Supporting Information

Benzannulation of Isobenzopyryliums with Electron-Rich Alkynes: A Modular Access to β-Functionalized Naphthalenes

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Table of Contents

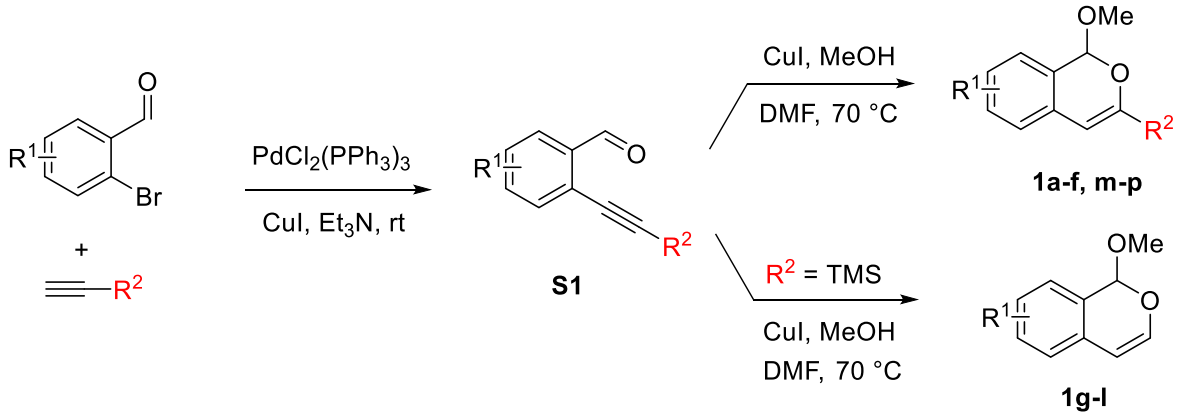
I. General Information

All air or moisture sensitive reactions were conducted in oven-dried glassware under nitrogen atmosphere using dry solvents. Flash column chromatography was performed over silica gel (230-400 mesh) purchased from Qindao Puke Co., China. Anhydrous *N*, *N*-dimethylformamide and anhydrous acetonitrile were purified by the Innovative® solvent purification system. Anhydrous dichloromethane was distilled with calcium hydride. Toluene and 1, 2-dichloroethane were purchased from Sigma–Aldrich and used as received. Triethylamine was purchased from Acros and used as received. ^{1}H and ^{13}C NMR spectra were collected on a Bruker AV 400 MHz NMR spectrometer using residue solvent peaks as an internal standard (^{1}H NMR: $CDCl_3$ at 7.26 ppm, C_6D_6 at 7.16 ppm, CD_2Cl_2 at 5.32 ppm, ^{13}C NMR: $CDCl_3$ at 77.0 ppm, C_6D_6 at 128.06 ppm, CD_2Cl_2 at 53.84 ppm). Mass spectra were collected on an Agilent GC/MS 5975C system, or a MALDI Micro MX mass spectrometer, or an API QSTAR XL System.

II. Substrate Preparation

Alkynes used this work are all known compounds. They were prepared according to the procedures in the literature and the characterization data match the reported data.[1]

General Procedure A.



This procedure was modified from the literature.[2,3] Under N_2, to a flame-dried flask charged with the 2-bromobenzaldehyde (10 mmol, 1.0 equiv), CuI (38.1 mg, 0.2 mmol, 0.02 equiv) and $PdCl_2(PPh_3)_3$ (140.4 mg, 0.2 mmol, 0.02 equiv) were sequentially added Et_3N (17 mL) and the terminal alkyne (20 mmol, 2.0 equiv). The reaction was stirred at room temperature and the progress was monitored by ^1H NMR of the reaction mixture. Upon completion, DCM (50 mL) was added. The reaction mixture was filtered through a short pad of celite, and the filtrate was concentrated. The residue was purified by silica gel column chromatography to afford 2-alkynylbenzaldehyde **S1**.

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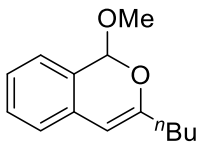
1 (a) M. P. Schramm, V. Shubinets, S. A. Kozmin, *Org. Synth.*, 2010, **87**, 253-262; (b) W. Zhao, Z. Wang, J. Sun, *Angew. Chem., Int. Ed.*, 2012, **51**, 6209-6213; (c) Y. Wang, L.-J. Song, X. Zhang, J. Sun, *Angew. Chem., Int. Ed.*, 2016, **55**, 9704-9708; (d) T. Hamada, X. Ye, S. S. Stahl, *J. Am. Chem. Soc.*, 2008, **130**, 833-835; (e) S. Ding, G. Jia, J. Sun, *Angew. Chem., Int. Ed.*, 2014, **53**, 1877-1880.

2 Y. Luan, K. S. Barbato, P. N. Moquist, T. Kodama, S. E. Schaus, *J. Am. Chem. Soc.*, 2015, **137**, 3233-3236.

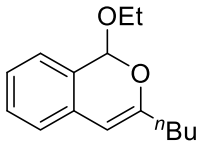
3 N.-T. Patil, Y. Yamamoto, *J. Org. Chem.*, 2004, **69**, 5139-5142.

Under N_2, to a flame-dried flask charged with **S1** (5 mmol, 1.0 equiv) and CuI (95.2 mg, 0.5 mmol, 0.1 equiv) were added DMF (2 mL) and MeOH (0.4 mL, 10 mmol, 2.0 equiv) *via* syringe. The reaction was heated to 70 °C, and the progress was monitored by 1H NMR of the reaction mixture. Upon completion, water (10 mL) and EtOAc (10 mL) were added. he organic layer was separated, and the aqueous layer was extracted with EtOAc (10 mL×3). The combined organic layers were washed with water (10 mL×3), and dried over Na_2SO_4, filtered, and concentrated. The crude product was purified by silica gel (washed with Et_3N) column chromatography to afford the substrate **1**.



1a

3-Butyl-1-methoxy-1*H*-isochromene (1a) was prepared as an oil according to the General Procedure A. It is a known compound. The spectra data are consistent with the literature.[3]



1a'

3-Butyl-1-ethoxy-1*H*-isochromene (1a') was prepared as a yellow oil according to the General Procedure A, in which EtOH was used in place of MeOH.

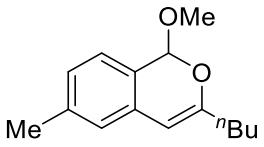
^{1}H NMR (400 MHz, C_6D_6) δ 7.15 - 7.08 (m, 1H), 7.08 - 6.97 (m, 2H), 6.96 - 6.89 (m, 1H), 5.97 (s, 1H), 5.67 (s, 1H), 3.92 - 3.80 (m, 1H), 3.54 - 3.41 (m, 1H), 2.33 - 2.13 (m, 2H), 1.65 - 1.50 (m, 2H), 1.39 - 1.23 (m, 2H), 1.06 (t, J = 7.1 Hz, 3H), 0.87 (t, J = 7.4 Hz, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 154.5, 129.2, 127.9, 127.5, 126.4, 125.9, 123.6, 100.7, 99.0,

63.1, 34.1, 29.5, 22.4, 15.4, 14.1.

IR (thin film) 3070, 3028, 2957, 2930, 2870, 1657, 1077 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{20}O_2$ (M^+): 232.1463, Found: 232.1469.



1b

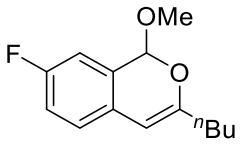
3-Butyl-1-methoxy-6-methyl-1*H*-isochromene (1b) was prepared as a yellow oil according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 6.99 (d, J = 7.7 Hz, 1H), 6.88 - 6.83 (m, 1H), 6.74 (s, 1H), 5.89 (s, 1H), 5.68 (s, 1H), 3.31 (s, 3H), 2.32 - 2.17 (m, 2H), 2.11 (s, 3H), 1.66 - 1.53 (m, 2H), 1.37 - 1.25 (m, 2H), 0.88 (t, J = 7.4 Hz, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 154.5, 138.8, 131.3, 126.7, 126.4, 124.7, 124.2, 100.7, 100.3, 54.5, 34.1, 29.6, 22.5, 21.4, 14.1.

IR (thin film) 3013, 2956, 2828, 1657, 1078 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{20}O_2$ (M^+): 232.1463, Found: 232.2467.



1c

3-Butyl-7-fluoro-1-methoxy-1*H*-isochromene (1c) was prepared as a yellow oil according to the General Procedure A.

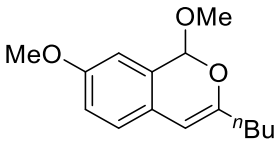
^{1}H NMR (400 MHz, C_6D_6) δ 6.82 - 6.74 (m, 1H), 6.74 - 6.68 (m, 1H), 6.68 - 6.60 (m, 1H), 5.62 (s, 1H), 5.54 (s, 1H), 3.22 (s, 3H), 2.26 - 2.08 (m, 2H), 1.61 - 1.47 (m, 2H), 1.36 - 1.21 (m, 2H), 0.87 (t, J = 7.4 Hz, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 161.4 (d, J = 243.9 Hz), 153.7 (d, J = 2.5 Hz), 128.7 (d, J = 7.1 Hz), 127.5 (d, J = 2.9 Hz), 125.1 (d, J = 7.6 Hz), 116.3 (d, J = 21.7 Hz), 113.3 (d, J = 22.5

Hz), 99.8, 99.5 (d, J = 2.4 Hz), 54.7, 33.9, 29.5, 22.4, 14.1.

IR (thin film) 3069, 2958, 2932, 2870, 2831, 1660, 1500 cm^{-1}.

HRMS (CI) Calcd for $C_{14}H_{17}FO_2$ (M^+): 236.1213, Found: 236.1203.



1d

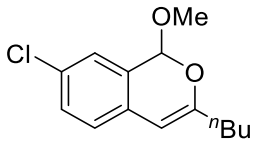
3-Butyl-1,7-dimethoxy-1*H*-isochromene (1d) was prepared as a yellow oil according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 6.87 - 6.85 (m, 1H), 6.83 - 6.76 (m, 1H), 6.76 - 6.71 (m, 1H), 5.84 (s, 1H), 5.67 (s, 1H), 3.32 (s, 3H), 3.29 (s, 3H), 2.33 - 2.16 (m, 2H), 1.67 - 1.53 (m, 2H), 1.40 - 1.25 (m, 2H), 0.88 (t, J = 7.4 Hz, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 158.6, 152.3, 128.5, 124.8, 124.4, 115.7, 111.7, 100.3, 100.2, 54.9, 54.6, 33.9, 29.6, 22.5, 14.1.

IR (thin film) 3067, 2996, 2956, 2870, 2832, 1661, 1504 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{20}O_3$ (M^+): 248.1412, Found: 248.1408.



1e

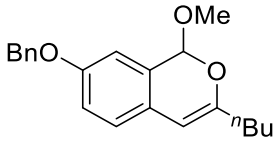
3-Butyl-7-chloro-1-methoxy-1*H*-isochromene (1e) was prepared as a yellow oil according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 7.09 - 7.03 (m, 1H), 7.01 (s, 1H), 6.58 (d, J = 8.2 Hz, 1H), 5.58 (s, 1H), 5.50 (s, 1H), 3.21 (s, 3H), 2.25 - 2.06 (m, 2H), 1.60 - 1.45 (m, 2H), 1.33 - 1.21 (m, 2H), 0.86 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 154.9, 131.0, 129.7, 129.4, 128.5, 126.6, 124.8, 99.8, 99.4, 54.8, 33.9, 29.4, 22.4, 14.1.

IR (thin film) 3072, 3031, 2957, 2868, 2831, 1656, 1487 cm^{-1}.

HRMS (CI) Calcd for $C_{14}H_{17}ClO_2$ (M^+): 252.0917, Found: 252.0970.



1f

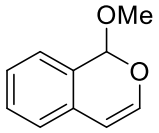
7-(Benzyloxy)-3-butyl-1-methoxy-1*H*-isochromene (1f) was prepared as a colorless oil according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 7.27 - 7.22 (m, 2H), 7.19 - 7.13 (m, 2H), 7.11 - 7.07 (m, 1H), 6.88 - 6.84 (m, 2H), 6.83 - 6.80 (m, 1H), 5.85 (s, 1H), 5.67 (s, 1H), 4.66 (s, 2H), 3.32 (s, 3H), 2.35 - 2.13 (m, 2H), 1.67 - 1.52 (m, 2H), 1.39 - 1.24 (m, 2H), 0.89 (t, J = 7.4 Hz, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 157.8, 152.5, 137.7, 128.7, 128.5, 127.9, 127.7, 124.8, 124.7, 116.5, 112.8, 100.3, 100.2, 70.2, 54.6, 33.9, 29.6, 22.5, 14.1.

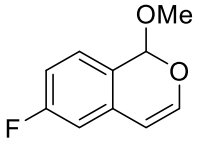
IR (thin film) 3064, 3033, 2956, 2868, 2829, 1660, 1502 cm^{-1}.

HRMS (CI) Calcd for $C_{21}H_{24}O_3$ (M^+): 324.1725, Found: 324.1720.



1g

1-Methoxy-1*H*-isochromene (1g) was prepared as an oil according to the General Procedure A. It is a known compound. The spectra data are consistent with the literature.[3]



1h

6-Fluoro-1-methoxy-1*H*-isochromene (1h) was prepared as a yellow solid according

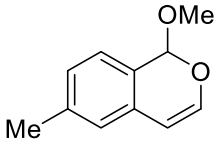
to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 6.76 - 6.68 (m, 1H), 6.68 - 6.59 (m, 1H), 6.53 - 6.45 (m, 1H), 6.36 (d, J = 5.7 Hz, 1H), 5.65 (s, 1H), 5.48 (d, J = 5.7 Hz, 1H), 3.19 (s, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 163.6 (d, J = 245.8 Hz), 143.3, 132.0 (d, J = 9.2 Hz), 128.5 (d, J = 8.9 Hz), 123.9 (d, J = 2.9 Hz), 113.5 (d, J = 22.3 Hz), 110.4 (d, J = 22.4 Hz), 104.1 (d, J = 2.4 Hz), 99.0, 54.9.

IR (thin film) 3076, 2997, 2957, 2932, 2908, 2831, 1638, 1026 cm^{-1}.

HRMS (CI) Calcd for $C_{10}H_9FO_2$ (M^+): 180.0587, Found: 180.0585.



1i

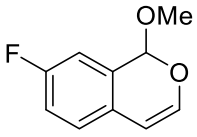
1-Methoxy-6-methyl-1*H*-isochromene (1i) was prepared as a yellow oil according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 6.94 (d, J = 7.7 Hz, 1H), 6.84 (d, J = 7.7 Hz, 1H), 6.65 (s, 1H), 6.48 (d, J = 5.7 Hz, 1H), 5.83 (s, 1H), 5.71 (d, J = 5.7 Hz, 1H), 3.27 (s, 3H), 2.06 (s, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 142.5, 138.9, 127.9, 127.6, 126.6, 125.6, 124.6, 104.8, 99.6, 54.9, 21.3.

IR (thin film) 3071, 3022, 2994, 2905, 2828, 1636, 1025 cm^{-1}.

HRMS (CI) Calcd for $C_{11}H_{12}O_2$ (M^+): 176.0837, Found: 176.0839.



1j

7-Fluoro-1-methoxy-1*H*-isochromene (1j) was prepared as a yellow solid according to the General Procedure A.

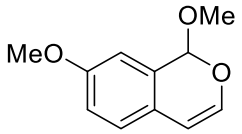
^{1}H NMR (400 MHz, C_6D_6) δ 6.78 - 6.60 (m, 2H), 6.60 - 6.49 (m, 1H), 6.35 (d, J = 5.7 Hz,

1H), 5.57 (d, *J* = 5.7 Hz, 1H), 5.55 (s, 1H), 3.18 (s, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 161.8 (d, *J* = 245.0 Hz), 141.6 (d, *J* = 2.5 Hz), 129.7 (d, *J* = 7.2 Hz), 126.0 (d, *J* = 3.0 Hz), 125.6 (d, *J* = 7.7 Hz), 116.3 (d, *J* = 21.8 Hz), 113.5 (d, *J* = 22.7 Hz), 104.0, 98.8 (d, *J* = 2.3 Hz), 55.1.

IR (thin film) 3085, 3054, 2981, 2932, 2832, 1640, 1500, 1025 cm^{-1}.

HRMS (CI) Calcd for $C_{10}H_9FO_2$ (M^+): 180.0587, Found: 180.0583.



1k

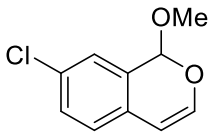
1,7-Dimethoxy-1*H*-isochromene (1k) was prepared as a yellow oil according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 6.80 - 6.72 (m, 2H), 6.72 - 6.66 (m, 1H), 6.43 (d, *J* = 5.7 Hz, 1H), 5.78 (s, 1H), 5.73 (d, *J* = 5.7 Hz, 1H), 3.28 (s, 3H), 3.25 (s, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 159.1, 140.5, 129.5, 125.3, 122.9, 115.6, 111.8, 104.6, 99.5, 54.9, 54.9.

IR (thin film) 2999, 2942, 2832, 1618, 1502, 1029 cm^{-1}.

HRMS (CI) Calcd for $C_{11}H_{12}O_3$ (M^+): 192.0786, Found: 192.0788.



1l

7-Chloro-1-methoxy-1*H*-isochromene (1l) was prepared as a yellow solid according to the General Procedure A.

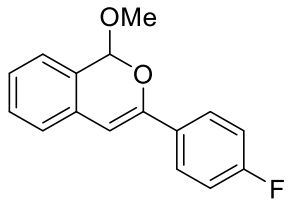
^{1}H NMR (400 MHz, C_6D_6) δ 7.03 - 6.97 (m, 1H), 6.97 - 6.93 (m, 1H), 6.52 - 6.45 (m, 1H), 6.34 (d, *J* = 5.7 Hz, 1H), 5.53 (d, *J* = 5.7 Hz, 1H), 5.51 (s, 1H), 3.16 (s, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 142.6, 131.9, 129.5, 129.4, 128.2, 126.8, 125.3, 103.9, 98.7,

55.1.

IR (thin film) 3075, 2998, 2958, 2931, 2830, 1634, 1488, 1027 cm^{-1}.

HRMS (CI) Calcd for $C_{10}H_9ClO_2$ (M^+): 196.0291, Found: 196.0291.



1m

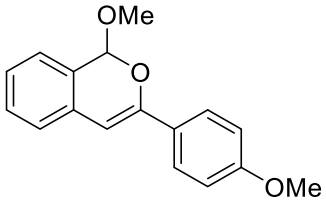
3-(4-Fluorophenyl)-1-methoxy-1*H*-isochromene (1m) was prepared as a colorless solid according to the General Procedure A.

^{1}H NMR (400 MHz, CD_2Cl_2) δ 7.86 - 7.77 (m, 2H), 7.42 - 7.33 (m, 1H), 7.31 - 7.19 (m, 3H), 7.17 - 7.08 (m, 2H), 6.56 (s, 1H), 6.13 (s, 1H), 3.58 (s, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 163.5 (d, J = 248.2 Hz), 149.1, 131.4 (d, J = 3.3 Hz), 131.0, 129.5, 127.1 (d, J = 8.1 Hz), 126.8, 126.4, 124.6, 115.7, 115.5, 100.7, 100.4, 54.8.

IR (thin film) 3070, 2999, 2917, 2829, 1634, 1604, 1503, 1029 cm^{-1}.

HRMS (CI) Calcd for $C_{16}H_{13}FO_2$ (M^+): 256.0900, Found: 256.0899.



1n

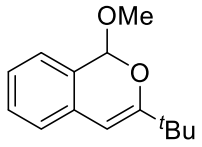
1-Methoxy-3-(4-methoxyphenyl)-1*H*-isochromene (1n) was prepared as a colorless solid according to the General Procedure A.

^{1}H NMR (400 MHz, CD_2Cl_2) δ 7.79 - 7.72 (m, 2H), 7.38 - 7.33 (m, 1H), 7.28 - 7.16 (m, 3H), 6.99 - 6.91 (m, 2H), 6.49 (s, 1H), 6.11 (s, 1H), 3.84 (s, 3H), 3.58 (s, 3H).

^{13}C NMR (101 MHz, C_6D_6) δ 160.8, 150.2, 131.5, 129.5, 128.2, 127.9, 126.8, 126.4, 126.3, 124.4, 114.3, 100.4, 99.4, 54.9, 54.7.

IR (thin film) 3068, 3000, 2924, 2833, 1606, 1508, 1032 cm^{-1}.

HRMS (CI) Calcd for $C_{17}H_{16}O_3$ (M^+): 268.1099, Found: 268.1093.



1o

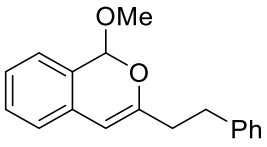
3-(*Tert*-butyl)-1-methoxy-1*H*-isochromene (1o) was prepared as a yellow solid according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 7.14 - 7.08 (m, 1H), 7.05 - 6.99 (m, 2H), 6.98 - 6.90 (m, 1H), 5.84 (s, 1H), 5.81 (s, 1H), 3.29 (s, 3H), 1.22 (s, 9H).

^{13}C NMR (101 MHz, C_6D_6) δ 161.3, 131.4, 129.3, 127.2, 126.3, 126.0, 124.1, 100.3, 97.4, 55.0, 35.6, 28.3.

IR (thin film) 3073, 3030, 2965, 2911, 2828, 1645, 1064 cm^{-1}.

HRMS (CI) Calcd for $C_{14}H_{18}O_2$ (M^+): 218.1307, Found: 218.1305.



1p

1-Methoxy-3-phenethyl-1*H*-isochromene (1p) was prepared as a pale yellow oil according to the General Procedure A.

^{1}H NMR (400 MHz, C_6D_6) δ 7.19 - 6.96 (m, 8H), 6.86 (d, J = 7.5 Hz, 1H), 5.86 (s, 1H), 5.58 (s, 1H), 3.29 (s, 3H), 2.86 (t, J = 7.9 Hz, 2H), 2.60 - 2.40 (m, 2H).

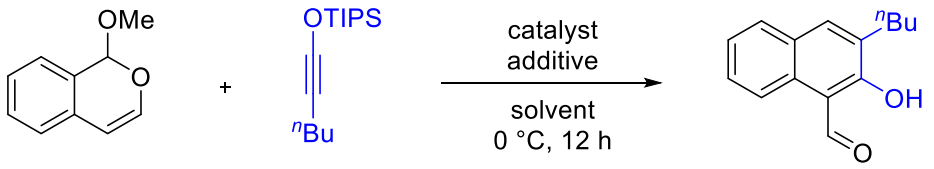
^{13}C NMR (101 MHz, C_6D_6) δ 153.6, 141.7, 131.1, 129.3, 128.8, 128.7, 127.2, 126.44, 126.36, 126.1, 123.7, 101.1, 100.3, 54.7, 36.4, 33.9.

IR (thin film) 3067, 3028, 2915, 2829, 1656, 1610, 1078 cm^{-1}.

HRMS (CI) Calcd for $C_{18}H_{18}O_2$ (M^+): 266.1307, Found: 266.1306.

III. Synthesis of β-Naphthols from Siloxy Alkynes

Table S1. Condition Optimization for the Synthesis of 4a.

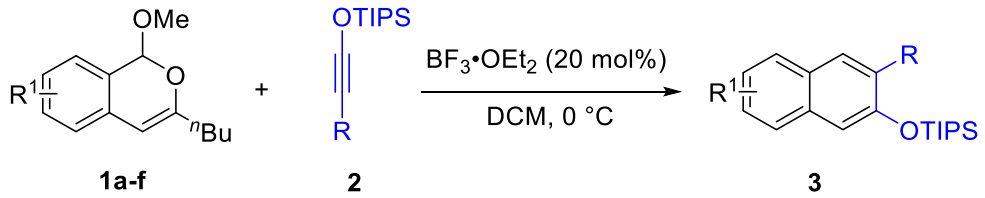


1g **2a** **4a**

entry	catalyst	additive	solvent	yield (%)[a]
1	$HNTf_2$	-	DCM	<5
2	CH_3SO_3H	-	DCM	<5
3	AgOTf	-	DCM	<5
4	$AgNTf_2$	-	DCM	<5
5	TMSOTf	-	DCM	53
6	$TiCl_4$	-	DCM	<5
7	$BF_3•OEt_2$	-	DCM	64
8	$BF_3•OEt_2$ (1.0 equiv)	-	DCM	68
9	$BF_3•OEt_2$ (2.0 equiv)	-	DCM	72
10	$BF_3•OEt_2$ (2.0 equiv)	2,4-di-*tert*-butylpyridine	DCM	72
11	$BF_3•OEt_2$ (2.0 equiv)	2,6-lutidine	DCM	81
12	$BF_3•OEt_2$ (2.0 equiv)	2,4,6-collidine	DCM	85 (78)[b]
13	$BF_3•OEt_2$ (2.0 equiv)	2,4,6-collidine	MeCN	6
14	$BF_3•OEt_2$ (2.0 equiv)	2,4,6-collidine	toluene	35
15	$BF_3•OEt_2$ (2.0 equiv)	2,4,6-collidine	DCE	82

[a] Reaction scale: **1g** (0.05 mmol), **2a** (0.06 mmol), catalyst (10 mol%), additive (0.05 mmol), solvent (0.5 mL). Yield is based on analysis of the ^1H NMR spectrum of the crude product using CH_2Br_2 as the internal standard. [b] Yield in parentheses is isolated yield.

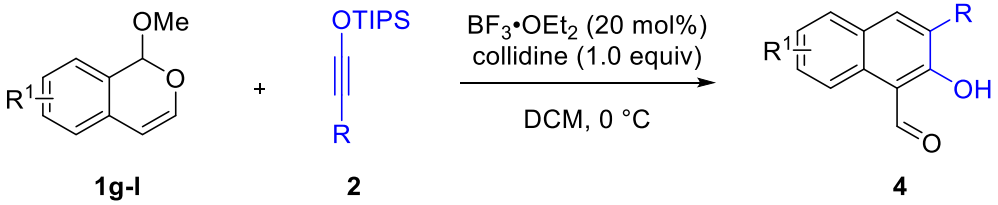
General Procedure B.



1a-f **2** **3**

Under N_2 at room temperature, an oven-dried 25-mL Schlenk tube was charged with acetal **1** (0.5 mmol, 1.0 equiv), alkyne **2** (0.6 mmol, 1.2 equiv) and CH_2Cl_2 (5.0 mL). The mixture was cooled to 0 °C and then $BF_3{\cdot}OEt_2$ (12.7 μL, 0.10 mmol, 0.2 equiv) was added. The reaction mixture was then slowly warmed to room temperature and stirred overnight. Upon completion (reaction time is specified in each case shown below), the reaction was quenched by addition of a saturated aqueous $NaHCO_3$ solution (8 mL). The aqueous layer was separated and extracted by DCM (10 mL ×3). The combined organic layers were washed with water (10 mL ×3), dried with Na_2SO_4, filtered, and concentrated. The crude product was purified by silica gel to afford the pure naphthalene product **3**.

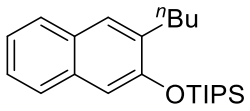
General Procedure C.



1g-l **2** **4**

Under N_2 at room temperature, an oven-dried 25-mL Schlenk tube was charged with starting materials **1g-l** (0.5 mmol, 1.0 equiv), **2** (0.6 mmol, 1.2 equiv), 2,4,6-collidine (66.1 μL, 0.5 mmol, 1.0 equiv) and CH_2Cl_2 (5.0 mL). The mixture was cooled to 0 °C and then $BF_3{\cdot}OEt_2$ (126.7 μL, 1.0 mmol, 2.0 equiv) was added. The reaction mixture was slowly warmed to room temperature and stirred overnight. Upon completion (reaction time is specified in each case shown below), the reaction was quenched by

addition of a saturated aqueous $NaHCO_3$ solution (8 mL). The aqueous layer was separated and extracted by DCM (10 mL ×3). The combined organic layers were washed with water (10 mL ×3), dried with Na_2SO_4, filtered, and concentrated. The crude product was purified by silica gel to afford the pure naphthalene product **3**.



3a

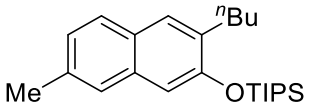
((3-Butylnaphthalen-2-yl)oxy)triisopropylsilane (3a) was prepared as a colorless oil from 3-butyl-1-methoxy-1*H*-isochromene **1a** (109.2 mg, 0.5 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (152.7 mg, 0.6 mmol) according to the General Procedure B (12 h, eluent: hexanes) in 81% yield (144.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, J = 8.0 Hz, 1H), 7.63 (d, J = 8.1 Hz, 1H), 7.57 (s, 1H), 7.39 - 7.32 (m, 1H), 7.32 - 7.27 (m, 1H), 7.10 (s, 1H), 2.79 (t, J = 7.6 Hz, 2H), 1.67 (m, 2H), 1.49 - 1.35 (m, 5H), 1.16 (d, J = 7.5 Hz, 18H), 0.96 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.0, 135.0, 133.2, 129.0, 128.2, 127.0, 126.0, 125.1, 123.3, 112.4, 32.2, 31.1, 22.8, 18.1, 14.1, 13.1.

IR (thin film) 3056, 2949, 2867, 2724, 1466, 1257 cm^{-1}.

HRMS (CI) Calcd for $C_{23}H_{36}OSi$ (M^+): 356.2535, Found: 356.2531.



3b

((3-Butyl-7-methylnaphthalen-2-yl)oxy)triisopropylsilane (3b) was prepared as a colorless oil from 3-butyl-1-methoxy-6-methyl-1*H*-isochromene **1b** (116.2 mg, 0.5 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (152.7 mg, 0.6 mmol) according to the General Procedure B (12 h, eluent: hexanes) in 84% yield (155.8 mg).

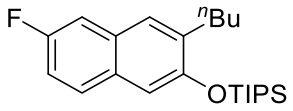
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, J = 8.3 Hz, 1H), 7.51 (s, 1H), 7.41 (s, 1H), 7.12 (d, J = 8.3 Hz, 1H), 7.02 (s, 1H), 2.75 (t, J = 7.6 Hz, 2H), 2.46 (s, 3H), 1.72 - 1.58 (m, 2H), 1.48

- 1.32 (m, 5H), 1.15 (d, *J* = 7.4 Hz, 18H), 0.94 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.1, 134.6, 133.9, 133.4, 127.9, 127.2, 126.8, 125.6, 125.1, 111.9, 32.3, 31.1, 22.8, 21.6, 18.1, 14.1, 13.1.

IR (thin film) 3048, 2948, 2867, 2727, 1470, 1252 cm^{-1}.

HRMS (CI) Calcd for $C_{24}H_{38}OSi$ (M^+): 370.2692, Found: 370.2699.



3c

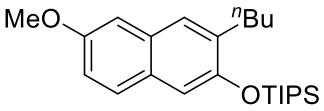
((3-Butyl-6-fluoronaphthalen-2-yl)oxy)triisopropylsilane (3c) was prepared as a colorless oil from 3-butyl-7-fluoro-1-methoxy-1*H*-isochromene **1c** (118.1 mg, 0.5 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (152.7 mg, 0.6 mmol) according to the General Procedure B (24 h, eluent: hexanes) in 68% yield (127.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 - 7.55 (m, 1H), 7.50 (s, 1H), 7.34 - 7.28 (m, 1H), 7.17 - 7.09 (m, 1H), 7.09 (s, 1H), 2.77 (t, *J* = 7.6 Hz, 2H), 1.71 - 1.57 (m, 2H), 1.48 - 1.34 (m, 5H), 1.15 (d, *J* = 7.5 Hz, 18H), 0.95 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.4 (d, *J* = 242.1 Hz), 152.3, 136.2, 130.1, 129.4 (d, *J* = 8.9 Hz), 128.1 (d, *J* = 8.6 Hz), 127.4 (d, *J* = 5.1 Hz), 115.3 (d, *J* = 25.2 Hz), 112.4, 110.0 (d, *J* = 20.4 Hz), 32.1, 31.1, 22.8, 18.1, 14.0, 13.1.

IR (thin film) 2949, 2868, 1608, 1503, 1468, 1377, 1253 cm^{-1}.

HRMS (CI) Calcd for $C_{23}H_{35}FOSi$ (M^+): 374.2441, Found: 374.2437.



3d

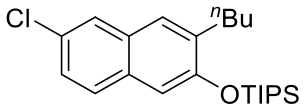
((3-Butyl-6-methoxynaphthalen-2-yl)oxy)triisopropylsilane (3d) was prepared as a colorless oil from 3-butyl-1,7-dimethoxy-1*H*-isochromene **1d** (124.2 mg, 0.5 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (152.7 mg, 0.6 mmol) according to the General Procedure B (24 h, eluent: hexanes) in 77% yield (149.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 (d, J = 9.6 Hz, 1H), 7.47 (s, 1H), 7.06 - 7.00 (m, 3H), 3.89 (s, 3H), 2.76 (t, J = 7.6 Hz, 2H), 1.71 - 1.60 (m, 2H), 1.47 - 1.32 (m, 5H), 1.15 (d, J = 7.4 Hz, 18H), 0.95 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.0, 151.3, 135.3, 129.8, 128.4, 127.5, 127.1, 117.7, 112.5, 105.4, 55.3, 32.2, 31.2, 22.8, 18.1, 14.1, 13.1.

IR (thin film) 3059, 2948, 2867, 2724, 1606, 1503, 1467, 1388, 1250 cm^{-1}.

HRMS (CI) Calcd for $C_{24}H_{38}O_2Si$ (M^+): 386.2641, Found: 386.2635.



3e

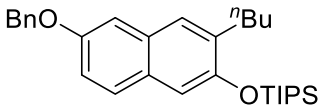
((3-Butyl-6-chloronaphthalen-2-yl)oxy)triisopropylsilane (3e) was prepared as a colorless oil from 3-butyl-7-chloro-1-methoxy-1*H*-isochromene **1e** (101.1 mg, 0.4 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (122.2 mg, 0.48 mmol) according to the General Procedure B (24 h, eluent: hexanes) in 63% yield (98.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 (s, 1H), 7.55 (d, J = 8.7 Hz, 1H), 7.48 (s, 1H), 7.31 - 7.26 (m, 1H), 7.06 (s, 1H), 2.76 (t, J = 7.6 Hz, 2H), 1.71 - 1.59 (m, 2H), 1.46 - 1.33 (m, 5H), 1.15 (d, J = 7.4 Hz, 18H), 0.95 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.2, 136.2, 131.4, 129.6, 128.8, 127.6, 127.3, 125.9, 125.7, 112.3, 32.1, 31.1, 22.7, 18.1, 14.0, 13.1.

IR (thin film) 2949, 2867, 2278, 1631, 1594, 1494, 1463, 1256 cm^{-1}.

HRMS (CI) Calcd for $C_{23}H_{35}ClOSi$ (M^+): 390.2146, Found: 390.2140.



3f

((6-(Benzyloxy)-3-butylnaphthalen-2-yl)oxy)triisopropylsilane (3f) was prepared as a colorless solid from 7-(benzyloxy)-3-butyl-1-methoxy-1*H*-isochromene **1f** (129.8 mg, 0.4 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (122.2 mg, 0.48 mmol) according

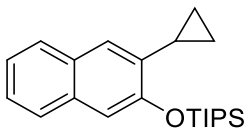
to the General Procedure B (12 h, eluent: hexanes) in 77% yield (142.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 - 7.52 (m, 1H), 7.51 - 7.44 (m, 3H), 7.44 - 7.37 (m, 2H), 7.37 - 7.30 (m, 1H), 7.15 - 7.09 (m, 2H), 7.05 (s, 1H), 5.15 (s, 2H), 2.75 (t, *J* = 7.6 Hz, 2H), 1.72 - 1.58 (m, 2H), 1.47 - 1.33 (m, 5H), 1.15 (d, *J* = 7.4 Hz, 18H), 0.95 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 155.2, 151.3, 137.2, 135.4, 129.7, 128.6, 128.5, 127.9, 127.6, 127.5, 127.1, 118.1, 112.5, 106.9, 70.1, 32.2, 31.2, 22.8, 18.1, 14.1, 13.1.

IR (thin film) 3063, 3033, 2946, 2867, 1605, 1504, 1250 cm^{-1}.

HRMS (CI) Calcd for $C_{30}H_{42}O_2Si$ (M^+): 462.2954, Found: 462.2971.



3g

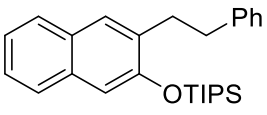
((3-Cyclopropylnaphthalen-2-yl)oxy)triisopropylsilane (3g) was prepared as a colorless oil from 3-butyl-1-methoxy-1*H*-isochromene **1a** (65.5 mg, 0.3 mmol) and ((cyclopropylethynyl)oxy)triisopropylsilane (85.8 mg, 0.36 mmol) according to the General Procedure B (12 h, eluent: hexanes) in 81% yield (82.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 - 7.59 (m, 2H), 7.38 - 7.31 (m, 1H), 7.31 - 7.26 (m, 2H), 7.12 (s, 1H), 2.35 - 2.25 (m, 1H), 1.48 - 1.37 (m, 3H), 1.17 (d, *J* = 7.5 Hz, 18H), 1.03 - 0.95 (m, 2H), 0.79 - 0.72 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.8, 135.9, 132.8, 129.0, 127.0, 126.0, 125.1, 123.6, 123.4, 112.4, 18.1, 13.1, 10.9, 8.0.

IR (thin film) 3070, 3012, 2954, 2865, 1632, 1600, 1461, 1259 cm^{-1}.

HRMS (CI) Calcd for $C_{22}H_{32}OSi$ (M^+): 340.2222, Found: 340.2226.



3h

Triisopropyl((3-phenethylnaphthalen-2-yl)oxy)silane (3h) was prepared as a

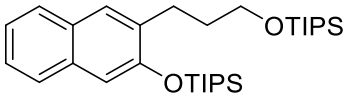
colorless oil from 3-butyl-1-methoxy-1*H*-isochromene **1a** (54.6 mg, 0.25 mmol) and triisopropyl((4-phenylbut-1-yn-1-yl)oxy)silane (90.8 mg, 0.3 mmol) according to the General Procedure B (12 h, eluent: hexanes) in 57% yield (57.7 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 - 7.62 (m, 2H), 7.54 (s, 1H), 7.39 - 7.33 (m, 1H), 7.31 - 7.26 (m, 3H), 7.24 - 7.17 (m, 3H), 7.14 (s, 1H), 3.14 - 3.06 (m, 2H), 3.03 - 2.95 (m, 2H), 1.49 - 1.38 (m, 3H), 1.18 (d, J = 7.5 Hz, 18H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 152.9, 142.2, 133.8, 133.4, 129.0, 128.7, 128.5, 128.3, 127.0, 126.1, 125.8, 125.3, 123.5, 112.5, 36.5, 33.3, 18.2, 13.2.

IR (thin film) 3058, 3027, 2954, 2864, 2722, 1633, 1598, 1461, 1256 cm^{-1}.

HRMS (CI) Calcd for $C_{27}H_{36}OSi$ (M^+): 404.2535, Found: 404.2539.



3i

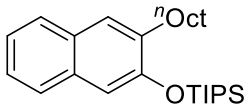
Triisopropyl(3-(3-((triisopropylsilyl)oxy)naphthalen-2-yl)propoxy)silane (3i) was prepared as a colorless solid from 3-butyl-1-methoxy-1*H*-isochromene **1a** (65.5 mg, 0.3 mmol) and 3,3,11,11-tetraisopropyl-2,12-dimethyl-4,10-dioxa-3,11-disilatridec-5-yne (148.6 mg, 0.36 mmol) according to the General Procedure B (24 h, eluent: hexanes) in 66% yield (102.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 (d, J = 8.1 Hz, 1H), 7.62 (d, J = 8.2 Hz, 1H), 7.60 (s, 1H), 7.38 - 7.31 (m, 1H), 7.31 - 7.27 (m, 1H), 7.09 (s, 1H), 3.76 (t, J = 6.3 Hz, 2H), 2.87 (t, J = 7.6 Hz, 2H), 1.98 - 1.88 (m, 2H), 1.45 - 1.35 (m, 3H), 1.15 (d, J = 7.5 Hz, 18H), 1.11 - 1.01 (m, 21H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.0, 134.3, 133.2, 129.0, 128.3, 127.0, 126.0, 125.1, 123.4, 112.4, 62.9, 33.0, 27.5, 18.2, 18.1, 13.1, 12.1.

IR (thin film) 3056, 2950, 2864, 2724, 1633, 1599, 1462, 1255 cm^{-1}.

HRMS (CI) Calcd for $C_{31}H_{54}O_2Si_2$ (M^+): 514.3662, Found: 514.3666.



3j

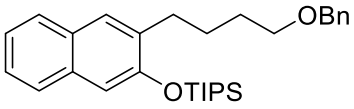
Triisopropyl((3-octylnaphthalen-2-yl)oxy)silane (3j) was prepared as a colorless oil from 3-butyl-1-methoxy-1*H*-isochromene **1a** (65.5 mg, 0.3 mmol) and (dec-1-yn-1-yloxy)triisopropylsilane (111.8 mg, 0.36 mmol) according to the General Procedure B (12 h, eluent: hexanes) in 71% yield (88.5 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, J = 8.0 Hz, 1H), 7.62 (d, J = 8.1 Hz, 1H), 7.56 (s, 1H), 7.37 - 7.31 (m, 1H), 7.31 - 7.26 (m, 1H), 7.09 (s, 1H), 2.76 (t, J = 7.6 Hz, 2H), 1.73 - 1.61 (m, 2H), 1.45 - 1.36 (m, 5H), 1.34 - 1.24 (m, 8H), 1.15 (d, J = 7.4 Hz, 21H), 0.87 (t, J = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.0, 135.0, 133.2, 129.1, 128.2, 127.0, 126.0, 125.1, 123.4, 112.4, 31.9, 31.5, 30.1, 29.7, 29.6, 29.3, 22.7, 18.2, 14.1, 13.1.

IR (thin film) 3056, 2932, 2860, 2722, 1633, 1599, 1461, 1255 cm^{-1}.

HRMS (CI) Calcd for $C_{27}H_{44}OSi$ (M^+): 412.3161, Found: 412.3154.



3k

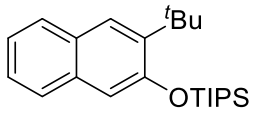
((3-(4-(Benzyloxy)butyl)naphthalen-2-yl)oxy)triisopropylsilane (3k) was prepared as a yellow oil from 3-butyl-1-methoxy-1*H*-isochromene **1a** (65.5 mg, 0.3 mmol) and ((6-(benzyloxy)hex-1-yn-1-yl)oxy)triisopropylsilane (129.8 mg, 0.36 mmol) according to the General Procedure B (12 h, eluent: hexanes) in 71% yield (98.9 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 (d, J = 8.0 Hz, 1H), 7.62 (d, J = 8.1 Hz, 1H), 7.56 (s, 1H), 7.38 - 7.31 (m, 5H), 7.31 - 7.26 (m, 2H), 7.09 (s, 1H), 4.50 (s, 2H), 3.51 (t, J = 6.1 Hz, 2H), 2.80 (t, J = 7.1 Hz, 2H), 1.83 - 1.67 (m, 4H), 1.45 - 1.34 (m, 3H), 1.14 (d, J = 7.5 Hz, 18H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 152.9, 138.7, 134.5, 133.3, 129.0, 128.31, 128.29, 127.6, 127.4, 127.0, 126.0, 125.2, 123.4, 112.4, 72.8, 70.4, 31.2, 29.8, 26.5, 18.1, 13.1.

IR (thin film) 3058, 2944, 2862, 2720, 1633, 1600, 1461, 1256 cm^{-1}.

HRMS (CI) Calcd for $C_{30}H_{42}O_2Si$ (M^+): 462.2954, Found: 462.2946.



3l

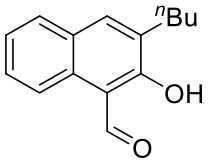
((3-(*tert*-Butyl)naphthalen-2-yl)oxy)triisopropylsilane (3l) was prepared as a colorless oil from 3-butyl-1-methoxy-1*H*-isochromene **1a** (87.3 mg, 0.4 mmol) and ((3,3-dimethylbut-1-yn-1-yl)oxy)triisopropylsilane (122.2 mg, 0.48 mmol) according to the General Procedure B (24 h, eluent: hexanes) in 34% yield (48.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, J = 8.2 Hz, 1H), 7.73 (s, 1H), 7.61 (d, J = 8.1 Hz, 1H), 7.40 - 7.34 (m, 1H), 7.33 - 7.27 (m, 1H), 7.11 (s, 1H), 1.57 - 1.44 (m, 12H), 1.21 (d, J = 7.5 Hz, 18H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.7, 140.9, 132.9, 128.7, 127.5, 125.7, 125.44, 125.40, 123.4, 113.3, 35.3, 29.9, 18.3, 13.4.

IR (thin film) 3057, 2957, 2869, 2720, 1632, 1595, 1456, 1252 cm^{-1}.

HRMS (CI) Calcd for $C_{23}H_{36}OSi$ (M^+): 356.2535, Found: 356.2541.



4a

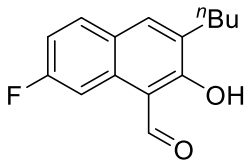
3-Butyl-2-hydroxy-1-naphthaldehyde (4a) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (81.1 mg, 0.5 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (152.7 mg, 0.6 mmol) according to the General Procedure C (12 h, eluent: hexanes/EtOAc = 100:1) in 78% yield (88.8 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.60 (s, 1H), 10.81 (s, 1H), 8.32 (d, J = 8.5 Hz, 1H), 7.82 (s, 1H), 7.75 (d, J = 8.1 Hz, 1H), 7.60 - 7.50 (m, 1H), 7.45 - 7.36 (m, 1H), 2.80 (t, J = 7.6 Hz, 2H), 1.75 - 1.64 (m, 2H), 1.49 - 1.38 (m, 2H), 0.97 (t, J = 7.4 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.4, 164.5, 137.6, 132.6, 131.8, 128.8, 128.1, 127.6, 124.3, 118.2, 110.8, 31.3, 29.3, 22.6, 14.0.

IR (thin film) 3449, 2955, 2865, 1635, 748 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{17}O_2$ ($M+H^+$): 229.1229, Found: 229.1223.



4b

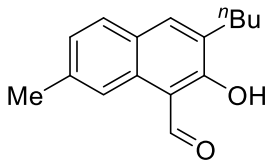
3-Butyl-7-fluoro-2-hydroxy-1-naphthaldehyde (4b) was prepared as a yellow solid from 6-fluoro-1-methoxy-1*H*-isochromene **1h** (72.1 mg, 0.4 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (122.2 mg, 0.48 mmol) according to the General Procedure C (12 h, eluent: hexanes/DCM = 10:1) in 53% yield (52.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.60 (s, 1H), 10.66 (s, 1H), 7.95 - 7.87 (m, 1H), 7.79 (s, 1H), 7.76 - 7.69 (m, 1H), 7.20 - 7.12 (m, 1H), 2.77 (t, J = 7.6 Hz, 2H), 1.73 - 1.62 (m, 2H), 1.48 - 1.36 (m, 2H), 0.97 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 192.8, 165.2, 162.4 (d, J = 247.6 Hz), 137.2, 133.3 (d, J = 9.7 Hz), 131.7 (d, J = 2.7 Hz), 131.2 (d, J = 9.8 Hz), 124.5, 113.9 (d, J = 24.6 Hz), 110.6 (d, J = 5.0 Hz), 103.1 (d, J = 23.5 Hz), 31.3, 29.2, 22.6, 14.0.

IR (thin film) 3443, 2956, 2930, 2865, 1631, 913, 741 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{16}FO_2$ ($M+H^+$): 247.1134, Found: 247.1137.



4c

3-Butyl-2-hydroxy-7-methyl-1-naphthaldehyde (4c) was prepared as a yellow solid from 1-methoxy-6-methyl-1*H*-isochromene **1i** (88.1 mg, 0.5 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (152.7 mg, 0.6 mmol) according to the General Procedure C

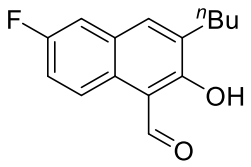
(12 h, eluent: hexanes/EtOAc = 100:1) in 78% yield (94.9 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.59 (s, 1H), 10.79 (s, 1H), 8.09 (s, 1H), 7.76 (s, 1H), 7.64 (d, J = 8.2 Hz, 1H), 7.24 (d, J = 8.3 Hz, 1H), 2.77 (t, J = 7.6 Hz, 2H), 2.54 (s, 3H), 1.74 - 1.61 (m, 2H), 1.47 - 1.36 (m, 2H), 0.96 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.3, 164.5, 138.2, 137.5, 132.1, 131.4, 128.7, 126.3, 125.8, 117.7, 110.5, 31.3, 29.2, 22.6, 22.3, 14.0.

IR (thin film) 3449, 2957, 2929, 2866, 1635, 1307, 803 cm^{-1}.

HRMS (CI) Calcd for $C_{16}H_{18}O_2$ (M^+): 242.1307, Found: 242.1308.



4d

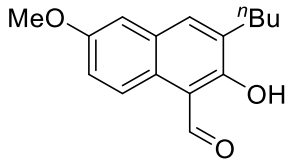
3-Butyl-6-fluoro-2-hydroxy-1-naphthaldehyde (4d) was prepared as a pale yellow solid from 7-fluoro-1-methoxy-1*H*-isochromene **1j** (72.1 mg, 0.4 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (122.2 mg, 0.48 mmol) according to the General Procedure C (16 h, eluent: hexanes/EtOAc = 100:1) in 67% yield (66.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.48 (s, 1H), 10.77 (s, 1H), 8.34 - 8.23 (m, 1H), 7.75 (s, 1H), 7.42 - 7.37 (m, 1H), 7.37 - 7.30 (m, 1H), 2.79 (t, J = 7.6 Hz, 2H), 1.73 - 1.61 (m, 2H), 1.49 - 1.37 (m, 2H), 0.97 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.2, 163.8, 159.6 (d, J = 244.5 Hz), 136.5 (d, J = 4.4 Hz), 134.2, 128.6 (d, J = 8.6 Hz), 128.4 (d, J = 1.4 Hz), 120.4 (d, J = 8.4 Hz), 117.6 (d, J = 24.3 Hz), 112.4 (d, J = 20.4 Hz), 110.9, 31.2, 29.4, 22.6, 13.9.

IR (thin film) 3452, 2954, 2930, 1640, 1454, 1412, 742 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{16}FO_2$ ($M+H^+$): 247.1134, Found: 247.1131.



4e

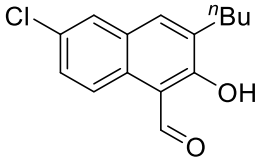
3-Butyl-2-hydroxy-6-methoxy-1-naphthaldehyde (4e) was prepared as a yellow solid from 1,7-dimethoxy-1*H*-isochromene **1k** (69.8 mg, 0.36 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (111.0 mg, 0.44 mmol) according to the General Procedure C (12 h, eluent: hexanes/EtOAc = 50:1) in 61% yield (57.7 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.32 (s, 1H), 10.76 (s, 1H), 8.22 (d, J = 9.2 Hz, 1H), 7.74 (s, 1H), 7.25 - 7.19 (m, 1H), 7.13 - 7.05 (m, 1H), 3.91 (s, 3H), 2.78 (t, J = 7.6 Hz, 2H), 1.75 - 1.63 (m, 2H), 1.49 - 1.36 (m, 2H), 0.97 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.4, 162.6, 156.5, 136.6, 133.1, 128.8, 126.5, 119.8, 119.7, 111.1, 107.9, 55.4, 31.3, 29.4, 22.6, 14.0.

IR (thin film) 3444, 2958, 2933, 2871, 1622, 1307, 750 cm^{-1}.

HRMS (CI) Calcd for $C_{16}H_{19}O_3$ ($M+H^+$): 259.1334, Found: 259.1333.



4f

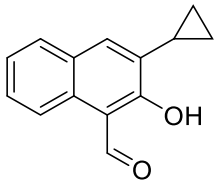
3-Butyl-6-chloro-2-hydroxy-1-naphthaldehyde (4f) was prepared as a yellow solid from 7-chloro-1-methoxy-1*H*-isochromene **1l** (98.3 mg, 0.5 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (152.7 mg, 0.6 mmol) according to the General Procedure C (12 h, eluent: hexanes/EtOAc = 100:1) in 56% yield (74.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.54 (s, 1H), 10.75 (s, 1H), 8.24 (d, J = 9.0 Hz, 1H), 7.76 - 7.66 (m, 2H), 7.56 - 7.39 (m, 1H), 2.79 (t, J = 7.6 Hz, 2H), 1.72 - 1.62 (m, 2H), 1.50 - 1.36 (m, 2H), 0.97 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.1, 164.4, 136.3, 134.1, 130.04, 130.00, 128.6, 128.5, 127.5, 119.9, 110.7, 31.2, 29.3, 22.5, 13.9.

IR (thin film) 3444, 2959, 2932, 2869, 1637, 913 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{16}ClO_2$ ($M+H^+$): 263.0839, Found: 263.0850.



4g

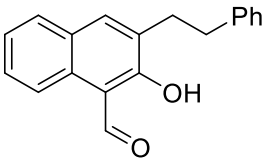
3-Cyclopropyl-2-hydroxy-1-naphthaldehyde (4g) was prepared as an orange solid from 1-methoxy-1*H*-isochromene **1g** (64.9 mg, 0.4 mmol) and ((cyclopropylethynyl)oxy) triisopropylsilane (114.5 mg, 0.48 mmol) according to the General Procedure C (19 h, eluent: hexanes/EtOAc = 200:1) in 85% yield (72.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.71 (s, 1H), 10.81 (s, 1H), 8.30 (d, J = 8.4 Hz, 1H), 7.71 (d, J = 8.0 Hz, 1H), 7.58 - 7.51 (m, 2H), 7.43 - 7.35 (m, 1H), 2.36 - 2.23 (m, 1H), 1.12 - 1.01 (m, 2H), 0.83 - 0.75 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.2, 164.8, 133.4, 133.1, 131.3, 128.7, 127.9, 127.4, 124.3, 118.1, 110.4, 9.3, 7.6.

IR (thin film) 3450, 3028, 2989, 2937, 2807, 1625, 1301 cm^{-1}.

HRMS (CI) Calcd for $C_{14}H_{13}O_2$ ($M+H^+$): 213.0916, Found: 213.0919.



4h

2-Hydroxy-3-phenethyl-1-naphthaldehyde (4h) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (64.9 mg, 0.4 mmol) and triisopropyl((4-phenylbut-1-yn-1-yl)oxy)silane (145.2 mg, 0.48 mmol) according to the General Procedure C (19 h, eluent: hexanes/EtOAc = 200:1) in 74% yield (81.3 mg).

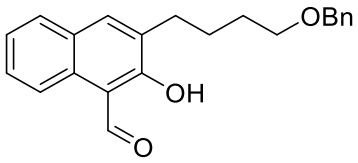
^{1}H NMR (400 MHz, $CDCl_3$) δ 13.63 (s, 1H), 10.83 (s, 1H), 8.33 (d, J = 8.5 Hz, 1H), 7.74 (s, 1H), 7.71 (d, J = 8.0 Hz, 1H), 7.60 - 7.53 (m, 1H), 7.45 - 7.37 (m, 1H), 7.33 - 7.27 (m,

2H), 7.25 - 7.17 (m, 3H), 3.16 - 3.06 (m, 2H), 3.06 - 2.95 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.4, 164.3, 141.6, 138.0, 131.9, 131.3, 128.9, 128.5, 128.4, 128.3, 127.5, 126.0, 124.4, 118.2, 110.9, 35.4, 31.9.

IR (thin film) 3068, 3028, 2931, 2866, 1631, 1308 cm^{-1}.

HRMS (CI) Calcd for $C_{19}H_{17}O_2$ ($M+H^+$): 277.1229, Found: 277.1230.



4i

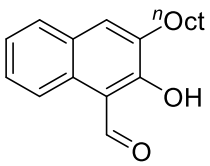
3-(4-(Benzyloxy)butyl)-2-hydroxy-1-naphthaldehyde (4i) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (48.7 mg, 0.3 mmol) and ((6-(benzyloxy)hex-1-yn-1-yl)oxy)triisopropylsilane (129.8 mg, 0.36 mmol) according to the General Procedure C (16 h, eluent: hexanes/EtOAc = 60:1) in 71% yield (71.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.60 (s, 1H), 10.78 (s, 1H), 8.29 (d, J = 8.4 Hz, 1H), 7.80 (s, 1H), 7.73 (d, J = 7.9 Hz, 1H), 7.59 - 7.52 (m, 1H), 7.44 - 7.38 (m, 1H), 7.38 - 7.34 (m, 4H), 7.32 - 7.27 (m, 1H), 4.53 (s, 2H), 3.55 (t, J = 6.3 Hz, 2H), 2.83 (t, J = 7.4 Hz, 2H), 1.90 - 1.79 (m, 2H), 1.79 - 1.68 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.3, 164.3, 138.6, 137.6, 132.0, 131.8, 128.8, 128.3, 128.1, 127.6, 127.53, 127.45, 124.3, 118.1, 110.8, 72.9, 70.1, 29.5, 29.3, 25.7.

IR (thin film) 3455, 3067, 3031, 2936, 2860, 1631, 1308 cm^{-1}.

HRMS (CI) Calcd for $C_{22}H_{22}O_3$ (M^+): 334.1569, Found: 334.1556.



4j

2-Hydroxy-3-octyl-1-naphthaldehyde (4j) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (64.9 mg, 0.4 mmol) and (dec-1-yn-1-

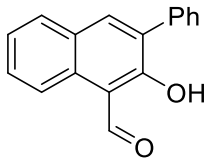
yloxy)triisopropylsilane (149.1 mg, 0.48 mmol) according to the General Procedure C (19 h, eluent: hexanes/EtOAc = 100:1) in 65% yield (74.0 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.59 (s, 1H), 10.81 (s, 1H), 8.31 (d, J = 8.5 Hz, 1H), 7.81 (s, 1H), 7.75 (d, J = 8.1 Hz, 1H), 7.59 - 7.52 (m, 1H), 7.44 - 7.37 (m, 1H), 2.78 (t, J = 7.6 Hz, 2H), 1.75 - 1.65 (m, 2H), 1.45 - 1.22 (m, 10H), 0.88 (t, J = 6.4 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.3, 164.4, 137.5, 132.5, 131.7, 128.8, 128.0, 127.5, 124.3, 118.1, 110.7, 31.9, 29.6, 29.5, 29.4, 29.3, 29.1, 22.6, 14.1.

IR (thin film) 2925, 2858, 1632, 1450, 1308 cm^{-1}.

HRMS (CI) Calcd for $C_{19}H_{25}O_2$ ($M+H^+$): 285.1855, Found: 285.1848.



4k

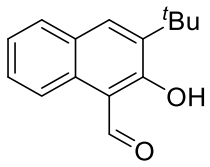
2-Hydroxy-3-phenyl-1-naphthaldehyde (4k) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (64.9 mg, 0.4 mmol) and triisopropyl((phenylethynyl) oxy)silane (131.8 mg, 0.48 mmol) according to the General Procedure C (12 h, eluent: hexanes/EtOAc = 200:1) in 59% yield (58.8 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.81 (s, 1H), 10.86 (s, 1H), 8.35 (d, J = 8.5 Hz, 1H), 8.04 (s, 1H), 7.84 (d, J = 8.0 Hz, 1H), 7.71 - 7.66 (m, 2H), 7.66 -7.60 (m, 1H), 7.54 - 7.41 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.5, 163.2, 139.0, 136.1, 132.5, 131.7, 129.5, 129.4, 129.0, 128.3, 128.0, 127.7, 124.7, 118.2, 111.3.

IR (thin film) 3454, 3061, 2950, 2873, 1628, 1305 cm^{-1}.

HRMS (CI) Calcd for $C_{17}H_{13}O_2$ ($M+H^+$): 249.0916, Found: 249.0910.



4l

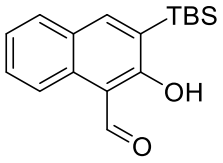
3-(*tert*-Butyl)-2-hydroxy-1-naphthaldehyde (4l) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (64.9 mg, 0.4 mmol) and ((3,3-dimethylbut-1-yn-1-yl)oxy)triisopropylsilane (122.2 mg, 0.48 mmol) according to the General Procedure C (12 h, eluent: hexanes/EtOAc = 200:1) in 26% yield (24.0 mg), together with **3l** in 62% yield (89.8 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 14.16 (s, 1H), 10.81 (s, 1H), 8.28 (d, J = 8.5 Hz, 1H), 7.93 (s, 1H), 7.77 (d, J = 8.0 Hz, 1H), 7.59 - 7.50 (m, 1H), 7.45 - 7.36 (m, 1H), 1.52 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.6, 166.0, 139.2, 135.4, 131.9, 129.4, 128.3, 127.4, 124.3, 117.8, 111.3, 35.2, 29.4.

IR (thin film) 3453, 3067, 2960, 2873, 1625, 1307 cm^{-1}.

HRMS (CI) Calcd for $C_{15}H_{17}O_2$ ($M+H^+$): 229.1229, Found: 229.1232.



4m

3-(*tert*-Butyldimethylsilyl)-2-hydroxy-1-naphthaldehyde (4m) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (64.9 mg, 0.4 mmol) and *tert*-butyldimethyl(((triisopropylsilyl)oxy)ethynyl)silane (142.4 mg, 0.48 mmol) according to the General Procedure C (12 h, eluent: hexanes/EtOAc = 200:1) in 36% yield (40.9 mg), together with **3m** in 49% yield (81.8 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 13.60 (s, 1H), 10.81 (s, 1H), 8.32 (d, J = 8.5 Hz, 1H), 8.09 (s, 1H), 7.80 (d, J = 8.0 Hz, 1H), 7.64 - 7.54 (m, 1H), 7.46 - 7.37 (m, 1H), 0.96 (s, 9H), 0.41 (s, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 193.3, 169.6, 147.5, 133.7, 129.7, 129.3, 129.1, 127.5, 124.2,

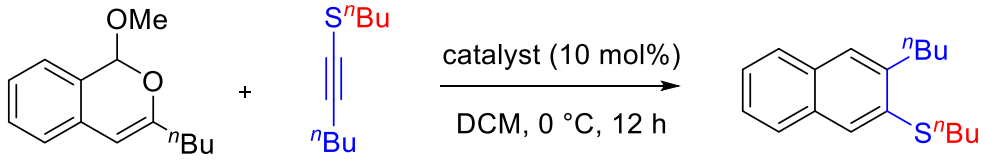
118.1, 110.0, 27.1, 17.5, -4.8.

IR (thin film) 3453, 3069, 2942, 2859, 1627, 1251 cm^{-1}.

HRMS (CI) Calcd for $C_{17}H_{23}O_2Si$ ($M+H^+$): 287.1467, Found: 287.1465.

IV. Synthesis of β-Naphthyl Thioethers from Thioalkynes

Table S2. Condition Optimization for the Synthesis of 6a.



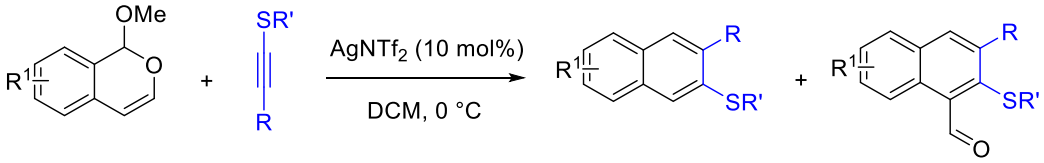
1a **5a** **6a**

entry	catalyst	yield[a] (%)
1	TMSOTf	73
2	TMSOTf (1.0 equiv)	65
3	$TiCl_4$	3
4	$TiCl_4$ (1.0 equiv)	32
5	$BF_3•OEt_2$	70
6	$BF_3•OEt_2$ (0.2 equiv)	72 (68[b])
7	$BF_3•OEt_2$ (1.0 equiv)	80
8	$HNTf_2$	20
9	CH_3SO_3H	7
10	$Sc(OTf)_3$	88
11	$Au(PPh_3)Cl$	<5
12	AgOTf	80
13	$AgNTf_2$	**89 (83[b])**

[a] Reaction scale: **1a** (0.05 mmol), **6a** (0.06 mmol), catalyst (10 mol%), DCM (0.5 mL). Yield is based on ^1H NMR analysis of the crude product using CH_2Br_2 as the internal standard. [b] Yield in parentheses is isolated yield.

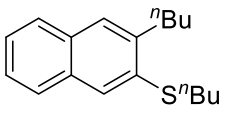
General Procedure D.

1 **5** **6**



1 **5** **6** **7**

At room temperature, under N_2, an oven-dried 25 mL Schlenk tube was charged with $AgNTf_2$ (0.03 mmol, 0.1 equiv) and CH_2Cl_2 (3.0 mL). The reaction mixture was cooled to 0 °C, followed by addition of the starting materials **1** (0.3 mmol, 1.0 equiv) and **5** (0.36 mmol, 1.2 equiv). The reaction mixture was then warmed to room temperature slowly and stirred overnight. Upon completion, the reaction was quenched by addition of 5 mL saturated $NaHCO_3$ solution. The organic layer was separated and extracted by 5 mL DCM for 3 times. Washed with 5 mL water for 3 times and dried with Na_2SO_4. Filtered and concentrated. The crude product was purified by silica gel to afford the desired product **6** (or **7**).



6a

Butyl(3-butylnaphthalen-2-yl)sulfane (6a) was prepared as a colorless solid from 3-butyl-1-methoxy-1*H*-isochromene **1a** (65.5 mg, 0.3 mmol) and butyl(hex-1-yn-1-yl)sulfane (61.3 mg, 0.36 mmol) according to the General Procedure D (12 h, eluent: hexanes) in 83% yield (67.8 mg).

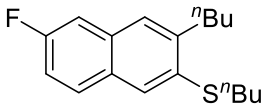
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 - 7.68 (m, 2H), 7.63 (s, 1H), 7.59 (s, 1H), 7.43 - 7.35 (m, 2H), 3.04 (t, J = 7.2 Hz, 2H), 2.86 (t, J = 7.6 Hz, 2H), 1.80 - 1.66 (m, 4H), 1.59 - 1.40

(m, 4H), 1.02 - 0.95 (m, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 139.5, 135.7, 132.4, 131.5, 127.1, 127.0, 126.4, 125.5, 125.1, 124.7, 33.5, 32.7, 32.4, 30.7, 22.7, 22.2, 14.0, 13.7.

IR (thin film) 3053, 2954, 2928, 2864, 2359, 1452 cm^{-1}.

HRMS (CI) Calcd for $C_{18}H_{24}S$ (M^+): 272.1599, Found: 272.1608.



6b

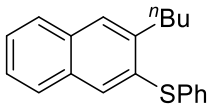
Butyl(3-butyl-6-fluoronaphthalen-2-yl)sulfane (6b) was prepared as a colorless oil from 3-butyl-7-fluoro-1-methoxy-1*H*-isochromene **1c** (70.9 mg, 0.3 mmol) and butyl(hex-1-yn-1-yl)sulfane (61.3 mg, 0.36 mmol) according to the General Procedure D (37 h, eluent: hexanes) in 76% yield (66.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 - 7.66 (m, 1H), 7.62 (s, 1H), 7.53 (s, 1H), 7.37 - 7.31 (m, 1H), 7.21 - 7.13 (m, 1H), 3.01 (t, J = 7.2 Hz, 2H), 2.85 (t, J = 7.6 Hz, 2H), 1.77 - 1.64 (m, 4H), 1.57 - 1.40 (m, 4H), 1.02 - 0.93 (m, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.3 (d, J = 244.8 Hz), 140.9, 134.9 (d, J = 2.8 Hz), 132.1 (d, J = 9.1 Hz), 129.4, 128.7 (d, J = 8.9 Hz), 126.4 (d, J = 5.3 Hz), 125.1, 115.7 (d, J = 25.4 Hz), 110.1 (d, J = 20.5 Hz), 33.5, 32.9, 32.3, 30.7, 22.7, 22.2, 14.0, 13.7.

IR (thin film) 3062, 2955, 2865, 2359, 1495, 1203 cm^{-1}.

HRMS (CI) Calcd for $C_{18}H_{23}FS$ (M^+): 290.1504, Found: 290.1499.



6c

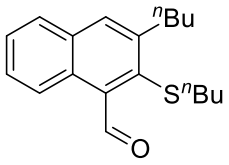
(3-Butylnaphthalen-2-yl)(phenyl)sulfane (6c) was prepared as a colorless solid from 3-butyl-1-methoxy-1*H*-isochromene **1a** (65.5 mg, 0.3 mmol) and hex-1-yn-1-yl(phenyl)sulfane (68.5 mg, 0.36 mmol) according to the General Procedure D (19 h, eluent: hexanes) in 46% yield (40.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (s, 1H), 7.77 (d, J = 8.1 Hz, 1H), 7.70 (s, 1H), 7.66 (d, J = 8.0 Hz, 1H), 7.47 - 7.37 (m, 2H), 7.31 - 7.19 (m, 5H), 2.88 (t, J = 7.6 Hz, 2H), 1.72 - 1.61 (m, 2H), 1.46 - 1.34 (m, 2H), 0.93 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 141.4, 136.7, 133.1, 132.7, 132.5, 132.4, 129.9, 129.2, 128.8, 127.8, 127.1, 126.5, 126.3, 125.6, 33.8, 32.9, 22.6, 14.0.

IR (thin film) 3057, 2952, 2863, 2359, 1583, 1475, 1446 cm^{-1}.

HRMS (CI) Calcd for $C_{20}H_{20}S$ (M^+): 292.1286, Found: 292.1290.



7a

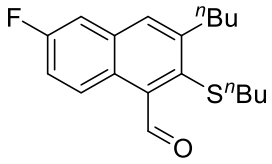
3-Butyl-2-(butylthio)-1-naphthaldehyde (7a) was prepared as a yellow solid from 1-methoxy-1*H*-isochromene **1g** (48.7 mg, 0.3 mmol) and butyl(hex-1-yn-1-yl)sulfane (61.3 mg, 0.36 mmol) according to the General Procedure D (12 h, eluent: hexanes/EtOAc = 100:1) in 78% yield (70.5 mg), together with **6a** in 10% yield (8.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 11.00 (s, 1H), 8.82 (d, J = 8.4 Hz, 1H), 7.88 (s, 1H), 7.79 (d, J = 8.2 Hz, 1H), 7.59 - 7.48 (m, 2H), 3.07 (t, J = 7.6 Hz, 2H), 2.76 (t, J = 7.4 Hz, 2H), 1.74 - 1.63 (m, 2H), 1.53 - 1.42 (m, 4H), 1.42 - 1.32 (m, 2H), 0.99 (t, J = 7.3 Hz, 3H), 0.86 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 195.4, 143.2, 141.0, 135.5, 133.3, 132.6, 129.6, 127.8, 127.6, 127.0, 124.6, 39.6, 33.8, 33.7, 31.7, 22.6, 21.9, 14.0, 13.5.

IR (thin film) 3059, 2957, 2928, 2863, 1685, 1455 cm^{-1}.

HRMS (CI) Calcd for $C_{19}H_{24}OS$ (M^+): 300.1548, Found: 300.1548.



7b

3-Butyl-2-(butylthio)-6-fluoro-1-naphthaldehyde (7b) was prepared as a yellow solid from 7-fluoro-1-methoxy-1*H*-isochromene **1j** (54.1 mg, 0.3 mmol) and butyl(hex-1-yn-1-yl)sulfane (61.3 mg, 0.36 mmol) according to the General Procedure D (19 h, eluent: hexanes) in 59% yield (56.0 mg), together with **6b** in 28% yield (24.2 mg).

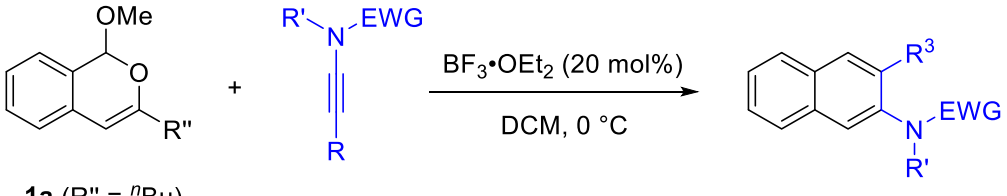
^{1}H NMR (400 MHz, $CDCl_3$) δ 10.98 (s, 1H), 8.90 - 8.80 (m, 1H), 7.81 (s, 1H), 7.41 - 7.35 (m, 1H), 7.34 - 7.28 (m, 1H), 3.05 (t, J = 7.6 Hz, 2H), 2.75 (t, J = 7.2 Hz, 2H), 1.73 - 1.62 (m, 2H), 1.56 - 1.50 (m, 2H), 1.50 - 1.42 (m, 2H), 1.42 - 1.33 (m, 2H), 0.99 (t, J = 7.3 Hz, 3H), 0.87 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 195.3, 161.1 (d, J = 249.0 Hz), 144.6, 140.3 (d, J = 2.7 Hz), 135.6, 134.5 (d, J = 9.2 Hz), 131.8 (d, J = 5.2 Hz), 127.7 (d, J = 8.8 Hz), 126.6, 117.9 (d, J = 24.5 Hz), 110.6 (d, J = 20.4 Hz), 39.7, 33.8, 33.6, 31.7, 22.6, 21.9, 14.0, 13.6.

IR (thin film) 2958, 2929, 2864, 1683, 1630, 1495 cm^{-1}.

HRMS (CI) Calcd for $C_{19}H_{23}FOS$ (M^+): 318.1454, Found: 318.1448.

V. Synthesis of β-Naphthylamines from Ynamides

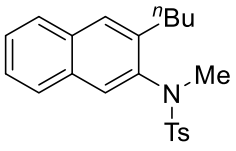


1a (R" = ^{n}Bu)
1g (R" = H)

8

9

The products **9a-9d** were prepared according to the General Procedure B, except that the ynamide **8** was used in place of the siloxy alkyne **2**.



9a

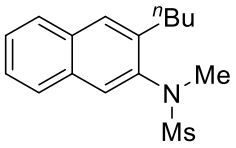
***N*-(3-Butylnaphthalen-2-yl)-*N*,4-dimethylbenzenesulfonamide (9a)** was prepared as a colorless solid from 3-butyl-1-methoxy-1*H*-isochromene **1a** (54.6 mg, 0.25 mmol) and *N*-(hex-1-yn-1-yl)-*N*,4-dimethylbenzenesulfonamide (79.6 mg, 0.3 mmol) according to the General Procedure B (30 h, eluent: hexanes/EtOAc = 20:1) in 80% yield (73.2 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, J = 8.2 Hz, 1H), 7.74 (s, 1H), 7.61 (d, J = 8.2 Hz, 2H), 7.51 (d, J = 8.1 Hz, 1H), 7.49 - 7.42 (m, 1H), 7.40 - 7.34 (m, 1H), 7.32 (d, J = 8.1 Hz, 2H), 7.01 (s, 1H), 3.21 (s, 3H), 3.19 - 3.10 (m, 1H), 2.88 - 2.77 (m, 1H), 2.48 (s, 3H), 1.77 - 1.66 (m, 2H), 1.50 - 1.39 (m, 2H), 0.98 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.6, 141.0, 139.4, 134.5, 133.1, 131.7, 129.4, 128.5, 128.4, 127.22, 127.18, 126.6, 126.0, 125.5, 40.1, 32.6, 31.3, 22.8, 21.6, 14.1.

IR (thin film) 3058, 2956, 2866, 2440, 1348, 1162 cm^{-1}.

HRMS (CI) Calcd for $C_{22}H_{25}NO_2S$ (M^+): 367.1606, Found: 367.1602.



9b

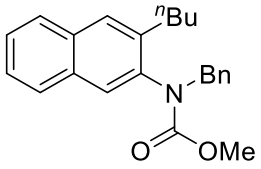
***N*-(3-Butylnaphthalen-2-yl)-*N*-methylmethanesulfonamide (9b)** was prepared as a colorless solid from 3-butyl-1-methoxy-1*H*-isochromene **1a** (54.6 mg, 0.25 mmol) and *N*-(hex-1-yn-1-yl)-*N*-methylmethanesulfonamide (56.8 mg, 0.3 mmol) according to the General Procedure B (30 h, eluent: hexanes/EtOAc = 10:1) in 56% yield (41.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 - 7.71 (m, 4H), 7.53 - 7.40 (m, 2H), 3.34 (s, 3H), 3.13 - 2.97 (m, 4H), 2.91 - 2.75 (m, 1H), 1.78 - 1.66 (m, 2H), 1.51 - 1.40 (m, 2H), 0.99 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 140.5, 139.1, 133.2, 132.0, 128.9, 127.3, 127.2, 126.8, 125.9, 125.8, 39.6, 36.2, 32.5, 31.2, 22.7, 14.0.

IR (thin film) 3056, 3018, 2955, 2866, 1340, 1151 cm^{-1}.

HRMS (CI) Calcd for $C_{16}H_{21}NO_2S$ (M^+): 291.1293, Found: 291.1300.



9c

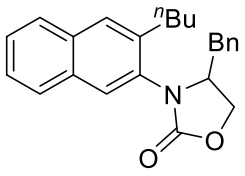
Methyl benzyl(3-butylnaphthalen-2-yl)carbamate (9c) was prepared as a colorless oil from 3-butyl-1-methoxy-1*H*-isochromene **1a** (54.6 mg, 0.25 mmol) and methyl benzyl(hex-1-yn-1-yl)carbamate (73.6 mg, 0.3 mmol) according to the General Procedure B (12 h, eluent: hexanes/EtOAc = 40:1) in 85% yield (73.7 mg).

^{1}H NMR (400 MHz, C_6D_6) δ 7.61 - 7.54 (m, 2H), 7.42 (d, J = 8.1 Hz, 1H), 7.32 (s, 1H), 7.28 - 7.18 (m, 3H), 7.15 - 7.11 (m, 1H), 7.09 - 7.03 (m, 3H), 5.09 (d, J = 14.3 Hz, 1H), 4.51 (d, J = 14.4 Hz, 1H), 3.46 (s, 3H), 2.69 - 2.55 (m, 1H), 2.55 - 2.40 (m, 1H), 1.69 - 1.55 (m, 1H), 1.54 - 1.40 (m, 1H), 1.35 - 1.23 (m, 2H), 0.90 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.8, 138.7, 138.5, 137.5, 132.8, 131.9, 129.2, 128.4, 127.8, 127.6, 127.5, 127.2, 127.1, 126.2, 125.4, 54.8, 52.9, 32.0, 30.3, 22.8, 14.0.

IR (thin film) 3057, 3028, 2953, 2864, 1705, 1452 cm^{-1}.

HRMS (CI) Calcd for $C_{23}H_{25}NO_2$ (M^+): 347.1885, Found: 347.1899.



9d

4-Benzyl-3-(3-butylnaphthalen-2-yl)oxazolidin-2-one (9d) was prepared as a colorless solid from 3-butyl-1-methoxy-1*H*-isochromene **1a** (54.6 mg, 0.25 mmol) and methyl benzyl(hex-1-yn-1-yl)carbamate (77.2 mg, 0.3 mmol) according to the General Procedure B (12 h, eluent: hexanes/EtOAc = 10:1) in 74% yield (66.4 mg).

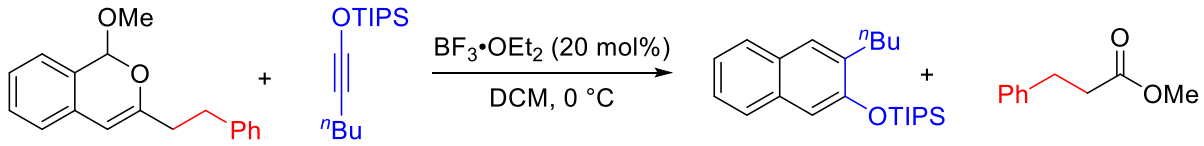
^{1}H NMR (400 MHz, C_6D_6) δ 7.67 - 7.61 (m, 3H), 7.57 (s, 1H), 7.34 - 7.23 (m, 2H), 7.00 - 6.94 (m, 3H), 6.66 - 6.60 (m, 2H), 4.14 - 4.01 (m, 1H), 3.91 - 3.77 (m, 2H), 2.82 (t, J = 7.6 Hz, 2H), 2.75 - 2.64 (m, 1H), 2.43 - 2.33 (m, 1H), 1.80 - 1.65 (m, 2H), 1.45 - 1.35 (m, 2H), 0.93 (t, J = 7.3 Hz, 3H).

^{13}C NMR (101 MHz, CD_2Cl_2) δ 157.3, 139.5, 136.1, 133.6, 132.5, 130.1, 129.3, 129.2, 128.8, 127.9, 127.6, 127.4, 127.3, 127.1, 126.2, 68.1, 67.8, 39.4, 32.7, 31.1, 23.2, 14.2.

IR (thin film) 3058, 2928, 2863, 2360, 1756, 1403 cm^{-1}.

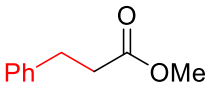
HRMS (CI) Calcd for $C_{24}H_{26}NO_2$ (M^+): 360.1964, Found: 360.1956.

VI. Mechanistic Study



1p **2a** **3a**, 74% **11**, 37%

The reaction between 1-methoxy-3-phenethyl-1*H*-isochromene **1p** (106.5 mg, 0.4 mmol) and (hex-1-yn-1-yloxy)triisopropylsilane (122.2 mg, 0.48 mmol) according to the General Procedure B (16 h, eluent: hexanes/EtOAc = 50:1) resulted in formation of **3a** in 74% yield (105.0 mg) and ester **11** in 37% yield (24.3 mg).



11

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 - 7.27 (m, 2H), 7.24 - 7.17 (m, 3H), 3.67 (s, 3H), 3.01 - 2.90 (m, 2H), 2.69 - 2.59 (m, 2H).

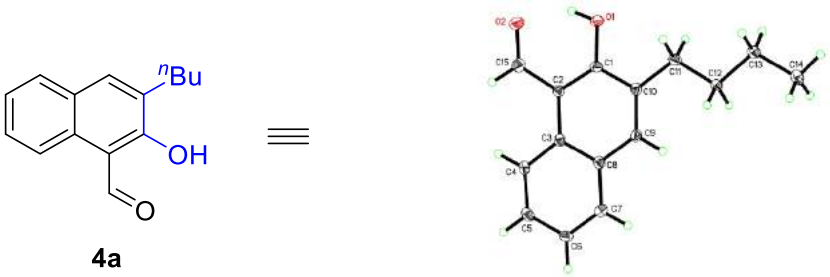
^{13}C NMR (101 MHz, $CDCl_3$) δ 173.3, 140.5, 128.5, 128.3, 126.3, 51.6, 35.7, 30.9.

IR (thin film) 3069, 3029, 2952, 2864, 1738, 1640, 1445 cm^{-1}.

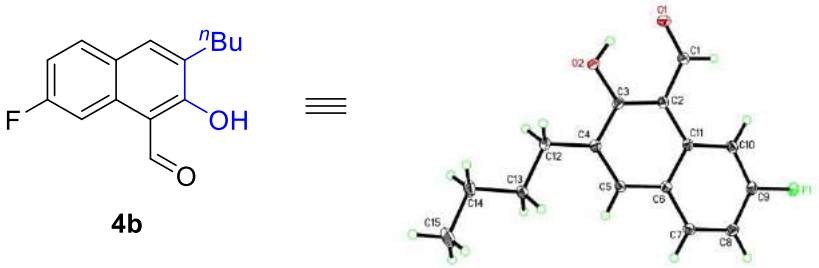
HRMS (CI) Calcd for $C_{10}H_{12}O_2$ (M^+): 164.0837, Found: 164.0842.

VII. Product Structure Determination

We have determined the structures of products **4a** and **4b** by X-ray crystallography. The X-ray data have been deposited at the Cambridge Crystallographic Data Center (CCDC 1995829 for **4a**, CCDC 1995830 for **4b**).



4a



4b

Table S3. Crystal data and structure refinement for 4a.

Identification code	**4a**
Empirical formula	$C_{15}H_{16}O_2$
Formula weight	228.28
Temperature/K	100.00(10)
Crystal system	monoclinic
Space group	$P2_1/c$
a/Å	12.3890(5)
b/Å	12.5456(4)
c/Å	7.5297(3)
α/°	90
β/°	99.928(4)
γ/°	90
Volume/Å^3	1152.81(8)
Z	4
ϱ_{calc}g/cm^3	1.315
μ/mm^{-1}	0.086

F(000)	488.0
Crystal size/mm^3	0.38 × 0.18 × 0.15
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	6.382 to 51.992
Index ranges	-13 ≤ h ≤ 15, -15 ≤ k ≤ 9, -9 ≤ l ≤ 8
Reflections collected	4219
Independent reflections	2233 [R_{int} = 0.0250, R_{sigma} = 0.0392]
Data/restraints/parameters	2233/0/156
Completeness to theta = 25.0°	98.4%
Goodness-of-fit on F^2	1.003
Final R indexes [I>=2σ (I)]	R_1 = 0.0434, wR_2 = 0.1029
Final R indexes [all data]	R_1 = 0.0634, wR_2 = 0.1124
Largest diff. peak/hole / e Å^{-3}	0.19/-0.25

Table S4. Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 4a. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
O1	219.8(8)	3695.2(8)	1738.0(14)	20.4(3)
O2	-926.9(8)	2120.5(9)	2350.5(14)	24.8(3)
C1	1004.4(11)	3000.5(12)	1500.2(17)	15.6(3)
C2	842.5(11)	1901.6(12)	1605.2(18)	15.3(3)
C3	1695.7(11)	1184.9(12)	1288.5(18)	15.4(3)
C4	1594.4(12)	60.0(12)	1264.9(18)	18.1(3)
C5	2444.2(12)	-577.1(12)	976.8(18)	20.4(4)
C6	3433.6(12)	-132.6(13)	679.5(18)	20.6(4)
C7	3548.8(12)	947.0(13)	654.2(18)	19.7(4)
C8	2695.1(11)	1629.3(12)	955.7(17)	15.6(3)
C9	2813.2(11)	2757.9(11)	907.7(18)	15.9(3)
C10	2009.0(11)	3449.1(12)	1164.3(18)	15.4(3)
C11	2106.3(11)	4644.5(12)	1114.1(19)	17.4(3)
C12	3187.1(12)	5076.9(12)	745.7(18)	16.5(3)
C13	3200.8(12)	6291.1(12)	708(2)	20.6(4)
C14	4258.4(12)	6737.7(13)	245(2)	25.0(4)
C15	-163.4(12)	1531.8(13)	2116.6(19)	19.7(4)

Table S5. Anisotropic Displacement Parameters (Å^2×10^3) for 4a. The Anisotropic displacement factor exponent takes the form: -2π^2[h^{2}a*^{2}U_{11}+2hka*b*U_{12}+…].

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
O1	16.0(5)	16.2(6)	30.7(6)	-1.6(5)	8.4(5)	1.1(5)
O2	18.6(6)	23.3(6)	34.2(6)	-1.4(5)	8.9(5)	0.6(5)
C1	16.7(7)	16.4(8)	13.7(7)	-0.1(6)	2.9(6)	3.9(7)
C2	17.4(7)	15.1(8)	14.1(7)	0.5(6)	4.1(6)	0.0(7)
C3	18.0(8)	16.0(8)	12.1(7)	1.1(6)	2.6(6)	-0.5(6)
C4	19.9(8)	16.4(8)	18.2(7)	1.0(6)	3.7(6)	-3.3(7)

C5	29.0(8)	12.6(8)	19.5(8)	-1.3(6)	3.8(6)	0.8(7)
C6	22.1(8)	17.7(8)	23.0(8)	-1.2(7)	6.6(6)	5.4(7)
C7	18.9(8)	21.1(8)	20.1(8)	-0.3(7)	6.2(6)	0.7(7)
C8	18.3(7)	15.4(8)	13.2(7)	0.1(6)	3.0(6)	-0.2(7)
C9	16.2(7)	14.9(8)	17.2(7)	0.1(6)	4.9(6)	-2.4(7)
C10	18.2(7)	15.0(8)	13.3(7)	0.4(6)	3.3(6)	-1.6(7)
C11	19.3(8)	14.9(8)	18.3(7)	-0.6(6)	3.7(6)	1.7(7)
C12	17.2(8)	13.2(8)	19.5(7)	-0.1(6)	4.6(6)	0.1(6)
C13	21.8(8)	13.9(8)	27.1(8)	-0.3(6)	6.8(6)	0.0(7)
C14	27.0(9)	16.1(8)	32.8(9)	1.6(7)	7.7(7)	-2.5(7)
C15	19.0(8)	18.8(8)	21.1(8)	-1.9(6)	3.5(6)	-2.5(7)

Table S6. Bond Lengths for 4a.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
O1	C1	1.3405(16)	C5	C6	1.399(2)
O2	C15	1.2365(17)	C6	C7	1.362(2)
C1	C2	1.397(2)	C7	C8	1.409(2)
C1	C10	1.4277(19)	C8	C9	1.424(2)
C2	C3	1.4387(19)	C9	C10	1.3596(19)
C2	C15	1.4429(18)	C10	C11	1.5055(19)
C3	C4	1.417(2)	C11	C12	1.5140(19)
C3	C8	1.4190(19)	C12	C13	1.5238(19)
C4	C5	1.369(2)	C13	C14	1.5199(19)

Table S7. Bond Angles for 4a.

Atom	Atom	Atom	Angle/˚	Atom	Atom	Atom	Angle/˚
O1	C1	C2	121.30(12)	C6	C7	C8	121.22(14)
O1	C1	C10	116.21(13)	C3	C8	C9	119.45(13)
C2	C1	C10	122.48(13)	C7	C8	C3	119.45(14)
C1	C2	C3	119.37(12)	C7	C8	C9	121.10(13)
C1	C2	C15	118.12(13)	C10	C9	C8	123.32(13)
C3	C2	C15	122.44(13)	C1	C10	C11	118.24(12)
C4	C3	C2	123.96(12)	C9	C10	C1	117.15(13)
C4	C3	C8	117.86(13)	C9	C10	C11	124.61(13)
C8	C3	C2	118.17(13)	C10	C11	C12	116.02(12)
C5	C4	C3	120.98(13)	C11	C12	C13	112.00(12)
C4	C5	C6	120.78(14)	C14	C13	C12	112.68(12)
C7	C6	C5	119.68(14)	O2	C15	C2	124.27(14)

Table S8. Hydrogen Bonds for 4a.

D	H	A	d(D-H)/Å	d(H-A)/Å	d(D-A)/Å	D-H-A/°
O1	H1	O2	0.84	1.77	2.5218(14)	148.1

Table S9. Torsion Angles for 4a.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
O1	C1	C2	C3	178.19(11)	C4	C3	C8	C9	177.87(13)
O1	C1	C2	C15	-4.7(2)	C4	C5	C6	C7	-0.8(2)
O1	C1	C10	C9	-179.58(11)	C5	C6	C7	C8	1.2(2)
O1	C1	C10	C11	0.29(18)	C6	C7	C8	C3	-0.1(2)
C1	C2	C3	C4	-176.44(13)	C6	C7	C8	C9	-179.26(13)
C1	C2	C3	C8	2.70(19)	C7	C8	C9	C10	179.04(13)
C1	C2	C15	O2	5.1(2)	C8	C3	C4	C5	1.7(2)
C1	C10	C11	C12	-179.77(12)	C8	C9	C10	C1	0.1(2)
C2	C1	C10	C9	1.3(2)	C8	C9	C10	C11	-179.72(13)
C2	C1	C10	C11	-178.80(13)	C9	C10	C11	C12	0.1(2)
C2	C3	C4	C5	-179.19(12)	C10	C1	C2	C3	-2.8(2)
C2	C3	C8	C7	179.53(12)	C10	C1	C2	C15	174.30(12)
C2	C3	C8	C9	-1.32(19)	C10	C11	C12	C13	179.58(12)
C3	C2	C15	O2	-177.88(13)	C11	C12	C13	C14	-177.05(12)
C3	C4	C5	C6	-0.6(2)	C15	C2	C3	C4	6.6(2)
C3	C8	C9	C10	-0.1(2)	C15	C2	C3	C8	-174.24(12)
C4	C3	C8	C7	-1.28(19)					

Table S10. Hydrogen Atom Coordinates (Å×10⁴) and Isotropic Displacement Parameters (Å²×10³) for 4a.

Atom	*x*	*y*	*z*	U(eq)
H1	-323	3362	1986	31
H4	927	-257	1452	22
H5	2361	-1330	979	25
H6	4022	-582	496	25
H7	4217	1245	429	24
H9	3488	3042	685	19
H11A	1980	4931	2286	21
H11B	1514	4920	174	21
H12A	3322	4801	-428	20
H12B	3786	4820	1692	20
H13A	2576	6547	-192	25
H13B	3103	6565	1903	25
H14A	4347	6490	-956	38
H14B	4880	6493	1138	38
H14C	4230	7518	253	38
H15	-244	787	2285	24

Table S11. Crystal data and structure refinement for 4b.

Identification code	**4b**
Empirical formula	$C_{15}H_{15}FO_2$
Formula weight	246.27
Temperature/K	100.01(10)
Crystal system	monoclinic
Space group	$P2_1/n$
a/Å	7.37471(14)
b/Å	19.0645(3)
c/Å	9.32895(18)
α/°	90
β/°	111.872(2)
γ/°	90
Volume/Å^3	1217.19(4)
Z	4
ρ_{calc}g/cm^3	1.344
μ/mm^{-1}	0.810
F(000)	520.0
Crystal size/mm^3	0.25 × 0.1 × 0.08
Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	9.278 to 133.95
Index ranges	$-5 \le h \le 8$, $-22 \le k \le 21$, $-11 \le l \le 9$
Reflections collected	3701
Independent reflections	2115 [R_{int} = 0.0121, R_{sigma} = 0.0172]
Data/restraints/parameters	2115/0/165
Completeness to theta = 66.5°	97.3%
Goodness-of-fit on F^2	1.001
Final R indexes [I>=2σ (I)]	R_1 = 0.0307, wR_2 = 0.0798
Final R indexes [all data]	R_1 = 0.0325, wR_2 = 0.0814
Largest diff. peak/hole / e Å^{-3}	0.19/-0.21

Table S2. Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 4b. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
F1	-1615.6(8)	6535.8(3)	780.5(6)	22.27(17)
O1	4661.9(11)	6960.2(4)	7640.6(8)	22.56(19)
O2	5464.4(10)	5678.6(4)	8367.1(8)	19.74(18)
C1	3508.0(14)	6761.5(5)	6364.1(11)	18.0(2)
C2	3149.0(13)	6034.0(5)	5909.1(10)	14.7(2)
C3	4185.2(14)	5515.7(5)	6956.1(11)	14.9(2)
C4	3962.1(14)	4786.8(5)	6593.8(11)	15.0(2)
C5	2693.0(14)	4608.3(5)	5149.0(11)	15.3(2)
C6	1595.4(13)	5106.2(5)	4027.6(11)	15.1(2)
C7	311.0(14)	4883.4(5)	2552.3(11)	16.7(2)
C8	-766.1(14)	5357.0(5)	1458.0(11)	17.5(2)

C9	-547.0(14)	6065.1(5)	1861.3(11)	16.8(2)
C10	663.8(14)	6315.7(5)	3264.7(11)	15.9(2)
C11	1790.8(13)	5831.8(5)	4396.9(10)	14.0(2)
C12	5129.8(14)	4266.4(5)	7802.9(11)	16.6(2)
C13	4832.9(14)	3499.4(5)	7306.4(11)	17.6(2)
C14	6050.7(16)	3001.6(6)	8576.8(12)	24.4(2)
C15	5911.7(19)	2247.6(6)	8009.6(16)	34.1(3)

Table S13. Anisotropic Displacement Parameters ($Å^2×10^3$) for 4b. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
F1	23.6(3)	17.5(3)	17.1(3)	5.2(2)	-2.4(2)	4.3(2)
O1	27.5(4)	15.2(4)	19.2(4)	-3.4(3)	1.9(3)	-2.4(3)
O2	23.5(4)	14.8(3)	13.9(3)	-1.3(3)	-1.1(3)	0.1(3)
C1	20.3(5)	14.6(5)	16.4(5)	0.2(4)	3.6(4)	0.1(4)
C2	15.4(5)	13.2(5)	15.0(5)	1.1(4)	5.1(4)	0.6(4)
C3	13.9(4)	16.7(5)	12.7(4)	-0.3(4)	3.3(4)	-0.9(4)
C4	14.7(4)	14.6(5)	15.5(5)	1.2(4)	5.5(4)	0.8(4)
C5	16.6(5)	11.7(4)	16.8(5)	0.7(4)	5.1(4)	0.6(4)
C6	14.6(4)	14.3(5)	16.0(5)	0.1(4)	5.4(4)	0.0(4)
C7	17.4(5)	14.0(5)	17.3(5)	-1.1(4)	4.8(4)	0.0(4)
C8	16.0(5)	19.6(5)	13.8(4)	-1.5(4)	1.9(4)	-0.7(4)
C9	15.1(4)	17.6(5)	15.6(5)	5.1(4)	3.3(4)	3.7(4)
C10	16.6(5)	12.4(4)	17.6(5)	1.1(4)	5.2(4)	0.6(4)
C11	13.6(4)	14.0(5)	14.3(4)	1.0(4)	5.0(4)	0.4(3)
C12	16.9(5)	15.8(5)	14.4(4)	2.5(4)	2.7(4)	1.7(4)
C13	18.2(5)	14.6(5)	19.3(5)	3.5(4)	6.1(4)	2.1(4)
C14	26.0(5)	19.8(5)	24.9(5)	8.3(4)	6.7(4)	4.9(4)
C15	39.1(7)	17.2(6)	44.0(7)	10.2(5)	12.9(6)	7.9(5)

Table S14. Bond Lengths for 4b.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
F1	C9	1.3605(11)	C6	C7	1.4144(14)
O1	C1	1.2372(13)	C6	C11	1.4199(14)
O2	C3	1.3393(12)	C7	C8	1.3726(14)
C1	C2	1.4459(14)	C8	C9	1.3946(14)
C2	C3	1.3993(13)	C9	C10	1.3669(14)
C2	C11	1.4454(13)	C10	C11	1.4154(13)
C3	C4	1.4251(14)	C12	C13	1.5249(13)
C4	C5	1.3670(14)	C13	C14	1.5228(13)
C4	C12	1.5081(13)	C14	C15	1.5219(16)
C5	C6	1.4212(14)			

Table S15. Bond Angles for 4b.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
O1	C1	C2	124.14(9)	C11	C6	C5	119.58(9)
C3	C2	C1	118.67(9)	C8	C7	C6	121.22(9)
C3	C2	C11	119.52(9)	C7	C8	C9	117.34(9)
C11	C2	C1	121.79(9)	F1	C9	C8	117.49(8)
O2	C3	C2	121.60(9)	F1	C9	C10	118.08(9)
O2	C3	C4	115.84(9)	C10	C9	C8	124.43(9)
C2	C3	C4	122.56(9)	C9	C10	C11	118.65(9)
C3	C4	C12	118.74(9)	C6	C11	C2	117.86(9)
C5	C4	C3	116.92(9)	C10	C11	C2	123.73(9)
C5	C4	C12	124.34(9)	C10	C11	C6	118.40(9)
C4	C5	C6	123.54(9)	C4	C12	C13	115.23(8)
C7	C6	C5	120.46(9)	C14	C13	C12	112.64(8)
C7	C6	C11	119.96(9)	C15	C14	C13	111.97(9)

Table S16. Hydrogen Bonds for 4b.

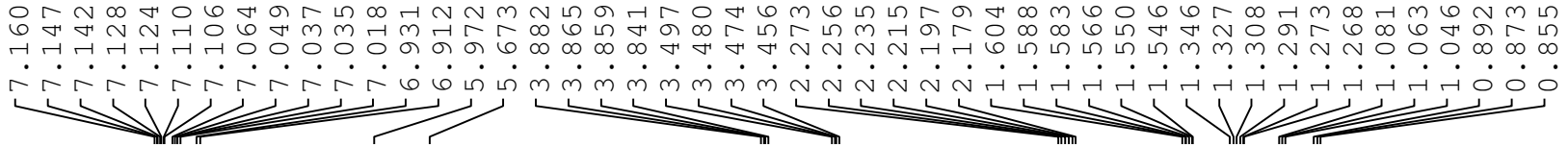
D	H	A	d(D-H)/Å	d(H-A)/Å	d(D-A)/Å	D-H-A/°
O2	H2	O1	0.84	1.80	2.5457(9)	147.6

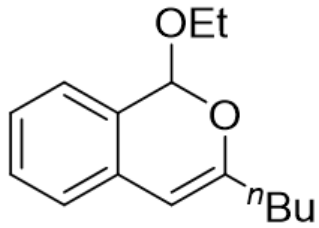
Table S17. Torsion Angles for 4b.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
F1	C9	C10	C11	-179.70(7)	C5	C4	C12	C13	0.80(14)
O1	C1	C2	C3	-1.14(15)	C5	C6	C7	C8	179.72(8)
O1	C1	C2	C11	-179.63(9)	C5	C6	C11	C2	1.27(13)
O2	C3	C4	C5	-178.74(8)	C5	C6	C11	C10	-179.29(8)
O2	C3	C4	C12	0.89(13)	C6	C7	C8	C9	-0.19(14)
C1	C2	C3	O2	1.19(14)	C7	C6	C11	C2	-178.86(8)
C1	C2	C3	C4	-178.42(8)	C7	C6	C11	C10	0.58(13)
C1	C2	C11	C6	177.29(8)	C7	C8	C9	F1	-179.86(8)
C1	C2	C11	C10	-2.12(14)	C7	C8	C9	C10	0.08(15)
C2	C3	C4	C5	0.89(14)	C8	C9	C10	C11	0.36(15)
C2	C3	C4	C12	-179.49(8)	C9	C10	C11	C2	178.73(8)
C3	C2	C11	C6	-1.18(13)	C9	C10	C11	C6	-0.68(13)
C3	C2	C11	C10	179.41(8)	C11	C2	C3	O2	179.71(8)
C3	C4	C5	C6	-0.81(14)	C11	C2	C3	C4	0.11(14)
C3	C4	C12	C13	-178.80(8)	C11	C6	C7	C8	-0.14(14)
C4	C5	C6	C7	179.86(8)	C12	C4	C5	C6	179.59(8)
C4	C5	C6	C11	-0.27(14)	C12	C13	C14	C15	-173.71(9)
C4	C12	C13	C14	180.00(8)					

Table S18. Hydrogen Atom Coordinates (Å×10⁴) and Isotropic Displacement Parameters (Å²×10³) for 4b.

Atom	*x*	*y*	*z*	U(eq)
H2	5513	6116	8478	30
H1	2814	7109	5637	22
H5	2536	4125	4880	18
H7	192	4397	2314	20
H8	-1626	5208	466	21
H10	747	6805	3476	19
H12A	4785	4324	8725	20
H12B	6534	4381	8113	20
H13A	3434	3378	7004	21
H13B	5186	3435	6390	21
H14A	7434	3153	8962	29
H14B	5596	3025	9449	29
H15A	6450	2216	7197	51
H15B	4540	2101	7595	51
H15C	6656	1941	8871	51





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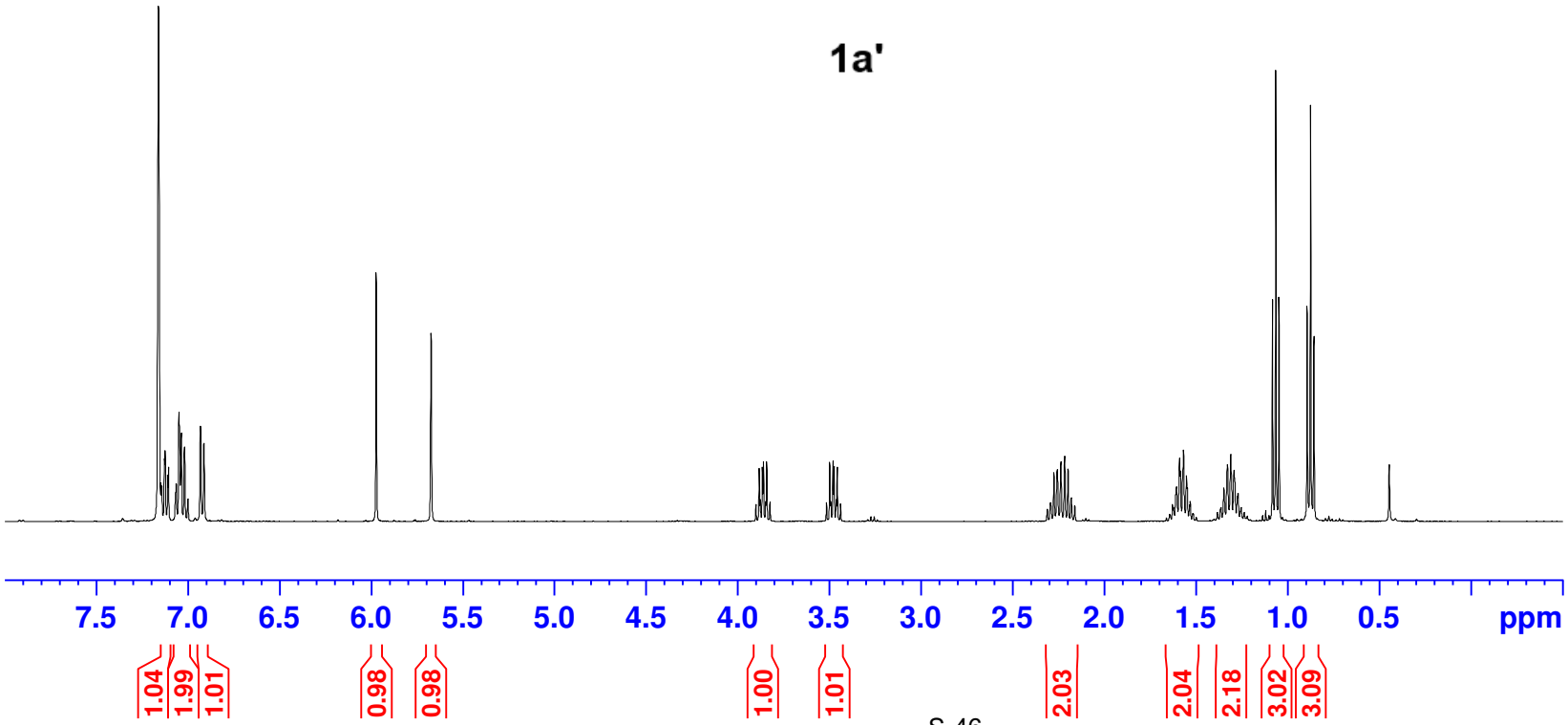


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TD                    65536
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NS                        8
DS                        0
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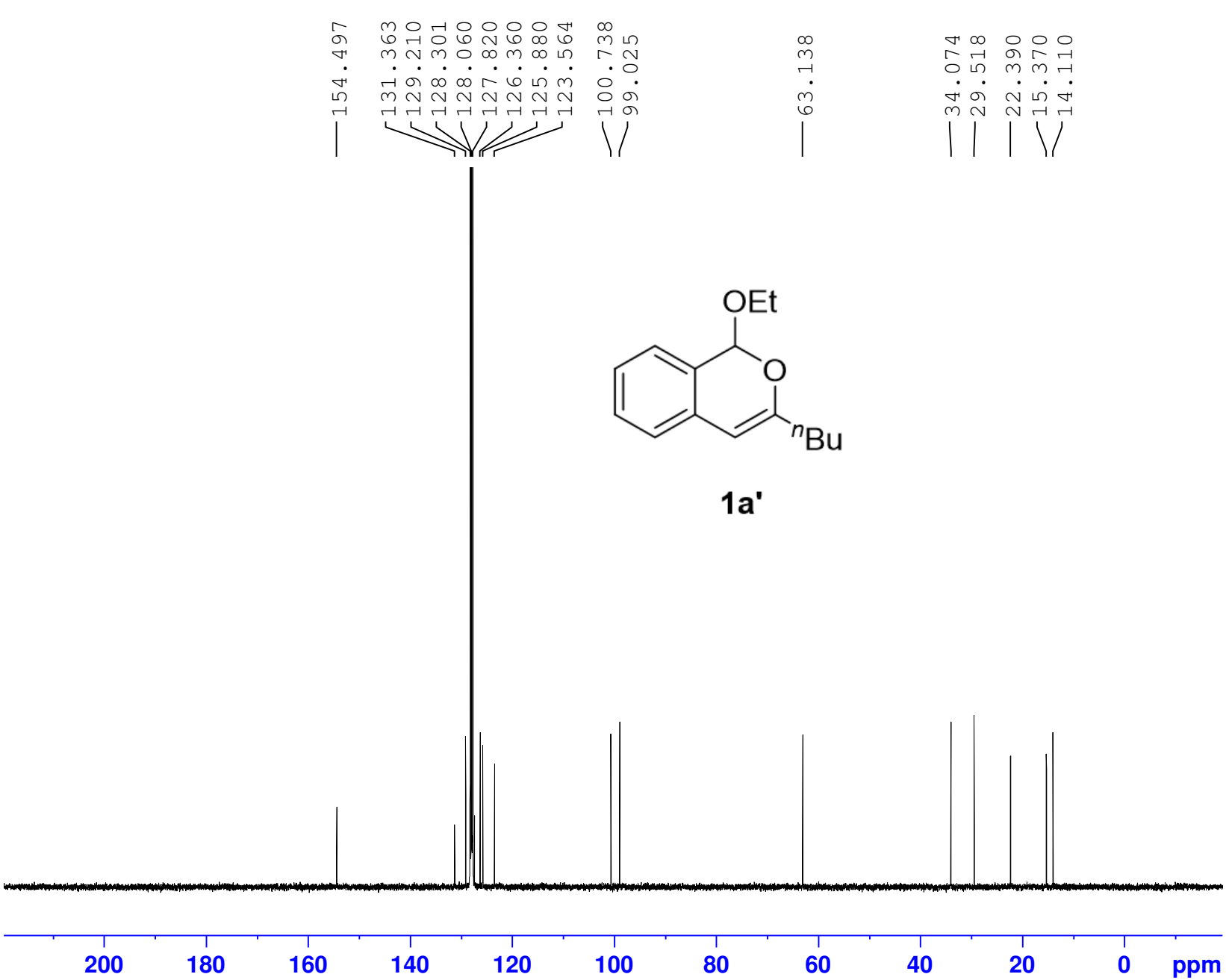
FIDRES            0.125483 Hz
AQ                3.9845889 sec
RG                      287
DW                 60.800 usec
DE                  6.00 usec
TE                  295.6 K
D1              1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
NUC1                      1H
P1                    13.60 usec
PL1                   -1.00 dB
SFO1          400.1324710 MHz

F2 - Processing parameters
SI                        32768
SF            400.1300438 MHz
WDW                        EM
SSB       0
LB                    0.30 Hz
GB        0
PC                    1.00
```



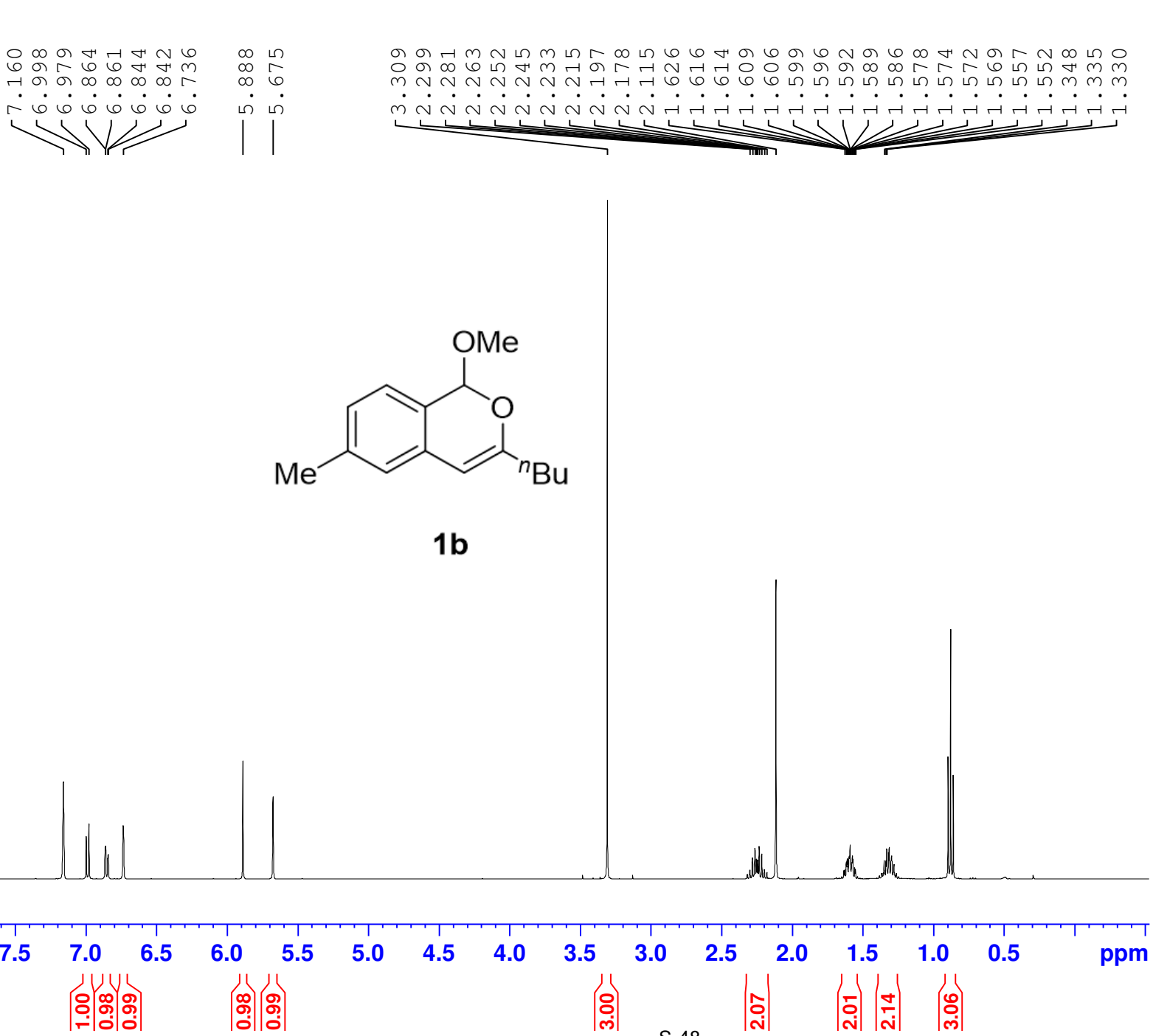
Current Data Parameters
NAME wuan-67
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151222
Time 23.29
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT C6D6
NS 150
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 2050
DW 20.800 usec
DE 6.00 usec
TE 295.7 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.25 usec
PL1 -3.00 dB
SFO1 100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL12 12.45 dB
PL13 18.00 dB
PL2 -1.00 dB
SFO2 400.1316005 MHz

F2 - Processing parameters
SI 32768
SF 100.6127430 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

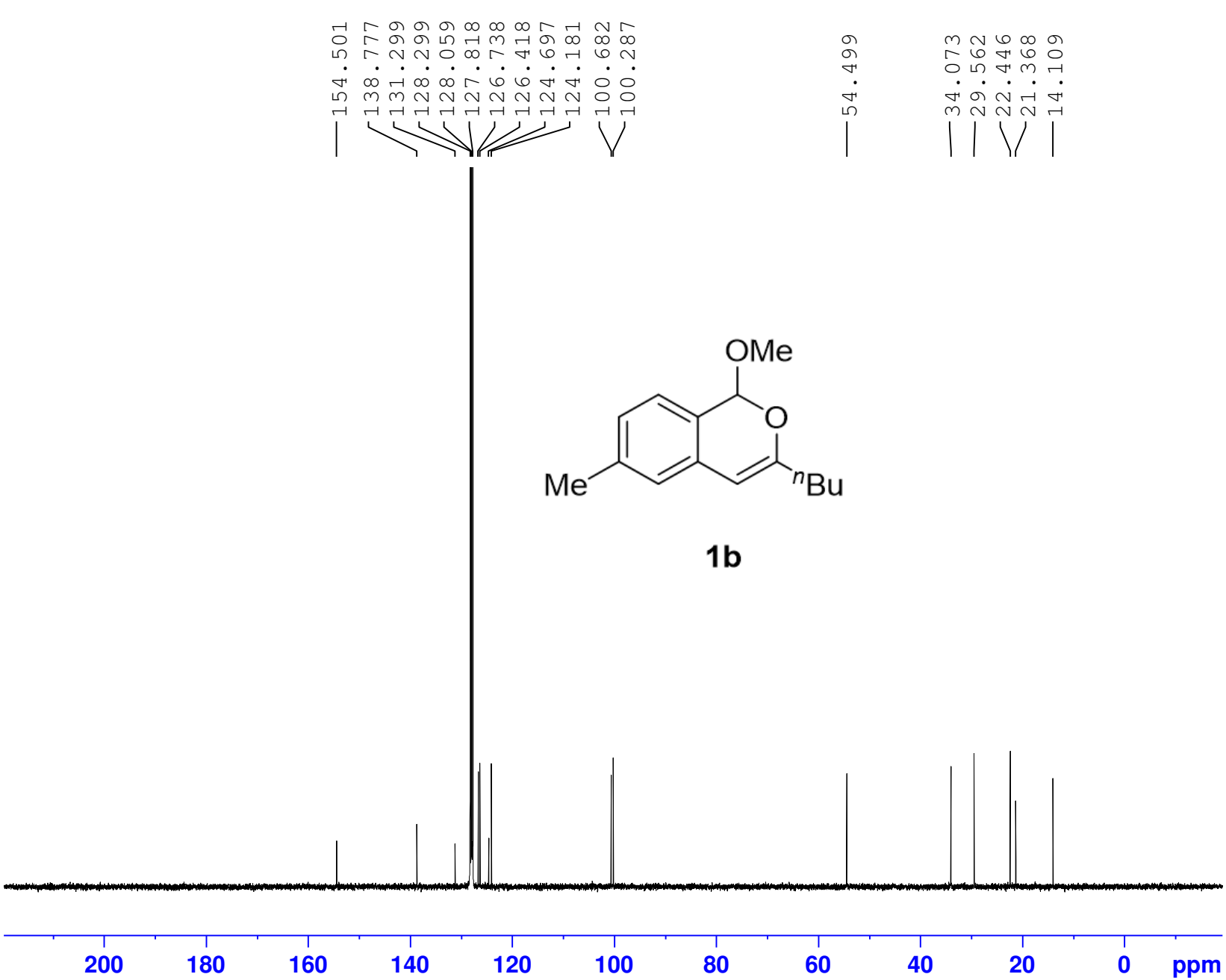



```
Current Data Parameters
NAME                 wuan-106
EXPNO                       3
PROCNO                      1

F2 - Acquisition Parameters
Date_               20151223
Time                    3.20
INSTRUM                spect
PROBHD    5 mm PABBO BB-
PULPROG                 zg30
TD                     65536
SOLVENT                 C6D6
NS                         4
DS                         0
SWH                 8223.685 Hz
FIDRES              0.125483 Hz
AQ                  3.9845889 sec
RG                       161
DW                    60.800 usec
DE                     6.00 usec
TE                     295.7 K
D1                 1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
NUC1                       1H
P1                     13.60 usec
PL1                    -1.00 dB
SFO1           400.1324710 MHz

F2 - Processing parameters
SI                         32768
SF              400.1300437 MHz
WDW                           EM
SSB          0
LB                      0.30 Hz
GB           0
PC                      1.00
```



BRUKER

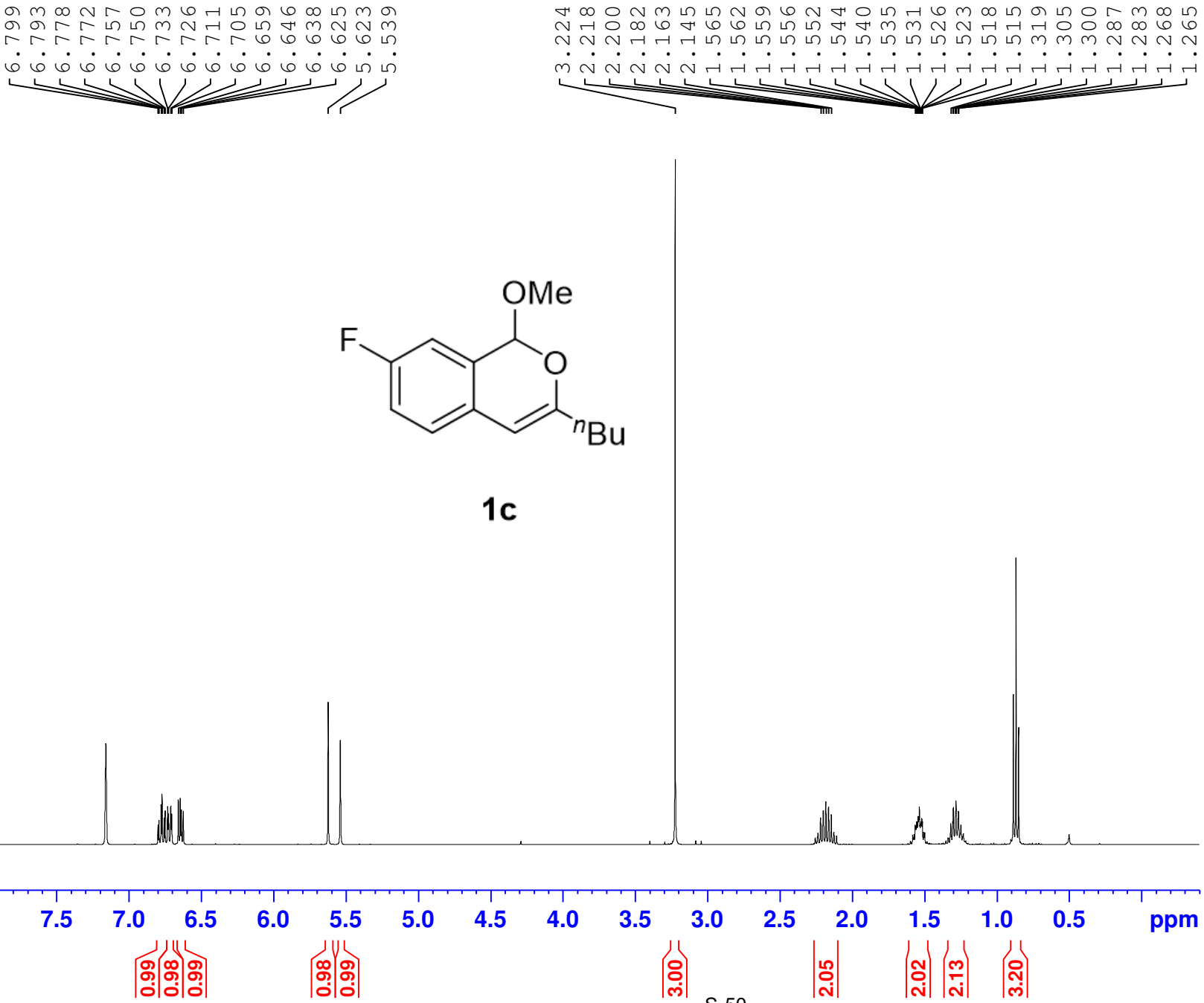
```
Current Data Parameters
NAME                  wuan-106
EXPNO                        4
PROCNO                       1

F2 - Acquisition Parameters
Date_                 20151223
Time                      3.26
INSTRUM                  spect
PROBHD    5 mm PABBO BB-
PULPROG                 zgpg30
TD                       65536
SOLVENT                  C6D6
NS                        125
DS                          0
SWH                24038.461 Hz
FIDRES              0.366798 Hz
AQ                  1.3631488 sec
RG                       2050
DW                     20.800 usec
DE                      6.00 usec
TE                     296.4 K
D1                 2.00000000 sec
d11                0.03000000 sec
DELTA              1.89999998 sec
TD0                         1

======== CHANNEL f1 ========
NUC1                       13C
P1                        9.25 usec
PL1                      -3.00 dB
SFO1              100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2                waltz16
NUC2                        1H
PCPD2                    80.00 usec
PL12                     12.45 dB
PL13                     18.00 dB
PL2                      -1.00 dB
SFO2              400.1316005 MHz

F2 - Processing parameters
SI                       32768
SF                100.6127430 MHz
WDW                         EM
SSB          0
LB                        1.00 Hz
GB           0
PC                        1.40
```

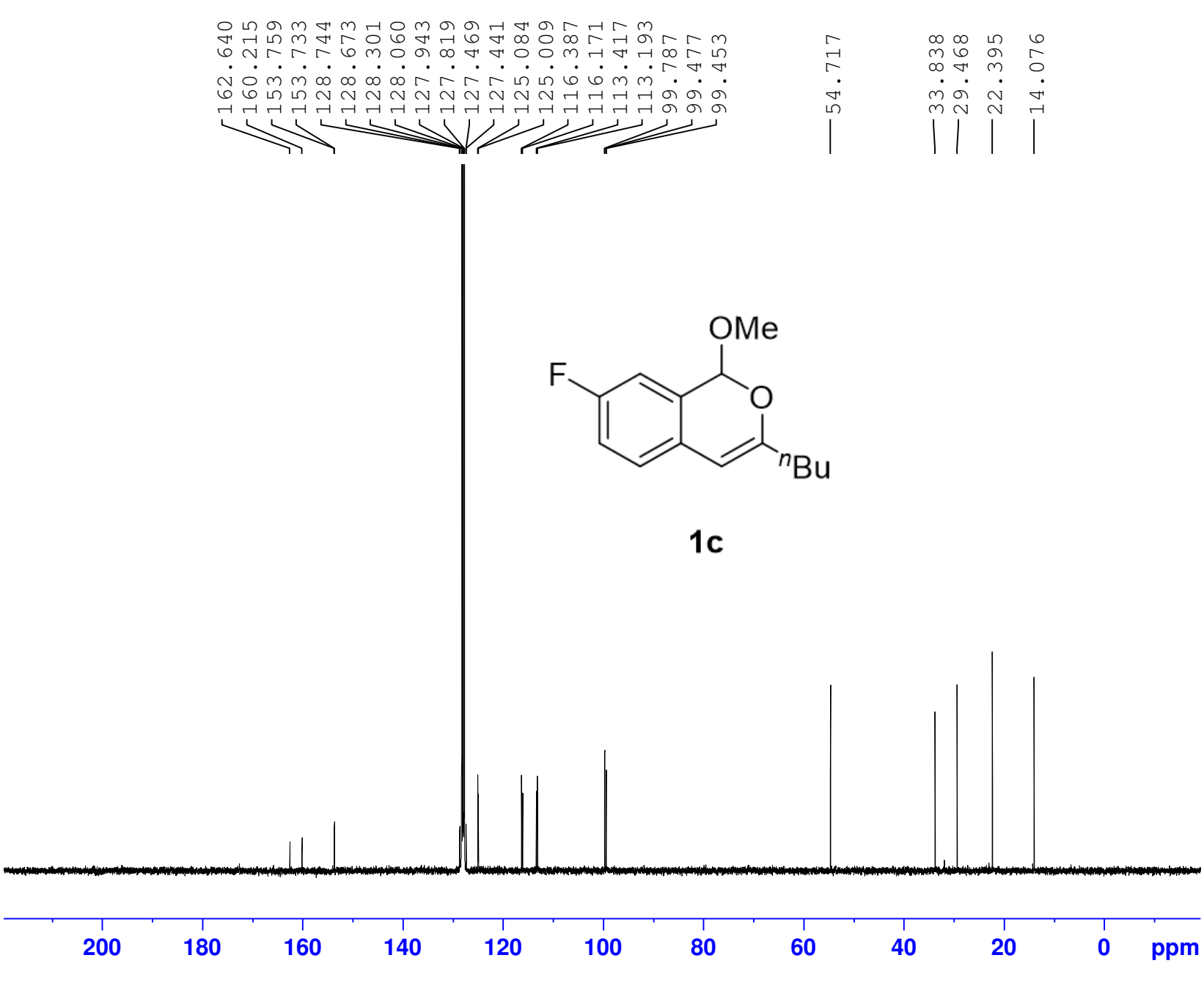



```
Current Data Parameters
NAME                 wuan-107
EXPNO                       2
PROCNO                      1

F2 - Acquisition Parameters
Date_               20151222
Time                   22.29
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                 zg30
TD                     65536
SOLVENT                 C6D6
NS                         4
DS                         0
SWH                 8012.820 Hz
FIDRES              0.122266 Hz
AQ                  4.0894465 sec
RG                     49.32
DW                    62.400 usec
DE                     6.50 usec
TE                    297.2 K
D1                  1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
SFO1              400.1324710 MHz
NUC1                      1H
P1                     14.50 usec
PLW1              11.99499989 W

F2 - Processing parameters
SI                     65536
SF                400.1299965 MHz
WDW                       EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



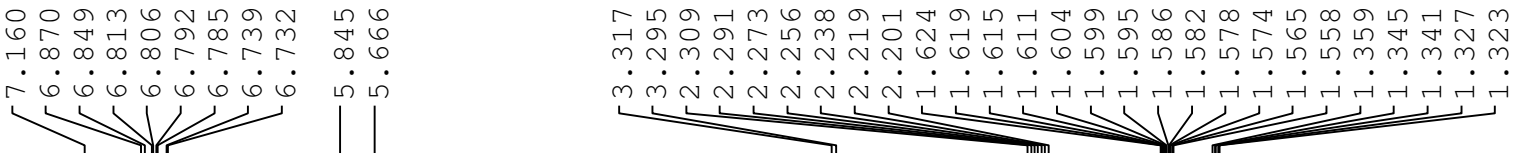
Current Data Parameters
NAME wuan-107
EXPNO 4
PROCNO 1

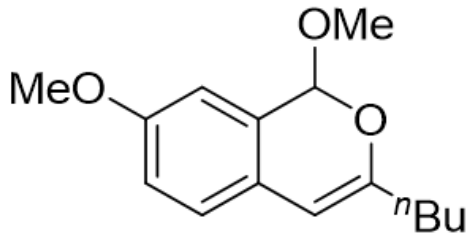
F2 - Acquisition Parameters
Date_ 20151222
Time 23.01
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT C6D6
NS 154
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 2050
DW 20.800 usec
DE 6.00 usec
TE 295.3 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.25 usec
PL1 -3.00 dB
SFO1 100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL12 12.45 dB
PL13 18.00 dB
PL2 -1.00 dB
SFO2 400.1316005 MHz

F2 - Processing parameters
SI 32768
SF 100.6127429 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40





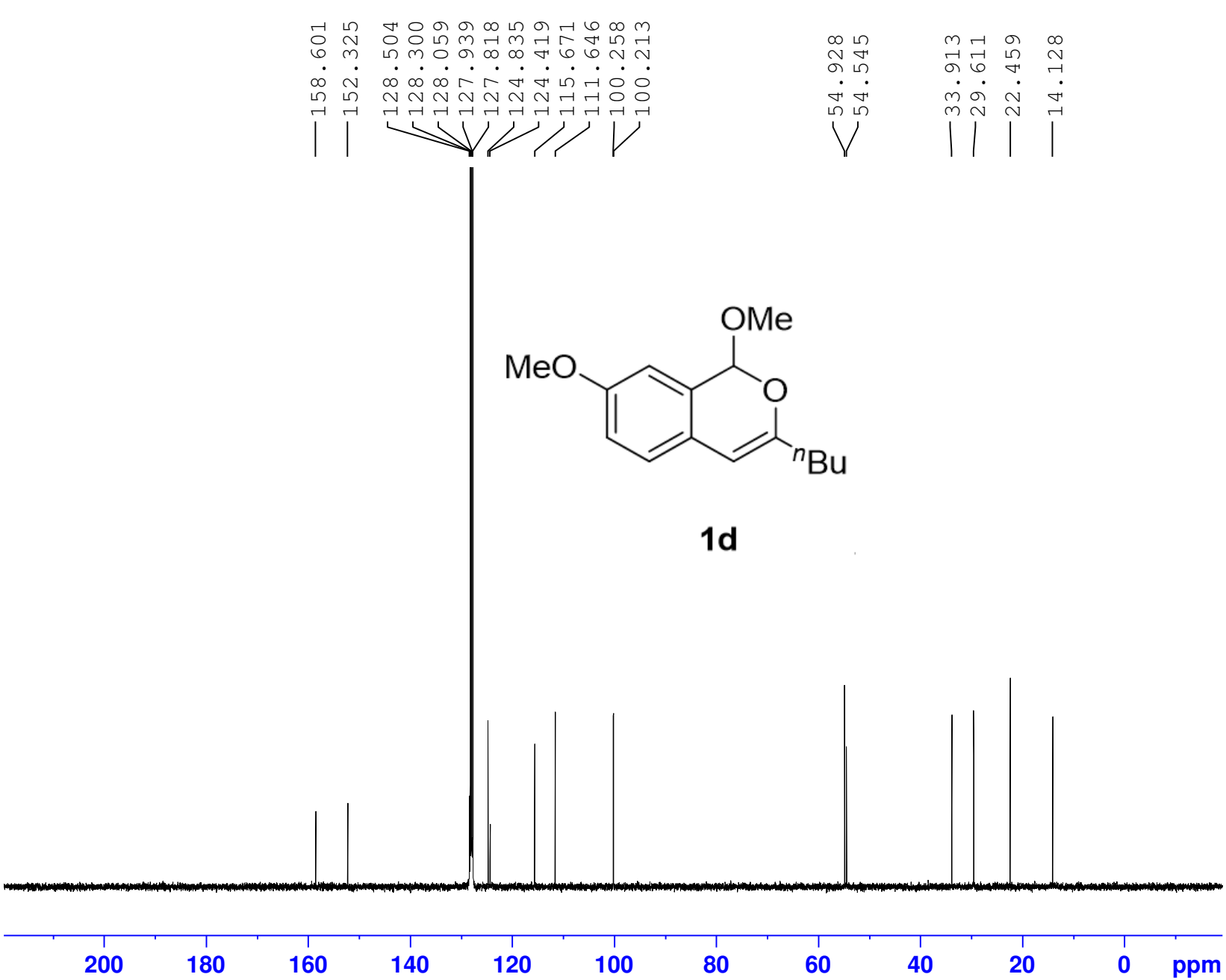
1d


```
Current Data Parameters
NAME                  wuan-108
EXPNO                        2
PROCNO                       1

F2 - Acquisition Parameters
Date_                 20151223
Time                      3.31
INSTRUM                  spect
PROBHD    5 mm PABBO BB-
PULPROG                  zg30
TD                      65536
SOLVENT                  C6D6
NS                          4
DS                          0
SWH                  8223.685 Hz
FIDRES               0.125483 Hz
AQ                   3.9845889 sec
RG                        128
DW                     60.800 usec
DE                      6.00 usec
TE                      295.7 K
D1                  1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
NUC1                       1H
P1                      13.60 usec
PL1                     -1.00 dB
SFO1             400.1324710 MHz

F2 - Processing parameters
SI                      32768
SF                400.1300435 MHz
WDW                        EM
SSB          0
LB                      0.30 Hz
GB           0
PC                      1.00
```



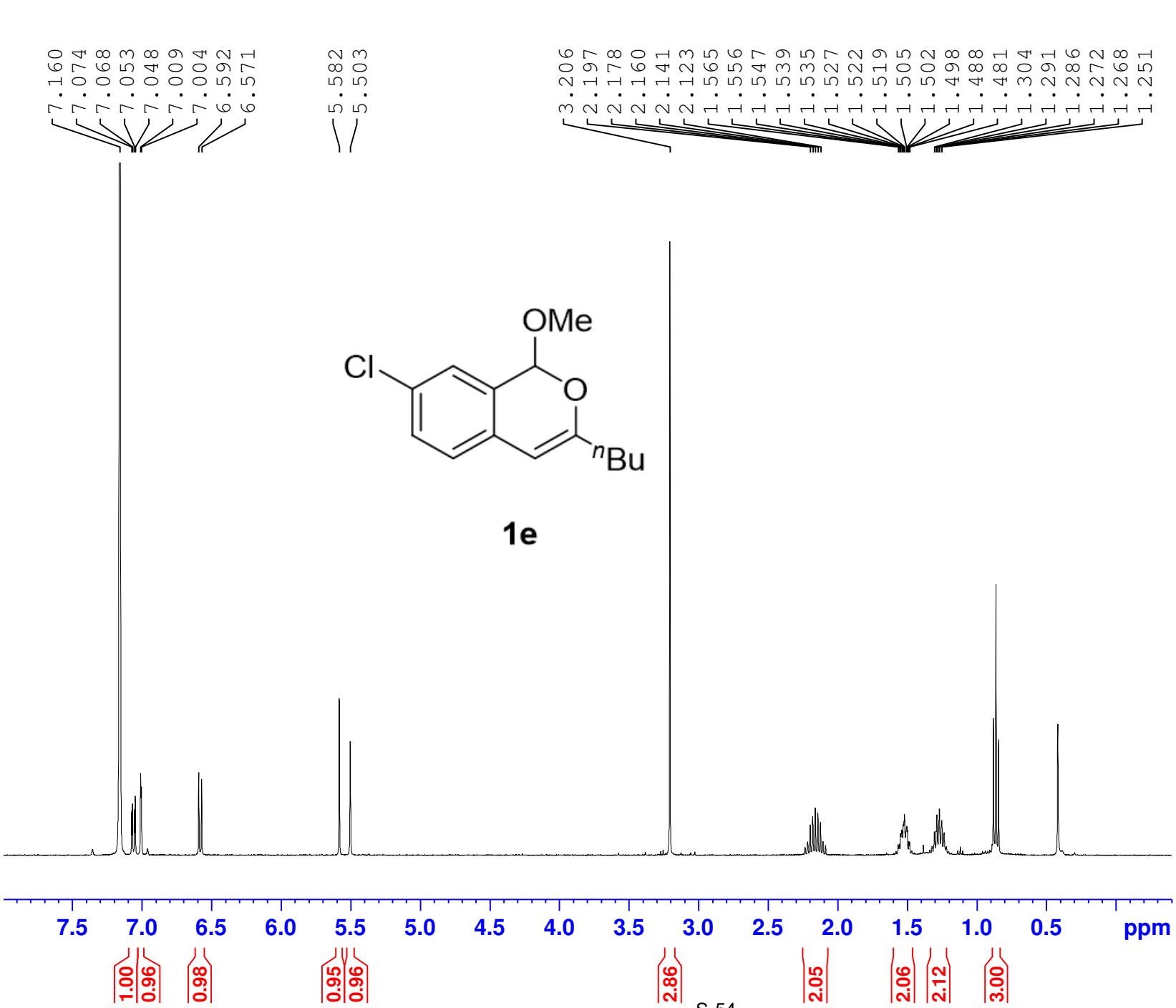

```
Current Data Parameters
NAME                wuan-108
EXPNO                      3
PROCNO                     1

F2 - Acquisition Parameters
Date_               20151223
Time                    3.38
INSTRUM                spect
PROBHD    5 mm PABBO BB-
PULPROG                zgpg30
TD                      65536
SOLVENT                 C6D6
NS                       118
DS                         0
SWH                24038.461 Hz
FIDRES              0.366798 Hz
AQ                  1.3631488 sec
RG                       2050
DW                     20.800 usec
DE                      6.00 usec
TE                     296.4 K
D1                 2.00000000 sec
d11                0.03000000 sec
DELTA              1.89999998 sec
TD0                        1

======== CHANNEL f1 ========
NUC1                      13C
P1                       9.25 usec
PL1                     -3.00 dB
SFO1             100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2               waltz16
NUC2                       1H
PCPD2                   80.00 usec
PL12                    12.45 dB
PL13                    18.00 dB
PL2                     -1.00 dB
SFO2             400.1316005 MHz

F2 - Processing parameters
SI                       32768
SF               100.6127430 MHz
WDW                         EM
SSB          0
LB                       1.00 Hz
GB           0
PC                       1.40
```

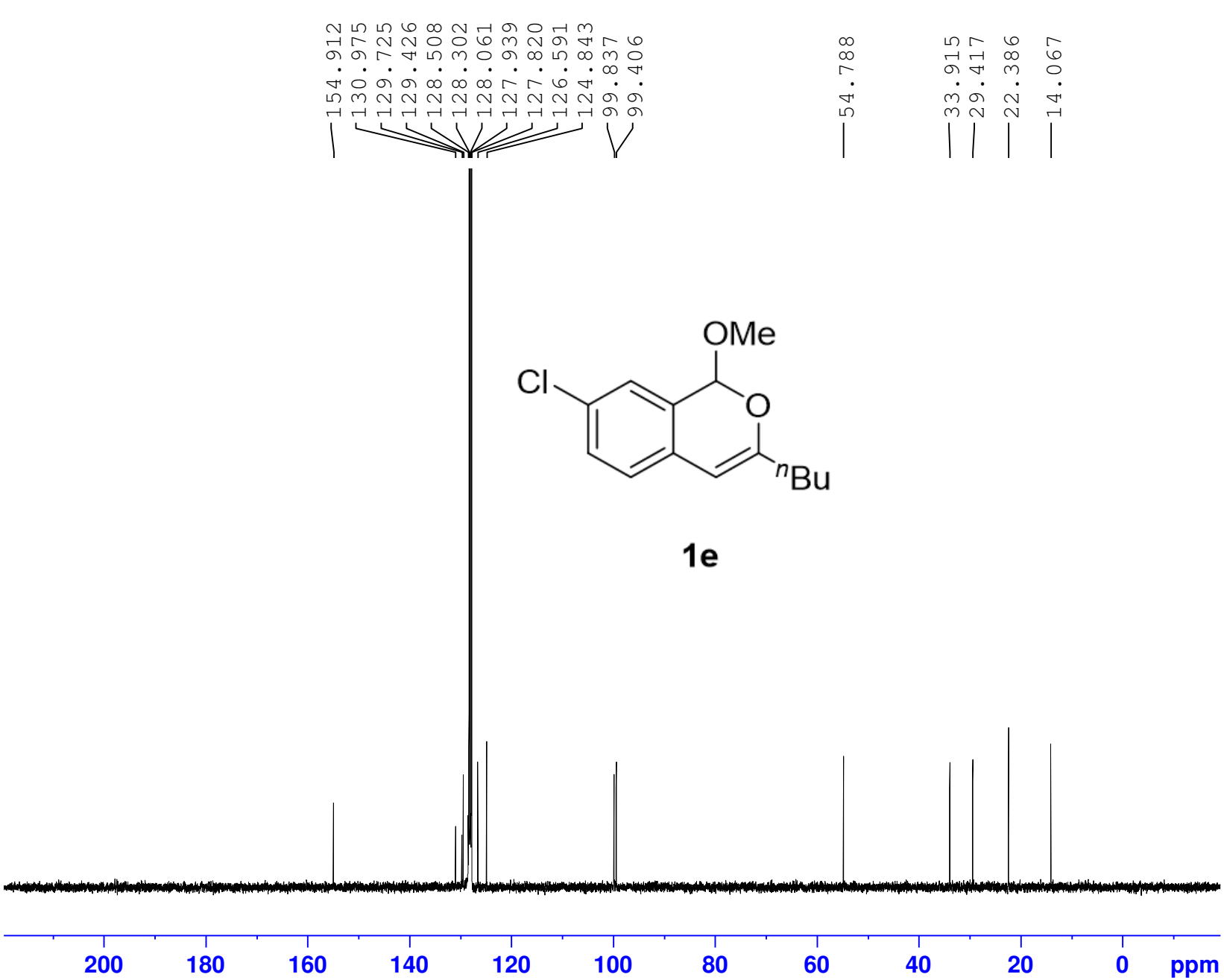



```
Current Data Parameters
NAME                  wuan-122
EXPNO                        1
PROCNO                       1

F2 - Acquisition Parameters
Date_                 20151119
Time                     22.23
INSTRUM                  spect
PROBHD    5 mm PABBO BB-
PULPROG                  zg30
TD                      65536
SOLVENT                  C6D6
NS                          4
DS                          0
SWH                  8223.685 Hz
FIDRES               0.125483 Hz
AQ                   3.9845889 sec
RG                        456
DW                     60.800 usec
DE                      6.00 usec
TE                      294.5 K
D1                 1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
NUC1                       1H
P1                      13.60 usec
PL1                     -1.00 dB
SFO1           400.1324710 MHz

F2 - Processing parameters
SI                      32768
SF             400.1300439 MHz
WDW                        EM
SSB          0
LB                      0.30 Hz
GB           0
PC                      1.00
```



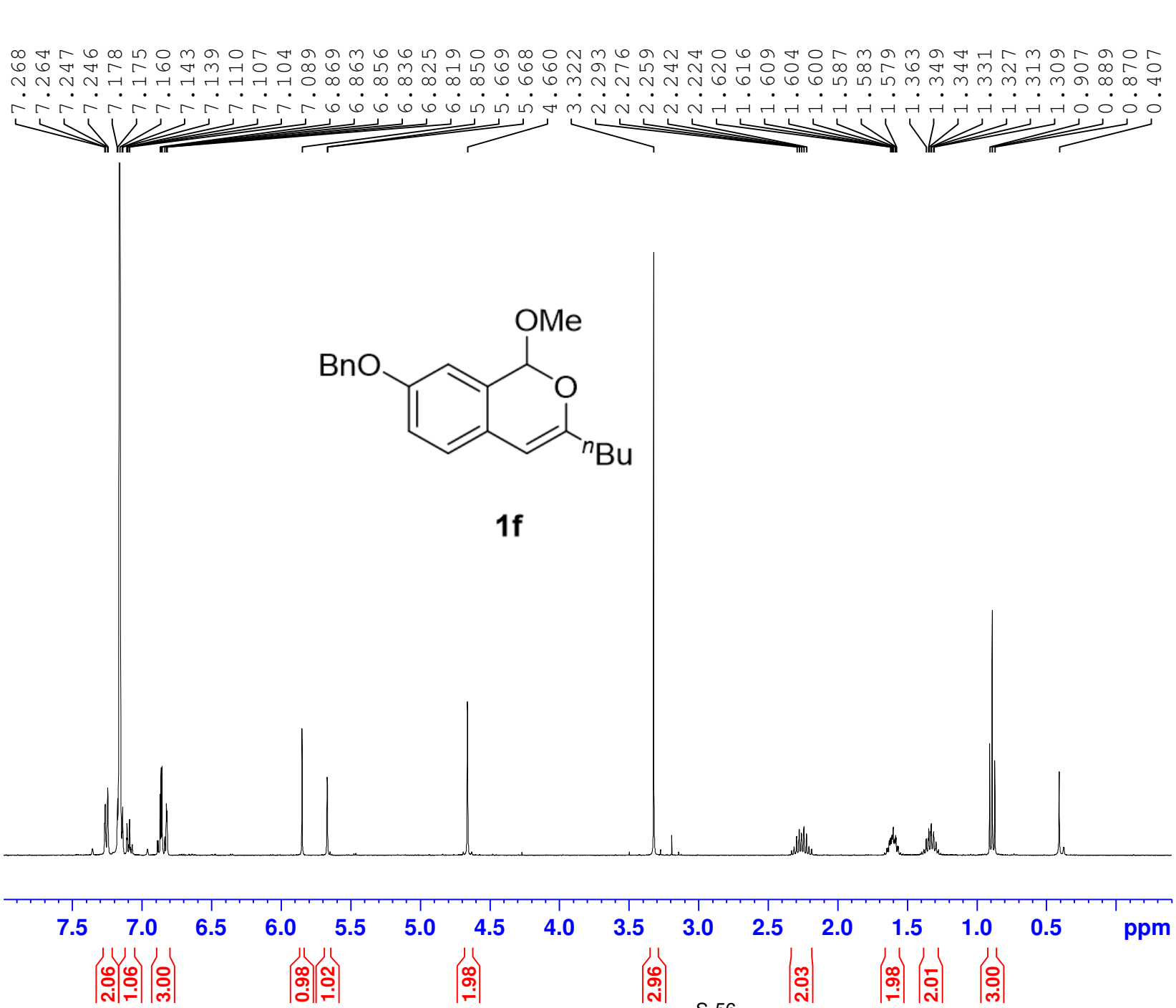
Current Data Parameters
NAME wuan-122
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151222
Time 23.14
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT C6D6
NS 201
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 2050
DW 20.800 usec
DE 6.00 usec
TE 295.5 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.25 usec
PL1 -3.00 dB
SFO1 100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL12 12.45 dB
PL13 18.00 dB
PL2 -1.00 dB
SFO2 400.1316005 MHz

F2 - Processing parameters
SI 32768
SF 100.6127431 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

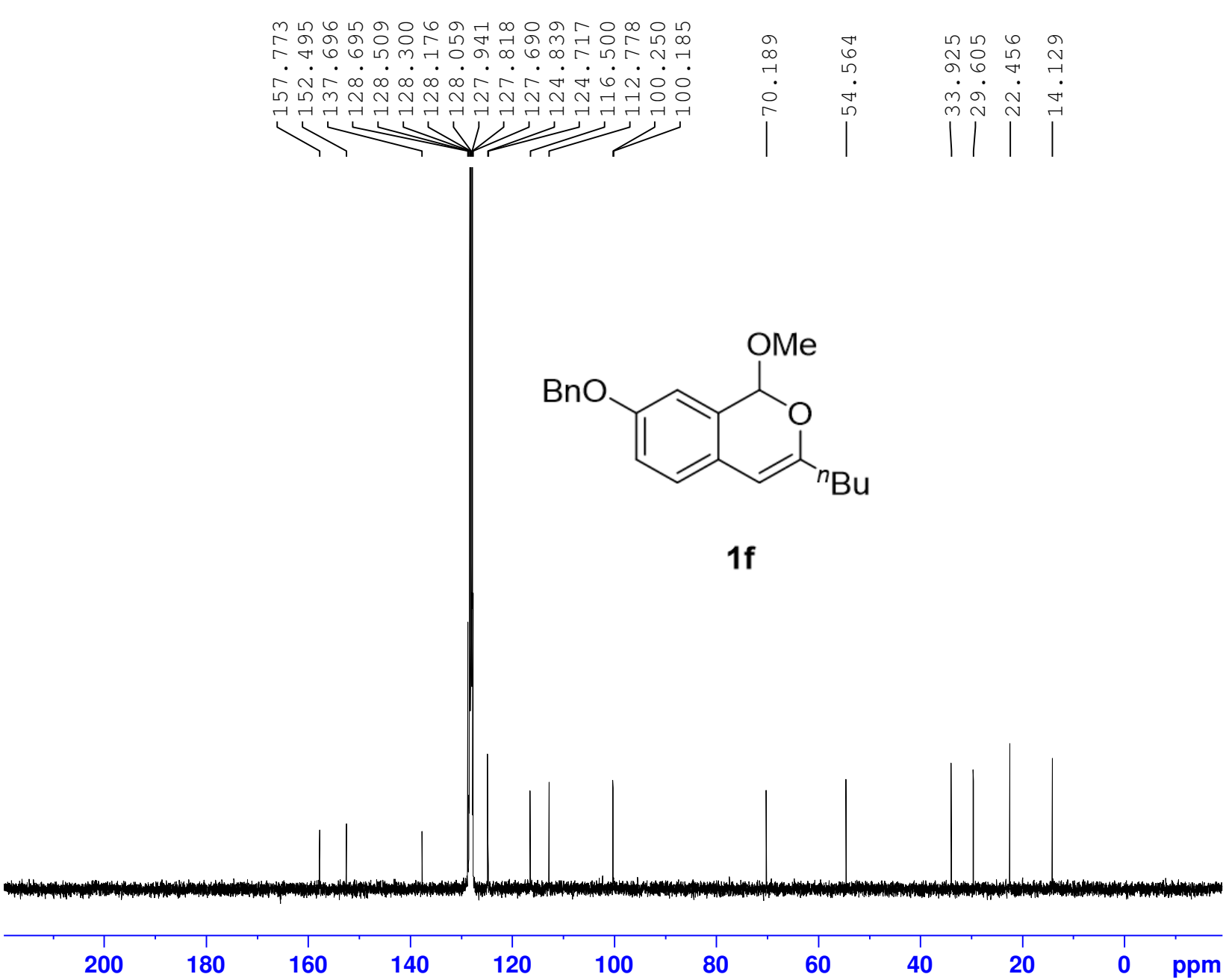


Current Data Parameters
NAME wuan-148-1
EXPNO 3
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151223
Time 7.52
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT C6D6
NS 4
DS 0
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9845889 sec
RG 512
DW 60.800 usec
DE 6.00 usec
TE 296.0 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
NUC1 1H
P1 13.60 usec
PL1 -1.00 dB
SFO1 400.1324710 MHz

F2 - Processing parameters
SI 32768
SF 400.1300435 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



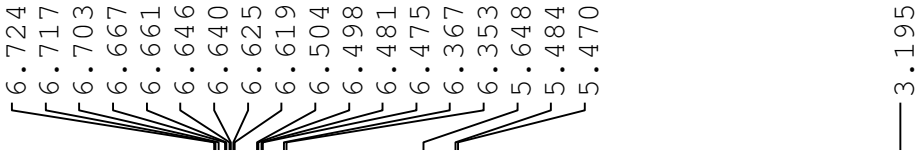

```
Current Data Parameters
NAME          wuan-148-1
EXPNO                  4
PROCNO                 1

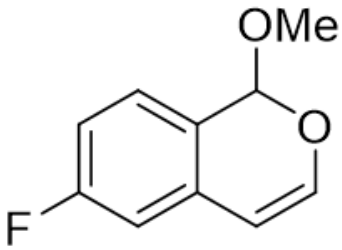
F2 - Acquisition Parameters
Date_           20151223
Time                8.19
INSTRUM            spect
PROBHD   5 mm PABBO BB-
PULPROG          zgpg30
TD                65536
SOLVENT             C6D6
NS                  1117
DS                     0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                  2050
DW                20.800 usec
DE                 6.00 usec
TE                296.7 K
D1            2.00000000 sec
d11           0.03000000 sec
DELTA         1.89999998 sec
TD0                    1

======== CHANNEL f1 ========
NUC1                 13C
P1                  9.25 usec
PL1                -3.00 dB
SFO1         100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2          waltz16
NUC2                 1H
PCPD2              80.00 usec
PL12               12.45 dB
PL13               18.00 dB
PL2                -1.00 dB
SFO2         400.1316005 MHz

F2 - Processing parameters
SI                  32768
SF           100.6127434 MHz
WDW                  EM
SSB       0
LB                  1.00 Hz
GB        0
PC                  1.40
```





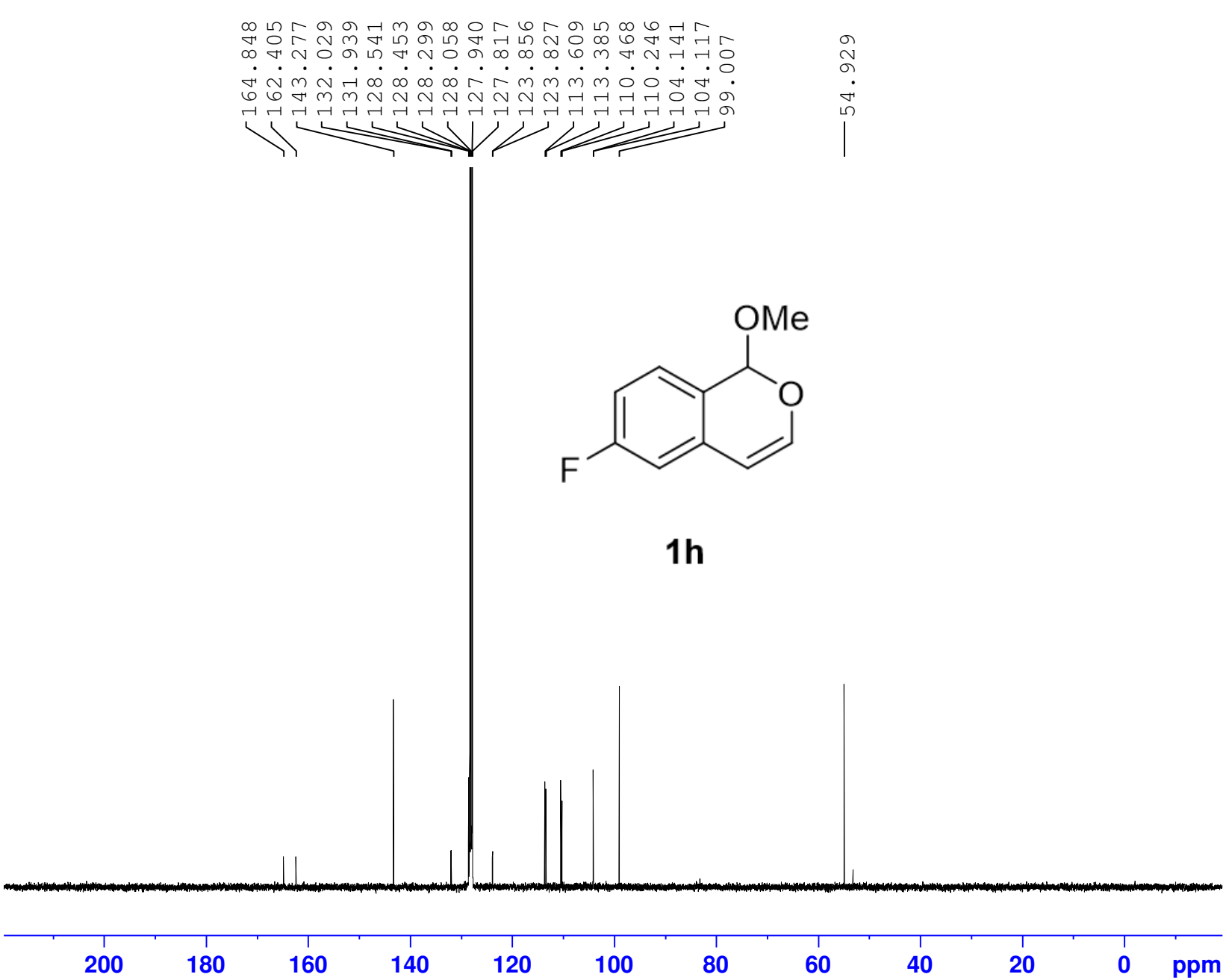
1h


```
Current Data Parameters
NAME                  wuan-85-1
EXPNO                         4
PROCNO                        1

F2 - Acquisition Parameters
Date_                  20151223
Time                       0.37
INSTRUM                   spect
PROBHD    5 mm PABBO BB-
PULPROG                    zg30
TD                        65536
SOLVENT                    C6D6
NS                            4
DS                            0
SWH                    8223.685 Hz
FIDRES                 0.125483 Hz
AQ                     3.9845889 sec
RG                          203
DW                        60.800 usec
DE                         6.00 usec
TE                        295.3 K
D1                    1.00000000 sec
TD0                           1

======== CHANNEL f1 ========
NUC1                         1H
P1                        13.60 usec
PL1                       -1.00 dB
SFO1                400.1324710 MHz

F2 - Processing parameters
SI                        32768
SF                  400.1300437 MHz
WDW                          EM
SSB                   0
LB                        0.30 Hz
GB                    0
PC                        1.00
```



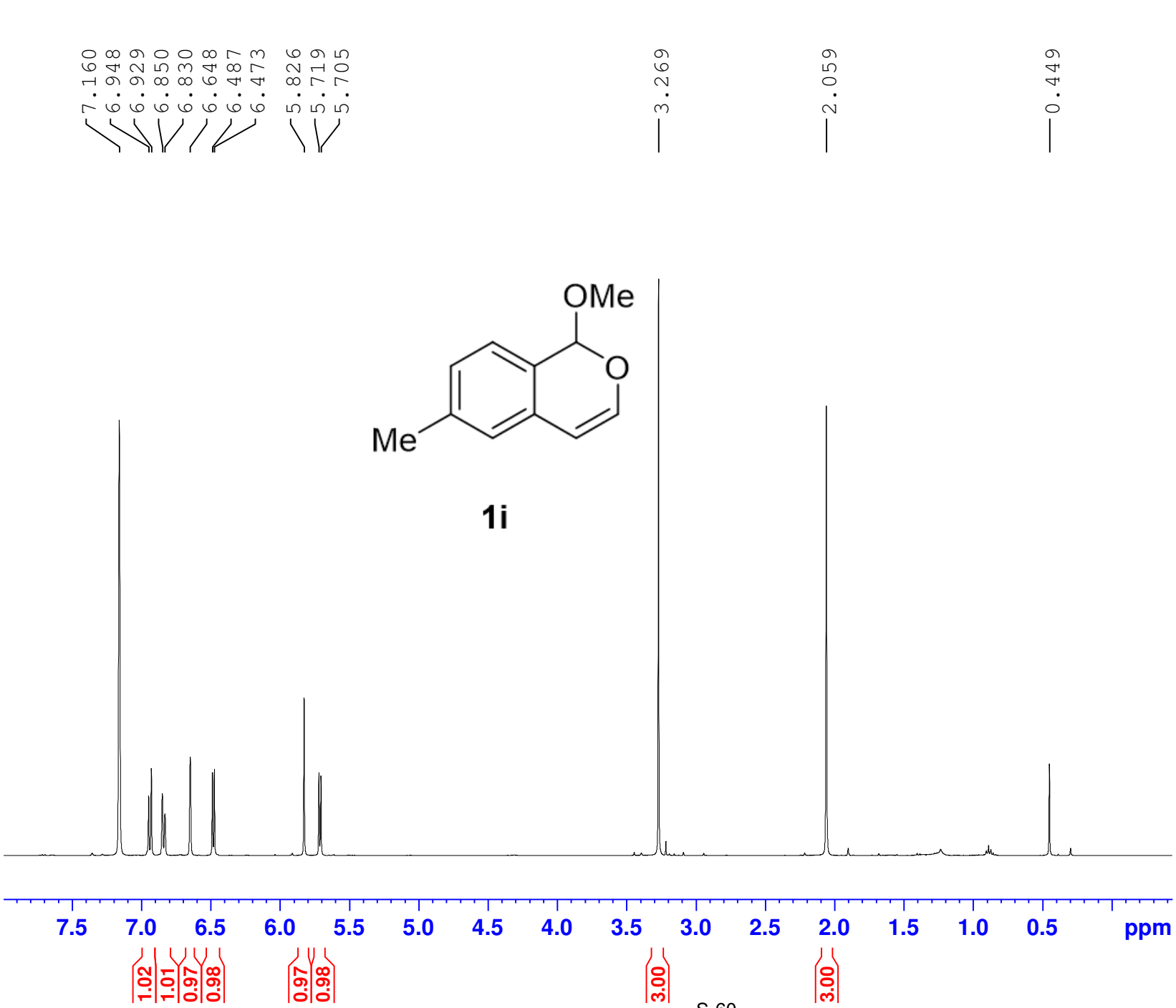

```
Current Data Parameters
NAME                  wuan-85-1
EXPNO                         3
PROCNO                        1

F2 - Acquisition Parameters
Date_                  20151223
Time                       0.30
INSTRUM                   spect
PROBHD    5 mm PABBO BB-
PULPROG                  zgpg30
TD                        65536
SOLVENT                     C6D6
NS                           161
DS                             0
SWH                  24038.461 Hz
FIDRES                0.366798 Hz
AQ                    1.3631488 sec
RG                         2050
DW                       20.800 usec
DE                        6.00 usec
TE                       296.0 K
D1                    2.00000000 sec
d11                   0.03000000 sec
DELTA                 1.89999998 sec
TD0                            1

======== CHANNEL f1 ========
NUC1                         13C
P1                         9.25 usec
PL1                       -3.00 dB
SFO1                100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2                 waltz16
NUC2                         1H
PCPD2                     80.00 usec
PL12                      12.45 dB
PL13                      18.00 dB
PL2                       -1.00 dB
SFO2                400.1316005 MHz

F2 - Processing parameters
SI                           32768
SF                  100.6127435 MHz
WDW                             EM
SSB                0
LB                            1.00 Hz
GB                 0
PC                            1.40
```

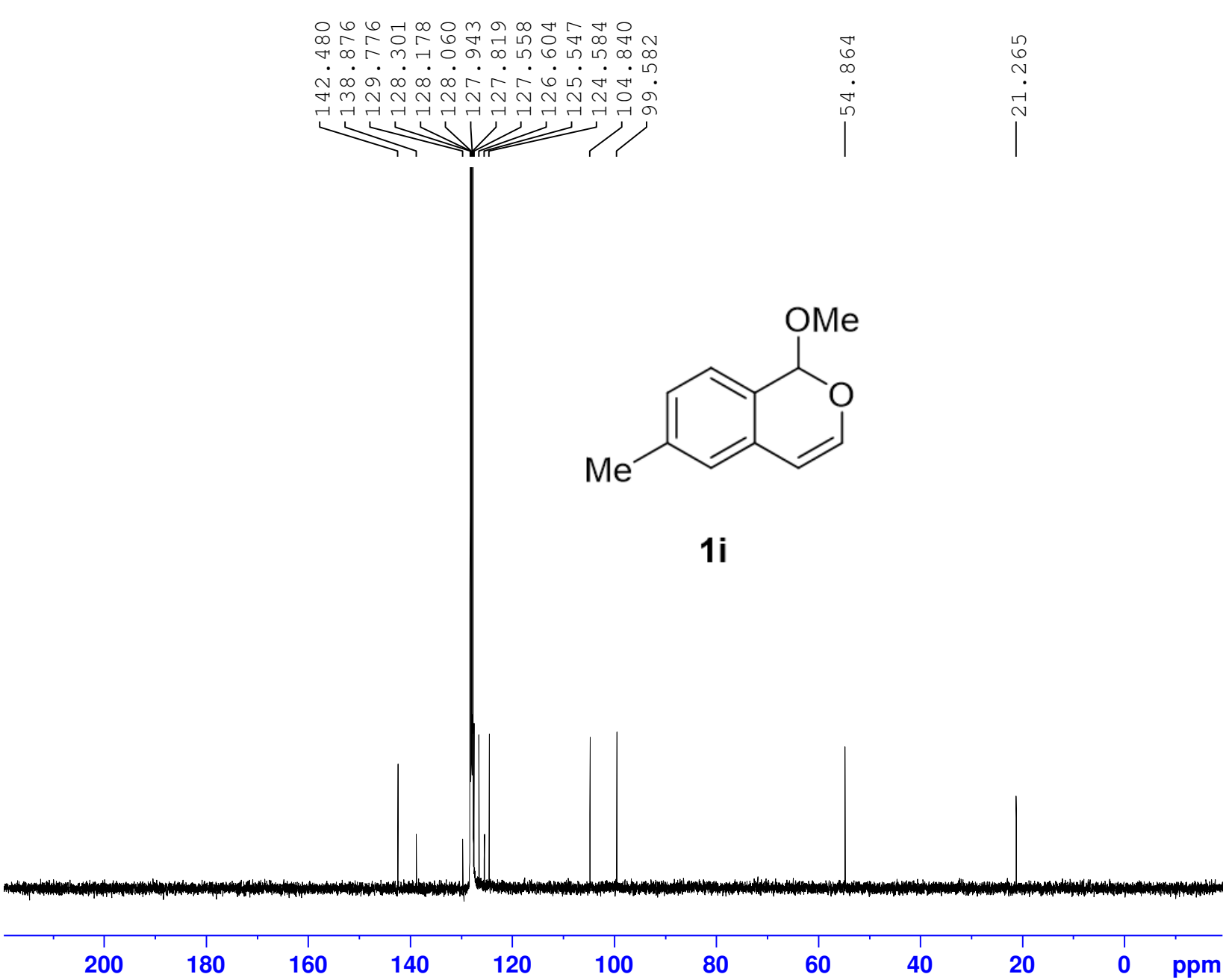


Current Data Parameters
NAME wuan-84(repurify)
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151028
Time 23.43
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT C6D6
NS 8
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 103.52
DW 62.400 usec
DE 6.50 usec
TE 297.3 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1299965 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



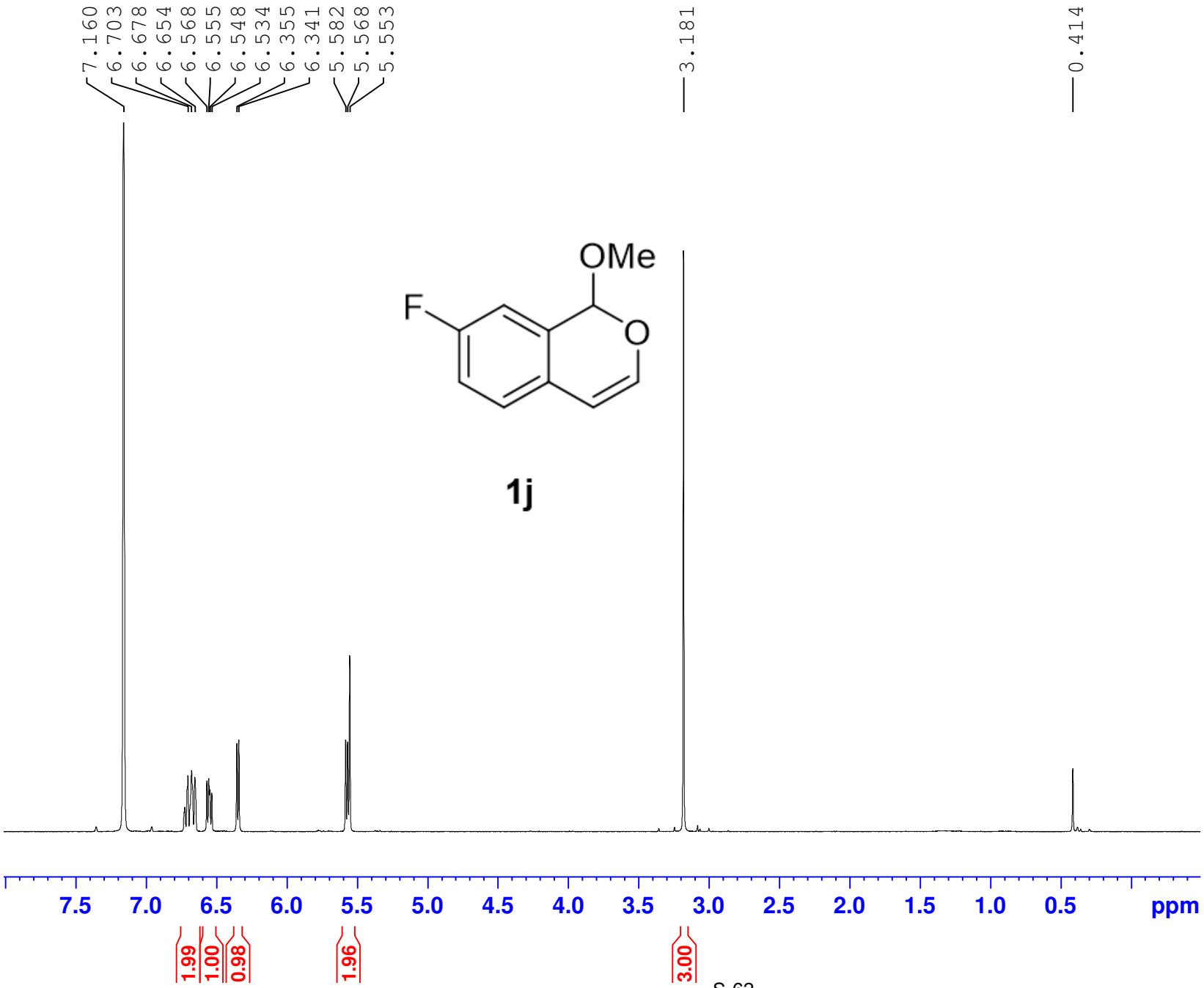

```
Current Data Parameters
NAME      wuan-84(repurify)
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_           20151222
Time              23.38
INSTRUM           spect
PROBHD   5 mm PABBO BB-
PULPROG          zgpg30
TD                65536
SOLVENT             C6D6
NS                  453
DS                    0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                 2050
DW               20.800 usec
DE                6.00 usec
TE                295.7 K
D1           2.00000000 sec
d11          0.03000000 sec
DELTA        1.89999998 sec
TD0                   1

======== CHANNEL f1 ========
NUC1                 13C
P1                 9.25 usec
PL1               -3.00 dB
SFO1        100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2         waltz16
NUC2                 1H
PCPD2             80.00 usec
PL12              12.45 dB
PL13              18.00 dB
PL2               -1.00 dB
SFO2        400.1316005 MHz

F2 - Processing parameters
SI                 32768
SF          100.6127434 MHz
WDW                 EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

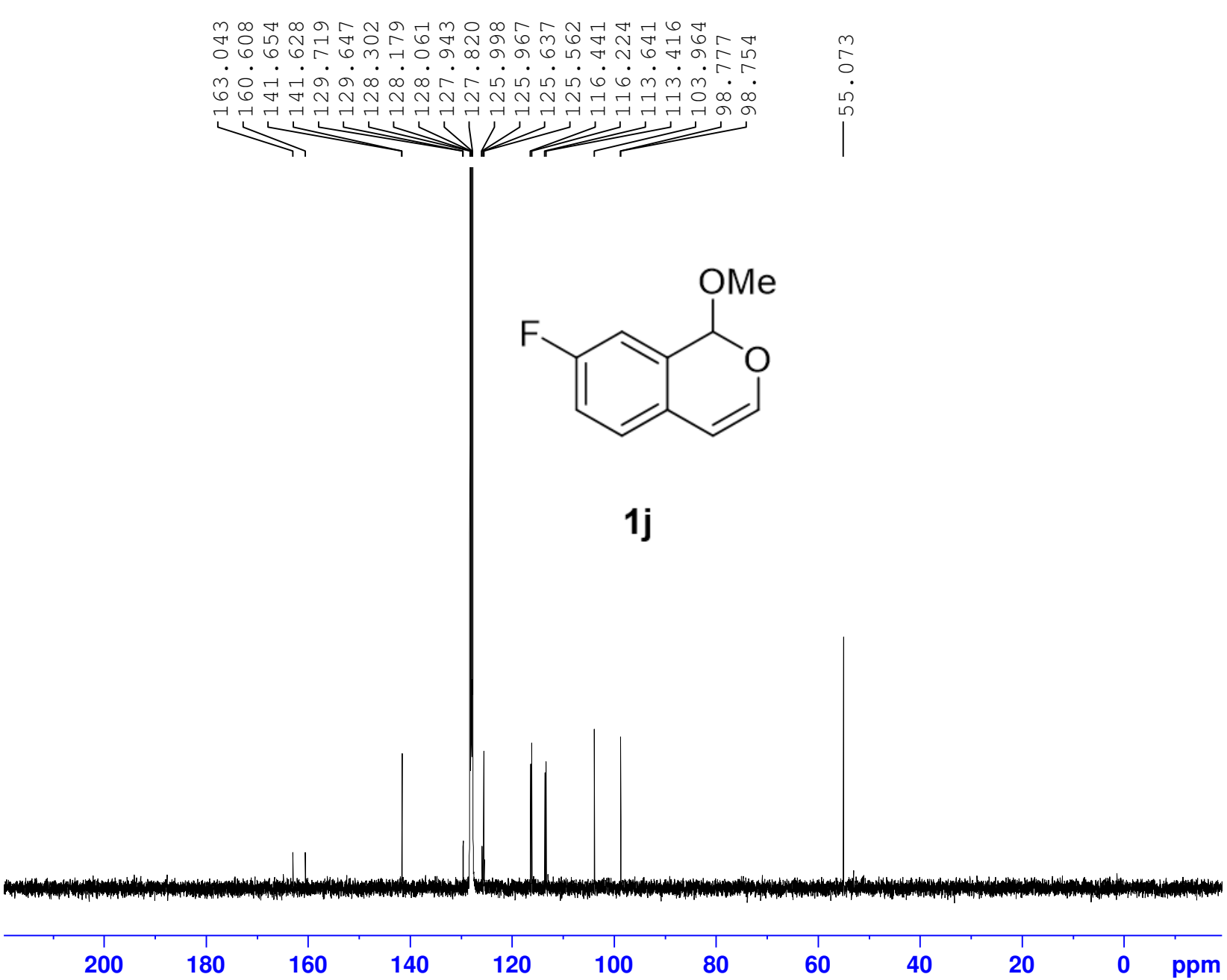



```
Current Data Parameters
NAME          wuan-165-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160215
Time               22.56
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT             C6D6
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 297.1 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1299962 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



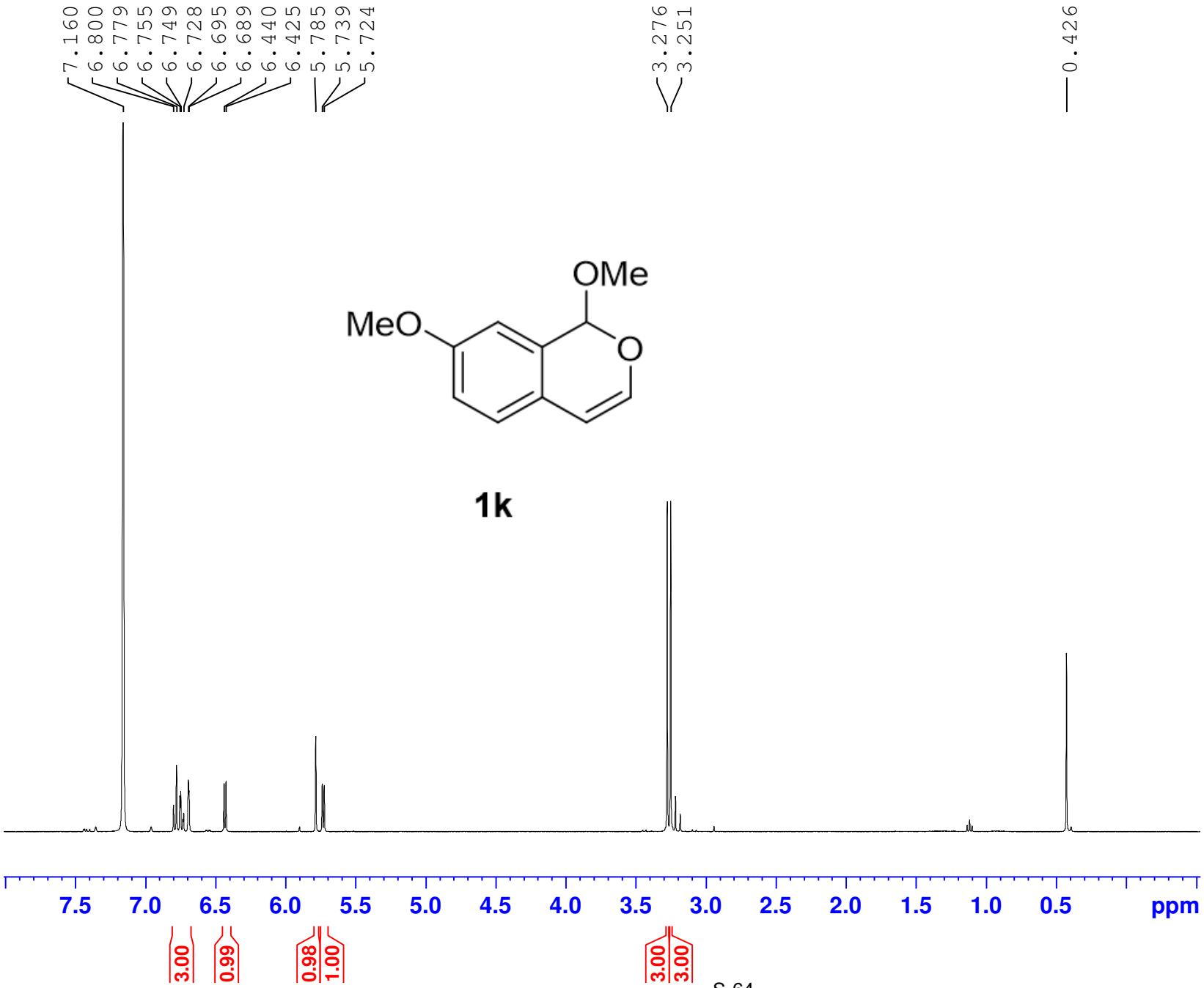
Current Data Parameters
NAME wuan-86
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151223
Time 0.48
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT C6D6
NS 710
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 2050
DW 20.800 usec
DE 6.00 usec
TE 296.1 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.25 usec
PL1 -3.00 dB
SFO1 100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL12 12.45 dB
PL13 18.00 dB
PL2 -1.00 dB
SFO2 400.1316005 MHz

F2 - Processing parameters
SI 32768
SF 100.6127431 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

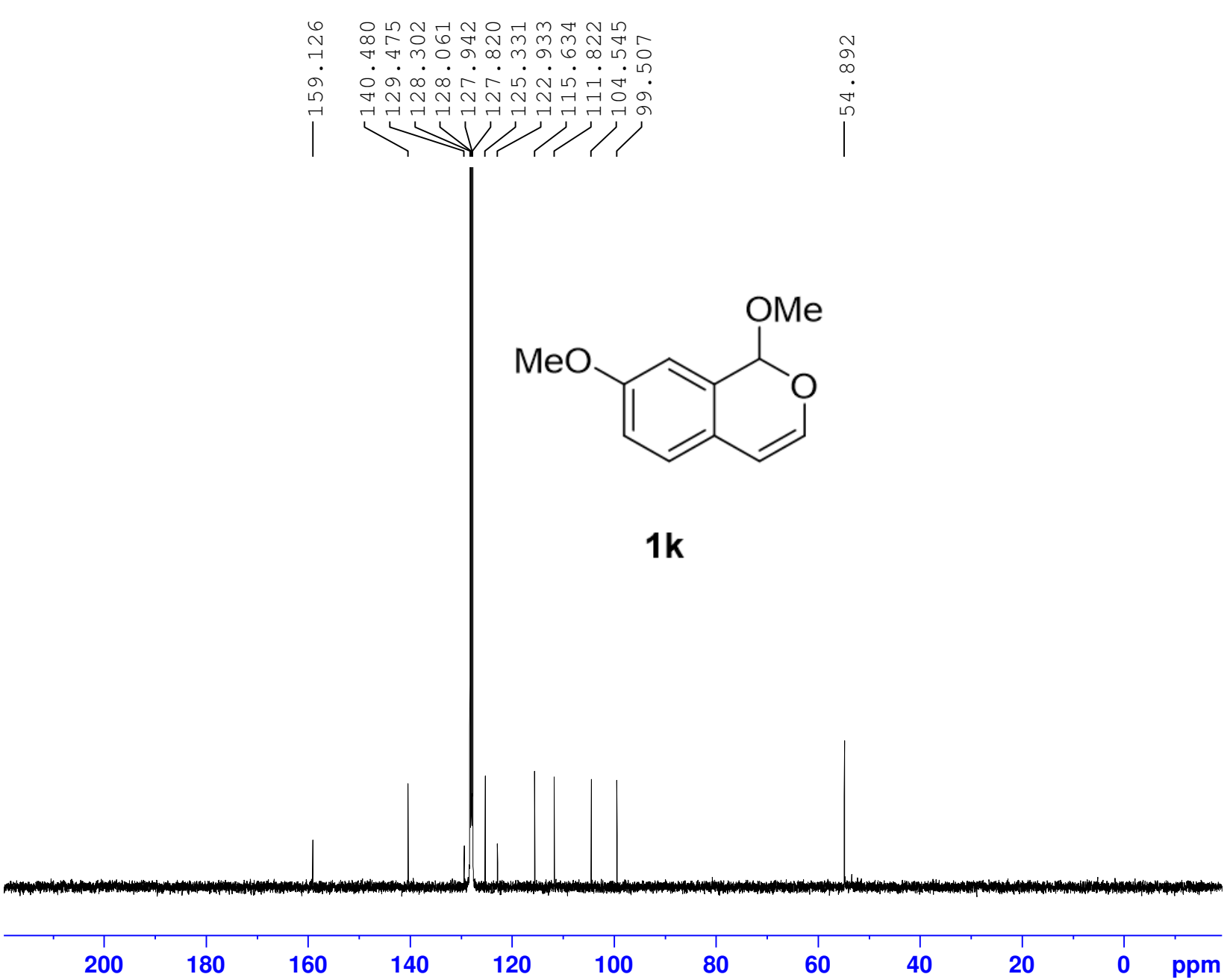



```
Current Data Parameters
NAME                  wuan-87
EXPNO                       1
PROCNO                      1

F2 - Acquisition Parameters
Date_               20151029
Time                   23.37
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                 zg30
TD                     65536
SOLVENT                C6D6
NS                        8
DS                        0
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894465 sec
RG                    187.77
DW                    62.400 usec
DE                     6.50 usec
TE                    297.4 K
D1                 1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1             400.1324710 MHz
NUC1                       1H
P1                      14.50 usec
PLW1             11.99499989 W

F2 - Processing parameters
SI                         65536
SF               400.1299965 MHz
WDW                          EM
SSB          0
LB                      0.30 Hz
GB           0
PC                      1.00
```



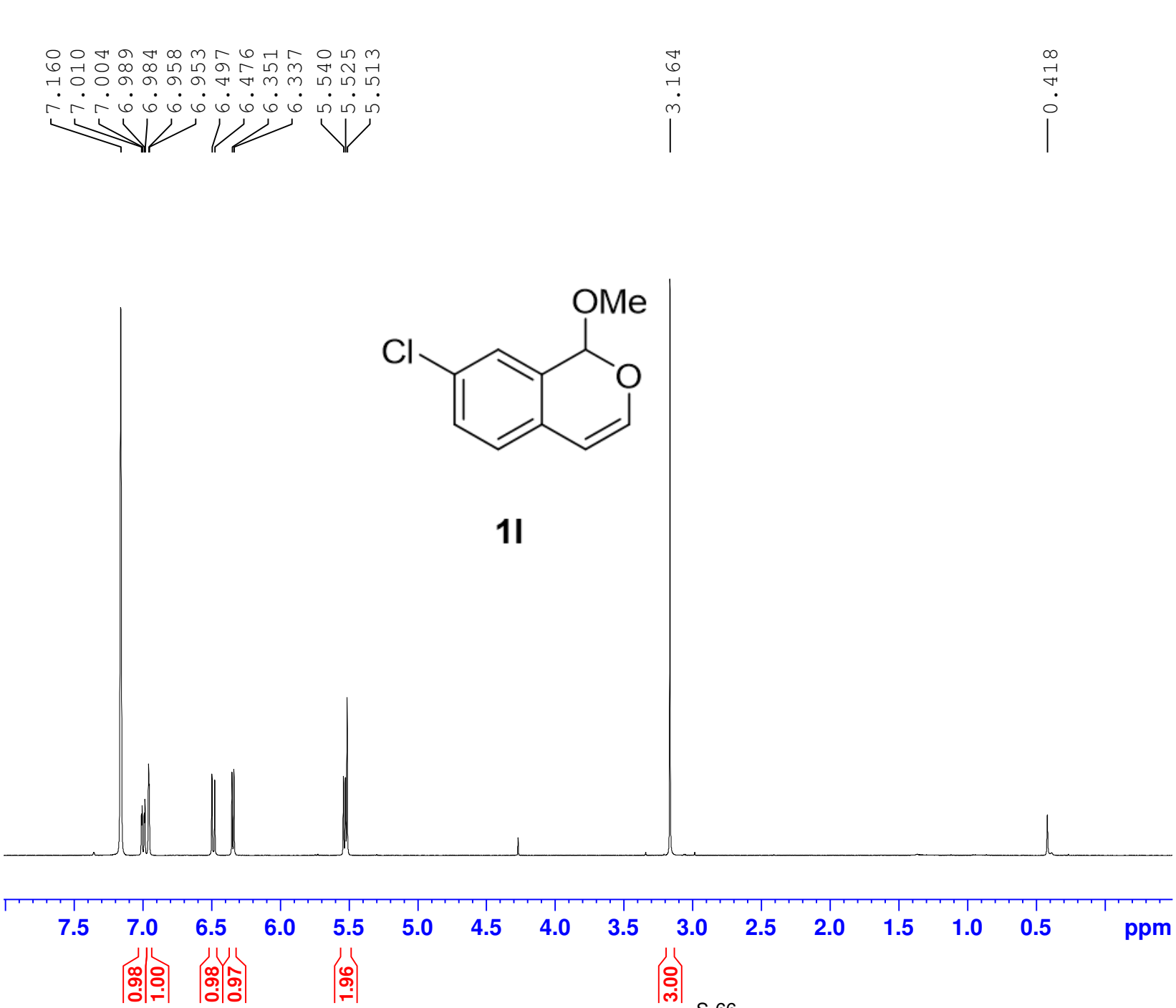
Current Data Parameters
NAME wuan-87
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151223
Time 4.10
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT C6D6
NS 224
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 2050
DW 20.800 usec
DE 6.00 usec
TE 296.4 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.25 usec
PL1 -3.00 dB
SFO1 100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL12 12.45 dB
PL13 18.00 dB
PL2 -1.00 dB
SFO2 400.1316005 MHz

F2 - Processing parameters
SI 32768
SF 100.6127431 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

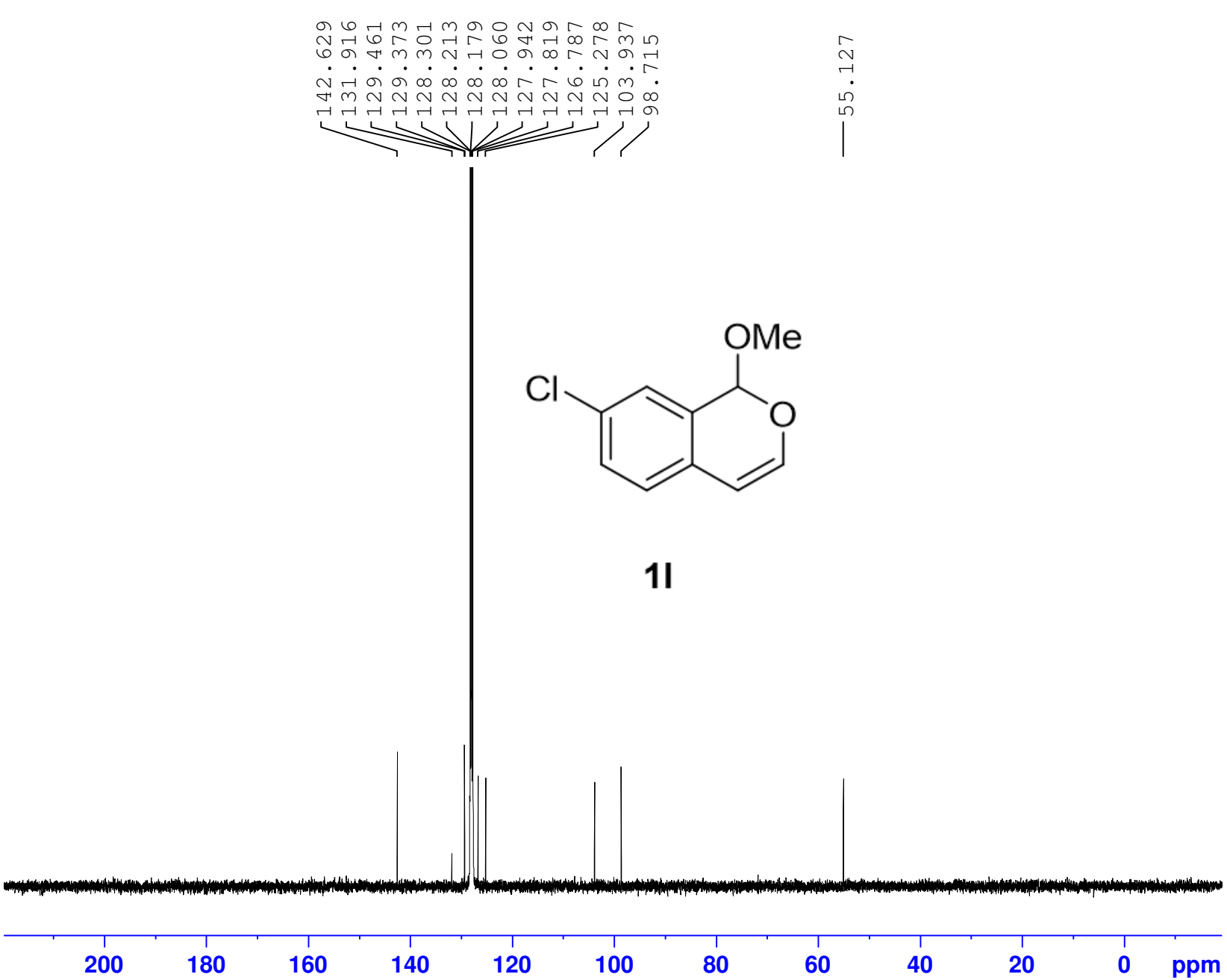


Current Data Parameters
NAME wuan-121-1
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151209
Time 21.15
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 4
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 187.77
DW 62.400 usec
DE 6.50 usec
TE 296.6 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1300283 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



1l

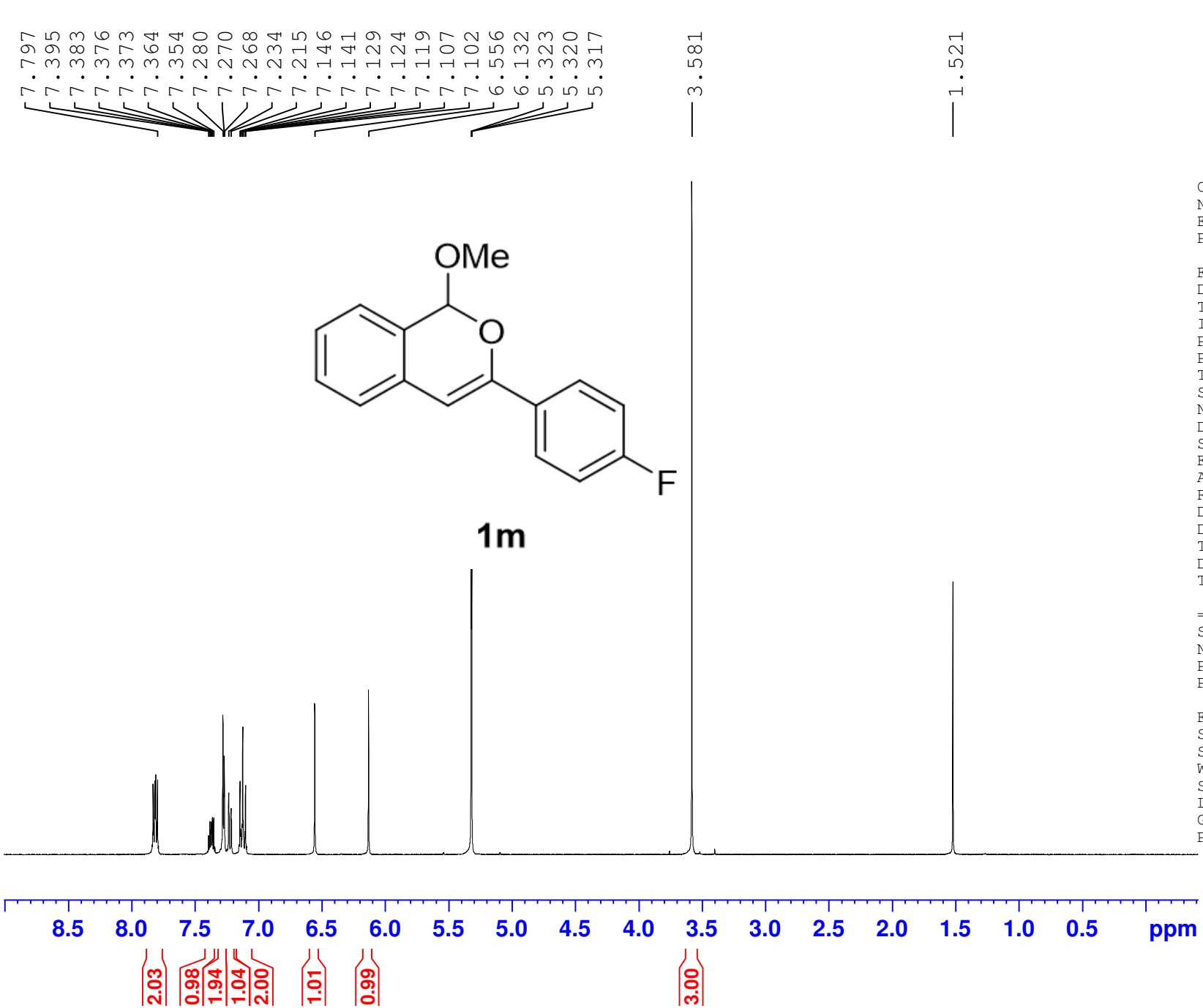
```
Current Data Parameters
NAME          wuan-121-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151209
Time               21.16
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   325
DS                     0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                297.1 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                 13C
P1                  9.70 usec
PLW1         46.98899841 W

======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127392 MHz
WDW                  EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```

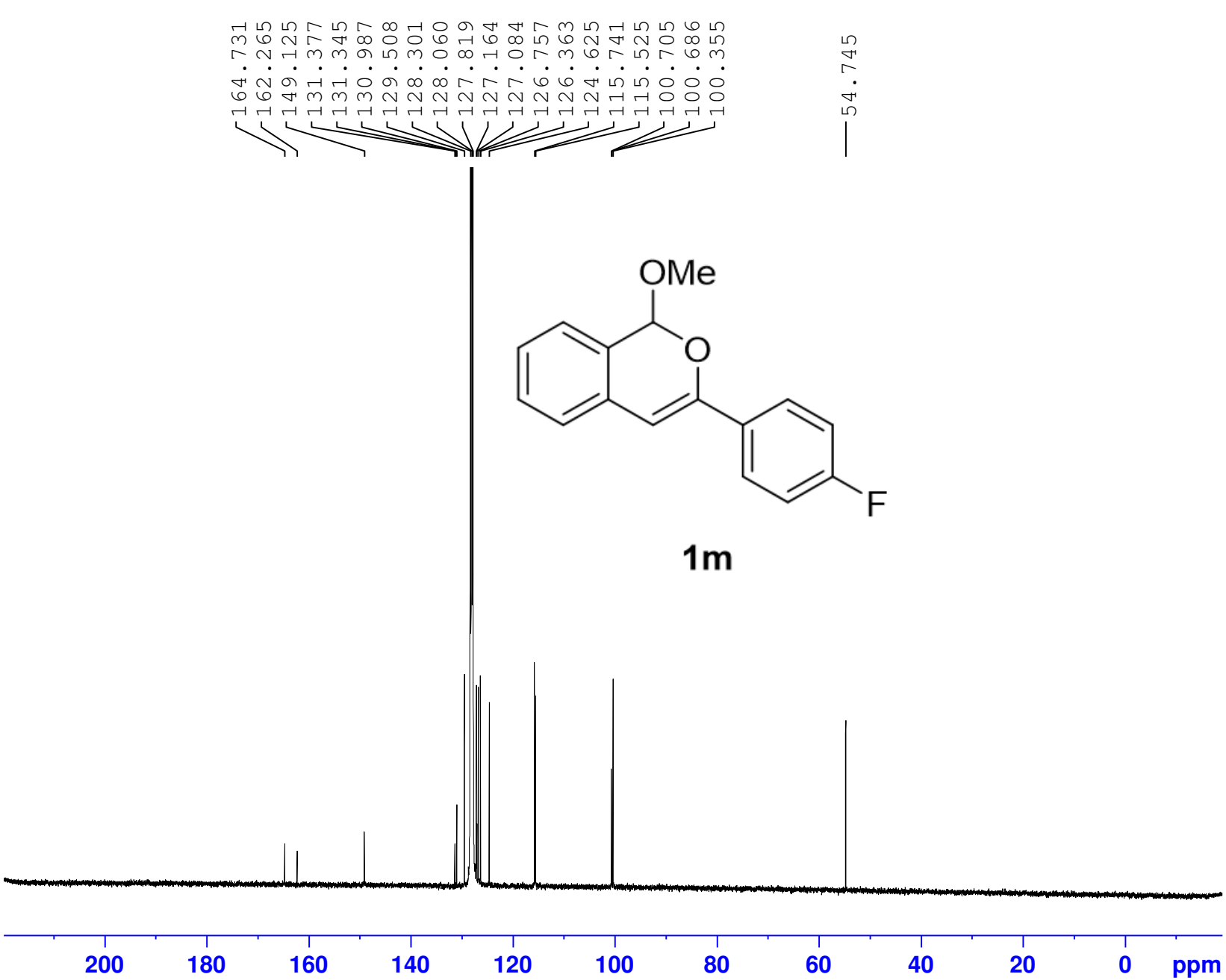



```
Current Data Parameters
NAME          wuan-190-1
EXPNO                  4
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160901
Time               23.42
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT          CD2Cl2
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 299.6 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300153 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



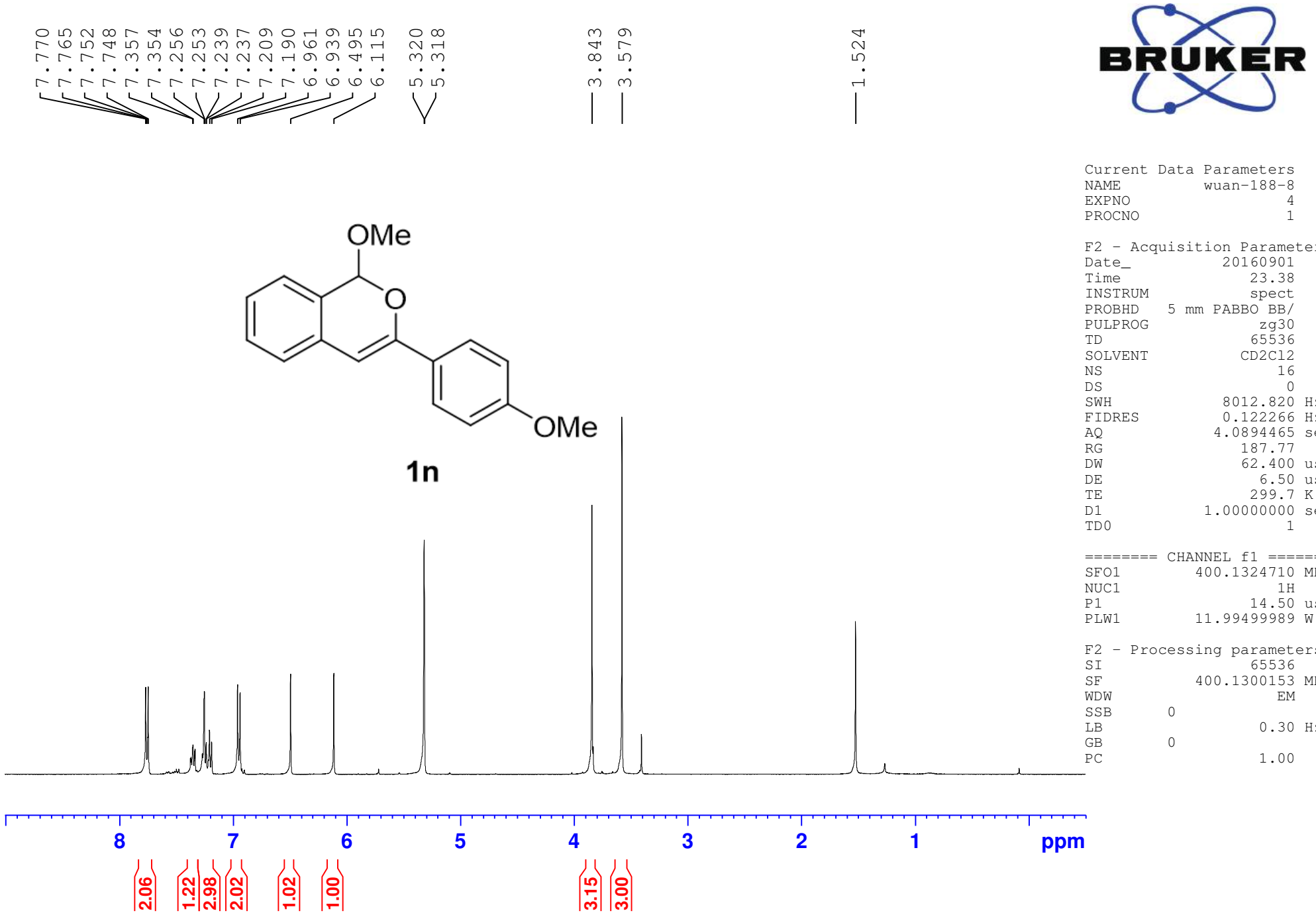

```
Current Data Parameters
NAME          wuan-190-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160113
Time                2.22
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                65536
SOLVENT            C6D6
NS                 9182
DS                    0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                298.1 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1         46.98899841 W

======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                1H
CPDPRG[2        waltz16
PCPD2             90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127308 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

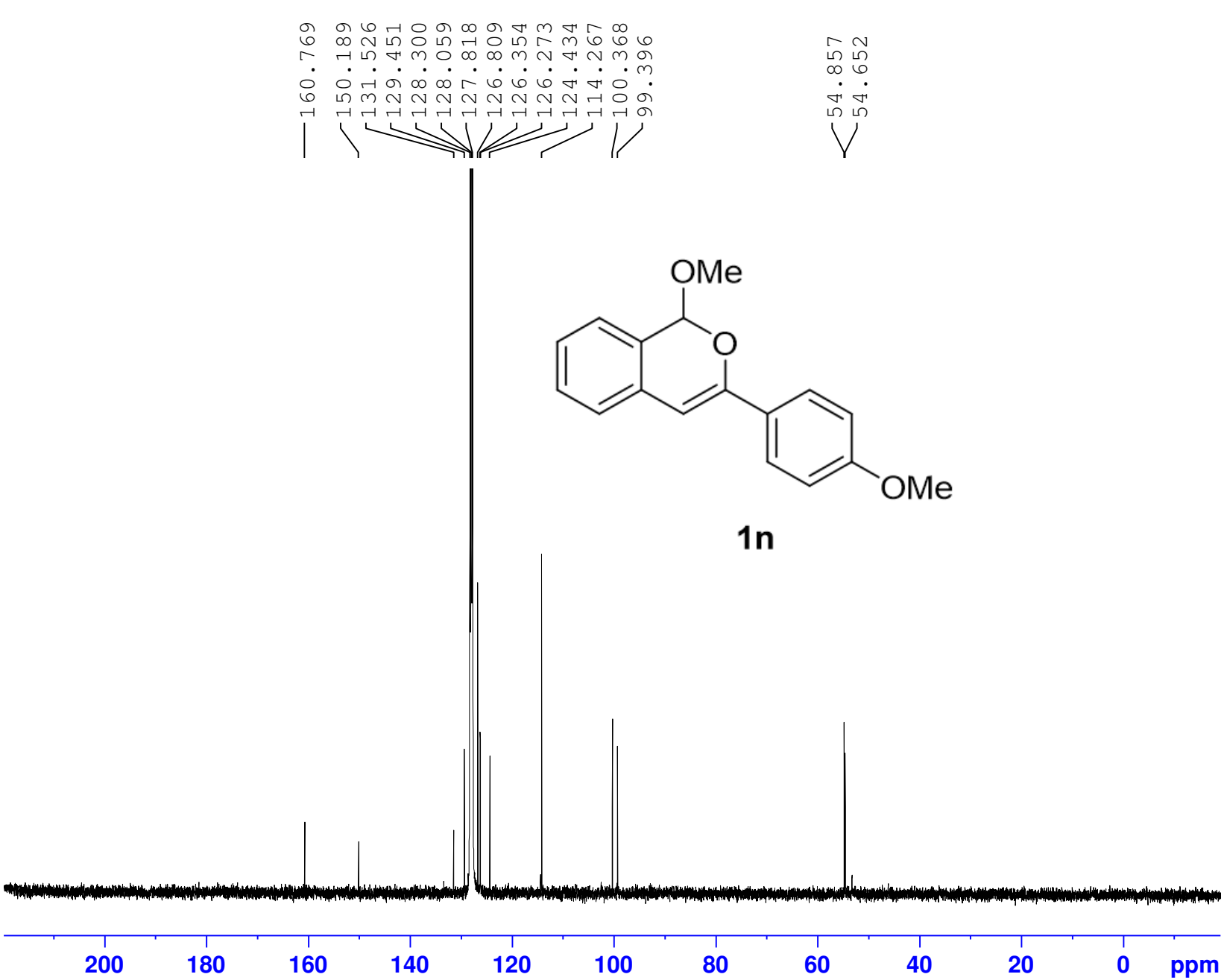



```
Current Data Parameters
NAME          wuan-188-8
EXPNO                  4
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160901
Time               23.38
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT          CD2Cl2
NS                    16
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                187.77
DW                62.400 usec
DE                 6.50 usec
TE                299.7 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300153 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



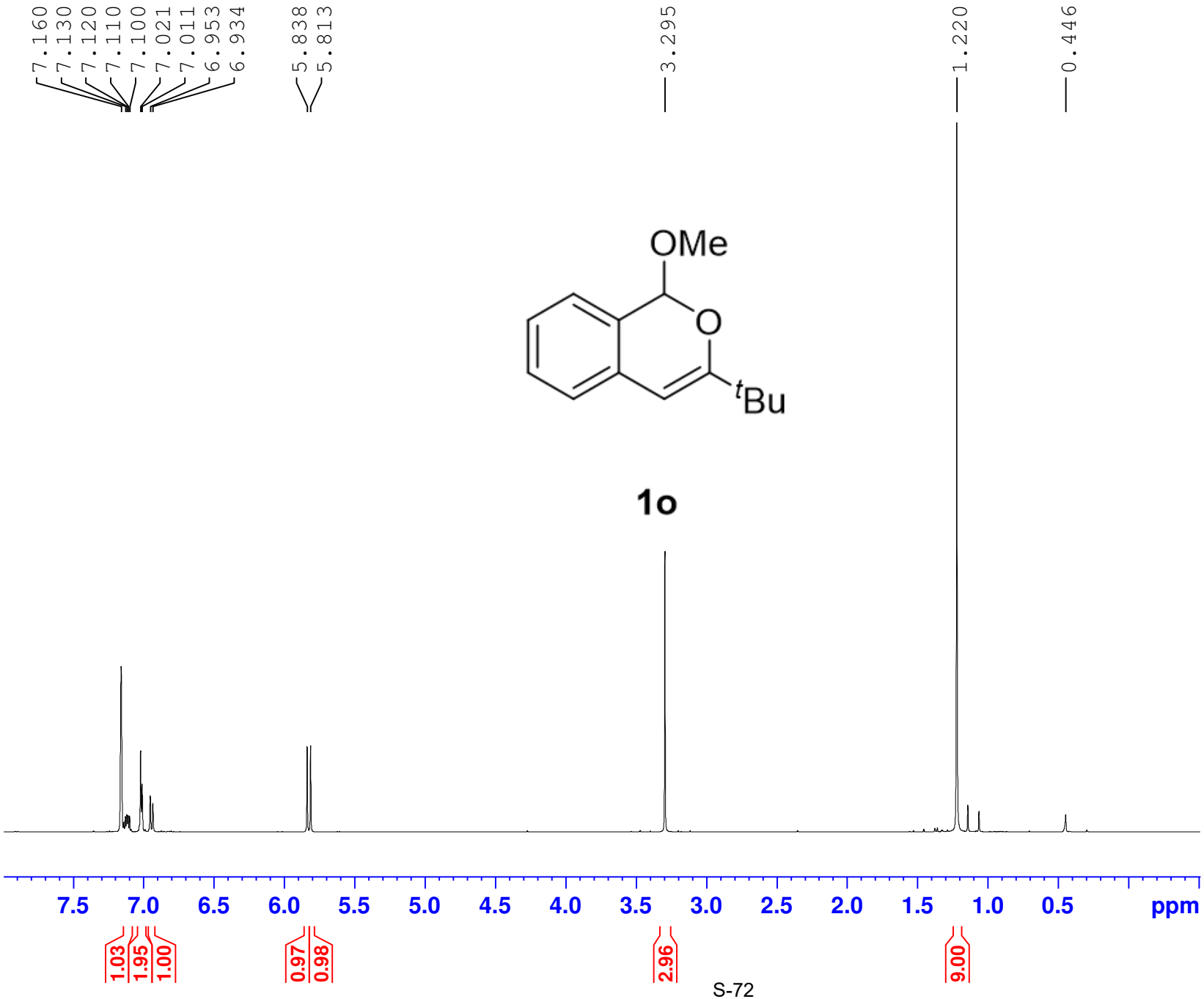

```
Current Data Parameters
NAME          wuan-188-8
EXPNO                  3
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160129
Time               11.34
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            C6D6
NS                  1838
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE               297.1 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2        waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127311 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

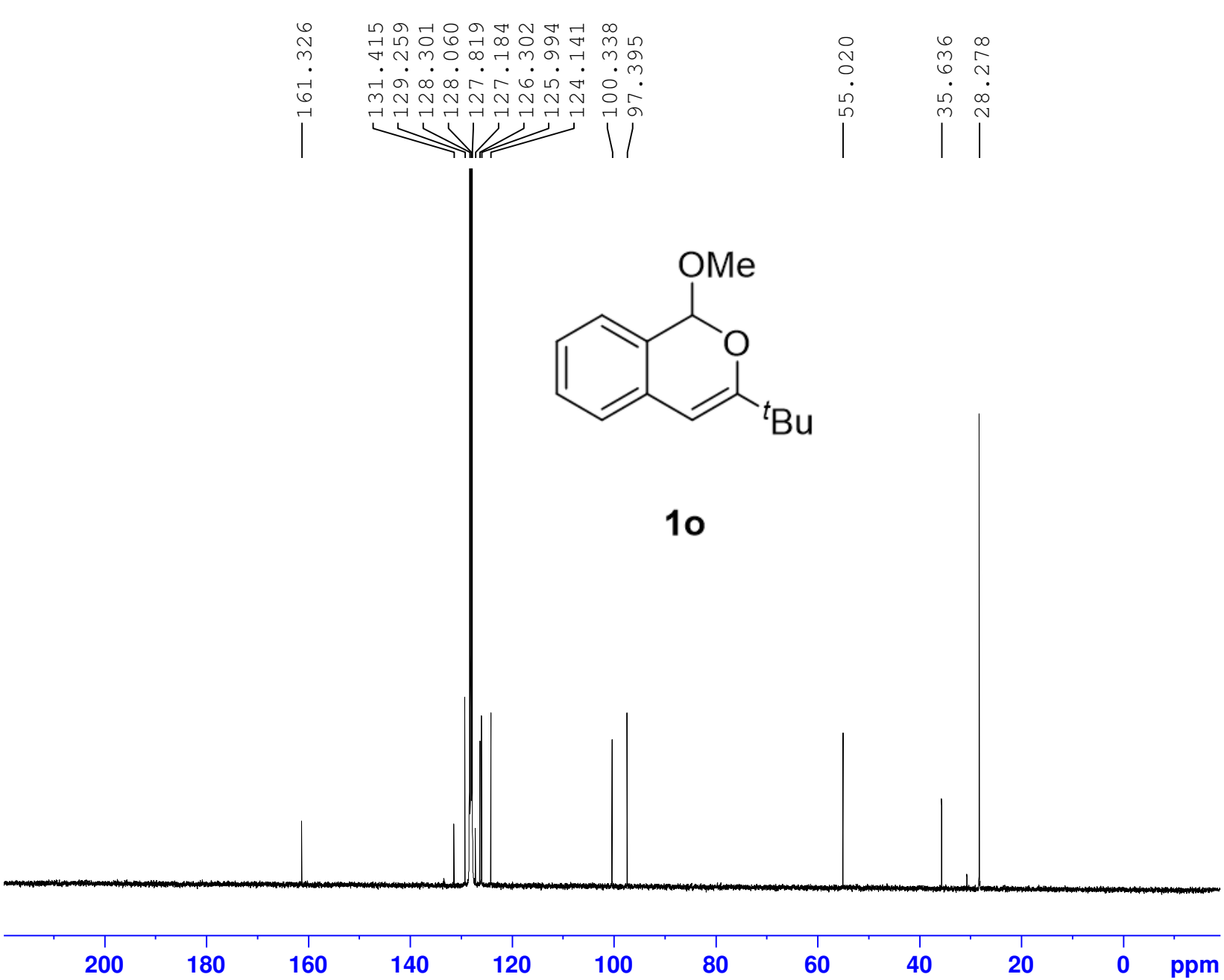



```
Current Data Parameters
NAME                 wuan-189
EXPNO                       3
PROCNO                      1

F2 - Acquisition Parameters
Date_               20160116
Time                   17.33
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                 zg30
TD                     65536
SOLVENT                 C6D6
NS                         4
DS                         0
SWH                 8012.820 Hz
FIDRES              0.122266 Hz
AQ                  4.0894465 sec
RG                     82.92
DW                    62.400 usec
DE                     6.50 usec
TE                    296.6 K
D1                  1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
SFO1             400.1324710 MHz
NUC1                       1H
P1                    14.50 usec
PLW1             11.99499989 W

F2 - Processing parameters
SI                         65536
SF               400.1299965 MHz
WDW                        EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



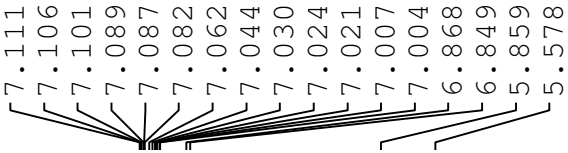

```
Current Data Parameters
NAME                  wuan-189
EXPNO                        4
PROCNO                       1

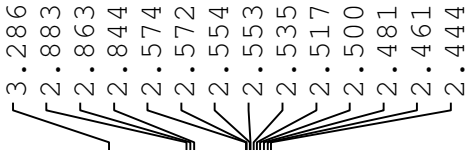
F2 - Acquisition Parameters
Date_                 20160116
Time                     17.41
INSTRUM                  spect
PROBHD    5 mm PABBO BB/
PULPROG                 zgpg30
TD                       65536
SOLVENT                    C6D6
NS                          938
DS                            0
SWH                 24038.461 Hz
FIDRES               0.366798 Hz
AQ                   1.3631488 sec
RG                      196.92
DW                      20.800 usec
DE                       6.50 usec
TE                      297.8 K
D1                  2.00000000 sec
D11                 0.03000000 sec
TD0                          1

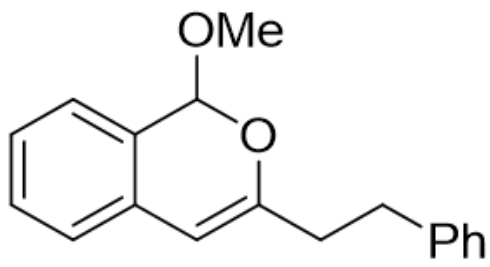
======== CHANNEL f1 ========
SFO1                100.6228298 MHz
NUC1                        13C
P1                        9.70 usec
PLW1                46.98899841 W

======== CHANNEL f2 ========
SFO2                400.1316005 MHz
NUC2                        1H
CPDPRG[2                waltz16
PCPD2                    90.00 usec
PLW2                11.99499989 W
PLW12                0.34213999 W
PLW13                0.27713001 W

F2 - Processing parameters
SI                          32768
SF                  100.6127309 MHz
WDW                            EM
SSB                 0
LB                        1.00 Hz
GB                  0
PC                        1.40
```







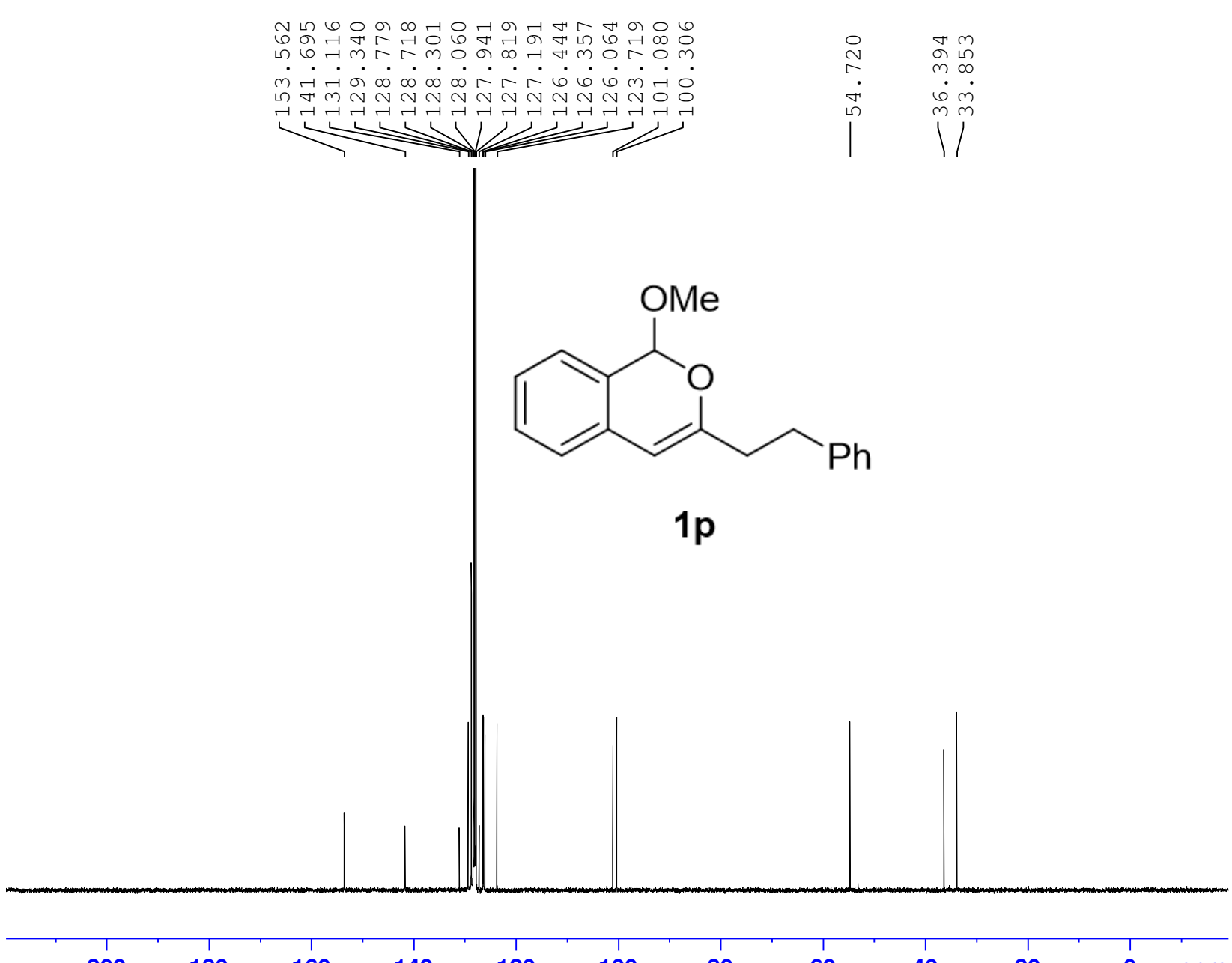
1p


```
Current Data Parameters
NAME          wuan-159-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151223
Time                7.56
INSTRUM            spect
PROBHD   5 mm PABBO BB-
PULPROG             zg30
TD                 65536
SOLVENT             C6D6
NS                     4
DS                     0
SWH             8223.685 Hz
FIDRES          0.125483 Hz
AQ              3.9845889 sec
RG                   128
DW                60.800 usec
DE                 6.00 usec
TE                295.9 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
NUC1                  1H
P1                13.60 usec
PL1               -1.00 dB
SFO1         400.1324710 MHz

F2 - Processing parameters
SI                 32768
SF           400.1300437 MHz
WDW                   EM
SSB       0
LB                0.30 Hz
GB        0
PC                1.00
```



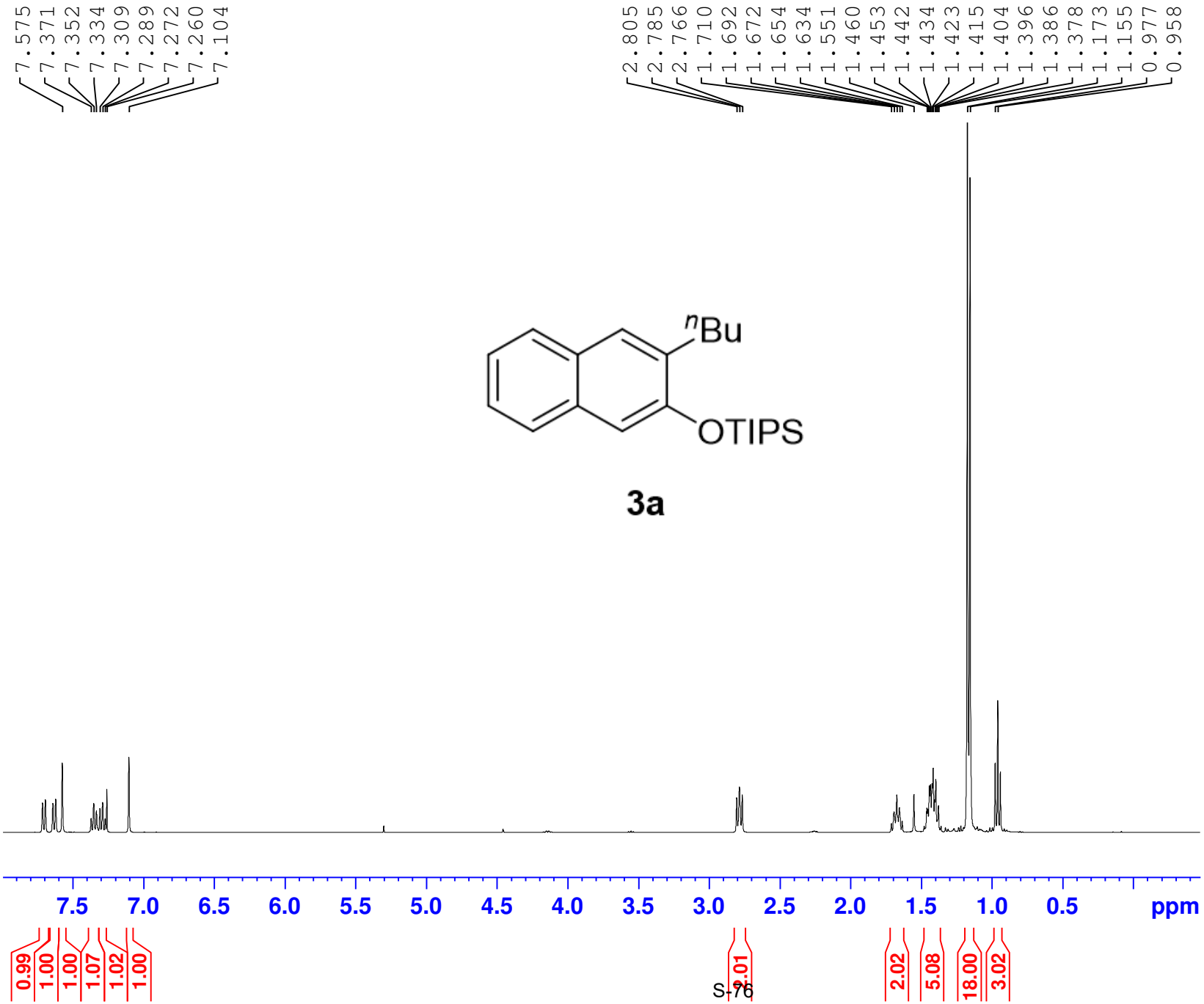

```
Current Data Parameters
NAME                 wuan-159-1
EXPNO                         3
PROCNO                        1

F2 - Acquisition Parameters
Date_                  20151223
Time                       8.10
INSTRUM                   spect
PROBHD    5 mm PABBO BB-
PULPROG                  zgpg30
TD                        65536
SOLVENT                     C6D6
NS                           229
DS                             0
SWH                  24038.461 Hz
FIDRES                0.366798 Hz
AQ                    1.3631488 sec
RG                         2050
DW                       20.800 usec
DE                        6.00 usec
TE                        296.7 K
D1                   2.00000000 sec
d11                  0.03000000 sec
DELTA                1.89999998 sec
TD0                            1

======== CHANNEL f1 ========
NUC1                         13C
P1                         9.25 usec
PL1                       -3.00 dB
SFO1                100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2                waltz16
NUC2                         1H
PCPD2                     80.00 usec
PL12                      12.45 dB
PL13                      18.00 dB
PL2                       -1.00 dB
SFO2                400.1316005 MHz

F2 - Processing parameters
SI                           32768
SF                  100.6127441 MHz
WDW                             EM
SSB                0
LB                         1.00 Hz
GB                 0
PC                         1.40
```

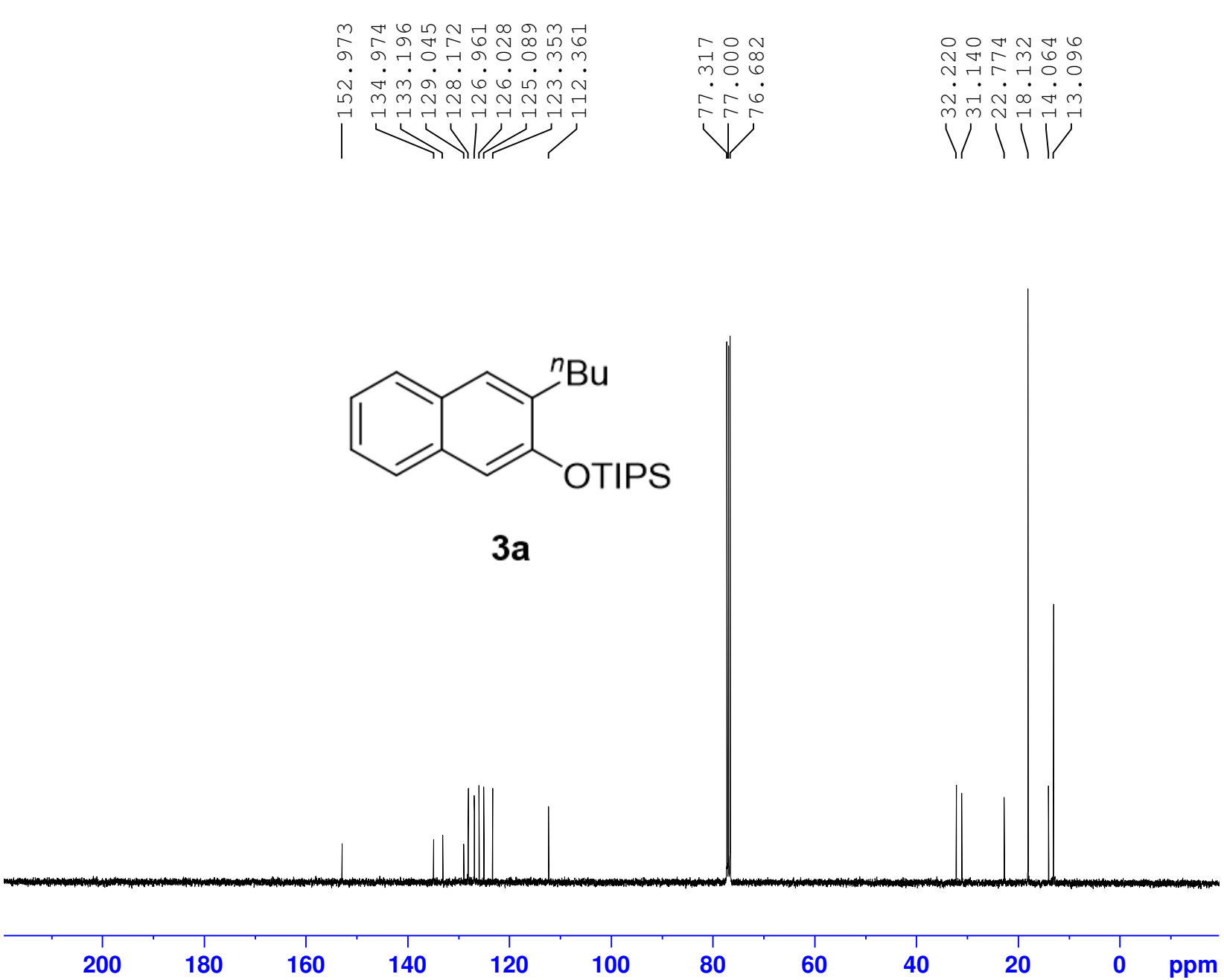


Current Data Parameters
NAME wuan-55-1
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151209
Time 18.12
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 70.97
DW 62.400 usec
DE 6.50 usec
TE 296.0 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1300094 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



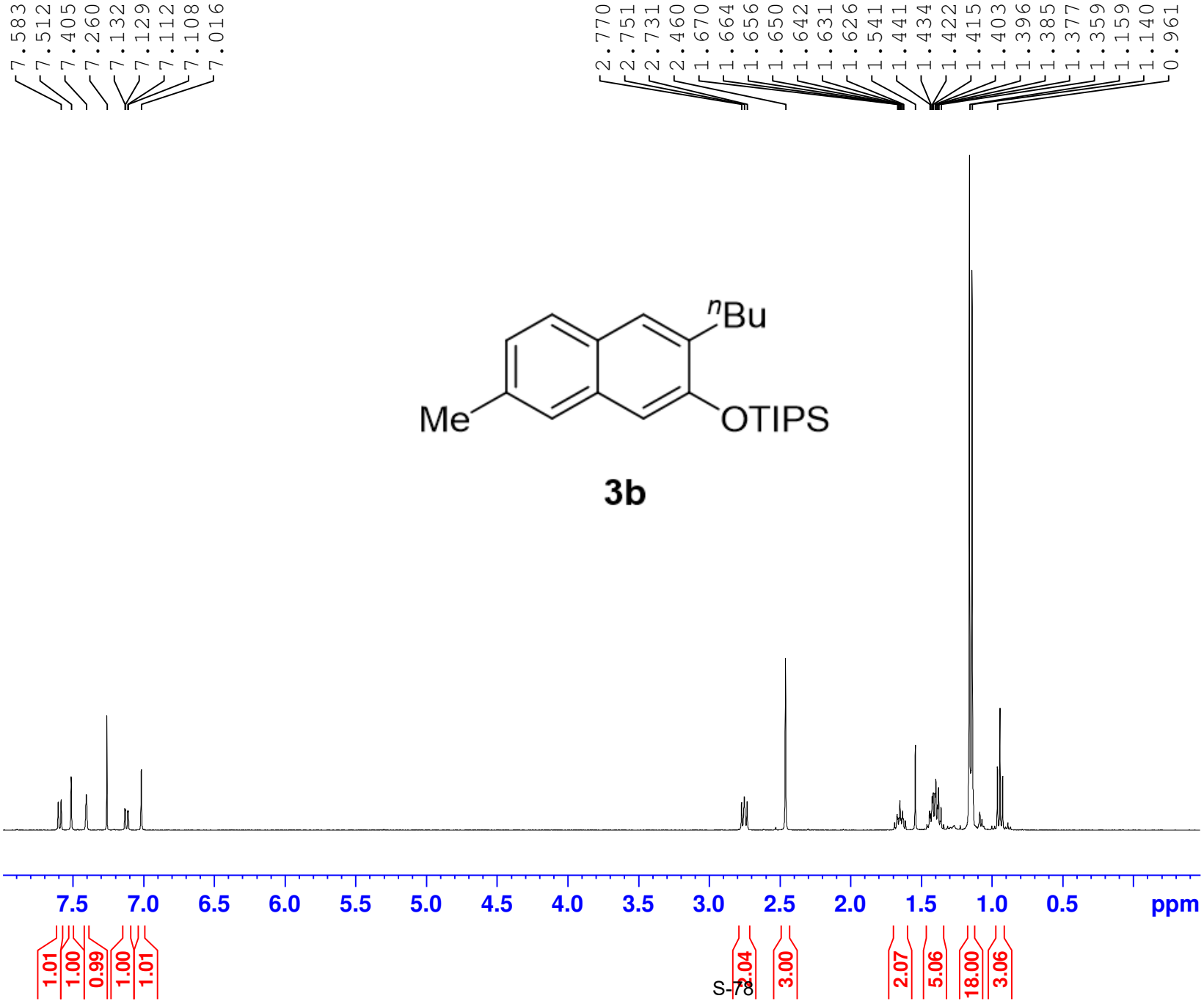

```
Current Data Parameters
NAME                wuan-55-1
EXPNO                       3
PROCNO                      1

F2 - Acquisition Parameters
Date_                20151209
Time                    18.23
INSTRUM                 spect
PROBHD    5 mm PABBO BB/
PULPROG                zgpg30
TD                      65536
SOLVENT                 CDCl3
NS                        237
DS                          0
SWH                24038.461 Hz
FIDRES              0.366798 Hz
AQ                  1.3631488 sec
RG                     196.92
DW                     20.800 usec
DE                      6.50 usec
TE                     297.1 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1             100.6228298 MHz
NUC1                     13C
P1                      9.70 usec
PLW1             46.98899841 W

======== CHANNEL f2 ========
SFO2             400.1316005 MHz
NUC2                     1H
CPDPRG[2              waltz16
PCPD2                   90.00 usec
PLW2             11.99499989 W
PLW12             0.34213999 W
PLW13             0.27713001 W

F2 - Processing parameters
SI                      32768
SF               100.6127712 MHz
WDW                        EM
SSB          0
LB                      1.00 Hz
GB           0
PC                      1.40
```

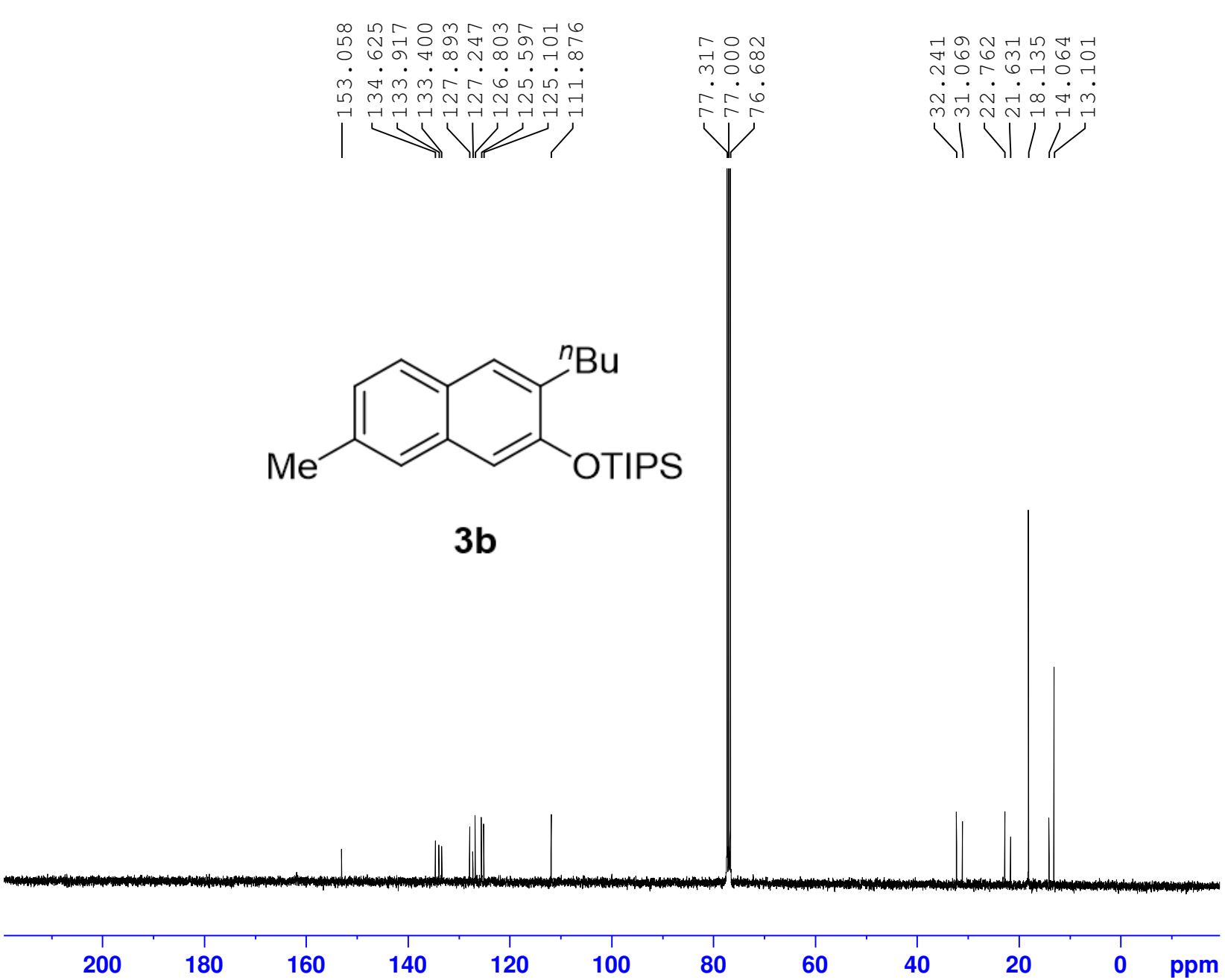



```
Current Data Parameters
NAME                  wuan-119A
EXPNO                         1
PROCNO                        1

F2 - Acquisition Parameters
Date_                  20151113
Time                      19.25
INSTRUM                   spect
PROBHD    5 mm PABBO BB-
PULPROG                    zg30
TD                        65536
SOLVENT                   CDCl3
NS                            4
DS                            0
SWH                    8223.685 Hz
FIDRES                 0.125483 Hz
AQ                     3.9845889 sec
RG                          406
DW                        60.800 usec
DE                         6.00 usec
TE                        293.7 K
D1                    1.00000000 sec
TD0                           1

======== CHANNEL f1 ========
NUC1                         1H
P1                        13.60 usec
PL1                       -1.00 dB
SFO1                400.1324710 MHz

F2 - Processing parameters
SI                        32768
SF                  400.1300054 MHz
WDW                          EM
SSB                   0
LB                        0.30 Hz
GB                    0
PC                        1.00
```



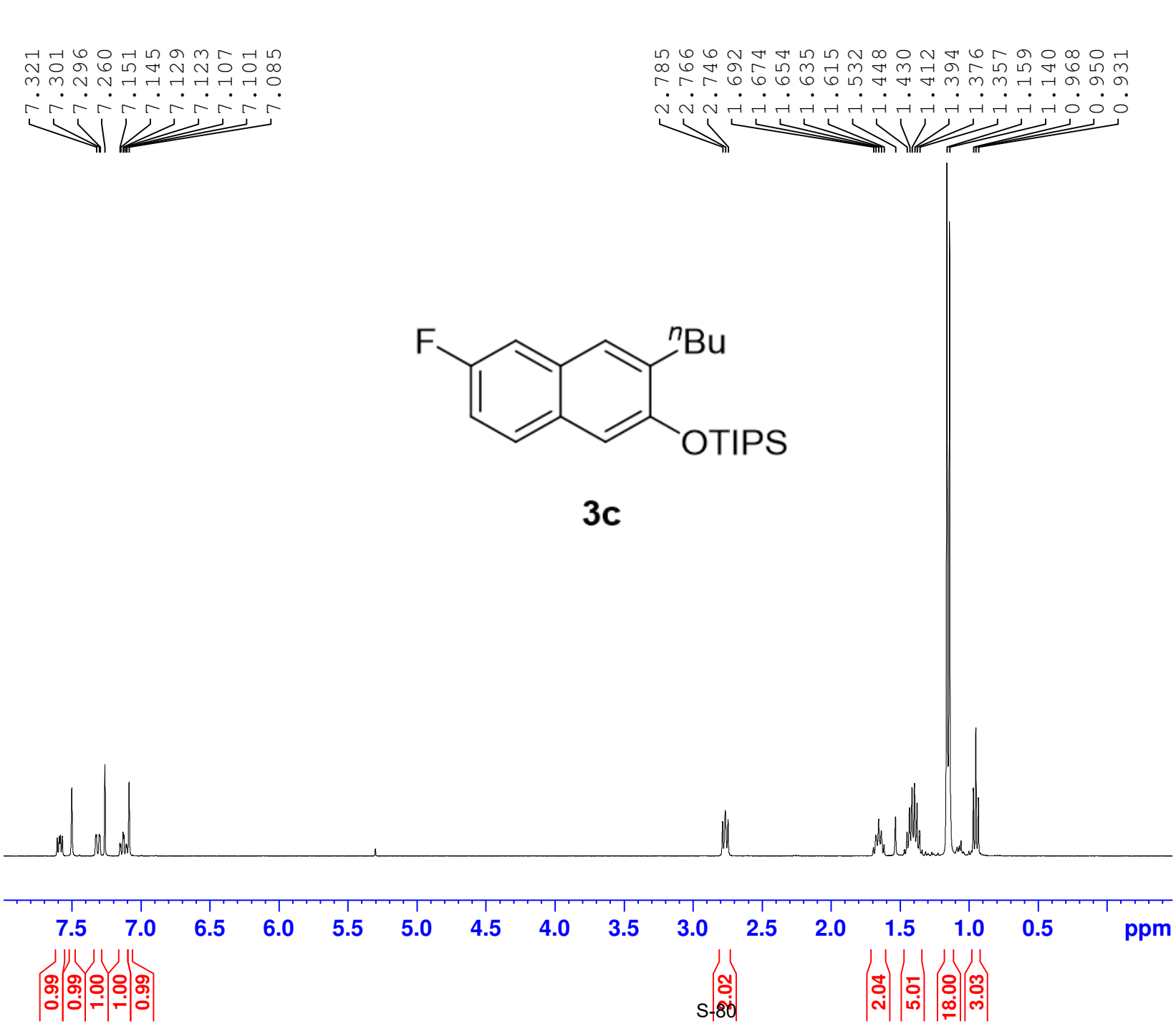
Current Data Parameters
NAME wuan-119A
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151114
Time 11.30
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 441
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 297.9 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127705 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

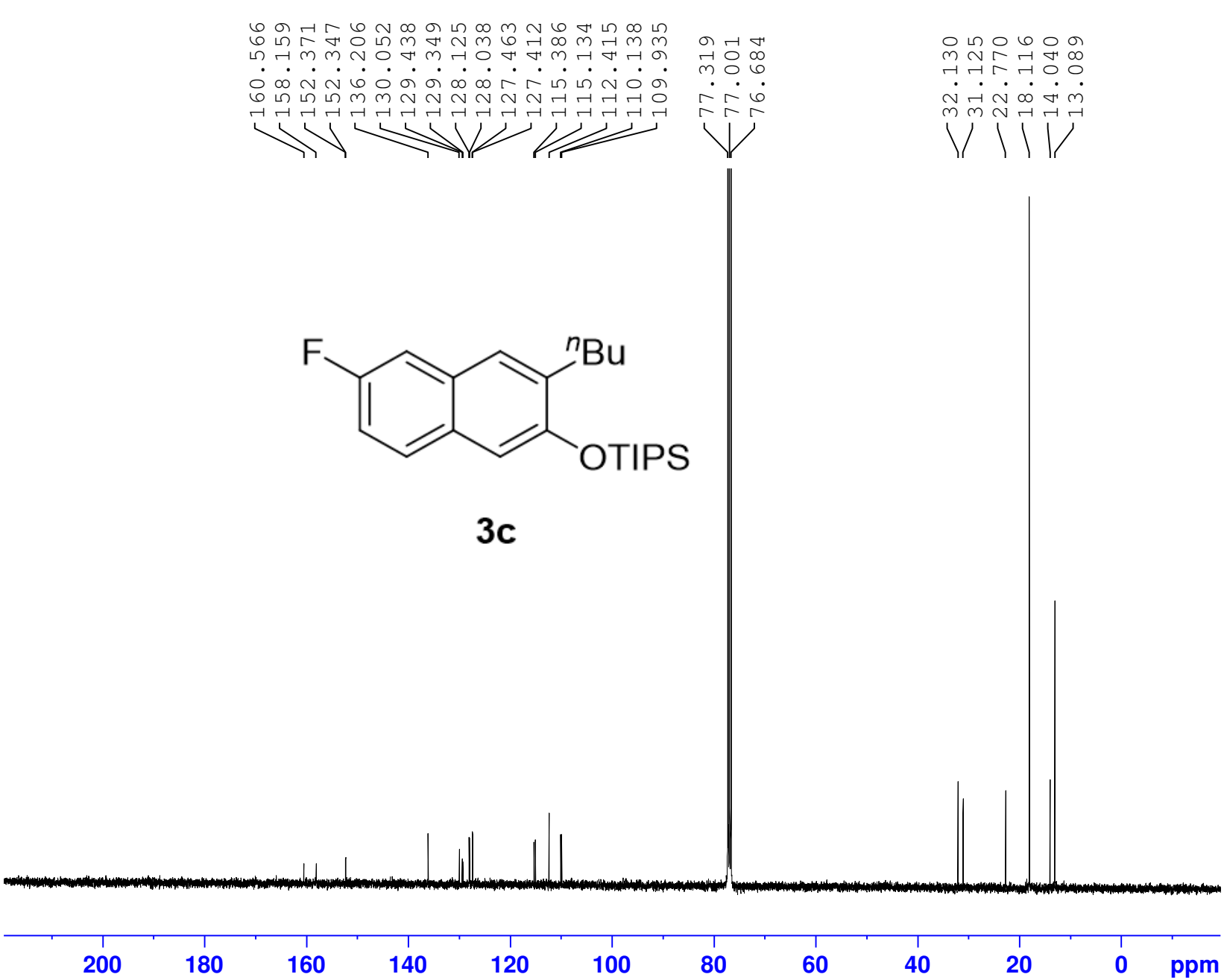


Current Data Parameters
NAME wuan-129-1
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151127
Time 14.47
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 4
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 103.52
DW 62.400 usec
DE 6.50 usec
TE 296.3 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1300092 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



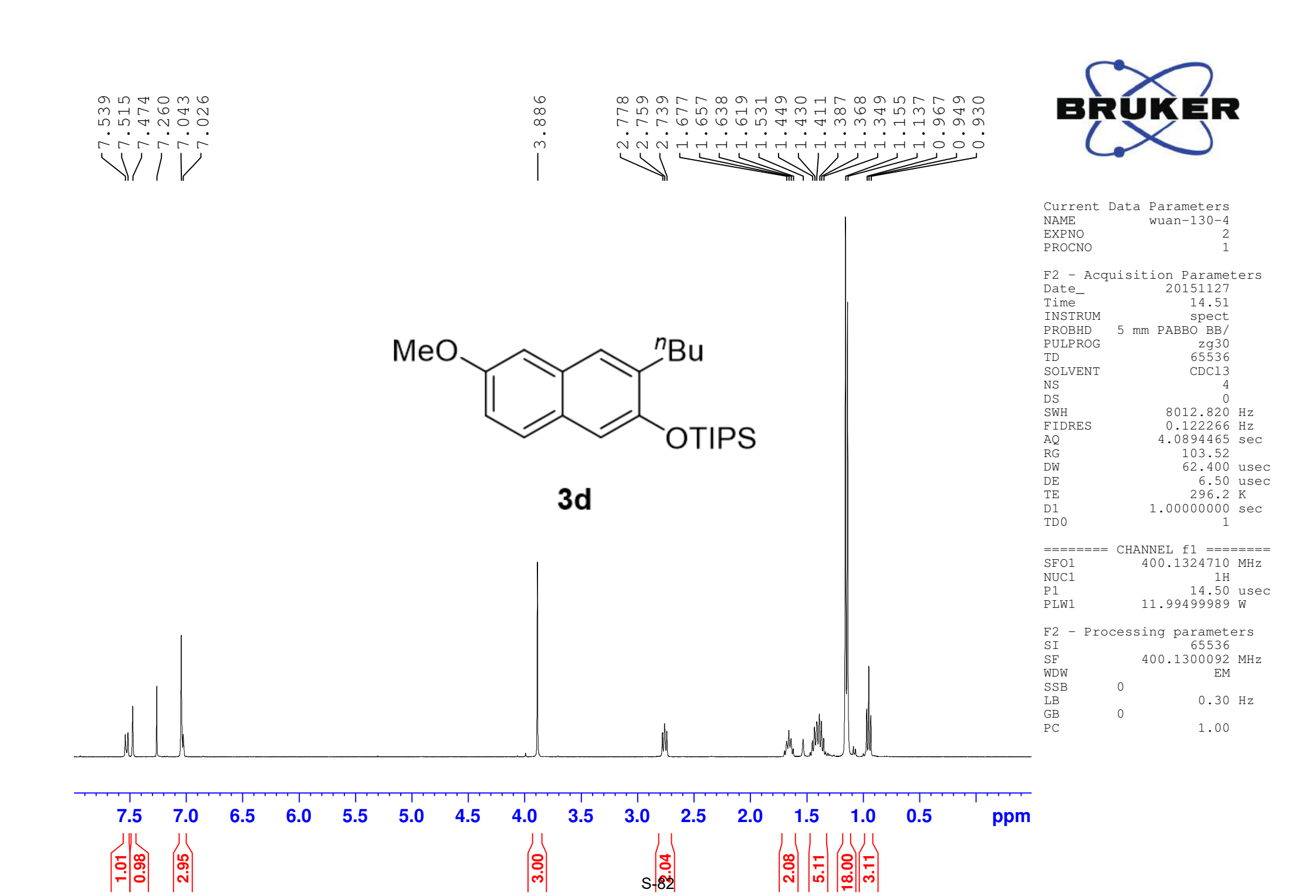

```
Current Data Parameters
NAME          wuan-129-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151128
Time               19.16
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                  1167
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                299.1 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127693 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```

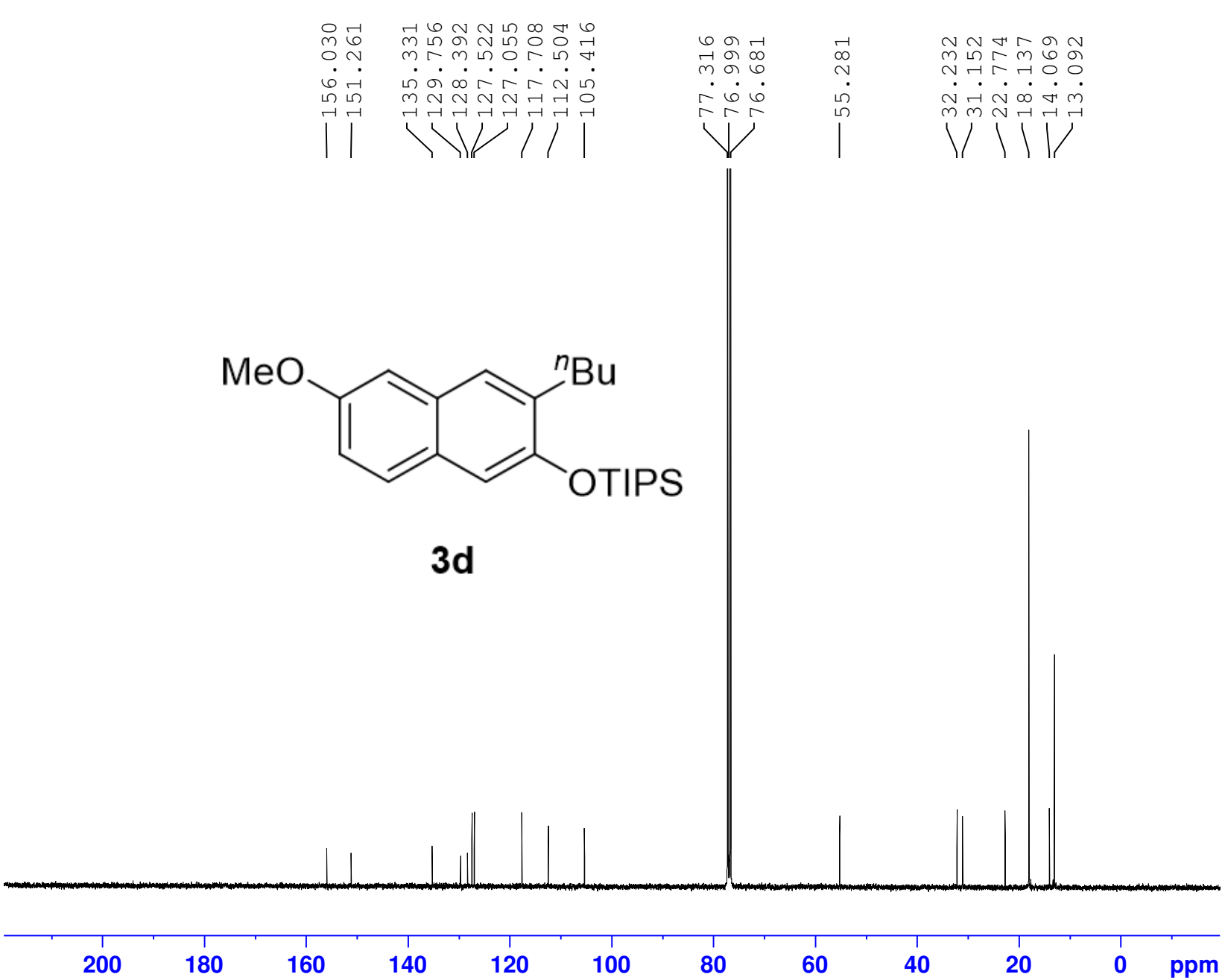


Current Data Parameters
NAME wuan-130-4
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151127
Time 14.51
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 4
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 103.52
DW 62.400 usec
DE 6.50 usec
TE 296.2 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1300092 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



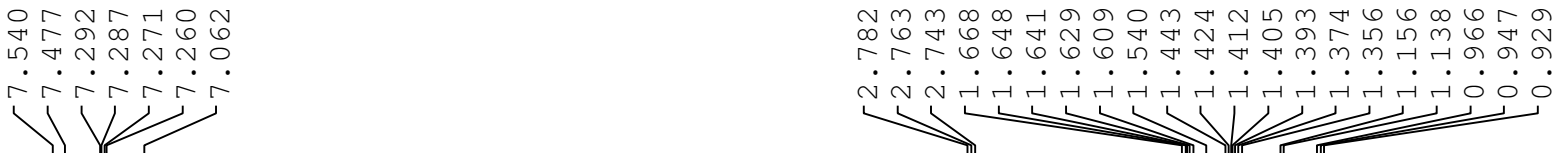

```
Current Data Parameters
NAME          wuan-130-4
EXPNO                  3
PROCNO                 1

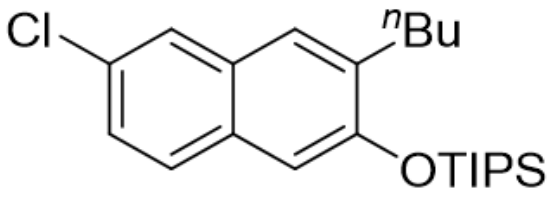
F2 - Acquisition Parameters
Date_           20151203
Time               12.23
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                  1076
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                297.2 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127707 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```





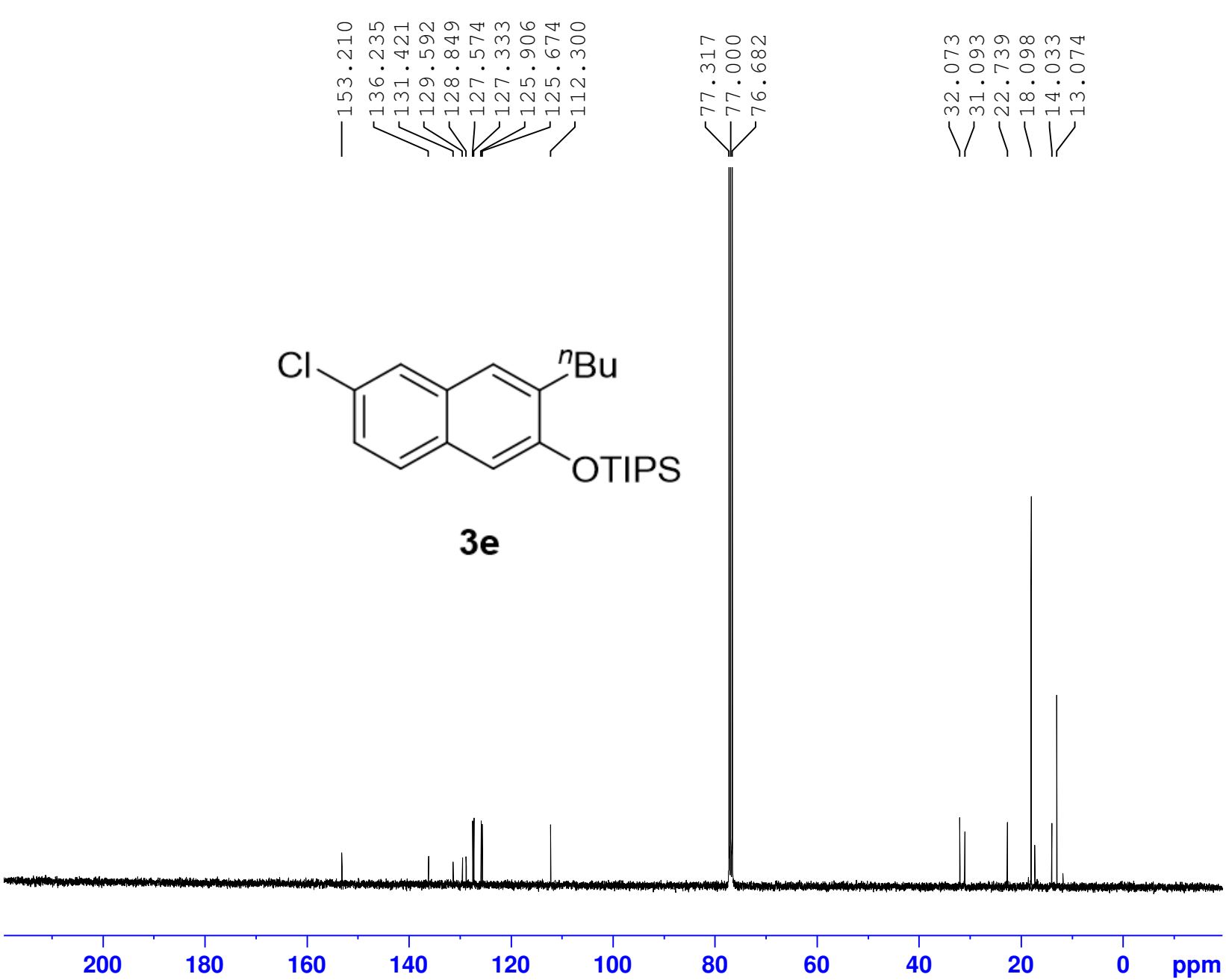
3e


```
Current Data Parameters
NAME          wuan-133-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151128
Time               11.25
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 297.1 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300093 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



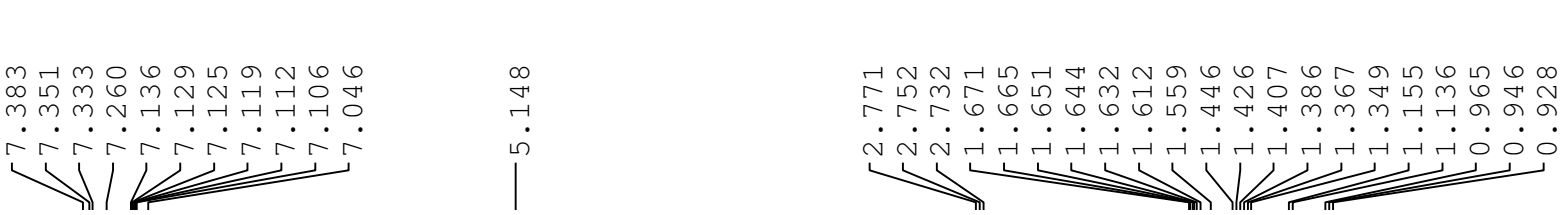
Current Data Parameters
NAME wuan-133-1
EXPNO 2
PROCNO 1

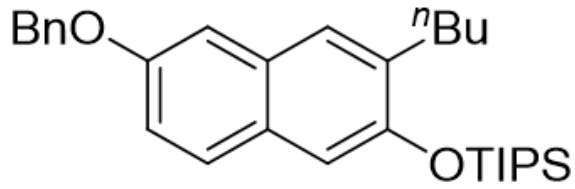
F2 - Acquisition Parameters
Date_ 20151128
Time 11.39
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 844
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 298.1 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127697 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40





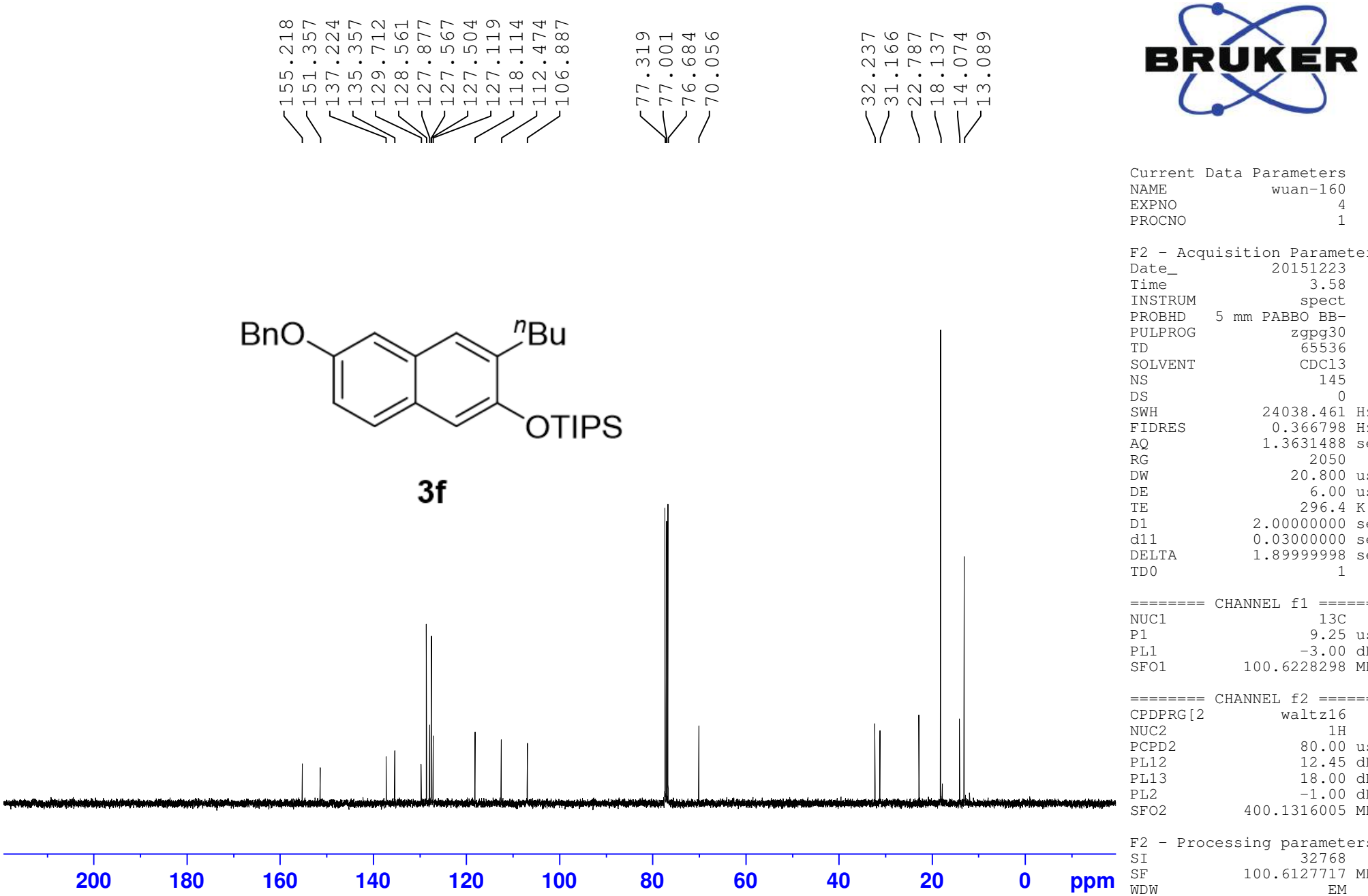
3f


```
Current Data Parameters
NAME                  wuan-160
EXPNO                        2
PROCNO                       1

F2 - Acquisition Parameters
Date_                 20151218
Time                     18.26
INSTRUM                  spect
PROBHD    5 mm PABBO BB-
PULPROG                   zg30
TD                       65536
SOLVENT                  CDCl3
NS                           4
DS                           0
SWH                   8223.685 Hz
FIDRES                0.125483 Hz
AQ                    3.9845889 sec
RG                         406
DW                      60.800 usec
DE                       6.00 usec
TE                       293.4 K
D1                  1.00000000 sec
TD0                          1

======== CHANNEL f1 ========
NUC1                        1H
P1                       13.60 usec
PL1                      -1.00 dB
SFO1              400.1324710 MHz

F2 - Processing parameters
SI                       32768
SF                400.1300054 MHz
WDW                         EM
SSB          0
LB                       0.30 Hz
GB           0
PC                       1.00
```



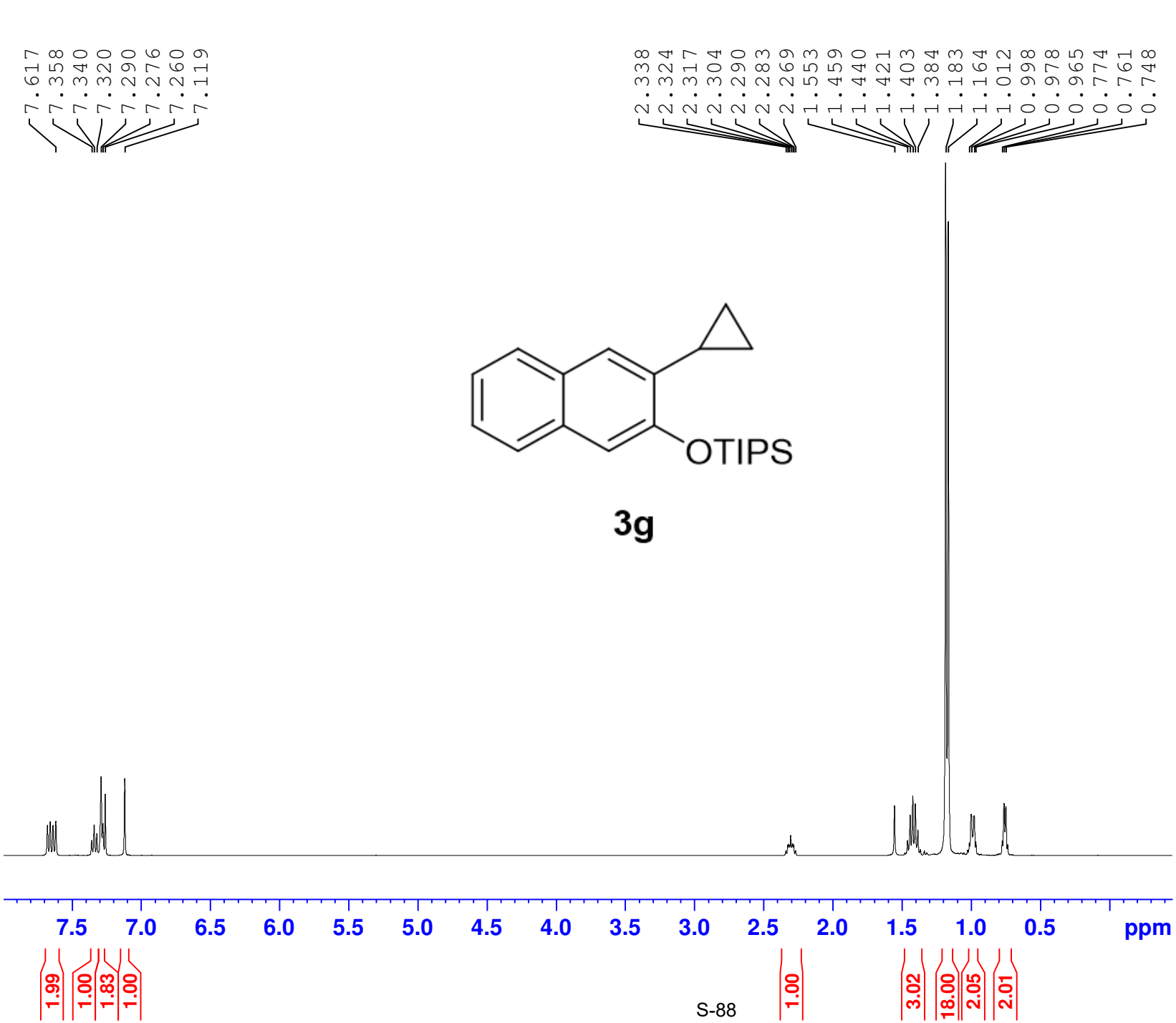

```
Current Data Parameters
NAME                 wuan-160
EXPNO                       4
PROCNO                      1

F2 - Acquisition Parameters
Date_               20151223
Time                    3.58
INSTRUM                spect
PROBHD    5 mm PABBO BB-
PULPROG                zgpg30
TD                      65536
SOLVENT                 CDCl3
NS                        145
DS                          0
SWH                24038.461 Hz
FIDRES              0.366798 Hz
AQ                  1.3631488 sec
RG                       2050
DW                     20.800 usec
DE                      6.00 usec
TE                     296.4 K
D1                 2.00000000 sec
d11                0.03000000 sec
DELTA              1.89999998 sec
TD0                         1

======== CHANNEL f1 ========
NUC1                       13C
P1                        9.25 usec
PL1                      -3.00 dB
SFO1              100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2               waltz16
NUC2                       1H
PCPD2                   80.00 usec
PL12                    12.45 dB
PL13                    18.00 dB
PL2                     -1.00 dB
SFO2              400.1316005 MHz

F2 - Processing parameters
SI                       32768
SF                100.6127717 MHz
WDW                         EM
SSB          0
LB                       1.00 Hz
GB           0
PC                       1.40
```



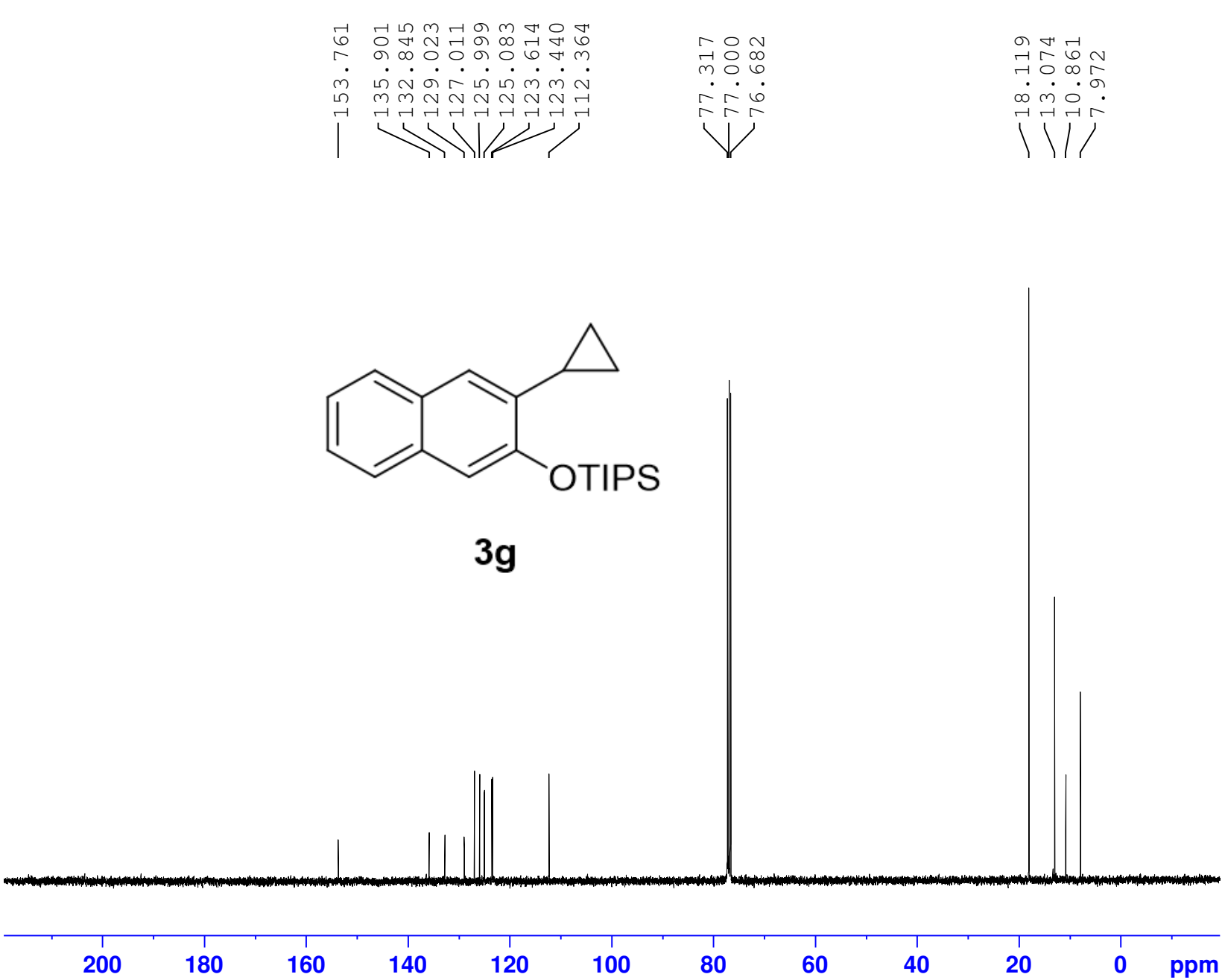
BRUKER

```
Current Data Parameters
NAME          wuan-197-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160202
Time               23.31
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 70.97
DW                62.400 usec
DE                 6.50 usec
TE                296.5 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300092 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



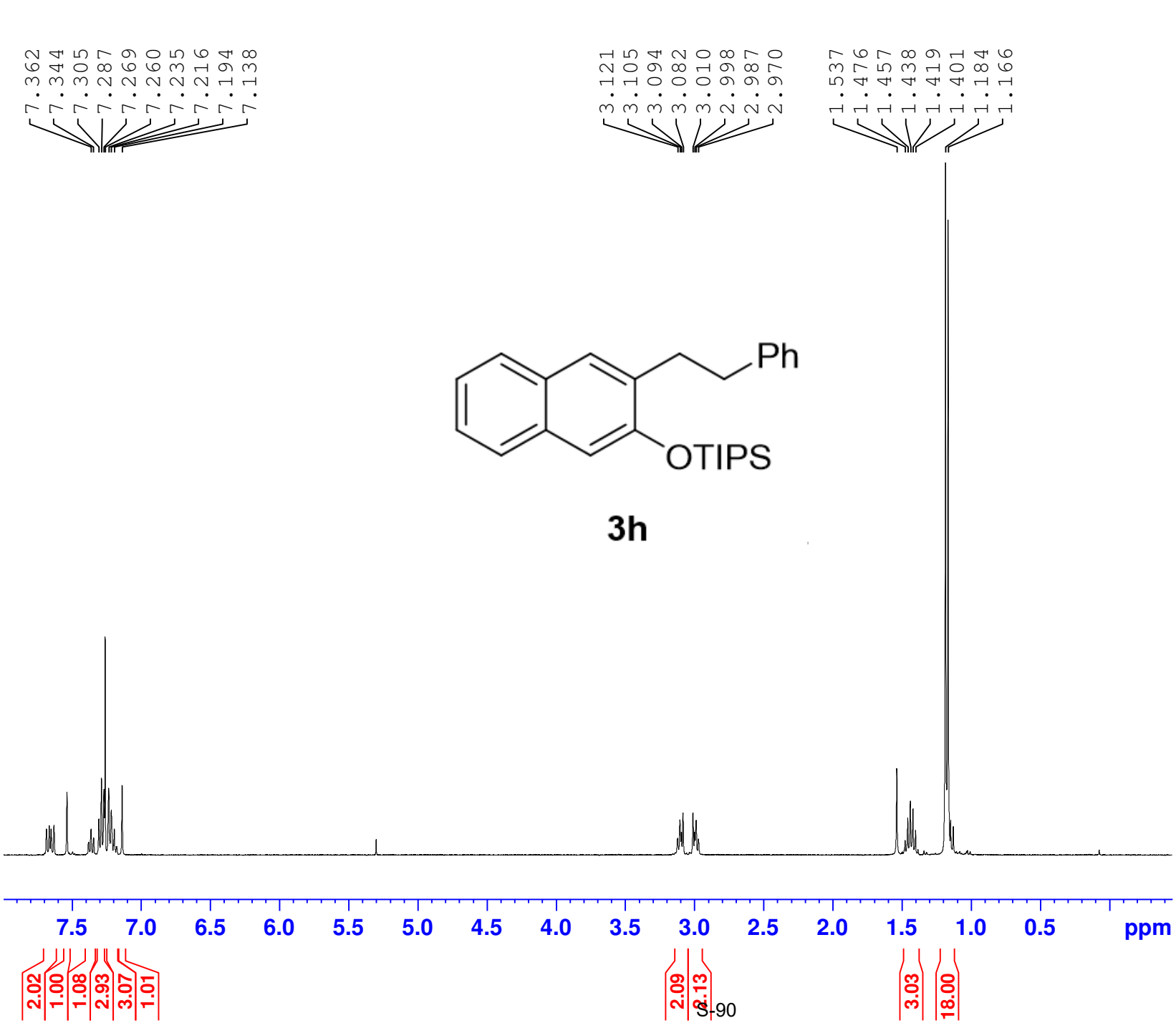

```
Current Data Parameters
NAME          wuan-197-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160202
Time               23.37
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   228
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE               297.5 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127714 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

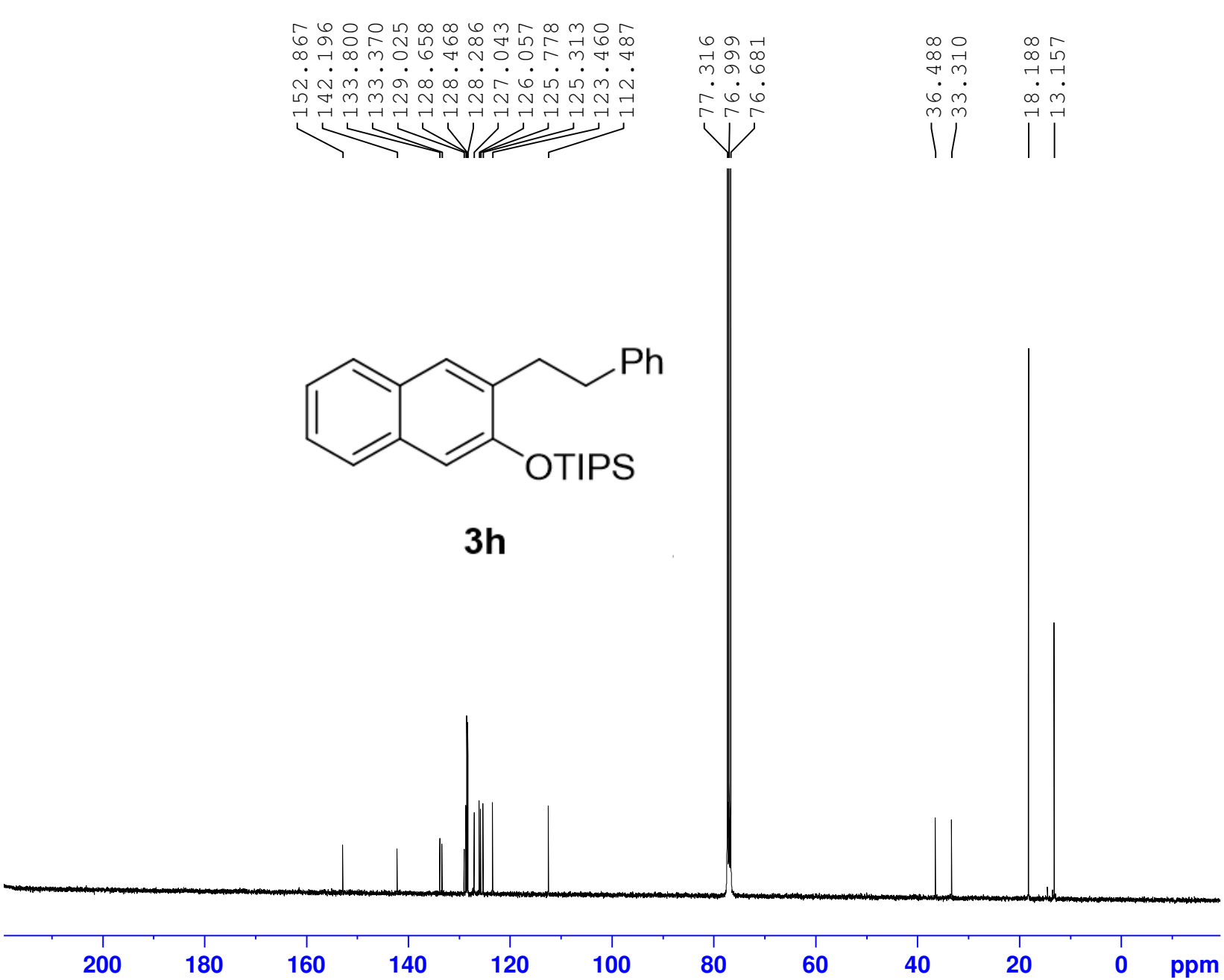



```
Current Data Parameters
NAME          wuan-195-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160113
Time               16.09
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 296.4 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



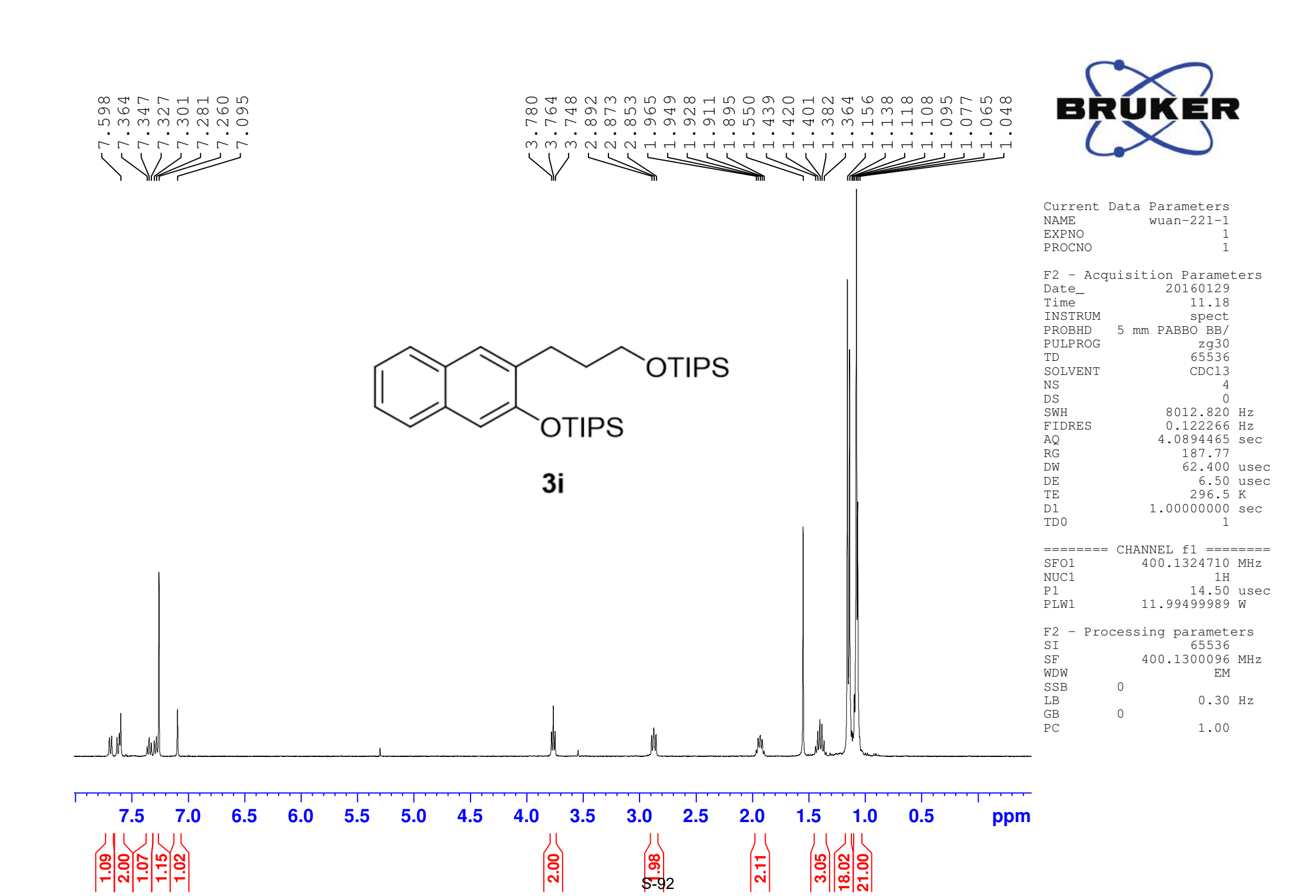
Current Data Parameters
NAME wuan-195-1
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20160116
Time 23.52
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 12734
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 297.5 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127699 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

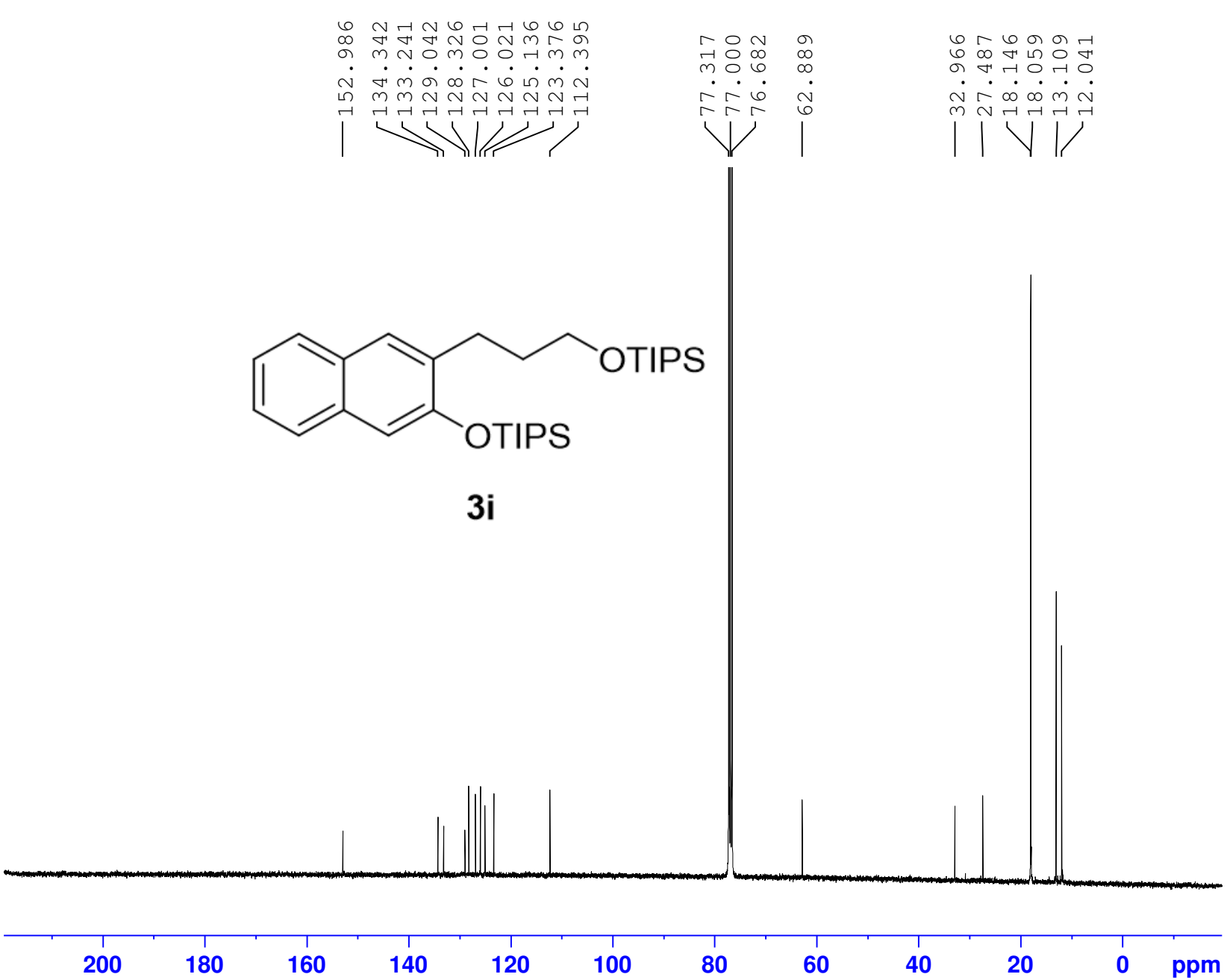


Current Data Parameters
NAME wuan-221-1
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20160129
Time 11.18
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 4
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 187.77
DW 62.400 usec
DE 6.50 usec
TE 296.5 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1300096 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



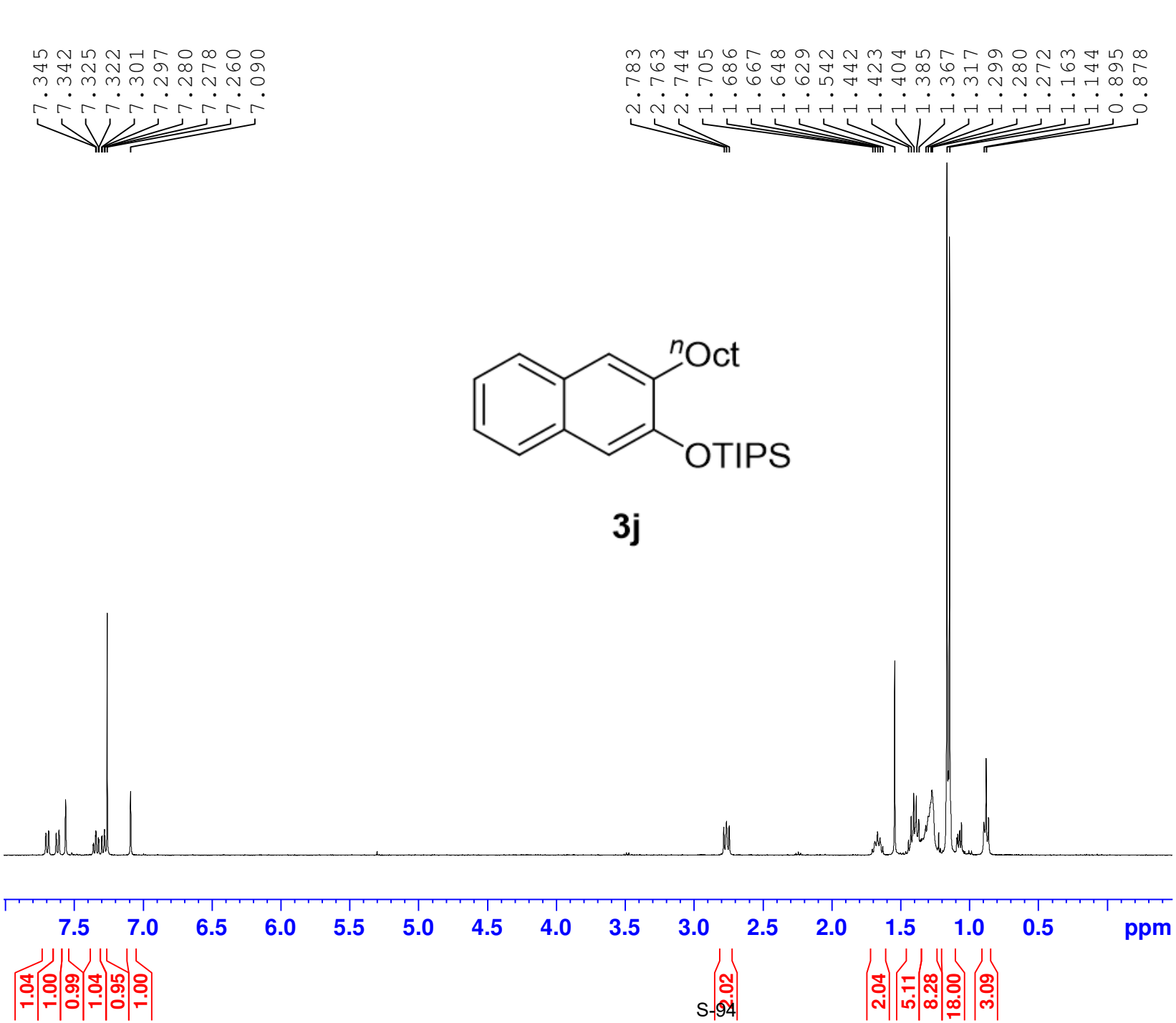
Current Data Parameters
NAME wuan-174
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20160112
Time 9.02
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 10491
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 298.8 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127697 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

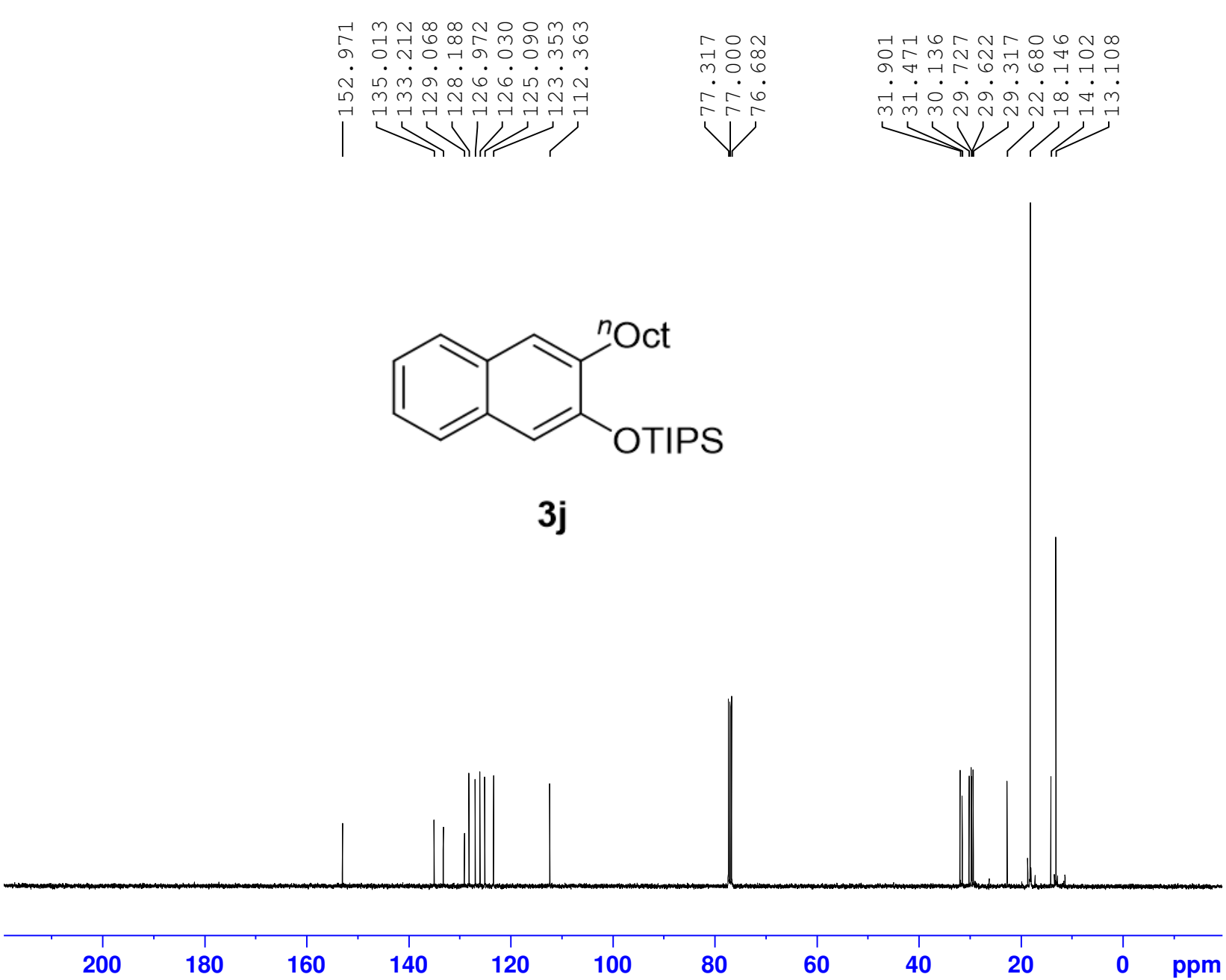


Current Data Parameters
NAME wuan-176
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151231
Time 14.28
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 4
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 187.77
DW 62.400 usec
DE 6.50 usec
TE 296.4 K
D1 1.00000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1300094 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



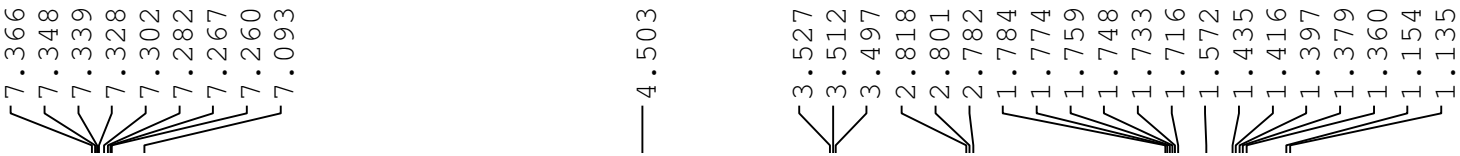

```
Current Data Parameters
NAME                 wuan-176
EXPNO                       2
PROCNO                      1

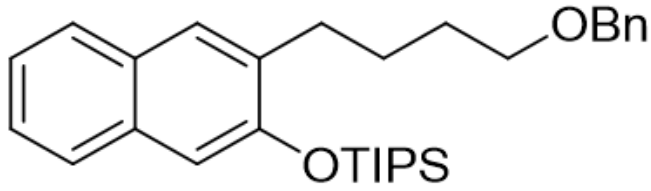
F2 - Acquisition Parameters
Date_               20160202
Time                   20.15
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                zgpg30
TD                      65536
SOLVENT                 CDCl3
NS                        127
DS                          0
SWH                24038.461 Hz
FIDRES              0.366798 Hz
AQ                  1.3631488 sec
RG                     196.92
DW                     20.800 usec
DE                      6.50 usec
TE                     297.5 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1             100.6228298 MHz
NUC1                     13C
P1                      9.70 usec
PLW1             46.98899841 W

======== CHANNEL f2 ========
SFO2             400.1316005 MHz
NUC2                     1H
CPDPRG[2              waltz16
PCPD2                   90.00 usec
PLW2             11.99499989 W
PLW12             0.34213999 W
PLW13             0.27713001 W

F2 - Processing parameters
SI                      32768
SF               100.6127733 MHz
WDW                        EM
SSB          0
LB                      1.00 Hz
GB           0
PC                      1.40
```





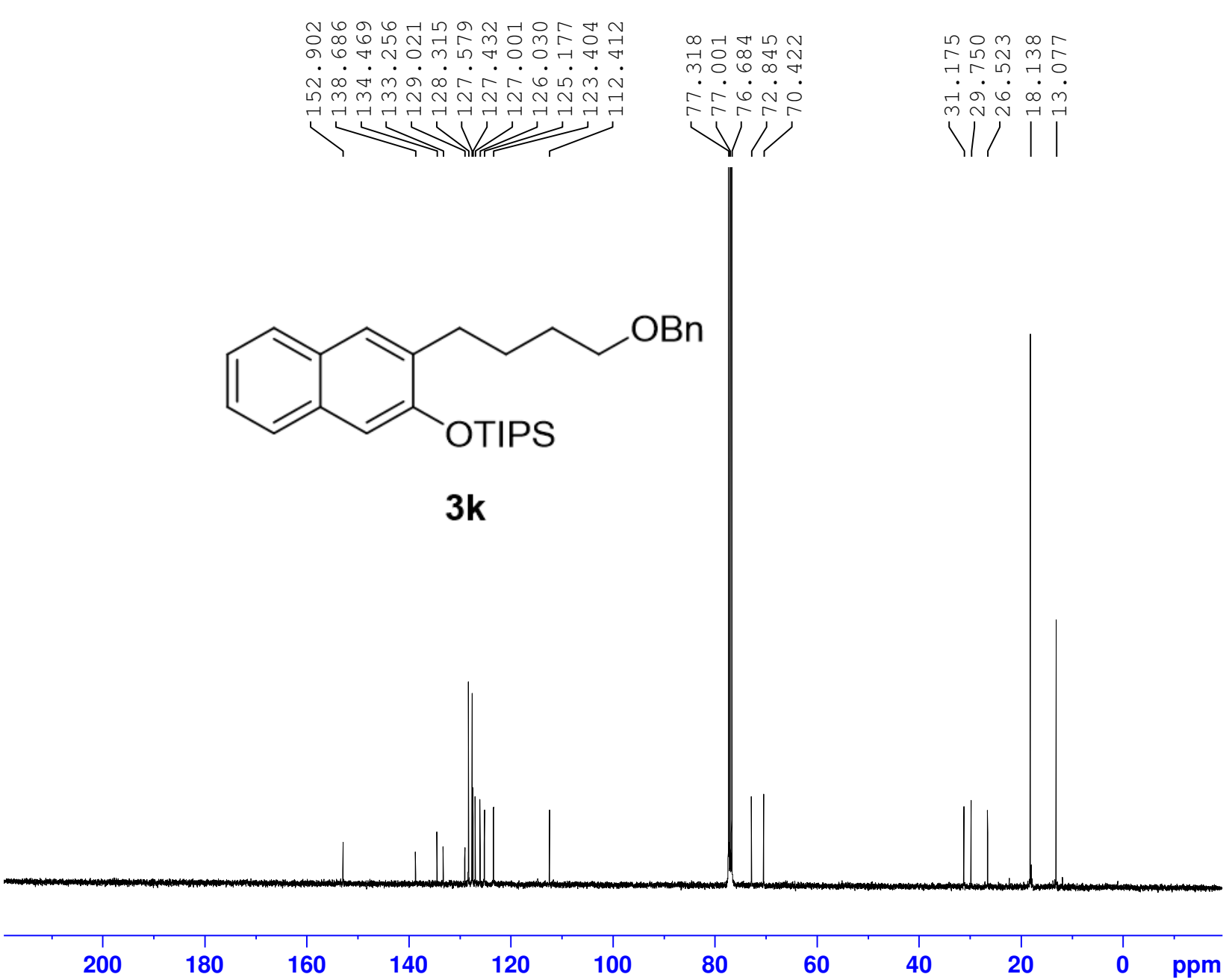
3k


```
Current Data Parameters
NAME          wuan-224-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160130
Time               16.47
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     8
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                126.97
DW                62.400 usec
DE                 6.50 usec
TE                296.5 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                0.30 Hz
GB        0
PC                1.00
```



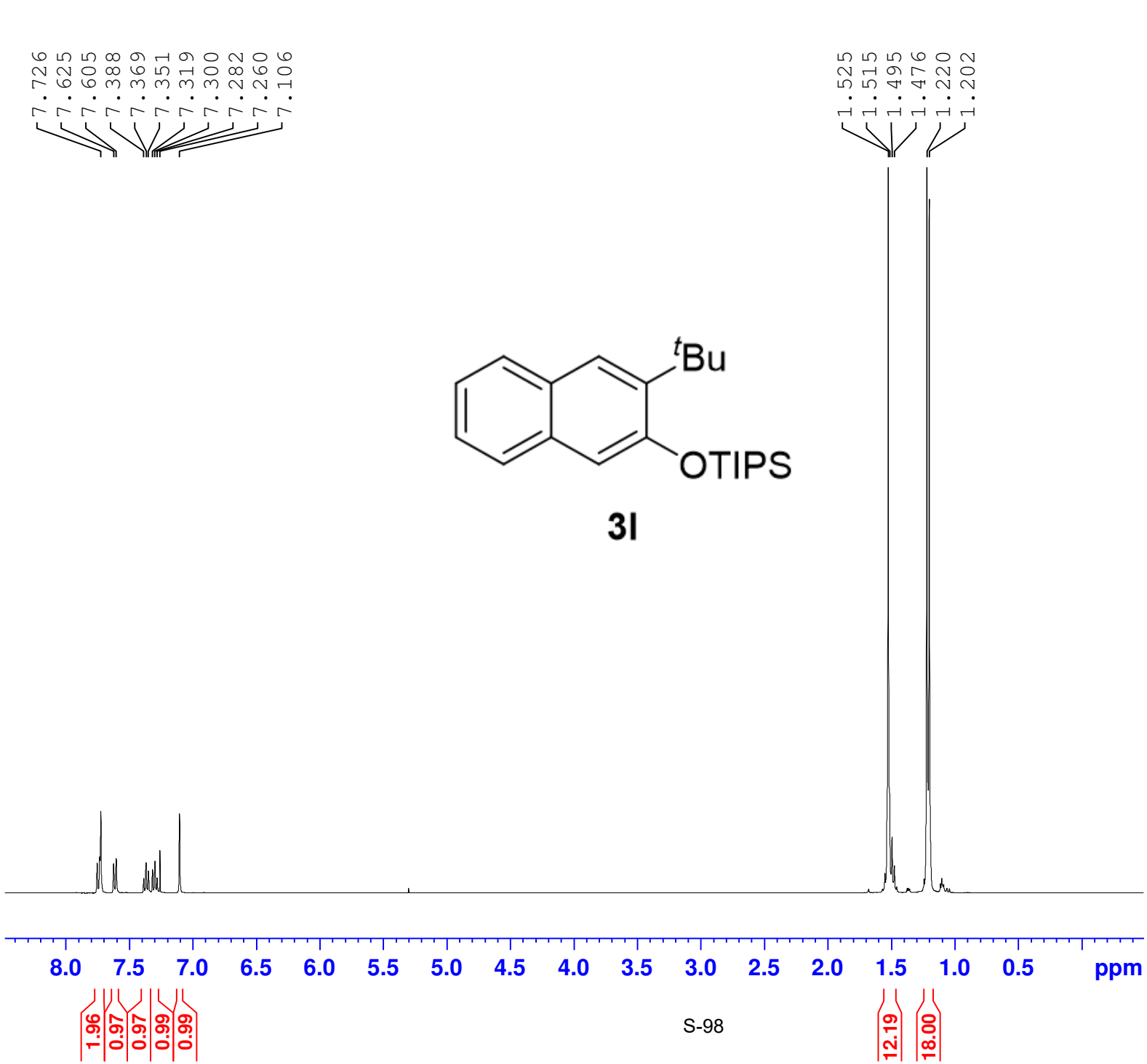

```
Current Data Parameters
NAME          wuan-224-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160202
Time               13.11
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                65536
SOLVENT           CDCl3
NS                 1974
DS                    0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                297.3 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1         46.98899841 W

======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127708 MHz
WDW                  EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

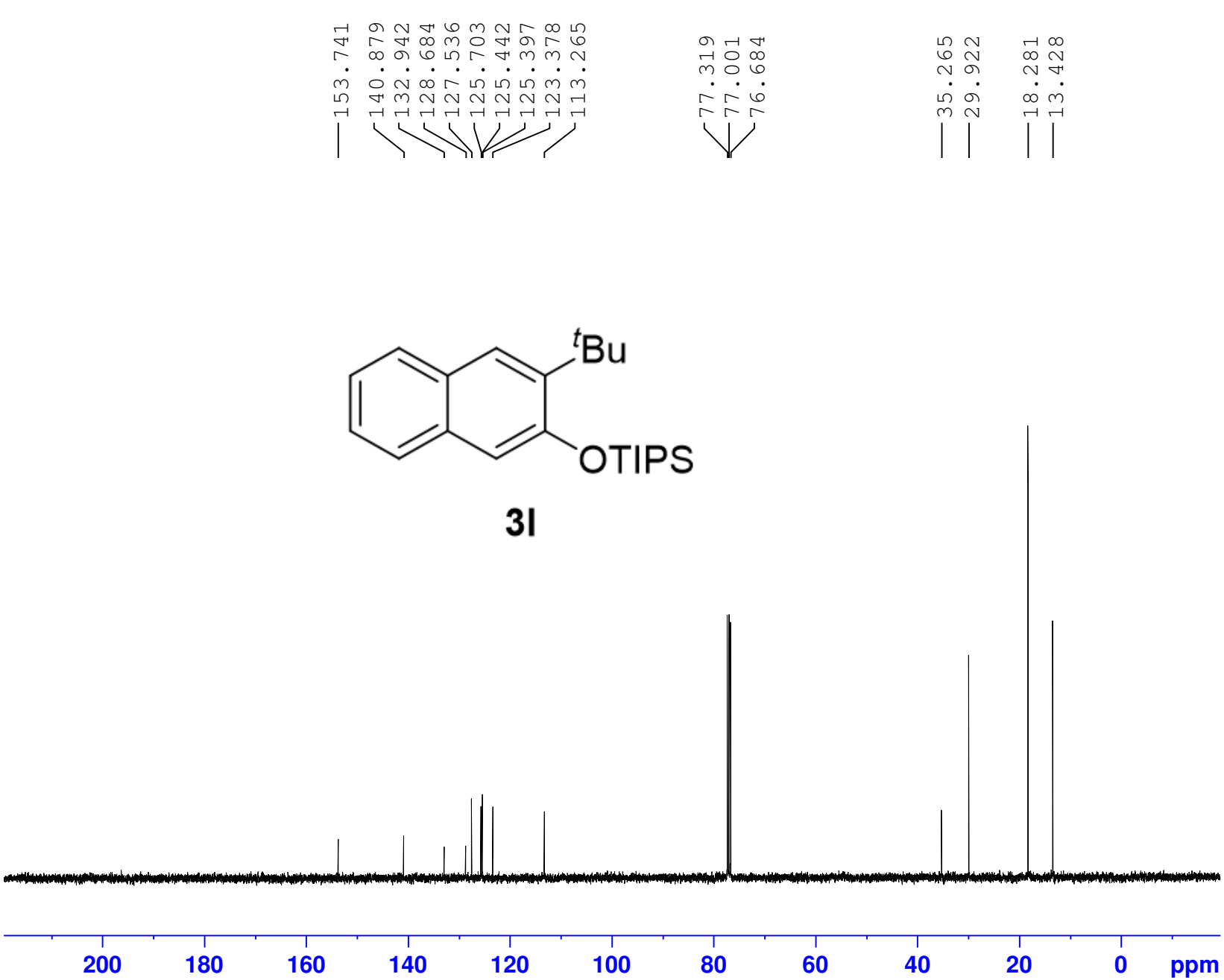



```
Current Data Parameters
NAME          wuan-239-3
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160604
Time               20.12
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 54.81
DW                62.400 usec
DE                 6.50 usec
TE                299.6 K
D1           1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



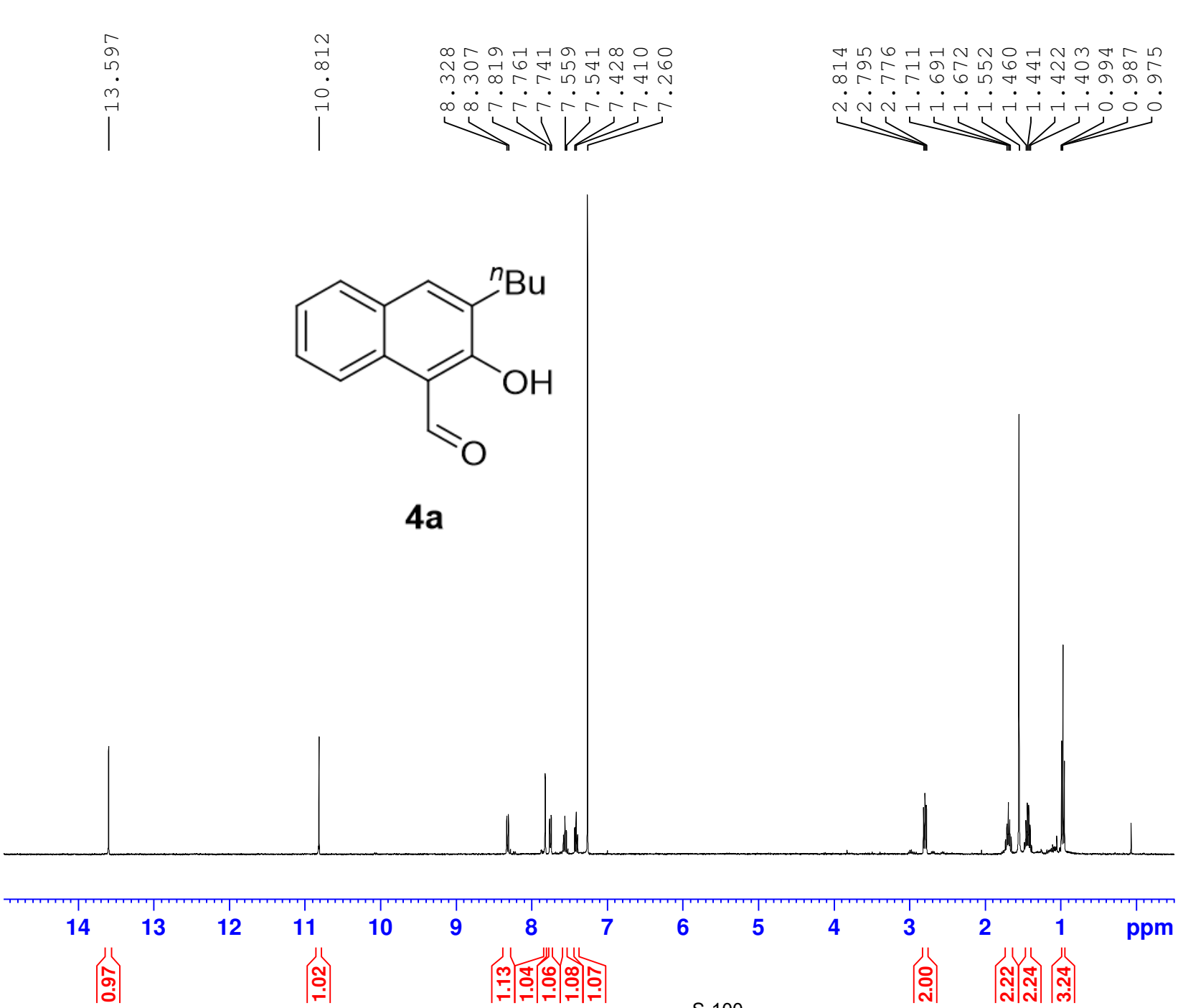

```
Current Data Parameters
NAME          wuan-239-3
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160604
Time               20.16
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                    71
DS                     0
SWH            24038.461 Hz
FIDRES          0.366798 Hz
AQ              1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                300.4 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1          100.6228298 MHz
NUC1                  13C
P1                  9.70 usec
PLW1          46.98899841 W

======== CHANNEL f2 ========
SFO2          400.1316005 MHz
NUC2                  1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2          11.99499989 W
PLW12          0.34213999 W
PLW13          0.27713001 W

F2 - Processing parameters
SI                 32768
SF            100.6127707 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```

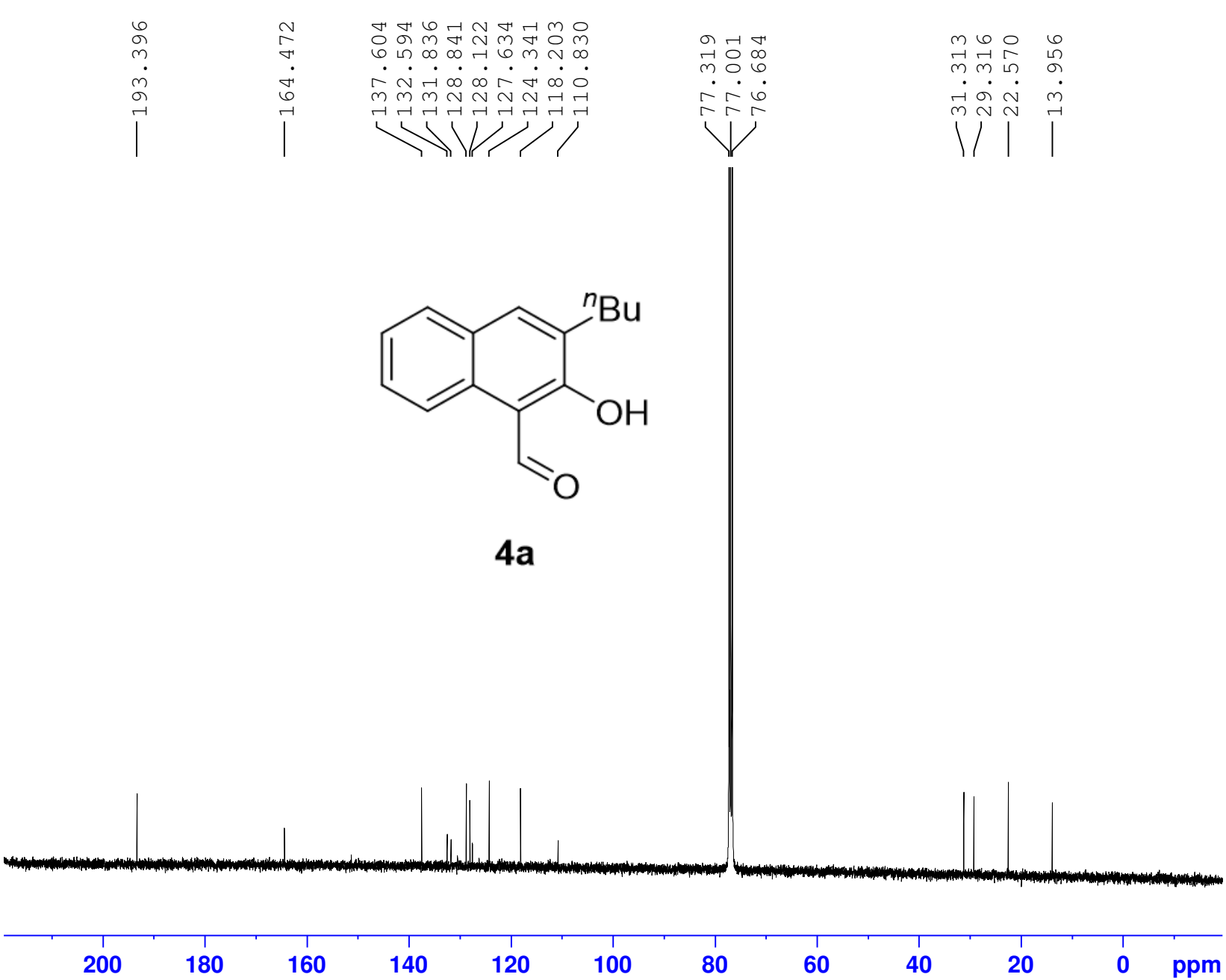



```
Current Data Parameters
NAME         wuan-112A-2
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151112
Time               19.52
INSTRUM            spect
PROBHD   5 mm PABBO BB-
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     8
DS                     0
SWH             8223.685 Hz
FIDRES          0.125483 Hz
AQ              3.9845889 sec
RG                   812
DW                60.800 usec
DE                 6.00 usec
TE                293.4 K
D1           1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
NUC1                  1H
P1                13.60 usec
PL1               -1.00 dB
SFO1        400.1324710 MHz

F2 - Processing parameters
SI                 32768
SF          400.1300053 MHz
WDW                   EM
SSB       0
LB                0.30 Hz
GB        0
PC                1.00
```




```
Current Data Parameters
NAME          wuan-112A-2
EXPNO                   2
PROCNO                  1

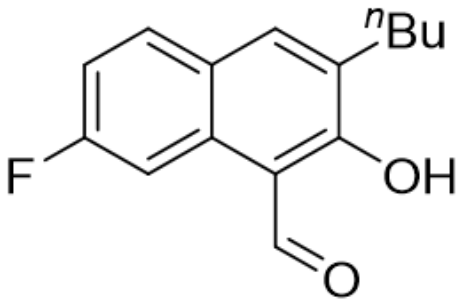
F2 - Acquisition Parameters
Date_            20151113
Time                10.17
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG            zgpg30
TD                  65536
SOLVENT             CDCl3
NS                  10060
DS                      0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                298.3 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                  13C
P1                  9.70 usec
PLW1         46.98899841 W

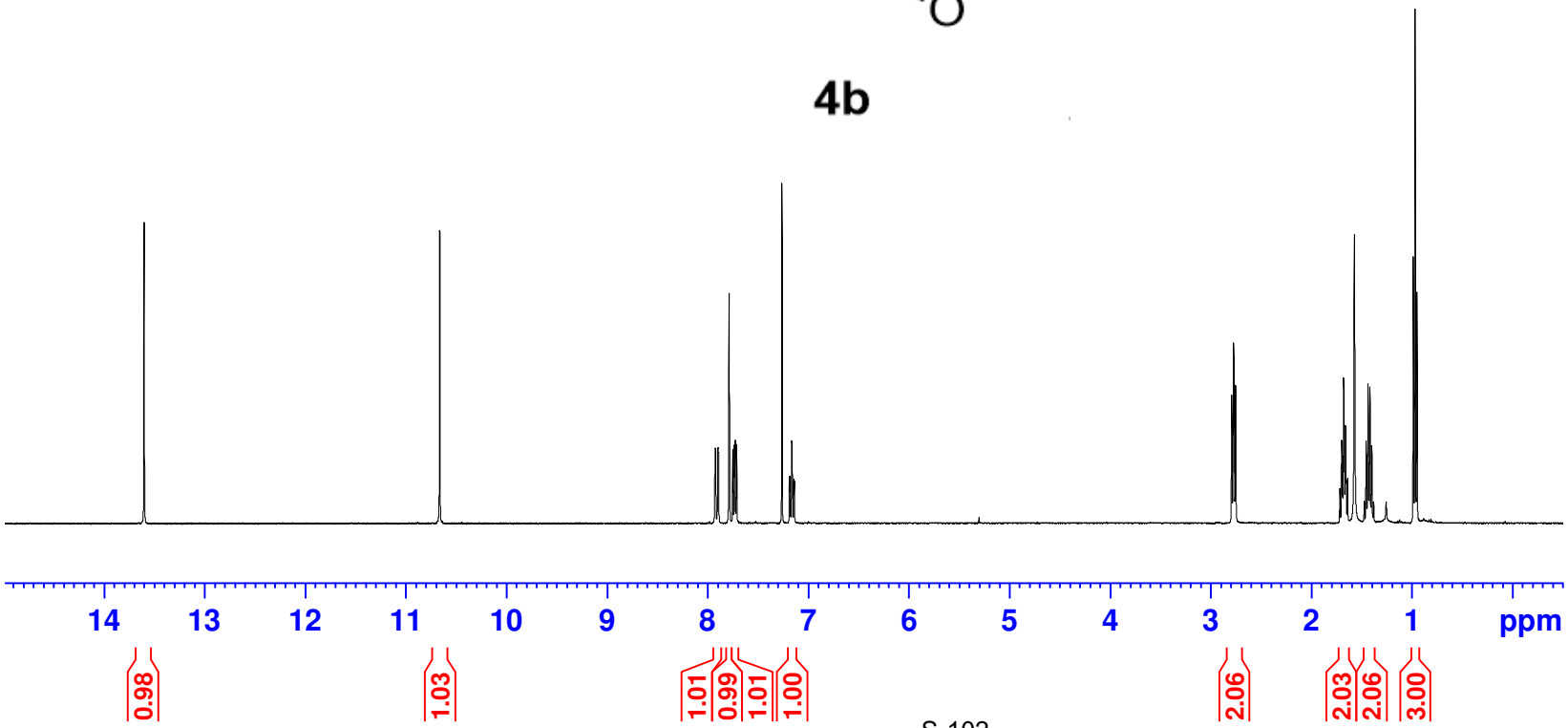
======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                  1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                  32768
SF           100.6127693 MHz
WDW                    EM
SSB       0
LB                  1.00 Hz
GB        0
PC                  1.40
```

13.601
10.662
7.925
7.920
7.897
7.892
7.785
7.749
7.734
7.726
7.711
7.260
7.185
7.180
7.164
7.159
7.143
7.137
2.790
2.771
2.751
1.714
1.696
1.677
1.658
1.638
1.570
1.453
1.434
1.416
1.397
0.985



4b

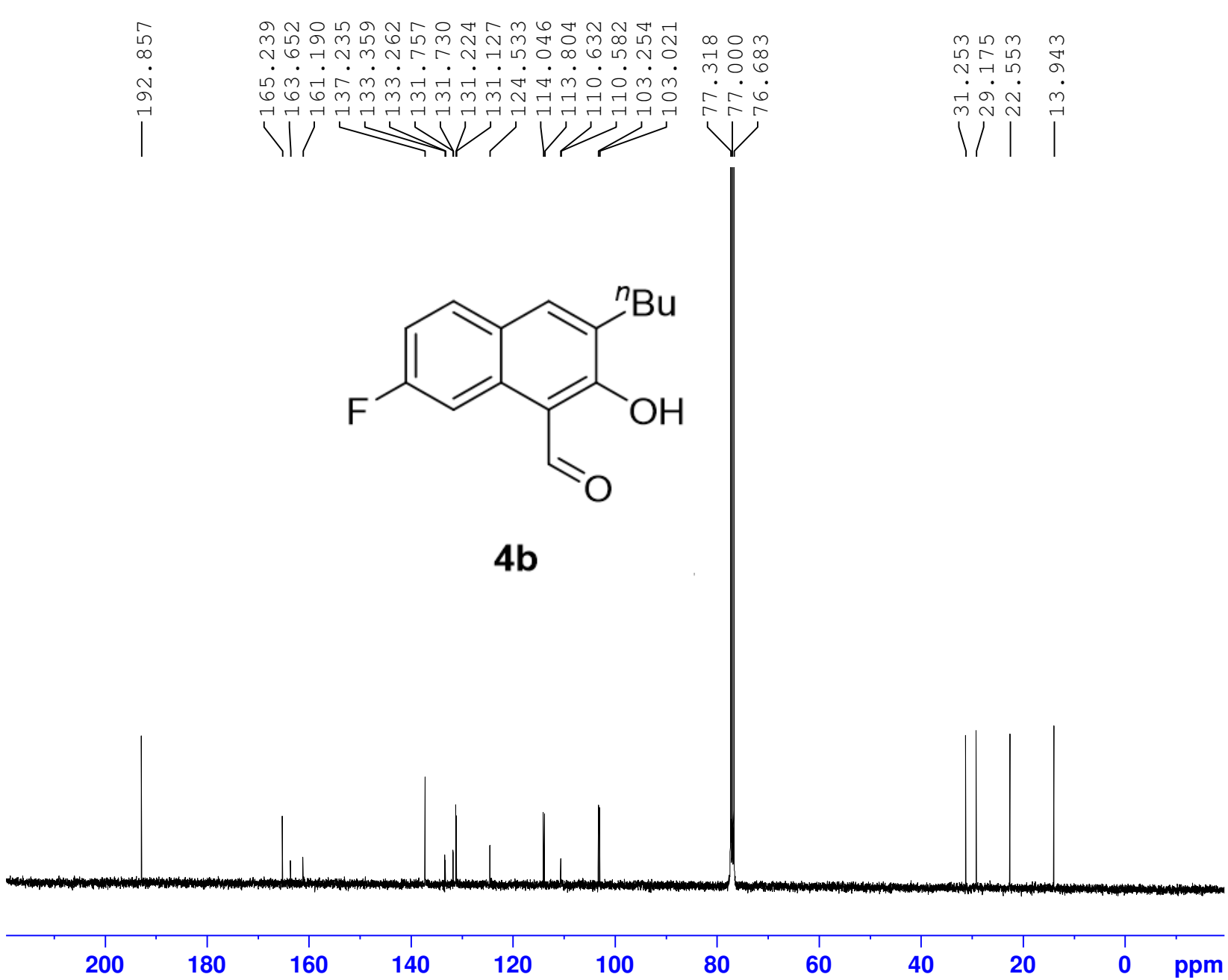



```
Current Data Parameters
NAME                  wuan-146-4
EXPNO                          1
PROCNO                         1

F2 - Acquisition Parameters
Date_                   20151214
Time                       11.27
INSTRUM                    spect
PROBHD    5 mm PABBO BB/
PULPROG                     zg30
TD                         65536
SOLVENT                    CDCl3
NS                             4
DS                             0
SWH                     8012.820 Hz
FIDRES                  0.122266 Hz
AQ                      4.0894465 sec
RG                         187.77
DW                         62.400 usec
DE                          6.50 usec
TE                         296.3 K
D1                    1.00000000 sec
TD0                            1

======== CHANNEL f1 ========
SFO1                 400.1324710 MHz
NUC1                         1H
P1                        14.50 usec
PLW1                 11.99499989 W

F2 - Processing parameters
SI                         65536
SF                   400.1300092 MHz
WDW                           EM
SSB                0
LB                         0.30 Hz
GB                 0
PC                         1.00
```



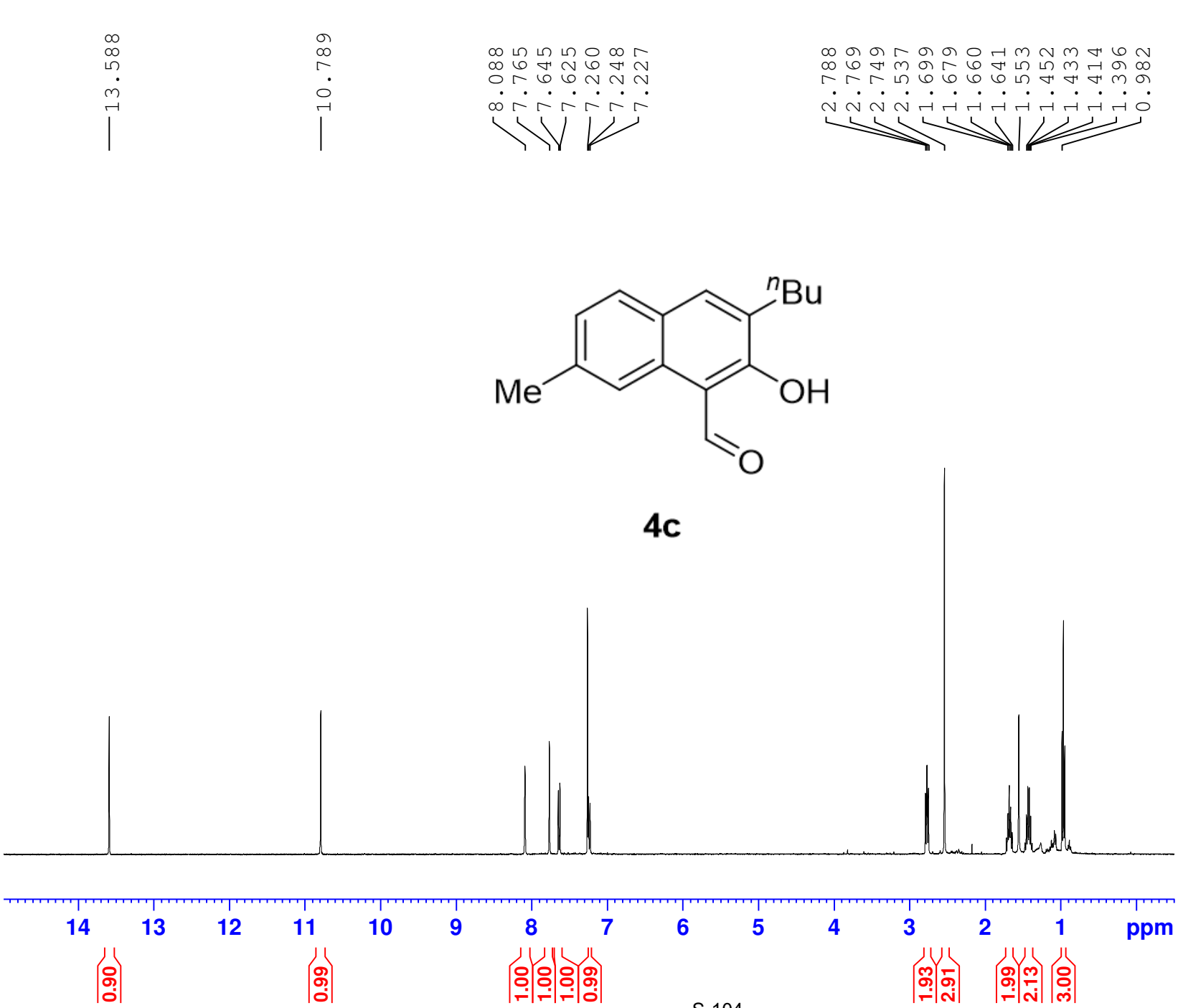

```
Current Data Parameters
NAME          wuan-146-4
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151214
Time               13.01
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                65536
SOLVENT           CDCl3
NS                 1602
DS                    0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                297.8 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                 13C
P1                 9.70 usec
PLW1         46.98899841 W

======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127701 MHz
WDW                  EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```

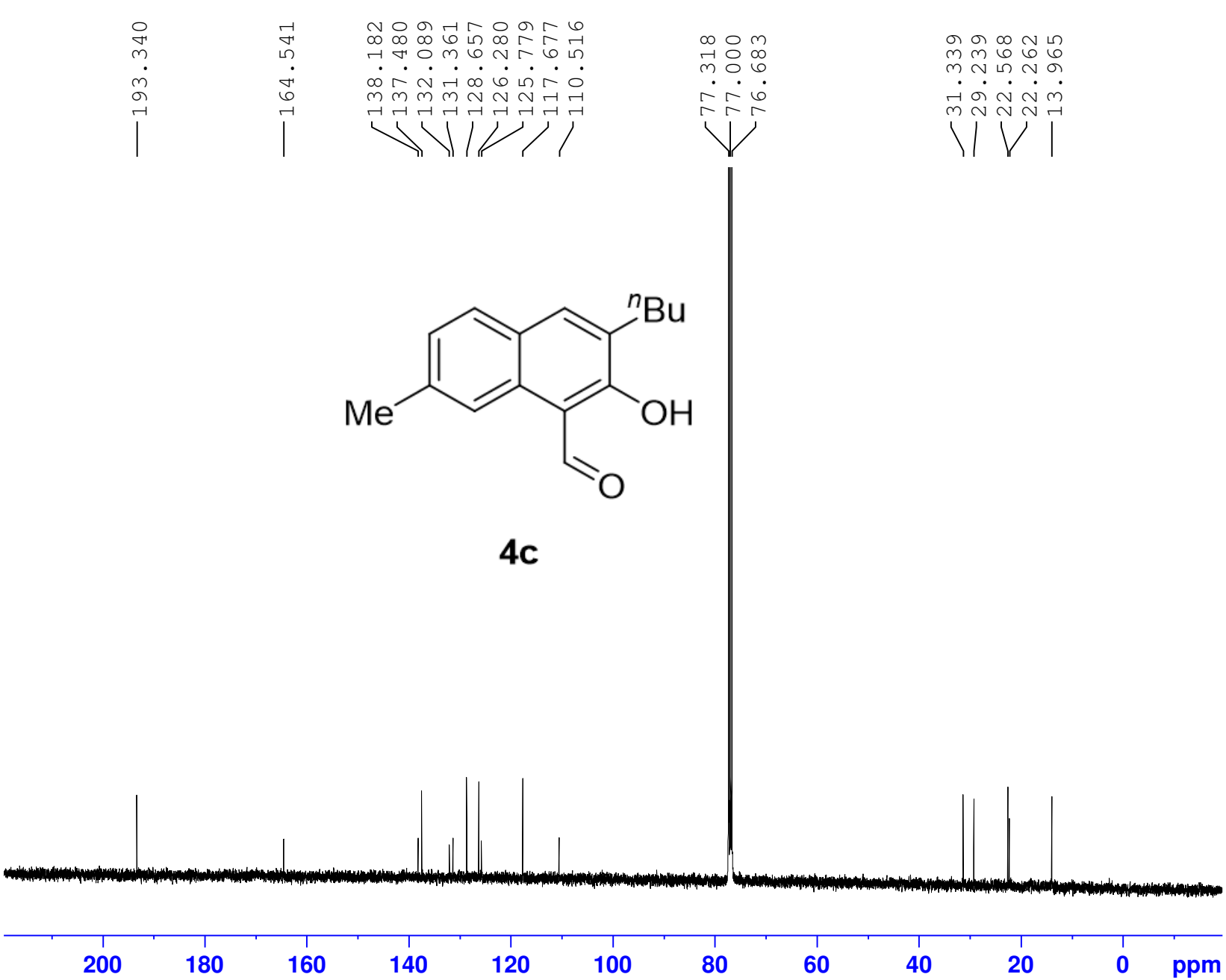



```
Current Data Parameters
NAME          wuan-118A-3
EXPNO                   2
PROCNO                  1

F2 - Acquisition Parameters
Date_            20151114
Time                17.49
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                      4
DS                      0
SWH              8012.820 Hz
FIDRES           0.122266 Hz
AQ               4.0894465 sec
RG                  187.77
DW                  62.400 usec
DE                   6.50 usec
TE                  296.7 K
D1             1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1          400.1324710 MHz
NUC1                    1H
P1                  14.50 usec
PLW1          11.99499989 W

F2 - Processing parameters
SI                  65536
SF            400.1300093 MHz
WDW                    EM
SSB       0
LB                  0.30 Hz
GB        0
PC                  1.00
```



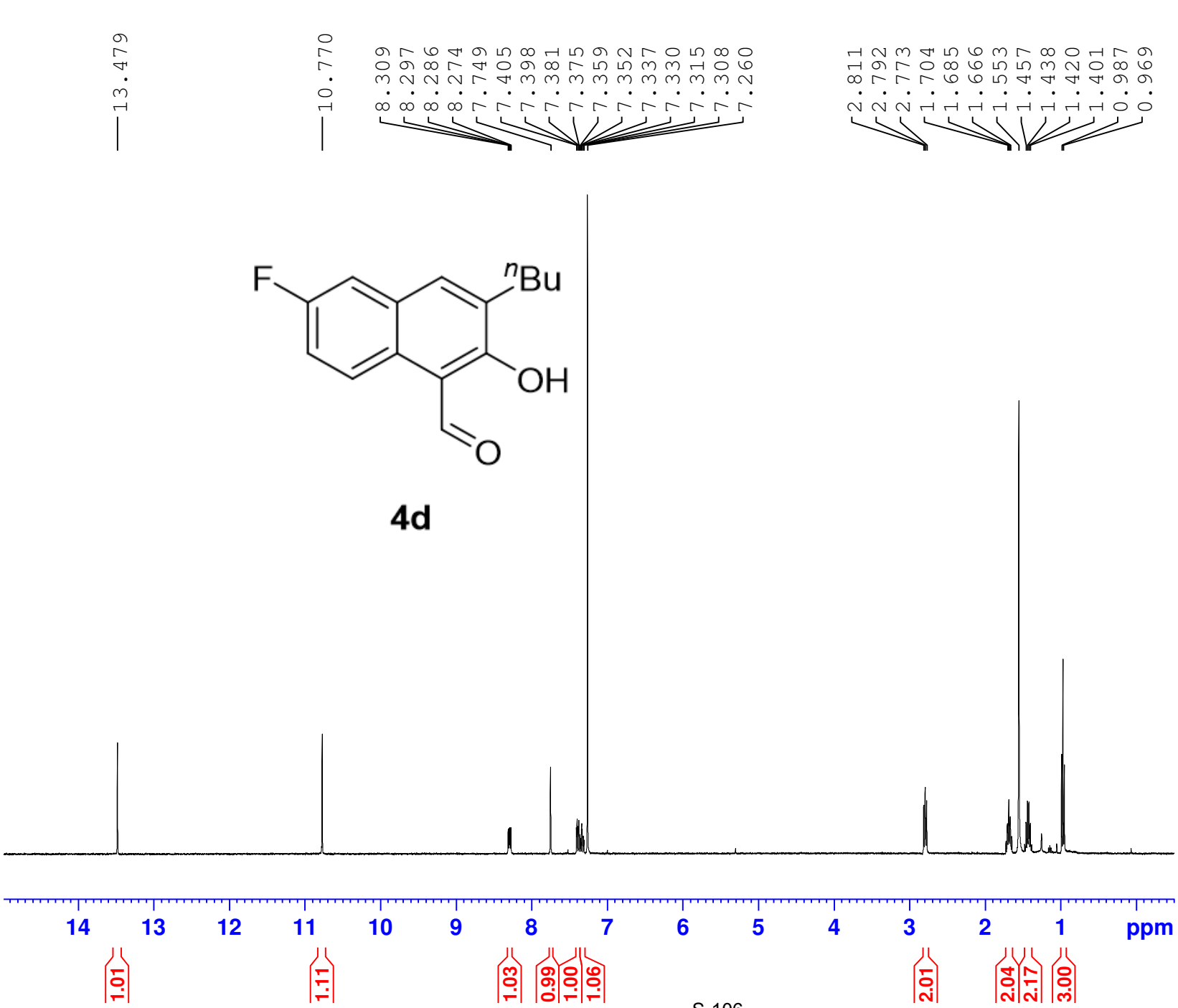

```
Current Data Parameters
NAME          wuan-118A-3
EXPNO                   3
PROCNO                  1

F2 - Acquisition Parameters
Date_           20151114
Time               17.56
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                  1225
DS                     0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                297.8 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1         46.98899841 W

======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127701 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```



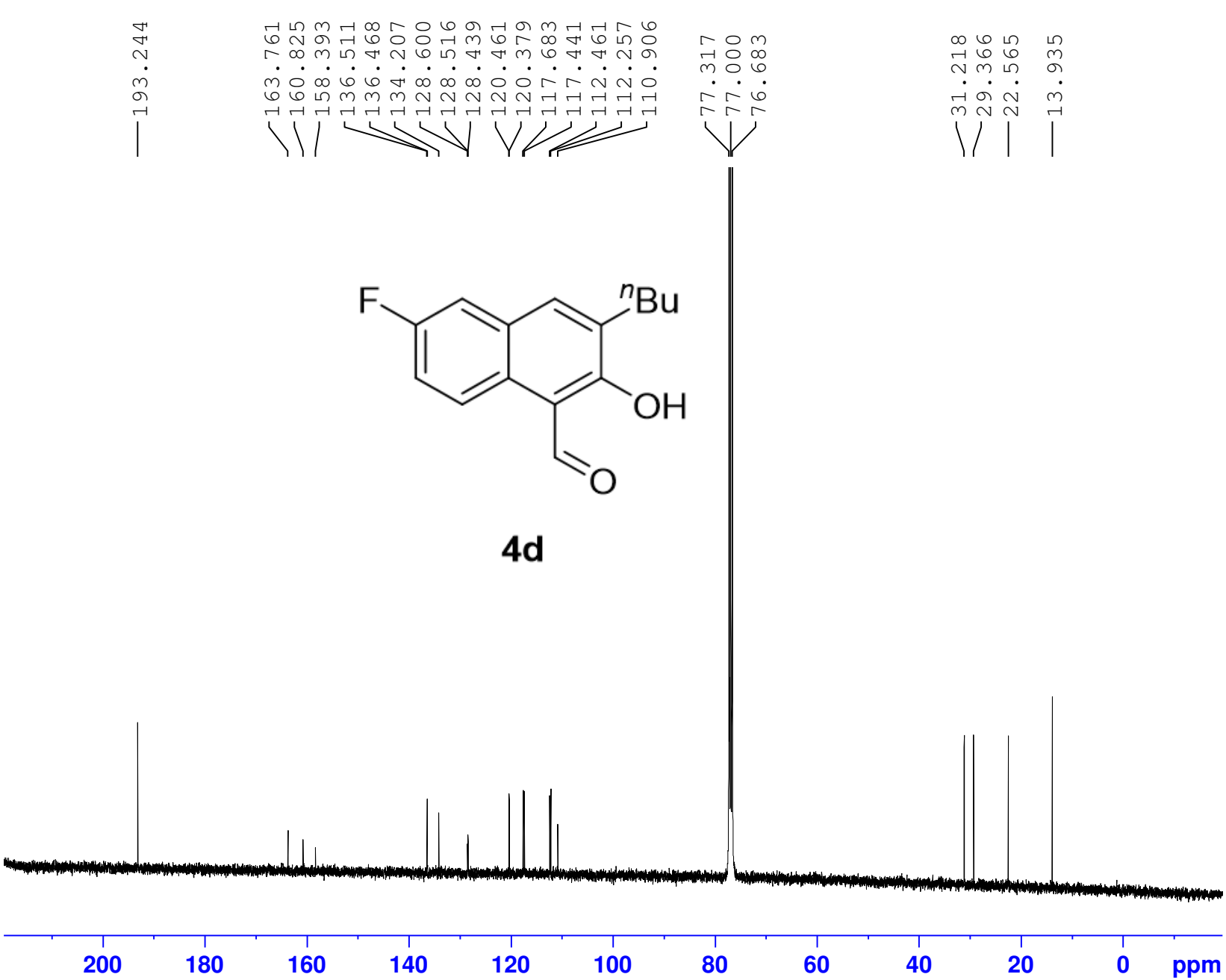
BRUKER

```
Current Data Parameters
NAME          wuan-136-3
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151204
Time               20.51
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     8
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                62.400 usec
DE                 6.50 usec
TE                296.5 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



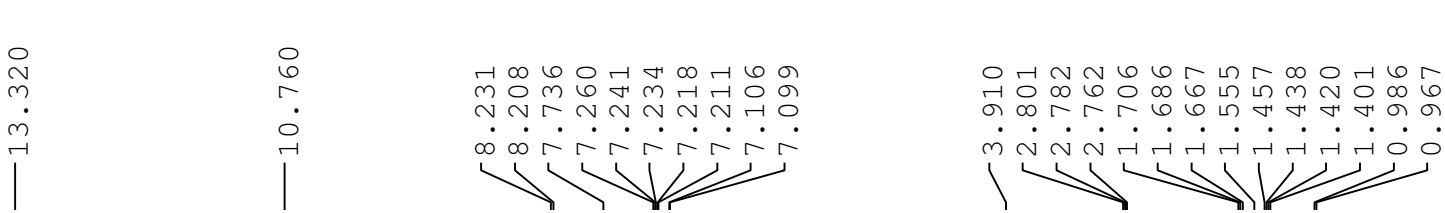

```
Current Data Parameters
NAME          wuan-136-3
EXPNO                  5
PROCNO                 1

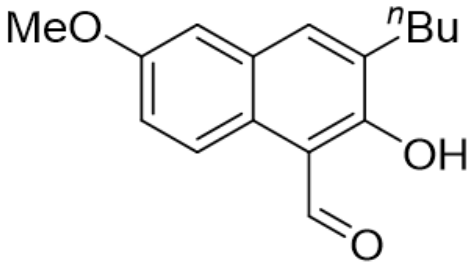
F2 - Acquisition Parameters
Date_           20151206
Time               23.41
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                 10530
DS                     0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ            1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                298.2 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                  13C
P1                 9.70 usec
PLW1         46.98899841 W

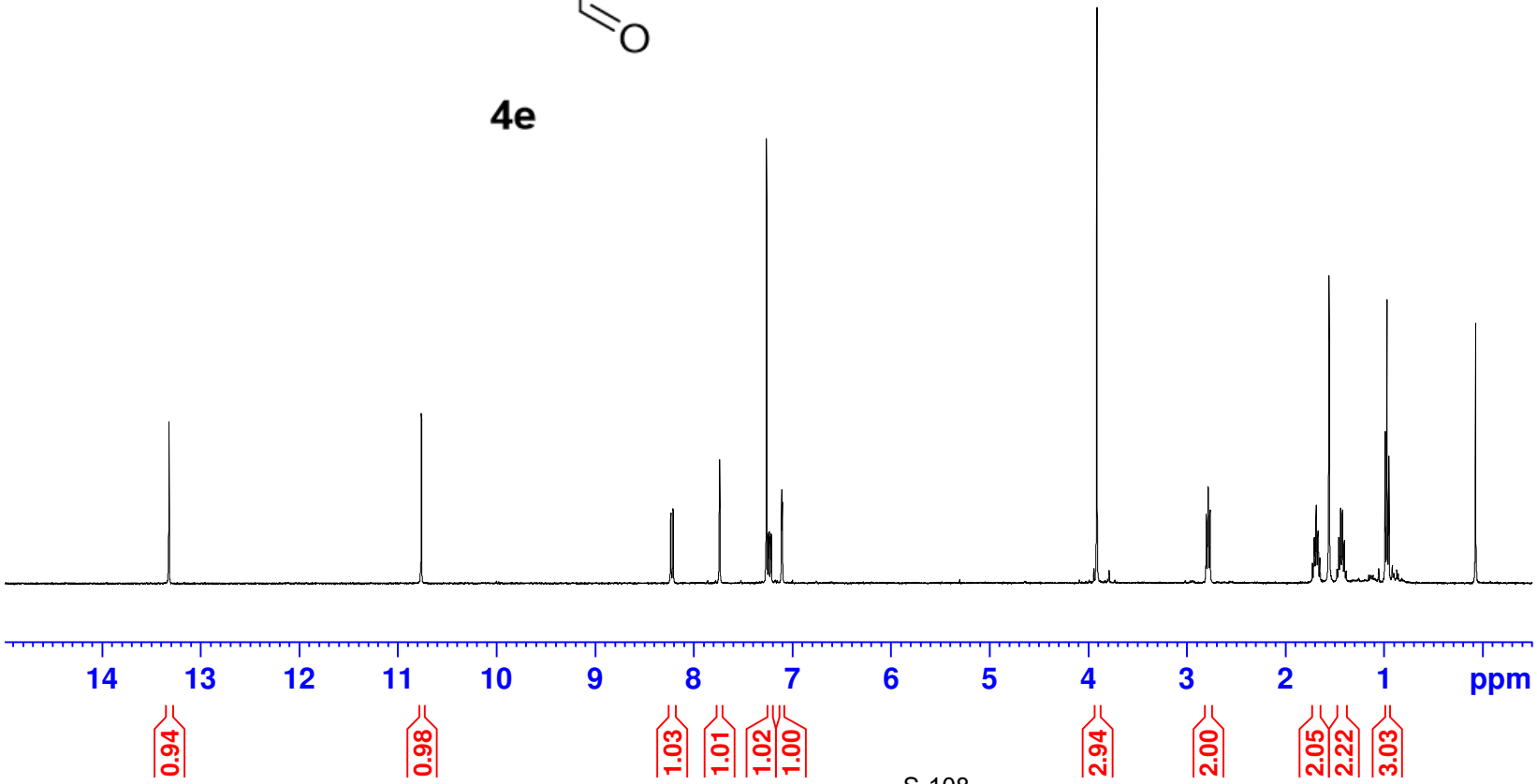
======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                  1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127695 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```





4e

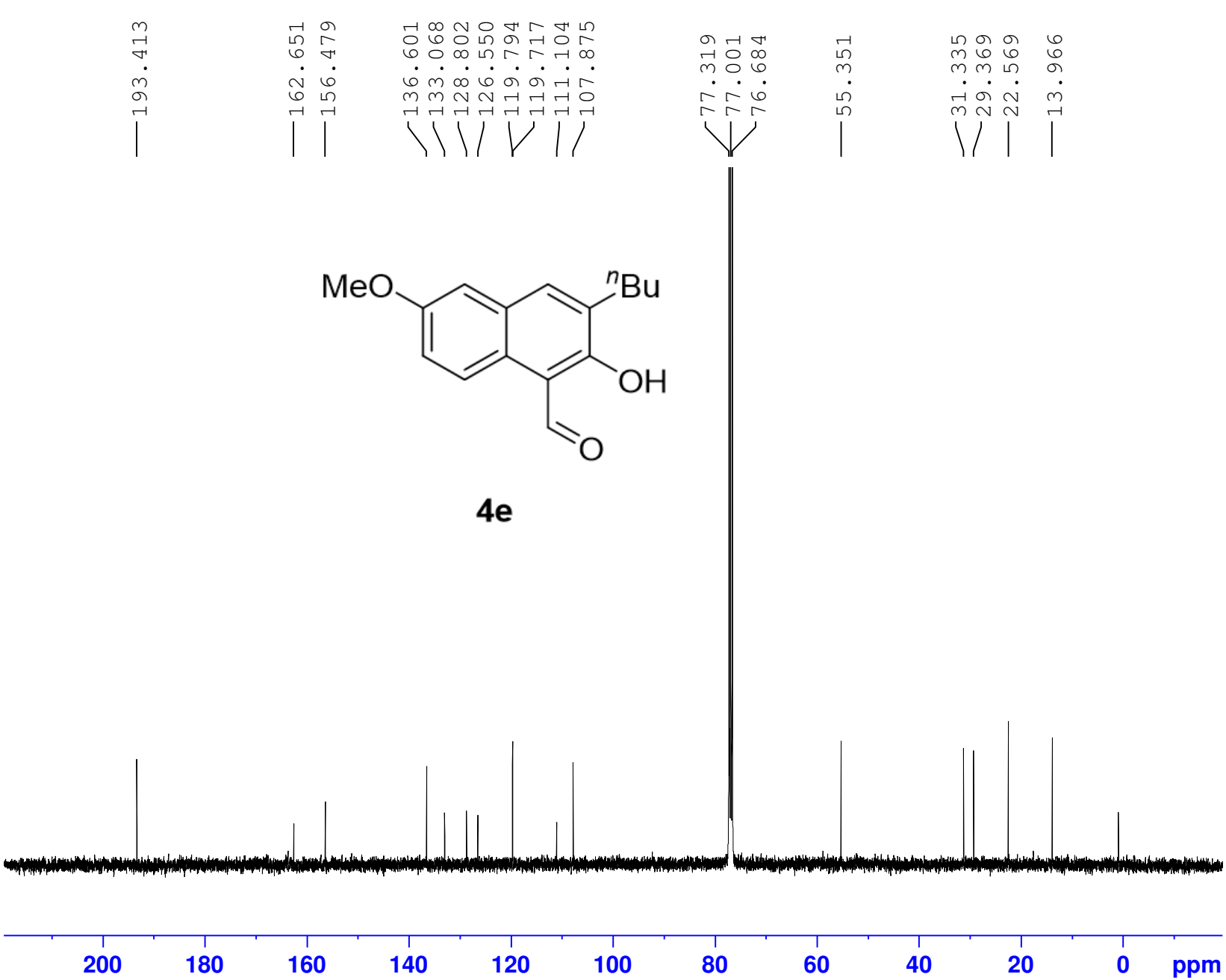



```
Current Data Parameters
NAME          wuan-137-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151204
Time               20.37
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                62.400 usec
DE                 6.50 usec
TE                296.6 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300092 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



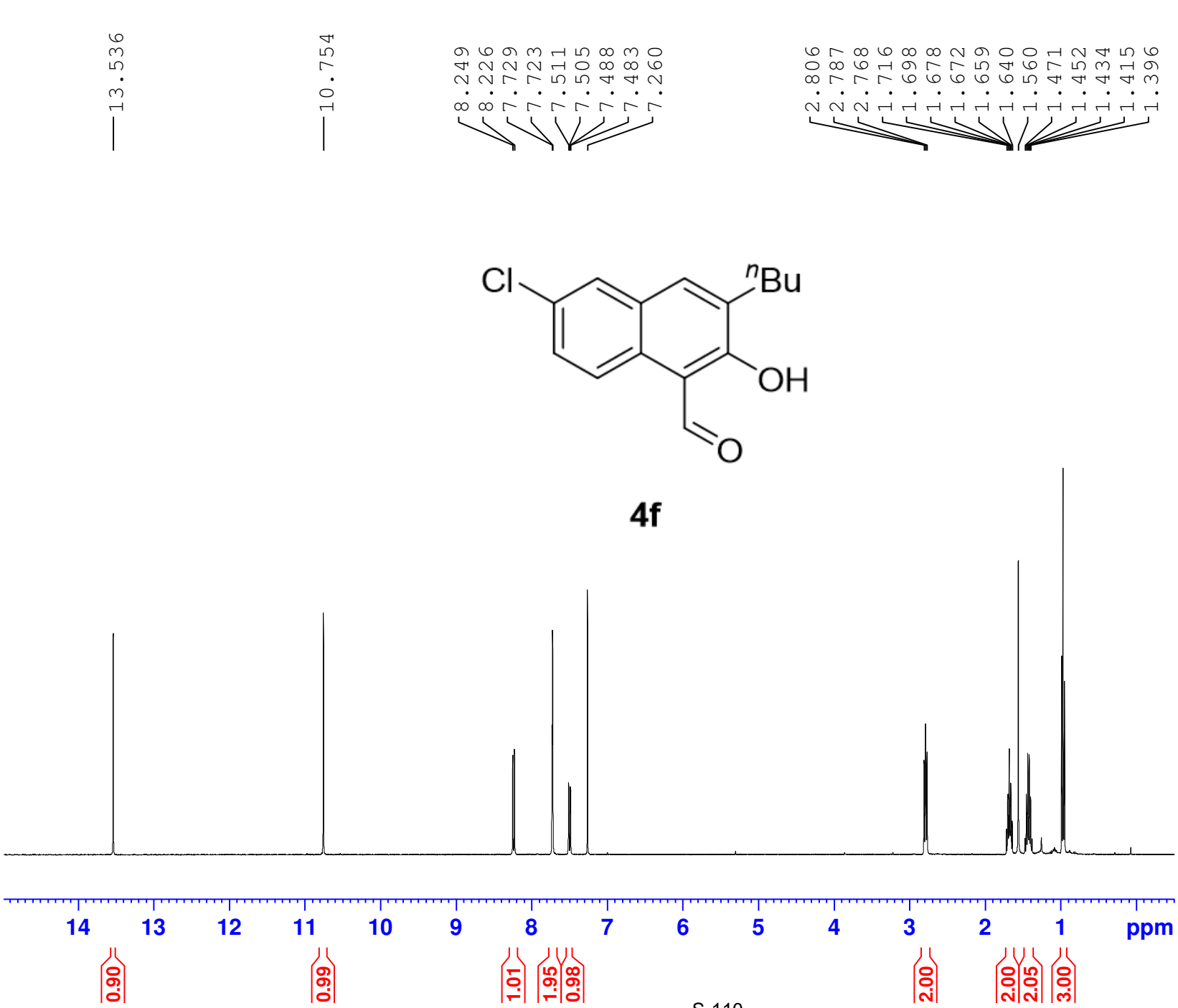
Current Data Parameters
NAME wuan-137-1
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20151206
Time 0.30
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 3212
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 298.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127694 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

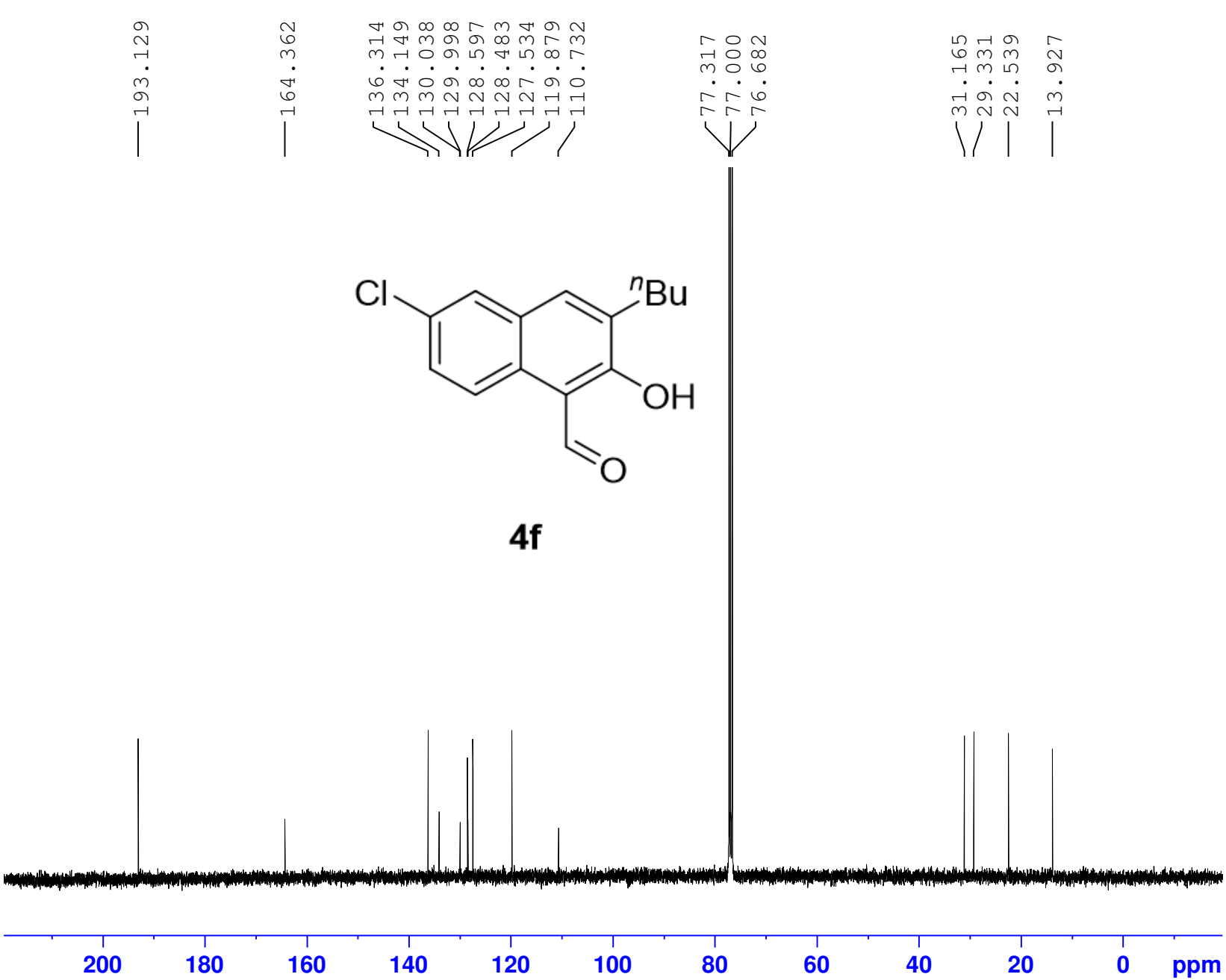



```
Current Data Parameters
NAME          wuan-147-2
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151212
Time               10.37
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     8
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 297.1 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300093 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



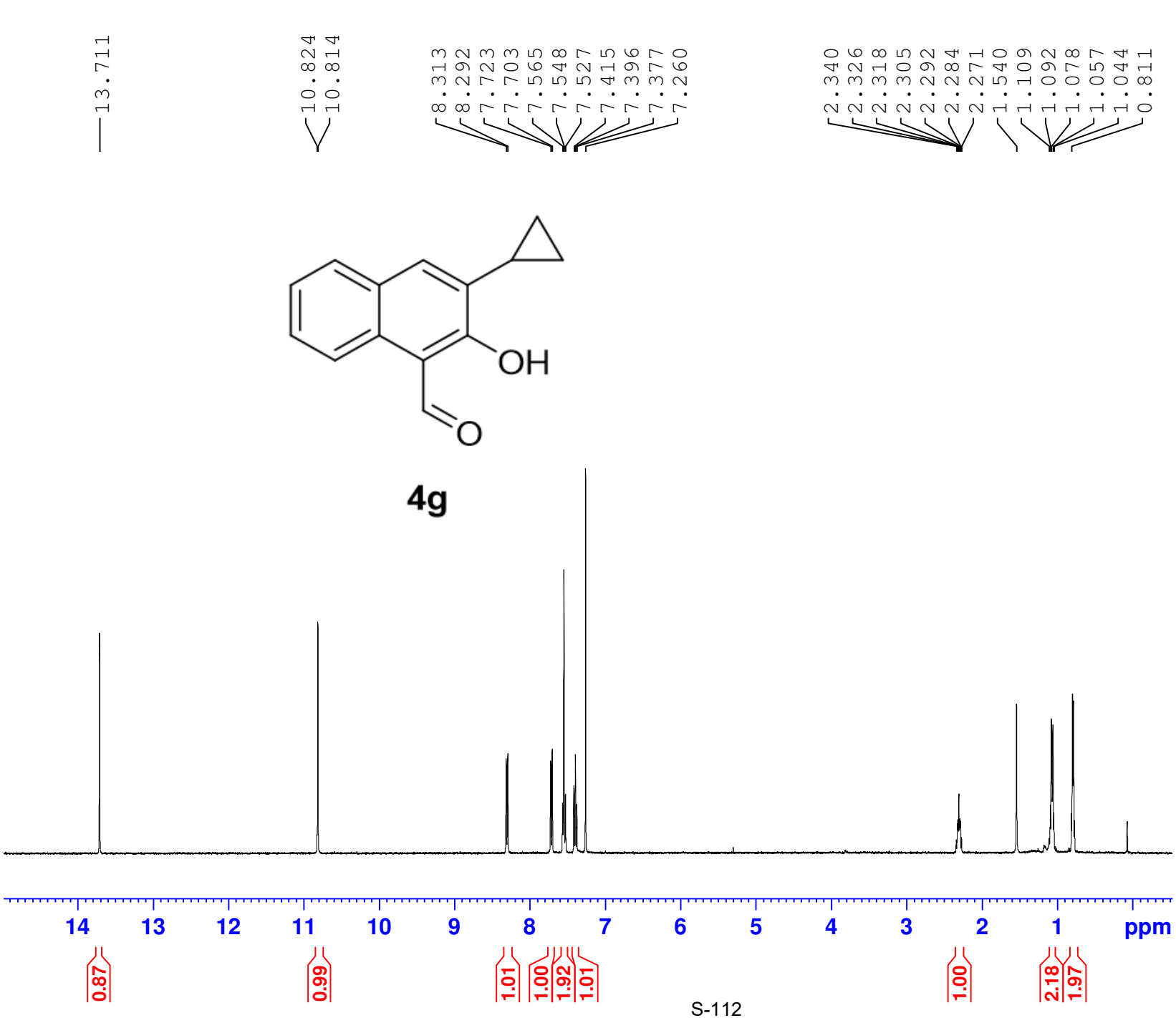

```
Current Data Parameters
NAME          wuan-147-2
EXPNO                  4
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151212
Time               11.39
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   785
DS                     0
SWH            24038.461 Hz
FIDRES          0.366798 Hz
AQ              1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                298.0 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1          100.6228298 MHz
NUC1                  13C
P1                  9.70 usec
PLW1          46.98899841 W

======== CHANNEL f2 ========
SFO2          400.1316005 MHz
NUC2                  1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2          11.99499989 W
PLW12          0.34213999 W
PLW13          0.27713001 W

F2 - Processing parameters
SI                 32768
SF            100.6127700 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```



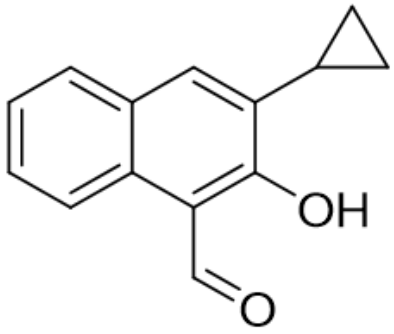

```
Current Data Parameters
NAME          wuan-236-2
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160216
Time               21.48
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 297.0 K
D1            1.00000000 sec
TD0                    1

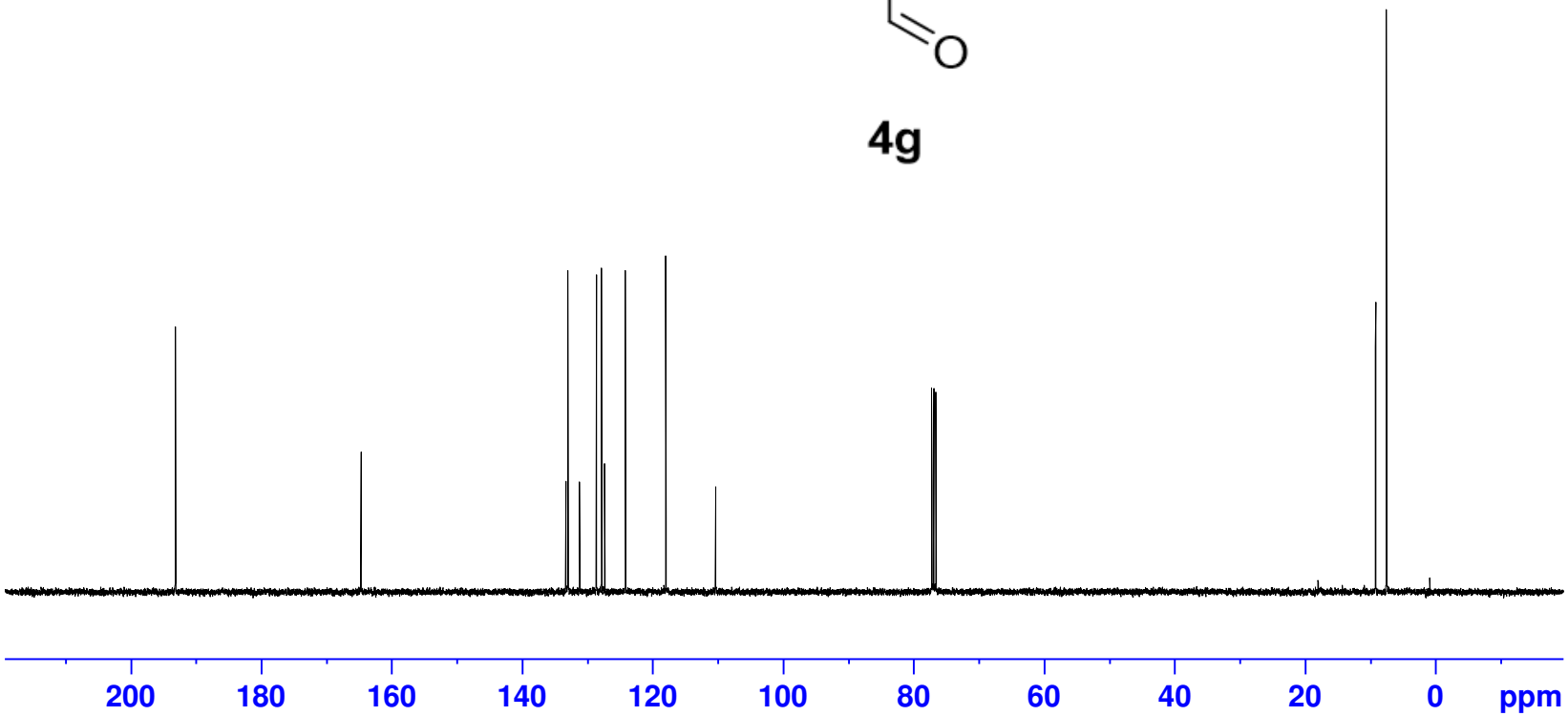
======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```

193.249
164.806
133.393
133.075
131.295
128.709
127.943
127.448
124.275
118.077
110.449
77.318
77.000
76.683
9.286
7.613



4g




```
Current Data Parameters
NAME          wuan-236-2
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160217
Time               18.13
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                    64
DS                     0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                297.5 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                    1

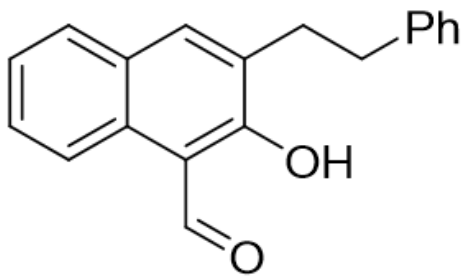
======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1         46.98899841 W

======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

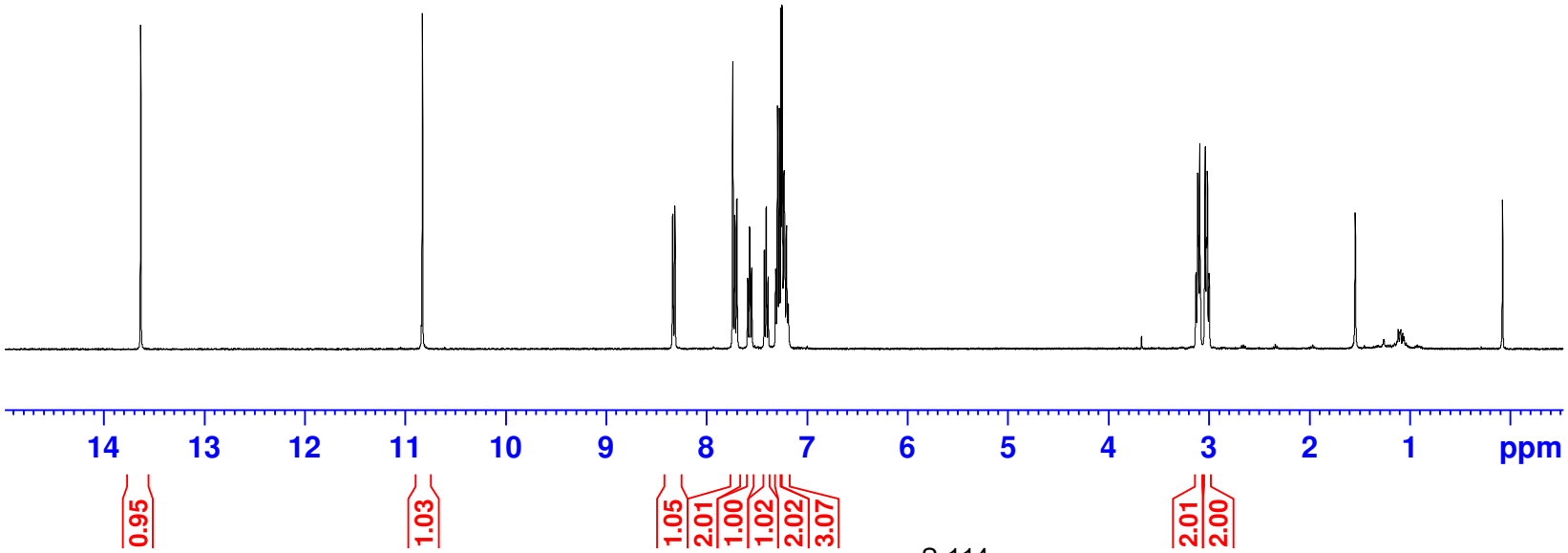
F2 - Processing parameters
SI                 32768
SF           100.6127797 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```

13.632

10.828
8.336
8.315
7.738
7.717
7.697
7.589
7.571
7.550
7.424
7.405
7.386
7.312
7.292
7.274
7.260
7.247
7.228
7.203
7.186
3.127
3.110
3.101
3.089
3.034
3.023
3.014
2.996
1.542



4h

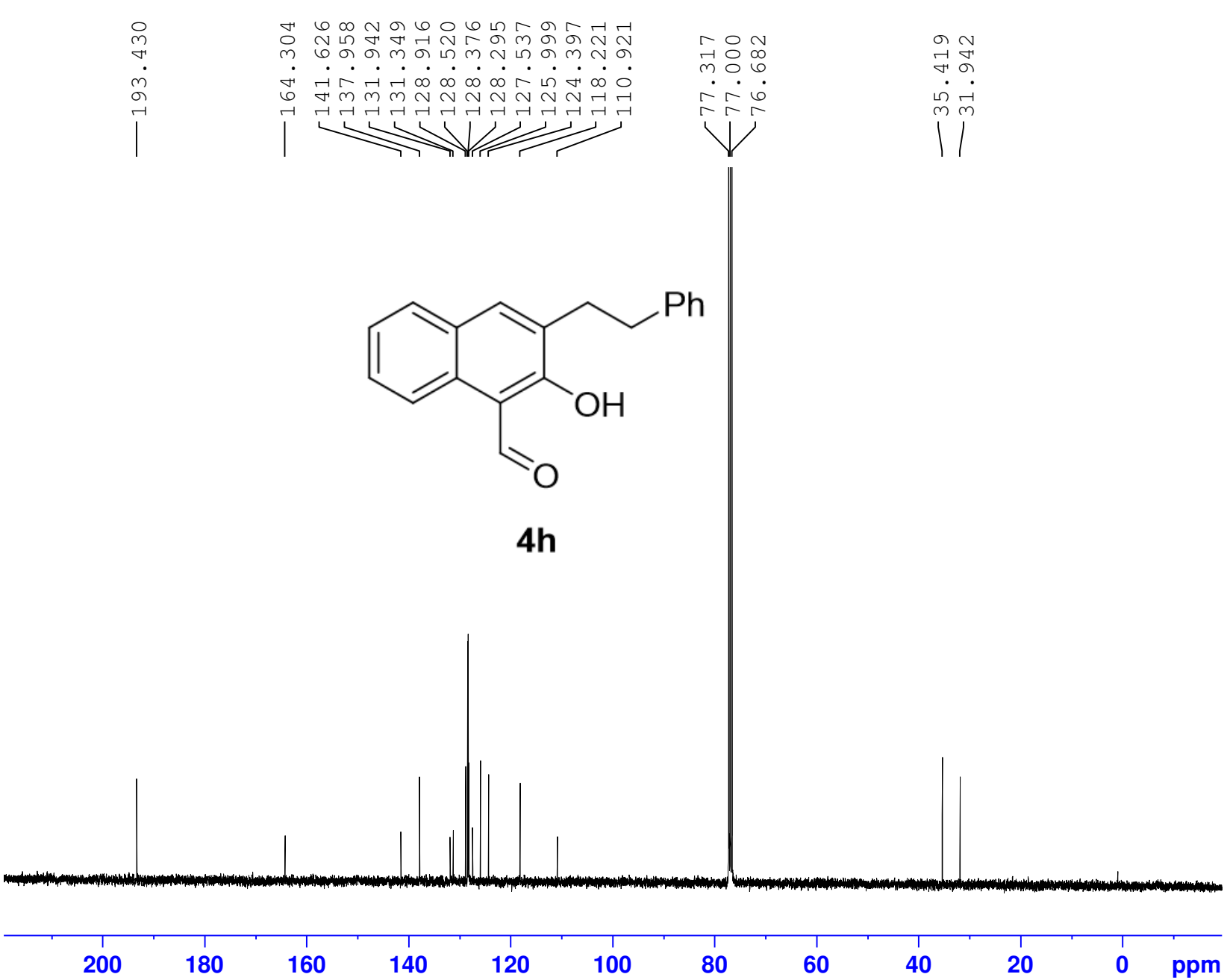



```
Current Data Parameters
NAME          wuan-238-2
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160217
Time               18.18
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 296.8 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300095 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



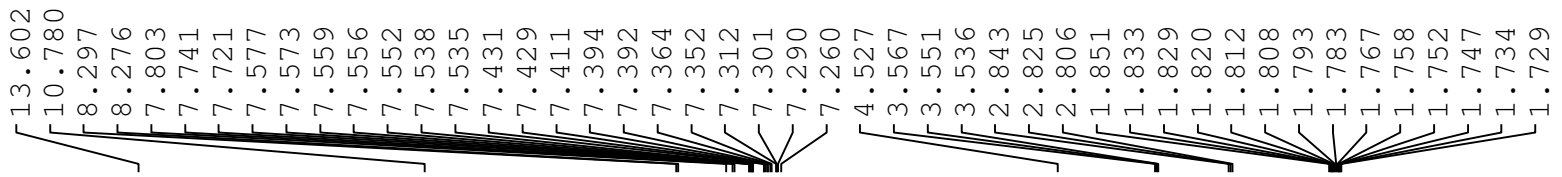

```
Current Data Parameters
NAME          wuan-238-2
EXPNO                  3
PROCNO                 1

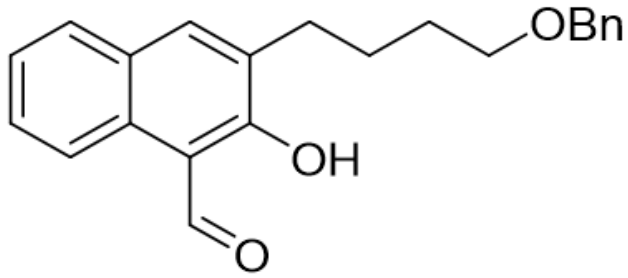
F2 - Acquisition Parameters
Date_           20160217
Time               18.23
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                65536
SOLVENT           CDCl3
NS                  956
DS                    0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                297.8 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                 13C
P1                 9.70 usec
PLW1         46.98899841 W

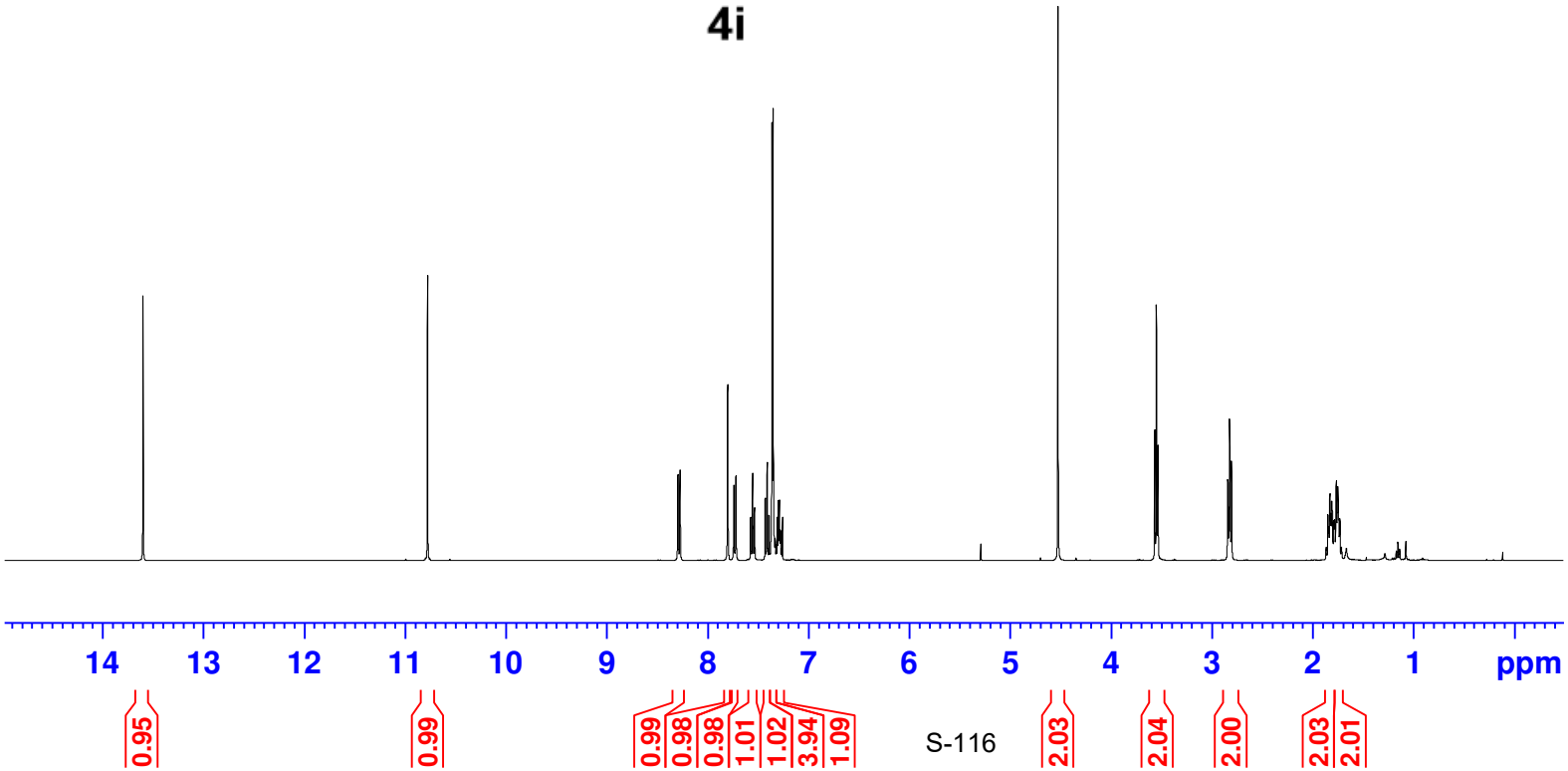
======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127706 MHz
WDW                  EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```





4i

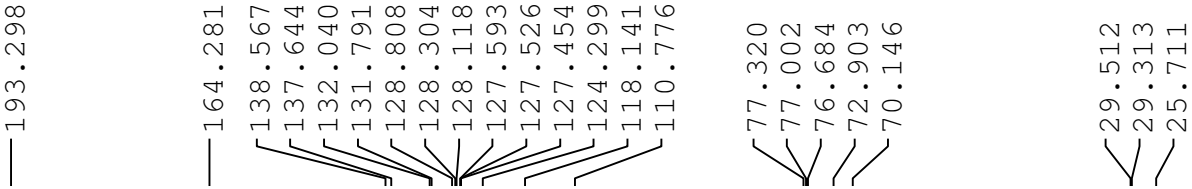


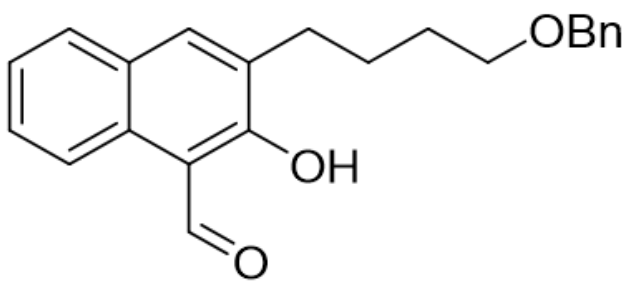

```
Current Data Parameters
NAME          wuan-237-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160604
Time               19.58
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 45.67
DW                62.400 usec
DE                 6.50 usec
TE                299.3 K
D1             1.00000000 sec
TD0                    1

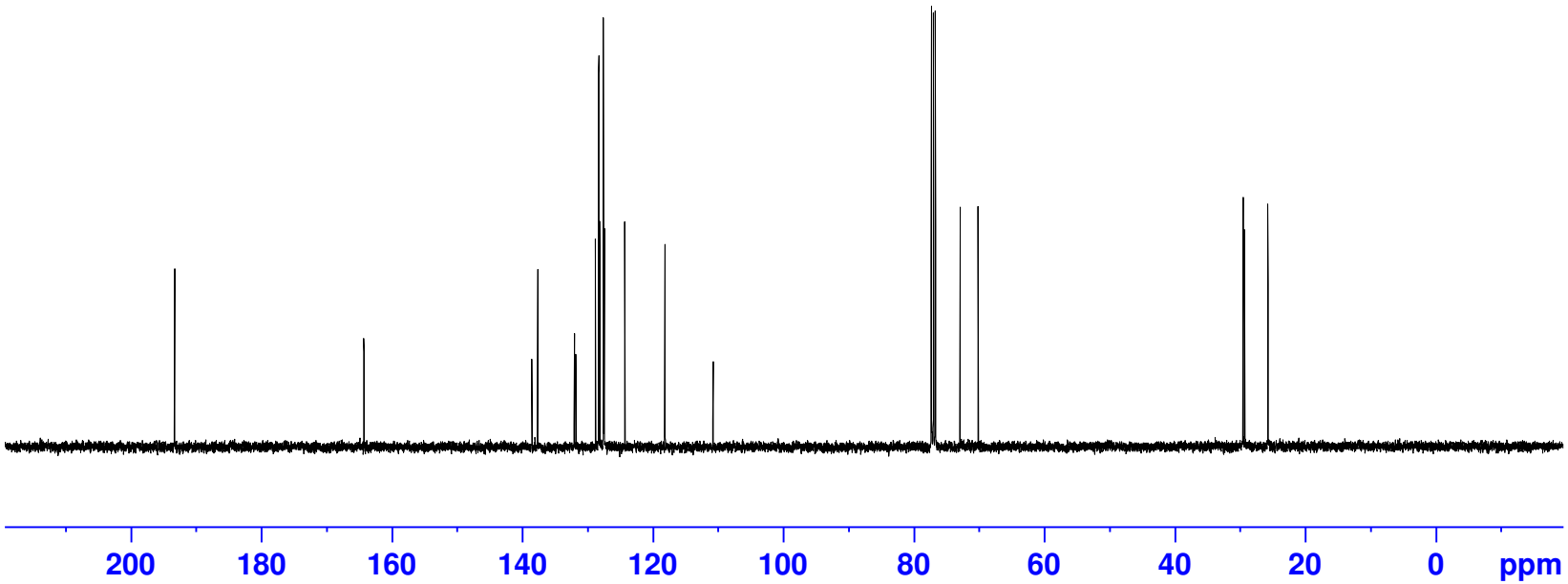
======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```





4i



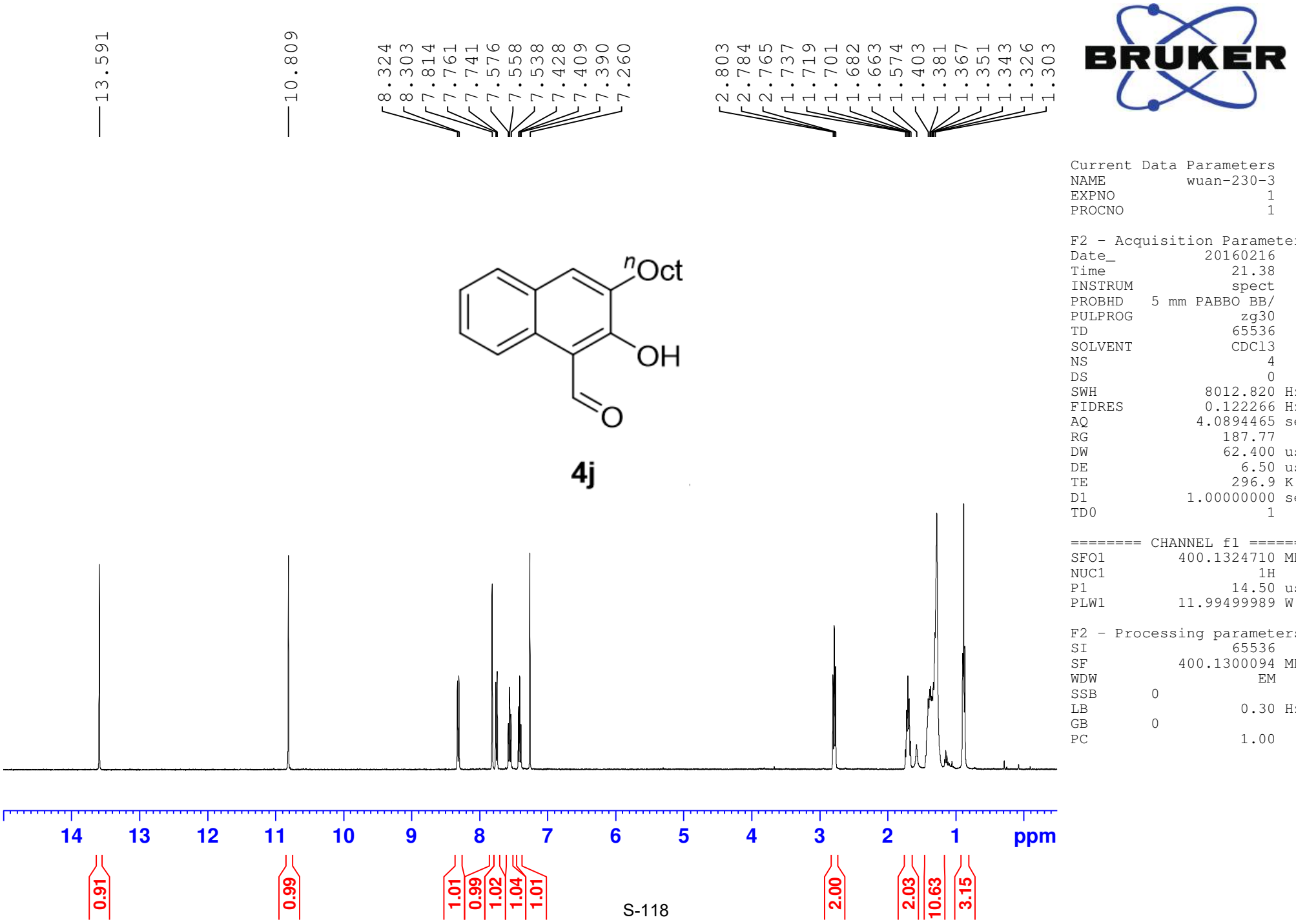

```
Current Data Parameters
NAME          wuan-237-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160604
Time               20.02
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                    71
DS                     0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                300.3 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                  13C
P1                 9.70 usec
PLW1         46.98899841 W

======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                  1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127774 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```



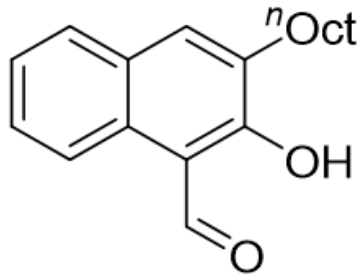
Current Data Parameters
NAME wuan-230-3
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20160216
Time 21.38
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 4
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 187.77
DW 62.400 usec
DE 6.50 usec
TE 296.9 K
D1 1.00000000 sec
TD0 1

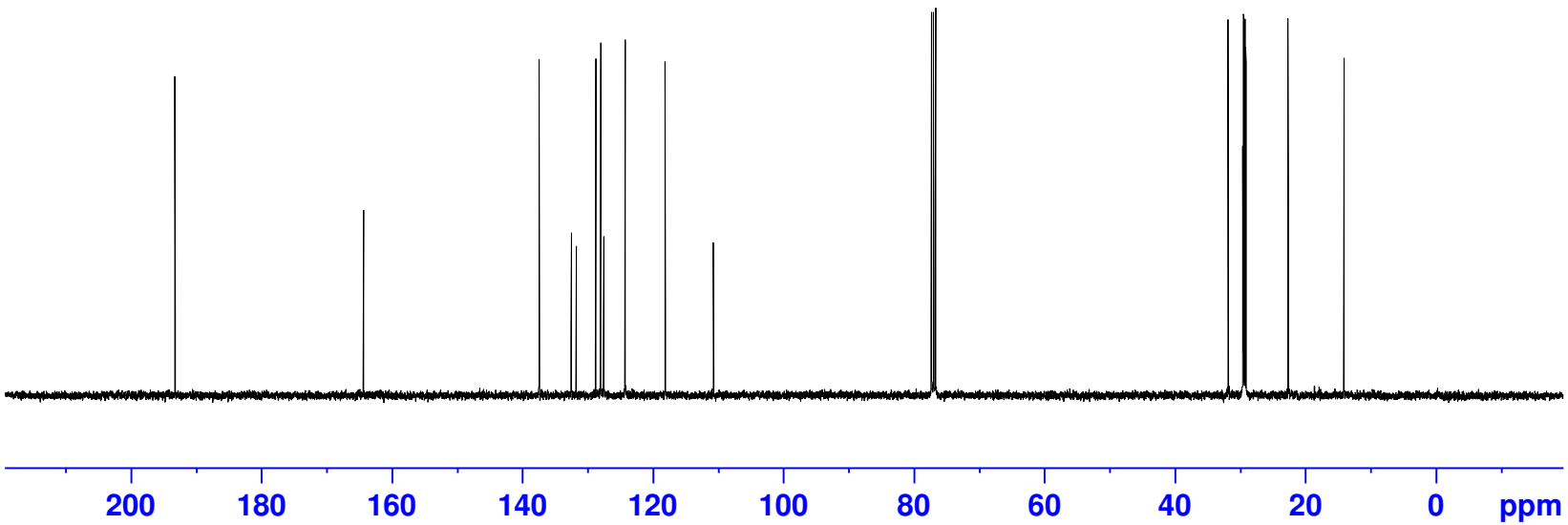
======== CHANNEL f1 ========
SFO1 400.1324710 MHz
NUC1 1H
P1 14.50 usec
PLW1 11.99499989 W

F2 - Processing parameters
SI 65536
SF 400.1300094 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

193.261
164.364
137.455
132.529
131.737
128.767
128.025
127.546
124.255
118.120
110.724
77.316
76.999
76.681
31.860
29.565
29.500
29.440
29.244
29.095
22.638
14.071



4j




```
Current Data Parameters
NAME          wuan-230-3
EXPNO                  2
PROCNO                 1

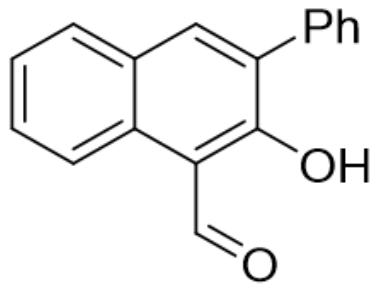
F2 - Acquisition Parameters
Date_           20160217
Time               18.03
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   123
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE               296.7 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

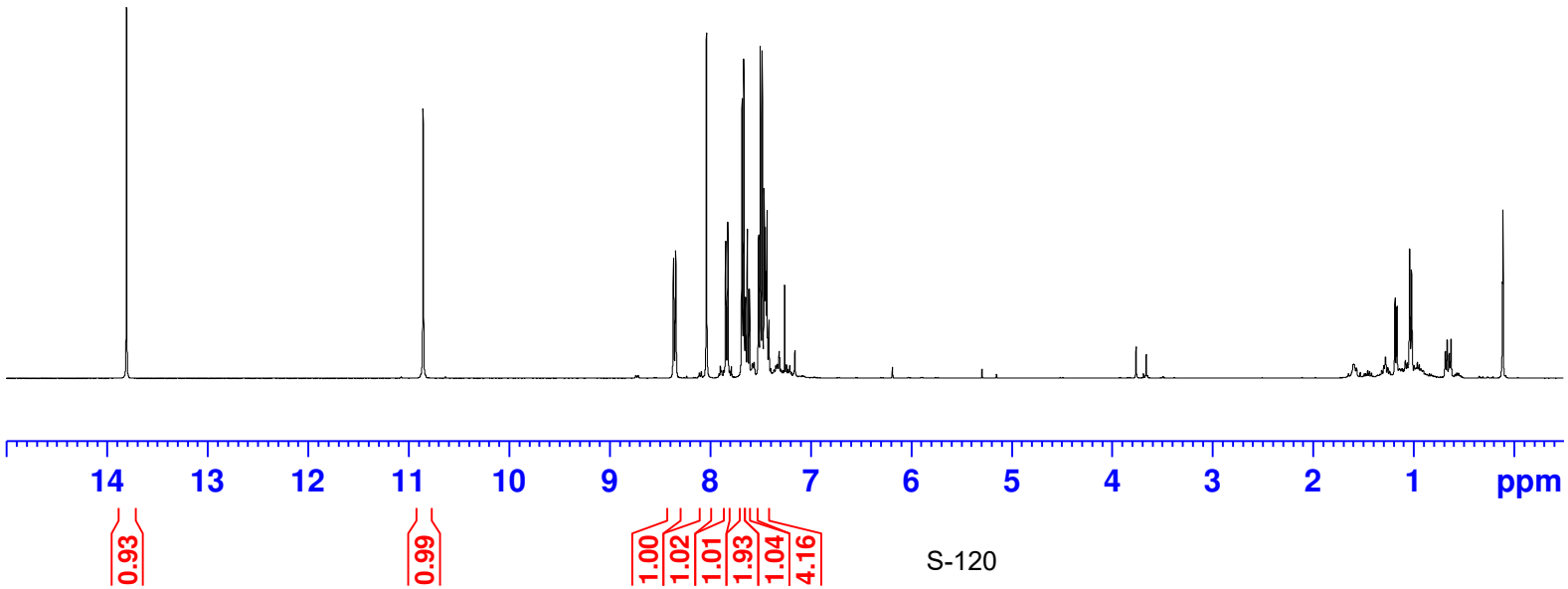
======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127757 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

13.809
10.858
8.365
8.344
8.038
7.846
7.826
7.687
7.684
7.679
7.666
7.651
7.648
7.633
7.630
7.612
7.609
7.519
7.515
7.501
7.498
7.482
7.464
7.456
7.453
7.450
7.446
7.444
7.435
7.428
7.416
7.260



4k

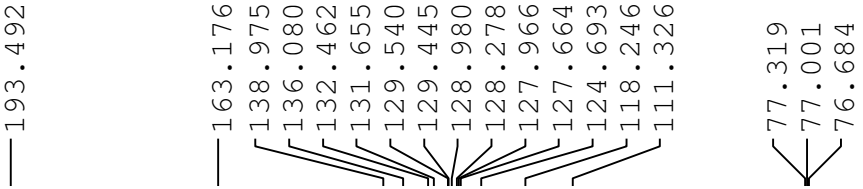


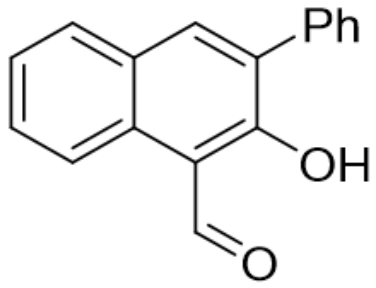

```
Current Data Parameters
NAME                wuan-240-3
EXPNO                        1
PROCNO                       1

F2 - Acquisition Parameters
Date_                 20160604
Time                     20.05
INSTRUM                  spect
PROBHD    5 mm PABBO BB/
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                          4
DS                          0
SWH                  8012.820 Hz
FIDRES               0.122266 Hz
AQ                   4.0894465 sec
RG                       62.93
DW                      62.400 usec
DE                       6.50 usec
TE                      299.5 K
D1                   1.00000000 sec
TD0                         1

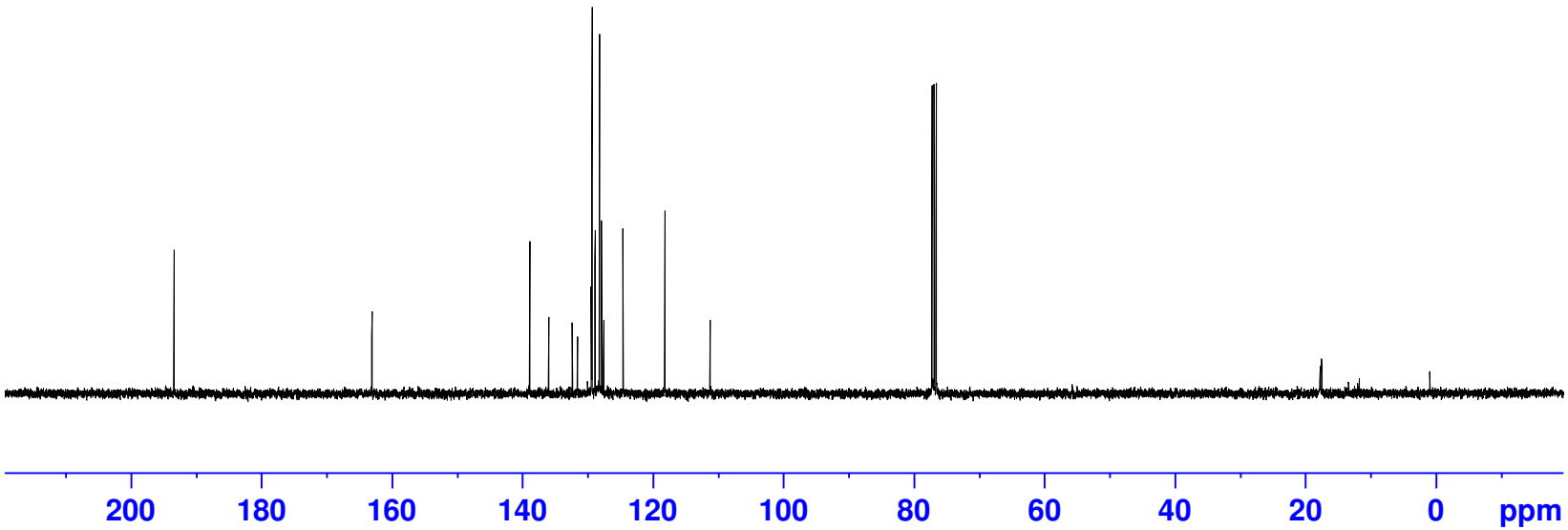
======== CHANNEL f1 ========
SFO1               400.1324710 MHz
NUC1                       1H
P1                      14.50 usec
PLW1               11.99499989 W

F2 - Processing parameters
SI                      65536
SF                 400.1300095 MHz
WDW                        EM
SSB          0
LB                       0.30 Hz
GB           0
PC                       1.00
```





4k



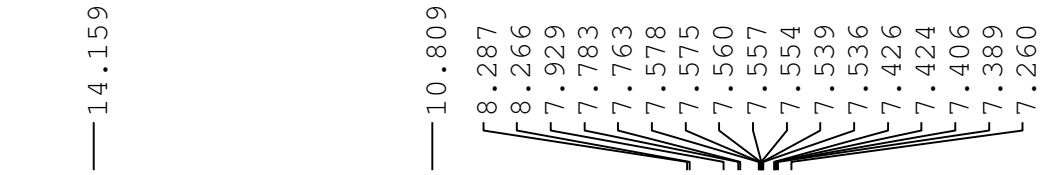

```
Current Data Parameters
NAME          wuan-240-3
EXPNO                  2
PROCNO                 1

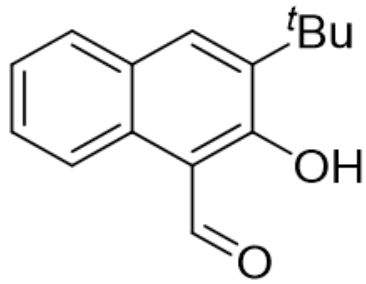
F2 - Acquisition Parameters
Date_           20160604
Time               20.06
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                    84
DS                     0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                300.0 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         100.6228298 MHz
NUC1                 13C
P1                 9.70 usec
PLW1         46.98899841 W

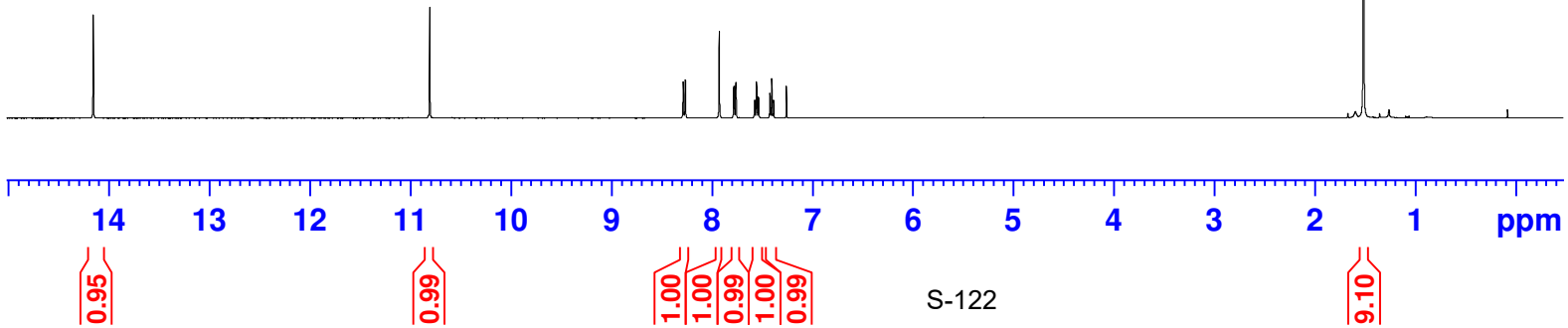
======== CHANNEL f2 ========
SFO2         400.1316005 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2         11.99499989 W
PLW12         0.34213999 W
PLW13         0.27713001 W

F2 - Processing parameters
SI                 32768
SF           100.6127752 MHz
WDW                  EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```





4l

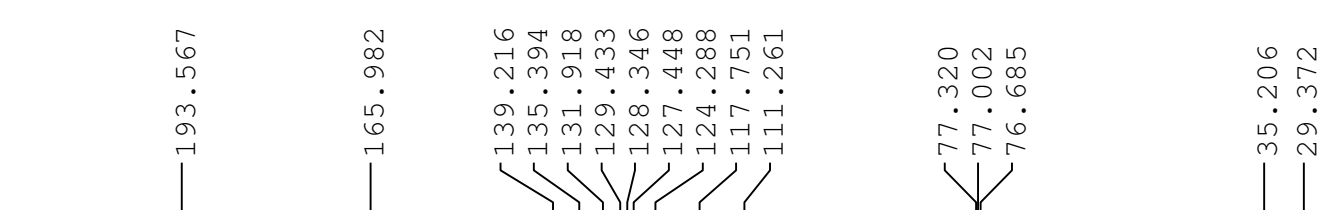


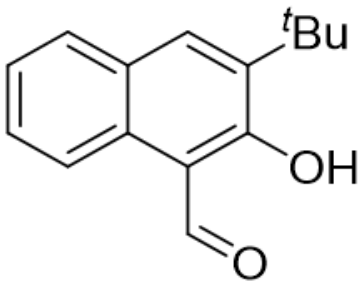

```
Current Data Parameters
NAME          wuan-239-4
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160605
Time               22.27
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 82.92
DW                62.400 usec
DE                 6.50 usec
TE                299.8 K
D1           1.00000000 sec
TD0                    1

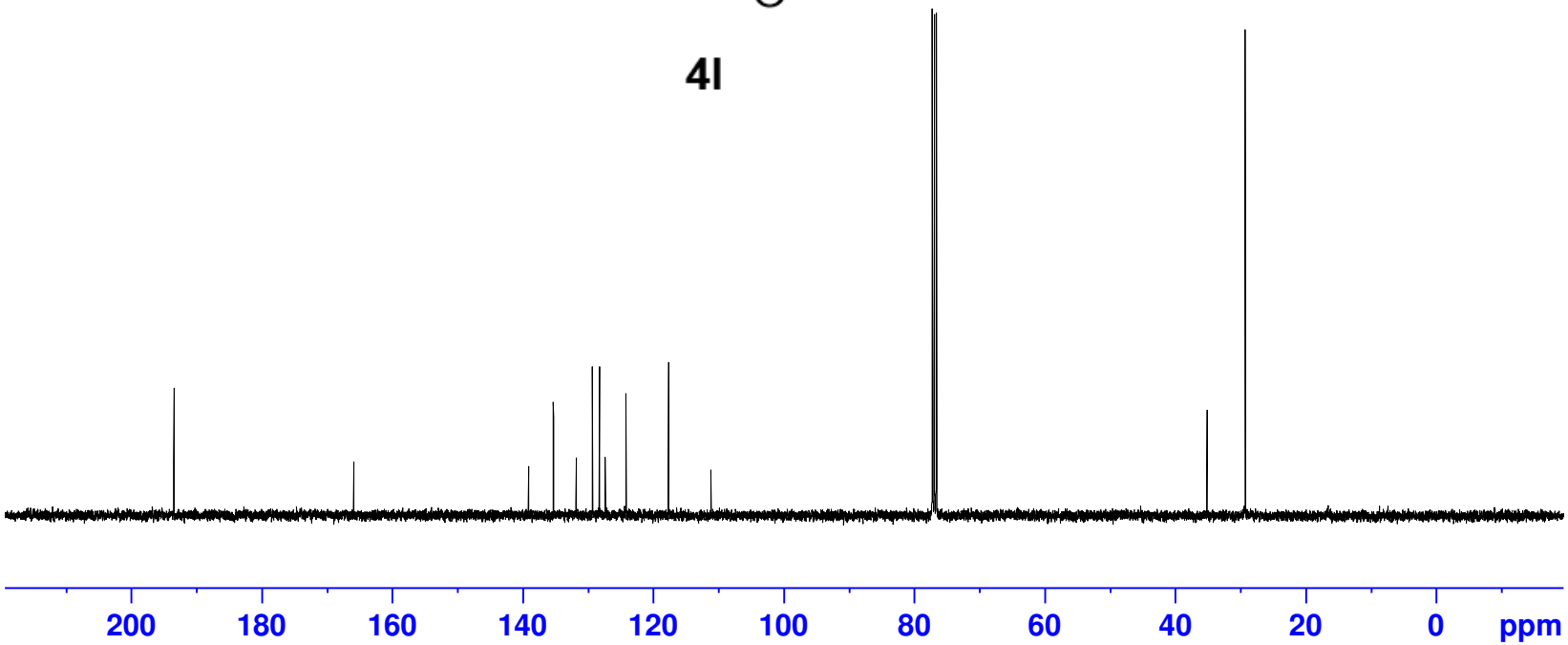
======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```





4l



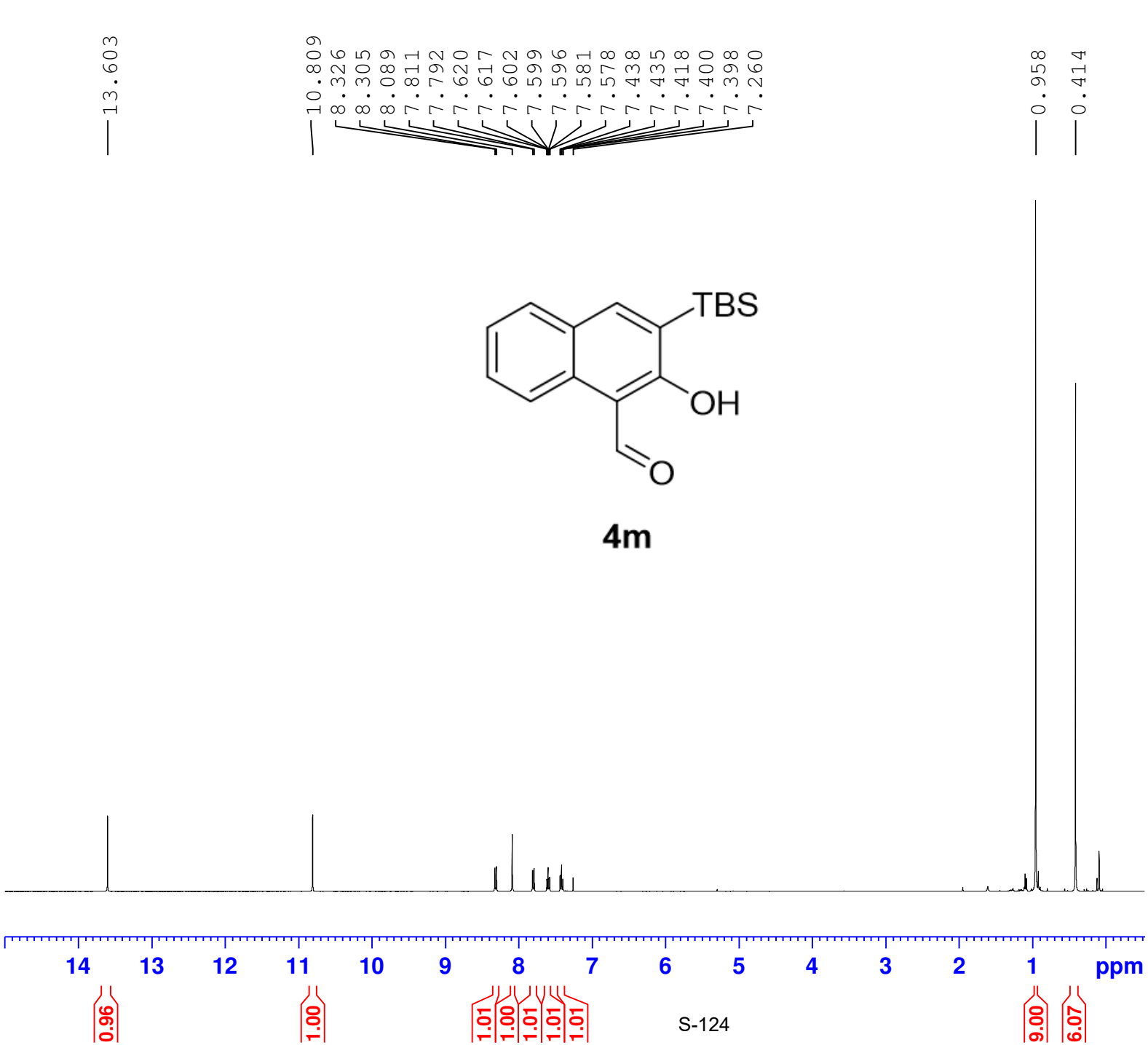

```
Current Data Parameters
NAME          wuan-239-4
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160605
Time               22.33
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   125
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                300.8 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127707 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```



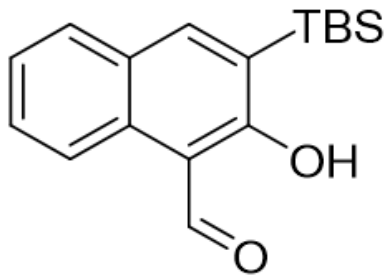

```
Current Data Parameters
NAME                 wuan-245-3
EXPNO                         1
PROCNO                        1

F2 - Acquisition Parameters
Date_                  20160605
Time                      22.10
INSTRUM                   spect
PROBHD    5 mm PABBO BB/
PULPROG                    zg30
TD                        65536
SOLVENT                   CDCl3
NS                            4
DS                            0
SWH                    8012.820 Hz
FIDRES                 0.122266 Hz
AQ                     4.0894465 sec
RG                        49.32
DW                        62.400 usec
DE                         6.50 usec
TE                        300.0 K
D1                     1.00000000 sec
TD0                           1

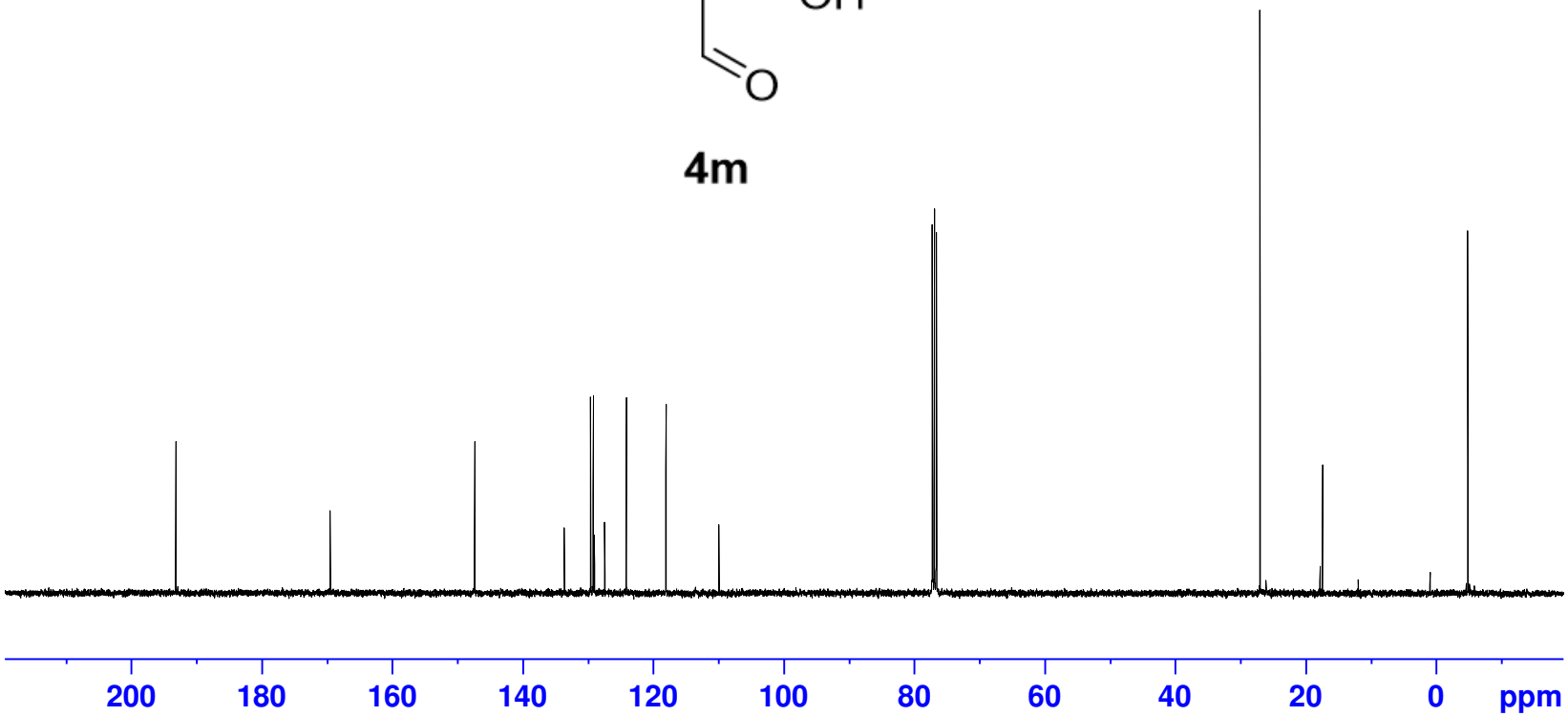
======== CHANNEL f1 ========
SFO1                 400.1324710 MHz
NUC1                         1H
P1                        14.50 usec
PLW1                 11.99499989 W

F2 - Processing parameters
SI                            65536
SF                   400.1300093 MHz
WDW                          EM
SSB                0
LB                         0.30 Hz
GB                 0
PC                         1.00
```

193.263
169.599
147.461
133.722
129.694
129.294
129.113
127.527
124.190
118.146
110.031
77.320
77.002
76.685
27.086
17.482
-4.777



4m




```
Current Data Parameters
NAME          wuan-245-3
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160605
Time               22.18
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   178
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                300.8 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127714 MHz
WDW                  EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

7.594
7.419
7.407
7.402
7.399
7.391
7.383
7.375
7.260

3.055
3.037
3.018
2.881
2.862
2.842
1.782
1.764
1.745
1.727
1.708
1.701
1.689
1.685
1.670
1.579
1.561
1.550
1.542
1.523
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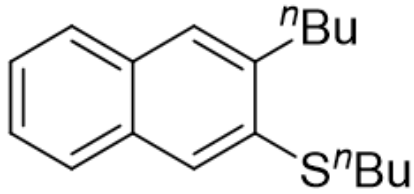
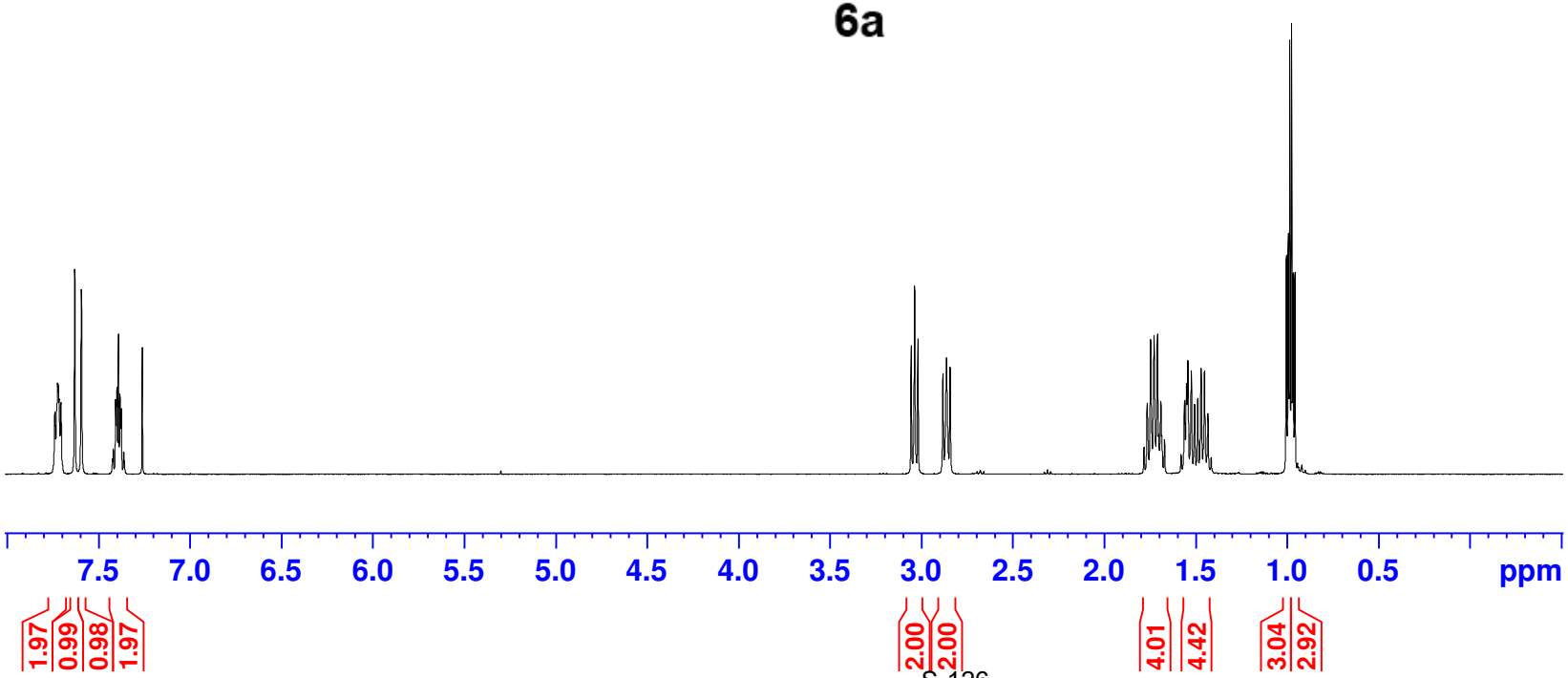
1.488
1.470
1.451
1.432
1.003
0.993



6a

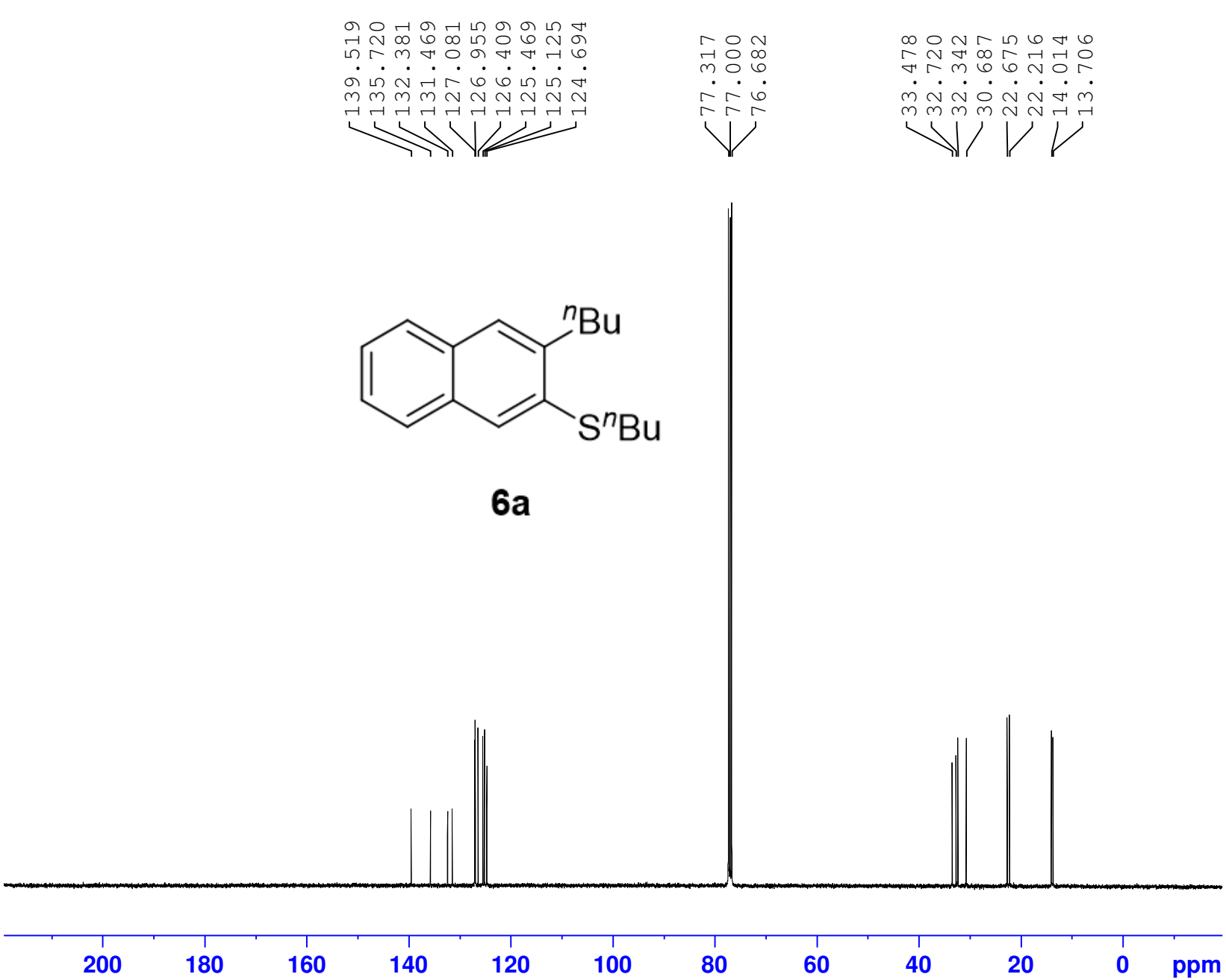



```
Current Data Parameters
NAME          wuan-179-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160104
Time               17.19
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 82.92
DW                62.400 usec
DE                 6.50 usec
TE                296.7 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



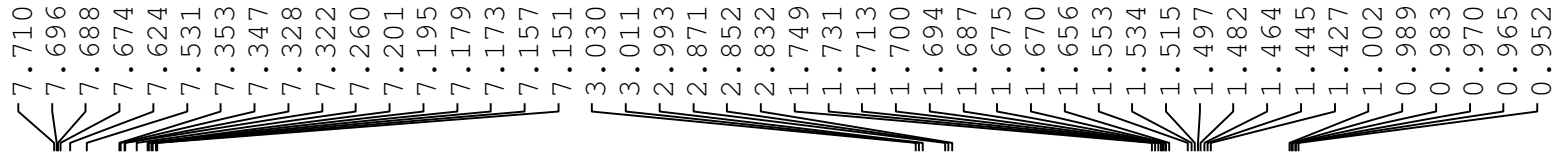
Current Data Parameters
NAME wuan-179-1
EXPNO 5
PROCNO 1

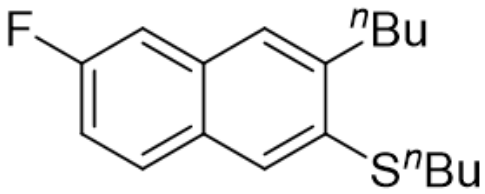
F2 - Acquisition Parameters
Date_ 20160108
Time 12.44
INSTRUM spect
PROBHD 5 mm DUL 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 1969
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 297.7 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.60 usec
PLW1 31.98900032 W

======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 9.10000038 W
PLW12 0.24608000 W
PLW13 0.19933000 W

F2 - Processing parameters
SI 32768
SF 100.6127719 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40





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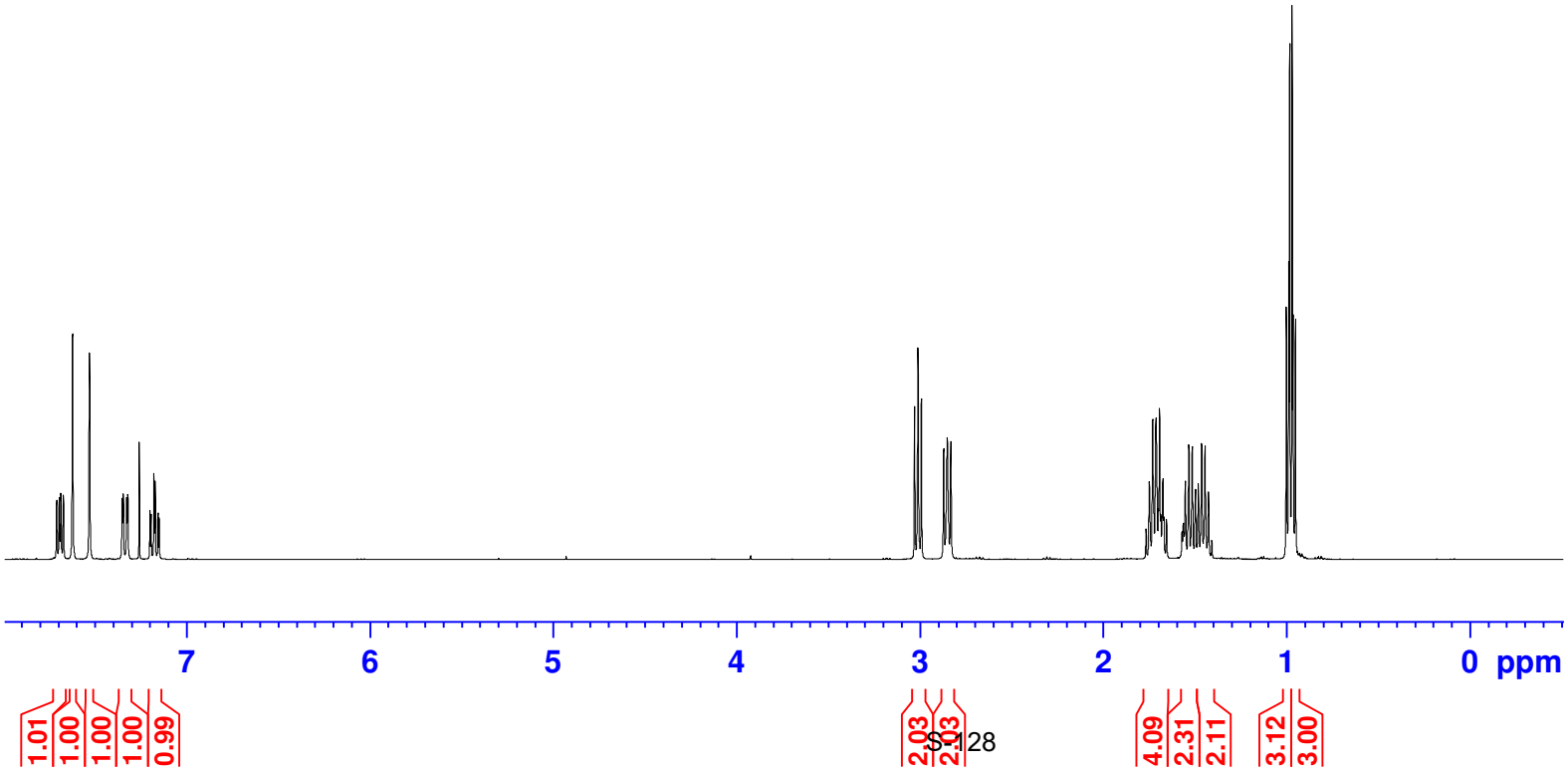
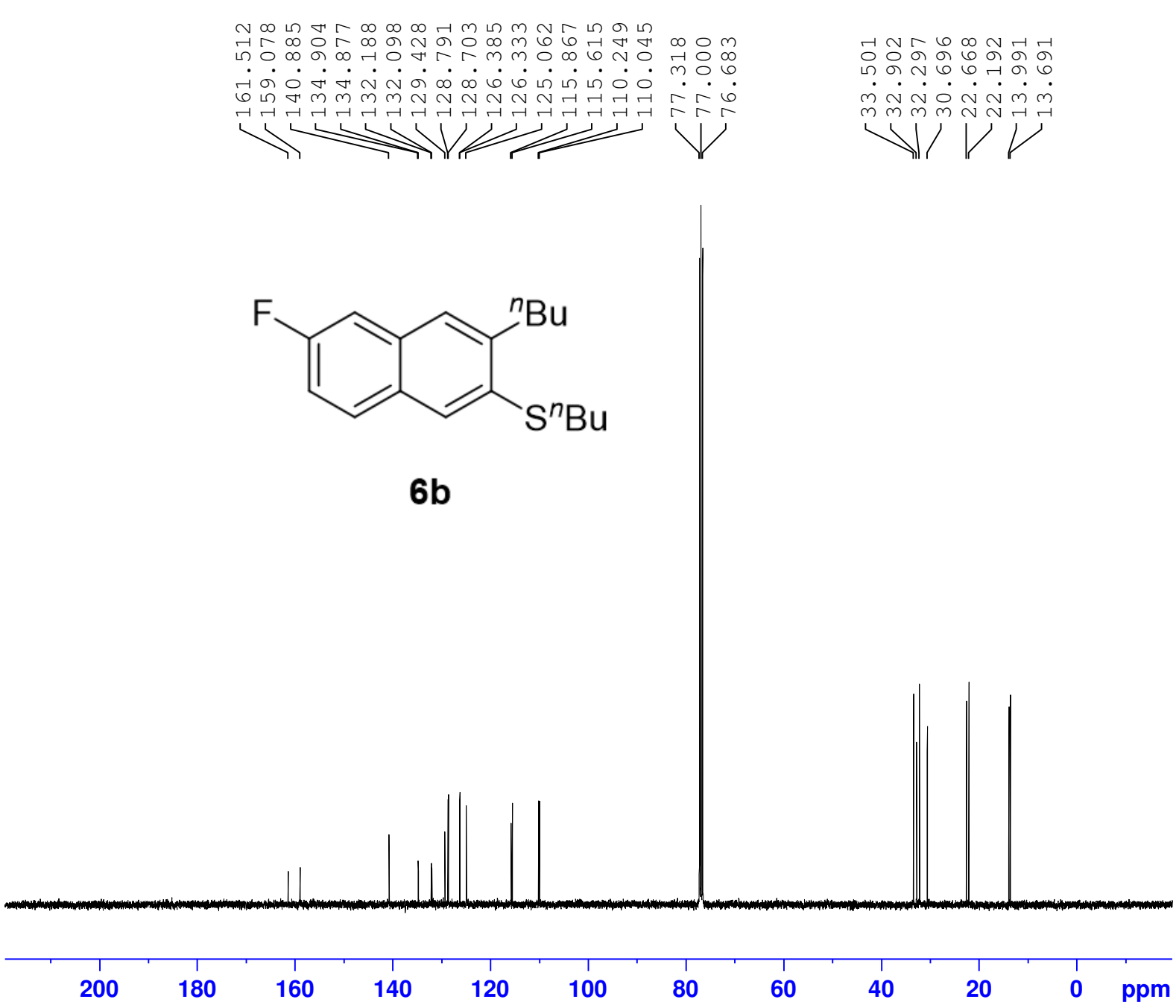



```
Current Data Parameters
NAME          wuan-241-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160328
Time               18.38
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 70.97
DW                62.400 usec
DE                 6.50 usec
TE                296.4 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300096 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



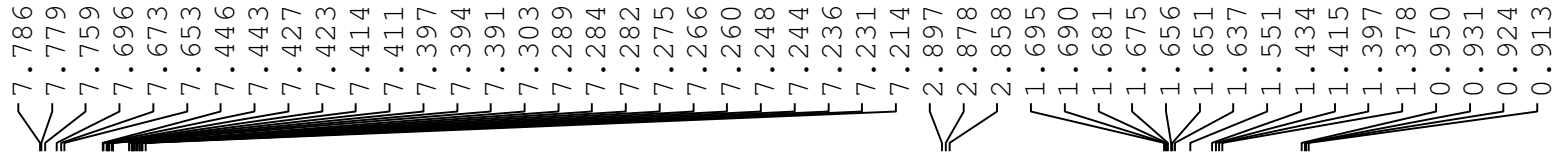
Current Data Parameters
NAME wuan-241-1
EXPNO 3
PROCNO 1

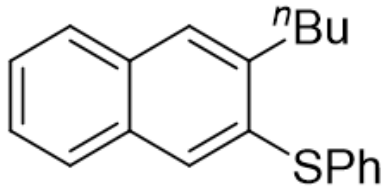
F2 - Acquisition Parameters
Date_ 20160328
Time 19.12
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 412
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 297.3 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

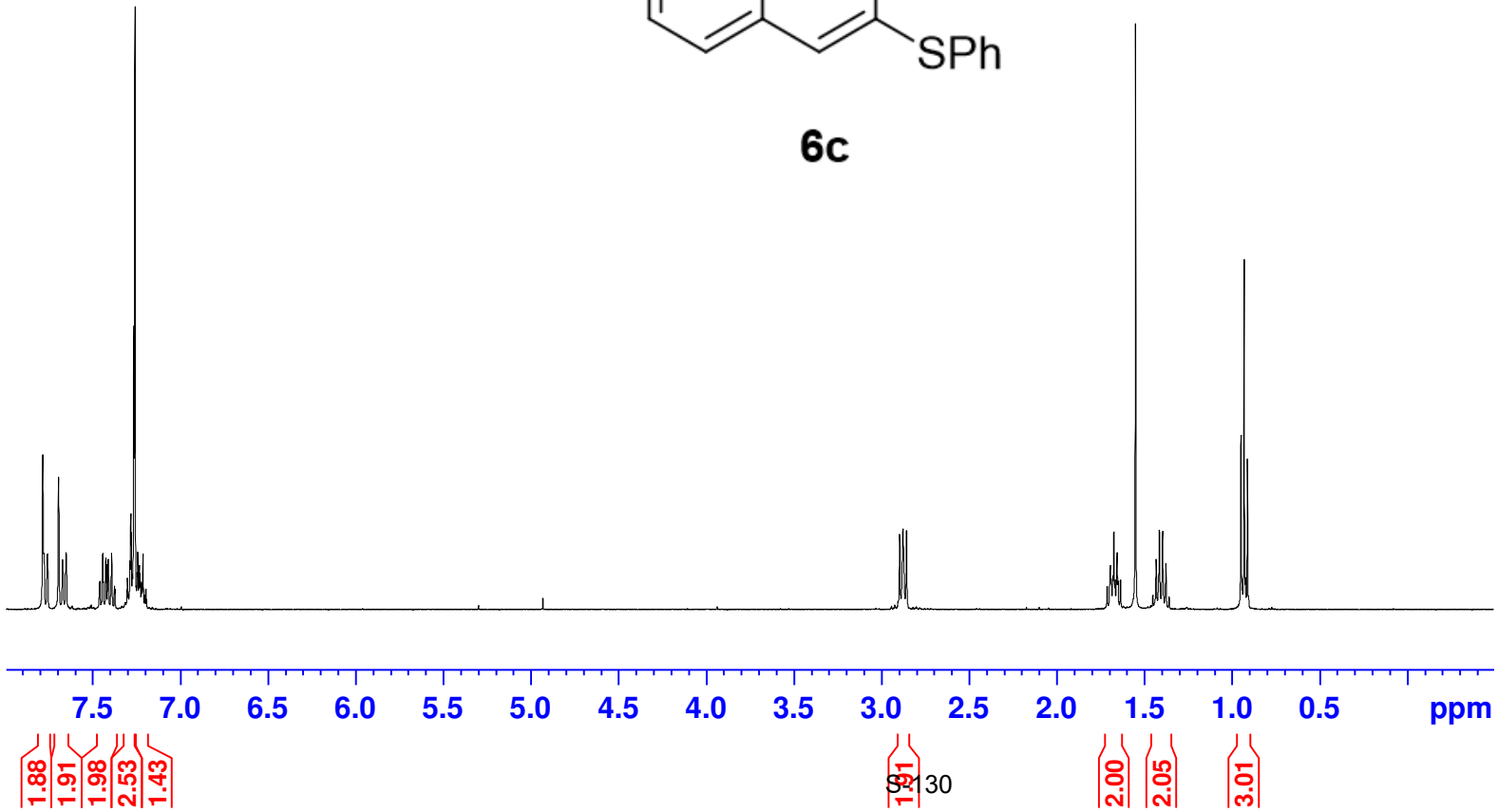
======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127714 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40





6c

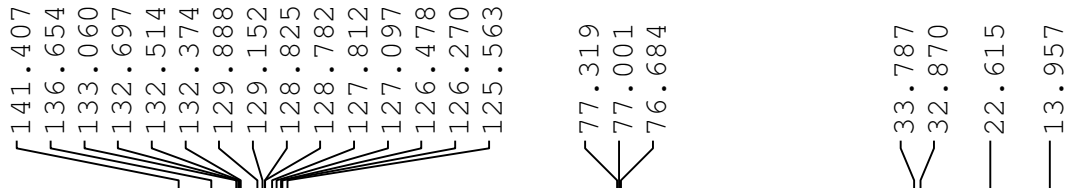


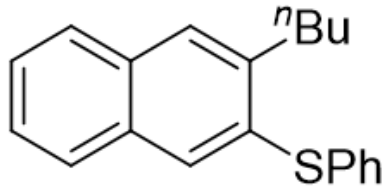

```
Current Data Parameters
NAME          wuan-295-2
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160405
Time                1.21
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 298.1 K
D1             1.00000000 sec
TD0                    1

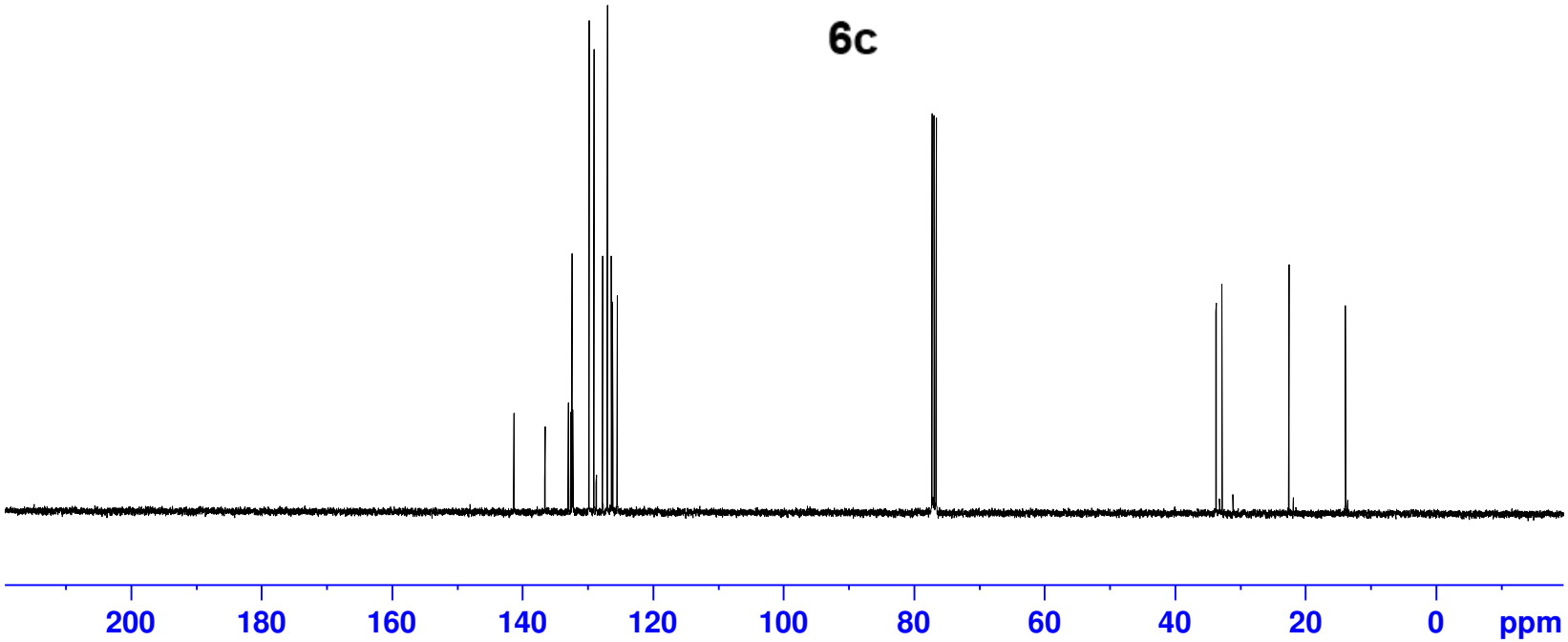
======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300095 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```





6c



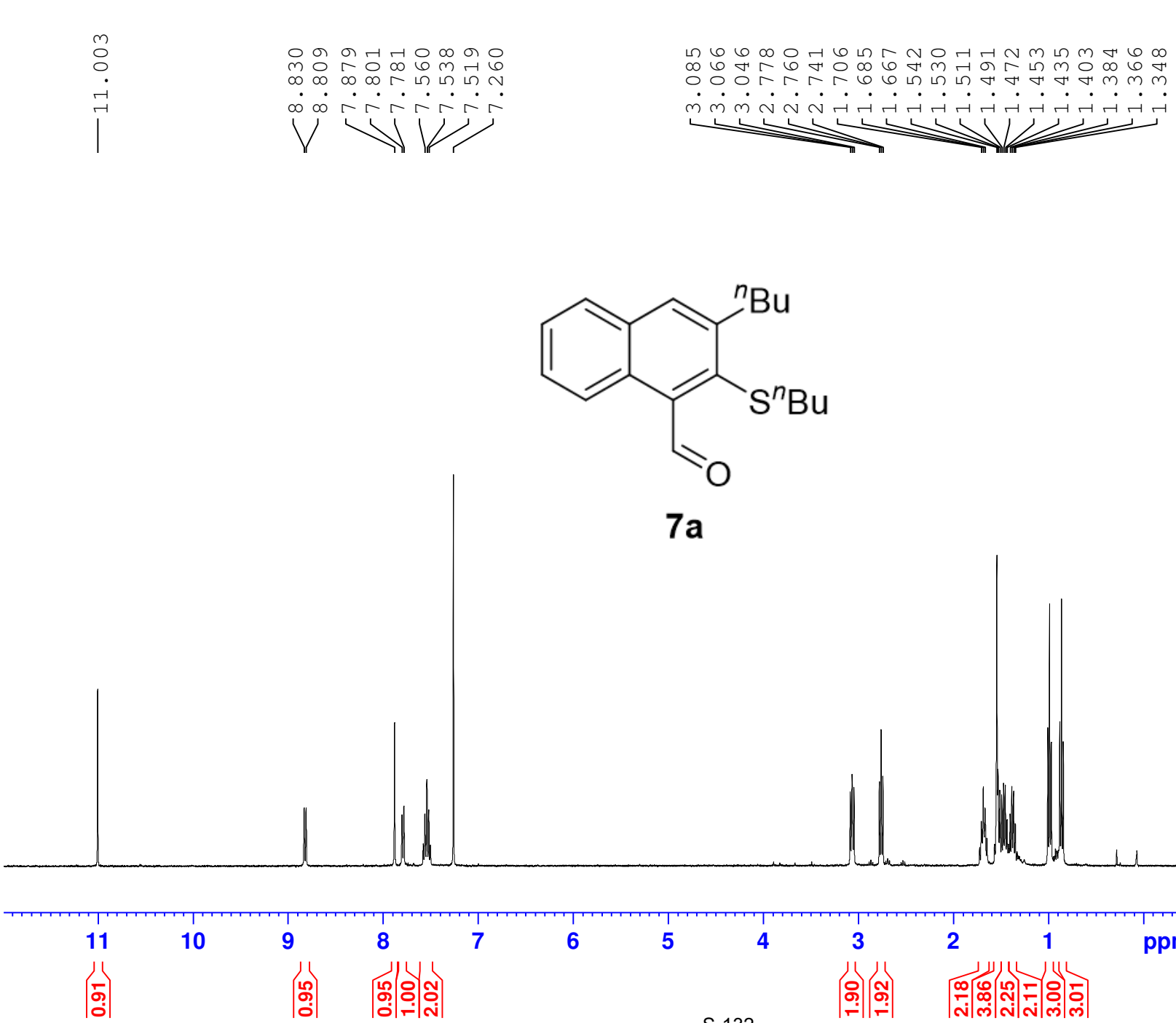

```
Current Data Parameters
NAME          wuan-295-2
EXPNO                  3
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160603
Time               19.12
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   166
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                298.9 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                 13C
P1                9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2            90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127752 MHz
WDW                  EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```



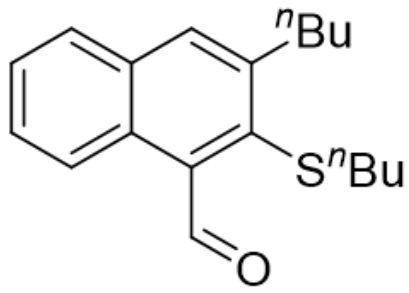

```
Current Data Parameters
NAME          wuan-219-2
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160127
Time               22.07
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                 62.400 usec
DE                  6.50 usec
TE                 296.3 K
D1            1.00000000 sec
TD0                    1

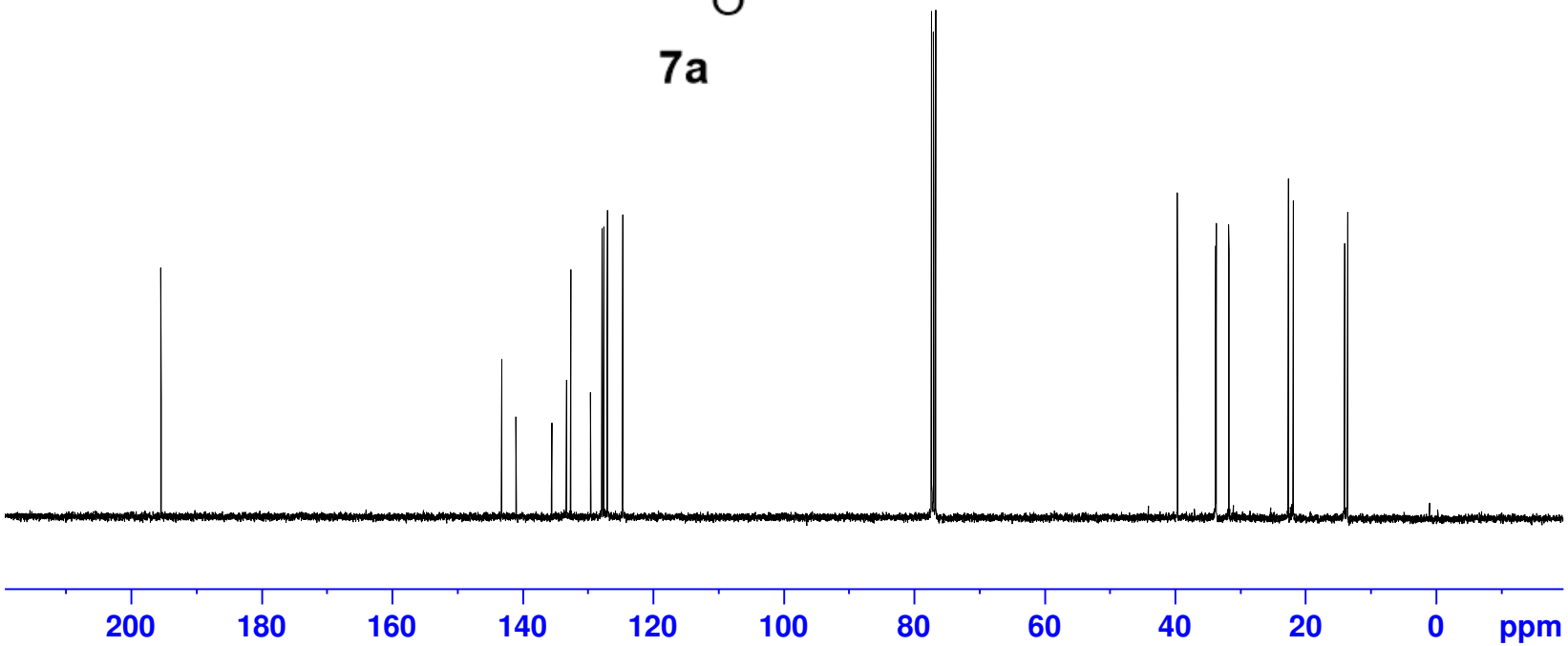
======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300095 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```

195.422
143.216
140.998
135.537
133.261
132.603
129.572
127.839
127.581
127.021
124.637
77.317
77.000
76.682
39.614
33.761
33.662
31.736
22.625
21.846
13.975
13.533



7a



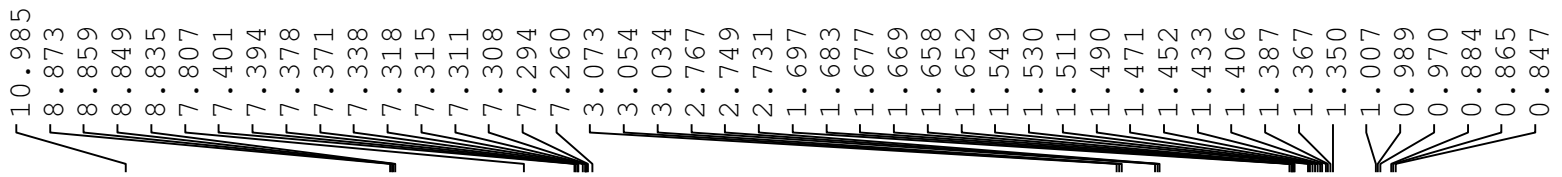

```
Current Data Parameters
NAME          wuan-219-2
EXPNO                  4
PROCNO                 1

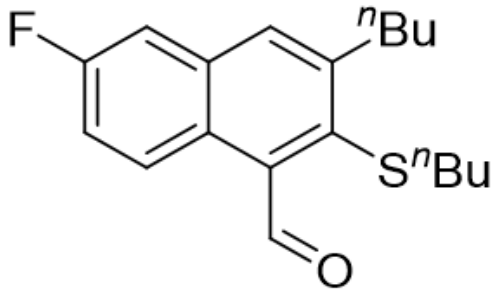
F2 - Acquisition Parameters
Date_           20160202
Time               20.29
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   263
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                297.6 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

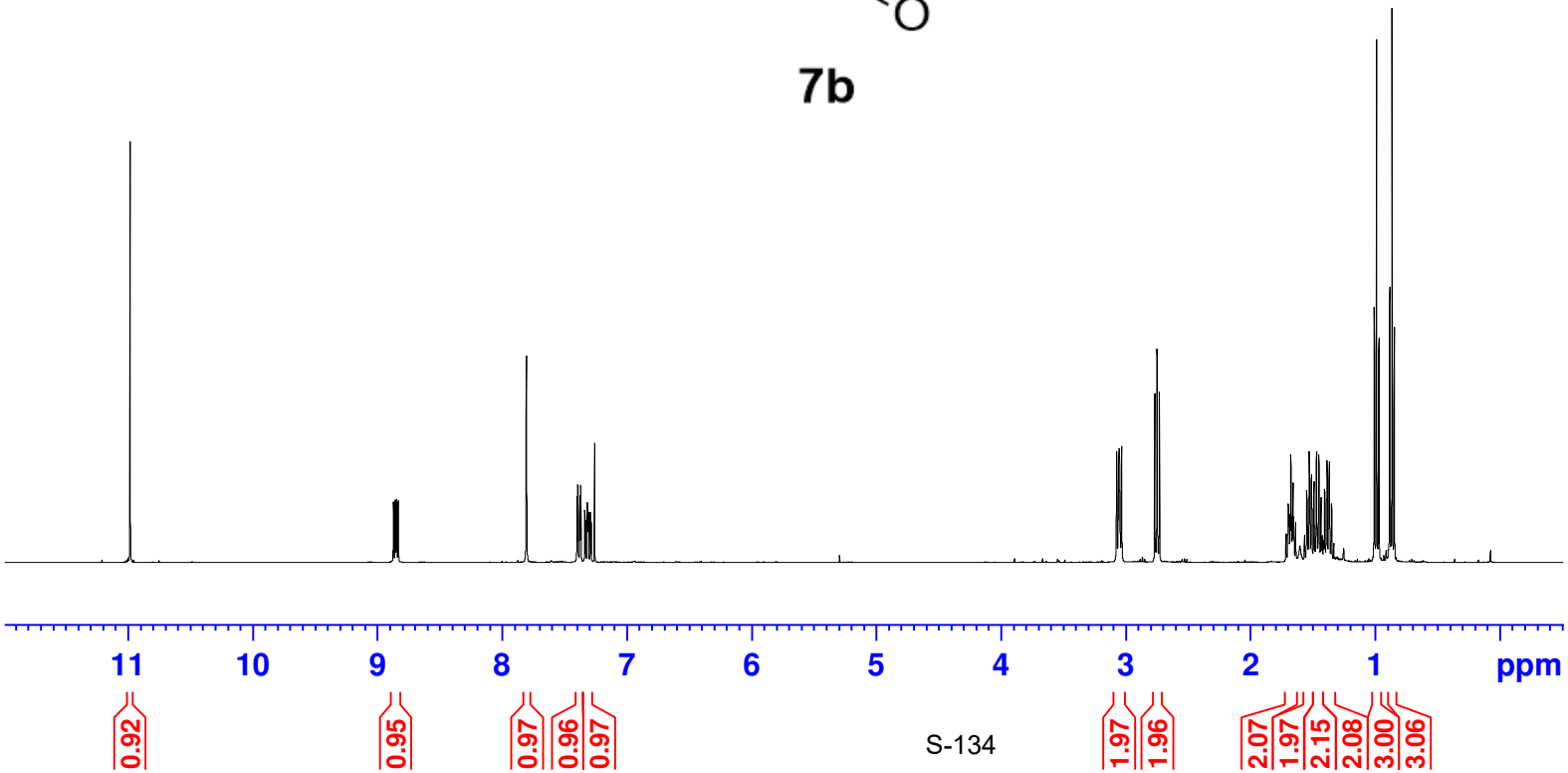
======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127740 MHz
WDW                  EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```





7b

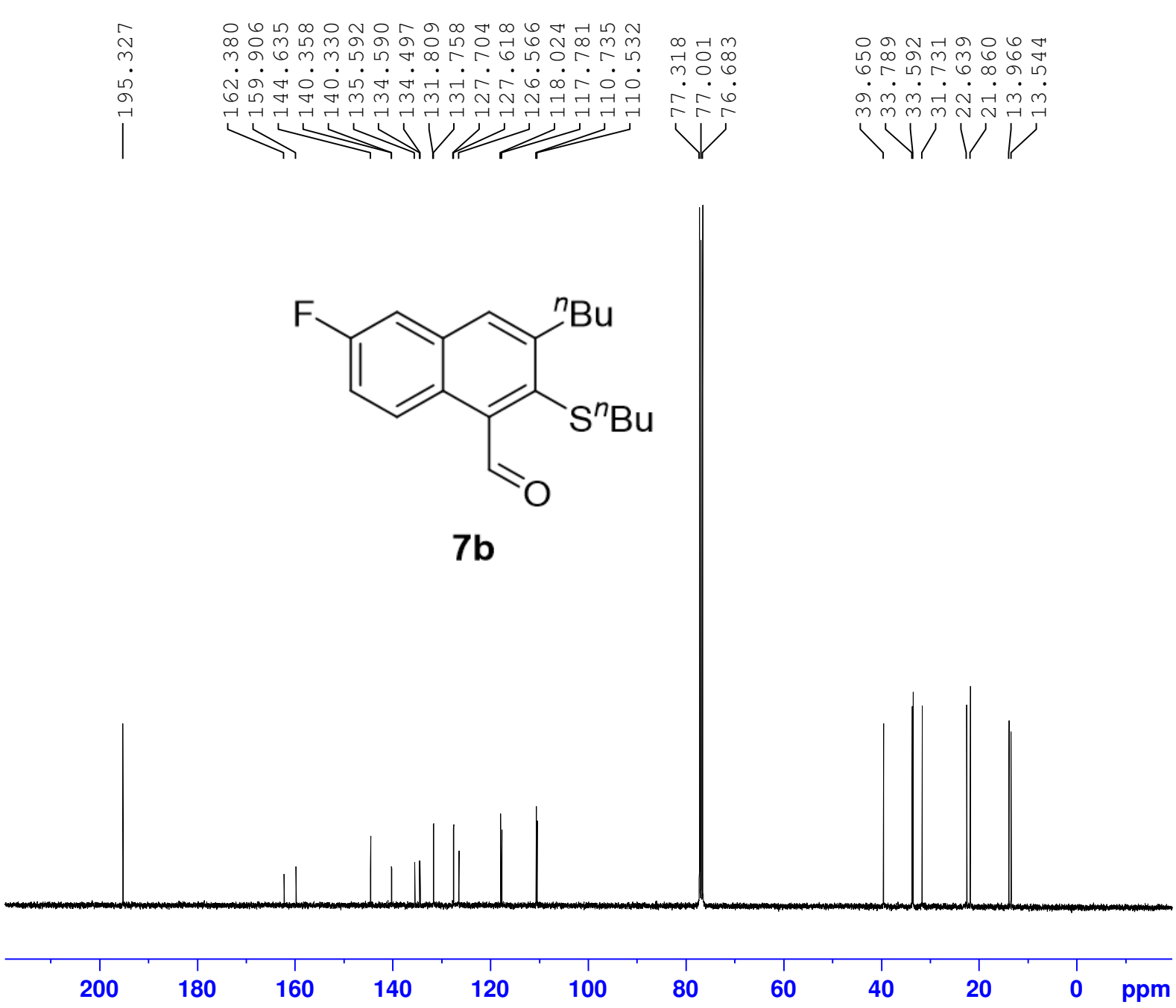



```
Current Data Parameters
NAME          wuan-242-2
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160324
Time               13.06
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 70.97
DW                62.400 usec
DE                 6.50 usec
TE                296.9 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300095 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



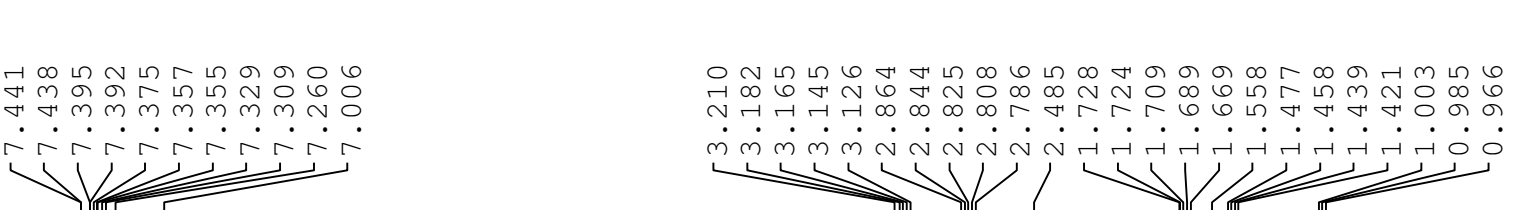
Current Data Parameters
NAME wuan-242-2
EXPNO 3
PROCNO 1

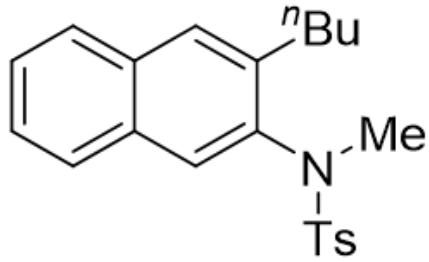
F2 - Acquisition Parameters
Date_ 20160324
Time 13.17
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 718
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 297.9 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127710 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40





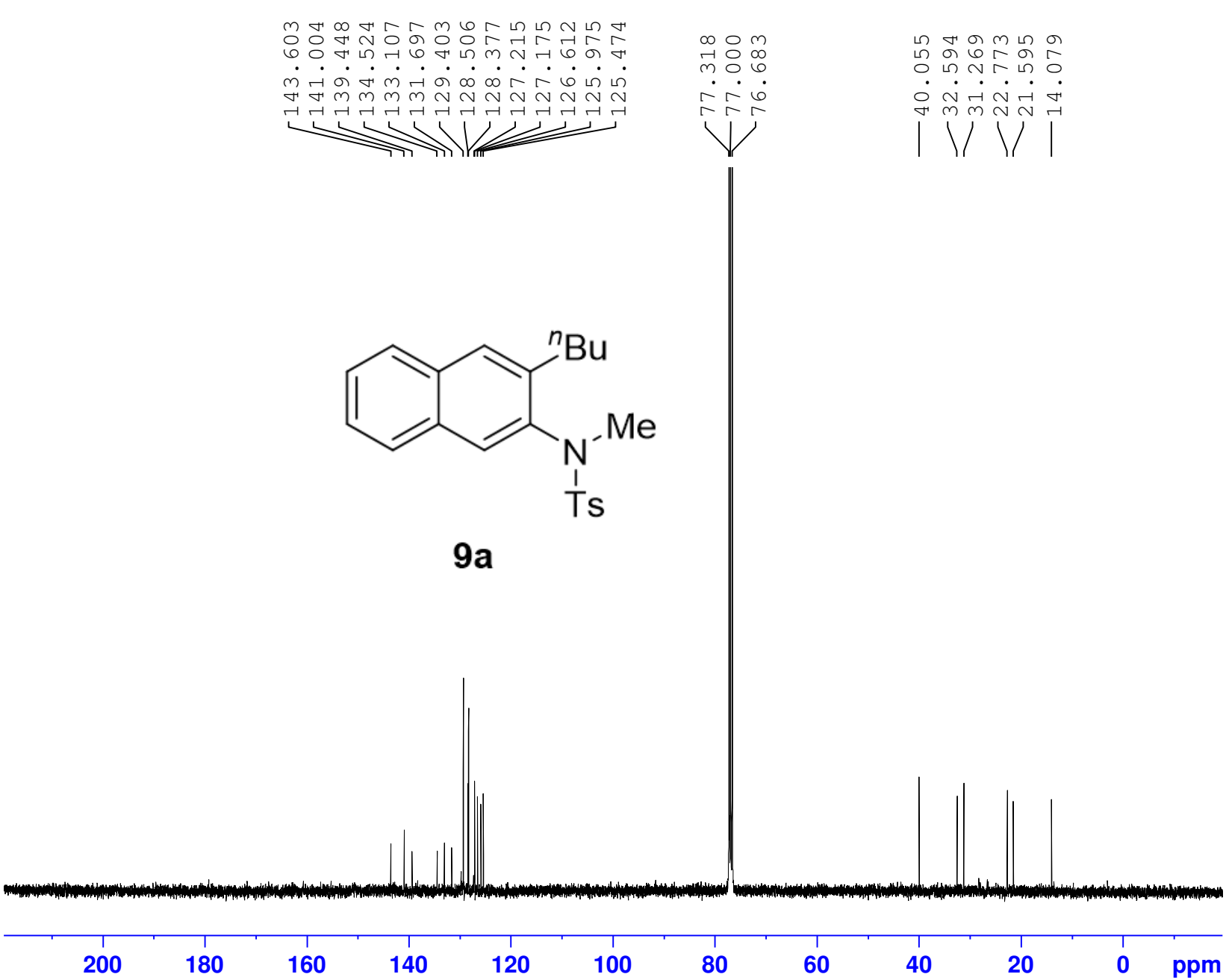
9a


```
Current Data Parameters
NAME          wuan-178-1
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160102
Time               20.25
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                62.400 usec
DE                 6.50 usec
TE                298.1 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300094 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



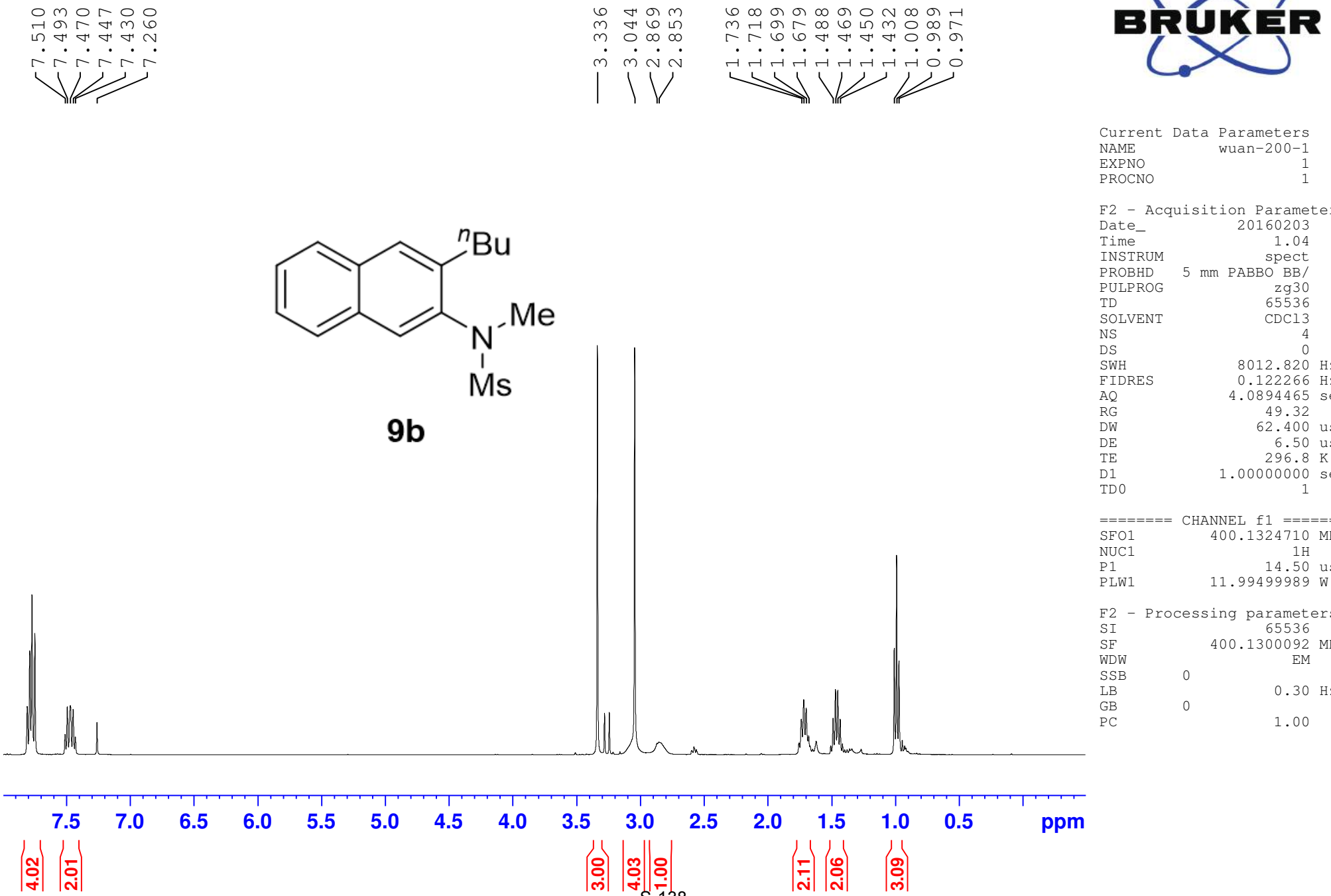

```
Current Data Parameters
NAME          wuan-178-1
EXPNO                  3
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160102
Time               20.33
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                  1380
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                299.0 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                 9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127700 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

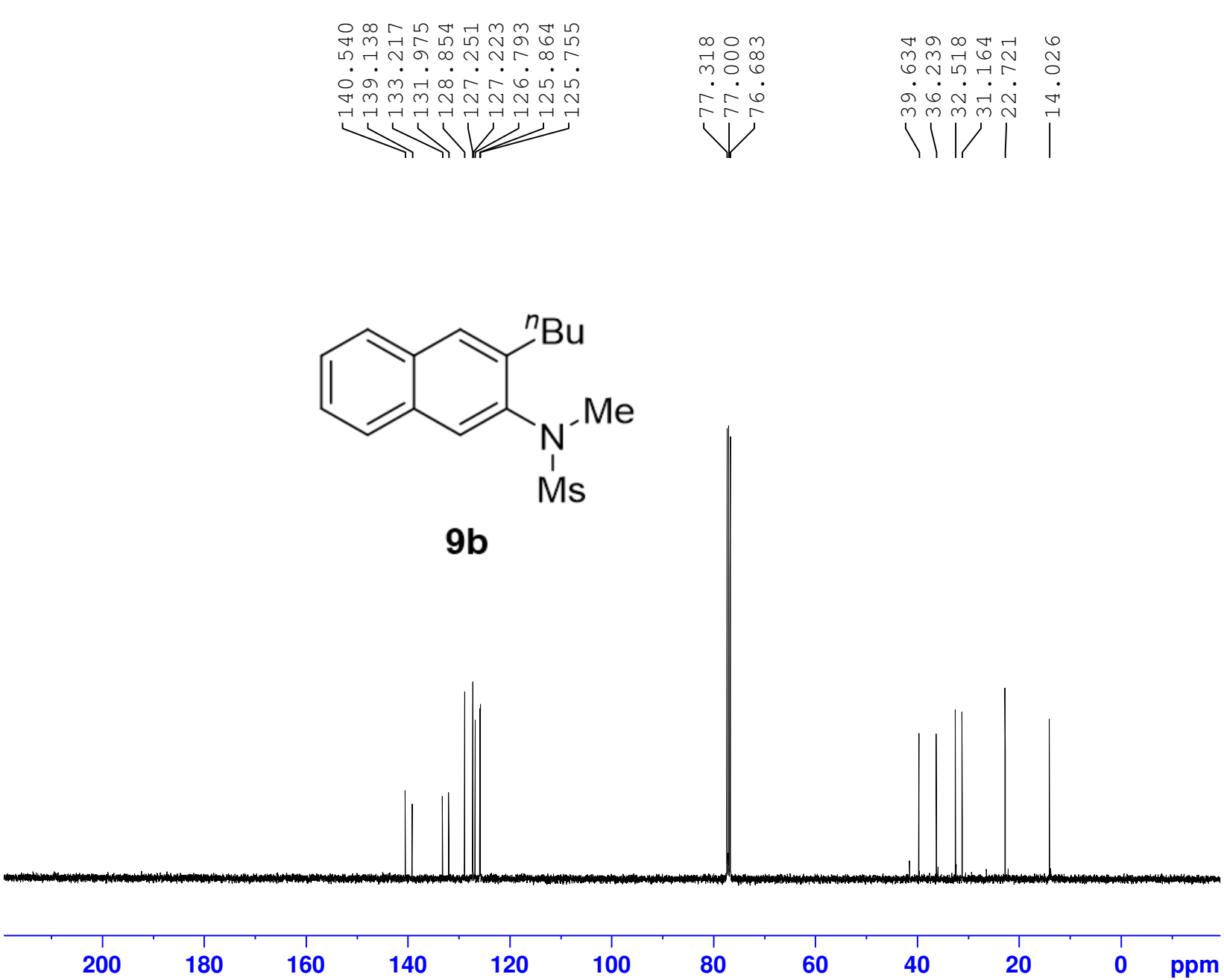



```
Current Data Parameters
NAME          wuan-200-1
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160203
Time                1.04
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 49.32
DW                62.400 usec
DE                 6.50 usec
TE                296.8 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300092 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



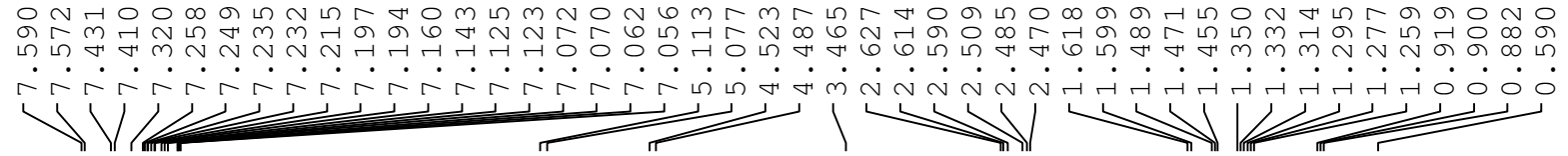

```
Current Data Parameters
NAME                wuan-200-1
EXPNO                        2
PROCNO                       1

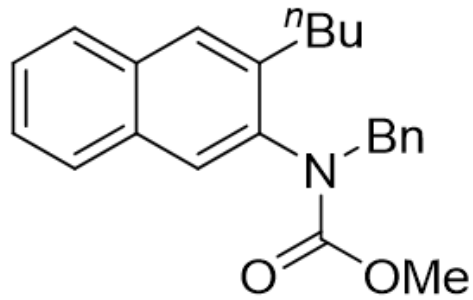
F2 - Acquisition Parameters
Date_                 20160203
Time                      1.09
INSTRUM                  spect
PROBHD    5 mm PABBO BB/
PULPROG                 zgpg30
TD                       65536
SOLVENT                  CDCl3
NS                         129
DS                           0
SWH                24038.461 Hz
FIDRES              0.366798 Hz
AQ                  1.3631488 sec
RG                     196.92
DW                     20.800 usec
DE                      6.50 usec
TE                     297.9 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                          1

======== CHANNEL f1 ========
SFO1               100.6228298 MHz
NUC1                       13C
P1                       9.70 usec
PLW1               46.98899841 W

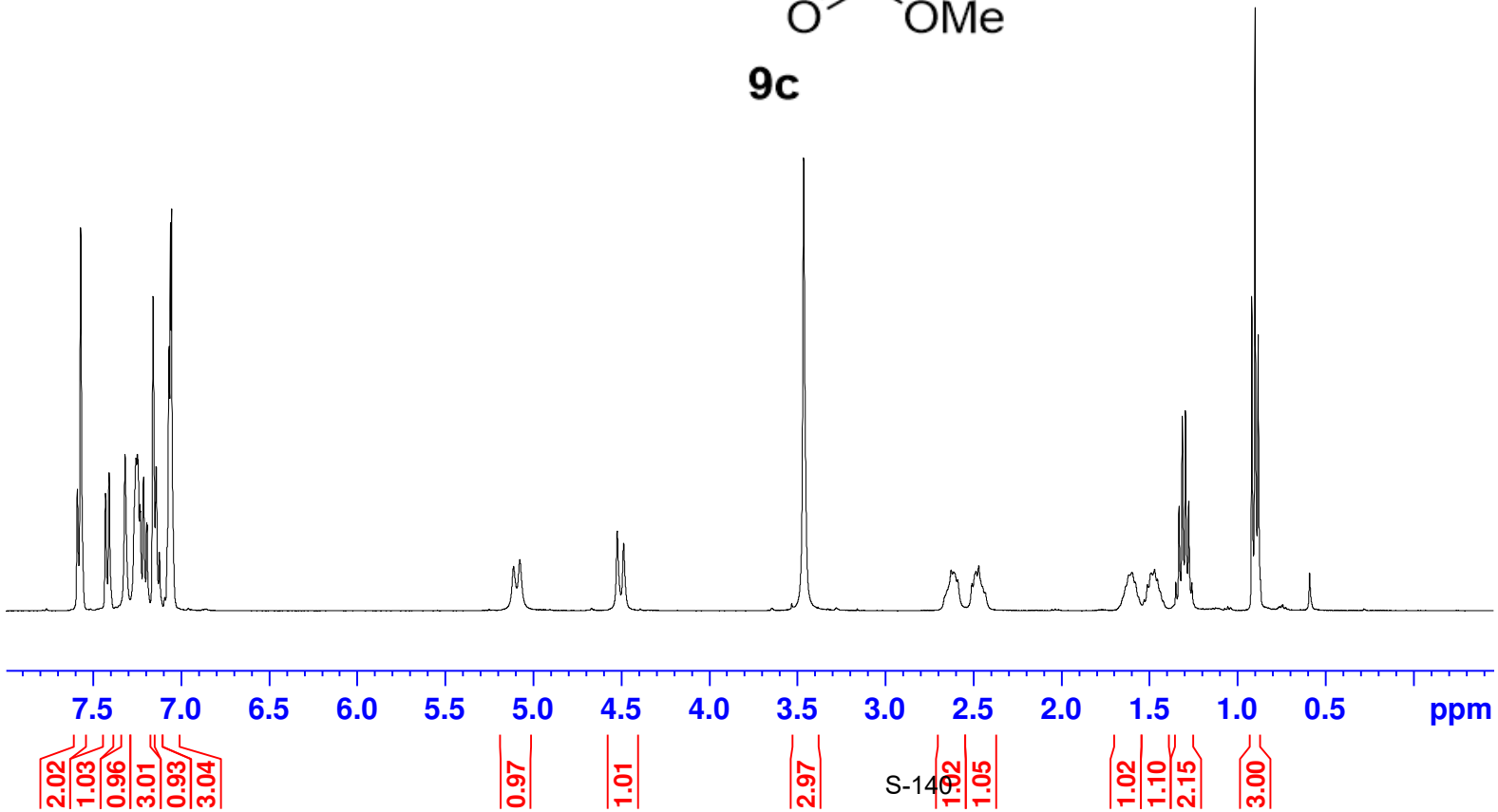
======== CHANNEL f2 ========
SFO2               400.1316005 MHz
NUC2                       1H
CPDPRG[2               waltz16
PCPD2                   90.00 usec
PLW2               11.99499989 W
PLW12               0.34213999 W
PLW13               0.27713001 W

F2 - Processing parameters
SI                         32768
SF                 100.6127760 MHz
WDW                           EM
SSB          0
LB                       1.00 Hz
GB           0
PC                       1.40
```





9c

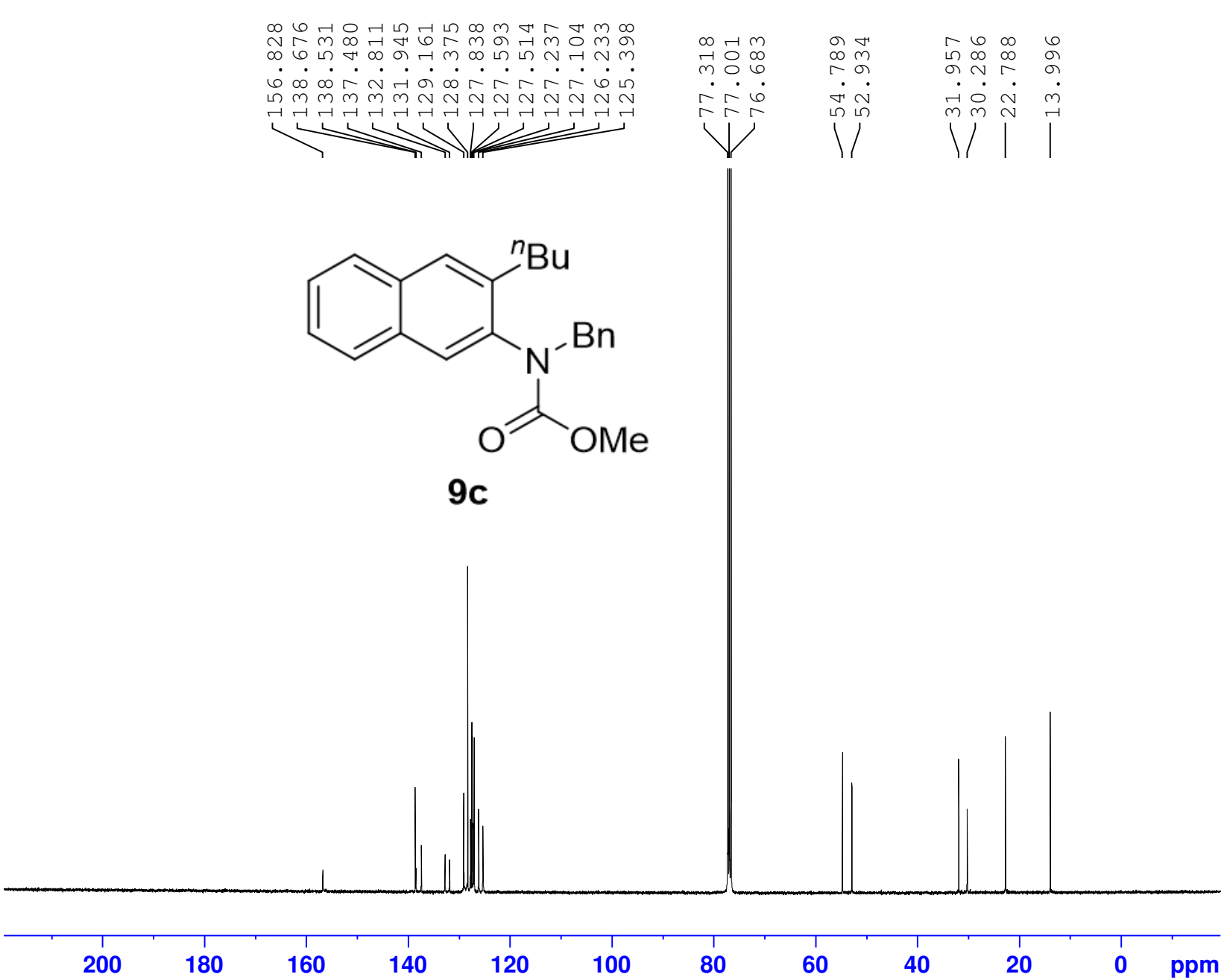



```
Current Data Parameters
NAME          wuan-209-1
EXPNO                  4
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160605
Time               23.31
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT             C6D6
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 88.84
DW                62.400 usec
DE                 6.50 usec
TE                330.1 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1299957 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



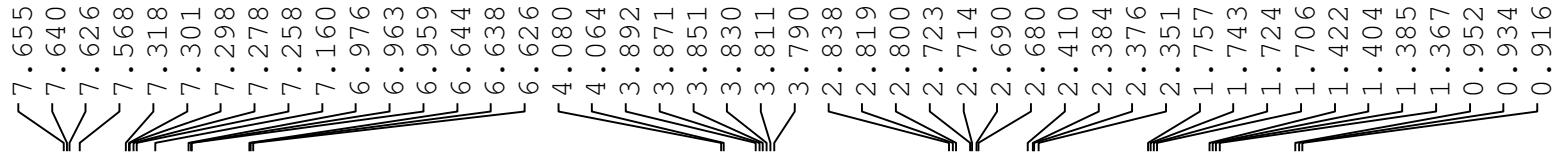
Current Data Parameters
NAME wuan-209
EXPNO 3
PROCNO 1

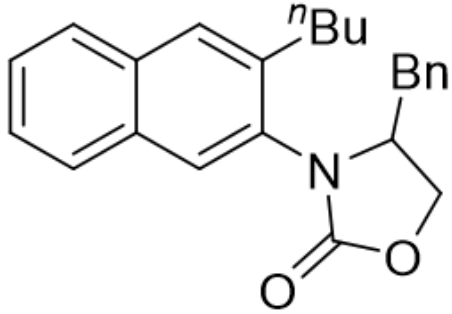
F2 - Acquisition Parameters
Date_ 20160203
Time 1.17
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 10330
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631488 sec
RG 196.92
DW 20.800 usec
DE 6.50 usec
TE 297.9 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1

======== CHANNEL f1 ========
SFO1 100.6228298 MHz
NUC1 13C
P1 9.70 usec
PLW1 46.98899841 W

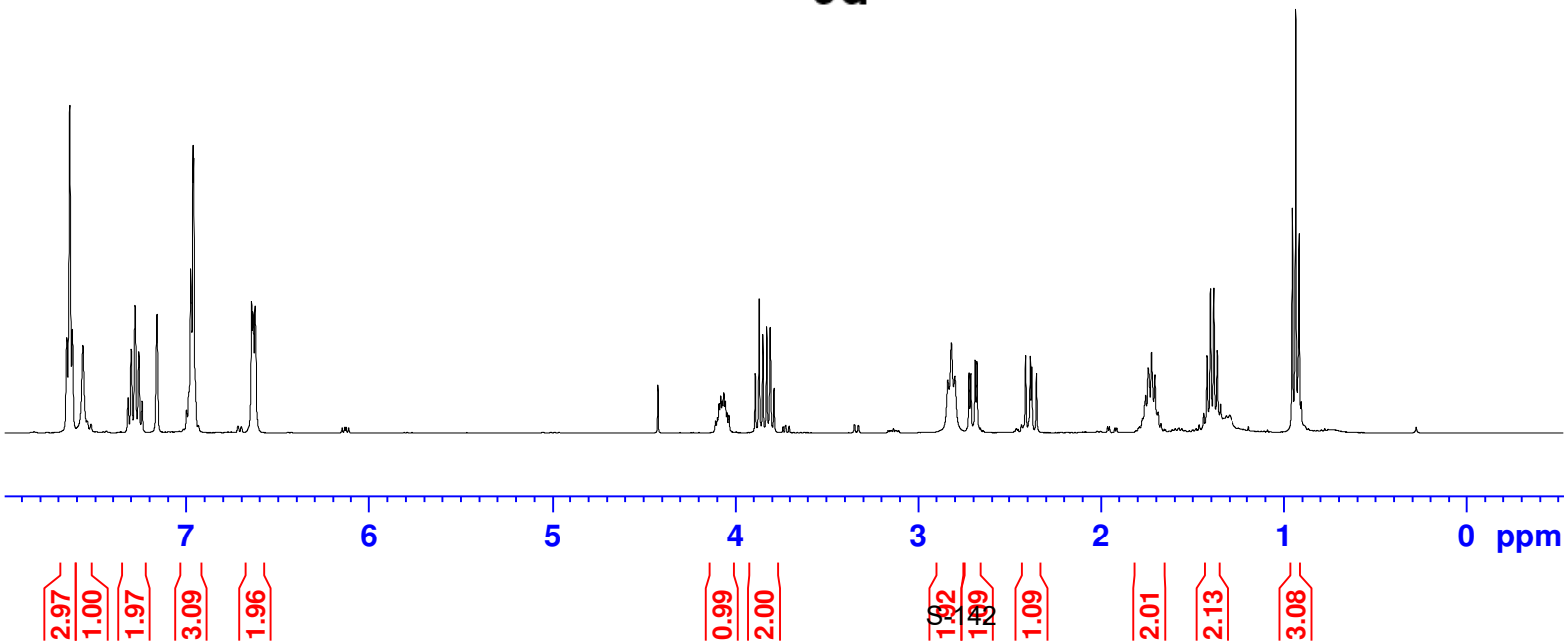
======== CHANNEL f2 ========
SFO2 400.1316005 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 11.99499989 W
PLW12 0.34213999 W
PLW13 0.27713001 W

F2 - Processing parameters
SI 32768
SF 100.6127716 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40





9d

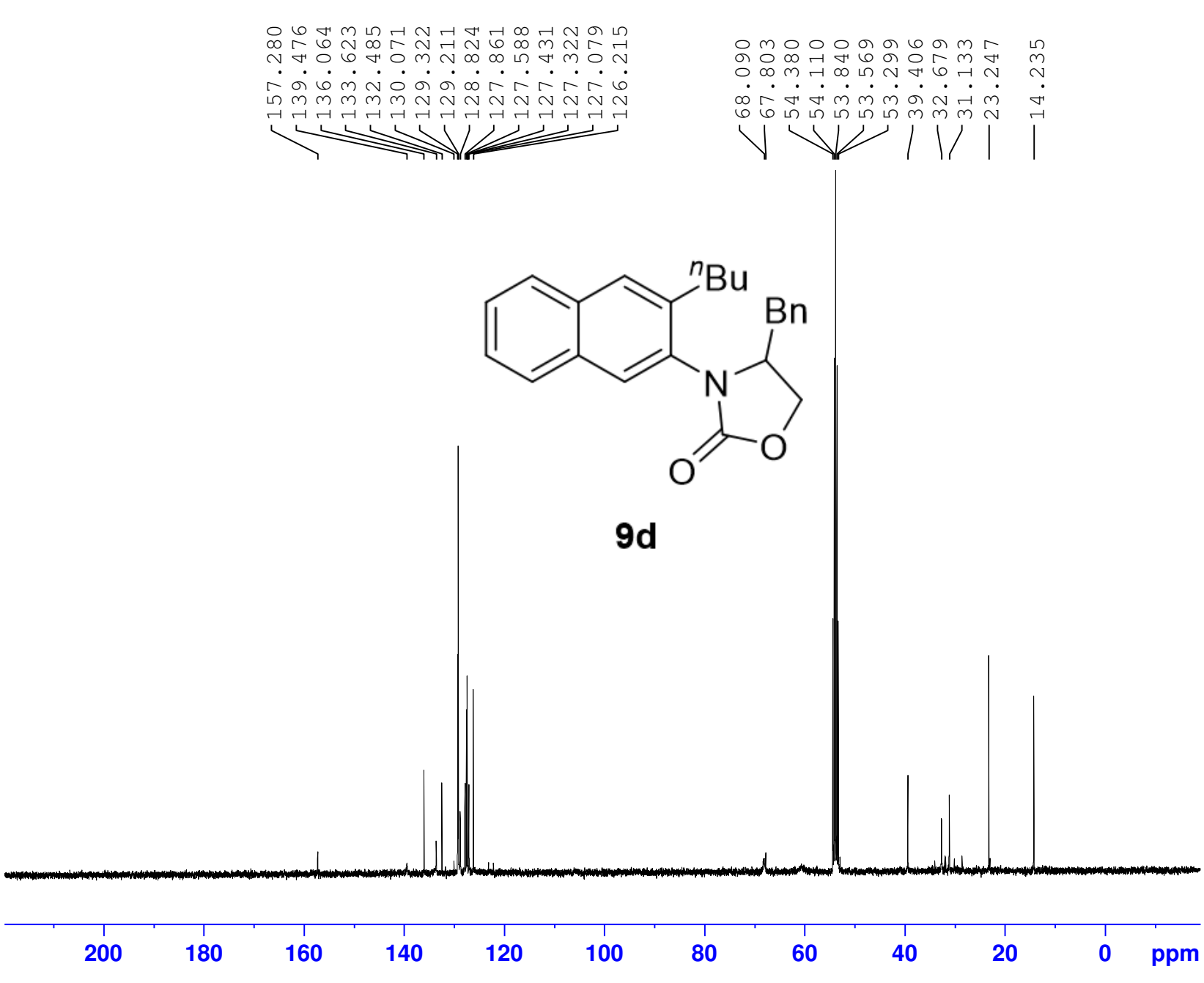



```
Current Data Parameters
NAME          wuan-212-3
EXPNO                  3
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160605
Time               23.42
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT             C6D6
NS                     4
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 70.97
DW                62.400 usec
DE                 6.50 usec
TE                330.1 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1299957 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```



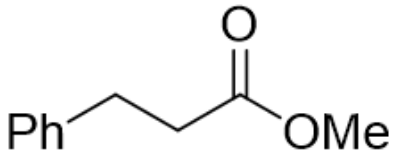

```
Current Data Parameters
NAME          wuan-212-4
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20160902
Time               23.29
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                65536
SOLVENT           CD2Cl2
NS                   663
DS                     0
SWH          24038.461 Hz
FIDRES        0.366798 Hz
AQ            1.3631488 sec
RG               196.92
DW               20.800 usec
DE                6.50 usec
TE                300.5 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

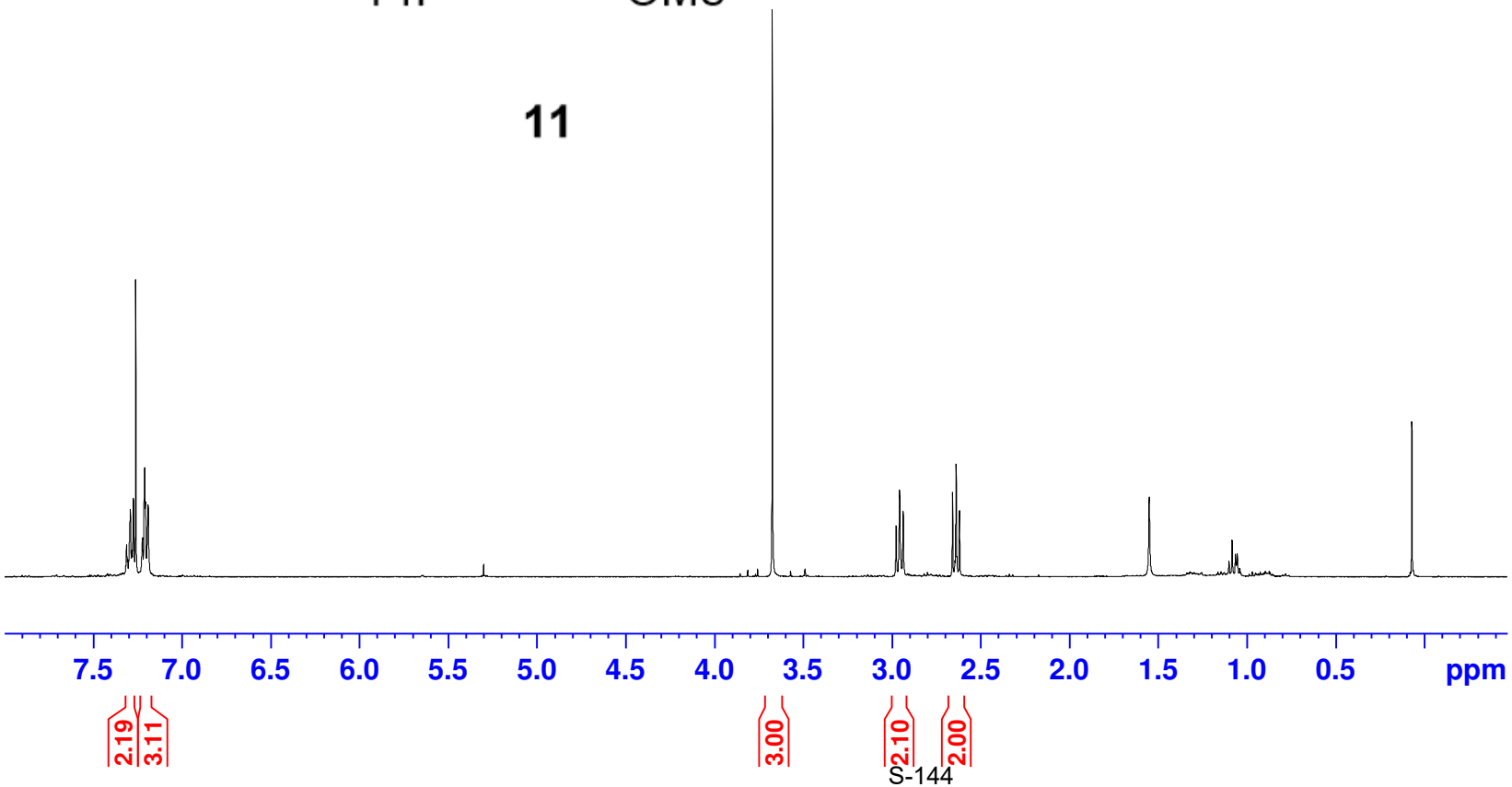
======== CHANNEL f1 ========
SFO1        100.6228298 MHz
NUC1                13C
P1                9.70 usec
PLW1        46.98899841 W

======== CHANNEL f2 ========
SFO2        400.1316005 MHz
NUC2                1H
CPDPRG[2        waltz16
PCPD2            90.00 usec
PLW2        11.99499989 W
PLW12        0.34213999 W
PLW13        0.27713001 W

F2 - Processing parameters
SI                 32768
SF          100.6127262 MHz
WDW                   EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```



11

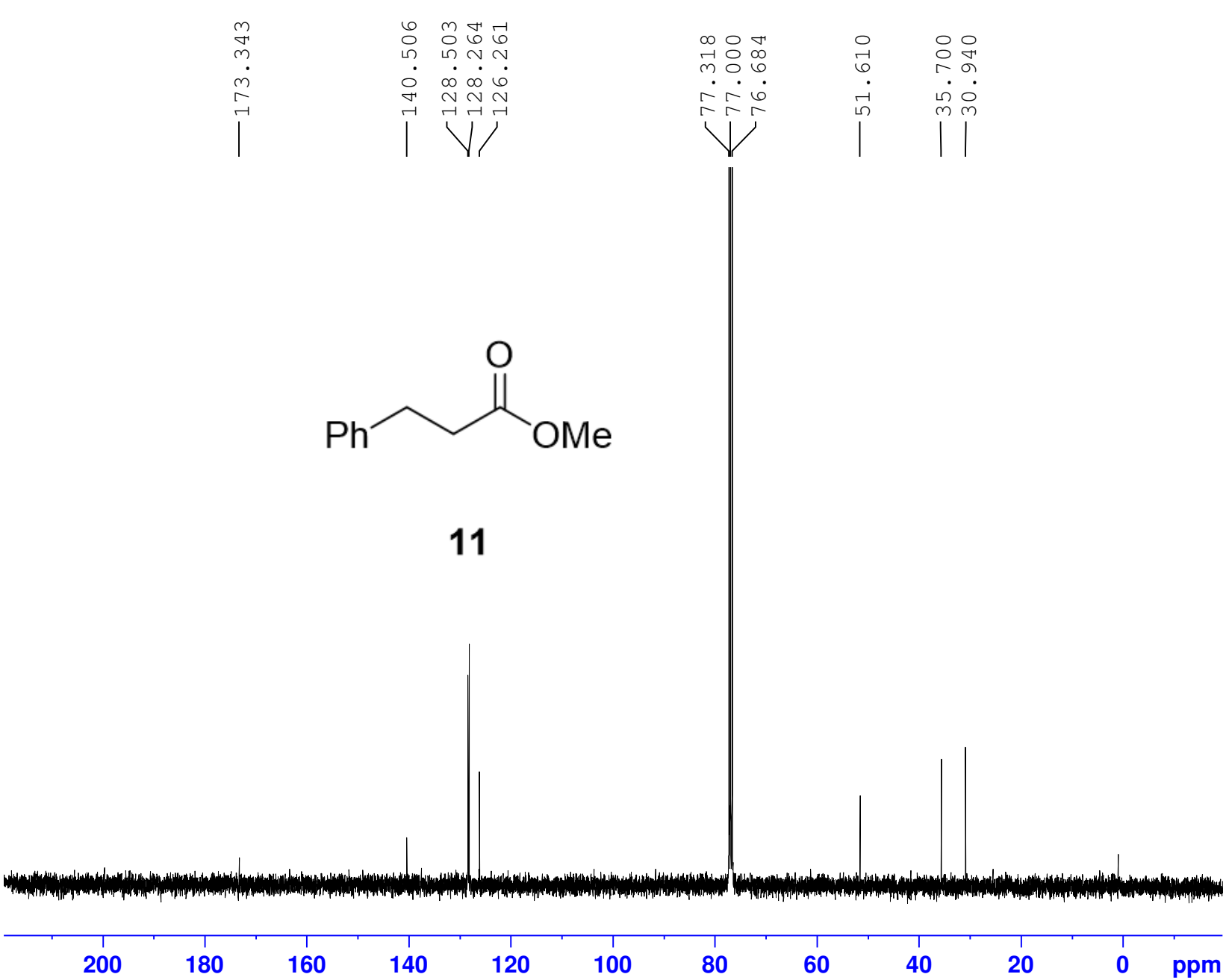



```
Current Data Parameters
NAME          wuan-162-3
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151221
Time               13.59
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                     8
DS                     0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 187.77
DW                62.400 usec
DE                 6.50 usec
TE                296.8 K
D1             1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.1324710 MHz
NUC1                   1H
P1                 14.50 usec
PLW1         11.99499989 W

F2 - Processing parameters
SI                 65536
SF           400.1300095 MHz
WDW                   EM
SSB       0
LB                 0.30 Hz
GB        0
PC                 1.00
```




```
Current Data Parameters
NAME          wuan-162-3
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20151221
Time               14.08
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   574
DS                     0
SWH            24038.461 Hz
FIDRES          0.366798 Hz
AQ              1.3631488 sec
RG                196.92
DW                20.800 usec
DE                 6.50 usec
TE                297.7 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1          100.6228298 MHz
NUC1                  13C
P1                  9.70 usec
PLW1          46.98899841 W

======== CHANNEL f2 ========
SFO2          400.1316005 MHz
NUC2                  1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2          11.99499989 W
PLW12          0.34213999 W
PLW13          0.27713001 W

F2 - Processing parameters
SI                 32768
SF            100.6127701 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```