Mn-Catalyzed Azidation-Peroxidation of Alkenes

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Contents

1. General information

^{1}H 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 $CDCl_3$). $CDCl_3$ 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 **2c, 2o** [1]**, 2l** [2], **2p**, **2q** [3] were prepared according to the reported literatures.

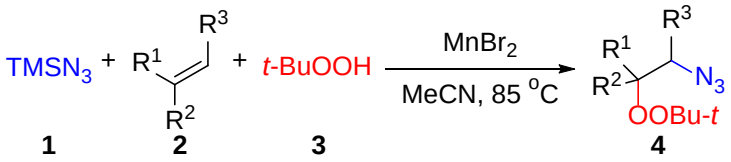
CAUTION-1: Mixing a metal salt and peroxide can cause explosion. See: Jones, A. K.; Wilson, T. E.; Nikam, S. S. *In Encyclopedia of Reagents for Organic Synthesis*, Paquette, L. A. Ed.; John Wiley & Sons, Inc. **1995**, *2*, 880.

CAUTION-2: Organic azides are potentially explosive substances that can decompose with the slight input of energy from external sources (heat, light, pressure, etc.). When choosing alkenes as substrates to prepare organic azides, we keep in mind the following equation.

$[N(C) + N(O)]/N(N) \geq 3$

See H. C. Kolb, M. G. Finn, K. B. Sharpless, *Angew. Chem. Int. Ed.* **2001**, *40*, 2004.

2. General procedure for synthesis of 4, 7, 9

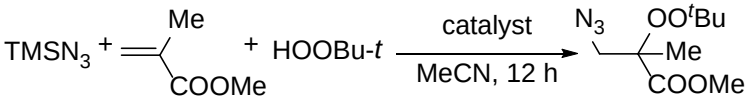


1 **2** **3** **4**

To a dry Schlenk tube were added $TMSN_3$**1** (2.5 mmol), alkene **2** (0.5 mmol), $Cu(OAc)_2$ (0.025 mmol), and anhydrous MeCN (2.0 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 85 ^oC for 12 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**, **7, 9.**

3.Optimization of the three-component reaction conditions

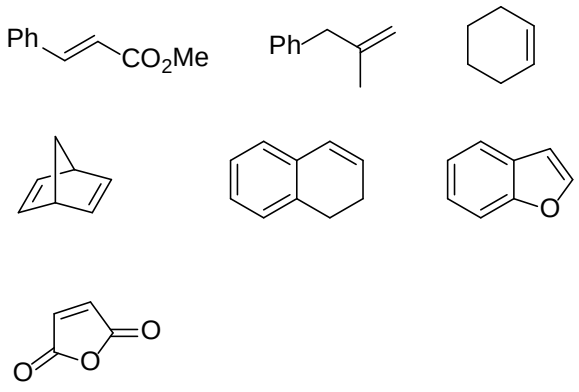
Table S1 Optimization of the three-component reaction conditions[a]



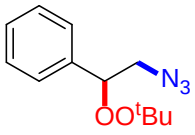
Entry	Catalyst	Yields (%)
1	CuBr	7
2	$MnCl_2$	31
3	$Mn(acac)_2$	41
4	$Mn(OAc)_2$	44
5	$MnBr_2$	51
6	MnO_2	36
7	$Mn(acac)_3$	37
8	$Mn(OAc)_3 \cdot 2H_2O$	37
9	$Co(acac)_3$	17
10	$FeCl_3$	14
11	$AgNO_3$	14

Reaction conditions: $TMSN_3$ (3 equiv), methyl methacrylate (0.5 mmol), TBHP (in decane; 5 equiv), catalyst (5 mol %), and solvent (2.0 mL) at 85 ^oC under N_2 atmosphere for 12 h. The yields were based on 2a and determined by ^1H NMR using an internal standard.

4. Substrates which did not undergo azidation-proxidation

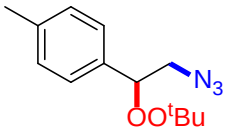


5. Characterization of 4



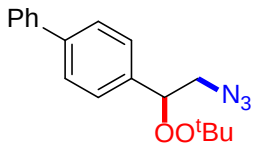
4a

(2-Azido-1-(*tert*-butylperoxy)ethyl)benzene (4a): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 62% yield (73mg); Colorless oil; IR (KBr):ν_{max}2980, 2927, 2102, 1619, 1454, 1386, 1364, 1255, 1096, 1059, 873, 756, 699 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.37-7.32 (m, 5H), 5.06 (dd, *J* =7.2 Hz, 4.4 Hz, 1H), 3.59 (dd, *J* = 13.2 Hz, 7.2 Hz, 1H), 3.44 (dd, 13.2 Hz, *J* = 4.4 Hz, 1H),1.26(s, 9H);^{13}C NMR (100 MHz,$CDCl_3$) δ 137.8, 128.5, 128.6, 126.9, 84.7, 80.3, 54.1, 26.3; HRMS (ESI) calcd for $C_{12}H_{17}N_3O_2Na(M+Na)^+$: 25.8.1213; found:258.1208, calcd for $C_{12}H_{17}NO_2Na$ $(M-N_2+Na)^+$: 208.1332; found:208.1332.



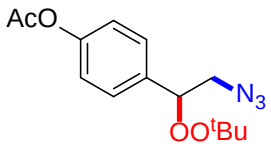
4b

1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-4-methylbenzene (4b): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 51% yield (64mg); Colorless oil; IR (KBr): ν_{max} 2979, 2927, 2101, 1515, 1451, 1362, 1255, 1193, 1021, 871, 812, 766, 666 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.16-7.08 (m, 4H), 4.94 (q, *J* = 7.2 Hz, 4.8 Hz,1H), 3.50 (dd, *J* = 13.2 Hz,7.2 Hz, 1H), 3.34 (dd, *J* = 13.2 Hz,4.8 Hz, 1H), 2.26 (s, 3H), 1.17 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.2, 134.7, 129.1, 126.8, 84.5, 80.7, 54.0, 26.3, 21.1; HRMS (ESI) calcd for $C_{13}H_{19}N_3O_2Na$ $(M+Na)^+$: 272.1369; found: 272.1364.



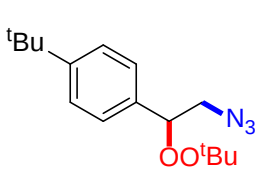
4c

4-(2-Azido-1-(*tert*-butylperoxy)ethyl)-1,1'-biphenyl (4c): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 56% yield (87mg); Colorless oil; IR (KBr): ν_{max} 2979, 2101, 1658, 1598, 1483, 1363, 1267, 1194, 914, 755, 692 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.60-7.57 (m, 4H), 7.45-7.41 (m, 4H), 7.36-7.32 (m, 1H), 5.11 (dd, J =7.2 Hz, 4.4 Hz, 1H), 3.62 (dd, J =13.2 Hz, 7.2 Hz, 1H), 3.48 (dd, J = 13.2 Hz, 4.4 Hz, 1H), 1.28 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.4, 140.7, 136.8, 128.8, 127.4, 127.3, 127.2, 127.1, 84.5, 80.9, 54.0, 26.4. HRMS (ESI) calcd for $C_{18}H_{21}N_3O_2$ $(M+Na)^+$: 334.1526; found: 334.1519.



4d

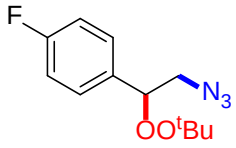
1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-4-methoxybenzene (4d): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 65% yield (95 mg); Colorless oil; IR (KBr): ν_{max} 2981, 2102, 1763, 1603, 1508, 1442, 1367, 1108, 1015, 911, 864, 651 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.37-7.34 (m, 2H), 7.10-7.08 (m, 2H),5.06 (dd, J = 7.2 Hz, 4.4 Hz,1H), 3.55 (dd, J = 13.2 Hz, 7.2 Hz, 1H), 3.41 (dd, J = 13.2 Hz, 4.4 Hz, 1H), 2.28 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.2, 150.5, 135.3, 127.8, 121.5, 84.1, 80.8, 53.9, 26.2, 21.0; HRMS (ESI) calcd for $C_{14}H_{19}N_3O_4Na$ $(M+Na)^+$: 312.1268; found: 312.1255.



4e

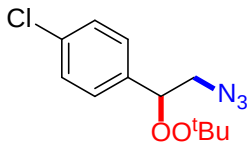
1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-4-(tert-butyl)benzene (4e): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 69% yield

(100 mg); Colorless oil; IR (KBr): ν_{max} 2965, 2100, 1630, 1460, 1362, 1268, 1193, 1022, 912, 873, 764 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.39-7.37 (m, 2H), 7.28-7.26 (m, 2H), 5.04 (dd, J = 6.8 Hz,4.4 Hz, 1H), 3.59 (dd, J = 13.2 Hz, 7.2 Hz, 1H), 3.46 (dd, J = 13.2 Hz, 4.8 Hz, 1H), 1.31 (s, 9H) ,1.27 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.3, 134.7, 126.6, 126.4, 84.5, 80.8, 54.0, 34.6, 31.3, 26.4; HRMS (ESI) calcd for $C_{16}H_{25}N_3O_2Na$ $(M+Na)^+$:314.1839; found: 312.1830.



4f

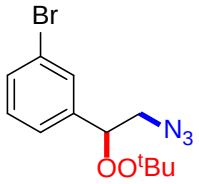
1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-4-fluorobenzene (4f): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 68% yield (86 mg); Colorless oil; IR (KBr): ν_{max} 2980, 2102, 1606, 1511, 1449, 1363, 1229, 1192, 1096, 1019, 867, 832, 668 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.27-7.23 (m, 2H), 7.10-6.96 (m, 2H),4.96 (dd, J = 7.2 Hz, 4.4 Hz,1H), 3.49 (dd, J = 13.2 Hz, 7.2 Hz, 1H), 3.34 (dd, J = 13.2 Hz,4.4 Hz, 1H), 1.18 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ162.7(d, J =246.0 Hz), 133.7, 128.6(d, J = 8.0 Hz), 115.4(d, J = 22.0Hz),83.9, 80.9, 53.9, 26.3; ^9F NMR (CDCl3, 376 MHz) δ-113.38; HRMS (ESI) calcd for $C_{12}H_{16}FN_3O_2Na$ $(M+Na)^+$: 276.1119; found: 276.1110.



4g

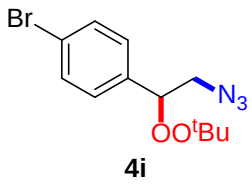
1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-4-chlorobenzene (4g): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 51% yield (69 mg); Colorless oil; IR (KBr): ν_{max} 2980, 2103, 1632, 1490, 1362, 1253, 1193, 1090, 1016, 869, 824, 547 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.35-7.27 (m, 4H),5.03 (dd, J = 7.6 Hz, 4.4 Hz,1H), 3.55 (dd, J = 13.2 Hz, 7.6 Hz, 1H), 3.42 (dd, J = 13.2 Hz, 4.4 Hz, 1H), 1.25 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 136.4, 134.2, 128.7, 128.2, 84.0, 81.0, 53.9, 26.3; HRMS (ESI) calcd for $C_{12}H_{16}ClN_3O_2Na$

$(M+Na)^+$: 292.0823; found: 292.0810.



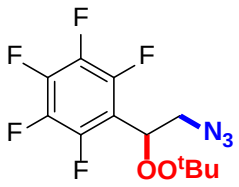
4h

1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-3-bromobenzene (4h): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 74% yield (117 mg); Colorless oil; IR (KBr): ν_{max} 2980, 2101, 1571, 1471, 1361, 1254, 1193, 1070, 912, 812, 750, 694 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.50-7.43 (m, 2H), 7.28-7.20 (m, 2H),5.02 (dd, J = 7.6 Hz, 4.4 Hz,1H), 3.53 (dd, J = 13.2 Hz, 7.2 Hz, 1H), 3.38 (dd, J = 13.2 Hz, 4.4 Hz, 1H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.3, 131.4, 130.0, 129.8, 125.4, 122.5, 84.0, 81.1, 53.9, 26.3; HRMS (ESI) calcd for $C_{12}H_{16}BrN_3O_2Na$ $(M+Na)^+$: 336.0318; found: 336.0318.



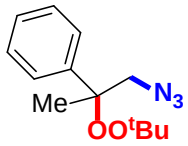
4i

1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-4-bromobenzene (4i): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 57% yield (89 mg); Colorless oil; IR (KBr): ν_{max} 2924, 2102, 1641, 1484, 1363, 1256, 1193, 1074, 1013, 869, 819 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.51-7.49 (m, 2H), 7.24-7.22 (m, 2H),5.02 (dd, J = 7.2 Hz, 4.8 Hz,1H), 3.54 (dd, J = 13.2 Hz,7.2 Hz, 1H), 3.40 (dd, J = 13.2 Hz, 4.4 Hz, 1H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 137.0, 131.6, 128.5, 122.4, 84.1, 81.0, 53.9, 26.3. HRMS (ESI) calcd for $C_{12}H_{16}BrN_3O_2Na$ $(M+Na)^+$: 336.0318; found: 336.0320.



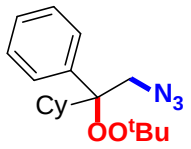
4j

1-(2-Azido-1-(*tert*-butylperoxy)ethyl)-2,3,4,5,6-pentafluorobenzene (4j): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 66% yield (108 mg); Colorless oil; IR (KBr): ν_{max} 2982, 2104, 1548, 1483, 1395, 1269, 1193, 1108, 801, 757 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 4.46 (dd, J = 8.4 Hz, 4.8 Hz, 1H), 3.98 (dd, J = 13.2 Hz, 8.4 Hz, 1H), 3.44 (dd, J =13.2 Hz, 4.8 Hz, 1H), 1.22 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.5(d, J =250.0Hz), 141.4(d, J =253.8 Hz), 137.5(d, J =251.8 Hz), 111.47(t, J =15.7 Hz),81.5, 76.1, 51.3, 26.1 ; ^9F NMR (CDCl3, 376 MHz) δ -141.18, -141.49, -141.52, -141.53, -152.85, -152.89, -152.92, -161.44, -161.45, -161.47, -161.49, -161.51, -161.52; HRMS (ESI) calcd for $C_{12}H_{12}F_5N_3O_2Na$ $(M+Na)^+$: 348.0742; found: 348.0734.



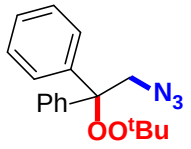
4k

(1- Azido-2-(*tert*-butylperoxy)propan-2-yl)benzene (**4k**): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, Rf = 0. 6) in 78% yield (97mg); Colorless oil; IR (KBr): νmax 2982, 2106, 1449, 1368, 1304, 1257, 1194, 1096, 867, 761, 698 cm-1; ^1H NMR (400 MHz, $CDCl_3$) δ 7.34-7.18 (m, 5H), 3.48 (d, J =12.8 Hz, 1H), 3.45(d, J =12.8 Hz, 1H), 1.55 (s, 3H) ,1.20 (s, 9H); 13C NMR (100 MHz, CDCl3) δ 142.2, 128.1, 127.5, 125.6, 83.6, 79.6, 57.4, 26.6, 22.4; HRMS (ESI) calcd for $C_{13}H_{19}N_3O_2Na$ (M+Na)+: 272.1369; found: 272.1365.



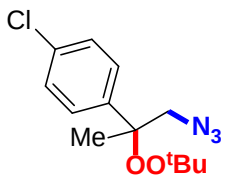
4l

(2-Azido-1-(*tert*-butylperoxy)-1-cyclohexylethyl)benzene (4l): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 69% yield (110 mg); Colorless oil; IR (KBr): ν_{max} 2931, 2857, 2103, 1448, 1363, 1265, 1195, 803, 766, 700 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.25-7.15 (m, 5H), 3.90 (d, J = 19.6 Hz, 1H), 3.87 (d, J = 18.8 Hz, 1H), 1.89-1.78 (m, 2H) , 1.60-1.46 (m, 4H), 1.26 (s, 9H) , 1.12-1.07 (m, 2H), 0.85-0.63 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.4, 127.3, 126.9, 126.7, 87.1, 79.7, 53.2, 43.7, 27.7, 26.7, 26.5, 26.3, 26.2,25.8; HRMS (ESI) calcd for $C_{18}H_{27}N_3O_2Na$ $(M+Na)^+$: 340.1995; found: 340.1986.



4m

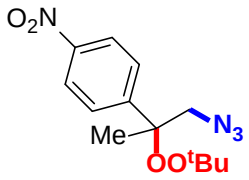
(2-Azido-1-(*tert*-butylperoxy)ethane-1,1-diyl)dibenzene (**4m**): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, Rf = 0. 6) in 76% yield (118mg); Colorless oil; IR (KBr): ν_{max} 2980, 2102, 1597, 1448, 1362, 1304, 1254, 1194, 875, 756, 697 cm^{-1}; ^1H NMR (400 MHz, CDCl3) δ 7.30-7.25 (m, 10H), 4.20 (s, 2H), 1.18 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.9, 127.8, 127.6, 127.2, 86.3,8 0.1, 55.6, 26.5; HRMS (ESI) calcd for $C_{18}H_{21}N_3O_2Na$ (M+Na)+:334.1526; found: 334.1515.



4n

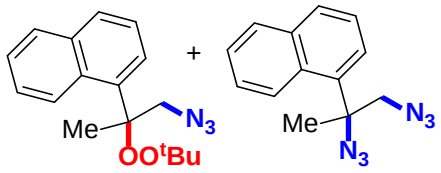
1-(1-Azido-2-(*tert*-butylperoxy)propan-2-yl)-4-chlorobenzene (4n): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 86%

yield (123 mg); Colorless oil; IR (KBr): ν_{max} 2981, 2104, 1490, 1452, 1366, 1303, 1265, 1194, 1096, 1015, 866, 824, 757 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.35-7.29 (m, 4H), 3.52 (d, J = 46.0 Hz, 1H), 3.49 (d, J = 46.0 Hz, 1H),1.60 (s, 3H) ,1.27 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.8, 133.3, 128.2, 127.2, 83.3, 79.8, 57.4, 26.5, 22.3; HRMS (ESI) calcd for $C_{13}H_{18}ClN_3O_2Na$ $(M+Na)^+$: 306.0980; found: 306.0975.



4o

1-(1-Azido-2-(*tert*-butylperoxy)propan-2-yl)-4-nitrobenzene (4o): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 58% yield (85mg); Colorless oil; IR (KBr): ν_{max} 2982, 2104, 1602, 1523, 1453, 1351, 1193, 1106, 854, 752, 698 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, J = 8.4 Hz, 2H), 7.60 (d, J = 8.8 Hz, 2H), 3.65 (d, J = 12.8 Hz, 1H), 3.51 (d, J = 13.2 Hz, 1H), 1.67 (s, 3H) ,1.30 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.6, 147.1, 126.8, 123.2, 83.5, 80.2, 57.3, 26.4, 22.4; HRMS (ESI) calcd for $C_{13}H_{18}N_4O_4Na$ $(M+Na)^+$: 317.1220; found: 317.1210.



4p **5a**

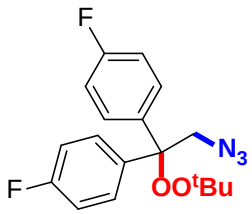
2-(1-Azido-2-(*tert*-butylperoxy)propan-2-yl)naphthalene (4p) and 2-(1,2-diazidopropan-2-yl)naphthalene (5a): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f= 0. 6) in 75% yield (106mg); **4q**/**5a**=3:1; Colorless oil; IR (KBr): ν_{max}2998, 2101, 1568, 1454, 1354, 1251, 1194, 1023, 819, 750 cm^{-1};

4p ^1H NMR (400 MHz, $CDCl_3$) δ 8.63(d, J = 8.4 Hz, 1H), 7.60 (d, J = 8.0 Hz, 1H), 3.89(d, J = 13.2 Hz, 1H), 3.71 (d, J = 12.8 Hz, 1H), 1.80 (s, 3H), 1.17 (s, 9H); HRMS

(ESI) calcd for $C_{17}H_{21}N_3O_2Na$ $(M+Na)^+$: 322.1526; found: 322.1518.

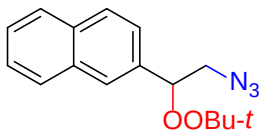
5a ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.55(d, J = 8.8 Hz, 1H), 7.76(d, J = 8.4 Hz, 1H), 3.83(d, J = 12.8 Hz, 1H), 3.50 (d, J = 12.8 Hz, 1H), 1.82 (s, 3H); HRMS (ESI) calcd for $C_{13}H_{12}N_6Na$ $(M+Na)^+$: 275.1016; found: 275.1009.

Overlap: 7.46-7.26 (m, 8H), 7.73-7.71 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 137.1, 134.6, 131.2, 130.3, 129.6, 129.3, 129.0, 126.6, 125.7, 125.6, 125.4, 125.2, 124.8, 124.7, 85.6,79. 6,67.3, 59.1, 57.1, 26.7, 23.6, 22.9.



4q

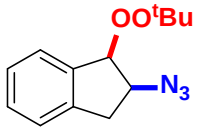
4,4'-(2-Azido-1-(*tert*-butylperoxy)ethane-1,1-diyl)bis(fluorobenzene) (4q): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 76% yield (132 mg); Colorless oil; IR (KBr): ν_{max} 2981, 2104,1660, 1603, 1508, 1451, 1363, 1232, 1193, 1077, 1016, 872, 833, 758 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.18-7.15 (m, 4H), 6.91-6.87 (m, 4H), 4.03 (s, 2H), 1.07 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.1(d, J = 246.0 Hz), 137.5 (d, J = 2.0 Hz), 132.4 (d, J = 10.0 Hz), 129.1 (d, J = 8.0 Hz), 115.6 (d, J = 22.0 Hz), 114.7 (d, J = 22.0 Hz), 114.5 (d, J = 24.80 Hz), 85.7, 80.3, 55.8, 26.4; ^{9}F NMR (CDCl3, 376 MHz) δ -114.04. HRMS (ESI) calcd for $C_{18}H_{19}F_2N_3O_2Na$ $(M+Na)^+$: 370.1338; found: 370.1326.



4r

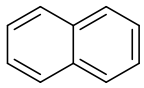
2-(2-Azido-1-(*tert*-butylperoxy)ethyl)naphthalene (**4r**): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 66% yield (94mg); white solid; IR (KBr): ν_{max} 2978, 2101, 1508, 1448, 1364, 1263, 1194, 1023, 819, 750 cm-1; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85-7.81 (m, 4H), 7.48-7.45 (m, 3H), 5.23 (dd,

J = 4.4 Hz, 7.6 Hz, 1H), 3.67 (dd, *J* = 7.6 Hz, 13.2 Hz, 1H), 3.49 (dd, *J* = 4.4 Hz, 13.2 Hz, 1H), 1.27 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 135.3, 133.3, 133.1, 128.2, 128.0, 127.7, 126.2, 124.3, 84.8, 80.9, 54.0, 26.3. HRMS (ESI) calcd for $C_{16}H_{19}N_3O_2Na$ $(M+Na)^+$: 308.1369; found: 308.1362.



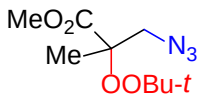
4s

2-Azido-1-(*tert*-butylperoxy)-2,3-*dihydro*-1H-indene (4s major): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 5) in 45% yield (56mg);_d.r. 7:1 (determined by ^{1}H NMR using Isolated product); Colorless oil; IR (KBr): ν_{max} 2979, 2105, 1657, 1596, 1265, 1195, 912, 752 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 7.44-7.22 (m, 5H), 5.39 (d, *J* = 3.6 Hz, 1H), 4.44 (ddt, J = 8.0 Hz, 5.2Hz, 3.6 Hz, 1H), 3.48 (dd, *J* = 7.6 Hz, 16.4 Hz, 1H), 2.83 (dd, *J* = 5.2 Hz, 16.4 Hz, 1H), 1.32 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) *δ* 140.9, 137.1, 129.6, 127.2, 126.0, 124.9, 91.5, 81.0, 65.7, 36.5, 26.4. HRMS (ESI) calcd for $C_{13}H_{17}N_3O_2Na$ $(M+Na)^+$: 270.1213; found: 270.1208.



5b

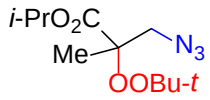
Naphthalene (5b)[4]: Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 8) in 37% yield (24mg); Colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 7.84-7.82 (m, 4H), 7.48-7.45 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) *δ* 133.5. 128.0, 125.9.



4w

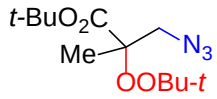
Methyl 3-azido-2-(*tert*-butylperoxy)-2-methylpropanoate (4w): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f= 0. 6) in 40% yield

(46mg); Colorless oil; IR (KBr): ν_{max} 2980，2106，1740，1635，1453，1427，1396，1375，1267，1117，745 cm-1; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.92 (d, J = 12.8 Hz, 1H), 3.75 (s, 3H), 3.34 (d, J = 13.2 Hz, 1H), 1.40 (s,3H), 1.23 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ171.8, 83.3, 80.6, 53.1, 52.1, 26.4, 18.9; HRMS (ESI) calcd for $C_9H_{17}N_3O_4Na$ $(M+Na)^+$: 254.1111; found:254.1107.



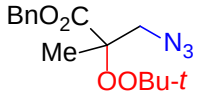
4x

Isopropyl 3-azido-2-(*tert*-butylperoxy)-2-methylpropanoate (4x): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f= 0. 6) in 43% yield (56mg); Colorless oil IR (KBr): ν_{max} 3415，3107，2106，1734，1625，1419，1383，1107，623 cm-1; ^{1}H NMR (400 MHz, $CDCl_3$) δ5.06-5.00 (m, 1H), 3.87(d, J = 12.8 Hz, 1H), 3.33 (d, J = 12.8 Hz, 1H), 1.34 (s, 3H), 1.25 (d, J = 3.6 Hz, 3H), 1.23 (d, J = 3.6 Hz, 3H), 1.21 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.8, 83.0, 80.3, 68.8, 53.1, 26.4, 21.6, 18.8; HRMS (ESI) calcd for $C_{11}H_{21}N_3O_4Na$$(M+Na)^+$:282.1424; found:282.1419.



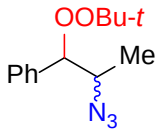
4y

***Tert*-butyl 3-azido-2-(*tert*-butylperoxy)-2-methylpropanoate (4y):** Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f= 0. 6) in 43% yield (46mg); Colorless oil; IR (KBr): ν_{max} 3410，3106，2106，1733，1420，1383，1127，622 cm-1; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.89 (d, J = 13.2Hz, 1H), 3.30 (d, J = 13.2 Hz, 1H), 1.48 (s, 9H), 1.35 (s, 3H), 1.25 (s, 9H), ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.5, 83.4, 81.7, 80.2, 53.1, 27.9, 26.5, 18.9; HRMS (ESI) calcd for $C_{12}H_{23}N_3O_4$ Na $(M+Na)^+$:296.1581; found:296.1575.



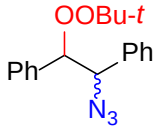
4z

Benzyl3-azido-2-(*tert*-butylperoxy)-2-methylpropanoate (4z): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f= 0. 6) in 46% yield (71mg); Colorless oil; IR (KBr): ν_{max} 3055，2984，2106，1741，1427，1413，1390，1272，1196，1121，966，857，747cm-1; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37-7.33 (m, 5H), 5.24 (d, *J* = 12.0 Hz, 1H), 5.16 (d, *J* = 12.4 Hz, 1H), 3.95 (d, *J* = 13.2 Hz, 1H), 3.38 (d, *J* = 13.2 Hz, 1H), 1.42 (s, 3H), 1.19 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.0, 135.4, 128.4, 128.2, 128.1, 83.2, 80.5, 66.7, 53.0, 26.3, 18.8; HRMS (ESI) calcd for $C_{15}H_{21}N_3O_4$ Na $(M+Na)^+$:330.1424; found:330.1418.



7

2-Azido-1-(*tert*-butylperoxy)propyl)benzene (7): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 71% yield (89mg); d.r. 2:1(determined by ^{1}H NMR using crude product); Colorless oil; IR (KBr): ν_{max} 2980, 2106, 1657, 1596, 1364, 1265, 1197, 913, 752, 699 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34-7.29 (m, 10H), 4.87 (d, *J* = 4.0 Hz, 1H), 4.78 (d, *J* = 7.6 Hz, 1H), 3.94-3.88 (m, 1H), 3.75-3.72 (m, 1H), 1.25 (s, 9H) ,1.22 (s, 9H), 1.16 (d, *J* = 6.8 Hz, 3H), 1.01 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.0, 136.8, 128.2, 128.1, 128.0, 127.6, 127.4, 89.1, 88.0, 80.6, 59.9, 59.2, 26.3, 16.3, 14.9; HRMS (ESI) calcd for $C_{13}H_{19}N_3O_2Na$ $(M+Na)^+$: 272.1369; found: 272.1364.

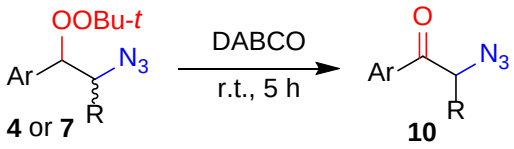


9

1-Azido-2-(*tert*-butylperoxy)ethane-1,2-diyl)dibenzene (9): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 59% yield (92 mg); d.r. 1:1(determined by ^{1}H NMR using crude product); Colorless oil; IR (KBr): ν_{max} 2980, 2105, 1614, 1454, 1361, 1256, 1195, 914, 754, 699, 654 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25-7.00 (m, 20H), 5.12 (d, *J* =35.2 Hz, 1H), 5.06 (d, J

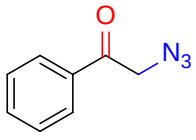
=35.2 Hz, 1H), 5.02(d, *J* =133.2 Hz, 1H), 4.73 (d, *J* =133.2 Hz, 1H), 1.23 (s, 9H), 1.18 (s, 9H) ; ^{13}C NMR (100 MHz, $CDCl_3$) δ 137.2, 136.2, 135.8, 135.7, 130.0, 129.2, 128.9, 128.13, 128.08, 128.0,127.9, 127.8, 127.7, 127.6, 127.55, 127.5, 94.0, 89.0, 88.7, 80.9, 68.7, 67.1, 26.4, 26.3; HRMS (ESI) calcd for $C_{18}H_{21}N_3O_2Na(M+Na)^+$: 334.1526; found: 334.1516.

6. General procedure for synthesis of 10



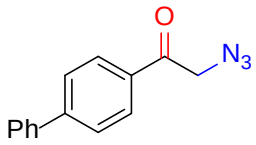
To a dry Schlenk tube were added DABCO (0.9 mmol), azidation-proxidation products **4** or **7** (0.3 mmol) and anhydrous MeCN (2.0 mL) under N_2 atmosphere at room temperature. Subsequently, the resulting solution was stirred at room temperature for 5 h. The solvent was evaporated under vacuum and the residue was purified by flash column chromatography on silica gel (eluent: ethylacetate/ petroleum ether) to give the α-azido carbonyls **10**.

7. Characterization of 10



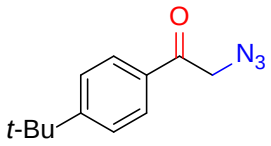
10a

2-Azido-1-phenylethan-1-one (**10a**):[5] Isolated by flash column chromatography (ethyl acetate/petroleum ether = 5:1, R_f = 0. 5) in 84% yield (41mg); Colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91-7.89 (m, 2H), 7.64-7.60 (m, 1H), 7.52-7.48 (m, 2H), 4.56 (s, 2H) ; ^{13}C NMR (100 MHz, $CDCl_3$) δ 193.2, 134.3, 133.0, 128.9, 127.8, 54.8 ;



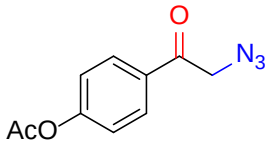
10b

1-([1,1'-Biphenyl]-4-yl)-2-azidoethan-1-one (**10b**): Isolated by flash column chromatography (ethyl acetate/petroleum ether = 5:1, R_f = 0. 6) in 72% yield (51mg); white solid; IR (KBr): ν_{max} 2905, 2362, 2098, 1682, 1451, 1341, 1273, 1229, 910, 835, 756, 685 cm-1; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98-7.96 (m, 2H), 7.72-7.70 (m, 2H), 7.63-7.61 (m, 2H), 7.50-7.40 (m, 3H), 4.58 (s, 2H) ; ^{13}C NMR (100 MHz, $CDCl_3$) δ 192.7, 146.8, 139.4, 133.0, 129.0, 128.5, 127.5, 127.2, 54.8 ; HRMS (ESI) calcd for $C_{14}H_{11}N_3ONa$ (M+Na)+: 260.0794; found: 260.0794.



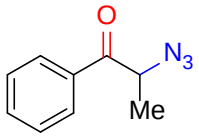
10c

2-Azido-1-(4-(tert-butyl)phenyl)ethan-1-one (**10c**):[5] Isolated by flash column chromatography (ethyl acetate/petroleum ether = 5:1, R_f = 0. 5) in 52% yield (34mg); Colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 4.4 Hz, 2H), 7.51(d, *J* = 4.4 Hz, 2H), 4.54 (s, 2H), 1.35 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 192.8, 158.1, 131.8, 127.9, 125.9, 54.8, 35.3, 31.0, 29.7.



10d

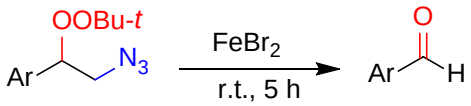
4-(2-Azidoacetyl)phenyl acetate (**10d**):[5] Isolated by flash column chromatography (ethyl acetate/petroleum ether = 5:1, R_f = 0. 5) in 44% yield (29mg); Colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 32 Hz, 2H), 7.23 (d, *J* = 4.0 Hz, 2H), 4.54 (s, 2H), 2.33 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 192.0, 168.6, 155.0, 131.8, 129.5, 122.2, 54.7, 21.0.



10e

2-Azido-1-phenylpropan-1-one (**10e**):[6] Isolated by flash column chromatography (ethyl acetate/petroleum ether = 5:1, R_f = 0. 6) in 78% yield (41mg); Colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95-7.93 (m, 2H), 7.64-7.59 (m, 1H), 7.52-7.48 (m, 2H), 4.72 (q, J = 10.4 Hz, 3.6 Hz, 1H), 1.57 (d, J = 2.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.6, 134.2, 133.8, 128.8, 128.5, 58.3, 16.4.

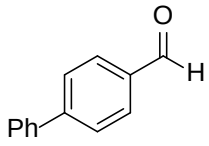
8. General procedure for synthesis of 11



4 **11**

To a dry Schlenk tube were added $FeBr_2$ (0.36 mmol), azidation-proxidation products **4** (0.3 mmol) and anhydrous MeCN (2.0 mL) under N_2 atmosphere at room temperature. Subsequently, the resulting solution was stirred at room temperature for 5 h. The solvent was evaporated under vacuum and the residue was purified by flash column chromatography on silica gel (eluent: ethylacetate/ petroleum ether) to give the aldehydes or ketones **11**.

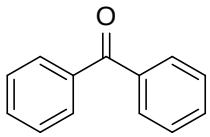
9. Characterization of 11



11a

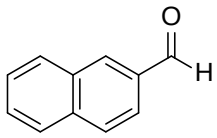
[1,1'-Biphenyl]-4-carbaldehyde (**11a**):[7]Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 8) in 75% yield (41mg); Colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.0 (s, 1H), 7.89 (d, J = 8.4 Hz, 2H), 7.69 (d, J = 8.4 Hz, 2H), 7.59 (d, J = 7.2 Hz, 2H), 7.46-7.38 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$)

δ 191.7, 146.9, 139.5, 135.0, 130.1, 128.8, 128.3, 127.5, 127.2;



11b

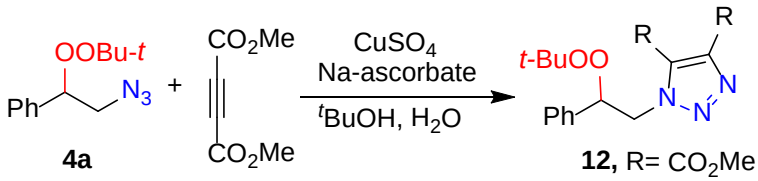
Benzophenone (**11b**):[8]Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 64% yield (35mg); white solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, J = 7.6 Hz 4H), 7.47 (t, J = 6.8 Hz, 2H), 7.37 (t, J = 7.6 Hz, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.7, 137.0, 131.8, 129.4, 127.7.



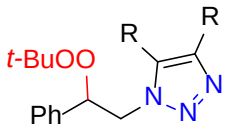
11c

2-Naphthaldehyde (**11c**):[9]Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 71% yield (33mg); white solid;^{1}H NMR (400 MHz, $CDCl_3$) δ 10.1 (s, 1H), 8.17 (s, 1H), 7.88-7.86 (m, 2H), 7.81-7.78 (m, 2H), 7.57-7.47 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 191.9, 136.1, 134.2, 133.8, 132.3, 129.2, 128.8, 128.7, 127.8, 126.8, 122.4;

10.Procedure for synthesis of 12 and Characterization of 12



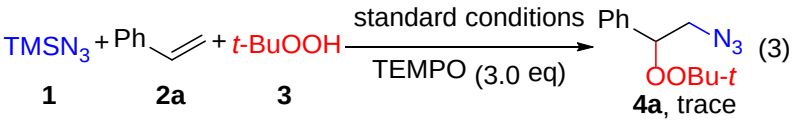
To a dry Schlenk tube were added CuSO4 (0.06 mmol), Na-ascorbate (0.9 mmol), ^{t}BuOH (1.5ml), and H_2O (2.0 mL) at room temperature. Subsequently, **4a** (0.3 mmol) and dimethyl succinate (0.6 mmol) was added to the mixture, and the resulting solution was stirred at room temperature. for 12 h. The solvent was evaporated under vacuum. The residue was purified by flash column chromatography on silica gel (eluent: ethylacetate/ petroleum ether) to give the peroxide **12**.



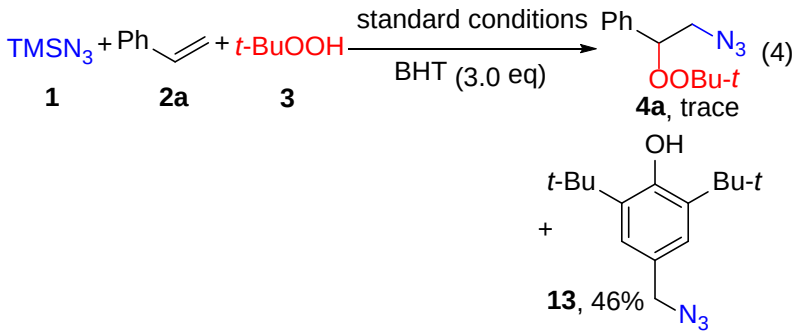
12, R= CO_2Me

Dimethyl1-(2-(*tert*-butylperoxy)-2-phenylethyl)-1H-1,2,3-triazole-4,5-dicarboxylate (**12**):Isolated by flash column chromatography (DCM/CH3OH = 20:1, R_f = 0. 2) in 69% yield (75mg); white solid; IR (KBr): ν_{max} 3080，2905, 2362, 2098, 1619, 1420, 1383, 1273, 1229,1129，910, 835, 756, 685，623 cm-1; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36-7.28 (m, 5H), 5.30(dd, J = 4.8 Hz, 8.8 Hz, 1H), 5.10 (dd, J = 8.8 Hz, 14.0 Hz, 1H), 4.80(dd, J = 4.4 Hz, 14.0 Hz, 1H), 3.96 (s, 3H)，3.94(s, 3H)，1.05 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.3，158.8，139.4，136.3，131.0，128.9，128.7，126.8，84.1，81.1，53.3，53.1，52.6，26.0. HRMS (ESI) calcd for $C_{18}H_{24}N_3O_6$ $(M+H)^+$:378.1660; found:378.1652.

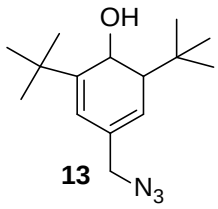
11. Control reactions with radical tracking agents



To a dry Schlenk tube were added $TMSN_3$**1** (2.5 mmol), alkene **2a** (0.5 mmol), $Cu(OAc)_2$ (0.025 mmol), TEMPO(1.5 mmol, 3 equiv),and anhydrous MeCN (2.0 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 85 ^{o}C for 12 h. The resulting mixture was cooled to room temperature and the solvent was evaporated under vacuum. The formation of **4a** was determined by ^{1}H NMR and **4a** was observed in only trace amount.



To a dry Schlenk tube were added $TMSN_3$**1** (2.5 mmol), alkene **2a** (0.5 mmol), $Cu(OAc)_2$ (0.025 mmol), BHT(1.5 mmol, 3 equiv),and anhydrous MeCN (2.0 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 85 ^{o}C for 12 h. The resulting mixture was cooled to room temperature and the solvent was evaporated under vacuum. The formation of **4a** was determined by ^{1}H NMR and **4a** was observed in only trace amount. The residue was purified by flash column chromatography on silica gel (eluent: ethylacetate/ petroleum ether) to give the BHT-azide adduct **13**.



4-(Azidomethyl)-2,6-di-*tert*-butylcyclohexa-2,4-dien-1-ol (**7**)**:**[10] Isolated by flash column chromatography (ethyl acetate/petroleum ether = 20:1, R_f = 0. 6) in 46% yield (60.5mg); Colorless oil; IR (KBr): ν_{max} 2958, 2096, 1649, 1438, 1366, 1244, 1156, 913, 859, 752 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.10 (s , 2H), 5.26 (s, 1H), 4.26 (s, 2H), 1.45 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.9, 136.2, 126.1, 125.2, 55.4, 34.3, 30.2.

12. References:

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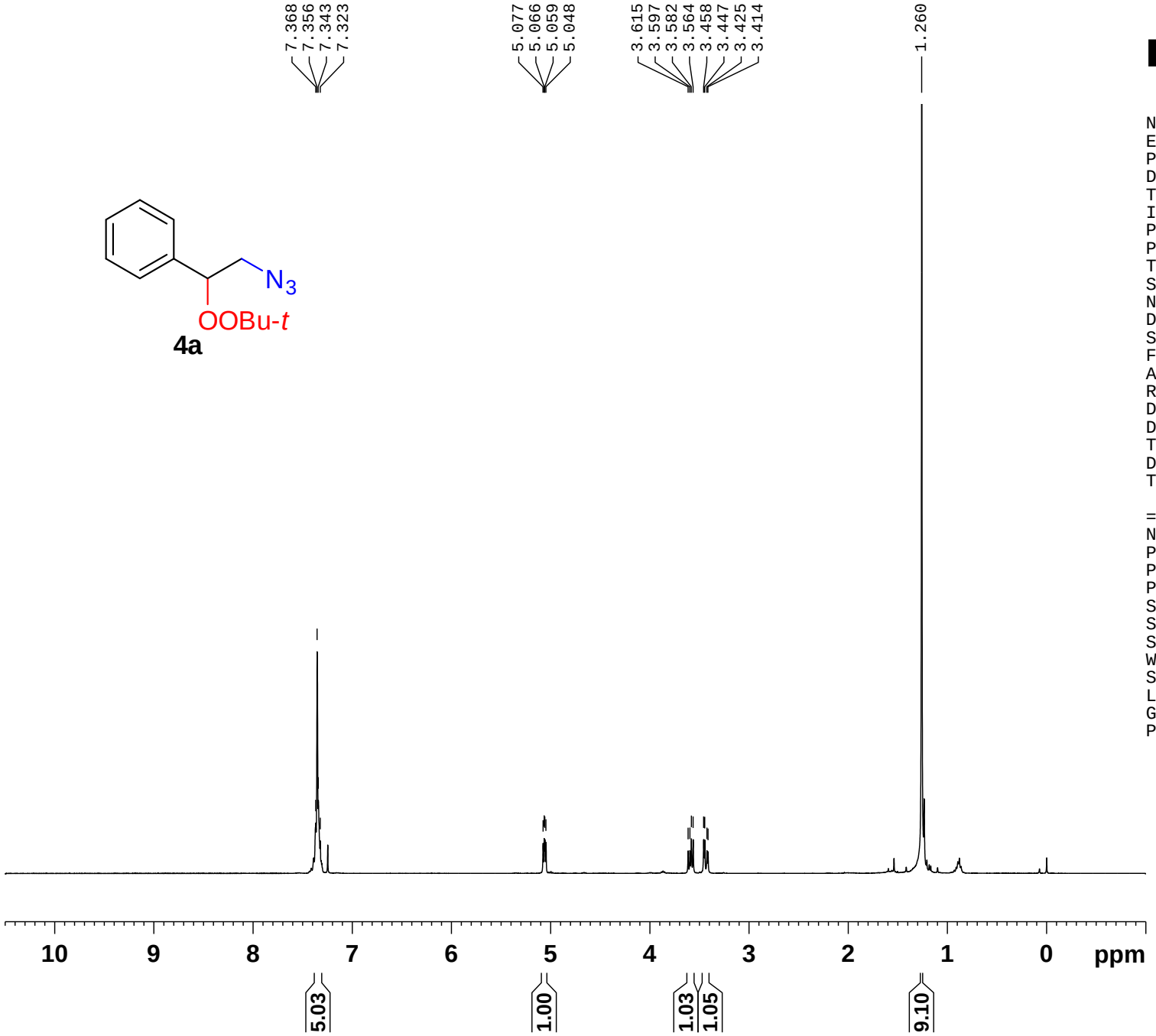


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PROCNO                   1
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TD                   32768
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DS                       0
SWH               6393.862 Hz
FIDRES            0.195125 Hz
AQ               2.5625076 sec
RG                     144
DW                  78.200 usec
DE                   6.50 usec
TE                  297.0 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
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PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300145 MHz
WDW                    EM
SSB                     0
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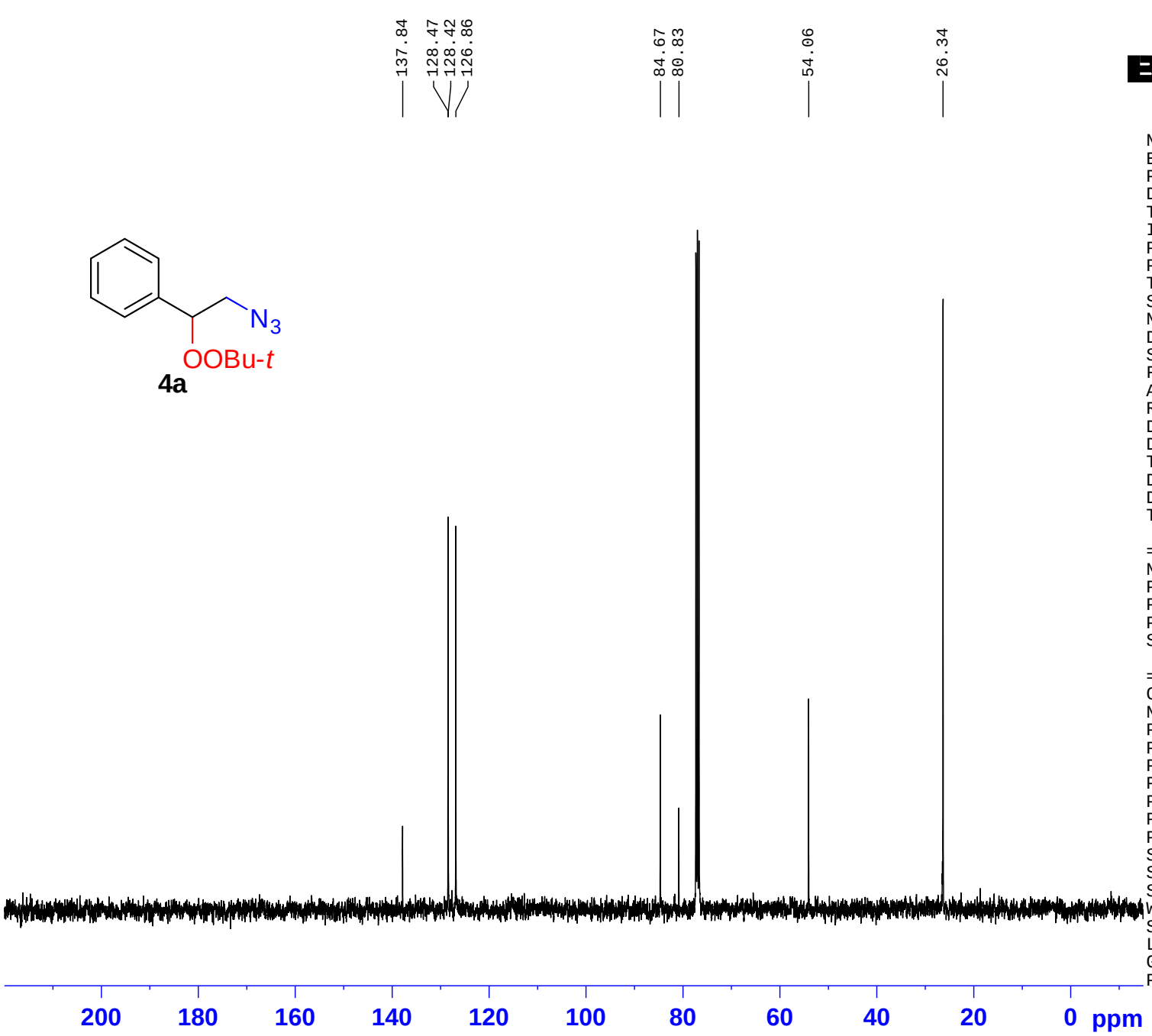


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DS                      4
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FIDRES           0.385323 Hz
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RG                    2050
DW                  19.800 usec
DE                   8.00 usec
TE                  298.0 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
SFO1          100.6238364 MHz

======== CHANNEL f2 ========
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PCPD2               80.00 usec
PL2                  1.80 dB
PL12                17.19 dB
PL13                18.46 dB
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PL12W          0.25809658 W
PL13W          0.19265592 W
SFO2          400.1316005 MHz
SI                 32768
SF            100.6127728 MHz
WDW                   EM
SSB                    0
LB                  3.00 Hz
GB                     0
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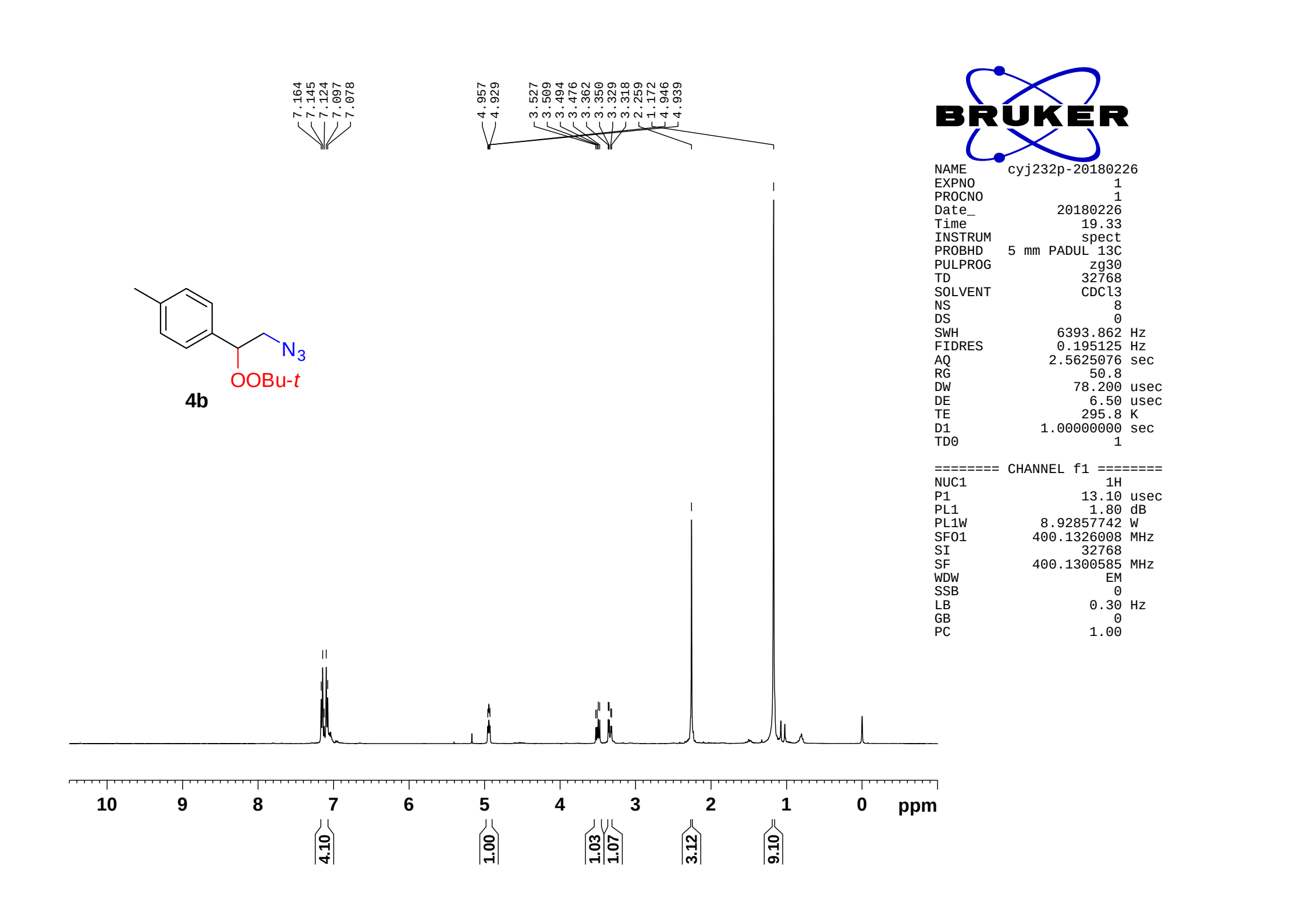


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DS                       0
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FIDRES            0.195125 Hz
AQ              2.5625076 sec
RG                    50.8
DW                  78.200 usec
DE                   6.50 usec
TE                  295.8 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W          8.92857742 W
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SI                   32768
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WDW                    EM
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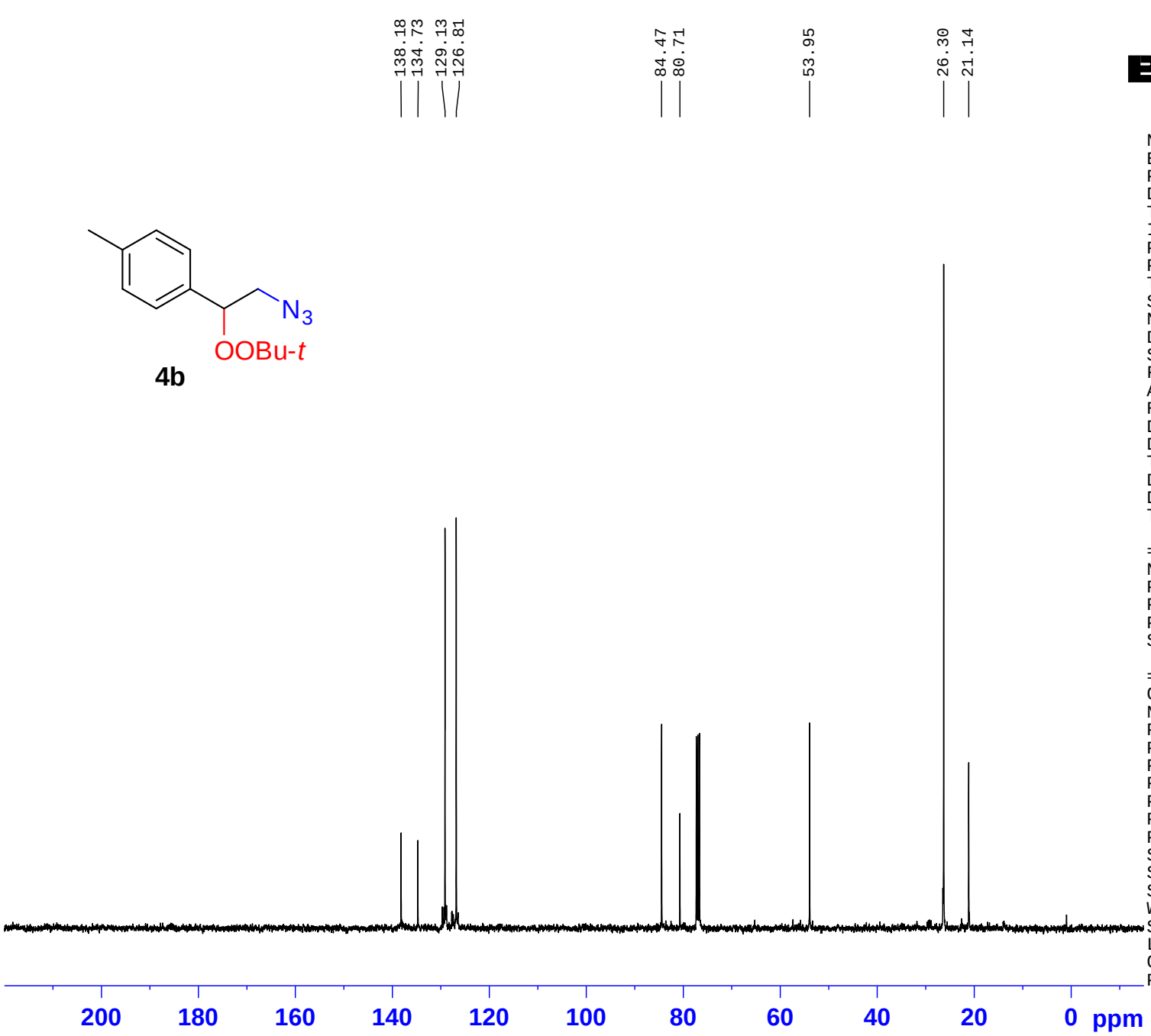


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PROCNO                   1
Date_             20180227
Time                 9.23
INSTRUM             spect
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TD                 65536
SOLVENT            CDCl3
NS                    64
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FIDRES           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
SFO1        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
SFO2        400.1316005 MHz
SI                 32768
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WDW                   EM
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LB                  3.00 Hz
GB                     0
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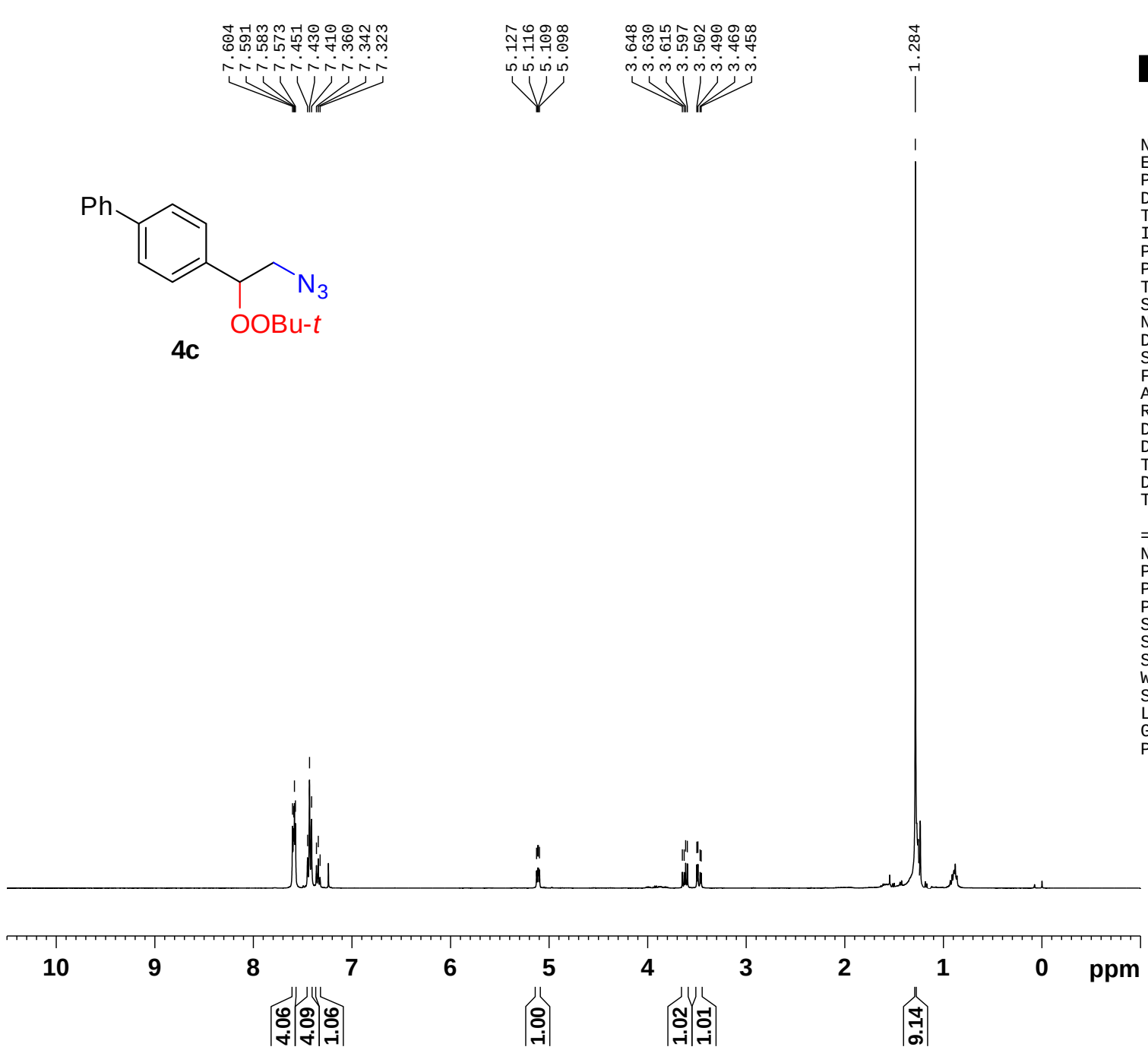


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PROCNO                   1
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TD                   32768
SOLVENT              CDCl3
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DS                       0
SWH               6393.862 Hz
FIDRES           0.195125 Hz
AQ               2.5625076 sec
RG                     128
DW                  78.200 usec
DE                   6.50 usec
TE                  295.5 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W           8.92857742 W
SFO1          400.1326008 MHz
SI                   32768
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WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
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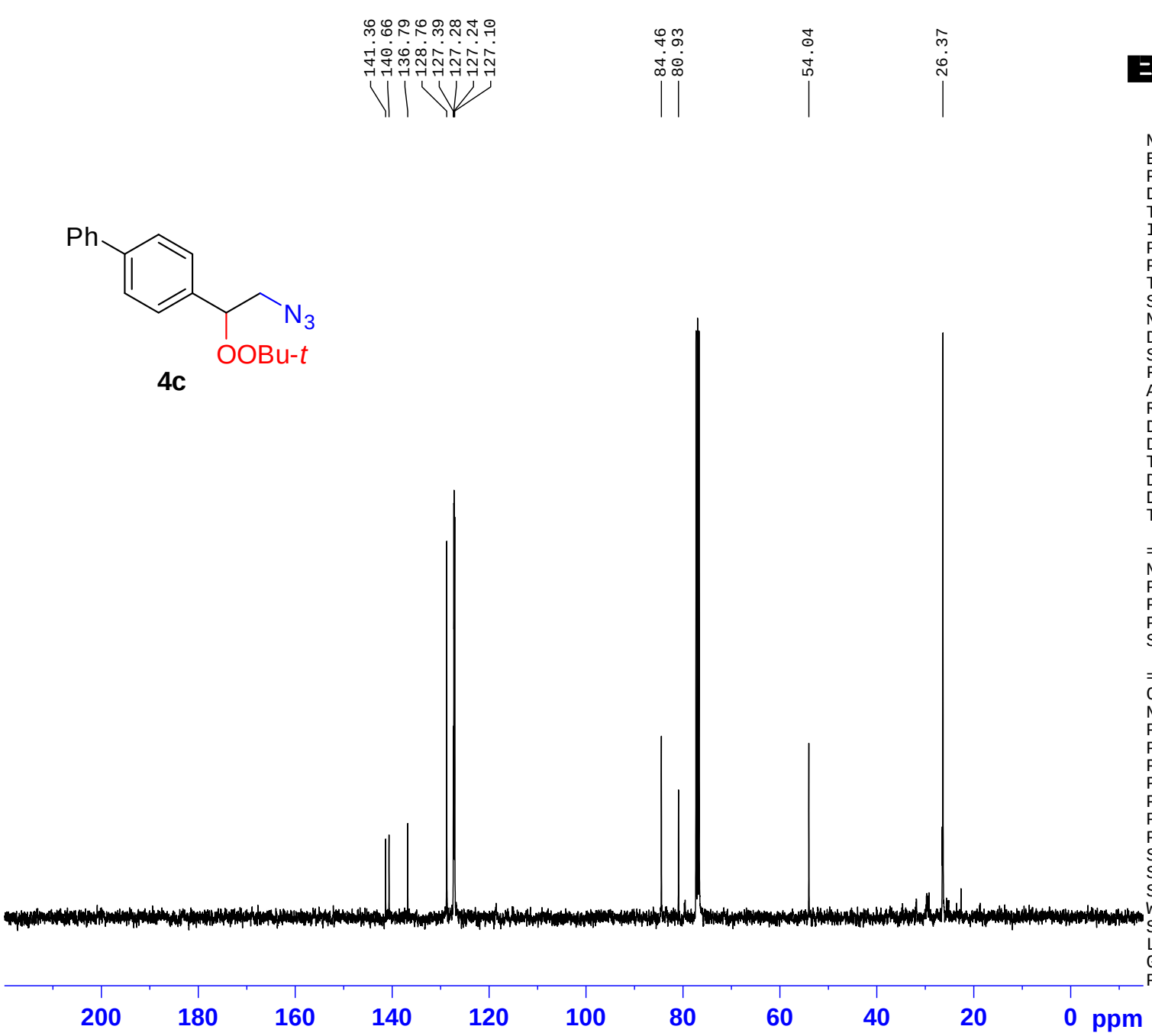

BRUKER

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PROCNO	1
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FIDRES	0.385323 Hz
AQ	1.2976629 sec
RG	2050
DW	19.800 usec
DE	8.00 usec
TE	296.5 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	10
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NUC1	13C
P1	13.50 usec
PL1	3.00 dB
PL1W	43.93649673 W
SFO1	100.6238364 MHz
======== CHANNEL f2 ========	
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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
SFO2	400.1316005 MHz
SI	32768
SF	100.6127742 MHz
WDW	EM
SSB	0
LB	3.00 Hz
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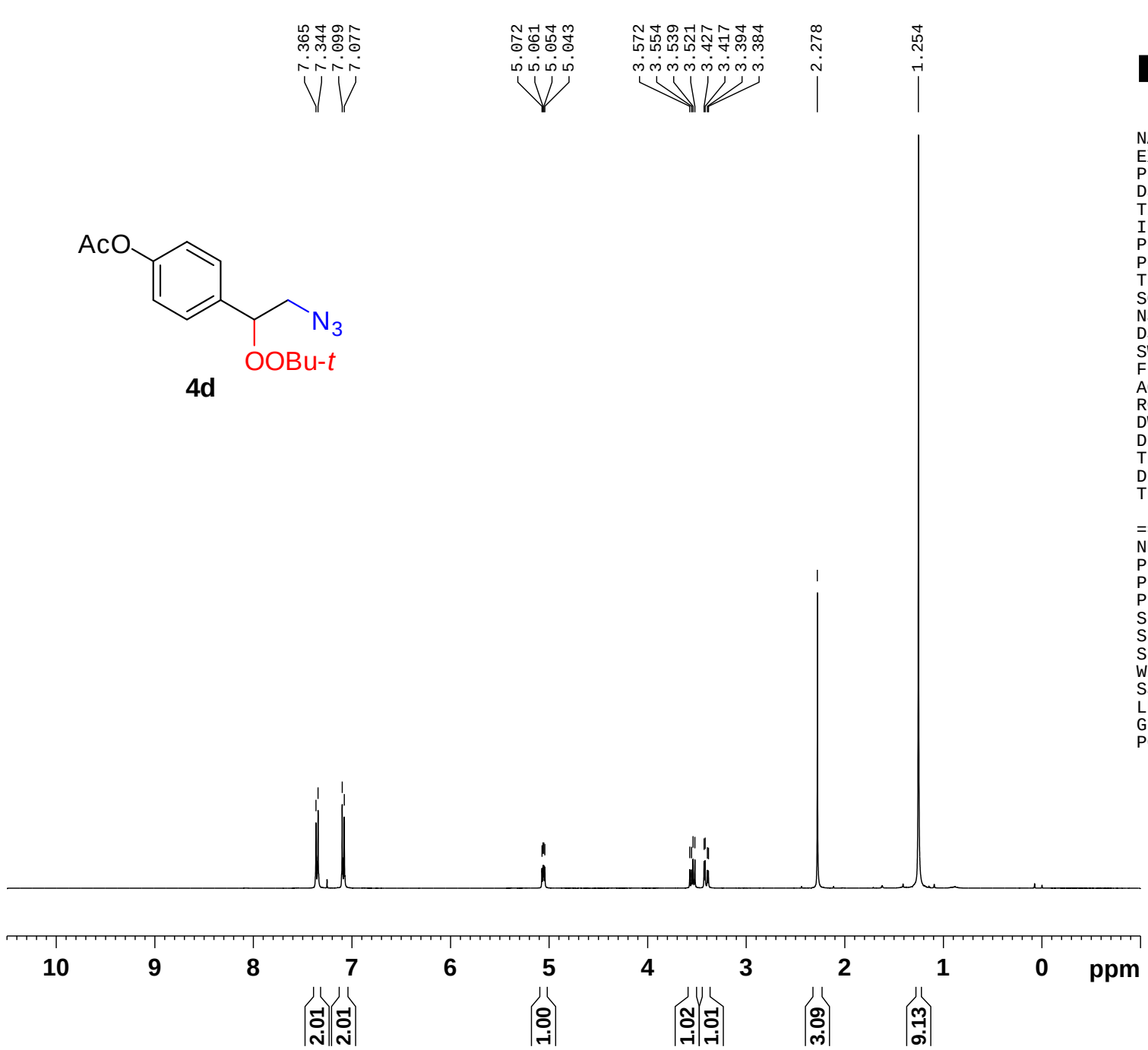
PC	1.40

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PROCNO                   1
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TD                   32768
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TE                 296.8 K
D1              1.00000000 sec
TD0                      1

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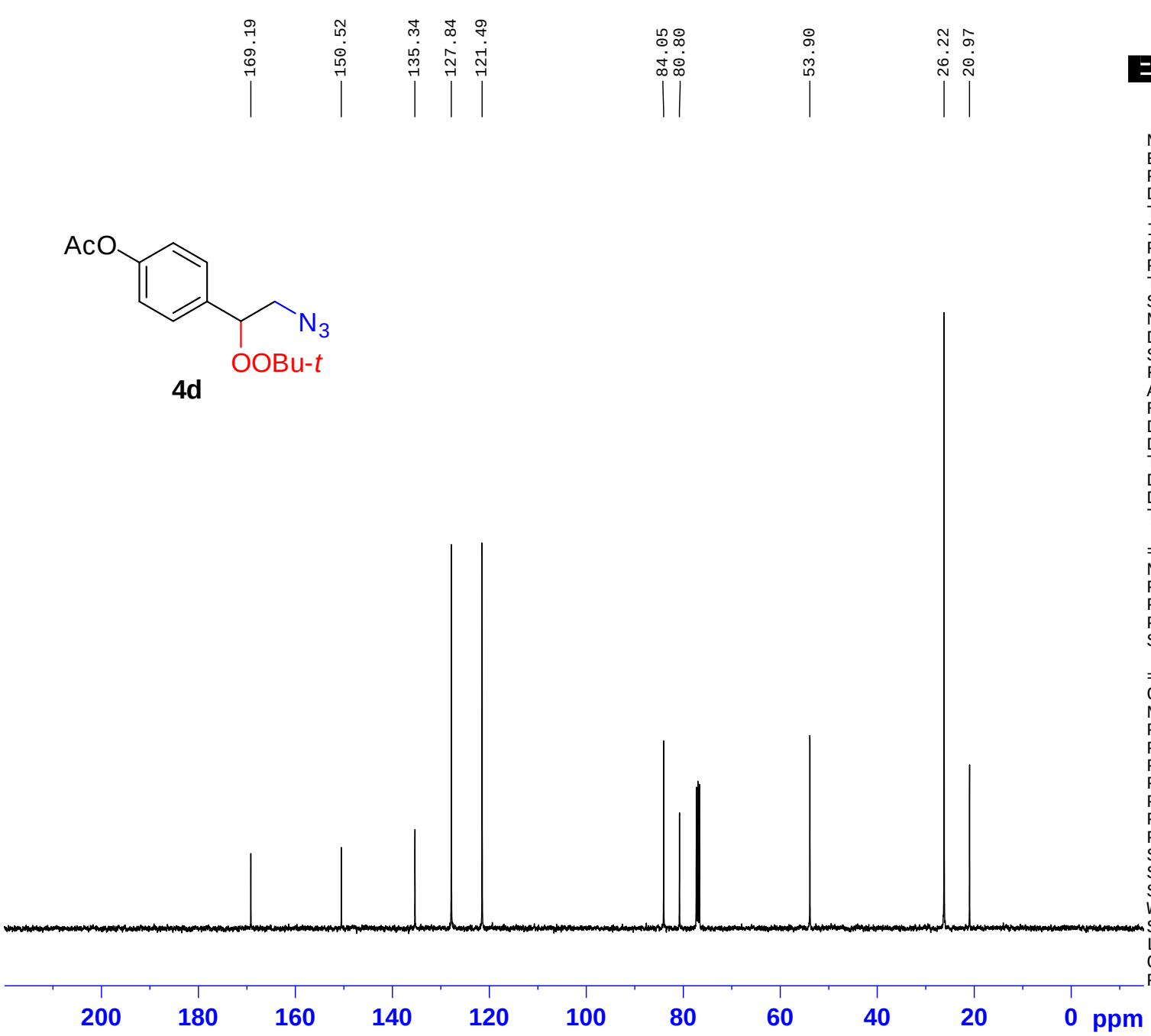


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RG                        2050
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DE                       8.00 usec
TE                      296.5 K
D1                   2.00000000 sec
D11                  0.03000000 sec
TD0                         10

======== CHANNEL f1 ========
NUC1                       13C
P1                       13.50 usec
PL1                       3.00 dB
PL1W               43.93649673 W
SFO1               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
SFO2               400.1316005 MHz
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WDW                         EM
SSB                          0
LB                        3.00 Hz
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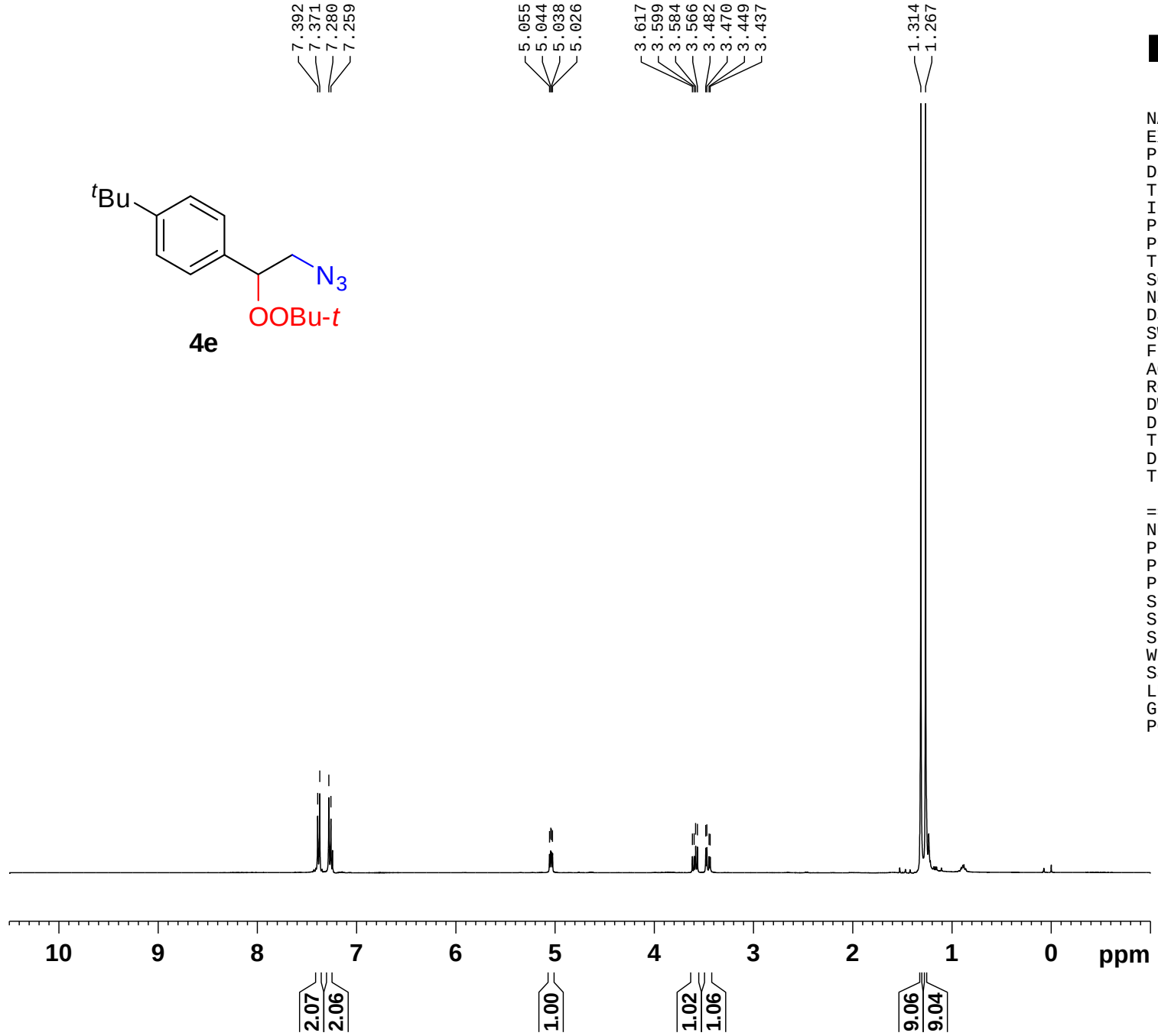


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PROCNO                   1
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TD                   32768
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FIDRES            0.195125 Hz
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RG                    80.6
DW                  78.200 usec
DE                   6.50 usec
TE                  298.3 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
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PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
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WDW                    EM
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GB                      0
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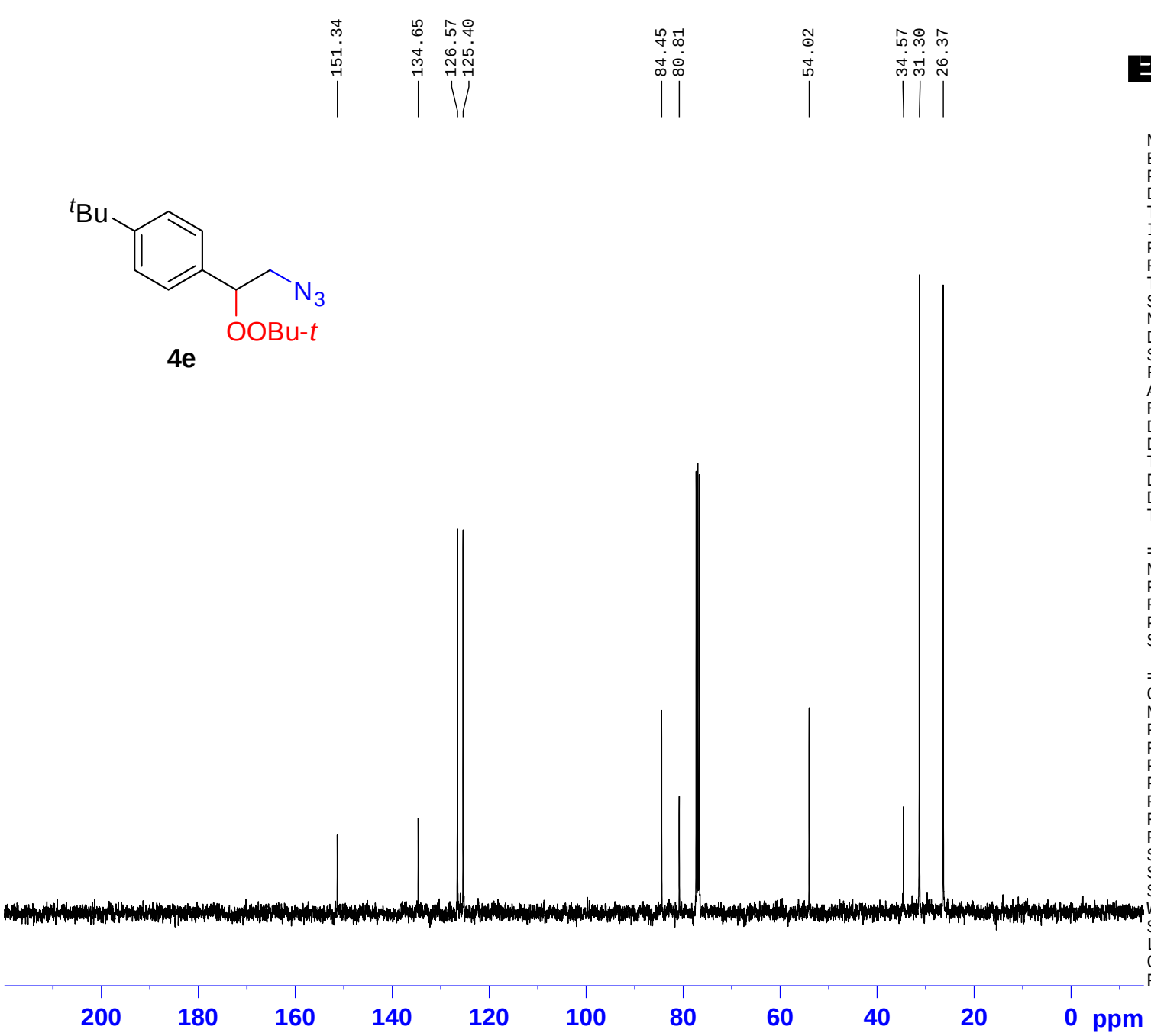


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DE                 8.00 usec
TE                298.9 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                   10

======== CHANNEL f1 ========
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PL1                 3.00 dB
PL1W        43.93649673 W
SFO1        100.6238364 MHz

======== CHANNEL f2 ========
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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
SFO2        400.1316005 MHz
SI                 32768
SF          100.6127727 MHz
WDW                   EM
SSB                    0
LB                  3.00 Hz
GB                     0
PC                  1.40
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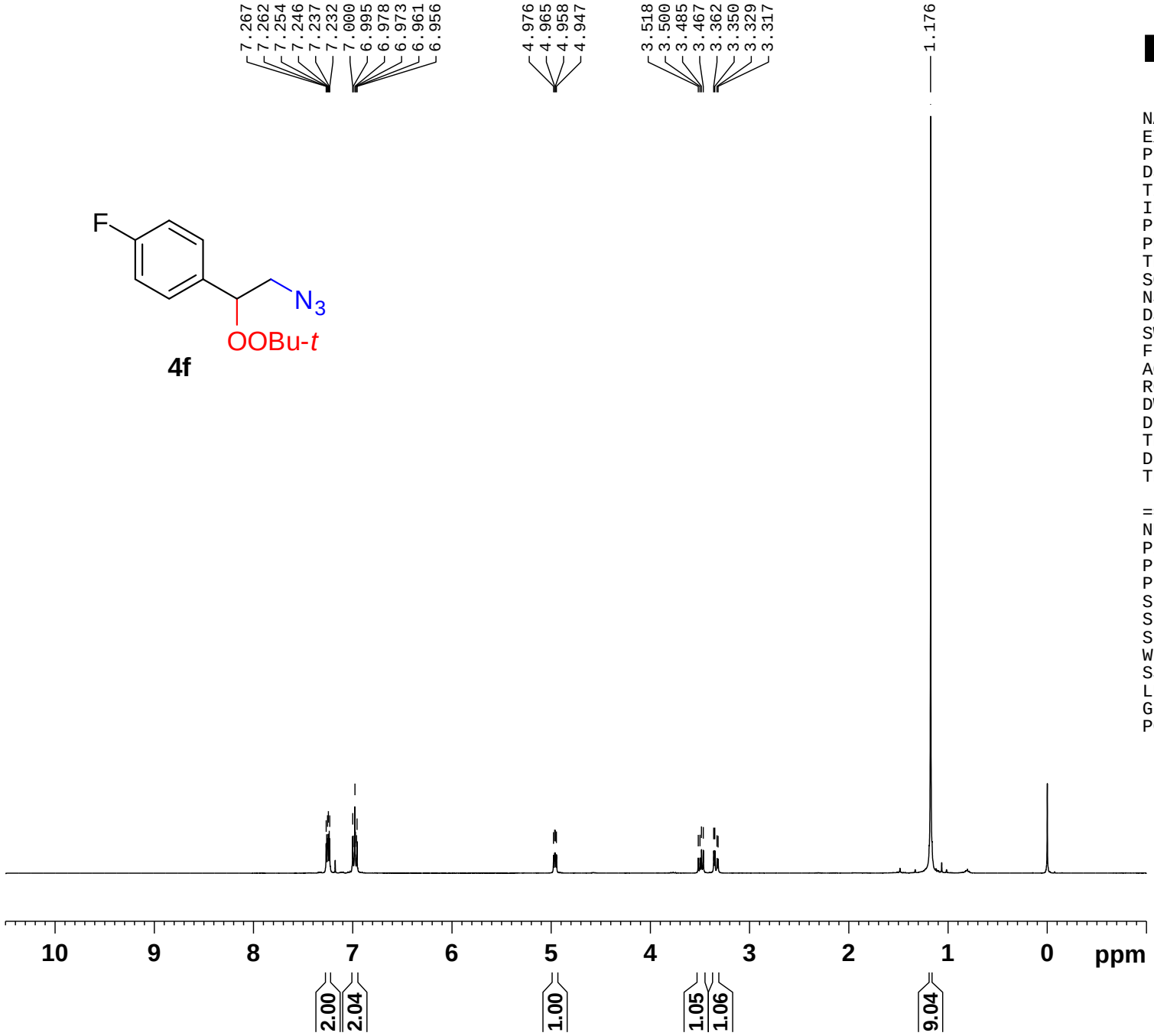


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TD                   32768
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NS                       8
DS                       0
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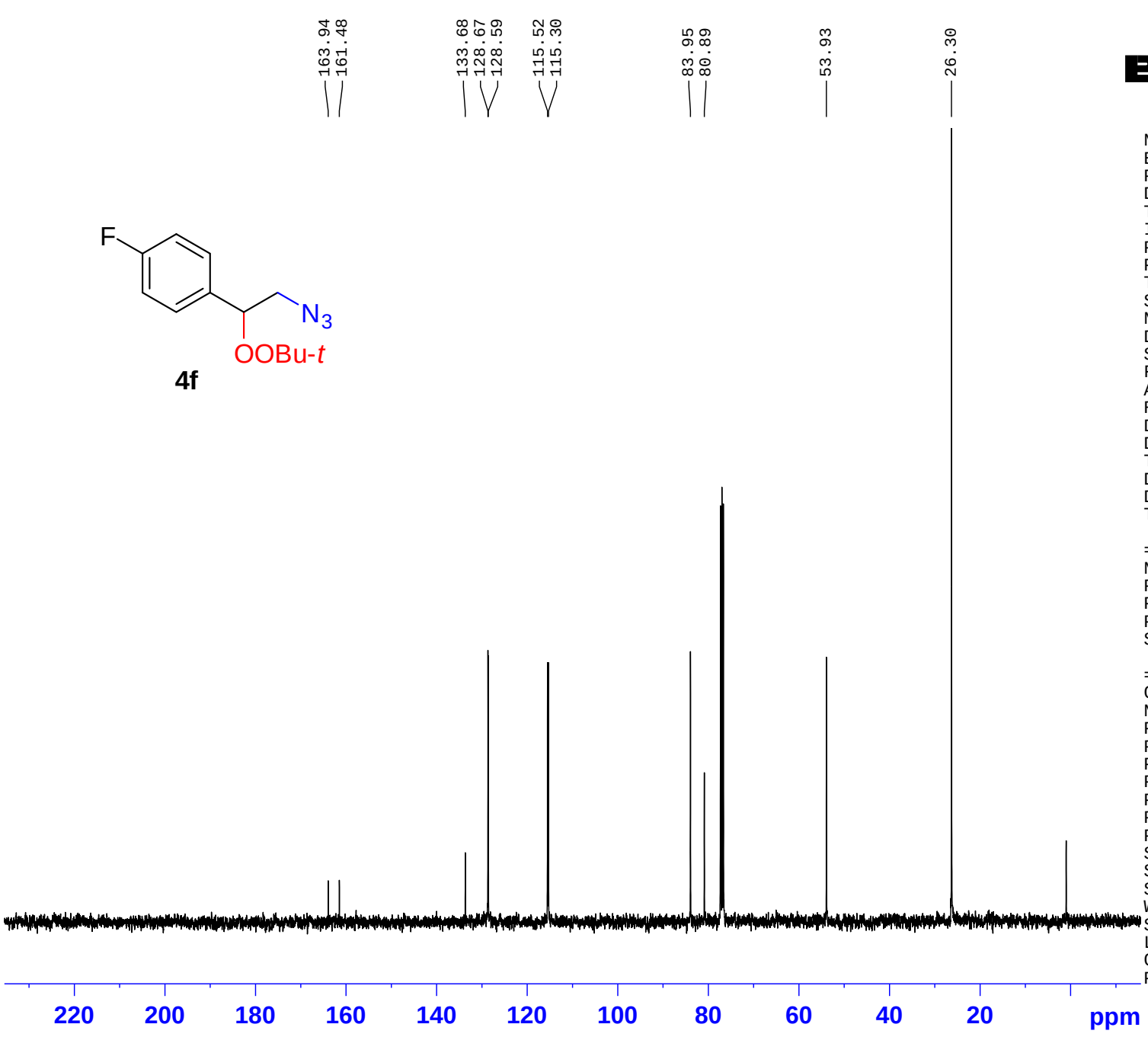
FIDRES            0.195125 Hz
AQ               2.5625076 sec
RG                    90.5
DW                  78.200 usec
DE                   6.50 usec
TE                  298.1 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300434 MHz
WDW                     EM
SSB                      0
LB                    0.30 Hz
GB                       0
PC                    1.00
```



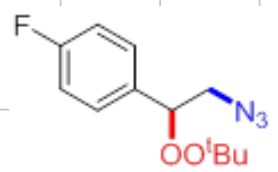

```
NAME      cyj238p1-20180228
EXPNO                    2
PROCNO                   1
Date_             20180228
Time                 17.19
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG           zgpg30
TD                  65536
SOLVENT             CDCl3
NS                     64
DS                      4
SWH              25252.525 Hz
FIDRES           0.385323 Hz
AQ               1.2976629 sec
RG                   2050
DW                 19.800 usec
DE                  8.00 usec
TE                 299.0 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
SFO1         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
SFO2         400.1316005 MHz
SI                 32768
SF           100.6127727 MHz
WDW                   EM
SSB                    0
LB                  3.00 Hz
GB                     0
PC                  1.40
```

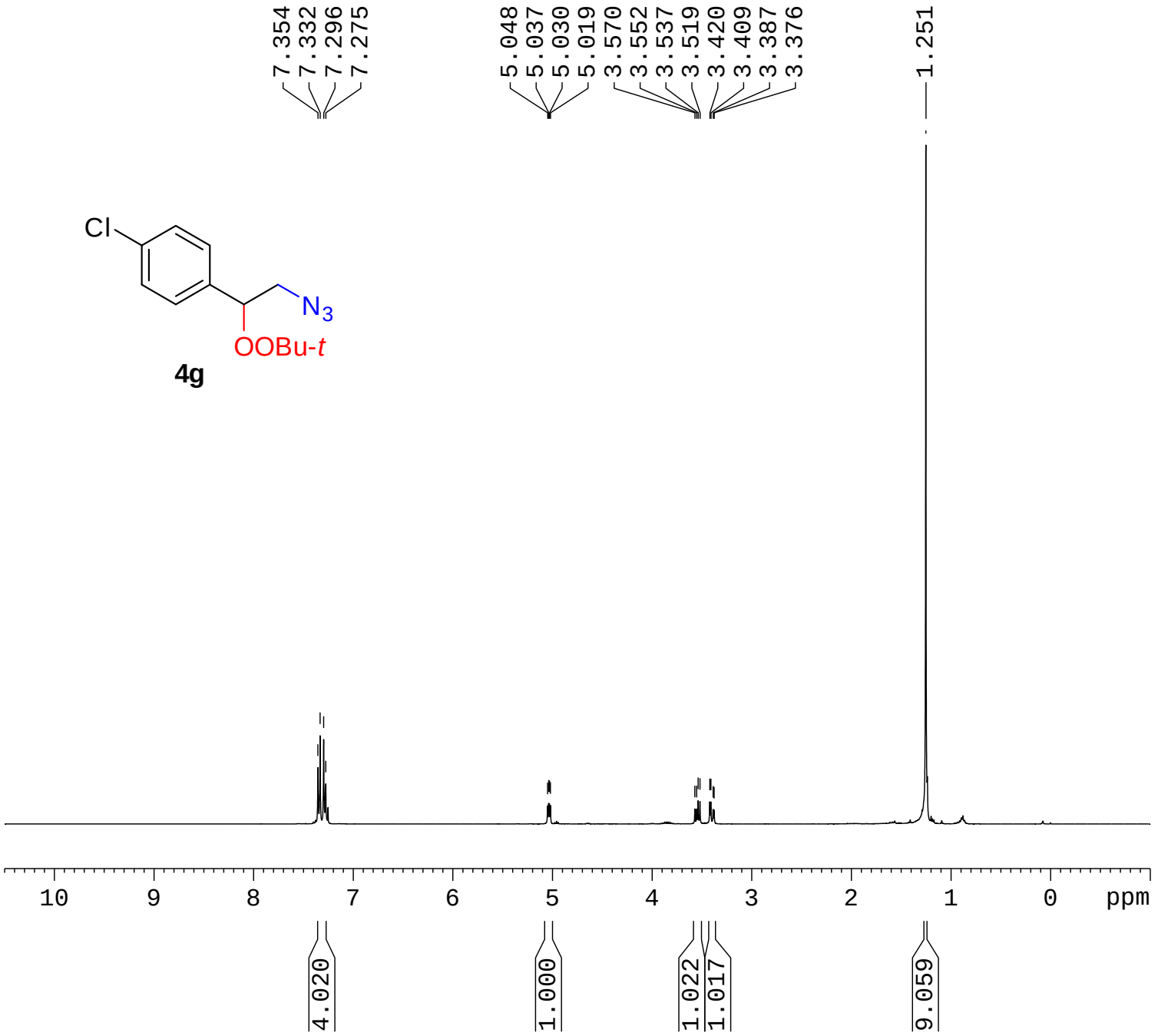
yhj
single_pulse

−113.38

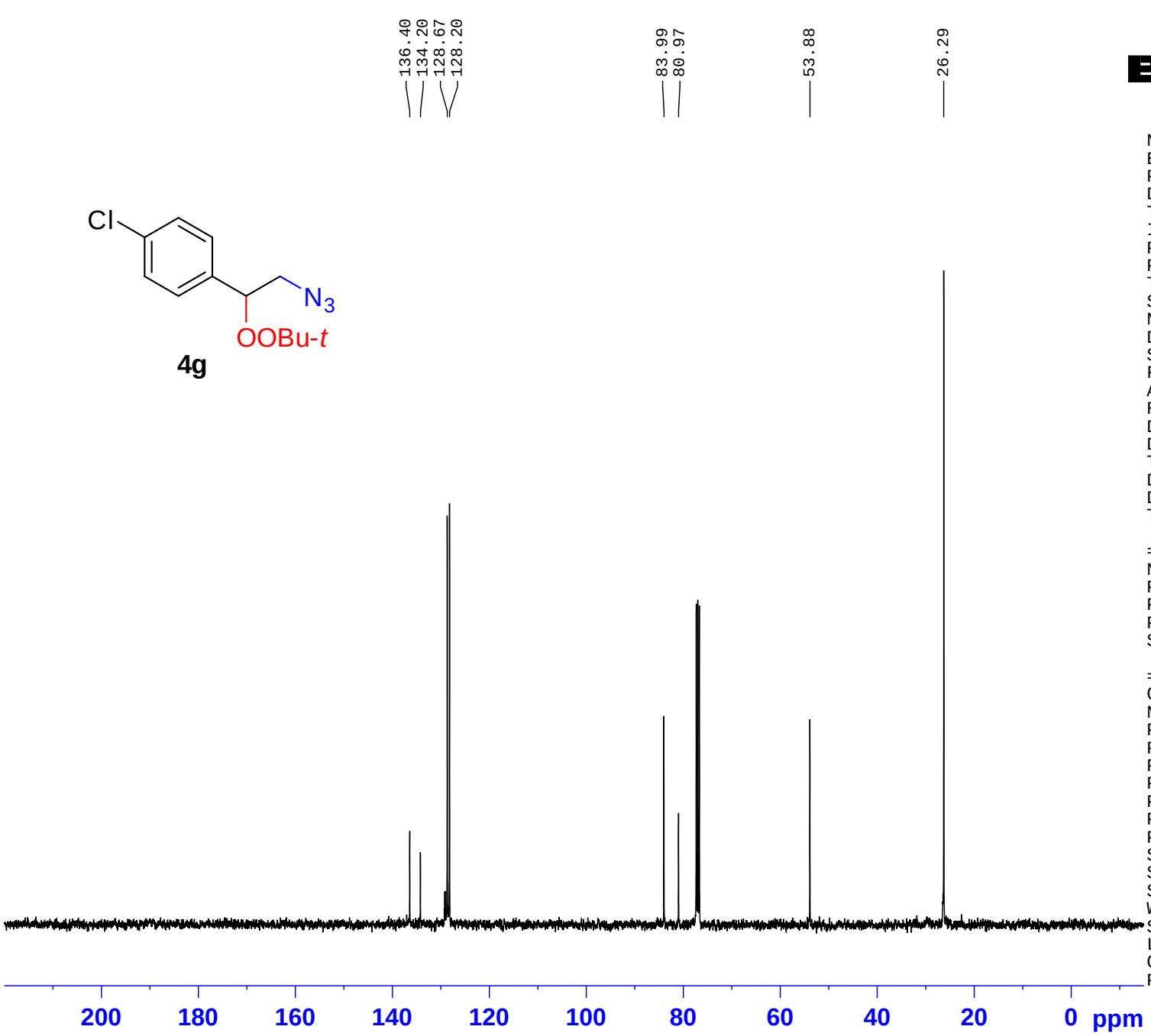


4f

f1 (ppm)



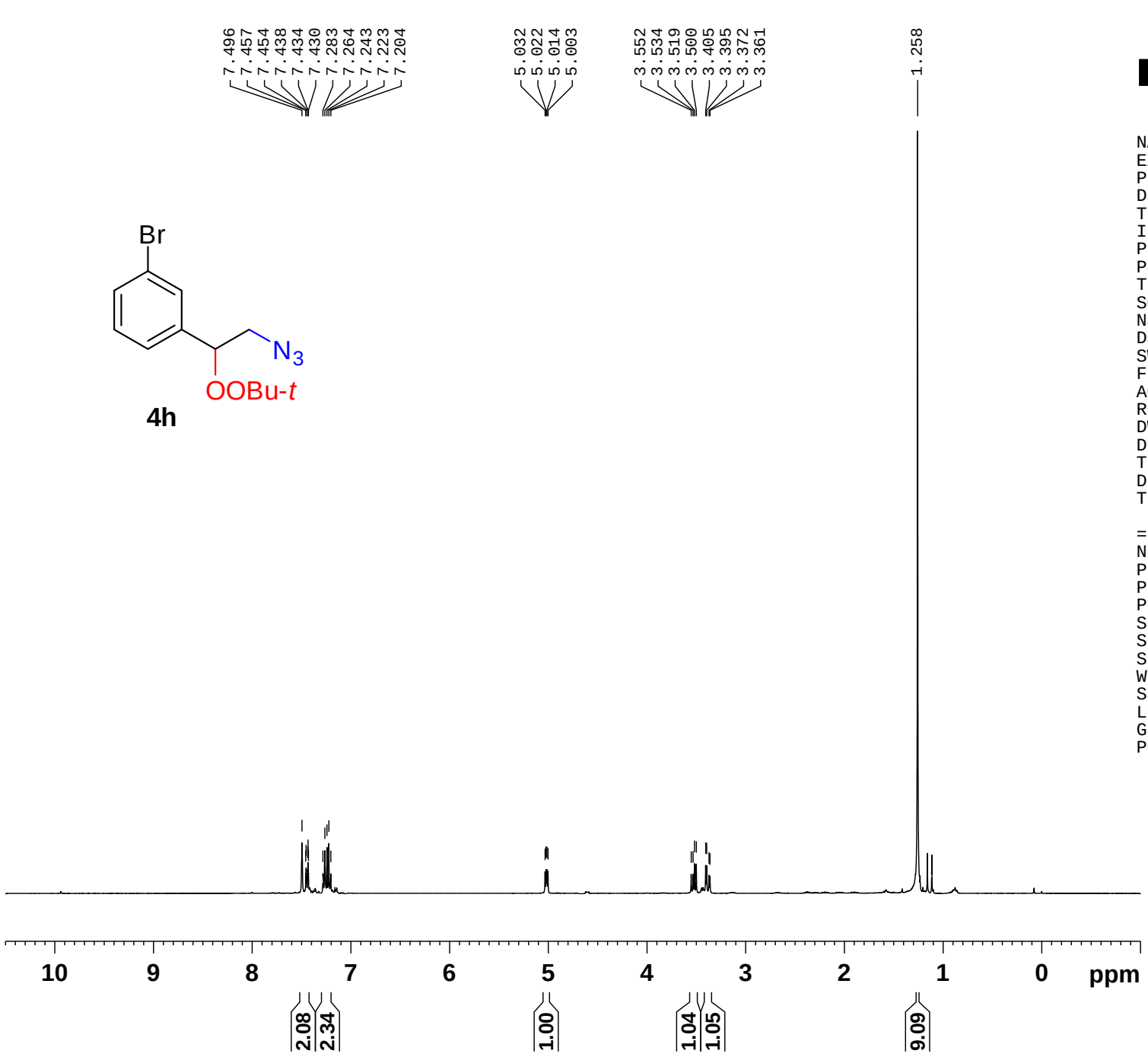
NAME	cyj234p-20180226
EXPNO	1
PROCNO	1
Date_	20180226
Time	19.44
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	90.5
DW	78.200 usec
DE	6.50 usec
TE	295.8 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	13.10 usec
PL1	1.80 dB
PL1W	8.92857742 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300132 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00




```
NAME      cyj234p-20180227
EXPNO                    2
PROCNO                   1
Date_             20180227
Time                 9.32
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                296.3 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                   10

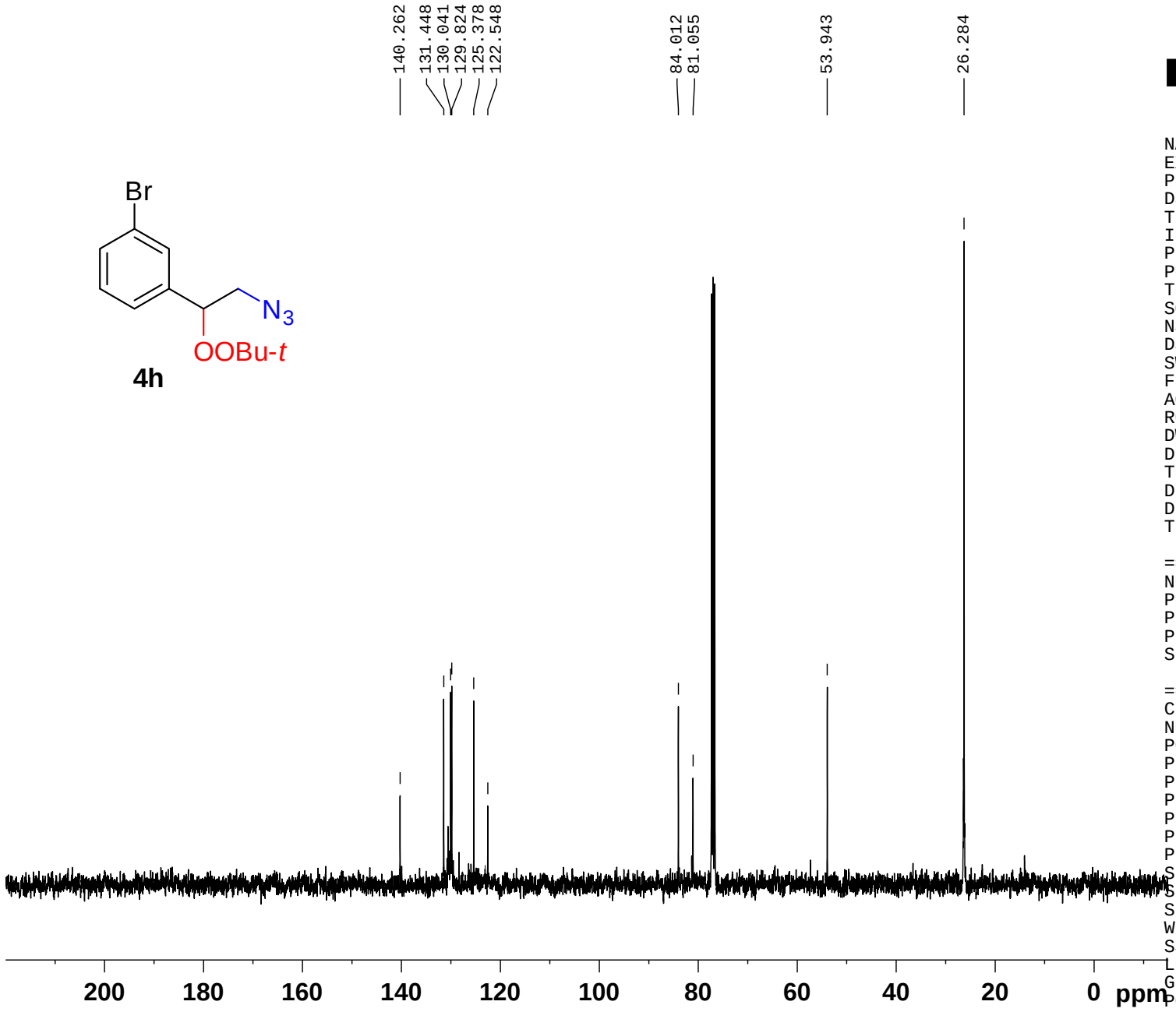
======== CHANNEL f1 ========
NUC1                 13C
P1                 13.50 usec
PL1                 3.00 dB
PL1W        43.93649673 W
SFO1        100.6238364 MHz

======== 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
SFO2        400.1316005 MHz
SI                 32768
SF          100.6127743 MHz
WDW                   EM
SSB                    0
LB                  3.00 Hz
GB                     0
PC                  1.40
```



BRUKER

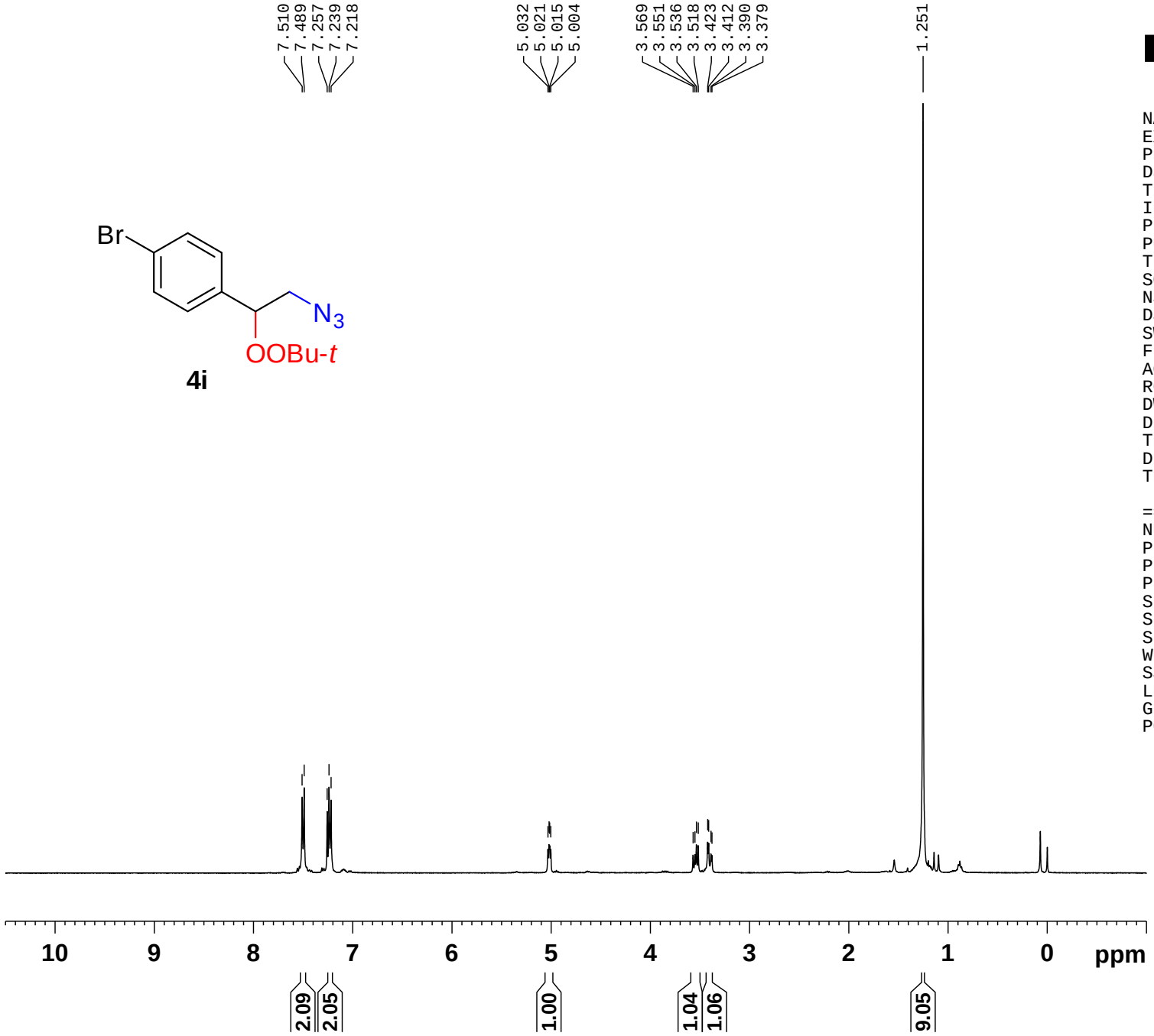
NAME	cyj298ap-20180329
EXPNO	1
PROCNO	1
Date_	20180329
Time	16.41
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	45.2
DW	78.200 usec
DE	6.50 usec
TE	297.8 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	13.10 usec
PL1	1.80 dB
PL1W	8.92857742 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300163 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00




```
NAME      cyj760ap1-201801102
EXPNO                       2
PROCNO                      1
Date_            20181102
Time                    9.39
INSTRUM                spect
PROBHD   5 mm PABBO BB-
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                   6.50 usec
TE                  294.0 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                      3

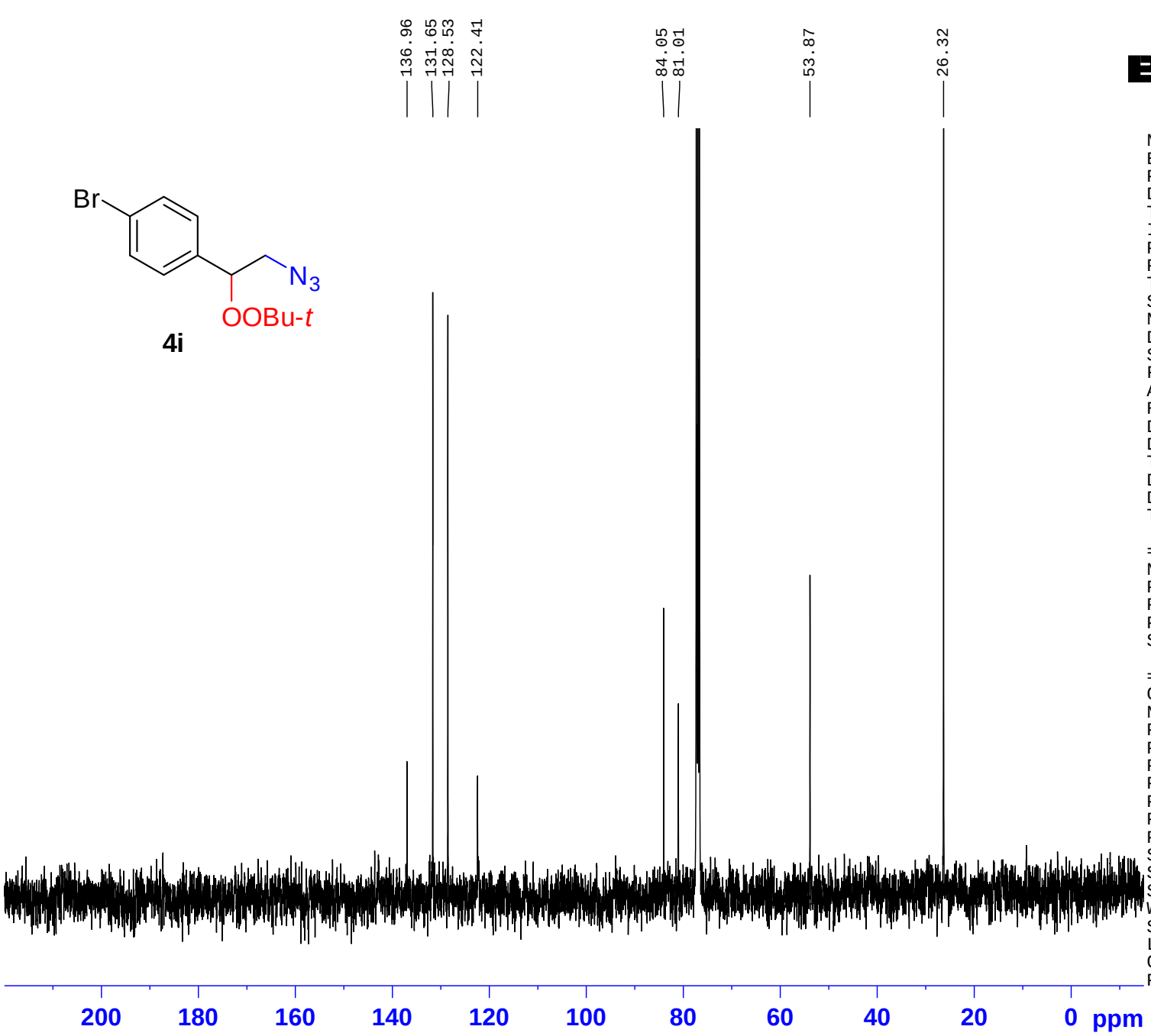
======== CHANNEL f1 ========
NUC1                   13C
P1                   15.00 usec
PL1                   2.00 dB
PL1W          55.31277084 W
SFO1          100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2           waltz16
NUC2                  1H
PCPD2               80.00 usec
PL2                 -1.00 dB
PL12                16.72 dB
PL13                15.50 dB
PL2W          17.01305389 W
PL12W          0.28759566 W
PL13W          0.38087484 W
SFO2          400.1316005 MHz
SI                 32768
SF            100.6127760 MHz
WDW                   EM
SSB                    0
LB                  3.00 Hz
GB                     0
PC                  1.40
```




```
NAME      cyj241ap-2018228
EXPNO                    1
PROCNO                   1
Date_             20180228
Time                 16.40
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                  298.9 K
D1             1.00000000 sec
TD0                      1

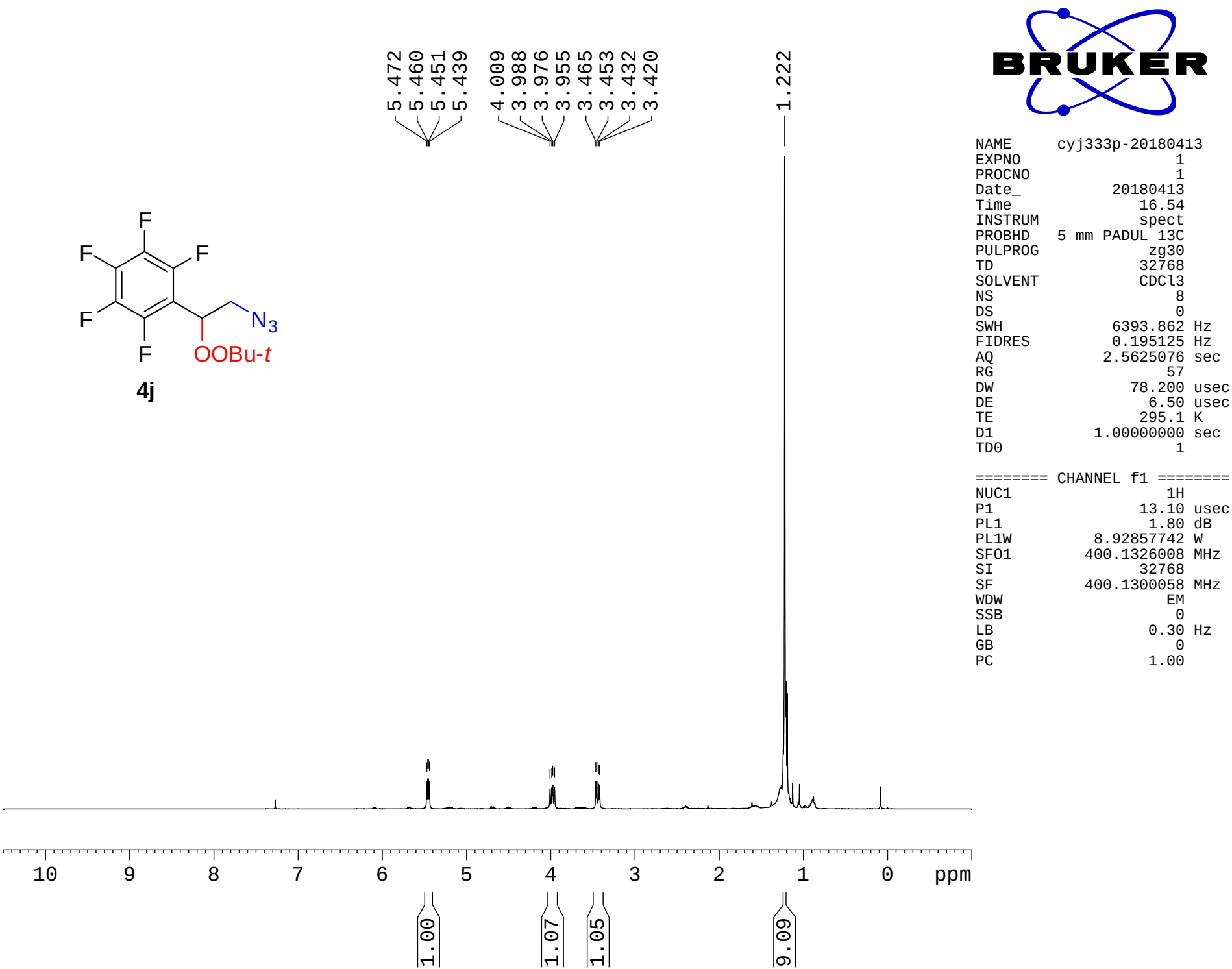
======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300111 MHz
WDW                     EM
SSB                      0
LB                    0.30 Hz
GB                       0
PC                    1.00
```




```
NAME      cyj241ap-20180301
EXPNO                    2
PROCNO                   1
Date_             20180301
Time                 9.55
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                298.4 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                   10

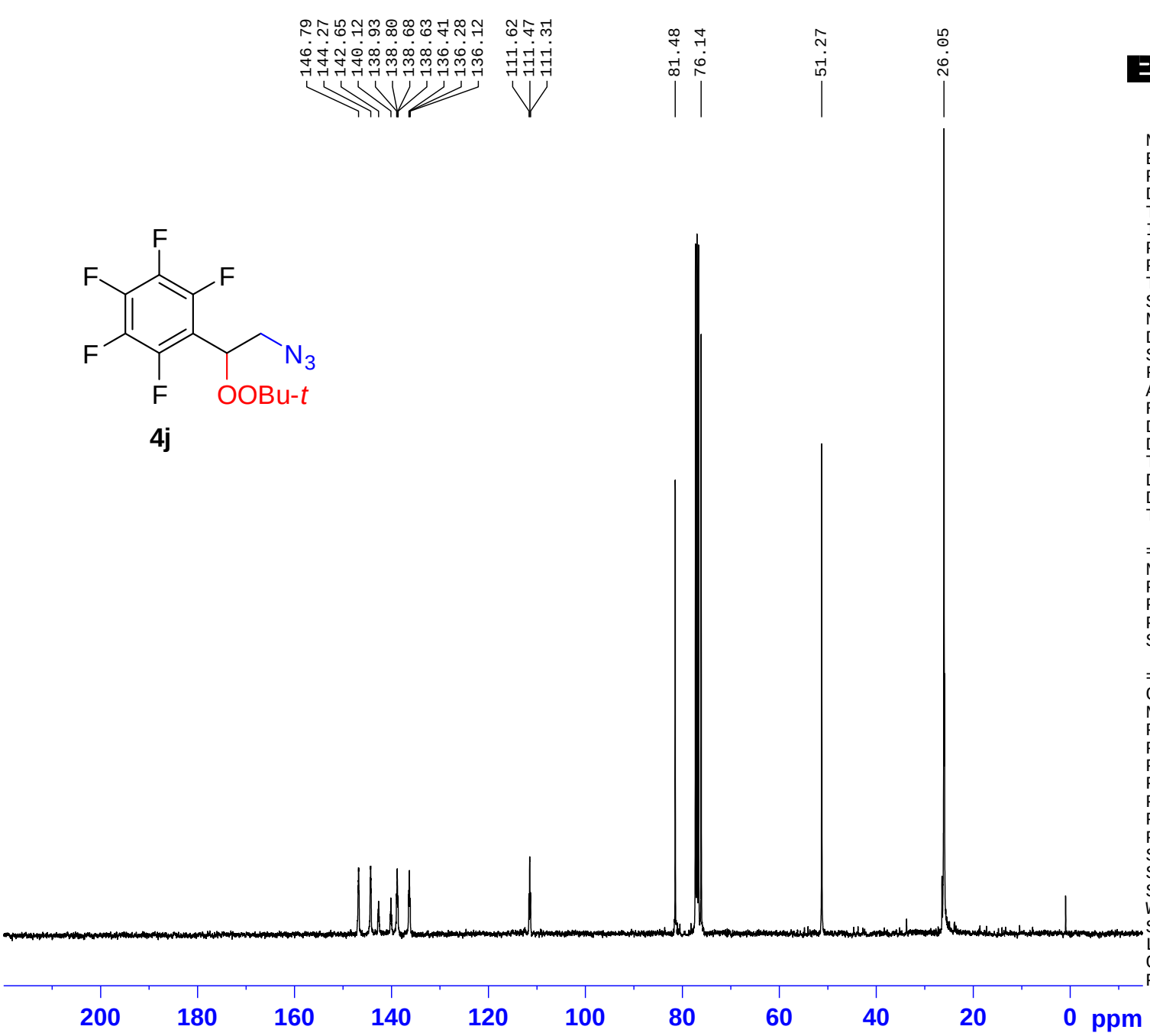
======== CHANNEL f1 ========
NUC1                 13C
P1                 13.50 usec
PL1                 3.00 dB
PL1W        43.93649673 W
SFO1       100.6238364 MHz

======== 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
SFO2       400.1316005 MHz
SI                 32768
SF         100.6127707 MHz
WDW                   EM
SSB                    0
LB                  3.00 Hz
GB                     0
PC                  1.40
```



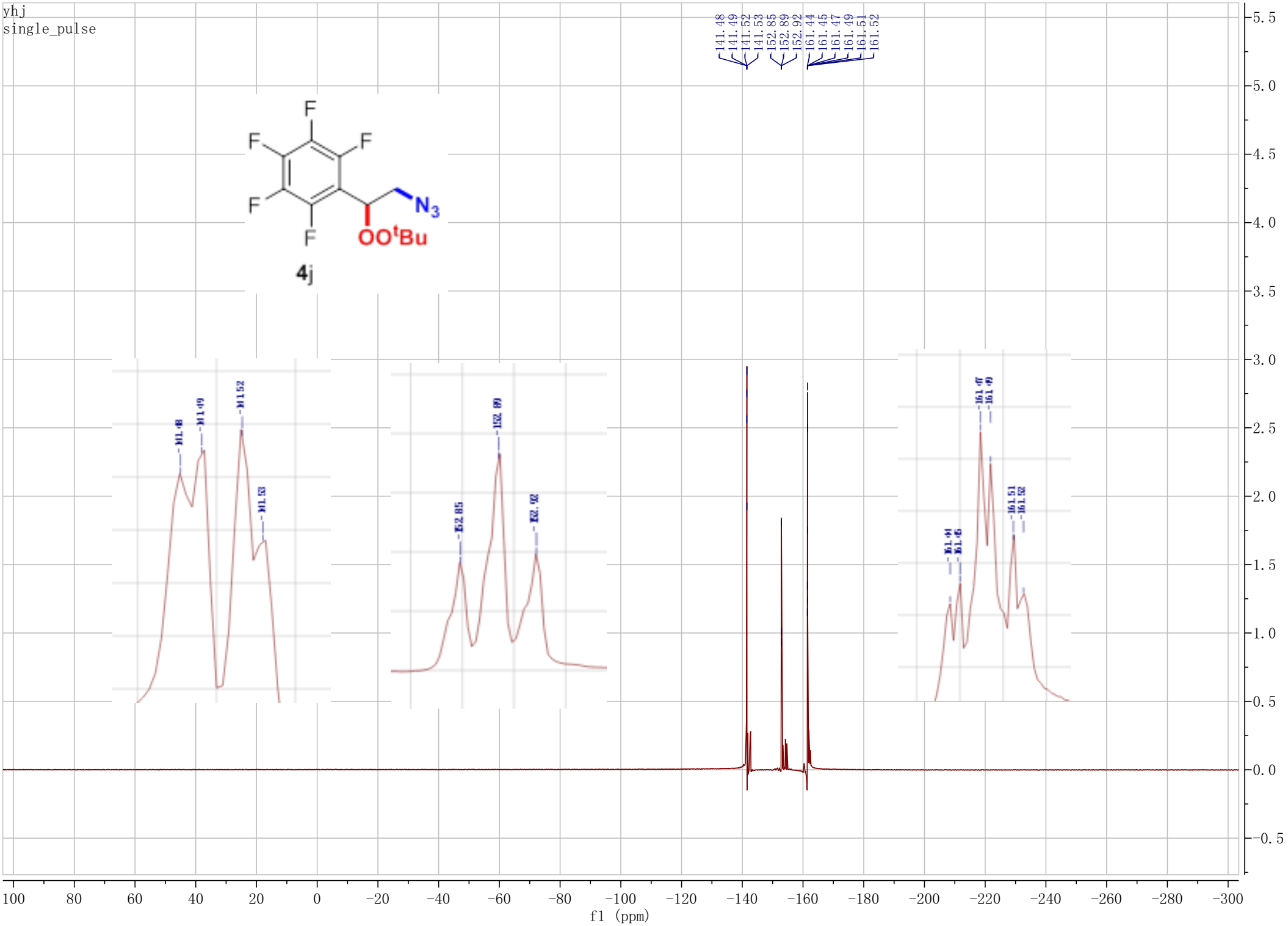
BRUKER

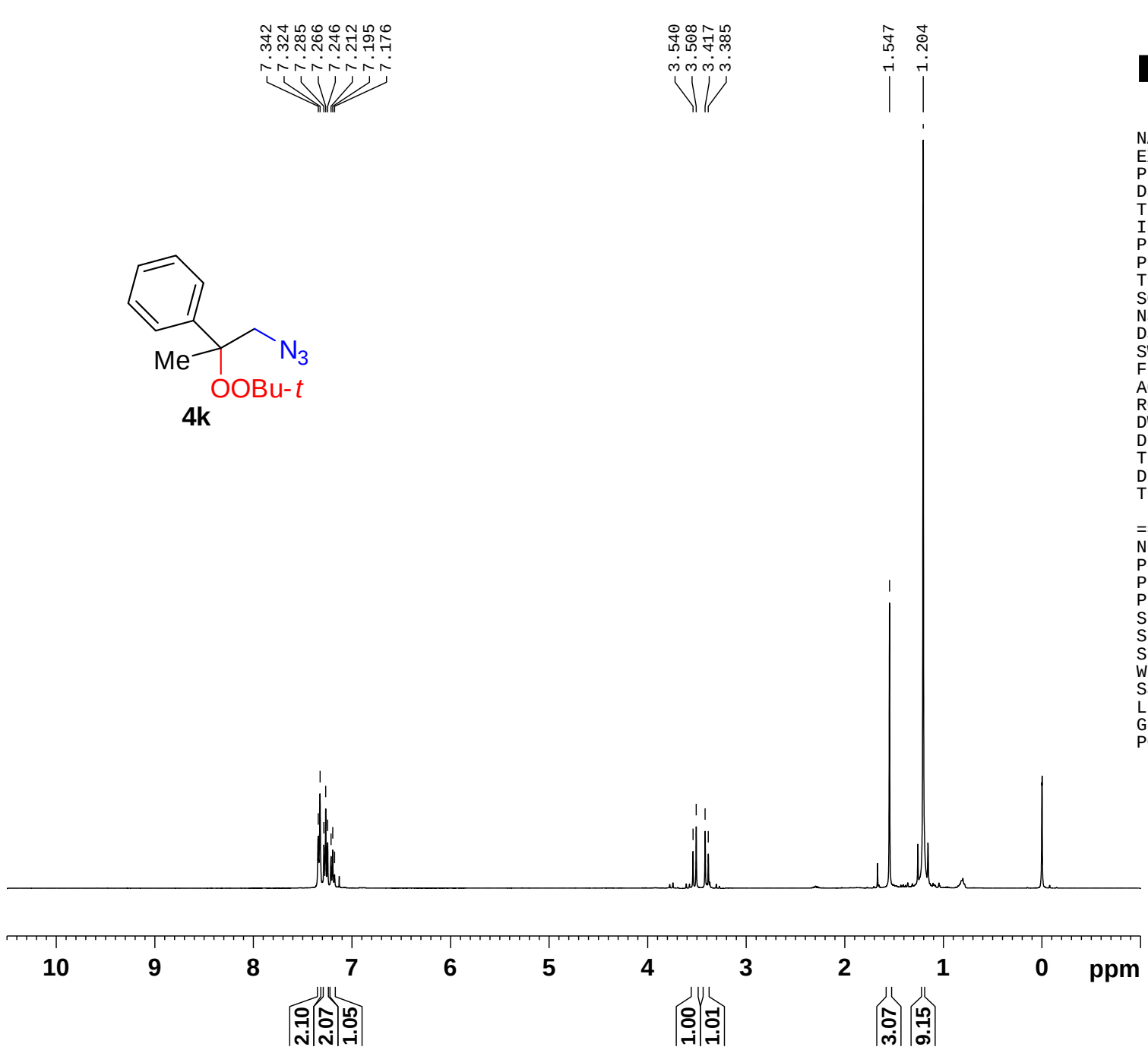
NAME	cyj333p-20180413
EXPNO	1
PROCNO	1
Date_	20180413
Time	16.54
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	57
DW	78.200 usec
DE	6.50 usec
TE	295.1 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	13.10 usec
PL1	1.80 dB
PL1W	8.92857742 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300058 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00



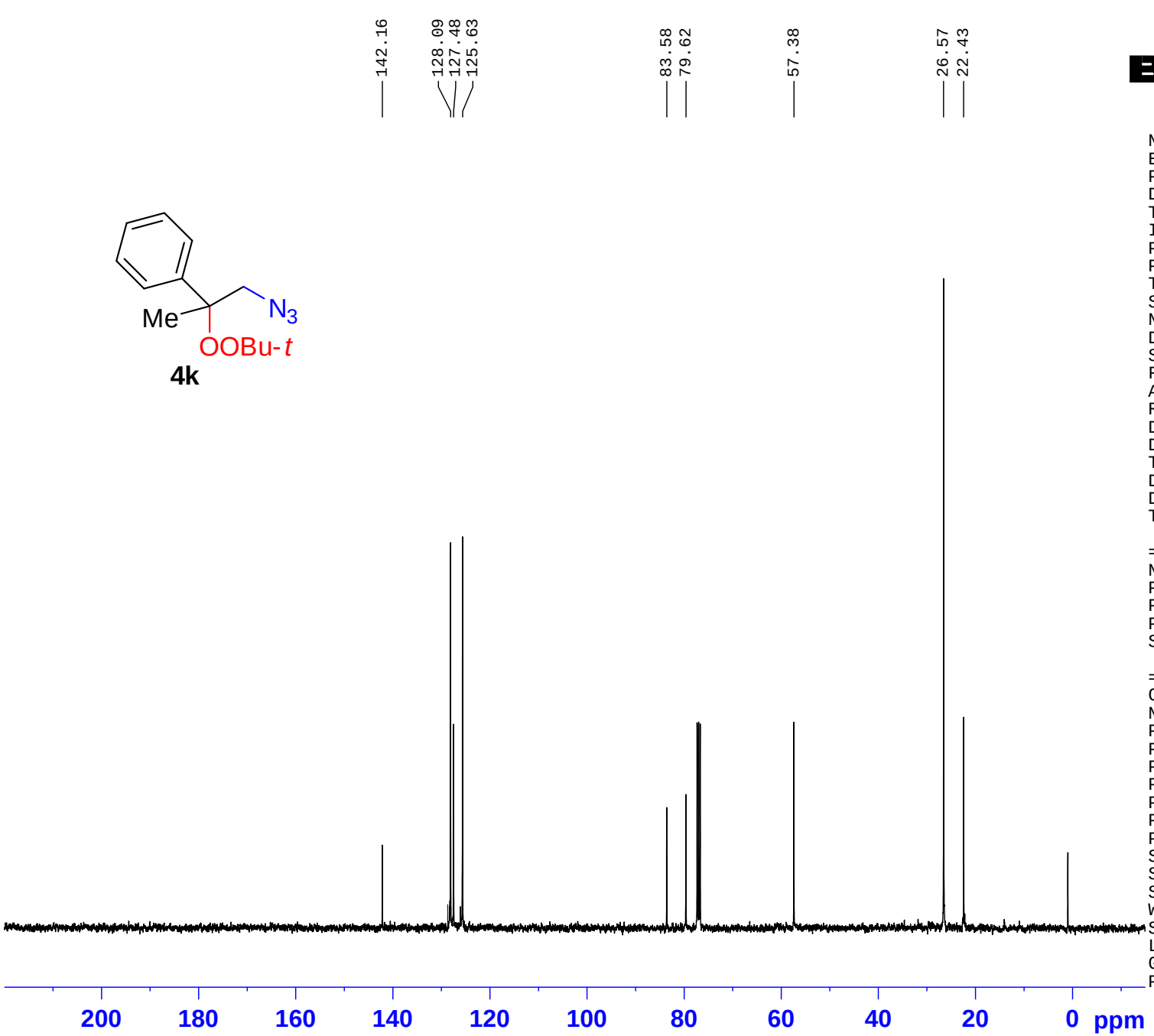
BRUKER

NAME	cyj333pagain
EXPNO	2
PROCNO	1
Date_	20180102 1
Time	3 38.00
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	1464
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
SFO1	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
SFO2	400.1316005 MHz
SI	32768
SF	100.6127680 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40


yhj
single_pulse
141.48
141.49
141.52
141.53
152.85
152.89
152.92
161.44
161.45
161.47
161.49
161.51
161.52
F
F
F
F
F
N3
OO^tBu
4j
f1 (ppm)



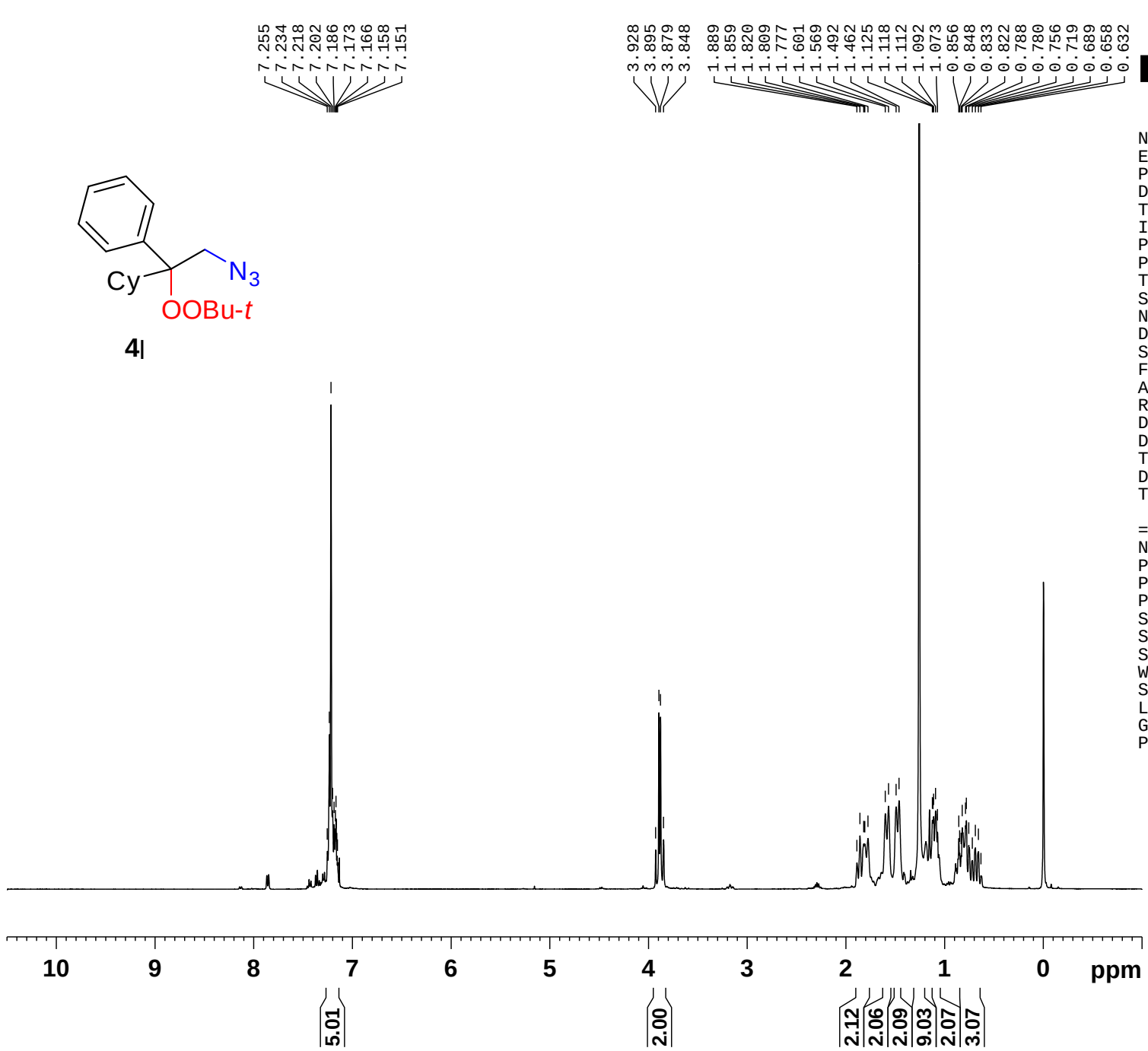
NAME	cyj229ap-20180125
EXPNO	1
PROCNO	1
Date_	20180125
Time	9.40
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	40.3
DW	78.200 usec
DE	6.50 usec
TE	291.9 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	13.10 usec
PL1	1.80 dB
PL1W	8.92857742 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300622 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00




```
NAME      cyj229ap-20180125
EXPNO                    2
PROCNO                   1
Date_             20180125
Time                 16.56
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                293.3 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                  10

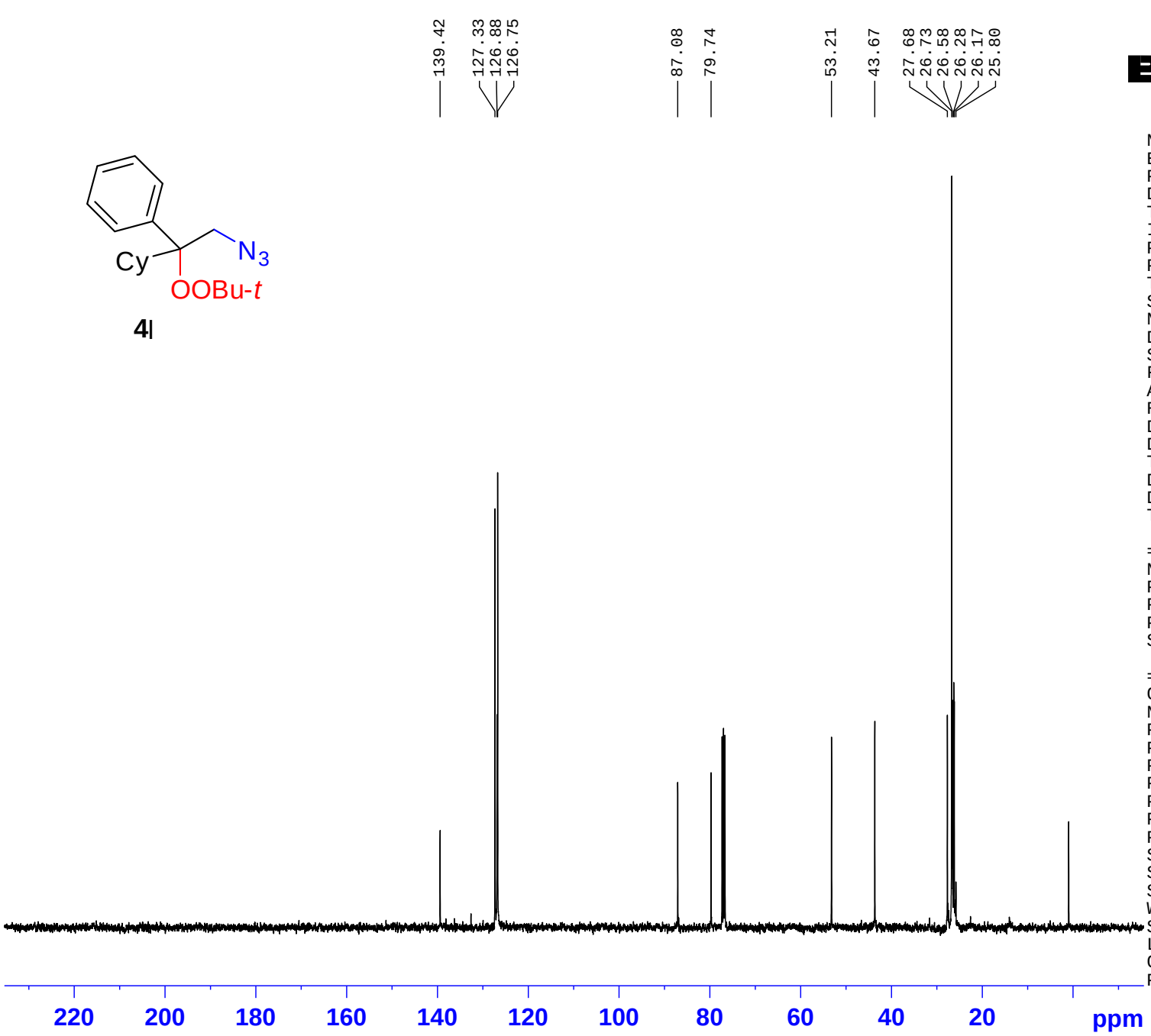
======== CHANNEL f1 ========
NUC1                13C
P1                13.50 usec
PL1                3.00 dB
PL1W       43.93649673 W
SFO1       100.6238364 MHz

======== 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
SFO2       400.1316005 MHz
SI               32768
SF         100.6127813 MHz
WDW                 EM
SSB                  0
LB                3.00 Hz
GB                   0
PC                1.40
```



BRUKER

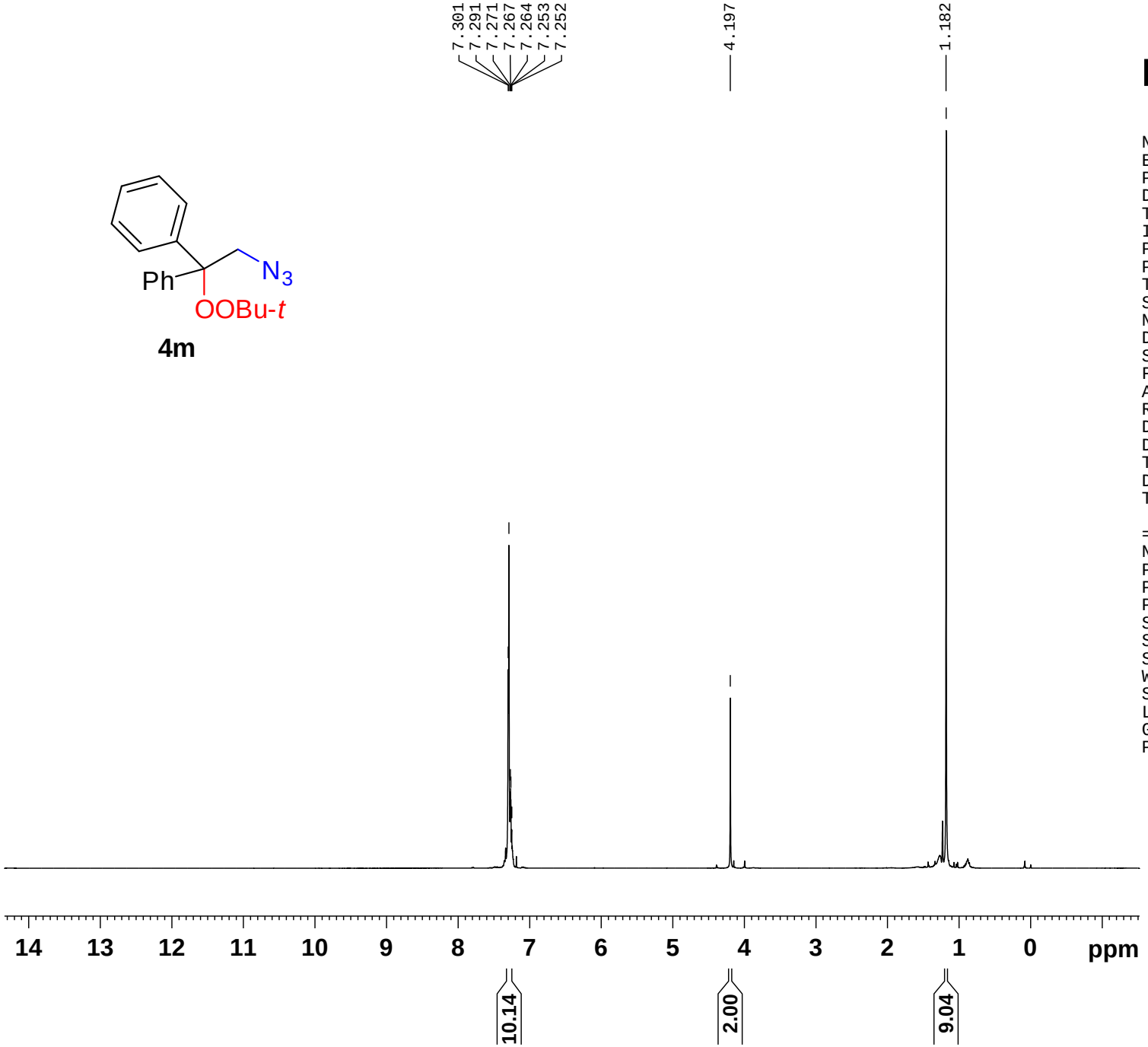
NAME	cyj272p-20180313
EXPNO	1
PROCNO	1
Date_	20180313
Time	18.22
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	40.3
DW	78.200 usec
DE	6.50 usec
TE	295.6 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	13.10 usec
PL1	1.80 dB
PL1W	8.92857742 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300605 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00




```
NAME          cyj-272p-again
EXPNO                      2
PROCNO                     1
Date_               20181015
Time                   24.15
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 use
TE                    294.9   K
D1               2.00000000 sec
D11              0.03000000 sec
TD0                       10

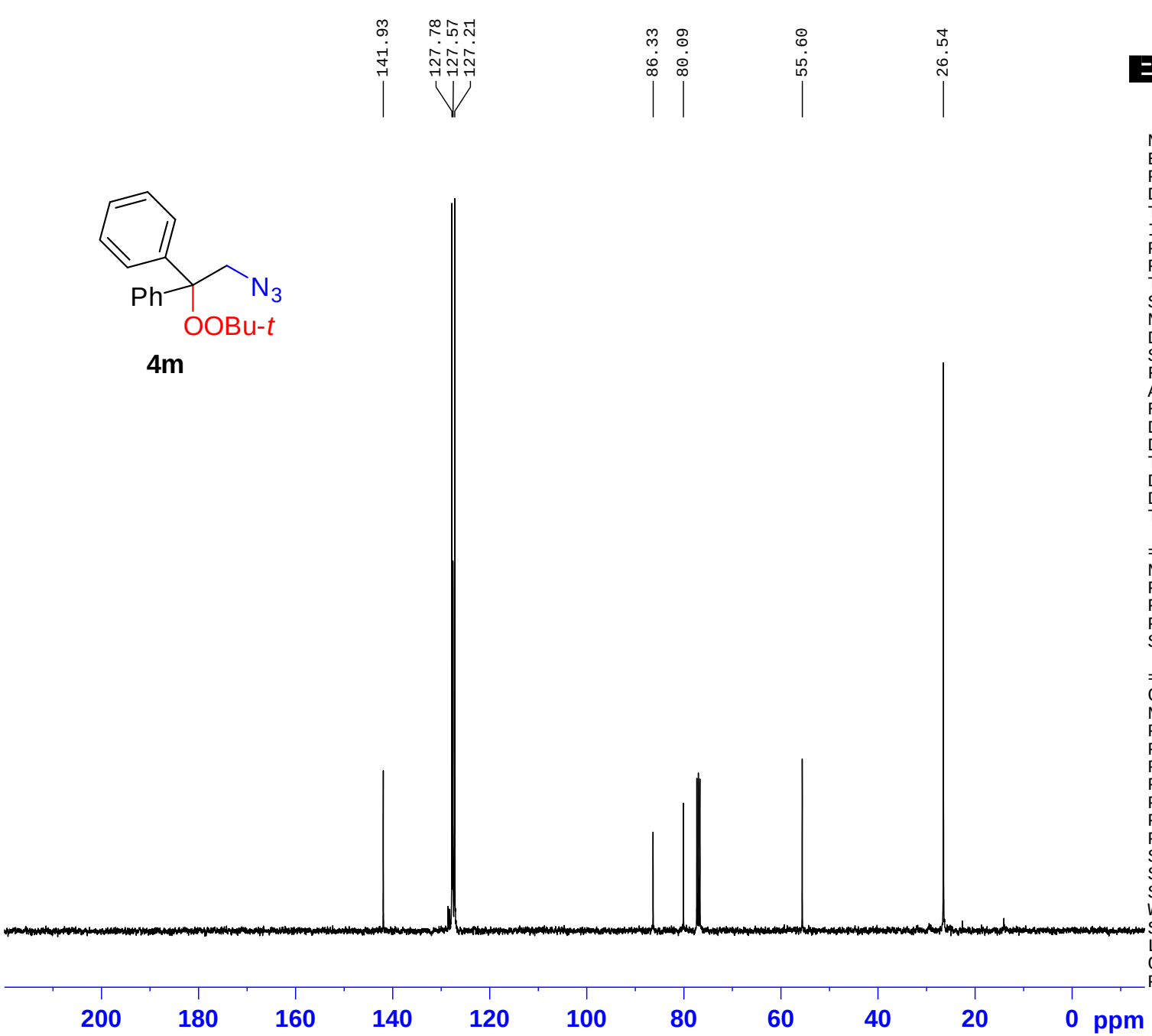
======== CHANNEL f1 ========
NUC1                    13C
P1                  13.50 usec
PL1                  3.00 dB
PL1W         43.93649673 W
SFO1         100.6238364 MHz

======== 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
SFO2         400.1316005 MHz
SI                   32768
SF           100.6127806 MHz
WDW                    EM
SSB                     0
LB                   3.00 Hz
GB                      0
PC                   1.40
```



BRUKER

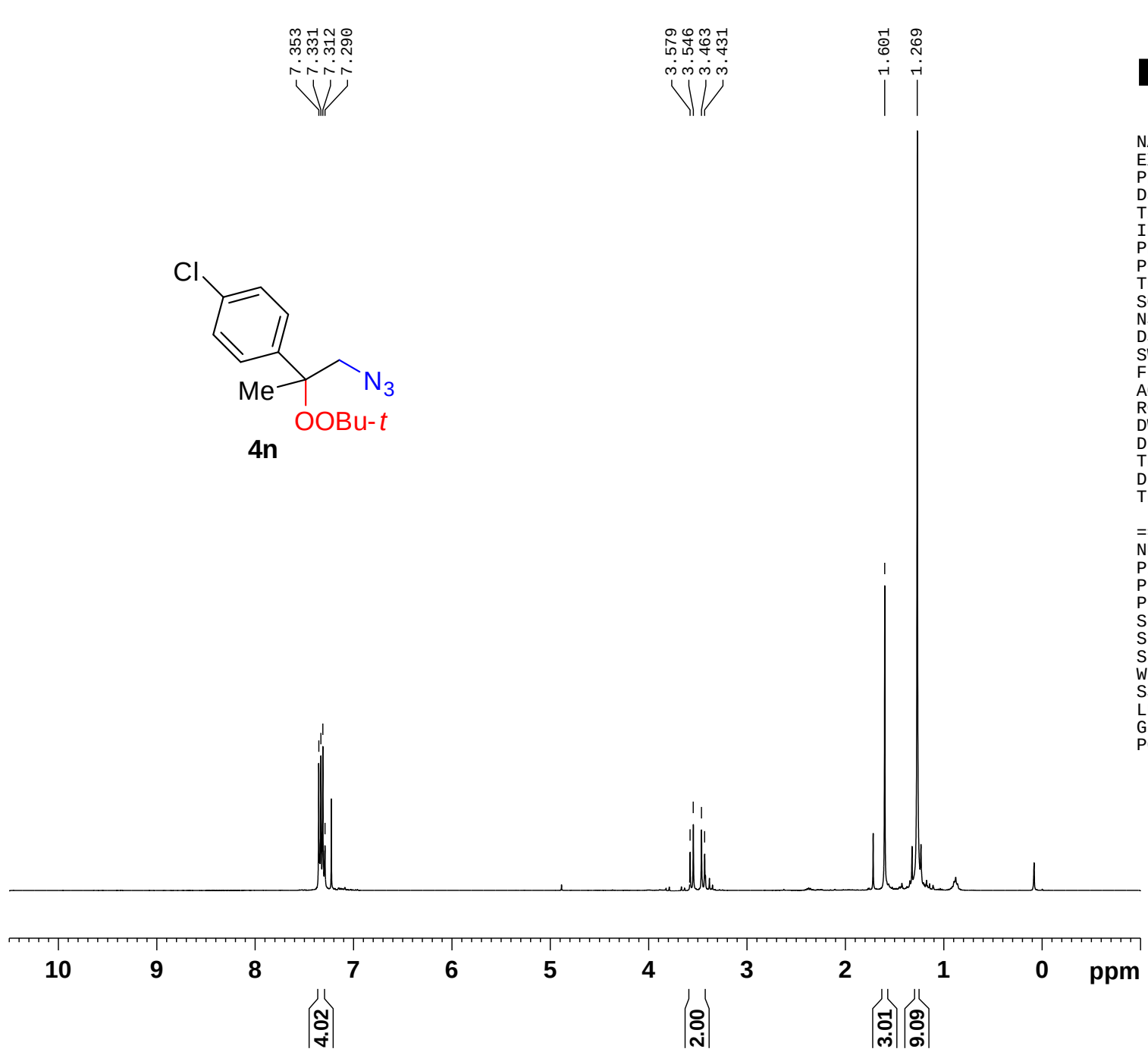
NAME	cyj251ap-20180306
EXPNO	1
PROCNO	1
Date_	20180306
Time	9.17
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	57
DW	78.200 usec
DE	6.50 usec
TE	296.8 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	13.10 usec
PL1	1.80 dB
PL1W	8.92857742 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300390 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00



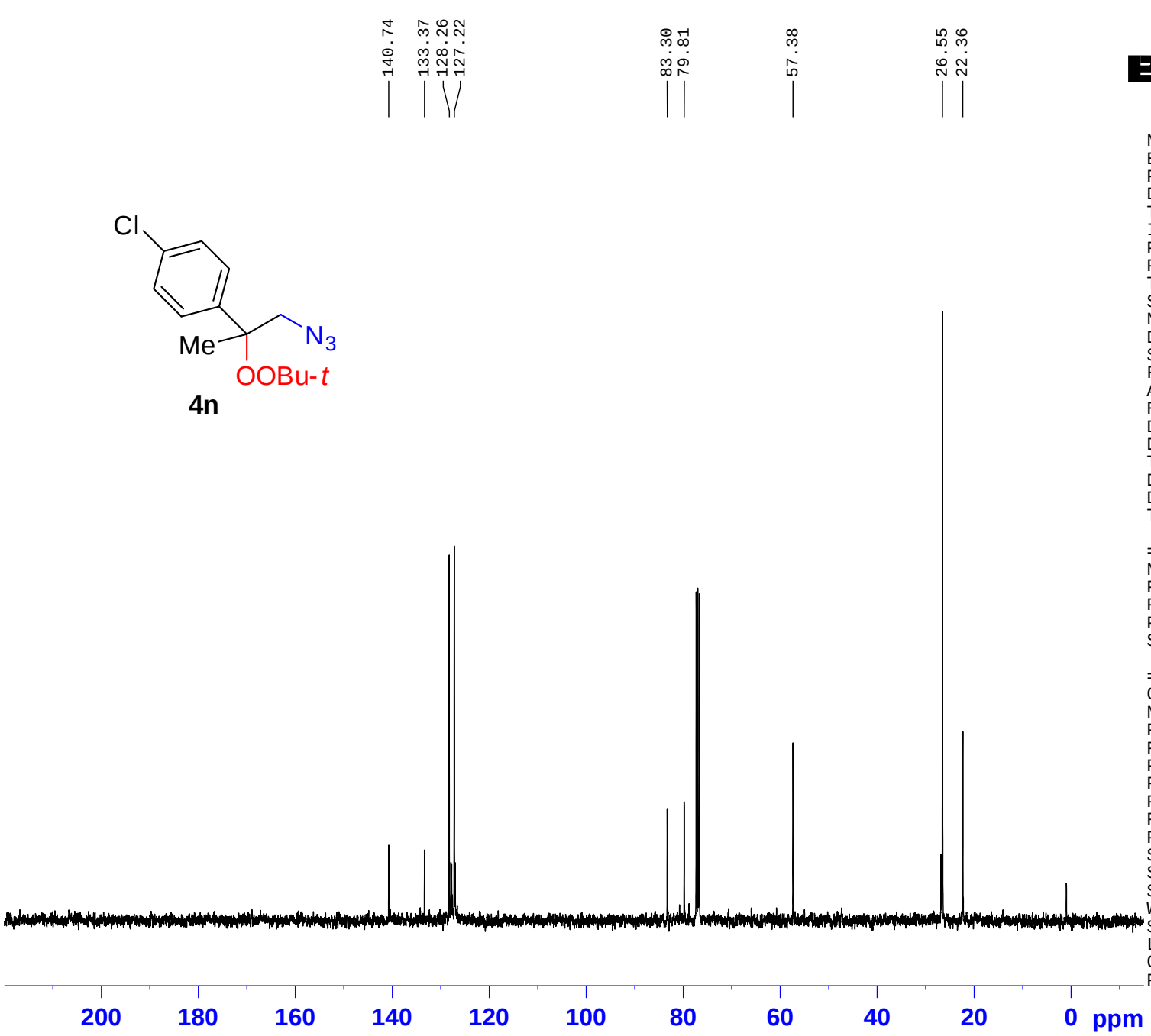

```
NAME      cyj251ap-c-20180314
EXPNO                       2
PROCNO                      1
Date_                20180314
Time                    22.00
INSTRUM                 spect
PROBHD   5 mm PADUL 13C
PULPROG                zgpg30
TD                      65536
SOLVENT                 CDCl3
NS                         32
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                       296.6 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
SFO1               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
SFO2               400.1316005 MHz
SI                         32768
SF                 100.6127843 MHz
WDW                           EM
SSB                            0
LB                        3.00 Hz
GB                             0
PC                        1.40
```



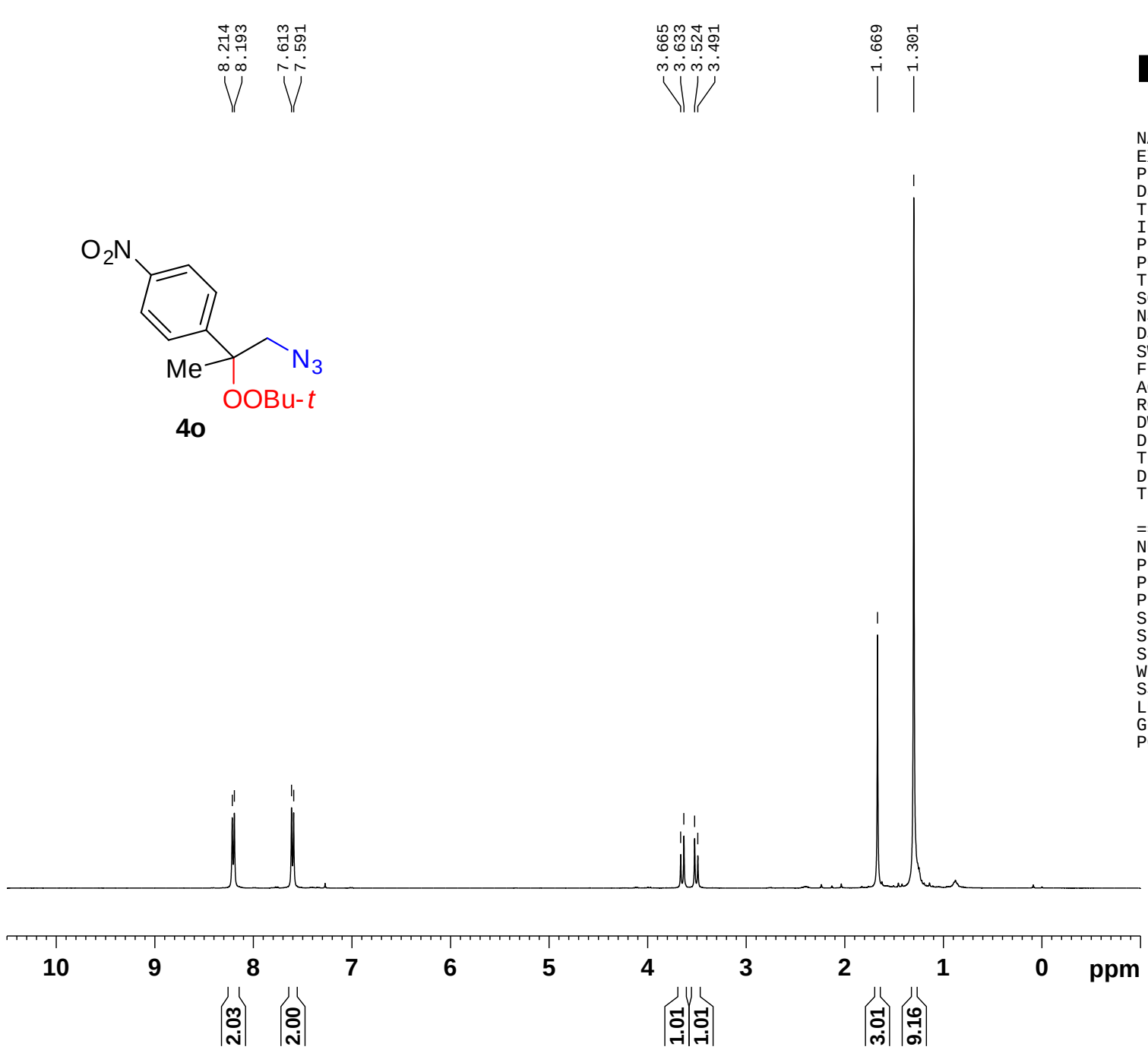
NAME	cyj248ap-20180303
EXPNO	1
PROCNO	1
Date_	20180303
Time	20.04
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	40.3
DW	78.200 usec
DE	6.50 usec
TE	298.5 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	13.10 usec
PL1	1.80 dB
PL1W	8.92857742 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300237 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00




```
NAME      cyj763ap-201801101
EXPNO                      2
PROCNO                     1
Date_               20181101
Time                   18.08
INSTRUM                spect
PROBHD   5 mm PABBO BB-
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                     6.50 usec
TE                     294.4 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                        3

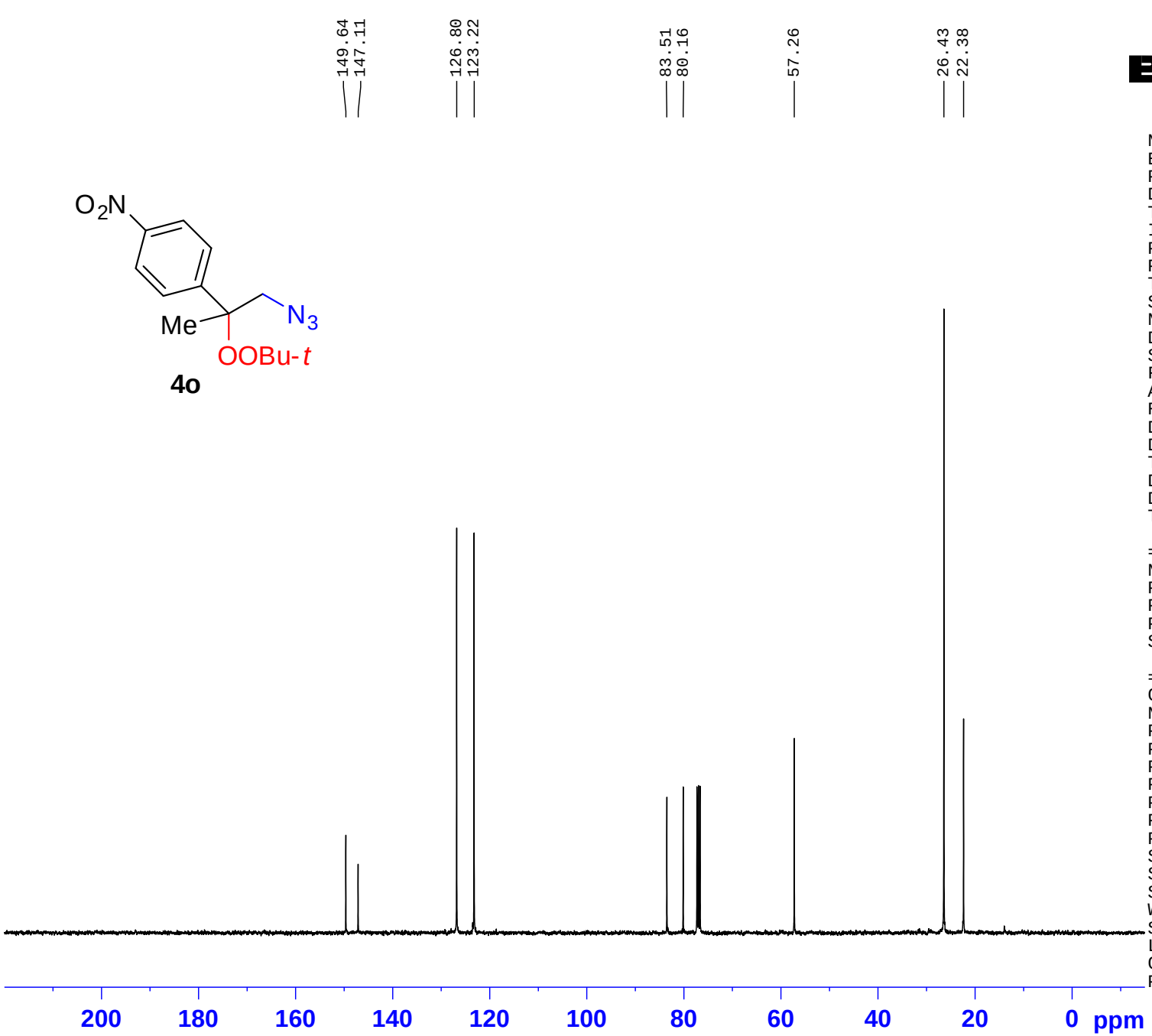
======== CHANNEL f1 ========
NUC1                     13C
P1                     15.00 usec
PL1                     2.00 dB
PL1W            55.31277084 W
SFO1            100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2             waltz16
NUC2                    1H
PCPD2                80.00 usec
PL2                  -1.00 dB
PL12                 16.72 dB
PL13                 15.50 dB
PL2W            17.01305389 W
PL12W            0.28759566 W
PL13W            0.38087484 W
SFO2            400.1316005 MHz
SI                    32768
SF              100.6127767 MHz
WDW                      EM
SSB                       0
LB                     3.00 Hz
GB                        0
PC                     1.40
```




```
NAME      cyj297p-20180329
EXPNO                    1
PROCNO                   1
Date_             20180329
Time                 16.36
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                  297.7 K
D1             1.00000000 sec
TD0                      1

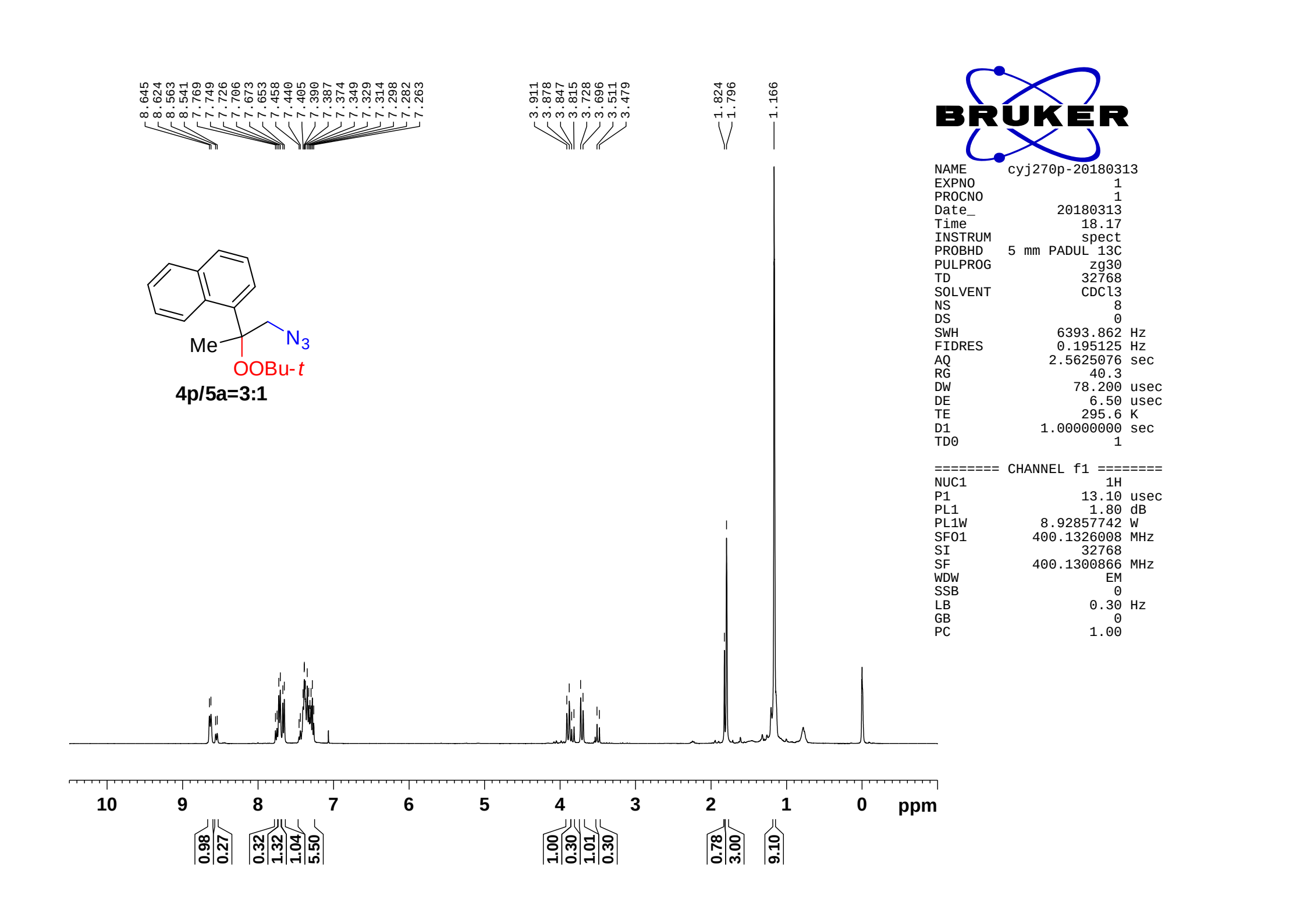
======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W           8.92857742 W
SFO1          400.1326008 MHz
SI                   32768
SF            400.1300053 MHz
WDW                     EM
SSB                      0
LB                    0.30 Hz
GB                       0
PC                    1.00
```




```
NAME      cyj297p-20180331
EXPNO                    2
PROCNO                   1
Date_             20180331
Time                 14.28
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                 296.3 K
D1              2.00000000 sec
D11             0.03000000 sec
TD0                    10

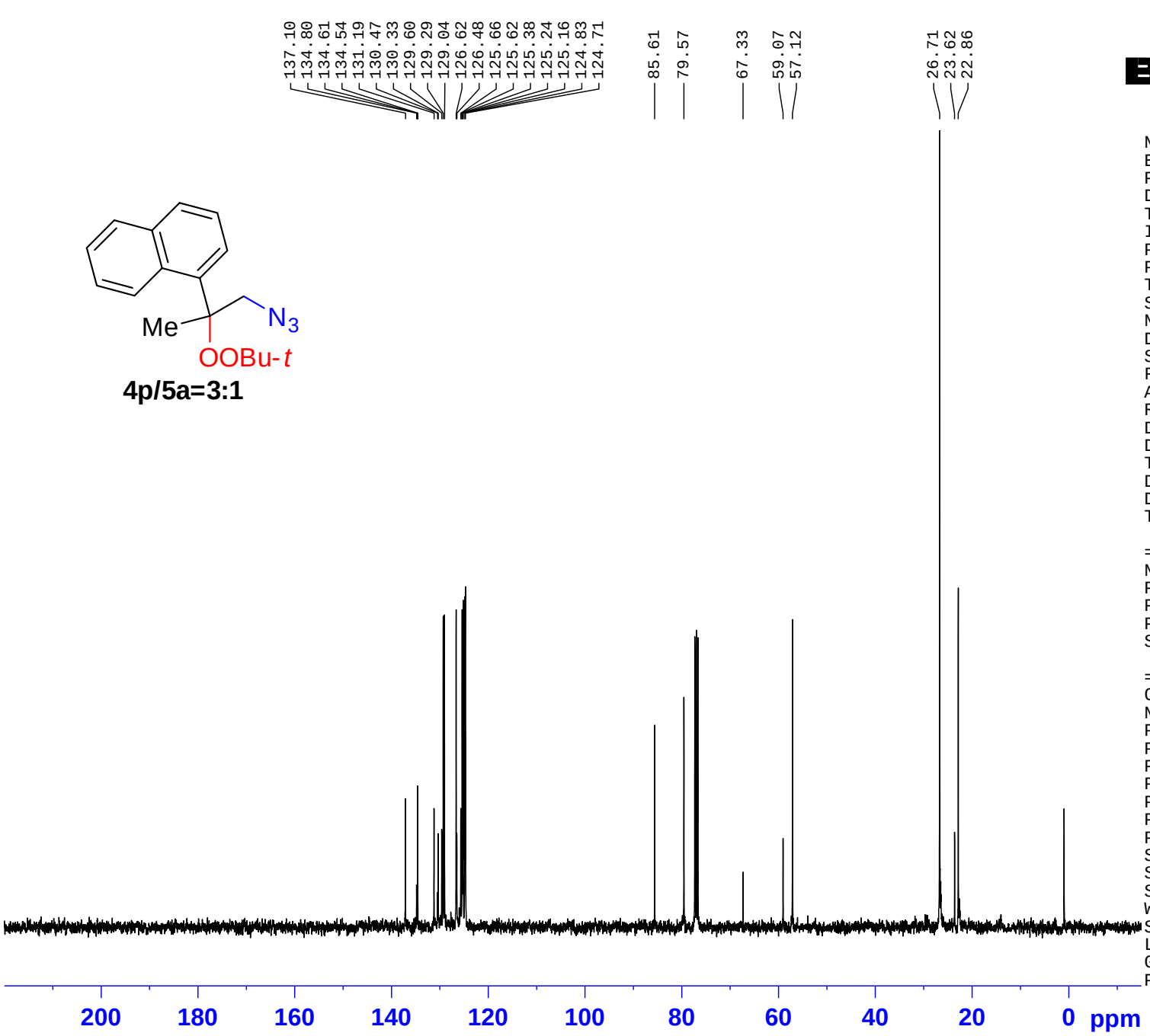
======== CHANNEL f1 ========
NUC1                  13C
P1                  13.50 usec
PL1                  3.00 dB
PL1W         43.93649673 W
SFO1         100.6238364 MHz

======== 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
SFO2         400.1316005 MHz
SI                 32768
SF           100.6127800 MHz
WDW                   EM
SSB                    0
LB                  3.00 Hz
GB                     0
PC                  1.40
```



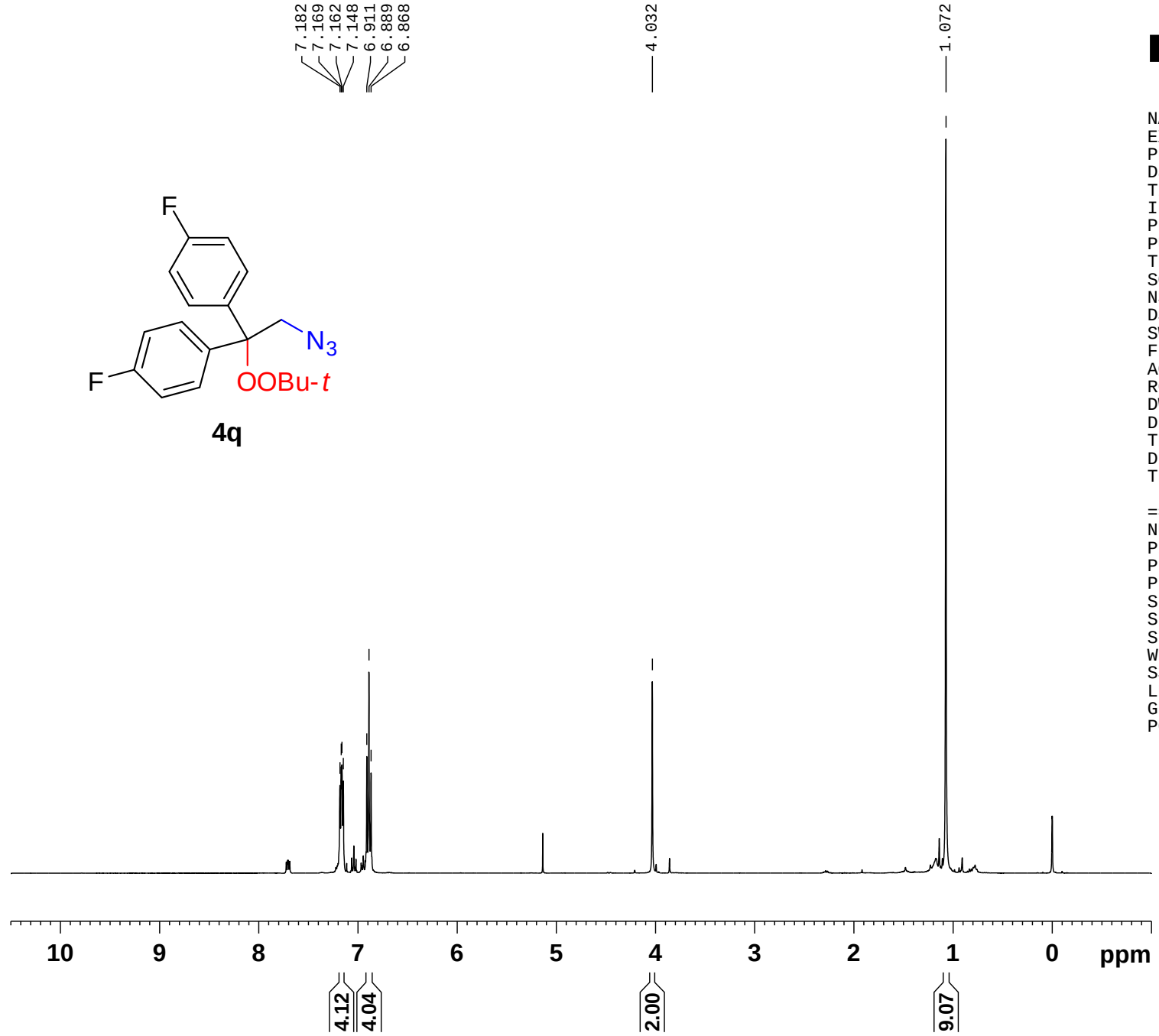

```
NAME      cyj270p-20180313
EXPNO                    1
PROCNO                   1
Date_             20180313
Time                 18.17
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   32768
SOLVENT              CDCl3
NS                       8
DS                       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                  295.6 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300866 MHz
WDW                     EM
SSB                      0
LB                    0.30 Hz
GB                       0
PC                    1.00
```



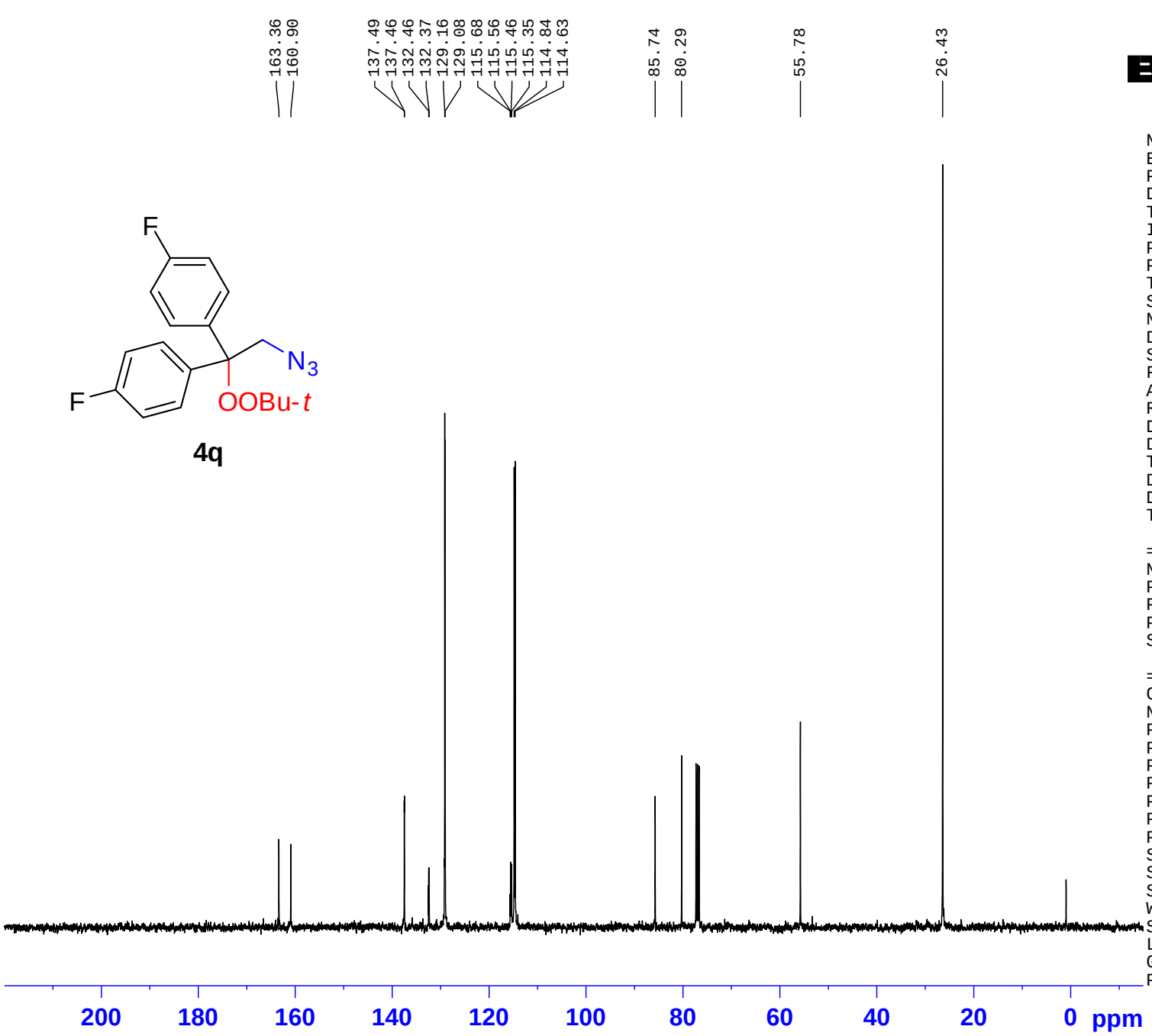
BRUKER

NAME	cyj-270p-20180315
EXPNO	2
PROCNO	1
Date_	20180315
Time	21.22
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	296.4 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
SFO1	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
SFO2	400.1316005 MHz
SI	32768
SF	100.6127853 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40




```
NAME      cyj271p-20180314
EXPNO                    1
PROCNO                   1
Date_             20180314
Time                 21.46
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                      36
DW                  78.200 usec
DE                   6.50 usec
TE                  295.9 K
D1              1.00000000 sec
TD0                      1

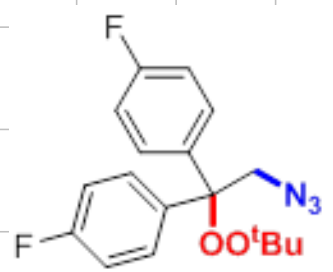
======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300682 MHz
WDW                     EM
SSB                      0
LB                    0.30 Hz
GB                       0
PC                    1.00
```



BRUKER

NAME	cyj271p-c-20180314
EXPNO	2
PROCNO	1
Date_	20180314
Time	21.53
INSTRUM	spect
PROBHD	5 mm PADUL 13C
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	24
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	296.2 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
SFO1	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
SFO2	400.1316005 MHz
SI	32768
SF	100.6127808 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40

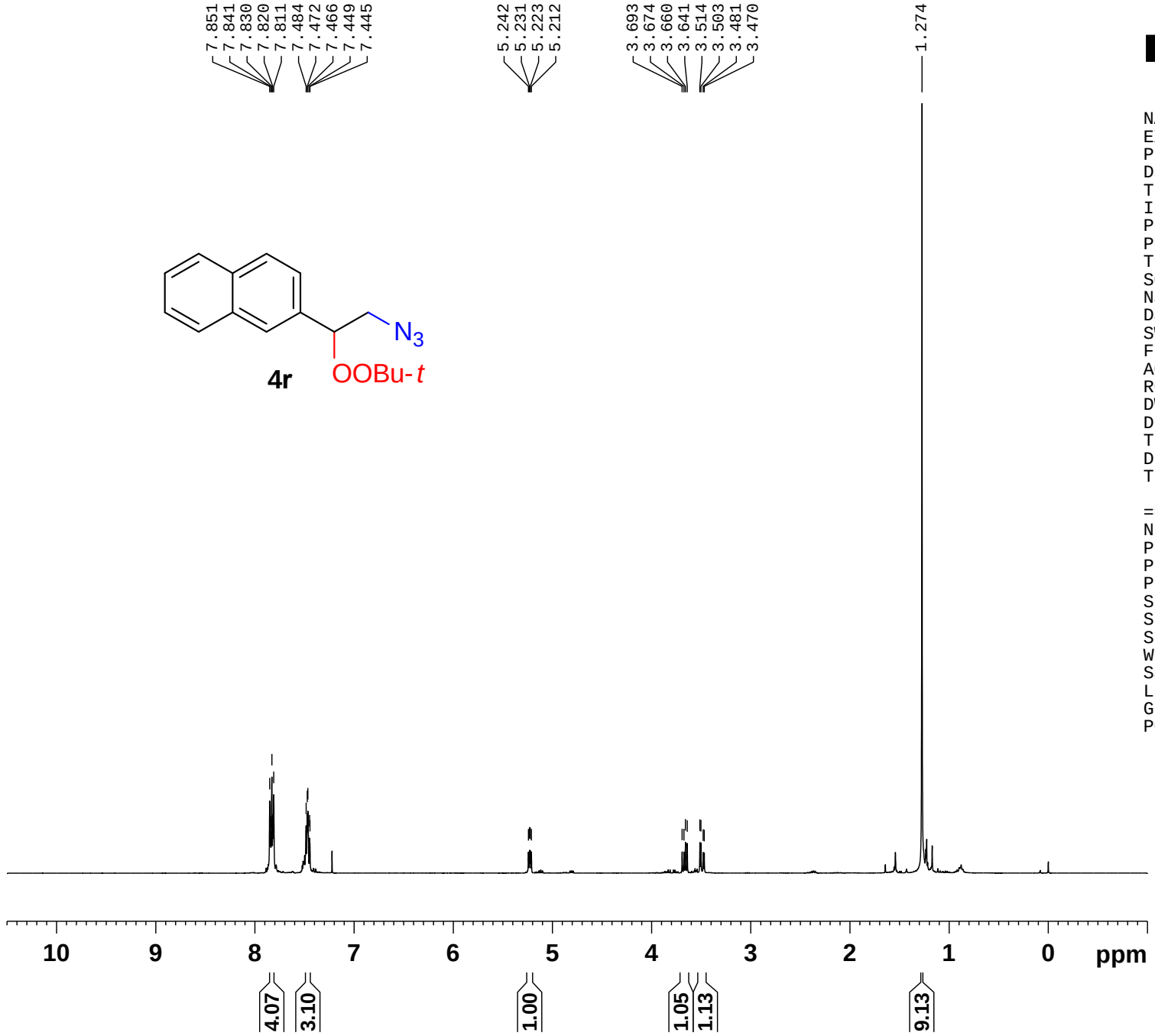
yhj
single_pulse



4r

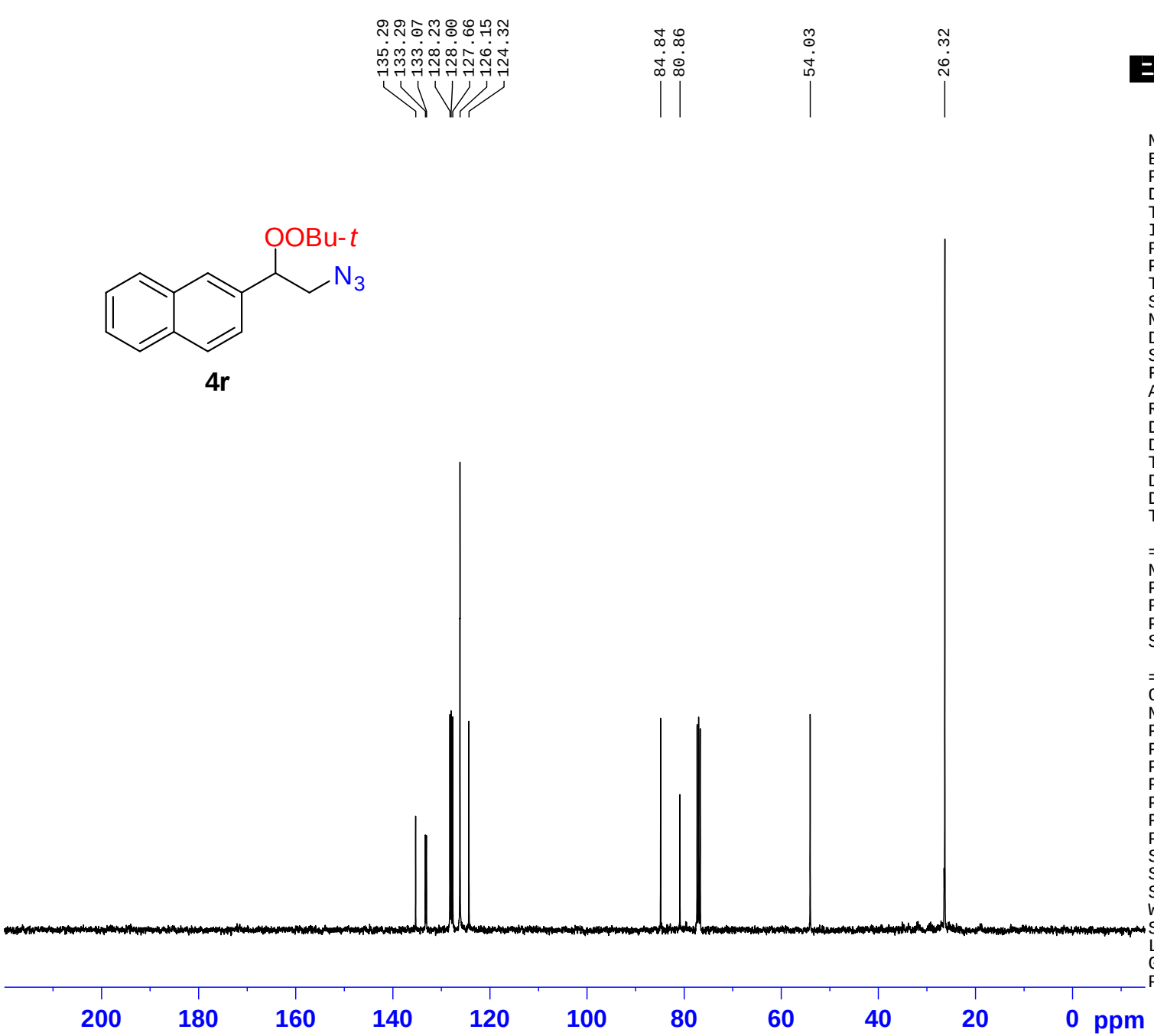
-114.04

f1 (ppm)

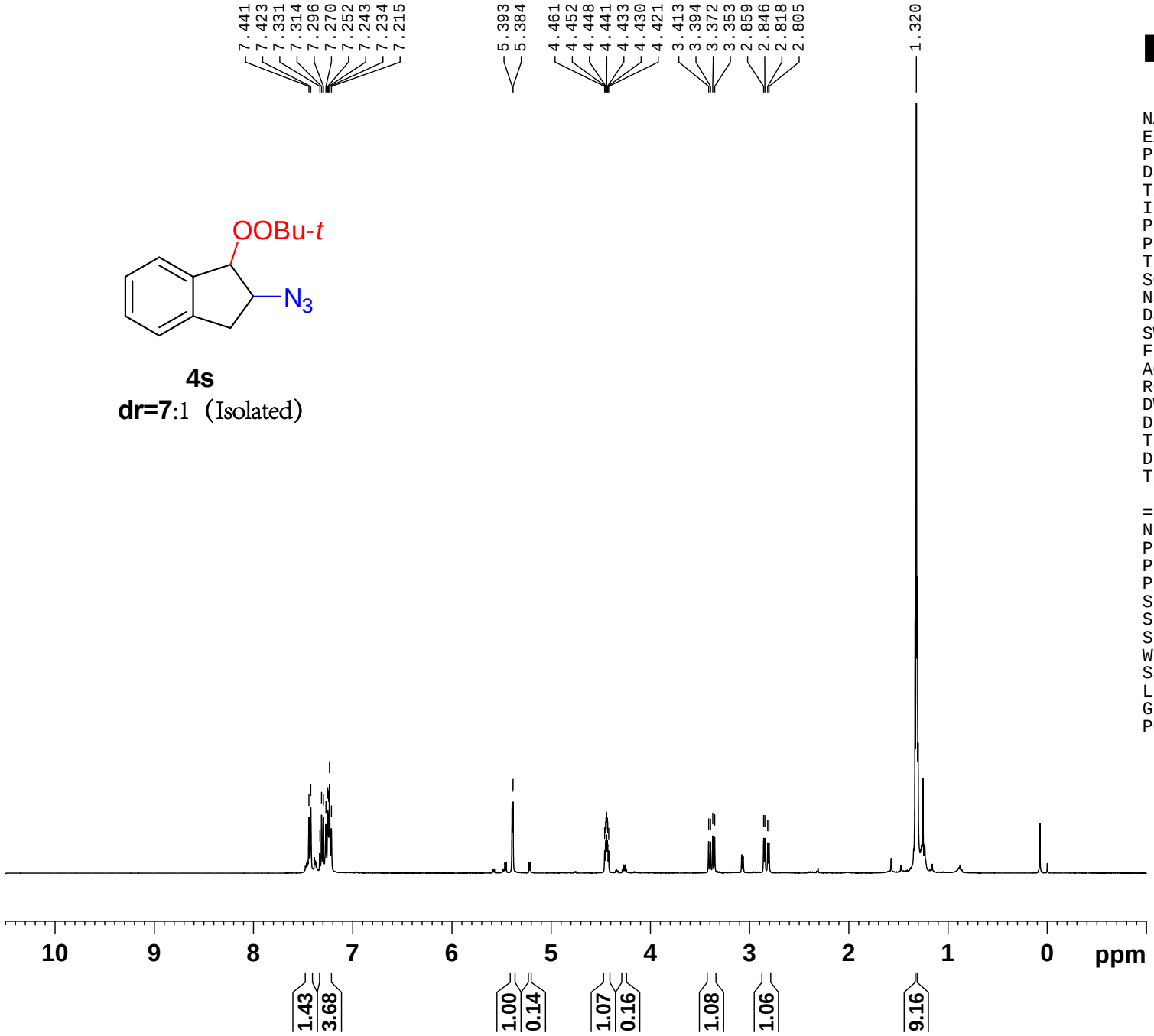


BRUKER

NAME	cyj504bp-20180619
EXPNO	1
PROCNO	1
Date_	20180619
Time	19.43
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	90.5
DW	78.200 usec
DE	6.50 usec
TE	297.1 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	10.40 usec
PL1	-1.00 dB
PL1W	17.01305389 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300257 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00



NAME	cyj736p2-201801025
EXPNO	2
PROCNO	1
Date_	20181025
Time	17.34
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	64
DS	4
SWH	25252.525 Hz
FIDRES	0.385323 Hz
AQ	1.2976629 sec
RG	2050
DW	19.800 usec
DE	6.50 usec
TE	294.4 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	3
======== CHANNEL f1 ========	
NUC1	13C
P1	15.00 usec
PL1	2.00 dB
PL1W	55.31277084 W
SFO1	100.6238364 MHz
======== CHANNEL f2 ========	
CPDPRG2	waltz16
NUC2	1H
PCPD2	80.00 usec
PL2	-1.00 dB
PL12	16.72 dB
PL13	15.50 dB
PL2W	17.01305389 W
PL12W	0.28759566 W
PL13W	0.38087484 W
SFO2	400.1316005 MHz
SI	32768
SF	100.6127835 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40

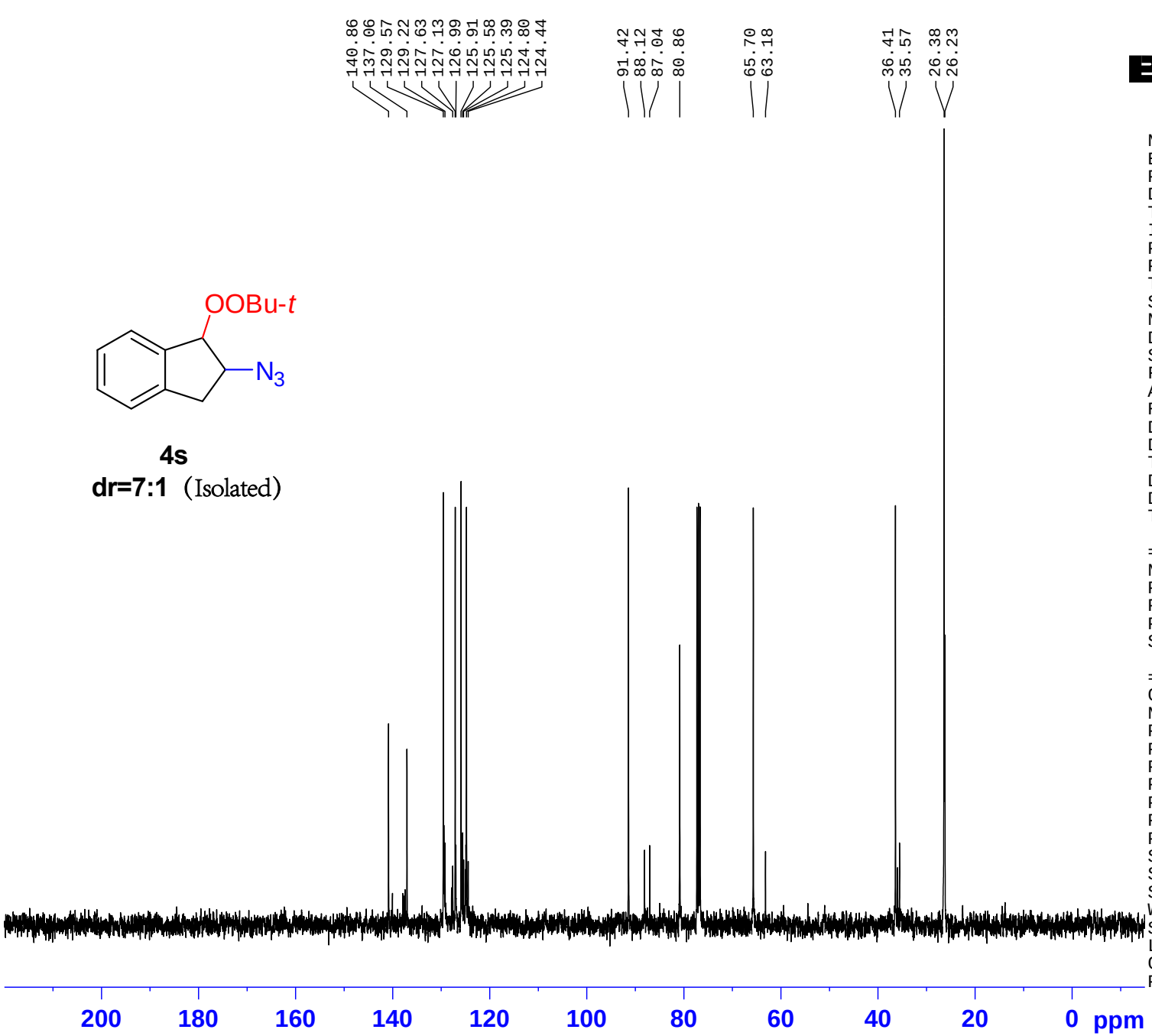


4s

dr=7:1 (Isolated)

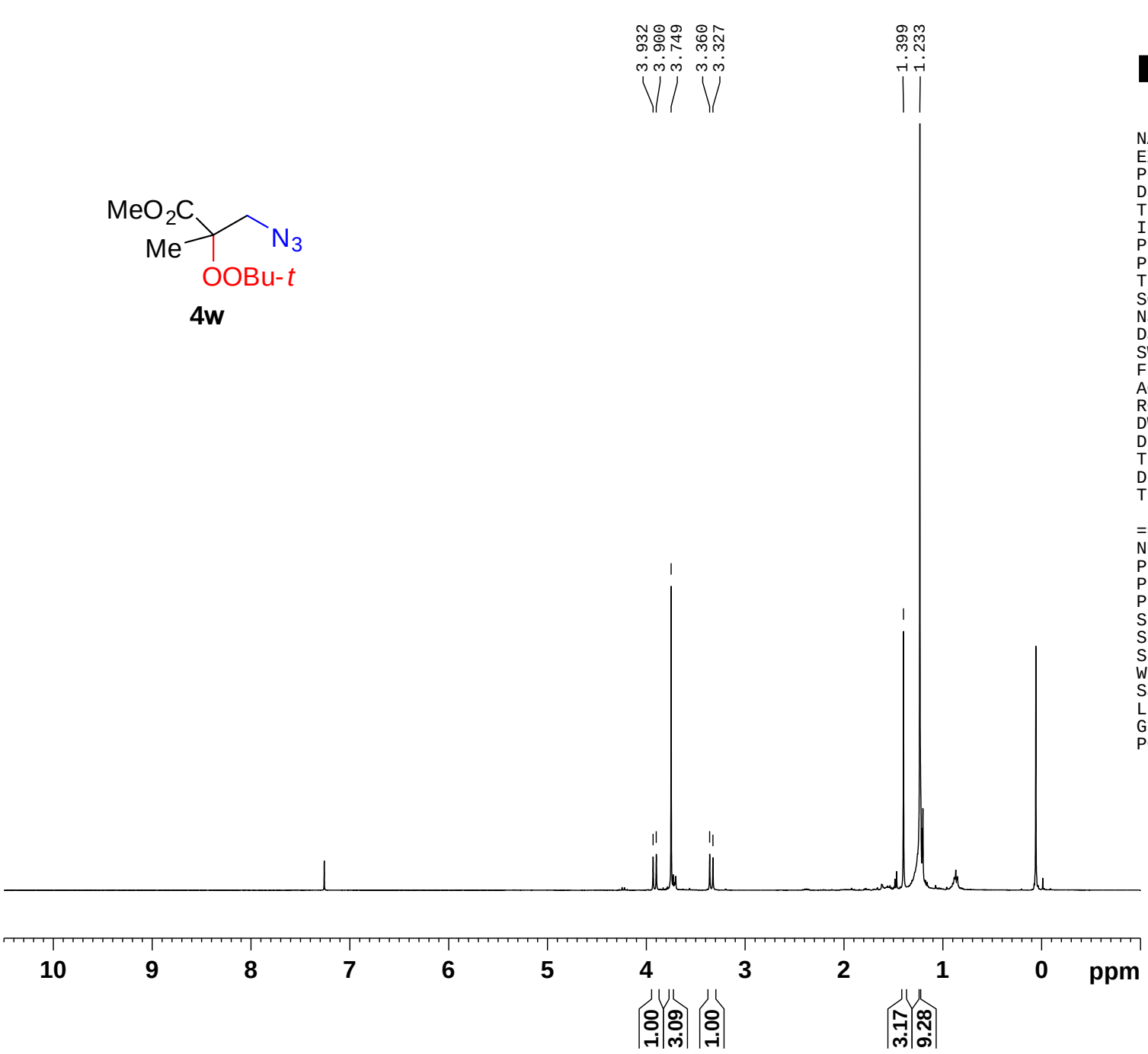
```
NAME      cyj275p1-20180320
EXPNO                    1
PROCNO                   1
Date_             20180320
Time                 16.58
INSTRUM              spect
PROBHD   5 mm PADUL 13C
PULPROG               zg30
TD                   32768
SOLVENT              CDCl3
NS                       8
DS                       0
SWH               6393.862 Hz
FIDRES            0.195125 Hz
AQ               2.5625076 sec
RG                    90.5
DW                  78.200 usec
DE                   6.50 usec
TE                  293.5 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300168 MHz
WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
```



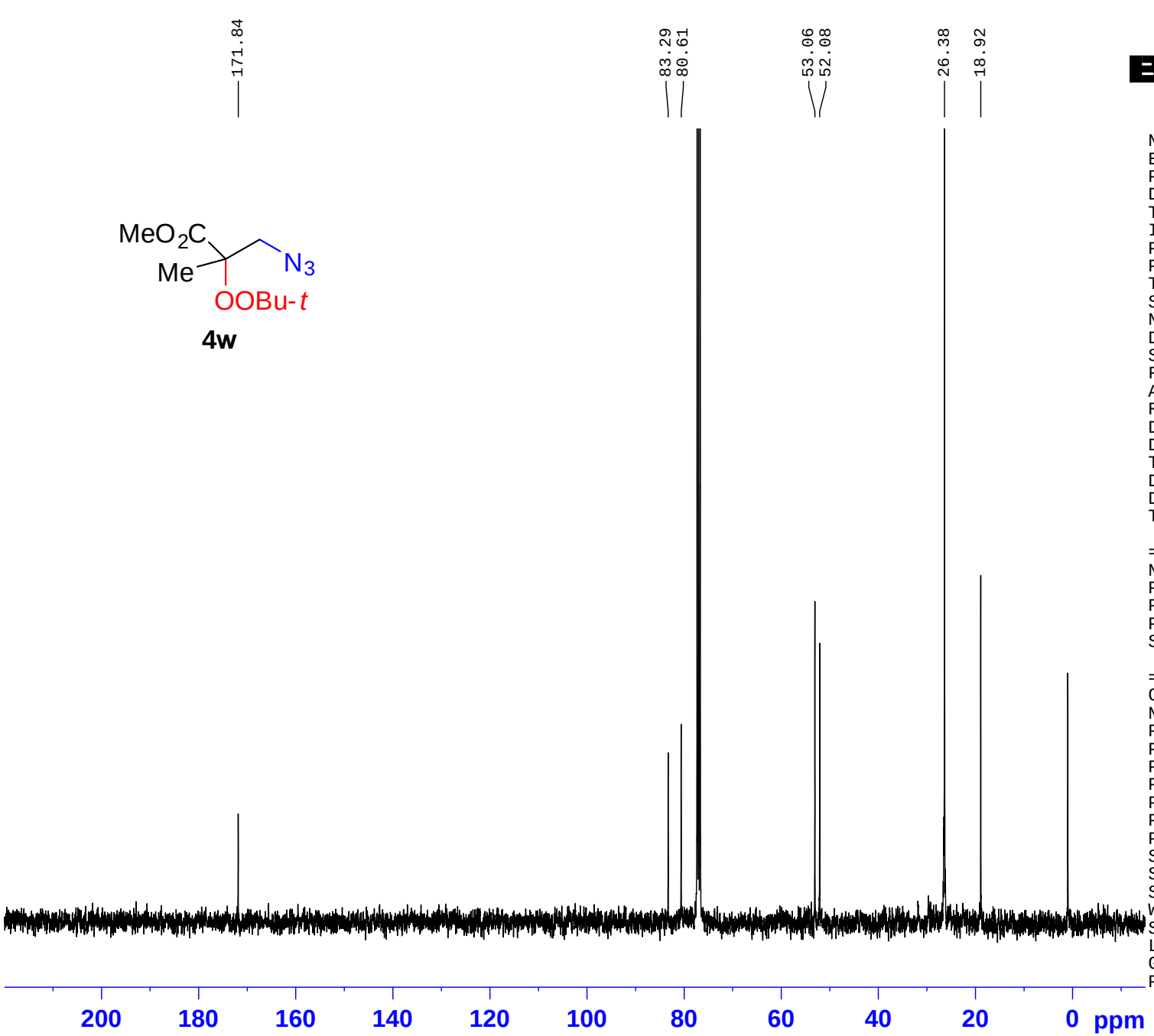
BRUKER

NAME	cyj461cp-201801027
EXPNO	2
PROCNO	1
Date_	20181027
Time	20.21
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	24
DS	4
SWH	25252.525 Hz
FIDRES	0.385323 Hz
AQ	1.2976629 sec
RG	2050
DW	19.800 usec
DE	6.50 usec
TE	294.0 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	3
======== CHANNEL f1 ========	
NUC1	13C
P1	15.00 usec
PL1	2.00 dB
PL1W	55.31277084 W
SFO1	100.6238364 MHz
======== CHANNEL f2 ========	
CPDPRG2	waltz16
NUC2	1H
PCPD2	80.00 usec
PL2	-1.00 dB
PL12	16.72 dB
PL13	15.50 dB
PL2W	17.01305389 W
PL12W	0.28759566 W
PL13W	0.38087484 W
SFO2	400.1316005 MHz
SI	32768
SF	100.6127856 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40




```
NAME      cyj719bp-20181009
EXPNO                    1
PROCNO                   1
Date_             20181009
Time                 18.27
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                  293.5 K
D1               1.00000000 sec
TD0                      1

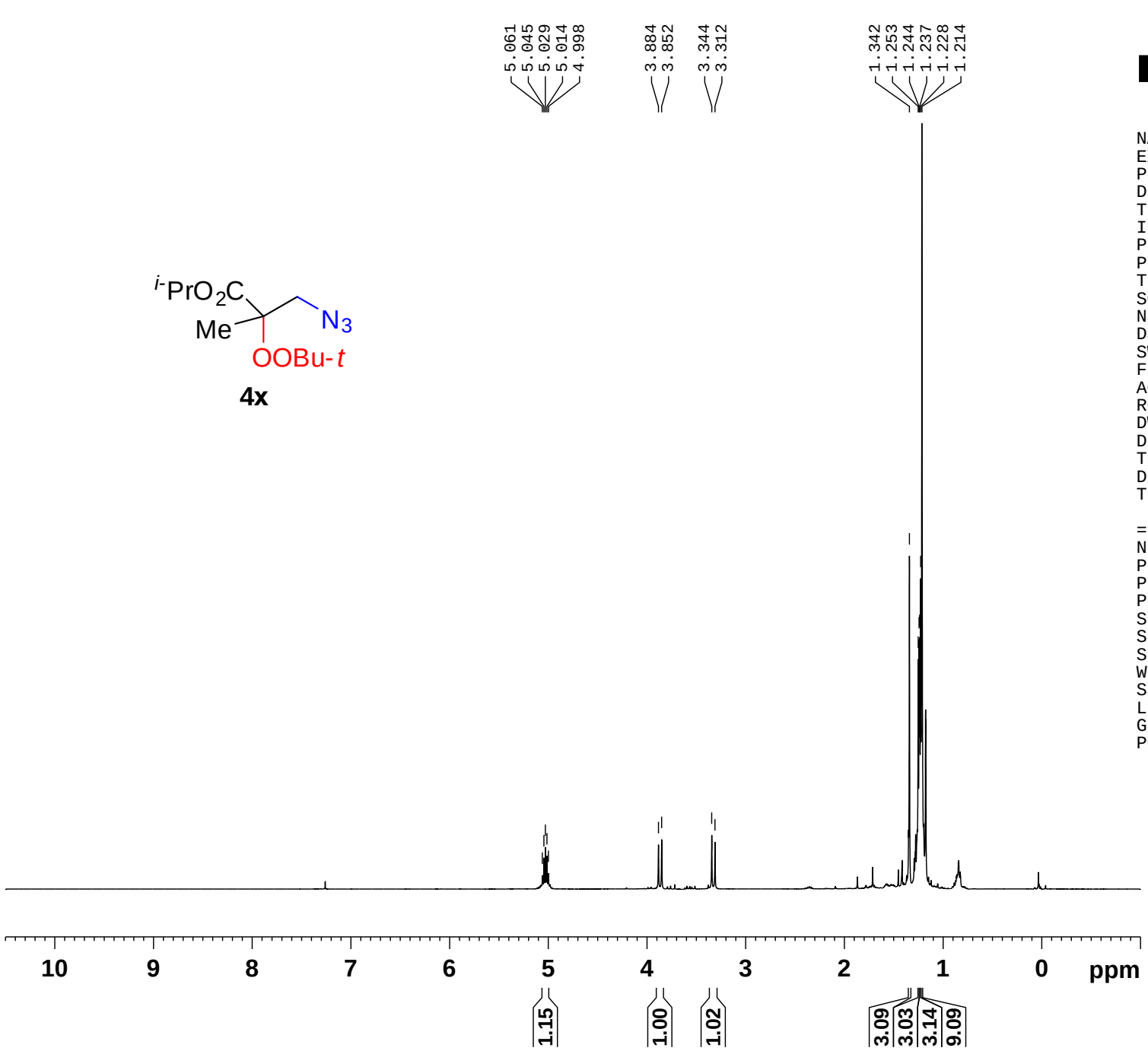
======== CHANNEL f1 ========
NUC1                    1H
P1                   10.40 usec
PL1                  -1.00 dB
PL1W          17.01305389 W
SFO1          400.1326008 MHz
SI                   32768
SF            400.1300104 MHz
WDW                     EM
SSB                      0
LB                   0.30 Hz
GB                       0
PC                   1.00
```




```
NAME      cyj719bp-201801009
EXPNO                      2
PROCNO                     1
Date_               20181009
Time                   18.45
INSTRUM                spect
PROBHD   5 mm PABBO BB-
PULPROG                zgpg30
TD                      65536
SOLVENT                 CDCl3
NS                        168
DS                          4
SWH                 25252.525 Hz
FIDRES                0.385323 Hz
AQ                  1.2976629 sec
RG                       2050
DW                     19.800 usec
DE                      6.50 usec
TE                     294.7 K
D1                  2.00000000 sec
D11                 0.03000000 sec
TD0                         3

======== CHANNEL f1 ========
NUC1                      13C
P1                     15.00 usec
PL1                     2.00 dB
PL1W               55.31277084 W
SFO1               100.6238364 MHz

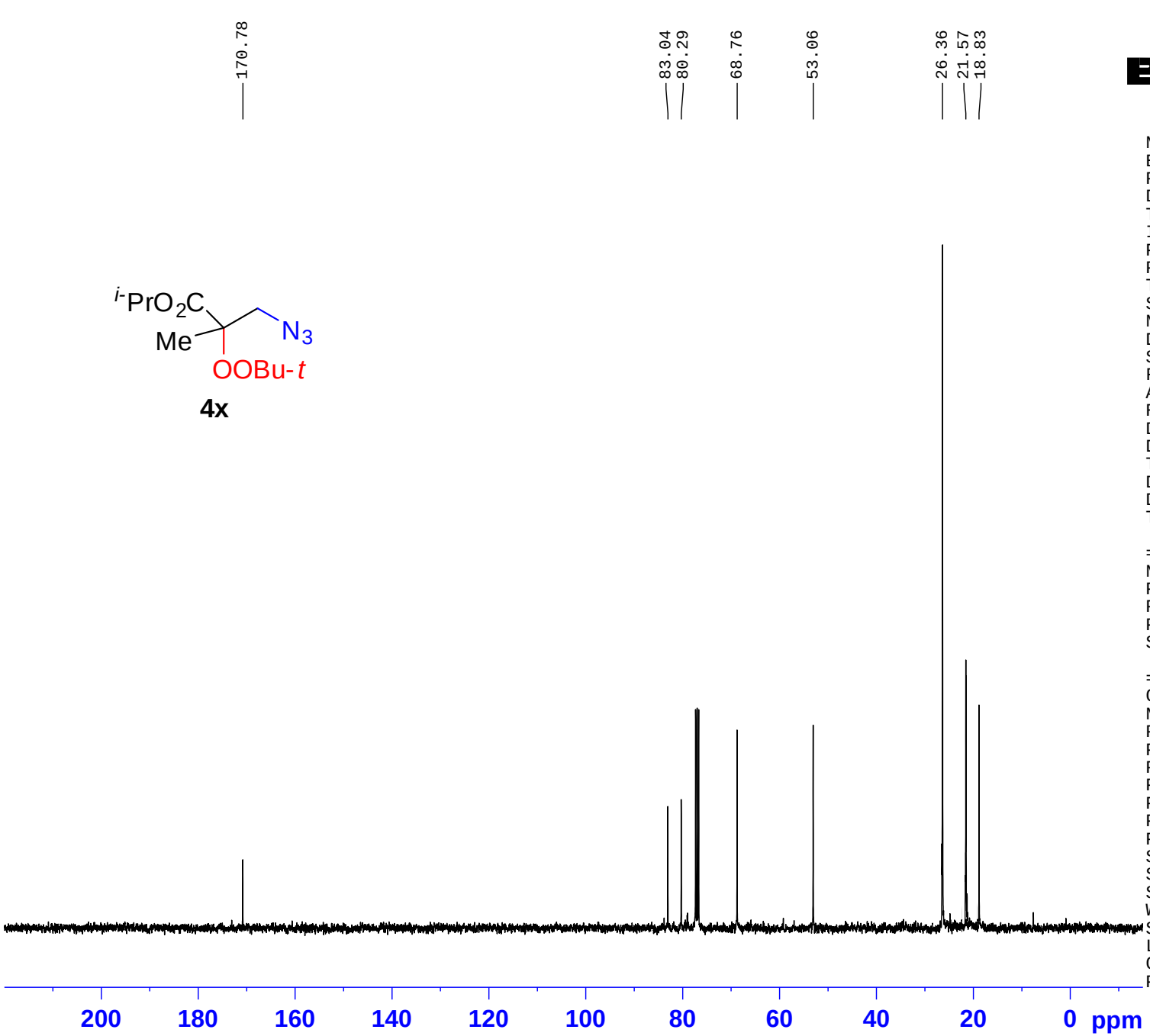
======== CHANNEL f2 ========
CPDPRG2                waltz16
NUC2                       1H
PCPD2                  80.00 usec
PL2                    -1.00 dB
PL12                   16.72 dB
PL13                   15.50 dB
PL2W               17.01305389 W
PL12W               0.28759566 W
PL13W               0.38087484 W
SFO2               400.1316005 MHz
SI                       32768
SF                 100.6127720 MHz
WDW                        EM
SSB                         0
LB                      3.00 Hz
GB                          0
PC                      1.40
```



4x

```
NAME      cyj742cp-20181017
EXPNO                    1
PROCNO                   1
Date_             20181017
Time                 17.24
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                  293.8 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   10.40 usec
PL1                  -1.00 dB
PL1W          17.01305389 W
SFO1          400.1326008 MHz
SI                   32768
SF            400.1300105 MHz
WDW                     EM
SSB                      0
LB                    0.30 Hz
GB                       0
PC                    1.00
```

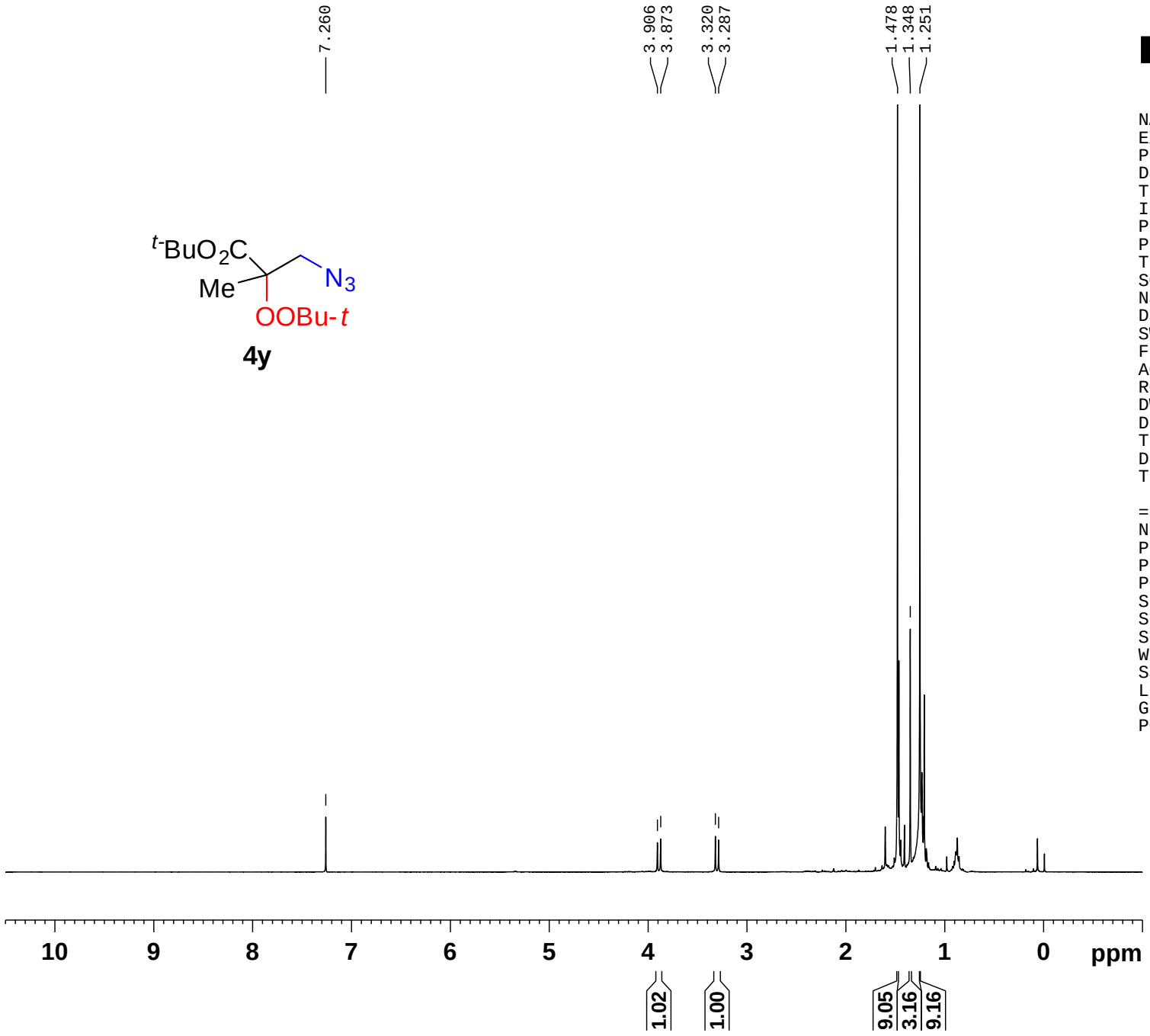


4x

```
NAME      cyj742cp-201801017
EXPNO                     2
PROCNO                    1
Date_              20181017
Time                 17.29
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                   6.50 usec
TE                   294.9 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                      3

======== CHANNEL f1 ========
NUC1                   13C
P1                   15.00 usec
PL1                   2.00 dB
PL1W          55.31277084 W
SFO1          100.6238364 MHz

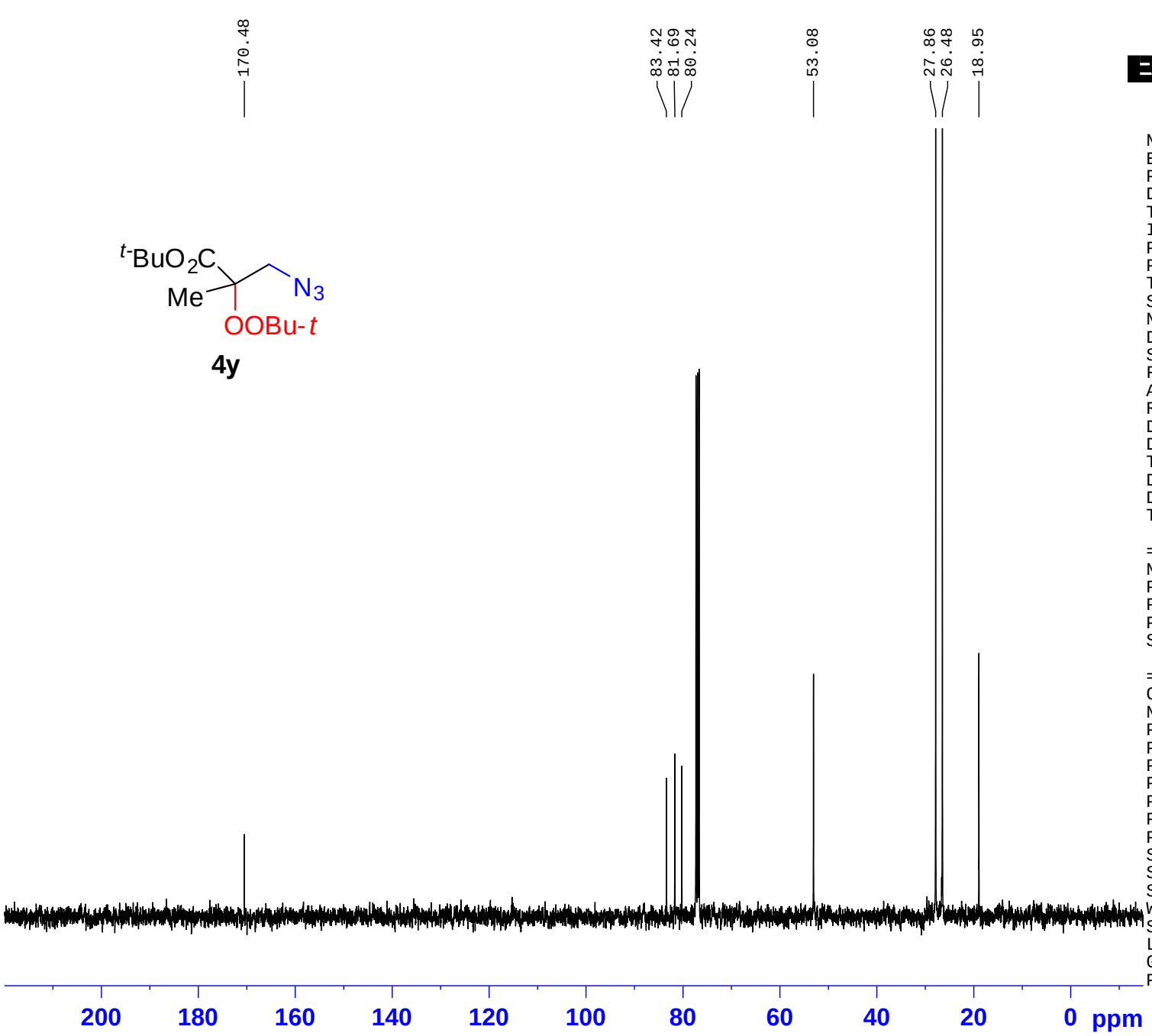
======== CHANNEL f2 ========
CPDPRG2           waltz16
NUC2                   1H
PCPD2                80.00 usec
PL2                  -1.00 dB
PL12                 16.72 dB
PL13                 15.50 dB
PL2W          17.01305389 W
PL12W          0.28759566 W
PL13W          0.38087484 W
SFO2          400.1316005 MHz
SI                    32768
SF            100.6127751 MHz
WDW                     EM
SSB                      0
LB                    3.00 Hz
GB                       0
PC                    1.40
```



4y

BRUKER

NAME	cyj728ap-20181014
EXPNO	1
PROCNO	1
Date_	20181014
Time	23.13
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	161
DW	78.200 usec
DE	6.50 usec
TE	293.7 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	10.40 usec
PL1	-1.00 dB
PL1W	17.01305389 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300105 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

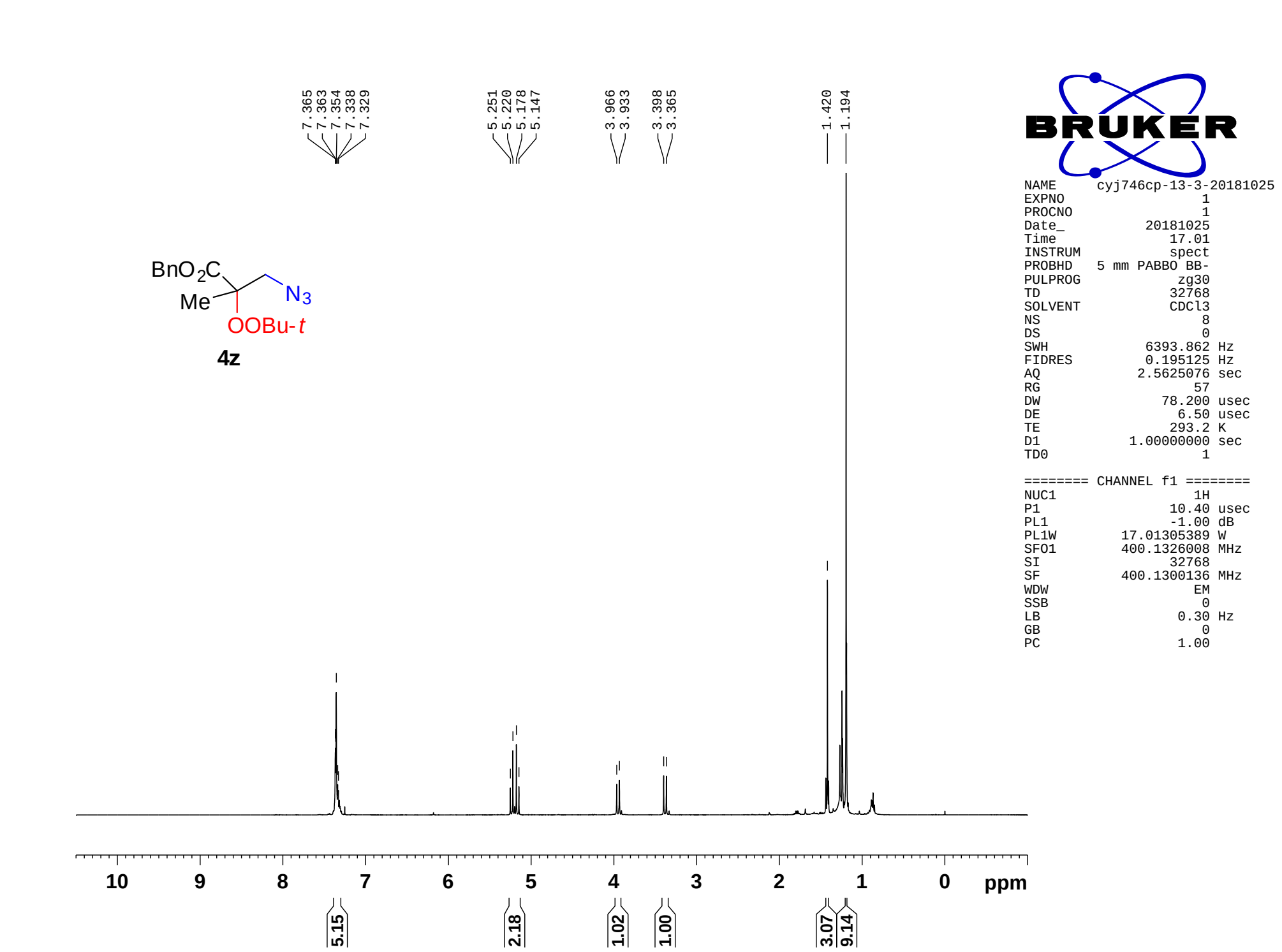


4y

```
NAME          cyj728p-201801026
EXPNO                         2
PROCNO                        1
Date_                  20181026
Time                       9.30
INSTRUM                  spect
PROBHD    5 mm PABBO BB-
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                        6.50 usec
TE                       293.6 K
D1                    2.00000000 sec
D11                   0.03000000 sec
TD0                          3

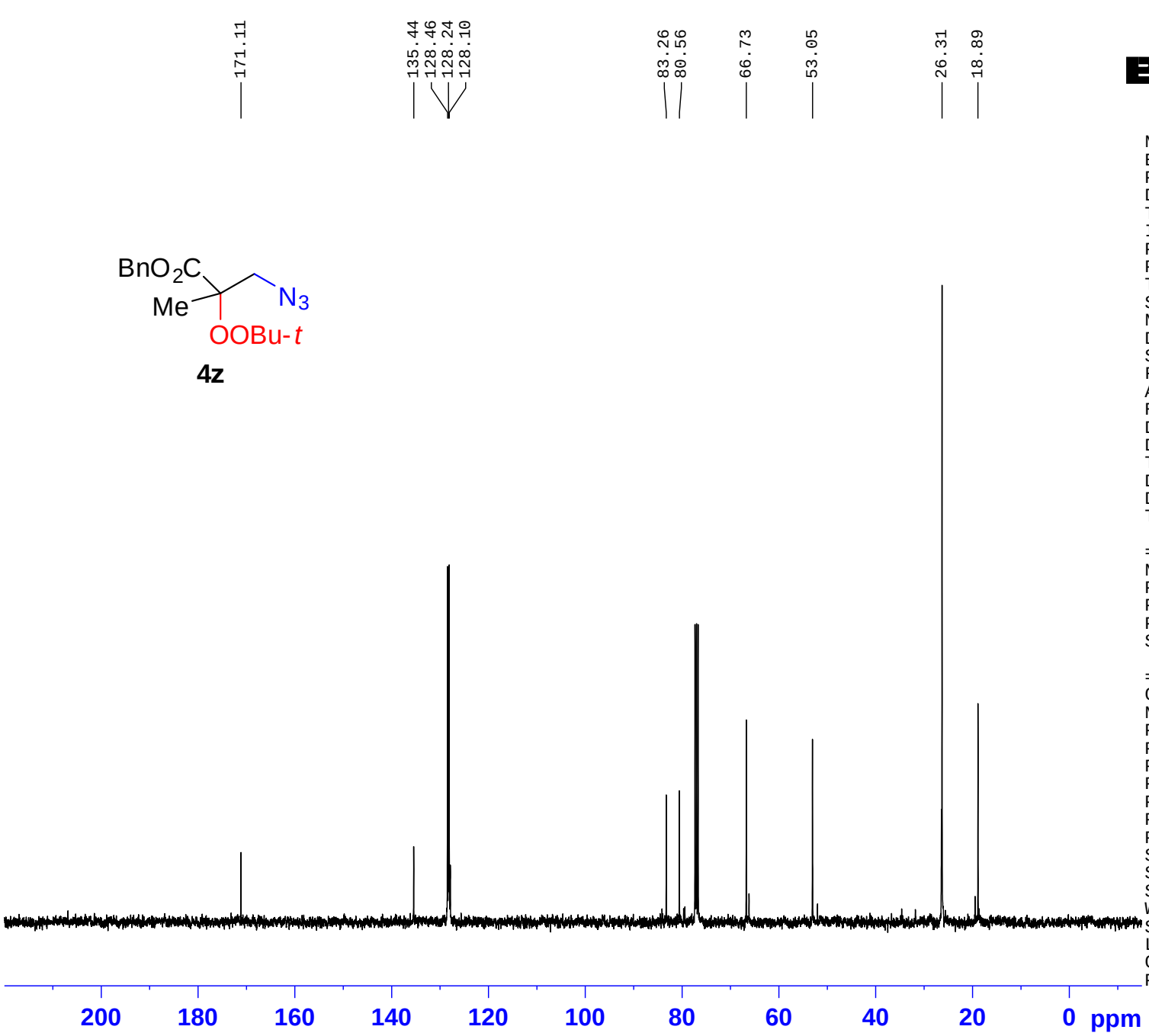
======== CHANNEL f1 ========
NUC1                       13C
P1                       15.00 usec
PL1                       2.00 dB
PL1W                55.31277084 W
SFO1                100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2                waltz16
NUC2                       1H
PCPD2                    80.00 usec
PL2                      -1.00 dB
PL12                     16.72 dB
PL13                     15.50 dB
PL2W                17.01305389 W
PL12W                0.28759566 W
PL13W                0.38087484 W
SFO2                400.1316005 MHz
SI                       32768
SF                  100.6127729 MHz
WDW                         EM
SSB                          0
LB                        3.00 Hz
GB                           0
PC                        1.40
```




```
NAME      cyj746cp-13-3-20181025
EXPNO                  1
PROCNO                 1
Date_           20181025
Time              17.01
INSTRUM           spect
PROBHD   5 mm PABBO BB-
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                293.2 K
D1           1.00000000 sec
TD0                   1

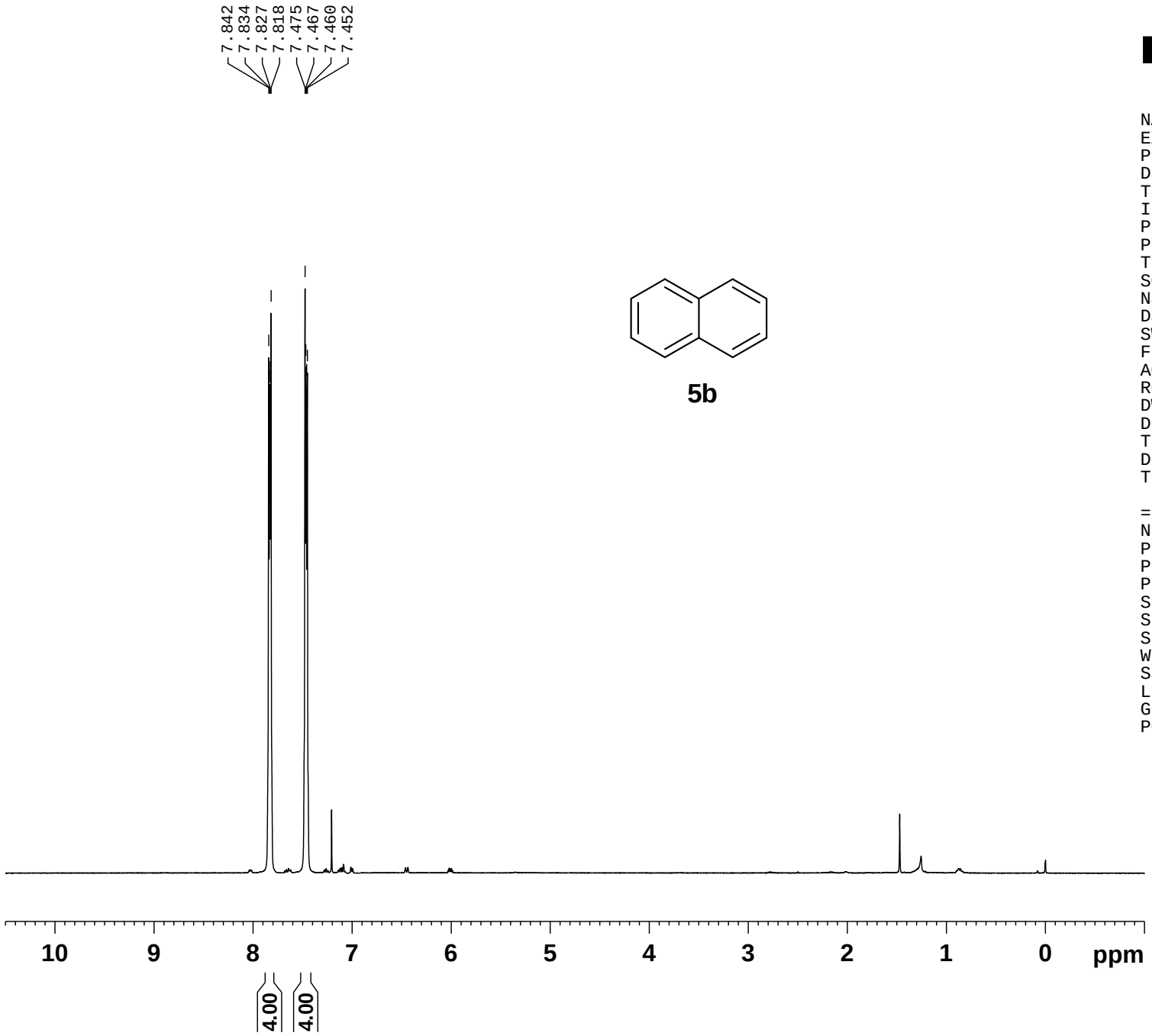
======== CHANNEL f1 ========
NUC1                 1H
P1                10.40 usec
PL1               -1.00 dB
PL1W        17.01305389 W
SFO1        400.1326008 MHz
SI                32768
SF          400.1300136 MHz
WDW                  EM
SSB                   0
LB                0.30 Hz
GB                    0
PC                1.00
```




```
NAME      cyj746cp-201801025
EXPNO                      2
PROCNO                     1
Date_               20181025
Time                   17.06
INSTRUM                spect
PROBHD   5 mm PABBO BB-
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                     6.50 usec
TE                     294.6 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                         3

======== CHANNEL f1 ========
NUC1                      13C
P1                      15.00 usec
PL1                      2.00 dB
PL1W              55.31277084 W
SFO1              100.6238364 MHz

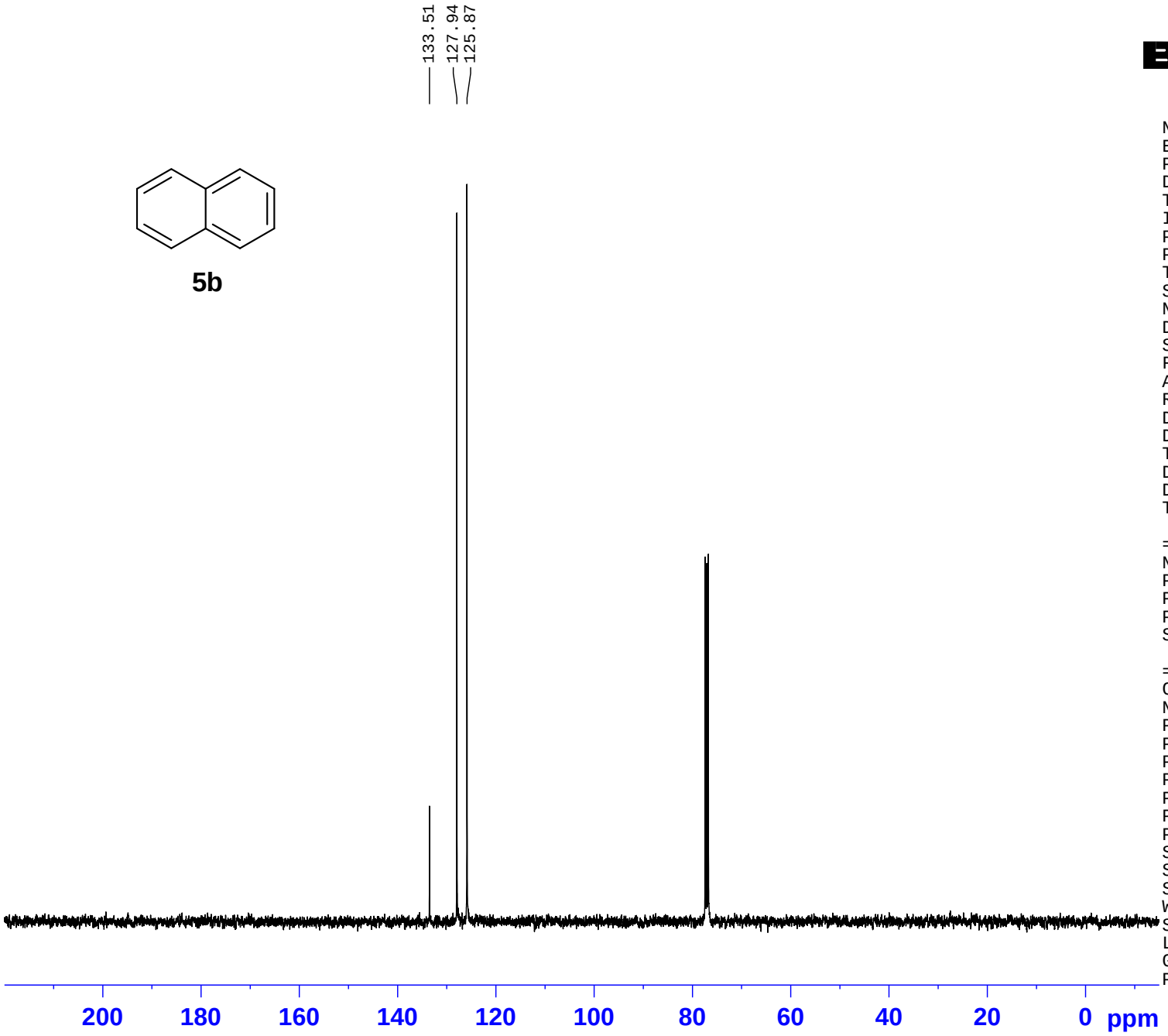
======== CHANNEL f2 ========
CPDPRG2               waltz16
NUC2                      1H
PCPD2                  80.00 usec
PL2                    -1.00 dB
PL12                   16.72 dB
PL13                   15.50 dB
PL2W              17.01305389 W
PL12W              0.28759566 W
PL13W              0.38087484 W
SFO2              400.1316005 MHz
SI                      32768
SF                100.6127774 MHz
WDW                        EM
SSB                         0
LB                      3.00 Hz
GB                          0
PC                      1.40
```



5b

NAME cyj772p-20181108
EXPNO 1
PROCNO 1
Date_ 20181108
Time 20.50
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 32768
SOLVENT CDCl3
NS 8
DS 0
SWH 6393.862 Hz
FIDRES 0.195125 Hz
AQ 2.5625076 sec
RG 161
DW 78.200 usec
DE 6.50 usec
TE 297.7 K
D1 1.00000000 sec
TD0 1

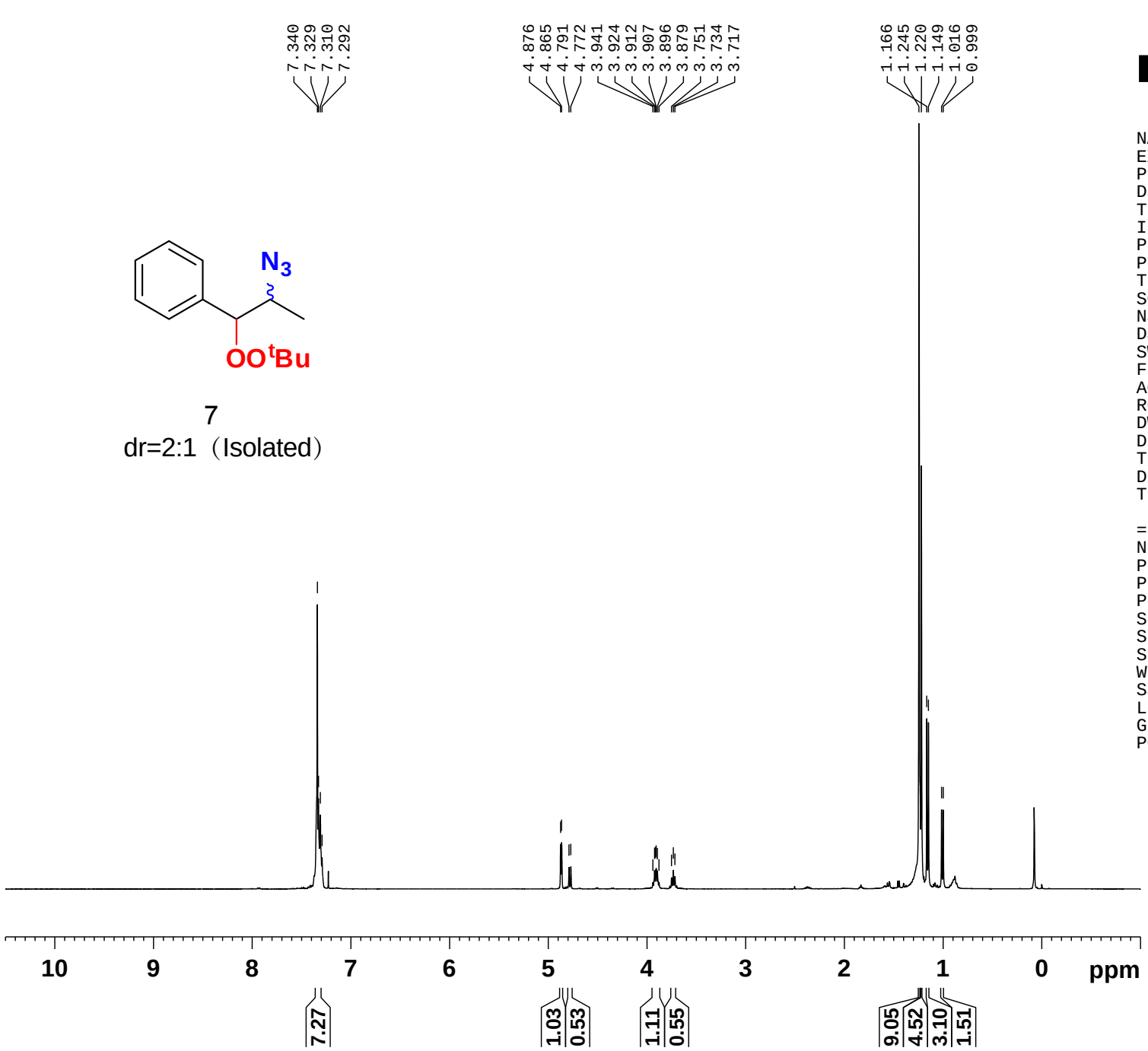
======== CHANNEL f1 ========
NUC1 1H
P1 10.40 usec
PL1 -1.00 dB
PL1W 17.01305389 W
SFO1 400.1326008 MHz
SI 32768
SF 400.1300320 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00




```
NAME      cyj772p-201801112
EXPNO                     2
PROCNO                    1
Date_              20181112
Time                 16.41
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                   6.50 usec
TE                  296.5 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                      3

======== CHANNEL f1 ========
NUC1                   13C
P1                   15.00 usec
PL1                   2.00 dB
PL1W          55.31277084 W
SFO1          100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2           waltz16
NUC2                   1H
PCPD2                80.00 usec
PL2                  -1.00 dB
PL12                 16.72 dB
PL13                 15.50 dB
PL2W          17.01305389 W
PL12W          0.28759566 W
PL13W          0.38087484 W
SFO2          400.1316005 MHz
SI                    32768
SF            100.6127690 MHz
WDW                     EM
SSB                      0
LB                    3.00 Hz
GB                       0
PC                    1.40
```

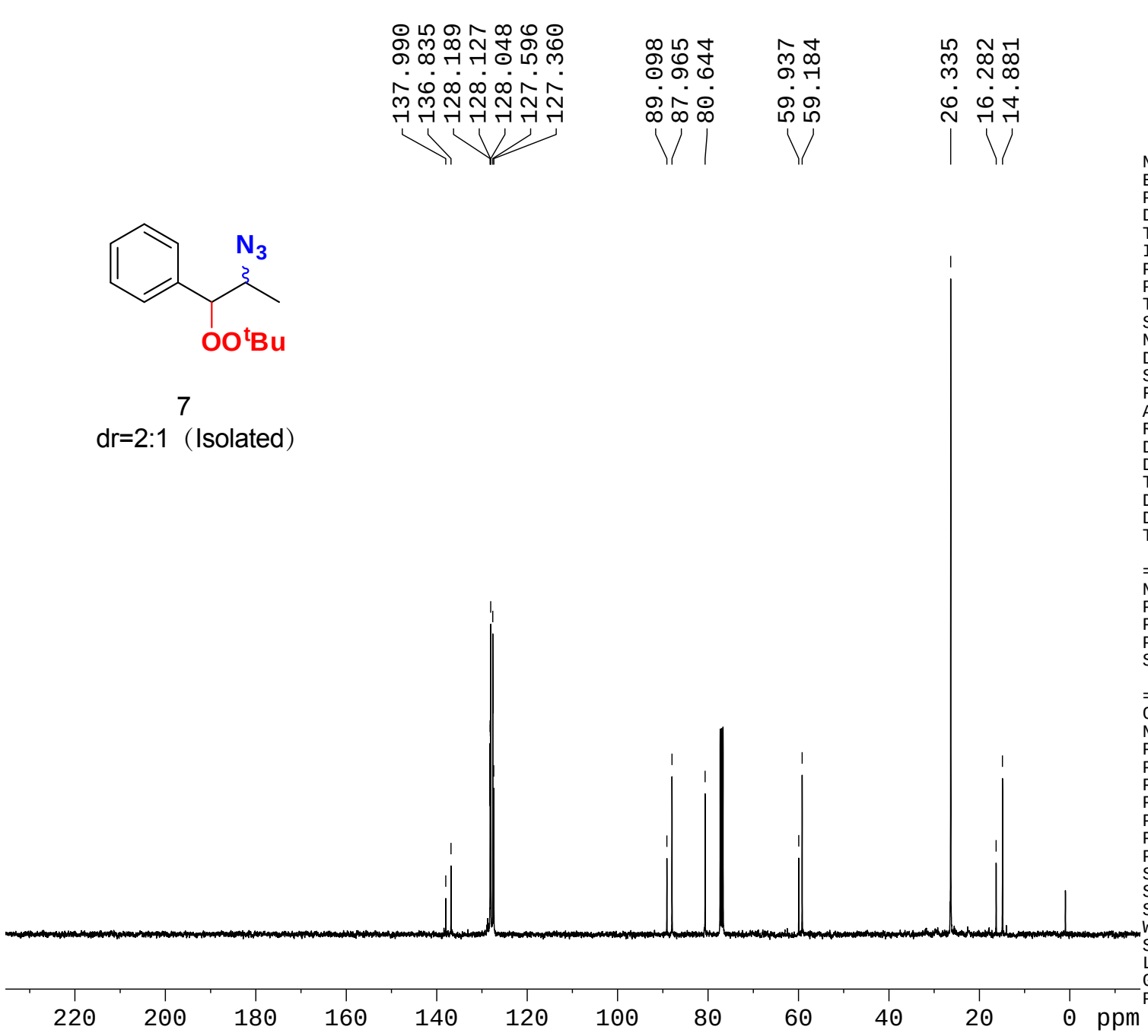


7

dr=2:1（Isolated）

```
NAME      cyj261ap-20180309
EXPNO                    1
PROCNO                   1
Date_             20180309
Time                 21.31
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                  297.6 K
D1              1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   13.10 usec
PL1                   1.80 dB
PL1W          8.92857742 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300224 MHz
WDW                     EM
SSB                      0
LB                    0.30 Hz
GB                       0
PC                    1.00
```



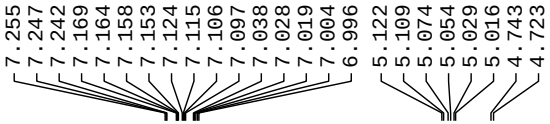
7

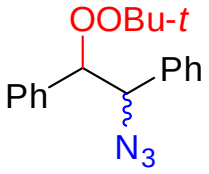
dr=2:1（Isolated）

```
NAME      cyj261ap-20180331
EXPNO                    2
PROCNO                   1
Date_             20180331
Time                 14.01
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                  296.5 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
SFO1          100.6238364 MHz

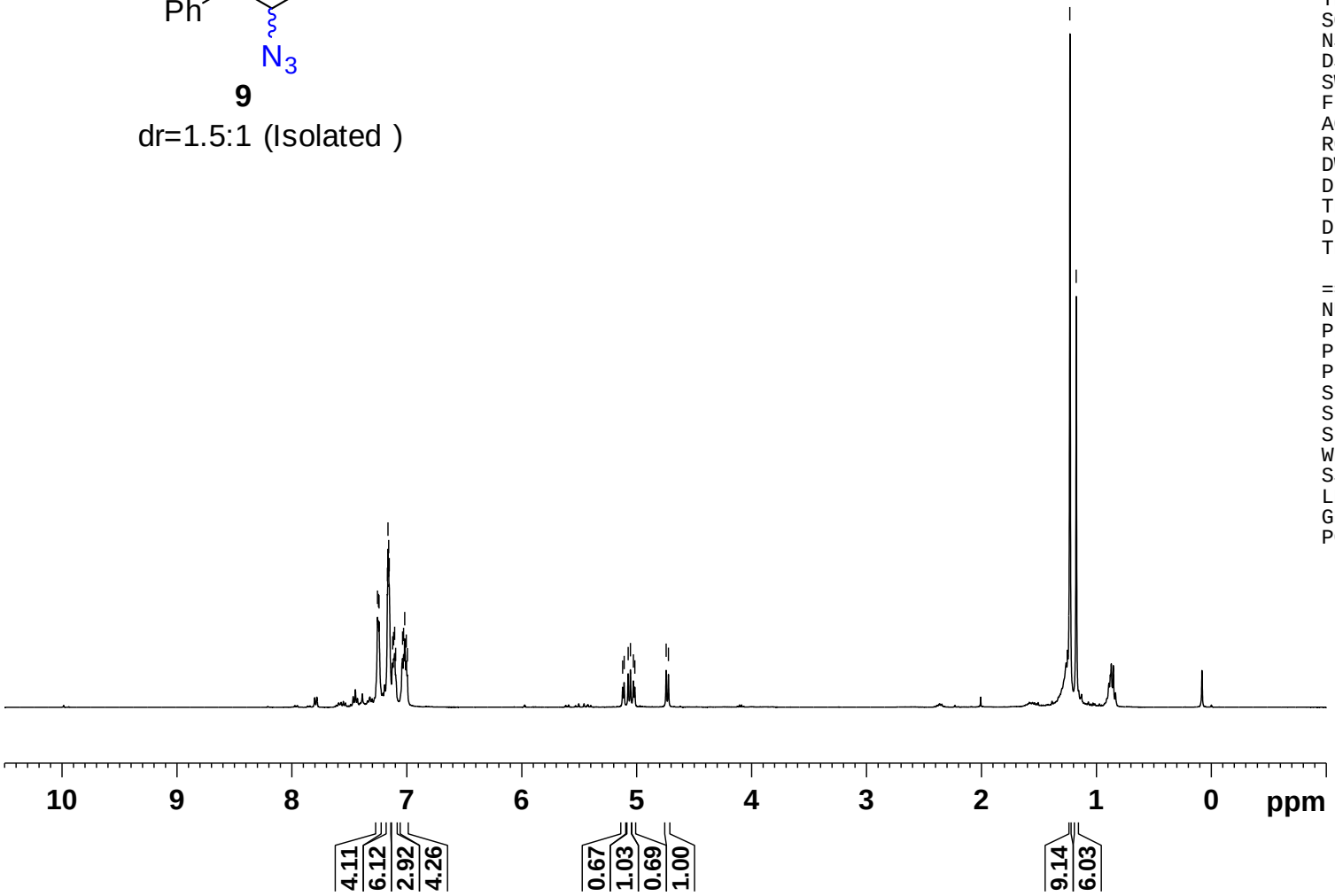
======== CHANNEL f2 ========
CPDPRG2           waltz16
NUC2                   1H
PCPD2               80.00 usec
PL2                  1.80 dB
PL12                17.19 dB
PL13                18.46 dB
PL2W            8.92857742 W
PL12W           0.25809658 W
PL13W           0.19265592 W
SFO2          400.1316005 MHz
SI                  32768
SF            100.6127787 MHz
WDW                    EM
SSB                    0
LB                  3.00 Hz
GB                     0
PC                  1.40
```





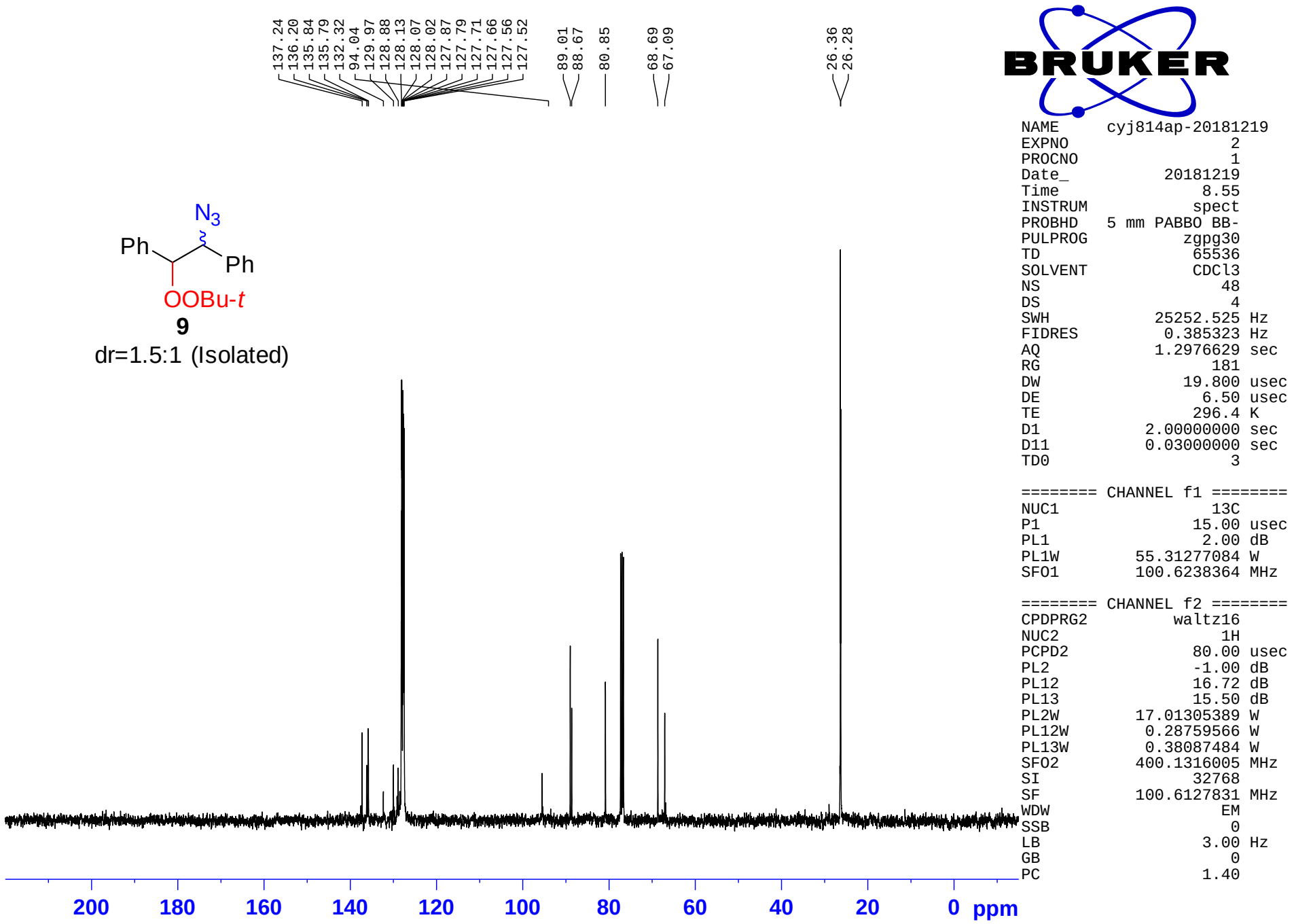
9

dr=1.5:1 (Isolated)




```
NAME      cyj814ap-20181219
EXPNO                    1
PROCNO                   1
Date_             20181219
Time                 8.50
INSTRUM             spect
PROBHD   5 mm PABBO BB-
PULPROG               zg30
TD                   32768
SOLVENT              CDCl3
NS                       8
DS                       0
SWH               6393.862 Hz
FIDRES            0.195125 Hz
AQ                2.5625076 sec
RG                    28.5
DW                  78.200 usec
DE                   6.50 usec
TE                  295.3 K
D1              1.00000000 sec
TD0                      1

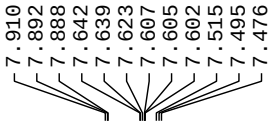
======== CHANNEL f1 ========
NUC1                    1H
P1                  10.40 usec
PL1                 -1.00 dB
PL1W         17.01305389 W
SFO1         400.1326008 MHz
SI                   32768
SF           400.1300374 MHz
WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
```

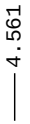


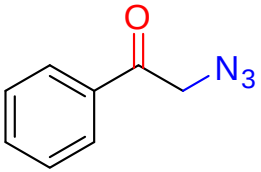

```
NAME      cyj814ap-20181219
EXPNO                     2
PROCNO                    1
Date_              20181219
Time                   8.55
INSTRUM               spect
PROBHD   5 mm PABBO BB-
PULPROG              zgpg30
TD                    65536
SOLVENT               CDCl3
NS                       48
DS                        4
SWH               25252.525 Hz
FIDRES             0.385323 Hz
AQ                1.2976629 sec
RG                      181
DW                   19.800 usec
DE                    6.50 usec
TE                   296.4 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                       3

======== CHANNEL f1 ========
NUC1                    13C
P1                   15.00 usec
PL1                   2.00 dB
PL1W            55.31277084 W
SFO1            100.6238364 MHz

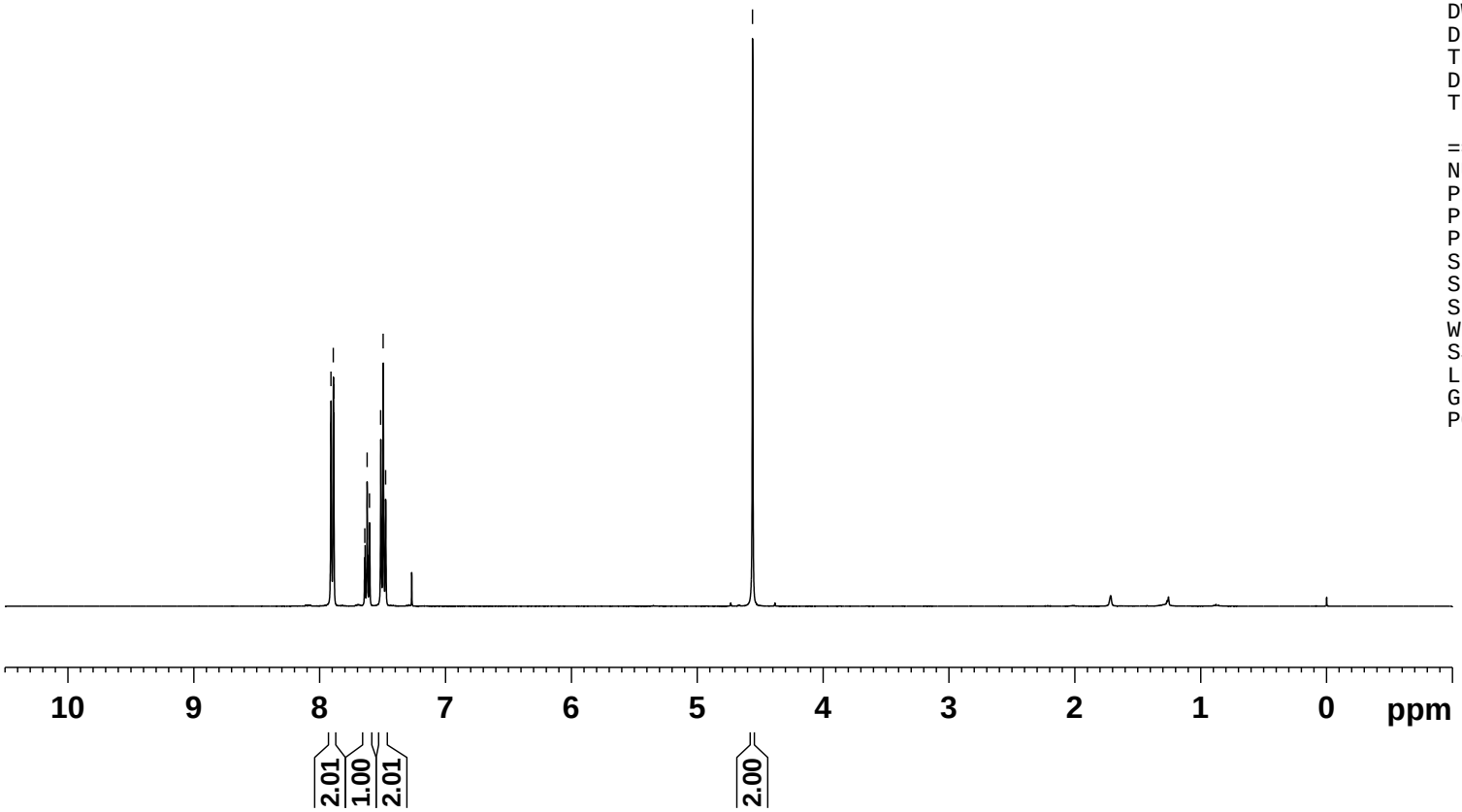
======== CHANNEL f2 ========
CPDPRG2            waltz16
NUC2                    1H
PCPD2                80.00 usec
PL2                  -1.00 dB
PL12                 16.72 dB
PL13                 15.50 dB
PL2W            17.01305389 W
PL12W            0.28759566 W
PL13W            0.38087484 W
SFO2            400.1316005 MHz
SI                    32768
SF              100.6127831 MHz
WDW                      EM
SSB                       0
LB                    3.00 Hz
GB                        0
PC                     1.40
```





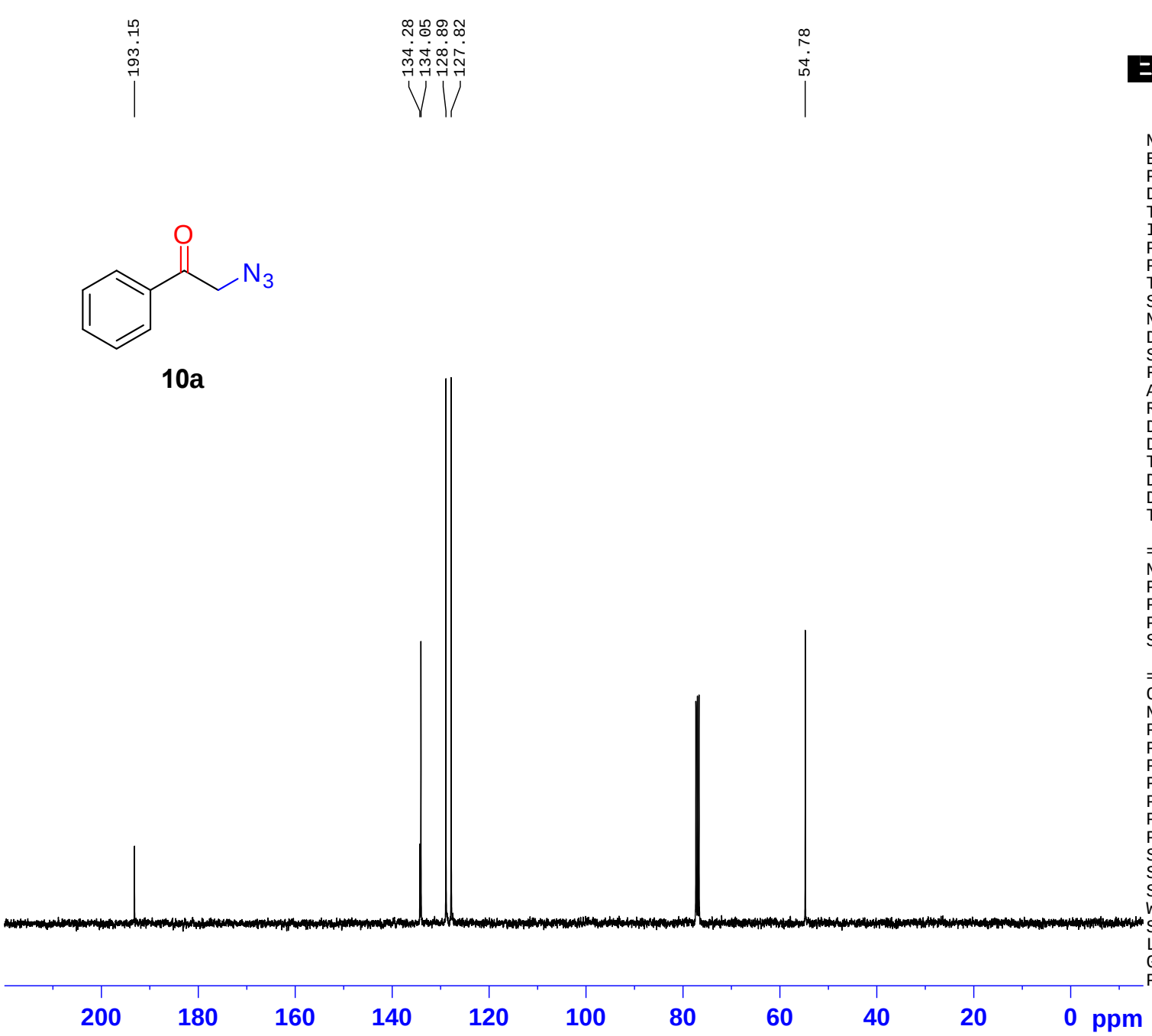


10a




```
NAME      cyj505cp-20180622
EXPNO                    1
PROCNO                   1
Date_             20180622
Time                 17.24
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                  296.9 K
D1             1.00000000 sec
TD0                      1

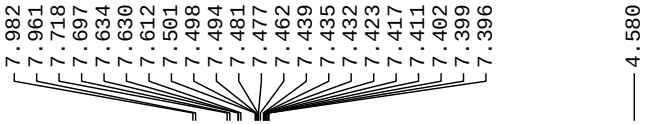
======== CHANNEL f1 ========
NUC1                    1H
P1                   10.40 usec
PL1                  -1.00 dB
PL1W          17.01305389 W
SFO1          400.1326008 MHz
SI                   32768
SF            400.1300069 MHz
WDW                     EM
SSB                      0
LB                   0.30 Hz
GB                       0
PC                   1.00
```

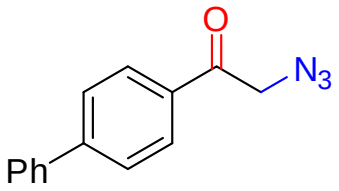



```
NAME      cyj505cp-20180622
EXPNO                    2
PROCNO                   1
Date_             20180622
Time                 17.28
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG             zgpg30
TD                   65536
SOLVENT              CDCl3
NS                      64
DS                       4
SWH              25252.525 Hz
FIDRES           0.385323 Hz
AQ               1.2976629 sec
RG                     181
DW                  19.800 usec
DE                   6.50 usec
TE                  298.0 K
D1               2.00000000 sec
D11              0.03000000 sec
TD0                      3

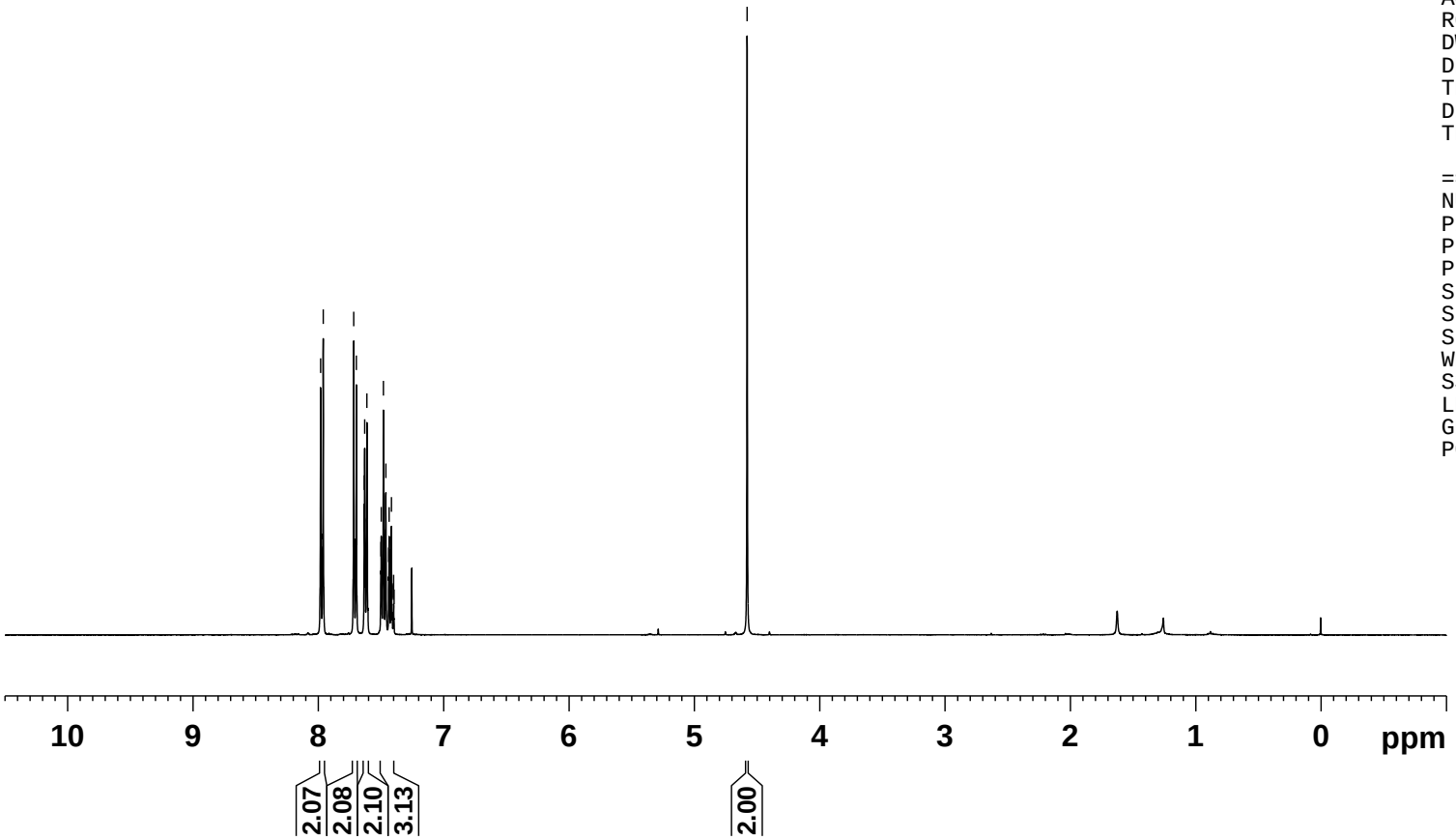
======== CHANNEL f1 ========
NUC1                   13C
P1                  15.00 usec
PL1                  2.00 dB
PL1W          55.31277084 W
SFO1          100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2           waltz16
NUC2                   1H
PCPD2               80.00 usec
PL2                 -1.00 dB
PL12                16.72 dB
PL13                15.50 dB
PL2W          17.01305389 W
PL12W          0.28759566 W
PL13W          0.38087484 W
SFO2          400.1316005 MHz
SI                  32768
SF            100.6127790 MHz
WDW                    EM
SSB                     0
LB                   3.00 Hz
GB                      0
PC                   1.40
```



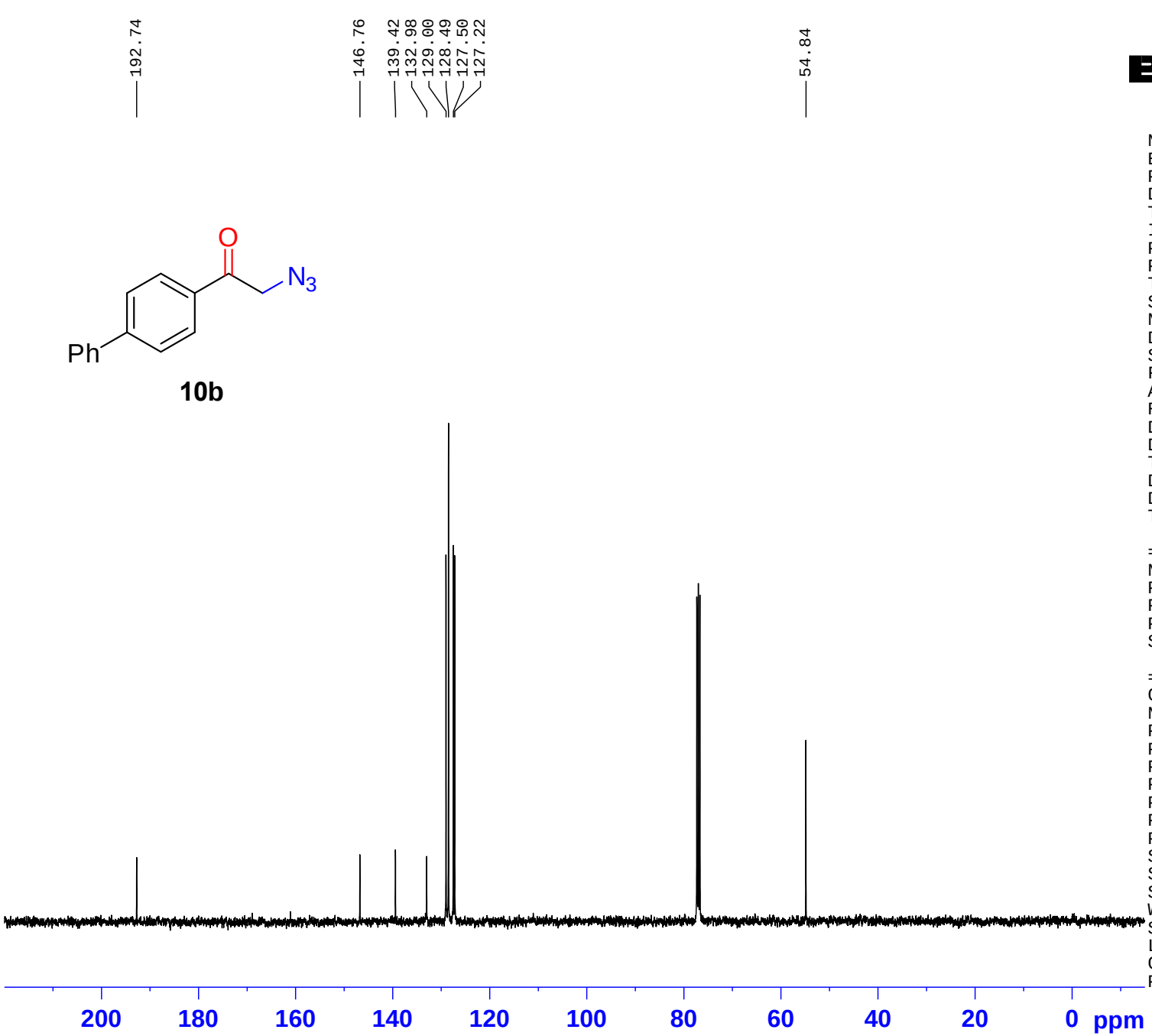


10b




```
NAME      cyj505dp-20180622
EXPNO                    1
PROCNO                   1
Date_             20180622
Time                 17.36
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                  296.9 K
D1             1.00000000 sec
TD0                      1

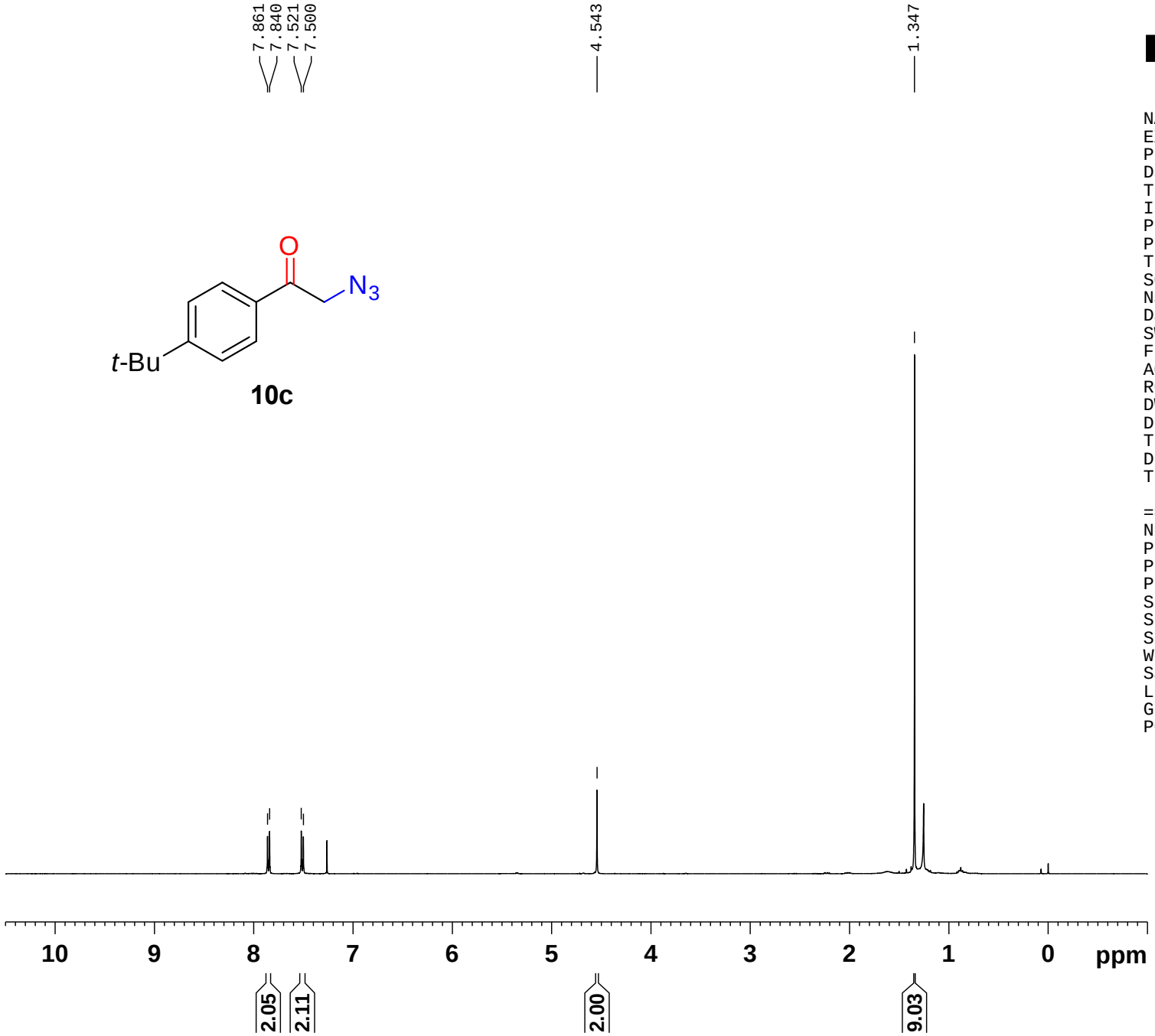
======== CHANNEL f1 ========
NUC1                    1H
P1                   10.40 usec
PL1                  -1.00 dB
PL1W          17.01305389 W
SFO1          400.1326008 MHz
SI                   32768
SF            400.1300128 MHz
WDW                     EM
SSB                      0
LB                   0.30 Hz
GB                       0
PC                   1.00
```




```
NAME      cyj505dp-20180622
EXPNO                    2
PROCNO                   1
Date_             20180622
Time                 17.39
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG             zgpg30
TD                   65536
SOLVENT              CDCl3
NS                     112
DS                       4
SWH              25252.525 Hz
FIDRES           0.385323 Hz
AQ               1.2976629 sec
RG                     181
DW                  19.800 usec
DE                   6.50 usec
TE                  297.8 K
D1               2.00000000 sec
D11              0.03000000 sec
TD0                      3

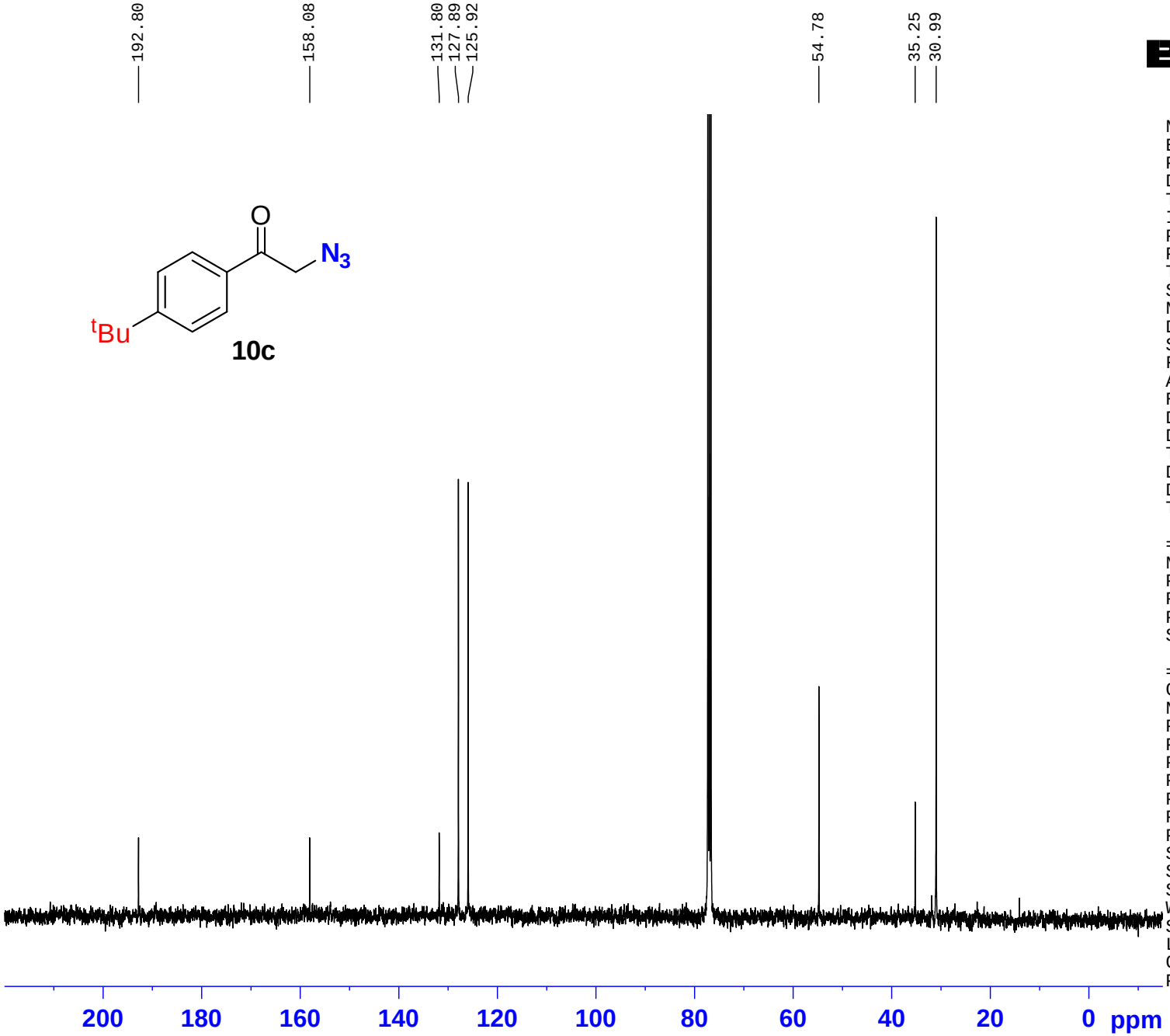
======== CHANNEL f1 ========
NUC1                   13C
P1                  15.00 usec
PL1                  2.00 dB
PL1W          55.31277084 W
SFO1          100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2           waltz16
NUC2                   1H
PCPD2               80.00 usec
PL2                 -1.00 dB
PL12                16.72 dB
PL13                15.50 dB
PL2W          17.01305389 W
PL12W          0.28759566 W
PL13W          0.38087484 W
SFO2          400.1316005 MHz
SI                  32768
SF            100.6127759 MHz
WDW                    EM
SSB                     0
LB                   3.00 Hz
GB                      0
PC                   1.40
```




```
NAME      cyj464p1-20180615
EXPNO                    1
PROCNO                   1
Date_             20180615
Time                 20.59
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                  295.5 K
D1              1.00000000 sec
TD0                      1

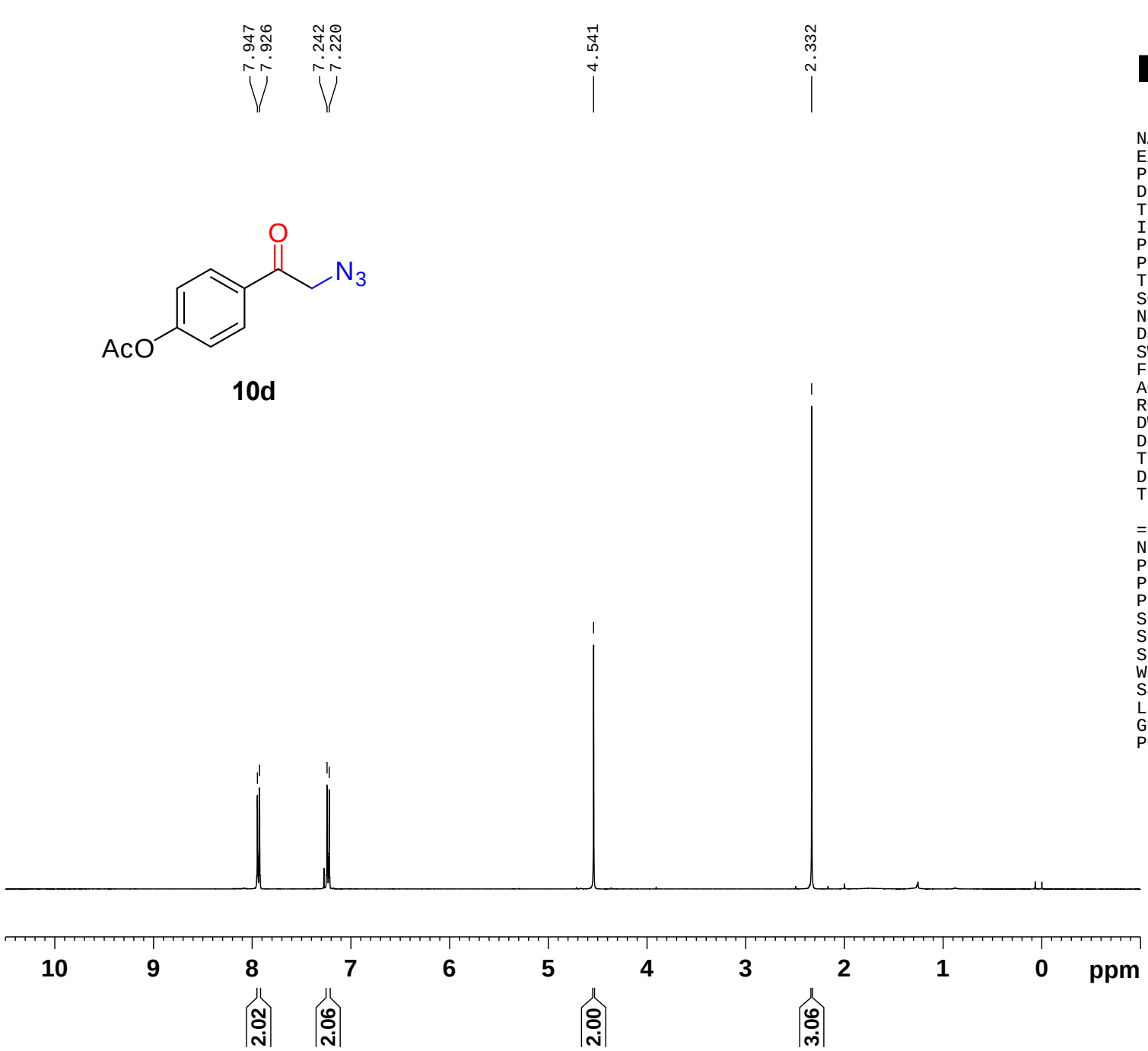
======== CHANNEL f1 ========
NUC1                    1H
P1                   10.40 usec
PL1                  -1.00 dB
PL1W          17.01305389 W
SFO1          400.1326008 MHz
SI                   32768
SF            400.1300096 MHz
WDW                     EM
SSB                      0
LB                   0.30 Hz
GB                       0
PC                   1.00
```



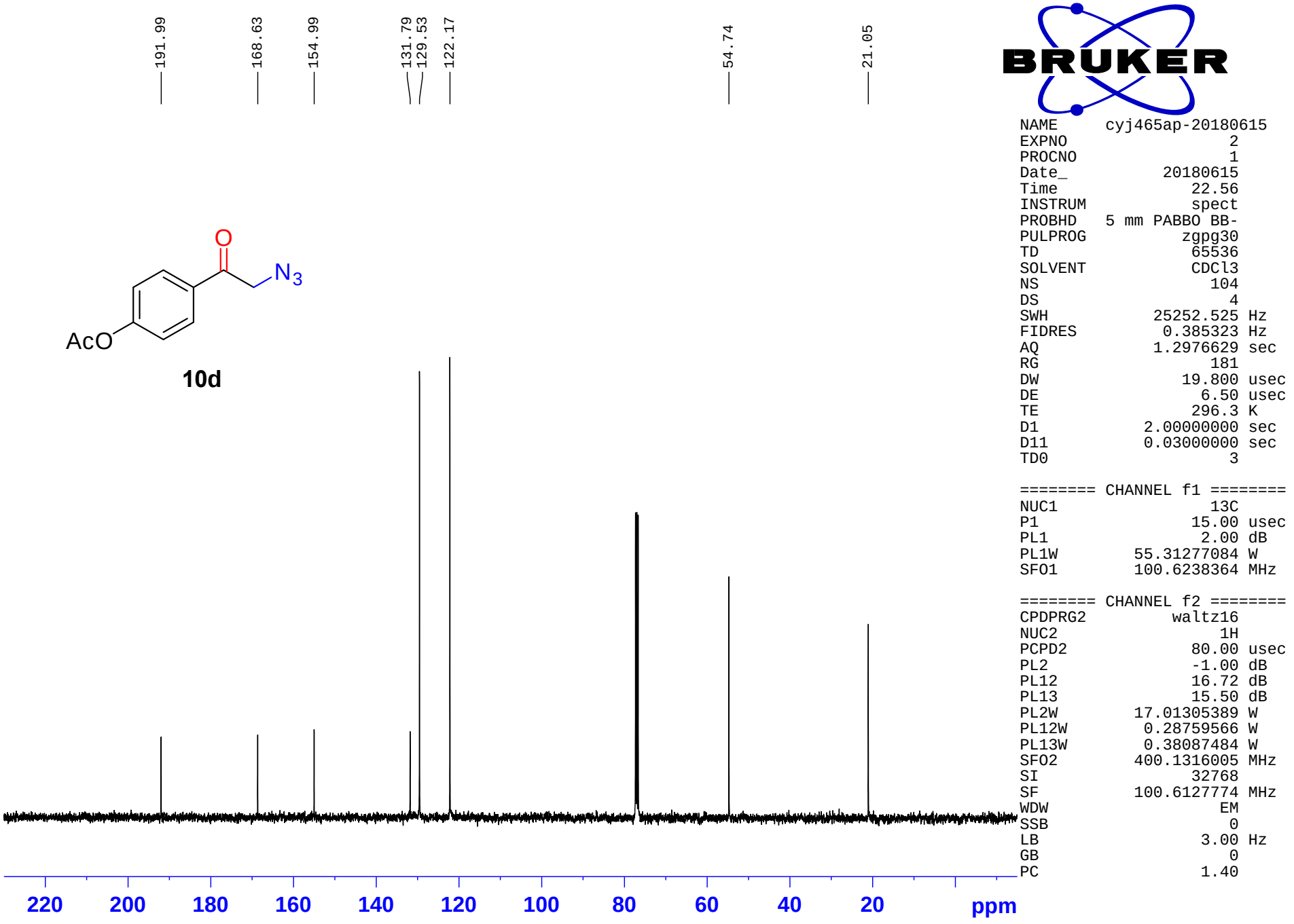

```
NAME      cyj464p1-20180601
EXPNO                     2
PROCNO                    1
Date_              20180615
Time                 21.04
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG           zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   624
DS                     4
SWH            25252.525 Hz
FIDRES          0.385323 Hz
AQ             1.2976629 sec
RG                   181
DW                19.800 usec
DE                 6.50 usec
TE                296.6 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    3

======== CHANNEL f1 ========
NUC1                 13C
P1                15.00 usec
PL1                2.00 dB
PL1W        55.31277084 W
SFO1        100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2          waltz16
NUC2                 1H
PCPD2             80.00 usec
PL2               -1.00 dB
PL12              16.72 dB
PL13              15.50 dB
PL2W        17.01305389 W
PL12W        0.28759566 W
PL13W        0.38087484 W
SFO2        400.1316005 MHz
SI                32768
SF          100.6127714 MHz
WDW                  EM
SSB                   0
LB                 3.00 Hz
GB                    0
PC                 1.40
```



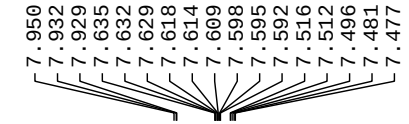
NAME	cyj465p-20180615
EXPNO	1
PROCNO	1
Date_	20180615
Time	9.50
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	181
DW	78.200 usec
DE	6.50 usec
TE	295.3 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	10.40 usec
PL1	-1.00 dB
PL1W	17.01305389 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300051 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

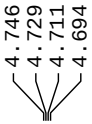


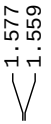

```
NAME      cyj465ap-20180615
EXPNO                     2
PROCNO                    1
Date_              20180615
Time                  22.56
INSTRUM               spect
PROBHD   5 mm PABBO BB-
PULPROG              zgpg30
TD                    65536
SOLVENT               CDCl3
NS                      104
DS                        4
SWH               25252.525 Hz
FIDRES             0.385323 Hz
AQ                1.2976629 sec
RG                      181
DW                   19.800 usec
DE                    6.50 usec
TE                   296.3 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                       3

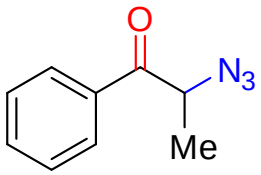
======== CHANNEL f1 ========
NUC1                    13C
P1                   15.00 usec
PL1                   2.00 dB
PL1W          55.31277084 W
SFO1          100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2            waltz16
NUC2                    1H
PCPD2                80.00 usec
PL2                  -1.00 dB
PL12                 16.72 dB
PL13                 15.50 dB
PL2W          17.01305389 W
PL12W          0.28759566 W
PL13W          0.38087484 W
SFO2          400.1316005 MHz
SI                   32768
SF            100.6127774 MHz
WDW                     EM
SSB                      0
LB                    3.00 Hz
GB                       0
PC                    1.40
```

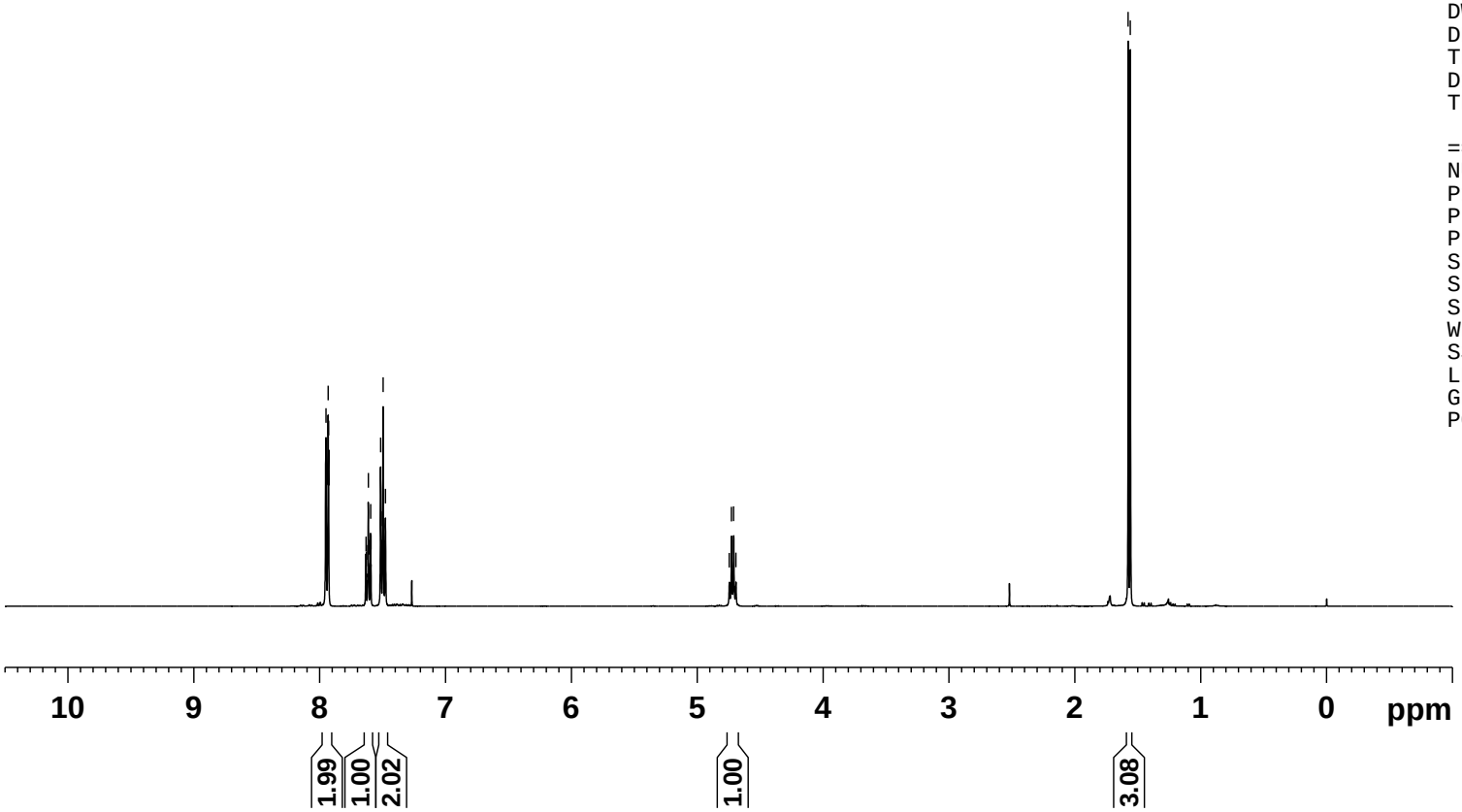






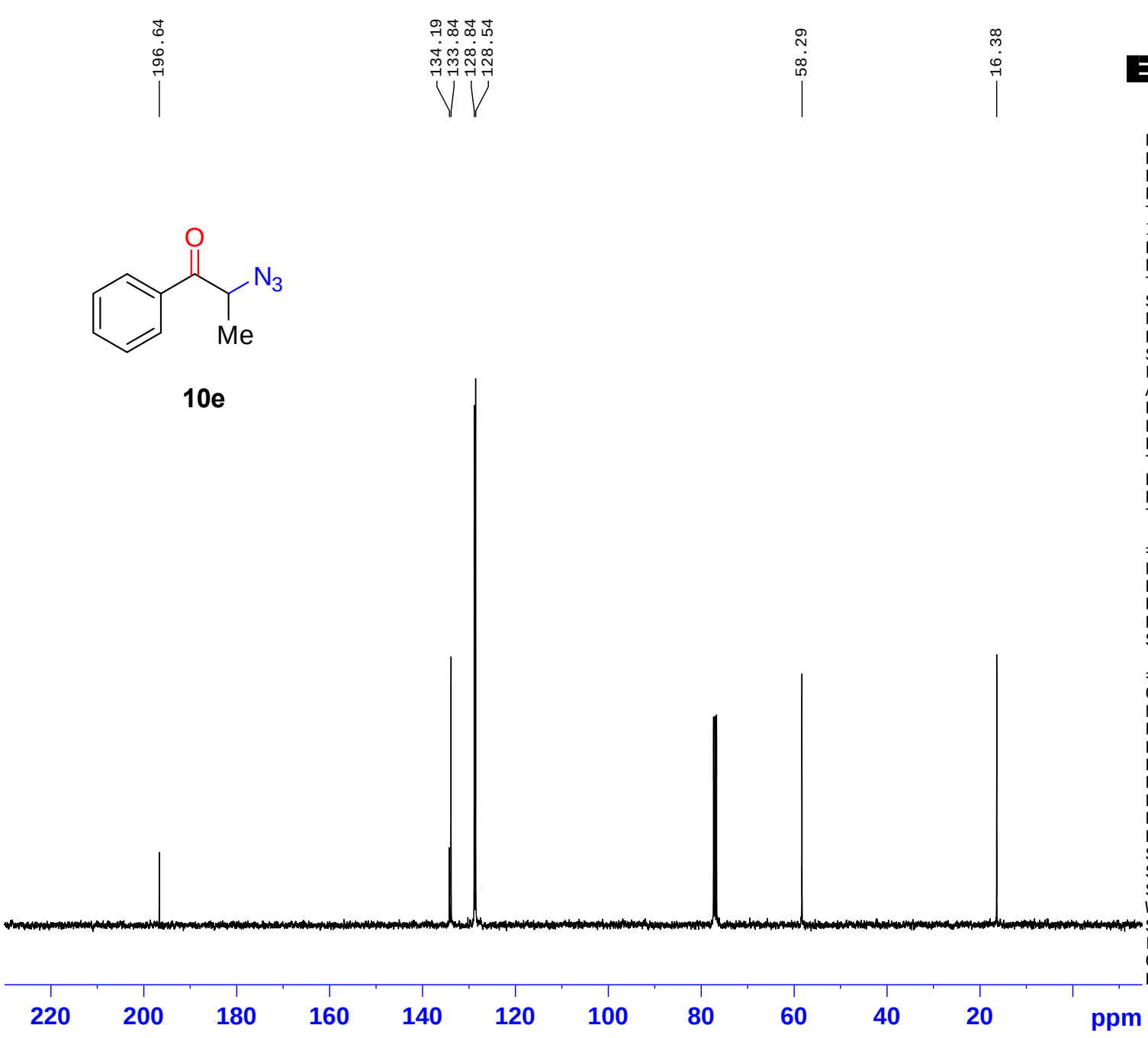


10e




```
NAME      cyj505ap-20180621
EXPNO                    1
PROCNO                   1
Date_             20180622
Time                 16.49
INSTRUM              spect
PROBHD   5 mm PABBO BB-
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                  296.7 K
D1             1.00000000 sec
TD0                      1

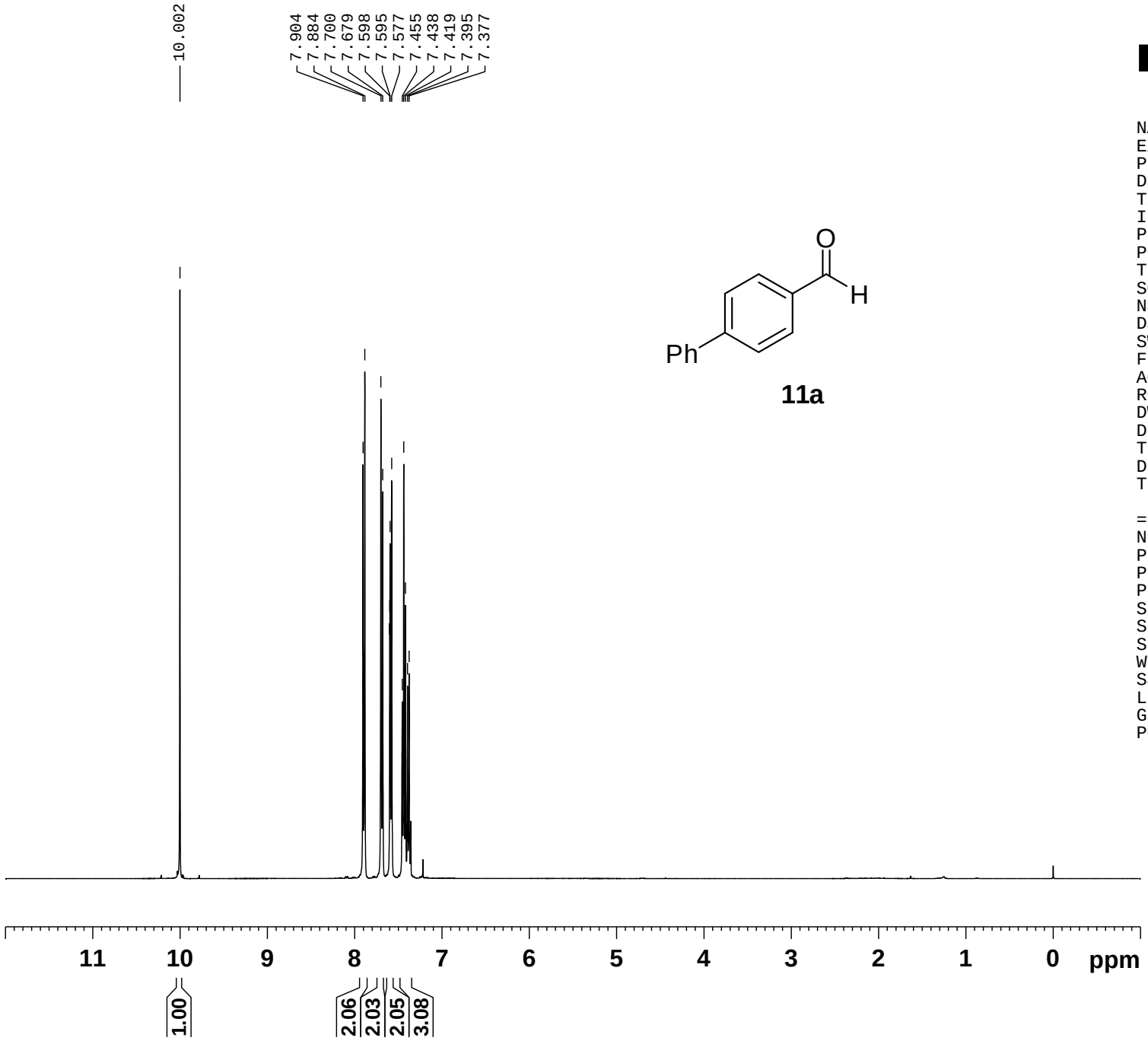
======== CHANNEL f1 ========
NUC1                    1H
P1                   10.40 usec
PL1                  -1.00 dB
PL1W          17.01305389 W
SFO1          400.1326008 MHz
SI                   32768
SF            400.1300074 MHz
WDW                     EM
SSB                      0
LB                   0.30 Hz
GB                       0
PC                   1.00
```




```
NAME      cyj505ap-20180622
EXPNO                    2
PROCNO                   1
Date_             20180622
Time                 16.55
INSTRUM              spect
PROBHD   5 mm PABBO BB-
PULPROG             zgpg30
TD                   65536
SOLVENT              CDCl3
NS                      80
DS                       4
SWH              25252.525 Hz
FIDRES           0.385323 Hz
AQ               1.2976629 sec
RG                     181
DW                  19.800 usec
DE                   6.50 usec
TE                  297.7 K
D1               2.00000000 sec
D11              0.03000000 sec
TD0                      3

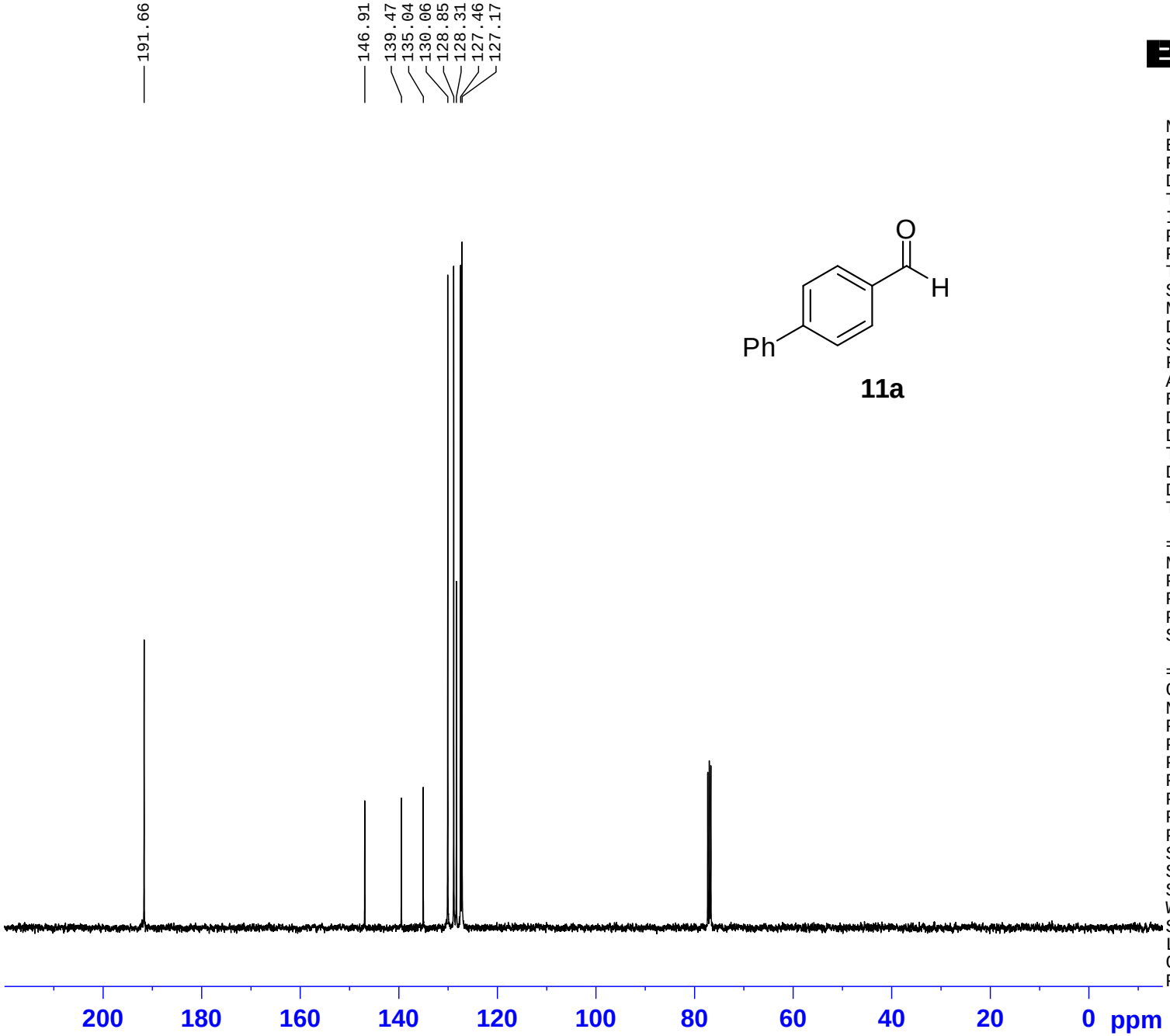
======== CHANNEL f1 ========
NUC1                   13C
P1                  15.00 usec
PL1                  2.00 dB
PL1W          55.31277084 W
SFO1          100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2           waltz16
NUC2                   1H
PCPD2               80.00 usec
PL2                 -1.00 dB
PL12                16.72 dB
PL13                15.50 dB
PL2W          17.01305389 W
PL12W          0.28759566 W
PL13W          0.38087484 W
SFO2          400.1316005 MHz
SI                  32768
SF            100.6127788 MHz
WDW                    EM
SSB                     0
LB                   3.00 Hz
GB                      0
PC                   1.40
```



11a

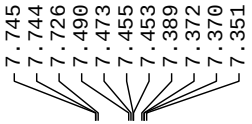
NAME	cyj769dp-20181108
EXPNO	1
PROCNO	1
Date_	20181108
Time	17.41
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	57
DW	78.200 usec
DE	6.50 usec
TE	297.9 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	10.40 usec
PL1	-1.00 dB
PL1W	17.01305389 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300267 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00



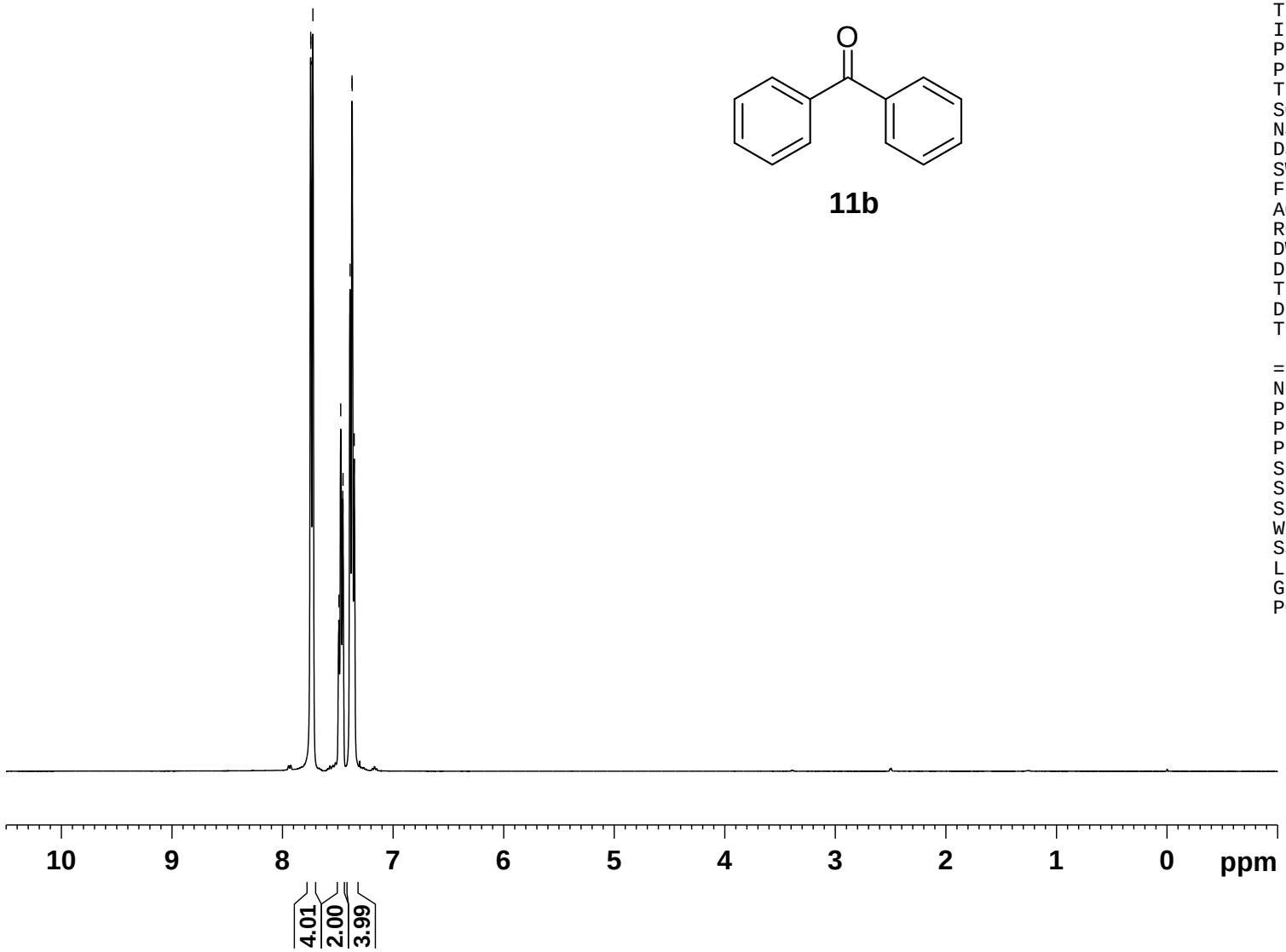

```
NAME      cyj769dp-201801108
EXPNO                      2
PROCNO                     1
Date_               20181108
Time                   17.44
INSTRUM                spect
PROBHD   5 mm PABBO BB-
PULPROG                zgpg30
TD                      65536
SOLVENT                 CDCl3
NS                         40
DS                          4
SWH                 25252.525 Hz
FIDRES                0.385323 Hz
AQ                    1.2976629 sec
RG                         2050
DW                    19.800 usec
DE                     6.50 usec
TE                     298.8 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                         3

======== CHANNEL f1 ========
NUC1                       13C
P1                    15.00 usec
PL1                    2.00 dB
PL1W              55.31277084 W
SFO1              100.6238364 MHz

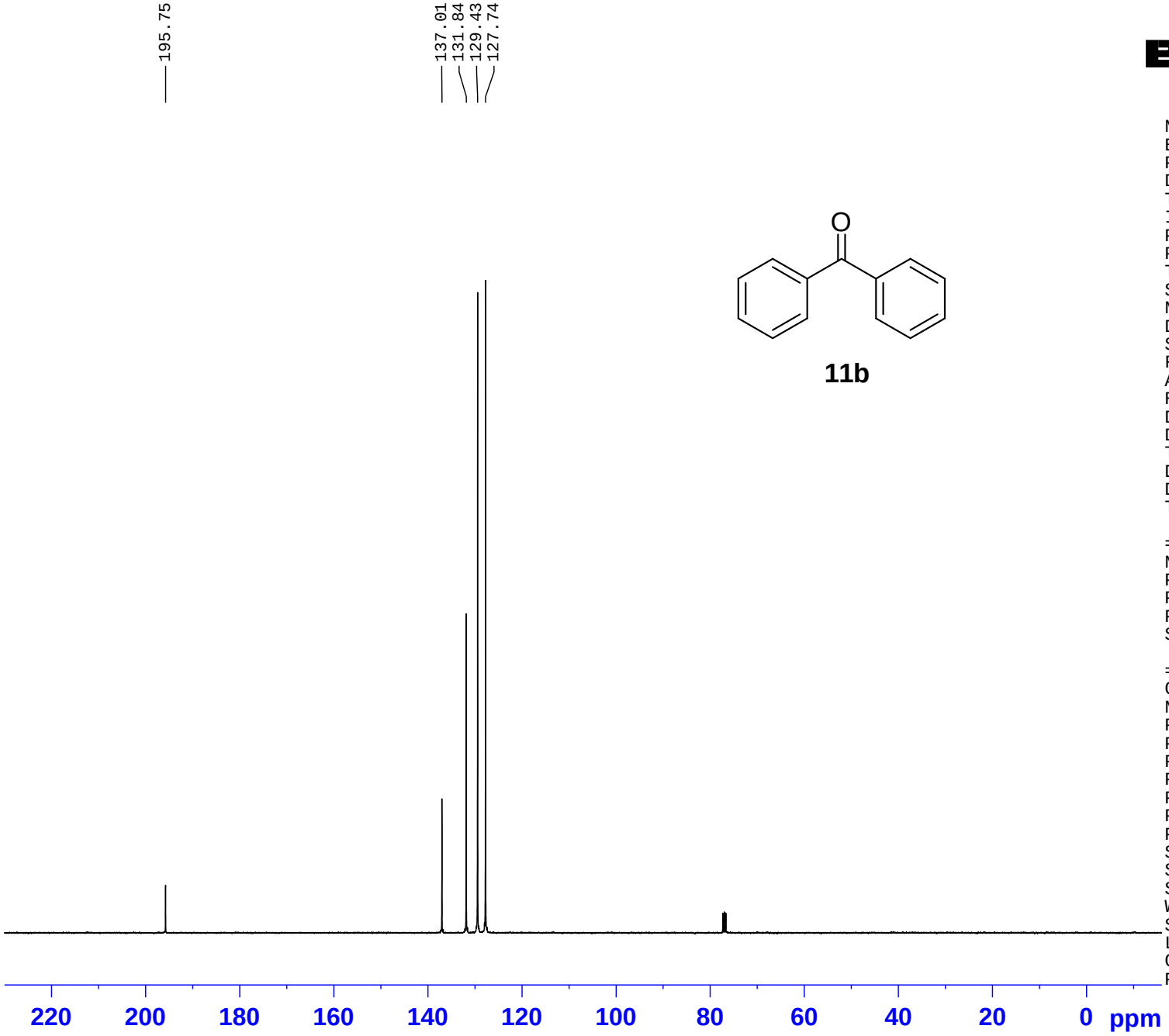
======== CHANNEL f2 ========
CPDPRG2                waltz16
NUC2                       1H
PCPD2                 80.00 usec
PL2                   -1.00 dB
PL12                  16.72 dB
PL13                  15.50 dB
PL2W              17.01305389 W
PL12W              0.28759566 W
PL13W              0.38087484 W
SFO2              400.1316005 MHz
SI                      32768
SF                100.6127912 MHz
WDW                        EM
SSB                         0
LB                     3.00 Hz
GB                          0
PC                     1.40
```



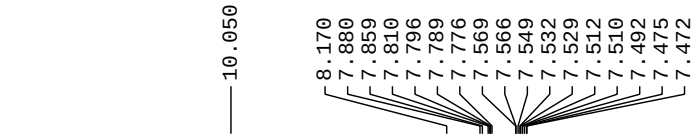
11b

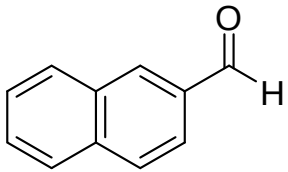


NAME	cyj769ap1-20181107
EXPNO	1
PROCNO	1
Date_	20181107
Time	9.51
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	16
DW	78.200 usec
DE	6.50 usec
TE	296.9 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	10.40 usec
PL1	-1.00 dB
PL1W	17.01305389 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1299936 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00

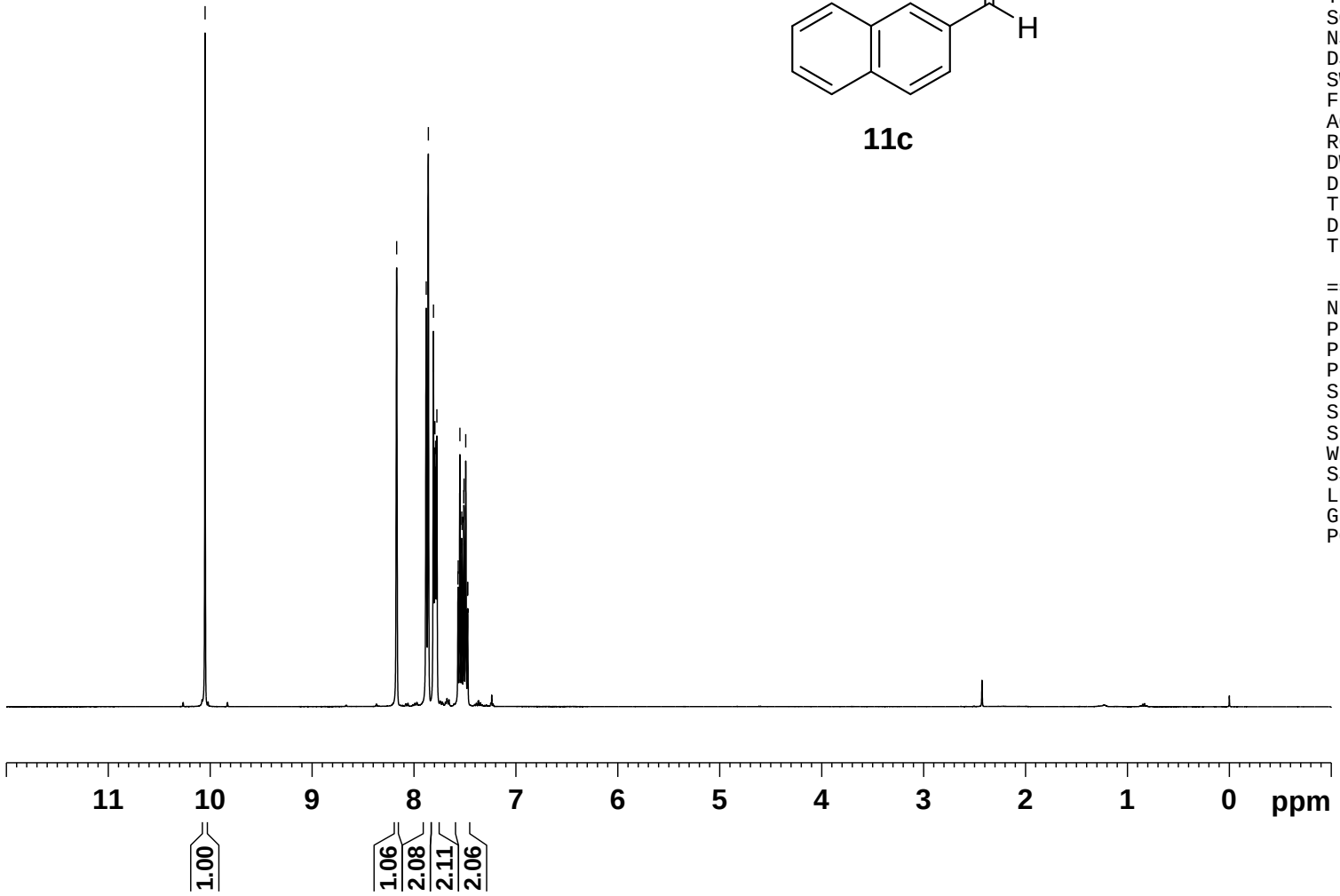


NAME	cyj769ap1-201801107
EXPNO	2
PROCNO	1
Date_	20181107
Time	17.25
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zgpg30
TD	65536
SOLVENT	CDCl3
NS	40
DS	4
SWH	25252.525 Hz
FIDRES	0.385323 Hz
AQ	1.2976629 sec
RG	2050
DW	19.800 usec
DE	6.50 usec
TE	298.3 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	3
======== CHANNEL f1 ========	
NUC1	13C
P1	15.00 usec
PL1	2.00 dB
PL1W	55.31277084 W
SFO1	100.6238364 MHz
======== CHANNEL f2 ========	
CPDPRG2	waltz16
NUC2	1H
PCPD2	80.00 usec
PL2	-1.00 dB
PL12	16.72 dB
PL13	15.50 dB
PL2W	17.01305389 W
PL12W	0.28759566 W
PL13W	0.38087484 W
SFO2	400.1316005 MHz
SI	32768
SF	100.6128242 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40

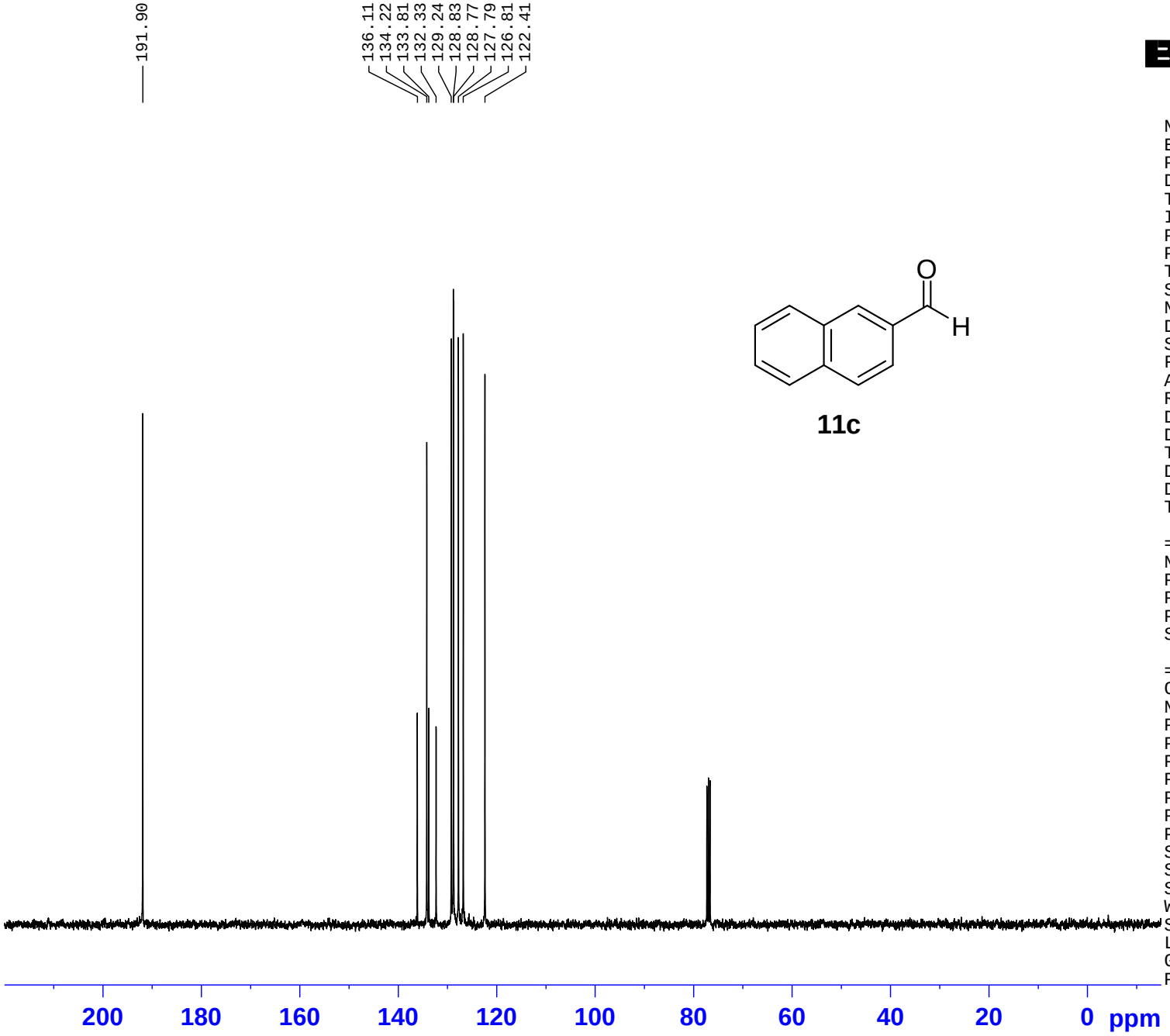




11c

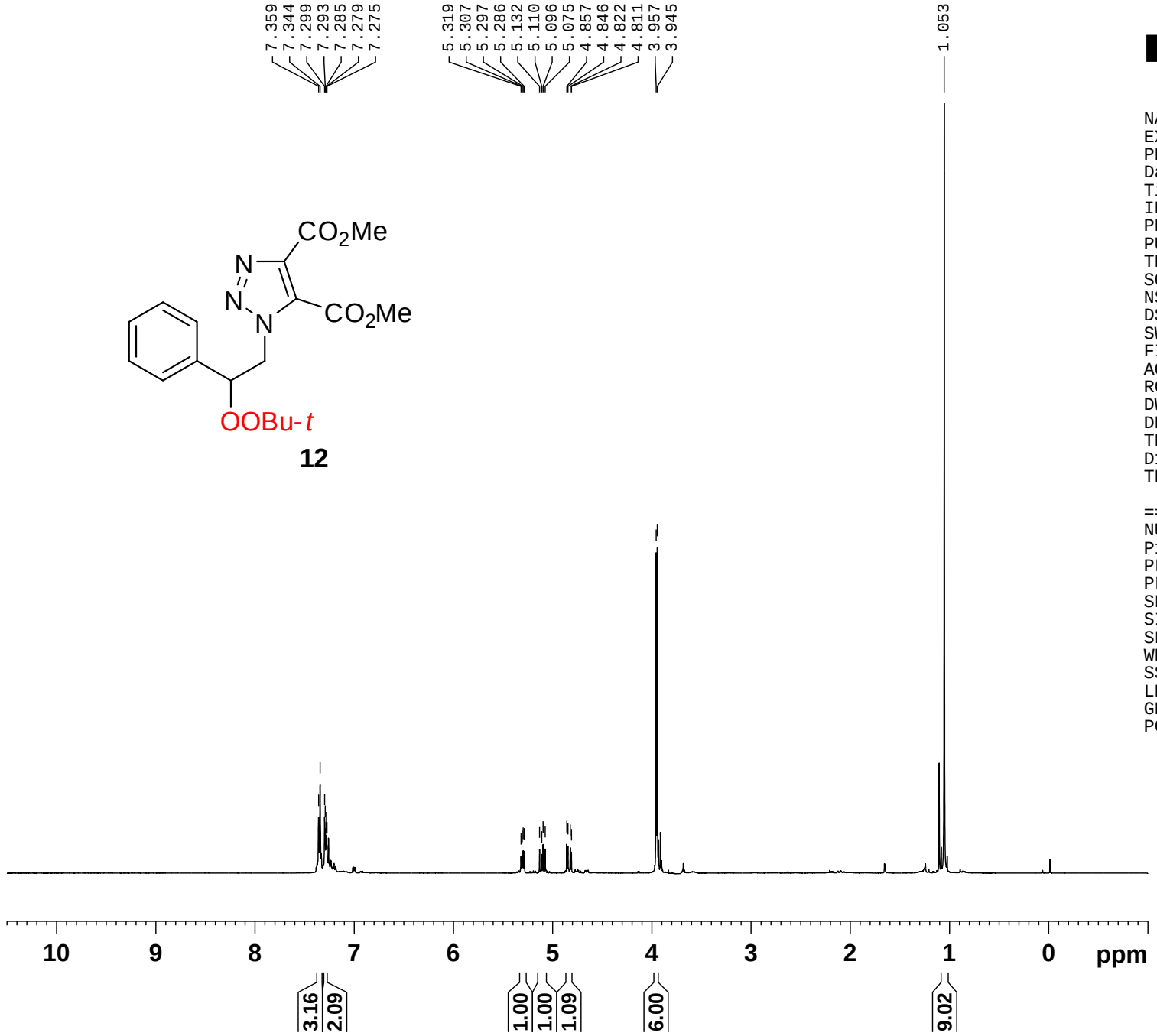


NAME	cyj769bp1-20181108
EXPNO	1
PROCNO	1
Date_	20181108
Time	17.31
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	57
DW	78.200 usec
DE	6.50 usec
TE	297.8 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	10.40 usec
PL1	-1.00 dB
PL1W	17.01305389 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300190 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00



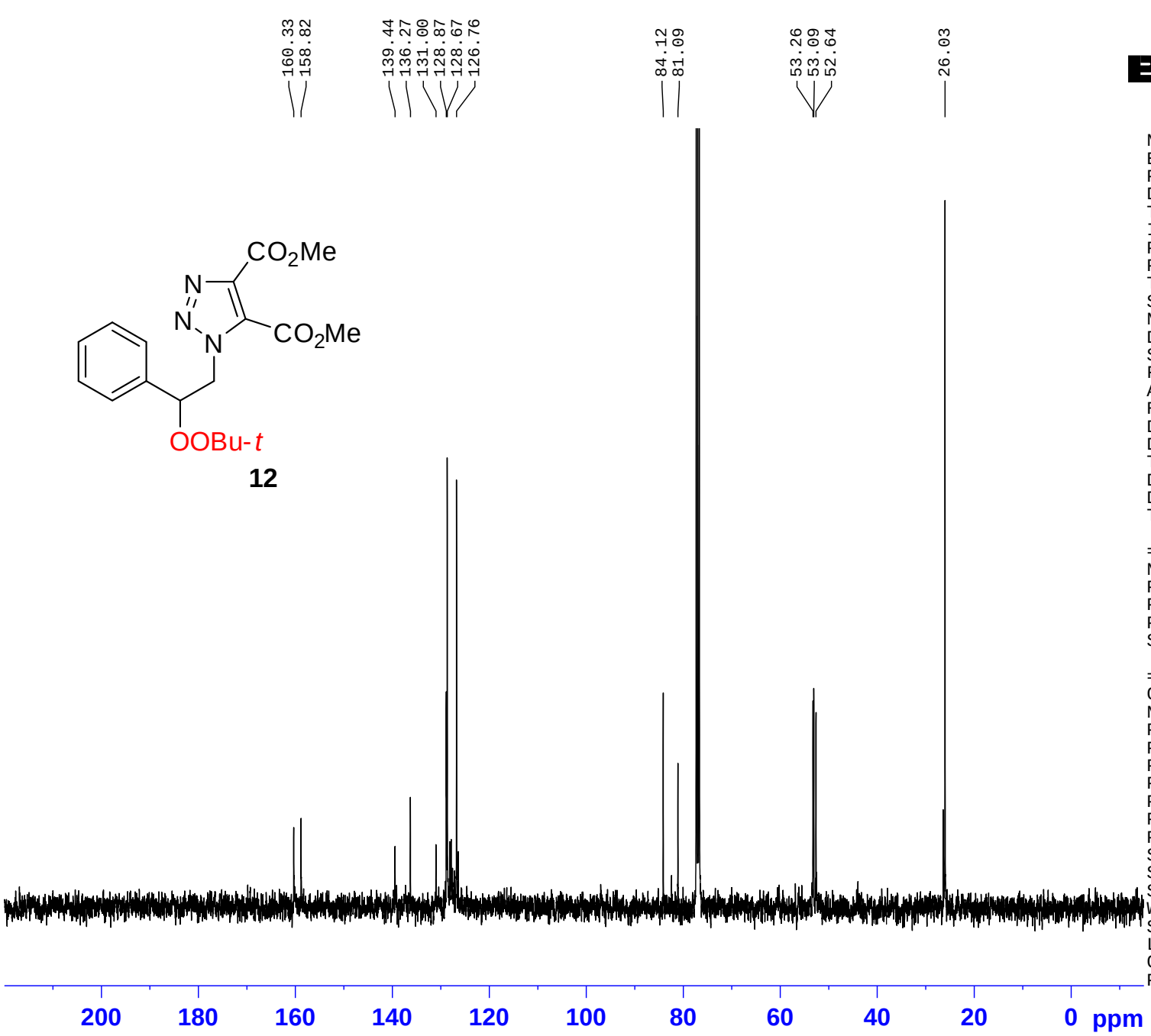
11c

NAME	cyj769bp1-201801108
EXPNO	2
PROCNO	1
Date_	20181108
Time	17.35
INSTRUM	spect
PROBHD	5 mm PABBO BB-
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	6.50 usec
TE	299.0 K
D1	2.00000000 sec
D11	0.03000000 sec
TD0	3
======== CHANNEL f1 ========	
NUC1	13C
P1	15.00 usec
PL1	2.00 dB
PL1W	55.31277084 W
SFO1	100.6238364 MHz
======== CHANNEL f2 ========	
CPDPRG2	waltz16
NUC2	1H
PCPD2	80.00 usec
PL2	-1.00 dB
PL12	16.72 dB
PL13	15.50 dB
PL2W	17.01305389 W
PL12W	0.28759566 W
PL13W	0.38087484 W
SFO2	400.1316005 MHz
SI	32768
SF	100.6127963 MHz
WDW	EM
SSB	0
LB	3.00 Hz
GB	0
PC	1.40



BRUKER

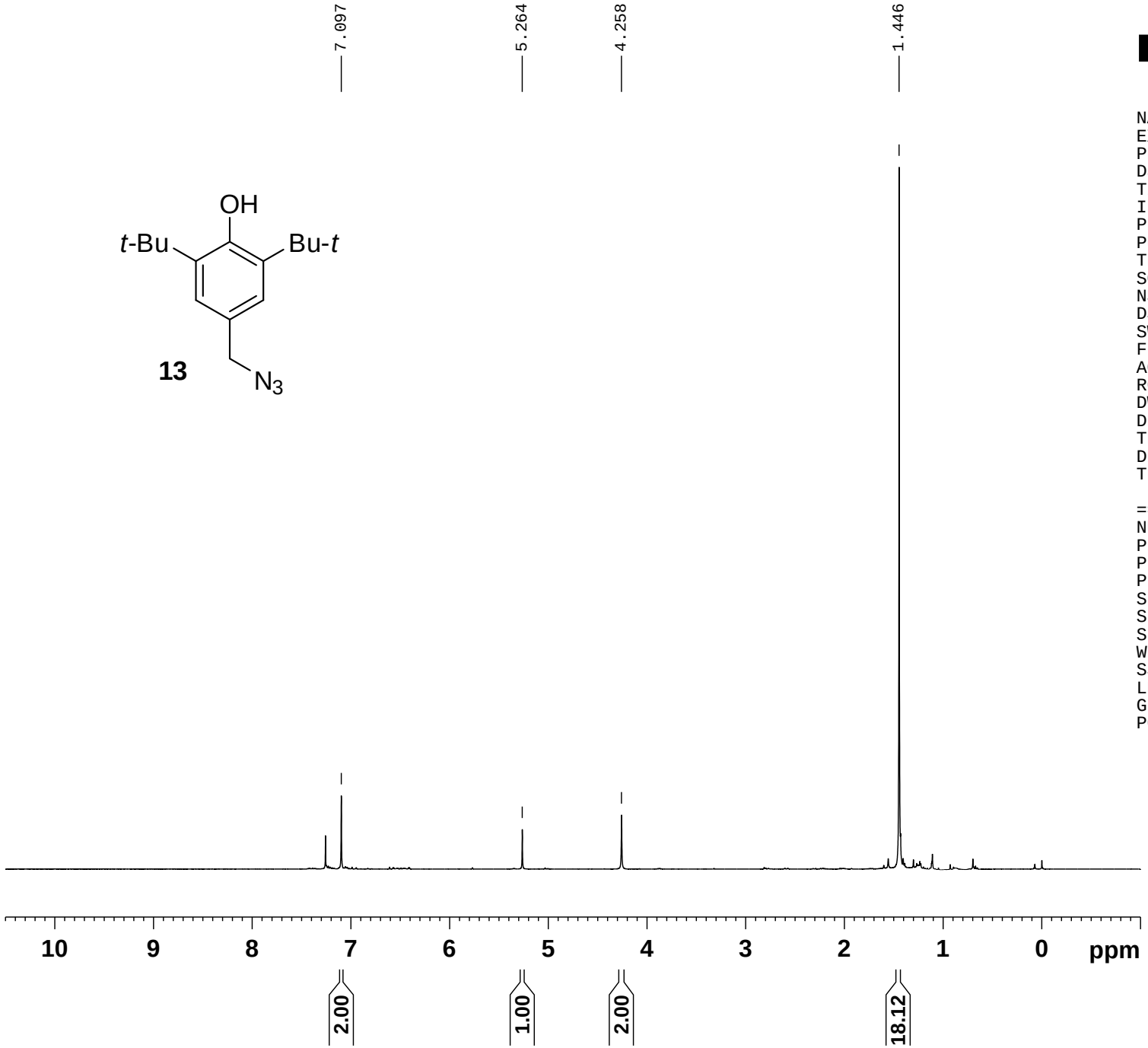
NAME	cyj759p-20181027
EXPNO	1
PROCNO	1
Date_	20181027
Time	19.45
INSTRUM	spect
PROBHD	5 mm PABBO BB-
PULPROG	zg30
TD	32768
SOLVENT	CDCl3
NS	8
DS	0
SWH	6393.862 Hz
FIDRES	0.195125 Hz
AQ	2.5625076 sec
RG	128
DW	78.200 usec
DE	6.50 usec
TE	293.0 K
D1	1.00000000 sec
TD0	1
======== CHANNEL f1 ========	
NUC1	1H
P1	10.40 usec
PL1	-1.00 dB
PL1W	17.01305389 W
SFO1	400.1326008 MHz
SI	32768
SF	400.1300107 MHz
WDW	EM
SSB	0
LB	0.30 Hz
GB	0
PC	1.00




```
NAME      cyj759ap-201801027
EXPNO                      2
PROCNO                     1
Date_               20181027
Time                   19.52
INSTRUM                spect
PROBHD   5 mm PABBO BB-
PULPROG                zgpg30
TD                      65536
SOLVENT                 CDCl3
NS                        104
DS                          4
SWH                 25252.525 Hz
FIDRES                0.385323 Hz
AQ                  1.2976629 sec
RG                       2050
DW                     19.800 usec
DE                      6.50 usec
TE                     293.9 K
D1                  2.00000000 sec
D11                 0.03000000 sec
TD0                         3

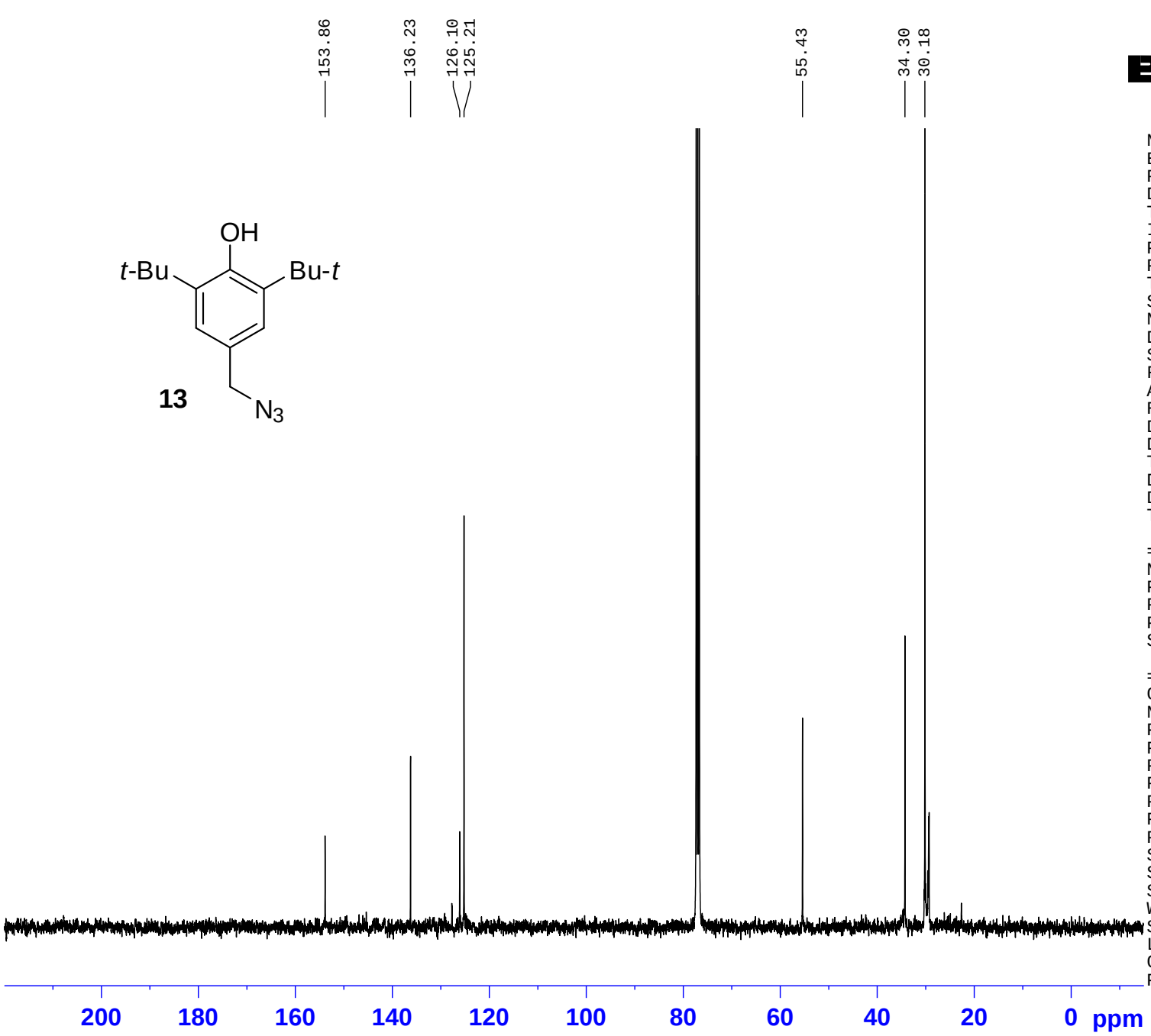
======== CHANNEL f1 ========
NUC1                      13C
P1                     15.00 usec
PL1                     2.00 dB
PL1W               55.31277084 W
SFO1               100.6238364 MHz

======== CHANNEL f2 ========
CPDPRG2                waltz16
NUC2                       1H
PCPD2                  80.00 usec
PL2                    -1.00 dB
PL12                   16.72 dB
PL13                   15.50 dB
PL2W               17.01305389 W
PL12W               0.28759566 W
PL13W               0.38087484 W
SFO2               400.1316005 MHz
SI                       32768
SF                 100.6127752 MHz
WDW                         EM
SSB                          0
LB                      3.00 Hz
GB                           0
PC                      1.40
```




```
NAME      cyj-277bp-20180316
EXPNO                      1
PROCNO                     1
Date_               20180316
Time                   22.08
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                    294.4 K
D1                1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
NUC1                      1H
P1                     13.10 usec
PL1                     1.80 dB
PL1W             8.92857742 W
SFO1           400.1326008 MHz
SI                     32768
SF             400.1300112 MHz
WDW                       EM
SSB                        0
LB                     0.30 Hz
GB                         0
PC                     1.00
```




```
NAME      cyj277bp1-20180320
EXPNO                      2
PROCNO                     1
Date_               20180320
Time                   17.14
INSTRUM                spect
PROBHD   5 mm PADUL 13C
PULPROG              zgpg30
TD                    65536
SOLVENT               CDCl3
NS                      936
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
SFO1            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
SFO2            400.1316005 MHz
SI                     32768
SF              100.6127721 MHz
WDW                       EM
SSB                        0
LB                      3.00 Hz
GB                         0
PC                      1.40
```