2p-20171028
 EXPNO 2
 PROCNO 1
 Date_ 20171028
 Time 21.05
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 80
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.6 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

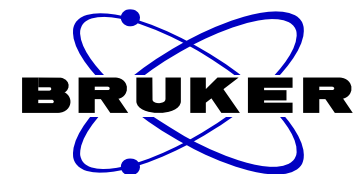
===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127804 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40



5d (major)

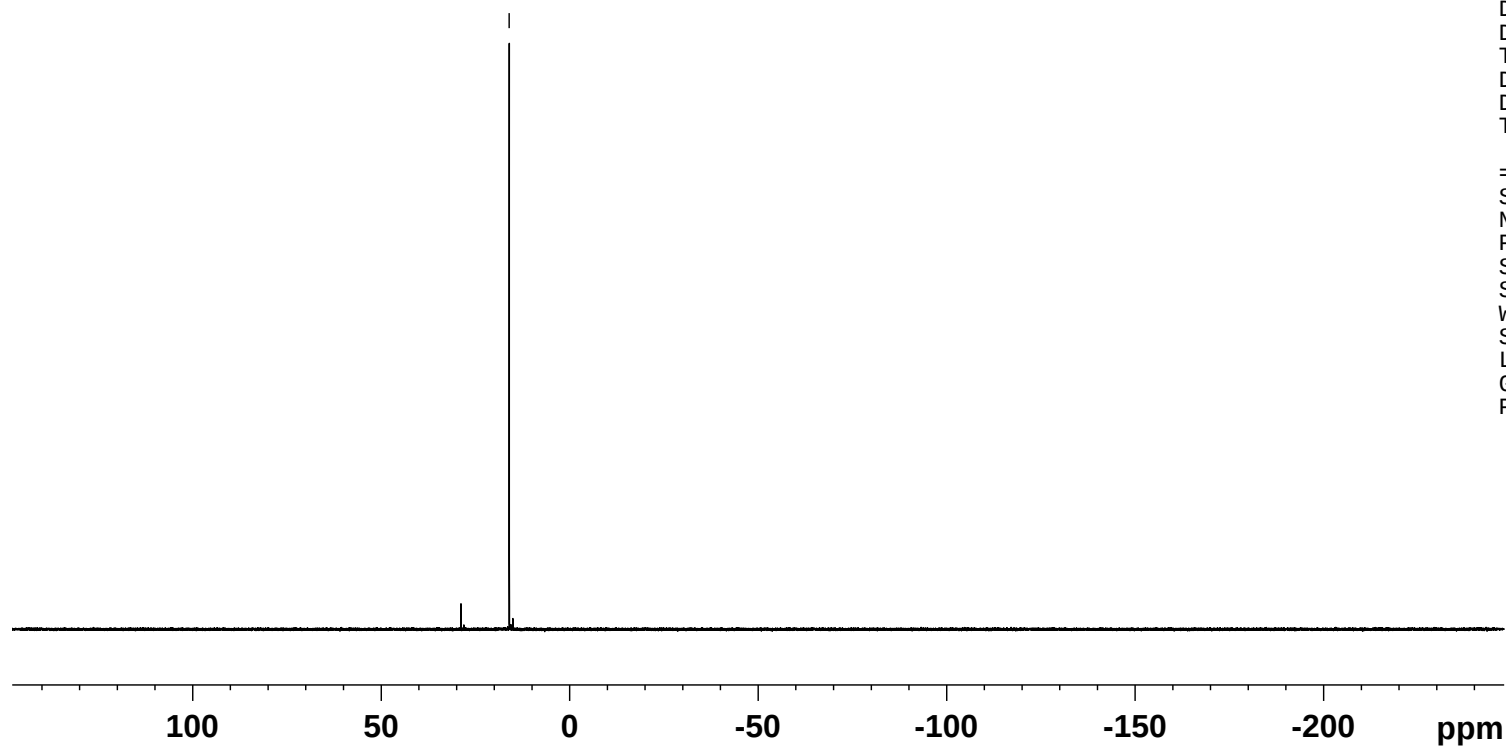
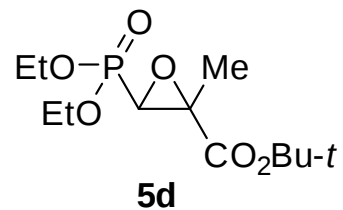


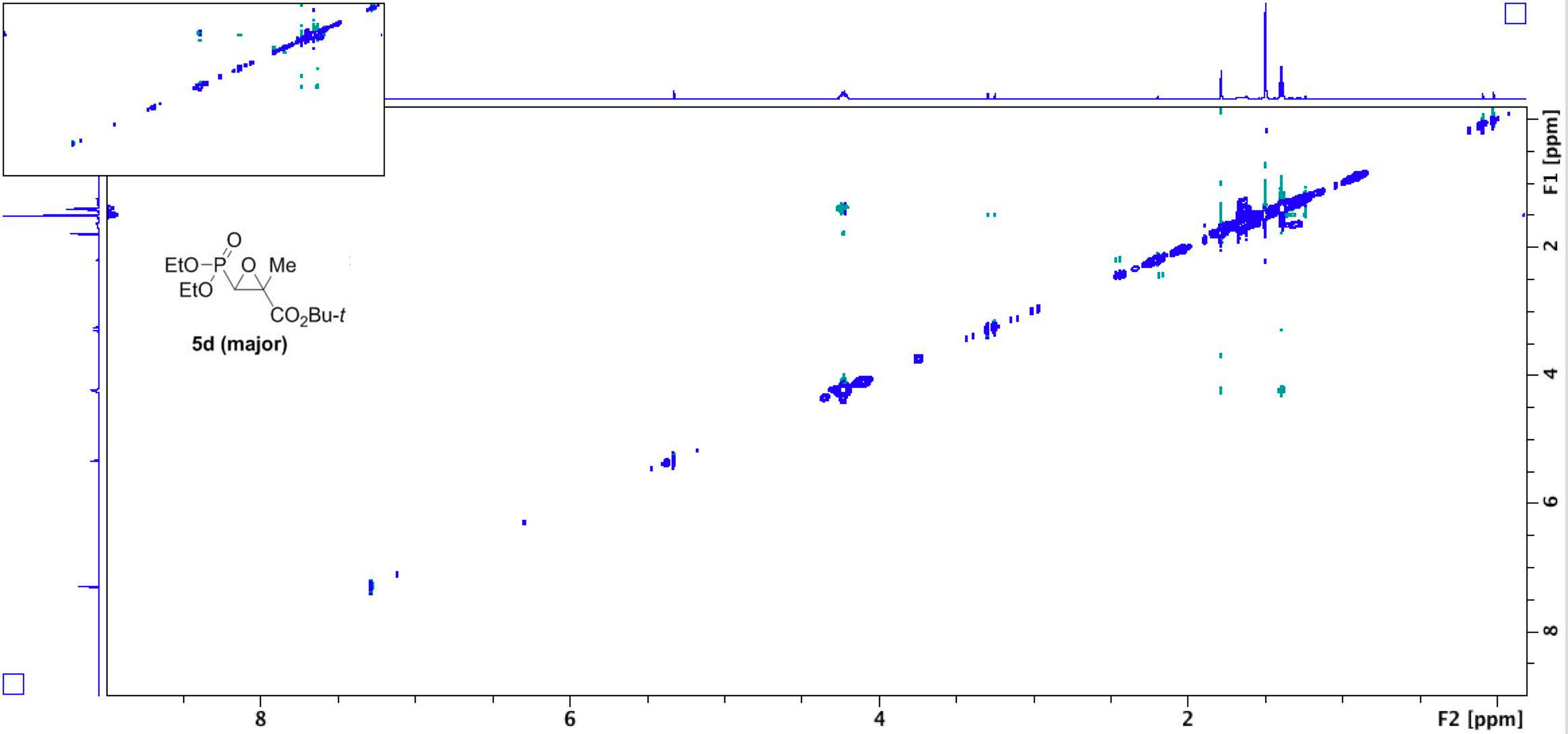


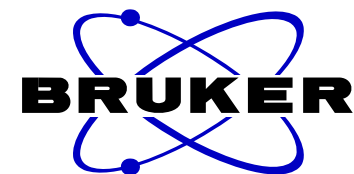
NAME cy-189a-p
EXPNO 4
PROCNO 1
Date_ 20171017
Time 10.04
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 296.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

16.037





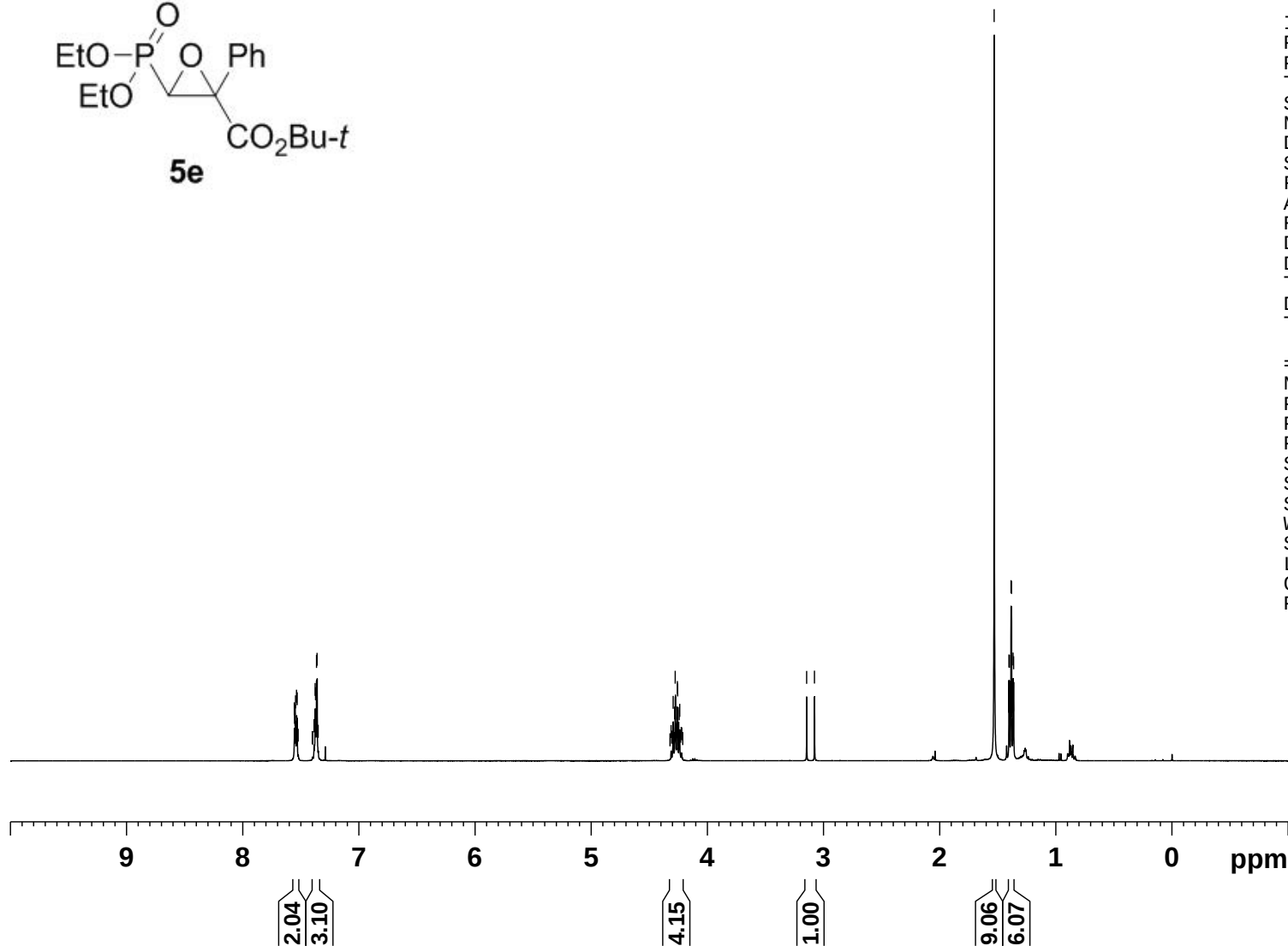
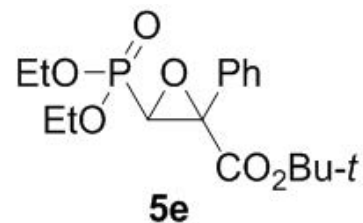


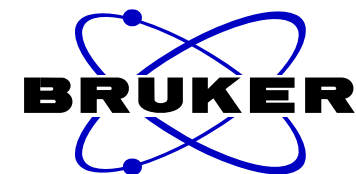
NAME cy-210-1p-20171028

EXPNO 1
 PROCNO 1
 Date_ 20171028
 Time 18.54
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 50.8
 DW 78.200 usec
 DE 6.50 usec
 TE 294.8 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1299978 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

7.556
7.554
7.550
7.548
7.545
7.537
7.532
7.523
7.401
7.399
7.396
7.386
7.382
7.377
7.373
7.365
7.360
7.350
 4.322
4.312
4.307
4.294
4.282
4.276
4.273
4.269
4.264
4.258
4.256
4.246
4.242
4.238
4.230
4.225
4.220
4.212
3.146
3.078
 1.530
1.403
1.399
1.386
1.381
1.368
1.364

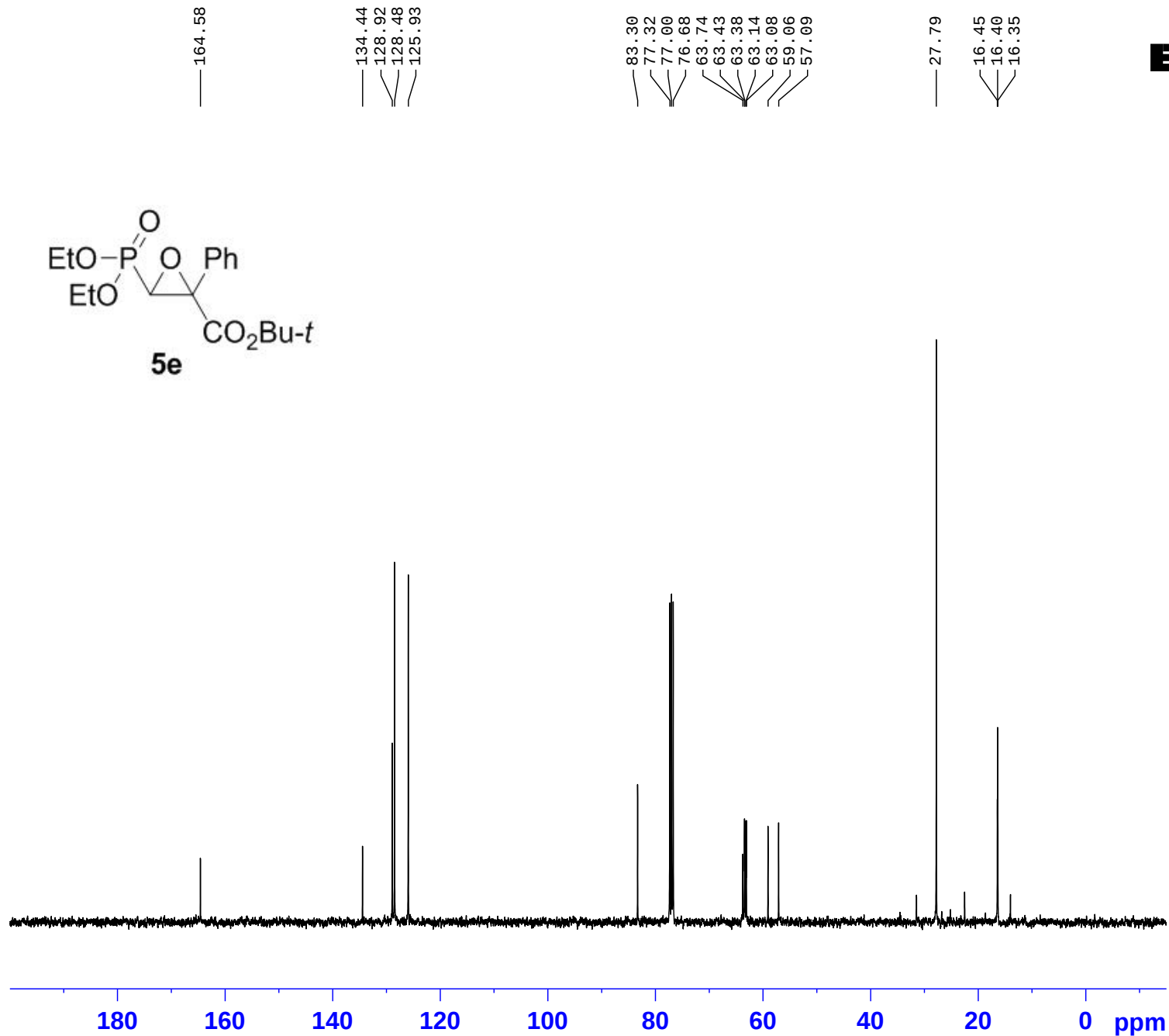


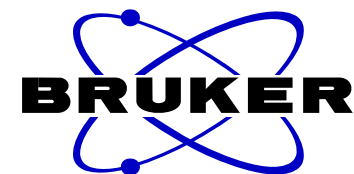


NAME cy-210-1p-20171028
 EXPNO 2
 PROCNO 1
 Date_ 20171028
 Time 18.58
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 56
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.5 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

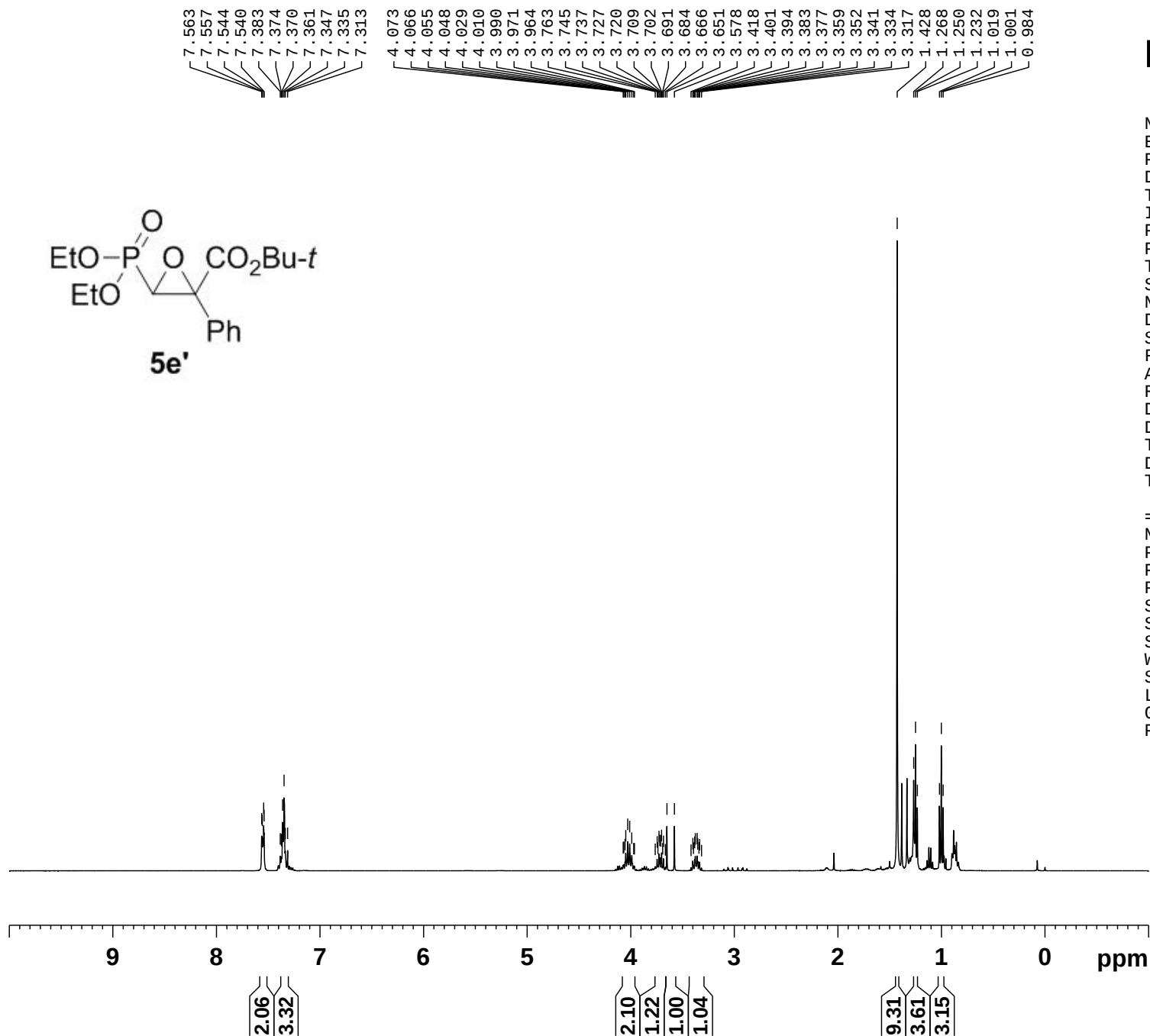
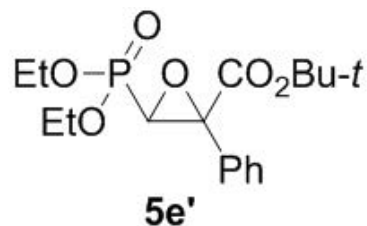
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127788 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

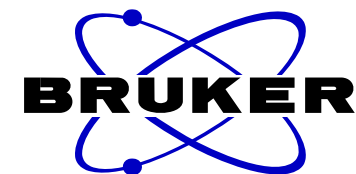




NAME cy-210-2p-20171028
 EXPNO 1
 PROCNO 1
 Date_ 20171028
 Time 19.05
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 50.8
 DW 78.200 usec
 DE 6.50 usec
 TE 294.7 K
 D1 1.00000000 sec
 TD0 1

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1299887 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00



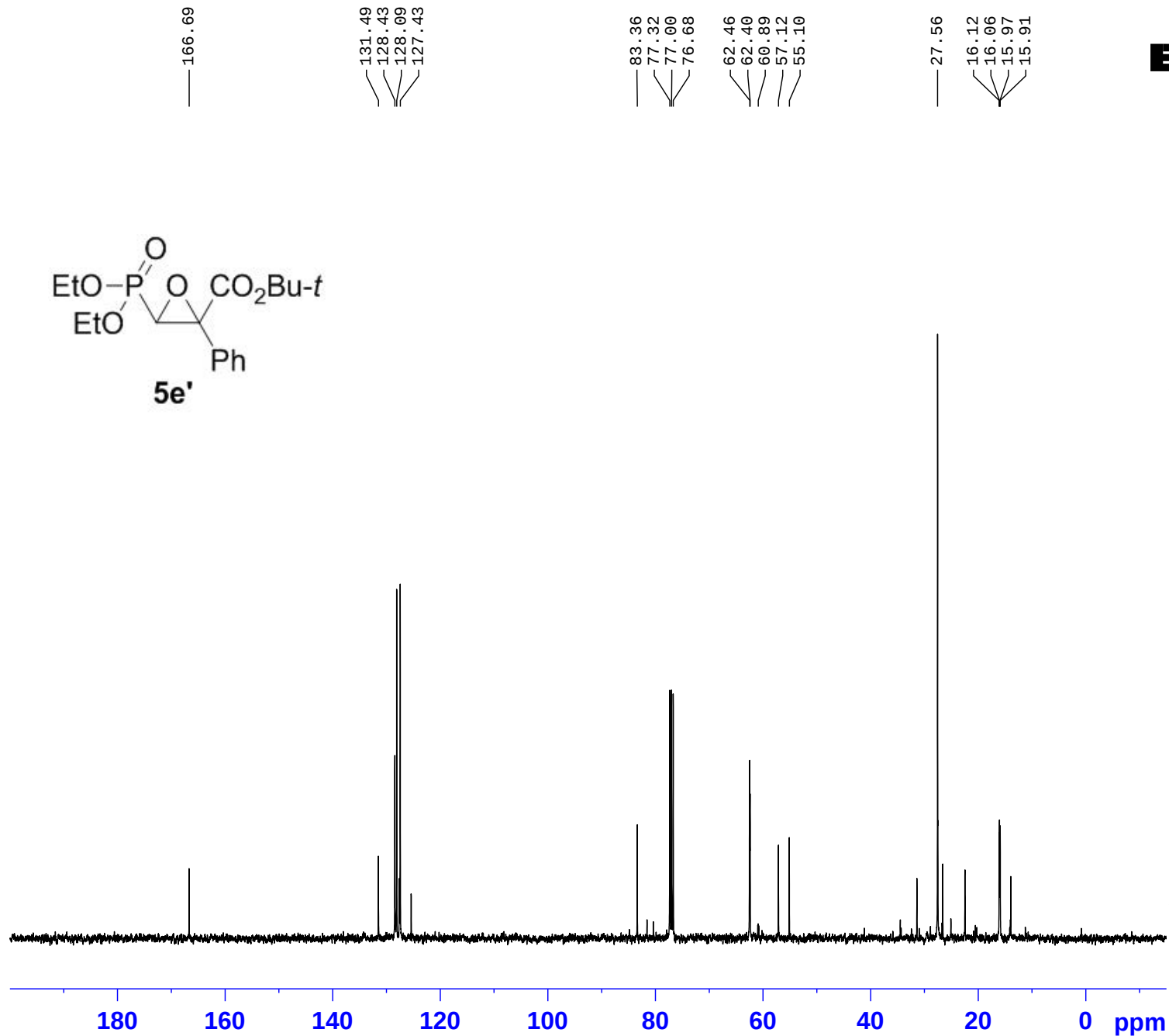


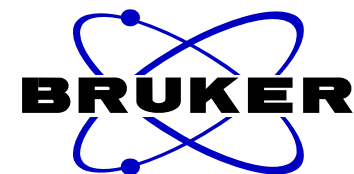
NAME cy-210-2p-20171028

EXPNO 2
PROCNO 1
Date_ 20171028
Time 19.13
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 48
DS 4
SWH 25252.525 Hz
FIDRES 0.385323 Hz
AQ 1.2976629 sec
RG 2050
DW 19.800 usec
DE 8.00 usec
TE 295.6 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 10

===== CHANNEL f1 =====
NUC1 13C
P1 13.50 usec
PL1 3.00 dB
PL1W 43.93649673 W
SF01 100.6238364 MHz

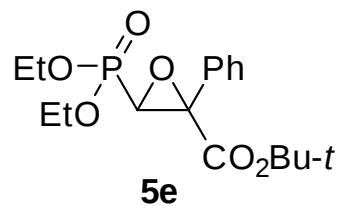
===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 1.80 dB
PL12 17.19 dB
PL13 18.46 dB
PL2W 8.92857742 W
PL12W 0.25809658 W
PL13W 0.19265592 W
SF02 400.1316005 MHz
SI 32768
SF 100.6127821 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40



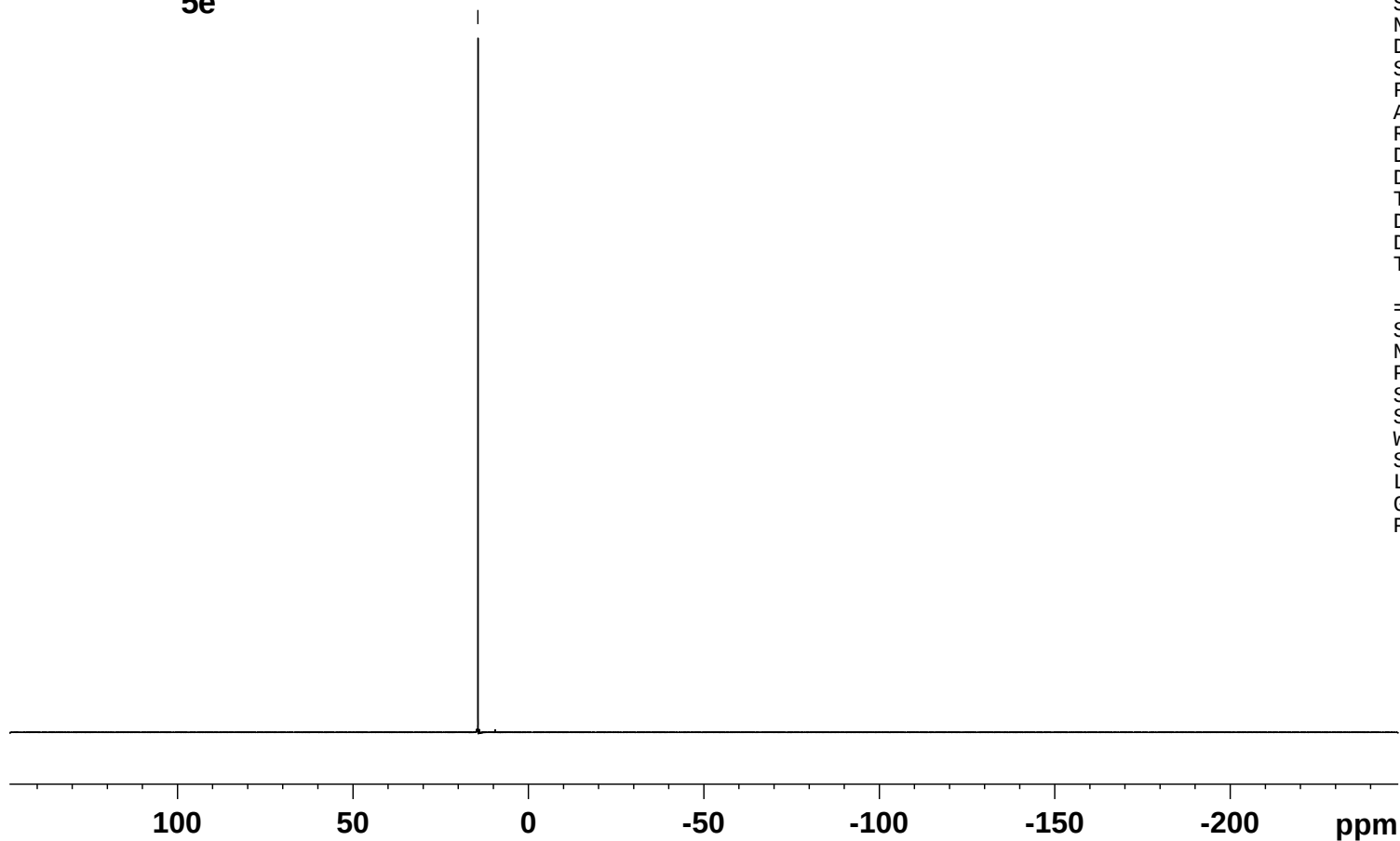


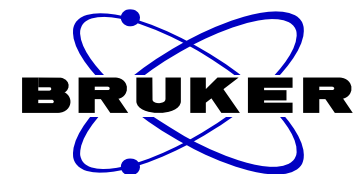
NAME cy-210-1p
EXPNO 4
PROCNO 1
Date_ 20171024
Time 14.34
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 296.4 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



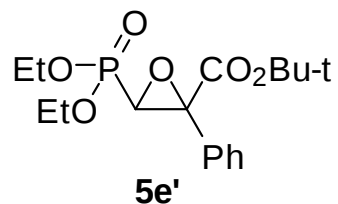
14.394





NAME cy-210-2p
EXPNO 4
PROCNO 1
Date_ 20171024
Time 14.39
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 296.5 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

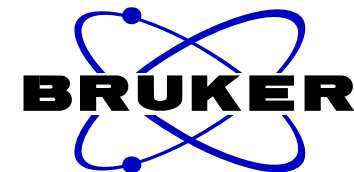
===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



—13.645

X₁

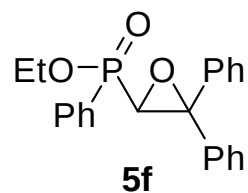
100 50 0 -50 -100 -150 -200 ppm



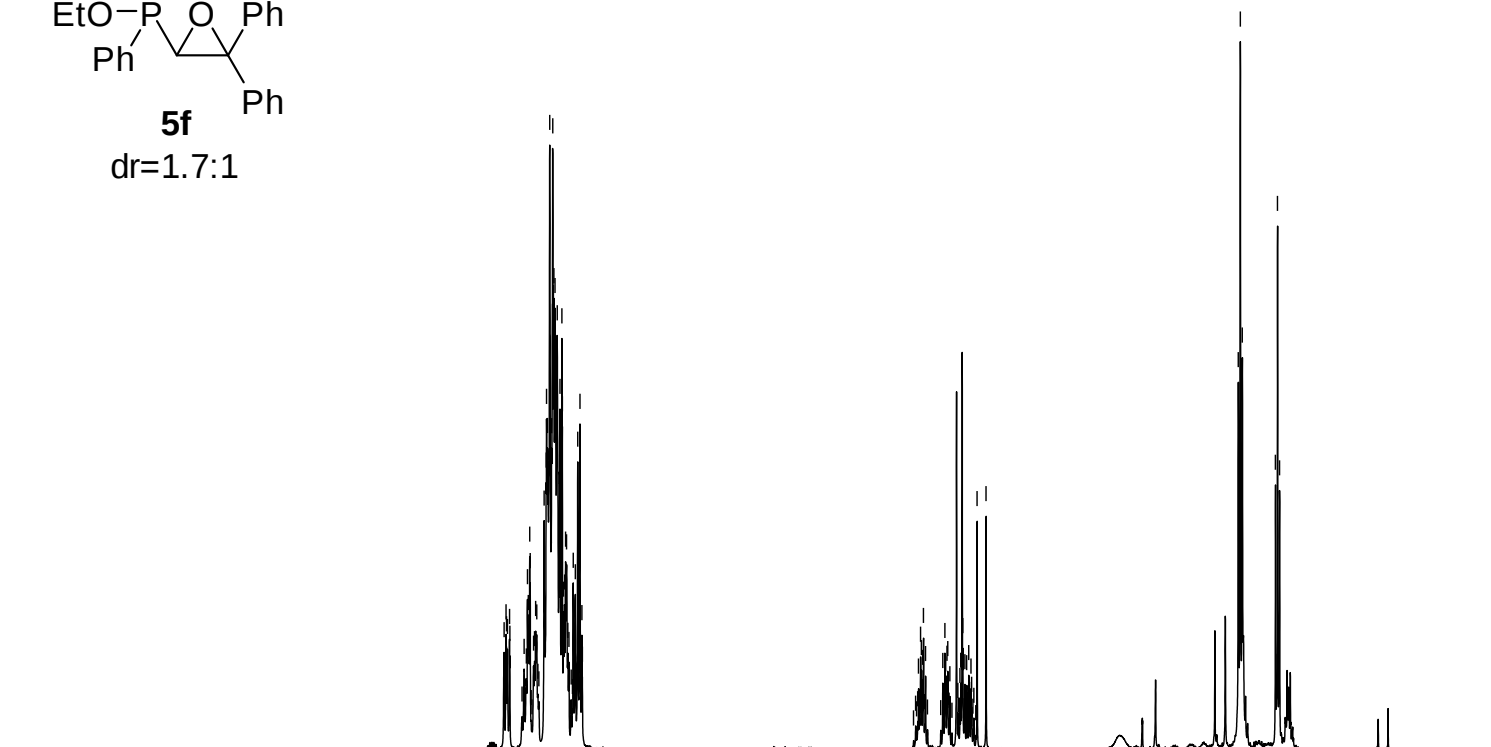
NAME cy-211p-20171024
EXPNO 1
PROCNO 1
Date_ 20171024
Time 9.56
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 50.8
DW 78.200 usec
DE 6.50 usec
TE 294.4 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300064 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

7.498
7.492
7.479
7.474
7.426
7.418
7.353
7.335
7.332
7.326
7.323
7.319
7.305
7.292
7.287
7.278
7.272
7.268
7.258
7.253
7.239
7.224
7.218
7.215
7.211
7.203
7.198
7.194
7.184
7.175
7.166
7.157
7.099
7.081
7.060
7.041
3.581
3.503
1.305
1.287
1.270
0.981
0.963
0.946



dr=1.7:1

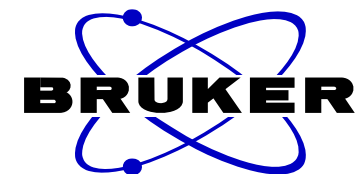


11 10 9 8 7 6 5 4 3 2 1 0 ppm

2.087
5.616
29.337
5.291

2.004
1.753
2.518
1.329
1.000

6.126
3.182



NAME cy-211p-20171028

EXPNO 2
 PROCNO 1
 Date_ 20171028
 Time 18.49
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 832
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 296.0 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

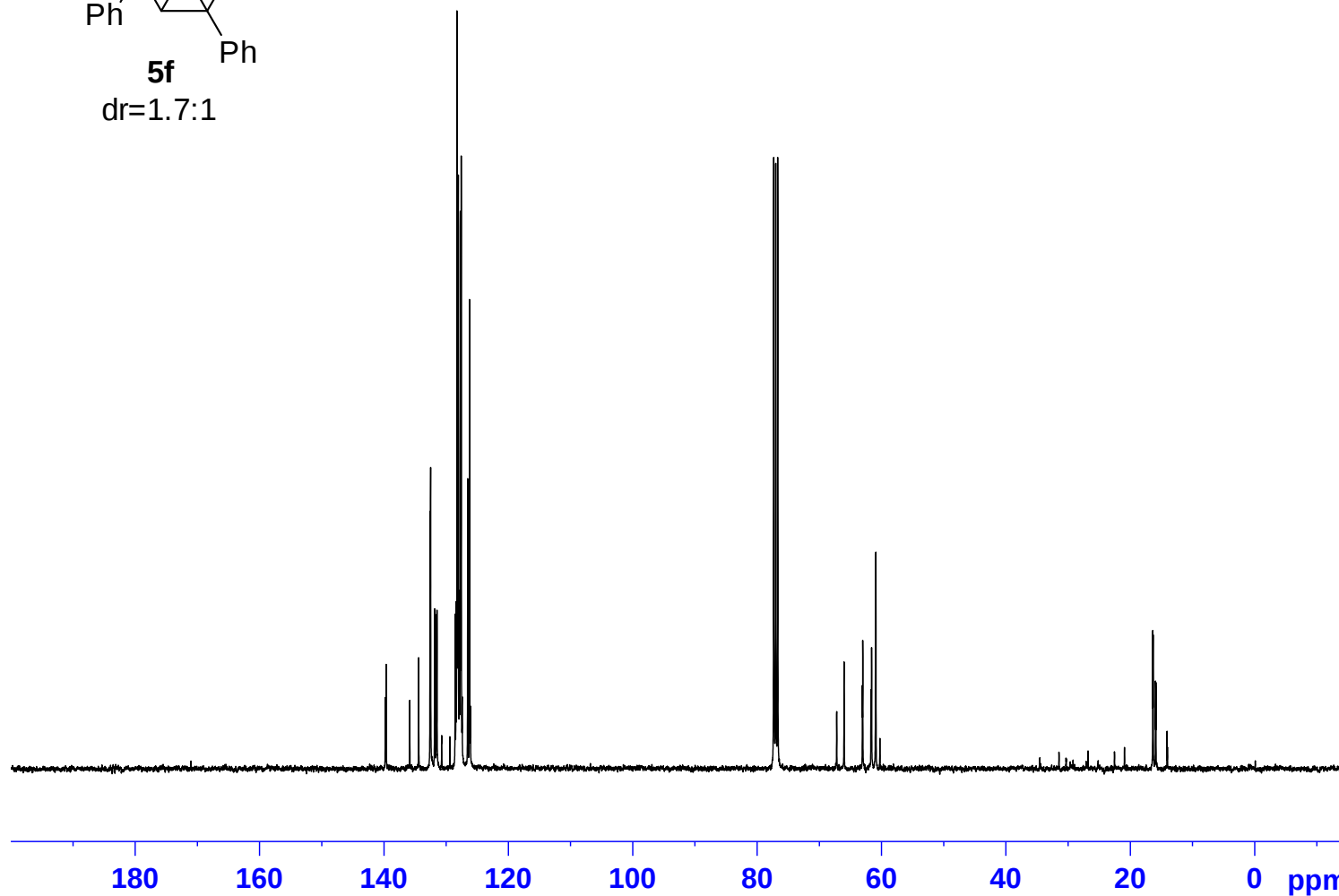
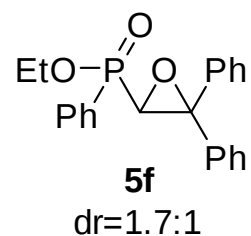
===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

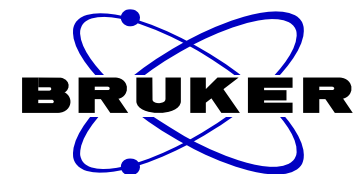
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127807 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

139.78
 139.63
 135.84
 134.41
 132.58
 132.49
 131.85
 131.57
 131.47
 128.54
 128.41
 128.26
 128.20
 128.04
 127.88
 127.72
 127.57
 126.53
 126.22

77.32
 77.00
 76.68
 67.22
 66.04
 63.09
 63.03
 61.71
 61.60
 60.97
 60.91
 60.28

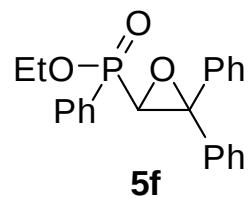
16.39
 16.33
 15.95
 15.89



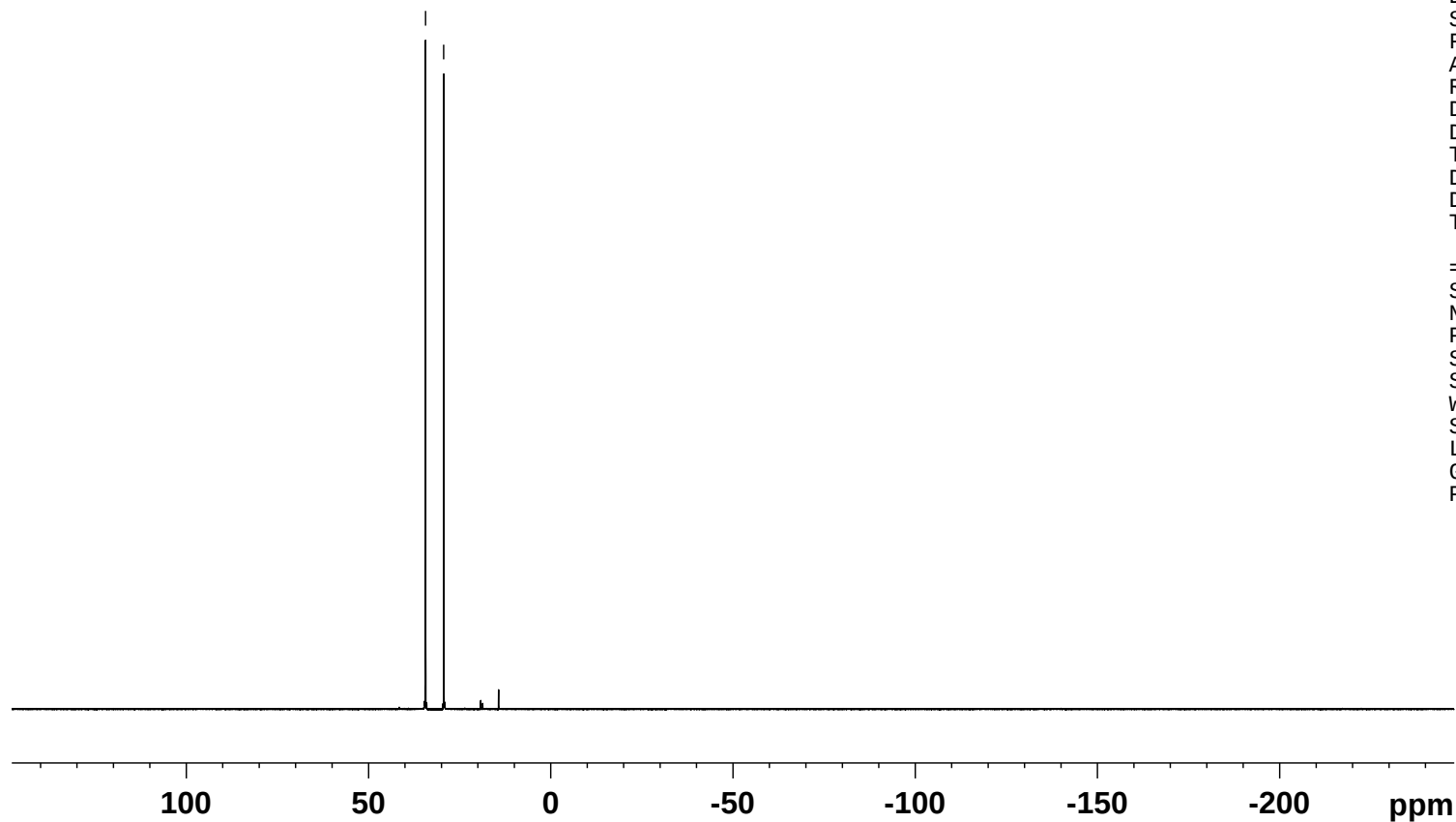


NAME cy-211p
EXPNO 4
PROCNO 1
Date_ 20171024
Time 14.29
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 296.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

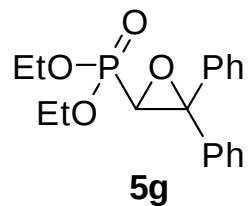
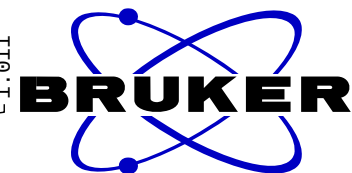
===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



34.369
29.372

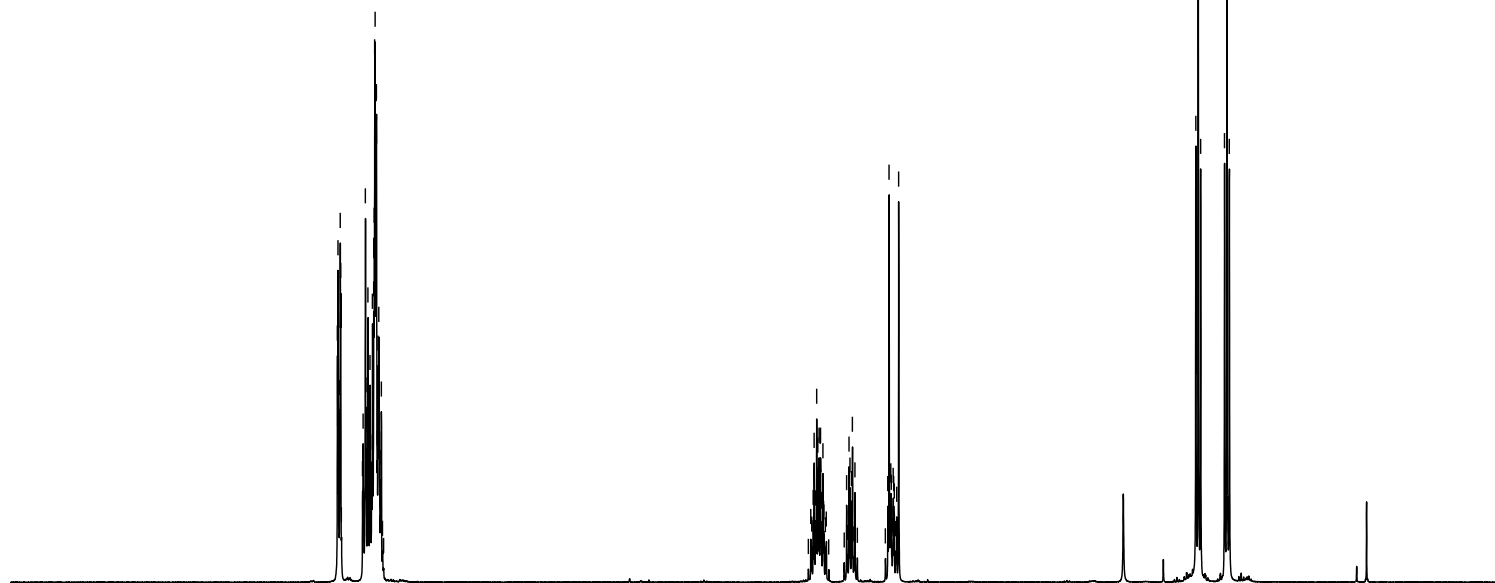


7.588
7.583
7.578
7.571
7.567
7.564
7.402
7.398
7.394
7.381
7.377
7.366
7.362
7.357
7.350
7.347
7.343
7.335
7.329
7.320
7.316
7.312
7.309
7.305
7.302
7.300
7.294
7.288
7.282
7.272
7.267
7.263
4.079
4.072
4.062
4.054
4.045
4.036
4.028
4.026
4.020
4.018
4.008
4.003
3.833
3.816
3.798
3.790
3.772
3.530
3.520
3.512
3.507
3.504
3.490
3.486
3.482
3.464
3.450
1.259
1.241
1.223
1.047
1.029
1.011



NAME cy-188p-20170919
EXPNO 1
PROCNO 1
Date_ 20170919
Time 23.00
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 203
DW 78.200 usec
DE 6.50 usec
TE 294.2 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300085 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

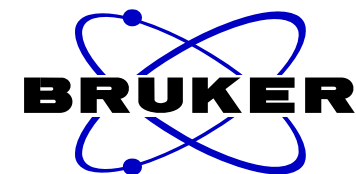


9 8 7 6 5 4 3 2 1 0 ppm

2.01
8.32

2.08
1.03
2.00

3.14
3.00



NAME cy-212p-20171024
 EXPNO 2
 PROCNO 1
 Date_ 20171024
 Time 9.10
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 232
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.0 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

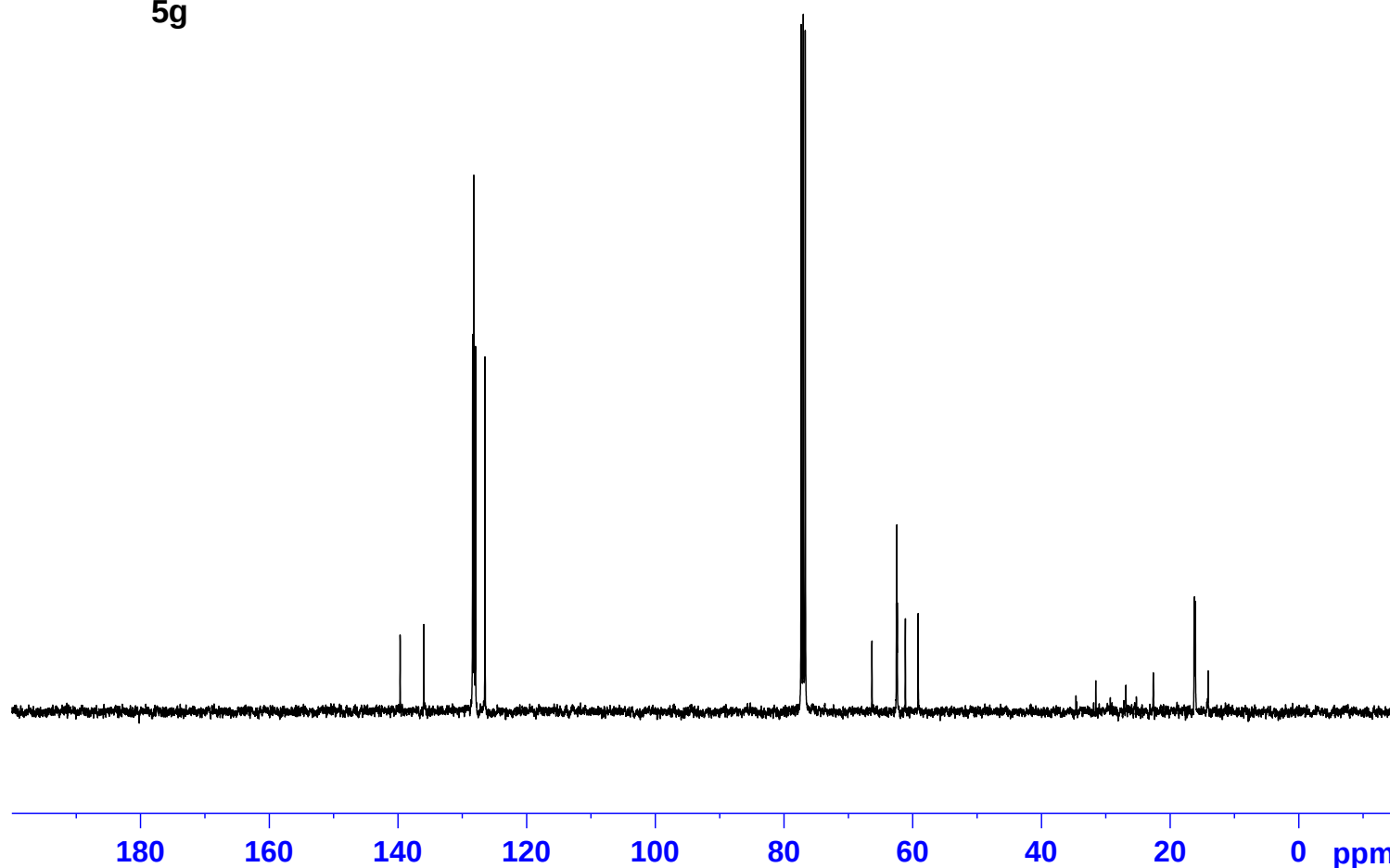
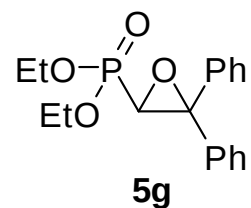
===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

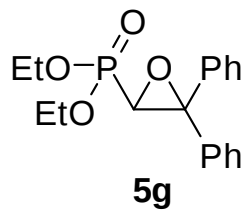
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127749 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

139.65
 135.96
 128.38
 128.19
 128.15
 127.93
 126.45

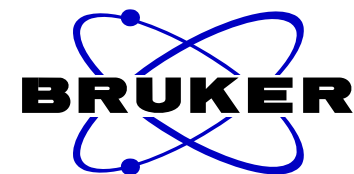
77.32
 77.00
 76.68
 66.32
 62.53
 62.46
 62.39
 61.13
 59.15

16.26
 16.20
 16.11
 16.06





— 15.072

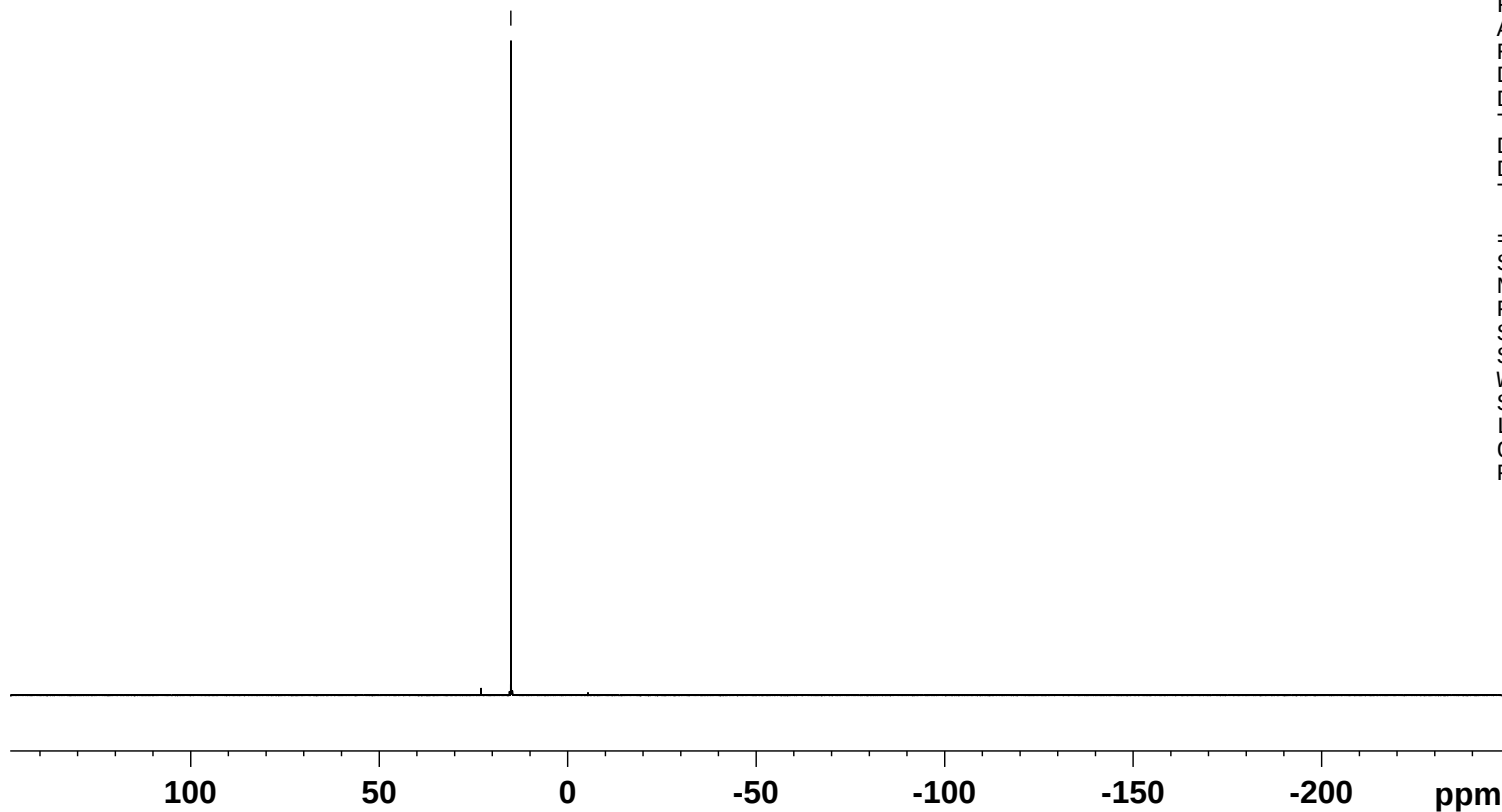


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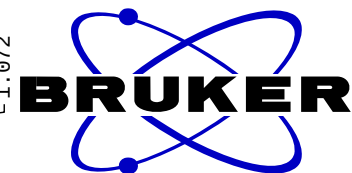
NAME                cy-188p
EXPNO                3
PROCNO               1
Date_                20170920
Time                9.51
INSTRUM              spect
PROBHD               5 mm PABBO BB/
PULPROG              zgpg30
TD                   65536
SOLVENT              CDCl3
NS                   32
DS                   4
SWH                  96153.844 Hz
FIDRES               1.467191 Hz
AQ                   0.3408372 sec
RG                   190.02
DW                   5.200 usec
DE                   6.50 usec
TE                   0.0 K
D1                   2.00000000 sec
D11                  0.03000000 sec
TD0                  1
  
```

```

===== CHANNEL f1 =====
SF01                242.9411216 MHz
NUC1                 31P
P1                   11.90 usec
SI                   32768
SF                   242.9532693 MHz
WDW                  EM
SSB                  0
LB                   3.00 Hz
GB                   0
PC                   1.40
  
```

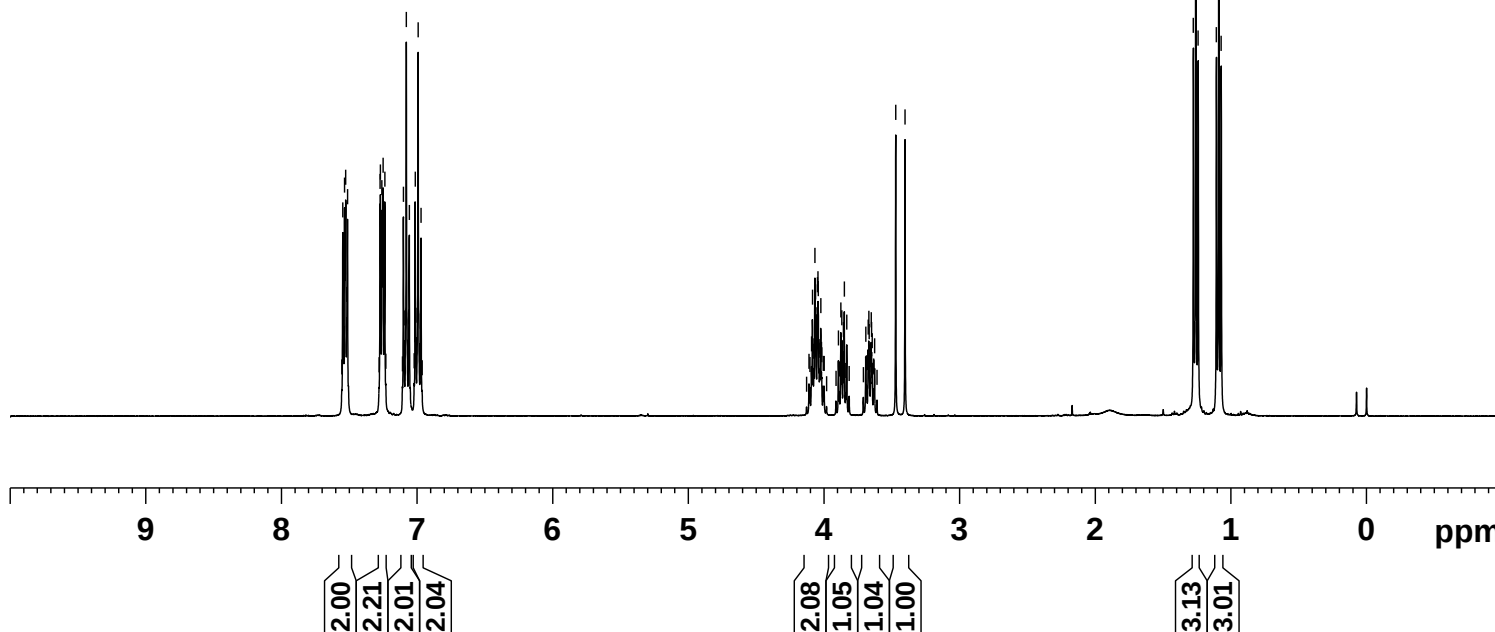
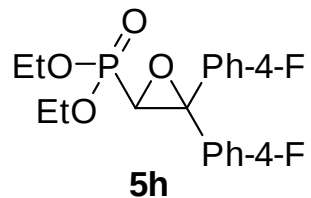


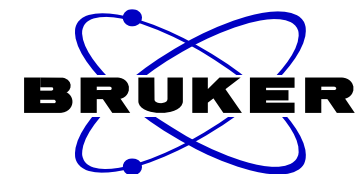
7.548
7.543
7.535
7.526
7.518
7.513
7.273
7.270
7.260
7.256
7.251
7.243
7.238
7.231
7.101
7.096
7.079
7.062
7.057
7.021
7.014
7.008
6.992
6.975
6.970
4.110
4.092
4.085
4.080
4.074
4.067
4.062
4.048
4.044
4.042
4.037
4.031
4.024
4.019
4.016
4.006
3.998
3.893
3.875
3.868
3.857
3.850
3.832
3.692
3.687
3.674
3.669
3.667
3.656
3.652
3.649
3.644
3.627
3.471
3.402
1.277
1.259
1.242
1.107
1.089
1.072



NAME cy-195bp-20170929
EXPNO 1
PROCNO 1
Date_ 20170929
Time 9.33
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 203
DW 78.200 usec
DE 6.50 usec
TE 296.6 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300059 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

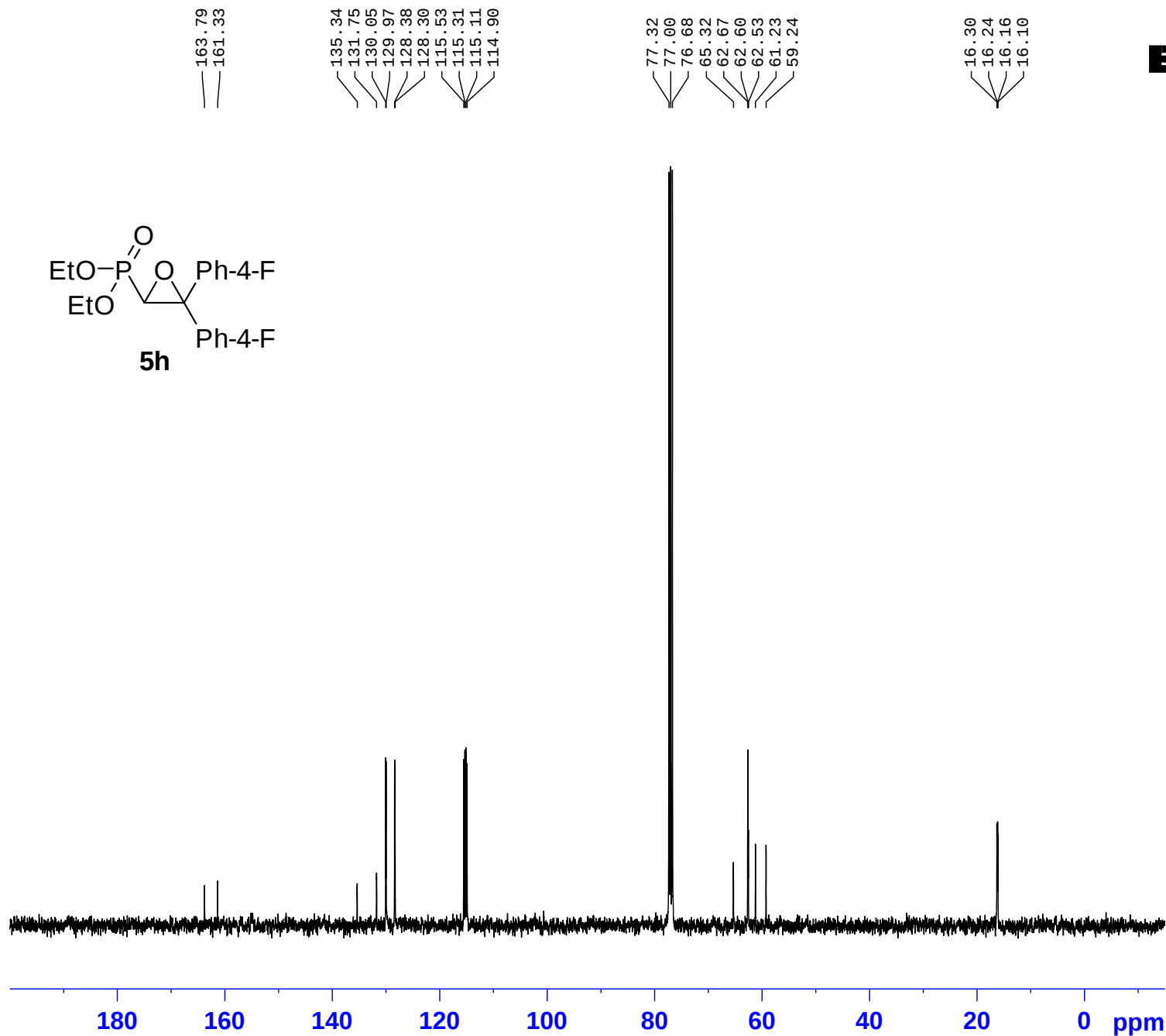


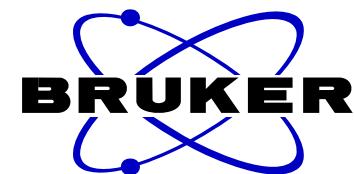


NAME cy-195bp-20170929
 EXPNO 2
 PROCNO 1
 Date_ 20170929
 Time 9.41
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 88
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 297.8 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

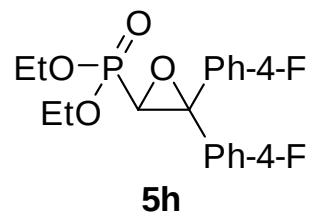
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127728 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40



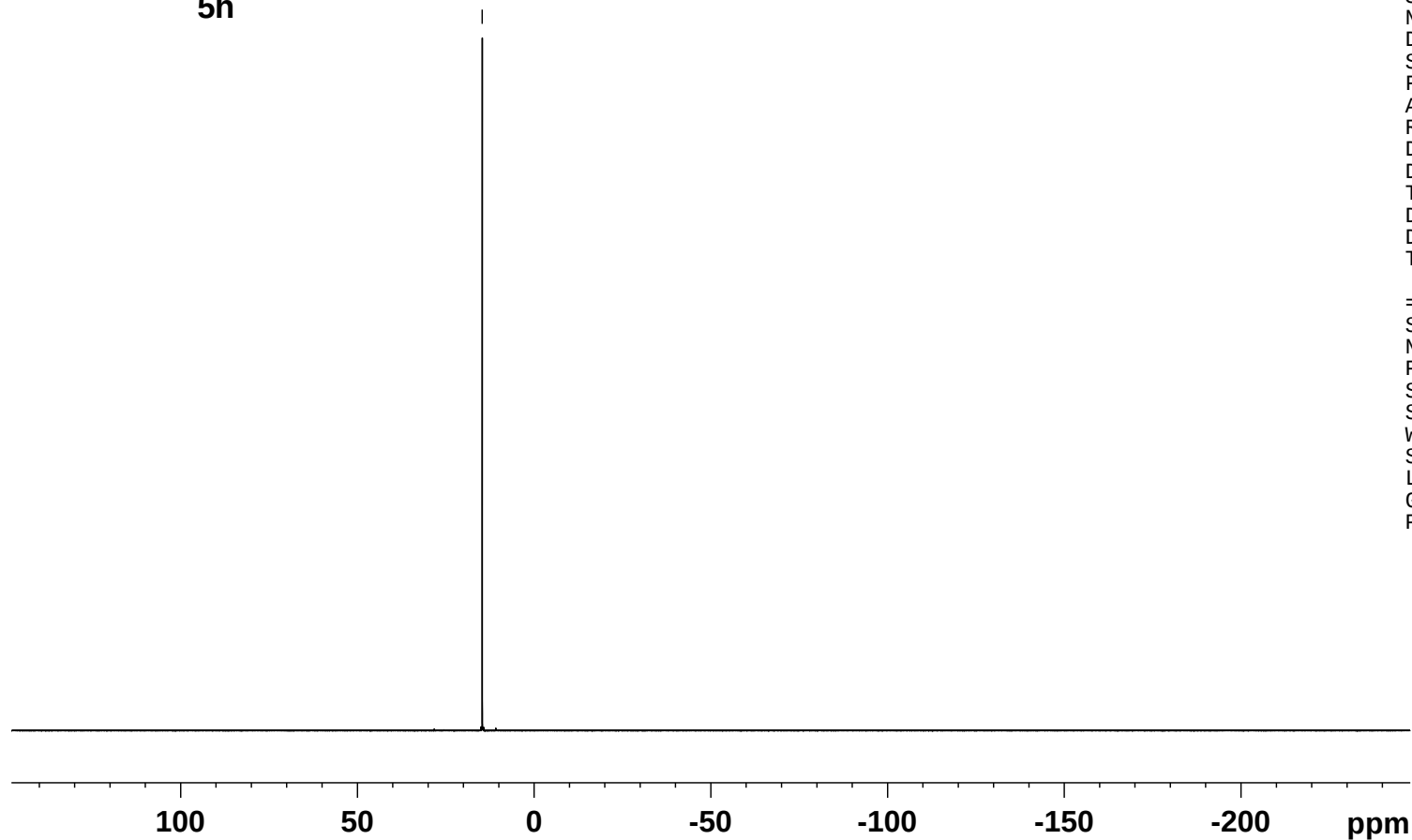


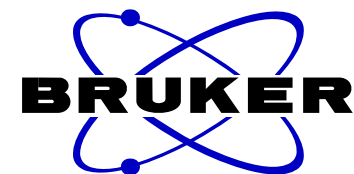
NAME cy-205b-p
EXPNO 3
PROCNO 1
Date_ 20171017
Time 10.14
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 296.3 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



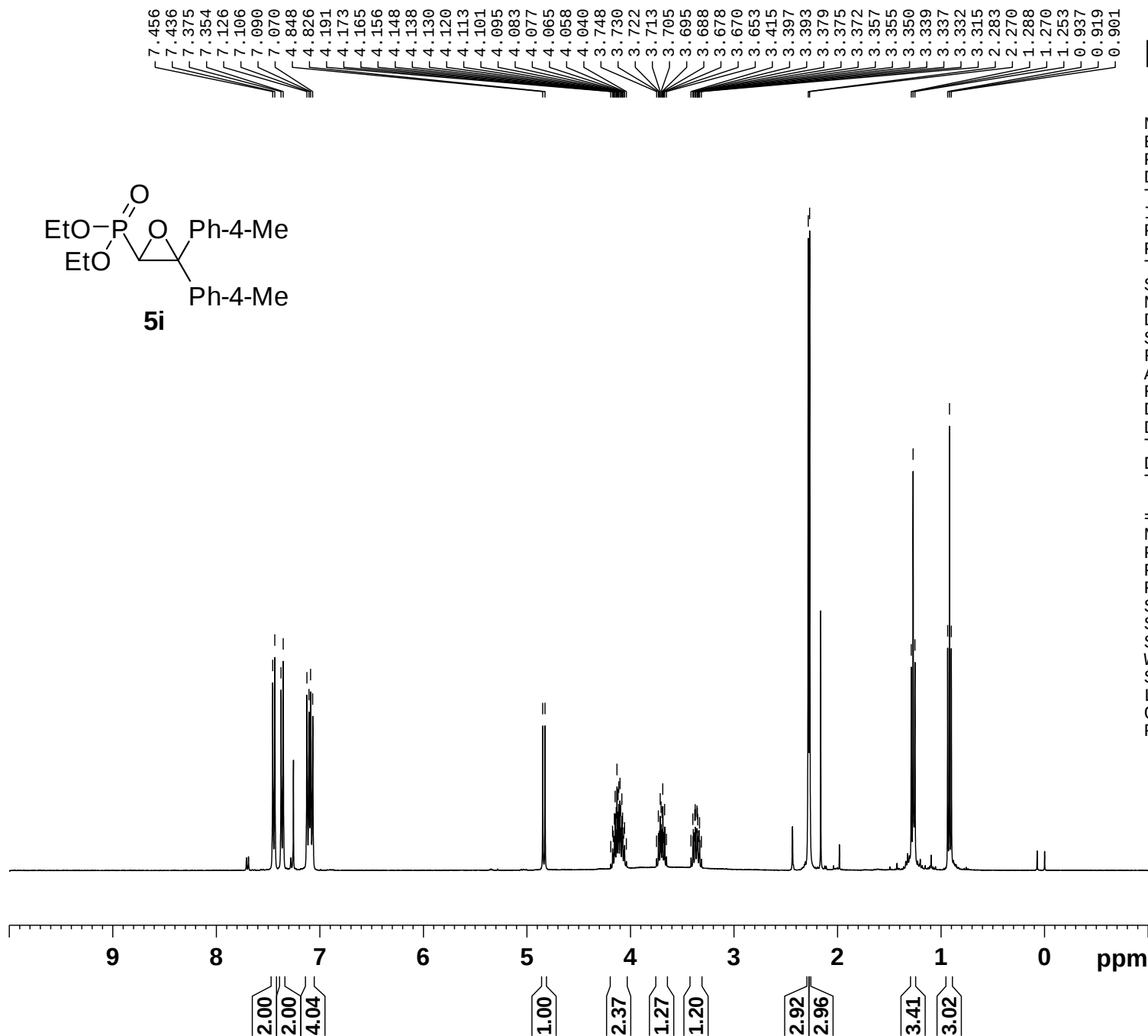
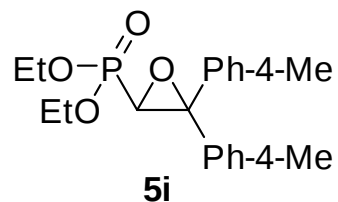
— 14.695

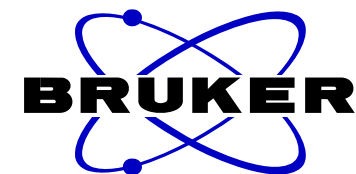




NAME cy-195ap-20171007
EXPNO 1
PROCNO 1
Date_ 20171007
Time 20.33
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 181
DW 78.200 usec
DE 6.50 usec
TE 297.0 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300114 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

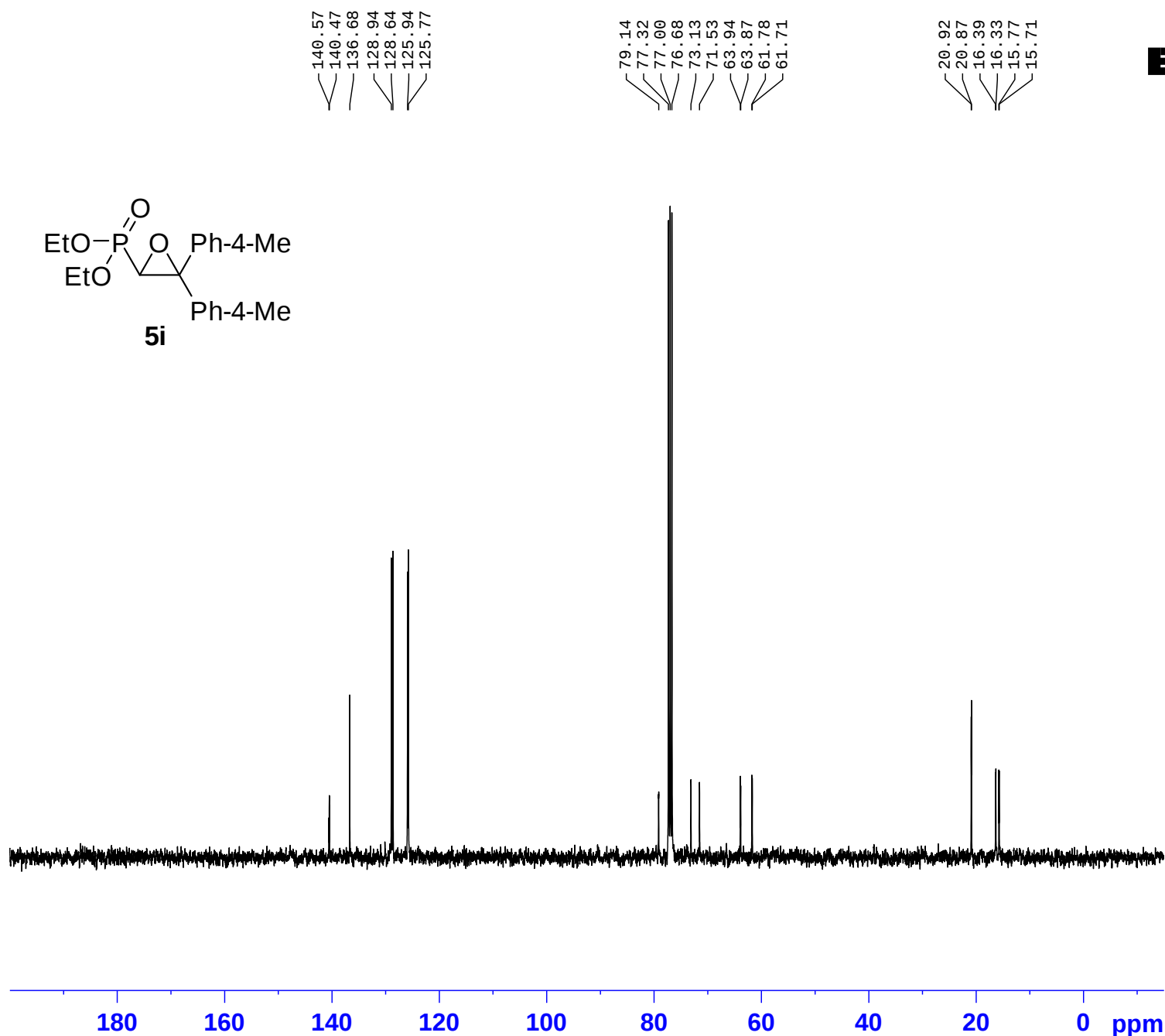
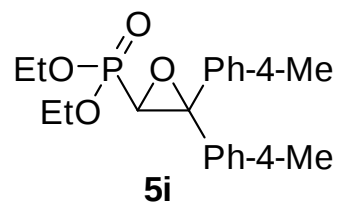


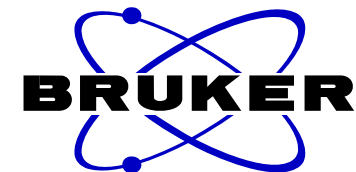


NAME cy-195ap-20171007
 EXPNO 2
 PROCNO 1
 Date_ 20171007
 Time 20.38
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 96
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 297.6 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

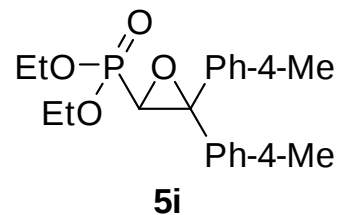
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127740 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40



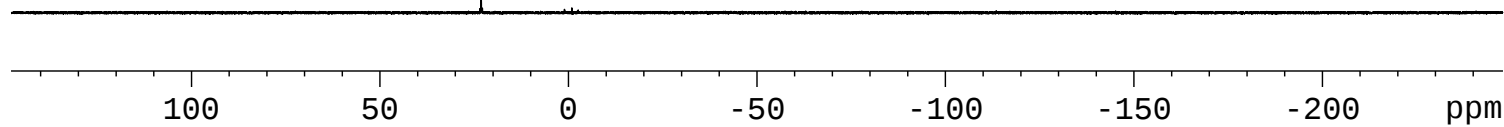


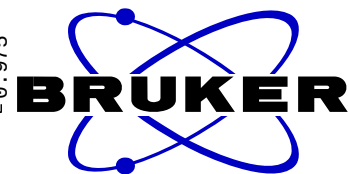
NAME cy-195ap
EXPNO 3
PROCNO 1
Date_ 20171013
Time 10.14
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



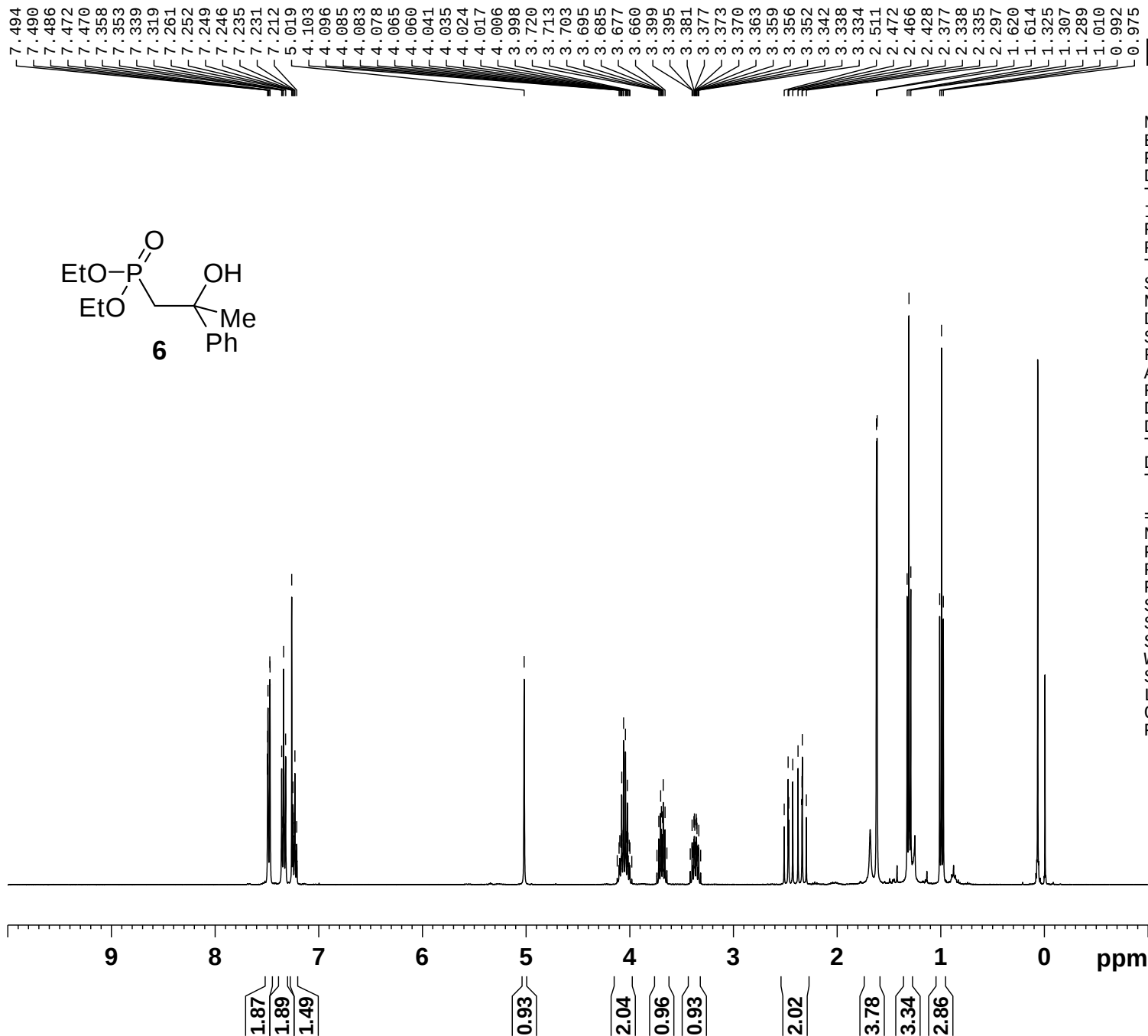
— 23.158

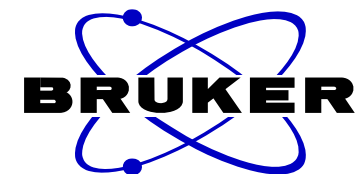




NAME cyj84-20171026
EXPNO 1
PROCNO 1
Date_ 20171026
Time 21.15
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 228
DW 78.200 usec
DE 6.50 usec
TE 294.6 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1300096 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

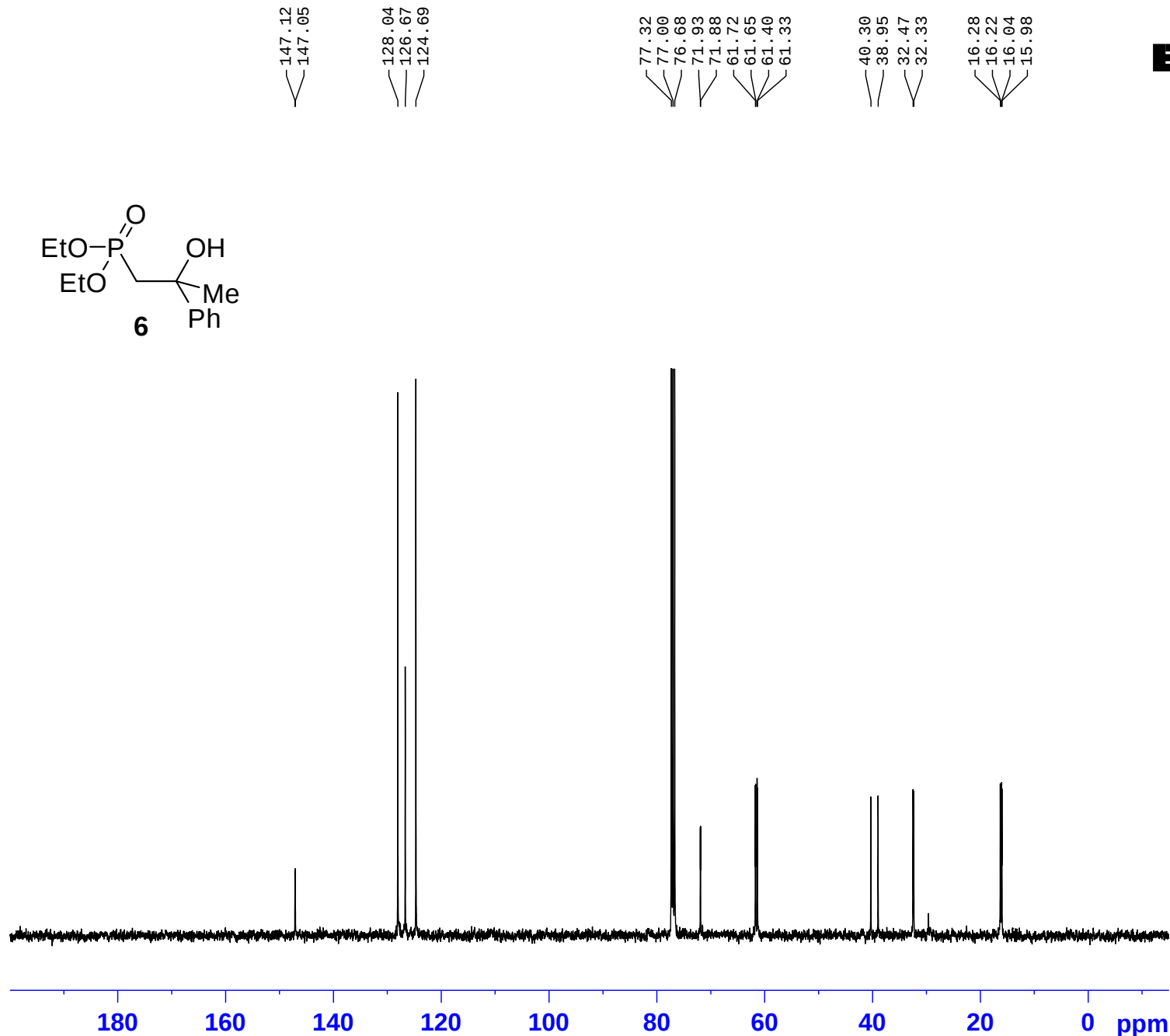
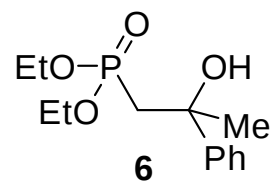


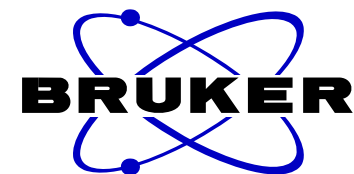


NAME cyj-84p-20171028
 EXPNO 2
 PROCNO 1
 Date_ 20171028
 Time 17.53
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 176
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.8 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

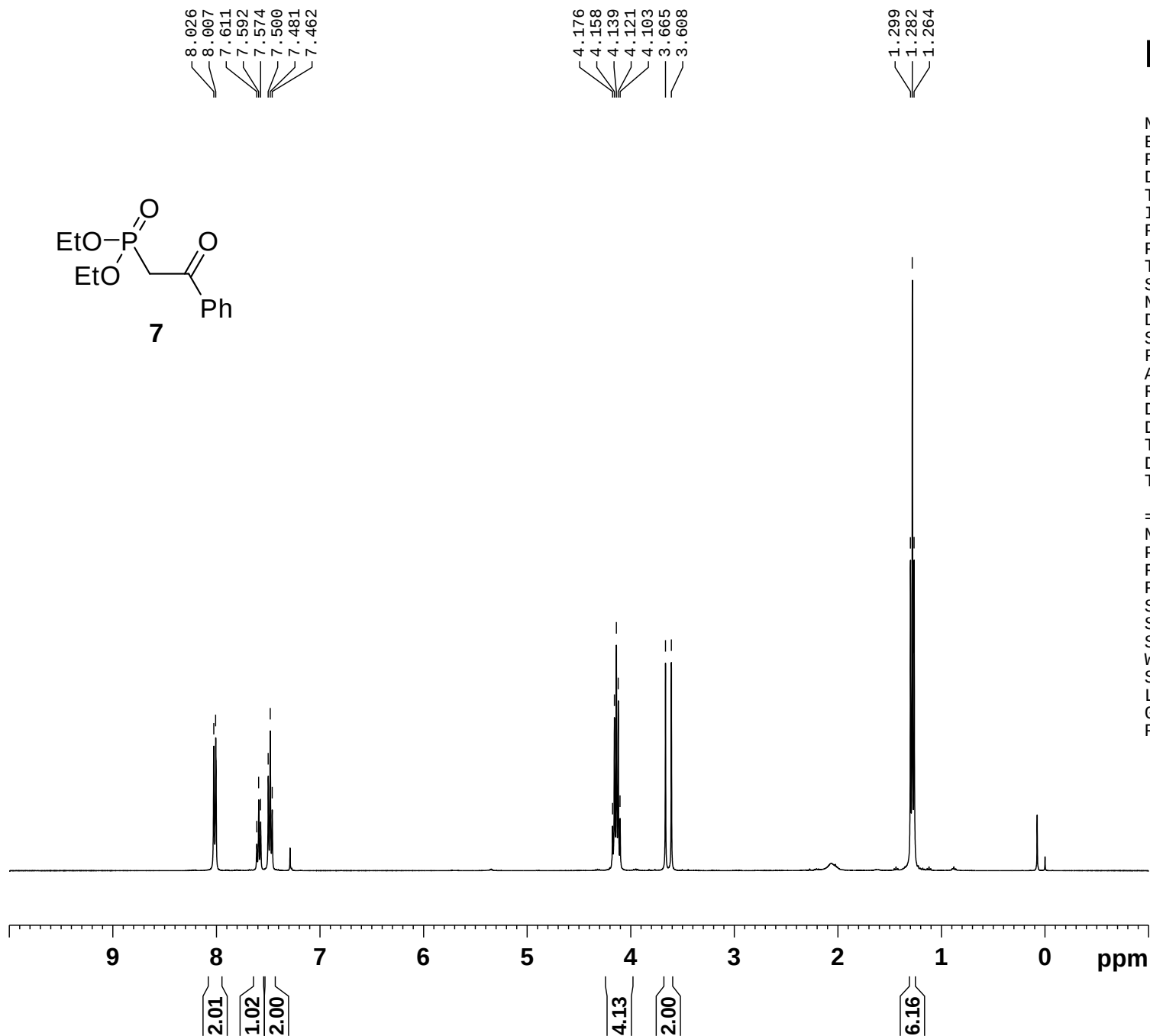
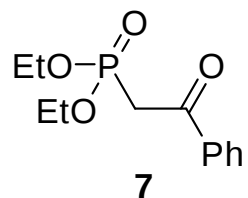
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127764 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

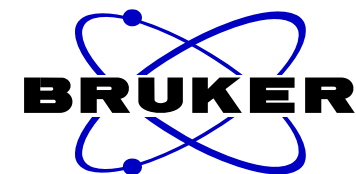




NAME cy-204-20171016
EXPNO 1
PROCNO 1
Date_ 20171016
Time 9.33
INSTRUM spect
PROBHD 5 mm PADUL 13C
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 128
DW 78.200 usec
DE 6.50 usec
TE 298.4 K
D1 1.00000000 sec
TD0 1

===== CHANNEL f1 =====
NUC1 1H
P1 13.10 usec
PL1 1.80 dB
PL1W 8.92857742 W
SF01 400.1326008 MHz
SI 32768
SF 400.1299980 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



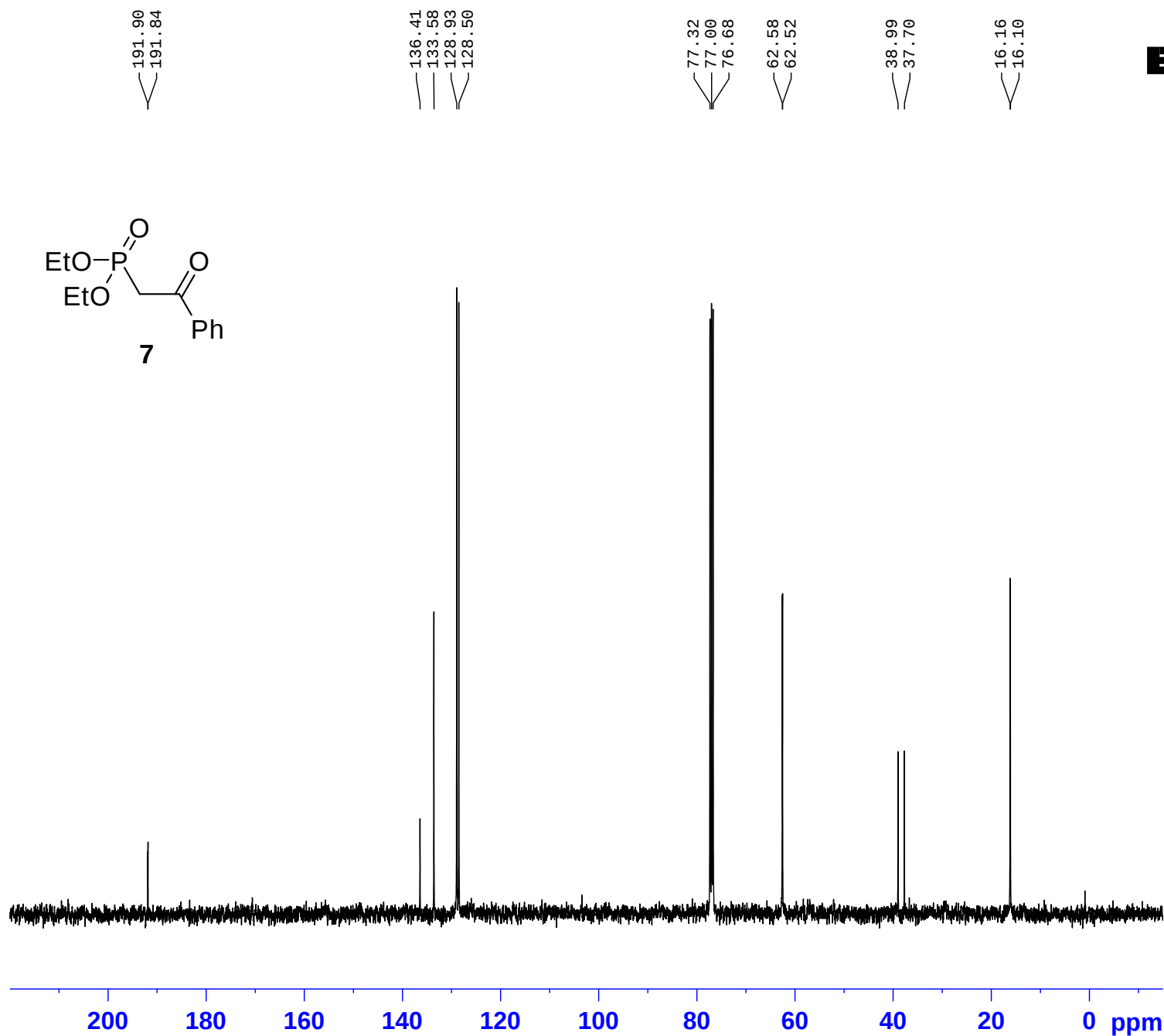
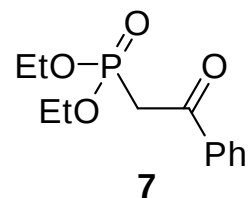


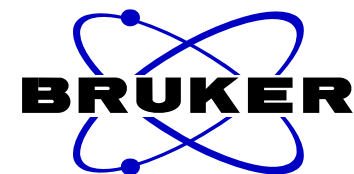
NAME cy-204p-20171018

EXPNO 2
 PROCNO 1
 Date_ 20171018
 Time 16.37
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 56
 DS 4
 SWH 25252.525 Hz
 FIDRES 0.385323 Hz
 AQ 1.2976629 sec
 RG 2050
 DW 19.800 usec
 DE 8.00 usec
 TE 295.3 K
 D1 2.00000000 sec
 D11 0.03000000 sec
 TD0 10

===== CHANNEL f1 =====
 NUC1 13C
 P1 13.50 usec
 PL1 3.00 dB
 PL1W 43.93649673 W
 SF01 100.6238364 MHz

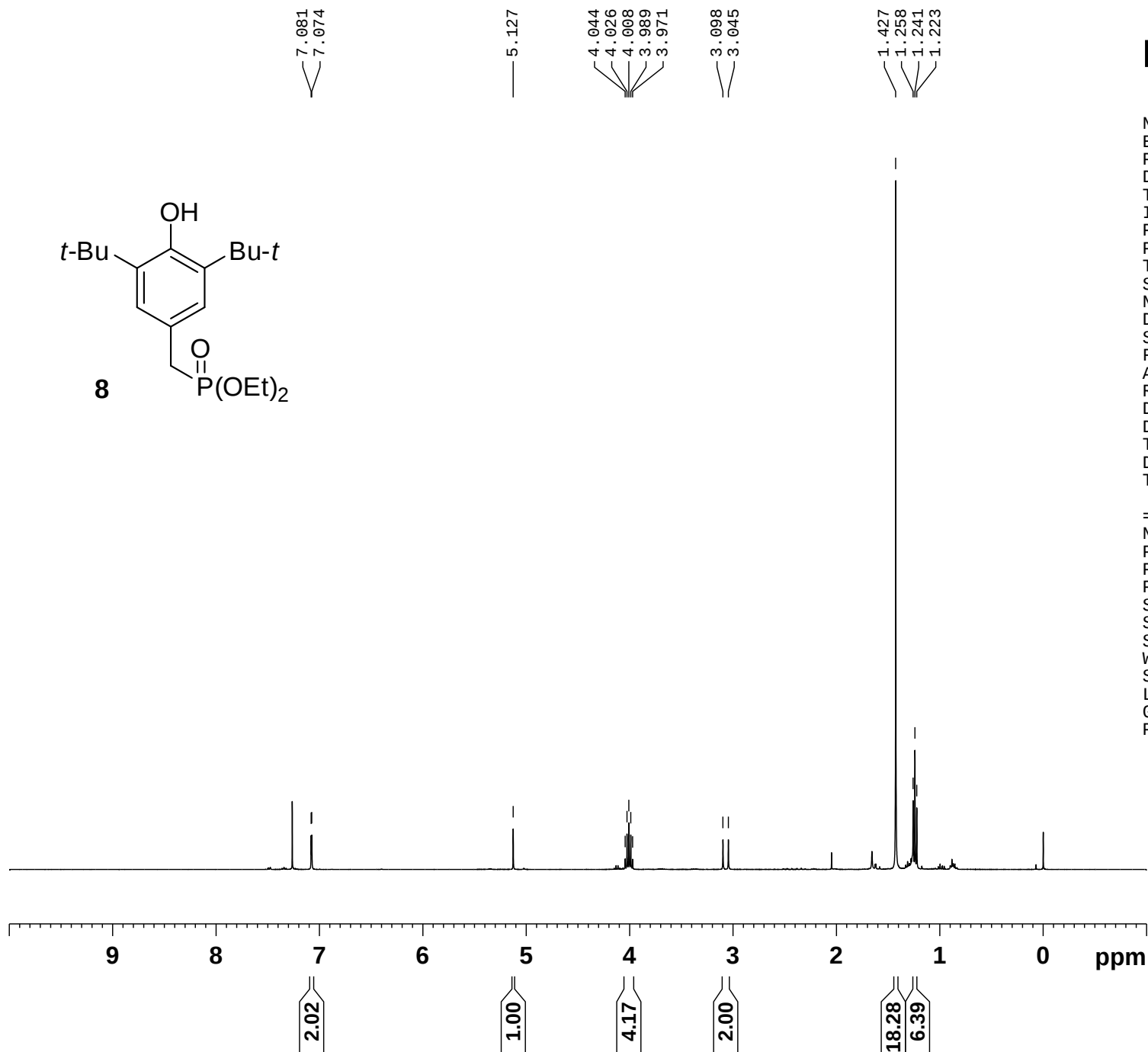
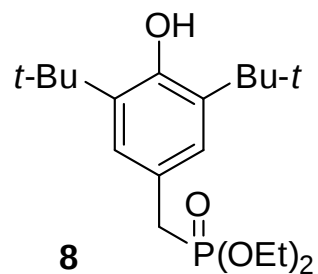
===== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 1.80 dB
 PL12 17.19 dB
 PL13 18.46 dB
 PL2W 8.92857742 W
 PL12W 0.25809658 W
 PL13W 0.19265592 W
 SF02 400.1316005 MHz
 SI 32768
 SF 100.6127787 MHz
 WDW EM
 SSB 0
 LB 3.00 Hz
 GB 0
 PC 1.40

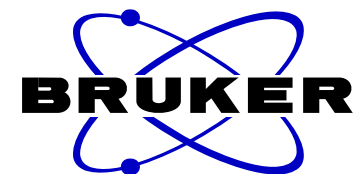




NAME cy-207b-3p-20171028
 EXPNO 1
 PROCNO 1
 Date_ 20171028
 Time 19.18
 INSTRUM spect
 PROBHD 5 mm PADUL 13C
 PULPROG zg30
 TD 32768
 SOLVENT CDCl3
 NS 8
 DS 0
 SWH 6393.862 Hz
 FIDRES 0.195125 Hz
 AQ 2.5625076 sec
 RG 256
 DW 78.200 usec
 DE 6.50 usec
 TE 294.7 K
 D1 1.00000000 sec
 TD0 1

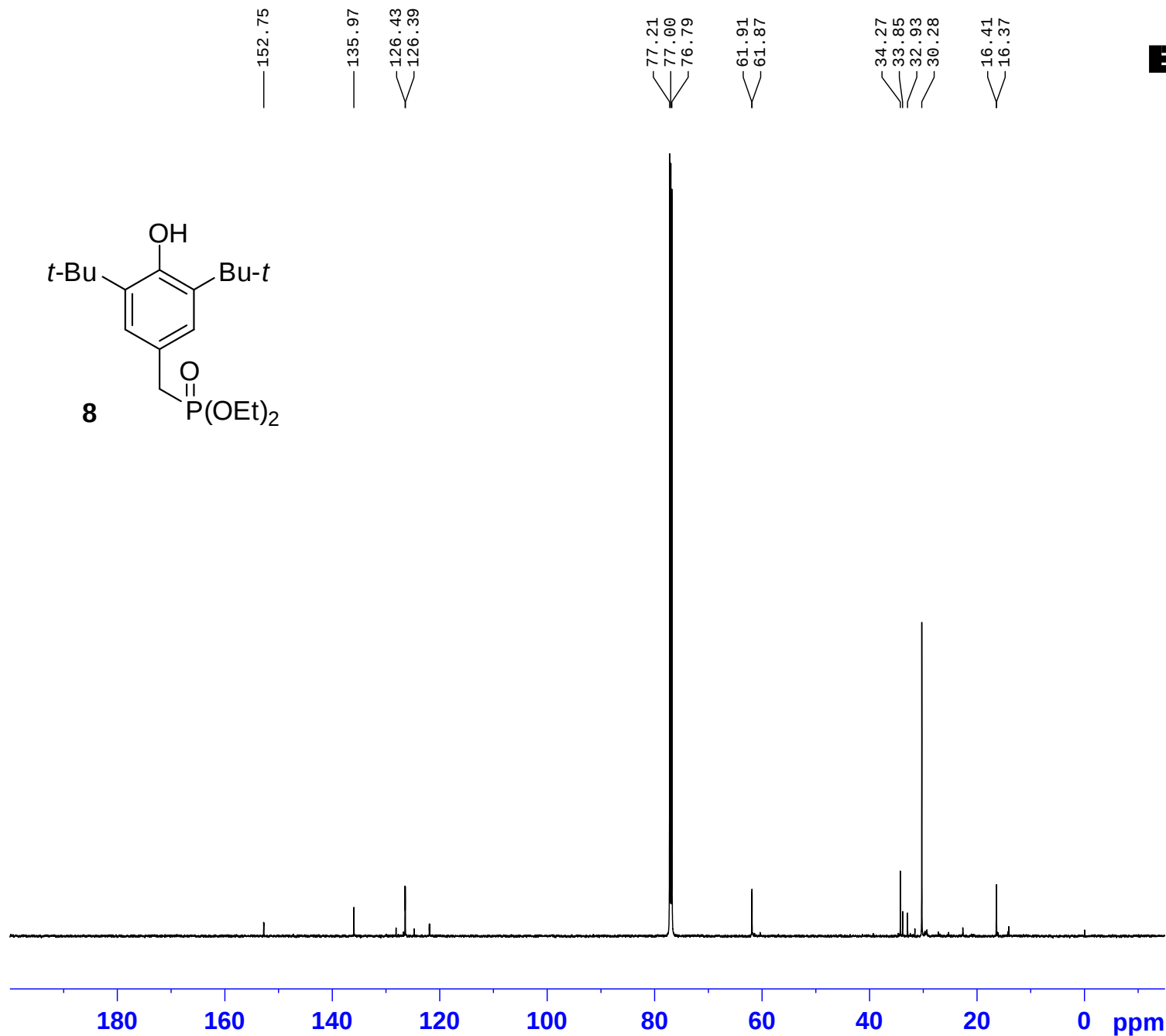
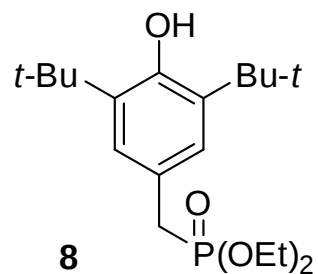
===== CHANNEL f1 =====
 NUC1 1H
 P1 13.10 usec
 PL1 1.80 dB
 PL1W 8.92857742 W
 SF01 400.1326008 MHz
 SI 32768
 SF 400.1300085 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

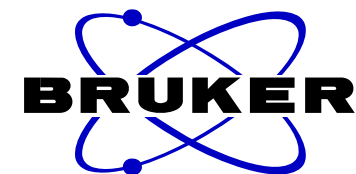




NAME cy-207b-3p
EXPNO 2
PROCNO 1
Date_ 20171031
Time 9.58
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 2856
DS 4
SWH 37878.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 190.02
DW 13.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 3

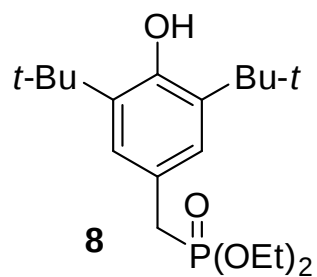
===== CHANNEL f1 =====
SF01 150.9294669 MHz
NUC1 13C
P1 11.90 usec
SI 32768
SF 150.9128686 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40





NAME cy-207b-3p
EXPNO 3
PROCNO 1
Date_ 20171031
Time 9.53
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 64
DS 4
SWH 96153.844 Hz
FIDRES 1.467191 Hz
AQ 0.3408372 sec
RG 190.02
DW 5.200 usec
DE 6.50 usec
TE 0.0 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

===== CHANNEL f1 =====
SF01 242.9411216 MHz
NUC1 31P
P1 11.90 usec
SI 32768
SF 242.9532693 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



27.369

